Performance Certification to EMC Directive

Normative Standard: **EN61000-6-2:2016, EN 61000-6-3: 2007 & A1:2011**

Test Unit Description and Serial Number:

TFT EP0879 BLUETOOTH ADAPTER INTERFACE

S/N: EMI Prototype

Test Report # 3830

Dates of Test: 07-10-2018 through 07-12-2018

Test Laboratory:

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

Industry Canada Industrie Canada

EN 61000-6-3 :2007 & A1:2011 EMISSIONS

TEST METHOD	Limit
IEC 61000-6-3 Am 1:2007 & A1:2011 (Cispr 11) Radiated Emissions	B
IEC 61000-6-3 Am 1:2007 & A1:2011 (Cispr 11) Conducted Emissions (DC Power Supply)	B

EN 61000-6-2 :2016 IMMUNITY

TEST METHOD		LEVEL
IEC 61000-4-2 :2008-12 Electrostatic Discharge Test	2, 4, 6 and 8 kV Air Discharge 2, 4 & 6 kV Contact Discharge	A
IEC 61000-4-3 :2006+A1:2007+A2:2010 Radiated Immunity Test	13 V/M (10 V/M minimum) 1000 Hz, 80% AM modulation, 900 Mhz, 100% AM, 200 Hz, Square Wave, 25 MHz to 2.7 GHz	A
IEC 61000-4-4 :2012-04 Electrical Fast Transients	.5, 1 and 2 kV Line to Line	A
IEC 61000-4-5 : 2005 Electrical Surge Test	.5 kV Line to Line	A
IEC 61000-4-6 :2013-10 Conducted Immunity	3 & 10 V RMS Common Mode	A
IEC 61000-4-8 :2009 Magnetic Immunity	30 A/M Min (800 A/M Applied) Three Axes, 40Hz to 500 Hz	A
EN 61000-4-29 Dips Test	40%, 70% Dips, 85%, 120% Variations	N/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

BBB MEMBER CHICAGO & NORTHERN ILLINOIS

Nemko Accredited ELA

ACIL

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

CE

Industry Canada Industrie Canada

Midwest EMI Associates Test Service
Report No. 3830

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
EN 61000-4-29 DC Dips Test

Test Device: **TFT EP0879 BLUETOOTH ADAPTER INTERFACE**

Serial Number: **EMI Prototype**

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

Dates of Test: 07-10-2018 through 07-12-2018

Technical Data Taken by and Report Written by:

George A. Bowman

George Bowman
Midwest EMI Associates

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 EP0879 BLUETOOTH ADAPTER INTERFACE to the IEC 61000-6-2 industrial and 61000-6-3 residential, commercial and light industrial 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, IEC 61000-4-8 magnetic immunity test and IEC 61000-4-29 DC dips test. This version provides Bluetooth wireless capability to the TFT Monitor system.

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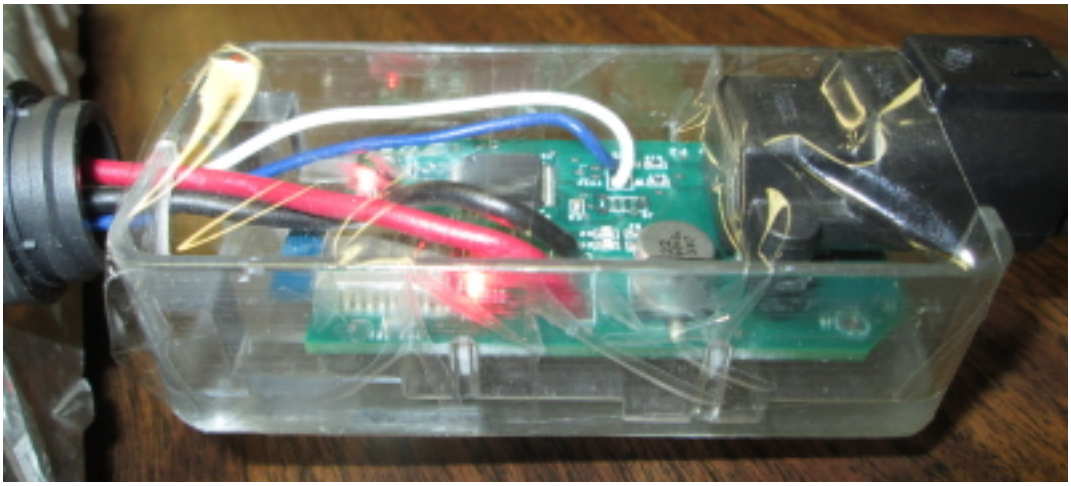
2.0 TEST FACILITY:

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 anechoic 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 YE-BT1 Wireless Interface - FOR RC MONITORS AND VUMS - The YE-BT1 wireless Bluetooth interface which is attached between the Monitor and the incoming interface cable allows remote control of the Monitor via a variety of TFT peripheral wireless devices.



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 however for some tests grounding was supplied to the platform.

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 where possible however the Bluetooth adapter was always in operation.

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 (2016), "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 1: Immunity for residential, commercial and light-industrial environments"

EN 61000-6-2 Ed. 2.0 (2016), "Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments"

EN 61000-6-3 Ed. 2.0 (2007) & A1:2011, "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 3: Emission standard for residential, commercial and light-industrial environments"

EN 61000-6-4 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.

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

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

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

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.*

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

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

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

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

SPECTRUM ANALYZER CHARACTERISTICS

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

TEK 2756P Analyzer

Bandwidth Setting	Wideband 6dB Bandwidth	Correction Factor	Factor Applied
3 MHz	3.028 MHz	-9.623 dB	-10 dB
1 MHz	915.0 kHz	0.7716 dB	0 dB
0.1 MHz	116.4 kHz	18.68 dB	20 dB
10 kHz	9.96 kHz	40.03 dB	40 dB
1 kHz	926 Hz	60.67 dB	60 dB
0.1 kHz	96 Hz	80.35 dB	80 dB
10 Hz	10 Hz	100 dB	100 dB

TEK 2712 Analyzer (Dual Analyzers in Use)

Bandwidth Setting	Wideband 6dB Bandwidth	Correction Factor	Factor Applied
5 MHz	4.92 MHz	-13.84 dB	-14 dB
1 MHz	932.0 kHz	0.6117 dB	0 dB
300 kHz	310 kHz	10.173 dB	10.5 dB
120 kHz	119 kHz	18.5 dB	18.5 dB
9 kHz	8.48 kHz	41.43 dB	41 dB
3 kHz	3300 Hz	49.63 dB	50.5 dB
1 kHz	860 Hz	61.31 dB	60 dB
200 Hz	200 Hz	73.98 dB	74 dB

6.3 CERTIFICATES OF CALIBRATION

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

	Instrument	Serial No	Calibration Due
a)	Tek2756P Spectrum Analyzer	BO20224	26-Mar-19
b)	Wavetek 2520A RF Generator	222011	30-Mar-19
c)	Carver TFM-35 250 W/Ch. Audio Amp	3097104	1-Jun-01
d)	ENI RF Power Amplifier (525LA)	367	30-Mar-19
e)	ENI RF Power Amplifier (2100L)	129	30-Mar-19
f)	Eaton 15100B Power Amplifier	1529-07090	24-Mar-19
g)	Tektronix TDS 420 Oscilloscope	B021212	24-Mar-19
h)	EMCO 3109 Power Biconical (1/3/10 Meters)	9011-2504	17-Mar-19
i)	EMCO 3101 Power Conical	9007-3450	7-Nov-93 (1/3m)
j)	EMCO 6502 Active Loop	1038	18-Mar-19
k)	EMCO 3301B Active E Field	9009-3044	19-Mar-19
l)	EMCO 3147 Wide Range Log Periodic	9102-1019	23-Mar-19
m)	EMCO 3107B Power E Field	9310-2435	N/A
m)	Amplifier Research FM1000	12456	N/A
n)	Amplifier Research FP1000	60701	21-Mar-19
o)	Amplifier Research FP1000	60488	3-Mar-19
p)	IFI EFS-4 E Field Susceptibility (Holladay 3004EX with HSE405 Probe)	39883	14-Mar-19
q)	IFI LMT-B Light Modulator	1117-B	n/a
r)	IFI EFS-1 E Field Susceptibility	245738	1-Feb-99
s)	Solar 6741-1 RF Current Probe	911308	n/a
t)	Fluke 45 True RMS Voltmeter	EJ574714013	24-Mar-19
u)	Schaffner NSG 435 ESD Gun	107	15-Mar-19
v)	Solar Loop Sensor 7334-1	n/a	n/a
w)	Solar Loop Sensor 9311-1	931101	n/a
x)	Solar RF Coupler 7415-3906016	n/a	n/a
y)	Solar Line Impedance Stabilization Network	8028-50-TS-24-BNC	n/a
z)	Solar VDE Filter Network	8907-250-TS-24-BP	n/a
aa)	Ohmic Instrument BET-300-ADL	522	25-Mar-19
ab)	Werlatone C1795 Dir. Coupler	3442	30-Mar-19
ac)	Solar Current Injection Probe Type 9108-1N	935012	n/a
ad)	Tektronix TR 503B Tracking Generator	B011216	25-Mar-19
ae)	Acme 2KVA Isolation Transformer	T-3-53042-S	n/a
af)	Xentek Extreme Isolation Transformer Model 5410 (2 in use)	n/a	n/a
ag)	Tektronix P6202 RF Probe	n/a	n/a
ah)	Staco Power Variac Type 3PN2210 (0-140VAC) 3.1KVA	n/a	n/a
ai)	Helmholtz Coil Stepdown Xfrmr-Chicago Xfrmer Type P-6492	n/a	n/a
aj)	Goldstar Signal Generator Mod FG-2002c	201621	25-Mar-19
ak)	Holladay Magnetic Field Probe Model HI-3624	83957	15-Mar-19
al)	Tektronix 2712 Spectrum Analyzer (Quasipeak)	B022520	24-Mar-19
am)	Voltec PM100 Power Analyzer	AA04/8495	25-Mar-19
an)	EMCO 3142 Biconilog Antenna	1052	1-Mar-19
ao)	Haefely P90.1 IEC 61000-4-4 Fast Transient Tester	083 593-14	19-Mar-19
ap)	Hewlett Packard 3400A AC Voltmeter	1218A14443	24-Mar-19
aq)	Amplifier Research FP2031 Isotropic Probe	18309	5-Mar-19

ar)	Haefely 250 600/00 (61000-4-5 Surge Tester)	583 334-05	19-Mar-19
as)	Fischer CISPR 14 Absorbing Clamp type F-201	235	7-Mar-19
at)	Fischer IEC 801-6 Transducer	165	23-Mar-19
au)	Solar 9123-1N Current Clamp	956015	23-Mar-19
av	Fischer IC 801-6 CDN FCC-801-M3-25	95	7-Mar-19
aw)	Tektronix 2712 Spectrum Analyzer (Quasipeak) B022981	n/a	24-Mar-19
ax)	C. C. Moore Automated Mast Assembly Model DAPM4/6	n/a	n/a
ay)	C. C. Moore Automated Turntable Model DTT-4	n/a	n/a
az)	Antenna Research LPB2520	1152	20-Mar-19
ba)	Behlman Power Pass 50 Hz AC Source (50, 60, 400 Hz)	n/a	n/a
bb)	California Instruments WP1251 AC Source (50, 60 Hz)	n/a	n/a
bc)	Plitron Extreme Toroidal Isolation Transformers (2)	n/a	n/a
bd)	Edmund Scientific Thermometer/Hygrometer	n/a	31-Mar-19
be)	Coaxial Bird Pads (x2) 8306-030-N3DB	n/a	30-Mar-19
bf)	High Current Source, Associated Research 3030D	A140006	25-Mar-19
bg)	California Instruments 5001ix High Power Source	HK52945	25-Mar-19
bh)	Line Leakage tester, Associated Research 510L	130007	25-Mar-19
bi)	Hipot Tester, Associated Research 3570D	90595	25-Mar-19
bh)	GAASfet Preamplifier	n/a	30-Mar-19
bi)	Ametek Tachometer Model 1726	R035292	24-Mar-19
bj)	Bird Attenuator (x2), 75 Watt, 75-A-MFN-10	R035290	30-May-04
bk)	HP 8482A Power Sensor	2652A18474	24-Mar-19
bl)	HP 435B Power Meter	2702A17563	24-Mar-19
bm	Simpson Model 383 Thermometer	B001531	24-Mar-19
bn)	Wavetek 27XT Voltmeter	96120787	24-Mar-19
bo)	HP 8657A Programmable Synthesizer	365	27-Mar-19
bp)	Fluke 75	n/a	24-Mar-19
bq)	Fluke 21 Series III	n/a	24-Mar-19
br)	ENI 525LA	n/a	19-Mar-19
bs)	Tek 495P Opt 5/7	B020147	30-Mar-19
bt)	Amplifier Research FP2036 (.5-5Ghz)	n/a	4-Sep-19

Note: Items that do not show a current calibration are obsolete, were not used in test or do not need calibration because they have no calibratable parts. In particular the following items are present at this facility but do not carry current calibration:
c) Carver TFM-35 250 W/Ch. Audio Amp 1-Jun-01
i) EMCO 3101 Power Conical 7-Nov-93 (1/3m)
r) IFI EFS-1 E Field Susceptibility 1-Feb-99
bj) Bird Attenuator (x2), 75 Watt, 75-A-MFN-10 30-May-04

7.0 CONCLUSION OF RADIO FREQUENCY INTERFERENCE EMISSIONS AND SUSCEPTIBILITY TESTS:

The TFT EP0879 BLUETOOTH ADAPTER INTERFACE was evaluated for all tests in the configuration requested by the sponsor group for compliance with the generic instruments standards, IEC 61000-6-2 :2007 & A1:2011 and IEC 61000-6-3 :2005. The configuration requested was that of the packaged unit system in an orientation that exercised the wireless remote function. For test purposes the sponsor group supplied a YE-RF-BT Tactile touch controller configured for the YE-BT1 Bluetooth interface that could be observed during all test sequences to verify communication link.

The sponsor group supplied a single change to improve device performance during conducted emissions testing.

Changes

Added AISM 1003-103J in place of R11 on the Bluetooth adapter board.

8.0 CANADIAN TESTING REQUIREMENTS (ICES-001)

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

In this Standard,

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

Labeling Requirements

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

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

unit:

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

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

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

9.0 FCC COMPLIANCE STATEMENT

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device maynot cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

FCC WARNING

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

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

Nemko Laboratory Authorization
Authorization Number: ELA 175

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

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

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

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

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

This Authorization is valid through 23 December 2018

Nemko USA, San Diego, 23 December 2016

For Nemko AS

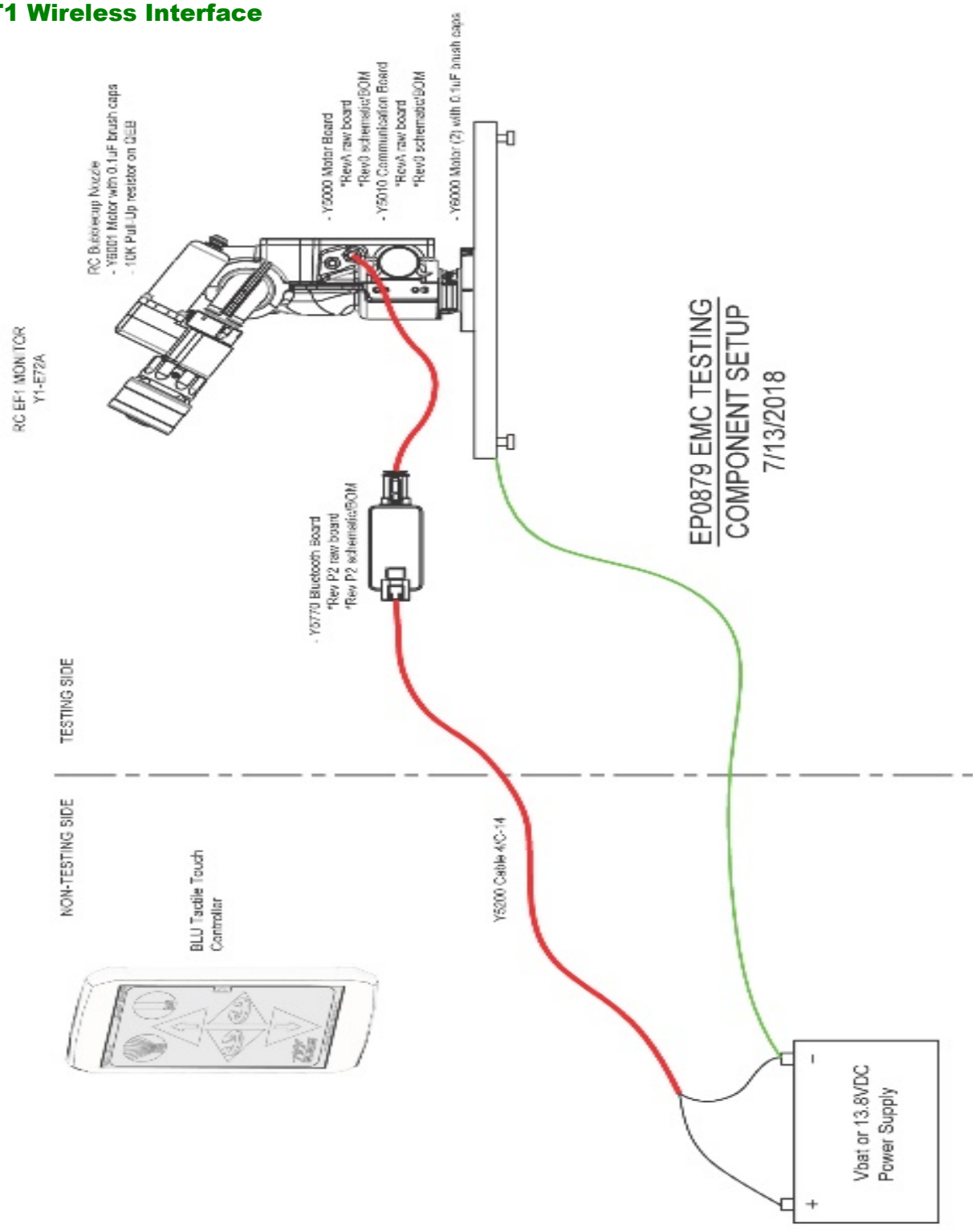
James E Morris

James E. Morris, Nemko USA

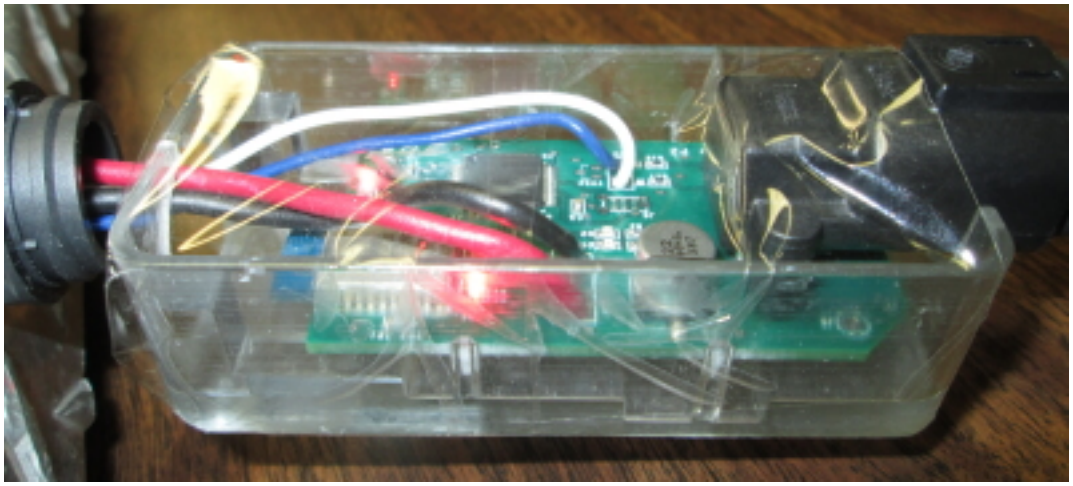
EMC and Wireless Divisions Manger

Nemko AS - Head Office, Gaustadalléen 30, P.O. Box 73 Blindern, 0314 Oslo, Norway
Phone: +47 22 96 03 30 - Fax: +47 22 96 05 50

YE-BT1 Wireless Interface



YE-BT1 Bluetooth Adapter – EP 0879 Project



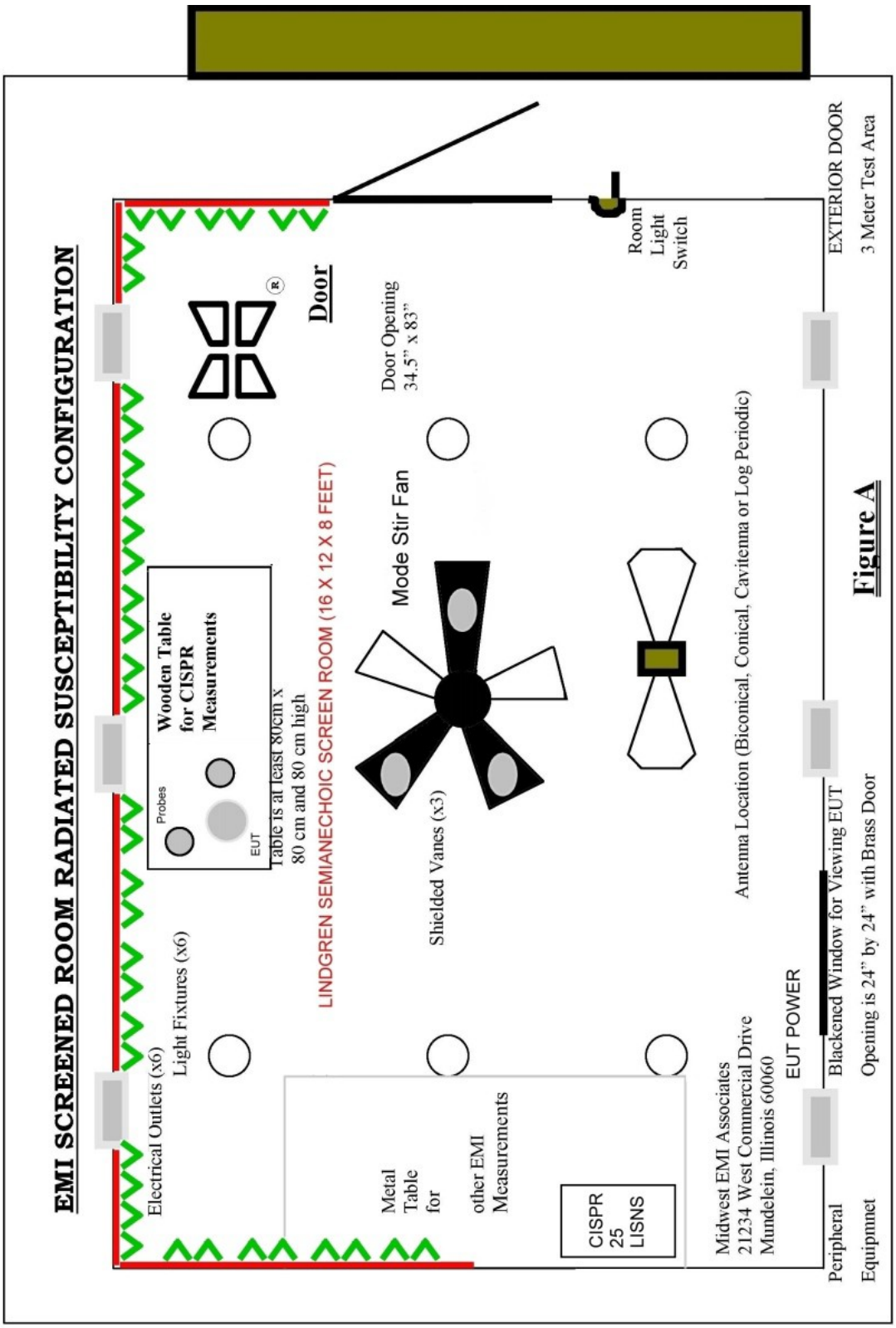

EMI SCREENED ROOM RADIATED SUSCEPTIBILITY CONFIGURATION
Electrical Outlets (x6)
Light Fixtures (x6)
Probes
EUT
Wooden Table for CISPR Measurements
Table is at least 80cm x 80 cm and 80 cm high
LINDGREN SEMIANECHOIC SCREEN ROOM (16 X 12 X 8 FEET)
Door
Door Opening 34.5" x 83"
Mode Stir Fan
Shielded Vanes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

Figure A

Table of Contents

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 EP0879 BLUETOOTH ADAPTER INTERFACE** 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.

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.

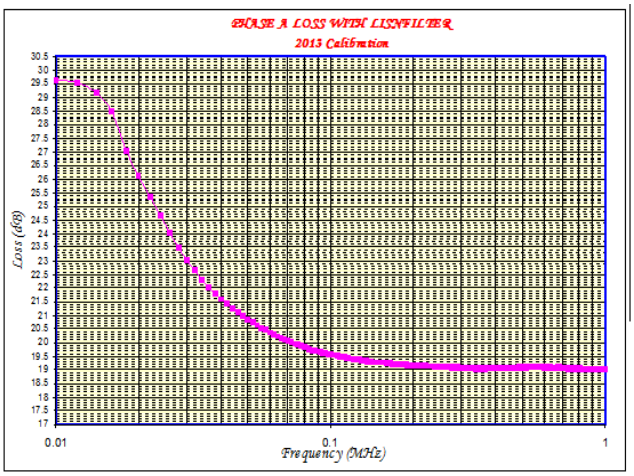
VDE LIMITS

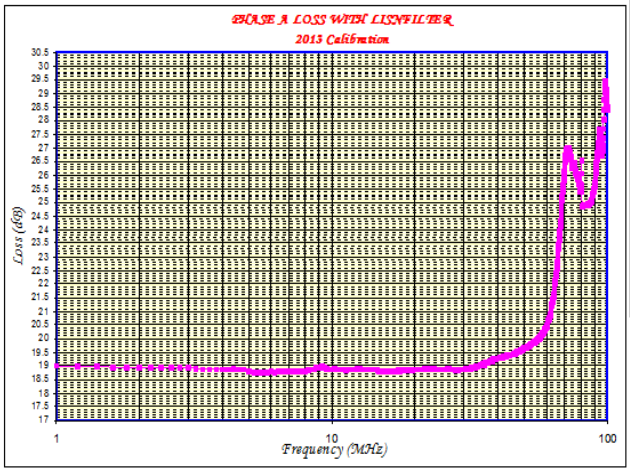
For CISPR 11 (EN55011), 22 (EN55022) or 14 (EN55014) B level conducted compliance starting at 150 kHz the allowed level is 66 dBuV and decreases at a linear rate with the log of frequency to 56 dBuV at 500 kHz. From 500 kHz to 5 MHz the allowed level is 56 dBuV, and 60 dBuV from 5 MHz to 30 MHz at the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

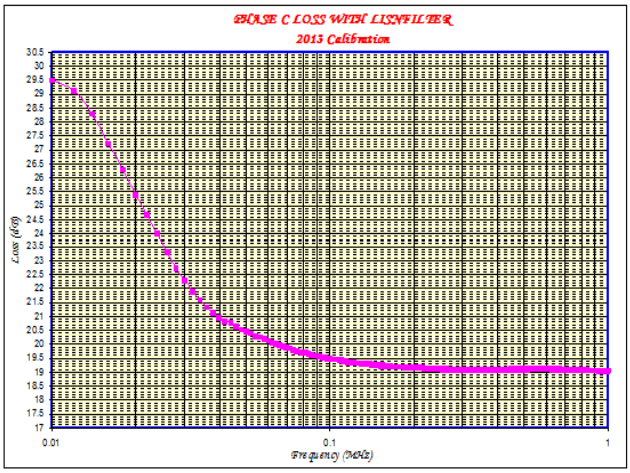
CALIBRATION DATA:

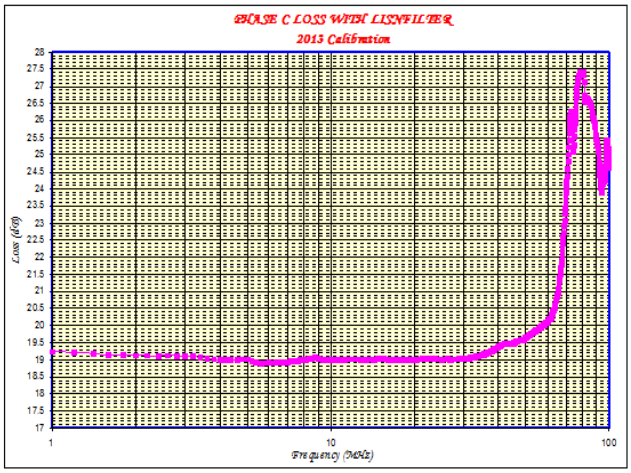
The results of the latest recalibration of the LISN's are contained on the next page over the range of 1 kHz to 1 MHz. The LISN is isolated from the spectrum analyzer by two 10-dB pads on either side of a five-pole rolloff filter. The insertion loss of each LISN has been compared and calibrated to that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

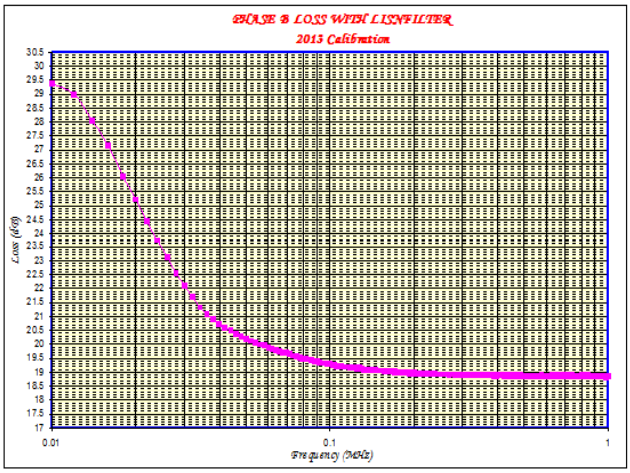
In the range higher than 1 MHz up to 100 MHz the characteristic of each LISN is flat with an insertion loss of no greater than 1.5 dB. In all cases the deviation from the perfect LISN response has been compensated for in a computer correction table file (approximately 150 points). The actual lower end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

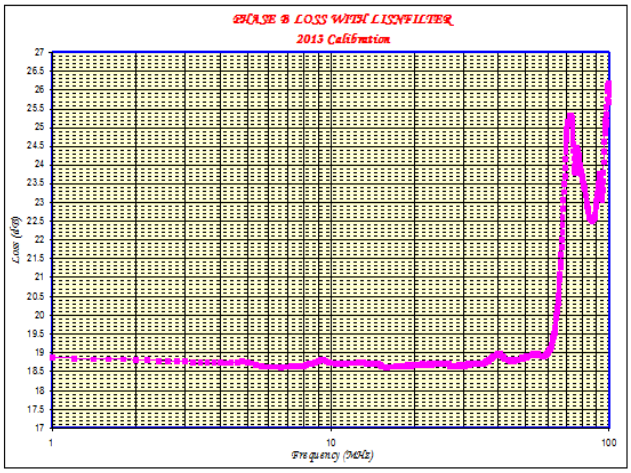

PHASE A LOSS WITH LISNFILTER
2013 Calibration
Loss (dB)
Frequency (MHz)
0.01
0.1
1


PHASE A LOSS WITH LISNFILTER
2013 Calibration
Loss (dB)
Frequency (MHz)
1
10
100


PHASE C LOSS WITH LISNFILTER
2013 Calibration
Loss (dB)
Frequency (MHz)
0.01
0.1
1

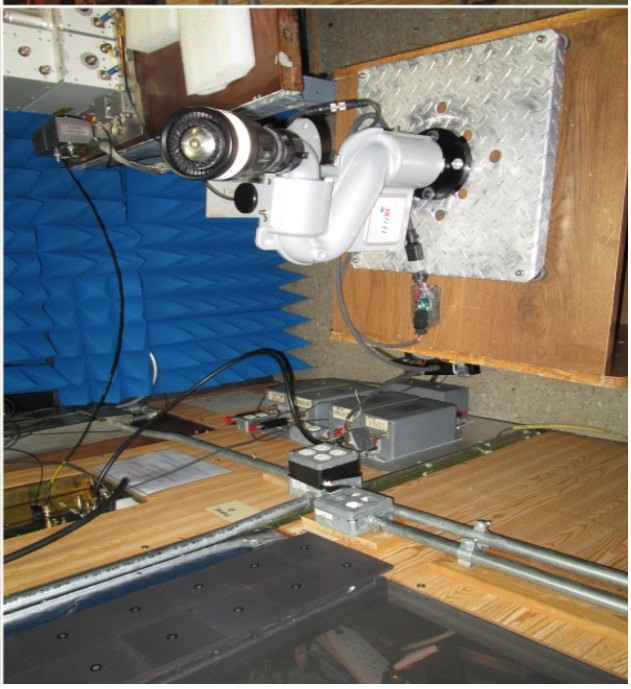

PHASE C LOSS WITH LISNFILTER
2013 Calibration
Loss (dB)
Frequency (MHz)
1
10
100

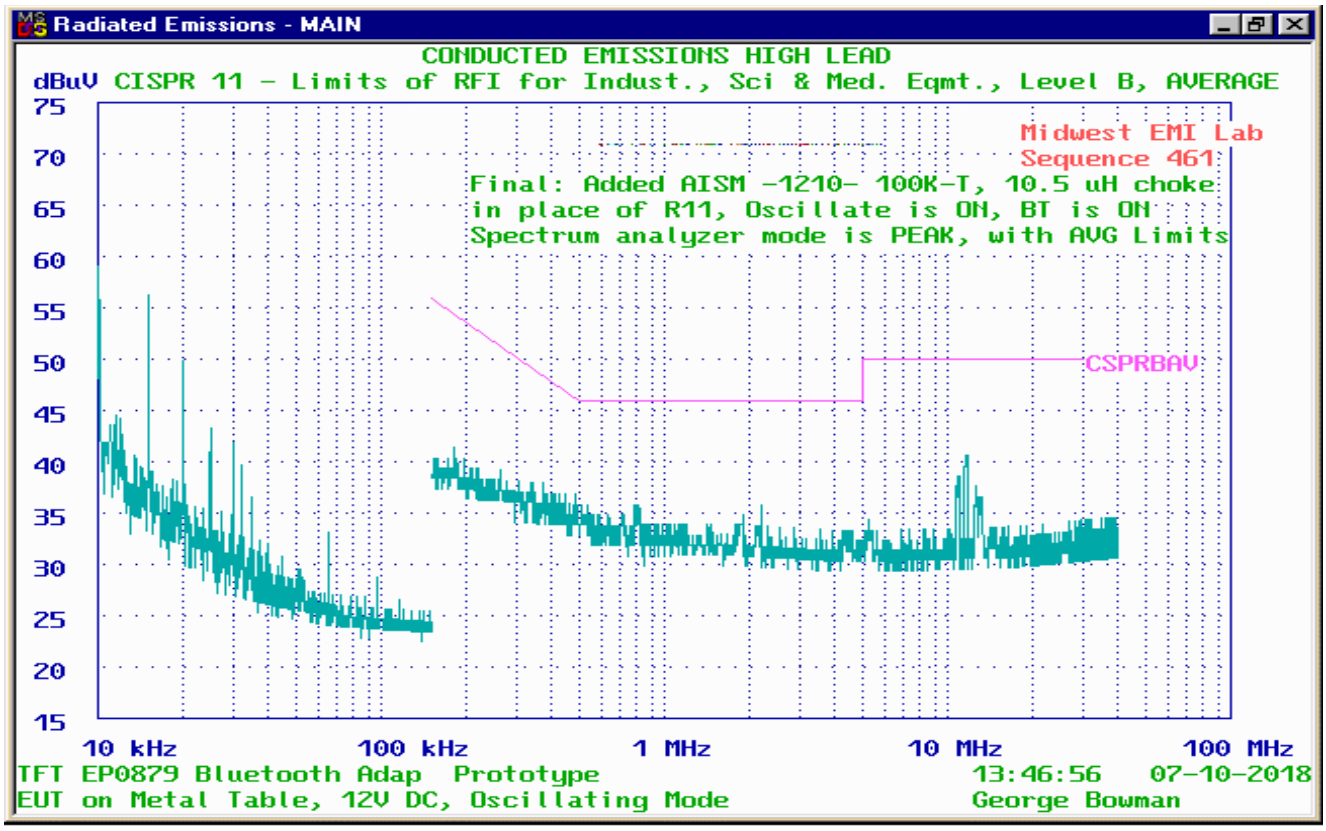

PHASE B LOSS WITH LISNFILTER
2013 Calibration
Loss (dB)
Frequency (MHz)
0.01
0.1
1

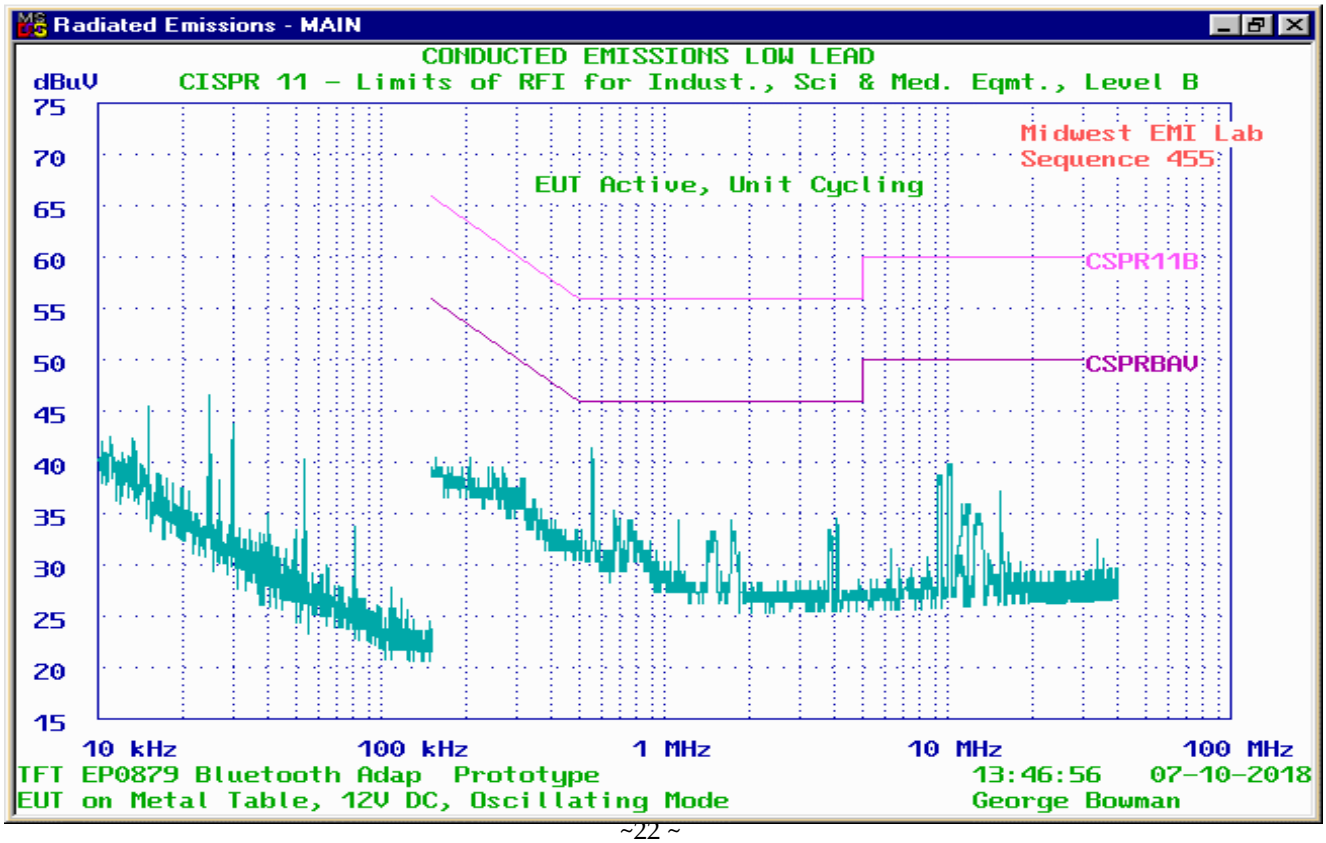

PHASE B LOSS WITH LISNFILTER
2013 Calibration
Loss (dB)
Frequency (MHz)
1
10
100

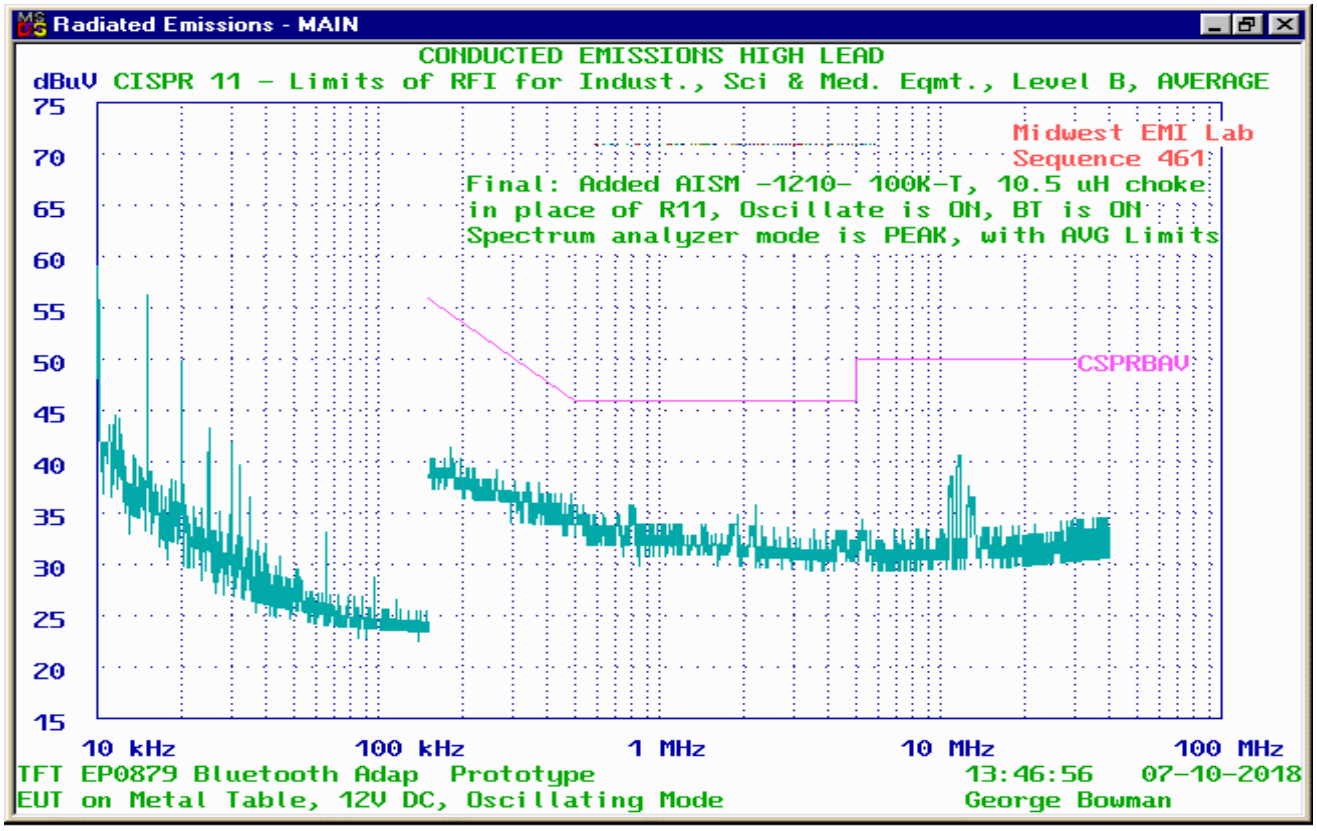
4.0 CONCLUSION OF RADIO FREQUENCY INTERFERENCE EMISSIONS TESTS:

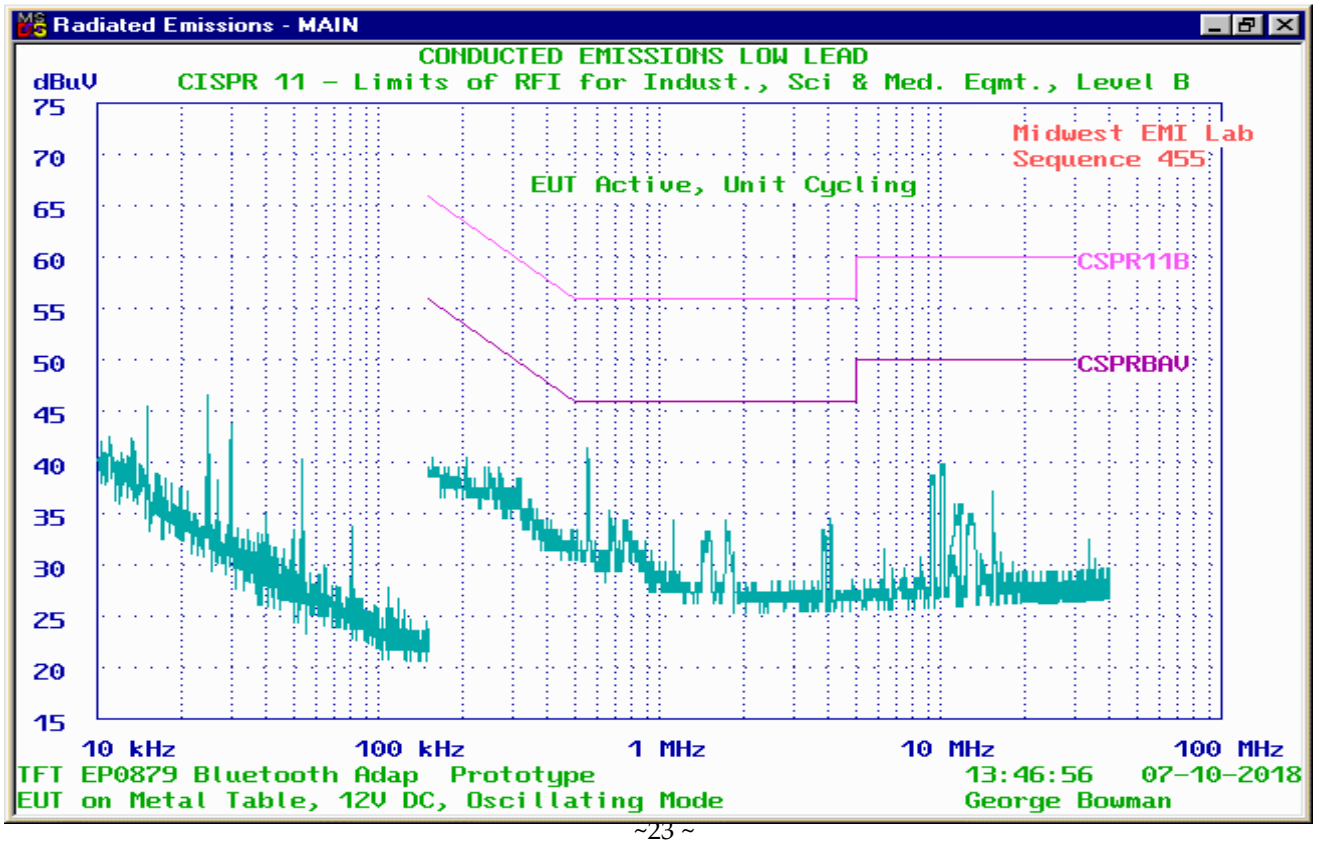
The TFT YE-BT1 Bluetooth Adapter with Monitor was measured for its conducted emissions per EN61000-6-3 for DC operated devices. After measuring and improving the system the Cispr B objective was achieved after adding the change shown in the summary at the beginning of this report.




Radiated Emissions - MAIN
CONDUCTED EMISSIONS HIGH LEAD
dBuV CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B, AVERAGE
Midwest EMI Lab
Sequence 461
Final: Added AISM -1210- 100K-T, 10.5 uH choke
in place of R11, Oscillate is ON, BT is ON
Spectrum analyzer mode is PEAK, with AVG Limits
CSPRBAV
75
70
65
60
55
50
45
40
35
30
25
20
15
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT EP0879 Bluetooth Adap Prototype
EUT on Metal Table, 12V DC, Oscillating Mode
13:46:56 07-10-2018
George Bowman


Radiated Emissions - MAIN
CONDUCTED EMISSIONS LOW LEAD
dBuV CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
Midwest EMI Lab
Sequence 455
EUT Active, Unit Cycling
CSPR11B
CSPRBAV
75
70
65
60
55
50
45
40
35
30
25
20
15
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT EP0879 Bluetooth Adap Prototype
EUT on Metal Table, 12V DC, Oscillating Mode
13:46:56 07-10-2018
George Bowman


Radiated Emissions - MAIN
CONDUCTED EMISSIONS HIGH LEAD
dBuV CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B, AVERAGE
Midwest EMI Lab
Sequence 461
Final: Added AISM -1210- 100K-T, 10.5 uH choke
in place of R11, Oscillate is ON, BT is ON
Spectrum analyzer mode is PEAK, with AVG Limits
CSPRBAV
75
70
65
60
55
50
45
40
35
30
25
20
15
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT EP0879 Bluetooth Adap Prototype
EUT on Metal Table, 12V DC, Oscillating Mode
13:46:56 07-10-2018
George Bowman


Radiated Emissions - MAIN
CONDUCTED EMISSIONS LOW LEAD
dBuV CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
Midwest EMI Lab
Sequence 455
EUT Active, Unit Cycling
CSPR11B
CSPRBAV
75
70
65
60
55
50
45
40
35
30
25
20
15
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT EP0879 Bluetooth Adap Prototype
EUT on Metal Table, 12V DC, Oscillating Mode
13:46:56 07-10-2018
George Bowman

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 EP0879 BLUETOOTH ADAPTER INTERFACE 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 in the semi-anechoic room. An initial test was conducted with the EUT in non-oscillating mode (unit at rest) but with the BT adapter active for all testing. Those initial results are shown on the next page (Seq. 361 and 362) and found no emissions close to the limit when tested at 1 meter.

Final Testing – 07-11-2018

Seq. 209 shows the ambient; Seq. 207 shows the peak mode in comparison in the range of 25-75 MHz. Original testing was performed on Seq. 201 ambient and 206 quasipeak which revealed a large ambient interference at the time of test. After the interference had passed and comparing the two graphs it is seen none of the EUT generated emissions were above the B level limit.
Tabular data is shown at the end of the graphical data.

In the 75-170 MHz range, Seq. 202 shows the ambient and Seq. 210 shows the quasipeak emissions. Ambient emissions consist of the FM band and an intentional radiators at 147 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.

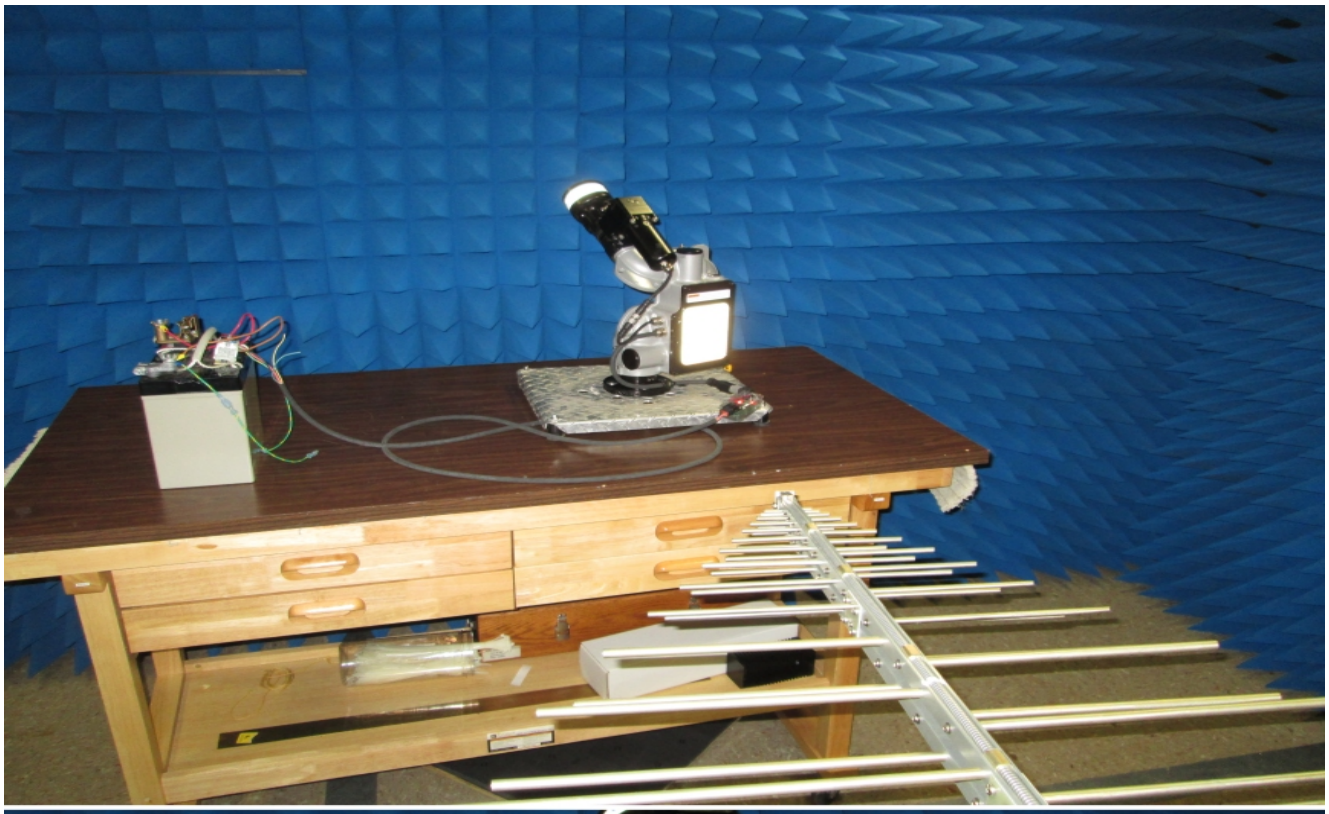
In the 170-300 MHz range, the ambient is shown on Seq. 203, and peak level on Seq. 210. No areas of emission from the EUT appeared to exceed the limit.

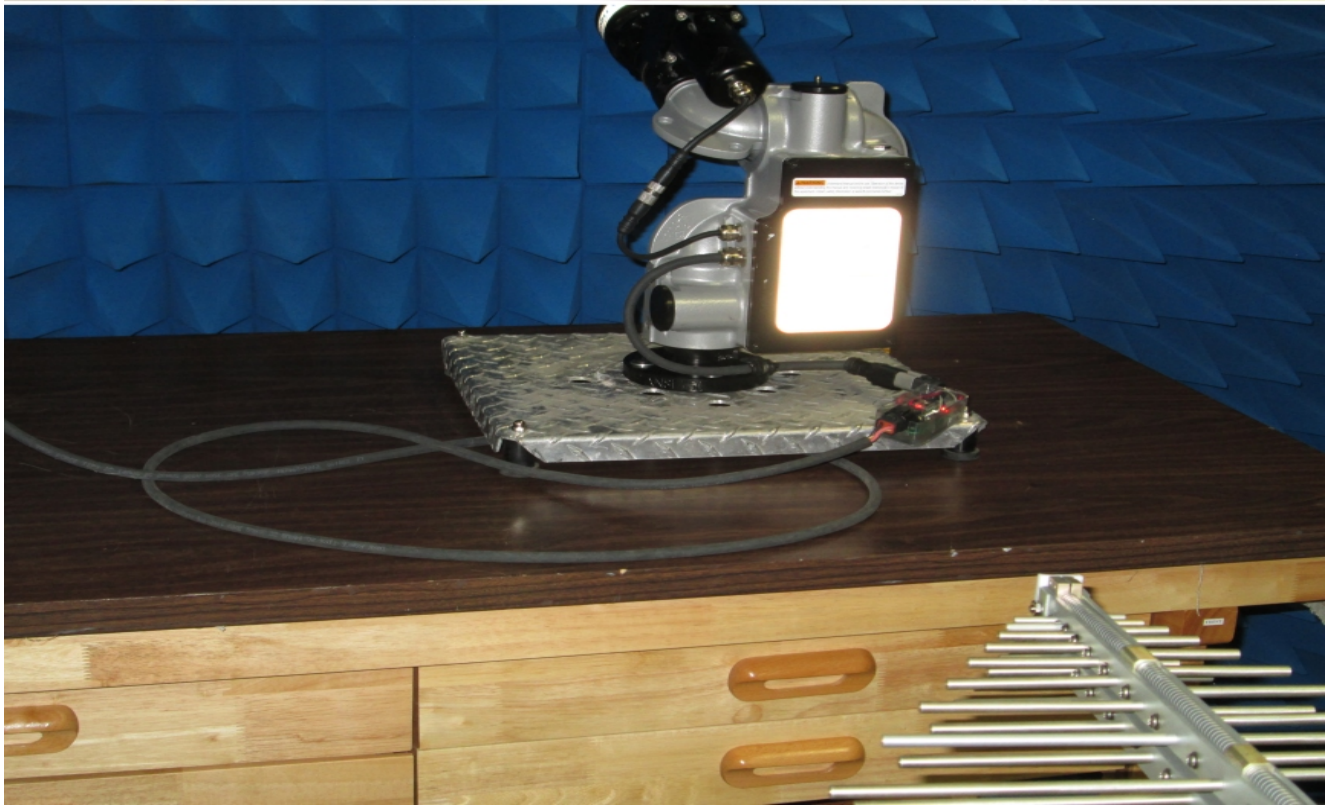
In the 300-640 MHz, the ambient is shown on Seq. 204 and the quasipeak level emissions are shown on Seq 212. Other high emissions are numerous UHF TV stations and they are identified. Two emissions found in this range different from the ambient were individually inspected and not found to be due to the EUT but were from limo taxi services.

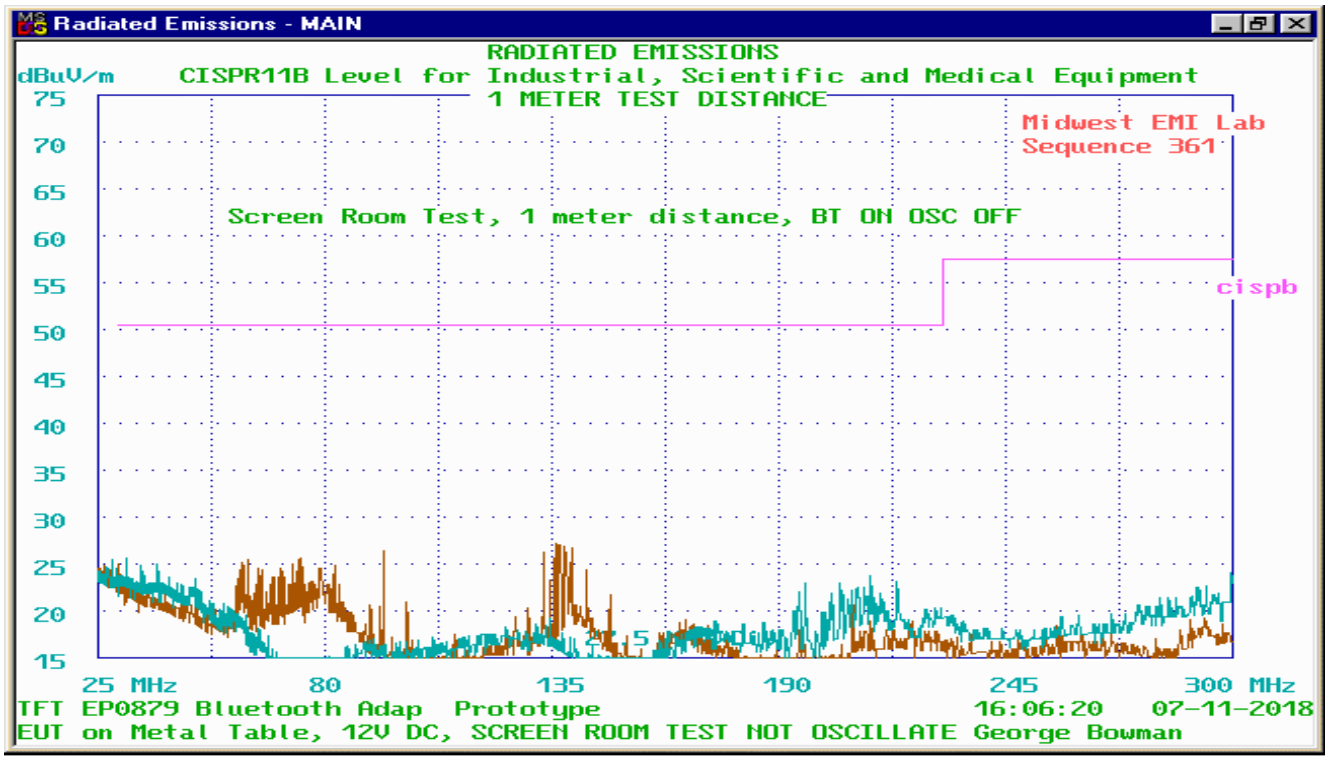
In the 620-1000 MHz, the ambient is shown on Seq. 205 and peak level on Seq. 213. Other high emissions are numerous UHF TV stations and the cell telephone band around 900 MHz that is identified. When the graphs were overlaid, no excess level introduced by the EUT was seen.

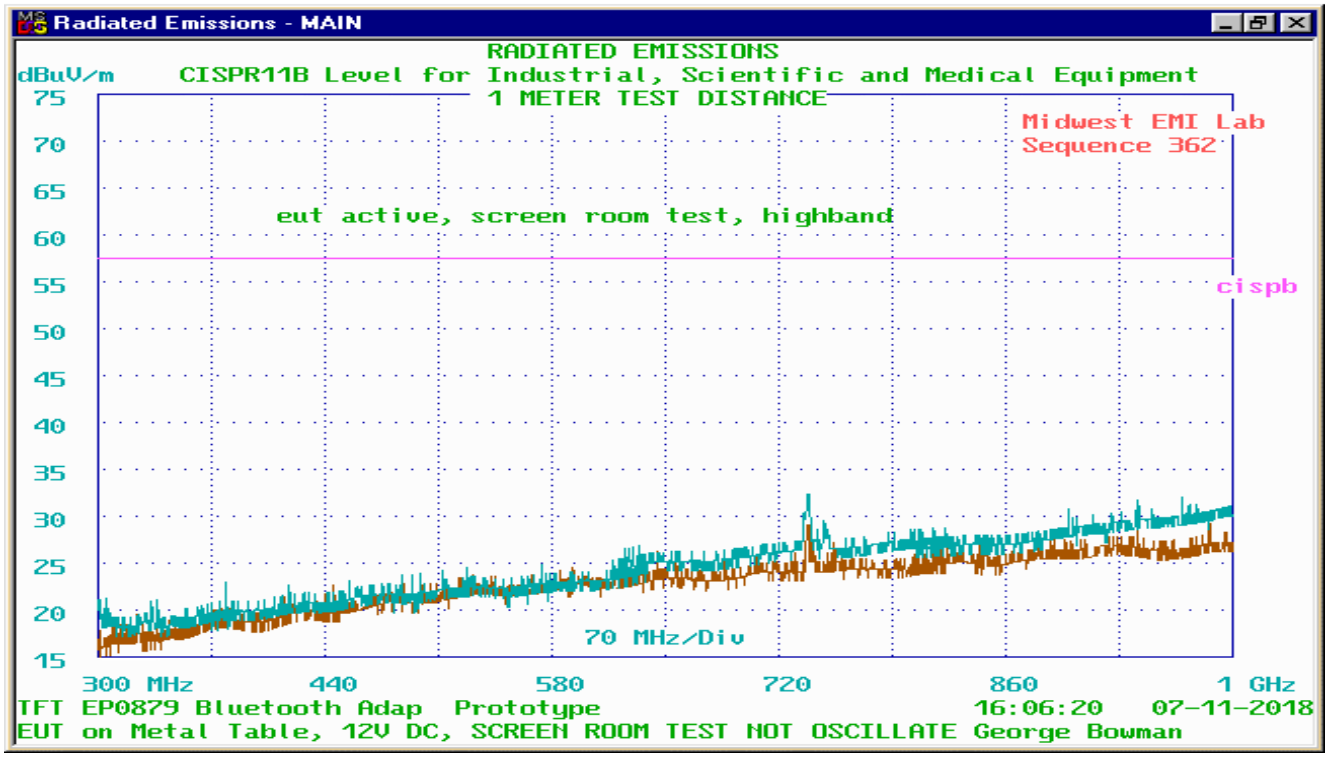
In the microwave bands 1-6 GHz, the data follows the tabular data in the data set. The results show that except in the 2.4 to 2.5 GHZ band there are no significant issues. In that band, Seq. 353, the licensed Bluetooth module operates and appeared to be putting out signals that are appropriate for a 3 meter distance. In the final graph the 2nd harmonic of the Bluetooth fundamental, Seq. 355, was close to but passing the average limit at 4.96 GHz.

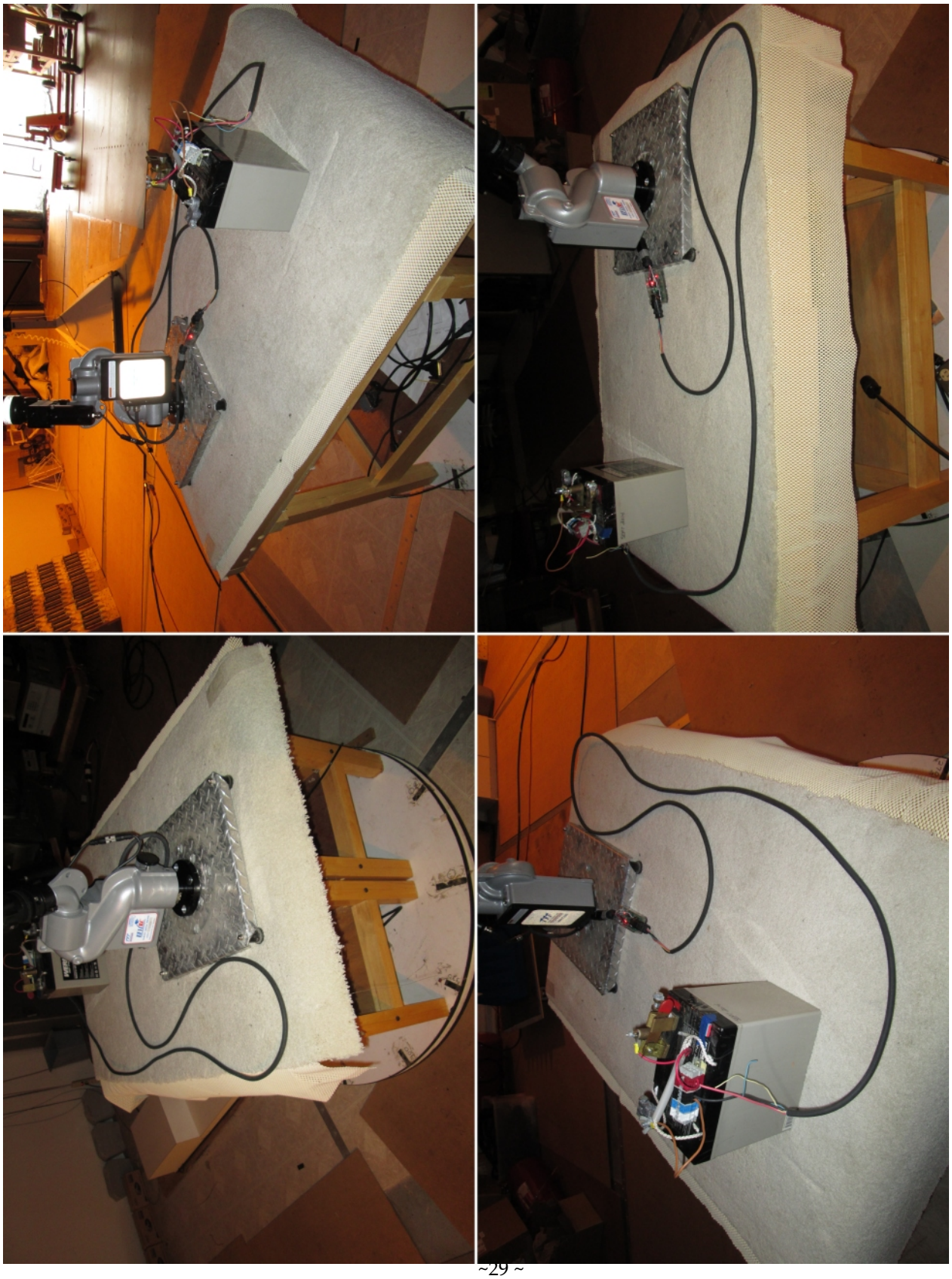
The Bluetooth module was fully compliant with the Cispr 11 B level specification. The actual battery used for this test was a large 12 volt lead acid battery.

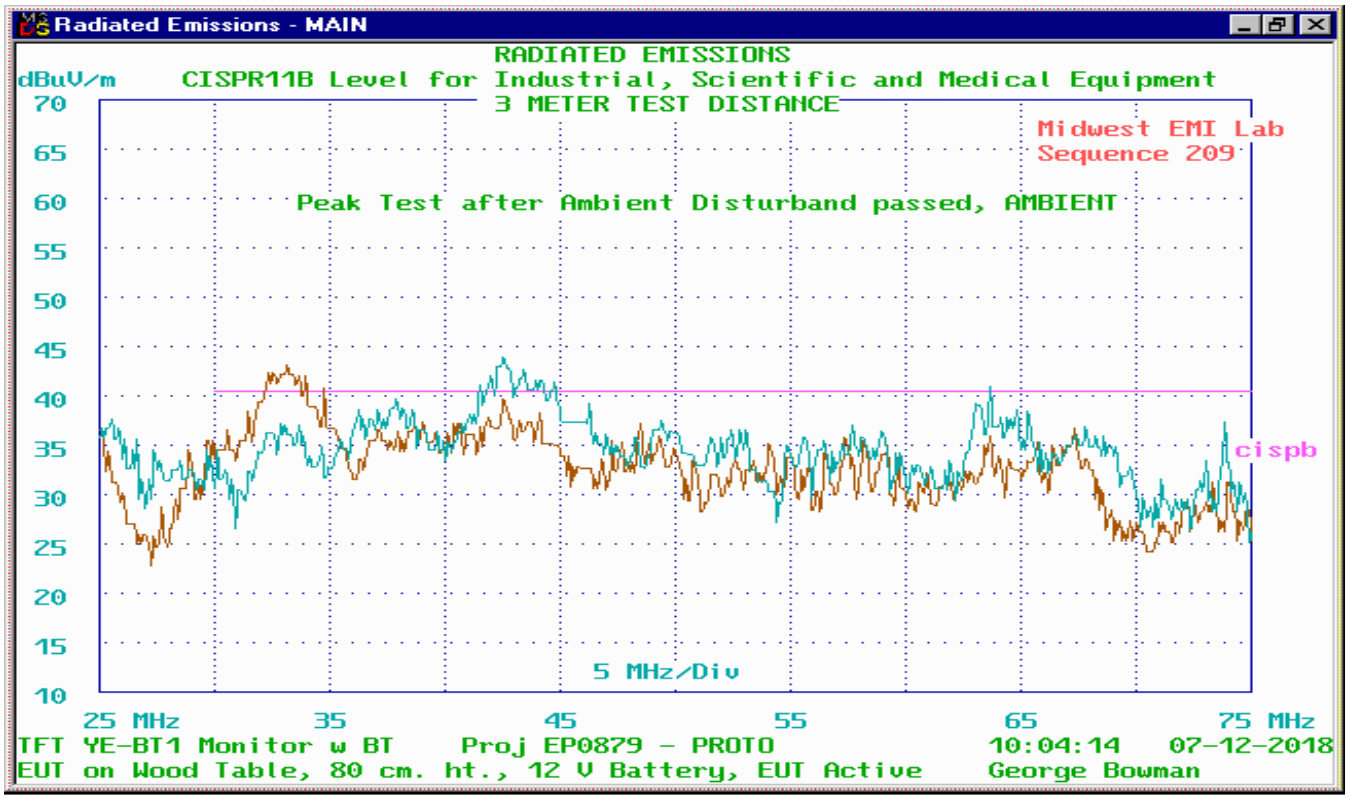


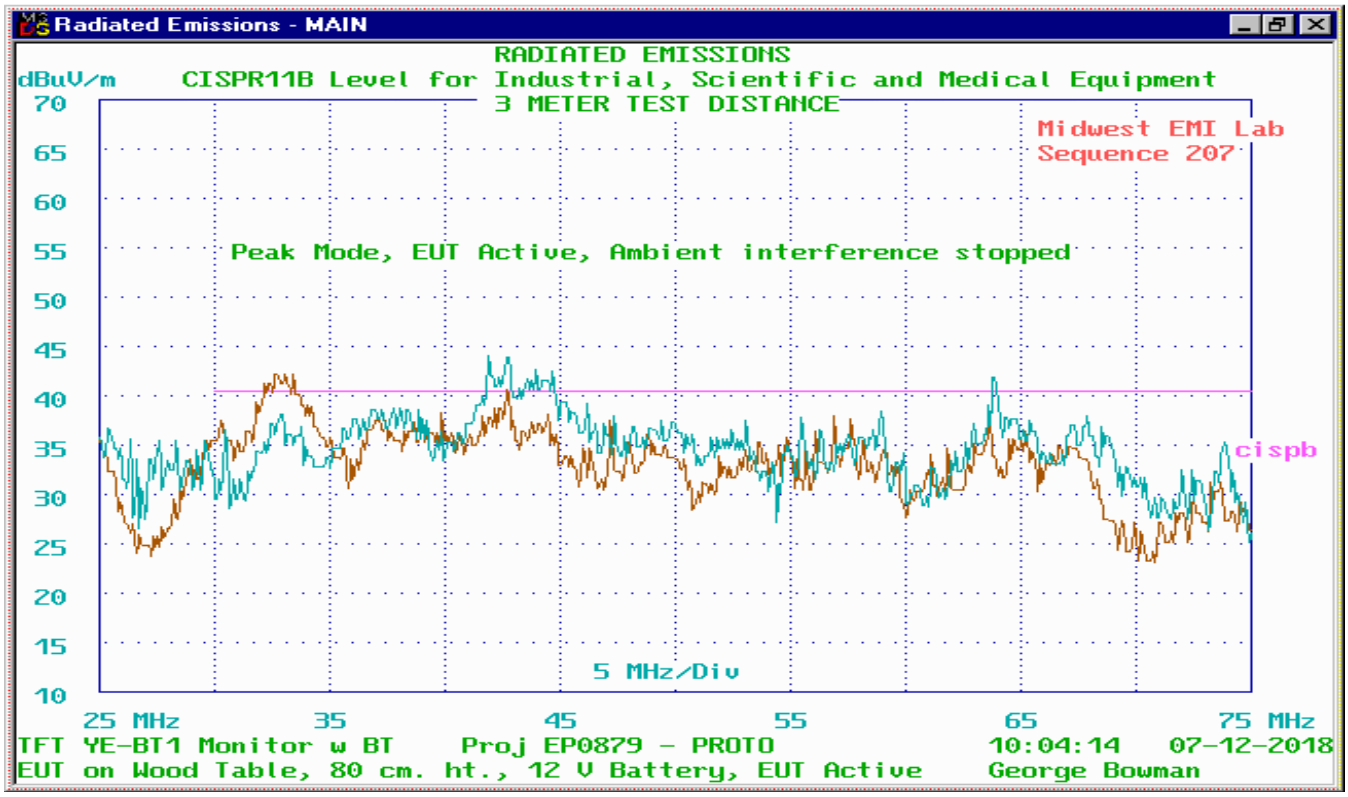


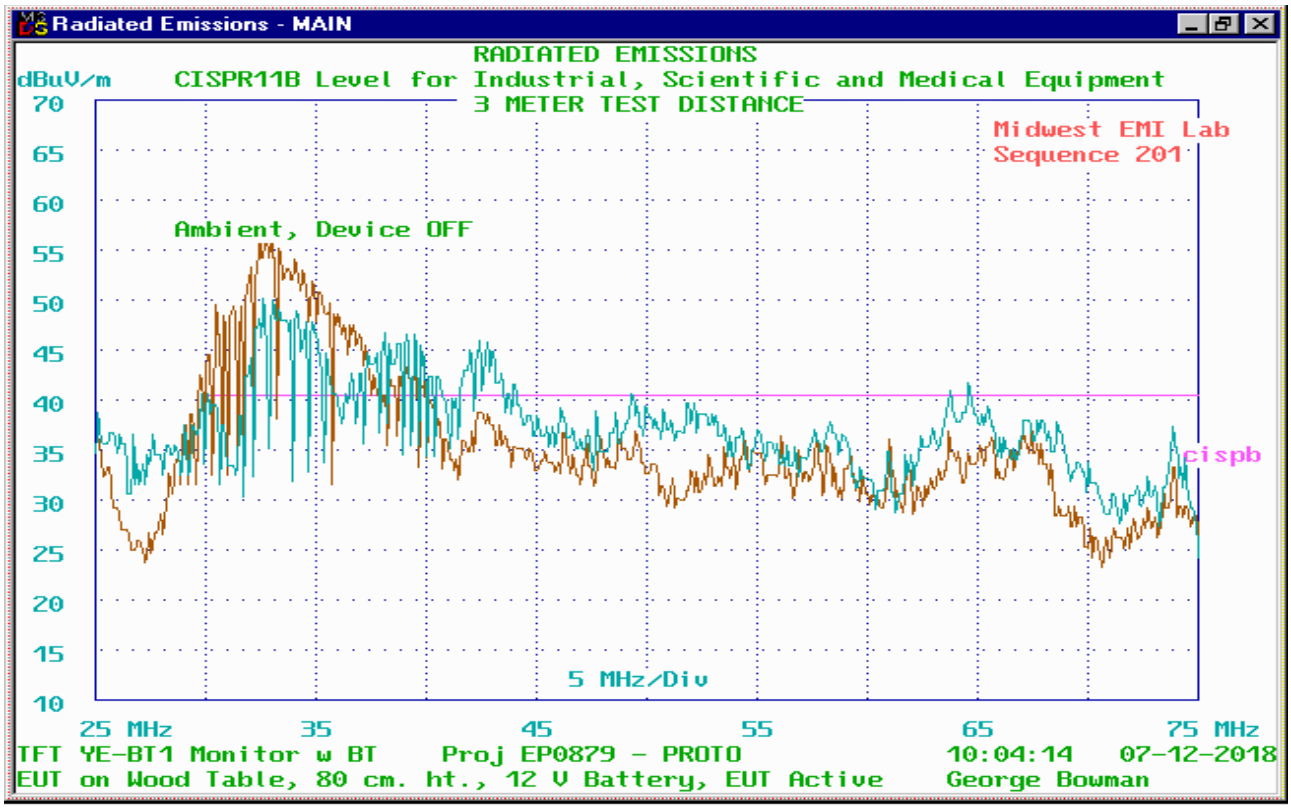

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
1 METER TEST DISTANCE
Midwest EMI Lab
Sequence 361
Screen Room Test, 1 meter distance, BT ON OSC OFF
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
25 MHz
80
135
190
245
300 MHz
TFT EP0879 Bluetooth Adap Prototype
16:06:20 07-11-2018
EUT on Metal Table, 12V DC, SCREEN ROOM TEST NOT OSCILLATE George Bowman

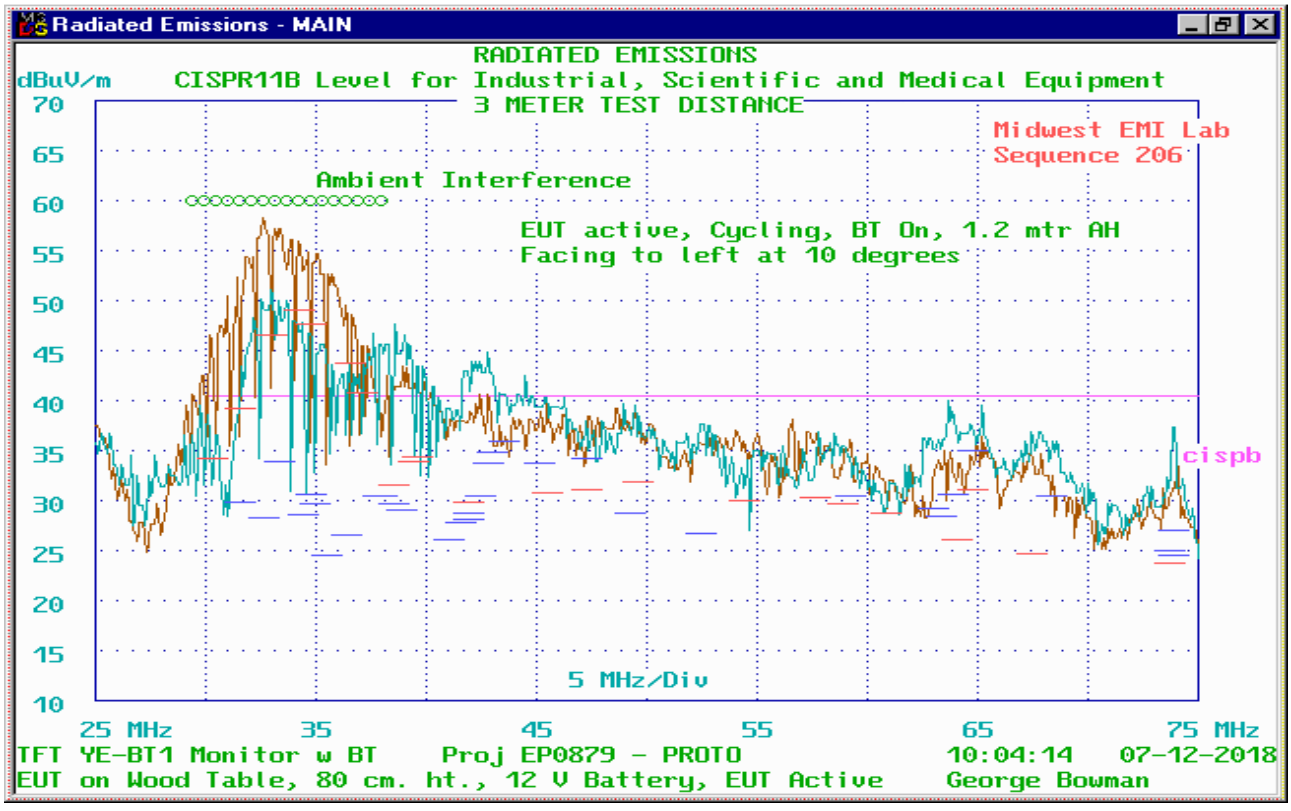

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
1 METER TEST DISTANCE
Midwest EMI Lab
Sequence 362
eut active, screen room test, highband
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
70 MHz/Div
300 MHz
440
580
720
860
1 GHz
TFT EP0879 Bluetooth Adap Prototype
16:06:20 07-11-2018
EUT on Metal Table, 12V DC, SCREEN ROOM TEST NOT OSCILLATE George Bowman

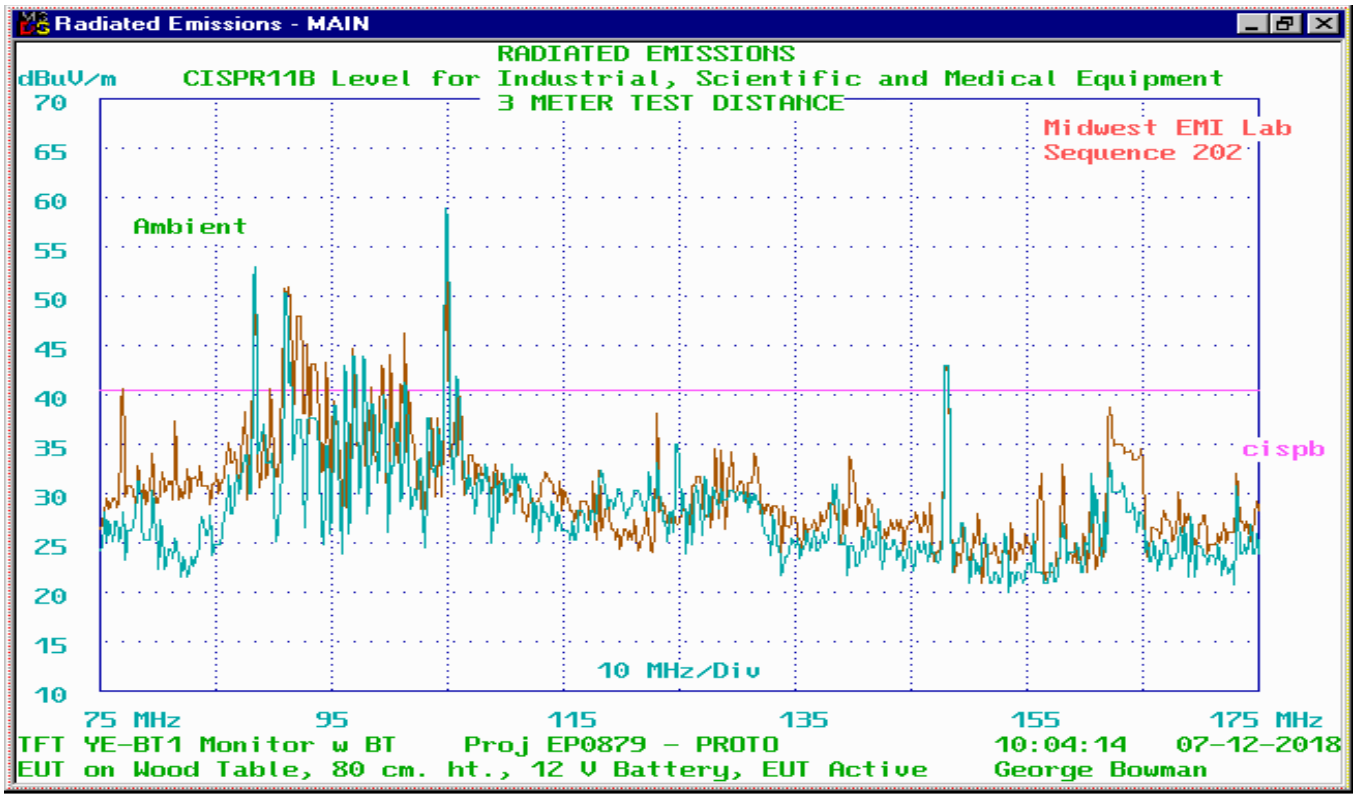


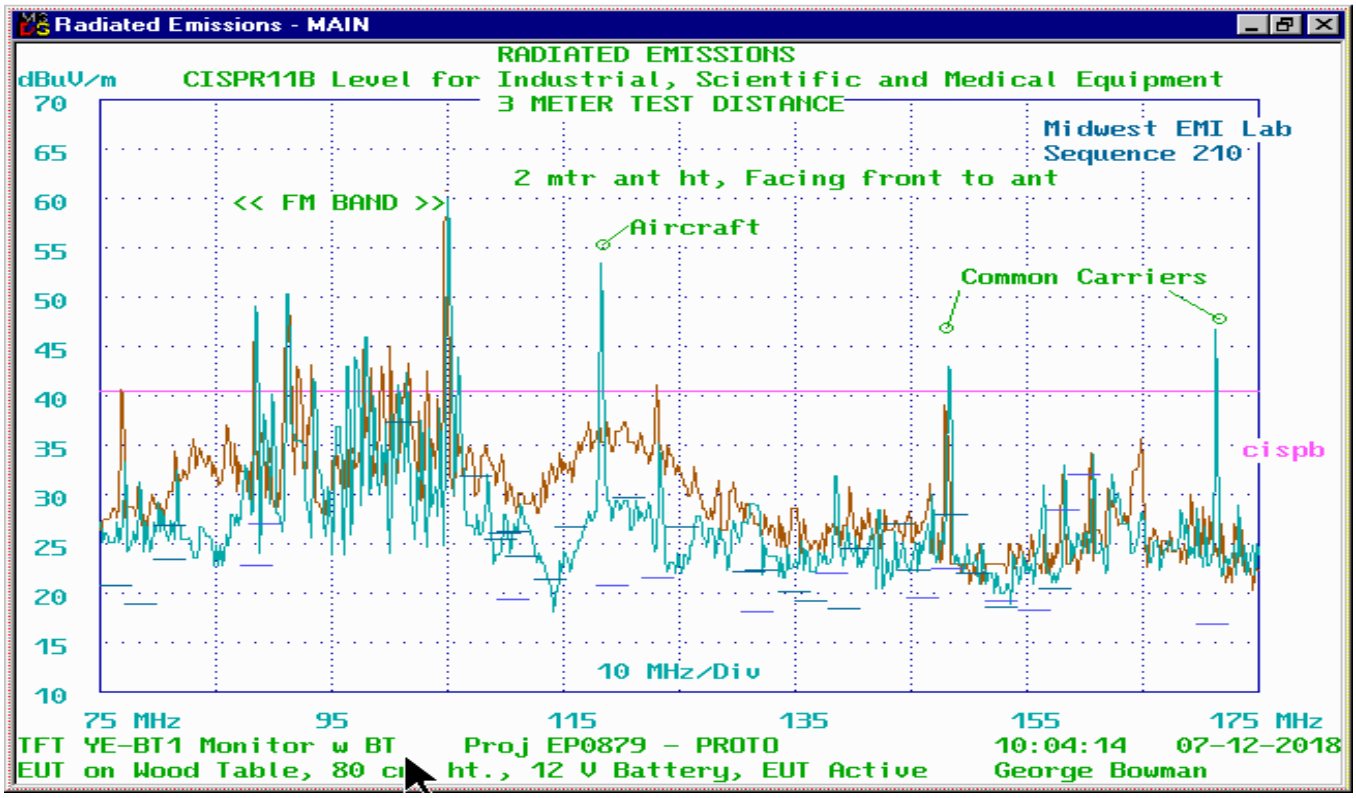

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 209
Peak Test after Ambient Disturband passed, AMBIENT
cispb
5 MHz/Div
25 MHz 35 45 55 65 75 MHz
TFT YE-BT1 Monitor w BT Proj EP0879 - PROTO 10:04:14 07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active George Bowman

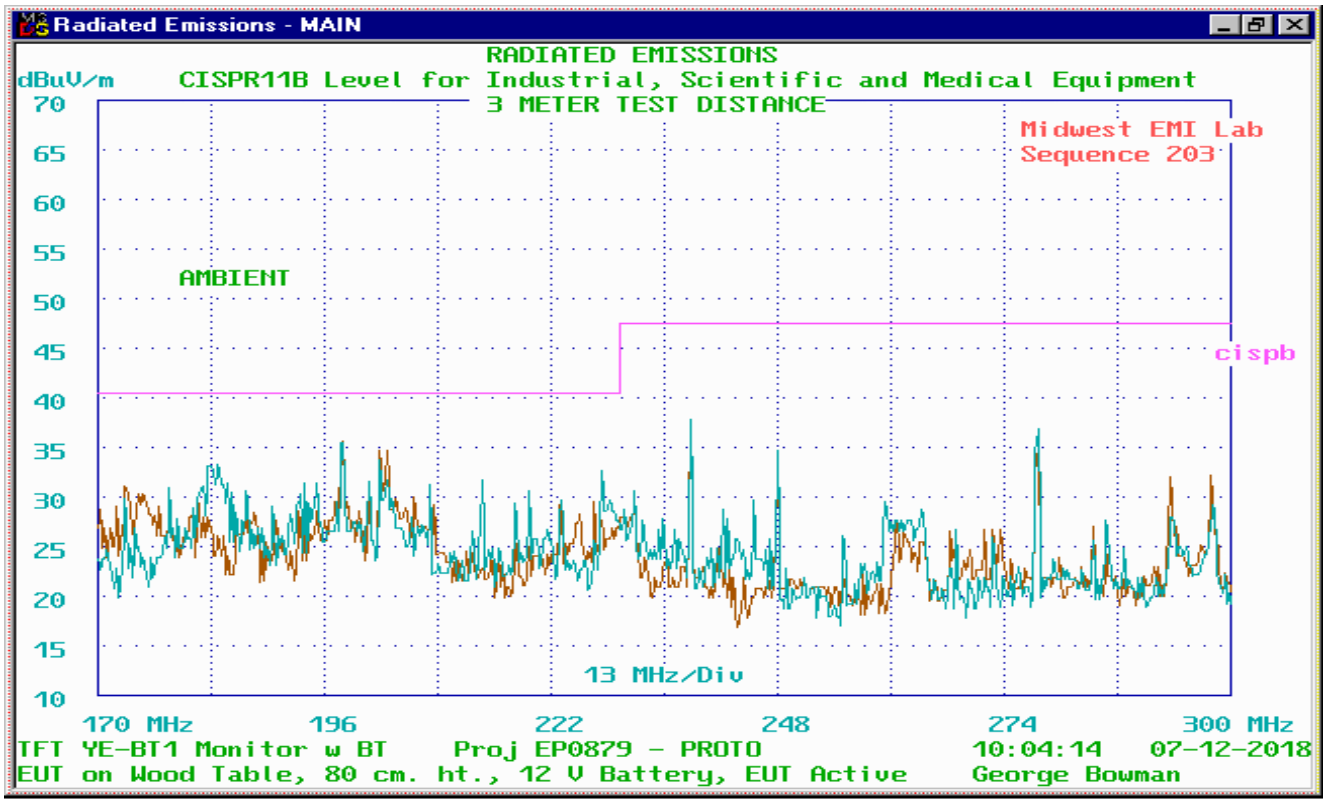

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 207
Peak Mode, EUT Active, Ambient interference stopped
cispb
5 MHz/Div
25 MHz 35 45 55 65 75 MHz
TFT YE-BT1 Monitor w BT Proj EP0879 - PROTO 10:04:14 07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active George Bowman

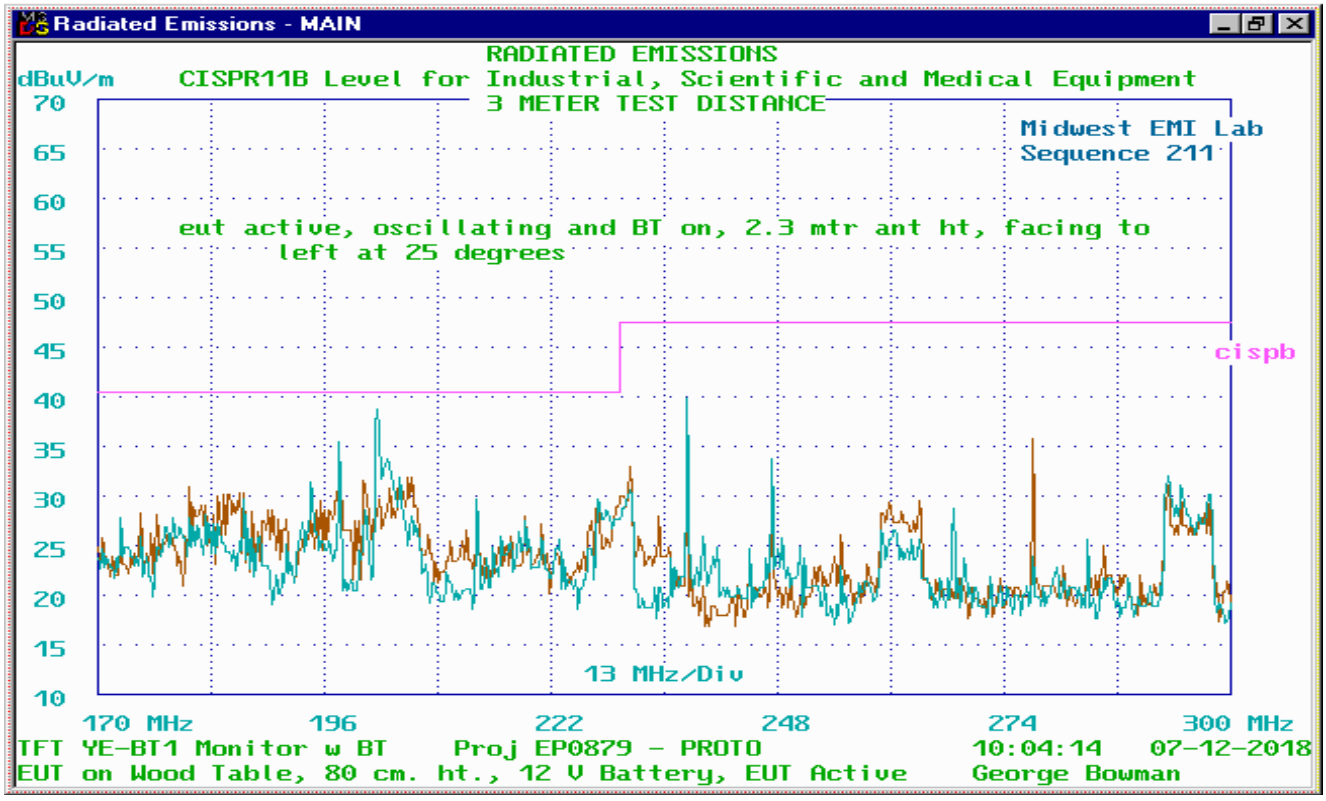

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 201
Ambient, Device OFF
cispb
5 MHz/Div
25 MHz
35
45
55
65
75 MHz
TFT YE-BT1 Monitor w BT
Proj EP0879 - PROTO
10:04:14
07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
George Bowman

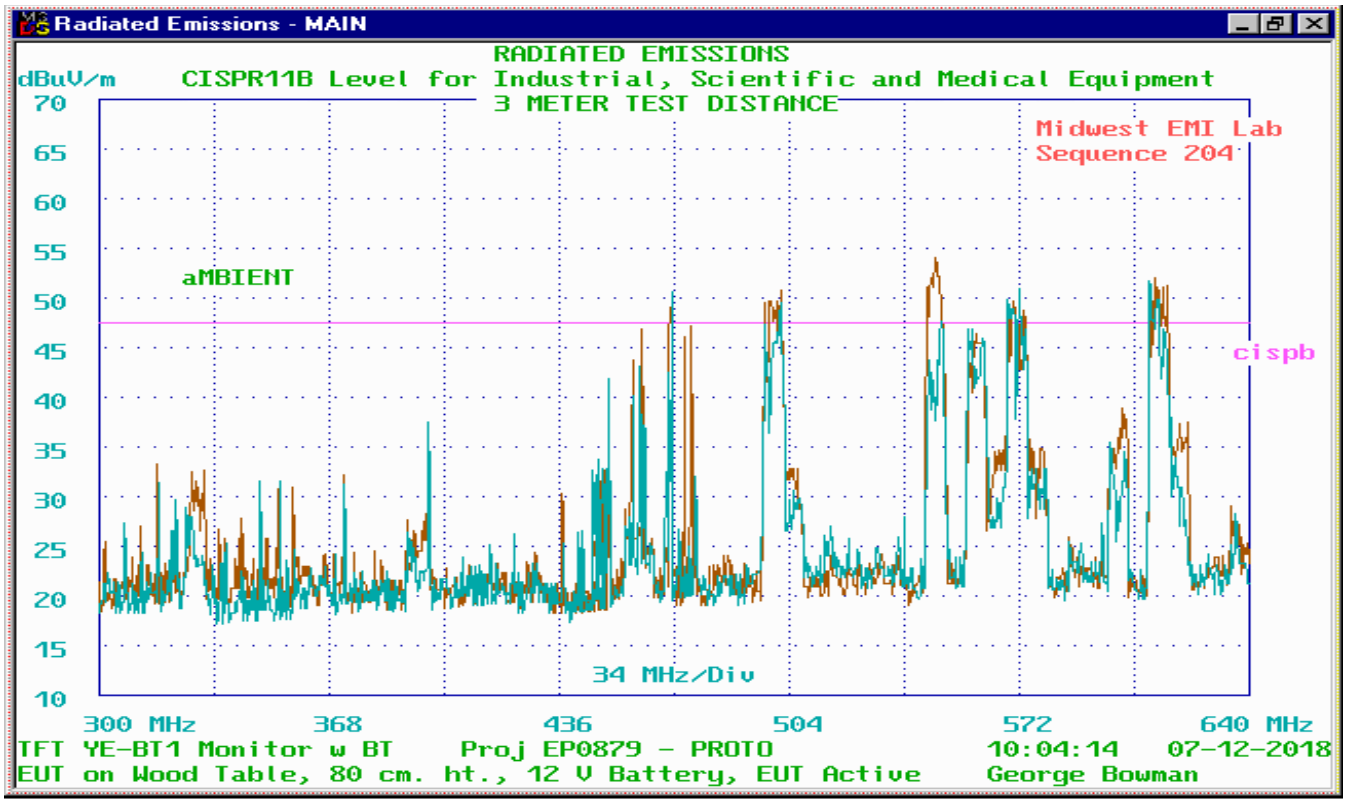

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 206
Ambient Interference
EUT active, Cycling, BT On, 1.2 mtr AH
Facing to left at 10 degrees
cispb
5 MHz/Div
25 MHz
35
45
55
65
75 MHz
TFT YE-BT1 Monitor w BT
Proj EP0879 - PROTO
10:04:14
07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
George Bowman

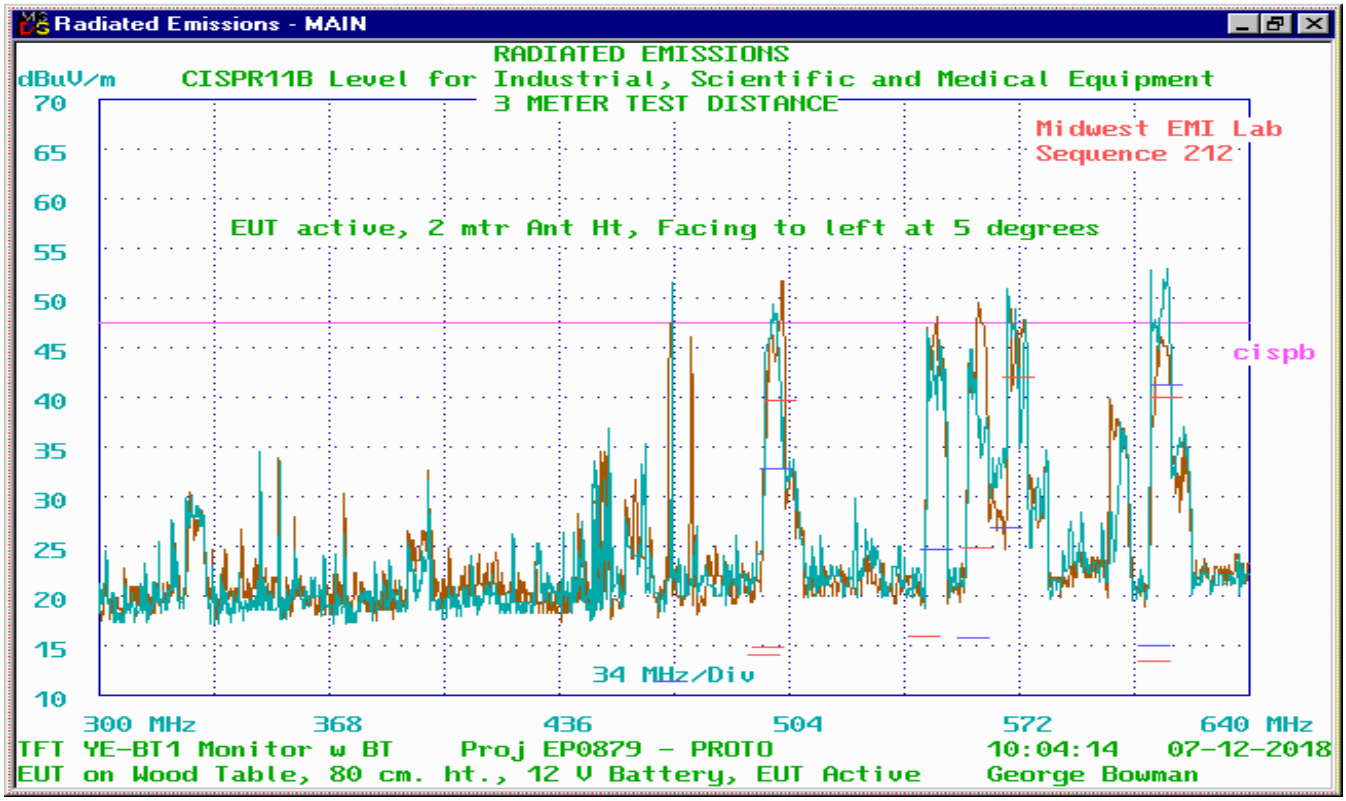

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 202
Ambient
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
10 MHz/Div
75 MHz
95
115
135
155
175 MHz
TFT YE-BT1 Monitor w BT
Proj EP0879 - PROTO
10:04:14
07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
George Bowman

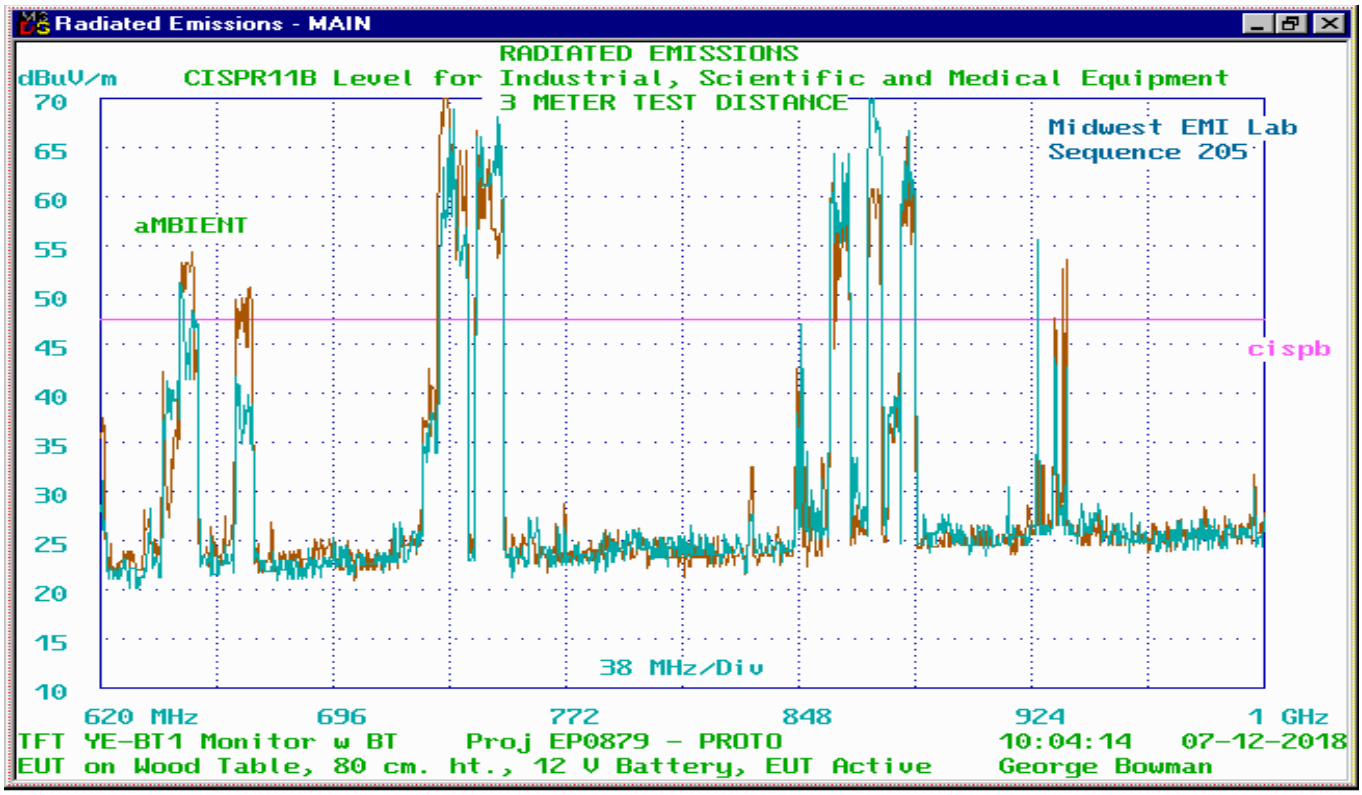

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 210
2 mtr ant ht, Facing front to ant
<< FM BAND >>
Aircraft
Common Carriers
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
10 MHz/Div
75 MHz
95
115
135
155
175 MHz
TFT YE-BT1 Monitor w BT
Proj EP0879 - PROTO
10:04:14
07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
George Bowman

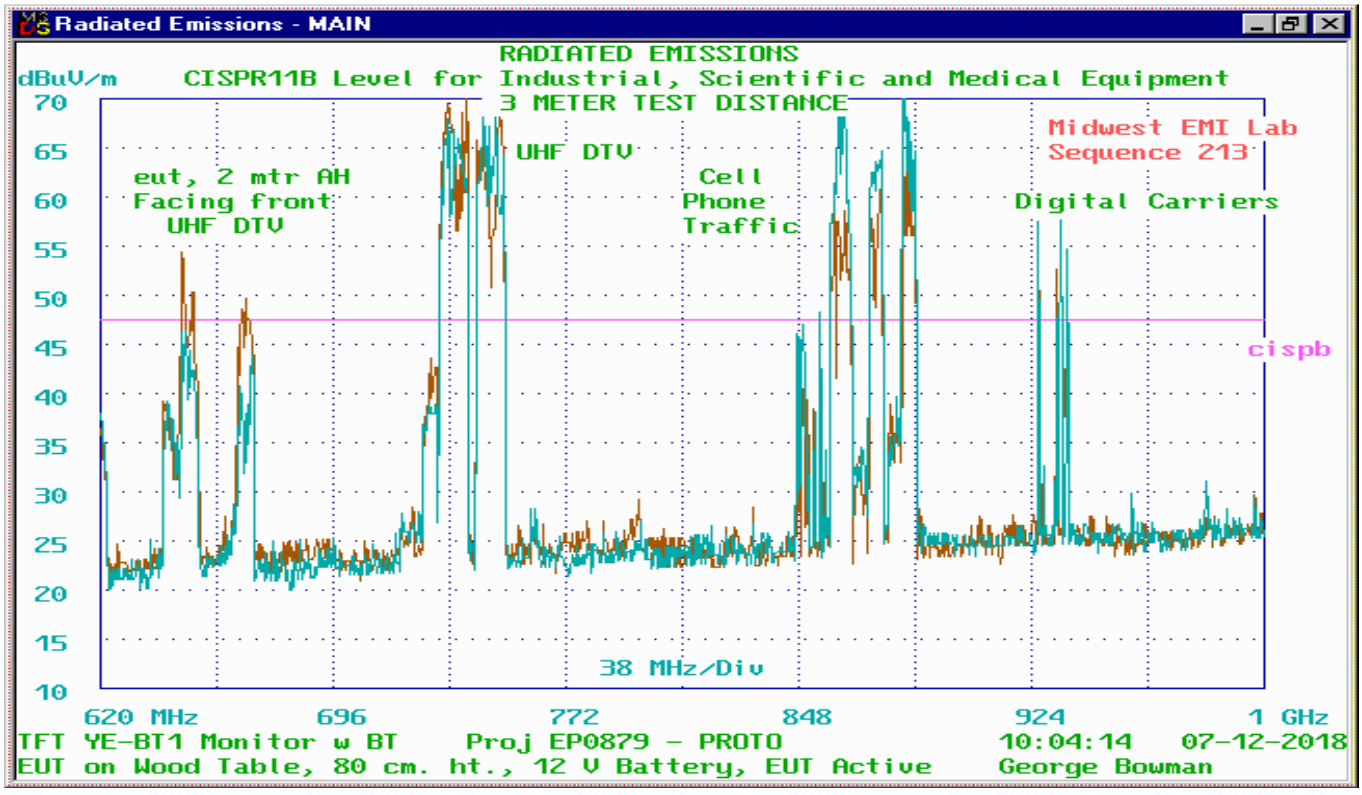

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 203
AMBIENT
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
13 MHz/Div
170 MHz
196
222
248
274
300 MHz
TFT YE-BT1 Monitor w BT
Proj EP0879 - PROTO
10:04:14
07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 211
eut active, oscillating and BT on, 2.3 mtr ant ht, facing to
left at 25 degrees
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
13 MHz/Div
170 MHz
196
222
248
274
300 MHz
TFT YE-BT1 Monitor w BT
Proj EP0879 - PROTO
10:04:14
07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 204
aMBIENT
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
34 MHz/Div
300 MHz
368
436
504
572
640 MHz
TFT YE-BT1 Monitor w BT
Proj EP0879 - PROTO
10:04:14
07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 212
EUT active, 2 mtr Ant Ht, Facing to left at 5 degrees
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
34 MHz/Div
300 MHz
368
436
504
572
640 MHz
TFT YE-BT1 Monitor w BT
Proj EP0879 - PROTO
10:04:14
07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 205
aMBIENT
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
38 MHz/Div
620 MHz
696
772
848
924
1 GHz
TFT YE-BT1 Monitor w BT
Proj EP0879 - PROTO
10:04:14
07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 213
UHF DTV
eut, 2 mtr AH
Facing front
UHF DTV
Cell
Phone
Traffic
Digital Carriers
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
38 MHz/Div
620 MHz
696
772
848
924
1 GHz
TFT YE-BT1 Monitor w BT
Proj EP0879 - PROTO
10:04:14
07-12-2018
EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
George Bowman

SHEET 1 **cispb RADIATED QUASI-PEAK REPORT**
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 10:04:14 **Midwest EMI**
DATE: 07-12-2018 **Associates**
TEST ITEM: TFT YE-BT1 Monitor w BT
SERIAL NUMBER: Proj EP0879 - PROTO **Sequence Number: 206**
COMMENTS: EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
TEST PERFORMED BY: George Bowman

Peak Frequency (MHz)	Peak Interference (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer (dBuV/m)	Spec. Level (dBuV/m)		Antenna Polar (H/V)
30.25356	48.416	30.4424	34.299	40.500		Horizontal
31.4887	52.400	31.6799	39.278	40.500		Horizontal
32.88248	58.736	33.0785	46.593	40.500	*	Horizontal
34.4629	55.655	34.3061	49.126	40.500	*	Horizontal
34.92513	54.239	34.7379	47.722	40.500	*	Horizontal
36.85973	47.415	36.6685	43.816	40.500	*	Horizontal
37.36591	45.590	37.1691	40.891	40.500	*	Horizontal
38.79785	43.278	38.6059	31.595	40.500		Horizontal
39.33224	43.632	39.5314	33.985	40.500		Horizontal
39.59508	43.590	39.5623	34.381	40.500		Horizontal
41.8786	41.320	42.0426	29.908	40.500		Horizontal
45.53104	40.767	45.5726	30.819	40.500		Horizontal
47.2738	44.972	47.2466	31.145	40.500		Horizontal
49.52047	40.531	49.6253	31.936	40.500		Horizontal
54.29983	38.291	54.4846	30.040	40.500		Horizontal
57.52369	39.444	57.6909	30.462	40.500		Horizontal
59.17223	36.909	58.9842	29.817	40.500		Horizontal
60.95139	35.877	60.897	28.834	40.500		Horizontal
63.89977	38.040	64.1006	26.195	40.500		Horizontal
64.75331	38.119	64.79649	31.151	40.500		Horizontal
67.28785	36.522	67.4807	24.804	40.500		Horizontal
73.99151	41.682	73.7971	23.874	40.500		Horizontal
31.54669	43.377	31.5451	29.889	40.500		Vertical
33.57604	50.789	33.4416	34.000	40.500		Vertical
32.56659	50.963	32.601	28.363	40.500		Vertical
34.68338	47.597	34.5066	28.613	40.500		Vertical
34.98535	46.547	34.7918	30.765	40.500		Vertical
35.20682	45.804	35.0076	29.729	40.500		Vertical
35.72408	43.939	35.5241	24.661	40.500		Vertical
36.29786	43.604	36.4603	26.719	40.500		Vertical
38.00205	46.085	37.8197	30.581	40.500		Vertical
38.21584	46.072	38.0286	30.587	40.500		Vertical
38.79579	45.727	38.643	29.832	40.500		Vertical
39.1722	45.960	38.9842	29.101	40.500		Vertical
41.00549	39.720	41.0799	26.183	40.500		Vertical
41.52352	40.015	41.5603	27.882	40.500		Vertical
41.83289	42.052	42.0321	28.883	40.500		Vertical
41.838	43.711	42.0332	28.183	40.500		Vertical
42.38899	44.348	42.5642	30.471	40.500		Vertical
42.74743	46.384	42.9418	33.892	40.500		Vertical
42.89475	43.801	42.9612	34.888	40.500		Vertical

SHEET 2 **cispb RADIATED QUASI-PEAK REPORT**
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 10:04:14 **Midwest EMI**
DATE: 07-12-2018 **Associates**
TEST ITEM: TFT YE-BT1 Monitor w BT
SERIAL NUMBER: Proj EP0879 - PROTO **Sequence Number: 206**
COMMENTS: EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
TEST PERFORMED BY: George Bowman

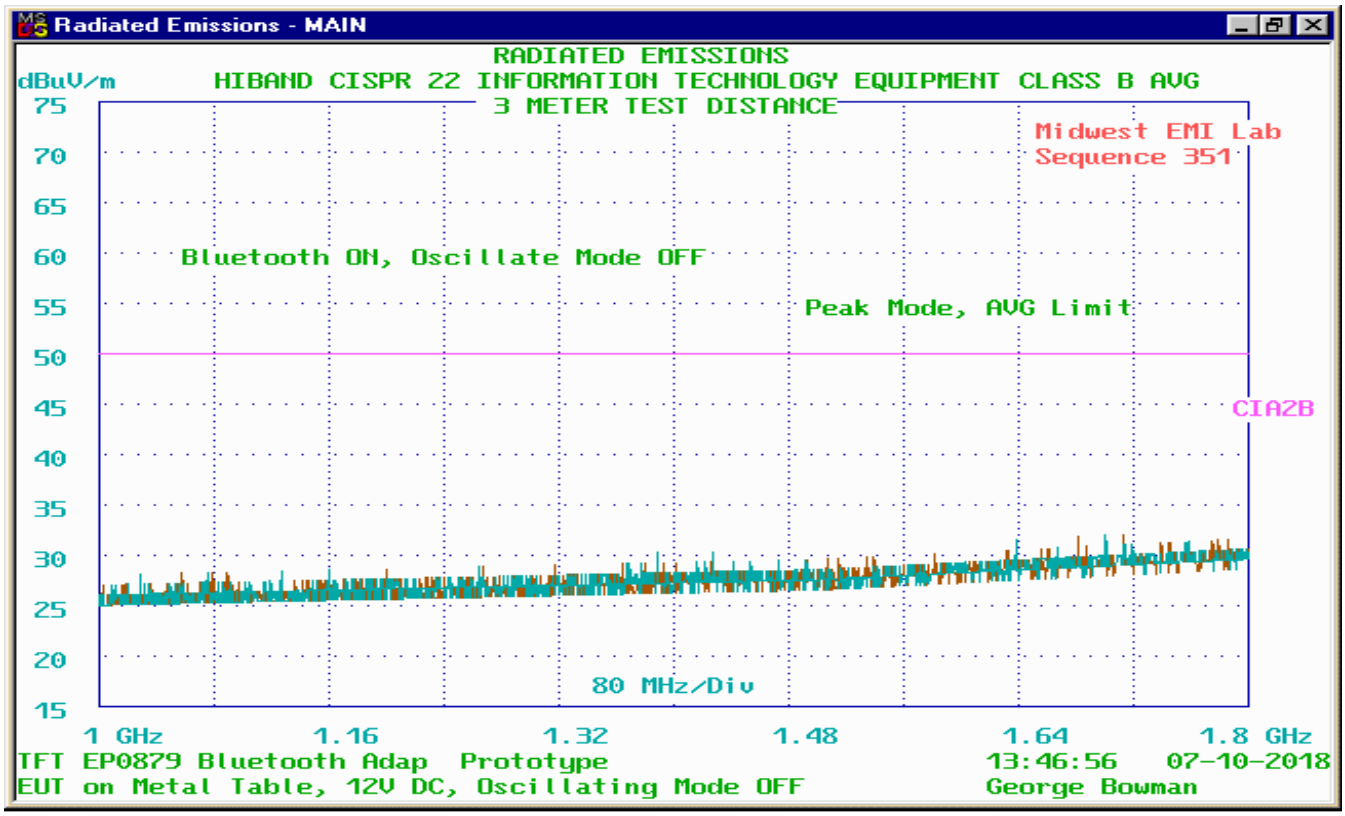
Peak Frequency (MHz)	Peak Interference (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer (dBuV/m)	Level (dBuV/m)	Spec. Antenna Polar (H/V)
43.40057	*42.003*	*43.4926*	*35.986*	*40.500*	*Vertical*
45.31302	*40.240*	*45.2298*	*33.905*	*40.500*	*Vertical*
47.24764	*39.527*	*47.2516*	*34.237*	*40.500*	*Vertical*
49.41146	*40.169*	*49.2491*	*28.855*	*40.500*	*Vertical*
52.32677	*40.556*	*52.4964*	*26.810*	*40.500*	*Vertical*
59.19118	*37.843*	*59.2392*	*30.486*	*40.500*	*Vertical*
63.11502	*35.173*	*63.003*	*29.269*	*40.500*	*Vertical*
63.18186	*39.241*	*63.3267*	*28.575*	*40.500*	*Vertical*
63.85079	*41.795*	*64.0164*	*30.675*	*40.500*	*Vertical*
64.64028	*41.620*	*64.76909*	*35.149*	*40.500*	*Vertical*
64.71083	*40.870*	*64.794*	*35.141*	*40.500*	*Vertical*
68.25230	*38.716*	*68.32989*	*30.583*	*40.500*	*Vertical*
73.51756	*44.893*	*73.67919*	*25.095*	*40.500*	*Vertical*
74.01264	*42.471*	*73.991*	*27.061*	*40.500*	*Vertical*
73.97416	*46.882*	*73.947*	*24.666*	*40.500*	*Vertical*

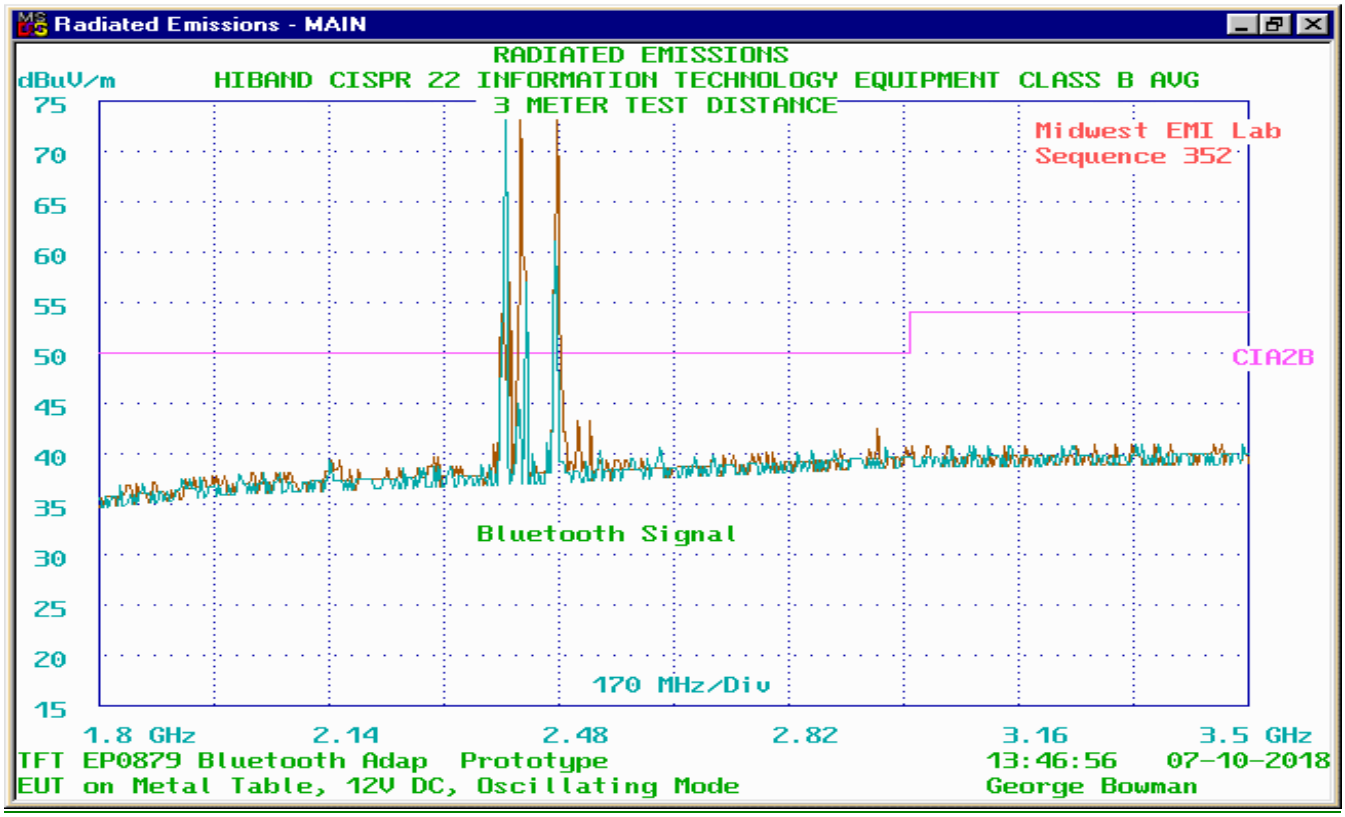
SHEET 1 **cispb RADIATED QUASI-PEAK REPORT**
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 10:04:14 **Midwest EMI**
DATE: 07-12-2018 **Associates**
TEST ITEM: TFT YE-BT1 Monitor w BT
SERIAL NUMBER: Proj EP0879 - PROTO **Sequence Number: 210**
COMMENTS: EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
TEST PERFORMED BY: George Bowman

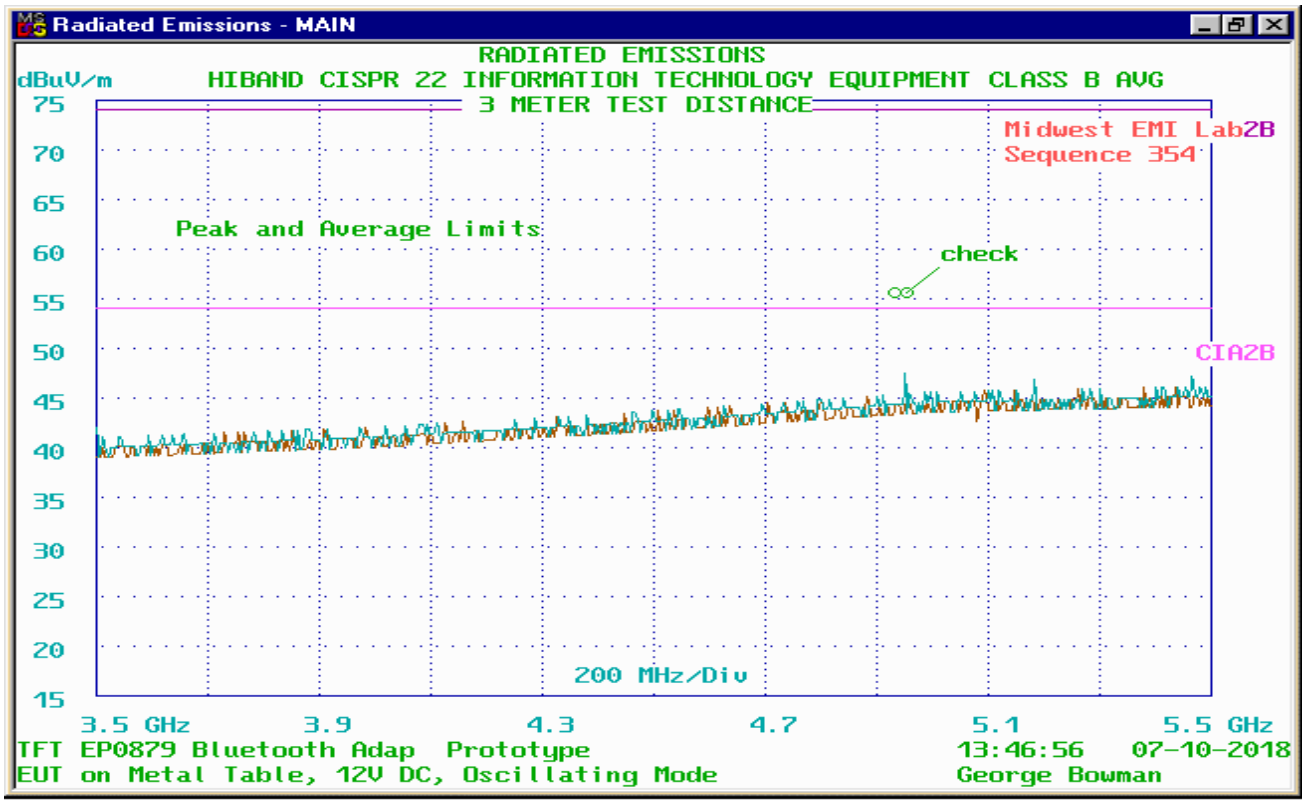
Peak Frequency (MHz)	Peak Interference (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer (dBuV/m)	Spec. Level (dBuV/m)	Antenna Polar (H/V)
76.40000	36.986	76.5296	20.805	40.500	Horizontal
78.40000	38.275	78.4256	18.978	40.500	Horizontal
81.21184	44.644	81.1758	26.912	40.500	Horizontal
81.04425	37.352	81.1707	23.511	40.500	Horizontal
100.8	37.157	100.9992	37.389	40.500	Horizontal
115.6	44.056	115.7576	26.860	40.500	Horizontal
109.6	39.322	109.7576	25.529	40.500	Horizontal
107.3041	37.949	107.5033	31.926	40.500	Horizontal
109.8	38.331	109.9928	26.240	40.500	Horizontal
110.6	40.764	110.736	26.270	40.500	Horizontal
111.4	39.097	111.5704	23.904	40.500	Horizontal
110.9284	39.421	110.7668	26.271	40.500	Horizontal
113.8	38.793	113.7864	21.492	40.500	Horizontal
121	38.883	120.8288	29.698	40.500	Horizontal
125.6	38.852	125.412	26.780	40.500	Horizontal
130.8239	36.714	130.9903	22.189	40.500	Horizontal
132.2	36.531	132.004	22.357	40.500	Horizontal
134.8011	46.196	134.9147	20.181	40.500	Horizontal
136.4	36.920	136.576	19.289	40.500	Horizontal
139	35.463	139.16	18.536	40.500	Horizontal
140.4	43.550	140.2032	24.570	40.500	Horizontal
143.8235	43.955	143.9011	27.106	40.500	Horizontal
145.4	47.678	145.256	22.386	40.500	Horizontal
148.6	34.605	148.4872	28.011	40.500	Horizontal
150.4	35.534	150.2024	22.032	40.500	Horizontal
153	36.260	152.8632	18.659	40.500	Horizontal
157.2	35.993	157.364	20.494	40.500	Horizontal
88.59999	50.030	88.508	22.825	40.500	Vertical
89.37175	39.453	89.295	27.070	40.500	Vertical
111.0205	36.339	110.8373	19.421	40.500	Vertical
119.2	37.414	119.364	20.821	40.500	Vertical
123.2	37.779	123.2736	21.573	40.500	Vertical
131.8	34.859	131.7288	18.270	40.500	Vertical
138.4	35.530	138.236	22.055	40.500	Vertical
146.2209	35.375	146.0513	19.597	40.500	Vertical
148	44.719	148.1216	22.514	40.500	Vertical
152.6	52.061	152.6832	19.262	40.500	Vertical
155.8142	34.602	155.8094	18.395	40.500	Vertical
158	36.334	158.0912	28.536	40.500	Vertical
160.0313	36.374	159.9897	32.070	40.500	Vertical
171	45.457	170.9016	16.952	40.500	Vertical

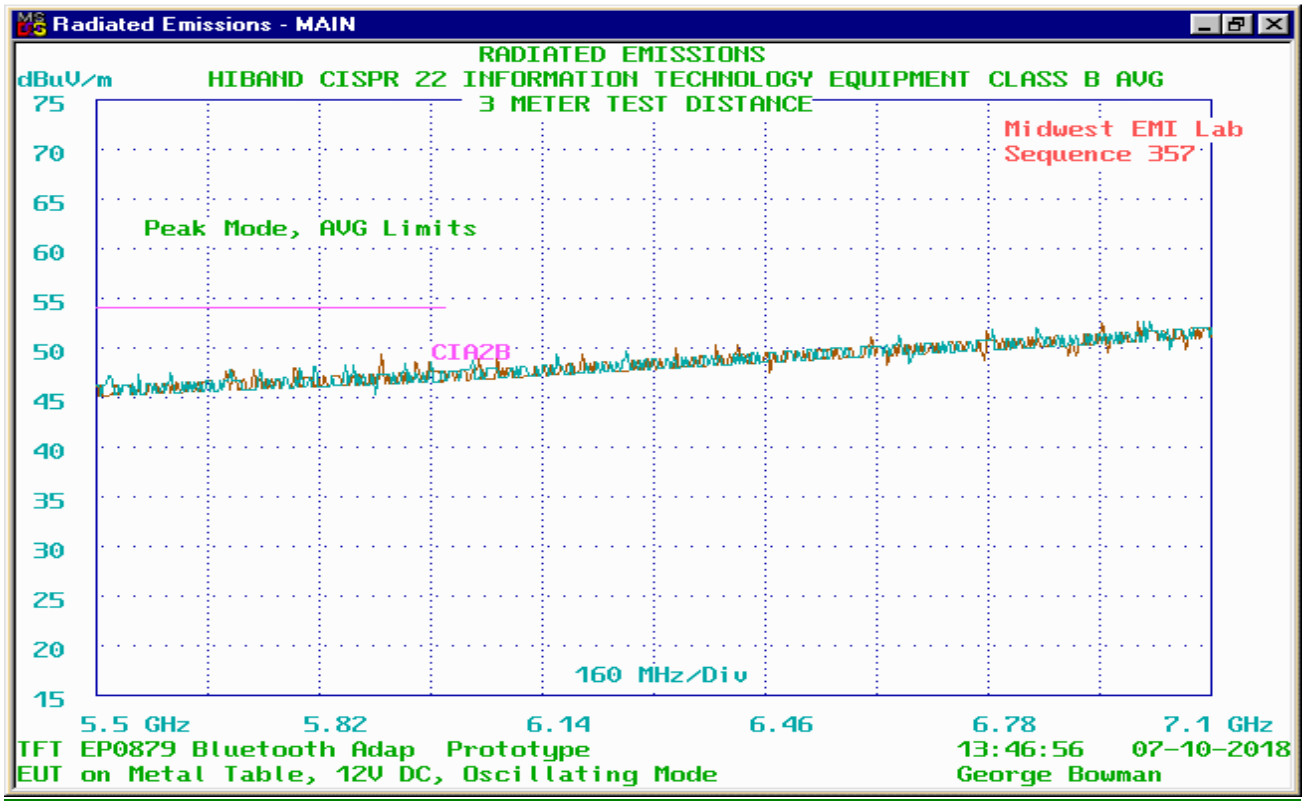
SHEET 1 **cispb RADIATED QUASI-PEAK REPORT**
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 10:04:14 **Midwest EMI**
DATE: 07-12-2018 **Associates**
TEST ITEM: TFT YE-BT1 Monitor w BT
SERIAL NUMBER: Proj EP0879 - PROTO **Sequence Number: 212**
COMMENTS: EUT on Wood Table, 80 cm. ht., 12 V Battery, EUT Active
TEST PERFORMED BY: George Bowman

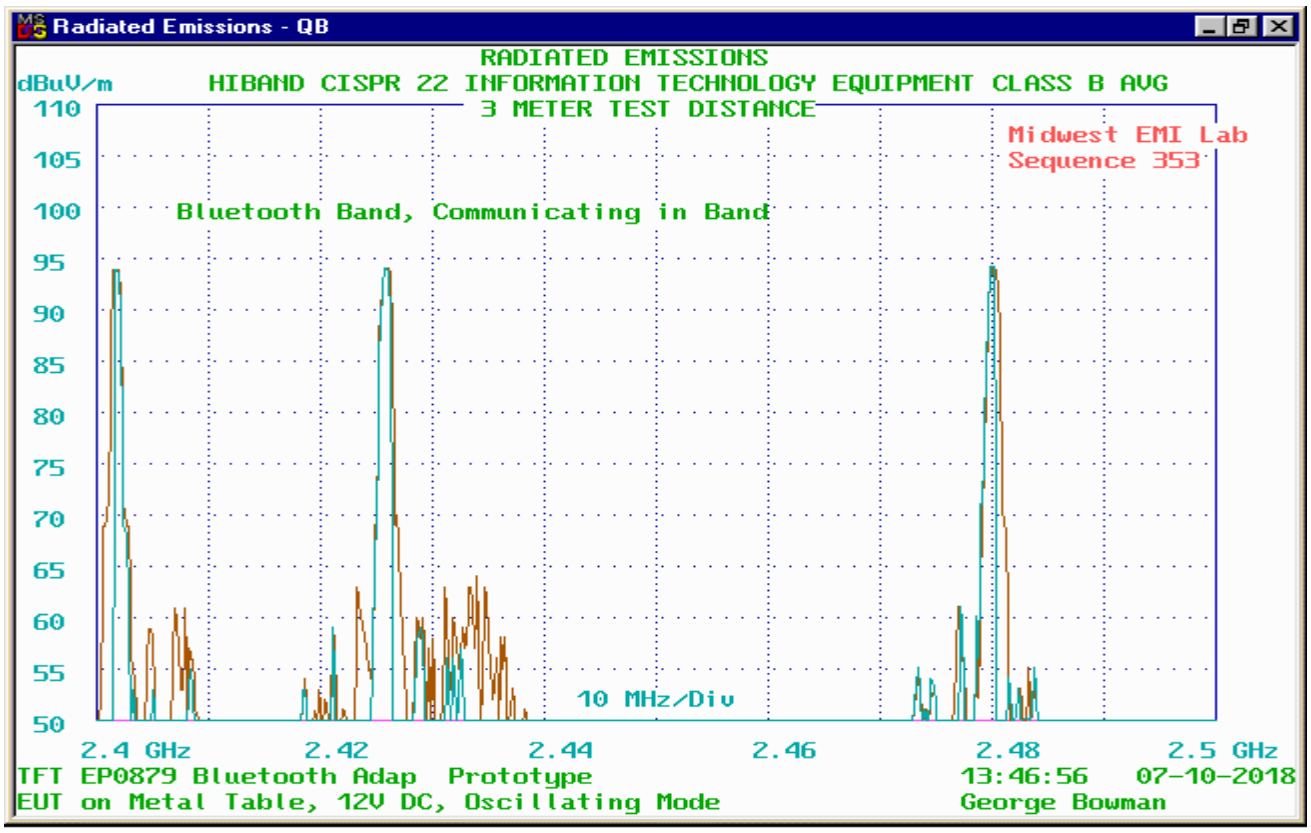
Peak Frequency (MHz)	Peak Interference (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer (dBuV/m)	Spec. Level (dBuV/m)	Antenna Polar (H/V)
469.2	*50.452*	*469.2936*	*11.455*	*47.500*	*Horizontal*
496.4	*47.662*	*496.2736*	*14.158*	*47.500*	*Horizontal*
498.4	*47.722*	*498.5152*	*14.926*	*47.500*	*Horizontal*
501.2	*51.201*	*501.2048*	*39.801*	*47.500*	*Horizontal*
544.4	*52.586*	*544.324*	*16.086*	*47.500*	*Horizontal*
560	*49.260*	*560.2016*	*24.966*	*47.500*	*Horizontal*
572.4	*49.943*	*572.5904*	*42.147*	*47.500*	*Horizontal*
612.4	*47.086*	*612.5288*	*13.591*	*47.500*	*Horizontal*
615.6719	*47.623*	*615.5767*	*40.121*	*47.500*	*Horizontal*
469.2	*50.780*	*469.0328*	*11.472*	*47.500*	*Vertical*
500	*49.700*	*500.1984*	*32.908*	*47.500*	*Vertical*
548	*46.720*	*548.1984*	*24.822*	*47.500*	*Vertical*
558.4	*46.190*	*558.4640*	*15.889*	*47.500*	*Vertical*
568.4	*51.696*	*568.3432*	*26.997*	*47.500*	*Vertical*
612.7117	*53.261*	*612.5205*	*15.121*	*47.500*	*Vertical*
615.2	*55.095*	*615.1608*	*41.294*	*47.500*	*Vertical*

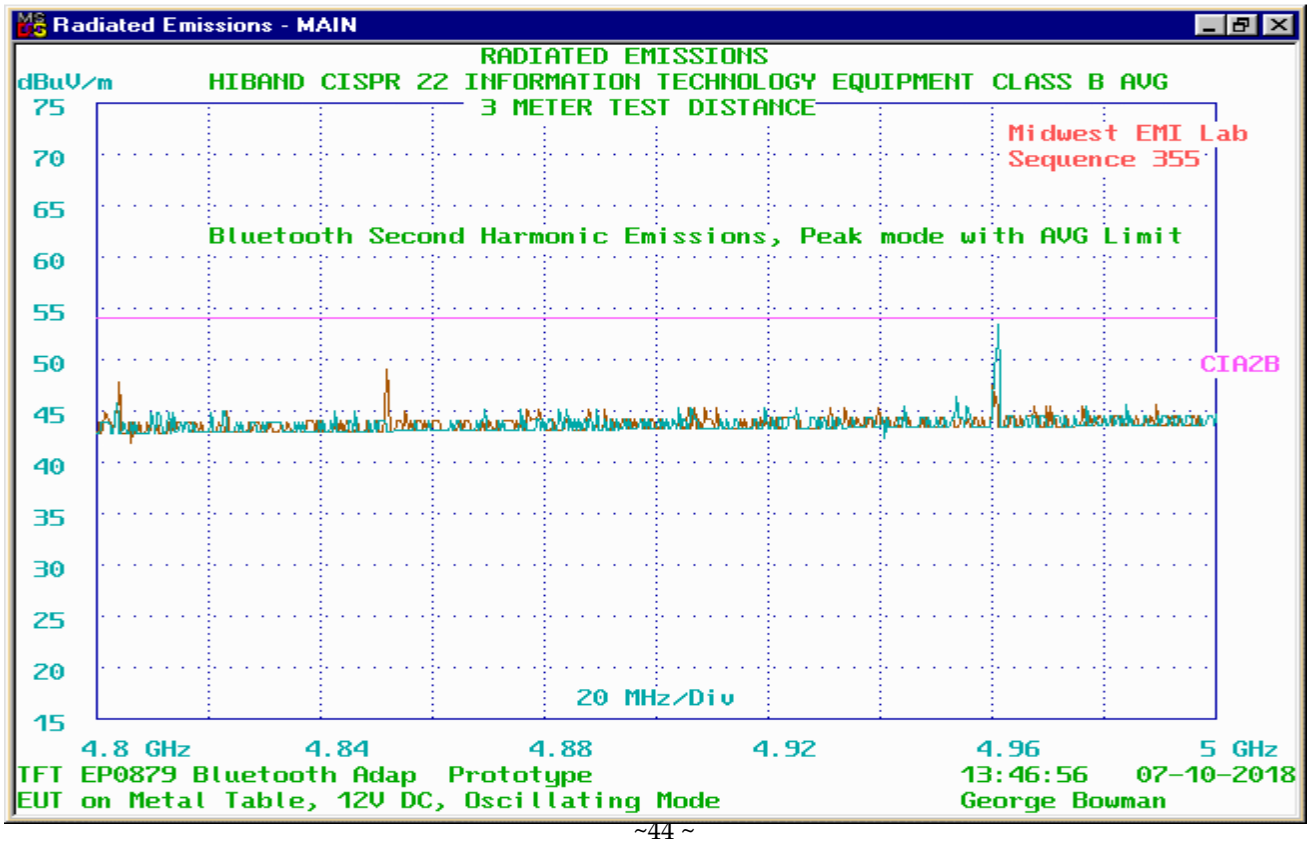

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
HIBAND CISPR 22 INFORMATION TECHNOLOGY EQUIPMENT CLASS B AVG
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 351
Bluetooth ON, Oscillate Mode OFF
Peak Mode, AVG Limit
CIA2B
80 MHz/Div
1 GHz
1.16
1.32
1.48
1.64
1.8 GHz
TFT EP0879 Bluetooth Adap Prototype
EUT on Metal Table, 12V DC, Oscillating Mode OFF
13:46:56 07-10-2018
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
HIBAND CISPR 22 INFORMATION TECHNOLOGY EQUIPMENT CLASS B AVG
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 352
CIA2B
Bluetooth Signal
170 MHz/Div
1.8 GHz
2.14
2.48
2.82
3.16
3.5 GHz
TFT EP0879 Bluetooth Adap Prototype
EUT on Metal Table, 12V DC, Oscillating Mode
13:46:56 07-10-2018
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
HIBAND CISPR 22 INFORMATION TECHNOLOGY EQUIPMENT CLASS B AVG
3 METER TEST DISTANCE
Midwest EMI Lab2B
Sequence 354
Peak and Average Limits
check
CIA2B
75
70
65
60
55
50
45
40
35
30
25
20
15
200 MHz/Div
3.5 GHz
3.9
4.3
4.7
5.1
5.5 GHz
TFT EP0879 Bluetooth Adap Prototype
EUT on Metal Table, 12V DC, Oscillating Mode
13:46:56 07-10-2018
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
HIBAND CISPR 22 INFORMATION TECHNOLOGY EQUIPMENT CLASS B AVG
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 357
Peak Mode, AVG Limits
CIA2B
75
70
65
60
55
50
45
40
35
30
25
20
15
160 MHz/Div
5.5 GHz
5.82
6.14
6.46
6.78
7.1 GHz
TFT EP0879 Bluetooth Adap Prototype
EUT on Metal Table, 12V DC, Oscillating Mode
13:46:56 07-10-2018
George Bowman


Radiated Emissions - QB
RADIATED EMISSIONS
dBuV/m
HIBAND CISPR 22 INFORMATION TECHNOLOGY EQUIPMENT CLASS B AVG
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 353
Bluetooth Band, Communicating in Band
110
105
100
95
90
85
80
75
70
65
60
55
50
10 MHz/Div
2.4 GHz
2.42
2.44
2.46
2.48
2.5 GHz
TFT EP0879 Bluetooth Adap Prototype
EUT on Metal Table, 12V DC, Oscillating Mode
13:46:56 07-10-2018
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
HIBAND CISPR 22 INFORMATION TECHNOLOGY EQUIPMENT CLASS B AVG
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 355
Bluetooth Second Harmonic Emissions, Peak mode with AVG Limit
CIA2B
75
70
65
60
55
50
45
40
35
30
25
20
15
20 MHz/Div
4.8 GHz
4.84
4.88
4.92
4.96
5 GHz
TFT EP0879 Bluetooth Adap Prototype
EUT on Metal Table, 12V DC, Oscillating Mode
13:46:56 07-10-2018
George Bowman

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

- 4 KV is available on the instrument but not presently required by standards.

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, Latest Edition, 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:

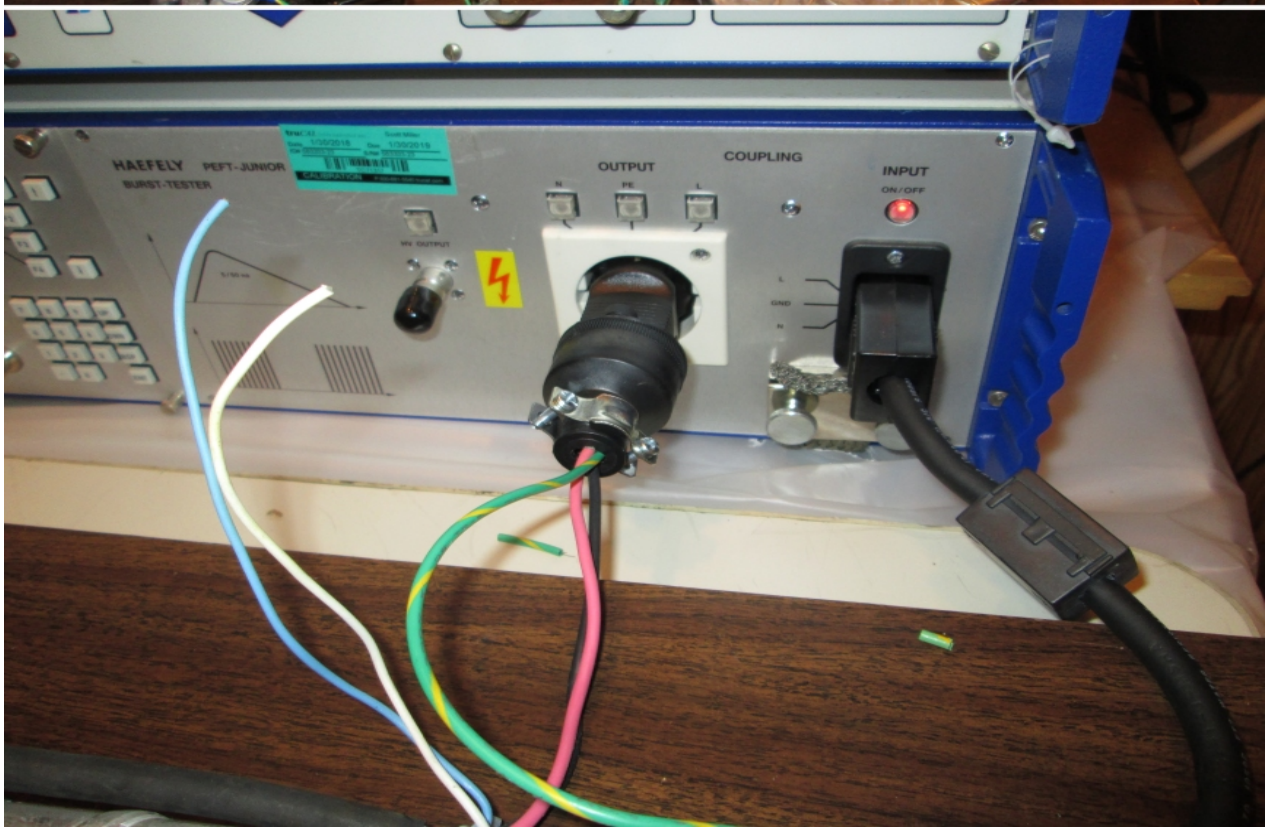
1) Any variation in a displayed character on a front panel display
2) Any permanent cessation of communication or adverse effect noticeable as a result of the application of EFT pulses
3) Any response of any kind that required an operator intervention to reset or recontrol the device to resume normal 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 BLUETOOTH ADAPTER YE-BT1 was tested at 1 KV via the standard enclosure port plug without any adverse effects being detected. The EUT passed the test with an "A" acceptance level. The active leads are plus, minus and platform ground. The lower portion of the attached table shows the test results.


Mundelein, Illinois
SURGE TEST


HAEFELY
PEFT-JUNIOR
BURST-TESTER
OUTPUT
COUPLING
INPUT
ON / OFF

Midwest EMI Associates
21234 West Commercial Drive
Mundelein, Illinois 60060

IEC Publication Number 61000-4-4 :2012

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

Manufacturer: TFT Test Engineer Initials: JB

Equipment Under Test: MONITOR w/ BLUETOOTH Date of Test: 7/11/18

Model #: YE-BT1 Serial #: EP0829

Temperature: 75 F Humidity Level: 62.5%

APPLIED BURST LEVEL: ~~.5~~ .220 Kilovolt (Test Severity Level 1) PHASE 3A+3B

REPETITION FREQUENCY: 5 Kilohertz **AC ADAPTER TYPE: (TWO) (THREE) TERMINAL**

BURST DURATION: 10 ~~15~~ Msec BURST PERIOD: 300 Msec

TEST DURATION: 60 Seconds/PHASE

POWER INPUT: (120 VAC / 60 Hz) (230VAC / 50 Hz) (208VAC/3PH, 50 Hz) OR **BAT VOLT:** 12 V

INSTRUMENT SETUP/NOMINAL CONDITIONS: MONITOR CYCLING, BT ON

Mode of appearance	PLUS OBSERVATIONS	MINUS
Neutral with respect to the GRP	✓	✓
Line with respect to the GRP	✓	✓
Neutral and Line with respect to the GRP	✓	✓
PE with respect to the GRP	✓	✓
Line and PE with respect to the GRP		
Neutral and PE with respect to the GRP		
Neutral, Line and PE with respect to the GRP		

* Failure Mode was: NONE

Checkmark Indicates no failure was observed, * Indicates Device Malfunctioned

APPLIED BURST LEVEL: 1 Kilovolt (Test Severity Level 2) EN61000-4-4 TEST

REPETITION FREQUENCY: 5 ~~2.5~~ Kilohertz **AC ADAPTER TYPE: (TWO) (THREE) TERMINAL**

BURST DURATION: 15 Msec BURST PERIOD: 300 Msec

TEST DURATION: 60 Seconds/PHASE

POWER INPUT: (120 VAC / 60 Hz) (230VAC / 50 Hz) (208VAC/3PH, 50 Hz) OR **BAT VOLT:** 12 V

INSTRUMENT SETUP/NOMINAL CONDITIONS: MONITOR CYCLING

mode of appearance PLUS	PLUS OBSERVATIONS	MINUS
Neutral with respect to the GRP	✓	✓
Line with respect to the GRP	✓	✓
Neutral and Line with respect to the GRP	✓	✓
PE with respect to the GRP	✓	✓
Line and PE with respect to the GRP		
Neutral and PE with respect to the GRP		
Neutral, Line and PE with respect to the GRP		

* Failure Mode was: NONE

Checkmark Indicates no failure was observed, * Indicates Device Malfunctioned

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 2.7 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 three bands covers 27 MHz to 6000 MHz however the actual test range covered was 25 MHz to 6 GHz.

3.0 TEST PROCEDURES:

3.1 POWER LEADS & CABLE PLACEMENT:

The TFT EP0879 BLUETOOTH ADAPTER INTERFACE 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/amplifier possibly used during the test were:
a) The EMCO Model 3107B Power E field antenna from 10 KHz to 25 MHz, horizontal polarization only,
b) The Antenna Research LPB 2520 Biconilog antenna from 25-2700 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 - 2700 MHz a 100 watt Ophir linear amplifier module was used. Above this range a TWT amplifier may be used up to 6 GHz.
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 1% per step every 8 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:

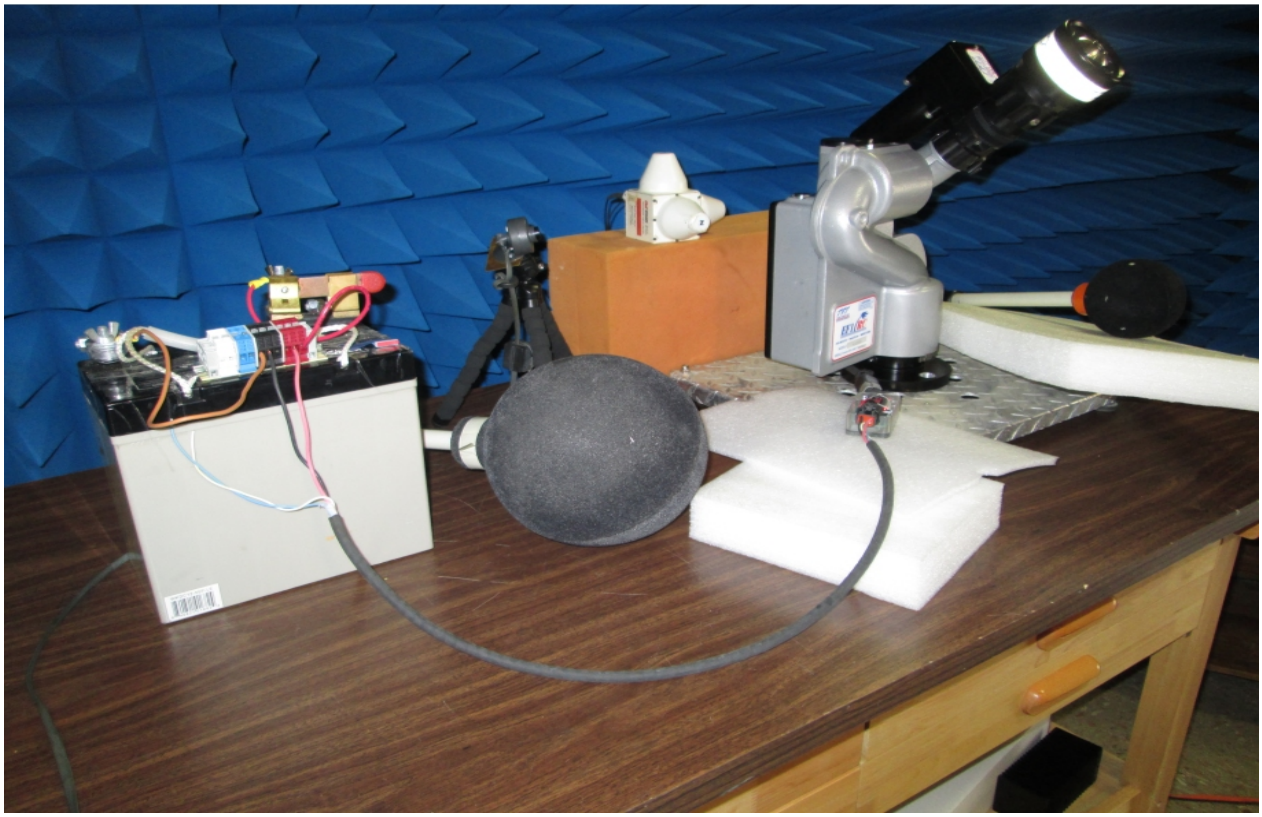
The radiated susceptibility immunity should not be lower than 3 or 10 V/M as prescribed by EN 61000-4-3. The IEC range is 80 MHz to 6000 MHz. A graph is shown of the actual averaged field strength presented to the prototype during the test.

4.2 RESULTS OF TEST:

The TFT EP0879 Bluetooth Adapter was exposed to a 13 V/M immunity wave from 25 to 2200 MHz with 1000 Hz, 80% modulation and also with GSM pulse modulation, 217 Hz rate. There was no interruption to communications noticed and as a system perform normally throughout the test.

The system was also tested manually from 2.2 GHz to 6 GHz with pulse modulation at a level of 10 V/M or higher with no change to operation noted.


varian
CAUTION
VZC6961 4 to 8GHz 20 Watts SN-6562
3500
730



Date: 7/11/18 Page 1 of 2	IMMUNITY Worksheet	Midwest EMI Associates Mundelein, Illinois	Form: SAEJ1113-21 or EN 61000-4-3/6

Device: TFT EP0879 Sponsor: TIM MILLER S/W Ver: 1.61 S/N: PROTO

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

Probes: (CS114) (Fischer CDN) (A/R FP2031) (A/R FP2036) (A/R P1000) (OPHIR Injection Clamp)

Technician: GB

Project No: TFT EP0879

Mod Freq: 2 10 100 (1000) Hz

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

POWER: 230 208 120 VAC or 12 VDC
Power Frequency: (50) (60) (400) Hz

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

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

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

Frequency (M=MHz) (K=KHz)	Inc Freq (KHz) or (1%) if blank	Immunity Level (V) (V/M) (mA)	Dwell Time: (Sec)	Antenna Type & Polar	Results: Include any Failure Modes Observed in the EUT during the test. Video Camera System Used? (Yes) (No)
25M	1%	13	8	BL H	Pairing up, OSC + BT ON, OK
96M	"	"	"	"	"
157M	"	"	"	"	"
301M	"	"	"	"	"
500M	"	"	"	"	"
762M	"	"	"	"	"
1113M	"	"	"	"	"
1571M	"	"	"	"	"
1837M	"	"	"	"	"
3200M	"	"	"	"	"
25M	1%	13	8	BL V	Pairing up, OSC + BT ON, OK
111M	"	"	"	"	"
239M	"	"	"	"	"
387M	"	"	"	"	"
500M	"	"	"	"	"
799M	"	"	"	"	"
977M	"	"	"	"	"
1213M	"	"	"	"	"
1591M	"	"	"	"	"
1837M	"	"	"	"	"
2200M	"	"	"	"	"

Notes: NO FAULTS

Date: 7/11/18 Page 2 of 2	IMMUNITY Worksheet	Midwest EMI Associates Mundelein, Illinois	Form: SAEJ1113-21 or EN 61000-4-3/6

Device: TFT EP0879 Sponsor: TOM MILLER S/W Ver: 1.01 S/N: PROTO

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

Probes: (CS114) (Fischer CDN) (A/R FP2031) (A/R FP2036) (A/R P1000) (OPHIR Injection Clamp)

Technician: (GB)

Project No: TFT EP0879

Mod Freq: 2 10 100 (1000) Hz

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

POWER: 230 208 120 VAC or 12 VDC
Power Frequency: (50) (60) (400) Hz

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

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

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

Frequency (M=MHz) (K=KHz)	Inc Freq (KHz) or (1%) if blank	Immunity Level (V) (V/M) (mA)	Dwell Time: (Sec)	Antenna Type & Polar	Results: Include any Failure Modes Observed in the EUT during the test. Video Camera System Used? (Yes) (No)
2200M	1%	10	8	H H	Going up, OSC + BT ON ADK
2600	"	"	"	H H	" " " "
3300	"	"	"	"	" " " "
3700	"	"	"	H H	" " " "
2200M	1%	10	8	H V	Going up, OSC + BT ON, ADK
2500M	"	"	"	"	" " " "
3000	"	"	"	"	" " " "
4000	"	"	"	"	" " " "
		TNT	TEST (MANUAL)		
3000M	1%	10	8	H H	Going up, OSC + BT, ADK
6000M	"	"	"	H H	" " "
3000M	1%	10	8	H V	Going up, OSC + BT, ADK
6000M	"	"	"	"	" " " "

Notes:

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	10 Sec	0,90,180,270	1,2,3
2	1 KV	10 Sec	0,90,180,270	1,2,3
3	2 KV	20 Sec	0,90,180,270	1,2

3.3 SURGE GENERATOR CHARACTERISTICS:

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

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

3.4 COUPLING DECOUPLING NETWORK CHARACTERISTICS:

Coupling Capacitors: 18 uF

3.5 QUALITY:

Meets the design and manufacturing requirements of ISO 9001

3.6 GROUND REFERENCE PLANE:

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

3.7 REFERENCE DOCUMENT:

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

IEC 61000-4-5, 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:

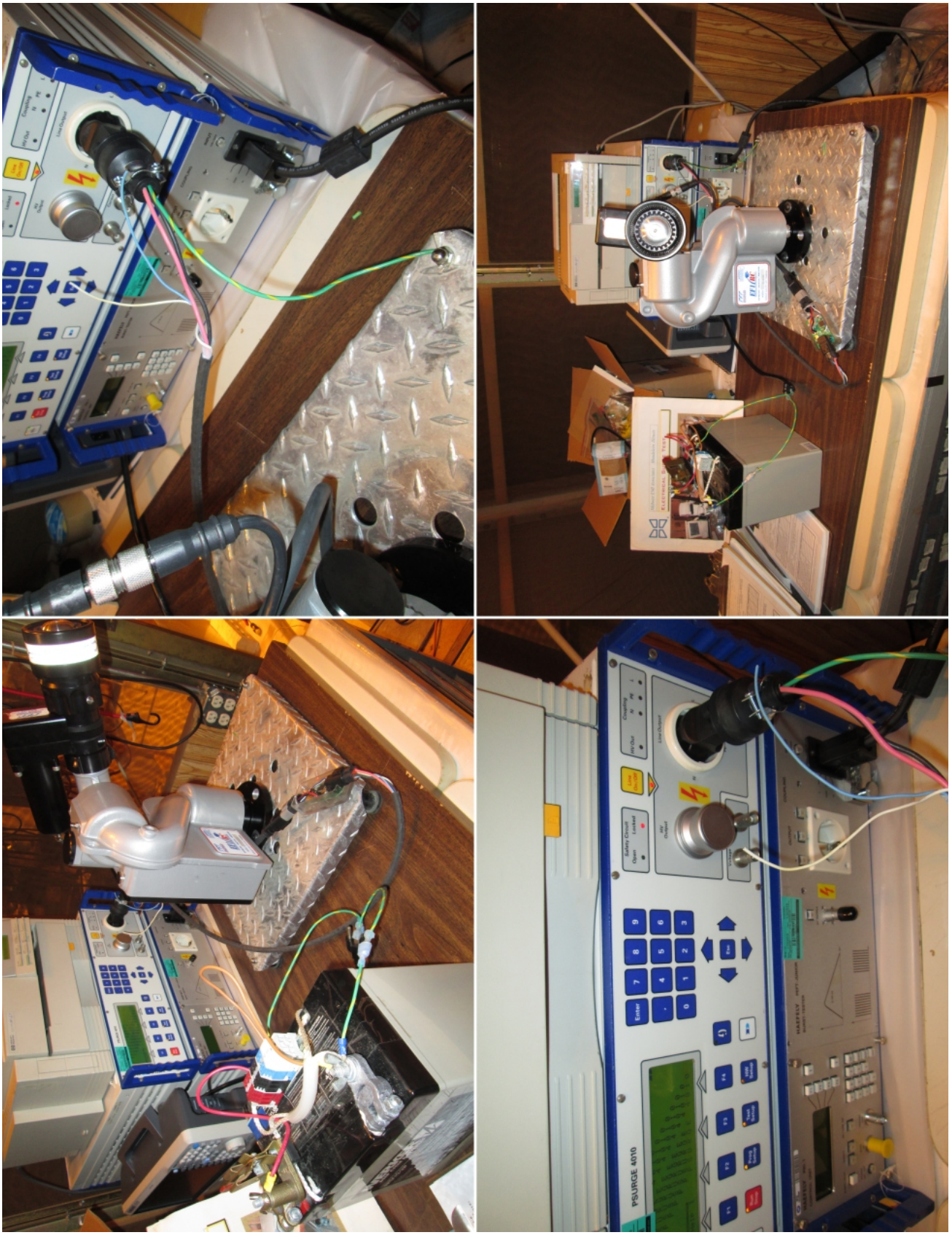
1) Any permanent variation in a displayed image
2) Any permanent variation in the normal operation of the device or permanent changes to the EUT.
3) Any response of any kind that required an operator intervention to reset or recontrol the device to resume normal operation.
4) Damage to the EUT such that 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 EP 0879 BLUETOOTH ADAPTER was tested on its DC leads in line to line mode at a 500 volt application in positive and negative polarities. The EUT Bluetooth experienced no anomalies with this application and passed the test. The EUT Bluetooth was also tested at a 1000 volt application in both polarities from line and neutral to earth potential with no malfunctions or change to operation noted.

(During testing it was noted that the Monitor would not complete its normal oscillating pattern. The problem was traced to the surge machine which uses 20 mH inductors for isolation purposes. When the motor reached an endspot the resulting transient, a peak of 35 volts, appeared to interfere with the oscillating program so that it stalled. This is for informational purposes only and does not reflect the actual operating conditions in a fire truck.)


PSURGE 4010

NOAX OSCILLATE TIL END
35V TRANSIENT AT TERR. STOP

Haefely Trench AG EMC Test Systems Basel/Switzerland

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

System: PSURGE 4010
Test: LASTTEST
Start-Date: 11.07.2018 Start-Time: 11:20

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

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
N-PE	1	+1.00kV	-----	+0.59kV	+0.06kA	
N-PE	2	+1.00kV	-----	+0.40kV	+0.06kA	
N-PE	3	+1.00kV	-----	+0.39kV	+0.06kA	
N-PE	4	+1.00kV	-----	+0.37kV	+0.06kA	
N-PE	5	+1.00kV	-----	+0.37kV	+0.06kA	
N-PE	6	+1.00kV	-----	+0.37kV	+0.06kA	
N-PE	7	+1.00kV	-----	+0.39kV	+0.06kA	
N-PE	8	+1.00kV	-----	+0.43kV	+0.06kA	
N-PE	9	+1.00kV	-----	+0.41kV	+0.06kA	
N-PE	10	+1.00kV	-----	+0.41kV	+0.06kA	
N-PE	11	+1.00kV	-----	+0.42kV	+0.06kA	
N-PE	12	+1.00kV	-----	+0.41kV	+0.06kA	
N-PE	13	+1.00kV	-----	+0.46kV	+0.06kA	
N-PE	14	+1.00kV	-----	+0.44kV	+0.06kA	
N-PE	15	+1.00kV	-----	+0.46kV	+0.06kA	
N-PE	16	+1.00kV	-----	+0.45kV	+0.06kA	
N-PE	17	+1.00kV	-----	+0.45kV	+0.06kA	
N-PE	18	+1.00kV	-----	+0.42kV	+0.06kA	
N-PE	19	+1.00kV	-----	+0.48kV	+0.06kA	
N-PE	20	+1.00kV	-----	+0.48kV	+0.06kA	
N-PE	21	+1.00kV	-----	+0.51kV	+0.06kA	
N-PE	22	+1.00kV	-----	+0.43kV	+0.06kA	
N-PE	23	+1.00kV	-----	+0.48kV	+0.06kA	
N-PE	24	+1.00kV	-----	+0.46kV	+0.06kA	
N-PE	25	+1.00kV	-----	+0.49kV	+0.06kA	
N-PE	26	+1.00kV	-----	+0.42kV	+0.06kA	
N-PE	27	+1.00kV	-----	+0.54kV	+0.06kA	
N-PE	28	+1.00kV	-----	+0.48kV	+0.06kA	
N-PE	29	+1.00kV	-----	+0.48kV	+0.06kA	
N-PE	30	+1.00kV	-----	+0.52kV	+0.06kA	
N-PE	31	+1.00kV	-----	+0.50kV	+0.06kA	
N-PE	32	+1.00kV	-----	+0.50kV	+0.06kA	
N-PE	33	+1.00kV	-----	+0.53kV	+0.06kA	
N-PE	34	+1.00kV	-----	+0.40kV	+0.06kA	
N-PE	35	+1.00kV	-----	+0.53kV	+0.06kA	
N-PE	36	+1.00kV	-----	+0.52kV	+0.06kA	
N-PE	37	+1.00kV	-----	+0.48kV	+0.06kA	
N-PE	38	+1.00kV	-----	+0.45kV	+0.06kA	
N-PE	39	+1.00kV	-----	+0.55kV	+0.06kA	
N-PE	40	+1.00kV	-----	+0.49kV	+0.06kA	

>>> Test passed. <<<

Test: LASTTEST
Stop-Date: 11.07.2018 Stop-Time: 11:27

Haefely Trench AG EMC Test Systems Basel/Switzerland

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

System: PSURGE 4010
Test: LASTTEST
Start-Date: 11.07.2018 Start-Time: 11:28

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

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
N-PE	1	-1.00kV	-----	-0.38kV	-0.06kA	
N-PE	2	-1.00kV	-----	-0.41kV	-0.06kA	
N-PE	3	-1.00kV	-----	-0.52kV	-0.06kA	
N-PE	4	-1.00kV	-----	-0.56kV	-0.06kA	
N-PE	5	-1.00kV	-----	-0.49kV	-0.06kA	
N-PE	6	-1.00kV	-----	-0.42kV	-0.06kA	
N-PE	7	-1.00kV	-----	-0.45kV	-0.06kA	
N-PE	8	-1.00kV	-----	-0.39kV	-0.06kA	
N-PE	9	-1.00kV	-----	-0.42kV	-0.06kA	
N-PE	10	-1.00kV	-----	-0.44kV	-0.06kA	
N-PE	11	-1.00kV	-----	-0.44kV	-0.06kA	
N-PE	12	-1.00kV	-----	-0.45kV	-0.06kA	
N-PE	13	-1.00kV	-----	-0.46kV	-0.06kA	
N-PE	14	-1.00kV	-----	-0.50kV	-0.06kA	
N-PE	15	-1.00kV	-----	-0.52kV	-0.06kA	
N-PE	16	-1.00kV	-----	-0.50kV	-0.06kA	
N-PE	17	-1.00kV	-----	-0.51kV	-0.06kA	
N-PE	18	-1.00kV	-----	-0.55kV	-0.06kA	
N-PE	19	-1.00kV	-----	-0.54kV	-0.06kA	
N-PE	20	-1.00kV	-----	-0.59kV	-0.06kA	
N-PE	21	-1.00kV	-----	-0.53kV	-0.06kA	
N-PE	22	-1.00kV	-----	-0.58kV	-0.06kA	
N-PE	23	-1.00kV	-----	-0.55kV	-0.06kA	
N-PE	24	-1.00kV	-----	-0.60kV	-0.06kA	
N-PE	25	-1.00kV	-----	-0.60kV	-0.06kA	
N-PE	26	-1.00kV	-----	-0.58kV	-0.06kA	
N-PE	27	-1.00kV	-----	-0.54kV	-0.06kA	
N-PE	28	-1.00kV	-----	-0.66kV	-0.06kA	
N-PE	29	-1.00kV	-----	-0.58kV	-0.06kA	
N-PE	30	-1.00kV	-----	-0.58kV	-0.06kA	
N-PE	31	-1.00kV	-----	-0.60kV	-0.05kA	
N-PE	32	-1.00kV	-----	-0.61kV	-0.06kA	
N-PE	33	-1.00kV	-----	-0.61kV	-0.06kA	
N-PE	34	-1.00kV	-----	-0.64kV	-0.06kA	
N-PE	35	-1.00kV	-----	-0.63kV	-0.05kA	
N-PE	36	-1.00kV	-----	-0.64kV	-0.05kA	
N-PE	37	-1.00kV	-----	-0.66kV	-0.05kA	
N-PE	38	-1.00kV	-----	-0.65kV	-0.05kA	
N-PE	39	-1.00kV	-----	-0.71kV	-0.05kA	
N-PE	40	-1.00kV	-----	-0.67kV	-0.05kA	

>>> Test passed. <<<

Test: LASTTEST
Stop-Date: 11.07.2018 Stop-Time: 11:35

System: PSURGE 4010
Test: LASTTEST
Start-Date: 11.07.2018 Start-Time: 11:12

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

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
L1-PE	1	+1.00kV	-----	+0.47kV	+0.06kA	
L1-PE	2	+1.00kV	-----	+0.50kV	+0.06kA	
L1-PE	3	+1.00kV	-----	+0.46kV	+0.06kA	
L1-PE	4	+1.00kV	-----	+0.46kV	+0.06kA	
L1-PE	5	+1.00kV	-----	+0.49kV	+0.06kA	
L1-PE	6	+1.00kV	-----	+0.49kV	+0.06kA	
L1-PE	7	+1.00kV	-----	+0.51kV	+0.06kA	
L1-PE	8	+1.00kV	-----	+0.47kV	+0.06kA	
L1-PE	9	+1.00kV	-----	+0.47kV	+0.06kA	
L1-PE	10	+1.00kV	-----	+0.50kV	+0.06kA	
L1-PE	11	+1.00kV	-----	+0.54kV	+0.06kA	
L1-PE	12	+1.00kV	-----	+0.48kV	+0.06kA	
L1-PE	13	+1.00kV	-----	+0.50kV	+0.06kA	
L1-PE	14	+1.00kV	-----	+0.47kV	+0.06kA	
L1-PE	15	+1.00kV	-----	+0.48kV	+0.06kA	
L1-PE	16	+1.00kV	-----	+0.49kV	+0.06kA	
L1-PE	17	+1.00kV	-----	+0.45kV	+0.06kA	
L1-PE	18	+1.00kV	-----	+0.44kV	+0.06kA	
L1-PE	19	+1.00kV	-----	+0.52kV	+0.06kA	
L1-PE	20	+1.00kV	-----	+0.57kV	+0.06kA	
L1-PE	21	+1.00kV	-----	+0.44kV	+0.06kA	
L1-PE	22	+1.00kV	-----	+0.51kV	+0.06kA	
L1-PE	23	+1.00kV	-----	+0.41kV	+0.06kA	
L1-PE	24	+1.00kV	-----	+0.46kV	+0.06kA	
L1-PE	25	+1.00kV	-----	+0.44kV	+0.06kA	
L1-PE	26	+1.00kV	-----	+0.45kV	+0.06kA	
L1-PE	27	+1.00kV	-----	+0.40kV	+0.06kA	
L1-PE	28	+1.00kV	-----	+0.52kV	+0.06kA	
L1-PE	29	+1.00kV	-----	+0.43kV	+0.06kA	
L1-PE	30	+1.00kV	-----	+0.47kV	+0.06kA	
L1-PE	31	+1.00kV	-----	+0.52kV	+0.06kA	
L1-PE	32	+1.00kV	-----	+0.45kV	+0.06kA	
L1-PE	33	+1.00kV	-----	+0.51kV	+0.06kA	
L1-PE	34	+1.00kV	-----	+0.52kV	+0.06kA	
L1-PE	35	+1.00kV	-----	+0.41kV	+0.06kA	
L1-PE	36	+1.00kV	-----	+0.59kV	+0.06kA	
L1-PE	37	+1.00kV	-----	+0.52kV	+0.06kA	
L1-PE	38	+1.00kV	-----	+0.53kV	+0.06kA	
L1-PE	39	+1.00kV	-----	+0.37kV	+0.06kA	
L1-PE	40	+1.00kV	-----	+0.51kV	+0.06kA	

>>> Test passed. <<<

Test: LASTTEST
Stop-Date: 11.07.2018 Stop-Time: 11:19

Haefely Trench AG EMC Test Systems Basel/Switzerland

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

System: PSURGE 4010
Test: LASTTEST
Start-Date: 11.07.2018 Start-Time: 11:05

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

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
L1-PE	1	-1.00kV	-----	-0.96kV	-0.01kA	
L1-PE	2	-1.00kV	-----	-0.96kV	-0.01kA	
L1-PE	3	-1.00kV	-----	-0.96kV	-0.01kA	
L1-PE	4	-1.00kV	-----	-0.96kV	-0.01kA	
L1-PE	5	-1.00kV	-----	-0.96kV	-0.01kA	
L1-PE	6	-1.00kV	-----	-0.96kV	-0.01kA	
L1-PE	7	-1.00kV	-----	-0.96kV	-0.01kA	
L1-PE	8	-1.00kV	-----	-0.96kV	-0.04kA	
L1-PE	9	-1.00kV	-----	-0.95kV	-0.05kA	
L1-PE	10	-1.00kV	-----	-0.51kV	-0.05kA	
L1-PE	11	-1.00kV	-----	-0.53kV	-0.06kA	
L1-PE	12	-1.00kV	-----	-0.85kV	-0.06kA	
L1-PE	13	-1.00kV	-----	-0.72kV	-0.06kA	
L1-PE	14	-1.00kV	-----	-0.68kV	-0.06kA	
L1-PE	15	-1.00kV	-----	-0.60kV	-0.06kA	
L1-PE	16	-1.00kV	-----	-0.61kV	-0.07kA	
L1-PE	17	-1.00kV	-----	-0.51kV	-0.06kA	
L1-PE	18	-1.00kV	-----	-0.90kV	-0.07kA	
L1-PE	19	-1.00kV	-----	-0.85kV	-0.06kA	
L1-PE	20	-1.00kV	-----	-0.44kV	-0.06kA	
L1-PE	21	-1.00kV	-----	-0.42kV	-0.07kA	
L1-PE	22	-1.00kV	-----	-0.44kV	-0.07kA	
L1-PE	23	-1.00kV	-----	-0.57kV	-0.07kA	
L1-PE	24	-1.00kV	-----	-0.49kV	-0.06kA	
L1-PE	25	-1.00kV	-----	-0.38kV	-0.06kA	
L1-PE	26	-1.00kV	-----	-0.40kV	-0.06kA	
L1-PE	27	-1.00kV	-----	-0.48kV	-0.06kA	
L1-PE	28	-1.00kV	-----	-0.44kV	-0.07kA	
L1-PE	29	-1.00kV	-----	-0.50kV	-0.06kA	
L1-PE	30	-1.00kV	-----	-0.54kV	-0.06kA	
L1-PE	31	-1.00kV	-----	-0.63kV	-0.06kA	
L1-PE	32	-1.00kV	-----	-0.37kV	-0.06kA	
L1-PE	33	-1.00kV	-----	-0.40kV	-0.06kA	
L1-PE	34	-1.00kV	-----	-0.44kV	-0.06kA	
L1-PE	35	-1.00kV	-----	-0.41kV	-0.06kA	
L1-PE	36	-1.00kV	-----	-0.33kV	-0.06kA	
L1-PE	37	-1.00kV	-----	-0.37kV	-0.06kA	
L1-PE	38	-1.00kV	-----	-0.38kV	-0.06kA	
L1-PE	39	-1.00kV	-----	-0.39kV	-0.06kA	
L1-PE	40	-1.00kV	-----	-0.40kV	-0.06kA	

>>> Test passed. <<<

Test: LASTTEST
Stop-Date: 11.07.2018 Stop-Time: 11:12

Haefely Trench AG EMC Test Systems Basel/Switzerland

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

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: 11.07.2018 Start-Time: 09:56

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

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
L1-N	1	-0.50kV	-----	-0.12kV	-195A	
L1-N	2	-0.50kV	-----	-0.12kV	-195A	
L1-N	3	-0.50kV	-----	-0.12kV	-195A	
L1-N	4	-0.50kV	-----	-0.12kV	-195A	
L1-N	5	-0.50kV	-----	-0.12kV	-195A	
L1-N	6	-0.50kV	-----	-0.12kV	-195A	
L1-N	7	-0.50kV	-----	-0.12kV	-195A	
L1-N	8	-0.50kV	-----	-0.12kV	-195A	
L1-N	9	-0.50kV	-----	-0.12kV	-196A	
L1-N	10	-0.50kV	-----	-0.12kV	-196A	
L1-N	11	-0.50kV	-----	-0.12kV	-196A	
L1-N	12	-0.50kV	-----	-0.12kV	-196A	
L1-N	13	-0.50kV	-----	-0.12kV	-196A	
L1-N	14	-0.50kV	-----	-0.12kV	-196A	
L1-N	15	-0.50kV	-----	-0.12kV	-195A	
L1-N	16	-0.50kV	-----	-0.12kV	-195A	
L1-N	17	-0.50kV	-----	-0.12kV	-195A	
L1-N	18	-0.50kV	-----	-0.12kV	-195A	
L1-N	19	-0.50kV	-----	-0.12kV	-196A	
L1-N	20	-0.50kV	-----	-0.12kV	-196A	
L1-N	21	-0.50kV	-----	-0.12kV	-195A	
L1-N	22	-0.50kV	-----	-0.12kV	-196A	
L1-N	23	-0.50kV	-----	-0.12kV	-196A	
L1-N	24	-0.50kV	-----	-0.12kV	-195A	
L1-N	25	-0.50kV	-----	-0.12kV	-195A	
L1-N	26	-0.50kV	-----	-0.12kV	-196A	
L1-N	27	-0.50kV	-----	-0.12kV	-195A	
L1-N	28	-0.50kV	-----	-0.12kV	-196A	
L1-N	29	-0.50kV	-----	-0.12kV	-195A	
L1-N	30	-0.50kV	-----	-0.12kV	-195A	
L1-N	31	-0.50kV	-----	-0.12kV	-195A	
L1-N	32	-0.50kV	-----	-0.12kV	-195A	
L1-N	33	-0.50kV	-----	-0.12kV	-195A	
L1-N	34	-0.50kV	-----	-0.12kV	-195A	
L1-N	35	-0.50kV	-----	-0.12kV	-195A	
L1-N	36	-0.50kV	-----	-0.12kV	-195A	
L1-N	37	-0.50kV	-----	-0.12kV	-196A	
L1-N	38	-0.50kV	-----	-0.12kV	-195A	
L1-N	39	-0.50kV	-----	-0.12kV	-195A	
L1-N	40	-0.50kV	-----	-0.12kV	-195A	

>>> Test passed. <<<

Test: P5KL1NPS
Stop-Date: 11.07.2018 Stop-Time: 10:03

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: 11.07.2018 Start-Time: 09:47

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

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
L1-N	1	+0.50kV	-----	+0.09kV	+217A	TEST
L1-N	2	+0.50kV	-----	+0.09kV	+218A	IN
L1-N	3	+0.50kV	-----	+0.09kV	+219A	OSC
L1-N	4	+0.50kV	-----	+0.09kV	+220A	REST
L1-N	5	+0.50kV	-----	+0.09kV	+220A	MODE
L1-N	6	+0.50kV	-----	+0.09kV	+220A	
>>> Pause switched ON. <<<						
>>> Pause switched OFF. <<<						
L1-N	7	+0.50kV	-----	+0.09kV	+224A	
L1-N	8	+0.50kV	-----	+0.09kV	+220A	
L1-N	9	+0.50kV	-----	+0.09kV	+220A	
L1-N	10	+0.50kV	-----	+0.09kV	+220A	
L1-N	11	+0.50kV	-----	+0.09kV	+220A	
L1-N	12	+0.50kV	-----	+0.09kV	+220A	
L1-N	13	+0.50kV	-----	+0.09kV	+220A	
L1-N	14	+0.50kV	-----	+0.09kV	+220A	
L1-N	15	+0.50kV	-----	+0.09kV	+220A	
L1-N	16	+0.50kV	-----	+0.09kV	+220A	
L1-N	17	+0.50kV	-----	+0.09kV	+220A	
L1-N	18	+0.50kV	-----	+0.09kV	+220A	
L1-N	19	+0.50kV	-----	+0.09kV	+220A	
L1-N	20	+0.50kV	-----	+0.09kV	+220A	
L1-N	21	+0.50kV	-----	+0.09kV	+220A	
L1-N	22	+0.50kV	-----	+0.09kV	+220A	
L1-N	23	+0.50kV	-----	+0.09kV	+220A	
L1-N	24	+0.50kV	-----	+0.09kV	+220A	
L1-N	25	+0.50kV	-----	+0.09kV	+220A	
L1-N	26	+0.50kV	-----	+0.09kV	+220A	
L1-N	27	+0.50kV	-----	+0.09kV	+220A	
L1-N	28	+0.50kV	-----	+0.09kV	+220A	
L1-N	29	+0.50kV	-----	+0.09kV	+220A	
L1-N	30	+0.50kV	-----	+0.09kV	+220A	
L1-N	31	+0.50kV	-----	+0.09kV	+220A	
L1-N	32	+0.50kV	-----	+0.09kV	+220A	
L1-N	33	+0.50kV	-----	+0.09kV	+220A	
L1-N	34	+0.50kV	-----	+0.09kV	+220A	
L1-N	35	+0.50kV	-----	+0.09kV	+220A	
L1-N	36	+0.50kV	-----	+0.09kV	+220A	
L1-N	37	+0.50kV	-----	+0.09kV	+220A	
L1-N	38	+0.50kV	-----	+0.09kV	+220A	
L1-N	39	+0.50kV	-----	+0.09kV	+220A	
L1-N	40	+0.50kV	-----	+0.09kV	+220A	
>>> Test passed. <<<						

Test: P5KL1NPS
Stop-Date: 11.07.2018 Stop-Time: 09:54

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-400 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 12 Vdc through two 50 uH 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

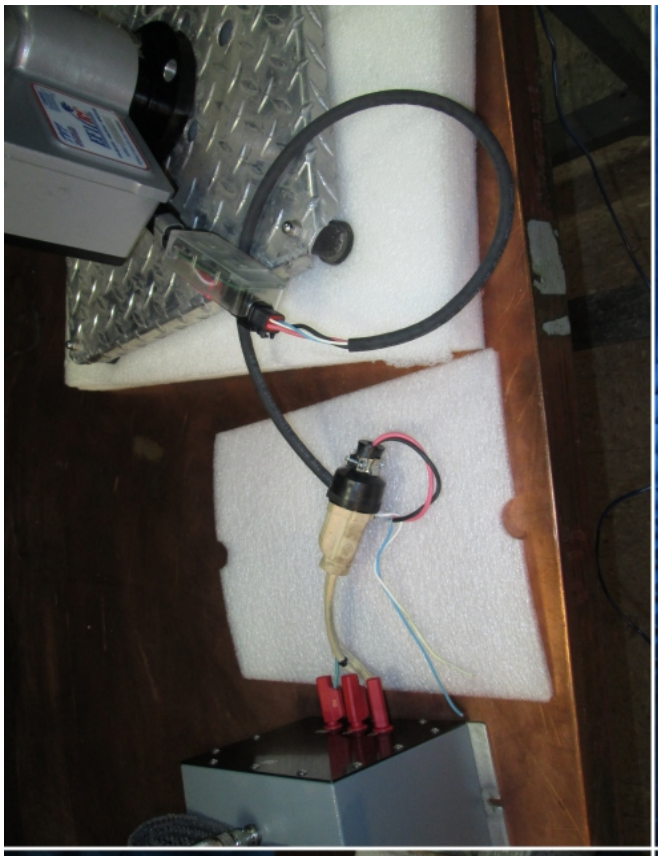
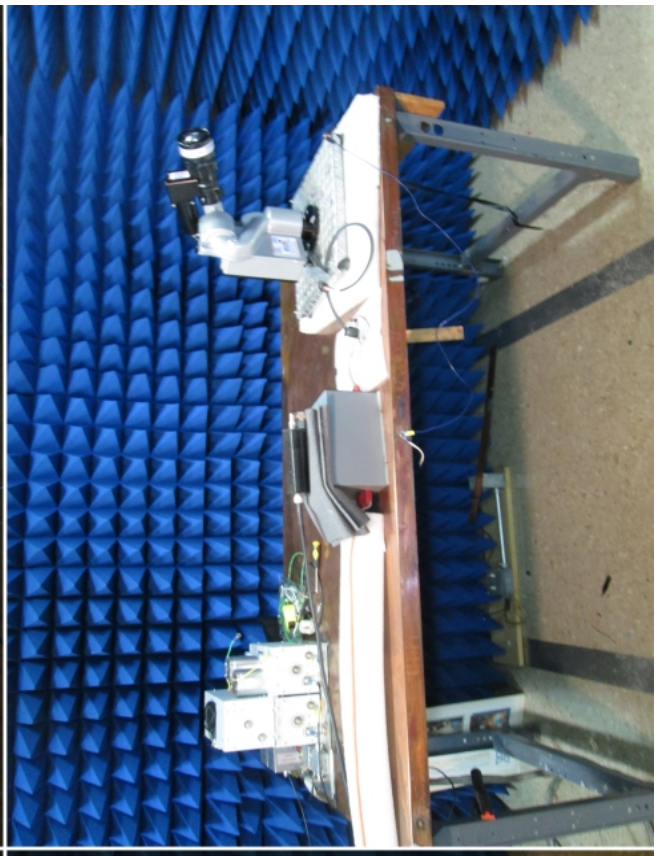
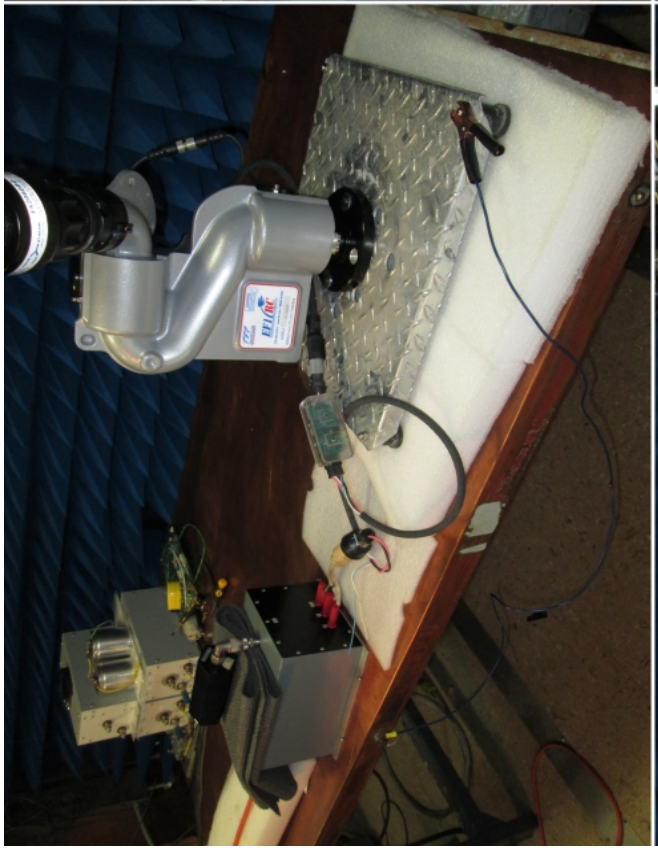
750 over the 150 KHz to 400 MHz range. The range required to pass for this test is only 150 KHz to 80 MHz. In the higher range of 80-400 MHz the dwell time was also 3 seconds.

4.2 RESULTS OF TEST

Testing 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 400 MHz. Since this is the required level and just the .15-80 Mhz range needs to be passed the device passed the test. The wire bundle included the communications wires so no additional cable wires needed testing.

In a second test the level was increased to 10 Vrms and the test was rerun over the entire range of frequencies. No communications disruptions occurred during this test.

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


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 EP0879 BLUETOOTH ADAPTER INTERFACE** was powered by 12VDC 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.

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 (07-12-18)

The ESD test was conducted on 8 surfaces in areas showing cracks in the package, switches, connectors or screws. All referenced portions of the case received ESD pulses of 2, 4, 6 and 8 KV air discharge as well as contact discharge of 2, 4 and 6 KV.

All plastic portions of the case when tested resulted in no discharges including the input cabling wire. The HCP and VCP planes all readily accepted charge. The following symptoms were noted during the test:

None

The device was given an "A" acceptance rating.

ESD TEST LOCATIONS

TFT EP0879 BLUETOOTH ADAPTER

TEST POINT	Description
1	HCP
2	VCP
3	Enclosure Bottom
4	Enclosure Left Side
5	Enclosure Right Side
6	Cable input
7	Input Connector
8	Output Connector
9	
10	
11	
12	

Note: Photograph of locations are attached

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

Sponsor Group: _TFT (EP0879) Bluetooth Adapter Serial Number: Prototype
Manager:_Tim Miller_ Temp: 82.1°F Hum: 55.3% Technician: GB S/W ver.:_____

Date of Test: 07/12/18 Time: 1:25 PM EUT: Prototype / Production Unit
Placement of EUT: ESD Table _____✓_____ Pole Mount _____ Wood Table ____ FLOOR ___
Grounding: Pole___ Terminal Strip __✓___ FLOOR____ 1 Meg to Metal Frame of EUT. __
Configuration of EUT: EUT power 12 VDC, EUT is oscillating under control of operator
Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated

Reference: EN 61000-4-2		**TEST POINT:** HCP				**TEST POINT:** VCP			
		PLUS POLARITY		**MINUS POLARITY**		**PLUS POLARITY**		**MINUS POLARITY**	
REF. LINE	**KILO VOLTS**	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode
1	1								
2	4	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
3	3								
4	4	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
5	5								
6	6	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
7	7								
8	8	(✓)		(✓)		(✓)		(✓)	
9									
10									

Reference: EN 61000-4-2		**TEST POINT:** Top and Bottom Sides				**TEST POINT:** Left and Right Sides			
		PLUS POLARITY		**MINUS POLARITY**		**PLUS POLARITY**		**MINUS POLARITY**	
REF. LINE	**KILO VOLTS**	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode
1	1								
2	2	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
3	3								
4	4	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
5	5								
6	6	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
7	7								
8	8	**N/A**		**N/A**		**N/A**		**N/A**	
9									
10									

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

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

Sponsor Group: TFT (EP0879) Bluetooth Adapter Serial Number: Prototype
Manager: Tim Miller Temp: 82.1°F Hum: 55.3% Technician: GB S/W ver.:
Date of Test: 07/12/18 Time: 1:25 PM EUT: Prototype / Production Unit
Placement of EUT: ESD Table ✓ Pole Mount Wood Table FLOOR
Grounding: Pole Terminal Strip ✓ FLOOR 1 Meg to Metal Frame of EUT.
Configuration of EUT: EUT power 12 VDC, EUT is oscillating under control of operator
Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated

Reference: EN 61000-4-2		TEST POINT: Front and Back Sides				TEST POINT: Input Connector			
		PLUS POLARITY		MINUS POLARITY		PLUS POLARITY		MINUS POLARITY	
REF. LINE	KILO VOLTS	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode
1	1								
2	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	3								
4	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	5								
6	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	7								
8	8	N/A		N/A		N/A		N/A	
9									
10									

Reference: EN 61000-4-2		TEST POINT: Output Connector				TEST POINT: Cable in or out			
		PLUS POLARITY		MINUS POLARITY		PLUS POLARITY		MINUS POLARITY	
REF. LINE	KILO VOLTS	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode
1	1								
2	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	3								
4	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	5								
6	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	7								
8	8	N/A		N/A		N/A		N/A	
9									
10									

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

APPENDIX 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.

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.

Calculations

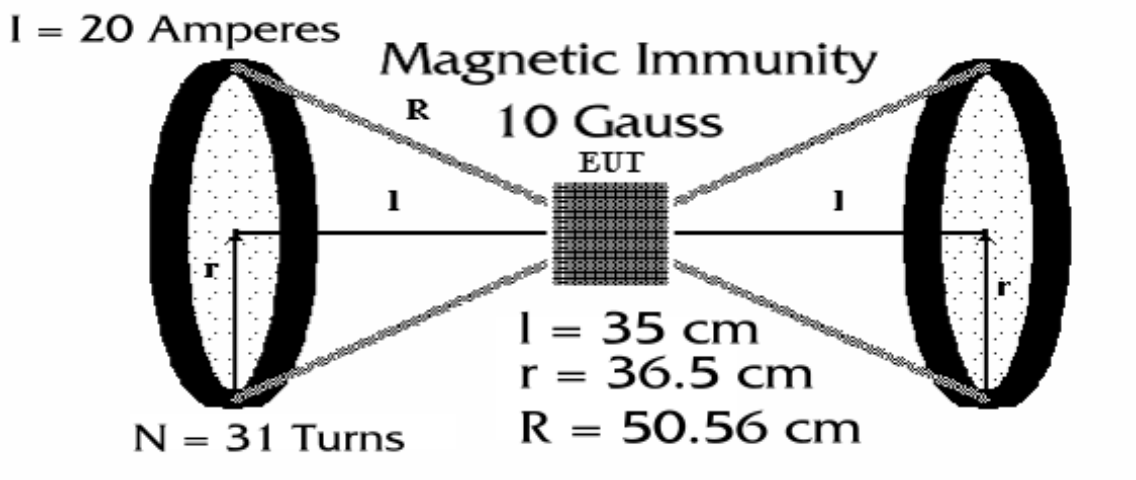
Given: Coil Diameter: 73 cm.
Current: 20 amperes

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

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

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

B (V/m) = 188.5 * I * r^2 * N N = 25 Turns
R^3 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).

Test Set Up

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.

3.1 LIMITS AND TEST RESULTS

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.

4.0 RESULTS

The TFT EP0879 BLUETOOTH ADAPTER was exposed in three axes to a swept field as measured by Holladay Magnetic Field Probe Model HI-3624. The current was maintained fairly constant at 22 amperes in the range of 40 to 500 Hz resulting in a 10 to 6 gauss field being applied in this range. There was no apparent effect on the device due to the 40 Hz to 500 Hz magnetic field. The EUT passed the IEC 61000-4-8 recommendation.

APPENDIX I

VOLTAGE DIPS, SHORT INTERRUPTIONS AND VOLTAGE VARIATION ON DC INPUT

(IEC 61000-4-29: 2001 and successors)

Appendix I Voltage dips, short interruptions and voltage variations on DC input power ports

Clause	Description / Method	Results	Pass / Fail
	1.0 PURPOSE:		
	The purpose of this test is to insure that commercial or medical devices will not be susceptible to dips and variations caused by insufficient filtering on DC power supply lines. The device should show no degradation to prescribed dips and variations sequences which range from .01, .1 or longer in seconds as specified.		
	2.0 DESCRIPTION OF TEST APPARATUS and SET UP:		
	DESCRIPTION OF TEST APPARATUS: The California Instruments 5001ix which has a program to run the test is used. There is no specific required physical mounting requirement for the EUT in this test. Power is supplied directly from the 5001ix. The program is selected and run through from a lookup table inside which is part of the programming. POWER LEADS: The **EUT** was powered by 14/8 V DC in alternative tests to determine if all voltages within the range of the EUT will meet the requirement.	TEST PROCEDURES: The EN 61000-4-29 standard requires that the electromagnetic environment of the test laboratory does not affect the test results. Relative humidity must be controlled so that it will not affect test results. It is recommended to apply the stimulus for a period of 10 minutes or longer as needed to determine an effect, if any.	
Clause	**Description / Method**	**Results**	Pass / Fail
	TEST REQUIREMENT: **The EUT must not be susceptible to power line dips or variations as defined by agreement with the customer. In this case the sponsor group has not established a requirement to meet the dips/variations requirement because the application requires battery power from the vehicle.**	**TEST RESULTS:** **The test result shows the limit of the apparatus to accept dips and variations for informational purposes only.**	

California Instruments
Compliance Test System

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

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

Time test started:	Wednesday, July 11, 2018 5:03:55 PM		
Time test completed:	Wednesday, July 11, 2018 5:14:45 PM		
Selected test file:	Generic IEC 1000-4-29 Short Interruptions - LCR 600.429		
Selected test type:	DC Voltage Dips and Interruptions Immunity test		
Test operator:	Midwest EMI		
Test Site:	California Room	Ambient Temperature:	81F
Humidity:	54%	Pressure:	
EUT description:	TFT EP0879		
User Comment:	Bluetooth and Cycling are ON		

TEST CONDITIONS:

Maximum EUT DC voltage (Vdc):	14.0 VDC, Channel A
Minimum EUT DC voltage (Vdc):	8.0 VDC, Channel A
Max. EUT Vdc =	SELECTED
Min. EUT Vdc =	SKIPPED
DC Voltage Dips and Short Interruptions	SELECTED
DC Voltage Variations	SKIPPED

DC Voltage Dips and Short Interruptions Test Sequence

Step #	Dip to % Unom	Time	Repeat	Delay (s)
1	68	0.010	3	10
2	68	0.030	3	10
3	68	0.050	3	10
4	68	0.070	3	10
5	68	0.100	3	10
6	38	0.010	3	10
7	38	0.020	3	10
8	38	0.030	3	10
9	38	0.040	3	10
10	0	0.001	3	10
11	End of list			

USER OBSERVATIONS OF EUT DURING TEST:

Observations:

California Instruments — Printed on: 7/11/2018 5:14:50 PM — Page 1

California Instruments
Compliance Test System

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

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

Time test started:	Wednesday, July 11, 2018 5:30:34 PM		
Time test completed:	Wednesday, July 11, 2018 5:48:09 PM		
Selected test file:	Midwest 4-29 Variations.429		
Selected test type:	DC Voltage Dips and Interruptions Immunity test		
Test operator:	midwest EMI		
Test Site:	Cal Room	Ambient Temperature:	78
Humidity:	54%	Pressure:	
EUT description:	TFT EP0879		
User Comment:	OSC and BT ON		

TEST CONDITIONS:

Maximum EUT DC voltage (Vdc):	14.0 VDC, Channel A
Minimum EUT DC voltage (Vdc):	8.0 VDC, Channel A
Max. EUT Vdc =	SKIPPED
Min. EUT Vdc =	SELECTED
DC Voltage Dips and Short Interruptions	SKIPPED
DC Voltage Variations	SELECTED

DC Voltage Variations Test Sequence

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

USER OBSERVATIONS OF EUT DURING TEST:

Observations:

California Instruments — Printed on: 7/11/2018 5:48:28 PM — Page 1

Test Results - Dips

The Monitor with Bluetooth adapter was placed into Oscillating Mode for this test. When the 68% dip was applied at a Vcc of 14 volts, the system as a whole passed .01, .03, .05, .07, and .1 second dips successfully.

When the 38% dip was applied at a Vcc of 14 volts, the Monitor portion which uses motors to oscillate the nozzle stopped with any application shown above however the Bluetooth module itself continued to work normally.

When the 68% dip was applied at a Vcc of 8 volts, the Monitor portion stopped with any applied dip shown above but the Bluetooth adapter continued to work normally.

When the 38% dip was applied at a Vcc of 8 volts, both Monitor and Bluetooth stopped functioning with any application shown above. When power restores the Bluetooth module automatically reboots and starts broadcasting while the Monitor stays in a safe stopped mode.

Test Results – Variations

The Monitor with Bluetooth adapter was placed into Oscillating Mode for this test. When the 85% and 120% variations tests were applied to the system at a nominal of 14 Volts, both Monitor and Bluetooth continued to work normally for all applications, the system as a whole passed .1, .3, 1, 3 and 10 seconds successfully.