F2 Labs
16740 Peters Road
Middlefield, Ohio 44062
United States of America
www.f2labs.com

EMC TEST REPORT

Manufacturer:	**The Clark-Reliance Corporation** **16633 Foltz Parkway** **Strongsville, Ohio 44149** **United States of America**
Product:	**Boiler Drum Water Level Indicator/Controller**
Model:	**Eye-Hye SmartLevel SC Series**
Testing Commenced:	**Apr. 15, 2013**
Testing Ended:	**Apr. 17, 2013**
Summary of Test Results:	**Page 5**
Directive:	**EMC Directive (2004/108/EC)**
Deviations (if applicable):	**N/A**

Standards:

- **EN 61326-1:2006 - Electrical Equipment for measurement, control and laboratory use – EMC Requirements - Part 1: General requirements**
  - **EN 61000-4-2:1995, inc. A2:2001** - Electromagnetic Compatibility-Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test
  - **EN 61000-4-3:2002** - Electromagnetic Compatibility-Part 4: Testing and measurement techniques – Section 3: Radiated, radio-frequency, electromagnetic field immunity test
  - **EN 61000-4-4:2004** - Electromagnetic Compatibility-Part 4: Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test
  - **EN 61000-4-5:1995, inc. A1:2001** - Electromagnetic Compatibility-Part 4: Testing and measurement techniques – Section 5: Surge immunity test
  - **EN 61000-4-6:2009** - Electromagnetic Compatibility-Part 4: Testing and measurement techniques – Section 6: Conducted immunity test
  - **EN 61000-4-11:2004** - Electromagnetic Compatibility-Part 4: Testing and measurement techniques – Section 11: Voltage dips and interruptions immunity test
- **EN 55011:2009, inc. A1:2010 -** Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio frequency equipment
- **EN 61000-3-2:2006** - Electromagnetic compatibility (EMC) -Part 3-2: Limits - Limits for harmonic current emissions (equipment input current $\leq$ 16A per phase) (IEC 61000-3-2:2005)
- **EN 61000-3-3:1995, inc. A1:2001** - Electromagnetic compatibility (EMC) -Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current $\leq$ 16A per phase and not subject to conditional connection (IEC 61000-3-3:1994)

Evaluation Conducted by: Joe Knepper, EMC Proj. Eng.

Report Reviewed by: Ken Littell, EMC Tech. Mgr.

F2 Labs
26501 Ridge Road
Damascus, MD 20872
Ph 301.253.4500
Fax 301.253.5179

F2 Labs
16740 Peters Road
Middlefield, OH 44062
Ph 440.632.5541
Fax 440.632.5542

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GENERAL REPORT SUMMARY

This electromagnetic emission and immunity test report was generated by F2 Labs. The test report is based on testing performed by F2 Labs personnel according to the measurement procedures described in the test specifications given below and in the Test Procedures section of this report.

SECTION	TEST	RESULTS
9	Electrostatic Discharge	Pass
10	Radiated Immunity	Pass
11	Electrical Fast Transient Burst	Pass
12	Power Surge	Pass
13	Conducted Immunity	Pass
14	Voltage Dips & Interruptions	Pass
15	Radiated Emissions	Pass
16	Conducted Emissions	Pass*
17	Harmonic Current and Voltage Fluctuations	Pass

**Passes with modifications per Section 8.0 of this Test Report.*

Note: Pass/Fail criteria are based upon the following condition: Where the results are compared to published test standard or manufacturer specified limits, the PASS or FAIL opinion is considered without applying the laboratory stated measurement uncertainty.

Reports noted as a revision replace all previously issued reports and/or antecedent report revisions issued under this job number.

1.0 ADMINISTRATIVE DATA

1.1 Management of Test Sample

The test sample was inventoried at the F2 Labs facility and returned to The Clark-Reliance Corporation, according to the agreement between F2 Labs and the Client.

1.2 Abbreviations and Acronyms

The following abbreviations and acronyms may be used in this document.

AM	Amplitude Modulation
BCI	Bulk Current Injection
CDN	Coupling/Decoupling Network
EFT	Electrical Fast Transients
EMC	Electromagnetic Compatibility
EMIC	Electromagnetic Injection Clamp
EN	European Norm
ESD	Electrostatic Discharge
EUT	Equipment Under Test
GRP	Ground Reference Plane
HCP	Horizontal Coupling Plane
HGP	Horizontal Ground Plane
IEC	International Electrotechnical Commission
kHz	kiloHertz
LISN	Line Impedance Stabilization Network
MHz	MegaHertz
OATS	Open Area Test Site
RF	Radio Frequency
VCP	Vertical Coupling Plane

1.3 Document History

Document Number	Description	Issue Date	Approved By
F2LQ5374-A-01E	First Issue	Apr. 24, 2013	K. Littell

2.0 PERFORMANCE CRITERIA

The following Performance Criteria is determined from Section 6 of EN 61326-1:2006.

SPECIFICATION	MINIMUM PERFORMANCE CRITERION
EN 61000-4-2	B
EN 61000-4-3	A
EN 61000-4-4	B
EN 61000-4-5	B
EN 61000-4-6	A
EN 61000-4-11	B, C

Performance Criterion A: During testing, normal performance within the specification limits.

Example 1 If electronic equipment is required to work with high reliability, the EUT shall operate without any apparent degradation from the manufacturer's specification.

Performance Criterion B: During testing, temporary degradation, or loss of function or performance which is self-recovering.

Example 1 A data transfer is controlled/checked by parity check or by other means. In the case of malfunctioning, such as caused by a lightning strike, the data transfer will be repeated automatically. The reduced data transfer rate at this time is acceptable.

Example 2 During testing, an analogue function value may deviate. After the test, the deviation vanishes.

Example 3 In the case of a monitor used only for man-machine monitoring, it is acceptable that some degradation takes place for a short time, such as flashes during the burst application.

Performance Criterion C: During testing, temporary degradation, or loss of function or performance which requires operator intervention or system reset occurs.

Example 1 In the case of an interruption in the mains longer than the specified buffer time, the power supply unit of the equipment is switched off. The switch-on may be automatic or carried out by the operator.

Example 2 After a program interruption caused by a disturbance, the processor functions of the equipment stops at a defined position and is not left in a "crashed state." The operator's decision prompts may be necessary.

Example 3 The test results in an opening of an over-current protection device that is replaced or reset by the operator.

3.0 MEASUREMENT OF UNCERTAINTY BUDGETS

The uncertainty in EMC measurements arises from several factors which affect the results, some associated with environmental conditions in the measurement room, the test equipment being used and the measurement techniques adopted.

The measurement uncertainty budgets detailed below are calculated from the test and calibration data.

MEASUREMENT	EXPANDED UNCERTAINTY
Conducted Emissions	3.75dB
Conducted Immunity	CDN 2.91dB BCI 3.77dB
Radiated Immunity	2.12dB
Radiated Emissions	6.93dB
Harmonics	7.10%
Flicker	7.66%

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4.0 LISTS OF EUT, ACCESSORIES AND TEST EQUIPMENT

4.1 Equipment Under Test (EUT):

Device	Manufacturer	Model Number	Serial Number
Level Detector	The Clark-Reliance Corp.	SmartLevel	122021240000
Which includes the following:			
Medium Level Indicators	The Clark-Reliance Corp.	N/A	N/A
Small Level Indicators	The Clark-Reliance Corp.	N/A	N/A

4.2 Accessories (Support Equipment):

Device	Manufacturer	Model Number	Serial Number
Water Container	The Clark-Reliance Corp.	None Spec.	None Spec.

4.3 Cables:

Cable Function	Length	Shielded (Yes/No)
AC Mains	<3m	No
Probe Inputs x 24	<3m	Yes
Level Indicator I/O	<3m	Yes

The customer states that all I/O lines will be run through conduit and grounded per installation manual.

5.0 MODE OF OPERATION

The EUT was set up in a normal testing manner, powered at 230V, 50 Hz. The EUT was monitoring water levels.

6.0 METHOD OF MONITORING

The EUT was monitored visually by the LED's on the four status bars.

7.0 IMMUNITY DEGRADATION DEFINITION

The following shall constitute degradation:

- if the EUT indicates a wrong level;
- if the EUT has any component failures.
- if the EUT loses power completely.

8.0 REQUIRED MODIFICATIONS

The following modifications were made to the EUT to meet conducted emissions requirements:

- Added a line filter (Schaffner #2010-3-06) at AC Input.

Refer to photograph on page 63 for details.

9.0 ELECTROSTATIC DISCHARGE TEST

9.1 Electrostatic Discharge Test Procedure

The ESD generator and discharge gun were used to conduct the tests outlined below. The waveform conforms to EN 61000-4-2. The generator was used to simulate electrostatic discharges to the EUT.

A horizontal coupling plane (HCP) conforming to the dimensions of EN 61000-4-2 was placed on a non-conductive table 0.8 meter above the ground reference plane (GRP). The HCP was connected to the GRP via two 470k ohm resistors. The EUT was placed on non-conductive material 0.5 mm above the HCP. The vertical coupling plane (VCP) was connected to the GRP through two 470k ohm resistors and positioned 10 cm from the appropriate face of the EUT, as required.

During the test, three different methods were used to determine if the equipment was susceptible to ESD: direct contact, air discharge and indirect discharge.

The direct contact method was used on all exposed conductive surfaces. Each point was contacted 10 consecutive times in the positive polarity and 10 consecutive times in the negative polarity with an electrostatic discharge from the ESD Gun.

The indirect discharge method was used on one point of the horizontal coupling plane (HCP) and to one point on the vertical coupling plane (VCP) located 10 cm from the edge of the EUT on all four sides of the EUT.

The air discharge method was used on all exposed non-conductive materials. These materials were scanned with the tip of the ESD gun. If the gun discharged at any point, 10 consecutive discharges in both positive and negative polarities were then made to that point.

Test Equipment Used:

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Temp/Hum. Recorder	CL119	Extech	RH520	H005869	Jan. 2, 2014
ESD Generator	CL004	Haefley Trench	PESD 1600	H603-060	Jan. 7, 2014

9.2 Electrostatic Discharge Test Data Sheet

Test Date:	Apr. 15, 2013	**Test Engineer:**	J. Knepper
Standard:	EN 61326-1:2006	**Air Temperature:**	22.9° C
Minimum Performance Criteria:	B	**Relative Humidity:**	55%

Conductive Surfaces:

Discharge Point	Levels (kV)	Method	Achieved Performance Criterion	Pass/Fail
Small Water Gauge Screws	± 2, 4	Contact	B*	Pass
Medium Water Gauge Screws	± 2, 4	Contact	B*	Pass
Conduit Connectors	± 2, 4	Contact	A	Pass
Key Hole	± 2, 4	Contact	A	Pass
Hinges	± 2, 4	Contact	A	Pass
Small Water Gauge Screws	± 2, 4	Contact	B*	Pass
Medium Water Gauge Screws	± 2, 4	Contact	B*	Pass

Coupling Planes:

Discharge Point	Levels (kV)	Method	Achieved Performance Criterion	Pass/Fail
Vertical Coupling Plane – Right Side	± 2, 4	Contact	A	Pass
Vertical Coupling Plane – Left Side	± 2, 4	Contact	A	Pass
Vertical Coupling Plane – Front	± 2, 4	Contact	A	Pass
Vertical Coupling Plane – Rear	± 2, 4	Contact	A	Pass
Horizontal Coupling Plane – Right Side	± 2, 4	Contact	B*	Pass
Horizontal Coupling Plane – Left Side	± 2, 4	Contact	B*	Pass
Horizontal Coupling Plane – Front	± 2, 4	Contact	B*	Pass
Horizontal Coupling Plane – Rear	± 2, 4	Contact	B*	Pass

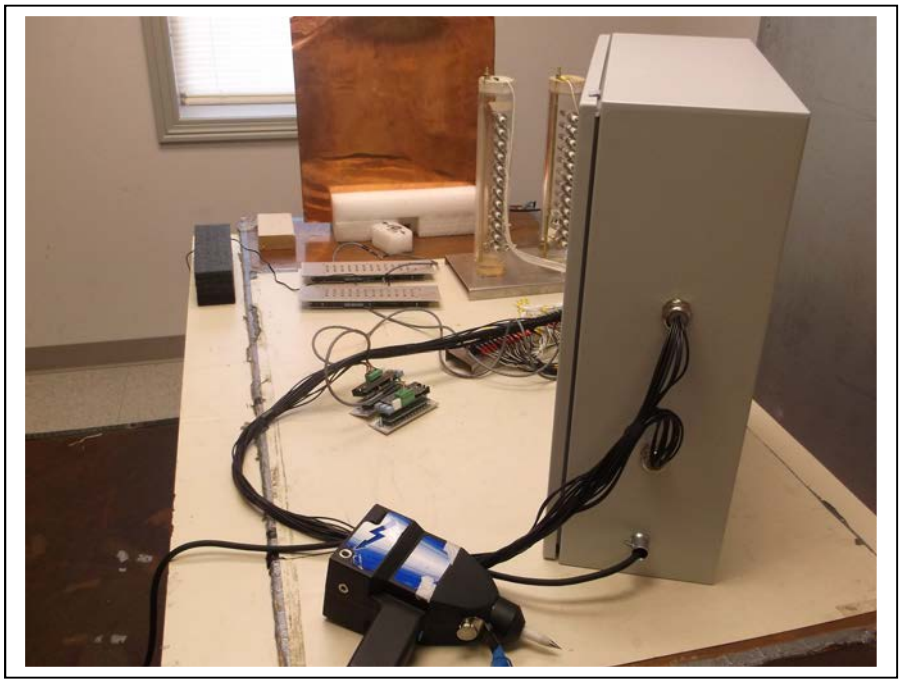
Non-Conductive Surfaces:

Attempted Discharge Point	Levels (kV)	Method	Achieved Performance Criterion	Pass/Fail
Panel Label	± 2, 4, 8	Air	No Discharge	Pass

**On all sides HCP at -4kV, and contact discharges @±4kV, the EUT's indicator lights extinguished and recovered without operator intervention.*

Please refer to the photographs on pages 14-29 for details of actual test points. "C" denotes a contact discharge point. "A" denotes a point where a discharge was observed during a scan of a non-conductive surface. Absence of any Air Discharge points indicates no arc was drawn through the insulated surfaces.

9.3 Photograph(s) of the Electrostatic Discharge Test Setup



Enclosure: Front View

Enclosure: Rear View

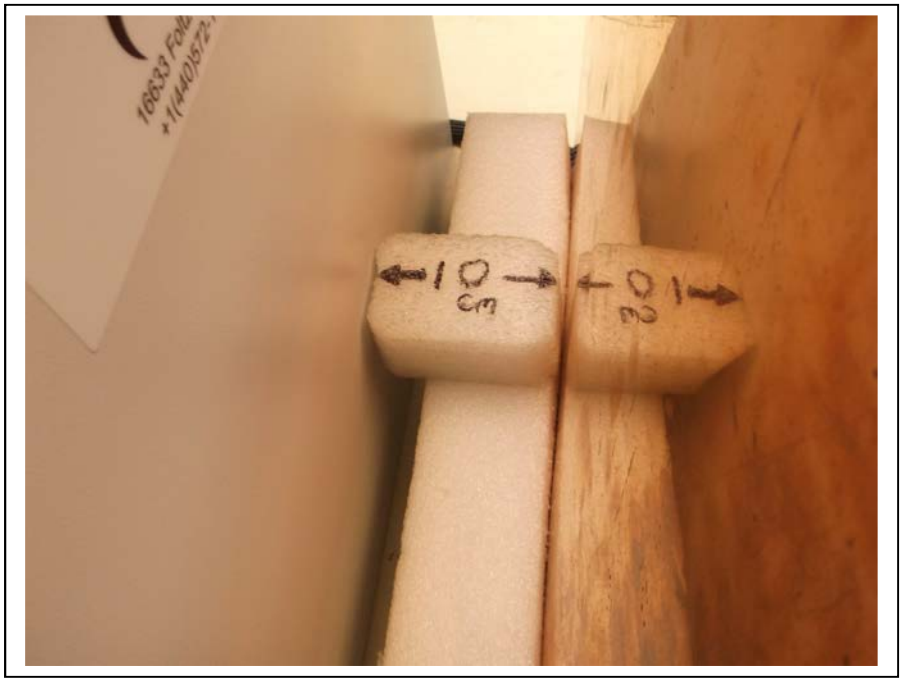
Enclosure: Right Side View

Enclosure: Left Side View

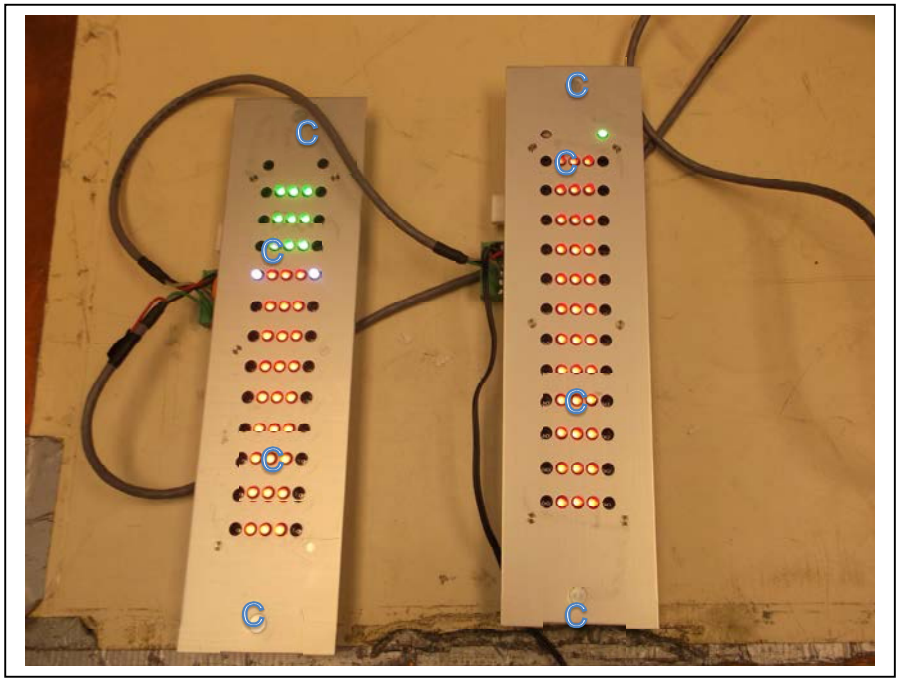
Enclosure: Top View

Enclosure: HCP

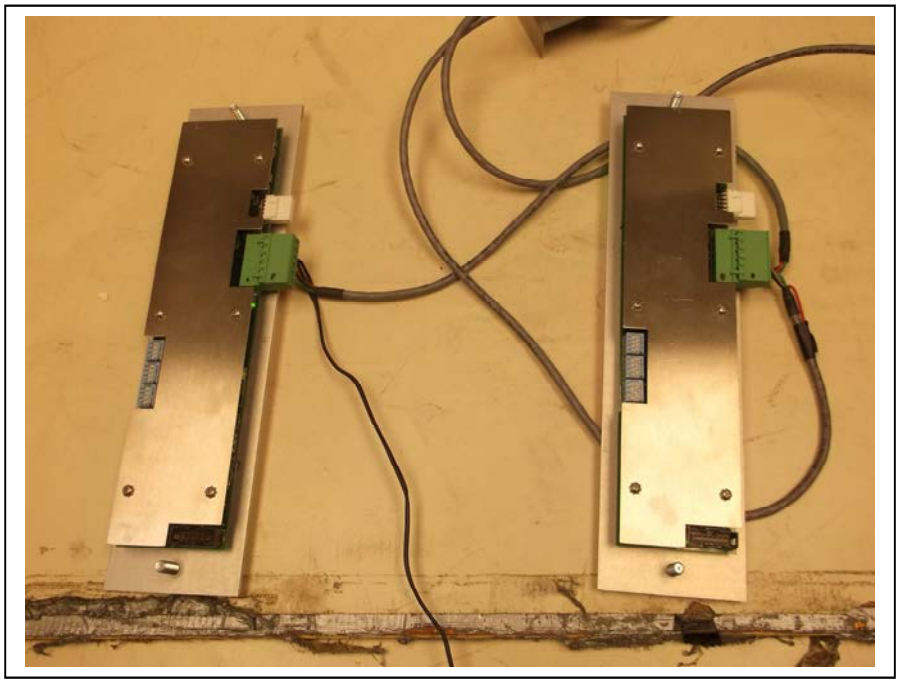
Enclosure: VCP



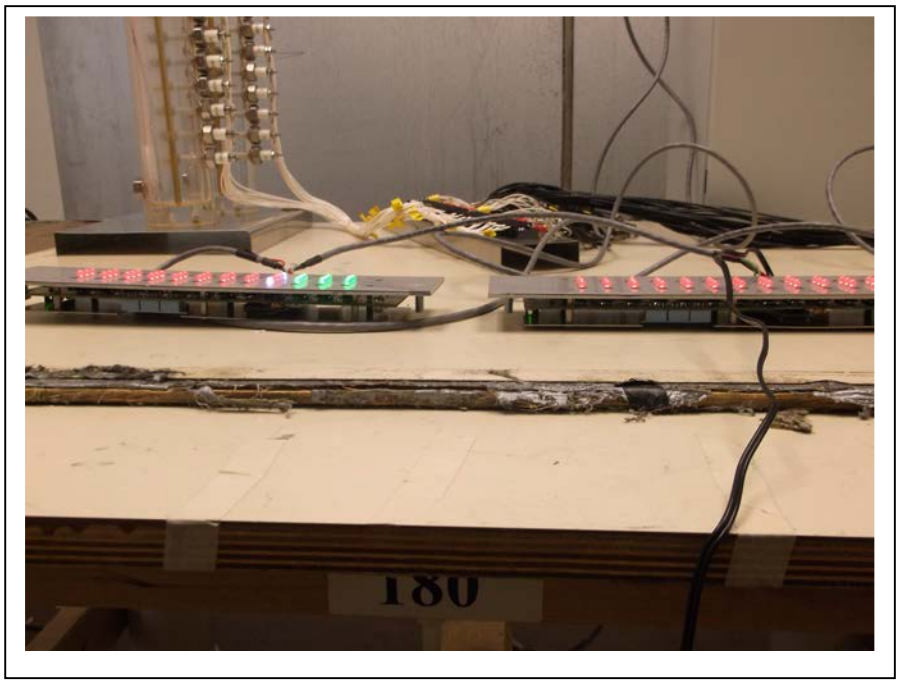
Large Gauge: Front View



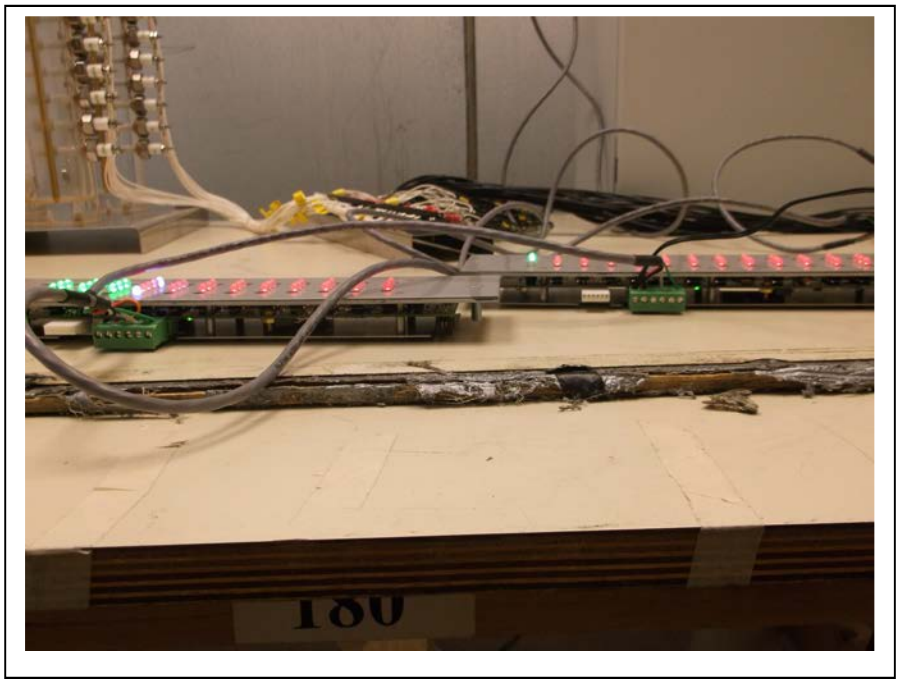
Large Gauge: Rear View



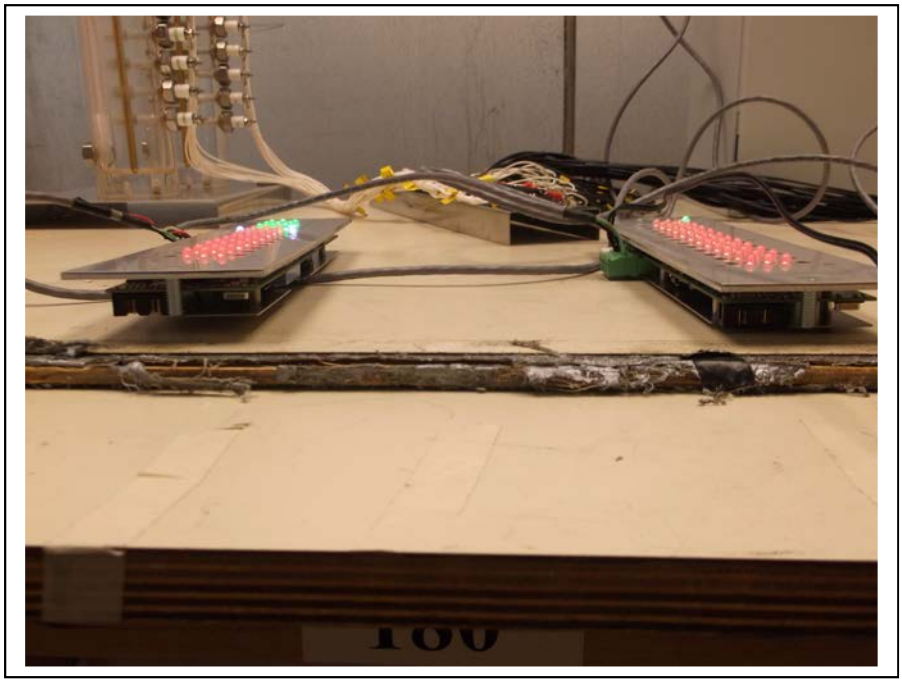
Large Gauge: Right Side View



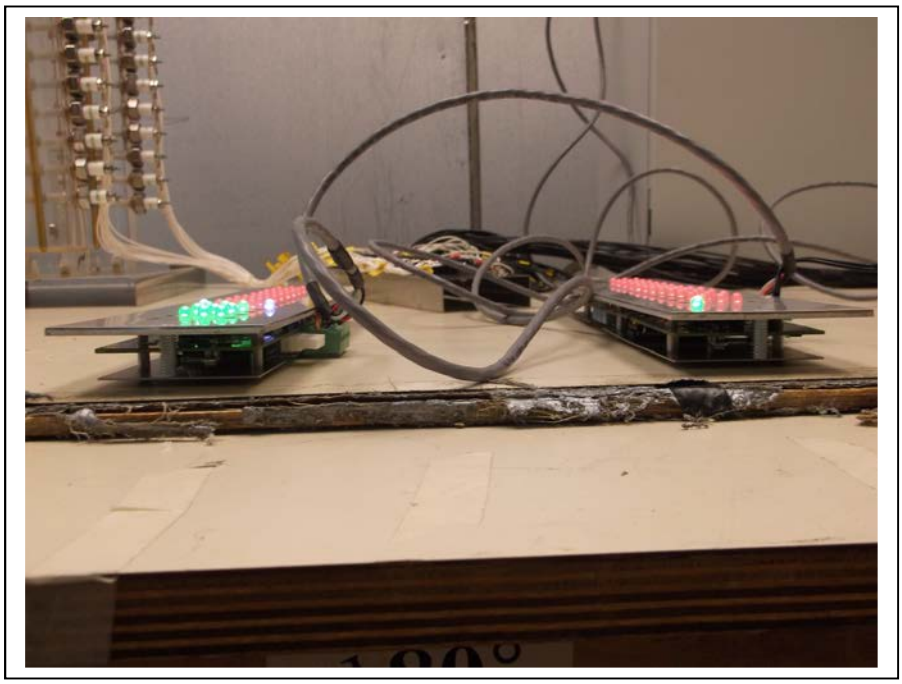
Large Gauge: Left Side View



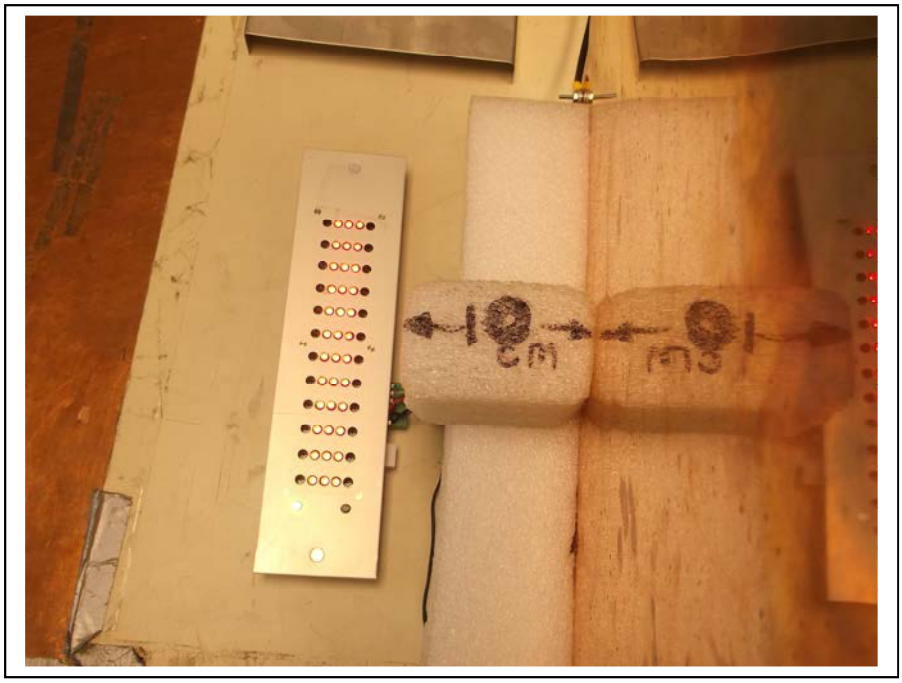
Large Gauge: Top

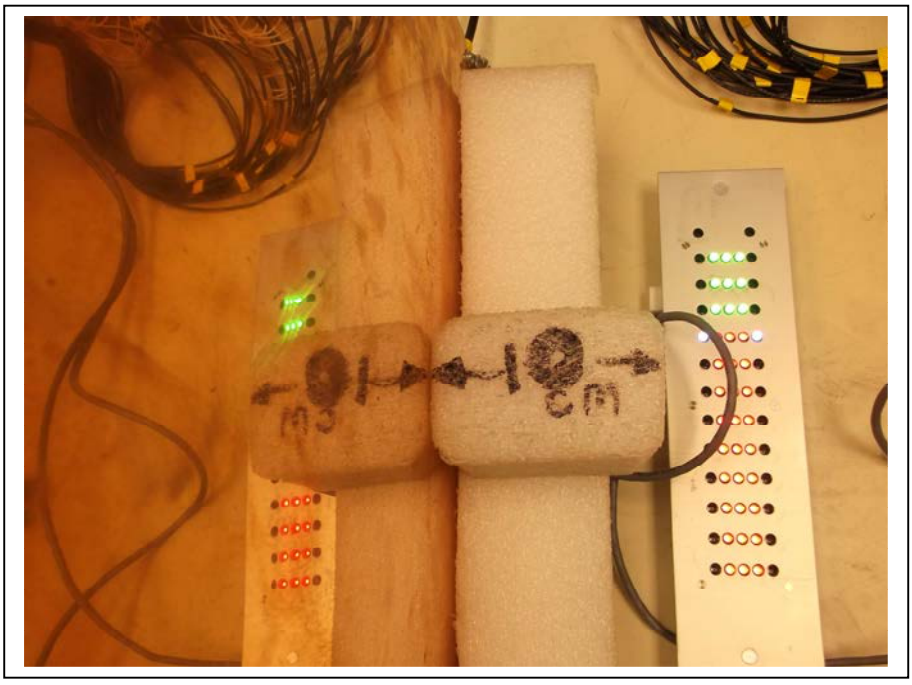


Large Gauge: Bottom

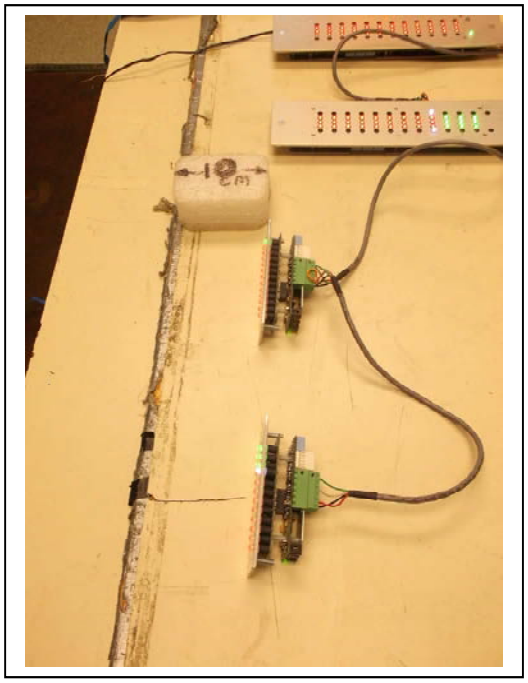


Large Gauge: VCP

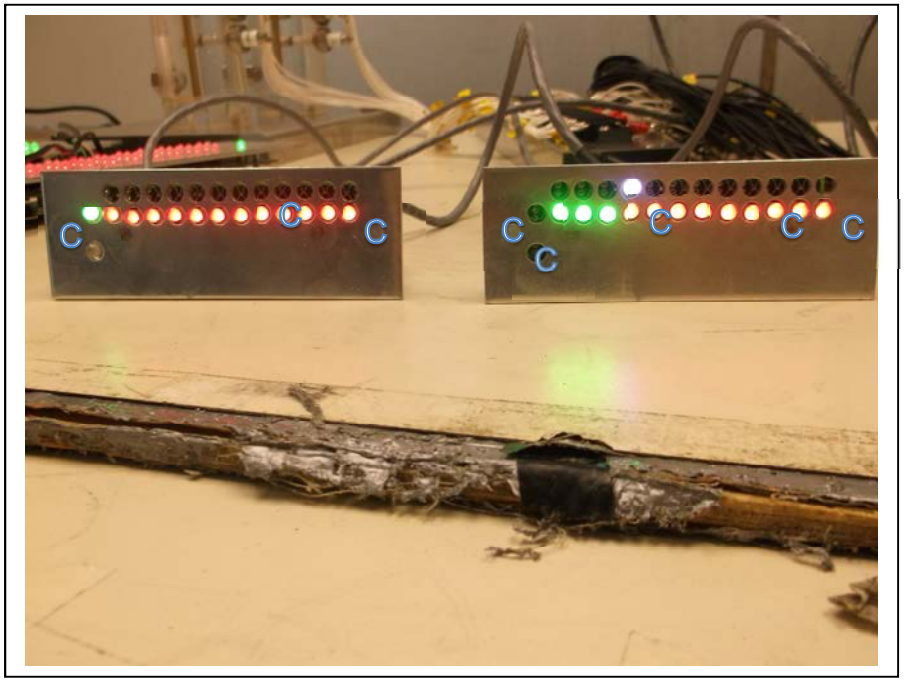




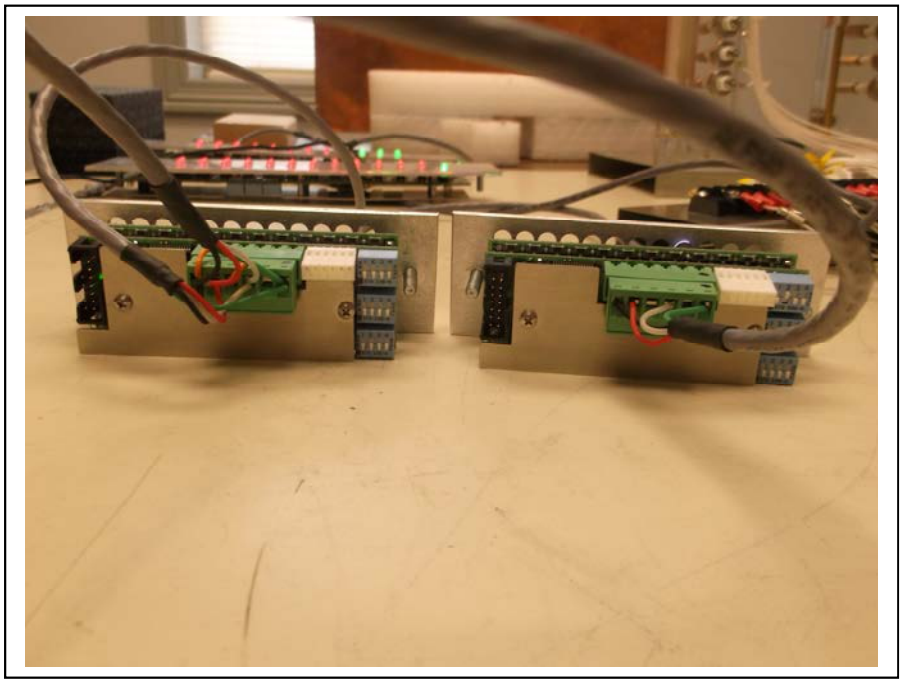
HCP



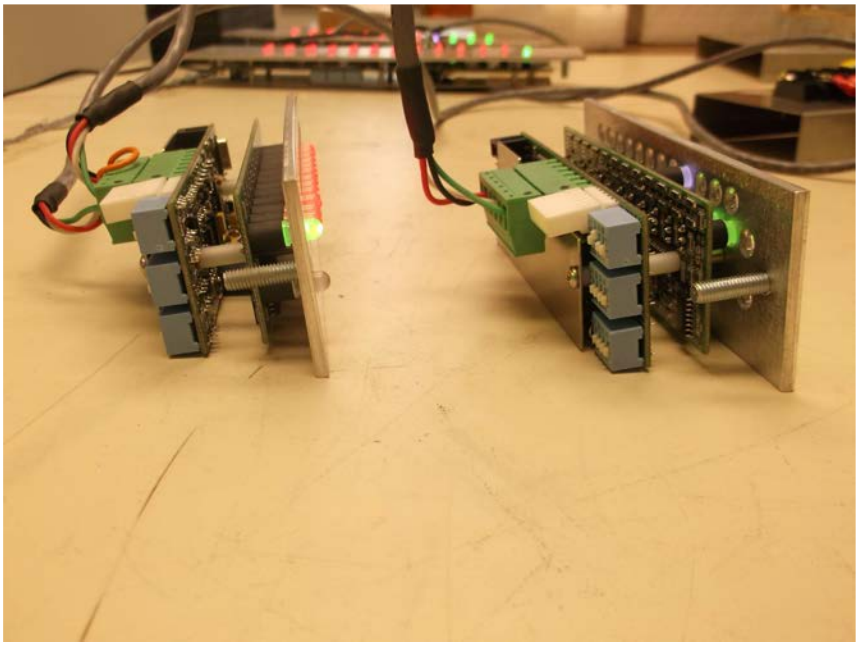
Small Gauge: Front View



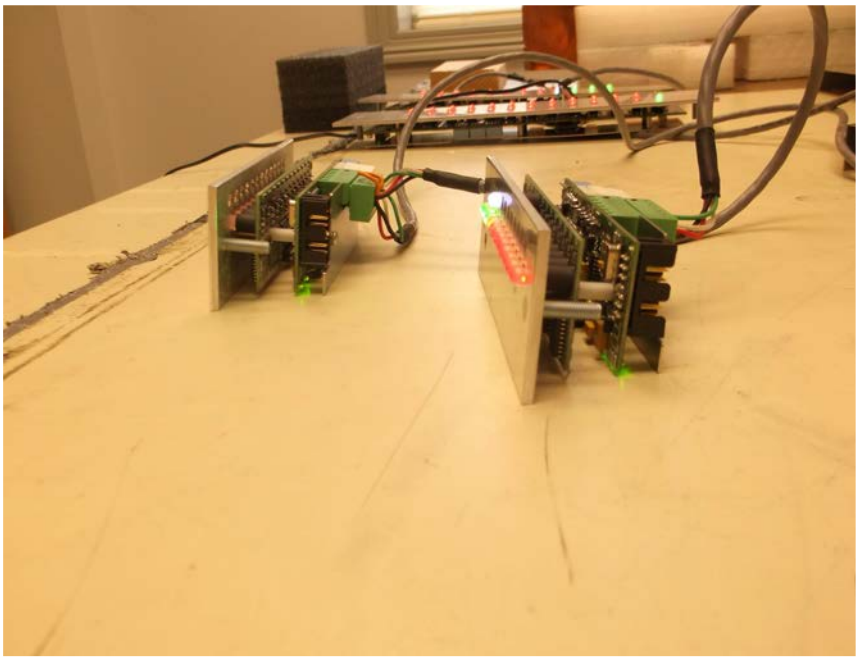
Small Gauge: Rear View



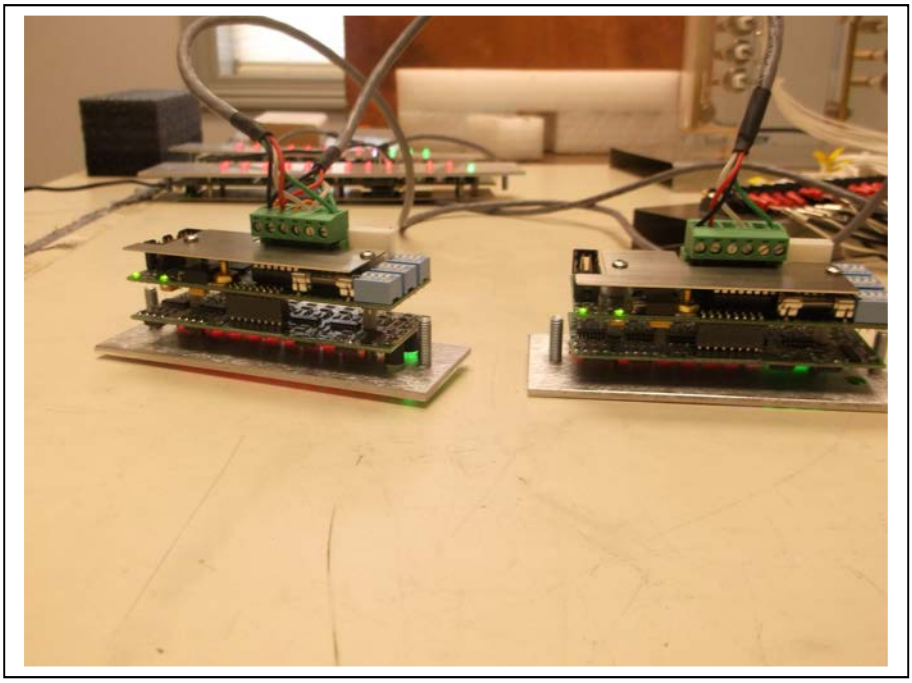
Small Gauge: Right Side View



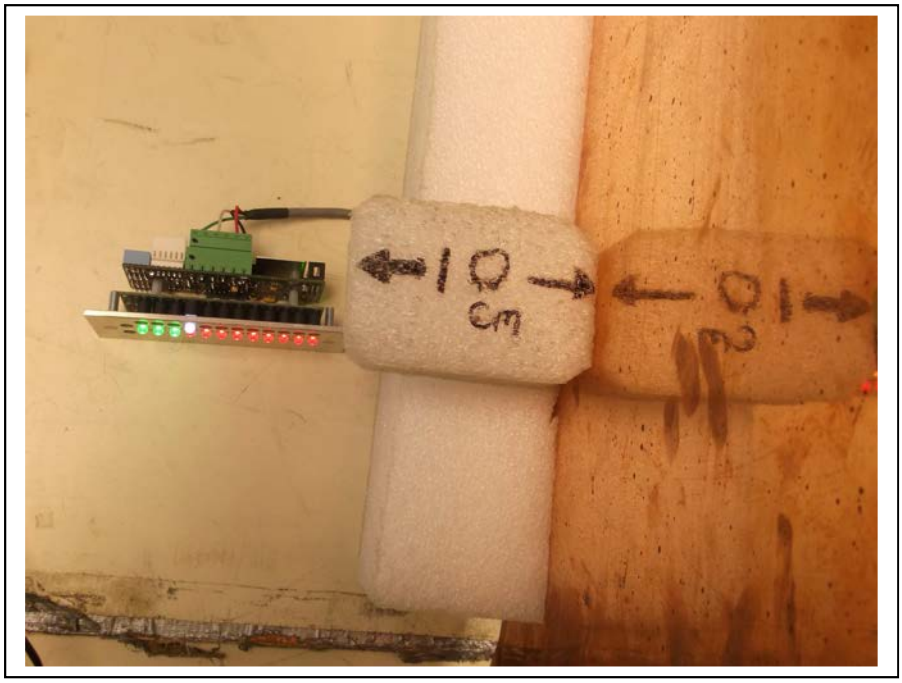
Small Gauge: Left Side View

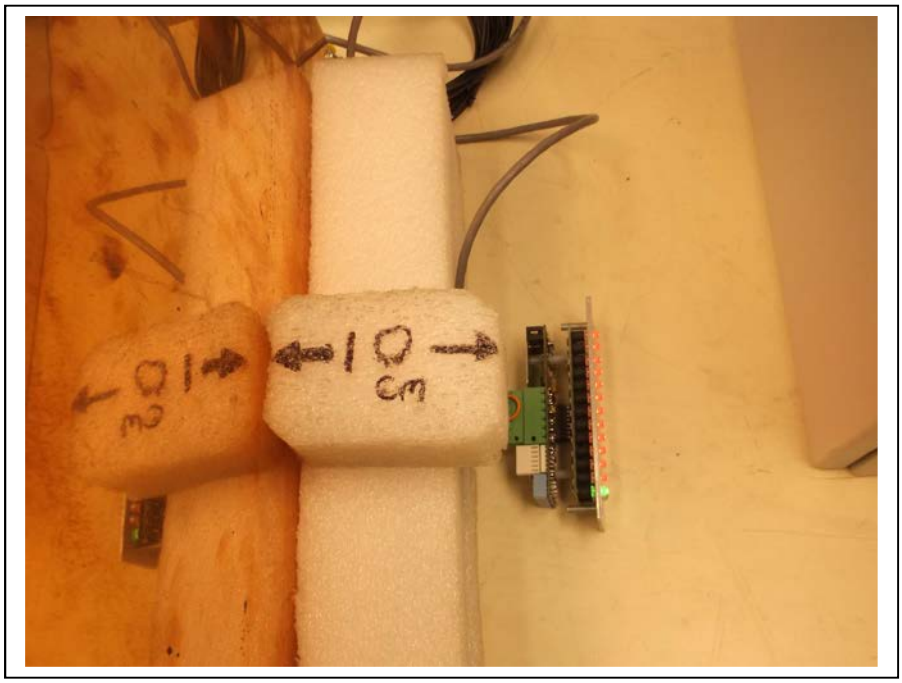


Small Gauge: Top View

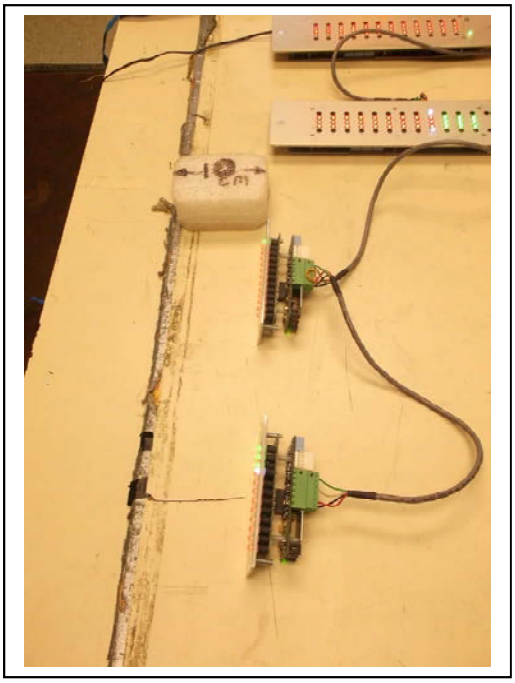


Small Gauge: VCP

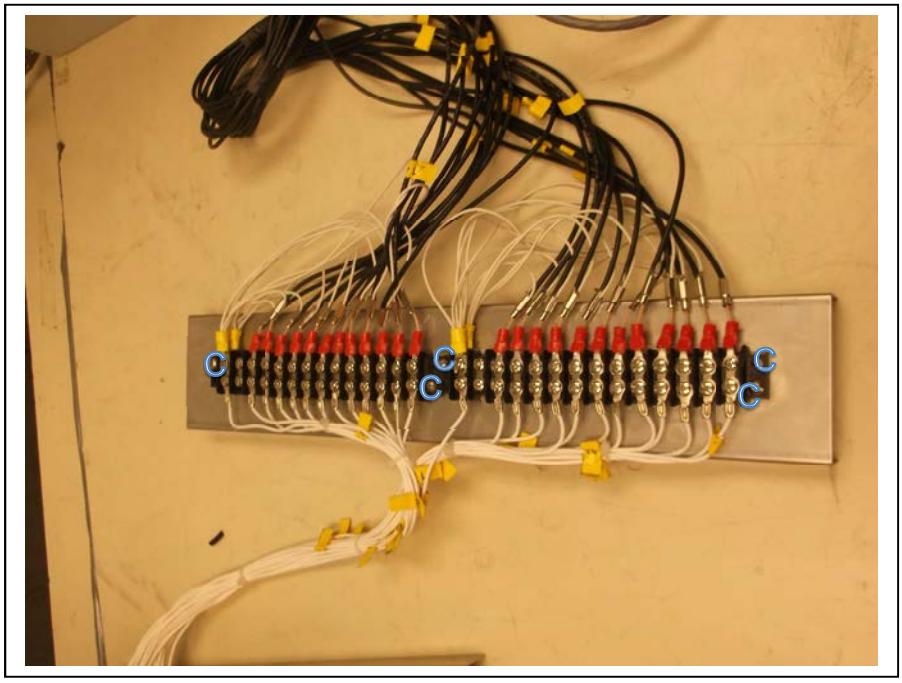




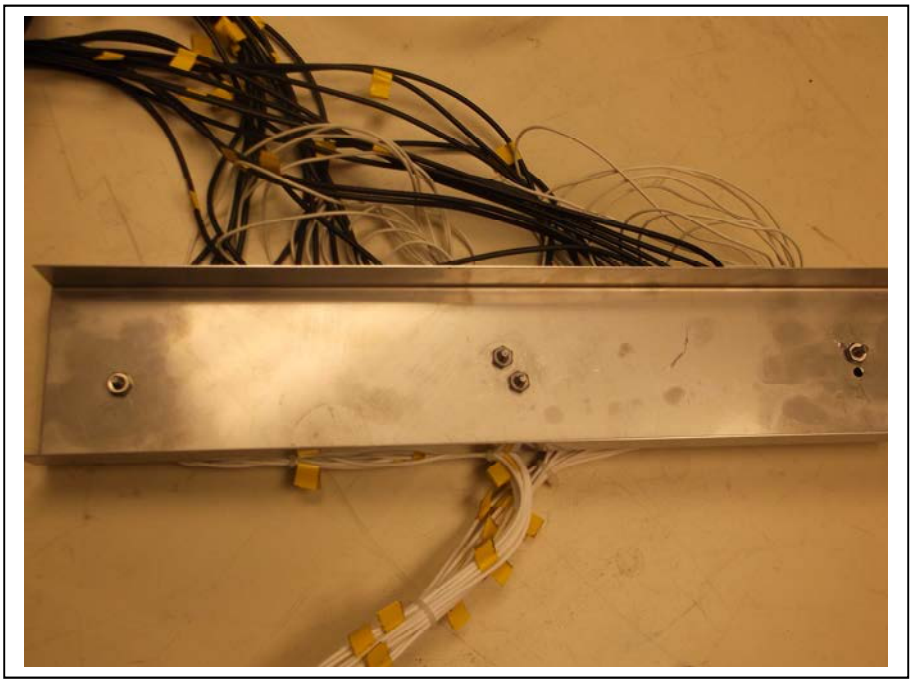
Small Gauge: HCP



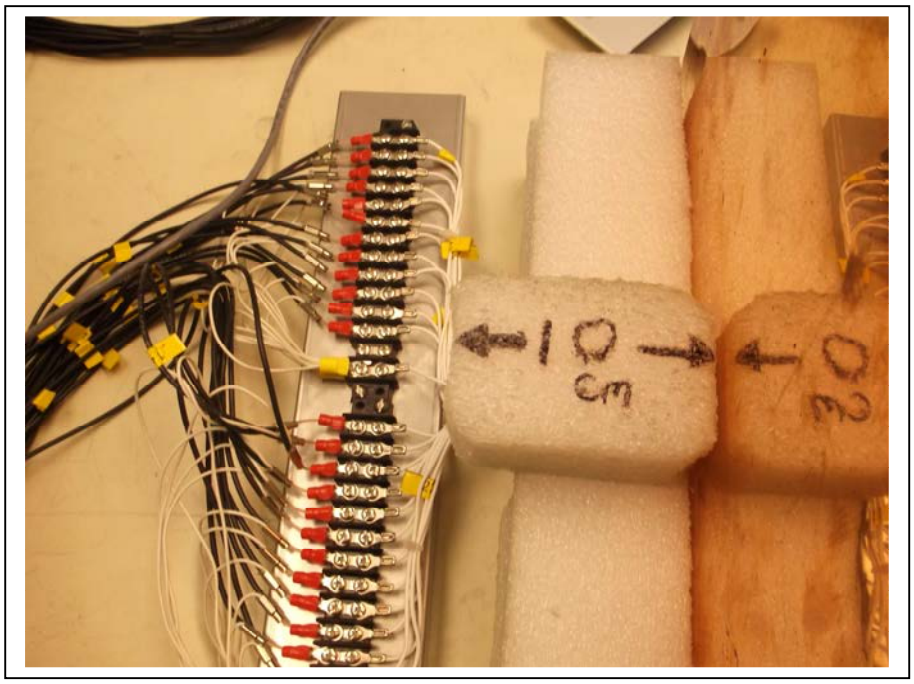
Relay Panel: Front View



Relay Panel: Rear View



Relay Panel: VCP



Relay Panel: HCP

10.0 RADIATED IMMUNITY TEST

10.1 Radiated Immunity Test Procedure

The Equipment Under Test (EUT) was placed in a semi-anechoic chamber on a 0.8-meter high non-conductive table. A broadband antenna was placed 1.8 meters from the EUT and was used to radiate RF energy at the EUT in both horizontal and vertical polarities.

The RF energy consisted of a signal that was stepped at 1% increments through the frequency ranges of 80 MHz to 1000 MHz, 1400 MHz to 2000 MHz, and 2000 MHz to 2700 MHz, at a rate slower than the reaction time of the EUT. The signal was 80% AM modulated with a 1 kHz sine wave and had a minimum calibrated field strength of 3.0/1.0 volts/meter at the surface of the EUT, as specified in the following test data sheet. The EUT was exposed to the RF energy on four different surfaces (front, rear, left and right sides).

The test setup conformed to figure 2 of EN 61000-4-3.

Test Equipment Used:

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shield Room	0175	Ray Proof	N/A	11645	Nov. 13, 2013
Temp/Hum. Recorder	CL137	Extech	RH520	CH16992	Apr. 24, 2013
Antenna 1-Chamber	0142	ETS/EMCO	3142B	9811-1330	Verified
Antenna, Horn	0138	ARA	DWG-118/A	1109	Verified
Amplifier	0171	Instruments for Industry	SMX 100	2158-1096	Verified
Amplifier	0185	Ophir	5151F	1001	Verified
Power Meter; Power Sensor	CL148	Agilent Technologies	E4418B; E9300B	MY41294473; MY41496326	Apr. 30, 2013
Signal Generator	0213	Hewlett Packard	8648C	3623A03444	Nov. 26, 2014
Software:	Tile Version 1.0		Software Verified: Apr. 15, 2013		

10.2 Radiated Immunity Test Data Sheet

Test Date:	Apr. 15, 2013	**Test Engineer:**	J. Knepper
Standard:	EN 61326-1:2006	**Air Temperature:**	22.6° C
Minimum Performance Criteria:	A	**Relative Humidity:**	54%

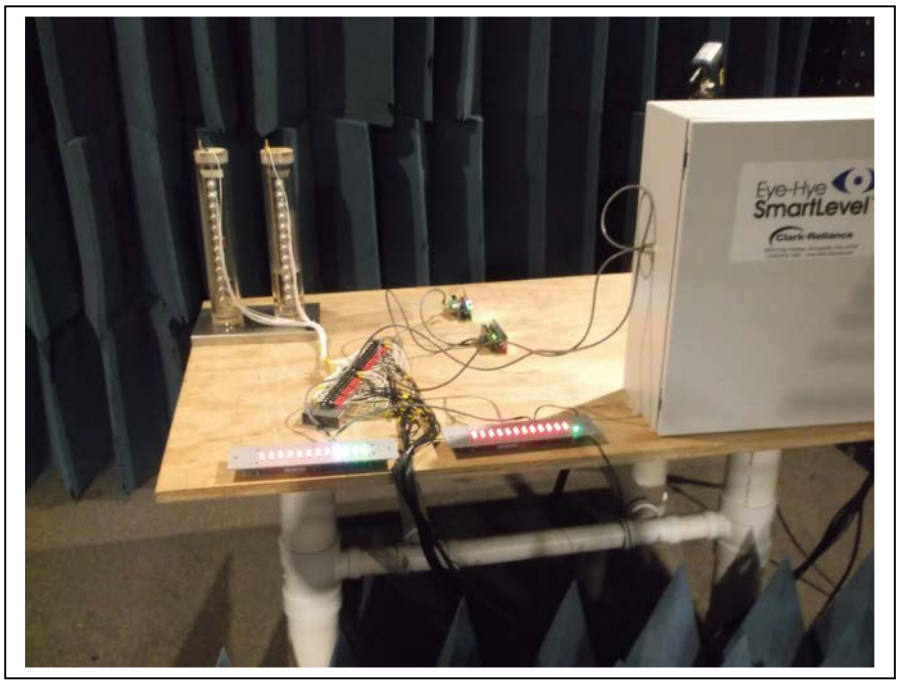
Side of EUT Exposed to Antenna	Antenna Polarization	Frequency Range (MHz)	Minimum Calibrated RF Field Strength	Achieved Performance Criterion	Pass/Fail
Front	Horizontal	80 to 1000	3.0 V/m	A	Pass
Right Side	Horizontal	80 to 1000	3.0 V/m	A	Pass
Rear	Horizontal	80 to 1000	3.0 V/m	A	Pass
Left Side	Horizontal	80 to 1000	3.0 V/m	A	Pass
Front	Vertical	80 to 1000	3.0 V/m	A	Pass
Right Side	Vertical	80 to 1000	3.0 V/m	A	Pass
Rear	Vertical	80 to 1000	3.0 V/m	A	Pass
Left Side	Vertical	80 to 1000	3.0 V/m	A	Pass

Side of EUT Exposed to Antenna	Antenna Polarization	Frequency Range (MHz)	Minimum Calibrated RF Field Strength	Achieved Performance Criterion	Pass/Fail
Front	Horizontal	1400 to 2000	3.0 V/m	A	Pass
Right Side	Horizontal	1400 to 2000	3.0 V/m	A	Pass
Rear	Horizontal	1400 to 2000	3.0 V/m	A	Pass
Left Side	Horizontal	1400 to 2000	3.0 V/m	A	Pass
Front	Vertical	1400 to 2000	3.0 V/m	A	Pass
Right Side	Vertical	1400 to 2000	3.0 V/m	A	Pass
Rear	Vertical	1400 to 2000	3.0 V/m	A	Pass
Left Side	Vertical	1400 to 2000	3.0 V/m	A	Pass

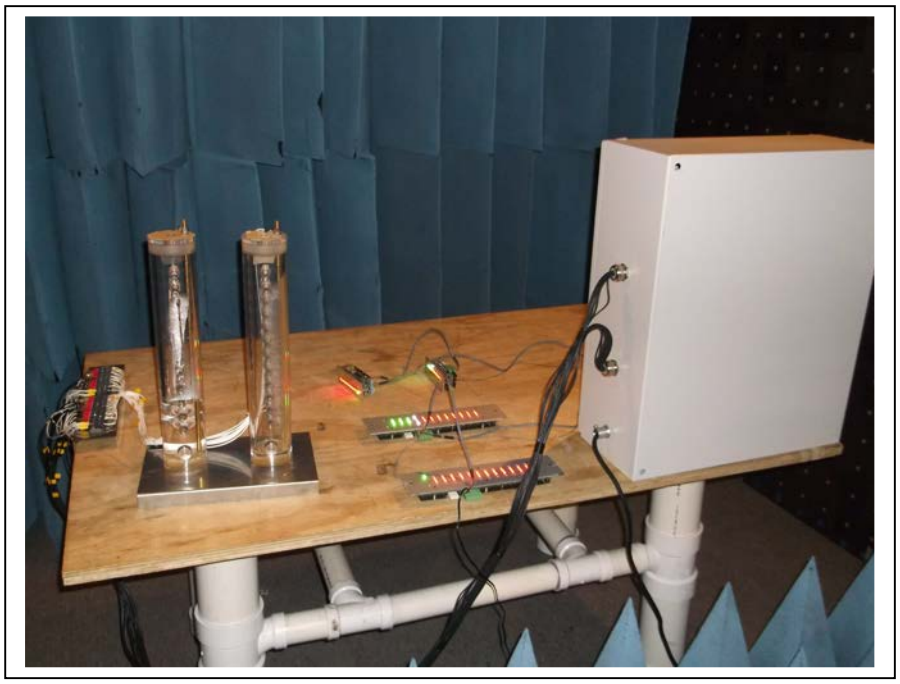
Side of EUT Exposed to Antenna	Antenna Polarization	Frequency Range (MHz)	Minimum Calibrated RF Field Strength	Achieved Performance Criterion	Pass/Fail
Front	Horizontal	2000 to 2700	1.0 V/m	A	Pass
Right Side	Horizontal	2000 to 2700	1.0 V/m	A	Pass
Rear	Horizontal	2000 to 2700	1.0 V/m	A	Pass
Left Side	Horizontal	2000 to 2700	1.0 V/m	A	Pass
Front	Vertical	2000 to 2700	1.0 V/m	A	Pass
Right Side	Vertical	2000 to 2700	1.0 V/m	A	Pass
Rear	Vertical	2000 to 2700	1.0 V/m	A	Pass
Left Side	Vertical	2000 to 2700	1.0 V/m	A	Pass

10.3 Photograph(s) of the Radiated Immunity Test Setup

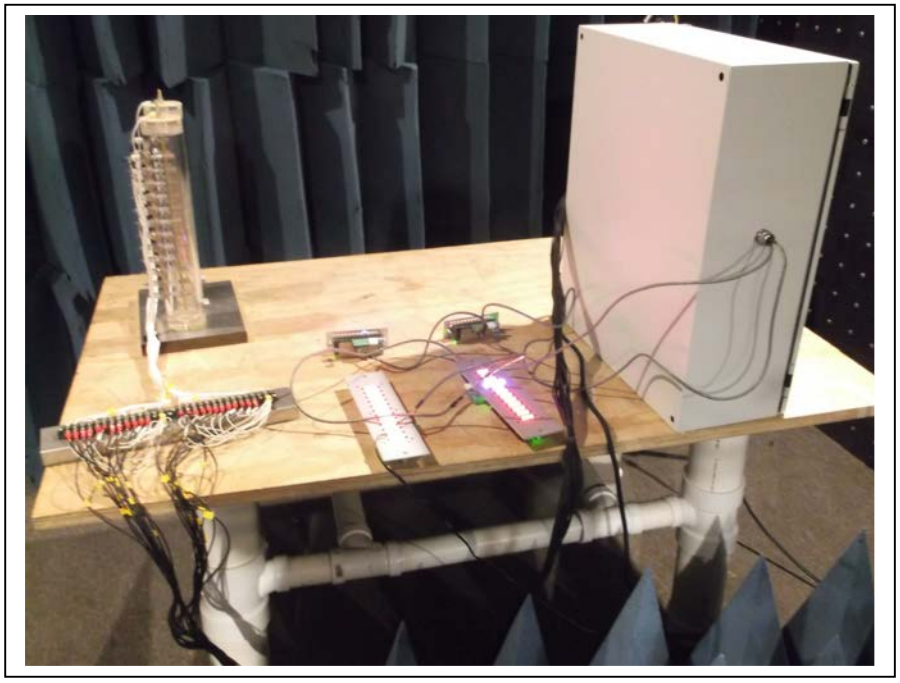
Front View



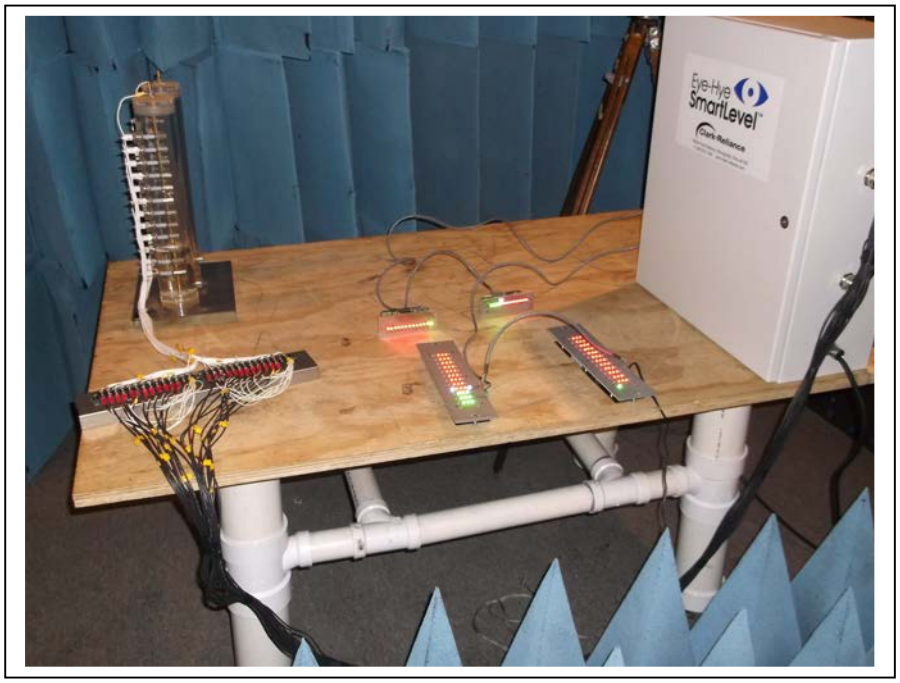
Rear View



Right Side View



Left Side View



11.0 ELECTRICAL FAST TRANSIENT/BURST TEST

11.1 Electrical Fast Transient/Burst Test Procedure

The Electrical Fast Transient Burst generator was used to conduct the tests outlined below. The waveform conforms to EN 61000-4-4. This generator was used to simulate RF energy coupled onto power and data cables from switches, relays, motors, and any other device that could produce a voltage "spike."

During the testing, the product was placed on a non-conductive surface 10 cm above a GRP. The setup conformed to EN 61000-4-4, figure 7. The transient energy (as defined in EN 61000-4-4) was coupled to the cables under test at various levels and polarities as defined by the standard. (Refer to the test data sheet for the details of this test.)

During the test, all data cables that may have a practical length greater than 3.0 meters, and all power mains cables were tested as outlined below.

AC Mains

The transient energy was coupled through the EFT generator coupling/decoupling network to each conductor of the power mains cable with respect to ground.

Test Equipment Used:

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Temp/Hum. Recorder	CL119	Extech	RH520	H005869	Jan. 2, 2014
EMC Immunity Tester	CL077	EMC-Partner	TRA2000IN6	780	Jan. 23, 2014
Software:	Genecs Generator Controlling Software Version 2.58		Software Verified: Apr. 15, 2013		

11.2 EFT Test Data Sheet

Test Date:	Apr. 15, 2013	**Test Engineer:**	J. Knepper
Standard:	EN 61326-1:2006	**Air Temperature:**	21/2° C
Minimum Performance Criterion:	B	**Relative Humidity:**	54%

AC Power Lines:

Description of Power Line Conductor	Test Level	Polarity	Test Duration	Achieved Performance Criterion	Pass/Fail
Live	1.0 kV	+ / -	1 minute	A	Pass
Neutral	1.0 kV	+ / -	1 minute	A	Pass
Earth	1.0 kV	+ / -	1 minute	A	Pass
Live and Neutral	1.0 kV	+ / -	1 minute	A	Pass
Live and Earth	1.0 kV	+ / -	1 minute	A	Pass
Neutral and Earth	1.0 kV	+ / -	1 minute	A	Pass
Live, Neutral and Earth	1.0 kV	+ / -	1 minute	A	Pass

11.3 Photograph(s) of the Electrical Fast Transient Test Setup

12.0 SURGE IMMUNITY TEST

12.1 Surge Immunity Test Procedure

The test was performed on the unit as per EN 61000-4-5. The surge pulse duration from the combination wave generator was 1.2/50 µs voltage into an open circuit as high as 1.0 kV and an 8/20 µs current pulse into a short circuit. Each pulse was injected 5 times, per phase, in each polarity with a minimum of 10 seconds interval between each pulse. The unit setup was similar to the schematic shown in Figure 8 of EN 61000-4-5.

AC Mains

The AC Mains lines were coupled to the surge generator's coupling/decoupling network. Surges were applied to each AC line and protective earth in both line-to-line and line-to-earth modes.

Test Equipment Used:

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Temp/Hum. Recorder	CL119	Extech	RH520	H005869	Jan. 2, 2014
EMC Immunity Tester	CL077	EMC-Partner	TRA2000IN6	780	Jan. 23, 2014
Software:	Genecs Generator Controlling Software Version 2.58		Software Verified: Apr. 15, 2013		

12.2 Surge Immunity Test Data Sheet

Test Date:	Apr. 15, 2013	**Test Engineer:**	J. Knepper
Standard:	EN 61326-1:2006	**Air Temperature:**	21.5° C
Minimum Performance Criterion:	B	**Relative Humidity:**	52%

Cable Designation AC Port Testing	Level (kV)	Phase (Degrees)	Achieved Performance Criterion	Pass/Fail
Line 1 to Line 2	+0.5	0	A	Pass
Line 1 to Line 2	-0.5	0	A	Pass
Line 1 to Earth	+0.5	0	A	Pass
Line 1 to Earth	-0.5	0	A	Pass
Line 2 to Earth	+0.5	0	A	Pass
Line 2 to Earth	-0.5	0	A	Pass

Cable Designation AC Port Testing	Level (kV)	Phase (Degrees)	Achieved Performance Criterion	Pass/Fail
Line 1 to Line 2	+0.5	90	A	Pass
Line 1 to Line 2	-0.5	90	A	Pass
Line 1 to Earth	+0.5	90	A	Pass
Line 1 to Earth	-0.5	90	A	Pass
Line 2 to Earth	+0.5	90	A	Pass
Line 2 to Earth	-0.5	90	A	Pass

Cable Designation AC Port Testing	Level (kV)	Phase (Degrees)	Achieved Performance Criterion	Pass/Fail
Line 1 to Line 2	+0.5	180	A	Pass
Line 1 to Line 2	-0.5	180	A	Pass
Line 1 to Earth	+0.5	180	A	Pass
Line 1 to Earth	-0.5	180	A	Pass
Line 2 to Earth	+0.5	180	A	Pass
Line 2 to Earth	-0.5	180	A	Pass

Cable Designation AC Port Testing	Level (kV)	Phase (Degrees)	Achieved Performance Criterion	Pass/Fail
Line 1 to Line 2	+0.5	270	A	Pass
Line 1 to Line 2	-0.5	270	A	Pass
Line 1 to Earth	+0.5	270	A	Pass
Line 1 to Earth	-0.5	270	A	Pass
Line 2 to Earth	+0.5	270	A	Pass
Line 2 to Earth	-0.5	270	A	Pass

Cable Designation AC Port Testing	Level (kV)	Phase (Degrees)	Achieved Performance Criterion	Pass/Fail
Line 1 to Earth	+1.0	0	A	Pass
Line 1 to Earth	-1.0	0	A	Pass
Line 2 to Earth	+1.0	0	A	Pass
Line 2 to Earth	-1.0	0	A	Pass

Cable Designation AC Port Testing	Level (kV)	Phase (Degrees)	Achieved Performance Criterion	Pass/Fail
Line 1 to Earth	+1.0	90	A	Pass
Line 1 to Earth	-1.0	90	A	Pass
Line 2 to Earth	+1.0	90	A	Pass
Line 2 to Earth	-1.0	90	A	Pass

Cable Designation AC Port Testing	Level (kV)	Phase (Degrees)	Achieved Performance Criterion	Pass/Fail
Line 1 to Earth	+1.0	180	A	Pass
Line 1 to Earth	-1.0	180	A	Pass
Line 2 to Earth	+1.0	180	A	Pass
Line 2 to Earth	-1.0	180	A	Pass

Cable Designation AC Port Testing	Level (kV)	Phase (Degrees)	Achieved Performance Criterion	Pass/Fail
Line 1 to Earth	+1.0	270	A	Pass
Line 1 to Earth	-1.0	270	A	Pass
Line 2 to Earth	+1.0	270	A	Pass
Line 2 to Earth	-1.0	270	A	Pass

12.3 Photograph(s) of Surge Immunity Test Setup

13.0 CONDUCTED IMMUNITY TEST

13.1 Conducted Immunity Test Procedure

The Equipment Under Test (EUT) was placed 0.1 meter above a ground reference. A bulk current injection probe (BCI), EM Injection Clamp (EMIC) or Coupling/Decoupling Network (CDN) was connected to the EUT's power cord and was used to couple RF energy onto all lines of the power to the EUT. A Bulk Current Injection Clamp (BCI) or EM Injection Clamp (EMIC) was used to couple RF energy onto all data, control and I/O lines if an appropriate coupling/decoupling network (CDN) was not available.

The RF energy consisted of a signal that was stepped at 1% increments through the frequency range of 0.15 MHz to 80 MHz at a rate slower than the reaction time of the EUT. The signal was 80% AM modulated with a 1 kHz sine wave and had a minimum calibrated level of 3.0 Volts rms.

The test setup conformed to figure 2 of EN 61000-4-6.

Test Equipment Used:

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Temp/Hum. Recorder	CL119	Extech	RH520	H005869	Jan. 2, 2014
Amplifier	0208	Amplifier Research	25A250A #1	301006	N/A
Coupling/Decoupling Network	CL010	Fischer Custom Communications	801-M3-16A	97-12	Oct. 3, 2016
Signal Generator	CL126	Hewlett Packard	8648A	3619U00447	Sept. 13, 2013
Software:	Tile Version 1.0		Software Verified: Apr. 15, 2013		

13.2 Conducted Immunity Test Data Sheet

Test Date:	Apr. 15, 2013	**Test Engineer:**	J. Knepper
Standard:	EN 61326-1:2006	**Air Temperature:**	22.3° C
Minimum Performance Criterion:	A	**Relative Humidity:**	54%

Line Tested	Coupling	Frequency Range	Minimum Calibrated RF Level	Achieved Performance Criterion	Pass/Fail
AC Mains	CDN	0.15 MHz to 80 MHz	3.0 volts rms	A	Pass

13.3 Photograph(s) of the Conducted Immunity Test Setup

14.0 VOLTAGE DIPS AND INTERRUPTIONS TEST

14.1 Voltage Dips and Interruptions Test Procedure

The AC mains input was coupled to the voltage generator. The voltage was disrupted according to the specification.

The EUT was tested for each selected combination of test level and duration with a sequence of 6 interruptions. Each interruption was applied with a minimum delay interval of 10 seconds between each test event.

Industry standard mounting, bonding, and grounding of the unit were used for the formal test setup. A photograph of the typical unit setup during the test is included.

Prior to the start of the test, a functional test was performed on EUT to ensure proper operation

Test Equipment Used:

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Temp./Hum. Recorder	CL119	Extech	RH520	H005869	Jan. 2, 2014
EMC Immunity Tester	CL077	EMC-Partner	TRA2000IN6	780	Jan. 23, 2014
Software:	Genecs Generator Controlling Software Version 2.58		Software Verified: Apr. 15, 2013		

14.2 Voltage Dips and Interruptions Test Data Sheet

Test Date:	Apr. 15, 2013	**Test Engineer:**	J. Knepper
Standard:	EN 61326-1:2006	**Air Temperature:**	21.3° C
Minimum Performance Criterion:	B, C	**Relative Humidity:**	54%

Test Level	Duration (mS)	Number of Repetitions	Achieved Performance Criterion	Pass/Fail
30% Interruption	500	6	B*	Pass
100% Interruption	10	6	A	Pass
100% Interruption	20	6	A	Pass
100% Interruption	5000	6	B*	Pass

**EUT lost power but recovered without operator intervention.*

14.3 Photograph(s) of Voltage Dips and Interruptions Test Setup

15.0 RADIATED EMISSIONS TEST

15.1 Radiated Emissions Test Procedure

The EUT was initially placed in a semi-anechoic chamber, and wide band characterization measurements were performed to determine the frequencies at which significant emissions occurred.

The equipment was installed on a 0.8-meter high non-conductive turntable on an Open Area Test Site (OATS) as described in EN 55011. A receiving antenna was located 10.0 meters from the edge of the Equipment under Test (EUT). The antenna was attached to an antenna mast that allowed the antenna height to be adjusted from 1.0 to 4.0 meters above the ground plane.

The equipment was then fully exercised with all cabling attached to the EUT. While the equipment was energized, the receiving antenna was scanned from 1.0 meter to 4.0 meters in both vertical and horizontal polarities while the turntable was adjusted 360 degrees to determine the maximum field strength. During the test, frequencies identified as being generated by the EUT in the frequency range of 30 MHz to 1000 MHz were measured. The highest levels were recorded along with antenna polarity. These levels were then compared to the Class A limits specified in EN 55011.

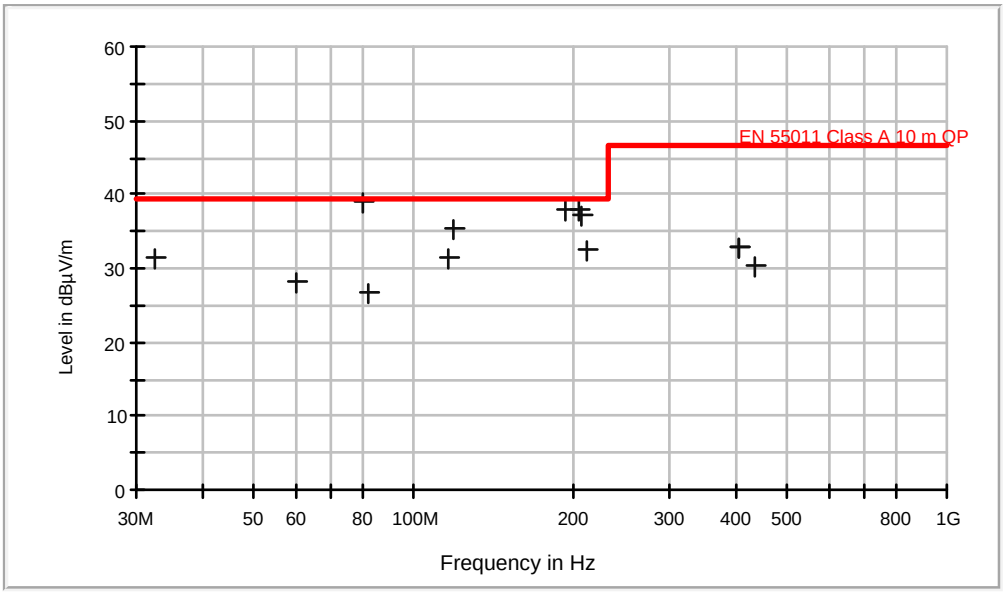
Test Equipment Used:

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shield Room	CL014	Shielding Resources	3 Meter	001	May 19, 2013
Digital Thermometer with Humidity	CL075	ACU-Rite	00891	None Specified	Verified
OATS-10m	CL017	Compliance Labs	N/A	001	Sept. 19, 2013
Spectrum Analyzer	0204	Hewlett Packard	HP8591A	3149A02546	Nov. 26, 2013
Spectrum Analyzer	CL138	Agilent Technologies	E4407B	US41192779	Sept. 14, 2013
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Nov. 8, 2013
Antenna 1-Chamber	0142	ETS/EMCO	3142B	9811-1330	Verified
Antenna 2-OATS	0105	Sunol Sciences	JB1	A101101	May 17, 2013
Pre-Amplifier	CL045	Hewlett-Packard	8447D	2944A08445	Sept. 20, 2013
Software:	Tile Version 1.0		Software Verified: Apr. 17, 2013		
Software:	EMC 32, Version 5.20.2		Software Verified: Apr. 17, 2013		

15.2 Radiated Emissions Test Data Sheet

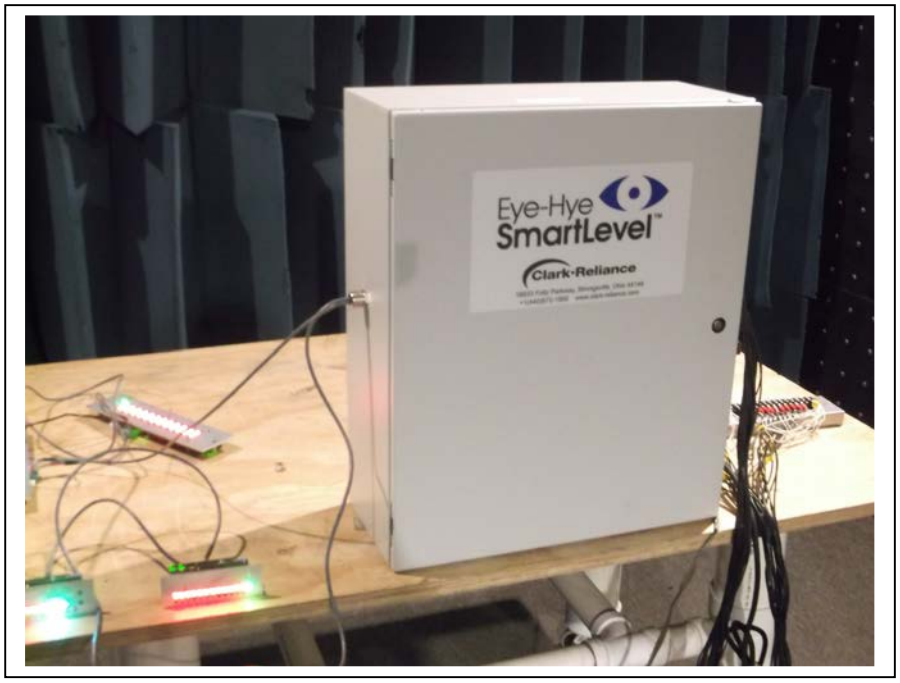
Test Date:	Apr. 17, 2013	**Test Engineer:**	J. Knepper
Standard:	EN 55011:2009, inc. A1:2010	**Air Temperature:**	24.0°C
Limit:	Class A	**Relative Humidity:**	39%
Distance:	10.0 meters		

Frequency (MHz)	Antenna Polarization	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
32.560000	V	12.5	19.0	31.5	40.0	-8.5
59.980000	V	19.0	9.0	28.0	40.0	-12.0
79.640000	V	29.5	9.4	38.9	40.0	-1.1
81.550000	H	17.6	9.1	26.7	40.0	-13.3
115.810000	V	16.3	15.1	31.4	40.0	-8.6
118.170000	H	19.8	15.6	35.4	40.0	-4.6
192.310000	H	23.4	14.4	37.8	40.0	-2.2
204.590000	H	24.4	13.4	37.8	40.0	-2.2
206.990000	V	23.0	14.1	37.1	40.0	-2.9
209.970000	H	19.3	13.1	32.4	40.0	-7.6
406.120000	V	12.9	19.9	32.8	47.0	-14.2
407.560000	H	13.1	19.9	33.0	47.0	-14.0
437.150000	H	9.7	20.8	30.5	47.0	-16.5



15.3 Photograph(s) of the Radiated Emissions Test Setup

Pre-scan



OATS

16.0 CONDUCTED EMISSIONS TEST

16.1 Conducted Emissions Test Procedure

The equipment was installed on a 0.8-meter high non-conductive table as described in EN 55011. Power was provided to the Equipment under Test (EUT) through a Line Impedance Stabilization Network (LISN). An EMI receiver was also connected to the LISN to measure the RF emissions on the power lines of the EUT. The EUT was fully exercised with all cabling attached. The setup conforms to EN 55011. During the test, each conductor of the power mains was tested and emissions were measured over the frequency range of 0.15 MHz to 30 MHz. The highest levels were recorded and plots were taken showing the emissions on each conductor. These levels were compared to the Class A limits specified in EN 55011.

Test Equipment Used:

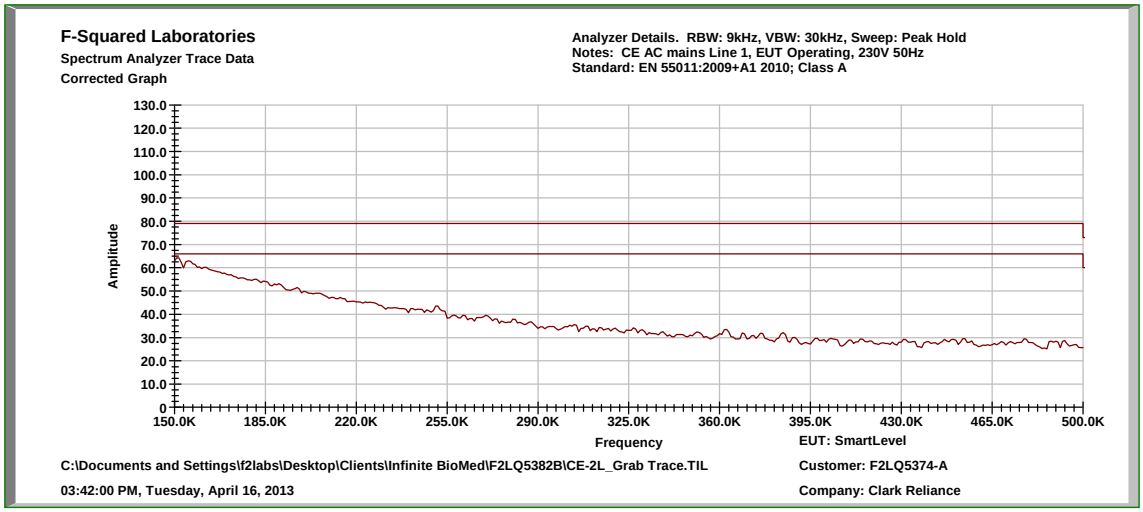
Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Temp/Hum. Rec.	CL119	Extech	RH520	H005869	Jan. 2, 2014
Transient Limiter	CL102	Hewlett Packard	11947A	3107A03325	Jan. 23, 2014
LISN 2	0147	Solar	8028-50-TS-24-BNC	1128	Oct. 28, 2016
LISN 4	0146	Solar	8028-50-TS-24-BNC	1127	Oct. 28, 2016
Software:	Tile Version 1.0		Software Verified: Apr.16, 2013		
Spectrum Analyzer	CL147	Agilent	E7402A	MY45101241	Oct. 8, 2013

16.2 Conducted Emissions Test Data Sheet

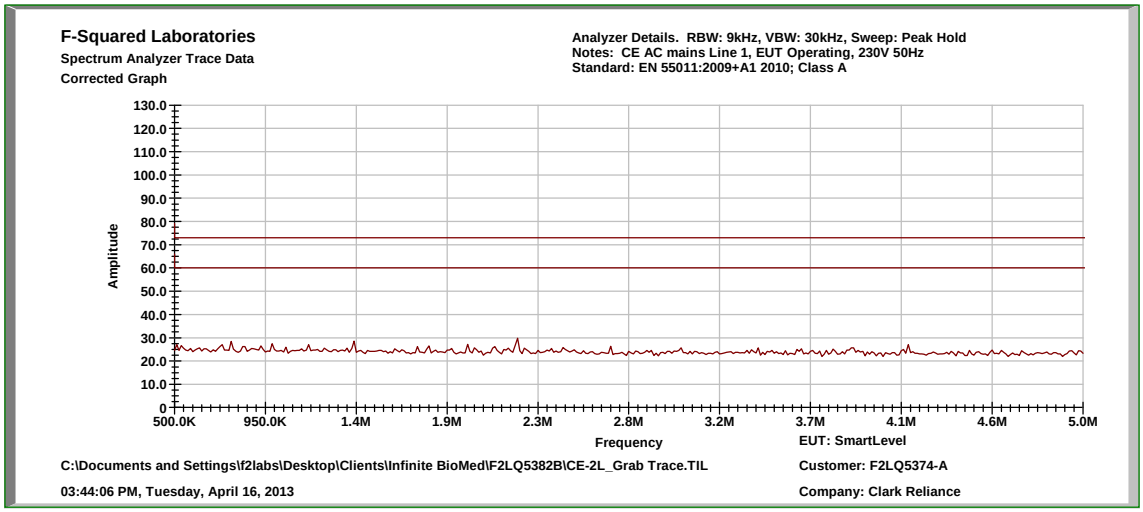
Test Date:	Apr. 16, 2013	**Test Engineer:**	J. Knepper
Standard:	EN 55011:2009, inc. A1:2010	**Air Temperature:**	21.9° C
Limit:	Class A	**Relative Humidity:**	55%
Pass/Fail:	Pass*		

**Data below reflects results with modifications, per Section 8.0 of this Test Report.*

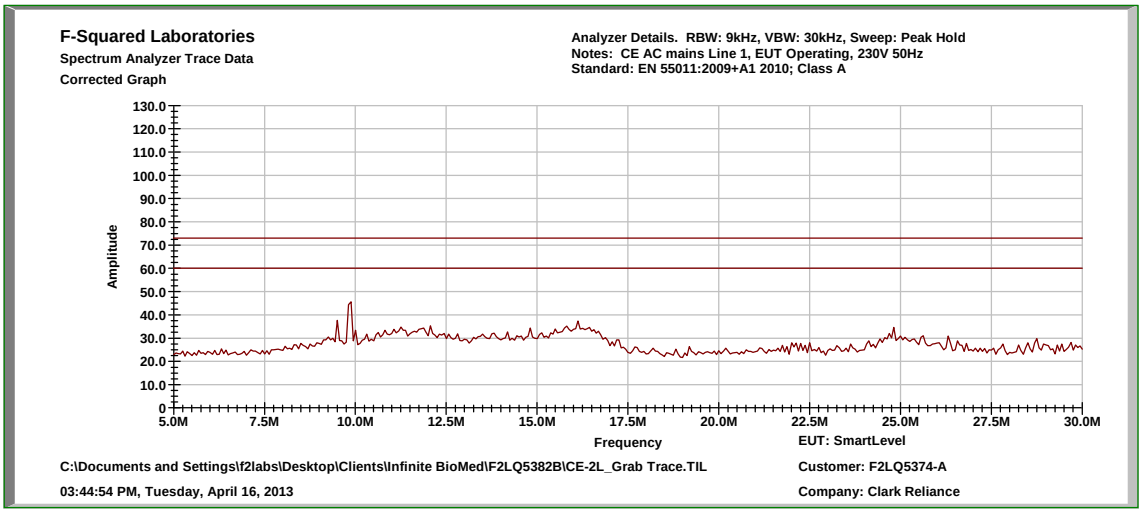
Conducted Test – Line 1: 0.15 MHz to 0.5 MHz



Conducted Test – Line 1: 0.5 MHz to 5.0 MHz

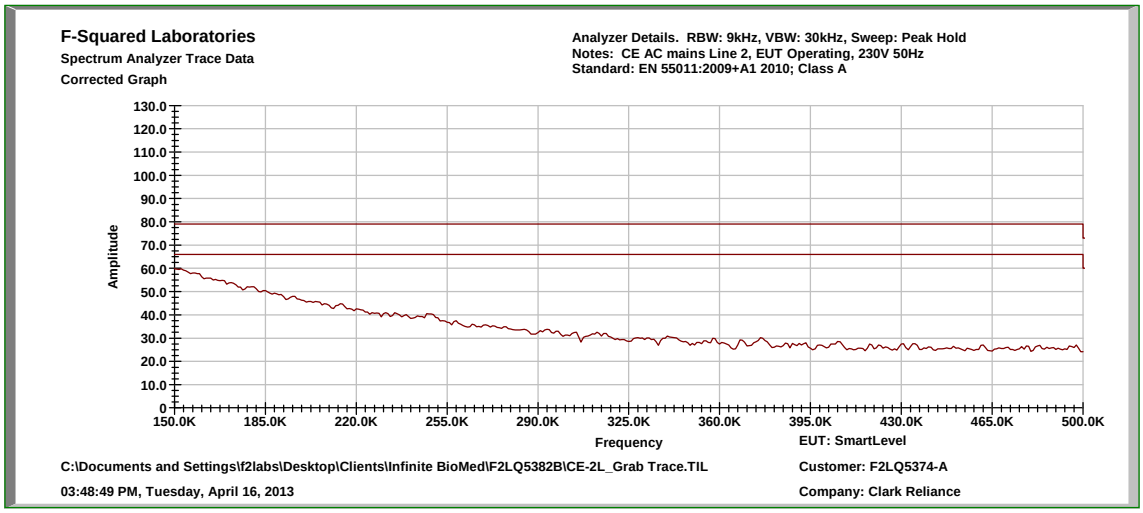


Conducted Test – Line 1: 5.0 MHz to 30.0 MHz

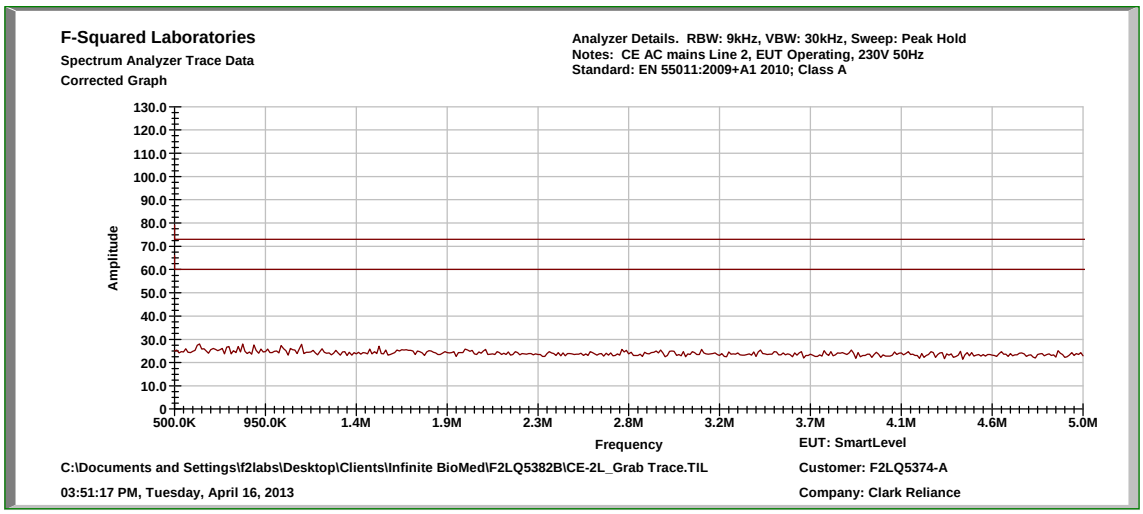


Top Discrete Measurements								
No.	**Conductor**	**Frequency (MHz)**	**Detector**	**Level (dBµV)**	**Adjustment (dB)**	**Results (dBµV)**	**Limit (dBµV)**	**Margin (dB)**
1	Line 1	0.150	Quasi-Peak	44.4	11.0	55.4	79.0	-23.6
			Average	12.54	11.0	23.54	66.0	-42.5
2	Line 1	9.5	Quasi-Peak	24.64	11.0	35.64	73.0	-37.4
			Average	21.4	11.0	32.4	60.0	-27.6
3	Line 1	9.875	Quasi-Peak	23.33	11.0	34.33	73.0	-38.7
			Average	18.84	11.0	29.84	60.0	-30.2

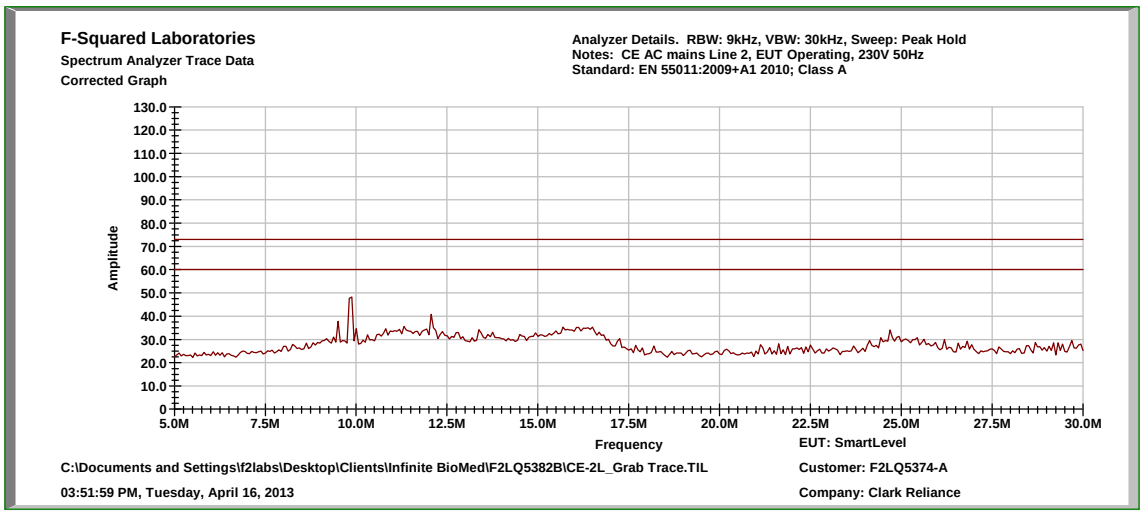
Conducted Test – Line 2: 0.15 MHz to 0.5 MHz



Conducted Test – Line 2: 0.5 MHz to 5.0 MHz



Conducted Test – Line 2: 5.0 MHz to 30.0 MHz



Top Discrete Measurements								
No.	**Conductor**	**Frequency (MHz)**	**Detector**	**Level (dBµV)**	**Adjustment (dB)**	**Results (dBµV)**	**Limit (dBµV)**	**Margin (dB)**
1	Line 2	0.150	Quasi-Peak	45.07	11.0	56.07	79.0	-22.9
			Average	11.45	11.0	22.45	66.0	-43.6
2	Line 2	9.5	Quasi-Peak	20.9	11.0	31.9	73.0	-41.1
			Average	10.28	11.0	21.28	60.0	-38.7
3	Line 2	9.875	Quasi-Peak	32.54	11.0	43.54	73.0	-29.5
			Average	26.04	11.0	37.04	60.0	-23.0

16.3 Photograph(s) of the Conducted Emissions Test Setup

17.0 HARMONIC CURRENT AND VOLTAGE FLUCTUATION TEST

17.1 Harmonic Current and Voltage Fluctuation Test Procedure

The EUT's power input was connected to a California Instruments 5001iX-CTS AC power source. The EUT's harmonic current emissions and voltage fluctuations were measured and compared to the appropriate class in accordance with EN 61000-3-2 and EN 61000-3-3.

Industry standard mounting, bonding, and grounding of the unit were used for the formal test setup.

Prior to the start of the test, a functional test was performed on EUT to ensure proper operation.

Test Equipment Used:

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
AC Power System	CL097	California Instruments	PACS-1-CTS	71565	Aug. 10, 2013
AC Power System	CL062	California Instruments	5001iX-CTS	7000-417-1	Aug. 10, 2013
Temp/Hum. Recorder	CL137	Extech	RH520	CH16992	Apr. 24, 2013

17.2 Harmonic Current and Voltage Fluctuation Test Data Sheet

Test Date:	Apr. 16, 2013	**Test Engineer:**	J. Knepper
Standards:	EN 61000-3-2:2006, inc. A1 :2010; EN 61000-3-3:1995, inc. A1 :2001	**Air Temperature:**	21.8° C
Level:	Class A Harmonics	**Relative Humidity:**	55%

Test	Line Tested	Pass/Fail
EN 61000-3-2	AC Mains	Pass
EN 61000-3-3	AC Mains	Pass

17.3 Harmonic Current and Voltage Fluctuation Test Plots

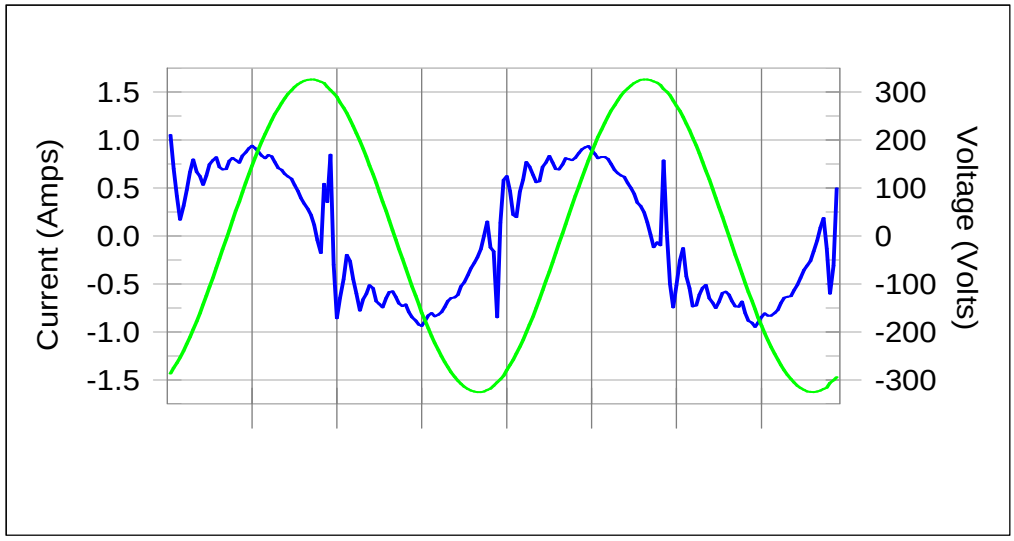
Harmonics – Class-A per Ed. 3.0 (2005-11) (run time)

EUT: SmartLevel
Test Category: Class-A per Ed. 3.0 (2005-11) (European limits)
Test Date: 4/16/2013
Test Duration (min): 10
Customer: Clark Reliance
Test Result: Pass

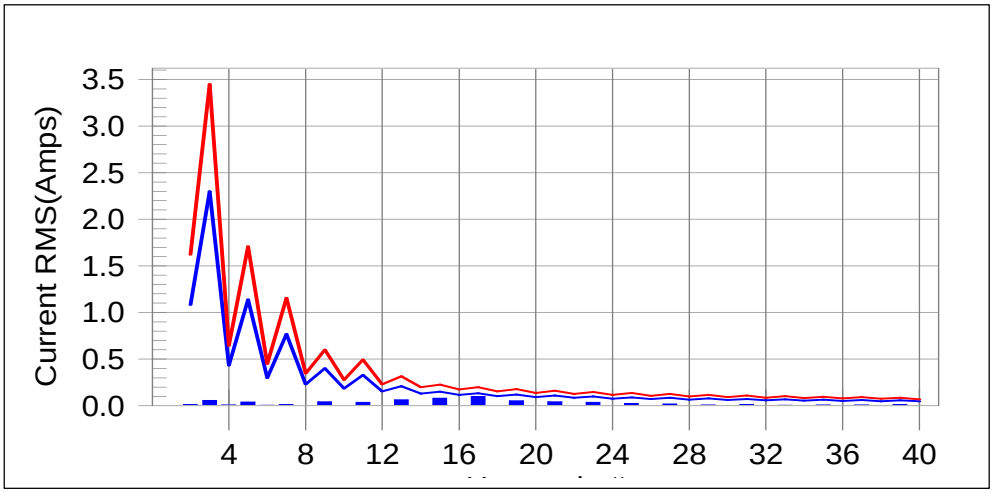
Start Time: 1:38:19 PM
Data File Name: H-000933.cts_data
Comment: F2LQ5374-A
Source Qualification: Normal

Tested by: JK
Test Margin: 100%
End Time: 1:48:41 PM

Current & Voltage Waveforms



Harmonics and Class A Limit Line - European Limits



Test Result: Pass. Worst harmonic was #17 with 71.48% of the limit.

Current Test Result Summary (run time)

EUT: SmartLevel
Test Category: Class-A per Ed. 3.0 (2005-11) (European limits)
Test Sate: 4/16/2013 Start Time: 1:38:19 PM
Test Duration (min): 10 Data File Name: H-000933.cts_data
Customer: Clark Reliance Comment: F2LQ5374-A
Test Result: Pass Source Qualification: Normal

Tested by: JK
Test Margin: 100%
End Time: 1:48:41 PM

THC(A): 0.18 I-THD(%): 30.12 POHC(A): 0.064 POHC Limit(A): 0.257

Highest parameter values during test:

V_RMS (Volts):	230.27	Frequency(Hz):	50.00
I_Peak (Amps):	1.166	I_RMS (Amps):	0.647
I_Fund (Amps):	0.614	Crest Factor:	1.806
Power (Watts):	38.6	Power Factor:	0.259

Harm #	Harms (avg)	100% Limit	% of Limit	Harms (max)	150 %Limit	% of Limit	Status
2	0.013	1.080	1.2	0.013	1.620	0.82	Pass
3	0.058	2.300	2.5	0.058	3.450	1.69	Pass
4	0.009	0.430	2.1	0.009	0.645	1.38	Pass
5	0.038	1.140	3.3	0.040	1.710	2.36	Pass
6	0.006	0.300	1.8	0.006	0.450	1.30	Pass
7	0.010	0.770	1.4	0.014	1.155	1.18	Pass
8	0.000	0.230	0.0	0.004	0.345	1.03	Pass
9	0.041	0.400	10.3	0.044	0.600	7.25	Pass
10	0.000	0.184	0.0	0.002	0.276	0.59	Pass
11	0.036	0.330	10.9	0.037	0.495	7.57	Pass
12	0.000	0.153	0.0	0.001	0.230	0.50	Pass
13	0.065	0.210	30.7	0.066	0.315	20.91	Pass
14	0.000	0.131	0.0	0.002	0.197	1.16	Pass
15	0.079	0.150	52.9	0.081	0.225	36.17	Pass
16	0.000	0.115	0.0	0.004	0.173	2.06	Pass
17	0.094	0.132	71.5	0.098	0.199	49.15	Pass
18	0.000	0.102	0.0	0.003	0.153	1.72	Pass
19	0.050	0.118	42.6	0.054	0.178	30.11	Pass
20	0.000	0.092	0.0	0.004	0.138	2.95	Pass
21	0.041	0.107	38.6	0.044	0.161	27.48	Pass
22	0.000	0.084	0.0	0.002	0.125	1.49	Pass
23	0.033	0.098	33.8	0.036	0.147	24.20	Pass
24	0.000	0.077	0.0	0.002	0.115	1.97	Pass
25	0.022	0.090	24.2	0.024	0.135	17.82	Pass
26	0.000	0.071	0.0	0.002	0.106	1.55	Pass
27	0.019	0.083	22.6	0.021	0.125	16.82	Pass
28	0.000	0.066	0.0	0.001	0.099	1.36	Pass
29	0.009	0.078	11.3	0.011	0.116	9.09	Pass
30	0.000	0.061	0.0	0.002	0.092	2.46	Pass
31	0.011	0.073	14.7	0.012	0.109	11.05	Pass
32	0.000	0.058	0.0	0.001	0.086	1.09	Pass
33	0.006	0.068	8.2	0.006	0.102	5.95	Pass
34	0.000	0.054	0.0	0.002	0.081	2.03	Pass
35	0.009	0.064	14.3	0.010	0.096	10.50	Pass
36	0.000	0.051	0.0	0.001	0.077	1.45	Pass
37	0.010	0.061	16.4	0.010	0.091	11.40	Pass
38	0.000	0.048	0.0	0.002	0.073	2.45	Pass
39	0.013	0.058	22.0	0.014	0.087	15.75	Pass
40	0.000	0.046	0.0	0.002	0.069	2.70	Pass

Voltage Source Verification Data (run time)

EUT: SmartLevel
Test Category: Class-A per Ed. 3.0 (2005-11) (European limits)
Test Date: 4/16/2013
Test Duration (min): 10
Customer: Clark Reliance
Test Result: Pass

Start Time: 1:38:19 PM
Data File Name: H-000933.cts_data
Comment: F2LQ5374-A
Source Qualification: Normal

Tested by: JK
Test Margin: 100%
End Time: 1:48:41 PM

Highest parameter values during test:

Voltage (Vrms):	230.27	Frequency(Hz):	50.00
I_Peak (Amps):	1.166	I_RMS (Amps):	0.647
I_Fund (Amps):	0.614	Crest Factor:	1.806
Power (Watts):	38.6	Power Factor:	0.259

Harm #	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.058	0.461	12.57	OK
3	0.491	2.072	23.71	OK
4	0.009	0.461	1.98	OK
5	0.056	0.921	6.11	OK
6	0.046	0.461	9.91	OK
7	0.050	0.691	7.24	OK
8	0.032	0.461	6.85	OK
9	0.039	0.461	8.38	OK
10	0.009	0.461	1.99	OK
11	0.033	0.230	14.29	OK
12	0.005	0.230	2.26	OK
13	0.046	0.230	20.12	OK
14	0.009	0.230	3.90	OK
15	0.033	0.230	14.48	OK
16	0.021	0.230	8.98	OK
17	0.057	0.230	24.68	OK
18	0.020	0.230	8.54	OK
19	0.061	0.230	26.49	OK
20	0.026	0.230	11.36	OK
21	0.077	0.230	33.63	OK
22	0.011	0.230	4.84	OK
23	0.093	0.230	40.50	OK
24	0.010	0.230	4.39	OK
25	0.105	0.230	45.48	OK
26	0.014	0.230	5.88	OK
27	0.148	0.230	64.45	OK
28	0.006	0.230	2.47	OK
29	0.136	0.230	59.19	OK
30	0.020	0.230	8.81	OK
31	0.141	0.230	61.24	OK
32	0.012	0.230	5.01	OK
33	0.115	0.230	49.88	OK
34	0.012	0.230	5.32	OK
35	0.075	0.230	32.58	OK
36	0.012	0.230	5.35	OK
37	0.054	0.230	23.39	OK
38	0.010	0.230	4.54	OK
39	0.051	0.230	22.29	OK
40	0.011	0.230	4.74	OK

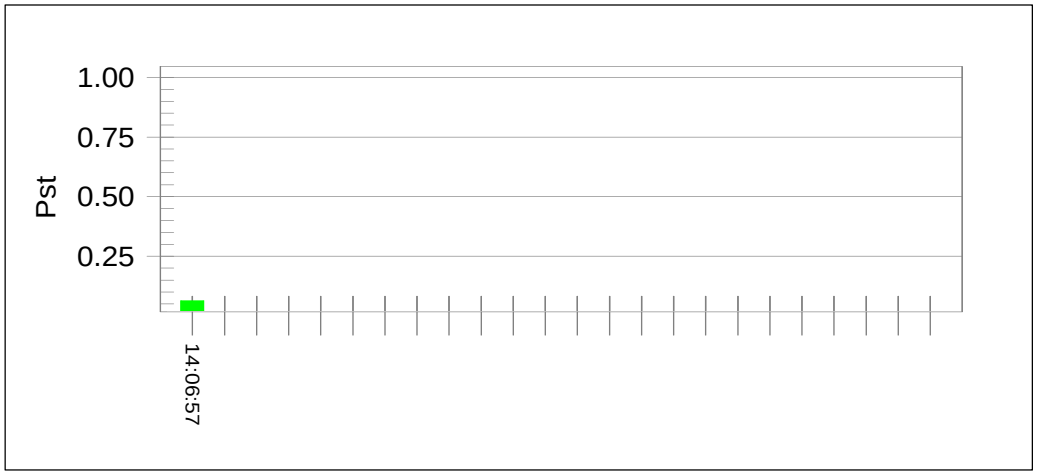
Flicker Test Summary per EN/IEC61000-3-3 (run time)

EUT: SmartLevel
Test Category: All parameters (European limits)
Test Date: 4/16/2013
Test Duration (min): 10
Customer: Clark Reliance
Test Result: Pass

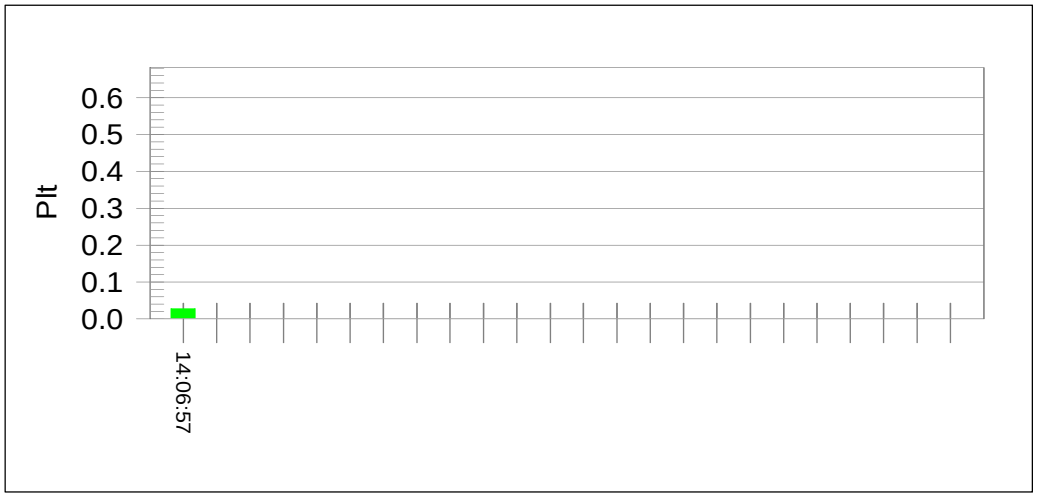
Start Time: 1:56:37 PM
Data File Name: F-000934.cts_data
Comment: F2LQ5374-A
Status: Test Completed

Tested by: JK
Test Margin: 100%
End Time: 2:06:58 PM

Pst and Limit Line - European Limits



Plt and Limit Line



Parameter values recorded during the test:

Vrms at the end of test (Volt):	230.96			
Highest dt (%):	0.00	Test limit (%):	3.30	Pass
Time(mS) > dt:	0.0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	0.00	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.064	Test limit:	1.000	Pass
Highest Plt (2 hr. period):	0.028	Test limit:	0.650	Pass

17.4 Photograph(s) of Harmonic Current and Voltage Fluctuation Test Setup

18.0 PHOTOGRAPH(S) OF MODIFICATIONS