H.B. Compliance Solutions

EMC Test Report

For the

PI Engineering Inc.

X-Keys XK-16

Tested under

EN 55022: 2007 & EN 55024: 1998 Information Technology Equipment

Radio Disturbance & Immunity Characteristics

February 24, 2012

Prepared for:

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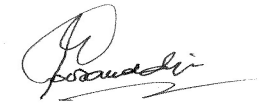

Hoosamuddin Bandukwala

Cert # ATL-0062-E

Engineering Statement: The measurements shown in this report were made in accordance with the procedure indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

Report Status Sheet

Revision #	Report Date	Reason for Revision
Ø	February 24, 2012	Initial Issue

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Compliance Criteria

The EUT is considered immune to the threat environment if the compliance criteria provided below are met. These compliance criteria are taken from EN 55024 Section 7.0

For all the immunity tests, the results are evaluated against performance criteria relating to the operating conditions and functional specifications of the EUT, and defined as follows:

– **Performance Criterion A**:

The EUT shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer when the equipment is used as intended. The performance level may be replaces by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

– **Performance Criterion B**:

After the test, the EUT shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed, after the application of the phenomena below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance.
During the test, degradation of performance is allowed. However, no change of operating state or stored data is allowed to persist after the test.
If the minimum performance level (or the permissible performance loss) is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

– **Performance Criterion C**:

Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions.
Functions, and/or information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

EXECUTIVE SUMMARY

1. Testing Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with EN 55022 & 55024. All tests were conducted using measurement procedure from CISPR 16 as appropriate.

Emission Requirements – Test Name	Test Method/Standard	Result	Comments
Conducted Emissions	EN 55022:2007	N/A	DC Powered Device
Radiated Emissions	EN 55022:2007	Pass	None
Harmonic Current Emission	EN 61000-3-2: 2001	N/A	DC Powered Device
Voltage Fluctuations & Flicker	EN 61000-3-3: 1995 (A1:2001)	N/A	DC Powered Device

Immunity Requirements – Test Name	Test Method/Standard	Result	Comments
Electrostatic Discharge (ESD)	EN 61000-4-2: 1999	Pass	None
Radiated Immunity	EN 61000-4-3	Pass	None
Electrical Fast Transient/Burst	EN 61000-4-4: 1995	N/A	DC Powered Device. Cable less than 3 meters
Surge	EN 61000-4-5: 1995 (A1: 2001)	N/A	DC Powered Device
Conducted Immunity	EN 61000-4-6: 2003 (A1: 2004, A2:2006)	N/A	DC Powered Device. Cable less than 3 meters
Magnetic Field Immunity	EN 61000-4-8: 1994	N/A	No Magnetic sensitive components. Test not applicable
Voltage Dips & Interruptions	EN 61000-4-11: 1994 (A1: 2001)	N/A	DC Powered Device

EQUIPMENT CONFIGURATION

1. Overview

H.B Compliance Solutions was contracted by PI Engineering to perform testing on the X-Keys XK-16 under the purchase order number 012312PVE.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the PI Engineering, X-Keys XK-16.

The tests were based on EN 55022 & EN 55024 standards. The tests described in this document were formal tests as described with the objective of the testing was to evaluate compliance of the Equipment Under Test (EUT) to the requirements of the aforementioned specifications. PI Engineering should retain a copy of this document and it should be kept on file for at least five years after the manufacturing of the EUT has been permanently discontinued. The results obtained relate only to the item(s) tested.

Product Name:	PI Engineering Inc.
Model(s) Tested:	XK-0981-UCK16
Supply Voltage Input:	5Vdc
Test Item:	Pre-Production
Environmental Test Conditions:	Temperature: 15-35°C Humidity: 30-60% Barometric Pressure: 860-1060 mbar
Modification to the EUT:	None
Evaluated By:	Staff at Emerson Network
Test Date(s):	02/07/12 – 02/23/12

2. Test Facility

All testing was performed at Emerson Network Power. This facility is located at 2900 S. Diablo Way, Suite 190, Tempe, AZ 85282. All equipment used in making physical determination is accurate and bears recent traceability to the National Institute of Standards and Technology.

Test facility at Emerson Network power is an A2LA accredited test site. The A2LA certificate number is 2716.01. The scope of accreditation covers the FCC Method - 47 CFR Part 15, ICES-003, CISPR 22, AS/NZS 3548 and VCCI

Radiated Emissions measurements were performed in a semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at Emerson Network Power.

3. Description of Test Sample

The PI Engineering, is a USB keyboard which has been designed to offer extra programmable keys. It runs off USB power port of a computer which is 5Vdc.

4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
# 1	X-Keys XK-16 Stick	XK-0981-UCK16	None

Table 1. Equipment Configuration

5. Support Equipment

All support equipment supplied is listed in the following Support Equipment List.

Ref ID	Name / Description	Manufacturer	Model #	Serial #
#2	Laptop Computer	Dell	D620	RF621A02

Table 2. Support Equipment

6. Ports and Cabling Information

Ref ID	Port name on the EUT	Cable Description	Qty.	Length (m)	Shielded? (Y/N)	Termination Box ID & Port ID
#4	USB	USB	1	2	N	Laptop

Table 3. Ports and Cabling Information

7. Method of Monitoring EUT Operation

LED's on the front of the device was monitored for any errors. Also one of the keys was pressed on the device to produce a constant character on the screen of a laptop which was observed throughout the testing test.

8. Mode of Operation

The EUT will be configured in its normal operation for which the USB cable is connected to a laptop for use as a USB keyboard. Keys were programmed and software was run with H-Pattern. These settings were created for testing purpose only.

During immunity testing, each function of the EUT shall be tested in the mode that is most critical from a typical use perspective, using equipment options, cable layout and accessories in a typical configuration, consistent with normal use.

9. Modifications

9.1 Modifications to EUT

Modifications were made to the EUT to meet Radiated Emissions requirements. 0.01uF by pass capacitor was placed near the U1 power pins on the Printed Circuit Board.

9.2 Modifications to Test Standard

No Modifications were made to the test standard.

10. Disposition of EUT

The test sample including all support equipment submitted to H.B Compliance Solutions for testing will be returned to PI Engineering upon completion of testing & certification

Criteria for Emissions

1. Conducted Emissions

Test Requirement(s):	EN 55022:2007	**Test Engineer(s):**	None
Test Results:	N/A	**Test Date(s):**	None

Test Procedures: The EUT was placed on a non-metallic table, 80cm above the ground plane inside a shielded enclosure. The EUT was powered through a 50Ω/50µH LISN. The conducted emissions tests were performed using the mode of operation and configuration noted within this report. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Equipment is tested with power cords that are the same as those cords normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network). All 50 Ohm measuring ports of the LISN are terminated by 50 Ohms, either by the 50 Ohm EMI receiver or a 50 Ohm resistive load.

Refer to the Emissions Tests Calculations section in the Radiated Emissions section for sample calculations. For the purposes of the conducted emissions test, the Antenna Factor (AF) is replaced by the LISN correction factor.

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.150 - 30	9.0	9.0	9.0
Measurements were made using the bandwidths and detectors specified. No video filter was used.			

Table 1.Conducted Emissions – Measurement Bandwidth

Frequency Range (MHz)	55011, Class A Limits (dBuV)		55011, Class B Limits (dBuV)	
	Quasi-Peak	Average	Quasi Peak	Average
0.15 – 0.5	79	66	66 - 56	56 - 46
0.5 – 5.0	73	60	56	46
5.0 – 30	73	60	60	50
Note 1 – The lower limit shall apply at the transition frequencies. **Note 2 – The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.50MHz**				

Table 2. Conducted Emissions Limits – Limits from EN 55022

2. Radiated Emissions

Test Requirement(s):	EN 55022/A1: 2007	**Test Engineer(s):**	Frank Farrone
Test Results:	Pass	**Test Date(s):**	02/23/12

Test Procedures:

The final radiated emissions test was performed using the parameters described above as worst case. That final test was conducted at a facility that meets the ANSI C63.4 NSA requirements. The frequency range noted in the data sheets was scanned/tested at that facility. Emissions were maximized as specified, by varying table azimuth, antenna height, and manipulating cables.

Using the mode of operation and configuration noted within this report, a final radiated emissions test was performed. The frequency range investigated (scanned), is also noted in this report. Radiated emissions measurements were made at the EUT azimuth and antenna height such that the maximum radiated emissions level will be detected. This requires the use of a turntable and an antenna positioner. The preferred method of a continuous azimuth search is utilized for frequency scans of the EUT field strength with both polarities of the measuring antenna. A calibrated, linearly polarized antenna was positioned at the specified distance from the periphery of the EUT.

> *Note: The specified distance is the horizontal separation between the closest periphery of the EUT and the center of the axis of the elements of the receiving antenna. However, if the receiving antenna is a log-periodic array, the specified distance shall be the distance between the closest periphery of the EUT and the front-to-back center of the array of elements.*

Tests were made with the antenna positioned in both the horizontal and vertical polarization planes. The measurement was varied in height above the conducting ground plane to obtain the maximum signal strength. Though specified in the report, the measurement distance shall be 3 meters. At any measurement distance, the antenna height was varied from 1 meter to 4 meters. These height scans apply for both horizontal and vertical polarization, except that for vertical polarization the minimum height of the center of the antenna shall be increased so that the lowest point of the bottom of the antenna clears the ground surface by at least 25 cm.

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
30 MHz to 1 GHz	120 kHz	120 kHz	N/A
1 GHz to 11 GHz	1MHz	N/A	1MHz
Measurements were made using the bandwidths and detectors specified. The video filter was at least as wide as the IF bandwidth of the measuring receiver.			

Table 7. Radiated Emissions – Measurement Bandwidth

Frequency Range (MHz)	55022, Class A Limits (dBuV)	55022, Class B Limits (dBuV)
	Quasi-Peak	Quasi Peak
30 –230	50	40.5
230 – 1000	57	47.5
Note 1 – The lower limit shall apply at the transition frequencies.		

Table 8. Radiated Emissions Limits below 1GHz – Limits from EN 55022

Frequency Range (GHz)	55022, Class A Limits (dBuV)		55022, Class B Limits (dBuV)	
	Average	Peak	Average	Peak
1 – 3	56	76	50	70
3 – 6	60	80	55	74
Note 1 – The lower limit shall apply at the transition frequencies.				

Table 9. Radiated Emissions Limits above 1 GHz– Limits from EN 55022

Conditional testing procedure for above 1GHz Radiated Emission Testing:

If the highest frequency of the internal sources of the EUT is less than 108MHz, the measurement shall only be made up to 1GHz

If highest frequency is between 108MHz - 500 MHz then measurement is made upto 2 GHz

If highest frequency is between 500MHz - 1GHz, then measurement is made upto 5GHz

And if highest frequency is above 1GHz then the measurement shall be made upto 5 times the highest frequency or 6GHz, whichever is less.

Emissions Tests Calculations

In the case of indoor measurements, radiated emissions measurements are made by the manipulation of correction factors using Rohde and Schwarz ES-K1 software. This is done automatically by the software during the final measurement process.

In both cases, the level of the Field Strength of the interfering signal is calculated by adding the Antenna Factor, Cable Factor and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + (CF –AG)

Where: FS = Field Strength

RA = Receiver (indicated) Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

This laboratory uses an approach of combining the CF and AG using an end-to-end measurement of the entire cabling system, including the test cable, any in-line amplifiers, attenuators, or transient protection networks, all measured in-situ.

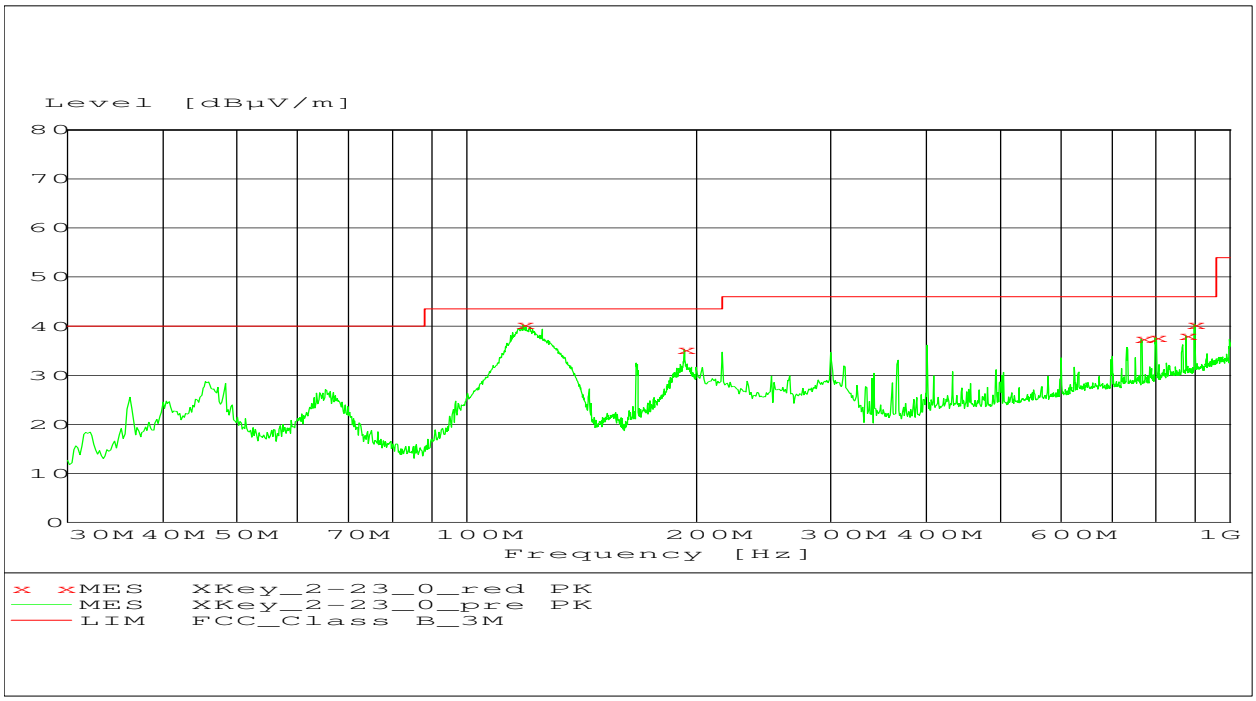
For a sample calculation, assume a receiver reading of 52.5 dBuV is obtained. With an antenna factor of 7.4 and a combined cable factor (CF + AG) of -27.9:

FS = 52.5 + 7.4 + (-27.9) = 32 dBuV/m

FS = 32 dBuV/m

If desired, this can be converted into its corresponding level in uV/m:

FS = 10^((32 dBuV/m)/20) = 39.8 uV/m

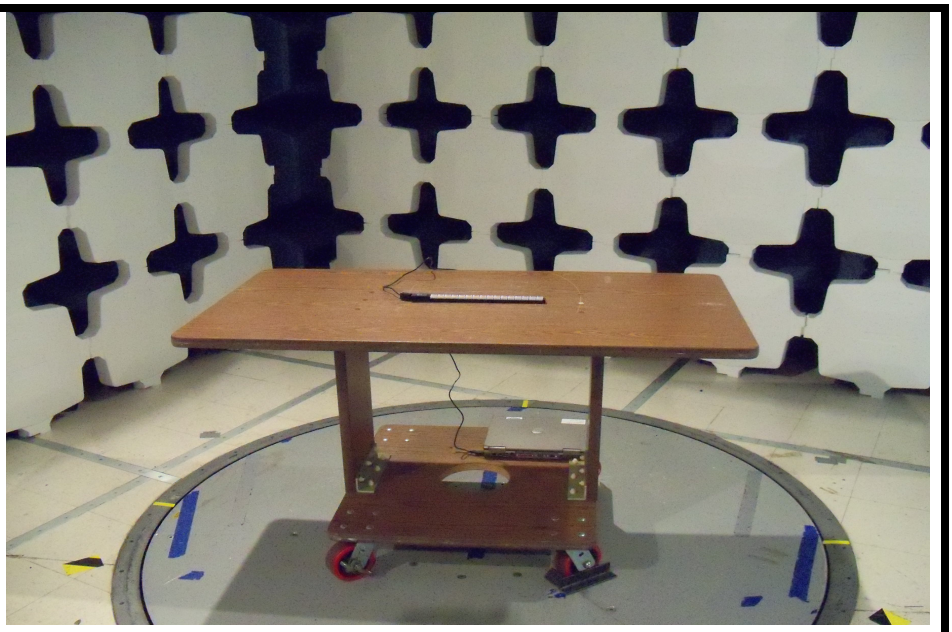


Plot 3 – Radiated Emissions – 30MHz to 1GHz Class B Limits

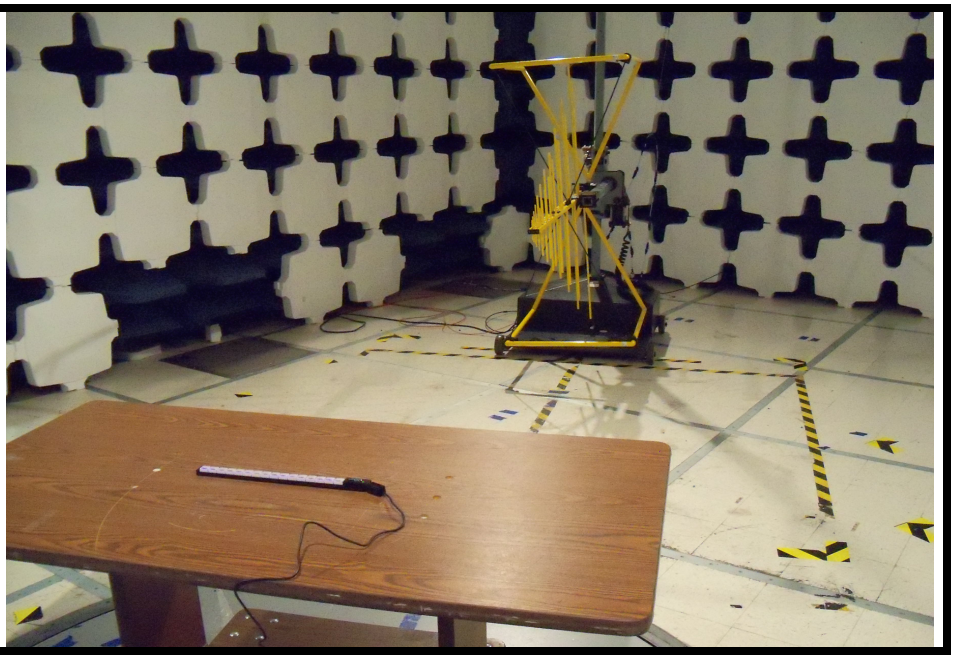
Frequency (MHz)	Measured Level	Height(cm)	Azimuth (deg)	Polarization
118.58	40.25	300	135	Horizontal
192.63	35.20	100	135	Vertical
765.33	37.44	100	135	Horizontal
800.00	37.77	100	135	Horizontal
875.55	38.01	200	315	Vertical
896.88	40.38	100	135	Horizontal

Table 10. Final PK Measurement Results for Radiated Emissions

Radiated Emission Test Setup Photos



Test Setup Photo 1– Radiated Emissions



Test Setup Photo # 2 – Radiated Emissions

3. Harmonics Current Emissions

Test Requirement(s):	EN 61000-3-2:2001	**Test Engineer(s):**	None
Test Results:	None	**Test Date(s):**	None

Test Procedures:

Switch-mode power supplies can draw high harmonic currents from the AC mains, which can cause a variety of undesirable effects in the ac power distribution system. The end result for electronic products connected to the AC mains can be improper operation, over-stressed ac input components and product failure. The power distribution system must bear the burden of excessive neutral currents that over-stress neutral wiring and inefficient power transmission to the loads connected to the system.

This test measures the harmonic currents injected into the AC mains by the EUT. It is applicable to electrical and electronic equipment having an input current up to and including 16A per phase, and intended to be connected to public low-voltage distribution systems of between 220 V and 250 V at 50 Hz line to neutral.

The test is conducted using frequency domain instrumentation as described in EN 61000-3-2 Annex B. The amplitude of each specific harmonic is measured.

While the measurements are being made, the test voltage (U) at the terminals of the equipment under test, when operated according to annex C, shall meet the following requirements.

The test voltage (U) shall be the rated voltage of the equipment. In the case of a voltage range, the test voltage shall be 230 V for single-phase supplies. The test voltage shall be maintained within $\pm$2.0% and the frequency within $\pm$0.5% of the nominal value.

The harmonic ratios of the test voltage (U) shall not exceed the following values with the EUT connected as in normal operation:

0,9% for harmonic of order 3;

0,4% for harmonic of order 5;

0,3% for harmonic of order 7;

0,2% for harmonic of order 9;

0,2% for even harmonics of order from 2 to 10;

0,1% for harmonics of order 11 to 40;

The peak value of the test voltage shall be with 1.40 and 1.42 times its r.m.s. value and shall be reached within 87degrees to 93degrees after the zero crossing. This requirement does not apply when Class A or B equipment is tested.

Equipment Classification

Class A: *Balanced three-phase equipment and all other equipment, except that stated in one of the following classes.*

Class B: *Portable tools and arc welding equipment which is not professional equipment.*

Class C: *Lighting equipment, including dimming devices.*

Class D: *Equipment having specified power according to EN 61000-3-2 of P≤600W, of the following equipment types:*

Personal Computers, Personal Computer Monitors and Television Receivers

Power Input Current Harmonics Test Data

Test Parameters							
Equipment Class		Voltage THD (%)		Volt.THD Out of Spec.		RMS Voltage (V)	
Max. Power (W)		Mean Power (W)		Power Factor		Frequency (Hz)	
Current THD (%)		Peak Current (A)		RMS Current (A)		Fund.Current (A)	
Comments							
None							
EUT Operating Modes							
Deviations From Test Standard							
None							
Results							
N/A							

4. Voltage Fluctuations and Flicker

Test Requirement(s):	EN 61000-3-3: 1995 (A1:2001)	**Test Engineer(s):**	None
Test Results:	None	**Test Date(s):**	None

Test Procedures:

The power quality of the AC mains can deteriorate due to voltage fluctuations caused by devices such as electronic ballast's and light dimmer switches. The phase-controlled ac input of these devices may cause large rms current changes on the AC mains, which result in substantial rms voltage deviations. In addition, the amplitude and frequency of these deviations can cause incandescent lamps to flicker, which can be irritating to humans.

This test is conducted using frequency domain instrumentation as described in EN 61000-3-3 Section 4. All types of voltage fluctuations are assessed at the supply terminals of the EUT by direct measurement using a flickermeter, which complies with the specification given in IEC 868.

The test supply voltage (open-circuit voltage) shall be the rated voltage of the equipment. If a voltage range is stipulated for the equipment, the test voltage shall be 230 V single-phase. These test voltage shall be maintained within $\pm$ 2% of the nominal value. The frequency shall be 50 Hz $\pm$0,5%.

The percentage total harmonic distortion of the supply voltage shall be less than 3%.

Fluctuations of the test supply voltage during a test may be neglected if the Pst value is less that 0,4. This condition shall be verified before and after each test.

Voltage Fluctuations and Flicker Test Data

Test Parameters							
PST Integration Time		PST Integration Periods		Test Duration		Frequency (Hz)	
Line Voltage (V)		Pst Errors		Plt Errors		Dt Errors	
Comments							
None							
EUT Operating Modes							
Deviations From Test Standard							
None							
Results							
N/A							

Criteria for Immunity

5. Electrostatic Discharge (ESD)

Test Requirement(s):	EN 61000-4-2: 1999	**Test Engineer(s):**	Frank Farrone
Test Results:	Pass	**Test Date(s):**	02/08/2012

Test Procedures:

An ESD Immunity test was performed using the mode of operation and configuration noted within this report. The EUT was tested using air and contact discharges. The specified number of air discharges was applied to each of the non-conductive surfaces of the EUT as listed in the test data below. The specified number of contact discharges was applied to each of the conductive surfaces, seams, and control surfaces of the EUT as listed in the test data. If a response is detected after discharge; the type of response, discharge level and location are noted. Testing was conducted with the EUT fully cabled. Discharges were made to the connector shells, not to the individual conductors.

The Standard relates to immunity requirements and test methods for electrical and electronic equipment subjected to static electricity discharges from operators directly and to adjacent objects. It also defines ranges of test levels that relate to different environmental and installation conditions and establishes test procedures. The object of the Standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment subjected to electrostatic discharges. In addition, it includes electrostatic discharges that may occur from personnel to objects near vital equipment. The standard also relates to equipment, systems, sub-systems, and peripherals that may be involved in static electricity discharges due to environmental and installation conditions, such as low relative humidity, use of low-conductivity (artificial-fiber) carpets, vinyl garments, etc., that may exist in all locations classified in standards relevant to electrical and electronic equipment

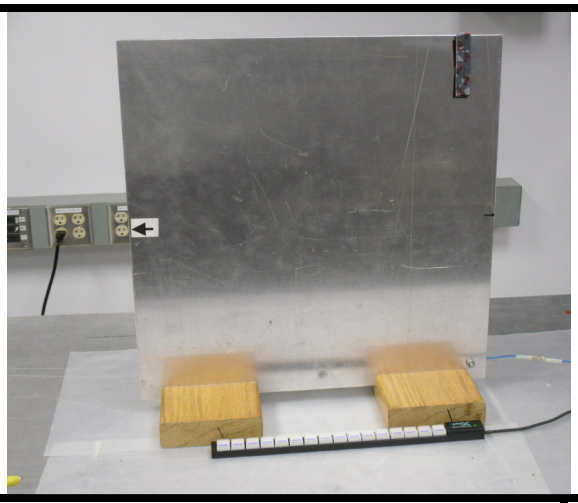
Test Parameters			
Energy Storage Capacitor:	150pf	Discharge Resistance:	330 ohms
Polarity of Output Voltage:	Positive and Negative	Time Between Successive Discharges:	>= 1 second
Comments			
None			
EUT Operating Modes			
Normal			
Deviations From Test Standard			
None			
EUT Functions Monitored			
LED's in front panel of the units were monitored for errors and also one of the key was pressed to display character on laptop screen fo errors			
Results			
Pass			
Meets Performance Criteria Criteria - Device met the Compliance Criteria for the standard which is also defined at the beginning of this report.			

ESD Test Data

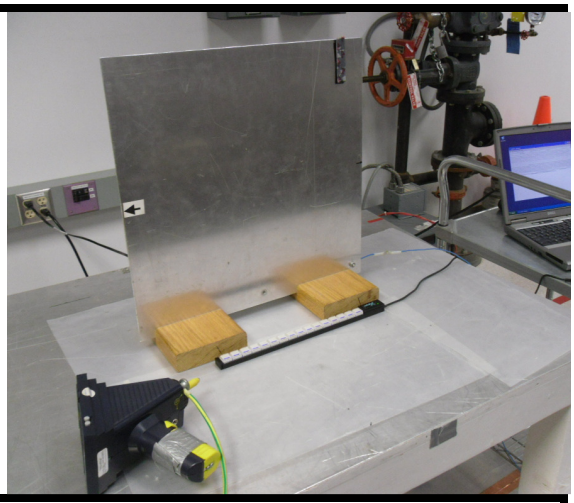
Test Level	Amplitude (kV)	Polarity (+/-)	Discharge Type	Application	Tested (y/n)	EUT Susceptibility
1	2	+	Contact	Direct	Yes	None
1	2	-	Contact	Direct	Yes	None
2	4	+	Contact	Direct	Yes	None
2	4	-	Contact	Direct	Yes	None
1	2	+	Air	Direct	Yes	None
1	2	-	Air	Direct	Yes	None
2	4	+	Air	Direct	Yes	None
2	4	-	Air	Direct	Yes	None
3	8	+	Air	Direct	Yes	None
3	8	-	Air	Direct	Yes	None
1	2	+	Contact	Indirect	Yes	None
1	2	-	Contact	Indirect	Yes	None
2	4	+	Contact	Indirect	Yes	None
2	4	-	Contact	Indirect	Yes	None

Notes: ESD was applied to all exposed surfaces of the EUT except where the user documentation specifically indicated a requirement for appropriate protective measures

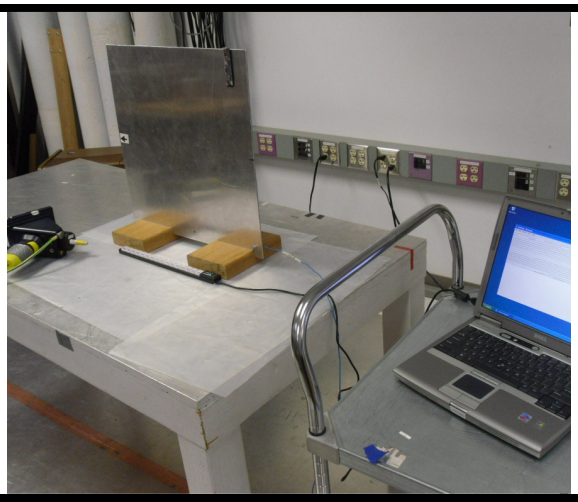
ESD Test Setup Photo



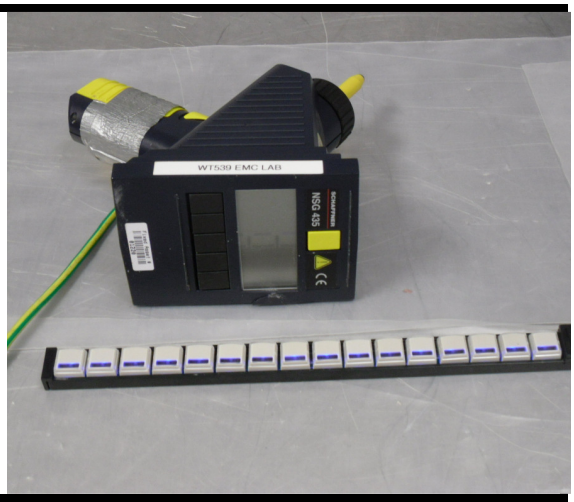
Test Setup Photo # 3 - ESD



Test Setup Photo # 4 - ESD



Test Setup Photo # 5 - ESD



Test Setup Photo # 6 - ESD

Radiated Immunity

Test Requirement(s):	EN 61000-4-3: 2001	**Test Engineer(s):**	Frank Farrone
Test Results:	Pass	**Test Date(s):**	02/08/2012

Test Procedures:

This test determines the radiated immunity characteristics of the EUT between 80 MHz and 1.0 GHz, per the spec limits given in EN 55024 Table 1. The test was run per the procedures given in EN 61000-4-3.

The test is performed in the 3-meter absorber-lined chamber containing hybrid conductive foam and sintered ferrite tile panel absorbers on all four walls and the ceiling. Ferrite tile absorbers are placed in a rectangular pattern on the floor between the EUT and the source antenna to reduce ground plane reflections.

The uniform area is calibrated in the empty enclosure with the ferrite tiles on the floor. The positioning of the ferrite tiles and the antenna mast are plainly marked on the chamber floor. The full 16 point calibration is carried out at least once per year or any time a major change is made in the room or the test equipment. The distance from the tip of the transmitting antenna to the plane of the uniform field is 3.1 meters. The height of the transmitting antenna is 200 cm.

The purpose of the field calibration is to ensure the uniformity of the filed over the test sample is sufficient to ensure the validity of the test results. Modulation is not present during the calibration to provide proper indication of electric field by the field sensor. The immunity test was performed using the concept of a “uniform area” which is an imaginary vertical plane measuring 1.5 meters by 1.5 meters located .8 meters above the ground plane which has an electric field uniformity in the range of -0 to +6 dB of the test level. In the test set up, the face of the EUT coincides with the vertical plane of uniform electric field. Because it is impossible to establish a uniform field close the ground plane, floor standing EUT’s may be exposed to un-calibrated fields below the 80 cm height.

The test is performed in both horizontal and vertical antenna polarizations. All four sides of the EUT are illuminated by the source antenna for a total of eight immunity scans while monitoring the EUT for indications of susceptibility.

Radiated Immunity Test Data

Test Parameters							
Start Frequency (MHz):	80	Stop Frequency (MHz):	1 GHz	Test Level (V/m):	>3	Spec. Level (V/m):	3
Start Frequency (MHz):	N/A	Stop Frequency (MHz):	N/A	Test Level (V/m):	N/A	Spec. Level (V/m):	N/A
Start Frequency (MHz):	N/A	Stop Frequency (MHz):	N/A	Test Level (V/m):	N/A	Spec. Level (V/m):	N/A
Start Frequency (MHz):	N/A	Stop Frequency (MHz):	N/A	Test Level (V/m):	N/A	Spec. Level (V/m):	N/A
Modulation Frequency:	1 KHz	Modulation Type:	AM	Step Size (%):	1	Dwell Time (Sec.):	10
Modulation Depth (%):	80	Polarities Tested:	2	Sides Tested:	4		

Comments:	Field Intensity (V/m)		
None	Height (m)	Left	Right
EUT Operating Modes:	@ 0.4m Min	2.36	2.40
Normal	@ 0.4m Max	7.51	8.95
Deviations From Test Standard:			
None			
EUT Functions Monitored:	For EUT's > 1.5m x 1.5m		

LED's in front panel of the units were monitored for errors and also one of the key was pressed to display character on laptop screen for errors

Results

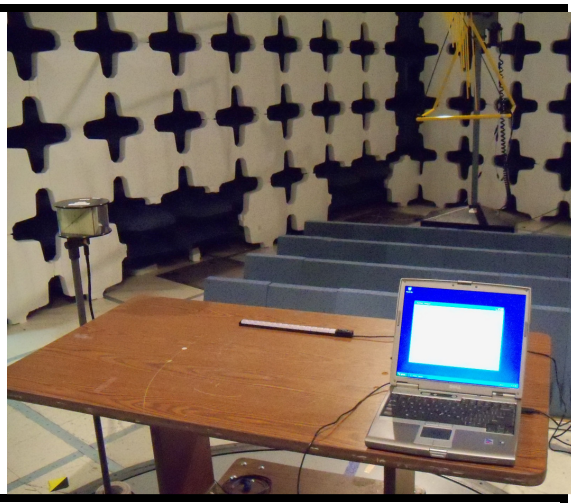
Test Criteria -
No degradation of performance was noted.

Frequencies of interest (MHz) ☒ N/A	

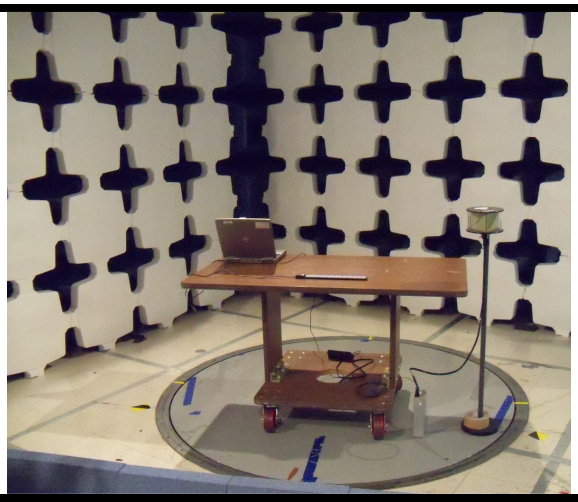
Scan Number	Fixed Frequency (MHz)	Antenna Polarity (V/H)	EUT Azimuth	Scan Level (Vrms/m)	Response/Threshold (Vrms/m)	Spec. Limit (Vrms/m)
1	80 - 1000	V	0	> 3.0	None	3.0
2	80 - 1000	V	90	> 3.0	None	3.0
3	80 - 1000	V	180	> 3.0	None	3.0
4	80 - 1000	V	270	> 3.0	None	3.0
5	80 - 1000	H	0	> 3.0	None	3.0
6	80 - 1000	H	90	> 3.0	None	3.0
7	80 - 1000	H	180	> 3.0	None	3.0
8	80 - 1000	H	270	> 3.0	None	3.0

Radiated Immunity Test Setup Photo

Test Setup Photo # 7 - ESD



Test Setup Photo # 8 - ESD



Test Setup Photo # 9 - ESD

Test Setup Photo # 10 - ESD

6. Electrical Fast Transient (EFT)/Burst

Test Requirement(s):	EN 61000-4-4: 1995 (A1,A2:2001)	**Test Engineer(s):**	None
Test Results:	None	**Test Date(s):**	None

Test Procedures:

An EFT/Burst Immunity test was performed using the mode of operation and configuration noted within this report. The test is intended to demonstrate the immunity of electrical and electronic equipment when subjected to types of transient disturbances such as those originating from switching transients (interruption of inductive loads, relay contact bounce, etc.). The repetitive fast transient test is a test with bursts consisting of a number of fast transients, coupled into power supply, control and signal ports of electrical and electronic equipment. Significant for the test is short rise time, the repetition rate and the low energy of the transients.

Electrical Fast Transient Test Data

Test Parameters							
Burst rep rate:		Burst Freq (<2kV):		Pulse Duration:		Pulse Amplitude:	
Burst Duration:		Burst Freq (>2kV):		Pulse Rise Time:			
Comments							
EUT Operating Modes							
Deviations From Test Standard							
None							
EUT Functions Monitored							
Results							
N/A							
Meets Performance Criteria - Criteria -							

Line Under Test	Coupling Mode	Polarity	Voltage	EUT Susceptibility
AC Power Line	L-E	+		
	L-E	-		
	N-E	+		
	N-E	-		
	L+N-E	+		
	L+N-E	-		
	PE-E	+		
	PE-E	-		
	L+PE-E	+		
	L+PE-E	-		
	N+PE-E	+		
	N+PE-E	-		
	L+N+PE-E	+		
	L+N+PE-E	-		
Signal Lines	Coupling Mode		Voltage	EUT Susceptibility
	Clamp	+		
	Clamp	-		
	Clamp	+		

7. Surge

Test Requirement(s):	EN 61000-4-5: 1995 (A1:2001)	**Test Engineer(s):**	None
Test Results:	None	**Test Date(s):**	None

Test Procedures:

A Surge Immunity test was performed using the mode of operation and configuration noted within this report. The task of the defined laboratory test is to find the reaction of the EUT under specified operational conditions caused by surge voltages from switching and lightning effects at certain threat levels.

System switching transients can be separated into transients associated with:

a) Major power system switching disturbances, such as capacitor bank switching;
b) Minor switching activity near the instrumentation or load changes in the power distribution system;
c) Resonating circuits associated with switching devices, such as thyristors;
d) Various system faults, such as short circuits and arcing faults to the earthing system of the installation.

Surge Test Data

Test Parameters			
Open Circuit Voltage, Risetime:		Short-Circuit Current Risetime:	
		Surge Repetition Rate:	
Open Circuit Voltage, Time to ½ Value:		Short-Circuit Current time to ½ Value:	
Comments			
None			
EUT Operating Modes			
Normal			
Deviations From Test Standard			
None			
EUT Functions Monitored			
Results			
N/A			
Meets Test Criteria -			

Test Amplitude (V)	Test Level	Polarity (+/-)	Coupling Type	Power or Signal Line	EUT Susceptibility
		+	Line to Earth	AC	
		-	Line to Earth	AC	
		+	Line to Earth	AC	
		-	Line to Earth	AC	
		+	Line to Earth	AC	
		-	Line to Earth	AC	
		+	Line to Line	AC	
		-	Line to Line	AC	
		+	Line to Line	AC	
		-	Line to Line	AC	

8. Conducted Immunity

Test Requirement(s):	EN 61000-4-6 (A1:2004, A2:2006)	**Test Engineer(s):**	None
Test Results:	None	**Test Date(s):**	None

Test Procedures:

A Conducted RF Immunity test was performed using the mode of operation and configuration noted within this report. The source of disturbance covered by the standard is basically an electromagnetic field, coming from intended RF transmitters, that may act on the whole length of cables connected to installed equipment. The dimensions of the disturbed equipment, mostly a sub-part of a larger system, are assumed to be small compared with the wavelengths involved. The ingoing and outgoing leads: e.g. mains, communication lines, and interface cables, behave as passive receiving antenna networks because they can be several wavelengths long. The use of coupling and decoupling devices to apply the disturbing signal to one cable at a time, while keeping all other cables non-excited, can only approximate the real situation where disturbing sources act on all cables simultaneously, with a range of different amplitudes and phases. Coupling and decoupling devices are defined by their characteristics. Any coupling and decoupling device fulfilling these characteristics can be used.

Conducted Immunity Test Data

Test Parameters							
Test Level:		Spec. Level:		Modulation Freq.:			
Start Frequency:		Stop Frequency:		Modulation Type:			
Step Size:		Dwell Time:		Modulation Depth:			
Comments							
None							
EUT Operating Modes							
Deviations From Test Standard							
None							
EUT Functions Monitored							
Results							
N/A							
Meets Test Criteria	No degradation of performance detected during or after the applied test						

Port Under Test	Coupling Mode (CDN/Probe)	Frequency Range Tested (MHz)	Scan Level (Vrms)	Response/Threshold (Vrms/m)	Specification Limit (Vrms)
	CDN				3
	BCI Probe				3
	BCI Probe				3
	BCI Probe				3

Notes: None

9. Magnetic Immunity

Test Requirement(s):	EN 61000-4-8: 1993 (A1:2001)	**Test Engineer(s):**	N/A
Test Results:	None	**Test Date(s):**	N/A

Test Procedures:

A Magnetic Immunity test was performed using the mode of operation and configuration noted within this report. The test was run per the procedures given in EN 61000-4-8.

The EUT and any associated equipment that is part of the test set up, and I/O cables is placed on top of 10-cm spacers above the ground plane. The cables (where applicable) must be positioned such that at least 1 meter of their length is exposed to the magnetic field. The cables may have to be serpentine on the spacers to accomplish this. Remotely located devices (such as ethernet host PC's) must be located at a minimum distance of 1 meter (39.4 inches) away from the induction coil. The EUT will be subjected by using an induction coil of standard dimension 1m x 1m as specified in the standard.

There are two separate loops used to perform the magnetic field immunity test. The first is a vertical loop that uses the Ground Reference Plane (GRP) as the bottom leg of the loop. This loop is used to apply the "X" (passing through the sides of the EUT) and "Z" (passing through the front and back of the EUT) components of the magnetic field to the EUT. The second is a horizontal loop that is supported over the GRP around the EUT. This is used to apply the "Y" (passing through the top and bottom of the EUT) component of the magnetic field to the EUT. In each case the loops must be located at least 1 meter (39.4 inches) from any magnetic material except the GRP and the EUT. It may be necessary to remove items from the test area in order to accommodate this requirement.

The induction coil will be rotated by 90^{o} in order to expose the EUT to the test field with different orientations.

Magnetic Field Immunity Test Data

Test Parameters							
Test Level:		Spec. Level:		Power Freq.:		Sides Tested:	
Comments							
EUT Operating Modes							
Deviations From Test Standard							
EUT Functions Monitored							
Results							
No magnetic sensitive components – Therefore this test is not applicable							
Criteria -							

Magnetic Field (A/m)	Magnetic Field (µT)	Axis (X, Y, Z)	EUT Susceptibility (Pass/Fail)

10. Voltage Dips & Interruptions

Test Requirement(s):	EN 61000-4-11: 1994 (A1:2001)	**Test Engineer(s):**	None
Test Results:	None	**Test Date(s):**	None

Test Procedures:

A Voltage Dip and Voltage Interruption Immunity test was performed using the mode of operation and configuration noted within this report. The standard applies to electrical and electronic equipment having a rated input current not exceeding 16 A per phase. It does not apply to electrical and electronic equipment for connection to D.C. networks or 400 Hz A.C. networks. Electrical and electronic equipment may be affected by voltage dips, short interruptions or voltage variations of power supply. Voltage dips and short interruptions are caused by faults in the network, in installations or by a sudden large change of load. In certain cases, two or more consecutive dips or interruptions may occur. The continuously varying loads connected to the network cause voltage variations.

In cases where both 230 VAC and 120 VAC tests are performed, the 5 second voltage drop out will only be performed on the 230 VAC test run.

Voltage test level (%UT)	Voltage dip (%UT)	Duration (Periods)
<5	>95	0.5
70	30	25
NOTE: UT is the a.c. Mains Voltage prior to application of the test level		

Table 11. Voltage Dips – Limit Table

Voltage test level (%UT)	Voltage dip (%UT)	Duration (s)
<5	>95	5
NOTE: UT is the a.c. Mains Voltage prior to application of the test level		

Table 12. Voltage Interruption – Limit Table

Voltage Dips and Interruptions Test Data

Test Parameters
Comments
None
EUT Operating Modes
Deviations From Test Standard
None
EUT Functions Monitored
Results
N/A
Meets Performance Criteria

Nominal Voltage = 230V	Susceptibility Criteria	EUT Susceptibility (Pass/Fail)	Comments
> -95% @ 10 ms (0.5 cy)	B		
-30% @ 0.5 s (25 cy)	C		
< -95% @ 5 s (250 cy)	C		
Nominal Voltage = 120V	**Susceptibility Criteria**	**EUT Susceptibility (Pass/Fail)**	**Comments**
> -95% @ 10 ms (.5 cy)	B		
-30% @ 0.5 s (25 cy)	C		
> -95% @ 5 s (250 cy)	C		

Test Equipment

Equipment	Manufacturer	Model	Serial #	Last Cal Date	Cal Due Date
EMI Receiver	Rohde & Schwarz	ESCS-30	828985/007	09-03-11	09-03-12
Bilog Antena	Chase	CBL6140	1040	12-06-11	12-06-12
EMI Receiver	Rohde & Schwarz	ESMI	840607/005	12-17-11	12-17-12
ESD Simulator	Schaffner	NSG 435	1727	30-Apr-11	30-Apr-12
Signal Generator	Rohde& Schwarz	SMY02	DE23712	12-Sep-11	12-Sep-12
RF Millivoltmeter	Boonton	9200A	547-07BA	23-Jul-11	23-Jul-12
10dB Attenuator	Mini Circuits	Nat-10	T48020	23-Jul-11	23-Jul-12
Directional Coupler	Werlatone	C3908-13	19283	15-Jun-11	15-Jun-12
Data Processing Unit	Emco	7110	9202-1169	NCR	N/A
Field Probe	Emco	7122	9203-1100	12-Jun-11	12-Jun-12
Bilog Antenna	Schaffner	CBL6140A	1183	09-Nov-11	09-Nov-12
Amplifier	Amplifier Research	100W1000 M7	11869	NCR	N/A
Power Analysis System	Xitron	2503AH	25035901015	NCR	N/A

Table 1 – Test Equipment List

END OF TEST REPORT