NTS Labs, LLC Test Report for EMI Immunity Testing of the ExpressVote®XL

Prepared For
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Performed By
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Revision History

Rev.	Description	Issue Date
0	Initial Release	09/07/2023
1	• Corrected unit name and address on cover page • Revised test specification VVSG throughout • Added EUT part and serial numbers to Tables 3.0-1 and 5.0-1 • Revised Table 4.2-1	10/10/2023

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1.0 Introduction

This document presents the test procedures used and the results obtained during the performance of an Electromagnetic Interference (EMI) test program. The test program was conducted to assess the ability of the specified Equipment Under Test (EUT) to successfully satisfy the requirements listed in Section 2.0.

2.0 References

The following references listed below form a part of this document to the extent specified herein.

- Test Specification: VVSG 2.0
  EN 61000-4-2
  EN 61000-4-3
  EN 61000-4-4
  EN 61000-4-5
  EN 61000-4-6
  EN 61000-4-11
- Pro V&V, Inc Purchase Order(s) 2023-010, dated 04/24/2023
- NTS Labs, LLC Quote(s) OP0638254, dated 04/19/2023
- ISO/IEC 17025:2017(E) *General Requirements for the Competence of Testing and Calibration Laboratories*, dated 11/1/2017

3.0 Product Selection and Description

Pro V&V, Inc selected and provided the following test sample(s) to be used as the Equipment Under Test:

Table 3.0-1: Product Identification - Equipment Under Test (EUT)

Item	Qty.	Name/Description	Part Number	Serial Number
1	1	ExpressVote®XL	ExpressVoteXL	XL0118120458
2	1	ExpressVote®XL	ExpressVoteXL	XL0122080503
3	1	Universal Voting Control	UVC	UVC05170051
4	1	Universal Voting Control	UVC	UVC09211413
5	1	Universal Voting Control	UVC	UVC09211419

3.1 Security Classification

Non-classified

4.0 General Test Requirements

4.1 Test Equipment

The instrumentation used in the performance of these tests is periodically calibrated and standardized within manufacturer's rated accuracies and are traceable to the National Institute of Standards and Technology. The calibration procedures and practices are in accordance with ISO 17025:2017. Certification of calibration is on file subject to inspection by authorized personnel.

4.2 Measurement Uncertainties

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below were calculated using the approach described in CISPR 16-4-2:2003 using a coverage factor of k=2, which gives a level of confidence of approximately 95%. The levels were found to be below levels of CISPR and therefore no adjustment of the data for measurement uncertainty is required.

Table 4.2-1: Measurement Uncertainties

Measurement Type	Measurement Units	Frequency Range	Expanded Uncertainty
Radiated Immunity	V/m	80MHz - 10GHz	-26.3% to 29.97%
ESD	KV	NA	+/- 8.6%
Fast Transients	Voltage	NA	+/- 5.98%
	Time	NA	+/- 8.6%
Surge	Voltage	NA	+/- 4.9%
Conducted Immunity (CDN)	Voltage	NA	-12.6% to 13.3%
Conducted Immunity (BCI)	Voltage	NA	-13.5% to 15.3%
Voltage Dips / Interrupts	Voltage	NA	+/- 2.3%
	Time	NA	+/- 0.08 ms

5.0 Test Descriptions and Results

Table 5.0-1: Summary of Test Information & Results

Section	Test	Specification	Test Facility	Test Date	Part #	Serial #	Test Result
5.1	Electrostatic Discharge	VVSG 2.0 EN 61000-4-2	Longmont	08/08/2023	ExpressVoteXL	XL0122080503	Passed
					UVC	UVC05170051	
5.2	Radiated RF Immunity	VVSG 2.0 EN 61000-4-3	Longmont	08/10/2023 - 08/11/2023	ExpressVoteXL	XL0122080503	A test deviation occurred, see NOD 1 for details. The EUT Passed
					UVC	UVC09211413	
5.3	Electrical Fast Transient/Burst	VVSG 2.0 EN 61000-4-4	Longmont	08/09/2023	ExpressVoteXL	XL0122080503	Passed
					UVC	UVC05170051	
5.4	Surge Immunity	VVSG 2.0 EN 61000-4-5	Longmont	08/09/2023	ExpressVoteXL	XL0122080503	Passed
					UVC	UVC05170051	
5.5	Conducted RF Immunity	VVSG 2.0 EN 61000-4-6	Longmont	08/11/2023	ExpressVoteXL	XL0118120458	Passed
					UVC	UVC09211419	
5.6	Voltage Dips and Interruptions	VVSG 2.0 EN 61000-4-11	Longmont	08/09/2023 - 08/11/2023	ExpressVoteXL	XL0118120458	Passed
					UVC	UVC09211419	

The decision rule for Test Results was based on the Test Specification used for testing.

5.1 Electrostatic Discharge (ESD)

5.1.1 Test Procedure

VVSG 2.0

EN 61000-4-2

5.1.2 Test Result

Passed

5.1.3 Test Datasheets

National Technical Systems

Electrostatic Discharge per IEC / EN 61000-4-2

Standard Referenced: VVSG 2.0 Date: 8/8/2023

Temperature: 21°C Humidity: 55% Pressure: 838 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Shoe-shine Mode

Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
8/8/23	0800	Setup for 4-2 testing	TW	Complete
		Performed 4-2 pre-test verification prior to testing	TW	Complete
		Bleed-off cable: 936kohms and 941kohms	TW	---
	0815	Begin Electrostatic Discharge. +/- 8kV Contact, +/-2, 4, 8, 15kV Air. 120 VAC / 60 Hz (4.1.2.8)	TW	---
	1300	Completed 4-2 testing	TW	Pass

National Technical Systems

Electrostatic Discharge per IEC / EN 61000-4-2

Standard Referenced: VVSG 2.0 Date: 8/8/2023

Temperature: 21°C Humidity: 55% Pressure: 838 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Shoe-shine Mode

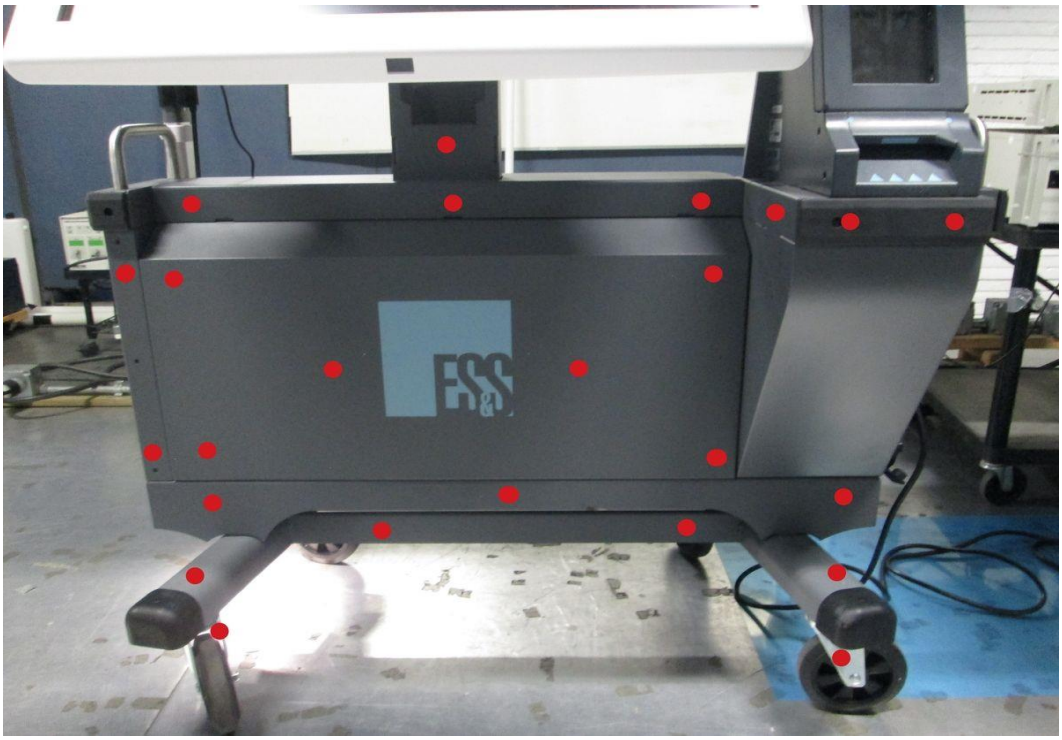
Test Engineer: T. Wittig

Test Location	Voltage Level	Polarity		Number of Pulses	Pulses Per Second	Comments	Criteria Met	Pass/ Fail
	(kV)	+	-					
Indirect Discharge Points								
VCP	8	X	X	10	1	Front Side	A	Pass
VCP	8	X	X	10	1	Left Side	A	Pass
VCP	8	X	X	10	1	Right Side	A	Pass
VCP	8	X	X	10	1	Back Side	A	Pass
Contact Discharge Points - **RED** Dots.								
Photo 1.	8	X	X	10	1		A	Pass
Photo 2.	8	X	X	10	1		A	Pass
Photo 3.	8	X	X	10	1		A	Pass
Photo 4.	8	X	X	10	1		A	Pass
Photo 5.	8	X	X	10	1		A	Pass
Photo 6	8	X	X	10	1		A	Pass
Photo 7	8	X	X	10	1	ND	-	-
Photo 8	8	X	X	10	1		A	Pass
Photo 9	8	X	X	10	1		A	Pass
Photo 10	8	X	X	10	1	ND	-	-
Air Discharge Points - **BLUE** Dots								
Photo 1.		X	X	10	1		A	Pass
Photo 2.		X	X	10	1	ND	-	-
Photo 3.		X	X	10	1	ND	-	-
Photo 4.		X	X	10	1	ND	-	-
Photo 5.		X	X	10	1	ND	-	-
Photo 6		X	X	10	1	ND	-	-
Photo 7		X	X	10	1		A	Pass
Photo 8		X	X	10	1		A	Pass
Photo 9		X	X	10	1	ND	-	-
Photo 10		X	X	10	1		A	Pass
ND: No Discharge points found								

5.1.4 Test Photographs

ESD Test Setup

ESD Test Setup Photo 1

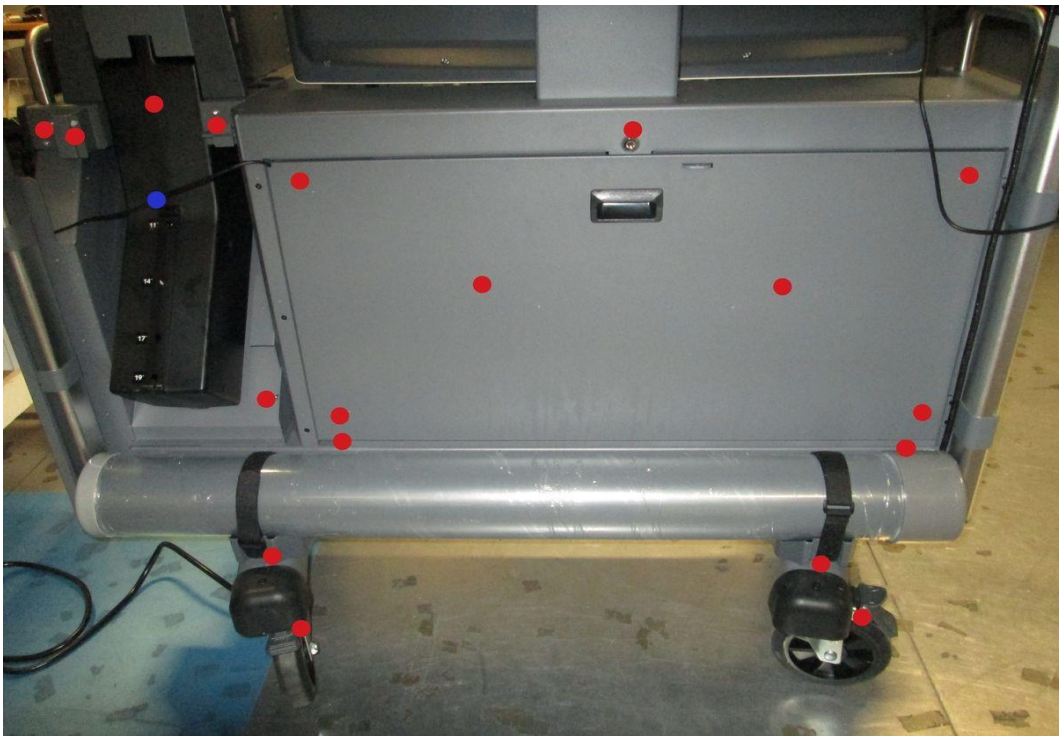


ESD Test Setup Photo 2

ESD Test Setup Photo 3

ESD Test Setup Photo 4

ESD Test Setup Photo 5

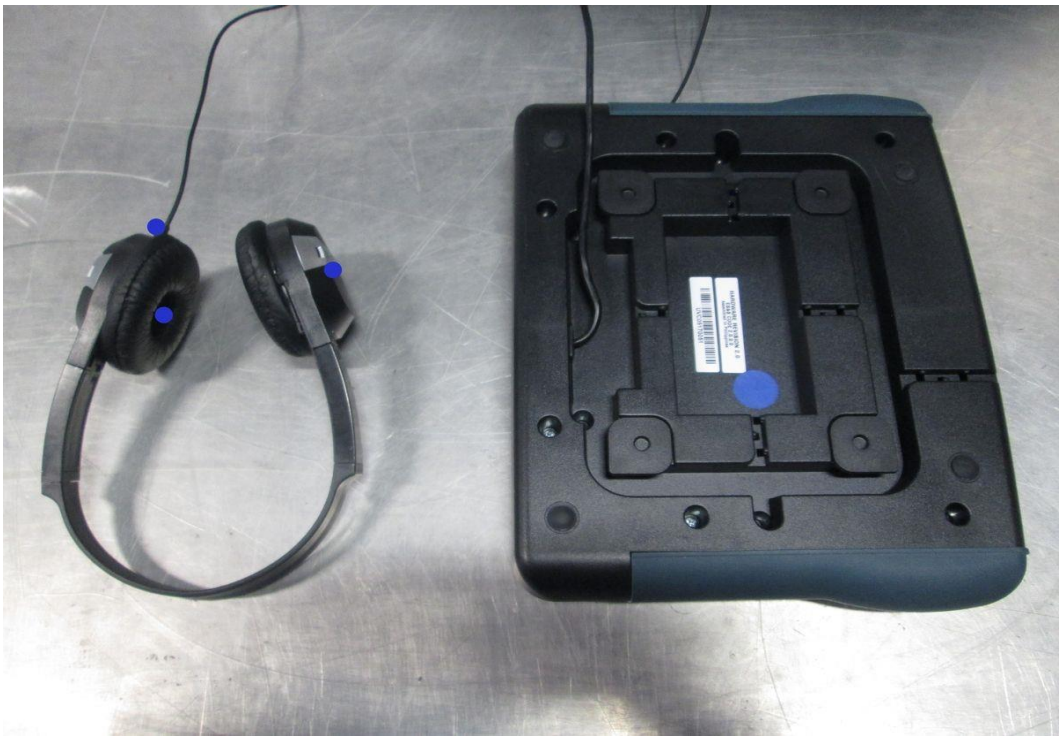


ESD Test Setup Photo 6

ESD Test Setup Photo 7

ESD Test Setup Photo 8

ESD Test Setup Photo 9



ESD Test Setup Photo 10

ESD Test Setup Photo 11

5.1.5 Test Equipment List

Table 5.1-1: Electrostatic Discharge Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059918	Ground Plane (Fixed)	NTS Labs, LLC	GP2	NCR	NCR
WC059665	Gun (ESD Simulator)	EMC-Partner	ESD3000	07/21/2023	07/31/2024
WC059692	Meter (Digital Multimeter)	Fluke	83-3	09/12/2022	09/12/2023
WC078488	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	02/15/2023	02/15/2024

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.2 Radiated RF Immunity

5.2.1 Test Procedure

VVSG 2.0

EN 61000-4-3

5.2.2 Test Result

A test deviation occurred, see NOD 1 for details. The EUT Passed.

5.2.3 Test Datasheets

National Technical Systems

Radiated RF Immunity per 61000-4-3

Standard Referenced: VVSG 2.0 Date: 8/10/2023

Temperature: 25°C Humidity: 51% Pressure: 836 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Shoe-shine Mode

Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
8/10/2023	1000	Performed 4-3 pre-test verification prior to start of test	TW	Complete
	1030	Setup EUT in GP0 chamber	TW	---
		Begin Radiated RF Immunity 10V/m, 80 - 1000 MHz, 1% Step, 80% AM, 1kHz sine, 3s dwell 4.1.2.10)	TW	---
		Completed Front, Right and Back sides, V-H poles	TW	---
	1600	Done for the day	TW	---
8/11/2023	0900	Resumed 10V/m, 80 - 1000 MHz on the right side	TW	---
		From 518 to 585MHz, EUT would lock-up and rebooting was required, repeated failure several times	TW	---
		NOD was issued and email from client to procced	TW	---
		Client checked cable routing, at ~ 579-585MHz, unit failed	TW	---
		Client disconnected the UVC and headphoes, at 575MHz, EUT failed	TW	---
		Mitigation included changing out UVC and headphones	TW	---
	1030	Conclusion: client swapped the UVC (Universal Voting Console) and EUT passes, Original SN: UVC05170051, Replacement SN: UVC09211413	TW	---
		Ran over the frequency range 4 times and could not repeat failure		
		Return to formal testing, begin over on the right side at 80MHz, V-pole Pass	TW	---
		H-pole: Pass	TW	---
		Completed all 4-3 testing	TW	Pass

National Technical Systems

Radiated RF Immunity per 61000-4-3

Standard Referenced: VVSG 2.0

Date: 8/10/2023

Temperature: 25°C Humidity: 51%

Pressure: 836 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Shoe-shine Mode

Test Engineer: T. Wittig

Frequency	Modulation				Step Size	Field	Polarity	Dwell	Comments	Criteria Met	Pass / Fail
(MHz)	Type	%	Freq	Form	(%)	(V/m)	(V or H)	(sec)			
80 - 1000	AM	80	1kHz	Sine	1	10	V	3	Front	A	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	H	3		A	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	V	3	Right	A	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	H	3		A	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	V	3	Back	A	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	H	3		A	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	V	3	Left	A	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	H	3		A	Pass

5.2.4 Notice of Deviation (NOD)

NOTICE OF DEVIATION

Client:	PRO V&V	Job #:	PR171953	NOD #:	1
P. O. #:	2023-011	Date of Deviation:	8/11/2023	CAR #:	NA
Notification Made To: (Client Contact)	M. Walker	Notification Made By:	T. Wittig		
If notification was not made, provide justification:	NA				
Date:	8/11/2023	Via:	Verbal		
Test:	EN61000-4-3	Test Item:	Voting Machines		
Specification:	VVSG	Model or P/N:	ExpressVoteXL		
Revision/Date:	2005	Serial Number:	XL0122080503		

REQUIREMENTS: *(Reference paragraph or section of specification)*

Radiated RF Immunity
10V/m, 80 - 1000 MHz, 1% Step, 80% AM,
1kHz sine, 3s dwell

DESCRIPTION OF DEVIATION

At ~585 MHz, EUT locks up, repeatable several times

DISPOSITIONS/COMMENTS/RECOMMENDATIONS:

Client will troubleshoot, to attempt to fix the failure, and move to formal testing.

Client Disposition Authorization	8/11/23 Date	NTS Quality Representative	8-11-23 Date
NTS Project Manager	8/11/23 Date	NA Government QAR (if applicable)	NA Date

NOTE: IT IS THE CLIENT'S RESPONSIBILITY TO ANALYZE AND DISPOSITION DEVIATIONS ON CLIENT TEST PROGRAMS.

FOR NTS QA USE:	Tracking Code: 3
	Risk Level: Low

Tracking Codes:

1. Employee Error - Training	2. Employee Error - Process	3. Test Equipment Problem	4. Equipment Limitations	5. Customer Item Problem	6. Other

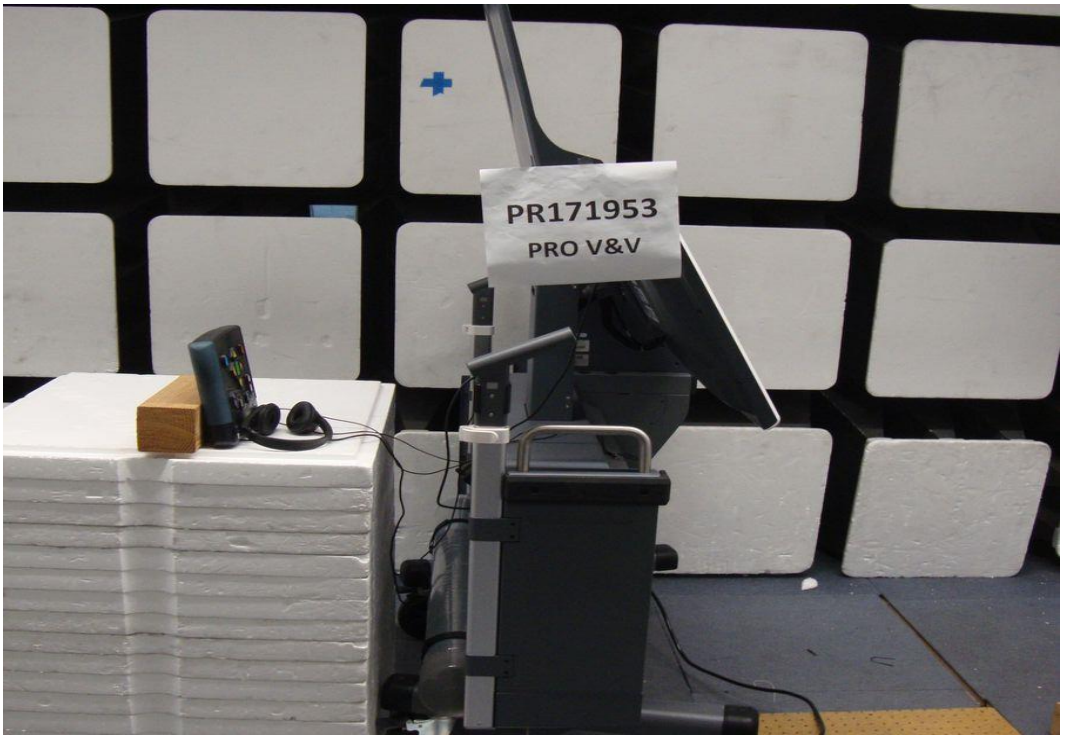
Risk Levels:

Low	Medium	High

COR 16.0, REV. 7

5.2.5 Test Photographs

Radiated Immunity Test Setup - Front



Radiated Immunity Test Setup - Left

Radiated Immunity Test Setup - Right

Radiated Immunity Test Setup - Back

5.2.6 Test Equipment List

Table 5.2-1: Radiated RF Immunity Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059916	Chamber (EMI, Semi-Anechoic)	NTS Labs, LLC	GP0	NCR	NCR
WC059439	Meter (Digital Multimeter)	Fluke	85	08/15/2022	08/15/2023
WC059710	Amplifier (Pre/RF/Low Noise)	Ophir RF	5127F	09/17/2012	NCR
WC059712	Coupler (Bi-Directional)	Werlatone	C3908-10	06/14/2021	NCR
WC059805	Antenna (Log Periodic)	ETS-Lindgren	3142B	NCR	NCR
WC059852	Generator (Signal)	Anritsu Wiltron	69367B	02/24/2023	02/24/2024
WC070467	Meter (Power)	Agilent Technologies	E4418B	04/11/2023	04/11/2024
WC070506	Sensor (Power)	Hewlett Packard	E4421A	04/14/2023	04/14/2024
WC078488	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	02/15/2023	02/15/2024
WC080773	Cable (Test)	N/A	90-195-048	09/15/2022	09/15/2023

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.3 Electrical Fast Transient (EFT) / Burst

5.3.1 Test Procedure

VVSG 2.0

EN 61000-4-4

5.3.2 Test Result

Passed

5.3.3 Test Datasheets

National Technical Systems

Electrical Fast Transient/Burst per IEC / EN 61000-4-4

Standard Referenced: VVSG 2.0 Date: 8/9/2023

Temperature: 25˚C Humidity: 47% Pressure: 838 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Shoe-shine Mode

Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
8/9/2023		Performed 4-4 pre-test verification prior to testing	TW	Complete
	1500	Begin Electrical Fast Transient / Burst. Mains: +/- 2kV, I/O: +/- 1kV (4.1.2.6)	TW	---
	1600	Completed 4-4 testing	TW	Pass

National Technical Systems

Electrical Fast Transient/Burst per IEC / EN 61000-4-4

Standard Referenced: VVSG 2.0 Date: 8/9/2023

Temperature: 25˚C Humidity: 47% Pressure: 838 mb

Input Voltage: 120Vac/60Hz Capacitive Coupling Clamp Verification N/A

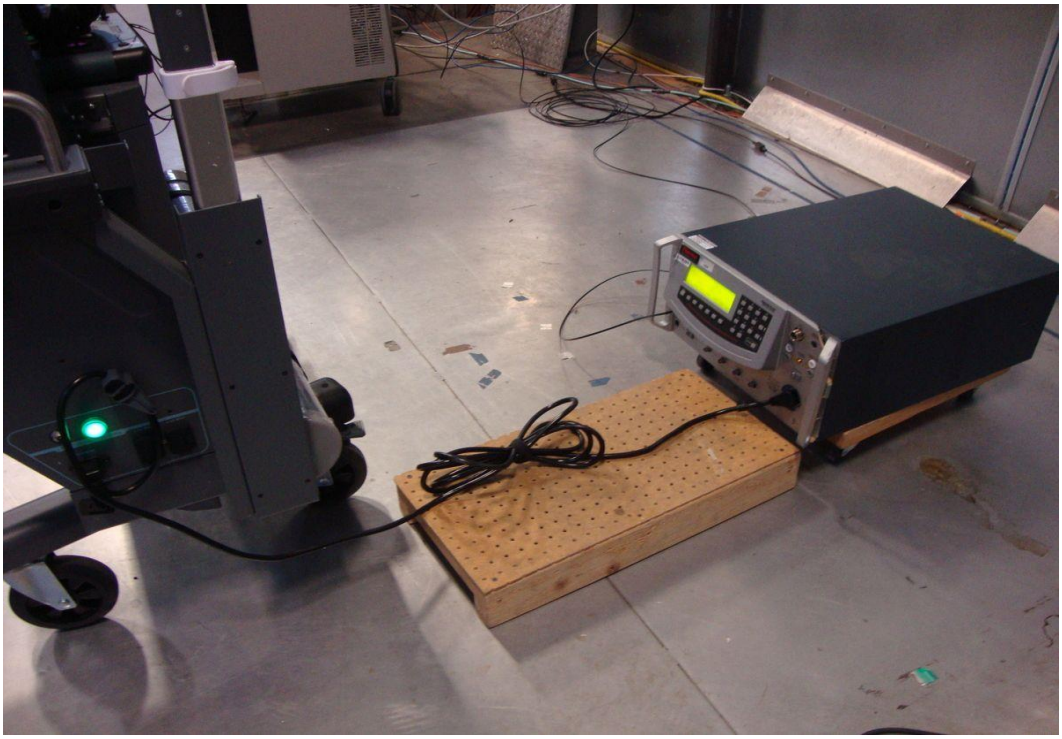
Configuration of Unit: Shoe-shine Mode

Test Engineer: T. Wittig

Voltage (kV)	Polarity +/-	Time (sec)	Injection Type	L1	L2	L3	N	PE	Rep Freq.	Comments	Criteria Met	Pass/ Fail
1.0	±	60	CDN	X					100 kHz	AC Mains	A	Pass
1.0	±	60	CDN						100 kHz		A	Pass
1.0	±	60	CDN					X	100 kHz		A	Pass
1.0	±	60	CDN		X	X		X	100 kHz		A	Pass

5.3.4 Test Photographs

EFT Test Setup



EFT Test Setup - AC Mains

5.3.5 Test Equipment List

Table 5.3-1: Electrical Fast Transient/Burst Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059623	Chamber (EMI, Semi-Anechoic)	Rayproof	SR2	NCR	NCR
WC059692	Meter (Digital Multimeter)	Fluke	83-3	09/12/2022	09/12/2023
WC059729	Power Supply (AC)	Pacific Power Source	TMX 140	NCR	NCR
WC059768	Generator (Spike/Transient)	Thermo Fisher Scientific	EMC Pro Plus	11/09/2022	11/09/2023
WC070508	Software	Keytek	CEWare	NCR	NCR
WC078488	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	02/15/2023	02/15/2024

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.4 Surge Immunity

5.4.1 Test Procedure

VVSG 2.0

EN 61000-4-5

5.4.2 Test Result

Passed

5.4.3 Test Datasheets

National Technical Systems

Surge Immunity per IEC / EN 61000-4-5

Standard Referenced: VVSG 2.0 Date: 8/9/2023

Temperature: 24°C Humidity: 41% Pressure: 838 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Shoe-shine Mode

Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
8/9/2023	0880	Performed 4-5 pre-test verification	TW	Ok
	0830	Begin Surge Immunity. Mains: +/- 2kV CM, +/- 2kV DM, (0, 90, 180, 270) (4.1.2.7)	TW	---
	1500	Completed 4-5 testing	TW	Pass

National Technical Systems

Surge Immunity per IEC / EN 61000-4-5

Standard Referenced: VVSG 2.0 Date: 8/9/2023

Temperature: 24°C Humidity: 41% Pressure: 838 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Shoe-shine Mode

Test Engineer: T. Wittig

Voltage (kV)	Polarity +/-	L1	L2	L3	N	PE	Phase (deg)	Number of Pulses	Delay (sec)	Comments	Criteria Met	Pass/ Fail
0.5	±	X			X		0	5	30	Differential Mode	A	Pass
0.5	±	X			X		90	5	30		A	Pass
0.5	±	X			X		180	5	30		A	Pass
0.5	±	X			X		270	5	30		A	Pass
0.5	±	X				X	0	5	30	Common Mode Line	A	Pass
0.5	±	X				X	90	5	30		A	Pass
0.5	±	X				X	180	5	30		A	Pass
0.5	±	X				X	270	5	30		A	Pass
0.5	±				X	X	0	5	45	Common Mode Neutral	A	Pass
0.5	±				X	X	90	5	45		A	Pass
0.5	±				X	X	180	5	45		A	Pass
0.5	±				X	X	270	5	45		A	Pass
1.0	±	X			X		0	5	60	Differential Mode	A	Pass
1.0	±	X			X		90	5	60		A	Pass
1.0	±	X			X		180	5	60		A	Pass
1.0	±	X			X		270	5	60		A	Pass
1.0	±	X				X	0	5	60	Common Mode Line	A	Pass
1.0	±	X				X	90	5	60		A	Pass
1.0	±	X				X	180	5	60		A	Pass
1.0	±	X				X	270	5	60		A	Pass
2.0	±	X				X	0	5	60	Differential Mode	A	Pass
2.0	±	X				X	90	5	60		A	Pass
2.0	±	X				X	180	5	60		A	Pass
2.0	±	X				X	270	5	60		A	Pass
2.0	±	X				X	0	5	60	Common Mode Line	A	Pass
2.0	±	X				X	90	5	60		A	Pass
2.0	±	X				X	180	5	60		A	Pass
2.0	±	X				X	270	5	60		A	Pass
2.0	±				X	X	0	5	60	Common Mode Neutral	A	Pass
2.0	±				X	X	90	5	60		A	Pass
2.0	±				X	X	180	5	60		A	Pass
2.0	±				X	X	270	5	60		A	Pass

5.4.4 Test Photographs

Surge Immunity Test Setup

5.4.5 Test Equipment List

Table 5.4-1: Surge Immunity Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059918	Ground Plane (Fixed)	NTS Labs, LLC	GP2	NCR	NCR
WC059692	Meter (Digital Multimeter)	Fluke	83-3	09/12/2022	09/12/2023
WC059729	Power Supply (AC)	Pacific Power Source	TMX 140	NCR	NCR
WC059768	Generator (Spike/Transient)	Thermo Fisher Scientific	EMC Pro Plus	11/09/2022	11/09/2023
WC070508	Software	Keytek	CEWare	NCR	NCR
WC078488	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	02/15/2023	02/15/2024

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.5 Conducted RF Immunity

5.5.1 Test Procedure

VVSG 2.0

EN 61000-4-6

5.5.2 Test Result

Passed

5.5.3 Test Datasheets

National Technical Systems

Conducted RF Immunity per IEC / EN 61000-4-6

Standard Referenced: VVSG 2.0 Date: 8/11/2023

Temperature: 25°C Humidity: 44% Pressure: 837 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Shoe-shine Mode

Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
8/11/2023	1245	Setup EUT for 4-6 testing	TW	---
	1256	Begin Conducted RF Immunity. 10Vrms, 0.15 - 80 MHz, 1% Step, 80% AM, 1kHzsine, 3s dwell.(4.1.2.11)	TW	---
	1345	Completed 4-6 testing	TW	Pass

National Technical Systems

Conducted RF Immunity per IEC / EN 61000-4-6

Standard Referenced: VVSG 2.0 Date: 8/11/2023

Temperature: 25°C Humidity: 44% Pressure: 837 mb

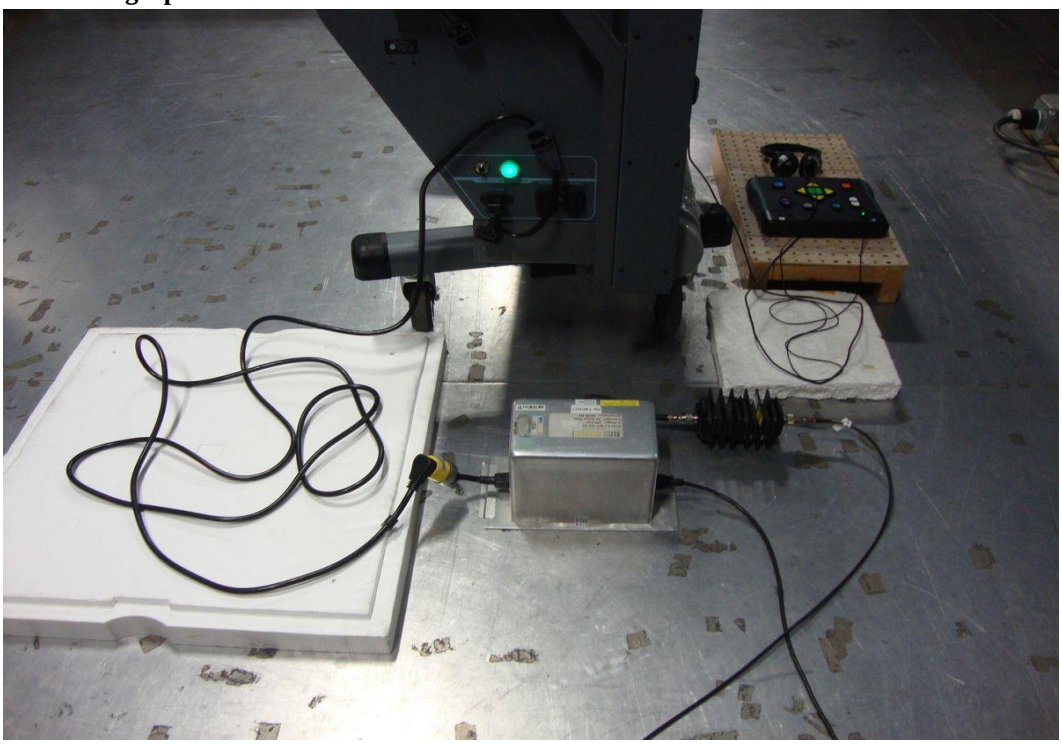
Input Voltage: 120Vac/60Hz

Configuration of Unit: Shoe-shine Mode

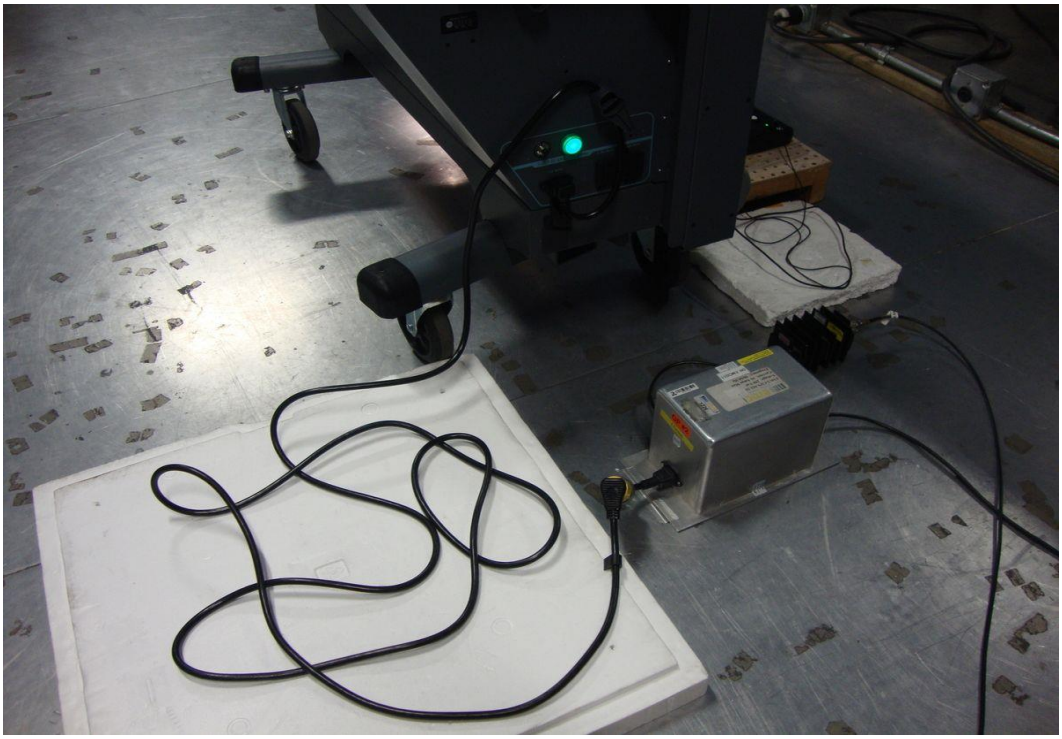
Test Engineer: T. Wittig

Frequency (MHz)	Modulation			Level	Dwell	Comments	Criteria Met	Pass/ Fail
	Type	%	Freq	(V/m)	(sec)			
0.150 - 80.0	AM	80	1KHz	10	3	AC Mains	A	Pass

5.5.4 Test Photographs



Conducted Immunity Test Setup



Conducted Immunity Test Setup - AC Mains

5.5.5 Test Equipment List

Table 5.5-1: Conducted RF Immunity Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059918	Ground Plane (Fixed)	NTS Labs, LLC	GP2	NCR	NCR
WC059656	Analyzer (Spectrum)	Rigol Technologies	DSA815	08/24/2022	08/24/2023
WC059658	Coupler (Bi-Directional)	Werlatone	C9475	03/22/2022	09/04/2023
WC059661	Network (Coupling/Decoupling)	EMC Integrity	EMCI-CDN-M3-16	02/24/2023	03/03/2024
WC059692	Meter (Digital Multimeter)	Fluke	83-3	09/12/2022	09/12/2023
WC059694	Generator (Signal)	Hewlett Packard	8648C	04/11/2023	04/11/2024
WC059699	Amplifier (Wideband/Power)	Instruments For Industry	M100	NCR	NCR
WC059773	Attenuator (Coaxial)	Aeroflex/Weinschel	40-6-34	03/22/2022	NCR
WC078488	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	02/15/2023	02/15/2024

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.6 Voltage Dips and Interruptions

5.6.1 Test Procedure

VVSG 2.0

EN 61000-4-11

5.6.2 Test Result

Passed

5.6.3 Test Datasheets

National Technical Systems

Voltage Dips and Interrupts per IEC / EN 61000-4-11

Standard Referenced: EN 61000-4-11 Date: 8/9/2023

Temperature: 23˚C Humidity: 50% Pressure: 837 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Shoe-shine Mode

Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
		Performed 4-11 pre-test verification prior to testing	TW	Complete
		Setup EUT for 4-11 testing	TW	---
8/9/2023		Voltage Dips and Interruptions. Electric power increases of 7.5% and reductions of 12.5% of nominal specified power. (Inc./Red. of Nom. Voltage) (4.1.2.5)	TW	---
	1317	Begin 129 Vac Line Voltage Variations (+7.5% of nominal 120V) 2 hrs.	TW	Pass
	1517	Begin 105 Vac Line Voltage Variations (-12.5% of nominal 120V) 2 Hrs.	TW	Pass
8/10/2023	0815	Begin Surges of +15% line variations of nominal voltage (138V) 2 Hrs.	TW	Pass
	1030	Begin 'Surges of -15% line variations of nominal voltage (102V) 2 Hrs	TW	Pass
8/11/2023	1200	Begin Voltage Dips and Interruptions. 70% nom, 0.6 cycles / 40% nom, 6 cycles & 1 sec. / 0% nom, 300 cycles. (4.1.2.5)	TW	---
		Completed all 4-11 testing	TW	Pass

National Technical Systems

Voltage Dips and Interrupts per IEC / EN 61000-4-11

Standard Referenced: EN 61000-4-11 Date: 8/9/2023

Temperature: 23˚C Humidity: 50% Pressure: 837 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Shoe-shine Mode

Test Engineer: T. Wittig

% Nominal	No. of Cycles	Phase Angle (deg) 0	90	180	270	Time between dropouts (sec)	mber of te	Comments	Criteria Met	Pass / Fail
40%	6	x				10	3		A	Pass
40%	6		x			10	3		A	Pass
40%	6			x		10	3		A	Pass
40%	6				x	10	3		A	Pass
40%	60	x				10	3		A	Pass
40%	60		x			10	3		A	Pass
40%	60			x		10	3		A	Pass
40%	60				x	10	3		A	Pass
70%	0.6	x				10	3		A	Pass
70%	0.6		x			10	3		A	Pass
70%	0.6			x		10	3		A	Pass
70%	0.6				x	10	3		A	Pass
0%	300	x				10	3		A	Pass
0%	300			x		10	3		A	Pass
Line Voltage Variation Tests										
129 Vac Line Voltage Variations (+7.5% of nominal 120V) 2 hrs.									A	Pass
105 Vac Line Voltage Variations (-12.5% of nominal 120V) 2 Hrs.									A	Pass
Surges of +15% line variations of nominal voltage (138V) 2 Hrs.									A	Pass
Surges of -15% line variations of nominal voltage (102V) 2 Hrs									A	Pass

5.6.4 Test Photographs

Voltage Dips and Interruptions Test Setup

5.6.5 Test Equipment List

Table 5.6-1: Voltage Dips and Interruptions Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059918	Ground Plane (Fixed)	NTS Labs, LLC	GP2	NCR	NCR
WC059680	Power Supply (AC)	California Instruments	1251P	NCR	NCR
WC059692	Meter (Digital Multimeter)	Fluke	83-3	09/12/2022	09/12/2023
WC059768	Generator (Spike/Transient)	Thermo Fisher Scientific	EMC Pro Plus	11/09/2022	11/09/2023
WC078469	Software	ETS-Lindgren	C47213	NCR	NCR
WC078488	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	02/15/2023	02/15/2024

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

End of Test Report