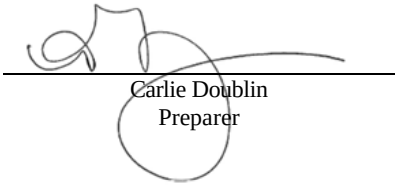
National Technical Systems Test Report for Electromagnetic Interference (EMI) Testing of the Thermal Config #1 and #2

Prepared For
Pro V&V, Inc | 6705 Obyssey Drive NW, Suite C | Huntsville, AL 35806

Performed By
National Technical Systems | 1736 Vista View Drive | Longmont, CO 80504-5242 | 303-776-7249 | www.nts.com



Carlie Doublin
Preparer

John Hill
Program Manager

Revision History

Rev.	Description	Issue Date
0	Initial Release	08/05/2022

Table of Contents

List of Tables

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: See Table 5.0-1
- Pro V&V, Inc Purchase Order(s) 2022-012, dated 06/29/2022
- National Technical Systems (NTS) Quote(s) OP0620236, dated 06/27/2022
- 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	Thermal Config #1	ClearMark Thermal	4610001001
2	1	Thermal Config #2	ClearMark Thermal	4610001002

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 Unit	Frequency Range
Radiated Immunity	V/m	80-2,700 MHz
ESD	kV	N/A
EFT	Voltage	N/A
	Timing	N/A
Surge	Voltage	N/A
RF Common Mode (CDN Method)	Vrms	N/A
RF Common Mode (BCI Method)	Vrms	N/A

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	EN 61000-4-2	Longmont	07/25/2022	ClearMark Thermal	4610001001 4610001002	Complies
5.2	Radiated RF Immunity	EN 61000-4-3	Longmont	07/25/2022 - 07/26/2022	ClearMark Thermal	4610001001 4610001002	Complies
5.3	Electrical Fast Transient / Burst	EN 61000-4-4	Longmont	07/26/2022	ClearMark Thermal	4610001001 4610001002	Complies
5.4	Surge Immunity	EN 61000-4-5	Longmont	07/26/2022	ClearMark Thermal	4610001001 4610001002	Complies
5.5	Conducted RF Immunity	EN 61000-4-6	Longmont	08/01/2022	ClearMark Thermal	4610001001 4610001002	Complies
5.6	Power Frequency H-Field Immunity	EN 61000 4-8	Longmont	08/01/2022	ClearMark Thermal	4610001001 4610001002	Complies
5.7	Voltage Dips and Interruptions	EN 61000-4-11	Longmont	07/25/2022 - 07/26/2022	ClearMark Thermal	4610001001 4610001002	Complies

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

5.1 Electrostatic Discharge

5.1.1 Test Procedure

EN 61000-4-2

5.1.2 Test Result

The Thermal Config #1 and #2 met the specification requirements for Electrostatic Discharge.

5.1.3 Test Datasheets

National Technical Systems

Electrostatic Discharge per IEC / EN 61000-4-2

Standard Referenced:	IEC/EN 61000-4-2	Date:	7/20/2022
Temperature:	25°C	Humidity: 40%	Pressure: 841 mb
Input Voltage:	120Vac/60Hz		
Configuration of Unit:	Printing/scanning mode (Thermal Configuration #2)		
Test Engineer:	T. Wittig		

Date	Time	Log Entries	Initials	Result
7/20/22	0800	Setup for Electrostatic Discharge (4.1.2.8) +/- 8kV Contact, +/-2, 4, 8, 15kV Air. 120 VAC / 60 Hz (4.1.2.8) (ClearMark 2) Thermal Configuration 2	TW	
		Bleed-off cables measure: 929k ohms and 936k ohms	TW	Pass
		Performed pre-test verification prior to testing	TW	
	1430	Completed 4-2 testing	TW	Pass

National Technical Systems

Electrostatic Discharge per IEC / EN 61000-4-2

Standard Referenced: IEC/EN 61000-4-2 Date: 7/21/2022

Temperature: 24°C Humidity: 46% Pressure: 840 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Printing/scanning mode (Laser Configuration #2)

Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
7/21/22	1500	Setup for Electrostatic Discharge (4.1.2.8) +/- 8kV Contact, +/-2, 4, 8, 15kV Air. 120 VAC / 60 Hz (4.1.2.8) Laser Config 2	TW	
	1630	Done for the day	TW	
7/22/22	0800	Resumed 4-2 testing	TW	
	1500	Completed 4-2 testing	TW	Pass

National Technical Systems

Electrostatic Discharge per IEC / EN 61000-4-2

Standard Referenced: IEC/EN 61000-4-2 Date: 7/20/2022

Temperature: 25°C Humidity: 40% Pressure: 841 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Printing/scanning mode (Configuration Thermal #2)

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
HCP	8	X	X	10	1	Edge of HCP at Front of UUT	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		A	Pass
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		A	Pass
Photo 11.	8	X	X	10	1		A	Pass
Photo 11.	8	X	X	10	1		A	Pass
Air Discharge Points - **BLUE** DOTS								
Photo 1.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 2.	2, 4, 8, 15	X	X	10	1		A	Pass
Photo 3.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 4.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 5.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 6.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 7.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 8.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 9.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 10.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 11.	2, 4, 8, 15	X	X	10	1		A	Pass
Photo 12.	2, 4, 8, 15	X	X	10	1	ND	-	-

ND: No Discharge points found

National Technical Systems

Electrostatic Discharge per IEC / EN 61000-4-2

Standard Referenced: IEC/EN 61000-4-2 Date: 7/21/2022

Temperature: 24°C Humidity: 46% Pressure: 840 mb

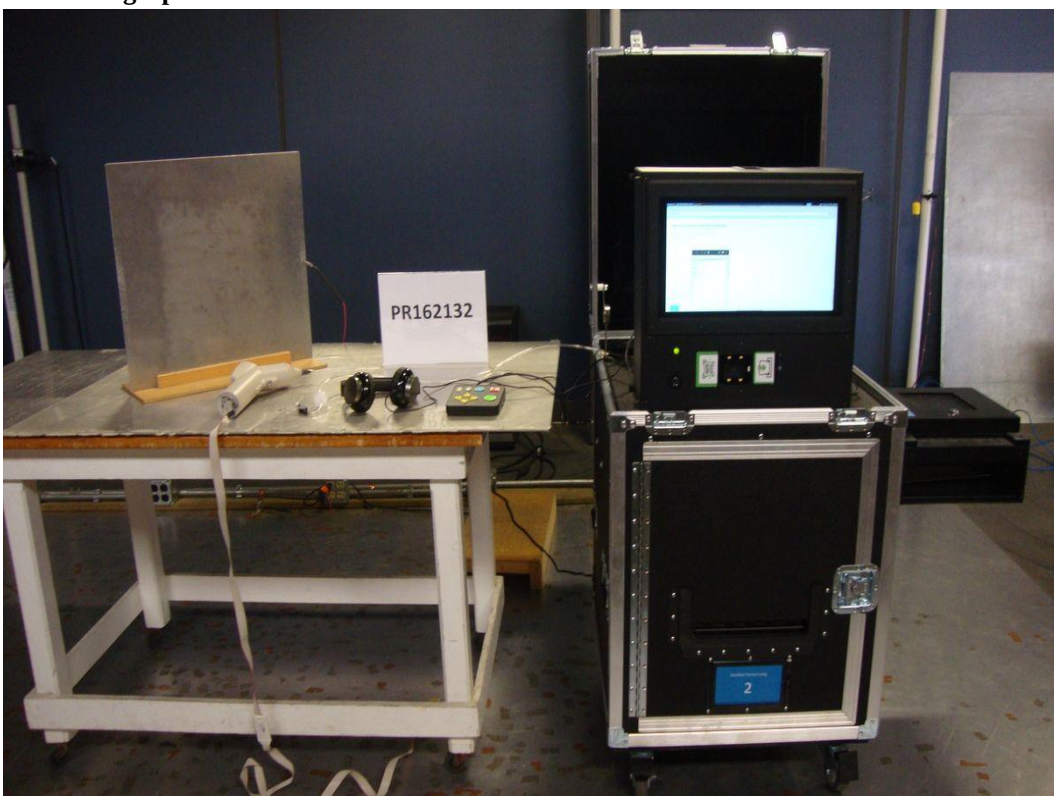
Input Voltage: 120Vac/60Hz

Configuration of Unit: Printing/scanning mode (Laser Configuration #2)

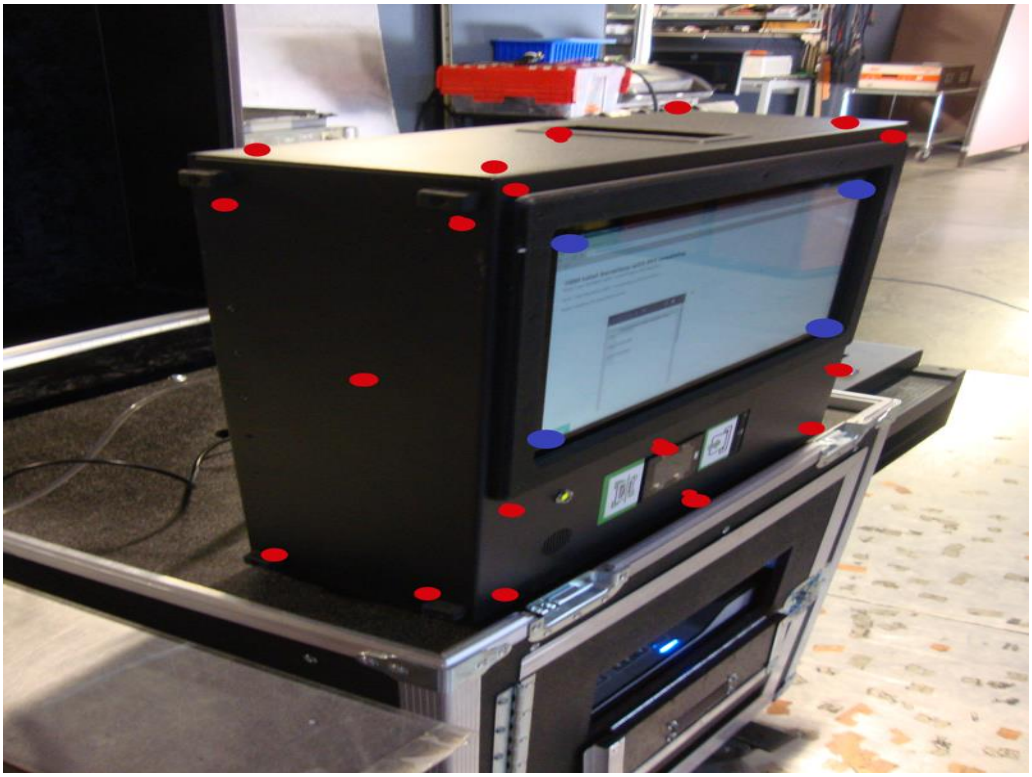
Test Engineer: T. Wittig

Test Location	Voltage Level (kV)	Polarity +	Polarity -	Number of Pulses	Pulses Per Second	Comments	Criteria Met	Pass/ Fail
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
HCP	8	X	X	10	1	Edge of HCP at Front of UUT	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		A	Pass
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		A	Pass
Photo 11.	8	X	X	10	1		A	Pass
Air Discharge Points - **BLUE** DOTS								
Photo 1.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 2.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 3.	2, 4, 8, 15	X	X	10	1		A	Pass
Photo 4.	2, 4, 8, 15	X	X	10	1	ND	-	-
Photo 5.	2, 4, 8, 15	X	X	10	1	ND	-	-

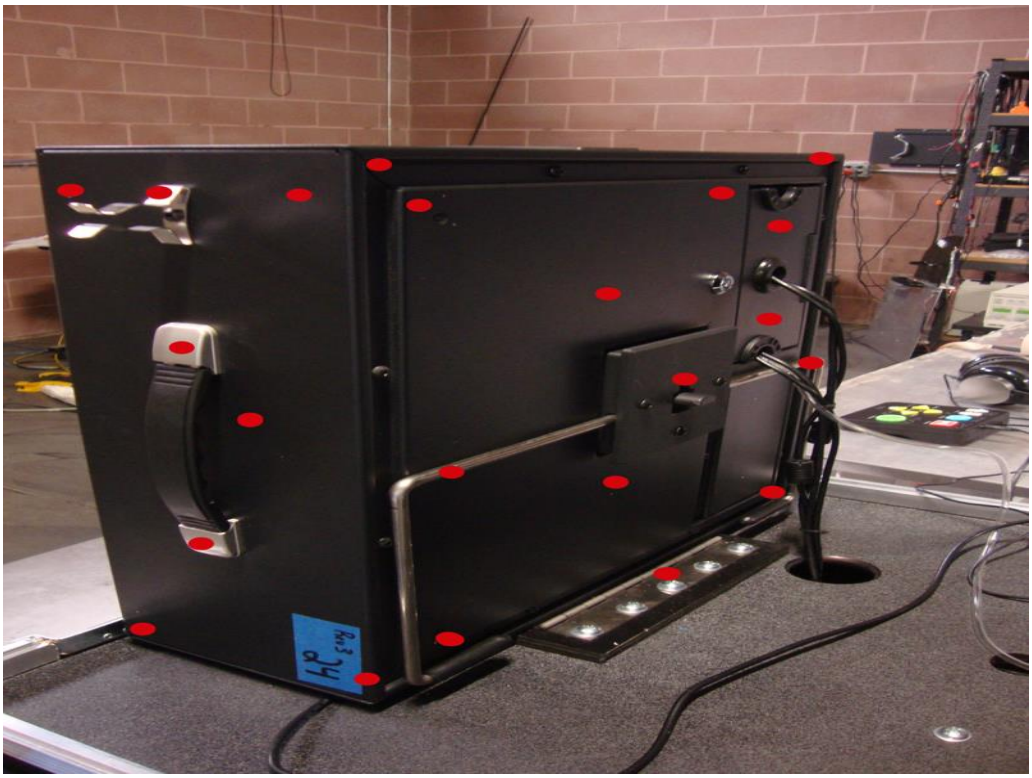
5.1.4 Test Photographs



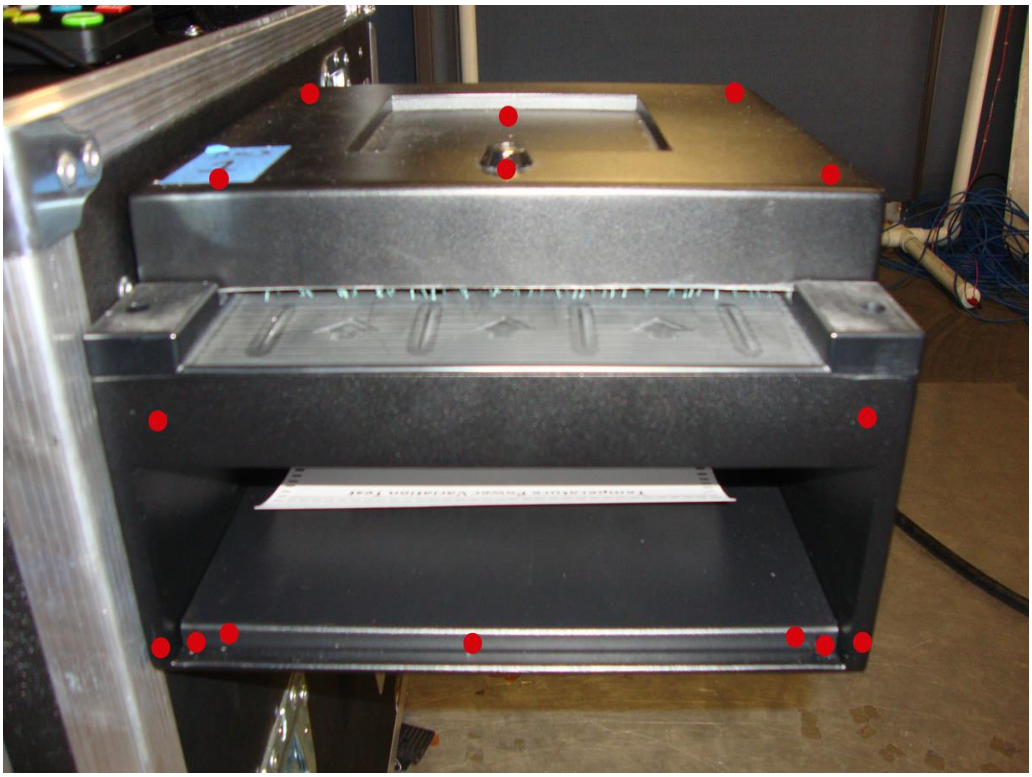
Electrostatic Discharge - Photo 1



Electrostatic Discharge - Photo 2



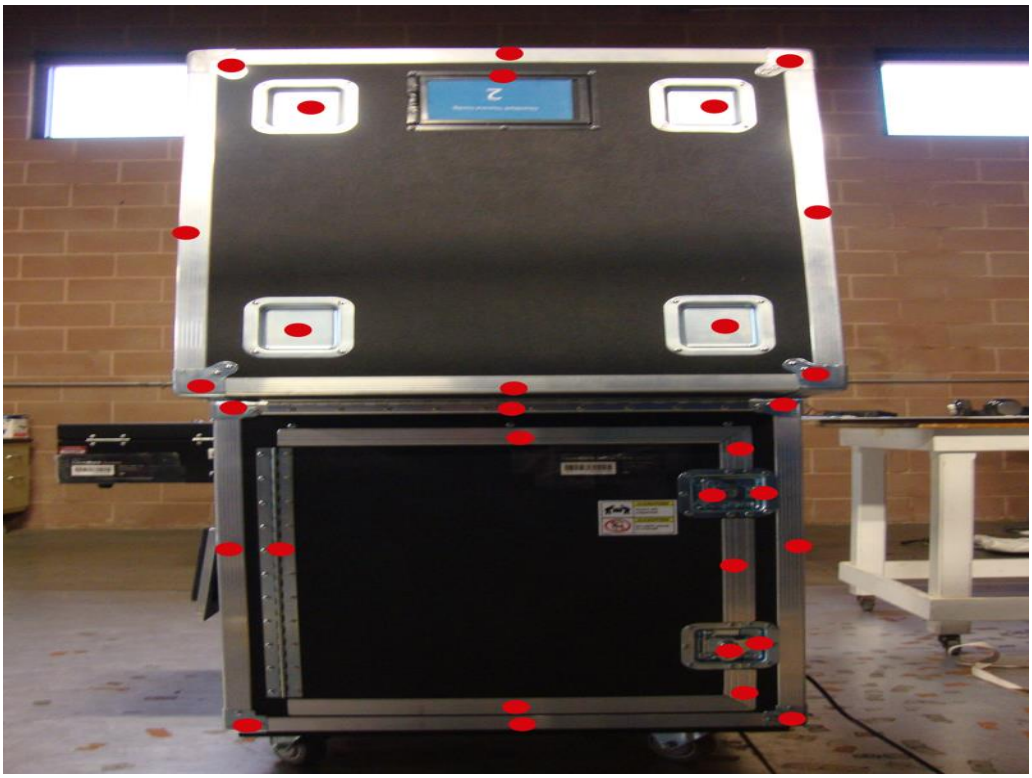
Electrostatic Discharge - Photo 3



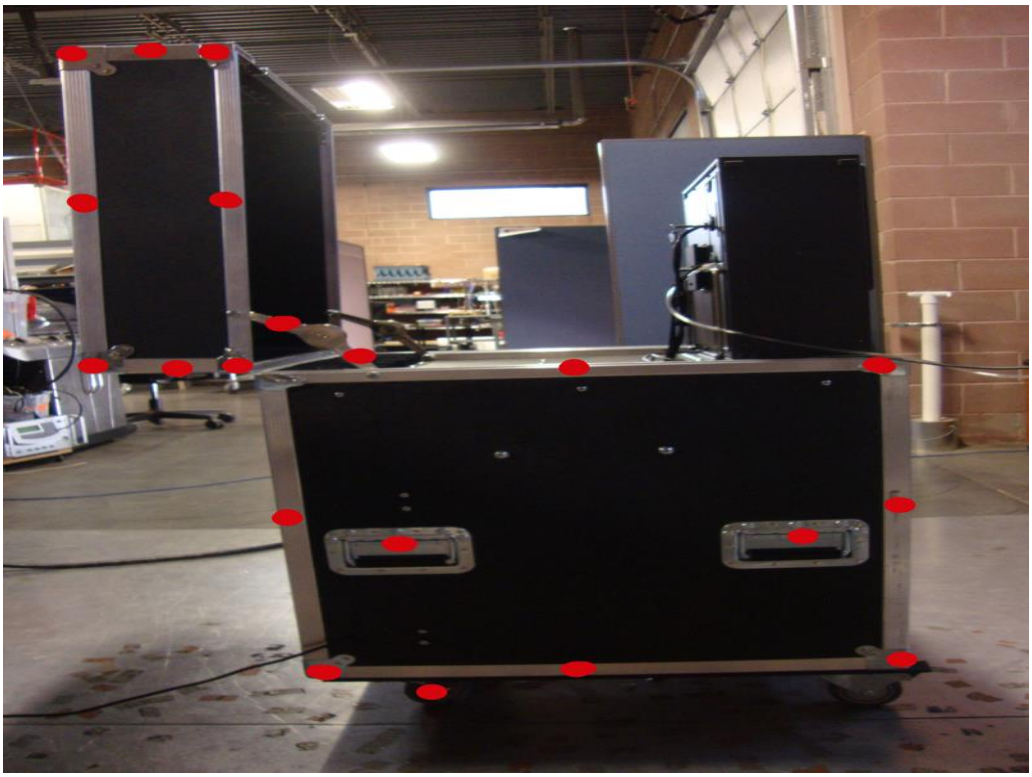
Electrostatic Discharge - Photo 4

Electrostatic Discharge - Photo 5

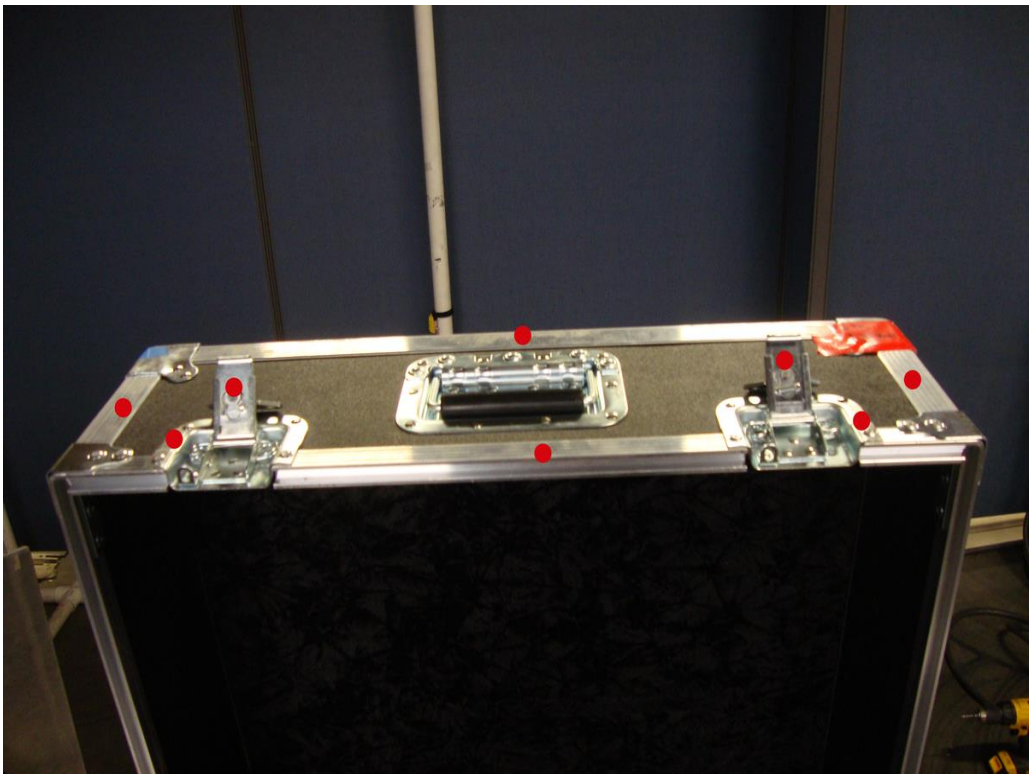
Electrostatic Discharge - Photo 6



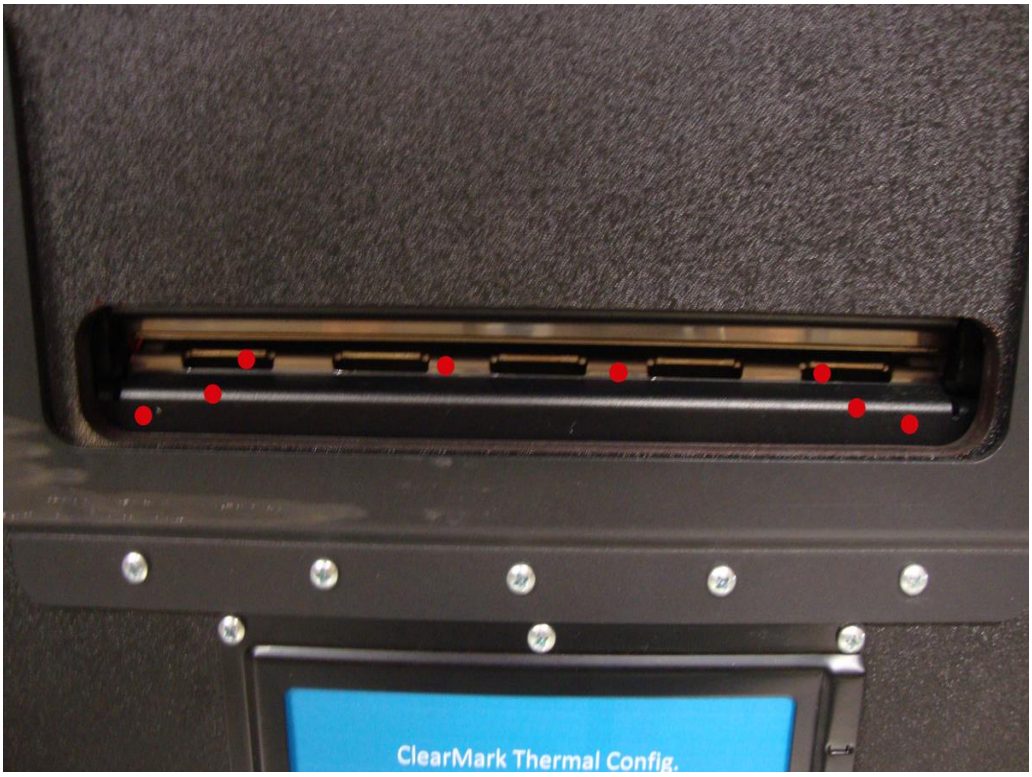
Electrostatic Discharge - Photo 7



Electrostatic Discharge - Photo 8



Electrostatic Discharge - Photo 9



Electrostatic Discharge - Photo 10

Electrostatic Discharge - Photo 11

Electrostatic Discharge - Photo 12

5.1.5 Test Equipment List

Table 5.1-1: Electrostatic Discharge Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059917	Ground Plane (Fixed)	National Technical Systems	GP #1	NCR	NCR
WC059439	Meter (Digital Multimeter)	Fluke	85	07/30/2021	07/30/2022
WC059665	Gun (ESD Simulator)	EMC-Partner	ESD3000	05/31/2022	05/31/2023
WC078487	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	06/22/2022	06/22/2023

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.2 Radiated RF Immunity

5.2.1 Test Procedure

EN 61000-4-3

5.2.2 Test Result

The Thermal Config #1 and Thermal Config #2 met the specification requirements for Radiated RF Immunity.

5.2.3 Test Datasheets

National Technical Systems

Radiated RF Immunity per EN 61000-4-3

Standard Referenced: EN 61000-4-3 Date: 7/22/2022

Temperature: °25C Humidity: 48% Pressure: 839 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Processing ballots (Re-test)

Test Engineer: Casey Lockhart

Date	Time	Log Entries	Initials	Result
7/22/22	1400	Re-test of Radiated RF Immunity10V/m, 80 - 1000 MHz, 1% Step, 80% AM, 1kHz sine, 3s dwell, 120 VAC / 60 Hz (4.1.2.10) (ClearMark 1)	CL	---
		Note: The client notieced a problem wiht the printer after testing was completed. The printer was cleaned andtesting all over again.		
		Note: had issues with camera in chamber. Got Front side completed and H pol of Right side done.	CL	
7/27/22		Radiated RF Immunity 10V/m, 80 - 1000 MHz, 1% Step, 80% AM, 1kHz sine, 3s dwell 120 VAC / 60 Hz (4.1.2.10) (ClearMark 1)	CL	Pass

National Technical Systems

Radiated RF Immunity per EN 61000-4-3

Standard Referenced: EN 61000-4-3 Date: 7/27/2022

Temperature: °23C Humidity: 67% Pressure: 839 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Laser config#1

Test Engineer: Casey Lockhart

Date	Time	Log Entries	Initials	Result
7/27/22	1100	Radiated RF Immunity 10V/m, 80 - 1000 MHz, 1% Step, 80% AM, 1kHz sine, 3s dwell 120 VAC / 60 Hz (4.1.2.10) (ClearMark 1) Start on Right Side, Vpol. NOTE: Item #ComponenModeSerial NumbeTEST Thermal CONFIG 1AIOThermal Printe461000100RE, RI Thermal CONFIG 1ScanneThermal Printe463000100RE, RI Thermal CONFIG 1PrinteThermal Printe462000100RE, RI Thermal CONFIG 1Power SupplyThermal PrinteY1823NKF012046RE, RI Thermal CONFIG 1ATThermal PrinteATI-6RE, RI	CL	

National Technical Systems

Radiated RF Immunity per EN 61000-4-3

Standard Referenced: EN 61000-4-3 Date: 7/22/2022

Temperature: °25C Humidity: 48% Pressure: 839 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Processing ballots (Re-test)

Test Engineer: Casey Lockhart

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

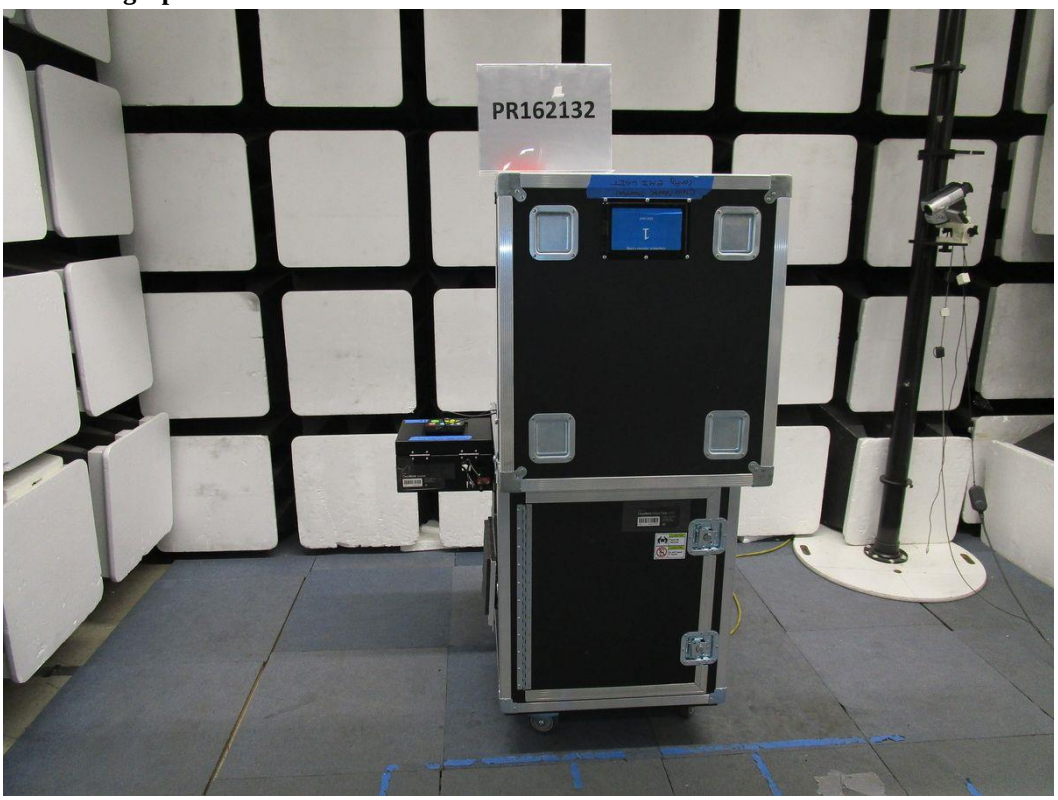
National Technical Systems

Radiated RF Immunity per EN 61000-4-3

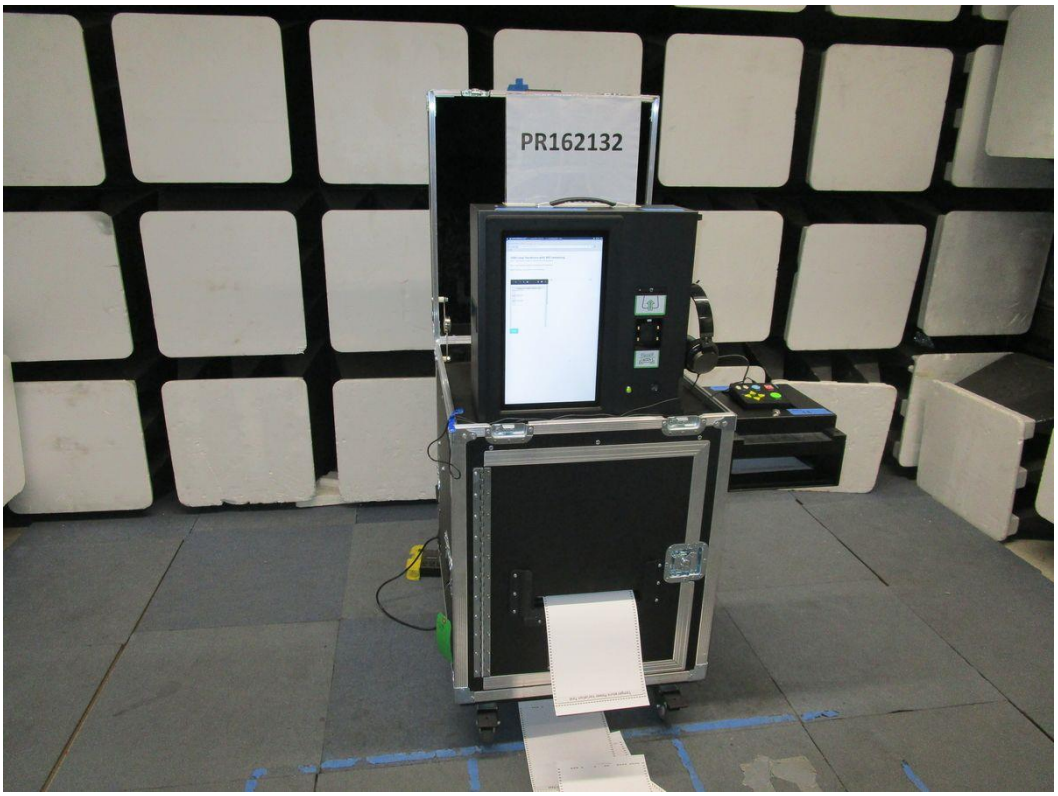
Standard Referenced:	EN 61000-4-3	Date:	7/27/2022
Temperature:	°23C Humidity: 67.00%	Pressure:	839 mb
Input Voltage:	120Vac/60Hz		
Configuration of Unit:	Laser config#1		
Test Engineer:	Casey Lockhart		

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

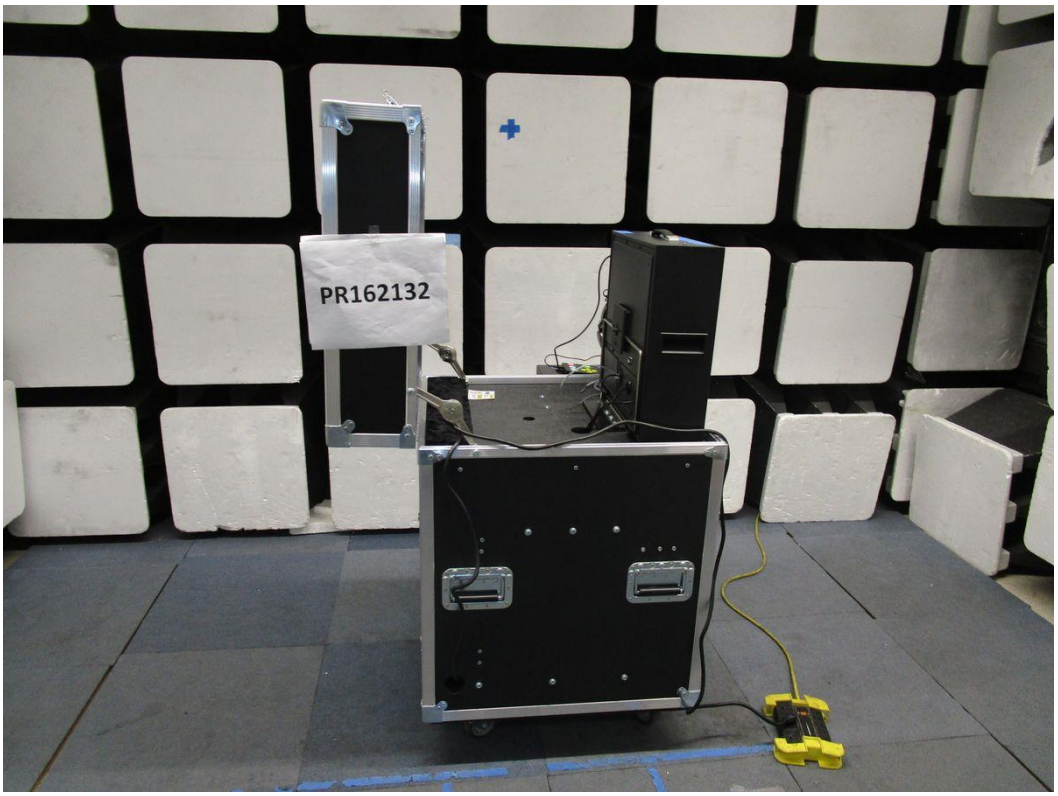
5.2.4 Test Photographs



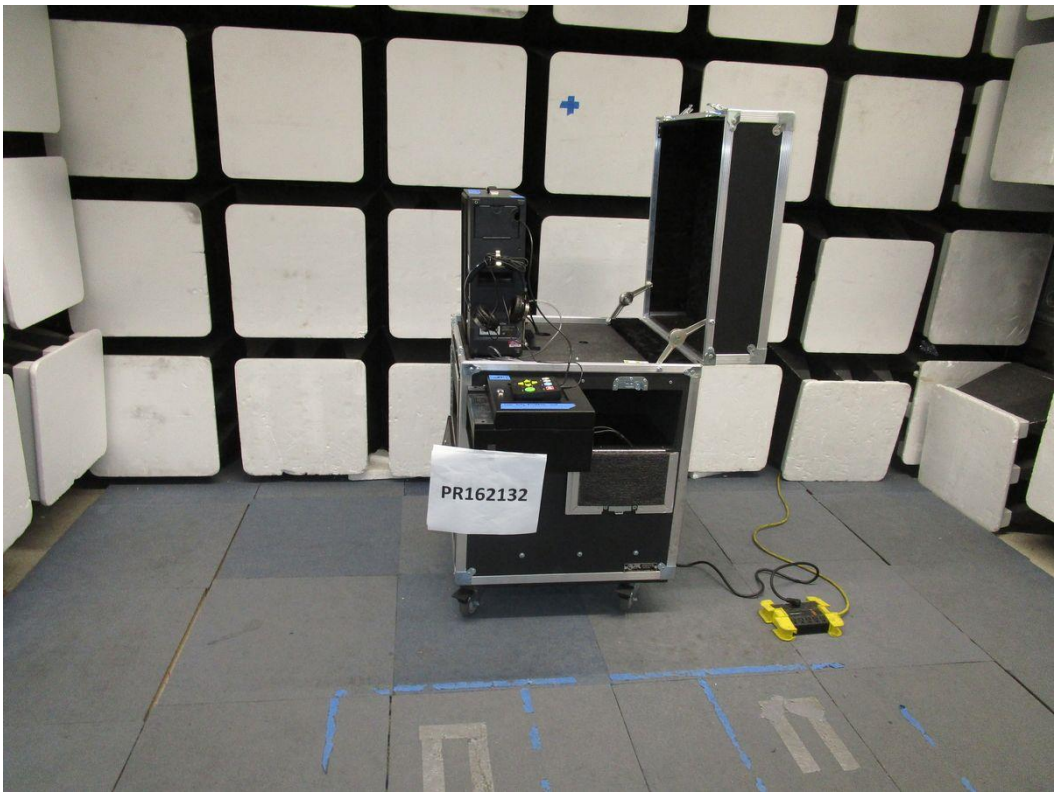
Radiated RF Immunity-Back



Radiated RF Immunity-Front



Radiated RF Immunity-Left



Radiated RF Immunity-Right

5.2.5 Test Equipment List

Table 5.2-1: Radiated RF Immunity Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059916	Ground Plane (Fixed)	National Technical Systems	GP #0	NCR	NCR
WC059669	Meter (Digital Multimeter)	Fluke	83-3	09/23/2021	09/23/2022
WC059712	Coupler (Bi-Directional)	Werlatone	C3908-10	06/14/2021	NCR
WC059713	Amplifier (Pre/RF/Low Noise)	Ophir RF	5127F	NCR	NCR
WC059805	Antenna (Log Periodic)	ETS-Lindgren	3142B	NCR	NCR
WC059852	Generator (Signal)	Anritsu Wiltron	69367B	02/15/2022	02/15/2023
WC070467	Meter (Power)	Agilent Technologies	E4418B	02/15/2022	02/15/2023
WC078489	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	05/22/2022	05/22/2023

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.3 Electrical Fast Transient / Burst

5.3.1 Test Procedure

EN 61000-4-4

5.3.2 Test Result

The Thermal Config #1 and Thermal Config #2 met the specification requirements for Electrical Fast Transient Burst.

5.3.3 Test Datasheets

National Technical Systems

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

Standard Referenced: IEC/EN 61000-4-4 Date: 7/26/2022
Temperature: 23°C Humidity: 54% Pressure: 838 mb
Input Voltage: 120Vac/60Hz Capacitive Clamp Verification Check NA
Configuration of Unit: Printer/scanning mode (Laser Configuration #3)
Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
7/26/22	1330	Performed 4-4 pre-test verification prior to testing	TW	---
		Client setup EUT	TW	---
	1345	Begin 4-4 testing	TW	---
	1445	Completed 4-4 testing, observed loss of communications during testing, EUT self recovered at the end of testing - passed performance criteria	TW	Pass

National Technical Systems

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

Standard Referenced: IEC/EN 61000-4-4 Date: 7/27/2022
Temperature: 23°C Humidity: 54% Pressure: 839 mb
Input Voltage: 120Vac/60Hz
Configuration of Unit: Printer/scanning mode (Thermal Configuration #2)
Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
7/27/22	0800	Performed 4-4 pre-test verification prior to testing	TW	
		Client setup EUT	TW	
	0900	Begin 4-4 testing	TW	
	1000	Completed 4-4 testing	TW	Pass

National Technical Systems

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

Standard Referenced: IEC/EN 61000-4-4 Date: 7/27/2022

Temperature: 23°C Humidity: 54% Pressure: 839 mb

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

Configuration of Unit: Printer/scanning mode (Thermal Configuration #2)

Test Engineer: T. Wittig

Voltage (kV)	Polarity +/-	Time (sec)	Injection Type	L1	L2	L3	N	PE	Rep Freq.	Comments	Criteria Met	Pass/ Fail
2.0	±	60	CDN	X					100 kHz	AC	A	Pass
2.0	±	60	CDN		X				100 kHz	AC	A	Pass
2.0	±	60	CDN					X	100 kHz	AC	A	Pass
2.0	±	60	CDN		X	X		X	100 kHz	AC	A	Pass

National Technical Systems

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

Voltage (kV)	Polarity +/-	Time (sec)	Injection Type	L1	L2	L3	N	PE	Rep Freq.	Comments	Criteria Met	Pass/ Fail
2.0	±	60	CDN	X					100 kHz	AC	B	Pass
2.0	±	60	CDN		X				100 kHz	AC	B	Pass
2.0	±	60	CDN					X	100 kHz	AC	B	Pass
2.0	±	60	CDN		X	X		X	100 kHz	AC	B	Pass

5.3.4 Test Photographs

Electrical Fast Transient/Burst Setup

Electrical Fast Transient/Burst AC Mains

Electrical Fast Transient/Burst Setup

Electrical Fast Transient/Burst 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
WC059918	Ground Plane (Fixed)	National Technical Systems	GP #2	NCR	NCR
WC059439	Meter (Digital Multimeter)	Fluke	85	07/30/2021	07/30/2022
WC059668	Oscilloscope (Digital)	Tektronix	TDS2002B	06/21/2022	06/21/2023
WC059768	Generator (Spike/Transient)	Thermo Fisher Scientific	EMC Pro Plus	11/09/2021	11/09/2022
WC070508	Software	Keytek	CEWare	NCR	NCR
WC078487	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	06/22/2022	06/22/2023

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.4 Surge Immunity

5.4.1 Test Procedure

EN 61000-4-5

5.4.2 Test Result

The Thermal Config #1 and Thermal Config #2 met the specification requirements for Surge Immunity.

5.4.3 Test Datasheets

National Technical Systems

Surge Immunity per IEC / EN 61000-4-5

Standard Referenced: EN 61000-4-5 Date: 7/28/2022

Temperature: 25˚C Humidity: 56% Pressure: 844 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Printing/scanning mode (Thermal Configuration #2)

Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
7/28/22	0830	Setup for 4-5 testing	TW	---
		Performed 4-5 pre-test verification prior to testing	TW	---
	0900	Begin 4-5 testing	TW	---
	1500	Completed 4-5 testing	TW	Pass

National Technical Systems

Surge Immunity per IEC / EN 61000-4-5

Standard Referenced: EN 61000-4-5 Date: 7/29/2022

Temperature: 24˚C Humidity: 54% Pressure: 842 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Printing/scanning mode (Laser Configuration #3)

Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
7/29/22	0830	Setup for 4-5 teasting	TW	---
	0900	Begin 4-5 testing	TW	---
	1530	Completed Testing	TW	Pass

National Technical Systems

Surge Immunity per IEC / EN 61000-4-5

Standard Referenced: EN 61000-4-5 Date: 7/29/2022

Temperature: 24°C Humidity: 54% Pressure: 842 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Printing/scanning mode (Laser Configuration #3)

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	45		A	Pass
0.5	±	X			X		90	5	45	Differential Mode	A	Pass
0.5	±	X			X		180	5	45		A	Pass
0.5	±	X			X		270	5	45		A	Pass
0.5	±	X				X	0	5	45		A	Pass
0.5	±	X				X	90	5	45	Common Mode Line	A	Pass
0.5	±	X				X	180	5	45		A	Pass
0.5	±	X				X	270	5	45		A	Pass
0.5	±				X	X	0	5	45		A	Pass
0.5	±				X	X	90	5	45	Common Mode Neutral	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		A	Pass
1.0	±	X				X	90	5	60	Differential Mode	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		A	Pass
1.0	±	X				X	90	5	60	Common Mode Line	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		A	Pass
1.0	±				X	X	90	5	60	Common Mode Neutral	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		A	Pass
2.0	±	X				X	90	5	60	Differential Mode	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		A	Pass
2.0	±	X			X		90	5	60	Common Mode Line	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		A	Pass
2.0	±				X	X	90	5	60	Common Mode Neutral	A	Pass
2.0	±				X	X	180	5	60		A	Pass
2.0	±				X	X	270	5	60		A	Pass

National Technical Systems

Surge Immunity per IEC / EN 61000-4-5

Standard Referenced: EN 61000-4-5 Date: 7/28/2022
Temperature: 25°C Humi 56% Pressure: 844 mb
Input Voltage: 120Vac/60Hz
Configuration of Unit: Printing/scanning mode (Thermal Configuration #2)
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	45	Differential Mode	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
0.5	±	X				X	0	5	45	Common Mode Line	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
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
1.0	±				X	X	0	5	60	Common Mode Neutral	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 Setup Laser #3

Surge Immunity 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)	National Technical Systems	GP #2	NCR	NCR
WC059668	Oscilloscope (Digital)	Tektronix	TDS2002B	06/21/2022	06/21/2023
WC059768	Generator (Spike/Transient)	Thermo Fisher Scientific	EMC Pro Plus	11/09/2021	11/09/2022
WC070450	Meter (Digital Multimeter)	Fluke	87-5	03/23/2022	03/23/2023
WC070508	Software	Keytek	CEWare	NCR	NCR
WC078487	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	06/22/2022	06/22/2023

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.5 Conducted RF Immunity

5.5.1 Test Procedure

EN 61000-4-6

5.5.2 Test Result

The Thermal Config #1 and Thermal Config #2 met the specification requirements for Conducted RF Immunity.

5.5.3 Test Datasheets

National Technical Systems

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

Standard Referenced: EN 61000-4-6 Date: 8/1/2022
Temperature: 27C Humidity: 46% Pressure: 840 mb
Input Voltage: 120Vac/60Hz
Configuration of Unit: Printing/scanning mode (Thermal Configuration #2)
Test Engineer: T. Wittig/W. Koenig

Date	Time	Log Entries	Initials	Result
8/1/22	1100	Tear down from GP0 to GP1. Conducted RF Immunity. 10Vrms, 0.15 - 80 MHz, 1% Step, 80% AM, 1kHz sine, 3s dwell.	TW	---
	1200	Completed 4-6 testing	TW	Pass

National Technical Systems

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

Standard Referenced: EN 61000-4-6 Date: 7/26/2022
Temperature: 26°C Humidity: 57% Pressure: 838 mb
Input Voltage: 120Vac/60Hz
Configuration of Unit: Printing/scanning mode (Laser Configuration #3)
Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
7/26/22	1400	Setup for 4-6 testing	TW	---
	1415	Begin 4-6 testing	TW	---
	1515	Completed 4-6 testing	TW	Pass

National Technical Systems

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

Standard Referenced: EN 61000-4-6 Date: 8/1/2022

Temperature: 27C Humidity: 46% Pressure: 840 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Printing/scanning mode (Thermal Configuration #2)

Test Engineer: T. Wittig/W. Koenig

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

National Technical Systems

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

Standard Referenced: EN 61000-4-6 Date: 7/26/2022

Temperature: 26°C Humidity: 57% Pressure: 838 mb

Input Voltage: 120Vac/60Hz

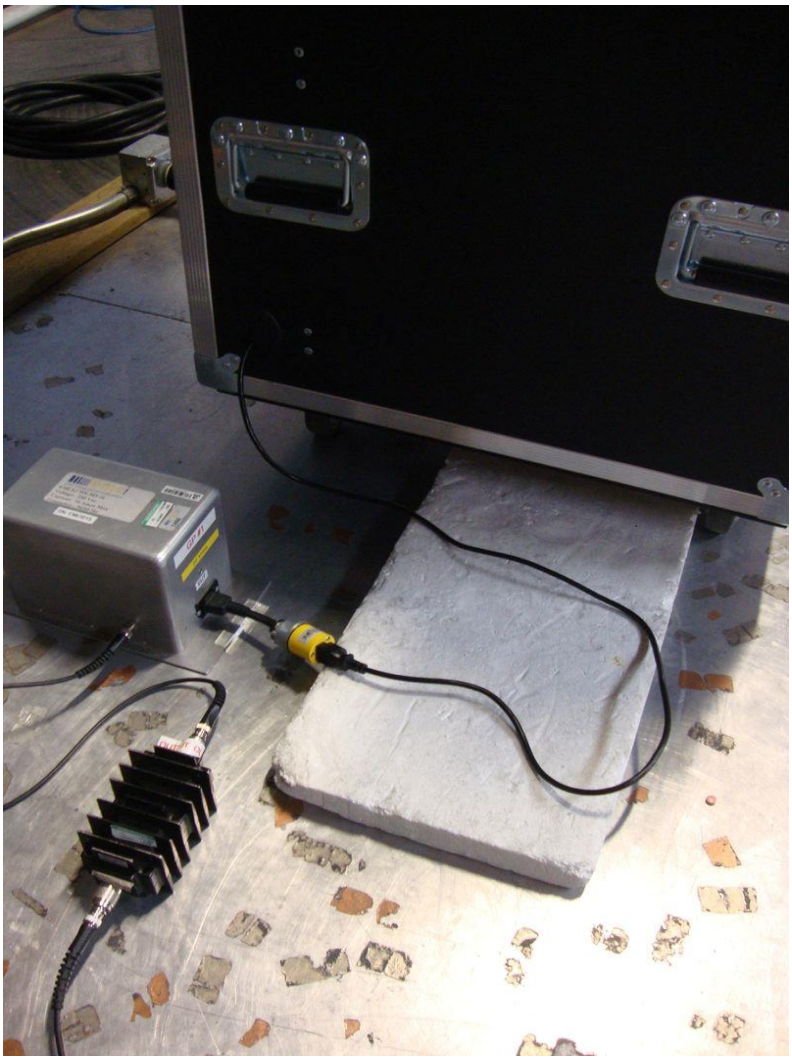
Configuration of Unit: Printing/scanning mode (Laser Configuration #3)

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 RF Immunity Setup



Conducted RF Immunity 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)	National Technical Systems	GP #2	NCR	NCR
WC059694	Generator (Signal)	Hewlett Packard	8648C	05/20/2021	02/07/2023
WC059695	Attenuator (Coaxial)	Aeroflex/Weinschel	40-6-34	02/03/2022	02/03/2023
WC059700	Coupler (Bi-Directional)	Werlatone	C9475-13	02/03/2022	02/03/2023
WC059702	Network (Coupling/Decoupling)	EMC Integrity	EMCI-CDN-M3-16	02/03/2022	02/03/2023
WC059764	Amplifier (Pre/RF/Low Noise)	Amplifier Research	75A250A	04/22/2014	NCR
WC059772	Analyzer (Spectrum)	Rigol Technologies	DSA815	06/14/2022	06/14/2023
WC070450	Meter (Digital Multimeter)	Fluke	87-5	03/23/2022	03/23/2023
WC078487	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	06/22/2022	06/22/2023

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.6 Power Frequency H-Field Immunity

5.6.1 Test Procedure

EN 61000 4-8

5.6.2 Test Result

The Thermal Config #1 and Thermal Config #2 met the specification requirements for Power Frequency H-Field Immunity.

5.6.3 Test Datasheets

National Technical Systems

Power Frequency H-field Immunity per IEC / EN 61000-4-8

Standard Referenced: EN 61000-4-8 Date: 8/1/2022
Temperature: 26C Humidity: 51%% Pressure: 844 mb
Input Voltage: 120Vac/60Hz
Configuration of Unit: Printing/scanning Mode (Laser Configuration #3)
Test Engineer: W. Koenig /T. Wittig

Date	Time	Log Entries	Initials	Result
8/1/22	1400	Performed 4-8 pre-test verification	WK/TW	---
	1415	Begin 4-8 testing	WK/TW	---

National Technical Systems

Power Frequency H-field Immunity per IEC / EN 61000-4-8

Standard Referenced: EN 61000-4-8 Date: 8/1/2022
Temperature: 26C Humidity: 51%% Pressure: 844 mb
Input Voltage: 120Vac/60Hz
Configuration of Unit: Printin/scanning Mode (Thermal Configuration #2)
Test Engineer: W. Koenig /T. Wittig

Date	Time	Log Entries	Initials	Result
8/1/22	1300	Performed 4-8 pre-test verification	WK/TW	---
	1315	Begin 4-8 testing	WK/TW	---
	1400	Completed 4-8 testing	WK/TW	Pass

National Technical Systems

Power Frequency H-field Immunity per IEC / EN 61000-4-8

Standard Referenced:	EN61000-4-8	Date:	8/1/2022
Temperature:	26C	Humidity: 51%%	Pressure: 844 mb
Input Voltage:	120Vac/60Hz	Ambient Field:	Pass
Configuration of Unit:	Printing/scanning Mode (Laser Configuration #3)		
Test Engineer:	W. Koenig/T. Wittig		

Frequency (Hz)		Field Strength	EUT Location	Dwell Time	Comments	Criteria Met	Pass/ Fail
50	60	(A/m)	(Axis)	(sec)			
X		30	1	60		A	Pass
	X	30	1	60		A	Pass
X		30	2	60		A	Pass
	X	30	2	60		A	Pass
X		30	3	60		A	Pass
	X	30	3	60		A	Pass
X		30	4	60		A	Pass
	X	30	4	60		A	Pass

National Technical Systems

Power Frequency H-field Immunity per IEC / EN 61000-4-8

Standard Referenced: EN 61000-4-8 Date: 8/1/2022

Temperature: 26C Humidity: 51%% Pressure: 844 mb

Input Voltage: 120Vac/60Hz Ambient Field: Pass

Configuration of Unit: Printin/scanning Mode (Thermal Configuration #2)

Test Engineer: W. Koenig/T. Wittig

Frequency (Hz)		Field Strength	EUT Location	Dwell Time	Comments	Criteria Met	Pass/ Fail
50	60	(A/m)	(Axis)	(sec)			
X		30	1	60		A	Pass
	X	30	1	60		A	Pass
X		30	2	60		A	Pass
	X	30	2	60		A	Pass
X		30	3	60		A	Pass
	X	30	3	60		A	Pass
X		30	4	60		A	Pass
	X	30	4	60		A	Pass

5.6.4 Test Photographs

Power Frequency H-Field Immunity Setup

Power Frequency H-Field Immunity Setup

5.6.5 Test Equipment List

Table 5.6-1: Power Frequency H-Field Immunity Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059918	Ground Plane (Fixed)	National Technical Systems	GP #2	NCR	NCR
WC059685	Monitor (Current)	Pearson Electronics	110A	07/14/2022	07/14/2023
WC059767	Power Supply (AC)	California Instruments	1251P	NCR	NCR
WC070286	Antenna (Loop)	EMC Integrity	EMCI-4-8-2m-1.5m	12/13/2018	NCR
WC070450	Meter (Digital Multimeter)	Fluke	87-5	03/23/2022	03/23/2023

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.7 Voltage Dips and Interruptions

5.7.1 Test Procedure

EN 61000-4-11

5.7.2 Test Result

The Thermal Config #1 and Thermal Config #2 met the specification requirements for Voltage Dips and Interruptions.

5.7.3 Test Datasheets

National Technical Systems

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

Standard Referenced: EN 61000-4-11 Date: 7/22/2022
Temperature: 26°C Humidity: 49% Pressure: 839 mb
Input Voltage: 120Vac/60Hz
Configuration of Unit: Printer/scanning mode (Thermal configuration #2)
Test Engineer: T. Wittig

Date	Time	Log Entries	Initials	Result
7/22/22	0900	Setup for PQF, line variations testing	TW	---
	0915	Begin testing	TW	---
	1500	Completed 2 of 4 voltages	TW	---
7/23/22	0830	Resumed line varions testing	TW	---
	1230	Completed line varions testing	TW	Pass
	1300	Setup for 4-11 testing	TW	---
		Performed 4-11 pre-test varification	TW	---
	1330	Begin 4-11 testing	TW	---
	1430	Completed testing	TW	Pass

National Technical Systems

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

Standard Referenced: EN 61000-4-11 Date: 7/27/2022
Temperature: 26°C Humidity: 48% Pressure: 838 mb
Input Voltage: 120Vac/60Hz
Configuration of Unit: Printing/scanning mode (Laser Configuration #3)
Test Engineer:

Date	Time	Log Entries	Initials	Result
7/27/22	1000	Setup for PQF, line variations testing	TW	---
	1030	Begin testing	TW	---
	1400	Completed 2 of 4 voltages	TW	---
7/28/22	0900	Resumed line variation testing	TW	---
	1300	Completed line variation testing	TW	Pass
8/1/22	0950	Setup for 4-11 testing	TW	---
		Performed 4-11 pre-test varification prior to testing	TW	---
	1000	Begin 4-11 testing	TW	---
	1100	Completed testing	TW	Pass

National Technical Systems

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

Standard Referenced: EN 61000-4-11 Date: 7/22/2022

Temperature: 26°C Humidity: 49% Pressure: 839 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Printer/scanning mode (Thermal configuration #2)

Test Engineer: T. Wittig

% Nominal	No. of Cycles	Phase Angle (deg)				Time between dropouts (sec)	Number of tests	Comments	Criteria Met	Pass/ Fail
		0	90	180	270					
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
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
0%	300	x				30	3		A	Pass
0%	300			x		30	3		A	Pass

National Technical Systems

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

Standard Referenced: EN 61000-4-11 Date: 7/27/2022

Temperature: 26°C Humidity: 48% Pressure: 838 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Printing/scanning mode (Laser Configuration #3)

Test Engineer: T. Wittig

% Nominal	No. of Cycles	Phase Angle (deg)				Time between dropouts (sec)	Number of tests	Comments	Criteria Met	Pass/ Fail
		0	90	180	270					
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
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
0%	300	x				30	3		A	Pass
0%	300			x		30	3		A	Pass
129Vac Line Voltage Variations (+7.5% of nominal 120V) 2hrs.									A	Pass
105Vac Line Voltage Variations (-12.5% of nominal 120V) 2hrs.									A	Pass
Surges of +15% line variations of nominal voltage (138V) 2hrs.									A	Pass
Surges of -15% line variations of nominal voltage (102V) 2hrs.									A	Pass

5.7.4 Test Photographs

Voltage Dips and Interruption Setup

5.7.5 Test Equipment List

Table 5.7-1: Voltage Dips and Interruptions Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059918	Ground Plane (Fixed)	National Technical Systems	GP #2	NCR	NCR
WC059439	Meter (Digital Multimeter)	Fluke	85	07/30/2021	07/30/2022
WC059668	Oscilloscope (Digital)	Tektronix	TDS2002B	06/21/2022	06/21/2023
WC059767	Power Supply (AC)	California Instruments	1251P	NCR	NCR
WC059768	Generator (Spike/Transient)	Thermo Fisher Scientific	EMC Pro Plus	11/09/2021	11/09/2022
WC070508	Software	Keytek	CEWare	NCR	NCR
WC078487	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	06/22/2022	06/22/2023

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

End of Test Report