

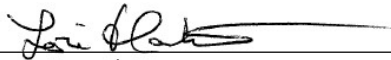
Element Materials Technology Denver-Longmont A.K.A. NTS Labs, LLC Test Report for Electromagnetic Interference (EMI) Testing of the Vanguard Vault

Prepared For

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Prepared By

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A handwritten signature in black ink, appearing to read 'Lori Hartman', written over a horizontal line.

Lori Hartman
Preparer

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Eugene DeVito
Program Manager

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Revision History

Rev.	Description	Issue Date
0	Initial Release	04/22/2025
1	Customer's edits incorporated for PN and Mode of Operation	04/30/2025

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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 at Element Materials Technology Denver-Longmont (hereafter referred to as "Element"). The test program was conducted to assess the ability of the specified Equipment Under Test (EUT) to successfully satisfy the requirements defined in the test specification.

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
- SLI Compliance Purchase Order 20250319-02 dated 03/19/2025.
- Element Quotation OP0671388 dated 03/19/2025.
- ISO/IEC 17025:2017(E) *General Requirements for the Competence of Testing and Calibration Laboratories*, dated 11/2017.

3.0 Product Selection and Description

SLI Compliance 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	Vanguard Vault	VV-600 2007030	V2520003701
2	1	Vanguard Vault Ballot Box	2007060	X2520014901
3	1	ATI	2007080-A	NA
4	1	Imprinter	2007050	I2520013501
5	1	Headphones	Headphones	NA
6	1	ATI	2007080	NA

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 (Immunity)

Measurement Type	Measurement Unit	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
Magnetic Immunity	Amps	NA	./+/- 0.8%
Pulsed Magnetic Immunity	Amps	NA	./+/- 9.9%

5.0 Test Description 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	Longmont	04/18/2025	VV-600 2007030	V2520003701	Passed
					2007060	X2520014901	
					2007050	I2520013501	
					Headphones	NA	
					2007080	NA	
5.2	Radiated RF Immunity	VVSG 2.0	Longmont	04/15/2025 - 04/16/2025	2007080	NA	Passed
					VV-600 2007030	V2520003701	
					2007060	X2520014901	
					2007080-A	NA	
					2007050	I2520013501	
5.3	Electrical Fast Transient / Burst	VVSG 2.0	Longmont	04/16/2025	Headphones	NA	Passed
					2007080	NA	
					VV-600 2007030	V2520003701	
					2007060	X2520014901	
					2007050	I2520013501	
5.4	Surge Immunity	VVSG 2.0	Longmont	04/17/2025	Headphones	NA	Passed
					2007080	NA	
					VV-600 2007030	V2520003701	
					2007060	X2520014901	
					2007050	I2520013501	
5.5	Conducted RF Immunity	VVSG 2.0	Longmont	04/17/2025	Headphones	NA	Passed
					2007080-A	NA	
					2007050	I2520013501	
					2007060	X2520014901	
					VV-600 2007030	V2520003701	
5.6	Voltage Dips and Interruptions	VVSG 2.0	Longmont	04/16/2025 - 04/17/2025	Headphones	NA	Passed
					2007080	NA	
					2007050	I2520013501	
					2007060	X2520014901	
					VV-600 2007030	V2520003701	

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

5.1 Electrostatic Discharge

5.1.1 Test Procedure

The EUT was tested in accordance with VVSG 2.0.

5.1.2 Test Result

The EUT passed the defined requirements.

5.1.3 Test Datasheets

Element Materials Technology				
Electrostatic Discharge per IEC / EN 61000-4-2				
Standard Referenced: VVSG 2.0		Date: 4/18/2025		
Temperature: 18°C		Humidity: 33%		Pressure: 833 mb
Input Voltage: 120Vac/60Hz				
Configuration of Unit: Fully exercising all features				
Test Engineer: T. Wittig				
Date	Time	Log Entries	Initials	Result
4/18/2025	0705	Performed ESD check, bleed-off cables measure to 934kohms and 938kohms	TW	Complete
	0708	Client arrived and setup EUT for 4-2 testing	TW	Complete
	0809	Begin Electrostatic Discharge. IEC 6100042, Per Latest Version and test protocol. +/-8kV Contact, +/-2, 4, 8, 15kV Air	TW	---
	0912	Complete Contact discharges	TW	---
		Continue ESD testing Air discharge	TW	---
	1109	Completed 4-2 testing	TW	Pass

Element Materials Technology

Electrostatic Discharge per IEC / EN 61000-4-2

Standard Referenced: VVSG 2.0

Date: 4/18/2025

Temperature: 18°C

Humidity: 33%

Pressure: 833 mb

Input Voltage: 120Vac/60Hz

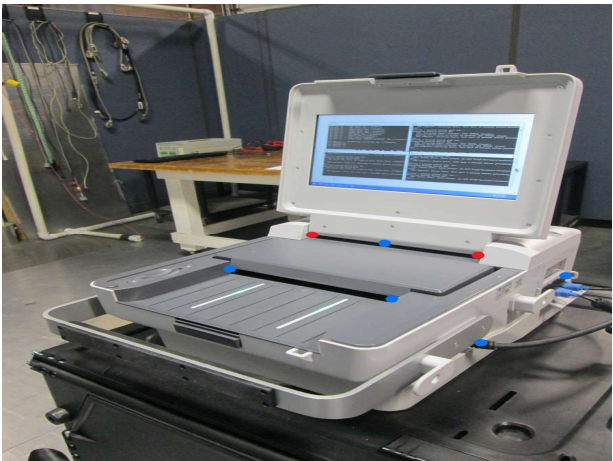
Configuration of Unit: Fully exercising all features

Test Engineer: T. Wittig

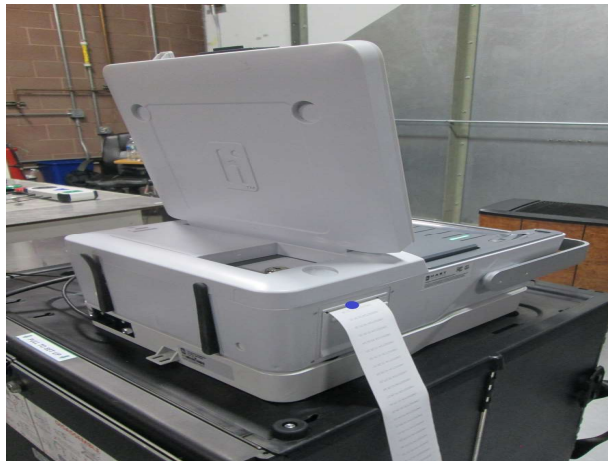
Test Location	Voltage Level	Polarity		Number of Pulses	Pulses Per Second	Comments	Criteria Met	Pass/Fail
	(kV)	+	-					
Indirect Discharge Points								
VCP	8	X	X	10	1	Front Side	A	Pass
VCP	8	X	X	10	1	Left Side	A	Pass
VCP	8	X	X	10	1	Right Side	A	Pass
VCP	8	X	X	10	1	Back Side	A	Pass
HCP	8	X	X	10	1	Edge of HCP at Front of UUT	A	Pass
Contact Discharge Points - RED Arrows.								
Photo 1	8	X	X	10	1		A	Pass
Photo 2	8	X	X	---	---	ND	-	-
Air Discharge Points - BLUE Arrows.								
Photo 1	2, 4, 8, 15	X	X	10	1		A	Pass
Photo 2	2, 4, 8, 15	X	X	10	1		A	Pass

ND: No Discharge points found

5.1.4 Test Photographs



4-2 Test Setup Photo 1



4-2 Test Setup Photo 2



4-2 Test Setup Photo 3



4-2 Test Setup Photo 4



4-2 Test Setup

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	GP1	02/03/2025	05/03/2025
WC059482	Meter (Digital Multimeter)	Fluke	87/5 Multimeter	08/23/2024	08/23/2025
WC059688	Gun (ESD Simulator)	EMC-Partner	ESD3000DN1	07/09/2024	07/31/2025
WC078486	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	08/12/2024	08/31/2025

Calibration Abbreviations

CAL: Calibration

NCR: No Calibration Required

5.2 Radiated RF Immunity

5.2.1 Test Procedure

The EUT was tested in accordance with VVSG 2.0.

5.2.2 Test Result

The EUT passed the defined requirements.

5.2.3 Test Datasheets

Element Materials Technology				
Radiated RF Immunity per IEC 61000-4-3				
Standard Referenced: VVSG 2.0		Date: 4/15/2025 - 4/16/2025		
Temperature: 21°C Humidity: 20%		Pressure: 842 mb		
Input Voltage: 120Vac/60Hz				
Configuration of Unit: Fully exercising all features				
Test Engineer: T. Wittig				
Date	Time	Log Entries	Initials	Result
4/15/2025	0942	Performed 4-3 pre-test verification prior to testing	TW	Complete
	1036	Setup the Vanguard Vault in GP0	TW	Complete
	1058	Begin Radiated RF Immunity - IEC 61000-4-3, Per Latest Version and test protocol. 10V/m, 80 - 1000 MHz, 1% Step, 80% AM, 1kHz sine, 3s dwell	TW	---
		Front side - Ok	TW	---
		Right side: V-Pole - Ok	TW	---
	1256	H-Pole: at ~150 MHz, unit stopped ShoeShine mode	TW	---
		Went back and found the range the shoeshine mode would not operate from 149 - 167 MHz	TW	---
		Continue 4-3 testing on H-pole from 167 MHz to 1 GHz - Ok Please statement from Client below:	TW	---
		<p>* "Based on conversations with Jared (Hart Representative) , it was determined that the shoe-shine functionality operations stopping at 149-167 mHz range is due to the way the test software handles the drivers. In this range, the driver (PDI USB) disables causing the scanner to stop. To resume operations, the device manager is accessed and the PDI USB driver is re-enabled and the test software is then resumed. This appears to be purely a test software issue, no resetting of any hardware takes place during this procedure.</p> <p>The explanation from Jared is that in the official application proper procedure, the driver will be initialized each time the scanner is used.</p> <p>Jared has been asked to provide an RCA for further explanation."</p>	TW	---
	1451	Resume testing on Back side, V-Pole	TW	---
	1519	Back side, H-Pole	TW	---
		Stopped at step 155 at 370 MHz	TW	---
	1549	Done for the day	TW	---
4/16/2025	0706	Client arrived, started EUT for 4-3 testing, found that the Imprinter was not operating properly, client replaced unit with MN: 2007080, NSN.		---
		* See statement from Client below	TW	---

		"Switching out the ATI controller on the Vault from 2007080-A to 2007080. The fault appears to be mechanical rather from testing. It was noticed that the ATI needed to have the button (select, help and jelly switches) needed to be pressed hard to get a response, the scroll wheel operated without issue. It was manageable before but after use it appears to be weakening from its initial state. Backup controller has been placed and all buttons respond as expected."	TW	---
	0726	Re-started 4-3 testing on V-H Poles on the Back side	TW	---
	0832	Completed Back side of EUT - Ok	TW	---
	0835	Begin Right Side	TW	---
*	0945	Completed 4-3 testing, Client will performed post test	TW	*Pass

Element Materials Technology											
Radiated RF Immunity per IEC 61000-4-3											
Standard Referenced: VVSG 2.0					Date: 4/15/2025 - 4/16/2025						
Temperature: 21°C		Humidity: 20%			Pressure: 842 mb						
Input Voltage: 120Vac/60Hz											
Configuration of Unit: Fully exercising all features											
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	10	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	H	3		10	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	V	3	Right	10	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	H	3		10	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	V	3	Back	10	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	H	3		10	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	V	3	Left	10	Pass
80 - 1000	AM	80	1kHz	Sine	1	10	H	3		10	Pass

5.2.4 Test Photographs



4-3 Test Setup - Front



4-3 Test Setup - Right



4-3 Test Setup - Back



4-3 Test Setup - Left

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	Chamber (EMI, Semi-Anechoic)	National Technical Systems	GP0	NCR	NCR
WC059457	Coupler (Bi-Directional)	Werlatone	C3908-10	08/21/2020	NCR
WC059621	Meter (Digital Multimeter)	Fluke	87V	08/28/2023	05/07/2025
WC059710	Amplifier (Pre/RF/Low Noise)	Ophir RF	5127F	09/17/2012	NCR
WC059797	Generator (Signal)	Wiltron	68369B	07/25/2024	07/31/2025
WC059805	Antenna (Log Periodic)	ETS-Lindgren	3142B	NCR	NCR
WC070467	Meter (Power)	Agilent Technologies	E4418B	07/30/2024	07/30/2025
WC070506	Sensor (Power)	Hewlett Packard	E4421A	07/30/2024	07/31/2025
WC076935	Cable (Test)	Teledyne-taber	RF Coax Cable	NCR	NCR
WC078469	Software	ETS-Lindgren	C47213	NCR	NCR
WC078490	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	03/17/2025	03/31/2026

Calibration Abbreviations

CAL: Calibration

NCR: No Calibration Required

5.3 Electrical Fast Transient / Burst

5.3.1 Test Procedure

The EUT was tested in accordance with VVSG 2.0.

5.3.2 Test Result

The EUT passed the defined requirements.

5.3.3 Test Datasheets

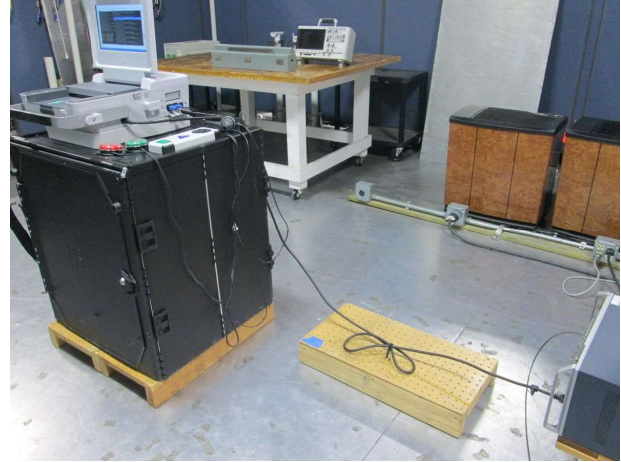
Element Materials Technology				
Electrical Fast Transient/Burst per IEC / EN 61000-4-4				
Standard Referenced: VVSG 2.0		Date: 4/16/2025		
Temperature: 18°C	Humidity: 25%	Pressure: 830 mb		
Input Voltage: 120Vac/60Hz				
Configuration of Unit: Fully exercising all features				
Test Engineer: T. Wittig				
Date	Time	Log Entries	Initials	Result
4/16/2025	1014	Performed 4-4 pre-test verification prior to testing	TW	Complete
		Setup Vault up on GP #1	TW	Complete
	1041	Begin Electrical Fast Transient / Burst IEC 6100044, Per Latest Version and test protocol. Mains: +/-2kV, I/O: +/-1kV. One AC main, Four I/O < 3M	TW	---
		Running at a 100 kHz repetition rate	TW	---
	1103	Completed 4-4 testing	TW	Pass

Element Materials Technology												
Electrical Fast Transient/Burst per IEC / EN 61000-4-4												
Standard Referenced: VVSG 2.0		Date: 4/16/2025										
Temperature: 18°C	Humidity: 25%	Pressure: 830 mb										
Input Voltage: 120Vac/60Hz		Capacitive Coupling Clamp Verification N/A										
Configuration of Unit: Fully exercising all features												
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					100kHz	AC Mains	A	Pass
2.0	±	60	CDN				X		100kHz		A	Pass
2.0	±	60	CDN					X	100kHz		A	Pass
2.0	±	60	CDN	X			X	X	100kHz		A	Pass

5.3.4 Test Photographs



4-4 Test Setup



4-4 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
WC059917	Ground Plane (Fixed)	National Technical Systems	GP1	02/03/2025	05/03/2025
WC059482	Meter (Digital Multimeter)	Fluke	87/5 Multimeter	08/23/2024	08/23/2025
WC059668	Oscilloscope (Digital)	Tektronix	TDS2002B	06/28/2024	06/28/2025
WC059768	Generator (Spike/Transient)	Thermo Fisher Scientific	EMC Pro Plus	12/03/2024	12/04/2025
WC070508	Software	Keytek	CEWare	NCR	NCR

Calibration Abbreviations

CAL: Calibration

NCR: No Calibration Required

5.4 Surge Immunity

5.4.1 Test Procedure

The EUT was tested in accordance with VVSG 2.0.

5.4.2 Test Result

The EUT passed the defined requirements.

5.4.3 Test Datasheets

Element Materials Technology				
Surge Immunity per IEC / EN 61000-4-5				
Standard Referenced: VVSG 2.0		Date: 4/17/2025		
Temperature: 24°C Humidity: 20%		Pressure: 824 mb		
Input Voltage: 120Vac/60Hz				
Configuration of Unit: Fully exercising all features				
Test Engineer: T. Wittig				
Date	Time	Log Entries	Initials	Result
4/17/2025		Performed 4-5 pre-test verification	TW	Complete
		EUT setup and ready to test	TW	---
	0749	Begin Surge Immunity IEC 6100045, Per Latest Version and test protocol.. Mains: +/-2kV CM, +/-2kV, DM, (0, 90, 180, 270)	TW	---
		*At 1000V, L1/L2, 180 degrees, stopped ShoeShine mode	TW	---
		*At 2000V, L1/PE, 180 degrees, stopped ShoeShine mode	TW	---
		*At -2000V, L2/PE, 180 degrees, stopped ShoeShine mode	TW	---
		* is due to the way the test software handles the drivers. In that range, the driver (PDI USB) disables stopping the scanner. The issue is resolved by accessing the device manager and reenabling the driver at which point the operations will resume. This is purely a software issue, there is no resetting of hardware that takes place. In the field, the application process will re-initialize the driver each time the scan is used, similar to reenabling the driver manually through device manager in the test software.	TW	---
	1342	Completed 4-5 testing	TW	*Pass

Element Materials Technology

Surge Immunity per IEC / EN 61000-4-5

Standard Referenced: VMSG 2.0

Date: 4/17/2025

Temperature: 24°C

Humidity: 20%

Pressure: 824 mb

Input Voltage: 120Vac/60Hz

Configuration of Unit: Fully exercising all features

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
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	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



4-5 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
WC059917	Ground Plane (Fixed)	National Technical Systems	GP1	02/03/2025	05/03/2025
WC059482	Meter (Digital Multimeter)	Fluke	87/5 Multimeter	08/23/2024	08/23/2025
WC059668	Oscilloscope (Digital)	Tektronix	TDS2002B	06/28/2024	06/28/2025
WC059768	Generator (Spike/Transient)	Thermo Fisher Scientific	EMC Pro Plus	12/03/2024	12/04/2025
WC070508	Software	Keytek	CEWare	NCR	NCR
WC078486	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	08/12/2024	08/31/2025

Calibration Abbreviations

CAL: Calibration

NCR: No Calibration Required

5.5 Conducted RF Immunity

5.5.1 Test Procedure

The EUT was tested in accordance with VVSG 2.0.

5.5.2 Test Result

The EUT passed the defined requirements.

5.5.3 Test Datasheets

Element Materials Technology				
Conducted RF Immunity per IEC / EN 61000-4-6				
Standard Referenced: VVSG 2.0		Date: 4/17/2025		
Temperature: 25°C	Humidity: 20%	Pressure: 830 mb		
Input Voltage: 120Vac/60Hz				
Configuration of Unit: Fully exercising all features				
Test Engineer: T. Wittig				
Date	Time	Log Entries	Initials	Result
4/17/2025		Setup for 4-6 testing on GP #1	TW	Complete
	1346	Begin Conducted RF Immunity IEC 6100046, Per Latest Version and test protocol. 10Vrms, 0.15 80 MHz, 1% Step 80% AM, 1kHz sine, 3s dwell.	TW	---
	1436	Completed 4-6 testing on AC mains	TW	Pass

Element Materials Technology								
Conducted RF Immunity per IEC / EN 61000-4-6								
Standard Referenced: VVSG 2.0					Date: 4/17/2025			
Temperature: 25°C		Humidity: 20%			Pressure: 830 mb			
Input Voltage: 120Vac/60Hz								
Configuration of Unit: Fully exercising all features								
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



4-6 Test Setup_ACMains

5.5.5 Test Equipment List

Table 5.5-1: Conducted RF Immunity Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059917	Ground Plane (Fixed)	National Technical Systems	GP1	02/03/2025	05/03/2025
WC059482	Meter (Digital Multimeter)	Fluke	87/5 Multimeter	08/23/2024	08/23/2025
WC059655	Generator (Signal)	Hewlett Packard	8648A	11/26/2024	11/30/2025
WC059656	Analyzer (Spectrum)	Rigol Technologies	DSA815	09/20/2024	09/20/2025
WC059657	Amplifier (Pre/RF/Low Noise)	Instruments For Industry	M100	NCR	NCR
WC059661	Network (Coupling/Decoupling)	EMC Integrity	EMCI-CDN-M3-16	12/09/2024	01/30/2026
WC059695	Attenuator (Coaxial)	Aeroflex/Weinschel	40-6-34	01/09/2025	01/30/2026
WC059700	Coupler (Bi-Directional)	Werlatone	C9475-13	01/09/2025	01/30/2026
WC078469	Software	ETS-Lindgren	C47213	NCR	NCR
WC078486	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	08/12/2024	08/31/2025

Calibration Abbreviations

CAL: Calibration

NCR: No Calibration Required

5.6 Voltage Dips and Interruptions

5.6.1 Test Procedure

The EUT was tested in accordance with VVSG 2.0.

5.6.2 Test Result

The EUT passed the defined requirements.

5.6.3 Test Datasheets

Element Materials Technology

Voltage Dips and Interrupts per IEC / EN 61000-4-11				
Standard Referenced: VVSG 2.0		Date: 4/16/2025		
Temperature: 26° C		Humidity: 17%		Pressure: 830 mb
Input Voltage: 120Vac/60Hz				
Configuration of Unit: Fully exercising all features				
Test Engineer: T. Wittig				

Date	Time	Log Entries	Initials	Result
4/16/2025	1124	Setup variable power supply to perform Voltage Dips and Interruptions IEC 61000-4-11, Per Latest test protocol. Electric power increases of 7.5% and reductions of 12.5% of nominal specified power. One AC main 120Vac/60Hz (Inc./Red. of Nom. Voltage)	TW	---
	1133	Begin electric power increases of 7.5% of nominal specified power.	TW	Pass
	1234	Begin reductions of 12.5% of nominal specified power.	TW	Pass
	1335	Begin Surge of +/-15% line variation of nominal line voltage (138V)	TW	Pass
	1436	Begin Surge of +/-15% line variation of nominal line voltage (102V)	TW	Pass
	1545	Done for the day	TW	---
4/17/2025	0654	Performed 4-11 pre-test verification for Voltage Dips and Interruptions IEC 61000-4-11, Per Latest Version and test protocol. 30% nom @10ms / 60% nom @100ms & 1 sec. >95% interrupt @5 sec.	TW	---
		Client brought EUT up for test	TW	---
	0713	Begin 4-11, Voltage Dips and Interruptions	TW	---
	0736	Completed 4-11 testing in full	TW	Pass

Element Materials Technology										
Voltage Dips and Interrupts per IEC / EN 61000-4-11										
Standard Referenced:		VVSG 2.0				Date: 4/16/2025				
Temperature:		26°C		Humidity: 17%		Pressure: 830 mb				
Input Voltage:		120Vac/60Hz								
Configuration of Unit:		Fully exercising all features								
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				10	3		A	Pass
0%	300			x		10	3		A	Pass
Line Voltage Variation Testing										
129Vac Line Voltage Variations (+7.5% of nominal 120V)									A	Pass
105Vac Line Voltage Variations (-12.5% of nominal 120V)									A	Pass
Surges of +15% line variations of nominal voltage (138V)									A	Pass
Surges of -15% line variations of nominal voltage (102V)									A	Pass

5.6.4 Test Photographs



4-11 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
WC059917	Ground Plane (Fixed)	National Technical Systems	GP1	02/03/2025	05/03/2025
WC059482	Meter (Digital Multimeter)	Fluke	87/5 Multimeter	08/23/2024	08/23/2025
WC059668	Oscilloscope (Digital)	Tektronix	TDS2002B	06/28/2024	06/28/2025
WC059675	Power Supply (AC)	California Instruments	5001IX208-150/300	09/07/2023	09/07/2025
WC059768	Generator (Spike/Transient)	Thermo Fisher Scientific	EMC Pro Plus	12/03/2024	12/04/2025
WC070508	Software	Keytek	CEWare	NCR	NCR
WC078486	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	08/12/2024	08/31/2025

Calibration Abbreviations

CAL: Calibration

NCR: No Calibration Required

End of Test Report