

Electrical Hardware Test Plan

EAC VVSG 1.0

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Prepared for:

Vendor Name	<i>Hart InterCivic</i>
Vendor System	<i>Verity 2.3</i>
EAC Application No.	<i>HRT-Verity-2.3</i>
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**Accredited by the Election
Assistance Commission (EAC)
for Selected Voting System Test
Methods or Services**



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1 INTRODUCTION

This test plan covers the EMC (Electromagnetic Compatibility) and EMI (Electromagnetic Interference) test requirements and methods for the Hart InterCivic 2.3 voting system, Verity Scan, Controller / Touch Writer Duo, hereafter known as the Unit Under Test (UUT), to the requirements as stated in Election Assistance Commission 2005 Voluntary Voting System Guidelines Version 1.0.

1.1 Qualifications

The UUT supplied by Hart InterCivic is representative of product produced in their volume manufacturing process.

1.2 Hardware Test Lab Facility

NTS, EMI / EMC Test Lab
1736 Vista View Drive
Longmont, Colorado 80504

1.3 Reference Documents

- Election Assistance Commission: 2005 Voluntary Voting System Guidelines (EAC VVSG), 2005, Version 1.0, Volumes I and II.
- EAC Voting System Testing and Certification Program Manual, United States Election Assistance, v 2.0, May 2015.
- NIST Handbook 150-2016.
- NIST Handbook 150-22-2017.
- NOC 2007-05 - Voting System Test Laboratory (VSTL) responsibilities in the management and oversight of third party testing.
- EAC Notice of Clarification 08-001: Validity of Prior Non-Core Hardware Environmental and EMC Testing.
- EAC Decision on Request for Interpretation 2007-05 (COTS).
- EAC Decision on Request for Interpretation 2008-02 Battery Back Up for Op Scan.
- EAC Decision on Request for Interpretation 2008-10 (EFT) .
- EAC Decision on Request for Interpretation 2009-03 Battery Back Up for Central Count.
- EAC Decision on Request for Interpretation 2010-01 Voltage Levels and ESD Test.
- SLI VSTL Quality System Manual, v 2.6, prepared by SLI, March 28, 2018.



2 Product Description

2.1 Intended Use

The UUT is intended to be used in the polling place environment.

2.2 Unit Under Test

Product / Model	Serial Number	Description	Qty
Verity Scan 3005800	S1801828310 S1801828210 (ESD)	Verity Scan - Precinct ballot scanner device.	2
Verity Controller (3005825), Touch Writer Duo daisy chain configuration. (3005700) 1x Controller 2x Touch Writer Duo	C1801827310 B1801826910 B1801825610 ESD: C1801827710 B1801826210 B1801825110	Verity Controller - is a poll worker device use for management of voting devices. Verity Touch Writer Duo - is a voting device that prints to ab 8.5"x11" or 8.5"x14" thermal paper ballot. They are networked together via a daisy-chain network cable (100Mbit Ethernet over a proprietary cable). An optional accessibility controller (ATI) may be equipped.	2 set

2.3 AC Power Adapter

Product	Manufacturer	Model	Part Number
Verity Scan, Controller, & Touch Writer Duo	SL Power Electronics	TE60B2449F02	N/A

2.4 Power Requirements

Input Voltage Rating as it appears on unit, power supply, or power brick	100-240VAC, 50-60Hz, 1.5A
Input Current (specify @ 230 Vac/50 Hz)	1.5A (100-240VAC, 50-60Hz)
Input Power	120VAC



2.5 Support Equipment (SE)

Product / Model	Serial Number	Description	Qty
Ballot Box	N/A	For Scan	1
Accessible Booth with ATI Tray	N/A	For Touch Writer Duo	1
Standard Booth	N/A	For Touch Writer Duo	1

2.6 UUT Software / Firmware

Name	Version / Revision	Functionality
Test Software	2.3.0 / 2.3.1	Election software for operational status check.
Firmware	V17	Verity Device Microcontroller.
Firmware	V1	Verity Touch Writer Duo Microcontroller.

2.7 Accessories

Type	Model	Function
Test Ballots	N/A	View Ballots
Verity Key - Security Key	N/A	User authentication and configuration of election security.
Verity vDrive	N/A	Load election definitions, record CVRs and audit logs.
COTS Jelly Switch	N/A	Enable voters with limited body mobility to vote independently and privately.
COTS headphones	2005230	For visually impaired voters and voters having trouble reading the ballot.
Hart Verity ATI Module	2005018	Audio-Tactile Interface (ATI) intended for voters that cannot, or prefer not to, use the touch screen.

2.8 Engineering Changes

Hardware changes include the following:

- New tablet board due to the end-of-life of the current Intel chip. Same plastics, same look. Selectively phased-in to the following only:
 - A. Verity Scan
 - B. Verity Controller
 - C. Verity Touch Writer Duo (will only be tested with the new board)
- Verity Scan: new tablet motherboard and scanner head due to obsolescence and cost. Same manufacturer. Going from PageScanIV to PageScanV.



3 Operating Modes and Test Configuration

3.1 Operating Modes

Prior and during testing, proper operation of the UUT shall be confirmed using Hart InterCivic software. An operational status check shall be performed prior to and after each test to fully exercise the UUT and ensure that no damage has occurred as a result of the test.

To fully exercise all the features of each product, diagnostic software is run during electrical tests to exercise the model's particular hardware features.

Verity Scan:

- Scanner LEDs to Set Ready to Scan (green indicators)
- Set poll worker LED to voting in session (flashing blue)
- Tablet Locked
- Scanner – Continuously scanning in “shoe shine” mode. The scan rate is approximately once every 30 seconds
- File I/O test running.

Controller, and 2 **Touch Writer Duo** units are daisy-chained via network cables. All ports are active:

Controller:

- Printing to thermal printer
- Writing data to USB flash drive
- Bar code scanner plugged in and actively scanning (trigger held down).
- Network data transfer to/from Touch Writer Duo devices.

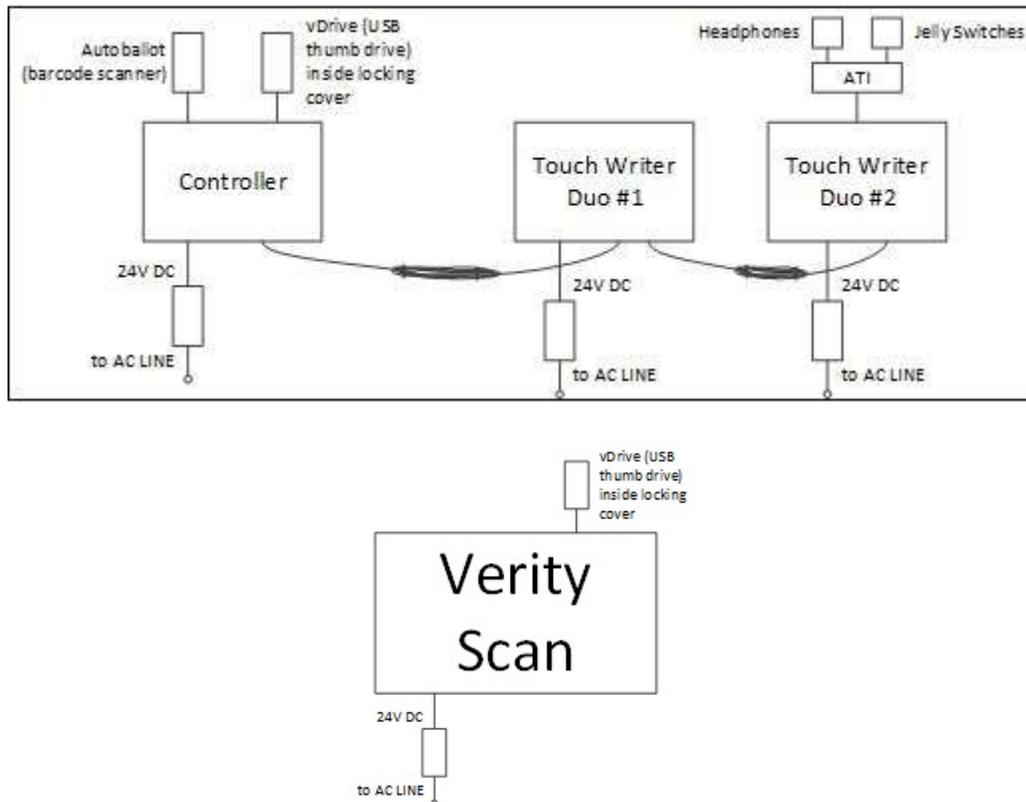
Touch Writer Duo (unit 1):

- Network data transfer to/from Controller
- Printing to thermal printer
- Paper path indicator LEDs lit
- Set poll worker LED to voting in session
- Tablet Locked

Touch Writer Duo (unit 2):

- Network data transfer to/from Controller
- Printing to thermal printer
- Paper path indicator LEDs lit
- Set poll worker LED to voting in session
- Tablet Locked
- Optional Accessibility controller attached:
 - playing audio to headphones
 - ATI: red/green jelly buttons plugged in
 - Displaying button presses from ATI

3.2 Block Diagram



3.3 Treatment of Test Failures

Failures of electrical tests or failures of the exercising software to perform shall be documented in the electrical test report.

3.4 Backup Units

Backup units of the same model with unique serial numbers may be used throughout EMC/EMI testing provided the following criteria are met:

- Issue with the UUT
- Backup unit is identical to the UUT
- All hardware components are listed in Manufacturer’s BOM or APL

3.5 Test Documentation

A test report shall be obtained from the test lab that meets the pertinent requirements of EN45001, and ISO/IEC17025, “General Requirements of Testing and Calibration Laboratories”.



4 EMC / EMI Test Requirements

4.1 Electromagnetic Emissions

Objective: To verify that the electromagnetic emissions generated by the product under normal use and in the product's intended environment are below a level as specified by the 2005 VVSG 1.0.

4.1.1 Radiated Electromagnetic Emissions

Test Method: FCC Part 15, Radio Frequency Devices

Deviations from Test Method: None

Exit Criteria: The UUT shall meet the following emissions limits:

Frequency Band (MHz)	Class B Equipment 10m Measurement Distance (dBuV/m)
30 – 88	29.5
88-216	33.1
216 – 960	36.6
960-1000	43.5
1000-5000 (GHz)	43.5

4.1.2 Conducted Electromagnetic Emissions

Test Method: FCC Part 15, Radio Frequency Devices

Deviations from Test Method: None

Exit Criteria: The UUT shall meet the following emissions limits:

Frequency Band (MHz)	Class B Equipment Quasi-Peak Measurement (dBuV)	Average Measurement (dBuV)
0.15 – 0.5	66 decreasing with the log of the frequency to 56	56 decreasing with the log of the frequency to 46
0.5 – 5.0	56	46
5.0 – 30	60	50

4.2 Electromagnetic Immunity

Objective: To verify that the product performs as intended when exposed to different types of electromagnetic energies that may be encountered under normal use in the product's intended environment.



4.2.1 Immunity Compliance Criteria

Criteria A: The UUT shall be able to withstand the test without disruption of normal operation or loss of data.

Criteria B: The UUT shall be able to withstand the test without damage or loss of data. The equipment may reset or have momentary interruption so long as normal operation is resumed without human intervention or loss of data. Loss of data refers to votes that have been completed and confirmed to the voter.

Criteria C: The COTS and support equipment may have temporary loss of function or degradation of performance, where the correction **does not require** operator intervention or system reset.

4.2.2 Electrostatic Disruption

The test for electrostatic disruption **shall** be conducted in compliance with the test specified in IEC 61000-4-2 (2008-12) Ed. 2.0. *Contact discharge at the 8 kV level is the preferred test method. Where contact discharge cannot be applied, air discharge shall be used at all four identified test levels (2 kV, 4 kV, 8 kV, 15 kV). During exploratory pre-testing, investigation of the possibility of windowing effects should be explored. If there are indications that a unit has sensitivity at a lower voltage but not at a higher voltage, test levels shall be added to evaluate the immunity at lower voltage levels*

Test Method: IEC61000-4-2, Ed. 2, Electrostatic Disruption Test, (2008)

Test Levels: Will not exceed the required ESD limits for all ESD test levels.

Test Location	Discharge Voltage +/- (kV)
Indirect Contact: HCP	8.00
Indirect Contact: VCP	8.00
Direct Contact to Metallic Surfaces	8.00
Air Discharges to Insulated Surfaces	2.00, 4.00, 8.00, 15.00

Deviations from Test Method: None

Exit Criteria: B

4.2.3 Electromagnetic Susceptibility

Test Method: IEC61000-4-3, Radiated, Radio-Frequency, Electromagnetic Field Immunity Test, (1996)



Test Levels:

Frequency Range (MHz)	Test Level (V/m)	Modulation / Sweep
80 to 1000	10 V/m	1 kHz 80% AM, 1% steps with 3s dwell
Clock Frequencies	10 V/m	1 kHz 80% AM, 1% steps with 3s dwell

Deviations from Test Method: None

Exit Criteria: A

4.2.4 Electrical Fast Transient

Test Method: IEC61000-4-4, Electrical Fast Transient Test, (1995-01)

Note: Repetition Rate for all transient pulses will be 100 kHz

Test Levels:

- a. +2 kV and -2 kV on External Power lines (both AC and DC)
- b. +1 kV and -1 kV on Input/Output lines (signal, data, and control lines) longer than 3 meters
- c. Repetition Rate for all transient pulses will be 100 kHz

Deviations from Test Method: None

Exit Criteria: A

4.2.5 Lightning Surge

Test Method: IEC61000-4-5, Lightning Surge Test, (1995-02)

Test Levels:

Test Voltage: +/- kV	Coupling Mode
+/- 2 kV	AC line to line (Differential Mode)
+/- 2 kV	AC line to earth (Common Mode)
+ or - 0.5 kV	DC line to line >10m (Differential Mode)
+ or - 0.5 kV	DC line to earth >10m (Common Mode)
+/- 1 kV	I/O sig/control >30m

Deviations from Test Method: None

Exit Criteria: A

4.2.6 Conducted RF Immunity

Test Method: IEC61000-4-6, Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields, (1996-04)

Test Levels:

Conducted RF Energy



10V rms over the frequency range 150 KHz to 80 MHz with an 80% amplitude modulation with a 1 KHz sine wave AC & DC power.
10V sig/control >3 m over the frequency range 150 KHz to 80 MHz with an 80% amplitude modulation with a 1 KHz sine wave

Deviations from Test Method: None

Exit Criteria: A

4.2.7 Magnetic Fields Immunity

Test Method: IEC61000-4-8, Power Frequency Magnetic Field Immunity Test, (1993-06)

Test Levels:

AC magnetic fields of: 30 A/m at 60 Hz.

Deviations from Test Method: None

Exit Criteria: A

4.2.8 Electrical Power Disturbance

Test Method: IEC61000-4-11, Voltage Dips, Short Interruptions and Voltage Variations Immunity Tests, (1994-06)

Test Levels:

Electrical Power Disturbance
Voltage dip of 30% of nominal @10 ms;
Voltage dip of 60% of nominal @100 ms & 1 sec
Voltage dip of >95% interrupt @5 sec
Surges of + 15% and - 15% line variations of nominal line voltage
Electric power increases of 7.5% and reductions of 12.5% of nominal specified power supply for a period of up to four hours at each power level

Deviations from Test Method: None

Exit Criteria: A

5 EMC / EMI Test Summary

The following Table shows the tests to be performed on the UUT.

Test	Test Specification	VVSG 1.0	Comments
Electromagnetic Emissions Tests			
Radiated Electromagnetic Emissions	FCC, Part 15 Class B ANSI C63.4	V1: 2.1.4 (b,c), 4.1.2.9, 4.1.7.1 V2: 4.8	



Test	Test Specification	VVSG 1.0	Comments
Conducted Electromagnetic Emissions	FCC, Part 15 Class B ANSI C63.4	V1: 2.1.4 (b,c), 4.1.2.9, 4.1.7.1 V2: 4.8	
Electromagnetic Immunity Tests			
Electrostatic Disruption	IEC 61000-4-2 (2008-12) Ed.2.0	V1: 2.1.4 (b), 4.1.2.8, 4.1.7.1 V2: 4.8	See RFI 2010-01
Electromagnetic Susceptibility	IEC 61000-4-3 (1996)	V1: 2.1.4 (b), 4.1.2.10, 4.1.7.1 V2: 4.8	
Electrical Fast Transient	IEC 61000-4-4 (2004-07) Ed.2.0	V1: 2.1.4 (b), 4.1.2.6, 4.1.7.1 V2: 4.8	
Lightning Surge	IEC 61000-4-5 (1995-02)	V1: 2.1.4 (b), 4.1.2.7, 4.1.7.1 V2: 4.8	
Conducted RF Immunity	IEC 61000-4-6 (1996-04)	V1: 2.1.4 (b), 4.1.2.11, 4.1.7.1 V2: 4.8	
Magnetic Fields	IEC 61000-4-8 (1993-06)	V1: 2.1.4 (b), 4.1.2.12, 4.1.7.1 V2: 4.8	
Electrical Power Disturbance	IEC 61000-4-11 (1994-06)	V1: 2.1.4 (b), 4.1.2.5, 4.1.7.1 V2: 4.8	60 Hz input of 120/60 (0.6 cycles, 6 cycles, 300 cycles)

6 Handling Hardware Anomalies and Incidents

6.1 Hardware Test Anomalies

An anomaly with the subcontractor’s test equipment or a procedural misstep can cause a test to fail. For any suspected test equipment issue or procedural error, analysis will be performed and the decision whether to continue testing based on the severity of the anomaly will be appropriately tracked. The subcontractor test lab will issue a corrective action to address any test equipment and/or procedure errors. This is part of the hardware test subcontractor’s quality system process that allows the hardware test lab to train all personnel, repair/calibrate equipment, and prevent any recurrence.

6.2 Hardware Incident Process

For every test failure of any voting system component at the hardware test lab, the lab completes a data sheet (per their laboratory procedures and templates) and immediately informs the SLI Hardware Specialist or designated SLI personnel. This can be communicated in the daily status update, with the data sheet attached.

- **Failure Analysis:** Once a failure has occurred, the SLI Hardware Specialist or



designated SLI personnel will be involved with the subcontractor test lab(s) to identify the hardware discrepancy in the device. The results of the analysis will be documented and tracked in the discrepancy reporting tool used for the test campaign. The analysis will focus on the failure, what caused the failure, the severity (minor or major), and possible impacts to other testing.

- Mitigation: The SLI Hardware Specialist or designated SLI personnel monitors any work done by the manufacturer, with the full understanding of what is occurring and why.
 - The Manufacturer will document what work is done and the SLI Hardware Specialist or designated SLI personnel will sign off on or can stop the work at any time.
 - The Hardware Specialist or designated SLI personnel will determine the number of "minor" fixes the manufacturer can incorporate without a re-start of the test.
 - A **minor** change made by the manufacturer can include grounding the chassis or adding ferrites.
 - Any **major** component replacement is cause for failing a test and requiring a restart. Example: Bad motherboard. Analysis: What was the cause; did the ESD test cause the motherboard to malfunction? Does this impact other hardware tests? The Manufacturer can only replace like for like components and this process must be monitored by the SLI Hardware Specialist or designated SLI personnel.
 - Any modification to the equipment is followed up with the related manufacturer EC(s). All related ECs must be entered into the hardware test report and the certification test report.

When issues are identified during hardware environmental testing, they result in discrepancies. Discrepancies are tracked in the discrepancy reporting tool.

End of ELEC Hardware Test Plan
