

# Voting System Qualification Test Report

## *Election Systems & Software, LLC*

### *EVS Release 4.5.3.0, Version 1*

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Division of Elections  
R. A. Gray Building, Room 316  
500 S. Bronough Street  
Tallahassee, FL 32399-0250

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## Executive Summary

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Election Systems & Software, LLC submitted an application requesting Florida certification of the *EVS Release 4.5.3.0, Version 1* voting system. This release is a modification to the *EVS 4.5.2.0, Version 1* release (certified on June 15, 2016). Specifically, *EVS 4.5.3.0, Version 1* provides a new central count high-speed scanner, the DS450®; the election management system (EMS) was revised to accommodate the new scanner model. In addition, changes in ExpressVote® and the EMS allow ExpressVote to display candidates in a contest in dual columns, as well as other minor enhancements. The Election Reporting Manager® (ERM) has undergone optimization within the archiving process.

The voting system application submitted for certification includes an election management system known as ElectionWare®; a precinct scanner (DS200®); two devices for Florida voters with disabilities—a precinct ballot marking device (AutoMARK®) and a vote capture device with a verifiable paper record that is digitally scanned for tabulation (ExpressVote); and two models of high-speed central count scanner (Model DS850® and the new Model DS450). Precinct results may be uploaded to the election management system manually, or via wireless or landline modems.

BVSC conducted the certification testing in two phases. Phase I consisted of verifying the setup of the two configurations of the election management system, restoration/import of two elections (general and primary elections), creation of two elections (municipal and presidential preference primary elections), a physical audit, and a functional audit. BVSC then conducted mock elections and election cycle events, such as loading the tabulators with the requisite media, opening and closing of polls, feeding ballots, central count tabulation, and election night and post-election reporting. BVSC performed tests to verify compliance with standards for accessibility. Phase II consisted of conducting contest recounts, conducting mass ballot count testing for the DS450 central count scanner, and conducting additional tests as necessary to observe the voting system's capabilities.

Qualification test results affirm that the voting system under test, *EVS Release 4.5.3.0, Version 1*, met applicable requirements of the Florida Voting Systems Standards, Florida Statutes and Rules, and the Help America Vote Act for usability and accessibility. BVSC, therefore, recommends certification of the referenced voting system.

## Introduction

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Election Systems & Software, LLC (ES&S) submitted an application requesting Florida voting systems certification of the *EVS Release 4.5.3.0, Version 1* voting system. This release is a modification to the certified *EVS Release 4.5.2.0, Version 1* (certified on June 15, 2016).

*EVS 4.5.3.0, Version 1* provides a new central count high-speed scanner, the DS450®; and changes to the election management system (EMS) to accommodate the new scanner model. In addition, changes in ExpressVote® and the EMS allow ExpressVote to display candidates in a contest in dual columns, as well as other minor enhancements. The Election Reporting Manager® (ERM) has undergone optimization within the archiving process.

The scope of the certification effort included verifying that the voting system under test met the applicable standards, rules, statutes, and federal laws for use in the state of Florida. Testing included qualification testing, regression testing on machines that did not change, such as the DS850®, DS200®, ExpressVote, and AutoMARK®, and a mass ballot count test of the DS450. Volume testing of any voting machines or marking devices is considered to be outside the scope of this certification. Testing was completed on December 19, 2017.

## System Overview

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*EVS 4.5.3.0, Version 1* is a paper-based voting system with an element for compliance with the Help America Vote Act (HAVA) provisions for precinct voting. The Florida certified voting system includes the Election Management System (EMS), a precinct scanner, Americans with Disabilities Act (ADA)-compliant accessibility devices, and central count scanners.

The EMS hardware platform is configured as either a stand-alone or a server/client configuration. The stand-alone configuration includes the election management system and the election results reporting manager; whereas, the server/client configuration includes one or more workstations (clients) which interconnect with a server. The system includes an option to upload election results wirelessly or using an analog modem.

The EMS software configuration includes:

- ElectionWare® – an election management system that integrates the jurisdiction, districts, contests, and candidate databases as the main pre-voting phase and post-voting phase that allows ballot images to be viewed. It provides the method to configure elections, create ballot design, add languages (including audio), export ballot/election definitions and view ballot images.
- Election Reporting Manager – a client application used for integrating the acquisition, consolidation, and reporting of election results. Additional ERM clients can be configured to display scrolling results and over the Intranet.
- Regional Results Transfer – an optional application that allows results files accumulated on DS200 media devices at remote polling locations to be sent to the county's central office from sites around the county that collect several local, or "regional," precinct results. The results files are loaded from the DS200 media devices into the Regional Results Transfer station at each regional site, which in turn sends the results to the county's central office.
- ExpressLink® – an ancillary on-demand application that prints a voter's ExpressVote activation card with the appropriate ballot style information (using the ExpressVote Activation Card Printer).

ExpressLink can run in either a standalone mode or in monitor mode<sup>1</sup> where it monitors requests from a voter registration system over a shared network folder.

The voting equipment includes the DS200, ExpressVote, AutoMARK Voter Assist Terminal, the DS850, and introduces the DS450.



The DS200 is a voter interface device used to scan paper ballots. It is a precinct tabulator that can also be used for tabulating vote-by-mail ballots (formerly known as absentee ballots). This tabulator captures the voter's selections and digitally images the ballot. The DS200 uses a universal serial bus (USB) drive for downloading the election definition, provides an option to capture cast ballot images on the USB, and provides the election results on the USB. The results data can be directly uploaded into ERM or the DS200 can transmit results via secure wireless or analog network telecommunications into ERM.



The ExpressVote is a voter interface device approved in Florida for use by voters with special needs. This system combines paper-based voting with touch screen technology to produce an independent voter-verifiable paper record that is digitally scanned for tabulation. The voter uses the ExpressVote to navigate the ballot through touchscreen, physical keypad, assistive support peripherals such as a sip and puff device, or other assistive equipment such as a two position switch. The ExpressVote includes a mandatory vote summary screen that requires voters to confirm or revise selections prior to printing the summary of ballot selections using the internal thermal printer. Once printed, ES&S ballot scanners process the vote summary card.



The ExpressVote rolling kiosk houses the ExpressVote. This hard-sided enclosure provides voter privacy screens, angle adjustment to accommodate seated or standing voters, and a secure repository for marked ExpressVote vote summary cards to be tabulated at a later time.

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<sup>1</sup> Monitor mode testing with voter registration systems is outside the scope of Florida certification testing.



The AutoMARK Voter Assist Terminal (VAT) is a voter interface device that allows a voter to mark a blank, preprinted ballot or assists a voter with contest selections via visual display, audio, or both. The voter uses the AutoMARK to navigate the ballot through touchscreen, physical keypad, assistive support peripherals such as sip and puff device, or other assistive equipment such as a two position switch. Also, the voter can use the AutoMARK to review a marked ballot and either to cast the ballot into an optical scan tabulator (like the DS200) or, if available, to deposit the ballot into an attached ballot box, known as the AutoCAST™, for later tabulation.



The DS850 optical tabulator is a high-speed scanner for use with vote-by-mail ballot tabulation or contest/race recounts. The DS850 uses digital cameras to image paper ballots, capture voter selections on the image, and evaluate the results. It uses a USB drive for downloading the election definition, captures the cast ballot images on the USB, and provides the results on the USB. The results data are uploaded into ERM. The DS850 also uses two commercial off-the-shelf (COTS) printers, one for printing reports and the other for recording and printing an audit log.



This certification application introduces the DS450 high-throughput scanner and tabulator. The DS450 is very similar to the DS850. It is used for vote-by-mail ballot tabulation or contest/race recounts and employs the same technology for capturing ballot images, evaluating voter selections, downloading the election definition, and uploading results. The DS450 also uses two commercial off-the-shelf (COTS) printers, one for printing reports and the other for recording and printing an audit log.

## Components under Review

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The components of the voting system being reviewed for certification include the following:

- Upgraded ElectionWare election management system
- Upgraded Election Reporting Manager (ERM)
- Upgraded ExpressVote (ballot marking device for voters with disabilities)
- Upgraded ExpressVote Previewer (EMS component)
- An optional DS450 central count tabulator/scanner

## Conduct of Tests / Findings

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The test objective was to verify that the *EVS Release 4.5.3.0, Version 1* voting system meets the applicable requirements of the Florida Voting Systems Standards (FVSS), Florida Statutes and Administrative Rules, and HAVA for usability and accessibility.

The FVSS qualification examination for this effort encompassed a physical and functional audit of the components under review. BVSC conducted additional tests to verify compliance with standards for sound pressure levels and to observe ballot sensitivity. In addition, BVSC conducted a mass ballot count test on the new DS450 central count tabulator, as well as regression testing on other voting equipment to ensure that system modifications did not affect unchanged procedures.

### Physical Audit

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BVSC conducted a physical audit to verify that the voting system under test matched the specifications described in the application and the technical data package (TDP) documentation. The audit covered the election management system in both the standard and the standalone configurations, all precinct and central count scanners, and all accessible voting devices.

#### **Findings:**

BVSC found no issues with the setup of the ElectionWare voting system configurations or the configurations of the scanners or accessible voting devices.

### Functional System Audit

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BVSC conducted a functional system audit to verify that all components of the voting system operated as described in the TDP.

### Voting Equipment Menus – Administrative and Diagnostic Reports

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BVSC performed a functional audit by testing all available menu options and administrative reports as well as systems functions in the course of testing.

### Mock Elections

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BVSC conducted mock elections incorporating multiple-card ballots of varying ballot lengths (11-inch to 19-inch). BVSC used four election types: presidential preference primary (PPP), municipal, primary, and general. The tests included both hand marked and machine marked ballots, as well as those cast via the accessible voting ballot marking devices (AutoMARK and ExpressVote), and used single-card and multi-card elections. All activities simulating an election were conducted using all equipment, from initial preparations and L&A, through voting, election night and precinct level reporting, as well as recounts and post-election audit activities. BVSC used ballot test decks and pre-determined results to compare to actual results.

### Pre-Election Activities

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Pre-election activities included coding or verifying the coding of the election database for each of the four election types (PPP, municipal, primary, and general), preparing the election media, preparing the ballot

test decks, preparing and validating the expected results, and preparing the voting equipment. A universal primary contest (UPC) was included in the primary election definition.

### *Election Activities*

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Election activities included opening polls, casting ballots using prepared test decks, and closing polls.

### *Post-Election and Reporting Activities*

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BVSC examined test results against expected results. Post-election activities included producing extensible mark-up language (XML) election night and precinct-level results files and generating system reports.

Activities included uploading election results and verifying results in the ERM by defined election group (vote-by-mail voting, early voting, Election Day voting, and provisional voting). BVSC uploaded results directly, since modem testing was done in a separate test.

As an ancillary component of the voting system, the XML file utility, which produces the partial and complete summary XML files and the 30-day precinct-level XML files, was examined in a separate environment using an in-house developed program to verify that the tool could produce these files as expected.

### **Findings:**

The system performed as indicated in the vendor's TDP and in accordance with FVSS, Florida Statutes, and Administrative Rules.

Staff was able to verify that the XML utility correctly produced the files in the specified XSD format and that the vote totals (candidate, total precinct votes, and total precinct groups) matched the report totals.<sup>2</sup>

### *Central Count Tabulator Mass Ballot Count*

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BVSC conducted a mass ballot count with three DS450 central count scanners using a primary election definition. The minimum requirement is a ballot count of 192,000 ballots. The number of scanners to be used for this activity is at the vendor's discretion. The test deck contained 20 precincts (including three split precincts), with 16 ballot cards for each precinct and/or precinct split, and four political parties. Staff ran the test deck through three DS450 units fifteen times, for a total of 192,000 ballots.

Specific details follow:

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<sup>2</sup> Since content is user driven by each county who defines distinctly its election in the tabulation system, the content was not programmatically validated.



**Table 1. Mass Ballot Count details for DS450**

Election definition used:	Primary Election
Ballot length:	14 inches
Number of scanner units used:	3
Number of test deck sets:	40
Number of runs per test deck:	15
Number of ballots per deck:	320
Number of cards per ballot:	1
Total number of ballots cast:	192,000
Total number of vote targets:	10,876,800

## **Findings**

The mass ballot count test was successful. The tested DS450s met the acceptance criteria for the central count scanner mass ballot count. No anomalies were observed. BVSC satisfactorily scanned 192,000 ballots with 10,876,800 vote targets.

Acceptance criteria are shown in the table below:

**Table 2. Acceptance criteria for DS450**

DS450 Mass Ballot Count – Acceptance Criteria	Expected	Accepted
Did the memory registers overflow?	No	✓
Did the public counters increment appropriately?	Yes	✓
Did the tabulated results agree with predetermined vote totals?	Yes	✓
Number of errors (must not exceed 1 in 1,000,000 vote targets). An error is defined as a target scan that produces a result other than the expected result.	≤ 1/1M vote targets	✓
Number of multiple feeds (must not exceed 1 in 5,000 ballots). A multiple feed occurs when the machine pulls multiple ballots and does not “catch” the error.	≤ 1/5K ballots	✓
Number of incorrect rejections of ballots (must not exceed 3%)	≤ 3% total ballots	✓

## **Contest Recounts**

BVSC conducted a recount to verify compliance with section 102.141(7), F.S., and Rule 1S-2.031, Florida Administrative Code (governing recount procedures). BVSC selected one countywide race and one district-

wide race in the general election, and suppressed the results of all other races, as per rule. The recount was conducted using a DS450 high throughput tabulator.

### **Findings:**

BVSC found that the voting system under test complied with applicable statutes and standards. ElectionWare allows the user to report results from only the affected races. Furthermore, a recount can be conducted on more than one race at a time, as demonstrated by processing both the countywide race and district-wide race in one recount.

## **Folded Ballots**

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Although Florida law and FVSS do not require this test, BVSC conducted a folded-ballot test to simulate the processing of vote-by-mail ballots. The objective was to observe the behavior of the DS450 tabulator when folded ballots are scanned.

BVSC created a test deck with 11-inch PPP election ballots and 17-inch primary election ballots. Different fold types were included in each test deck.

BVSC cast ballots into the DS450 and compared the results.

### **Findings:**

The DS450 scanner operated as expected. It accepted all ballots it was programmed to accept, and rejected ballots it was programmed to reject, such as overvoted, undervoted, and write-in<sup>3</sup> ballots.

## **Scanner Sensitivity**

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BVSC subjected the DS450 to scanner sensitivity testing. Since neither the DS850 nor the DS200 underwent a firmware change, these tabulators were not included in this test activity. Florida law and FVSS have no requirements for this test, so results are obtained for information purposes only. The purpose of the scanner sensitivity test is to observe the scanner's ability to read marks made by various types of marking instruments (pens, pencils, highlighters, etc.). The sensitivity test also demonstrates the scanner's ability to detect a marking when the vote target is not fully or properly marked (such as "✓", "X", "O", etc.).

BVSC created the test decks by marking the first position on blank ballots with various marking instruments. The test deck included two ballots for each marking instrument: a baseline ballot with selected ovals fully marked (●), and a test ballot marked with a horizontal line 1 millimeter thick through the center of the target (⇨).

For testing the scanners' ability to detect a variety of improperly marked targets, BVSC marked the target using the vendor's approved pen (VL Ballot Pen - a BIC Grip Roller ball point pen (.7mm), Part# 6100). These results were compared to a baseline of the same targets, fully marked (●), using the same pen.

### **Findings:**

BVSC observed that the DS450 central count scanner is able to detect a wide variety of marks made by several different marking instruments. However, the scanner consistently detected marks by marking instruments limited to softer grades of pencil (2B to 6B), a black felt tip pen, and the vendor's

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<sup>3</sup> Write-ins are not included in primary election ballots; they were included in this test for observation purposes and to maximize test resources.

recommended pen (VL Ballot Pen). As such, the vendor clearly documents in its user manual and other documentation the recommended marking device(s).

## Accessibility – Force

The force test is used to determine compliance with section 101.56062(1)(l), F.S., which requires that “the force required to operate or activate the controls must be no greater than 5 pounds of force.” BVSC conducted the force test during an accessible-voting session on the ExpressVote using a calibrated Dillon model GL digital force gauge and multiple voter input methods: the touchscreen and the audio tactile keypad.

### **Findings:**

No measurement exceeded the maximum of 5 pounds of force. BVSC found that the ExpressVote complied with section 101.56062(1)(l), F.S.

## Accessibility – Sound Pressure Level

The sound pressure level test is conducted to verify conformance to section 101.56062(1)(g-i), F.S., which describes the sound pressure level standards for a voting system’s audio voting features. BVSC conducted a sound pressure level test on the ExpressVote, whose firmware version changed since the last certification. BVSC tested the ExpressVote using the AVID brand audio headsets supplied by the vendor.<sup>4</sup>

BVSC used an ITU-T P.50<sup>5</sup> test signal that was incorporated into an election definition. The test signal replaced the initial sound file normally heard by a voter at the beginning of an accessible voting session. The election definition repeated the test signal as a loop. BVSC captured instrument readings for the duration of the loop.

### **Findings:**

BVSC found that the ExpressVote complies with the applicable statute. The results of the sound pressure level tests for the ExpressVote are in the table below.

**Table 3. Sound pressure level test results - ExpressVote**

Sound Pressure Level Test Results – ExpressVote				
	Average Maximum Volume (dBA) <sup>6</sup>	Average Default Volume (dBA)	Gain (dBA) <sup>7</sup>	Intermediate Level (dBA) <sup>8</sup>
<b>Right Headphone</b>	100.98	63.10	37.88	76.40
<b>Left Headphone</b>	101.88	63.50	38.38	75.90

<sup>4</sup> The vendor’s application for certification lists “AVID [brand] stock headphones” in the Component Version List. The TDP recommends “3.5mm” headphones (ExpressVote Maintenance Manual, Firmware Version 1.4, Document Revision 1.0, September 15, 2017, pg. 8). The vendor supplied the following: AVID educational headphones (unmarked).

<sup>5</sup> ITU-T P.50 - “ITU-T” is the telecommunication standardization sector of the “ITU,” which is the International Telecommunication Union. ITU is a United Nations specialized agency for information and communication technologies. The “P.50” represents one of their “P Series” objective transmission standards/measures used for testing the transmission quality of artificial voices.

<sup>6</sup> Must be greater than 97 dB (decibels weighted).

<sup>7</sup> Maximum volume minus default volume. Must be greater than 20 dB.

<sup>8</sup> Must be between (Default volume + 12 dB) and 97 dB.

## Accessibility – Voter Interface

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BVSC verified that the ExpressVote satisfies requirements for voter interface and interactions in accordance with applicable statutes and standards. Characteristics of the system such as ballot appearance, languages, input methods and feedback were examined.

### **Findings:**

BVSC found that the ExpressVote complied with applicable statutes and standards.

## Simulated Failure / System Recovery

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BVSC tested the ability of both the ExpressVote and the DS450 to shut down in a controlled manner according to specifications, and recover from a simulated systems failure when the equipment is disconnected from the electrical outlet.

For the ExpressVote, BVSC staff powered up the unit and disconnected the AC adapter. The equipment was left running on battery power until the unit drained the battery and performed a shutdown operation. Ballots were marked at a rate of 8 ballots/hour during the test. BVSC reconnected the AC adapter and reviewed the audit log to determine the length of time the machine remained in a usable state before complete drainage of the battery power occurred. The table below reflects the outcome of this test.

**Table 4. ExpressVote battery life test results**

ExpressVote Battery Life Test Results		
	Battery Life per TDP	Actual Battery Life
ExpressVote	At least 2 hours	5 hours 3 minutes

The DS450 has no internal battery; however, ES&S recommends that the equipment be connected to an uninterruptable power supply (UPS)<sup>9</sup> which will, according to TDP documentation, provide the ability to complete an interrupted run, initiate a controlled shutdown, and correctly save and disposition data on re-start.

### **Findings:**

- The ExpressVote battery pack powered the device for longer than the stated minimum battery life. It is expected that in a real-world scenario, in which the unit would be utilized during the battery interval, battery power would drain quicker relative to the number of ballots processed.
- The DS450 unit successfully powered up, retained all counts and tabulation, and operated as expected. The DS450 does not allow ballot tabulation while the unit is on backup power. The unit displays a series of warnings and gives instructions for the user to save any unsaved data and manually power down the machine. In addition, the backup power supply emits a series of beeps at about 30-second intervals and the machine displays a final warning 60 seconds before performing a final shutdown.

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<sup>9</sup> ES&S recommended UPS specification: APC Back UPS RS 1500 or Back UPS Pro 1500

## Modems

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BVSC conducted regression testing of the ability of the voting system to report and accumulate results from precinct scanners via modem communication. Staff used the general election definition and test deck from the General mock election<sup>10</sup>, used earlier in this certification. Staff tested six DS200 precinct scanners, each using a different modem carrier or technology (landline, AT&T®, Sprint®, and Verizon Wireless®). Staff also used the PPP mock election test deck for a second modem test on a primary election.

### **Findings:**

BVSC verified that the voting system performed as expected.

## Source Code Review

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BVSC examined the source code with Klocwork® static source code analysis tool. BVSC determined that *EVS 4.5.3.0, Version 1* source code posed no significant safety, security, or operational risks.

## Conclusion

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Qualification test results affirm that the voting system under test, *EVS Release 4.5.3.0, Version 1*, met applicable requirements of the Florida Voting Systems Standards, Florida Statutes and Administrative Rules, and HAVA for usability and accessibility. The Florida Division of Elections, Bureau of Voting Systems Certification, therefore, recommends certification of the referenced voting system.

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<sup>10</sup> The General mock election was conducted using the 2012 Miami-Dade County election definition. The vendor selected the election definition for testing based on requirements as stipulated in the test plan.

Copies of this election definition were used to conduct additional testing, such as the modem test, due to availability and other test design considerations.

## Appendix A – Tables Index

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## Appendix B – Acronyms

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ADA	Americans with Disabilities Act
BVSC	Bureau of Voting Systems Certification
CF	Compact Flash (memory cards)
COTS	Commercial off the Shelf (software/hardware)
EAC	U.S. Election Assistance Commission
EMS	Election Management System
ESS	Election Systems & Software, LLC
EVS	ElectionWare Voting System
F.S.	Florida Statutes
FVSS	Florida Voting Systems Standards
GB	Gigabytes
HAVA	Help America Vote Act
LAN	Local Area Network
L&A	Logic and Accuracy (voting system test)
MB	Megabytes
PPP	Presidential Preference Primary election
TDP	Technical Data Package
USB	Universal Serial Bus
VVSG	Voluntary Voting Systems Guidelines
XML	Extensible Markup Language
XSD	XML Schema file

## **Appendix C – Component Version List**

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The component version list describes in detail the components of the voting system.

*[Redacted pursuant to section 282.318, Florida Statutes, and to the U.S. Department of Homeland Security's designation of elections as a critical infrastructure.]*





Florida Department of State  
**KEN DETZNER**  
Secretary of State