



VSAP BALLOT AND QR CODES

VERIFICATION, AUDITABILITY, ACCURACY AND SECURITY



The Voting Solutions for All People (VSAP) Ballot Marking Device (BMD) is a voting innovation that improves the voting experience for all voters using technology while retaining a paper ballot as the official, durable and auditable record of the voter's selections. Throughout the voting experience guidance is provided to the voter promoting verification of selections prior to and after printing the paper ballot. Importantly, the BMD does not record votes electronically and does not retain any information about the voter's ballot after the voting session has ended.

Los Angeles County is working closely with our Technical Advisory Committee, that includes national experts in the field of election technology, design and research, to ensure the will of the voters is accurately reflected in election results. Central to this assurance is the voter's ability to verify that the BMD accurately recorded the voter's selections on the paper ballot. It also implemented a security architecture that uses secure boot and trusted computing to minimize the chance that unauthorized and/or malicious software could be installed on the device.

THE BMD BALLOT

The BMD ballot is printed on specially coated thermal paper designed to be durable enough to ensure retention throughout the legally required period associated with the election. An official tint and watermark for the election, provided by the California Secretary of State (SOS), is printed on the back of the ballot. The BMD ballot has four areas of information, as can be seen in Figure 1 below.





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Ballot Style
22300
Serial Number
1
Precinct Number
9950001A

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DEMONSTRATION BALLOT

VSAP Demonstration Election

VSAP
Voting Solutions
for All People

County of Los Angeles

MAYOR	LATOYA WILLIAMSON	4N	PRESIDENT AND VICE PRESIDENT	CAROL HOW /ANDY WU	N
UNIFIED SCHOOL DISTRICT BOARD MEMBERS	SANDRA WOODS	4E	UNITED STATES SENATOR	PORTER VANDEVOORDE	Y
	No Selection	H			
	No Selection	J			
STATE SENATOR	DORIS TRAN	3C			
MEMBER OF THE STATE ASSEMBLY	RUSSEL RIVERA	3K			
UNITED STATES REPRESENTATIVE	MONIQUE JACKSON	35			
DISTRICT MEASURE A	YES on Measure A	4S			
COUNTY SUPERVISOR	KENDRICK YOUNG	45			
JUDGE OF THE SUPERIOR COURT	KASEY MCCRARY	3Z			
COUNTY MEASURE B	NO on Measure B	4A			
GOVERNOR	ANTONY BATHLONE	X			
For Chief Justice of Supreme Court	NO	3Q			
For Presiding Justice, Court of Appeal, Second Appellate District, Division One	NO	3S			
For Presiding Justice, Court of Appeal, Second Appellate District, Division Two	NO	3U			
For Associate Justice, Court of Appeal, Second Appellate District, Division One	NO	3W			
For Associate Justice, Court of Appeal, Second Appellate District, Division Two	NO	3Y			

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1. The Election Header, across the top and down the left side, consisting of the Official Ballot designation, the election title and date, the party (for Presidential Primary elections only), and the County name and seal.
2. A Ballot Activation QR code in the upper left corner, which tells the BMD which ballot style to activate. The ballot style, serial number and precinct number, (a numeric ID for the precinct) are also printed to the right of this QR code.
3. A Vote Selections Print Area below the election header, where the contest names and vote selections are printed for each contest on the ballot. Printed to the right of each selection (i.e. candidate name or measure response) is the unique ID of the vote selection. This information is the official record of the votes cast and is also used for auditing and recount purposes.
4. A Vote Selections QR Code below the County name and seal, which encodes the vote selection IDs in the same order in which they are printed on the ballot. The QR code issued by the VSAP Tally System to read and process the votes cast on the ballot.

Figure 1. Sample of a voted and printed BMD ballot.





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QR CODE VERIFICATION

The QR code is a widely used, open format for encoding data in a resilient two-dimensional barcode. Since it is an open format, there are numerous free applications that are publicly available for scanning and decoding a QR code, so that the contents may be read. Any voter can use a QR code reader to scan the Vote Selections QR code on their ballot and verify that the selections in the QR code are match the selections printed on the ballot.

Visual Ballot Inspection

As an example, when the Vote Selections QR code printed on the ballot shown in Figure 1 is scanned by a QR code reader, the following data will appear:

```
VER:A.SEL:4N/4E/H/J/3C/3K/35/4S/45/3Z/4A/X/3Q/3S/3U/3W/3Y/N/Y.
BMD:0000046.SIG:4R57D5C44QKEJRS3OBF33PL0Z6U9THBR74NTA1VVH
K09E6NFDH4DWXPY8Q9ZF6VD0LAQ1E6IY6AGQC1S4TG095N8NEN3AFOET12.
```

This data is stored as a string of text organized in a key-value pair format designed for the BMD. The table in Figure 2 provides a breakdown and description of the key-value pairs in the example above.

Key	Value	Description
VER	A	Version of the VSAP key-value format
SEL	4N/4E/H/J/3C/3K/35/4S/45/3Z/4A/X/3Q/3S/3U/3W/3Y/N/Y	The vote selection IDs listed in the same order as those printed on the ballot
BMD	0000046	Device ID of the BMD
SIG	4R57D5C44QKEJRS3OBF33PL0Z6U9THBR74NTA1VVHK09E6NFDH4DWXPY8Q9ZF6VD0LAQ1E6IY6AGQC1S4TG095N8NEN3AFOET12	The digital signature applied to the data in the Ballot Activation and Vote Selection QR codes by the BMD security module

Figure 2. Description of key-value pairs encoded in the Vote Selections QR code.

QR Code Independent Audit

Voters can also go online to check the values of vote selection IDs that are contained in the QR code. The values to be checked are only contained in the SEL key values in the QR code (see text in red above). To do so, voters can go online here (<https://lavote.net/ballot-marking-device-code-list>). The webpage shows the SEL key values and the respective values in human readable text (in English). Voters can use browser’s search mechanism to perform searches of SEL key value and see the respective value.

¹ For example, on iOS devices like the iPhone there are apps such as QR Code Reader (TapMedia LTD), Barcode Scanner, and others. On Android devices, the native Camera app has QR code reading capabilities, however there are also dedicated apps such as QR Code Reader (TWMobile). You can install one of these apps and point them at the QR code in the image of the ballot at the beginning of this paper and verify that you get the same result as reported.

