

**VoTeR Center**

**UConn Voting Technology Research Center**

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## **Engineering Notes:**

### **Follow up on the problem encountered in the Town of Wilton using new non-volatile memory cards**

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**Version 1.0**

#### **Summary**

In preparation for the November 2012 elections, problems were reported in the Town of Wilton when the new nonvolatile cards were undergoing pre-election testing. The AccuVote Optical Scan tabulator was not able to use the cards for some technical reason. Subsequently VoTeR Center examined the data on these cards and found no problems. On the possibility that something may be wrong with the Wilton tabulator, a follow up visit to Wilton by a Center Engineer was scheduled. The examination of the tabulator determined that at least one of the pins on the tabulator's connector differed from the rest of the pins. It was also observed that the nonvolatile cards showed intermittent poor connections with the tabulator as compared to the standard (older) cards. This suggested that the dimensions of the cards were not identical. Detailed comparisons were made of the dimensions of the two card types. It was determined that the dimensions differed by 10% in the thickness of the card in the pin area and by 20% in the distance of the pin contacts from the edge of the card. This explains why the connections between the standard card and the tabulator are tighter and more reliable than the connections between the new card and the tabulator. The conclusion is that the connectors on the tabulators need to be diligently maintained and replaced as needed, and that the new nonvolatile cards, while being software compatible, are not 100% compatible in physical dimensions. Electro-mechanical problems are possible given that the new cards are smaller in key pin dimensions.

This analysis was performed on request of the Office of the Secretary of the State.

## **A. The Results of AV-OS Examination in Wilton**

Town of Wilton reported problems in preparation for the November 2012 elections when the new style nonvolatile cards were undergoing pre-election testing. Specifically, the Registrar of Voters reported that when they tried to use the new cards in Wilton District 2 during the pre-election procedure, the AV-OS (AccuVote Optical Scan) tabulator showed “Remove write protected card” immediately after inserting the card into the machine. The same behavior was observed for both new memory cards, serial numbers 001135872 and 001135883.

The Center received these memory cards from the Town of Wilton on December 5, 2012. The examination of the card contents showed no problems: the cards contained correct data and programming for Wilton District 2. There were no problems using the cards with the Center’s tabulators, and the pre-election testing was successfully performed with both cards.

During our follow-up with the Registrars of Voters, it was mentioned that they tried to use these cards with only one (primary) AV-OS tabulator in District 2. Thus, it was possible that the AV-OS tabulator was the cause of the problem. Prior reports also indicated that in some cases the AV-OS connector, called the J40 connector, was responsible for poor contacts between the card and the tabulator. This information, along with the examination of the memory card specification from EPSON (the original manufacturer of the cards) led us to believe that the J40 connector may be a contributing factor. On February 4<sup>th</sup>, Tigran Antonyan examined the AV-OS in question (AV-OS S/N: 40126) at location in Wilton.

The examination revealed a problem with the J40 connector: the connector pin #1 on the AV-OS was much lower compared to the rest of the pins. This was observed even without opening the top lid of the machine by looking into the card insertion slot (less than 4mm) with the help of a flashlight.

The tabulator was tested using the old and the new memory cards. It was noted that when inserting a new nonvolatile memory card, the “low battery” indicator (the “#” sign in the lower left corner of the AV-OS LCD display) was flashing. This indicates that the pins are not very well connected. When inserting an original memory card, the card is recognized as usual. This strongly suggested that in addition to the observed problem with the J40 connector there are physical differences between the new (nonvolatile) and the original card. This led the Center to examine the physical dimensions of the two cards.

We also note that both card types were properly recognized by the second tabulator (AV-OS S/N: 40127) in District 2 of Wilton.

## **B. Differences in the Dimensions of the Cards**

The Center measured the dimensions of the two card types used with AccuVote Optical Scan (AV-OS) voting tabulators with the focus on the size of the electrical connectors. Two important physical differences were readily identified when comparing the new nonvolatile memory card with the original memory card (powered by CR2016 3V battery).

### Connector Area Thickness

The thickness of the connector area is essential for the AV-OS J40 connector to make a solid contact with all 40 pins of the memory cards when they are inserted into the AV-OS tabulator.

The measurements show that the new card is about 10% thinner in this area as compared to the original card: 1.63 mm for the new card vs. 1.80 mm for the original card.



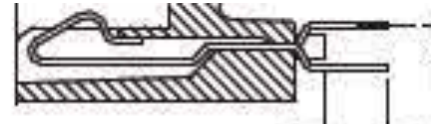
Original battery-powered card



New nonvolatile card

#### Card Thickness Measurement at the Connector Area

The cross-section of the pin on the J40 connector is shown in the figure. The card presses down on the pin when the card is inserted. This indicates that the connections are tighter when using the thicker original card.

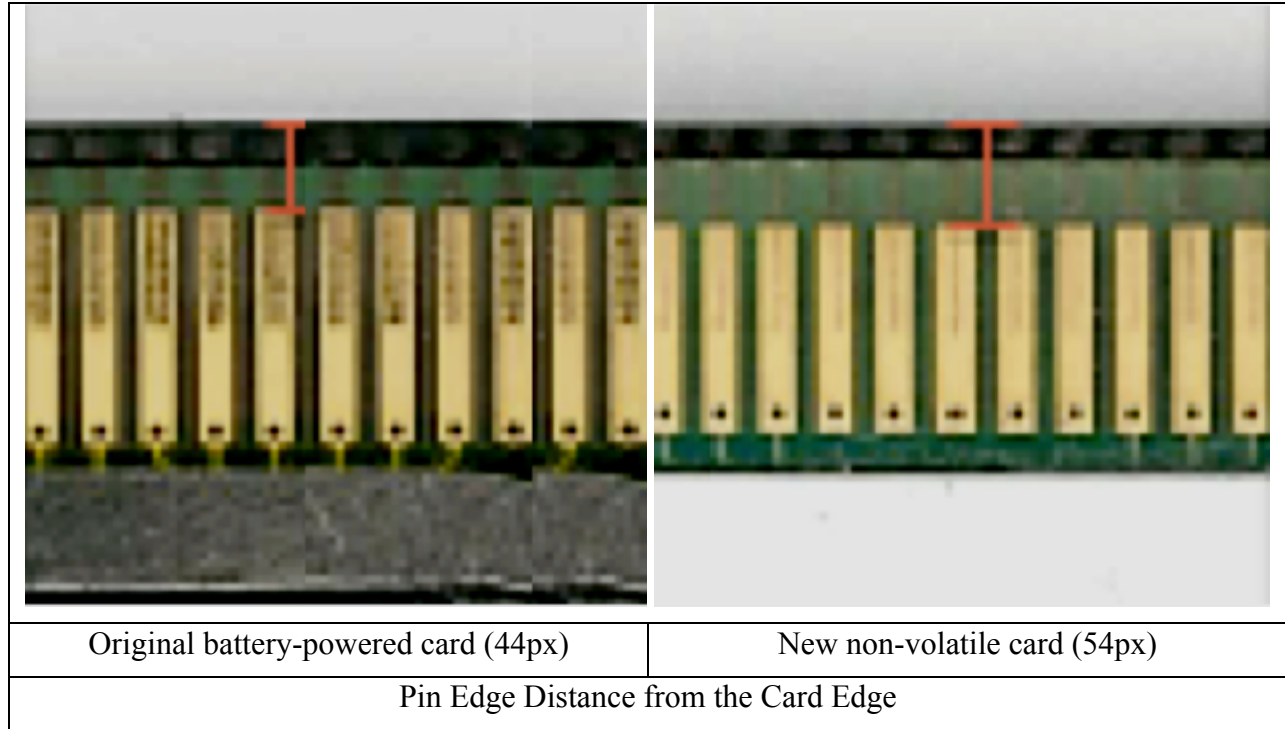


### Pin Edge Distance From Card Edge

Measurements were also taken of the distance from the card edge to the edge of the connector pin. To measure this distance we used a flatbed optical scanner (Ricoh Aficio MP 6001) at 600 dpi. We measured the distance in pixels (px) using an image editor.

This distance for the original card is 44px as compared to the 54px for the new card. This is about a 20% difference. At 600dpi the difference of 10px =  $10 * 25.4 / 600 = 0.423$  mm.

While we note this difference, it is not clear whether this is a contributing factor to the observed problem.



### Conclusion

The reported problem (“Remove write protected card” error) is due to the J40 connector’s physical condition on the AV-OS S/N 40126 (Wilton, District 2). The connector needs to be replaced.

Furthermore, during the routine maintenance of the tabulator the J40 connectors in all tabulators need to be inspected.

Lastly, due to the physical differences between the old and the new cards, we conclude that while the new nonvolatile memory cards (P/N 181-001004 REV 1) normally work without problems in AV-OS tabulators, a less-than-perfect conditions of the J40 connectors may lead to malfunctions when using the new cards.

[end]