OMB Control # 3265-0024.
Expires: 9/30/2025

Voting System Anomaly Root Cause Analysis Template v2.0

Root Cause Analysis for:

VV40ECT-74: VxScan Radiated Electromagnetic Emissions (Class B) Failure at 54 MHz and 66 MHz - Rev. 1
VxSuite, Version 4.0 and EAC Certification #VXS4

VotingWorks
548 Market St, Ste 53001
San Francisco, CA 94104-5401

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Contents

Introduction

This document describes the cause of failure of Radiated Electromagnetic Emissions testing (IEC61000-4-3 (2020) Level 3) from 30 MHz to 1 GHz in the hardware certification process with SLI Compliance and Element in March 2025. In that test, excess RF emissions were detected in the lower range of the spectrum, and even when using an improved backup power supply (APC Back-UPS Pro, BN1500M2) and other mitigations, problematic spikes were detected at approximately 54 and 66 MHz. Previous RF emissions testing conducted on VxScan in July 2024 with NOVO Engineering and Nemko did not show this issue. An investigation of the issue was then important to narrow down its cause at SLI/Element and prevent it in the design going forward.

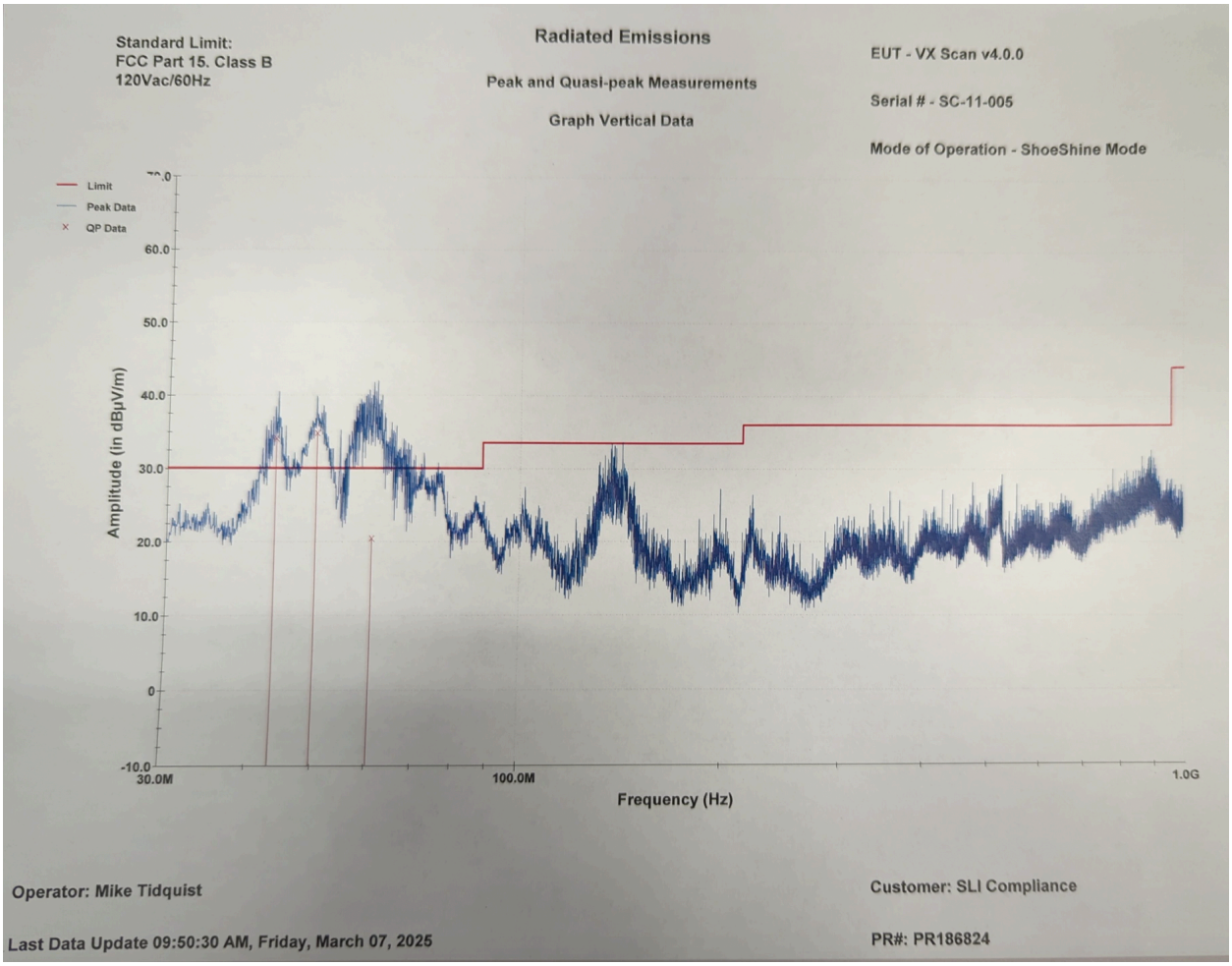
Anomaly Description

Complete all sections. Descriptions must be as detailed as possible, while being clear and concise since the anomaly is the source of the entire RCA. This detail should include a complete list and/or description of the "symptoms" of the anomaly and the conditions present which the symptoms occurred.

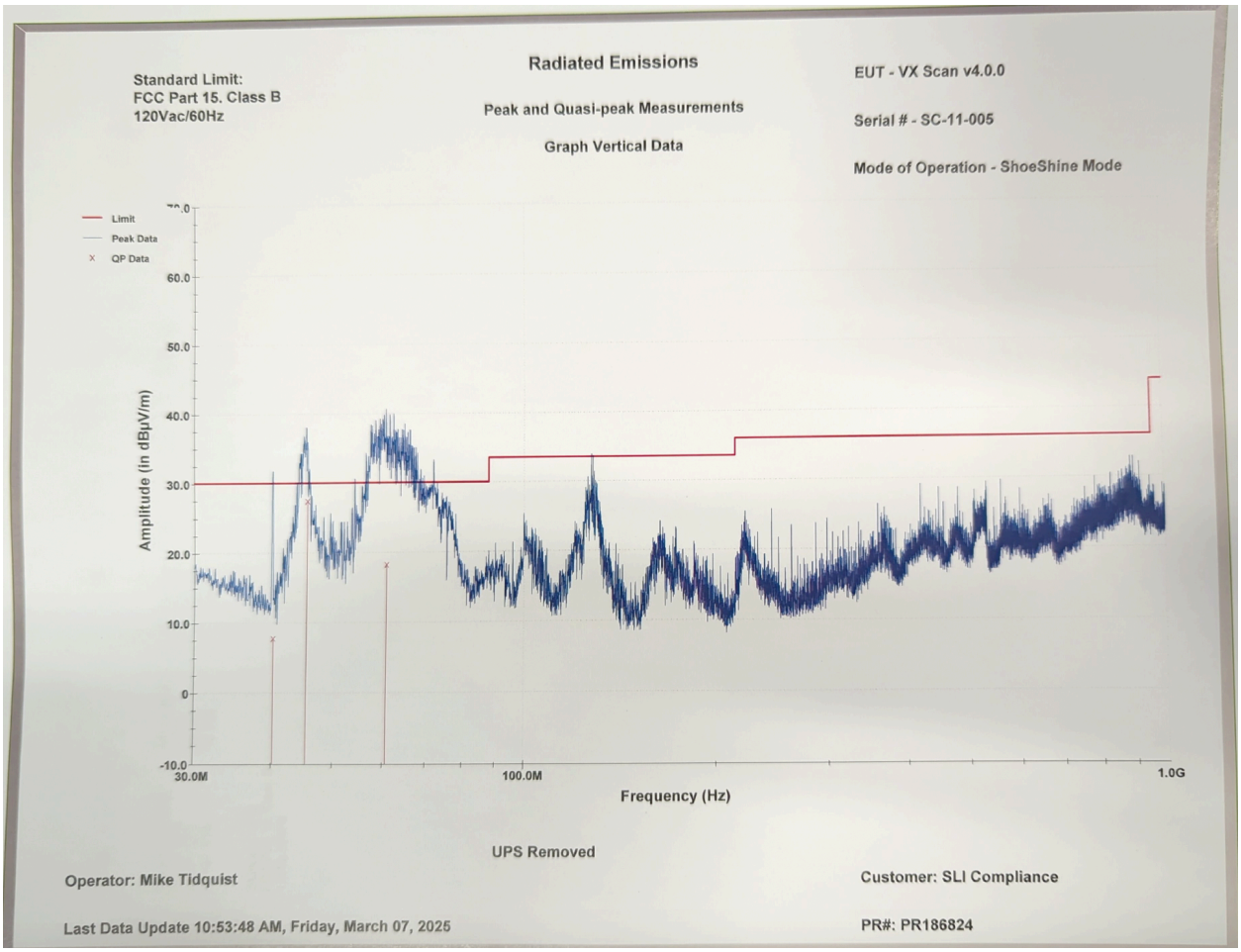
Date of Anomaly: March 7, 2025	Time of Anomaly: 9 AM (Mountain Time)
Place of Anomaly: Element, Longmont, CO	Person identifying Anomaly: Jessica Myers, VotingWorks
Expected Results of actions leading up to anomaly: VxScan and the Anker UPS were set up to undergo standard tests for radiated emissions (FCC Part 15, Class B) at Element in Longmont, Colorado with SLI Compliance. The system was expected to pass emissions tests without issue, based on past EMC testing with NOVO Engineering and Nemko in July 2024 where VxScan did not show concerning emissions. The tests at SLI had slightly different conditions from tests in July 2024 that did not have the Anker UPS, but emissions were not expected to be worse with the UPS at SLI.	

Detailed description of the event / anomaly:

Instead of passing emissions tests, the VxScan system when connected with the Anker UPS failed Radiated Emissions testing from 30 Mhz to 1 GHz. Since this was unexpected, a series of additional tests followed to confirm emissions behavior of the system, showing that the UPS appeared to show problematic emissions. This can be seen in emissions data from when VxScan was powered through the UPS connected to mains (first graph below, QP amplitudes exceeding desired amplitudes in red):



Powering VxScan directly through mains and no UPS also showed some noisy emissions in a similar frequency range, but the QP amplitudes did not exceed emissions limits in this case. So connecting the Anker UPS appeared to contribute to the excess emissions (2nd graph below, exceeding desired amplitudes in red):



Applying mitigations, such as replacing the Anker UPS with the APC UPS, still appeared to show excess emissions in the lower frequency band, with spikes around 54 and 66 MHz, although QP data were not available.

If the anomaly is repeatable, provide step by step instructions to recreate it:

- Image VxScan with a test software (“Hardware Test Utility”) that continuously runs its major components, including running the scanner in shoeshine mode.
- Set up the VxScan system to be powered from the Anker UPS, which in turn is powered by plugging directly into mains.
- Power on VxScan and run the test software utility. Insert a sheet of paper, thermal paper, USB stick, and smart card into VxScan to implement shoeshine mode.
- Measure radiated emissions from the system according to FCC Part 15, Class B, standards.

Chronology of Events / Timeline

Provide a detailed chronology of the events leading up to, and following, the anomaly. Add additional events if necessary.

ID	Date/Time	Description	Entity Org/person	Result / Notes
1	3/7/25, 8:30am (Mountain Time)	VxScan + Anker UPS was scanned for radiated emissions, 30 MHz - 1 GHz, according to FCC Part 15, Class B, standards. Two ferrites were clipped onto the scanner USB data cable to the SBC, to address previous successful radiated RF immunity mitigations that led to passed tests.	Jessica Myers, VotingWorks, with SLI Compliance and Element	System failed emissions test, with excess emissions around 40-65 MHz, especially in the vertical direction. Initial investigations with a near-field probe indicated ~50 MHz noise from the Anker UPS near the main control panel and screen. The VxScan system also showed a source of noise around the right side of the scanner access panel door, near the printer stepper motor. It was also noted that this noise was present with the UPS wireless functionality switched off according to the user-controlled IoT button on the front. If the IoT button were on, more emissions would be expected in the higher frequency range. Plans were made to retest using an alternate UPS (APC) already used for VxMark, another product in the VxSuite family.
2	3/10/25, 12:20pm	VxScan + APC UPS was scanned for radiated emissions, 30 MHz - 1 GHz.	Jessica Myers, Don Chu, VotingWorks, with SLI Compliance and Element	System failed emissions test, with excess QP emissions spikes at about 54 MHz and 66 MHz. Overall noise across the spectrum was lower than in the Anker tests, and the APC data was noticeably cleaner. A near-field probe was used to analyze more sources of emissions around the system. Plans were made to test additional mitigations to the VxScan unit itself to the printer motor housing and cables and the touchscreen control electronics, in an attempt to attenuate potential sources of the spikes.
3	3/10/25, 2:38pm	VxScan + APC UPS, with more mitigations, was scanned for radiated emissions, 30 MHz - 1 GHz.	Jessica Myers, Don Chu, VotingWorks, with SLI Compliance and Element	Data was collected on these potential mitigations with the APC UPS, although no QP data was collected to definitively say if the mitigations could have passed. Similar spikes were seen in the lower frequency range.

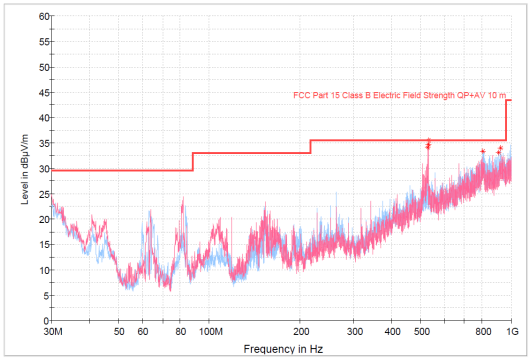
				Plans were made to (1) continue other EMC tests at Element to analyze the system and the Anker UPS, and (2) do deeper investigations on VxScan emissions with an outside party: NOVO Engineering in San Diego. The initial focus of NOVO was to analyze the UPS and the printer, since data from SLI/Element suggested those were sources of problematic emissions.
4	3/31/25	NOVO Engineering finished conducting EMC tests of interest on another VxScan unit, along with a new Anker UPS and APC UPS, sharing findings with VotingWorks.	Al Walters, Jeff Johnson, NOVO Engineering, with Pius Wong VotingWorks	The Anker UPS failed Voltage Drop tests, while the alternate UPS (APC) passed. Minimal differences in the UPS's were found in the other emissions, EFT, and voltage interruption tests. Emissions were analyzed with a near-field probe, with plans to investigate it further according to FCC Class B standards with test vendor Nemko.
5	4/1/25	The VxScan units at Element/SLI were examined to assess the possibility that some cabling features were acting as an antenna and emitting low frequency noise, a known potential failure mode NOVO Engineering had discovered previously in July 2024.	Chris Pedersen, VotingWorks	Three VxScan units at Element/SLI were examined visually and physically (004, 005, and 007). Grounding wires connected to the scanner were confirmed to be connected and routed properly. This suggested that the failure mode NOVO discussed in July 2024 may not be applicable to the current units at Element/SLI, and further investigations of other sources of the noise were needed.
6	4/25/25, 2pm (Pacific Time)	After NOVO Engineering continued EMC testing of VxScan over several weeks, e-field probe analysis suggested a possible source of emissions near 55 MHz during printing. This led to testing an individual printer component outside VxScan. Copper shielding applied around the isolated board external to VxScan mitigated these emissions partially, according to probe data.	Al Walters, NOVO Engineering, with Jesse DeWald, VotingWorks	Data was collected on emissions from the VxScan unit using 2 versions of the Hardware Test Utility: the original version (Hardware Test Utility v1) that used too much paper for each line of text, and the updated version (Hardware Test Utility v2) that unspooled a more realistic and reasonable amount of paper with each printed line. This data suggested the printer system might be a source of low frequency emissions, at least in the near-field. VotingWorks prepared a test rig for NOVO to analyze the printer subsystem by itself. Further probing identified the printer control board near the power connections as a potential source of emissions in question. Emissions spikes from 55-470 MHz appeared to be reduced following copper foil shielding applied to the printer controller board.

7	4/27/25, 3pm (Pacific Time)	NOVO Engineering analyzed the VxScan printer controller with an h-field near-field probe. Results did not corroborate or clarify earlier probe findings about the printer controller board.	Mike Engelmann, Al Walters, NOVO Engineering	NOVO engineers performed emissions testing of the VxScan using the H20 h-probe from a TekBox TBPS1WA2/20 EMC probe set. This was independent of the e-field probe used previously. None of the observed emissions replicated the low frequency characteristics of the SLI test failure. Additionally, EMC measurements were performed using the same probe with the scanner grounding wire disconnected and separately with the ground point of the printer control board disconnected. No differences in the emission spectra were observed. Plans were made to scan VxScan and UPS configurations in 3m and 10m chambers for deeper analysis, to isolate far-field sources of emissions instead of just near-field.
8	4/28/25, 4pm (Pacific Time)	Standard FCC emissions testing was performed on VxScan in different configurations for benchmark data: 1. 3 m chamber, Anker UPS, Hardware Test Utility v1 2. 10 m chamber, Anker UPS, Hardware Test Utility v1 3. 10 m chamber, APC UPS, Hardware Test Utility v1 4. 10 m chamber, APC UPS, Hardware Test Utility v2 All conditions failed emissions tests.	Al Walters, Mike Engelmann, NOVO Engineering, and Nemko San Diego	QP data showed consistent excess emissions at 66 MHz, with potential additional emissions of concern nearing FCC limits at other frequencies <80 MHz. Even the 3m chamber test failed at 66 MHz, when the 3m test did not fail previously in July 2024 without a UPS and with different test software. This further suggested that the Anker UPS or some other factor could be contributing to failing tests at this present time. In the 10 m chamber (which more accurately reflected testing with SLI), switching to the APC UPS and to the newer Hardware Test Utility v2 still had failing emissions at 66 MHz, and so further investigation was needed. Plans were made to analyze VxScan in the 10 m chamber without a UPS, selectively activating and deactivating key functions to try to isolate root causes of the spikes.
9	4/29/25	Standard FCC emissions testing was performed on VxScan in different configurations, without a UPS, with Hardware Test Utility v2 installed, and all VxScan internal connections maintained and powered on, in a 10 m chamber:	Al Walters, Mike Engelmann, NOVO Engineering, and Nemko San Diego	QP data again showed consistent excess emissions at 66 MHz, with potential additional emissions of concern nearing FCC limits at other frequencies <80 MHz. Emissions were then concluded to be related to powering the scanner or printer and not actually activating them, or from the components that were not directly powered on or off in tests thus

		1. No functions running (except screen) 2. All functions running continuously 3. No printing, but all other functions running 4. No scanning, but all other functions running All conditions failed emissions tests in a similar fashion as previous scans.		far: the SBC, display, power supplies, or some combinations of these. Plans were made to analyze VxScan with specific components physically disconnected from power in the 10 m chamber, to isolate the sources of far-field noise. Additional near-field probe analysis could detect the 66 MHz spike through the scanner power cable, and possibly through the ribbon cable to the lower scanner contact-image sensor (CIS). Ground connections were altered to connect the shield of the scanner power cable to the earth ground of the power supply.
10	5/5/25	Standard FCC emissions testing was performed on VxScan in different configurations, without a UPS, with Hardware Test Utility v2 running continuously, in a 10 m chamber: 1. Disconnected scanner & printer 2. Disconnected scanner 3. Disconnected printer 4. Disconnected display, scanner, & printer 5. All connected, with ferrite choke added to scanner ribbon cable Data identified connecting the scanner as a key source of emissions.	Al Walters, Mike Engelmann, NOVO Engineering, and Nemko San Diego; Pius Wong, Jesse DeWald, VotingWorks	The combinations of spectra obtained suggested: ● The scanner was a source of the 66 MHz spike and other potentially concerning emissions <80 Mhz. Spectral patterns in this range suggested the amplification of harmonics of a 6 MHz signal. ● The choke added to the scanner ribbon cable was not optimal to reduce emissions, and a better choke selection is needed. Disconnecting the display, scanner, and printer all at the same time yielded a passing emissions test with no at-risk QPs. The manufacturers of the scanner and display were consulted about potential emissions sources. The scanner manufacturer confirmed there was a 6 MHz clock associated with the contact-image sensors. This could explain the spikes seen at 6 MHz apart from 48-80 MHz. Plans were made to attempt to mitigate the emissions via additional shielding in the front of the scanner component emissions source, and application of a choke with impedance optimized to filter noise <80MHz. Other mitigations were still being researched.
11	5/9/25	Standard FCC emissions testing was performed on VxScan with various configurations and proposed	Al Walters, Mike Engelmann, NOVO	The combinations of spectra obtained suggested: ● Foil shielding around large areas surrounding the scanner could mitigate

		mitigations for the 40-80 MHz spikes associated with the scanner, to at least narrow down sources: ● Shielding along inner walls ● Ferrites applied to scanner power cable ● Shielding applied to exposed surface above scanner ● Decoupling frame and board ground on the scanner PCB ● Tie shielding of power cable to frame ground ● Tie metal scanner tab to frame ground	Engineering, and Nemko San Diego; Pius Wong, Jesse DeWald, VotingWorks	some of the spikes in question, but not all. ● UPS usage introduced some broadband emissions but none that posed problematic QPs. ● Grounding configuration changes did not solve the emissions issues, and it likely was not the source. Plans were made to attempt to mitigate the emissions via additional shielding in the front of the scanner component emissions source, and application of a choke with impedance optimized to filter noise <80MHz. Other mitigations were still being researched.
12	5/28/25	Standard FCC emissions testing was performed on VxScan components with various component configurations in order to specify the sources of 6 MHz harmonic spikes detected along ribbon cables and several other parts of the scanner system.	Al Walters, Mike Engelmann, NOVO Engineering, and Nemko San Diego	A key finding was that pulling the VxScan scanner components outside the enclosure while leaving them electrically connected and functional resulted in passing emissions scans. This suggested that a part of the enclosure was coupling with the scanner emissions to radiate excess RF emissions, or possibly the cabling routing configuration. More investigation ruled out a variety of cable routing and ground connection features as the cause of emissions. The original cable routing and grounding features would be maintained.
13	6/9-10/25	NOVO Engineering investigated VxScan emissions in a 1m chamber at EMI engineering lab RF2B in San Diego, to more quickly isolate emissions sources related to the frame and develop mitigations.	Al Walters, Mike Engelmann, NOVO Engineering, and RF2B	Similar emissions spikes could be reproduced from 40-80 MHz in the 1m chamber as in the 10 m chamber, in the same VxScan configurations previously tested. The 54 MHz spur was observed using a UHF antenna to “bounce” or change when opening and closing the metal scanner access door above the scanner. Leaving it completely open mitigated some emissions, but closing it worsened emissions. Deeper investigations found that sufficient electrical contact was not made between the scanner access panel and the conductive bracket underneath it on the left side, potentially leading to poorer grounding when closed or exposing slots for RF to emit and become amplified. Pushing down on the

				scanner access panel could improve contact and lead to lower emissions spikes around 54 MHz.
14	6/13/25	Standard FCC emissions testing was performed on VxScan components with various configurations, including: ● Improving electrical contact between scanner access panel and its supporting bracket on the left side, using copper tape and/or a weight ● Application of ferrites to cabling	Al Walters, Mike Engelmann, NOVO Engineering, and Nemko San Diego; Jessed DeWald, Pius Wong, VotingWorks	The copper tape led to near elimination of the harmonic spikes of 6 MHz previously seen across the 40-80 Mhz range. This required the scanner access panel to be closed, as well as the pollworker door closed and properly sealed. After eliminating the 6 MHz harmonic spikes, a broadband "hump" was still seen in the lower frequency range, leading to a single possibly problematic QP at 60 MHz, even with the copper tape. Applying different ferrite chokes along scanner components did not mitigate this, and so further scans in different directions suggested the source of this specific noise to be at the AC power cord. Ferrite chokes offering more than 200 ohms @ 60 Mhz were applied to the AC power cord externally near the VxScan power entry port, which reduced the peak of the broadband 60 MHz noise by 10 dBuV/m, leading to a passing scan. Powering with the UPS showed similar passing results. Plans were made to test again using more manufacturing-ready components and procedures, including using more robust conductive EMI gasket tape instead of copper tape, and applying a ferrite internally on the AC power lines instead of externally. Also because testing was done on a unit that already had many modifications thus far to grounding, shielding, PCB components, and parts taken in and out, a new unit was sent to NOVO Engineering for further investigation and verification of findings.
15	6/23/25	Standard FCC emissions testing was performed on a new VxScan test unit that was not previously modified for attempting to pass RF emissions testing. It would only be modified to: ● Apply EMI gasket to the left underside of the scanner access panel. ● Add ferrite to the internal AC power	Al Walters, Mike Engelmann, NOVO Engineering, and Nemko San Diego	The original emissions of interest between 40-80 MHz were no longer an issue, confirming that the root causes were primarily from lack of bridging the scanner access panel properly when closed and, secondarily, some AC power line noise. However, a new previously unobserved spike was now seen at around 30 MHz. It was noted that the APC UPS was not plugged in and fully charged at the start of the chamber testing like it is intended to be, and so it was charging while powering VxScan itself. This data was to be

		lines near the AC entry port.		retaken with a properly configured APC UPS that was fully charged and plugged in before use.
16	7/10/25	Standard FCC emissions testing was performed on the VxScan unit just tested at Nemko, except that the APC UPS would now be configured properly, plugged in and fully charged for testing.	Al Walters, Mike Engelmann, NOVO Engineering, and Nemko San Diego	NOVO and Nemko reported passing results for VxScan in this configuration, both without the UPS and with the UPS:  The 54 and 66 MHz spikes seen at SLI were not present, not other 6 MHz harmonics. This further confirmed the root cause of failures at SLI being from improper contact on the left side of the scanner access panel, coupled with noise from the AC power input.

Investigative Team and Method

This section shall describe how the investigative team is assembled by the voting system manufacturer, who it consists of, and how it gathers the data to be used in the analysis. Include the RCA method employed by the manufacturer in conducting the analysis and why this method was used.

Names and Positions of members of the investigation team:
Jessica Myers, Head of Compliance
Don Chu, Lead Design Engineer
Jesse DeWald, Head of Hardware
Al Walters, Engineer; Jeff Johnson, Engineer; Mike Engelmann, Engineer (NOVO Engineering team)
Pius Wong, Quality Assurance Lead
Chris Pedersen, Operations & Prototyping Support Technician

Describe the data gathering process:

Jessica Myers headed the investigation at first starting with the radiated emissions tests on 3/7/25, as she initiated testing at Element with SLI Compliance. Don Chu took over on 3/10/25, as he applied his expertise and experience in the design of VxScan to these tests and mitigations. Jessica and Don directly received the data from SLI, handled the devices under test when needed, and coordinated the response with other VotingWorks staff offsite.

Following the initial emissions failures, Don planned for systematic investigation to find potential mitigations, isolating if they were caused more by the UPS or by VxScan components. He analyzed emissions around specific components using the near-field probe, applied shielding and other emissions-attenuating features, and swapped out components as needed to help narrow down possible sources of the failures. Chis Pedersen also was on-site at SLI and inspected test units, ruling out any production issues.

Following the failed EMC tests described above (as well as several passing EMC tests), the outside engineering agency NOVO Engineering was recruited to perform more testing on the VxScan system, including using the Anker and APC UPS devices. NOVO previously tested a VxScan prototype without a UPS in July 2024, where no concerns were found in standard FCC emissions tests in a 3 m chamber using production software. This time they would also use the same test software utility used at SLI and conduct the failing tests from SLI in a 10 m chamber. Pius Wong coordinated getting results from NOVO to VotingWorks, also working with Jesse DeWald to provide NOVO with test equipment. Initial work used near-field probes to find potential emissions sources that could explain what was seen at Element. It suggested some inconsistency in the Anker UPS product emissions between different units, or differences in analysis methods. Analysis continued with a 10 m emissions chamber at test vendor Nemko San Diego in April through July 2025, as well as 1 m chamber at RF2B San Diego. These analyses identified problematic frequency emissions and narrowed down their sources to specific components. From this root cause data, they suggested mitigations.

Describe which methodology(s) is used to conduct the root cause analysis:

The investigative team began with the "5 Why's" strategy to discuss the causes of failures in radiated emissions tests, and to define the next courses of action in the investigations. This started by asking why the VxScan system was showing excess emissions, leading to questioning paths related to the Anker UPS and various parts of the VxScan unit.

The UPS was an early focus of the investigation due to it not being a part of past emissions tests, with a line of questioning such as follows:

- Why would the Anker UPS contribute to excess radiated emissions, despite its reported FCC certification?
- Why would the Anker UPS emit more at lower frequencies <100 MHz?
- Why would the upper portion of the Anker UPS show higher levels of noise using the near-field probe?
- Why would the IoT, power control, and display electronics of the Anker UPS radiate excess emissions?
- Why would a similar Anker UPS not show the same emissions in another test setup using the near-field probe?

These questions led to a final answer of differing build quality for the commercial off-the-shelf Anker UPS power electronics unit-to-unit. This was also confirmed by other testing on EFT resistance. As a result, the Anker UPS was deemed too unpredictable or problematic for radiated emissions and would be replaced with another UPS showing better performance. Even if this did not solve all emissions problems, it should reduce some of the sources of noise in the lower frequency range.

Then aspects of VxScan were investigated with similar lines of questioning, focusing on both VxScan components and on specific frequencies of interest. For example, the answers to each of these two questions led to similar intersecting investigative paths:

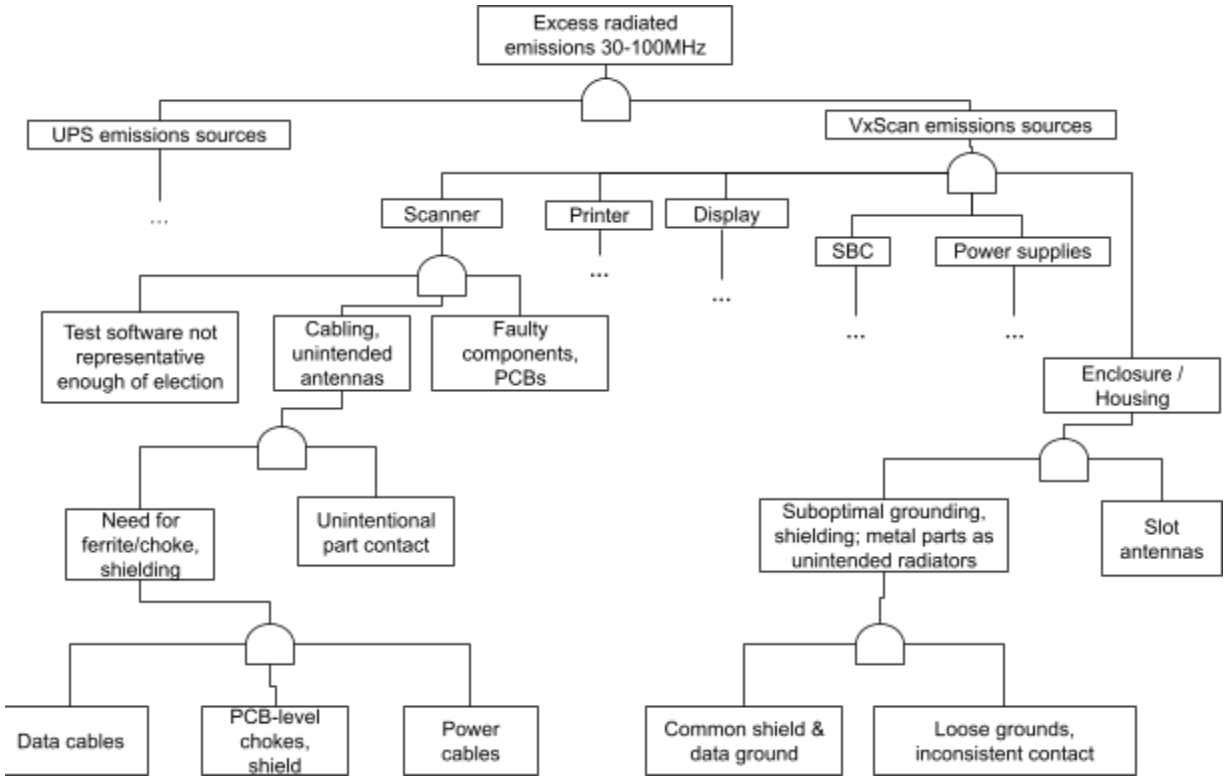
- Why would the printer, scanner, power components, and housing components contribute to radiated emissions at lower frequencies?

And:

- Why would VxScan emit noise <100 MHz as both resonant spikes around 48, 54, 60, 66, and 72 MHz, and also broadband noise from 40-100 MHz centered on 60 MHz?

These questions were parts of the analysis that followed the fault tree analysis pattern below. Each branch was investigated either at on-site at Element or with NOVO Engineering, a testing partner, to identify the root cause of the failure seen at SLI/Element.

EAC (Election Assistance Commission) Root Cause Analysis



Ultimately the scanner, power supply, and enclosure/housing branches led to finding the root causes of the failure seen at SLI. However, other VxScan components were investigated, too, in similar detail, including the printer, display, SBC, and UPS. Components were systematically adjusted while analyzing with near-field probes and with far-field antennas in 1m, 3m, and 10m chambers. Different tools were used due to limitations in scheduling and availability, and the fault tree had to be analyzed across several months. Mitigations were developed to target the root causes in the scanner, power supply, and enclosure/housing.

Findings and Root Cause

The primary root cause of the observed emissions failure was:

1. Insufficient contact between the closed scanner access panel and the metal support bracket underneath it on the left. This results in only partial or no electrical contact on the left, leading to insufficient grounding of the conductive metal access panel when closed, as well as a small gap from which emissions can leak and be amplified. The panel no longer acts as an effective shield to the emissions sources under the panel; and in fact it would amplify emissions from 48 to 80 Mhz, 6 Mhz apart, largely seen at 54 Mhz and 66 MHz. These are harmonic frequencies of 6 MHz, which is a frequency emitted by clocks associated with the contact image sensor on the scanner PCB underneath the panel.

Secondary root causes of the observed emissions failure were also:

1. Unpredictable broadband noise contributed from the Anker UPS.
2. Broadband noise centered around 60 Mhz contributed from the AC power entry port.

These secondary causes brought emissions close to the threshold of passing/failing, and so they contributed to the failure, although the emissions associated with these two features were not as strong as associated with the insufficiently grounded scanner access panel.

Other key findings were as follows:

1. The Anker UPS was too unpredictable or problematic for radiated emissions, as well as for other electromagnetic compatibility tests. To eliminate one likely source of electrical and emissions faults and complications, the Anker UPS was to be replaced with the APC UPS also used with VxMark (APC® Back-UPS Pro 10-Outlet Tower Uninterruptible Power Supply, 1,500VA/900 Watts, BN1500M2).
2. The scanner PCB had clock components that were the source of 6 MHz signals that likely resulted in harmonic resonant emissions from 48 to 80 MHz seen at SLI/Element and at Nemko in far-field testing. These harmonics became coupled to scanner power and data cables, as well as the scanner access panel when it was in the closed position but not fully grounded.
3. Past emissions tests done with NOVO Engineering/Nemko in July 2024 did not reveal the failures seen at SLI/Element in March 2025 due to at least four differences in test conditions:
    - *No UPS previously.* When the Anker UPS was present, the power electronics near the UPS display contributed to excess emissions.
    - *3 m test chamber previously.* In the 10 m chamber, emissions dropoffs did not occur as might have been extrapolated from the 3 m test data, due to more

complex far-field emissions interactions and resonance from limited shielding/grounding of cables and other components.

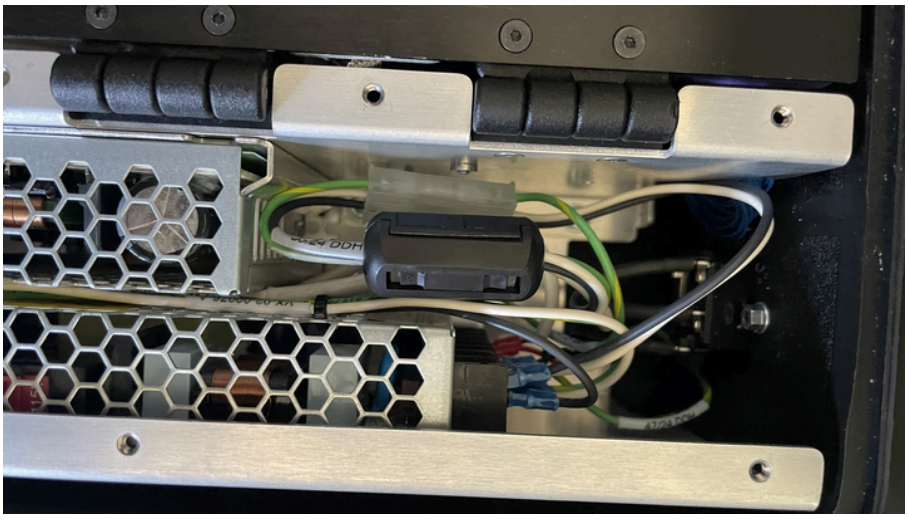
- *Different test software previously.* At SLI a basic Hardware Test Utility (version 1) was used that stressed all VxScan functions continuously beyond what would be seen in any election. By contrast, previous July 2024 emissions testing with NOVO/Nemko used only the production app in shoeshine mode, which still stressed the machine but more closely represented realistic continuous operation during an election. The newer Hardware Test Utility (version 2) better reflects the stress of continuous operation in an election the old version (version 1) and will be used for further certification tests.
- *Different tested unit*. The actual physical unit tested in July 2024 had been built with confirmed electrical connection between the scanner access panel and the bracket underneath. Assembly variation led to more inconsistent connection in the other tested units without any EMI gasket tape.

Corrective Action(s)

The following actions must be taken to address this emissions failure:

1. Apply EMI gasket tape under the left side of the scanner access panel, where it makes contact with the support bracket underneath. It can be a 2.5-2.7" strip of a compressible conductive gasket meant for repeated industrial use, such as the tested component Wurth 3021005, which is widely available. The height can be 0.010" to 0.030" to fill a possible gap between the scanner access panel and the bracket when the panel is closed. See the image below for an example application:

2. Apply a ferrite targeting 60 MHz emissions to the internal AC power line, around the L1, L2, and ground lines. This can be the tested component Fair-Rite 0461164951, which is widely available. See image below for how it can be applied internally on the right-side internal compartment of VxScan:



3. Replace the Anker UPS with the APC Back-UPS Pro, BN1500M2 during regular use of VxScan.

Solution Management

The purpose of this section is to manage the corrective action(s) moving forward. This should detail all process changes to manage those corrective actions, and steps taken to ensure the actions eliminate the anomaly over time.

Plans to manage the solution following this RCA are as follows:

Testing and verification:

- Certification testing will continue as planned applying the 3 mitigations described above to VxScan units.
- Continuous electrical hardware testing will be conducted with the updated Hardware Test Utility. It no longer prints an entire sheet of paper at every cycle, while also allowing more control of individual VxScan functions.

Design & Production:

- Design and assembly plans will be modified to incorporate the addition of the EMI gasket and AC power line ferrite. These do not change other assembly steps, as there already is room for each component in the design.
- The EMI gasket tape and ferrite will be sourced based on reliability of supply as well as functional equivalence to the components previously verified in the Nemko emissions testing chamber.