Technical Note

Title:	**VeriSafe Absence of Voltage Tester Installation Considerations in High Capacitance Environments**
Document No.:	C11750
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IMPORTANT: If existing VeriSafe AVT installations are not exhibiting the 4-flash code described in this technical note, no action or firmware update is required.

Products Affected:

VeriSafe 1.0 Absence of Voltage Testers (AVTs) manufactured **prior to July 22, 2021.**

VS-AVT-C02-L03, VS-AVT-C08-L10, VS-AVT-C02-L03E, VS-AVT-C08-L10E, VS-AVT-C02-L03A, VS-AVT-C08-L10A

As of July 22, 2021, all affected part numbers are being manufactured with a firmware revision that eliminates the connectivity diagnostic error described in this notice. AVTs manufactured after this date (see the **Appendix** to identify the location of the AVT manufactured date) perform the connectivity diagnostic in a way that is not susceptible to rare application conditions involving high system capacitance.

VeriSafe AVT Connectivity Diagnostic:

When the absence of voltage test is initiated, the VeriSafe AVT performs multiple self-diagnostics to ensure that it is operating correctly and safely. The connectivity diagnostic is used to determine if the AVT sensor leads are in contact with a circuit conductor at the time of test. When the AVT sensor leads for each phase are connected to the same conductor, the connectivity diagnostic will pass, and the AVT will continue with the absence of voltage test sequence. If the connectivity diagnostic does not pass, the AVT will signal that the connection was not verified using the 4-flash diagnostic code on the Indicator Module.

The VeriSafe AVT is designed with two sensor leads for each phase. The two leads for each phase have a different purpose. The detection lead is used to detect voltage and the termination lead is used to verify that the detection lead is in contact with a conductor. If the detection lead is not in contact with a conductor, the connectivity diagnostic will prevent the AVT from returning a green absence of voltage indication. The connectivity diagnostic is performed by charging a capacitor within the sensor lead circuit for each phase inside the Isolation Module. If the discharge time is within a preset range, the connectivity diagnostic returns a passing result. The termination lead provides a load to aid the discharge process. If the detection lead is electrically connected to the termination lead, the discharge time should be inside the desired range and the connectivity test will pass**.** If the detection lead is not in contact with a conductor, the discharge time will be outside of

the preset range and the criteria for the connectivity diagnostic will not be satisfied. If the connectivity diagnostic is not satisfied on any of the three phases, the green absence of voltage indicator on the AVT will not illuminate and the user will be notified with the 4-flash diagnostic code.

System Capacitance:

The capacitance of the electrical system where the AVT is installed has the potential to negatively impact the connectivity diagnostic. If the system capacitance is high without any added load or resistance, the time required for the connectivity diagnostic to discharge will increase, possibly falling outside of the preset range. If system capacitance causes the discharge time to be outside of the preset range, the connectivity diagnostic will not be satisfied. This results in the 4-flash diagnostic code, even when sensor leads are properly terminated, and the system is de-energized. Although the AVT does not return the expected absence of voltage indication, this is a fail-safe condition.

Issues with the connectivity diagnostic are infrequent but could occur on electrical systems that have the high capacitance and no load. Applications with long cable runs (~100' or greater) of large gage wire (4/0 AWG or greater) in metal conduit and open or isolated at both ends (no load) may be susceptible. These are not strict guidelines as the overall system capacitance is impacted by many variables including wire and insulation type, conduit size and type, conductor proximity to one another, environmental conditions/temperature, battery voltage etc. A system that is isolated or open on both ends with no load when the AVT test is performed along with high system capacitance is the most problematic, as shown in ***Figure 1***.

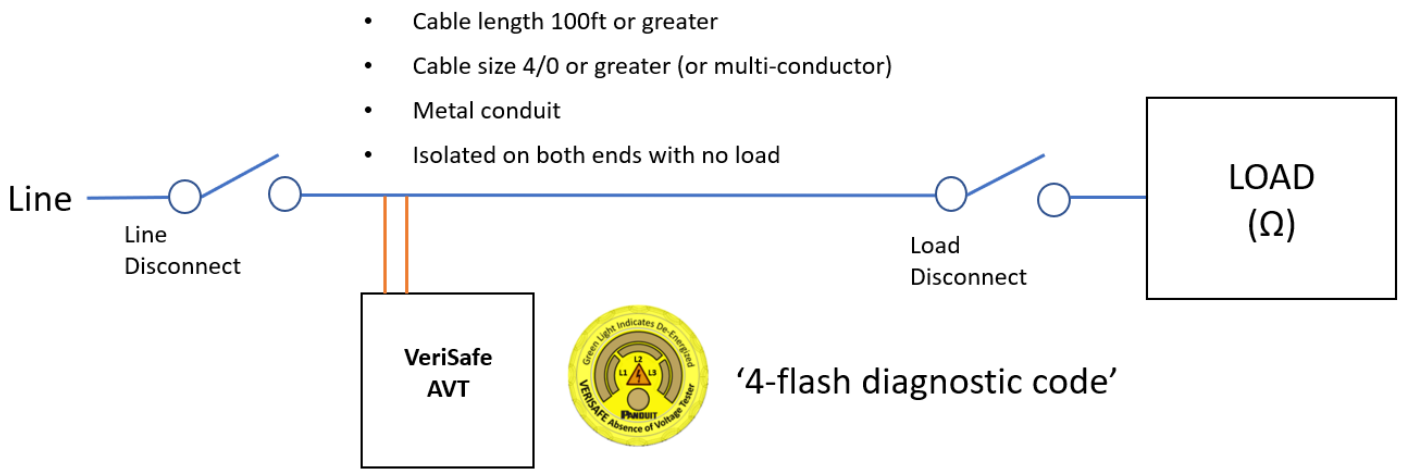

Figure 1 – Scenario Where System Capacitance May Affect the Connectivity Diagnostic

Due to the relationship between system capacitance, system load, and discharge time of the connectivity diagnostic, closing the downstream disconnect, as shown in ***Figure 2***, will often resolve the issue. The added load counters the system capacitance and allows the discharge time of the connectivity diagnostic to fall within the preset range. Assuming that the electrical system is de-energized below the AVT threshold, the AVT will provide the green absence of voltage indication.

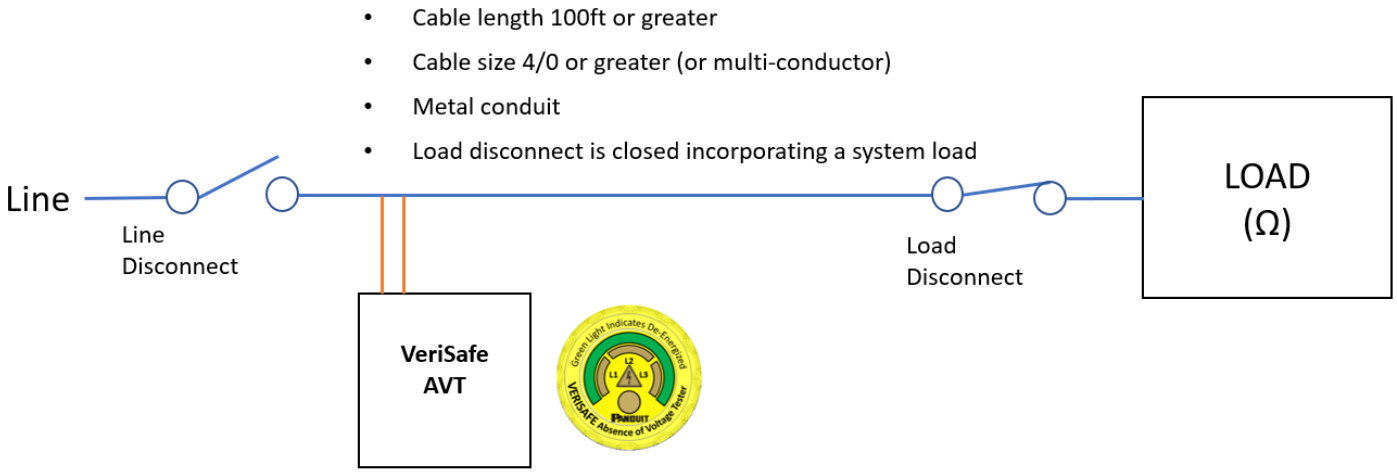

Figure 2 – A Load Applied to the System Counters High System Capacitance Resolving the Issue

AVT Threshold and the Connectivity Diagnostic:

The connectivity diagnostic involves charging capacitors for each phase and measuring the time it takes them to discharge below the AVT threshold. The threshold is designed to be 3.0V or less, as defined by requirements in UL 1436. The threshold of each individual AVT will vary due to the tolerances of the associated components and circuits. With the variation in threshold value for each unit, there is also variation in the time required for the capacitor discharge with the connectivity test because the time measured is the time that it takes for the capacitor to discharge below the threshold value. This means that the capacitance of the electrical system that the AVT is installed in may negatively impact the connectivity test of one AVT unit but not another due to the difference in the threshold value between units. An AVT that has a threshold value at the lower end of the tolerance range will be much more sensitive to electrical system capacitance than those at the high end. Therefore, this issue is normally resolved by replacing the AVT with one that has a higher threshold.

The threshold value for an individual AVT remains constant and each unit is factory tested to ensure the threshold values are within an acceptable range.

Conclusion:

In rare instances, an AVT (manufactured prior to Julu 22, 2021) with proper physical terminations on an unpowered system, may signal the 4-flash diagnostic code indicating a connectivity error, rather than the expected green absence of voltage indication. This does not result in an unsafe condition or represent an unsafe failure of any AVT safety functions. To summarize the information in this notice:

1. The AVT performs a connectivity diagnostic as part of the absence of voltage test sequence. If the criteria for the connectivity diagnostic is not satisfied, the result is communicated to the user via a diagnostic code that consists of a series of 4-flashes of the yellow indicator.
2. The connectivity diagnostic involves charging a capacitor in the AVT and measuring the time it takes to discharge below the absence of voltage threshold. That discharge time must fall within a preset range to satisfy the connectivity diagnostic criteria.

3. The timing, and result, of the connectivity diagnostic can be impacted by the capacitance and load (or resistance) of the electrical system where it is installed. If the capacitance is high with no resistance or load present, the connectivity diagnostic may indicate a connectivity error even though the AVT is properly installed.
4. The threshold of an individual AVT will vary due to the tolerances of the associated components and circuits. The threshold level is verified for each unit at the factory and does not change.
5. Because the connectivity diagnostic measures the time it takes a capacitor to discharge below the AVT threshold, discharge time will be greater for AVT units that have lower threshold values, and those units will be more sensitive to the high electrical system capacitance.
6. A change to the connectivity diagnostic was implemented in units manufactured after July 22, 2021. AVTs manufactured after this date perform the connectivity diagnostic in a way that is not susceptible to variations in system capacitance and the AVT threshold as described in this notice.

What to do if you are experiencing the 4-flash Diagnostic Code and have verified that the AVT sensor and ground leads are installed properly:

1. Check for the common attributes of no-load and high system capacitance.
    a. Cable runs greater than 100 feet.
    b. Cable size 4/0 or greater, or runs of parallel cables.
    c. System is isolated or open on both ends (no load) at the time of test.
2. If the AVT test is being performed with a system open or isolated on both ends of the cabling, is it possible to run the test with the load connected (***Figure 2***)? Is it possible to add load to the system in another way?
3. Replace the unit with a VeriSafe AVT manufactured after July 22, 2021. Contact Panduit Tech Support for additional assistance.

Appendix

Location of AVT Manufactured Date