MANUAL

ControlFire® Trouble Shooting Guide

Copyright © 2019 Hunting Energy Services. All Rights Reserved

Table of Contents

1 INTRODUCTION

The following Troubleshooting Guide is designed to aid users of the ControlFire switch system in identifying and troubleshooting errors while running the system.

1.1 TROUBLESHOOTING TIPS

Below are helpful tips regarding ControlFire and related troubleshooting:

1. Attempt to read switches/Simulator through the WL truck, wireline, cable head, CCL/GR tool and any auxiliary equipment above the gun string BEFORE going out to location!

2. Make sure the ControlFire Command and Control panel is "ON" and in the correct mode! USB cable needs to be shielded and away from any power cords/sources.

3. If you cannot read any switches downhole, check to make sure your depth correlation tool is working properly. If your perforating CCL or GR tool is not working, then the problem is above the guns.

4. If you cannot read any switches downhole, always check that the surface equipment is working correctly before pulling out of the well. All ControlFire panels come with a cable that runs from the Command and Control Panel to the Switch Simulator. If you are unable to read switches, disconnect the line from the Control panel to the slip rings and connect Control panel to the Simulator (or a switch if Simulator is not available) using the given cable. If you can read the Simulator/switch, then you know the problem is slip ring down, likely downhole. If you cannot read switches, then you need to troubleshoot on surface and may not need to pull out of hole.

5. "Invalid End of String. Switch OverCurrent" means you most likely have a short.

6. "Invalid End of String. Switch Timeout" means you have an open.

7. "CRC Error" between the Perf board and the switch means that you have an electrical leak or intermittent connection and not enough voltage is being sent down the line. You can try increasing the Communication Voltage in the W/L Power Supply Settings menu by 5 Volts. Repeat if necessary. If the leak is too severe, no increase in voltage will help and you will have to pull out of hole.

8. If the software locks up due to a Windows crash, unplug and reconnect the USB cable. If problem continues, restart the program or turn the Control panel on and off. If communication is still not working, you may have to restart the computer.

9. If you are having trouble downhole and need to call for assistance, stay in the current window in which you are experiencing problems. It is best to troubleshoot over the phone when you can tell the Hunting representative exactly what you see.

10. When using the ControlFire Shooting Supply Panel, wait 5 seconds after switching modes (CCL to ARM CF) before using the software. This will prevent software lockups.
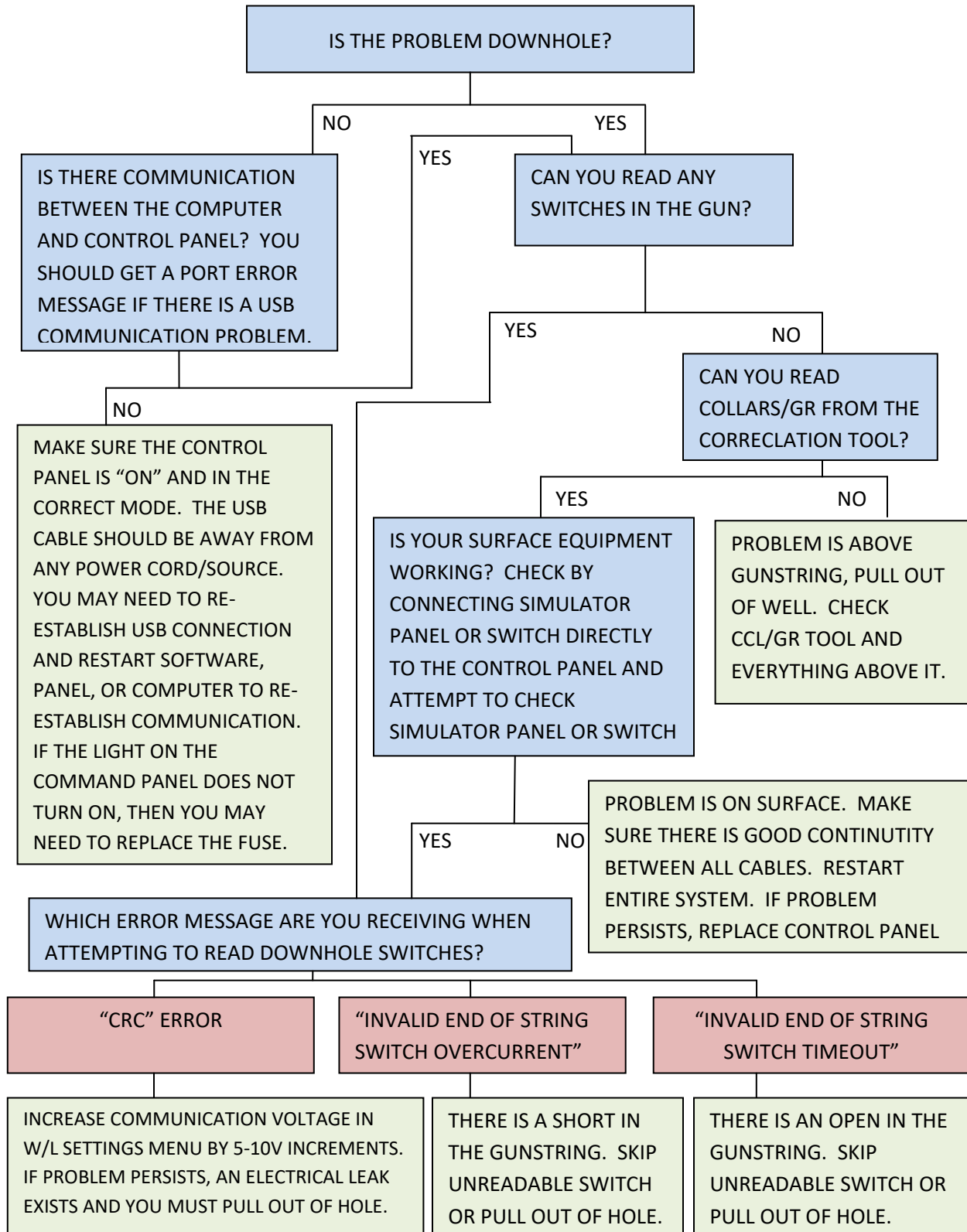
1.2 TROUBLESHOOTING FLOWCHART

IS THE PROBLEM DOWNHOLE?

NO — YES

YES

IS THERE COMMUNICATION BETWEEN THE COMPUTER AND CONTROL PANEL? YOU SHOULD GET A PORT ERROR MESSAGE IF THERE IS A USB COMMUNICATION PROBLEM.

CAN YOU READ ANY SWITCHES IN THE GUN?

YES — NO

CAN YOU READ COLLARS/GR FROM THE CORRECLATION TOOL?

NO

MAKE SURE THE CONTROL PANEL IS "ON" AND IN THE CORRECT MODE. THE USB CABLE SHOULD BE AWAY FROM ANY POWER CORD/SOURCE. YOU MAY NEED TO RE-ESTABLISH USB CONNECTION AND RESTART SOFTWARE, PANEL, OR COMPUTER TO RE-ESTABLISH COMMUNICATION. IF THE LIGHT ON THE COMMAND PANEL DOES NOT TURN ON, THEN YOU MAY NEED TO REPLACE THE FUSE.

YES — NO

IS YOUR SURFACE EQUIPMENT WORKING? CHECK BY CONNECTING SIMULATOR PANEL OR SWITCH DIRECTLY TO THE CONTROL PANEL AND ATTEMPT TO CHECK SIMULATOR PANEL OR SWITCH

PROBLEM IS ABOVE GUNSTRING, PULL OUT OF WELL. CHECK CCL/GR TOOL AND EVERYTHING ABOVE IT.

PROBLEM IS ON SURFACE. MAKE SURE THERE IS GOOD CONTINUITY BETWEEN ALL CABLES. RESTART ENTIRE SYSTEM. IF PROBLEM PERSISTS, REPLACE CONTROL PANEL

YES — NO

WHICH ERROR MESSAGE ARE YOU RECEIVING WHEN ATTEMPTING TO READ DOWNHOLE SWITCHES?

"CRC" ERROR

"INVALID END OF STRING SWITCH OVERCURRENT"

"INVALID END OF STRING SWITCH TIMEOUT"

INCREASE COMMUNICATION VOLTAGE IN W/L SETTINGS MENU BY 5-10V INCREMENTS. IF PROBLEM PERSISTS, AN ELECTRICAL LEAK EXISTS AND YOU MUST PULL OUT OF HOLE.

THERE IS A SHORT IN THE GUNSTRING. SKIP UNREADABLE SWITCH OR PULL OUT OF HOLE.

THERE IS AN OPEN IN THE GUNSTRING. SKIP UNREADABLE SWITCH OR PULL OUT OF HOLE.

Figure 1 Troubleshooting Flowchart

2 CREATING A GUN STRING
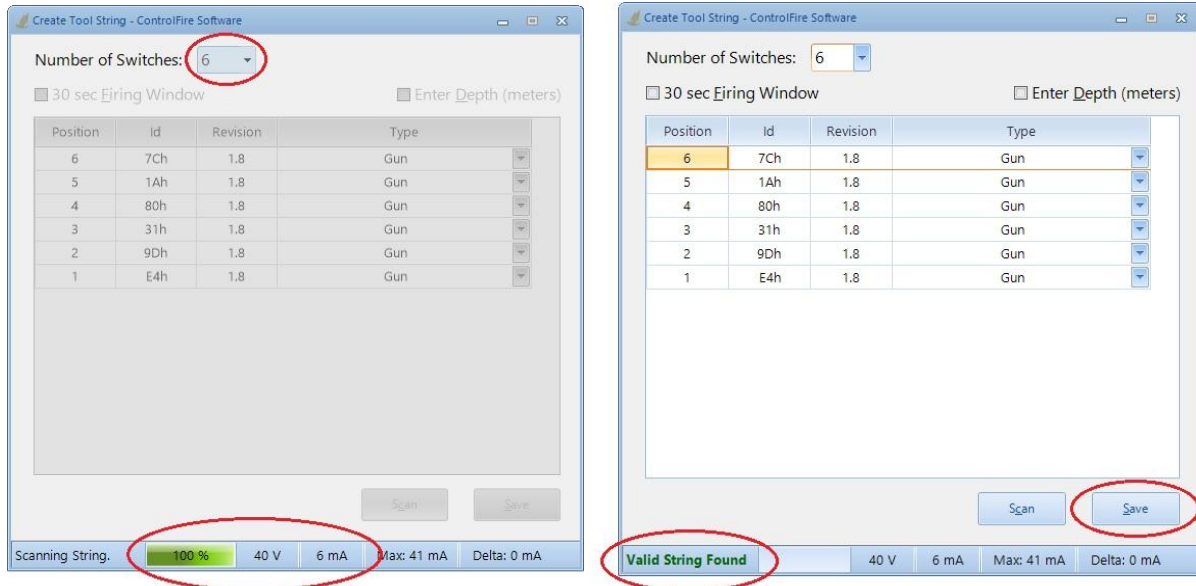
2.1 SUCCESSFUL GUN STRING CREATION

Figure 2 Successful Gun String Creation

Signature: Steady voltage delivered and current is drawn (>0 mA), Green scan status reaches 100%, Status reads "Valid String Found", Number of switches found matches input, User allowed to "Save" gun string.

Troubleshoot: None
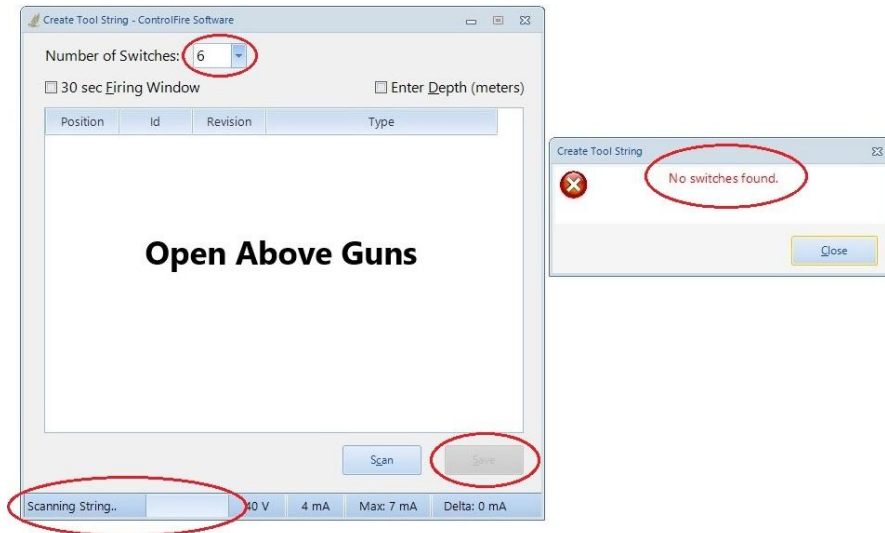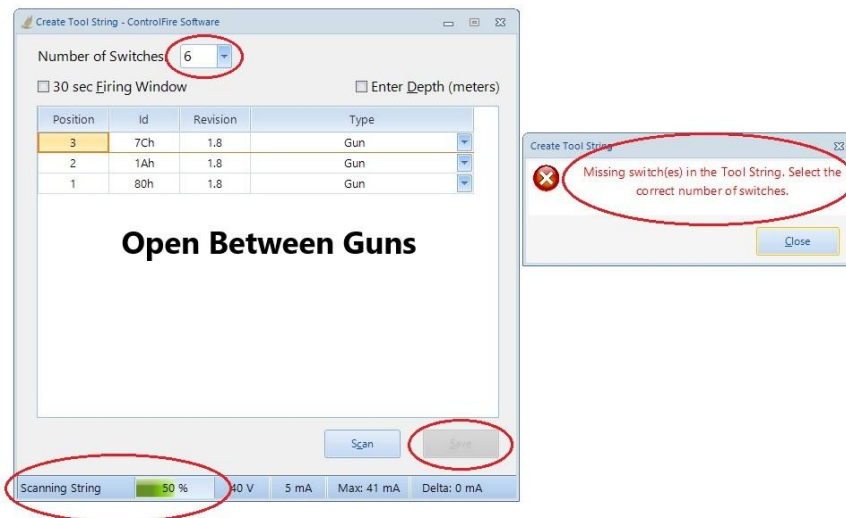
2.2 OPEN IN GUN STRING

Figure 3 Open Above Guns

Figure 4 Open Between Guns

Error Signature: Error message appears: "No switches found" or "Missing switches". Scan string status does not reach 100%, Number of switches found does not equal input, User unable to "Save" gun string.

Troubleshoot: You cannot fix a downhole open without coming out of hole. If zero switches read, open is between collector ring and first switch. This is typically caused by a bad ground to the first switch or a bad contact in tools/subs/cablehead above the first switch. If open is detected between switches then problem is between guns. This is typically caused by an open connection or a bad ground between guns. Always perform several gun create attempts, increase the Communication Voltage 5V at a time and confirm that surface equipment is working properly before coming out of hole.
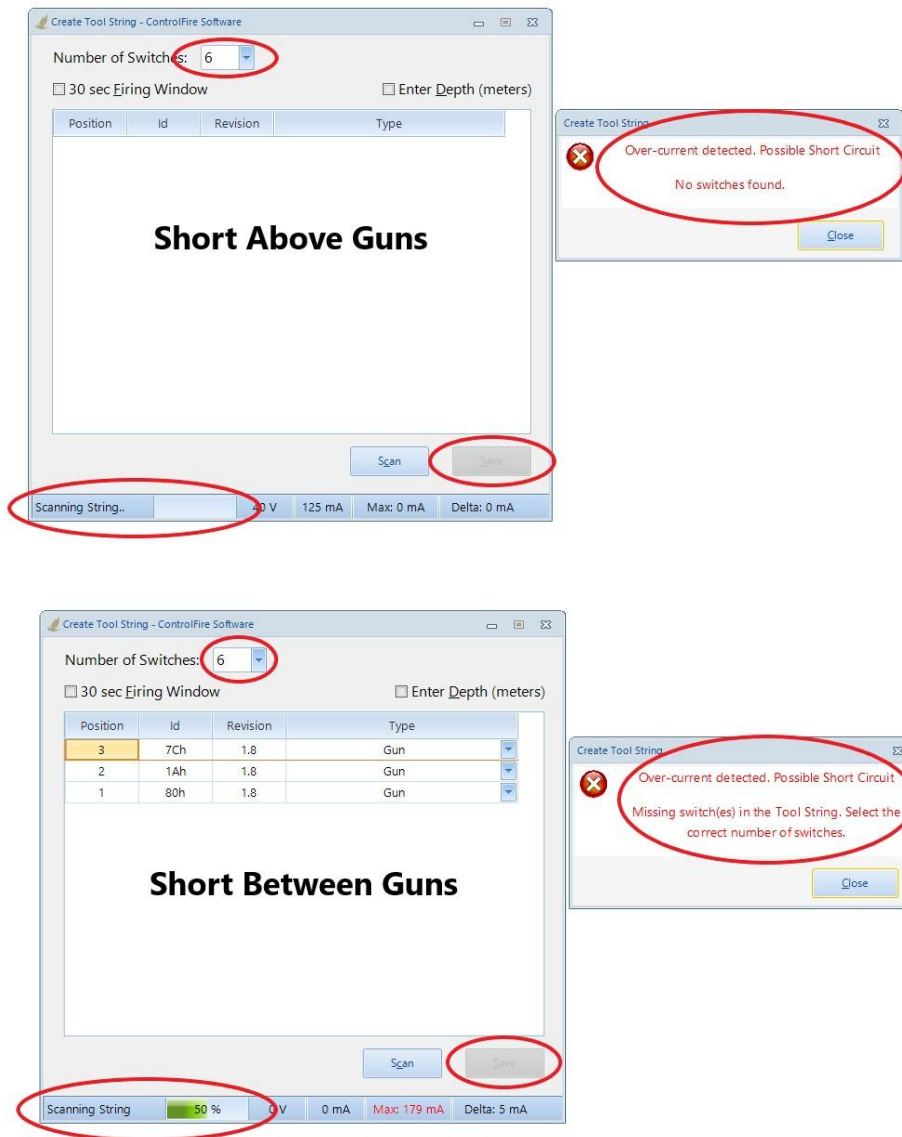
2.3 SHORT IN GUN STRING

Figure 5 Short Above and Between Guns

Error Signature: Error message appears: "Over-current detected. Possible Short Circuit". Scan string status does not reach 100%, High current (>Gun Check Current Limit) seen, Number of switches found does not match input, User unable to "Save" gunstring.

Troubleshoot: You cannot fix a downhole short without coming out of hole. If zero switches read, short is between collector ring and first switch. This is typically caused by a shorted contact/wire in tools/subs/cablehead above the first switch. If short is detected between switches then problem is between guns. This is typically caused by a pinched wire or a shorted contact between guns. Always perform several gun create attempts, decrease the Communication Voltage 5V at a time and confirm that surface equipment is working properly before coming out of hole.
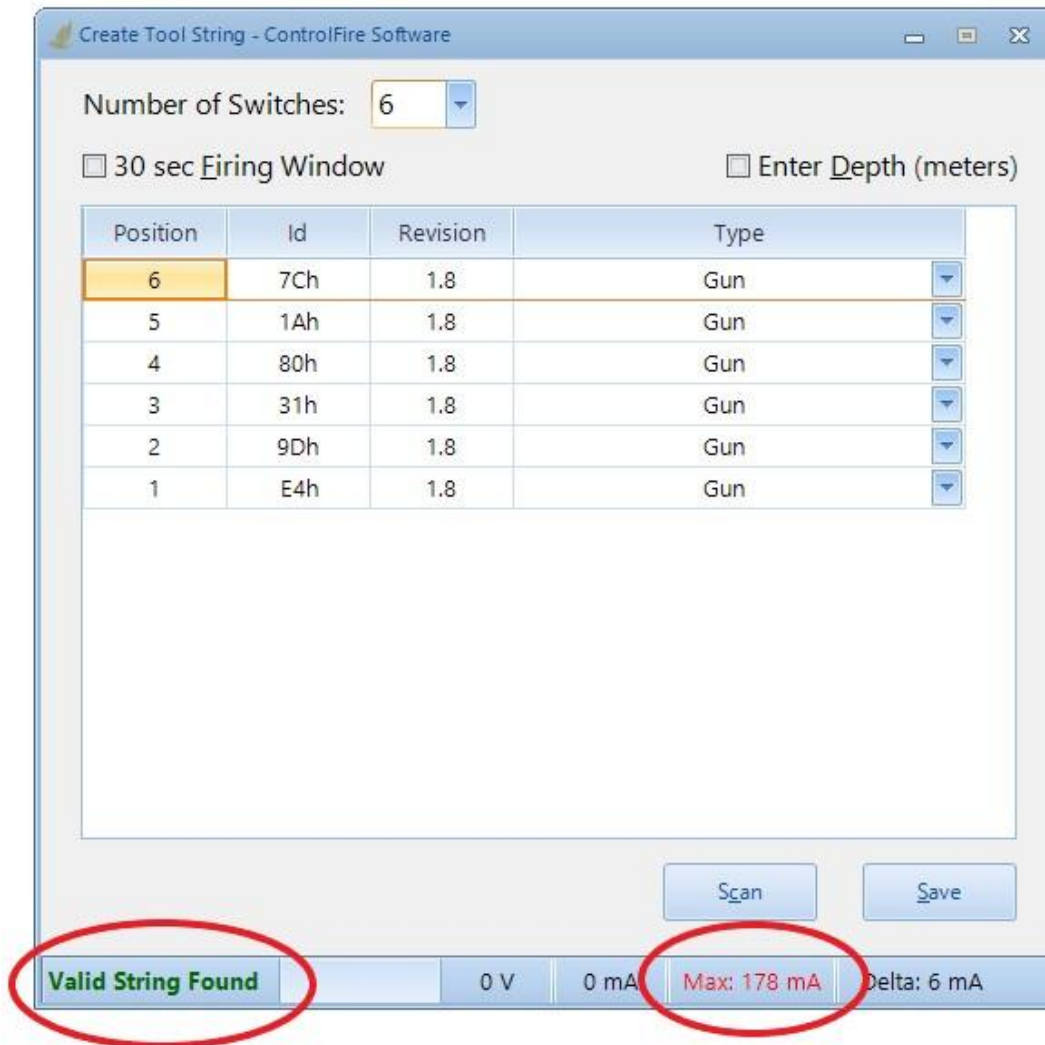
2.4 INCORRECT PLUGSHOOT WIRING

Figure 6 Incorrect Plugshoot Wiring

Error Signature: Valid string found BUT overcurrent read (>Gun Check Current Limit).

Troubleshoot: If the plug switch is wired to the plug shoot adapter using the blue wire rather than the correct green wire, the gun can still be created successfully. If you were to shoot the plug, you would only see voltage and zero current because the igniter is not hooked up to the switch at all. You must pull out of hole to correct wiring mistake. Note that you will get this same error signature if the plug shoot is wired correctly but the blue wire is not terminated and is exposed and shorts to the sub body. Always terminate the plug wire with electrical tape or scotchlock/nut to avoid this reading.

3 VERIFYING A GUN STRING
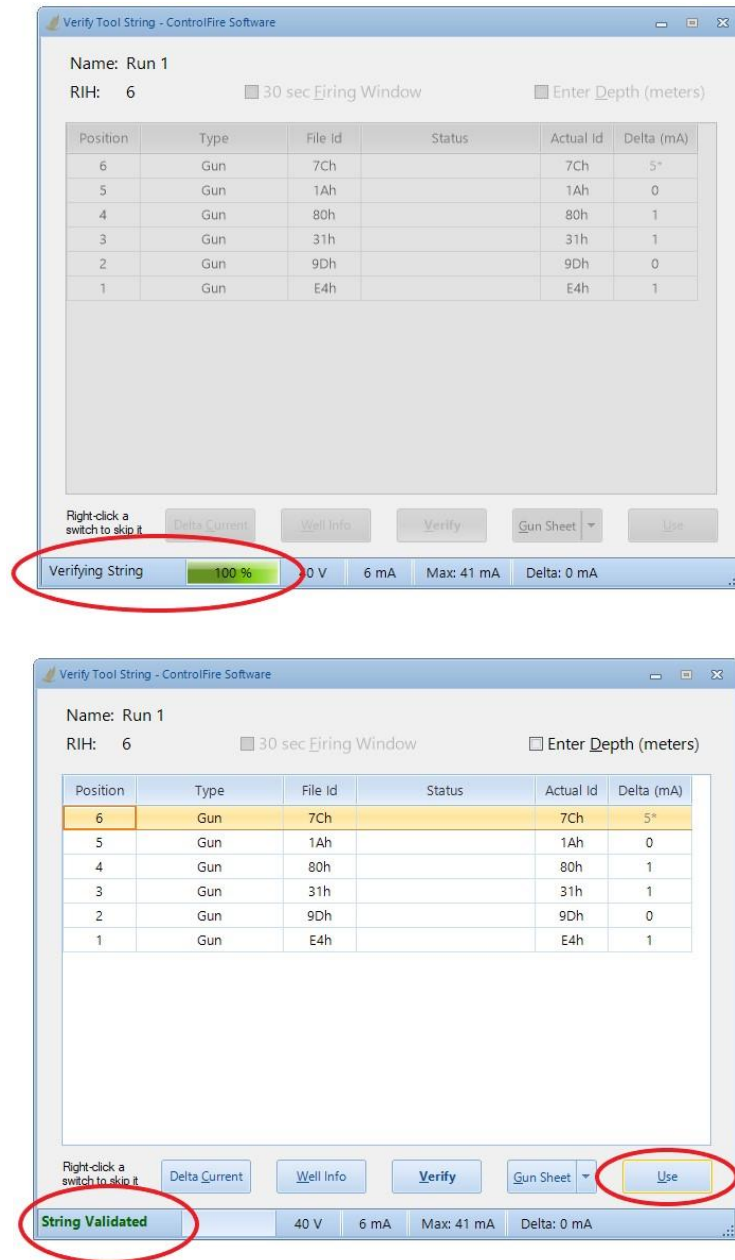
3.1 SUCCESSFUL GUN STRING VERIFICATION

Figure 7 Successful Gun String Verification

Signature: Steady voltage delivered and current is drawn (>0 mA), Verifying string status reaches 100%, Status reads "String Validated", Actual Id matches File Id, User allowed to "Use".

Troubleshoot: None
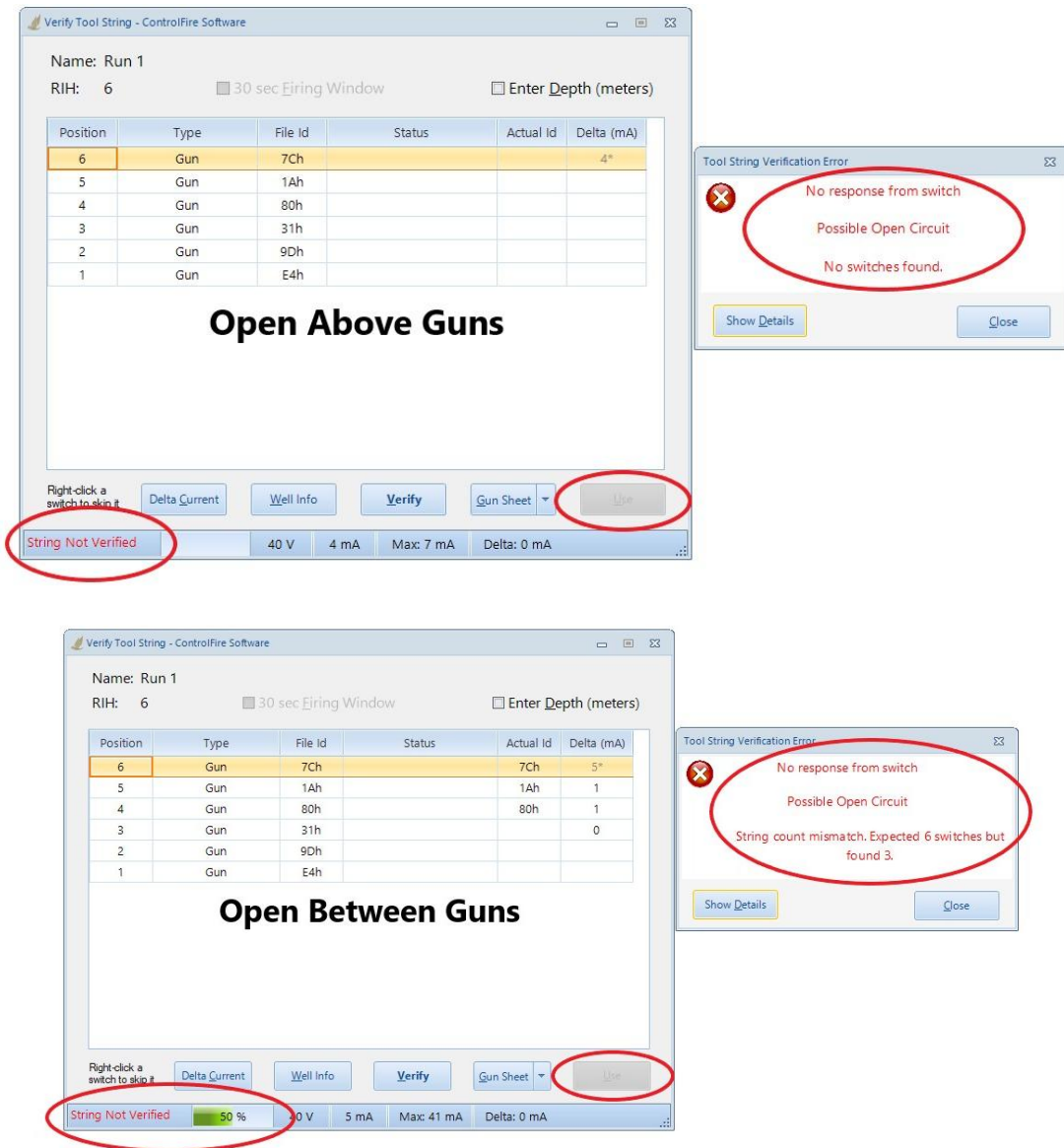
3.2 ERROR: OPEN IN GUN STRING

Figure 8 Open Above and Between Guns

Error Signature: Error message appears: "No response from switch. Possible Open Circuit". Verifying string status does not reach 100%, Status reads "String Not Verified", Actual ID does not match File Id, User unable to "Save" or "Use" gun string.

Troubleshoot: You cannot fix a downhole open without coming out of hole. If zero switches read, open is between collector ring and first switch. This is typically caused by a bad ground to the first switch or a bad contact in tools/subs/cablehead above the first switch. If open is detected between switches then problem is between guns. This is typically caused by an open connection or a bad ground between guns. Always perform several Verify attempts, increase the Communication Voltage 5V at a time and confirm that surface equipment is working properly before coming out of hole.
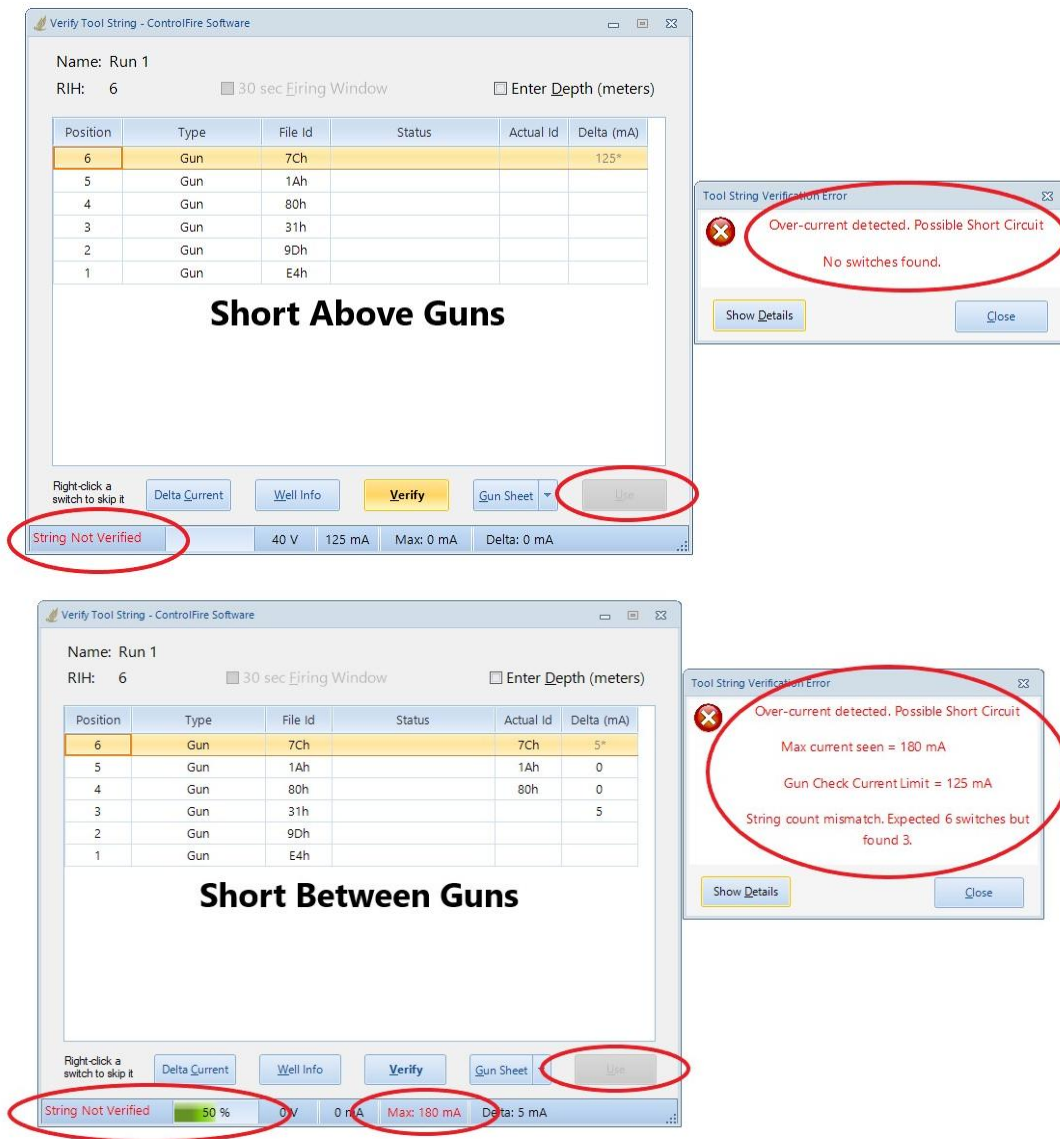
3.3 ERROR: SHORT IN GUN STRING

Figure 9 Short Above and Between Guns

Error Signature: Error message appears: "Overcurrent Detected (Short)", Verifying string status does not reach 100%, Status reads "String Not Verified".   Overcurrent (>100 mA) seen, Actual ID does not match File Id, User unable to "Save" or "Use" gun string.

Troubleshoot: You cannot fix a downhole short without coming out of hole. If zero switches read, short is between collector ring and first switch. This is typically caused by a shorted contact/wire in tools/subs/cablehead above the first switch. If short is detected between switches then problem is between guns. This is typically caused by a pinched wire or a shorted contact between guns.
Always perform several Verify attempts and decrease the Communication Voltage 5V at a time. If you start getting CRC errors then the supplied Communication Voltage is too low and you should increase it. Confirm that surface equipment is working properly before coming out of hole.

4 CHECKING A GUN STRING
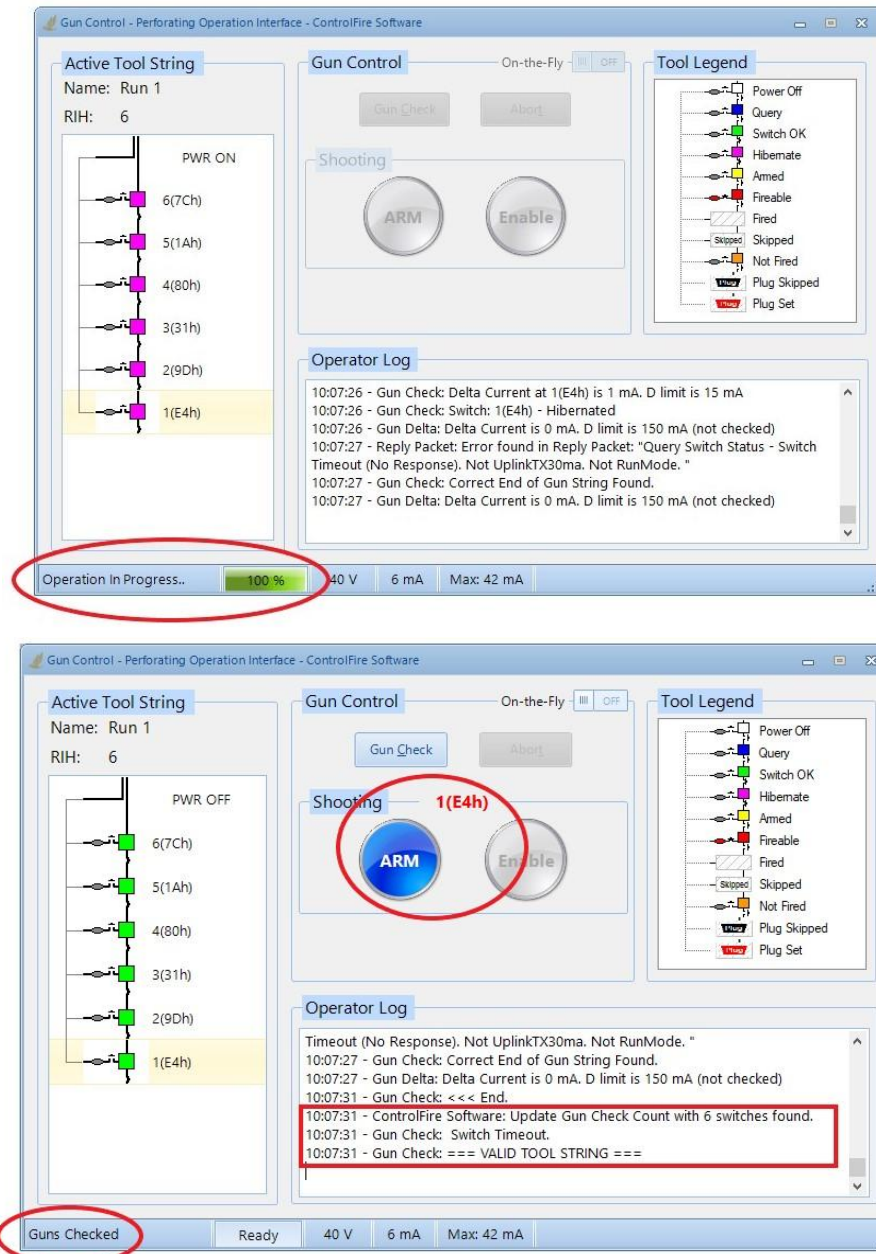
4.1 SUCCESSFUL GUN CHECK

Figure 10 Successful Gun Check

Signature: Steady voltage delivered and current is drawn (>0 mA), Operation In Progress reads 100%, Green boxes for all switches, Operator Log shows correct # of switches read and reads "Valid Tool String", Status bar reads: "Guns Checked", ARM button is available for bottom switch.

Troubleshoot: None
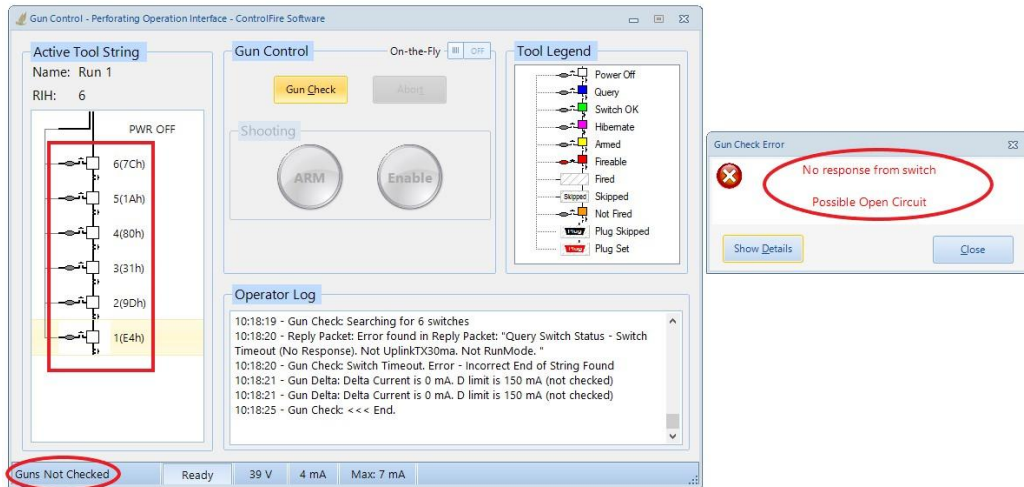
4.2 ERROR: OPEN ABOVE GUNS

Figure 11 Open Above Guns

Signature: Error message appears: "No response from switch. Possible Open Circuit", Status reads "Guns Not Checked".   Operation In Progress does not reach 100%, Switch boxes remain powered off (white), ARM button is unavailable for bottom switch.

Troubleshoot: You cannot fix a downhole open without coming out of hole. If zero switches read, open is between collector ring and first switch. This is typically caused by a bad ground to the first switch or a bad contact in tools/subs/cablehead above the first switch. Always perform several Gun Check attempts, increase the Communication Voltage 5V at a time and confirm that surface equipment is working properly before coming out of hole.
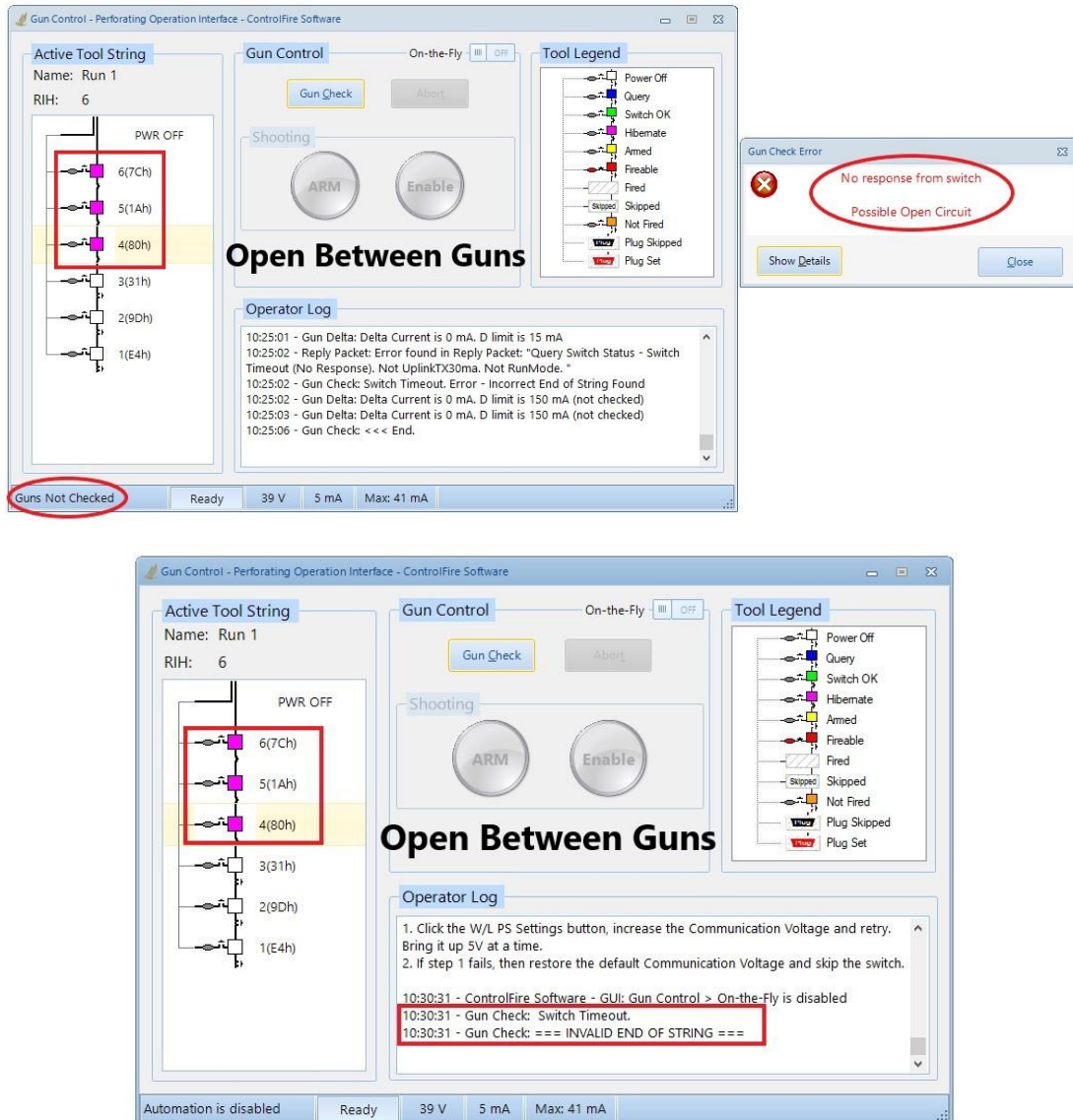
4.3 ERROR: OPEN BETWEEN GUNS

Figure 12 Open Between Guns

Signature: Error message appears: "No response from switch. Possible Open Circuit", Status reads "Guns Not Checked", Operation In Progress does not reach 100%, Operator Log reads "Invalid End of String" and "Switch Timeout", ARM button is unavailable for bottom switch.

Troubleshoot: You cannot fix a downhole open without coming out of hole. Confirm that surface equipment is working properly before coming out of hole. An open between switches is typically caused by an open connection or a bad ground between guns. Always perform several Gun Check attempts and increase the Communication Voltage 5V at a time. If increasing the voltage fails, then restore the default Communication Voltage and skip the switch.
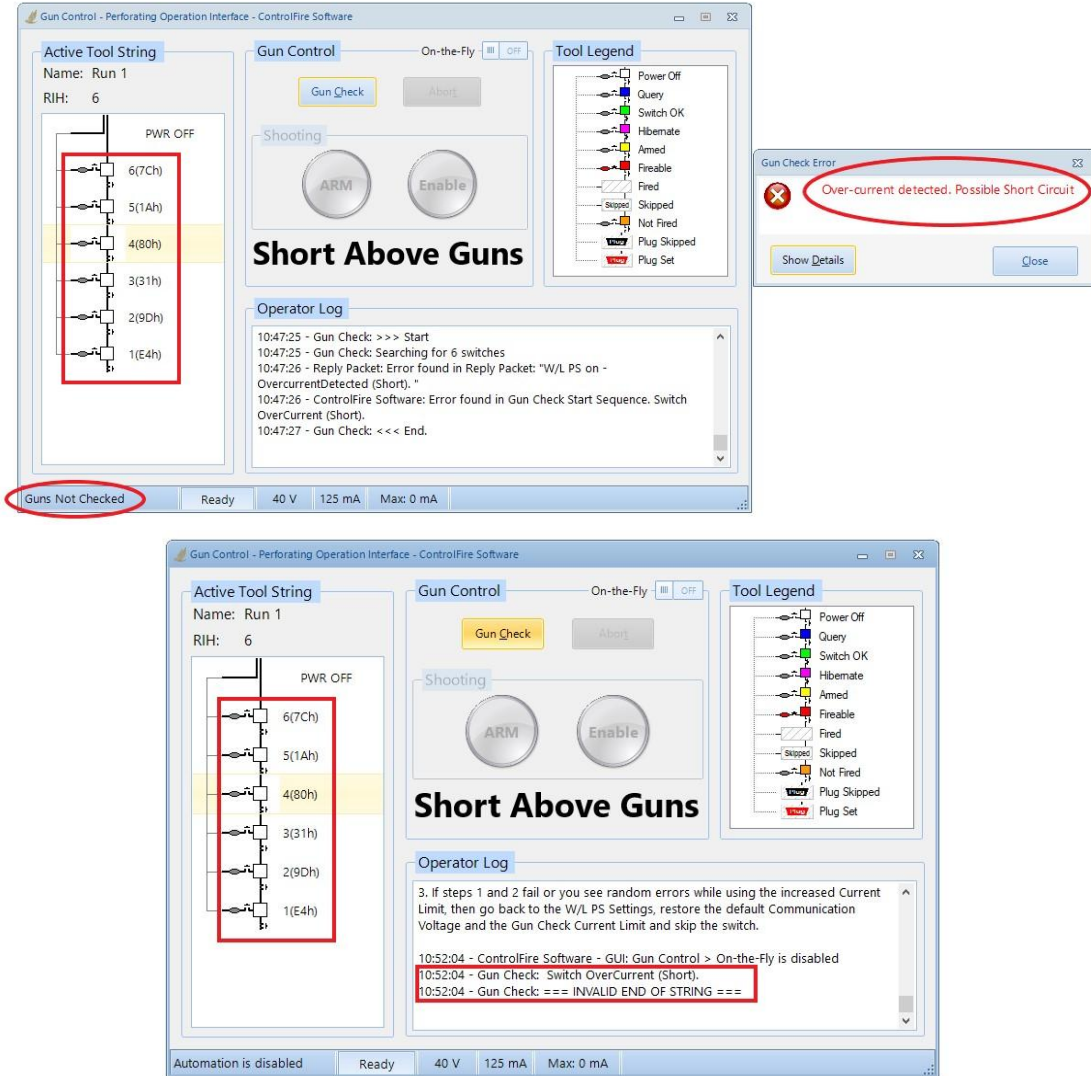
4.4 ERROR: SHORT ABOVE GUNS

Figure 13 Short Above Guns

Signature: Error message appears: "Over-current detected. Possible Short Circuit", Status reads "Guns Not Checked", Operation In Progress does not reach 100%, Switch boxes remain powered off (white), Operator Log reads "Invalid End of String" and "Switch OverCurrent", ARM button is unavailable for bottom switch.

Troubleshoot: You cannot fix a downhole short without coming out of hole. If zero switches read, short is between collector ring and first switch. This is typically caused by a shorted contact/wire in tools/subs/cablehead above the first switch. Perform several Gun Check attempts, try decreasing the Communication Voltage 5V at a time. If you start getting CRC errors then the supplied Communication Voltage is too low and you should increase it. Confirm that surface equipment is working properly before coming out of hole.
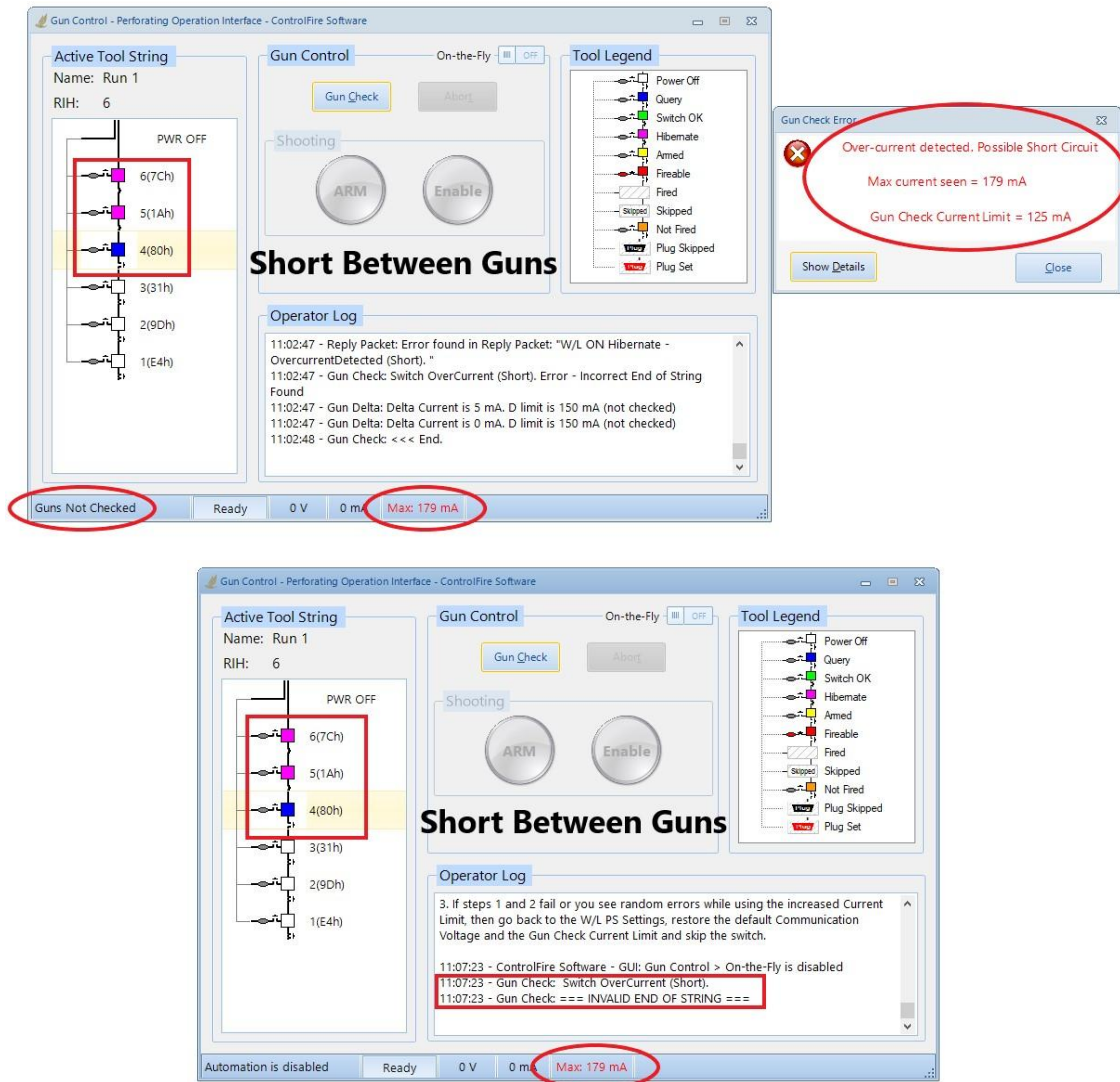
4.5 ERROR: SHORT BETWEEN GUNS

Figure 14 Short Between Guns

Signature: Error message appears: "Over-current detected. Possible Short Circuit", Status reads "Guns Not Checked". Operation In Progress does not reach 100%, Operator Log reads "Invalid End of String" and "Switch OverCurrent (Short)", Over-current (>Gun Check Current Limit) seen, ARM button is unavailable.

Troubleshoot: You cannot fix a downhole short without coming out of hole. Confirm that surface equipment is working properly before coming out of hole. If short is detected between switches then problem is between guns. This is typically caused by a pinched wire or a shorted contact between guns. Perform several Gun Check attempts, try decreasing the Communication Voltage 5V at a time. If you start getting CRC errors then the supplied Communication Voltage is too low and you should increase it. If decreasing the voltage fails, then restore the default Communication Voltage and skip the switch.
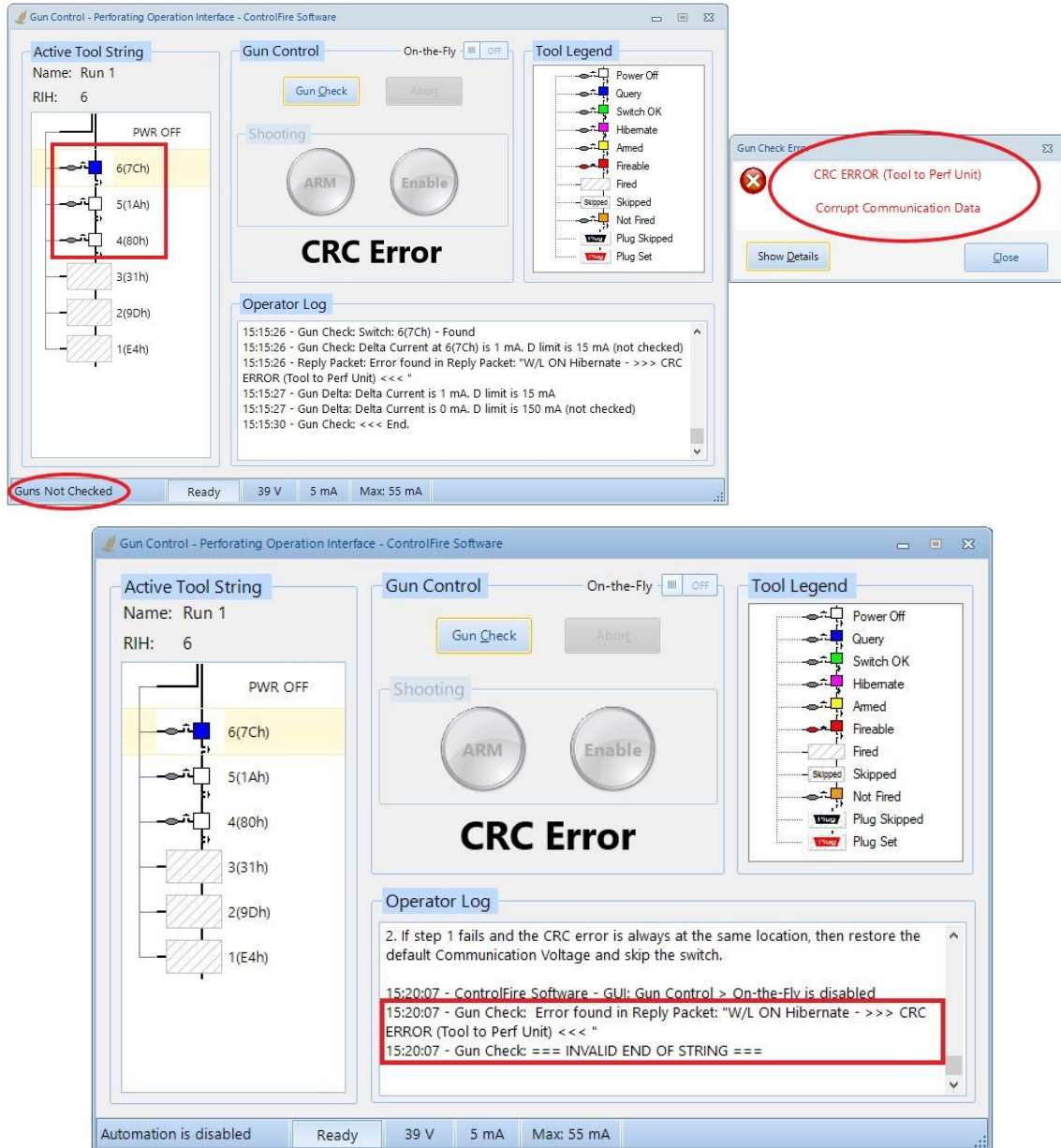
4.6 ERROR: CRC ERROR

Figure 15 CRC Error

Signature: Error message appears: "CRC ERROR. Corrupt Communication Data". There are four types of CRC errors: "Host to Perf Unit", "Perf Unit to Host", "Perf Unit to Tool", "Tool to Perf Unit". CRC Error message also appears in Operator log. Status reads "Guns Not Checked", Operation In Progress does not reach 100%, Switch boxes remain powered off (white), ARM button is unavailable for bottom switch.
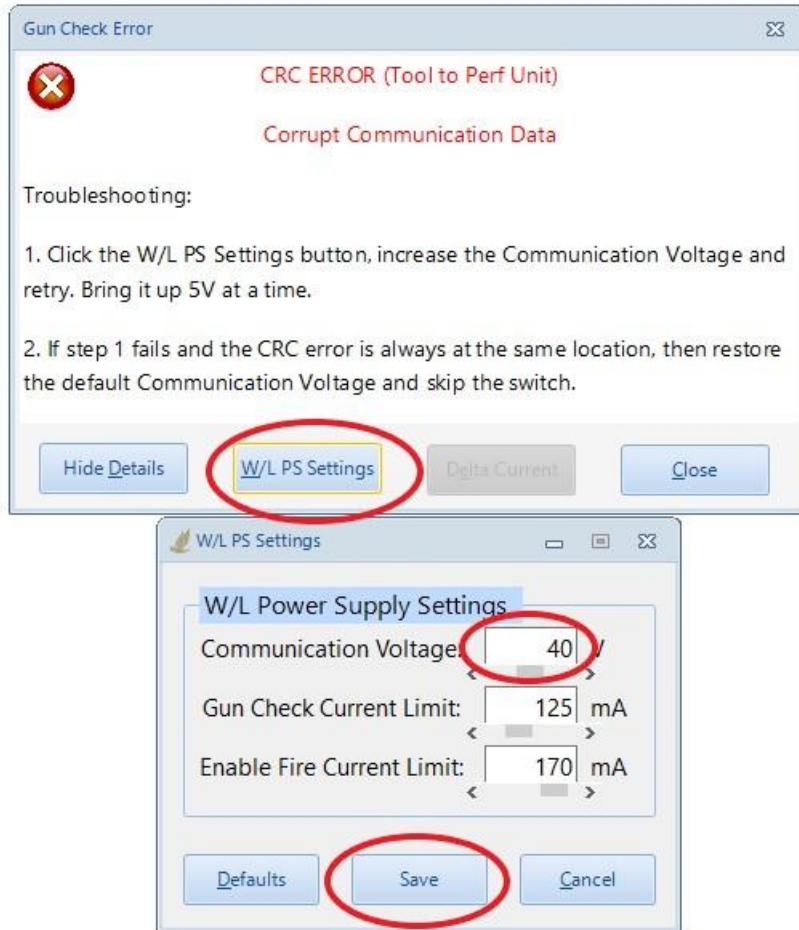
Figure 16 CRC Troubleshooting

Troubleshoot: If a CRC error occurs between the Perf Unit and a switch (i.e., "Tool to Perf Unit" or "Perf Unit to Tool"), there is insufficient voltage to communicate to the switches due to electrical leak in the gun string. The leak could be in the wireline head or auxiliary equipment above the gunstring. This may be able to be fixed downhole depending on the severity of the leak. To restore communication downhole, select the "Change" button from the Main screen or click the "W/L Power Supply Settings" button in the pop-up message (see Figure 16) . Increase the Communication Voltage by 5V and click on "Save". Try a Gun Check again. If the CRC error persists, repeat the Voltage increase in 5V increments until the max allowed voltage is reached. If the Gun Check is still unsuccessful, the leak is too severe and you must come out of well to identify and fix the leaking equipment.

5   FIRING A GUN

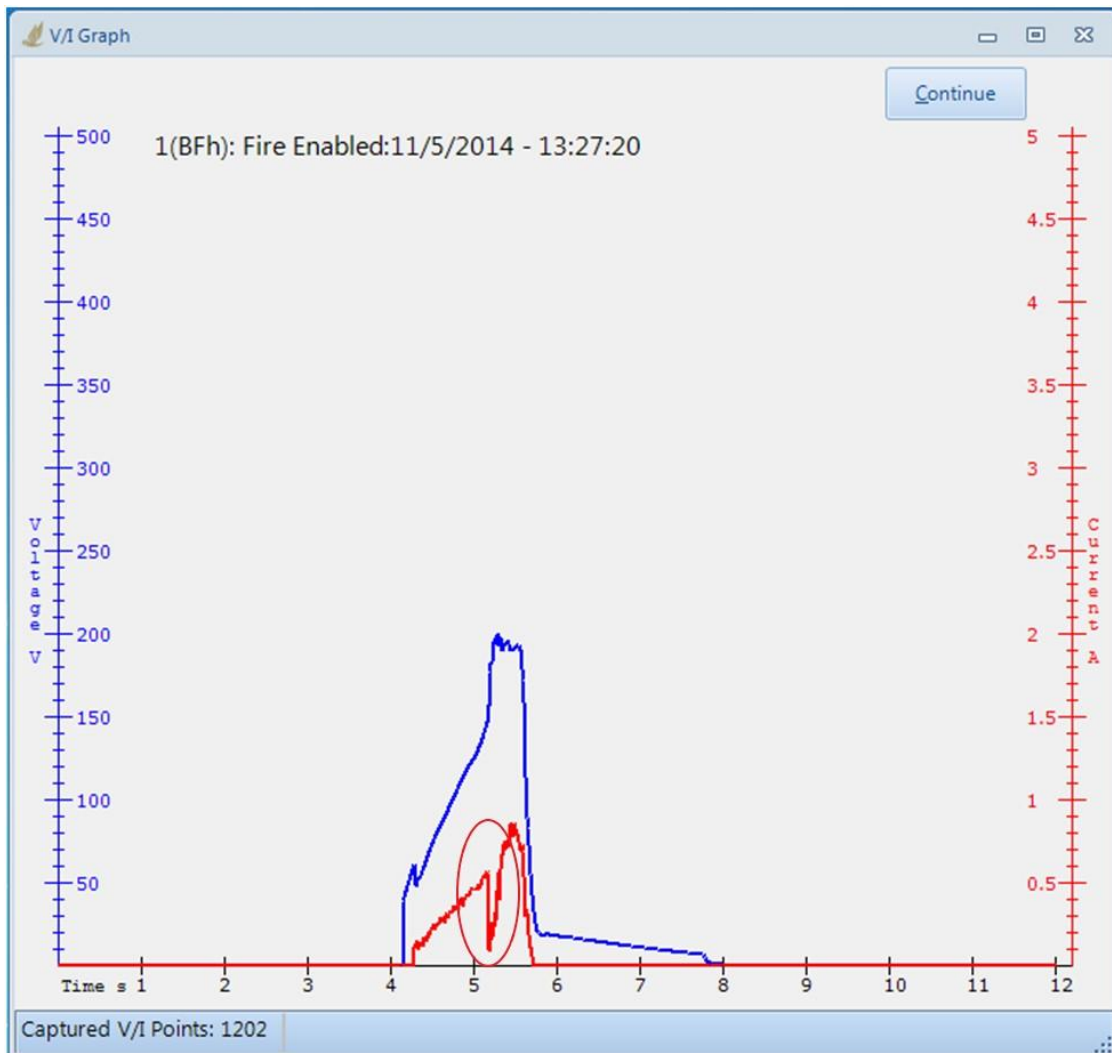## 5.1   SUCCESSFUL FIRE

Figure 17 Successful Fire

Signature: Voltage (blue) comes up smoothly and current (red) follows at >50V. Current breaks after reaching 0.5-1.0 Amps (for 50 ohm resistorized detonator).   Immediately roll voltage down to zero after seeing current break.

Troubleshoot: None

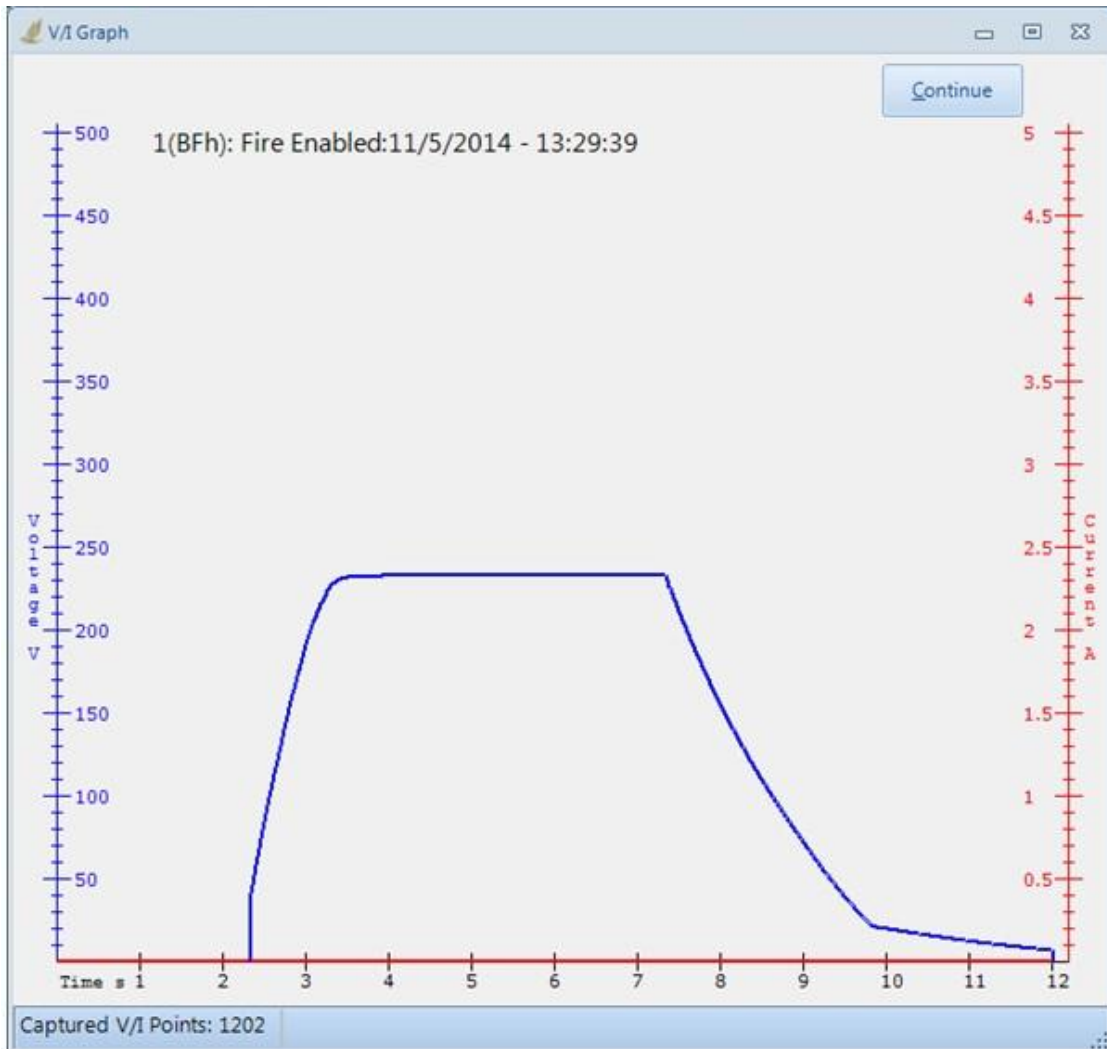## *5.2 ERROR: DETONATOR/IGNITER OPENS BELOW SWITCH*

Figure 18 Detonator/Igniter Opens Below Switch

Error Signature: Voltage (blue) comes up smoothly, but zero current (red) is drawn.

Troubleshoot: You cannot fix a downhole open without coming out of hole. If the VI Plot shows an open during firing, there is an open between the switch and detonator/igniter or in the detonator/igniter itself. Typically, this is the result an open connection to the detonator wires or an open contact between the switch and setting tool firing head if error occurs when firing an igniter. Always confirm that surface equipment is working properly before coming out of hole.

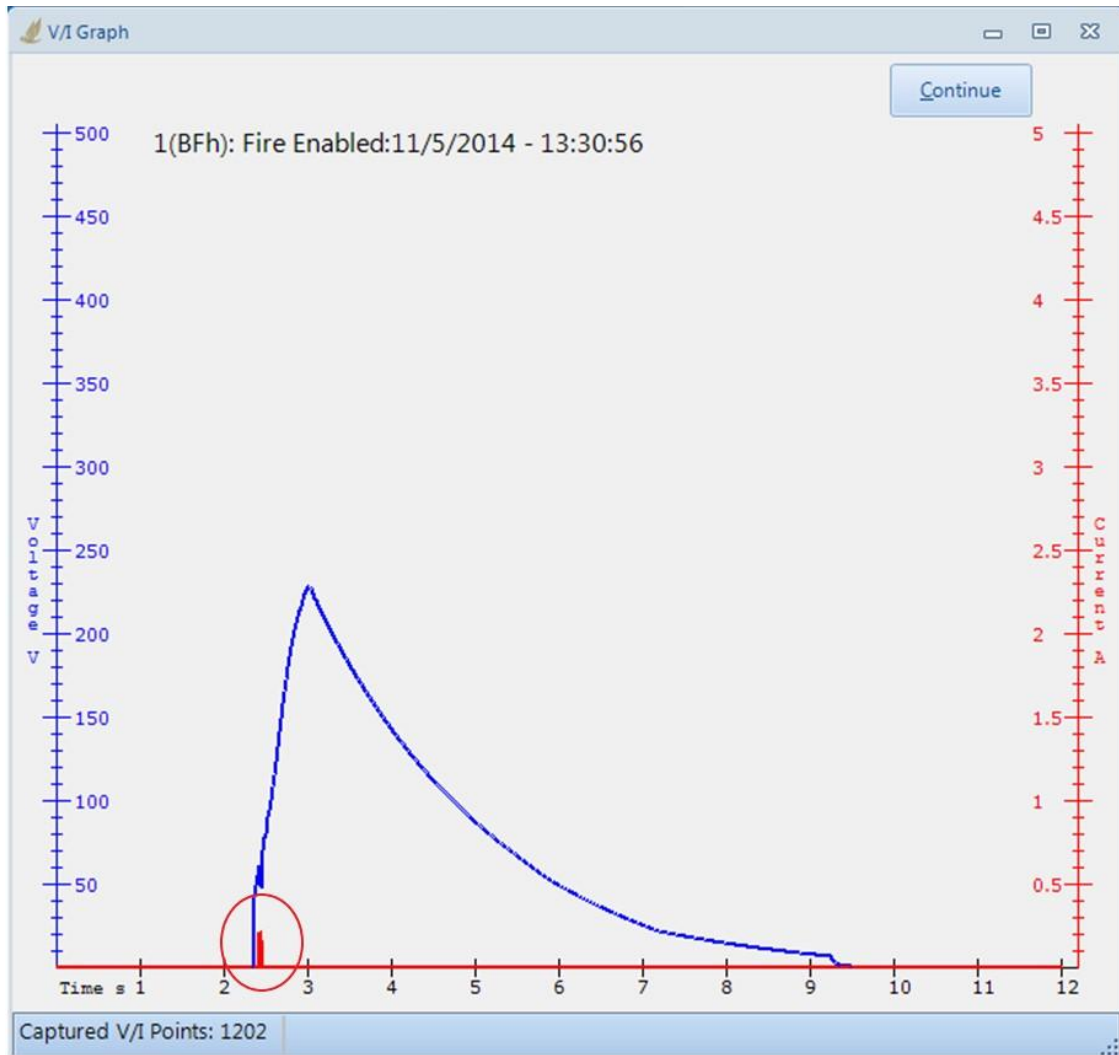## 5.3 ERROR: DETONATOR/IGNITER SHORTS BELOW SWITCH

Figure 19 Detonator/Igniter Shorts Below Switch

Error Signature: Voltage (blue) comes up smoothly, but current (red) only spikes then immediately returns to zero.

Troubleshoot: You cannot fix a downhole short without coming out of hole. If the VI Plot shows a short during firing, there is a short between the switch and detonator/igniter or in the detonator/igniter itself. Typically, this is the result of pinched detonator wires or a shorted contact between the switch and setting tool firing head if error occurs when firing an igniter. This error is also the result of not turning the shunt connector from SHUNT to ARM when using the RF-Safe ControlFire Assembly.
Always confirm that surface equipment is working properly before coming out of hole.
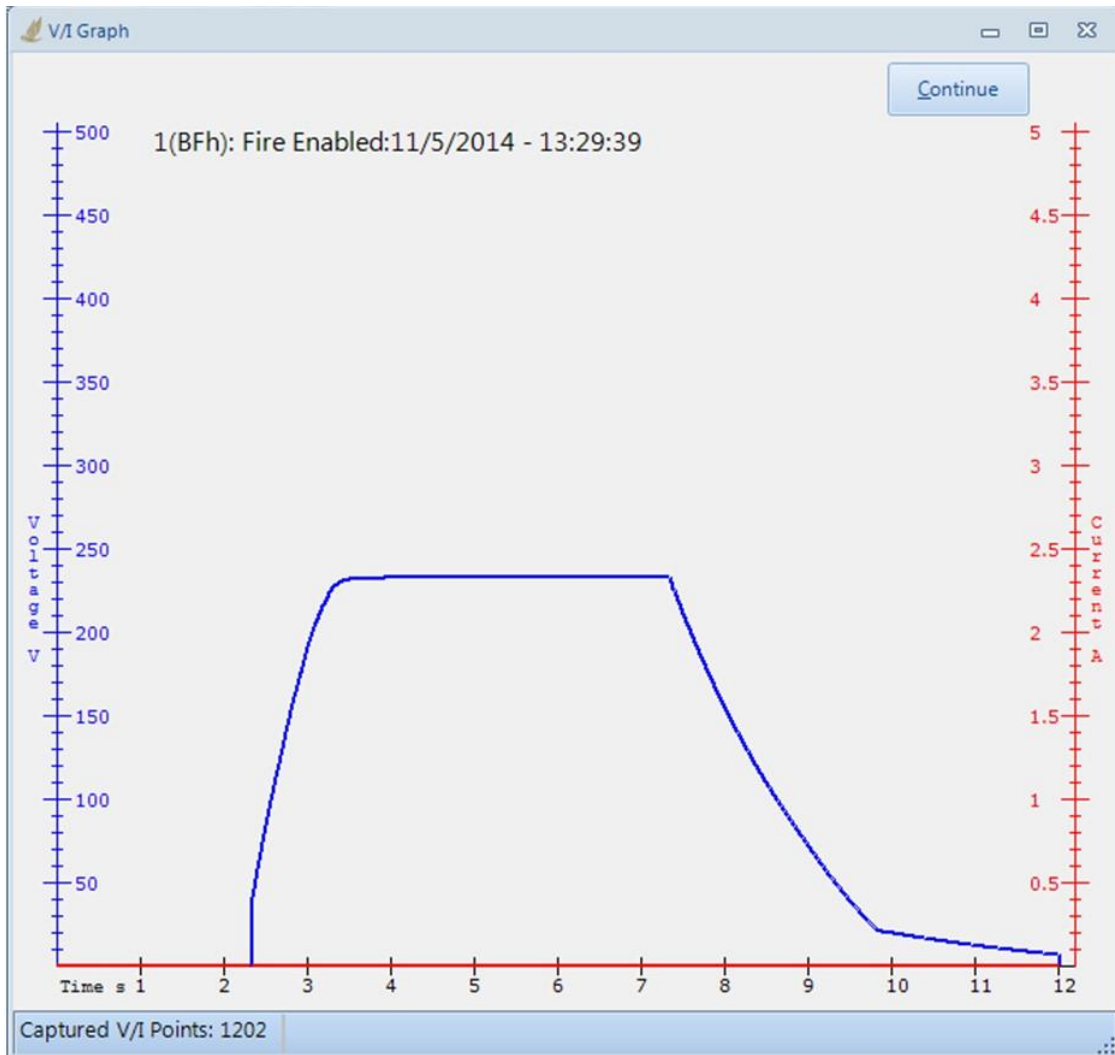
5.4 ERROR: IGNITER WIRED INCORRECTLY

Figure 20 Igniter Wire Incorrectly

Error Signature: Voltage (blue) comes up smoothly, but zero current (red) is drawn.

Troubleshoot: You cannot fix a downhole open without coming out of hole. If the VI Plot shows an open during firing, there is an open between the switch and detonator/igniter or in the detonator/igniter itself. Typically, this is the result of an open connection to the detonator wires or an open contact between the switch and setting tool firing head if error occurs when firing an igniter.   This may also be the result of wiring the plug switch incorrectly when firing an igniter. The green wire from the plug switch must be connected to the plug shoot adapter contact. Always confirm that surface equipment is working properly before coming out of hole.

6 USB COMMUNICATION
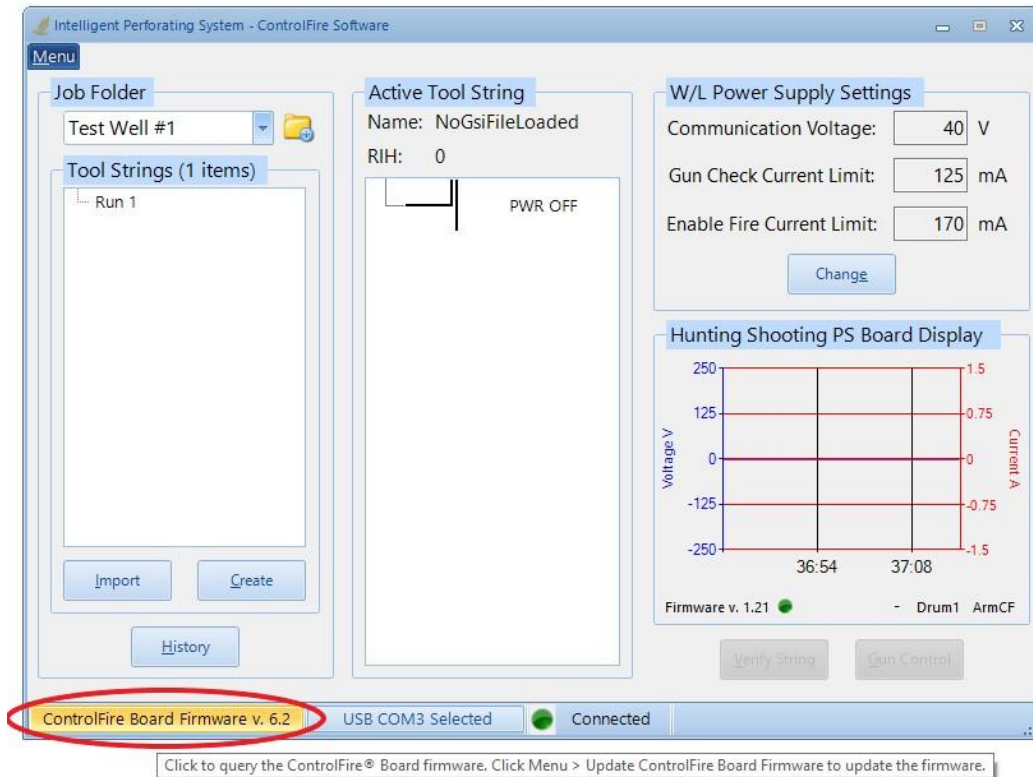
6.1 SUCCESSFUL USB COMMUNICATION

Figure 21 Successful USB Communication

Signature: USB COM signal in bottom left hand corner is green and reads "USB COM# Selected".
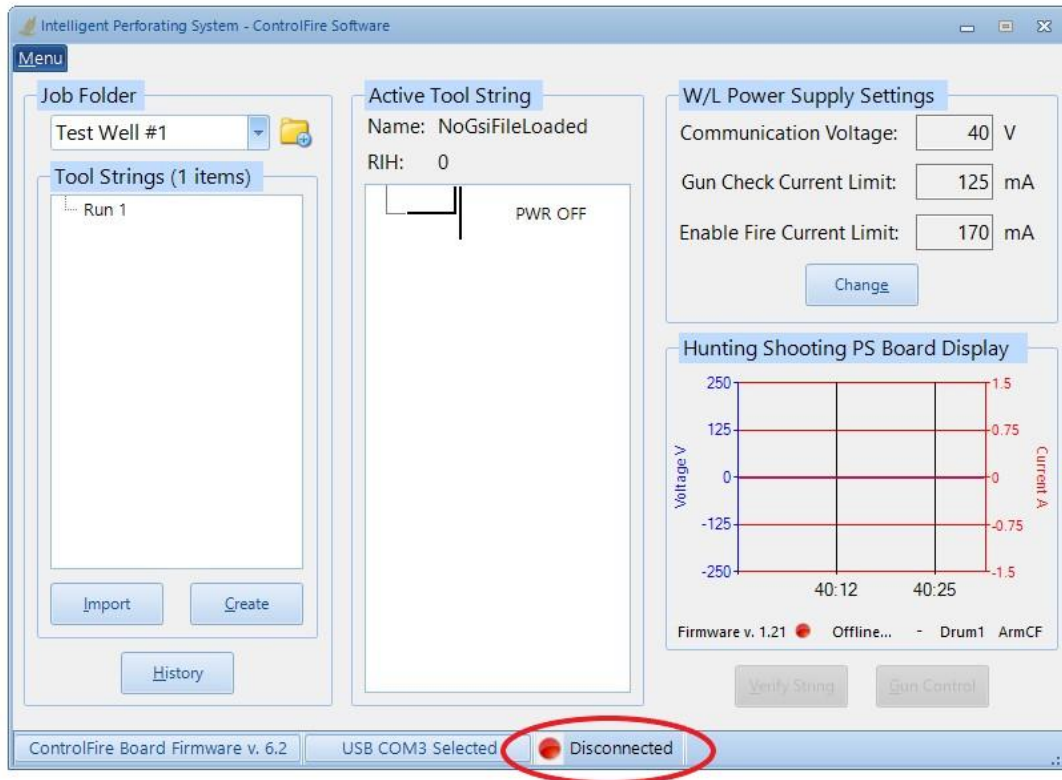
6.2 USB COMMUNICATION LOST

Figure 22 USB Communication Lost

Signature: USB COM signal in the status bar turns from green to red.

Troubleshoot: Communication of the ControlFire board with software has been lost. Make sure USB cable is securely connected on both ends. Once reconnected, press "ControlFire Board Firmware" to verify communication. On rare occasions, computer may need to be restarted to re-establish communication. USB cable should not be near a power source or power cord. If USB cable being used was not distributed with panel, cable must be shielded and no greater than 6 feet in length. If communication problem persists, check to see that panels are turned on and in ControlFire mode. If fuse is blown in PCCP, replace fuse.

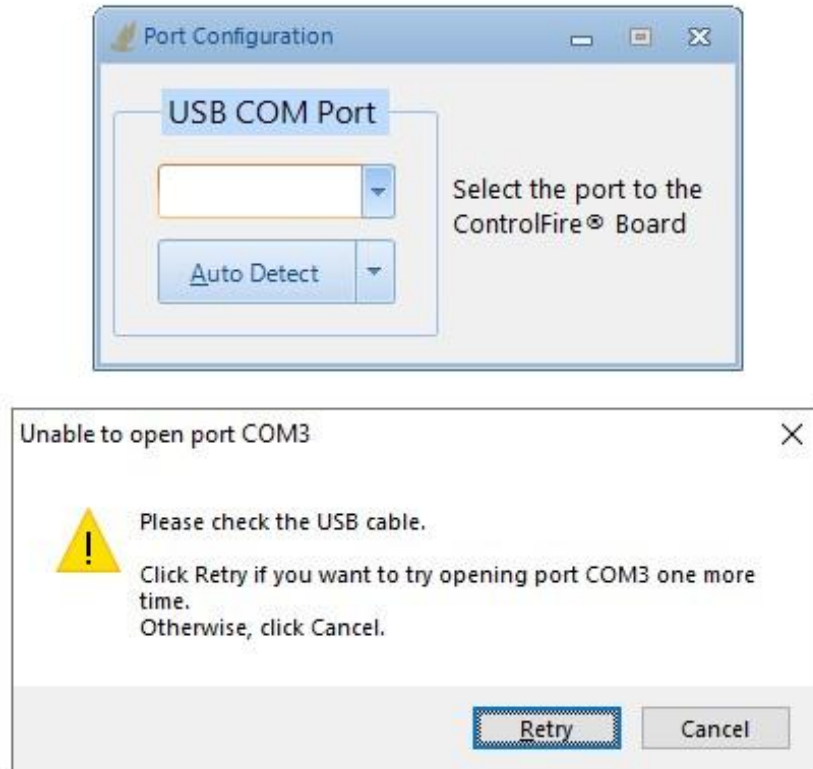## *6.3 ERROR: USB COMMUNICATION LOST DURING STARTUP*

Figure 23 USB Communication Lost During Startup

Error Signature: Pop-Up "Unable to open port" message appears.

Troubleshoot: Communication of the Perforating Command & Control Panel with software has been lost. Make sure USB cable is securely connected on both ends. Press "Auto Detect" and successful communication should occur within a few seconds. On rare occasions, computer may need to be restarted to re-establish communication. USB cable should not be near a power source or power cord. If USB cable being used was not distributed with panel, cable must be shielded and no greater than 6 feet in length. If communication problem persists, check to see that panels are turned on and in ControlFire mode. If fuse is blown in PCCP, replace fuse.

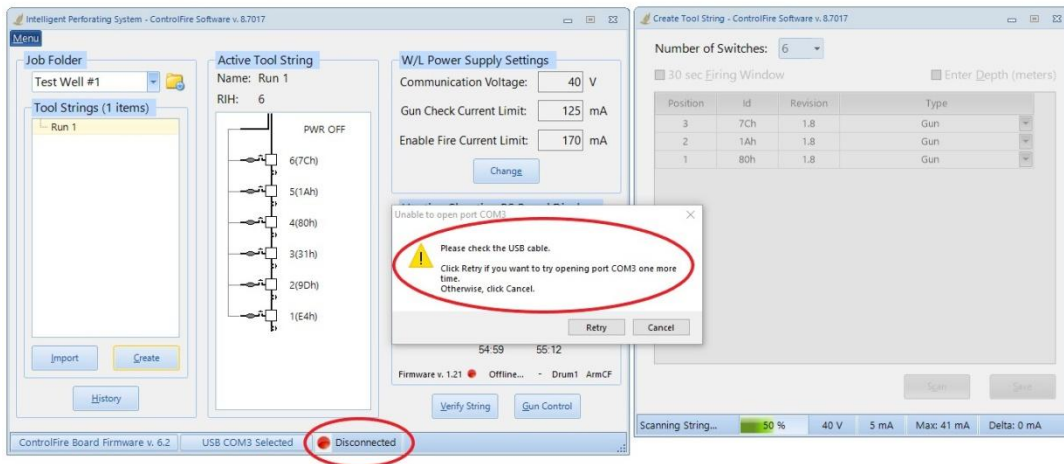## 6.4 ERROR: USB COMMUNICATION LOST DURING GUN CREATION

Figure 24 USB Communication Lost During Gun Creation

Error Signature: Unsuccessful gun creation, Pop-Up "Unable to open port" appears, USB COM signal in the status bar turns from green to red.

Troubleshoot: Communication of the ControlFire board with software has been lost. Make sure USB cable is securely connected on both ends. Once reconnected, Press "OK" and successful communication should occur within 10 seconds. On rare occasions, computer may need to be restarted to re-establish communication. USB cable should should not be near a power source or power cord. If USB cable being used was not distributed with panel, cable must be sheilded and no greater than 6 feet in length. If communication problem persists, check to see that panels are turned on and in ControlFire mode. If fuse is blown in PCCP, replace fuse.

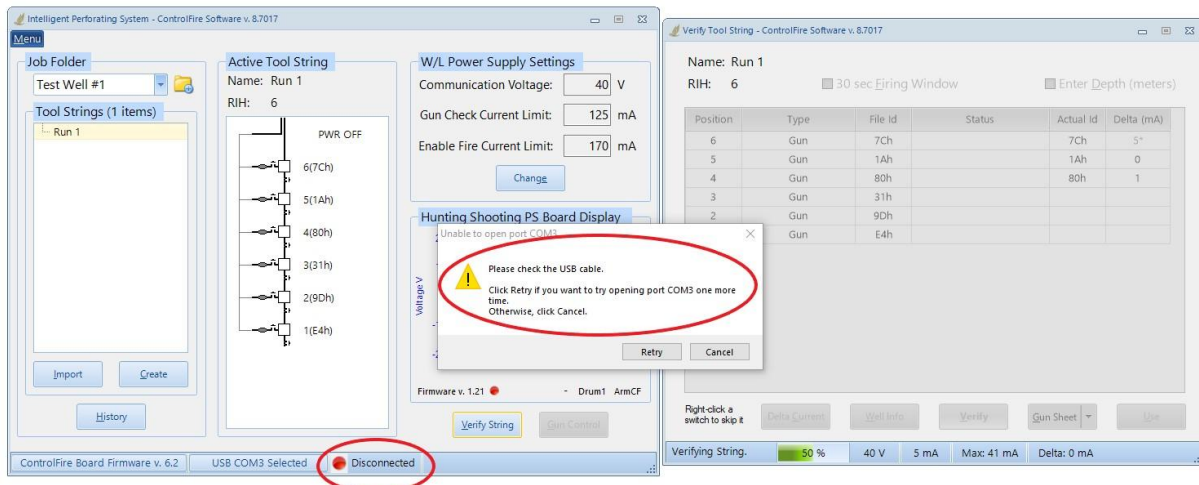## 6.5 ERROR: USB COMMUNICATION LOST DURING GUN VERIFICATION

Figure 25 USB Communication Lost During Gun Verification

Error Signature: Unsuccessful gun verification, Pop-Up "Unable to open port" appears, USB COM signal in bottom left hand corner turns from green to red.

Troubleshoot: Communication of the ControlFire board with software has been lost. Make sure USB cable is securely connected on both ends. Once reconnected, Press "OK" and successful communication should occur within 10 seconds. On rare occasions, computer may need to be restarted to re-establish communication. USB cable should should not be near a power source or power cord. If USB cable being used was not distributed with panel, cable must be sheilded and no greater than 6 feet in length. If communication problem persists, check to see that panels are turned on and in ControlFire mode. If fuse is blown in PCCP, replace fuse.
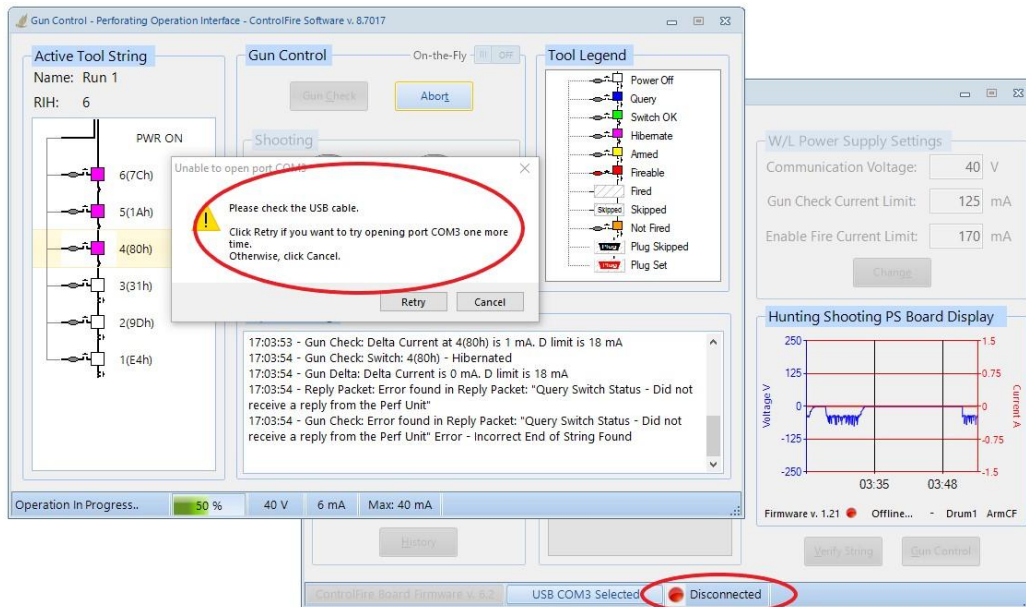
6.6 ERROR: USB COMMUNICATION LOST DURING GUN CHECK

Figure 26 USB Communication Lost During Gun Check

Error Signature: Unsuccessful gun check, Pop-Up "Unable to open port" appears, USB COM signal in bottom left hand corner turns from green to red.

Troubleshoot: Communication of the ControlFire board with software has been lost. Make sure USB cable is securely connected on both ends. Once reconnected, Press "OK" and successful communication should occur within 10 seconds. On rare occasions, computer may need to be restarted to re-establish communication. USB cable should should not be near a power source or power cord. If USB cable being used was not distributed with panel, cable must be sheilded and no greater than 6 feet in length. If communication problem persists, check to see that panels are turned on and in ControlFire mode. If fuse is blown in PCCP, replace fuse.

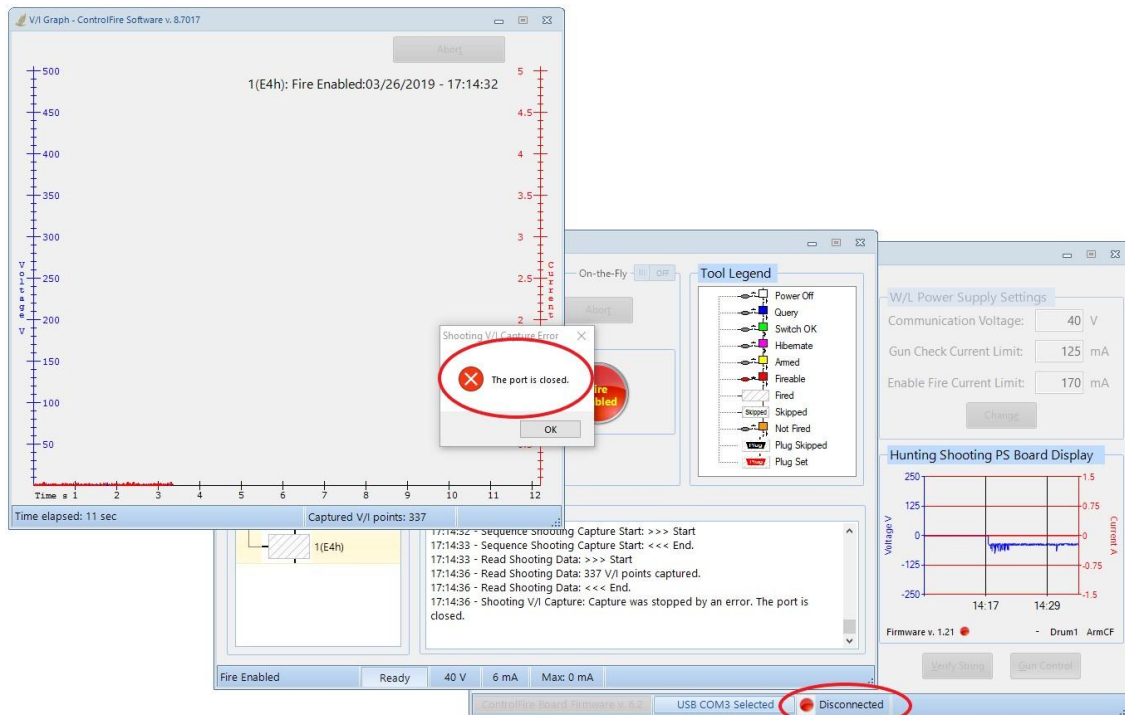## 6.7   ERROR: USB COMMUNICATION LOST DURING GUN FIRING

Figure 27 USB Communication Lost During Gun Firing

Error Signature: Unsuccessful gun fire, Pop-Up " VI Capture Error" message appears, USB COM signal in bottom left hand corner turns from green to red.

Troubleshoot: Communication of the Perforating Command & Control Panel with software has been lost. Make sure USB cable is securely connected on both ends. Once reconnected, Press "OK" and successful communication should occur within 10 seconds. On rare occasions, computer may need to be restarted to re-establish communication. USB cable should should not be near a power source or power cord. If USB cable being used was not distributed with panel, cable must be sheilded and no greater than 6 feet in length. If communication problem persists, check to see that panels are turned on and in ControlFire mode. If fuse is blown in PCCP, replace fuse.

7 CONTACTS

EMAIL: controlfire@hunting-intl.com; TTN.TTSA@hunting-intl.com

WEBSITE: www.hunting-intl.com

SALES: HOUSTON, TX
sales@hunting-intl.com
(281) 448-2200

ControlFire MANUFACTURING - HOUSTON, TX
(713) 463-5881

ControlFire RF-SAFE ASSEMBLY MANUFACTURING - MILFORD, TX
(972) 493-2580