



Falcon Series

Application Note: Tech Support Frequently Asked Questions

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My Falcon does not communicate with the controller PC. What can I do to troubleshoot?

1. Check your Thunderbolt 3 cable. All Thunderbolt 3 cables use the USB Type-C connector and support USB 3.0. However not all USB Type-C cables can support Thunderbolt 3, depending on cable length and quality. Verify that your connection cable is a Thunderbolt 3 cable, not just a USB Type-C cable. Thunderbolt 3 cables will carry  the Thunderbolt 3 mark

We recommend either StarTech (www.startech.com) or Sonnet (www.sonnetstore.com) Thunderbolt 3 cables; we have tested and verified both of these brands for compatibility.

CableMatters brand cables are NOT compatible.

For longer cables (>0.5m) we have verified that the following are compatible while supporting 40Gbps bandwidth:

- Protocol Insight, PN: EnhanceConn - Thunderbolt3 6ft/2m 40Gbps active cable and cable retention device
- StarTech Series TBLT3MM2MA Thunderbolt 3 Cable - 6 ft / 2m - 4K 60Hz - 40Gbps
- Sonnet Thunderbolt 3 Cable (40Gbps; 1-meter)
- [Apple Thunderbolt 4 Cable](#) (40 Gbps; 1.8-meter)

Background: Prior to Thunderbolt 3, Thunderbolt 2 and the original Thunderbolt shared the same cable type and Mini DisplayPort connector, with top data transfer speeds of 20Gbps and 10Gbps, respectively. Thunderbolt 3 has a top data transfer speed of 40Gbps as long as the cable is 0.5m (1.6 ft.) or shorter. For 1m (3.2 ft.) or longer cables, Thunderbolt 3 supports passive cables that have a top speed of 20Gbps and active cables that retain the 40Gbps speed.

2. Check that you are connecting to the Thunderbolt 3 connector on your controller PC. Since Thunderbolt 3 devices use discrete Thunderbolt chips to function, they will not work if they are plugged into a USB-C port unless that port specifically supports Thunderbolt 3.
3. Check the Thunderbolt 3 drivers on the controller PC. Ensure that the Thunderbolt 3 drivers are the latest supplied by your PC manufacturer. If your controller PC is a desktop using a PCIe-to-Thunderbolt 3 adaptor card, verify that the adapter card is supported by the bios of your PC.
4. For more information refer to the Installation Guide application note.

My Falcon connects to the controller PC but I cannot see it in the Falcon software.

Microsoft implemented Kernel DMA protection in recent OS releases. You can find more information on this here: [Kernel DMA Protection \(Memory Access Protection\) for OEMs | Microsoft Docs](#)

If you open the Device Manager you will see the instrument is recognized and the driver is installed, however it may have a “!” by it, refer to [Figure 1 - Device Manager / Instrument Message](#). Looking in Instrument Properties, General tab, you may see the device has been blocked.

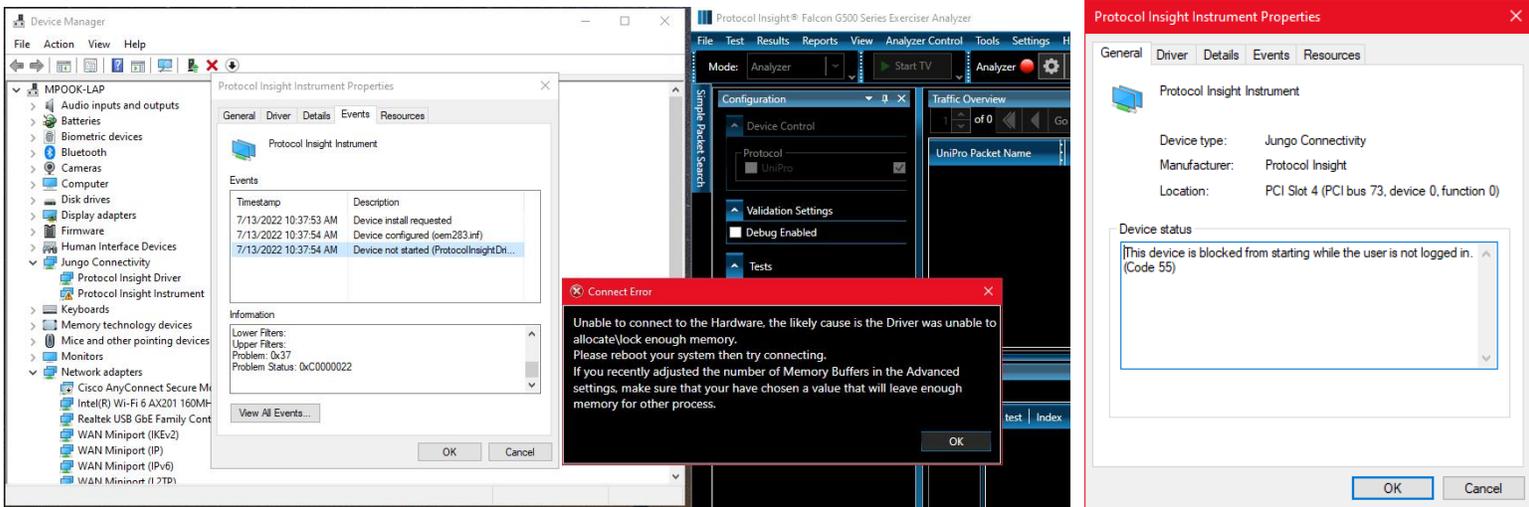


Figure 1 - Device Manager / Instrument Message

To resolve this issue:

1. Ensure you are logged into Windows.
2. Unplug the Thunderbolt cable from the controller PC, wait a moment and then reattach it.
3. This should allow Windows to initialize the device.
4. Relaunch the Falcon Software and verify the instrument is connected.

If the above steps do not resolve the issue.

1. Turn off the Falcon Protocol Analyzer and disconnect the Thunderbolt cable from the controller PC.
2. Reboot the controller PC and then login to Windows.
3. Turn on the PA and connect it to the controller PC using the Thunderbolt cable.
4. This should allow Windows to initialize the device.
5. Relaunch the Falcon Software and verify the instrument is connected.

Is there a way to search for the errors in the UniPro or UFS Packet List?

There are two Trace Validation tests in the SearchTVs folder, one for UniPro and one for UFS. These can be selected from the Analyzer Configuration or Exerciser+Configuration windows. Once the TV has been run click on a result in the TV Results window and then use the down arrow on the keyboard to move to successive errors in the trace.

You can also create a Trace Validation test to search for packets with errors or use Simple Packet Search to search for NACs and then look for the red packets.

How do the hardware counters in Instrument Status work in relation to analyzer trace capture?

The Hardware Counters in the Instrument Status window are unrelated to the analyzer trace capture. The hardware counters monitor the UniPro link and count the bits on the link to show if the link is active. Once the instrument obtains sync with the KCode symbols on UniPro link the hardware counters will start incrementing and will continue incrementing as long as there is traffic on the link.

When the analyzer Run button is clicked the analyzer will begin filling its trace memory and it will continue to fill memory until triggered or Stopped. Then the memory stops filling and offloads to the GUI. However the hardware counters never stop incrementing, even after the analyzer Stop button is pressed or after a trigger event.

What is the difference between Symbol Errors in the Instrument Status window and red error packets in the UniPro and UFS Packet listing windows?

Symbol errors counted in the Instrument Status window are KCode raw bit capture errors, typically caused by signal integrity problems, probing issues or M-PHY issues.

Red packets in the List windows show protocol decode issues that typically occur when the host or device are not correctly transmitting data and the packet's protocol information is invalid. Red packets also mark any packets corrupted by symbol errors counted in the Instrument Status window.

Thus, invalid packet protocol errors are shown as red packets only in the List windows and not in the Instrument Status window, but KCode bit errors will show in both the Instrument Status and as red packets in the List windows.

How do I capture an analyzer trace when the UniPro link is already established?

The analyzer can capture a trace from an existing UniPro link, but the analyzer needs to be told what power mode the UniPro link is operating at. Once told what speed and link width to expect it can sync to the existing traffic on the bus provided it sees at least one Start of Burst.

The “Initial Power Mode” setting under Settings->Instrument Configuration is used to tell the analyzer the initial power mode to assume to sync to the link. Once the initial power mode is configured in the Instrument Configuration window the analyzer will remember that setting for the next time you hit Run and any subsequent Runs, but the GUI reverts to the default setting in the display.

Why did I get the message “State machine did not run” when running a Trace Validation test?

Trace Validation (TV) is a state machine analysis tool that analyzes captured traces using specific and/or logic and states to find problems and events. TV tests can be run against any captured trace as a complete post-capture analysis tool for search, pass/fail testing, stress test analysis or for general debug.

There are generally five types of TV tests that can be run: pre-defined CTS tests, debug tests, SearchTVs, Advanced Trigger and custom tests. The application software library includes hundreds of pre-defined CTS, debug, and SearchTV test cases that can be used as-is or modified and saved as their own unique analysis test cases, and users can use the Trace Validation Test Editor or Advanced Trigger Test Editor to create their own custom tests.

Pre-defined CTS tests are supplied with the application software library for most UniPro and UFS CTS tests defined by the respective standards organizations. There are three common reasons why CTS test cases will not run and the message “**State machine did not run**” is generated:

1. **The Test Configuration is not set correctly for the CTS test case being executed.**

For example, when executing a UFS CTS test case to evaluate proper LUN behavior, the correct “Configured LUN” must be selected in the Configuration window, otherwise the “State machine did not run” message will be generated.

To run all LUN tests select the following LUNs in the Configured LUN section of the Configuration pane: LUN 0, all four W-LUNs (the well known LUNs - Boot LUN, UFS Device LUN, RPMB, Report LUNs) and the NONE LUN (LU agnostic - for running tests against the device).

2. **The Device Under Test must be properly configured for the CTS tests to be executed.**

Some tests will not run if the DUT settings (Menu->Settings->Device Configuration) are not set correctly. For example, UFS CTS test case 8.1.1 will not run if MaxContextID of a LUN is set to 0, this must be changed in the Settings->Device Config->UFS LUN Configuration->Miscellaneous section.

3. **No Protocol Insight CTS test case marker is present in the trace.**

When the CTS tests are executed the Falcon Exerciser inserts a specific Protocol Insight marker packet into the trace to indicate the beginning of each CTS test in the trace. If TV does not find the marker packet the TV will not complete and will instead generate the message “State machine did not run”. For this reason, the TV CTS tests supplied with the application software library should only be used to analyze traces generated with the Falcon Exerciser for the matching CTS Stim test case.

Debug tests are designed to analyze any trace for issues commonly associated with UniPro or UFS turn-on, not just traces generated by the Falcon Exerciser for CTS. Examples include Link Startup problems and UFS packet latency. Debug tests are intended to be used with traces captured in either exerciser or analyzer mode. If no states in the captured trace match the criteria of the debug TV the message “**State machine did not run**” will be generated.

SearchTVs are tests created by Protocol Insight to search a trace for specific conditions. The Application software library includes three search TVs, “Find UniPro Error Packets”, “Find UFS Error Packets” and “Find Protocol Insight CTS Markers”. If no states in the captured trace match the criteria of the SearchTV the message “**State machine did not run**” will be generated.

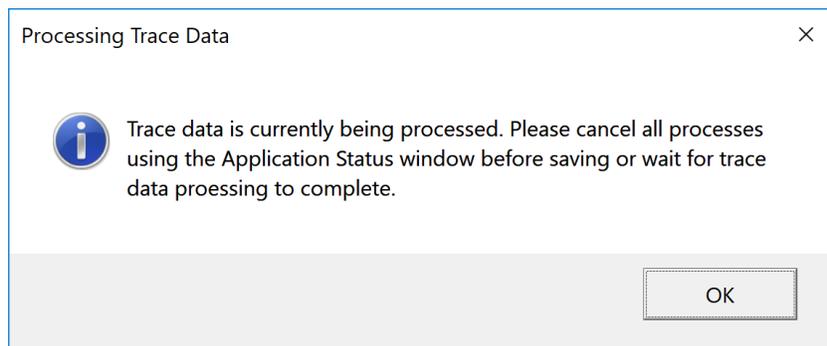
Custom TV and Advanced Trigger tests can be created by the user, either from scratch or from a pre-defined test in the application software library. See the separate Trace Validation Editor or Advanced Trigger User Guides for more information. If no states in the captured trace match the criteria of the custom TV the message “**State machine did not run**” will be generated.

How do I adjust equalization settings for the PHY for my Falcon?

The PHY can be tuned from the Smart Tune™ tab in the Settings window. This requires expert knowledge of the instrument, Device Under Test and test fixture configurations and should only be done on the advice and recommendation of Protocol Insight Support. For information on how to use Smart Tune contact your local Protocol Insight representative or support@protocolinsight.com.

Why can't I save my trace?

After your Falcon has captured a trace it is off-loaded to the application software and background calculations are initiated to update the Traffic Overview and Events windows. During these background calculations you will get the following dialog if you try to save the trace:



To save your trace immediately you must cancel background calculations by clicking the cancel button next to the **i** icon on the tool bar.

To disable automatic background calculation of the Traffic Overview and/or Events windows uncheck the appropriate box under Calculation Preferences in User Preferences from the Settings menu. This will allow you to immediately save the file after it is offloaded from the instrument. Note that until Traffic Overview is calculated the Simple Packet Search functionality will not be available.

Why does the Falcon G400C/G450C/G500C/G550C report errors after an unexpected power transition on the link?

If the Host or Device suddenly experiences a power event you may see several symbols errors in the Instrument Status hardware counters. This occurs because the link suddenly transitions to DIFF-Z after the power event. If a DIFF_Z event is expected, such as HIBERNATE, the RX PHY will mask any voltage transitions during the DIFF-Z event. However, if the DIFF-Z event is unexpected, such as a power off event, the RX PHY will see what is essentially noise, many differential voltage transitions occurring around the switching threshold. The instrument decodes this random noise into error packets, which are reflected in the counters and the trace. While the analyzer is attempting to reacquire the link, you may see Prepare and Sleep packets or Unexpected Data, as shown in Figure 2. Once the link returns to a normal state, typically a LINE RESET, the analyzer will resume normal operation. If the host puts the link into the HIBERNATE state prior to the power event, then the analyzer will expect DIFF-Z and these errors will not be captured.

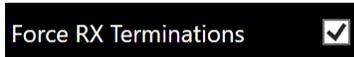
UniPro Packet List											
Test Case:											
B1	B2	In test	Index	Direction	Time	Device	Host	Power Mode	Error	MIBAttribute	Mibvalue
			15455625	Sublink1	14.626050294000 s		Prepare	PWM-G1 x1	NONE		
			15455626	Sublink1	14.626051254000 s		Sleep	PWM-G1 x1	NONE		
			15455627	Sublink1	14.626104948000 s		Prepare	PWM-G1 x1	NONE		
			15455628	Sublink1	14.626105910000 s		Sleep	PWM-G1 x1	NONE		
			15455629	Sublink1	14.626193874000 s		Prepare	PWM-G1 x1	NONE		
			15455630	Sublink1	14.626194834000 s		Sleep	PWM-G1 x1	NONE		
			15455631	Sublink1	14.626439468000 s		Prepare	PWM-G1 x1	NONE		
			15455632	Sublink1	14.626440428000 s		Sleep	PWM-G1 x1	NONE		
			15455633	Sublink1	14.626481834000 s		Prepare	PWM-G1 x1	NONE		
			15455634	Sublink1	14.626482792000 s		Sleep	PWM-G1 x1	NONE		
			15455635	Sublink1	14.626531932000 s		Prepare	PWM-G1 x1	NONE		
			15455636	Sublink1	14.626532892000 s		Sleep	PWM-G1 x1	NONE		
			15455637	Sublink1	14.626660972000 s		Prepare	PWM-G1 x1	NONE		
			15455638	Sublink1	14.626661932000 s		Sleep	PWM-G1 x1	NONE		
			15455639	Sublink1	14.626750246000 s		Prepare	PWM-G1 x1	NONE		

Figure 2 - Packets After Unexpected Power Change

Why are these error packets not seen on all channels or all devices? The PHY differential RX channels have natural PVT variations that are calibrated when the instrument is manufactured. This calibration adjusts the voltage offset of the differential P and N pairs. After calibration small variations on the switching threshold across the RX PHY channels is expected. The variation in switching threshold makes some channels more sensitive to the DIFF-Z noise compared to others. Other system factors can also affect this. Thus, you may see these errors on some of the RX channels or you may have cases where you do not see these errors at all. Simply masking out these events can mask actual problems with the link.

What is the “Force RX Terminations” setting for in Advanced Settings?

You can find the Force RX Terminations settings in the Advanced Settings, under Settings, Advanced Settings.



RX termination will be enabled during PREPARE and it is turned off at the end of BURST. This setting forces the termination on the RX to be enabled at all time. The RX termination is a differential termination, as defined in the M-PHY Specification. Enabling this setting may negatively impact the protocol analyzer's ability to acquire the signal and may also impact the link quality itself (e.g. the system will not operate correctly).

In DIFF_N it is the responsibility of the TX to hold the line in DIFF_N. The M_PHY specification allows this to be held with the standard resistance, but also allows a pull-up / pull-down pair of resistors, up to 10k ohm. Forcing RX Termination at all times may collapse the DIFF_N signal as the RX resistance will dominate.

Default Settings

- Falcon G400C/G450C - this setting is **disabled** by default.
- Falcon G500C/G550C - this setting is **enabled** by default. Currently, in some cases, the PHY is not able to enable the RX termination fast enough to meet specification. A future release of the firmware will correct this issue and this setting will be disabled by default, as it was in prior generations.

How can I reduce the size of my trace to share with other users?

There are three ways to dramatically reduce trace size when saving:

1. After you capture the trace use **File-> Save or Export Trace**, and under the File Size option choose Smallest to maximize compression. If the trace is still too large, see #2
2. To reduce file size further, use **File-> Save or Export Trace**, and under the File Size option choose Custom, then under File Options choose Maximum Compression and under Other uncheck Save Trace Validation results and Save calculated data. If the trace is still too large, see #3
3. To reduce file size further, in the **Packet List window** place Bookmark B1 at the beginning protocol command sequence of the packets in error and put Bookmark B2 at the end of the error packets. Then use **File-> Save or Export Trace**, and under the File Size option choose Custom, then under Packet Range choose From: B1 To: B2.

Contact Information

1. For additional information, to request a demonstration or quote, or place an order, please contact your local Protocol Insight representative or sales@protocolinsight.com
2. Support materials and examples files are available at <http://www.protocolinsight.com/support-materials/>
3. For technical support please contact your local Protocol Insight representative or support@protocolinsight.com