Titan Ridge Generation 3 Microcontroller and High-Speed Test Adapters

User Manual

Table of Contents

Introduction

This user's guide documents the Titan Ridge Generation 3 Microcontroller (CG3-TPA-TR) as used with USB, Thunderbolt and DisplayPort test products. The Titan Ridge Generation 3 Microcontroller, when used with CIO and Tx High-Speed TPAs (CG3-TPA-HS), can be used for testing USB, Thunderbolt and DisplayPort hosts or cables.

Using test scripts, available from Intel for registered and licensed users, the Titan Ridge Generation 3 Microcontroller and High-Speed Test Adapters can be used to set-up the necessary test modes, set the Power-in and Power-out voltages, and set load currents. The Power-in and Power-out is fully programmable over the low and high voltage ranges. The load current can be programmed over the full load range of a Type-C cable. The Titan Ridge Generation 3 Microcontroller user interface is via USB.

Figure 1. The Titan Ridge Generation 3 Microcontroller and High-Speed Test Adapters

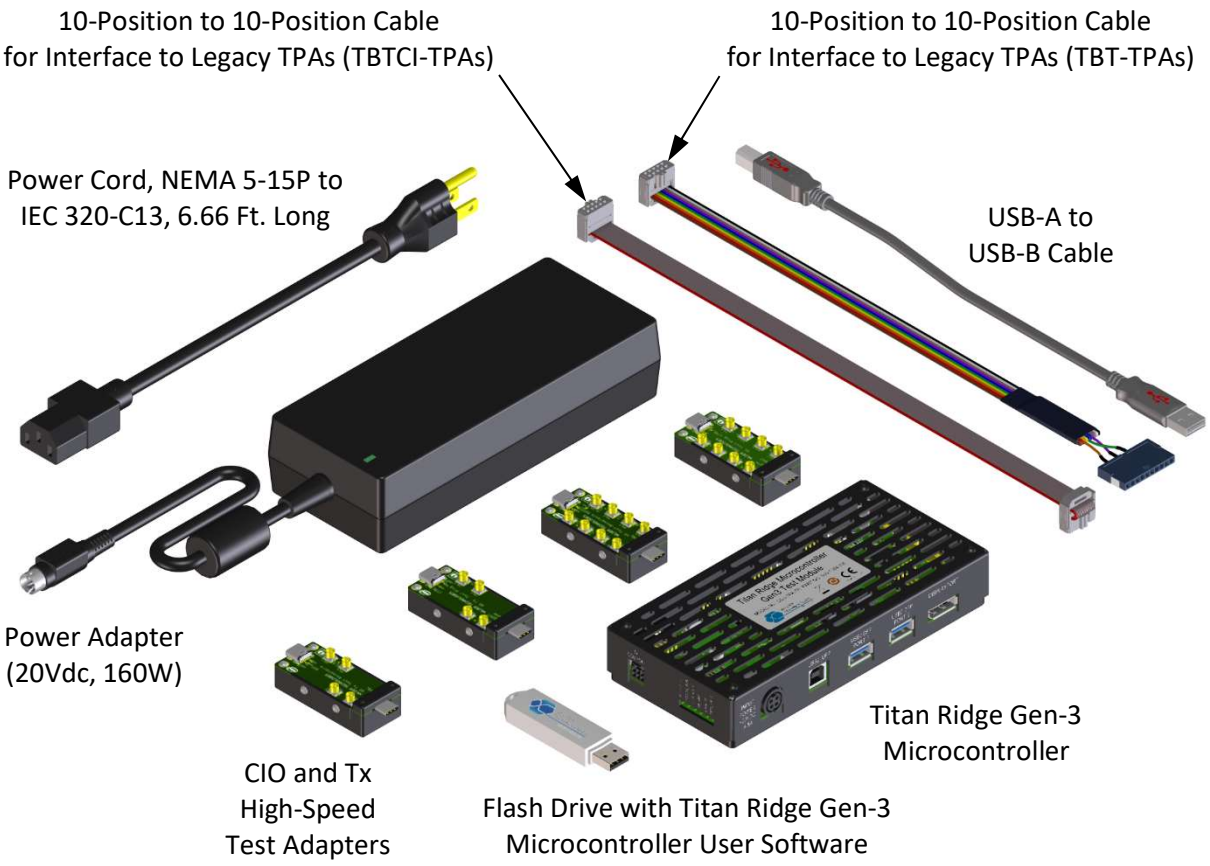


Figure 2. Full Kit (CG3-TPA-TR-K) Included Items

The above figure illustrates the components included with the CG3-TPA-TR-K (Full-Kit) product.

Product Inspection

Upon receiving the Titan Ridge Generation 3 Microcontroller and/or High-Speed TPAs from Wilder Technologies, perform the following product inspection:

- Inspect the outer shipping container, foam-lined instrument case, and product for damage. Retain the outer cardboard shipping container until the contents of the shipment have been inspected for completeness and the product has been checked mechanically and electrically. Use the foam-lined instrument-case for secure storage of the Wilder Technologies Thunderbolt Generation 3 Microcontroller and High-Speed Test Adapters when not in use.

- Locate the shipping list and verify that all items ordered were received.

- In the unlikely event that the product is defective or incomplete, the “Limited Warranty” section discusses how to contact Wilder Technologies for technical assistance and/or how to package the product for return.

The Titan Ridge Generation 3 Microcontroller and High-Speed TPAs Care and Handling Precautions

When using the Titan Ridge Generation 3 Microcontroller with the High-Speed Test Adapters careful handling is required to avoid damage. Improper handling techniques, or using too small a cable bend radius, can damage the coaxial cable connectors used on the test adapters or the connected instrument cables. This can occur at any point along the connection scheme. To achieve optimum performance and to prolong the Titan Ridge Generation 3 Microcontroller and the High-Speed TPA's life, observe the following handling precautions:

- **CAUTION 1: Avoid Torque Forces** (Manipulation)
  While individual coaxial cables connected to the test adapters have some rotational freedom, manipulating the TPA as a unit, with one end held stationary, in excess of +/- 90° may damage or severely degrade performance. Adherence to Caution 5 (below) helps to avoid exceeding manipulation limits.

- **CAUTION 2: Avoid Sharp Cable Bends**
  Never bend coaxial cables into a radius of 26 mm (1-inch) or less. Never bend cables greater than 90°. Single or multiple cable bends must be kept within this limit. Bending Legacy Thunderbolt TPA cables, for example, less than a 26 mm (1-Inch) radius will permanently damage or severely degrade test adapter performance.

- **CAUTION 3: Avoid Cable Tension** (Pull Forces)
  Never apply tension (pull forces) to an individual coaxial cable that is greater than 2.3 kg (5 lbs.). To avoid applying tension, always place accessories and equipment on a surface that allows adjustment to eliminate tension on the TPA and cables. Use adjustable elevation stands or apparatus to accurately place and support the connected TPA.

- **CAUTION 4: Connect the TPAs First**
  To prevent twisting, bending, or applying tension to the coaxial cables when connecting a TPA, always attach the TPA to the device under test (DUT), cable under test, or to the Titan Ridge Gen-3 Microcontroller before attaching any SMA or SMP connectors. Carefully align the TPA and DUT connectors and then gently push the connectors together until fully seated.

  If the TPA must be turned or twisted to make connection to the DUT or Microcontroller, avoid using the TPA housing alone to make this occur. Try to distribute the torque forces along the length of the test setup and cabling. If this is not possible, it is recommended to first loosen or disconnect the SMA or SMP connections at the TPA, make the connection to the DUT and then re-tighten or attach the test equipment leads.

NOTE: Only grip the test adapter housing when inserting or extracting the TPA to or from the DUT or Microcontroller. Pulling directly on the TPA cables or using them to insert the TPA may cause damage.

- **CAUTION 5: Carefully Make SMA Connections**

  To connect the SMA connectors, follow these steps:

  1. Hold the cable stationary by grasping the cable at the black heat-shrink section near the SMA connector.

  2. Insert the mating SMA barrel and hand-tighten the free-spinning SMA nut onto the connector while avoiding pulling, bending, or twisting the coaxial cable.

  3. SMA connectors have flats that accept an open-end 1/4-inch or 6.5 mm wrench. When attaching instrument cables to the Titan Ridge Gen-3 Microcontroller, it is recommended that the SMA connectors be mechanically held and the test leads be tightened to the equipment manufacturer's torque recommendations, normally 5 in-lbs., using a 5/16-inch or 8 mm open-end wrench.

If the test set-up requires repositioning, first loosen or disconnect the SMA connections to avoid twisting, bending, or tension.

NOTE: For Legacy test adapters, a drop in signal amplitude by half or 6db during the testing of a lane may indicate that a cable has been mechanically pulled free of coaxial cable connections internal to the assembly. This could be determined by checking if the cable has any lateral play relative to the TPA. This would only occur when the TPA has exceeded the pull force as specified within the mechanical specification. If the cable cannot be re-seated, the test adapter will need to be sent back to the factory for service.

- **CAUTION 6: Independently Support Instrument Cables or Accessories**

  Excessive weight from instrument cables and/or accessories connected to the Titan Ridge Generation 3 Microcontroller or Test Adapters can cause damage or affect the test adapter performance. Be sure to provide appropriate means to support and stabilize all test set-up components.

General Titan Ridge Generation 3 Microcontroller, Test Adapter, Cable, and Connector

Observing simple precautions can ensure accurate and reliable measurements.

Handling and Storage

Before each use of the Titan Ridge Generation 3 Microcontroller or Test Adapters, ensure that all connectors are clean. Handle all cables carefully and store the test adapter in the foam-lined instrument case when not in use, if possible. For test adapters, do not set connectors contact end down. Where applicable, install the SMA protective end caps when the test adapter is not in use.

Visual Inspection

Be sure to inspect all cable connectors carefully before making a connection. Inspect all cables for metal particles, scratches, deformed threads, dents, or bent, broken, or misaligned SMA/SMP connector center conductors. Do not use damaged cables.

Cleaning

If necessary, clean the connectors using low-pressure (less than 60 PSI) compressed air or nitrogen with an effective oil-vapor filter and condensation trap. Clean SMA connector threads, if necessary, using a lint-free swab or cleaning cloth moistened with isopropyl alcohol. Always completely dry a connector before use. Do not use abrasives to clean the connectors. Re-inspect connectors, making sure no particles or residue remains.

Making Connections

Before making any connections, review the “Care and Handling Precautions” section. Follow these guidelines when making connections:

- Align cables carefully
- Make preliminary connections lightly
- To tighten SMA connections, turn connector nut only
- Do not apply bending force to coaxial cables
- Do not over-tighten preliminary connections
- Do not twist or screw-in cables
- For SMA connections, use an appropriately sized torque wrench, and do not tighten past the “break” point of the torque wrench

Electrostatic Discharge Information

Protection against electrostatic discharge (ESD) is essential while connecting, inspecting, or cleaning the Titan Ridge Generation 3 Microcontroller and test adapter connectors, especially when attached to a static-sensitive circuit (such as those found in test sets).

Electrostatic discharge can damage or destroy electronic components. Be sure to perform all work on electronic assemblies at a static-safe workstation, using two types of ESD protection:

- Conductive table-mat and wrist-strap combination
- Conductive floor-mat and heel-strap combination

When used together, both of these types provide a significant level of ESD protection. Used alone, the table-mat and wrist-strap combination provide adequate ESD protection. To ensure user safety, the static-safe accessories must provide at least 1 MΩ of isolation from ground. Acceptable ESD accessories may be purchased from a local supplier.

WARNING: These techniques for a static-safe work station should not be used when working on circuitry with a voltage potential greater than 500 volts.

Titan Ridge Gen-3 Microcontroller and High-Speed Test Adapter Thunderbolt Test Set-up

The figure, below, shows a simplified set-up example of a Titan Ridge Generation 3 Microcontroller and a USB Type-C High-Speed Test Adapter used to test a typical Thunderbolt DUT.

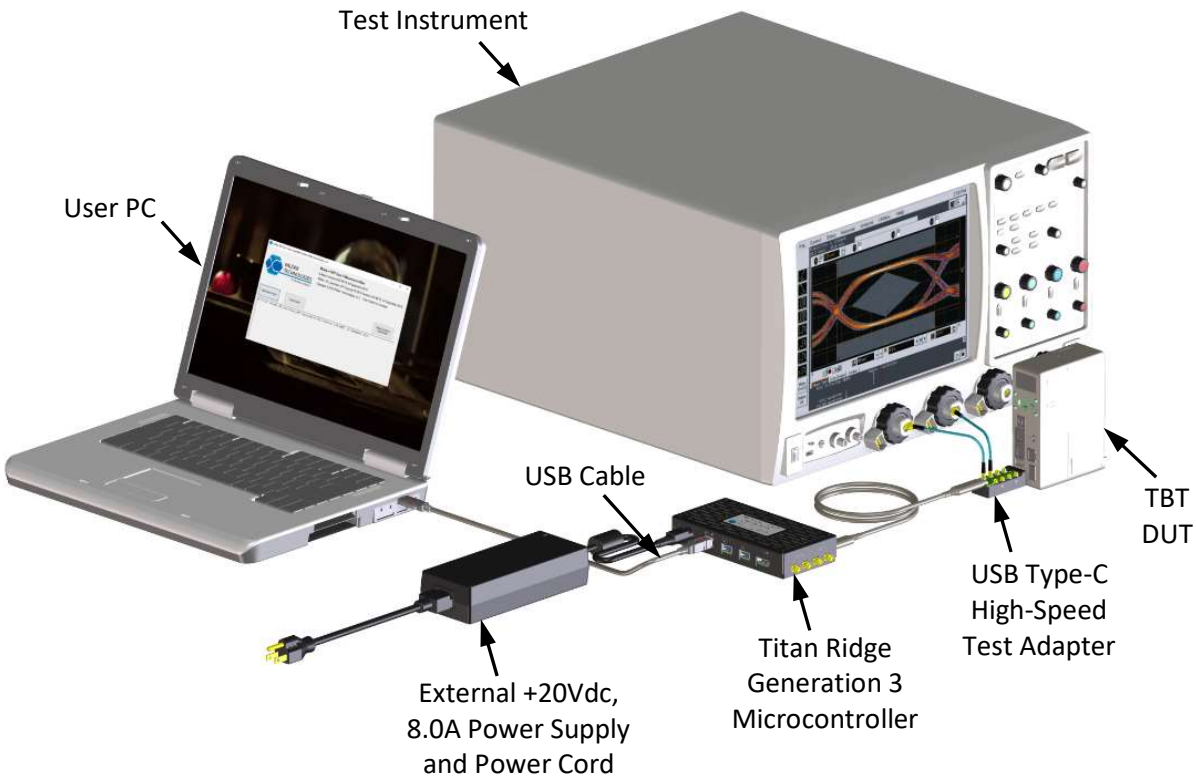


Figure 3. A USB Type-C CIOR Test Adapter mated to a Titan Ridge Generation 3 Microcontroller

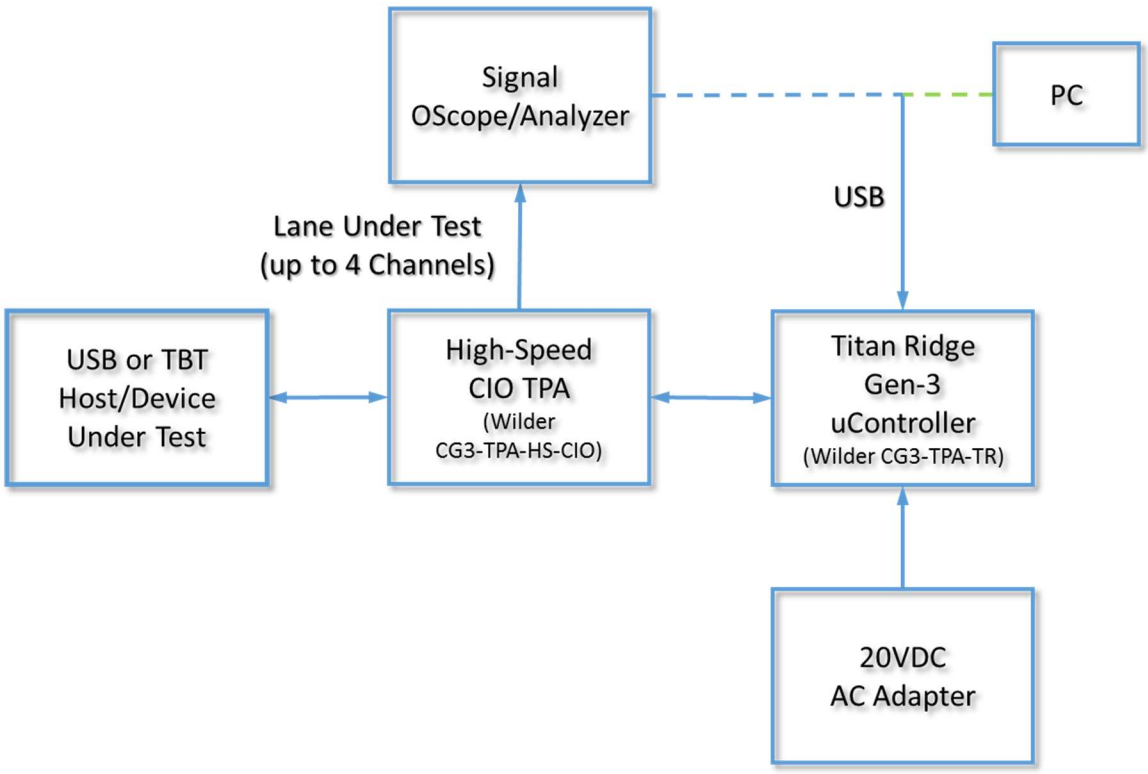
(NOTE: Some illustrated items have been simplified for clarity.)

User Models (USB or Thunderbolt)

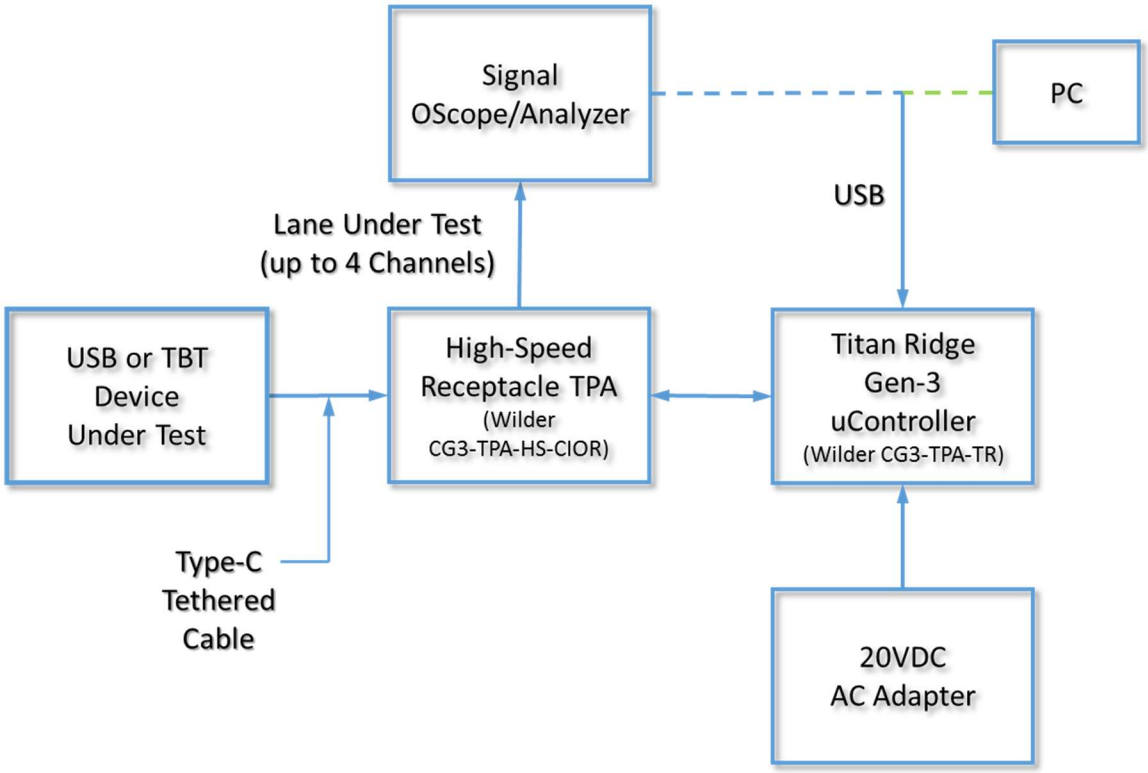
The Titan Ridge Generation 3 Microcontroller and associated High-Speed Test Adapters are capable of performing within the scope of measurements contained in the associated CTS PHYs, limited only by the specifications, environmental, care and handling as stated in this document.

The following examples are suggestions and/or references for possible testing setups.

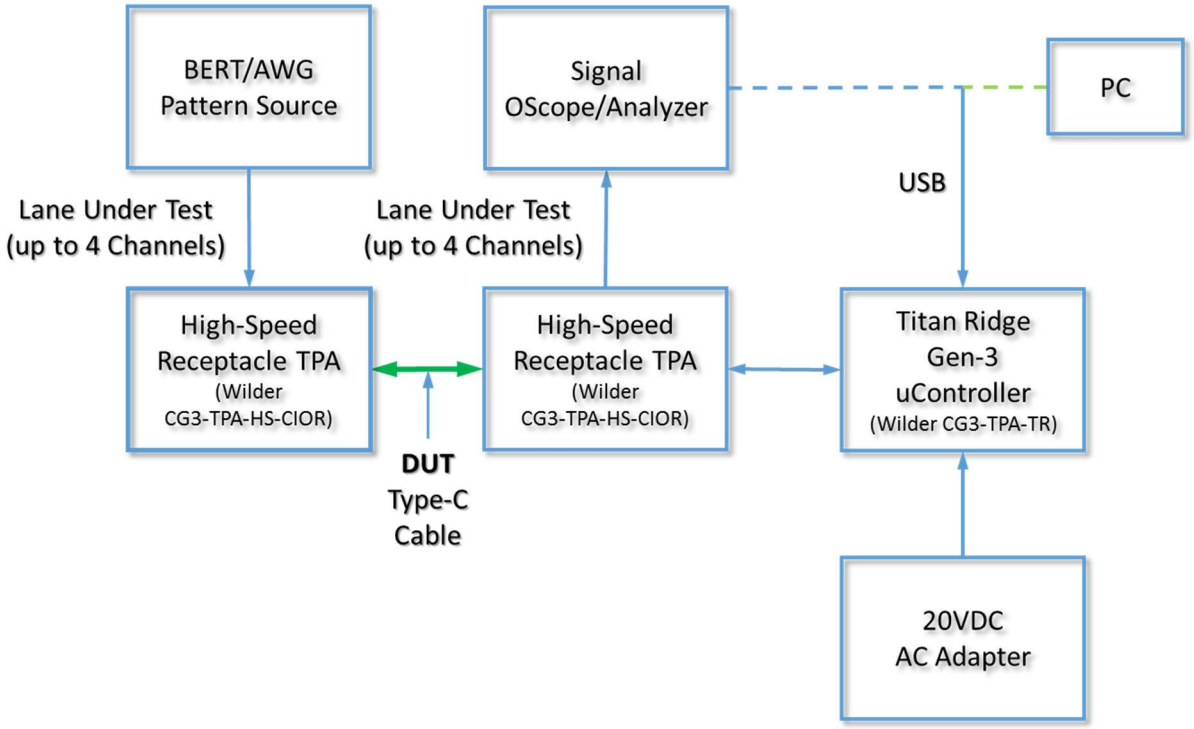
This first example illustrates a USB or Thunderbolt Type-C Host/Device test using a CIO High-Speed Type-C TPA connected to Titan Ridge Gen-3 Microcontroller, connected to a Signal Oscilloscope/Analyzer.



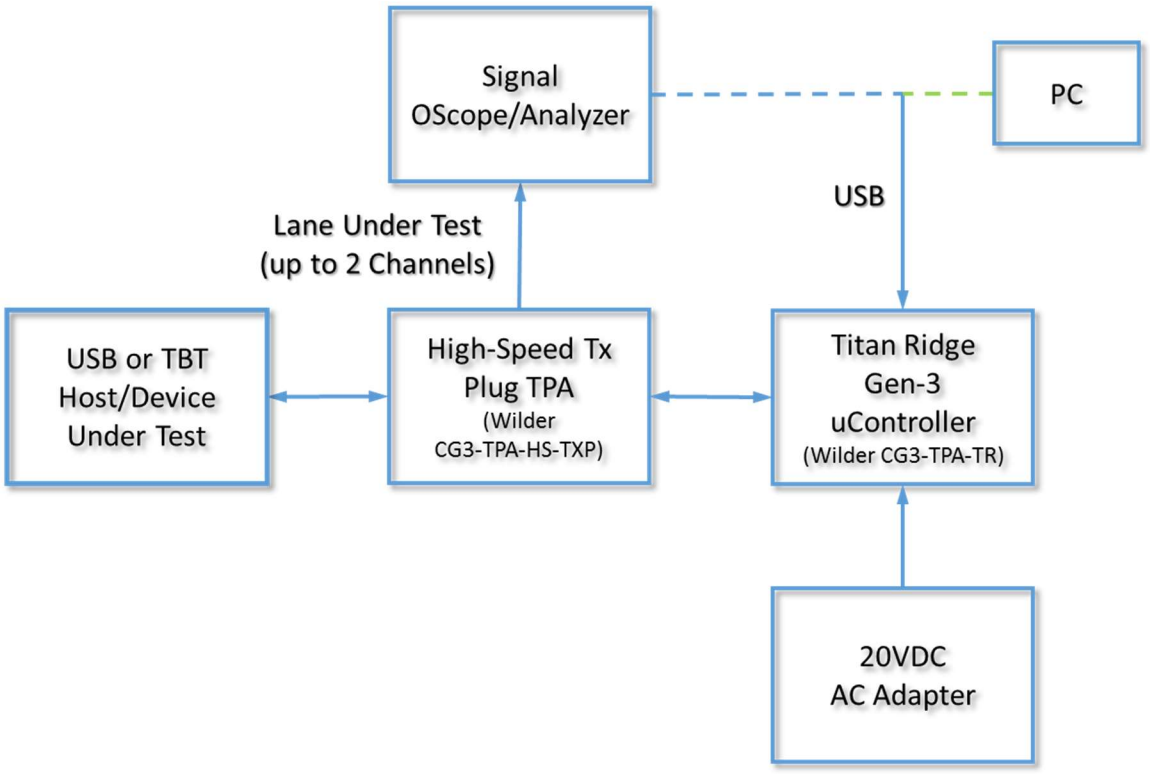
This second example illustrates a USB or Thunderbolt Type-C Device test using a CIO High-Speed Type-C TPA connected to Titan Ridge Gen-3 Microcontroller, connected to a Signal Oscilloscope/Analyzer



This third example illustrates a USB or Thunderbolt Type-C Cable test using two CIO High-Speed Type-C TPAs, a Titan Ridge Gen-3 Microcontroller, a BERT/AWG Pattern Source and a Signal Oscilloscope/Analyzer.



This fourth example illustrates a USB or Thunderbolt Type-C Host/Device Transmitter test using a Tx High-Speed Type-C TPA connected to Titan Ridge Gen-3 Microcontroller, connected to a Signal Oscilloscope/Analyzer.



Titan Ridge Gen-3 Microcontroller and High-Speed Test Adapter DisplayPort Test Set-up

The figure, below, shows a simplified set-up example of a Titan Ridge Generation 3 Microcontroller and a USB Type-C High-Speed Test Adapter used to test a typical DisplayPort DUT.

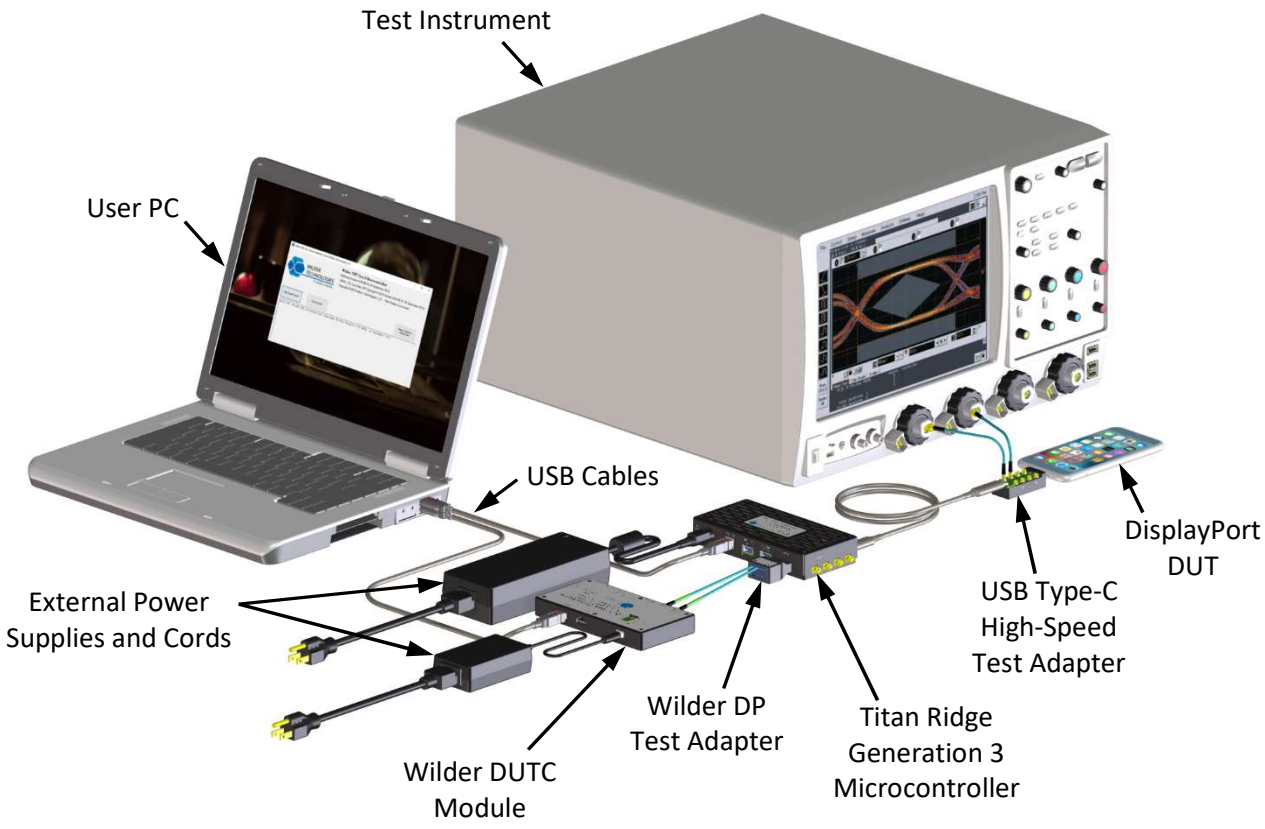
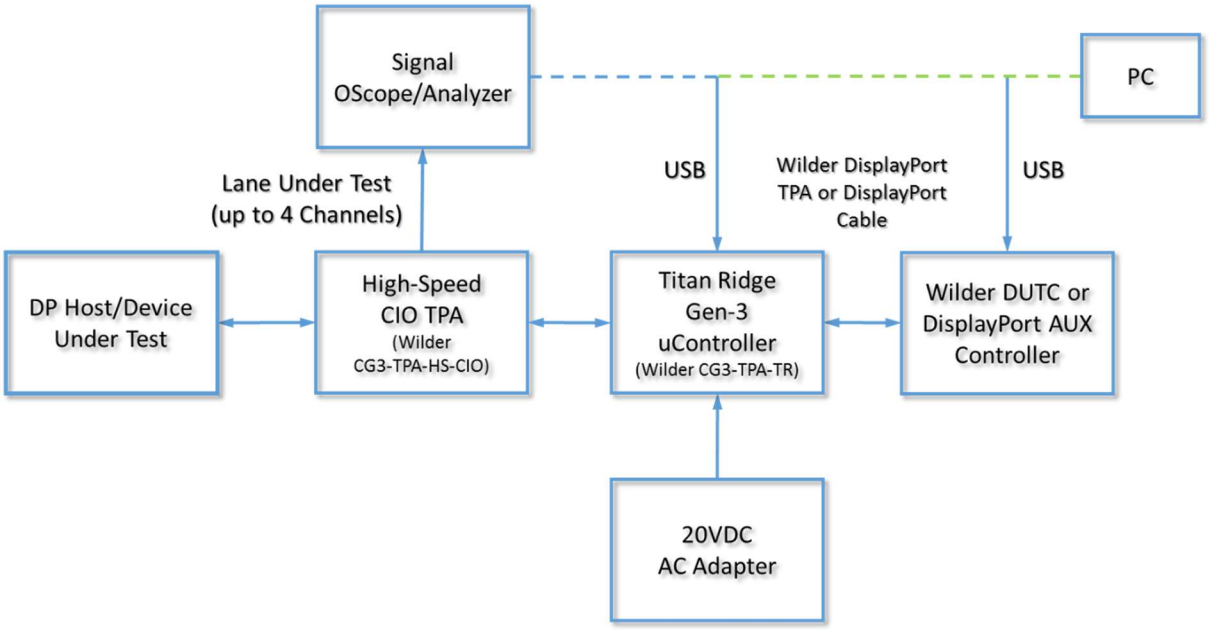


Figure 4. A USB Type-C CIOR Test Adapter mated to a Titan Ridge Generation 3 Microcontroller

(NOTE: Some illustrated items have been simplified for clarity.)

User Model (DisplayPort)

This example illustrates a DisplayPort Type-C Host/Device test using a CIO High-Speed Type-C TPA, a Titan Ridge Gen-3 Microcontroller, a Wilder DisplayPort TPA, a Wilder DUTC or DisplayPort Aux. Controller and a Signal Oscilloscope/Analyzer.



Mechanical and Environmental Specifications (Microcontroller)

NOTE: All specifications in this manual are subject to change.

Table 1. General Specifications, Titan Ridge Generation 3 Microcontroller

ITEM	DESCRIPTION
Usage Environment	Controlled Indoor Environment
CG3-TPA-TR (Microcontroller) Length x Width x Height	168.4 mm (6.63 in) x 79.00 mm (3.11 in) x 30.6 mm (1.20 in)
Operating Temperature	0°C to +55°C (32°F to +131°F) (Characteristic)
Storage Temperature	-40°C to +70°C (-40°F to +158°F) (Characteristic)
Power Dissipation	20 Watts max. (Microcontroller Module, alone)

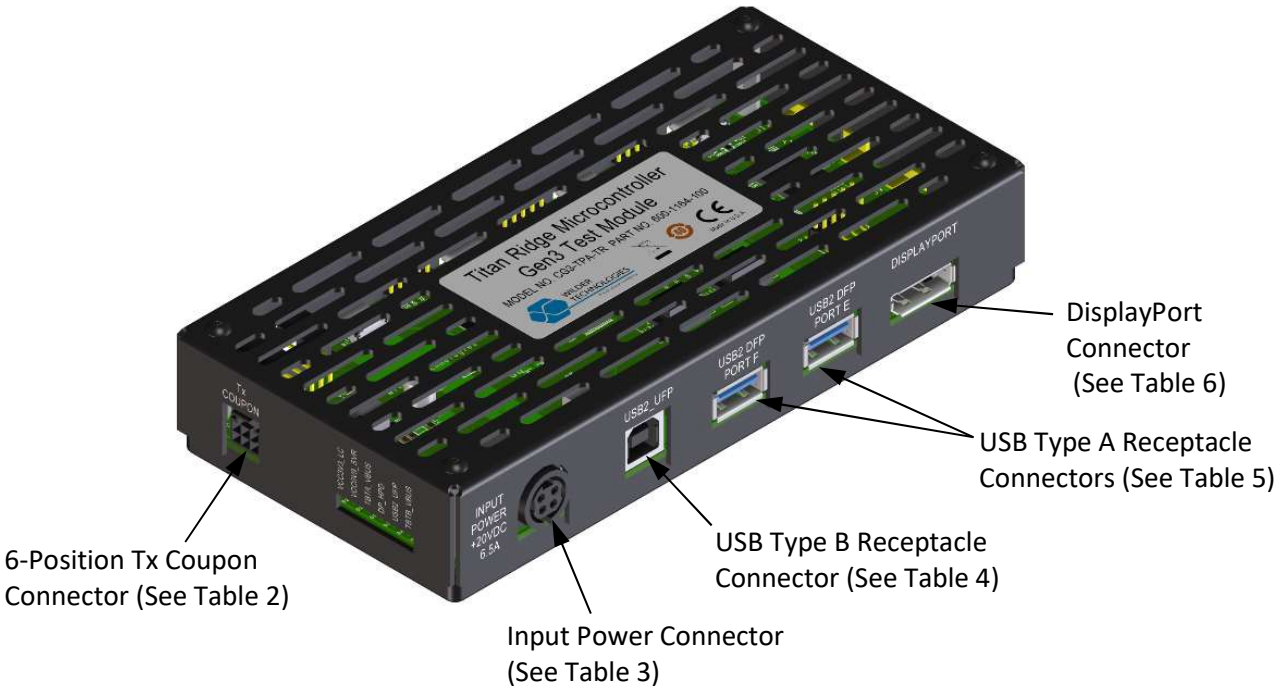


Figure 5. Connectors (Titan Ridge Generation 3 Microcontroller)

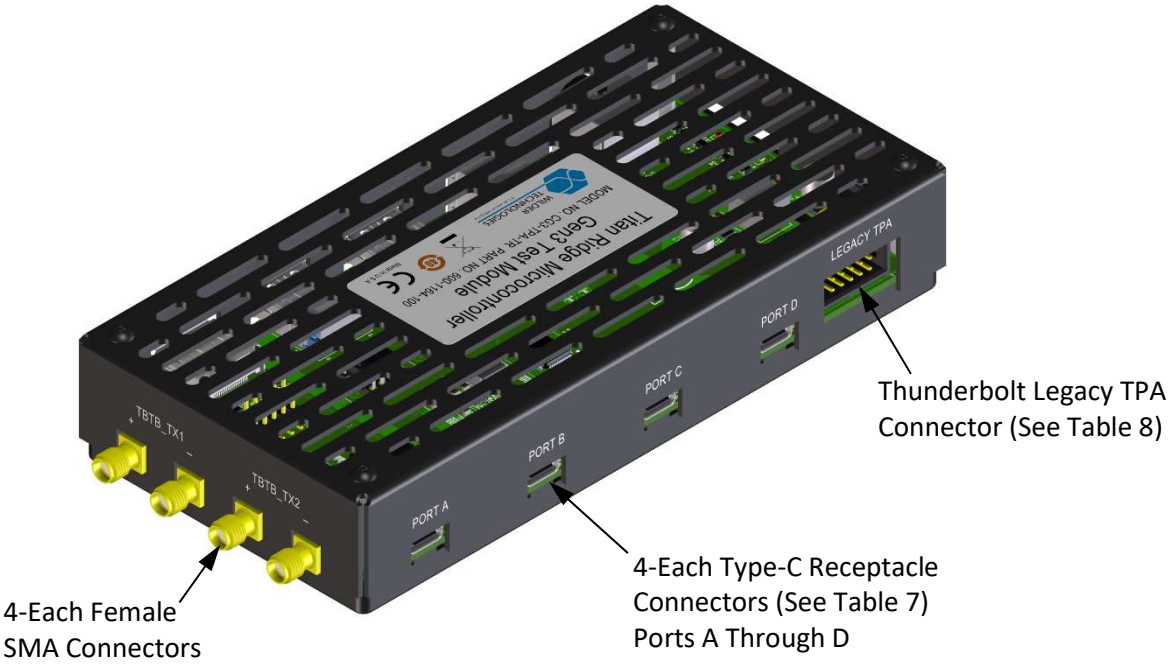


Figure 6. Connectors (Titan Ridge Generation 3 Microcontroller)

Titan Ridge Generation 3 Microcontroller Pin-out

The Titan Ridge Generation 3 Microcontroller provides several interface/access connectors to facilitate USB, Thunderbolt, and DisplayPort testing. Figures 3 and 4, above, refer to the pin-description tables that follow for each of the connector types.

Table 2. Tx Coupon Header Pin Assignments

Pin Description	Connector Pin Number
Tx Coupon +5Vdc	1
Ground	2
Tx DC Level Detect	3
SDA	4
SCL	5
Ground	6

Table 3. Input Power Connector Pin Assignments

Pin Description	Connector Pin Number
Vo-	1
Vo+	2
Vo-	3
Vo+	4

Table 4. USB Type-B 2.0 Receptacle Connector (USB2_UFP) Pin Assignments (PC User Interface)

Pin Description	Connector Pin Number(s)
Vbus (5V)	1
D-	2
D+	3
Ground	4
Shell (Ground)	5, 6

Table 5. USB Type-A Receptacle Connectors (USB2 DFP, Port E and F, SuperSpeed Disabled)

Pin Description	Connector Pin Number(s)
VBUS (Bypassed with 22uF and 2.2uf Capacitor to Ground)	1
D-	2
D+	3
Ground	4
StdA_SSRX- (Not Connected)	5
StdA_SSRX+ (Not Connected)	6
GND_DRAIN (Ground)	7
StdA_SSTX- (Not Connected)	8
StdA_SSTX+ (Not Connected)	9
Shield/Connector Shell (Ground)	Shell

Table 6. DisplayPort Receptacle Connector (Source)

Pin Description	Connector Pin Number(s)
ML Lane 0 (p) – Source (Not Connected)	1
Ground	2
ML Lane 0 (n) – Source (Not Connected)	3
ML Lane 1 (p) – Source (Not Connected)	4
Ground	5
ML Lane 1 (n) – Source (Not Connected)	6
ML Lane 2 (p) – Source (Not Connected)	7
Ground	8
ML Lane 2 (n) – Source (Not Connected)	9
ML Lane 3 (p) – Source (Not Connected)	10
Ground	11
ML Lane 3 (n) – Source (Not Connected)	12
Config 1 (CAD) – Pulled-Down with 1M Ohm Resistor	13
Config 2 (CEC) – Pulled-Down with 1M Ohm Resistor	14
AUX CH (p) – 47pF Capacitor in series with AUX-CH (n)	15
Ground	16
AUX CH (n) – 47pF Capacitor in series with AUX-CH (p)	17
HPD, Hot Plug Detect	18
DP_RTN (Return DP_PWR)	19
DP_PWR (Bypassed with 2.2uF Capacitor to DP_RTN)	20
Shield/Connector Shell (Ground)	Shell

Table 7. USB Type-C Connector Ports A, B, C, D (Receptacles)

Pin Description	Connector Pin Number	Port A Connected? Yes or No	Port B Connected? Yes or No	Port C and D Connected? Yes or No
GND (Signal Ground)	A1	Yes	Yes	Yes
TX0_P (USB SuperSpeed, Transmit 0 Positive)	A2	Yes	No	No
TX0_N (USB SuperSpeed, Transmit 0 Negative)	A3	Yes	No	No
VBUS (Bus Power)	A4	Yes	Yes	Yes
CC1 (Configuration Channel 1)	A5	Yes	Yes	Yes
USB2_P (USB 2.0 Differential Pair Positive)	A6	Yes	Yes	No
USB2_N (USB 2.0 Differential Pair Negative)	A7	Yes	Yes	No
SBU1 (Side Band Use 1)	A8	Yes	No	No
VBUS (Bus Power)	A9	Yes	Yes	Yes
RX1_N (USB SuperSpeed, Receive 1 Negative)	A10	Yes	No	No
RX1_P (USB SuperSpeed, Receive 1 Positive)	A11	Yes	No	No
GND (Signal Ground)	A12	Yes	Yes	Yes
GND (Signal Ground)	B1	Yes	Yes	Yes
TX1_P (USB SuperSpeed, Transmit 1 Positive)	B2	Yes	No	No
TX1-N (USB SuperSpeed, Transmit 1 Negative)	B3	Yes	No	No
VBUS (Bus Power)	B4	Yes	Yes	Yes
CC2 (Configuration Channel 2)	B5	Yes	Yes	Yes
USB2_P (USB 2.0 Differential Pair Positive)	B6	Yes	Yes	No
USB2_N (USB 2.0 Differential Pair Negative)	B7	Yes	Yes	No
SBU2 (Side Band Use 2)	B8	Yes	No	No
VBUS (Bus Power)	B9	Yes	Yes	Yes
RX0_N (USB SuperSpeed, Transmit 0 Negative)	B10	Yes	No	No
RX0_P (USB SuperSpeed, Transmit 0 Positive)	B11	Yes	No	No
GND (Signal Ground)	B12	Yes	Yes	Yes
CGND (Signal Ground, Case/Shell)	G1, G2, G3, G4	Yes	Yes	Yes

Table 8. Legacy TPA Connector (Thunderbolt Only)

Pin Description	Connector Pin Number(s)
No Connect	1, 2, 3, 5, 7, 9, 10
LSRX	4
LSTX	6
Ground	8

Mechanical and Environmental Specifications (High-Speed TPAs)

NOTE: All specifications in this manual are subject to change.

Table 10. General Specifications, CIO and Tx High-Speed TPAs

ITEM	DESCRIPTION
Usage Environment	Controlled Indoor Environment
CG3-TPA-HS (High-Speed TPAs) Length x Width x Height	62.05 mm (2.44 in) x 27.53 mm (1.08 in) x 16.23 mm (0.64 in)
Operating Temperature	0°C to +55°C (32°F to +131°F) (Characteristic)
Storage Temperature	-40°C to +70°C (-40°F to +158°F) (Characteristic)

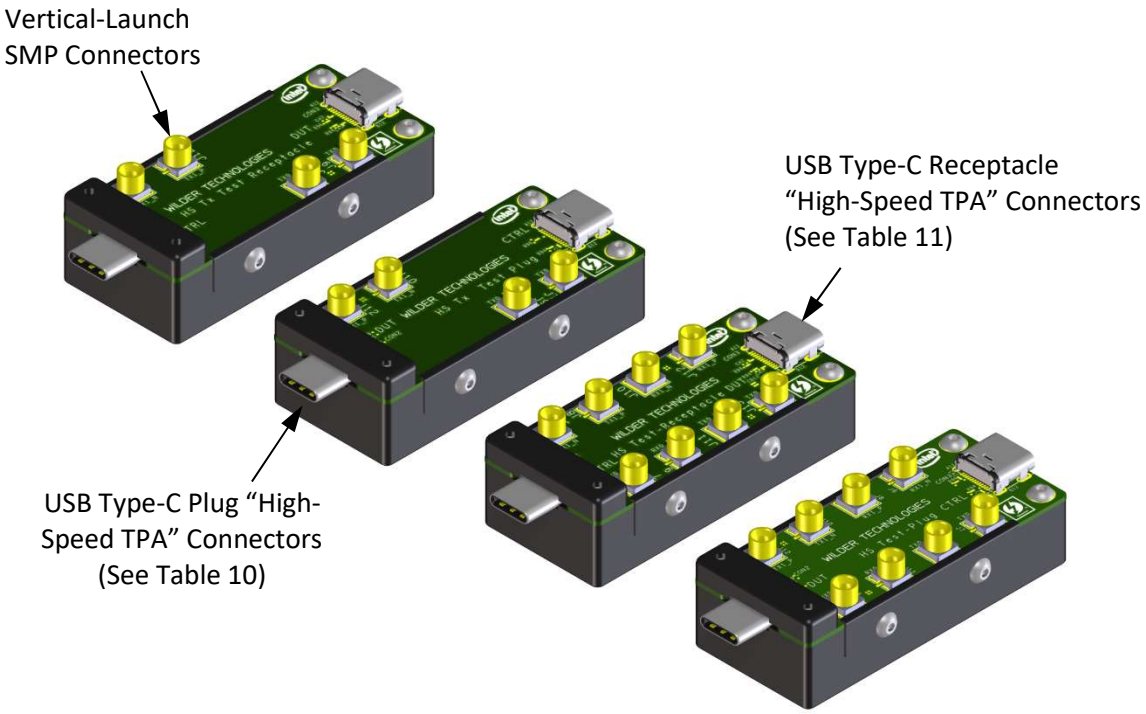


Figure 7. Connectors (CIO and Tx High-Speed TPAs)

Table 11. CIO and Tx High-Speed TPA "Plug" Pin Assignments

Pin Description	Plug Connector Pin Number (CON2)	Destination CIO TPA	Destination Tx TPA
GND (Signal Ground)	A1	CON3-A1	CON3-A1
TX0_P (USB SuperSpeed, Transmit 0 Positive)	A2	J9 (SMP)	J9 (SMP)
TX0_N (USB SuperSpeed, Transmit 0 Negative)	A3	J7 (SMP)	J7 (SMP)
VBUS (Bus Power) Bypassed with 4-each 470nF Capacitors (1880nF total) to GND, Both Ends	A4	CON3-A4	CON3-A4
CC1 (Configuration Channel 1)	A5	CON3-A5	CON3-A5
USB2_P (USB 2.0 Differential Pair Positive)	A6	CON3-A6	CON3-A6
USB2_N (USB 2.0 Differential Pair Negative)	A7	CON3-A7	CON3-A7
SBU1 (Side Band Use 1)	A8	CON3-A8	CON3-A8
VBUS (Bus Power) Bypassed with 4-each 470nF Capacitors (1880nF total) to GND, Both Ends	A9	CON3-A9	CON3-A9
RX1_N (USB SuperSpeed, Receive 1 Negative)	A10	J6 (SMP, Through 220nF Capacitor)	CON3-A10
RX1_P (USB SuperSpeed, Receive 1 Positive)	A11	J8 (SMP, Through 220nF Capacitor)	CON3-A11
GND (Signal Ground)	A12	CON3-A12	CON3-A12
GND (Signal Ground)	B1	CON3-B1	CON3-B1
TX1_P (USB SuperSpeed, Transmit 1 Positive)	B2	J12 (SMP)	J12 (SMP)
TX1-N (USB SuperSpeed, Transmit 1 Negative)	B3	J10 (SMP)	J10 (SMP)
VBUS (Bus Power) Bypassed with 4-each 470nF Capacitors (1880nF total) to GND, Both Ends	B4	CON3-B4	CON3-B4
CC2 (Configuration Channel 2)	B5	CON3-B5	CON3-B5
USB2_P (USB 2.0 Differential Pair Positive)	B6	CON3-B6	CON3-B6
USB2_N (USB 2.0 Differential Pair Negative)	B7	CON3-B7	CON3-B7
SBU2 (Side Band Use 2)	B8	CON3-B8	CON3-B8
VBUS (Bus Power) Bypassed with 4-each 470nF Capacitors (1880nF total) to GND, Both Ends	B9	CON3-B9	CON3-B9
RX0_N (USB SuperSpeed, Transmit 0 Negative)	B10	J11 (SMP, Through 220nF Capacitor)	CON3-B10
RX0_P (USB SuperSpeed, Transmit 0 Positive)	B11	J13 (SMP, Through 220nF Capacitor)	CON3-B11
GND (Signal Ground)	B12	CON3-B12	CON3-B12
CGND (Signal Ground, Case/Shell)	G1, G2, G3, G4	G1, G2, G5, G6	G1, G2, G5, G6

Table 12. CIO and Tx High-Speed TPA "Receptacle" Pin Assignments

Pin Description	Receptacle Connector Pin Number (CON3)	Destination CIO TPA	Destination Tx TPA
GND (Signal Ground)	A1	CON2-A1	CON2-A1
TX0_P (USB SuperSpeed, Transmit 0 Positive)	A2	J9 (SMP)	J9 (SMP)
TX0_N (USB SuperSpeed, Transmit 0 Negative)	A3	J7 (SMP)	J7 (SMP)
VBUS (Bus Power) Bypassed with 4-each 470nF Capacitors (1880nF total) to GND, Both Ends	A4	CON2-A4	CON2-A4
CC1 (Configuration Channel 1)	A5	CON2-A5	CON2-A5
USB2_P (USB 2.0 Differential Pair Positive)	A6	CON2-A6	CON2-A6
USB2_N (USB 2.0 Differential Pair Negative)	A7	CON2-A7	CON2-A7
SBU1 (Side Band Use 1)	A8	CON2-A8	CON2-A8
VBUS (Bus Power) Bypassed with 4-each 470nF Capacitors (1880nF total) to GND, Both Ends	A9	CON2-A9	CON2-A9
RX1_N (USB SuperSpeed, Receive 1 Negative)	A10	J6 (SMP, Through 220nF Capacitor)	CON2-A10
RX1_P (USB SuperSpeed, Receive 1 Positive)	A11	J8 (SMP, Through 220nF Capacitor)	CON2-A11
GND (Signal Ground)	A12	CON2-A12	CON2-A12
GND (Signal Ground)	B1	CON2-B1	CON2-B1
TX1_P (USB SuperSpeed, Transmit 1 Positive)	B2	J12 (SMP)	J12 (SMP)
TX1-N (USB SuperSpeed, Transmit 1 Negative)	B3	J10 (SMP)	J10 (SMP)
VBUS (Bus Power) Bypassed with 4-each 470nF Capacitors (1880nF total) to GND, Both Ends	B4	CON2-B4	CON2-B4
CC2 (Configuration Channel 2)	B5	CON2-B5	CON2-B5
USB2_P (USB 2.0 Differential Pair Positive)	B6	CON2-B6	CON2-B6
USB2_N (USB 2.0 Differential Pair Negative)	B7	CON2-B7	CON2-B7
SBU2 (Side Band Use 2)	B8	CON2-B8	CON2-B8
VBUS (Bus Power) Bypassed with 4-each 470nF Capacitors (1880nF total) to GND, Both Ends	B9	CON2-B9	CON2-B9
RX0_N (USB SuperSpeed, Transmit 0 Negative)	B10	J11 (SMP, Through 220nF Capacitor)	CON2-B10
RX0_P (USB SuperSpeed, Transmit 0 Positive)	B11	J13 (SMP, Through 220nF Capacitor)	CON2-B11
GND (Signal Ground)	B12	CON2-B12	CON2-B12
CGND (Signal Ground, Case/Shell)	G1, G2, G5, G6	G1, G2, G3, G4	G1, G2, G3, G4

Titan Ridge Generation 3 Microcontroller Software

Introduction

The Wilder Technologies Titan Ridge Generation 3 Microcontroller (CG3-TPA-TR) uses TCL scripts to configure the DUT to output patterns. These test scripts (available through Intel's IBL website to registered Thunderbolt™ users) operate the Wilder Technologies Titan Ridge Generation 3 Microcontroller via a USB connection from a PC.

The included User Interface (UI) Software (SW) runs on a PC and operates the Titan Ridge Generation 3 Microcontroller via a USB connection from a PC. The UI provides Screens that allow interaction with the Titan Ridge Microcontroller Hardware. The SW will run on most PCs with Windows 7, 8, and 10. A powered USB port is required.

This Manual is for UI Software Version 1.05, API Version 1.05 and Firmware Version 0.0.0.4. The Firmware is Field Upgradable.

Microcontroller LED Status Indicators

The Microcontroller LED Status Indicators can be viewed through the rectangular opening on the left side of the Microcontroller module.

Figure 8. Titan Ridge Generation 3 Microcontroller LED Status Indicators

Microcontroller LED Status Indicators (cont.)

LED Indicator	Reference Designator	LED States
VCC3v3_LC	D25	3.3V Output from the Titan Ridge
VCC0V9_SVR	D22	0.9V Output from the Titan Ridge
TBTA_VBUS	D8	VBUS is present on Port A
DP_HPD	D9	DisplayPort HPD is present
USB2_UFP	D10	VBUS is present on USB Type-B port
TBTB_VBUS	D11	VBUS is present on Port B

Titan Ridge Generation 3 Microcontroller Software File List

These files are included in the Flash Drive.

Wilder_TR_Controller_GUI	The Wilder Titan Ridge Microcontroller UI Executable
910-0060-000 Rev B.pdf	Titan Ridge Gen-3 Microcontroller User Manual
Vendor Driver	Thunderbolt Microcontroller USB Drivers

Software Installation

The SW will run on Windows 7, 8, and 10. Microsoft .NET Version **4.5** or greater is required. Some Windows 7 computers do not have this version. It may be downloaded from the Microsoft web site. If .NET is earlier than 4.5 there may be a message reporting that .NET is too old or an Error Message that includes the text “IAsyncState”.

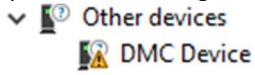
Copy the software distribution files to a folder on the PC from which the Titan Ridge Generation 3 Microcontroller UI Software will be run. The .exe file should remain in this folder, but all other files can be moved.

Run the `Wilder_TR_Controller_GUI.exe` program. The start screen should report that it is software version is **1.05** or later. The Log Box should report that the API version is **1.05** or later.

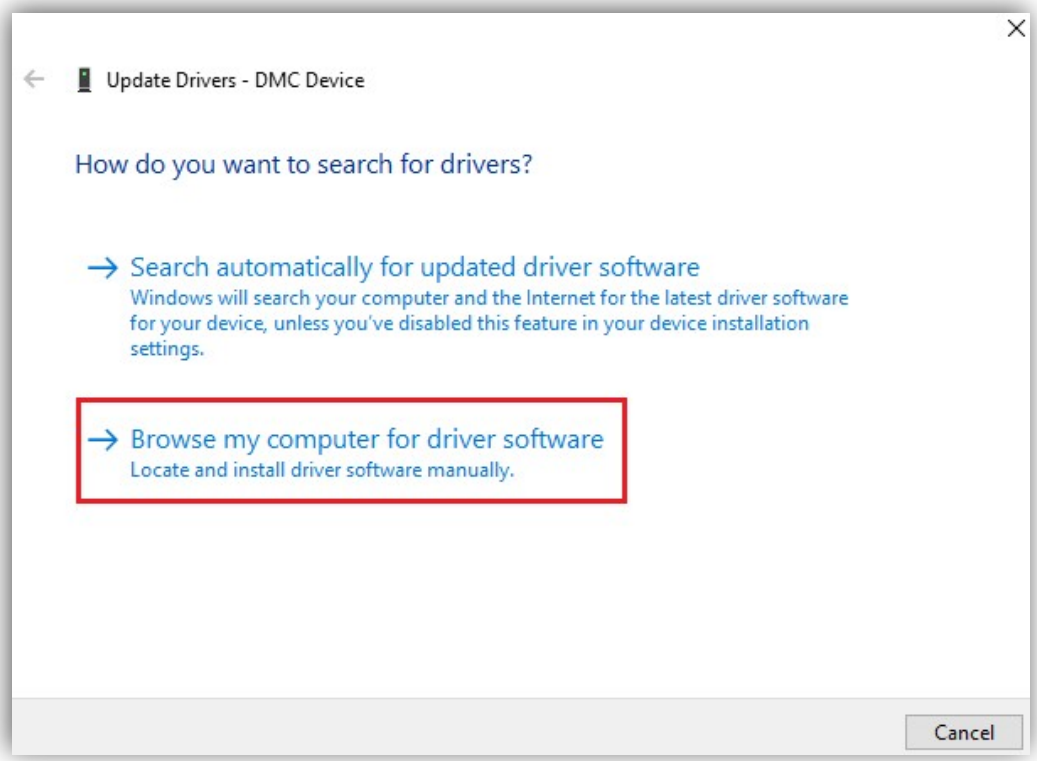
Driver Installation

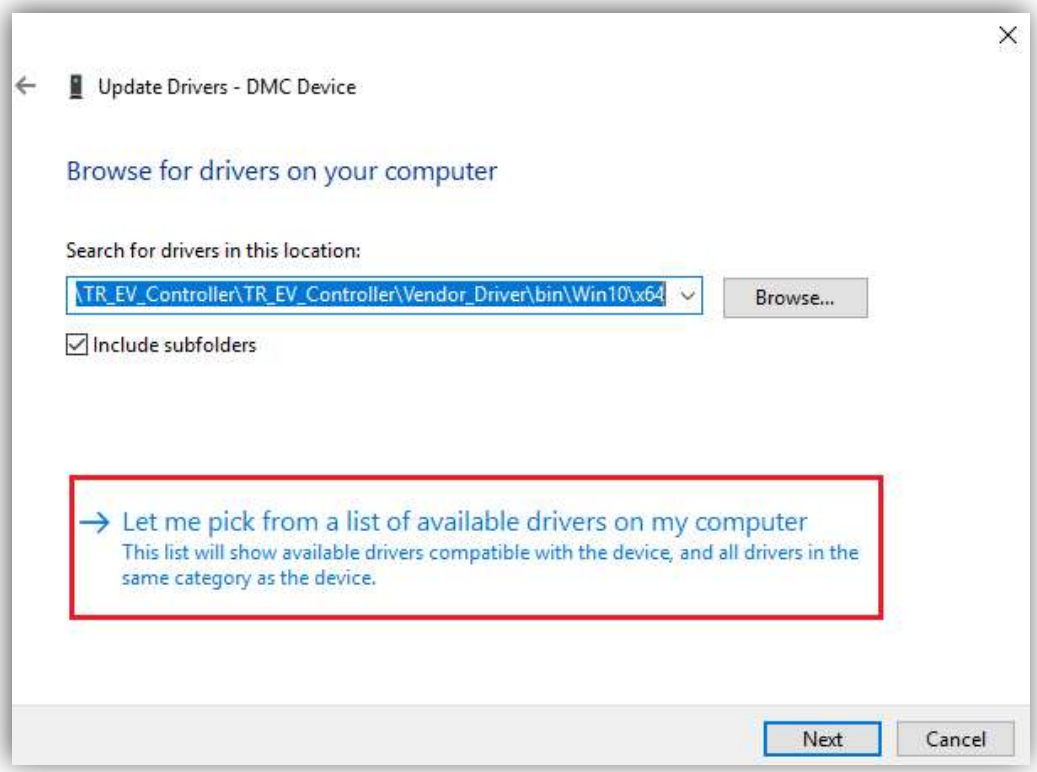
When first plugging in the Titan Ridge Generation 3 Microcontroller to the control PC, you will need to install the drivers. The steps for this are below:

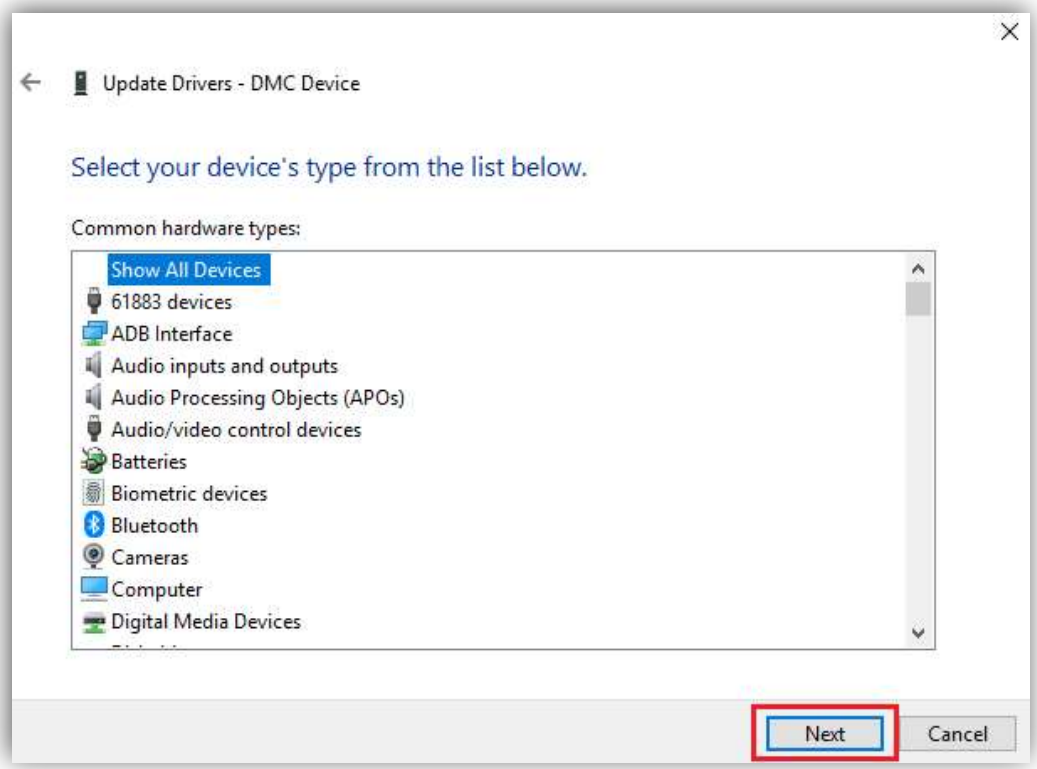
1. Attach the Power to the Microcontroller
2. Attach the USB Type-A to USB Type-B from the control PC to the Microcontroller
3. Open Device Manager and look for DMC Device issue such as in this image:

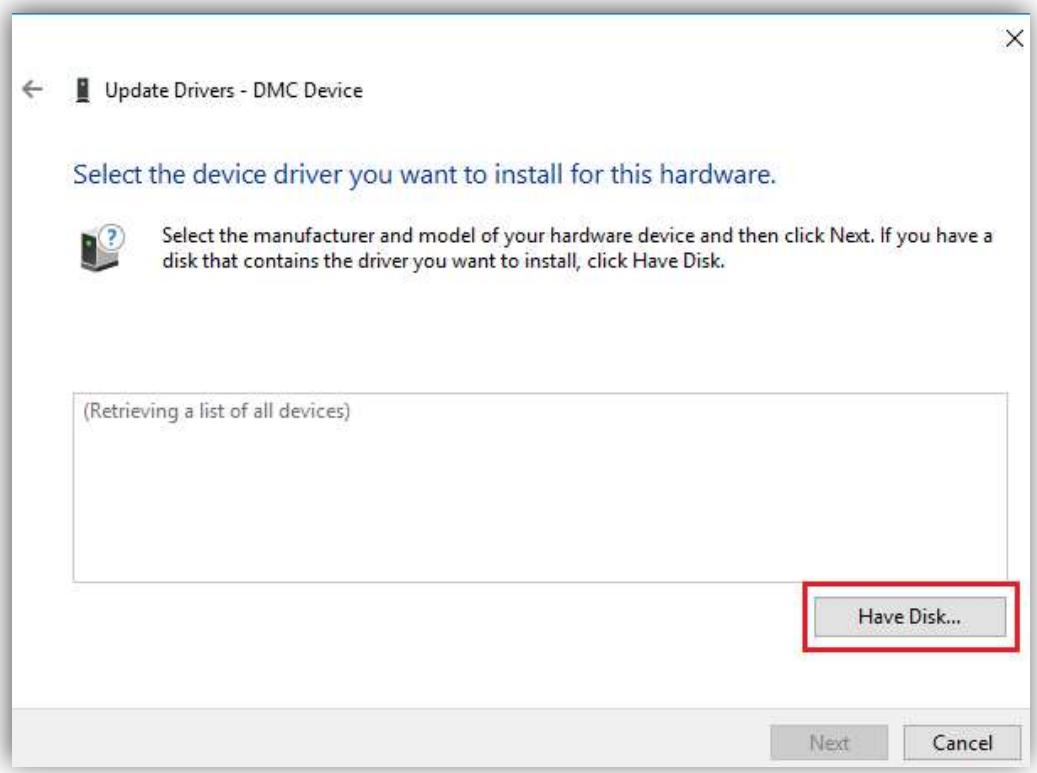


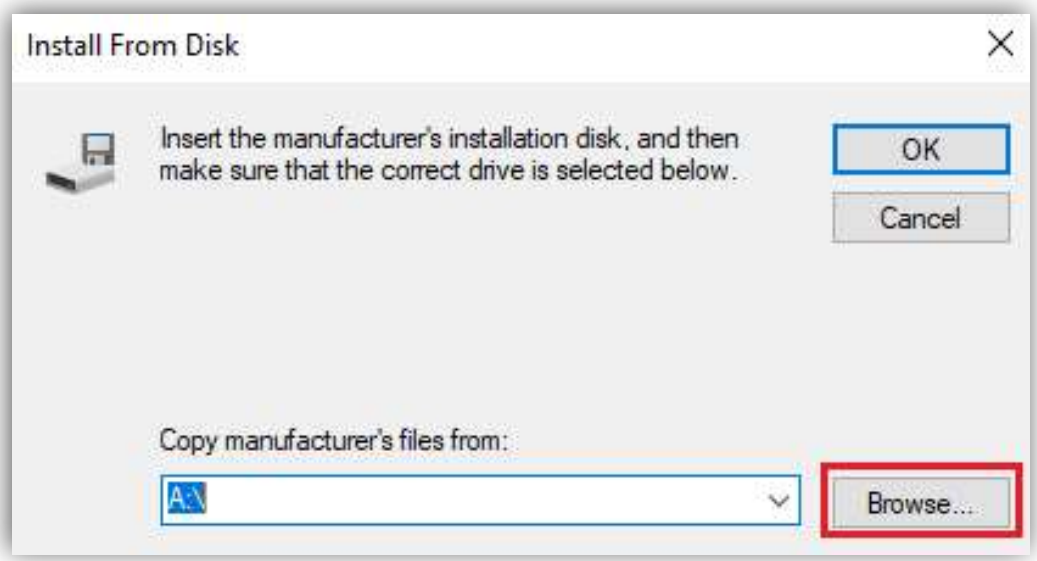
4. Right click on the “DMC Device” and select “Update Driver”
5. Follow the below images by selecting the buttons outlined in red.



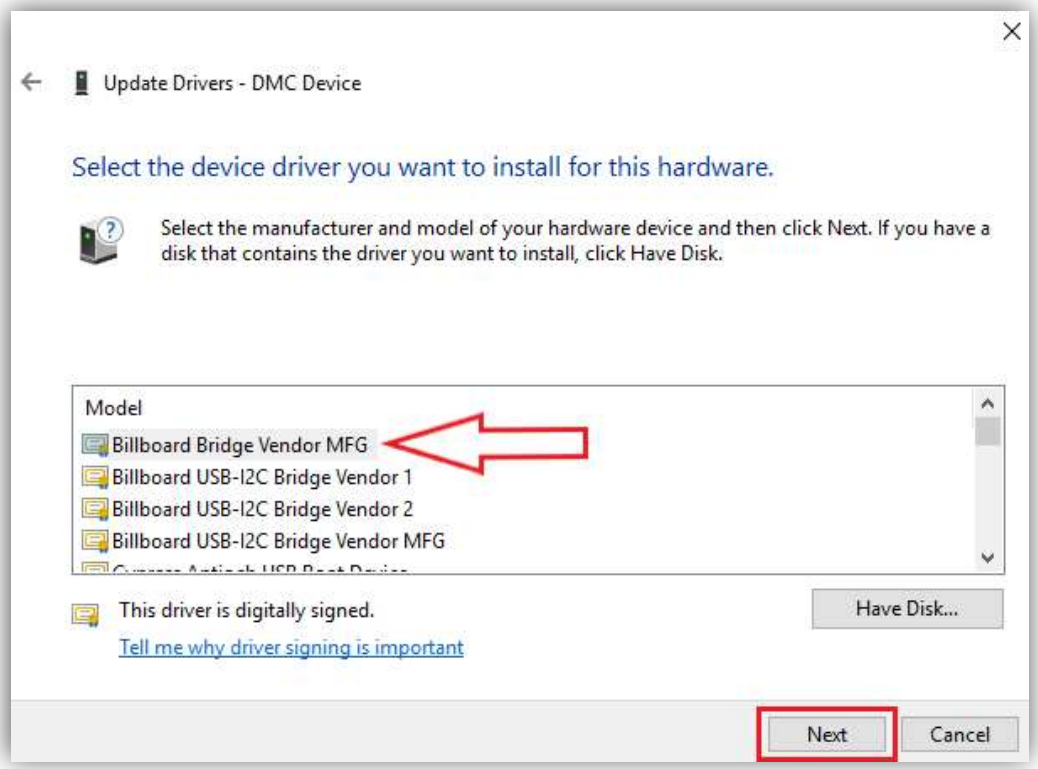


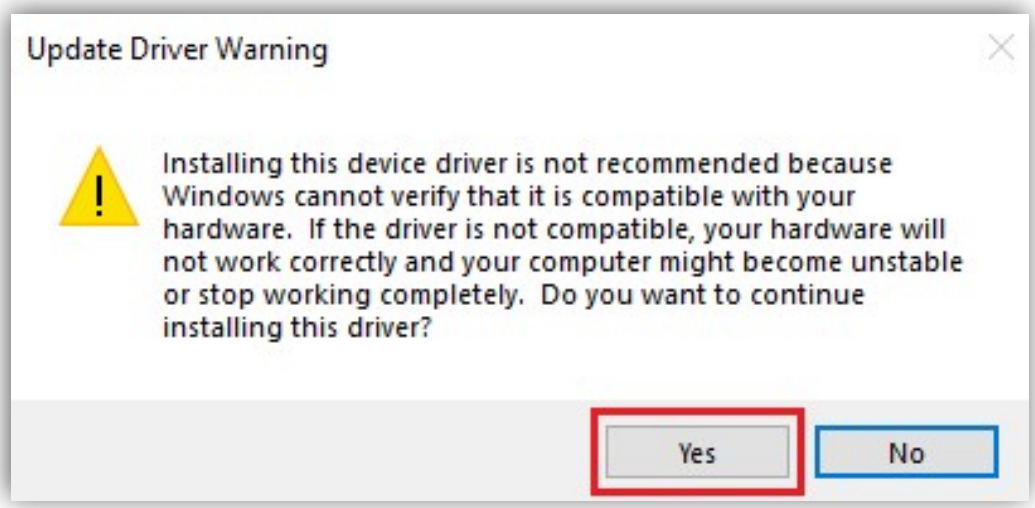






Browse to your directory which has the downloaded Vendor Drivers folder and navigate to your windows version and your architecture (64bit for example). After selecting the cyusb3.inf file, select "Open", and then "OK".





Select “Yes” in the warning pop-up. Click “Close”, and then you are finished. You should now see the “Billboard Bridge Vendor MFG” listed under your Universal Serial Bus Controllers in Device manager.

Titan Ridge Generation 3 Microcontroller UI Operation

The UI Screen comes up when `Wilder_TR_Controller_GUI.exe` is run. Version information and several buttons will appear. Information, Status and Errors will appear in the Log Box. Errors are listed under each UI function description. Status and Errors are more thoroughly described further in this section.

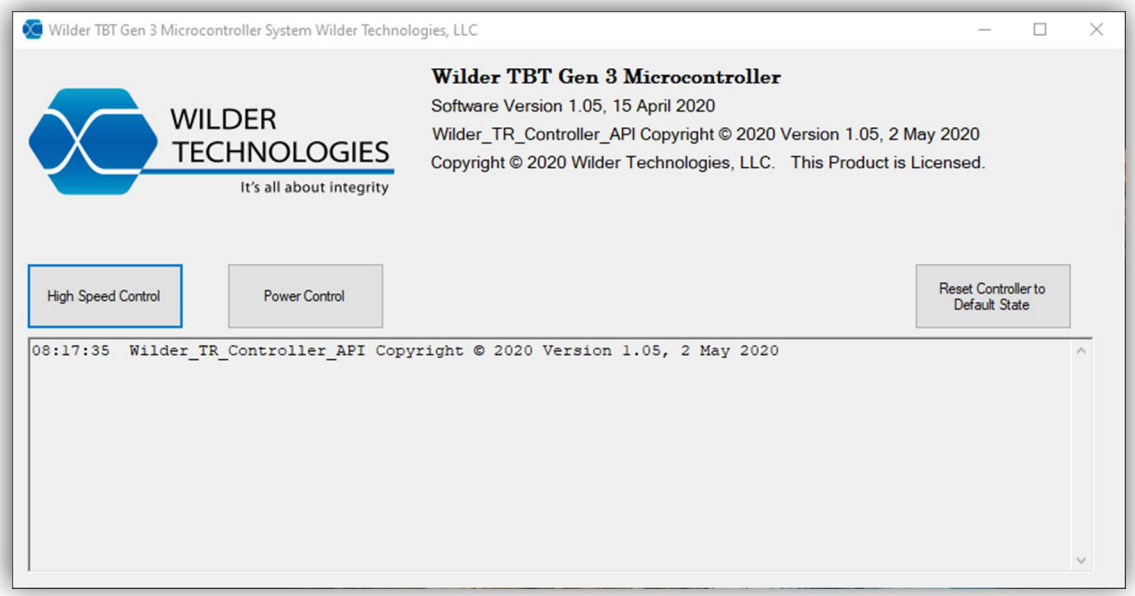


Figure 9. Titan Ridge Generation 3 Microcontroller UI Main Screen

Titan Ridge Generation 3 Microcontroller UI Connection to Titan Ridge Generation 3 Microcontroller Hardware

To operate both the UI and Hardware (HW) together, the UI must connect to the Titan Ridge Generation 3 Microcontroller Hardware.

- Connect the HW to the 20 Volt power supply.
- Connect the USB Type-A to USB Type-B cable to the USB2_UFP port on the controller.

If the UI Software session is exited, the Microcontroller Hardware will retain its state.

High Speed Control

The Titan Ridge Generation 3 Microcontroller Test module's primary use is for electrical testing per the USB Type-C Thunderbolt Alternate Mode Electrical Host/Device Compliance Test Specification. The High-Speed Control window allows the user to configure which alternate modes are supported by the controller, along with enable/disable the port and display the DUT's various settings.

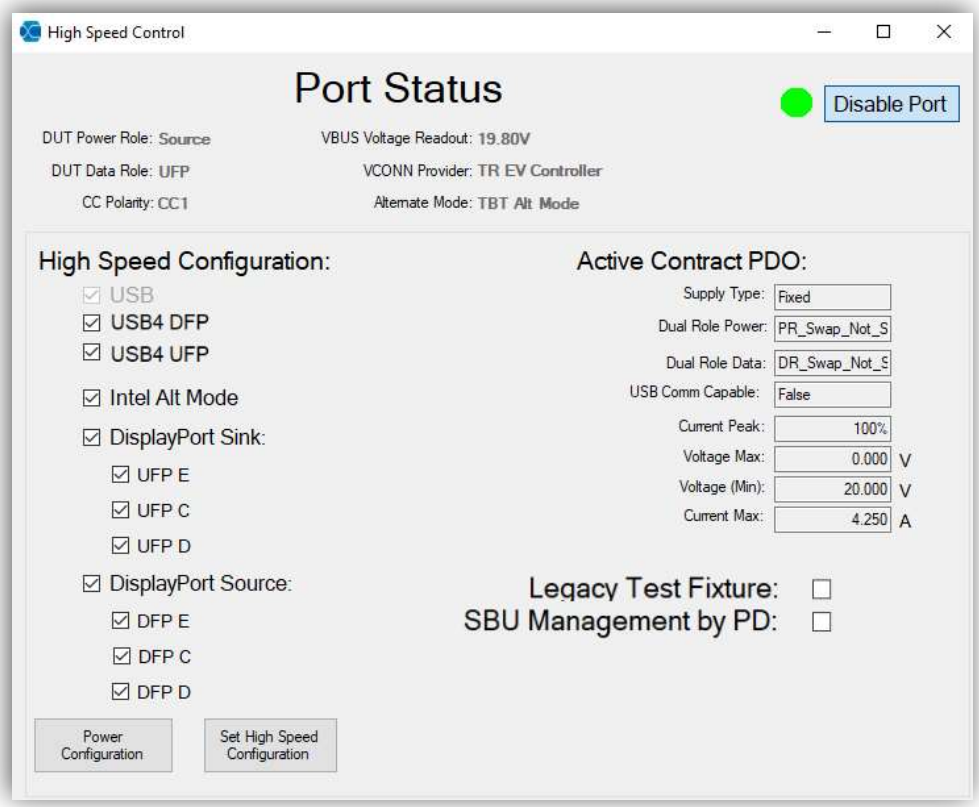


Figure 10. Titan Ridge Generation 3 Microcontroller UI High Speed Control

Port A is the only port which supports Thunderbolt and DisplayPort testing and is capable of sourcing up to 85W or sink 100W with external e-load. Ports C through D are only for power, sourcing up to 15W each or sinking up to 100W with external e-load.

The Port Status section displays the current settings of the DUT such as power and data role, CC Polarity, who the VCONN Provider is and the VBUS Voltage and current alternate mode (if applicable).

The High-Speed Control window also allows the user to configure which alternate modes are supported and control over the DisplayPort pin configurations. Once the user has the selected their High-Speed Configuration, the controller is updated via the “Set High Speed Configuration” button.

PDO Active contract displays basic information of the active contract between the controller and the DUT which is attached. This allows the user to know if the desired contract has been selected or basic information regarding active PDO.

There are two additional checkboxes located underneath the Active Contract PDO information. The first is the Legacy Test Fixture checkbox. The controller is capable of also using the Legacy Plug and Receptacle Test Adapters (Wilder part numbers 640-0845-000 and 640-0846-000 respectively). When “Legacy Test Fixture” is checked, the Legacy TPA port becomes enabled and signals are routed to this port rather than Port A. The second checkbox is the ‘SBU Managed by PD’. This checkbox is used when interfacing with a USB4 DUT.

Lastly, up to 7 Source and Sink PDO's can be configured via the "Power Configuration" button as seen below in Figure 11. When the PDO's are configured as needed, the PDO listing can be updated by clicking the "Update Source PDO List" button. The Source and Sink PDO list can be dynamically updated while there is an active connection to the DUT.

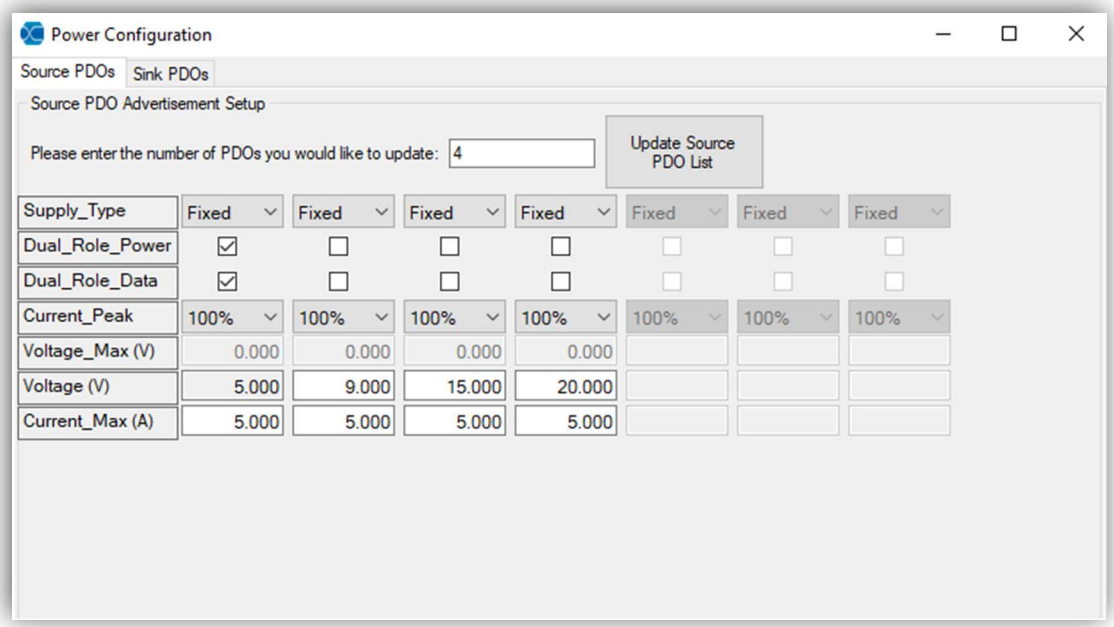


Figure 11. Titan Ridge Generation 3 Microcontroller UI Power Configuration

Power Control

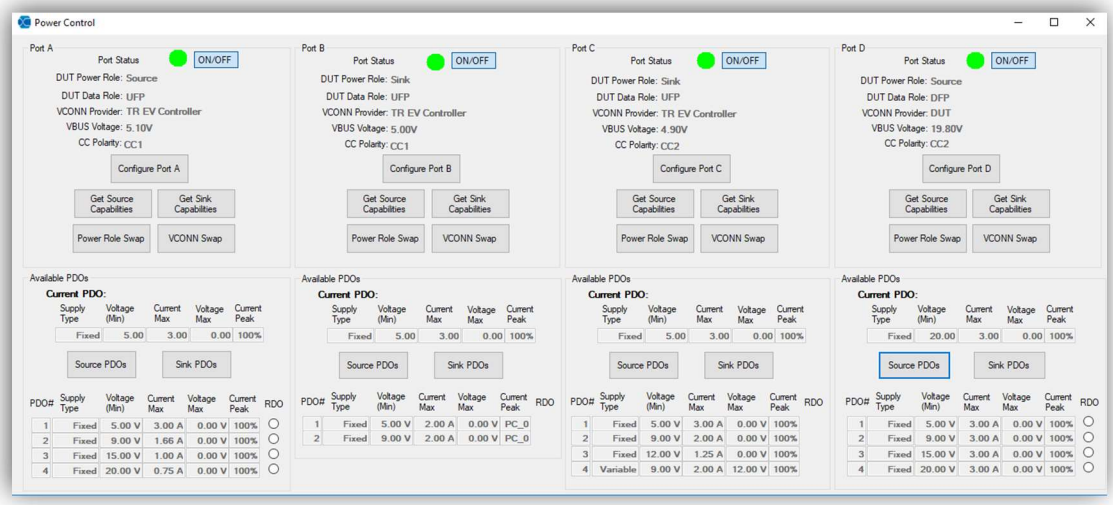


Figure 12. Titan Ridge Generation 3 Microcontroller UI Power Control

A secondary functionality that the Microcontroller can be used for is basic power delivery control. The power control window enables the user to have control over all four USB Type-C ports on the fixture. The Port Status fields are updated every 7 seconds automatically. There are 5 major buttons which either query the DUT or configure the Titan Ridge Generation 3 Microcontroller.

Power Role Swap will trigger a series of events with the DUT. If the Microcontroller is acting as a Source and the command is transmitted successfully, the Microcontroller will respond with a "Success" response code and start a Sender Response Timer. If the Accept message is received, the Microcontroller will turn off its power supply and assert Rd. After this, the Microcontroller will send the PS_RDY message to the DUT. If PS_RDY is received from the DUT, this would mark the successful completion of the Power Role Swap sequence.

If the Microcontroller is acting as a Sink and the Power Role Swap command is transmitted successfully, the Microcontroller will respond with a Success response code and start a Sender Response Timer. If an Accept message is received, the Microcontroller will stop sinking power. When the PS_RDY message is received from the DUT, the Microcontroller will assert Rp and start sourcing power and send a PS_RDY message to the DUT.

VCONN Swap will also trigger a series of events with the DUT. If an Accept message is received and the Microcontroller is currently a VCONN Source, the Microcontroller will wait for the PS_RDY message from the DUT. Once received, the Microcontroller will turn off VCONN. If an Accept is received from sending the VCONN Swap command and the Microcontroller was not VCONN Source, the Microcontroller will turn on VCONN and send the PS_RDY message.

The Power Control screen also allows the user to query the DUT's source or sink capabilities. If the user sends the "Get Source Capabilities" command, the user will be able to see each PDO listed in the Available PDOs box by clicking the Source PDOs button. Once these source PDOs are displayed, there is an additional option to request a specific power data object by selecting one of the radio buttons adjacent to the desired PDO row. The same concept applies to the "Get Sink Capabilities" button, but without the RDO column.

Just like when using the High-Speed Control screen, the user has full control over the Source/Sink PDOs as well as the different alternate modes the Microcontroller will support on the specified port. As stated earlier, Port A is the only port which has full High-Speed capabilities. Ports B through D can only supply power to the DUT for charging and provide basic power delivery testing. Once the High-Speed Configuration section has been filled out, the Microcontroller can be updated by pressing the "Set High Speed Configuration" button in the bottom right of the screen.

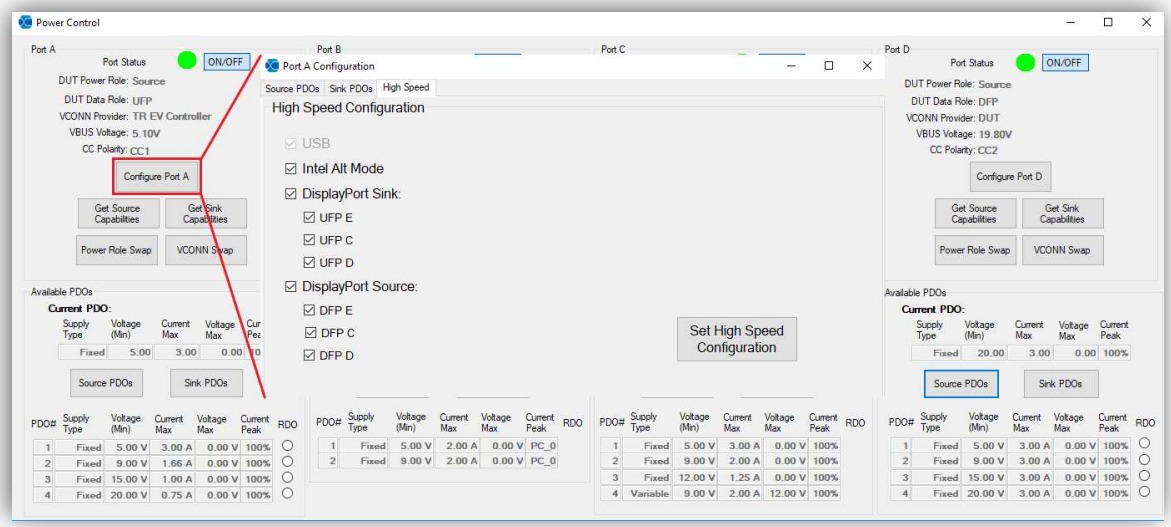


Figure 13. Titan Ridge Generation 3 Microcontroller UI Power Configuration from Power Control

Wilder Technologies, LLC – Limited Warranty

Wilder Technologies, LLC warrants that each Test Adapter, 1) is free from defects in materials and workmanship and, 2) conforms to Wilder Technologies specifications for a period of 3-months. **See Consumable and Fragile Material Warranty for exceptions to the 3-month warranty**

The warranty period for a Test Adapter is a specified, fixed period commencing on the date of ship from Wilder Technologies, LLC. If you did not purchase your Test Adapter directly from Wilder Technologies, LLC, the serial number and a valid proof of purchase will be required to establish your purchase date. If you do not have a valid proof of purchase, the warranty period will be measured from the date of ship from Wilder Technologies, LLC.

If, during the warranty period, the Test Adapter is not in good working order, Wilder Technologies, LLC will, at its option, repair or replace it at no additional charge, except as is set forth below. In some cases, the replacement Test Adapter may not be new and may have been previously installed. Regardless of the Test Adapter's production status, Wilder Technologies, LLC appropriate warranty terms apply.

Consumable and Fragile Material Warranty
Wilder Technologies, LLC warrants that consumable materials and all fragile materials supplied by Wilder Technologies, LLC either as part of an instrument or system, or supplied separately, will be free from defects in material and workmanship at the time of shipment.

Extent of Warranty
The warranty does not cover the repair or exchange of a Test Adapter resulting from misuse, accident, modification, unsuitable physical or operating environment, improper maintenance by you, or failure caused by a product for which Wilder Technologies, LLC is not responsible. The warranty is voided by removal or alteration of Test Adapter or parts identification labels. The initial three months are unconditional; the remaining months excludes plugs, receptacles and SMA connectors. Connectors are wear items and excluded from the warranty after the initial three months.

These warranties are your exclusive warranties and replace all other warranties or conditions, express or implied, including but not limited to, the implied warranties or conditions or merchantability and fitness for a particular purpose. These warranties give you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction. Some jurisdictions do not allow the exclusion or limitation of express or implied warranties, so the above exclusion or limitation may not apply to you. In that event, such warranties are limited in duration to the warranty period. No warranties apply after that period.

Items Not Covered by Warranty
Wilder Technologies, LLC does not warrant uninterrupted or error-free operation of a Test Adapter.

Any technical or other support provided for a Test Adapter under warranty, such as assistance via telephone with "how-to" questions and those regarding Test Adapter set-up and installation, will be provided **WITHOUT WARRANTIES OF ANY KIND**.

Warranty Service
Warranty service may be obtained from Wilder Technologies, LLC by returning a Wilder Technologies, LLC Returns Material Authorization and the Test Adapter to Wilder Technologies, LLC during the warranty period. To obtain RMA number, contact support@wilder-tech.com.

You may be required to present proof of purchase or other similar proof of warranty entitlement. You are responsible for any associated transportation charges, duties and insurance between you and Wilder Technologies, LLC. In all instances, you must ship Test Adapters in Wilder Technologies, LLC approved packaging. Information on packaging guidelines can be found at: www.wilder-tech.com. Wilder Technologies, LLC will ship repaired or replacement Test Adapter Delivery Duty Prepaid (DDP) and will pay for return shipment. You will receive title to the repaired or replacement Test Adapter and you will be the importer of record.

Wilder Technologies, LLC – Terms & Conditions of Sale

1. **Other Documents:** This Agreement may NOT be altered, supplemented, or amended by the use of any other document(s) unless otherwise agreed to in a written agreement signed by both you and Wilder Technologies, LLC. If you do not receive an invoice or acknowledgement in the mail, via e-mail, or with your Product, information about your purchase may be obtained at support@wilder-tech.com or by contacting your sales representative.

2. **Payment Terms, Orders, Quotes, Interest:** Terms of payment are within Wilder Technologies, LLC's sole discretion, and unless otherwise agreed to by Wilder Technologies, LLC, payment must be received by Wilder Technologies, LLC prior to Wilder Technologies, LLC's acceptance of an order. Payment for the products will be made by credit card, wire transfer, or some other prearranged payment method unless credit terms have been agreed to by Wilder Technologies, LLC. Invoices are due and payable within the time period noted on your invoice, measured from the date of the invoice. Wilder Technologies, LLC may invoice parts of an order separately. Your order is subject to cancellation by Wilder Technologies, LLC, in Wilder Technologies, LLC's sole discretion. Unless you and Wilder Technologies, LLC have agreed to a different discount, Wilder Technologies, LLC's standard pricing policy for Wilder Technologies, LLC-branded systems, which includes hardware, software and services in one discounted price, allocates the discount off list price applicable to the service portion of the system to be equal to the overall calculated percentage discount off list price on the entire system. Wilder Technologies, LLC is not responsible for pricing, typographical, or other errors in any offer by Wilder Technologies, LLC and reserves the right to cancel any orders resulting from such errors.

3. **Shipping Charges; Taxes; Title; Risk of Loss:** Shipping, handling, duties and tariffs are additional unless otherwise expressly indicated at the time of sale. Title to products passes from Wilder Technologies, LLC to Customer on shipment from Wilder Technologies, LLC's facility. Loss or damage that occurs during shipping by a carrier selected by Wilder Technologies, LLC is Wilder Technologies, LLC's responsibility. Loss or damage that occurs during shipping by a carrier selected by you is your responsibility. You must notify Wilder Technologies, LLC within 7 days of the date of your invoice or acknowledgement if you believe any part of your purchase is missing, wrong or damaged. Unless you provide Wilder Technologies, LLC with a valid and correct tax exemption certificate applicable to your purchase of Product and the Product ship-to location, you are responsible for sales and other taxes associated with the order. **Shipping dates are estimates only**.

4. **WARRANTY:** WILDER TECHNOLOGIES, LLC, warrants that the item(s) manufactured under the Buyer's contract shall be free from defects in materials and workmanship furnished by WILDER TECHNOLOGIES, LLC, and shall conform to the applicable drawings and specifications. WILDER TECHNOLOGIES, LLC'S liability herein, for breach of warranty, contract or negligence in manufacturing, shall be limited to repair or replacement. Repair or replacement of defective items will be applicable only if the Buyer notifies WILDER TECHNOLOGIES, LLC, by written notice within 30-days of delivery. All claims shall be addressed to: support@wilder-tech.com or WILDER TECHNOLOGIES, LLC, 6101A East 18th Street, Vancouver, Washington 98661 U.S.A.; ATTENTION: Customer Service Manager. WILDER TECHNOLOGIES, LLC, reserves the right to inspect at the Buyer's plant all items claimed to be defective or nonconforming prior to authorizing their return. WILDER TECHNOLOGIES, LLC, assumes no liability for the results of the use of its components in conjunction with other electric, electronic or mechanical components, circuits and/or systems. The foregoing constitutes the sole and exclusive remedy of the Buyer and the exclusive liability of WILDER TECHNOLOGIES, LLC, and is IN LIEU OF ANY AND ALL OTHER WARRANTIES, STATUTORY, IMPLIED OR EXPRESSED AS TO MERCHANTABILITY, FITNESS FOR THE PURPOSE SOLD, DESCRIPTION, QUALITY, and PRODUCTIVENESS OR ANY OTHER MATTER. Without limiting the foregoing, in no event shall WILDER TECHNOLOGIES, LLC, be liable for loss of use, profit or other collateral, or for special and/or consequential damages.

5. **RETURNED GOODS:** WILDER TECHNOLOGIES, LLC, will accept only those goods for return that have been authorized for return. All goods authorized for return shall be assigned a Returned Material Authorization (RMA) Number. The RMA Number shall be clearly marked on the shipping container(s) and all documentation accompanying the goods authorized for return. The RMA Number shall be assigned by WILDER TECHNOLOGIES, LLC pursuant to the conditions set forth in Paragraph 4, WARRANTY.

6. **UNITED STATES GOVERNMENT CONTRACTS:** In the event this offer is accepted under Government contract, WILDER TECHNOLOGIES, LLC, agrees to accept clauses required by Government regulations and to waive WILDER TECHNOLOGIES, LLC conditions inconsistent therewith. WILDER TECHNOLOGIES, LLC, certifies that it is a regular manufacturer or dealer of the goods and/or services offered herein and that the prices offered do not exceed those charged to any customer for like quantities, services or materials under the same conditions.

Compliance with Environmental Legislation

Wilder Technologies, LLC, is dedicated to complying with the requirements of all applicable environmental legislation and regulations, including appropriate recycling and/or disposal of our products.

WEEE Compliance Statement

The European Union adopted Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE), with requirements that went into effect August 13, 2005. WEEE is intended to reduce the disposal of waste from electrical and electronic equipment by establishing guidelines for prevention, reuse, recycling and recovery.

Wilder Technologies has practices and processes in place to conform to the requirements in this important Directive.

In support of our environmental goals, effective January 1st, 2009 Wilder Technologies, LLC has partnered with EG Metals Inc. – Metal and Electronics Recycling of Hillsboro, Oregon, www.egmetalrecycling.com, to recycle our obsolete and electronic waste in accordance with the European Union Directive 2002/96/EC on waste electrical and electronic equipment ("WEEE Directive").

As a service to our customers, Wilder Technologies is also available for managing the proper recycling and/or disposal of all Wilder Technologies products that have reached the end of their useful life. For further information and return instructions, contact support@wilder-tech.com.

CE

Compliance to RoHS 2 Substance Restrictions

Wilder Technologies, LLC certifies that the parts described in this document are compliant to the substance restrictions of Directive 2011/65/EU and Amendment Directive (EU) 2015/863 of the European Parliament, and of the Council of 8 June, 2011 and 31 March, 2015 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS 2 Directive), prohibiting the use in homogeneous materials in excess of the listed maximum concentration value, except in cases where use is allowed by applicable exemptions listed in Annex III and Annex IV of the Directive.

Compliance with RoHS 2 has been verified through internal controls at design and production sites, including establishment of processes for specifying and controlling materials and segregation of non-compliant parts, receipt of supplier declarations of compliance and/or analytical test.

Glossary of Terms

TERMINOLOGY	DEFINITION
Alt Mode (Alternate Mode)	Operation defined by a vendor or standards organization that is associated with a SVID assigned by the USB-IF. Entry and exit into and from an Alternate Mode is controlled by *USB PD r2.0 v1.1* Structured VDM Enter Mode and Exit Mode commands.
API	Application Program Interface
Captive Cable (Tethered)	Cable that is terminated on one end with a USB Type-C plug and has a vendor-specific means with which to connect (hard-wired or custom detachable) on the opposite end.
CC	Configuration Channel
DFP	Downward Facing Port
DLL	Dynamic Link Library (an API is usually inside)
DP	DisplayPort
DUT	Device Under Test
Far-End Crosstalk or FEXT	Crosstalk that is propagated in a disturbed channel in the same direction as the propagation of a signal in the aggressor channel. The terminals of the aggressor channel and the victim channel are usually close to each other.
Informative	The designation of a test that is not required for compliance but is considered important from a characterization standpoint. It is provided for informational purposes only.
Initiator	Port that initiates a *USB PD r2.0 v1.1* Vendor-Defined Message. It is independent of the port's PD role (e.g., Provider, Consumer, Provider/Consumer, or Consumer/Provider).
Insertion loss	The ratio, expressed in dB, of incident power to delivered power.
Near-End Crosstalk or NEXT	Crosstalk that is propagated in a disturbed channel in the opposite direction as the propagation of a signal in the aggressor channel. The terminals of the aggressor channel and the victim channel are usually close to each other.
Normative	The designation of a test that is required for compliance.
Physical Link	Two differential signal pairs, one pair in each direction, that connect two physical phys.
Port	Bidirectional channel for isochronous stream transport from Thunderbolt Source to Thunderbolt Sink. Thunderbolt contains two ports in this application.
Responder	Port that responds to the Initiator of a *USB PD r2.0 v1.1* Vendor-Defined Message. Independent of the port's PD role (e.g., Provider, Consumer, Provider/Consumer, or Consumer/Provider).
Return Loss	The ratio, expressed in dB, of incident power to reflected power.
SBU	Sideband Use.
TBT-TPA	Thunderbolt Test Point Access. A specialized assembly that interfaces to a Thunderbolt receptacle or plug and enables access to signals for measurement or stimulation.
UPF	Upward Facing Port
USB Type-C	Generic reference to a USB Type-C Plug, USB Type-C Port, USB Type-C Receptacle, or USB Type-C Cable Assembly, as specified in *USB Type-C r1.1*.
VCONN-Powered	VCONN is a 5V, 1W power supply used to power the IC within an electronically marked Type-C cable. The DFP will supply the VCONN power upon start-up
VDM	Vendor Defined Messages (subset of PD messages on the CC lines)

Index

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