

# Thunderbolt Generation 2 Microcontroller

User Manual



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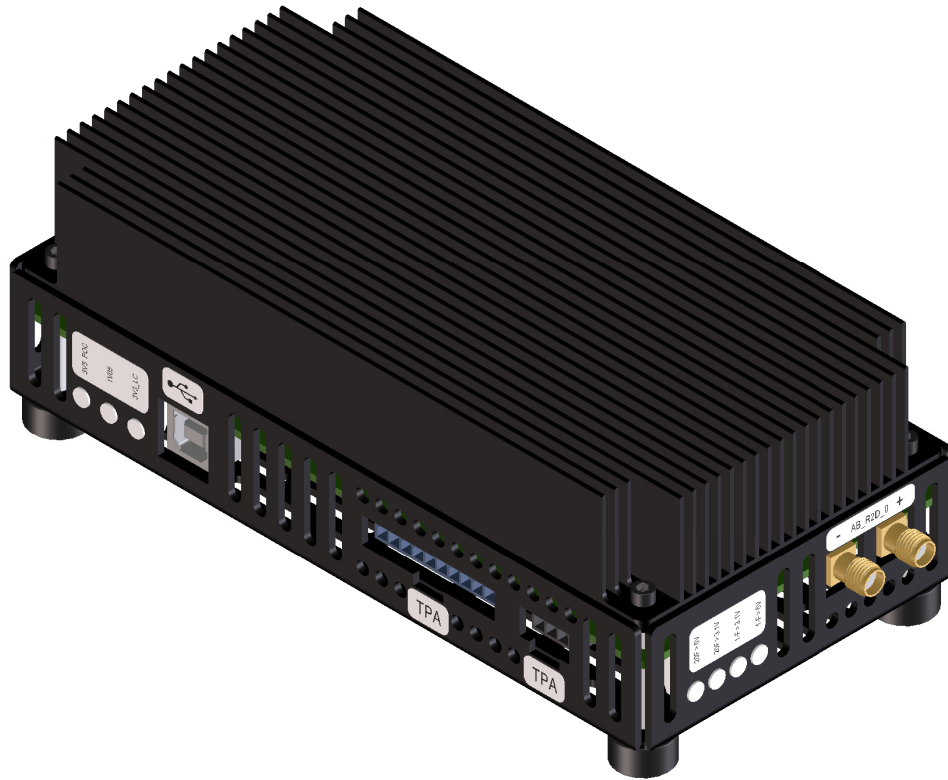
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### Introduction

This user's guide documents the Thunderbolt Generation 2 Microcontroller (TBT-TPA-UHG2) as used with Thunderbolt test products. The Thunderbolt Generation 2 Microcontroller, when paired with Thunderbolt TPAs, can be used for testing Thunderbolt hosts or cables. Using test scripts, available from Intel for registered and licensed Thunderbolt users, the UHG2 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 Thunderbolt cable. The UHG2 user interface is via USB.

The UHG2 is supplied with a +12Vdc, 3.4A universal power supply and power cord, a 1-meter USB interface cable assembly, and mating connectors and contacts for the external power supply connectors.



**Figure 1. The Thunderbolt Generation 2 Microcontroller.**

Provided with each TBT-TPA-UHG2 Thunderbolt Generation 2 Microcontroller are the following supporting materials.

- (1) Universal +12Vdc Power Supply (not shown)
- (1) NEMA 5-15P Power Cord (not shown)
- (1) USB Cable, Type A to Type B, 3 ft (not shown)
- (3) Mating Connectors and Contacts for External Power Supply Connections (not shown)

## Product Inspection

Upon receiving the Thunderbolt Generation 2 Microcontroller 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 2 Microcontroller 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 Thunderbolt Generation 2 Microcontroller Care and Handling Precautions

When using the Thunderbolt Generation 2 Microcontroller with Thunderbolt 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 connections within the adapter housing or the cables themselves. This can occur at any point along the cable. To achieve optimum performance and to prolong the Thunderbolt Generation 2 Microcontroller and Thunderbolt TPA's life, observe the following handling precautions:

- **CAUTION 1: Avoid Torque Forces (Twisting)**  
While individual coaxial cables within test adapters have some rotational freedom, twisting the Thunderbolt 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 twist 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 the Thunderbolt TPA cables 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 Thunderbolt TPA and cables. Use adjustable elevation stands or apparatus to accurately place and support the Thunderbolt TPA.
- **CAUTION 4: Connect the Thunderbolt TPAs First**  
To prevent twisting, bending, or applying tension to the coaxial cables when connecting a Thunderbolt TPA, always attach the Thunderbolt TPA to the device under test (DUT) or cable under test before attaching any SMA connectors. Carefully align the Thunderbolt connectors and then gently push the connectors together until fully seated.

If the Thunderbolt TPA must be turned or twisted to make connection to the DUT, avoid using the Thunderbolt 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 connections at the Thunderbolt TPA, make the connection to the DUT and then re-tighten or attach the test equipment leads.

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

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

To connect the Thunderbolt TPA 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 Thunderbolt TPA coaxial cable.
3. The Thunderbolt TPA SMA connectors have flats that accept an open-end 1/4-inch or 6.5 mm wrench. When attaching instrument cables to these test adapters, 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.

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**NOTE: 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.**

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

Excessive weight from instrument cables and/or accessories connected to the Thunderbolt Generation 2 Microcontroller or Thunderbolt TPA 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 Thunderbolt Generation 2 Microcontroller, Test Adapter, Cable, and Connector

Observing simple precautions can ensure accurate and reliable measurements.

### Handling and Storage

Before each use of the Thunderbolt Generation 2 Microcontroller, 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 Thunderbolt test adapters, do not set connectors contact end down. 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 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 Thunderbolt Generation 2 Microcontroller and 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 work station, 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 M $\Omega$  of isolation from ground. Acceptable ESD accessories may be purchased from a local supplier.

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**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.**

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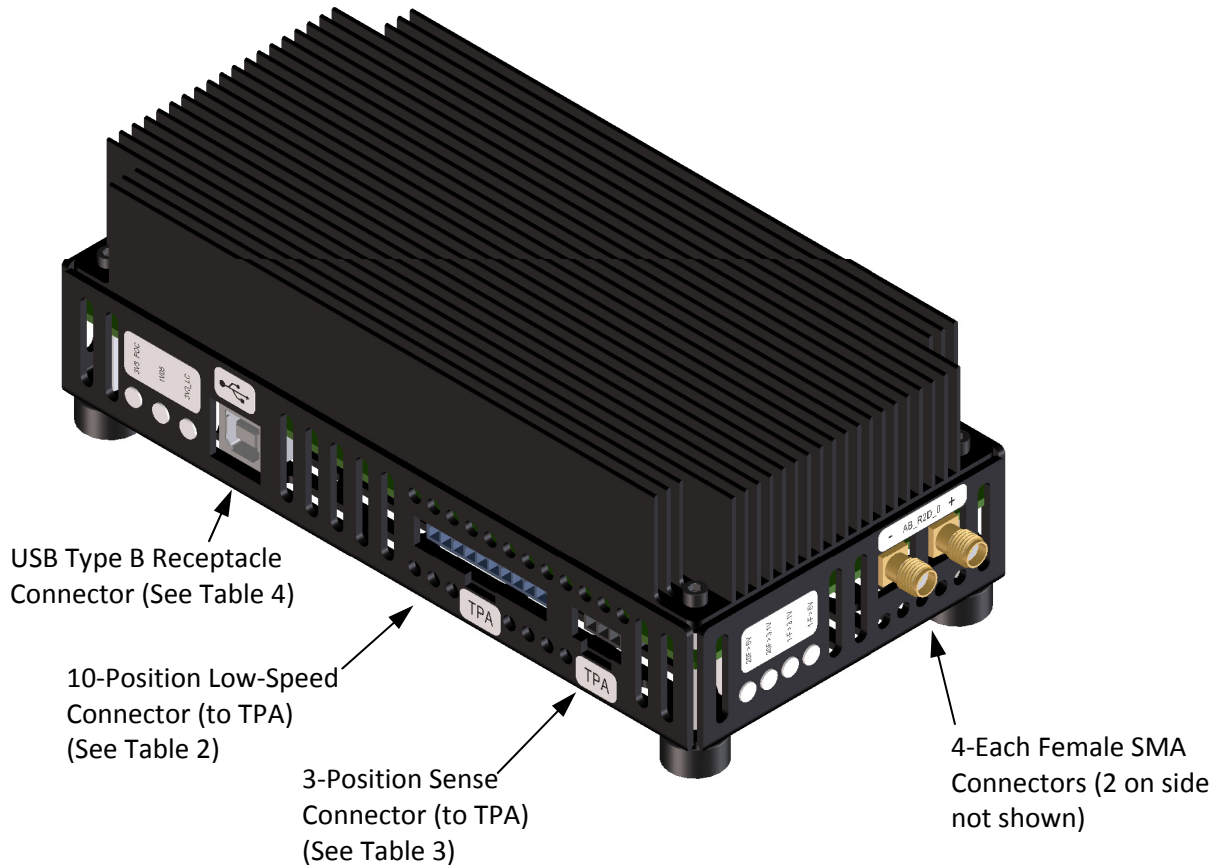


## Mechanical and Environmental Specifications

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

**Table 1. General Specifications**

ITEM	DESCRIPTION
Usage Environment	Controlled indoor environment
TBT-TPA-UHG2 Length x Width x Height	161.5 mm (6.36 in) x 80.3 mm (3.16 in) x 57.1 mm (2.25 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



**Figure 2. Connectors (Thunderbolt Generation 2 Microcontroller shown)**

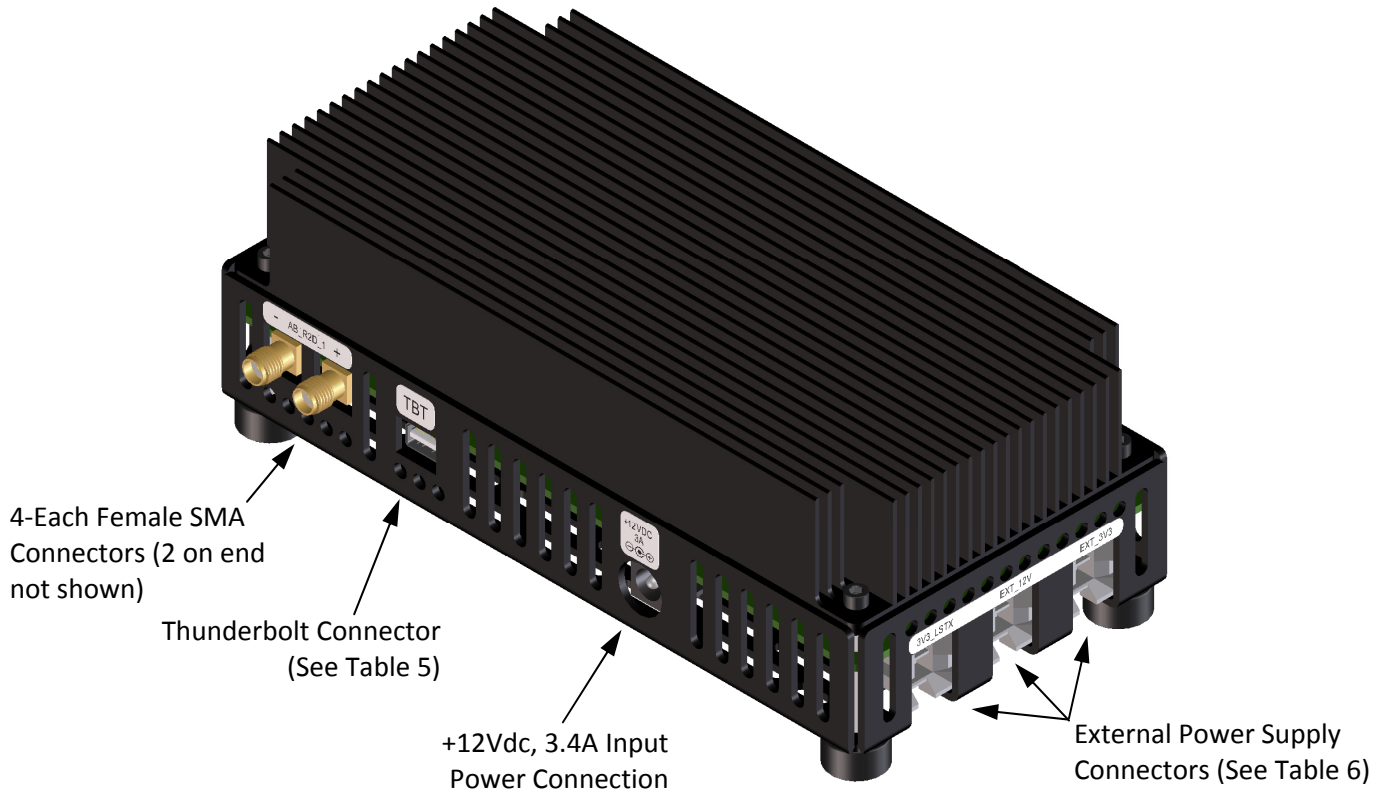


Figure 3. Connectors (Thunderbolt Generation 2 Microcontroller shown)

### Thunderbolt Generation 2 Microcontroller Pin-out

The Thunderbolt Generation 2 Microcontroller has two low-speed connectors, a USB connector, a Thunderbolt receptacle connector, three external power supply input connectors and a power jack. Of the two low-speed connectors, one is for connection of the Thunderbolt TPA, and one is for power sensing of the TPA. Labels clearly mark each position of the two low-speed connectors. The USB connector provides the user interface to the Thunderbolt Generation 2 Microcontroller. The power jack provides analog power to the Thunderbolt Generation 2 Microcontroller. Figures 2 and 3, above, refer to pin-description tables for each of the connector types.

Table 2. TBT-TPA-UHG2 10-position Connector Header, J1, (TPA Low-Speed)

LABEL	PIN NO.	DESCRIPTION
HPD	Pin 1	Hot Plug Detect
1-F (PIF)	Pin 2	Main connector pin 1 force (Power-In Force)
20F (POF)	Pin 3	Main connector pin 20 force, (Power-Out Force)
LST	Pin 4	Low-speed Transmit
CF1	Pin 5	Configure 1
LSR	Pin 6	Low-speed Receive
CF2	Pin 7	Configure 2
GND	Pin 8	Ground
NC	Pin 9	No-Connect
NC	Pin 10	No-Connect

Table 3. TBT-TPA-UHG2 3-position Connector Header, J2, (TPA Sense)

LABEL	PIN NO.	DESCRIPTION
20S (POS)	Pin 1	Main connector pin 20 sense, (Power-Out Sense)
GDS	Pin 2	Ground Sense
1-S (PIS)	Pin 3	Main connector pin 1 sense, (Power-In Sense)

Table 4. TBT-TPA-UHG2 Pin Assignments for USB Connector J3

SIGNAL IDENTIFICATION	PIN NO.	DESCRIPTION
VCC	Pin 1	+5V power supply
D-	Pin 2	Data (n)
D+	Pin 3	Data (p)
RTN	Pin 4	Return, (connected to Ground)
CGND	Connector Shell	Connected to CGND1

**Table 5. TBT-TPA-UHG2 Pin Assignments for Thunderbolt Connector J22**

SIGNAL IDENTIFICATION	PIN NO.	DESCRIPTION
HV/AC Gnd	1	Pin 1 Power In, filtered
HPD	2	Hot Plug Detect
Rx0_P	3	Port 0 receive positive, DUT centric
Tx0_P	4	Port 0 transmit positive, Config 1 – Filtered , DUT centric
Rx0_N	5	Port 0 receive negative, DUT centric
Tx0_P	6	Port 0 transmit negative, Config 2 – Filtered, DUT centric
AC Gnd	7	AC Ground
Ground	8	Ground
LSTX	9	Low-speed Transmit
No-Connect	10	No-connect, internally terminated to 50 ohms
LSRX	11	Low-speed Receive
No-Connect	12	No-connect, internally terminated to 50 ohms
Ground	13	Ground
Ground	14	Ground
Rx1_P	15	Port 1 receive positive, DUT centric
Tx1_P	16	Port 1 transmit positive, DUT centric
Rx1_N	17	Port 1 receive negative, DUT centric
Tx1_N	18	Port 1 transmit negative, DUT centric
Ground	19	Ground
DP PWR	20	Pin 20 Power Out, filtered

Table 6. TBT-TPA-UHG2 Pin Assignments for External Power Supply Connectors

EXTERNAL 3.3V POWER SUPPLY CONNECTOR (J4)		
SIGNAL IDENTIFICATION	PIN NO.	DESCRIPTION
GND	Pin 1	Ground
GND	Pin 2	Ground
EXT_PWR_IN_3V3	Pin 3	External 3.3V Power Supply
EXT_PWR_IN_3V3	Pin 4	External 3.3V Power Supply

EXTERNAL 12V POWER SUPPLY CONNECTOR (J12)		
SIGNAL IDENTIFICATION	PIN NO.	DESCRIPTION
GND	Pin 1	Ground
GND	Pin 2	Ground
EXT_PWR_IN_12V	Pin 3	External 12V Power Supply
EXT_PWR_IN_12V	Pin 4	External 12V Power Supply

EXTERNAL 3.3V_LSTX POWER SUPPLY CONNECTOR (J16)		
SIGNAL IDENTIFICATION	PIN NO.	DESCRIPTION
GND	Pin 1	Ground
GND	Pin 2	Ground
EXT_VCC3V3_LSTX	Pin 3	External 3.3V_LSTX Power Supply
EXT_VCC3V3_LSTX	Pin 4	External 3.3V_LSTX Power Supply

## Electrical Specifications

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

**Table 7. Thunderbolt Generation 2 Microcontroller Electrical Specifications**

SPECIFICATION	MINIMUM	TYPICAL	MAXIMUM	NOTES
Low Voltage, (V)		3.3		As applied to 20F
High Voltage, two schottky drops below the analog input power, (V)	12		18.9	As applied to 20F
Load Resistance Range (ohms)	2		open	As applied to 1-F
Load Resistance, LSB, (ohms)		520		
Maximum power dissipation (W)			20	
HPD current (mA), V <sub>hpd</sub> = 3.3V			3.1	

## Thunderbolt Generation 2 Microcontroller User Model

The figure, below, shows a simplified set-up example of a Thunderbolt Generation 2 Microcontroller and a Thunderbolt Plug Test Adapter used to test a typical Thunderbolt DUT.

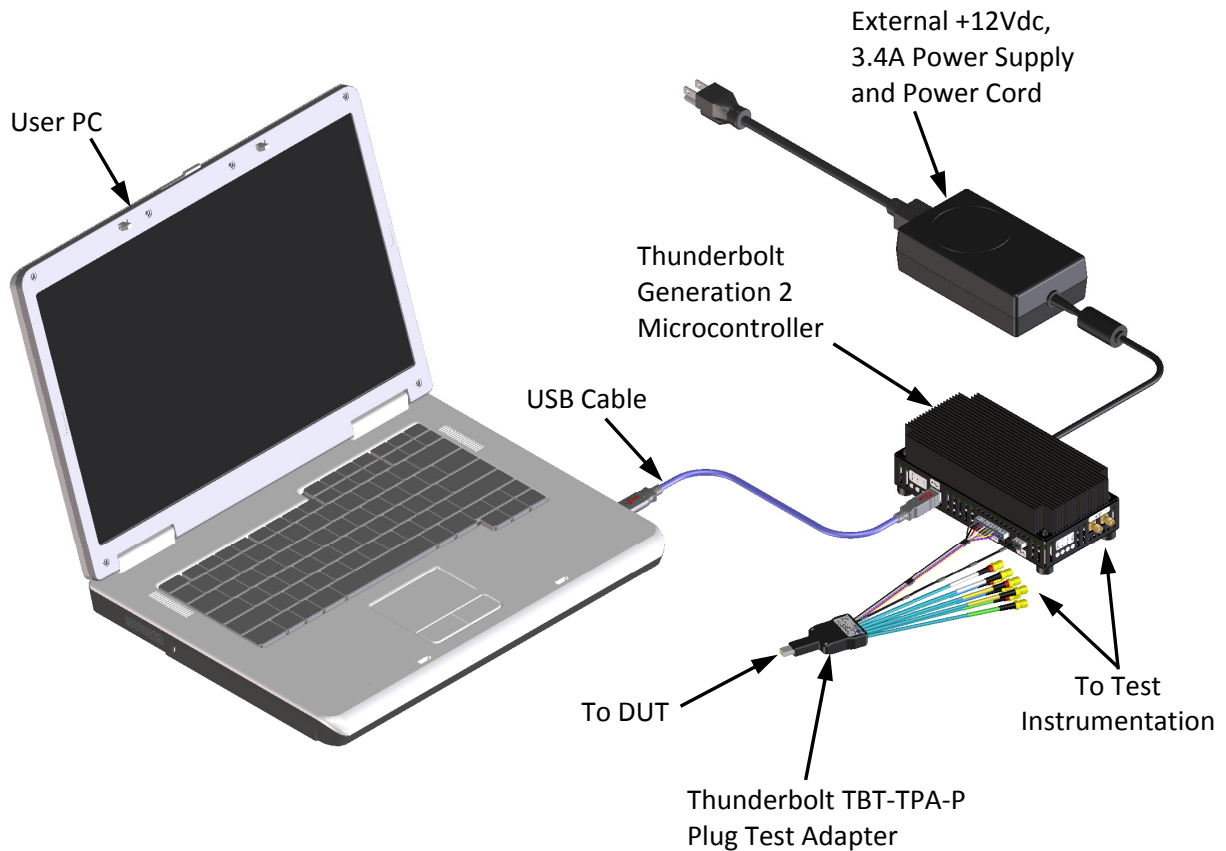


Figure 4. One TBT-TPA-P (Plug Test Adapter) mated to a TBT-TPA-UHG2 (Thunderbolt Generation 2 Microcontroller)

Text should be added referencing the power test section of the microcontroller (bus powered and self powered interface.) Additionally, information should be added about where the user obtains the necessary scripts to run the microcontroller. The user must be a registered and licensed Thunderbolt user to obtain the Intel login and access to the necessary scripts.

## Thunderbolt Generation 2 Microcontroller Software

### Introduction

Information should be added about where the user obtains the necessary scripts to run the microcontroller. The user must be a registered and licensed Thunderbolt user to obtain the Intel login and access to the necessary scripts.

Test scripts (available through Intel) operate the Wilder Technologies Thunderbolt Generation 2 Microcontroller (UHG2) via a USB connection from a PC. The scripts will run on most PCs with Vista, Windows 7 or Windows 8. A powered USB port is required.

### Licensing

Need data here, or omit.



## Thunderbolt Generation 2 Microcontroller Reference Information

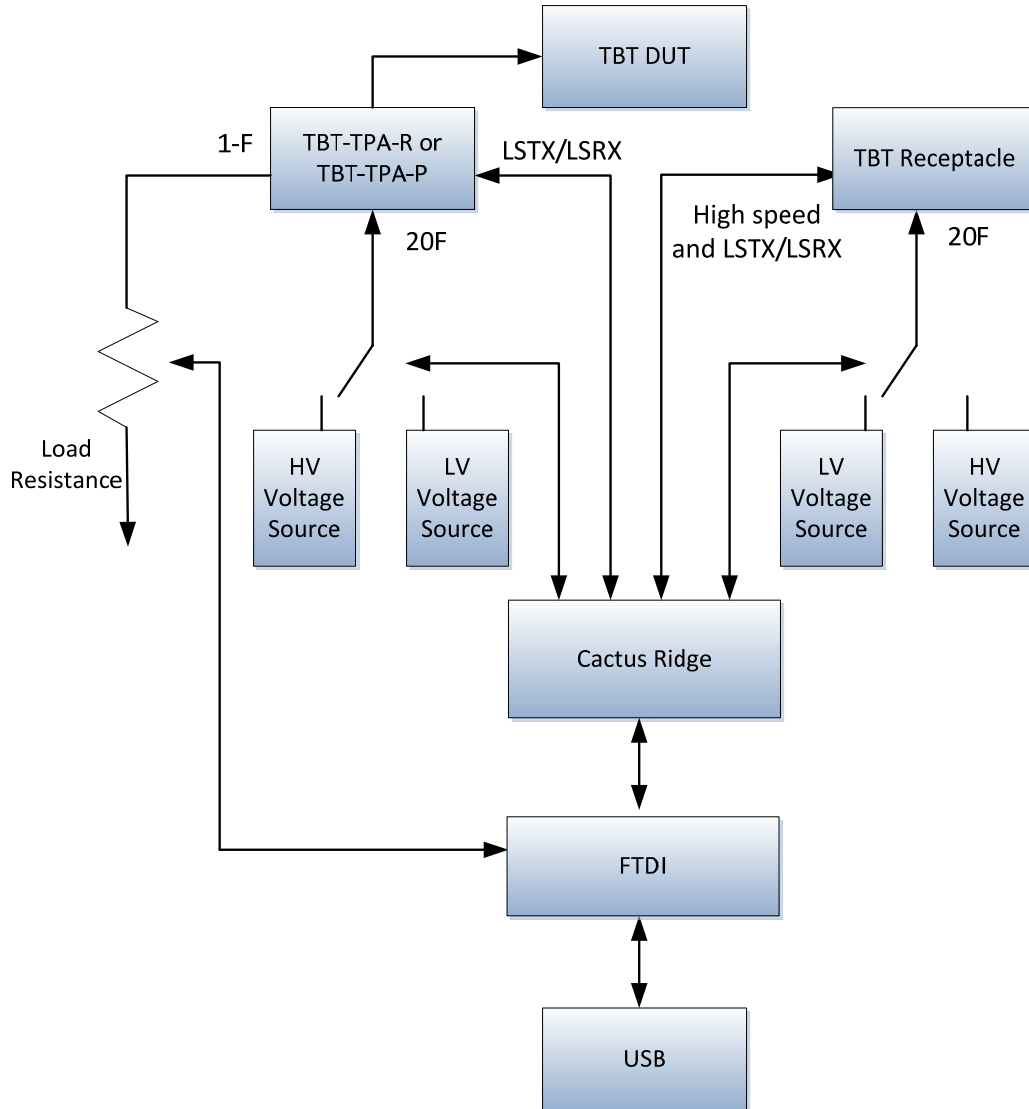


Figure 5. Thunderbolt Generation 2 Microcontroller Block Diagram

## 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 12 months. **See Consumable and Fragile Material Warranty for exceptions to the 12 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](mailto: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](http://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

- 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](mailto:support@wilder-tech.com) or by contacting your sales representative.
- 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.
- 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.**
- 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](mailto: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.
- 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.
- 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 1<sup>st</sup>, 2009 Wilder Technologies, LLC has partnered with EG Metals Inc. – Metal and Electronics Recycling of Hillsboro, Oregon, [www.egmetalrecycling.com](http://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](mailto:support@wilder-tech.com).

## Glossary of Terms (Thunderbolt)

TERMINOLOGY	DEFINITION
Aggressor	A signal imposed on a system (i.e., cable assembly) to measure response on other signal carriers.
Daisy-chain	Thunderbolt link between multiple boxes, going from box to box to box, detachable by an end user. A Thunderbolt cable-connector assembly for the box-to-box connection shall have two ports. DisplayPort Sinks can only be at the end of the Daisy-chain.
Dual-protocol	Thunderbolt runs PCIe and DisplayPort protocols
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.
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.
Port	Bidirectional channel for isochronous stream transport from Thunderbolt Source to Thunderbolt Sink. Thunderbolt contains two ports in this application.
Normative	The designation of a test that is required for compliance.
Victim	A signal carrier on a system that has a response imposed on it by other signals in the system.

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