Connect Tech Inc.

Embedded Computing Experts

USERS GUIDE

GraphiteVPX/CPU TX2/TX2i

CTIM-00476 Revision 0.06 2021-11-04

NVIDIA ELITE PARTNER

CONNECT TECH
www.connecttech.com
support@connecttech.com

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PREFACE

Disclaimer

The information contained within this user's guide, including but not limited to any product specification, is subject to change without notice.

Connect Tech assumes no liability for any damages incurred directly or indirectly from any technical or typographical errors or omissions contained herein or for discrepancies between the product and the user's guide.

Customer Support Overview

If you experience difficulties after reading the manual and/or using the product, contact the Connect Tech reseller from which you purchased the product. In most cases the reseller can help you with product installation and difficulties.

In the event that the reseller is unable to resolve your problem, our highly qualified support staff can assist you. Our support section is available 24 hours a day, 7 days a week on our website at: https://connecttech.com/support/resource-center/. See the contact information section below for more information on how to contact us directly. Our technical support is always free.

Contact Information

Contact Information	
Mail/Courier	Connect Tech Inc. Technical Support 489 Clair Rd. W. Guelph, Ontario Canada N1L 0H7
Contact Information	sales@connecttech.com support@connecttech.com www.connecttech.com Toll Free: 800-426-8979 (North America only) Telephone: +1-519-836-1291 Facsimile: 519-836-4878 (on-line 24 hours)
Support	Please go to the Connect Tech Resource Center for product manuals, installation guides, device drivers, BSPs and technical tips. Submit your technical support questions to our support engineers. Technical Support representatives are available Monday through Friday, from 8:30 a.m. to 5:00 p.m. Eastern Standard Time.

Limited Product Warranty

Connect Tech Inc. provides a one-year Warranty for the VPG003 GraphiteVPX/CPU. Should this product, in Connect Tech Inc.'s opinion, fail to be in good working order during the warranty period, Connect Tech Inc. will, at its option, repair or replace this product at no charge, provided that the product has not been subjected to abuse, misuse, accident, disaster or non-Connect Tech Inc. authorized modification or repair.

You may obtain warranty service by delivering this product to an authorized Connect Tech Inc. business partner or to Connect Tech Inc. along with proof of purchase. Product returned to Connect Tech Inc. must be pre-authorized by Connect Tech Inc. with an RMA (Return Material Authorization) number marked on the outside of the package and sent prepaid, insured and packaged for safe shipment. Connect Tech Inc. will return this product by prepaid ground shipment service.

The Connect Tech Inc. Limited Warranty is only valid over the serviceable life of the product. This is defined as the period during which all components are available. Should the product prove to be irreparable, Connect Tech Inc. reserves the right to substitute an equivalent product if available or to retract the Warranty if no replacement is available.

The above warranty is the only warranty authorized by Connect Tech Inc. Under no circumstances will Connect Tech Inc. be liable in any way for any damages, including any lost profits, lost savings or other incidental or consequential damages arising out of the use of, or inability to use, such product.

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ESD Warning

Electronic components and circuits are sensitive to ElectroStatic Discharge (ESD). When handling any circuit board assemblies including Connect Tech COM Express carrier assemblies, it is recommended that ESD safety precautions be observed. ESD safe best practices include, but are not limited to:

- Leaving circuit boards in their antistatic packaging until they are ready to be installed.
- Using a grounded wrist strap when handling circuit boards, at a minimum you should touch a grounded metal object to dissipate any static charge that may be present on you.
- Only handling circuit boards in ESD safe areas, which may include ESD floor and table mats, wrist strap stations and ESD safe lab coats.
- Avoiding handling circuit boards in carpeted areas.
- Try to handle the board by the edges, avoiding contact with components.

REVISION HISTORY

Revision	Date	Changes
0.00	2016/09/18	Initial Release
0.01	2016/09/30	Naming Change Embedded System to GraphiteVPX/CPU
0.02	2016/10/27	Update to some photos, added weight.
0.03	2017/10/20	Added TX2 part #'s and RTG004 details
0.04	2018/03/01	Updated part #s
0.05	2019-04-16	Added TX2i, supports HDMI 2.0
0.06	2021-11-04	Updated format, Updated address, Removed TX1 references

INTRODUCTION

Connect Tech's GraphiteVPX/CPU TX2/TX2i is a VITA 65 compliant 3U VPX single board computer that brings the NVIDIA® Jetson™ TX2/TX2i embedded computing platform to the VPX form factor.

This complete host solution delivers over 1 TeraFLOPs of performance, with multiple USB 3.0 and 2.0 ports, multiple GbE channels, and 6 x2 CSI-2 (or 3 x4 CSI-2) camera interfaces to round out the VPG003 GraphiteVPX/CPU feature set.

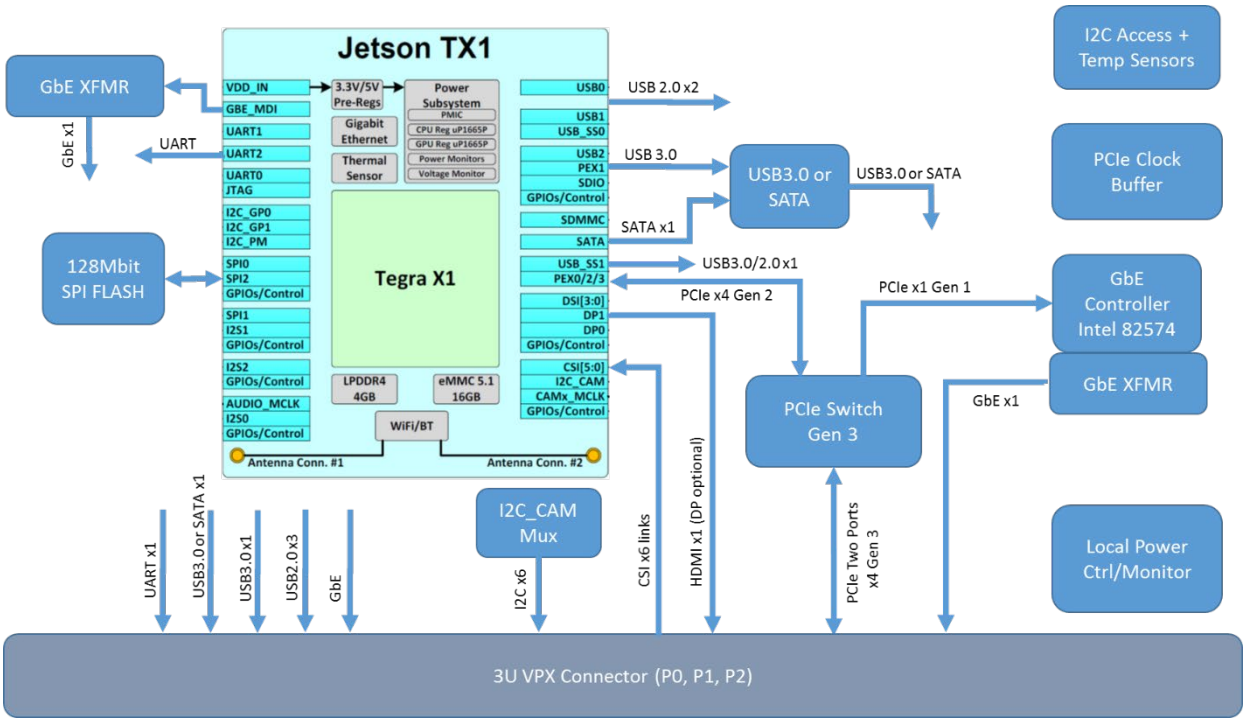
Product Features and Specifications

Specifications	
Processor	NVIDIA Jetson TX2/TX2i, 1 TFLOP/s, 256-CUDA Cores (Pascal) with a Hex core 64-bit ARM, quad core A57 + dual core Denver, (TX2)
Memory	8GB LPDDR4 (TX2/TX2i)
On Board Storage	32GB eMMC (TX2/TX2i)
Display	1x HDMI Link (Supports up to HDMI 2.0 UHD 4K [2160p] at 60Hz)
Ethernet	2x Gigabit Ethernet (10/100/1000) Links
USB	1x USB 2.0 (OTG) / 1x USB 3.0/2.0 ports (TX2/TX2i)
Serial	1x RS-232 (TX2/TX2i debug port)
Video Input	6x 2-lane CSI-2/MIPI Camera Sensor Inputs (Can be configured as 3x 4-lane CSI-2/MIPI)
Power Requirement	12V (VS1), 5V (VS3), 3V3_AUX (VS2 is not used)
Operating Temperature	-40°C to +70°C - Conduction Cooled edge temperatures
Dimensions	Standard 3U VPX VITA 65 – 1" pitch
Weight	450g
Accessories	RTG004 – RTM for the VPG003 CPU board
Warranty and Support	1 Year Warranty and Free Support

Part Numbers / Ordering Information

Part Number	
VPG003-21	Graphite VPX/CPU – TX2, North America
VPG003-22	Graphite VPX/CPU – TX2, EU/Japan
VPG003-23	Graphite VPX/CPU – TX2, Israel
VPG003-24	Graphite VPX/CPU – TX2, Korea
VPG003-25	Graphite VPX/CPU – TX2, China
RTG004	RTM for Development on the VPG003 CPU board

PRODUCT OVERVIEW



DETAILED FEATURE DESCRIPTION VPG003

The VPG003 GraphiteVPX/CPU is a Ruggedized NVIDIA Jetson TX2/TX2i System. The VPG003 comes with the NVIDIA Linux for Tegra Ubuntu Image with the Connect Tech Board Support Package preinstalled.

OpenVPX Payload Profile: MOD3-PAY-2F-16.2.7-2

Power Input

The VPG003 GraphiteVPX/CPU accepts a standard VPX VITA 46 power input set. VS1 = 12V, VS2 = 3.3V (not used), VS3 = 5V and 3V3_AUX.

Console

The VPG003 GraphiteVPX/CPU has a console port to allow for remote or headless use of the System. With an RS-232 Link at a 115200 baud rate, the Console allows for additional connection to the console outside of using the display of the VPG003 GraphiteVPX/CPU.

10/100/1000 Ethernet

Two ports of GbE are available, one interface comes from the TX2/TX2i onboard Ethernet controller. The second is on the PCIe bus and comes from the Intel 82574 Ethernet Controller. Both with distinct MAC Id's.

Display (HDMI only)

One HDMI video output is available for display up to 4k.

MIPI CSI 2.0 Camera inputs

There are 6 independent x2 CSI-2 (or 3 independent x4 CSI-2) camera inputs available to the user.

USB 3.0/2.0 and OTG

The VPG003 has two ports capable of USB 3.0 or 2.0 (USB A and USB B) and an extra USB 2.0 port used as either a host or client port selected through the USB ID pin state. Client mode is used to update the TX2/TX2i's software. In host mode, the port acts as a standard host USB 2.0 port. The USB 3.0 B port and the SATA port are mutually exclusive and are selected via the J2 header block.
Note: When using the RTG004, the USB3.0 B and SATA port selection jumper on the VPG003 (J2F) must match the settings of J1A on the RTM.

Note: TX2 versions of the VPG003 only contain ONE USB 3.0 capable port.

SATA 2.0

One SATA Gen 2 port is available direct from the TX2/TX2i for additional storage capability. The SATA port and the USB 3.0 B port are mutually exclusive and are selected via the J2 header block.

Note: When using the RTG004, the USB3.0 B and SATA port selection jumper on the VPG003 (J2F) must match the settings of J1A on the RTM.

PCIe Switch Description

The VPG003 GraphiteVPX/CPU has a PEX8718 Gen 3 capable PCIe Switch that has 2 x4 ports connected to the backplane using 2x 4 lane DATAPLANE downstream ports. This switch can run at Gen 3 on the backplane links while the Host is operating at Gen 2 having a maximum speed of 5.0 Gbps Gen 2 PCIe. The advantage is that Gen 3 PCIe is a more robust standard and more stable then Gen 2 PCIe over the same backplane links.

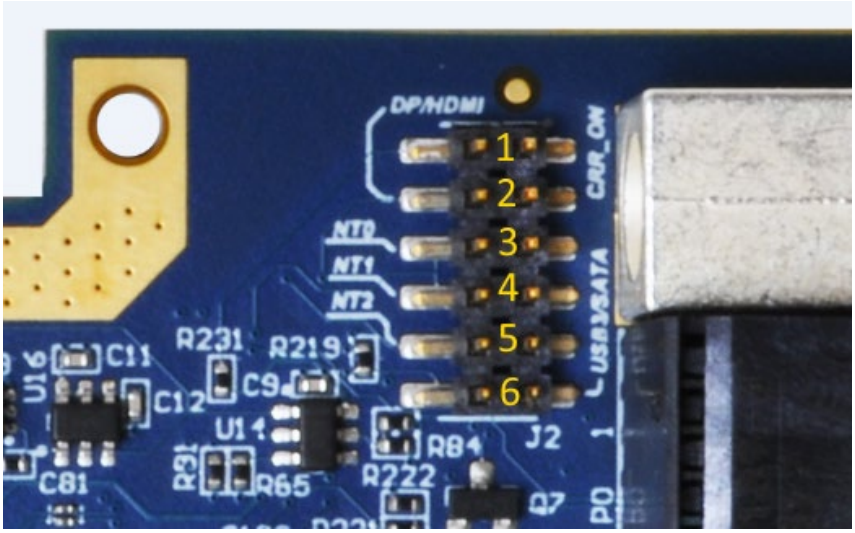
System LEDs

The VPG003 GraphiteVPX/CPU has 7 System LEDs on the front face:

LED	Description	LED Colour
PB_OK	Backplane Power OK	Blue
FAIL	System in Reset	Red
PCIe0	PCIe Link Status to TX2	Blue
PCIe1	PCIe Link Status Intel GbE	Blue
PCIe2	PCIe Link Status Backplane Port 2	Blue
PCIe3	PCIe Link Status Backplane Port 1	Blue
PERR	Fatal PCIe Error Detected	Red

Jumper Summary & Locations

J2 is a 2mm standard header that is used for PCIe Backplane Port configuration and selection of USB 3.0 or SATA.



Header Position #	Description	
1	This is a Factory Jumper used to force on power when no module is present. Do Not install.	CRR_ON
2	This is Unused. Not Installed, Display = HDMI	DP/HDMI
3	PCIe Non-Transparent Port setup: Installed – NT port is assigned to backplane PCIe port 2	NT0*
4	PCIe Non-Transparent Port setup: Installed – **Default mode** – NT port Disabled on all ports.	NT1*
5	PCIe Non-Transparent Port setup: Installed – NT port is assigned to backplane PCIe port 3.	NT2*
6	Second USB 3.0 port or SATA Sel jumper Installed = USB3.0, Removed = SATA	USB3/SATA

*Note: Only one NT jumper can be installed at any one time. One site needs to be installed at all times.

Backplane VPX Pinout Details

Designator	Description
P0	VPX Utility Connector (Power, I2C, etc)
P1	VPX PCIe, Two 4 Lane PCIe Data Plane + VPX CPU I/O
P2	VPX CPU I/O

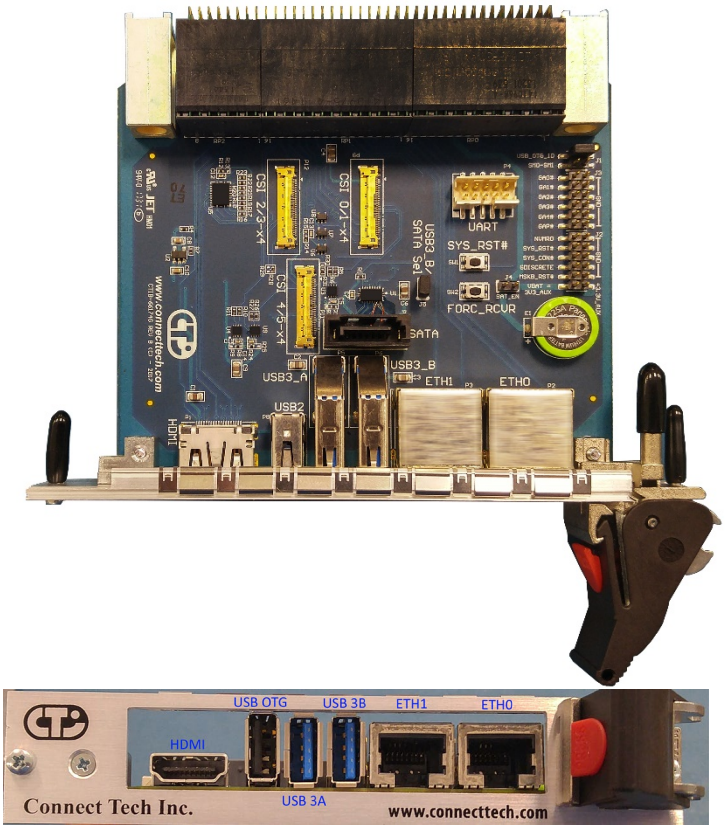
Full pinout details (CTIM-00482) are available only under an NDA (Non-Disclosure Agreement). Please contact sales at Connect Tech Inc. for further information.

1-800-426-8979

sales@connecttech.com
https://www.connecttech.com

DETAILED FEATURE DESCRIPTION RTG004

The RTG004 GraphiteVPX/CPU TX2/TX2i RTM (Rear Transition Module) is supplied to allow user access to all the interfaces available in a lab development environment.



Power Input

The RTG004 accepts a standard VPX VITA 46 power input on the rear of the backplane VS1 = Not Used, VS2 = 3.3V, VS3 = 5V (HDMI pwr) and 3V3_AUX.

Console

The RTG004 has console port access using P4, a 10 pin Minitek keyed connector. Cable CBG111 is used (drawing is available here CTIC-00430) to allow for remote or headless use of the System. The cable is supplied with each RTG004 (Note: only one serial connector is used, the other is not connected).

10/100/1000 Ethernet

Two Gigabit Ethernet RJ45 ports are available, one interface comes from the TX2 onboard (ETH0). The second is a PCIe based Intel 82574 Ethernet Controller (ETH1).

Display (HDMI only)

One HDMI video connector is available for display up to 4k.

MIPI CSI 2.0 Camera inputs

There are 3 independent CSI-2 x4 camera inputs available to the user using connectors P9, P11 and P12. These are I-PEX Micro coax connectors that are compatible with Leopard Imaging cameras LI-IMX185-MIPI-CS (1080p), and LI-IMX274-MIPI-CS (4k). The RTG004 is setup to allow 3 2-lane cameras (IMX185) or 3 4-lane cameras (IMX274). Up to 6 2-lane cameras can be supported with the VPG003, however, this RTM design allows for only 3. Contact Connect Tech Sales if any different RTG interfaces are required.

USB 3.0/2.0 and OTG

The RTG004 has two ports capable of USB 3.0 or 2.0 (USB 3A with TX2) and an extra USB 2.0 port used as either a host or client port selected through the USB ID pin state on J1 Header. Client mode is used to update the TX2/TX2i module's base software load. In host mode (with J5 jumper installed) the port acts as a standard host USB 2.0 port. The USB 3.0B port and the SATA port are mutually exclusive and are selected via the J5 header block (Jumper installed for SATA).

Note: The USB3.0 B and SATA port selection jumper on the VPG003 (J2F) must match the settings of the RTM.

Note: TX2 versions of the VPG003 only contain ONE USB 3.0 capable port.

SATA 2.0

One SATA Gen 2 port is available direct from the TX2/TX2i for additional storage capability. The SATA port and the USB 3B port are mutually exclusive and are selected via the J5 header block (installed for SATA mode) on the RTG004.

Note: The USB3.0 B and SATA port selection jumper on the VPG003 (J2F) must match the settings of the RTM.

General Purpose VPX Headers

The RTG004 contains access to some VPX specific backplane signals on the J1, J2 and J3 connectors. SM0-SM1 are the I2C management interface for the backplane. GAx, are all the geographical addressing pins. Other signals include SYS_RST#, SYS_CON#, and VBAT. An option to use the 3V3_AUX as opposed to the RTC battery is available by installing the VBAT to 3V3_AUX jumper on J2.

Push Buttons

The RTG004 contains two push buttons SW1 (SYS_RST#) and SW2 (FORCE_RECOVERY).

Force Recovery Mode

The USB OTG Port of the RTG004 can be used to reprogram the TX2 when put into force recovery mode. To enable force USB recovery mode on the VPG003 follow the steps below:

1) Power down the system completely. The system power MUST be OFF, not in suspend or sleep mode.

2) Connect the OTG USB port to an x86 host device with Nvidia Jetpack installed.

3) Hold the Recovery button Power on the system with the Recovery button still depressed. After three (3) seconds release the Recovery button.

4) The TX2/TX2i will be detected on the other host system via lsusb as a new NVIDIA Target device.

5) After successfully updating the system software, power off the system. A clean power up will revert the OTG port back into host mode.

RTC Backup Battery

The RTG004 contains a small CR1225 backup battery to feed the VBAT signal to the TX2/TX2i's RTC if so desired. Install J4 to allow the battery to be connected to the RTC. An option to use the 3V3_AUX as opposed to the RTC battery is available by installing the VBAT to 3V3_AUX jumper on J2.

CURRENT CONSUMPTION DETAILS

Below are the maximum ratings of the VPG003 GraphiteVPX/CPU with 12V (VS1) and 5V (VS3) combined totals.

Theoretical Maximum VPG003	Watts
Maximum	30W
Typical	20W

Theoretical Maximum RTG004	Watts
Maximum (with a USB3.0 device current of 2.5A)	12W
Typical	2W

Below are measurements taken with the VPG003 GraphiteVPX/CPU running in various configurations.

Actual Measurements	Watts
Booted into Ubuntu, idle	10W
Booted into Ubuntu, running a Feature Tracker Demo	20W
Booted into Ubuntu, running NVStreamer Demo with a USB camera and 1080p video. PCIe links on the backplane. 2 x4 lanes connected at Gen 3.	23W

SOFTWARE / BSP DETAILS

All Connect Tech NVIDIA Jetson TX2/TX2i based products are built upon a modified Linux for Tegra (L4T) Device Tree that is specific to each CTI product.

WARNING: The hardware configurations of CTI's products differ from that of the NVIDIA supplied evaluation kit. Please review the product documentation and install ONLY the appropriate CTI L4T BSPs. Failure to follow this process could result in non-functional hardware.

Connect Tech's Custom L4T BSP (CTI-L4T)

Connect Tech offers a custom BSP to add additional peripheral support on CTI's Jetson Carrier Boards. The CTI-L4T can be downloaded directly from Connect Tech here:

https://connecttech.com/jetson/nvidia-jetson-support/jetson-tx2-support/

BSPs, supporting documentation and release notes can be found at:
https://www.connecttech.com/jetson

https://connecttech.com/resource-center/l4t-board-support-packages/

NVIDIA Linux For Tegra (L4T)

The VPG003 GraphiteVPX/CPU is designed to be used with the stock **NVIDIA Linux For Tegra (L4T) Builds**. However, the Connect Tech Board Support Package is required for full functionality.

NVIDIA's L4T can be downloaded directly from NVIDIA here:
https://developer.nvidia.com/embedded/

NVIDIA Jetpack for L4T

The JetPack for L4T is an on-demand all-in-one package that bundles and installs all software tools required to develop for the NVIDIA's TX2/TX2i Platform with Connect Tech's Jetson Carrier Boards. JetPack includes host and target development tools, APIs and packages (OS images, tools, APIs, middleware, samples, documentation including compiling samples) to enable developers to jump start their development environment for developing with the Jetson Embedded Platform. The latest release of JetPack runs on an Ubuntu 14.04 Linux 64-bit host system and supports the latest Jetson TX2/TX2i Development Kit.

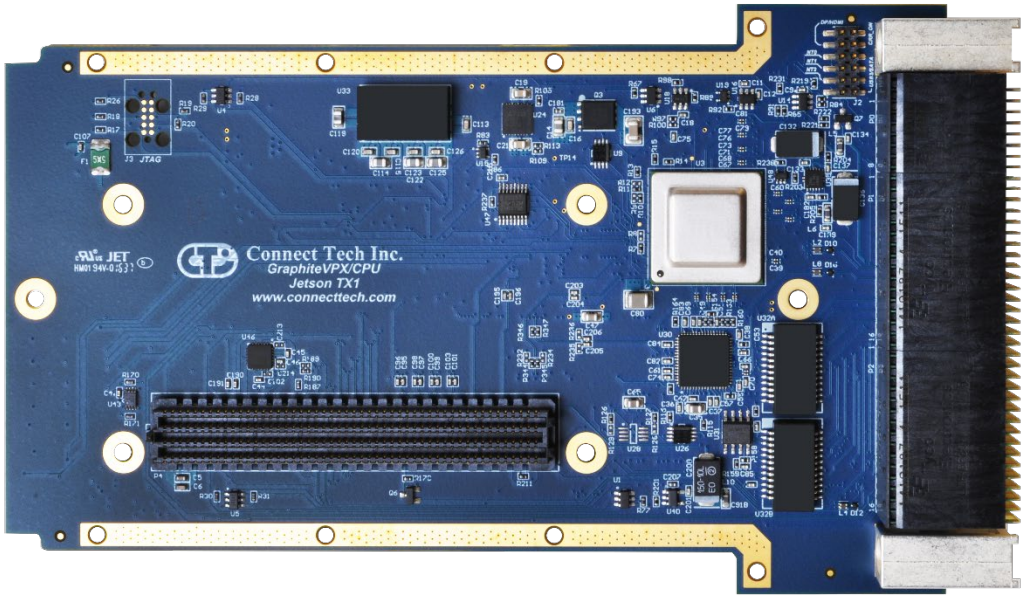
NVIDIA's Jetpack can be downloaded directly from NVIDIA here:

https://developer.nvidia.com/embedded/jetpack

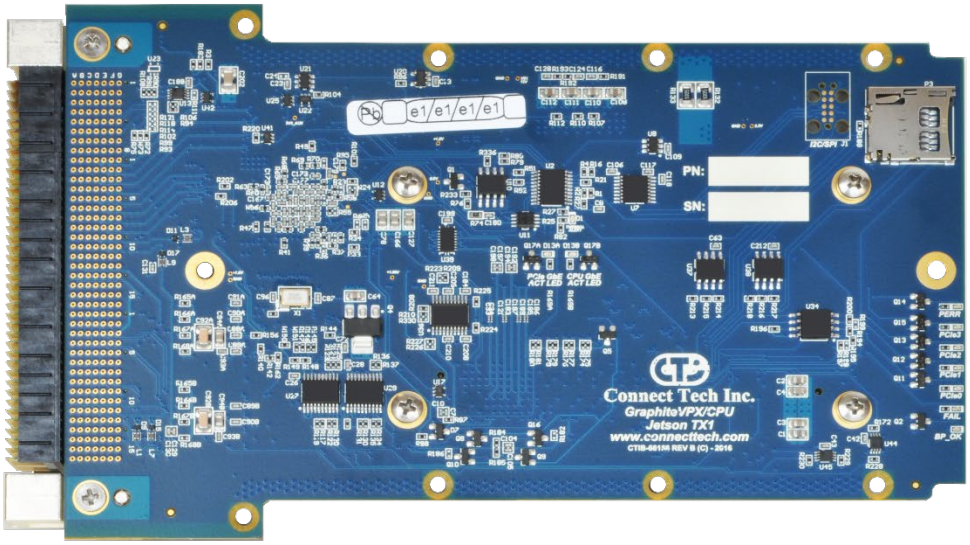
MECHANICAL DETAILS

A complete **3D STEP Model** file of VPG003 GraphiteVPX/CPU can be requested from sales@connecttech.com.

VPG003 GraphiteVPX/CPU – Top Side

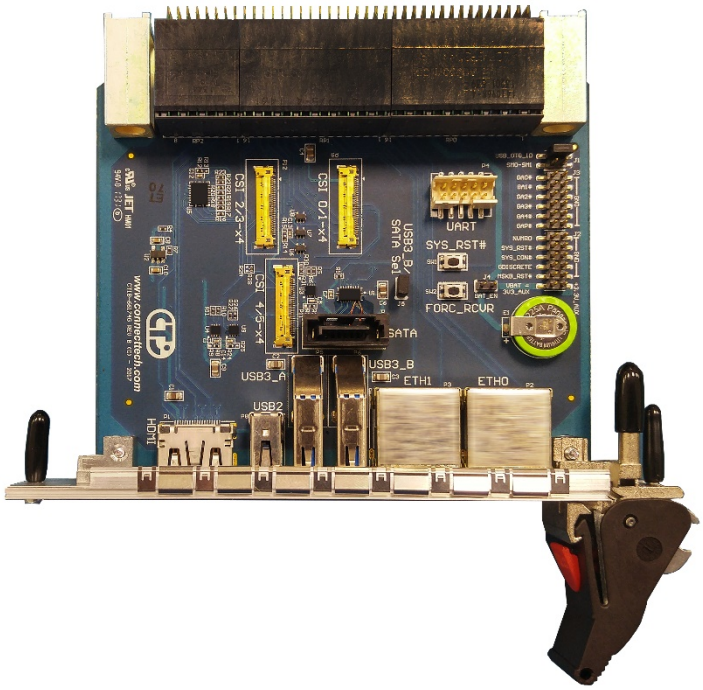


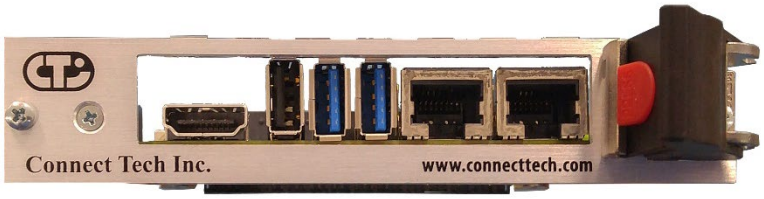
VPG003 GraphiteVPX/CPU – Bottom Side



RTG004 DETAILS

RTM for Development

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