CONNECT TECH TX2 Rudi Embedded System with NVIDIA User Guide

Connect Tech

Rudi Embedded System with NVIDIA Jetson TX2, TX2i or TX1

Contents

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: http://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 42 Arrow Road Guelph, Ontario Canada N1K 1S6
Email/Internet	sales@connecttech.com support@connecttech.com www.connecttech.com

Limited Product Warranty

Connect Tech Inc. provides a one-year Warranty for the Rudi Embedded System. 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.

Copyright Notice

Trademark Acknowledgment

REVISION HISTORY

Revision	Date	Changes
0.00	2016/12/22	Initial Release
0.01	2017/02/24	Added disassembly instructions, mounting bracket details, updated part numbers
0.02	2017/08/04	Added cable drawing links, removed drawings from doc
0.03	2017/08/28	Updated 3D model link
0.04	2017/10/19	Updated the power adapter reference P/N for ESG505/506's Added TX 2 relevant info
0.05	2017/12/12	Updated TX2 specs
0.06	2018/01/19	Updated photos
0.07	2018/02/06	Updated product name & URL
0.08	2019/04/08	Updated to TX2i, Updated HDMI and PNs

INTRODUCTION

Connect Tech's Rudi is a small form factor embedded system based on the NVIDIA® Jetson™ TX2/TX2i/TX1. Housed in a compact enclosure with optional mounting brackets. Rudi features revolutionary the NVIDIA Maxwell™ or Pascal™ based architecture with 256 CUDA cores delivering over 1 TeraFLOP of performance with a 64-bit Quad or Hex core ARM A57 CPU.

Product Features and Specifications

Specifications	
Processor	NVIDIA Jetson TX2/TX2i
Memory	TX2: 8GB LPDDR4
Storage	TX2: 32GB eMMC
Display	1x HDMI Type A Link (Supports up to HDMI 2.0 UHD 4K [2160p] at 60Hz)
Ethernet	2x Gigabit Ethernet (10/100/1000) Links
USB	3x USB 2.0, 2x USB 3.0 Links
WiFi	IEEE 802.11 ac
Bluetooth	Bluetooth 4.0 (24 Mbps)
Serial	2x RS-232 (Default: 1 console, 1 general purpose)
CAN Bus	1x CAN Bus 2.0b
Power Operation	Auto Power On in Event of Power Failure External Power On/Off Control Button
Power Requirement	+12V DC Input Nominal
Operating Temperature	-20^{o}C to +80^{o}C with Minimum Airflow of 25 CFM for Standalone Operation
Dimensions	Without Mounting Bracket: 135mm x 50mm x 105mm (5.31″ x 1.97″ x 4.13″)
Weight	0.703kg / 1.55lb (base enclosure only)
Accessories (included)	12V Power Supply Brick (90~264 Vac), Power supply adapter (ESG505/506 only), and a CAN Bus Terminal Connector
Accessories (optional)	Dual-Band Antenna, Edge Mounting Brackets, I/O breakout cable.
Warranty and Support	1 Year Warranty and Free Support

Part Numbers / Ordering Information

Part Number		
Ordering Part Numbers Rudi Enclosure with TX 2 and DC Barrel Power Connector	**Manual Power On/Off Switch**	**Auto-Power On Mode**

	ESG503-21 – North America ESG503-22 – EU	ESG504-21 – North America ESG504-22 – EU
	ESG503-23 – Israel ESG503-24 – Korea ESG503-25 – China *the ‘x’ in the part number denotes module type: 0 = TX1 2 = TX2	ESG504-23 – Israel ESG504-24 – Korea ESG504-25 – China *the ‘x’ in the part number denotes module type: 0 = TX1 2 = TX2
Ordering Part Numbers Rudi Enclosure with TX 2 and 2 Pin Locking Terminal Power Connector 	**Manual Power On/Off Switch**	**Auto-Power On Mode**
	ESG505-21 – North America ESG505-22 – EU	ESG506-21 – North America ESG506-22 – EU
	ESG505-23 – Israel ESG505-24 – Korea	ESG506-23 – Israel ESG506-24 – Korea
	ESG505-25 – China *the ‘x’ in the part number denotes module type: 0 = TX1 2 = TX2	ESG506-25 – China *the ‘x’ in the part number denotes module type: 0 = TX1 2 = TX2
Ordering Part Numbers for Accessories	MSG067	Mounting Bracket (x2)
	MSG066	Dual-Band SMA Antenna
	CBG258	MISC I/O Cable: 2×6 Pin (0.100” pitch) to Flying lead (12” length)

PRODUCT OVERVIEW

Connector Locations (Front)

Connector Locations (Rear)

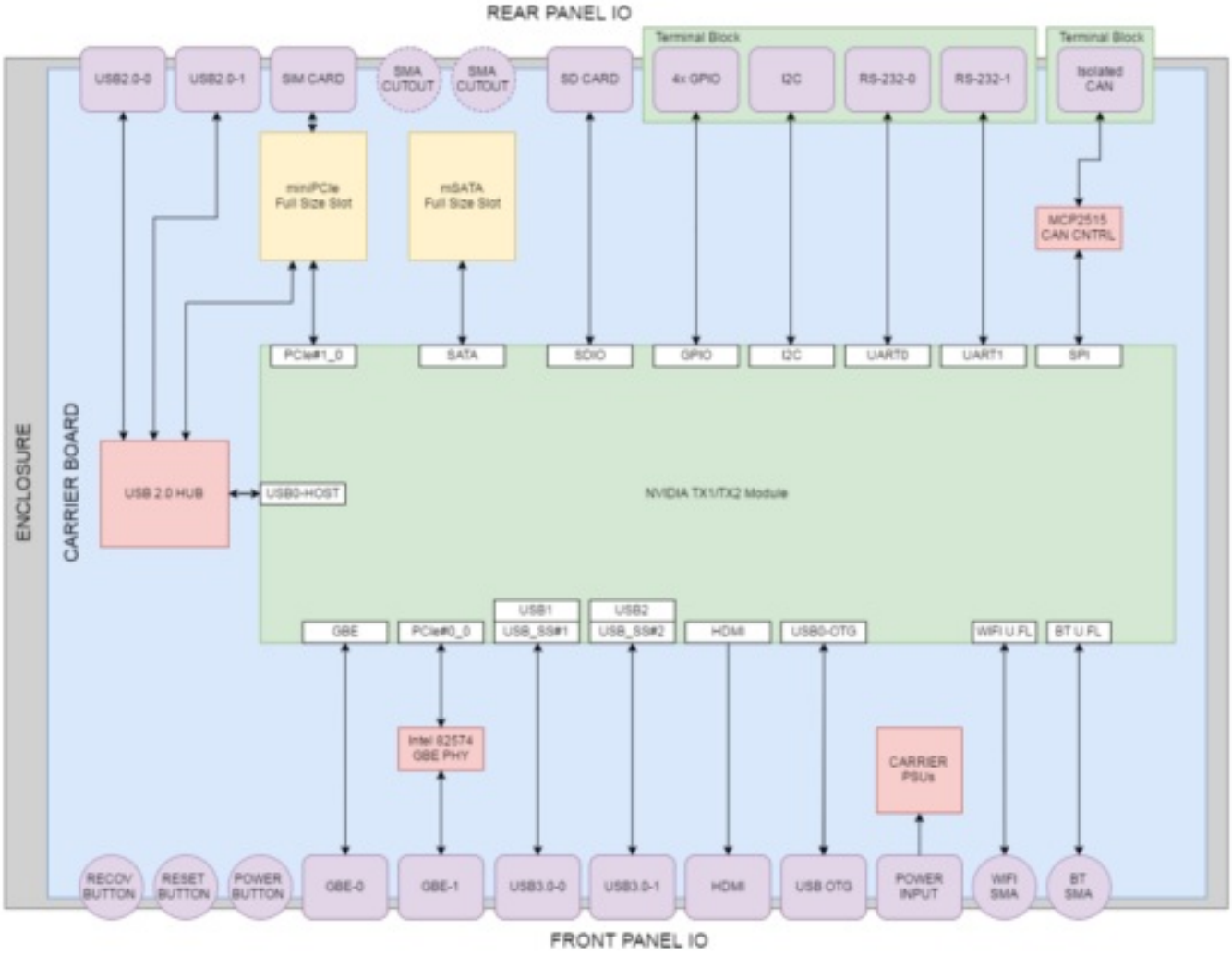
Connector Summary

Designator	Connector	Description
12V PWR	Power Input	Power Input Connector – 2.1mm Barrel. Or Two Pin Terminal Connector 3.5mm Pitch
OTG USB	USB micro	USB 2.0 micro Type A/B Connector
USB 3.0 A	USB 3.0 Port A	USB 3.0 SuperSpeed Type A Connector
USB 3.0 B	USB 3.0 Port B	USB 3.0 SuperSpeed Type A Connector
USB 2.0 A	USB 2.0 Port A	USB 2.0 Port 1 Type A Connector
USB 2.0 B	USB 2.0 Port B	USB 2.0 Port 2 Type A Connector
HDMI	HDMI	HDMI Type A Connector
GbE 1	Gigabit Ethernet Port 1	Gigabit Ethernet (10/100/1000) Port 1 RJ-45 (TX2/TX2i)
GbE 2	Gigabit Ethernet Port 2	Gigabit Ethernet (10/100/1000) Port 2 RJ-45 (Intel)
ANT 1	Antenna 1	NVIDIA Jetson TX2/TX2i J8 U.FL (WiFi)
ANT 2	Antenna 2	NVIDIA Jetson TX2/TX2i J9 U.FL (Bluetooth)
SD Card	SD Card	Full Size SD card Push/Push Connector
Sim Card	Sim Card	Standard Size SIM Card Push/Push Connector (used with onboard miniPCIe site only).
CAN Bus	3 Pin Terminal Block	3 Pin Terminal Block 3.5mm pitch
I/O	12 Pin Header Block	12 Pin 0.100” 6×2 Header Block (I2C, GPIO and UARTs)

Switch Summary

Designator	Function	Description
Power Button	Power ON/OFF	Rudi System Power ON/OFF Button
Reset	Hardware Reset	Rudi System Reset push button
Recovery	Force Recovery	Used for TX2/TX2i system programming (used in conjunction with the dual purpose USB OTG port).

Block Diagram



DETAILED FEATURE DESCRIPTION

The Rudi Embedded System is an NVIDIA Jetson TX2/TX2i-based embedded system. The Rudi comes with an NVIDIA Jetson TX2/TX2i preloaded with the latest Linux for Tegra (Ubuntu) with the Connect Tech Board Support Package installed.

Power Input

The Rudi Embedded System accepts a single power input to power the entire system. An input range of +12.0V +/- 10% DC is required. In addition, both reverse polarity protection, and surge protection has been designed into the Rudi Embedded System.

Function	**Power**		
Location	Rear panel 12V PWR		
Type	DC Barrel Connector 2.0mm center pin 2.5 A Max rated		
Pinout	Pin	Description	
	Inner	Power	
	Outer	GND	
	Power Input Range: +12V +/-10%		
Features	The power input has reverse polarity and su rge protection built-in.		

Power Input (Alternate 2 pin Terminal ESG505/506)

The Rudi Embedded System accepts a single power input to power the entire system. An input range of +12.0V +/- 10% DC is required. In addition, both reverse polarity protection, and surge protection has been designed into the Rudi Embedded System.

Function	**Power**		
Location	Rear panel 12V PWR		
Type	Two (2) Pin Terminal Connector 3.5mm pitc h with screw locking.		
Mating	1847055		
Pinout	Pin	Description	
	Left	GND	
	Right	POWER	
	Power Input Range: +12V +/-10%		
Features	The power input has reverse polarity and su rges protection built-in.		

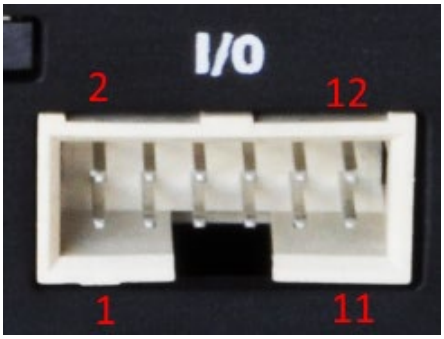
USB OTG

Function	USB 2.0 port (Host or Target device capable)	
Location	Front panel OTG	
Type	Micro USB Type A/B	
Features	Multi-function port. Used as a 3rd USB 2.0 Host port, or during Force Recovery mode it becomes a Target device port that can attach to another host to interface directly to the TX2/TX2i for flash reprogramming operations.	

I/O Connector

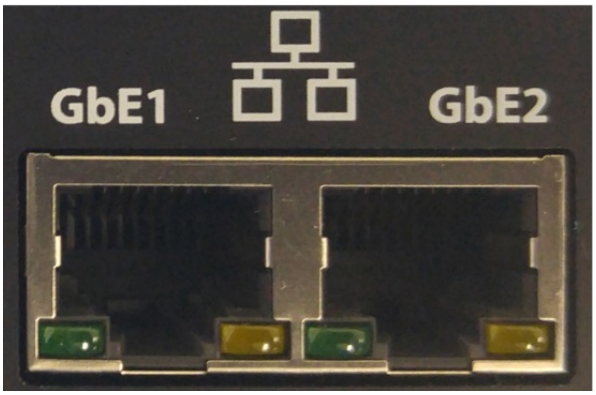
The Rudi Embedded System has a console port to allow for remote or headless use of the System. With an RS-232 Link, the RS232 Console port allows for additional debugging of the Rudi Embedded System.

Function	Misc I/O Features (I2C, GPIO, UARTs)		
Location	Rear panel I/O connector		
Type	2×6 0.100” pitch Header Block		
Pinout	Pin	Signal	Description
	1	I2C_CLK	3.3V General Purpose I2C Bus Clock. (Attached to TX1 I2C-0)
	2	I2C_DATA	3.3V General Purpose I2C Bus Data. (Attached to TX1 I2C-0)
	3	GND	Digital GND
	4	GND	Digital GND
	5	GPIO1	3.3V General Purpose I/O
	6	GPIO2	3.3V General Purpose I/O
	7	GPIO3	3.3V General Purpose I/O
	8	GPIO4	3.3V General Purpose I/O
	9	UART1_RX	General Purpose UART RS-232 Receive.
	10	UART1_TX	General Purpose UART RS-232 Transmit.
	11	UART0_RX	Console UART RS-232 Receive.
	12	UART0_TX	Console UART RS-232 Transmit.
Features	This port includes a variety of add-on features for General purpose use. One I2C bus, Four GPIOs, and two UARTs.		



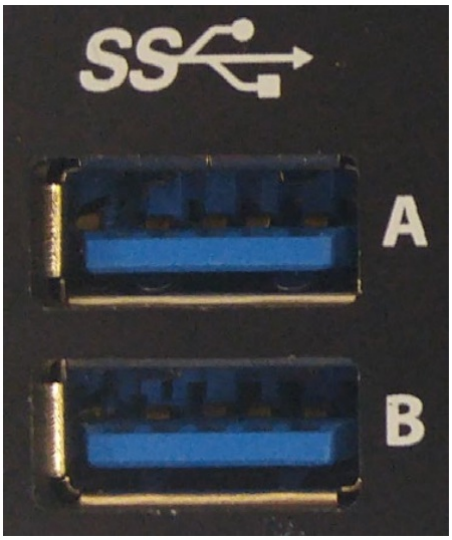
10/100/1000 Ethernet (GBE)

Function	Gigabit Ethernet Connector
Location	Front panel GbE1 and GbE2
Type	Standard RJ45 receptacle
Pinout	Standard GbE pinout
Features	GbE 1 – TX2/TX2i direct controller port capable of 10/100/1000 Base-T Gigabit EthernetGbE 2 – PCIe Intel-based controller port capable of 10/100/1000 Base-T Gigabit Ethernet.



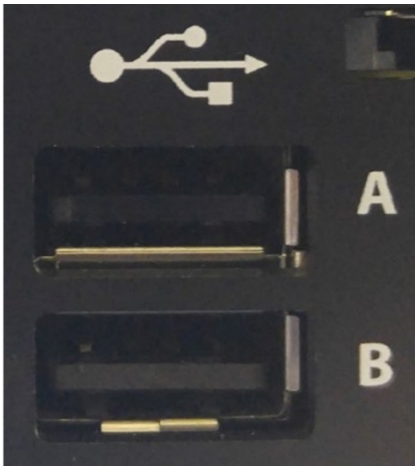
USB 3.0

Function	USB 3.0
Location	Front panel SS-A, SS-B
Type	Industry Standard USB 3.0 Type A Connector
Pinout	Standard USB 3.0 pinout
Features	SuperSpeed USB 3.0 interfaces capable of either USB 3.0 or USB 2.0 interfaces.

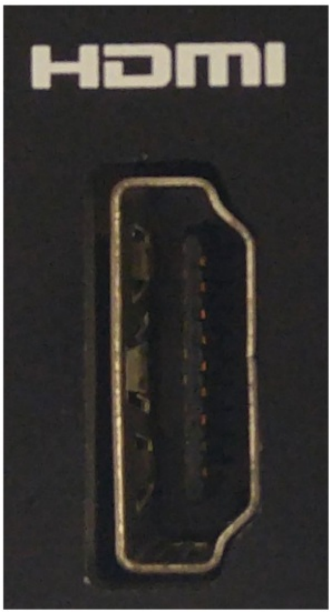


USB 2.0

Function	USB 2.0
Location	Rear panel USB-A, USB-B
Type	Industry Standard USB 2.0 Type-A Connector
Pinout	Standard USB 2.0 pinout
Features	Full Speed USB 2.0 interfaces. Note these ports are disabled during Force Recovery Mode.



HDMI

Function	HDMI v1.4b Display Interface	
Location	Front panel HDMI	
Type	Standard HDMI Type A receptacle.	
Pinout	Standard HDMI 1.4b pinout	
Features	HDMI Display output, capable of resolution up t o 3840×2160.	

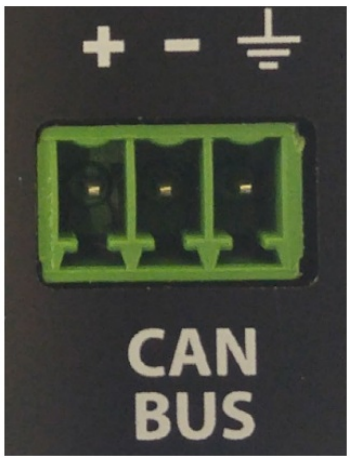
Antenna 1
The Rudi Embedded System enables access to the NVIDIA Jetson WiFi and Bluetooth modems. The external SMA Antenna 1 Connector is attached internally to the J8 U.FL on the Jetson TX2/TX2i.

Function	Antenna 1	
Location	Front panel ANT1	
Type	Micro High-Frequency SMA Connector (Female s ocket)	
Features	Dual-Band capable WiFi Antenna port 2.4/5.8GH z	

Antenna 2
The Rudi Embedded System enables access to the NVIDIA Jetson WiFi and Bluetooth modems. The external SMA Antenna 2 Connector is attached internally to the J9 U.FL on the Jetson TX2/TX2i/TX1

Function	Antenna 2	
	Front panel ANT2	
Type	Micro High Frequency SMA Connector (Female s ocket)	
Features	Bluetooth Antenna port – 2.45GHz	

CAN Bus

Function	CAN Bus	
Location	Rear panel CAN BUS	
Type	Three pin 3.5mm Terminal connector	
Pinout	`+' = CAN _H `-` = CAN _L GND = Isolated CAN Bus GND signal.	
Features	CAN Bus 2.0b capable interface with an internally isolated GND reference. Mating connector P/N options: Phoenix Contact – # 1840379 On Shore Technology Inc. – # OSTTJ0311530	

SD Card

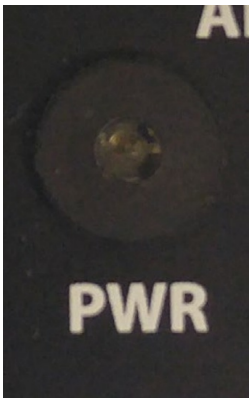
Function	**Full-Size SD Card**	
Location	Rear panel SD CARD	
Type	Full-size Push/Push SD Card connector	
Features	Standard Full-size Secure Digital Card interface for use with SDHC and Standard SD Cards.	

SIM Card

Function	**Full-Size SIM Card**	
Location	Rear panel SIM	
Type	Full-size Push/Push SIM card connector	
Features	Full-size SIM card interface that is used exclusively with the mPCIe port when used in conjunction with a mPCIe Cell modem expansion card.	

SWITCH DESCRIPTION

The Rudi Embedded System has a single Power Button on the Front Faceplate.
Power Button

Function	Power Button	
Notes	A nearly flush switch with an easy toggle press to turn the system on. Blue light in the center will indicate the system is fully powered. The System will turn off if the PWR button is held for s everal seconds.	

Reset Button

Function	Reset Button	
Notes	System Reset button. The button is slightly recessed so it is protected from accidental contact. The papercli p-sized hole provides access.	

Recovery Button

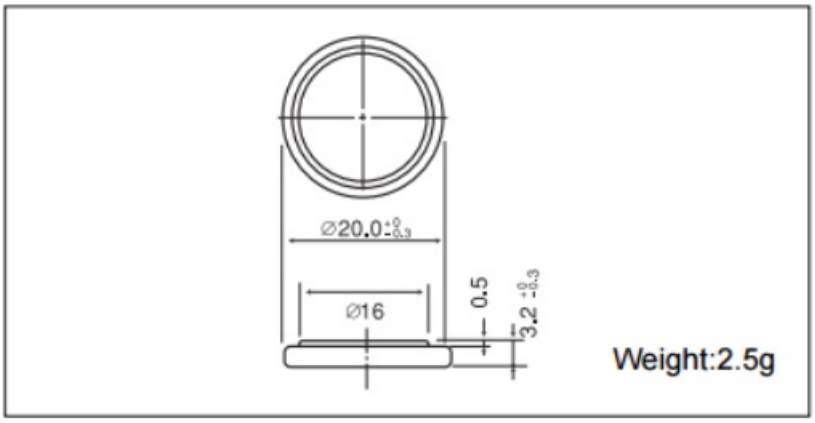
Function	Recovery Button	
Notes	Used in conjunction with the USB OTG port for reprogr amming the TX2/TX2i onboard the eMMC drive. By holding this button and powering on the system (or toggling reset), the TX2/TX2i will enter recovery mode for reprogramming. It also turns the USB OTG port int o a target device port instead of a host port to enable another system to discover it over USB.	

Force Recovery Mode

USB OTG port of the Rudi can be used to reprogram the TX2/TX2i when put into force recovery mode.
To enable force USB recovery mode using the Rudi Embedded System 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 another host device that will be supplying the new system file.
3. Using a paper clip or similar depress the Recovery button
4. Power on the system with the Recovery button still depressed. After three (3) seconds release the Recovery button.
5. The TX2/TX2i/TX1 will show up on the host system as a new NVIDIA Target device.
6. After successfully updating the system software, power off the system. A clean power up will revert the OTG port back into host mode.

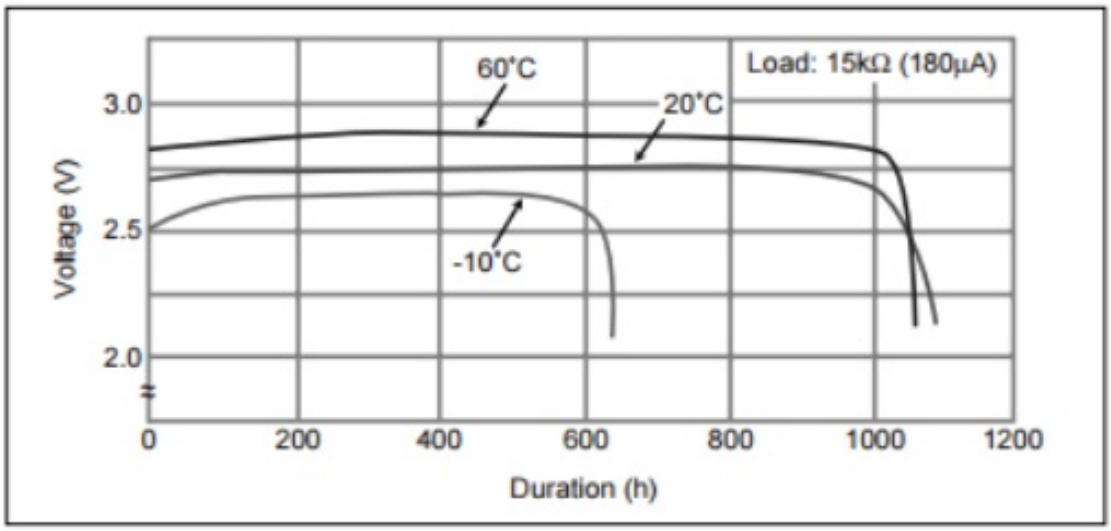
RTC Battery
Included in the Rudi Embedded System is a BR2032 coin battery to provide RTC backup power for the TX2/TX2i. Information about battery life can be found in CTI App Note CTIN-00009 **https://www.connecttech.com/pdf/CTIN-00009.pdf**.
The battery is a poly-carbon-monofluoride Lithium coin cell, some details can be found below.
Dimensions (mm)



Specification

Nom [nal voltage (V)	
Nominal capacity (mAh)	**190**
Continuous standard load (mA)	0_03
Operating temperature (C)	-30 – +80

Temperature Characteristics



EXPANSION OPTIONS

The Rudi Embedded System has two internal expansion ports. One full-size mini PCIe Expansion Slot and one full-size mSATA slot.
miniPCIe Expansion Card

Function	Full-size Mini PCIe expansion slot
Location	Internal
Features	The internal mPCIe supports either a PCIe or USB2.0 based expansion card that allows adding features to the Rudi to include options like:· 3G-SDI Video Capture · Analog Video Capture (NTSC/PAL) · GbE Expansion · Multi-port Serial · Cell Modem

mSATA Expansion Card

Function	Full size mSATA expansion slot
Location	Internal
Features	The internal mSATA slot supports additional storage of up to 1TB.

Contact **sales@connecttech.com** for details on expansion port options.

RUDI OPERATION

1. Ensure external power supply is turned OFF and unplugged from the AC power source.
2. Connect power cable from the +12V brick supply to the Rudi Embedded System. Ensure that the power supply being used is in the acceptable range of +12V +/-10%.
3. Connect any additional system cables such as USB, Ethernet, HDMI etc.
4. Switch ON the Power Supply. DO NOT power up your system by plugging in live power. The system protects from some surges, but it is good practice to plug the barrel connector in to Rudi, before plugging the brick into an AC source.
   a. Toggle the front PWR button on the the Rudi Embedded System for startup if an ESG503. Please allow 15 to 30 seconds to power up into the Linux for Tegra (L4T) Ubuntu Operating System.
   b. If Auto-Power On Mode is enabled, the Rudi will power on as soon as power is applied.

SYSTEM LEDS

The Rudi Embedded System has 5 System LEDs on the front, in 3 different colors.

LED	Description	LED Colour
PWR	System Power	Blue
ACT1	Gigabit Ethernet ACT 1	Orange
LINK1	Gigabit Ethernet LINK 1	Green
ACT2	Gigabit Ethernet ACT 2	Orange
LINK2	Gigabit Ethernet LINK 2	Green

The LEDs can be found on the front panel of the Rudi Embedded System.

CURRENT CONSUMPTION DETAILS
Below are the maximum ratings of the Rudi Embedded System.

Theoretical Maximum	**Amps**	**Watts**
The theoretical absolute maximum total draw of all functionality on the Rudi E mbedded System	1.7A	21W

Please refer to the NVIDIA Jetson TX2/TX2i manual for full details on the current consumption and operational details.

Actual Measurements	**Amps**	**Watts**
System Idle	0.400A	4.8W
HDMI video output, USB keyboard/mouse, 2x GBE running, system sitting in Ubuntu Desktop (GUI)	0.600A	7.2W

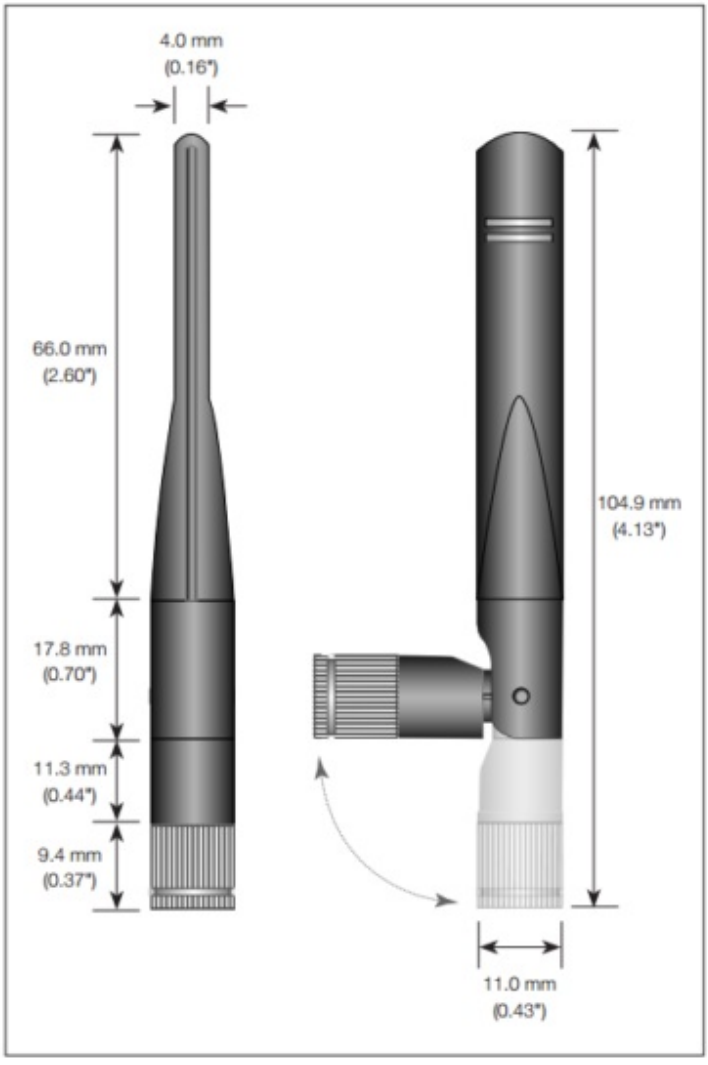
ACCESSORIES

Power Brick
Included with the Rudi Embedded System is a +12Vdc 65W power brick capable of accepting 90-264Vac (47-63Hz) power input.

If using the 2-terminal locking power connector (ESG505/506), CBG277 will be provided for adapting the above power supply to the Rudi power input. View the CBG277 drawing.

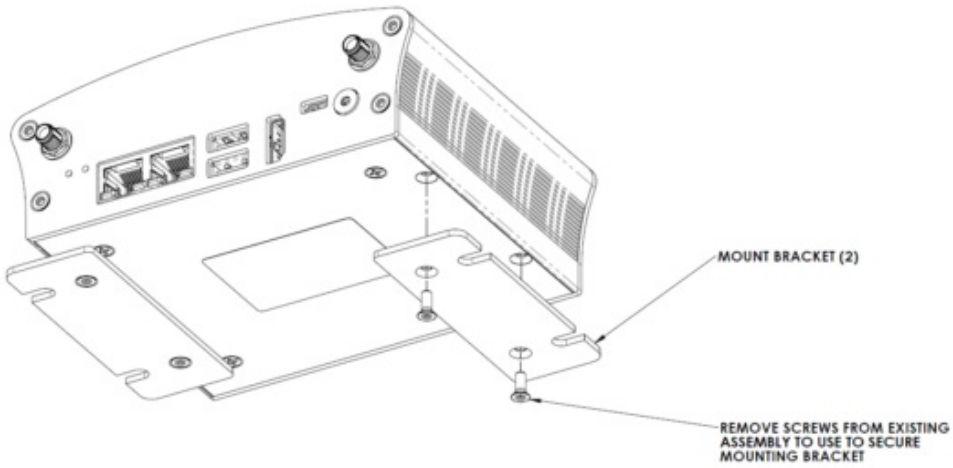
CAN Bus Terminal Connector'
Another included accessory is a 3 pin CAN Bus terminal connector for ease-of-use wiring using screw clamp terminals.

Dual-Band Antenna
An optional accessory is a standard dual-band antenna for use with WiFi and Bluetooth modems. The antenna comes with an SMA Male connector and a tilt feature.
CTI P/N: MSG066

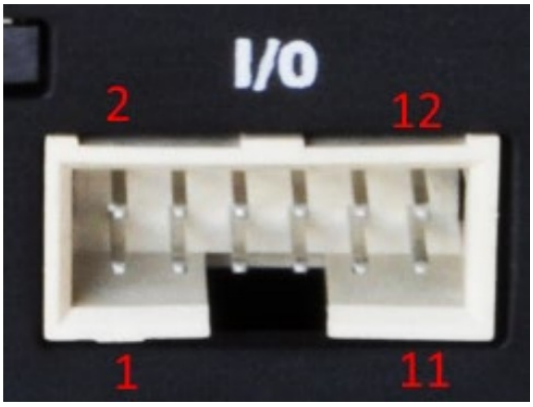


Mounting Brackets
An optional accessory is (2) two flush mount brackets to fasten Rudi to another surface.

CTI P/N: MSG067



MISC I/O Breakout Cable
An optional accessory for the MISC I/O connector is available to help break out the connections to flying leads. The cable is a standard 2×6 position 0.100" pitch socket header with 12" of flying lead to configure as required. CTI P/N: CBG258. View the drawing.



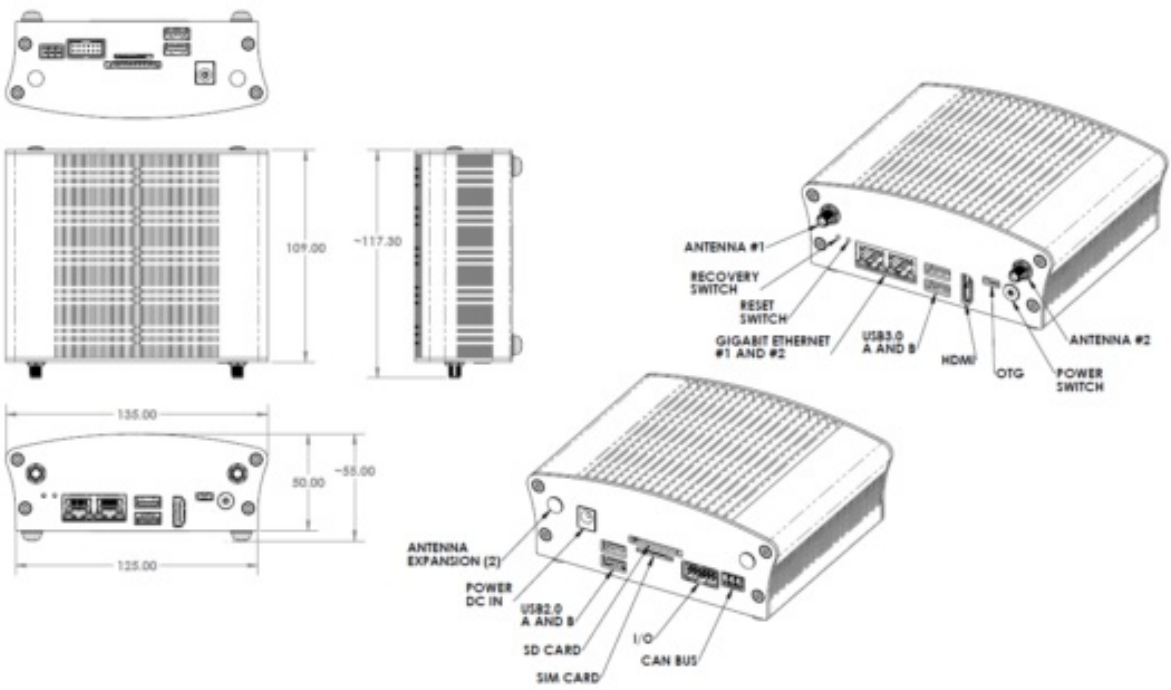
SOFTWARE / BSP DETAILS

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/product/rudi-embedded-system-with-nvidia-jetson-tx2-tx1/
BSPs, supporting documentation and release notes can be found at:
https://www.connecttech.com/jetson
https://connecttech.com/resource-center/cti-l4t-nvidia-jetson-board-support-package-release-notes/
NVIDIA Linux For Tegra (L4T)
The Rudi Embedded System 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, and 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 both the latest Jetson
TX2/TX2i Development Kit and Jetson TK1 Development Kit.
NVIDIA's Jetpack can be downloaded directly from NVIDIA
here: **https://developer.nvidia.com/embedded/jetpack**

MECHANICAL DETAILS

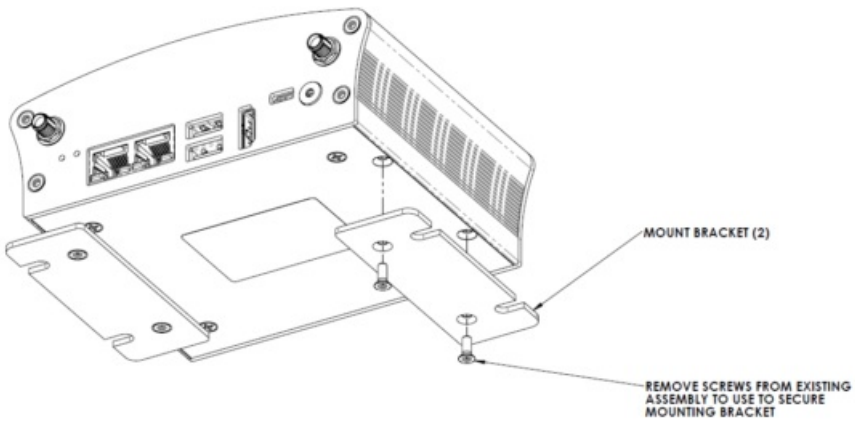
A complete 3D STEP Model file of Rudi Embedded System can be downloaded here: **https://www.connecttech.com/ftp/3d_models/ESG503_3D_MODEL.zip**

Rudi Embedded System

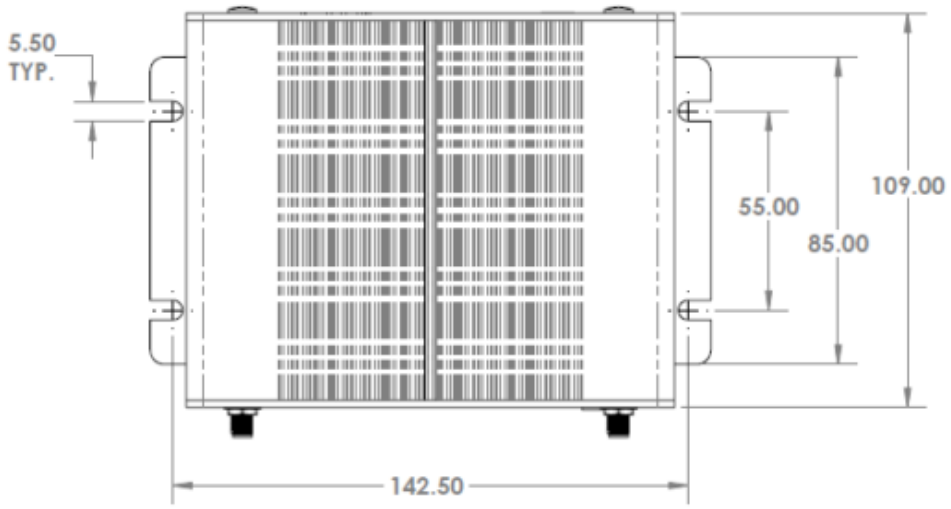


Mechanical Mounting Package

The Rudi Embedded System has an optional mounting edge bracket to allow for wall or rack-mount use.



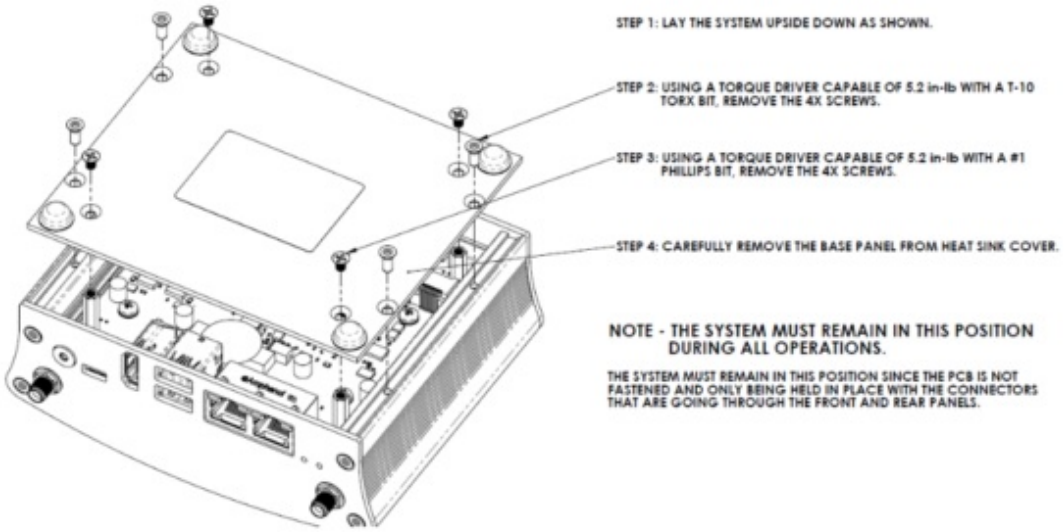
Please contact sales for additional information: **sales@connecttech.com**

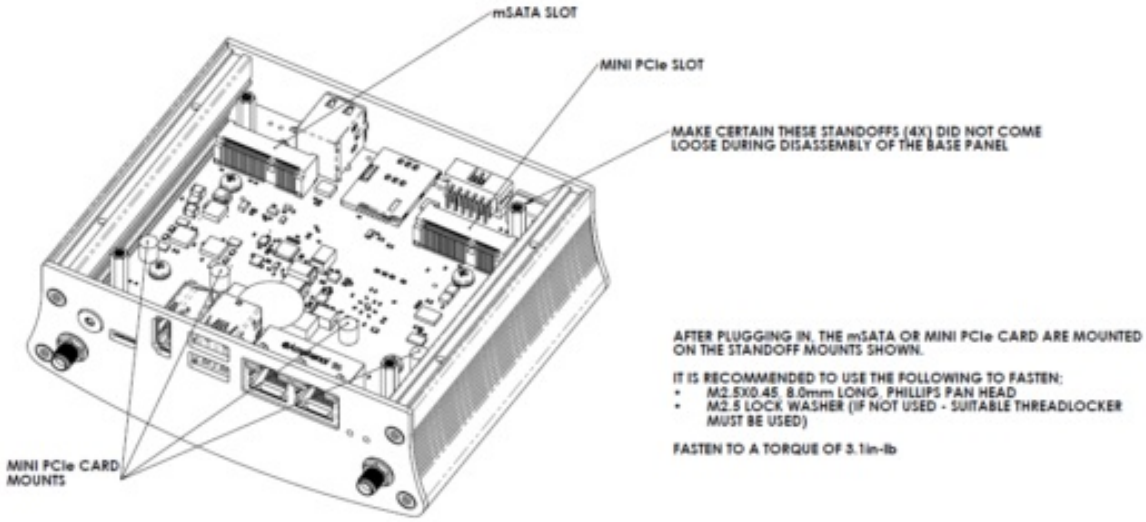


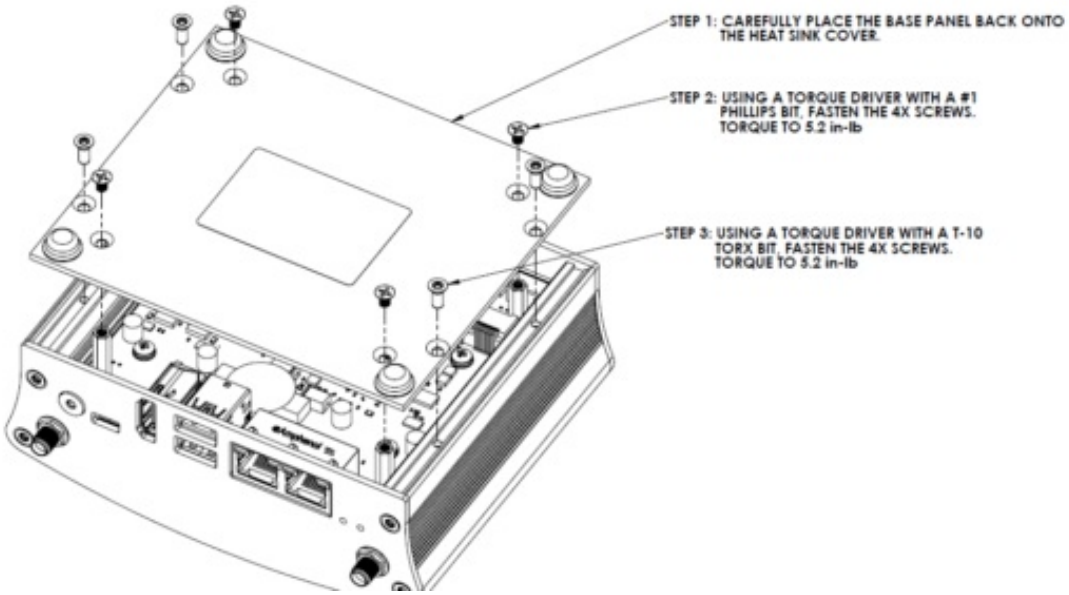
Bottom Disassembly Instructions (ESD CAUTION!)
The Rudi Embedded System has two expansion slots. One is an mSATA slot for storage expansion, the other is a mini PCIe slot for feature expansion. These slots can be accessed by removing the bottom cover by precisely following the instructions shown below.

INSTRUCTIONS FOR DISASSEMBLY

THE FOLLOWING PAGES SHOW THE DISASSEMBLY OF THE BASE PANEL TO GAIN ACCESS INTO THE SYSTEM TO ALLOW FOR PLUG-INS INTO MINI PCIe SLOTS.
ALL OPERATIONS MUST BE COMPLETED IN A ESD-CONTROLLED ENVIRONMENT. WRIST OR HEEL ESD STRAPS MUST BE WORN DURING ANY OPERATION OUTLINED.
ALL FASTENERS TO BE REMOVED AND RE-ASSEMBLED USING PROPER TORQUE DRIVERS







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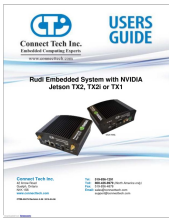
Documents / Resources

	**CONNECT TECH TX2 Rudi Embedded System with NVIDIA** [pdf] User Guide TX2 Rudi Embedded System with NVIDIA, TX2, Rudi Embedded System with NVIDIA, Embedded System with NVIDIA, System with NVIDIA

References

- Rudi Embedded System with NVIDIA® Jetson™ TX2 - Connect Tech Inc.
- Resource Center - Connect Tech Inc.
- Connect Tech Inc., Embedded Computing Experts
- NVIDIA® Jetson Solutions - Connect Tech Inc.
- JetPack SDK | NVIDIA Developer
- User Manual