# TK1-SOM and Supporting Power Supply Unit (PSU)

## Reference Guide—Page 1

System-on-Module
NVIDIA Tegra K1

### Software Instructions

The TK1-SOM comes pre-flashed with the basic Linux for Tegra (L4T) software R21.3 including the graphical desktop. If the user needs to make changes to the L4T source code, patches for the entire L4T tree are available by request. Instructions for setting up the software environment and flashing the TK1-SOM board are also available for download. As new L4T distributions are released from NVIDIA, CEI will provide updated software patches as well. These L4T software patches include the necessary changes to enable TK1-SOM board support in U-boot and the Linux Kernel as well as specific flashing parameters. Packages such as CUDA and OpenCV4Tegra will need to be installed by the user. These packages can be found on the NVIDIA website: **https://developer.nvidia.com/linux-tegra-r213**.

The TK1-SOM is released in the default L4T configuration. When you first turn on the module, it is configured in power saving mode. For maximum performance, the user can change the CPU and the GPU clocks speeds to 2 GHz, and 852 MHz, respectively. Instructions to perform these changes can be found at:
**http://elinux.org/Jetson/Performance**

U-boot and Linux kernel boot messages can be seen over the UART port. Use an RS232 serial cable (not included in the development kit) to connect the RS232 port on TK1-SOM to the Linux host PC to access the debug console. Note: The UART cable must be connected in a null-modem configuration (TK1 TX -> UART RX and TK1 RX -> UART TX). Set up the terminal on the host PC as follows. In terminal enter: sudo gtkterm -s 115200 -p /dev/ttyUSB0.

| Color | Name | Type | Description |
|---|---|---|---|
| Black | GND | GND | Device ground supply pin. |
| Brown | CTS# | Input | Clear to Send Control input / Handshake signal. |
| Red | VCC | Output or input | Power Supply Output except for the TTL-232RG-VIP-WE where this is an input and power is supplied by the application interface logic. |
| Orange | TXD | Output | Transmit Asynchronous Data output |
| Yellow | RXD | Input | Receive Asynchronous Data input. |
| Green | RTS# | Output | Request To Send Control Output / Handshake signal. |

**To log into the TK1-SOM:** Username: Ubuntu
Password: Ubuntu

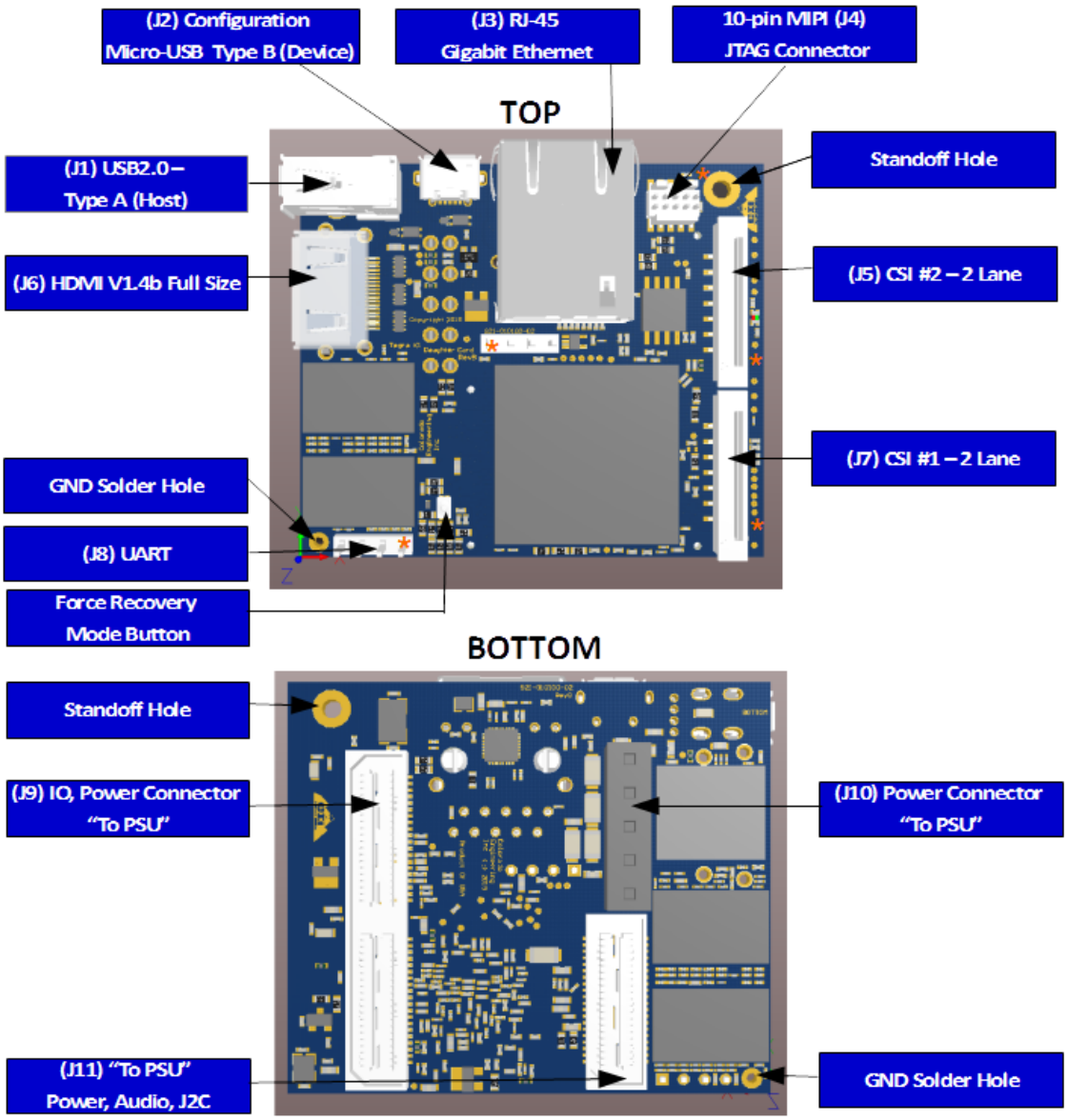
**Questions?**
**sales@coloradoengineering.com**

# TK1-SOM and Supporting Power Supply Unit (PSU)

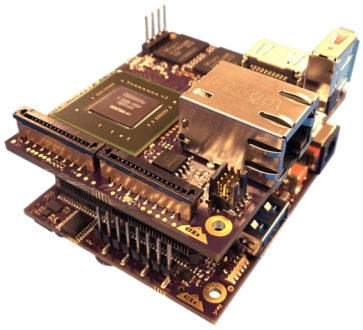
## Reference Guide—Page 2

System-on-Module
NVIDIA Tegra K1

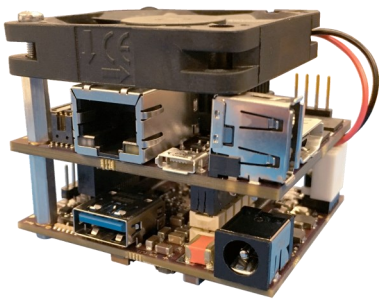
### GPU Board



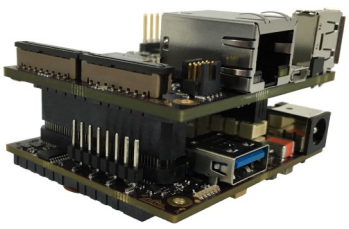

TK1-SOM Top



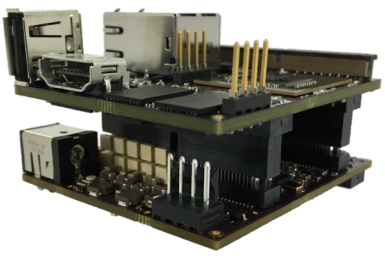
TK1-SOM Front



TK1-SOM Left Side



TK1-SOM Right Side



## Pinouts of (UART) J8, J2000, (JTAG) J4, CSI2 (J5), (CSI1) J7 Connectors on GPU

### J8 - UART

| Pin | Function |
|---|---|
| 1 | RX |
| 2 | TX |
| 3 | CTS-L |
| 4 | RTS-L |

### J2000 (Not Installed)

| Pin | Function |
|---|---|
| 1 | RX |
| 2 | TX |
| 3 | CTS-L |
| 4 | RTS-L |

### J4 – JTAG (1.8V)

| Pin | Function |
|---|---|
| 1 | 1.8V |
| 2 | TMS |
| 3 | GND |
| 4 | TCK |
| 5 | GND |
| 6 | TDO |
| 7 | GND |
| 8 | TDI |
| 9 | GND |
| 10 | SRST-N |

### J5 – CSI #2 (1.8V 3.3V) (Jumper Selectable)

| Pin | Function |
|---|---|
| 1 | GND |
| 2 | D0_N |
| 3 | D0_P |
| 4 | GND |
| 5 | DI_N |
| 6 | DI_P |
| 7 | GND |
| 8 | CLK_N |
| 9 | CLK_P |
| 10 | GND |
| 11 | GPJO0 |
| 12 | MLLK |
| 13 | SCL |
| 14 | SDA |
| 15 | +3.3V |

### J7 – CSI #2

| Pin | Function |
|---|---|
| 1 | GND |
| 2 | D0_N |
| 3 | D0_P |
| 4 | GND |
| 5 | DI_N |
| 6 | DI_P |
| 7 | GND |
| 8 | CLK_N |
| 9 | CLK_P |
| 10 | GND |
| 11 | GPJO0 |
| 12 | MLLK |
| 13 | SCL |
| 14 | SDA |
| 15 | +3.3V |

Note: Pin 1 is indicated by orange *

## Pinout for J10 (I2CHDR), J5 (GPIOHDR), J4A2 (Fan Header) on PSU

### J5 (GPIO Header)

| Pin | Function |
|---|---|
| 1 | GPIO-0 |
| 2 | GPIO-1 |
| 3 | GPIO-2 |
| 4 | GPIO-3 |
| 5 | GPIO-4 |
| 6 | I2C.SCL |
| 7 | I2C.SDA |
| 8 | GND |

### J10 (I2C Header)

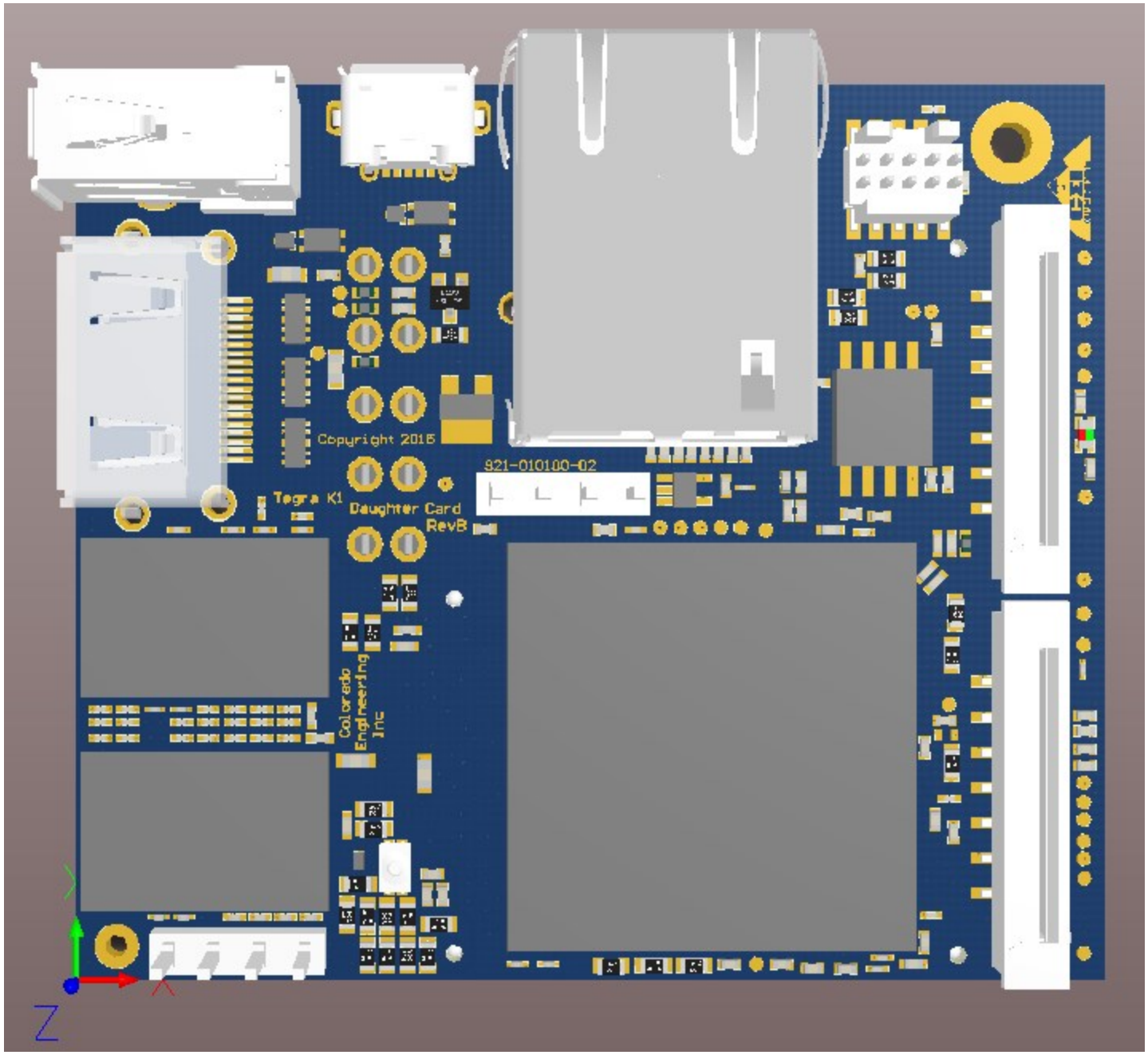
| Pin | Function |
|---|---|
| 1 | NC |
| 2 | NC |
| 3 | NC |
| 4 | NC |
| 5 | GND |
| 6 | +3.3V |
| 7 | I2C.SDA |
| 8 | I2C.SCL |

### J4A2 (Fan Header)

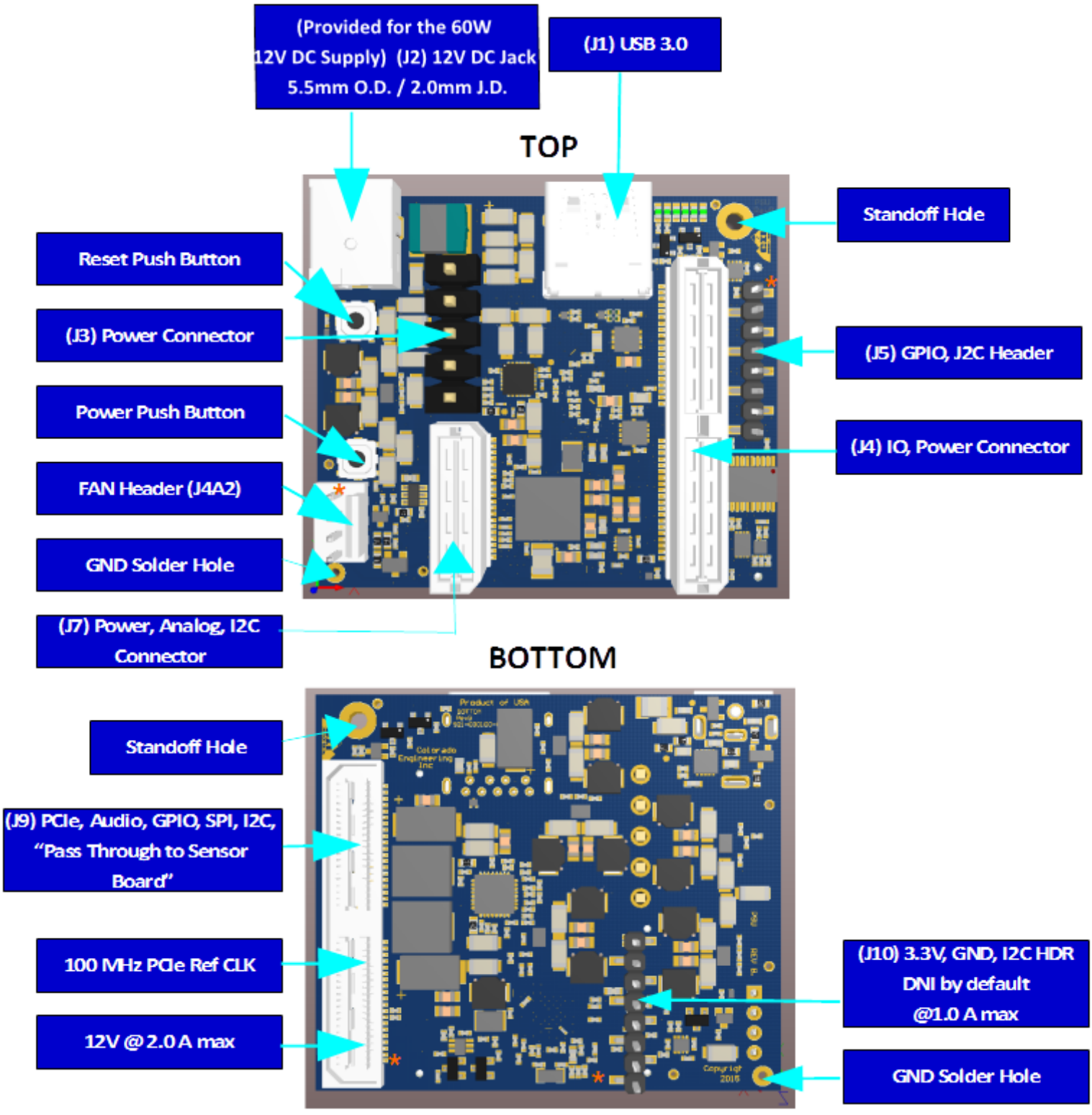
| Pin | Function |
|---|---|
| 1 | Enable_L |
| 2 | NC |
| 3 | Power (+12V) |
| 4 | GND |

Note: Pin 1 is indicated by orange *

## GPU Board Top



## Power Supply Unit (PSU)



## Pinout for J9 Connector on PSU

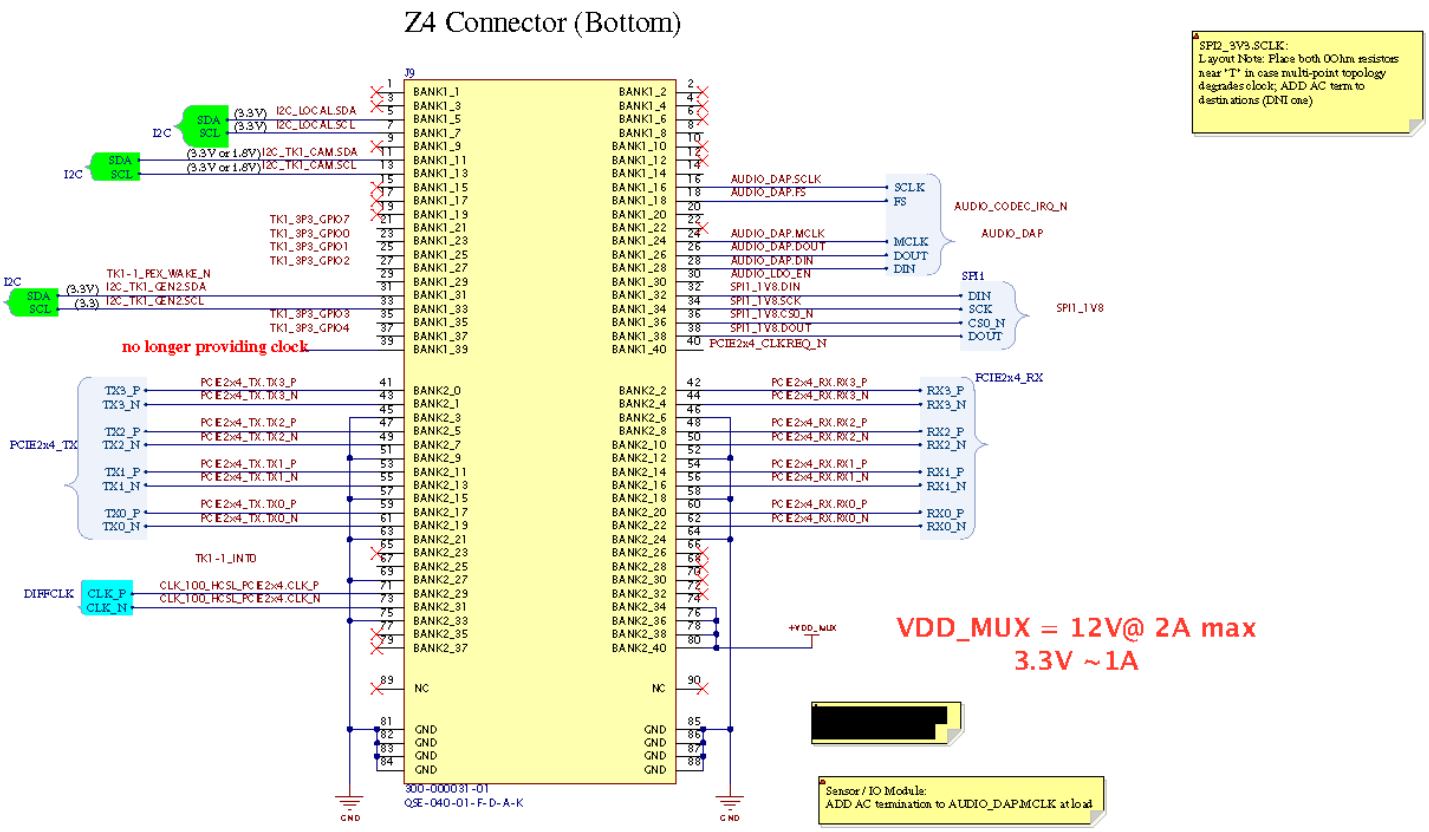
**J9 Connector on PSU**

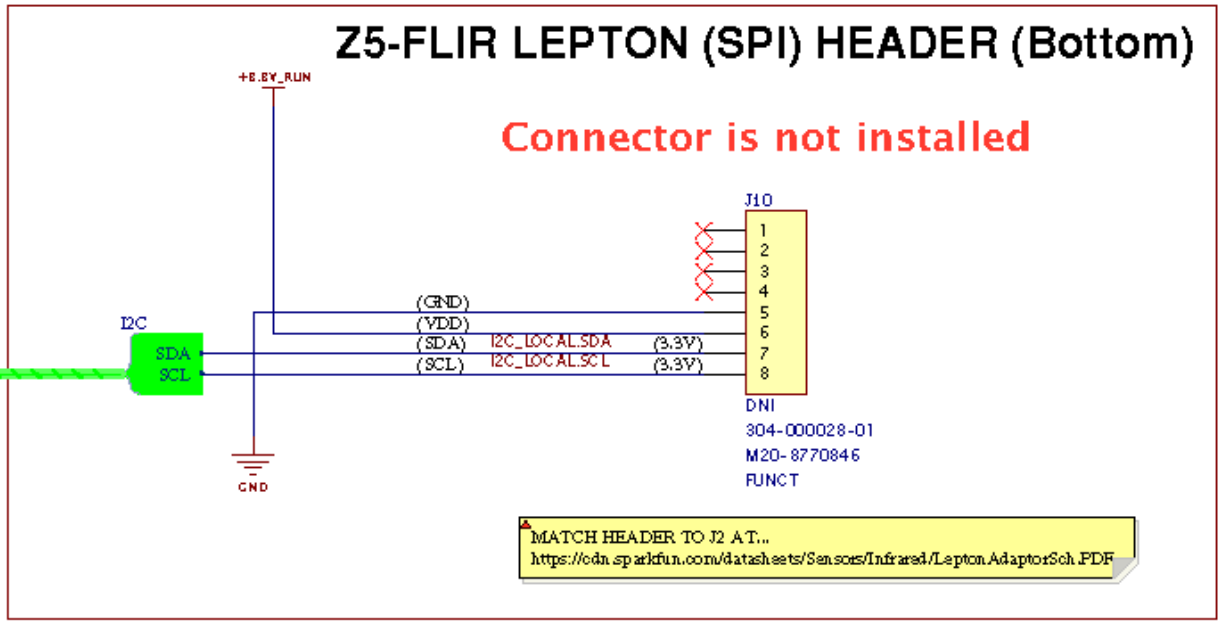
J9 is the high speed connector with the IO for the sensor board; with PCI Express x4, 1.8V, Audio DAP, 12C interfaces as well as GPIO.

| Function | Pin |
|---|---|
| I2C_TK1_CAM.SDA | J9/11 |
| I2C_TK1_CAM.SCL | J9/13 |
| TK1-1_PCIE2X4_PERST_N | J9/14 |
| AUDIO_DAP.SCLK | J9/16 |
| AUDIO_DAP.FS | J9/18 |
| AUDIO_CODEC_IRQ_N | J9/20 |
| TK1_3P3_GPIO7 | J9/21 |
| TK1_3P3_GPIO0 | J9/23 |
| AUDIO_DAP.MCLK | J9/24 |
| TK1_3P3_GPIO1 | J9/25 |
| AUDIO_DAP.DOUT | J9/26 |
| TK1_3P3_GPIO2 | J9/27 |
| AUDIO_DAP.DIN | J9/28 |
| TK1-1_PEX_WAKE_N | J9/29 |
| AUDIO_LDO_EN | J9/30 |
| I2C_TK1_GEN2.SDA | J9/31 |
| SPI1_1V8.DIN | J9/32 |
| I2C_TK1_GEN2.SCL | J9/33 |
| SPI1_1V8.SCK | J9/34 |
| TK1_3P3_GPIO3 | J9/35 |
| SPI1_1V8.CS0_N | J9/36 |
| TK1_3P3_GPIO4 | J9/37 |
| SPI1_1V8.DOUT | J9/38 |
| PCIE2X4_CLKREQ_N | J9/40 |

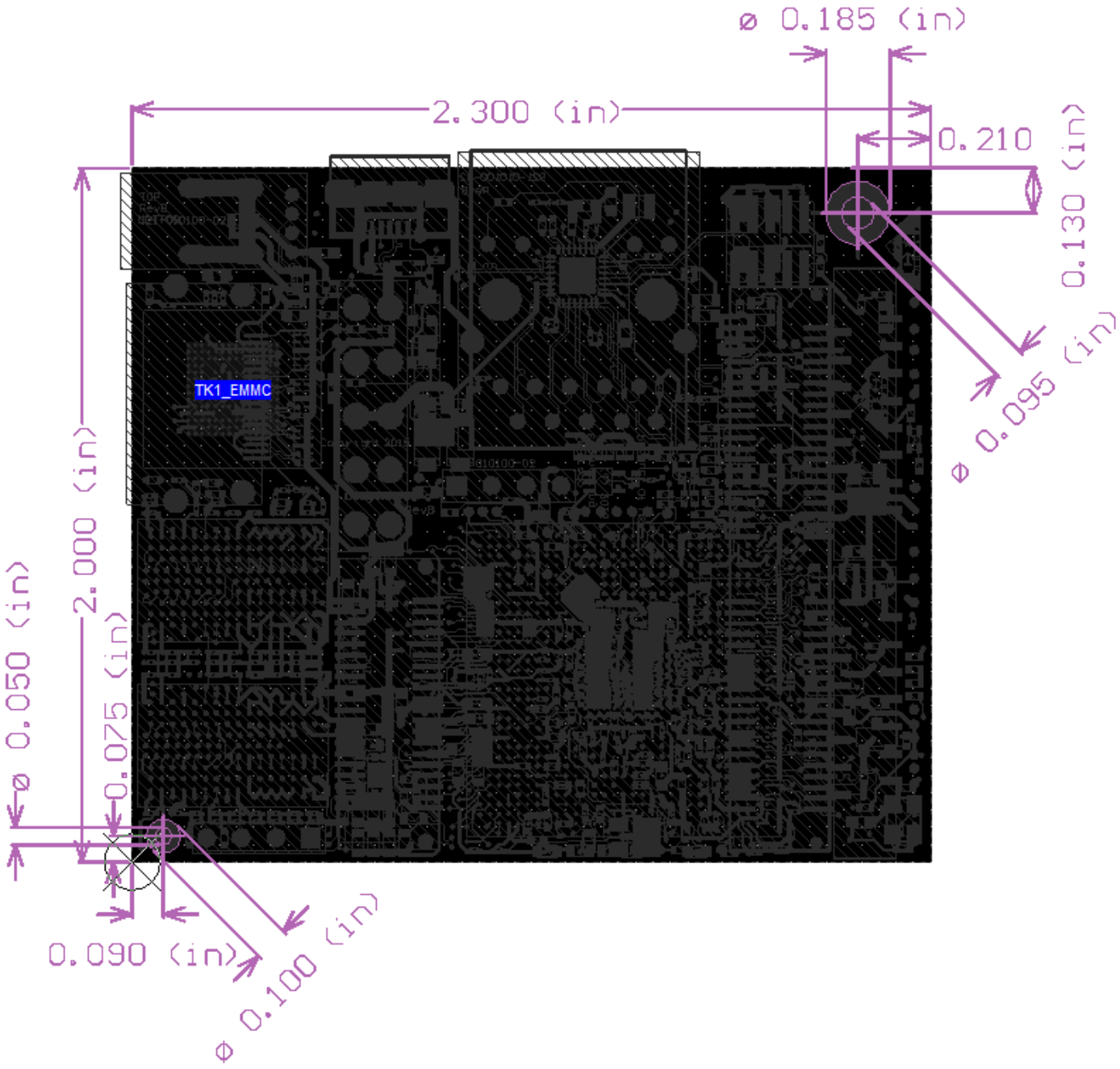
| Function | Pin |
|---|---|
| PCIE2X4_TX.TX3_P | J9/41 |
| PCIE2X4_RX.RX3_P | J9/42 |
| PCIE2X4_TX.TX3_N | J9/43 |
| PCIE2X4_RX.RX3_N | J9/44 |
| GND | J9/45 J9/46 J9/51 J9/52 J9/57 J9/58 J9/63 J9/64 J9/69 J9/75 J9/81 J9/82 J9/83 J9/84 J9/85 J9/86 J9/87 J9/88 |
| PCIE2X4_TX.TX2_P | J9/47 |
| PCIE2X4_RX.RX2_P | J9/48 |
| PCIE2X4_TX.TX2_N | J9/49 |
| I2C_LOCAL.SDA | J9/5 |
| PCIE2X4_RX.RX2_N | J9/50 |
| PCIE2X4_TX.TX1_P | J9/53 |
| PCIE2X4_RX.RX1_P | J9/54 |
| PCIE2X4_TX.TX1_N | J9/55 |
| PCIE2X4_RX.RX1_N | J9/56 |
| PCIE2X4_TX.TX0_P | J9/59 |
| PCIE2X4_RX.RX0_P | J9/60 |
| PCIE2X4_TX.TX0_N | J9/61 |
| PCIE2X4_RX.RX0_N | J9/62 |
| TK1-1_INT0 | J9/67 |
| I2C_LOCAL.SCL | J9/7 |
| CLK_100_HCSL_PCIE2X4.CLK_P | J9/71 |
| CLK_100_HCSL_PCIE2X4.CLK_N | J9/73 |
| +VDD_MUX | J9/74 J9/76 J9/78 J9/80 |
| EXTRA_GPIO_CS1_N | J9/8 |

## Schematics Showing Z Connector



## Mechanical Drawing of Standoff and Solder Holes



## Frequently Asked Questions

**Q: What is the current draw limit on the 1.2V, 1.8V, and 12V power rails on header Z1?**
**A:** 12V @ 2.0 A & 3.3V @ 1.0 A are available for an add-on card.

**Q: What frequency is available on the system clock pins on header Z1?**
**A:** There is a 100 MHz PCIe reference clock available for an add-on card. Any other clocks would have to be derived from this.

**Q: What is the idle power consumption?**
**A:** 5 - 10W idle power consumption.

**Q: Does the platform require a fan?**
**A:** A fan is included in addition to the heat sink. Fan is recommended, but depending on application may be omitted.

**Q: What is the bandwidth limit of the PCIe Gen2 x4 connection?**
**A:** The PCIe bandwidth limit is 2 GB/s.

**Q: Do you have a breakout board with a standard PCIe connector?**
**A:** The breakout board has a mini PCIe card slot, with the exception of UIM support as is done on the Jetson board. This is different from a PCIe edge connector, but is still a standard form factor of PCISIG.

**Q: Is it possible to modify the bootloader on the TK1-SOM?**
**A:** It is possible to modify the bootloader on the TK1-SOM. We use UBoot for the bootloader, and can provide the source code if needed. Our UBoot program is slightly different from the default bootloader provided by NVIDIA. These differences include mapping to different peripherals and memory components from the Jetson TK1 board. The specific guide we followed for customizing the bootloader is the NVIDIA document entitled “Platform Adaption for the Tegra Linux Driver Package.” Please refer to this guide if you will be developing your own bootloader.

**Q: Is the bootloader on the board locked down, or can we replace it? We want to run our system in HYP mode; the default boot process from NVIDIA turns this off.**
**A:** You can replace the default bootloader; we modified the NVIDIA-provided uboot program developed for the Jetson TK1 board in order to work with the TK1-SOM. You may download this and modify it to your own needs. Virtualization is supported on the Cortex–A15.

**Q: What add-on boards do you support for the TK1 SOM and when will those boards become available?**
**A:** Currently a Gen2x4 PCIe breakout board is in development; it should be available in Q1 2016.

## Frequently Asked Questions — continued

**Q: How much power are the GPU, CPU, and DRAM using?**
**A:** GPU max power: 5 watts; CPUs max power: 15 watts; DDR3 max power: 5 watts (2 GB); 10 watts (4 GB)

**Q: Do you supply a WiFi attachment module and Linux drivers?**
**A:** USB WiFi modules can be connected to the TK1-SOM, and mini-PCIE WiFi modules can be connected to the PCIe breakout board. Linux drivers should be available from the WiFi module manufacturer.

**Q: Does CEI provide customization?**
**A:** Yes! Email **sales@coloradoengineering.com** for more information.

**Q: What is the temperature range for this board?**
**A:** Operating: -20 to 55 degrees Celsius; Storage: -40 to 75 degrees Celsius

**Q: Do I need to buy any other boards to make an embedded device?**
**A:** The Power Supply Unit and the SOM boards make a complete Ubuntu system. All other boards are optional.

**Q: Can I run Android on the TK1-SOM?**
**A:** The Jedroid operating system is an open source Android OS for the Jetson TK1 board. We have not been able to get Android running on the TK1-SOM, but it does run on the Jetson, so with some modification it should be possible.

**Q: Does the product come with Linux4Tegra pre-installed? If so: do you happen to know which version?**
**A:** The latest version (as of 11/18/15), L4T 21.4, comes pre-installed on the TK1-SOM.

**Q: What is the process for flashing the eMMC? Does it use the microUSB port in the same way as a Jetson TK1 board?**
**A:** The process is the same as flashing the Jetson TK1 Board via the microUSB; however, the files have changed to suit the TK1-SOM Board.