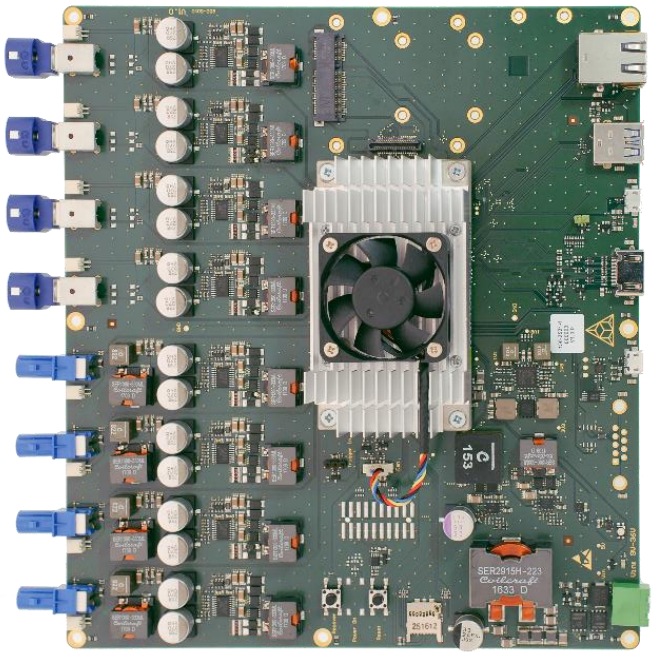
BLUETECHNIX
Embedding Ideas

multi-tof CamHub



Hardware User Manual

Version 2.1

Contact

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Information

For further information on technology, delivery terms and conditions and prices please contact BECOM BLUETECHNIX (http://www.bluetechnix.com).

Warning

Due to technical requirements components may contain dangerous substances.

1 Introduction

The multi-tof CamHub is part of the multi-tof platform, which is designed to process the stream of up to eight time-of-flight sensors, called multi-tof FrontEnds. The CamHub allows connecting four FrontEnds with high-speed differential signal connectors (Rosenberger HSD), and four coaxial signal connectors (FAKRA). Also phantom powering of the FrontEnds is possible.

The processing unit is a Jetson TX2 module, which is based on nvidia's Tegra TX2 processor.

1.1 Overview

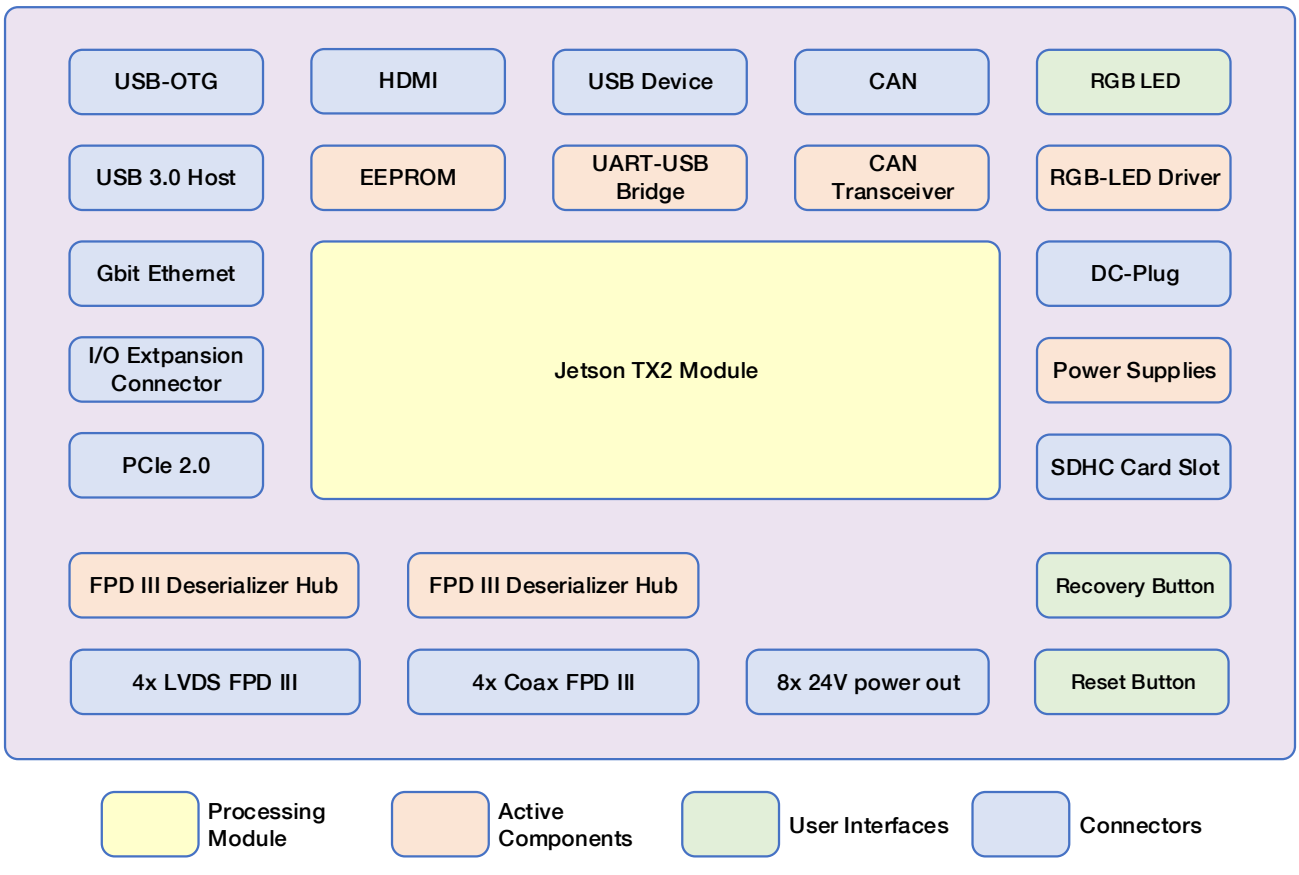

Figure 1-1 main components and interfaces

1.2 Key Features

- Processing Module (**Jetson TX3**)
- 2 FPD Link III deserializer hubs (**DS90UB964**)
- USB/UART Bridge (**FT234**)
- CAN Transceiver (**TLE6250**)
- RGB-LED Driver wit I²C interface (**NCP5623**)
- EEPROM (**24AA64T**)

- Power Supplies

1.3 Available extensions

Currently there are no extension modules available from Bluetechnix. PCIe Mini cards are supported.

1.4 Applications

- Automotive
  - Driver surveillance
  - Telematics
- Consumer
  - People counting
  - Human Machine Interface (HMI)
- Industrial
  - Process monitoring
  - Security and alarms systems

2 General Description

The multi-tof FrontEnds are only capable to deliver raw data. They are designed to stream the pixel data to the CamHub in 12bit raw mode via a FPD III serializer.

The multi-tof CamHub is designed to combine the streams of up to eight FrontEnds into two 4-lane MIPI CSI 2 streams, and deliver them to the processing module, a powerful Jetson TX2, based on nvidia's Tegra TX2 processor. The processor is able to compute the 3D-data out of all RAW-data streams coming from the FrontEnds.

These 3D streams can either be sent over gigabit ethernet or USB 3.0 to a host PC, or the data can be visualized by directly connecting a HDMI compatible monitor.

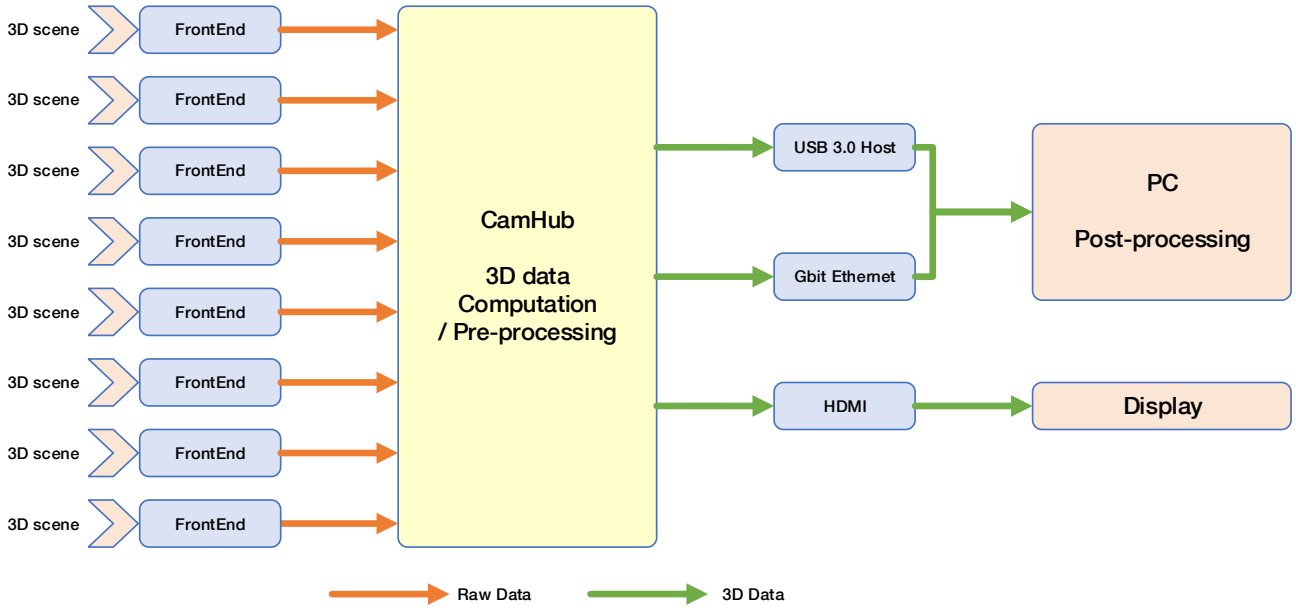

Figure 2-1 Processing chain

2.1 Functional Description

Figure 2-2 shows the interconnection of the Jetson module with all the components and connectors on the CamHub.

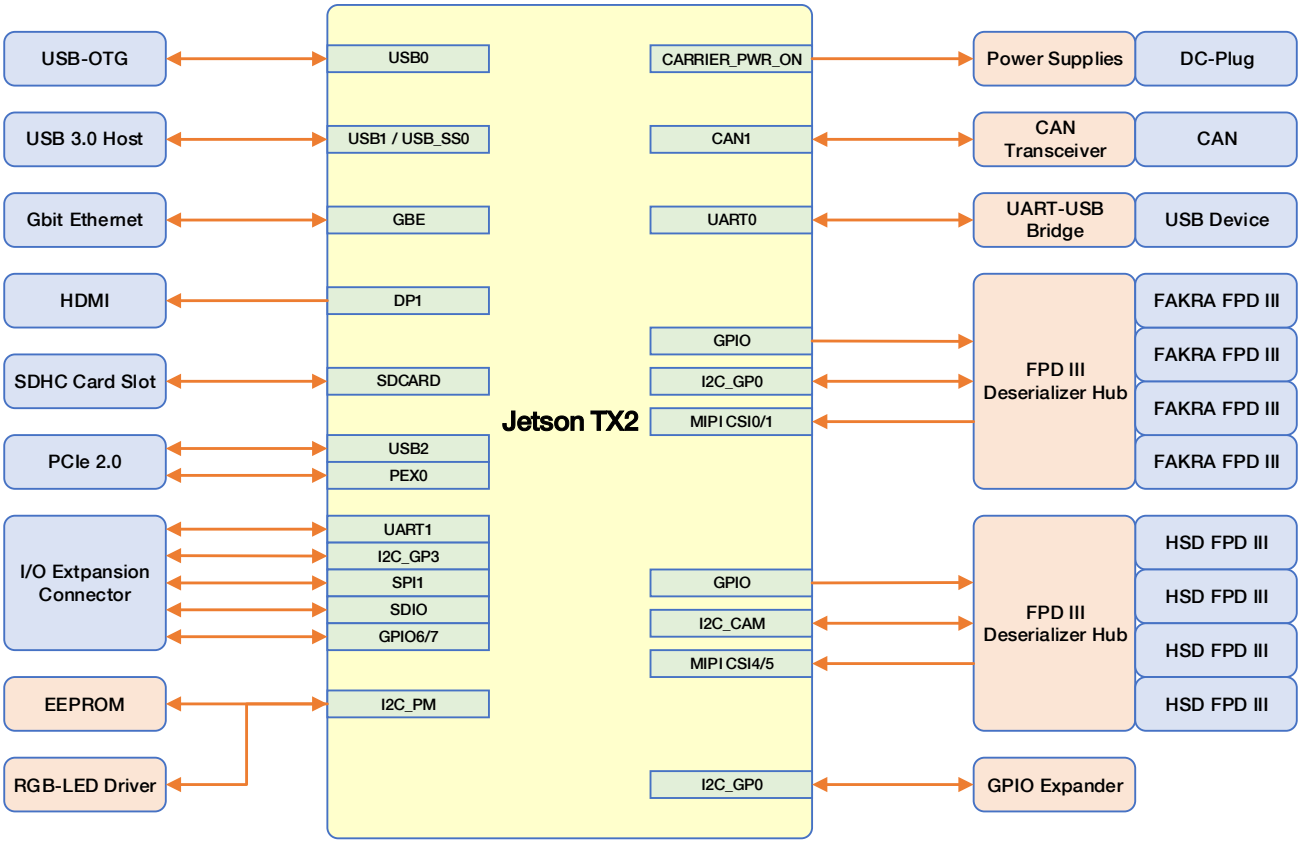

Figure 2-2 CamHub interconnection diagram

2.2 FrontEnd Accessibility

Each FrontEnd is connected to one of the two FPD Link III Serializer hubs. They merge the raw data into a MIPI CSI 2 stream with up to four virtual channels, which is delivered to the Jetson module.

Each Deserializer hub has eight GPIOs, which can be routed to the four Frontends. These GPIOs are used for reset, and trigger functionality.

FrontEnd Port #	Jetson Pin	Deserializer Pin	Functionality
0	GPIO13	GPIO0	Reset
	GPIO14	GPIO 1	Trigger
1	GPIO15	GPIO 2	Reset
	GPIO16	GPIO 3	Trigger
2	GPIO17	GPIO 4	Reset
	GPIO18	GPIO 5	Trigger
3	GPIO19	GPIO 6	Reset
	GPIO20	GPIO 7	Trigger
4	GPIO0	GPIO 0	Reset
	GPIO1	GPIO 1	Trigger
5	GPIO2	GPIO 2	Reset
	GPIO3	GPIO 3	Trigger
6	GPIO4	GPIO 4	Reset
	GPIO5	GPIO 5	Trigger
7	GPIO11	GPIO 6	Reset
	GPIO12	GPIO 7	Trigger

Table 2-1 Jetson – Deserializer GPIO Assignment

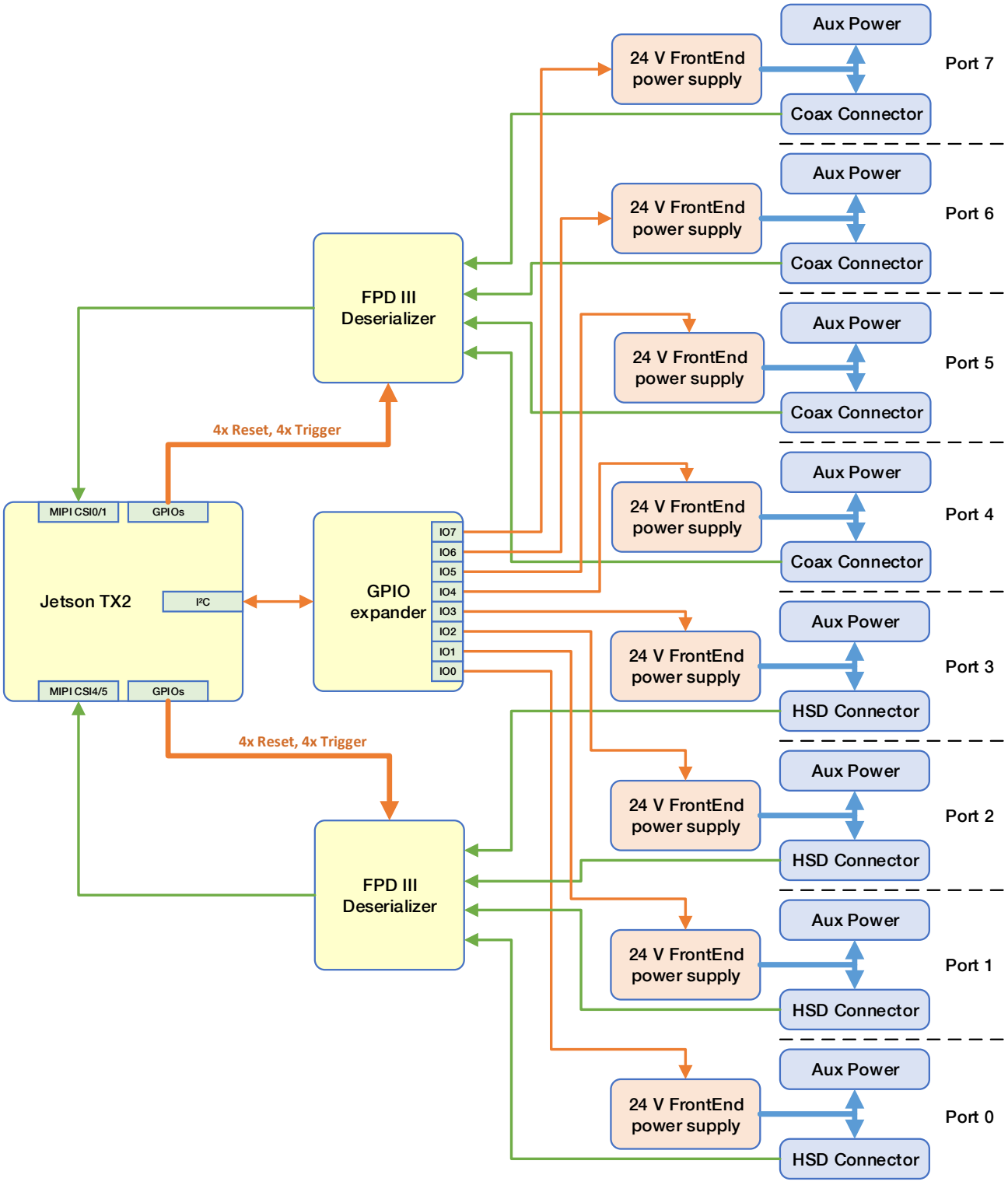

Figure 2-3 Frontent interconnection diagram

The FrontEnds can be powered via Power over Cable (PoC) or an auxiliary power connector.

This phantom- or auxiliary power suppy is generated separately for each frontend, and must be turned on by the I/O pins of the on-board GPIO expander.

FrontEnd Port	GPIO-Expander Pin
0	P00
1	P01
2	P02
3	P03
4	P04
5	P05
6	P06
7	P07

Table 2-2 Power enable pin assignment

2.3 Components

2.3.1 Processing Module

The CamHub mates with all nvidia Jetson modules, however the standard multi-tof platform package comes with a pre-mounted Jetson TX2 module.

For further information on the Tegra modules check out the latest datasheet on the nvidia website.

For further information on the module software refer to the multi-tof SUM on the BECOM-Bluetechnix website.

2.3.2 Deserializer

There are two DS90UB964 FPD Link III Deserializer Hubs from Texas Instruments, that are used to convert the LVDS signals to a MIPI CSI 2 stream. One of them is connected to four high speed differential connectore (HSD from Rosenberger), the second accepts the LVDS signals via a FAKRA coaxial connector.

The Parts can be configured via I²C, both have the 7-bit address 0x30, but are connected to different I²C busses:

- Device 0 (HSD) to I2C_CAM
- Device 1 (FAKRA) to I2C_GP0

The Deserializers are configured for HF-12bit raw mode with strapping resistor deviders, but in some cases this mode is not captured correctly. Therefore, it is recommended to reconfigure the mode registers upon chip initialization routine.

For a detailed description refer the latest datasheet on the TI website.

2.3.3 GPIO Expander

The PCA9535BS.118 GPIO expander is only used to enable the 24V power supplies for the FrontEnds. Each pin of its IO-port 0 enables the corresponding output supply.

I²C address: 0x20

2.3.4 EEPROM

A 24AA64T-I/MC EEPROM is accessible via I²C (address: 0x54). It can be used to store hardware related information e.g. revision information or default settings.

2.3.5 RGB LED Driver

The RGB LED is driven by the NCP5623 from ON Semiconductor, which is accessible via I²C on address 0x70.

2.3.6 USB – UART Bridge

To have easy access to the processors debug messages, the UART interface used for the debug messages is routed to a USB-to-UART bridge. The USB signals are accessible via the USB-Micro-A Connector.

2.3.7 CAN Transceiver

The processors CAN1 interface is connected to a TLE5623 CAN Transceiver.

2.4 Connectors and Interfaces

TBD

2.4.1 JTAG

A standard ARM JTAG connector (20 pins, 2.54 mm pitch) (X3) is available for processor debugging, but it is normally not assembled. If debugging with an ARM JTAG (e.g ARM DSTREAM) is needed, this connector must be mounted manually.

2.4.2 Extension Connector

The extension connector is a non-standard connector incorporates several interfaces such as SDIO, SPI, I²C and GPIOs, and provides 8.5 V and 1.8 V supplies.

2.4.1 PCIe Mini slot

The PCIe Mini slot supports full size (50.95 mm), as well as half size cards (26.8 mm).

2.4.2 HDMI

The HDMI connector provides a standard interface for digital video and audio signals. The HDMI/DVI connector is connected to the HDMI interface of the Jetson module.

2.4.3 Debug USB

The Tegra Debug UART (UART0) is routed through a USB/UART bridge (FT234 from FTDI) to the USB-Device connector.

2.4.4 USB-OTG

The USB-OTG compliant USB0 host interface is routed to a mini USB-A/B connector.

2.4.5 USB 3.0 Host

The processors USB1 host interface and the SS0 super-speed extension is routed to the USB 3.0 connector.

2.4.6 CAN

The CAN signals are available on a standard 9-pole D-Sub connector.

Pin Numper	Description
1	GND
2	External GND
3	CAN High
5	CAN Low
4, 6, 7, 8, 9,	Not connected

Table 2-3 CAN connector pin description

2.4.7 Ethernet

As the GBit Ethernet PHY is already integrated on the Jetson module, the LAN signals are routed directly to a RJ45 LAN connector with integrated magnetics.

2.4.8 SD Card

There is a micro SD-card holder connected to the SD-card interface. The card holder is not located on a PCB edge, so if the CamHub is enclosed into a chassis, the card holder won't be accessible.

2.4.9 WIFI / Bluetooth

The Jetson module comes already with WiFi and Bluetooth functionality, but antennas have to be applied externally. Two mounting holes are available to fasten a SMA to U.FL adaptor cable. Then two standard 2.4 GHz antennas can be mounted to the holder.

2.4.10 HSD Frontend Connectors

There are four connectors for FrontEnds with a differential FPD Link III interface. The used connectors are D4S20L-40MA5-C from Rosenberger. The LVDS signals are routed to a DS90UB964 deserializer hub, which is able to multiplex all four serial streams into one MIPI-CSI 2 stream. These signals are routed to the four-lane MIPI interface CSI4/5.

2.4.11 FAKRA Frontend Connectors

There are four connectors for FrontEnds with a coaxial FPD Link III interface. The used connectors are FA1-NCRP-PCB-8 from Amphenol. The serial signals are routed to a DS90UB964 deserializer hub, which is able to multiplexe all four serial streams into one MIPI-CSI 2 stream. These signals are routed to the four-lane MIPI interface CSI0/1.

2.5 User-Interface

2.5.1 Reset Button

A small reset button is located right next to the DC plug with a horizontal actuation button. If the CamHub is enclosed into a chassis, the button could be pressed with a small screwdriver by sparing a 2 mm hole in the front plate.

2.5.2 Power On/Off Button

The power button is normally not mounted, the board starts booting automatically when the main power is applied.

2.5.3 RGB LED

The RGB-LED can be used to indicate the current processor state. It must be configured by the on-board LED-driver (see chapter 2.3.5).

2.6 Recovery Boot Mode

When this push button is held while pressing and releasing the reset button, and afterwards released, the Jetson module starts the recovery-boot-mode. Then it is expected that a binary file will be sent on the USB-OTG interface.

2.6.1 Power Supply

The CamHub must be powered by an external 12 V or 24 V power supply connected to the green 3 pole terminal connector. The minimum current if only one frontend is connected is 2 A at 12 V, or 1 A at 24 V. Applying additional FrontEnds increases the current by 1 A for each module at 12 V or 0.5 A at 24 V.

3 Specifications

3.1 Electrical Specifications

3.1.1 Maximum Ratings

Stressing the device above the rating listed in the absolute maximum ratings table may cause permanent damage to the device. These are stress ratings only. Operation of the device at these or any other conditions greater than those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Symbol	Parameter	Min	Max	Unit
V_{IO}	Input or output voltage	-0.5	1.8	V
V_{IN}	Input supply voltage	-58	58	V
T_{AMB}	Ambient temperature	-20	85	°C
T_{STO}	Storage temperature	-40	105	°C
φ_{AMB}	Relative ambient humidity		90	%

Table 3-1: Absolute maximum ratings

3.1.2 ESD Sensitivity

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

3.1.3 Operating Conditions

Symbol	Parameter	Min	Typical	Max	Unit
V_{IN}	Input supply voltage[1)]	9	12 / 24	36	V
P	Board Power Consumption[2)]	TBD	-	TBD	W
V_{USBx}	USB Supply Voltage	4.5	5.0	5.5	V
I_{USB3}	USB 3.0 Supply Current	-	-	900	mA
I_{USBOTG}	USB OTG Supply Current	-	-	500	mA

Table 3-2: Electrical characteristics

[1)] If the input voltage sinks below the specified minimum value, or rises above the maximum, the protection circuit immediately turns off all voltage rails. The Board turns on again, when the supply voltage returns within specified parameters.

[2)] The Power consumption refers to a CamHub with a Jetson TX2 module with Linux running in idle state and no Extension Boards or USB-Devices plugged in.

3.1.4 Power distribution

The board is designed to work with 12 V and 24 V power rails. The input voltage range is 9 V to 36 V, and is protected against wrong polarity, higher constant voltages up to 56 V and voltage transients up to 5 kW.

The following diagram shows the power distribution on the board. The power source for the Jetson module is always on, the other supplies are enabled by the module, either via the CARRIER_PWR_ON signal or the I²C controlled GPIO expander.

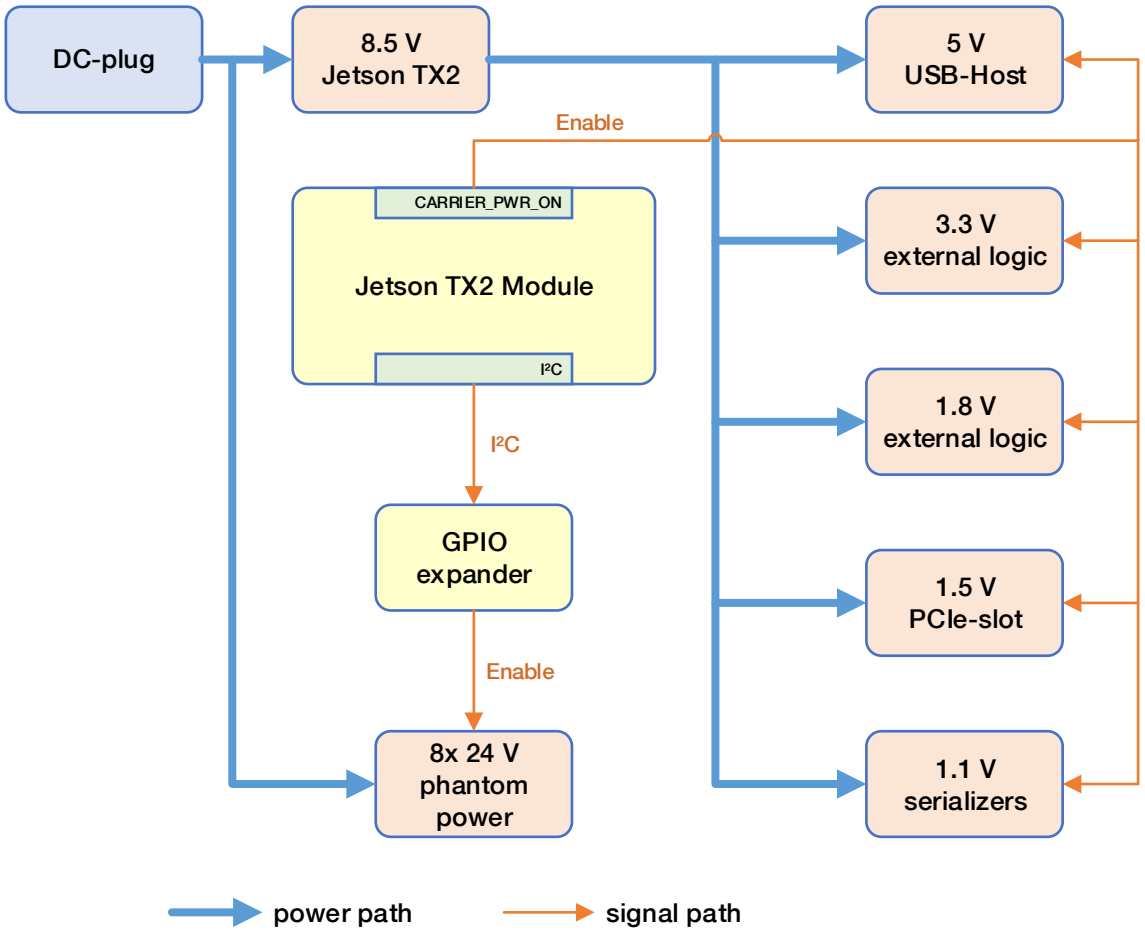

Figure 3-1 power distribution

4 Mechanical Outline

This section shows the mechanical outline of the CamHub. All dimensions are given in mm.

4.1 Top View

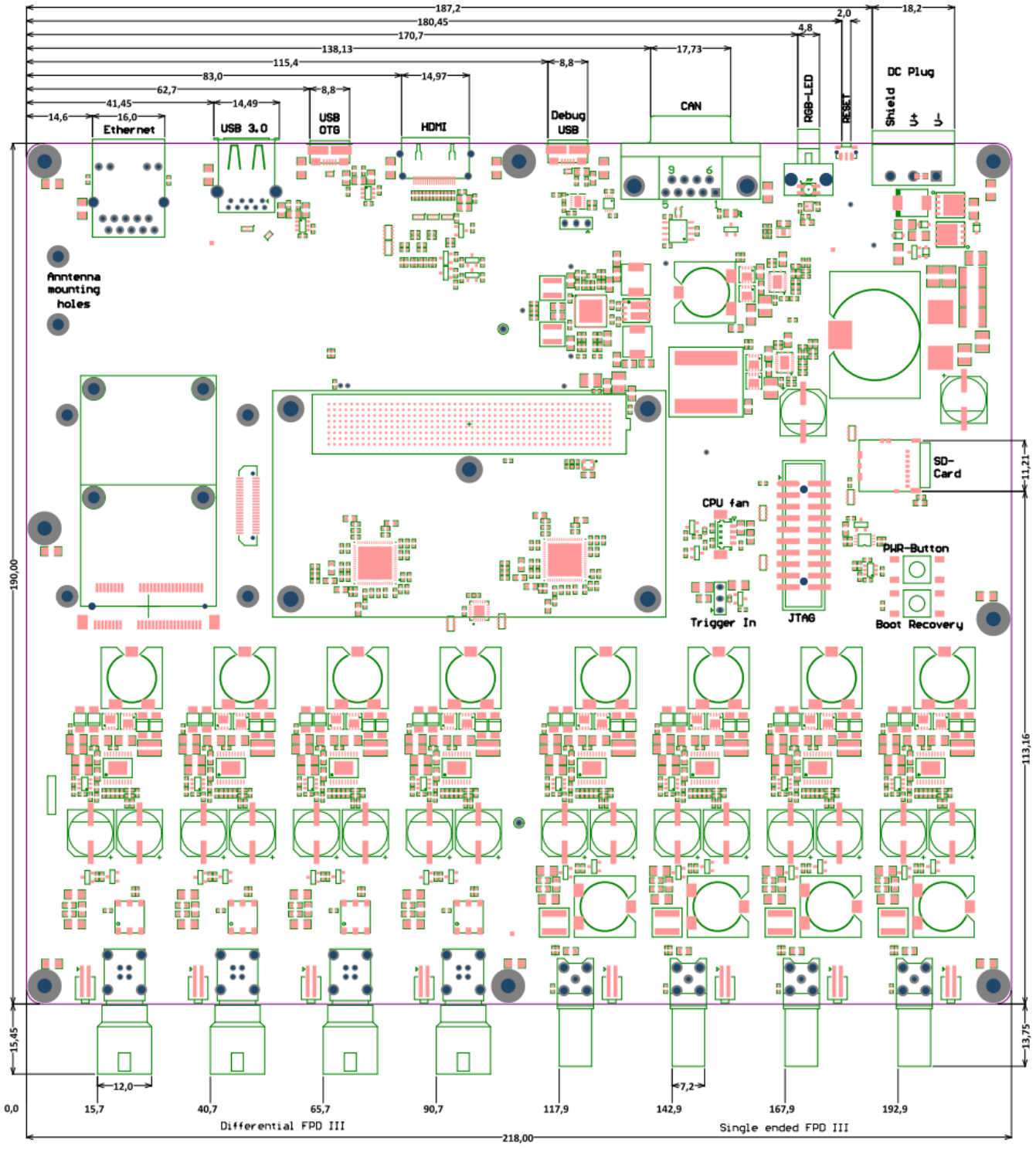

Figure 4-1 Mechanical outline top view

4.2 Bottom View

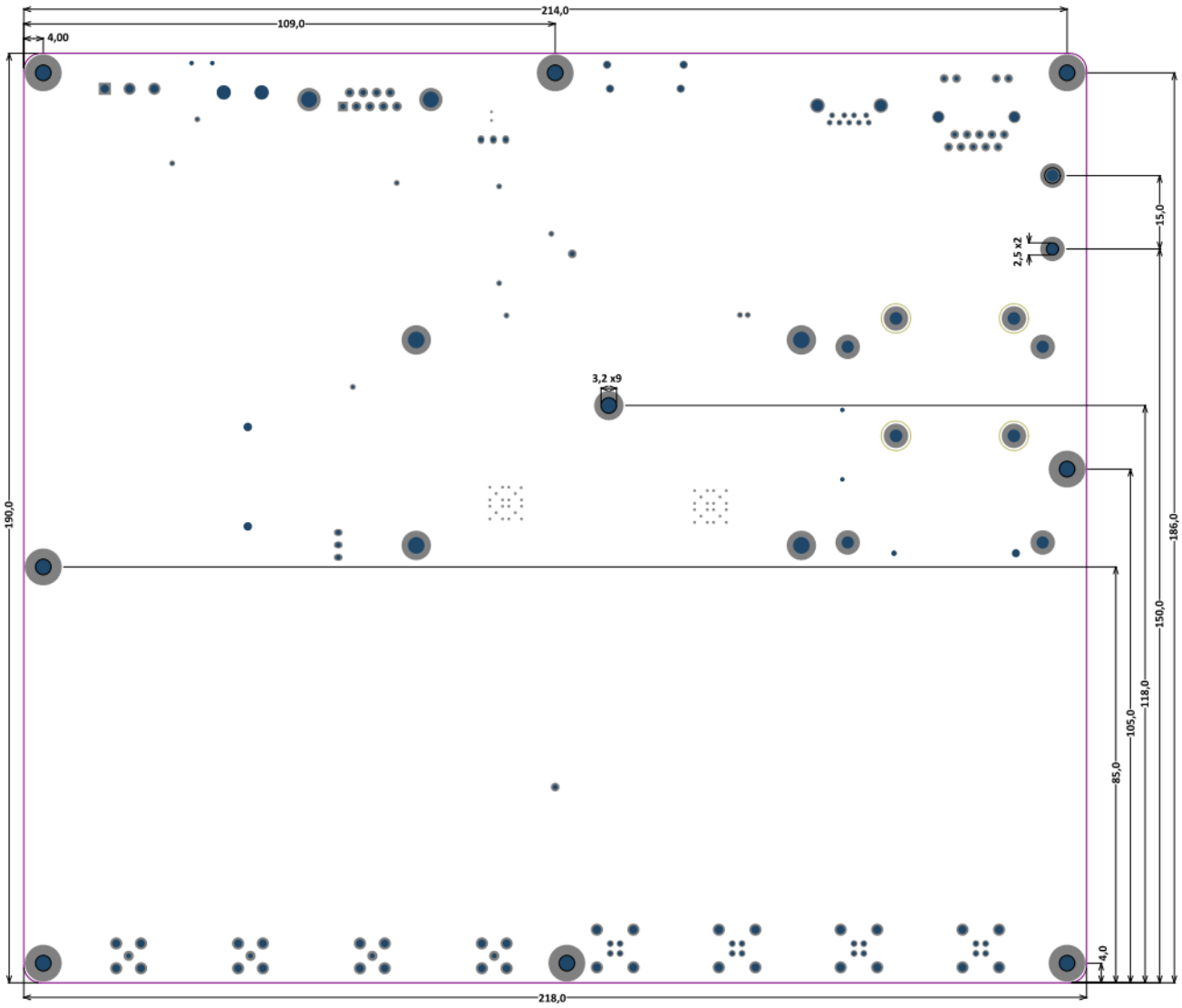

Figure 4-2 Mechanical outline bottom view

4.3 Side Views

Figure 4-3 Mechanical outline front view

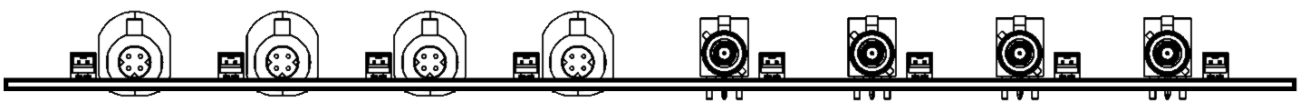

Figure 4-4 Mechanical outline rear view

5 Support

5.1 General Support

General support for products can be found at Bluetechnix' support site https://support.bluetechnix.at/wiki

5.2 Board Support Packages

Board support packages and software downloads are available at https://support.bluetechnix.at/wiki/I.MX6

5.3 i.MX Software Support

5.3.1 Linux

Linux BSP and images of derivates can be found at Bluetechnix' support site https://support.bluetechnix.at/wiki at the software section of the related product.

5.3.2 Android

Please contact Bluetechnix for support information.

5.3.3 Win CE

Please contact Bluetechnix for support information.

5.4 i.MX Design Services

Based on more than seven years of experience with Blackfin and i.MX, Bluetechnix offers development assistance as well as custom design services and software development.

5.4.1 Upcoming Products and Software Releases

Keep up to date with all product changes, releases and software updates of Bluetechnix at http://www.bluetechnix.com.

6 Product History

6.1 Version Information

Version	Component	Type
1.1.0	Multi-ToF-Cam-Hub	X-grade

Table 6-1: Overview CamHub product changes

6.2 Anomalies

Version	Date	Description
V1.1.0	2018 02 21	CAN not yet supported
V1.1.0	2018 02 21	PCIe not yet supported
V1.1.0	2018 02 21	Single ended FrontEnd not yet supported

Table 6-2 – Product anomalies

7 Document Revision History

Version	Date	Document Revision
0	2018 02 21	First Draft V1.0 of the Document

Table 7-1: Revision history

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