BLUETECHNIX
Embedding Ideas

multi-tof FrontEnd

Hardware User Manual

Version 1.1

Contact

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Table of Contents

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Information

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Warning

Due to technical requirements components may contain dangerous substances.

1 Introduction

The multi-tof FrontEnd is part of the multi-tof platform, which is designed to process the stream of up to eight multi-tof FrontEnd time-of-flight sensors. The CamHub allows connecting four FrontEnds with high-speed differential signal connectors (Rosenberger HSD), and four coaxial signal connectors (FAKRA). This document describes the differential version with Phantom power option.

1.1 Overview

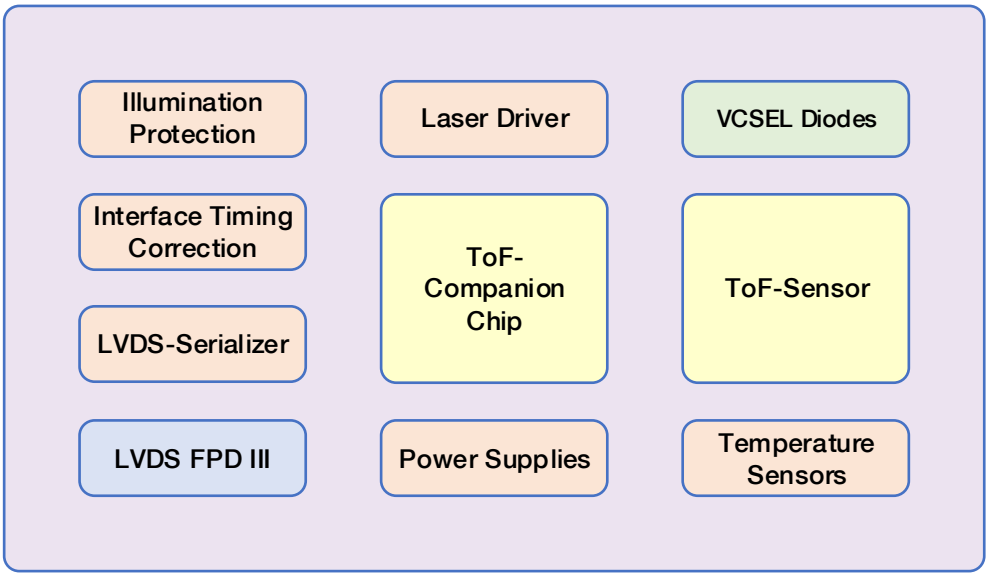


Figure 1-1 main components and interfaces

1.2 Key Features

- ToF-Sensor (Melexis **MLX75023**)
- ToF-CC (Melexis **MLX75123**)
- 2 FPD Link III serializer (Texas Instruments **DS90UB933**)
- CPLD (Xilinx **XC2C32A**)
- FET-Driver (Michrochip **MD1210K6-G**)
- Cortex-M0+ Controller (NXP **MKL04Z16**)
- VCSEL Diode (Princeton Optronics **PCW-SMV-2-W0850-1-D110**)
- Power Supplies (Texas Instruments **LMR23615, LP873222, LM3671, LM27761, TPS40170, LMR16006**)
- Temperature Sensors (Texas Instruments **TMP108**)

1.3 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 capable to deliver raw data of a 3D scene captured by the incorporated ToF-sensor and illumination. They are designed to stream the pixel data to the CamHub in 12bit raw mode via a FPD III serializer.

The illumination is based on two VCSEL laser diodes with a maximum optical output power of 2W each. The VCSEL driver consist of two stages, a high speed FET drive and a N-MOSFET.

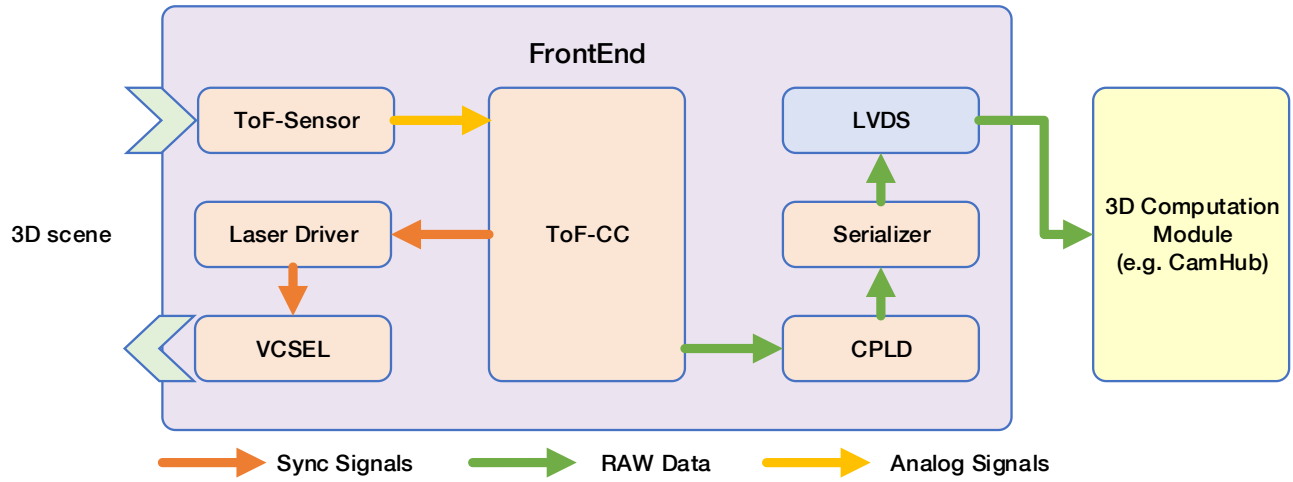


Figure 2-1 Processing chain

2.1 Components

The multi-tof-FrontEnd consists of the following main components

2.1.1 ToF-Sensor

The incoming light is captured by the MLX75023 ToF sensor. He is only capable of delivering the anaog pixel value at the currently addressed pixel.

2.1.2 ToF-CC (Companion Chip)

The MLX75123 ToF-CC has many functions. During the integration phase, he generates the modulation signals for the sensor as well as for the illumination.

Afterwards he captures the analog values of the ToF-sensor with its integrated 12-bit ADC. The digital value will be streamed via a 12-bit parallel interface.

2.1.3 VCSEL

There are two VCSEL laser diodes that are needed to illuminate the 3D scene.

2.1.4 Laser Driver

The laser driver consists of two stages. The first stage is a high-speed FET-driver (MD1210K6-G). The second stage are two M-channel MOSFETs, which each driving a laser diode.

2.1.5 Illumination Surveillance

If for some reason the illumination should fail, e.g. permanent lighting, the illumination surveillance needs to disable the driver to prevent the module from over-heating and more important for eye-safety reasons.

Therefore, the analog modulation signal on the VCSEL is monitored, as well as the PCB temperature next to the lasers.

Following fail operation modes are detected:

- Permanent Illumination
- No Illumination
- Over-Temperature
- Wrong laser diode voltage

2.1.6 Serializer

A DS90UB933 serialize is used, to transform the parallel RAW-pixel-data into a LVDS FPD-III stream.

2.1.7 CPLD

The ToF-CC generates synchronization signals, that don’t meet the requirements specified by the serializer. Therefore, a new Timing needs to be generated by the CPLD. By doing this, the last 20 pixels of each line in the frame will get lost, the resulting resolution of the 3D-image is 300 x 240 pixel.

2.2 Functional Description

Figure 2-2 shows the interconnection and data flow between all components on the CamHub.

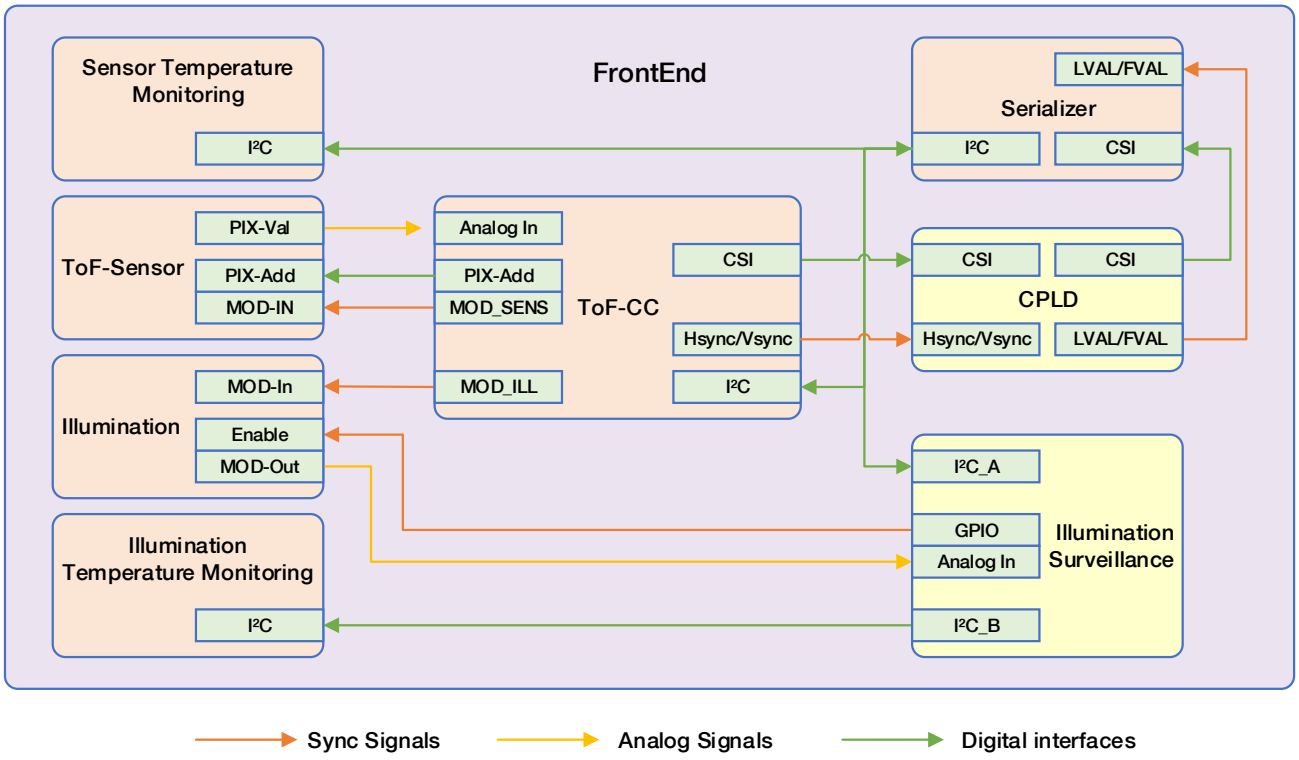


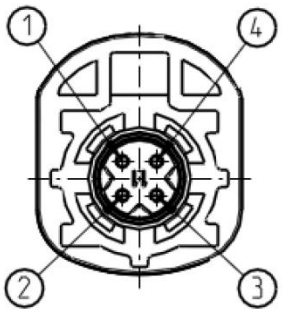
Figure 2-2 Frontend interconnection diagram

2.3 Connectors

The Frontend has three connectors, but for normal operation just the Rosenberger high speed differential connector is needed. The other are for programming purposes and auxiliary power supply.

2.3.1 HSD Connector

The used connectors are D4S20L-40MA5-C from Rosenberger. The LVDS signals are routed to the DS90UB933 serializer. the Power-over-Cable (PoC) feature can be used, if phantom powering is supported by the host interface.



Pin Numper	Description
1	LVDS_N / power supply
2	GND
3	LVDS_P / power supply
4	GND

Table 2-1 HSD connector pin description

2.3.2 AUX Power

If the host doesn't provide power-over-cable the FrontEnd can be powered over an auxiliary power connector. A Molex-PicoSPOX two pin header is used for this purpose. Pin number 1 is the positive supply voltage, pin number two (in close proximity to the HSD connector) is power ground.

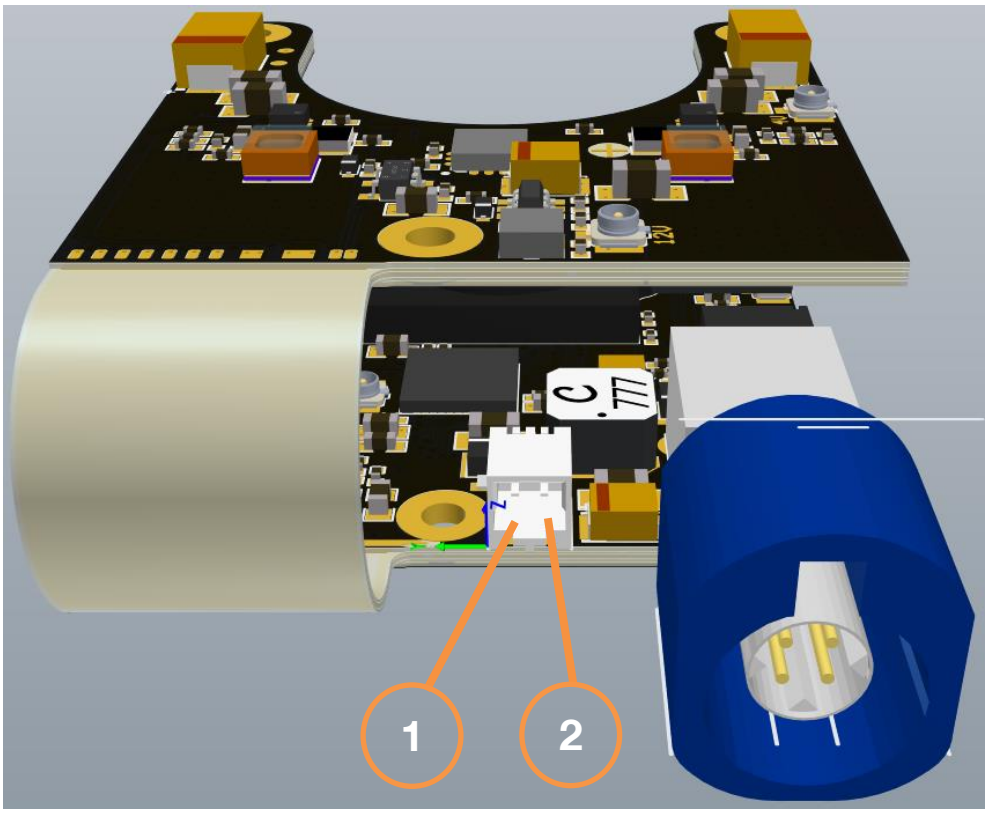


Figure 2-3 Auxiliary Power Connector

2.3.3 JTAG Connector

There are two programmable devices on the FrontEnd, the CPLD and the Kinetis MKL04Z16VFK4. Both devices can be programmed over the same JTAG connector. The connector is a standard 10 pole 2 row 1.27 mm pitch socket.

Pin Number	Description	Pin Number	Description
1	CPLD TMC	**2**	CPLD TDO
3	Kinetis SDA	**4**	CPLD TDI
5	CPLD Vref	**6**	CPLD TCK
7	Kinetis SCL	**8**	Kinetis Vref
9	Kinetis RESET	**10**	GND

Table 2-2 JTAG connector Pin Description

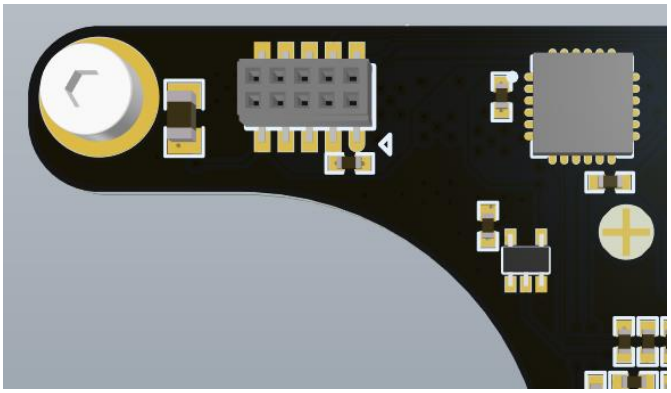


Figure 2-4 JTAG Connector Position

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
$V_{IO\ CPLD}$	Input or output voltage (CPLD Interface)	-0.3	2.1	V
$V_{IO-MKL04}$	Input or output voltage (Kinetis Interface)	-0.3	3.6	V
V_{IN}	Input supply voltage	-0.3	28	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)]	16	24	28	V
P	Average Board Power Consumption[2)]	TBD	-	TBD	W
I_{PK}	Peak input Current during Integration	-	-	2	A

Table 3-2: Electrical characteristics

[1)] If the input voltage sinks below the specified minimum value, 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 FrontEnd running with a modulation frequency of 40 MHz, a frame rate of 20 fps and an integration time of 600 µs.

3.1.4 Power distribution

The board is designed to work with a regulated 24 V power supply. The input voltage range is 16 V to 28 V.

The following diagram shows the power distribution on the board. The power source for the serializer (1.8 V) is always on, all other supplies, besides the illumination power, are enabled by the host via I²C.

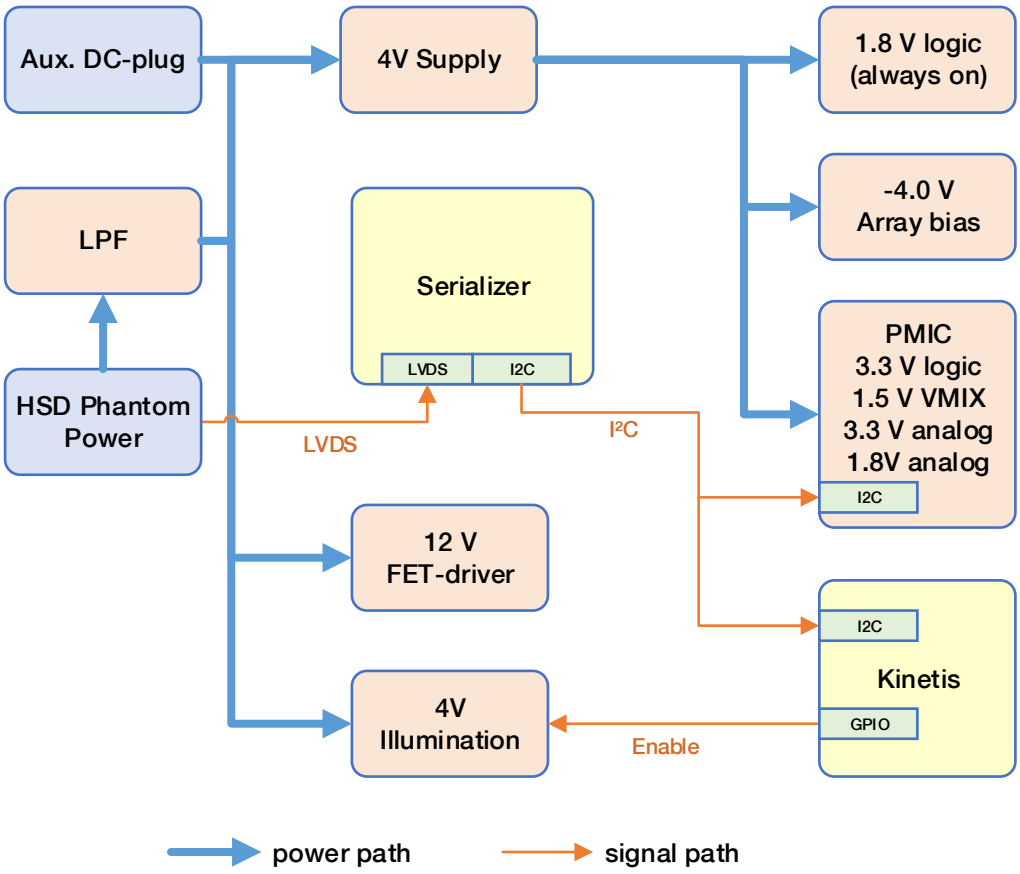


Figure 3-1 power distribution

4 Mechanical Outline

This section shows the mechanical outline of the FrontEnd when it is unfolded. All dimensions are given in mm.

4.1 Top View

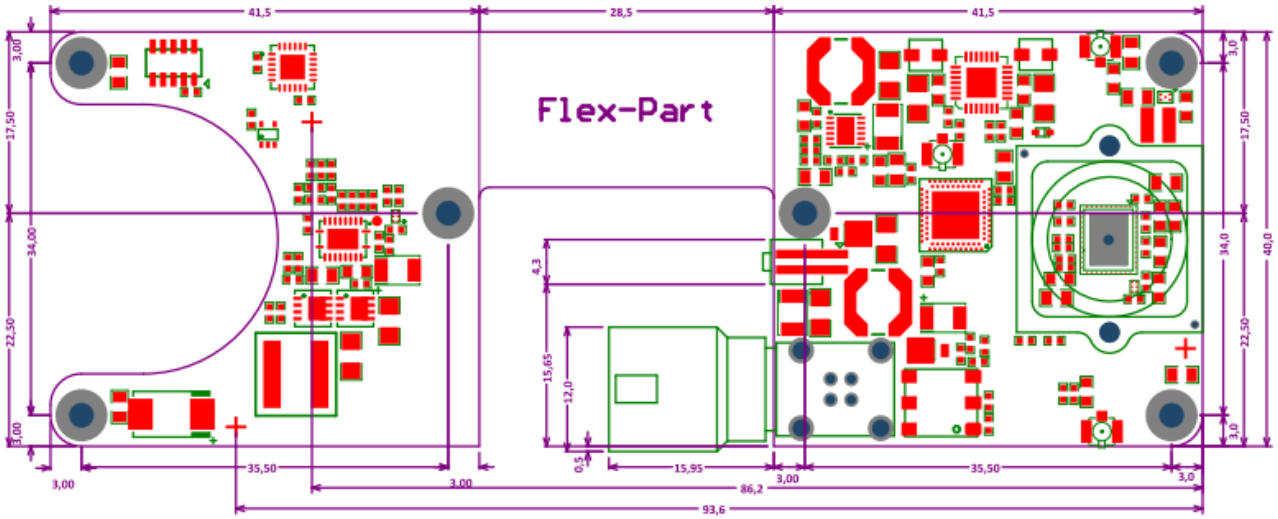


Figure 4-1 Mechanical outline top view

4.2 Bottom View

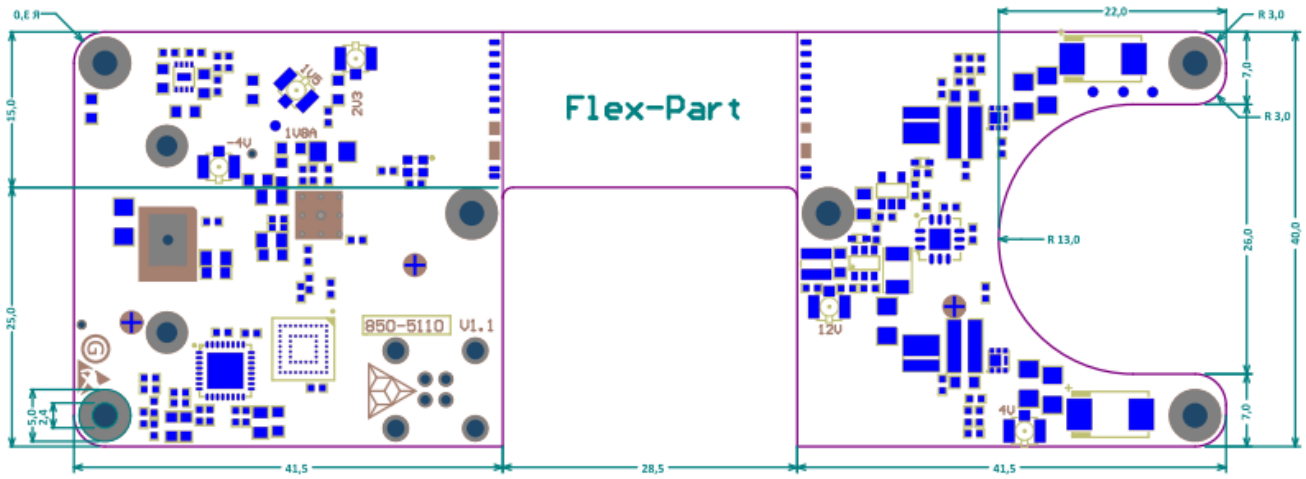


Figure 4-2 Mechanical outline bottom view

5 Support

TBD

6 Product History

6.1 Version Information

Version	Component	Type
1.1.0	Multi-tof-FrontEnd	x-grade

Table 6-1: Overview CamHub product changes

6.2 Anomalies

Version	Date	Description

Table 6-2 – Product anomalies

7 Document Revision History

Version	Date	Document Revision
1	2018 03 15	First Draft V1.0 of the Document

Table 7-1: Revision history

A List of Figures and Tables

Figures

Tables