PCB ARTS

User Guide

Helium

Reliable embedded system accelerated by NVIDIA® Jetson™ that is ideal for AI-supported applications - whether in the automotive industry, industrial automation or aerospace. Thanks to its flexible interfaces and robust design, it is the perfect choice for powerful edge computing in any environment.

Revision 1.0
Date 10.07.2025

NVIDIA Preferred Partner

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Table of Contents

1. Legal Notice

This manual contains information that must be observed for your personal safety and to prevent damage to property. PCB Arts GmbH 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.

1.1 Qualified Personnel

The product/system described in this documentation may only be used by personnel qualified for the task in question. Qualified personnel must observe the associated documentation for the respective task, in particular the safety and warning instructions contained therein. Resulting from their training and experience, qualified personnel is capable of recognizing risks and avoiding possible hazards when handling these products/systems.

1.2 Disclaimer

PCB Arts has checked the contents of the manual for conformity with the hardware and software described. Nevertheless, deviations cannot be ruled out, so complete conformity cannot be guaranteed. The information in this publication is checked regularly and any necessary corrections are included in subsequent editions.

1.3 Contact Information

Logistic Address	PCB Arts GmbH Kurgartenstraße 59, 90762 Fürth, Germany
Support E-Mail	support@pcb-arts.com
Contact Information	mail@pcb-arts.com

1.4 Limited Product Warranty

PCB Arts GmbH provides a one-year warranty for this product. Should this product fail, when it's installed correctly during the warranty period, PCB Arts GmbH will repair or replace this product at no charge. If the product has been subjected to abuse, misuse, accident, disaster or purchased from non-authorized companies, PCB Arts will add a charge for repair or replacements.

The above warranty is the only warranty authorized by PCB Arts GmbH. Under no circumstances will PCB Arts GmbH 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.

1.5 Trademark Acknowledgement

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1.6 Copyright Notice

2. Revision History

Revision	Date	Changes
0.1	25.05.2025	Initial Release
1.0	10.07.2025	Official Release

3. Introduction

Helium is one of the smallest edge AI embedded system accelerated by NVIDIA® Jetson™ product family. The Helium is a full embedded system with Orin Nano 4/8GB or Orin NX 8/16GB compatibility. It comes pre-flashed with the latest JetPack released from NVIDIA. With purchasing this product, you accept the EULA from NVIDIA.

- **NVIDIA® Jetson™ Orin Nano / NX with Super Mode:** up to 157 TOPs AI computing power
- **Camera interfaces:** 4x GMSL2 with up to 20 Gbit/s
- **Rugged connectivity:** 2x Gigabit Ethernet (M12), 1x USB 3.2 Gen 2 USB-C Screwable (10Gbit/s)
- **Robust design:** IP67 protection class, waterproof and dustproof, shock-resistant
- **Choice of connectivity:** M.2 E-Key for e.g WiFi, M.2 B-Key for e.g 4G or 5G
- **Compliance for 24/7 Operation:** Build for for 24/7 operations

More information about Helium: https://www.pcb-arts.com/en/helium

3.1 Ordering Information

Part Number	Description
HON1-D1-V5	Helium with Jetson Orin Nano 4GB
HON2-D1-V5	Helium with Jetson Orin Nano 8GB
HOX1-D1-V5	Helium with Jetson Orin NX 8GB
HOX2-D1-V5	Helium with Jetson Orin NX 16GB
H-DBG	Helium USB-C Adapter for UART & USB 3.2 Communication
H-FAN	Helium FAN Option (Degrades IP67 rating)
PSU-001	PSU with M12 A-Coded Output 24V 80W
CABLE-001	M12 (X-Coded) to RJ45 LAN Cable (3m)
CABLE-002	SMA to FAKRA Cable for GMSL (5m)
ANT-001	WiFi/BT Antenna
ANT-002	LTE Antenna

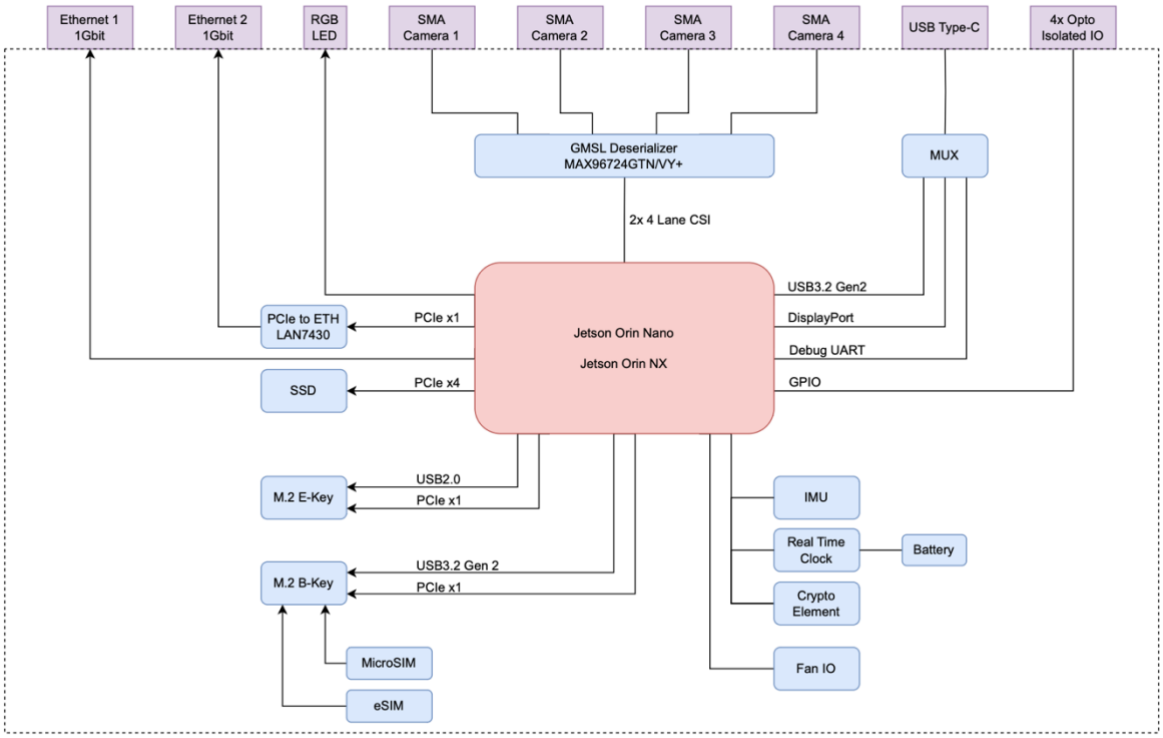
3.2 Scope of delivery

When ordering a sample unit, the Helium will come with a Power supply and cable (**PSU-001**), 1x M12 to RJ45 Cable (**CABLE-001**), 1x GMSL to Fakra Cable (**CABLE-002**) and an active cooling solution (**H-FAN**). Ordering Helium in higher quantities, Helium will be deliverd without any accessories. In both versions, sealing caps will be delivered in the package to cover unused IO's.

4. Technical Specifications

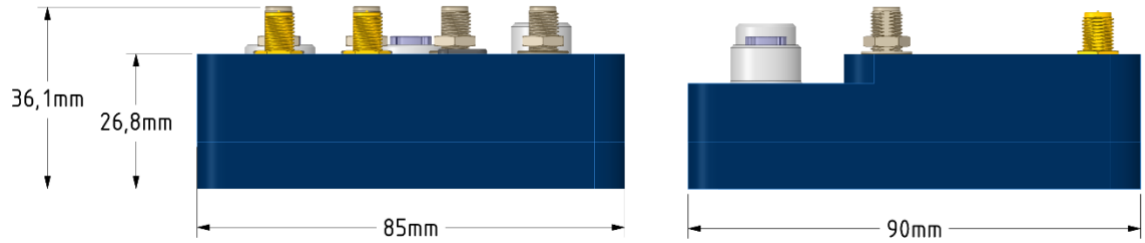
Specifications				
Product Name	**Helium HON1-D1-V5**	**Helium HON2-D1-V5**	**Helium HOX1-D1-V5**	**Helium HOX2-D1-V5**
NVIDIA Jetson SOM	Orin Nano 4GB	Orin Nano 8GB	Orin NX 8GB	Orin NX 16GB
AI Performance	34 TOPS	67 TOPS	117 TOPS	157 TOPS
GPU	512-core NVIDIA Ampere GPU with 16 Tensor Cores	1024-core NVIDIA Ampere GPU with 32 Tensor Cores		
CPU	6-Core Arm® Cortex®-A78AE			8-Core Arm® Cortex®-A78AE
Memory (RAM)	4GB (LPDDR5)	8GB (LPDDR5)		16GB (LPDDR5)
NVIDIA Jetson Power Modes	7W - 10W - 25W		10W - 15W - 25W - 40W	
USB	1x USB 3.2 (Connector: Type-C with Screw Terminal)			
GMSL2	4x GMSL2 up to 20Gbit/s (Connector: 4x SMA COAX)			
Networking	2x 1G Ethernet (Connector: M12 X-Code)			
Wireless Expansion	1x M.2 E-Key for WiFi (2x Connector: RP-SMA) 1x M.2 B-Key for LTE/5G (Connector: SMA)			
Power Input	+12V to +48V DC Power Input (Connector: M12 8-Pin A-Code)			
I/O	4x Opto Isolated GPIOs (Within Power Connector) 1x RGB LED			
RTC Battery	Battery Holder prepared			
Video Output	Display Port over USB-C			
Debug	Over USB-C			
Storage	128GB (BGA SSD)			
Operating System	Ubuntu 22.04 (JetPack 6.2)			
IP Class	IP67 with passive cooling			
Dimensions	90 x 85 x27 mm (LxWxH)			
Weight	350 gramms			
Operating Temperature	-40°C to + 85°C with active cooling option or custom designed passive cooling			
Mounting Options	Mounting Holes, Wall Mounting and DIN-rail Mounting			
Case	Lightblue aluminium case			
Certifications	CE, EMC, RoHS			

4.1 Block Diagramm

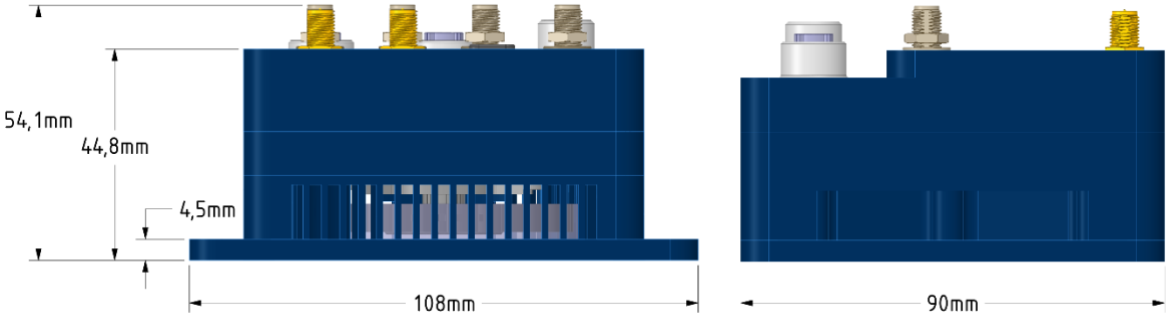


4.2 Dimensions

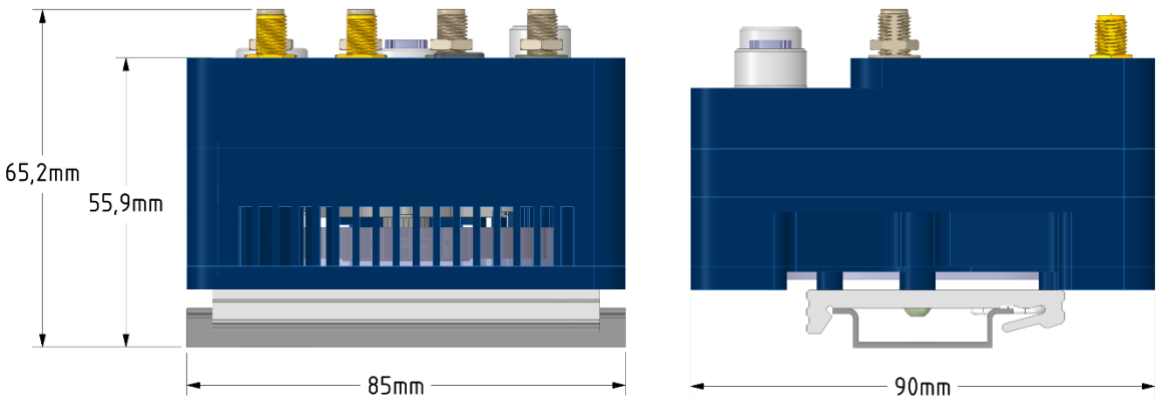
4.2.1 Dimensions Helium without active cooling



4.2.2 Dimensions Helium with wall mount cooling



4.2.3 Dimensions Helium with Din Rail mount cooling

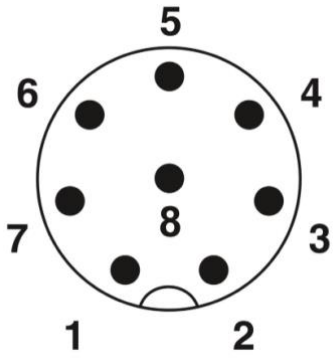


4.3 External Connectors

Location	External Connector	Description
Front	DC-In	+12V to +48V M12 A-Code, with 4x Opto Isolated GPIOs
Front	Ethernet 1	M12 X-Coded Gigabit Ethernet Connector
Front	Ethernet 2	M12 X-Coded Gigabit Ethernet Connector
Front	Cam1, Cam2, Cam3, Cam4	GMSL2 SMA (Female) Camera connectors
Front	Antenna 1, Antenna 2	SMA connectors (Male) for WiFi, LTE or 5G Antennas
Front	USB-C	USB 3.2 Type C-Connector (IP67 rated)
Back	FAN Terminal	Fan adaption interface with I2C. If want to use, please get in touch with PCB Arts.

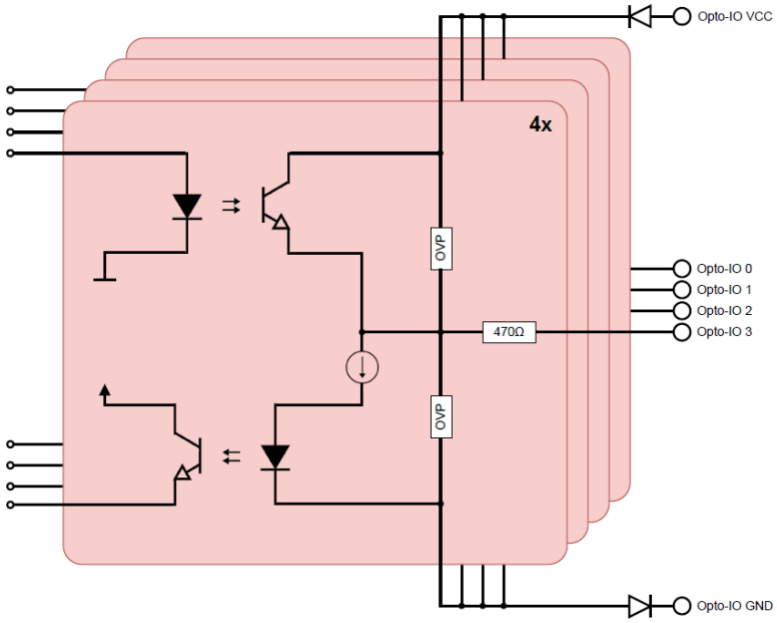
4.3.1 DC-In & GPIOs

Function	Description
Type	M12 A-Coded 8 pin
Connector	Sealed 8pin M12 A-Code
Pinout	Pin 1 = Opto-IO 0 Pin 2 = Power Positive Pin 3 = Opto-IO 1 Pin 4 = Opto-IO GND Pin 5 = Opto-IO VCC Pin 6 = Opto-IO 2 Pin 7 = Power Negative Pin 8 = Opto-IO 3
Mating Connector	Phoenix Contact - 1511860



View into Helium Connector

Notes	The power supply input of the Helium allows 12V-48V±10%. The overvoltage protection of Helium triggers both at positive and negative 54V. The input voltage is reverse polarity protected.



Notes	The input GPIOs can be driven by a voltage up to 48 V DC. The driving source must be capable to drive 5mA per input. The high going threshold voltage is 2.5V, the low going threshold voltage is 1.5V The output are bipolar Transistor Outputs, no power is delivered through these outputs. The inputs and Outputs are Overvoltage Protected at 55V from Opto-IO-GND to Opto-IO-VCC. The Opto IO Supply is polarity protected both for the Inputs and the outputs. The outputs are short circuit protected over the whole voltage range by the series resistors.

4.3.2 Ethernet 1

Function	Description	
Type	M12 X-Coded 8 pin	
Connector	Sealed 8pin M12 X-Code	
Pinout	IEEE-802.3 specification	
Mating Cable	Standard M12 X-Code to RJ45 CAT 6	
Notes	The Ethernet 1 is directly mapped the NVIDIA Jetson Ethernet Pins.	

4.3.3 Ethernet 2

Function	Description	
Type	M12 X-Coded 8 pin	
Connector	Sealed 8pin M12 X-Code	
Pinout	IEEE-802.3 specification	
Mating Cable	Standard M12 X-Code to RJ45 CAT 6	
Notes	The Ethernet 2 is connected via PCIe c9 (x1) to a LAN7430, the needed adaption in the kernel and device-tree is automatically in the BSP.	

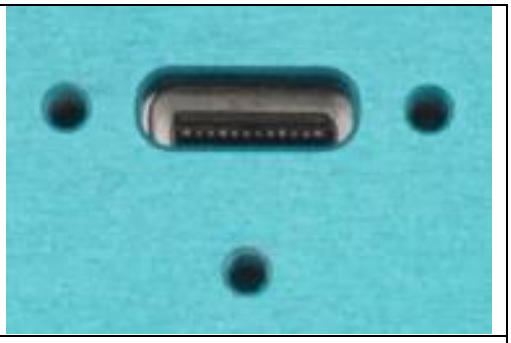
4.3.4 Cameras

Function	Description	
Type	SMA STD Female Sealed Connector	
Pinout	Cam 1 = GMSL 2 Cam 2 = GMSL 1 Cam 3 = GMSL 0 Cam 4 = GMSL 3	
Mating Cable	SMA Male to Fakra (Z type)	
Notes	All the camera interfaces are connected to the MAX96724 and share a total bandwidth of 20Gbit/s but no more than 6Gbit/s per port. The PoC (Power over Coax) voltage is enabled by default and can be disabled for all ports at once to reset the cameras. This is done by setting the MFP2 of the MAX96724 to an output and pulling it down. To enable it again, pull it high. The power good of the PoC supply can be read back with MFP1. 1 = PG The PoC voltage can be switched from 12V to 24V. **WARNING: Not all GMSL cameras support 24V PoC!** Setting MFP0 as an output can switch the PoC voltage, pulling it low sets 12V, pulling it high sets 24V. The maximum PoC output power per camera Port is 5W. There are supported partners directly available by PCB Arts, with drivers and compatibilities already built into the BSP. Please contact support@pcb-arts.com for a list of supported cameras partners.	

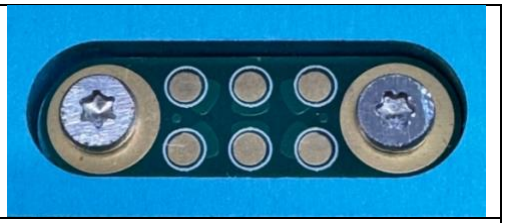
4.3.5 Antennas

Function	Description	
Type	SMA STD Male Sealed Connector	
Pinout	Antenna 1 = WiFi or Antenna 1 = LTE Antenna 2 = WiFi (AUX)	
Mating Antenna	TBD	
Notes	The antenna connectors will be pre-configured at every Helium, that can be connected directly to M.2 wireless connectivity modules. Either WiFi or 4G/5G is possible.	

4.3.6 USB-C

Function	Description	
Type	Sealed USB Type C	
Pinout	Universal Serial Bus Type-C Cable and Connector Specification	
Mating Cable	Standard USB 3.2 Gen 2 Type C. Optional: with screw terminal	
Notes	The USB-C is for flashing, UART communication, USB 3.2 communication and display Port. When a device with Video output is connected, there is no UART communication possible.	

4.3.7 FAN Terminal

Function	Description	
Type	Custom Sealed Adaption PCB	
Pinout	Get in touch with PCB Arts.	
Notes	This Interface is meant for a FAN adaptation of the Helium, please do not use this pins for own adaptions without consulting PCB Arts in advance.	

4.4 Cooling Solutions

Helium has two different cooling possibilities with an active fan, directly available from PCB Arts (IP67 is no longer possible) or with a custom designed heat-sink. Since every use-case is different there is this flexibility with the custom heatsink to adapt into customer´s solution. Either the customer designs a heatsink himself, or PCB Arts can support with that. In case of an assistance request, please contact support@pcb-arts.com.

To design a custom heat-sink please go to the Helium Website or Webshop, where PCB Arts provides a STP file for the enclosure of Helium. Also be aware of the maximum power of the different NVIDIA Jetsons, mentioned in the specifications above.

Helium has an internal preheater, which is automatically activated when powering up the device at temperatures underneath -20°C. When the preheater is activated, the LED flashes red instead of constantly illuminating blue/turquoise. As soon as the SOM is preheated to 0°C, Helium starts to boot normally. This preheating time takes between one to two minutes at -40°C.

5. Installation

Helium comes with empty M.2 Interfaces to allow put in M.2 Modules. When planning to install radio interfaces into Helium, please get in touch with PCB Arts before ordering, therefore SMA connectors will be prepared and installed into the housing. For shipping safety reasons, also no battery will be installed into the battery coin cell holder.

M.2 Interfaces:

- E-Key 2230 (WiFi) PCIe x1 and USB 2.0
- B-Key 3042 or 3052 (4G, 5G, GPS) PCIe x1 and USB 3.2 Gen 2

5.1 Insert M.2 Modules

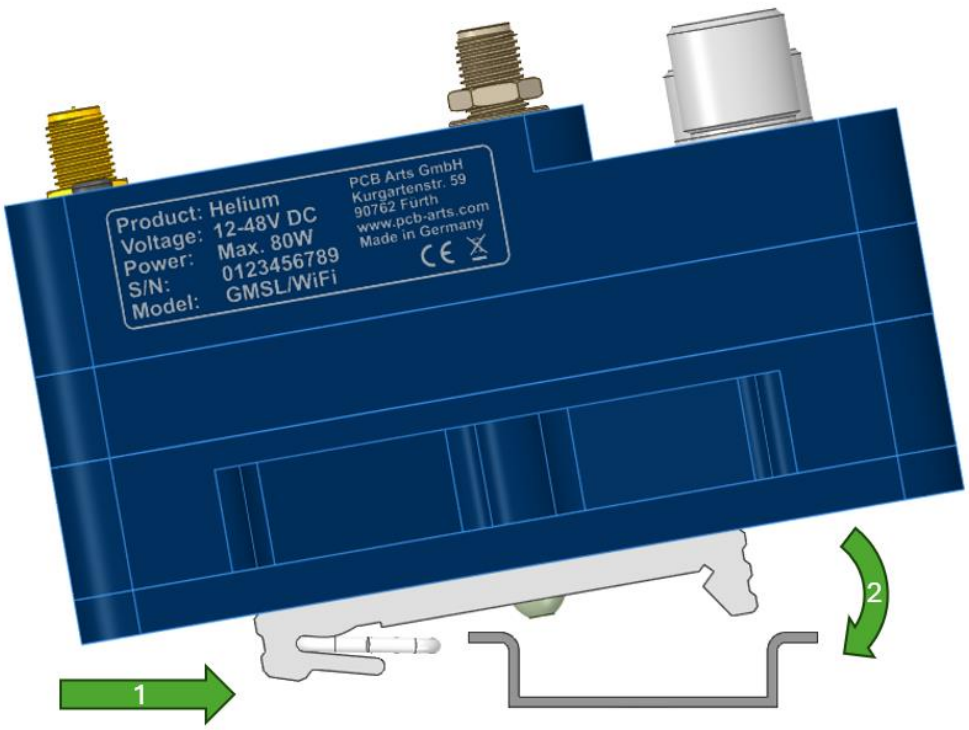
Please contact support@pcb-arts.com

5.2 Insert Battery coin cell

Please contact support@pcb-arts.com

5.3 DIN-Rail Installation

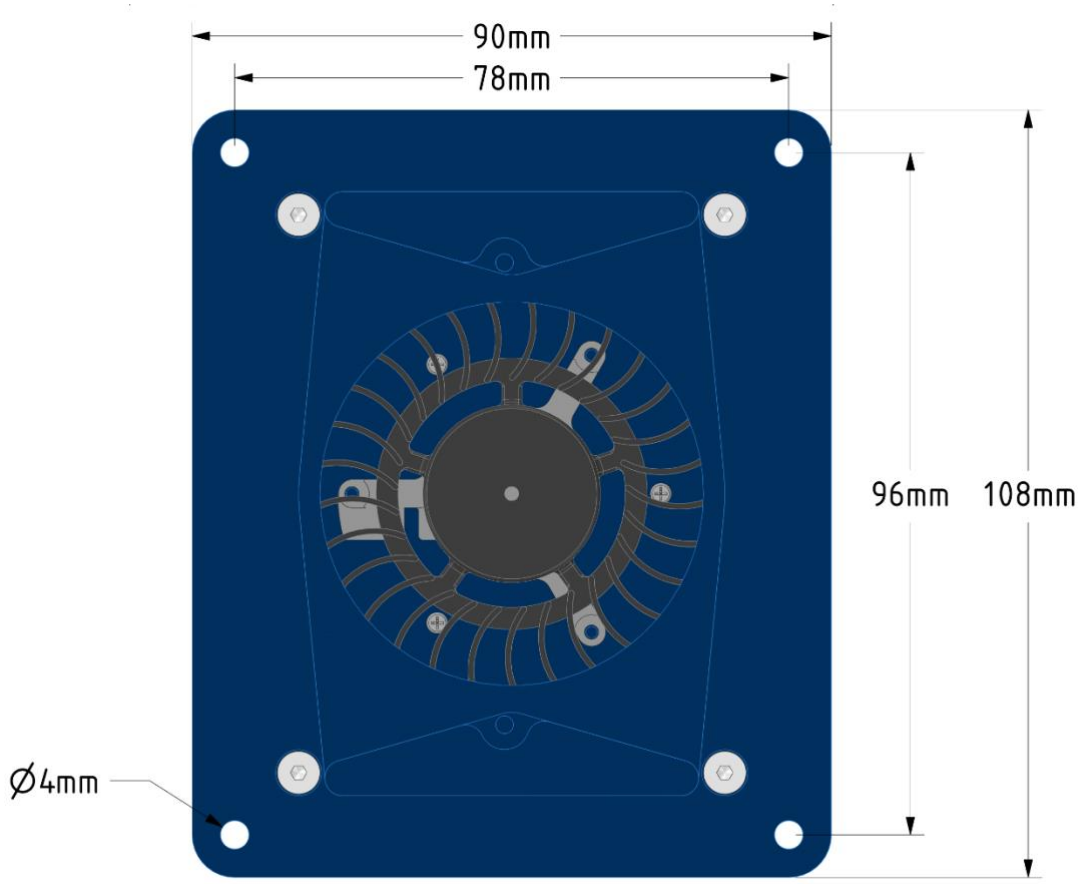
To mount Helium on a DIN-Rail, first slide on the side with the spring of the DIN-Rail mounting clip on the Din-Rail (1). Then further push it in this direction to compress the spring and flip the Helium straight to the DIN-Rail (2).



5.4 Wall-Mount Installation

Helium with Wall Mount can be attached to any wall or mounting plate which is capable of properly holding the device. For mounting, it is recommended to use one DIN912 M3 screw together with a DIN125 washer for each of the four mounting holes. Please ensure that there are enough threads in the mounting plate so that the helium is securely fastened.

Bolt Pattern:



6. Operations

6.1 First Bootup

To boot up Helium, please plug the DC-In into the device, after that it automatically boots up. Also, when powering down the device, it will automatically power itself up. It's build for 24/7 operations. When not having a sample unit with an active fan, please make sure a proper cooling solution is installed.

When first booting up Helium, it's recommended to use a USB-C docking station for Display Port, keyboard and mouse. Also, it's possible to access via SSH / Ethernet. The hostname in the network has the following scheme: helium-X where X is the serial number, engraved on the Helium.

E.g. Helium S/N: 00000001, then the hostname is: helium-1

Helium can be connected via network with "ssh helium@helium-1".

To access the operating system upon first start-up, use the following default access credentials:

- **Username:** helium
- **Password:** helium

Important: For security reasons it is recommended to change the default password after the first boot.

6.2 Re-flash Helium

For re-flashing Helium please plug Helium via USB-C to the host computer, it automatically detects it’s device mode. Then power on the device, by plugging in the DC-In. It is in flashing mode when the LED of Helium is blue. For getting the supported JetPack Version and for a detailled flashing instruction please visit the online-documentation.

6.3 Build in functionalities

Helium has build-in sensors and functionalities for different applications, which are user-adaptable. Included in every Helium are:

Part	Description
4x Opto Isolated GPIOs	Opto Isolated IO's which can be used as Input or Output.
IMU ICM-42670-P	A 3-axis gyroscope and 3-axis accelerometer which can be read out via I2C.
Crypto Chip ATSHA204A	A crypto security chip to encrypt the software, which is running on Helium.
External RTC	An external RTC for keeping the time without access to an NTP server.
GMSL MAX96724	A GMSL deserializer, which is connected with 8x MIPI CSI Lanes to it's two ports. It's connected to CSI0,1,2,3 and has a dedicated I2C Channel (CAM_I2C).

For a detailed software-documentation please visit the online-documentation.

6.4 UART Debugging

For UART Debugging the USB-C Port can be used, with the Helium USB-C Adapter for UART & USB 3.2 Communication (**H-DBG**), which is available at the online Webshop of PCB Arts. There are two USB-C Ports, one with a UART to USB Converter, which can be directly plugged into a computer. The BAUD Rate is 115200. The other USB-C Port can be used as a normal USB 3.2 Port and plug in cameras, mouse, keyboards etc..

Attention: When a device with a video output is connected to the H-DBG, then no UART communication is possible!

6.5 IP67 Rating

The IP67 Rating is just matched, when the ports are either connected or the delivered caps are screwed on the connectors. When USB-C is plugged, then no IP67 rating is achievable anymore. The USB-C doesn't need a cap to be IP67 rated.

7. Conformity

The official documentation of the simplified conformity and the quick guide can be found under following link:

https://static.pcb-arts.com/helium/Quick_Start_Declaration_of_Conformity_Short_Helium.pdf

The official documentation of conformity can be found under the following link:

https://static.pcb-arts.com/helium/Declaration_of_Conformity_Helium.pdf