

Modular embedded System for NVIDIA Jetson EdgeKit

Instruction manual

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Version

0.5

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<https://www.pcb-arts.com>

Please read this manual before operating the EdgeKit and follow the instructions when operating.

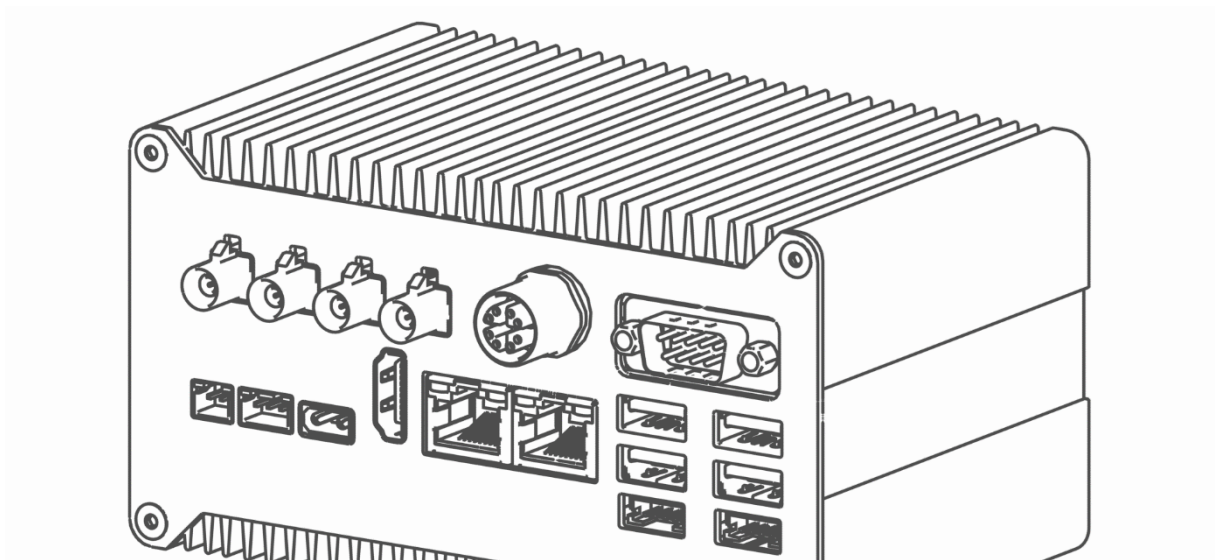


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1 Legal Notice

This manual contains information that you must observe for your personal safety and to prevent damage to property. The instructions for your personal safety are highlighted by a warning triangle, Notes on property damage alone are without a warning triangle.

Qualified personnel

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

Disclaimer

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

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2 Document revisions

Document version	Changes
0.1	Initial document for pilot phase
0.2	Updated all functionalities for released EdgeKit
0.3	Review and first release
0.4	Added legal page & safety instructions
0.5	Added frequency usages & deleted Jetson Nano/TX2

3 Product revisions

Product version	Changes
0.1	Engineering prototype
1.0	Pilot phase release
1.1	Production release

4 Overview

The EdgeKit is a modular embedded System for NVIDIA's Jetson family (Xavier NX, Orin NX, Orin Nano). Different hardware interfaces can be selected for the EdgeKit, which are required for the specific AI use case. The interfaces that are not required for the usecase are not installed in the hardware. Thus, the EdgeKit enables fast and cost-efficient prototyping and rollouts.

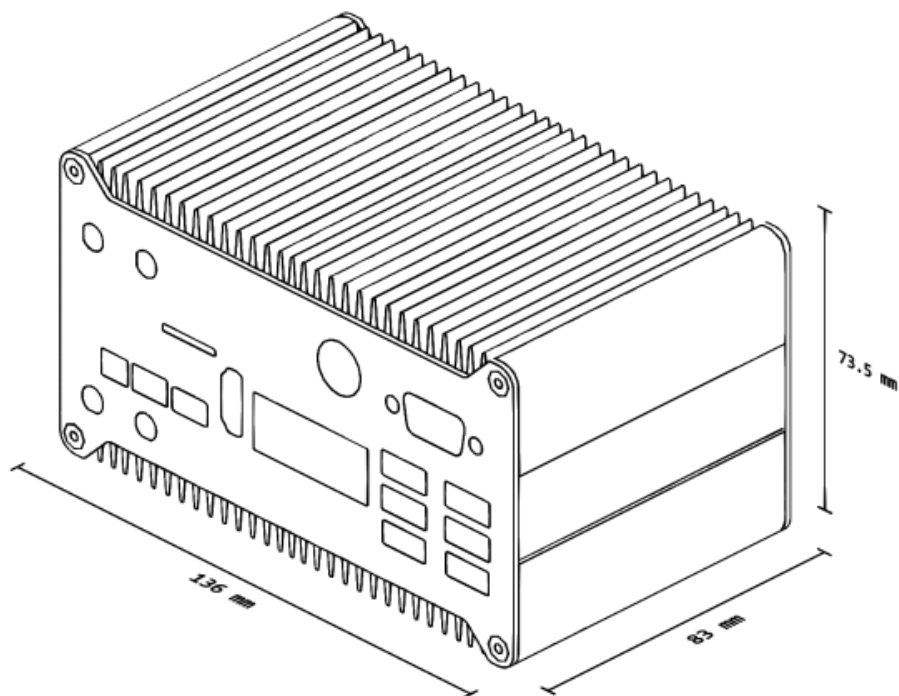
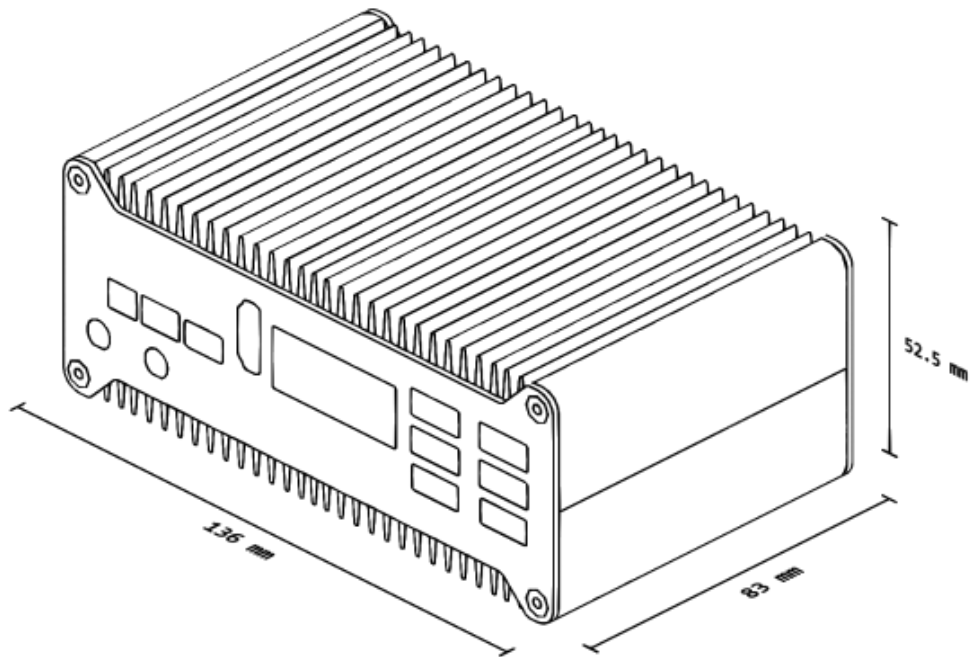
5 EdgeKit Features

5.1 Specifications

Description	Specification
DC Voltage Input	12V, 24V, 48V, 12V – 48V
Power consumption	Max. 60W
Ambient Temperature range	0°C to 50°C
Humidity	Not condensing
Displayport	No
HDMI 2.0	Yes
Fan	Optional
M.2 Key E, M (x1, depending on config x4)	Optional
miniPCIe	Optional
USB 3.1 (shared)	2 or 4 (optional)
CAN	Optional
Micro USB	1x Micro USB
1 Gbit Ethernet	1 or 2 (optional)
PoE	No
CSI	2, 4 or 6 (2- lanes)
UART	1x on 40 Pin Header, 1x inside EdgeKit
I2C	2
I2S	1
SPI	2

GPIOs	6
Opto Isolated GPIOs	4x In, 4x Out (optional)

5.2 Mechanical Specifications



Dimensions	136 mm x 73.5 mm x 83 mm (large case) 136 mm x 52.5 mm x 83 mm (small case) height +14 mm (with fans)
Weight	800 – 1000gr.

The housing is made of anodized aluminium. The engraving of EdgeKit is customizable with your company's logo. The color of the heat sinks of EdgeKit is customizable, when purchasing higher quantities units, since the manufacturing process is changed.

5.3 Options

If EdgeKit doesn't fit perfectly into your system, we could help you with custom design. We could do a customized design, just write us an email to edgekit@pcb-arts.com

5.4 SMC

There is a System Management Controller (SMC) installed on EdgeKit, the controller takes over all functionalities regarding the power management. It has an automatic installed watchdog, which will hard restart the EdgeKit, if the Linux OS doesn't react anymore.

The default state of EdgeKit is "Always on", so the EdgeKit tries in every situation to be online. The Linux suspend and halt mode aren't possible in this state. These two modes can't be monitored by the SMC and only possible to wake up through the power button. If EdgeKit is deployed somewhere inaccessible the "Always on" mode is highly recommended.

Also another state of EdgeKit is possible, this will interact normally with the power button of EdgeKit. The system could be completely turned off and needs human onsite interaction to power it on again. In this state the EdgeKit also supports suspend and halt modes.

This option cannot be changed after production.

6 Scope of delivery

The package includes an individual configured EdgeKit, including all the necessary antennas for e.g. WiFi, LTE or GPS. Additionally a power supply connector is enclosed.

7 Intended use

7.1 Power supply input

The required voltage and power is engraved on the housing, or you can find it in your order. The assignment of plus and minus for the 2-pin terminal can be seen in the picture in the section [Interfaces](#). For the barrel terminal the center is positive, and the housing is negative. If an incorrect Voltage is applied to the EdgeKit the blue LED starts flashing fast.

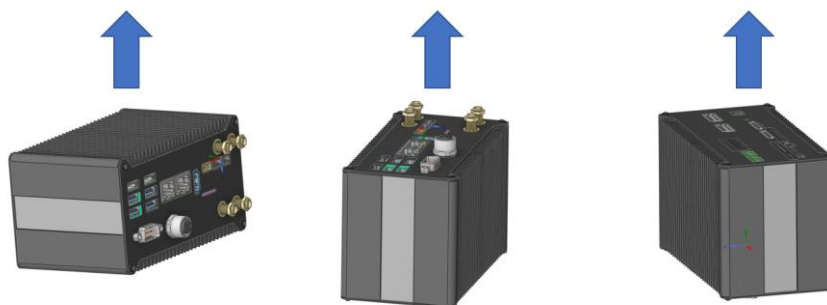
Recommended power supplies:

Connector Type	Manufacturer	Manufacturer number	DC Out
Barell	MeanWell®	GST60A12	12V
Barell	MeanWell®	GST60A24	24V
Barell	MeanWell®	GST60A48	48V
2 Pin	MeanWell®	NDR-75-12	12V
2 Pin	MeanWell®	NDR-75-24	24V
2 Pin	MeanWell®	NDR-75-48	48V

7.2 Thermal

The major dissipated Power is caused by the integrated System on Module. To prevent the System from overheating due to a lack of airflow, it is necessary to position it like described.

It always needs to be mounted ether the way that the interconnectors are on the top and bottom side. These mounting positions apply for every ordered mounting option.



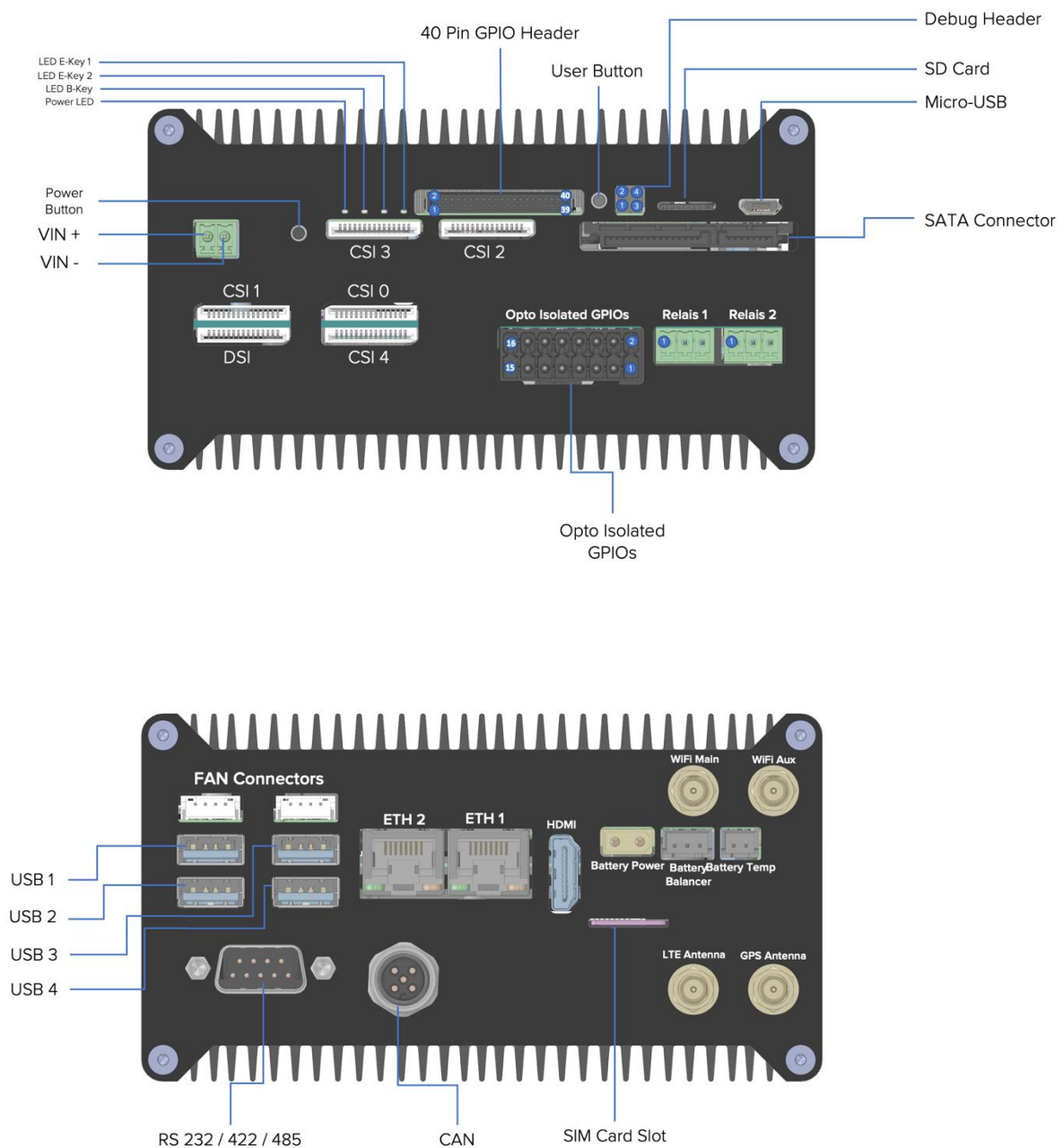
The heatsink of EdgeKit is design to handle a total power dissipation of 15W. The power consumption of the system hardly depends on the software which is running. Therefore, we would

recommend to order the Active Cooling Option for your test system and decide in the deployment phase, if you need a the fans or not.



Warning: The EdgeKit housing can become very hot (approx. 60°C) if the cooling is too low or if it is mounted incorrectly.

7.3 Interfaces



7.3.1 Power Button

When the button is pressed shortly, the system powers up and the Jetson starts booting. If it is pressed shortly during operation, a message on the screen asks whether you want to enter sleep mode, lock mode or shut down the EdgeKit.

If the button is pressed for about 10 seconds, a hard reset is initiated.

7.3.2 Radio Interfaces

When the WiFi Option was ordered, the EdgeKit is equipped with an integrated Intel 8265NGW Chipset. The WiFi Antennas need to be connected externally at the so marked Connectors. See [Interfaces](#) for more information. Every System with WiFi will be delivered with two Antennas, that can be connected to these connectors. If your usecase requires different antennas, these can connect to the SMA-reverse connectors instead.

When the LTE or GPS Option is ordered, the EdgeKit offers the SMA connectors for these Antennas, too.

Note: No radio interface of EdgeKit offers integrated Antennas.

7.3.3 USB Interfaces

The EdgeKit can be equipped with 2x or 4x USB 3.1.

Important notice: USB Cameras are not recommended, since there are a lot of driver incompatibilities. Use Ethernet or FPD Link instead.

Choosing the SATA or LTE options will each allocate one USB Port. That means if either one or both options are selected, there will only be two external accessible USB Ports available. Instead of providing these Interfaces to the user, they are used internally for the named options. The table below shows the available options:

USB No.	Usage
1	Standard
2	Standard
3	Optional or LTE Card
4	Optional or SATA Interface

7.3.4 CSI Interface

The EdgeKit provides the standard 15 pin 1mm pitch FPC connector for its CSI interfaces. These are pin compatible to the standard Raspberry Pi Cameras. All CSIs share the same, multiplexed, I2C bus. For supporting CSIs on EdgeKit, the original BSP from PCB Arts needs to be installed. The original BSP from PCB Arts supports sensors like the IMX219 out of the box.

Pin	Description	Pin	Description
1	GND	9	CAM_CLK_P
2	CAM_D0_N	10	GND
3	CAM_D0_P	11	CAM_PWDN

4	GND	12	CAM_MCKL
5	CAM_D1_N	13	CAM_SCL
6	CAM_D1_P	14	CAM_SDA
7	GND	15	3V3 (1.5A Polyfuse)
8	CAM_CLK_N		

7.3.5 Debugging Header

Pin 1 is shown in the [Interfaces Section](#). The logic level of the UART is 3.3V. To enter the flashing mode of the Jetson SoM connect Force Recovery to GND.

Function	Pin	Pin	Function
GND	2	4	UART2 TxD
Force Recovery	1	3	UART2 RxD

7.3.6 SATA Interface

For applications with high demand of storage, the SATA option is available for EdgeKit. A USB to SATA Bridge is integrated in that configuration. USB Ports 3 and 4 will no longer be available. The average speeds over this interface are 160Mbyte/s reading and 90Mbyte/s writing. The SATA Connector provides the voltages: 3.3V, 5V and 12V – each of them are protected by a 1.75A PTC polyfuse.

7.3.7 Periphery Hardware

EdgeKit has different periphery Modules e.g. (GPS, WiFi, LTE and SSD) optionally installed. See the list below for type and manufacturer information:

Function	Manufacturer	Modell
2nd Ethernet Chipset	Realtek	RTL8111
GPS Chipset	uBlox	NEO-M8
LTE Module	Quectel	EC25EFA
Integrated SSD	Transcend	TSXXXGMTE110S
WiFi Module	Intel	8265NGW

7.3.8 GPIO Header

The as **GPIO** marked Pins are all attached to an I2C port expander, how this is controlled is explained in section [Extended GPIOs](#). Pin 1 is marked in the [Interfaces section](#). All GPIOs can be used bidirectional (input or output). The powerpins **3V3** and **5V** can be used to supply your external circuitry. The maximum current of each rail is 1A. The logiclevel of the IO Pins is 3.3V. Each IO Pin can source and sink up to 10mA, the maximum current of all IO Pins together is 100mA.

Function	Pin	Pin	Function
3V3	1	2	5V
I2C1 SDA	3	4	5V
I2C1 SDL	5	6	GND
GPIO_P0.0	7	8	UART1 TX
GND	9	10	UART1 RX
UART1 RTS	11	12	I2S0 CLK
SPI1 SCK	13	14	GND
GPIO_P0.1	15	16	SPI CS1
3V3	17	18	SPI CS0
SPI0 MOSI	19	20	GND
SPI0 MISO	21	22	SPI1 MISO
SPI0 SCK	23	24	SPI0 CS0
GND	25	26	SPI0 CS1
I2C2 SDA	27	28	I2C2 SCL
GPIO_P0.2	29	30	GND
GPIO_P0.4	31	32	GPIO_P0.3
GPIO_P0.5	33	34	GND
I2S0 LRCK	35	36	UART1 CTS
SPI1 MOSI	37	38	I2S0 SDIN
GND	39	40	I2S0 SDOUT

7.3.9 Micro-USB

The Micro USB can be used for flashing the Jetson module. Use a high quality Micro USB for flashing the module, this is a common issue, since it is a highspeed flashing.

7.3.10 Relais

If this option is selected, two separate relays can be switched via the I2C port expander (control explained below). These can switch 50V AC @ 2A or 100V DC, at currents up to 0,5A.

Relay	Pin	Relay Contact	Function
-------	-----	---------------	----------

1	1	14	N.O.
1	2	12	N.C.
1	3	11	COM
2	1	24	N.O.
2	2	22	N.C.
2	3	21	COM

7.3.11 Opto Isolated IO Pins

The opto-isolated IO pins provide four digital inputs and four digital outputs.

The inputs can be driven by a voltage up to 30V DC. **The Input voltage must not be reverse polarity.** The driving source must be capable to drive 5mA per input. The Input signals are inverted, meaning an applied voltage above the input threshold Voltage leads to a logical 0. An inactive Input will read a logic 1 in software. 0-1V Logical high, 3V - 30V Logical low

The Outputs are n.o. MosFet Outputs. No Power is delivered through these outputs. If a logic 0 is written to the output, the resistance between "DO 1.x A" and "DO 1.x B" is >1MΩ. If a logic 1 is written, the output resistance between the two terminals will be 1Ω. The maximum on state current is 100mA, the maximum blocking voltage is 30V.

Function	Pin	Pin	Function
DO 1.0A	1	2	DO 1.0B
DO 1.1A	3	4	DO 1.1B
DO 1.2A	5	6	DO 1.2B
DO 1.3A	7	8	DO 1.3B
DI 1.0Neg	9	10	DI 1.0Pos
DI 1.1Neg	11	12	DI 1.1Pos
DI 1.2Neg	13	14	DI 1.2Pos
DI 1.3Neg	15	16	DI 1.3Pos

7.3.12 DC Power supply Input

In case of no Battery option:

The Powersupply Input of the EdgeKit is dependent of the ordered configuration. If a fixed Inputvoltage is ordered, an Inputvoltage of $\pm 10\%$ of the nominal voltage is allowed. If the Wideband Input is ordered, the input voltage can be from 12V $_{-10\%}$ to 48V $_{+10\%}$. To prevent the EdgeKit from damage due to overvoltage, a crowbar circuit is present, that triggers at 55V and shorts the input. Also, the input is reverse polarity protected.

In case of the Battery option:

The Power supply Input of the EdgeKit allows 12V $\pm 10\%$ or 24V $\pm 10\%$, dependent of the ordered configuration. To prevent the EdgeKit from damage due to overvoltage, a crowbar circuit is present, that triggers at 27V and shorts the input. Also, the input is reverse polarity protected.

7.3.13 CAN Interface

The connection on the SOM of the Jetson Xavier NX is used directly, this function is not available on the Jetson Nano. The CAN Interface is digital isolated and has the capability to enable a 120Ω termination resistor.

7.3.14 FAN Connector

The EdgeKit always provides two JST PH4 Fan Connectors. If a FAN unit has been ordered, it is connected via this interface. Both connectors provide the PWM signal, to control the RPM of the fans. This function can be controlled by the Jetson and is normally temperature controlled. So only if the temperature of the Nvidia Chipset rises, the fans start to spin. The connector above USB1 and USB2 also can monitor the spinning speed of the fans by reading the tachometer signal.

7.3.15 Ethernet

These are 2x 1 Gbit interfaces, ETH1 is directly connected to the Jetson board, ETH2 is provided via an internal PCIe hub and an Ethernet PHY.

7.3.16 LED's

LED	Information
Power	Blinking fast: Wrong voltage as Input Pulsing: EdgeKit off On: EdgeKit on
LTE	Shows LTE activity, controlled by the LTE Module
Wifi 2	Shows Wifi 2 activity, controlled by the WiFi Module
Wifi 1	Shows Wifi 1 activity, controlled by the WiFi Module

8 Jetson Software

The EdgeKit is shipped without all SDKs from NVIDIA, i.e. CUDA, OpenCV, DeepStream and various developer tools. Normally the latest from PCB Arts adjusted BSP will be automatically flashed on EdgeKit.

The default login is: username: **edgekit** / password: **edgekit**, please change it as soon as possible, since this isn't a secure password.

Python test scripts for RS communication, GPS, GPIOs and CSI are stored under /home/local/share/edgekit-samples.

8.1 Serial Interfaces

EdgeKit can communicate RS232, RS422 or RS485, in which mode you want to communicate you can select via the MODE pins. The table below describes the possible modes.

Mode 0	Mode 1	Function
0	0	Loopback
1	0	RS 232
0	1	RS 485 (Half-Duplex)
1	1	RS 422 (Full Duplex)

General for Serial Communication The MUX Pin must be pulled high to put the UART communication from the 40 pin header (Nano: /dev/ttyTHS1, NX: /dev/ttyTHS0) to the internal one. RS 422/485 Works only with active Flow Control (RTS).

Features

- All Modes can be slew limited to 250kbps to minimize Electromagnet Interference (EMI)
- Termination 120 Ohm on receiver, if termination pin is HIGH it will terminate (RS422/485)

Module	Linux-Pin	Function	Usage
NX	393	Internal UART Switch	High = RSXXX, Low = 40 Pin Header
NX	228	120 Ohm Termination	High = on, Low = off
NX	231	Slew Limit	High = on, Low = off
NX	229	Mode 1	
NX	230	Mode 0	

8.1.1 UART

The default maximum speed of Linux is 4MBaud.

UART0: For E-Key Wifi or GPS Communication. The Pin for Muxing is shown in the testscripts.

UART1: For 40 Pin Header or RS232 or RS422 or RS485 Communication. The Pin for Muxing is shown in the testscripts. The RTS pin of the Jetson works in connection with the transceiver as follows - for RS422 / RS485.

If RTS is Low, then data can be sent but not received.

If RTS is High, then data can be received but not sent.

UART2: Debug UART

8.2 I2C Interfaces

8.2.1 User Button

This button can be pressed from the outside, the readout works via the port expander as described in section [extended GPIOs](#).

8.2.2 Extended GPIOs for Main and Industrial

Running the command "cat /sys/kernel/debug/gpio" as root on the EdgeKit will give you all the information for the GPIOs. You see one or two small sections (16Pins) with gpiochipX. These are the Port-expanders, they can be written or read like normal GPIOs.

You can recognize the port expander on the mainboard by the name "main00" for the first pin. The control of the pins is available via several possibilities. In the Python test scripts, which are preloaded to /home/local/share/edgekit-samples an example way is shown.

8.2.3 CSI Interfaces

The Jetson Nano normally supports 4x CSI, but in the pilot only 3x of them are usable.

The initialization happens during the booting of the EdgeKit, for this the i2c-6 (i2c_cam) is switched through an I2C mux and then each camera is initialized one after the other. The I2C mux is necessary so that the same cameras with the same I2C addresses can be connected. By default only cameras with IMX219 sensor are supported.

Useable CSI Interfaces on Nano: DSI, CSI2, CSI3, CSI4

8.3 Cloud "EdgeFleet" Software

If you've choosed a cloud connection, you automatically will have a tun0 interface. This interface will try to connect as soon as possible to your instance of the EdgeFleet (End 2 End Encrypted). At this moment you can access your hardware via SSH directly through your instance. More information will follow in later manual revisions.

8.4 Restore Image

Please contact the PCB Arts team for support.

9 Additional equipment

9.1 GPIO 2.54mm adapter

For some use-cases you need a Raspberry Pi 40 Pin compatible break out adapter, which isn't included normally in the package. This can be ordered separately.

10 Frequency bands and maximum transmit power

The following antenna outputs are available (recognizable by the engraving on the antenna connector):

Engraving	Frequency or frequency band	Max. Transmitting power
WiFi	2412-2472MHz, 2422-2462MHz, 2402-2480MHz	20 dBm
WiFi	5180-5240MHz, 5260-5320MHz, 5500-5700MHz, 5745-5825MHz, 5190-5230MHz, 5270-5310MHz, 5510-5670MHz, 5755-5795MHz, 5720 MHz, 5710MHz, 5210-5290MHz, 5530-5690MHz, 5775MHz	23 dBm
GPS	1558-1615 MHz	-
LTE	GSM850/EGSM900	33 dBm \pm 2 dB
	DCS1800/PCS1900	30 dBm \pm 2 dB
	GSM850/EGSM900 (8-PSK)	27 dBm \pm 3 dB
	DCS1800/PCS1900 (8-PSK)	26 dBm \pm 3 dB
	WCDMA band	24 dBm \pm 1 dB
	LTE-FDD bands	23 dBm \pm 2 dB
	LTE-TDD bands	23 dBm \pm 2 dB

European Union

The low band 5.15 -5.35 GHz is for indoor use only.

	AT	BE	BG	CH	CY	CZ	DE
	DK	EE	EL	ES	FI	FR	HR
	HU	IE	IS	IT	LI	LT	LU
	LV	MT	NL	PL	PT	RO	SE
	SI	SK	TR	UK			

This equipment complies with the essential requirements of the European Union directive 2014/53/EU. See Statements of European Union Compliance. European Union Declarations of Conformity.

11 Conformity

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

https://static.pcb-arts.com/edgekit/Declaration_of_Conformity_Short_Quick_Guide.pdf

The official documentation of conformity for RED can be found under following link, this is applied when WiFi, LTE or GPS is chosen for the EdgeKit:

https://static.pcb-arts.com/edgekit/Declaration_of_Conformity_EdgeKit_RED.pdf

The official documentation of conformity for EMC can be found under following address, this is applied when WiFi, LTE or GPS is not chosen for the EdgeKit:

https://static.pcb-arts.com/edgekit/Declaration_of_Conformity_EdgeKit_EMV.pdf

12 Disclaimer

Thank you for reading this manual. If you have found any errors in this document, please let us know. Please treat all specifications with caution as there may be any typos or errors. This is the preliminary version of this manual.

PCB Arts Team

13 Copyright

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