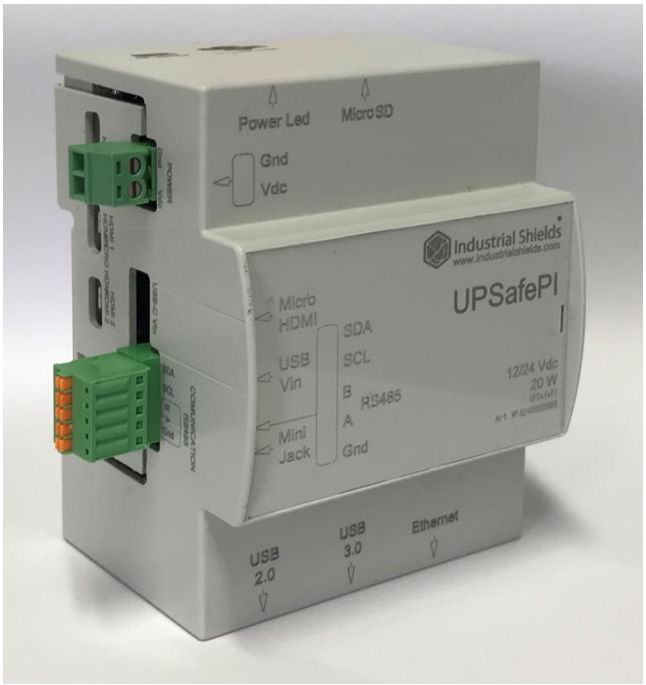
INDUSTRIAL SHIELDS

UPSafePi



UPS Safe Pi:

- Raspberry Pi 4
- UPS & RTC shield
- Enclosure

Industrial Shields

Raspberry Pi UPSafePi

Revised December 2021

Preface

This User Guide is been implemented by Boot & Work, S.L. working under the name Industrial Shields.

Purpose of the manual

The information contained in this manual can be used as a reference to operate, to functions, and to the technical data of the signal modules, power supply modules and interface modules.

Intended Audience

This User Guide is intended for the following audience:

- Persons in charge of introducing automation devices.
- Persons who design automation systems.
- Persons who install or connect automation devices.
- Persons who manage working automation installation.

Intended use or of Industrial Shields products

Consider the following:

Industrial Shields products should only be used for the cases of application foreseen in the catalogue and the associated technical documentation. If third-party products and components are used, they must have been recommended or approved by Industrial Shields.

The correct and safe operation of the products requires that your transport, storage, installation, assembly, operation and maintenance have been carried out in a correct It must respect the permissible ambient conditions. You should also follow the indications and warnings that appear in the associated documentation.

The product / system dealt with in this documentation should only be handled or manipulated by qualified personnel for the task entrusted and observing what is indicated in the documentation corresponding to it, particularly the safety instructions and warnings included in it. Due to their training and experience, qualified personnel are in a position to recognize risks resulting from the handling or manipulation of such products / systems and to avoid possible hazards.

Disclaimers

Weights and Dimensions

Dimensions and weights are nominal and they are not used for manufacturing purposes, even when tolerances are shown.

Performance Data

The performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of INDUSTRIAL SHIELDS's test conditions, and the users most correlate it to actual application requirements. Actual performance is subject to the INDUSTRIAL SHIELDS Warranty and Limitations of Liability.

Change in Specifications

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when features are changed, or published ratings or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special numbers may be assigned to fix or establish key specifications for your

application on your request. Please consult with your INDUSTRIAL SHIELDS representative at any time to confirm actual specifications of purchased products.

Errors and Omissions

The information in this document has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

These components may only be operated in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used. These components may only be handled by qualified and trained technical personnel who are knowledgeable and observe all of the safety information and instructions on the components and in the associated technical user documentation. When carrying out a risk assessment of a machine in accordance with the EU Machinery Directive, the machine manufacturer must consider the following residual risks associated with the control and drive components of a PDS.

Table of Contents

INDUSTRIAL SHIELDS

1 General Description

This device consists of a Raspberry Pi 4 attached to a UPS & RTC shield, all in a perfect fitted enclosure.

1.1. General Specifications

1.1.1. Raspberry Pi 4

Processor	Broadcom BCM2711, quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
Memory	2GB, 4GB or 8GB LPDDR4 (depending on model)
Connectivity	2.4 GHz and 5.0 GHz IEEE 802.11b/g/n/ac wireless LAN, Bluetooth 5.0, BLE Gigabit Ethernet 2 × USB 3.0 ports 2 × USB 2.0 ports.
GPIO	Standard 40-pin GPIO header (fully backwards-compatible with previous boards)
Video & Sound	2 × micro HDMI ports (up to 4Kp60 supported) 2-lane MIPI DSI display port 2-lane MIPI CSI camera port 4-pole stereo audio and composite video port
Multimedia	H.265 (4Kp60 decode); H.264 (1080p60 decode, 1080p30 encode); OpenGL ES 3.1 graphics, Vulkan 1.0
SD card support	Micro SD card slot for loading operating system and data storage
Input Power	5V DC via USB-C connector (minimum 3A*) 5V DC via GPIO header (minimum 3A*) Power over Ethernet (PoE)–enabled (requires separate PoE HAT)
Environment	Operating temperature 0–50ºC

*A good quality 2.5A power supply can be used if downstream USB peripherals consume less than 500mA in total.

1.1.2. UPS & RTC shield

- Plug & Play UPS Smart Shield and Real Time Clock (RTC) for Raspberry Pi
- Avoid any SD corruption issue
- 12Vdc or 24Vdc
- With RS485 protocol available
- Compatible with all Raspberry Pi 2, 3, 4 & all Raspberry Pi B models
- Recharge Time: Less than 1 minute
- Reconnecting time: Less than 20 seconds
- With reboot button (or the possibility to add an external one)
- Vin ESD protection

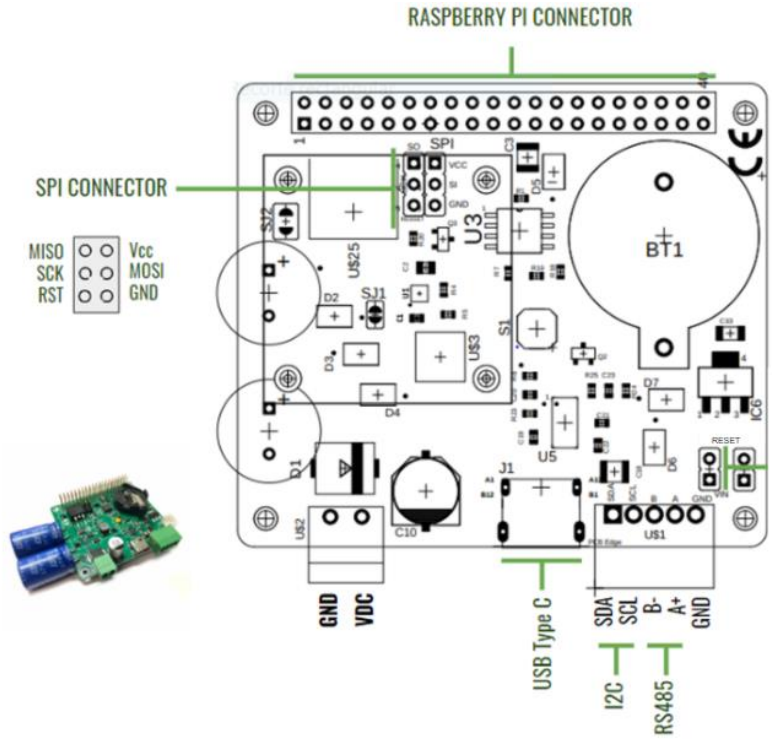
Operational Voltage	Current	Max. Current	Super Capacitors	Certificate	Possible MCU Connections	RTC
12 or **24Vdc** (Antipolarity + Filter)	**3 A** (Autoprotected by chip)	**3,5 A**	x2 (**25F**) **2.7V**	CE, RoHs	-Raspberry Pi 2 & 2B -Raspberry Pi 3 & 3B -Raspberry Pi 4B	**DS3231** Coin cell : CR1220

1.2. Available Communications & Accessories

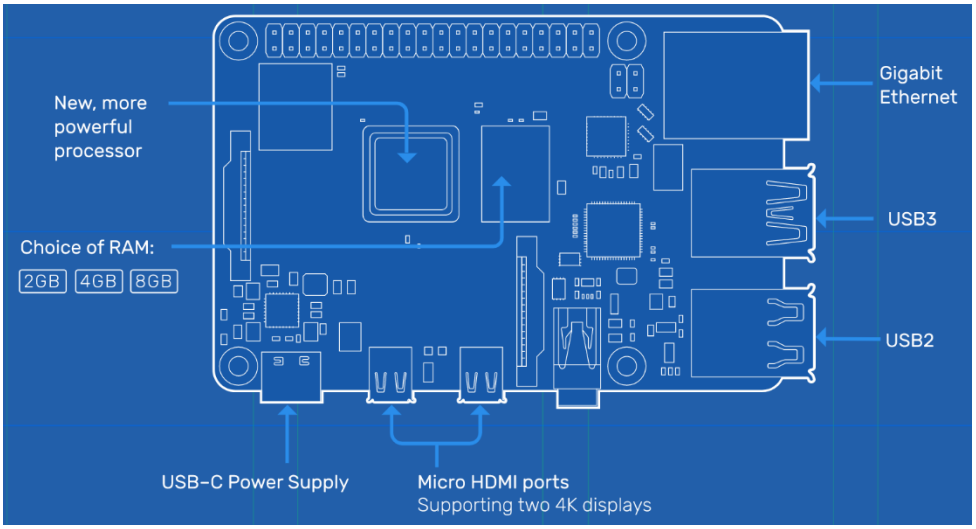
- RS-485 Port
- ICSP Connector
- I2C (3,3Vdc)
- USB Type-C (Power Only)
- RTC
- Raspberry Pi Connectors

1.2. Pinout

1.1.1 UPS & RTC Shield

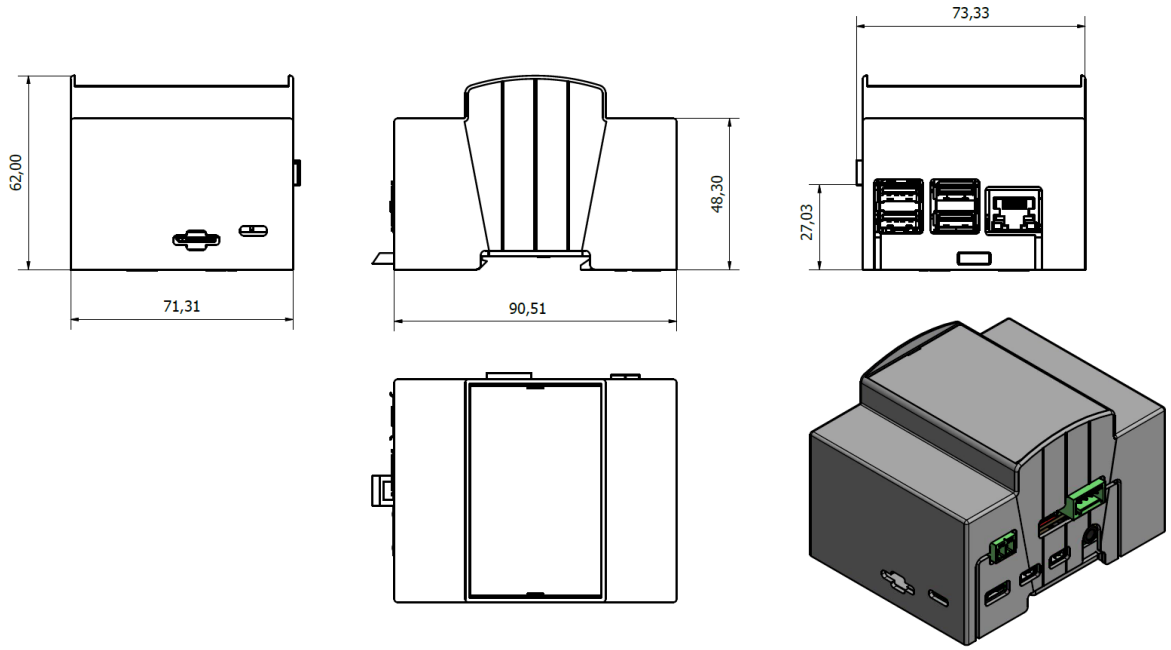


1.1.2 Raspberry Pi 4



1.4. Mechanical dimension

1.4.1. Overall device



1.4.1. UPS & RTC shield

*The capacitors will be assembled in a different way.

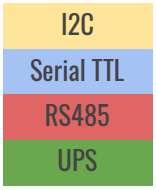
1.5. Main parameters

Parameter	Value	Conditions
Input parameters		
Input voltage (screw terminal)	7V DC … 28V DC	At screw terminal
Input voltage (USB terminal)	5V DC	USB terminal
Average input current	0.5A	Charge mode + RPi Booting at Vin = 24V
Output parameters		
Output voltage range	4.75V DC … 5.5V DC	
Output current range	0Aavg … 2Aavg	
Output ripple	20mV pp	Raspberry Pi as a web server
Control parameters		
Pin 16 (GPIO23)	3.3V – 5V (Inputs maximum voltage)	
Pin 13 (GPIO27)	3.3V – 5V (Outputs maximum voltage)	

1.6. Raspberry PI 4 Pinout Connector

	NC	1	2	Vin	
SDA	GPIO2	3	4	Vin	
SCL	GPIO3	5	6	GND	
	NC	7	8	GPIO14	TXD
	GND	9	10	GPIO15	RXD
	GPIO17	11	12	NC	
DE	GPIO27	13	14	GND	
	NC	15	16	GPIO23	UPS Control from RASPBERRY
	NC	17	18	GPIO24	UPS Control to RASPBERRY
	NC	119	20	GND	
	NC	21	22	NC	
	NC	23	24	NC	
	GND	25	26	NC	
	NC	27	28	NC	
	NC	29	30	GND	
	NC	31	32	NC	
	NC	33	34	GND	
	NC	35	36	NC	
	NC	37	38	NC	

	GND	39	40	NC	



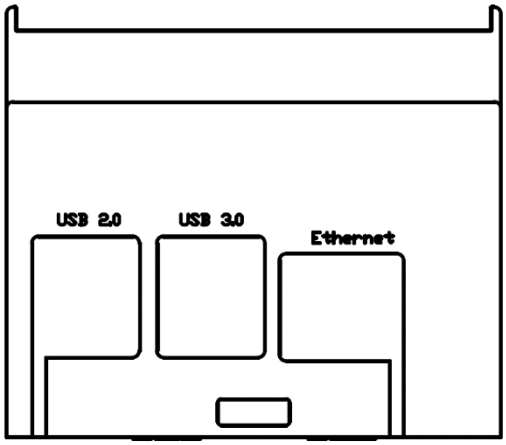
- GPIO24 (Raspberry's 18 pin) is used by UPS to report if an emergency power-off is needed. If the UPS shield detects that the external power supply has been lost, this pin is going to be connected to GND. In the opposite case, this pin is not going to be connected. Because of this, it is recommended to configure this pin with a pull-up software.
- GPIO23 (Raspberry's 16 pin) is used to report a finished saving process. If system fails, the UPS shield will maintain the power supply till it receives a low logic value from this pin. If this pin is not connected, the UPS shield will manage that, in the case of a failure, it must provide power till the capacitors run out of energy.
- GPIO27 (Raspberry's 13 pin) is the 485 half duplex control. The transmission will be enabled with a positive logical value. The reception will be enabled with a negative logical value.
- **CAUTION:** this shield is used to discharge the capacitors but, when they are fully charged, it is very important to ensure that any short-circuit happens because it may brake the shield.
- The reset white connector it must have a normally open push button and, when it is pushed, the power supply is going to be removed from the Raspberry. This job can be equally done pushing the reset button in the shield.

NOTE: If using Raspberry Pi 2 or Raspberry Pi 2 model B, consider the following information:

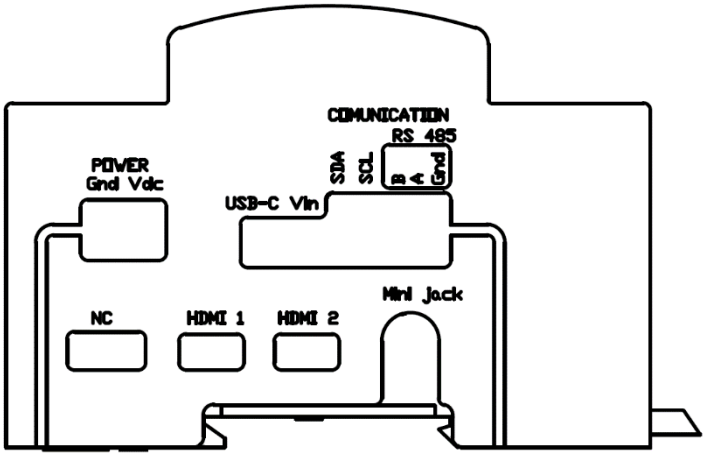
- GPIO27 is GPIO2 on a Raspberry Pi 2 or Raspberry Pi 2 B model.
- GPIO2 & GPIO3 are GPIO8 & GPIO9 respectively on a Raspberry Pi 2 or Raspberry Pi 2 B model.
- GPIO23 & GPIO24 are GPIO4 & GPIO5, respectively on a Raspberry Pi 2 or Raspberry Pi 2 B model.

1.8. UPSafe Pi Serigraphy:

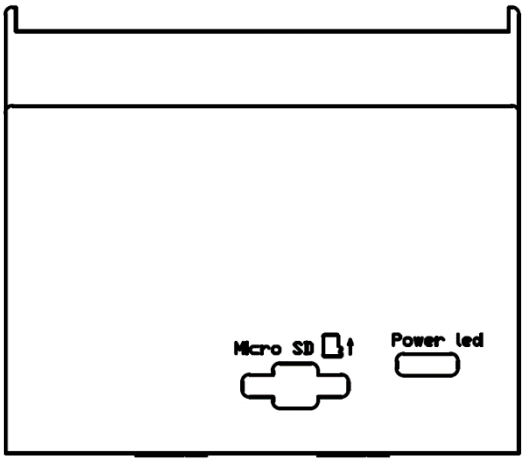
1.1.3 View 1



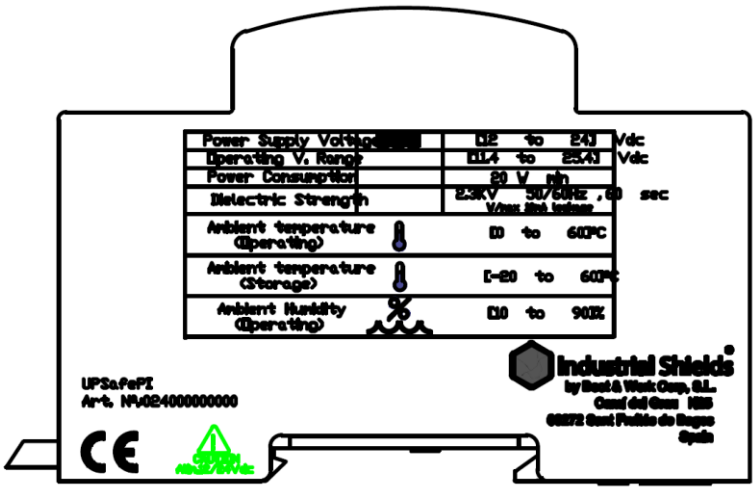
1.1.4 View 2



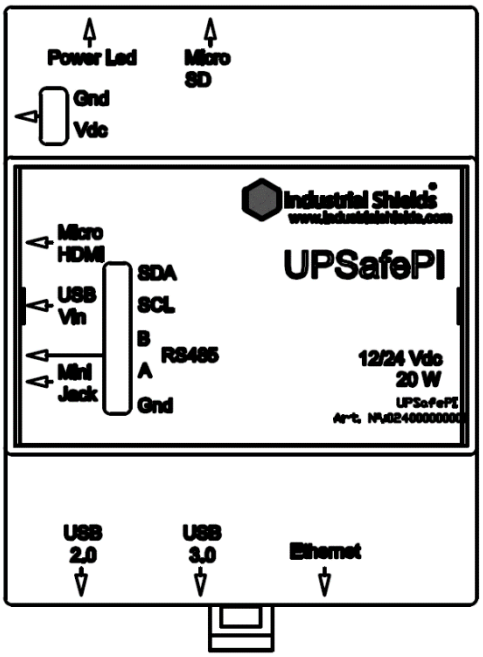
1.1.5 View 3



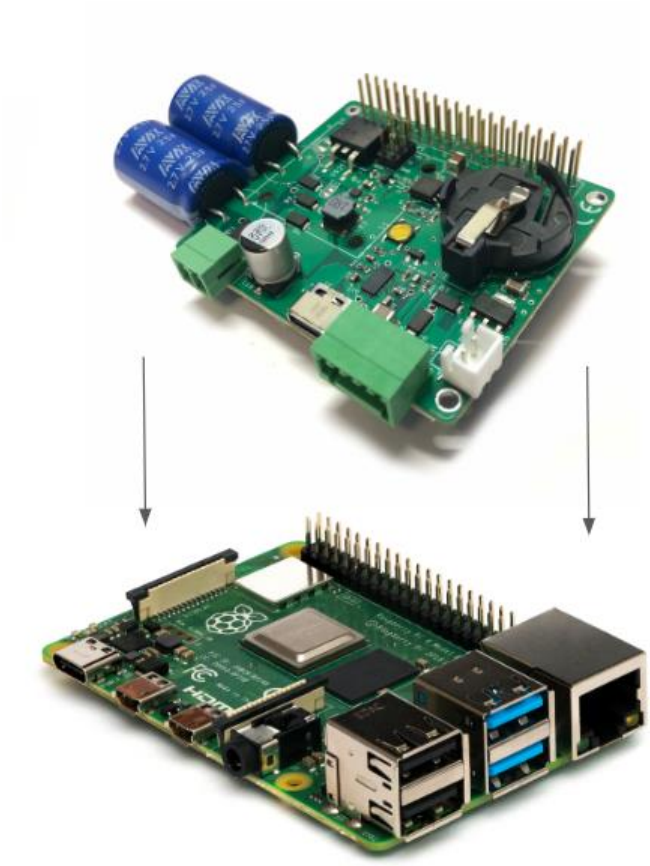
1.1.6 View 4



1.1.7 View 5



1.7. Raspberry Pi Connections:



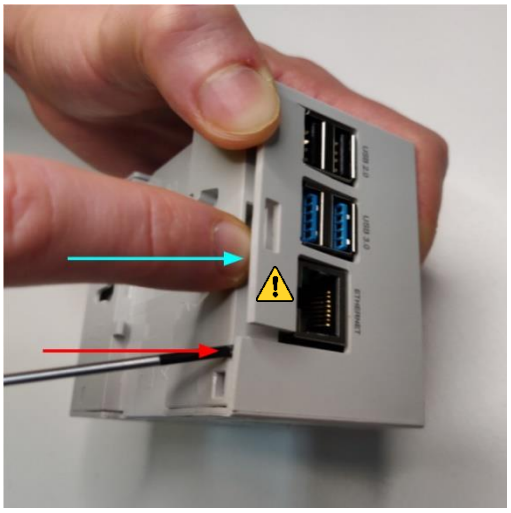
1.2 Unmount/Mount instructions

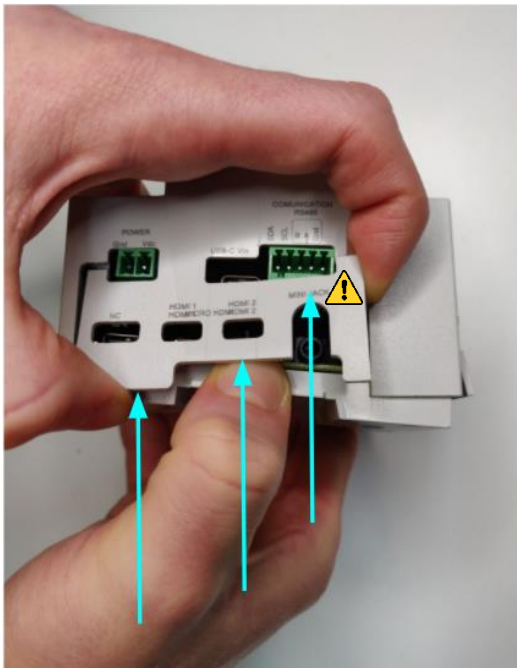
The device must be unmounted to place the Raspberry with the UPS shield (if required) or to access to the cell coin slot.

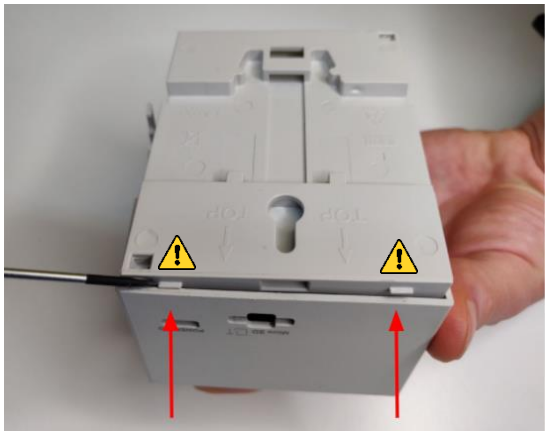
1.2.1 Unmount

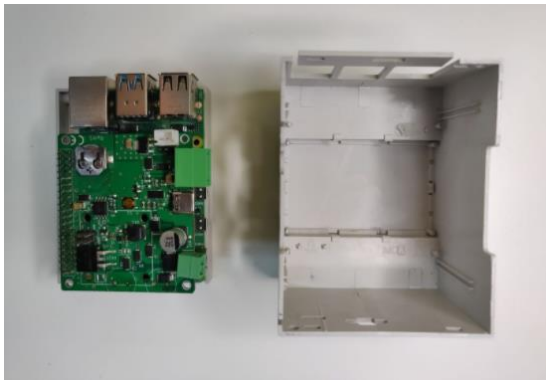
The steps to unmount it are the following ones:

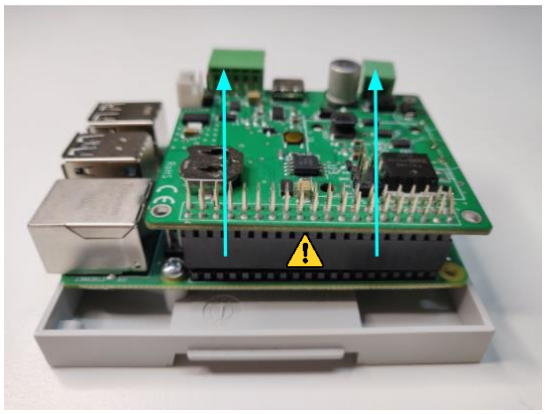
- Carefully, push with the fingers where the blue arrow is located and push with a screwdriver (or screw/unscrew if required) where the red arrow is located. Be delicate with the spots pointed with the alert sign. Remember to remove all the connectors and the microSD card to mount/unmount the device and place them again when the process is finished.

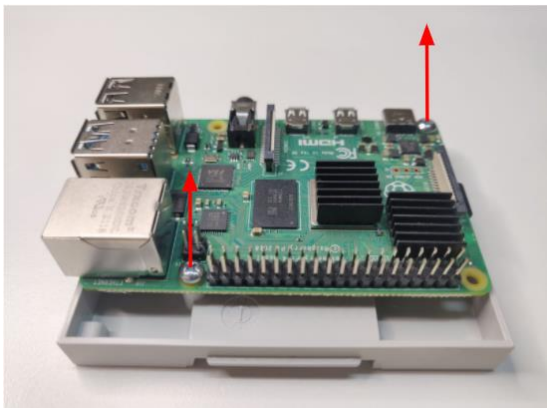










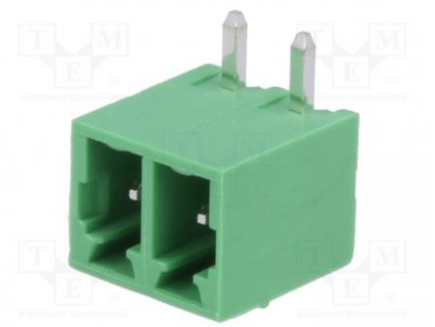


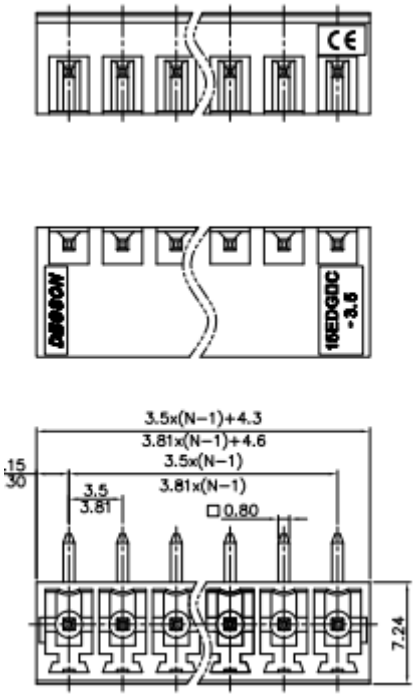
- The steps to mount it are the same but inversely (be careful with the plastic tabs and be sure that everything is placed in the right way).

1.8. Connectors:

- POWER CONNECTOR:

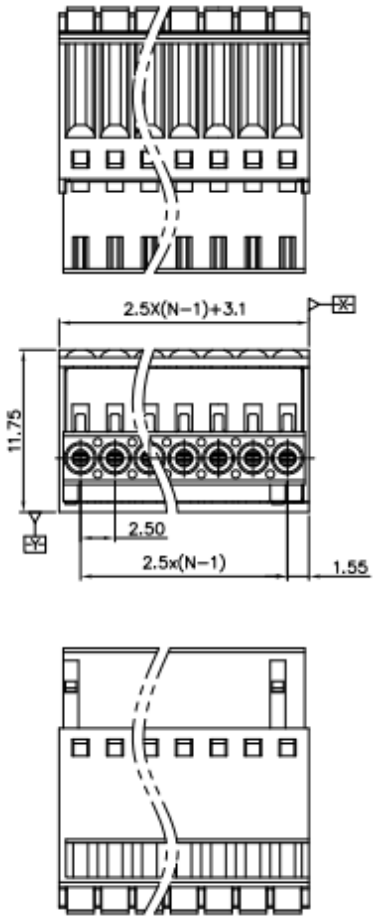
SKU: 15EDGRC-3.81-02P-14-00A(H)





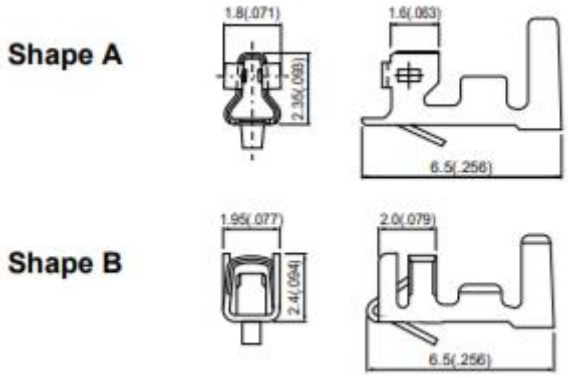
- COMMUNICATIONS CONNECTOR:

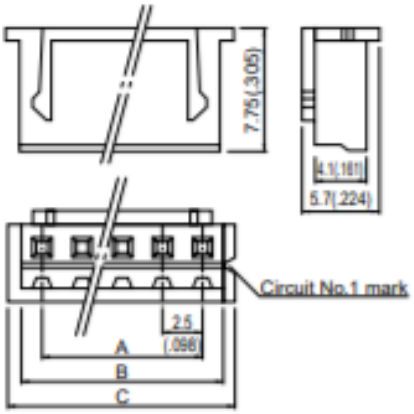
SKU: 15EDGKD-2.5-XXP-1Y-00A(H)



- RESET CONNECTOR:

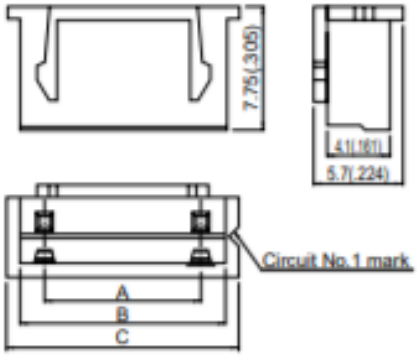
SKU: B2B-XH-A (LF)(SN)



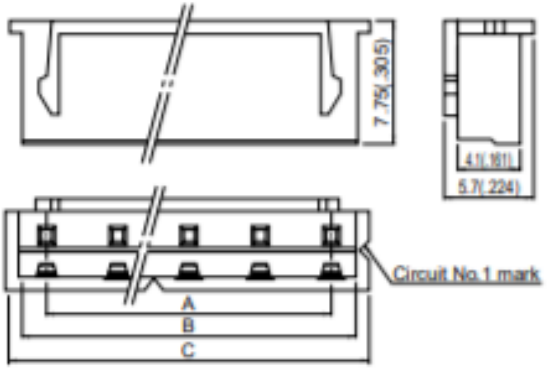


Plugged up

(2 circuits 10.0mm(.394") pitch)



(6 circuits 5.0mm(.197") pitch)



2 Raspberry Pi Software

To start working with the UPS on your Rasbperry Pi module, you need to download the rpishutdown file and rpshutdown.service provided on this link.

2.1. Standard image installation

Raspberry must be used with an image installed in a SD card inserted in the available slot. By default, it is not provided but you can acquire it to install your OS required version. The most used and recommended one is Raspbian.

Even so, if you want to install another operating system compatible with Raspberry Pi 4B, all the services, scripts and executables must be added to the new image to be able to operate with the additional communications, the I/Os of the PLC as well as the internal UPS, among other functionalities.

Here are the steps to do it easily once the new image is installed:

1. Download the Raspberry Pi Imager from this URL: https://www.raspberrypi.org/software/
2. Download an operating system image from Raspberry Pi. All the operating system images available here: https://www.raspberrypi.org/software/operating-systems/
3. Take your microSD card with an adapter for your PC, and write the image from the Raspberry Pi Imager.
4. Once written, you can introduce the microSD card in your Raspberry PLC.

2.2. Enable the controlled shutdown on your Raspberry Pi

Rpishutdown service allows the UPS to do a controlled shutdown of the Operative System once it detects that the main power inlet of the Raspberry PLC has been disabled. Then it closes all the opened processes before the shutdown, protecting the SD card image and all the files included.

Once both files are downloaded, the next step is copying these files on the expected folders:

We are going to copy to:

/usr/local/bin/

the *rpishutdown* file. This file is usually created by default but, in case that it is not created, you can directly create this folder going to execute this command:

```
sudo mkdir -p /usr/local/bin/
```

Once we are on the expected folder, we are going to execute these commands in the following command:

```
cd /usr/local/bin
sudo chmod ugo+x rpishutdown
```

Now that the rpishutdown file has permissions, the next step is to copy the rpishutdown.service on the expected folder using the following command:

```
mv rpishutdown.service /lib/systemd/system
```

We are going to activate the services because, when the system restarts, they must run automatically:

```
sudo systemctl enable rpishutdown.service
```

To start the services at this moment:

```
sudo systemctl start rpishutdown.service
```

The service can be also stopped if needed:

```
sudo systemctl stop rpishutdown.service
```

2.3. How to execute commands before the Power Off process

To execute specific commands before finishing the Power Off process, you must follow the next steps:

- Create this path inside the /etc folder:

```
sudo mkdir -p rpishutdown/hooks/
```

- Inside this folder, create a file called pre-poweroff:

```
sudo nano pre-poweroff
```

The file type can be anyone you want (Bash Scripts, Python, C++, etc.) but the most important thing is that it must be called **pre-poweroff** without any extension (you must indicate the file type with the

corresponding **Shebang**). The script execution time cannot surpass ~**6** seconds, as it is the Raspberry's Power Off period.

- Give the execution permissions to the file:

```
sudo chmod ugo+x pre-poweroffs
```

Following these steps, the file must be executed before the Raspberry Power Off.

2.4. Enable the RTC functionality on your Raspberry Pi

To enable the RTC functionalities, the steps to follow are:

- In order to ensure you have got the latest updates you should run the following commands:

```
sudo apt-get update
sudo apt-get -y upgrade
```

- In the file */boot/config.txt* uncomment the line:

```
dtparam=i2c_arm=on
```

and at the end of the file */boot/config.txt*, after the [all] statement introduce the following line:

```
dtoverlay=i2c-rtc,sd3231
```

Finally, the last step requires to restart the Raspberry Pi so that the changes made are saved and you can work with the RTC integrated in the UPS.

2.5. Enable the RS-485 functionality on your Raspberry Pi

The UPS Shield module contains a 2-wire RS-485 (or RS-422) transceiver. The transceiver is driven by the Raspberry Pi UART interface on the GPIO14 and GPIO15 pins. We send and receive data by /dev/ttyS0.

- In order to ensure you have got the latest updates you should run the following commands:

```
sudo apt-get update
sudo apt-get -y upgrade
```

and at the end of the file */boot/config.txt*, after the [all] statement introduce the following line:

```
enable_uart=1
```

The following table includes the RS-485 port requirements:

Parameter	Value	Conditions
RS-485 Interface	2-wire, half duplex	Transceiver chip ISL8483E
Communication Type		
RX/TX direction control	Manual	Diver enabled by a low TX data bit Driver disabled 25 us after the end of a low TX data bit
	Controlled by GPIO24	Optional
Failsafe biasing	390R to GND 390R to 5V	
Line Termination	120R	390R//220R//390R+2*10R
Protection	ESD to +/- 15 kV	No Surge/Burst protection
Echo-feature	RX always enabled TX enabled at data	Optional
Data transmission speed	0...250kbps	25 us transmission pause between TX and RX required

3 Revision Table

Revision Number	Date	Changes
0	28/12/2021	First implementation
1	25/07/2023	Minor Changes

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