

# USER MANUAL

## ESP32 MiniPLC

Part No. 0000001

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## Power connection setup

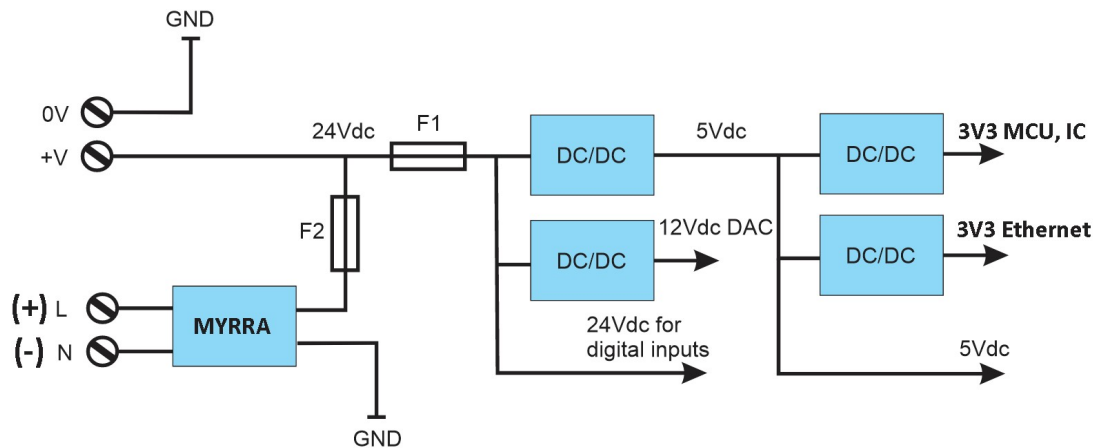
The MiniPLC can be powered either by an external 24VDC power supply or through its internal power supply. It is equipped with an integrated MYRRA 47156 power supply, which supports input voltages from 120VDC to 370VDC and 85VAC to 265VAC, operating at a frequency of 47 to 63Hz.

**MiniPLC power consumption: typ. 1.85W, max. 3W.**

MYRRA 47156 specifications:

Output voltage (DC Volts)	Output current (DC mA)	Output Power (W)	Efficiency (%)	Ta (°C)
24	220	5	79	+50

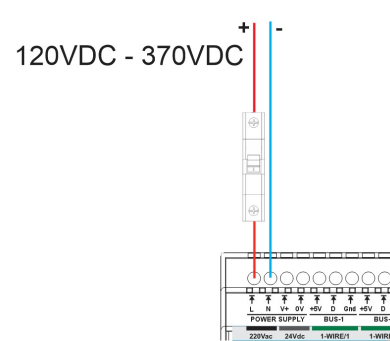
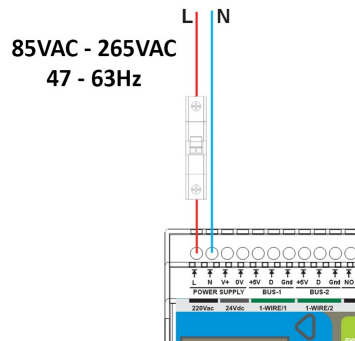
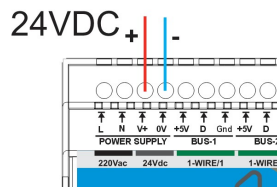
The following is a simplified schematic of the internal power distribution:



24VDC External power supply:

AC via internal power supply:

DC via internal power supply:

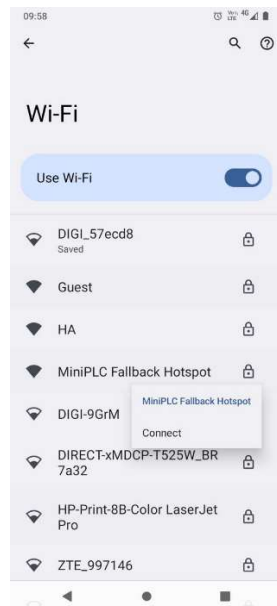


***\*Do not operate the internal power supply while a 24Vdc external power source is connected to the MiniPLC terminals V+ and 0V.***

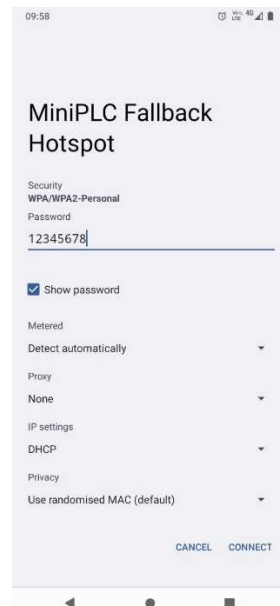
## Connecting to the wireless network

To link the MiniPLC to your home Wi-Fi network, start by powering up the MiniPLC, and then use your mobile device or laptop:

1. Connect to "MiniPLC Fallback Hotspot"

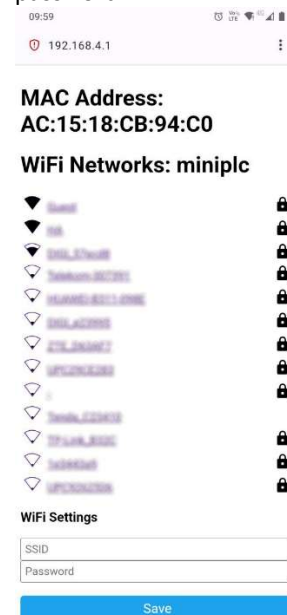


2. Log in using the password "12345678"

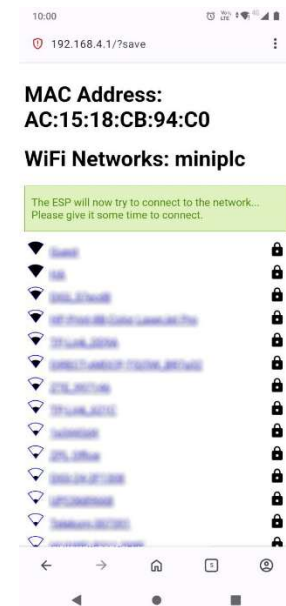


3. Access the URL <http://192.168.4.1>

Choose your home Wi-Fi network and input the password



4. After pressing Save, you can view the assigned address of the MiniPLC in your router's interface.



## Web Server

With the factory firmware settings, the MiniPLC includes a built-in web server. You can access it through your web browser by entering the address that your Wi-Fi router has assigned to the MiniPLC.

### Build in webserver:

MiniPLC

started 29 minutes 35 seconds ago

Sensor and Control

1-WIRE Dallas temperature BUS1

29.1 °C

1-WIRE Dallas temperature BUS2

29.5 °C

ADC AI1

8.410 V

ADC AI2

0.056 V

ADC AI3

0.046 V

ADC AI4

0.046 V

Button #1

☐

Button #2

☐

Button #3

☐

Button #4

☐

Current time

2025-04-07 15:09

DAC 0-10V

100

0

100

DI #1

☐

DI #2

☐

DI #3

☐

DI #4

☐

LED #2

☐

LED #3

☐

MAX 31856 Temperature 1

22.41 °C

MAX 31856 Temperature 2

23.30 °C

Modbus Sensor

11 °C

RELAY #1

☐

RELAY #2

☐

RELAY #3

☐

RELAY #4

☐

RELAY #5

☐

RELAY #6

☐

Switch buzzer

☐

OTA Update

Choose File

NO FILE CHOSEN

UPDATE

Debug Log

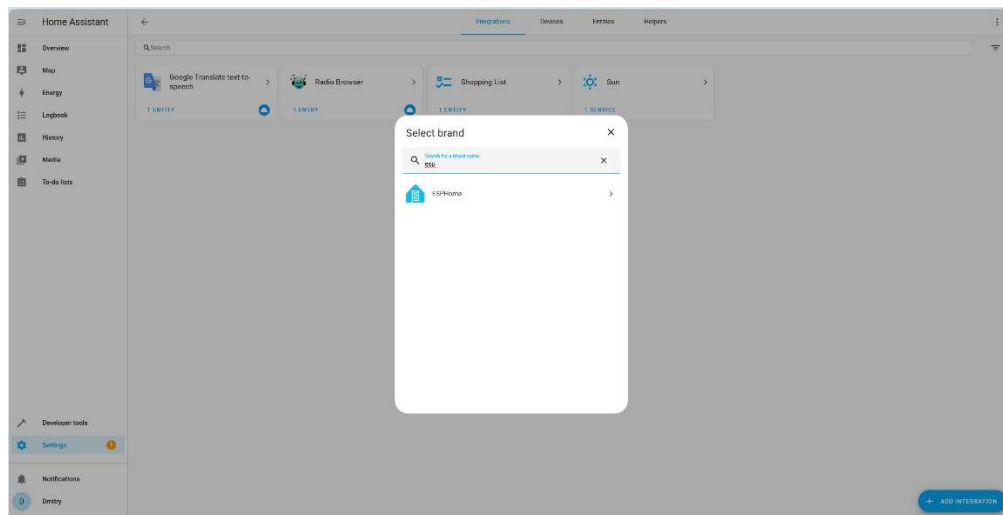
Time	Level	Tag	Message
18:09:18	[D]	[modbus_controller.sensor:025]	Sensor new state: 11.00
18:09:18	[D]	[sensor:094]	'Modbus Sensor': Sending state 11.00000 °C with 0 decimals of accuracy
18:09:18	[D]	[ads1115.sensor:017]	'ADC AI2': Got Voltage=0.018173V
18:09:18	[D]	[sensor:094]	'ADC AI2': Sending state 0.00512 V with 3 decimals of accuracy
18:09:18	[D]	[ads1115.sensor:017]	'ADC AI3': Got Voltage=0.015000V
18:09:18	[D]	[sensor:094]	'ADC AI3': Sending state 0.00500 V with 3 decimals of accuracy
18:09:19	[D]	[ads1115.sensor:017]	'ADC AI1': Got Voltage=2.000425V
18:09:19	[D]	[sensor:094]	'ADC AI1': Sending state 0.41388 V with 3 decimals of accuracy
18:09:19	[D]	[modbus_controller.sensor:025]	Sensor new state: 11.00
18:09:19	[D]	[sensor:094]	'Modbus Sensor': Sending state 11.00000 °C with 0 decimals of accuracy
18:09:19	[D]	[ads1115.sensor:017]	'ADC AI4': Got Voltage=0.015000V
18:09:19	[D]	[sensor:094]	'ADC AI4': Sending state 0.00500 V with 3 decimals of accuracy
18:09:19	[D]	[dallas.temp.sensor:054]	'1-WIRE Dallas temperature BUS2': Got Temperature=29.77°C
18:09:19	[D]	[sensor:094]	'1-WIRE Dallas temperature BUS2': Sending state 29.08250 °C with 1 decimals of accuracy
18:09:19	[D]	[dallas.temp.sensor:054]	'1-WIRE Dallas temperature BUS1': Got Temperature=29.17°C
18:09:19	[D]	[sensor:094]	'1-WIRE Dallas temperature BUS1': Sending state 29.12500 °C with 1 decimals of accuracy
18:09:20	[D]	[modbus_controller.sensor:025]	Sensor new state: 11.00
18:09:20	[D]	[sensor:094]	'Modbus Sensor': Sending state 11.00000 °C with 0 decimals of accuracy
18:09:21	[D]	[modbus_controller.sensor:025]	Sensor new state: 11.00
18:09:21	[D]	[sensor:094]	'Modbus Sensor': Sending state 11.00000 °C with 0 decimals of accuracy
18:09:22	[D]	[modbus_controller.sensor:025]	Sensor new state: 11.00
18:09:22	[D]	[sensor:094]	'Modbus Sensor': Sending state 11.00000 °C with 0 decimals of accuracy
18:09:22	[D]	[text.sensor:004]	'Current time': Sending state '2025-04-07 15:09'
18:09:23	[D]	[modbus_controller.sensor:025]	Sensor new state: 11.00
18:09:23	[D]	[sensor:094]	'Modbus Sensor': Sending state 11.00000 °C with 0 decimals of accuracy
18:09:23	[D]	[ads1115.sensor:017]	'ADC AI2': Got Voltage=0.018562V
18:09:23	[D]	[sensor:094]	'ADC AI2': Sending state 0.00560 V with 3 decimals of accuracy
18:09:23	[D]	[ads1115.sensor:017]	'ADC AI3': Got Voltage=0.015180V
18:09:23	[D]	[sensor:094]	'ADC AI3': Sending state 0.00500 V with 3 decimals of accuracy
18:09:24	[D]	[ads1115.sensor:017]	'ADC AI1': Got Voltage=2.003113V
18:09:24	[D]	[sensor:094]	'ADC AI1': Sending state 0.40994 V with 3 decimals of accuracy
18:09:24	[D]	[modbus_controller.sensor:025]	Sensor new state: 11.00
18:09:24	[D]	[sensor:094]	'Modbus Sensor': Sending state 11.00000 °C with 0 decimals of accuracy
18:09:24	[D]	[ads1115.sensor:017]	'ADC AI4': Got Voltage=0.015180V
18:09:24	[D]	[sensor:094]	'ADC AI4': Sending state 0.00500 V with 3 decimals of accuracy
18:09:24	[D]	[dallas.temp.sensor:054]	'1-WIRE Dallas temperature BUS2': Got Temperature=29.13°C
18:09:24	[D]	[sensor:094]	'1-WIRE Dallas temperature BUS2': Sending state 29.50000 °C with 1 decimals of accuracy
18:09:24	[D]	[dallas.temp.sensor:054]	'1-WIRE Dallas temperature BUS1': Got Temperature=29.17°C
18:09:24	[D]	[sensor:094]	'1-WIRE Dallas temperature BUS1': Sending state 29.08250 °C with 1 decimals of accuracy
18:09:25	[D]	[modbus_controller.sensor:025]	Sensor new state: 11.00
18:09:25	[D]	[sensor:094]	'Modbus Sensor': Sending state 11.00000 °C with 0 decimals of accuracy

## Connecting to the Home Assistant platform

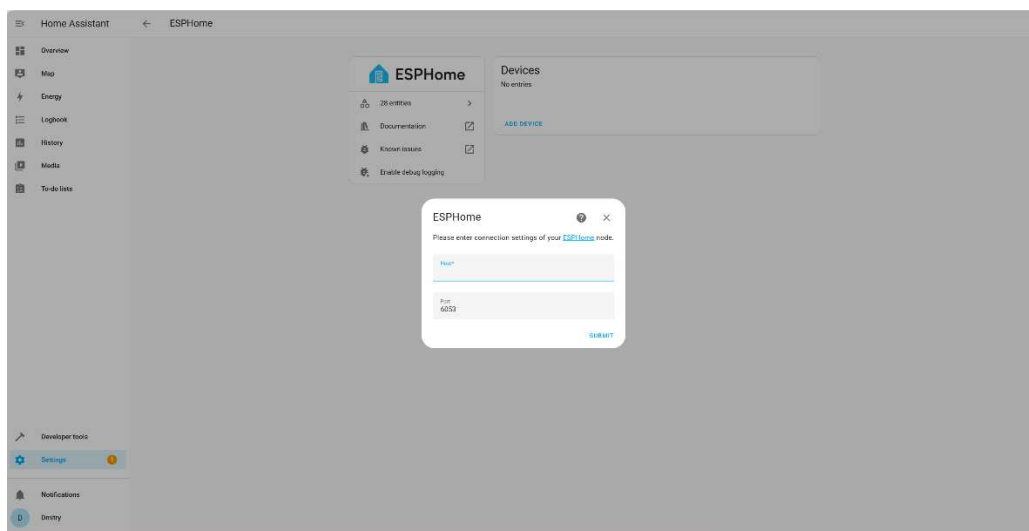
To connect the MiniPLC to your Home Assistant setup, follow these steps:

- 1.Power the MiniPLC
- 2.Connect to Wi-Fi
- 3.Integrate with Home Assistant:

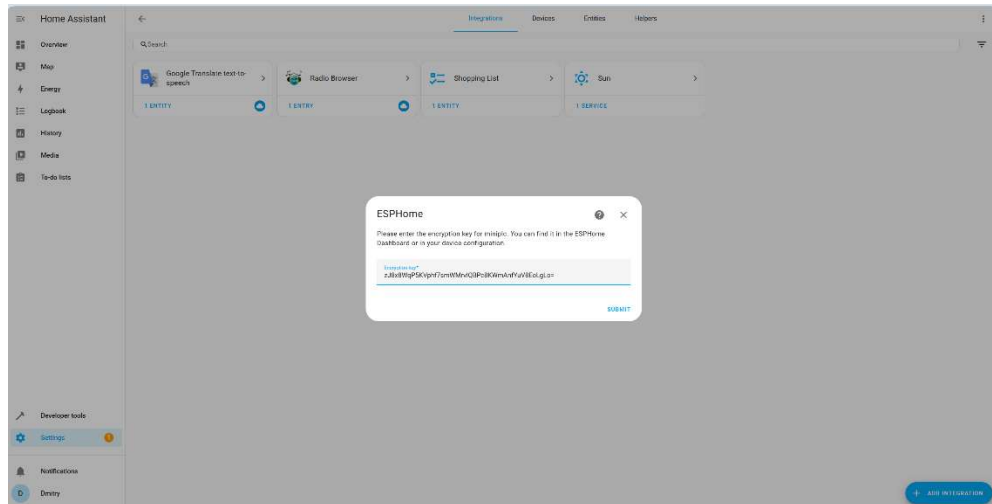
Setup ESPHome integration in Home Assistant:



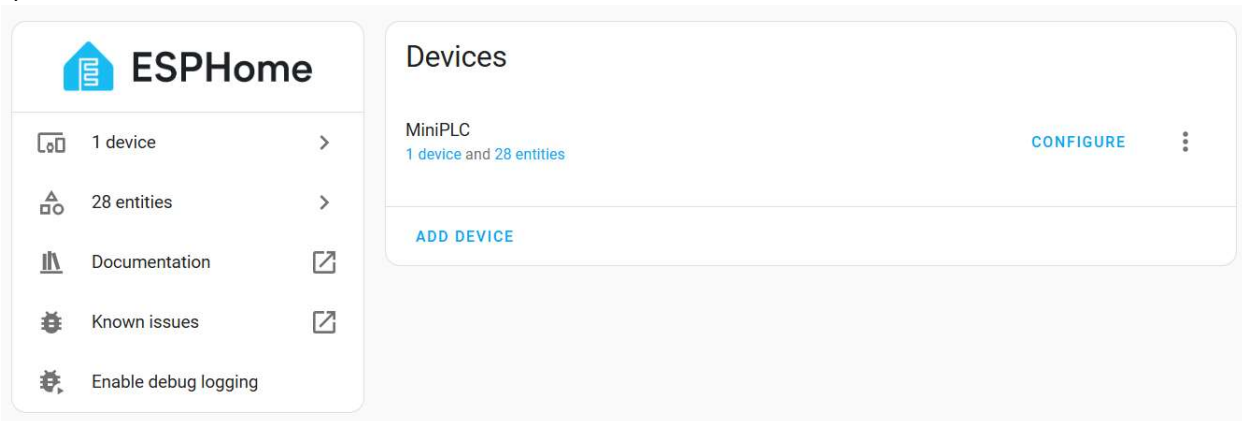
In the ESPHome integration press "Add device" and enter the address that your Wi-Fi router has assigned to the MiniPLC:













Input the encryption key from your configuration file, or the default encryption key provided in the factory setup firmware "zJ8x8WqP5KVphf7smWMrvlQBpc8KWmAnfYuV8EoLgLo=":



By following these steps, you can effectively connect and integrate the ESP32 MiniPLC with your Home Assistant system:





















### Controls

	DAC 0-10V	<input type="checkbox"/>
	LED #2	<input type="checkbox"/>
	LED #3	<input type="checkbox"/>
	RELAY #1	<input type="checkbox"/>
	RELAY #2	<input type="checkbox"/>
	RELAY #3	<input type="checkbox"/>
	RELAY #4	<input type="checkbox"/>
	RELAY #5	<input type="checkbox"/>
	RELAY #6	<input type="checkbox"/>
	Switch buzzer	<input checked="" type="checkbox"/>

[ADD TO DASHBOARD](#)

### Sensors

	1-WIRE Dallas temperature...	29.1 °C
	1-WIRE Dallas temperature...	29.5 °C
	ADC AI1	8.412 V
	ADC AI2	0.055 V
	ADC AI3	0.044 V
	ADC AI4	0.047 V
	Button #1	Off
	Button #2	Off
	Button #3	Off
	Button #4	Off
	Current time	2025-04-07 15:01
	DI #1	Off
	DI #2	Off
	DI #3	Off
	DI #4	Off
	MAX 31856 Temperature 1	22.45 °C
	MAX 31856 Temperature 2	23.36 °C
	Modbus Sensor	11 C

[ADD TO DASHBOARD](#)



## Firmware Download

### Pre-installed Firmware:

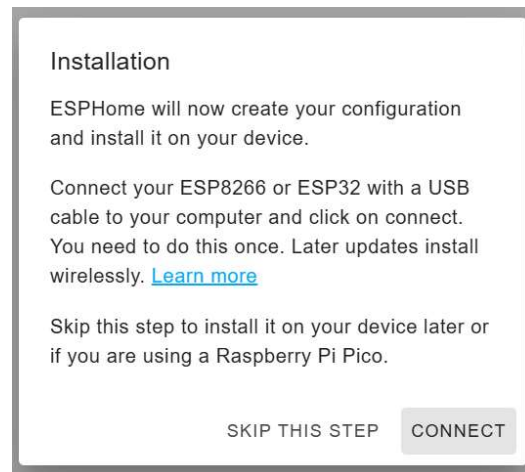
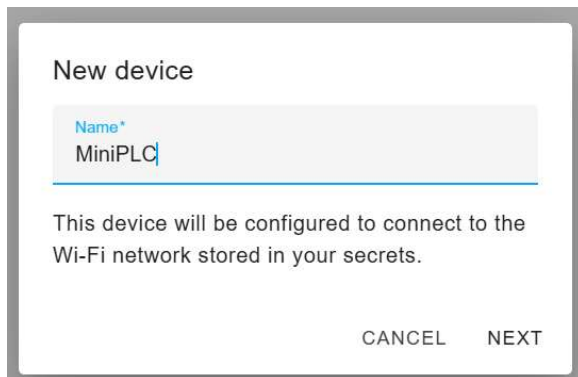
The ESP32 MiniPLC comes with ESPHome firmware pre-installed, meaning it's ready for integration with Home Assistant right out of the box.

Reprogramming MiniPLC: You can reprogram or update the settings via ESPHome using the USB Type-C interface, wireless or manually via OTA in the embedded web server.

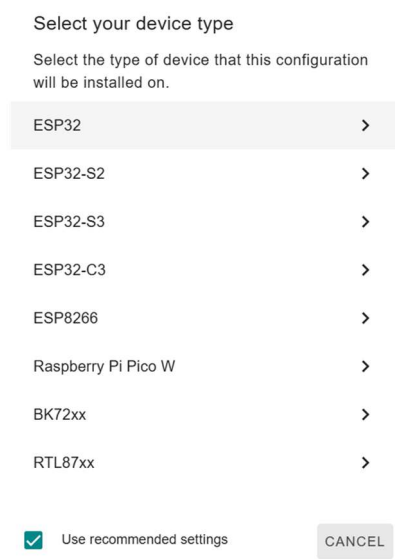
### Downloading firmware via USB:

In the ESPHome dashboard add a New device Skip the test:

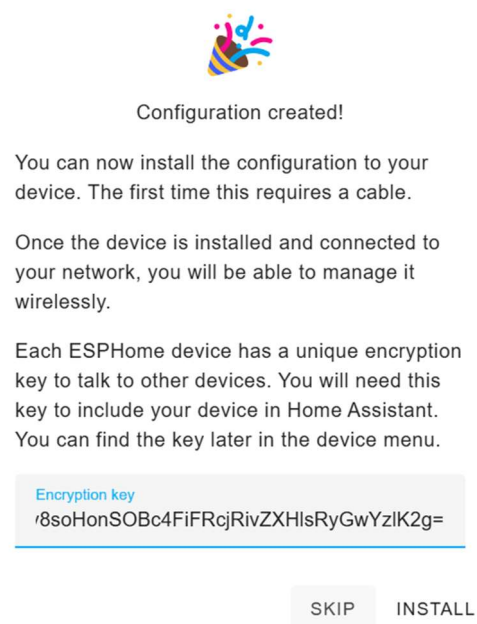
- "MiniPLC"



### Select the device type - ESP32:



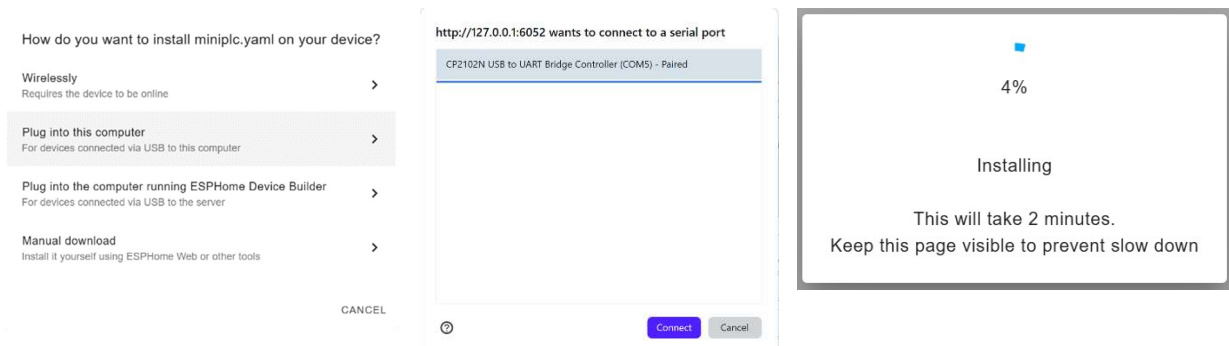
### Choose skip installation:



<https://github.com/isystemsautomation/HOMEMASTER/tree/main/Firmware/MiniPLC>):



Install the settings through a USB cable:



## Wiring diagrams:

### 1-WIRE

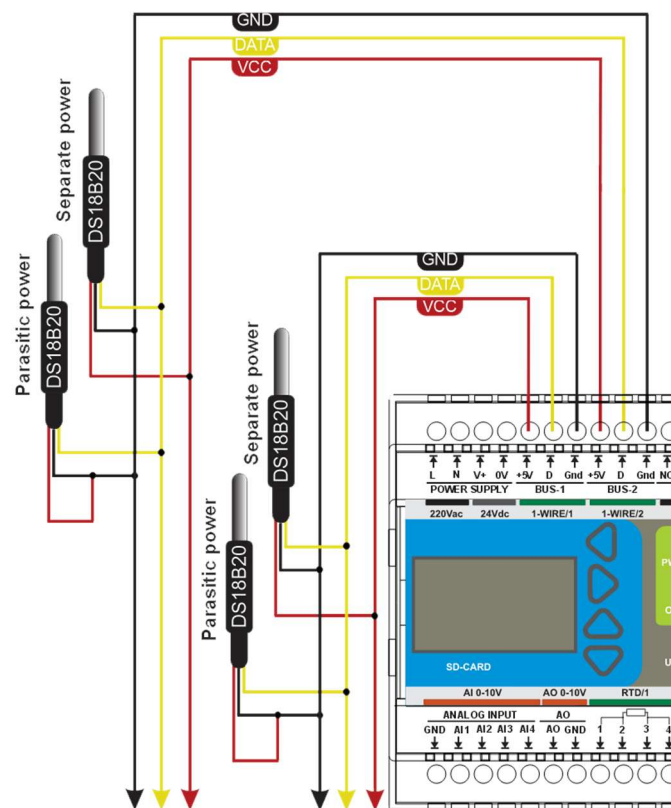
It is advisable to connect a maximum of 20 sensors to the 1-wire bus for optimal performance.

While it is technically feasible to connect up to 32 sensors, doing so will necessitate more complex wiring, which may result in reduced cable length and longer polling intervals.

For the signal lines DATA and GND, utilize a twisted pair from a shielded CAT5/6/7 cable. The VDD line can be connected to an additional conductor within the same cable.

Please ensure that the cable shield remains unconnected, and refrain from transmitting any other data signals through the same cable.

#### Connection Diagram:



The maximum permissible length of a 1-wire bus is contingent upon the chosen wiring topology. In a linear configuration and a bus topology with short taps, the length can extend up to 300 meters. Conversely, for bus topologies featuring long taps and star configurations, the

limit is reduced to 100 meters. When sensors are connected in a parasitic manner, the overall length must also not exceed 100 meters.

Numerous 1-wire sensors are designed to operate with parasitic power supply, allowing them to draw power through the data line (DATA) while the sensor's VDD is linked to GND. This configuration enables the elimination of one conductor, albeit at the cost of the maximum allowable length of the 1-wire bus.

## Relay Output

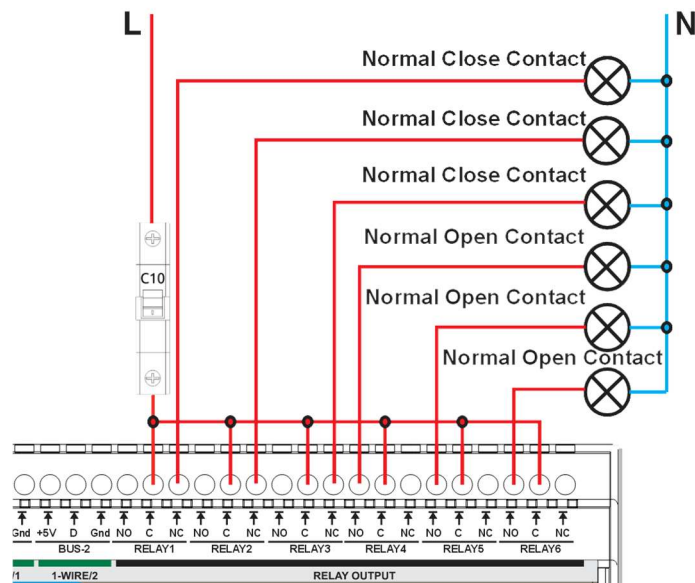
MiniPLC equipped with 6 digital outputs (incorporating relays with optocoupler and varistor for enhanced surge protection)

relays: Hongfa HF115F/005-1ZS3

dry contact specifications:

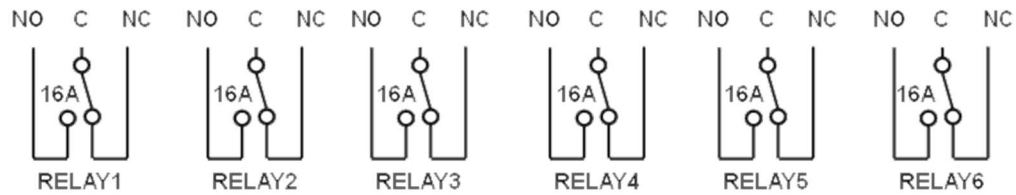
- 250VAC 16A at  $\cos\varphi = 1$ ,
- 250VAC 9A at  $\cos\varphi = 0.4$
- 30VDC 10A

Connection example:



Depending on the power and type of load, it is necessary to select a protective circuit breaker. At high power of consumers, it is necessary to install a separate protective circuit breaker on each relay. Or use a contactor.

## Relay contacts inside MiniPLC:



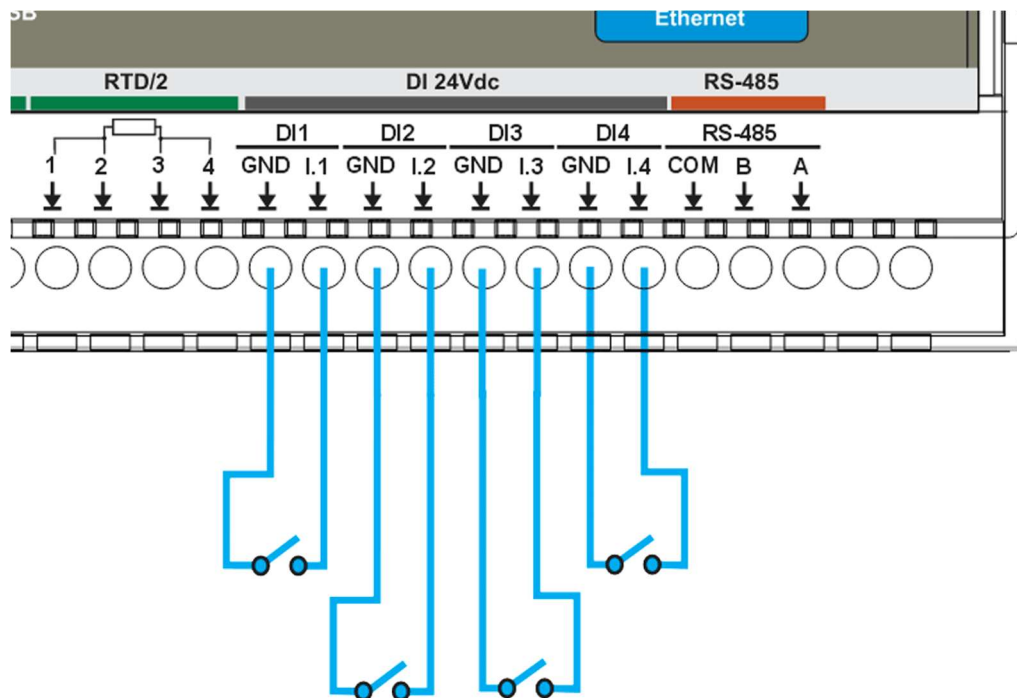
**C\*** Each relay contact is protected from overvoltage by a varistor connected to contact "C"

## Digital Inputs

MiniPLC equipped with 4 isolated, surge protected digital sourcing inputs:

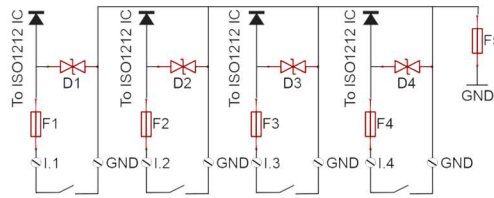
- logic 0: 0 ... 9.2VDC
- undefined: 9.2 ... 15.8VDC
- logic 1: 15.8 ... 24VDC

Connection example:



Digital inputs are designated as source inputs. It is important to note that digital input channels are not intended to serve as a power supply for any devices

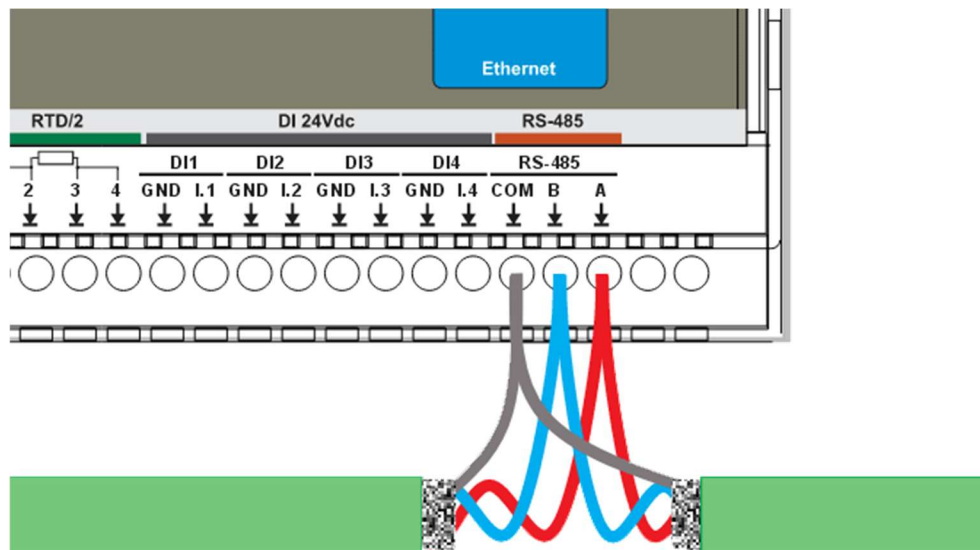
## Fuses and TVS diodes within the MicroPLC:



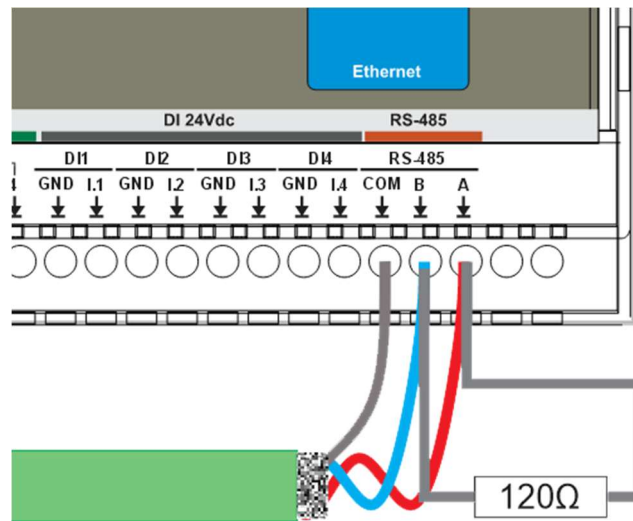
## RS-485

In RS-485 communication systems, it is essential to utilize a shielded twisted pair cable to ensure optimal performance. A notable example of such a cable is the Belden 3105A, compliant with standards EN:50290-2-23 and IEC:60502. However, any cable exhibiting comparable specifications can effectively facilitate the interconnection of all devices within the network.

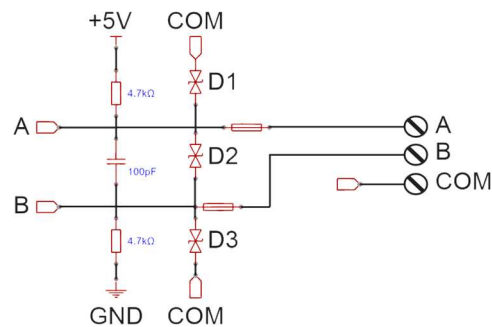
### Connection example:



To avoid signal reflections, it is necessary to connect 120 Ohm termination resistors to the ends of the communication cable.:



Automatic fuses and TVS diodes inside MiniPLC for protection:



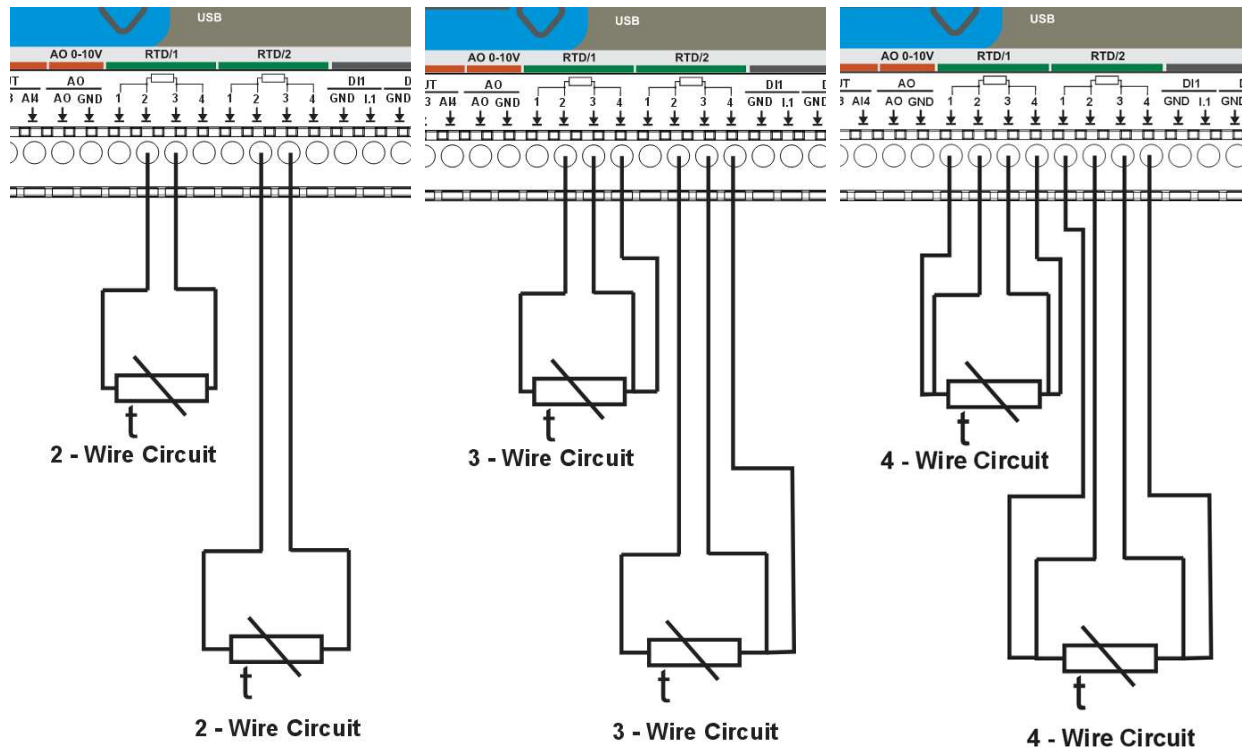
## RTD inputs

MiniPLC equipped with the MAX31865, capable of measuring 100Ω to 1kΩ Platinum RTDs (PT100 to PT1000) at 0°C. It supports 2-, 3-, and 4-wire sensor connections, features a 15-bit ADC resolution, and offers a nominal temperature resolution of 0.03125°C (which may vary due to RTD nonlinearity). The total accuracy under all operating conditions is a maximum of 0.5°C

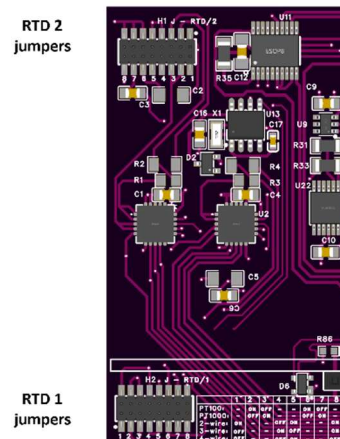
(0.05% of full scale). It includes fully differential VREF inputs, a maximum conversion time of 21ms, and  $\pm 45\text{V}$  input protection.

Additionally, it provides fault detection for open RTD elements, shorted RTDs, out-of-range voltage, or shorts across the RTD element

### Connection example:



To configure the RTD for 2, 3, or 4 wire circuits with either PT100 or PT1000 types, it is essential to adjust the jumper settings on the MCU board:





The factory's default jumper setup is configured for a 2-wire PT100 RTD type for the RTD/1 channel, and a 2-wire PT1000 RTD type for the RTD/2 channel:

	<b>J1</b>	<b>J2</b>	<b>J3</b>	<b>J4</b>	<b>J5</b>	<b>J6</b>	<b>J7</b>	<b>J8</b>
<b>PT100</b>	-	ON	OFF	-	-	ON	OFF	-
<b>PT1000</b>	-	OFF	ON	-	-	OFF	ON	-
<b>2-WIRE</b>	ON	-	-	OFF	ON	-	-	ON
<b>3-WIRE</b>	OFF	-	-	ON	OFF	-	-	ON
<b>4-WIRE</b>	OFF	-	-	OFF	ON	-	-	OFF

Additionally, it is essential to configure the reference resistor in the YAML file:

```
#MAX 31865 RTD
```

```
- platform: max31865
```

```
  name: "MAX 31856 Temperature 1"
```

```
  cs_pin: GPIO1
```

```
#Reference resistance for PT100
```

```
  reference_resistance: 400  $\Omega$ 
```

```
  rtd_nominal_resistance: 100  $\Omega$ 
```

```
  update_interval: 60s
```

```
- platform: max31865
```

```
  name: "MAX 31856 Temperature 2"
```

```
  cs_pin: GPIO3
```

```
#Reference resistance for PT1000
```

```
  reference_resistance: 4000  $\Omega$ 
```

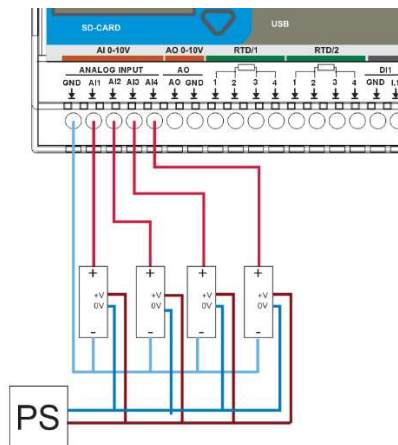
```
  rtd_nominal_resistance: 1000  $\Omega$ 
```

```
  update_interval: 60s
```

## 0-10V Analog inputs

MiniPLC integrated with the ADS1115, providing 4 analog inputs from 0 to 10VDC, featuring a 16-bit resolution through an operational amplifier, a maximum sampling rate of 0.86 ksp/s, ESD ratings of 2kV HBM and 1.5kV CDM, and includes EMI and RF filtering.

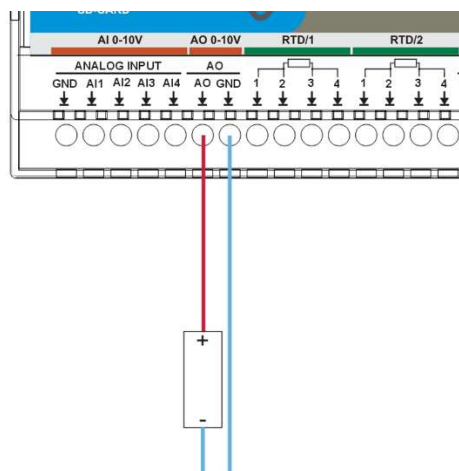
### Connection example:



## 0-10V Analog output

A MiniPLC combined with the MCP4725, delivering an analog output range of 0 to 10VDC, with a resolution of 12 bits achieved through an operational amplifier.

### Connection example:



## Bus system configuration

### I2C:

- sda: GPIO32
- scl: GPIO33

### I2C addresses:

- pcf8574/2: 0x38
- pcf8574/1: 0x39
- ads1115: 0x48
- SH1106 128x64: 0x3C
- pcf8563: 0x51

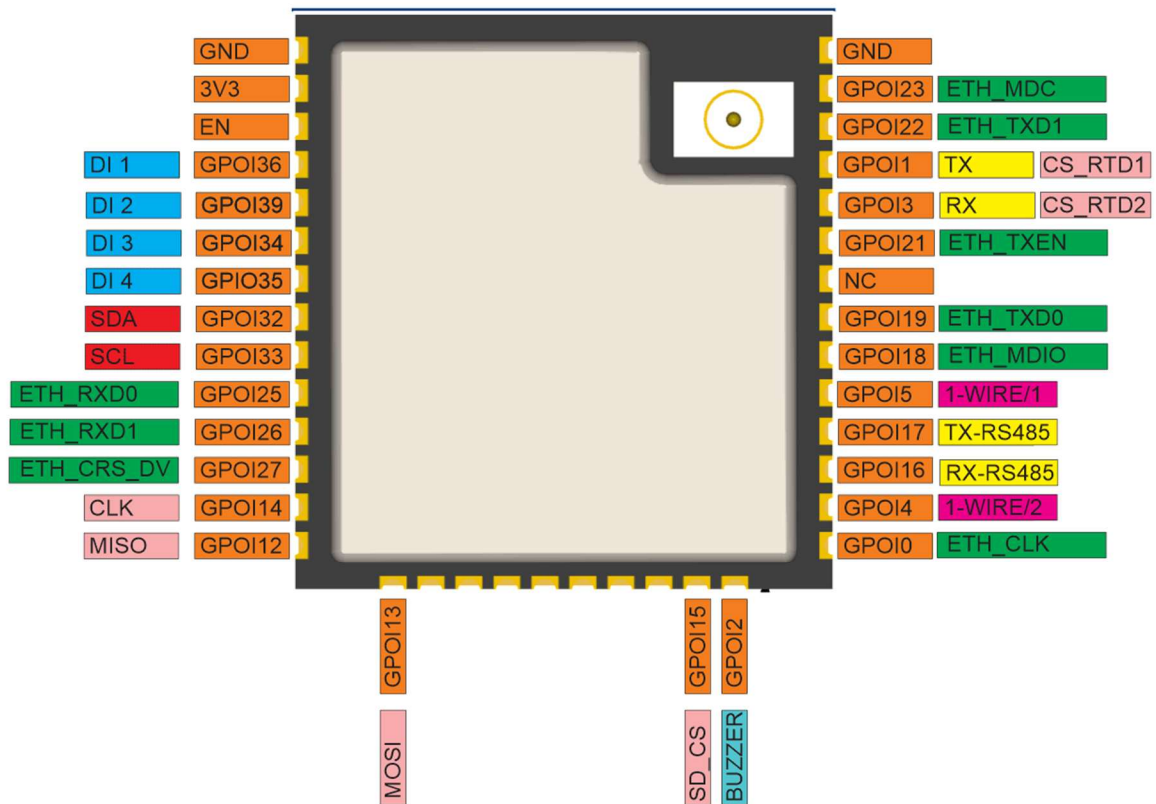
### SPI:

- miso\_pin: GPIO12
- mosi\_pin: GPIO13
- clk\_pin: GPIO14

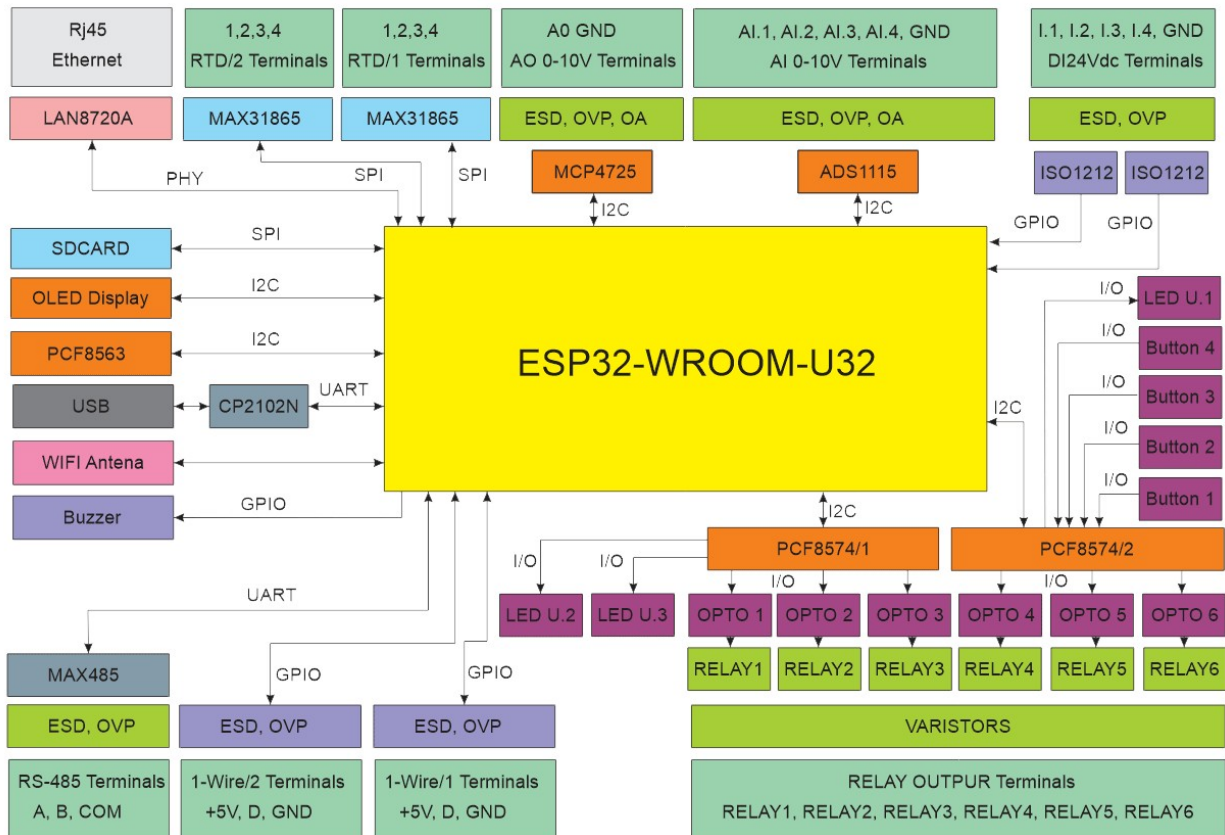
### SPI CS pins:

- max31865 RTD1: GPIO01
- max31865 RTD2: GPIO03
- SDCARD: GPIO15

## ESP32 Pinout



## MiniPLC Function Block Diagram



## MiniPLC boards

