

**ES32-POE**

**ESP32-POE-ISO**

# **User Manual**

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**[www.olimex.com](http://www.olimex.com)**

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# 1. Introduction to ESP32-POE and ESP32-POE-ISO

[ESP32-PoE](#) and [ESP32-PoE-ISO](#) are ESP32-powered Wi-Fi/Bluetooth/Ethernet development boards with Power-Over-Ethernet feature. The boards are the perfect addition to any project that requires extra connectivity.

The PoE is currently handled by TPS2375/6 chip (Si3402-B in older revisions) that is IEEE 802.3af-compliant, including pre-standard (legacy) PoE support.

The PoE powering requires at least 37V DC to operate successfully. The board can takes power from the Ethernet cable and can be expanded with sensors and more. Perfect solution for Internet-of-Things projects.

Both ESP32-POE and ESP32-POE-ISO are mature, popular, and well-known products, with wide software support.

**+ Important notice:** [ESP32-PoE](#) has **no galvano isolation** of Ethernet's power supply, when you program the board via the micro USB connector the Ethernet cable should be disconnected (if you have power over the Ethernet enabled)! Consider using Olimex [USB-ISO](#) to protect your computer and board from accidental short circuits. Also consider using Olimex [ESP32-PoE-ISO](#) board instead since it is insulated.

## 1.1. ESP32-POE features

- ESP32-WROOM-32E module WiFi + Bluetooth ® + Bluetooth LE module from Espressif Inc (ESP32-WROOM-32UE or ESP32-WROVER-E/IE depending on variant)
- ESP32-WROOM-32E/UE have 4MB flash and 520 KB SRAM
- ESP32-WROVER-E/IE have 4MB Flash 520KB SRAM and 8MB PSRAM
- High reliable industrial grade (-40+85C) variant available (-IND)
- CE-RED and LVD certification
- Original design by OLIMEX Ltd
- Power Over Ethernet negotiation circuit, 802.3-compliant, with minimum operating voltage of 37VDC
- DC-DC converter with 3A at 5V output
- Li-Po battery charger and connector
- Battery level monitor pin on ADC
- External power supply detection pin on ADC
- [UEXT connector](#)
- User button
- Reset button
- Micro USB with programmer for ESP32 programming
- MicroSD card
- Two extension connectors 0.1" step spaced at 1"
- PCB dimensions: (80 x 28)mm ~ (3.15 x 1.1)"

## 1.2. ESP32-POE-ISO features

- ESP32-WROOM-32E WiFi + Bluetooth ® + Bluetooth LE module by Espressif Inc (ESP32-WROOM-32UE or ESP32-WROVER-E/IE depending on variant)
- ESP32-WROOM-32E and ESP32-WROOM-32UE have 4MB flash and 520 KB SRAM
- ESP32-WROVER-E/IE have 4MB Flash 520KB SRAM and 8MB PSRAM
- Power Over Ethernet negotiation circuit 802.3 compliant, with minimum operating voltage of 35VDC
- High reliable industrial grade -40+85C available (-IND)
- CE-RED and LVD certification
- Original design by OLIMEX Ltd
- Low power design – 200uA consumption in deep sleep
- Ethernet 100Mb interface with IEEE 802.3 PoE support
- 3000VDC galvanic insulation between the PoE Ethernet part and board's power supply circuit
- Micro USB connector for ESP32 programming
- MicroSD card working in 1 bit mode
- LiPo battery charger with LiPo battery connector
- Battery level monitor pin on ADC
- External power supply detection pin on ADC
- DC-DC 2W 5V/400mA
- [UEXT connector](#)
- User button
- Reset button
- Two extension connectors, 0.1" step spaced at 1"
- PCB dimensions: (98x28)mm ~ (3.8x1")

## 1.3. PoE standard

ESP32-POE and ESP32-POE-ISO are compliant with the IEEE 802.3af PoE standard and provide up to 15.4 W of DC power (minimum 37V DC and 350 mA). Only 12.95 W are assured to be available at the powered device as some power dissipates in the cable.

ESP32-POE-ISO has 2W DC-DC 5V-5V insulation converter which prevents electrical influence between different sources of power but limits the power usage to 2W only!

## 1.4. The difference between ESP32-POE and ESP32-POE-ISO:

**ESP32-POE** is not galvanically isolated which means that it's not safe to connect it to other devices which use non isolated power supply while it is powered. It should have only one power supply and one ground attached to it at a time.

+ This means **YOU SHOULD NOT CONNECT** ESP32-POE to computer's USB port while it is powered by Ethernet POE!!! If you connect USB while ESP32-POE is powered by Ethernet you will damage the board or your computer or both. This will also void the warranty!

**ESP32-POE-ISO**, on the other hand comes with 3000VDC galvanic insulation between the Ethernet POE part and ESP32 power supply, so there is no problem to connect to USB and program or debug while the board is also powered from a PoE source.

## 1.5. The differences between different versions of ESP32-POE and ESP32-POE-ISO:

[ESP32-POE-EA](#) and [ESP32-POE-ISO-EA](#) have ESP32-WROOM-32UE module with U.FL connector and external antenna attached.

[ESP32-POE-IND](#) and [ESP32-POE-EA-IND](#) and [ESP32-POE-ISO-IND](#) and [ESP32-POE-ISO-EA-IND](#) use industrial grade components suitable for -40+85C operating temperature.

[ESP32-POE-WROVER](#) and [ESP32-POE-ISO-WROVER](#) comes with ESP32-WROVER-E chip with 4MB flash and 8MB PSRAM, while [ESP32-POE-WROVER-EA](#) and [ESP32-POE-ISO-WROVER-EA](#) have a WROVER module with extra U.FL connector and external antenna attached.

+ WROVER module uses two extra ESP32 pins for the PSRAM and these pins can't be used for other purposes. This is important especially if you switch from regular version to WROVER version. This is easily noticeable in the middle of the schematic. GPIO16 and GPIO17 are used by the PSRAM, so GPIO17 that was used for Ethernet clock was replaced by GPIO0 and GPIO16 was replaced by GPIO33. You should do the requires software changes in your code if you switch from ESP32-POE to WROVER version.

## 1.6. Order codes for ESP32-POE and accessories:

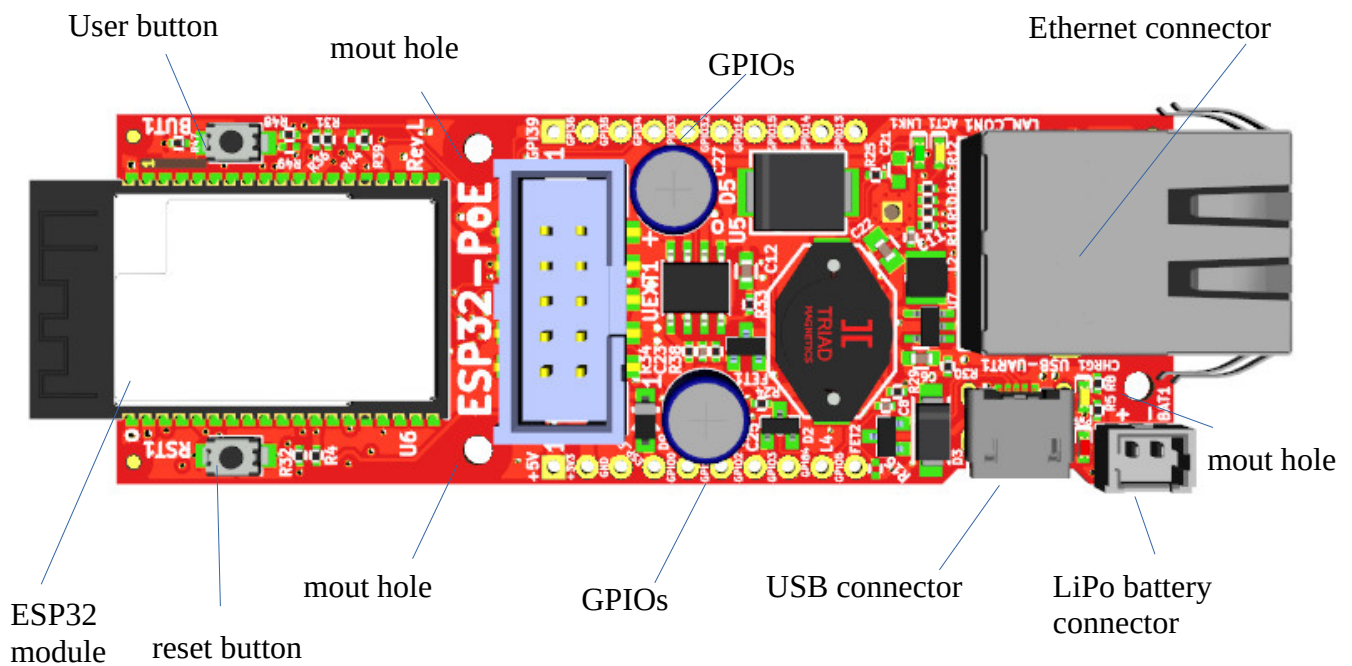
<a href="#"><u>ESP32-POE</u></a>	commercial grade 0-70C board with internal antenna
<a href="#"><u>ESP32-POE-EA</u></a>	commercial grade 0-70C board with external antenna
<a href="#"><u>ESP32-POE-IND</u></a>	industrial grade -40+85C board with internal antenna
<a href="#"><u>ESP32-POE-EA-IND</u></a>	industrial grade -40+85C board with external antenna
<a href="#"><u>ESP32-POE-WROVER</u></a>	commercial grade 0-70C board with 8MB PSRAM and internal antenna
<a href="#"><u>ESP32-POE-WROVER-EA</u></a>	commercial grade 0-70C board with 8MB PSRAM and external antenna
 <a href="#"><u>BATTERY-LIPO1400mAh</u></a>	 Lipo battery 3.7V 1400mAh – note these batteries can be shipped only by ground so we can deliver only to EU destinations.
<a href="#"><u>UEXT modules</u></a>	Different sensors, relays, LCDs, RTC, GSM, GPS, accessories which can be connected to UEXT connector

## 1.7. Order codes for ESP32-POE-ISO and accessories:

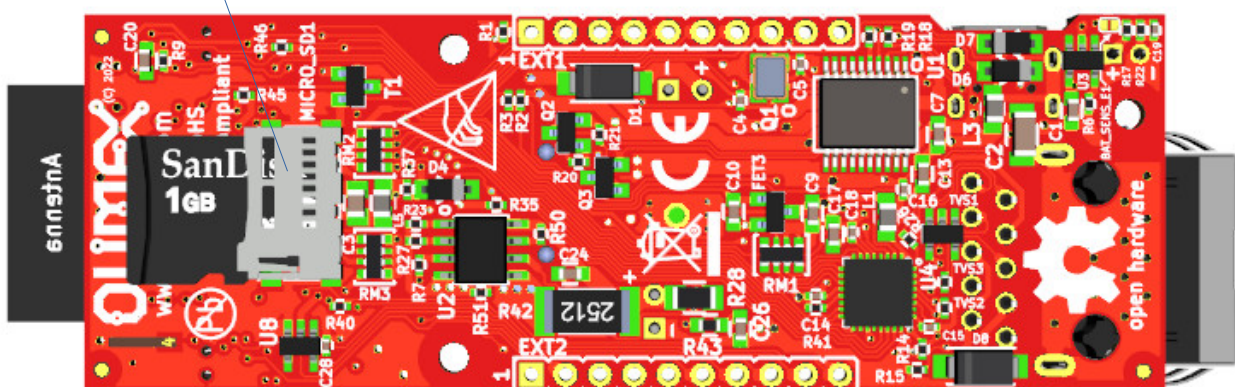
<a href="#"><u>ESP32-POE-ISO</u></a>	commercial grade 0-70C board with internal antenna
<a href="#"><u>ESP32-POE-ISO-EA</u></a>	commercial grade 0-70C board with external antenna
<a href="#"><u>ESP32-POE-ISO-IND</u></a>	industrial grade -40+85C board with internal antenna
<a href="#"><u>ESP32-POE-ISO-EA-IND</u></a>	industrial grade -40+85C board with external antenna
<a href="#"><u>ESP32-POE-ISO-WROVER</u></a>	commercial grade 0-70C board with 8MB PSRAM and internal antenna
<a href="#"><u>ESP32-POE-ISO-WROVER-EA</u></a>	commercial grade 0-70C board with 8MB PSRAM and ext. antenna
 <a href="#"><u>BATTERY-LIPO1400mAh</u></a>	 Lipo battery 3.7V 1400mAh – note these batteries can be shipped only by ground so we can deliver only to EU destinations.
<a href="#"><u>UEXT modules</u></a>	different sensors, relays, LCDs, RTC, GSM, GPS, accessories which can be connected to UEXT connector

## 2. HARDWARE

### 2.1. ESP32-POE layout:

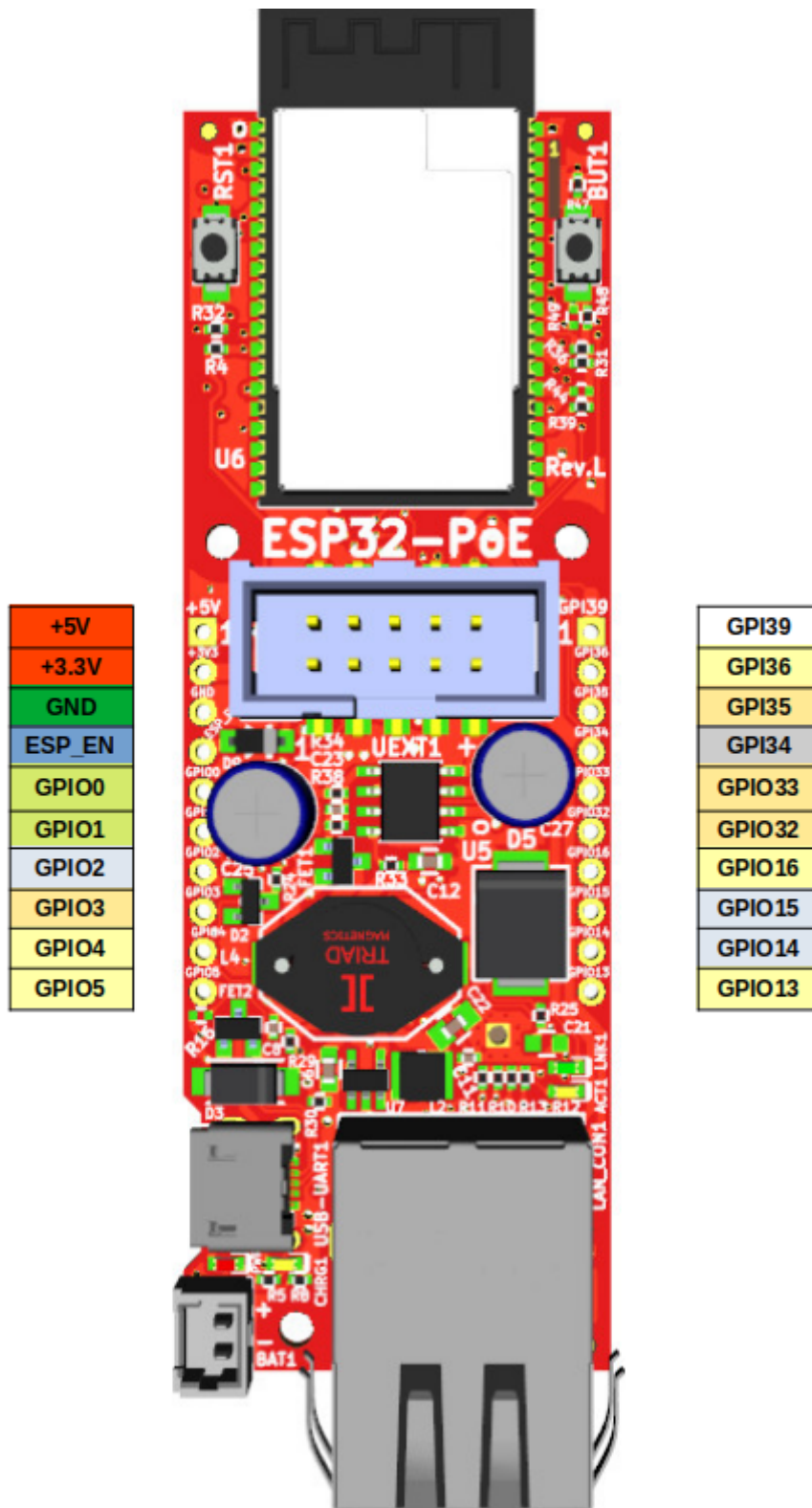


Micro SD card connector





## 2.2. ESP32-POE GPIOs:



## POWER SUPPLY pads:

- +5V**
1. Can be input and output; if you use it as input make sure no other 5V sources are applied to the board (having Li-Po battery is OK);
  2. When the board is attached to USB or to Ethernet PoE this line can be used **ONLY** as output to power attached peripherals;
  3. If you want to use as input i.e. to feed power from external 5V to this line make sure that board is not connected to USB!
  4. When you use the 5V line as output to power external devices it can provide up to 0.8A @ 5V (i.e. 4W) maximum. This includes the 3.3V power output. The combined power draw of +5V output and +3.3V output must not exceed 4W!
- +3.3V** output which can source up to 0.5A @ 3.3V i.e. (1.65W) Make sure the combined power sourced from +3.3V and +5V does not exceed 4W!
- GND** Ground, the board has common ground.

## GPIO pads:

**ESP\_EN** resets the ESP32 module

**GPIO0, GPIO2** – are boot mode bootstrap pins make sure they are properly configured during power up

**GPIO1, GPIO3** are used for USB programming, they can be freed up if you

**GPIO2, GPIO14, GPIO15** are used for the SD-card, if no SD card they are free to use

**GPIO2, GPIO4, GPIO5, GPIO13, GPIO14, GPIO15, GPIO16, GPIO36** are shared on both UEXT and EXT headers so if you use them on the one connector do not use on the other

**GPIO39** is connected to measure external power supply voltage

**GPIO34** is connected to user button and has 10K pullup

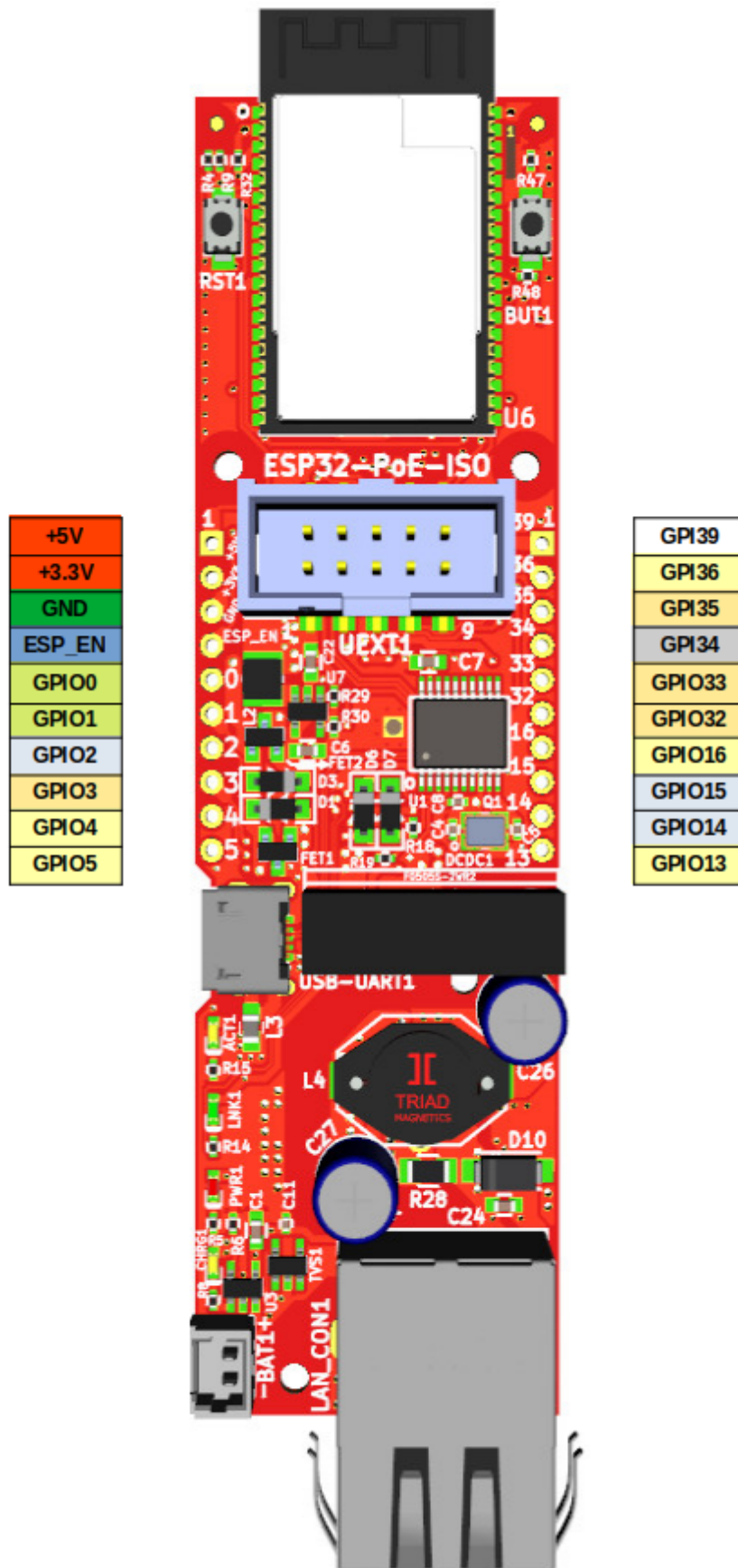
**GPIO35** is free to use by default but may be connected to measure the LiPo battery voltage if you close BAT\_SENS\_E1 jumper

**+ESP32-POE-ISO-WROVER** and **ESP32-POE-ISO-WROVER-EA** have no GPIO16 led out, since it is used for the PSRAM. It is replaced by GPIO33. GPIO17 is replaced by GPIO 0, this is important for the Ethernet connectivity, since GPIO17 is Ethernet clock out. Make sure to use new assignments if your board variant comes with the WROVER chip.

The ESP32 chip has very advanced multiplexing and you can define any free GPIO pin for I2C, UART, SPI operation as long as you are within the maximum supported (some penalties to SPI's maximum frequency apply, when not using the dedicated pins). Notice that some ESP32 pins can only be inputs. Defining pins is for another job is purely software effort.

For further analysis of pins it is highly recommended to check on the schematic.

## 2.3. ESP32-POE-ISO GPIOs:



## POWER SUPPLY pads:

- +5V**
1. Can be used as either input and output. If you use it as input make sure no other 5V source is applied to the board (Li-Po battery is OK);
  2. When the board is connected to USB or to Ethernet PoE this line can be used as output and power supplement electronic
  3. If you want to use as input i.e. to feed power from external 5V to this line make sure board is not connected to USB!
  4. When you use as output i.e. you feed external electronics from it up to 0.2A @ 5V (i.e. 1W) can be sourced maximum. This includes the 3.3V power output. The combined power must not exceed 1W.
- +3.3V** output which can source up to 0.33A @ 3.3V i.e. (1W) - make sure the combined power sourced from +3.3V and +5V does not exceed 1W

## GPIO pads:

**ESP\_EN** resets ESP32 module

**GPIO0, GPIO1** are used only during programming, after that are free to use

**GPIO2, GPIO14, GPIO15** are used for the SD-card, if no SD card they are free to use

**GPIO2, GPIO4, GPIO5, GPIO13, GPIO14, GPIO15, GPIO16, GPIO36** are shared on both UEXT and EXT headers so if you use them on the one connector do not use on the other

**GPIO39** is connected to measure external power supply voltage;

**GPIO35** is used for battery measurement of the LiPo battery;

**GPIO34** is connected to used button and has a 10K pullup resistor.

**+ESP32-POE-ISO-WROVER** and **ESP32-POE-ISO-WROVER-EA** have no GPIO16 led out, since it is used for the PSRAM. It is replaced by GPIO33. GPIO17 is replaced by GPIO 0, this is important for the Ethernet connectivity, since GPIO17 is Ethernet clock out. Make sure to use new assignments if your board variant comes with the WROVER chip.

The ESP32 chip has very advanced multiplexing and you can define any free GPIO pin for I2C, UART, SPI operation as long as you are within the maximum supported (some penalties to SPI's maximum frequency apply, when not using the dedicated pins). Notice that some ESP32 pins can only be inputs. Defining pins for another job is purely software effort.

For further analysis of pins it is highly recommended to check on the schematic.

## 2.4. ESP32-POE(-ISO) schematics

This is an open hardware design made with KiCAD. All design files and exports can be found at our [GitHub](#).

ESP32-POE schematic hardware revision L is at [GitHub](#)

ESP32-POE board revision changes are at [GitHub](#)

ESP32-POE-ISO schematic revision L is at [GitHub](#)

ESP32-POE-ISO board revision changes are at [GitHub](#)

## 2.5. ESP32-POE(-ISO) power supply

ESP32-POE(-ISO) can be powered by 4 sources:

- Ethernet PoE
- USB-micro connector
- Li-Po battery
- EXT1 pin 1 (+5V) but note that this signal is connected to USB 5V signal so when you power via this EXT1 pin you should not connect the board to the USB!

- The standard power consumption of ESP32-POE(-ISO) is between 50mA and 200mA depending on the operation mode. When using power-down modes and Li-Po battery power it can go down to micro amperes.

- Li-Po battery gets automatically charged with about 100mA when external power supply is present.

When the LiPo battery is attached and external power supply is missing internal DCDC step-up converter and switching circuit automatically powers ESP32-POE from the battery. 1400mAh battery will provide about 8 hours of stand alone operation.

+ The LiPo battery connector is JST 2.0 mm connector and with Olimex's battery polarity. If you use batteries from other manufacturers please make PLUS and MINUS are connected properly as you may damage the board!

+ Is it safe to have USB and PoE connected and enabled at the same time? If you are using ESP32-POE or any of its variants – no, it is not safe and should be avoided at all costs. If you are using ESP32-POE-ISO or any of its variants – yes, it is safe to have them both attached and enabled.

### 2.5.1. External power sense feature

This allows to detect when the board has external powering. This is helpful if you want to switch between different power modes depending on whether the board is powered from a battery or external power source. By default the external power sense is enabled and it is available on GPI39!

Refer to this Arduino IDE example to see how you can check for the presence external power and check the battery measurement:

[https://github.com/OLIMEX/ESP32-POE/blob/master/SOFTWARE/ARDUINO/ESP32\\_PoE\\_PowerReading/ESP32\\_PoE\\_PowerReading.ino](https://github.com/OLIMEX/ESP32-POE/blob/master/SOFTWARE/ARDUINO/ESP32_PoE_PowerReading/ESP32_PoE_PowerReading.ino)

### 2.5.2. Battery measurement feature

This allows to measure the Li-Po battery's voltage. This is helpful so you can evaluate when the battery is going to drain out so you can power off the board safely or switch to more conservative power method.

In **ESP32-POE** and its variants the battery measurement features is disabled by default but you can enabled it by soldering together the pads of STM jumper BAT\_SENS\_E1 jumper, after closing it – it will be routed to GPI35!

In **ESP32-POE-ISO** and its variants – the battery measurement is enabled and it is available on GPI35!

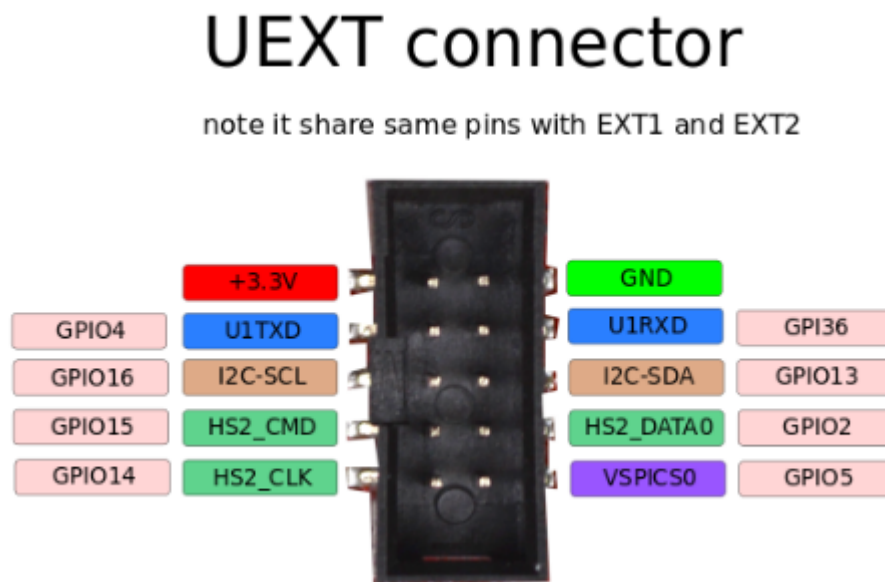
Refer to this Arduino IDE example to see how you can check for external power and check the battery measurement:

[https://github.com/OLIMEX/ESP32-POE/blob/master/SOFTWARE/ARDUINO/ESP32\\_PoE\\_PowerReading/ESP32\\_PoE\\_PowerReading.ino](https://github.com/OLIMEX/ESP32-POE/blob/master/SOFTWARE/ARDUINO/ESP32_PoE_PowerReading/ESP32_PoE_PowerReading.ino)

## 2.6. UEXT connector:

UEXT connector stands for Universal EXTension connector and typically contains +3.3V, GND, UART, I2C, SPI signals.

UEXT is 0.1" 2.54mm step boxed plastic connector. All signals are with 3.3V levels.



Olimex has developed number of extension [MODULES](#) compatible with this connector. There are temperature, humidity, pressure, magnetic field, light sensors. Modules with LCDs, LED matrix, relays, Bluetooth, Zigbee, Wi-Fi, GSM, GPS, RFID, RTC, EKG, sensors, and more.



## 2.7. LED description

Board comes with 4 on-board status LEDs. These are not connected to the ESP32 directly and can't be used as general purpose LEDs.

LED **CHRG1** shows whether the Li-Po battery attached to the board is currently charging. When it is off it means that either there is no battery attached or it is already fully charged. Refer to "BL4054/BL4054B" datasheet and check for "CHRGb" port for more detailed information.

LED **PWR1** is turned on when there is 5V DC applied to the board. It only activates from external power supply, USB power supply, or PoE powering. It won't turn on when board is powered from a Li-Po battery at BAT1 connector (to conserve energy required to power that LED).

LEDs **LNK1** and **ACT1** are Ethernet link and activity LEDs. LNK1 is turned on when 100 Mbps speed is detected, and turns off at 10Mbps or less. ACT1 blinks when activity is detected. For more information about their behavior, refer to the manual of "LAN8710A/LAN8710AI" and check the table describing "REGOFF" port (ACT1 is connected to it) and "nINTSEL" port (LNK1 is connected to it).

During USB power up the CHRG1 and PWR1 LEDs should light up.

**Important! In order to reduce current consumption the LEDs would remain off when the board is powered from Li-Po battery! Do not count on the LEDs when the board is powered only from a Li-Po battery!**

## 3. SOFTWARE:

ESP32-POE and ESP32-POE-ISO are very popular boards and supported by a lot of software tools, among them (there are ready-to-use configs for ESP32-POE and ESP32-POE-ISO):

- [Espressif ESP-IDF](#)
- [Arduino IDE](#)
- [MicroPython](#)
- [ESPhome](#)
- [PlatformIO](#)

### 3.1. Olimex-made software

We provide some examples for basic functions at our GitHub:

- For Arduino you can find them here:

<https://github.com/OLIMEX/ESP32-POE/tree/master/SOFTWARE/ARDUINO>

- For ESP-IDF here:

<https://github.com/OLIMEX/ESP32-POE/tree/master/SOFTWARE/ESP-IDF>

## 4. Frequently asked questions:

- **Is it safe to have USB powering and PoE powering connected and enabled at the same time?**

- If you are using **ESP32-POE** or any of its variants – **no**, it is not safe and should be avoided at all costs.

- If you are using **ESP32-POE-ISO** or any of its variants – **yes**, it is safe to have them both enabled.

- **Where are I2C, UART, SPI pins exposed?**

The ESP32 chip has very advanced multiplexing and you can define any free GPIO pin for I2C, UART, SPI operation as long as you are within the maximum supported (some penalties to SPI's maximum frequency apply, when not using the dedicated pins). Notice that some ESP32 pins can only be inputs. Double check if the pins you want to use are free. Defining pins for another function is a purely software effort.

- **I provide 24V to the Ethernet of ESP32-PoE-ISO's but it doesn't seem powered. What is the problem?**

TPS2375PW (Si3402) would NOT work with 24V DC. The recommended voltage is 48V DC and the minimum is around 37V DC. For more info refer to TPS2375PW's (Si3402-B's) datasheet.

- **I power the board from the Ethernet connector. What current do I have available for additional circuits?**

Depends on the board used. If you are using **ESP32-POE** the PoE circuit can safely provide up to 4W, i.e. 800mA @ 5V. Part of this wattage is used to power the ESP32 module, the battery charger, and other circuits part of the board design; the remaining wattage is available for additional circuits (up to around 600mA). Make sure the total current consumption does not exceed 800mA @ 5V.

If you are using **ESP32-POE-ISO** the isolated DCDC that we use provides up to 2W, this means 400mA @ 5V, 100mA are reserved for the battery charge (available if no battery is connected) and 100mA are provided for ESP32, which leaves up to 200mA @ 5V for your additional circuits.

- **I power the board from the battery connector. The LEDs remain off. Is it broken?**

Probably not. This is a low-power design. The LEDs would not turn on when operating on battery to save power. You need other ways to determine if it works or not. For example, something over the serial lines or over the Ethernet (with no PoE enabled else it would get powered from there).

- **A specific resistor gets very hot! What is this component? Is it safe? Can I remove it?**

This is probably the resistor that is required by the IEEE standards. It is used for MPS (maintain power signature). Search online "maintain power signature poe" to get the general idea.

We didn't ensure MPS in the first hardware revisions of the board (e.g. had no resistor in place), but this caused availability problems when using some power saving modes – the board consumed less wattage than PoE equipment can detect, which led to PoE equipment shutting the board off.

If you have soldering experience and the resistor bothers you, you might try desoldering it and see if that effects your setup negatively. Notice that we don't recommend doing so.

- **ESP32-PoE and ESP32-POE-ISO don't work well with bauds over 115200. What to do?**

Some older drivers might have wrong timings, causing worse throughput. Download and install the latest drivers for CH340.

- **Help! Ethernet is not working. I use ESP32-POE-WROVER and ESP32-POE-ISO-WROVER**

The WROVER module require two addition pins compared to the WROOM module. This required two pin changes – GPIO16 and GPIO17 are used by the PSRAM of the WROVER, so we have replaced GPIO16 with GPIO33 and GPIO17 with GPIO0. The change of GPIO17 affects the Ethernet since it serves as Ethernet clock source. Make sure to replace GPIO17 with GPIO0 in your code or configuration!

## 5. Useful links

The main pages of ESP32-POE and ESP32-POE-ISO are the main hubs for other locations, make sure to first check the product page at our web-site.

ESP32-POE main product page:

<https://www.olimex.com/Products/IoT/ESP32/ESP32-POE/open-source-hardware>

ESP32-POE-ISO main product page:

<https://www.olimex.com/Products/IoT/ESP32/ESP32-POE-ISO/open-source-hardware>