ArduPLC MEGA

MANUAL

Contents

1. General Description.

ArduPLC MEGA is a microcontroller device that offers us the possibility to connect and control electrical or electronic devices directly without the need for additional components. Basically it is an Arduino with real possibility of control.

Thanks to its RS485 and ETHERNET port, it is recommended for distributed applications such as home automation, connection to industrial PLCs, control, etc.

All inputs and outputs are accessible through robust screw terminals. ArduPLC is delivered in a standard DIN rail enclosure. This facilitates the assembly within electrical panels for automation, home automation, etc.

2. Characteristics.

- Power Supply: 6.5-30V DC, reverse polarity protected, 2A fuse (Rated input voltage 24VDC for correct operation of some features)

- Microcontroller: Atmel ATmega2560 compatible with Arduino Mega.

- 6 Mains Relays 5A.

- 8 opto-isolated digital inputs – 12-24VDC negative or positive common

- 6 inputs either digital or analogue with 5V/10V/20mA input range

- 2 analogue outputs – 0/5V o 0/10V.

- 1 x 1-wire port

- Ethernet port using W5500.

- USB Port.

- RS485 serial communications port

- I2C expansion port via RJ12 6/6.

- Buzzer.

- 2 general purpose LED's.

- RTC with back-up battery.

- 2 general purpose potentiometers.

- Arduino compatible shield socket for the addition of shields.

- uSD socket.

- DIN rail mount.

- Screw Terminals.

- Optimized design for EMC and I / O protections

3. Microcontroller

ArduPLC MiCRO is based on Arduino and therefore we can use any of the Arduino development environments to program our device. The equivalence between the ArduPLC NANO and Arduino I / Os are as follows:

Arduino Mega I/O	ArduPLC MEGA I/O
0	SHIELD – UART1 – USB RX
1	SHIELD – UART1 – USB TX
2	SHIELD
3	SHIELD
4	SHIELD
5	SHIELD
6	SHIELD
7	SHIELD
8	SHIELD
9	SHIELD
10	SHIELD – CS W5500
11	SHIELD
12	SHIELD
13	SHIELD
14	ENCODER – INPUT
15	ENCODER – CHANNEL B
16	UART2 – RS485 TX
17	UART2 – RS485 RX
18	ENCODER – CHANNEL A
19	RTC – INT
20	I2C – SDA

21	I2C – SCL
22	DIN1
23	DIN2
24	DIN3
25	DIN4
26	DIN5
27	DIN6
28	DIN7
29	DIN8
30	RELAY 1
31	RELAY 2
32	RELAY 3
33	RELAY 4
34	RELAY 5
35	RELAY 6
36	LED L1 – GREEN
37	LED L2 – RED
38	1-WIRE
44	AOUT1 – PWM
45	AOUT2 – PWM
46	uSD CS
47	uSD INSERT
48	DREADY
49	BUZZER
50	SPI MISO
51	SPI MOSI
52	SPI SCK
53	SPI SS
ADC0	SHIELD
ADC1	SHIELD

ADC2	SHIELD
ADC3	SHIELD
ADC4	SHIELD
ADC5	SHIELD
ADC6	AIN1
ADC7	AIN2
ADC8	AIN3
ADC9	AIN4
ADC10	AIN5
ADC11	AIN6
ADC14	POT1
ADC15	POT2
INT6	INT W5500
INT7	AUX

4. Power Supply.

ArduPLC MEGA incorporates a high efficiency switched regulator to generate the 5V required for internal operation. Thanks to this controller we can feed the ArduPLC MEGA board externally from 6.5VDC to 30VDC without risk of overheating.
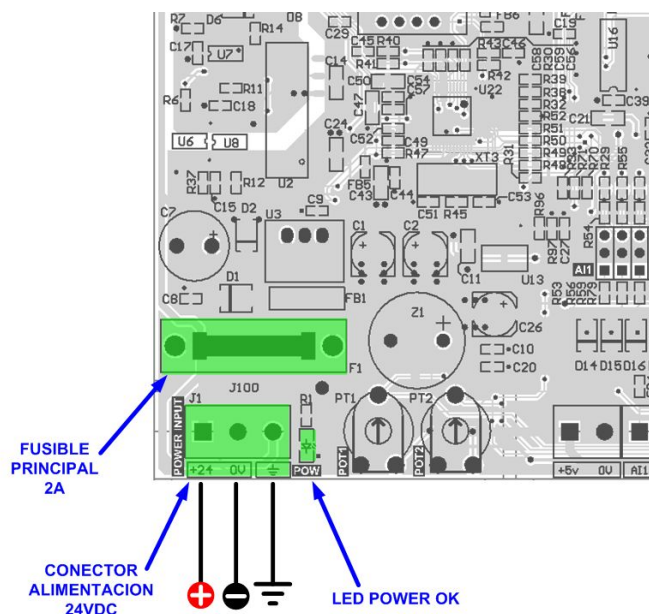
For external power supply there is a protection fuse. To replace it, remove the cover using a screwdriver and replace the fuse with an equivalent 2A - 5x20mm.

IMPORTANT NOTE: For proper operation, feed the board to 24VDC, but can be used between 6.5VDC and 30VDC without causing any damage. Note the supply voltage for the following features:

- 24V output to power digital inputs (see section 6).
- 24V in RJ12 connector for I2C bus (see section 16).
- 24V on pin "Vin" shield (see section 17).

5. Output Relays.

The output relays are of the normally open type. All outputs have totally independent commons.

Example of connection to control 4 lamps:
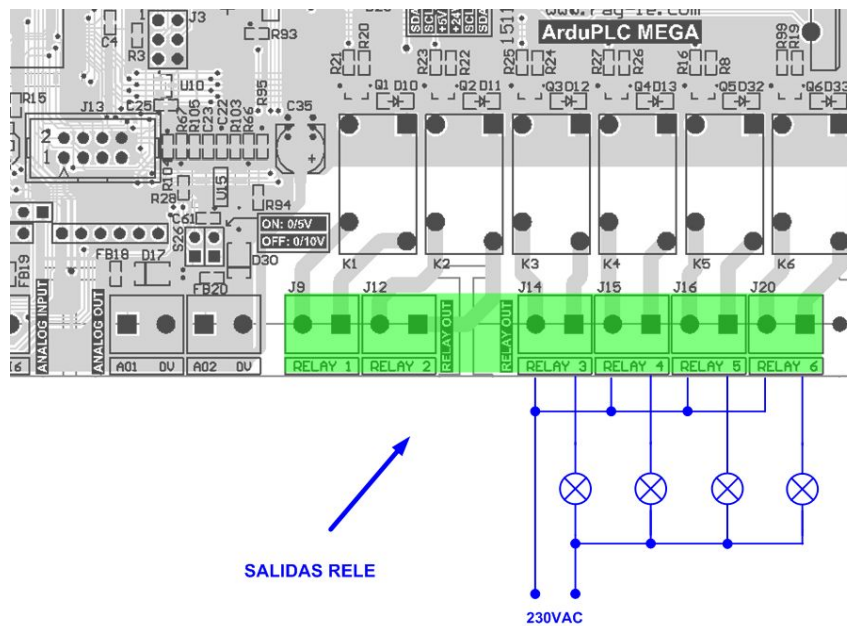
Relay Technical Characteristics:

- Maximum Current 5A

- Maximum Voltage: 250VAC o 30VDC

- Maximum Power: 1250VA, 500W

- Electrical Life: 100,000 operations at 5A , 250VAC

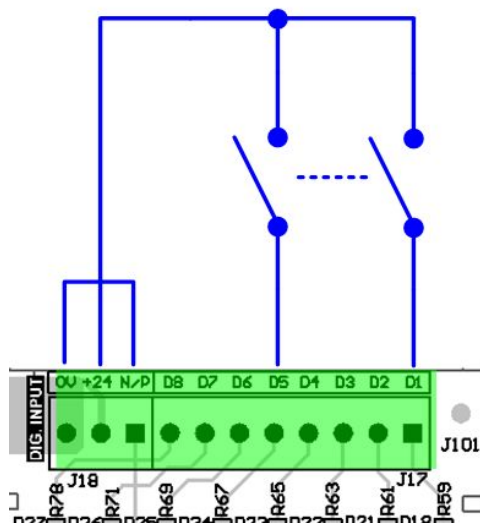- Mechanical Life: 10,000,000 operations

6. Entradas digitales.

The digital inputs are activated with logic levels from 5VDC to 30VDC referenced to the N / P pin. This way we can activate the entries in the COMMON POSITIVE or COMMON NEGATIVE form.
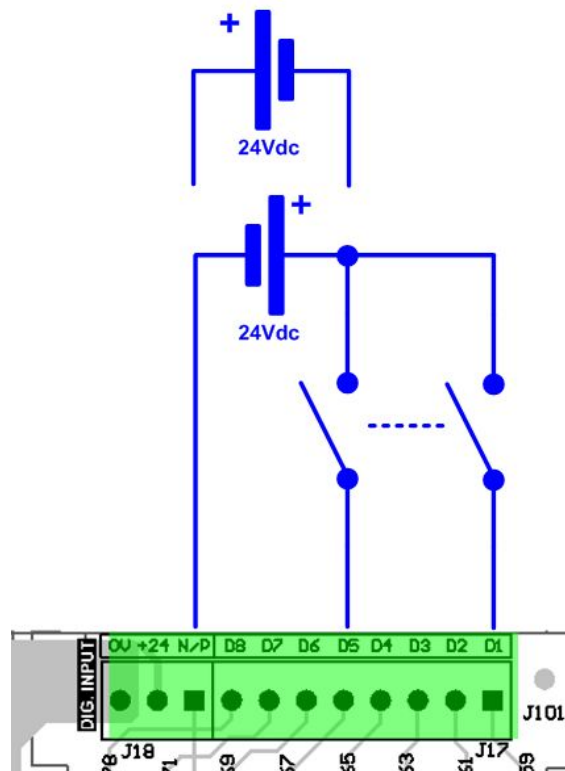
An example of connection for 2 switches in COMMON POSITIVE mode would be as follows:
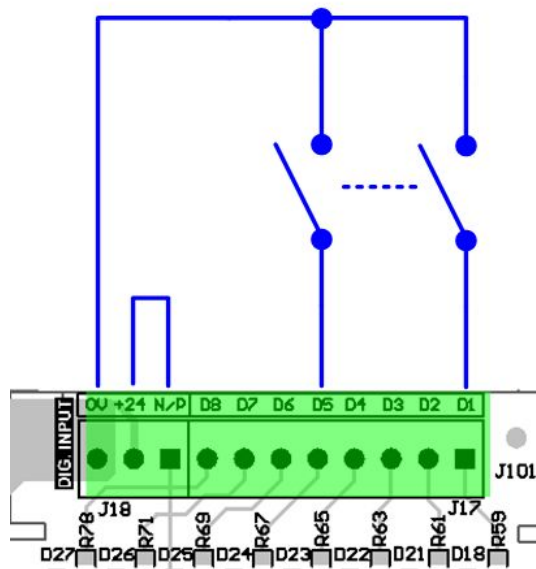
COMMON NEGATIVE Connection:
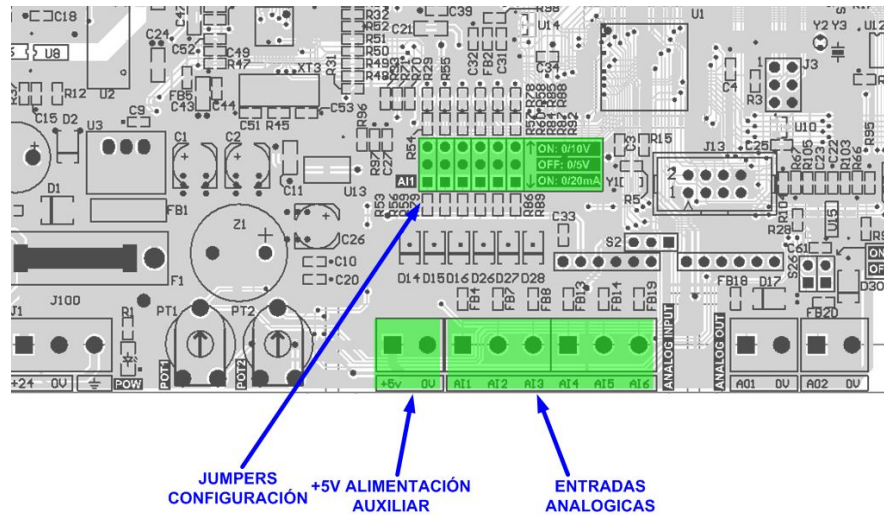
Connection COMMON or COMMON POSITIVE NEGATIVE with external 24V source:

Digital Input Technical Characteristics:
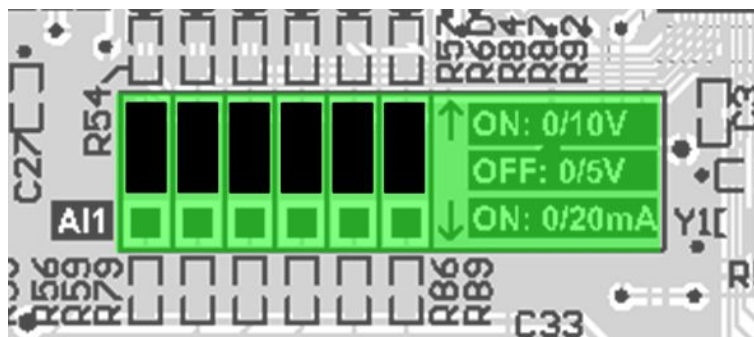
- Isolation: 3Kv

- Input Range (On):   5-30VDC.

- Input Current: 5mA @ 24VDC

- Maximum frequency: 1Khz

- Auxiliary 5V Output Current (Max):   100mA
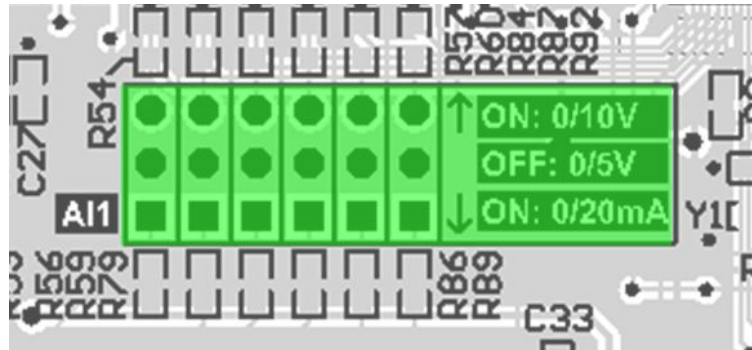
6. Analogue Inputs.

ArduPLC MEGA has 6 analogue inputs that can be configured, independently, for one of the following ranges:
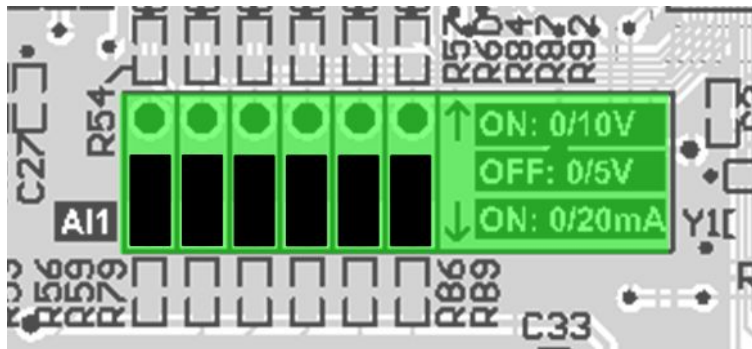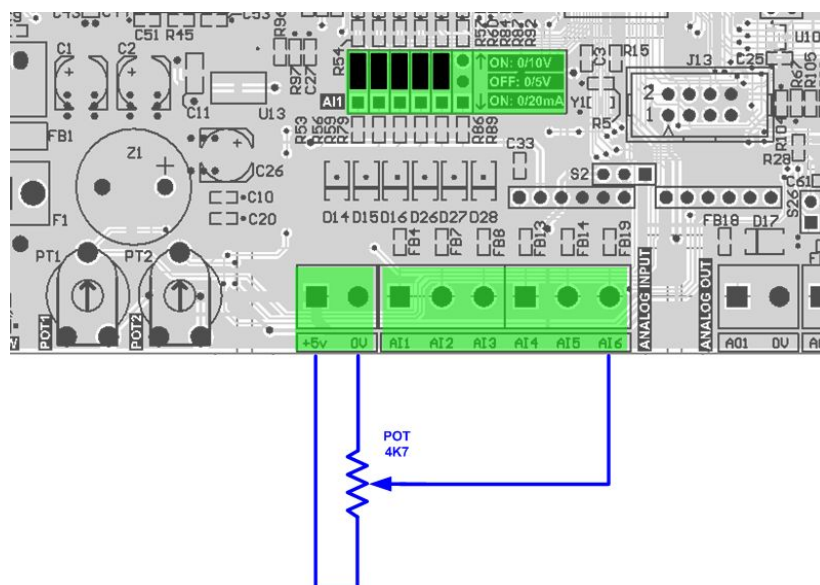
0-10V: jumper as shown:
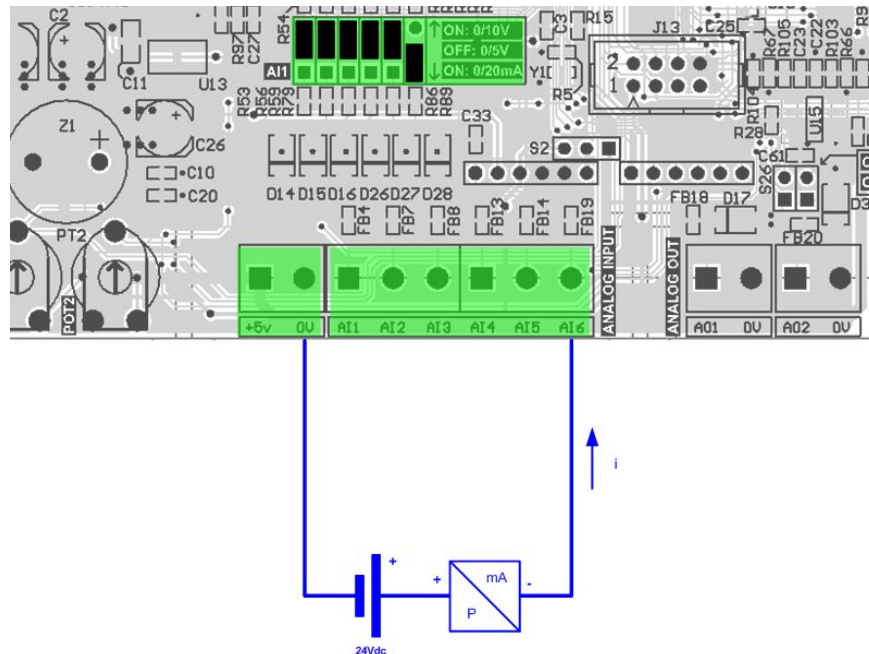
- 0-5V: jumper as shown:

0-20mA: jumper jumper as shown:

The following is an example of a connection for an external potentiometer connected to 5V:
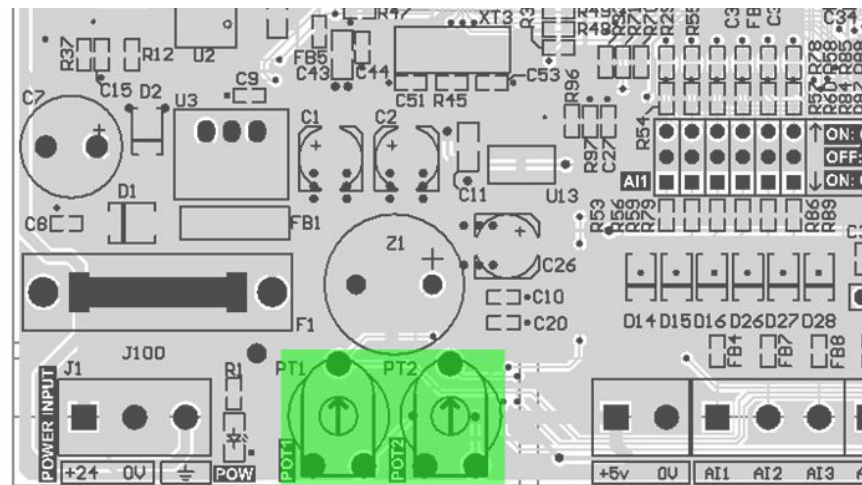
Connection example for a two-wire 4 / 20mA pressure transducer:

For the range 0 / 20mA, the digital conversion values are as follows:

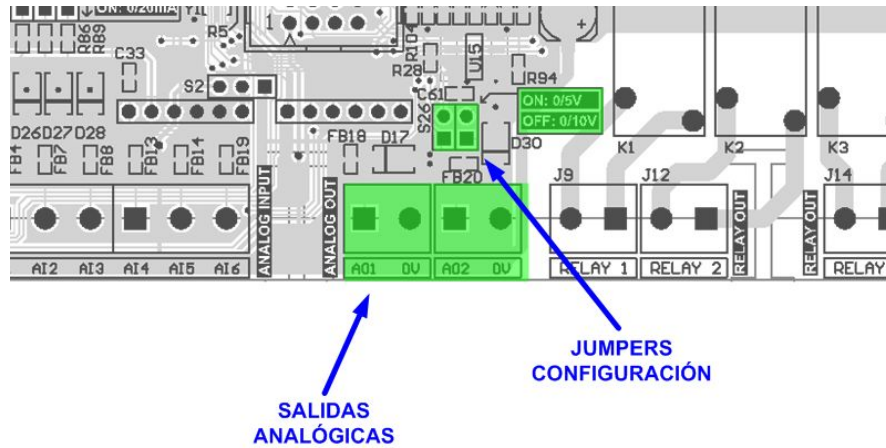| Current	Converted Value
0 mA	0
4 mA	204
20 mA	1023

In addition, ArduPLC MEGA has two potentiometers for general purposes (see assignment of pins in table of section 3), like adjustment of times, ranges, etc .:

Analogue Inputs Specifications:

- Resolution : 10 bits (1024 points).

- Range: 0/5V o 0/10V o 0/20mA

- Maximum Output Current 5V: 100mA max.

7. Analogue Outputs.

ArduPLC MEGA has 2 analog outputs that we can configure, independently, for one of the following ranges:

- 0-5V: jumper jumper as shown:
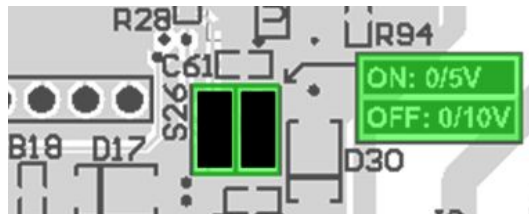
- 0-10V: jumper jumper as shown:
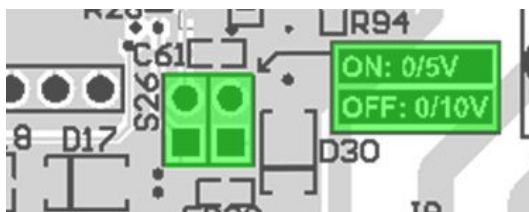
Analogue Output Specifications:

- Resolution : 8 bits (256 points).

- Range: 0/5V o 0/10V.

- Maximum output current: 20mA.

8. USB Port.

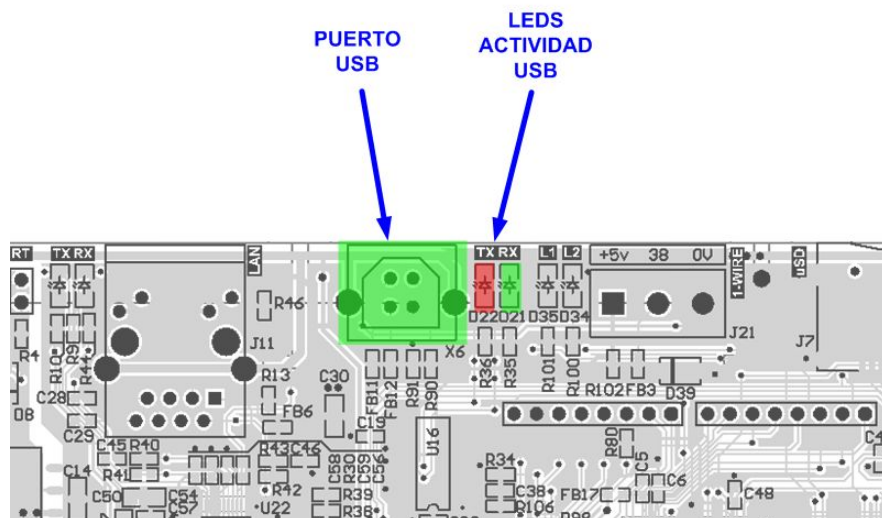ArduPLC MEGA incorporates a USB port managed by FTDI driver FT232RL.

You can load the programs directly via USB from the Arduino IDE or development environment.

The RX and TX diodes show the activity on the selected port.

9. RS485 Port

ArduPLC MEGA incorporates an RS485 port totally isolated galvanically and with automatic control of direction of data. With this RS485 port we can implement communication buses based on two wires such as MODBUS.
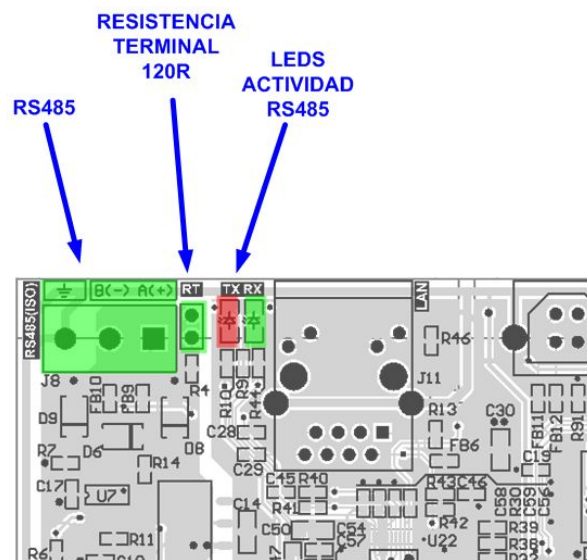
If necessary, you can activate or deactivate the 120 Ohm bus termination resistor with the RT jumper.

You can observe the activity of the port communications with the TX and RX LEDs.

Technical Specifications

- Maximum baud rate: 500 Kbps

- ESD protection +/– 15Kv

- Automatic data direction control

- Supports ¼ load function for 128 network devices

- 3000v galvanic isolation

10.   Ethernet Port.

The Ethernet port is based on the Wiznet W5500 chip

Technical Specifications:

- protocols: TCP, UDP, ICMP, IPv4, ARP, IGMP, PPPoE.

- Supports 8 independent sockets connections simultaneously.

- Supports Power-down

- Supports Wake on LAN on UDP

- Supports High Speed Serial Peripheral Interface(SPI MODE 0, 3)

- Internal 32Kbytes Memory for Tx/Rx Buffers

- 10BaseT/100BaseTX Ethernet PHY

- Supports Auto Negotiation (Full and half duplex, 10 and 100-based)

11.   1-WIRE Port.

We have a 1-WIRE port with 4K7 PULL-UP resistor included. We can also use this pin as a general 5V I / O as it is directly connected to the microcontroller. The port has an auxiliary voltage of 5V to supply sensors, transducers, etc ...

PUERTO 1-WIRE
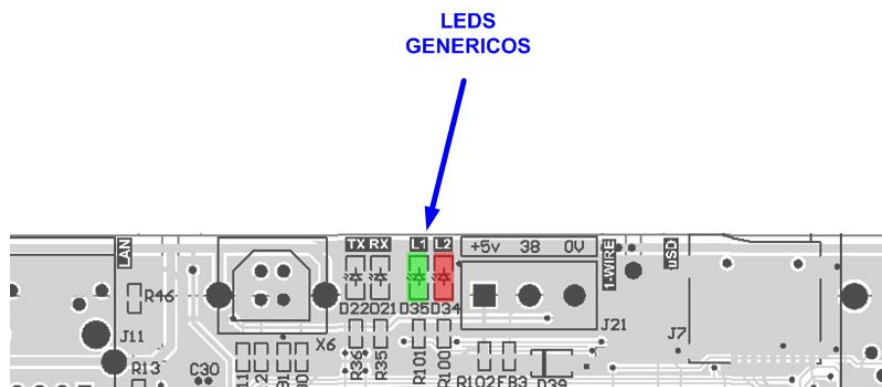
Technical Specifications :

- Maximum Output Current 5V: 100mA max.

- PULL-UP Resistor :   4K7

12.   Buzzer and LED's.

You can make acoustic signals with the built-in buzzer:
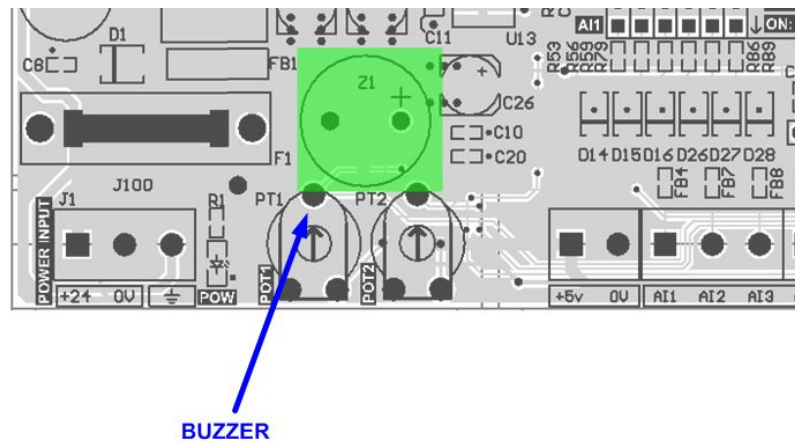
There are also 2 general purpose LED's
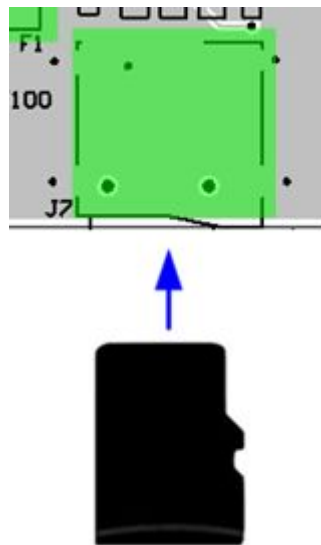

Refer to the pin assignment for the buzzer and LEDs in the table in section 3 of this manual.

13.   uSD Card.

ArduPLC MEGA incorporates a socket for compatible uSD cards. To use uSD cards, use the standard "SD" Arduino library. Insert the card as follows until you click:
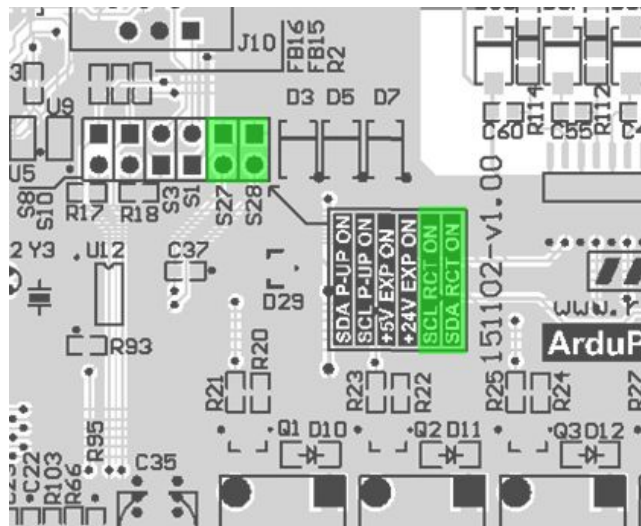

Refer to the pin assignment for the use of uSD cards in the table in section 3 of this manual

14. RTC.

ArduPLC has a real-time clock or RTC based on the PCF8563T chip. This chip is controlled by the I2C bus. You can use Arduino's standard "Rtc_Pcf8563" library to control this watch.

The integrated battery in the plate keeps the time and date on the watch in the absence of power. The life of this stack is estimated at 10 years.

You can deactivate the I2C bus connected to the RTC by removing the S27 (SCL_RTC) and S28 (SDA_RTC) jumpers. For example, if you interconnect two MEGA ArduPLCs via the RJ12 expansion bus, you must deactivate the I2C bus in one of the two ArduPLCs.

The PCF8563 chip has an interrupt signal. You must activate the PULL UP resistor to use this signal. Refer to the pin assignment for use of this interrupt in the table in section 3 of this manual.

15.   RJ12 Expansion Bus.

ArduPLC MICRO facilitates the interconnection of other devices through the RJ12 expansion bus based on the I2C protocol.
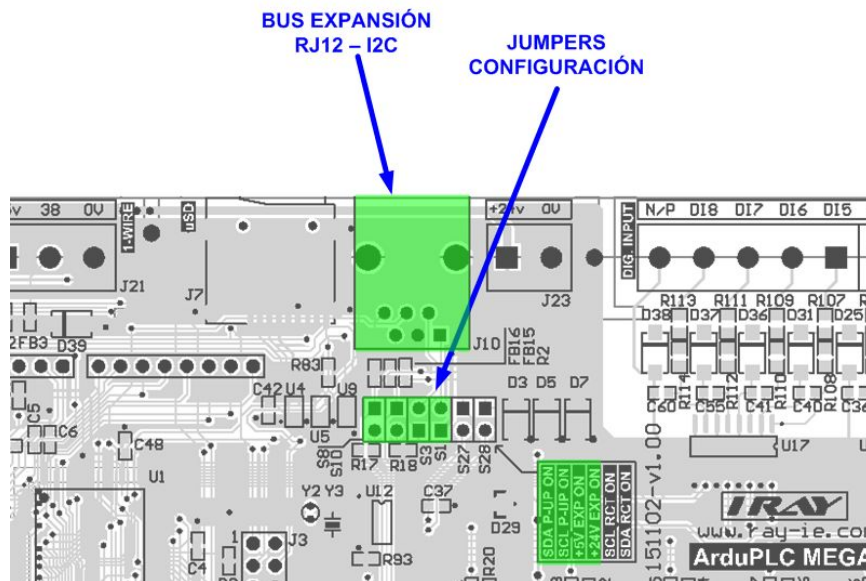
In this connector we find:

- I2C bus signals.

- 5VDC or 24VDC power (or external supply voltage).

- DREADY interrupt signal.

Depending on the case, you may be interested in deactivating any of these lines such as power lines so they do not have conflicts with other devices that use the I2C bus. For example, if you interconnect two modules together, one of them must have the bus power disconnected. You also have to keep in mind that there can only be one PULL-UP resistor on the entire bus, deactivating the remaining ones.

RJ12 I2C Bus Pinouts:

| PIN RJ12	Function
1	+24VDC
2	+5VDC
3	GND
4	DREADY
5	SCL
6	SDA

The connector configuration jumpers are listed below, from left to right:
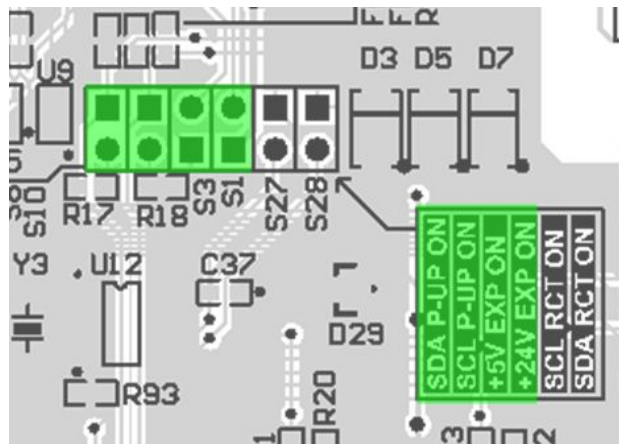
- SDA PULL-UP: on/off pull-up resistor

- SCL PULL-UP: on/off pull-up resistor

- +5ON: 5VDC power on/off.

- +24ON: 24VDC power on/off

16.   Arduino Compatible Shield Socket.

We can install an Arduino-compatible Shield on the ArduPLC MEGA board as long as the Shield's measurements allow it.
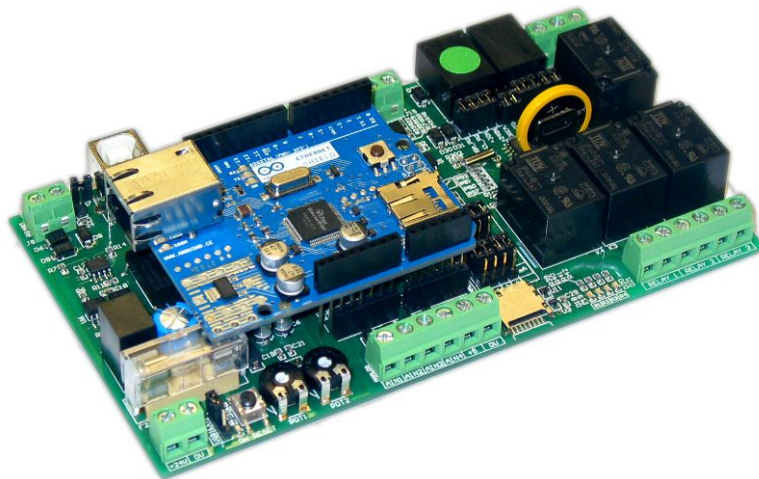

ArduPLC V2 with ArduinoE thernet .Shield

Note that ArduPLC MEGA uses specific microcontroller pins to use its own resources, therefore these pins should not be used for the shield:

Arduino Mega I/O	ArduPLC MEGA I/O
0	SHIELD – UART1 – USB RX
1	SHIELD – UART1 – USB TX
10	SHIELD – CS W5500

Using the jumper S2, you can select the voltage of the "Vin" pin.
Note that there may be shields that do not support "Vin" voltage of
24VDC.
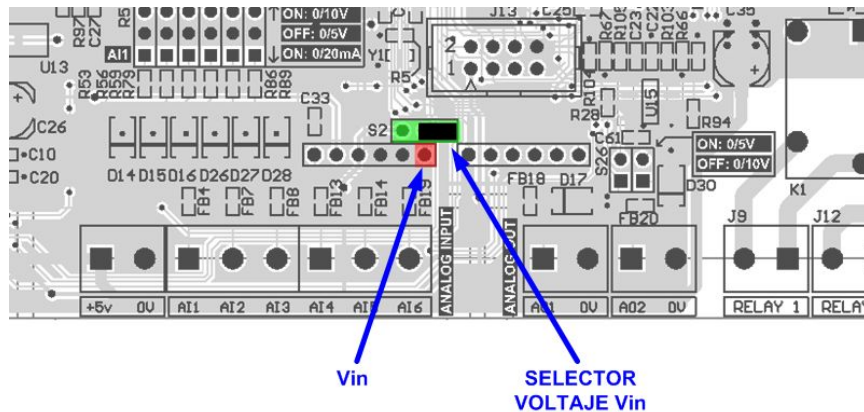
Set the jumper to the left to select 5VDC on the "Vin" pin.

Set the jumper to the right to assign the ArduPLC MEGA power
supply to the "Vin" pin.

17.   HMI (Optional).

Optionally we can acquire ArduPLC MEGA with a HMI (Human-Machine Interface) interface. This consists of a 1.3 "OLED screen and a rotary encoder with a pulse. This way, the user can interact with the control program by displaying or modifying parameters.
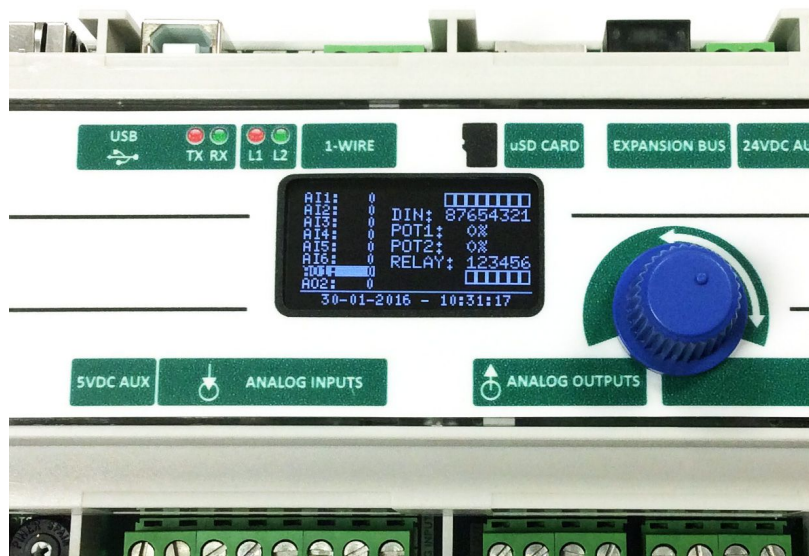
HMI Specifications:

- OLED 1.3" monochrome 128x64 pixel, I2C

- 24ppr rotary encoder with puch button.

- Recommended library for OLED: 8uglib.n

- Recommended library for encoder: ClickEncoder.h

Refer to the pin assignment for use of the encoder in the table in section 3 of this manual.

18.   Programming.

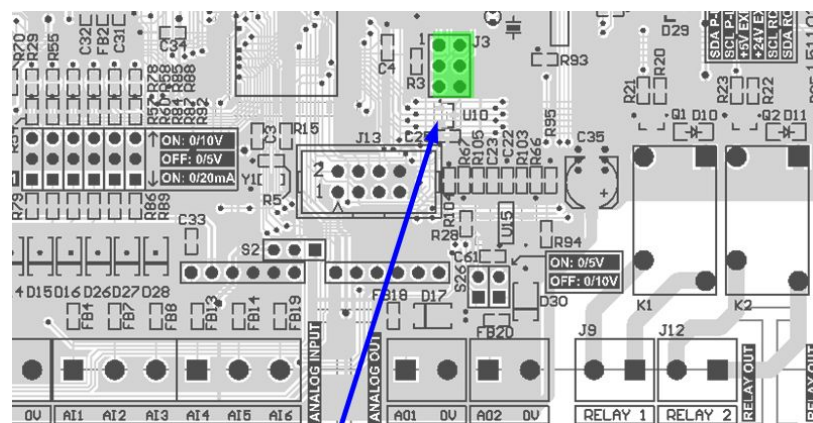You can programme the ArduPLC MEGA in 2 ways;

● Using an external programmer via the ICSP connector. This is the native way to program Atmel AVR microcontrollers. The most commonly used programmer for this purpose is the AVR MKII:

To program the microcontroller with this programmer we have to access the board either by removing the upper or lower cover of the DIN box.

CONECTOR PROGRAMADOR ICSP

- Using the available USB port and the bootloader loaded in the microcontroller.

ArduPLC MEGA comes standard with the Arduino MEGA 2560 bootloader loaded so we only need a USB cable connected to our computer to download programs from the Arduino IDE.

19.   Test Sketch.

ArduPLC MEGA brings a test or demo sketch loaded as standard. You can easily interact with device resources through the USB port. Connect ArduPLC MEGA to a PC via the USB port. Wait for the virtual serial port to install correctly. Run any serial monitor program such as hyperterminal or the serial monitor that comes with the Arduino IDE. Set the communication to 9600, n, 8, 1, open the port and press '?' to display the menu. Follow the instructions to activate relays, read entries, date, time, etc. You can do the same operation for the RS485 port.

To test the Ethernet port, connect ArduPLC MEGA to your local network and open your web browser. Enter the IP address: 192.168.1.190. You will need to modify the Sketch to change this IP if your IP address range is different.

It has available this sketch as well as the necessary documentation of ArduPLC MEGA in GitHub at the following address:

If you have the HMI interface you can identify the following parameters. You can modify the analogue outputs with the encoder.

20.   Technical Specifications.

Power Supply Range:	6.5 a 30 VDC
Power Consumption:	200mA @ 24V (4.8W máx.)
Power protection:	Reverse polarity, 2A Fuse
I/O Protection:	Transients and EMI
Analogue Input Range:	0-5V, 0-10V 0-20mA
Digital Input Voltage Range:	12VDC - 30VDC
Analogue OutPut Range:	0-5VDC, 0-10VDC
Max analogue output current:	20mA
1-wire I/O level:	5V
Relay Contact Ratings:	5A @ 250VAC, 30VDC
RS485 Port:	3000V Isolation , ¼ load , +/- 15Kv ESD Protection, auto data direction control
Operating temperature:	-10 to 50 ºC
Width:	208 mm
Height:	90 mm
Depth:	58 mm
Weight:	350 g.