MOLTINO 4x4 renaissance

Arduino controlled compact I/O module

Hardware features

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Rev.: 1.
2025.08.05.

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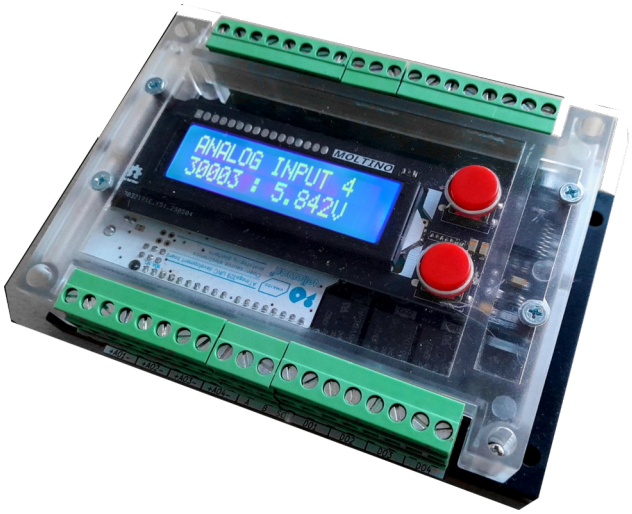
1. General information

MOLTINO is a versatile family of modular input/output (I/O) devices designed for measurement, control, and monitoring in industrial, academic, and development environments. It is a documented hardware platform with publicly available schematics to support firmware creation and system integration. Users are encouraged to develop their own firmware and applications tailored to specific use cases. The system is compatible with a wide range of Arduino Uno form factor controllers, including AVR, STM32, ESP32, RP2040, among others, offering flexibility and scalability for different performance needs. These platforms also enable the integration of additional features such as wireless communication (Wi-Fi, Bluetooth), real-time clock (RTC), external storage, or advanced processing capabilities, significantly expanding the development possibilities depending on the project. MOLTINO is committed to fostering openness and collaboration while ensuring commercial viability and product reliability.



Main features MOLTINO 4x4 renaissance:

- 4 0-10V/0-20mA analog inputs (16bit resolution)
- 4 multifunction smart digital inputs
- 4 0-10V/300mA analog outputs
- 4 relay outputs
- Logic compatible with 5V and 3.3V
- Integrated power supply
- Integrated RS485 communication
- Optional LCD screen
- Modular design
- Maximum protection

- **Flexible firmware development:**

MOLTINO allows anyone to develop their own firmware tailored to specific needs. Thanks to its compatibility with standard Arduino Uno form factor boards, developers can easily use a wide range of controllers available on the market — including AVR, STM32, ESP32, and RP2040 — to create powerful and customized solutions.

Ready-to-Use Firmware:

Precompiled firmware versions are also available for download, eliminating the need for firmware development in many cases. These firmwares are personalizable and configurable, can be adapted to various use cases with minimal effort.

2. Analog inputs

The MOLTINO 4x4 features **four configurable analog inputs.** Each input supports measurement ranges of 0 to 10 V or 0 to 20 mA, selectable via jumper. Analog-to-digital conversion is handled by the onboard AD1115 converter, providing **16-bit resolution per channel.** Communication with the microcontroller is carried out via the I²C bus. The inputs are protected against overvoltage.
The silkscreen on the printed circuit board, located in front of the pluggable terminals, indicates the input numbering and the polarity.

3. Analog outputs

The MOLTINO 4x4 features **four independent analog outputs**, each capable of delivering a **programmable DC voltage in the range of 0 to 10 V**. Each output supports a maximum current of **300 mA** and is protected by a **self-resetting fuse**, ensuring safety against overloads.

The analog signal is generated using **pulse-width modulation (PWM)** originating from the microcontroller board. The **output resolution** directly depends on the **PWM resolution** used in the control system.

The printed circuit board includes silkscreen markings in front of the pluggable terminals to identify the numbering and the polarity of each output.

4. Digital inputs

The MOLTINO 4x4 is equipped with 4 independent digital inputs, designed to support both direct current (DC) and alternating current (AC) signals. Each input features a jumper-selectable extended voltage range, allowing compatibility with various control signal types.

The supported voltage levels are as follows:

- **Low level** in **low range**:
  0 V – 4 V DC / 0 V – 8 V AC
- **Low level** in **high range**:
  0 V – 24 V DC / 0 V – 48 V AC
- **High level** in **low range**:
  5 V – 48 V DC / 10 V – 96 V AC
- **High level** in **high range**:
  25 V – 120 V DC / 50 V – 240 V AC

Each input is equipped with a **green LED indicator**, located directly behind the connection terminal, to display the logic state of the signal.

The inputs are **optically isolated using optocouplers**, ensuring **galvanic isolation** both between channels and from the control system.

An integrated **anti-jitter circuit** based on a **CD4093 logic IC** is included in each input path. At the front end of this circuit, a **low-pass filter** with a **cutoff frequency of 25 Hz** is used. This filter can be **individually enabled or disabled** for each input via jumpers, allowing precise adjustment depending on the characteristics of the input signal. The combination of filtering and jitter suppression provides **high immunity to line noise and environmental interference**.

Additionally, the filter allows detection of the **presence or absence of AC voltage**, interpreting it as either a logical high or low level as appropriate. The relevant input channels and configuration options are **clearly marked with silkscreen** on the PCB next to the corresponding jumpers.

The **printed circuit board** features **silkscreen labels in front of the plug-in terminals** to clearly indicate the **numbering and polarity** of each input.

5. Digital outputs

The MOLTINO 4x4 provides 4 independent digital outputs via relays. Each output can switch loads of up to **10 A**, assuming a **resistive load**. The relays are of the **normally open (NO)** type.

Each relay is equipped with an blue LED indicator that visually displays its activation status. Load connection is made through **screw terminal blocks**, rated to handle the corresponding current and power levels.

The outputs are numbered from **1 to 4**.

The silkscreen on the printed circuit board, located in front of the pluggable terminals, indicates the output numbering.

To activate the relays, the control system must apply a **high logic level** to the respective control pins (**port reference**).

In order to guarantee galvanic isolation of the power section, the printed circuit board includes separation slots around the relay terminals.

6. Communication system

Data Communication via RS485

The MOLTINO 4x4 mainboard features RS485 communication, making it suitable for demanding industrial environments. The entire RS485 circuit is integrated on the mainboard, including protections designed to safeguard the device from communication line disturbances. These protections include:

- 100 mA PTCs in series on both communication lines
- Transient voltage suppression diode at the RS485 circuit input

The circuit includes a termination resistor for the communication line, which is **disconnected by default**. To enable it, the **JP3 solder jumper** must be closed.
Another jumper affects communication mode selection: a **removable jumper** switches between RS485 and USB communication modes.

Data Communication via USB

Arduino-compatible boards and their derivatives support communication through the USB port. Some use a USB/RS232 converter, while others offer native USB support.

The MOLTINO 4x4 mainboard communicates with the control board via the serial port. In this configuration, the **removable jumper** mentioned earlier allows switching between USB and RS485 modes.
If the control board uses a USB/RS232 converter, the RS485 circuit must be **disconnected** to communicate with the microcontroller. This is the jumper's purpose.

When uploading firmware to the microcontroller via USB, the USB communication mode must be selected.
Important: There is no need to remove the control board from the MOLTINO to upload the firmware, nor to connect external power. The **MOLTINO 4x4 does not operate from the USB 5V supply**; the USB is used exclusively for data communication.

Other Communication Options

Arduino-based boards support a wide range of communication methods, including wireless options. Depending on the firmware protocol and the board type, the integration possibilities of the MOLTINO 4x4 are virtually unlimited.

Thanks to its open hardware design, anyone with programming knowledge can complete and expand the development of a new device using the MOLTINO platform.

7. Power supply system

The MOLTINO 4x4 supports **two power supply methods**, offering flexibility for integration in both industrial environments and development setups.

Primary power via the main board

The **main board** includes an integrated **switching power supply**, designed to accept input voltages of up to **28 V DC**. This power supply features built-in **protection against overvoltage, overcurrent, and reverse polarity**, ensuring safe and reliable operation in demanding applications.

- **Overcurrent protection** is implemented using a **self-resetting fuse (PTC)** that limits device consumption to a maximum of **2 A**.
- Voltage regulation is handled by an **LM2596 switching regulator**, capable of delivering up to **3 A** at its output.
- The presence of input voltage is indicated by a **red LED** located behind the corresponding plug-in terminal.

Auxiliary 5 V power supply

The board also includes a dedicated **5 V auxiliary power supply**, which serves the following functions:

- Powering the **integrated relays**,
- Supplying power to the **optional LCD display**,
- Providing a **5 V output** for sensors and other external peripherals.

This output can supply up to **2 A at 5 V**.

Power via the control board

The second method of powering the system is through the **power input connector of the control board** (Arduino-compatible). In this case, the input voltage tolerance depends on the specific board used:

- For example, an **Arduino UNO R4** supports input voltages up to **24 V DC**, while an **Arduino UNO R3** is limited to **15 V DC**.
- In industrial environments with standard **24 V** power supplies, it is recommended to use the **integrated power supply of the MOLTINO** to ensure compatibility and protection.
- The **minimum required voltage** for reliable operation of the MOLTINO system is **13.4 V**, which should be considered when selecting the control board.

In general, **any development board with Arduino form factor** is suitable for controlling the MOLTINO.

Logic level selection

Depending on the microcontroller used on the control board, it may be necessary to select the **logic voltage level: 5 V or 3.3 V**. For this purpose, the main board includes a **solder jumper** that allows switching between the two levels, adapting the I/O logic to the appropriate voltage standard.

Reset button

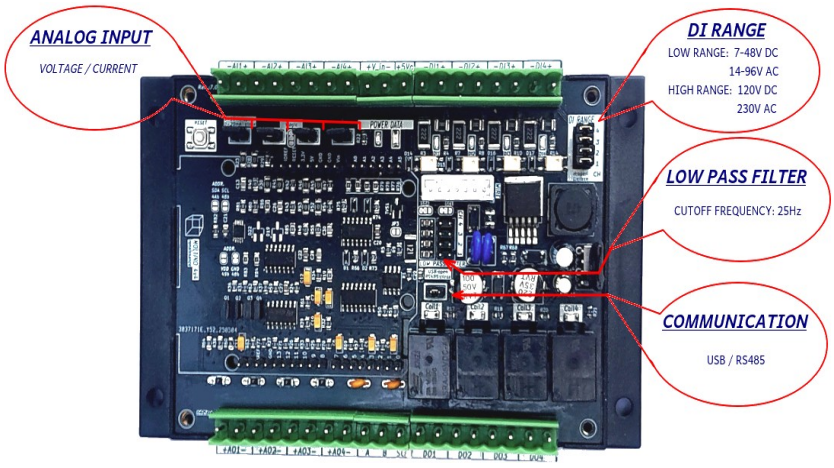
The reset button located on the main board allows the system to be restarted when necessary. It is connected to the reset terminal of the control board and can be operated externally through an opening in the enclosure cover aligned with the button.

8. Configuration via jumpers

The motherboard of the system includes a set of configuration jumpers that allow the user to adjust various operational parameters. These jumpers are of two types:

- Removable jumpers: used to change the functional modes of the system.

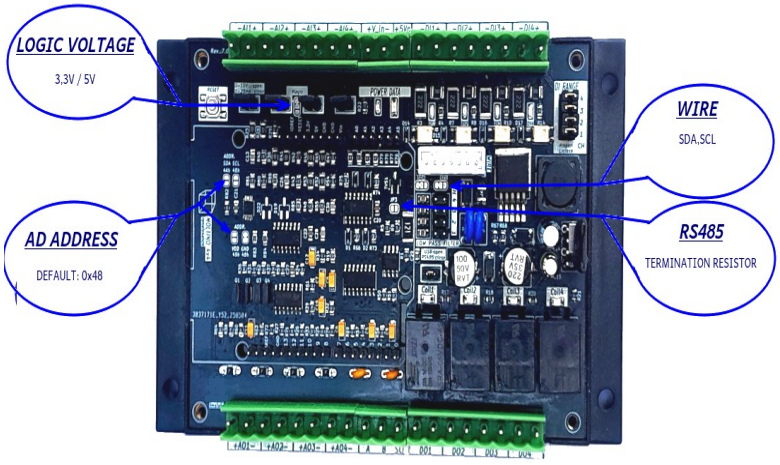
- Solder jumpers: used to adjust hardware-level settings that adapt the motherboard to the specific characteristics of the processor board in use.



Bridge jumpers

Removable Jumpers

- Select the type of analog input signal: voltage or current.
- Adjust the sensitivity range for digital inputs.
- Enable or disable the low-pass filter for digital inputs.
- Select the wired communication mode: USB or RS485.



Solder jumpers

Solder Jumpers

- Select the logic voltage of the motherboard: 5 V or 3.3 V.
- Set the I²C address of the analog-to-digital converter.
- Adjust the SDA/SCL line mapping according to the Arduino board in use.
- Insert or omit the termination resistor (120 Ω) on the RS485 line.

9. Display module

Lcd board

The LCD module is an optional component that enables the display of useful information such as operating status, configuration parameters, current values, and other system variables. Although the device can operate independently without this module, its inclusion facilitates direct monitoring.

The displayed data depends on the loaded firmware, which determines the values to be shown. Communication between the LCD module and the main board is carried out via the I2C bus.

The module includes two push buttons connected to two digital inputs of the control board. A debouncing (antijitter) circuit is implemented between the buttons and the inputs to eliminate signal noise caused by mechanical bouncing.

A solderable jumper is provided for selecting the logic voltage level, allowing operation at either 3.3 V or 5 V, depending on system requirements.

The LCD screen is controlled through a PCF8574 serial-to-parallel I/O expander, which interfaces with the microcontroller over the I2C bus. Three solderable jumpers are available for configuring the I2C address; the default address is 0x27.

On the bottom side of the module, a trimmer potentiometer allows for contrast adjustment of the display. Additionally, the firmware can control the display backlight, enabling or disabling it as needed.