Hardware Guide

January 2015

Revision 003

a general-purpose, professional input/output module based on a standard Arduino board

Be sure to always remove the power supply before installing or removing the Arduino board inside iono.

iono must be operated with both side covers installed.

Follow all applicable electrical safety standards, guidelines, specifications and regulations for installation, wiring and operations of iono modules.

Carefully and fully read this iono hardware guide before installation.

iono is not authorised for use in safety-critical applications where a failure of the product would reasonably be expected to cause personal injury or death. Safety-critical applications include, without limitation, life support devices and systems, equipment or systems for the operation of nuclear facilities and weapons systems. iono is neither designed nor intended for use in military or aerospace applications or environments and for automotive applications or environment. Customer acknowledges and agrees that any such use of iono is solely at Customer's risk, and that Customer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

Sfera Labs, a division of Home Systems Consulting S.p.A., may make changes to specifications and product descriptions at any time, without notice. The product information on the web site or materials is subject to change without notice.

Please download and read the iono Terms and Conditions document available at:

http://www.iono.cc

Introduction

iono combines the ease of use of the Arduino platform with multiple input and output interfaces; the result is a rugged, safe, reliable and easy to connect module, suited for installation both in industrial and residential environments.

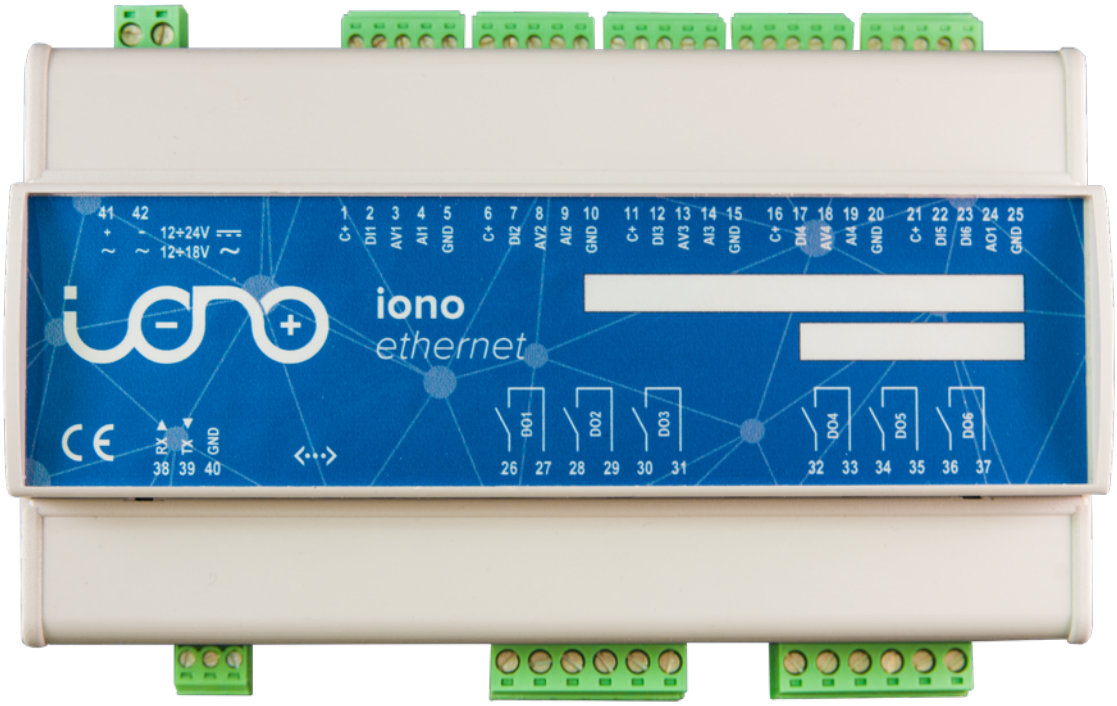
iono is available in three versions, all using the same shield board and case, but with different Arduino boards pre-installed.

iono ethernet has an Arduino Ethernet board, while iono uno uses an Arduino Uno board.

iono solo comes without any Arduino board, so you can use your preferred Arduino board, as far as it is fully compatible with the Arduino 1.0 pinout and fits the iono case.

The different versions all share the same I/O board and case, and the electrical characteristics are common. The information contained in this manual cover all versions, except where explicitly stated otherwise.

iono ethernet and iono uno are compliant with the CE certification requirements for electromagnetic compatibility (2004/108/CE), electrical safety (2006/95/CE) as well as the RoHS directive for hazardous substances (2011/65/UE).



Features

The iono module's key features are:

- ✓ 12/24Vdc or 12/18Vac power supply
- ✓ 4 multi-mode inputs: either to be used as digital or as 0÷10V or 0÷20mA analog signals
- ✓ 2 digital inputs for potential-free contacts
- ✓ 1 analog output 0÷10V controlled by PWM signal
- ✓ redundancy of common terminals for simplified wiring
- ✓ 6 power relay outputs rated for 12A at 250V, which can tolerate large peak currents (inrush current) up to 80A
- ✓ output relays with bistable coil, to minimize the current consumption
- ✓ built in slot for the installation of an Arduino Uno or Arduino Ethernet boards, leaving the USB or Ethernet connector accessible
- ✓ 1 terminal block with asynchronous communication port (TX / RX) at TTL level
- ✓ removable terminal blocks for easier installation
- ✓ inputs protected against electrostatic discharges and temporary over voltages
- ✓ doubled internal insulation between high voltage areas (relay outputs) and all other components
- ✓ compliance with Electromagnetic Compatibility and Electrical Safety standard
- ✓ standard modular housing 9 units size, suitable for mounting on Omega rail.

Usage and connections

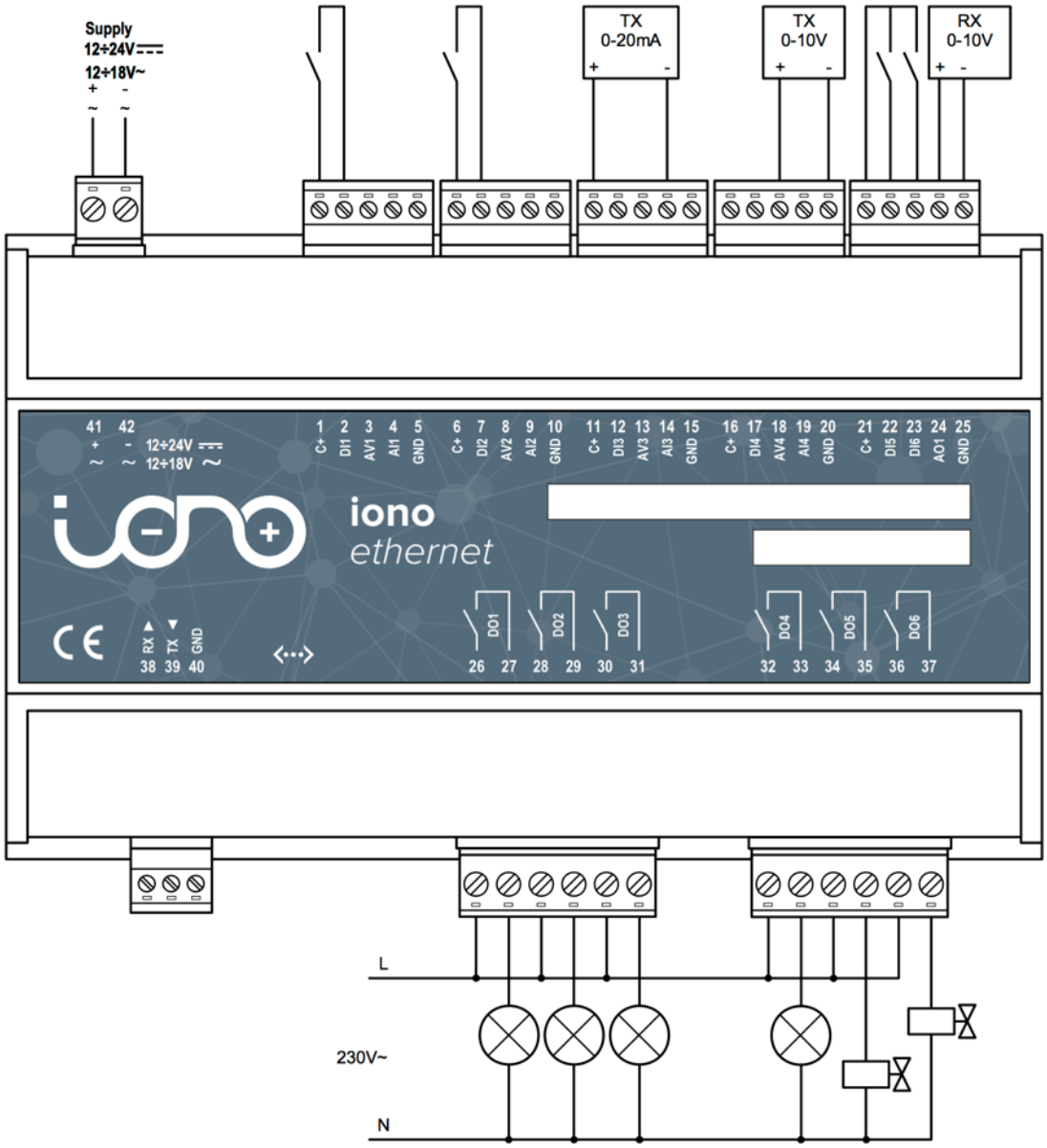


FIGURE 1 CONNECTION EXAMPLE

Power supply

iono can be powered by DC or AC voltage:

✓ DC: nominal voltage in the range 12V to 24V (MIN=11, MAX=30Vdc)

✓ AC: nominal voltage in the range 12V~ to 18V~ (10.8¸21.0V~).

When DC powered, make sure to respect the correct polarity shown in the schematic diagram (+ -).

Multi-mode inputs: analog mode

iono features 4 multi-mode inputs (1, 2, 3, 4). Depending on terminal blocks wiring, digital (ON-OFF), analog 0÷10V or analog 0÷20mA signals can be applied.

When using analog inputs, 0÷10V and 0÷20mA are converted to 0÷5V levels in order to be compatible with the Arduino platform input pins. Both active and passive 0÷20mA (or 4÷20mA) transmitters can be connected, using the C+ terminal as power supply; the 0÷20mA transmitter shown in the schematic here below is a 2-wire passive type.

Multi-mode inputs: digital mode

In digital mode, an external potential free contact can be connected between terminals C+ and DIx (x=1, 2, 3, 4); otherwise, the Dix terminal can be connected to an external voltage signal (in the range 9÷40V) referred to the GND of the iono module.

DI5 and DI6 digital inputs

All specifications in the previous point apply to both DI5 and DI6 digital inputs connections.

Analog output

iono features a 0÷10V output (AO1) which can be controlled by the PWM function of the Arduino platform; the 0÷100% duty cycle of PWM signal corresponds to a 0÷10V output voltage.

This is a sink/source output (the current direction at this output can be both positive and negative).

Relay digital outputs

iono features 6 power relay outputs which can withstand high inrush currents thanks to the special contact built.

These relays have bistable coils, which are powered only for the short time needed to move the contact from one position to the other one.

This guarantees very low total current consumption and low power dissipation resulting in lower self-heating. It also maintains ”mechanical memory” in case of module power supply failure.

A dedicated internal circuit manages the relay coils, matching the closed status of each relay to the high state of the related control pin of the Arduino platform.

Asynchronous serial communication port

iono features a 3-way terminal block for the connection to an asynchronous serial external device. Pins TX and RX of the terminal block are connected to the related pins TX and RX of the Arduino platform, through two protection series resistors.

Mapping

The following table shows the mapping of the inputs and outputs of the iono module into the related pins of the Arduino platform.

iono inputs and outputs	Arduino pins
DI1 – AV1 – AI1	A0
DI2 – AV2 – AI2	A1
DI3 – AV3 – AI3	A2
DI4 – AV4 – AI4	A3
DI5	2
DI6	3
DO1	A4
DO2	A5
DO3	5
DO4	6
DO5	7
DO6	8
AO1	9
RX	RX
TX	TX

Quick start

Be sure to always remove the power supply before installing or removing the Arduino board inside iono.

iono must be operated with both side covers installed.

Follow all applicable electrical safety standards, guidelines, specifications and regulations for installation, wiring and operations of iono modules.

Carefully read the iono hardware guide before installation.

iono ethernet

iono ethernet ships with our HTTP server sketch pre-installed (you can download the iono Web Library from the downloads section for the details), and the following network configuration:

- ✓ Address: 192.168.0.100
- ✓ Netmask: 255.255.255.0
- ✓ Gateway: 192.168.0.1
- ✓ DNS: 192.168.0.1

1. connect iono to a regulated power source (check the data sheet for the power requirements)
2. gently remove the side cover on the inputs side
3. check that the LD1 power LED, next to the power supply terminals, is on
4. connect iono to your network and, from a device with a compatible network address, go to the iono URL using any modern web browser: http://192.168.0.100. Note that JavaScript must be enabled on the browser
5. click the settings icon and enter your preferred network parameters and password, then press save
6. you should now be able to access iono again using the newly assigned address.

iono uno

iono uno ships with a simple test sketch pre-installed. This sketch will simply intermittently glow the LD2 LED, that is associated to the AO1 analog output voltage level.

1. connect iono to a regulated power source (check the data sheet for the power requirements)
2. gently remove the side cover on the inputs side
3. check that the LD1 power LED, next to the power supply terminals, is on
4. check that the LD2 LED, the one next to the AO1 analog output terminal block, constantly glows in on-off cycles of about 4 seconds
5. once you know that iono is working you will most likely want to load your own sketch to do something slightly more useful than glowing a LED. Check the downloads section for the iono base library and examples.

iono solo

iono solo doesn't ship with a pre-installed sketch, for the simple reason that there is no Arduino module installed!

Still, before installing your own Arduino board, you should check that it powers-up normally.

1. connect iono to a regulated power source (check the data sheet for the power requirements)
2. gently remove the side cover on the inputs side
3. check that the LD1 power LED, next to the power supply terminals, is on
4. remove the power supply
5. gently remove the side cover on the outputs side
6. install your Arduino board
7. reconnect the power supply and check that LD1 goes back on.

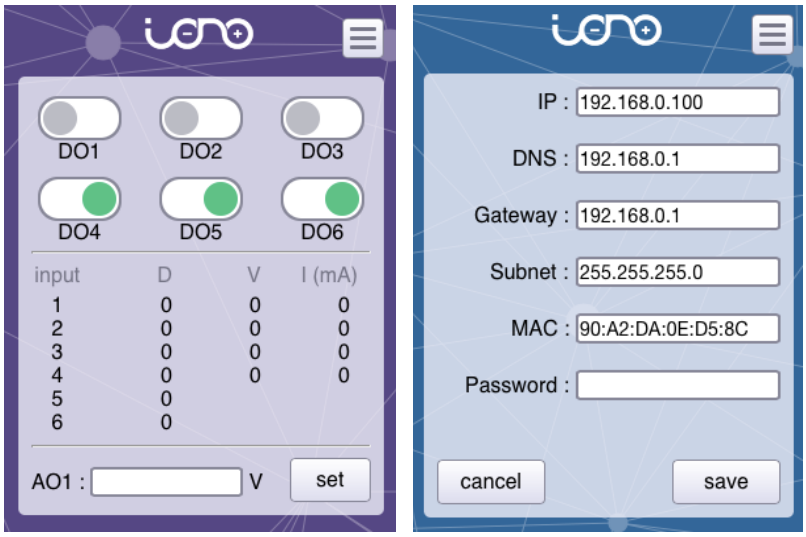
iono ethernet web app user guide

The pre-installed iono ethernet web app can be used from any modern browser, including browsers of all mobile devices, to easily control the output relays, the 0…10V analog output and check the status of all inputs.

JavaScript must be enabled on the browser, or this app will not work.

Simply push the DOx switches to flip the relays, or enter a decimal number, e.g. 8.3, then press [set] to set the analog output.

From the control page you can access the configuration page pressing the icon on the top-right corner.



Using the configuration page you can change the network parameters, including the MAC address (unless you know exactly what you are doing, always use the MAC address printed on the Arduino ethernet board).

You can also set a password to restrict access to the web app. Please note that this app does not use the HTTPS encrypted protocol, and all data, including the password, are sent over the network unencrypted.

Factory reset

The web app sketch implements a simple factory reset procedure, to restore the original network settings and remove the password.

Power off iono, then short-circuit pins RX and TX and power it back on.

Now go to http://192.168.0.100/, set the new configuration and save, wait for the process to complete and remove the short-circuit.

Installing and removing the Arduino board

With iono solo you will have to install your own Arduino compatible board. iono accepts the original Arduino Uno and Ethernet Rev 3 boards, or other boards that are fully compatible with the Arduino 1.0 pinout specification.

Installing boards that are not fully compatible, both mechanically and electrically, may and probably will damage the iono board, and may create a safety risk.

You are responsible for the installation of the Arduino board inside iono solo. The factory warranty does not cover any damage directly or indirectly caused by the installation and removal of Arduino or compatible boards in iono.

iono solo is shipped with two plastic turrets next to the Arduino pins. These turrets should fit in the corresponding holes on your board. You may want to remove the turrets if they don't fit your board. It is up to you to determine if the mechanical coupling between iono and arduino is appropriate for your application.

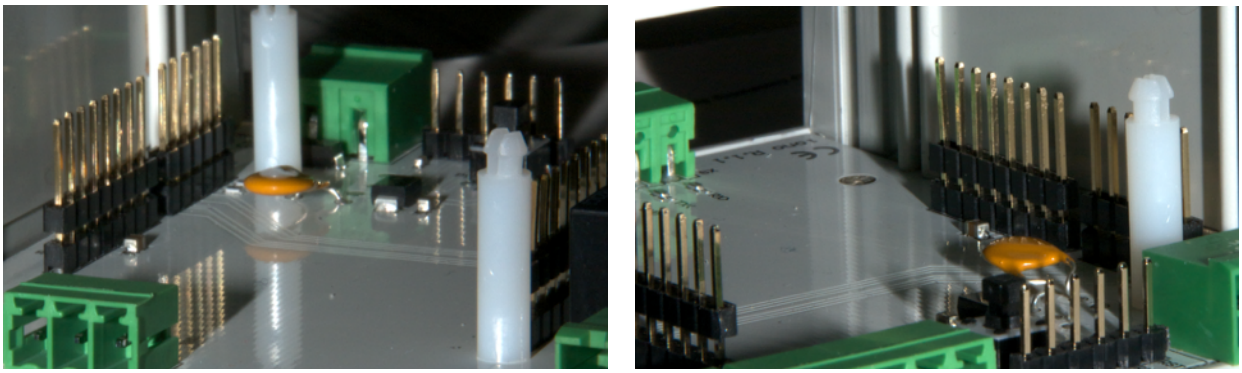


FIGURE 2 TURRETS INSTALLED ON THE IONO BOARD

To install the Arduino board, first line-up the connectors pins on both sides and also the Arduino board holes with the turrets heads. Visually confirm the alignment, then gently push down on both sides at the same time to lock the board firmly in place.

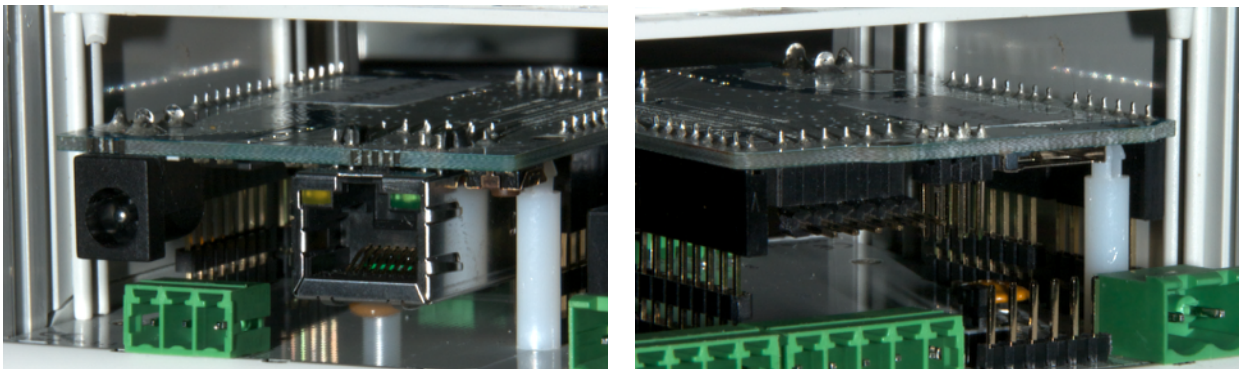


FIGURE 3 AN ARDUINO BOARD WITH PINS AND TURRETS PROPERLY ALIGNED

To remove the board, you should apply a gentle pressure to separate the turrets heads from the board. Be very careful to keep the Arduino board parallel to the iono board at all times, or you will bend the connection pins. You may consider cutting the turrets to simplify the removal of your Arduino board.

Programming

Arduino Uno

The Arduino Uno board, when mounted into a iono module, must be programmed through the USB port.

Arduino Ethernet

The Arduino Ethernet board requires the “USB Serial Light Adapter” for programming, as shown below.

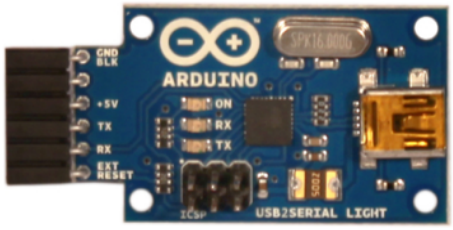


FIGURE 4 THE USB SERIAL ADAPTER

In order to access the programming connector inside the iono module, the cover placed on the same side of the power supply terminal block must be removed, gently sliding it outward, and giving access to the programming connector indicated by the red arrow below. The yellow arrow indicates the reset button of the Arduino board.

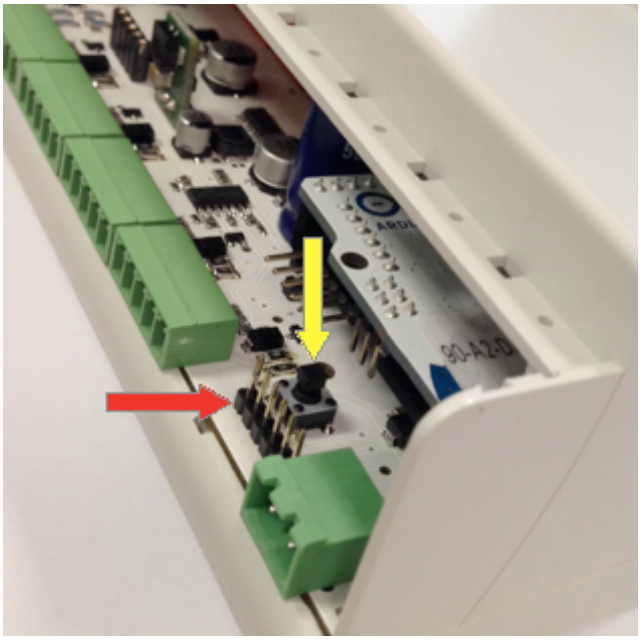


FIGURE 5 USB ADAPTER CONNECTOR AND RESET BUTTON

Insert the USB Serial Adapter as shown below.

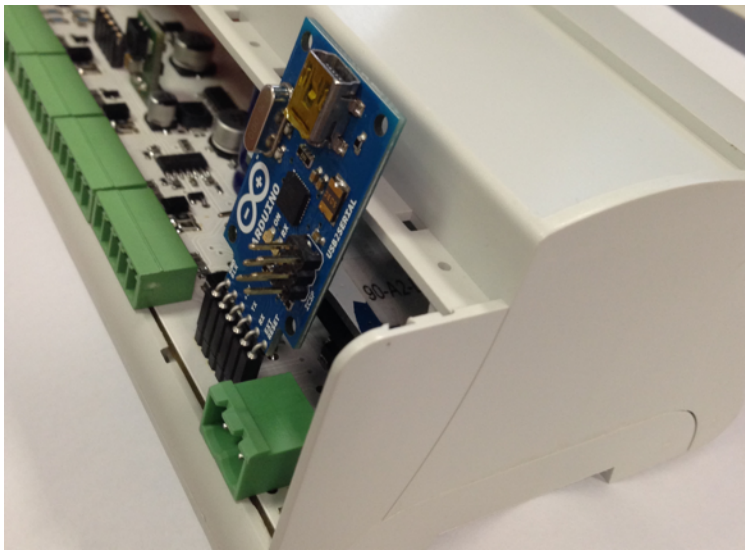


FIGURE 6 SERIAL ADAPTER INSERTED IN THE IONO USB ADAPTER CONNECTOR

Connect the adapter to a PC and perform the programming as usual. This operation does not require the iono module to be connected to a power supply.

Block diagram

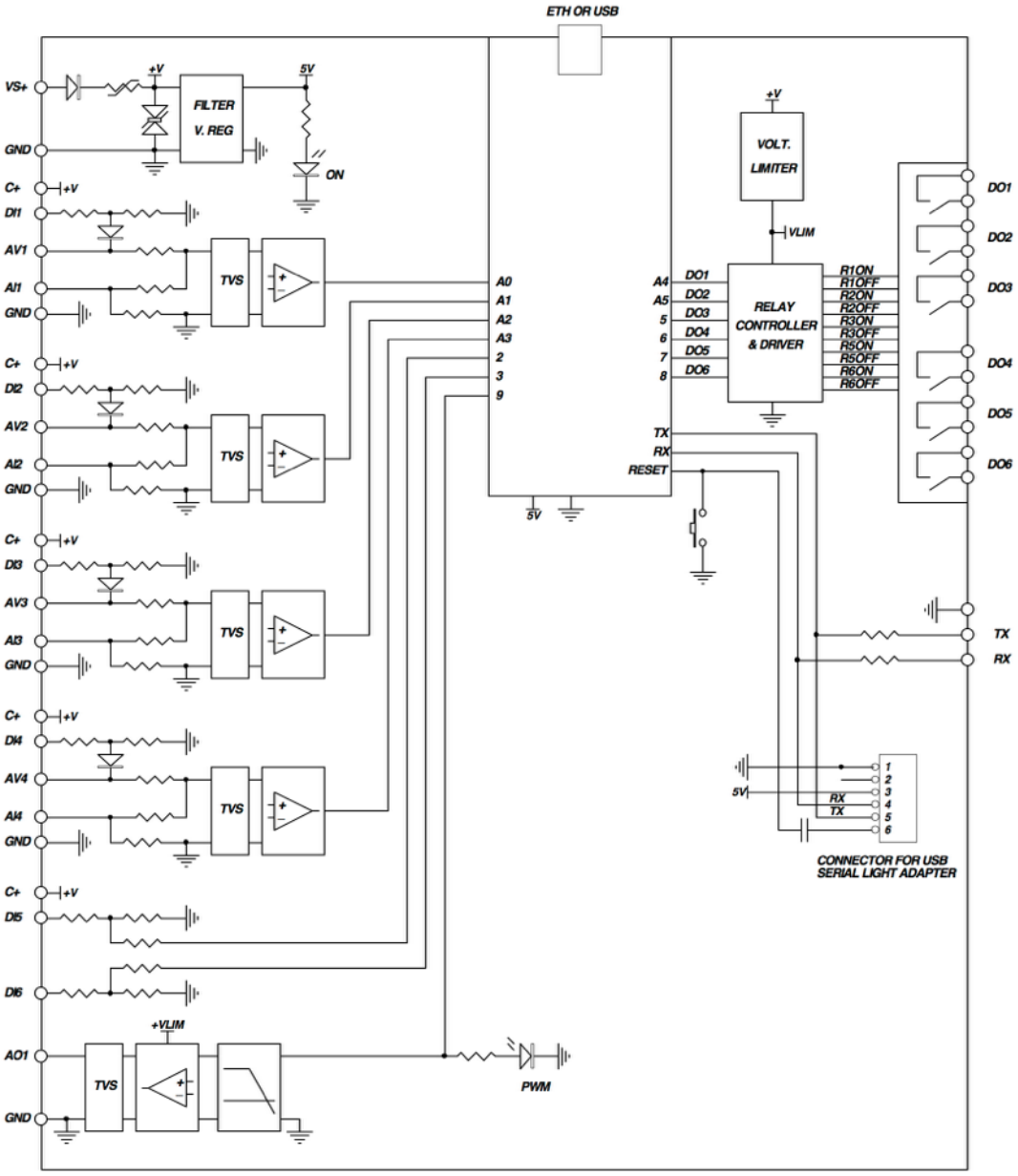


FIGURE 7 BLOCK DIAGRAM

Technical specifications

Power supply	12/24V⎓ nom. (11…30V⎓) 12/18V~ nom. (10.8…21.0V~)
Current consumption at VS+=12V⎓ and unconnected inputs	8mA w/o Arduino 32mA with Arduino UNO 92mA with Arduino Ethernet
Current consumption at VS+=12V⎓ and digital inputs closed to C+	26mA w/o Arduino 51mA with Arduino UNO 111mA with Arduino Ethernet
Current consumption at VS+=24V⎓ and unconnected inputs	7mA w/o Arduino 20mA with Arduino UNO 49mA with Arduino Ethernet
Current consumption at VS+=24V⎓ and digital inputs closed to C+	42mA w/o Arduino 56mA with Arduino UNO 85mA with Arduino Ethernet
Arduino platform compatibility	Uno Ethernet
Inputs	4 multi-mode (digital or analog 0…10V or 4…20mA) 2 digital
Voltage range at digital inputs (1-6)	9…40V⎓
Current for each digital input (1-6)	2,7mA at VS+=12V⎓ 5,5mA at VS+=24V⎓
Voltage threshold digital inputs 1-4 (typ.)	VIH: 7.3V VIL: 6.2V
Voltage threshold digital inputs 5-6 (typ.)	VIH: 5.1V VIL: 4.5V
Impedance for analog 0…10V inputs (1¸4)	94 kΩ
Impedance for analog 0…20mA inputs (1-4)	250 Ω

Conversion error for analog 0…10V inputs (1-4)	2% of full scale
Conversion error for analog 0…20mA inputs (1-4)	2% of full scale
Max cable length for digital inputs (1-6)	30 meters
Max cable length for analog inputs (1-4)	15 meters
Digital outputs	6 power relays with bistable coil
MAX output contact rating (each output)	• Resistive load (cos ϕ = 1): 12A at 250V~ (3000VA) • Inductive load (cos ϕ = 0.5): 3.6A at 250V~ (900VA) • Incandescent lamps: 8A at 250V~ (2000VA) • Fluorescent lamps:350W with 42uF MAX power factor correction capacitor
Analog output	0…10V PWM controlled by Arduino PWM out max 10 mA source/sink current
Suggested minimum PWM frequency for analog output	120 Hz
Duty cycle to voltage error for analog output	2% of full scale
Communication ports	• USB for Arduino Uno • Ethernet for Arduino Ethernet • Async serial port at TTL level on terminal block
Housing	standard 9M for DIN rail
Operating temperature	0…+50 °C
Storage temperature	-20…+70 °C
Protection degree	IP20

Dimensions

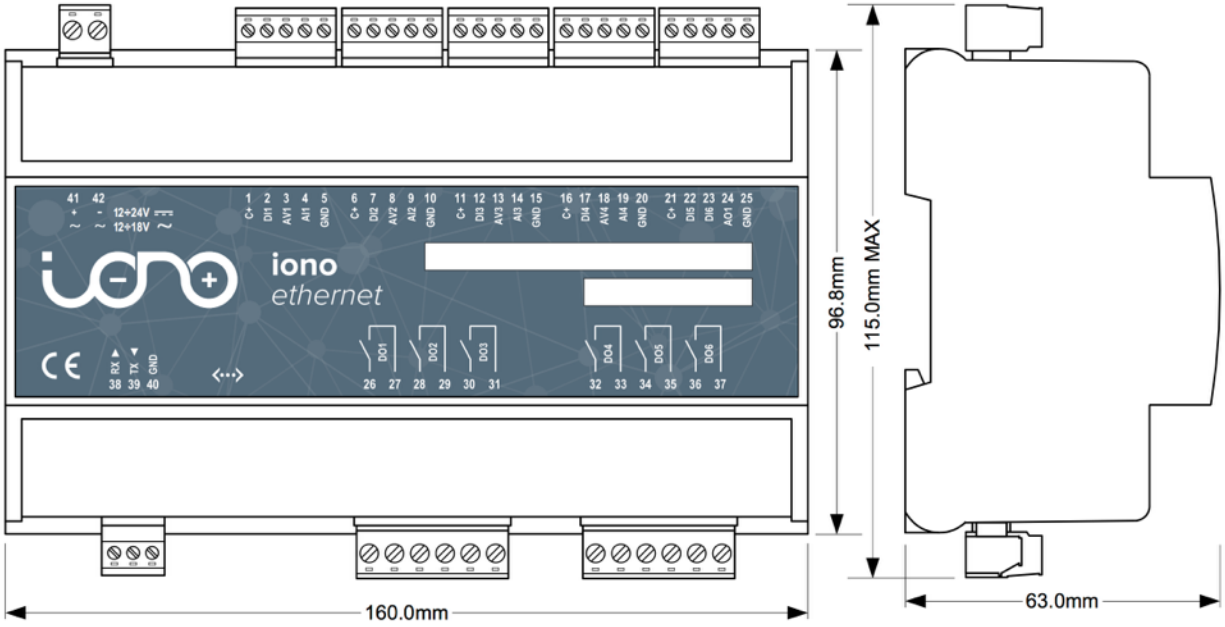


FIGURE 8 DIMENSIONS

Disposal

(Waste Electrical & Electronic Equipment)

(Applicable in the European Union and other European countries with separate collection systems). This marking on the product, accessories or literature indicates that the product should not be disposed of with other household waste at the end of their working life. To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate these items from other types of waste and recycle them responsibly to promote the sustainable reuse of material resources. Household users should contact either the retailer where they purchased this product, or their local government office, for details of where and how they can take these items for environmentally safe recycling. This product and its electronic accessories should not be mixed with other commercial wastes for disposal.

Installation and use restrictions

Standards and regulations

The design and the setting up of electrical systems must be performed according to the relevant standards, guidelines, specifications and regulations of the relevant country. The installation, configuration and programming of the devices must be carried out by trained personnel.

The installation and wiring of connected devices must be performed according to the recommendations of the manufacturers (reported on the specific data sheet of the product) and according to the applicable standards.

All the relevant safety regulations, e.g. accident prevention regulations, law on technical work equipment, must also be observed.

Safety instructions

Protect the unit against moisture, dirt and any kind of damage during transport, storage and operation. Do not operate the unit outside the specified technical data.

Never open the housing. If not otherwise specified, install in closed housing (e.g. distribution cabinet). Earth the unit at the terminals provided, if existing, for this purpose. Do not obstruct cooling of the units. Keep out of the reach of children.

Set-up

For the first installation of the device proceed according to the following procedure:

- ✓ make sure all power supplies are disconnected
- ✓ install and wire the device according to the schematic diagrams on the specific data sheet of the product
- ✓ after completing the previous steps, switch on the 230 Vac supplying the power supply and the other related circuits.

Standards

This device complies with the essential requirements of the following directives:

- ✓ 2004/108/CE (EMC)
- ✓ 2006/95/CE (Low Voltage)
- ✓ 2011/65/UE (RoHS).