Iono RP User Guide

April 2022

Revision 004

IRMB10X *Iono RP*

IRMB10R *Iono RP with RTC*

IRMB10S *Iono RP with RTC and Secure Element*

a general-purpose, industrial input/output module based on the Raspberry Pi RP2040

Iono RP must be operated with the plastic case installed.

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

Carefully and fully read this Iono RP user guide before installation.

Iono RP 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 RP 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 RP 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 S.r.l. 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 Sfera Labs Terms and Conditions document available at:

http://www.sferalabs.cc

Safety information

Carefully and fully read this user guide before installation and retain it for future reference.

Qualified personnel

The product described in this manual must be operated only by personnel qualified for the specific task and installation environment, in accordance with all relevant documentation and safety instructions. A qualified person should be capable of fully identifying all installation and operation risks and avoid potential hazards when working with this product.

Hazard levels

This manual contains information you must observe to ensure your personal safety and prevent damage to property. Safety information in this manual are highlighted by the safety symbols below, graded according to the degree of danger.

Indicates a hazardous situation which, if not avoided, **will** result in death or serious personal injury.

Indicates a hazardous situation which, if not avoided, **may** result in death or serious personal injury.

Indicates a hazardous situation which, if not avoided, can result in minor or moderate personal injury.

Indicates a situation which, if not avoided, can result in damage of property.

Safety instructions

General 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 unit. Keep out of the reach of children.

⚠ WARNING

Life threatening voltages are present within and around an open control cabinet.

When installing this product in a control cabinet or any other areas where dangerous voltages are present, always switch off the power supply to the cabinet or equipment.

⚠ WARNING

Risk of fire if not installed and operated properly.

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

Ensure that the product is properly installed and ventilated to prevent overheat.

NOTICE

The connection of expansion devices to this product may damage the product and other connected systems, and may violate safety rules and regulations regarding radio interference and electromagnetic compatibility.

Use only appropriate tools when installing this product. Using excessive force with tools may damage the product, alter its characteristics or degrade its safety.

Battery

This product optionally uses a small lithium non-rechargeable battery to power its internal real time clock (RTC).

WARNING

Improper handling of lithium batteries can result in an explosion of the batteries and/or release of harmful substances.

Worn-out or defective batteries can compromise the function of this product.

Replace the RTC lithium battery before it is completely discharged. The lithium battery must be replaced only with an identical battery. See the "Replacing the RTC backup battery" section for instructions.

Do not throw lithium batteries into fire, do not solder on the cell body, do not recharge, do not open, do not short-circuit, do not reverse polarity, do not heat above 100°C and protect from direct sunlight, moisture and condensation.

Dispose of used batteries according to local regulations and the battery manufacturer's instructions.

Introduction

Iono RP combines the ease of use of the Raspberry Pi RP2040 microcontroller 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 RP has an embedded RP2040, with a dual-core Arm Cortex M0+ processor, clocked up to 133 MHz, 264KB of SRAM, and a large 16MB on-board Flash memory.

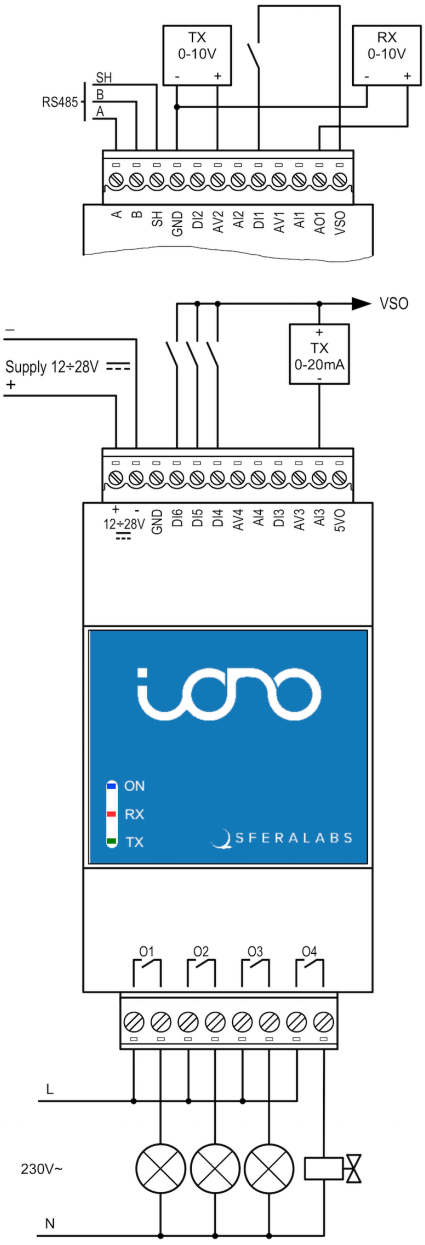
A hidden USB 1.1 port with device and host support is primarily used to easily flash the microcontroller, but could also be used to connect external USB devices.

Features

The Iono RP key features are:

- ✓ 12÷28Vdc power supply, with surge and reverse polarity protection, and 1.1A resettable fuse
- ✓ RP2040, dual-core Arm Cortex M0+ processor, clocked up to 133 MHz, 264KB of SRAM
- ✓ 16MB on-board Flash memory
- ✓ 4 multi-mode inputs: either to be used as digital or as 0÷30V or 0÷20mA analog signals
- ✓ 2 digital inputs for potential-free contacts or TTL level input/output
- ✓ 1 buffered analog output 0÷10V controlled by a RP2040 PWM output
- ✓ 4 power relay outputs rated for 6A at 250V
- ✓ standard RS-485 interface to the RP2040 UART serial pins, with electrostatic discharge protection
- ✓ 1-Wire, I2C and Wiegand support
- ✓ optional real time clock with on-board Lithium / Manganese Dioxide back-up battery
- ✓ optional secure element chip
- ✓ optional earthquake sensor module
- ✓ removable terminal blocks for easier installation
- ✓ inputs protected against electrostatic discharges and temporary over voltages
- ✓ compact, standard modular housing 3 units size, suitable for mounting on Omega rail.

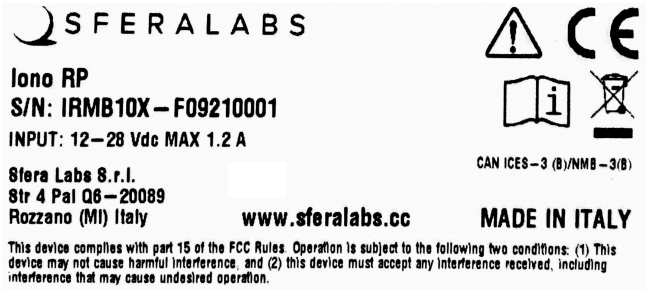
Usage and connections



CONNECTION EXAMPLE

Device identification

The device can be identified with the information provided in the rating and identification plate, permanently attached to the side of the case.



EXAMPLE RATING AND IDENTIFICATION PLATE

Power supply

Iono RP can be powered with DC voltage only:

✓ DC: nominal voltage in the range 12V to 28V (min=11V, max=30V)

Respect the correct polarity shown in the schematic diagram (+ -). The power supply circuit implements reverse polarity protection using an auto resetting fuse and surge protection up to ±500V/2ohms 1.2/50µs.

Multi-mode inputs

Iono RP features 4 multi-mode inputs. Depending on terminal blocks wiring, digital (ON-OFF), voltage (0÷30V) or current (0÷25mA) signals can be applied.

Analog mode

When using analog inputs (AV1-4, AI1-4), 0÷30V and 0÷25mA are converted to 0÷3.3V levels in order to be compatible with the RP2040 analog input pins. Both active and passive 0÷20mA (or 4÷20mA) transmitters can be connected, using the VSO terminal as power supply; the 0÷20mA transmitter shown in the connection example diagram above is a 2-wire passive type.

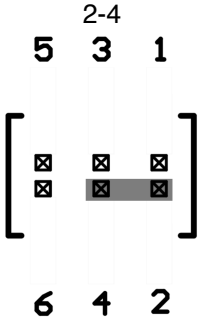
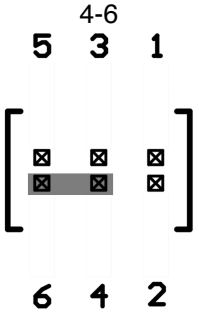
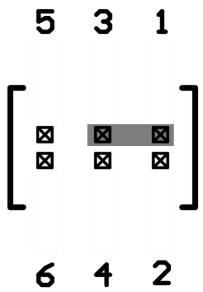
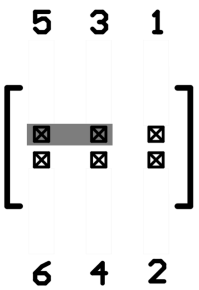
Digital mode

In digital mode, an external potential free contact can be connected between terminals VSO and DI1-4; otherwise, the DIx terminal can be connected to an external voltage signal (in the range 0÷40V) referred to GND of the Iono RP module.

DI5 and DI6 digital inputs

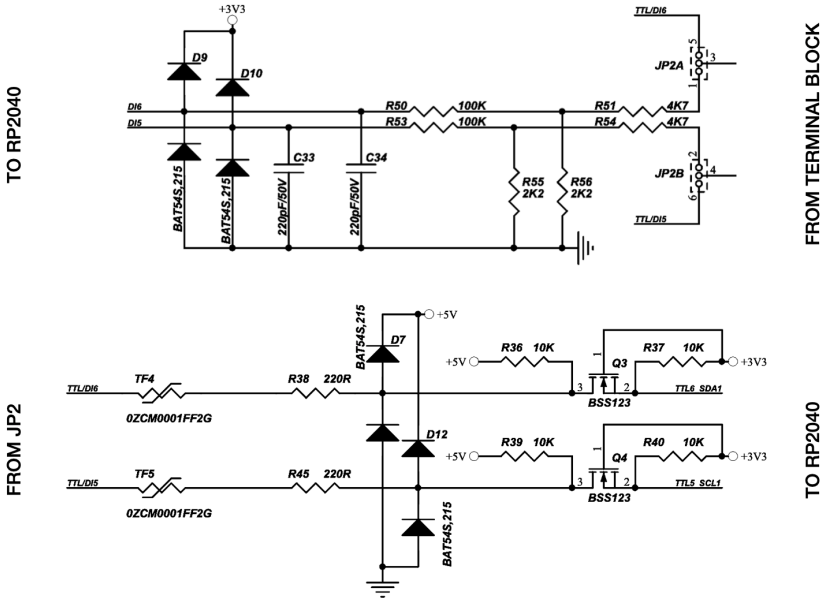
An external potential free contact can be connected between terminals VSO and DI5-6; otherwise, the DI5-6 terminals can be connected to an external voltage signal (in the 0÷40V range) referred to the GND of the Iono RP module.

DI5-6 are connected to the RP2040 GPIO inputs through a protection network. If you need to bypass the protection network to use DI5 or DI6 as general-purpose TTL-level (0-5V) input/output lines, or for 1-Wire or Wiegand support, you can set the JP2 jumpers according to the following table.

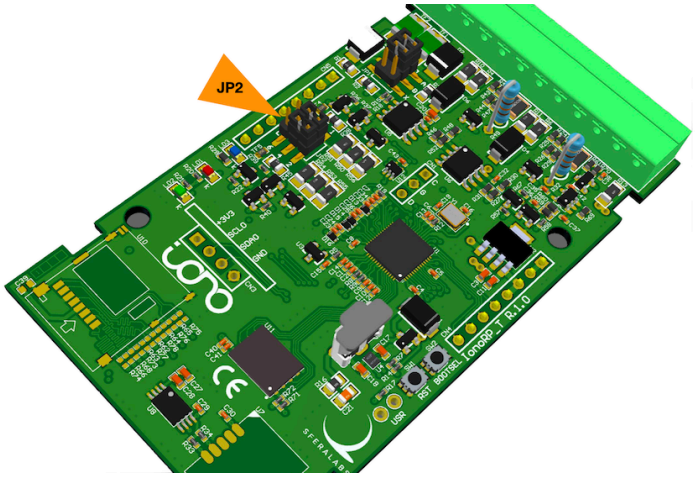
	DIGITAL INPUT	TTL I/O (BYP)
DI5	2-4 	4-6 
DI6	1-3 	3-5 

NOTICE

Note that, with the jumpers in the BYP position, you should limit the voltage applied to DI5 or DI6 between +0V and +5V (TTL level). Exceeding this voltage range will result in damage to the RP2040 board and Iono RP.



DI5-DI6 JUMPERS SCHEMATIC



DI5-DI6 JUMPERS POSITION

Analog output

Iono RP features a 0÷10V output (AO1) which can be controlled by the GPIO8 pin of the RP2040, configured as a PWM output; the 0% - 100% duty cycle of the PWM output is converted 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 RP has four single pole single throw power relays, with normally open contacts.

The relays are driven by distinct GPIO pins of the RP2040.

RS-485 serial port

Iono RP uses the RP2040 UART0 TX/RX pins (GPIO16 and GPIO17 respectively) to implement a standard RS-485 serial port.

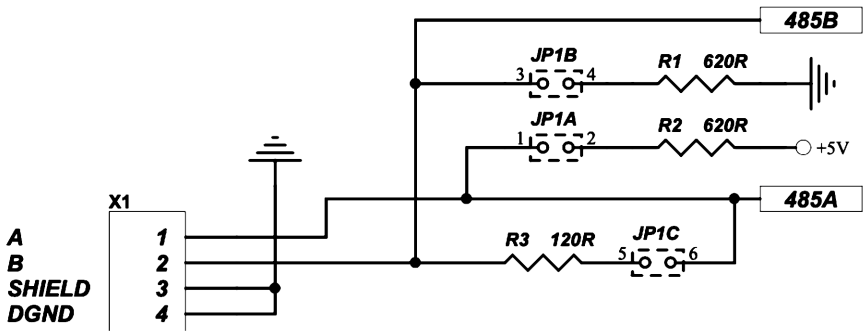
Simply connect the RS-485 A, B and GND to the RS-485 pins of the terminal block.

The RS-485 port is protected from ESD and voltage surges, and supports half-duplex communication up to to 115200 bps.

The RS-485 TX/RX switching is controlled by a digital output pin of the RP2040 (GPIO25). You should set GPIO25 low to enable transmission on the RS-485, and set it high to allow reception of incoming data.

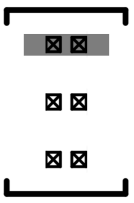
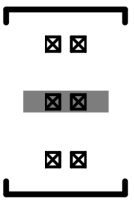
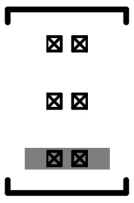
If GPIO25 is left high, or not configured as output during transmission, the Iono RP RS-485 driver will automatically drive the RS-485 lines in the dominant state, so that it is not strictly required to control GPIO25 in order to transmit data.

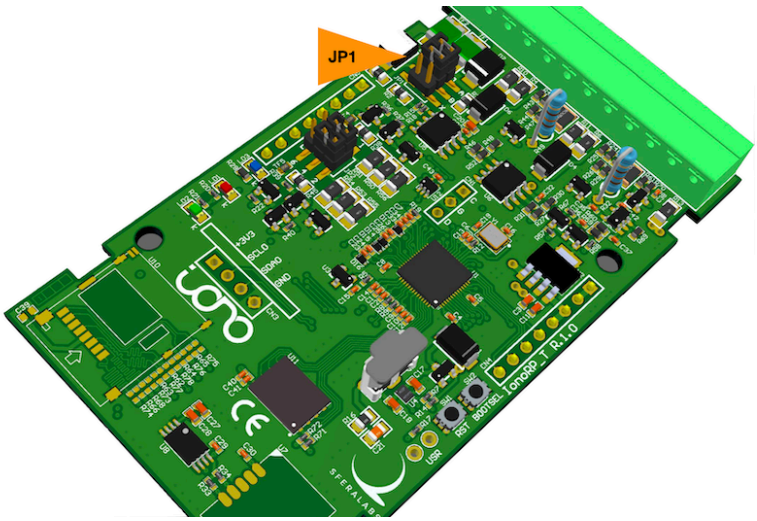
The RS-485 line has 620 Ohm pull-up and pull-down resistors on lines A and B. The biasing resistors ensure that, during idle periods the data lines are kept at a stable voltage level and prevent false triggering of receiver input. A 120 Ohm termination resistor between A and B can also be enabled.



RS-485 JUMPERS SCHEMATIC

These resistors can be enabled installing jumpers on JP1 according to the following table.

A PULL-UP	B PULL-DOWN	TERMNATION
		



RS-485 JUMPERS POSITION

EERAM

Iono RP has a Microchip 47L16 16 Kbit SRAM with EEPROM Backup. This chip combines the persistent storage characteristics of a traditional EEPROM, without the limitations in terms of number of erase cycles. It is connected to the RP2040 I2C bus (I2C0, pins 2 and 3, address: 0x50 for the SRAM and 0x18 for the control register).

Mapping

The following table shows the mapping of the inputs and outputs of the Iono RP module to the related pins of the RP2040 microcontroller.

Iono RP inputs and outputs	RP2040 pins
DI1 – AV1 – AI1	38 (GPIO26)
DI2 – AV2 – AI2	39 (GPIO27)
DI3 – AV3 – AI3	40 (GPIO28)
DI4 – AV4 – AI4	41 (GPIO29)
DI5 (digital input mode)	36 (GPIO24)
DI6 (digital input mode)	35 (GPIO23)
DI5 (BYP - TTL I/O mode)	9 (GPIO7)
DI6 (BYP - TTL I/O mode)	8 (GPIO6)
O1	16 (GPIO13)
O2	15 (GPIO12)
O3	14 (GPIO11)
O4	13 (GPIO10)
AO1	11 (GPIO8)
RS-485 RX	28 (GPIO17)
RS-485 TX	27 (GPIO16)
RS-485 TX-ENABLE (active low)	37 (GPIO25)
I2C SDA for EERAM and optionals	2 (GPIO0)
I2C SCL for EERAM and optionals	3 (GPIO1)

Hardware Installation

For the initial set-up, the plastic DIN rail case must be removed to access the circuit boards and internal connectors.

The case also needs to be opened to change the factory configuration of the internal jumpers for the RS-485 termination resistors or digital input configuration (see below).

The USB connector and the BOOTSEL button can be accessed by simply removing the front panel.

NOTICE

Before opening the Iono RP case, disconnect all power sources and any connection to external devices.

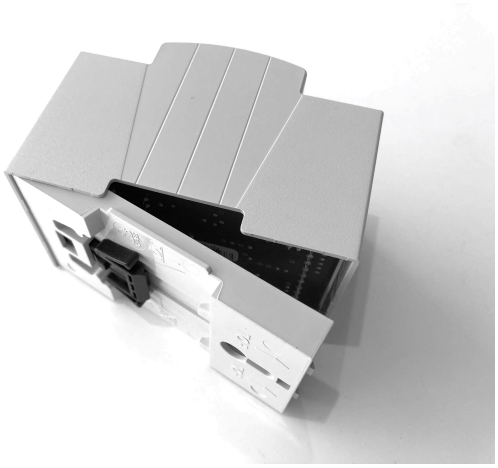
Opening the case

Follow these steps, in the exact order, to open the case:

1. Remove the green pluggable terminal blocks
2. Remove the black plastic DIN rail hook
3. With a small flat screwdriver gently separate the bottom case and boards assembly from the top cover
4. The circuit boards assembly will simply slide out of the case, as it is mechanically held in place by the bottom case only

Closing the case

5. Replace the circuit boards assembly inside the case; ensure that the terminal block connectors are aligned with the opening in the case
6. Replace the case bottom, then gently push the other side in place
7. Replace the black plastic DIN rail hook.



OPENING AND CLOSING THE CASE

NOTICE

Static electricity can damage the components in your system. To protect your system's components from static damage during the installation process, touch any of the unpainted metal surfaces on your computer's frame or wear an ESD wrist strap before handling internal components. Either method will safely discharge static electricity that's naturally present in your body.

When handling the Iono RP circuit boards, be sure to hold them along the side edges using your thumb and index finger. Avoid touching the components and pin connectors as damage may occur.

Software development

Programming Iono RP is as simple as any other RP2040-based boards, like the original Raspberry Pi Pico board.

You can program it in C/C++ or MicroPython, using any IDE or tool available for the RP2040 microcontroller or Pico board.

Refer to the following link for an overview on how to get started with RP2040 programming:

https://www.raspberrypi.org/documentation/rp2040/getting-started/

For resources and examples specific to Iono RP, go to:

https://github.com/sfera-labs/iono-rp

Iono Uno, Iono MKR and Arduino IDE compatibility

If you are familiar with Iono Uno, Iono MKR or with the Arduino IDE, visit https://github.com/sfera-labs/iono.

This repository contains libraries and examples originally for Iono Uno and Iono MKR (based on the Arduino platform) which have now been adapted to support Iono RP too.

You'll be able to use your Arduino code and the Arduino IDE with Iono RP.

Programming interfaces

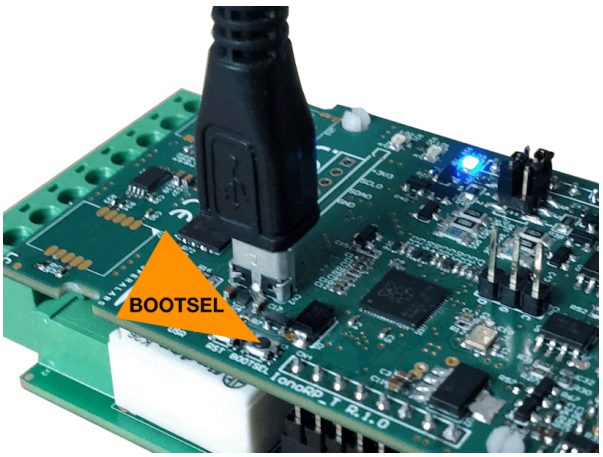
Iono RP features the same programming interfaces of the Pico board: USB and SWD.

USB interface

The simplest way to program Iono RP is by connecting it to a computer via USB, then dragging and dropping a program file onto it or using your IDE's features.

To set Iono RP to *BOOTSEL mode* and have your computer see it as a USB Mass Storage Device:

- Remove power to Iono RP and make sure the USB is unplugged;
- Push and hold the BOOTSEL button and connect the USB cable from your computer;
- Release the BOOTSEL button after Iono RP is connected;
- It will mount as a Mass Storage Device called RPI-RP2.



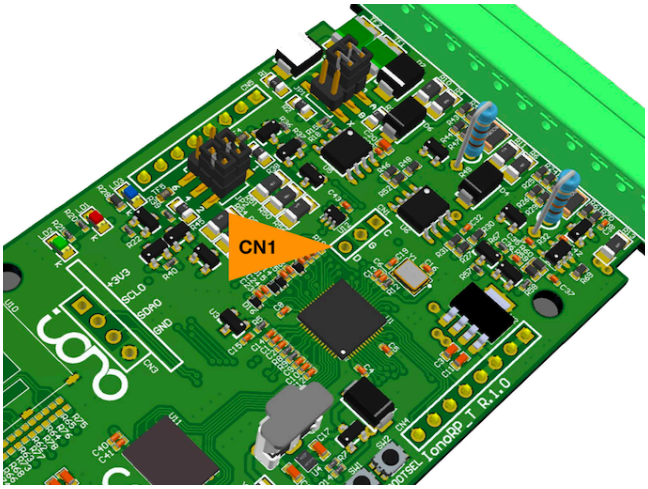
BOOTSEL BUTTON AND USB CONNECTION

Programming Iono RP via USB does not require it to be connected to a power supply, but when powered only though USB most of Iono's I/O will not be functional.

SWD interface

Serial Wire Debug (SWD) is a standard interface on Cortex-M-based microcontrollers, which the host computer can use to reset the board, load code into flash, set the code running, and interactively debug it.

Iono RP exposes the RP2040 SWD interface on the CN1 header:



SWD INTERFACE

where the pin C is the SWCLK line, the pin D is the SWDIO line and G is GND.

When using the SWD interface Iono RP needs to be connected to a power supply or powered via USB.

You can use a standard debug probe, the GPIOs of a Raspberry Pi or a Pico board to connect to the SWD interface.

For more details, refer to chapter 5 and 6 of the "Getting started with Raspberry Pi Pico" guide:

https://datasheets.raspberrypi.org/pico/getting-started-with-pico.pdf

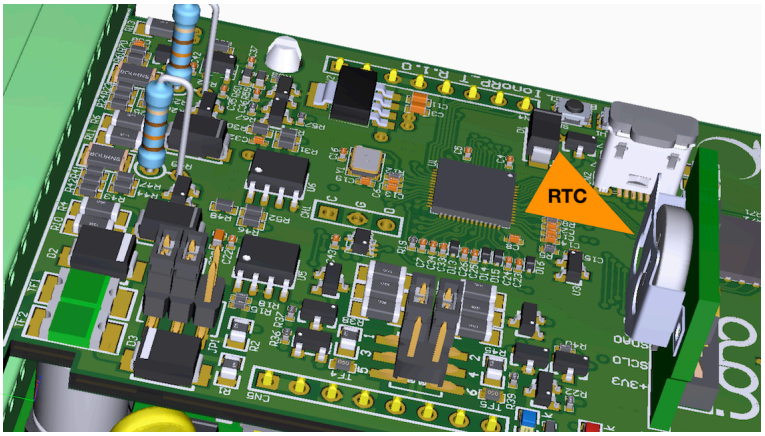
Optional components

Real Time Clock module

Iono RP can be shipped with an optional, factory-installed hardware real time clock with a dedicated long-life non-rechargeable back-up battery.

The battery is only used to power the RTC chip when the main power is not available. Depending on operating conditions it should last up to two years if the Iono RP board is not powered, more if the Iono RP receives external power.

The RTC module is based on the Microchip MCP79410 real-time clock/calendar chip. It is connected to the RP2040 via the I2C bus (I2C0, pins 2 and 3, address: 0x57 for the EEPROM and 0x6f for the SRAM/RTCC registers).



OPTIONAL REAL TIME CLOCK MODULE AND BATTERY

Replacing the RTC backup battery

The Iono RP RTC module uses a **CR1025** Lithium / Manganese Dioxide (Li/MnO2) battery.

WARNING

Improper handling of lithium batteries can result in an explosion of the batteries and/or release of harmful substances.

Worn-out or defective batteries can compromise the function of this product.

KEEP OUT OF REACH OF CHILDREN. Swallowing may lead to serious injury or death in as little as 2 hours due to chemical burns and potential perforation of the esophagus. Immediately see doctor.

Replace the RTC lithium battery before it is completely discharged. Replace the battery every 5 years even if the battery is still working properly. The lithium battery must be replaced only with an identical **CR1025** Lithium / Manganese Dioxide (Li/MnO2) battery.

Do not throw lithium batteries into fire, do not solder on the cell body, do not recharge, do not open, do not short-circuit, do not reverse polarity, do not heat above 100°C and protect from direct sunlight, moisture and condensation.

Dispose of used batteries according to local regulations and the battery manufacturer's instructions.

The RTC backup battery holder is soldered to the bottom layer of the RTC module circuit board. The battery is not accessible from the outside. You should first remove the case top body to gain access to the Iono RP circuit boards.

NOTICE

Before opening the Iono RP Base case, disconnect all power sources and any connection to external devices, including USB cables.

Use a non-conductive pin or small tool to help extract the battery from its holder. Insert the new battery with a gentle push. You don't need tools to insert the battery. The battery is held into place by a spring contact.

Be sure to insert the battery so that the positive (+) terminal of the battery is in contact with the outer body of the battery holder, and the negative (-) terminal is in contact with the contact pad of the circuit board, as shown in the photo below.

Reversing the battery polarity may damage the product.

The real time clock will reset its time immediately when the RTC backup battery is disconnected.

ATECC608 secure element

Iono RP can be shipped with an optional, factory-installed hardware secure element chip, the ATECC608 from Microchip. The ATECC608 is connected to the to the RP2040 via the I2C bus (I2C0, pins 2 and 3, address: 0x60).

Its key features are:

- ✓ Cryptographic co-processor with secure hardware-based key storage
- ✓ Protected storage for up to 16 Keys, certificates or data
- ✓ Hardware support for asymmetric sign, verify, key agreement – ECDSA: FIPS186-3 Elliptic Curve Digital Signature
    - ✓ ECDH: FIPS SP800-56A Elliptic Curve Diffie-Hellman
    - ✓ NIST standard P256 elliptic curve support
- ✓ Hardware support for symmetric algorithms
    - ✓ SHA-256 & HMAC hash including off-chip context save/restore
    - ✓ AES-128: encrypt/decrypt, Galois field multiply for GCM
- ✓ Networking key management support
    - ✓ Turnkey PRF/HKDF calculation for TLS 1.2 & 1.3

- ✓ Ephemeral key generation and key agreement in SRAM – Small message encryption with keys entirely protected

✓ Secure boot support

- ✓ Full ECDSA code signature validation, optional stored digest/signature – optional communication key disablement prior to secure boot
- ✓ Encryption/Authentication for messages to prevent on-board attacks

✓ Internal high-quality FIPS 800-90 A/B/C Random Number Generator (RNG)

✓ Two high-endurance monotonic counters

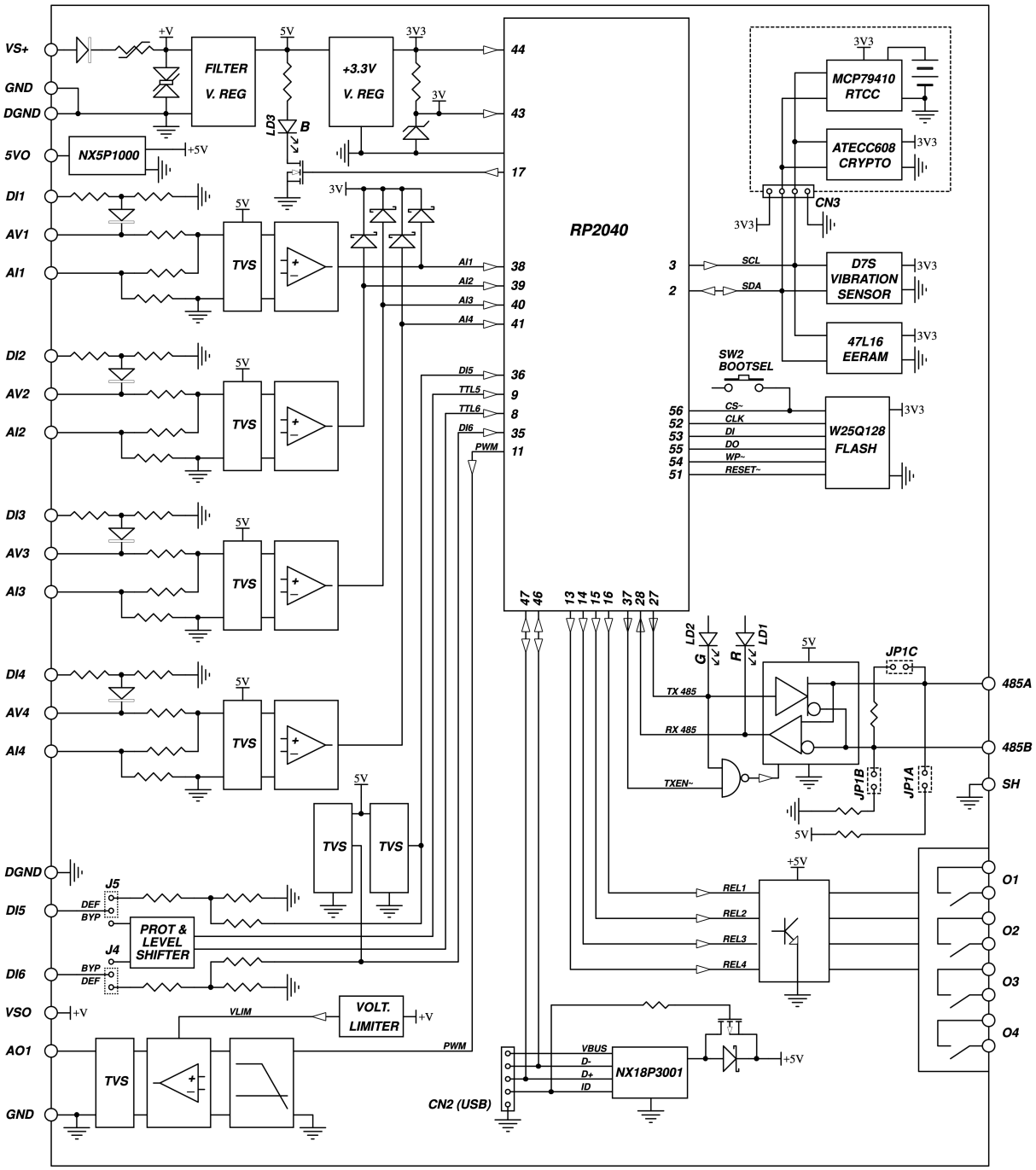
✓ Guaranteed unique 72-bit serial number.

Earthquake sensor module

Iono RP can be shipped with an optional, factory-installed earthquake sensor module based on the OMRON D7S vibration sensor. It is connected to the RP2040 via the I2C bus (I2C0, pins 2 and 3, address: 0x55).

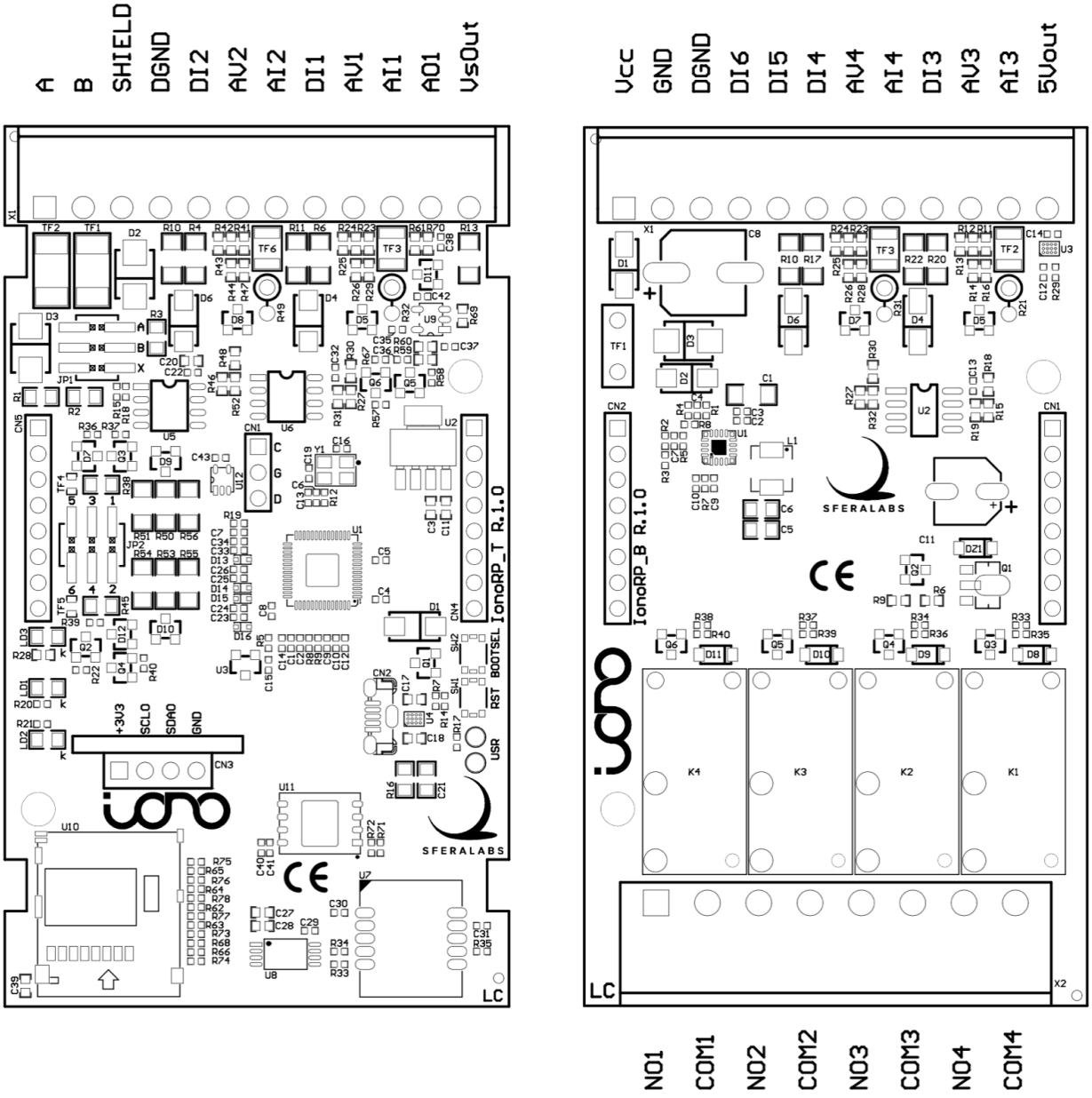
This module is soldered to the top-level circuit board and cannot be removed by the user.

Block diagram



BLOCK DIAGRAM

Board layout



BOARD LAYOUT

Technical specifications

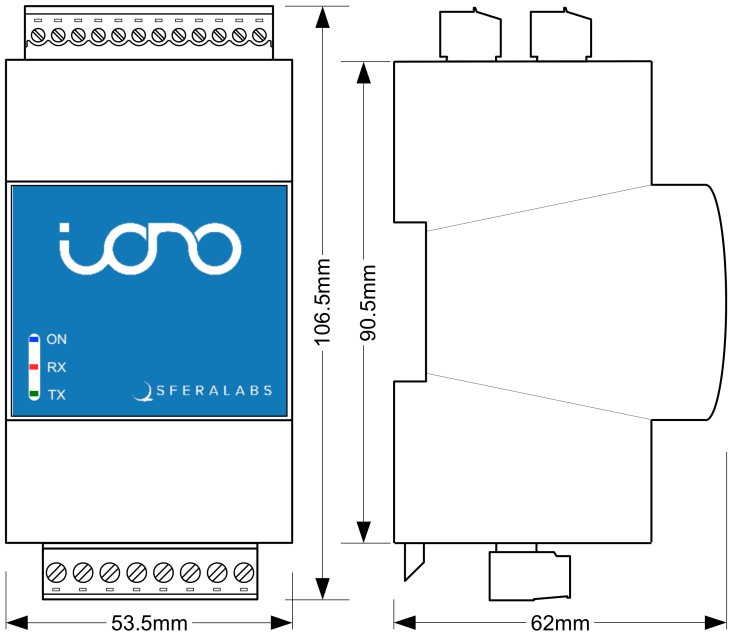
POWER SUPPLY	
Power supply operating voltage (VS)	12…28 V⎓ nom. (11…30 V⎓) Reverse polarity protection with 1.1 A resettable fuse. Surge protection up to ±500 V / 2 Ohms 1.2/50 µs
Current consumption at VS+ 12V⎓ unconnected inputs and relays off	43 mA
Current consumption at VS+ 12V⎓ digital inputs closed to VSO and relays on	122 mA
Current consumption at VS+ 24V⎓ unconnected inputs and relays off	28 mA
Current consumption at VS+ 24V⎓ digital inputs closed to VSO and relays on	66 mA
VSO output voltage (min.)	VS - 1 V
VSO output current (max.)	300 mA
5VO output voltage (typ.)	5.0 V (no load)
5VO output current (max.)	350 mA
5VO overcurrent protection threshold	420 mA
USB port output current (max.)	500 mA
ARCHITECTURE	
Microcontroller	Raspberry Pi RP2040 dual-core Arm Cortex M0+, 133 MHz, 264KB SRAM 16MB on-board Flash memory
COMMUNICATION PORTS	
Serial communication ports	RS-485 Half-Duplex with manual or automatic TX/RX management
Baud Rates	1200 to 115200
ESD-Protection Voltage on RS-485 A/B	±15 kV human body model ±8 kV contact discharge
Surge protection on RS-485 A/B	Surge protection up to ±500 V / 2 Ohms 1.2/50 µs; 600 W peak pulse power capability at 10/1000 µs waveform
Fail safe feature on RS-485	Optional with jumpers (not installed)
USB port	Micro-USB B Receptacle USB 1.1, host and device support
AV1-AV4: ANALOG VOLTAGE INPUTS	

AV1-AV4: ANALOG VOLTAGE INPUTS	
Input voltage range	+0…+30 V
Input impedance	> 450 kOhm
ADC characteristics	SAR ADC 500kS/s max, with 48MHz clock 12-bit with 8.7 ENOB
Max cable length	15 meters
AI1-AI4: ANALOG CURRENT INPUTS	
Input current range	+0…+25 mA
Input impedance	120 Ohm
ADC characteristics	SAR ADC 500kS/s max, with 48MHz clock 12-bit with 8.7 ENOB
Max cable length	15 meters
AO1: ANALOG VOLTAGE OUTPUT	
Output range	+0…+10 V
Output drive current	30 mA (Max)
Total Error	±2 % of full-scale (Max)
Max cable length	15 meters
DI1-DI4: DIGITAL INPUTS	
Input voltage range	+0…+40 V
Input impedance	49 kOhm
Voltage threshold	VIH: 4.9 V VIL: 3.4 V
Max cable length	30 meters
DI5-DI6: DIGITAL INPUTS	
Input voltage range	+0…+40 V
Input impedance	6.5 kOhm
Voltage threshold	VIH: 5.1 V VIL: 3.4 V
Max cable length	30 meters
DI5-DI6: DIGITAL INPUT/OUTPUT	
Output voltage	VOL: 0.1 V VOH: 5.0 V

Input voltage threshold	VIH: 1.4 V VIL: 1.1 V
Pull-up (+5 V)	10 kOhm
Max cable length	10 meters
O1-O4: RELAYS	
Rated current	6 A
Rated voltage	250 V AC
Rated load (AC1, resistive load)	1500 VA
Rated load (AC15, cos ϕ = 0.5)	250 VA
Single phase motor rating (230 V AC)	185 W
Breaking capacity (DC1)	• 3 A at 30 V DC • 0.35 A at 110 V DC • 0.2 A at 220 V DC
Electrical life at rated load AC1	50000 cycles
Mechanical life	20000000 cycles
Operate/release time	6/4 ms
Dielectric strength between open contacts	1000 V AC
Type of insulation between coil and contacts	Basic
Dielectric strength between coil and contacts	4000 V AC
EERAM	
Capacity	16 Kbit (2048 x 8 bits)
SRAM r/w cycles	Infinite
EEPROM store cycles	> 1000000
Data retention	> 200 years
EMI IMMUNITY STANDARDS	
Electromagnetic immunity compliance	EN 61000-4-2 (ESD) EN 61000-4-3 (Radiated RF Field) EN 61000-4-4 (Burst/fast transient) EN 61000-4-5 (Surge) EN 61000-4-6 (Conducted) EN 61000-4-8 (Power frequency magnetic field)
ENVIRONMENTAL	
Operating temperature	-20…+60 °C (non-condensing humidity)
Relative humidity	5% to 90% noncondensing
Storage temperature	-30…+80 °C
Protection degree	IP20

MECHANICAL	
3.81 mm pitch terminal block characteristics	Maximum conductor cross section: 1.3 mm2 (16AWG), or 0.5 mm2 when using ferrules (highly recommended) Recommended stripping length: 6 mm Screw thread: M2 Maximum screws tightening torque: 0.3 Nm
5.08 mm pitch terminal block characteristics (relays)	Maximum conductor cross section: 3.3 mm2 (12AWG) Recommended stripping length: 7 mm Screw thread: M3 Maximum screws tightening torque: 0.5 Nm
Dimensions	3 module Din Rail enclosure width: 53.5 mm height: 90.5mm depth: 62.0mm
Weight	150 gr

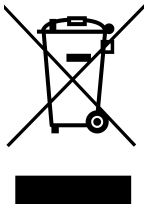
Dimensions



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.

Iono RP optionally contains a small non rechargeable manganese dioxide lithium coin battery. The battery is not accessible from the outside. You should first remove the case body to gain access to the Iono RP circuit boards. Always remove the battery before disposing of this product.

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

Carefully read the safety information section at the beginning of this document.

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.

Conformity Information

EU

This device complies with the following applicable European Community harmonised standards:

- ✓ 2014/30/EU - Electromagnetic Compatibility Directive (EMC)
- ✓ 2014/35/EU - Low Voltage Directive (LVD)
- ✓ 2011/65/EU and 2015/863/EU - Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

The following harmonised standards have been used to demonstrate conformity to these directives:

- ✓ EN60664-1:2020 - Insulation coordination for equipment within low-voltage systems
- ✓ EN61000-6-1:2019 - EMC Immunity for residential, commercial and light-industrial environments
- ✓ EN 61000-6-3:2007/A1:2011/AC:2012 - EMC Emission standard for residential, commercial and light-industrial environments

The declaration of conformity is available at: https://www.sferalabs.cc

USA

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help.

Shielded cables must be used with this equipment to maintain compliance with FCC regulations.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CANADA

This Class B digital apparatus complies with Canadian ICES-003(B).

Cet appareil numérique de la classe B est conforme à la norme NMB-003(B) du Canada.

RCM AUSTRALIA / NEW ZEALAND

This product meets the requirements of the standard EN 61000-6-3:2007/A1:2011/ AC:2012 - Emission for residential, commercial and light-industrial environments.