



Exo Sense Py User Guide

January 2019

Revision 002

ESYS11X Exo Sense Py

a professional indoor environment sensor based on the Pycom development boards



Safety information	4
Qualified personnel	4
Hazard levels	4
Safety instructions	5
General safety instructions	5
Battery	5
Introduction	7
Features	8
Usage and connections	9
Terminal blocks	9
Device identification	10
Power supply	10
Pressure, temperature, humidity and gas sensors	10
Light sensor	11
Acoustic noise sensor	11
TTLx/DIx: TTL input/output or generic digital inputs	12
DO1: Open collector output	13
Buzzer	13
RS-485 serial port	13
Mapping	15
I2C addresses	15
Hardware Installation	16
Opening the case	16
Closing the case	17
Pycom development board installation	17
Exo Sense Py software development	19
Programming	19
Low level boot loader jumper	19
Boot mode jumper	20
Optional components	21
Real Time Clock module	21
Replacing the RTC backup battery	21
Earthquake sensor module	22
Block diagram	23
Board layout	24
Technical specifications	25

Dimensions	27
Disposal	28
Installation and use restrictions	28
Standards and regulations	28
Safety instructions	28
Set-up	28
Conformity Information	29
EU	29
USA	29
CANADA	30
RCM AUSTRALIA / NEW ZEALAND	30

Be sure to always remove the power supply before installing or removing the Pycom board inside Exo Sense Py.

Exo Sense Py must be operated with the plastic case installed.

Follow all applicable electrical safety standards, guidelines, specifications and regulations for installation, wiring and operations of Exo Sense Py.

Carefully and fully read this Exo Sense Py user guide before installation.

Exo Sense Py 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. Exo Sense Py 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 Exo Sense Py 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.

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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. Do not obstruct cooling of the unit. Keep out of the reach of children.



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.



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.



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).



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

Exo Sense Py is an extremely versatile indoor environment sensor. It combines the computing power and wireless capabilities of the Pycom development boards with several environmental sensors and input/output lines.

Exo Sense Py embeds temperature, humidity, air quality, pressure, light and ambient noise sensors. Two digital input/output lines and an open-collector output line are also available on the terminal block. It can optionally have a factory-installed earthquake sensor module, PIR sensor and real time clock module with battery back-up.

An ESD-protected RS-485 bus is available for wired serial communication using the industry standard Modbus protocol or any other half-duplex serial protocol.

You can use your preferred Pycom development board, as far as it is fully compatible with the Exo Sense Py pinout and fits the Exo Sense Py case.

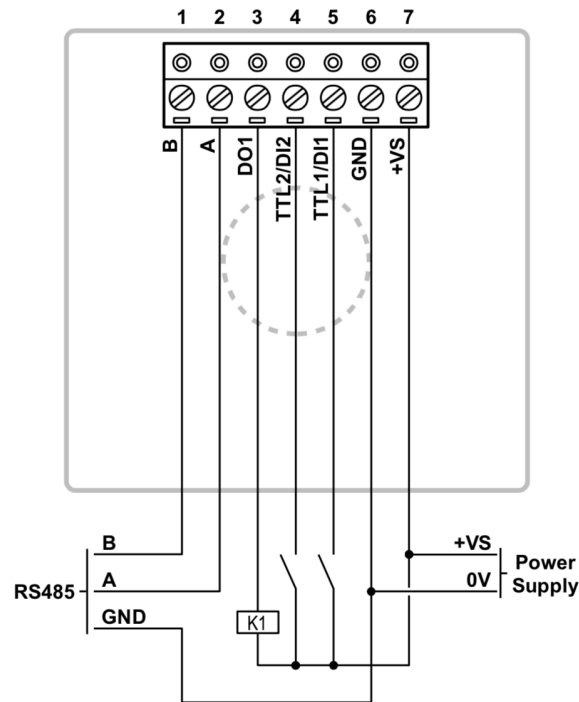


Features

The Exo Sense Py key features are:

- ✓ 12÷28Vdc power supply, with surge and reverse polarity protection, and 1.1A resettable fuse
- ✓ Compatible with the Pycom development boards. Currently the following boards are supported: WiPy 3.0, SiPy, LoPy4, GPy and FiPy
- ✓ Bosch BME680 integrated pressure, temperature, humidity and air quality (Volatile Organic Compounds) sensor
- ✓ Texas Instruments OPT3001 Ambient Light Sensor
- ✓ Environmental noise sensor. The noise sensor is specifically designed to prevent full audio recording, to protect the privacy of the room occupants
- ✓ Two digital inputs for potential-free contacts or TTL level input/output with 1-Wire, I2C and Wiegand support
- ✓ One open collector output with a maximum output current of 100mA, protected against over-current and short circuits
- ✓ Standard RS-485 interface to the Pycom serial lines, with electrostatic discharge (ESD) protection
- ✓ On-board buzzer, connected to a GPIO pin of the Pycom board, for acoustic feedback
- ✓ Pycom board programming pin-headers, compatible with FTDI USB serial cable
- ✓ Pycom board low level boot loader jumper
- ✓ Optional real time clock with on-board Lithium / Manganese Dioxide back-up battery
- ✓ Optional earthquake sensor module
- ✓ Optional PIR sensor
- ✓ 80x80 mm wall mount ABS case with fast snap-in terminal block for easier installation.

Usage and connections



CONNECTION EXAMPLE

Terminal blocks

Exo Sense Py has a 7 position terminal block attached to the back of the wall mount case. This terminal block is connected to a 7 pin header soldered to the circuit board.

The maximum conductor cross section is 2.5 mm² (14 AWG). Recommended stripping length is 7 mm. Screw thread is M3. Never exceed 0.6 Nm torque when tightening the screws.



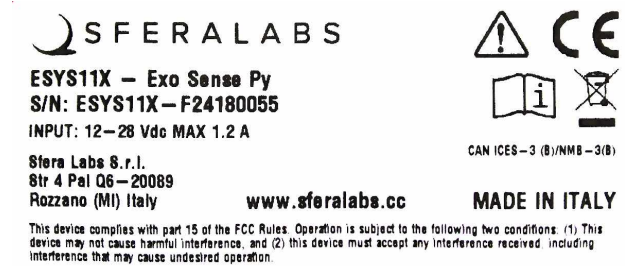
Ensure that all cables entering the Exo Sense Py case are isolated to avoid electrical contact with the back of the printed circuit board or other conductive elements.

The cables should be routed out of the case through the circular hole at the center of the case back frame.

Ensure the cables cannot be punctured when the case is closed and that they don't exercise mechanical pressure on the printed circuit board.

Device identification

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



EXAMPLE RATING AND IDENTIFICATION PLATE

Power supply

Exo Sense Py 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 $\pm 500V/20\Omega$ 1.2/50 μ s.

Pressure, temperature, humidity and gas sensors

The Pressure, temperature, humidity and gas sensors are integrated in a Bosch BME680 environmental sensor with I2C digital interface.

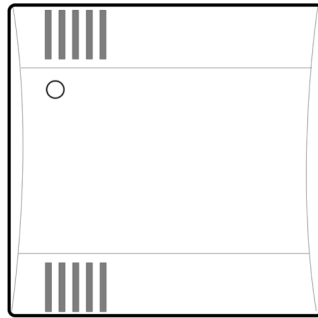
The gas sensor within the BME680 can detect a broad range of gases to measure air quality. Gases that can be detected by the BME680 include Volatile Organic Compounds (VOC) from paints (such as formaldehyde), lacquers, paint strippers, cleaning supplies, furnishings, office equipment, glues, adhesives and alcohol.

Refer to the Bosch BME680 official data sheet for detailed information on the usage of this sensor. The I2C SDA line is connected to the Pycom board P9 pin, and the SCL line to the P10 pin.

The BME680 is soldered on the Exo Sense Py printed circuit board close to the lower left ventilation grille. The upper grille, thanks to the air convection movement caused by the small temperature gradient between the inside of the case and the environment air temperature, creates a natural air flow to improve the performance of the BME680 embedded sensors.

Exo Sense Py must be mounted vertically, possibly on a vertical wall or flat surface, as illustrated. Installing Exo Sense Py in any other position or orientation will make the temperature, humidity and air quality readings completely unreliable.

TOP



BOTTOM

EXO SENSE PY WALL MOUNT ORIENTATION

The BME680 generates some internal heat, that also depends on the use of the gas sensor. The Exo Sense Py and the Pycom board also generate heat inside the case, that depend on the electronic components power load. Both these heat sources must be taken into account and properly compensated to ensure accurate readings from the BME680.

Light sensor

The light sensor is based on the Texas Instruments OPT3001 Ambient Light Sensor.

This I2C sensor implements accurate optical filtering to match the human eye response to light and rejects 99% of IR. The light intensity range is from 0.01 lux to 83 k lux.

Refer to the Texas Instruments OPT3001 official data sheet for detailed information on the usage of this sensor. The I2C SDA line is connected to the Pycom board P9 pin, and the SCL line to the P10 pin. The OPT3001 interrupt output is connected to the Pycom P13 pin. A pull-up resistor keeps this pin to high logic state when idle.

The OPT3001 is soldered on the Exo Sense Py printed circuit board just below the top left ventilation grille. An optical guide is used to direct the external ambient light to the sensor's surface.

Note that the Pycom board RGB led could theoretically interfere with the light sensor's accuracy. For best performance the RGB led should be off when reading the light intensity.

Acoustic noise sensor

The acoustic noise sensor is built with an analog microphone coupled to an analog audio amplifier and filter stage with peak hold. Its output is connected to the Pycom board P14 analog input line. The voltage level on this line is proportional to the detected acoustic noise detected.

The noise sensor is specifically designed to prevent full audio recording, to protect the privacy of the room occupants.

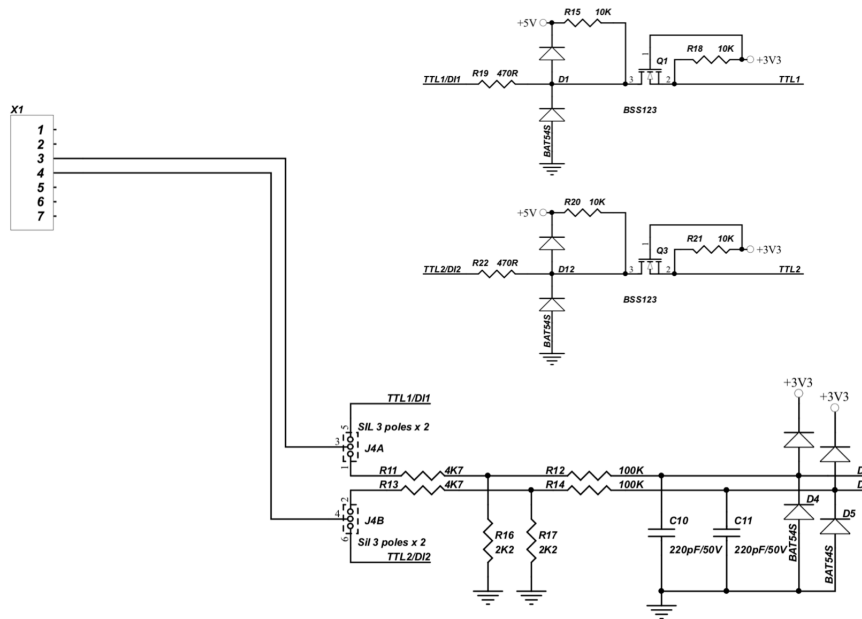
The Exo Sense Py noise sensor is designed to detect the presence of noise in an indoor environment and provide a qualitative indication of its intensity, but is not a calibrated phono-meter. Its frequency range is approximately 125Hz to 8000Hz and measured

minimum sensitivity is approximately 55dB. The theoretical maximum voltage level at the P14 pin is approximately 3.0V.

TTLx/DIx: TTL input/output or generic digital inputs

TTL1/DI1 and TTL2/DI2 are dual-purpose pins. Using internal jumpers, they serve as TTL I/O lines or generic digital inputs.

When TTL2/DI2 is configured as TTL I/O, it can be used as the DATA1 line of a Wiegand interface, in combination with TTL1/DI1, or as any other generic TTL I/O function.



TTL LEVEL CONVERTER CIRCUIT AND INPUT MODE SELECTION JUMPERS

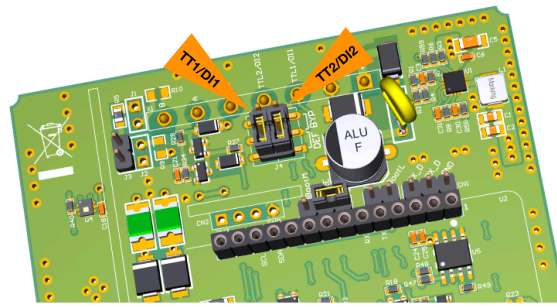
The TTL1-TTL2 front-end circuits have 10kOhm pull-up and series 470Ohm resistors.

When these pins are configured as generic digital inputs, they are protected by a resistor network, and pulled to ground when not connected. They accept positive voltage levels up to 40Vdc.

The DI1-DI2 front-end circuits have 2.2kOhm pull-down and series 4.7kOhm resistors.



Never apply voltage levels outside the specified operating limits to DI1 or DI2.



INPUT MODE SELECTION JUMPERS POSITION

To use the TTLx/DIx lines as generic inputs, the corresponding jumper should be set across the two pins closer to the Pycom board.

Set the jumpers across the center and the pin opposite the Pycom board to use the input as TTL I/O.



Note that the Exo Sense Py board and the Pycom board could be damaged if the jumpers are configured for TTL mode and voltages outside the 0-5V range are applied to the inputs.

DO1: Open collector output

DO1 can be used as open collector (OC) output, controlled by the Pycom board P23 pin.

It is connected to a discrete open collector driver with a maximum output current of 100mA and is protected against over-current and short circuits.

When the over-current protection is triggered, the output will open, stopping the current flow. A simple reset to 0 of the corresponding Pycom board pin will reset the protection.

To drive a load using the OC output, connect its positive input to the VS power supply pin and the negative input to the OC pin.

Buzzer

Exo Sense Py has an on-board buzzer that can be controlled using the Pycom board P8 pin. Simply set P8 high to emit a continuous sound, and back to low to stop. The buzzer is not intended to emit sound indefinitely and could be damaged doing so.

The microphone acoustic noise detector readings may become unreliable when the buzzer is active.

RS-485 serial port

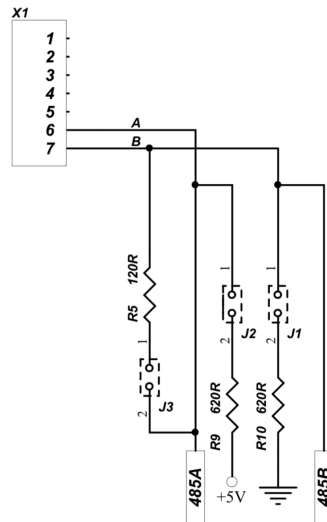
Exo Sense Py uses the Pycom board UART TX/RX pins (P1/P0) to implement a standard RS-485 serial port.

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.

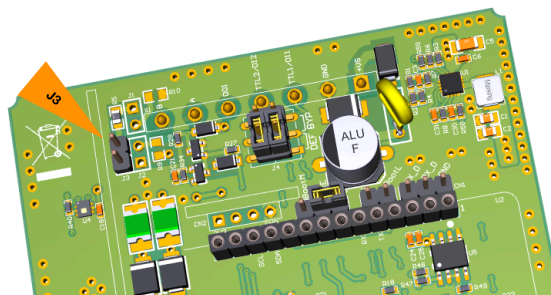
The RS-485 TX/RX switching is controlled by the Pycom board P12 pin. You should set P12 high to enable transmission on the RS-485, and set it low to allow reception of incoming data.

A 120 Ohm termination resistor between A and B can be enabled installing jumper J3.



RS-485 JUMPERS SCHEMATIC

Polarization jumpers J1 and J2 are not installed.



RS-485 TERMINATION JUMPER POSITION

Mapping

The following table shows the mapping of the inputs and outputs of the Exo Sense Py module to the related pins of the Pycom development board.

Exo Sense Py inputs and outputs	Pycom pins
TTL1	P20
TTL2	P19
DI1	P18
DI2	P17
DO1	P23
Microphone	P14
OPT3001 interrupt output	P13
Buzzer	P8
PIR (optional)	P16
RS-485	RX (P4) / TX (P3)
RS-485 TX-ENABLE	P12
I2C SDA for BME680, OPT3001, optional RTC and D7S	SDA (P9)
I2C SCL for BME680, OPT3001, optional RTC and D7S	SCL (P10)
Low level boot loader jumper	P2
Boot mode jumper	P12

I2C addresses

The following table shows the addresses of all I2C devices.

Device	I2C address
BME680	0x77
D7S	0x55
OPT3001	0x40
MCP79410 RTC (optional)	0x6f
MCP79410 EEPROM (optional)	0x57

Hardware Installation

For the initial set-up, the plastic wall mount case must be removed to access the circuit board and internal connectors.

The case also needs to be opened to connect a programming/console cable to the programming port pins (P0/P1) of the Pycom development board, and if the factory configuration of the internal jumpers for the RS-485 termination resistors or digital input configuration must be changed.

NOTICE

Before opening the Exo Sense Py 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:

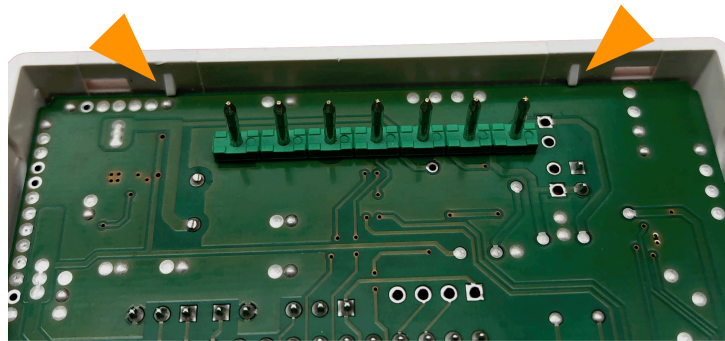
1. Use a small flat screwdriver to gently separate the front plastic cover from the wall mount back
2. The circuit board should remain attached to the front plastic cover; pay attention not to drop the circuit board, as it could be not firmly attached
3. With a small flat screwdriver gently separate the circuit board from the front cover cover. In some cases the circuit board could separate from the front case and remain connected to the terminal block.



SEPARATE THE FRONT PLASTIC COVER FROM THE WALL MOUNT BACK

Closing the case

4. Replace the circuit board assembly inside the front cover; respect the orientation, with the light sensor aligned to the optical guide
5. Align the front cover and circuit board with the wall mount back, so that the connection pins on the circuit board match the terminal block receptacles on the wall mount back
6. Gently snap in the front plastic cover to the wall mount back.



THE PCB HOLDERS OF THE FRONT COVER



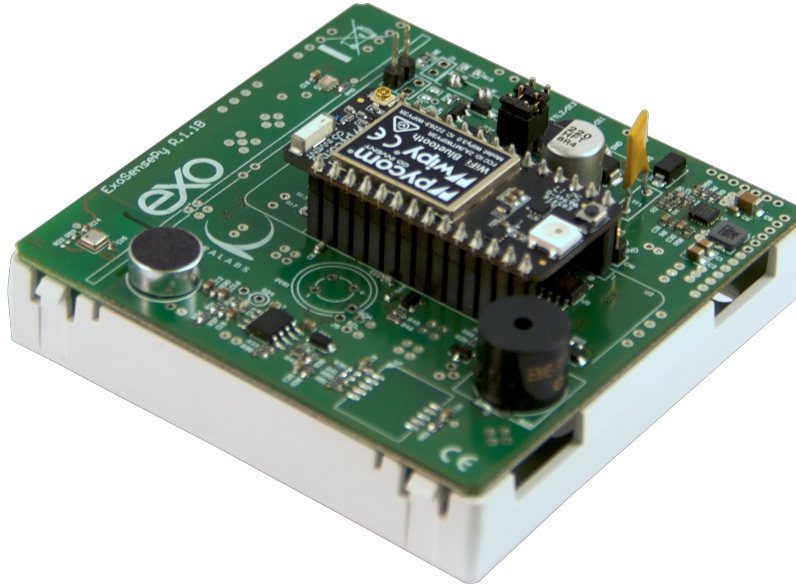
ALIGN THE CONNECTION PINS WITH THE TERMINAL BLOCK

Pycom development board installation

To install your own Pycom development board in Exo Sense Py, or replace a pre-installed board, no tools are required. The Exo Sense Py board top side pin headers (female) connect to the pin headers (male) of the bottom Pycom development board. The Pycom development board is installed with the RGB led near the buzzer.

NOTICE

Both the Pycom development board and the Exo Sense Py circuit board will likely be damaged if the pins are not correctly aligned.



PYCOM DEVELOPMENT BOARD INSTALLATION

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 Exo Sense Py circuit board or the Pycom development board, be sure to hold it along the side edges using your thumb and index finger. Avoid touching the components and pin connectors as damage can occur.

Exo Sense Py software development

Since Exo Sense Py is an I/O expansion for a standard Pycom development board, you don't need any specific tool or library to work on it.

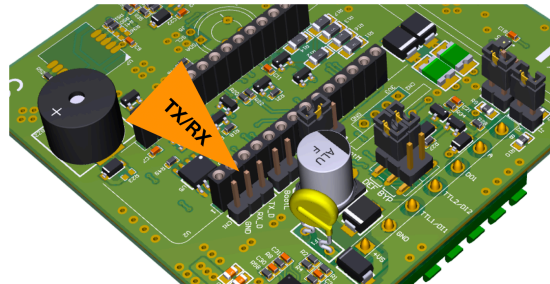
Our libraries and examples, available with source code on GitHub, will provide you with some handy utilities to speed up your development, including functionalities to monitor the inputs and control the outputs, Modbus support and more.

Go to <https://github.com/sfera-labs> to access the code and documentation.

Programming

The Pycom development board, when mounted in Exo Sense Py, can be programmed through a 3.3V level serial interface connected to the Exo Sense Py serial programming pin headers, located next to the Pycom board.

An FTDI TTL-232R-RPi cable is recommended, as it is electrically and mechanically compatible with the programming pins.



PROGRAMMING PINS

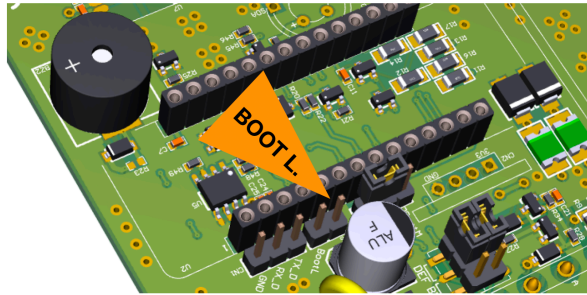
When using the FTDI TTL-232R-RPi cable, connect the black wire to the Exo Sense Py serial programming GND header, the orange wire (TXD) to the RX_D header and the yellow wire (RXD) to the TX_D header.

Connect the USB adapter to a PC and perform the programming as usual. This operation requires the Exo Sense Py to be connected to a power supply.

Low level boot loader jumper

The Exo Sense Py boot loader jumper can be used to momentarily connect the Pycom development board P2 pin to ground in order to update the Pycom's board firmware via the programming cable.

This jumper must not be installed for normal operations.



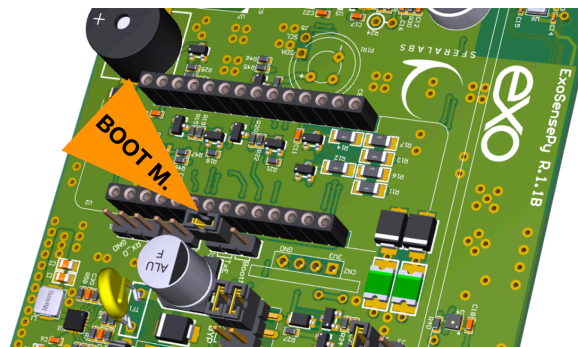
BOOT LOADER JUMPER

Boot mode jumper

The Exo Sense Py boot mode jumper can be used to momentarily connect the Pycom development board P12 pin to 3.3V in order to enable safe boot with the latest firmware (1-3 sec), previous user update (4-6 sec), or factory firmware (7-9 sec).

Extract the jumper from its default position (TXE), closer to the boot loader jumper, and insert between the center and opposite pin to enable safe boot.

Replace the jumper in its default position (TXE) for normal operations, because the P12 pin is used to control the TX enable line of the RS-485 interface.



BOOT MODE JUMPER

Optional components

Real Time Clock module

Exo Sense Py 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 Exo Sense Py board is not powered, more if the Exo Sense Py receives external power.

The RTC module is based on the Microchip MCP79410 real-time clock/calendar chip. It is connected to the Pycom board via the I2C bus.

The RTC module is soldered to the Exo Sense Py circuit board and cannot be removed by the user.

Replacing the RTC backup battery

The Exo Sense Py RTC module uses a **CR1025** Lithium / Manganese Dioxide (Li/MnO₂) battery.



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 cover to gain access to the Exo Sense Py circuit boards.

NOTICE

Before opening the Exo Sense Py Base case, disconnect all power sources and any connection to external devices.

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.

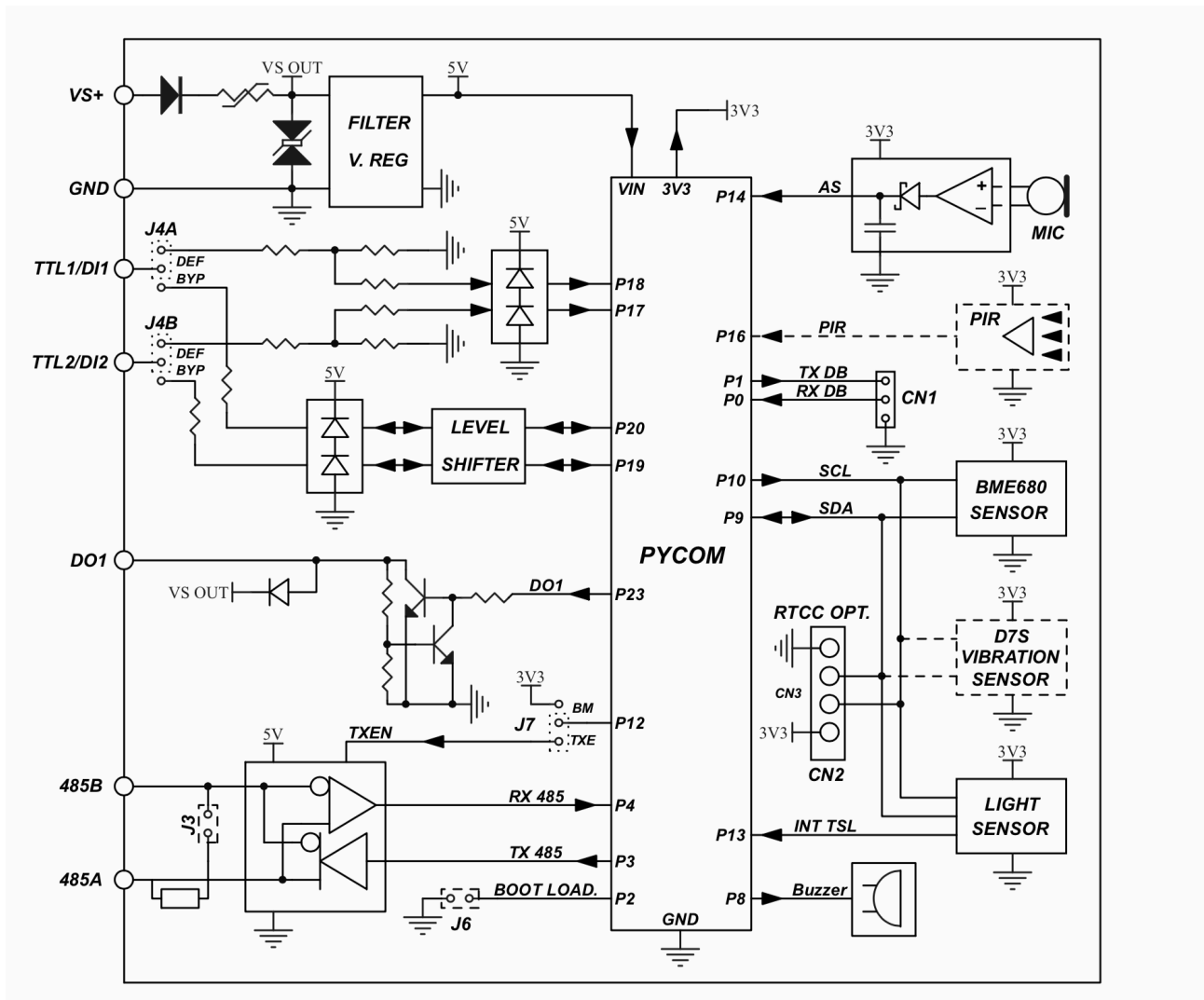
The real time clock will reset its time immediately when the RTC backup battery is disconnected.

Earthquake sensor module

Exo Sense Py can be shipped with an optional, factory-installed earthquake sensor module based on the OMRON D7S vibration sensor. It is connected to the Pycom board via the I2C bus.

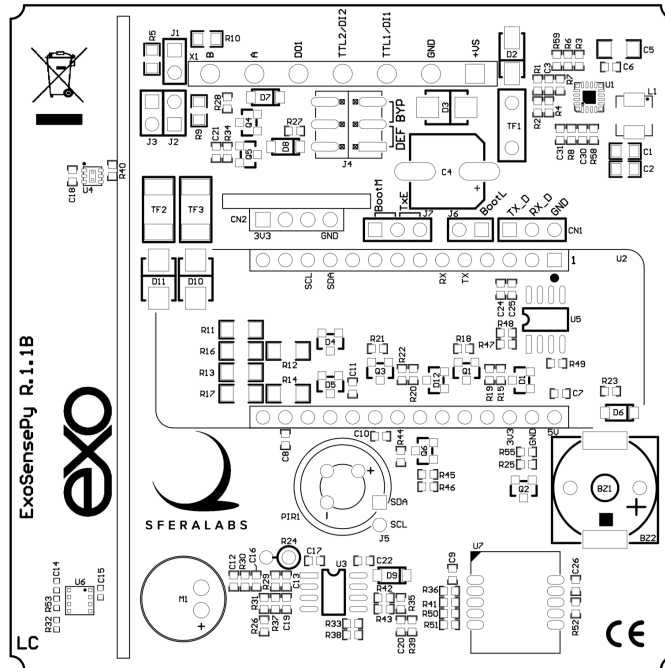
This module is soldered to the Exo Sense Py circuit board and cannot be removed by the user.

Block diagram



BLOCK DIAGRAM

Board layout



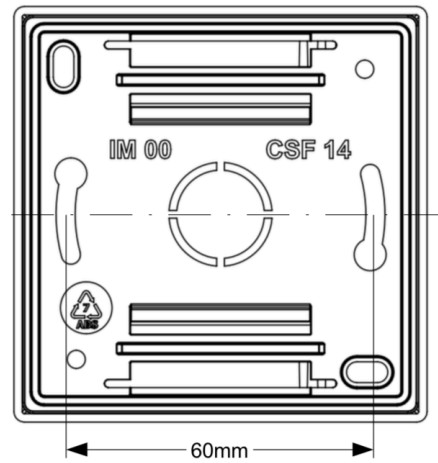
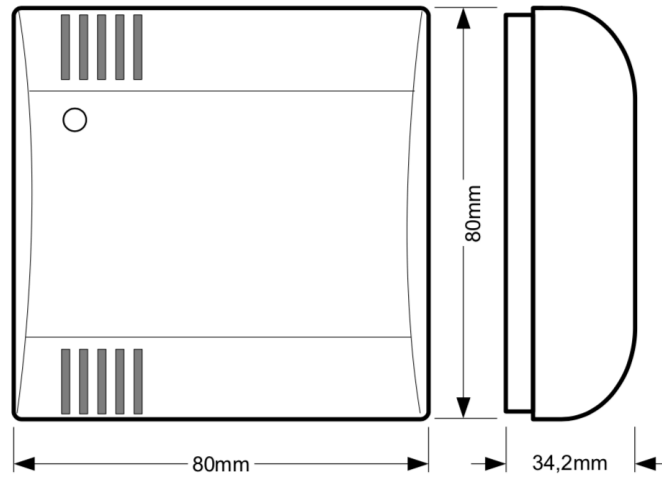
BOARD LAYOUT (TOP VIEW)

Technical specifications

Power supply	12...28V \equiv nom. (11...30V \equiv) Reverse polarity and surge protection up to $\pm 500V/20\text{ohms } 1.2/50\mu\text{s}$ using an auto resetting fuse and diodes
Current consumption at VS+ 12V \equiv DO1 off, RS-485 on	65mA with WiPy 3.0
Current consumption at VS+ 12V \equiv DO1 off, RS-485 off	60mA with WiPy 3.0
Current consumption at VS+ 24V \equiv DO1 off, RS-485 on	45mA with WiPy 3.0
Current consumption at VS+ 24V \equiv DO1 off, RS-485 off	35mA with WiPy 3.0
Pycom development boards compatibility	WiPy 3.0, SiPy, LoPy4, GPy and FiPy
Voltage range at digital inputs DIx	0...40V \equiv
Current for each digital input DIx	1.8mA at VS+ 12V \equiv 3.5mA at VS+ 24V \equiv
Voltage threshold digital inputs DIx (typ.)	VIH: 5.3V VIL: 5.2V
Voltage range at TTL I/O TTLx	0...5V \equiv
Impedance for TTL I/O TTLx	470 Ω
Voltage threshold TTL I/O TTLx (typ.)	VIH: 1.18V VIL: 1.17V
Maximum recommended cable length for digital input DIx	30 meters
Maximum recommended cable length for TTL I/O TTLx	5 meters
Open collector OC1 rating	NPN type, common on VS+, short circuit protected 100mA MAX output current
Maximum recommended cable length for open collector output OC1	2m

Communication ports	RS-485 half-duplex with data direction management controlled by Pycom pin P12
Baud Rates on COMM ports	1200 to 115200
ESD-Protection Voltage on RS-485 A/B	±15kV human body model ±8kV contact discharge
Surge protection on RS-485 A/B	Surge protection up to ±500V/2ohms 1.2/50µs; 600W peak pulse power capability at 10/1000µs waveform
Fail safe feature on RS-485	Optional with jumpers (not installed)
7-pin terminal block characteristics	Maximum conductor cross section: 2.5 mm ² (14 AWG) Recommended stripping length: 7 mm Screw thread: M3 Maximum screws tightening torque: 0.6 Nm
Housing	Wall mount 80x80mm ABS case
Operating temperature	-10...+50 °C
Storage temperature	-20...+70 °C
Relative humidity	5% to 90% noncondensing
Protection degree	IP20
Weight	75 g (Exo Sense Py) 80 g (Exo Sense Py with WiPy 3.0)

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.

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 the power supply and the other related circuits.

Conformity Information

The declaration of conformity is available on the internet at the following address:

<https://www.sferalabs.cc/exo-sense-py/>

EU

This device complies with the essential requirements of the following directives and harmonised standards:

- ✓ 2014/30/UE (EMC)
- ✓ EN61000-6-1:2007 (EMC Immunity for residential, commercial and light-industrial environments)
- ✓ EN 61000-6-3:2007/A1:2011/AC:2012 (EMC Emission for residential, commercial and light-industrial environments)
- ✓ 2011/65/UE (RoHS)

USA

FCC Radio Frequency Interference Statement:

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:

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

Modifications:

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Conditions of Operations:

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.

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