

4ZeroBox

The IoT Platform for Industry 4.0 Solutions

QUICK GUIDE



TOI s.r.l.

Galleria G. B. Gerace, 14
56126 Pisa, Italy
VAT: IT02188290502

www.zerynth.com

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GENERAL SPECIFICATIONS

4ZeroBox is a modular hardware electronic unit that simplifies the development of Industrial IoT applications allowing rapid integration with sensors, actuators, and Cloud services.

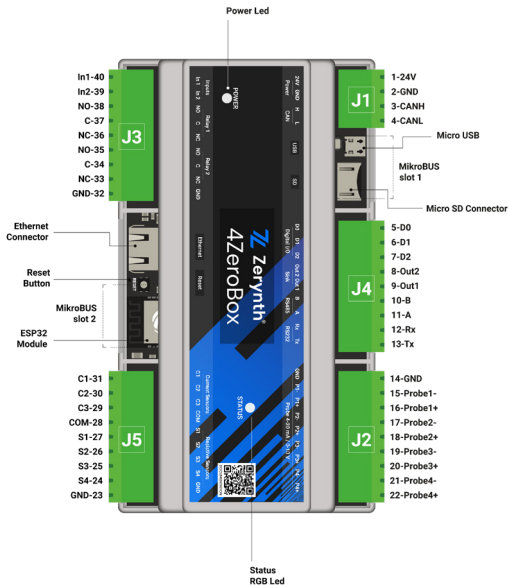
4ZeroBox mounts a powerful ESP32 Microcontroller by Espressif Systems (240MHz, 4Mb Flash, 512KB SRAM) and provides many onboard features like: a DIN-rail mountable case with industrial grade sensor channels, support for Wi-fi, Bluetooth, Ethernet, LoRa, CAN, RS485, RS232, SD Card, JTAG, I2C, SPI; last but not least, there are 2 on-board MikroBUS sockets to extend the 4ZeroBox with hundreds of MikroElektronika click boards (see “MikroBus Slots” section).

4ZeroBox lets the user choose the best installation strategy, adapting it to the specific industrial environment. While allowing to acquire data from the PLC via digital ports- filtering the data onboard to avoid bandwidth overload and waste of cloud resources- it also enable the installation and management of external sensors, for a full Industrial IoT experience.

4ZeroBox is programmable in Python (or hybrid C/Python) thanks to the Zerynth software.

The 4ZeroBox general characteristics are:

- DIN-rail mountable (9 slots)
- 8 to 36V Power Supply
- 4 selectable analog input channels:
 - 4-20mA single-ended
 - 4-20mA differential
 - 0-10V standard
- 3 current transformers (non-invasive)
- 4 resistive sensor channels (NTC, RTD, contact, proximity, etc.)
- 2 opto-isolated digital inputs
- 2 sink digital output (60A @30V)
- MicroSD card slot
- 1 Digital I/O + 2 Digital Input (3.3V)
- 2 NO/NC Relay (10A @ 250V AC)
- CAN peripheral
- Crypto Chip-Secure Hardware Encryption
- Connectivity:
 - WiFi (Client and AP mode supported)
 - Bluetooth® Low-Energy
 - Ethernet
- RS-485 and RS232 peripherals
- 2 onboard mikroBUS sockets
- LiPo battery support
- LiPo battery onboard charging unit
- JTAG support
- RGB status led
- Espressif ESP32-32bit Microcontroller 240MHz clock, 4Mb of Flash, 312Kb SRAM
- Python-Programmable thanks to Zerynth technology



SCREW DESCRIPTION

Connector J1 (Upper-Left Corner)	Symbol	Description
Screw Number 1	24V	External Power Supply 24Vdc pin
Screw Number 2	GND	Ground pin
Screw Number 3	H	High Channel for CAN Bus (Term Resistor can be enabled through SW1)
Screw Number 4	L	Low Channel for CAN Bus (Term Resistor can be enabled through SW1)
Connector J4 (Upper-Center)	Symbol	Description
Screw Number 5	D0	Digital Input directly connected to the microcontroller with integrated ADC functionalities (Max 3.3V input)
Screw Number 6	D1	Digital Input directly connected to the microcontroller with integrated ADC functionalities (Max 3.3V input)
Screw Number 7	D2	Digital Input/Output directly connected to the micro- controller (Max 3.3V input)
Screw Number 8	Out2	Sink2 Output to enable external circuits
Screw Number 9	Out1	Sink1 Output to enable external circuits
Screw Number 10	B	B Channel of RS485 Bus (Pull-Down and/or Term Resistor can be enabled through SW1)
Screw Number 11	A	A Channel of RS485 Bus (Pull-Up and/or Term Resistor can be enabled through SW1)
Screw Number 12	RX	RX Channel of RS232 Bus
Screw Number 13	TX	TX Channel of RS232 Bus
Connector J2 (Upper-Right Corner)	Symbol	Description
Screw Number 14	GND	Ground pin
Screw Number 15	P1-	Negative terminal of Probe1 for 0-10V or 4-20mA Sensor (according to SW2 position)
Screw Number 16	P1+	Positive terminal of Probe1 for 0-10V or 4-20mA Sensor (according to SW2 position)
Screw Number 17	P2-	Negative terminal of Probe2 for 0-10V or 4-20mA Sensor (according to SW2 position)

Screw Number 18	P2+	Positive terminal of Probe2 for 0-10V or 4-20mA Sensor (according to SW2 position)
Screw Number 19	P3-	Negative terminal of Probe3 for 0-10V or 4-20mA Sensor (according to SW2 position)
Screw Number 20	P3+	Positive terminal of Probe3 for 0-10V or 4-20mA Sensor (according to SW2 position)
Screw Number 21	P4-	Negative terminal of Probe4 for 0-10V or 4-20mA Sensor (according to SW2 position)
Screw Number 22	P4+	Positive terminal of Probe4 for 0-10V or 4-20mA Sensor (according to SW2 position)
Connector J3 (Lower-Left Corner)		
	Symbol	Description
Screw Number 23	GND	Ground pin
Screw Number 24	NC2	Normal Closed Terminal of Relay 2
Screw Number 25	COM2	Common Terminal of Relay 2
Screw Number 26	NO2	Normal Open Terminal of Relay 2
Screw Number 27	NC1	Normal Closed Terminal of Relay 1
Screw Number 28	COM1	Common Terminal of Relay 1
Screw Number 29	NO1	Normal Open Terminal of Relay 1
Screw Number 30	In2 Opto2	Opto-Isolator Input 2 - input terminal with isolated positive terminal- from 5Vdc to 24Vdc (according to SW2 position)
Screw Number 31	In1 Opto1	Opto-Isolator Input 1 - input terminal with isolated positive terminal- from 5Vdc to 24Vdc (according to SW2 position)
Connector J5 (Lower-Right Corner)		
	Symbol	Description
Screw Number 32	GND	GND- Negative Terminal for Resistive Sensors
Screw Number 33	S4	Input for Resistive Sensor 4
Screw Number 34	S3	Input for Resistive Sensor 3
Screw Number 35	S2	Input for Resistive Sensor 2
Screw Number 36	S1	Input for Resistive Sensor 1
Screw Number 37	COM	COM pin for Current Transformers
Screw Number 38	C3	Input pin for Current Transformer 3
Screw Number 39	C2	Input pin for Current Transformer 2
Screw Number 40	C1	Input pin for Current Transformer 1

IMPORTANT: Current Transformers (CTs) are sensors that measure alternating current (AC). They are particularly useful for measuring whole building electricity consumption or generation.

TECHNICAL SPECIFICATIONS

Power Supply	
Voltage	8 to 36 Vdc
Power Consumption	Typical: 1 W; Maximum: 5 W.
Inputs / Outputs	
ADC Inputs Resolution	11 bit + sign.
4-20mA Channels- x4 (according to switches position)	Min supported input current 4 mA Max supported input current 20 mA
0-10V Channels- x4 (according to switches position)	Min supported input voltage 0 V Max supported input voltage 10 V
Resistive Channels (x4)	Min supported Resistor value 0 Ω Max supported Resistor value 70 K Ω
Current Channels (x3)	Min supported input current-50 mA Max supported input current 50 mA
Opto-Isolator Inputs	Input Voltage 5 to 24V
Relays	10 A- 250 VAC (general use) at 40°C 8 A- 30 VDC (resistive load) at 40°C
Sinks	60A- 30V (general use) at 40°C
Digital I/O	Max supported voltage 3.3 V

IMPORTANT: Values in table are referred to related standards; 4-20mA channels are compatible also with 0-20mA industrial standard (software settings).

Environmental Conditions	
Temperature	-40 to +85 °C
Humidity	Max 80% not condensing
Storage Temperature	-40 to +85 °C
Degree Protection	< IP40

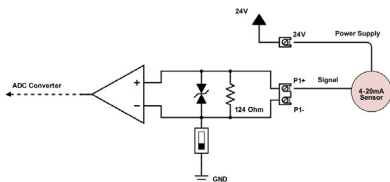
Connections	
Power Supply, Sensors, RS485, RS232, CAN, Relays, Opto-Isolators, Sinks	Pluggable Screw Connectors 5.08 pitch
Ethernet	RJ45 Connector
Programming	Micro USB Connector
Li-Po Battery	JST Connector
Micro SD	Micro SD Slot
MikroBus Click Add-on	MikroBus Slots
Enclosure	
Dimensions	L: 160 mm; H: 90 mm; W: 58 mm
Material	PC (UL 94 V-0), Light Grey
Standards	RoHS compliant DIN EN 60715 TH35 REACH compliant

ELECTRICAL CONNECTIONS

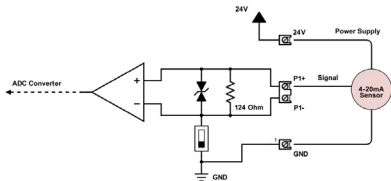
4-20mA Channels

The 4ZeroBox has 4 analog channels for 4-20mA probes. These channels can be used for reading 2, 3 and 4 wires 4-20mA sensors; through switches positions, standard mode or differential mode can be chosen.

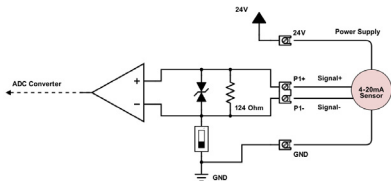
The following diagrams report various wiring configuration.



2 wire 4-20mA Sensor Reading Circuit

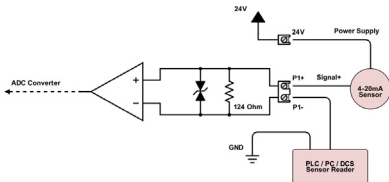


3 wires 4-20mA Sensor Reading Circuit



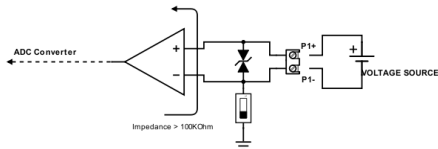
4 wires 4-20mA Sensor Reading Circuit

The 4-20mA channels can be also used for reading current signals with other reader or PLC (Differential mode). The following diagrams report various wiring configuration for the serial reading of 4-20mA signals.



0-10V Channels

Same screws used for 4-20mA sensor reading of the 4ZeroBox can be set by dip-switches to read industrial standard 0-10V sensors. Through switches positions, standard mode or differential mode can be chosen; the following diagram report 0-10V Sensor reading circuit.

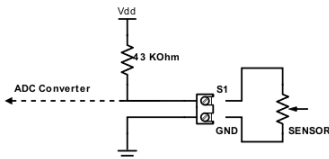


0-10V Sensor Reading Circuit

Resistive Channels

S1, S2, S3, S4 represent 4 inputs for resistive channels; resistive probes are sensors that change their resistive value in function of their related measured physical quantity. Examples of these probes are RDT Sensors (Resistance Temperature Detector), NTC Sensors (Negative Temperature Coefficient), Contact Sensors, Proximity Sensors etc.

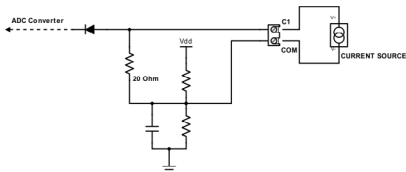
The following diagram report Resistive Sensor reading wiring configuration.



Resistive Sensor Reading Circuit

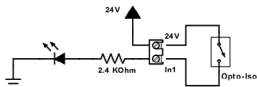
Current Transformers Channels

C1, C2, C3, in combination with COM to close the current measurement loop, are the input screws for connecting 3 different current transformers; these sensors measure alternating current (AC) and they are particularly useful for measuring whole building electricity consumption or generation.

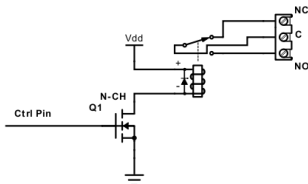


Current Transformer Reading Circuit

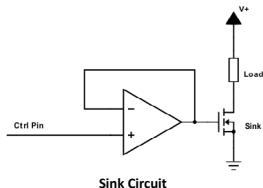
Opto-Isolators, Relay, Sinks



Opto-Isolator Reading Circuit



Relay Circuit



MikroBus Slots

4ZeroBox has 2 dedicated slots for MikroBus click boards so the user can extend 4ZeroBox with hundreds of MikroElektronika click boards (available on www.mikroe.com/click) to add extra-features to 4ZeroBox (for example GPS module, LoRa module, GPRS Module, etc.). More info in "4ZeroBox User Manual".

DIP-SWITCHES AND JUMPER SETTINGS

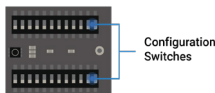
Jumper JP1

Jumper JP1 selects the power supply source for the board; possible choices are:

- E5V: External 5V → provided by onboard DC-DC converter powered through screw connector with external power supply;
- U5V: USB 5V → provided by VBUS connected to the micro-USB interface.

IMPORTANT: During the programming phase, jumper JP1 must be in U5V position and the external power supply must be detached; once programmed and installed on DIN rail, jumper JP1 of the 4ZeroBox must be placed in E5V position.

Dip-Switches



Switch SW1 (the lower one) handles functionalities related to MikroBus Slots, RS485 peripheral, and CAN peripheral; more details in the following table.

Switch SW1		
OFF Position	Pin No.	ON Position
CS pin on MikroBus Slot 1 disabled	1	CS pin on MikroBus Slot 1 enabled
CS pin on MikroBus Slot 2 disabled	2	CS pin on MikroBus Slot 2 enabled
RX pin on MikroBus Slot 1 disabled	3	RX pin on MikroBus Slot 1 enabled
RX pin on MikroBus Slot 2 disabled	4	RX pin on MikroBus Slot 2 enabled
TX pin on MikroBus Slot 1 disabled	5	TX pin on MikroBus Slot 1 enabled
TX pin on MikroBus Slot 2 disabled	6	TX pin on MikroBus Slot 2 enabled
Pull-up on RS485 Ch A disabled	7	Pull-up on RS485 Ch A enabled
Pull-down on RS485 Ch B disabled	8	Pull-down on RS485 Ch B enabled
Term resistor on RS485 Bus disabled	9	Term resistor on RS485 Bus enabled
Term resistor on CAN Bus disabled	10	Term resistor on CAN Bus enabled
RST pin on MikroBus Slot 1 disabled	11	RST pin on MikroBus Slot 1 enabled
RST pin on MikroBus Slot 2 disabled	12	RST pin on MikroBus Slot 2 enabled

Switch SW2 (the upper one) handles functionalities related to 4-20mA and 0-10V Sensors, RS232 and USB peripheral, and Opto- Isolator Inputs; more details in the following table.

Switch SW2		
OFF Position	Pin No.	ON Position
0-10V range reading sensor enabled for Probe1	1	4-20mA range reading sensor enabled for Probe1
Probe1 differential measurement enabled	2	Probe1 measurement referred to on-board GND
0-10V range reading sensor enabled for Probe2	3	4-20mA range reading sensor enabled for Probe2
Probe2 differential measurement enabled	4	Probe2 measurement referred to on-board GND
0-10V range reading sensor enabled for Probe3	5	4-20mA range reading sensor enabled for Probe3
Probe3 differential measurement enabled	6	Probe3 measurement referred to on-board GND
0-10V range reading sensor enabled for Probe4	7	4-20mA range reading sensor enabled for Probe4

Probe4 differential measurement enabled	8	Probe4 measurement referred to onboard GND
Opto-Isolator input Ch 1 enabled to 24 V	9	Opto-Isolator input Ch 1 enabled to 5 V
Opto-Isolator input Ch 2 enabled to 24 V	10	Opto-Isolator input Ch 2 enabled to 5 V
USB RX channel disabled	11	USB RX channel enabled
RS232 RX channel disabled	12	RS232 RX channel enabled

ZERYNTH

Zerynth is a platform designed to simplify and accelerate the development of IoT applications. Zerynth offers developers, system integrators, and businesses a way to enable IoT for their products, rapidly.

Zerynth Programming Suite

Zerynth® (www.zerynth.com) is the official programming framework for the 4ZeroBox. Zerynth allows programming the 4ZeroBox applications in Python (or hybrid C/Python). Zerynth includes a compiler, a debugger, and an editor, alongside tutorials and example projects for an easy learning experience. The 4ZeroBox includes a Zerynth® OS License, thus it is programmable in Zerynth for free and without limitations. Zerynth® and all the required libraries can be installed on Windows, Linux and MAC using the Zerynth Installer (<https://www.zerynth.com/zsdk/>).

Zerynth Device Manager

Zerynth Device Manager (ZDM) is a cloud based device and data management service that makes it easy to securely register, organize, monitor, and remotely manage IoT devices at scale. The 4ZeroBox can be easily connected to the ZDM enabling:

- Devices onboarding and provisioning with gold-standard security practices;
- Devices lifecycle control with remote procedure call and over the air updates (FOTA);
- Data storage, aggregation and analysis;
- Events and alarms management;
- Easy integration with third-party services, clouds and dashboards.

Setup

Following the Official Documentation (<https://docs.zerynth.com/latest/zerynth-hardware/4ZeroBox/>), the user can configure the 4ZeroBox hardware features and all the required credentials, parameters, and libraries needed for programming the 4ZeroBox and connecting it to the Zerynth Device Manager.

Important note: The 4ZeroBox has a USB connection that requires specific drivers. If the 4ZeroBox is not automatically recognized by Zerynth Studio please follow the steps in the official documentation (<https://docs.zerynth.com/latest/reference/libs/zerynth/4zerobox/docs/getting-started/>).

Note: Software distributed by Zerynth® with or without the Zerynth® brand (including, but not limited to Zerynth® Device Manager and Zerynth® ecosystem) is not covered by the 4ZeroBox hardware warranty. Please refer to the licensing agreement accompanying the software for details of your rights with respect to its use.

DECLARATION OF CONFORMITY

Here described circuit board 4ZeroBox is sold with the declaration of conformity written following the laws in force in the European area.

Before Using the device in any way, please read this manual carefully and check the presence on the Declaration of Conformity before performing any operation.

Authorized Assistance: Zerynth (TOI S.r.l.) or an appointed qualified technician will carry on the authorized assistance on this device.

Electronic circuit board for equipment monitoring was built within the following directives and standards:



Dir. 2014/53/EU known as Radio Equipment Directive (RED)

Dir. 2014/35/EU known as Low Voltage Directive (LVT)

Dir. 2014/30/EU known as Electromagnetic Compatibility (EMC)

Dir. 2011/65/EC known as RoHS

Dir. 2012/19/EU known as WEEE Directive

Dir. 2001/95/EC known as General Product Safety Directive

International Standard IEC 61882:2016 risk analysis method following HAZOP study procedure. The following pictograms are shown on the device:



Electrocution risk. Live area.



Danger electrostatic field

SAFETY INFORMATION

In our website, you can find all the documents requested by the law to sell this product. If you need them in print, you can contact our customer service. If any part of the documentation is partially missing or unreadable, contact the manufacturer Zerynth (TOI S.r.l.) before performing any further operation on the product.

This chapter describes the basic safety rules to be observed during any operation involving the circuit board 4ZeroBox. The intervention procedures described in the following chapters must be carried out respecting both the manner of performance indicated and the general safety standards of this chapter.

Different nations may have different safety regulations. It should be noted, therefore, that in all cases where the standards of the manuals are in conflict or reductive compared to industry or nation's standards where the device is used, industry and nation's standards will have priority value on those manuals.

WARNING: The manufacturer cannot be held responsible in any case for incidental or consequential damages in connection, use, maintenance of the device even partial as well as ignoring safety rules and intervention procedures in the manual.

The non-observance of the operating standards and methods of intervention, installation, set up use and maintenance of the circuit board 4ZeroBox contained in this manual will avoid the warranty terms.

Safety standards

During the installation, the connection and the use of the circuit board, malfunctioning situations unforeseen in the documentation may occur. These situations, totally abnormal, can sometimes be caused by environmental factors or unforeseeable fortuitous failures by the manufacturer.

The manual must be kept by the user and/or by the personnel responsible for management, maintenance and use of the circuit board 4ZeroBox. In case of deterioration or loss, you can ask a certified copy to the manufacturer.

WARNING: Since describing all avoid and not feasible operations is impossible, all operations (other than normal use) which are not explicitly described in the manual supplied together with the device has to be considered not feasible.

DECOMMISSIONING AND DISPOSAL

Deactivation of the device

The device is produced and constructed according to criteria of strength, durability, and flexibility which allow its use for many years.

Upon reaching the end of its technical and operational life, the device must be decommissioned and put in conditions so that it cannot be used again for the purposes for which at the time it was designed and built, while making possible to re-use the raw materials that are part of it.

The same deactivation procedure must be carried out in all the following cases:

- Decommissioning of the device and storage in the warehouse.
- Final dismantling of the product and subsequent disposal.

WARNING: The manufacturer assumes no responsibility for damage to people or property resulting from the reuse of single parts of the device for functions or mounting configurations different than the original.

WARNING: The manufacturer disclaims any recognition, explicit or implied, of suitability for specific purposes of the products parts reused after its final deactivating for disposal.

Disposal of the device

The possibility to reuse some parts of the device is subject to the user's own responsibility.

On the device label, the symbol indicated on D.Lgs.49 of 14 March 2014 is shown. It adopts the directive 2012/19/EU that indicates the necessity to dispose of the product and its components in sorted waste. Specifically electrical and electronic waste.



WARNING: The manufacturer has no responsibility for damages caused to the device, if it is not used in its full original version and for the purpose indicated in this manual. The manufacturer is not responsible for any damage to people or property resulting from device parts recovery used after its disposal.