



TOPOSENS

ECHO ONE[®]

Instruction Manual



Toposens ECHO ONE®

3D Collision Avoidance System

English Version | Q1 2024



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Described Product

Toposens ECHO ONE® 3D Ultrasonic Collision Avoidance System.
For Firmware version 2.4.X – For Hardware Version 1.0

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Compliance Notice

Compliance with local occupational health and safety regulations and general safety regulations for equipment applications is crucial. The Toposens ECHO ONE® system must be operated in strict adherence to health, safety, and legal regulations to ensure both the safety of the operator and the efficient functionality of the system. Always refer to the latest regulations and guidelines in your jurisdiction before operation.

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Original Document

This document is an original document of MEYSENS GmbH.

**Scope of validity**

This document applies only to the Toposens ECHO ONE ® 3D Ultrasonic Collision Avoidance System, Hardware Version 1.0. For information on non-included accessories and the machine or system in which this product has been integrated into, refer to the corresponding documentation.

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1. Document Revision Table

Date	Description
24.12.2023	Initial Release

2. ABOUT THIS DOCUMENT

2.1. Purpose of this Document

This instruction manual contains information on the installation process, setup and the safe use of the product. This document will aid you in using the product and its components in a safe and efficient manner. Basic requirements for safe use are:

- Compliance with all supplied safety notes and handling instructions.
- Compliance with local occupational health and safety regulations and general safety regulations for equipment applications.

NOTICE



Read this instruction manual carefully to familiarize yourself with the product and its functions before starting to work with it.

NOTICE



This instruction manual is an integral part of the product and must be kept available for later reference.

2.2. Target Group

This instruction manual is intended for use by qualified personnel that has undergone relevant professional training, education, or has sufficient experience. They should be capable of identifying risks and hazards that can occur when using the product. Installation and maintenance may only be carried out by qualified personnel. When installing and operating the product, observe the applicable regulations and safety directives, including national and local safety regulations, as well as generally recognized technical regulations.

This instruction manual is intended for:

- Qualified personnel who integrate the product into a machine or vehicle.
- Qualified personnel who perform initial commissioning, operation, setup, testing and maintenance of the product.
- Qualified personnel who perform maintenance and checks on the machine or vehicle which has been equipped with the product.
- Planners, developers and operators of machines and vehicles.
- Personnel who have been appointed with transporting, storing or disposing of the product.

This manual does not cover the operation of the machinery or vehicle that incorporates the product. Such information is available in the respective machinery or vehicle manual. All relevant health, safety, and legal guidelines must be adhered to during the commissioning, operation, setup, testing, and maintenance of the product. Operation of the product necessitates technical expertise beyond the scope of this document.

2.3. Scope of Information

This instruction manual contains information with focus on the following topics:






- Safety Information
- Product Description
- Operation/Handling
- Technical Data and Dimensional Drawings
- Mechanical Installation
- Electrical Installation
- Initial Start-Up and Configuration
- Maintenance and Care
- Fault Diagnosis and Correction
- Decommissioning and Disposal

2.4. Terms and Abbreviations

Term/Abbreviation	Definition
TPU	Toposens Processing Unit
Toposens ECHO ONE® Sensor	ECHO ONE® 3D echolocation sensor
Toposens ECHO ONE® 3D Collision Avoidance System	Combination of an ECHO ONE® sensor and a Toposens Processing Unit (TPU) as well as accessories. When referring to the sensor or the TPU only, the text will explicitly refer to it as a single device, in all other cases the term “product” or “system” will be used
GUI	Graphical User Interface
Warning- and Stopping Zone	Stopping Zone is defined as a volume which, when violated by a detection will trigger the stopping signal (STOP). Warning Zone is defined as a volume which, when violated by a detection will trigger the warning signal (SLOW DOWN).
ZONE VIOLATION	Expression that indicates the presence of an object inside the Stopping- and/or Warning Zone
MMM	Medium Monitor Mode: When activated, the system synchronizes with nearby ECHO ONE® 3D Collision Avoidance Systems by monitoring the shared medium, ensuring synchronized operation and interference avoidance.
Target Device	Customer Product into which the “ECHO ONE® 3D Collision Avoidance System” will be integrated. (e.g. AGV)
Other Device	Unspecified Device. Used as placeholder for any unknown device the system will interface with.
Point Cloud	A list of spatial positions with meta information.
Ultrasonic emitter “Transducer”	Part of the sensor unit which emits ultrasonic signals
Microphone array	Part of the sensor which receives ultrasonic signals
Acoustic axis	Orientation of spatial coordinates. Axes intersect in position Zero position.

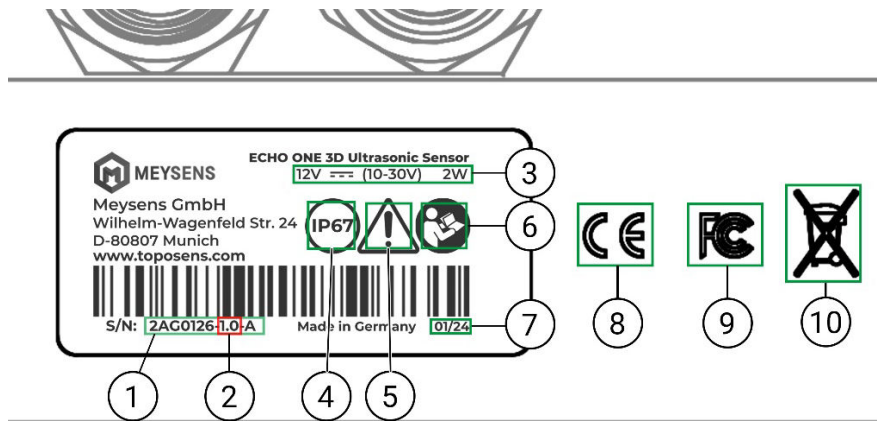
2.5. Explanation of Symbols

Safety warnings and important information contained in this document are marked with corresponding signal words and symbols. The respective signal word indicates the extent of the Danger. Always observe these warnings to avoid accidents, bodily harm and/or property damage.

DANGER	<p>DANGER</p> <p>... indicates a dangerous situation that will result in death or severe injury if not avoided.</p>
	
WARNING	<p>WARNING</p> <p>... indicates a dangerous situation which, if not avoided, could result in death or severe injury.</p>
	
AUTOMATIC STARTUP	<p>Warning: Automatic Startup</p> <p>Maintain a safe distance from equipment that may initiate an automatic startup. Refer to the equipment documentation to establish a safe state.</p>
	
FOR ATTENTION	<p>FOR ATTENTION</p> <p>... indicates a potentially dangerous situation that may result in property damage (but no bodily injuries) if not avoided.</p>
	
NOTICE	<p>NOTICE</p> <p>... highlights important information, tips and recommendations as well as information for efficient and smooth operation.</p>
	

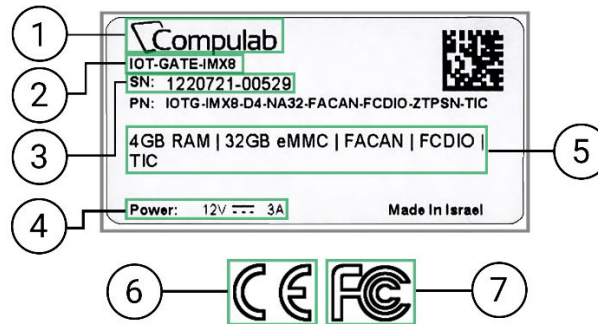
2.6. Product Labelling and Identification

The labelling contains essential technical details of the Toposens ECHO ONE® Sensor: Serial Number, Hardware Version, Power Supply Specifications, IP Rating, Ultrasonic Emission Warning, Manual Consultation Reminder, Production Date as well as conformity and RoHS markings.



1	Serial Number of Toposens ECHO ONE® Sensor
2	Hardware Version of Toposens ECHO ONE® Sensor
3	Power Supply Information
4	IP67 ingress protection
5	Attention due to ultrasonic emission symbol
6	Consult Manual before use symbol
7	Date of Production
8	CE conformity marking
9	FCC conformity marking
10	RoHS / WEEE conformity marking

The label contains essential technical details of the Toposens Processing Unit (TPU): OEM Serial Number, Hardware Configuration and Nominal Power Supply Specification, as well as CE and FCC conformity marks.



1	OEM Marking
2	OEM Product Name
3	OEM Serial Number
4	Nominal supply voltage
5	Hardware Configuration
6	CE conformity mark
7	FCC conformity mark

3. SAFETY Information

3.1. Safety precautions and potential hazards

To reduce the risk of injury and to avoid dangerous situations, the warnings given here and in the other chapters must be strictly observed.

Autonomous logistics vehicles equipped with sensor systems are designed to navigate and operate seamlessly in various environments. However, the integration of these advanced technologies brings forth certain potential risks and hazards:

- **Sensor Malfunction or Misreading:** Sensors may occasionally misinterpret data due to environmental conditions like environmental ultrasonic noise, metal working or compressed air use.
- **Operational Challenges in Dynamic Environments:** In environments with many moving objects or very high numbers of reflection surfaces, the system might face challenges in real-time decision-making, which could lead to delays or unforeseen stops.
- **System Over-reliance:** Relying solely on the system without manual oversight can pose risks, especially if the system encounters a scenario it wasn't designed for.
- **Interference with other devices:** The sensor system could potentially interfere with other acoustic or electronic systems in its vicinity, leading to malfunctions.
- **Unauthorized Access:** Unauthorized individuals with access to the system could tamper with system components.

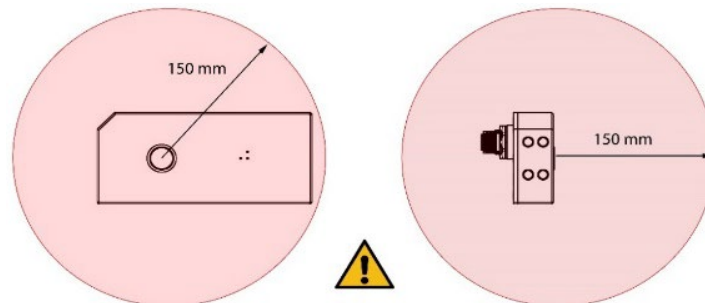
Precautionary Measures:

- **Regular Maintenance:** Ensure that the sensors are clean and free from obstructions. Regularly check for software updates and ensure the system is up-to-date and in good working order.
- **Controlled environments:** The sensor system must be complemented by another sensor system for personal/occupational safety if the machine is operated outside of controlled, cordoned off areas without human presence.
- **Manual Oversight:** Have trained personnel oversee the operations to intervene in case of unexpected behaviours.
- **Secure the System:** Implement security protocols to prevent unauthorized access or tampering.
- **Educate the Team:** Ensure that everyone involved with the operation of the vehicle is aware of its capabilities and limitations. Regular training sessions can help in understanding the system better and mitigating potential risks.

WARNING
Ultrasonic emissions


Ultrasonic emissions may irritate people, animals, and disrupt non-compatible devices.

- » Possible interference with other ultrasonic devices (e.g., alarm systems) may occur.
- » Non-compatible Ultrasonic devices can trigger or disrupt this system, affecting detection reliability.
- » Adhere to local ultrasonic exposure limits.
- » Do not aim the sensor at people or animals at close range.
- » Maintain a minimum 0.15 m / 6 in. distance from the ear to the sensor.
- » Do not touch the transducer or microphone array during operation.
- » Do not operate the system near non-compatible ultrasonic devices.


DANGER
Electrical Voltage


Electrical voltage can cause serious or fatal injuries as well as property damage. Please be aware of the following:

- » The product and its accessories must not be opened or modified.
- » Only qualified personnel may work on electrical equipment.
- » If the product is connected to a power source, it's components must be intact, sealed and mounted correctly.
- » If products components are damaged, the device(s) must be disconnected from the power supply and may only be put back into operation after repair the manufacturer.
- » Before making or disconnecting electrical connections, the power supply must be completely shut down. Residual charges must be dissipated.
- » Adhere to occupational health and safety regulations applicable to electrical installations.

3.2. Qualified Personnel

WARNING

Risk of injury due to inadequate training/education

Improper handling of this device can result in significant bodily injury and/or property damage. All work must be carried out by personnel which:

- have been briefed by the operator on potential hazards due to improper procedures.
- have specialized training, competencies, and experience as well as knowledge related to the relevant regulations. These personnel can independently perform tasks and recognize and avoid potential hazards.

The following qualifications are required for the performance of the corresponding activities:

Activities	Qualifications
Installation, Initial Start-Up Maintenance Replacement	<ul style="list-style-type: none"> • Practical technical and electrical training/education • Knowledge of current and applicable safety regulations • Knowledge of the structure and setup of the described connections and interfaces • Knowledge on how to safely operate equipment for the specific application • Knowledge of how to safely operate the machine or vehicle this system is integrated into
Start-Up and Configuration	<ul style="list-style-type: none"> • Basic knowledge of the software used • Knowledge of current and applicable safety regulations • Basic knowledge of the structure and setup of the described connections and interfaces • Basic knowledge of data transmission • Knowledge of how to safely operate the machine or vehicle this product is integrated into
Operation of the device for the respective application	<ul style="list-style-type: none"> • Qualifications and knowledge required by regulations, operator policy and manufacturer specification for the machine or vehicle, the product has been integrated into • Knowledge of the software and hardware environment for the respective application • Knowledge of the system's presence, function, potential hazards, capabilities and limitations

3.3. Intended Use

The product is a 3D ultrasonic collision avoidance system designed to detect its surroundings by calculating the 3D positions of ultrasonic echoes reflected off objects. It enhances the collision avoidance features of partially or fully autonomous vehicles. It is important to note that the **product**

does not offer a personal safety level. The product is a Class A device and therefore only intended for use in industrial environments.

3.4. Improper Use

Improper use includes any deviation from the prescribed "Intended use." Unauthorized modifications to the device(s) or software components are prohibited and considered improper use. Specific prohibitions include:

- Operation outside technical specifications or designated application areas.
- Usage as a safety component in violation of applicable machine safety standards.
- Deployment as an occupational safety component.
- Use as a collision avoidance system without complementary personal safety sensor system in areas with human traffic.
- Use in potentially explosive atmospheres.
- Exposure to corrosive or permanently wet environments.
- Operation under extreme environmental conditions.

The use of accessories not approved by MEYSENS GmbH is at the user's risk.

WARNING



Dangers of Improper Use

Any kind of improper use can lead to dangerous situations.

- » The device must be operated strictly according to its intended use and all instructions in this document.
- » All information contained in this instruction manual must be strictly observed.

4. Disclaimer

This manual is based on current standards, technical advancements, and experience. MEYSENS GmbH disclaims liability for damages resulting from:

- Non-adherence to product documentation.
- Incorrect or improper use.
- Operation by untrained or unqualified personnel.
- Unauthorized modifications to hardware or software.
- Damages from excessive mechanical stress or corrosive environments.
- Ignoring installation requirements.
- Use of unauthorized spare parts, consumables, or accessories.

The Toposens ECHO ONE® sensor, TPU, accessories, and software components are provided "as is." MEYSENS GmbH is not liable for direct or indirect damages or losses from product use. Usage outside specifications voids all claims against MEYSENS GmbH.

The system installer/operator is responsible for the safety and conformity of machines or vehicles incorporating this product.

Observe the operating and safety instructions for the machine or vehicle in which this product is integrated. These operating instructions do not contain any information or safety instructions relating to the machine or the vehicle in which this product has been integrated.

Warranty claims against MEYSENS GmbH are void if the device or Toposens software is utilized beyond its intended purpose or modified. This applies in particular to the opening of the housing and the modification of accessories also within the scope of assembly and electrical installation.

5. PRODUCT DESCRIPTION

5.1. Product Overview

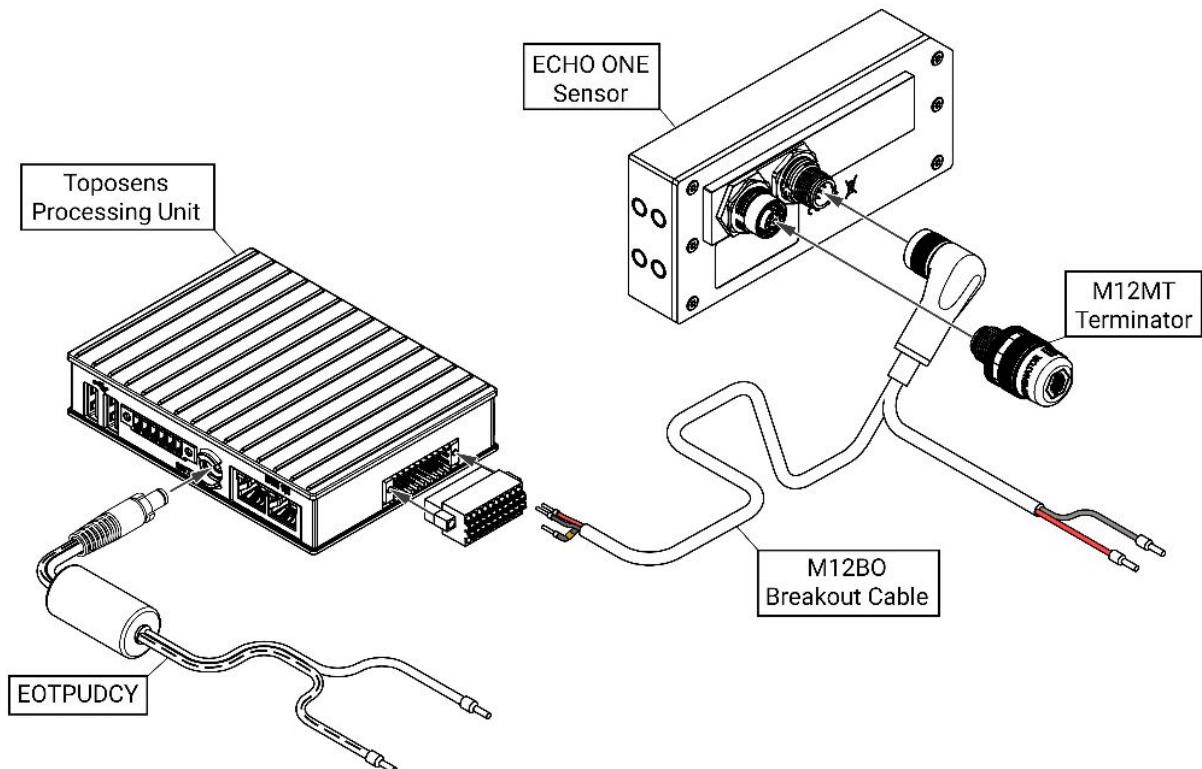
The Toposens ECHO ONE® 3D Collision Avoidance System is comprised of the Toposens ECHO ONE® 3D ultrasonic sensor and the Toposens Processing Unit (TPU), as well as other accessories. This assembly constitutes the complete system, designed to enhance spatial detection and collision avoidance in industrial environments.

The system operates using Time-of-Flight (ToF) technology. The sensor, with its wide aperture angle and reduced blind zone, measures distances by calculating the time ultrasonic signals take to return after reflecting off surfaces, thereby ensuring comprehensive spatial coverage.

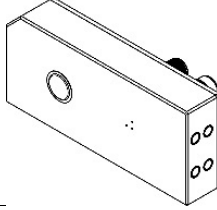
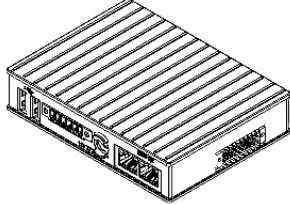
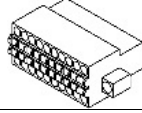
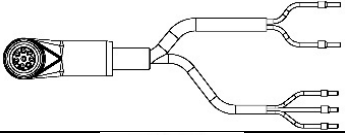

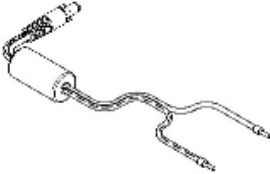
The sensor's data output is processed by the Toposens Processing Unit (TPU). The TPU offers two types of interfaces for data handling and system control:

1. **Ethernet Interface:** Provides access to the majority of the TPU's functionalities.
2. **Digital I/O Interface:** Facilitates discrete control commands as well as zone violation signals.

Zone parameters are adjustable through the graphical configuration interface, digital voltage signals and UDP communication over the Ethernet interface of the TPU. The system's design allows for integration with various control systems and applications, devoid of extensive user-interface elements to maintain a focus on technical utility.



5.2. Scope of delivery

Item ID	Amount	Description	Image
E0	1x	Toposens ECHO ONE® Ultrasonic Sensor	
E0TPU	1x	Toposens Processing Unit (TPU)	
E0TPUPC	1x	20 Pin Terminal Block	
M12BO	1x	Connection Cable between Toposens ECHO ONE® Sensor and TPU	
M12MT	1x	Sensor Bus Terminator for Toposens ECHO ONE® Sensor	
E0TPUDCY	1x	Lockable Power Cable for TPU	

5.3. Storage

Store the product in a dry environment in its original packaging. While product components can be stored in a temperature range between -20 °C to 70 °C, the ambient temperature should be kept between 0°C and 40°C to preserve the packaging materials. Do not expose the packaging to high humidity or moisture, prolonged direct sunlight, chemicals, smoke and other aerosols, or excessive dust buildup.

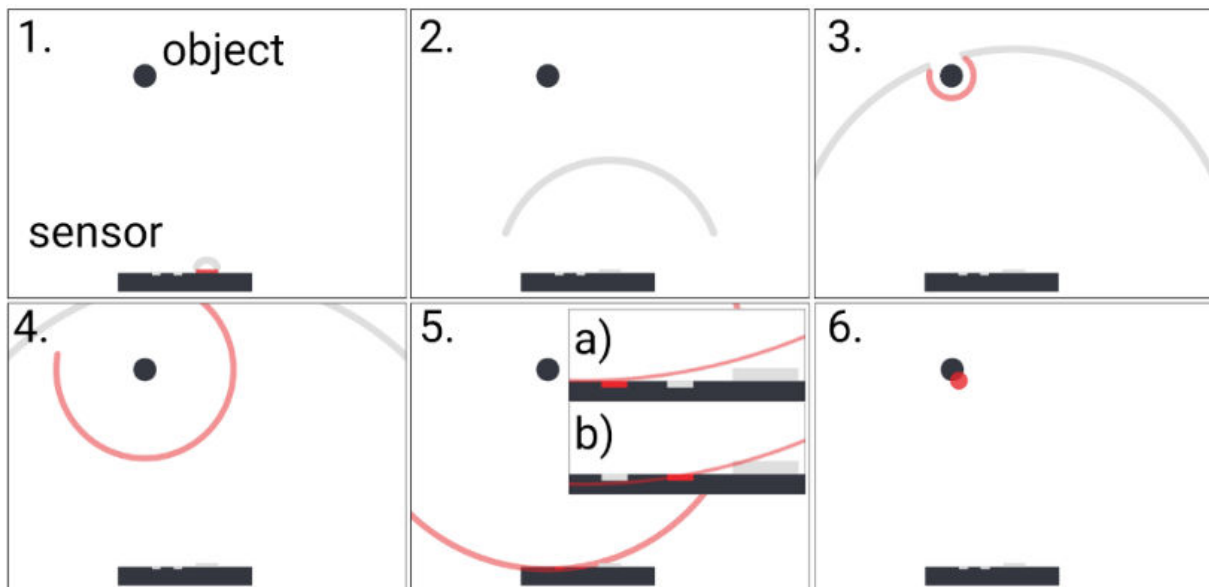
5.4. System Operation

5.4.1. Operating principle

The Toposens ECHO ONE® sensor extends the Time-of-Flight principle of conventional ultrasonic sensors to three dimensions. To determine the position of objects in 3D space, the system periodically performs the following steps:

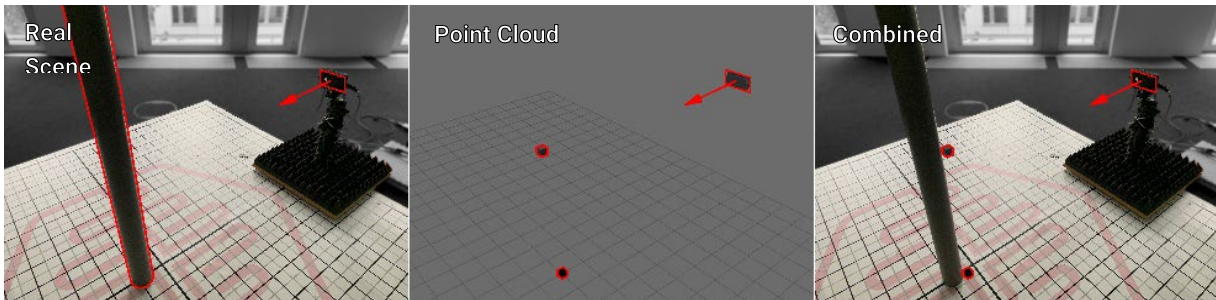
1. The ultrasound transducer emits an undirected ultrasonic pulse.
2. The ultrasonic pulse propagates through the air.
3. The pulse is reflected by objects within its range.
4. Reflected pulses travel back towards the sensor.
5. The sensor's microphone array receives these pulses.
 - a. The first microphone detects the echo and records the time of flight.
 - b. The second microphone detects the echo and records the time of flight.
6. The sensor calculates the position of the reflecting objects as 3D coordinates, based on the time-of-flight difference, measured by each microphone.

The 3D coordinates of the detected reflections, enriched with metadata, are provided to the TPU at the end of each measurement cycle. The raw point cloud data undergoes further processing on the TPU before being either used for binary zone violation surveillance or is output to a client device connected to the ethernet interface.

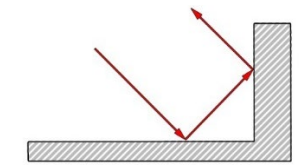


5.4.2. Point Cloud Characterisation

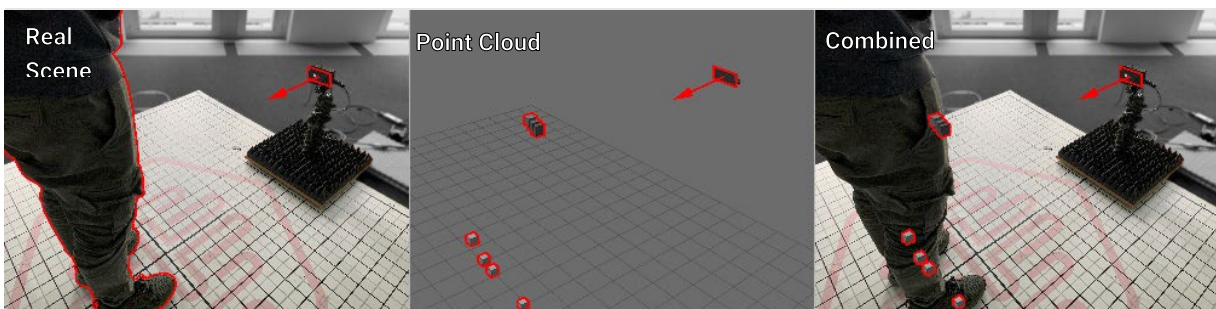
Depending on their shape and size, objects reflect ultrasonic waves differently, thereby generating point clouds of varied densities. Objects with simple shapes (e.g., walls and poles) have very few reflective features, resulting in fewer detected reflections per object and a sparser point cloud (see figure below). It should be noted that the material composition and surface structure of objects also affects their ultrasonic wave reflectivity, influencing the resultant point cloud density.



If the objects are located on the ground, the sensor is also able to detect signals which bounce back from the base of the object and the surface it rests on (retroreflection).



A complex object (e.g., a person) is a composition of several contiguous surfaces that form the shape – because of this, the sensor detections will result in a denser point cloud (see figure below).



5.4.3. Noise Immunity

The Toposens ECHO ONE® system demonstrates strong resilience to environmental noise. It effectively isolates its measurement pulse from background noise, allowing it to differentiate between noise and pertinent echoes. When external noise levels exceed a certain threshold within the critical frequency range of 30-45kHz, the system's ability to detect objects may diminish. Testing has shown that the sensor accurately detects a pole target located 1 meter away in environments with up to 100 dB SPL of broadband Gaussian noise.

5.4.4. Operational Guideline

Ensure adherence to the following guidelines for the integration and operation of the product:

- The product and its components are not to be utilized as part of a safety function or as safety components, particularly in applications involving personal protection.
- Do not use the product in environments with potentially explosive atmospheres.
- The installation location, bus structure, and power supply must align with the specifications outlined in the product documentation.
- Adhere to the system configurations specified in the operating instructions. Using multiple, independent sensor systems on a single machine is discouraged.
- Refrain from operating the product under environmental conditions that exceed its specified limits.
- The product should not be used alongside other ultrasonic devices that are not compatible.
- When operating the product in areas with human or animal presence, comply with local occupational safety regulations.

6. Product Specifications

6.1. Product Lifecycle and Accessibility

MEYSENS GmbH is committed to ensuring that users have continuous access to the Toposens ECHO ONE® 3D collision avoidance system and its components throughout its lifecycle. Here are key guidelines to ensure consistent product accessibility:

- **Software Updates:** Regular software updates will be provided to enhance performance, address bugs, and ensure compatibility. Users are encouraged to periodically check our official website, subscribe to our support email, or contact our support team for the latest software versions.
- **Hardware Replacement:** Genuine hardware replacements for the Toposens ECHO ONE® system, Toposens Processing Unit and accessories are available through authorized distributors. Using non-approved parts might compromise the system's performance and void warranty.
- **Customer Support:** Our support team is available to assist with any inquiries, troubleshoot issues, and provide guidance on the best practices for using the Toposens ECHO ONE® system.
- **Product Documentation:** Comprehensive documentation is available, detailing product specifications, usage guidelines, and safety precautions. Make sure to refer to the latest version for accurate information.

Please note:

- The use of accessories not approved by MEYSENS GmbH is at the user's own risk.
- Use of unauthorized spare parts, consumables, and accessories can lead to reduced system efficiency and potential risks.
- The Toposens ECHO ONE® sensor, the TPU, related accessories and software components are provided "as is". MEYSENS GmbH assumes no liability for any damages or losses from its use outside the specified guidelines.

Features	
Technology	3D Ultrasonic Echolocation and Ranging
Detection Range*	Up to 3000 mm
Field-of-View*	±55° Horizontal (±70° when Target <100 cm) ±55° Vertical (±70° when Target <100 cm)
Accuracy**	± 6 cm (for a Field of View up to ± 60°)
Working Frequency	40 kHz ± 1 kHz

*Target: 75 mm diameter pole

** Target: 75 mm diameter pole in 1 m distance

Electrical

Nominal Supply Voltage	12 V DC *
Operating Voltage Range	10V - 30 V DC *
Current Consumption typ. (12 V)	450 mA
Peak Current Consumption (12 V)	580 mA
Power Consumption avg. (12 V)	5.4 W

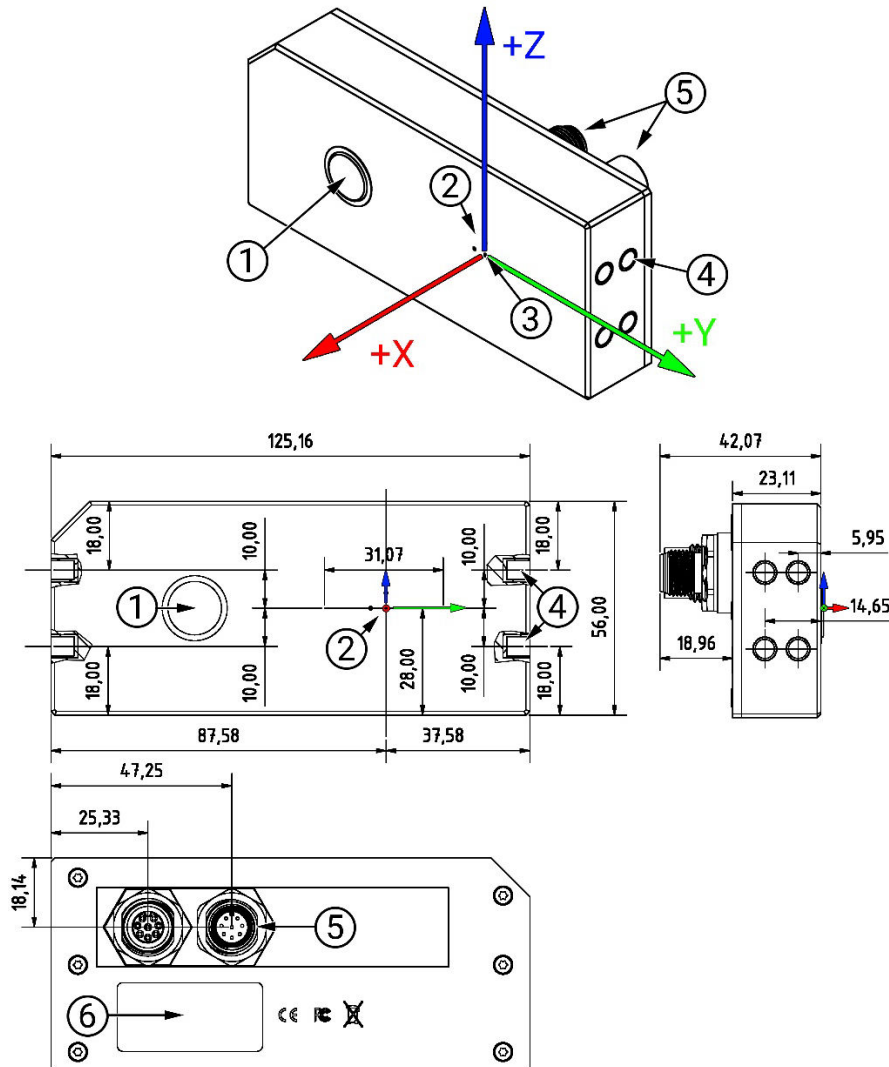
* SELV/PELV Power Supply

Environmental

Ambient operating temperature	-10 °C to 50 °C
Storage temperature	-20 °C to 70 °C

6.2. Component Specifications

6.2.1. ECHO ONE® Sensor



1	Ultrasonic emitter "Transducer"
2	Microphone array
3	Acoustic axis
4	Threaded inserts for M5x5 screws
5	M12 A-coded 8-pin plug and socket
6	Product Labelling and Identification

ECHO ONE® Component Specifications
Dimensions

Outline Dimensions [L x W x H]	125 mm x 56 mm x 42 mm (excl. Cable)
Weight	180 g

Electrical

Nominal Supply Voltage	12 V DC *
Operating Voltage Range	10V - 30 V DC *

* SELV/PELV Power Supply

Environmental

Ingress Protection	IP67 (Front, Back, Connectors with suitable termination)
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WARNING

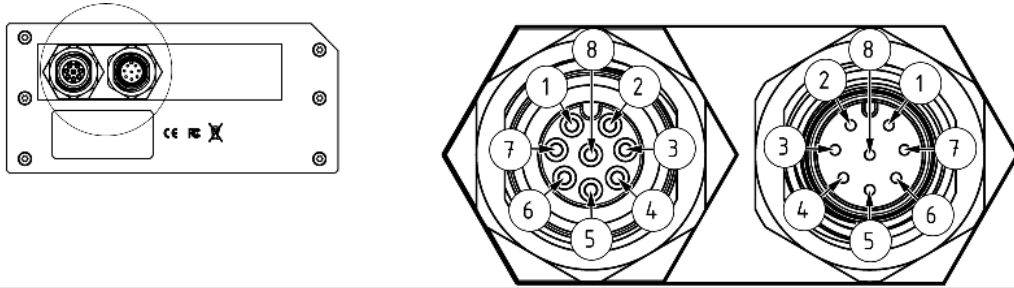

Permanent outdoor installation or wet environments

The sensor and other product components are not designed for permanent outdoor installation or use in permanently wet environments.

Compliance

EMC	EN 55011 Group 1 Class A
	EN 61326-1:2021
	EN 61000-4-2
	EN 61000-4-3
	EN 61000-4-4
	EN 61000-4-6
	FCC 47CFR Part 15: Subpart B - Class A
Declaration of conformity	CE, FCC, RoHS
Protection class	III (EN 61140)

Connector pinout

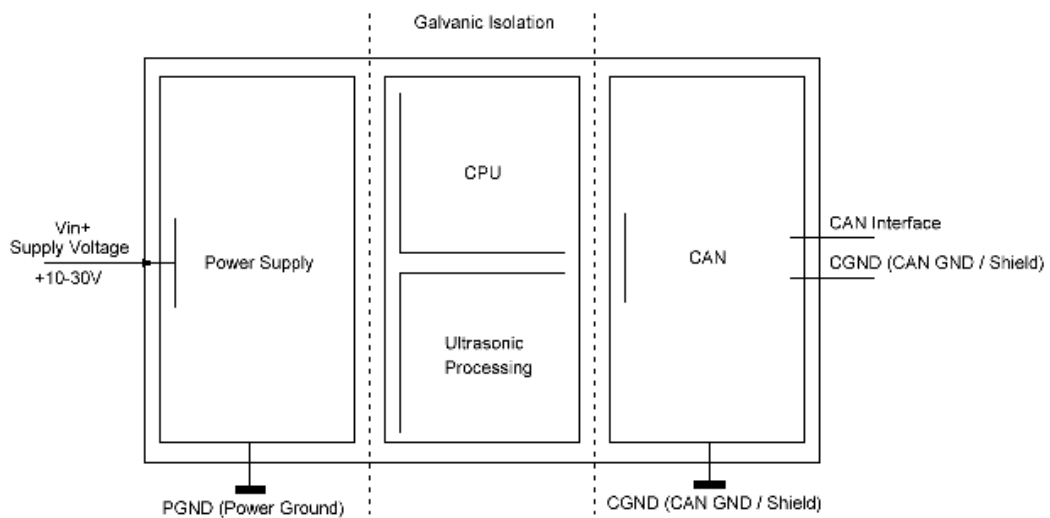

M12 A-coded 8-pin socket

Pin No.	Function
1	+V Out
2	+V Out
3	CAN High
4	CAN Low
5	-V Out
6	Reserved / Connect to shield
7	Reserved / Connect to shield
8	-V Out
Gehäuse	CAN GND / Shield

M12 A-coded 8-pin plug

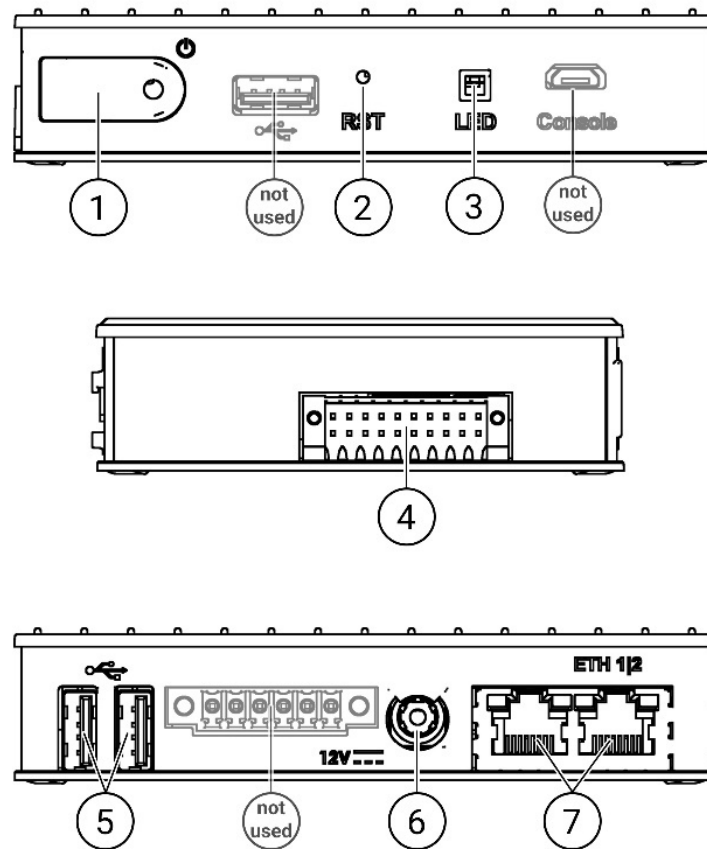
Pin No.	Function
1	+V In
2	+V In
3	CAN High
4	CAN Low
5	-V In
6	Reserved / Connect to shield
7	Reserved / Connect to shield
8	-V In
Gehäuse	CAN GND / Shield

Ground Layout



The Toposens ECHO ONE® sensor features galvanic isolation between its power supply ground potential and CAN interface to maintain signal integrity and prevent ground equalization currents from flowing.

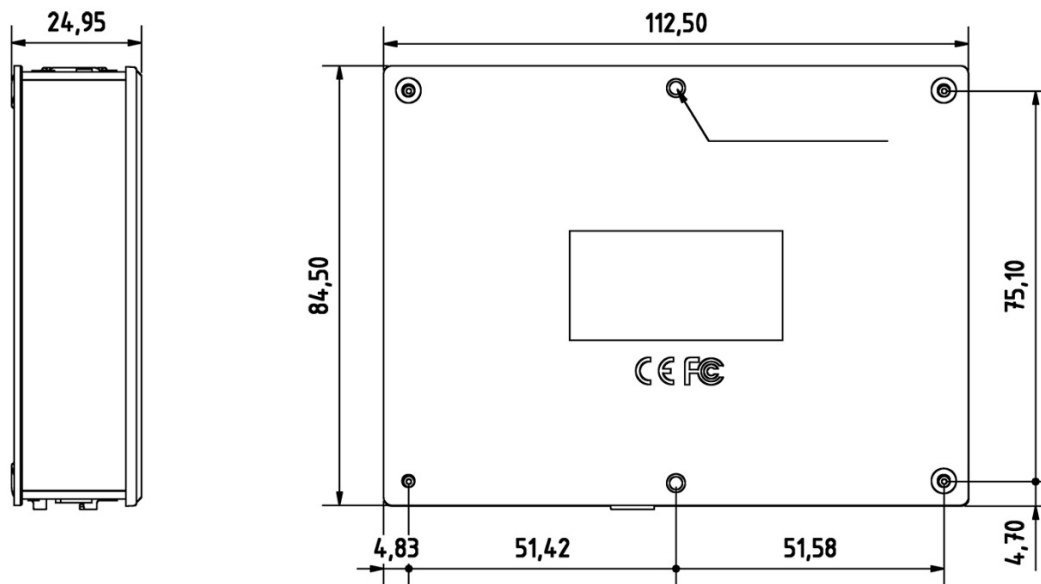
6.2.1. Toposens Processing Unit (TPU)



1	Power Button and LED indicator (lights up when powered)
2	Reset
3	Activity LED
4	Multifunction Connector Socket
5	USB (for Firmware Updates and Configuration Backup)
6	Lockable Power Input
7	Ethernet 1 and Ethernet 2 connector

TPU Component Specifications

All measurements within 0.1mm tolerance



Dimensions

Outline Dimensions [L x W x H]	113 mm x 85 mm x 25 mm (excl. Cable)
Weight	240 g
Enclosure Material	Aluminium housing
Mounting Options	M3 Threads, DIN-Rail (optional)

Electrical

Nominal Supply Voltage	12 V DC *
Operating Voltage Range	8 - 36 V DC *
I/O Supply Voltage (+V_IO)	15 – 30 V DC *

* SELV/PELV Power Supply

Environmental

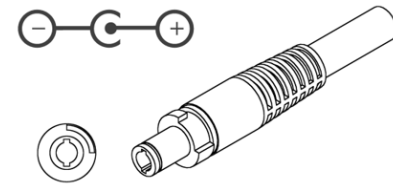
Cooling Solution	Passive, fanless
Ingress Protection	Use in dry conditions only

Compliance

EMC	FCC 47CFR part 15: 2015 – Class B VCCI-CISPR 32: 2016
	ICES-003: 2017 – Class B
	EN 55032: 2015 - Class B
	EN 61000-6-3: 2007
	EN 61000-3-2: 2014
	EN 61000-3-3: 2013
	EN 61000-6-2: 2019
	EN 55035: 2017
Declaration of conformity	CE, FCC, RoHS

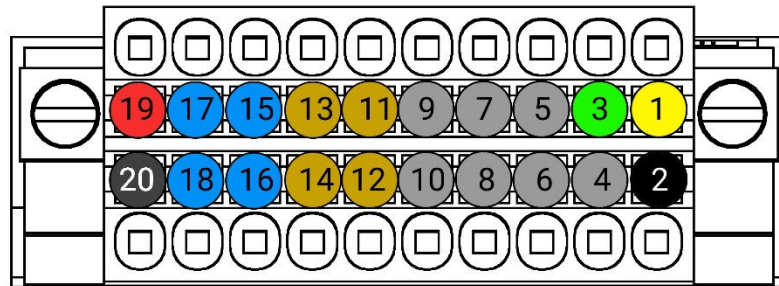
Power connector specification

The TPU uses a custom lockable barrel connector for its power input. Only use the E0TPUDCY cable supplied with the TPU for this purpose.



Multifunction connector specification

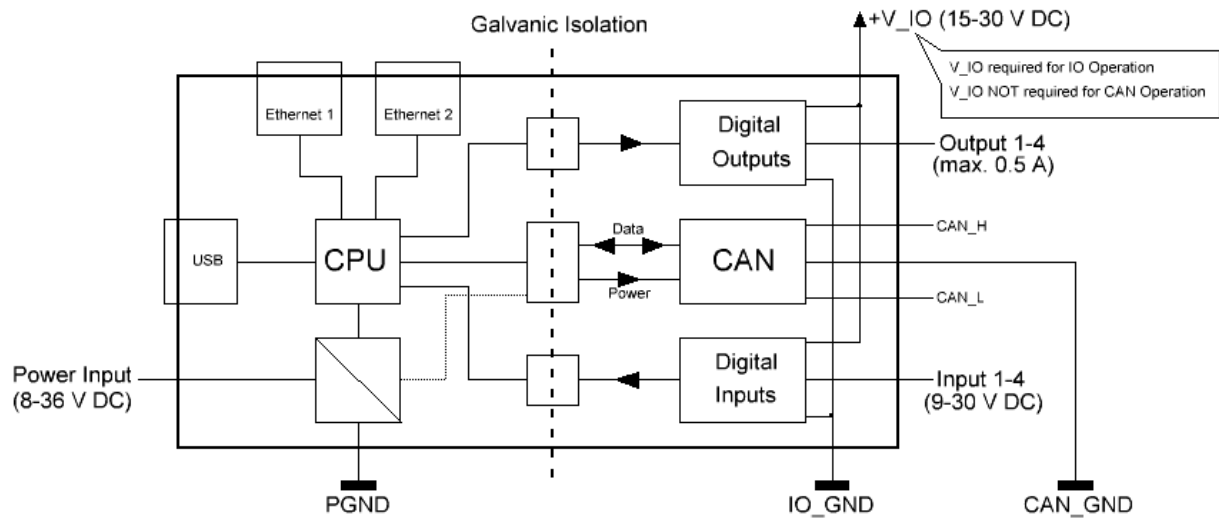
Multifunction Connector type	Removable Spring-cage terminal block
Number of contacts	20
Termination requirements	Stranded wire with shrouded ferrules, max. 0.34 mm ² (AWG22) Solid core wire, max. 0.5 mm ² (AWG20)



No.	Function	Description
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_GND	CAN GND and Shield - Isolated from Power Input
3	CAN_L	CAN_L bus line (dominant low)
4-10	NC	Do not connect
11	OUT1	Digital Output 1 (500mA max., Voltage Source/Sink= +V_IO/IO_GND)
12	OUT3	Digital Output 3 (500mA max., Voltage Source/Sink= +V_IO/IO_GND)
13	OUT2	Digital Output 2 (500mA max., Voltage Source/Sink= +V_IO/IO_GND)
14	OUT4	Digital Output 4 (500mA max., Voltage Source/Sink= +V_IO/IO_GND)
15	IN1	Digital Input 1 (Voltage Input >8V for activation, max. 30V, <3mA, Ref IO_GND)
16	IN3	Digital Input 3 (Voltage Input >8V for activation, max. 30V, <3mA, Ref IO_GND)
17	IN2	Digital Input 2 (Voltage Input >8V for activation, max. 30V, <3mA, Ref IO_GND)
18	IN4	Digital Input 4 (Voltage Input >8V for activation, max. 30V, <3mA, Ref IO_GND)
19	+V_IO	+15V to +30V Input for I/O Section – Isolated from Power Input
20	IO_GND	GND for I/O Section – Isolated from Power Input

Ground Layout

The TPU's CAN and I/O sections feature galvanic isolation, serving as a safeguard against unintended equalization currents while enhancing signal integrity. The ground potential for the input supply voltage (PGND) connects through the barrel jack (Power) input of the TPU. Both +V_IO and IO_GND remain isolated from PGND and the CAN Interface. To activate the TPU's digital inputs and outputs, connect a supply voltage ranging from 15 to 30 V DC between +V_IO and IO_GND. The CAN Module, with its own isolated power supply, operates independently without needing connections to +V_IO and IO_GND. While connecting PGND, IO_GND, and CAN_GND to the same potential is technically feasible, it is not advisable.



7. Product Installation

7.1. Preparation

Prior to installation, retain the sensor, TPU, and accessories within their packaging until the mounting area is fully prepared. Confirm that the mounting surface is clean and devoid of contaminants. To safeguard the sensor and reduce the risk of injury, remove or cover any sharp edges in the vicinity of the installation site. Pre-route all necessary cables between the proposed mounting locations of the sensor and the TPU. During installation, take care to ensure that cables are not compressed or pinched, and verify that the TPU's ventilation is not impeded by accumulated cables or adjacent devices.

7.1.1. Required tools and accessories

For installing the sensor, prepare the following tools and accessories:

- » Allen wrench (size 3)
- » Mounting bracket with screws M5x6 (Accessories List)
- » Screws for fastening the bracket to the mounting location
- » M12BO Cable for Power and Data connection (included)

For installing the TPU, select either a DIN-Mount Kit or suitable M3 screws for direct mounting and prepare the following tools and accessories:

- » 2mm Flathead Screwdriver for securing connectors
- » EOTPU DCY Cable for TPU Power Supply (included)
- » Cable Kit for I/O connections and I/O Power Supply
- » Ethernet Cable for Configuration
- » Ethernet Cable for Connection to Target device
- » M12 Terminator (included)

- » For DIN-Mount Kit: PH1 Screwdriver & 5.5 mm Wrench
- » For direct surface mounting: Suitable Screwdriver

7.1.2. Unpacking

Allow devices to acclimatize if exposed to large temperature variations, preventing condensate formation. When opening packaging, use appropriate tools. If using a knife, keep incisions shallow to avoid content damage. Dispose of unneeded packaging in compliance with local regulations.

NOTICE
Safe Handling


Place the product components on a soft surface to prevent damage. Avoid placing the sensor face-down to prevent performance degradation due to dirt or scratches.

Repacking

For repacking, use original packaging materials. If unavailable, ensure protection against mechanical shock and impact. Disconnect and pack all components and accessories separately.

NOTICE
Safe Handling


Disable the power supply before removing components. Avoid placing the sensor face-down to prevent damage due to dirt or scratches. Separate the components before packing.

7.2. Mechanical Installation

7.2.1. Sensor Mounting Options

The sensor is equipped with eight M5 threaded sleeves (DIN13-1). Use screws compliant with ISO 4762, with an immersion thread length of 5 mm and a maximum tightening torque of 2.5 Nm.

The mounting surface must be load-bearing, and not subject to strong vibrations or oscillations during normal machine operation.

**AUTOMATIC
STARTUP**
Risk of automatic Startup


When mounting the sensor system on a machine or vehicle, ensure it is in a safe state for work preventing unintentional Startups. Follow the machine's operating instructions and adhere to occupational health and safety rules as well as electrical safety regulations.

**FOR
ATTENTION**

Connector damage in humid environments

The supplied M12 connectors are moisture or dust resistant if seated and tightened correctly. Connect or disconnect connectors only in a dry environment. Ensure both sensor connections are occupied by either suitable M12 connectors or a M12 terminator. Unoccupied connections compromise the device's IP rating, reducing it to IP20. Make sure connectors are dry and free of contamination before mounting.

**FOR
ATTENTION**

Damage to threaded sleeves

Avoid damaging the threaded sleeves and housing by not exceeding the 2.5 Nm tightening torque.

- » Use appropriate screws to mount the sensor (EOSCW).
- » Do not exceed a tightening torque of 2.5 Nm.

**FOR
ATTENTION**

Inadequate sensor mounting

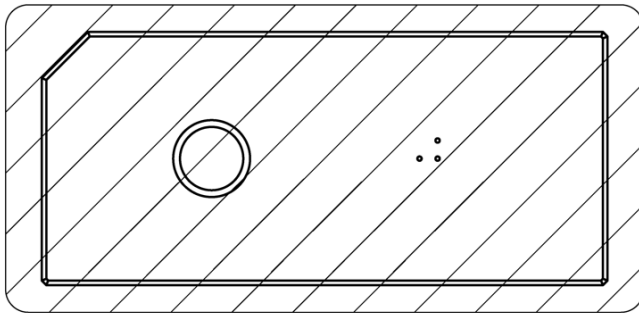
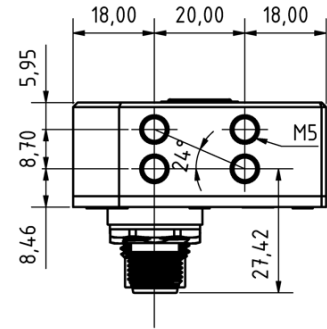
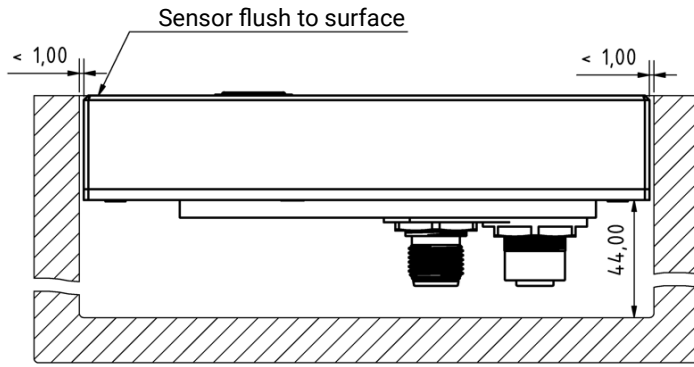
Improper fastening may damage the sensor.

- » Secure the sensor using at least two screws per side.
- » When using a C-bracket, attach it at a minimum of two points to the mounting surface.
- » If using two L-brackets, attach each bracket with at least two points to the mounting surface.
- » For occasional vibrations, use a medium-strength thread locker and other vibration mitigation measures.

NOTE

Conditions for sensor mounting

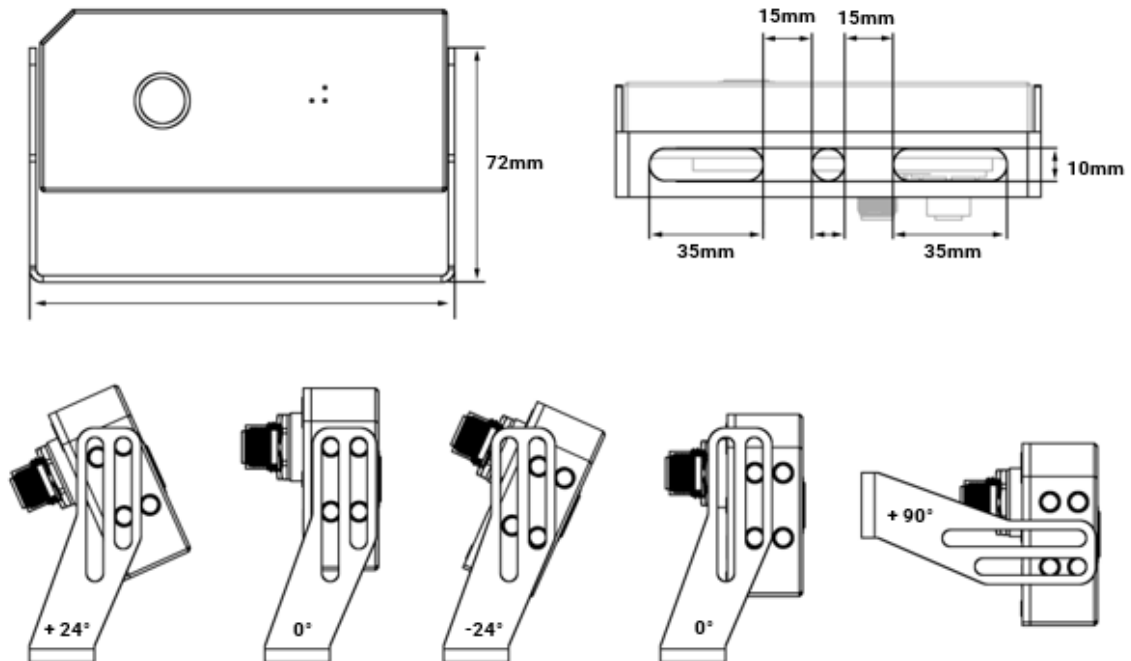
- » Keep the sensor front free of obstructions.
- » When installing the sensor in a recessed position, make sure the sensor front is installed flush with the mounting surface.
- » A gap >1mm around the sensor may reduce detection capability.
- » Depending on the installation situation, calibration of the sensor may be necessary.



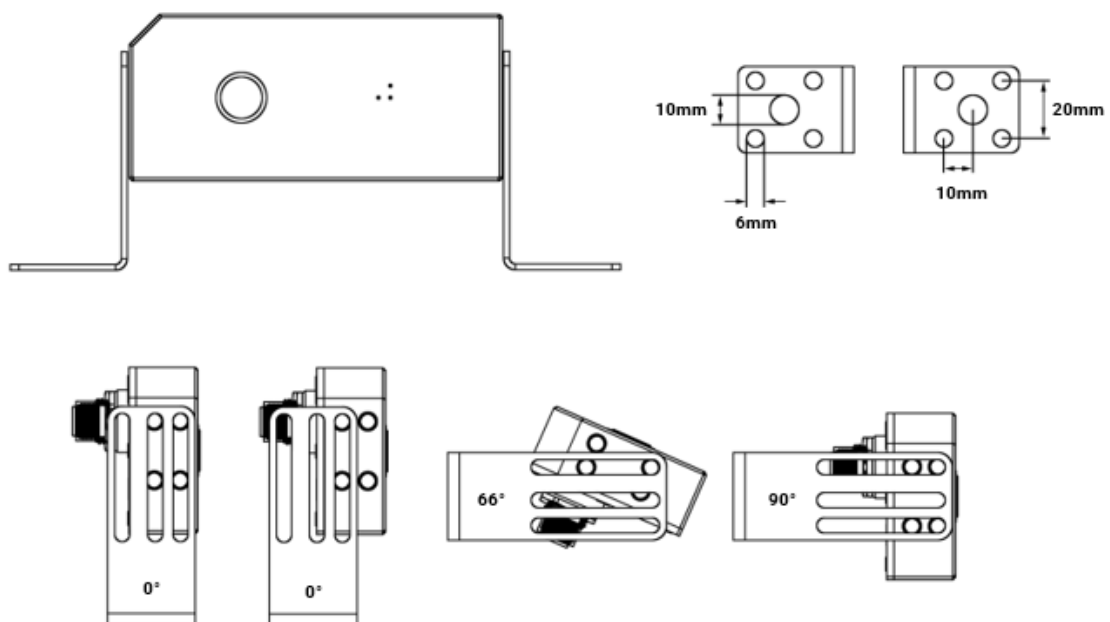
Installation of Mounting Brackets

The Toposens ECHO ONE® sensor can be installed using metal mounting brackets as illustrated in the following figures:

C-bracket: EOBRC



L-bracket: EOBRL



7.2.1. TPU Mounting Options

**FOR
ATTENTION**

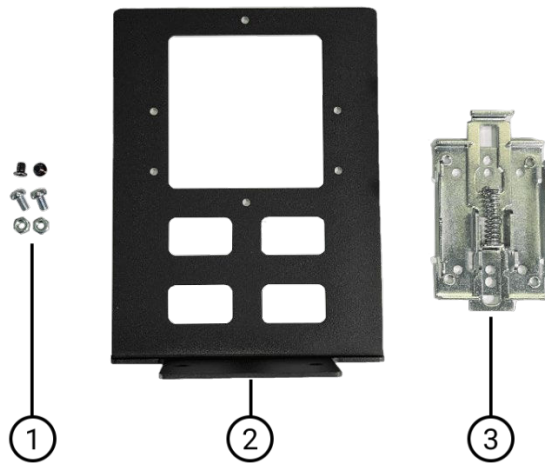


FOR ATTENTION

The TPU is not protected against dust or water ingress. Install TPU in a vented space to avoid excess heat aggregation. Leave space around the TPU for connectors and cables.

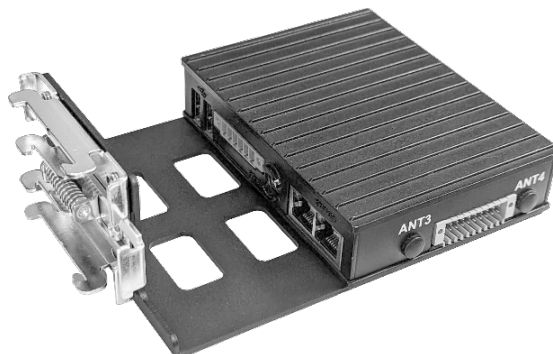
Installation of TPU SDIN-Rail Mount

Packaged contents of the SDIN-Rail Mount are shown in the graphic below:



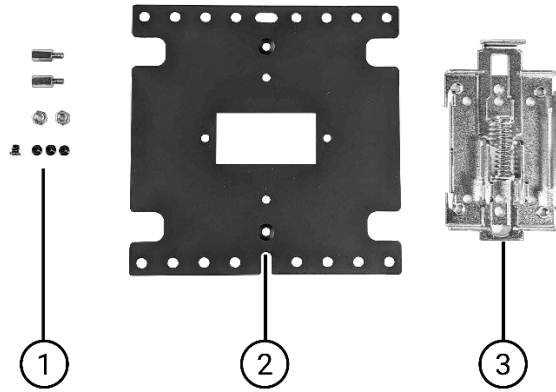
1	Mounting Screws for DIN-Mount (3) and TPU
2	TPU SDIN-Rail Mount
3	DIN-Mount

After completing the assembly of the DIN-Mount (3) onto the TPU SDIN-Rail Mount (2) using the provided screws, the TPU can then be affixed to this assembly utilizing the included [M3] screws. There are several possible positions for mounting the TPU. The image below illustrates one such example of the TPU mounted in a specific position.



Installation of TPU EOTPUDIN Mount

Packaged contents of the EOTPUDIN-Rail Mount are shown in the graphic below.



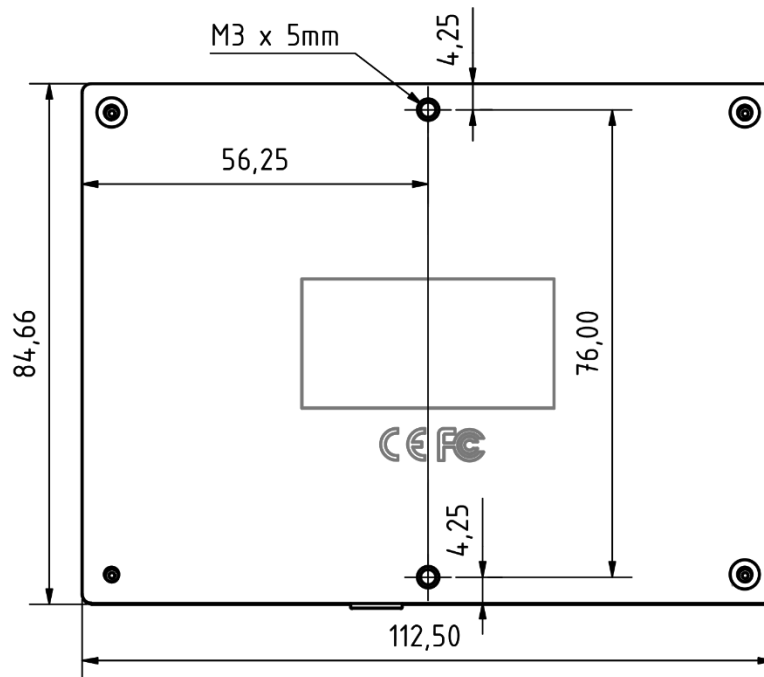
1	Mounting Screws for DIN-Mount
2	TPU SDIN-Rail Mount
3	DIN-Mount

This mounting mechanism facilitates various installation orientations for the TPU. The package includes extra screws and standoffs, which allow for raised mounting above the carrier plate. The accompanying image illustrates one possible option for mounting the TPU. Ensure to maintain a minimum clearance of 25mm for the multifunction connector and 35mm for both the power and Ethernet connectors during the installation planning process.



Direct installation of TPU on a surface

Refer to the provided technical drawing below for guidance on installing the TPU in specialized mounting locations. Ensure to maintain sufficient space around the TPU during installation, allowing access to its connectors. This requires a clearance of 25mm for the multifunction connector and 35mm for both the power and ethernet connectors.



7.1. Electrical Installation

DANGER


Electrical Voltage

Improper grounding can result in dangerous equipotential bonding currents, which can cause dangerous voltages on conductive surfaces or lead to cable or connector failure. Electrical voltage can cause serious or fatal injuries.

- » Only qualified personnel may work on electrical equipment.
- » Adhere to occupational health and safety rules and regulations for electrical installations.
- » Ensure proper grounding and prevent equipotential bonding currents across communication and/or I/O lines of the TPU, avoiding to dangerous voltages on conductive surfaces and preventing cable or connector failures.

Potentially dangerous voltages are used inside the housing of the device during operation. Electrical voltage can cause serious or fatal injuries.

- » The housings must not be opened.
- » The product and its components must not be modified.
- » The product's components must be protected from damage.
- » Damaged components must be immediately disconnected from the power supply and may only be put back into operation after repair by the manufacturer.

Connection cables and connectors may be damaged by mishandling.

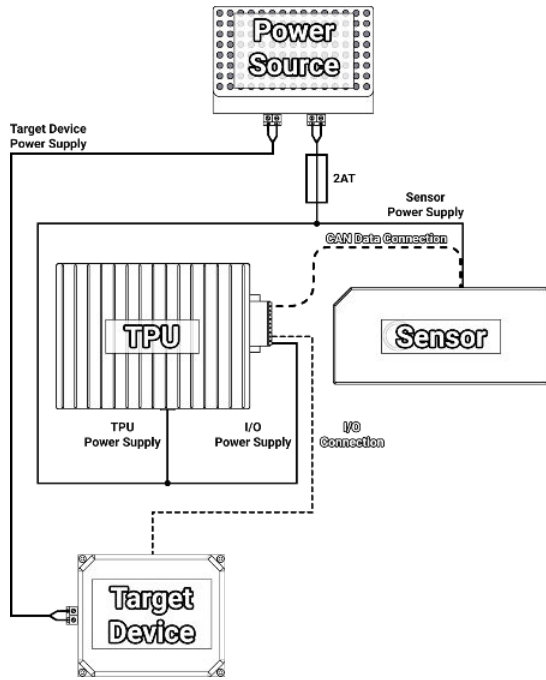
- » Do not subject the cables to tensile stress.
- » Do not pull the cables over sharp edges, use edge protectors and strain relief measures.
- » Observe the minimum bending radius of the cables.
- » If the cable is repeatedly moved or guided in a drag chain, it must be suitable for this.
- » Only use cables and connectors matching the requirements.
- » Keep connectors free from contamination or moisture when not connected.
- » Do not connect or disconnect connectors while powered.
- » Observe the conditions for device and connector IP ratings.

7.1.1. Power Supply requirements

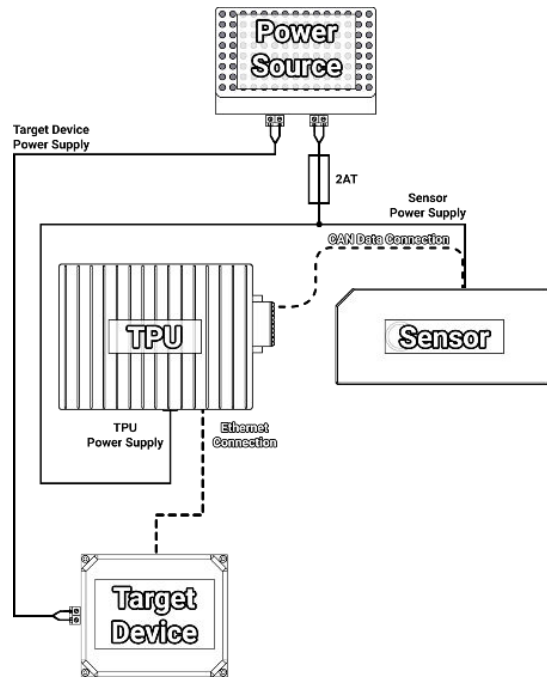
Observe the following recommendations for safe and trouble-free operation:

- The product's components must be protected by a common slow-blow fuse, suitable for DC voltages, with a maximum value of 2 A, which should be located as close as possible to the power supply source. If separate power supplies are used, this safety element can be substituted by individual component fuses rated at 1 A.
- All circuits connected to the product must be designed as circuits with safety extra-low voltage (SELV) or functional extra-low voltage with electrically safe isolation (PELV).
- The product is not intended for connection to the AC mains.
- The product is intended for operation on a fused DC power (SELV/PELV) source, with a voltage range of 10-30 VDC, capable of providing a minimum current of 1.5A.
- For reasons of protection against accidental contact, the bus running direction of the M12 connectors must be adhered to: The male connector of the sensor is used for power input and data connection, the female connector for terminating the bus with a suitable terminator.
- To achieve the best signal integrity, it is strongly recommended to use the included M12BO cable to connect the sensor to the TPU.

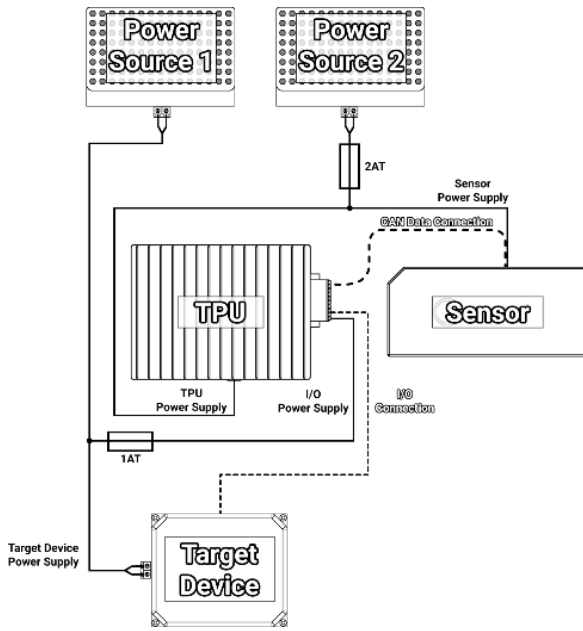
Power supply configurations



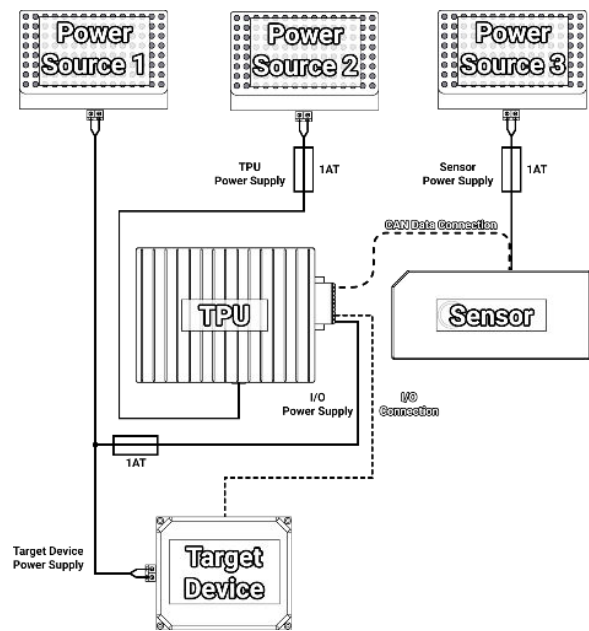
Common Power Supply for System and Target Device, I/O Connection



Common Power Supply for System and Target Device, Ethernet Connection

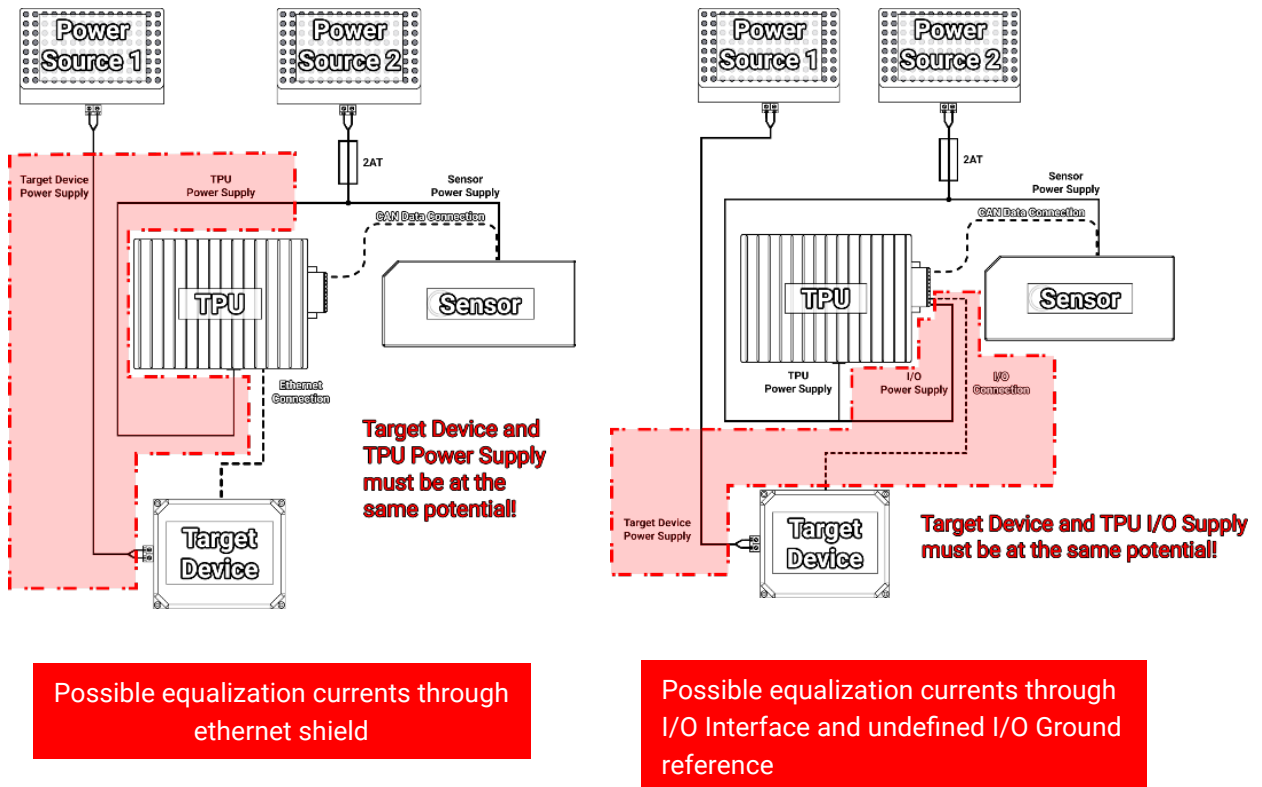


Separate Power Supply for System and Target Device, I/O Connection



Separate Power Supply for TPU, Sensor and Target Device, I/O Connection

To avoid unreliable operation and undesired equalization currents avoid the following power supply configurations:



7.1.1. Connector and cable requirements

It is recommended to exclusively use cables supplied as an accessory of the product. If other cables are used these minimum requirements need to be met.

TPU-to-Sensor connection

Wire gauge	≥ 0.22 mm ² (AWG 24)
Number of conductors	8
Shielding	Yes, Cu-Mesh
Permissible operating voltage	≥ 30 V DC
Current carrying capacity (all conductors)	≥ 2 A
Flammability	UL 2556 VW-1
Total Length	< 30 m

Recommended Sensor Bus cable types:

Lapp UNITRONIC® BUS CAN 2x0,22

HELUKABEL 81286 2x0,22

Lapp UNITRONIC® FD CP plus A 2X0,25

Connectors must fulfil the following specifications:

Connector type	M12 A-coded
Number of contacts	8
Shielding	Cable and connector housing shielded
Permissible operating voltage	≥ 30 V DC
Current carrying capacity per contact	≥ 2 A
Termination requirements	Shrouded ferrules or solid wire, max. 0.5 mm ² (AWG20)
IP Rating	IP67

TPU-IO and IO Power connection

Wire gauge for stranded wire	0.22 mm ² - 0.34 mm ² (AWG 24 – AWG 22)
Wire gauge for solid core wire	0.22 mm ² - 0.50 mm ² (AWG 24 – AWG 20)
Wire termination	Shrouded Ferrules for stranded wire
Permissible operating voltage	≥ 30 V DC
Current carrying capacity (all conductors)	≥ 2 A
Flammability	UL 2556 VW-1

Warning

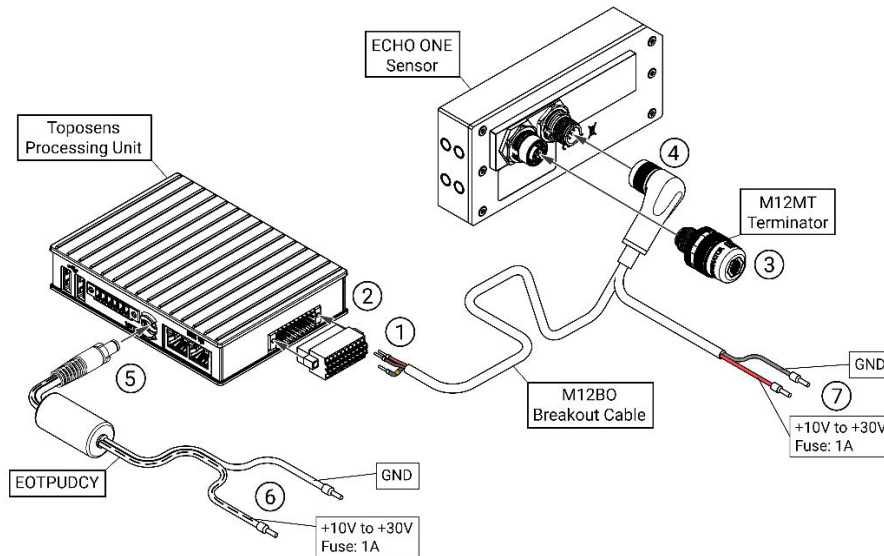
Unsuitable cables or connectors

Using unsuitable cables or connectors may result in malfunction, injury or risk of property damage.

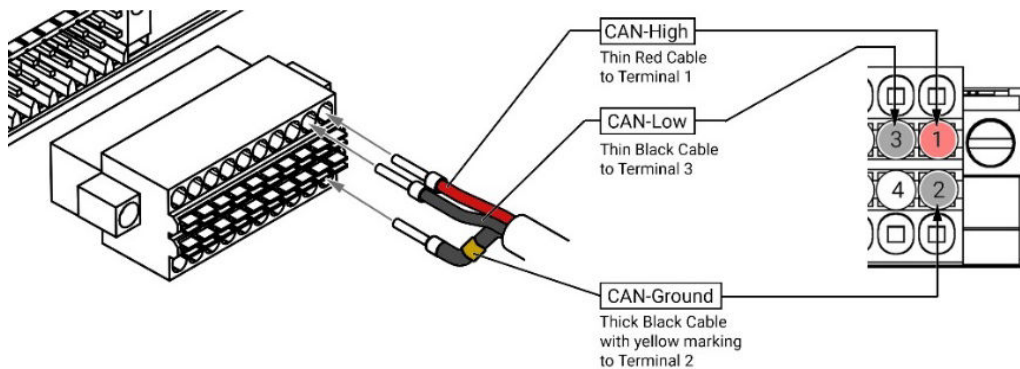
- » Observe the minimum requirements for the cables and connectors.
- » Check the cable and connector requirements that the machine or system places on the wiring.
- » Connectors can reduce the IP rating of the sensor.

7.1.1. Connection procedure

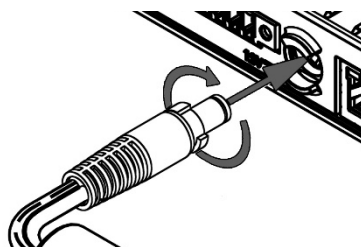
Prepare and route Signal and Power cables between the TPU, the Sensor and the device, the product is to be interfaced with. Follow the steps outlined below:



- (1) Connect the M12BO cable to the Multifunction-Connector of the TPU. Push the ferrules into the corresponding terminals until they are seated correctly.



- (2) Plug the Multifunction-Connector Block into corresponding socket on the TPU. Use the integrated screws to secure the terminal block.
- (3) Connect and tighten down in the CAN-Terminator. Use an M12 torque tool to ensure correct tightening torque.
- (4) Connect and tighten down in the M12BO Cable. Use an M12 torque tool to ensure correct tightening torque.
- (5) Connect the EOTPU DCY-cable to the TPU. After gently pushing in the connector, turn clockwise carefully to lock.



- (6) Connect power to TPU and the sensor to a fused, deenergized power supply with a voltage output of 10 – 30 V DC.

**FOR
ATTENTION**
Shortening cables

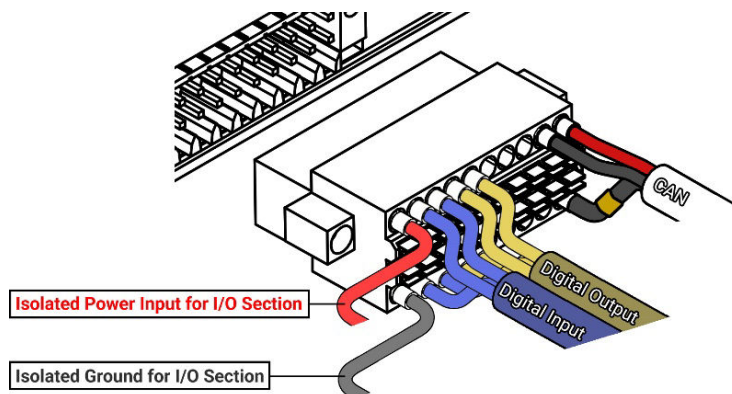

The EOTPUDCY-cable must not be shortened beyond the ferrite filter permanently mounted to the cable.

I/O connection

The system's digital input and output section requires an external power source and ground reference to operate. This section is galvanically isolated from the rest of the system, allowing the I/O section to be used at a different voltage level and ground reference from the TPU- or sensor power supply.

The I/O Section of the system must be supplied with a voltage ranging from +15 V to +30 V (+V_IO) in relation to a Ground reference (IO_GND). A digital input is activated when the voltage applied to the terminal exceeds +8 V.

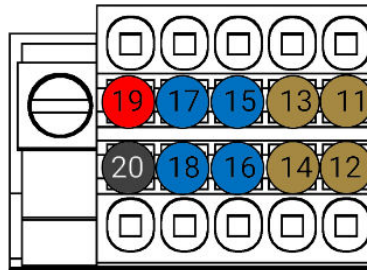
To prevent damage, input voltages should not be allowed to rise above +30 V. An active digital output will output voltage equivalent to the supply voltage (+V_IO). The maximum allowable sink or source current is 500 mA per Output while the maximum total I/O section current is 1 A.


NOTICE


The I/O section does not need to be powered by an external voltage (+V_IO) if the I/O functionality will **not** be used.

NOTICE

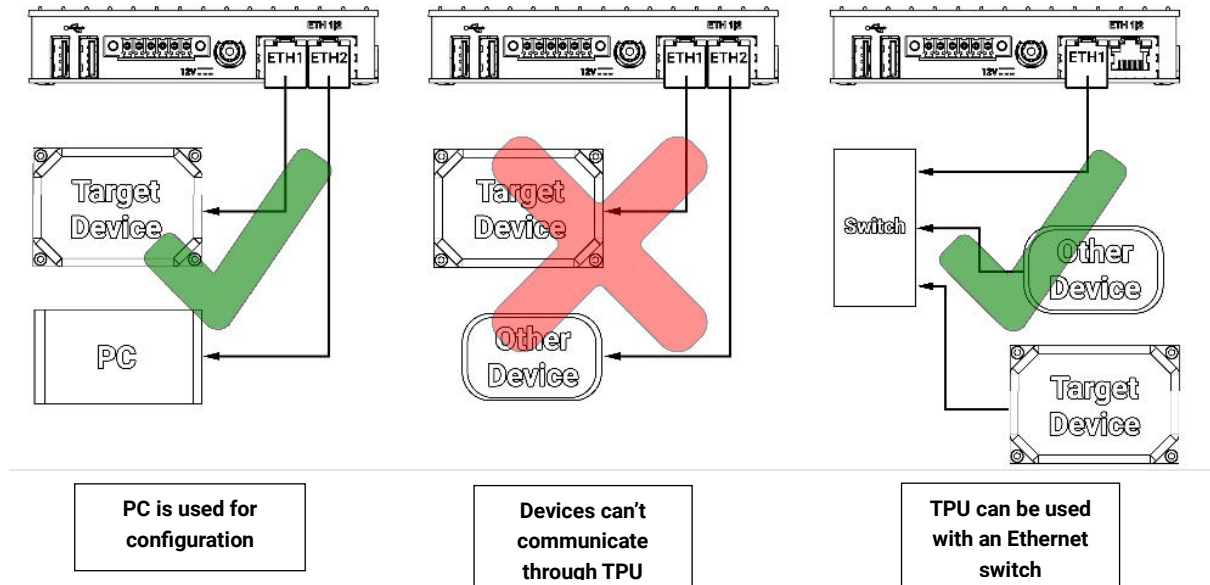

It is recommended to use ferrules on the TPU multifunctional connector instead of solid core wire due to better fatigue resistance during vibrations.



No.	Function	Description
11	OUT1	Digital Output 1 (500mA max., Voltage Source/Sink= +V_IO/IO_GND)
12	OUT3	Digital Output 3 (500mA max., Voltage Source/Sink= +V_IO/IO_GND)
13	OUT2	Digital Output 2 (500mA max., Voltage Source/Sink= +V_IO/IO_GND)
14	OUT4	Digital Output 4 (500mA max., Voltage Source/Sink= +V_IO/IO_GND)
15	IN1	Digital Input 1 (Voltage Input >8V for activation, max. 30V, <3mA, Ref IO_GND)
16	IN3	Digital Input 3 (Voltage Input >8V for activation, max. 30V, <3mA, Ref IO_GND)
17	IN2	Digital Input 2 (Voltage Input >8V for activation, max. 30V, <3mA, Ref IO_GND)
18	IN4	Digital Input 4 (Voltage Input >8V for activation, max. 30V, <3mA, Ref IO_GND)
19	+V_IO	+15V to +30V Input for I/O Section – Isolated from Power Input
20	IO_GND	GND for I/O Section – Isolated from Power Input

Ethernet connection

If one or both Ethernet Interfaces are to be used, make sure to use a high quality CAT5e cable which is flexible, robust and equipped with a vibration proof RJ45-connector. Note the diagram below for possible connection options:



NOTICE



ETH1 and ETH2 have dedicated functions – They cannot be used as pass-through/daisy-chain ports.

8. System Startup

8.1. Commissioning Checklist

Prior to initial power-up of the system, ensure the following aspects are verified:

Status	Checks to perform
<input type="checkbox"/>	Check that the sensor, TPU, and cables show no visible damage.
<input type="checkbox"/>	Confirm the sensor is clean and the sensor's protective film is removed.
<input type="checkbox"/>	Check if the polarity of the power supply is correct.
<input type="checkbox"/>	Verify supply voltage: 10 - 30 V DC for Sensor and TPU.
<input type="checkbox"/>	When using the I/O Section of the TPU: Verify supply voltage: 15 – 30 V DC for TPU I/O-Section.
<input type="checkbox"/>	Ensure the power supply can deliver peak currents over 1.5 A.
<input type="checkbox"/>	Confirm the presence of a common fuse element (2AT) or individual fuses (1AT) in the power supply line.
<input type="checkbox"/>	Validate that the used cables meet specified standards and conductors are correctly inserted into connectors.
<input type="checkbox"/>	Check that a M12 Terminator is attached to the sensor's female M12 connector.
<input type="checkbox"/>	Ensure correct connection of CAN_H, CAN_L, and CGND (cable shield).
<input type="checkbox"/>	Check that cable length between sensor and TPU does not exceed 30m.
<input type="checkbox"/>	Verify no non-Toposens devices are connected to the Sensor Bus.
<input type="checkbox"/>	Confirm that Sensor and TPU are mounted rigidly as per mounting instructions and cables are routed securely.
<input type="checkbox"/>	Check that the mounting surface is load-bearing, vibration-free, and suitable as per operating instructions.
<input type="checkbox"/>	Confirm that the sensor is either protruding or recessed flush into a surface with a surrounding slit <1mm.
<input type="checkbox"/>	Ensure connectors are free of contamination and are tightened correctly.
<input type="checkbox"/>	Check if all connections between the Sensor, TPU and the device the TPU is interfaced with, have been made.

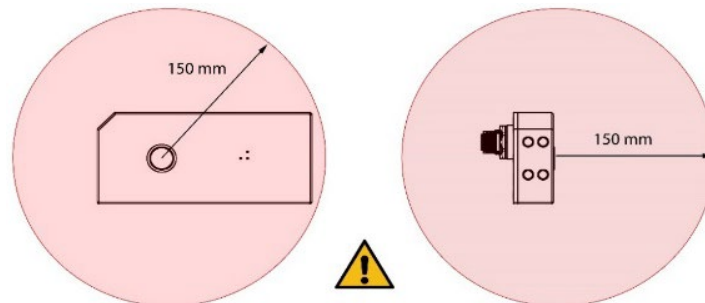
8.2. Initial Startup

Prior to initiating power to the system, verify that the installation has been completed in compliance with the outlined connection and installation procedures. Additionally, confirm that all items on the commissioning checklist have been thoroughly reviewed and addressed.

WARNING
Danger of ultrasonic emissions


Ultrasonic emissions may irritate people, animals, and disrupt non-compatible devices.

- » Possible interference with other ultrasonic devices (e.g., alarm systems) may occur.
- » Non-compatible Ultrasonic devices can trigger or disrupt this system, affecting detection reliability.
- » Adhere to local ultrasonic exposure limits.
- » Do not aim the sensor at people or animals at close range.
- » Maintain a minimum 0.15 m / 6 in. distance from the ear to the sensor.
- » Do not touch the transducer or microphone array during operation.
- » Do not operate the system near non-compatible ultrasonic devices.


DANGER
Electrocution Risk


Electrical voltage can cause serious or fatal injuries.

- » The housing must not be opened.
- » Disconnect power before working on the product.
- » The product must not be modified.
- » All components must be protected against damage.
- » If housing, cables, seals, or accessories are damaged, disconnect the product and only resume operation after repairs by the manufacturer.

Power-up Process of the system and its components:

- » After applying power to the system, components initiate automatically.
- » The sensor will perform various environmental measurements and self-tests. This process takes a maximum of five seconds.
- » The TPU's power button LED will light up. The startup procedure takes around 75 seconds before the full functionality is available.

NOTICE


To turn the TPU on or off, the power button can be used. Alternatively, enabling or disabling the power supply is also possible as this won't cause damage to the system.

9. Configuring the System

The Configuration Interface of the TPU can be accessed by utilizing the ETH2-port.

The ETH2 interface is configured with a static IP address (1.1.1.1) for exclusive configuration use.

ETH1's IP address can be altered for specific applications and offers secondary Configuration Interface access post-configuration.

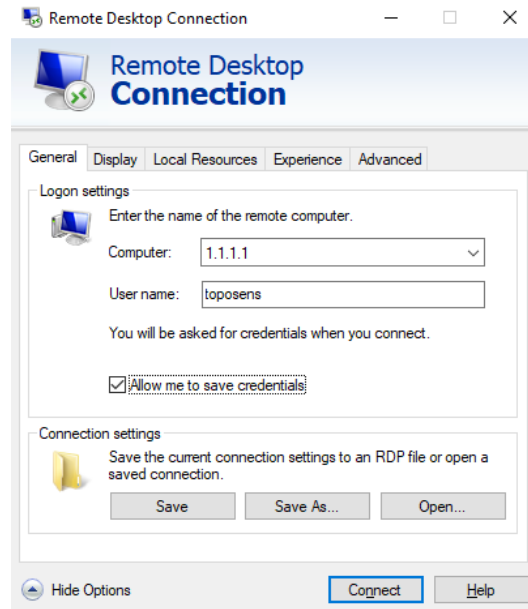
For initial connection, link your computer's Ethernet Port to the TPU's ETH2 interface using a CAT5e or CAT6 twisted pair cable. Set your network interface card to use DHCP or assign a static IP address in the same subnet (example: 1.1.1.2). Connection establishment might take up to 30 seconds in DHCP mode.

Post-connection, the Configuration Interface, a Graphical User Interface (GUI), is accessible through Remote Desktop Client (RDP) software.

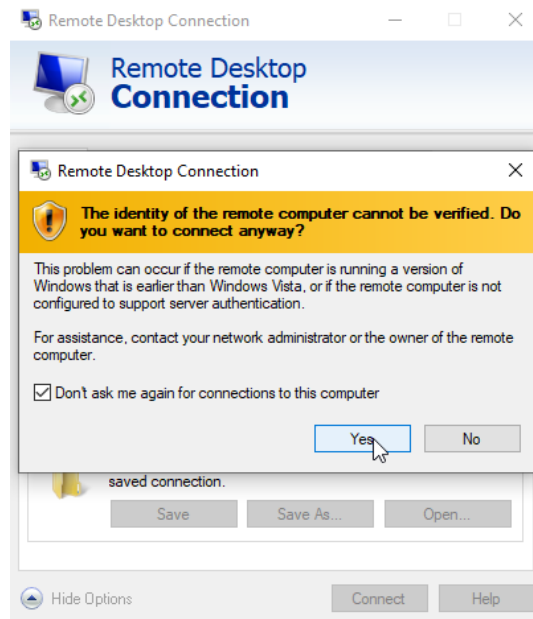
9.1. Accessing the Configuration Interface

9.1.1. RDP-connection on Microsoft Windows

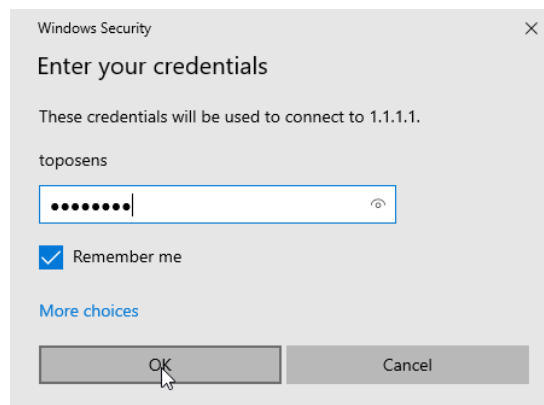
1. Start the integrated RDP-Client on Microsoft Windows by pressing WIN+R, entering "*mstsc*", and pressing Enter/Return.



2. Input the IP address "*1.1.1.1*" in the "*Computer*"-textbox.
3. Input "*toposens*" in the "*User Name*"-textbox.
4. Check the "*Allow me to save credentials*"-checkbox.
5. Click "*Connect*".



- For first-time connections, a warning may appear. Select “Don’t ask me again for connections to this computer” and click “Yes”.



- If prompted for credentials, enter “toposens” as the password and click “OK”. Optionally, select “Remember me”.
- The RDP-client software will connect and display the Configuration Interface of the TPU.

NOTICE
Optimal Screen Resolution


A screen resolution of 1920x1080 or higher is recommended for optimal display.

NOTICE
Other network connections


Disconnect from the Internet and/or disable other network connections if connection to the Configuration Interface fails.

9.1.2. RDP-connection on Linux

Linux supports multiple free RDP clients for connecting to the TPU's GUI. This manual focuses on "xfreerdp" installation and usage:

1. Open a terminal window.
2. Execute installation by entering:
`sudo apt install freerdp2-x11 freerdp2-shadow-x11` and pressing Enter/Return.
3. If prompted, provide credentials and confirm by pressing Enter/Return.
4. Await installation completion.
5. After the installation, connect to the TPU by entering:
`xfreerdp /f /u:toposens /p:toposens /v:1.1.1.1`
 and confirm by pressing Enter/Return.
6. The RDP-client software will connect and display the Configuration Interface of the TPU.

NOTICE
Keyboard layout settings

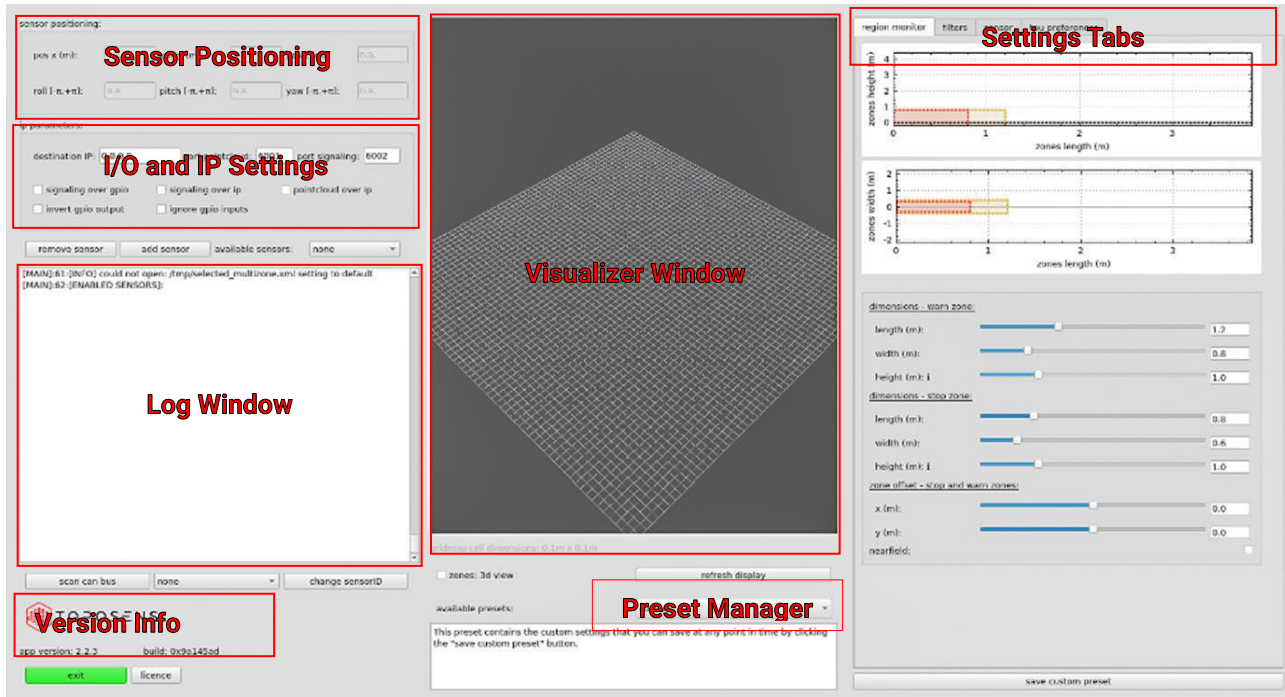

Make sure that the RDP program you use is set to use the correct Keyboard Layout. The English (QWERTY) layout is configured by default.

NOTICE
Other network connections


Disconnect from the Internet and/or disable other network connections if connection to the Configuration Interface fails.

9.2. Using the configuration interface

9.2.1. Configuration Window Overview



9.2.2. Adding and removing a sensor

After establishing a connection with the TPU Configuration Interface, a sensor that is physically connected must be added to the TPU's configuration to enable its usage:

1. Click the "scan can bus" button on the lower left of the window. The drop-down box next to the "scan can bus" button will be automatically populated with the alphanumeric ID of the connected sensor (e.g., "5d") after scanning has finished.
2. Click on "add sensor" and enter the sensor ID (exclude the "0x" prefix) into the dialog box and click "add". The ID will now appear in the "available sensors" drop-down box.
3. After a few seconds, a 3D representation of the sensor's point cloud output will be displayed in the central visualizer window.

NOTICE



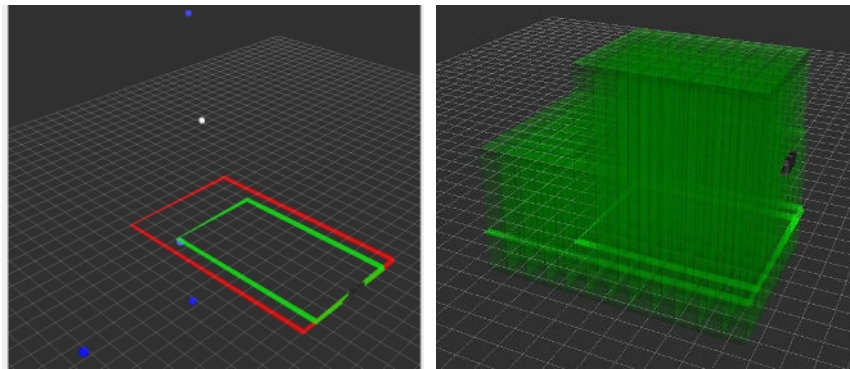
If the "add sensor" button (above log window) is disabled, the sensor is already registered and selectable in the "available sensors" drop down box.

To remove a sensor from the TPU's configuration, select its ID from the "available sensors" drop-down box and click "remove sensor".

available sensors: 0x343 ▼

9.2.3. Visualizer Window

The central visualization window displays real-time point cloud data and a scaled representation of the user definable stop- and warn zones. A brighter coloured data point indicates a higher acoustic intensity, while the colour of the zone markings indicates if a zone contains an object (red) or if it does not contain an object (green).



To visualize the zones in 3 dimensions, check the option “*zones: 3D view*” below the visualizer window.

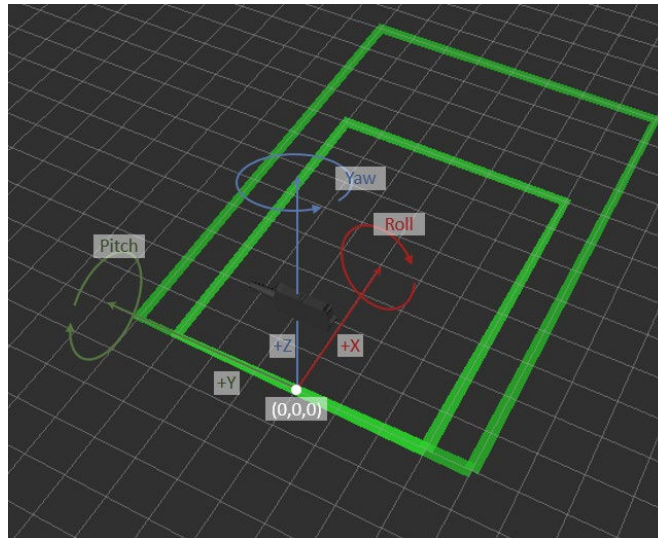


The graphical view can be rotated, panned and zoomed in and out by using the mouse:

- » Use the mouse wheel to zoom in and out.
- » Click and hold the mouse wheel while moving the mouse to pan.
- » Click and hold the left mouse button while moving the mouse to orbit around the current center point of the image.

9.2.4. Setting Sensor position and orientation

The coordinate system displayed in the visualizer window is centred around the point (0,0,0).



Since the sensor can be installed in any orientation, its relative position needs to be configured in relation to the origin of the coordinate system.

sensor positioning:

pos x:	<input style="width: 50px;" type="text" value="0.5"/>	pos y:	<input style="width: 50px;" type="text" value="0.7"/>	pos z:	<input style="width: 50px;" type="text" value="0.8"/>
roll:	<input style="width: 50px;" type="text" value="0.2"/>	pitch:	<input style="width: 50px;" type="text" value="0.2"/>	yaw:	<input style="width: 50px;" type="text" value="0.2"/>

$$\text{Radians} = (\text{Angle in degrees}) * \left(\frac{\pi}{180^\circ}\right)$$

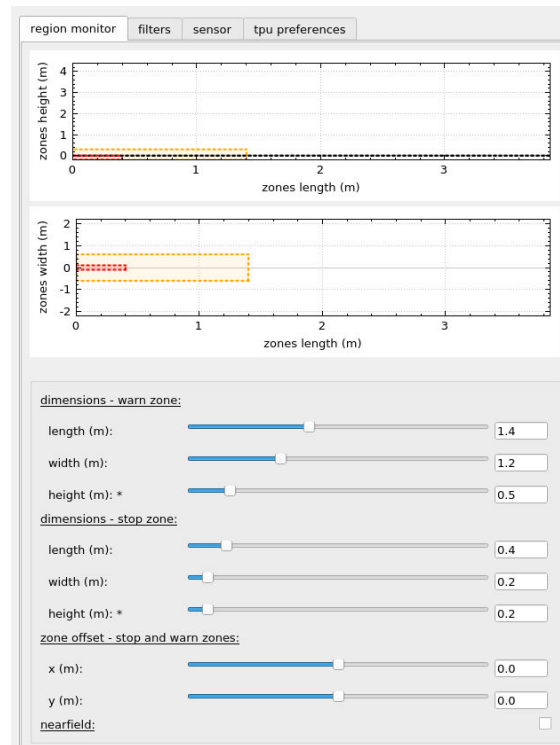
To configure the position and orientation of the sensor, enter its position coordinates x, y and z in relation to ground level. If the sensor has been mounted at an angle, enter its position angle pitch, roll and yaw (in radians) into the corresponding text boxes. Observe the dynamic update of the sensor position in the visualization to match the virtual positioning with the actual installation.

9.2.5. Region Monitor Configuration

The region monitor consists of three zones which are monitored for violations (presence of an object): a “warning zone”, a “stopping zone” and a “near-field zone”. If an object is detected inside one of these zones, the violated zone’s graphical representations colour turns from green to red in the visualizer window. This warn level change can be passed on to an external device by the means of I/O commands and/or Ethernet-Communication.

Warning- and Stopping Zones

The stopping- and warning zones are two rectangular volumes within the sensor Field-of-View intended for warning (e.g., to slow down an AGV) when approaching a potential obstacle and to request an emergency stop (e.g., to avoid an imminent collision).



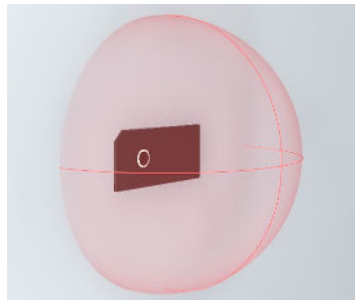
To change the dimensions of either zone, input the desired values for width, height and length into the corresponding text boxes or use the sliders. Changes are automatically stored and applied to the visualization window and TPU configuration.

NOTICE
Further Information


For further information about the parameters of the Region Monitor, their functionality and optimisation, please refer to the Toposens Application Manual.

Near-field zone

In the region directly adjacent to the sensor (up to 0.25 m), the presence of an object is output as a binary signal, 3D positional data is not available for objects located within this region. If an object is detected inside the near-field zone, the graphical representations colour of this zone will turn from green to red. This state change can be passed on to an external device.


NOTICE
Further Information


For further information about the near-field functionality, please refer to the Toposens Application Manual.

9.2.1. Filters configuration

The "filters" tab, located on the right side of the window, configures post-processing filters applied to the sensor's point cloud data. It includes six blocks:

- **filter handler:** Toggles all filters simultaneously. Individual filters can be deactivated even when the filter handler is activated.
- **multipath filter:** For special applications only (disabled by default)
- **dbscan filter:** Groups detections from sequential measurements into aggregated clusters based on proximity.
- **intensity filter:** Removes detections below a minimum intensity threshold, adjustable separately for regions below and above the "*z_boundary*".
- **window filter:** Excludes detections outside a user definable cubic 3D volume.
- **confidence filter:** Removes detections below a minimum confidence threshold.

The TPU is provided with a default filter configuration which has been optimized to work well in most situations. To further optimize performance in a specific application, filter parameters can be either set manually or automatically from a selection of presets.

- **Manual configuration:** input the desired values into the corresponding text boxes or use the sliders.
- **Preset configuration:** Select a suitable preset from the drop-down box located below the visualizer window. Presets are grouped based on the mounting height of the sensor above ground. Select the preset which approximates the actual installation height of your sensor the closest. After selecting a preset, the filter parameters will be automatically applied.

Any changes made to parameters will be applied directly and saved automatically. It is possible to save these values into a *"custom"* preset by clicking the *"save custom preset"* button. This preset *"custom"* can later be selected in the *"available presets"* drop-down box.

NOTICE
Further Information


For further information about the filter parameters, their functionality and optimisation, please refer to the Toposens Application Manual.

9.2.2. Sensor Configuration

The *"sensor"* tab contains eight parameters for configuring internal functions and operating modes of the sensor. The default parameters should not be changed, except for the option *"use_mmm"*, which should be set according to the deployment situation.

NOTICE
Further Information


For further information about the sensor parameters, their functionality and optimization, please refer to the Toposens Application Manual.

Configuration of the Medium Monitoring Mode (MMM)

To avoid interference between systems, the "Medium Monitoring Mode" (short "MMM") dynamically allocates time slots to Toposens ECHO ONE® systems for as long as at least a second system is detected in the vicinity. This mode allows multiple systems to operate in the same deployment area without interference.

The setting *"use_mmm"* should be enabled for multi system- and should be turned off for single system deployments.

NOTICE**Further Information**

For further information about the MMM functionality, please refer to the Toposens Application Manual.




























NOTICE**Functional Test and tuning**

Please note that a functional test and proper system and filter configuration are necessary before using the product for its intended purpose.

9.3. Interfacing with external devices

9.3.1. External Interface Overview

Two interfaces are available to connect the TPU to external devices - The “ETH1” Ethernet port or binary voltage input and output (I/O-Connection). The TPU supports UDP communication with external devices such as ECUs, PLCs, or standard PCs in accordance with the IEEE 802.3 standard for Ethernet interfaces.

Feature	Description	I/O Interface	Ethernet Interface
Point Cloud and Metadata 	X, Y & Z coordinates referenced to the coordinate origin set in the TPU, including intensity and confidence metadata output		
Zone Violation Signals 	Output of three “warn levels”, depending on the occupancy of the region monitor zones		
Discrete Zone Length Variation 	Switch zone length between two predefined values		
Continuously adjustable Zone Dimensions 	Change zone width, length and height dynamically		
Discrete Zone Shape Deflection 	Deflect zone geometry to a predefined arc on either side		
Region Monitor Enable / Disable 	Enable or disable the region monitor functionality		
System Active/Standby 	Set the system to active or standby mode		
Filter Settings 	Dynamically change filter settings		
Sensor Settings 	Dynamically change sensor settings		

NOTICE
Further Information


Refer to the Installation Section for information on physically connecting devices and signals to the TPU.

9.3.2. Configuration of I/O Interface

The TPU offers the option to output zone violation as binary voltage signals and accepts binary voltage signals to trigger functions like zone dimension and shape changes from and to an external device. To activate this functionality, check the box "signaling over gpio" checkbox in the Configuration interface section "ip parameters":



The Checkbox "Invert gpio output" inverts the output voltage level according to the following table:

State	"invert gpio output" disabled	"invert gpio output" enabled
	Output voltage:	Output voltage:
Output is active	+V_IO (HIGH)	IO_GND (LOW)
Output is not active	IO_GND (LOW)	+V_IO (HIGH)

The Checkbox "Ignore gpio output" disables external control via the digital inputs.

NOTICE

Electrical connections



Refer to the Installation section of this manual when connecting or disconnecting signals to and from the TPU.

The following Output signals are available on the multifunction connector terminals:

Digital Outputs			Function Description
OUT 1	OUT 2	OUT 3	
1	0	0	Stop Zone violated
0	1	0	Warn Zone violated
0	0	1	No Zones violated
1	1	0	Stop and Warn Zone violated

"1" indicates an active output.

....."0" indicates an inactive output.

The TPU accepts binary voltage inputs on the multifunction connector terminals to control the following functions:

Digital Inputs				Function Description
IN 1	IN 3	IN 2	IN 4	
1	1	0	0	Drive forward: Zone dimensions are applied as configured
1	1	1	0	Drive forward fast: Warning- and stopping zone length is increased
0	1	0	0	Turn right: Warning- and stopping zones are curved to the right
1	0	0	0	Turn left: Warning- and stopping zones are curved to the left
0	0	0	0	Turn off Region Monitor: The region monitor function is disabled
1	1	1	1	Standby Mode: Region monitor is disabled; sensor is put in standby mode
Other combinations				No Change / Don't Care

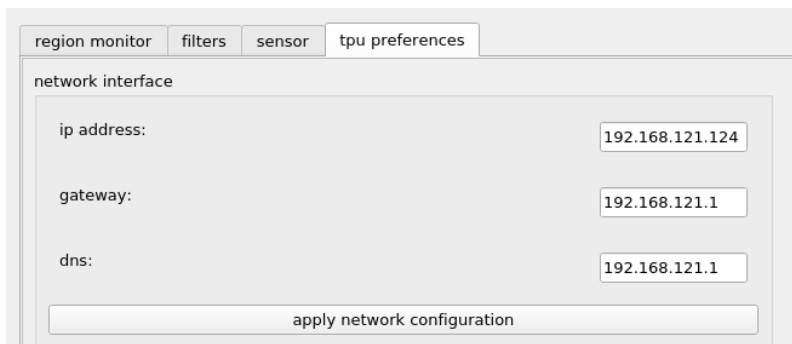
"1" indicates the presence of a voltage >8 V on an input.

"0" indicates no connection, connection to IO_GND or presence of a voltage <<8 V on an input.

Effects of inputs to the TPU via the binary voltage signals are instantly displayed in the visualization window.

9.3.3. Configuration of the ETH1 Interface

The ETH1-interface can be configured in the "tpu preferences"-tab, located on the right side of the screen:



1. Enter the desired IPv4 addresses in the corresponding textboxes "*ip address*", "*gateway*" and "*dns*".
2. Click "*apply network configuration*" to persistently save and apply these parameters for the ETH1 interface. The configuration interface can now also be accessed via the ETH1 interface.

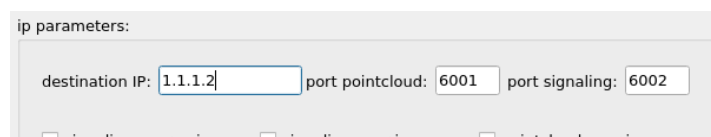
NOTICE | IP address conflict



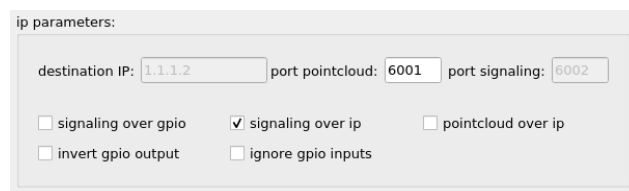
Set the IP address of the ETH1 Interface to be dissimilar to other devices already present on the same network to avoid malfunction.

9.3.4. Configuration of UDP Connection

The Toposens ECHO ONE® system facilitates access to point cloud data, zone violation signals, and configuration settings through the UDP interface. Configure the UDP connection by setting the target device IP in the "*ip parameters*" section, located on the left side of the screen. This setting specifies the IPv4 address and UDP port numbers for the remote UDP socket connection with the TPU. Ensure the address range aligns with the ETH1 interface configuration's subnet. The target device must maintain UDP sockets that accepts incoming connections on the ports defined in the "*port pointcloud*" and "*port signaling*" textboxes.



To enable the "*Zone violation signaling*"-feature, check the checkbox "*signaling over ip*".



To enable the "*Pointcloud over IP*"-feature, check the checkbox "*pointcloud over ip*".

9.3.5. Target device configuration (UDP)

To use the data provided by the TPU on Debian-based Linux systems, install the "*TPU Gateway Client Library*". Effects of commands sent to the TPU via UDP are directly applied in the configuration interface.

NOTICE

Dependencies for implementation



To implement UDP communication with the TPU, download and install the "*TPU Gateway Client Library*" (filename: "tpu-gateway-client_x.x.x_focal_xxx64.deb"), included with the firmware pack. This file can be downloaded from the Members Area at [Toposens.com](https://www.toposens.com).

To install the “TPU Gateway Client Library”, follow the steps below:

1. Download the most recent version of the firmware pack associated with the product from the members’ area of our website: [Toposens.com/members](https://toposens.com/members).
2. Extract the firmware pack to a local folder in the target devices filesystem.
 - If the target system uses an ARM based processor, use files named “*xxx_arm64.deb*”.
 - If the target system uses Intel or AMD processors, use files named “*xxx_amd64.deb*”.
3. Open a terminal window.
4. Execute the following command after navigating to the folder the firmware pack was extracted into.

```
sudo apt install ./tpu-gateway-client_XXX.deb
```

Replace “xxx” in the filename with the library version number and suitable processor architecture of the target system. Example: “*tpu-gateway-client_2.0.14_focal_amd64.deb*”.

5. Follow on-screen instructions as prompted.

Data provided by the TPU Gateway Client Library on the target device:

Point cloud information: X, Y & Z Coordinates relative to the coordinate origin of the TPU, including intensity and confidence metadata.

```

Bytes received: 127
Frame index: 178
Near Field Violated: 0
Points in cloud: 5
0 | x: 0.621674 y: -0.002286 z: 0.424572 intensity: 1.737897 confidence: 1.000000
1 | x: 0.326594 y: 0.783135 z: 0.376367 intensity: 0.355082 confidence: 0.691406
2 | x: 1.627788 y: 0.008001 z: 0.474585 intensity: 0.359399 confidence: 1.000000
3 | x: 2.125400 y: -0.891799 z: 0.632770 intensity: 4.000000 confidence: 0.841146
4 | x: 2.546662 y: 0.846719 z: 0.031135 intensity: 1.648214 confidence: 0.867188

Bytes received: 127
Frame index: 179
Near Field Violated: 0
Points in cloud: 5
0 | x: 0.621668 y: -0.002536 z: 0.424645 intensity: 1.740977 confidence: 1.000000
1 | x: 0.330554 y: 0.781554 z: 0.377800 intensity: 0.355056 confidence: 0.697917
2 | x: 1.627771 y: 0.006181 z: 0.471931 intensity: 0.357611 confidence: 1.000000
3 | x: 2.125093 y: -0.892272 z: 0.634113 intensity: 4.000000 confidence: 0.841146
4 | x: 2.546608 y: 0.843698 z: 0.025461 intensity: 1.645417 confidence: 0.841146

Bytes received: 127
Frame index: 180
Near Field Violated: 0
Points in cloud: 5
0 | x: 0.621668 y: -0.002536 z: 0.424645 intensity: 1.740977 confidence: 1.000000
1 | x: 0.330554 y: 0.781554 z: 0.377800 intensity: 0.355056 confidence: 0.697917
2 | x: 1.627771 y: 0.006181 z: 0.471931 intensity: 0.357611 confidence: 1.000000
3 | x: 2.125093 y: -0.892272 z: 0.634113 intensity: 4.000000 confidence: 0.841146
4 | x: 2.546608 y: 0.843698 z: 0.025461 intensity: 1.645417 confidence: 0.841146
    
```

Value	Valid Range	Precision	Description
x	0 - 4.000000	Single point precision float	x component of cartesian coordinate set Unit: Meters
y	-4.000000 - 4.000000	Single point precision float	y component of cartesian coordinate set Unit: Meters
z	-4.000000 - 4.000000	Single point precision float	z component of cartesian coordinate set Unit: Meters
intensity	0 - 4.000000	Single point precision float	Relative echo intensity value 1: Reflectivity of the standard test target (75 mm pole) 4: 100% Reflectivity (retroreflector)
confidence	0 - 1.000000	Single point precision float	Phase integrity based detection quality estimation A higher value indicates higher detection quality
Frame index	0 - 255	uint8	Current measurement index. Rolls over at 255
Points in cloud	0 - 50	uint8	Number of detected points contained in the current frame

NOTICE
Code example available


A code example titled "udp_pointcloud_client" is provided in the Members Area at [Toposens.com](https://www.toposens.com)

Zone Violation Information: Three "Warn Level" states will be indicated:

- "Warn Level 1": Stop zone violation.
- "Warn Level 2": Warn zone violation.
- "Warn Level 3": No zone violated.

```

-----
Status:          STOP
Warn Level:      1
Bytes received:  9
-----Possible warn levels-----
| STOP - 1 | WARN - 2 | FREE - 3 |
-----
Status:          STOP
Warn Level:      1
Bytes received:  9
-----Possible warn levels-----
| STOP - 1 | WARN - 2 | FREE - 3 |
-----
    
```

NOTICE
Code example available


A code example titled "udp_zone_signaling_client" is provided in the Members Area at [Toposens.com](https://toposens.com)

9.3.1. Remote parameter control (UDP)

The TPU supports parameter setting input through the UDP connection using the "*TPU Gateway Client Library*". This functionality does not require additional configuration on the TPU.

Direction of Motion: Alters the shape of zones from rectangular to curved based on the motion direction.

NOTICE
Code example available


A code example titled "udp_set_direction" is provided in the Members Area at [Toposens.com](https://toposens.com)

- **Parameters:** Modify zone dimensions, filter settings, and sensor settings.
- **Velocity:** Adjusts the length of the stop and warn zones in relation to forward velocity.
- **Zone Dimensions:** Alteration of the zone dimensions.

NOTICE
Persistent parameters


Changes made via the "*TPU Gateway Client Library*" are directly applied and saved. These settings persist through TPU reboots.

9.4. Backup and Restore

9.4.1. Exporting Configuration Parameters

Most configuration parameters set on the TPU can be saved to an USB drive. This feature can be used to back-up configuration parameters e.g., before performing an update, or to replicate configuration parameters to different units. To perform a configuration parameter export, follow these steps:

1. Prepare an USB drive with a single partition formatted in the exFAT, FAT32 or ext4 filesystem with at least 32MiB of available storage space. Standard USB Flash drives are preferred as USB HDDs and USB SSDs could exceed the power supply capabilities of the USB 2.0 standard.
2. Insert the USB drive into one of the two specified USB ports on the TPU, adjacent to power and Ethernet connectors.
3. Allow 15 seconds for the TPU to detect the USB drive.
4. Access the TPU's configuration interface.
5. Select the "TPU preferences"-tab in the top right corner of the screen.
6. Click "backup configuration files".
7. After completion, disconnect the USB drive.

NOTICE

Sensor Specific Parameters



"*Sensor id*" and "*sensor positioning*" are not included in the backup as they are unique for each system deployment.

9.4.2. Importing Configuration Parameters

To import TPU configuration parameters from an USB drive, follow these steps:

1. Insert a USB drive with configuration data into the TPU's active USB ports, located next to power and ethernet connectors. Use standard USB Flash drives for compatibility with USB 2.0 power capabilities.
2. Wait 15 seconds for the TPU to detect the USB drive.
3. Access the TPU's configuration interface.
4. Select the "TPU preferences"-tab in the top right corner of the screen.
5. Click "restore configuration files". Monitor the process and details in the log window.
6. After restoration, click "reboot TPU" to apply changes.
7. Remove the USB drive post-reboot.

9.5. Updating Software

NOTICE
Firmware Update


Product firmware updates will be regularly published in the member's area of our website: [Toposens.com/members](https://toposens.com/members). These Updates contain bugfixes, performance improvements and new features. We therefore recommend performing firmware updates on a regular basis.

Before updating the TPU or sensor firmware, make sure of the following conditions are met:

- TPU and sensor are connected to a stable power supply.
- TPU and sensor have a functional connection with each other.
- TPU and sensor firmware version are compatible with each other. This can be ensured by downloading firmware packs from the member's area of our website: [Toposens.com/members](https://toposens.com/members).
- The configuration parameters have been exported to retain the option to restore them later.

The following Sensor and TPU firmware combinations are compatible:

Sensor Firmware	TPU Firmware
1.x.x*	1.x.x*
2.0.6	2.0.8
2.4.0	2.2.3

*Contact Technical Support for legacy Software Update instructions

Firmware updates need to be performed in a specific order:

1. Update sensor firmware
2. Update TPU firmware
3. Update target device "*TPU Gateway Client Library*" if it is in use

NOTICE
Firmware Update


It is essential that all components of the product are updated in direct succession to maintain compatibility and ensure optimal performance.

9.5.1. Sensor Firmware Update

To Update the firmware of the sensor, follow these steps:

1. Prepare an USB drive with a single partition formatted in the exFAT, FAT32 or ext4 filesystem with at least 32MiB of available storage space. Standard USB Flash drives are preferred as USB HDDs and USB SSDs could exceed the power supply capabilities of the USB 2.0 standard.
2. Download the most recent version of the firmware pack associated with the product from the member's area of our website: [Toposens.com/members](https://toposens.com/members)
3. Extract the firmware pack to a local folder on the hard drive.
4. Connect the USB drive to an USB port on the PC.
5. Copy the "EchoOne_xxx.bin" to the root directory of the USB drive.
6. Eject and disconnect the USB drive from the PC.
7. Insert the USB drive into the TPU's active USB ports, located next to the power and Ethernet connectors.
8. Wait 15 seconds for the TPU to detect the USB drive.
9. Connect to the configuration interface of the TPU.
10. Select the sensor to be updated from the drop-down box "*available sensors*", located on the left of the screen.
11. Navigate to the "*tpu preferences*" tab in the upper right of the screen and click the "*firmware update: sensor*" button. This will open a dialog window, prompting the user to select a file from the USB drive.
12. Select the firmware file from the drop-down menu and click the "ok" button. During the update process, a pop-up window "*updating sensor firmware*" will be displayed until the process has finished.

9.5.2. TPU Firmware Update

To update the TPU firmware when using the configuration interface, execute the following steps:

1. Prepare an USB drive with a single partition formatted in the exFAT, FAT32 or ext4 filesystem with at least 32MiB of available storage space. Standard USB Flash drives are preferred as USB HDDs and USB SSDs could exceed the power supply capabilities of the USB 2.0 standard.
2. Download the most recent version of the firmware pack associated with the product from the member's area of our website: [Toposens.com/members](https://toposens.com/members).
3. Extract the firmware pack to a local folder on the hard drive.
4. Connect the USB drive to an USB port on the PC.
5. Copy "TPU_update_xxx.tpu" to the root directory of the USB drive.
6. Eject and disconnect the USB drive from the PC.
7. Plug the USB drive into one of the dual USB Ports, located on the same side as the power and ethernet connectors on the TPU.
8. Wait 15 seconds for the TPU to detect the USB drive.
9. Connect to the configuration interface of the TPU.
10. Navigate to the "*tpu preferences*" tab on the upper right side of the screen and click the "*firmware update: tpu*" button. This will open a dialog window, prompting the user to select a file from the USB drive.

11. Select the firmware file from the drop-down menu and click the “ok” button. During the update process, a pop-up window “*updating tpu firmware*” will be displayed until the process has finished. This process may take several minutes.
12. Once the process has finished, click the button “*reboot TPU*” or for the changes to take effect.
13. After rebooting, reconnect to the TPU configuration interface to confirm the currently installed firmware version, which is displayed on the lower left side of the screen.

9.5.1. Target device Library Update

To update the “*TPU Gateway Client Library*” on the target device the TPU is connected to, follow the steps outlined below:

1. Download the most recent version of the firmware pack associated with the product from the member’s area of our website: [Toposens.com/members](https://toposens.com/members).
2. Extract the firmware pack to a local folder in the target devices filesystem.
 - If the target system uses an ARM based processor, use files named “*xxx_arm64.deb*”.
 - If the target system uses Intel or AMD processors, use files named “*xxx_amd64.deb*”.

3. Open a terminal window.
4. Execute the following command:

```
sudo apt remove tpu-gateway-client
```

5. Follow on-screen instructions as prompted.
6. Execute the following command after navigating to the folder the firmware pack was extracted into to reinstall the library and finish the update:

```
sudo apt install ./tpu-gateway-client_xxx.deb
```

Replace “xxx” in the filename with the library version number and suitable processor architecture of the target system. Example: “*tpu-gateway-client_2.0.14_focal_amd64.deb*”.

Follow on-screen instructions as prompted.

10. Troubleshooting

WARNING
Danger due to malfunctions


Sensor malfunctions can lead to dangerous situations.

- » In the event of unidentifiable malfunctions or unresolvable issues, **stop operation and contact technical support**

Situation	Possible cause	Remedy
The sensor is not detected by the TPU and does not show up in the sensor list	No supply voltage available or supply voltage too low	Check power supply and fuses
	Bus topology and/or termination faulty	Check the structure and termination of the Sensor bus
	Firmware is mismatched	Update the firmware by following the process outlined in the "Updating Software" section
The sensor does not respond to commands from the TPU	The sensor cannot be addressed via its ID	Remove the sensor in the TPU configuration and pay attention to the correct ID when reading it
	Firmware is mismatched	Update the firmware by following the process outlined in the "Updating Software" section
Connection to sensor cannot be reestablished after reboot	Use of incorrect/damaged cables or loose connections	Check if the TPU-Sensor connection has been implemented as described in "Electrical Installation" section. Shut down Power supply and check Sensor-TPU wiring, reseal connectors. If custom cables are used, check if these cables meet the requirements outlined in the section "Connector and cable requirements"
	The sensor bus is not terminated properly	Make sure the terminator is correctly connected to the sensor
	Third-party devices are connected to the Sensor bus	Remove Third-party devices from the Sensor bus
Low detection rate or no detections displayed in visualizer window	The sensor is contaminated, or water is trapped in the microphone openings	Check the sensor for occlusion by dirt or water and clean/dry if necessary
	Sensor position is not set correctly	Ensure sensor ID is selected and added in drop-down box of available sensors. Check and correct sensor position settings
	Sensor position has been updated recently	Click " <i>refresh display</i> " below the visualizer window

Situation	Possible cause	Remedy
Low detection rate or no detections displayed in visualizer window	The sensor configuration has been changed to unsuitable values	Temporarily disable all filters by turning the " <i>filter handler</i> " off in the TPU configuration interface to differentiate between a hardware or settings issue. If the detection rate improves, load the " <i>Default Parameters</i> " preset. If the issue is not resolved, consult the " <i>Using the configuration interface</i> " section in this document, application manual and/or contact technical support if issue persists
High false positive rate	Erroneous filter or sensor settings	Load the " <i>Default Parameters</i> " preset to reset settings, load height preset matching the mounting height and enable the " <i>use_mmm</i> " option. If the issue is not resolved, consult the application manual and/or technical support
The data output is unsteady	The TPU-Sensor connection is unstable	Check the sensor connection. Tighten the connection if loose or replace connectors and cables if damaged
	Third party devices or multiple sensors are connected to the sensor bus	Remove other devices from the sensor bus
	The total cable length between TPU and Sensor is greater than 30 meters	Shorten the cable length between TPU and sensor
	MMM has reduced sensor performance to keep system operational in challenging conditions	If the medium is congested, MMM might reduce the sensor performance. This may happen when non-compatible ultrasound devices are operated nearby, many Toposens ECHO ONE® Systems are operated in close proximity or excessive ultrasonic noise disturbs normal operation temporarily. Full performance will be automatically restored when the medium is no longer congested. If the issue is not resolved, consult the application manual and/or technical support
The sensor or third-party devices behave differently than expected	There are other devices connected to the sensor bus	Remove other devices from the Sensor bus
TPU does not start up (LED not lighting up)	TPU has been manually shut down	Press the Power Button or cycle the power supply
	Incorrect / insufficient power supply	Redo Installation process and Commissioning Checklist. Check power supply voltage, polarity and fuses
	Reverse polarity	Disconnect TPU Power Cable and check the polarity of the Barrel Plug (Center Positive)
	Loose connections	Reseat the TPU Power Cable and lock it

Situation	Possible cause	Remedy
	Fuse has tripped	Check wiring for short circuits and replace with correctly rated fuse. If the short circuit is caused by a system component, contact Technical Support
RDP Connection to the TPU cannot be established	Wiring or topology error	Consult “Ethernet connection” section Check and replace Ethernet cable if necessary
	Invalid IP settings	Set PC NIC to a suitable static IP in same Subnet as the TPU Do not use IP 1.1.1.1
	Wrong ethernet port used	Connect the PC to the “ETH2” Port of the TPU
	Incompatible RDP client software	Only use software listed in this manual Update RDP client software
I/O signalling does not work	Wiring error	Check wiring on multifunction connector Check if correct mode is requested by the input signals – To confirm a wiring error, temporarily check “ <i>ignore gpio input</i> ” and monitor visualization window and output signals for changes Check minimum signal voltage levels Power Supply to I/O Section must be sufficient
		Configuration error
UDP signalling does not work	Wiring error	Check the ethernet cable Make sure the “ETH1”-port is used
	Erroneous IP configuration	Check “ETH1”- port configuration in the TPU configuration interface. TPU and target device must be configured in the same subnet, UDP Port numbers must match
	TPU configuration error	Enable “ <i>signaling over ip</i> ” in the TPU configuration interface
	Target Device configuration error	Verify UDP sockets accept connections Update the software by following the process outlined in the “Updating Software” section
Software Update fails or does not finish	Communication error	If the process has not finished after five minutes or fails, disconnect power from the system. Repower the system and verify software version by using the TPU configuration interface. If the software has not been updated correctly, repeat the full process. Contact technical support if the issue is not resolved

11. Technical Support

The support team offers services in both English and German languages. For region specific support, contact your local distributor from whom you have purchased our products.

E-Mail	support@toposens.com
Address	MEYSENS GmbH Wilhelm-Wagenfeld-Straße 24 80807 München

12. Maintenance

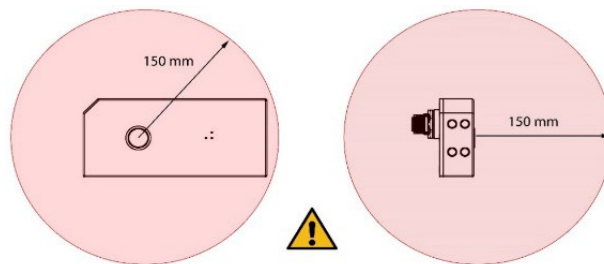
WARNING



Ultrasonic emissions

Ultrasonic emissions may irritate people, animals, and disrupt non-compatible devices.

- » Possible interference with other ultrasonic devices (e.g., alarm systems) may occur.
- » Non-compatible ultrasonic devices can trigger or disrupt this system, affecting detection reliability.
- » Adhere to local ultrasonic exposure limits.
- » Do not aim the sensor at people or animals at close range.
- » Maintain a minimum 0.15 m / 6 in. distance from the ear to the sensor.
- » Do not touch the transducer or microphone array during operation.
- » Do not operate the system near non-compatible ultrasonic devices.



DANGER



Electrocution Risk

Electrical voltage can cause serious or fatal injuries.

- » The housing must not be opened.
- » Disconnect power before working on the product.
- » The product must not be modified.
- » All components must be protected against damage.
- » If housing, cables, seals, or accessories are damaged, disconnect the product and only resume operation after repairs and inspection by the manufacturer.

**AUTOMATIC
STARTUP**

Risk of automatic Startup

When mounting the sensor system on a machine, ensure the machine is in a safe condition for work and to prevent unintentional restarts. Follow the machine's operating instructions and adhere to occupational health and safety rules as well as electrical safety regulations.

WARNING

Unsuitable Maintenance Measures

The sensor and TPU do not have user-serviceable internal components. Only qualified personnel should perform external maintenance tasks such as visual and functional inspections and cleaning, as detailed below.

12.1. Maintenance Procedures

- » Regularly inspect the sensor housing, microphone openings, cables, and connectors. This should be done during installation and every 6 months thereafter.
- » For harsh environments (e.g., heavy pollution, dust), reduce the inspection interval.
- » If acoustic system parts are covered or damaged, data output may be affected or result in loss of function.
- » Clean dust or dirt from microphone openings as instructed in this section to ensure proper sensor functionality.
- » Note that dents or deep scratches on the transducer may impair performance. The transducer is non-replaceable. Contact Technical support.
- » In case of defective connectors, housing cracks or damaged cables, immediately cease device operation. Contact Technical support.

Device	Activity	Interval	Implementation by
Sensor	Cleaning the microphone openings	As needed	Trained staff
Sensor	Cleaning the transducer surface	As needed	Trained staff
TPU	Visual inspection of the enclosure	Every 6 Months	Trained personnel
	Visual inspection of connectors and cables	Every 6 Months	Trained personnel
	Visual inspection of mounting	Every 6 Months	Trained personnel
	Cleaning	Every 6 Months	Trained personnel
General	Visual inspection of the sensor for mechanical stability	Every 6 months	Trained staff
	Visual inspection of the microphone openings	Every 6 months	Trained staff
	Visual inspection of the transducer surface	Every 6 months	Trained staff
	Visual inspection of the wiring for damage, loose connections, and water ingress.	Every 6 months	Trained staff

**FOR
ATTENTION**

Connectors damaged by corrosion

The connectors on the sensor will achieve an ingress protection rating of IP67 if they are used with suitable complementary connectors and are correctly tightened. Insufficiently tightened and/or unsuitable connectors will corrode in a humid environment.

- » Sensors with damaged connectors must be immediately removed from service.
- » The sensor and other system components are not designed for permanent outdoor installation or use in permanently wet environments.
- » Replace full cable/connector assemblies with listed parts that fulfil the required specifications.
- » Connectors on the sensor are not user replaceable.

**FOR
ATTENTION**
Loose, damaged or discoloured cables

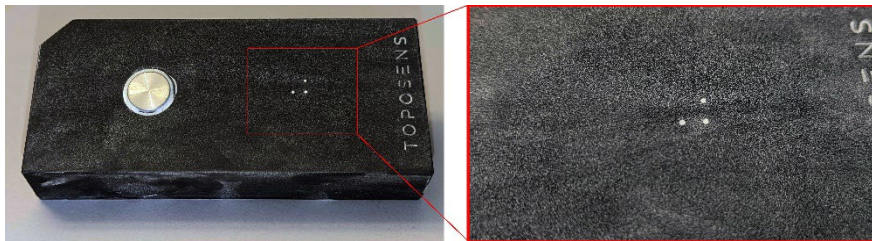

Damaged or worn cable insulation can lead to malfunction or damage to the product components and the machine or vehicle the product has been integrated into.

- » Damaged cables and accessories must be taken out of service immediately.
- » Replace defective cables only with listed parts that fulfil the specification.
- » When replacing cables or components, make sure the power supply and the machine or vehicle are turned off completely.

**FOR
ATTENTION**
Contaminated or damaged transducer or microphones


- » Scratches or dents to the transducer will reduce sensor performance.
- » Damage to the microphones will lead to unreliable operation or product failure.
- » If the acoustic elements are contaminated by dust or dirt, perform the cleaning procedure, as outlined in this manual.

12.2. Sensor Cleaning procedure



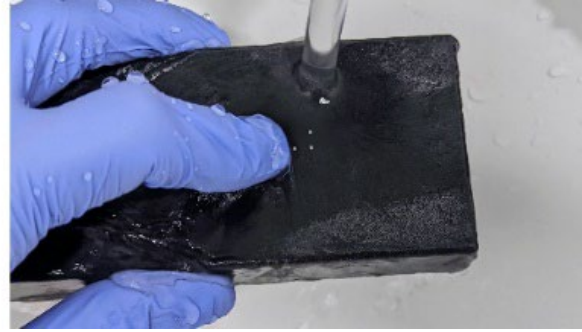
- Sensor cleaning can be carried out in the installed state if the power supply and the machine or vehicle, in which the product is integrated, have been completely shut off.
- Clean the sensor with water.
- Use soft material (e.g., a lint-free cloth) to remove dirt from the sensor.
- Use compressed air at low pressure (max. 4 bar/60 psi at 20 cm distance) to eject debris from the microphone openings.

**FOR
ATTENTION**
Sensor damage due to incorrect cleaning

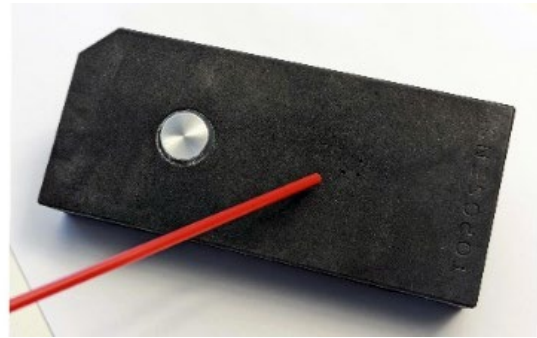
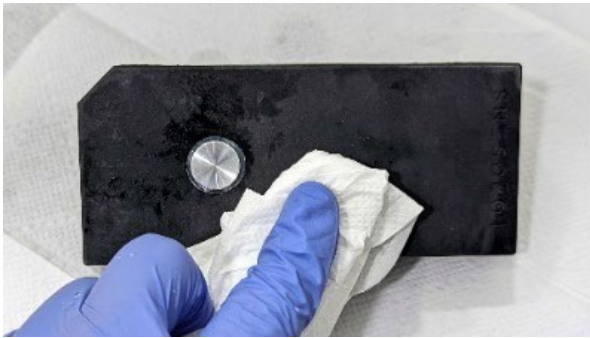

Aggressive chemicals, sharp objects or abrasive cleaning agents can damage the sensor or its components.

- » Do not use aggressive chemicals.
- » Do not use sharp objects to clean the microphone openings.
- » Do not use abrasive cleaning agents, cloths or brushes to clean the sensor.
- » Do not exceed recommended compressed air pressure and application distance.

Using a soft, lint-free cleaning cloth or gloved finger, loosen dirt trapped in the microphone openings by making circular motions over the microphone openings. Lightly tapping the enclosure around the microphone openings can help to loosen additional dirt. Do not use corrosive or solvent-based cleaners or alcohol.



After cleaning the microphone openings, dry the sensor with a paper towel. If water residue is still present in the microphone openings after this step, use low pressure compressed air to eject remaining droplets. Do not shake the sensor harshly to remove liquid residue.



12.3. Inspection of mounting

It is advisable to regularly check the mounting of the sensor and TPU, especially if these components are subjected to vibration. Pay close attention to all screw connections and reapply vibration mitigation measures and retighten if needed. Check electrical connections and retighten if necessary.

**FOR
ATTENTION**



Insufficient vibration mitigation

Unreliable operation due to a loose or damaged product component or accessory can result in damage to the product and the machine or vehicle.

- » All components must be installed securely.
- » If product components are mounted in an environment where vibration is expected, check for the presence and effectiveness of vibration mitigation measures like threadlocking compound, locking washers and nuts as well as rubber dampers.

13. Decommissioning

DANGER



Electrical voltage

Electrical voltage can cause serious or fatal injuries as well as property damage.

- » Work on electrical installations may only be carried out by qualified personnel.
- » Before making or disconnecting electrical connections, the power supply must be completely shut down. Residual charges must be dissipated.
- » Observe the national and local regulations.
- » Adhere to the safety requirements for working on electrical installations.

13.1. Powering down the System

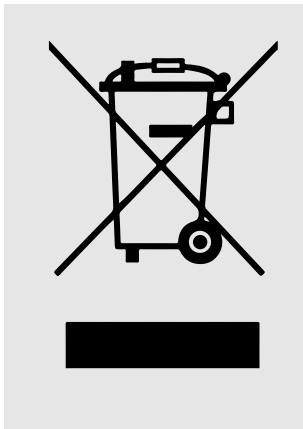
If you wish to install, maintain, or remove the Toposens ECHO ONE® system, the machine, or the vehicle in which the system is or has been integrated must be placed in a condition in accordance with the operating instructions that ensures no dangerous conditions can occur. Switch off the power supply before connections are made or released. If the product has been connected to other devices, I/O signal lines and other connections may still carry voltage after the power supply has been disconnected.

13.2. Disposal

The applicable national regulations for electronic components must be observed during disposal.

This Toposens product complies with the requirements of the EU Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment ("RoHS recast" or "RoHS 2").

The symbol on the device or on the packaging indicates that the device may harm the environment at the end of its life cycle. The device must not be disposed of in unsorted municipal waste. Disposal must be carried out properly in accordance with the locally applicable regulations. The device must be returned to the appropriate dealer or disposed of at a local recycling company. In case of doubt, contact the local waste disposal authorities.



WEEE-Reg.-Nr. DE 39801091



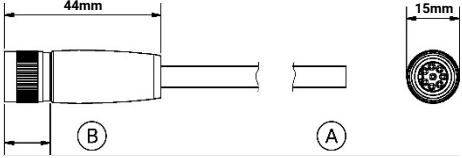
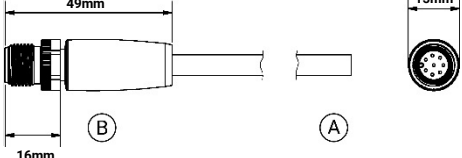
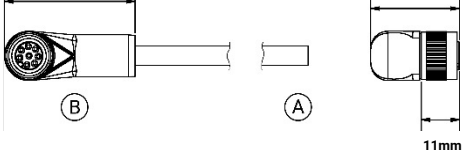

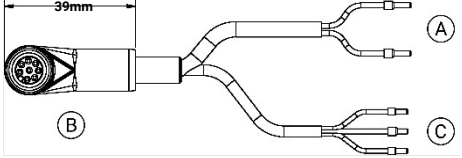
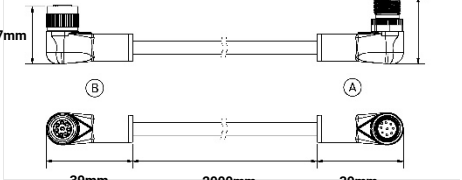
**FOR
ATTENTION**

Danger to the environment due to improper disposal



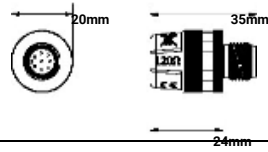
Improper disposal of the device may cause environmental damage.
Observe the valid environmental regulations.

14. Accessories list

Article description	Image
<p>M12FS Input side sensor connection cable 2m cable length 6mm cable outer diameter Conductor cross section 0.22 mm² (AWG24) Shielded version End A: Open End B: Straight, M12A cable socket</p>	
<p>M12MS Output side sensor connection cable 2m cable length 6mm cable outer diameter Conductor cross section 0.22 mm² (AWG24) Shielded version End A: Open End B: Straight, M12A cable connector</p>	
<p>M12FA Input side sensor connection cable 2m cable length 6mm cable outer diameter Conductor cross section 0.22 mm² (AWG24) Shielded version End A: Open End B: Angled, M12A cable socket</p>	
<p>M12MA Output side sensor connection cable 2m cable length 6mm cable outer diameter Conductor cross section 0.22 mm² (AWG24) Shielded version End A: Open End B: Angled, M12A cable connector</p>	
<p>M12BO Input side sensor port breakout cable 2m cable length Conductor cross section power supply 2x 0.5 mm² (AWG21) Conductor cross-section data 2x 0.25 mm² (AWG24) Shielded version End A: Ferrules 2x 0.25 mm² End B: Angled, M12A cable socket End C: Ferrules 2x 0.25 mm² & 1x 0.5 mm²</p>	
<p>M12EX2 Sensor patch cable 2m cable length 6mm cable outer diameter Shielded version End A: M12A cable plug angled End B: M12A cable socket angled Conductor cross section 8x0.22 mm² (AWG24)</p>	

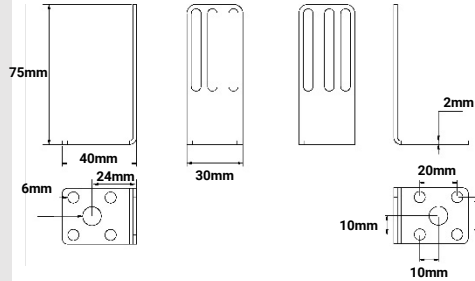
M12MT

120 Ohm Sensor bus Terminator
M12A connector
Directly attachable to the sensor
IP67



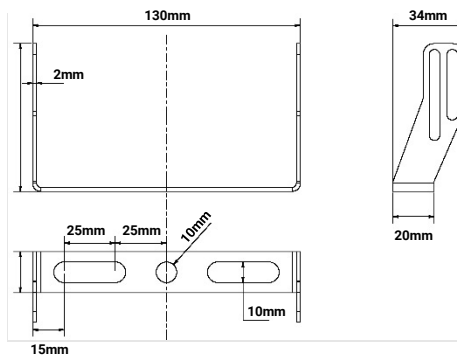
EOBRL

2x L-brackets for through-hole and surface mounting
Coated steel
Color: RAL 9005 Matt



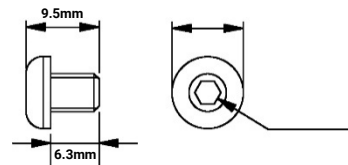
EOBRC

C-bracket for rotatable surface mounting
Coated steel
Color: RAL 9005 Matt



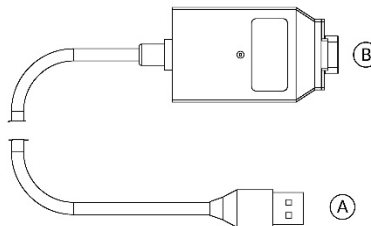
EOSCW

Screw set 8x M5x6
Hexagon socket head bolt
Black passivated steel
Strength class 10.9
Hex Button Head



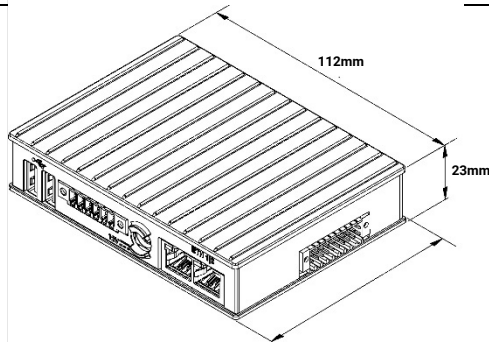
CANUSB

USB-CAN Adapter
End A: USB-A connector
End B: D-SUB 9 connector
Assignment according to CIA 303-1



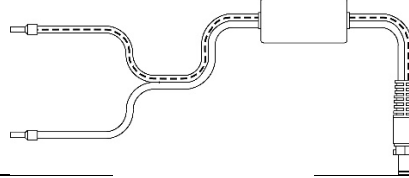
EOTPU

Toposens Processing Unit (TPU)
4x digital inputs and outputs (24V)
1x Ethernet Interface 10/100 (RJ45)
1x Ethernet Interface 10/100/1000 (RJ45)
3x USB-A Interface
RS485 & RS232
Versatile mounting options



EOTPUDCY
Lockable Power Cable for TPU

Cable length: 1.5m
 End A: 5.5mm custom barrel plug connector
 End B: Tinned wire, 1.31 mm² (AWG16)


EOTPUETH
CAT 5e Ethernet Cable

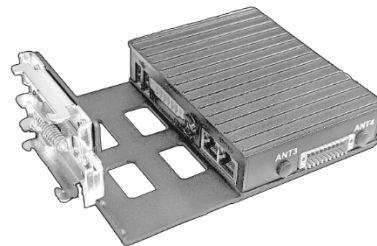
Cable length 0.5m
 End A: RJ45 connector
 End B: RJ45 connector


EOTPUDIN
DIN rail adapter for flat mounting of the TPU

Spring pressure system
 Space requirement with TPU: 5TE


EOTPUSDIN
Top-hat rail adapter for side mounting of the TPU

Spring pressure system
 Space requirement with TPU: 3TE



For customized connection cables and other requests, please contact our sales department for a quote:

sales@toposens.com

14.1. Replacement parts

E-Mail	sales@toposens.com
Address	MEYSENS GmbH Wilhelm-Wagenfeld-Straße 24 80807 München

15. Conformity & further information

To facilitate integration, the EU declaration of conformity and further documentation, test reports and certificates can be provided on request. To request additional information, contact the Toposens Sales department.

NOTICE

Online resources

Further documentation on this device can be found on the online product page at: toposens.com/members

- » Model-specific online data sheets with technical data, dimensional drawings, templates, and specification diagrams.
- » 3D CAD dimensional models in various formats
- » Additional resources related to the devices described herein
- » Resources related to accessories

Contact and additional documents
Software and application packages
toposens.com/members
Technical support
support@toposens.com
Sales department
sales@toposens.com