TOPOSENS

Toposens Processing Unit

Advanced 3D Collision Avoidance

Instruction Manual 1.0 | January 2023

For Firmware version 1.8.X

Described Product

Toposens Processing Unit

Hardware Version 1.0

Manufacturer

Toposens GmbH

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Legal Notice

Original Document

This document is an original document of Toposens GmbH.

CONTENT

1 ABOUT THIS DOCUMENT

1.1 Purpose of this Document

This instruction manual contains information on the installation process, setup and the safe use of the Toposens Processing Unit in combination with the ECHO ONE® sensors by Toposens GmbH. This document will aid you in using the Toposens Processing Unit 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.

This instruction manual is intended exclusively for use by qualified personnel, in particular trained specialists.

NOTICE

Read this instruction manual carefully to familiarize yourself with the device 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.

1.2 Target Group

This instruction manual is intended for:

- Professionals who integrate a Toposens Processing Unit in conjunction with a single or multiple ECHO ONE ultrasonic sensor(s) into a machine or vehicle.
- Professionals who perform initial commissioning, operation, setup, testing and maintenance of the Toposens Processing Unit.
- Professionals, that perform maintenance and checks on the machine or vehicle, which has been equipped with a Toposens Processing Unit.
- Planners, developers and operators of machines and vehicles.
- Personnel who have been appointed with transporting, storing or disposing of the Toposens Processing Unit.

This instruction manual does not contain any information on the operation of the machine or vehicle on which the device has been integrated into. Corresponding information can be found in the instruction manual of the respective machine or vehicle. The applicable health, safety and legal regulations must be observed when operating devices, machines, and vehicles. Using the Toposens Processing Unit requires additional technical skills which are not covered by this document.

1.3 Scope of Information

This instruction manual contains the following information:

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

1.4 Explanation of Symbols

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

⚠DANGER

DANGER

… indicates a dangerous situation that will result in death or serious injury if not avoided.

⚠WARNING

WARNING

… indicates a dangerous situation which, if not avoided, could result in death or serious injury.

⚠ATTENTION

ATTENTION

… indicates a dangerous situation which, if not avoided, may result in minor or moderate injury.

FOR ATTENTION

FOR ATTENTION

… indicates a potentially dangerous situation that may result in property damage if not avoided.

"FOR ATTENTION" is used to draw attention to practices that are unrelated to bodily injury.

NOTICE

… highlights tips and recommendations as well as information for efficient and smooth operation.

For better readability, the following chapters will refer to the Toposens Processing Unit as “TPU”.

1.5 Symbols on the device

FOR ATTENTION

Product markings

The product label attached to the device must not be removed

Symbol	Description
	Complies with EU regulations
	FCC conformity mark
	Read Manual before installation, use or maintenance

	This device complies with EU directive 2011/65/EU
	When disposing of electronic equipment, observe local and national regulations
S/N: **4AA0001**-V1.0-A-XX	Serial Number of the Device
S/N: 4AA0001-**V1.0**-A-XX	Hardware Version
S/N: 4AA0001-V1.0-A-**XX**	Interface Options

2 SAFETY INFORMATION

2.1 Qualified Personnel

⚠WARNING **Risk of injury due to inadequate training/education**

Improper handling of this device can result in significant bodily injury and property damage.

» All work must be carried out by personnel with appropriate qualifications.

The following qualifications are required to perform work on the device:

- **Instructed personnel** that have been briefed by the operator on their tasks and potential hazards due to improper procedures.
- **Qualified personnel** that 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
Assembly, Maintenance	• Basic practical-technical training/education. • Knowledge of work safety regulations
Electric Installation, Device Replacement	• Practical electrical training/education • Knowledge of current safety regulations • Knowledge of how to operate and control equipment for the specific application
Start-Up and Configuration	• Basic knowledge of the operating system used • Basic knowledge of the structure and setup of the described connections and interfaces • Basic knowledge of data transmission

Activities	Qualifications
Operation of the device for the respective application	• Knowledge of the operation and control of the devices for the respective application • Knowledge of the software and hardware environment for the respective application

2.2 Intended Use

The Toposens Processing Unit (TPU) is a dedicated control unit for the Toposens ECHO ONE 3D ultrasonic sensor and is to be used in an object collision avoidance application. The TPU is part of the ECHO ONE System, which consists of one or more* ECHO ONE 3D ultrasonic sensors and a singular TPU, which synchronizes the sensors connected to its dedicated CAN-Bus. Filtered point cloud data is available via the Ethernet Port of the TPU, Digital Inputs can be used to modify parameters during operation, Digital Outputs can be triggered by violations of user-defined zones.

The TPU is intended to be installed, operated and serviced by qualified personnel only. It is a Class A product that is certified for industrial use only. The TPU, its accessories and software components are provided "as is". The TPU is not subject to the provisions of the Machinery Directive 2006/42/EC and in particular ISO 13849-1:2015. For this reason, the TPU must not be used for safety functions of any kind.

Typical applications are:

The integration into machines as a controller for the ECHO ONE System. The ECHO ONE System can be used for collision avoidance on automated guided vehicles (AGVs) or for approaching objects, such as pallets, in an industrial environment. Due to the flexible point cloud data output, the system can also be used for customer developed, non-safety applications.

Toposens GmbH assumes no liability for loss or damage resulting directly or indirectly from the use of the TPU.

The TPU and the ECHO ONE Sensor must not be used as the only sensor system for collision avoidance, if the vehicle is operated outside of cordoned off areas which can be entered by non-qualified personnel. If the

TPU is used outside of its specification all claims against the Toposens GmbH expire.

2.3 Improper Use

All uses deviating from the "Intended use" are considered improper use. Modifications to the device or the software are considered improper use. In particular, use of the device is not permitted in the following cases:

- Outside the technical specifications and other areas of application
- As a safety component in accordance with the relevant applicable machine safety standards
- As a safety component for occupational safety
- In potentially explosive atmospheres
- In corrosive environments
- Under extreme environmental conditions

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

⚠WARNING **Danger due to improper use**

Any kind of improper use can lead to dangerous situations.

» The device may only be operated in accordance with its intended use.
» All information contained in this instruction manual must be strictly observed.
» If the device is mechanically damaged or defective, it must be removed from operation immediately.

2.4 Disclaimer

This instruction manual has been prepared based on the relevant standards and regulations, the latest technical developments and our knowledge and experience. The manufacturer accepts no liability for damage caused by the following:

- Non-compliance with the product documentation (e.g. the instruction manual)
- Incorrect or improper use
- Use of untrained or unqualified personnel
- Modifications to the hardware or software
- Damages resulting from excessive mechanical stresses
- Disregarding installation requirements
- Use of unauthorized spare parts, consumables, and accessories

Toposens GmbH cannot be held liable for any direct or indirect damages or losses that may arise from the use of the product.

The safety and conformity of the machine or vehicle in which this product is integrated is the responsibility of the system installer and/or operator.

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.

2.5 Modifications and Conversions

⚠WARNING

Danger due to changes to the device or software

Changes and modifications to the device or to the Toposens TPU software can lead to unforeseeable dangers or damage.

Any warranty claims against Toposens GmbH shall become invalid if the device or the Toposens software are used for purposes other than those for which they are intended or if they are modified. This applies in particular to the opening of the housing, also within the scope of assembly and electrical installation.

2.6 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.

⚠WARNING

Electrocution

Electrical voltage can cause severe or lethal injury.

- The device must not be modified.
- If the device is connected to a power source, the enclosure must be completely closed.
- If the housing of the TPU is damaged, the device must be disconnected from the power supply and may only be put back into operation after repair and inspection by the manufacturer.

⚠WARNING

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.
» The TPU may only be used in conjunction with a dedicated DC voltage source or an isolated battery power supply (rated voltage 8V - 36V) and corresponding overcurrent protection.
» Observe the national and local regulations.
» Observe the safety requirements for working on electrical installations.

⚠WARNING

Risk of bodily injury and property damage from potential equalizing currents.

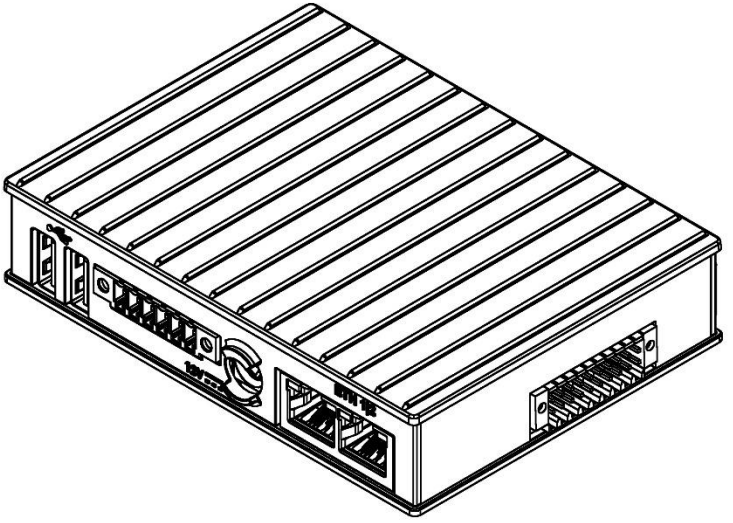
Improper grounding can result in dangerous equipotential bonding currents, which in turn can cause dangerous voltages on metal surfaces, such as connector housings. Electrical voltage can cause serious or fatal injuries.

» Work on electrical equipment may only be carried out by qualified personnel.
» Follow the instructions.
» Ensure correct grounding.
» The potential difference between I/O ground and Power supply ground must be less than 30VDC.
» Equalization currents over the communication and/or I/O lines of the TPU must be prevented.

3 PRODUCT DESCRIPTION

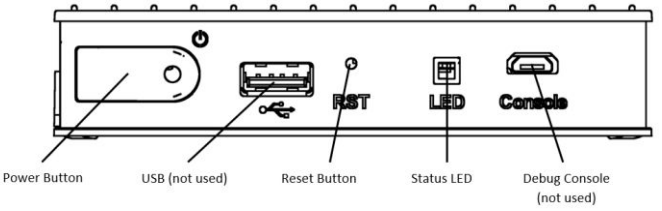
3.1 Product Overview

The Toposens Processing Unit (TPU) is a dedicated control unit for the Toposens ECHO ONE 3D ultrasonic sensor. The TPU controls ECHO ONE Sensors* connected to its dedicated CAN-Bus, incorporates proprietary point cloud processing algorithms, offers a variety of communication interfaces and convenient update, monitoring and setup functions. Point cloud data is processed in real time and can be used either as filtered point cloud data output via the ethernet interface or for detecting zone violations, which are either output over the ethernet interface or as a binary voltage signal over the Multifunction Connector. When used in a collision avoidance application, the dimensions of the warning and stop zone can be freely configured via the graphical user interface (GUI), digital Input signals or via the ethernet interface.

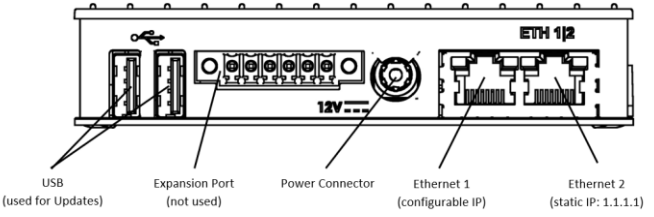


3.2 Device Description

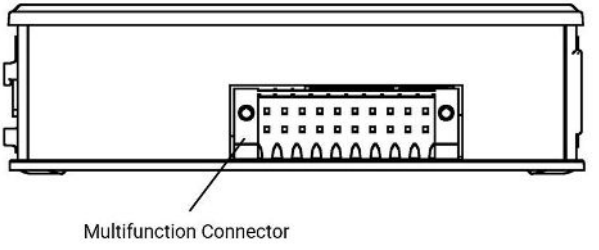
3.2.1 Front Panel



3.2.2 Back Panel



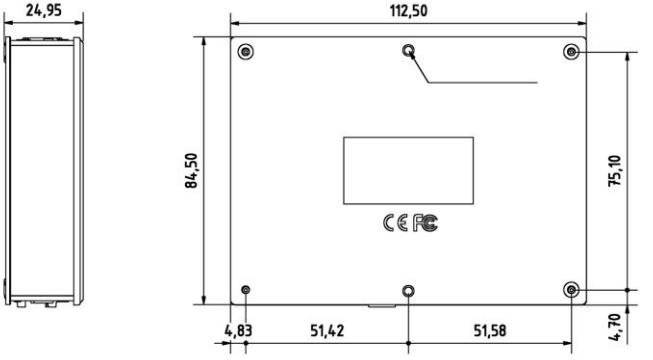
3.2.3 Left Side Panel



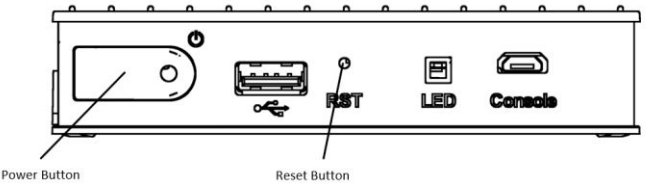
4 SPECIFICATIONS

4.1 Dimensions

All measurements within 0.1mm tolerance



4.2 Device controls



4.3 Connection cable requirements

Toposens recommends only using cables listed in the accessory list available on the website. If other cables are used these minimum requirements need to be observed:

4.3.1 TPU to Sensor connection

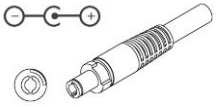
Wire gauge	**≥ 0.25 mm² (AWG 24)**
Number of conductors	**8**
Shielding	**Yes, Cu-Mesh**
Permissible operating voltage	**≥ 30 V DC**
Current carrying capacity (all conductors)	**≥ 2 A**
Flammability	**UL 2556 VW-1**

The used connectors must fulfill the following specifications:

Connector type	**M12 A-coded**
Number of contacts	**8**
Shielding	**Yes, cable shield and connector housing**
Permissible operating voltage	**≥ 30 V DC**
Current carrying capacity per contact	**≥ 2 A**
Termination requirements	**Shrouded ferrules or solid wire, max. 0.5 mm² (AWG20)**

4.3.2 TPU Power Input

The TPU uses a custom lockable barrel connector for its power input. Only use the cable supplied with your TPU for this purpose. Replacement parts are available by contacting support@toposens.com .



4.3.3 TPU IO connection

Connector type	**Kunacon PDFD25420500K**
Number of contacts	**20**
Termination requirements	**Stranded wire with shrouded ferrules, max. 0.34 mm² (AWG22)** **Solid wire, max. 0.5 mm² (AWG20)**

The TPU uses a custom variant of Multifunction connector. Only use the connector supplied with your TPU. Replacement Parts are available by contacting support@toposens.com .

⚠Warning

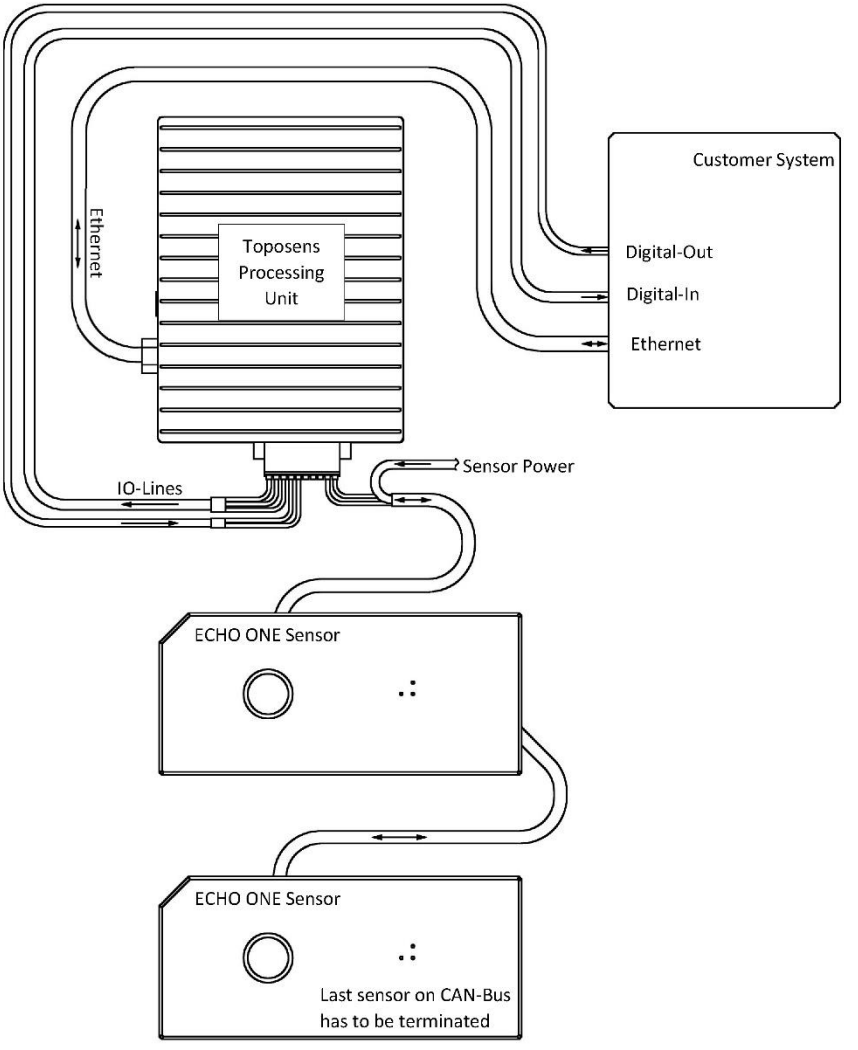
Unsuitable cables or connectors

Using improper cables or connectors may result in malfunction and injury.

Observe the minimum requirements for the cables and connectors. Also check the cable and connector requirements that the machine or system places on the wiring.

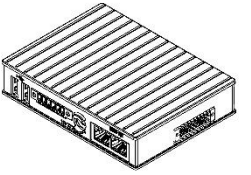
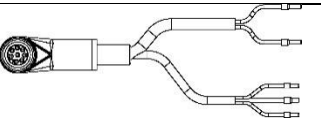
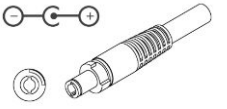
Connectors can reduce the protection class of the sensor.

4.4 Example System configuration



5 STORAGE AND PACKAGING

5.1 Scope of delivery

Item ID	Amount	Description	Image
EOTPU	1x	Toposens Processing Unit (TPU)	
EOTPUPC	1x	20 Pin Terminal Block	
M12BO	1x	Connection Cable to ECHO ONE Sensor	
M12MT	1x	Sensor Bus Terminator for ECHO ONE Sensor	
EOTPUY	1x	Lockable Power Cable for TPU	
-	1x	Safety Information	

5.2 Unpacking

If the packaged product has been recently exposed to large temperature differences, allow the packaged devices to acclimatize so that no condensate can form. Use proper tools when opening the packaging. If a knife is used, ensure that the incision is as shallow as possible to avoid damaging the contents. If the packaging is no longer required for later repackaging, please take it to a recycling point.

5.3 Storage

Store the TPU in a dry environment in its original packaging. The ambient temperature should be kept between 0°C and 40°C. Do not expose the packaging or the TPU to prolonged direct sunlight, aerosols, chemicals, smoke or excessive dust buildup.

5.4 Repacking

If you need to repack your TPU, use the original packaging materials. If they are no longer available, make sure that the TPU is protected against mechanical shock and impact and all accessories have been disconnected and packed separately. Since this manual is an integral part of the product, it must be included.

6 INSTALLATION

6.1 Preparations

While preparing the mounting position, leave the TPU and accessories in its packaging to prevent the ingress of dirt or scratching of the enclosure. It is advisable to route the required cables before mounting the TPU to a surface or attaching it to a DIN-Rail. Make sure that no cables are pinched during the mounting of the TPU, and ventilation is not inhibited by bunched up cables or other devices mounted close to the device. For this installation instructions it is assumed that an ECHO ONE Sensor and its wiring loom has already been installed beforehand.

6.1.1 Required tools and accessories

Either a DIN-Mount Kit or suitable M3 screws for direct mounting

- For DIN-Mount Kit: screwdriver
- EOTPUY Cable for TPU Power Supply (included with TPU)
- Cable Kit for IO connections and IO Power Supply
- Ethernet Cable for Configuration
- Ethernet Cable for Connection to Customer ECU
- Terminator (included with TPU)

6.2 Electrical Installation

⚠WARNING **Electrical Voltage**

The TPU does not feature dust or water ingress protection. Electrical voltage can cause serious or fatal injuries.

» Install the TPU in a place where it is protected from water and dust.

» Make sure that the TPU has sufficient ventilation.

⚠WARNING **Electric Shock**

Electrical voltage can cause severe or even lethal injury.

» Do not operate the device when the enclosure is open.

» The device must not be modified in any way.

» Protect the device from damage.

» Do not operate if the enclosure, connectors or connected cables are damaged. Disconnect the power source and do not put back into operation, until the device has been serviced by the manufacturer.

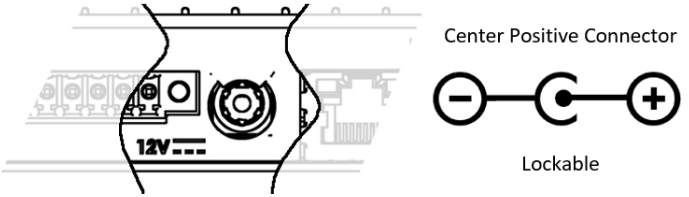
6.2.1 Connection instructions

Observe the following instructions for safe and reliable operation:

- Connect the connection cables in a de-energized state. The supply voltage must not be switched on until the installation has been completed and all cables have been connected to the device and accessories.
- For signal wires: We recommend stranded copper wire with a cross-section of 0.25 mm² (24 AWG).
- For power supply wires: The conductor cross-sections of the supply lines provided by the customer must comply with the applicable standards. A cross section of 0.5mm² (AWG 20) or more is recommended.
- The power supply must be protected with a slow-blow fuse of a nominal value of 2 A, located as close as possible to the power supply.
- All circuits connected to the device must be designed as circuits with safety extra-low voltage (SELV) or functional extra-low voltage with electrically safe isolation (PELV). (SELV = Safety Extra Low Voltage, PELV = Protective Extra Low Voltage).
- Suitable wire mounted connectors with sufficient current carrying capacity and voltage rating must be used.
- The housing of the device must not be opened.
- Before connecting cables or devices to the TPU, check the mechanical connection requirements, pin assignment as well as voltage and polarity.
- The connection cables must not be subjected to tensile stresses, sharp bends beyond 10x their outer diameter or repeated movement beyond specification – Installing a strain relief and using cable management techniques is highly recommended.

6.2.2 Connector Pinouts

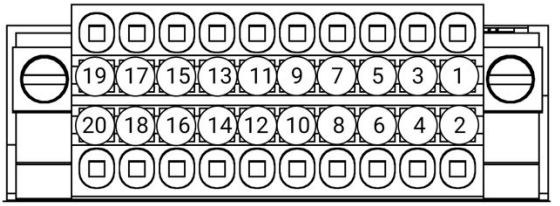
6.2.2.1 Power Input Jack



NOTICE

Rotate the Connector into the locked position after insertion. Do not use force.

6.2.2.2 Multifunction Connector



Pin 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	NC	Do not connect
5	NC	Do not connect
6	NC	Do not connect
7	NC	Do not connect
8	NC	Do not connect
9	NC	Do not connect
10	NC	Do not connect
11	OUT1	Digital Output 1 – Switches to +V_IO when Stop Zone is violated
12	OUT3	Digital Output 3 – Switches to +V_IO when all Zones are free
13	OUT2	Digital Output 2 – Switches to +V_IO when the Warning Zone is violated
14	OUT4	Digital Output 4 – Reserved for future use
15	IN1	Digital Input 1 – Voltage Input >8V causes left turn zone deflection
16	IN3	Digital Input 3 – Voltage Input >8V causes zone expansion / High Speed Mode
17	IN2	Digital Input 2 – Voltage Input >8V causes right turn zone deflection
18	IN4	Digital Input 4 – Reserved for future use
19	+V_IO	+24V Input for I/O Section – Isolated from Power Input
20	IO_GND	GND for I/O Section – Isolated from Power Input

NOTICE

Tighten the locking screws after insertion.

Observe the Specifications in Section 4.3.3

6.2.2.3 Ethernet Connectors

The TPU can be configured, parameterized and updated via a graphical user interface available over the ETH2-Port.

Additionally, the TPU offers some extended functionalities and control options over the ETH1-Port. These are described in the “Configuration and Operation” chapter.

The ETH1-Port is a standard EIA/TIA-568B compliant RJ45 Port with Auto-MDI-X and supports 10/100/1000 Mbps Data rates.

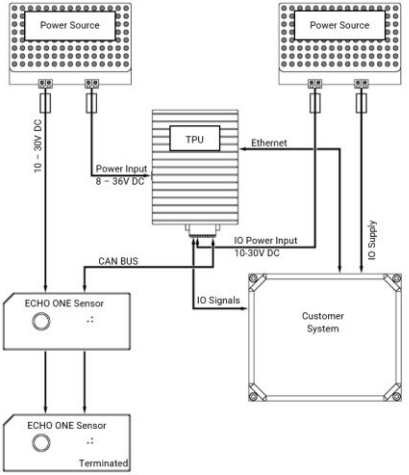
The ETH2-Port is a standard EIA/TIA-568B compliant RJ45 Port with Auto-MDI-X and supports 10/100 Mbps Data rates.

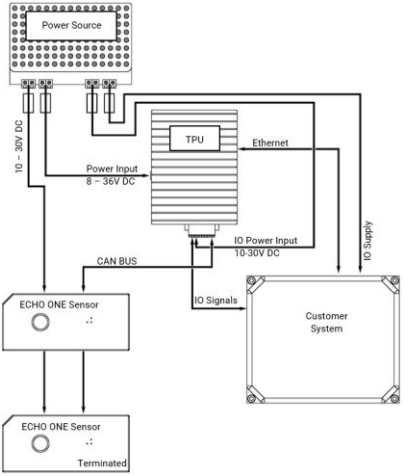
Choose your ethernet cable according to the desired data rate, length, mechanical parameters, resistance to chemicals or UV radiation, temperature range, and system requirements and compliance conditions. It is recommended to use at least a CAT5e cable on ETH2 and CAT6 on ETH1.

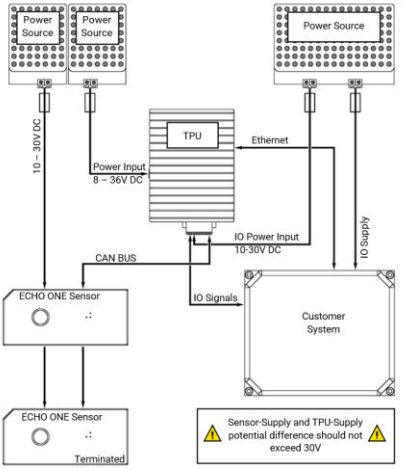
Please note that both ports can only be used with RJ45 or RJ45 compatible connectors.

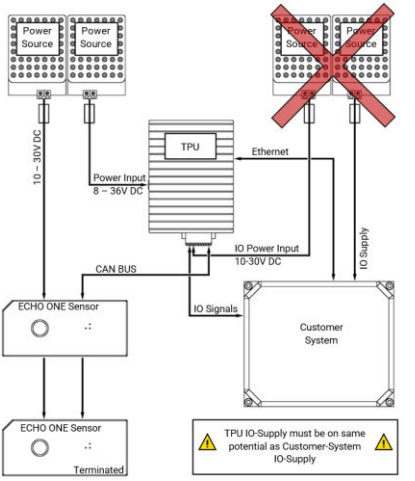
6.2.3 Connection Scheme

6.2.3.1 Recommended Power Supply Scheme

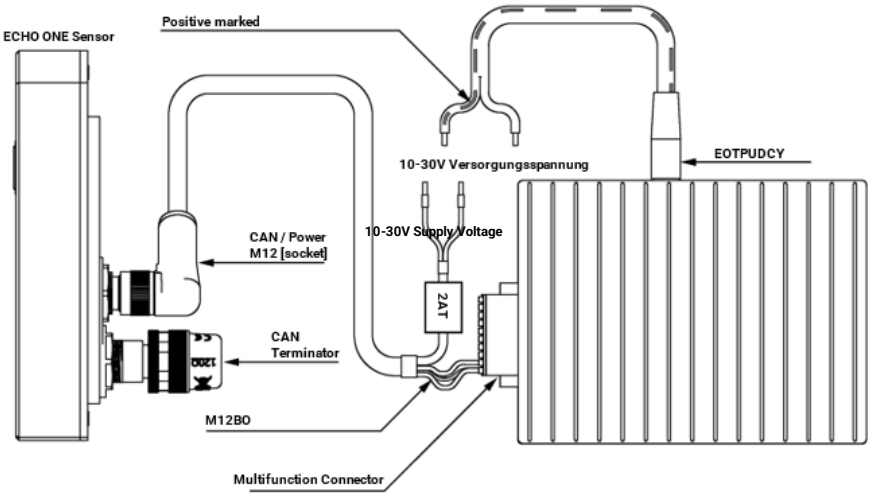


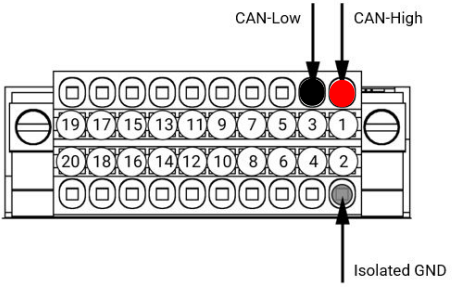




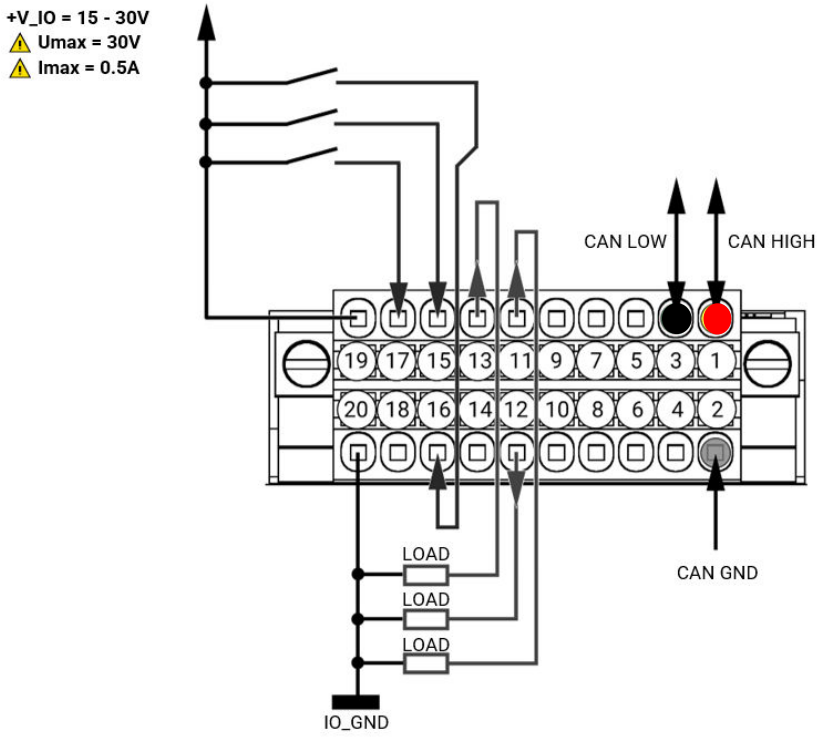


6.2.3.2 *Connection Scheme: TPU and Sensor*





6.2.3.3 Connection Scheme: TPU I/O



Logic **IN**: High-Signal (>8V) causes:	Logic **OUT**: Signal switches to +V_IO if:
Pin 15: Left Turn Zone deflection Pin 17: Right Turn Zone deflection Pin 16: High Speed / Zone expansion	Pin 13: Warning Zone violation Pin 12: All Zones free Pin 11: Stop Zone violation

Violations of the warning and stop zone (for more information, see the ECHO ONE Application manual at topsoens.com/downloads) can be signalled via the digital outputs of the TPU:

OUTPUT PIN 13 = +V_IO signals a violation of the warning zone

OUTPUT PIN 12 = +V_IO signals that stop and warning zone are free

OUTPUT PIN 11 = +V_IO signals a violation of the stop zone

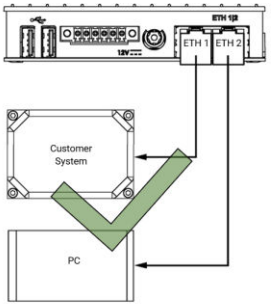
To warp the warning and stop zone in the direction of the turn during cornering, please use the following digital inputs:

INPUT PIN 15 = +V_IO	Left turn direction
INPUT PIN 17 = +V_IO	Right turn direction
INPUT Pin 15 = INPUT PIN 17 = IO_GND	Straight drive

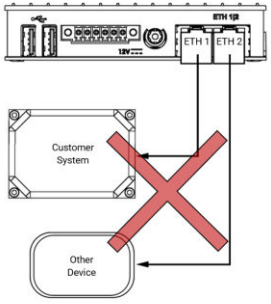
To extend the zone when driving fast and to reduce it back to the initial dimensions during normal driving, please use the following digital input:

INPUT PIN 16 = +V_IO	high speed mode / extended zones
INPUT PIN 16 = IO_GND	normal speed mode / normal zones

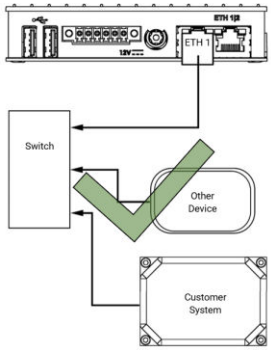
6.2.4 Connection Scheme: Ethernet



PC is used for configuration



Devices can't communicate through TPU

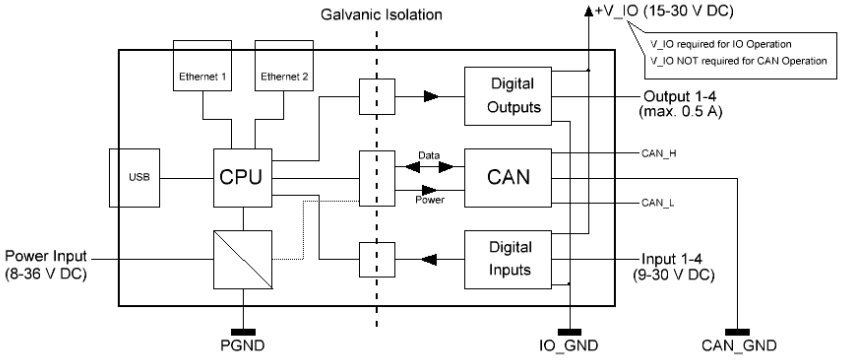


TPU can be used with an Ethernet switch

NOTICE

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

6.3 Isolation Concept



The TPU features galvanically isolated CAN- and IO-Modules. This configuration is used as a safeguard against undesired equalization currents and for improved signal integrity. PGND is the ground potential of the Input Supply Voltage, connected via the Barrel Jack Input. +V_IO and IO_GND are tied to the IO Module and are isolated from PGND and CAN_GND. In order to use the digital Inputs and Outputs of the TPU, a Supply Voltage between 15 – 30 V DC must be connected between IO_GND and +V_IO. The CAN Module is powered by an integrated isolated power supply and does not require +V_IO to operate. While it is possible to tie PGND, IO_GND and CAN_GND to the same potential, it is not recommended.

⚠WARNING

Risk of bodily injury and property damage from potential equalizing currents.

Improper grounding can result in dangerous equipotential bonding currents, which in turn can cause dangerous voltages on metal surfaces, such as connector housings. Electrical voltage can cause serious or fatal injuries.

» Work on electrical equipment may only be carried out by qualified personnel.
» Follow the instructions.
» Ensure correct grounding.
» The potential difference between I/O ground and power supply ground must be less than 30 V DC.
» Equalization currents over the communication and/or I/O lines of the TPU must be prevented.

7 INITIAL COMISSIONING

7.1 Commissioning Checklist

Check	Checks to perform
	The device shows no visual damage.
	Polarity of the power supply(s) is/are correct.
	The voltage of the power supply is between 8 – 36 V DC for the TPU Power Input and 15 – 30 V DC for the I/O-Section.
	The power supply can deliver peak currents above 1 A.
	The power supply lines are protected with an overcurrent protection element (e.g. a fuse).
	The cables used match or exceed the specifications.
	There is at least one and at most 8 ECHO ONE Sensors connected to the CAN Bus.
	A Terminator is connected to the last device on the CAN Bus.
	CAN_H, CAN_L und CAN_GND (Shield) are connected correctly.
	The total length of the CAN Bus is less than 30 meters.
	Maximum stub-length is below 1 meter.
	There are no non-Toposens devices connected to the CAN Bus.
	Sensor(s) and controller have been mounted conforming to the mounting instructions.
	The mounting surface is solid, does not vibrate during machine operation and is suitable for mounting accessories to the machine or vehicle.
	Mating surfaces of connectors were free of dirt before connecting.
	Wires are inserted into the connectors correctly.
	Connectors have been secured and fastened.

7.2 Initial Power-On

⚠WARNING **Danger of ultrasound emissions**

The sensor system can trigger and/or interfere with other ultrasonic devices (e.g. alarm systems). This can lead to dangerous situations.

- » The sensor system can be triggered and/or obstructed by other ultrasonic devices. This can lead to unreliable detection results.
- » Observe local ultrasonic exposure limits.
- » During operation, the sensor must not be pointed at people or animals from close range.
- » Do not touch or hold the ultrasound source close to your ear, keep a minimum distance of 0.15m.
- » Check the ECHO ONE Documentation for further safety information.

FOR ATTENTION **Finish connections before power up**

Connect all components of the system before you apply a supply voltage to the TPU and the connected devices.

The TPU starts as soon as sufficient voltage is applied to the power connector. An LED will light up the power button. The startup procedure takes around 90 seconds, before full functionality is available.

The power button is only used to manually switch the TPU off or on. Alternatively, the supply voltage can be switched off.

8 CONFIGURATION AND OPERATION

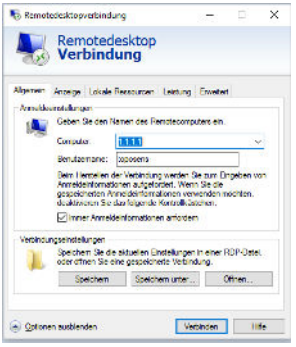
8.1 Configuring the TPU

1. To access the configuration graphical user interface (GUI) the TPU, connect a Linux or Windows PC to the ETH2 Ethernet interface. This interface is exclusively used for configuration purposes and is permanently set to the static IPv4 address **1.1.1.1.**
2. You can either configure the Ethernet interface of your Linux or Windows PC to a static IPv4 address in the same subnet (e.g. 1.1.1.2), or choose automatic configuration via DHCP.
3. Once the connection has been established you can access the configuration GUI using RDP-Client software. If automatic configuration has been chosen, it can take up to 30 seconds to negotiate the connection.

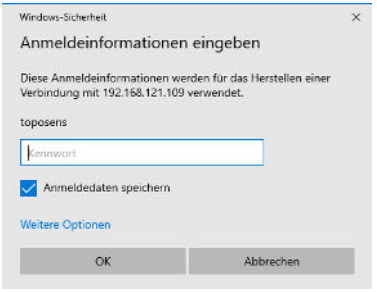
8.1.1 Connection using a Windows 10 PC

Start the integrated RDP-Client software by opening the Start-Menu and:

1. Type “**mstsc**” into the search box.
2. Click on the corresponding Icon in the list.



3. Enter the IP address **1.1.1.1** in the *Computer* textbox.
4. Enter “**toposens”** in the *User Name* textbox.
5. Check the "*Always request login information*“ checkbox.
6. Click „*Connect*“.



7. Enter “**toposens”** into the *Password* textbox and click „*OK*“. For convenience, the checkbox “*save credentials*” can be checked as well.

8. The RDP-client should now display the configuration GUI of the TPU:

8.1.2 Connection using a Linux PC

Linux offers several, free RDP clients that can be used to connect to the TPU's configuration GUI. This manual will describe the installation and use of "**xfreerdp**" as an example:

1. Open a terminal window.
2. Type "**sudo apt install freerdp2-x11 freerdp2-shadow-x11**" and hit Enter/Return.
3. Enter your credentials to allow installation if requested and confirm with Enter/Return.
4. Wait for the process to finish.
5. After the installation process has finished type "**xfreerdp /f /u:toposens /p:toposens /v:1.1.1.1**" and confirm with Enter/Return.
6. The RDP-client should now display the configuration GUI of the TPU:

8.1.3 User interface overview

For a detailed description of the GUI, please refer to the ECHO ONE Application manual at toposens.com/downloads/.

8.2 Setting up a Sensor on the TPU

Make sure that at least one ECHO ONE sensor has been connected to the TPU and is supplied with Power.

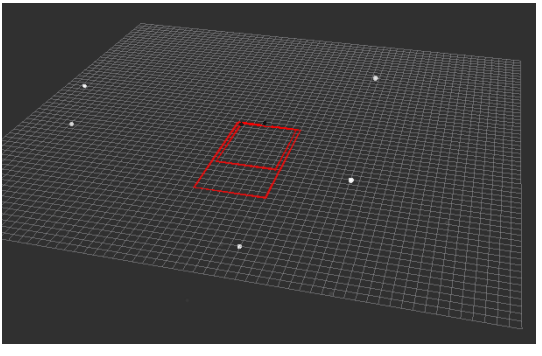
1. Click „*scan can bus*“ on the lower left of your screen:

   The drop-down box next to the „*scan can bus*“ button will be populated with the IDs of ECHO ONE sensors connected to the CAN Bus after the scan has been completed. IDs are displayed in hexadecimal data format (e.g. 238).

2. Click „*add sensor*“:

3. A Dialog box will open. Enter the ID into the textbox and click "*add*":
4. The Sensor will now be added to the system - this may take some time.

5. A 3D representation of the Sensor and its data output will become visible inside the visualizer window alongside the currently set zone dimensions after the process has finished.



NOTICE

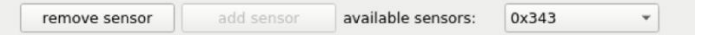
Refresh Visualizer window

If the visualizer window does not seem to update, click “refresh” until the small 3D representation of the ECHO ONE sensor is shown.

NOTICE

Swap sensors

If the "*add sensor*" button is grayed out, a sensor ID is already configured in the list (e.g. 343).



In this case, select the configured sensor from the “*available sensors*” drop-down box and click "*remove sensor*" before adding a sensor with a different ID.

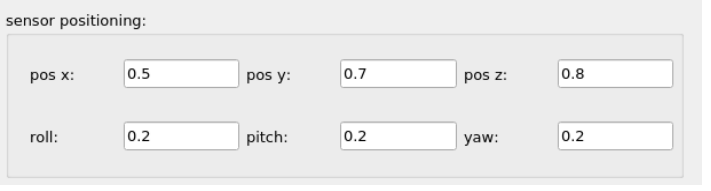
Now follow the procedure “*Setting up a Sensor on the TPU*” in section 8.2 of this document.

8.3 Geometry settings

In order to correctly transform the sensor's point cloud data to the displayed coordinate system, the TPU requires information about the installation position of the sensor. A configured sensor is represented as a 3D model inside the visualization window.

1. To edit the positional settings of a specific sensor, select the corresponding ID from the drop-down box:

   Enter the x, y and z coordinates (in meters) and the rotation of the sensor (in radians).

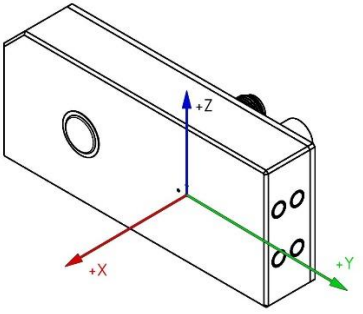


2. Once a value in the "*sensor positioning*" window has been changed, the visualizer window will be updated correspondingly within a few seconds.

NOTICE

Sensor coordiante system

All data refers to the origin (0,0,0) of the coordinate system, which is located in the sensor’s acoustic center.



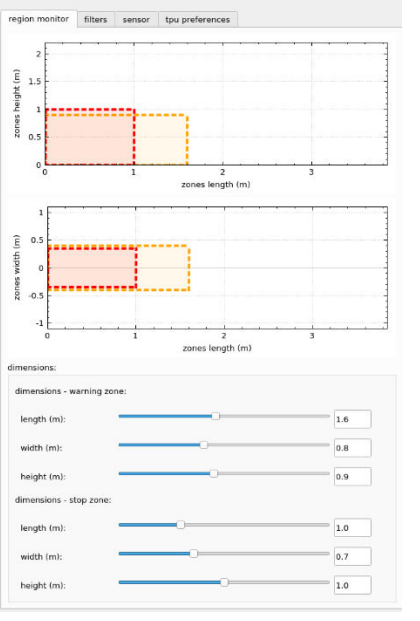
8.3.1 Setting up monitored zones

The TPU features two user-parameterizable zones, which are monitored for object ingress. The TPU can output a signal flag indicating when objects have been detected within a zone.

The TPU's software is built for a collision avoidance application, using the zones in an overlapping manner. The larger zone is designated as a "warning zone". If this warning zone is violated, the TPU's flag can be used to trigger e.g., a driving speed reduction, if the system is integrated into a mobile robotic platform. The second, smaller zone is defined as a "stopping zone", which can be used to initiate the quick stopping of e.g., a mobile robotic platform, to prevent it from colliding with an object.

8.3.1.1 Static adjustment of zone dimensions

1. To change the dimensions of either zone, select the "region monitor" tab:



NOTICE

Zone offsets

The zones height parameters are offset 0.2m below ground level. This is done to ensure the detection of objects with a very small vertical height and weak reflection properties.

A value of 0.2m should be added to the height parameter to match the height from ground level.

2. Use the sliders to set the desired width, height and length of the warning- and stopping zone. Changes to the values are automatically stored and applied. The result can be viewed in the visualizer window.

8.3.1.2 Dynamic zone dimension adjustment

The dimensions of the warning- and stopping zone can be altered during operation. The parameters can be either changed arbitrarily using the Ethernet interface or switched by using voltage signals on the digital Inputs of the TPU. Details are given in the chapter “Data Output settings”.

8.3.2 Presets and parameter storage

8.3.2.1 Loading a preset

The TPU's configuration GUI is shipped with three different parameter presets optimized for different sensor installation heights. Select a preset closest to the actual installation height of your sensor from the "*available presets*" drop-down box. the parameters are applied automatically to the currently active settings. The available presets are (see picture below):

- 18.5 cm
- 30 cm
- 60 cm

NOTICE

Default settings

Clicking on the button "*reset configuration*" in the "sensor" or "*filters*" tab will restore the original preset parameter values.

8.3.2.2 Saving a preset

Parameter changes will be applied and saved instantly but can also be saved as a custom preset by clicking the "*save custom preset*" button.

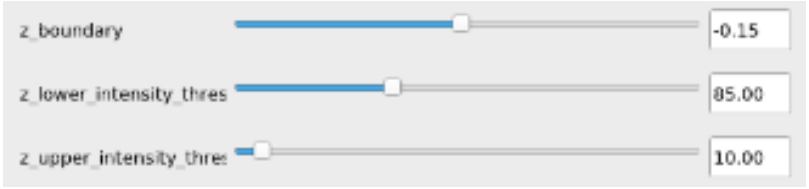
Your custom preset can later be selected in the "available presets" drop-down box and recalled in the same manner as the built-in presets discussed earlier.

8.4 Changing Filter parameters

To access the filter section, click on “*filters*” in the top right section of the screen. The settings on this page control the order and parameters of the integrated filter algorithms, which process the raw data output of the sensor.

The TPU comes with a default parameter setting which will work well for most industrial environments.

Therefore, most parameters in the “*filters*” tab are disabled by default (see picture below). Parameters which are highly dependent on the mounting situation and the desired sensitivity can be changed by the user:



NOTICE

Disabled parameter settings

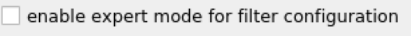
Disabled parameter settings are “greyed out”, enabled parameter settings can be identified by black text and blue sliders. These parameters can be changed by using the slider or entering a value into the corresponding textbox.

In order to fine-tune the Sensor System to your specific application, advanced settings might be required. In this case, “*expert mode*” can be enabled:

NOTICE

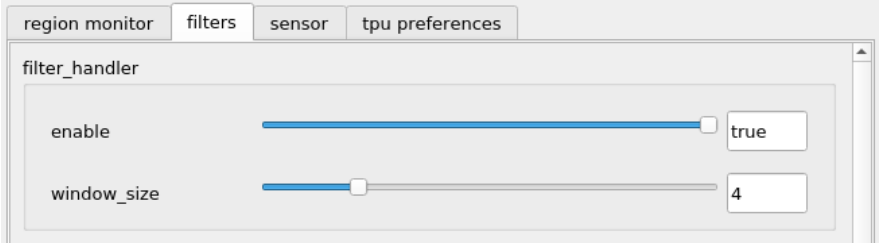
Expert mode

If more in-depth adjustments are required, more parameter settings can be enabled by clicking the checkbox “*enable expert mode for filter configuration*” at the bottom of the “*filters*” tab.



8.4.1 Using the Filter handler

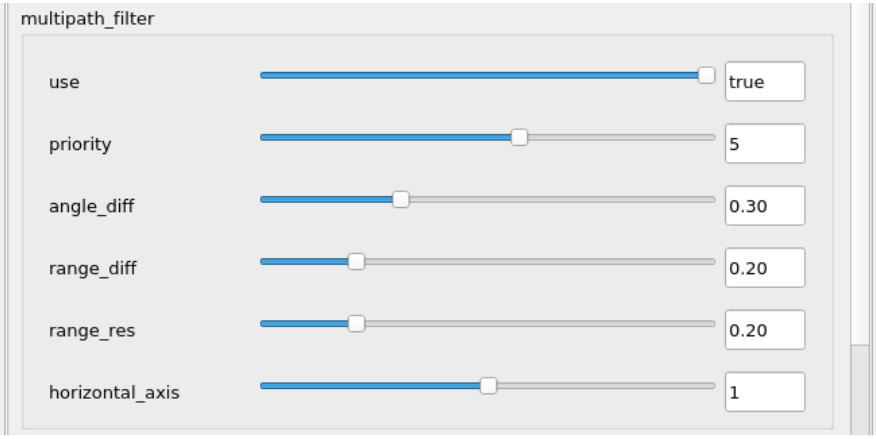
The filter handler summarizes the most important filter parameters.



The "*filter_handler*" has the following parameters:

- **"*enable*"**: This parameter simultaneously enables or disables all filters.
    - If this option is set to "false", all filters are bypassed and the raw point cloud data generated by the sensor is displayed in the visualizer window in the center of the screen.
    - If this option is set to "true", all filters are enabled. However, each filter can still be disabled independently.
- **"*window_size*"**: This parameter controls the number of accumulated successive scans to be considered for filtering. Low values (between 3 and 4) are used for speeds up to 1.5 m/s, higher values (from 5 up to 20) can used for static situations.

8.4.2 Using the multipath filter

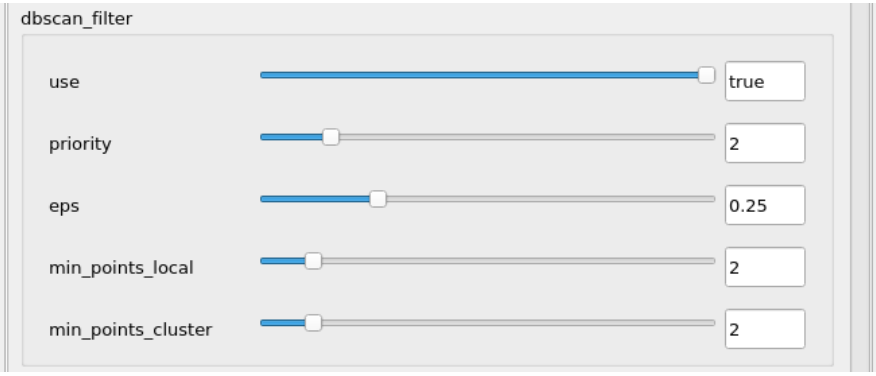


The multipath filter eliminates false points caused by secondary echoes.

The "*multipath_filter*" has the following parameters:

- „***use***": enables or disables this filter.
- „***priority***": sets the position in the filter chain.
- „***angle_diff***": sets the maximum angular difference of two points in order to cluster them in separate groups.
- „***range_diff***": sets the maximum difference between the measured distances of two points in order to sort them in separate groups.
- „**range_res**": sets the maximum difference between the measured distance of two clusters of points in order to be viewed as multiples of each other.
- „**horizontal_axis**": sets the minimum intensity threshold for the upper boundary.

8.4.3 Using the dbscan filter

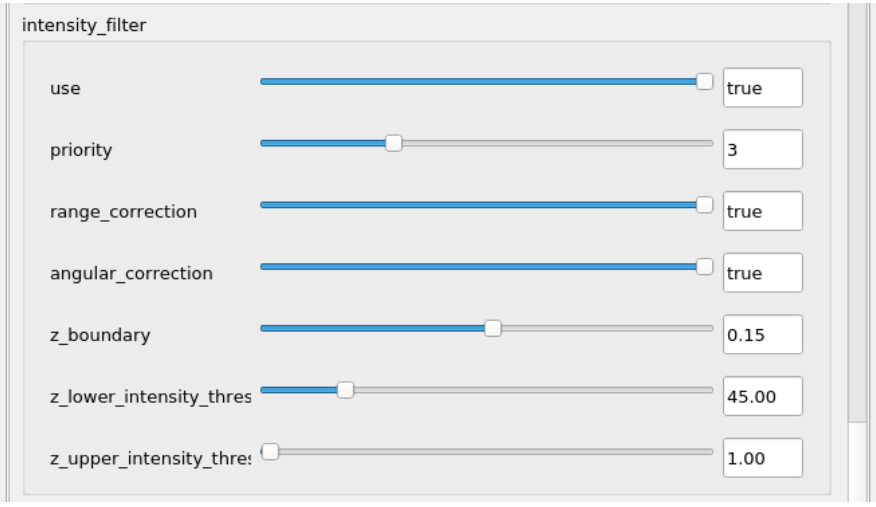


The dbscan filter looks for groups of points to replace them with an average point.

The „*dbscan_filter*“ has the following parameters:

- **“*use*”**: enables or disables this filter.
- “***priority***”: sets the position in the filter chain.
- “***eps***”: defines the maximum clustering radius around the center point of a cluster.
- “***min_points_local***”: Sets the minimum number of cluster members within the eps radius that are necessary to expand a cluster.
- “***min_points_cluster***”: Sets the minimum number of members necessary to create a new cluster.

8.4.4 Using the intensity filter

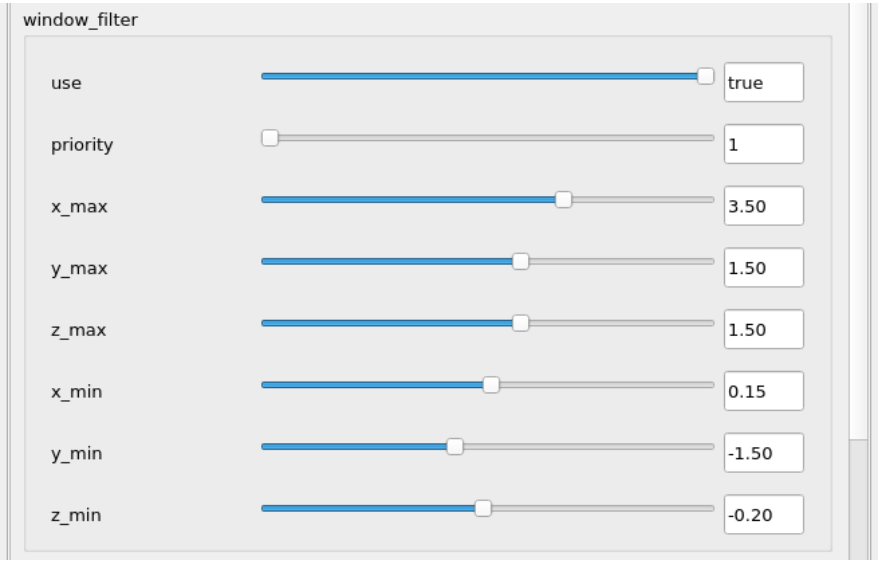


The intensity filter passes points whose intensity is above a certain threshold. The filter distinguishes between lower and upper regions of the detection volume, in which the intensity limits can be defined differently. The intensity filter also incorporates angular- and range related intensity corrections.

The "*intensity_filter*" has the following parameters:

- ***"use"***: enables or disables this filter.
- "***priority***": sets the position in the filter chain.
- "***z_boundary***": sets z-axis boundary between upper and lower detection volume.
- "***z_lower_intensity_threshold"***: sets the intensity threshold in the lower region.
- "***z_upper_intensity_threshold***": sets the intensity threshold in the upper region.

8.4.5 Using the window filter

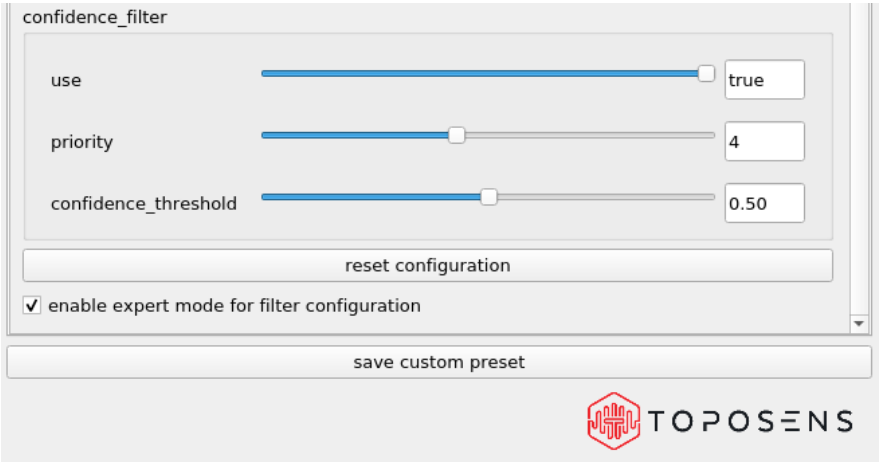


The window filter removes points outside of user definable detection volume.

The “window_filter” has the following parameters:

- **“*use*”**: enables or disables this filter.
- “***priority***”: sets the position in the filter chain.
- ***„x_max, y_max, z_max & x_min, y_min, z_min*“:** Define the detection volume.

8.4.6 Using the confidence filter



The confidence filter removes points whose confidence value is below a user definable threshold. The confidence value is calculated as a function of signal integrity and intensity.

The "*confidence_filter*" has the following parameters:

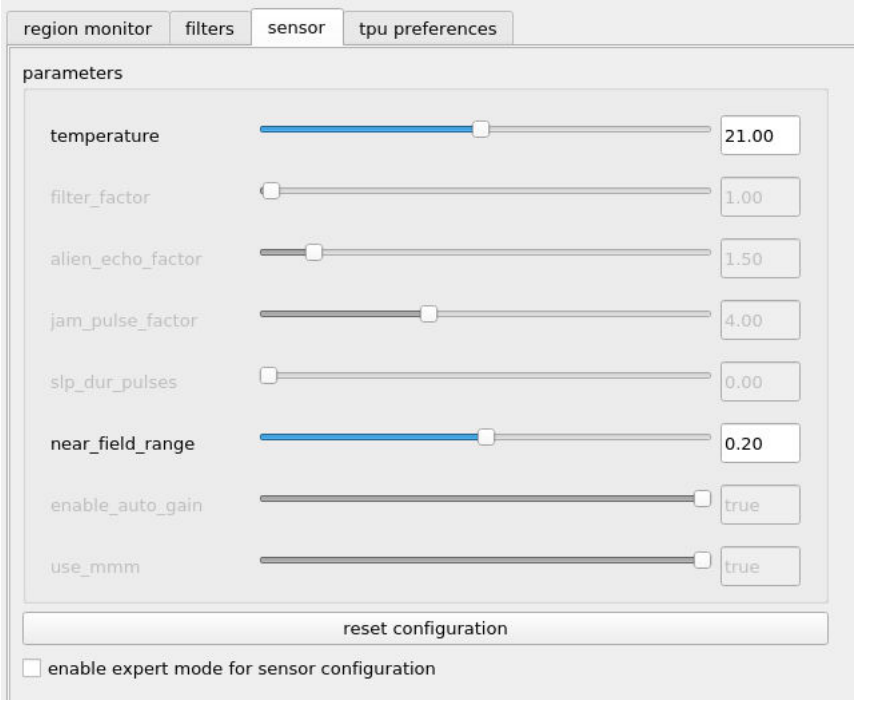
- ***"use"***: enables or disables this filter.
- "***priority***": sets the position in the filter chain.
- "***confidence_threshold***": This threshold defines the confidence value threshold for point rejection.

8.5 Adjusting sensor parameters

To access the sensor parameter section, click on “sensor” in the top right section of the screen. The settings on this page control the internal data acquisition settings of the sensor.

By default, the ECHO ONE sensor parameters have been set to values, which will ensure good performance in most circumstances.

Therefore, most parameters in the “sensor” tab are disabled by default. Parameters which commonly need to be adapted to the mounting situation and environmental parameters can be changed by the user:



NOTICE

Disabled parameter settings

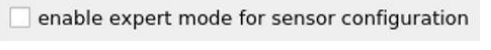
Disabled parameter settings are “greyed out”, enabled parameter settings can be identified by black text and blue sliders. These parameters can be changed by using the slider or entering a value into the corresponding textbox. Invalid values will be rejected.

In order to fine-tune the sensor system to your specific application, advanced settings might be required. In this case, “*expert mode*” can be enabled:

NOTICE

Expert mode

If more in-depth adjustments are required, more parameter settings can be enabled by clicking the checkbox “*enable expert mode for filter configuration*” at the bottom of the “*sensor*” tab.



8.5.1 Sensor parameters

The “sensor” tab contains all settings related to the transmission of the measurement pulse and echo acquisition. Most of these settings do not need to be changed by the user.

- “***temperature***”: Sets a static temperature for speed of sound calculation.
- **“filter_factor”**: Threshold for amplitude based echo rejection. A higher value lowers sensitivity.
- “***alien_echo_factor***”: Detection threshold for confirming the presence of other, non-synchronized ECHO ONE sensors. A higher value increases sensitivity.
- “***jam_pulse_factor***”: Sets the sensitivity for the detection of a synchronization signal sent by other Sensors. Higher values decrease sensitivity. If a non-synchronized ECHO ONE sensor is detected, this signal is used to synchronize two or more independent systems.
- “***slp_dur_pulses***”: Sets the time (in seconds) until switching to “sleep mode” after receiving data from a sensor. Only relevant in single-shot mode.
- “***enable_auto_gain”:*** Enables or disables automatic gain control.
- “***near_field_range***”: Sets the radius of a Sensor’s nearfield region. This value needs to be adjusted to be smaller than the Sensor’s mounting height.
- “***use_mm***”: Enables the automatic synchronization of two or more independent ECHO ONE Systems in the same space. It is not recommended to disable this setting.

NOTICE	**Persistent settings**
	Parameter changes in the “sensor” tab are applied instantly and stored in the sensor’s memory and on the TPU.

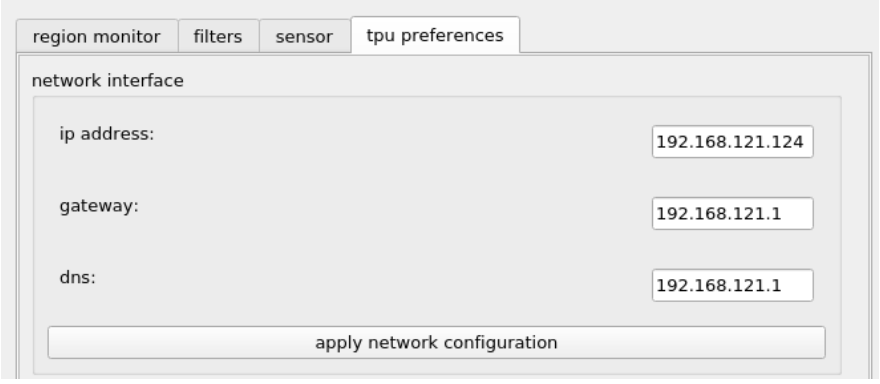
8.6 Data output settings

The TPU offers a variety of data output and external control options. The interfaces used are the “ETH1”-Ethernet interface and digital I/Os accessible via the Multifunction Connector.

8.6.1 Interface setup

8.6.1.1 Ethernet settings

The TPU is able to establish an UDP connection to external device like an ECU, PLC or PC. To setup the ETH1-Interface, navigate to the “tpu parameters” tab in the upper right 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 the change and restart the interface with the new configuration.

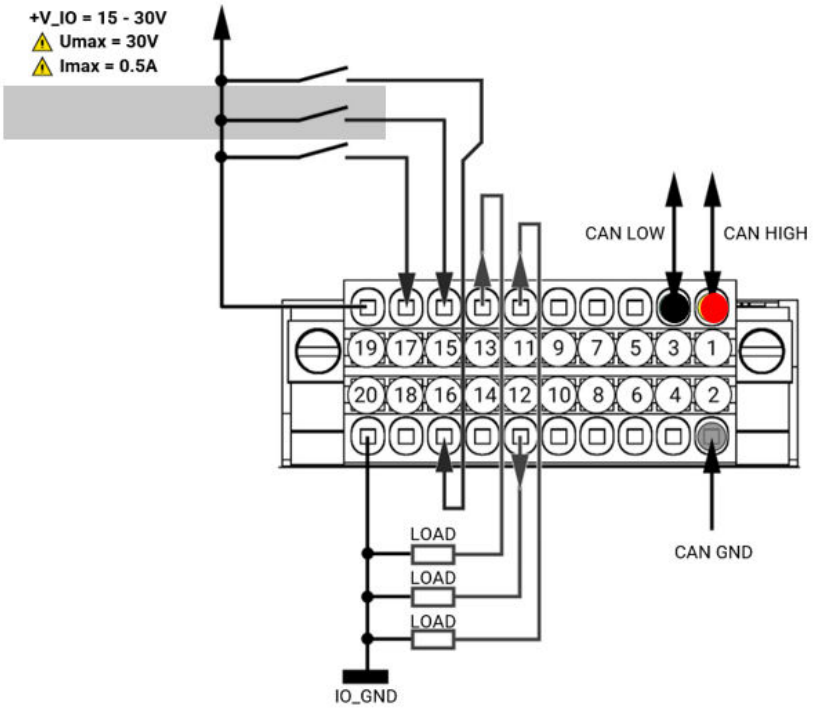
NOTICE

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 malfunctions.

3. Set the IPv4 address and UDP Port numbers of the device the TPU is supposed to connect to in the “*ip parameters*” section. The target device must have a UDP socket accepting incoming connections on the ports specified in the “*port pointcloud*” and “*port signaling*” textboxes.

8.6.1.2 Digital I/O settings



Logic **IN**: High-Signal (>8V) causes:	Logic **OUT**: Signal switches to +V_IO if:
Pin 15: Left Turn Zone deflection Pin 17: Right Turn Zone deflection Pin 16: High Speed / Zone expansion	Pin 13: Warning Zone violation Pin 12: All Zones free Pin 11: Stop Zone violation

8.6.2 Data I/O over Ethernet

The TPU offers the option to output point cloud data and zone violation triggers over the ETH1 Ethernet interface. This enables the use of the point cloud data captured by the ECHO ONE system in a Sensor Fusion application. Furthermore, zone parameters can be updated to adapt the system to changing driving speed and direction. Additionally, the ETH1 interface also is used for status and service functions.

NOTICE

Dependencies for implementation

All Ethernet data output & control options require the "*Toposens Processing Unit Gateway Client Lib*", which can be downloaded along application- and code examples in the Members Area on the Toposens.com website.

8.6.2.1 Zone violation triggers over Ethernet

To enable zone violation triggers to be output to the UDP socket specified in the previous setup step, check the checkbox "*signalling over ip*" on the upper left on the screen.

NOTICE

Format of UDP zone violation trigger package

Examples of UDP zone violation packages can be found on www.toposens.com/members/.

Since software is updated frequently, the documentation of this process is only available online.

8.6.2.2 Output point cloud data over Ethernet

To start point cloud data output via UDP, please check the checkbox “*pointcloud over ip*”.

NOTICE

Format of UDP point cloud data package

Examples of UDP point cloud packages can be found on www.toposens.com/members/.

NOTICE

Filters are bypassed in Point Cloud over Ethernet Mode

If the option to output the point cloud data over UDP is enabled, filtering is disabled.

Since software is updated frequently, the documentation of this process is only available online.

8.6.2.3 Input over Ethernet

Examples of UDP packages can be found on www.toposens.com/members/.

NOTICE

Persistent parameters

Zone dimension changes commanded over the Ethernet Interface are applied and stored immediately. The last stored parameters are automatically recalled during a reboot of the TPU.

NOTICE

Format of UDP zone dimension control package

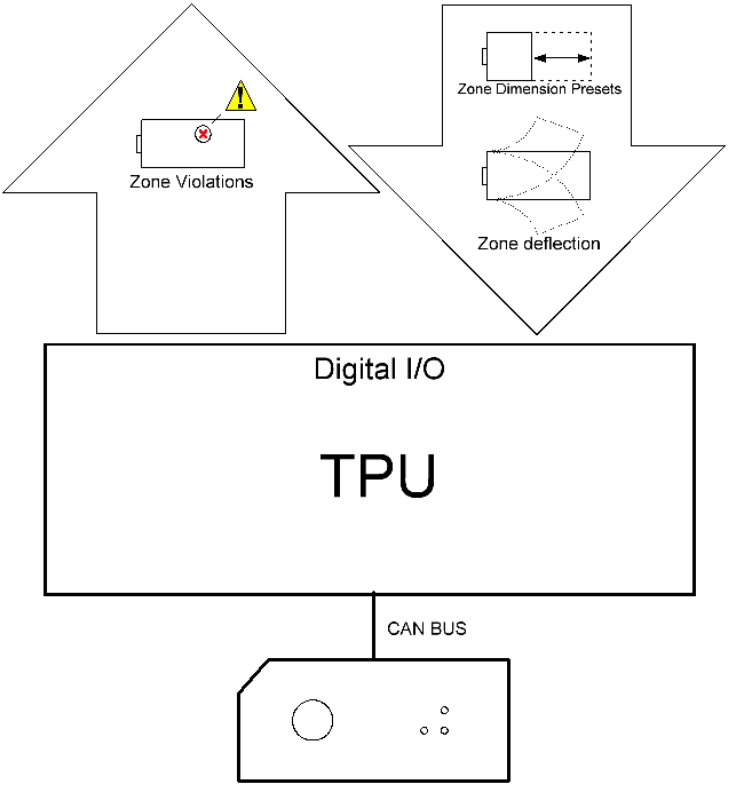
To simplify integration when using the Ethernet Interface, the Toposens TPU "*Gateway Client Library*" and code examples for "*udp_set_zone_dimensions*" and "*udp_set_curved_zones*" are available in the Members-Area of Toposens.com . Please refer to the online documentation, since it is updated and extended frequently.

Since software is updated frequently, the documentation of this process is only available online.

8.6.3 Signal and Control with Digital I/Os

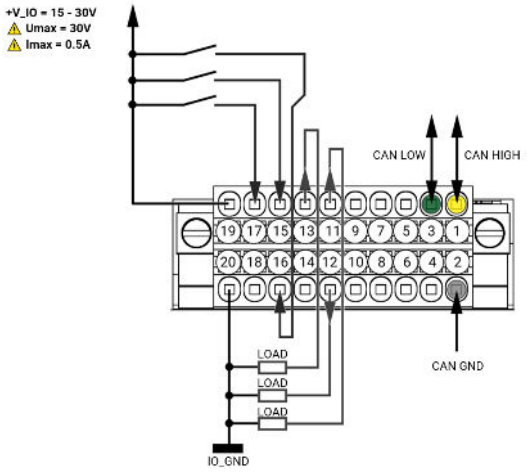
The TPU offers the option to output zone violation triggers and accept zone dimension and deflection commands over the digital I/Os accessible via the Multifunction Connector.

It is possible to invert I/O signals over the GUI via *ip parameters*.


Zone Violations
Zone Dimension Presets
Zone deflection
Digital I/O
TPU
CAN BUS

NOTICE

Multifunction Connector Pinout



Digital OUT: Signal switches to +V_IO if:

Pin 13: Warning Zone violation
Pin 12: All Zones free
Pin 11: Stop Zone violation

Digital IN: High-Signal (>8V) causes:

Pin 15: Left Turn Zone deflection
Pin 17: Right Turn Zone deflection
Pin 16: High Speed / Zone expansion

8.6.3.1 Signal output with Digital Outputs

To enable zone violation trigger output over the digital outputs, click the checkbox "*signaling over gpio*" in the "*ip settings*" section on the upper left of the screen.

8.6.3.2 Control input with digital inputs

Switching between a standard (user defined) and extended zone dimensions as well as left/right zone shape deflection for improving collision avoidance function during cornering of a vehicle is a standard feature available on the TPU. Applying a logic-high voltage to the corresponding digital input triggers one of the following functions:

Digital IN: High-Signal (>8V) causes:

Pin 15: Left Turn Zone deflection
Pin 17: Right Turn Zone deflection
Pin 16: High Speed / Zone expansion

8.7 Backup and Restore

8.7.1 Save a Backup

All settings made on the TPU can be backed up on a USB thumb drive (e.g. before a TPU update or for faster deployment). Select the “tpu preferences” page at the upper right of the screen.

1. Prepare the thumb drive: Make sure the drive only contains one partition and is formatted in the exFat or ext4 filesystem.
2. Insert the USB thumb drive into USB Port 1.
3. Wait about 15 seconds for the TPU to detect the thumb drive.
4. Click "*backup configuration files*" to save the configuration files of the TPU to the USB thumb drive.
5. Remove the USB thumb drive from the USB port as soon as the backup is finished.

8.7.2 Restore a Backup

All settings backed up on a USB thumb drive (e.g. before a TPU update or for faster deployment) can be restoed. Select the “tpu preferences” page at the upper right of the screen.

1. Prepare the thumb drive: Make sure the drive only contains one partition and is formatted in the exFat or ext4 filesystem.
2. Insert the USB thumb drive into USB Port 1.
3. Wait about 15 seconds for the TPU to detect the thumb drive.
4. Click "*restore configuration files*" to restore the configuration files of the USB drive to the TPU.
5. Remove the USB thumb drive from the USB port as soon as the restoration is finished.

8.8 Firmware Updates

NOTICE

Firmware Update

It is recommended to keep your TPU and ECHO ONE sensor firmware up to date.

- » Updates will contain bugfixes, performance improvements and new features.
- » It is possible to either update TPU and ECHO ONE sensor firmware via the TPU's GUI or with an unsupervised process over Ethernet.

NOTICE

Firmware update procedure

Follow the firmware update procedure and the order of the individual steps precisely.

- » Update your sensor's firmware first before updating the TPU's firmware.
- » Make sure that the TPU and sensor(s) are supplied with uninterrupted power and an active CAN Bus connection has been established between them.

8.8.1 Updating the sensor firmware

8.8.1.1 Updating the sensor firmware via the TPU GUI

The most up-to-date firmware version is available for download in the Members Area of the Toposens.com website. To transfer the firmware file to the TPU, a USB thumb drive can be used:

1. Prepare the thumb drive: Make sure the drive only contains one partition and is formatted in the exFat or ext4 filesystem. Make sure that there are at least ***32 MiB*** of space available.
2. Copy the downloaded firmware file to the root directory of the thumb drive.
3. Use the “save removal”-function of your OS to remove the thumb drive safely before unplugging it from your device.
4. Insert the USB thumb drive into USB Port 1.
5. Wait 15 seconds for the TPU to detect the thumb drive.
6. Select the sensor to be updated from the “*configured sensors*” drop-down box.
7. Navigate to the “*tpu preferences*” tab in the upper right of the screen.
8. Click “*firmware update*” in the “*firmware update sensor*” section.
9. Select the firmware file from the drop-down menu and click “ok”.
10. After the “updating sensor firmware” popup has disappeared, check the log window on the left side of the screen. The message *“[INFO] sensor updated successfully!!”* confirms a successful update.

NOTICE	**Sensor inactive during firmware update**
	Please note that the Sensor will suspend its function during the update process.

8.8.1.2 Updating the sensor firmware via Ethernet/UDP

The TPU offers a Sensor Firmware update process for unsupervised deployments over Ethernet/UDP.

NOTICE

Dependencies for implementation

Remote firmware updates require the "*Toposens Processing Unit Gateway Client Lib"*, which can be downloaded along application- and code examples in the Members Area on the Toposens.com website.

NOTICE

Ethernet interface setup

Make sure that the Ethernet interface is setup correctly by observing the following instructions:

- » Section 6.3.4: Connection scheme: Ethernet
- » Section 8.1: Configuring the TPU
- » Section 8.6.1.1: Ethernet settings

Navigate to the Members Area of the Toposens.com website and note the "*udp_firmware_update*" application example to implement the firmware update functionality in your application. Since software is updated frequently, the documentation of this process is only available online.

8.8.2 Updating the TPU firmware

8.8.2.1 Updating the TPU firmware via the user interface

The most up-to-date firmware version is available for download in the Members Area of the Toposens.com website. To transfer the firmware file to the TPU, a USB thumb drive can be used:

1. Prepare the thumb drive: Make sure the drive only contains one partition and is formatted in the exFat or ext4 filesystem. Make sure that there are at least ***32 MiB*** of space available.
2. Copy the downloaded firmware file to the root directory of the thumb drive.
3. Use the “save removal”-function of your OS to remove the thumb drive safely before unplugging it from your device.
4. Insert the USB thumb drive into USB Port 1.
5. Wait 15 seconds for the TPU to detect the thumb drive.
6. Navigate to the “*tpu preferences*” tab on the upper right side of the screen.
7. Click „*firmware update tpu*“.
8. Select the firmware file from the drop-down menu and click “ok”.
9. After the “updating tpu firmware” popup has disappeared, check the log window on the left side of the screen. The message *“[INFO] update tpu finished!!”* confirms a successful update.
10. Click “Reboot TPU” or cycle the power.

8.8.2.2 Updating the TPU firmware via Ethernet/UDP

The TPU offers a firmware update process over Ethernet/UDP.

Navigate to the Members Area of the Toposens.com website and note the “*udp_firmware_update*” application example to implement the firmware update functionality in your application. Since software is updated frequently, the documentation of this process is only available online.

NOTICE

Dependencies for implementation

Remote firmware updates require the “*Toposens Processing Unit Gateway Client Lib”*, which can be downloaded along application- and code examples in the Members Area on the Toposens.com website.

NOTICE

Ethernet interface setup

Make sure that the Ethernet Interface is setup correctly by observing the following instructions:

- » Chapter 6.3.4: Connection scheme: Ethernet
- » Chapter 8.1: Configuring the TPU
- » Chapter 8.6.1.1: Ethernet Settings

9 MAINTENANCE

⚠Warning

Danger of ultrasound emissions

The sensor system can trigger and/or interfere with other ultrasonic devices (e.g. alarm systems). This can lead to dangerous situations.

The sensor system can be triggered and/or obstructed by other ultrasonic devices. This can lead to unreliable detection results.

Observe local ultrasonic exposure limits.
During operation, the sensor must not be pointed at people or animals from close range.

Do not touch or hold the ultrasound source close to your ear, keep a minimum distance of 0.15m.

Check the ECHO ONE documentation for further safety information.

⚠Warning

Danger from unintentional restart

Follow the operating instructions for the machine or vehicle in which the sensor system has been integrated into. Bring the machine or vehicle into a safe state in which it can be worked on safely and restarting while the work is being carried out is impossible.

Observe the applicable rules of occupational safety and the safety regulations for electrical systems.

9.1 Maintenance procedures

⚠Warning

Danger of improper maintenance procedures

The device contains no internal components intended for user service.

External maintenance measures such as visual inspection and functional tests as well as cleaning must be carried out by qualified personnel using the processes described below.

If connectors or the enclosure is defective, disconnect the device until it has been serviced by the manufacturer.

FOR ATTENTION

FOR ATTENTION

The TPU contains no user serviceable parts.

It is recommended to perform the following procedures in regular intervals of 6 months at most.

If the TPU is used in dusty or other harsh environments or is subjected to vibrations, it is recommended to shorten this interval.

Device	Maintenance	Interval*	Executed by
Allgemein	Visual inspection of the enclosure	<6 Months *	Trained personell
	Visual inspection of connectors and cables	<6 Months *	Trained personell
	Visual inspection of mounting	<6 Months *	Trained personell
	Cleaning	<6 Months *	Trained personell

*The interval depends on the deployment situation.

9.1.1 Inspection of enclosure

FOR ATTENTION

FOR ATTENTION

The TPU is not protected against dust or water ingress.

The device needs to be taken out of service if the enclosure is damaged, shows signs of corrosion or is not sealed correctly. Check for missing or loose screws on the underside of the device.

9.1.2 Inspection of connectors and cables

- Examine connected cables for kinks, cuts or discolorations.
- Check if ferrules and/or wires are properly seated within the Multifunction connector.
- Check the locking screws on the Multifunction Connector.
- Check if the barrel power plug is inserted completely and rotated into the “locked” position.

FOR ATTENTION

FOR ATTENTION

Only replace defective cables and connectors after the power source has been disconnected.

Replace defective connectors with original spare parts.

9.1.3 Inspection of mounting

It is advisable to check the mounting of the TPU if it is mounted to a vehicle or is subjected to vibration. Pay close attention to the screws mounting the TPU to either a flat surface or to a variant of the DIN-Rail mounting kit. Since the DIN-Rail Kit is clipped onto the rail by constant spring tension, it is unlikely to loosen itself from the rail, except in extreme conditions. If sliding on the rail occurs, stopping elements can be purchased from a multitude of sources.

9.1.4 Cleaning procedure

1. Turn off the power supply.
2. Disconnect all cables and remove connectors.
3. Clean the enclosure with a lint free, dry cloth.
4. Use compressed air to remove dust from the connectors if necessary.

10 TROUBLESHOOTING

10.1 Troubleshooting Table

⚠Warning **Danger by Malfunction**

Malfunctions can lead to dangerous situations.

If non-identifiable malfunctions occur, shut down the device immediately and contact Toposens support (support@toposens.com).

Situation	Possible cause	Solution
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	Check Installation Instructions Redo Comissioning Checklist
	Loose connections	Replug the TPUs Power Cable and lock it
	Reverse Polarity	Disconnect TPUs Power Cable and check the polarity of the Barrel Plug (Center Positive)
	Fuse has tripped	Check the Power Supply Fuse

Situation	Possible cause	Solution
RDP Connection to the TPU fails	Wrong IP settings	Set your PC to a static IP in same Subnet as the TPU
	Wrong Ethernet Port used	Do not use 1.1.1.1 as your PCs static IP address
	Incompatible RDP Client	Connect your PC to the “ETH2” Port of the TPU
		Only Use Software listed in this manual
		Update your RDP Client
TPU does not detect any sensors on the bus	Sensor power supply issue	Check Sensor power supply. More Information can be found in ECHO ONE Instruction manual
	Bus issue	Check the wiring against the installation instructions
	Mismatched firmware	Check CAN-Bus termination
		Remove non-Toposens devices from the Bus
		More Information can be found in ECHO ONE Instruction manual
		Update the Firmware using the Tools integrated into the TPUs GUI

Situation	Possible cause	Solution
IO signaling does not work	Wiring error	Check wiring for correct input / output terminal
		Observe minimum voltage levels
	Configuration error	Power Supply to IO Section must be sufficient
		Enable I/O Signaling in the GUI
No points showing up in the visualizer window	No information about sensor location	Ensure sensor ID is selected and added in drop-down box of available sensors
Sensor model does not show up in visualizer window	Sensor location was recently changed	Click “refresh display” below the visualizer window

10.2 Technical Support

E-Mail	Support@Toposens.com
Address	Toposens GmbH Lyonel-Feininger-Straße 28 80807 München

11 DECOMISSIONING

11.1 Shutdown of the TPU

Shut down the power supply and bring the machine or vehicle into a safe state, so it can be worked on. Do not disconnect cables while the system is still powered. Consult the manual of the machine or device, in which the TPU has been integrated, to learn how to shut down the power supply and to establish a safe working environment.

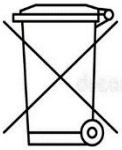
Please note that the TPU has multiple power connections and that the I/O Lines can be powered as well.

⚠WARNING **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.
- » Observe the safety requirements for working on electrical installations.

11.2 Disposal



Adhere to national and local regulations when disposing of electronic equipment.

EU-Directive RoHS

This Toposens product and the supplied parts (cable, terminator, etc.) meet 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 revision" or "RoHS 2").

The symbol on the device and/or on the packaging indicates that the device can harm the environment at the end of its life cycle. The device must not be disposed of with unsorted household waste. Disposal must be carried out by a specialized recycling company. The device must be returned to the appropriate dealer or disposed of at a local recycling company. Local environmental regulations must be observed. If in doubt, contact the local waste disposal authorities.

WEEE-Reg.-Nr. DE 39801091

FOR ATTENTION

Potential harm to the environment due to improper disposal!

When the device is disposed of improperly, environmental damage can occur.

Adhere to current environmental regulations.

12 TECHNICAL DATA

Dimensions	
Dimensions	112 x 84 x 25 mm
Weight	450 g
Housing Material	Aluminium
Mounting	M3 Screws, DIN-rail (optional)

Environmental Data	
Ambient Operating Temperature	-40° to 80° C
Cooling	Passive, fanless
Permissible relative humidity	10% to 90%, no condensation
Protection Type	Use in dry environment only

Electrical Properties	
Nominal Supply Voltage	12 V DC
Operating Voltage Range	8-36 V DC
Current Consumption typ. (12 V)	300 mA with Toposens Processing running and Ethernet connected
Peak Current Consumption (12 V)	1 A
Power Consumption avg. (12V)	4 W
Peak Power Consumption (12V)	12 W

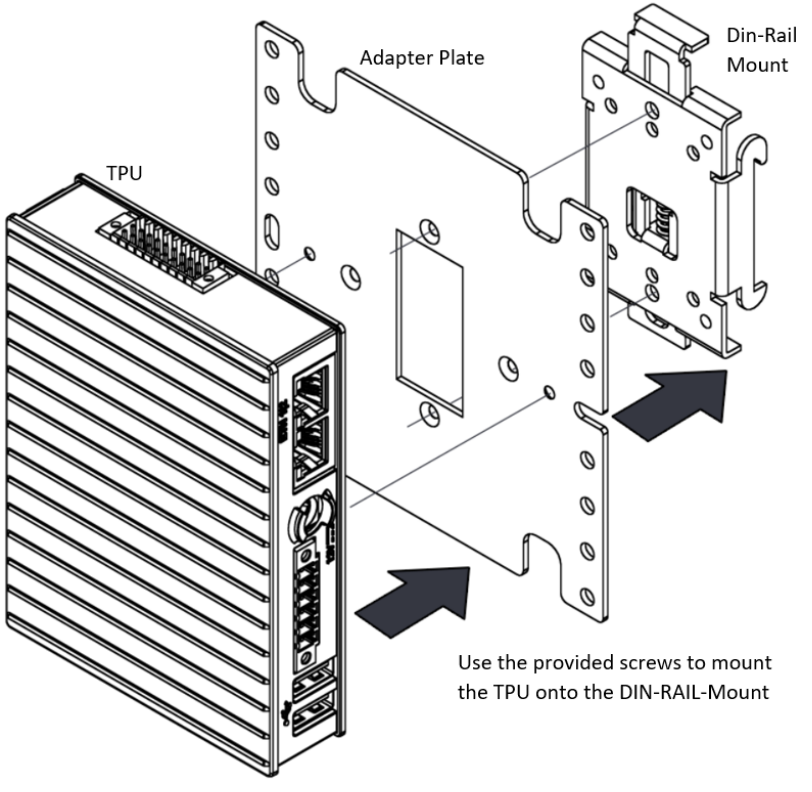
Connectivity	
Ethernet	1x 1000 Mbps Ethernet port, RJ45 connector 1x 100 Mbps Ethernet port, RJ45 connector
CAN Bus	1x CAN BUS, 1 Mbps (In use for Sensor Bus)
CAN Bus Termination	Internal, 120 Ohms
Digital Inputs (EN 61131-2)	4x Voltage Input, 8-30 V, 3 mA, isolated, Removable Connector
Digital Outputs (EN 61131-2)	4x Voltage Source, max. 0.5 A, isolated, Removable Connector
USB	3x USB2.0 ports, type-A Connector

Conformity	
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
Safety	IEC/EN/UL/CSA 62368-1: 2014
Declaration of Conformity	CE, FCC, RoHS
MTTF	>200,000 hrs

13 ACCESSORIES

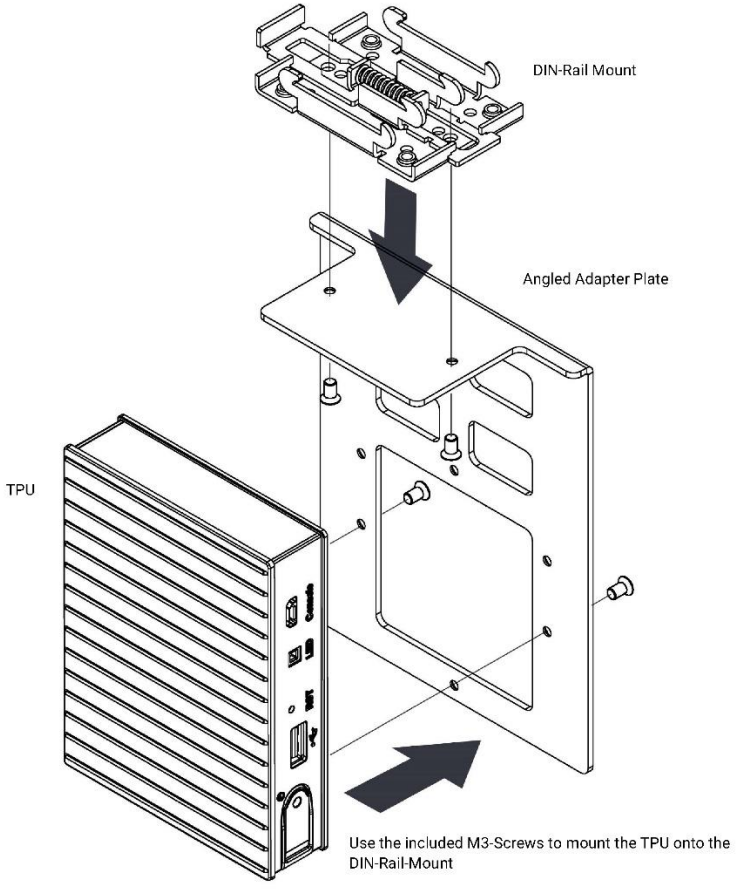
13.1 EOTPUDIN: Low Profile DIN-Rail Mount

Needed width to install the TPU with DIN-Mount: 87,5mm



13.2 EOTPUSDIN: Angled DIN-Mount Assembly

Needed width to install the TPU with DIN-Mount: 87,5mm



13.3 M12BO: Sensor to TPU connection cable

M12B0

Split Cable for Power and Data connection

2m Length

2x 6mm Cable diameter

Power Wire gauge 2x 0.5 mm² (AWG 20)

Data Wire gauge 2x 0.25 mm² (AWG24)

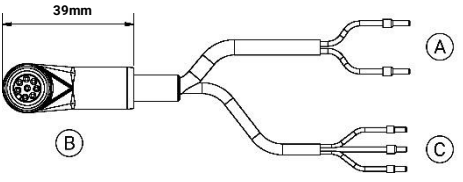
Shielded Data wire and connector

Termination A: Ferrules 2x 0.5 mm² (AWG 20)

Termination B: Angled, M12a Female Connector

Termination C: Ferrules 2x 0.25 mm² (AWG24) & 1x 0.34 mm² (AWG22)

IP67 rated connector



14 DOCUMENTATION

14.1 Compliance

To simplify integration, the EU Declaration of Conformity as well as other documentation, certificates and test reports are made available on a “on-request”- basis. You can reach us by e-mail at: support@toposens.com

14.2 Online Resources

Contact and Additional Documents	
Software and Application Packages	toposens.com/members
Further Information	toposens.com/downloads
Support	support@toposens.com
Sales	sales@toposens.com

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Document Version: 1.0
Publication Date: January 2023