

APPLICATION USER MANUAL

Velodyne LIDAR V23-1



1. Table of contents

1. Table of contents	2
2. About this document	2
2.1. Legend	2
3. What is Velodyne LIDAR?	2
3.1. Where can LIDAR sensors be used?	2
4. Hardware configuration	5
4.1. System configuration	5
4.1.1. Standalone system	5
4.1.2. Typical system	5
4.2. Module installation	5
4.2.1. Licensing	6
4.3. Device Network setup	6
4.4. Add a LIDAR Device inside DewesoftX	9
5. Synchronization	10
5.1. Software synchronization	10
5.2. GPS PPS synchronization	10
5.2.1. PIN-OUT: Velodyne LIDAR and DS-IMU2 cable	11
6. Outputs	15
7. Visualization	17
7.1. Map Widget	18
7.1.1. 3D models	18
7.1.2. Shortcuts	19
8. Warranty information	19
8.1. Calibration	22
8.2. Support	23
8.3. Service/repair	23
8.4. Restricted Rights	23
8.5. Printing History	23
8.6. Copyright	23
8.7. Trademarks	23
9. Safety instructions	24
9.1. Safety symbols in the manual	24
9.2. General Safety Instructions	24
9.2.1. Environmental Considerations	24
9.2.2. Product End-of-Life Handling	24
9.2.3. System and Components Recycling	24
9.2.4. General safety and hazard warnings for all Dewesoft systems	24
10. Documentation version history	27

2. About this document

This is the users manual for the Velodyne LIDAR module.

2.1. Legend

The following symbols and formats will be used throughout the document.



Important

It gives you important information about the subject.
Please read carefully!



Hint

It gives you a hint or provides additional information about a subject.



Example

Gives you an example of a specific subject.

3. What is Velodyne LIDAR?

Velodyne is a LIDAR technology company that develops LIDAR sensors and devices for testing and commercial use.

LIDAR stands for Light Detection and Ranging, and it is a method for measuring distances by illuminating the target with laser light and measuring the reflection with a sensor. Differences in laser light return times and wavelengths that can be used to make digital 3-D presentations of the environment.

In Dewesoft X software, Lidar sensors Velodyne Puck (VLP-16) and Ultra Puck (VLP-32) are supported by the Velodyne LIDAR module.



Image 1: Velodyne LIDAR sensor on a car

3.1. Where can LIDAR sensors be used?

Key applications for LIDAR measurement are:

- **Autonomous vehicles** with real-time perception data that enables safe and reliable operation of autonomous driving and advanced vehicle safety. Achieved range, accuracy and resolution are capable of autonomy level 4 and level 5.
- High-level **ADAS** for safe navigation, collision avoidance, lane keeping assist, automatic emergency braking, ...
- **Trucking**
- **Mapping** for building highly accurate 3D models of any environment.

- **Smart city** for monitoring and measuring conditions areas for pedestrian safety, vehicle traffic, parking space management, ...

4. Hardware configuration

4.1. System configuration

Velodyne LIDAR sensors can be used as standalone devices or as a part of a complete measurement system (Sirius, Krypton)..

4.1.1. Standalone system

Velodyne LIDAR can be used as a standalone system. That means only the Velodyne LIDAR sensor is used for the measurement.

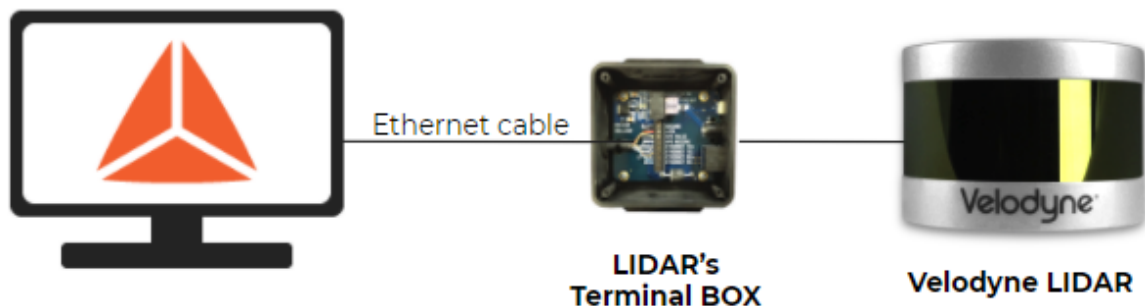


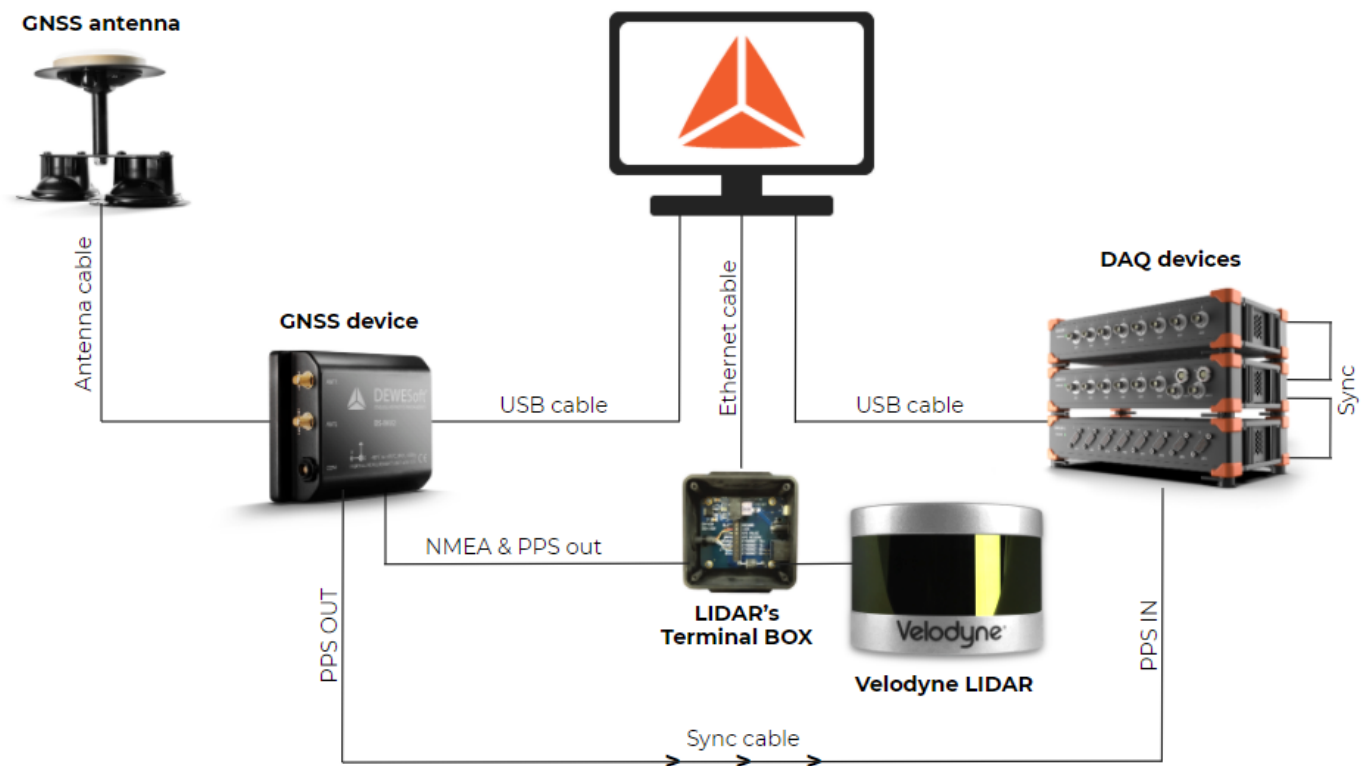
Image 2: Standalone system configuration

4.1.2. Typical system

Velodyne LIDAR sensors is usually used together in system with other devices, such as:

- Dewesoft DAQ devices
- GNSS devices

Such configurations allow the user to perform measurements on a higher level of complexity, but at the same time keeping it simple and completely synchronized inside Dewesoft X software. The possibility to gather data from multiple sources gives the user better overview and detailed information about measured systems.



All devices except GNSS antenna need to be powered.

Image 3: Configuration of a typical system

4.2. Module installation

Velodyne LIDAR module is supported for **Dewesoft X** versions from **2020.2**.

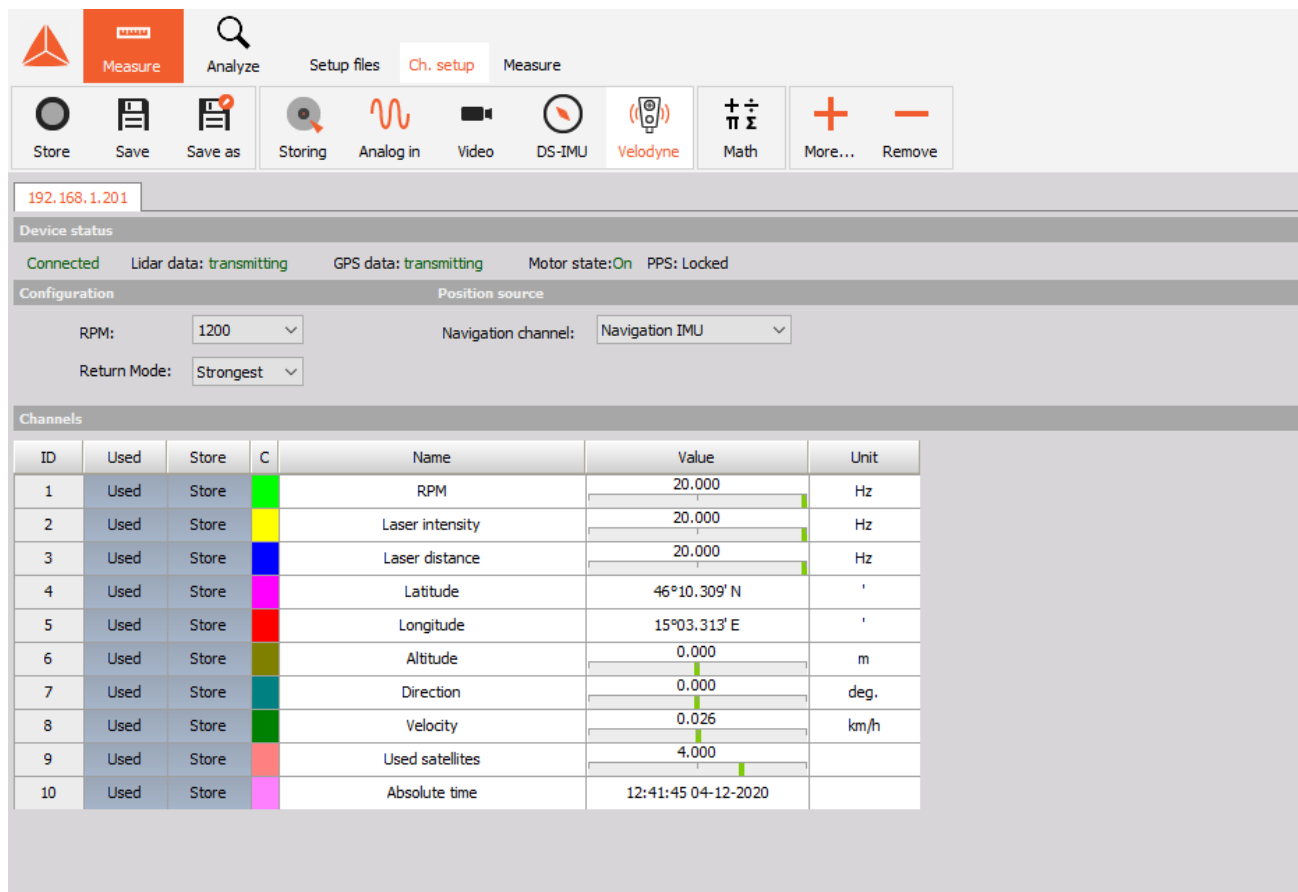


Image 4: Velodyne LIDAR module inside DewesoftX

Velodyne LIDAR module, can be **downloaded** from Dewesoft's [Downloads web page](#). When it is downloaded, move the Velodyne LIDAR .dll file to the **Addons folder** of your local installation (typically C:\DewesoftX\Bin64\Addons).

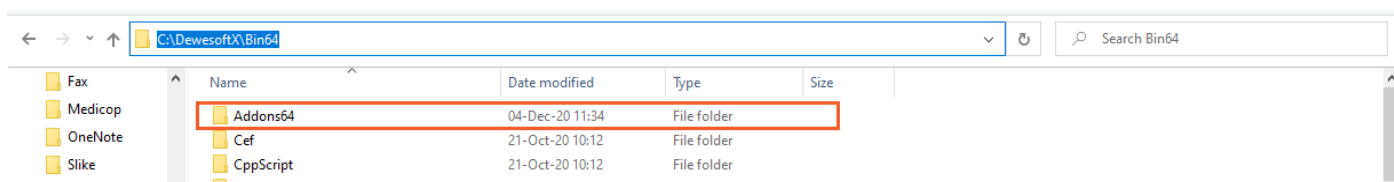


Image 5: Location of the Addons folder

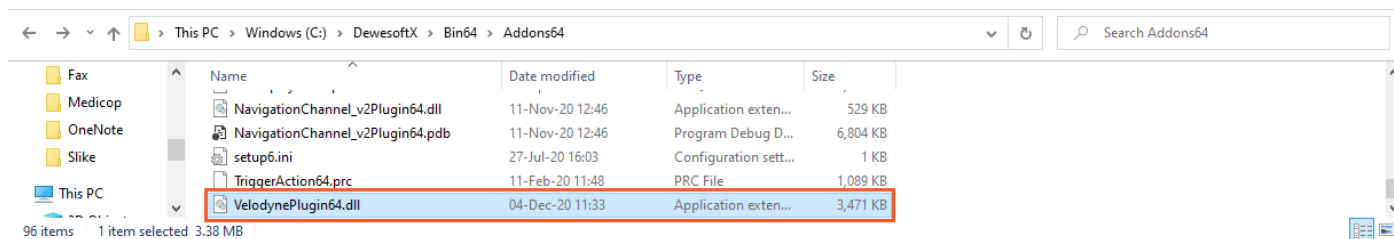


Image 6: Velodyne LIDAR plugin moved to the Addons folder

After completing the steps above, it is recommended to **run the DewesoftX** application **as an administrator**, to register newly added modules. The Velodyne LIDAR module enables adding a *Velodyne LIDAR sensor* as **a device** under the settings of DewesoftX.

4.2.1. Licensing

In case you have already purchased the Velodyne LIDAR device, you will need to enable the Velodyne LIDAR module inside your DewesoftX installation. Velodyne LIDAR module requires **its own license**, which is not included in the DewesoftX Professional license.

4.3. Device Network setup

In order to recognize Velodyne LIDAR sensors inside DewesoftX, the ethernet network setup needs to be done. **Velodyne LIDAR sensor IP address** is factory set on default value **192.168.1.201**.



Important

If using the computer's main Ethernet port, disconnect it from the network. If using the secondary Ethernet interface, the primary network address cannot be 192.168.1. If it is, use the primary Ethernet interface instead.

1. Open Network & Internet settings
2. Open the applicable Ethernet adapter and make sure the interface is enabled.
3. Open Properties → Internet Protocol Version 4 (TCP/IPv4).
4. Switch to 'Use the following IP address:.
5. Write in an IP address for the Ethernet port: 192.168.1.XXX
 - a. 'XXX' may be any integer from 0 to 255, except 201 (which is the LIDAR's IP)

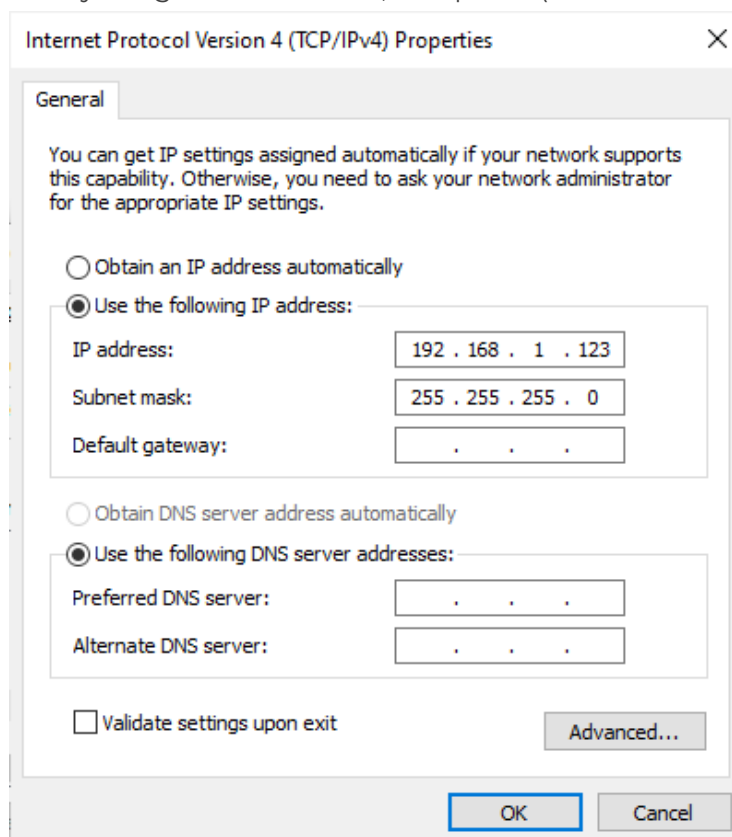


Image 7: Internet Protocol definition

4.4. Add a LIDAR Device inside DewesoftX

Open DewesoftX software and add Velodyne LIDAR device inside DewesoftX:

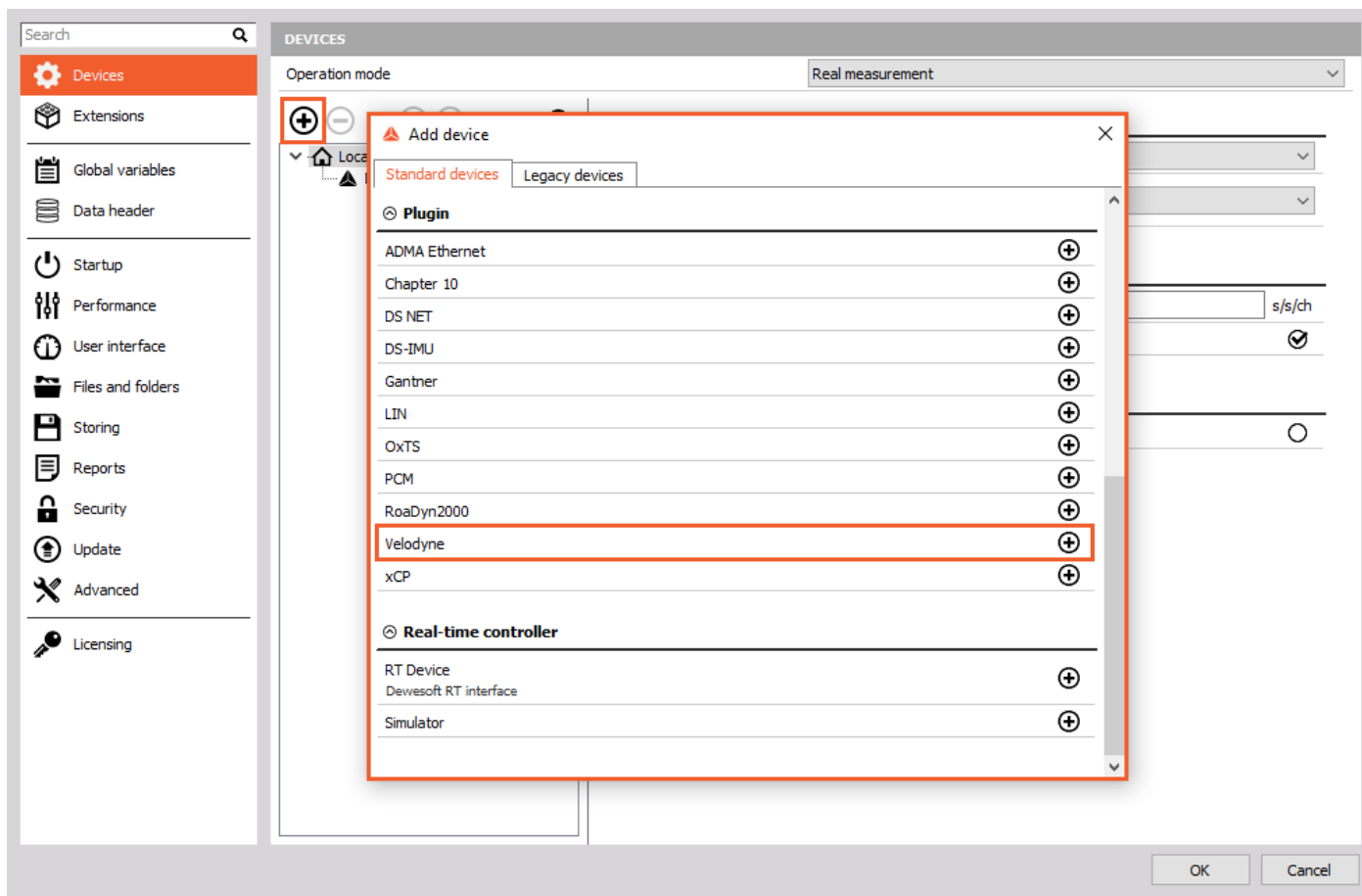


Image 8: Add Velodyne plugin

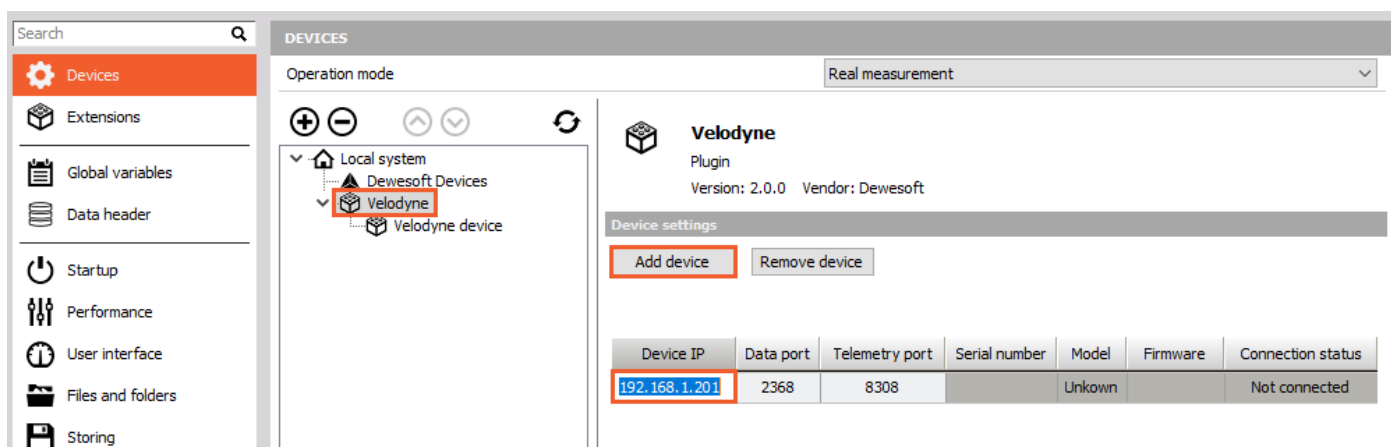


Image 9: Add a device with its IP address

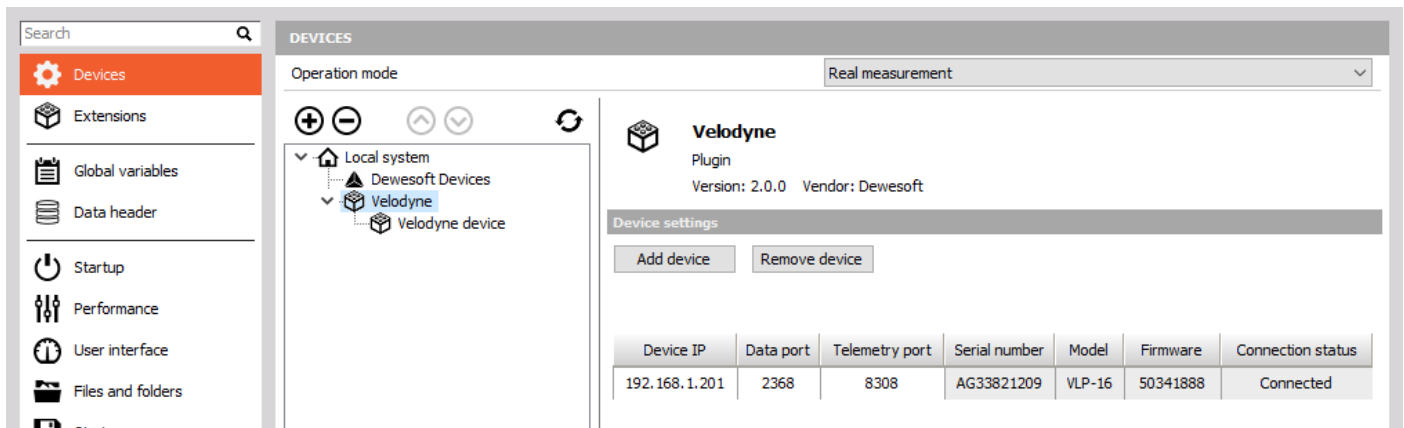


Image 10: Connected status indicates recognized and connected LIDAR device

The **Connection status** should turn to status **Connected**.

Settings can be closed by pressing **OK**. Velodyne module can be configured and used in channel setup.

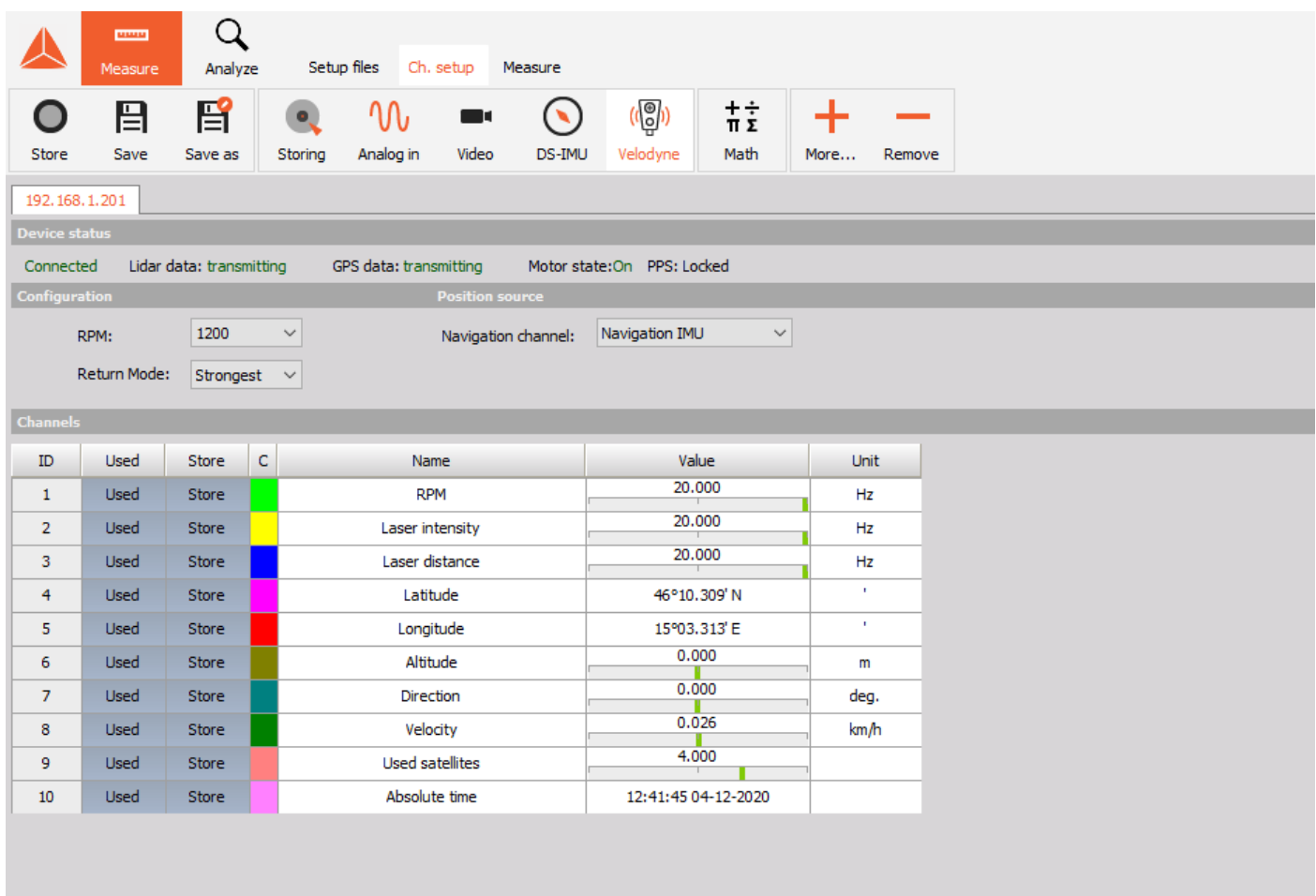


Image 11: Velodyne LIDAR module inside DewesoftX

5. Synchronization

Synchronization can be set under the Local system inside DewesoftX settings. LIDAR sensors can use GPS PPS synchronization from external sources or be in softsync (software synchronization).

5.1. Software synchronization

LIDAR can obtain software synchronization when it is used as a standalone device, and also when it is used together with other devices. The software synchronization accuracy is around 2-10 ms and this synchronization solution requires no additional hardware.

5.2. GPS PPS synchronization

Velodyne can be synchronized with other GNSS devices (DS-IMU, DS-VGPS-HS, ...) with a PPS signal, where the GNSS receiver is the source of NMEA messages for the LIDAR sensor. In order to obtain PPS synchronization for Velodyne LIDAR, it needs to be physically connected to the GNSS device.

5.2.1. PIN-OUT: Velodyne LIDAR and DS-IMU2 cable

With DS-IMU devices, the DS-IMU cable needs to be used, which has a DB9f connector, that has RS232 output for NMEA messages and GPS PPS TTL signal. Velodyne LIDAR sensors have a dedicated port (mating connector SM06B-SRSS-TB) used for GPS input.

The following connections between LIDAR's GPS connector (SM06B-SRSS-TB) and IMU (DB9) have to be made:

- DB9 pin 4 to SM06B pin 1 (PPS pulse)
- DB9 pin 2 to SM06B pin 4 (NMEA)
- DB9 pin 5 to SM06B pin 3 (GND)

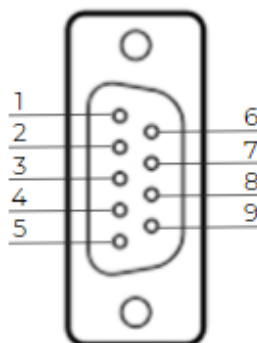
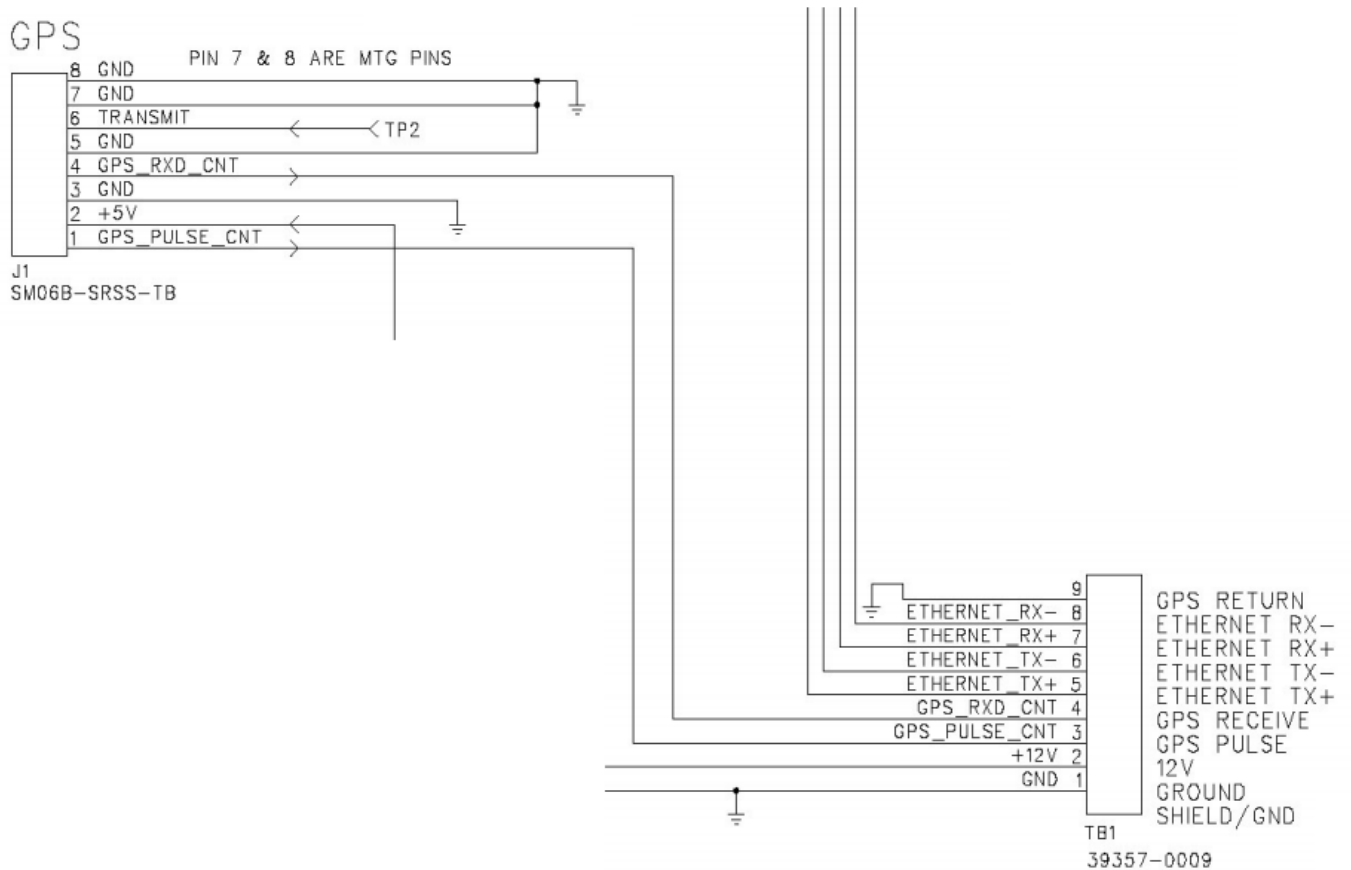


Image 12: DS-IMU2 cable DB9 pinout (see the following table)

DS-IMU2 pins	Description
1	+5V (USB)
2	TX AUX
3	RX AUX
4	PPS TTL
5	GND
6	PPS RADIO
7	Not connected
8	GPIO1 FLT
9	+15V (Ext power)



TERMINAL BLOCK

Image 13: Velodyne LIDAR GPS (SM06B-SRSS-TB) and Terminal block pinout

In case of using Dewesoft's GNSS device, Dewesoft can prepare and provide the cabling needed to connect both devices.

Synchronization settings have to be adjusted as well. This can be done in DewesoftX settings under Local system first.

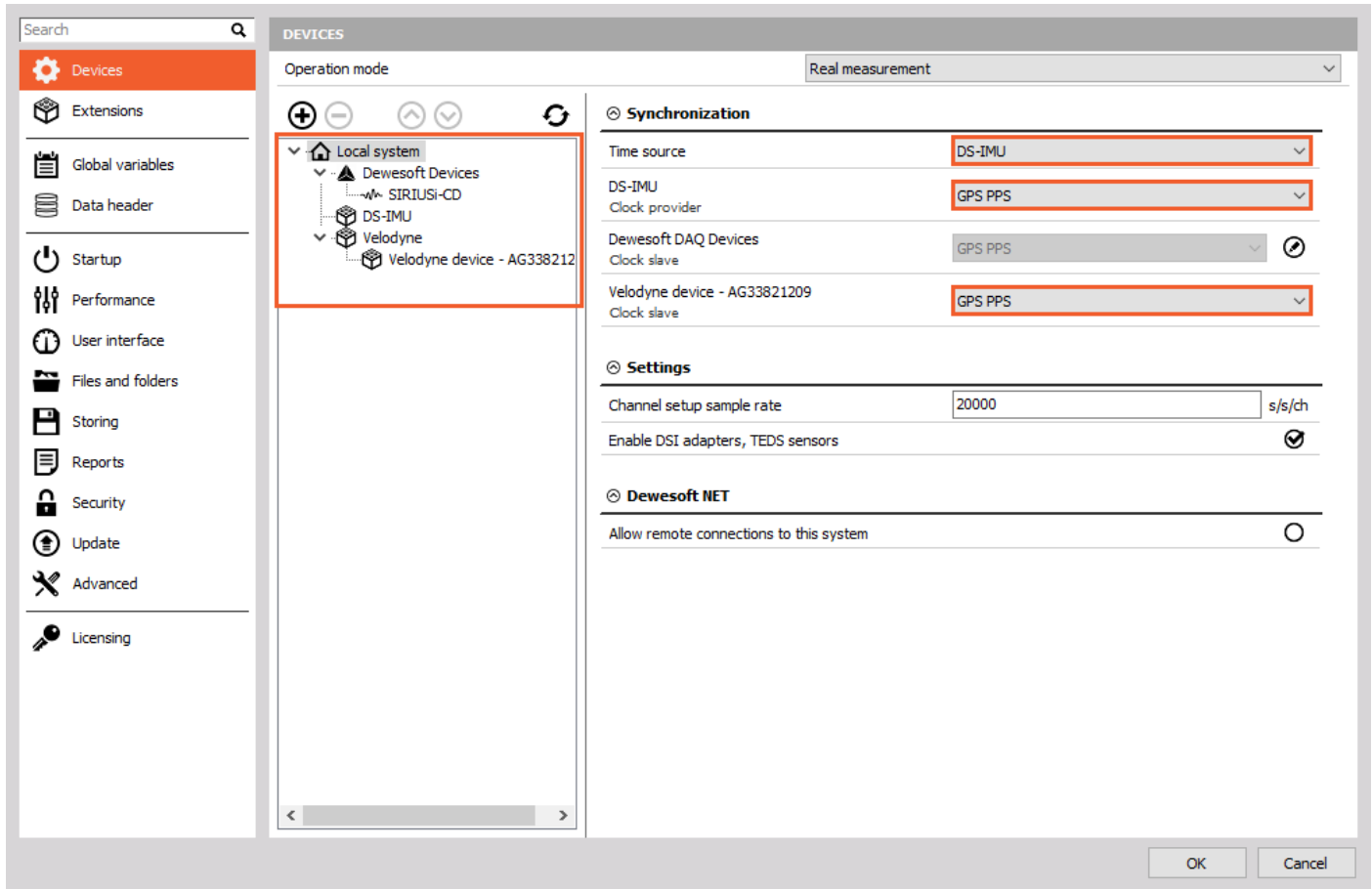


Image 14: GPS PPS Synchronization settings

Then the NMEA transmit has to be enabled in DS-IMU settings (Channel setup) as well (see image 15):

- Enable Activate NMEA option
- Set baudrate 9600
- Set NMEA rate on 1Hz
- Enable GPRMC option

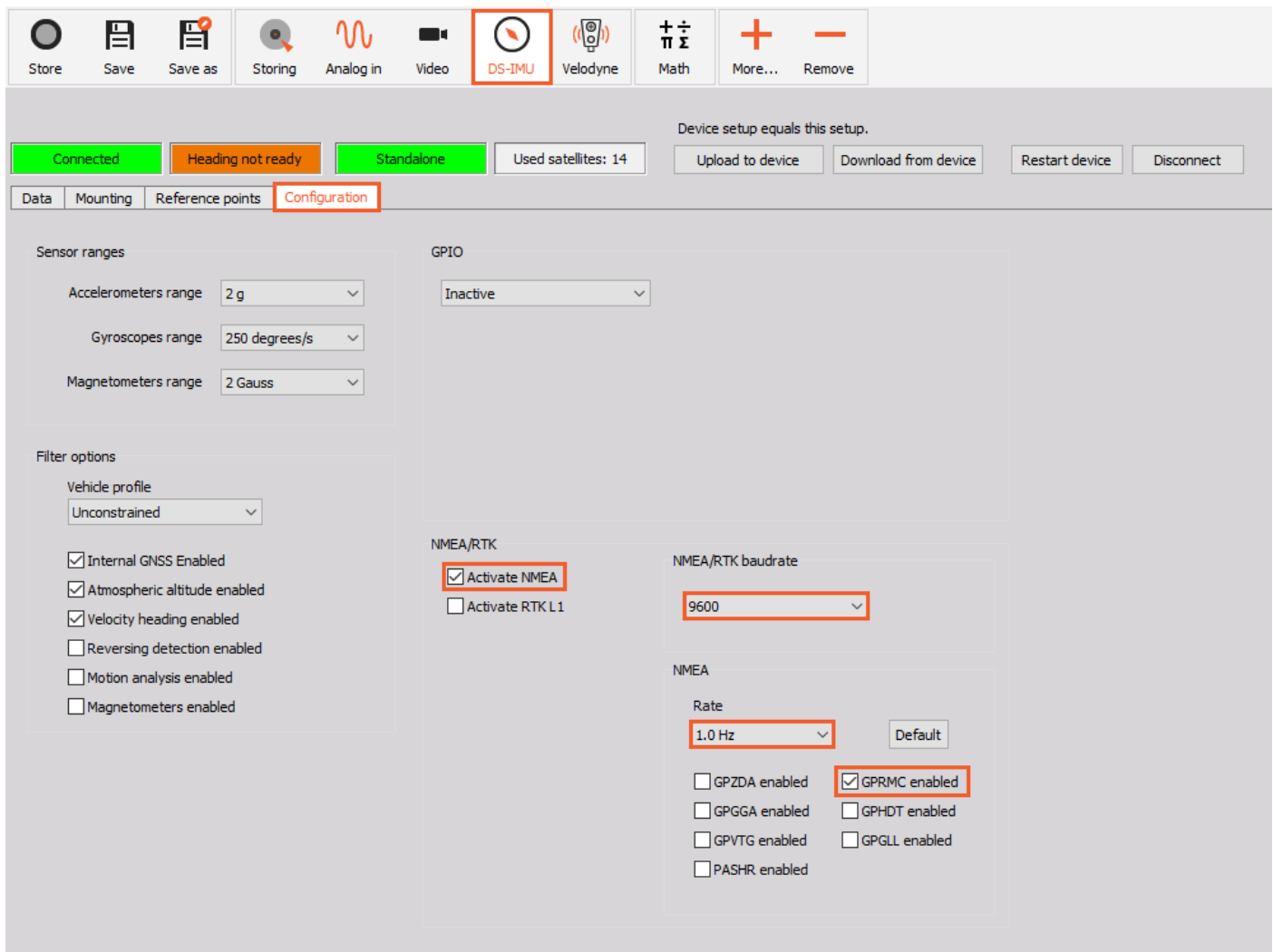


Image 15: Enabling NMEA messages on IMU device

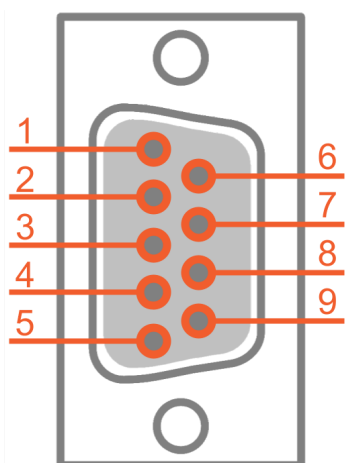
5.2.2 PIN-OUT: Velodyne LIDAR and NAVION i2 NMEA port

With NAVION i2, the connection box should be used and the NMEA output should be checked in the configuration tab of the NAVION i2 plugin.

The following connections between LIDAR's GPS connector (SM06B-SRSS-TB) and NAVION i2 (DB9) have to be made:

- DB9 pin 4 to SM06B pin 1 (PPS pulse)
- DB9 pin 2 to SM06B pin 4 (NMEA)
- DB9 pin 5 to SM06B pin 3 (GND)

COM I/O NMEA	D-SUB9f
Pin	Function
1	+5V
2	Tx NMEA
3	Rx NMEA
4	PPS
5	GND
6	
7	
8	Event in
9	



In case of using Dewesoft's GNSS device, Dewesoft can prepare and provide the cabling needed to connect both devices.

Synchronization settings have to be adjusted as well. This can be done in DewesoftX settings under Local system first.

6. Outputs

ID	Used	Store	C	Name	Value	Unit
1	Used	Store		RPM	20.000	Hz
2	Used	Store		Laser intensity	20.000	Hz
3	Used	Store		Laser distance	20.000	Hz
4	Used	Store		Latitude	46°10.309' N	'
5	Used	Store		Longitude	15°03.313' E	'
6	Used	Store		Altitude	0.000	m
7	Used	Store		Direction	0.000	deg.
8	Used	Store		Velocity	0.026	km/h
9	Used	Store		Used satellites	4.000	
10	Used	Store		Absolute time	12:41:45 04-12-2020	

Image 16: Velodyne LIDAR sensor output channels

Velodyne LIDAR module outputs the following channels:

Output channel name	Description
RPM	Set frequency of LIDAR sensor rotation measured in Hz by default.
Laser intensity	Energy of the reflected laser pulse. Coloring of the points is related to the intensity.
Laser distance	Distance or depth of the laser pulse, which practically means the distance of the surrounding objects from the LIDAR sensor.
Latitude	Latitude data obtained from the GNSS device.
Longitude	Longitude data obtained from the GNSS device.
Altitude	Altitude data obtained from the GNSS device.
Direction	Direction data obtained from the GNSS device.
Velocity	Velocity data obtained from the GNSS device.
Used satellites	Used satellites data obtained from the GNSS device.
Absolute time	Absolute time data obtained from the GNSS device.

7. Visualization

Velodyne LIDAR module outputs can be clearly visualized on Dewesoft's **Map widget**. Map widget is a visualization tool that can preview 2D and 3D data of selected channels with right positioning on the Earth's surface. There are a few options of previewing map by different layers, such as Street maps, Satellite maps, Solid colour, ...

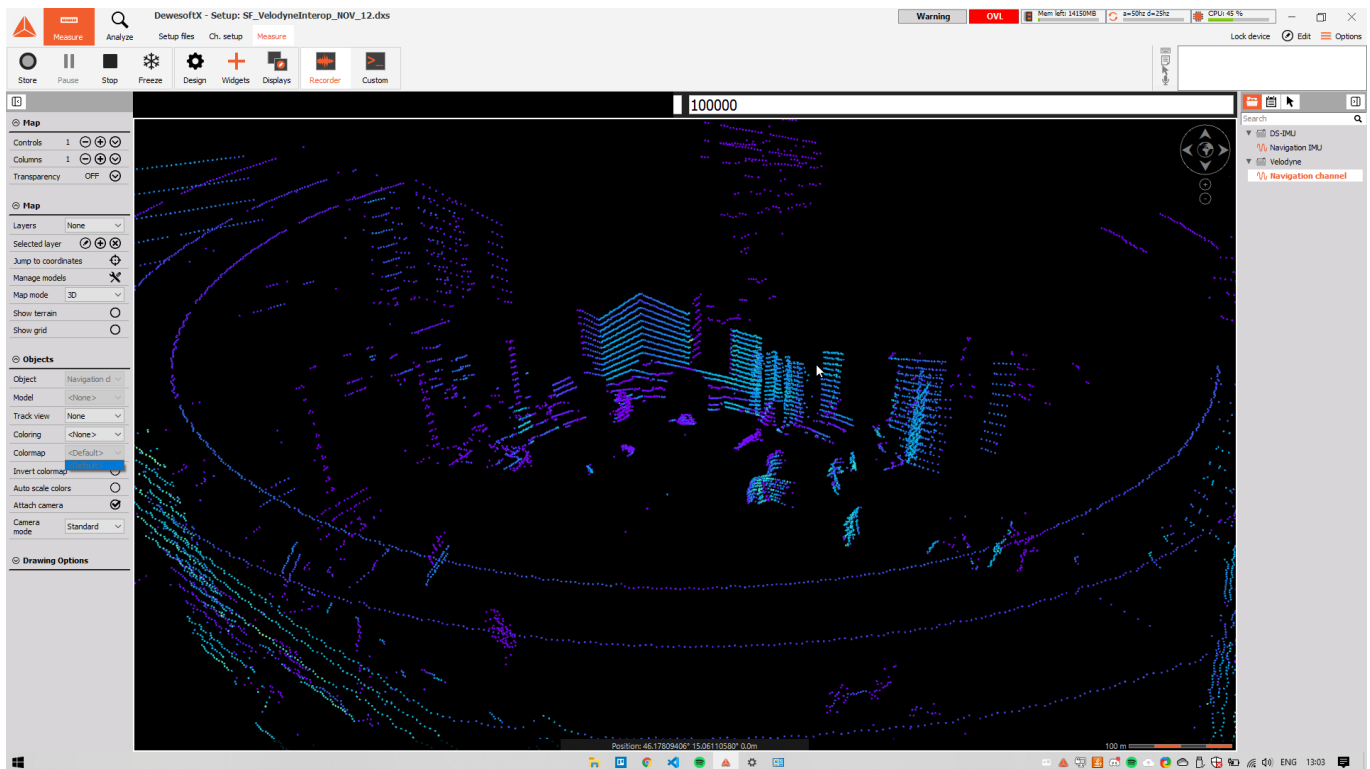


Image 17: 3D Map widget visualization of the office with LIDAR sensor and its data

7.1. Map Widget

On the Map widget you can preview 3D visualization of Velodyne LIDAR data. In order to preview LIDAR data, it is needed to select 3D visualization on the left side of the map widget user interface.

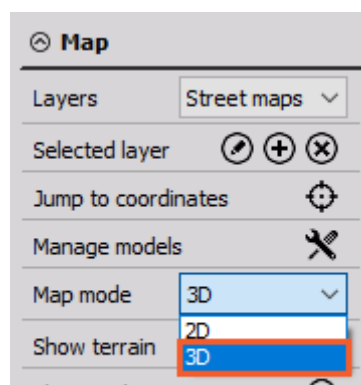


Image 18: 3D Map widget selection

7.1.1. 3D models

Predefined or custom 3D models of the vehicle for example, can be added in their real size scaling. This option gives a clear view of where the vehicle was moving, what environment surrounded it, and what were the distances between the vehicle object and surrounding area or items of interest.

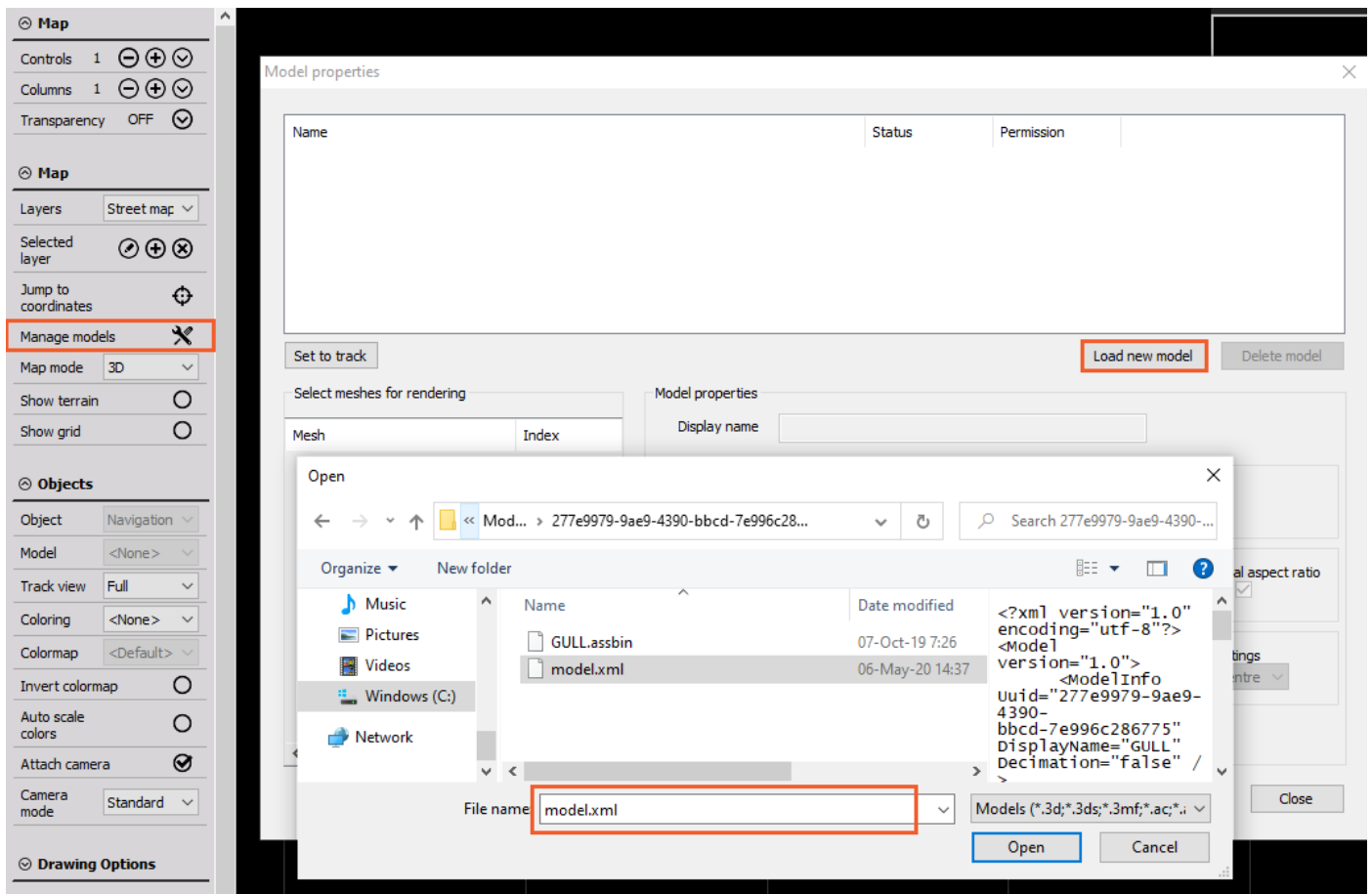


Image 19: Click on Manage models and add a new 3D model

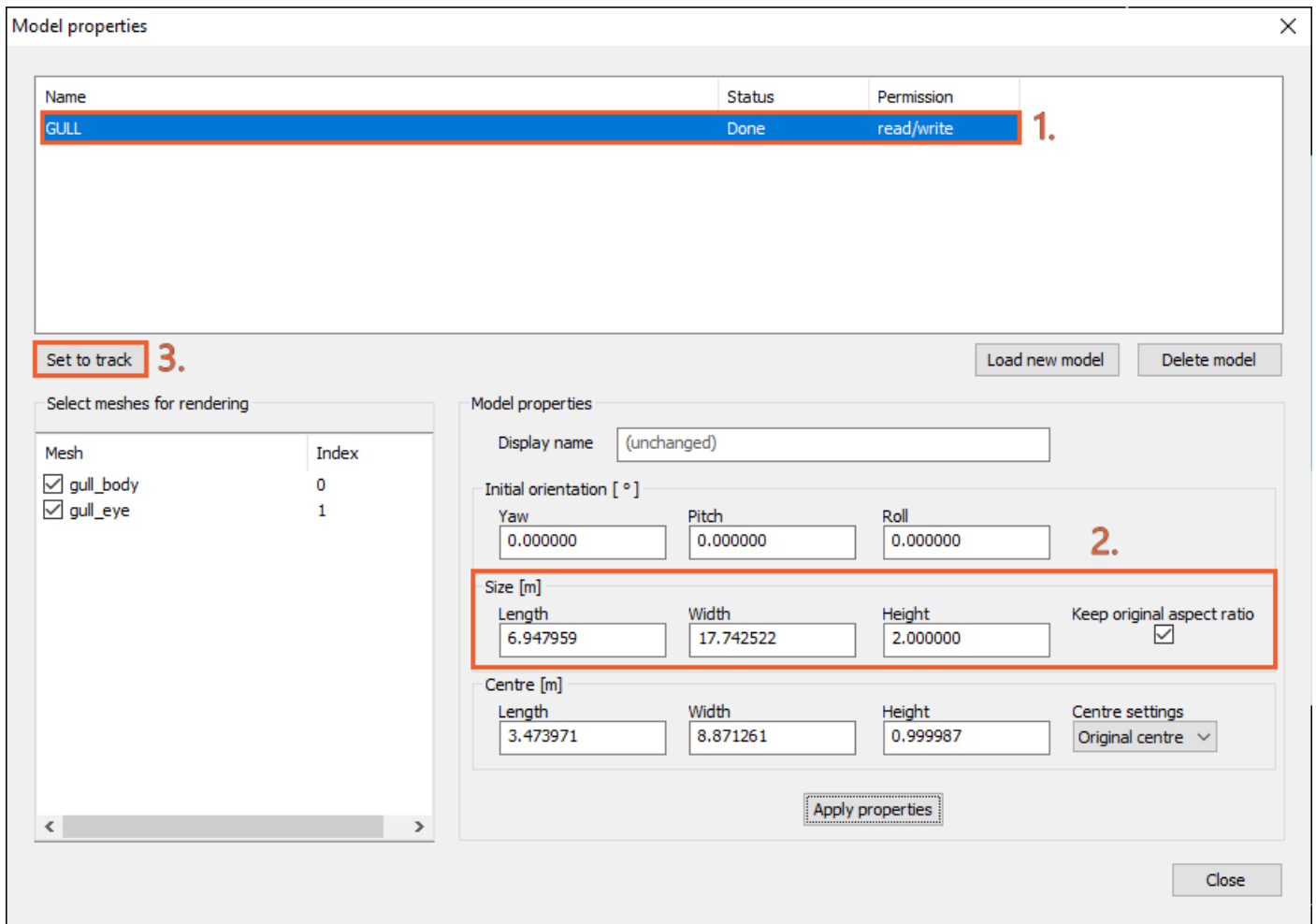


Image 20: Add imported 3D model to the Map widget visualization with the click on button Set to track

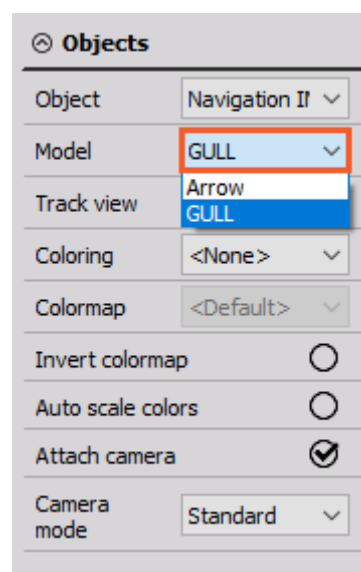


Image 21: Select 3D model under Objects → Model

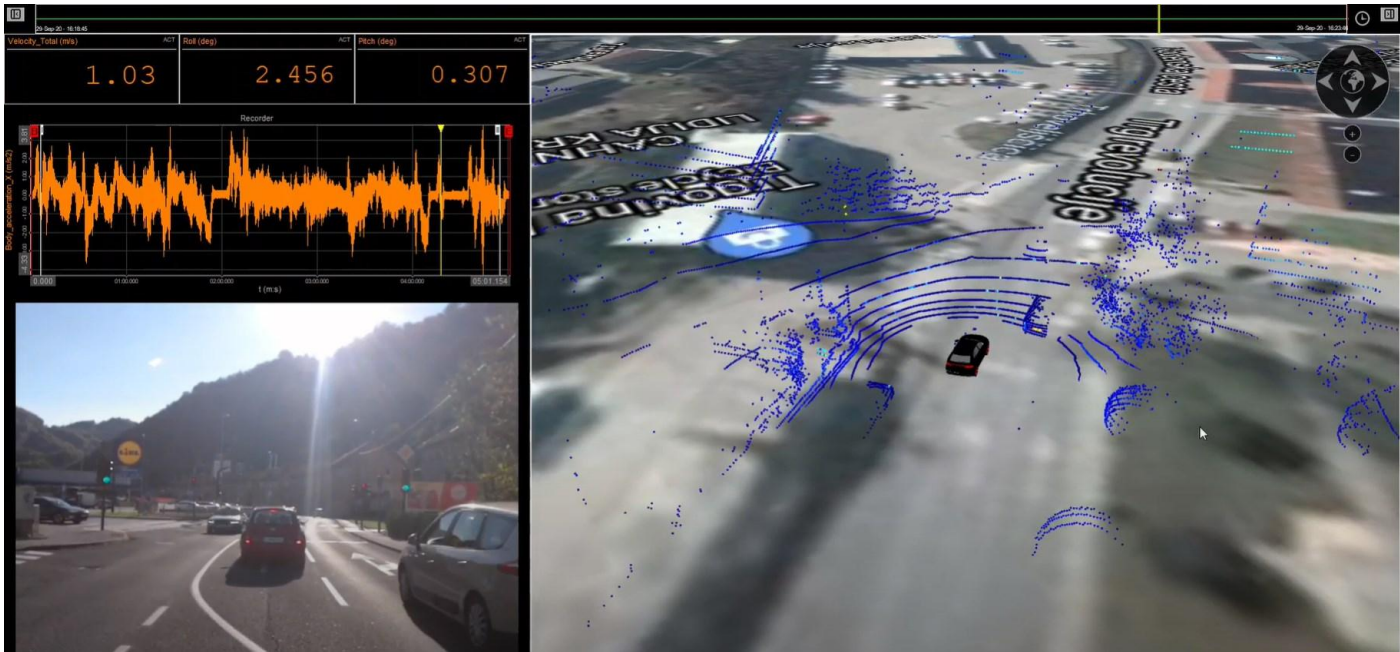


Image 22: 3D model together with LIDAR data on Map widget

7.1.2. Shortcuts

The following shortcuts can be used on the Map widget for LIDAR points data:

Shortcut	Description
CTRL + ALT + A	Change coloring on the next color
CTRL + ALT + S	Change coloring on the previous color
CTRL + ALT + Q	Invert colors

8. Warranty information

Notice

The information contained in this document is subject to change without notice.

Note:

Dewesoft d.o.o. shall not be liable for any errors contained in this document. Dewesoft MAKES NO WARRANTIES OF ANY KIND WITH REGARD TO THIS DOCUMENT, WHETHER EXPRESS OR IMPLIED. DEWESOFT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Dewesoft shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory, in connection with the furnishing of this document or the use of the information in this document.

The copy of the specific warranty terms applicable to your Dewesoft product and replacement parts can be obtained from your local sales and service office. To find a local dealer for your country, please visit <https://dewesoft.com/support/distributors>.

8.1. Calibration

Every instrument needs to be calibrated at regular intervals. The standard norm across nearly every industry is annual calibration. Before your Dewesoft data acquisition system is delivered, it is calibrated. Detailed calibration reports for your Dewesoft system can be requested. We retain them for at least one year, after system delivery.

8.2. Support

Dewesoft has a team of people ready to assist you if you have any questions or any technical difficulties regarding the system. For any support please contact your local distributor first or Dewesoft directly.

Dewesoft d.o.o.
Gabrsko 11a
1420 Trbovlje Slovenia

Europe Tel.: +386 356 25 300
Web: <http://www.dewesoft.com>
Email: Support@dewesoft.com
The telephone hotline is available Monday to Friday from 07:00 to 16:00 CET (GMT +1:00)

8.3. Service/repair

The team of Dewesoft also performs any kinds of repairs to your system to assure a safe and proper operation in the future. For information regarding service and repairs please contact your local distributor first or Dewesoft directly on <https://dewesoft.com/support/rma-service>.

8.4. Restricted Rights

Use Slovenian law for duplication or disclosure. Dewesoft d.o.o. Gabrsko 11a, 1420 Trbovlje, Slovenia / Europe.

8.5. Printing History

Version 2.0.0, Revision 217 Released 2015 Last changed: 23. July 2018 at 16:54.

8.6. Copyright

Copyright © 2015-2019 Dewesoft d.o.o. This document contains information which is protected by copyright. All rights are reserved. Reproduction, adaptation, or translation without prior written permission is prohibited, except as allowed under the copyright laws. All trademarks and registered trademarks are acknowledged to be the property of their owners.

8.7. Trademarks

We take pride in our products and we take care that all key products and technologies are registered as trademarks all over the world. The Dewesoft name is a registered trademark. Product families (KRYPTON, SIRIUS, DSI, DS-NET) and technologies (DualCoreADC, SuperCounter, GrandView) are registered trademarks as well. When used as the logo or as part of any graphic material, the registered trademark sign is used as a part of the logo. When used in text representing the company, product or technology name, the ® sign is not used. The Dewesoft triangle logo is a registered trademark but the ® sign is not used in the visual representation of the triangle logo.

9. Safety instructions

Your safety is our primary concern! Please be safe!

9.1. Safety symbols in the manual



Warning

Calls attention to a procedure, practice, or condition that could cause the body injury or death



Caution

Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

9.2. General Safety Instructions



Warning

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Dewesoft d.o.o. assumes no liability for the customer's failure to comply with these requirements.

All accessories shown in this document are available as an option and will not be shipped as standard parts.

9.2.1. Environmental Considerations

Information about the environmental impact of the product.

9.2.2. Product End-of-Life Handling

Observe the following guidelines when recycling a Dewesoft system:

9.2.3. System and Components Recycling

Production of these components required the extraction and use of natural resources. The substances contained in the system could be harmful to your health and to the environment if the system is improperly handled at its end of life! Please recycle this product in an appropriate way to avoid unnecessary pollution of the environment and to keep natural resources.



This symbol indicates that this system complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). Please find further information about recycling on the Dewesoft web site www.dewesoft.com

 Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment and is outside the scope of the 2002/95/EC RoHS Directive. However, we take care of our environment and the product is lead-free.

9.2.4. General safety and hazard warnings for all Dewesoft systems

Safety of the operator and the unit depend on following these rules.

- Use this system under the terms of the specifications only to avoid any possible danger.
- Read your manual before operating the system.
- Observe local laws when using the instrument.
- DO NOT touch internal wiring!
- DO NOT use higher supply voltage than specified!
- Use only original plugs and cables for harnessing.
- You may not connect higher voltages than rated to any connectors.
- The power cable and connector serve as Power-Breaker. The cable must not exceed 3 meters, the disconnect function must be possible without tools.
- Maintenance must be executed by qualified staff only.
- During the use of the system, it might be possible to access other parts of a more comprehensive system. Please read and follow the safety instructions provided in the manuals of all other components regarding warning and security advice for using the system.
- With this product, only use the power cable delivered or defined for the host country.
- DO NOT connect or disconnect sensors, probes or test leads, as these parts are connected to a voltage supply unit.
- Ground the equipment: For Safety Class 1 equipment (equipment having a protective earth terminal), a non-interruptible safety earth ground must be provided from the mains power source to the product input wiring terminals.
- Please note the characteristics and indicators on the system to avoid fire or electric shocks. Before connecting the system, please read the corresponding specifications in the product manual carefully.

- The inputs must not, unless otherwise noted (CATx identification), be connected to the main circuit of category II, III and IV.
- The power cord separates the system from the power supply. Do not block the power cord, since it has to be accessible for the users.
- DO NOT use the system if equipment covers or shields are removed.
- If you assume the system is damaged, get it examined by authorized personnel only.
- Adverse environmental conditions are Moisture or high humidity Dust, flammable gases, fumes or dissolver Thunderstorm or thunderstorm conditions (except assembly PNA) Electrostatic fields, etc.
- The measurement category can be adjusted depending on module configuration.
- Any other use than described above may damage your system and is attended with dangers like short-circuiting, fire or electric shocks.
- The whole system must not be changed, rebuilt or opened.
- DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until the safe operation can be verified by service-trained personnel. If necessary, return the product to Dewesoft sales and service office for service and repair to ensure that safety features are maintained.
- If you assume a more riskless use is not provided anymore, the system has to be rendered inoperative and should be protected against inadvertent operation. It is assumed that a more riskless operation is not possible anymore if the system is damaged obviously or causes strange noises. The system does not work anymore. The system has been exposed to long storage in adverse environments. The system has been exposed to heavy shipment strain.
- Warranty void if damages caused by disregarding this manual. For consequential damages, NO liability will be assumed!
- Warranty void if damage to property or persons caused by improper use or disregarding the safety instructions.
- Unauthorized changing or rebuilding the system is prohibited due to safety and permission reasons (CE).
- Be careful with voltages >25 VAC or >35 VDC! These voltages are already high enough in order to get a perilous electric shock by touching the wiring.
- The product heats during operation. Make sure there is adequate ventilation. Ventilation slots must not be covered!
- Only fuses of the specified type and nominal current may be used. The use of patched fuses is prohibited.
- Prevent using metal bare wires! Risk of short circuit and fire hazard!
- DO NOT use the system before, during or shortly after a thunderstorm (risk of lightning and high energy over-voltage). An advanced range of application under certain conditions is allowed with therefore designed products only. For details please refer to the specifications.
- Make sure that your hands, shoes, clothes, the floor, the system or measuring leads, integrated circuits and so on, are dry.
- DO NOT use the system in rooms with flammable gases, fumes or dust or in adverse environmental conditions.
- Avoid operation in the immediate vicinity of high magnetic or electromagnetic fields, transmitting antennas or high-frequency generators, for exact values please refer to enclosed specifications.
- Use measurement leads or measurement accessories aligned with the specification of the system only. Fire hazard in case of overload!

- Do not switch on the system after transporting it from a cold into a warm room and vice versa. The thereby created condensation may damage your system. Acclimatise the system unpowered to room temperature.
- Do not disassemble the system! There is a high risk of getting a perilous electric shock. Capacitors still might be charged, even if the system has been removed from the power supply.
- The electrical installations and equipment in industrial facilities must be observed by the security regulations and insurance institutions.
- The use of the measuring system in schools and other training facilities must be observed by skilled personnel.
- The measuring systems are not designed for use in humans and animals.
- Please contact a professional if you have doubts about the method of operation, safety or the connection of the system.
- Please be careful with the product. Shocks, hits and dropping it from already- lower level may damage your system.
- Please also consider the detailed technical reference manual as well as the security advice of the connected systems.
- This product has left the factory in safety-related flawlessness and in proper condition. In order to maintain this condition and guarantee safety use, the user has to consider the security advice and warnings in this manual.

EN 61326-3-1:2008

IEC 61326-1 applies to this part of IEC 61326 but is limited to systems and equipment for industrial applications intended to perform safety functions as defined in IEC 61508 with SIL 1-3.

The electromagnetic environments encompassed by this product family standard are industrial, both indoor and outdoor, as described for industrial locations in IEC 61000-6-2 or defined in 3.7 of IEC 61326-1.

Equipment and systems intended for use in other electromagnetic environments, for example, in the process industry or in environments with potentially explosive atmospheres, are excluded from the scope of this product family standard, IEC 61326-3-1.

Devices and systems according to IEC 61508 or IEC 61511 which are considered as “operationally well-tried”, are excluded from the scope of IEC 61326-3-1.

Fire-alarm and safety-alarm systems, intended for the protection of buildings, are excluded from the scope of IEC 61326-3-1.

10. Documentation version history

Version	Date	Notes
V20-1	10-12-2020	Initial version.
V21-1	22-01-2021	New template.
V23-1		Added supported models