LSH-10

Laser snow height

Manual

Setup version 2.52.10 (Firmware 2.45.00)

17.07.2026

Sommer Messtechnik

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Validity

This manual applies to the Laser snow height with the setup version 2.52.10, including all its sub-versions.

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EU conformity

CE

This product is in conformity with the following standards:

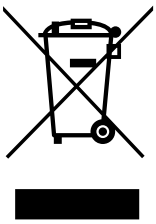
EMC	2014/30/EU	EN 301 489-1 V1.9.2
EMC	2014/30/EU	EN 61326-1:2013
		EN 55022:2010
LVD	2014/35/EU	EN 62311:2008
		EN 62368-1:2014
RED	2014/53/EU	EN 300 440-2 V1.4.1
RoHS II	2011/65/EU	EN 50581:2012
RoHS III	2015/863/EU	
REACH	1907/2006/EU	

Safety information

Please read this manual carefully before installing or operating this equipment. Non-compliance with the instructions given in this manual can result in failure or damage of the equipment or may put people at risk by injuries through electrical or mechanic impact.

- Make sure that the personnel responsible for installation, configuration and maintenance is familiar with the applicable regulations and standards!
- Do not perform any installations in bad weather conditions, e.g. thunderstorms.
- Prior to installation of equipment inform the owner of the measurement site or the authority responsible for it. Upon completion, secure the installation from trespassers.
- Maintenance and repair must be performed by trained personnel or an engineer of Sommer Messtechnik. Only replacement parts supplied by Sommer Messtechnik should be used for repairs.
- Make sure that NO power is connected to the equipment during installation and wiring!
- Only use a power supply that complies with the power rating specified for this equipment!
- Keep equipment dry during wiring and maintenance!
- If applicable, it is recommended to use accessories of Sommer Messtechnik with this equipment.

Disposal



After this device has reached the end of its lifetime, it must not be disposed of with household waste! Instead, dispose of the device by returning it to a designated collection point for the recycling of waste electrical and electronic equipment.

Feedback

Should you come across any error in this manual, or if you miss information to handle and operate the LSH-10 we are pleased to receive your feedback to office@sommer.at.

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1 What is the LSH-10?

The LSH-10 is a device for real-time non-contact determination of snow depth which has been developed to work under extreme conditions and environments.

The laser has an inbuilt heater which allows it to operate at temperatures sub-freezing. It can be applied to the site as a single sensor or as part of a comprehensive weather monitoring station to provide detailed insights into site-specific snow accumulation patterns.

2 Unpacking

When unpacking your LSH-10 sensor box please make sure that the following items are present:

Qty	Name
1	Laser Snow Depth Sensor, LSH-10, Standard Bundle, 10 m cable
1	USB to RS485 embedded converter cable, 1.8 m
1	Manual and Commander Software on USB stick

In case of missing or damaged items please contact your Sommer Messtechnik sales partner.

3 Get started

Follow the steps described below to set the basic configurations and to acquire the first measurement results.

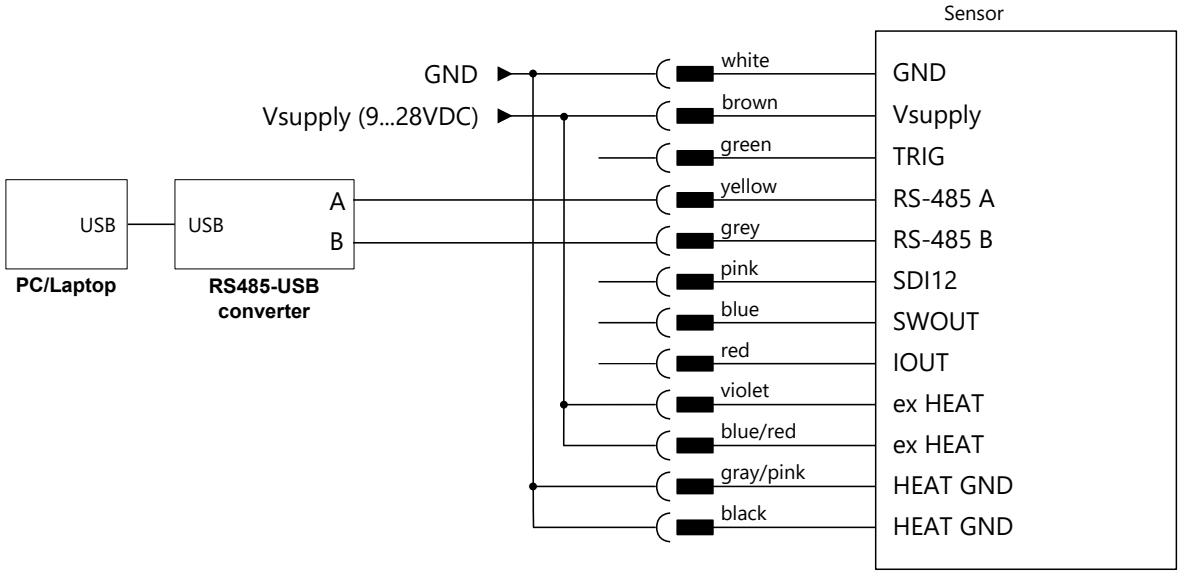


NOTE Perform the first start-up in your lab or office before installing the equipment in the field!

3.1 Connect the LSH-10 to your PC

1. Install or update the FTDI drivers for USB to Serial Communication.
2. Install the Commander support software (see Installation of Commander).
3. Connect the yellow and gray wires of the sensor cable to the RS-485 to USB converter cable and plug it into your PC as illustrated in the figure below.
4. Connect a 9…28 VDC power supply to the LSH-10 as shown in the figure below.
5. Click on Communication assistant on the right-hand side of the Commander window and follow the instructions.
   a. As Type of connection select *Serial connection*
   b. As Device type select *Sensor (9600 Bd)*
   c. Select New connection and select the COM port

   During this procedure the communication assistant will search for connected devices. Upon successful completion, the new connection is added to the connections list (tab Connections (F8)).
6. In the Communication section at the right-hand side of the Commander window select Mode Connection and the previously created connection from the drop-down list.
7. Click Connect to establish a connection with the LSH-10. If the connection was successful a green icon is displayed at the top-right corner of the Commander window.
8. Select the tab Parameters (F2) and click Download parameters from device on the left side of the Commander window. The complete parameter list is transferred from the sensor to your PC and displayed in the Parameter window.

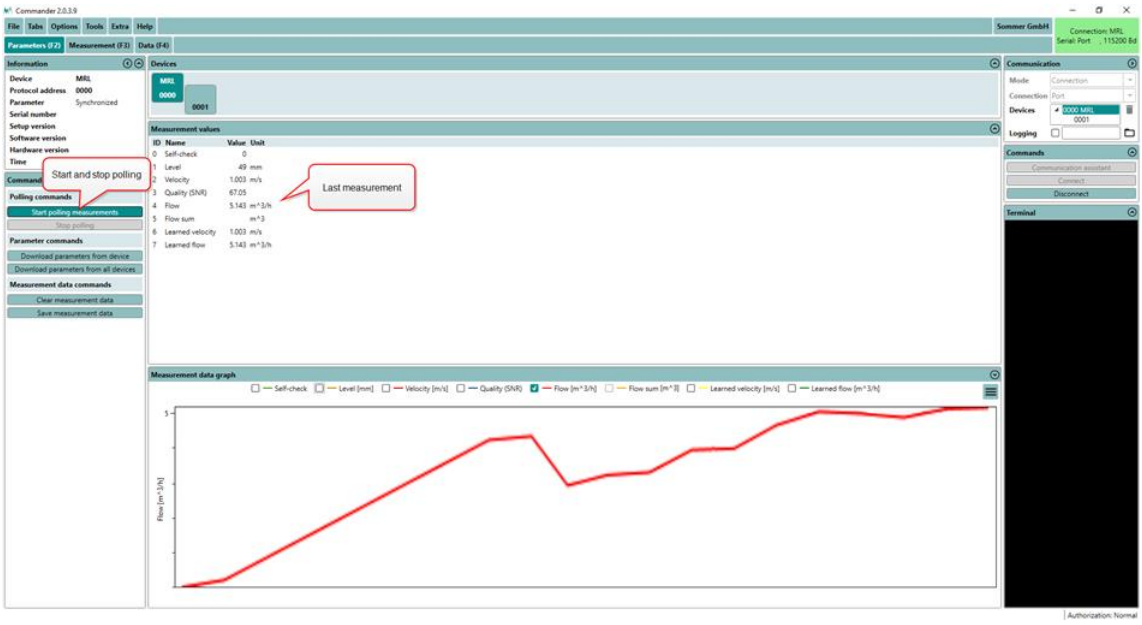


3.2 Configure the LSH-10

1. Select language, decimal character, units and decimal places (see General settings)
2. Configure the LSH-10 for the required application
3. Define scope and structure of the data output (see General settings)
4. Optional: Configure analog outputs (see Analog output)
5. Send any modifications to the LSH-10 by clicking Upload modified parameters to device.

3.3 Acquire measurements

1. Establish a connection to your device as described in Working with connections.
2. Download the setup of your device as described in Download setup.
3. Select the Measurement (F3) tab.
4. In the Commands section click Start polling measurement.
5. Select the option Polling with measurements. Now, the Commander will trigger measurements of the LSH-10 without any delays between measurements. The results are displayed Measurement values and plotted in the Measurement data graph.
6. To finish polling mode click Stop polling.



7. No data is stored during this time.

4 How the LSH-10 works

The LSH-10 is a sensor to measure distance non-contact. A red laser with a wavelength between 620-690nm is emitted from the sensor-head and reflected at any surface.

The laser signals produced by the sensor head are filtered for interferences and disturbing reflections, e.g. from precipitation. This permits reliable and accurate level measurements even during rain or snowfall, or when the snow is of very low density.

With the integrated, intelligent signal processing and the automatic switching between standby- and measurement-mode the power consumption can be minimized. With a 12-Ah battery the LSH-10 can be operated for approx. 24 days with one measurement per minute at temperatures above freezing.



5 Components

5.1 MAIN connector

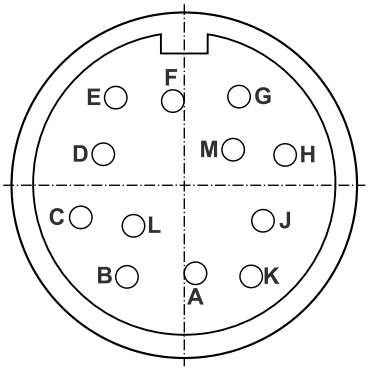


Figure 1 MAIN connector

	Pin	Color	Function	Description
Power supply	A	brown	Vsupply	9...28 VDC
	D	white	GND	Ground
Trigger input	B	green	Trig	low: 0...0.6 V, high: 2...27 V
RS-485 interface	C	yellow	RS485 A	1 x RS-485 (1200...115200 Baud)
	H	gray	RS485 B	1 x RS-485 (1200...115200 Baud)
SDI-12 interface	E	pink	SDI-12	1 x SDI-12 (1200 Baud)
Analog outputs	G	blue	SWOUT	Digital output
	F	red	IOUT1	Snow depth/distance (4...20 mA)
Heater	J	violet	Heater Vsupply	12V / 24V DC
	L	blue/red		12V / 24V DC
	K	grey/pink	Heater GND	Ground
	M	black		Ground

NOTE The analog outputs and the trigger input are referenced to GND on pin D.

ATTENTION The heating wire pairs are prone to short wiring errors. Please take care when connecting these wires to the heating supply. It is necessary to place at least one fuse (max. 2 A) in the heating supply output to avoid damage to the LSH-10.

6 Specifications

General	
Power supply	9…28 VDC
Housing	Dimensions: Ø 90 mm, Length 300 mm, Weight: 1,2 kg Material: Anodized aluminum
Sensor mount	Ø 32-60 mm
Operating temperature	-40…60 °C (-40…140 °F)
Protection	IP65
Lightning protection	Integrated (0,6 KV peak)

Snow depth measurement	
Measurement range	0 …10 m
Minimum distance to the maximum expected snow depth	0,15 m
Accuracy	less ± 3 mm
Resolution	0,1 mm
Measurement principle	Laser distance measurement
Measurement angle	0…30°

Energy consumption	
Consumption without heating	active (measurement approx. 1 sec), typ. 60 mA (12 V)
Consumption with heating	typ. up to 900 mA (12 V) or 1800 mA (24 V)
Consumption @ 12 V DC	sleep less 0,4 mA
Heating laser module	1 A (Active type less -9,5 °C)

Laser data	
Laser diode	Laser 635 nm (viewable red)
Laser class	class II, conforming to Standart IEC 825-1, EN 60825
Laser power	less 1 mW
Laser measurement diameter	less 10 mm in 10 m distance
Certificates	CE; FCC Zertifikat: EMC : 61326-1; EN 610101-1

Interfaces	
Analogue	Snow depth or distance 4…20 mA Signal; Resolution: 14 Bit max. Load: 250 Ω
Digital	SDI-12, RS-485 (Protocol ASCII / Modbus RTU) Digital output values string: Snow depth; Distance to snow

Packaging	
Carton	475x225x255 mm Weight: about 1,6 kg

7 Installation

7.1 Site selection

The selection of a suitable site is crucial to gain accurate level and snow depth data that are representative of the monitored area. Several aspects have to be considered when choosing a site, especially for snow depth measurements:

1. The measurement spot should be representative of the monitored area. This applies to the weather conditions as well as to the ground surface. Different surfaces, e.g. grass and gravel, have different thermal properties and consequently influence snow accumulation and snow melt.
2. The terrain should be flat. There should be no troughs or hills.
3. There should be no boulders, trees, fences or other objects on and around the measurement spot. Any obstacle can cause snow drift and thus affect the snow depth measurement.
4. The site should be exposed to wind as little as possible.
5. The site must be safe from avalanches.
6. If the measurement spot is on or near a slope any snow gliding has to be ruled out.
7. If the timing of an emerging snow cover is of interest (e.g. for monitoring of road conditions), the LSH-10 must be installed above a flat, paved or artificial surface.

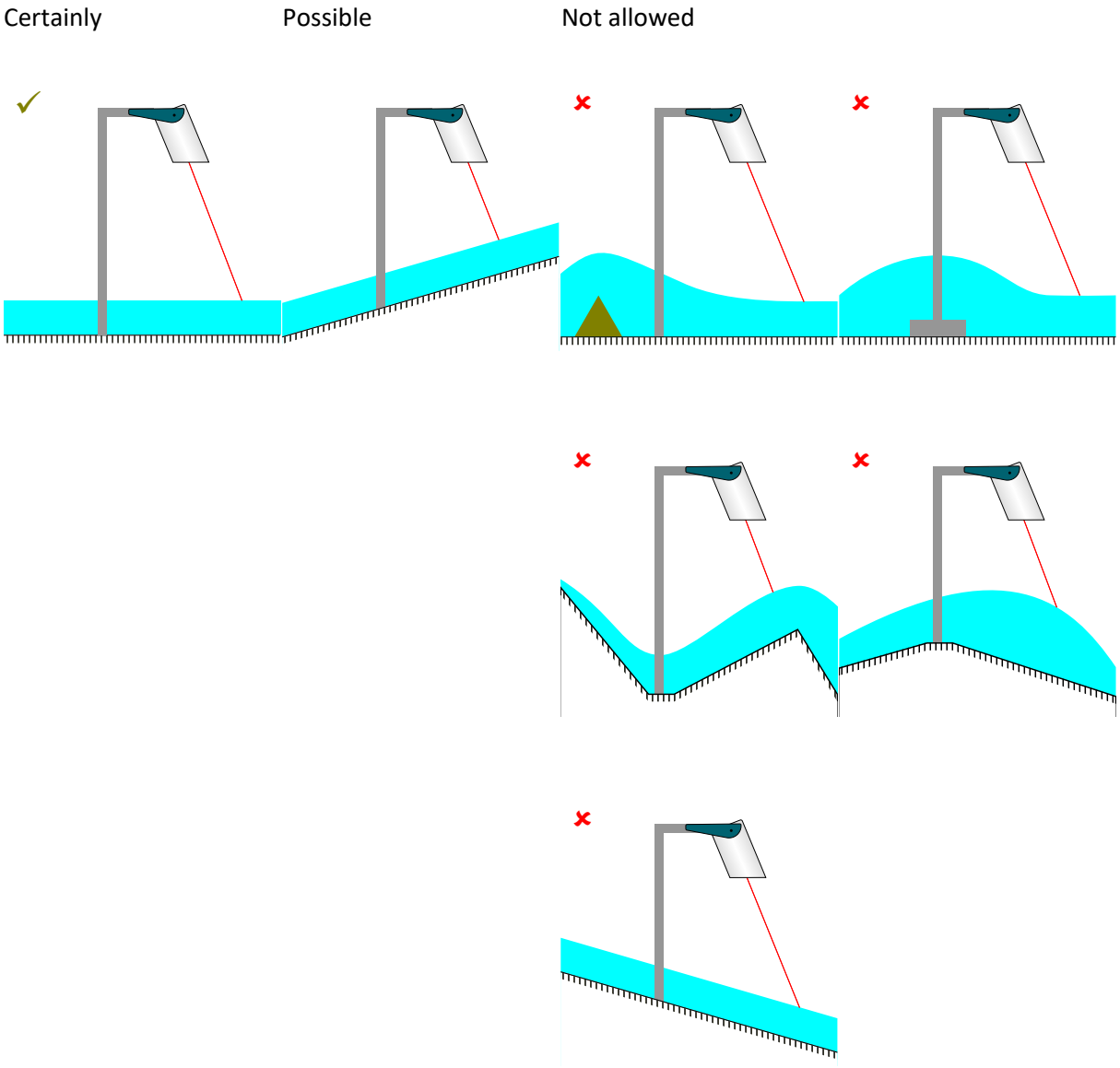
7.2 Things to consider for installation

The LSH-10 can be mounted to a horizontal tube with the included bracket (max. tube diameter 60 mm).

When planning the installation of a LSH-10 the extension of the laser measurement beam has to be taken into account. The higher the sensor is mounted the bigger the diameter of the measurement spot. Consequently, the mast and cross-beam must be designed in such a way that they do not interfere with the laser beam and thus create unwanted reflections. The LSH-10 must be mounted with an inclination angle, because of fallen down debris and to add some additional distance to the mounting mast. Choose sites with a lot of unused space underneath the mast.

Take care, that the inclination angle of the slope is not too steep, because the snow depth on steep slopes depends a lot from the wind situation and factors while it is snowing. It is something different, if you want to monitor a dedicated slope to forecast an avalanche risk actually on this certain slope, or if you want to measure snow depth to get a comparable information how much snow has been accumulated in the region in general.

Location options:



Take care about the surroundings. Don't mount it close to nearby items, which are interfering the snow surface. Don't mount it on mountain tops or ridges, where the wind blown out the snow and icing cover the sensor from underneath.

If you have to build some fences around the measuring spot, take care about the necessary fence height and the necessary distance to the measuring spot. Windblown dispersal has to be considered.

The laser can't measure in a predictable way when the snow surface has been cracked by people, animals, fallen down snow, or melting drops from the mounting complex, also the mast can crack an even plain snow surface by windblown dispersal.

It is recommended to mount the LSH-10 one meter above the maximum expected snow height and minimum 0.15 m above ground. The maximum mounting height is 10 m above ground. As an

accessory, Sommer Messtechnik provides a rotatable cross-arm or mounting accessories for easy sensor mounting.

If a snow-depth monitoring site needs to be secured by a fence, the distance between the fence and the LSH-10 should be large enough to avoid snow build-up or snow drift.

7.2.1 Power supply

The LSH-10 is designed for extreme environmental conditions at remote sites and with no grid connection. Energy consumption is most affected by the frequency of measurement and the state of the environment (weather, time of day, wind, etc.). The lower the temperature, the longer the heating runs before each measurement (if it is below -9,5 °C).

LSH-10 must have a continuous "Always On" power supply.

ATTENTION When connecting wires to the heating, it is necessary to install at least one fuse (max. 2 A) at the heating output (before the split of the wiring connectors) to avoid damage to the power supply and the LSH-10.

7.2.2 Signal cables

Please consider the maximum cable lengths for the applied transmission protocol:

Cross section	Max. cable length
12 × 0,25 mm²	~60 m (depending on wire cross section and number of sensors)
12 × 0,75 mm²	~300 m

NOTE Cable lengths longer than 60 m require a heavier gauge wire if the power supply drops below 11 V.

7.2.3 Lightning protection

If the underground at the measurement site permits sufficient current dissipation it is strongly recommended to equip the sensor support or mast with properly dimensioned lightning protection. Consult an expert for advice.

The LSH-10 is protected against overvoltage. If a data logger is mounted to the mast, its ground lug must be properly connected to earth ground.

NOTE Lightning protection, fuses and long cables are strongly affecting heating performances. We strongly recommend to keep the whole resistance of the wiring path (to sensor and back to supply) under 3-5 Ohms (DC driven).

7.3 Required tools and equipment

Prepare the following tools and equipment to install the LSH-10:

Qty	Tool
1	Mounting tube Ø 32…60 mm
1	Flat spanner 13 mm
1	Wire cutter
several	Cable ties

7.4 Mounting

The LSH-10 must be mounted with an inclination angle, because of fallen down debris and to add some additional distance to the mounting mast.

TIP

If the measurement spot is sloping, make sure the bottom surface LSH-10, where the laser exits the housing, should be perpendicular to the surface beneath.

When the measurement spot is sloping, ensure the laser beam is at a right angle (90°) to the surface you're measuring.

Make sure the slope isn't too steep, because the snow depth can change a lot depending on the wind.

NOTE Never tilt the LSH-10 towards the base of the mast as this can cause unwanted reflections. To avoid such a situation, consider rotating the mast or selecting another measurement spot.

If the surface is plain and horizontal **only then**, you can work with the internally measured inclination angle of the LSH-10 and then with the implemented test mode "GEOM, inclination compens.", to do the "Distance factor" automatically.

Connect the signal cable to the LSH-10 and route it to the location of the data acquisition unit. Fix the cable with cable ties.

ATTENTION

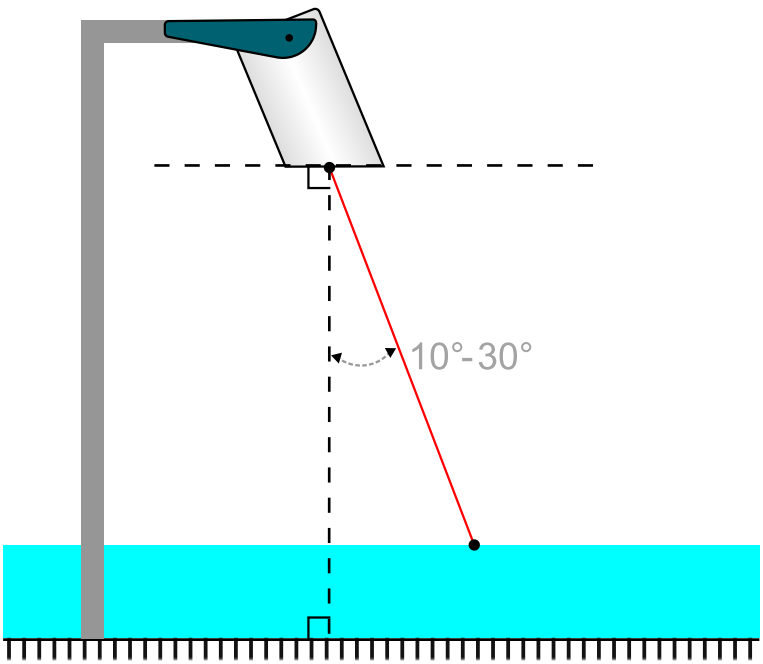
The LSH-10 contains a Class 2 laser module. Looking into the **laser beam may be hazardous to the eyes**.

Take care about "Laser beams" and helicopter traffic! Helicopter pilots must be alerted, if the measuring site complex could be possibly damaged in a way, that the LSH-10 laser beam doesn't points down anymore.

7.5 Installation and Setup Guide

7.5.1 Mounting the LSH-10

1. Attach to the mast
   - Mount the LSH-10 on a properly oriented arm or cantilever attached to the mast.
   - Adjust the laser to an inclination of 10–30 degrees from vertical.
     Ensure the underside of the LSH-10 housing is nearly horizontal in all directions.



2. Orient the laser

- Rotate the LSH-10 around the vertical axis to point toward a clear, unobstructed area on the ground.
- Avoid pointing it at the mast or areas where debris might accumulate.
- Ensure it does not point toward high-traffic areas where the snow surface could be disturbed.
- If the site has a slope, aim the laser uphill and perpendicular to the surface.

3. Secure the mounting
   - Tighten the screws to secure the sensor, ensuring it cannot shift accidentally. The screws should be snug but not overtightened.
   - Confirm the LSH-10 remains stable and cannot be moved with light pressure.
4. Positioning considerations
   - Ensure the arm or cantilever provides sufficient clearance from the mast under all potential snow depth conditions.
   - Use an arm of moderate length to achieve the required distance without needing to increase mast height.
   - Confirm the arm is strong enough to support maximum potential icing without bending or distortion.
5. Mast stability
   - Ensure the mast is stable and does not sway significantly in the wind.
   - After any climbing or adjustments, verify the LSH-10 remains properly positioned.
   - Perform checks after climbing to ensure the setup is unaffected.

7.5.2 Cable installation

Route the cable through a conduct or along the mast as required.

Turn off the entire system before connecting any cables.

Connect the LSH-10

- Attach the LSH-10 cable to the datalogger and power supply.
- Double-check all connections to avoid short circuits before powering the system back on.

7.5.3 Initial functionality check

Ground Testing

- Power on the system and confirm the LSH-10 and logger are functioning properly.
- Perform a simple distance measurement using the LSH-10.
- If the logger controls measurement timing, allow time for results to appear.

Logger Interface Check

- If using an RS-485 connection, disconnect the logger and connect a laptop with Commander software to the LSH-10. Ensure correct port settings or use an automatic scan to establish communication.

7.5.4 Configuration and calibration

Perform the following tests in sequence:

1. Geometric adjustment
   - Use the "GEOM, inclination compens." mode to determine the distance factor for the site (**only** if the surface is flat).
2. Locate laser target
   - Identify the laser target point using a reflective surface (e.g., paper).
   - Mark the target area with a clear, stable surface (e.g., a stone or slab) that integrates smoothly into the natural ground.
3. Snow depth adjustment
   - Measure the distance to the target surface and set the "Snow depth, distance to zero" value:
   - If snow is already present, input the current snow depth, if no snow is present, input "0".
4. Snow depth verification
   - Confirm the snow depth reading is accurate. If correctly configured, the snow depth should read zero.
5. Heating test
   - Verify the heating system is operational.
6. Optional tests
   - Simulate Dig Out: Test the logger response by setting the "Dig Out" to high voltage.
   - Simulate current output: Verify logger scaling for the 4-20 mA analog output.
   - Reset Measurements: Reset cumulative measurement values to start a new observation period.

7.5.5 Final steps

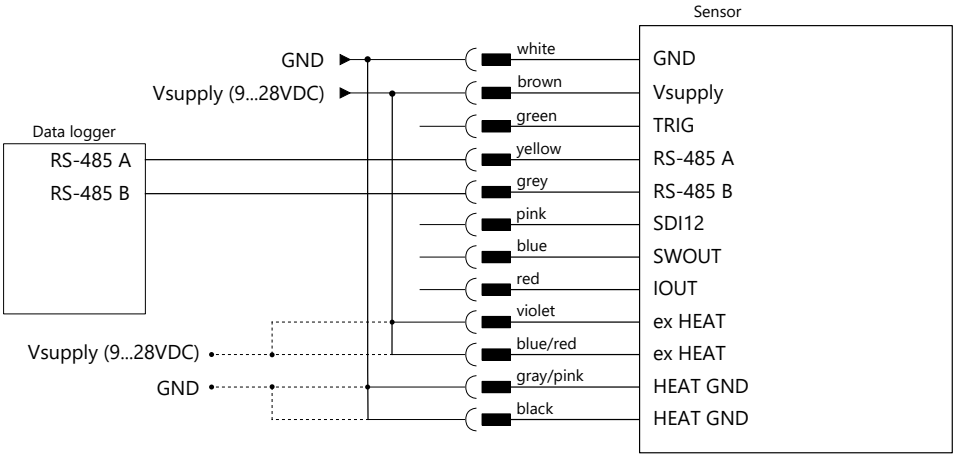
- Disconnect the laptop/Commander and reconnect the logger's RS-485 wires.
- Ensure the installation site is clean and free of items that could interfere with snow accumulation (e.g., poles, fences).

7.6 Wiring

ATTENTION
If multiple Sommer Messtechnik devices are connected to a data logger over the same bus, all devices must share the same ground (GND)!

7.6.1 RS-485 wiring

Connect the LSH-10 to a data logger or RS-485 network according to the figure below.



ATTENTION
If multiple Sommer Messtechnik devices are connected to a data logger over the same bus, all devices must share the same ground (GND)!

7.6.2 SDI-12 wiring

Connect the LSH-10 to a data logger by SDI-12 according to the figure below.

SDI-12 uses a shared bus with a ground wire, a data wire (indicated as SDI-12) and an optional +12 V wire.

NOTE The connection with the 12 V power supply is optional and depends on the connected SDI-12 master device (typically a data logger).

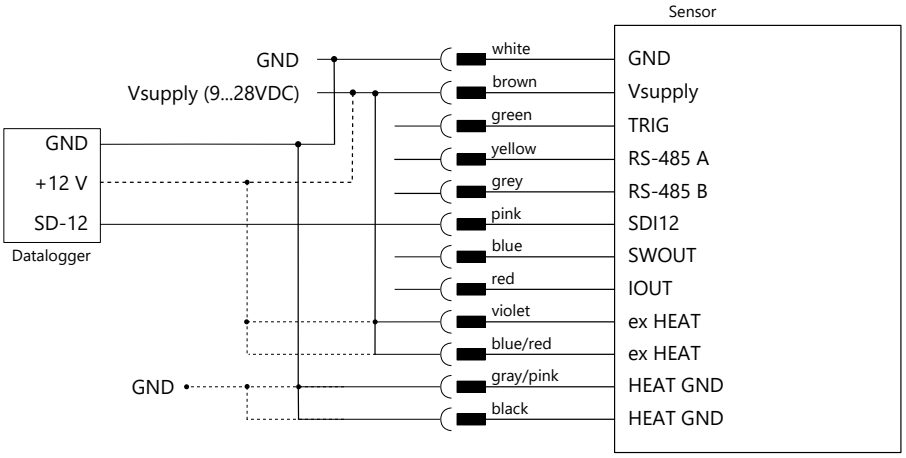
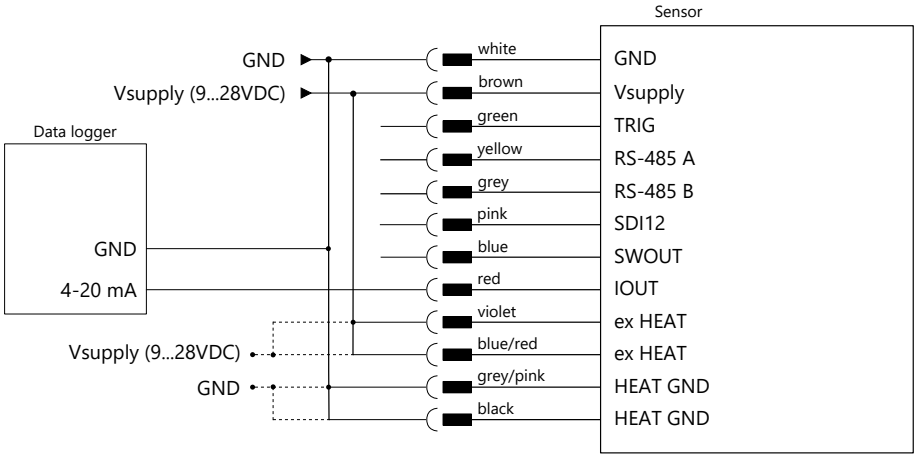


Figure 2 Wiring of the LSH-10 with a data logger via SDI-12

7.6.3 How to wire analog outputs

Connect the analog outputs of the LSH-10 to a data acquisition device according to the figure below.



NOTE If a data logger is connected to the IOUT outputs, the resistance of the logger input(s) must not exceed 470 Ω.

7.7 Testing

Verifying distance measurement for LSH-10 Sensor.

Follow these steps to verify the distance measurement using the Parameter (F2) tab:

1. Search for the laser target point
   - Select "Search flashing laser point" to identify the laser target.
   - The easiest way to find the target is using a sheet of paper.
   - Ensure the target surface is even, without dimples or swells, and aligns with the natural surface. This will serve as a reliable reference for the "Snow depth, distance to zero" measurement.
2. Measure inclination and set distance factor
   - Start the "GEOM, inclination compens." mode to measure the inclination and set the "Distance factor".
   - Answer all questions carefully during this process. After completing the adjustments, check the new "Distance factor" in the Commander interface.
3. Adjust snow depth measurement
   - Use the "Snow depth, adjust" mode to let the LSH-10 perform a measurement to the defined surface.
   - Set the "Snow depth, distance to zero" value:
   - If snow is present at the time of installation, input the actual snow depth.
   - If there is no snow, input 0.
   - After adjustments, the "Snow depth, distance to zero" value will be updated automatically.
4. Test snow depth measurement
   - Run the "Snow depth, test" mode to verify the measured distance and snow depth values.
5. Verify measurement accuracy
   - Move the object away from the laser and ensure the distance values change as expected.
   - Check that the difference between the measured distances corresponds to the height of the object that was moved.

7.8 Initial Power

Upon initial power-up of the system and when power is supplied to the sensor, the LSH-10 will stabilize **within 60 seconds or less**. The time from when power is applied to the sensor to when it begins reporting data is also 60 seconds or less.

NOTE

Due to the heating function of the LSH-10, ensure that the 'ex HEAT' and 'GND' cables are properly connected to the sensor.

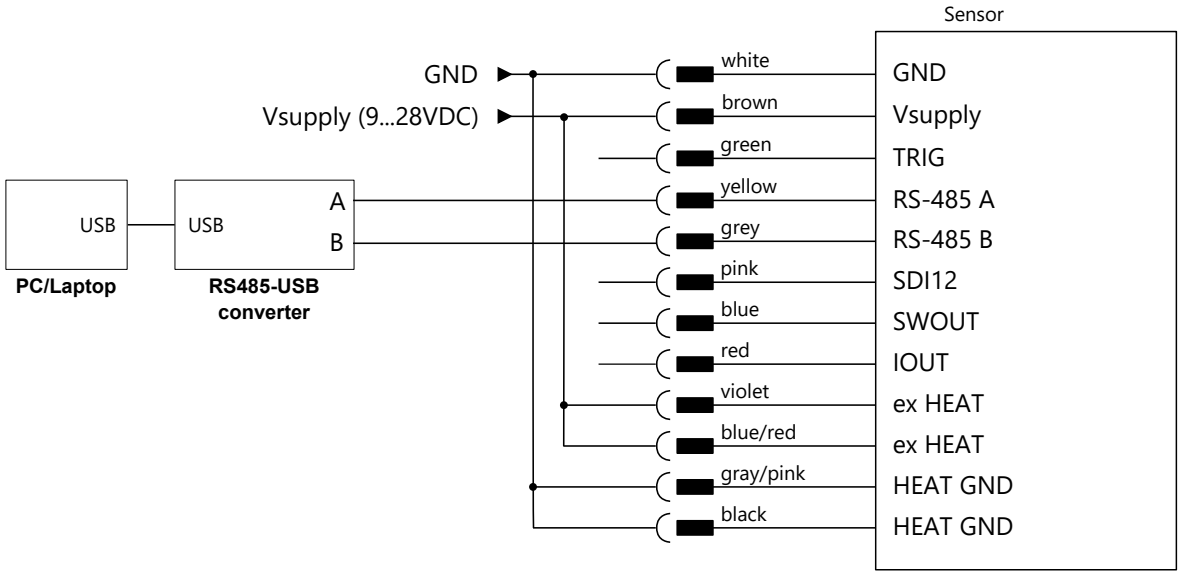
While both the heating and measurement functions can use the same power supply, it is also possible to split the heating and measurement functions, providing them with separate power supplies. This setup may be necessary for sites with limited power resources.

8 Operation

8.1 Connect device to PC

1. Install or update the FTDI drivers for USB to Serial Communication.
2. Install the Commander support software (see Installation of Commander).
3. Connect the yellow and gray wires of the sensor cable to the RS-485 to USB converter cable and plug it into your PC as illustrated in the figure below.
4. Connect a 9…28 VDC power supply to the LSH-10 as shown in the figure below.
5. Click on Communication assistant on the right-hand side of the Commander window and follow the instructions.
   a. As Type of connection select *Serial connection*
   b. As Device type select *Sensor (9600 Bd)*
   c. Select New connection and select the COM port

   During this procedure the communication assistant will search for connected devices. Upon successful completion, the new connection is added to the connections list (tab Connections (F8)).
6. In the Communication section at the right-hand side of the Commander window select Mode Connection and the previously created connection from the drop-down list.
7. Click Connect to establish a connection with the LSH-10. If the connection was successful a green icon is displayed at the top-right corner of the Commander window.
8. Select the tab Parameters (F2) and click Download parameters from device on the left side of the Commander window. The complete parameter list is transferred from the sensor to your PC and displayed in the Parameter window.



To activate the communication between your device and the Commander software follow the steps described in Working with connections.

8.2 How do I test the LSH-10 indoors?

To test the LSH-10 and to verify its distance/level measurements turn the device upside down so that it is facing the ceiling of a room. Now, click the button Snow depth, test in the Snow depth and geometry menu. The LSH-10 then triggers a measurement and returns the current distance and level.

Place a sturdy, flat object (e.g. book) underneath the LSH-10 and perform additional measurements to check a second distance/level.

9 Maintenance

The LSH-10 generally does not require any special maintenance. However, the device should be inspected occasionally for damage and a dirty sensor surface. To remove dirt use a wet cloth with little force. Do not use any abrasive detergent or scraping tool!

10 Support software Commander

10.1 Software features

The Commander is a multipurpose software tool to configure and operate any Sommer Messtechnik device. It offers the following functions:

- Communication with Sommer Messtechnik sensors and data loggers via serial connection, modem, socket, IP-call and Bluetooth®
- Management of connections and stations
- Configurations of sensors and data loggers
- Live data monitoring and storage
- Data management including download from data loggers and transmission to MDS (Measurement Data server)
- Terminal window to check data transfer and to access device settings directly

10.2 System requirements

The Commander software (version 3.0 and above) supports 32- and 64-bit versions of Windows 10 and Windows 11.

For correct operation Microsoft® .NET Framework 4.5 or later must be installed.

Make sure that you have installed and updated the latest version of the FTDI driver.

10.3 Installation of Commander

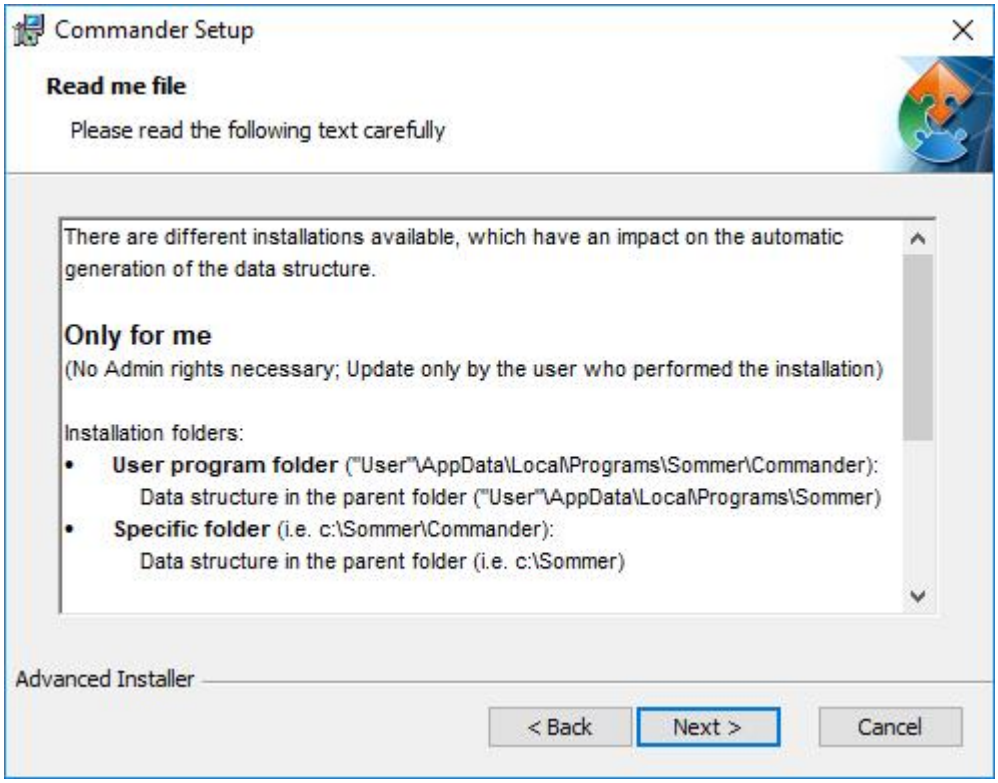
Follow the steps below to install the Commander software:

1. Plug the USB stick shipped with the device into your PC.
2. Double-click the commander.msi installer file on the USB drive.

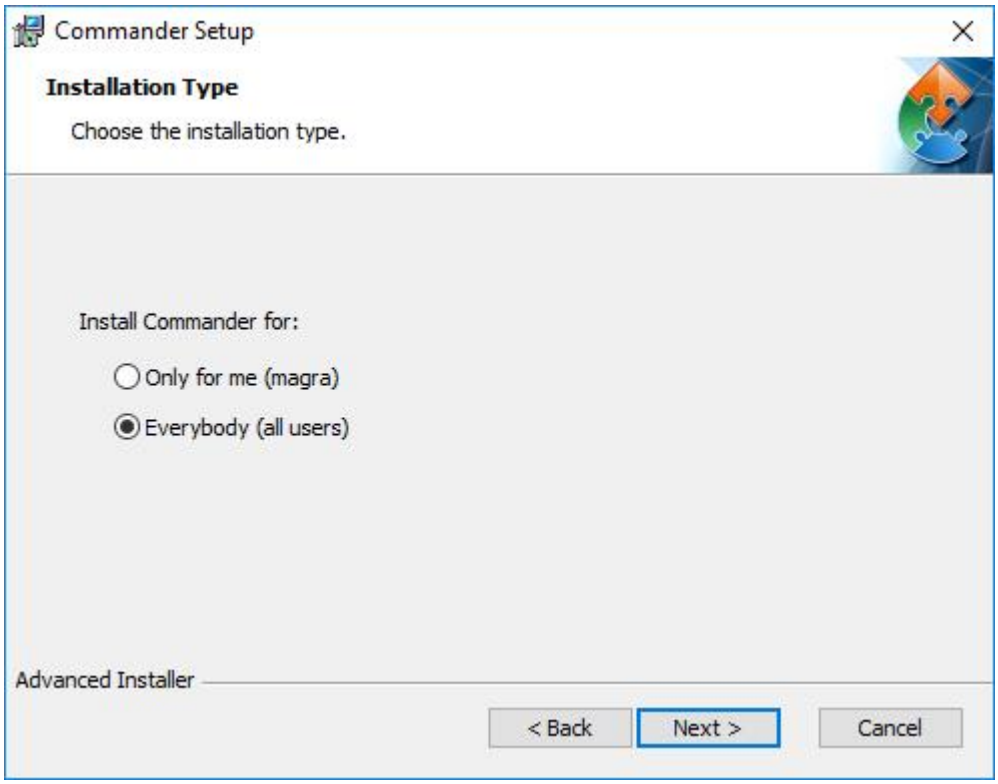
3. Click Next on the pop-up window



4. Read the instructions and click Next



5. Select the installation type and click Next



NOTE

Two installation types are available. Depending on the selection, the access rights and the folder structure differ:

Only for me

No admin rights are required. Updates are only available to the user who installed the software.

Installation folders:

- User program folder:
  Users\User\AppData\Local\Programs\Sommer\Commander
  Data structure:
  Users\User\AppData\Local\Programs\Sommer
- Specific folder (default):
  C:\Sommer\Commander
  Data structure (default):
  C:\Sommer

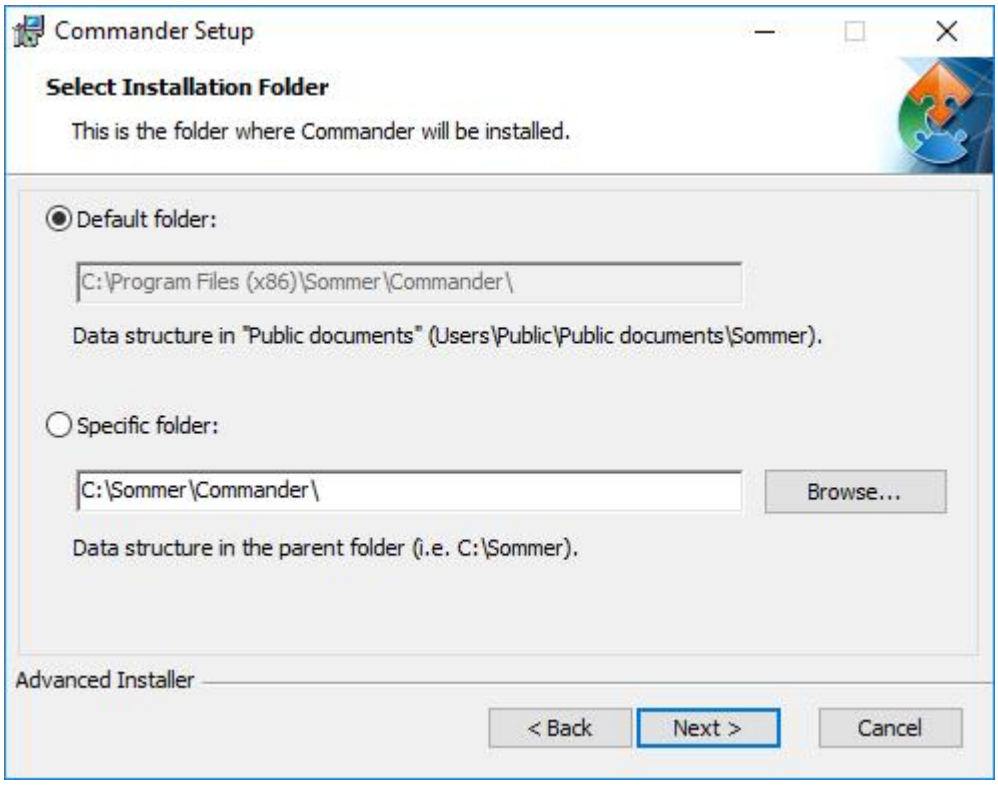
Everybody

Admin rights are required. Updates may only be performed by system administrators.

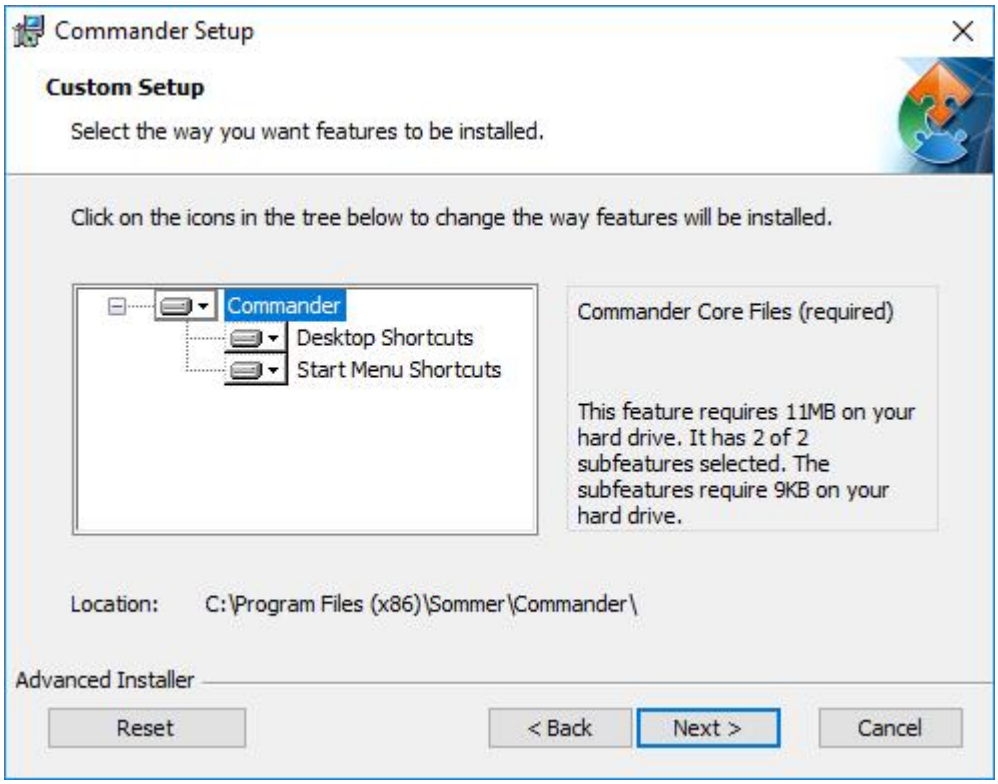
Installation folders:

- Standard program folder:
  Program Files (x86)\Sommer\Commander
  Data structure:
  Users\Public\Public documents\Sommer
- Specific folder (default):
  C:\Sommer\Commander
  Data structure (default):
  C:\Sommer

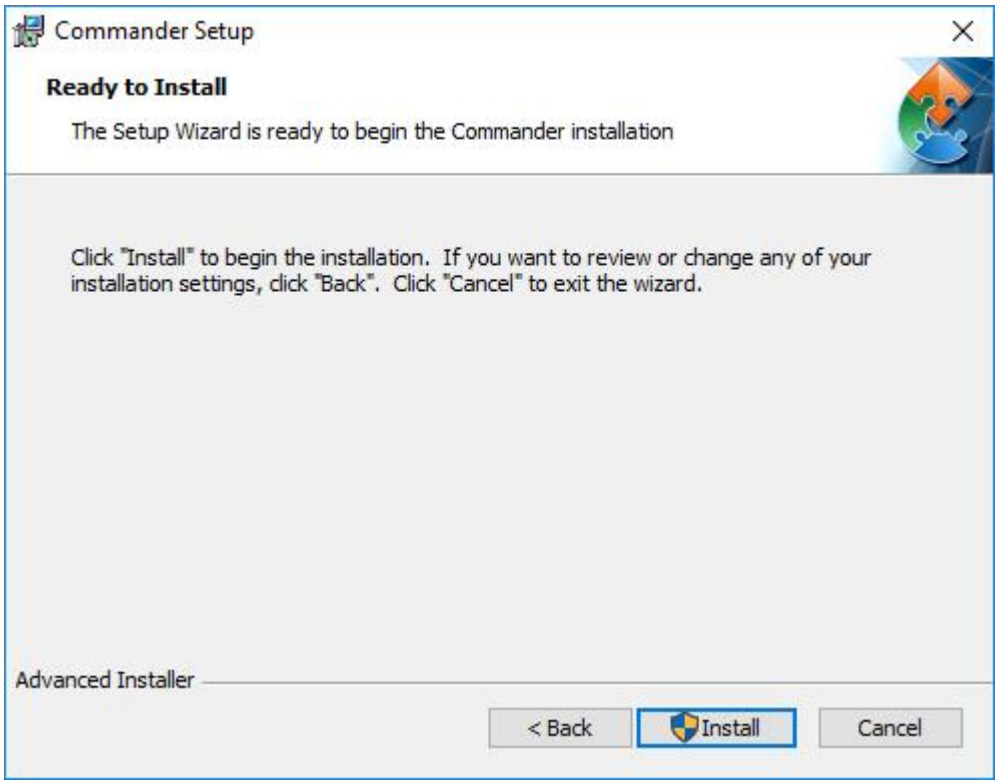
6. Select the installation directory and click Next



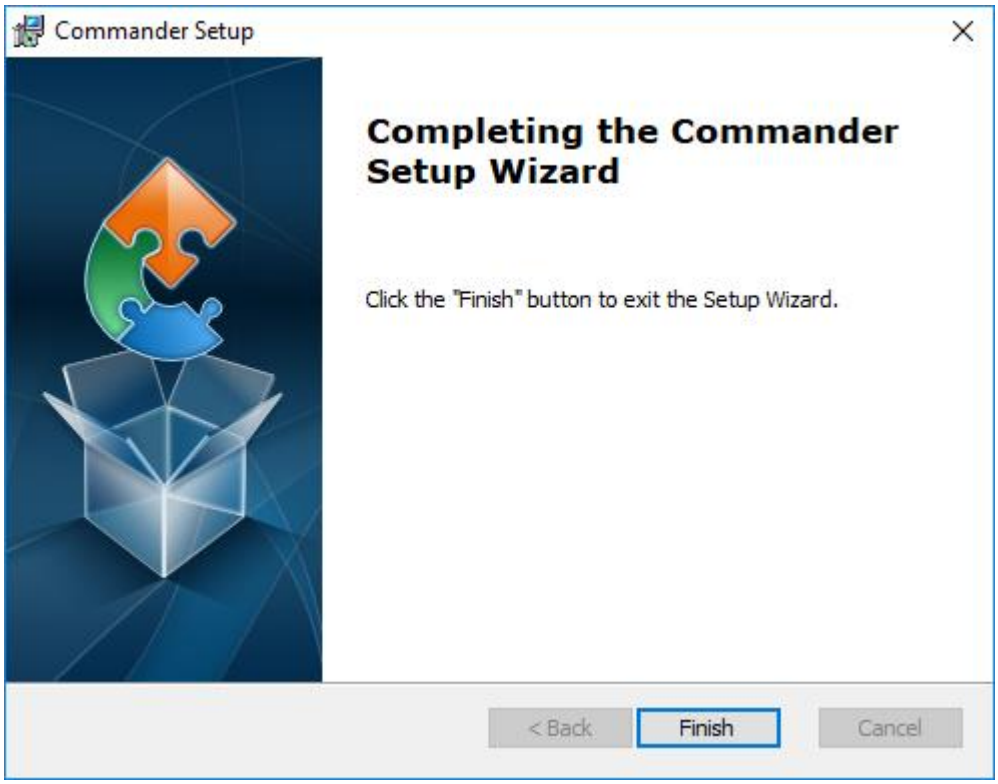
7. Select the features to be installed and click Next



8. Click Install to start the installation.



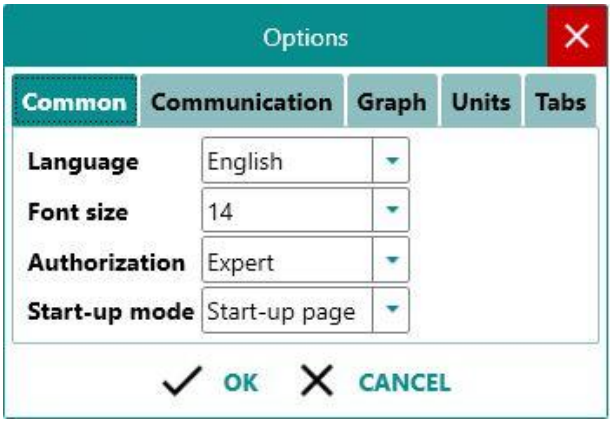
9. Click Finish to complete the installation.



10.4 Change authorization

To prevent unintended changes of parameters in the Technics menu authorization is generally set to *Normal*. Parameter modifications in Technics are enabled by switching the authorization level to *Expert* as described below:

1. On the upper tab bar click on Options and select Common.
2. In the Options window select authorization *Expert* and click OK.



10.5 Working with connections

10.5.1 Establish a connection with the Communication assistant

1. Install the Commander support software as described in Installation of Commander.
2. Connect the device to your PC.
3. Start the Commander software on your PC.
4. Click on Communication assistant on the right-hand side of the Commander window and follow the instructions. During this procedure the communication assistant will search for connected devices. Upon successful completion, the new connection is added to the connections list (tab Connections (F8)). See also pictures steps 1 to 8 in Create a station with the Communication assistant.
5. In the Communication section at the right-hand side of the Commander window select Mode Connection and the previously created connection from the drop-down list.
6. Click Connect to establish a connection with the LSH-10. If the connection was successful a green icon is displayed at the top-right corner of the Commander window.

To view the settings of the connected device or to read the current measurements, follow the steps described in Download setup and Record measurements.

10.5.2 Establish a connection manually

1. Install the Commander support software as described in Installation of Commander.
2. Connect the device to your PC.
3. Start the Commander software on your PC.
4. Select the required connection in the Connections list of the Connections (F8) tab and click Connect. If the connection was successful a green icon is displayed at the top-right corner of the Commander window.
   If you don't have the required connection available in the Connections list, create a new connection as described in Create a new connection.

To view the settings of the connected device or to read the current measurements, follow the steps described in Download setup and Record measurements.

10.5.3 Create a new connection

1. Select the Connections (F8) tab in the Commander. If the tab is not shown, select it with pressing F8.
2. Click New connection.

3. In the section Connection settings enter a name of the new connection, e.g. *Serial-com1-9600*, and the connection type, e.g. *Serial connection*.
4. Enter the required information for the selected connection type.
   If your LSH-10 is wired to your PC with a RS-485 to USB converter cable, select the port where the device is connected and select a Baud rate of 9800.

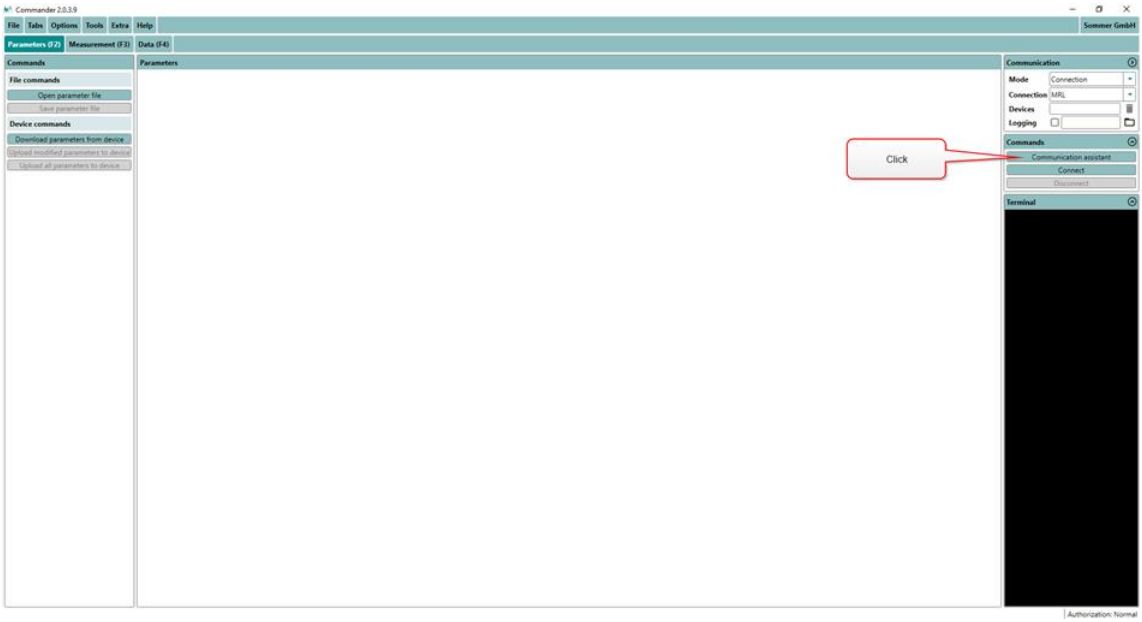
10.6 Working with stations

10.6.1 Create a station with the Communication assistant

In order to manage several data loggers, to connect to a data logger via IP-call and to download data, stations can be created in the Commander software. To view a list of all stations select the tab Stations (F7). If the tab is not shown, select it with pressing F7.

Perform the following steps to create a new station with the Communication assistant:

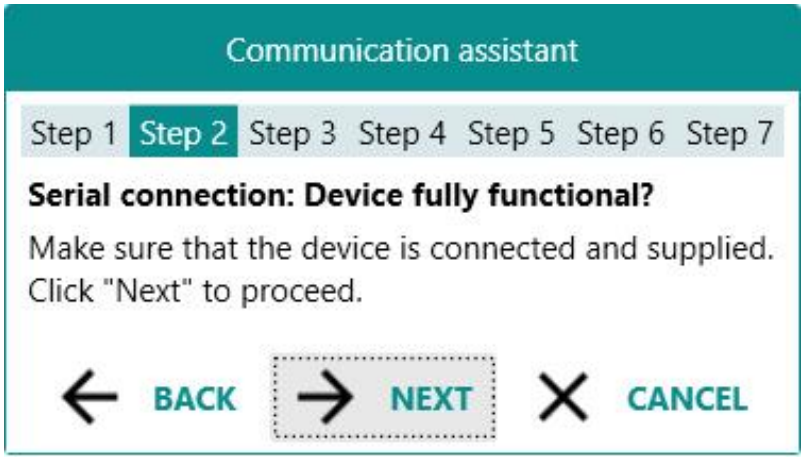
1. Click on Communication assistant in the Commander-window



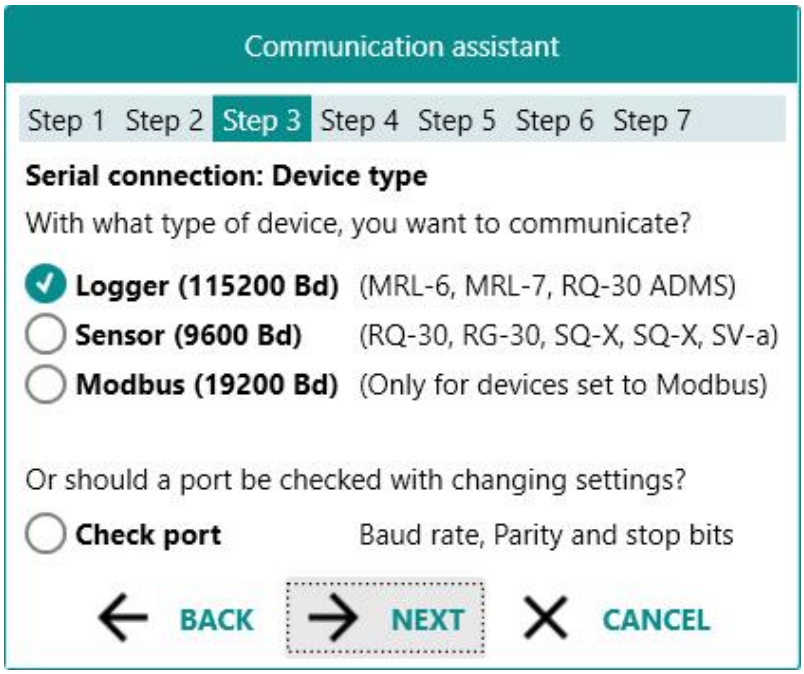
2. In the pop-up window choose the required connection and click Next.



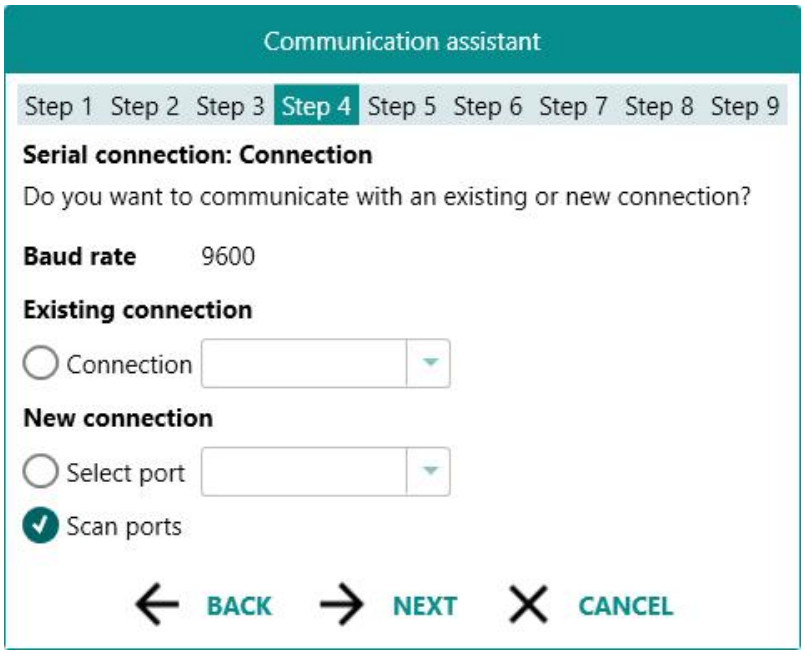
3. Verify that the LSH-10 is connected to your PC and a power supply. Click Next.



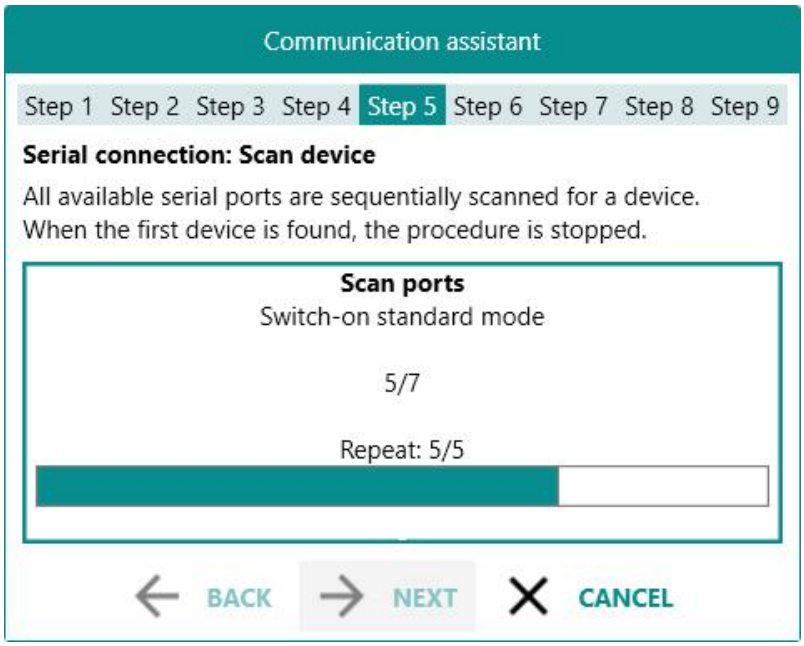
4. Select *Logger (115200 Bd)* and click Next.



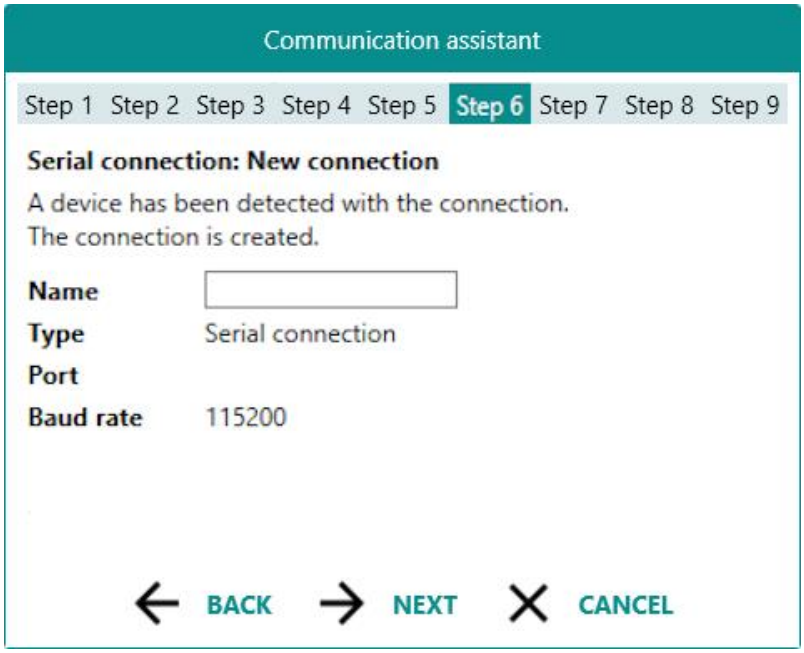
5. Select *Scan ports* and click Next.



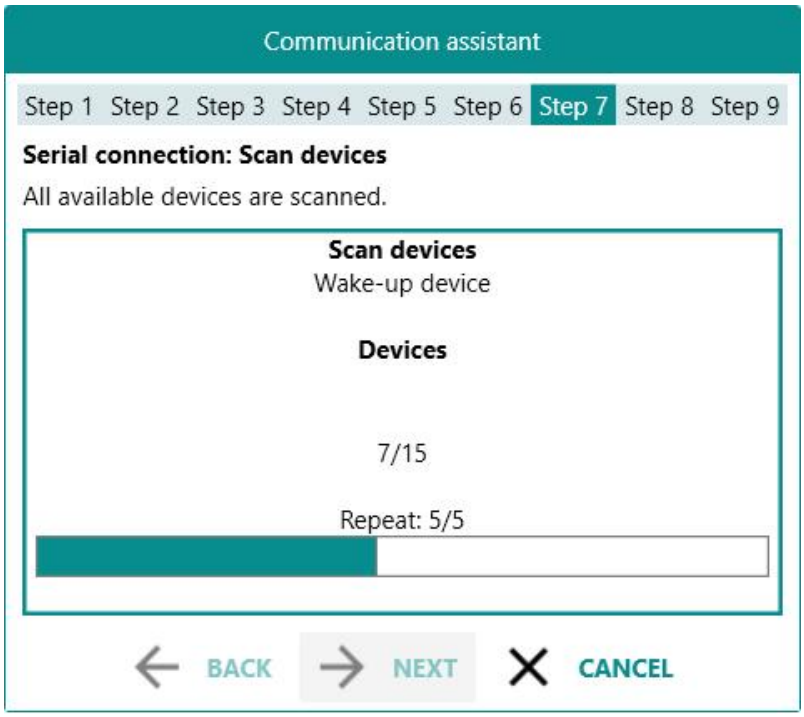
6. The Commander now scans all available ports.



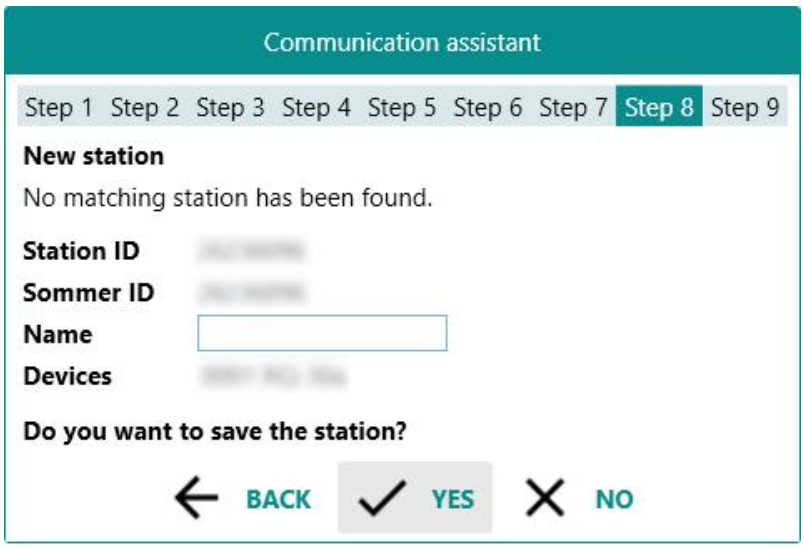
7. Adopt the *Name* provided by the communication assistant. Click Next.



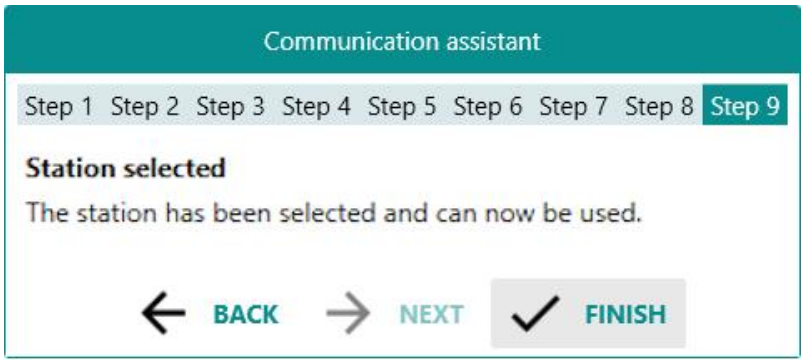
8. The Commander now scans the selected port for connected devices.



9. Adopt the *Name* of the new station or enter a new name. Click Next.



10. A new station has now been created. Click Finish.



11. The newly created station can now be selected in the Communication section of the Commander. Click Connect to activate the connection to your device.

10.6.2 Create a station manually

In order to manage several data loggers, to connect to a data logger via IP-call and to download data, stations can be created in the Commander software. To view a list of all stations select the tab Stations (F7).

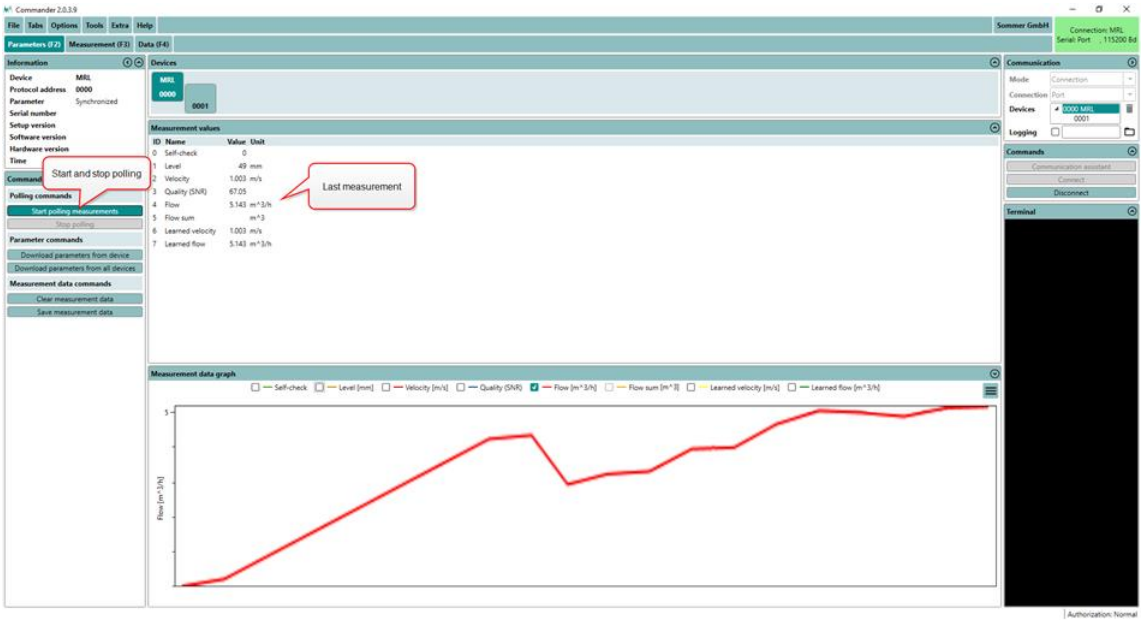
Perform the following steps to create a new station:

1. In the tab-menu Stations (F7) click New station.
2. Under Station settings enter the Station number and Sommer ID. By default both settings are set to the device's serial number (visible on the LSH-10 housing).
3. Select the Connections used for the station. Multiple selections are possible; the default connection can be selected by ticking the circular field.
4. Depending on the connection type, enter the additional information, e.g. Address for a Bluetooth connection or IMSI number for an IP call.
5. Enter the settings for Data management.When data are downloaded from a connected LSH-10 they are stored in an archive-file by default. Each archive-file contains the data of a year or month, as selected in Archive type. Selection *None* will save all data in one file.The default location for data files is C:\Users\Public\Documents\Sommer\Data\.
6. Save the newly created station with the button Save station.

10.7 Working with measurements

10.7.1 Poll continuous measurements

1. Establish a connection to your device as described in Working with connections.
2. Download the setup of your device as described in Download setup.
3. Select the Measurement (F3) tab.
4. In the Commands section click Start polling measurement.
5. Select the option Polling with measurements. Now, the Commander will trigger measurements of the LSH-10 without any delays between measurements. The results are displayed Measurement values and plotted in the Measurement data graph.
6. To finish polling mode click Stop polling.



7. No data is stored during this time.

NOTE The polling mode stops automatically after 30 minutes.

10.7.2 Record measurements

1. Establish a connection to your device as described in Working with connections.
2. Download the setup of your device as described in Download setup.
3. Select the Measurement (F3) tab.
4. Make sure that Measurement output is set to *Measured values push* or *Storage values push*.

5. If the connection with your device is active, the data will now be displayed in the measurement table and updated at the interval specified in the setup. Also, the incoming data strings are displayed in the Terminal.
6. Click Save measurement data in the Commands section to save the recorded measurements. The data are saved as a *.csv file in the SommerXF format.



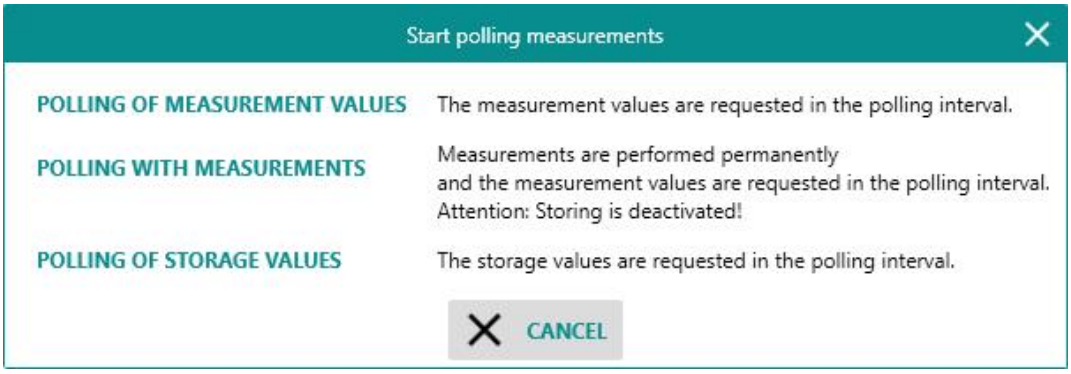
NOTE You can change the scope of the data output in the setup Information.

10.8 Working with data

10.8.1 View live data

Follow the steps below to view live data acquired from your device:

1. Establish a direct or remote connection with the LSH-10 using the Commander. Use an existing Commander-connection or -station if available.
2. In the Parameters (F2) tab download the parameters of the LSH-10.
3. Now, there are two options to view the measurement data:
    1. If Measurement output is set to *Measured values push* or *Storage values push*, data are displayed in the Measurement (F3) tab in the specified measurement interval.
    2. Open the Measurement (F3) tab and click Start polling measurements. This measurement mode can be stopped by clicking Stop polling, or it is finished automatically after 30 minutes.



10.9 Working with spectra

10.9.1 Record spectrum

1. Establish a connection to your device as described in Working with connections.
2. Download the setup of your device as described in Download setup.
3. Select the Measurement (F3) tab.
4. Click Start spectrum mode in the Commands section. Now the Commander collects the spectrum data and displays them in Spectrum graph.

> **NOTE** The collection of the spectrum data may require some time.

5. Click Save spectrum file in the Commands section to save the recorded spectra. The data are saved as a *.xlms file.

> **NOTE** The number of acquired spectra is displayed at the bottom of the Spectrum graph. You can navigate through the spectra by clicking the navigation buttons.

6. Click Stop spectrum mode to quit recording spectra.

10.9.2 Read spectrum file

1. Open the Commander.
2. Click Open spectrum file in the Commands section.
3. Select the desired spectrum file (*.xmls) and click Open. The spectra are now opened and displayed in the Spectrum graph.

> **NOTE** The number of acquired spectra is displayed at the bottom of the Spectrum graph. You can navigate through the spectra by clicking the navigation buttons.

10.10 Working with setups

10.10.1 Download setup

1. Establish a connection to your device as described in Working with connections.
2. Select the Parameters (F2) tab in the Commander software.
3. In the Commands section click Download parameters from device.
   The Commander now downloads the setup currently active on the LSH-10. This may take some time if you are downloading the setup for the first time to your PC. Consecutive downloads of a setup with the same version number will be faster as the parameter structure is already available.

You can now save the setup file by clicking Save parameter file, or edit the settings as described in Edit setup.



TIP Save the setup on your PC before you make any changes!

10.10.2 Open a setup file

1. Start the Commander on your PC and connect to your LSH-10 either directly with the USB to RS232 isolated converter cable or, if available, the optional Bluetooth connection.
2. Open the Parameters (F2) tab and click Open parameter file. Select the required file (extension .xmld or .xmla).

10.10.3 Edit setup

1. Open the setup file as described in Open a setup file or download it from your device as described in Download setup.
2. Adapt the values of the settings in question and press Enter after each. After you have changed a value, its text box will turn red.



NOTE If you have entered a value outside the data range of the setting, it will be forced to the next valid value! The valid range of each setting is listed in the Parameter definitions.

3. After you have adapted all required settings save the setup file and/or upload the setup to your device by clicking Upload modified parameters to device.

Once the setup has been saved or uploaded, the modified red text boxes will turn white again, indicating that the settings have been saved/applied.

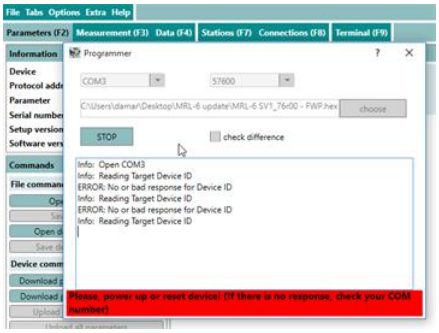
10.10.4 Upload new setup file

1. Establish a connection to your device as described in Working with connections.
2. Select the Parameters (F2) tab.
3. Download the setup currently on the LSH-10 as described in Download setup and save it by clicking Save parameter file. This step is recommended to have the latest setup available for documentation.
4. Click Open parameter file and select the required setup file (*.xlmd) on your PC.
5. Click Upload all parameters to device. This transfers the current setup to the LSH-10.
6. To verify the correct upload click Dowanload parameters from device. This will display the present setup of the LSH-10.

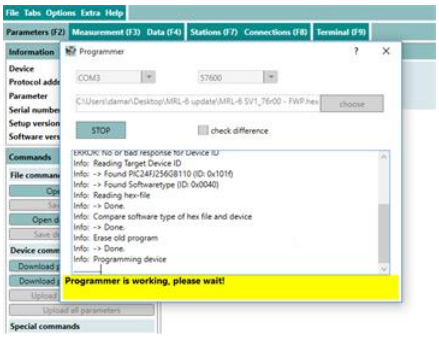
10.11 Update firmware

1. Connect the LSH-10 to your PC with the USB to RS485 isolated converter cable.
2. Make sure no connection is active in the Commander (no green icon at the top-right corner).
3. Click on the menu item Extra and select Start Programmer.
4. Select the firmware file (*.hex) provided by SOMMER Messtechnik. Make sure the file is stored on your PC and not on a USB or network drive.
5. Choose the COM-port the data logger is connected to and a Baud-rate of 57'600.
6. Perform the following three steps in short sequence:
   - Click Program
   - Unpower the data logger
   - Wait 3…5 seconds to enable full activation of the bootloader and a correct restart (capacitors must be discharged, and if the device had been in sleep mode, this can take some time)
   - Repower the data logger

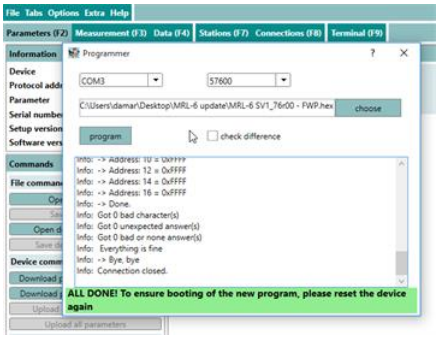
   The firmware currently present on the data logger is now erased and the new one copied to the data logger. During the update process the pop-up window may show the following messages:



The device is not ready; power needs to be on.



The programmer is active.



The firmware update has finished.

7. Close the programmer-window as soon as the firmware update has finished.
8. Switch off and repower the data logger again.
9. Open the Parameters (F2) tab.
10. Click Download parameters from device. The download of the new parameter list might take a few minutes as the parameter structure may need to be downloaded as well. After completion the new firmware and setup versions will be displayed in the Information section.

11 Configuration of the LSH-10

11.1 Software tools

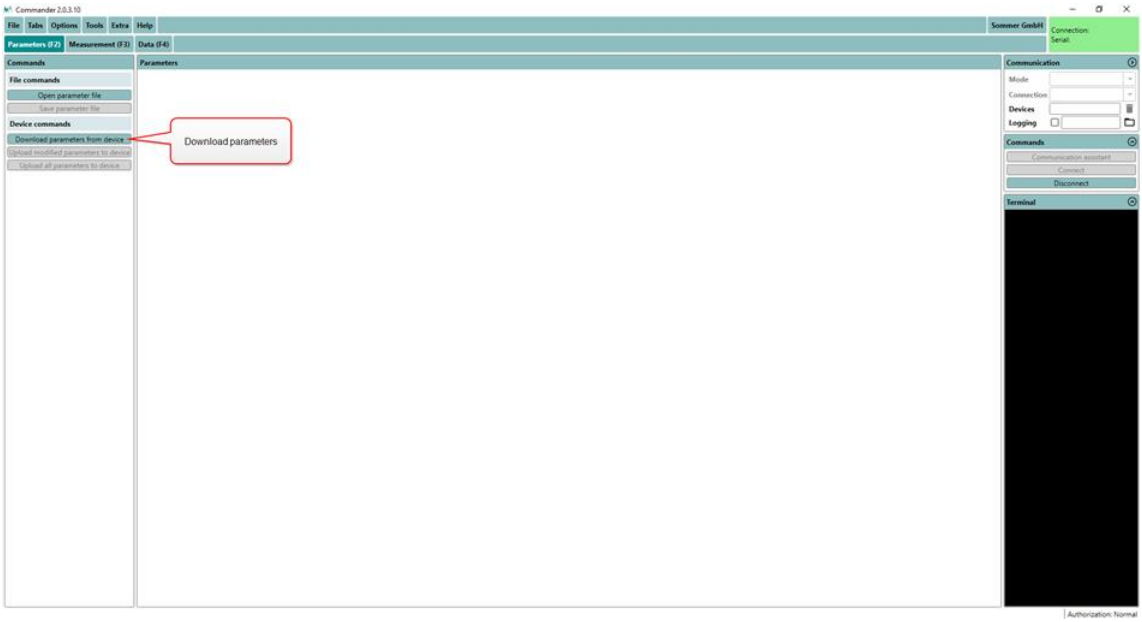
The LSH-10 can be configured with one of the following tools:

- Configuration with Commander support software
- Configuration with a terminal program

11.2 Configuration with Commander support software

Follow the steps below to modify the configuration parameters of the LSH-10:

1. Establish a connection between your PC and the LSH-10.
2. Click Download parameters from device. The complete parameter list is transferred from the LSH-10 to your PC and displayed in the Parameter window.



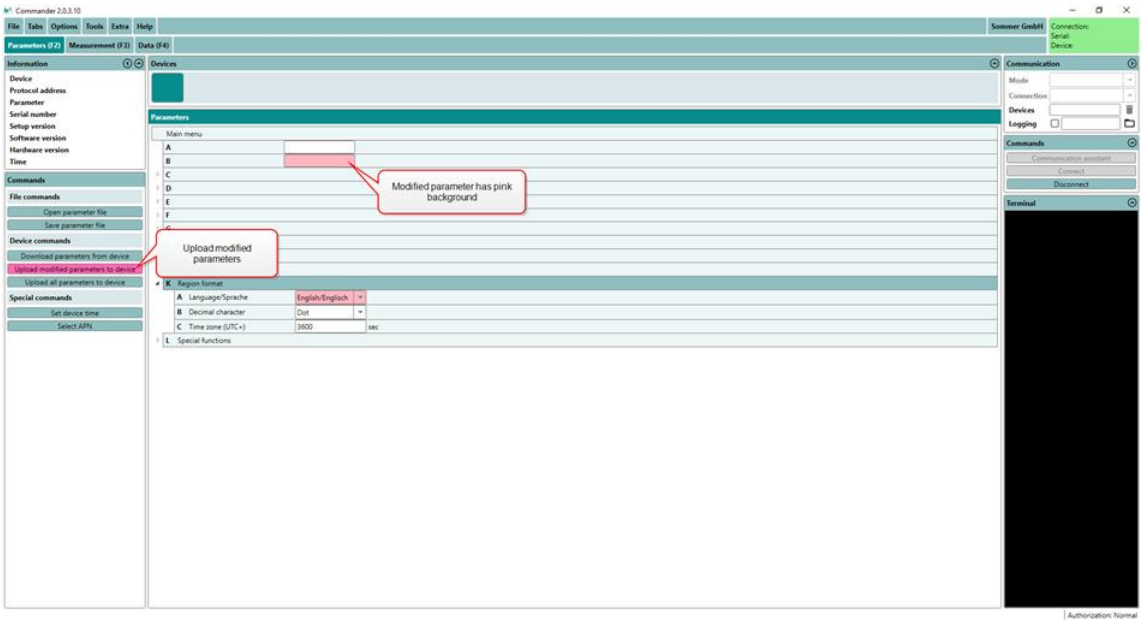
NOTE The first download of the parameter list may take a few minutes. After that the device is known to the PC and consecutive downloads are much faster.



3. Save the parameter file to your PC by clicking Save parameter file. This step is recommended to track any configuration changes.



4. Adapt the parameters required for your application. Changed values are displayed with a pink background.



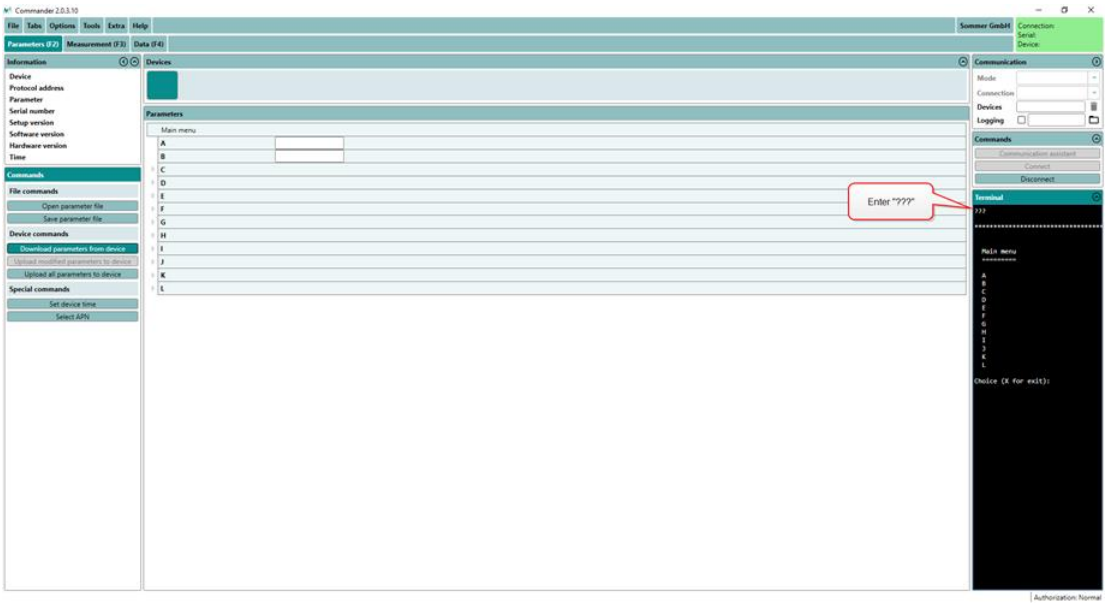
5. Send the modifications to the LSH-10 by clicking Upload modified parameters to device. Upon successful upload the pink backgrounds disappear again.

11.3 Configuration with a terminal program

The Commander software ships with an integrated terminal program. However, communication with the LSH-10 can be performed with any terminal program.

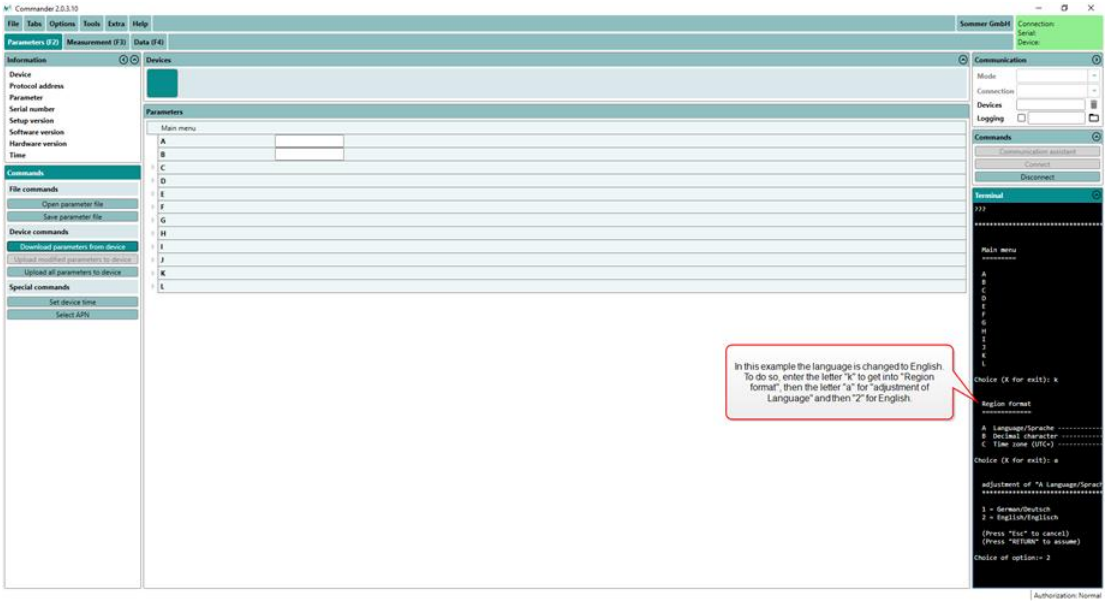
Follow the steps below to modify the configuration parameters of the LSH-10:

1. Establish a connection between your PC and the LSH-10.
2. In the terminal window enter three question marks (`???`) in quick succession. The main parameter menu is displayed in response.



NOTE As an unwanted switching into the menu mode must be avoided the timing of the three question marks `???` is very restrictive and must never be finished with Return/Enter. This is especially important for command line tools, which automatically send a closing "Carriage return". Before and after sending `???` no communication must occur for 1 second.

3. Read or modify the required parameters: The menu items can be selected by entering the letter assigned to each item. Upon selection a submenu is opened or the selected parameter is displayed with its unit. Changes to values are confirmed with Return/Enter or discarded with Esc. Menus are closed with X or Esc. After closing the main menu with X the device performs an initialization.



11.4 Conflict messages

During configuration with the Commander software, the LSH-10 may return conflict messages after one or more parameters have been changed and uploaded to the device. An example is shown in Figure 3.



Figure 3 Example of a conflict message

The pop-up window lists the parameters and their indices which have triggered the warning. See Parameter conflicts for details.

ATTENTION If a conflict occurs, invalid settings are replaced automatically with valid values. Verify the values of the conflicting parameters and adapt them if needed!

11.5 General settings

When first setting-up a LSH-10 at a measurement site, the parameters described below may need to be adapted.

11.5.1 Language/Sprache

The menu language.

11.5.2 Decimal character

The character used as decimal separator in the values of the settings, in serial data strings and in .csv files.

11.5.3 Units and decimals

The units and number of decimal digits. These have to be set prior to all other settings as all values are saved internally in this format. They are set in the parameter menu Units and decimals.

ATTENTION If units or decimals are changed, related parameters may need to be adjusted.

11.5.4 Output protocol

The type of the serial output protocol. The following options are available:

ID	Option	Description
1	Sommer (SBP) (default)	Sommer Bus Protocol; data values are returned with an index starting at 1. Multiple strings may be returned.
2	Standard	Standard protocol; data values are returned without an index in one string.
3	MODBUS	Modbus protocol

11.5.5 Information

The main measurement values are always included in the data output string. Additionally, special and analysis values can be included.

ID	Option	Description
1	Main values	Only the main values are returned.
2	& Special values (default)	Main values and special values are returned.
3	& Analysis values	Main, special and analysis values are returned.

11.6 Level/Distance measurements

11.6.1 Measurement interval

The Measurement interval determines how frequently measurements are updated. However, if the actual measurement duration exceeds the set interval, the duration takes precedence, and measurements occur consecutively as quickly as possible. The measurement interval also influences the laser's energy consumption. A larger interval results in lower energy usage. It's important to note that significantly extended intervals are necessary to achieve meaningful battery life, particularly in cold conditions.

11.6.2 Snow depth, adjust

Function to adjust the level measurement of the LSH-10 to the actual level. LSH-10 make a measurement to the defined surface and set indirectly the "Snow depth, distance to zero" value, by give in the actual snow depth.

11.6.3 Snow depth, test

Function starts measuring the distance and inclination. After that, the updated value is displayed in Snow depth, distance to zero.

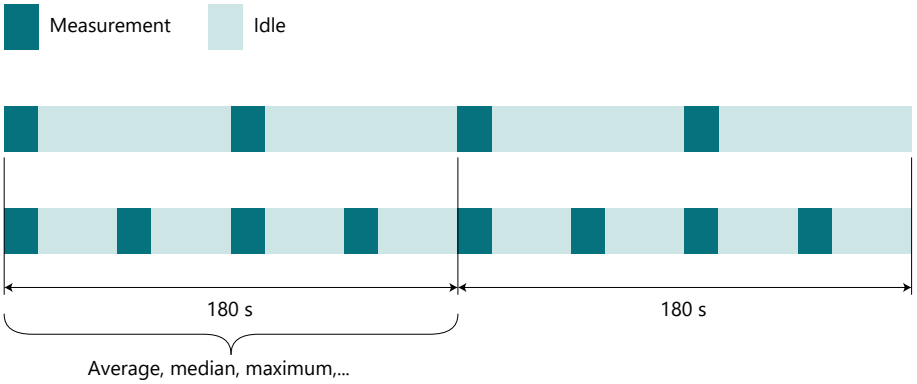
11.6.4 Snow depth, distance to zero

The distance between the sensors lower edge and the ground surface, e.g. lowest point of river bed, ground without snow.

11.6.5 Maximal filter delay

This submenu includes settings for the sloping filters, which determine the time required for the heating to stabilize before taking measurements. These filters influence the Snow depth and Snow depth, distance to zero values. You can manually adjust these settings in the 'snow depth and geometry' submenu.

Every level/distance measurement is stored internally in a buffer for filtering. This setting defines the length of the time window of which the data are stored in the buffer. If the buffer is full, the oldest value is replaced by the most recent one.



11.6.6 Type

The level/distance values in the buffer can be filtered by one of the following options:

ID	Option	Description
1	adaptive	The filter is using specific conditions.
2	fixed	The Maximal filter delay is used all the time

These filter abilities just affect "Snow depth" and "Distance" value.

12 Communication

12.1 Communication protocols

The LSH-10 provides the following communication protocols:

- RS-485 (Sommer Bus Protocol)
- Modbus
- SDI-12

12.2 Data output

The measurement values returned by the LSH-10 are arranged in a fixed sequence and identified by an index. They are divided into three groups and can be selected in Information.

12.2.1 Main values

Index	Measurement value	Unit	Description
01	Snow depth	mm	
02	Distance	mm	
03	Quality	%	Shows the accuracy of measurement statistics
04	Status	-	Status of snow cover
05	Uncertainty	-	Displays the estimated overall measurement accuracy, calculated by considering various factors of uncertainty
06	Function	-	Shows the decimal coded exception code

Table 1 Main values

12.2.2 Special values

Index	Measurement value	Unit	Description
07	AV1 (Default: Laser temp)	°C	Laser temperature at end of measurement
08	AV2 (Default: Inclination)	°	Inclination value of measured surface performed during measurement
09	AV3 (Default: Heat status)	-	This value displays the reason of heating processes and their further handling, while the measurement rows
10	AV4 (Default: Quality rate)	%/min	Shows how fast quality may change depending of the out-side conditions
11	Measurement interval	sec	The interval that the LSH-10 needs to make a meas-urement. Also used to configure the sensor to work with data loggers. The default setting 30 sec
12	Supply voltage	V	Power supply voltage, shows if battery is low, or there are some cable losses
13	Housing tem-perature	°C	Temperature of housing and outside environment

Table 2 Special values

12.2.3 Analysis values

Index	Measurement value	Unit	Description
09	Signal focus	dB	Diagnostic variable
10	Signal strength	dB	Diagnostic variable
11	Half-value width	%	Diagnostic variable
12	Noise ratio 50	%	Diagnostic variable
13	Noise ratio 85	%	Diagnostic variable

Index	Measurement value	Unit	Description
14	Echo amp.	-	Diagnostic variable
15	Var. 1	-	Diagnostic variable (highest snowflake-value at Optimisation *Outdoor*)
16	Var. 2	-	Diagnostic variable (drop of damping-value during snow settling)
17	Var. 3	-	Diagnostic variable
18	Dist. max. echo	mm	Diagnostic variable
19	Dist. last echo	mm	Diagnostic variable
20	Distance 0 C	mm	Diagnostic variable
21	Case temperature	°C	Diagnostic variable
22	Error code[1]	-	Diagnostic variable

Table 3 Analysis values

12.2.4 Exception values

Measurement data may be returned with the following exception values:

Value	Description
1.00	Sensor found a nearfield target (nearer than 200 mm)
2.00	The supply voltage is under the parametrised value, so all the heating will be skiped
4.00	The measurement could not be finished in the "Draft time". The measurement has been aborted
8.00	Laser module can’t exchange data in usable way anymore because of damage. The measurement has been aborted
16.00	Sensor can’t reach the -9.5° C before making measurement

[1]see Device Errors for details

Value	Description
32.00	Very slow heating, maybe wiring is not connected or something is damaged
64.00	Due to external influences measurement process are stopped
256.00	The laser module doesn't answer
512.00	The laser module answer is not readable
1024.00	Sensor use the laser module not as planned
2048.00	The laser module can't be initialised correctly
4096.00	The laser module has been detected wrong requests
8192.00	The laser module can't submit distance results

Table 4 Exception values

12.3 RS-485

12.3.1 What is RS-485?

RS-485 is a serial communication method for computers and devices. It is currently a widely used communication interface in data acquisition and control applications where multiple nodes communicate with each other.[1]

12.3.2 What can I do with it?

RS-485 communication is primarily used to trigger measurements and read their results. It also permits to change parameters of the LSH-10.

12.3.3 Configuration

The LSH-10 has serial RS-485 communication enabled by default. If the device is integrated into a RS-485 network or connected to a stand-alone data acquisition system, e.g. a data logger, the parameters listed in Output protocol may need to be adapted.

[1]https://www.lammertbies.nl/comm/info/RS-485.html

12.3.3.1 System key and device number

The system key and device number are used to identify a LSH-10 in a bus system. This is essential if multiple devices (LSH-10 and data loggers) are operated within the same system.

System key

The system key separates different conceptual bus systems. This may be necessary if the remote radio coverage of two measurement systems overlap. In wired setups, the system key should be set to *00*.

Device number

The device number is a unique number that identifies a device in a bus system.

ATTENTION Do not use a device number twice in your bus system! Otherwise communication will fail!

12.3.3.2 Measurement output

The serial data output can be triggered in the following ways:

ID	Option	Description
1	Interval	The output is only output by specified interval.
2	SDI12 / RS485	The serial data output is performed automatically right after each measurement.
3	TRIG input	The output is triggered by a positive edge of a control signal applied to the trigger input.

NOTE If Measurement output is set to *pos. TRIG input*, the data are returned with a delay of 200 ms after the trigger has been set. Make sure that your data acquisition system takes account of this lag to ensure that it receives the most recent data.

12.3.3.3 Operation modes

The selected combination of measurement trigger and output time determines the following operation modes:

	Mode		
Parameter	**Pushing**	**Polling**	**Apparent polling**
Measurement trigger	internal	TRIG input SDI-12/RS485	TRIG input SDI-12/RS485
OP, measurement output	after measurement	just per command	after measurement

12.3.3.4 Waking-up a connected data logger

The LSH-10 supports wake-up of a connected data logger that is in standby mode. Generally, this feature is only used in pushing and can be set under Wake-up sequence.

12.3.3.4.1 Sync sequence

The sync sequence is the string `UU~?~?` and is sent directly before a command. It is used to synchronize the receiving UART.

12.3.3.4.2 Prefix

The prefix is an arbitrary character; the LSH-10 uses a blank. This character is sent prior to any communication. Then the time of the Prefix holdback is waited and the command is sent afterwards. With this procedure the receiving device has time to wake-up.

12.3.3.5 Output protocols

For data output via RS-485 different protocols are available, which can be selected under Output protocol.

12.3.4 Data output options

Data are returned in two different formats, selectable in Output protocol:

- Sommer Bus Protocol (SBP)
- Standard protocol

12.3.5 Sommer Bus Protocol (SBP)

The data string of the Sommer Bus Protocol has the following format:

EXAMPLE `#M0001G01se01 1461|02 1539|03 25.25|04 0|ADC9;`

A data string contains max. 8 values and is max. 105 characters long.

12.3.5.1 Header

The header (`#M0001G01se`) identifies the data by system key, device number and string number.

Parameter	Format	Description
Start character	#	
Identifier	M	M identifies an output string
System key	dd	
Device number	dd	
Command ID	G	G defines an output string with string number
String number	dd	01 Main values 03 Special values
Command	se	se identifies automatically sent values

Table 5 Header of the Sommer Bus Protocol

12.3.5.2 Measurement value

A measurement value (`02 1539|`) has a length of 8 digits and is returned together with its index. If the measurement value is a floating point number, one digit is reserved for the decimal character. Values are returned right-aligned, so blanks may occur between index and value.

Parameter	Format	Description
Index	dd	2 numbers
Value	xxxxxxxx	8 character right-aligned
Separator	|	

Table 6 Values in Sommer Bus Protocol

12.3.5.3 End sequence

The data string is terminated with a CRC-16 in hex format (ADC9) followed by an end character and <CR><LF>. The CRC-16 is described in Sommer Messtechnik CRC-16.

Parameter	Format	Description
CRC-16	hhhh	4-digit hex number
End character	;	
Control characters	<CR><LF>	Carriage return and Line feed

Table 7 End sequence of the Sommer Bus Protocol

12.3.5.4 Example Sommer Bus Protocol

12.3.5.4.1 Main values

Main values are returned as in the following example:

EXAMPLE
```
#M0001G01se01    1461|02    1539|03    25.25|04
      0|3883;
```

#M0001G01se	Header with system key 00, device number 01 and string number 01
01 1461|	Level
02 1539|	Distance
03 25.25|	Temperature
04 0|	Status
3883;	Closing sequence

Table 8 Main values in Sommer Bus Protocol

12.3.5.4.2 Special values

Special values are returned as in the following example:

EXAMPLE `#M0001G01se01 1461|02 1539|03 25.25|04 0|3883;`

`#M0001G01se`	Header with system key 00, device number 01 and string number 01
`01 1461|`	Level
`02 1539|`	Distance
`03 25.25|`	Temperature
`04 0|`	Status
`3883;`	Closing sequence

Table 9 Special values in Sommer Bus Protocol

12.3.5.4.3 Analyis values

Analysis values are returned as in the following example:

EXAMPLE

```
#M0001G05se09 33.8|10 43.8|11 34|12
43.23|13 13.51|14 9|15 -28.6|7E66;
#M0001G06se16 1|17 2920|18 1565|19
5578|20 1472|21 25.70|22 0.00|0E53;
```

`#M0001G05se`	Header with system key 00, device number 01 and string number 05 for the analysis values 9 to 15
`0 933.8|`	Signal focus
`10 43.8|`	Signal strength
`11 34|`	Half value width
`12 43.23|`	Noise ratio 50
`13 13.51|`	Noise ratio 85
`14 9|`	Echo amp.
`15 -28.6|`	Var. 1

7E66;	Closing sequence
#M0001G06se	Header with system key 00, device number 01 and string number 06 for the analysis values 16 to 22
16 1|	Var. 2
17 2920|	Var. 3
18 1565|	Dist. max. echo
19 5578|	Dist. last echo
20 1472|	Distance 0 C
21 25.70|	Case temperature
22 0.00|	Error code
0E53;	Closing sequence

Table 10 Analysis values in Sommer Bus Protocol

12.3.6 Standard protocol

The data string of the Standard protocol has the following format:

EXAMPLE `M_0001 1461 1539 25.25 0`

12.3.6.1 Header

The header (`M_0001`) identifies the data by system key and device number.

Parameter	Format	Description
Identifier	`X_`	`M_` Measurement values `S_` Special values `V_` Analysis values
System key	`dd`	
Device number	`dd`	

Table 11 Header of the Standard protocol

12.3.6.2 Measurement values

Measurement values are returned in sequence and are separated by a blank. A measurement value has a length of 8 digits. If the measurement value is a decimal number, one digit is reserved for the decimal character. Values are returned right-aligned, so additional blanks may be returned between values.

Parameter	Format	Description
Separator	[blank]	blank
Value	xxxxxxxx	8 character right-aligned

Table 12 Values in Standard protocol

NOTE With the standard protocol the data strings can be very long. In contrast, the strings of the Sommer Bus Protocol are max. 105 characters long.

12.3.6.3 End sequence

The data string is terminated with <CR><LF>.

12.3.6.4 Example Standard protocol

12.3.6.4.1 Main values

Main values are returned as in the following example:

EXAMPLE M_0001 1461 1359 25.38 0 23.2 0

M_0001	Header with identifier for measurement values
1461	Snow depth
1359	Distance
25.38	Quality

0	Status
23.2	Uncertainty
0	Function

Table 13 Main values in Standard protocol

12.3.6.4.2 Special values

Special values are returned as in the following example:

EXAMPLE
```
S_0001   1004   46.5   2   11.69   0   11.5   9
```

M_0001	Header with identifier for measurement values
1004	AV1 (reserved for internal use only)
46,5	AV2 (reserved for internal use only)
2	AV3 (reserved for internal use only)
11.69	AV4 (reserved for internal use only)
0	Meas. interval
11.5	Supply voltage
9	Housing temp

Table 14 Special values in Standard protocol

12.3.6.4.3 Analyis values

Analysis values are returned as in the following example:

EXAMPLE
```
V_0001     39.2     43.8       30    42.85
13.56      9     -25.1         1     3023     1563
5543     1473     25.50      0.00
```

V_0001	Header with identifier for analysis values
39.2	Signal focus

43.8	Signal strength
30	Half value width
42.85	Noise ratio 50
13.56	Noise ratio 85
9	Echo amp.
-25.1	Var. 1
1	Var. 2
3023	Var. 3
1563	Dist. Max. echo
5543	Dist. Last echo
1473	Distance 0 C
25.50	Case temperature
0.00	Error code

Table 15 Analysis values in Standard protocol

12.3.7 RS-485 commands

12.3.7.1 Command structure

The structure of serial commands and answers is described in the following table:

Parameter	Format	Description
Start character	#	
Identifier	X	W Write: LSH-10 returns a confirmation on receipt. This command type demands a closing sequence with a valid CRC-16. S Silent: LSH-10 does not acknowledge the receipt of the command. This command type demands no closing sequence and therefore no CRC-16. R Read: LSH-10 returns the requested measurement value or parameter. This command type demands a closing sequence with a valid CRC-16. T Temporary: Write a volatile, temporary setting and receive a confirmation. A Answer: Answer of device to read or write command.
System key	dd	
Device number	dd	
Command	xxx	See table in section Commands.
Separator	|	
CRC-16	hhhh	4-digit hex number
End character	;	

Table 16 Structure of Sommer Bus Protocol commands and answers

12.3.7.2 Commands

The following commands can be used with the LSH-10:

Command	Description
`$mt`	Trigger a measurement
`$pt`	Return measurement values
`XX`	Read a parameter with identifier XX
`XX=xxxx`	Write a parameter with identifier XX and the value xxx

Table 17 List of Sommer Bus Protocol commands

12.3.7.3 Trigger a measurement

The command `$mt` triggers a complete measurement sequence as in the following example:

EXAMPLE `#W0001$mt|BE85;` Answer: `#A0001ok$mt|4FA9;`

12.3.7.4 Read a parameter value

Read measurement interval (in the example below the menu item `B`):

EXAMPLE `#R0001B|228B;` Answer: `#A0001B=300|F8B3;`

12.3.7.5 Request a complete data string

The command `$pt` requests a data string as in the following example:

EXAMPLE

Option 1

`#W0001$pt|7D19;` Answer: `#A0001ok$pt|8C35;`

Option 2

`#S0001$pt|` Answer: none

The data string is returned as soon as the LSH-10 has processed the command. If a wrong command is entered, the device returns `#A0001na$pt|3D40;`.

12.3.7.6 Request a single measurement value

The reading command `R` together with the index of the requested measurement returns a single measurement value. In the following example the measurement value with index `01` is requested:

EXAMPLE

Measurement Value cv:

`#R0001_010cv|EA62;` Answer: `#A0001ok_010cv1461 |5D62;`

Storage Value sv:

`#R0001_010sv|F853;` Answer: `#A0001ok_010sv1461 |1D31;`

12.3.8 Sommer Messtechnik CRC-16

The CRC-16 (cyclic redundancy check) used in data transmission of Sommer Messtechnik devices is based on the ZMODEM protocol. When data are exchanged between two devices the receiving device calculates the CRC-value. This value is compared to the CRC value sent by the other device to check if the data were transmitted correctly. Please refer to technical literature or contact Sommer Messtechnik for calculation of CRC-16 values.

You can here calculate the CRC of a command online .

If you need to compute CRCs automatically, you can implement the following procedure in your data logger or controller software.

The CRC-16 is calculated character by character. The start value for the initial CRC-16 calculation is always 0.

The following procedure returns the CRC-16 of a single character:

```
byte1 = CRC-16 right shift by 8 bits        upper byte disappears
uint1 = c                                   new character, upper byte = 0
uint2 = CRC-16 left shift by 8 bits         lower byte = 0
uint3 = crc16tab[byte1]                     Table value from the CRC-16 table
Crc16 = uint3 (excl. or) uint2 (excl. or) uint1
```

Computation CRC-16 in C/C++

```
1  crc16 = crc16tab[(unsigned char)(crc16>>8)] ^ (crc16<<8) ^ (unsigned int)(c);
```

The `crc16tab` array is listed in CRC-16 array.

EXAMPLE

Command to request measurement data `#W0001$pt|7D19;`

The first character is `#`, the last `|`. The CRC-16 of the command is `7D19` and its end character is `;`.

The CRC-16 is calculated sequentially with the start value `0` for the initial CRC-16 calculation:

Position	String	CRC-16
Start		0000
0	#	0023
1	#W	2357
2	#W0	4331
3	#W00	4997
4	#W000	4EDD
5	#W0001	743B
6	#W0001$	0537
7	#W0001$p	67D5
8	#W0001$pt	C935
9	#W0001$pt|	7D19

12.4 SDI-12

12.4.1 What is SDI-12?

SDI-12 (Serial Data Interface at 1200 Baud) is a serial data communication standard for interfacing multiple sensors with a single data recorder. For a detailed description on SDI-12 communication please refer to www.sdi-12.org.

12.4.2 What can I do with it?

The LSH-10 listens to standard SDI-12 commands as listed in the SDI-12 specifications of version 1.3, e.g., to trigger a measurement or retrieve measurement results. Additionally, a set of extended SDI-12 commands is implemented in all SOMMER sensors for instrument configuration.

12.4.3 Configuration

The LSH-10 has SDI-12 communication enabled by default. When setting up a SDI-12 network take the following considerations into account:

- Each device in the SDI-12 network must have a unique address, e.g. data logger address *0*, LSH-10 address *1*.
- If the LSH-10 operates in polling mode (Measurement trigger set to *SDI-12/RS-485*), measurements are triggered by `M!` commands and data are retrieved by `D!` commands.
- If the LSH-10 operates in pushing mode (Measurement trigger set to *interval*), data are retrieved by the `R!` commands.
- When multiple sensors are connected to the same network, data acquisition should be done in sequence, i.e., data should have been received from the first sensor before triggering the measurement of the second sensor.
- Most data loggers control the timing of messages (marking and spacing) automatically. If this is not the case, please refer to www.sdi-12.org.

12.4.4 Data structure

The answer from the SDI-12 device is a string containing the sensor address, the requested data and a terminating carriage return/line feed.

In a string containing measurement data, the measurements are returned in the same order as listed by the index in Data output.

EXAMPLE

`0+2591+706+25.53+62<CR><LF>`

Value	Content
0	Sensor address
2591	Measurement with index 01
706	Measurement with index 02
25.53	Measurement with index 03
62	Measurement with index 04

If a device returns more than 9 measurement values, or if the values are returned in groups (see also Request results) the measurement index increments in the next group.

EXAMPLE

`0D0!` Answer: `0+2591+706+25.53+62<CR><LF>`

`0D0!` Answer: `0+56.2+125+12.32<CR><LF>`

Value	Content
0	Sensor address
2591	Measurement with index 01
706	Measurement with index 02
25.53	Measurement with index 03
62	Measurement with index 04
0	Sensor address
56.2	Measurement with index 05
125	Measurement with index 06
12.32	Measurement with index 07

12.4.5 SDI-12 commands

The following tasks can be performed with standard and extended SDI-12 commands.

Extended SDI-12 commands are non-standard commands implemented by SOMMER to enable device configuration via SDI-12.

NOTE After any changes, the settings have to be adopted with the command `aXW_ts|!`, with `a` the sensor address.

12.4.5.1 Command structure

A standard SDI-12 command starts with the sensor address and ends with an exclamation mark, e.g., `0M!` to trigger a measurement.

Configuration commands contain additional information; see the sections below for details.

12.4.5.2 Identify device

The identification of a SDI-12 device is requested with the command `aI!`, with `a` the sensor address.

EXAMPLE

`0I!` Answer: `013Sommer USH 140r90 USH-9 <CR><LF>`

The answer contains the following information:

`0`	SDI-12 address
`1`	SDI-12 version prior to the point
`3`	SDI-12 version after the point
`Sommer`	Description of the company (6 characters and 2 blanks)
`USH`	Description of the firmware (5 characters and 2 blanks)
`140r90`	Firmware version (6 characters and 2 blanks)
`LSH-10`	Device designation (max. 13 characters)

12.4.5.3 Acquire measurements

To acquire a measurement from a sensor, two individual SDI-12 commands – trigger a measurement and request measurement values – need to be sent.

EXAMPLE

`0M!` Answer: `00084<CR><LF> and 0<CR><LF>` after 8 seconds

`0D0!` Answer: `0+2591+706+25.53+0<CR><LF>`

The first values in the response to the `aDn!` command is the sensor address.

12.4.5.4 Trigger measurement

The command `aM!` with sensor address `a` triggers a measurement as in the example below.

The response states the measurement duration and the number of measurement values (see example below). After completion of the measurement, the device will return an additional `a<CR><LF>`, with `a` the sensor address.

EXAMPLE

`0M!` Answer: `00084<CR><LF>` and `0<CR><LF>` after 8 seconds

The answer contains the following information:

`0`	SDI-12 address
`008`	Duration of the measurement in seconds
`4`	Number of measurement values

12.4.5.5 Request results

After each measurement, results are requested with the command `aDn!`, with `a` the sensor address and `n` the index of the returned data string.

EXAMPLE `0D0!` Answer: `0+2591+706+25.53+0<CR><LF>`

The leading `0` of the response is the sensor address.

Generally, the command `aD0!` is sufficient to request up to 9 measurement values. If more than 9 values need to be read, or if the values are returned in groups, the commands `aD1!`, `aD2!`, … may need to be issued after `aD0!`. For example, if a measurement returns 8 values in two groups of 4, the commands `aD0!` and `aD1!` need to be issued to receive all values.

12.4.5.6 Acquire continuous measurements

If the SDI-12 device is operating in continuous measurement mode (not polled by SDI-12), the command `aR0!` will request and return the current reading of the sensor. The values within the data string follow the order listed in the measurement table. The first values in the response to the `aRn!` command is the sensor address.

EXAMPLE

`0R0!` Answer: `0+2591+706+25.53+0<CR><LF>`

ATTENTION

If more than 8 values need to be read, or if the values are returned in groups, the commands `aR1!`, `aR2!`, … may need to be issued after `aR0!`. For example, if a measurement returns 8 values in two groups of 4, the commands `aR0!` and `aR1!` need to be issued to receive all values.

12.4.5.7 Configure parameter

The configuration parameters of a SOMMER sensor are read with the command `aXRpp!` and written with the command `aXWpp=vvv!`, with `a` the sensor address, `pp` the parameter identifier and `vvv` the value of the parameter.

12.4.5.8 Read and write a parameter

EXAMPLE

Reading of measurement interval (in this example menu item B)

`0XRB|!` Answer: `0B=300|<CR><LF>`

Setting of measurement interval to 60 s (in this example menu item B)

`0XWB=60|!` Answer: `0B=60|<CR><LF>`

12.4.5.9 Read and write a selector-parameter

Changing the measurement trigger (in the following example menu item A) from *interval* to *SDI-12/RS485*:

EXAMPLE

`0XRA|!` Answer: `0A=1|<CR><LF>`

`0XWA=3|!` Answer: `0A=3|<CR><LF>`

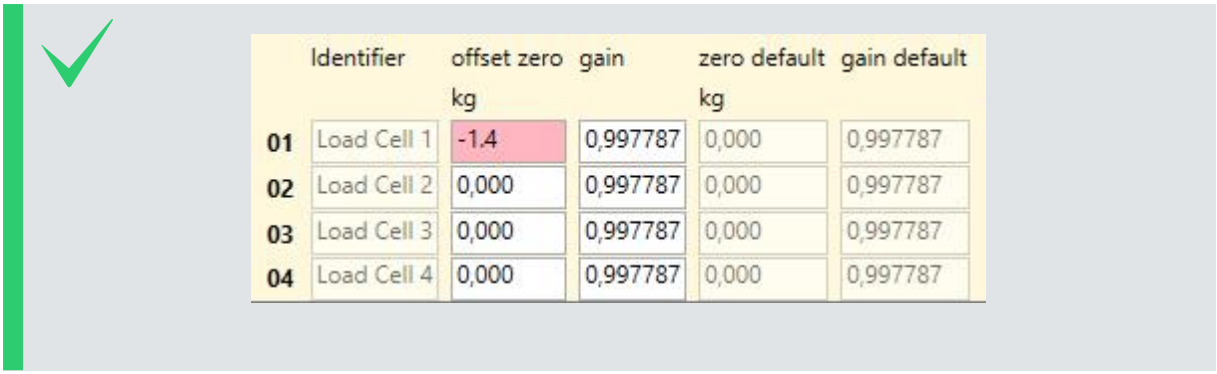
12.4.5.10 Read and write a parameters of a table

Some SOMMER sensors are equipped with multiple transducers and their settings are listed in a table (see example below). A value within such a table is addressed by its row-index (01, 02, …) and column-index (A, B, …). A corresponding SDI-command has the following format:

EXAMPLE

In this example of a snow scale the value in row 01 and column B of the parameter D-D-E is changed to -1.4.

`0XWDDE01B=-1.4|!` Answer: `0DDE01b=-1.4|<CR><LF>`



	Identifier	offset zero kg	gain	zero default kg	gain default
01	Load Cell 1	-1.4	0,997787	0,000	0,997787
02	Load Cell 2	0,000	0,997787	0,000	0,997787
03	Load Cell 3	0,000	0,997787	0,000	0,997787
04	Load Cell 4	0,000	0,997787	0,000	0,997787

12.4.5.11 Adopt settings

Some settings need to be adopted with the command `aXW_ts|!`, with `a` the sensor address. It is recommended to issue `aXW_ts|!` after each configuration change.

12.5 Modbus

12.5.1 What is Modbus?

Modbus is a serial communication protocol used for transmitting information over serial lines between electronic devices. The device requesting the information is called the Modbus Master and the devices supplying information are Modbus Slaves. In a standard Modbus network, there is one Master and up to 247 Slaves, each with a unique Slave Address from 1 to 247. The Master can also write information to Slaves.

Modbus has become a standard communication protocol in industry, and is now the most commonly available means of connecting industrial electronic devices. It is often used to connect a supervisory computer with a remote terminal unit (RTU) in supervisory control and data acquisition (SCADA) systems. Versions of the Modbus protocol exist for serial lines (Modbus RTU and Modbus ASCII) and for Ethernet (Modbus TCP).[1]

12.5.2 What can I do with it?

Modbus-communication with LSH-10 allows reading of measurement values and device information by a Modbus master. Additionally, the basic RS-485 port settings can be written to the LSH-10.

[1] http://www.simplymodbus.ca/FAQ.htm

12.5.3 Wiring

For Modbus communication the LSH-10 is wired according to the table below.

Modbus	Connector MAIN	Connection wire	Description
Common	Pin 1	White	GND
D1 - B/B	Pin 4	Yellow	RS-485 A
D0 - A/A	Pin 5	Grey	RS-485 B

Table 18 Modbus wiring

NOTE
Please note that different signal notations are in use for RS-485 connections:

TX+/RX+ or D+ or D1 as alternative for B

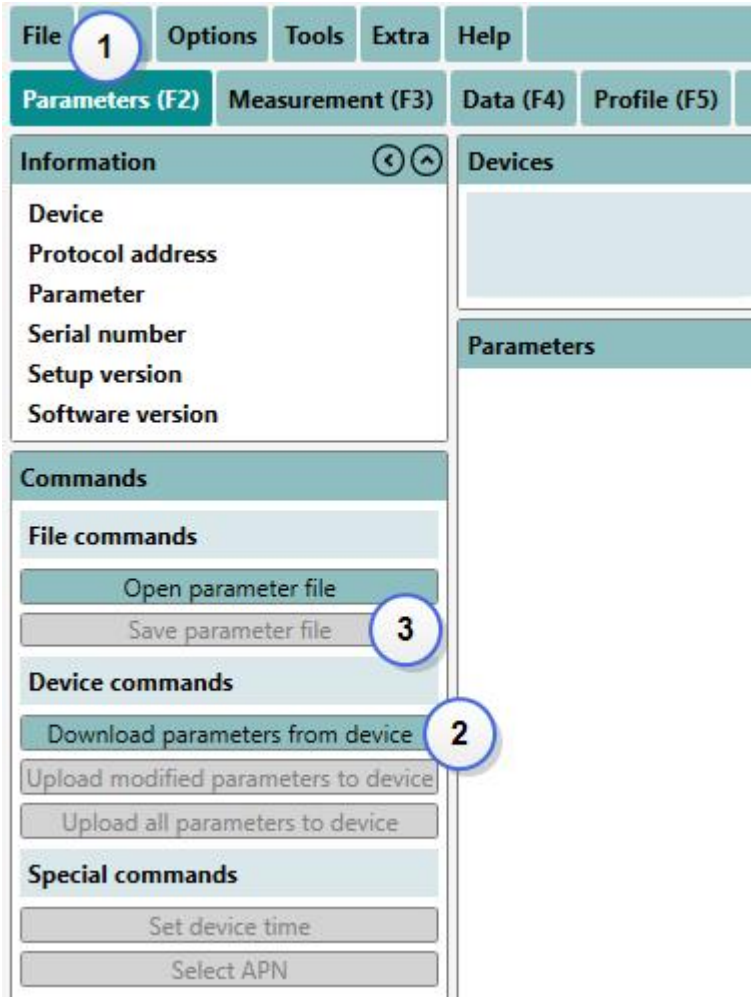
TX−/RX− or D− or D0 as alternative for A

NOTE If the LSH-10 is operated with multiple Modbus devices within the same network, termination resistors may be required. Please contact Sommer Messtechnik for details.

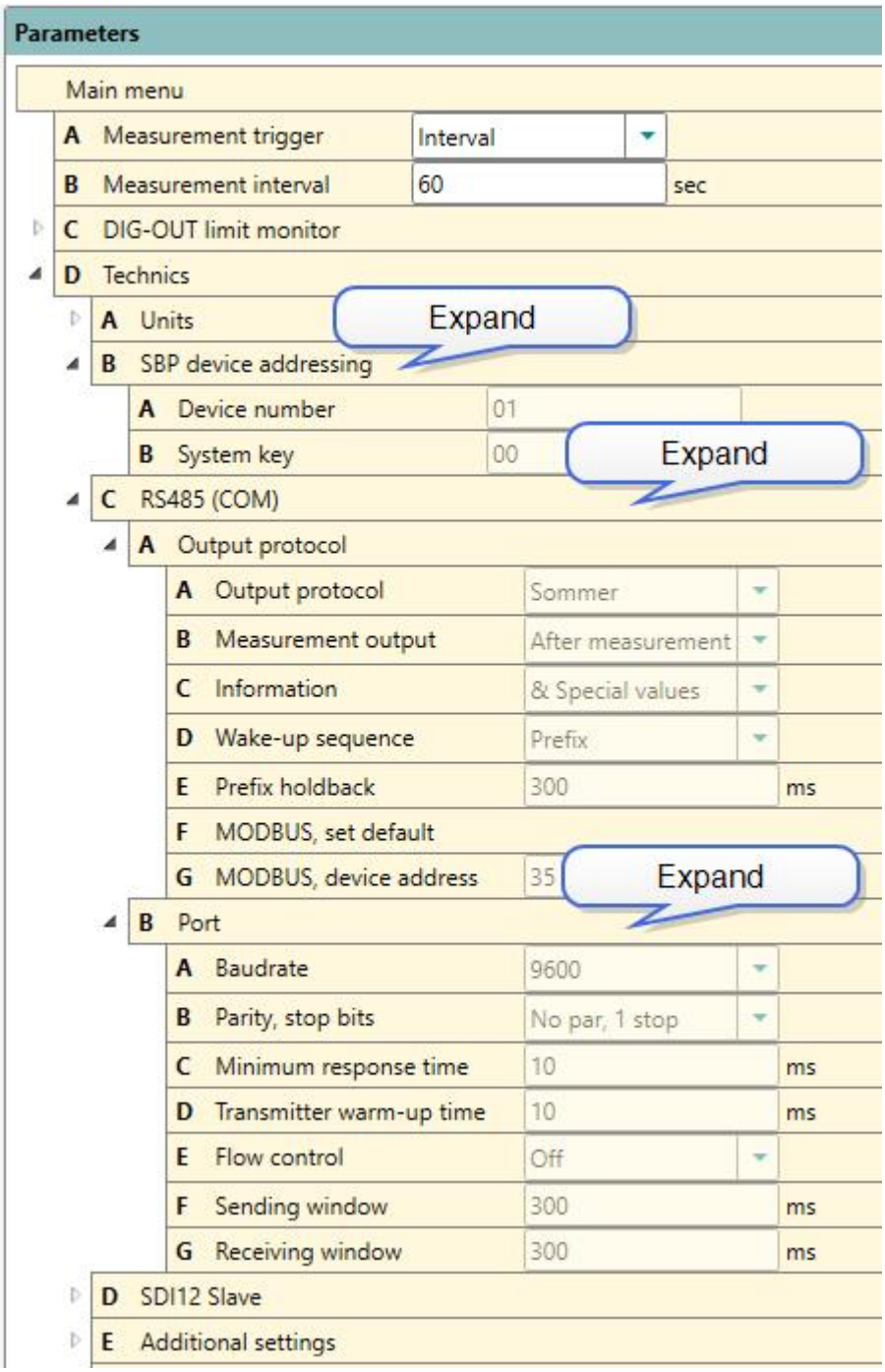
12.5.4 Modbus configuration

Follow the instructions below to change the communication of a Sommer Messtechnik device (in this example a RG-30) to Modbus:

1. Connect the USB to RS-485 converter to the data cable of the Sommer Messtechnik device and a USB port on your PC.
2. Connect the sensor to a power supply with the specified rating.
3. Start the Commander software on your PC.
4. Establish a connection to the Sommer Messtechnik device.
5. Download the sensor's parameters in the Parameters (F2) tab and save the parameter list on your PC.



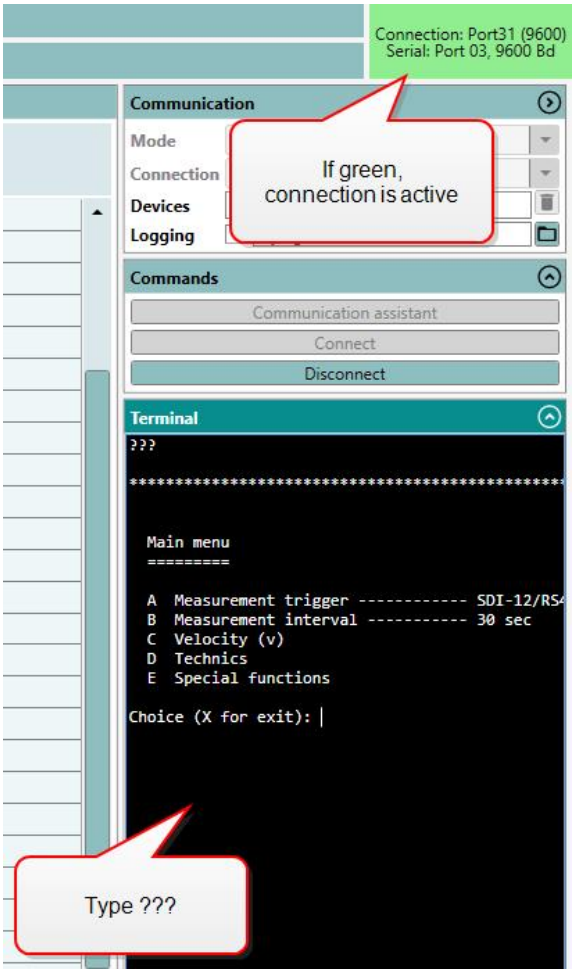
6. In the parameter list navigate to Technics and open the menu RS485 (COM) and take a screen-shot of the associated parameters. This and the previous step are helpful if you need to switch back to the standard communication mode at a later time.



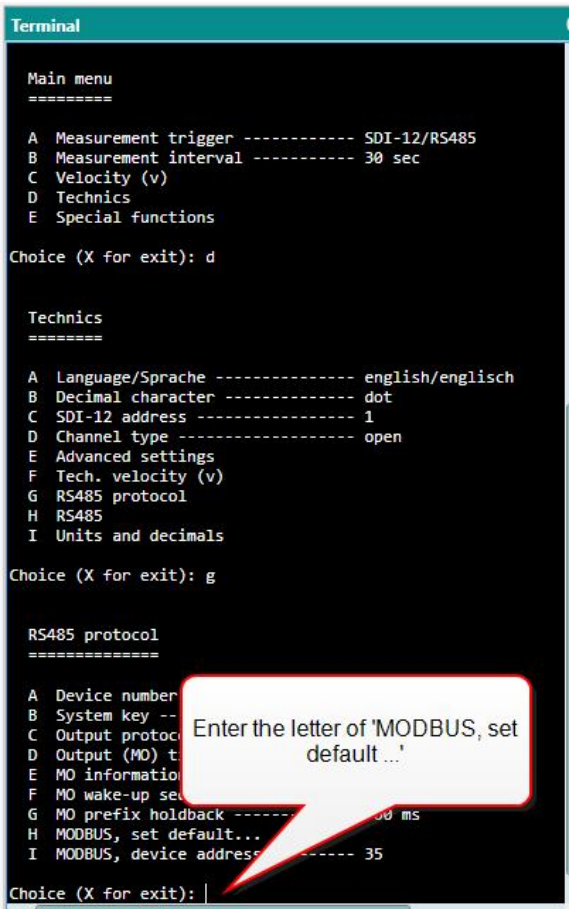
7. Set Measurement trigger to one of the following options:
   A. *Interval*, if measurements are triggered internally by the device.
   B. *SDI-12/RS-485*, if measurements are triggered by SDI-12.
   C. *TRIG input*, if measurements are triggered by a trigger input.
   D. *all allowed*, if measurements are triggered by one of the previous options.

NOTE Modbus cannot trigger measurements! Make sure to use the trigger option suitable for your application!

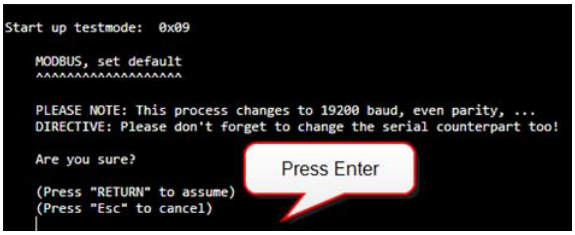
8. Verify that the connection to the Sommer Messtechnik device is active and click into the Terminal window. Type ??? to enter the sensor-menu.



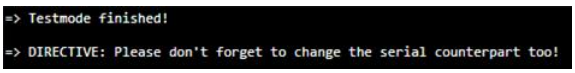
9. Navigate to *RS485 protocol* and select *MODBUS, set default …* Please note, that the index-letters might be different for your Sommer Messtechnik device!



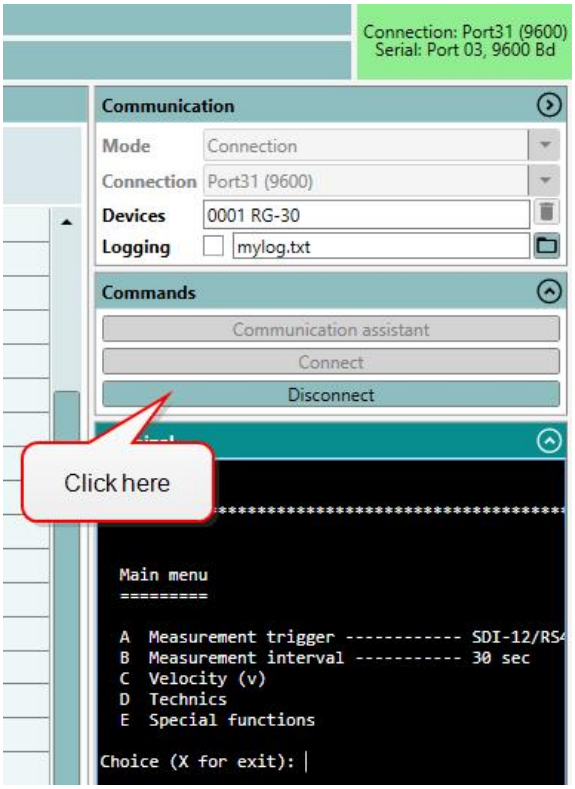
10. Acknowledge the safety-note.



11. After completion the following message will be displayed:



12. Enter X until you get back to the main menu. The Sommer Messtechnik device is now restarted and available for Modbus-communication. As the connection-parameters have been changed to Modbus, the connection to the sensor is lost. Press Disconnect for completion.



NOTE

By switching communication to Modbus with MODBUS, set default the following parameters are changed:

Parameter	Modbus setting
OP, measurement output	just per command
Output protocol (OP)	Modbus
MODBUS, device address	35
Sleep mode	Modbus, slow
Parity, stop bits	even par, 1 stop
Baud rate	19200
Flow control	off
Transmitter warm-up time	10 ms
Minimum response time	30 ms

TIP To change a parameter in the Technics menu you need to change your Commander-authorization to Expert. See Change authorization for instructions.

12.5.5 Modbus commands and registers

12.5.5.1 Read input registers

Input registers contain measurement values. The content of these registers is updated after each measurement.

	Register address	Variable	Unit / value	Bytes	Format
Tes value	0	Hardcoded test value	2.7519...	4	float
Main values	2	Snow depth	mm[1]	4	float
	4	Distance	mm[1]		
	6	Quality	°C		
	8	Status	%		
	10	Uncertainty	mm[1]		
	12	Function	-		
Special values	14	AV1 L temp. at e	°C/F[1]	4	float
	16	AV2 Inclination	°		
	18	AV3 Heat status	-		
	20	AV4 Quality rate	%/min		
	22	Meas. interval	sec		
	24	Supply voltage	V		
	26	Housing temp.	°C/F[1]		

[1] Unit according to submenu .

	Register address	Variable	Unit / value	Bytes	Format
Analysis values	28	Housing humidity	%	4	float
	30	Raw distance	mm		
	32	Sum awake time	h		
	34	Sum heat time	h		
	36	Sum laser time	h		
	38	Final return	-		
	40	Inclination	°		
	42	Inclin. dev.	°		
	44	Filter durat.	min		
	46	Filter gap	mm		
	48	Weighting	-		
	50	Quality rate	%/min		
	52	Num filtered	-		
	54	Heat duration	sec		
	56	Heat status	-		
	58	L temp. before H	°C		
	60	L temp. after H	°C		
	62	L temp. at end	°C		
	64	Raw dist. max	mm		
	66	Raw dist. med	mm		
	68	Raw dist. min	mm		
	70	L cat			
	72	L sub-cat			
	74	L measures			
	76	L return			
	78	L statistics			
	80	L prereturn			
	82	L prestatistics			
	84	Var1			
	86	Var2			
	88	Rest duration FH	sec		

	Register address	Variable	Unit / value	Bytes	Format
Device info	65533	Device type and configuration	320X	2	unsigned int
	65534	Software version	XYYZZ	2	unsigned int
	65535	Modbus implementation version	10100	2	unsigned int

Table 19 Input registers

NOTE

The 4-byte float values have the format *ABCD*, big-endian (*A* is the most significant byte).

Note the difference between float, double and decimal data types. While float is a 4-byte floating-point-number, double is a 8-byte and decimal a 16-byte floating-point number. Use the applicable conversion to obtain the correct measurement values!

12.5.5.2 Read and write holding registers

Holding resisters are mainly used to configure the Modbus adapter communication. Configuration settings are read with function 03 (read holding registers) and written with function 06 (write single registers).

NOTE Restart the Modbus adapter after changing the configuration!

	Register address	Variable	Range	Bytes	Format
Config values	0	Modbus default[1]	0 - 1…read 1…write	2	unsigned int
	1	Modbus device address	1 to 247		
	2	RS-485 baud rate	1…1200 baud 2…2400 baud 3…4800 baud 4…9600 baud 5…19200 baud 6…38400 baud 7…57600 baud 8…115200 baud		
	3	RS-485 parity/ stop bits	1…no parity, 1 stop bit 2…no parity, 2 stop bits 3…even parity, 1 stop bit 4…odd parity, 1 stop bit		

Table 20 Holding registers

12.5.5.3 Report slave ID

The Modbus function 17 (report slave ID, read only) can be used to read basic information of the LSH-10. The following example shows the response of function 17 of a RG-30 sensor, which is received in hex-format:

EXAMPLE 23 11 26 53 FF 27 74 20 53 6F 6D 6D 65 72 20
20 52 47 2D 33 30 20 20 20 32 5F 37 31 72 30 31 20 34
35 31 35 31 38 32 31 00 BB D4

[1] Writing "1" sets the Modbus default settings.

			Example	
	Content	**Length (Bytes)**	**HEX-value**	**Decimal, ASCII**
PDU* response	Slave address	1	23	35
	Function code	1	11	17
	Number of bytes (excl. slave-address, function code, NUL and CRC)	1	26	38
	Slave ID	1	53	"S"
	Run status (0=inactive; FF=active)	1	FF	255
	Modbus implementation version	2	27 74	10100
	Separator	1	20	" "
	Vendor string	7	53 6F 6D 6D 65 72 20	"Sommer "
	Separator	1	20	" "
	Device configuration	7	52 47 2D 33 30 20 20	"RG-30 "
	Separator	1	20	" "
	Software version	7	32 5F 37 31 72 30 31	2_71r01
	Separator	1	20	" "
	Serial number	8	34 35 31 35 31 38 32 31	45151821
	NUL	1	00	
	CRC	2	BB D4	

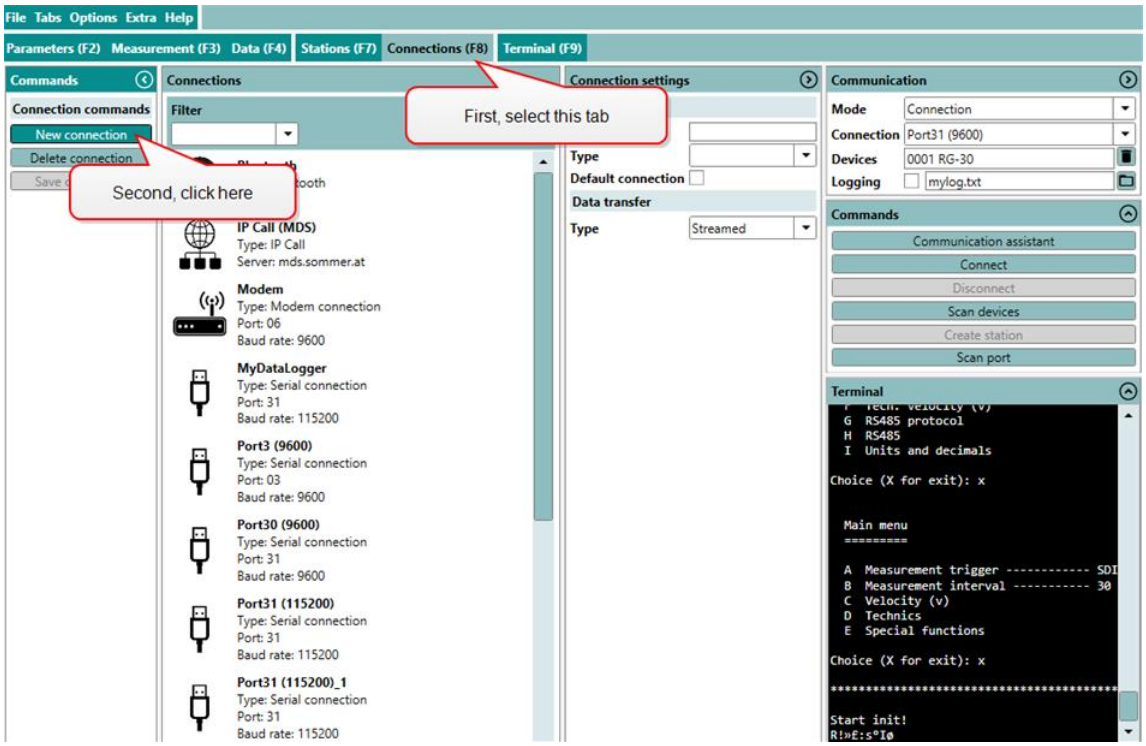
*Protocol Data Unit

Table 21 Slave ID

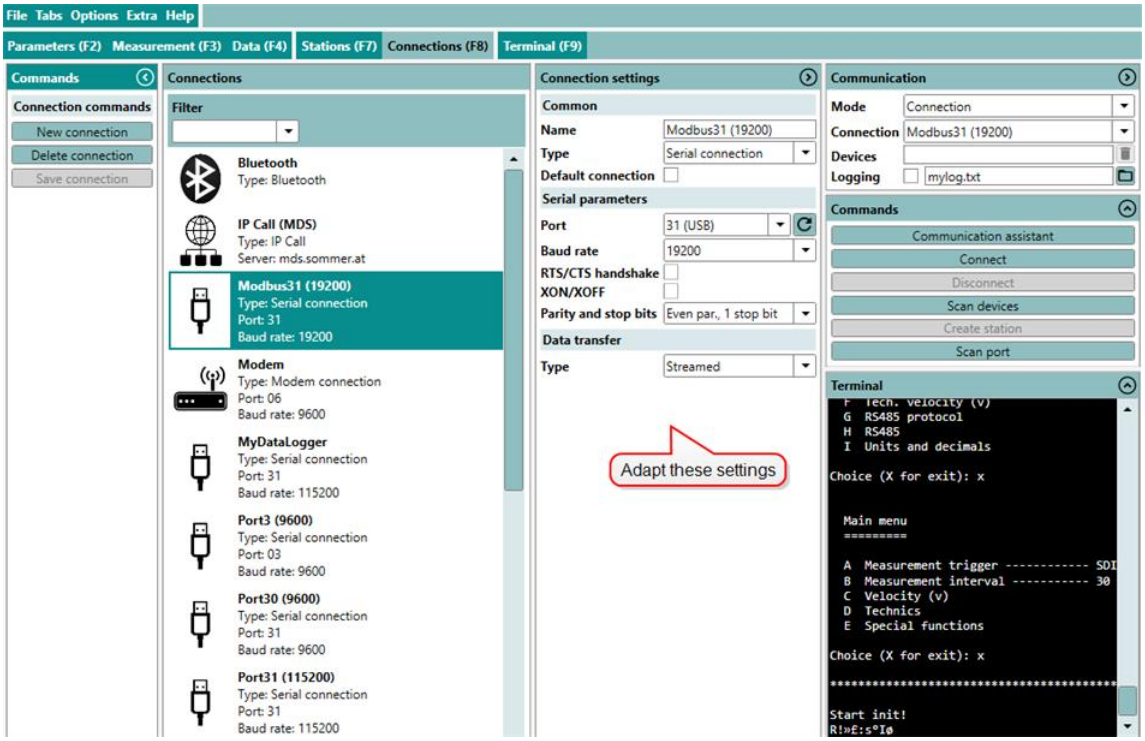
12.5.6 Reactivate Sommer Bus Protocol

Follow the instructions below to change the data output back to Sommer Bus Protocol:

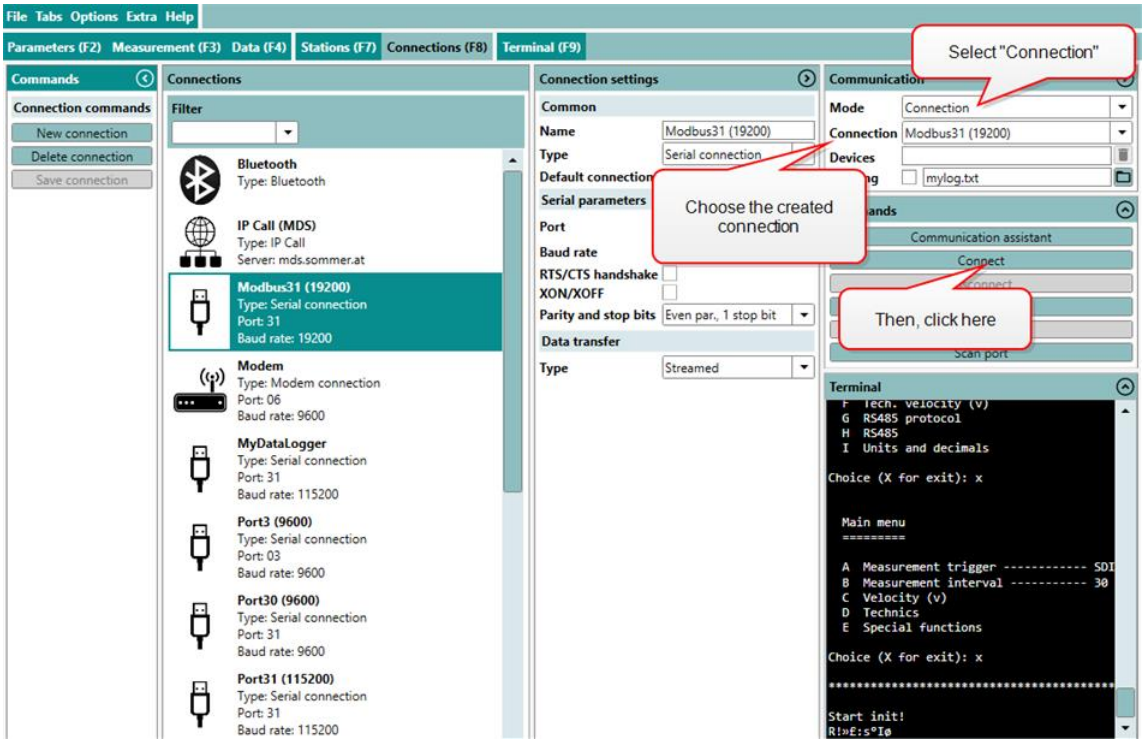
1. Open the Connections (F8) tab and click New connection.



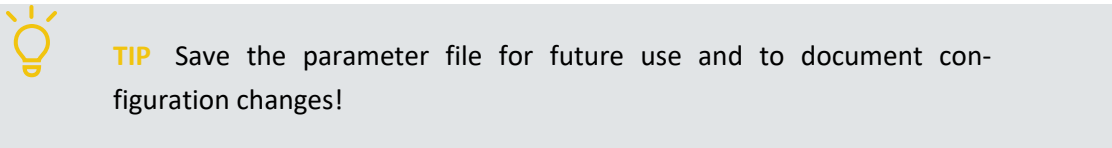
2. Enter the Name of the new connection. We recommend to use a meaningful name for later recognition, e.g. Modbus31 (19200) to indicate port 31 and Baud-rate 19200. Select the Type Serial connection and choose the Port your sensor is connected to, set the Baud-rate to *19200* and the Parity/stop bits to *Even par., 1 stop bit*.



3. Click Save connection.
4. In the Communication window select Mode Connection and choose the Connection you have created. Then click Connect.



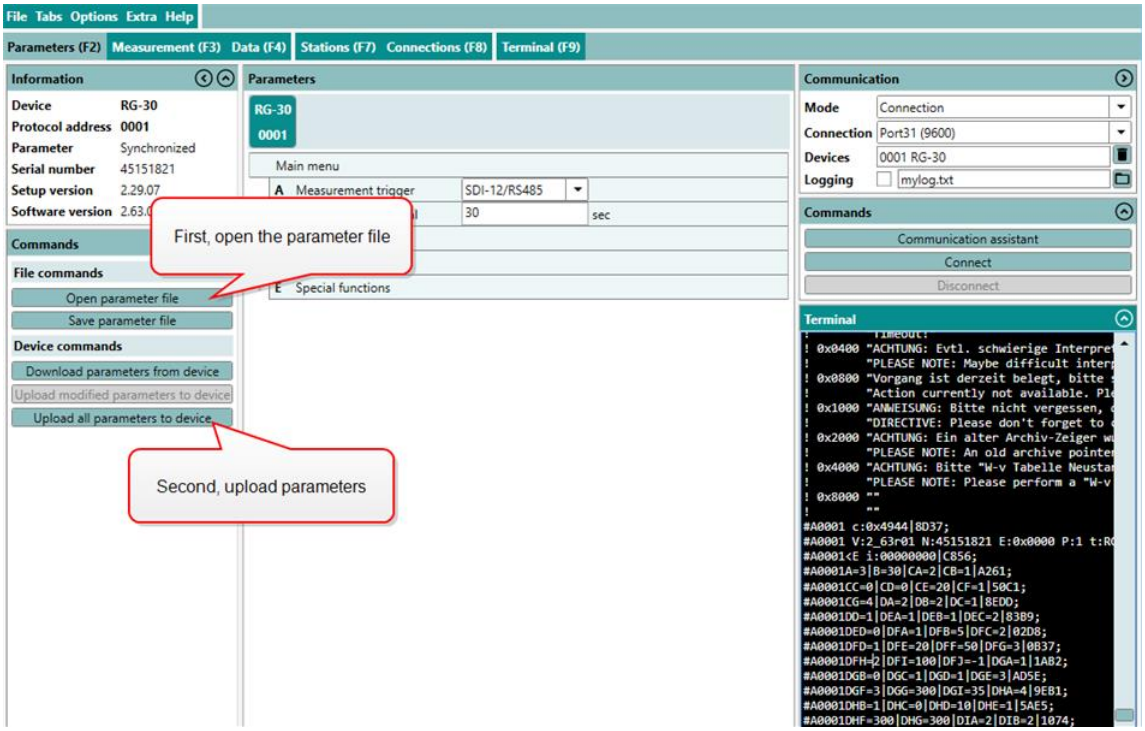
5. Download the parameters and save the parameter file as described in Modbus configuration.



TIP Save the parameter file for future use and to document configuration changes!

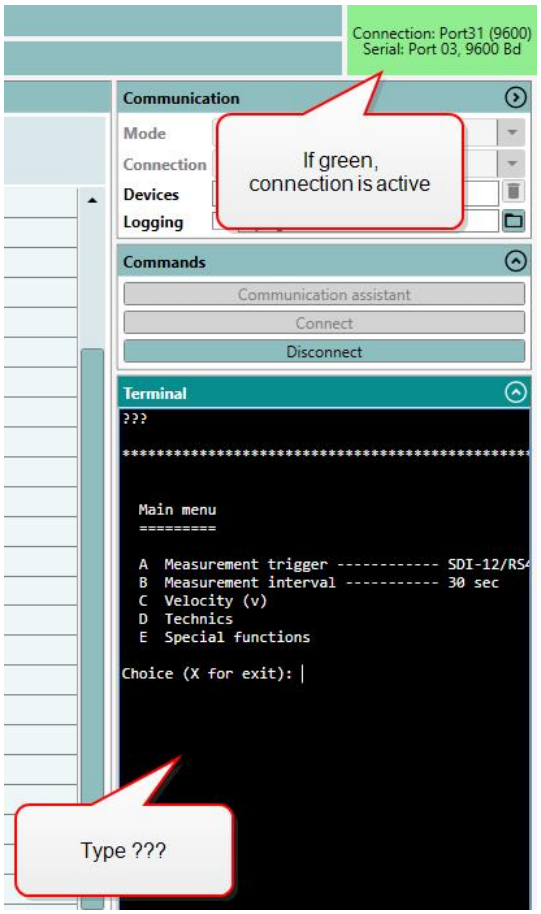
6. Now, two options are available to revert communication back to the Sommer Bus Protocol:

A. If a parameter file is available that has the Sommer Bus Protocol enabled, the file can be loaded by clicking Open parameter file, selecting the respective file and uploading the parameters to the device by clicking Upload all parameters to device.

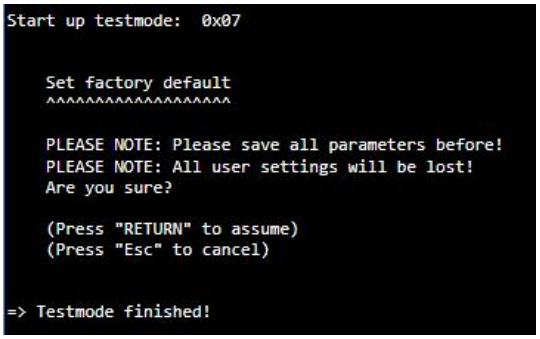


B. If no parameter file is available, the device has to be reset to its default configuration:

1. Click into the Terminal window and type ??? to enter the sensor-menu.



2. Navigate to Special functions and select Set factory default.
3. Acknowledge the safety-note.



4. Enter X until you get back to the main menu. The Sommer Messtechnik Sensor is now restarted and available in its initial configuration. As the connection-parameters have been changed to the default settings, the connection to the sensor is lost. Press Disconnect for completion.

7. Establish the original connection to the Sommer Messtechnik Sensor as described in Modbus configuration.

8. Download the sensor's parameters in the Parameters (F2) tab, adapt the required parameters, or upload your originally saved parameter file to the LSH-10.

12.5.7 PLC integration

The LSH-10 can be integrated into a PLC system as a slave device. It supports the PROFIBUS, PROFINET, EtherCAT and CANopen protocols. This requires an additional serial converter, e.g. Anybus Communicator.

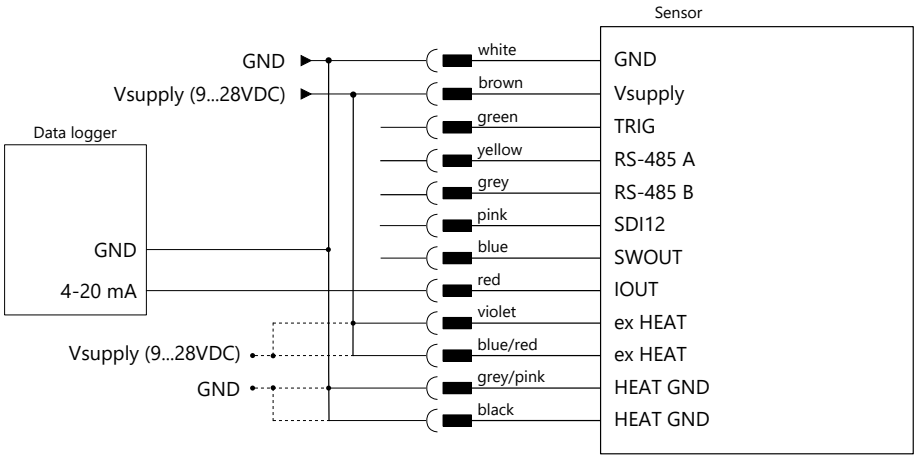
13 Analog output

13.1 What can I do with it?

Measurement values of level, distance, temperature and a status can be returned by two analog 4…20 mA signals. These analog signals can then be used to trigger a certain action, e.g. operate a switch.

13.2 How to wire analog outputs

Connect the analog outputs of the LSH-10 to a data acquisition device according to the figure below.



NOTE If a data logger is connected to the IOUT outputs, the resistance of the logger input(s) must not exceed 470 Ω.

13.3 Activation

In the setting Output status the state of the analog output can be set to one of the following options:

ID	Option	Description
1	Off (default)	Analog outputs are inactive.
2	Just during TRIG	Analog outputs are only active, if an external signal is present at the TRIG input. The outputs are high as long as the signal at the TRIG input is high.
3	Always on	Analog outputs are permanently active.

NOTE The LSH-10 delays analog data acquisition by 200 ms. If Output status is set to *just during TRIG*, the analog output must be read with a delay of min. 200 ms after the trigger has been sent. This ensures that the analog measurement has sufficiently stabilized. As the analog measurement itself requires some time, the result should be read with a delay of *measurement duration + min. 1 second*.

13.4 Scaling

The variables and their analog output range are configured as described below.

NOTE

The analog outputs may return currents between 0 and 21 mA. However, the accuracies stated in the specifications are only valid for signals within 4 to 20 mA!

If the measured value falls below or exceeds the 3.9…21 mA range, 3.9 mA and 21 mA, respectively, are returned. An exception are the measurement values `99999998` and `99999997`, which return a 3.8-mA and 3.7-mA signal, respectively.

ATTENTION The 4-mA output should correspond to a measurement value at or below the expected minimum! With low current output the accuracy tends to decrease and cross-talk with other analog channels may occur.

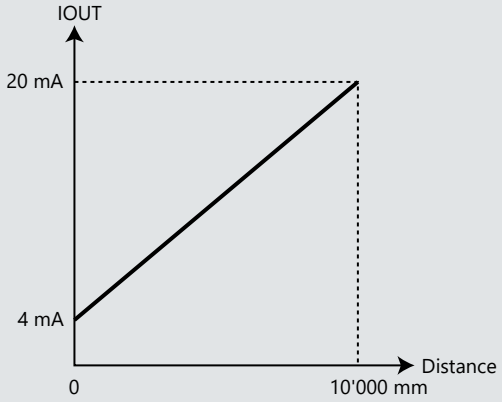
13.4.1 IOUT 1

The measured level or distance can be returned as an analog 4…20 mA signal on pin 8 of the MAIN connector. Select level or distance in Output value. The span and offset have to be selected to cover

the maximum expected level. See the illustration below for the default configuration.

EXAMPLE

In the default configuration the parameter IOUT1, 4 mA value is set to *0* and IOUT1, 4-20 mA span to *10'000 mm*, as illustrated below. If the LSH-10 is mounted at a lower height, it is recommended to keep this setting.



13.5 Simulate current output

With this function the analog outputs can be simulated. A user-defined current value between 4 and 20 mA is applied to the analog output pins, which can be read by a connected data acquisition device or multimeter. By pressing Return/Enter again the simulation stops.

14 Parameter definitions

A Measurement interval 104
B Snow depth and geometry 104
C Status limits 109
D Technics 109
E Region format 123
F Special functions 123
G Measurement table 125

A Measurement interval

generic-measurement-interval

An internal measurement interval can be set for the LSH-10. A measurement is always completed before a new one is initiated.

You can choose how often the LSH-10 takes measurements. Longer intervals between measurements save battery power. However, shorter intervals provide more detailed information. Adjust the interval based on your needs for battery life, ambient temperature and measurement detail.

Value range	Default	Units
30…18'000	30	s

B Snow depth and geometry

B-A GEOM, inclin. compens. results 104
B-B GEOM, inclination compens. 106
B-C Search flashing laser point 107
B-D Snow depth, distance to zero 107
B-E Snow depth, adjust 107
B-F Snow depth, test 108
B-G Moving Filter 108

B-A GEOM, inclin. compens. results

B-A-A Distance factor 105
B-A-B Form history 105
B-A-C Old distance factor 105
B-A-D Old form history 105

B-A-A Distance factor

This value can be calculated in "GEOM, inclination compens.". If the surface is not horizontal and flat, Distance factor must be entered **manually**.

Value range	Default
0.0…1.0	1.0

B-A-B Form history

This parameter shows the structure of the user inputs.

Parameter	Test mode usage	
0	-	"Distance factor" has been edited as parameter.
10	+	"Distance factor" has been set to 1.00 because of laboratory tests.
23	+	"Distance factor" is edited manually, because inclination is not valid.
24	+	"Distance factor" is edited manually, because ground is not plain, but uneven.
25	+	"Distance factor" is edited manually, because ground is not horizontal.
26	+	"Distance factor" is edited manually, because the restrictions were not accepted.
30	+	"Distance factor" is calculated and accepted by the user.

B-A-C Old distance factor

Shows the last successfully saved value. It can be useful when testing to return to the last successful measurement.

B-A-D Old form history

Displays the last saved parameter, can be used for testing.

B-B GEOM, inclination compens.

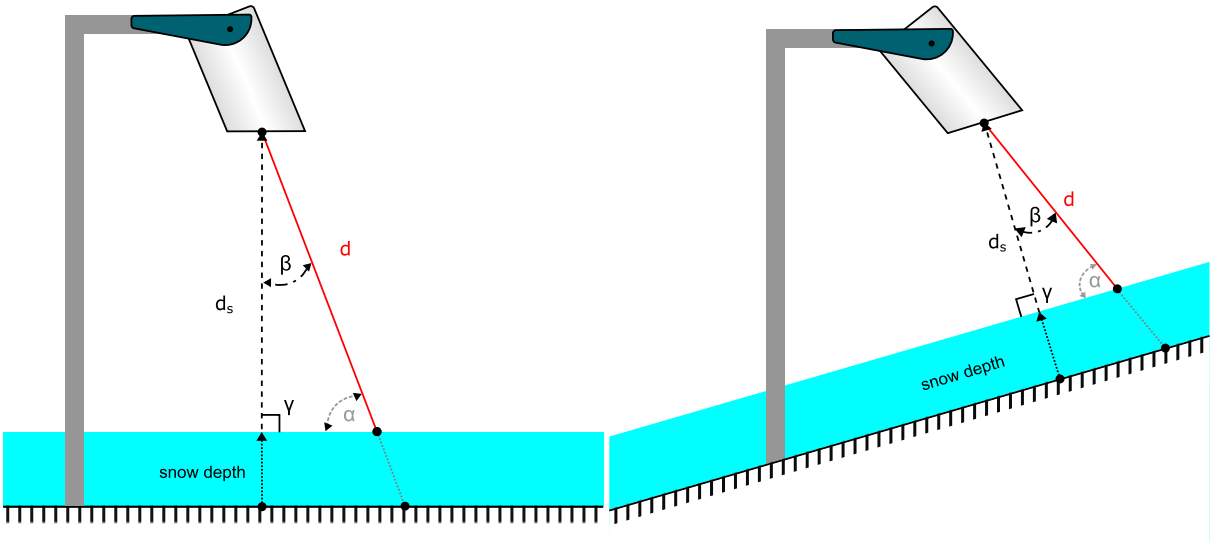
If the surface is plain and horizontal **only then**, you can work with the internally measured inclination angle of the LSH-10 and then with the implemented test mode "GEOM, inclination compens.", to do the "Distance factor" automatically.

Open menu for manual settings in relation to the GEOM inclination compensation of the LSH-10.

This test mode asks the user to describe the measuring site environment. Based on the user's answers, the LSH-10 will decide whether to continue, stop, or request further manual adjustment of the "Distance factor". This internal calculation is dependent on the accuracy and adequacy of all user announcements made above.

Questions that need to be answered accurately:

- Do wish to compensate an odd inclination between sensor and ground surface?
- Is the sensor fixed in proper target position?
- Do want to use the inclination measurement?
- Is the surface steady, plain without bumps within radius of 5m (15 ft)?
- Is the ground surface horizontal?



$\alpha + \beta + \gamma = 180°$

α - measured laser inclination

$\beta = (180° - \gamma) - \alpha = 90° - \alpha$

$$\text{distance factor} = \frac{d_s}{d} < 1$$

d_s - distance to zero

d - distance to the target surface

NOTE It is possible to calculate the "Distance factor" with reference measurements, but this also requires a good geometry knowledge.

B-C Search flashing laser point

Finding the laser spot on the ground can be challenging in grass, snow, gravel, or pavement.

Use this function to check where the laser flashing point reaches the relevant surface on installation.

To make it easier to find, take a piece of paper to trace the laser spot to the ground, place the paper on the ground and place a slap under it, or mark the position of the laser spot in another way.

B-D Snow depth, distance to zero

The distance between the sensors lower edge and the ground surface, e.g. lowest point of river bed, ground without snow.

These values can be automatically calculated in "GEOM, inclination compens." or entered manually if you can accurately measure the distance from the laser beam to the laser target point.

Value range	Default	Units
-9'999'999...99'999'999	1'000	mm

B-E Snow depth, adjust

Function to adjust the level measurement of the LSH-10 to the actual level. LSH-10 make a measurement to the defined surface and set indirectly the "Snow depth, distance to zero" value, by give in the actual snow depth. Adjusting the level will alter the parameter Snow depth, distance to zero.

NOTE Remember that Snow depth, distance to zero is also measured in the same direction as the "snow depth" itself, not necessarily in the direction of the laser beam. Changing the Distance factor later can also affect the Snow depth, distance to zero value.

B-F Snow depth, test

A function used to check the current measured snow depth level stored on the sensor based on the distance measured by the LSH-10.

B-G Moving Filter

B-G-A Maximal filter delay

This menu manages settings for sloping filters. It specifies the heating time required for the Measurement choice AV3 to reach optimal temperature for measurement. These settings impact Snow depth and Distance measurements and can be manually adjusted in the Snow depth and geometry submenu.

B-G-B Type

Function to select type of filter. If ‘fixed’ is selected then the ‘maximal filter delay’ is used all of the time when for measurement. ‘adaptive’ can also be selected which in turn is takes into account the Measurement choice AV3 values. Adaptive filter adapts to the quality of the signal from the laser.

The level/distance values in the buffer can be filtered by one of the following options:

ID	Option	Description
1	adaptive	This automatic filter evaluates the given filter time but does not use all measurements. Instead, it identifies and eliminates both positive and negative spikes. Additionally, it applies extra filters, such as the Min-Max Filter and Moving Average, to achieve the most reliable results. The filter length is automatically adjusted by the LSH-10 when necessary, and the used filter time is output as an analysis value.
2	fixed	This filter uses a fixed length and does not adjust itself. It employs the same internal filters as the adaptive filter but maintains a constant filter length. This setting is ideal for ignoring transient events, such as passing trains.

These filter abilities just affect Snow depth and Distance value.

C Status limits

C-A Snow depth limit 109
C-B Reflection, max snow depth 109
C-C Reflection, quality rate 109

C-A Snow depth limit

The level above which the status is set to high. This limit is used to report significant levels or snow depths.

C-B Reflection, max snow depth

This setting defines the maximum snow depth before the system begins recording snow settling.

C-C Reflection, quality rate

Set the level for the quality of the measurement, if this value is not reached the measurement values will no longer be returned. Status 10 "Reflection" parameters needs a special site preparation, to work as possible planned.

D Technics

D-A Heating & timing 110
D-B Units and decimals 110

D-C SBP device addressing 112
D-D RS-485 (COM) 112
D-E SDI-12 service 118
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D-A Heating & timing

D-A-A Draft measurement duration 110
D-A-B Special heating, quality rate 110
D-A-C Heating, minimal voltage 110
D-A-D Heating test 110

D-A-A Draft measurement duration

Measurement duration including the heating of the sensor when carrying out the measurement of distance.

D-A-B Special heating, quality rate

Additional heating stages. The LSH can be configured so that no heating occurs before the measurement, can be set to carry out the heating before the measurement and also can be set to highest priority so it ensures the temperature is the first priority in the measurement durational process.

D-A-C Heating, minimal voltage

Heating minimal voltage is set so that if not enough supplied voltage from the supply the heating function will not be fulfilled.

D-A-D Heating test

Heating test function to check heating is occurring with sensor.

D-B Units and decimals

D-B-A Snow depth, unit 111
D-B-B Snow depth, decimals 111
D-B-C Temperature, unit 111
D-B-D Temperature, decimals 111

D-B-A Snow depth, unit

`generic-units-level`

The following units of the level/distance can be selected:

ID	Option	Description
1	mm (default)	Millimeter
2	cm	Centimeter
3	m	Meter
4	in	Inch
5	ft	Feet

D-B-B Snow depth, decimals

`generic-decimals-level`

The number of decimal places for the measured level/distance.

Value range	Default	Units
0...6	0	-

D-B-C Temperature, unit

`generic-units-temperature`

The following units of the air temperature can be selected:

ID	Option	Description
1	°C (default)	Degrees Celsius
2	°F	Fahrenheit

D-B-D Temperature, decimals

`generic-decimals-temperature`

The number of decimal places for the measured air temperature.

Value range	Default	Units
0…6	2	-

D-C SBP device addressing

D-C-A Device number 112
D-C-B System key 112

D-C-A Device number

generic-rs-485-protocol-device-number

The device number is used for the unique identification of the device in a bus system.

Value range	Default	Units
0…98	1 (default)	-

D-C-B System key

generic-rs-485-protocol-system-key

The system key defines the bus system of the device. Thus, different conceptual bus systems can be separated. Interfering bus systems occur if the remote radio coverage of two measurement systems overlap. In general, the system key should be set to 00.

Value range	Default	Units
0…99	0	-

D-D RS-485 (COM)

D-D-A Output protocol 113
D-D-A-A Output protocol 113
D-D-A-B Measurement output 113
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D-D-A Output protocol

D-D-A-A Output protocol 113
D-D-A-B Measurement output 113
D-D-A-C Information 114
D-D-A-D Wake-up sequence 114
D-D-A-E Prefix holdback 114
D-D-A-F MODBUS, set default 115
D-D-A-G MODBUS, device address 115

D-D-A-A Output protocol

`generic-rs-485-protocol-type`

The type of the serial output protocol. The following options are available:

ID	Option	Description
1	Sommer (default)	Sommer Bus Protocol (SBP); data values are returned with an index starting at 1. Multiple strings may be returned.
2	Standard	Standard protocol; data values are returned without an index in one string.
3	MODBUS	Modbus protocol



NOTE For MODBUS applications run MODBUS, set default to get the appropriate communication settings.

D-D-A-B Measurement output

`generic-rs-485-protocol-measurement-output`

Specifies the timing of the serial data output.

ID	Option	Description
1	Interval	The output is only output by specified interval.
2	SDI12 / RS485	The serial data output is performed automatically right after each measurement.
3	TRIG input	The output is triggered by a positive edge of a control signal applied to the trigger input.

D-D-A-C Information

generic-rs-485-protocol-information

The main measurement values are always included in the data output string. Additionally, special and analysis values can be included.

ID	Option	Description
1	Main values	Only the main values are returned.
2	& Special values (default)	Main values and special values are returned.
3	& Analysis values	Main, special and analysis values are returned.

D-D-A-D Wake-up sequence

generic-rs-485-protocol-wake-up-sequence

Serial data can be transmitted to a recording device automatically without a request. However, many devices demand a wake-up sequence before they can receive and process data. The LSH-10 has the option to send a sync sequence and a prefix before data are transmitted. The following options are available:

ID	Option	Description
1	Off	No wake-up sequence
2	Sync	The sync sequence UU~?~? is sent before the output string.
3	Prefix (default)	A blank with a time delay is sent before the output string.
4	Prefix & Sync	A blank with a time delay and the sync sequence UU~?~? is sent before the output string.

D-D-A-E Prefix holdback

generic-rs-485-protocol-prefix-holdback

The hold-back time defines the time delay between the prefix and the data string.

Value range	Default	Units
0…5'000	300	ms

D-D-A-F MODBUS, set default

generic-rs-485-protocol-modbus-set-default

Sets all parameters required for Modbus communication automatically. The following settings are adapted:

Parameter	Modbus setting
OP, measurement output	just per command
Output protocol (OP)	Modbus
MODBUS, device address	35
Sleep mode	Modbus, slow
Parity, stop bits	even par, 1 stop
Baud rate	19200
Flow control	off
Transmitter warm-up time	10 ms
Minimum response time	30 ms

D-D-A-G MODBUS, device address

generic-rs-485-protocol-modbus-device-address

Unique device address for the Modbus protocol.

Value range	Default	Units
1…247	35	-

D-D-B Port

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D-D-B-B Parity, stop bits 116
D-D-B-C Minimum response time 116
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D-D-B-E Flow control 117
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D-D-B-G Receiving window 117

D-D-B-A Baudrate

generic-rs-485-port-baud-rate

The following transmission rates in bps (baud) can be selected:

ID	Option	Description
1	1'200	-
2	2'400	-
3	4'800	-
4	9'600 (default for sensors and data logger inputs)	-
5	19'200 (default if used with radio communication)	-
6	38'400	-
7	57'600	-
8	115'200 (default for data loggers)	-

D-D-B-B Parity, stop bits

`generic-rs-485-port-parity-stop-bits`

The following combinations of parity and stop bits can be selected:

ID	Option	Description
1	No par, 1 stop (default)	No parity and 1 stop bit
2	No par, 2 stop	No parity and 2 stop bits
3	Even par, 1 stop	Even parity and 1 stop bit
4	Odd par, 1 stop	Odd parity and 1 stop bit

D-D-B-C Minimum response time

`generic-rs-485-port-minimum-response-time`

This setting avoids failures of half-duplex interfaces. For this purpose the response to a command is delayed by the selected time. Additionally, the response is also kept temporally compact.

Value range	Default	Units
0…2'000	10	ms

D-D-B-D Transmitter warm-up time

`generic-rs-485-port-transmitter-warm-up-time`

The transmitter warm-up time defines the time before data is sent.

Value range	Default	Units
0…2'000	10	ms

D-D-B-E Flow control

`generic-rs-485-port-flow-control`

Flow control for the defined application.

ID	Option	Description
1	Off	no flow control
2	XOFF-XON blocking (default)	XOFF-XON flow control, especially adapted for half-duplex systems
4	DFM-RC	Flowcontrol for Sommer Messtechnik DFM point-to-point radios.
5	DFM-TM	Flowcontrol for Sommer Messtechnik DFM tiny-mesh radios.

ATTENTION To use spectrum mode (View spectral distribution) set Flow control to *XOFF-XON blocking*. This enables a return to normal mode at any time.

D-D-B-F Sending window

`generic-rs-485-port-sending-window`

If XON-XOFF flow control is activated data are transmitted in blocks with the defined length.

Value range	Default	Units
200…5'000	300	ms

D-D-B-G Receiving window

`generic-rs-485-port-receiving-window`

If XON-XOFF flow control is activated transmission of blocks is delayed by the specified time.

Value range	Default	Units
200…5'000	300	ms

D-E SDI-12 service

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D-E-B SDI12 Information 118
D-E-C SDI12 'M'-response 118

D-E-A SDI-12 address

`generic-sdi-12-address`

The address is a unique identifier of the sensor within a SDI-12 bus system.

Value range	Default	Units
0…9, A…Z, a…z	0	-

D-E-B SDI12 Information

`generic-sdi-12-information`

The scope of the data output.

ID	Parameter	Description
1	main values (default)	Only main values are returned.
2	& special values	Main values and special values are returned.
3	& analysis values	Main, special and analysis values are returned.

D-E-C SDI12 'M'-response

`generic-sdi-12-m-response`

Defines how an SDI-12 M-command received by the LSH-10 is answered if the requested number of measurement values exceeds 9. The following options are available:

ID	Parameter	Description
1	expand address	This option should only be used with SDI-12 standard V1.0. The measurement values can be requested with the commands `aD0!`, `aD1!`,..., with `a` the sensor address. Max. 9 values are returned for each command.
2	just expand output	The `M`-request received by the LSH-10 is answered according to SDI-12 standard V1.3, which supports transmitting more than 9 measurement values per answer.
3	as at 'C' request	The M-request received by the LSH-10 is answered as if several `C`-requests were sent.
4	M1, M2, M3 split (default)	The M-request received by the LSH-10 is answered as if several `Mk`-commands were sent, with k depending on the number of measurement values to be transmitted (`M1` returns the first 9 measurement values, `M2` the second nine values, etc).

D-F Analog output

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D-F-D IOUT1, 4 mA value 120
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D-F-A Output status

`generic-analog-out-status`

The status defines the behavior of the analog outputs.

ID	Option	Description
1	Off (default)	Analog outputs are inactive.
2	Just during TRIG	Analog outputs are only active, if an external signal is present at the TRIG input. The outputs are high as long as the signal at the TRIG input is high.
3	Always on	Analog outputs are permanently active.

D-F-B Output value

Defines the variable returned by IOUT1.

D-F-C IOUT1, 4-20 mA span

`usb-iout1-span`

Defines the output range of the 4-20 mA signal of IOUT1. The span should cover the expected range of the level or distance, respectively.

EXAMPLE

Minimum level: 0 cm

Maximum expected level: 400 cm

This gives an offset of 0 cm and a level span of 400 cm. To interpret the output more easily select a span value of 480 cm; thus, a current of 1 mA corresponds to a level of 30 cm.

Value range	Default	Units
-9'999'999…99'999'999	10'000 (default)	Unit of level

D-F-D IOUT1, 4 mA value

`ush-iout1-4ma-value`

Defines the minimum level/distance that corresponds to the 4 mA current output. For snow depth this value is usually zero.

Value range	Default	Units
-9'999'999…99'999'999	0	Unit of level

D-F-E Simulate current output

`generic-analog-out-simulate-current`

With this function the analog outputs can be simulated. Upon submission of a current value between 4 and 20 mA the corresponding values of the selected variable are displayed. The selected current is

also applied to the active analog outputs and can be read with a connected data logger or multimeter. By pressing Return/Enter again the simulation stops.

NOTE

If Output status is deactivated, no current output can be simulated.

If Output status is set to just during TRIG, the trigger must be set prior to simulation. Additionally, the trigger must be reset before each simulation.

D-G Simulate Dig Out

With this function the DIG outputs can be simulated. By pressing Enter / Return you start and end the simulation.

D-H Advanced settings

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D-H-B Sommer ID 122
D-H-C Geometry uncertainty choice 122
D-H-D Measurement choice AV1 122
D-H-E Measurement choice AV2 122
D-H-F Measurement choice AV3 122
D-H-G Measurement choice AV4 122

D-H-A Sleep mode

`generic-sleep-mode`

Defines the behavior of the LSH-10 between two measurements, provided the measurement interval is longer than the time of the measurement itself. The following options are available:

ID	Option	Description
1	MODBUS, fast	For MODBUS applications. The LSH-10 stays in normal mode. This option permits high data transmission rates, but increases power consumption.
2	MODBUS, slow	For MODBUS applications. The LSH-10 goes into idle mode and can be woken up by a command via the RS-485 interface with a low baud rate. This option reduces power consumption at lower data transmission rates.
3	Standard (default)	The LSH-10 goes into sleep mode and can be woken up by a command via the RS-485 interface only with a time delay. Option with the lowest power consumption.

D-H-B Sommer ID

generic-sommer-id

The Sommer ID is used to define stations within the Commander software. The ID is preset in the device and corresponds to its serial number.SOMMER suggests not to change the ID, except if a LSH-10 device is replaced. In such a case it can be practical to change the ID of the new device to the ID of the replaced device to guarantee data consistency.

D-H-C Geometry uncertainty choice

This parameter determines the value to which the relative aberrations of the measurement should be calculated. When selecting the "Snow depth" option, the uncertainty is low when the snow depth is low. Conversely, when selecting the "Distance" option, the uncertainty is low when the distance is low (which means the snow depth is high).

D-H-D Measurement choice AV1

Use this option if you does not want to record all LSH-10 measurement values. With this set of parameters, you can set 4 selected analysis channels to be displayed as "special values" to give them more importance.

Its determines which Analysis Value (AV) should be submitted at measurement output **position 7** (see Measurement output).

D-H-E Measurement choice AV2

Parameter determines which Analysis Value (AV) should be submitted at measurement output **position 8**.

D-H-F Measurement choice AV3

This parameter decides which Analysis Value (AV) is sent to measurement output **position 9**.

D-H-G Measurement choice AV4

Determines which Analysis Value (AV) should be submitted at measurement output **position 10**.

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E-A Language/Sprache

`generic-language`

The menu language.

ID	Option	Description
1	German/Deutsch	German language
2	English/Englisch (default)	English language

E-B Decimal character

`generic-decimals-character`

The character used as decimal separator in the values of the settings, in serial data strings and in .csv files.

ID	Option	Description
1	Comma	-
2	Dot (default)	-

F Special functions

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F-A Device status

generic-special-functions-device-status

Displays information about the device, setup / software versions, active time and number of reboots since first start.

F-B View setup

generic-special-functions-view-setup

In the terminal window, you can view all device parameters, service parameters and special functions.

F-C Continuous meas. mode (temp).

generic-special-functions-continuous-meas-mode

Inactive in the Commander menu. This feature can be triggered in the Commander under the Measurement (F3) tab with the command Start polling measurements and then Start polling WITH measurements. When active, measurements are performed continuously, ignoring the specified measurement interval.

F-D Sum reset

This test mode is to reset all "Sum measurement values" displayed in the measurement table. You can use it to reset the sums and start a new observation period and then check these sum values after a while, to make some energy consumption calculations for example.

F-E Set factory default

generic-special-functions-set-factory-default

All parameters are reset to factory defaults. Only available in terminal-mode.

F-F Temp. load factory default

generic-special-functions-temp-load-factory-default

Loads factory default values temporarily. Only available in terminal mode.

F-G Relaunch program

generic-special-functions-relaunch-program

The device is restarted. Powering the device off and on again is equivalent.

G Measurement table

generic-measurement-table

Appendix A Device Errors

By configuring the LSH-10 to return analysis values any error of the device can be recorded (see also Data output).

The error code is displayed as a decimal number of which the value left of the decimal point refers to fatal errors and the value right of the decimal point to minor errors. By converting these two numbers to their hex-values the errors as listed in the following tables can be identified.



NOTE If multiple errors occur, they are added and the summed error code is returned. The error code can be reset with the function Device status.

Error code	Name	Description
0x00000004	SYSTEM_MAIN_BAD_VSCHUSS_ ERROR	Supply voltage is out of bounds.
0x00000008	SYSTEM_MAIN_A6V0TO_LOW_ERROR	6V power supply for analog outputs and RS-485 interface is out of bounds.
0x00000010	SYSTEM_PRIMADC_NOXREF_ERROR	Power supply of AD-converter that reads the Pt1000 output is out of bounds.
0x00000020	SYSTEM_PRIMADC_BAD_SW_ERROR	Obsolete
0x00000040	SYSTEM_PRIMADC_AD7798_ERROR	Error-bit of AD-converter is set.
0x00000080	SYSTEM_PRIMADC_TIMEOUT_ERROR	AD-converter receives no results.
0x00000100	SYSTEM_PRIMADC_NOTCALIB_ERROR	Pt1000 is not or badly calibrated.
0x00000200	SYSTEM_PRIMADC_OUT_OF_ BOUNDS_ERROR	Current across Pt1000 and shunt resistor is too low.
0x00000400	SYSTEM_SCAN_ERROR	Measurement has been canceled.
0x00000800	SYSTEM_SCAN_BLOCKED_NEARFIELD	The target surface or another object is within the near field of the LSH-10. Subsequent measurement may be invalid!
0x00001000	SYSTEM_SCAN_ MIXEDMIRRORCONDIDTIONS	May only occur during indoor-use. LSH-10 returns *Hold* value.

Table 1 Fatal device errors

Error code	Name	Description
0x01	SYSTEM_MAIN_AVEXT_ERROR	Voltage of external power supply is not measured correctly.
0x02	SYSTEM_MAIN_A6V0_ERROR	Voltage of 6V power supply is too high.
0x04	SYSTEM_MAIN_TEMP_ERROR	Internal temperature sensor returns invalid data.
0x08	SYSTEM_NO_TARGET_CLEARANCE	May only occur during outdoor-use. Spread of distance acquired by confirmation-shots is too large.
0x10	SYSTEM_DIFFERENT_MIRRORING	May only occur during indoor-use.
0x40	SYSTEM_MAIN_REBOOT_ERROR	Repeated re-boot due to insufficient power supply or manual restarts.

Table 2 Minor device errors

Appendix B Troubleshooting

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B.1 Devices

B.1.1 The LSH-10 is not responding or returns unreadable characters

Reason	Solution
The power supply is not connected or turned off.	Check if the power supply is connected and on.
The polarity of connected power supply wires is wrong.	Check the polarity of connected wires.
Wrong sensor cable.	Use the original sensor cable configured by Sommer Messtechnik (only applicable to Sommer Messtechnik cables).
Power supply is insufficient. The LSH-10 requires a certain inrush-current that the power supply is not able to provide.	1. Use a power supply providing >0.5 A at 12 VDC or a fully charged battery. 2. In case of long sensor cables (>50 m) use a 24-VDC power supply. Please note that power supplied by the USB-port is insufficient to power the LSH-10!
The power supply voltage is out of range.	Adjust the power supply to match the specified voltage range.
The polarity of the connected RS-485-A and RS-485-B wires is wrong.	Reverse the polarity of the connected RS-485-A and RS-485-B wires.

Reason	Solution
The port settings of the LSH-10 and the data acquisition system do not match.	Use the Commander Communication assistant or adapt port settings on your device. **NOTE** Sommer Messtechnik devices require the following Baud rates: ■ Sensor: 9600 ■ Data logger: 115200 ■ Modbus: 19200 In case of doubt use the function Check port in the Communication assistant.
The LSH-10 is set to Modbus.	Connect to the sensor using the Communication assistant of the Commander and select the *Modbus* option in the *Serial connection*.
A sensor wire is not connected firmly to the terminal of the data acquisition device.	Check the firm connection of the sensor wires.
LSH-10 and data acquisition device have different grounds.	Connect the grounds of the LSH-10 and the data acquisition device.
A pin of the connector plug is bent or broken.	Verify that all connector pins are straight.
The sensor cable is damaged.	Replace the sensor cable.
The COM-port has not been assigned correctly to the USB converter.	1. Make sure to use a Sommer Messtechnik USB converter. Third party converters are not supported. 2. Check the COM-port number using Windows Device Manager. 3. Plug in the USB converter first, then start Commander.
The USB converter is faulty.	Replace the USB converter.
The USB port on your PC is not working.	Use another USB port.
The driver of the USB converter was incorrectly installed	Reinstall the driver of the USB converter.

B.1.2 The LSH-10 reboots repeatedly

Reason	Solution
The power supply has not enough current to start the LSH-10.	Verify that the power supply provides enough current. A LSH-10 consumes up to 140 mA @ 12 V. If required, power the LSH-10 by an additional or alternative supply.

B.2 Measurement data

B.2.1 Measurement data are not updated

The device is connected to the Commander, but the data are not updated.

Reason	Solution
Data traffic conflict	Reboot the device by interrupting the power supply.

B.2.2 Recorded data show frequent data gaps

Reason	Solution
Measured level is out of range.	Verify that level measurements are within the range of the LSH-10.
LSH-10 is not perpendicular to the ground	Verify that the LSH-10 is mounted perpendicular to the ground (see also Mounting).

B.3 Firmware & software

B.3.1 Commander loads wrong setup

If the setup is reloaded from the device the Commander seems to display an old version.

Cause	Solution
The device has been connected to the same PC before and several different setup files have been loaded.	■ In the Communication section of the Commander, select Mode *Connection* and click on the trash can icon on the right edge. Then, reload the setup from the device. ■ Delete the setup files of the device that have been downloaded by Commander to the folder *C:\Users\Public\Documents\Sommer\Setup*. The respective files can be identified by the serial number in the file name and the file date.

B.3.2 Firmware update via RS-485 is aborted

Reason	Solution
USB to RS-485 converter cable is damaged or can only operate on 9600 baud.	Replace USB to RS-485 converter cable. The programmer requires 57600 baud.

B.4 SDI-12

B.4.1 The LSH-10 is not detected by a SDI-12 master device

Reason	Solution
The LSH-10 and the SDI-12 master have different grounds.	Verify that the LSH-10 and the SDI-12 master are connected by a ground (GND) wire.

B.5 Analog output

B.5.1 The 4-20 mA output is wrong

Reason	Solution
Analog output settings incorrect.	1. Check analog output settings. 2. Run Simulate current output and verify the correct output.
Sensor and data acquisition system have different grounds.	Verify that sensor and data acquisition system have the same ground.
The analog output is read by a data acquisition system and the scaling in wrong.	Verify scale and offset on your data acquisition system.
Two or more analog outputs of the LSH-10 are read by a data acquisition system and the wiring is wrong, e.g. IOUT1 is read as IOUT2.	Verify the wiring on your data acquisition system and swap the wires if required.
The 4-20 mA output is delayed by approx. 150 ms. If the output is read before, a wrong value is acquired.	Sample the 4-20 mA output with a delay of more than 150 ms.

Appendix C CRC-16 array

CRC-16 array

```
crc16tab[] =
{
0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50A5, 0x60C6, 0x70E7,
0x8108, 0x9129, 0xA14A, 0xB16B, 0xC18C, 0xD1AD, 0xE1CE, 0xF1EF,
0x1231, 0x0210, 0x3273, 0x2252, 0x52B5, 0x4294, 0x72F7, 0x62D6,
0x9339, 0x8318, 0xB37B, 0xA35A, 0xD3BD, 0xC39C, 0xF3FF, 0xE3DE,
0x2462, 0x3443, 0x0420, 0x1401, 0x64E6, 0x74C7, 0x44A4, 0x5485,
0xA56A, 0xB54B, 0x8528, 0x9509, 0xE5EE, 0xF5CF, 0xC5AC, 0xD58D,
0x3653, 0x2672, 0x1611, 0x0630, 0x76D7, 0x66F6, 0x5695, 0x46B4,
0xB75B, 0xA77A, 0x9719, 0x8738, 0xF7DF, 0xE7FE, 0xD79D, 0xC7BC,
0x48C4, 0x58E5, 0x6886, 0x78A7, 0x0840, 0x1861, 0x2802, 0x3823,
0xC9CC, 0xD9ED, 0xE98E, 0xF9AF, 0x8948, 0x9969, 0xA90A, 0xB92B,
0x5AF5, 0x4AD4, 0x7AB7, 0x6A96, 0x1A71, 0x0A50, 0x3A33, 0x2A12,
0xDBFD, 0xCBDC, 0xFBBF, 0xEB9E, 0x9B79, 0x8B58, 0xBB3B, 0xAB1A,
0x6CA6, 0x7C87, 0x4CE4, 0x5CC5, 0x2C22, 0x3C03, 0x0C60, 0x1C41,
0xEDAE, 0xFD8F, 0xCDEC, 0xDDCD, 0xAD2A, 0xBD0B, 0x8D68, 0x9D49,
0x7E97, 0x6EB6, 0x5ED5, 0x4EF4, 0x3E13, 0x2E32, 0x1E51, 0x0E70,
0xFF9F, 0xEFBE, 0xDFDD, 0xCFFC, 0xBF1B, 0xAF3A, 0x9F59, 0x8F78,
0x9188, 0x81A9, 0xB1CA, 0xA1EB, 0xD10C, 0xC12D, 0xF14E, 0xE16F,
0x1080, 0x00A1, 0x30C2, 0x20E3, 0x5004, 0x4025, 0x7046, 0x6067,
0x83B9, 0x9398, 0xA3FB, 0xB3DA, 0xC33D, 0xD31C, 0xE37F, 0xF35E,
0x02B1, 0x1290, 0x22F3, 0x32D2, 0x4235, 0x5214, 0x6277, 0x7256,
0xB5EA, 0xA5CB, 0x95A8, 0x8589, 0xF56E, 0xE54F, 0xD52C, 0xC50D,
0x34E2, 0x24C3, 0x14A0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405,
0xA7DB, 0xB7FA, 0x8799, 0x97B8, 0xE75F, 0xF77E, 0xC71D, 0xD73C,
0x26D3, 0x36F2, 0x0691, 0x16B0, 0x6657, 0x7676, 0x4615, 0x5634,
0xD94C, 0xC96D, 0xF90E, 0xE92F, 0x99C8, 0x89E9, 0xB98A, 0xA9AB,
0x5844, 0x4865, 0x7806, 0x6827, 0x18C0, 0x08E1, 0x3882, 0x28A3,
0xCB7D, 0xDB5C, 0xEB3F, 0xFB1E, 0x8BF9, 0x9BD8, 0xABBB, 0xBB9A,
0x4A75, 0x5A54, 0x6A37, 0x7A16, 0x0AF1, 0x1AD0, 0x2AB3, 0x3A92,
0xFD2E, 0xED0F, 0xDD6C, 0xCD4D, 0xBDAA, 0xAD8B, 0x9DE8, 0x8DC9,
0x7C26, 0x6C07, 0x5C64, 0x4C45, 0x3CA2, 0x2C83, 0x1CE0, 0x0CC1,
0xEF1F, 0xFF3E, 0xCF5D, 0xDF7C, 0xAF9B, 0xBFBA, 0x8FD9, 0x9FF8,
0x6E17, 0x7E36, 0x4E55, 0x5E74, 0x2E93, 0x3EB2, 0x0ED1, 0x1EF0
}
```

Glossary

I

IP-Call

A technology that provides communication services over the Internet.

M

Modbus

A serial communications protocol for connecting industrial electronic devices.

R

RS-485

A standard defining the signal transmission in serial communication systems.

S

SBP

Sommer Bus Protocol

SDI-12

Asynchronous serial communications protocol for intelligent sensors (Serial Digital Interface at 1200 baud)

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