RHD

Rain disdrometer and hail detection sensor

Manual

Setup version V1.41 (Firmware 3.34)

07 April, 2020

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Validity

This manual applies to the Rain disdrometer and hail detection sensor with the SOMMER Toolbox version V1.41 or higher.

Created: 27.01.2020 Last update: 07 April, 2020

EU conformity

CE

Feedback

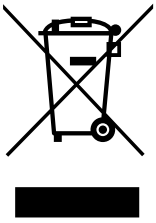
Should you come across any error in this manual, or if you miss information to handle and operate the RHD we are very grateful for your feedback to office@sommer.at.

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.

- Installation and electrical connections must be carried out by qualified personnel 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.

Content

1 What is the RHD?

The RHD is a low-cost, high precision, ultra-robust rain gauge. It features very low- power consumption, is maintenance- free and has a completely sealed acoustic sensor with no moving parts. The sensing device is a polished stainless steel hemisphere supported by a strong stainless steel arm. It detects changes of the acoustic pressure that are induced by the impact of raindrops or hailstones. The RHD also includes a distrometer that return the drop size distribution.

It features continuous or pulse analog voltage outputs and supports SDI-12 communication, serial RS-232, and Modbus RTU RS485 (using an optional adapter). The full configuration of the sensor can be customized at any time with a Plug-and-Play computer connection or remotely, using serial commands.

RHD	Rain & hail disdrometer
	The extremely robust and zero-maintenance RHD rain & hail disdrometer is an evolving acoustic instrument for the comprehensive measurement of the type, amount, intensity and structure of liquid and solid precipitation. Typical applications: • Meteorology (liquid and solid precipitation, rain and hail, hydrometeors) • High resolution rain and hail monitoring and warning • Roadside, railway, airport protection • Building and infrastructure surveillance and insurance • Land management (flood warning , soil erosion) • Agriculture • Maritime and offshore applications (wind turbines, buoys) • Mining industry • Applied scientific research

2 Before you start

Your sensor model RHD is delivered completely configured, ready to be plugged into a power supply and into your reading peripheral (I/O module, data logger, automation server, controller, computer, etc.).

The default operating configuration is described in the default settings table (Default settings). A configuration includes measurement settings (ex. averaging durations) and power, communication and mapping (ex. analog and/or digital outputs, voltage scales, duty-cycle, bus address) settings. You can adapt the default configuration at any time to almost any mode of use, following the instructions in this document. The sensors are compatible with both analog and/or digital peripherals.

The default configuration, as well as any other customized configuration, is non-volatile, so your sensor remains in the desired operating configuration whatever the powering scenario. Thus, even in case of repeated power failures, the sensor will always restart automatically in the desired configuration mode. When adding or replacing a Sommer Messtechnik sensor, it is possible to pre-configure it in order to achieve Plug and Play functionality without any on-site configuration.

The sensor is totally standalone, so that the full lifetime operation of the sensor on your installation doesn't require any software installation or maintenance.

When receiving your sensor, we recommend that you perform a quick and simple communication test, to get acquainted with the sensor's facilities. The USB dongle accessory, delivered with the sensor, and the free SOMMER Toolbox software suite allow you to realize these operations very easily. You can immediately establish a connection with a computer or laptop, access to all settings menus and see live data with a simple scope utility. You also have permanent access to the configuration and communication setups of the sensor either directly in a terminal console mode, or remotely, using other standard serial communication modes (serial commands, extended SDI-12 commands) also described in this document.

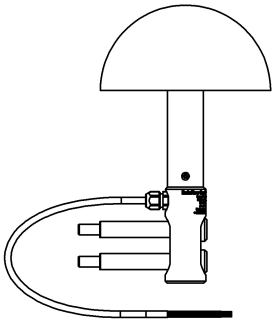
The sensors can simply be used for reading DC outputs (+0 to +2.5 V or +0 to +5 V analog voltages available; continuous or pulse). Note that the continuous DC analog voltages are persistent on the output so that the output voltages can be read at any time (the reading interval from your peripheral is independent of the duration of the sensor's time integration).

3 Unpacking

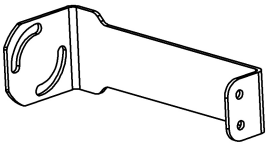
When unpacking your RHD sensor box please make sure that the following items are present:

Ref.	Description	Quantity
RHD	Rain & Hail sensor	1
FLARM	Flat arm	1
BRA01	Front bracket	1
BRA02	Back bracket	1
BRA03	Reduction shim	2
SK02S	Plastic sleeve	2
SK110	M10 x 110 mm screw	2
SK070	M10 x 70 mm screw	3
SK040	M10 x 40 mm screw	3
SK012	M10 x 12 mm screw	2
SK10N	M10 securing nut	5
CBTUB	Cable protection tube	1 x 3 m
CBTIE	Tie wrap	5
UDONG	USB dongle	1

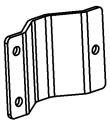
Sensor	Mounting kit



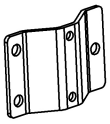
RHD



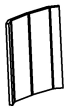
FLARM



BRA01

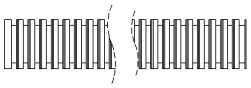


BRA02



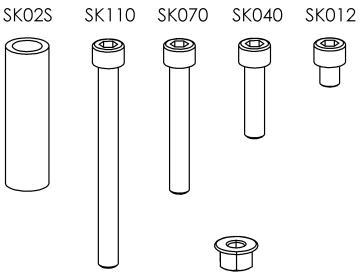
BRA03

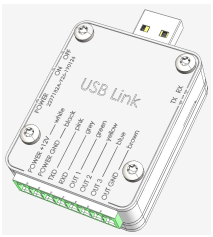
Cable protection	Screw kit	USB dongle



CBTUB

CBTIE





UDONG

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

Available accessories

Art	Accessory
21423	Signal converter 0-10 VDC to 4-20 mA
21431	RS-232-ModbusRTU adapter

4 How do I start?

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!

4.1 Initial check

When the sensor is unpacked, it should first be checked carefully for any signs of shipping damage.

It is then recommended to proceed to a first, quick and simple communication test, connecting your sensor to a computer or laptop.

Install the SOMMER Toolbox software suite first, then plug the sensor into the USB dongle accessory, establish a communication and browse all settings. These steps are described more in detail in the next sections of this chapter.

4.2 Install the SOMMER Toolbox software suite

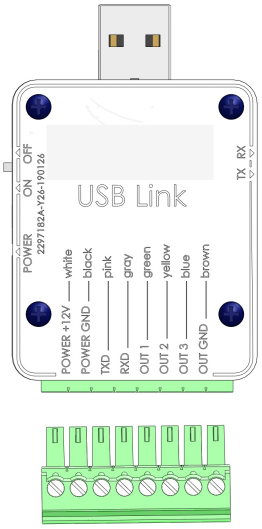
Download the SOMMER Toolbox software suite from the Sommer Messtechnik website and install the latest version of the toolbox.

Add an icon on your Desktop to ensure direct access to the SOMMER Toolbox program.

4.3 Plug your sensor

1. Connect the sensor to the USB dongle accessory:

   Your sensor is delivered with an 8-pin connector that you can plug directly into the USB dongle accessory.



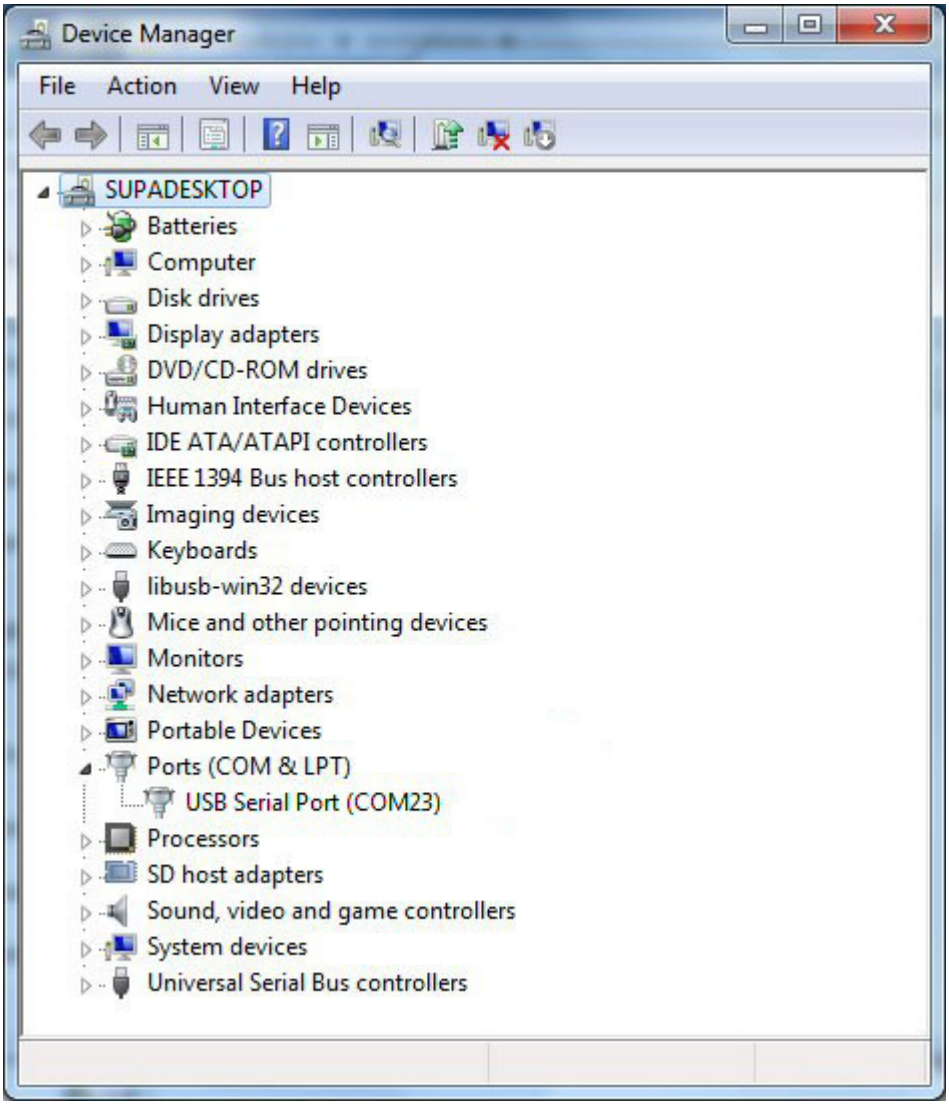
2. Connect the USB dongle to the computer.

   Wait for the device driver to be automatically installed and completed.

   (If the driver is not properly installed, you can download it from http://www.ftdichip.com/Drivers/VCP.htm and install it manually.)

3. Get the USB dongle serial port:

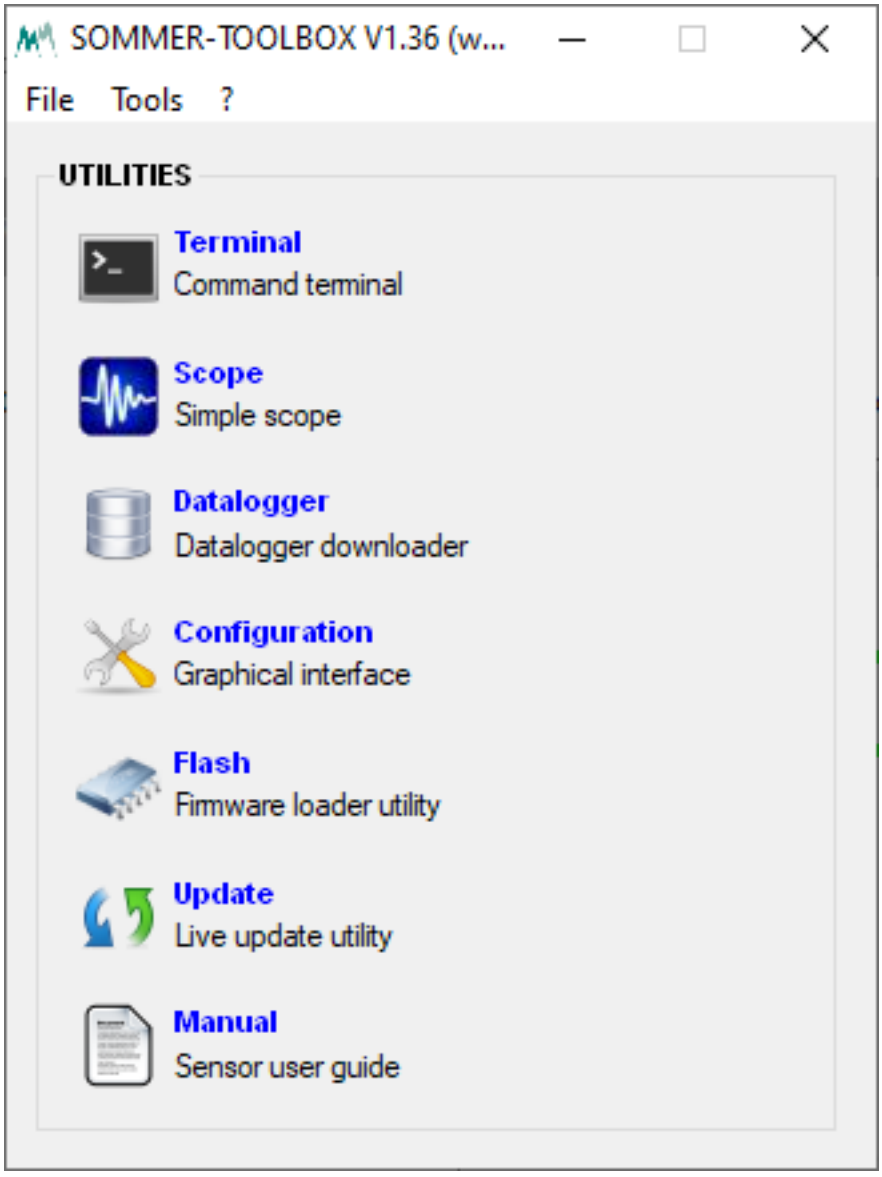
   In the “Configuration panel”, open the “Device manager”. In the “Ports (COM & LPT)” section, you will find a new serial communication port (ex: COM23).



4.4 Test your sensor

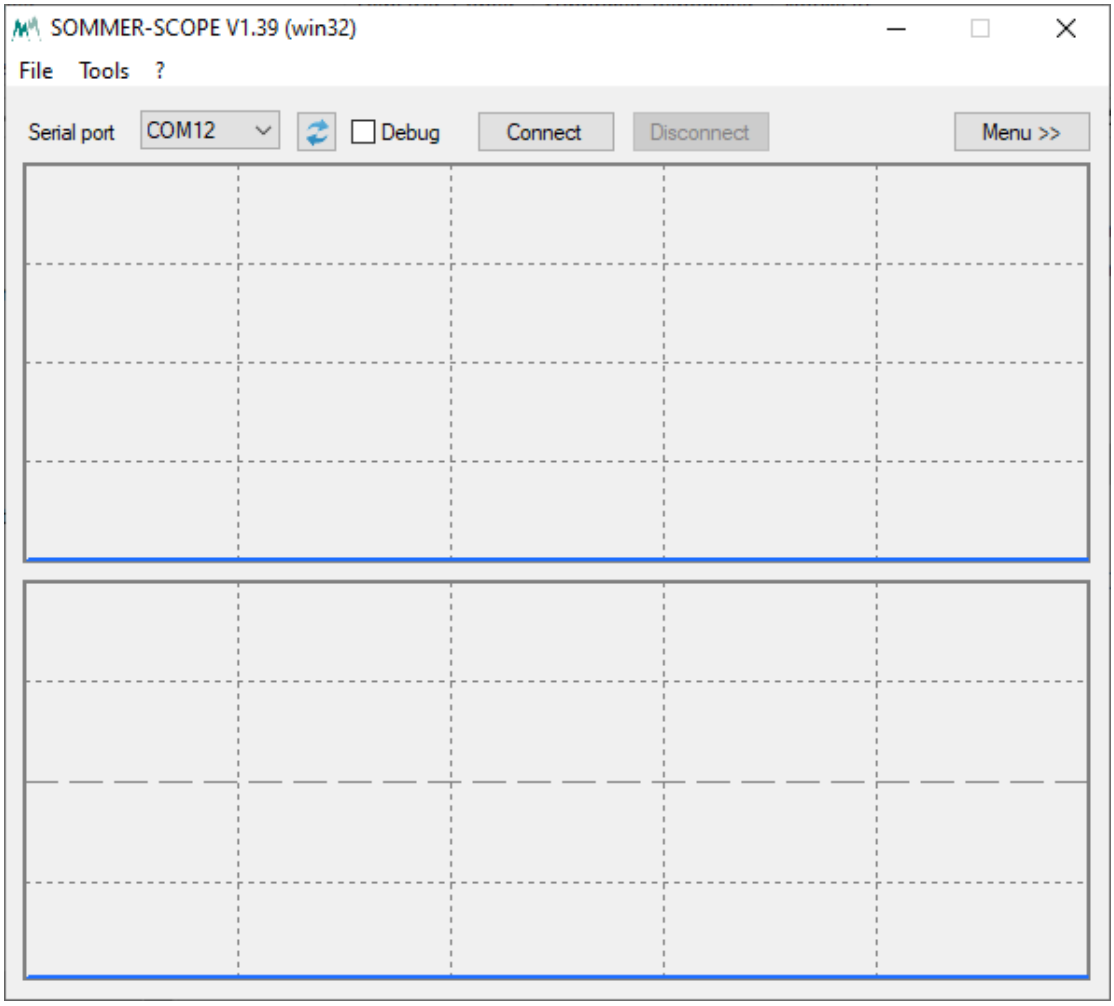
1. Open the SOMMER Toolbox software

   Open the software by double-clicking on the icon on your desktop.



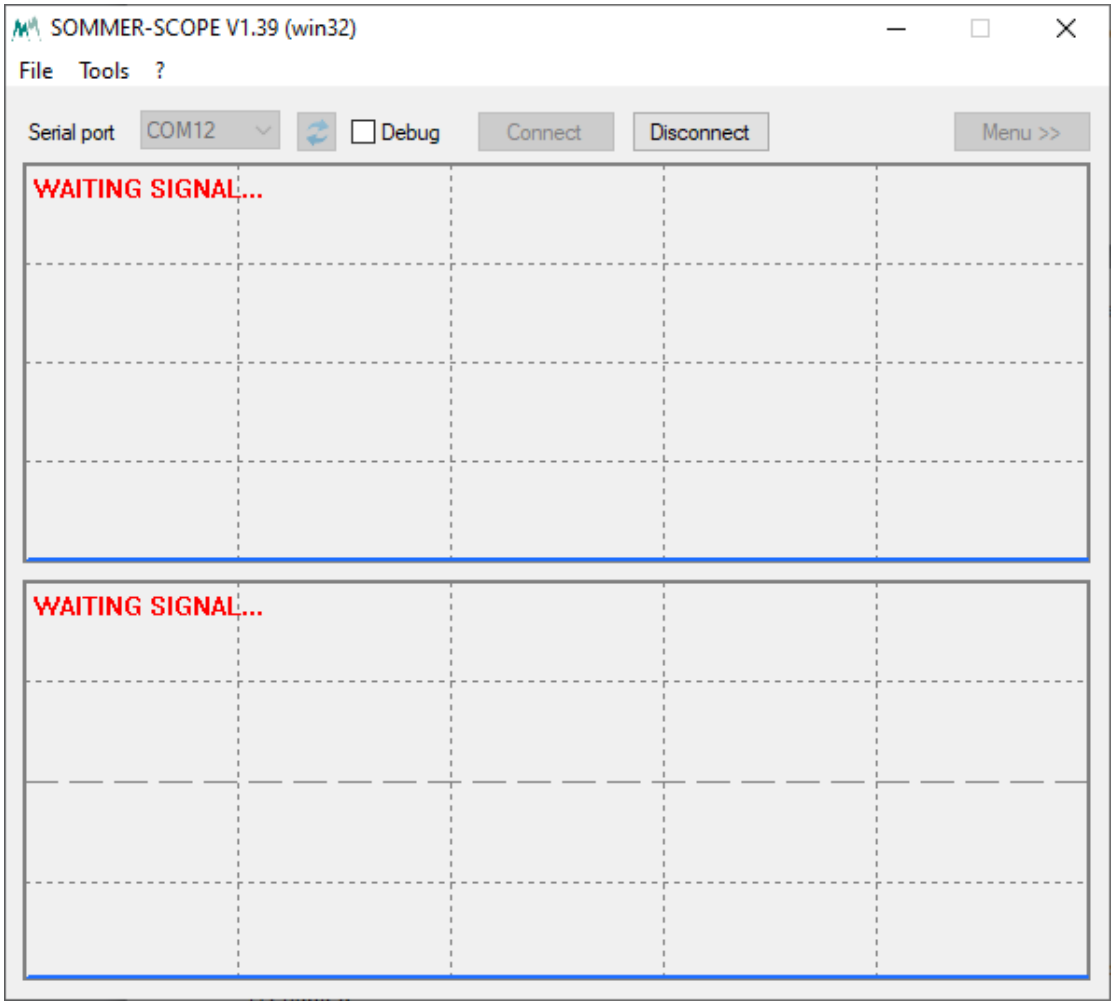
2. Start the Scope utility

   Start the utility by clicking on the Scope item.



3. Connect the sensor

   In the upper part of the window, select the serial port that the sensor is connected to in the list, then press the [Connect] button.



The connection procedure is completed when the [Connect] button is disabled and the [Disconnect] button is enabled.

NOTE Note: If the sensor has been plugged in after the start of the application and you can't find the serial port in the list, click on the reload button to update the list, and then select the right port.

4. Check live sensor response(s)

Once your sensor is plugged in and connected, test the signal(s) by tapping or scratching gently on the sensor until a live signal appears on the scope window (see example below). If no signal appears, check the wiring and try again. If you still don't get a live signal, please contact the Sommer Messtechnik support.

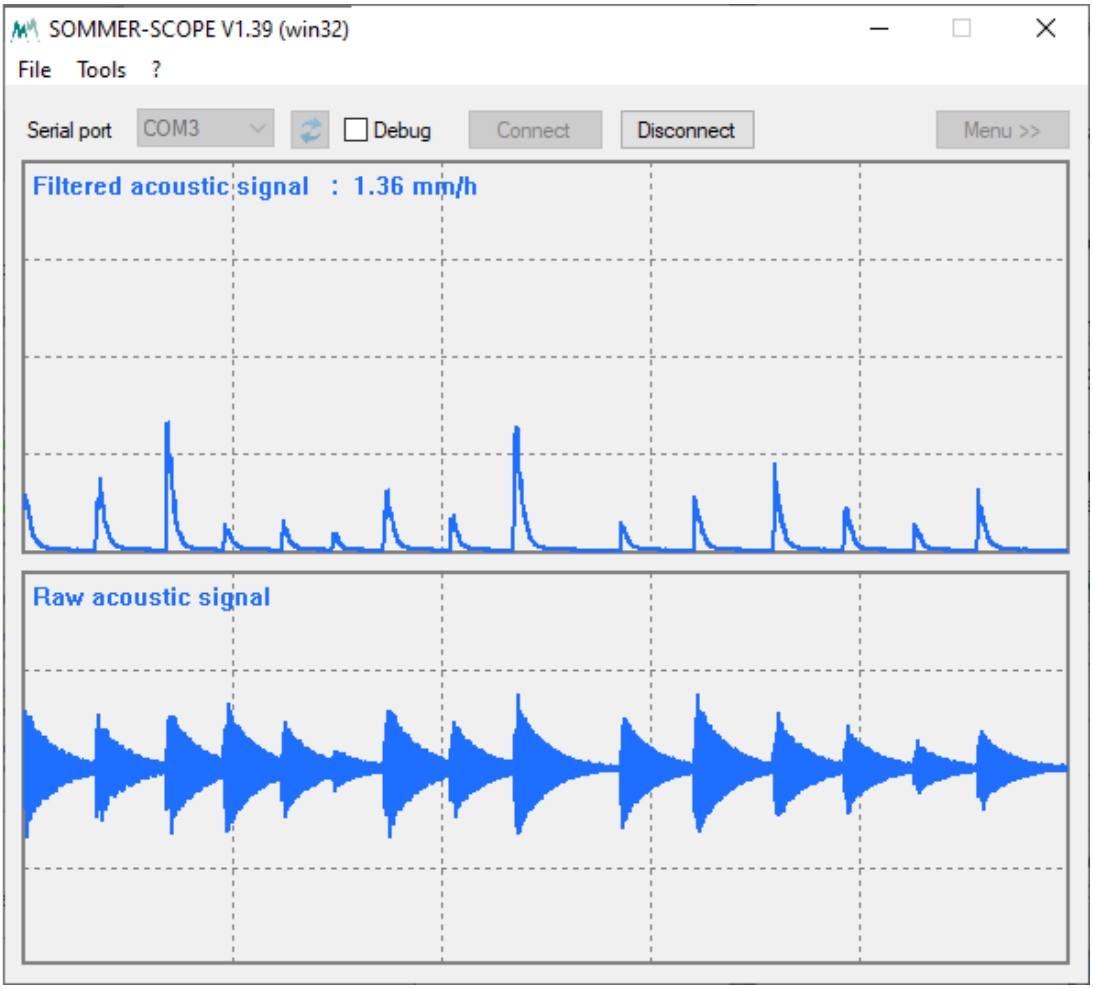


Figure 1 Typical RHD live response

5 Specifications

The RHD operates with the following power supply ratings:

Supply	Ratings
Voltage	6 V to 30 V DC (9.6 V and 16 V DC in case of powering through the SDI-12 terminals)
Current	< 1 mA in stand-by mode and 20 mA max in acquisition mode. For a typical nominal duty-cycle of 10%: 2.1 mA (20 mA for duty-cycle of 100%).

The RHD operates with the following nominal measurement scales and corresponding analog output voltages:

Analog output sensitivity and range	
Rain	Sensitivity @voltage range +2.5V: [10 mV/(mm/h)] i.e. +2.5V corresponds to 250 mm/h
	Sensitivity @voltage range +5V (default): [20 mV/(mm/h)] i.e. +5V corresponds to 250 mm/h
Hail	Sensitivity @voltage range +2.5V or +5V: 5 hit/s
	Sensitivity @voltage range +2.5V or +5V: 25 hit/s

6 Default settings

The RHD sensor is delivered with a standard configuration as follows:

6.1 Power supply and grounding

Wire	Signal	Unique or user-selectable setting
White	Power +	Positive power supply (6 to 30) VDC
Brown	Signals GND	OUT1 GND, OUT2 GND and SDI-12 GND
Black	Power GND	Negative power supply (Power GND), 0 VDC

6.2 Single-ended analog and pulse outputs

Wire	Signal	Disabled	Rain intensity				Hail intensity				Raw signal (±2.5V)
			DC voltage		DC pulse		DC voltage		DC pulse		
			+0V to +2.5V	+0V to +5V	+0V to +2.5V	+0V to +5V	+0V to +2.5V	+0V to +5V	+0V to +2.5V	+0V to +5V	
Green	OUT1	○	○	●	○	○	○	○			
Yellow	OUT2	○	○	○	○	○	○	●			○

1... Default setting, 2... User selectable

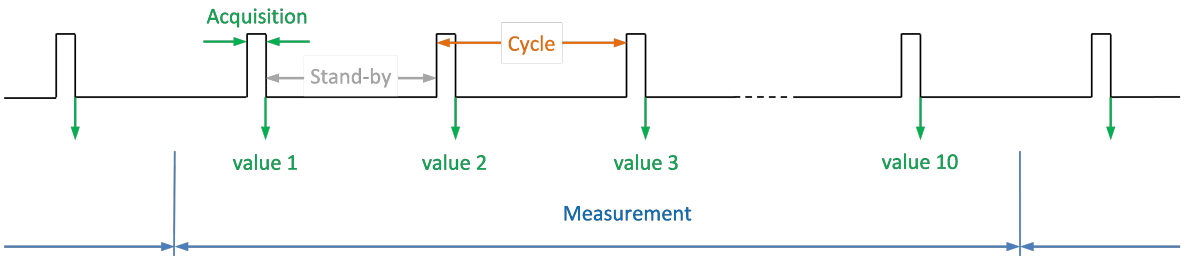
6.3 Serial or SDI-12 communication

Wire	Signal	Disabled	Rain intensity, dis-drometry and hail
Blue	SDI-12 (default address: 0)	○	●
Grey Pink	RX TX	○	●

1... Default setting, 0... User selectable

7 How does the RHD work?

With the default configuration, the sensor measures physical phenomena every minute during 6 seconds and delivers MIN, AVG, MAX numerical values or AVG voltages every 10 minutes:



Measurement settings	Description	Default value
Acquisition duration [A]	True observation time of the physical phenomena, also called time integration window.	6 seconds
Cycle duration [C]	Sum of the acquisition duration and a stand-by duration.	1 minute
Measurement duration [M]	Reading/writing data interval, called averaging duration.	10 minutes
Duty cycle	Ratio between acquisition duration and cycle duration, i.e. fraction of time in which the sensor is effectively active.	10%

- If you read the output data on the analog reading connection of the sensor (i.e. positive voltages on green and/or yellow wires), you will only get the average value.
- If you read the output data on a serial mode of communication of the sensor (SDI-12 and/or serial interface, respectively blue or grey/pink wires), you will be able to get average, min. and max. values.

The analog voltage outputs are persistent, so if your reading device is programmed to read a voltage value every ten minutes, you will always get a new result, whatever the synchronization between the reading device and the sensor is.

To change one or more measurement settings, use the Configuration utility (see p.).

8 Configuration

8.1 Configuration utility

Prerequisites:

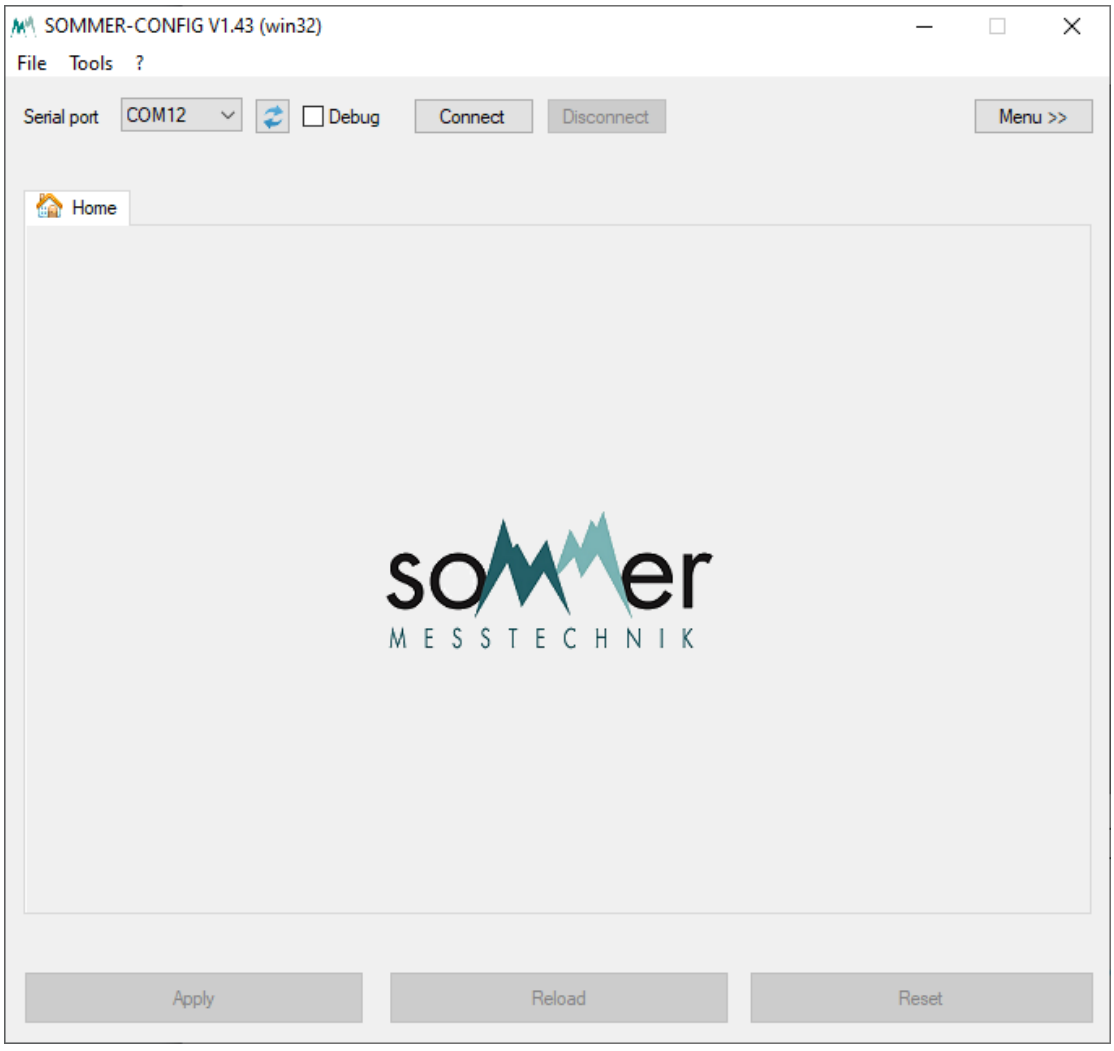
- The SOMMER Toolbox is installed (see Install the SOMMER Toolbox software suite).
- The sensor is plugged (see Install the SOMMER Toolbox software suite).

1. Open the SOMMER Toolbox

   Open the SOMMER Toolbox by double-clicking on the icon on your desktop.

2. Start the Configuration utility

   Start the utility by clicking on the corresponding item.

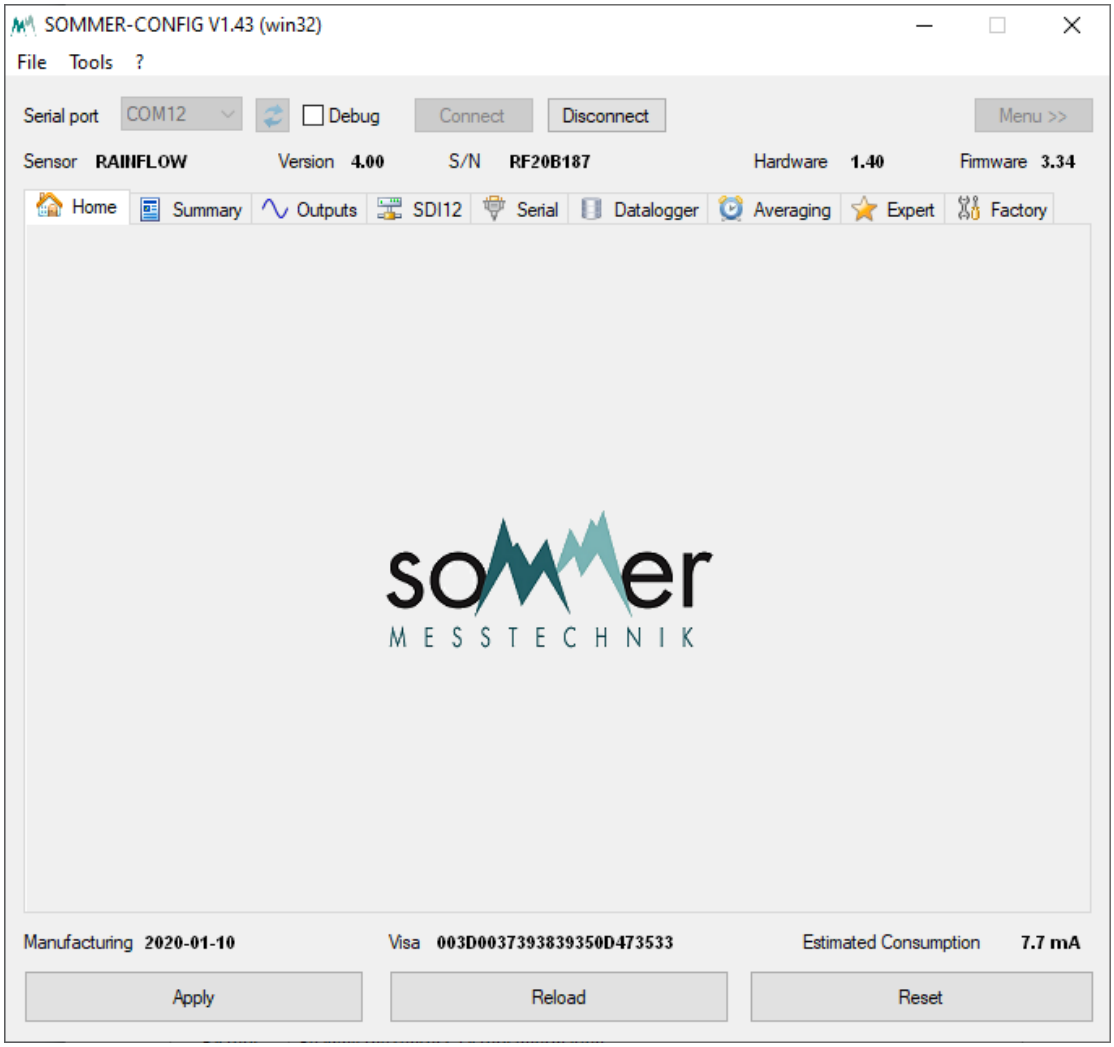


NOTE Only the "Home" panel is visible as long as there is no sensor connected.

3. Connect the sensor

   See Test your sensor.

   Once the sensor is connected, the configuration tabs appear and the control buttons are enabled.



Configuration panels		
Home	A single configuration application for all Sommer Messtechnik acoustic sensors.	
Summary	Current configuration.	Some of the information displayed on this tab may depend on the sensor type (SND, SAD, RHD, HID).
Outputs	Setting analog outputs, voltage ranges, and pulse settings.	
Sdi12	Setting SDI-12 settings.	
Serial	Serial settings.	
Datalogger	Internal data recorder.	
Averaging	Setting acquisition duration, cycle duration, duty cycle and measurement duration.	
Expert	Setting coefficients of the polynomial linearization functions, internal clock and timeout parameter.	
Factory	Reading the sensor's factory information.	

Control buttons	
[Apply]	Sends the complete configuration displayed in all tabs to the sensor. After receiving the configuration, the sensor restarts.
[Reload]	Reloads the sensor's configuration.
[Reset]	Resets the sensor with the default factory configuration. To confirm that the configuration has been properly installed, the application then reloads the configuration and displays it again. See the "Reset" command in Serial communication for more information.

4. Optional: check the current configuration:

   Click on the Summary tab to display all current parameter values.

5. Change parameters:

   Use the other tabs (click on the tab selection buttons) to make the required parameter changes then click on the [Apply] button to send your changes to the sensor.

Adjusting averaging calculations or power consumption settings for particular applications	
[A] Acquisition duration parameter, in seconds	The true measurement (= observation) duration, i.e. the time integration window used by the sensor to periodically acquire wind speed, snowdrift, sand aeolian transport or rain, before returning to stand-by (ex: 10 seconds every minute).
[S] Stand-by duration parameter, in seconds	Stand-by mode, i.e. the time between two measurement acquisitions.
[C] Cycle duration parameter, in seconds	[C] = [A] + [S], i.e. a cycle of measurement (acquisition duration + stand-by duration).
[M] Measurement duration parameter, in seconds	Also called writing intervalor averaging intervali.e. the time intervals at which output values or voltages are calculated and updated (this parameter is not used in pulse mode).
[D] Duty cycle parameter, in percentage	The cyclic ratio between the measurement duration and the stand-by duration; thus the rate of power consumption compared to power consumption when under continuous power (the lower the value of [D], the lower the total power consumption).
Relationships between parameters [A], [S], [C], [M] and [D]	[C] = [A] + [S] [D] = 100 x [A] / [C] [S] = [A] x (100 / [D] – 1) Note: [M] is independent from [A], [S], [C] and [D] (i.e. the writing interval can be chosen at any duration superior to [C])

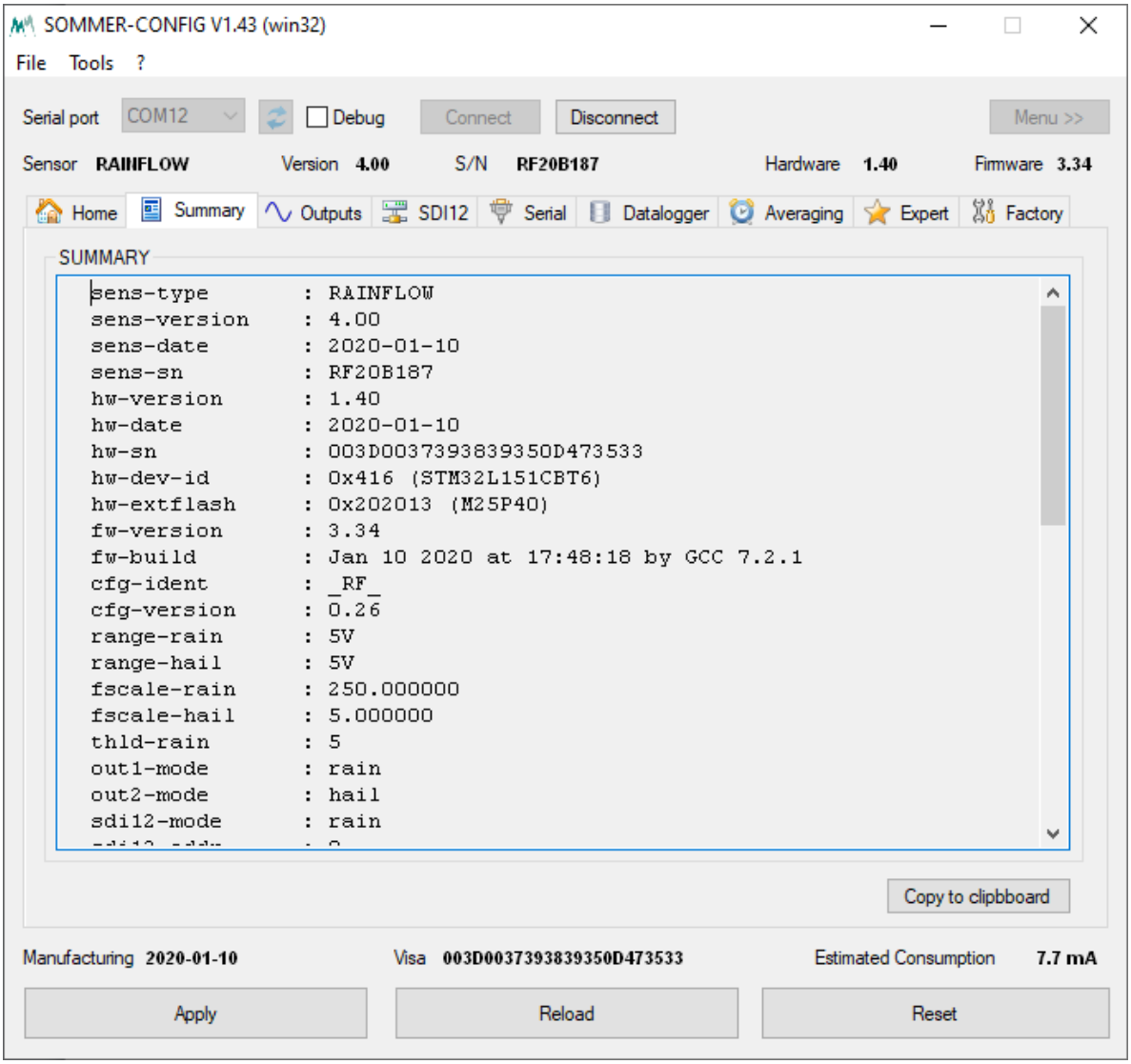
Adjusting averaging calculations or power consumption settings for particular applications		
Parameter settings recommendations (and default factory settings values). Notes: Set [A], [D] and [M] to fix [S] and [C]. Max. admissible value of [C] is 65535 s.	[A]	Set [A] according to the resolution you need based on the natural phenomenon; values can be set from 1 to 255 s. Typical values for wind, snow, sand, precipitation are between 5 and 30 s; the default factory value is 6 s.
	[D]	Set [D] to adjust the power consumption (especially in case of limited power consumption); values can be set from 0% (e.g., stand-by) to 100% (e.g., continuous powering). Typical values are between 5 and 100%; the default factory value for battery operated situations is 10%.
	[M]	Set [M] to your final end-user information or surveillance need, e.g., according to your reading, logging or alert threshold update period. Typical values are between 300 s (5 min) and 3600 s (60 min); the default factory value is 1800 s (30 min).
Output refresh interval	Analog mode	Output voltages are updated at every writing interval [M] and remain permanently available for reading (persistent voltages).
	Pulse mode	At each cycle the measured values are added to the previous sums. A pulse is generated when a sum exceeds the pulse-generation threshold. Pulses are delivered independently of [M].
	SDI-12 mode	Cumulative or reset string result is sent on request (see more in SDI-12 Serial Data Interface).

Adjusting averaging calculations or power consumption settings for particular applications		
	Serial mode	String result is sent through TX output at every writing interval (see more in Serial communication).
	Datalogger mode	Measurements are written into the internal memory at every writing interval [M].
Default factory setting summary	[M] = 600 s (writing interval of 10 min.) [A] = 6 s (true measurement duration) [D] = 10% (total consumption of 2.1 mA) Thus [S] = 54 s and [C] = 60 s. “The sensor measures physical phenomena every minute during 6 seconds and delivers MIN, AVG, MAX numerical values or AVG voltages every 10 minutes”.	

8.1.1 Summary panel

To quickly check the full configuration of your sensor, the summary panel lists all the settings and sensor information.

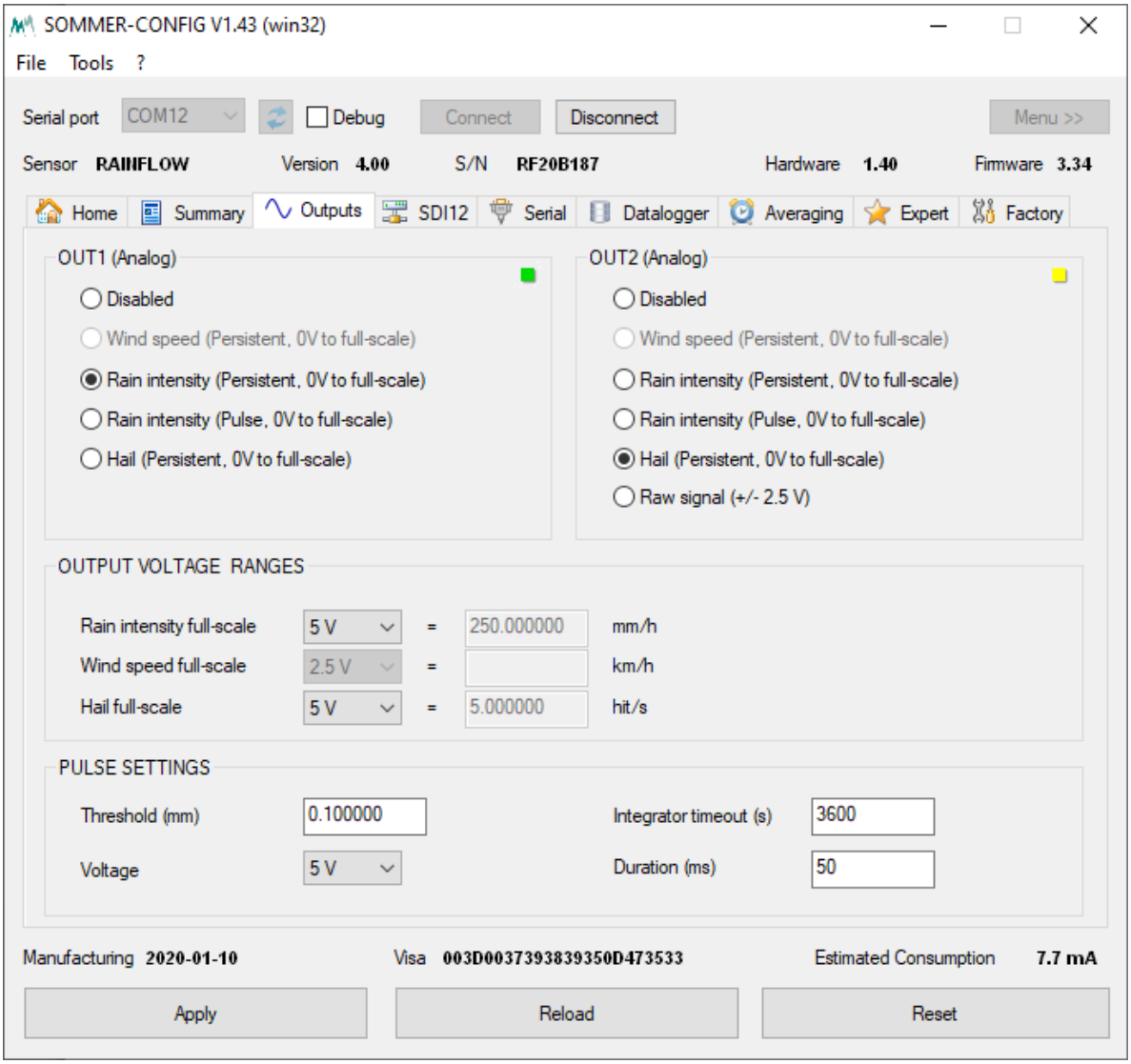
See Operating parameters for more details on parameters.



The [Copy to clipboard] button allows you to copy the whole configuration and paste it in another destination for example in case of concurrently testing different settings, or for diagnostic, reporting or backup reasons.

8.1.2 Outputs panel

The outputs panel allows you to set the so-called OUT1 and OUT2 analog outputs, which mapping is user-selectable as explained in the next paragraph.



When choosing to connect your sensor to the analog input(s) of a reading device (so the reading device reads positive continuous voltage or counts pulses from either the green or the yellow wire of the sensor), you can decide which output signal you want to be physically present on each of the wires.

This functionality, called the output mapping, is a facility that allows the sensor to be adapted to almost any reading device.

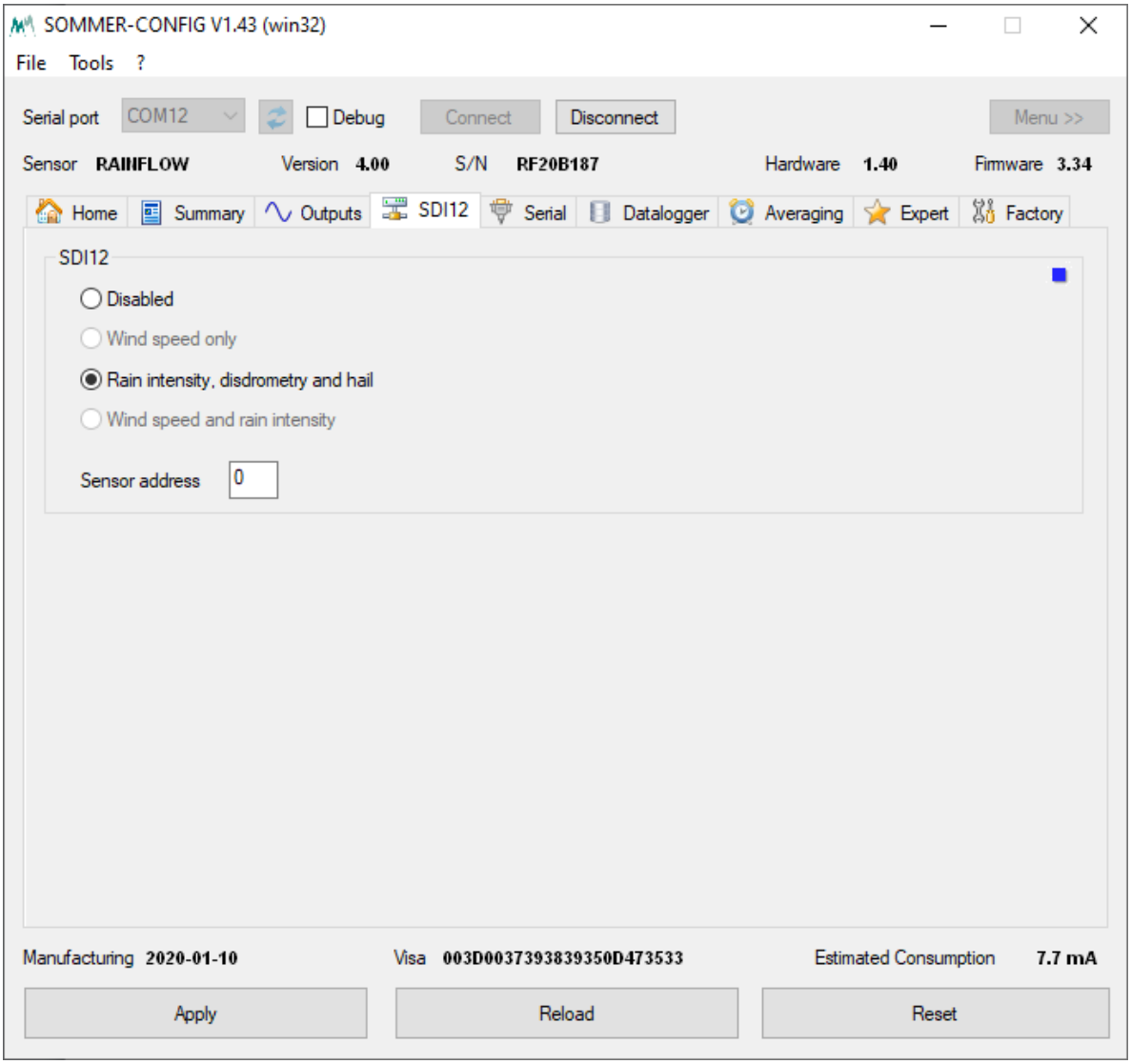
To understand the output mapping, the only thing to consider is that the sensors have two generic analog outputs, called OUT1 and OUT2. OUT1 is always carried by the green wire, OUT2 is always carried by the yellow wire. You decide which signal is attributed to OUT1 and OUT2 by selecting one of the options in this panel.

Further settings available in the output panel are the voltage ranges and the pulse settings, so that you can also adapt these to the characteristics of your reading device.

NOTE You can check the average power consumption corresponding to your selected settings at any time at the bottom right of the pane

8.1.3 SDI-12 panel

When choosing an SDI-12 interface for your sensor (see more details in the next paragraph), its positive voltage is always physically carried by the blue wire in all Sommer Messtechnik acoustic sensors, you can select in the SDI-12 panel the data frame content you need and set the sensor address of your choice. For more instructions about the use of the SDI-12 interface, please refer to SDI-12 Serial Data Interface .



SDI-12 stands for "serial data interface at 1200 baud" [Source: www.sdi-12.org]. It is recommended for applications of the sensors that you intend to interface with battery powered data recorders with minimal current drain and/or long distance cabling (typically up to 150 m).

It is possible to connect more than one Sommer Messtechnik acoustic sensor (as well as other SDI sensors) to a single data recorder thanks to the fact that SDI-12 is a multi-drop interface that can communicate with multiple and multi-parameter sensors. The SDI-12 bus is capable of having ten or more sensors connected to it. Some SDI-12 users connect more than ten sensors to a single data recorder. Multi-parameter means that a single sensor may return more than one measurement.

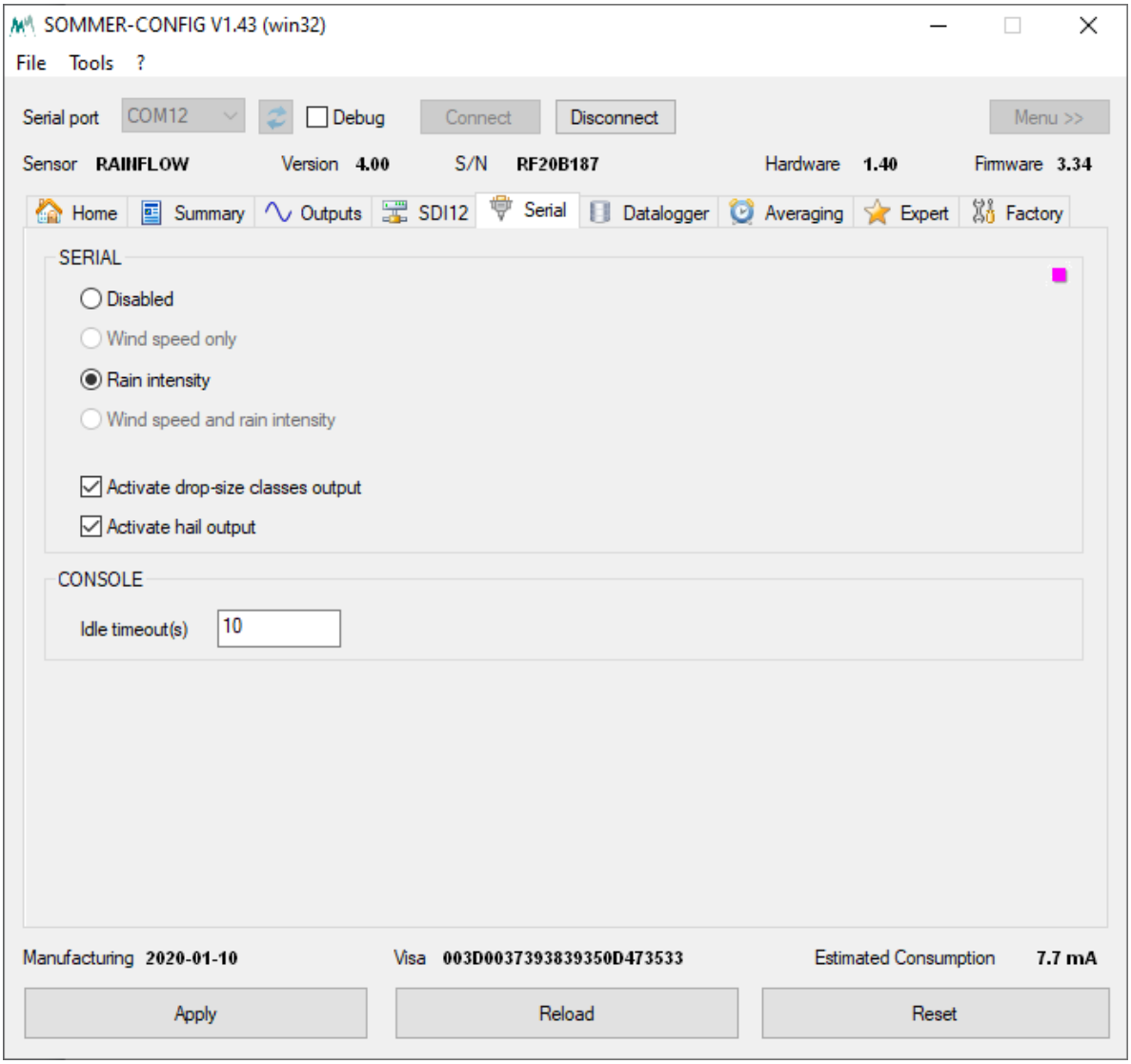
This serial-digital interface is thus a logical choice for interfacing your Sommer Messtechnik acoustic sensor with a distant data recorder.

This has advantages for sensors and data recorders:

- Unique and complex self-calibration algorithms are executed in the microprocessor-based sensor.
- The sensors can be interchanged without reprogramming the data recorder with calibration or other information.
- Power is supplied to sensors through the interface.
- The use of a standard serial interface eliminates significant complexity in the design of data recorders.
- SDI-12 data recorders interface with a variety of sensors.
- SDI-12 sensors interface with a variety of data recorders.
- Personnel trained for SDI-12 will have skills to work with a variety of SDI-12 data recorders and SDI-12 sensors.

8.1.4 Serial panel

Serial communication is always available and, unless disabled by the user, physically carried by the pink (TX) and grey (RX) wires in all Sommer Messtechnik acoustic sensors. You can select the data frame content you need in the Serial panel and set the idle timeout of your console.



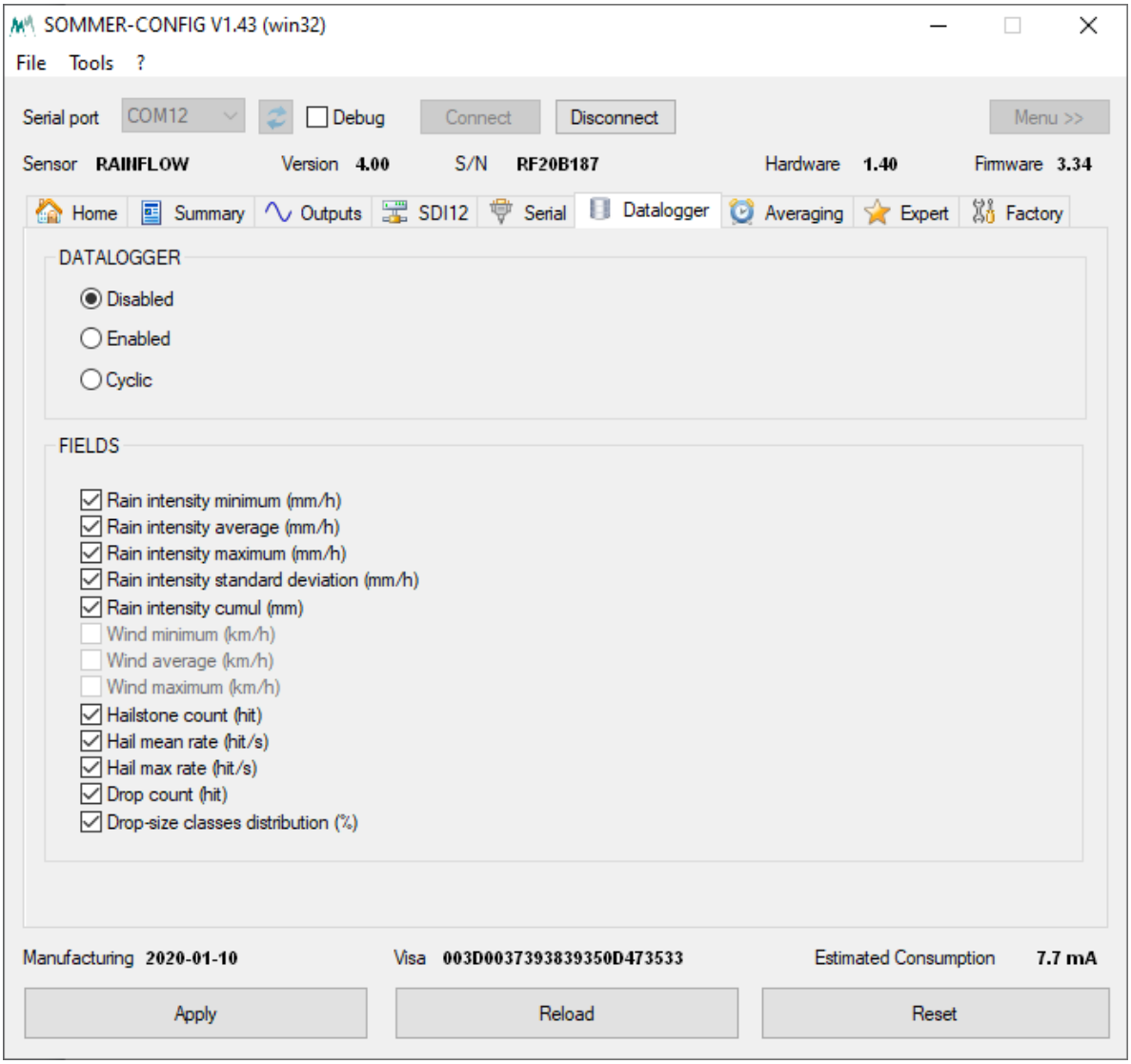
For more instructions on the use of the serial communication, please refer to Serial communication.

8.1.5 Data logger panel

The internal data logger can be configured as follows:

- Disabled: No data are recorded.
- Enabled: Data are recorded until the memory is full.
- Cyclic: Data are recorded and the oldest data are constantly overwritten when the memory is full.

The logging frequency matches the measurement duration (see next page).



You can individually select the fields you want to record.

NOTE The more fields you select, the fewer measurements you can record.

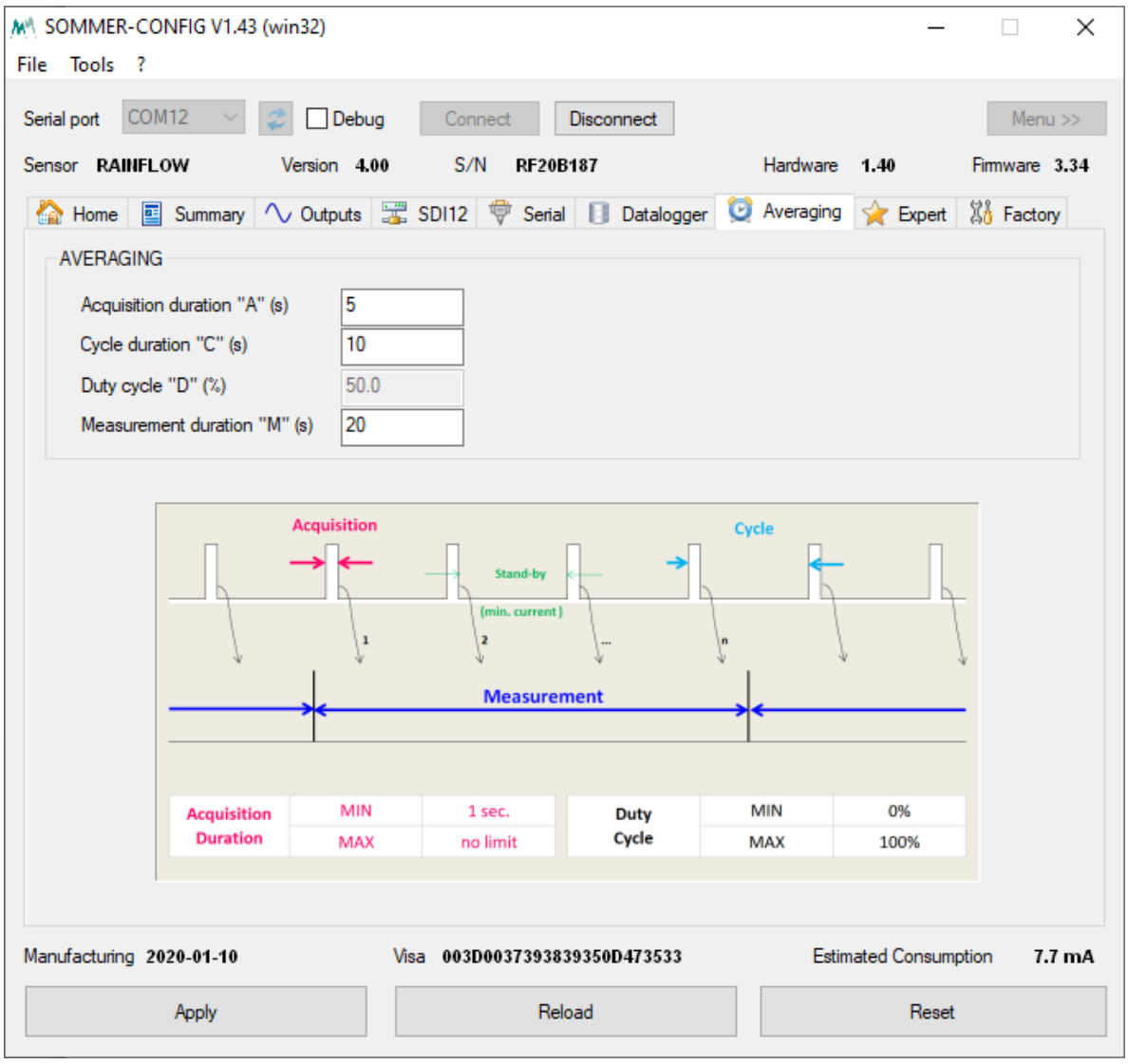
The data logger capacity indicates the estimated number of measurements and the duration of the measurement session based on the measurement duration.

ATTENTION The data logger must be erased after changing the configuration fields (see Download data from the datalogger).

8.1.6 Averaging panel

The averaging panel allows you to set all the measurement settings, i.e.

- Acquisition duration (true observation time of the physical phenomena, also called time integration window),
- Cycle duration (the sum of the acquisition duration and a stand-by duration),
- Duty cycle (ratio between acquisition duration and cycle duration, the fraction of time in which the sensor is effectively active),
- Measurement duration or also called the averaging duration (the reading or writing data interval you want).



For example, with the above default settings, the sensor will behave as follows:

- Measure the physical phenomena for a duration of 6 seconds every 60 seconds; thus, a stand-by duration of 54 seconds every minute, or in other words, a duty cycle of 10%.
- Provide the measurement result (i.e., the output data, digital or analog), every 10 minutes.

This way, your sensor, with an average total power consumption of 2.1 mA, every 10 minutes, will internally produce a data result that is the average, the min. and the max. values of 10 measurements of 6 seconds duration each (one measurement every minute) and deliver this result to your reading peripheral according to the output settings that have been enabled in the output panel.

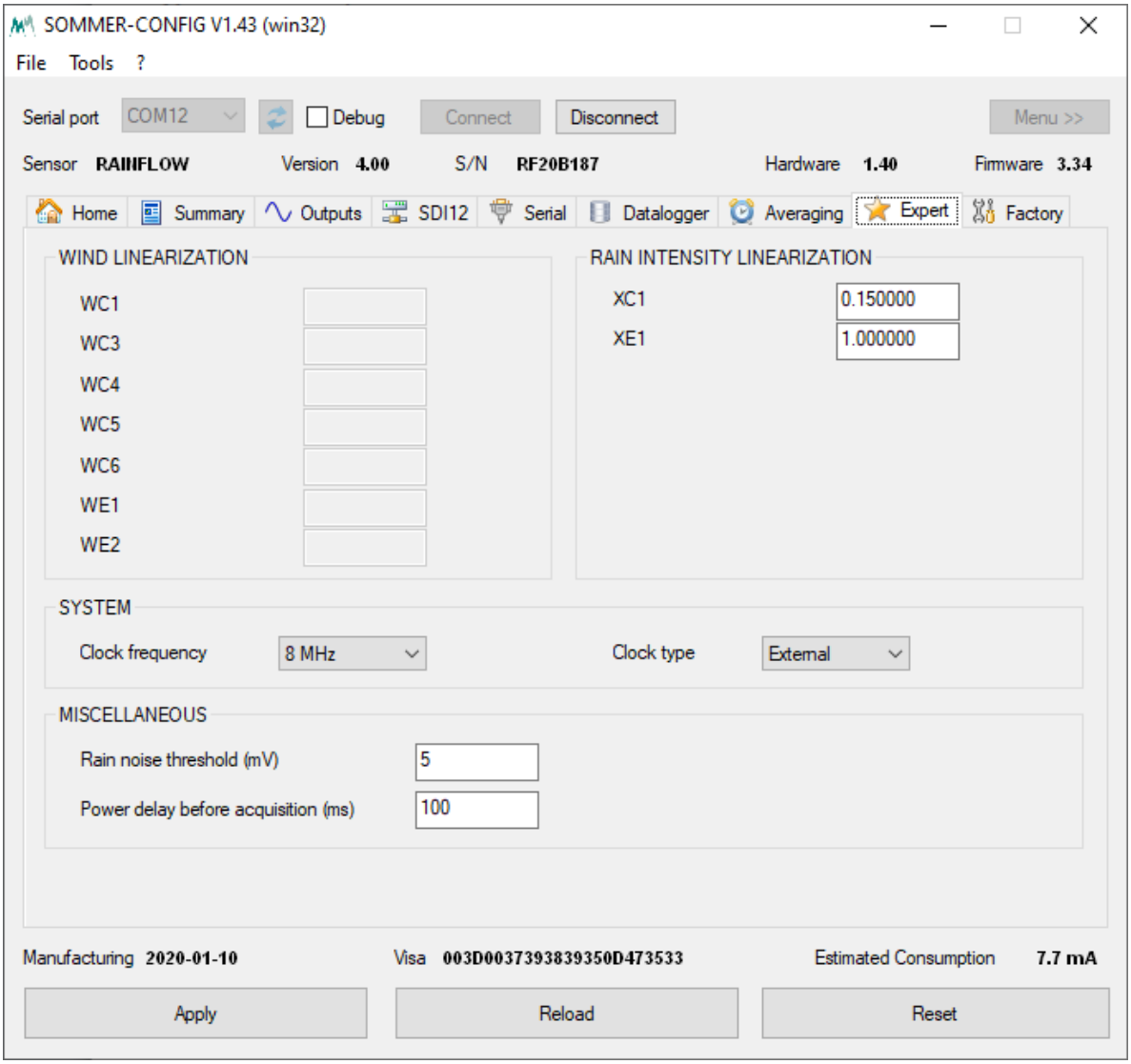
For advanced functions like hail detection (RHD, HDI) or disdrometry (RHD), it is recommended to set a duty-cycle of more than 50% (typically A = 5 s, C = 10 s and M = 600 s), so that a short duration event could not remain undetected or too much underestimated because of a too-long stand-by mode of the sensor.

NOTE If you read the output data on the analog reading connection of the sensor (i.e. positive voltages or pulses on green and/or yellow wires), you will only get the average value. If you read the output data on a serial mode of communication of the sensor (serial and/or SDI-12 panels, respectively blue and grey/pink wires), you will be able to get average, min. and max. values.

Another important characteristic of the Sommer Messtechnik acoustic sensor is that the analog voltage outputs are persistent, so, for instance in the example cited above, if your reading device is programmed to read a voltage value every ten minutes, you will always get a new result whatever the synchronization between the reading and the sensor.

8.1.7 Expert panel

The Expert panel setting, reserved for scientific users, or customized use of the sensors, allows you to set advanced linearization parameters, i.e. changing the internal calculation mode of the sensor.



For example, you can turn the sensor into pass-through mode, change the internal noise threshold or implement different coefficients to the internal calculation functions of the sensor.

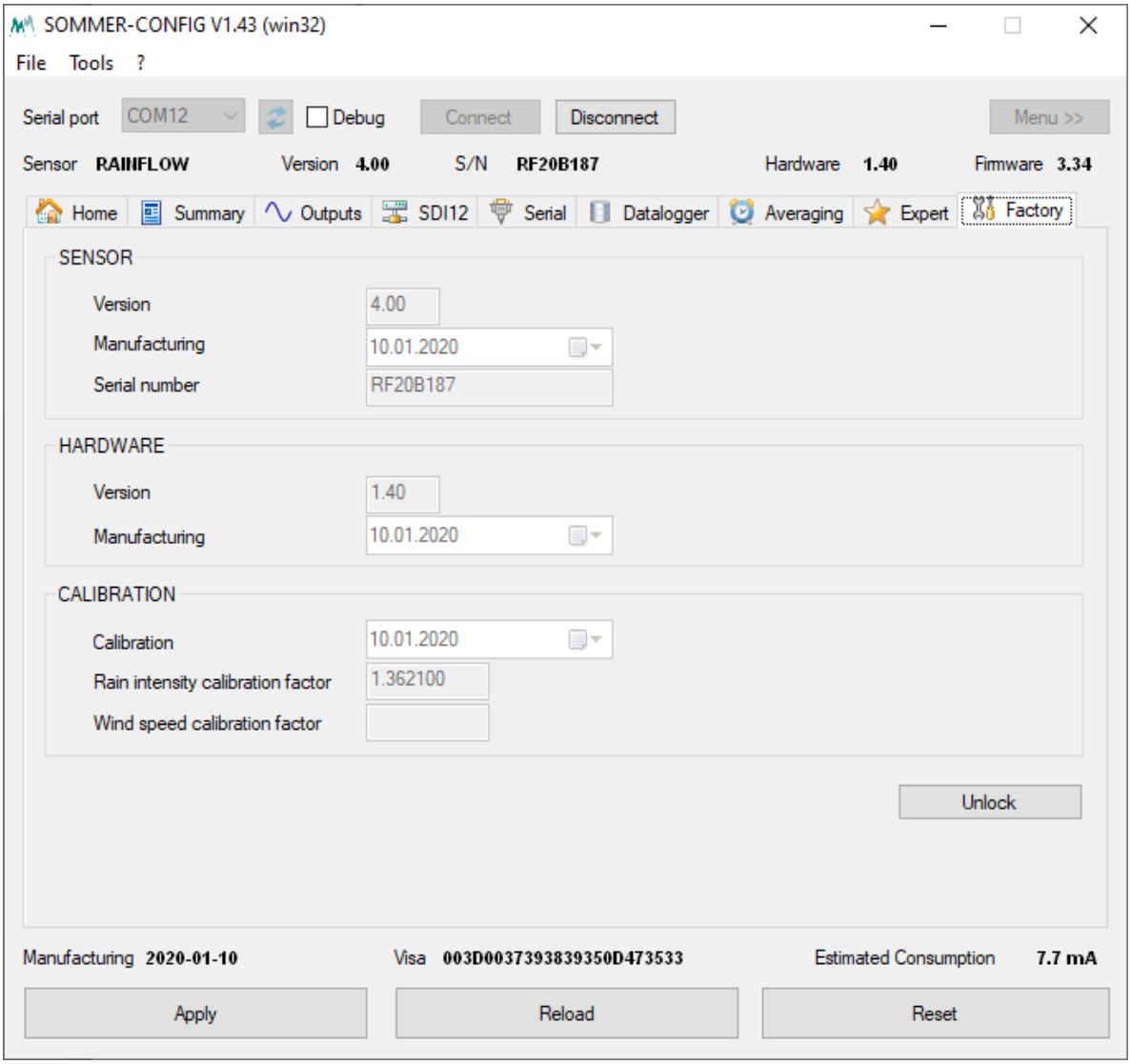
The [Reset] button allows you to always return to the default factory settings.

ATTENTION Changing these parameters is not recommended.

8.1.8 Factory panel

The factory panel displays, in a read-only mode, the factory identifiers and calibration settings of your sensor.

NOTE Only the manufacturer or the integrator can modify these parameters.



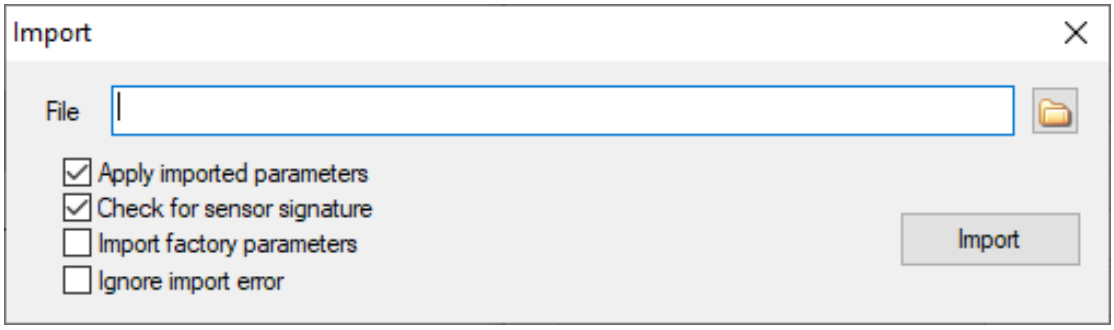
In case of failure of your sensor or when contacting support, it is recommended to keep a copy of this information at hand to facilitate the identification of your sensor.

8.2 Import configuration

This function allows you to reload in the Configuration utility a previously exported configuration of a sensor (*.isawcfg file).

1. Open the Import window:

   In the Configuration utility, select the "File > Import Configuration" menu. The Import window is displayed.



2. Select the file to import:

   Either enter the file name in the field or click on the selection button or drag and drop the file directly on the entry field.

3. Choose the import options

   The default settings cover most of the situations, but you can change any of the following options.

Option	Description
Apply imported parameters	Send the imported configuration directly to the sensor when the import is completed.
Check for sensor signature	Check if the imported file has been exported from the same sensor (check the sensor's physical address).
Import factory parameters	Include the factory parameters in the import. This operation requires a password to unlock the factory parameters.
Ignore import error	Continue the import even if an import error occurs. If this option is not activated, the import stops at the first error.

4. Start the import

   Start the import by clicking on the [Import] button.

> **NOTE** If the option "Apply imported parameters" is unchecked, you will need to click on the [Apply] button once the import is completed to send the imported configuration to the sensor.

8.3 Export configuration

The export function operates in the same way, it allows saving the current sensor configuration in a file.

1. Open the Export window:

   In the Configuration utility, select the "File > Export Configuration" menu. The Export window is displayed.

2. Enter the name of the export file

   The default file name is the sensor's serial number with an .isawcfg extension.

3. Start the export

   Start the export by clicking on the [Save] button.

8.4 Change a parameter in terminal mode

You can also configure your sensor using serial communication in terminal mode.

1. Open the SOMMER Toolbox

   Open the SOMMER Toolbox by double-clicking on the icon on your desktop.

2. Start the Terminal utility

   Start the Terminal utility by clicking on the corresponding item.

3. Connect the sensor

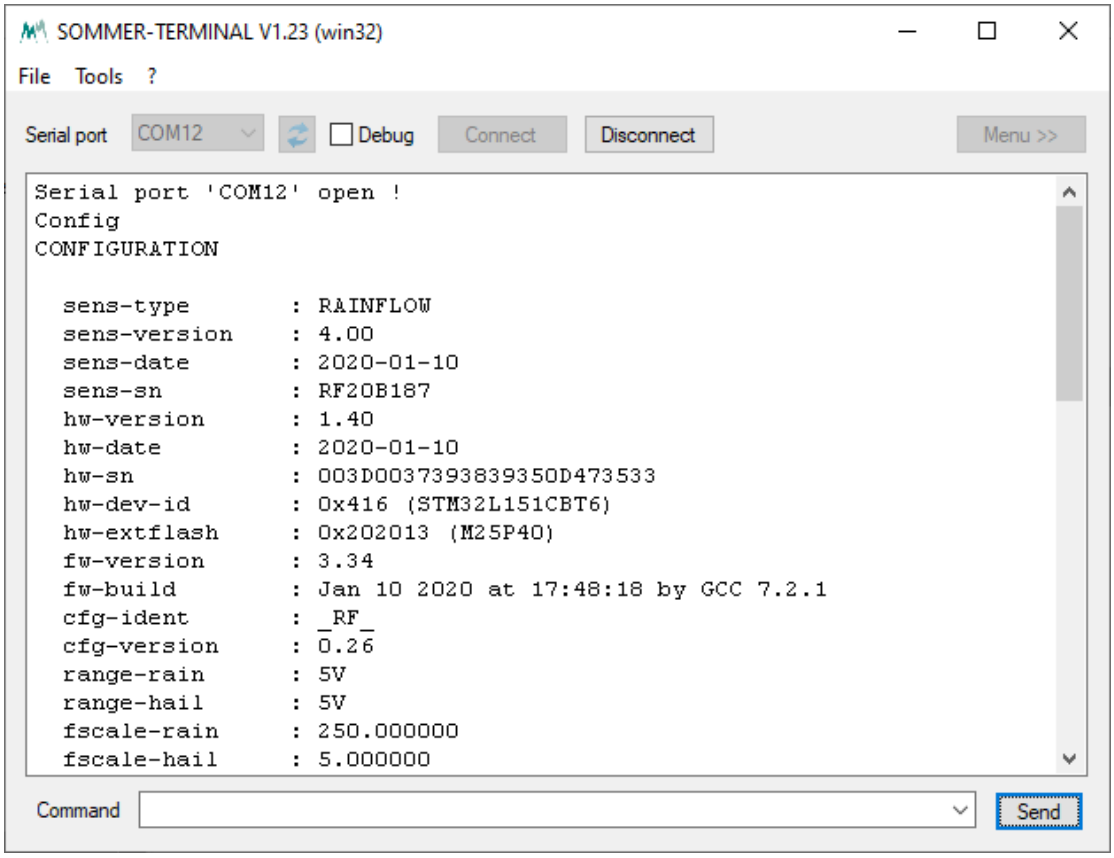
   See p. .

4. Optional: check the current configuration:

   Enter the Config command in the Command entry field and press the [Send] button.

   The values of all parameters are displayed.[1]

[1] All parameters are detailed in Operating parameters.



5. Change the required parameter:

   Enter the command set <parameter> <value> in the Command entry field, then press the [Send] button.

> **NOTE** More serial commands are available in Serial communication.

8.5 Update the sensor's firmware

Sommer Messtechnik constantly improves its products and provides occasional upgrades of the sensor firmware.

This chapter describes the procedure for quickly upgrading the sensor firmware.

Prerequisites:

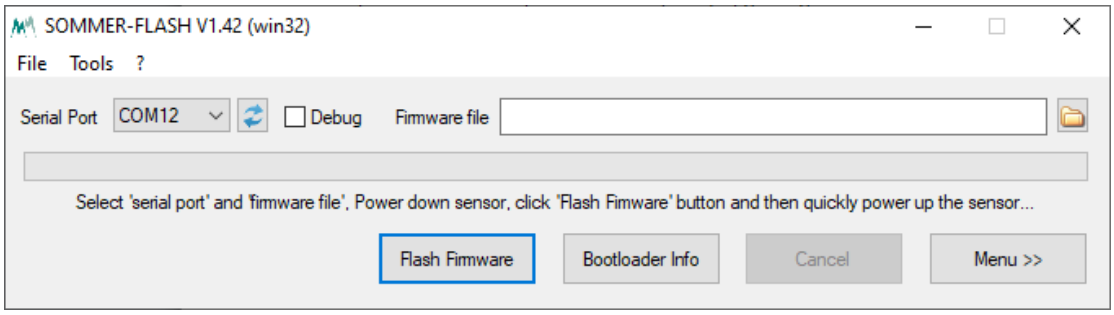
- The SOMMER Toolbox is installed (see p.).
- The last versions of the sensors firmwares are installed (use the Update facility to check).
- The sensor is plugged in (see p.).

1. Open the SOMMER Toolbox

   Open the SOMMER Toolbox by double-clicking on the icon on your desktop.

2. Start the Flash utility

   Start the Flash utility by clicking on the corresponding item.



3. Select the USB dongle serial port:

   Click on the drop-down list to select the right serial port.

> **NOTE** If you don't see the USB dongle serial port, it may be that another application is using it, so close all applications and restart Sommer-Flash.

4. Select the firmware file:

   Select the last version of the firmware corresponding to your sensor by using the button:

Sensor	Firmware file
RHD Rain & hail disdrometer	SOMMER -RainFlow-x.xx.bin

   where x.xx is the version number.

> **ATTENTION** Be sure you select the right firmware for your sensor!

5. Shut down the sensor power supply:

   Set the USB dongle's power switch to OFF.

6. Press the [Flash Firmware] button.

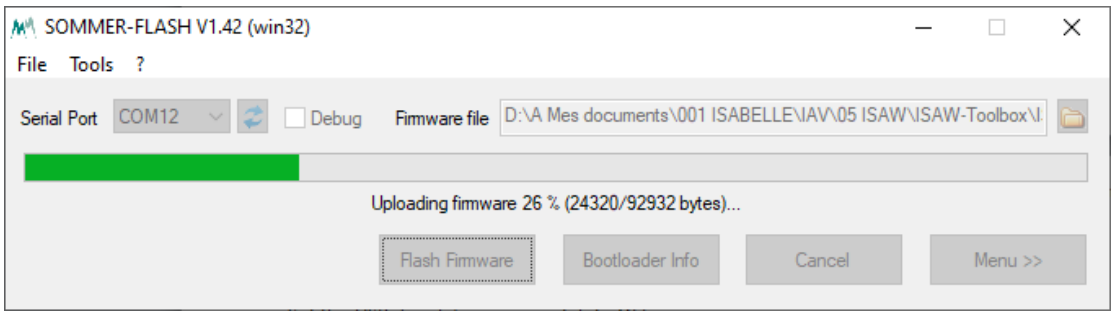
7. Power-on the sensor:

   Switch the USB dongle's power back to "ON".

   At this stage, Sommer-Flash will automatically search for a powered sensor during ten seconds.

8. Wait during the firmware upload.

   As soon as Sommer-Flash has found the powered sensor, the firmware upload starts automatically.



ATTENTION Do not disconnect the power supply during firmware upload.

   When the firmware upload is successfully completed, Sommer-Flash will display a confirmation message.

9. The sensor is now ready to use.

   You can close the Sommer-Flash utility and check the configuration of the sensor. You may have to set all the parameters (see section Configuration).

NOTE The [Boot loader Info] command button retrieves the information of the boot loader installed on the sensor.

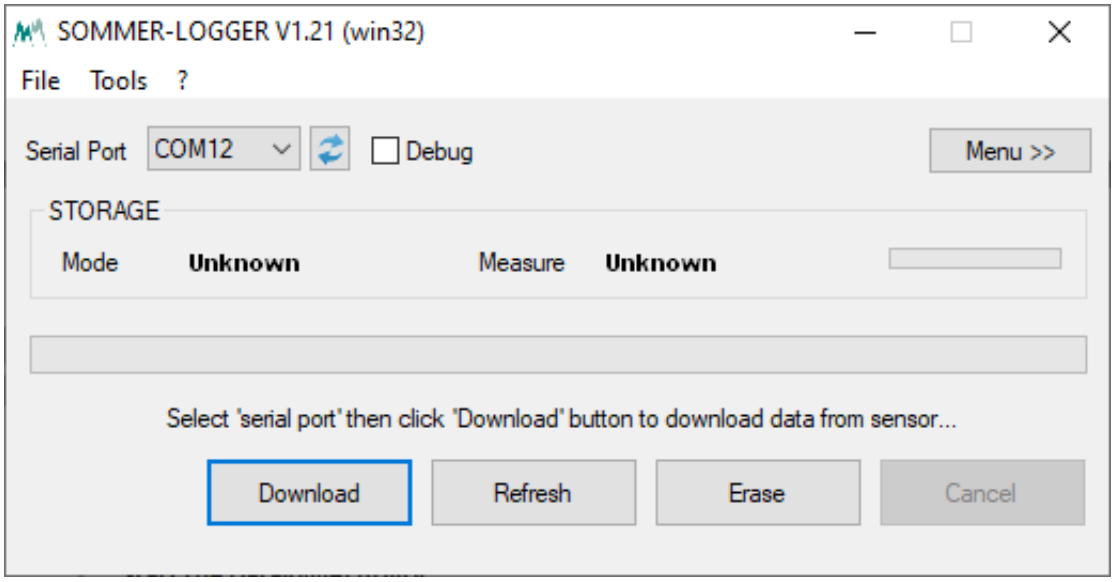
8.6 Download data from the datalogger

1. Open the Sommer-Toolbox

   Open the Sommer-Toolbox by double-clicking on the icon on your desktop.

2. Start the Data logger utility

   Start the Data logger utility by clicking on the corresponding item.



3. Select the USB dongle serial port:

   Click on the drop-down list to select the right serial port.

   The STORAGE section shows the data logger's current status:

   Mode: Disabled, Enabled or Cyclic

   Measure: Number of recorded measurements / Total number of recordable measurements

   The gauge shows the data logger's memory status.

   Use the [Refresh] button to update the STORAGE information.

4. Start the download:

   Click on the [Download] button, enter the name of the destination .CSV file, then click on the [Save] button to complete the download.

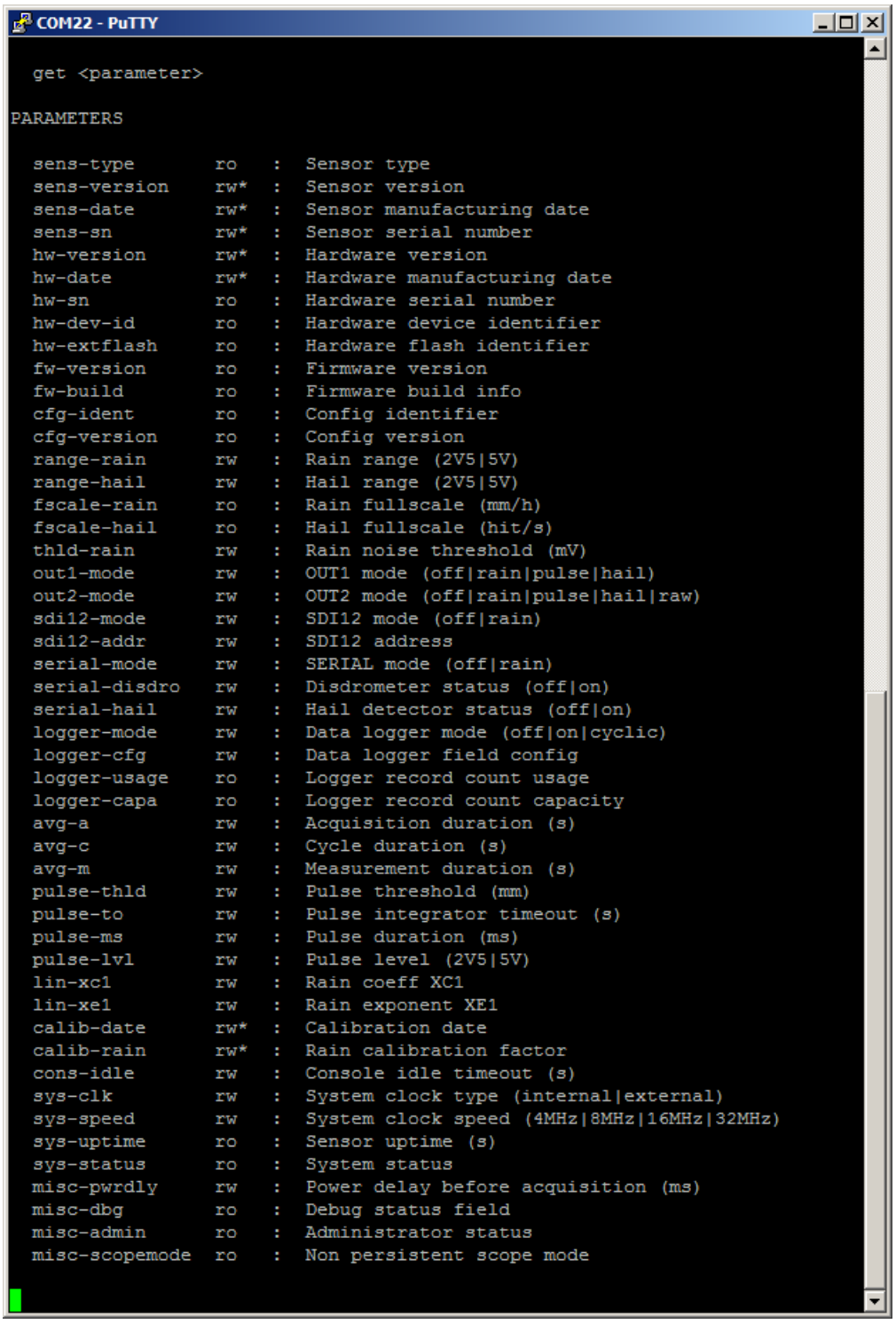
5. Optional: clear the data logger's memory

   To delete all logged data from the data logger, use the [Erase] button.

> **ATTENTION** This operation is irreversible: deleted data are definitely lost.

Appendix A Operating parameters

The screen below lists all the firmware's parameters. You can get this list in terminal mode by using the "get" or "set" command without argument. All parameters are described on the next pages.



ro: read-only – rw: read/write – rw*: read/admin-write

Parameter	Description	Type	Access [1]	Values / Format	Example
sens-type	Sensor type	string	ro	FLOWCAPT FLOWCAPT sensor SANDFLOW SANDFLOW sensor RAINFLOW RAINFLOW sensor HAILFLOW HAILFLOW sensor WINDFLOW WINDFLOW sensor	FLOWCAPT
sens-version	Model version of the sensor	version	rw*	<major>.<minor> where major and minor cannot exceed 255	4.0
sens-date	Date of manufacturing/assembly of the full sensor	date	rw*	YYYY-MM-DD YYYY: Year, MM: Month, DD: Day	2015-12-22
sens-sn	Sensor's serial number (matches sensor's body engraving)	string	rw*	FCxxxxxxx FLOWCAPT serial number SFxxxxxxx SANDFLOW serial number RFxxxxxxx RAINFLOW serial number HFxxxxxxx HAILFLOW serial number WFxxxxxx WINDFLOW serial number	FC15A04
hw-version	Version of electronic hardware	version	rw*	<major>.<minor> where major and minor cannot exceed 255	1.4
hw-date	Date of electronic hardware manufacturing/assembly	date	rw*	YYYY-MM-DD YYYY: Year, MM: Month, DD: Day	2015-12-22
hw-sn	Electronic hardware's serial number	string	ro	xxxxxxxxxxxxxxxxxxxxxx	002E0040363230360C473431

[1] ro: read-only – rw: read/write – rw*: read/admin-write

Parameter	Description	Type	Access [1]	Values / Format	Example
fw-version	Version of current firmware	version	ro	<major>.<minor> where major and minor cannot exceed 99	2.90
hw-ext-flash	Internal Flash memory identifier	string	ro	0xxxxxxx(<model>) (0x000000 if no Flash memory is soldered to the sensor's electronic board)	0x202013 (M25P40)
fw-build	Compilation information of current firmware	string	ro	Not specified	Dec 21 2015 at 21:08:34 by GCC 4.8.3
cfg-ident	Eeprom configuration map identifier	string	ro	_FC_ FLOWCAPT eeprom identifier _SF_ SANDFLOW eeprom identifier _RF_ RAINFLOW eeprom identifier _HF_ HAILFLOW eeprom identifier _WF_ WINDFLOW eeprom identifier	_FC_
cfg-version	Eeprom configuration map version	version	ro	<major>.<minor> where major and minor cannot exceed 255	0.21
range-wind	OUT1 and/or OUT2 range for full-scale wind speed	string	rw	2V5 2.5 volts for 250 km/h full-scale 5V 5 volts for 250 km/h full-scale	5V (default)
range-flux	OUT1 and/or OUT2 range for full-scale particle flux	string	rw	2V5 2.5 volts for 250 g/m²/s full-scale 5V 5 volts for 250 g/m²/s full-scale	5V (default)
range-rain	OUT1 and/or OUT2 range for full-scale rain intensity	string	rw	2V5 2.5 volts for 250 mm/h full-scale 5V 5 volts for 250 mm/h full-scale	5V (default)

[1] ro: read-only – rw: read/write – rw*: read/admin-write

Parameter	Description	Type	Access [1]	Values / Format	Example
range-hail	OUT1 and/or OUT2 range for full-scale hail intensity	string	rw	2V5 2.5 volts for 5 hit/s (RF4) or 25 hit/s (HF4) full-scale 5V 5 volts for 5 hit/s (RF4) or 25 hit/s (HF4) full-scale	5V (default)
fscale-wind	OUT1 and/or OUT2 full scale wind, km/h	string	ro	250	
fscale-flux	OUT1 and/or OUT2 full scale particle flux, g/m²/s	string	ro	250	
fscale-rain	OUT1 and/or OUT2 full-scale rain intensity, mm/h	string	ro	250	
fscale-hail	OUT1 and/or OUT2 full-scale hail intensity, hit/s	string	ro	5 or 25	
out1-mode	OUT1 mode (green wire)	string	rw	off Disabled wind Wind speed (Persistent, 0 to full-scale) flux Particle flux (Persistent, 0 to full-scale) rain Rain intensity (Persistent, 0 to full-scale) hail Hail intensity (Persistent, 0 to full-scale) pulse Particle flux (Pulse, 0 or full-scale)	flux (default)

[1] ro: read-only – rw: read/write – rw*: read/admin-write

Parameter	Description	Type	Access [1]	Values / Format	Example
out2-mode	OUT2 mode (yellow wire)	string	rw	off Disabled wind Wind speed (Persistent, 0 to full-scale) flux Particle flux (Persistent, 0 to full-scale) rain Rain intensity (Persistent, o to full-scale) hail Hail intensity (Persistent, 0 to full-scale) pulse Particle flux (Pulse, 0 or full-scale) raw Raw analog AC signal	wind (default)
sdi12-mode	SDI-12 mode (blue wire)	string	rw	off Disabled wind Wind speed only flux Particle flux only rain Rain intensity, disdrometry, hail all Wind speed and particle flux or rain	all (default)
sdi12-addr	SDI-12 address	string	rw	ASCII character (standard SDI-12 characters are 0 to 9)	0 (default)
serial-mode	Serial mode (pink wire)	string	rw	off Disabled wind Wind speed only flux Particle flux only rain Rain intensity, disdrometry, hail all Wind speed and particle flux	all (default)
serial-disdro	Rain disdrometer data output on serial mode	string	rw	off Disabled on Enabled	on (default)
Serial-hail	Hail data output on serial mode	string	rw	off Disabled on Enabled	on (default)

[1] ro: read-only – rw: read/write – rw*: read/admin-write

Parameter	Description	Type	Access [1]	Values / Format	Example
logger-mode	Datalogger mode	string	rw	off No recording on Data are recorded until memory is full. cyclic Data are recorded and the oldest data are constantly overwritten when memory is full.	off (default)
logger-cfg	Datalogger field configuration	integer	rw	The value is expressed in hexadecimal. Each bit matches a field. If the bit value is 1, the field is logged. Bit 7: min. flux/precipitation Bit 3: cum. flux/rain Bit 6: avg flux/ precipitation Bit 2: min. wind Bit 5: max. flux/ precipitation Bit 1: avg wind Bit 4: std flux/ precipitation Bit 0: max. wind	0xFF (default)
logger-usage	Datalogger record count usage	integer	ro	Number of recorded measurements.	0 (default)
logger-capa	Datalogger record count capacity	integer	ro	Maximum number of recordable measurements. Depends on the number of fields selected in logger-cfg.	0 (default)
avg-a	Acquisition duration (s)	integer	rw	Must be > 0 (see Averaging duration rules below)	6 (default)

[1] ro: read-only – rw: read/write – rw*: read/admin-write

Parameter	Description	Type	Access [1]	Values / Format	Example
avg-c	Cycle duration (s)	integer	rw	Must be >= avg-a and avg-m/avg-c is integer (see Averaging duration rules below)	60 (default)
avg-m	Measurement duration (s)	integer	rw	Must be >= avg-c and avg-c must be modulo avg-m (see Averaging duration rules below)	600 (default)
pulse-thld	OUT1/OUT2 flux pulse threshold (g x m-2)	float	rw	Must be > 500.0	10000.0 (default)
pulse-to	OUT1/OUT2 flux pulse reset timeout (s)	integer	rw	Must be > avg-m	3600 (default)
pulse-ms	OUT1/OUT2 flux pulse duration (ms)	integer	rw	1 < pulse-ms < 500	50
pulse-lvl	OUT1/OUT2 flux pulse level	string	rw	2V5 Pulse level is 2.5 volts 5V Pulse level is 5 volts	5V (default)
lin-wc1	Wind linearization coefficient WC1	float	rw	Default factory setting	
lin-wc3	Wind linearization coefficient WC3	float	rw	Default factory setting	
lin-wc4	Wind linearization coefficient WC4	float	rw	Default factory setting	
lin-wc5	Wind linearization coefficient WC5	float	rw	Default factory setting	
lin-wc6	Wind linearization coefficient WC6	float	rw	Default factory setting	
lin-we1	Wind linearization exponent WE1	float	rw	Default factory setting	
lin-we2	Wind linearization exponent WE2	float	rw	Default factory setting	
lin-xc1	Particle flux and precipitation intensity linearization coefficient XC1	float	rw	Default factory setting	

[1] ro: read-only – rw: read/write – rw*: read/admin-write

Parameter	Description	Type	Access [1]	Values / Format	Example
lin-xe1	Particle flux and pre-cipitation intensity lin-earization exponent XE1	float	rw	Default factory setting	
calib-date	Date of sensor calibration	date	rw*	YYYY-MM-DD YYYY: Year, MM: Month, DD: Day	2017-02-23
calib-wind	Wind calibration factor	float	rw*	Must be > 0	1.0 (default)
calib-flux	Particle flux calibration factor	float	rw*	Must be > 0	1.0 (default)
calib-rain	Rain intensity calibration factor	float	rw*	Must be > 0	1.0 (default)
cons-idle[2]	Timeout of console to return in idle mode	integer	rw	Seconds	10 (default)
sys-clk	System clock (It's not recommended to change this parameter)	string	rw	internal Use internal clock external Use external clock	external (default)
sys-speed	System speed (It's not recommended to change this parameter)	string	rw	4MHz Run at 4 MHz 8MHz Run at 8 MHz 16MHz Run at 16 MHz 32MHz Run at 32 MHz	8MHz (default)
sys-uptime	Time elapsed since power on	integer	ro	Seconds	3426
sys-status	System status	string	ro	OK No error ADC-OVERRUN ADC Error	OK

[1] ro: read-only – rw: read/write – rw*: read/admin-write

[2] When you enter this command, the console temporarily hides the measurement message (to clear the display), and then returns, after the selected timeout, to idle mode (stop hiding message).

Parameter	Description	Type	Access [1]	Values / Format	Example
misc-pwrdly	Analog stage power delay: time to wait after power on amplifier and start acquisition	Integer	rw	Milliseconds. Must be < 500	100 (default)
misc-debug	Debug bit-field status	Integer	ro	See "debug" command (Operating parameters).	0x0000 (default)
misc-admin[2]	Current admin rights status	string	ro	yes User is admin, special parameters can be changed. no User is not admin, special parameters cannot be changed.	no (default)

A.1 Averaging duration rules

The parameters "avg-a", "avg-c" and "avg-m" are interdependent and must satisfy the following rules:

`avg-a`, `avg-c` and `avg-m` are integers

`0 < avg-a <= avg-c <= avg-m`

`avg-m / avg-c` is an integer

The rules are checked each time a parameter is changed. In some cases, the user is unable to set the requested value. In this case, set the requested averaging parameters in the following order:

1. Set the `avg-a` parameter to 1.
2. Set the `avg-c` parameter to 1.
3. Set the `avg-m` parameter to the requested value.
4. Set the `avg-c` parameter to the requested value.
5. Set the `avg-a` parameter to the requested value.

[1] ro: read-only – rw: read/write – rw*: read/admin-write

[2] You can change the admin status using the “admin” command. Admin status is automatically reset to default ("no") after reboot.

Appendix B Disdrometry
Drop size classes

The disdrometry function (DSD) provides a statistic value result, defined as a distribution expressing the percentage of drops situated in as many drop-size classes, according to the following classification table.

The sensors classification table for drop-size includes 27 classes of equal intervals. The upper marker of the smallest class is a diameter of 0.75 mm and the lower marker of the biggest class is a diameter of 7 mm. The upper and lower markers typically correspond to the thresholds of respectively the detection and saturation of the sensor, with a certain margin of operation (drops with a diameter under 0.75 mm and over 7 mm can still be detected).

Class #	Class Label	Drop diameter Min. - Max. (mm)		
1	0.75		-	0.75
2	1	0.75	-	1
3	1.25	1	-	1.25
4	1.50	1.25	-	1.50
5	1.75	1.50	-	1.75
6	2	1.75	-	2
7	2.25	2	-	2.25
8	2.50	2.25	-	2.50
9	2.75	2.50	-	2.75
10	3	2.75	-	3
11	3.25	3	-	3.25
12	3.50	3.25	-	3.50
13	3.75	3.50	-	3.75
14	4	3.75	-	4
15	4.25	4	-	4.25
16	4.50	4.25	-	4.50
17	4.75	4.50	-	4.75
18	5	4.75	-	5
19	5.25	5	-	5.25
20	5.50	5.25	-	5.50
21	5.75	5.50	-	5.75

Class #	Class Label	Drop diameter Min. - Max. (mm)		
22	6	5.75	-	6
23	6.25	6	-	6.25
24	6.50	6.25	-	6.50
25	6.75	6.50	-	6.75
26	7	6.75	-	7
27	99	7	-	

Appendix C Serial communication

Sommer provides a serial communication with the sensor with any serial terminal utility like Putty, TeraTerm, HyperTerminal, or other.

C.1 Connect in terminal or console mode

First you need to connect the sensor to a computer with the USB dongle accessory (or using a FTDI 3.3V serial USB converter/adapter).

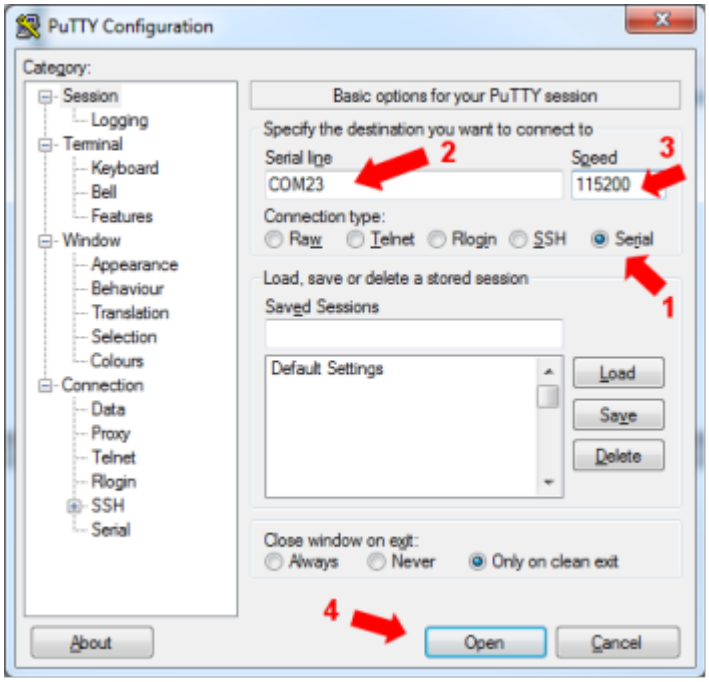
Prerequisite: The sensor is plugged (see p.).

ATTENTION Do not connect the sensor directly to a non-TTL serial port like standard RS232 (DB9 connector). You must use a 3.3V serial adapter; otherwise you may cause permanent damage to the sensor!

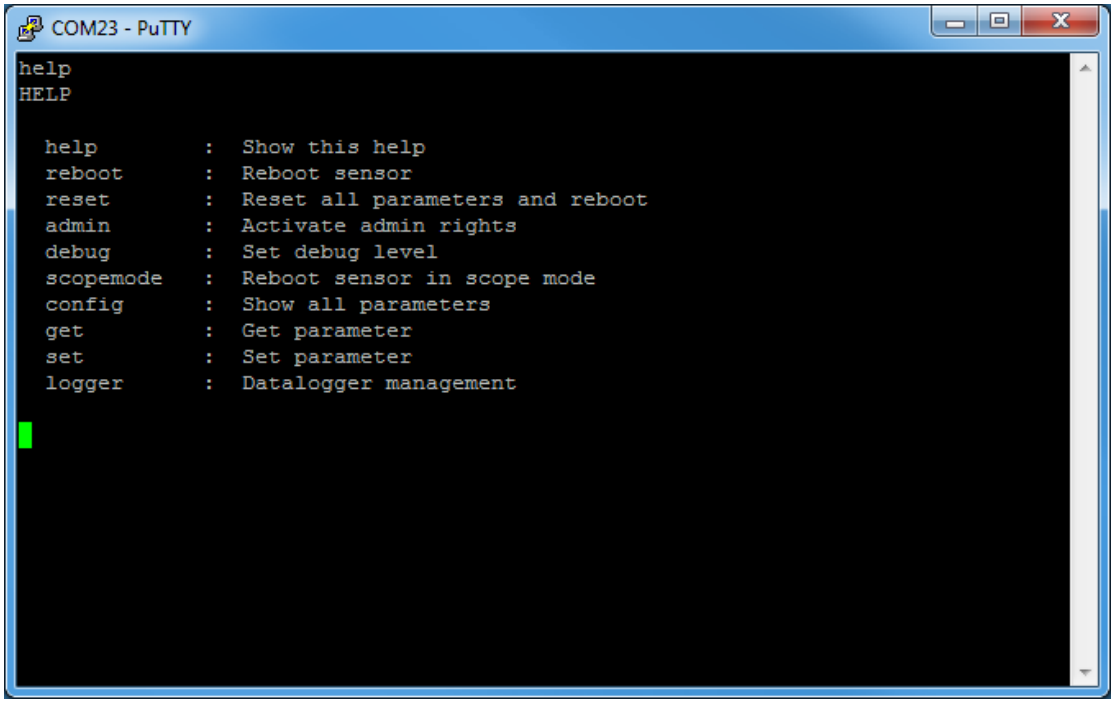
1. Connect your Terminal software

   Open your favourite serial terminal on the serial port (e.g.: COM23) at 115200 bauds, 8 bits, 1 stop, no parity. Input terminator is <CR>, Output terminator is <CRLF>.

   Example: You can use the lightweight and non-intrusive "putty.exe" freeware available at http://www.putty.org:



   Type "help" and press [Enter] to display all available commands:



2. Execute command

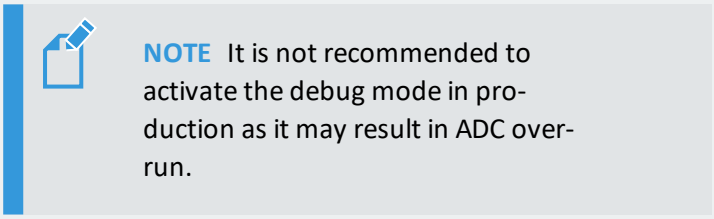
   Once connected, you can enter any command.

C.2 Console commands

All command results share the same format:

`OK`	Successful command.
`OK=<value>`	Successful command with return value.
`ER=<message>`	Command error with error message.

Command	Result / Description
`help`	Displays the list of all available commands.
`reboot`	After changing the sensor configuration you need to reboot the sensor by using the "reboot" command.
`reset confirm`	Recovers the default factory configuration and reboots the sensor. All parameters are reinitialized, except the following ones (internal factory parameters):

<table>
<tr><th>Command</th><th colspan="4">Result / Description</th></tr>
<tr><td></td><td>sens-type
sens-version
sens-date
sens-sn</td><td>hw-version
hw-date
hw-sn
fw-version</td><td>fw-build
cfg-ident
cfg-ver-sion
calib-date
calib-wind</td><td>calib-flux
sys-uptime
sys-status
misc-dbg</td></tr>
<tr><td><code>config</code></td><td colspan="4">Displays the sensor current configuration (list of all parameters and corresponding values).</td></tr>
<tr><td><code>admin <password></code></td><td colspan="4">Activates the admin rights and allows changing special parameters. This command is reserved for factory parameters initialization and requires a password.</td></tr>
<tr><td><code>debug <module> <on|off></code></td><td colspan="4">Activates / deactivates the debug mode for a given module. Debug messages are available on the serial console.
 

<code><module></code> can be:
<table><tr><td><code>all</code></td><td>Enable/disable all debug messages (very verbose).</td></tr><tr><td><code>console</code></td><td>Enable/disable console debug messages.</td></tr><tr><td><code>acq</code></td><td>Enable/disable acquisition buffer output.</td></tr><tr><td><code>measure</code></td><td>Enable/disable measurement calculation debug messages.</td></tr><tr><td><code>power</code></td><td>Enable/disable power status.</td></tr><tr><td><code>board</code></td><td>Enable/disable board debug messages.</td></tr><tr><td><code>sdi12</code></td><td>Enable/disable SDI-12 debug messages.</td></tr></table></td></tr>
</table>

Command	Result / Description
	EXAMPLE `debug sdi12 on` `OK`
`get <parameter>`	Allows getting a parameter value from the configuration. **EXAMPLE** `get sens-date` `OK=2016-01-28`
`set <parameter> <value>`	Allows changing a parameter value of the configuration. The list of all parameters and corresponding values are listed in Operating parameters. **NOTE** Remember you need to reboot the sensor after changing the sensor configuration. **EXAMPLE** `set sdi12-addr 7` `OK`

Command	Result / Description
`logger <command>`	Control the datalogger: `<command>` can be: `downloa` Dowload the data. `clear` Delete all logged data.
`logger <field> <on|off>`	Activates/deactivates the logging of a value: `<field>` can be: `rain_min` Minimum rain intensity (mm/h) `rain_avg` Average rain intensity (mm/h) `rain_max` Maximum rain intensity (mm/h) `rain_std` Rain intensity standard deviation (mm/h) `rain_cum` Cumulative rain (mm) `drop_hit` Number of drops (hit) `drop_size` Percentage of drops within the class (%) `hail_hit` Number of hailstones (hit) `hail_mean` Mean rate (hit/s) `hail_max` Max rate (hit/s)  **NOTE** The datalogger must be cleared after changing the configuration fields (see Download data from the datalogger).  **EXAMPLE** `logger win_min off`

C.3 Error messages

Error message	Description
Parameter is read-only	You cannot change this parameter.
Need admin permission	You need to use the "admin" command before executing the present command.
Busy	Command currently executed. Retry later.

Error message	Description
Invalid unsigned integer value/argument	Value or argument is not a valid integer (only digits and <+> (plus) character are allowed).
Invalid integer value/argument	Value or argument is not a valid integer (only digits, <+> (plus) and <-> (minus) character are allowed).
Invalid float value/argument	Value or argument is not a float (only digits, <+> (plus), <-> (minus) and <.> (dot) characters are allowed).
Invalid value/argument size	Value or argument size is too long or empty.
Invalid value/argument	Value or argument is not valid.
Invalid dependent value/argument	Value or argument is not valid and depends on another parameter.
Value/argument out of range	Value or argument is out of range.
Invalid internal function	Internal error.
Invalid internal parameter type	Internal error.
Invalid internal limit type	Internal error.
Unknown command	Command is unknown.
Unknown parameter	Parameter is unknown.
Forbidden	Operation is forbidden with these parameters.
Invalid password	Password is not valid.

3.4 Serial measurement frame

Get a measurement result in a CSV formatted parameter after each "avg-m" on the serial port (TX: pink wire).

The serial result is computed and reset every [Measurement duration] interval.

3.4.1 RAIN

```
RAIN;<counter>;<unit>;<min>;<avg>;<max>;<std>;<unit>;<sum>
```

<counter>	is a frame counter incremented at each result
<unit>	is the unit of the following values in the frame: “mm/h”
<min>	is the minimum of the rain measurement [mm/h]
<avg>	is the average of the rain measurement [mm/h]
<max>	is the maximum of the rain measurement [mm/h]
<std>	is the standard deviation of the rain measurement [mm/h]
<unit>	is the unit of the following value in the frame: “mm”
<sum>	is the cumulative rain [mm]

EXAMPLE RAIN;499;mm/h;32.11;34.27;38.93;6.42;mm;64.74

3.4.2 DROP

DROP;<counter>;<unit>;<hit_count>;<unit>;<unit>;<class>;<distrib>;<class>;<distrib>;…;<class>;<distrib>

<counter>	is a frame counter incremented at each result
<unit>	is the unit of the following values in the frame: “hit”
<hit_count>	is the number of drops [hit]
<unit>;<unit>	are the units of the following pairs of values in the frame: “mm;%”
<class>	is the fixed drop size class in millimetres [mm] (see DisdrometryDrop size classes)
<distrib>	is the percentage of drops within the class [%]

EXAMPLE DROP;1;hit;0;mm;%;0.75;0;1.00;0;1.25;0;1.50;0;1.75;0;2.00;0;2.25;0;2.50;0;2.75;0;3.00;0;3.25;0;3.50;0;3.75;0;4.00;0;4.25;0;4.50;0;4.75;0;5.00;0;5.25;0;5.50;0;5.75;0;6.00;0;6.25;0;6.50;0;6.75;0;7.00;0;99.00;0

3.4.3 HAIL

HAIL;<counter>;<unit>;<hit_count>;<unit>;<mean_rate>;<max_rate>

`<counter>`	is a frame counter incremented at each result
`<unit>`	is the unit the of following value in the frame: “hit”
`<hit_count>`	is the number of hailstones [hit]
`<unit>`	is the unit the of following values in the frame:” hit/s”
`<mean_rate>`	is the mean rate during measurement [hit/s]
`<max_rate>`	is the max rate [hit/s]

EXAMPLE `HAIL;685;hit;2865;hit/s;89.32;103.5`

Appendix D SDI-12 Serial Data Interface

The Sommer Messtechnik firmware supports Serial Digital Interface (SDI-12) standard V1.3 (the SDI-12 V1.3 standard specification can be found at http://www.sdi-12.org).

D.1 SDI-12 standard commands

Name	Command	Description/Response	
Acknowledge Active	a!		
Sensor Identification	aI!	13IAV-TECWINDFLO334 13IAV-TECFLOWCAP334 13IAV-TECRAINFLO334 13IAV-TECHAILFLO334 13IAV-TECSANDFLO334	
Change Address	aAb!	No need to reboot sensor	
Address query	?!		
Start Measurement	aM!	Always reset measure	
		sdi12-mode=wind	a0003
		sdi12-mode=rain	a0008
		sdi12-mode=all	a0008
Start Measurement and request CRC	aMC!	Always reset measure	
		sdi12-mode=wind	a0003
		sdi12-mode=rain	a0008
		sdi12-mode=all	a0008

Name	Command	Description/Response		
Send Data	aD0! … aD9!	sdi12-mod-e=wind	aD0!	Min. wind (km/h)
			aD1!	Avg wind (km/h)
			aD2!	Max. wind (km/h)
		sdi12-mod-e=rain sdi12-mod-e=all	aD0!	Min. rain intensity (mm/h)
			aD1!	Avg rain intensity (mm/h)
			aD2!	Max. rain intensity (mm/h)
			aD3!	Std rain intensity (mm/h)
			aD4!	Cumulative rain (mm)
			aD5!	Hail hit count (hit)
			aD6!	Hail mean rate (hit/s)
			aD7!	Hail max rate (hit/s)
Additional Measurements	aM1! … aM9!	No additional measurement a0000		
Additional Measurements and request CRC	aMC1! … aMC9!	No additional measurement a0000		
Start Verification	aV!	No verification a0000		

Name	Command	Description/Response	
Start Concurrent Measurement	aC!	Always reset measure	
		sdi12-mode=wind	a0003
		sdi12-mode=rain	a0008
		sdi12-mode=all	a0008
Start Concurrent Measurement and request CRC	aCC!	Always reset measure	
		sdi12-mode=wind	a0003
		sdi12-mode=rain	a0008
		sdi12-mode=all	a0008
Additional Concurrent Measurements	aC1! … aC9!	No additional measurement a00000	
Additional Concurrent Measurements and request CRC	aCC1! … aCC9!	No additional measurement a00000	

Name	Command	Description/Response		
Continuous Measurements	aR0! … aR9! aRC0! … aRC9!	sdi12-mode=wind	aR0!	Min. wind (km/h)
			aR1!	Avg wind (km/h)
			aR2!	Max. wind (km/h)
		sdi12-mode=rain sdi12-mode=all	aR0!	Min. rain intensity (mm/h)
			aR1!	Avg rain intensity (mm/h)
			aR2!	Max. rain intensity (mm/h)
			aR3!	Std rain intensity (mm/h)
			aR4!	Cumulative rain (mm)
			aR5!	Hail hit count (hit)
			aR6!	Hail mean rate (hit/s)
			aR7!	Hail max rate (hit/s)

NOTE

Wildcard character "?" is supported.

Start Measurement (aM!) and Send Data (aD0!...aD9!) always send measurement since last request. So in this mode, measurement is reinitialized after each request.

Continuous Measurement (aR0!...aR9!) sends the current measurement. So in this mode, measurement is reinitialized after M duration.

The interval used for the calculation of the min, max and average statistical values starts either with each SDI-12 command, or after the avg-m parameter's duration, depending on which of these two conditions occurs first.

D.2 SDI-12 extended commands

Sommer Messtechnik firmware can handle an extended SDI-12 command that allows sensor configuration from SDI-12 bus.

All SDI-12 extended commands derivate from console commands.

All SDI-12 extended commands, in compliance with SDI-12 standard V1.3, have a generic format like:

EXAMPLE `aXcooo…!`

EXAMPLE

`a`	Sensor address
`c`	Extended command identifier
`ooo`	Optional argument
`!`	Command terminator

For each SDI-12 extended command, the sensor answers with a response formatted in the same way:

`aOK`	Command success
`aOK:vvvv…<CR><LF>`	Command success with value
`aER:mmmm…<CR><LF>`	Command error with error message
`a`	Sensor address
`vvvv…`	Value
`mmmm…`	Error message (see Error messages)
`<CR><LF>`	Response terminator

NOTE

Writing to eeprom to store a new parameter can take some time, which is why the `aXS!` command is delayed.

When the `aXS!` command is received, the sensor checks if the parameter and the value are correct and then sends the `aOK` response before the value is written on eeprom. Sending another `aXS!` while the sensor is currently writing a previous parameter value may result in a "Busy" error. Waiting at least 20 ms between two `aXS!` commands is recommended.

To be assured of the integrity of the parameter's writing in the memory read the parameter value (`aXG!`) after each `aXS!` command.

Remember that you need to reboot the sensor after changing sensor configuration.

Name	Description	Command	Response
reboot (aXR!)	After changing the sensor configuration, you need to reboot the sensor by using this command.	aXR! a: Sensor address !: Command terminator	aOK<CR><LF> aER=mmmm...<CR><LF> a: Sensor address mmmm...: Error message (see Error messages) <CR><LF>: Response terminator
reset (aXZ...!)	Use this command if you want to recover the default factory configuration and reboot the sensor. All parameters are reinitialized, except internal factory parameters.	aXZcccccccc! a: Sensor address cccccccc: Reset confirmation "confirm" !: Command terminator	aOK<CR><LF> aER=mmmm...<CR><LF> a: Sensor address mmmm...: Error message (see Error messages) <CR><LF>: Response terminator
admin (aXA...!)	This command activates the admin rights and allows changing special parameters. This command is reserved for the initialization of factory parameters.	aXAwwwwwwww! a: Sensor address wwwwwwww: Admin password !: Command terminator	aOK<CR><LF> aER=mmmm...<CR><LF> a: Sensor address mmmm...: Error message (see Error messages) <CR><LF>: Response terminator

Name	Description	Command	Response
get (aXG…!)	The get command allows getting a parameter value from configuration.	aXGpppppp…! a: Sensor address pppppp…: Parameter name (see Operating parameters) !: Command terminator	aOK=vvvv…<CR><LF> aER=mmmm…<CR><LF> a: Sensor address vvvv…: Parameter value (see SDI-12 extended commands) <CR><LF>: Response terminator
set (aXS…!)	This command allows changing parameter values of the configuration.	aXSpppp…=vvvv…! a: Sensor address pppppp…: Parameter name (see Operating parameters) vvvv…: Parameter value (see Operating parameters) !: Command terminator	aOK<CR><LF> aER=mmmm…<CR><LF> a: Sensor address mmmm…: Error message (see Error messages) <CR><LF>: Response terminator
Disdrometer (aXD!)	This command allows getting disdrometer results.	aXD! a: Sensor address !: Command terminator	aOK=vvvv…<CR><LF> aER=mmmm…<CR><LF> a: Sensor address vvvv…: Disdrometry value mmmm…: Error message (see Error messages) <CR><LF>: Response terminator

NOTE

Due to the limited size of an SDI12 frame, for the disdrometry functions the RHD sensor (drop size classes, see DisdrometryDrop size classes), the class sizes do not appear in the response of the aXD! command (unlike for the serial command). Only the total number of drops followed by the distribution of the 27 counters is mentioned as follows:

aOK=<hit_count>;<distrib>;<distrib>;<distrib>;….

<hit_count> is the number of drops (resp. hailstones) [hit]

<distrib> [%]	is the percentage of drops (resp. hailstones) within the class