RG-30, RG-30a

Flow velocity Measurement System

Manual

Setup version 2.38 (Firmware 2.96)

25 November, 2019

Sommer Messtechnik

Sommer Messtechnik
Strassenhäuser 27
6842 Koblach
Austria
www.sommer.at
E office@sommer.at
T +43 5523 55989
F +43 5523 55989-19

Validity

This manual applies to the Flow velocity Measurement System with the setup version 2.38, including all its subversions.

Created: 19 Sept, 2018 Last update: 25 November, 2019

EU conformity

This product is in conformity with the following standards:

EMC	2014/30/EU	EN 301 489-1 V1.9.2
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	
RoHS III	2015/863/EU	

FCC compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

FCC ID: UXSIMS944

Feedback

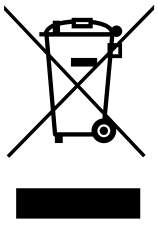
Should you come across any error in this manual, or if you miss information to handle and operate the RG-30 we are very grateful for your feedback to office@sommer.at.

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.
- Installation of equipment on towers, bridges and in discharge channels poses the risk of falling, slipping or dropping of objects. Contact your safety officer or consult applicable safety regulations for precautions and proper personal safety equipment.
- 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.
- For SAFETY-RELEVENT APPLICATIONS consider using a redundant system with additional data validation checks.

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 RG-30?

The RG-30 radar sensor is a measurement device for the contact-free determination of the flow velocity of open rivers and channels. The sensor detects the surface flow velocity by the principle of the Doppler frequency shift.

Due to the contact-free measurement method the RG-30 can be installed on extension arms without costly structural measures in the channel or river. This also has the advantage that the sensor is located outside the danger area of flood events and that it requires little maintenance over many years.

Figure 1 RG-30

2 Unpacking

When unpacking your RG-30 sensor box please make sure that the following items are present:

Art	Item
	RG-30 sensor in the required version
	Manual on USB stick

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

Available accessories

Art	Accessory
18711	Data cable for RQ-30 / RG-30, LiYCY 12x0,25mm², 10 m
18712	Data cable for RQ-30 / RG-30, LiYCY 12x0,25mm², 20 m
15833	Data cable for RQ-30 / RG-30 / SQ, 12x0,25 mm², up to 60m
15543	Data cable for configuration and testing of RQ-30 / RG-30 / SQ
20074	RG / RQ standart mouniting set, 2x U-bolt max. ∅60 mm
20470	Q-Commander software V1.0

3 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!

3.1 Connect the RG-30 to a PC

1. Install the Commander support software (see How do I install it?)
2. Connect the yellow and gray wire of the MAIN cable to the USB to RS485 isolated converter cable and plug it into your PC as illustrated in Figure 2.
3. Connect a 6...30 VDC power supply to the RG-30
4. Start the Commander software.
5. 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)).
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 RG-30. 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.

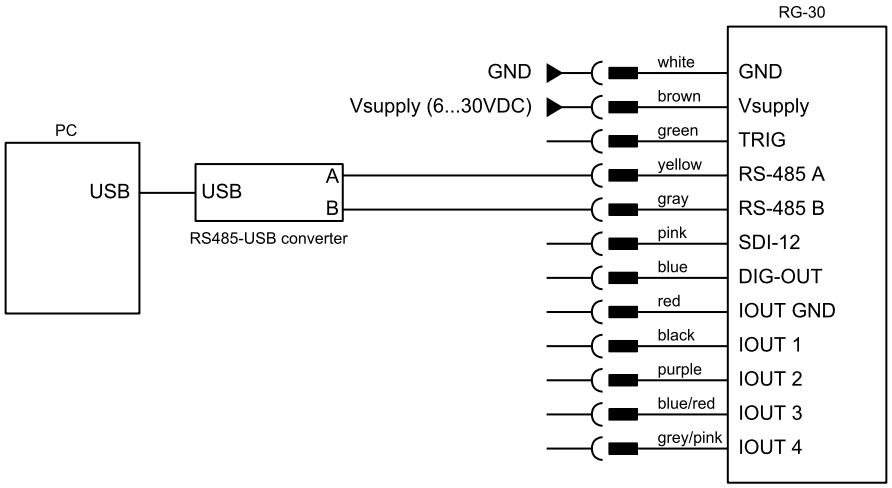


Figure 2 Wiring of the RG-30 to a PC

3.2 Configure the sensor

1. Select language, decimal character, units and decimal places (see General settings)
2. Select the measurement trigger (see General settings)
3. Set the parameters of the velocity measurement (see Velocity measurement)
4. Optional: Configure analog outputs (see How do I configure it?)
5. Send any modifications to the RG-30 by clicking Upload modified parameters to device.

3.3 Acquire measurements

Select the tab Measurement (F3) and click Start polling measurements. Select Polling with measurements and confirm the Warning. Now, the device performs consecutive measurements at the fastest possible rate. Click Stop polling to cancel data acquisition.

4 Specifications

Physical and environmental	
Power supply	6...30 VDC; Reverse voltage protection, overvoltage protection
Power consumption at 12 VDC	Standby approx. 1 mA Active measurement approx. 110 mA
Outputs	RS-485 ASCII / Modbus RTU SDI-12 Analog output 4...20 mA (14 bit, max. load 250 Ω)
Operating temperature	-35...60 °C (-31...140 °F)
Storage temperature	-40...60 °C (-40...140 °F)
Protection rating	IP 67
Lightning protection	Integrated protection against indirect lightning with a discharge capacity of 0,6 kW Ppp
Housing material	Powder coated aluminum
Mounting bracket	Ø34...48 mm
Size L x W x H	241 x 154 x 246 mm (9.49 x 6.06 x 9.69 in)
Weight	2.7 kg (5.95 lb)

Velocity measurement	
Detectable measurement range	0.10...15 m/s (depending on the flow conditions)
Accuracy	± 0.01 m/s; ± 1 %
Resolution	1 mm/s
Direction recognition	+/-
Measurement duration	5...240 s
Measurement interval	8 s...5 h
Measurement frequency	24 GHz (K-Band)

Radar opening angle	12°
Distance to water surface	0.50...35 m
Vertical inclination	Measured internally

Automatic vertical angle compensation	
Accuracy	± 1 °
Resolution	± 0.1 °

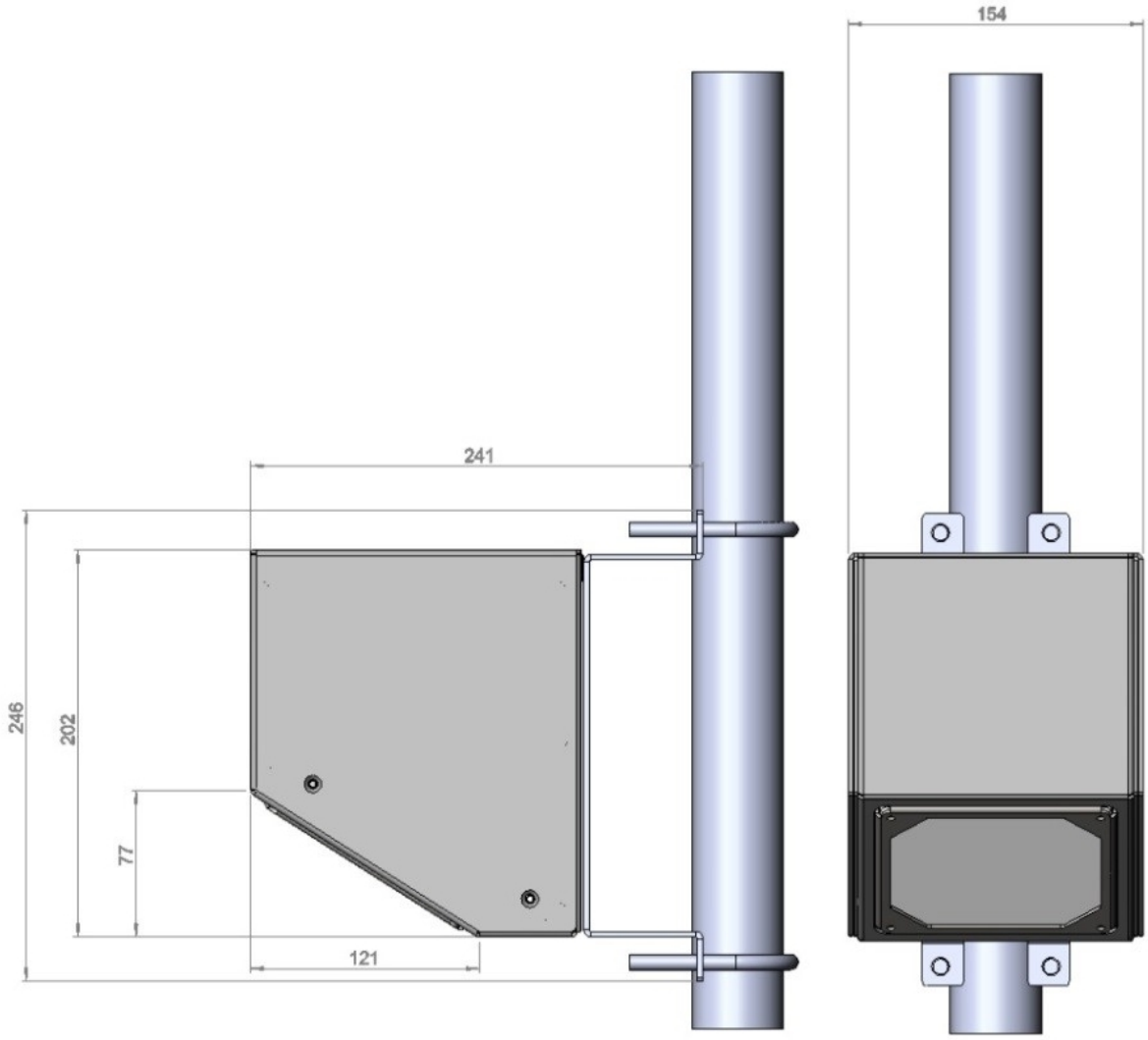


Figure 3 RG-30 dimensions

5 Connectors

5.1 Main

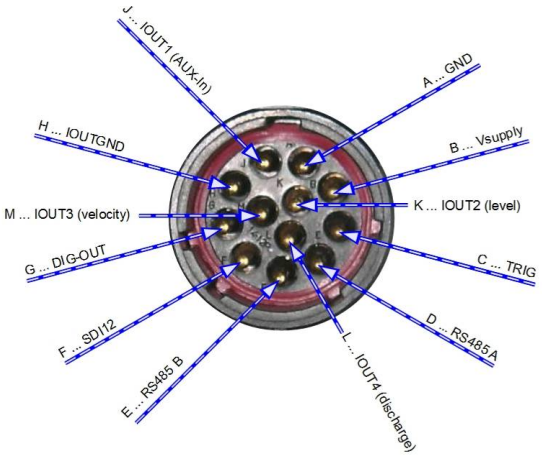


Figure 4 Pin configuration of connector MAIN

	Pin	Function	Description
Power supply	A	GND	Ground
	B	Vsupply	+6...+30 V
Trigger input	C	TRIG	low: 0...0.6 V high: 2...30 V
RS-485 interface	D	RS485 A	1 x RS-485 (1200...115200 Baud)
	E	RS485 B	
SDI-12 interface	F	SDI-12	1 x SDI-12 (1200 Baud)
Switched digital output	G	DIG-OUT	Max. 1.5 A
Analog outputs (RG-30 a only)	H	IOUTGND	Analog ground
	M	IOUT3	Velocity (4...20 mA)

Table 1: Configuration of connector MAIN

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

5.2 Connection cable for connector MAIN

The 12-pin connection cable is routed through one of the rubber-sealed holes on the front or back of the metal housing.

Color	Pin	Function	Description
white	A	GND	Ground
brow	B	Vsupply	6...30 VDC
green	C	TRIG	low: 0...0.6 V high: 2...30 V
yellow	D	RS485 A	1 x RS-485 (1200...115200 Baud)
gray	E	RS485 B	
pink	F	SDI12	1 x SDI-12 (1200 Baud)
blue	G	DIG-OUT	Max. 1.5 A
red	H	IOUTGND	Ground for analog outputs
blue/red	M	IOUT3	Velocity

Table 2: Configuration of cable MAIN

6 How does the RG-30 work?

6.1 Flow velocity

6.1.1 Principle of measurement

The contact-free measurement of the flow velocity is based on the principle of the Doppler Effect. The integrated velocity radar sensor transmits a signal with a constant frequency in a specific angle towards the water surface (see Figure 5). There, the signal is reflected and shifted in frequency due to the movement of the water body. The reflected signal is received by the antenna of the integrated velocity radar sensor. By comparing the emitted frequency to the frequency of the reflected signal from the water surface the local velocity can be determined.

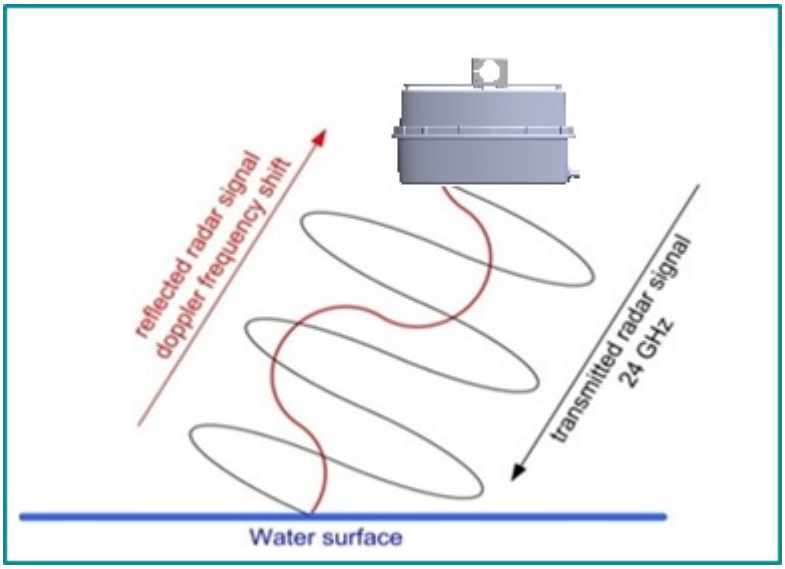


Figure 5 Principle of flow velocity sensor

6.1.2 Radar spectrum

The integrated velocity radar sensor has an opening angle of 12°. Thus, the reflected radar signal of an area is measured. The size of this area depends on the inclination angle and the distance between the sensor and the reflecting water surface.

The velocities appearing in the measured area have a specific distribution depending on the water flow conditions. The velocity distribution is determined with a digital signal processor via spectral analysis, and the dominant velocity in the measurement area is calculated.

As illustrated in Figure 6 the radar spectrum is recorded for water flows up- and downstream. In the lower part of Figure 6 the velocity spectrum of water flowing away from the radar sensor is dis-

played, in the upper part the spectrum of water flowing towards the sensor. The yellow area is the part of the spectrum used for analysis and the vertical green line indicates the resulting velocity.

By interpreting the radar spectra, velocity measurements can be analyzed in detail. A spectrum can have a narrow or broad peak, one or more maxima or it can identify only one velocity direction. Awareness of this can result in a modification of the settings for the velocity measurement.

For detailed information on how to proceed if more than one peak is visible in the radar spectrum please refer to Appendix A.

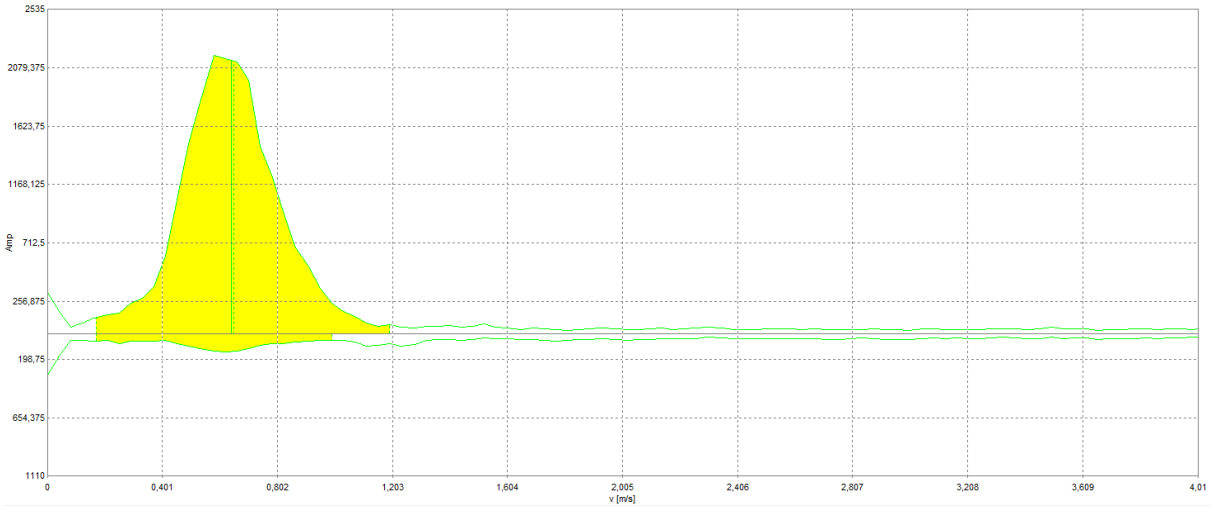


Figure 6 Radar spectrum

6.1.3 Flow direction separation

Water can either flow towards or away from the integrated velocity radar sensor. Depending on the flow direction a frequency shift to higher or lower frequencies occurs. This circumstance allows the RG-30 sensor to separate the water movements by their directions and to separately evaluate the corresponding velocity distribution.

6.1.4 Inclination angle measurement

As the RG-30 sensor is directed in a specific angle towards the water surface an angle correction has to be applied. The RG-30 measures its vertical inclination with an internal sensor and applies an automatic angle correction.

6.1.5 Conditions of the water surface

The water surface has to move distinctly and a minimum roughness has to be present to measure a discernible Doppler frequency shift. The more rippled the water surface and the higher the flow velocity is the more reliable the measurements are. The minimum ripple height for a valid analysis

is about 2 mm depending on the used frequency. For very slow moving rivers this requirement might not be fulfilled and a continuous and correct velocity measurement cannot be guaranteed.

7 Installation

7.1 Where should I install the RG-30?

The selection of a suitable measurement site for the RG-30 is crucial for the reliability and accuracy of the measurement results. Several aspects related to the hydraulic situation and the mounting of the sensor have to be considered.

7.1.1 Hydraulic requirements

Stationary waves

There must be no stationary waves present in the field of view of the RG-30 as they can negatively influence the measurement accuracy. Stationary waves may be caused by big stones and other obstacles; their impact depending on water level. Stationary waves cause errors in angle as the radar impulse is partly reflected from them and not the plane water surface. Also, they may over-estimate the water level.

Adequate wave movements

Waves or ripples with a height of at least 2 mm have to be present at the water surface over the full expected water level range. Especially very slow flowing rivers often do not meet this requirement (see also Conditions of the water surface).

Influence of wind

For slow moving, deep rivers the flow velocity measurement may be interfered by waves which are caused by wind. If such an influence is observed, the measurement site should be shielded from wind by proper means or an alternative site should be considered.

7.1.2 Installation requirements

Viewing direction

It is recommended to install the RG-30 with its tip pointing upstream. This has some essential advantages: For installations on bridges the influence of pillars on the water flow conditions are avoided. Addition-ally, the influence of precipitation is eliminated by a direction separation obtained from the velocity spectrum (see Flow direction separation).

Free field of view

The RG-30 sensor interprets all movements in its field of view. Therefore, no moving objects shall be present in the field of view of the RG-30. Figure 7 shows the size of the measurement spot and its distance from the RG-30 sensor for different installation heights. Consider these dimensions when installing the sensor.

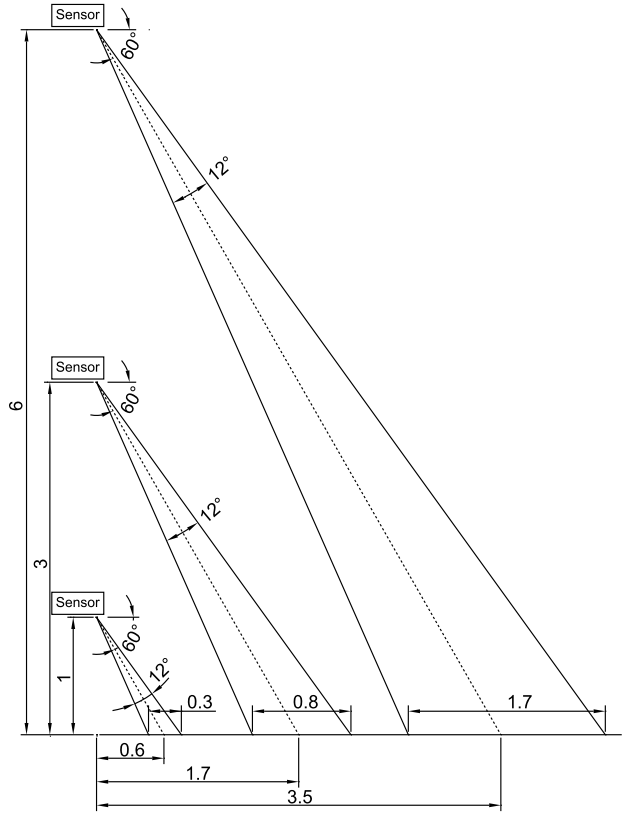


Figure 7 Measurement spot size for different mounting heights (dimensions in m)

Installation above open channels or rivers

The RG-30 can be mounted in a range between 0.5 to 15 m above the water surface. With the extended measurement range the RG-30 can be installed at a height up to 35 m above the water surface.

The sensor has to be mounted on a rigid structure that does not move, e.g. support beams or hand-rails of a bridge. An exception is the mounting on cable ways, which requires determination of the sensor inclination before each measurement to account for swinging (see parameter definition Inclination measurement).

Installation underneath bridges

When the RG-30 is installed underneath a bridge it has to be assured that no rain or melt water is dripping through the field of view of the velocity radar. The occurrence of such events may influence the measurement considerably.

Installation on extension arms

The RG-30 sensor can be mounted on an extension arm protruding from a river bank or channel wall. Sommer Messtechnik suggests installing a rotatable extension arm to facilitate maintenance.

7.1.3 Documentation

It is recommended to document the measurement site with pictures for future analysis. These may include:

- Measurement site with the installed sensor
- River or channel facing upstream and downstream
- Flow conditions at the measurement site
- Roughness of the river bed or channel walls

7.2 What do I need?

Prepare the following equipment and tools to install the RG-30:

- mounting tube Ø34…48 mm
- 13 mm open end wrench
- cable ties
- wire cutter

7.3 How do I install the RG-30?

7.3.1 Mounting

The RG-30 is mounted to a tube Ø34…48 mm with the supplied U-bolts. For alternative mounting methods please contact Sommer Messtechnik.

WARNING
The RG-30 must be installed parallel to the water surface! The angle between the water surface and the device should be within ±2.5°.

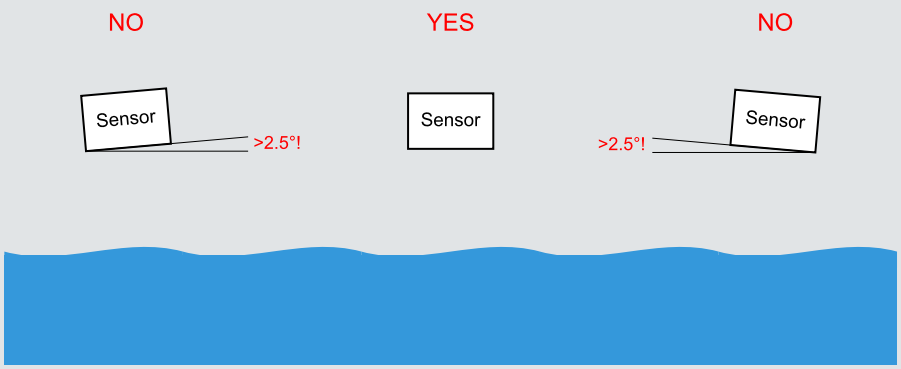


Figure 8 Parallel sensor installation

7.3.2 Power supply

The RG-30 is designed for extreme environmental conditions at remote sites and with no grid connection. The sensor switches automatically into standby-mode between measurements and thus consumes only approx. 3.5 Ah per day (measurement duration 30 sec and measurement interval 60 sec) which can be supplied by a 12V-solar-generator mounted to the mast.

7.3.3 Signal cables

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

Protocol	Max. cable length [m]
SDI-12	60
RS-485	300

Table 3: Maximum cable lengths

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

7.3.4 Lightning protection

It is recommended to equip the RG-30 sensor with properly dimensioned lightning protection. Consult an expert for advice.

The RG-30 is protected against overvoltage. If a data logger is mounted with the RG-30, its ground lug must be properly connected to earth ground.

8 Maintenance

The RG-30 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!

8.1 Device status

During operation the RG-30 continuously performs a self-check to identify any abnormal system behavior or device failure. This self-check is returned by the RG-30 as a code (SFCH-code) with a value of 1 to 16. In the table below the SFCH-code together with their cause and solution. An icon as specified in the legend below is linked to each SFCH-code to indicate the significance of a detected abnormality.

To view the self-check message open the Commander, connect to the RG-30 and open the tab Measurements (F3). In the main window a section named Self-check opens and displays the current device status.

Symbol	SFCH-Code	Description	Cause	Solution
	16	Sensor returns 999997, i.e., level can not be measured or measurement value has not been returned.	Sensor may not have been connected correctly or is malfunctioning.	Check correct sensor installation (facing water surface) and wire connections. If error persists, replace level sensor.
	15	Only applicable if Inclination measurement is set to *every measurement*. Inclinometer returns values outside the range 58 ±2.5°.	Sensor may be mounted improperly or is malfunctioning.	Check mounting position of sensor. If error persists, replace inclinometer.
	14	Velocity sensor returns excessive values.	Sensor may be mounted improperly or velocity settings are configured incorrectly.	Check/adjust sensor position Check/adapt settings in menus Velocity (v) and Tech. velocity (v).
	13	Velocity sensor operates in mode "peak-down-extrapolation".	Water flows very slowly and/or river has high waves. This may lead to overlapping velocity peaks.	Rivers with high waves should flow reasonably fast; change measurement site if this is not the case. Check/adapt settings in menus Velocity (v) and Tech. velocity (v). If waves are small, reduce the value of Minimum velocity or change the measurement site to a spot with higher flow velocities.

Symbol	SFCH-Code	Description	Cause	Solution
	12	Only applicable to RQ-30L. Water level is above W_Q, Q-30 fixation level.	Level sensor may be configured incorrectly, e.g., sign of water level range may be inverted.	Check/adapt settings of water level sensor.
	11	Not specified	-	-
	10	Velocity indicates wrong flow direction.	Sensor may not be properly configured or waves on the water surface are too shallow.	Check/adapt settings in menus Velocity (v) and Tech. velocity (v). If error persists, change measurement site.
	9	Velocity cannot be determined.	Flow conditions may be outside the range of detection, sensor may be configured incorrectly or is malfunctioning.	If error persists: Check/adapt settings in menus Velocity (v) and Tech. velocity (v). If error persists, change measurement site, replace sensor.
	8	Opposite direction content is too high.	Sensor may not be properly configured or is malfunctioning.	Check/adapt settings in menus Velocity (v) and Tech. velocity (v). If error persists, adjust sensor position, increase Stop, max. opp. direction, change measurement site, replace sensor.

Symbol	SFCH-Code	Description	Cause	Solution
	7	Quality (SNR) is insufficient in both flow directions	Sensor may not be properly configured or is malfunctioning.	Check/adapt settings in menus Velocity (v) and Tech. velocity (v). If error persists, adjust sensor position, increase Stop, max. opp. direction, change measurement site, replace sensor.
	6	No discharge values	Sensor cannot determine the cross-sectional area	Check/adapt settings in menu Level (W) and perform a level adjustment with Adjustment. Check the height reference (*height*, *sea level*, *distance to ground*) used to build the discharge table (see Profile section in Commander).
	5	Sensor did not measure flow velocity.	Water level below WLL, low level border, water level has not been adjusted, WLL, low level border is set too high.	Check/adapt settings in menus Velocity (v) and Tech. velocity (v). If error persists, change measurement site.

Symbol	SFCH-Code	Description	Cause	Solution
	4	Water level is above WMA, maximum level.	May occur if W-v learning has been optimized for low water levels (high water levels are extrapolated). Water level adjustment has not been performed, sensor has been improperly positioned, an obstacle may protrude into the field of view of the sensor.	Check/adapt settings in menu Level (W) and perform a level adjustment with Adjustment. Check the height reference (*height*, *sea level*, *distance to ground*) used to build the discharge table (see Profile section in Commander). Check that the field of view is free of any obstacles.
	3	Water level is below WCF, cease to flow level.	May occur during low water levels. Water level adjustment has not been performed, sensor has been improperly positioned, an obstacle may protrude into the field of view of the sensor.	Check/adapt settings in menu Level (W) and perform a level adjustment with Adjustment. Check the height reference (*height*, *sea level*, *distance to ground*) used to build the discharge table (see Profile section in Commander). Check that the field of view is free of any obstacles.

Symbol	SFCH-Code	Description	Cause	Solution
	2	Values of WCF, cease to flow level, WLL, low level border and WMA, maximum level are equal.	Occurs if W-v learning is not used.	Check/adapt settings in menu Level (W) and perform a level adjustment with Adjustment. Check the height reference (*height*, *sea level*, *distance to ground*) used to build the discharge table (see Profile section in Commander). Set the values of WCF, cease to flow level, WLL, low level border and WMA, maximum level only if the river shows a W-v relationship and if the values are known.
	1	No discharge table available.	Discharge table has not been uploaded, or discharge table has only one entry.	Upload discharge table. Check entries of discharge table.
	0	Sensor operates normally	-	-

Table 4: Device status codes

Symbol	Status
	Device failure
	Function check
	Out of range

Symbol	Status
	Normal operation with optimized setup
	Normal operation

Table 5: Device status symbols

9 Support software Commander

9.1 What can I do with it?

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
- Spectrum-Mode to visualize spectra of the level sensor (used for diagnostic purposes, e.g., multiple reflections)

9.2 How do I install it?

9.2.1 System requirements

The Commander software supports 32- and 64-bit versions of Windows 7 SP1, Windows 8, Windows 8.1 and Windows 10.

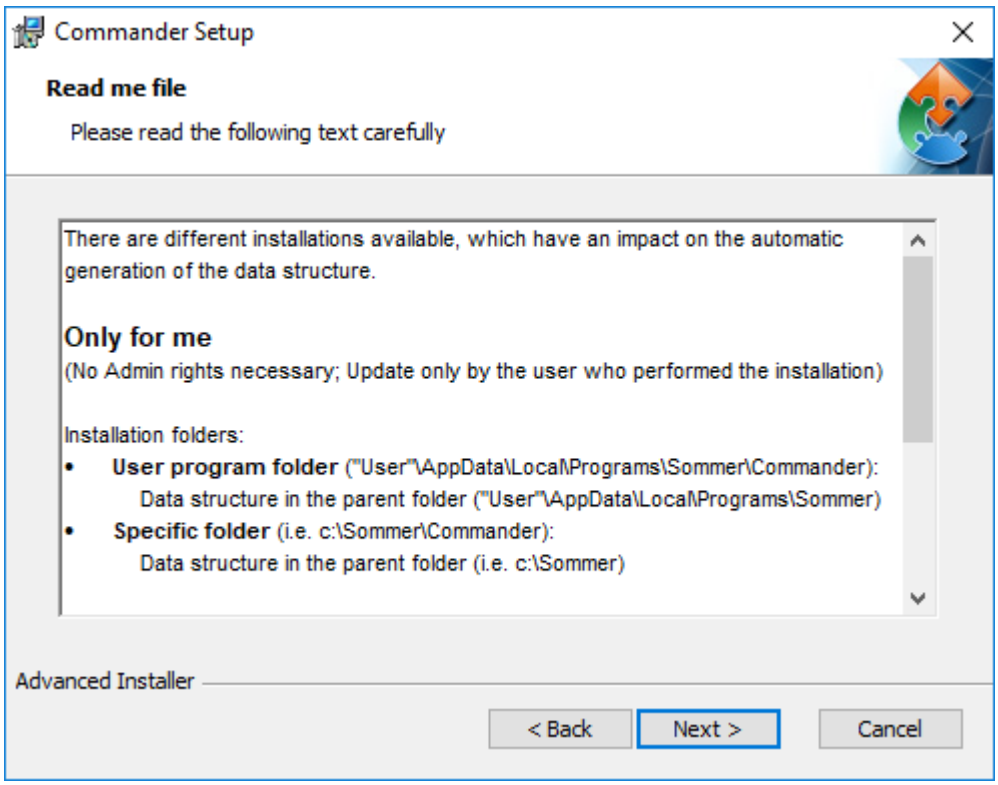
For correct operation Microsoft® .NET Framework 4.5 or later must be installed.

9.2.2 Installation procedure

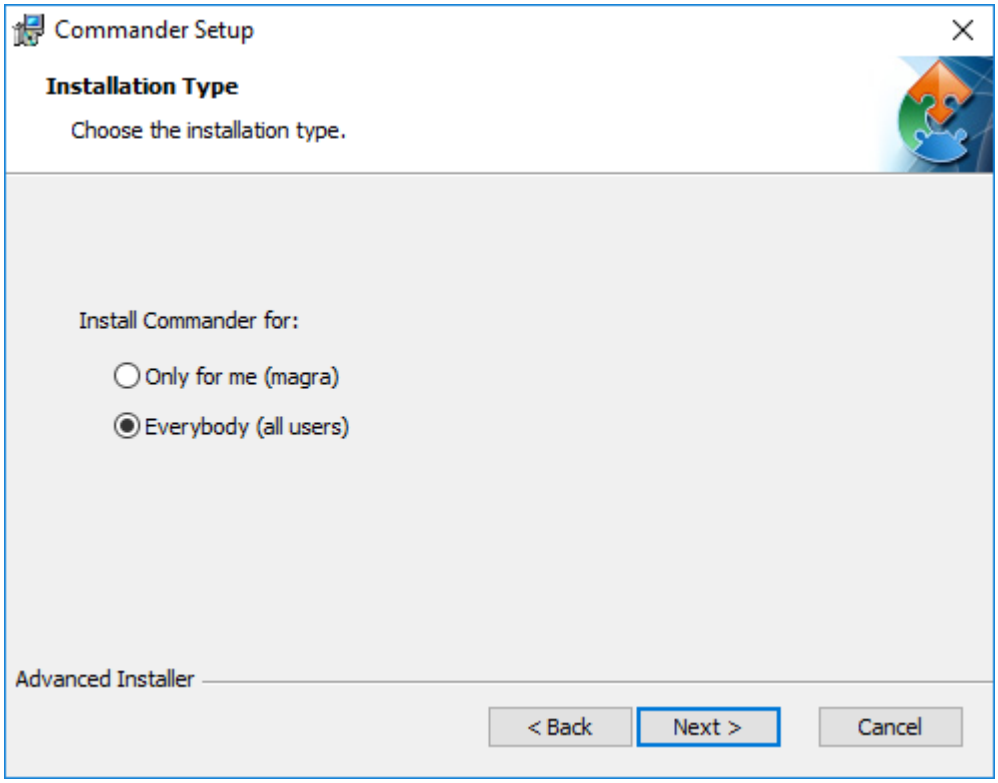
Follow the steps below to install the Commander software:

1. Double-click the commander.msi installer file
2. Click Next on the pop-up window

3. Read the instructions and click Next



4. 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

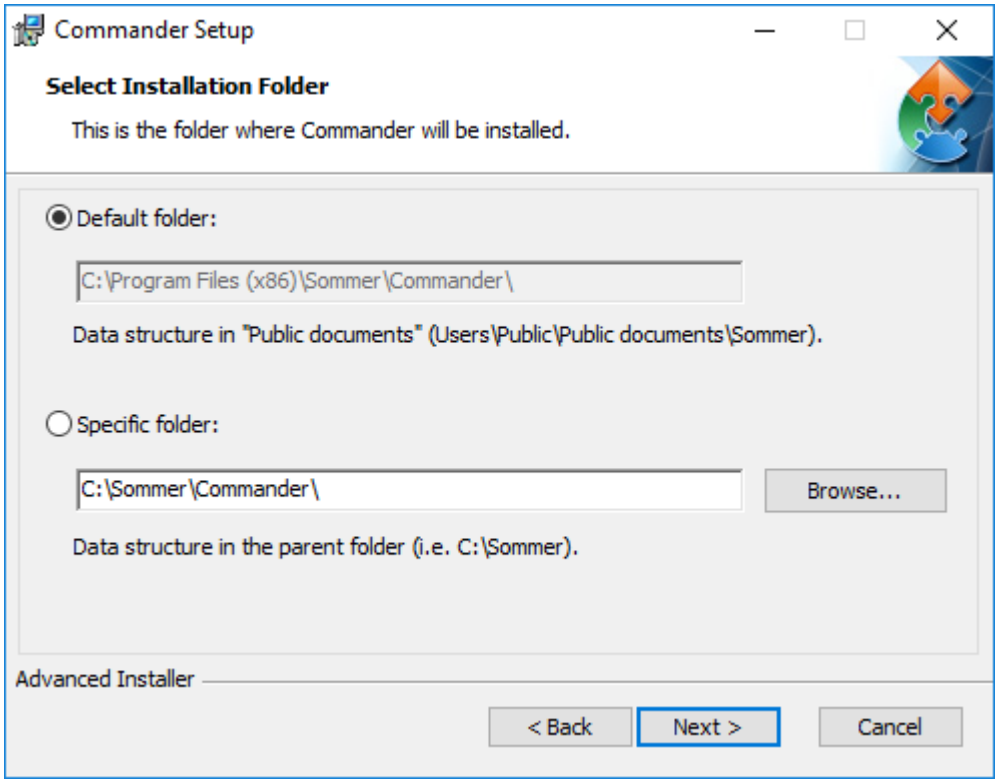
Everybody

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

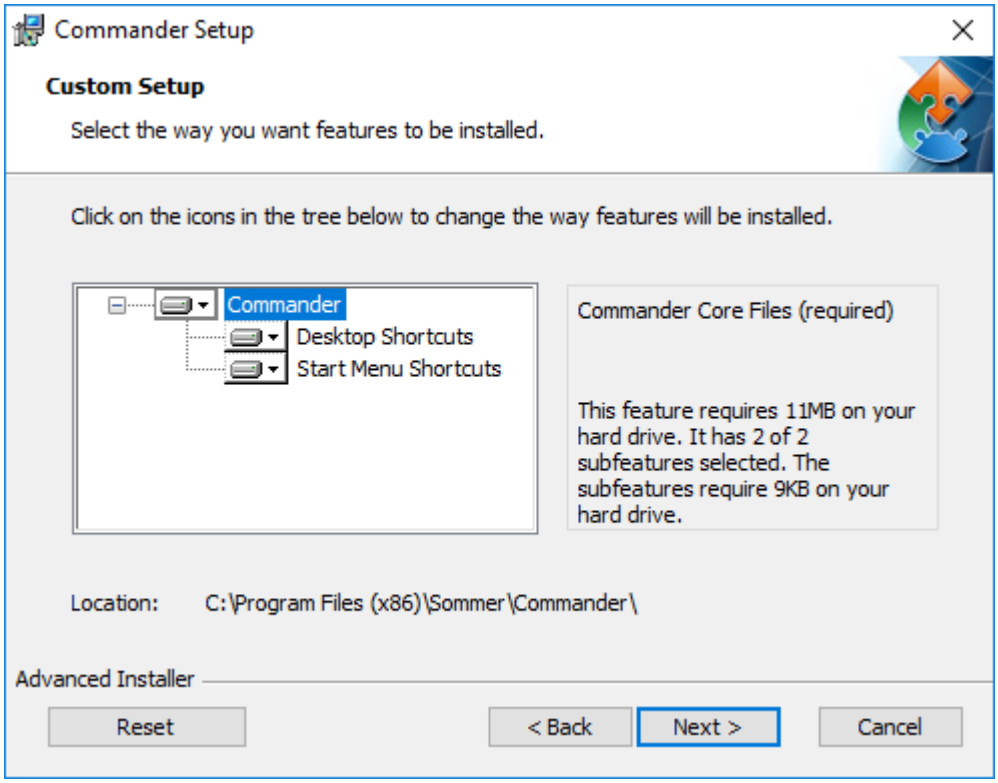
Installation folders:

- 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

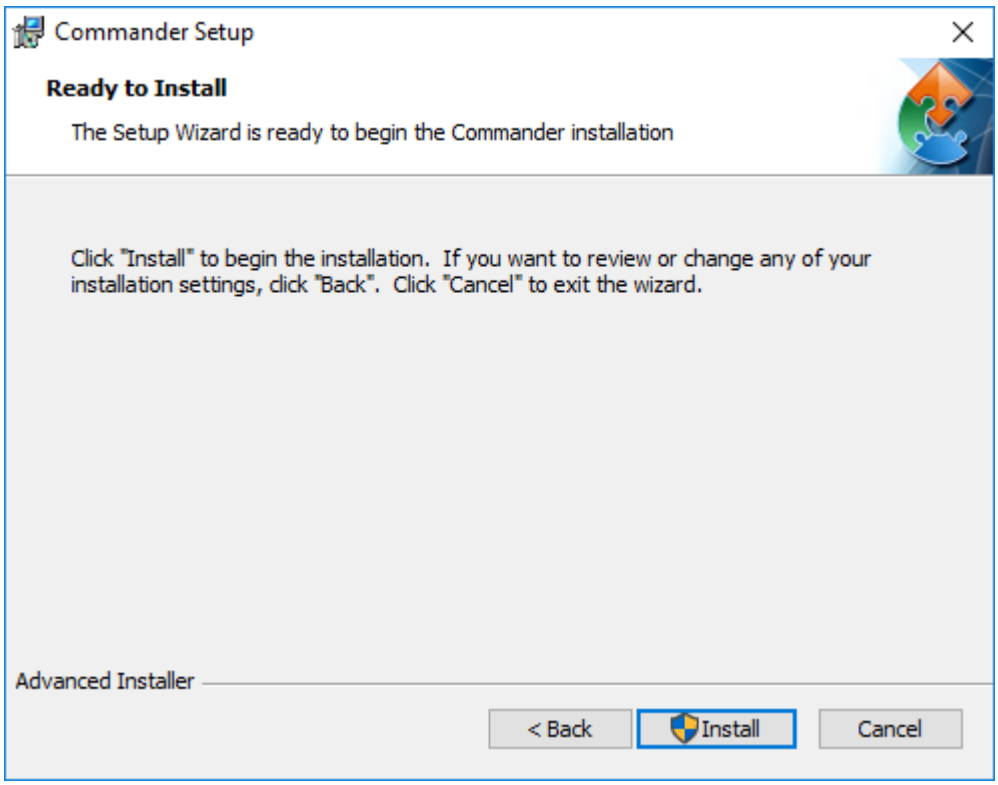
5. Select the installation directory and click Next.



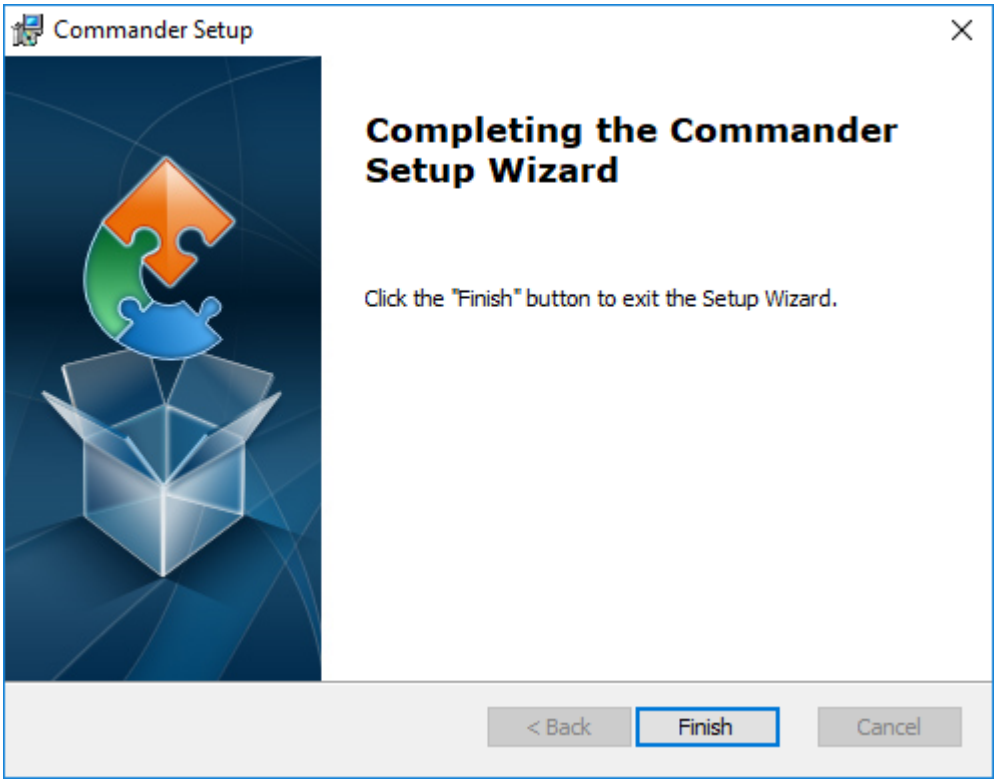
6. Select the features to be installed and click Next.



7. Click Install to start the installation.



8. Click Finish to complete the installation.


Commander Setup
Completing the Commander Setup Wizard
Click the "Finish" button to exit the Setup Wizard.
< Back
Finish
Cancel

10 How do I configure the RG-30?

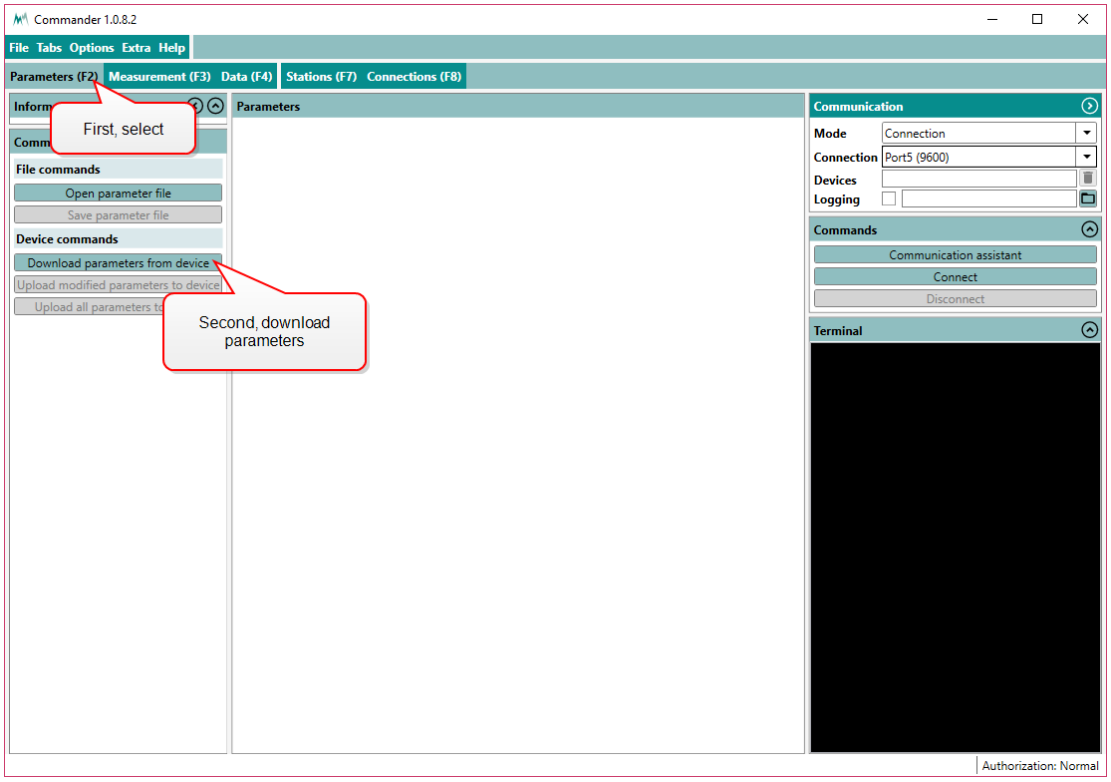
The RG-30 can be configured with one of the following tools:

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

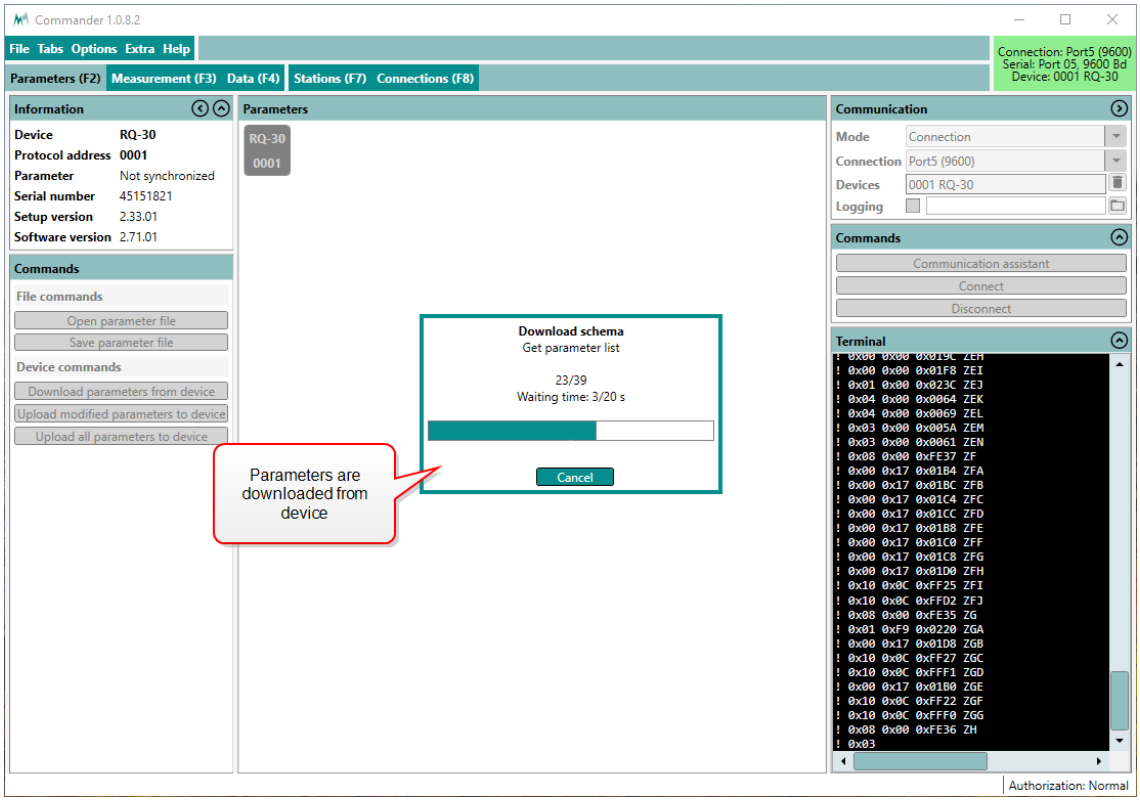
10.1 Configuration with Commander support software

Follow the steps below to modify the configuration parameters of the RG-30:

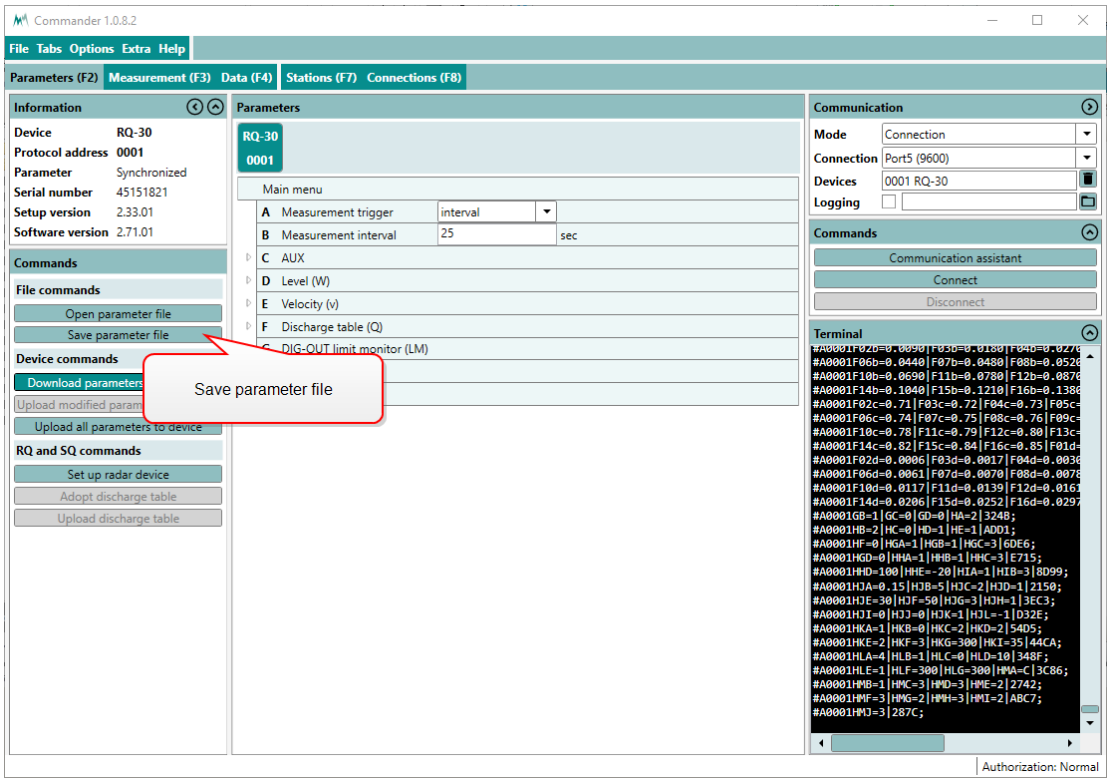
1. Establish a connection between your PC and the RG-30 as described in Connect the RG-30 to a PC.
2. Select the tab Parameters (F2) and click Download parameters from device. The complete parameter list is transferred from the sensor to your PC and displayed in the Parameter window.



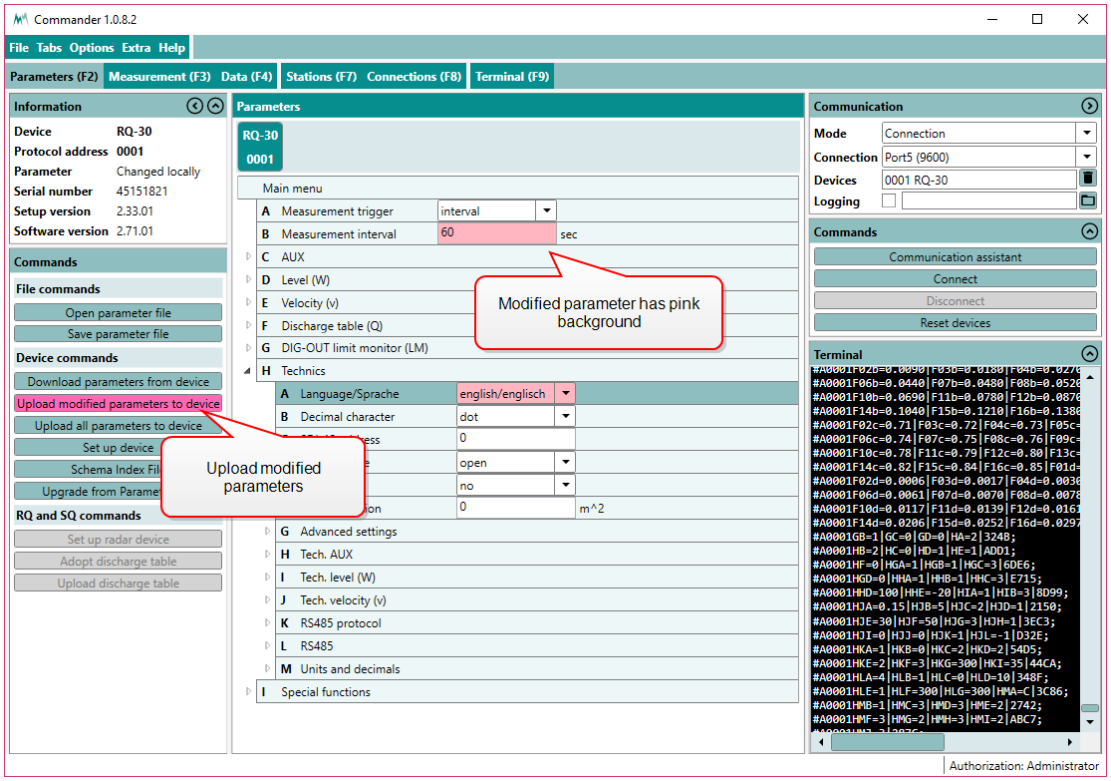
NOTE The first download of the parameter list may take a few minutes. After that the device is known to the PC and consecutive downloads are much faster.



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.



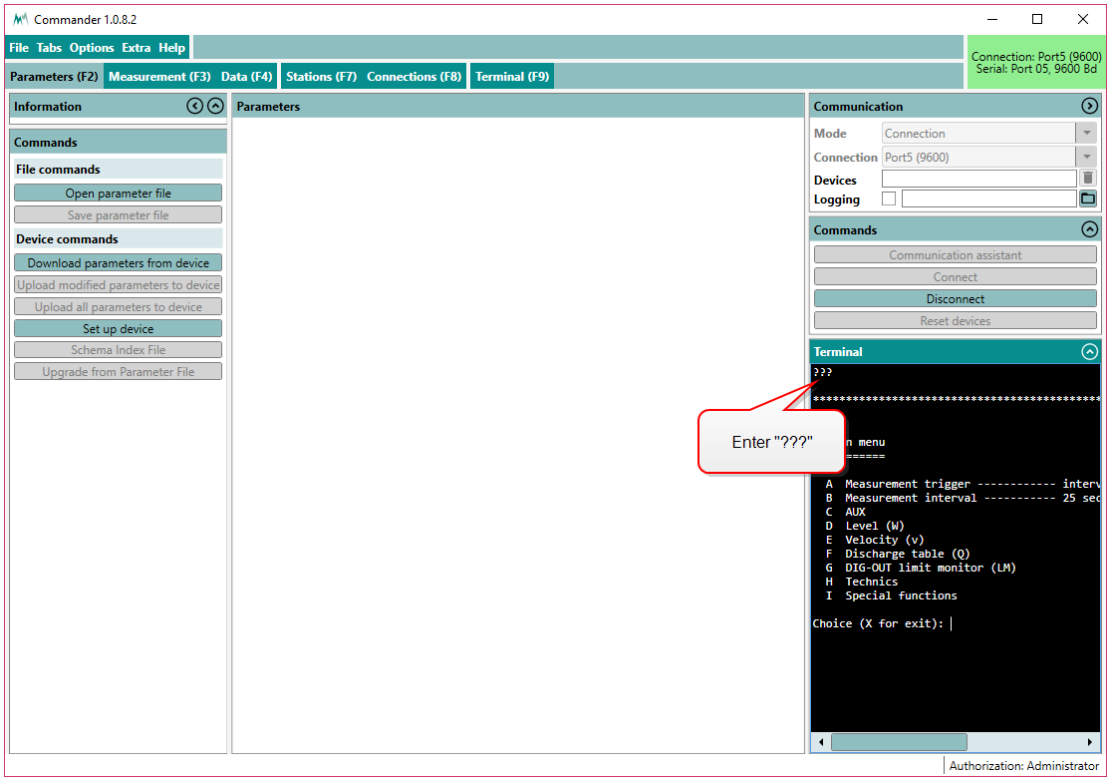
5. Send the modifications to the RG-30 by clicking Upload modified parameters to device. Upon successful upload the pink backgrounds disappear again.

10.2 Configuration with a terminal program

The Commander software ships with an integrated terminal program. However, communication with the RG-30 can be performed with any terminal program.

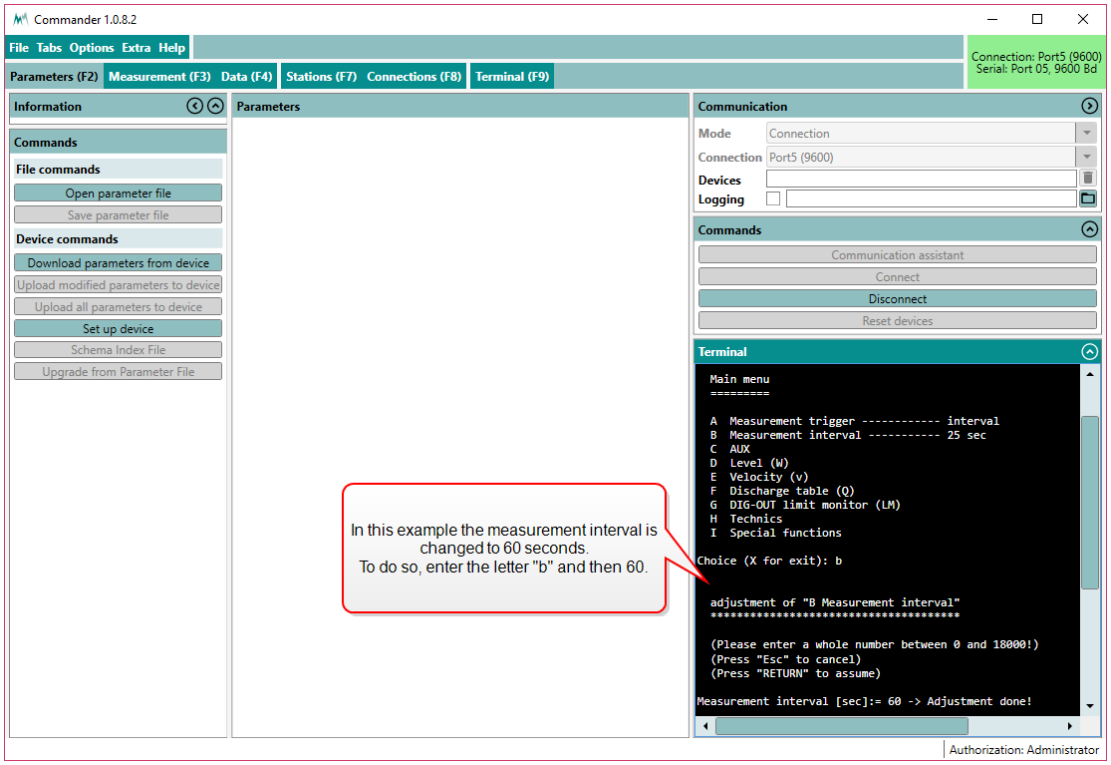
Follow the steps below to modify the configuration parameters of the RG-30:

1. Establish a connection between your PC and the RG-30.
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 has to 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 may automatically send a closing "Carriage return".

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. After closing the main menu withX the sensor performs an initialization.



10.3 Configuration errors

10.3.1 Device messages

During configuration via RS-485 the RG-30 may return the following messages. The device messages are bit-coded and returned in hex format. If multiple messages are present the message codes are summed up.

Message code	Description
0x0001	PLEASE NOTE: Parameter conflict (view manual)!
0x0002	PLEASE NOTE: setup conflict (view manual)!
0x0004	Mistake: Please just enter valid values!
0x0008	Mistake: Please, just enter menu choice characters!
0x0010	Cancel!

Message code	Description
0x0020	Testmode canceled!
0x0040	Error: CRC failure!
0x0080	Denied, due to temporarily loaded menu!
0x0100	Testmode finished!
0x0200	Timeout!
0x0400	PLEASE NOTE: Maybe difficult interpretation of archive data!
0x0800	Action currently not available. Please try again later!
0x1000	DIRECTIVE: Please don't forget to change the serial counterpart too!
0x2000	PLEASE NOTE: An old archive pointer has been replaced!
0x4000	PLEASE NOTE: Please perform a "W-v table reset"!

Table 6: Device messages

10.3.2 Conflict messages

During configuration via RS-485, the RG-30 may return conflict messages after one or more parameters have been changed and uploaded to the device. An example is shown in Figure 9.

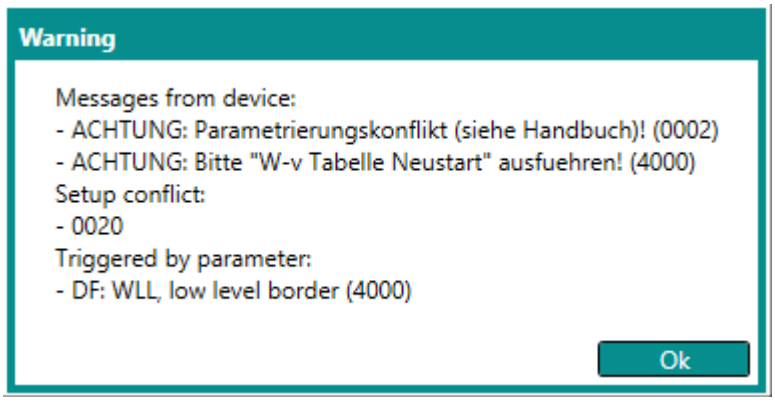


Figure 9 Conflict message

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

Setup conflict

A setup conflict message as listed below is returned if a modified setup with conflicting parameters is loaded onto the RG-30.

Conflict code	Parameter	Comment
0001	AUX, Status	Conflict with a hidden parameter. Please contact Sommer Messtechnik for advice.
0002	OP, measurement output	Set to *just per command* if Output protocol (OP) is set to *Modbus*.
0010	River inclination	Set to *0* if Possible flow directions is set to *two (tide)*.
0020	WLL, low level border WCF, cease to flow level	The water level parameters should respect the rule: WMA > WLL > WCF. If the specified levels violate this rule, they are adapted to the next valid value.
0040	Maximum velocity	Set to 5 m/s if value is ≥30 m/s or <1.5 m/s.
0080	Minimum velocity	Set to 25% of Maximum velocity if >25% of Maximum velocity. Set to 0.01 m/s if Maximum velocity is below 0.01 m/s.

Table 7: Conflict messages

10.4 What do I need to configure?

When first setting-up a RG-30 at a measurement site, the parameters described below may need to be adapted.

10.4.1 General settings

Language/Sprache

The menu language.

Decimal character

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

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.

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

10.4.2 Velocity measurement

The measurement of the flow velocity depends on the mounting position of the RG-30 sensor and the water flow conditions at the site. These conditions are defined by the settings under Velocity (v) and Tech. velocity (v)

Viewing direction

The viewing direction of the RG-30 sensor in relation to the flow direction of the river, either *upstream* or *downstream*.

Possible flow directions

The setting to define if the river only flows in one direction or if two flow directions can occur, e.g. under tidal influence (see also Flow direction separation).

Measurement duration

The duration of a single measurement. During this time the velocity radar signal is recorded and the radar spectrum is calculated. Generally, a measurement duration of 30 s is recommended. For very calm rivers a longer measurement duration should be selected.

Minimum velocity

The minimum expected velocity. No lower velocities are considered.

Maximum velocity

The maximum expected velocity. The velocity measurement is optimized for this setting. Usually a value of 5 m/s is adequate.

Meas. spot optimization

The expected velocity distribution in the measurement spot. The more irregular the distribution, the wider the selected spectral band width used for the velocity measurement.

For the first measurements at a new site the option *standard* is recommended. Later on, the measurement may be optimized by selecting another option.

Measurement type

The velocity measurement can either be performed continuously in one block, or in a sequence of five consecutive blocks with breaks in between. The sequenced method is more representative but slow-er. By default the selection should be set to *continuous*.

Criteria for invalid measurements and their handling

Velocity measurements can be defined as invalid by the criteria quality (SNR) and opposite direction content (Stop, min. quality (SNR) to Stop, replace value). These criteria and the handling of invalid measurements are controlled with these settings. Please refer to Tech. velocity (v) for details.

Inclination measurement

As described in Inclination angle measurement each velocity measurement has to be corrected for sensor inclination. If the RG-30 sensor is mounted stably it is sufficient to measure the installation angle with the first measurement after a sensor restart. If the sensor can move it is recommended to perform an inclination measurement with each velocity measurement.

View spectral distribution

With this function the RG-30 radar sensor is switched into spectrum mode and the spectra are recorded by the Commander and displayed in the Measurement tab. Please refer to Radar spectrum for more details on velocity radar spectra.

11 Serial communication

11.1 What are the options?

Serial data communication with the RG-30 can be performed by

- RS-485
- Modbus
- SDI-12

11.2 Which data do I get?

The measurement values returned by the RG-30 are arranged in a fixed sequence and identified by an index. They are divided into three groups and can be selected in OP, information.

11.2.1 Main values

The main values comprise the primary measurement values as listed in Table 8 and are always returned with the data string. Units and decimal places can be set in Units and decimals.

Index	Measurement value	Unit	Description
01	not used	-	-
02	not used	-	-
03	Velocity	[1]	Measured velocity
04	Quality (SNR)	-	Quality value containing SNR
05	not used	-	-
06	not used	-	-

Table 8: Main values

11.2.2 Special values

The special values comprise the learned velocity and discharge as well as some diagnostic values (see Table 9). By activating the W-v priority with the menu itemW-v priority the measured velocity

[1] Unit according to sub-menu Units and decimals

and discharge are returned instead (The learned velocity and discharge are then returned with the main values).

Index	Measurement value	Unit	Description
07	not used	-	-
08	not used	-	-
09	Opposite direction content	%	Fraction of counter-flow in measurement direction
10	Supply voltage	V	Voltage of the power supply input

Table 9: Special values

11.2.3 Analysis values

The analysis values as listed in Table 10 comprise diagnostic information of the velocity measurement.

Index	Measurement value	Unit	Description
11	Peak width	mm/s	Band width of the signal
12	CSR	%	Corrected intensity
13	Area of the peak	-	-
14	RMS at the PIC	mV	Diagnostic variable
15	Amplification	-	Value of the amplification regulation
16	Amplification relation	%	Diagnostic variable
17	Signal relation	%	Diagnostic variable
18	Error code	-	for diagnostic use of Sommer Messtechnik only
19	not used	-	-
20	not used	-	-
21	not used	-	-

Table 10: Analysis values

11.2.4 Exception values

Measurement data may be returned with the following exception values:

Value	Description
9999.998	Initial value: No measurement has been performed yet (position of decimal character is irrelevant).
9999.997	Conversion error: Caused by a technical problem (position of decimal character is irrelevant)
9999999	Positive overflow
-9999999	Negative overflow

Table 11: Exception values

11.2.5 Quality value

The quality value provides information about the velocity measurement and distribution and has the format: -21.89

	Description
-	Validity of the measurement
21	SNR in dB
8	Amplification, 0...9
9	Band width class, 0...9

Table 12: Format of the quality value

Validity of the measurement

Measurements with a negative quality value have been identified as invalid (so-called stop measurements).

A velocity measurement is flagged invalid if the opposite direction content exceeds the threshold defined in Stop, max. opp. direction or if the quality value is below the Stop, min. quality (SNR) limit.

SNR

The Signal-to-Noise Ratio contains the most important information of the quality value. Generally, a SNR lower than 30 indicates an insufficient flow velocity measurement.

Amplification

Depending on the condition of the water surface, e.g. waves, and the distance between water surface and sensor the received radar signals may fluctuate considerably. To compensate for these fluctuations the radar signal is amplified accordingly.

A high amplification value indicates a weak radar signal; a value of 0 is optimal.

Band width class

The band width class depends on the spectral velocity distribution. Generally, a high band width corresponds to a turbulent river, i.e. *Splash water*, a low band width to a calm river, i.e. *consistent*. This classification may not be very accurate. Observations of the flow conditions at the measurement site always have to be considered.

11.3 RS-485

11.3.1 What is it?

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]

11.3.2 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 RG-30.

11.3.3 How do I wire it?

The RG-30 can be connected to a data logger or a RS-485 network according to the figure below.

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

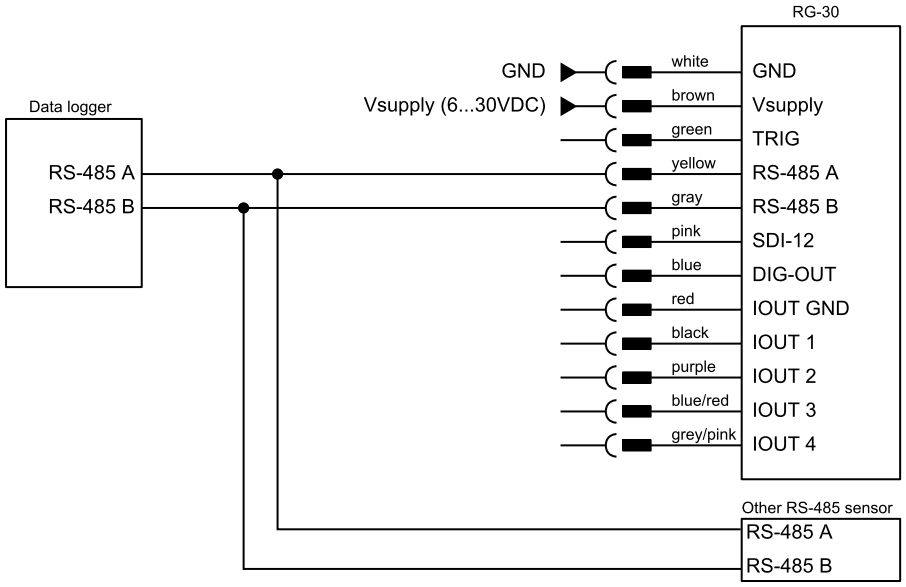


Figure 10 Wiring of the RG-30 with a data logger via RS-485

11.3.4 How do I configure it?

The RG-30 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 RS-485 ProtocolRS-485 Protocol may need to be adapted:

RS-485 Port

By default the serial port of the RG-30 is configured as follows:

Baud rate	9600
Data bits	8
Parity	none
Stop bits	1
Flow control	none

System key and device number

The system key and device number are used to identify a RG-30 in a bus system. This is essential if multiple devices (RG-30 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 general, 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.

OP, measurement output

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

Option	Description
just per command	The output is only requested by commands via the RS-485 or SDI-12 interface.
after measurement (default)	The serial data output is performed automatically right after each measurement.
pos. TRIG slope	The output is triggered by a positive edge of a control signal applied to the trigger input.

Operation modes

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

Pushing mode

This is the default operation mode: The measurements are triggered internally by the RG-30 and the data are returned automatically after each measurement. No external trigger is required. Set Measurement trigger to internal and OP, measurement output to *after measurement*.

Polling mode

A connected data logger triggers the measurements and the data output. Set Measurement trigger to TRIG input or SDI-12/RS485 and OP, measurement output to *just per command*.

Apparent polling

A connected data logger triggers only the measurements. The data output is performed automatically after each measurement. Set Measurement trigger to *TRIG input* or *SDI-12/RS485* and OP, measurement output to *after measurement*.

Waking-up a connected data logger

The RG-30 supports wake-up of a connected data logger that is in standby mode. Generally, this feature is only used in pushing mode and can be set under OP, wake-up sequence.

Sync sequence

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

Prefix

The prefix is an arbitrary character; the RG-30 uses a blank. This character is sent prior to any communication. Then the time of the OP, prefix holdback is waited and the command is sent afterwards. With this procedure the receiving device has time to wake-up.

Output protocols

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

11.3.5 How is the output structured?

Data are returned in different formats, selectable in Output protocol (OP):

- Sommer protocol
- Standard protocol
- Sommer old protocol

11.3.6 Sommer protocol

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

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

Header

The header (#M0001G00se) 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 05 Analysis values 09...15 06 Analysis values 16...22
Command	se	se identifies automatically sent values

Table 13: Header of the Sommer protocol

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 decimal 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 14: Values in Sommer protocol

End sequence

The data string is terminated with a CRC-16 in hex format (3883) followed by an end character and <CR><LF>. The CRC-16 is described in Sommer CRC-16.

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

Table 15: End sequence of the Sommer protocol

Example Sommer protocol

Main values

Main values are returned as in the following example:

EXAMPLE #M0001G00se01999999.8|02 9999998|03 0.433|04 40.93|0599999.98|0699999.98|2492;

#M0001G00se	Header with system key 00, device number 01 and string number 00
01999999.8|	not used
02 9999998|	not used
03 0.433|	Flow Velocity
04 40.93|	Quality (SNR) (see Quality value)
0599999.98|	not used
0699999.98|	not used
2492;	Closing sequence

Table 16: Main values in Sommer new protocol

Special values

Special values are returned as in the following example:

EXAMPLE `#M0001G01se079999.998|0899999.98|09 46|10 15.13|E308;`

`#M0001G01se`	Header with system key 00, device number 01 and string number 01
`079999.998|`	not used
`0899999.98|`	not used
`09 46|`	Opposite direction content
`10 15.13|`	Supply voltage
`E308;`	Closing sequence

Table 17: Special values in Sommer new protocol

Analysis values

Analysis values are returned as in the following example:

EXAMPLE

```
#M0001G02se11 430|12 293|13 78|14
116|15 11075|16 -40|E08D;
#M0001G03se17 0|18 0|19 9999998|20
9999998|21 9999998|3827;
```

`#M0001G02se`	Header with system key 00, device number 01 and string number 02 for the analysis values 11 to 16
`11 430|`	Peak width [mm/s]
`12 293|`	CSR [%]
`13 78|`	Area of the peak
`14 116|`	RMS at the PIC

15 11075|	Amplification
16 -40|	Amplification relation [%]
E08D;	Closing sequence
#M0001G03se	Header with system key 00, device number 01 and string number 03 for the analysis values 17 to 21
17 0|	Signal relation [%]
18 0|	Error code
19 9999998|	not used
20 9999998|	not used
21 9999998|	not used
3827;	Closing sequence

Table 18: Analysis values in Sommer new protocol

11.3.7 Standard protocol

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

EXAMPLE `M_0001 1461 1359 25.38 0`

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 19: Header of the Standard protocol

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 20: Values in Standard protocol

End sequence

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

Example Standard protocol

Main and special values

Main and special values are returned as in the following example:

EXAMPLE M_0001 999999.8 9999998 0.679 35.93 99999.98 99999.98 9999.998 99999.98 46 15.13

M_0001	Header with identifier for measurement values
999999.8	not used
9999998	not used
0.679	Velocity[1]

[1] The positions of the measured and learned velocity and discharge can be switched with the menu item W-v priority.

35.93	Quality (SNR) (see Quality value)
99999.98	not used
99999.98	not used
9999.998	not used
99999.98	not used
46	Opposite direction content
15.13	Supply voltage

Table 21: Main values in Standard protocol

Analysis values

Analysis values are returned as in the following example:

EXAMPLE
```
Z_0001      664      239       61       91
 11075       47        0      200  9999998  9999998
 9999998;
```

Z_0001	Header with identifier for analysis values
664	Peak width [mm/s]
239	CSR [%]
61	Area of the peak
91	RMS at the PIC
11075	Amplification
47	Amplification relation [%]
0	Signal relation [%]
200	Error code
9999998	not used

9999998	not used
9999998	not used

Table 22: Analysis values in Standard protocol

11.3.8 Sommer old protocol

The data string of the Sommer old protocol has the following format:

EXAMPLE `#M0001G00se00 -17.4|01 0.535|02 0.000|03 -1.89|04 0.0|05 0|B11D;`

This protocol is identical with the Sommer protocol except that the index of the measurement values starts at 0 instead of 1.

This protocol has been implemented for compatibility reasons: When a Sommer device with firmware < 2.0 is updated to version 2.x the protocol is automatically set to Sommer old. Thus, the setup of a connected data logger does not have to be adjusted.

11.3.9 Which commands are available?

Command structure

The structure of serial commands and answers (`#W0001$mt|BE85;`) is described in the following table:

Parameter	Format	Description
Start character	#	
Identifier	X	W RG-30 returns a confirmation on receipt. This command type demands a closing sequence with a valid CRC-16. S RG-30 does not acknowledge the receipt of the command. This command type demands no closing sequence and therefore no CRC-16. R RG-30 returns the requested measurement value or parameter. This command type demands a closing sequence with a valid CRC-16. T Write a volatile setting and receive a confirmation A Answer of device to read or write command
System key	dd	
Device number	dd	
Command	xxx	See Commands
Separator	|	
CRC-16	hhhh	4-digit hex number
End character	;	

Table 23: Structure of RS-485 commands and answers

Commands

The following commands can be used with the RG-30:

Command	Description
$mt	Trigger a measurement
$pt	Return measurement values
_dd0cv	Return a single measurement value with index dd
XX	Read a parameter of the sensor menu with identifier XX
XX=xxxx	Write a parameter with identifier XX and the value xxx to the sensor menu

Table 24: List of RS-485 commands

Trigger a measurement

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

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

Read a parameter value

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

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

Request a complete data string

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

EXAMPLE #S0001$pt| Answer: none

The data string is returned as soon as the RG-30 has processed the command.

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 (in this example a water level) is requested:

EXAMPLE

```
#R0001_010cv|EA62;
```

Answer: `#A0001ok_010cv1461     |07EB;`

11.3.10 Sommer CRC-16

The CRC-16 (cyclic redundancy check) used in data transmission of Sommer 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 for calculation of CRC-16 values.

11.4 SDI-12

11.4.1 What is it?

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.

11.4.2 What can I do with it?

The RG-30 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.

11.4.3 How do I wire it?

The RG-30 can be connected to a data logger via 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).

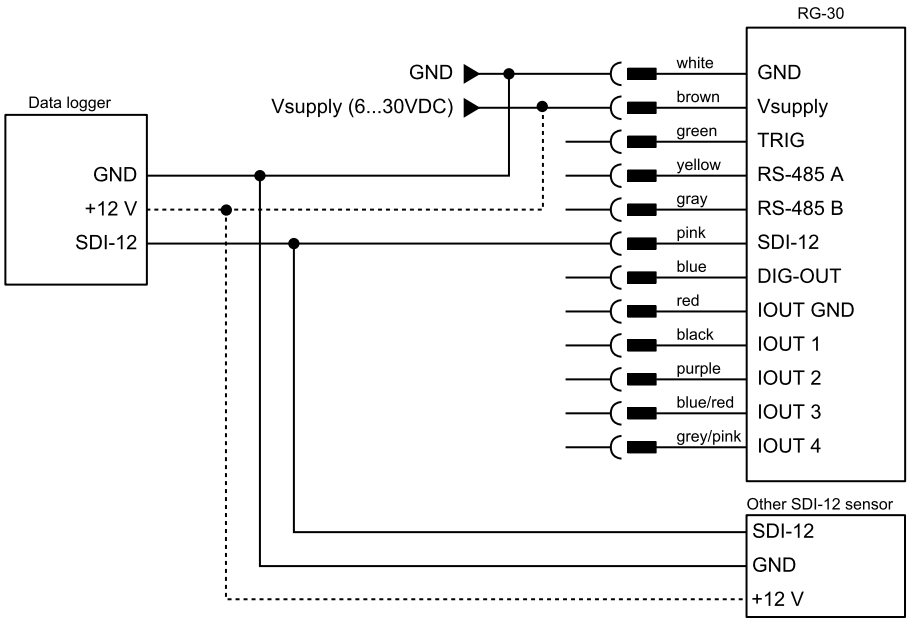


Figure 11 Wiring of the RG-30 with a data logger via SDI-12

11.4.4 How do I configure it?

The RG-30 has SDI-12 communication enabled by default. If the device is connected to a data acquisition system, e.g. data logger, and if multiple SDI-12 devices are connected to the same bus, the SDI-12 address may need to be adapted.

11.4.5 How are commands structured?

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

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

EXAMPLE

```
0+999999.9+0.535+0.250+1.99+1337.5+2122.6+0.250+133-
7.5+424+11.58+1041+937+0<CR><LF>
```

11.4.6 Which commands are available?

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.

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)
`RG-30`	Device designation (max. 13 characters)

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.

Trigger measurement

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

The response states that the measurement will take 8 seconds and that the device will return 4 measurement values. 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

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.

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>

If more than 9 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.

Configure device

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.

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>`

Read and write a parameter with options

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>`

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

Adopt settings

RG-30 settings are adopted with the command `aXW_ts|!`, with `a` the sensor address.

11.5 Modbus

11.5.1 What is it?

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]

11.5.2 What can I do with it?

Modbus-communication with RG-30 allows reading of measurement values and device information by a Modbus master. Additionally, the basic RS-485 port settings can be written to the RG-30.

11.5.3 How do I wire it?

For Modbus communication the RG-30 is wired according to the table below.

Modbus	Connector MAIN	Connection wire	Description
Common	A	White	GND
Vsupply	B	Brown	6...30 VDC
D1 - B/B	D	Yellow	RS-485 A
D0 - A/A	E	Grey	RS-485 B

Table 25: Connection to a Modbus

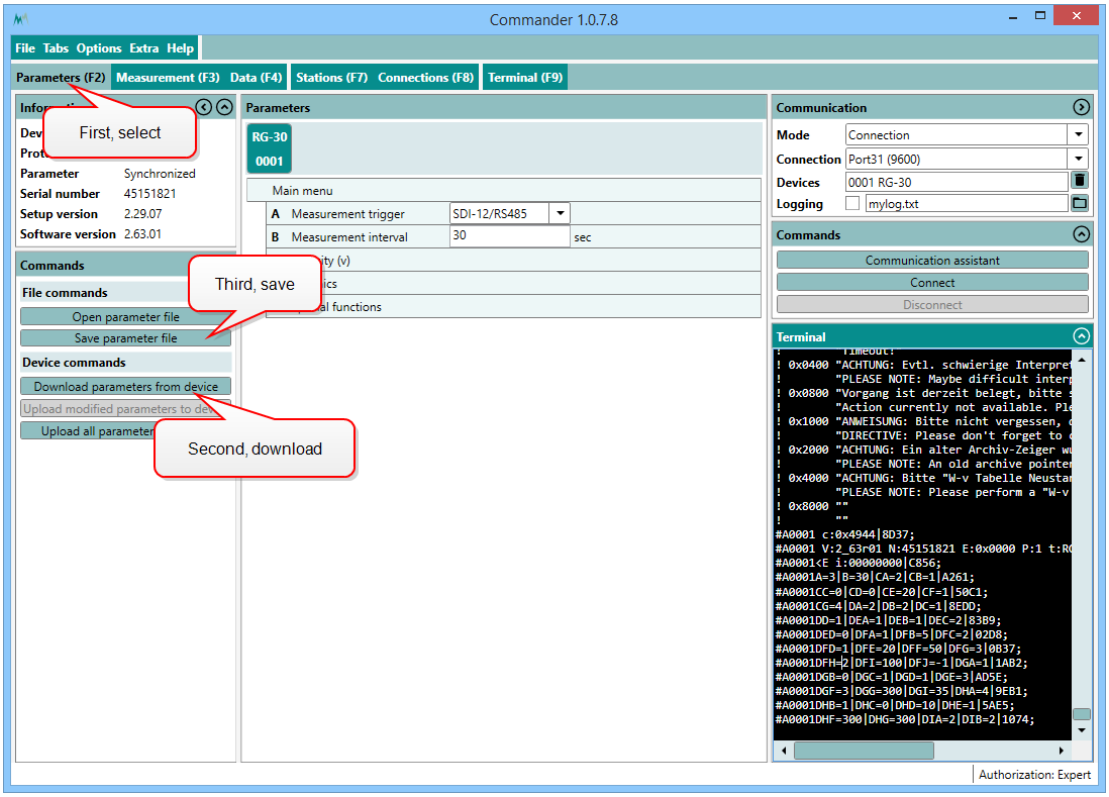
[1] http://www.simplymodbus.ca/FAQ.htm

NOTE The RG-30 does not have termination resistors and does not need BUS polarization resistors. Therefore, only a RS-485 BUS termination has to be implemented externally.

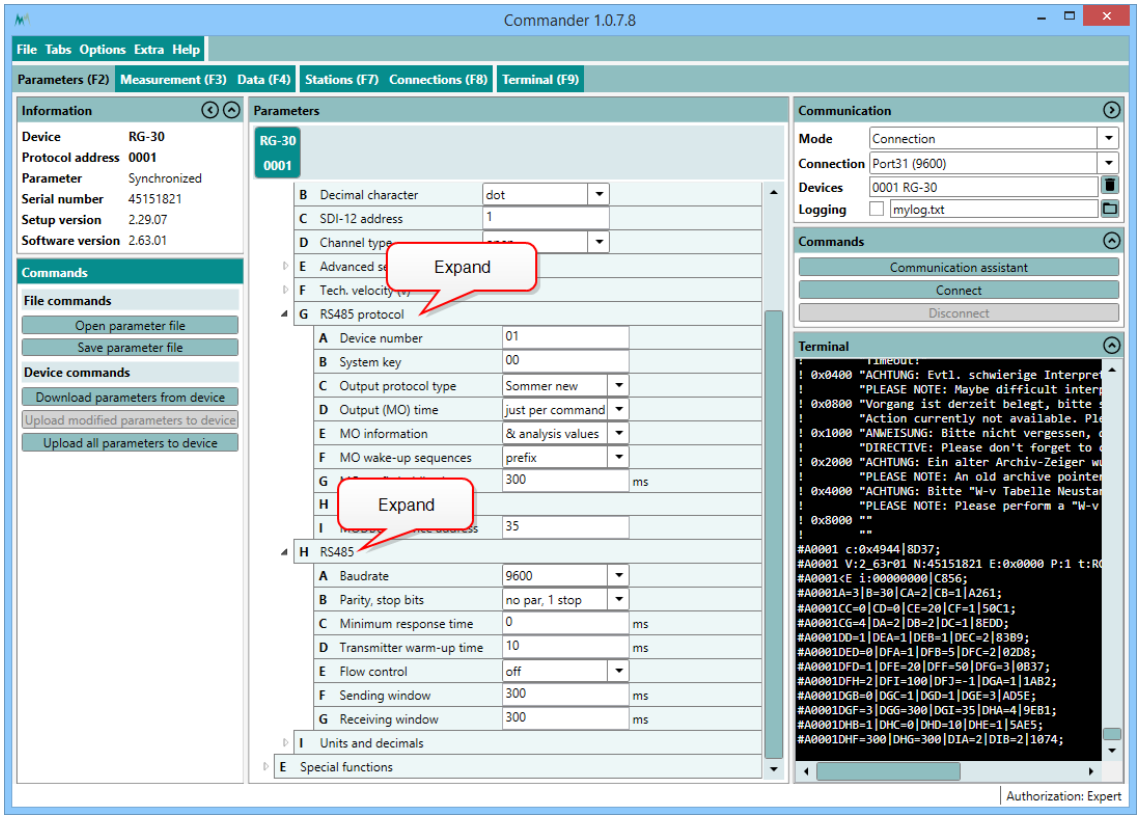
11.5.4 How do I configure it?

Follow the instructions below to change the communication of a Sommer-device to Modbus:

1. Connect the USB to RS-485 converter to the data cable of the Sommer-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-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 menus RS-485 protocol and RS485 and take a screenshot 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.

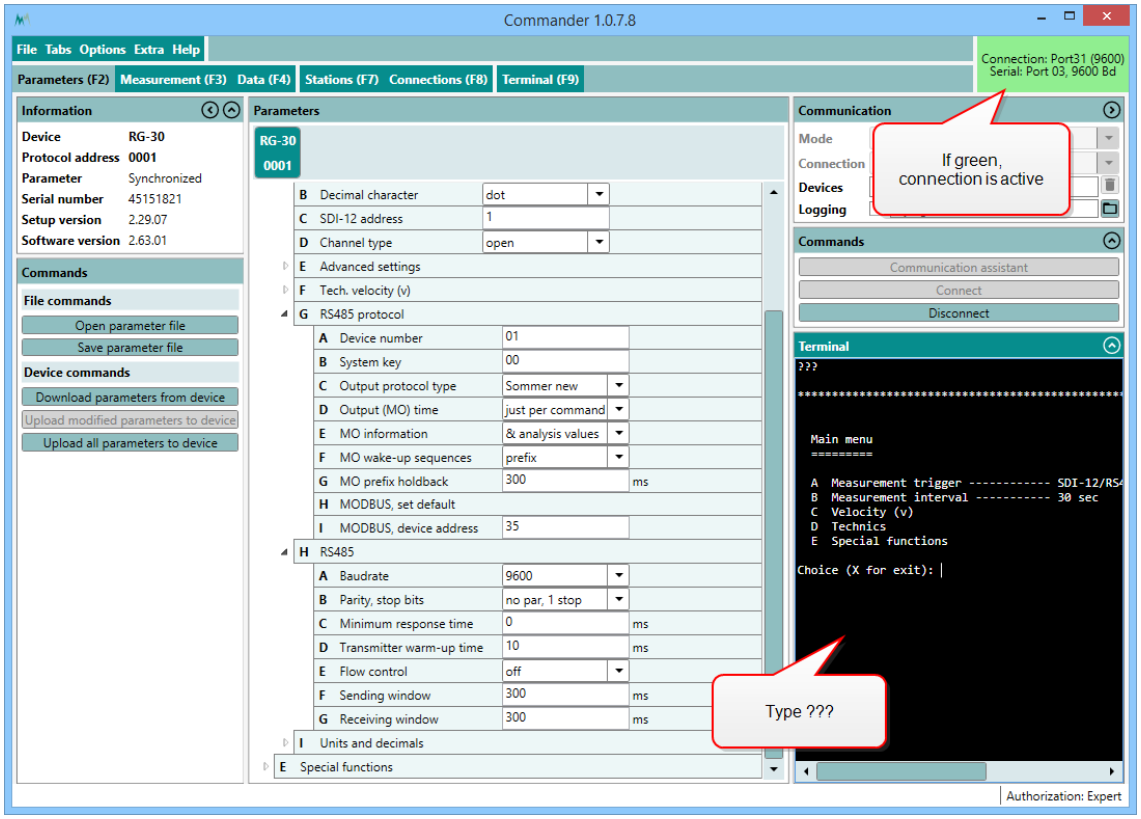
   B. *SDI-12/RS-485*, if measurements are triggered by SDI-12.

   C. *TRIG input*, if measurements are triggered by a trigger input.

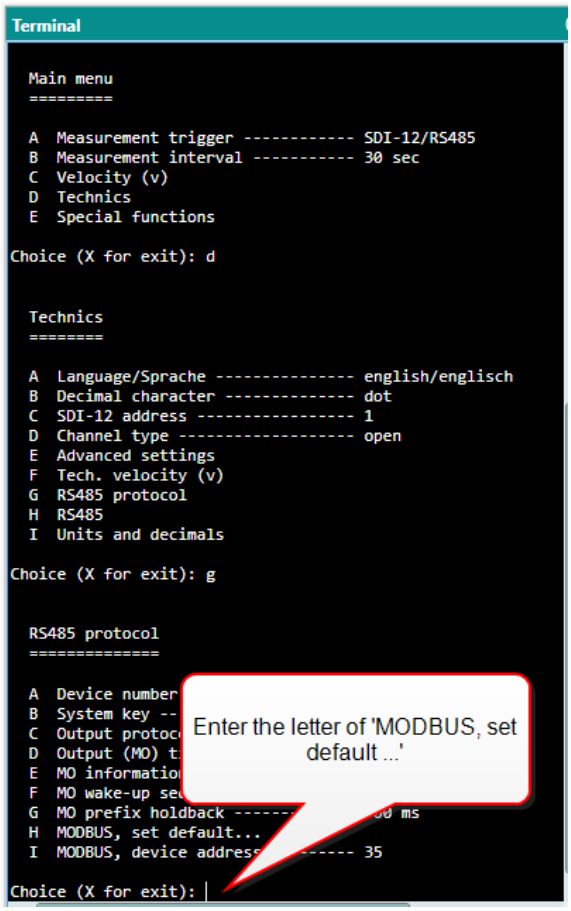
   D. *all allowed*, if measurements are triggered by one of the previous options.

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

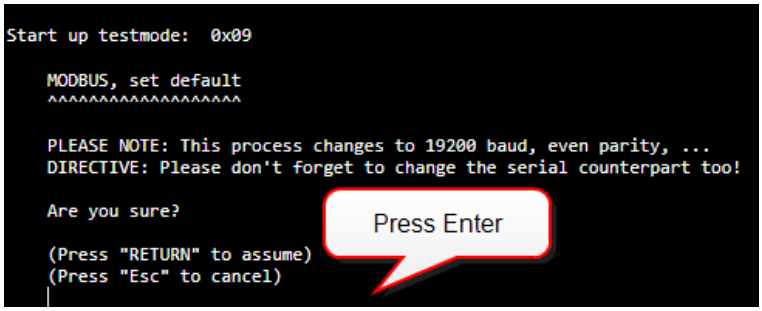
8. Verify that the connection to the Sommer-device is active and click into the Terminal window. Type ??? to enter the sensor-menu.



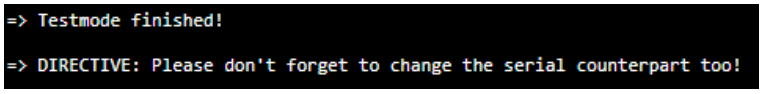
9. Navigate to *RS485 protocol* and select *MODBUS, set default…* Please note, that the index-letters might be different for your Sommer-device!



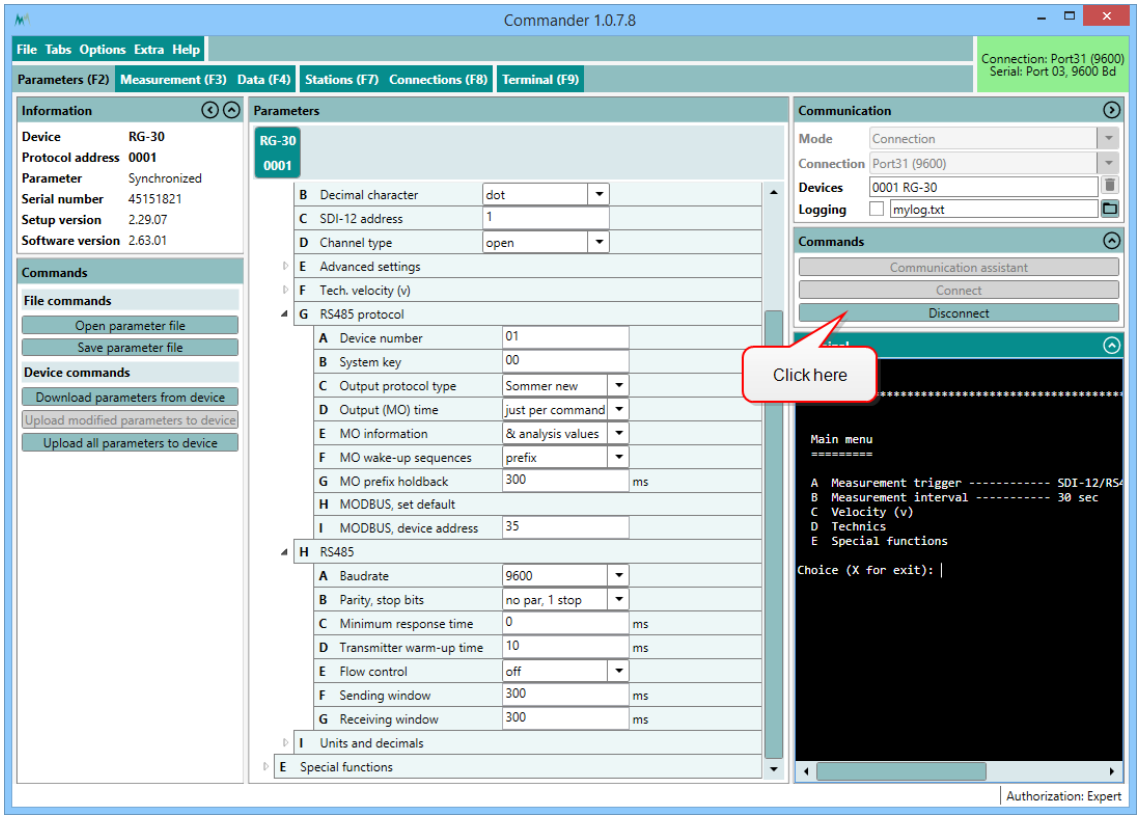
10. Acknowledge the safety-note.



11. After completion the following message will be displayed:



12. Enter X until you get back to the main menu. The Sommer-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

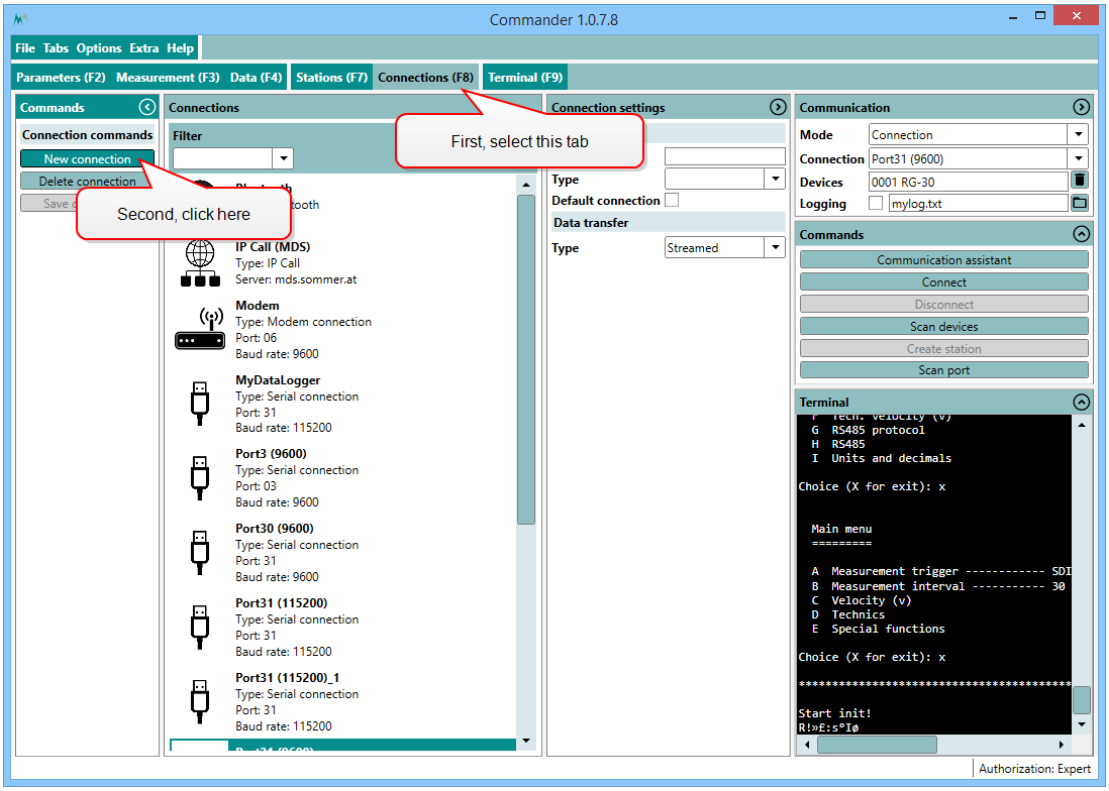
By switching communication to Modbus with MODBUS, set default the following parameters are changed:

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

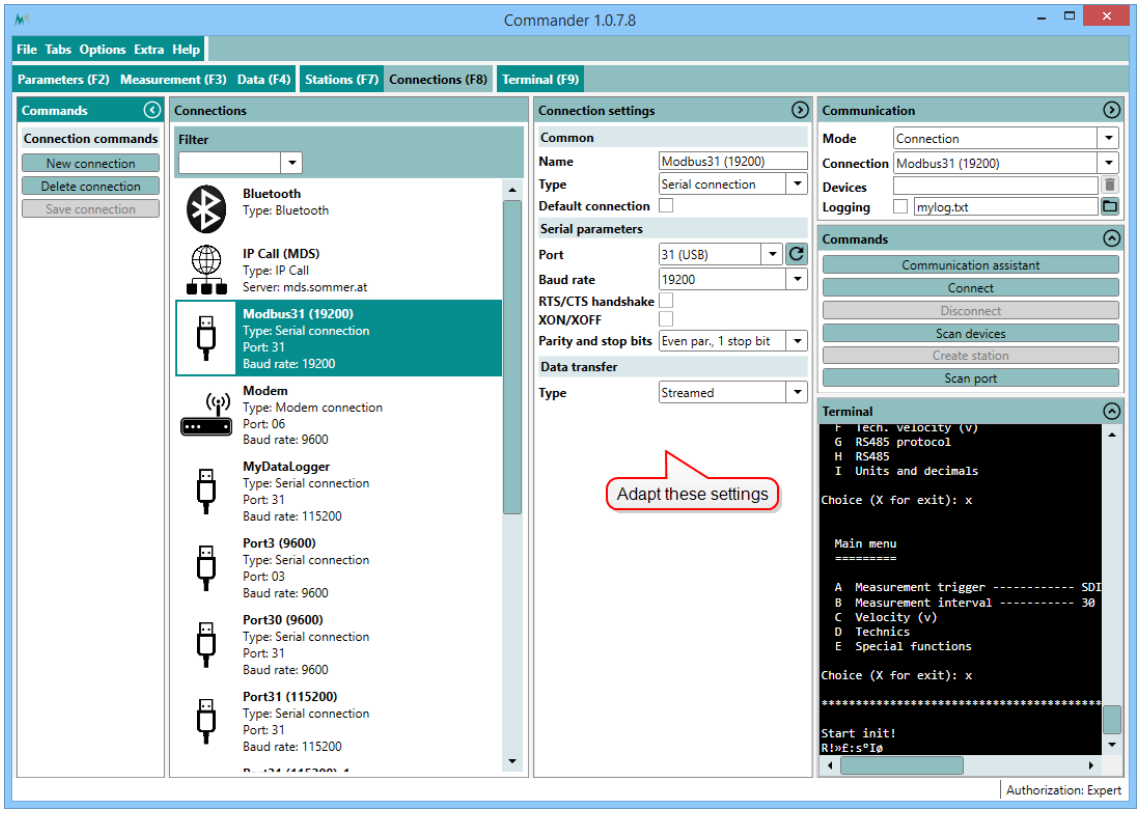
11.5.5 How do I switch back to Sommer protocol?

Follow the instructions below to change the data output back to Sommer-protocol:

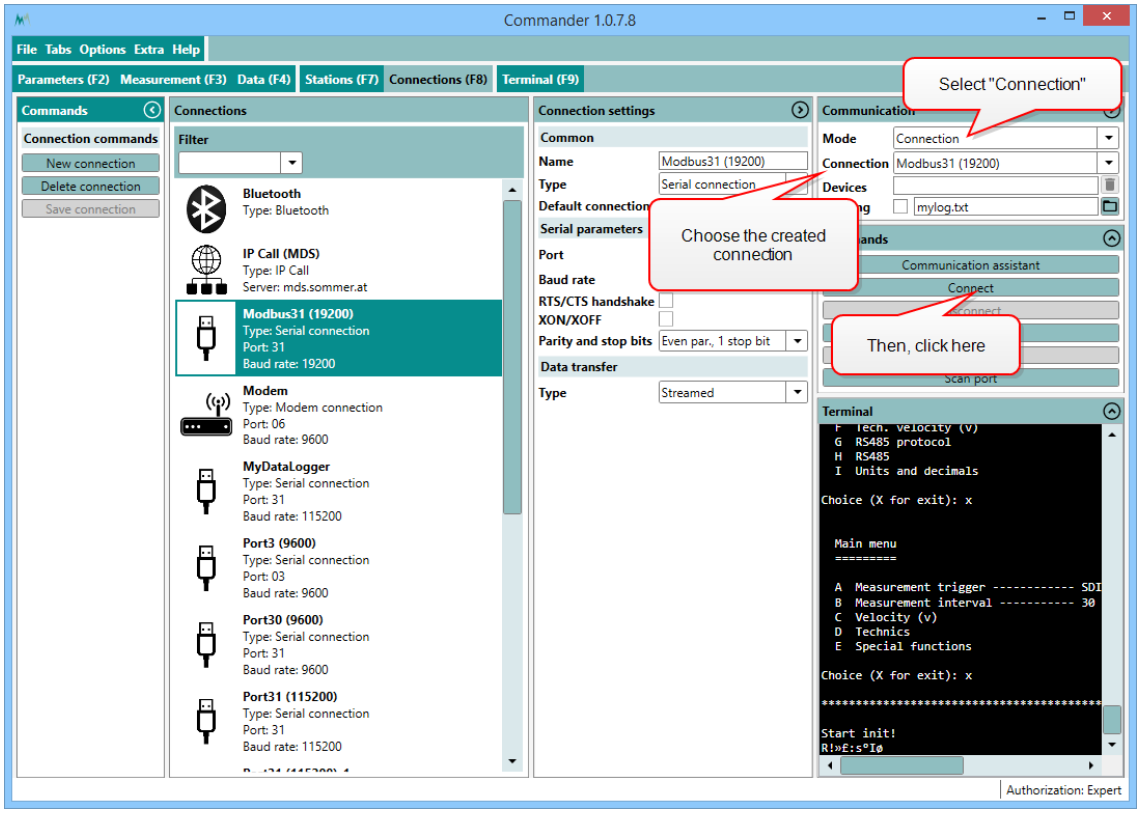
1. Open the Connections (F8) tab and click New connection.



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.

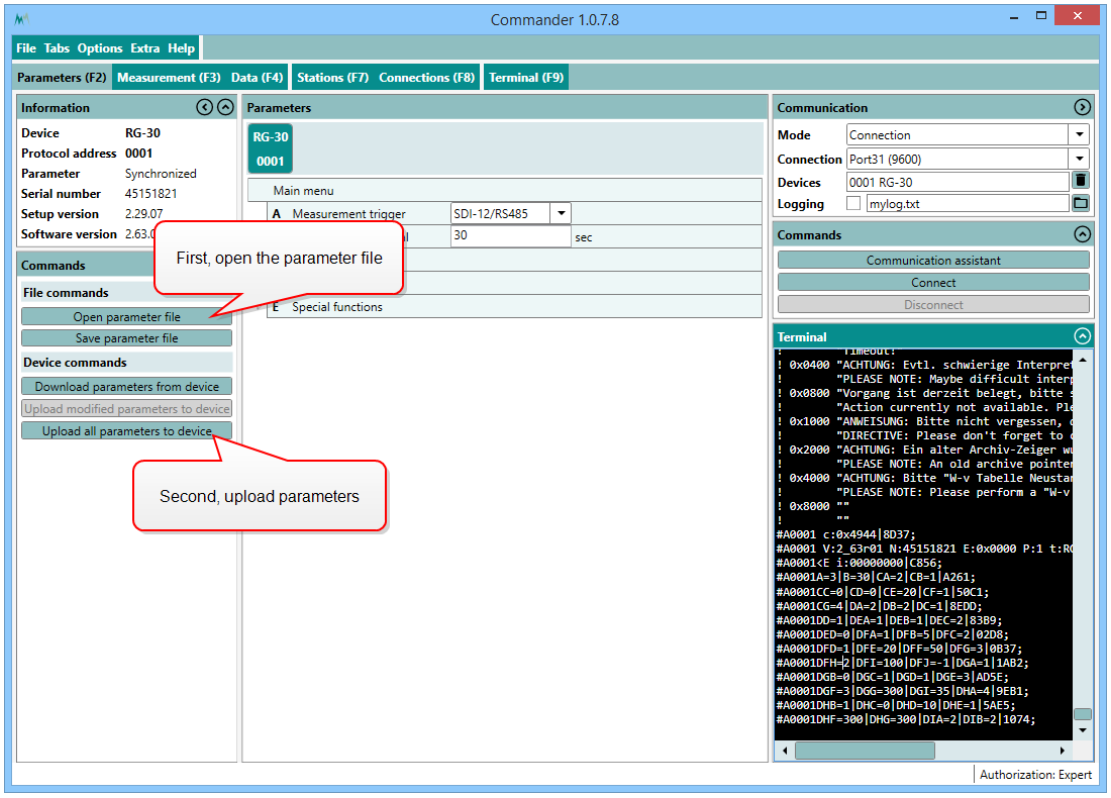


5. Download the parameters and save the parameter file as described in How do I configure it?.

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

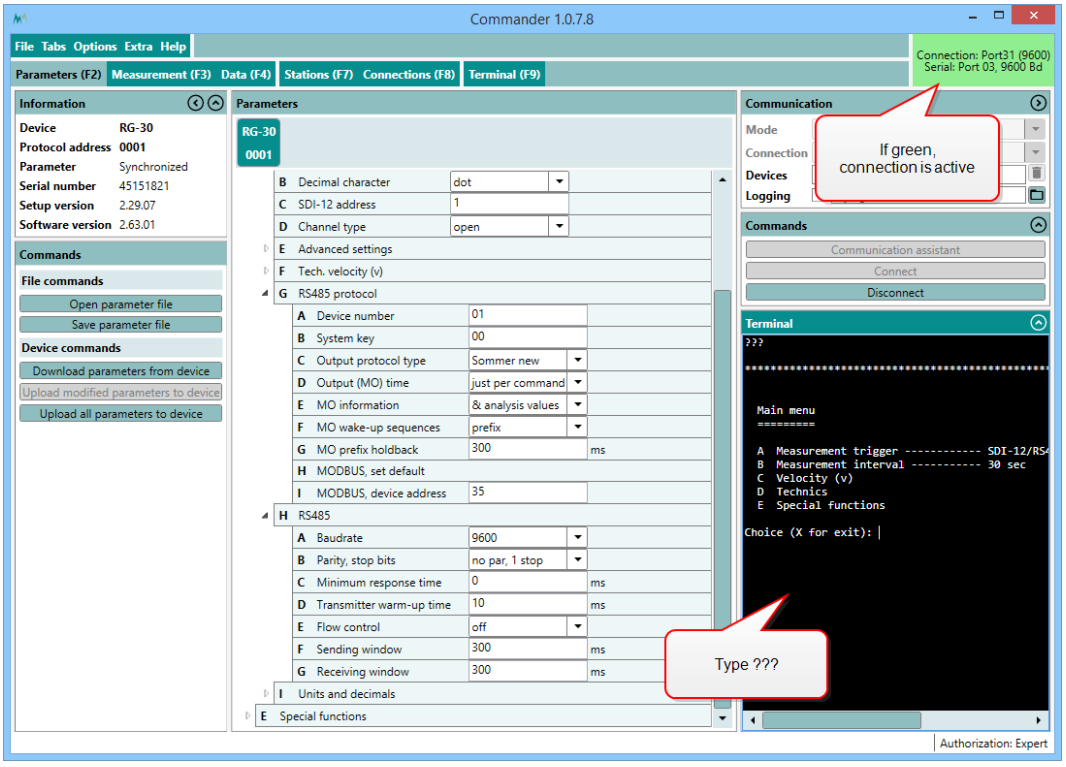
6. Now, two options are available to revert communication back to the Sommer-protocol:

A. If a parameter file is available that has the Sommer-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.

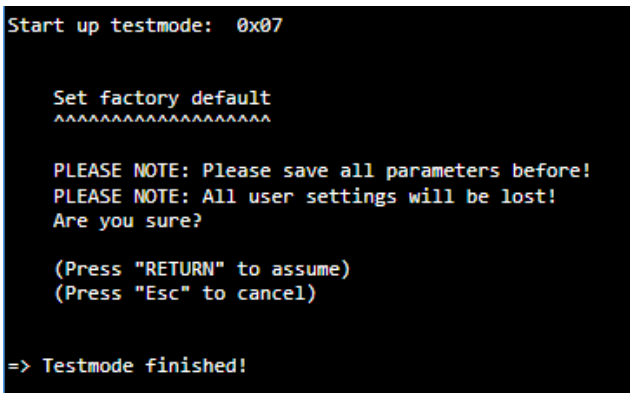


B. If no parameter file is available, the device has to be reset to its default configuration:

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-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-sensor as described in How do I configure it?.
8. Download the sensor's parameters in the Parameters (F2) tab, adapt the required parameters, or upload your originally saved parameter file to the RG-30.

11.5.6 Which commands are available?

Read measurement values

Measurement values are read from the registers of function 04 (read input registers, read only):

	Register address	Variable	Unit / value	Bytes	Format
Test value	0	Hard coded test value	2.7519...	4	float
Main values	2	not used		4	float
	4	not used			
	6	Velocity	[1]		
	8	Quality (SNR)	-		
	10	not used			
	12	not used			
Special values	14	not used		4	float
	16	not used			
	18	Opposite direction content	%		
	20	Supply voltage	V		

[1] Unit according to submenu Units and decimals.

	Register address	Variable	Unit / value	Bytes	Format
Analysis values	22	Peak width	mm/s	4	unsigned int
	24	CSR	%		
	26	Area of the peak	-		
	28	RMS at the PIC	mV		
	30	Amplification	-		
	32	Amplification relation	%		
	34	Signal relation	%		
	36	Error code	-		
	38	not used	-		
	40	not used	-		
	42	not used	-		
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 26: Function 04 Read input registers

Write single registers and read holding registers

Some RS-485 port settings can be written to the registers of function 06 (write single registers) or read from the registers of function 03 (read holding registers):

	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	0...1200 baud 1...2400 baud 2...4800 baud 3...9600 baud 4...19200 baud 5...38400 baud 6...57600 baud 7...115200 baud		
	3	RS-485 parity/ stop bits	0...no parity, 1 stop bit 1...no parity, 2 stop bits 2...even parity, 1 stop bit 3...odd parity, 1 stop bit		

Table 27: Function 06 and Function 03 to read and write configuration values

Report slave ID

The Modbus function 17 (report slave ID, read only) can be used to read basic information of the RG-30. The following example shows the response of function 17, 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[1] 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	

Table 28: Function 17 to report slave ID

1Protocol Data Unit

12 Analog output

12.1 What can I do with it?

Only available with RG-30a. Measurement values of flow velocity can be returned by analog 4…20 mA signals. These can be configured in 4-20 mA output IOUT3.

12.2 How do I wire it?

The analog outputs of the RG-30 can be connected to a data logger according to the figure below.

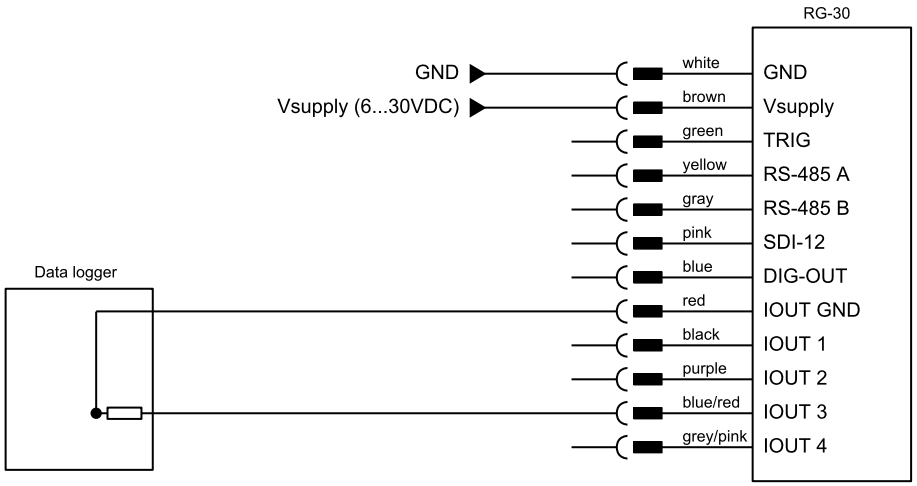


Figure 12 Wiring of analog outputs of the RG-30

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

12.3 How do I configure it?

The variables and their analog output range are configured in IOUT settings 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 val-

ues 99999998 and 99999997, which return a 3.8-mA and 3.7-mA signal, respectively.

WARNING 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.

12.3.1 IOUT3 – flow velocity

The analog output IOUT3 returns the water flow velocity. Only the maximum velocity at 20 mA has to be set; a velocity of zero is assumed at 4 mA.

If only uni-directional water flow is allowed (this option is set in Possible flow directions), the 4 mA signal corresponds to a velocity of 0 m/s. If two-directional flow is selected, a 12 mA signal corresponds to a velocity of 0 m/s. In this case the maximum negative velocity corresponds to 4 mA and the maximum positive velocity to 20 mA. See 12.3 for an illustration of these two situations.

12.3.2 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 with a connected data logger or multimeter. By pressing Return/Enter again the simulation stops.

13 Parameter definitions

A Measurement trigger

Measurements are initiated by one of the options listed in the table below.

The commands to trigger measurements via RS-485 and SDI-12 are described in Which commands are available? and Which commands are available?, respectively.

Measured data are either returned directly after the measurement or can be requested by commands via the RS-485 or SDI-12 interface. The format of the returned data can be configured in the sub-menu Output protocol (OP).

Option	Description
Interval (default)	Measurements are initiated in a specified interval.
TRIG input	Measurements are triggered by the positive edge of a DC-voltage signal applied to the TRIG input.
SDI-12/RS-485	Measurements are externally triggered by commands via the RS-485 or SDI-12 port.

B Measurement Interval

An internal measurement interval can be set for the RG-30. If selected in menu item Measurement trigger , measurements are performed in the defined interval. However, a measurement is always completed before a new one is initiated.

Unit	sec	seconds
Value range	1...18000	60 sec (default)

C Velocity (v)

C-A Viewing direction

This setting defines the viewing direction of the RG-30 sensor in relation to the flow direction of the river. The advantages of the different viewing directions are described in Installation requirements.

Option	Description
downstream	The RG-30 sensor is directed in flow direction.
upstream (default)	The RG-30 sensor is directed against the flow direction.

C-B Possible flow directions

Due to the direction separation (see Flow direction separation) the RG-30 sensor can identify the flow direction. Therefore it has to be defined if the river only flows in one direction or if bi-directional flow can occur as for example under tidal influence.

Option	Description
just downstream (default)	Only downstream flow is recorded.
two (tide)	Down- and upstream flow is recorded. Upstream flow is indicated by a negative sign.

C-C River inclination

The RG-30 sensor only measures its own vertical inclination. To compensate for the influence of a sloping river surface an additional correction can be set. It is either added or subtracted depending

on the flow direction. Generally, rivers do not show an appreciable inclination of the water surface. For the possible flow direction *two (tide)* an inclination of *0* has to be set.

Unit	Degree	
Value range	0...90	0 (default)

C-D Yaw angle

Usually the main water flow is perpendicular to the cross Section of a river and the RG-30 sensor is mounted in the same way. However, if the RG-30 sensor has to be rotated horizontally, the rotation angle can be considered for by adjusting this setting. To ensure a reliable and accurate velocity measurement it is recommended to select a yaw angle smaller than 30°.

Unit	Degree	
Value range	0...60	0 (default)

C-E Measurement duration

The measurement duration defines the duration of a single measurement. During this time the RG-30 signal is recorded and the velocity radar spectrum is analyzed. Usually measurement durations of about 60 s are recommended. It should be at least 10 s. A long measurement time increases power consumption.

Unit	Degree	
Value range	5...240	30 (default)

C-F Filter, no. of values

Every velocity measurement is stored internally in a buffer for filtering. This setting defines the number of measurement values in the buffer. If the buffer is full the oldest value is replaced by the most recently recorded value. The number of buffered values depends on the turbulence of the water surface. Highly turbulent rivers demand a small buffer, rivers or irrigation channels with low turbulence require a larger buffer.

Value range	1...120	1 (default) no filter is applied

C-G Filter, type

The velocity values in the buffer can be filtered by one of the following options:

Option	Description
moving average (default)	The mean value of all buffered values is calculated.
eliminate spikes	To eliminate spikes the mean value is calculated without the 5 highest and 5 lowest buffered values. If the buffer size is smaller than 15 two third of the values are eliminated.
minimum value	The smallest value from the buffer is returned.
median value	The median value of the buffered data is returned.

D Technics

D-A Language/Sprache

The menu language.

Option	Description
german/deutsch	German language
english/englisch (default)	English language

D-B Decimal character

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

Option	Description
comma	-
dot (default)	-

D-C SDI-12 address

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

Value Range	0…9, a…z, A…Z	0 (default)

D-D Channel type

This parameter specifies the type of flow channel where the RG-30 sensor is installed. The selection determines how the flow velocity is calculated from the velocity spectrum (see Unwanted reflections for details). One of the following options can be selected:

Option	Description
open	Open flow channel.
covered (default)	Closed or covered flow channel, e.g. discharge pipe.

D-E Advanced settings

D-E-A Reset behavior

The RG-30 keeps certain sensor data in its memory, e.g. the measured data for calculation of the moving average. This setting defines whether the acquired sensor data are deleted upon a sensor reset or not.

Option	Description
hard reset	A reset deletes all acquired and stored sensor data.
soft reset (default)	All acquired and stored sensor data are kept for measurements and calculations.

NOTE During the installation a hard reset is recommended. After finishing the installation a soft reset should be selected. This shortens start-up time.

D-E-B Inclination measurement

The measurement of the flow velocity has to be corrected for the inclination of the RG-30 sensor as described in Inclination angle measurement. The following angle corrections are available:

Option	Description
first measurement (default)	The inclination is only measured prior to the first measurement after the initialization process (after powering up and after parameter updates)
every measurement	The inclination is measured during each velocity measurement.

WARNING If the inclination of the RG-30 sensor can change, i.e. if mounted on a cable way, the inclination should be measured along each velocity measurement.

D-E-C Sleep mode

Defines the behavior of the RG-30 between two measurements, provided the measurement interval is longer than the time of the measurement itself. The following options are available:

Option	Description
MODBUS, fast	For MODBUS applications. The RG-30 stays in normal mode. This option permits high data transmission rates, but increases power consumption.
MODBUS, slow	For MODBUS applications. The RG-30 goes into idle mode and can be woken up by a command via the RS-485 interface. This option reduces power consumption at lower data transmission rates.
Standard (default)	The RG-30 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-E-D 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 RG-30 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-F Tech. velocity (v)

This submenu contains the technical parameters for the velocity measurement.

D-F-A Minimum velocity

The minimum velocity defines the lower limit for the velocity determination by spectral analysis.

Unit	m/s	
Value range	0...1.5	0.1 (default)

D-F-B Maximum velocity

The maximum velocity defines the upper limit of expected velocities. The velocity measurement is optimized for this setting. Usually a value of 5000 mm/s (5 m/s) is adequate. No extra margin has to be accounted for as this is included in the RG-30 sensor by default.

Unit	m/s	
Value range	0.000...99'999.999	5 (default)

D-F-C Meas. spot optimization

Inactive if parameter Channel type Channel type is set to covered.This parameter describes the expected flow velocity distribution within the measurement spot as illustrated in Figure 13. For a more heterogeneous flow distribution a wider spectral band width has to be selected. The options are as follows:

Option	Description
very constant veloc.	homogenous water surface, small bandwidth
standard (default)	heterogeneous water surface, wide bandwidth
bank area	heterogeneous water surface with very different velocities, very wide bandwidth
splash water	Splashing water surface, full bandwidth

For the initial measurements at a new site the option *standard* is recommended. Later on the measurement may be improved by selecting another optimization option.

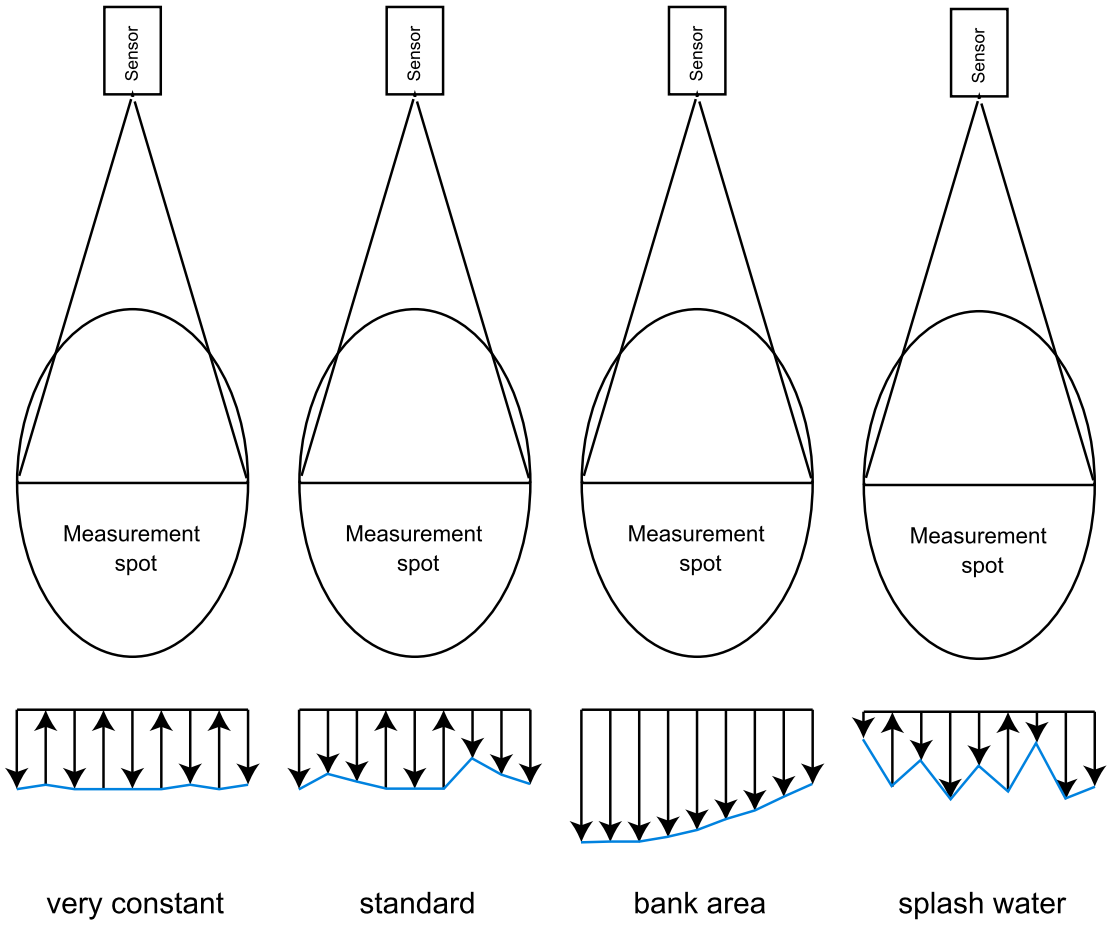


Figure 13 Measurement spot optimization concepts

D-F-D Measurement type

The flow velocity can be measured by two different methods:

Option	Description
continuous (default)	The measurement is performed in one piece.
sequenced	The measurement is split into five parts.

Continuous measurement type

The flow velocity measurement is performed continuously in one piece. This has the advantage of a fast measurement with little energy consumption. However, for highly fluctuating velocities the measurement time has to be increased considerably to gain accurate results.

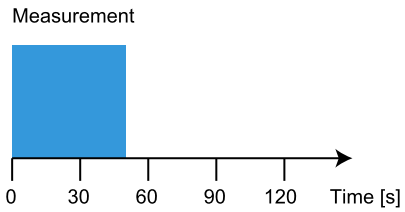


Figure 14 Continuous measurement type

Sequenced measurement type

The flow velocity measurement is divided into five sub-intervals of random length summing up to the specified measurement duration. This increases the complete measurement duration without increasing energy consumption. Thus, this method provides more accurate results for highly fluctuating velocities.

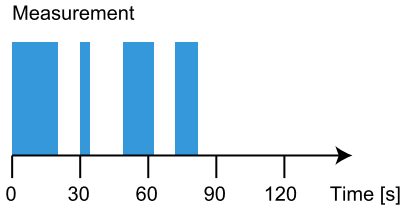


Figure 15 Sequenced measurement type

D-F-E Stop, min. quality (SNR)

This parameter defines the lower limit of the quality value, expressed by SNR. Flow velocities below this quality value are identified as invalid. Invalid measurements are handled according to the behavior set in Stop, behavior. A measurement with a low SNR occurs if the velocity is below the detection limit. It is recommended to set this parameter at measurement sites with tidal influence or with back-water and where the velocity can drop to zero.

Unit	-	
Value range	7...100	30 (default)

D-F-F Stop, max. opp. direction

The opposite direction content is the fraction of counter-flow in measurement direction. The parameter defines an upper limit for counter-flow, above which measurements are identified as invalid. Invalid measurements are handled according to the behavior set in Stop, behavior.

Unit	%	
Value range	10...1000	
Application range	30...100	200 (default)

D-F-G Stop, number of valid meas.

After an invalid measurement has occurred the selected number of valid measurements has to be re-turned before the measurements are tagged as valid again.

Value range	1...20	3 (default)

D-F-H Stop, behavior

This parameter defines the handling of invalid measurements. The following options can be set:

Option	Description
hold value	The last valid value is returned.
use replace value (default)	The replacement value set in Stop, replace value is returned.
use learn value	The learned value according to the water level of the W-v relation is returned.

D-F-I Stop, replace value

An invalid measurement is replaced by this value if option 2 in Stop, behavior is selected.

Unit	m/s	
Value range	-9.999...9.999	0 (default)

D-F-J Meas. spot weighting

Weighting factor used to adjust the flow velocity measurement to specific wave characteristics. For most applications the default of zero is applicable. Positive values reduce the flow velocity, negative values increase the velocity. For a river with a rough water surface, a value of 17 may be applied.

Unit	-	
Value range	-100...100	0 (default)

13.4.7 4-20 mA output IOUT3

D-G-A Status

The status defines the behavior of the analog outputs.

Option	Description
off (default)	Analog outputs are inactive.
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.
always on	Analog outputs are permanently active.

D-G-B IOUT3, Max. velocity

The maximum velocity that corresponds to the 20 mA current output. The 4 mA output is predefined to correspond to a velocity of 0.

Unit	Unit of velocity (V)	
Value range	-99'999.99...999'999.99	10 (default)

D-G-C Simulate current output

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

D-H RS-485 Protocol

D-H-A Device number

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

Value range	0...98	1 (default)

D-H-B 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	0...99	0 (default)

D-H-C Output protocol (OP)

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

Option	Description
Sommer new (default)	Sommer new protocol; data values are returned with an index starting at 1
Standard	Standard protocol; data values are returned without an index
compat. RQ-24 (A)	MIO protocol with checksum (comp. RQ-24)

Option	Description
compat. RQ-24 (B)	MIO protocol with CRC-16 (comp. RQ-24)
compat. RQ-24 (C)	Standard protocol (comp. RQ-24)
MODBUS	Modbus protocol
Sommer old	Sommer old protocol, data values are returned with an index starting at 0

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

D-H-D OP, measurement output

Specifies the timing of the serial data output.

Option	Description
just per command	The output is only requested by commands via the RS-485 or SDI-12 interface.
after measurement (default)	The serial data output is performed automatically right after each measurement.
pos. TRIG slope	The output is triggered by a positive edge of a control signal applied to the trigger input.

D-H-E OP, information

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

Option	Description
main values	Only the main values are returned.
& special values (default)	Main values and special values are returned.
& analysis values	Main, special and analysis values are returned.

D-H-F OP, 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 RG-30 has the option to send a sync sequence and a prefix before data are transmitted (see How do I configure it?). The following options are available:

Option	Description
off	No wake-up sequence
sync	The sync sequence UU~?~? is sent before the output string.
prefi (default)	A blank with a time delay is sent before the output string.
prefix & sync	A blank with a time delay and the sync sequence UU~?~? is sent before the output string.

D-H-G OP, prefix holdback

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

Unit	ms	Milliseconds
Value range	0…5'000	300 (default)

D-H-H MODBUS, set default

Only available in terminal mode. The Modbus protocol demands a defined setting, including multiple parameters. This command sets all these parameters automatically (see Modbus).

D-H-I MODBUS, device address

Unique device address for the Modbus protocol.

Value range	1…247	35 (default)

D-I RS-485 Port

D-I-A Baud rate

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

1'200
2'400
4'800
9'600 (default)
19'200
38'400
57'600
115'200

D-I-B Parity, stop bits

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

Option	Description
no par, 1 stop (default)	No parity and 1 stop bit
no par, 2 stop	No parity and 2 stop bits
even par, 1 stop	Even parity and 1 stop bit
odd par, 1 stop	Odd parity and 1 stop bit

D-I-C Minimum response time

Setting of this parameter avoids interference of communication at the RS-485 interface. For this purpose the response to a command is delayed by the selected time. Additionally, the response is kept compact.

Unit	ms	Milliseconds
Value range	0...2'000	10 (default)

D-I-D Transmitter warm-up time

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

Unit	ms	Milliseconds
Value range	0...2'000	10 (default)

D-I-E Flow control

The XOFF-XON flow control can be activated with this setting.

Option	Description
Off (default)	no flow control
XOFF-XON blocking	XOFF-XON flow control, especially adapted for half-duplex systems

WARNING In spectrum mode (View spectral distribution) set Flow control to *XOFF-XON blocking* to be able to return to normal mode again at any time.

D-I-F Sending window

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

Unit	ms	Milliseconds
Value range	200...5'000	300 (default)

D-I-G Receiving window

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

D-J Units and decimals

D-J-A Velocity, unit

The following units of the flow velocity can be selected:

Option	Description
mm/s	Millimeter per second
m/s (default)	Meter per second
km/h	Kilometer per hour
ft/s	Feet per second
in/s	Inch per second
mph	Miles per hour
kn	Knots

D-J-B Velocity decimals

The following units of the flow velocity can be selected:

Value range	0...6	3 (default)

E Special functions

E-A View spectral distribution

With this command the integrated velocity radar sensor is set into spectral mode. After each measurement a table containing the spectral velocity distribution for both movement directions is returned. The spectral mode is automatically switched off after 30 minutes. With the software Commander the spectra can be recorded, visualized and stored for expert analysis of the flow velocity signals (see How does the RG-30 work? and Unwanted reflections for details).

E-B Veloc. radar inspection

Diagnostic tool for in-depth device analysis. Inactive, for in-house use only.

E-C Continuous meas. mode (temp).

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

E-D View spectral trap

For expert use only! Inactive in the Commander menu.

The integrated velocity radar sensor has the option to save the spectra of special events. This command returns these spectra. One output contains four spectra.

Index	Option	Description
1	Stop	Spectrum of the last invalid measurement caused by a Stop event.
2	Reference	Spectrum of the measurement performed before the last event.
3	Trap	Spectrum of the measurement of the last event with the velocity increase according to menu item Spectral trap, veloc. rise.
4	Normal	Actual spectrum

E-E View setup

All parameters of the RG-30 are listed in the terminal window.

E-F Device status

Displays information about the sensor and the software version.

E-G Set factory default

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

E-H Temp. load factory default

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

E-I Relaunch program

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

E-J Replace program

The sensor is set into a "Boot Loader" mode for three minutes to upload new software.

Appendix A Unwanted reflections

A.1 Open channel

Depending on the dimensions of the water channel in which the RG-30 sensor is installed in, unwanted reflections may occur and distort the velocity spectrum. Such reflections can be detected by looking at a recorded velocity spectrum as shown in the following example:

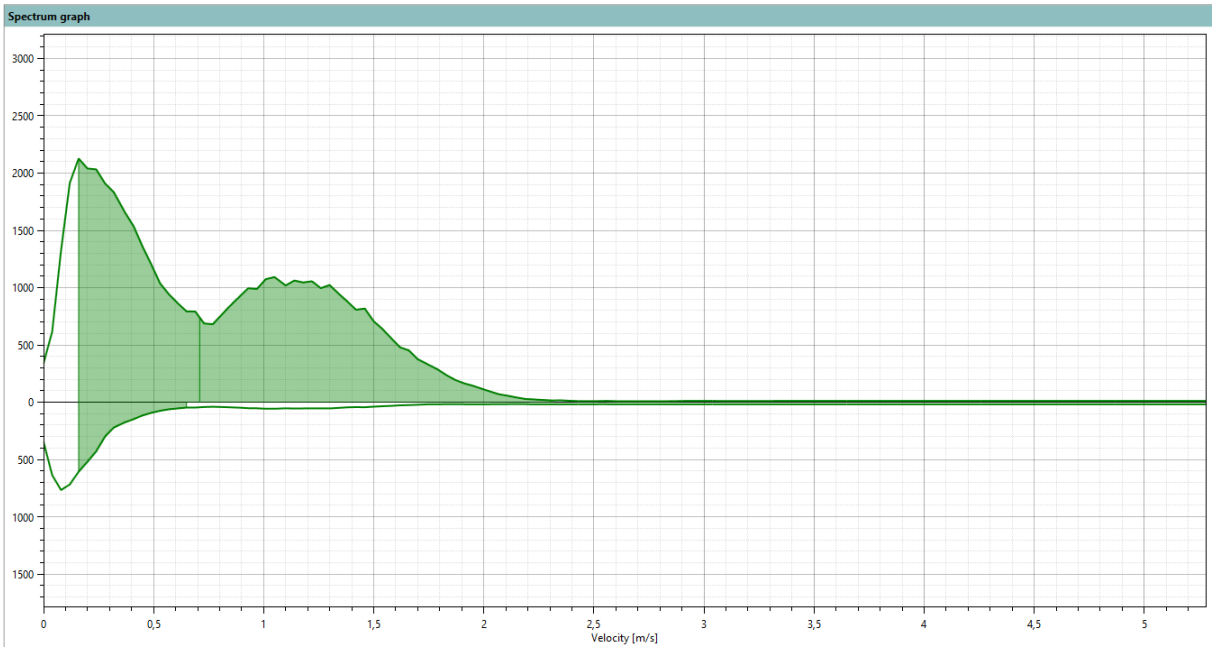


Figure 1 Velocity spectrum containing unwanted reflections

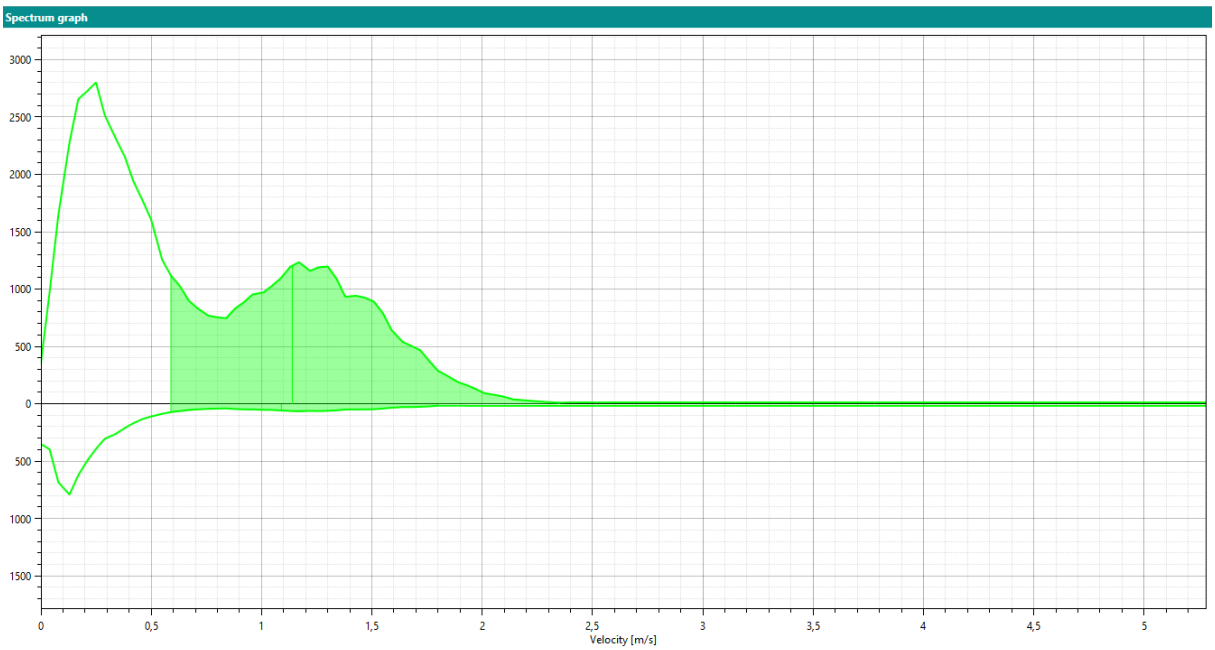


Figure 2 Velocity spectrum with adjusted minimum velocity

In the spectrum of Figure 1 two peaks can be observed: The first at approximately 0.15 m/s and the second at approx. 1.2 m/s. The shaded area is considered by the implemented algorithm to calculate the flow velocity. In this example the sensor determined a velocity of 0.71 m/s.

A second, independent measurement at the site revealed a flow velocity of 1.1 … 1.2 m/s. The discrepancy between these two results can be attributed to reflections on the channel wall, which caused a secondary peak in the spectrum at 0.15 m/s.

This means the first peak in the spectrum (at 0.15 m/s) is caused by an unwanted reflection in the channel where the RG-30 is installed. The result is that the algorithm implemented in the RG-30 is not able to determine the correct velocity. Due to the low velocity of the first peak the determined (and output-ted) velocity is lower than the real velocity:

To suppress this undesired behavior the setting Minimum velocity has to be set to a velocity higher than that of the first peak. Figure 2 shows the result of this procedure: The first peak is not shaded anymore, meaning it is not considered for the velocity calculation. Only the second peak is used by the algorithm and the calculated flow velocity of 1.15 m/s is in agreement with the velocity of the comparison measurement.

A.2 Closed channel

The example described above is valid for open channels only. If the RG-30 sensor is applied in a closed channel and the configuration Channel type is set to closed the first peak in the velocity spectrum is ignored. This peak results from reflections at the channel wall is removed before the velocity calculation.

Glossary

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

SDI-12
: Asynchronous serial communications protocol for intelligent sensors (Serial Digital Interface at 1200 baud)

Index