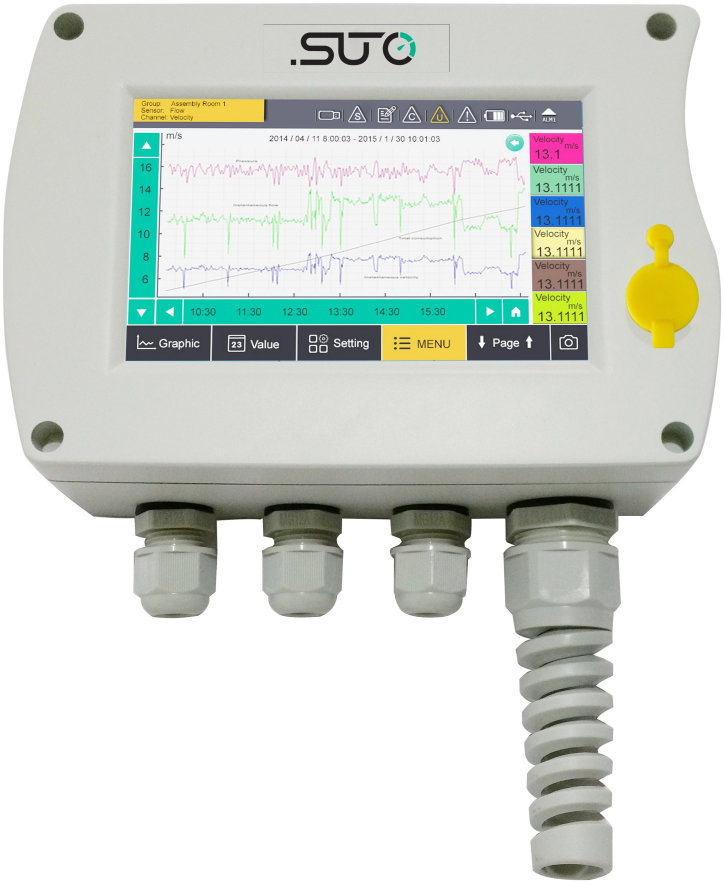
English

Instruction and operation manual

S 330 / 331

Display and data logger



Dear Customer,

thank you for choosing our product.

The operating instructions must be read in full and carefully observed before starting up the device. The manufacturer cannot be held liable for any damage which occurs as a result of non-observance or non-compliance with this manual.

Should the device be tampered with in any manner other than a procedure which is described and specified in the manual, the warranty is cancelled and the manufacturer is exempt from liability.

The device is destined exclusively for the described application.

SUTO offers no guarantee for the suitability for any other purpose. SUTO is also not liable for consequential damage resulting from the delivery, capability or use of this device.

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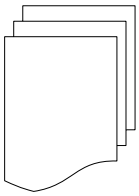
1. Safety instructions



Please check if this instruction manual accords to the product type.

Please observe all notes and instructions indicated in this manual. It contains essential information which have to be observed before and during installation, operation and maintenance. Therefore this instruction manual has to be read carefully by the technician as well as by the responsible user / qualified personnel.

This instruction manual has to be available at the operation site of the display and data logger at any time. In case of any obscurities or questions, regarding this manual or the product, please contact the manufacturer.

WARNING!

Compressed air!

Any contact with quickly escaping air or bursting parts of the compressed air system can lead to serious injuries or even death!

- Only use pressure tight installation material.
- Avoid that persons get hit escaping air or bursting parts of the instrument.
- The system must be pressureless during maintenance work.

WARNING!

Voltage used for supply!

Any contact with energized parts of the product, may lead to a electrical shock which can lead to serious injuries or even death!

- Consider all regulations for electrical installations.
- The system must be disconnected from any power supply during maintenance work.
- Any electrical work on the system is only allowed by authorized qualified personal.

WARNING!

Permitted operating parameters!

Observe the permitted operating parameters, any operation exceeding this parameters can lead to malfunctions and may lead to damage on the instrument or the system.

- Do not exceed the permitted operating parameters.
- Make sure the product is operated in its permitted limitations.
- Do not exceed or undercut the permitted storage and operation temperature and pressure.
- The product should be maintained and calibrated frequently, at least annually.

General safety instructions

- It is not allowed to use the product in explosive areas.
- Please observe the national regulations before/during installation and operation.

Remarks

- It is not allowed to disassemble the product.

ATTENTION!

Measurement values can be affected by malfunction!

The product must be installed properly and frequently maintained, otherwise it may lead to wrong measurement values, which can lead to wrong results.

Storage and transportation

- Make sure that the transportation temperature of the display and data logger is between -20°C... 60°C.
- For transportation it is recommended to use the packaging which comes with the display.
- Please make sure that the storage temperature of the display is between -10°C... 50°C.
- Avoid direct UV and solar radiation during storage.
- For the storage the humidity has to be <90%, no condensation.

2. Application

The universal display and data logger can display and record all relevant parameters (flow, dew point, pressure, temperature, power consumption, compressor status etc.) in a compressed air system.

The S 330 / 331 display and data logger is not developed to be used in explosive areas. For the use in explosive areas please contact the manufacturer.

The S 330 / 331 display and data logger is mainly used in compressed air systems in industrial environment.

3. Features

- High resolution 5” colour touch screen interface.
- All SUTO sensors are connectable as well as third party types.
- Up to 16 sensor inputs
- 2 wall casings available:
  - 4 cable glands
  - 7 cable glands
- USB interface for data transfer to data stick or PC.
- RS-485 (Modbus / RTU, SUTO-Bus) and Ethernet (Modbus / TCP, SUTO-Bus) interface to factory automation system.
- 10 W sensor power supply (24 VDC).
- Data logger option: 100 million values.
- Alarm monitoring with two relay outputs.
- Integrated web server for remote monitoring.
- Various options for system extension.

4. Technical Data

4.1 General

CE	
Data logger (only S 331)	Internal, 100 million values
Operating temperature	0°C... 50°C
Housing material	PC + ABS
Protection class	IP 65
Dimensions	See dimensional drawing on the next page
Display	5” high resolution graphic display, 800 x 480 pixels with touch interface
Cable entry	4.5 mm … 8 mm
Cable	Supply: AWG12 ... AWG24, 0.2 ... 2.5 mm²; Signals: AWG16 ... AWG28, 0.14 ... 1.5 mm²
Weight	0.52 kg

4.2 Electrical Data

Power supply	100... 240 VAC, 20 VA (option A1663) 18... 30 VDC, 20 W (option A1664)
Sensor supply	24 V, 10 W

4.3 Input-Signals

Digital input	2 x SDI Sensors 16 x RS-485 Modbus RTU Sensors
Analog input	2 x 0... 20 mA / 4... 20 mA / 0... 10V, 2 x pulse
Pulse input	100 Hz max;10.5 V, 21 mA

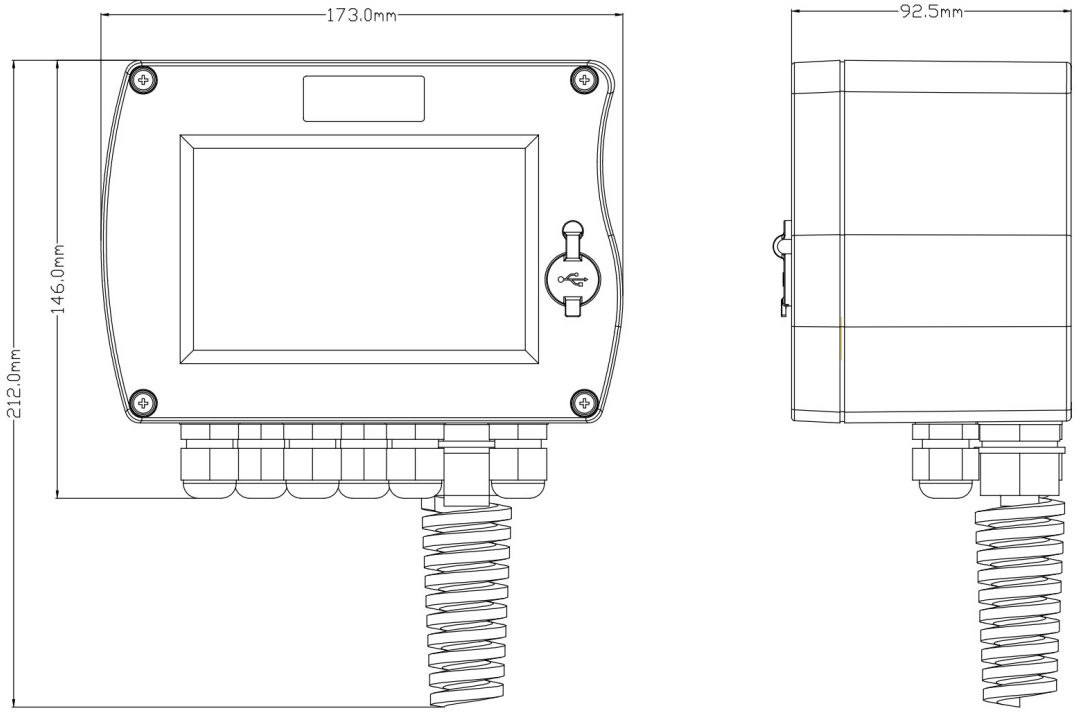
4.4 Output-Signals

Analog / Pulse output	4... 20 mA signals and pulse signal of sensors can be looped through the display by using the connection board
Alarm output	2 relays, 230 VAC, 3 A, NC

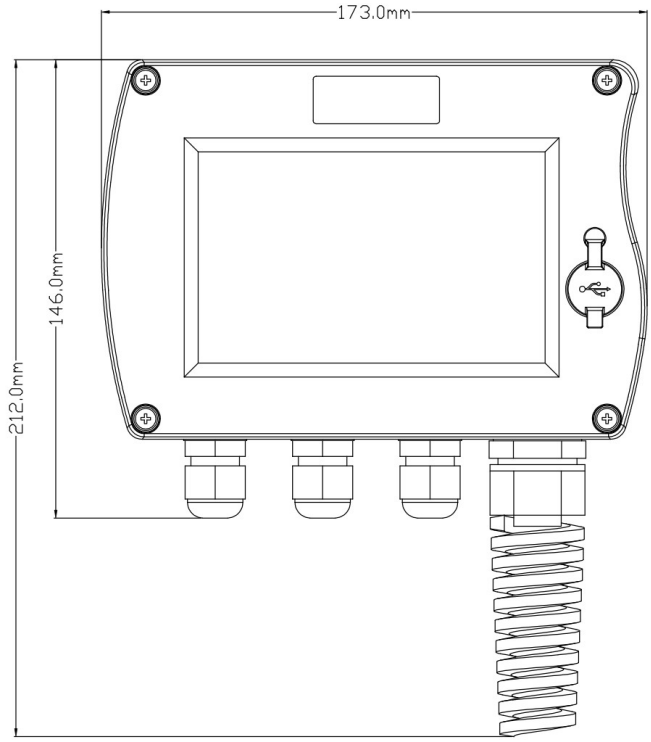
Interface	Ethernet / RS-485 Modbus TCP / RTU, USB stick, USB cable

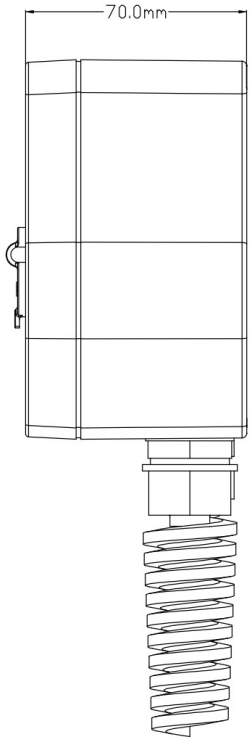
5. Dimensional drawing

Panel with wall mountable casing (7 glands):

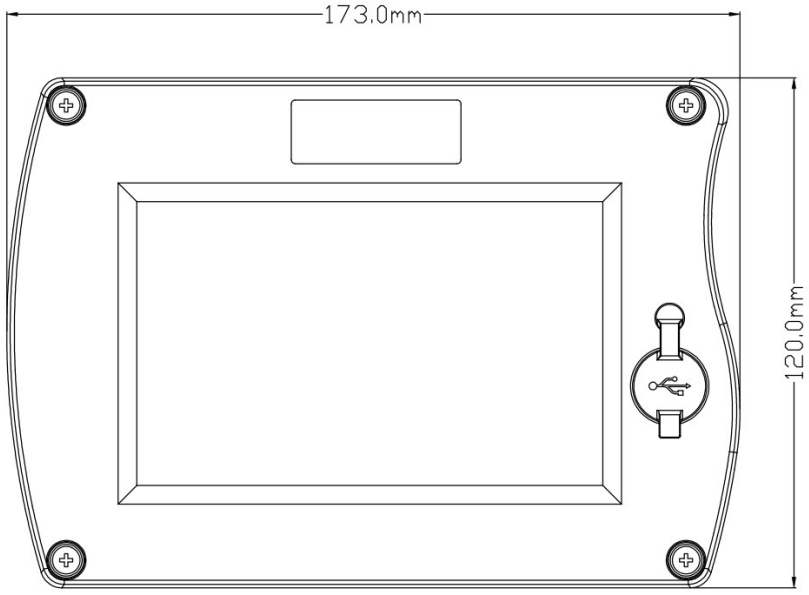


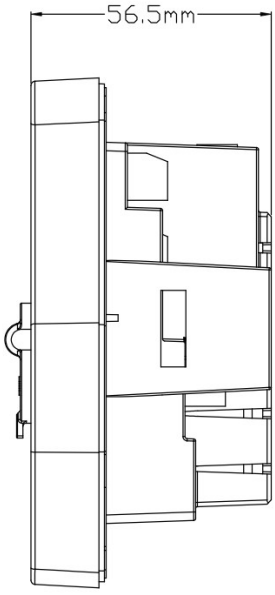
Panel with wall mountable casing (4 glands):



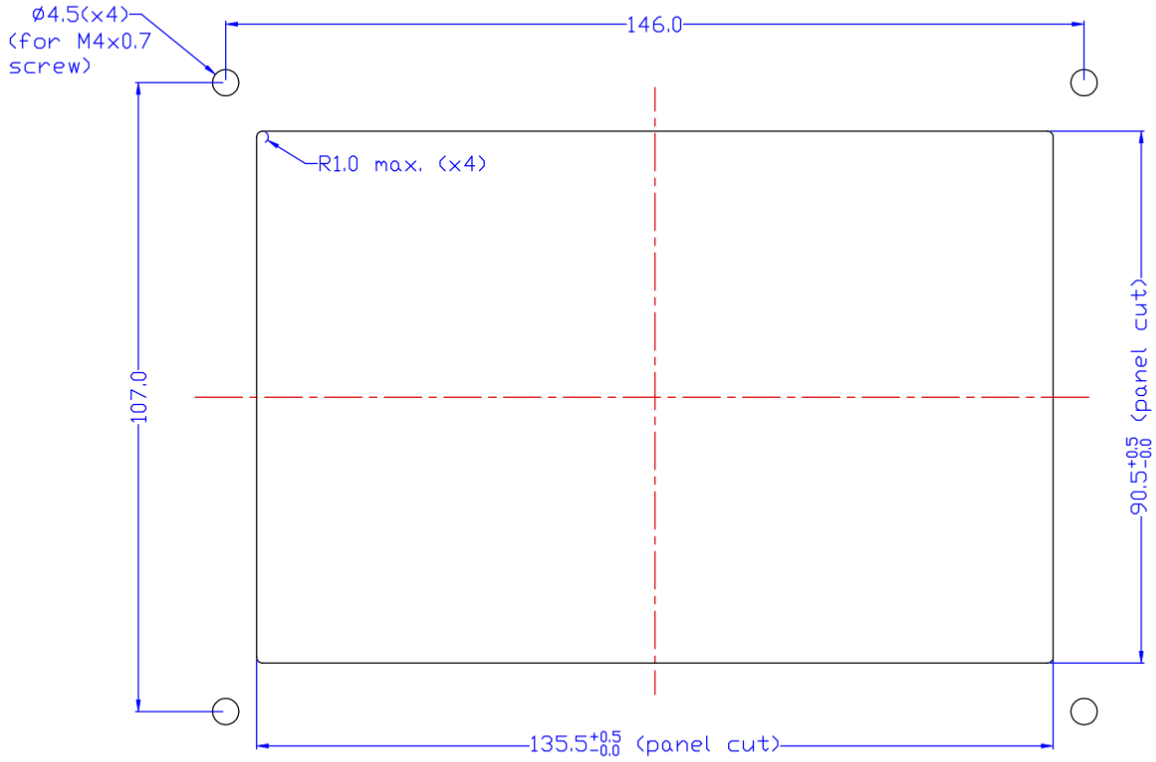


Panel:



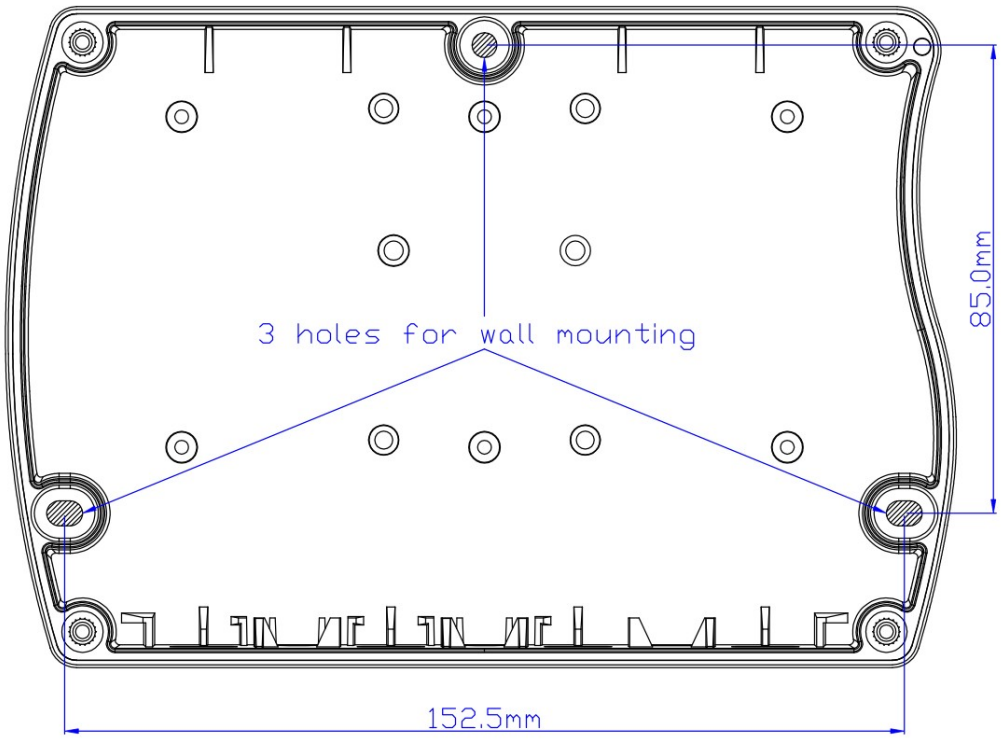


Panel cut size:



S 330/331 panel cut size

Wall mount instruction:



6. Installation

Please make sure that all components listed below are included in your package.

Qty	Description	Item No.
1	S 330 or S 331 Panel with ordered options and if ordered with casing	D500 0333/ D500 0331
1	USB A to USB micro cable	A553 0130
1	Instruction manual	No P/N

6.1 Installation Requirements

The instrument can either be mounted into a panel or if ordered with the optional wall casing on a wall. Please observe the drawings in chapter 5 for details. The housing of the S 330 / 331 must be fixed on the wall using suitable dowels and screws.

ATTENTION!

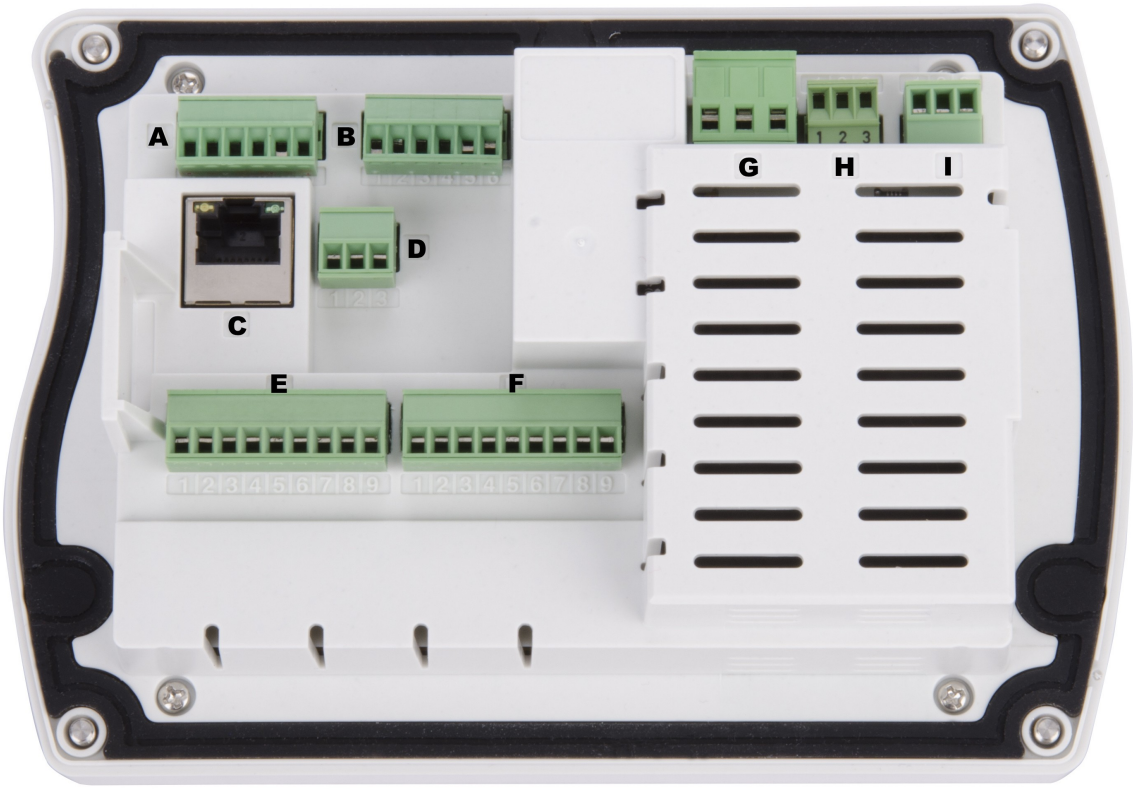
Wrong measurement is possible, if the display is not installed correctly.

- The sensor is for indoor use only! At an outdoor installation, the sensor must be protected from solar radiation and rain.
- It is strongly recommend not to install S 330 / 331 permanently in wet environment as it exists usually right after a compressor outlet.

6.2 Electrical connection

Terminal block layout at back side

The following diagram is the terminal block layout at the S 330 / 331 back side.



A : Input for digital sensor

B : Input for digital sensor

C : Ethernet

D : RS-485

E : Analog sensor (optional A 1662)

F : Analog sensor (optional A 1662)

G : Power supply

H : Relay output

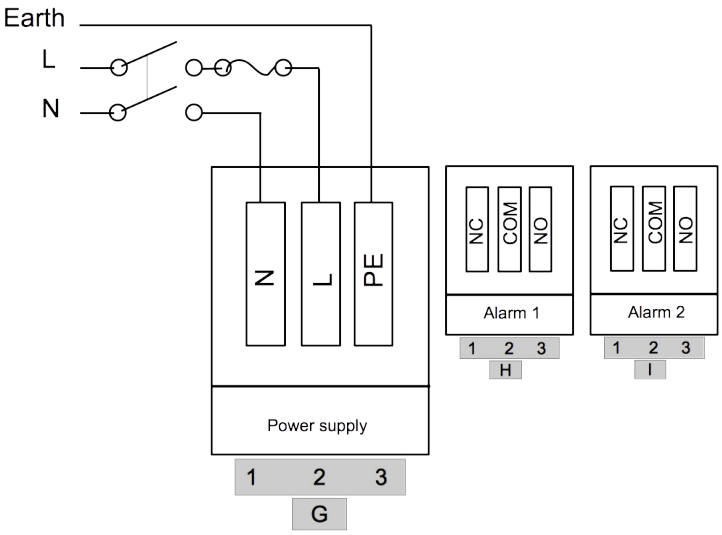
I : Relay output

Remark

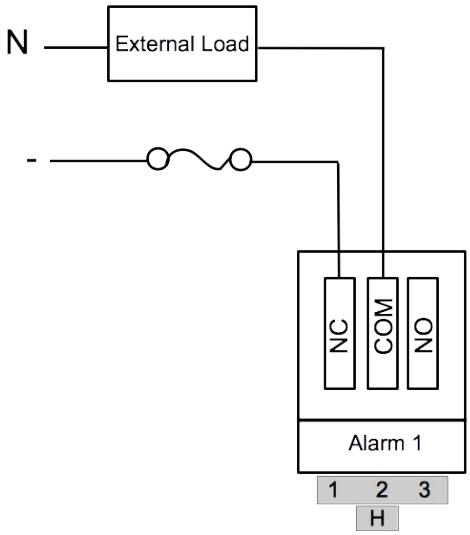
Depending on the selected options, not all terminals are available.

6.2.1 AC Power supply and alarm connection (A1663)

AC power connection

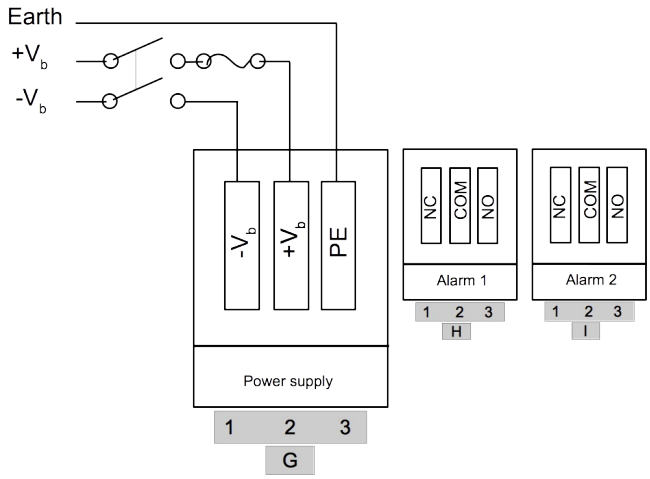


Alarm connection

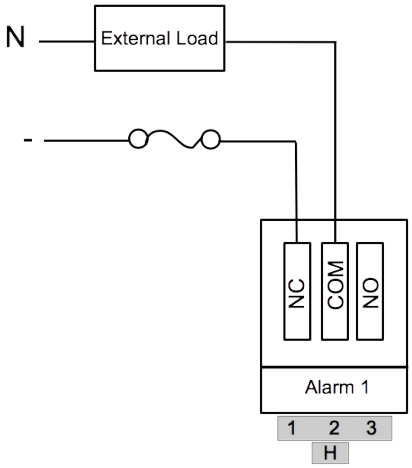


6.2.2 DC Power supply and alarm connection (A1664)

DC power connection



Alarm connection



6.2.3 Terminal signals of SDI and Modbus sensor input

Terminal	Pin	Signal	Description
A	1	SDI	Digital communication signal from sensor
	2	$-V_b$	Negative sensor supply
	3	$+V_b$	Positive sensor supply
	4	+D	Modbus sensor input
	5	-D	Modbus sensor input
	6	GND	GND for Modbus sensor communication
B	1	SDI	Digital communication signal from sensor
	2	$-V_b$	Negative sensor supply
	3	$+V_b$	Positive sensor supply
	4	+D	Modbus sensor input
	5	-D	Modbus sensor input
	6	GND	GND for Modbus sensor communication

The Modbus inputs have pull up / pull down resistors permanently connected, while terminal resistor is software controlled. It can be enable/disable through the display "communication" menu. RS-485 require a termination resistor at both far ends of the network. Please set it up correctly. In total up to 8 slaves can be connected to the 2 Modbus inputs.

ATTENTION!

Always connect earth connection!

When earth connection is missing, conductive components may carry supply voltage. Touching of such parts leads to an electrical shock which can lead to serious injuries or even death!

6.2.4 Terminal signals of Modbus slave

Terminal	Pin	Signal	Description
D	1	+D	Modbus output
	2	-D	Modbus output
	3	GND	GND for Modbus sensor communication

6.2.5 Connection of sensors to terminal A+B (via SDI) S 401 / S 430

S 330 / 331			S 400 / 420 / 430	S 450 / 452	S 201	S 220 / 212	S 215	Colour
Terminal	**Pin**	**Signal**	**Pin**	**Pin**	**Pin**	**Pin**	**Pin**	
A	1	SDI	A.1	4	A.1	1	1	brown
	2	$-V_b$	A.2	3	A.2	2	2	white
	3	$+V_b$	A.3	2	A.3	3	3	blue
B	1	SDI	A.1	4	A.1	1	1	brown
	2	$-V_b$	A.2	3	A.2	2	2	white
	3	$+V_b$	A.3	2	A.3	3	3	blue

6.2.6 Connection of sensors to terminal A+B (via Modbus) S 401 / S 430

S 330 / 331			S 220	S 430	S 120	Colour
Terminal	**Pin**	**Signal**	**Pin**	**Pin**	**Pin**	
A	2	$-V_b$	A.2	B.2	A.2 / B.2	white
	3	$+V_b$	A.3	B.3	A.3 / B.3	blue
	4	+D	A.4	B.4	A.4 / C.4	black
	5	-D	A.5	B.5	A.5 / C.5	grey
	6	GND	N/A	B.1	B.1	brown
B	2	$-V_b$	A.2	B.2	A.2 / B.2	white
	3	$+V_b$	A.3	B.3	A.3 / B.3	blue
	4	+D	A.4	B.4	A.4 / C.4	black
	5	-D	A.5	B.5	A.5 / C.5	grey
	6	GND	N/A	B.1	B.1	brown

6.2.7 Looping the 4... 20 mA signal or pulse signal to a PLC (A554 3313)

In case 4... 20 mA and pulse signal of the sensor need to be connected to PLC or SCADA system. For this a separated connection board is needed. With the connection board 2 x 4... 20 mA and 2 x pulse signals can be looped to PLC or SCADA system.

For wiring please refer to the instruction manual of the connection board.

Remarks

S 400 / 420 provide isolated pulse output also on connector B. Please refer to instructions manual S 400 / 420. S 450 provides isolated pulse and mA signals directly from the sensor.

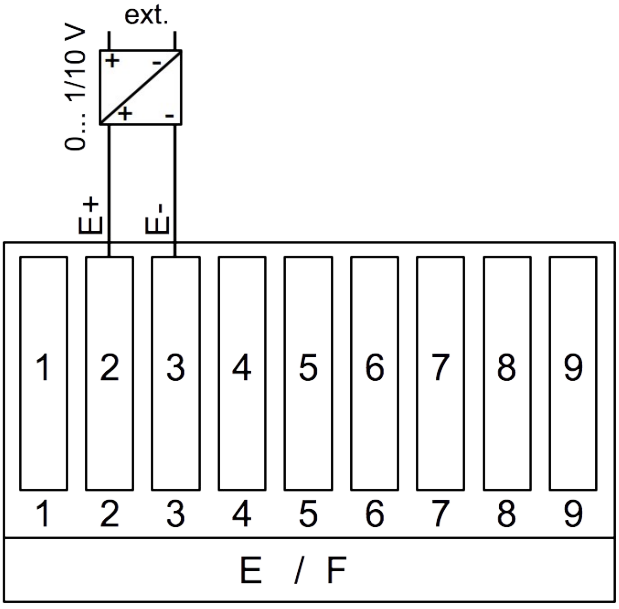
6.2.8 Terminal signals of RS-485 and Ethernet

For the connection of the RS-485 and Ethernet signal please refer to the Section 11 Industrial communication.

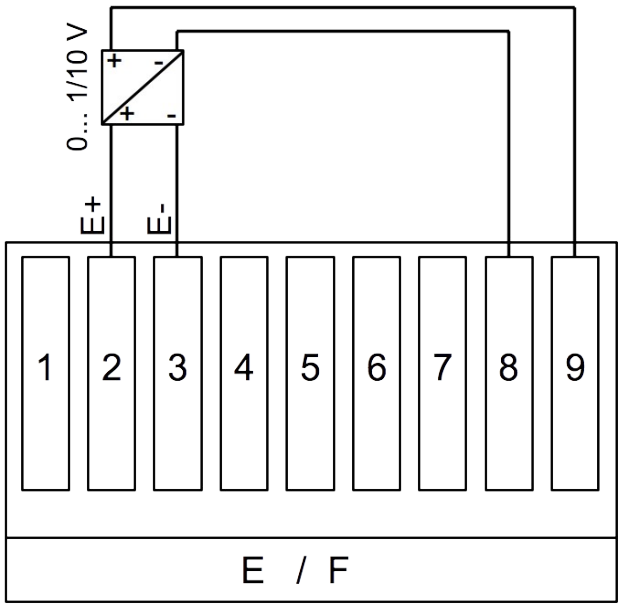
6.2.9 Terminal signals of analog card (option A1662)

This optional card offers two more sensor inputs at terminal E and F for 4... 20 mA, 0... 10 V and pulse signals. These inputs can be used to connect third party flow sensors.

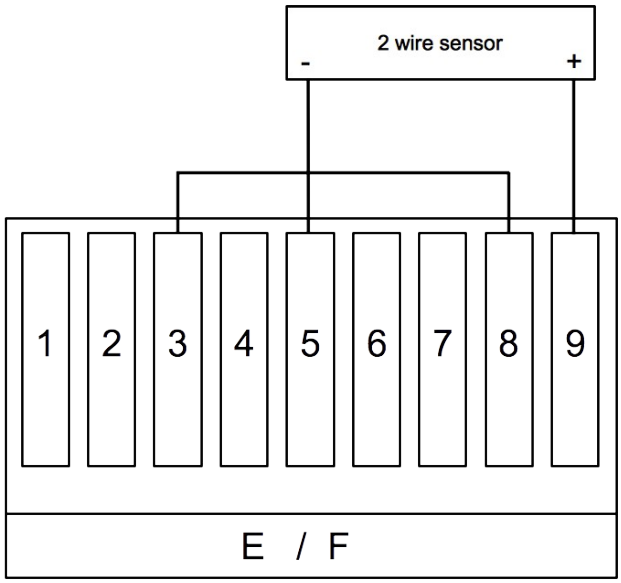
A. Process voltage input 0... 1 V or 0...10 V



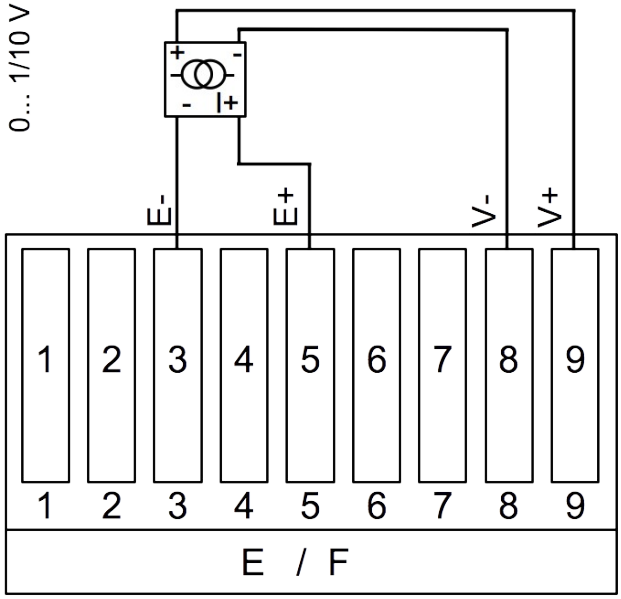
B. Process voltage input. Sensor is supplied by S 330 / 331



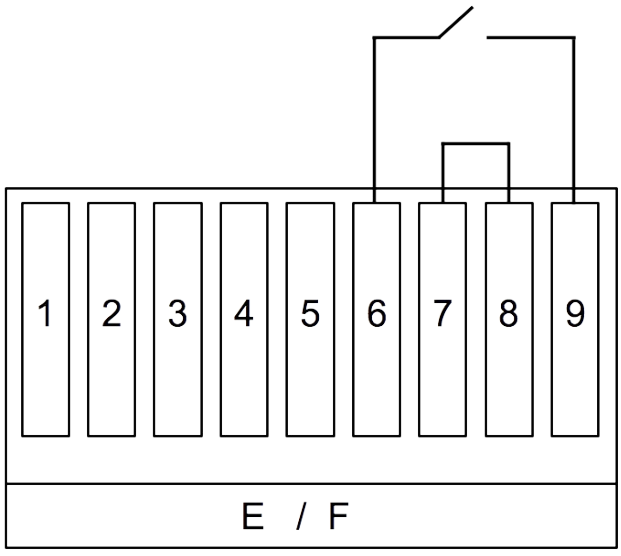
C. Loop current input 0... 20 mA / 4... 20 mA.



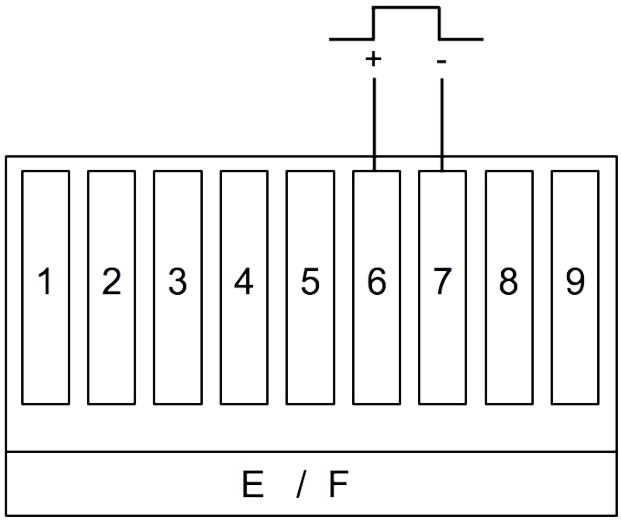
D. Process current input 0... 20 mA / 4... 20 mA. Sensor is supplied by S 330 / 331.



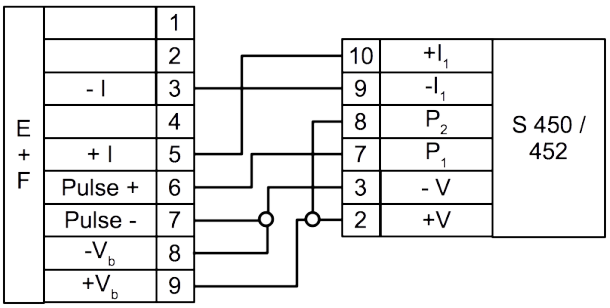
E. Connection of an isolated pulse input from a flow meter.

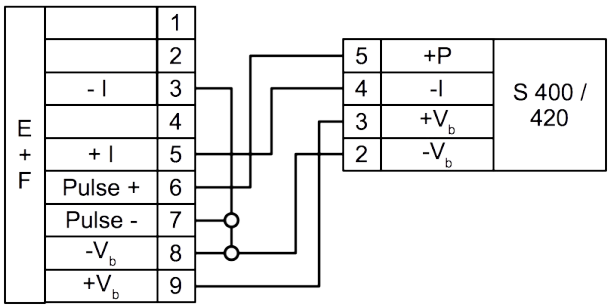


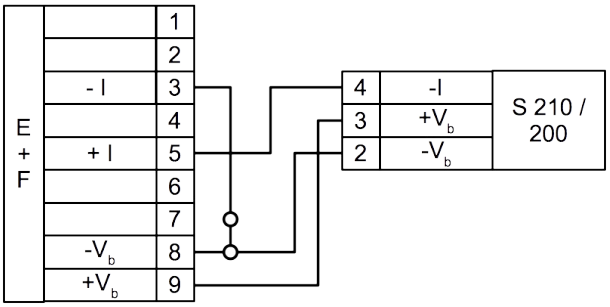
F. Connection of an active pulse signal from a flow meter.

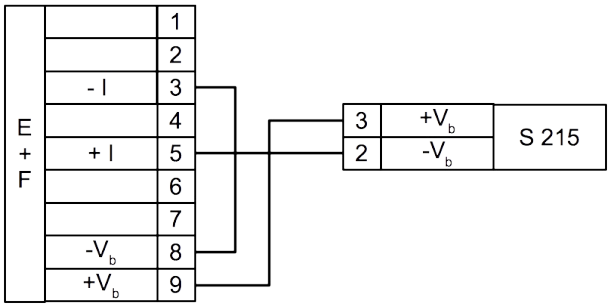


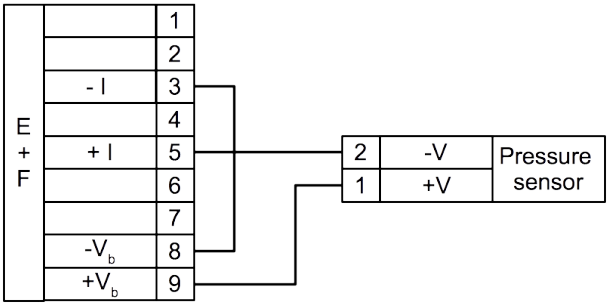
6.2.10 Connection of sensors to analog input module (option A1662)

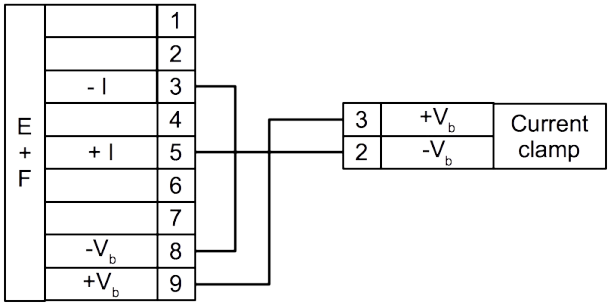












6.2.11 Power requirements for different sensors

S 330 / 331 can supply up to 10 W to external sensors for powering. Please use the table below to determine the maximum number of sensors that can be powered through S 330 / 331. If the maximum number is exceed, please select an external power supply.

Sensor	Power [W]	Sensor	Power [W]
S 430	3.0	S 201 / 220	1.3
S 450 / 452	5.0	S 212	1.0
S 400 / 420	3.0	S 215	0.5
Pressure sensor	0.5		

7. Configuration

The S 330 / 331 is delivered with specific customer settings according to the order.

In order to simplify the user interface not all settings but most of it are accessible via the user interface, instead a PC software can be used. This software is called S4C which can be downloaded from the company web page.

To change certain or all settings by the user, S 330 / 331 can be connected to the PC via the USB interface. After starting S4C all device settings are accessible.

All settings are stored permanently inside of the S 330 / 331. For changes please see sensor settings in chapter 8.6.

Amount of measuring channels

S 330 / 331 supports different kinds of sensor inputs (SUTO, Analogue, Modbus) . Besides it can also show virtual channels according to user's configuration.
However there is a limitation for total measuring channels it can support. It can support up to 100 measuring channels in total and details are shown in the table below.

	SDI	Analogue	Virtual Channel	Modbus
Max support	20	2	10	58

Remark

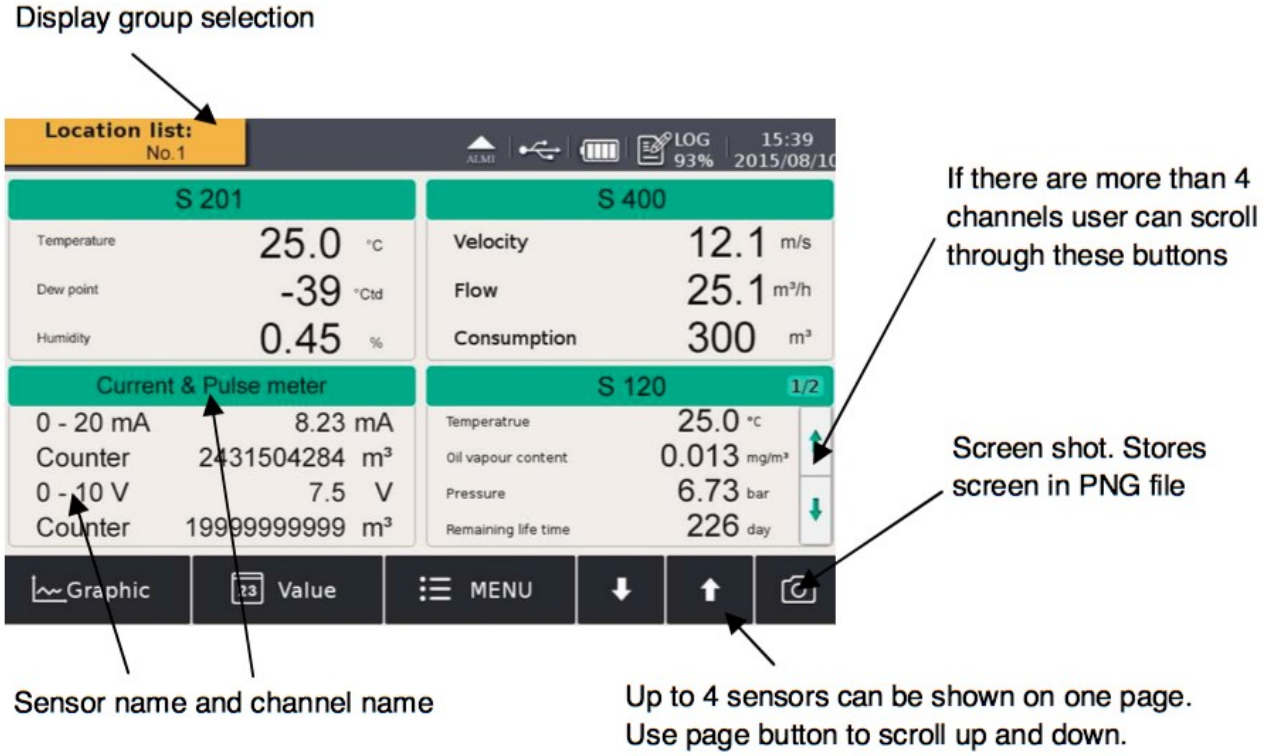
Other 10 ones are reserved.

8. Operation

When the S 330 / 331 starts up it will display the start up screen for a few seconds. During this time the sensor connections are established and a few other initialisation tasks are performed.

8.1 Value screen

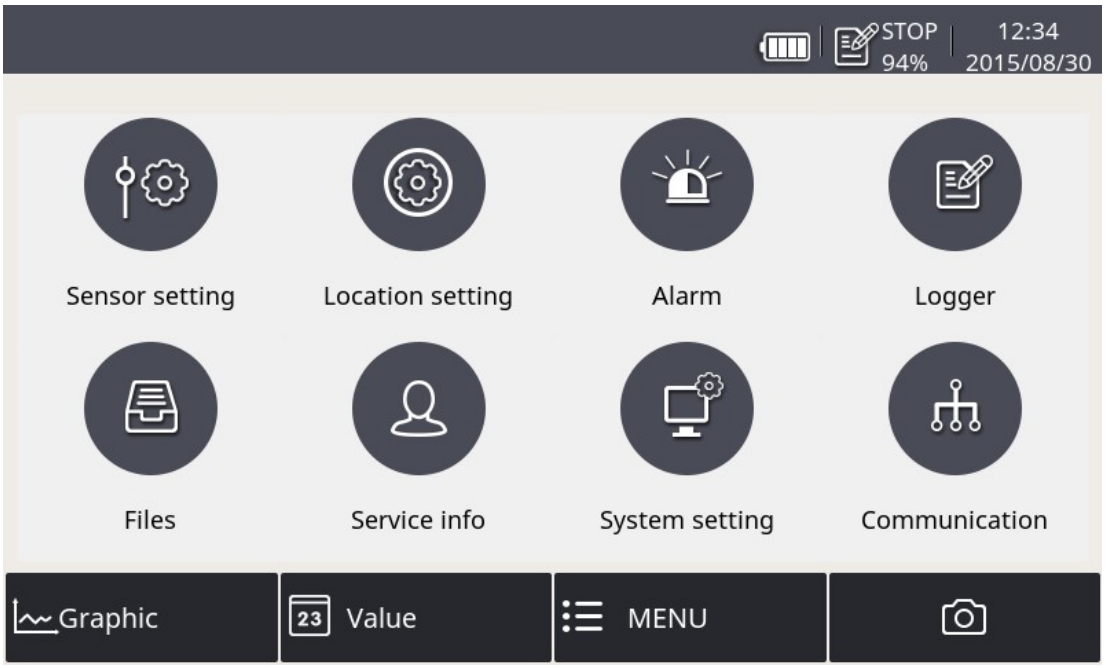
The S 330 / 331 will connect automatically to the connected sensors and starts to display the real time measurement values. The measurement values may be displayed on more than one page. To see another page, just touch the arrow buttons on the screen.



Remark

S 330 doesn't support the feature of ***Screen shot***.

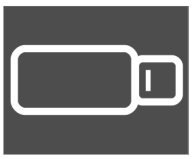
8.2 The main menu



The menu consists of the following sub-menus:

Sensor settings	Settings related to the connected sensors.
Location setting	S 330 supports location structure, that means sensors can be grouped into various locations for a better distinguishing.
Alarm	Alarm settings and status.
Logger	S 331 data logger settings.
Files	All recorded files and the memory status can be checked.
Service info	Useful information in case of a service issue.
Service setting	Many different settings are under this menu.
Communication	Modbus master, field bus RS-485 or Ethernet communication settings.

8.3 Description of display icons in status bar



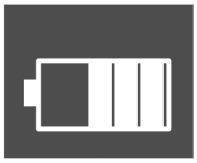
USB stick connected

System error

Sensor connection has changed, not matching with configuration

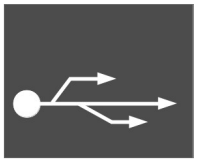
Sensor unit is not matching with configuration

Logger version S 331



RTC backup battery status

Sensor calibration is expired



USB to PC connected

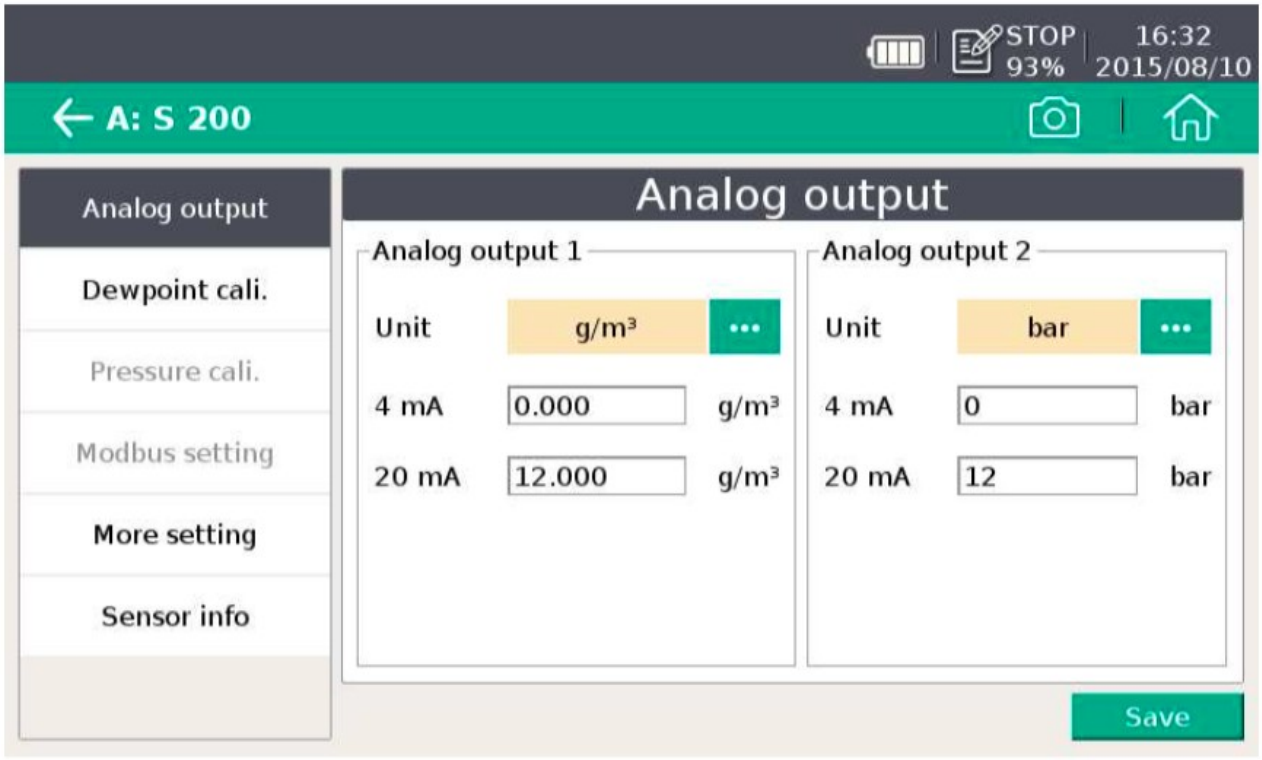
Alarm triggered

8.4 Graphic screen

8.5 Sensor setting

The following chapters describe the available settings of the different sensors. The sensor setting menu allows specific settings at the connected sensor. After selecting of “Sensor setting”, the next screen will show which kind of sensors are programmed. Changes can be done individually for each sensor, by selecting the related sensor.

8.5.1 Dew point setting

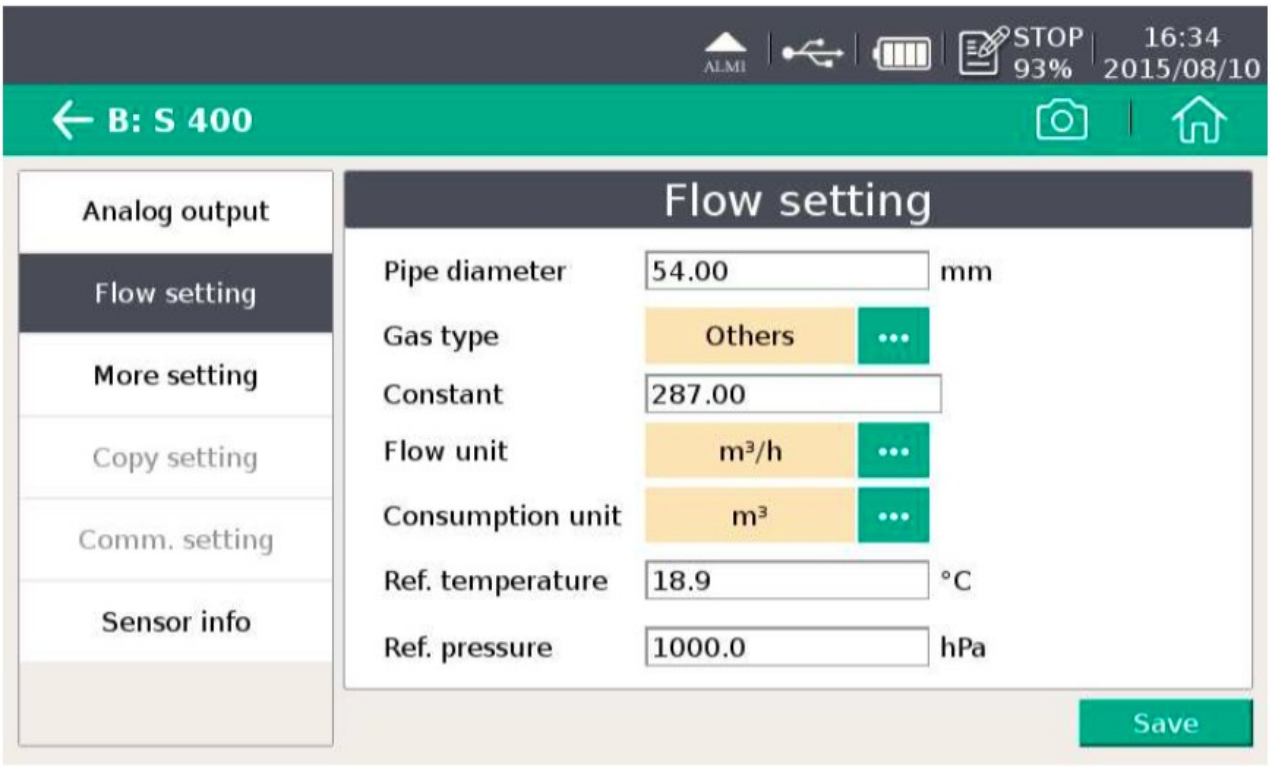


Analog output Select physical moisture unit and set scaling of analog output:
whenever moisture unit is changes, it is recommended to adjust the scaling of the analog output. The S 330 will recommend a standard scaling. The scaling is used to express the moisture through a 4... 20 mA signal, which then can be transferred to a PLC or SCADA system.
Set moisture unit: ppm (V), g/m^3, mg/m^3 and atmospheric dew point requires to enter a reference pressure.

Dew point cali.	Dew point sensor can be adjust at one point a reference value. We recommend to do this calibration only below -40°C dew point and by using a reliable reference.
Pressure calibration	Some dew point sensors have integrated pressure sensors which can be calibrated in the dialogue.
Modbus setting	Some sensors have Modbus interface. Communication parameters can be set here.
More setting	• Filters can be activated to dampen the output signal. • Auto cali setting allows the activation of an auto calibration function. • Absolute pressure required for g/m^3, mg/m^3, ppm[V] and atmospheric dew point calculation. The pressure has to be entered as absolute pressure (not gauge pressure!). For the unit atmospheric dew point and ppm[V], the line pressure (absolute) has to be entered. For the unit g/m^3, mg/m^3, if the calculate should be done under line pressure conditions, s reference pressure of 1013 hPa has to be entered.
Sensor info	Shows specific sensor information. Important for service inquiries.

Changes on the sensor settings are downloaded immediately into the sensor as soon as the changes are confirmed by pressing “Save”.

8.5.2 Flow sensor setting



Analog output Select physical flow unit and set scaling of analog output:
whenever the flow unit is changes, it is recommended to adjust the scaling of the analog output. The S 330 will recommend a standard scaling. The scaling is used to express the flow through a 4... 20 mA signal, which then can be transferred to a PLC or SCADA system.
Some sensors support active and passive analog outputs.

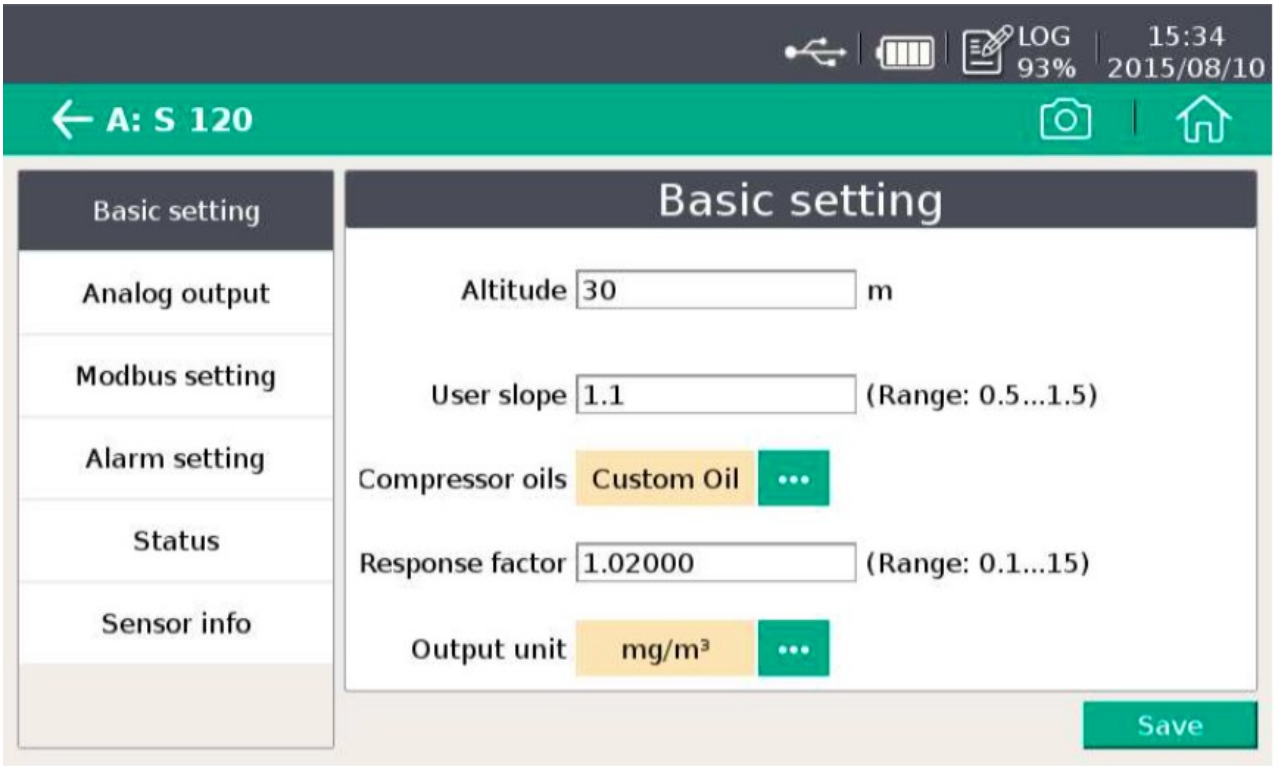
Flow setting **Pipe diameter:** for flow calculation
Gas type: select the gas type (some gases require real gas calibration, please contact the manufacturer).
Gas constant: showing gas constant of selected gas, or inputing gas constant for mixed gas or not-listed gas.
Flow unit: selection of the desired flow unit.
Consumption unit: selection of the desired consumption unit.
References pressure: in order to calculate the standard flow.
Reference temperature: in order to calculate the

	standard flow.
More setting	**Std. consumption:** set the internal consumption counter. **Rev. consumption:** some sensors support bi-directional flow measurement. This is the counter for the reverse direction. **Altitude:** please enter the altitude level, default is 0. **User slope:** allows a correction of the flow by a factor. **Temperature coefficient:** by default temperature.
Copy setting	Only function for S 551-P6.
Comm. setting	Some sensors have Modbus interface. Communication parameters can be set here.
Sensor info	Shows specific sensor information. Important for service inquiries.

Remark

Reference pressure and reference temperature are not related to the actual process pressure or temperature. They are used to calculate the standard flow at standard conditions, for example: 1000 hPa, 20°C.

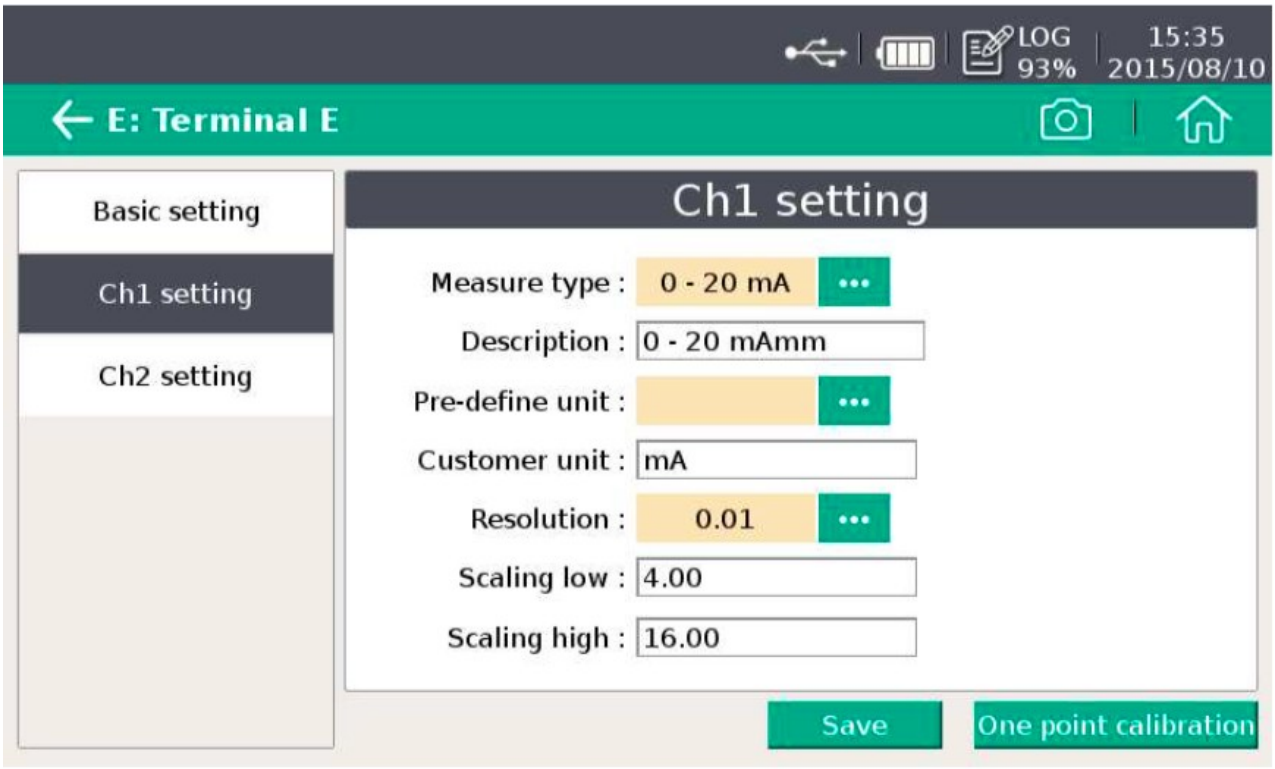
8.5.3 Oil vapor sensor setting



Basic setting	**Altitude:** please enter the altitude level, default is 0. **User slope:** allows a correction of the oil content by a factor. **Compressor oil:** select oil type, which is under measurement. **Output unit:** select unit of oil content.
Analog output	Set scaling of analog output (4... 20 mA).
Modbus setting	Set address, baud-rate and parity of Modbus communication.
Alarm setting	Enable or disable alarm function and set the alarm threshold.
Status	Shows the PID sensor lifetime, valid calibration time, remaining filter capacity (the filter is consumable component used for auto zero calibration). Gas temperature and pressure will also be displayed here. There is an indication at each line if value is normal or not.

8.5.4 Analog input setting

The S 330 / 331 has optional two analog input channel for various analog signals (4... 20 mA, 0... 10 V, etc.). These channel have to be prepared by S4C software. The following settings are available on the interface of S 330 / 331:



Basic setting

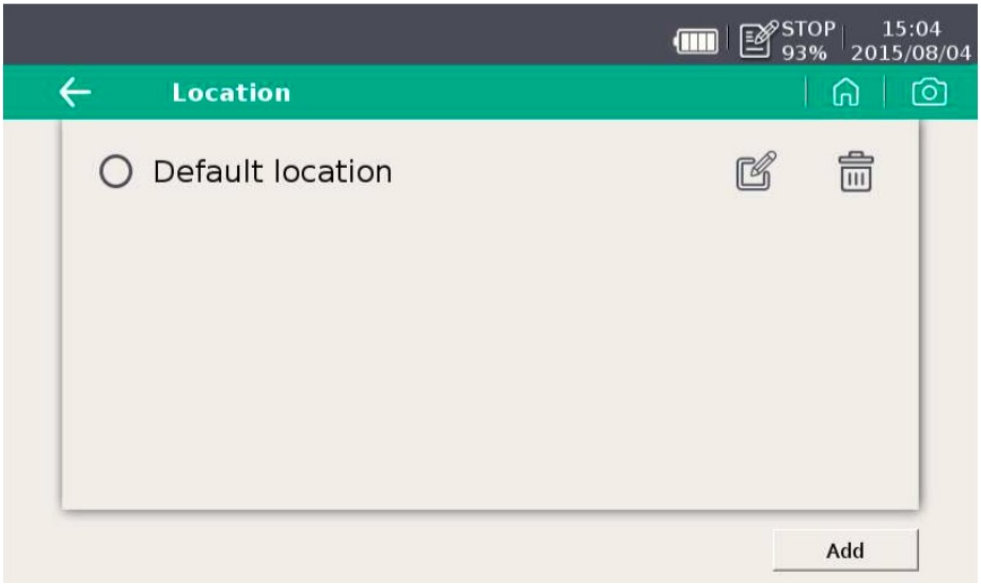
Sensor description: enter a sensor name.

CH 1 setting

Measure type: mA or voltage etc.
Description: enter a sensor name.
Predefine unit: select a physical unit.
Customer unit: free text for measurement unit.
Resolution: value resolution (how many digits behind the decimal point)
Scaling: define the scaling to calculate from the original value to the display value.
One point calibration: The instrument provides a one-point system calibration, which can eliminate accuracy failures of instrument and sensor. If an accurate reference is available (e.g. calibration lab), the system can be calibrated at one point to this reference. The calibration is stored inside the S 330 / 331.

	This calibration offset is applied to every sensor connected to the terminal which was used for calibration. Make sure if other sensors are connected, that the calibration offset is deleted.
Ch 2 setting (counter only)	**Measure type:** only counter is selectable. **Description:** enter a channel name. **Predefine unit:** select a physical unit. **Customer unit:** free text for measurement unit **Count/pulse:** one pulse is equal to how many consumption units.

8.5.5 Location setting



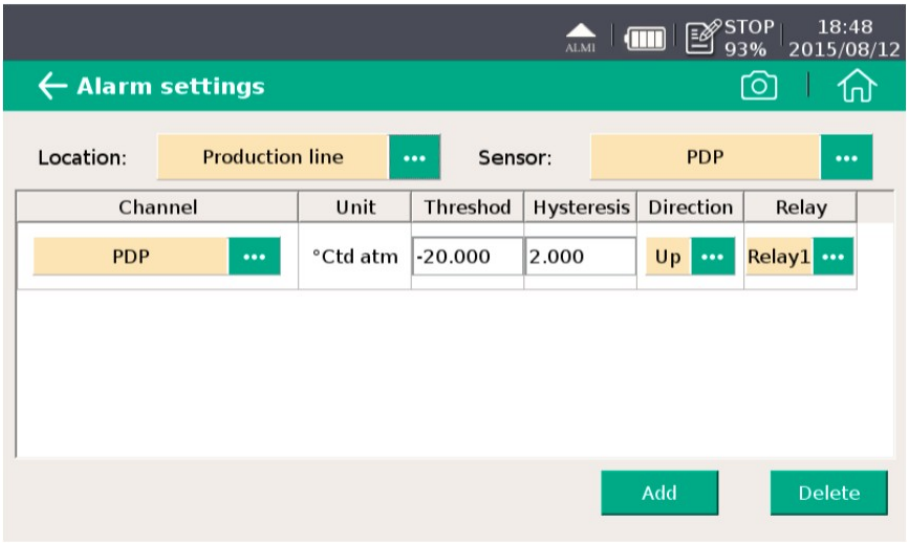
This function is used to assign the connected sensor and sub-displays (in case S 330 / 331 is a master device) into different locations (room1, room2 etc.)

1. Click Add to create a new location.
2. Please input a description for the location (e.g. room1 or production) and click ok.
3. Click on the created location. After that a new window is shown.
4. Click Add to create a new measuring point.
5. Please input a description for the measuring point (e.g. production line 1 or dryer) and click ok.

6. Click on the measuring point. After that a new window is shown.
7. Click Add to assign a sensor to the location (e.g. flow meter or dew point sensor).
8. Now make the connection from the logical sensor to the physical sensor.

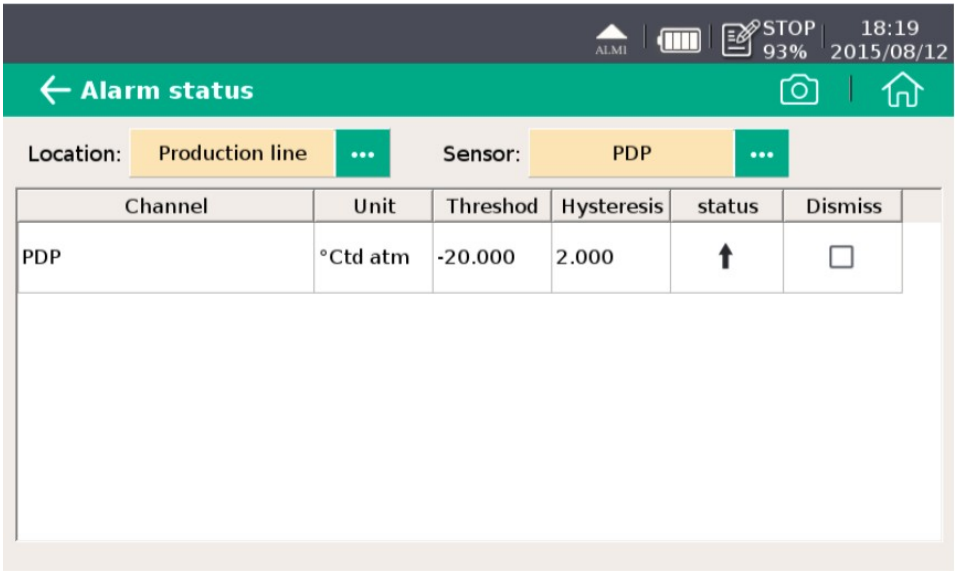
8.5.6 Alarm settings

The S 330 / 331 comes with two alarm relay outputs and optical alarm indication (flashing value).



The alarms are programmed under alarm settings menu.

1. Select “Location” then “Sensor”.
2. Press “Add” button to program an alarm based on selected sensor measurement.
3. To delete programmed alarm click the unit column to select it.
4. Press “Delete”.

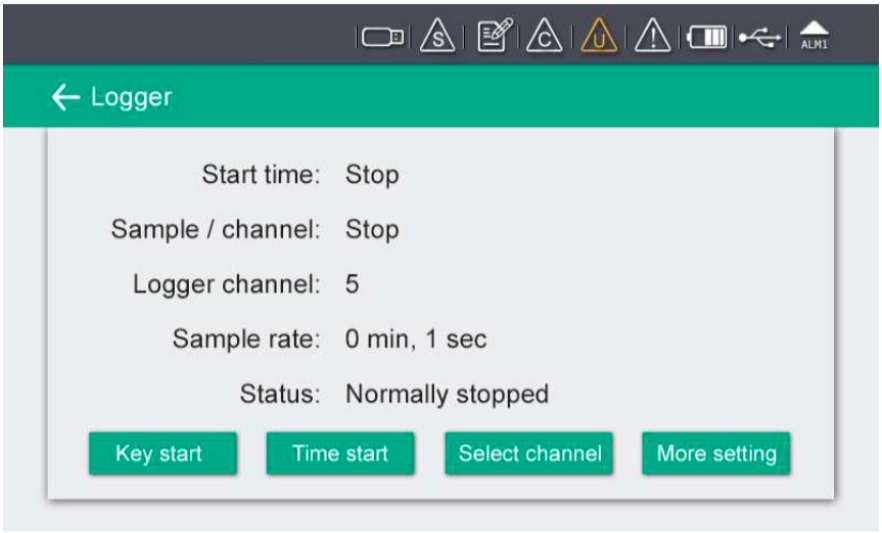


Select “Location” then “Sensor” to check alarm status.

In Alarm status all alarms which are triggered are shown including dismissed ones for relay if the “Dismiss” box is tricked then relay status will be changed which means the alarm will be dismissed.

8.6 Logger

In this sub-menu the logger status can be seen and programmed.



Start time Logger start time.

Sample / Channel Recorded sample number per logging channel.

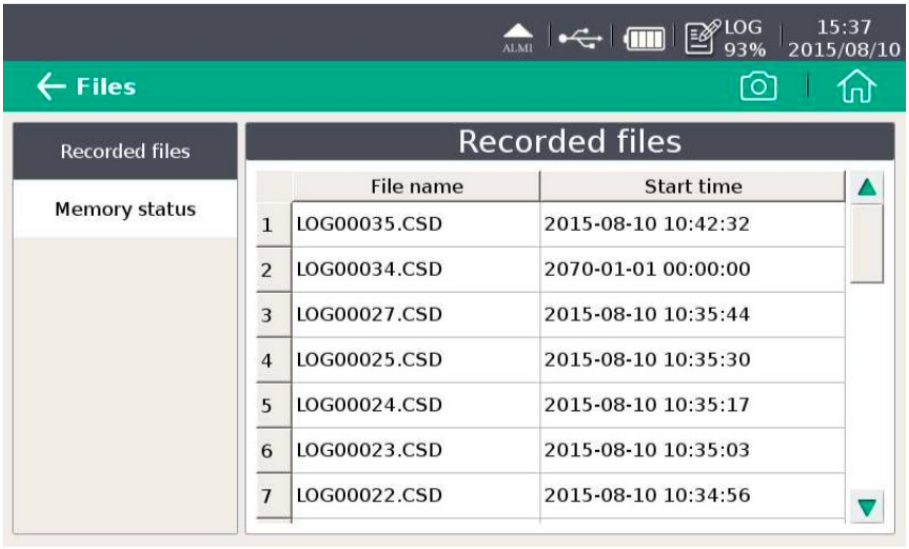
Logger channel Total recording channel number.

Sample rate Recording interval.

Status Logger status.

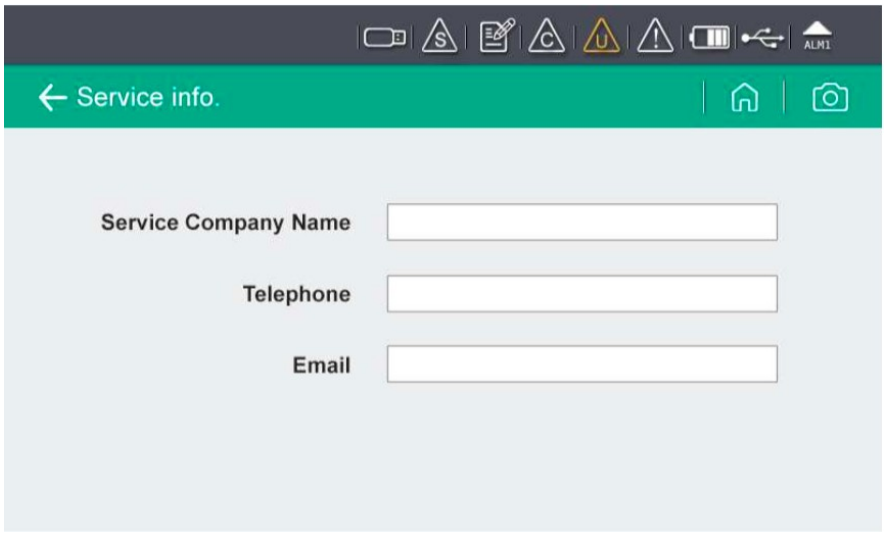
8.7 Files

This menu shows all recorded files. Single files can be selected for some recording details or can be deleted. Memory status inform about available memory.



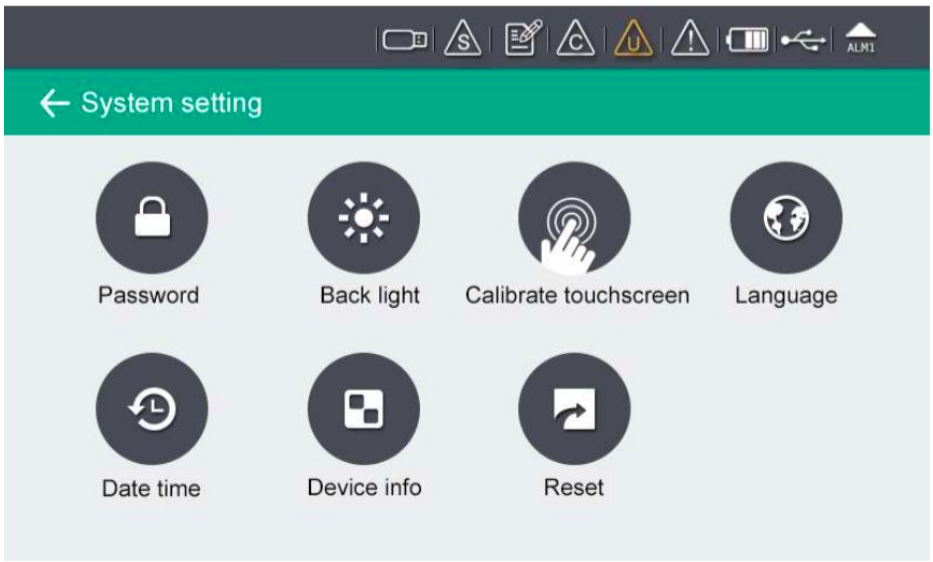
8.8 Service info

Contact information of service company can be set via S4C software.



8.9 System setting

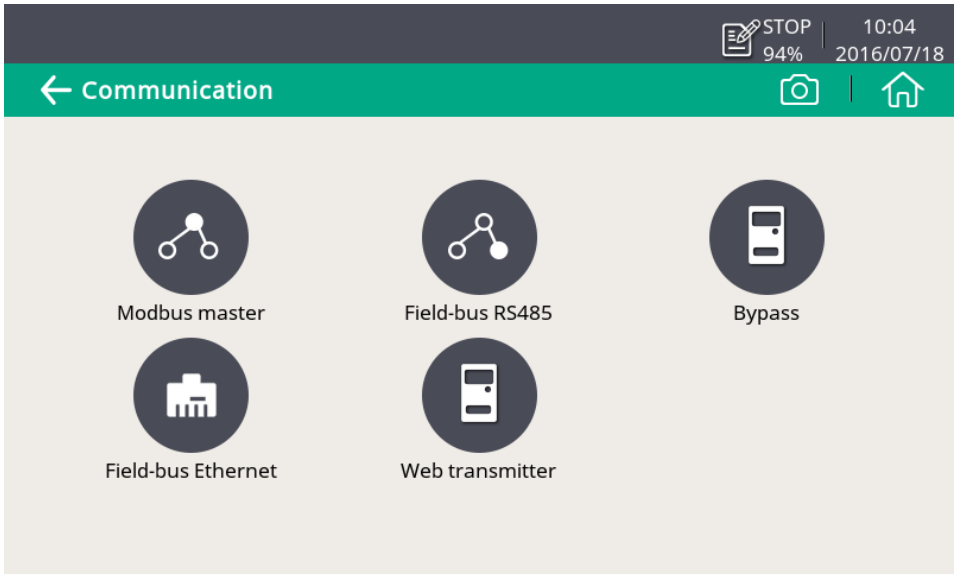
Variouse system settings can be done under this menu. Just click related buttons and following the instruction shown on the display.



Password	Set password to protect some critical operations e.g..
Back light	Adjust brightens and dimming time out.
Calibrate touch screen	Calibrate touch accuracy.
Language	Select user interface language.
Date time	Set date time.
Device info	Information for service cases.
Reset	Reboot the display.

8.10 Communication

In this submenu its is possible to determine the settings of the communication type. The following Communication types are available:



Just click the desired button and following the instruction shown on the display.

9. Signal inputs

9.1 Digital input

The display has two different digital inputs:

- 2 x SDI Sensors
- 16 x RS 485 Modbus RTU Sensors

9.2 Analog input

The display has two optional analog / pulse inputs:

- 2 x analog (0... 20 mA / 4... 20 mA / 0... 10 V)
- 2 x pulse

10. Signal outputs

10.1 Analog / Pulse output

A 4... 20 mA signals and pulse signal of sensors can be looped through the display by using the connection board.

10.2 Alarm output

The display has two alarm relay outputs (230 VAC, 3 A).

10.3 Interface

The data can be transmitted via Ethernet / RS-485 Modbus TCP / RTU to a data collection system or software. Alternatively the data can also be transferred via USB stick or USB cable.

11. Industrial communication

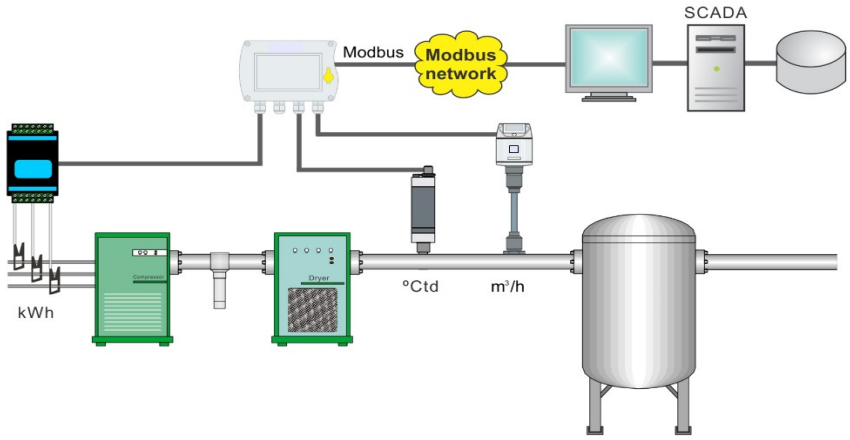
S 330 / 331 offer various industrial communication options. This manual will describe the differences of the installation / configuration and supports the user with the installation.

SUTO offers basically 2 application solutions:

11.1 Integration into an existing Factory Automation System

For this application there are several communication links available which are described briefly below. All of them in common is the limited functionality to only retrieve measurement data, however this is sufficient in most applications.

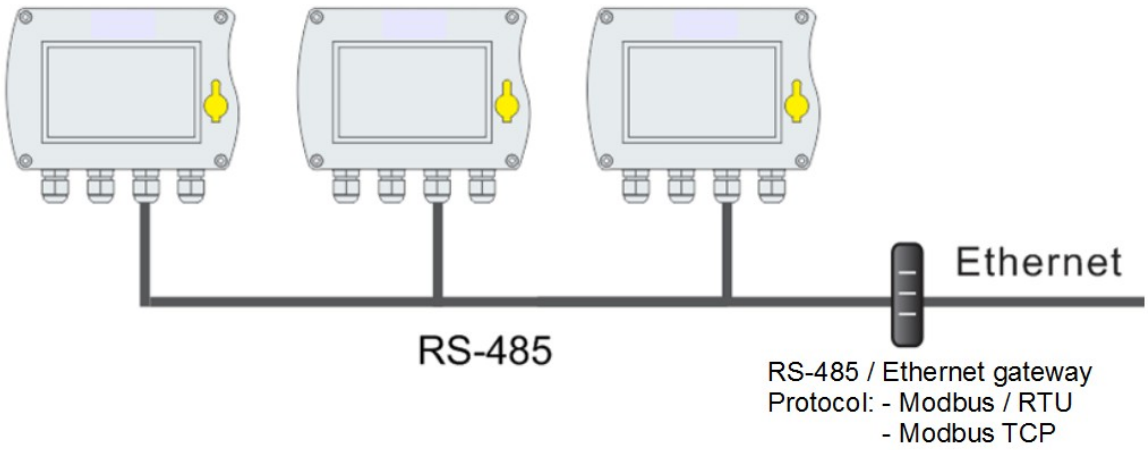
11.1.1 RS-485 with Modbus/RTU



Modbus is a popular industry bus which can be used to connect several S 330 / 331 to a ModbusMaster which could be a PLC or a SCADA system or a S 330 /331 Master.

11.1.2 RS-485 with RS-485 / Ethernet Gateway

In areas where Ethernet is not accessible RS-485 can be used to wire the instruments to an access point for Ethernet. Through the RS-485 / Ethernet gateway the link to Ethernet is established. The gateway can handle up to 30 x S 330 / 331. Please ensure that Modbus protocol is selected on S 330 / 331 menu.



RS-485 / Ethernet gateway
(A554 0013)

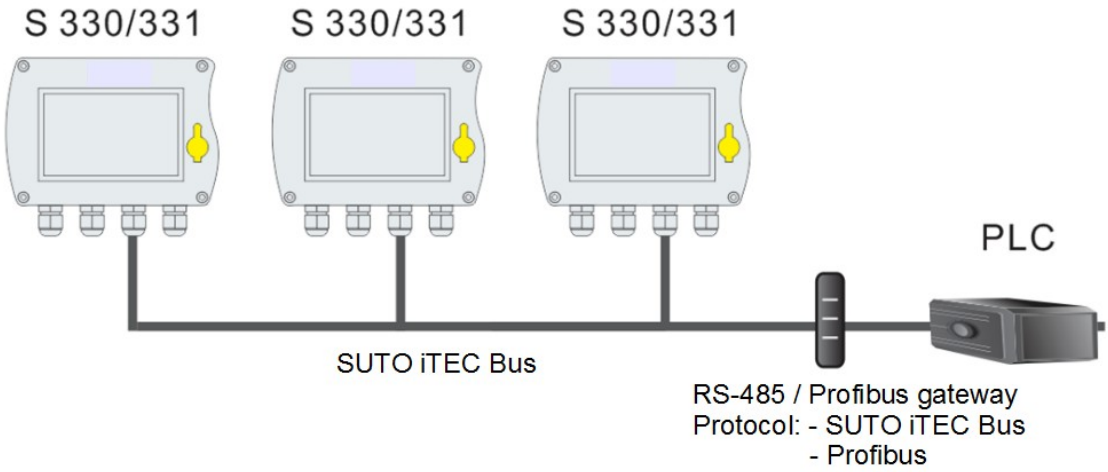
Remark

This gateway works only in a connection to a **Modbus/TCP** Master. (see alternative under 11.1.4 for Modbus TCP Ethernet).

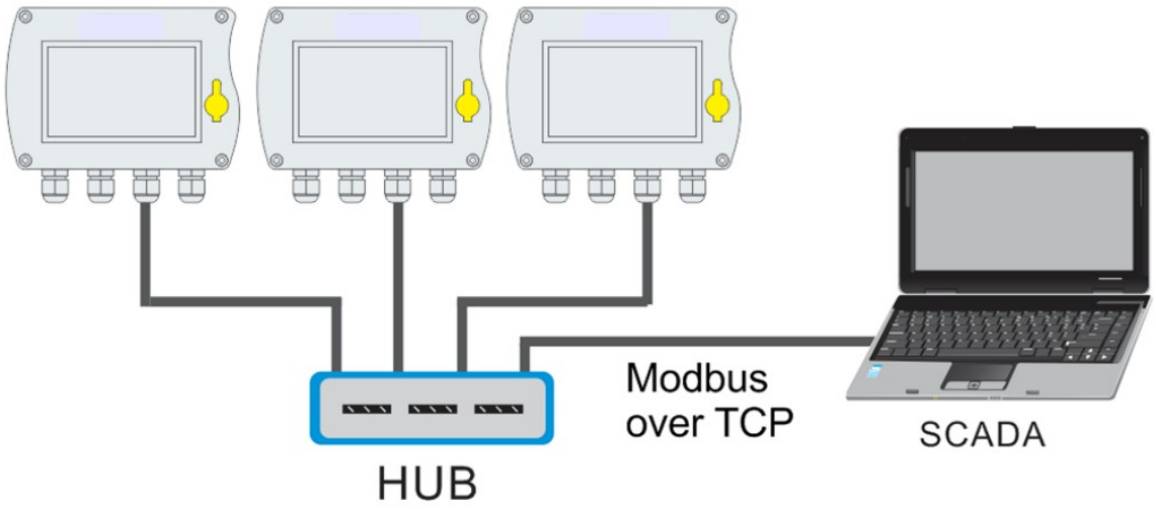
11.1.3 RS-485 with Gateway to Profibus

To connect S 330/331 to a Profibus-master SUTO offers a gateway from SUTO to Profibus. Depending on the number of sensors connected to S 330 / 331, between 4 to 10 S 330 / 331 can be routed to the Profibus. Profibus provides functionality to retrieve measurement values.

The SUTO - Profibus gateway (A554 0012) makes a link between RS-485 slaves running the SUTO protocol and a Profibus network on RS-485. Please contact our customer service for detailed information.



11.1.4 Field-bus Ethernet (Modbus TCP Ethernet)



S 330 / 331 is available with a Ethernet port. By selecting the **Modbus TCP Ethernet** protocol from the S 330 / 331 menu, the communication with a Modbus master can be established. This is a popular way to connect to a Modbus Master through Ethernet. Process visualization systems are using so called OPC servers to establish the link to Modbus.

11.2 Standalone / Complete solution

For this application SUTO provides complete solutions, including software for data recording and analyzes. It offers full functionality to the user and is not limited to retrieving measurement values only. If measurement values still need to be feed into a SCADA system or a Factory Automation System, there still the option to use the analogue signals for that purpose (4-20 mA, pulse).

11.2.1 Chose the Application Software

S4M-XL and S4M-S are designed for this application.

Using S4M-XL software

S4M-XL is capable to communicate with almost unlimited devices on a network (Ethernet, RS-485 or RS-485 / Ethernet gateway). The key features available are:

- Online measurement values of all instruments and all channels in parallel
- User can add his own plant schematics as a background picture to the online screen
- Online recording of selected channels over all instruments
- Data backup for online recording and recovery after power fail
- Alarm monitoring and recording of alarm history
- Start / stop logger inside S 331
- Read recorded data from S 331 data logger
- Report generation and graphical analyzes

Using S4M-S software

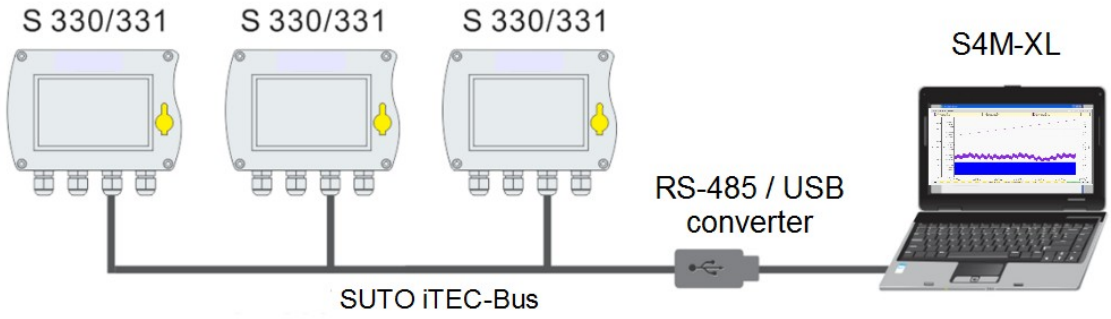
S4M-S can communicate through Ethernet and RS-485. It can detect up to 10 S 330 / 331 but only one S 330 / 331 can be selected to communicate at a time. The user has to select from a list of S 330 / 331. Through the Ethernet and RS-485 connection the full functionality of CSM-S is available, for the user it appears as if the device is connected directly to the local USB-Port.

The key features available are:

- Supporting RS-485 communication, USB, Ethernet and Service kit (connection SUTO flow / dew point sensors)
- Up to 10 remote units (S 330 / 331) can be detected via RS-485 and Ethernet. However, it can only communicate with one device at a time
- Fast logger reading via Ethernet / RS-485 / USB. For Ethernet and RS-485 1000 values per second and for USB 2500 values per second
- Graphical analyzes and printing
- Exporting data to MS-Excel files

11.2.2 Choose the physical connection method

1. RS-485



RS-485 is commonly used in industrial applications. It can reach up to 1000 m distance with a shielded 2-wire cable. If further distance is required, a repeater can be installed to reach another 1000 m. Up to 30 S 330 / 331 instruments can be connected to the RS-485 network. Please ensure that SUTO protocol is selected on S 330 / 331 menu and every S 330 / 331 has a unique device address (1 – 247).

Hardware Requirements:

- S 330 / 331
- RS-485 / USB converter (order number: A554 0331) and driver installed properly
- Cabling all the devices and also to the converter
- PC with operation system of XP, Vista 32, Vista 64, Windows7 32 or

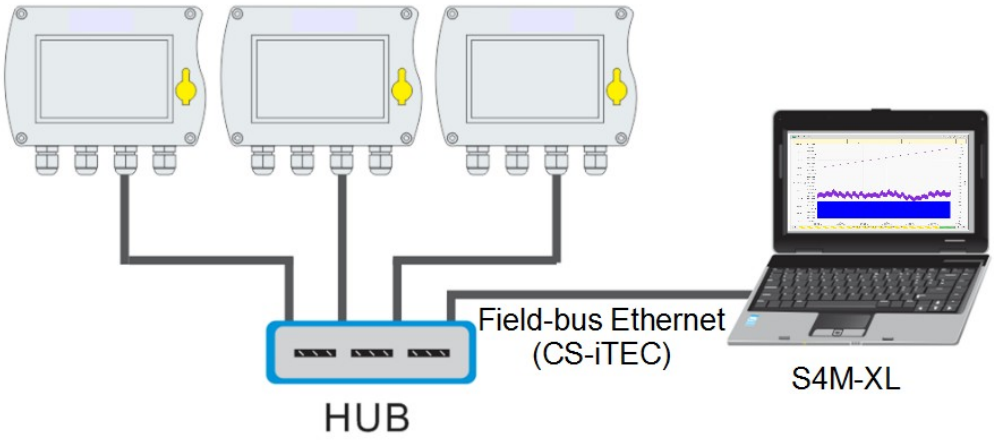
Windows7 64

Software Requirements:

S4M-S or S4M-XL

2. Ethernet (TCP/IP)

S 330 / 331 can be connected to an Ethernet switch or router or sometimes called a hub. Please consider following hardware and software requirements:



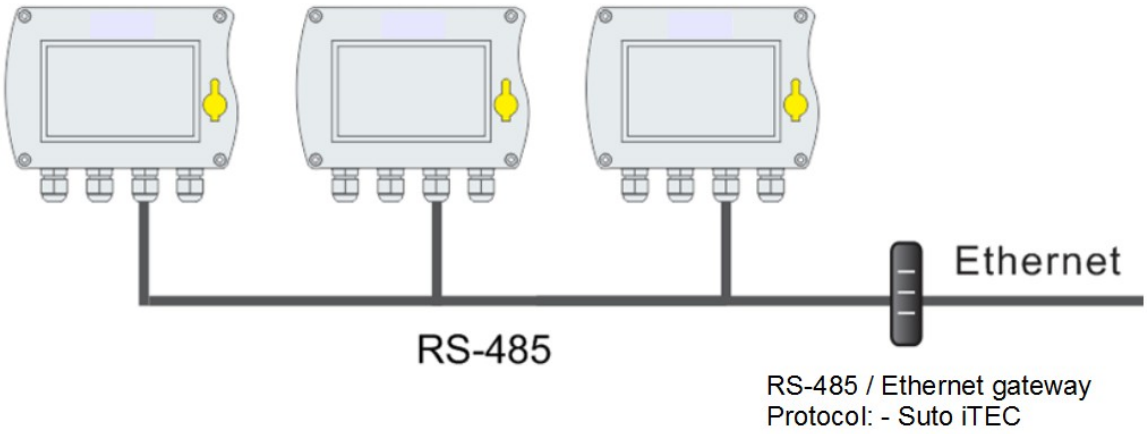
Hardware Requirements:

- S 330 / 331
- Standard RJ45 Ethernet cable, maximum length 100 meters
- S 330 / 331 connected into a LAN (Local Area Network)
- PC with Ethernet connection (XP, Vista 32, Vista 64, Windows7 32 or Windows7 64)

Software Requirements:

S4M-S or S4M-XL

3. RS-485 / Ethernet



In areas where Ethernet is not accessible RS-485 can be used to wire the instruments to an access point for Ethernet. Through the RS-485 / Ethernet gateway the link to Ethernet is established. The gateway can handle up to 30 S 330 / 331. Please ensure that SUTO Bus protocol is selected on S 330 / 331 menu and every S 330 / 331 has a unique device address (1 – 247).

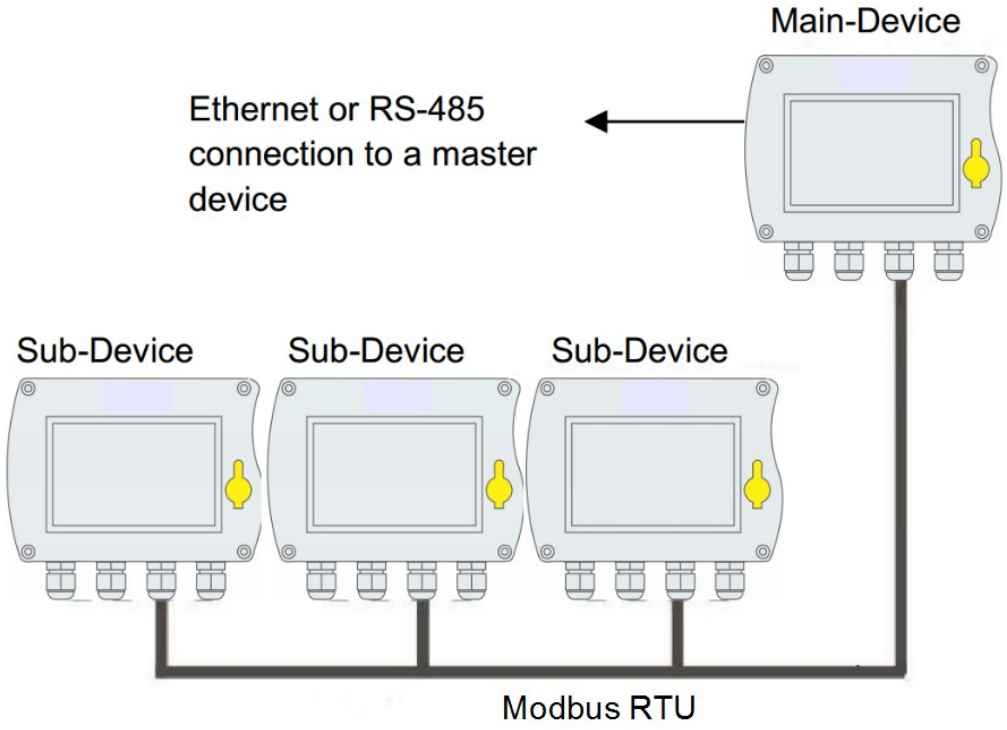
Hardware Requirements:

- S 330 / 331
- RS-485 / Ethernet gateway (A554 0010)
- Cabling all the devices and also to the gateway
- PC with operation system of XP, Vista 32, Vista 64, Windows7 32 or Windows7 64

Software Requirements:

S4M-XL

4. More complex network solutions



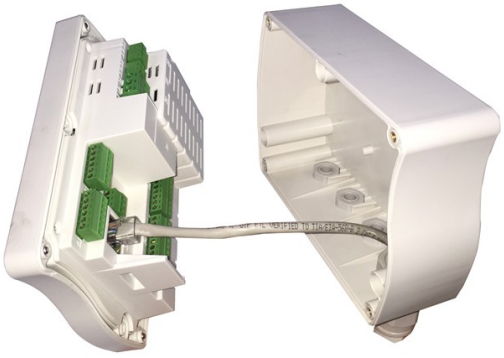
The picture above shows on the lowest level several S 330 / 331 (Sub-Device) - or any other device which has a Modbus/RTU interface can be connected - which are connected through Modbus/RTU to a Modbus-Master (Main-Device).

The Main-Device itself then can be connected to a next higher level Master Device either through RS-485 or Ethernet.

The Master-Device on top sees only the main device, which provides all measurement channels from the sub-devices.

11.2.3 Hardware setup

1. Ethernet hardware setup



Internal RJ45 connector

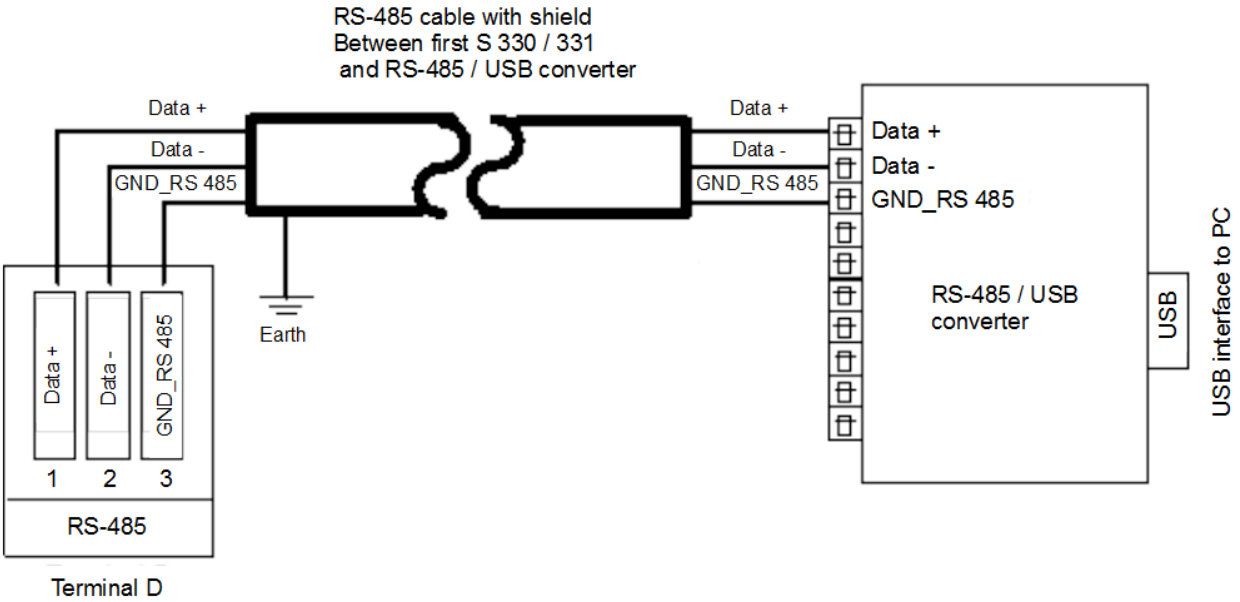
External RJ45 connector (IP65)

Connect Ethernet cable and mount bend protection sleeve

Ethernet cable:

An Ethernet cable with category 5 or better is applicable and the maximum cable length is 100 meter between S 330 / 331 and the connected HUB or computer.

2. RS-485 hardware setup



Through a RS-485 / USB converter the system is connected to a USB port of the office PC. RS485 network requires a termination resistor network. At both far ends of the devices, termination resistor must be turned on communication menu, all others S 330 / 331 remain off, Terminal resistor is software control in S 330 / 331. Please set it up correctly.

There are totally 3 poles on the terminal D for RS 485 network wiring. The pin function description is shown below.

Pin No.	Pin name	Function
1	Data +	Data + signal
2	Data -	Data - signal
3	GND RS-485	Ground of RS-485

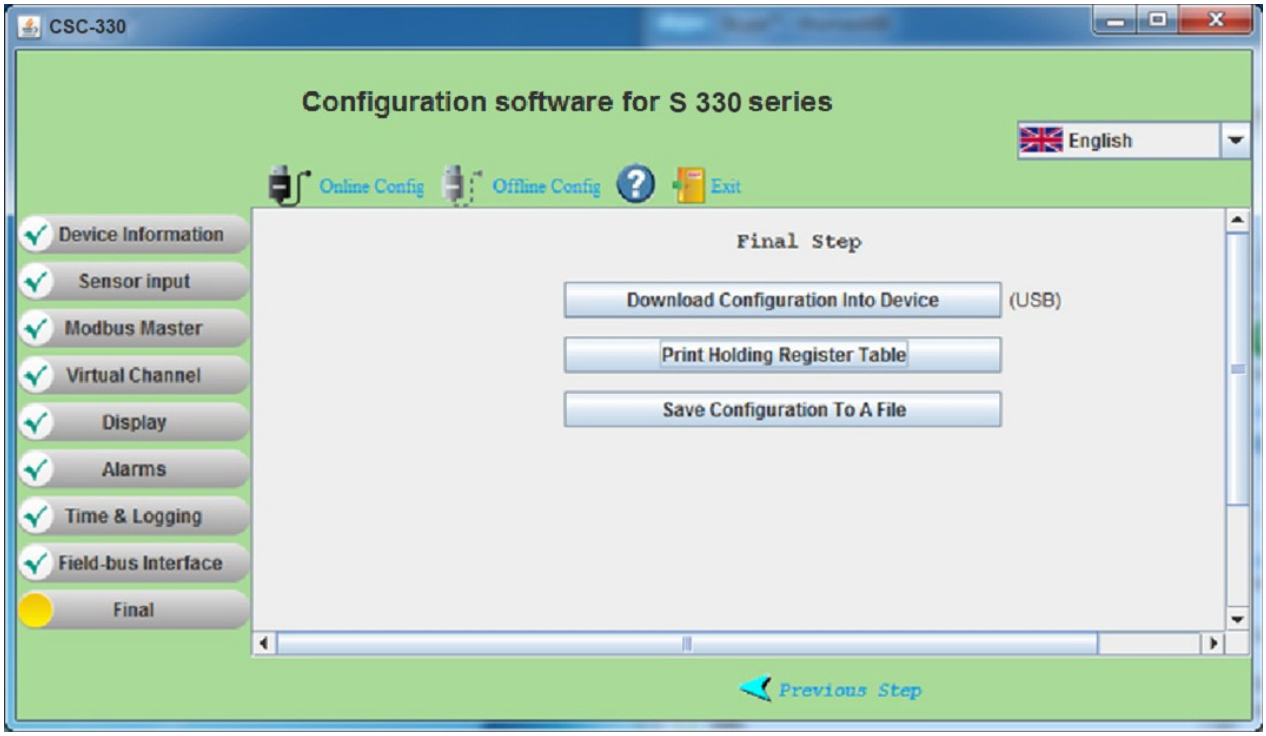
RS-485 cable:
Only cables according to the recommendations of EIA 485 standard should be used. A maximum of 30 devices may be connected to one segment. The bus cable must be laid at a distance of at least 20 cm from other cables. It should be laid in a separate, conductive, and earthed cable trunk. It must be ensured that no potential differences occur between the individual devices on the bus.

RS-485 Cable specification:

- Impedance: 135 – 165 Ohm @ 3 to 20 Mhz
- Cable capacity: < 30pF/m
- Cable diameter: > 0.64 mm
- Cross section: > 0.34 mm², conforms to AWG 22
- Loop resistance: < 110 Ohm per km
- Screening: Cu shielding braid or shielding braid and shielding foil
- Outer diameter for power and sensor cable: 4.5 ... 8mm

11.2.4 Settings on S 330 / 331

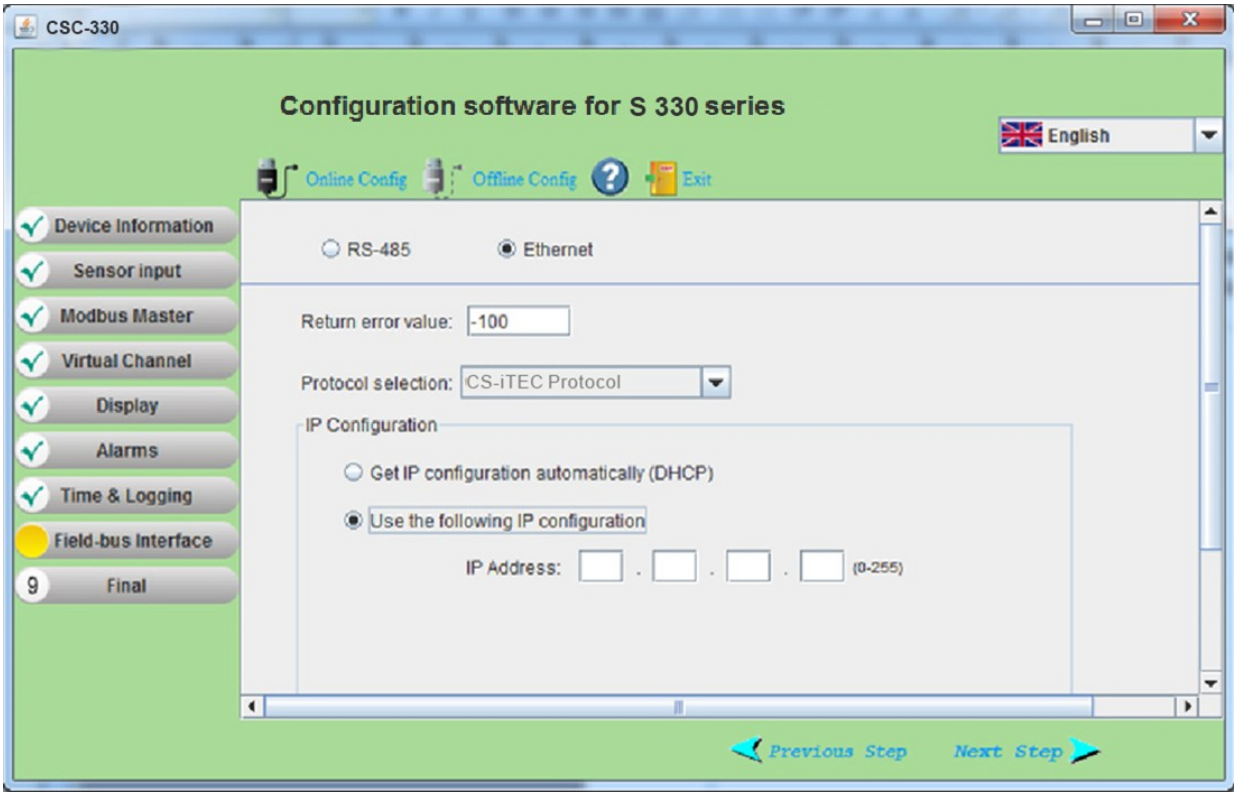
All device settings of S 330 / 331 can be done in a convenient way through the configuration software CSC (see next chapter).



There are many settings available, but the focus here is on the Flied-bus Interface settings.

1. RS-485 settings:

Setting	Description
Return error value	Is the value the salve device will return as a measurement value in case of any error condition.
Protocol selection	Please choose SUTO Protocol if using SUTO software, chose Modbus if device is connected to a Modbus network.
Address	Each device on the RS-485 network needs to have a unique device address. Please ensure that address 0 is not used and that there are no duplicated addresses.



2. Ethernet settings:

Setting	Description
Return error value	Is the value the salve device will return as a measurement value in case of any error condition.
Protocol selection	Please choose SUTO Protocol if using SUTO software, chose Modbus if device is connected to a Modbus network.
Get IP config automatically	Selecting this option will assign the S 330/331 an IP address through the network router. This is convenient but not a recommended choice in industrial networks. We recommend to choose a static IP address.
Use the following IP….	Enter the static IP address here.

Printing the Modbus slave register table

After the configuration of a S 330 / 331 is finished, one of the final steps is to print the Modbus register table. This table describes all Modbus register addresses and it’s measurement value contents. According to the table the Modbus master device needs to be programmed.

Example of a Modbus register table

Commnunication: [Ethernet]
Return error value: [-100.0] IP Address: [DHCP enable] Protecol: [Protocol]

Holding register table

Device Description	Sub Device Description	Sensor Description	Channel Type	Channel Description	Holding register	Modbus address	Data type	No. of byte	Unit	Resolu -tion	Read/ Writer	Func Code
Thomas:S 325(I)		S 215	Temperature	Temperature	1	0	FLOAT_L	4	°C	0.1	R	3
Thomas:S 325(I)		S 215	Humidity	Humidity	3	2	FLOAT_L	4	%	0.1	R	3
Thomas:S 325(I)		S 215	Dew point	Dew point	5	4	FLOAT_L	4	°Ctd	0.1	R	3
Thomas S 325(G)		S 400	Flow	Velocity	25	24	FLOAT_L	4	m³/min	0.1	R	3
Thomas S 325(G)		S 400	Consumption	Flow	27	26	UINT32_L	4	m³	1	R	3
Thomas S 325(E)		Pr. 16		Pr. 16 bar	41	40	FLOAT_L	4	bar	0.01	R	3
Thomas S 325(F)		Pt100		Pt100	43	42	FLOAT_L	4	°C	0.1	R	3
Thomas S 325(D)	Device(I)	S 400	Flow	Flow	67	66	FLOAT_L	4	m³/min	0.1	R	3
Thomas S 325(D)	Device(I)	S 400	Consumption	Consumption	69	68	UINT32_L	4	m³	1	R	3
Thomas S 325(D)		TF S 450	Flow	Flow	73	72	FLOAT_L	4	m³/min	0.1	R	3
Thomas S 325(D)		TF S 450	Standard consumption	Standard consumption	75	74	UINT32_L	4	m³	1	R	3
Thomas S 325(D)		Water Meter		Water Flow	83	82	FLOAT_L	4	l/min	0.1	R	3
Thomas S 325(D)				Virtual ch1	85	84	FLOAT_L	4	°C	1	R	3
Thomas S 325(D)				Virtual ch2	87	86	FLOAT_L	4	°C	1	R	3

11.2.5 Software Installation

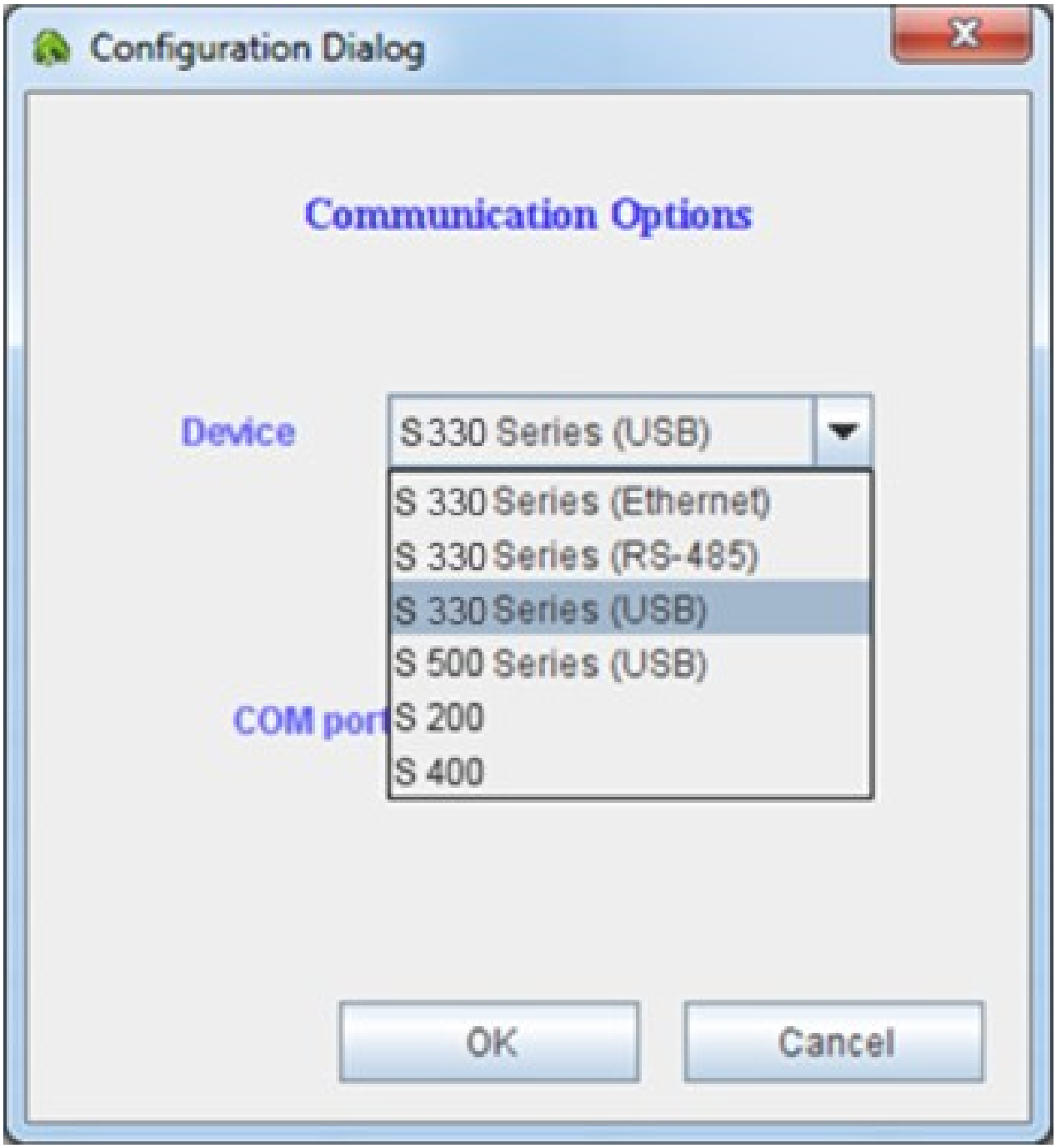
Following software is available for download from the company web page www.suto-itec.com:

CSC	Configuration software for S 330 / 331
S4M-S	Single device data acquisition and analyzes software
S4M-XL	Multiple device data acquisition and analyzes software

After downloading of the files, please follow the instructions to install the software.

1. Configuration of S4M-S

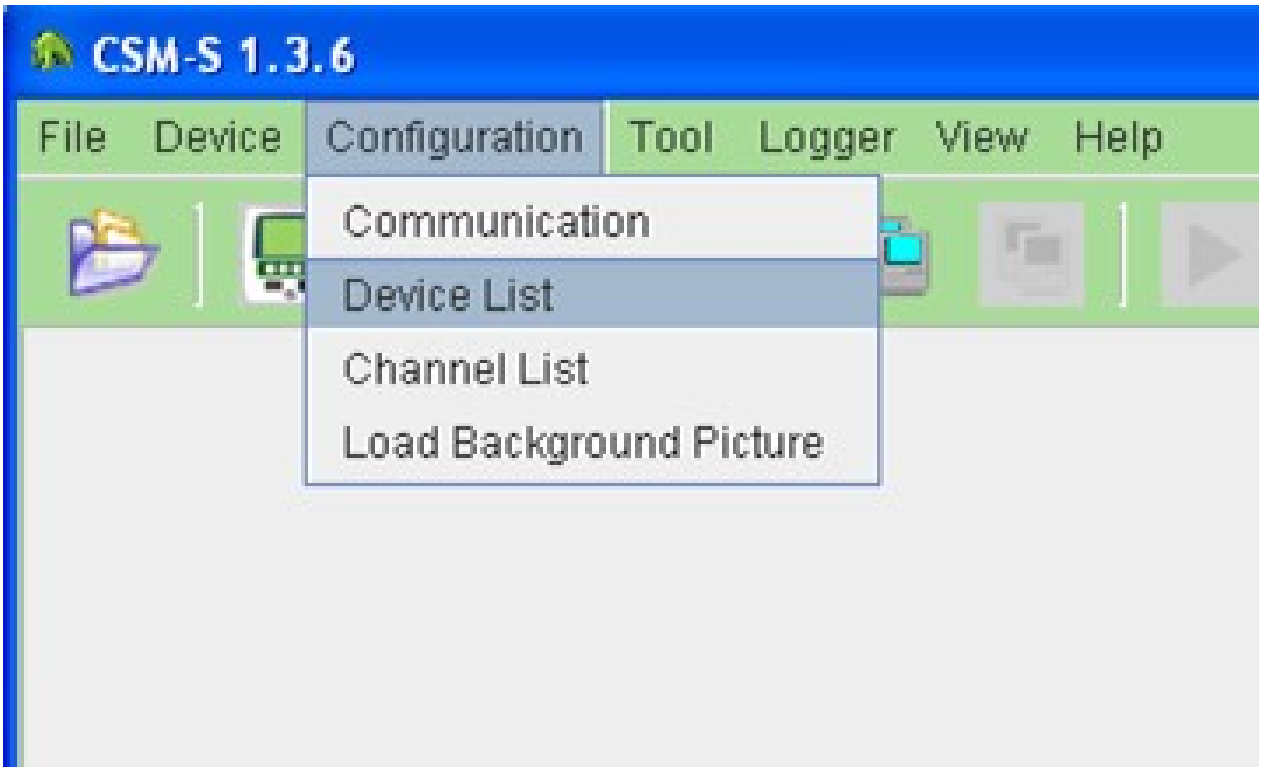
This chapter describes the basic configuration settings in the software in order to communicate with the devices. Start S4M-S and choose **Configuration → Communication** from the menu to open Configuration Dialog. Select the appropriate communication channel.



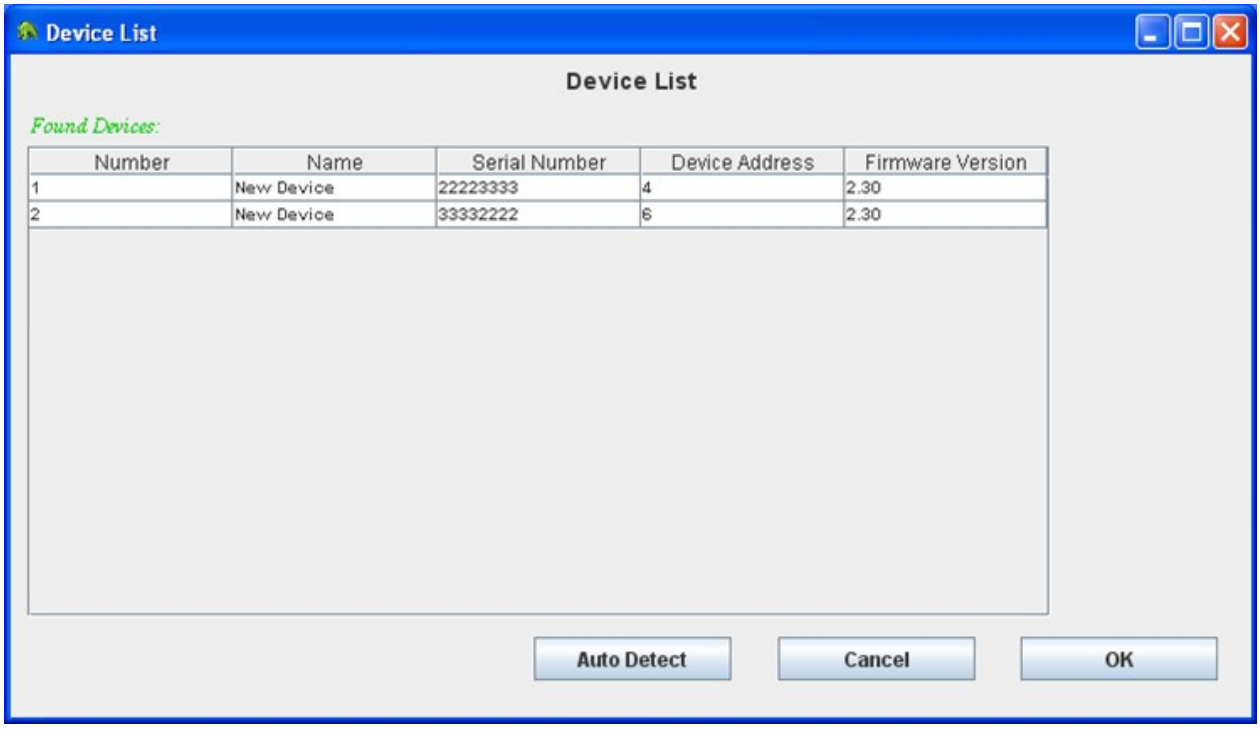
The S 330 series has 3 different selections: **Ethernet**, **RS-485** or **USB**. For **RS-485** it's required to additionally select **COM port** number. Then click **OK**.

Remark

If you don't know which COM port number should be selected please select **Help** —> **Help Contents** to read related section in the help file.



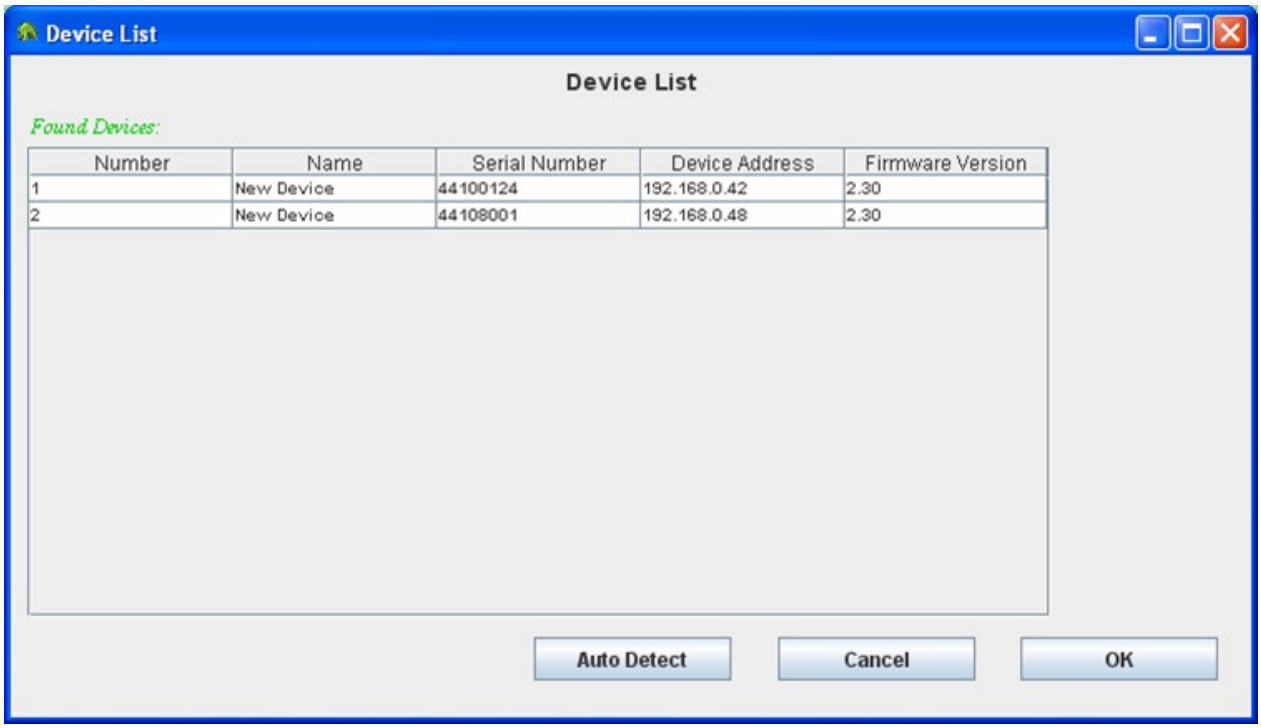
Choose **Configuration** → **Device list** from the menu to open Device List Dialog. Click **Auto Detect** to detect all devices connected.



A **Device List** dialog will then display all S 330/331 found in the RS-485 network. Choose the one you want to connect, then click **Select**.

Remark

S4M-S can only connect to one S 330 / 331 at a time. For multiple S 330 / 331 connection please refer to HelpFile of S4M-XL.

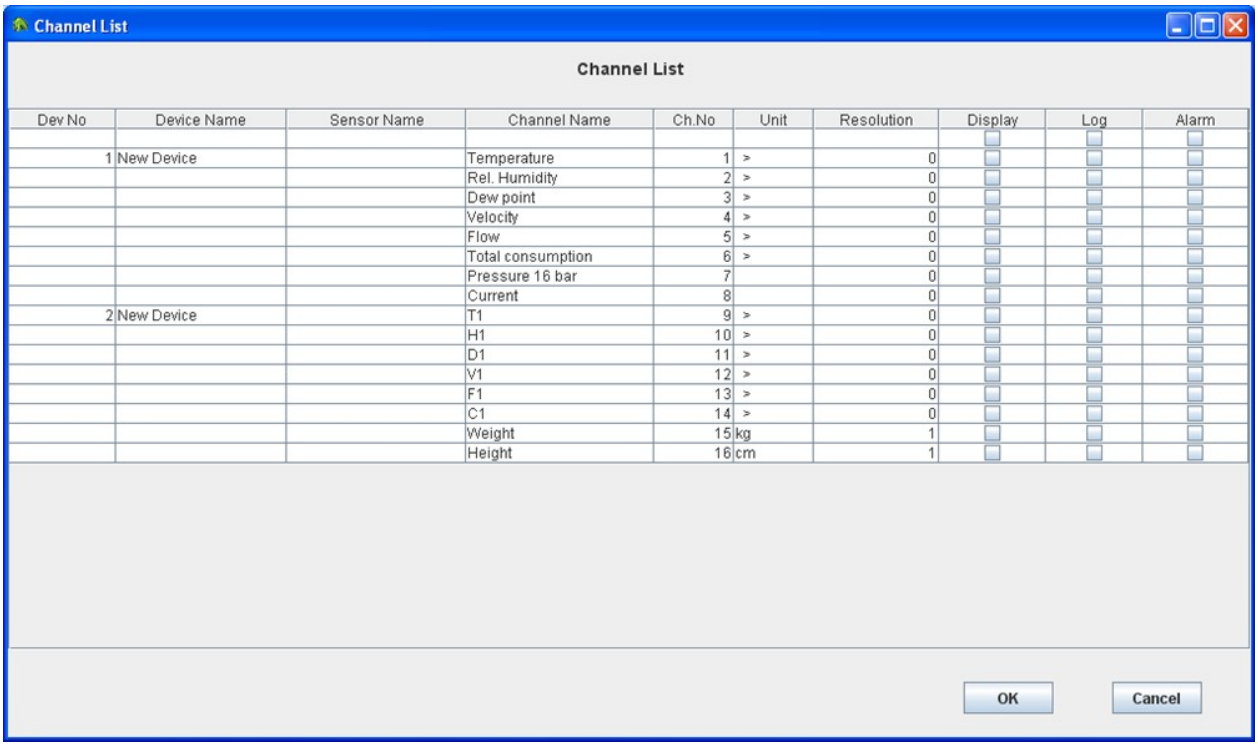


S4M-S software is capable to communicate with up to 30 S 330 / 331 at the same time. After clicking **Auto Detect** button, device list will display all S 330/331 found in the LAN. Click **OK**.

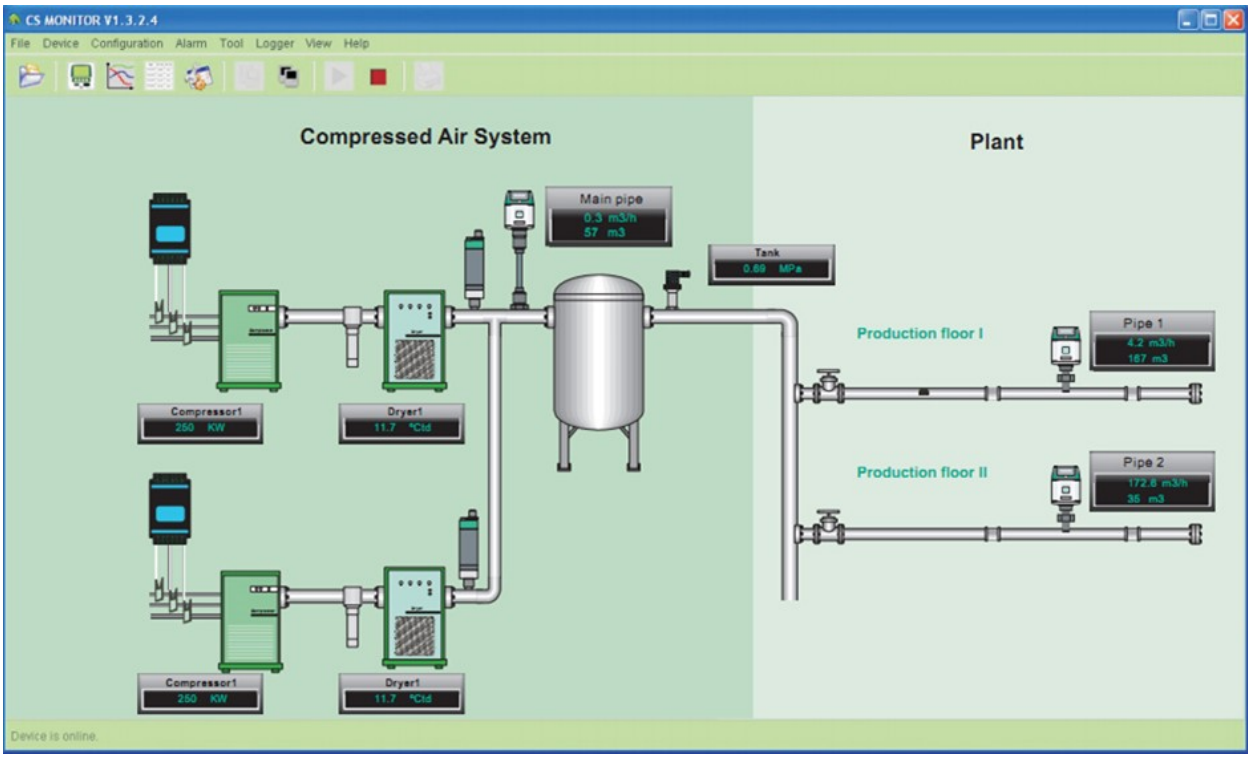
Remark

Auto Detect only needs to be done once unless hardware changed.

The next step is to select in the channel list the measurement channels which should be displayed on the screen and which channels should be logged or have an alarm monitoring.



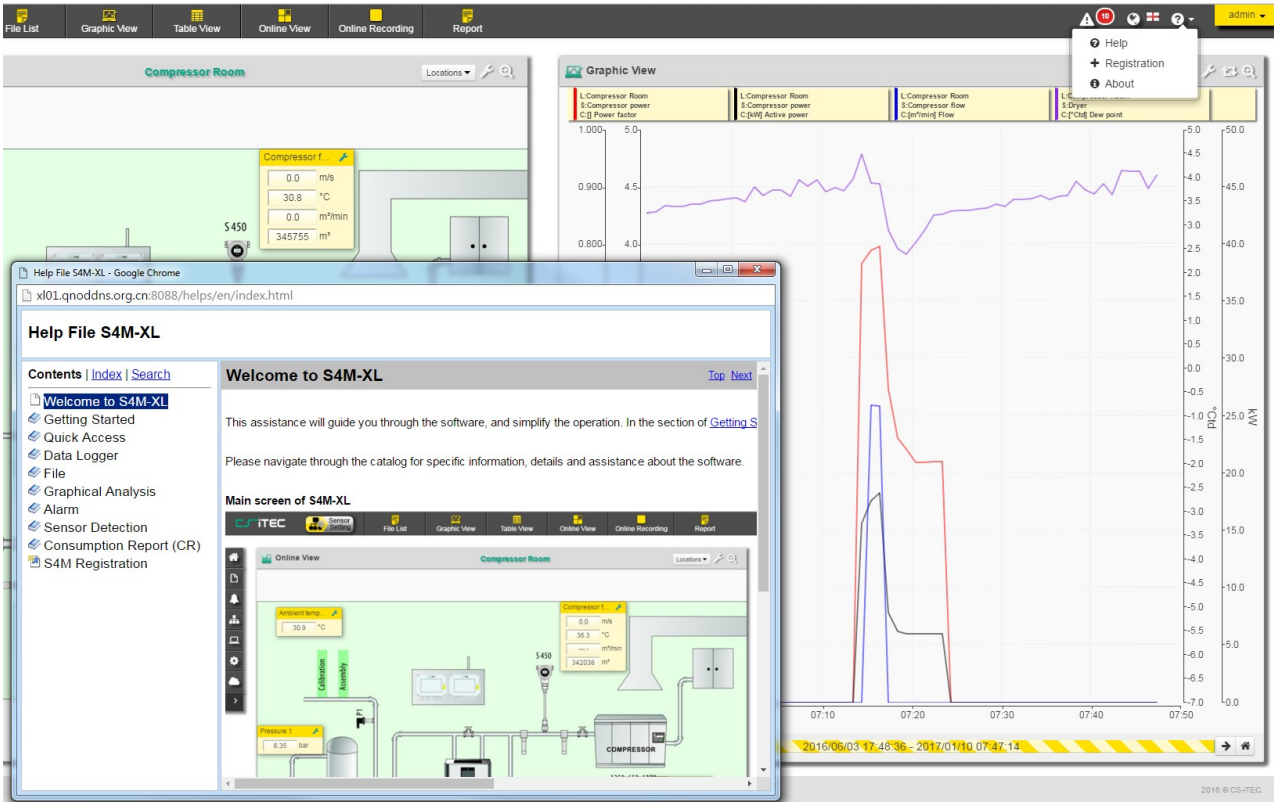
In the Channel list, all measurement channels will be listed. User can select those measurement he wants to show on the screen and those he wants to do data logging. User can also input a name for every sensor.



Select **Device —> Go online** to show online measurement as shown above. Press and hold the left mouse button, drag the mouse and move the meter windows to proper location, release the mouse to confirm moving.

2. Configuration of S4M-XL

You will be helped with Help File of S4M-XL.



11.2.6 Trouble shooting

1. Ethernet

Can not find any device or can not establish communication.

- Check device connection. There are 2 lights at S 330 / 331 Ethernet interface. When S 330 / 331 properly connected, the yellow one should be on indicating power supply is OK, while green light should be blinking which indicate data transmission.
- Check network cable. Make sure it's the right RJ45 Ethernet cable and connect properly.

  Note that 'Link' light on the switching hub should be on.
- Check if PC and S 330 / 331 are on the same subnet.
- Check if there exists a device or PC which has same IP address as the S 330 / 331.
- Make sure firewall settings on PC doesn't block S 330 / 331 communication which uses port 502.
- Check if the firewall is closed on the PC

- Make sure that the PC has installed only one Ethernet card

Communication is not stable.

- Check to make sure the speed of switching hub which S 330 / 331 connect to is 100Mbps.
- Check physical connection (network cable) making sure it's well connected.
- Try to set communication option again in **Configuration —> Communication**.
- Now try to communicate again.
- If it still not working, try to reset S 330 / 331 by power it off and on again. And restart software. Then retry the communication.

2. RS-485

Cannot find any device or cannot establish communication

- Check the RS485-USB converter has correct cable connection to the net work.
- Check each S 330 / 331 has an unique address set.

Communication is not stable or lost during online reading

- Check to ensure that only the last device on the RS 485 network has termination resistor switched on.
- Check to ensure bus cable must be laid at a distance of at least 20 cm from other cables.
- Check that bus cable is below 1000 m, otherwise consider to install a repeater.
- Check to ensure the length of each T (stub) connection is maximum 1m.

12. Optional extra accessories

It is possible to order also following extra accessories:

- Two analog inputs 0... 20 mA + 2 pulse inputs.
- Hat rail holder.
- Connection board for looping 4... 20 mA and pulse signal to PLC, mountable in wall casing A1666 + A1668.

13. Maintenance

To clean the sensor and its accessories it is recommended to use moist cloth only.

ATTENTION!

Do not use isopropyl alcohol to clean the display!

14. Disposal or waste

Electronic devices are recyclable material and do not belong in the household waste. The sensor, the accessories and its packings must be disposed according to your local statutory requirements. The dispose can also be carried by the manufacturer of the product, for this please contact the manufacturer.

15. Warranty

SUTO provides a warranty for this product of 24 months covering the material and workmanship under the stated operating conditions from the date of delivery. Please report any findings immediately and within the warranty time. If faults occurring during the warranty time SUTO will repair or replace the defective unit, without charge for labour and material costs but there is a charge for other service such as transport and packing costs.
Excluded from this warranty is:

- Damage caused by:
  - Improper use and non-adherence to the instruction manual.
  - Use of unsuitable accessories.
  - External influences (e.g. damage caused by vibration, damage during transportation, excess heat or moisture).

The warranty is cancelled:

- If the user opens the measurement instrument without a direct request written in this instruction manual.
- If repairs or modifications are undertaken by third parties or unauthorised persons.
- If the serial number has been changed, damaged or removed.

Other claims, especially those for damage occurring outside the instrument are not included unless responsibility is legally binding.

Warranty repairs do not extend the period of warranty.

ATTENTION!

Batteries have a reduced warranty time of 12 month.

Appendix A – Modbus communication example

03 (0x03) Read holding register

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Starting address Hi	1 byte	Byte count	1 byte
Starting address Lo	1 byte	Register Hi	1 byte
No. of points Hi	1 byte	Register Lo	1 byte
No. of points Lo	1 byte	:	:
CRC	2 bytes	Register Hi	1 byte
		Register Lo	1 byte
		CRC	2 bytes

05 (0x05) Write single coil

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Coil address Hi	1 byte	Coil address Hi	1 byte
Coil address Lo	1 byte	Coil address Lo	1 byte
Data Hi	1 byte	Data Hi	1 byte
Data Lo	1 byte	Data L	1 byte
CRC	2 bytes	CRC	2 bytes

16 (0x10) Write multiple registers

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Starting address Hi	1 byte	Starting address Hi	1 byte
Starting address Lo	1 byte	Starting address Lo	1 byte
No. of registers Hi	1 byte	No. of registers Hi	1 byte
No. of registers Lo	1 byte	No. of registers Lo	1 byte
Byte count	1 byte	CRC	2 bytes

Data Hi	1 byte		
Data Lo	1 byte		
:	:		
Data Hi	1 byte		
Data Lo	1 byte		
CRC	2 bytes		

17 (0x11) Report slave ID

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
CRC	2 bytes	Byte count	1 byte
		Slave ID	2 bytes
		Device run indicator	2 bytes
		Product code	2 bytes
		Product name	20 bytes
		CRC	2 bytes

Appendix B – LRC CRC calculation

LRC Generation

The Longitudinal Redundancy Checking (LRC) field is one byte, containing an 8–bit binary value. The LRC value is calculated by the transmitting device, which appends the LRC to the message. The device that receives recalculates an LRC during receipt of the message, and compares the calculated value to the actual value it received in the LRC field. If the two values are not equal, an error results.

The LRC is calculated by adding together successive 8–bit bytes in the message, discarding any carries, and then two's complementing the result. The LRC is an 8–bit field, therefore each new addition of a character that would result in a value higher than 255 decimal simply 'rolls over' the field's value through zero. Because there is no ninth bit, the carry is discarded automatically.

A procedure for generating an LRC is:

1. Add all bytes in the message, excluding the starting 'colon' and ending CRLF. Add them into an 8–bit field, so that carries will be discarded.
2. Subtract the final field value from FF hex (all 1's) to produce the ones–complement.
3. Add 1 to produce the twos–complement.

Placing the LRC into the Message

When the 8–bit LRC (2 ASCII characters) is transmitted in the message, the high–order character will be transmitted first, followed by the low–order character. For example, if the LRC value is 61 hex (0110 0001):

Colon	Addr	Func	Data Count	Data	Data	Data	Data	LRC Hi	LRC Lo	CR	LF
								"6" 0x36	"1" 0x31		

Example: an example of a C language function performing LRC generation is shown below.

The function takes two arguments:

```
unsigned char *auchMsg; /* A pointer to the message buffer containing binary data */
                        /* to be used for generating the LRC,                      */
unsigned short usDataLen; /* The quantity of bytes in the message buffer.          */
```

LRC Generation Function

```
static unsigned char LRC(unsigned char *auchMsg, unsigned short usDataLen)
 {
       unsigned char uchLRC = 0 ;                    /* LRC char initialized */
       while (usDataLen--)                          /* pass through message buffer */
             uchLRC += *auchMsg++ ;                /* add buffer byte without carry */
       return ((unsigned char)(-((char)uchLRC))) ;   /* return twos complement */
}
```

CRC Generation

The **C**yclical **R**edundancy **C**hecking (CRC) field is two bytes, containing a 16-bit binary value. The CRC value is first generated by the transmitting device, which appends the CRC to the message. The device that receives recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.

There are many ways of calculating a CRC checksum. To ensure correct calculation, please refer to [Reference 1] Modbus over serial line, where detailed descriptions and programming examples are available. Even more information and programming examples in different programming languages can be found on: www.modbus.org searching for CRC.

Below is a short text description of how the CRC is calculated. This description is then followed by a C programming example.

1. Load a 16-bit register with FFFF hex (all 1's). Call this the CRC register.

2. Exclusive **OR** the first 8-bit byte of the message with the low-order byte of the 16-bit CRC register, putting the result in the CRC register.

3. Shift the CRC register one bit to the right (toward the LSB), zero-filling the MSB. Extract and examine the LSB.

4. (If the LSB was 0): Repeat step 3 (another shift). (If the LSB was 1): Exclusive OR the CRC register with the polynomial value 0xA001 (1010 0000 0000 0001).

5. Repeat steps 3 and 4 until 8 shifts have been performed. When this is done, a complete 8-bit byte will have been processed.

6. Repeat steps 2 through 5 for the next 8-bit byte of the message. Continue doing this until all bytes have been processed.

7. The final content of the CRC register is the CRC value.

8. When the CRC is placed into the message, its upper and lower bytes must be swapped as described below.

Placing the CRC into the Message

When the 16-bit CRC (two 8-bit bytes) is transmitted in the message, the low-order byte will be transmitted first, followed by the high-order byte.

For example, if the CRC value is 1241 hex (0001 0010 0100 0001):

Addr	Func	Data count	Data	Data	Data	Data	CRC Lo	CRC Hi
							0x41	0x12

High-Order Byte Table

```
/* Table of CRC values for high–order byte */
static unsigned char auchCRCHi[] = {
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81,0x40
} ;
```

Low-Order Byte Table

```
/* Table of CRC values for low–order byte */
static char auchCRCLo[] = {
0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7,
0x05, 0xC5, 0xC4, 0x04, 0xCC, 0x0C, 0x0D, 0xCD, 0x0F, 0xCF, 0xCE, 0x0E,
0x0A, 0xCA, 0xCB, 0x0B, 0xC9, 0x09, 0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9,
0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD, 0x1D, 0x1C, 0xDC,
0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3,
0x11, 0xD1, 0xD0, 0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32,
0x36, 0xF6, 0xF7, 0x37, 0xF5, 0x35, 0x34, 0xF4, 0x3C, 0xFC, 0xFD, 0x3D,
0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A, 0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38,
0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0x2A, 0xEA, 0xEE, 0x2E, 0x2F, 0xEF,
0x2D, 0xED, 0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27, 0xE7, 0xE6, 0x26,
0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60, 0x61, 0xA1,
0x63, 0xA3, 0xA2, 0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64, 0xA4,
0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F, 0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB,
0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79, 0xBB, 0x7B, 0x7A, 0xBA,
0xBE, 0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5,
0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0,
```

```
0x50, 0x90, 0x91, 0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97,
0x55, 0x95, 0x94, 0x54, 0x9C, 0x5C, 0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E,
0x5A, 0x9A, 0x9B, 0x5B, 0x99, 0x59, 0x58, 0x98, 0x88, 0x48, 0x49, 0x89,
0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C,
0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83,
0x41, 0x81, 0x80, 0x40
};
unsigned short CRC16(unsigned char *puchMsg, unsigned short usDataLen){
  unsigned char uchCRCHi = 0xFF;                    /* high byte of CRC initialized
*/
  unsigned char uchCRCLo = 0xFF;                    /* low byte of CRC initialized
*/
  unsigned uIndex ;                                 /* will index into CRC lookup
table */
  while(usDataLen—)                                 /* pass through message
buffer */
  {
        uIndex = uchCRCHi ^ *puchMsg++ ;            /* calculate the CRC */
        uchCRCHi = uchCRCLo ^ auchCRCHi[uIndex] ;
        uchCRCLo = auchCRCLo[uIndex] ;
   }
   return (unsigned short int)((uchCRCHi << 8) | uchCRCLo);
}
```

Exception codes

The S 330/331 Modbus module uses the following exception codes, when responding to the master.

Exception code	Exception name
0x01	illegal function
0x02	Illegal data address
0x03	Illegal data value
0x04	Slave device failure
0x05	Acknowledge
0x06	Slave device busy

Appendix C – Float definition

32-bit floating-point format

The S 330/331 Modbus module IEEE '**Little-Endian**' representation for addresses and data items. This means that when a numerical quantity larger than a single byte is transmitted, the **Least** significant byte is sent first.

The data type **float** is represented by the 32-bit floating-point format. The representation of a 32-bit floating-point number as an integer is:

bit	31	30 23	22 0
	S	Exponent	Mantissa

The value of the number is:

$$(-1)^{S} * 2^{(Exponent-127)} * Mantissa$$

Value (decimal)	IEEE floating point format MSB LSB	Register N		Register N + 1	
		high	low	high	low
0.0	0x42C80000	0x00	0x00	0x42	0xC8
123.4	0x42F6CCCD	0xCC	0xCD	0x42	0xF6
2.0	0x40000000	0x00	0x00	0x00	0x40
-1.0	0xBF800000	0x00	0x00	0xBF	0x80
-80.0	0xC2A00000	0x00	0x00	0xC2	0xA0

Read 1st display value (Holding register address 0, 2 register)

Request: 0x01, 0x03, 0x00, 0x00, 0x00, 0x02, 0xC4, 0x0B

Response: 0x01, 0x03, 0x04, 0x99, 0x9A, 0x42, 0x55, 0x04, 0x1F

1st display value = 53.4

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