



Steam Flowrate Calculator and
Universal Controller

SPECTOR*control* Flow

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Applicability of this Manual

Product:

SPECTOR*control* Flow steam flowrate calculator and universal controller

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Scope of delivery/Product package

- 1 x SPECTOR*control* Flow steam flowrate calculator and universal controller
- 1 x Installation & Operating Manual

How to use this Manual

This Installation & Operating Manual describes the correct use of the SPECTOR*control* Flow steam flowrate calculator and universal controller. It applies to persons who integrate this equipment in control systems, install, bring into service, operate, maintain and dispose of this equipment. Anyone carrying out the above-mentioned activities must have read this Installation & Operating Manual and understood its contents.

- Read this Manual in full and follow all instructions given.
- Please also read the instructions for use of any accessories.
- The Installation & Operating Manual is part of the product package. Keep it in an easily accessible location.

Availability of this Installation & Operating Manual

- Make sure this Installation & Operating Manual is always available to the operator.
- If you pass on or sell the equipment to a third party, please also hand over the Installation & Operating Manual.

Illustrations and symbols used

1. Action to be taken

2.

- Lists
 - ◆ Bullet points in lists

A Keys to illustrations



Additional
information



Read the relevant
Installation & Operating Manual

Hazard symbols in this Manual



Danger zone/Dangerous situation



Danger of death from electric shock

Types of warning

DANGER

Warning of a dangerous situation that will result in death or serious injury.

WARNING

Warning of a dangerous situation that may result in death or serious injury.

CAUTION

Warning of a situation that may result in minor or moderate injury.

ATTENTION

Warning of a situation that will result in damage to property or the environment.

Specialist terms/Abbreviations

Here, we explain some abbreviations, specialist terms, etc., which are used in this Manual.

Controller

P component

The P component enables the controller gain to be adapted to the controlled system. The greater the P component, the more strongly the controller will react to deviations.

I component

The I component, or reset time T_n , ensures that control can take place without permanent deviation. The smaller the I component, the more strongly the controller will react to deviations.

D component

The D component, or derivative time T_v , responds to the rate of change of the actual value. When the setpoint is approached, the D component brakes and can therefore prevent the controlled variable from overshooting the setpoint. The greater the D component, the more strongly the controller will react to changes in the actual value.

Pulse / Pause

- “Min pulse” - Indicates the minimum time that the output is activated.
- “Min pause” - Indicates the minimum wait time between two activations.

The longer these times, the less frequently the output is activated. This reduces wear (e.g. to the control valve), but also the control accuracy.

Manipulated variable Min/Max

With continuous controllers, a variable or static “Min” manipulated variable can be entered. The advantage of the variable “Min” manipulated variable is that a variable minimum pump speed can be set, e.g. using calculations. This ensures that the pump works at the optimum operating point at different system pressures (normal operation/standby).

Valve runtime

Determine the valve runtime manually to achieve highly accurate controller positioning. Enter the duration of a single direction in seconds.

Specialist terms/Abbreviations

Dead zone

The effect of the dead zone is that the manipulated variable no longer changes when the setpoint plus/minus dead zone in % is reached.

Example using level:

Setpoint = 60%.

Dead zone = 5%. Setpoint [dead] = 3%.

58.5% ... 61.5% is the range within which the manipulated variable does not change.



Make sure that the controller is not oscillating.

Soft start

The soft start causes the setpoint of a controller to increase continually based on an adjustable ramp. A limit value and gradient can be set for this purpose. The soft start is activated when:

1. Control is enabled and the limit value is not reached.
2. The unit is switched from manual to automatic mode while the variable is below the limit value.

Usage for the intended purpose

The SPECTOR*control* Flow can be used in combination with various sensors for recording, processing and storing steam flowrate values.

The connected sensors can be used to generate additional limit values and freely configure the controller for various applications, e.g.:

- Continuous and pump controllers
- Valve and step controllers

Usage for the intended purpose includes use as a universal controller, e.g. as a:

- Level controller in combination with an NRG 26-xx level electrode
- Pressure controller in combination with a DRT... pressure transducer
- Temperature controller in combination with a TRG... Pt100 resistance thermometer

The SPECTOR*control* Flow is designed for installation in a control cabinet door or switch panel. It may only be operated when properly installed.

Configuration

Only configure the SC Flow on site.

IT security and rules for the use of Ethernet devices

The plant operator is responsible for the security of its IT network and must take appropriate action to protect plants, systems and components against unauthorised access.

If you use Ethernet devices in your plant, please pay attention to the instructions below:

- Do not connect plants, systems or components to an open network, such as the internet, without safeguards in place.
- Take suitable protective measures (e.g. a firewall) for connecting plants, systems and components to the company network or internet.
- Restrict access to all components to authorised persons only.
- Change default factory passwords before bringing into service for the first time!
- Deploy defence in depth mechanisms in your plant security, to restrict access and control to individual products and networks.

Applicable directives and standards

The SPECTOR*control* Flow has been tested and approved for use in the scope governed by the following directives and standards:

Directives:

- Directive 2014/30/EU EMC Directive

Standards:

- EN 61000-4 Electromagnetic compatibility (EMC)
- Industrial Formulation IAPWS IF97

Improper use



There is a danger of death due to explosion if the equipment is used in potentially explosive atmospheres.

Do not use the equipment in potentially explosive atmospheres.

Basic safety notes



There is a risk of electric shock during work on electrical systems.

- Always switch off the voltage to the equipment before working on the terminal strips.
- Check that the system is not carrying live voltage before commencing work.

Required personnel qualifications

Activity	Personnel	
Integration in control system	Specialist staff	Plant designer
Installation/electrical connection/bringing into service	Specialist staff	Electrician/installer The equipment may only be installed, wired and brought into service by qualified and competent staff.
Operation	Boiler service technician	Staff trained by the plant operator
Maintenance work	Specialist staff	Electrician Maintenance and refits may only be performed by authorised staff who have undergone specific training.
Refits	Specialist staff	Plant construction

Fig. 1

Notes on product liability

The manufacturer cannot accept any liability for damage resulting from improper use of the equipment.

Function

The SPECTOR*control* Flow can be used in combination with various sensors for recording, processing and storing steam flowrate values. The steam flowrate calculator calculates a mass flow from a volume flow with the aid of a pressure and/or temperature sensor. The data can be stored in the unit and exported for further processing. In addition, limit values can be generated and controller applications configured, e.g.:

- Continuous and step controllers for actuating valves and/or pumps

Digital and analogue logic operations and calculation functions offer further features for use as a universal controller.

Operation and configuration, see page 23

The SPECTOR*control* Flow is operated and configured directly on site using the colour touchscreen or via Ethernet using remote software.

Analogue and digital inputs and outputs

The necessary analogue and digital inputs and outputs are on the back of the unit, see page 19:

- 20 x digital inputs 24 V (maximum input frequency < 20 Hz, ≤ 50 ms)
- 12 x digital outputs 24 V
- 4 x analogue inputs (4..20 mA, 0..20 mA, 0..10 V, Pt100)
- 4 x analogue outputs (4..20 mA, 0..20 mA, 0..10 V)
- 1 x analogue input Pt100 (measuring range: 0 - 120°C)

The inputs, or input signals, can be switched directly on the controller or further processed by the logic and calculation functions, for example. They are then output once more via a digital or analogue output (IPO model). These signals are used to perform a great variety of tasks specific to the configuration.

The following functions and tasks can be carried out:

- 2 x steam flowrate calculators for mass flow and capacity (with pressure/temperature compensation)
or
- 1 x steam flowrate calculator with pressure and temperature compensation
- 3 x 3 trend logs for freely selectable input signals
- 4 x day/month accumulated flowrate logs
- 4 x calculations, e.g. for multiplying switching values, limit values and setpoints
- 5 x logic operations, e.g. for enabling the controller
- 2 x time switches
- List of fault indications
- 5 x integrated, freely customisable controllers with the following functions:
 - ◆ Continuous controller and continuous pump controller:
 - ◆ 3-point step controller
 - ◆ 2-point valve/pump controller
 - ◆ With P, PI or PID characteristic, dead zone, soft start, depending on the controller

Technical data

Supply voltage

- 24 V DC (---) +/- 30%

Power consumption

- Max. 14.4 VA

Current consumption

- Max. 0.6 A (at 24 V)

Required external fuse

- 10 A

Analogue inputs CH1 - CH4

- 0 - 20 mA Input impedance 200 Ω
- 4 - 20 mA Input impedance 200 Ω
- 0 - 10 V Input impedance 10 M Ω
- Pt100 3-conductor connection

Analogue outputs CH1 to CH4

- 0 - 20 mA Max. output load 470 Ω
- 4 - 20 mA Max. output load 470 Ω
- 0 - 10 V Min. output load 1 k Ω

Digital inputs 1 to 20 (two-conductor connection)

- Input voltage range 12 V to 30 V DC (---)

Digital outputs 1 to 12

- 0.5 A (protected against overcurrent and overheating)

Terminals/connectors for inputs/outputs

- 8 x 10-pin spring terminal strips, can be removed separately
- With 1 x 1.5 mm² solid or stranded wire
- With 1 x 1.0 mm² stranded wire with sleeve

Interfaces for data transmission

- 2 x Ethernet 10/100 Mbit switched (Modbus TCP/IP)
- 1 x USB host port (versions 2.0 and 1.1)
- 1 x slot for SD card
- 1 x RS485 steam flowrate meter VLM / SLM

Technical data

Indicators and controls

- Capacitive 5" touchscreen with LED backlight
- Resolution 800 x 480 pixels (WVGA)
- Brightness 200 Cd/m², dimmable
- Size (field of view) 110 mm x 65 mm

IP rating

- Front: IP 66
- Back: IP 20

Admissible ambient conditions

- Service temperature: 0°C – 50°C
- Storage temperature: -20°C – 70°C
- Transport temperature: -20°C– 70°C
- Air humidity: 5% – 85% relative humidity, non-condensing

Housing

- Material: Front (metal/glass) / back (metal electronics housing)
- Housing attachment with the supplied fastening elements
- Must be installed in a control cabinet or switch panel

Dimensions, see page 17

- Front panel (W x H) 147 mm x 107 mm
- Switch panel cutout (W x H) 136 mm x 96 mm
- Depth + protrusion (90 mm + 8 mm)

Weight

- Approx. 1 kg

Internal battery, permanently installed, non-replaceable

- Type: Lithium-ion, battery is charged automatically



If the equipment is out of service for six months or more, we recommend connecting it to the supply voltage for one day, to recharge the battery.

Rating plate/Identification

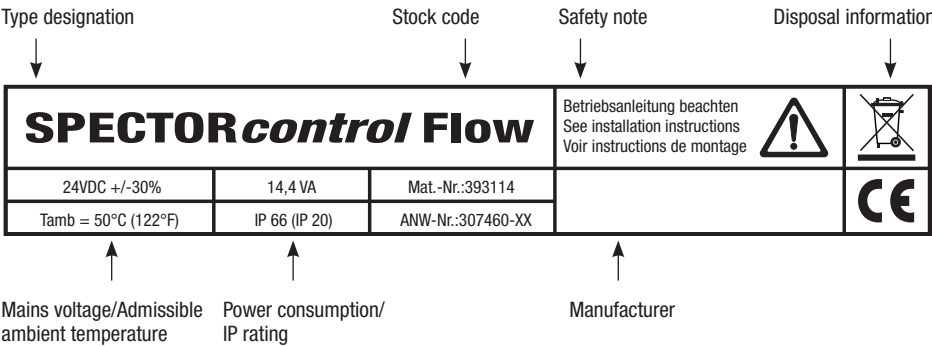


Fig. 2

Dimensions of the SPECTOR*control* Flow

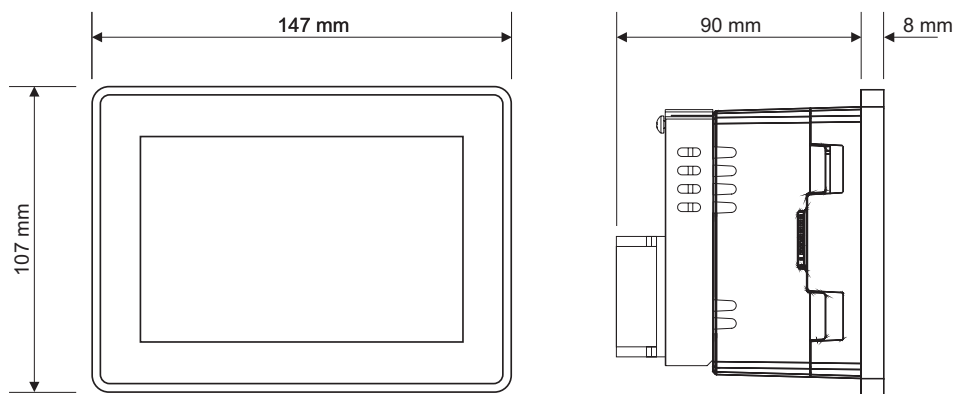


Fig. 3

Required aperture in the door of the control cabinet or in the switch panel

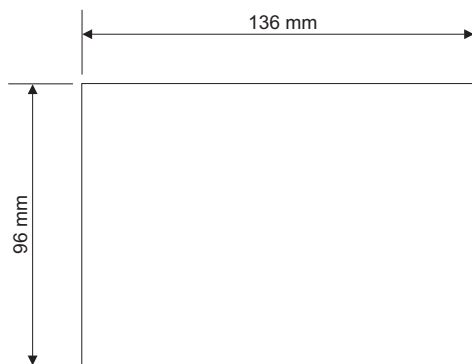


Fig. 4

Installing the SPECTOR*control* Flow

The SPECTOR*control* Flow is designed for installation in control cabinet doors or switch panels. The maximum panel thickness is 10 mm.

You will need the following tools:

- A tool to cut out the aperture
- A Phillips PH2 screwdriver

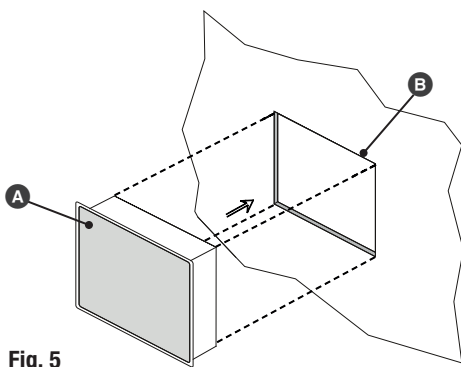


Fig. 5

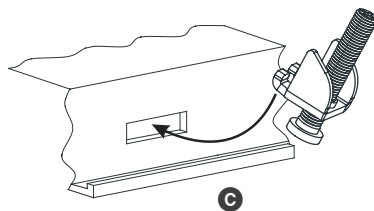


Fig. 6

- A** Display (with surrounding frame)
- B** Aperture 136 x 96 mm, e.g. in a control cabinet door
- C** Fastening element (supplied) for mounting hole in the unit

1. Cut an aperture (see Fig. 5) in the control cabinet door or switch panel.
2. Carefully push the steam flowrate calculator through the aperture.
3. Insert the supplied fastening elements and tighten them to a maximum tightening torque of 130 Ncm until the display frame is held securely against the installed gasket.
4. Remove the protective film from the display.

Connecting the SPECTORcontrol Flow

Interfaces on the back of the unit

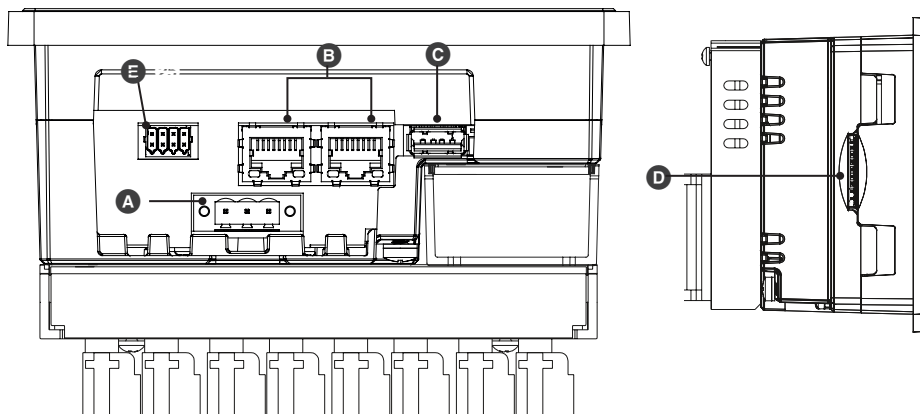


Fig. 7

- A 1 x 3-pin connection for 24 V DC supply voltage
- B 2 x Ethernet ports 10/100 Mbit switched (Modbus TCP/IP)
- C 1 x USB host port (versions 2.0 and 1.1) for USB sticks with FAT32/FAT or exFAT file format
- D 1 x slot for SD card with FAT32 file format (for service purposes)
- E 1 x RS485 Modbus RTU connection

Connection for 24 V DC supply voltage - pin assignment

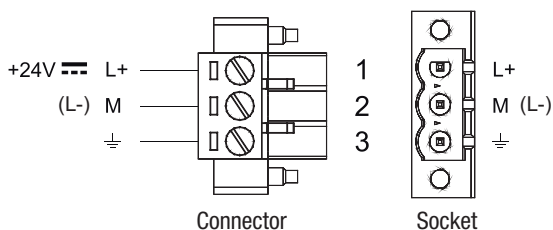


Fig. 8

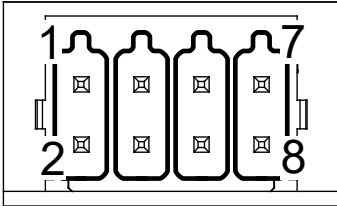


Use a SELV (Safety Extra Low Voltage) power supply unit for connecting the supply voltage. To connect the supply voltage to the 3-pin connector, use a cable with a max. conductor cross-section of 2.5 mm².

Connecting the SPECTORcontrol Flow

RS 485 Modbus RTU connection

The RS 485 interface on the SPECTORcontrol Flow

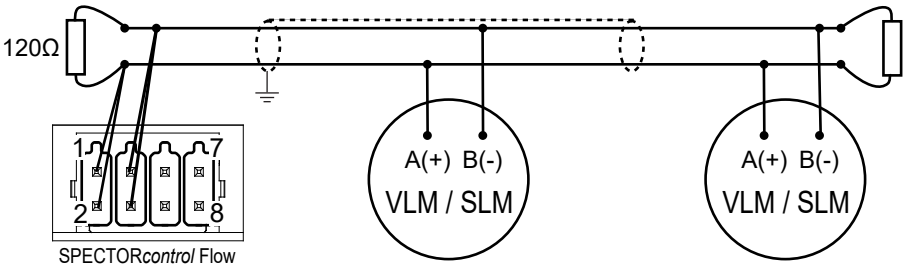


Conductor cross-section max. 0.5 mm².

Pin	Description
1	CHB-
2	CHA-
3	CHB+
4	CHA+
5	
6	GND
7	
8	Shield

Pins 1–2 and 3–4 must each be bridged externally!

Connection example



Use a shielded, twisted-pair data cable with low impedance. Earth the cable shield at only one point. Another cause of communication failures is bus reflections. To prevent reflections on the bus, the bus line must be terminated with a terminating resistor at both the beginning and the end of the line.

Parameters:

Baud rate	9600 bps
Parity	None
Base address	1
Cable length	Max. 1000 m (Cat5 500 m)
Terminating resistor	120 ohms

Connecting the SPECTOR*control* Flow

Inputs and outputs on the back of the unit

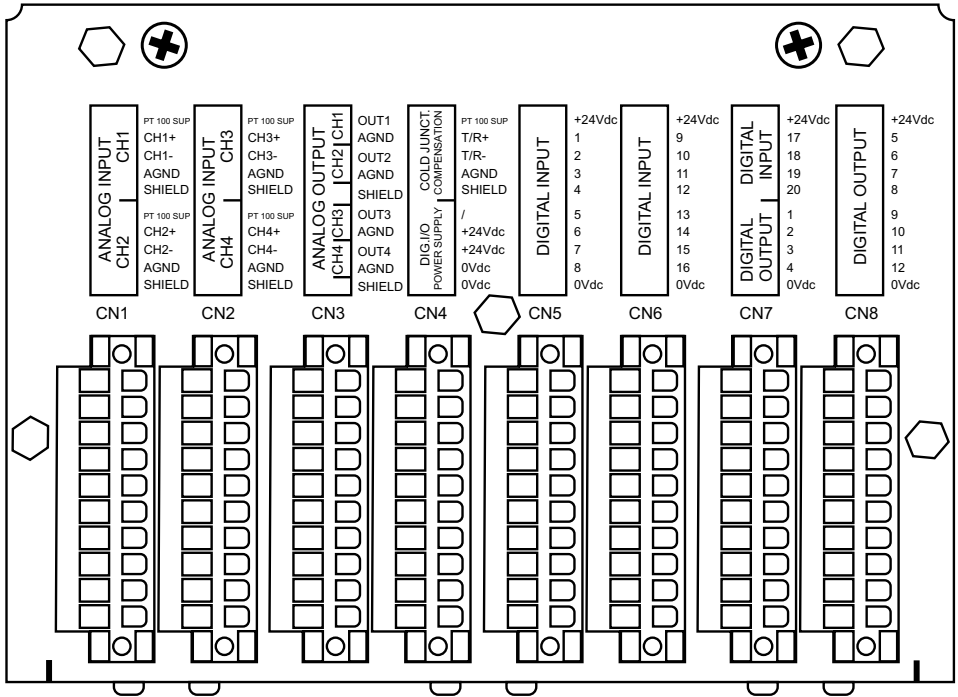


Fig. 12

The inputs and outputs on the back of the unit are distributed across multiple connectors (CN).

In the connection description, the channel number is indicated by an X.

The module must be supplied with 24 V DC, e.g. at CN4 7 and 9.

Connecting the SPECTORcontrol Flow

Analogue inputs (AI)

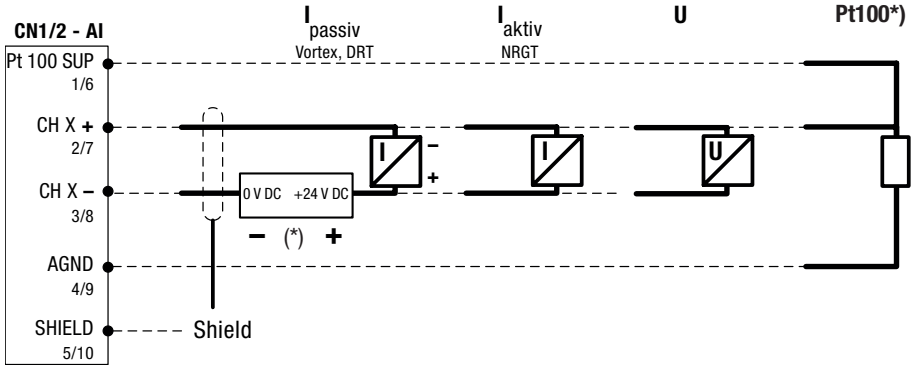


Fig. 9

* Supply voltage, for example 24 V DC from CN4:7 and 0 V DC from CN4:9

*) Analogue input 5, only PT100 on CN4. PT100Sub (1), T/R+ (2) and AGEND (4)

Analogue outputs (AO)

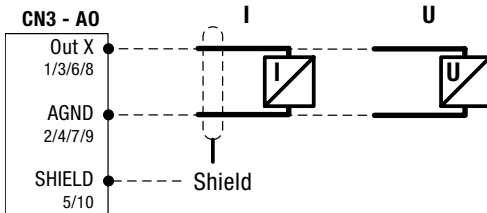


Fig. 10

Digital inputs (DI)/outputs (DO)

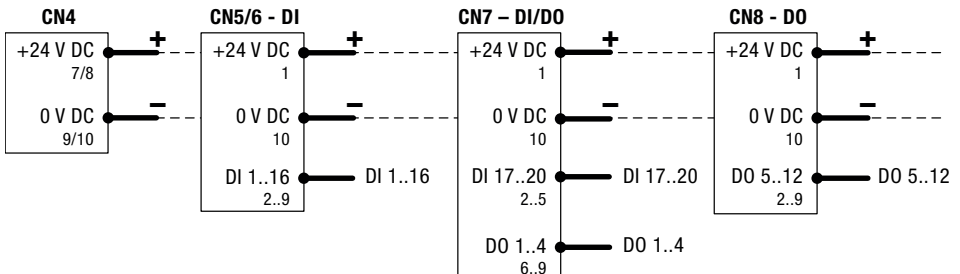


Fig. 11



Each +24 V and 0 V connection is bridged internally.

Operation and navigation

The steam flowrate calculator is operated either on the unit itself using the colour touchscreen or via Ethernet using remote software.

User interface

The user interface of the steam flowrate calculator is divided into three areas, see example:



- The title bar shows the selected menu and the time and date.
- The display area changes its appearance based on which menu is open.
- The toolbar shows the available features, which depend on the current menu.

Operation

Tap the buttons and input fields to initiate all inputs and actions, e.g. to open the Setup menus.

When you tap a button in the toolbar, this is then shown with a grey background.



All input fields, list boxes and buttons have a coloured background

Background colour	Description/Function
Yellow	Input field/List box/On/Off
Purple	Input field/On/Off
White	Shows readings, measurement signals and dimensions
Green	Status information for reading, signal > 0, status OK
Orange	Current status information for reading, signal above/below limit - Hi / Lo
Red	Status of error messages

Operation and navigation

Note on entering names

Always use unique names for all inputs/outputs and controllers, etc. This improves clarity and ensures clear assignment.

Maximum number of characters = 30

Entering names and parameters using the virtual keyboards

Tap a yellow input field to open an on-screen alphanumeric or numeric keyboard.

Type special characters by tapping “Shift” and “AltGr”.



The numeric keypad shows the old value (Old) and also the limits (Min / Max).

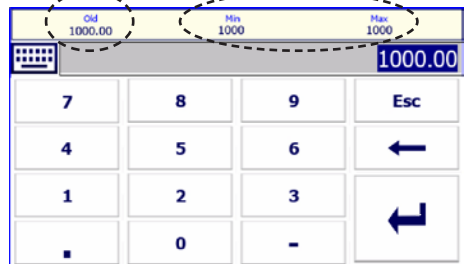


Your entry must be within these limits.



You cannot set an alarm limit that is higher than the preceding one, e.g.:

100% = 100 m³/h > HiHi ≤ 100 m³/h
Lo = 10 m³/h > Hi ≥ 10 m³/h



Apply your entry

Esc

Reject your entries and exit the keyboard

Entering parameters using list boxes

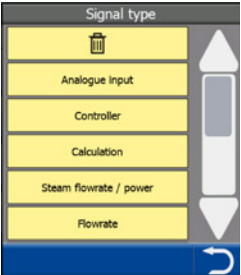
Some parameters, e.g. the analogue input signal, can be entered using list boxes.

Input	0-10V
Attenuat.	not active
HiHi	0-20mA
	4-20mA
	0-10V
Hi	PT100

Operation and navigation

Scroll bar for long lists and menus

You can scroll up and down through long lists and menus using scroll bars to navigate to the parameters you require.



Password protection for entering parameters

The entry and selection of parameters is password-protected by default. The password prompt appears automatically when you tap an input field. Users at the “user” level can adjust setpoints, switches and controller parameters. The configuration may only be changed by the “admin” user.



If you do not enter anything for 60 minutes, you will be logged off again.

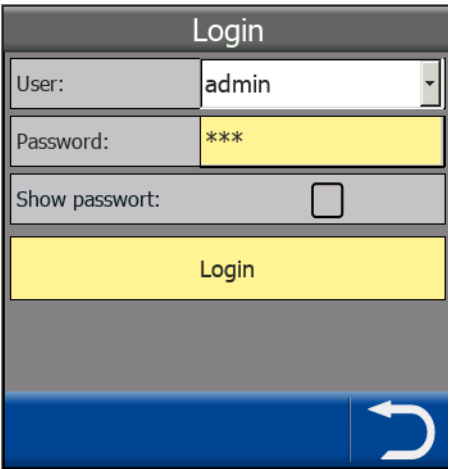
Factory setting

User level	admin	user
Password	aaa	bbb

Tap “Login” to confirm the password.

Recommendation when installing for the first time

Log in with the default password and change it when configuration is complete.



Maximum length of password:
10 characters

Changing the password

You can change the password at any time in the “Setup / User” menu.

Operation and navigation

General icons and functions

Icon	Description	
	Alarm signal	Grey = no alarm Yellow flashing = alarm that has not been acknowledged Yellow = active alarm that has been acknowledged
	Setup - further settings	Signals / Equipment
	Confirm, accept, Yes	
	Cancel, No	
	Return to previous page	
	Save (e.g. on a USB stick)	
	Delete signals, configurations	
	Return to home screen	
	Left/right cursor	
	Page forward/backward	
	Increase zoom level (+ / -)	
	Calibrate	

Operation and navigation

Icons and functions

Icon	Description
	Cumulated quantities
	Datalogs
	Controller
	Show current alarms
	System settings
	Inputs/outputs
	Functions
	Set range limits, alarms and alarm delays.
	Open the graphic representation of daily quantities.
	Open the graphic representation of monthly quantities.
	Open Setup Configuration Load available steam flowrate calculators. Save your own configuration.
	Open Setup Language Select the desired language.

Operation and navigation

Icon	Description
	Open Setup Info View software information and load updates. You can also view the PLC status and perform a reset.
	Open Setup Date / Time Set the date and time and switch between summer and winter time.
	Open Setup User Manage user profile and password.
	Open Setup Network View and change network settings. You can also set a remote access.
	Open Home Screen menu Decide on and set the appearance and content of the home screen.
	Analogue input
	Analogue output
	Digital input
	Digital output
	Setpoint
	Switches

Home screen

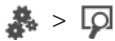
After system configuration, the home screen opens and provides an up-to-date overall view. Other menus can also be opened directly from the home screen.

You can edit and adjust the view and content of the home screen at any time as needed.



Configuring the screen view

Open the Home Screen menu



see example



Enter a name

You can enter a measuring point or plant name in the "Name" field.



You have a choice of three screen views



- Each button shows the screen view it represents.



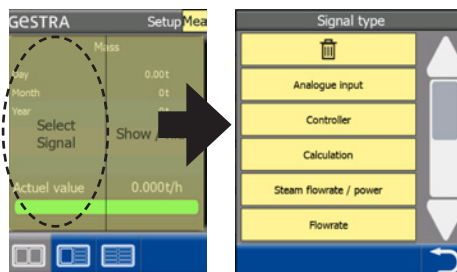
Home screen

Open the signal selection

Tap the “*Select Signal*” button to open the “*Signal type*” list box.

Here, you can select the readings and signals of all nodes and view them where you wish.

- Both analogue and digital actions (switches/setpoint function) can be performed. The parameter field to be displayed differs in that a button is shown.
- The parameters are shown in the centre.



A coloured bar chart indicates that alarm/switching limits have been reached

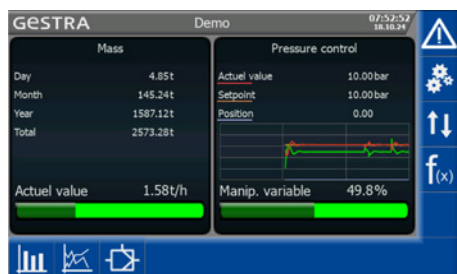
- When alarm/switching limits are assigned to an analogue signal, the associated bar chart changes colour when these limits are exceeded.
 - ◆ The status for Error, Manual, Stop and Flush is also shown in colour.



Bar chart display when alarm/signal limits are reached

Colour	Alarm / Status	Controller	Digital signal
Red	HiHi LoLo	Stop	Alarm
Orange	Hi Lo	Manual	—
Green	OK	Automatic mode	Active (On)
Grey	—	—	Not active (Off)

Example of a home screen



Cumulated quantity

This function enables time-dependent values (e.g. consumption values) to be shown as cumulated quantities. These are displayed as cumulated daily/monthly/yearly and total quantities.

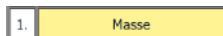
In addition, you can open a graphic representation of the day and month view for each cumulated quantity.



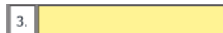
The “*Cumulated quantity*” menu shows an overview of the cumulated quantities that have been set up.

The overview page shows the status of the active signals.

To open a menu, tap on the row in question.



If you tap on an empty input field, you can create a new signal.



Nr.	Name	Value	State
1.	Mass	1.58t/h	Active
2.	Energy	1.34MW	Active
3.		0	Active
4.		0	Active
5.		0	Active

Description of display:

■ Name

The names of created signals.

■ Value

The current value of the signal.

■ Status

Displays the status and active alarms if an alarm or switching limit is reached:

- ◆ Active
- ◆ Off
- ◆ HiHi
- ◆ Hi
- ◆ Lo
- ◆ LoLo
- ◆ On
- ◆ Alarm

Cumulated quantity

Configuring a quantity

1. Masse (Example)

Open the menu for the required quantity.



The information below also applies to the creation of a new quantity.

Description of display:

■ Name

The names of created signals.



Switch the signal of the quantity on/off for further processing.

■ Signal

The signal that is to be shown as a cumulated quantity (e.g. the mass flow from the steam calculator).

■ Value

The current value of the signal.

■ Day / Month / Year / Total

The cumulated daily/monthly/yearly and total quantity (= sum total across all times).



Set all cumulated quantities to zero (recommended, e.g. after bringing into service).

■ Pulse output

The pulse output generates pulses based on the current input value. The weighting and length of the pulses can be adjusted.

Name	Signal	Value	Day	Month	Year	Total
Masse	Massflow	1.58t/h	4.85	145.24	1587.12	2573.28

Pulse output

Pulse / Flowr.	1.000t
Pulse duration	1s

Cumulated quantity

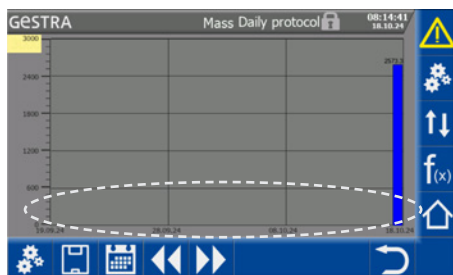
Graphic representation of daily and monthly quantities

■ Daily quantities

The daily values for one month are shown on the X-axis.



Use the arrow keys to page forward/back one month.

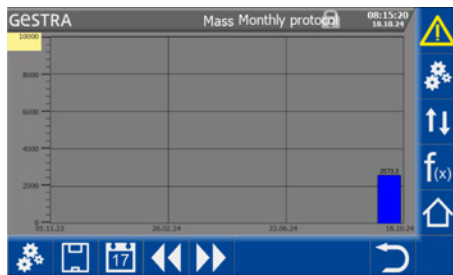


■ Monthly quantities

The monthly values for one year are shown on the X-axis.



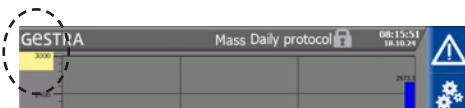
Use the arrow keys to page forward/back one year.



You can open the daily and monthly quantities from the last 36 months.

■ Scaling the Y-axis

Set the desired scale by tapping on the yellow Y-axis value at the top left.



■ Saving the daily and monthly quantities



Back up the daily and monthly quantities on a USB stick.

Cumulated quantity

Setting range limits and alarms for cumulated quantities

For further use, you need to set range limits and alarms suitable for your particular plant for each quantity you create.



Open the menu for setting range limits.

Description of display and settings:

■ Low flow

To prevent inaccurate measurements at very small flows (down to zero), here you can set a low flow cutoff to exclude the low flow from the measurement.

What happens if the flow is above or below the set low flow cutoff value?

a) Flow < set low flow cutoff

If the flow is below the set cutoff value, cumulation stops and the output value is set to “Zero”.

The message “*Low flow cutoff active*” appears here and in the “Cumulated quantity x” menu.

b) Flow > set low flow cutoff

Measurement (cumulation) continues.

■ 100%

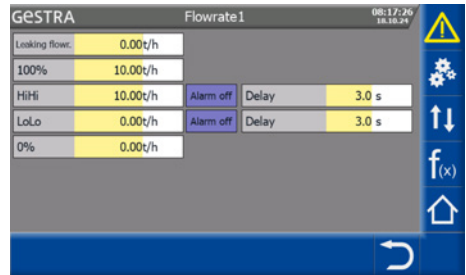
Set the upper limit of the signal range.

■ HiHi / LoLo

Set the required alarm limits.

■ 0%

Set the lower limit of the signal range.



■ Alarm On / Off (HiHi / LoLo)

Switch the alarm in question on/off.

Alarm On

If the alarm lasts longer than the set time delay, it is logged in the alarm history.

Alarm Off

If the alarm lasts longer than the set time delay, it is shown on the home screen (if activated there).

■ Delay (HiHi / LoLo)

Set the desired time delay for both alarms.

Setting range: 0 s to max. 255 s

Cumulated quantity

Analogue values or digital signals can be processed.

The input signal must have the appropriate dimension. This can be xxx/h, kW or MW.

External digital input signals are limited to an input frequency of 20 Hz (≥ 50 ms). Internal digital signals are limited to ≤ 5 Hz (≥ 200 ms).

Digital input signals

If you select a digital input signal, the following fields are added to the parameter page view:

- Unit
- Cumulated quantity/Pulse
- Mean value calculation

The unit and the cumulated quantity/pulse must be taken from the signal generator (e.g. counter) and form the basis for calculation.

Mean value

The mean value calculation smooths the output signal. It causes the quantity cumulation to lag behind the original input signal by the number of seconds entered.

Enter the time for calculating the mean value of the expected pulse intervals here.

Example

A counter sends one pulse per m^3 . The flowrate is $120 \text{ m}^3/\text{h}$. Thus, the pulse arrives on average every 30 s.

Without a mean value, the display would stay on "0" for 29 s and then jump to $3600 \text{ m}^3/\text{h}$ for 1 s.

Set the mean value to 30 s. The display then shows $120 \text{ m}^3/\text{h}$ for 30 seconds.

Disabling the mean value function

A mean value above "0 s" disables the function.

Datalog

In the “*Datalog*” menu, you can record signals (values) over a longer period (between 28 hours and 70 days, depending on the sample rate), and analyse them with the help of a graphic representation.



You can create up to three signals per datalog.

Description of graphic representation and analysis

Example using three analogue input signals

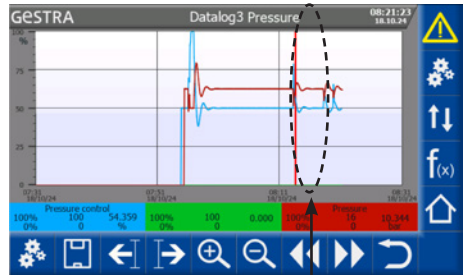
In this example, the signals from three analogue inputs are shown as three characteristic curves.

Organisation of axes

- The X-axis shows the characteristic over time (time and date) for each signal.
- The Y-axis shows the value in question in percent.

The ruler

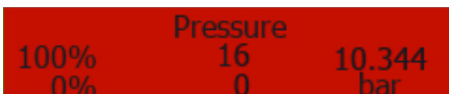
- The vertical ruler is used for orientation along the time axis.



The different coloured fields at the bottom of the screen contain numerical data on the input signals.



Each curve has the same colour as the field to which it refers.



- **0% / 100%**
The lower and upper range limits.
- **xx.x (e.g. 5.5)**
The current value at the ruler position.
- **% / bar / m³/h**
The dimension used.

Navigation using the function keys

- **Move the time axis**
- **Zoom in/zoom out of the visible time axis**
- **Position the ruler on the time axis**
- **Saving values**



Back up the numerical data in the individual coloured fields on a USB stick.

The data is saved in .csv format.

- **Open the Settings menu for datalogs**



When you want to edit an existing datalog or create a new one.

Datalog

Creating a new datalog



Open the “Datalog” menu and then go to Settings.

Description of display and settings:

■ Name

Assign any name you wish.



Enable the datalog.

The datalog is disabled as the default setting.

■ Sample rate

Define the sample rate to set the time until the next measurement.

Example:

5 s = a measurement takes place every 5 seconds

■ Duration

The duration and sample rate are dynamically connected. Setting the sample rate causes the duration to be automatically calculated and set.

■ Signals 1 to 3

You can select and record your desired input signals, as suitable for your on-site plant.

Opening signal selection:

Signal 1	Pressure control
----------	------------------

◆ When you tap on the desired button, the “Signal type” list box will appear, see page xy.

◆ Next, select the input signal you require.

■ 0% / 100%

Set the upper and lower range limits.

GESTRA		Datalog3		00:23:43 18.10.24
Name	Pressure log			
Sample time	5 s	Duration	140 h	
Signal 1	Pressure control	Controller Value	1	
0%	0.0 %	100%	100.0 %	
Signal 2			0	
0%	0.0	100%	100.0	
Signal 2	Pressure	Calculation Value	1	
0%	0.0 bar	100%	16.0 bar	



During initial configuration, the range limits 0% and 100% are copied from the signal source.

You can change the range limits at any time. The changes have no impact on the original signal.

Necessary range limit adjustment for digital input signals.



In the case of digital input signals, it is possible – in the case of frequent switching operations, for example – for the characteristic curve to take up the entire screen so that the other curves can no longer be seen.

Therefore, for digital input signals set the upper range limit to a value > 1 (e.g. 5), and then the characteristic curve will be positioned only in the bottom fifth of the display.

Controllers

If you wish, you can use the SPECTOR*control* Flow as a universal controller and freely configure it for various controller applications, e.g. as a:

- Continuous pump controller
- Valve or step controller

Digital and analogue logic operations and calculation functions offer further features for use as a universal controller.

The following pages briefly explain the possible uses and properties of the controller types set up in the factory.

Runtime-dependent pump switchover



Continuous and 2-point controllers can be configured as pump controllers. These allow pump switchover dependent on runtime and enabling.

No external position feedback signal



All controller applications work without an external position feedback signal.

For 3-point step controllers, a position feedback signal is generated internally over the valve runtime.

Controllers

Brief description of individual controller types

Continuous controller

Continuous controllers deliver an analogue value (0 to 100%) as a control signal and are suitable for actuating valves with positioners or frequency converters.

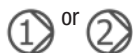
- The parameters “*P / I / D*” can be set.
- The external setpoint (e.g. the result of a calculation) or internal setpoint is shown on the parameter page and can be changed.
- If a soft start is activated, this is indicated by an exclamation mark (!) when there is activity in the “*Setpoint (w)*” bar chart.

Continuous pump controller

Continuous pump controllers additionally enable two pumps to be controlled. These are started, stopped and switched automatically as a function of their enable status and runtime.

- If the manipulated variable is below the shut-down threshold, the pumps are shut down.
- If the pumps receive a request, the pump with the shorter runtime switches on. This is indicated by pump 1 or 2 changing colour.

Configuring the pumps



Open the configuration menu for pumps 1 and 2.

- For each pump, you need to set an enable signal, “*Enable*”.

The pump runtime is also displayed.

- This “*Duration*” can be set individually.

If you wish to define a lead pump, for example, you must preset one of the pumps to xx hours.

Selecting the pump operating mode

Set the desired mode “*Automatic - Stop - On*” to control the pumps individually.

3-point step controller

3-point step controllers generate digital output signals for “Open” and “Closed” and are suitable for actuating motorised valves without a positioner.

- The “*Setpoint*” and parameters “*P / I / D*” can be set.
- The external setpoint (e.g. the result of a calculation) and internal setpoint are shown on the parameter page and can be changed.
- The calculated internal position is displayed.
- If a “*Soft start*” is activated, this is indicated by an exclamation mark (!) when there is activity in the “*Setpoint (w)*” bar chart.
- When an operating position (OP) is approached, this is indicated by “OP” in the “*Current position (yx)*” bar chart.
- If the operating position is active (the OP input was assigned in this way), a motorised valve moves into a defined switch position between Open and Closed.

Controllers

Intermittent blowdown program controller

The intermittent blowdown controller is enabled as standard. A signal can be assigned to the enabling function. This can be used to interrupt intermittent blowdown when the boiler is on standby.

An enable time delay can also be set. Set a time if several boilers work with one intermittent blowdown cooler.

Set the following parameters:

- Pulse interval
Time until the next intermittent boiler blowdown.
- Pulses
Number of pulses
- Interval
Time between pulses
- Duration
Length of a pulse
Intermittent boiler blowdown can be started for a cycle using the Manual button.

2-point valve controller

A digital output signal for actuating valves is generated on the basis of an On and Off switch-point. The location of the input fields varies depending on whether the control gain is positive or negative.

2-point pump controller

2-point pump controllers enable two pumps to be controlled. These are started, stopped and switched automatically as a function of their enable status and runtime.

- If the pumps receive a request, the pump with the shorter runtime switches on. This is indicated by pump 1 or 2 changing colour.
- In addition, a switch-on threshold can be entered for both pumps.
If values are above/below this threshold, both pumps are started and then switched off when the switch-off threshold is reached.

Configuring the pumps

To configure the pumps, refer to the instructions for the continuous pump controller.

Controllers

Selecting a controller to configure



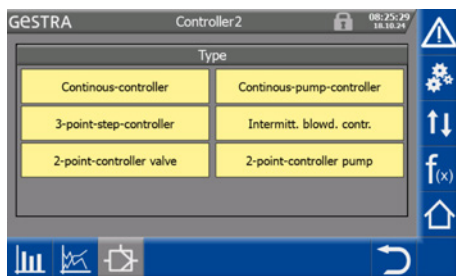
After setting the inputs, return to the home screen and open the “Controller” menu. Also see the example configuration on page 78.

Tap the first empty input field.

A list box opens showing various controller types that were set up at the factory.

Select the desired controller type.

The relevant parameter page then opens.

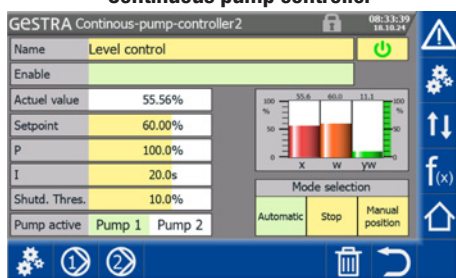


Overview of parameter pages for the individual controller types:

Continuous controller



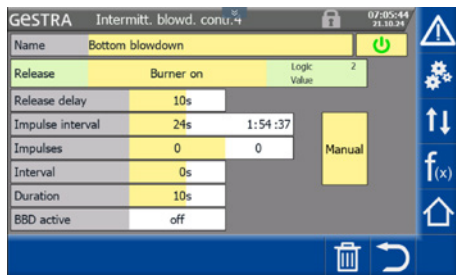
Continuous pump controller



3-point step controller

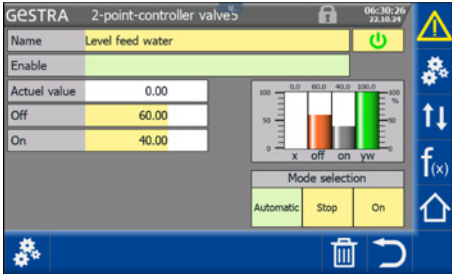


Intermittent blowdown controller

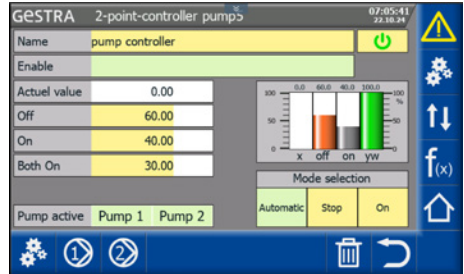


Controllers

2-point valve controller



2-point pump controller



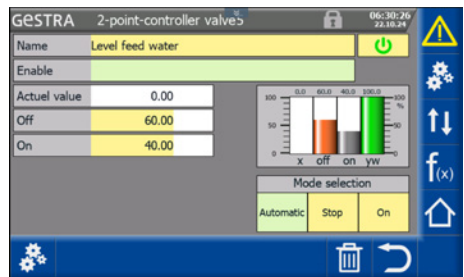
The parameter pages contain the name and other parameters for the specific controller type. The current values are also shown in a bar chart. You can also change the operating mode of the controllers.

-  Use this button to switch the controller on/off.

Description of bar charts

The bar charts provide an overview of current values:

- **x** = actual value
- **w** = setpoint
- **yx** = current position
- **yw** = manipulated variable
- **Off** = actual value at which the pump is switched off or the valve is closed.
- **On** = actual value at which the pump is switched on or the valve is opened.



Controllers

Changing the operating mode

On the parameter page, you can change the operating mode of the controller if necessary. The active mode has a green background.

- **Automatic**

- **Stop**

When Stop is selected, the manipulated variable goes to 0% or “*Valve closed*” is initiated.

- **Manual position**

Tapping this button opens an input window in which you can manually influence the manipulated variable.

There is always a smooth transition between Manual and Automatic, because the last manipulated variable is always used.

		Mode selection		
I	20.0s	Automatic	Stop	Manual position
D	0.0s			

ATTENTION

All manual operations are independent from the enable status. The operator is solely responsible for remaining within the limits!



If the controller is not in Automatic mode, a warning containing the message “Controller manual mode” is entered in the alarm history.

2-point valve controller

- **On**

The valve opens.

Mode selection		
Automatic	Stop	On

Intermittent blowdown controller

- **Manual**

An intermittent blowdown sequence is initiated and the pulse interval is reset.

Impulse interval	24s	1:54:37	Manual
Impulses	0	0	
Interval	0s		

Controllers

Setting the basic parameters in the Setup menu

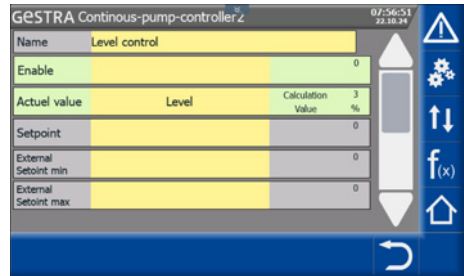
You can set the basic parameters and assign input signals in the Setup menu of the controller in question.



Tap the “*Setup*” button in the toolbar and open the Setup menu.

Example

Setup menu for a continuous pump controller



Description of all parameters:

■ Enable

With enable, the controller can be activated, depending on external conditions.

If no enable signal is selected, the controller is enabled automatically.

After an enable, the colour of the field in question turns from white to green. The enable is also shown on the parameter page.

If a controller enable lapses, the manipulated variable goes to 0%.

When another enable is issued, the controller starts with the 0% manipulated variable.

■ Actual value

The actual value is the value that is to be controlled.



The controller only works when the corresponding actual value is selected.

■ External setpoint

An external setpoint can be selected if it is available via Modbus or is generated from other signals in the system (e.g. calculation).

If no external setpoint is available, an internal setpoint can be assigned to the controller.

■ Manip. variable Min/Max

With continuous controllers, a **variable** or **static** “*Manip. variable Min/Max*” can be entered.

Advantages of the variable “Manip. variable Min”

The advantage of the variable “*Manip. variable Min*” is that a variable minimum pump speed can be set, e.g. using calculations. This ensures that the pump works at the optimum operating point at different system pressures (normal operation/standby).

■ Direction of process variable:

The direction of the process variable in a controller is influenced by positive/negative (inlet/outflow control).

■ Min. pulse/Min. pause

- ◆ Min. pulse indicates the minimum time that the output is activated.
- ◆ Min. pause is the minimum wait time between two activations.



The longer these times, the less frequently the output is activated. This reduces wear, but also the control accuracy.

Alarm

Alarms are indicated by a coloured warning triangle at the top right of the display.

Pay attention to the status and colour of the warning triangle

- Yellow, flashing
Active alarms are present that have not been acknowledged.
- Yellow, on continuously
Active acknowledged alarms are present.
- Grey
No alarms are active.



Opening the “Active Alarms” page



Tap the icon to open the list of active alarms.

Description of the alarm history:

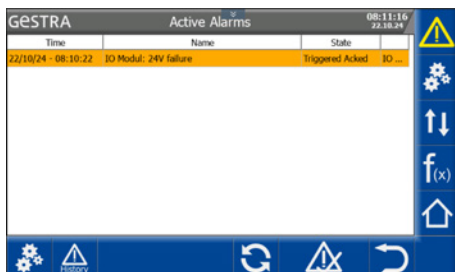
- The most recent alarm is always highlighted in red and shown at the top of the list.
- When alarms are acknowledged, the background colour of the alarm changes to orange if they have not yet expired and alarms are removed from the list if they have expired.
- Inactive, unacknowledged alarms are shown with a white background.

Example

An alarm, e.g. Level HiHi, occurs when the limit value is exceeded and the time delay has elapsed.

It expires when the level has fallen below the “HiHi” level and, as above, the time delay has elapsed.

If you do not acknowledge the alarm during this time, the alarm is considered as expired but unacknowledged.



Description of display:

- **Time**
Time at which the event occurred.
- **Name**
Name of the signal with a description of the alarm (e.g. HiHi or LoLo).
- **Status**
 - ◆ Pending, unacknowledged
 - ◆ Pending, acknowledged
 - ◆ No longer pending, unacknowledged

Acknowledging alarms



Tap this button to acknowledge alarms.

Alarm

Configuring alarms

Further actions can be performed if necessary when alarms occur.

A warning lamp or buzzer can be connected and triggered at a digital output, for example. You can configure this in the “Alarm” setup menu.



Open the “Alarm” setup menu.

Description of parameters:

■ Name

Enter a name for the alarm.

The alarm will then be available in the system under this name.

■ Acknowledge

This enables alarms to be acknowledged (reset) using a button.

■ Signal (On/Off)

The alarm signal remains active while the alarm is active.

■ Lamp (On/Off)

The lamp behaves like the alarm icon.

It is continuously on when the alarm is active and has been acknowledged.

and

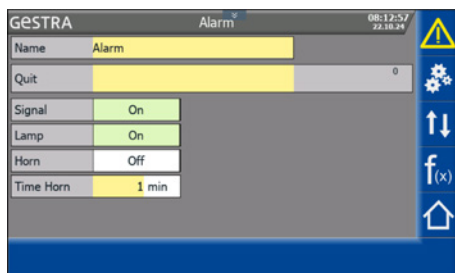
it flashes when the alarm is active but has not yet been acknowledged.

■ Buzzer (On/Off)

The buzzer is active for the duration of the set time and stops when the alarm is acknowledged.

■ Duration (1 to 60 minutes)

Set the desired duration for the buzzer.



Alarm

Opening the “Alarm History” of all alarms



Tap the icon to view the alarm history.

Description of options:

■ Sort alarm history

Time / Name / Status / Event Type

Repeatedly tap the individual fields in the top row to sort the list in ascending or descending order.

■ Save alarms



Back up the complete alarm history on a USB stick.

■ Set a display interval

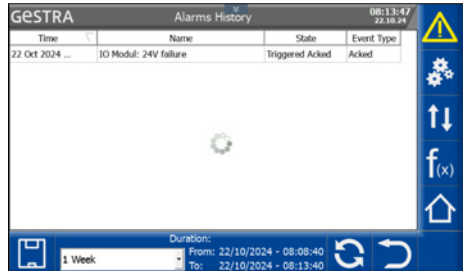
Select an interval to restrict the number of alarms shown.

You have a choice between the following display intervals:

◆ 1 Day / 1 Week / 4 Weeks

Alarms are saved and displayed for a maximum of four weeks.

■ Refresh the alarm history



Setup

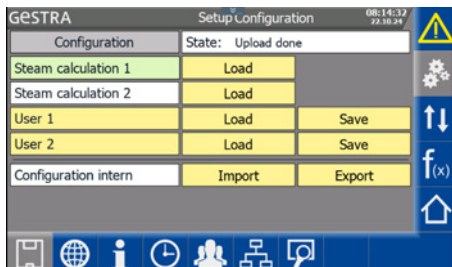
In the Setup menu, you can enter settings specific to your equipment.



If you tap on the icon at the top right, this always automatically opens the “Setup Configuration” menu.



The Setup menu is described on the following pages.



Description of display:

■ Configuration

All available steam flowrate calculator configurations are shown here:

◆ Row 1 / 2

Steam flowrate calculators preconfigured at the factory.

◆ Row 3 / 4

Two user-defined steam flowrate calculators to be freely configured and used.

■ Status

This row shows the status of a selected configuration.

■ Load / Save

Load or save the selected configuration.

■ Configuration USB / Import / Export

Configurations via USB stick for use on other devices, or for importing configurations from other devices.

Setup

Loading/configuring and saving a steam flowrate calculator

Loading the default configuration

Steam calculators 1 and 2 are preconfigured at the factory and can be loaded from the internal memory.

- Steam calculator 1
One steam calculator with pressure and temperature compensation.
- Steam calculator 2
Two steam calculators with pressure compensation.

In both cases, the analogue and digital inputs are already assigned.



You can find the table of factory settings on page 84.

Setting up a user-defined configuration

You can load the factory-preconfigured steam flowrate calculators and then configure them on site to suit your plant's requirements.

Saving a user configuration

Back up your configuration by saving it in row 3 or 4. Names can be edited.

Loading a user configuration

You can load and change user configurations at any time if you wish.



You can find an example configuration for a steam flowrate calculator on page 70.

"Setup Language" menu



Open the "*Setup Language*" menu and select the user language you require by tapping the flag of the country in question.



Setup

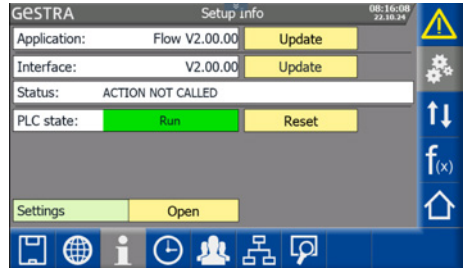
“Setup Info” menu

This page shows you the latest software versions and status of the PLC.

- Open the “*Setup Info*” menu and select the action you require.

Description of display:

- **Application**
The current visualisation software
- **Interface**
The software for the PLC
- **Status**
When copying from the interface
- **PLC status**
Shows the current status of the SPECTOR*control* Flow.



Performing an update

When necessary, you can perform a software update using a USB stick.

Data backup before an update



Before an update, always back up and export your settings.

Adhere to the correct sequence

First carry out the “*Application Update*”, then the “*Interface Update*”.

Preparations before an update

1. Copy the “*Updatepackage.zip*” update file and “*Interface*” folder to the root folder of the USB stick.



ATTENTION

Unwanted reactions may occur during the update process.

Secure actuators so they cannot start up inadvertently.

See following page for more information.

Setup

A) Application Update

1. Insert the USB stick in the USB port of the SPECTORcontrol Flow.
2. In the “*Application*” row, tap “*Update*”.
3. The file is then copied and the update takes place automatically. A progress bar at the bottom of the screen shows the progress of the update.
4. When the GESTRA logo appears, immediately disconnect the equipment from the mains, then switch it on again.
5. During the reboot that follows, a popup window, “*Found update package*”, opens.
6. Answer “*Yes*” to the prompt.

B) Interface Update

7. In the “*Interface*” row, tap “*Update*”.
- The progress of the update is shown through-out.

Performing a software reset

By performing a reset, you will restore the factory settings of the SPECTORcontrol Flow.

When this happens, all signals, logic operations, quantities, etc. will be erased.

The “Date / Time” menu

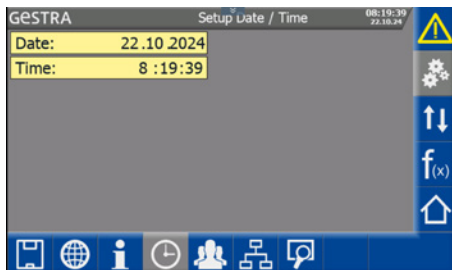


Open the “*Setup Date / Time*” menu and make the necessary settings.

Description of display/settings:

■ Date / Time

Tap the appropriate field and set the date and time.



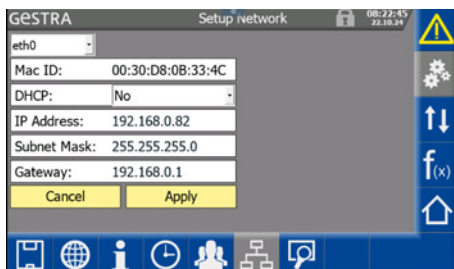
Setup

“Setup Network” menu

This menu shows the current network configuration.



Open the
“Setup Network” menu.



Description of display:

- **MAC ID**
The MAC address of the SPECTORcontrol FLOW.
- **DHCP**
Select address configuration with DHCP.
- **IP address**
The current IP address of the SPECTORcontrol FLOW.
- **Subnet Mask**
The current subnet mask.
- **Gateway**
The IP address of the gateway.
- **Cancel / Apply**
Discard/apply your settings.

■ Remote access:

The unit can be controlled remotely via VNC.

The VNC server can be deactivated if the function is not required.



If a connection is established via Real VNC Viewer, for example, make sure that the option “ColorLevel” = Full is selected in the settings.

FTP

The configuration and trends can also be stored internally in the unit. Access is possible via FTP.

User: admin or user with the corresponding password (“aaa” or “bbb”).

Setup

The “Home Screen” menu, configuring the view

After system configuration, the home screen opens and provides an up-to-date overall view. Other menus can also be opened directly from the home screen.

You can edit and adjust the view and content of the home screen at any time as needed.



Open the “Home Screen” menu, see example.



You can find out how to configure the home screen on page 28.



Inputs/outputs

This is where you can configure the analogue and digital inputs and outputs and setpoint(s) and switches of the system.

The configured inputs/outputs, setpoints and switches can then be selected and assigned in the various applications (e.g. steam calculator, quantity, controller, etc.) using “Select Signal” in the “Signal type” list.



The individual menus are explained on the following pages.

Inputs/outputs

Configuring an analogue input

To open the relevant parameter page, tap the required analogue input or a free input field.

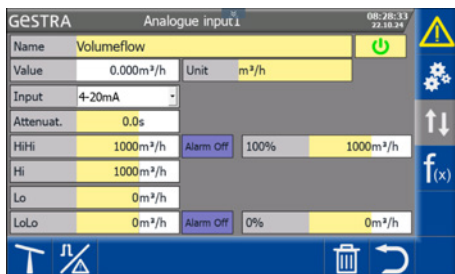
1.

4.



During initial configuration, you will see a list box containing the different types of input.

You can use the analogue input as a current, voltage or temperature input.



Set the parameters for the analogue input to suit your on-site plant or the connected equipment.



All parameters and names can be edited and freely configured

Description of parameters:

■ Name

Assign any name you wish. Assign a unique name that prevents ambiguity to the greatest possible extent.



Switch the analogue input on/off.

■ Value

View the current value at the analogue input.

■ Unit

Select the dimension or unit of the analogue input.

■ Input

Select the appropriate input type for the analogue input, e.g. 4-20 mA.

■ Damping

Smooths the input signal. The greater the damping, the smoother the signal.

This delays signal changes; therefore only select as much damping as actually necessary.

■ 100% / 0%

Set the upper and lower limits of the signal range.

■ HiHi / Hi / Lo / LoLo

Set the required alarm limits.



You cannot set an alarm limit that is higher than the preceding limit, e.g.:
 $100\% = 100 \text{ m}^3/\text{h} > \text{HiHi} \leq 100 \text{ m}^3/\text{h}$
 $\text{Lo} = 10 \text{ m}^3/\text{h} > \text{Hi} \geq 10 \text{ m}^3/\text{h}$

Inputs/outputs

■ Alarm On / Off (HiHi / LoLo)

Switch the alarm in question on/off.

Alarm On

If the alarm lasts longer than the set time delay, it is logged in the alarm history.

Alarm Off

If the alarm lasts longer than the set time delay, it is shown on the home screen (if activated there).

You can switch to the desired input/output via the buttons in the toolbar at the bottom of the screen.

Other functions in the toolbar:



Calibration

You can calibrate current and voltage inputs as necessary.



Delay

Set time delays for the HiHi and LoLo alarm limits.

Calibrating current and voltage inputs



Open the “*Calibration*” menu for the chosen analogue input.

Calibration



Calibration sets the readings to known values, e.g. Level 0% and Level 100%.

or

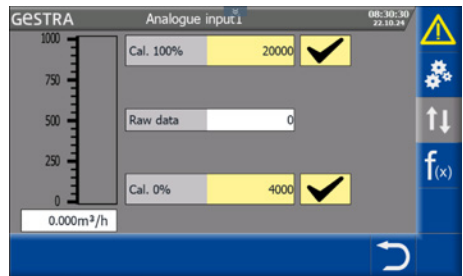
Cal. 0% / Cal. 100%

can be entered directly in the two input fields.

The bar chart shows the current value within the range limits.

Raw data

Here, you can see readings that the analogue input is processing internally, e.g. 4 to 20 mA.



Inputs/outputs

Setting a time delay for the HiHi and LoLo alarm limits



Open the “*Delays*” menu.

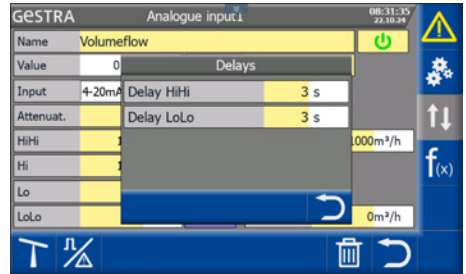
Time delays of 3 seconds are set for the HiHi and LoLo alarm limits as default.

Setting range

You can set time delays in the range from 0 s to 255 s.



Exit settings and return to the parameter page.



Configuring an analogue output



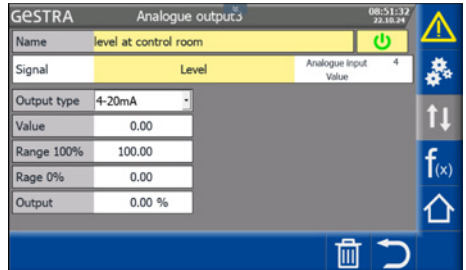
Open the “*Analogue output*” menu.

To open the relevant parameter page, tap the required analogue output or a free input field.



During initial configuration, you will see a list box containing the different types of output.

You can use the analogue output as a current or voltage output.



Description of parameters:

■ Name

Assign any name you wish. Assign a unique name that prevents ambiguity to the greatest possible extent.



Switch the analogue output on/off.

■ Signal

Tap the input field and select the signal that you wish to assign to the analogue output from the “*Signal type*” list.

Inputs/outputs

- **Output type**

Select the required output type,
e.g. 4-20 mA.

Not active = no output signals

- **Value**

The current value of the selected signal.

- **Range 100% / 0%**

Range limits

- **Output (in %)**

Output takes place between 0 - 100%.

Digital inputs

The SPECTOR*control* Flow has 20 digital inputs. If you wish, you can use these to record pulse values from counters or for enabling controllers.



Open the
“*Digital input*” menu.

To configure a digital input, see overleaf.

Inputs/outputs

Configuring a digital input

To open the parameter page of the digital input, tap the required digital input or a free input field.

Description of parameters:

■ Name

Enter a name,
e.g. Pump 1 enable.

-  Switch the signal of the digital input on/off for further processing.

■ Input signal

Status of the input signal (On / Off).

■ Invert

Invert the digital input signal.

■ Output signal

Status of the output signal for further processing:

On = 1 / Off = 0

■ Alarm

Switch the alarm on/off.

◆ Alarm On

If an output signal = 1, an alarm is triggered.
If the output signal was previously inverted, the alarm is triggered when the output signal = 0.

If the alarm lasts longer than the set time delay, it is logged in the alarm history.

■ Delay (in seconds)

Set the desired time delay for the alarm.

Setting range: 0 to 255 s

■ Invert

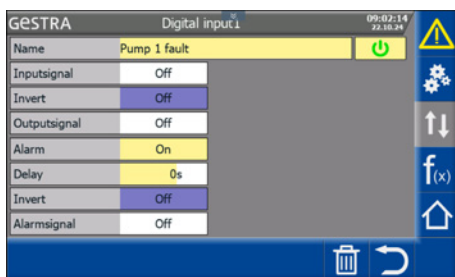
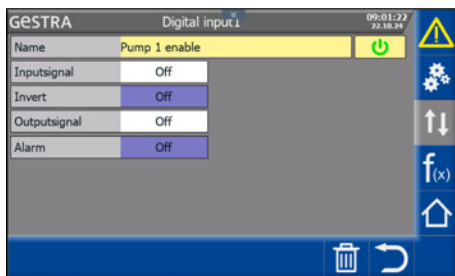
Invert the triggering of the alarm.

On > alarm when output signal = 0

Off > alarm when output signal = 1

■ Alarm signal

Status of the alarm signal.



Alarm On = an alarm is pending.

Alarm Off = no alarms are pending.

Inputs/outputs

Digital outputs

The SPECTORcontrol Flow has 12 digital outputs for actuating valves, indicator lights, etc.



Open the
“Digital output” menu.

Configuring a digital output

To open the relevant parameter page, tap the required digital output or a free input field.

Description of parameters:

■ Name

Assign any name you wish. Assign a unique name that prevents ambiguity to the greatest possible extent.



Switch processing of the digital signal on/off.

■ Signal

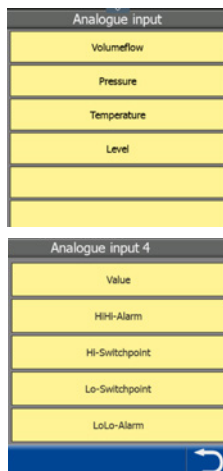
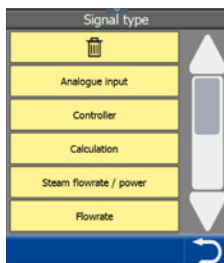
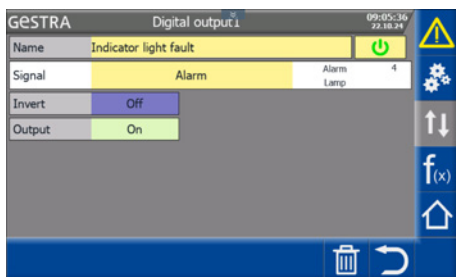
Tap the input field and select the signal that you wish to assign to the digital output from the “Signal type” list.

■ Invert

If necessary, you can invert the selected signal.

■ Output

Indicates the output of the output signal, On / Off.



Inputs/outputs

Setpoint

A setpoint is a signal that can be defined from the home screen and/or via Modbus. Controller setpoints can be defined, for example.

You can also set the setpoint here manually.

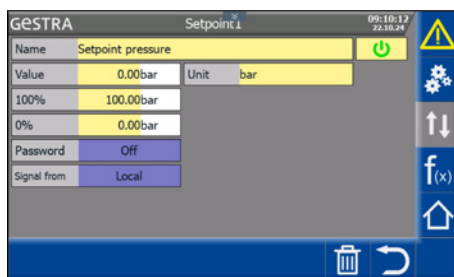


Open the
“Setpoint” menu.

Configuring a setpoint

To open the relevant parameter page, tap the required setpoint or a free input field.

Set the parameters for the setpoint.



Description of parameters:

- **Name**
Enter a name.
-  Switch the setpoint on/off.
- **Value / Unit**
Enter the desired value and relevant unit.
- **0% / 100%**
Enter the upper and lower range limits for the setpoint.
- **Password (Off / On)**
On
If you want to change the setpoint on the home screen, you will immediately be requested to enter a password.

■ Signal from Local

You can enter the setpoint manually in this menu and on the home screen.

Remote / Local

Select this parameter if you also wish the setpoint to be set externally via an existing Modbus connection.

Inputs/outputs

Switches

A switch is a signal that can be defined on the home screen and/or via Modbus.
It can be used to enable controllers, for example.



Open the
“Switch” menu.

Configuring a switch

To open the relevant parameter page, tap the required switch or a free input field.
Set the parameters for the switch.

Description of parameters:

■ Name

Enter a name.

-  Switch the signal of the switch on/off for further processing.

■ Reset

Select a signal that causes the switch to automatically reset (Off).

Example:

This allows you to remove the enable status, e.g. when an alarm has been triggered.

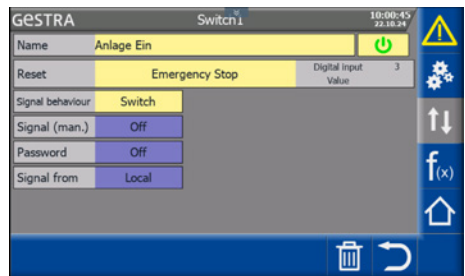
■ Signal behaviour

You can choose between buttons and switches.

Button

For a button, you can set a duty cycle from 0 s to 255 s.

After this time, the signal returns to “Off”.



■ Password (Off / On) On

If you want to actuate a switch on the home screen, you will immediately be requested to enter a password.

■ Signal from Local

You can actuate the switch manually in this menu or on the home screen.

Remote / Local

Select this parameter if you also wish the switch to be set externally via an existing Modbus connection.

Functions f(x)

On this screen, you can open and configure the steam calculator, calculations, logic and timer functions.



When you press the function key, this *automatically opens the “Steam calculator” input page.*

Functions f(x) / Steam calculator

The steam calculator calculates the mass flow and capacity of saturated and superheated steam as a function of the current process conditions.

In addition to the internal calculation, VLM / SLM flowrate meters can also be connected directly via Modbus RTU. In this case, the calculation takes place in the meter and the SPECTOR*control* Flow visualises the values.

Notes on using two steam calculators

As the number of analogue inputs is limited to four, the use of two steam calculators can only be achieved with pressure or temperature compensation.

The calculations take place as per the associated steam table

The steam calculator automatically uses the relevant steam table, detected by means of the signal sources, for calculation.

Signal sources:

- Pressure and temperature signal = superheated steam
or
- Pressure or temperature signal = saturated steam

Admissible pressure and temperature ranges

The pressure range is 1 - 50 barg.

The temperature range is 100°C - 500°C.



Before you can configure a steam flowrate calculator, you must adapt the analogue inputs to the on-site plant and connected equipment.

Configuring a steam flowrate calculator



Open the “Steam calculator” menu.



You can find an example configuration for a steam flowrate calculator on page 70.

Functions f(x) / Steam calculator

Tap an input field to open the parameter page.

Description of parameters:

■ Name

The name of the calculated signals (mass flow/capacity).

- Switch the signal on/off.

■ Mass flow

The current calculated mass flow value.

■ Capacity

The current calculated capacity value.

■ Status

With superheated steam measurement, the current status changes as a function of the temperature and pressure between water, saturated steam and superheated steam. The numerical temperature difference < / > from the saturated steam temperature is calculated.



An unfounded water alarm may occur near the saturation point, due to the error limits of the measuring sensors. The measured pressure may be 5% above the saturation pressure without triggering a water alarm. In this range, calculation is based on the saturated steam curve. The temperature measurement is ignored.

■ Pressure / Temperature (calculated)

Indicates calculated pressure and temperature signals.

This means:

- ◆ that when a pressure-compensated plant is set up for saturated steam calculation, the ideal temperature of the saturated steam curve is displayed.
- ◆ that for temperature-compensated saturated steam calculation, the pressure is displayed.

■ Volume flow / Density / Spec. volume / Enthalpy

The relevant calculated values are displayed under the values in the table.

These are volume flow, density, enthalpy and specific volume.

Other functions:

2 x Setup

The mass flow and capacity are configured using the appropriate Setup button.



Configure input signals

By tapping the Setup button in the toolbar.



Delete the signals and settings

Functions f(x) / Steam calculator

Configuring the input signals for the steam calculator



Open the input signals menu by tapping the Setup button in the toolbar.

■ Source

Select whether the signals are captured in an analogue manner or via Modbus RTU.

Description of analogue display:

■ Volume flow / Temperature / Pressure

These are the set analogue input signals.

■ Volume flow signal:

- ◆ Linear: The signal varies in proportion to the volume flow (VORTEX).
- ◆ Squared: The signal varies as the square of the volume flow (orifices, differential pressure transducers).

■ Correction

For certain measuring processes (orifices, differential pressure transducers), the volume flow signal needs to be corrected.

To achieve this, the specific volume under reference conditions is taken into consideration in the calculation. Please refer to your documents for this volume.

■ Signal - Pressure information

Here, define whether the input signal represents atmospheric pressure (Atmo.pressure) or absolute pressure (Abs. pressure).

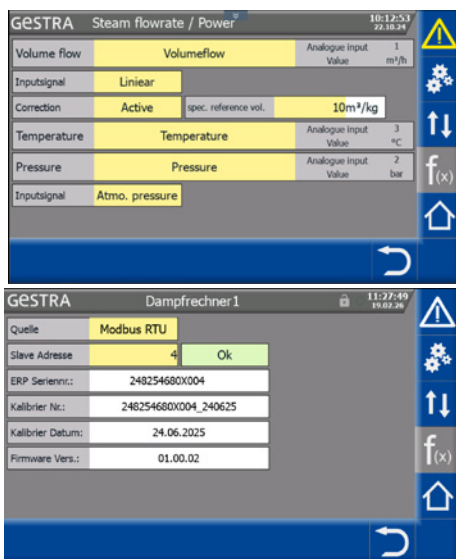
Information on the volume flow unit (m³/h)

Enter the volume flow unit in [m³/h]. Otherwise, an error message appears.

If this error message is shown, correct the unit in the analogue input.



You can find a description of configurable analogue inputs on page 54.



Description of the Modbus RTU display:

■ Slave address

The Modbus RTU slave address of the relevant VLM / SLM. The field after this shows the current status of the connection.

The factory-set slave address is 247 and can be changed via the SPECTORcontrol Flow if the status is OK.

- ERP serial no., calibration no., calibration date, firmware vers.: information read out from the VLM / SLM for identification and verification.



The factory-set slave address is 247.

Functions f(x) / Steam calculator

Settings for mass flow and capacity in the steam calculator

Setup

Tap the appropriate Setup button.

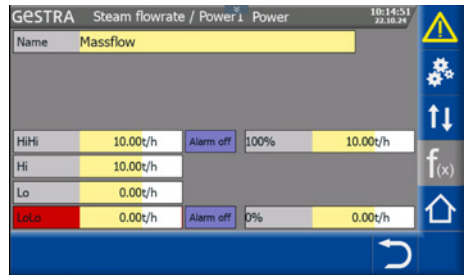
The relevant menu containing the factory settings opens.

Description of display:

- **Name**
Enter a name.
-  Switch the signal in question on/off for further processing.
- **Dimension (for mass flow only)**
Select the desired unit from the choice of kg/h or t/h.
The mass flow and capacity dimensions are directly interrelated:
 - ◆ kg/h <-> kW
 - ◆ t/h <-> MW
- **HiHi / Hi / Lo / LoLo**
Set the required alarm limits.



You cannot set an alarm limit that is higher than the preceding limit, e.g.:
 $100\% = 100 \text{ m}^3/\text{h} > \text{HiHi} \leq 100 \text{ m}^3/\text{h}$
 $\text{Lo} = 10 \text{ m}^3/\text{h} > \text{Hi} \geq 10 \text{ m}^3/\text{h}$



- **Alarm On / Off (HiHi / LoLo)**
Switch the alarm in question on/off.
Alarm On
If the alarm lasts longer than the set time delay, it is logged in the alarm history.
Alarm Off
If the alarm lasts longer than the set time delay, it is shown on the home screen (if activated there).



During monitoring of the HiHi or LoLo (Alarm On) limits, a group error is also enabled.
This covers water detection, signal input errors and range outside steam tables.

- **100% / 0%**
Set the upper and lower limits of the signal range.

Completing steam calculator configuration

When you have finished configuring the steam calculator, you can process the output signal as a quantity to obtain a cumulated mass flow or capacity.



You can find a description of this process on page 74.

Functions f(x) / Calculation

Configuring a calculation

The calculations and logic functions are used to link analogue values and digital signals available in the system to one another, in order to obtain new values and signals.

The results may be an overall quantity, a setpoint of a controller or the enabling of a controller, for example. The settings are based on graphic programming.

Two inputs are available for two calculations. The two results form the inputs for a further calculation.

The interim results are displayed.



If the input signal is digital, the interim result is hidden and the following input can be negated.

Basic arithmetic operations and comparator functions are available.

Signal selection

Input signal

Select the desired input signal by tapping the grey fields on the left.

Other functions:



Open the “Calculation x: Limits” menu to set alarms and range limits.

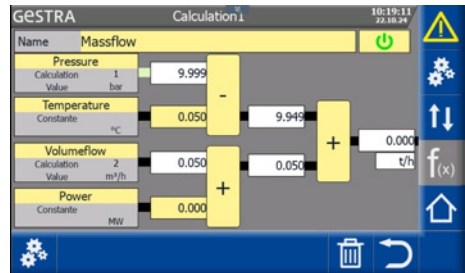
A calculation is a new signal in the system, which you can set in the unit, limits, ranges and alarms setup.

Limit = On

The output signal is limited within the range 0 to 100%.



Open the “Calculation” menu.



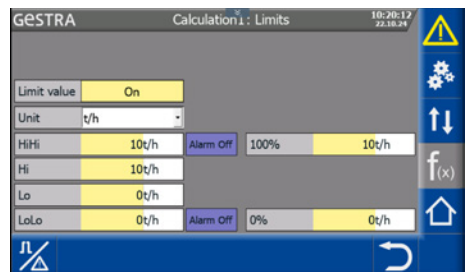
Example of a setpoint switch

A time switch (timer) is programmed for operation.

The setpoint does not change while the plant is in operation. If it is not in operation (operation negated), the setpoint is reduced by 3 bar.



If no signal is selected, you can enter a constant in the yellow field.



Functions f(x) / Logic operations

Configuring a logic operation

Logic operations enable binary links between signals with different origins using various logic gates. Analogue signals that deliver a logic “1” when the value > 1 can also be connected.



Basic knowledge of logic operations is required for these settings.



Open the
“Logic” menu.

Two inputs are available on two logic gates. The outputs of the gates form the inputs for a further gate.

All inputs can be negated if necessary.

Each gate can take on the function AND, OR, XOR, XNOR or RS.

A timer or edge generator with the functions TON, TOF, TP or RT (rising edge) and FT (falling edge) can be selected at the output.

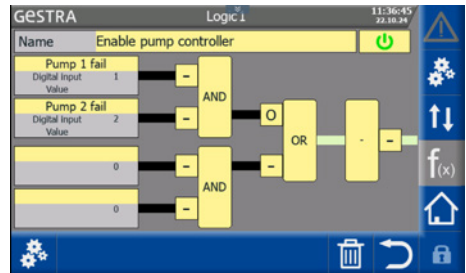
The time of the timers can be set from 1 second to 11 days (in seconds).

Edge detection detects an edge and delivers a pulse for one cycle (100 ms).

This pulse can be routed to other logic operations, digital outputs and calculations, for example.

If the status of a signal/gate is “1”, the colour changes to green.

A logic operation controls the enabling of a controller, for instance. Logic operations can be combined with one another.



Example:

The controller is to be enabled to carry out control when at least one pump is OK.

The result:

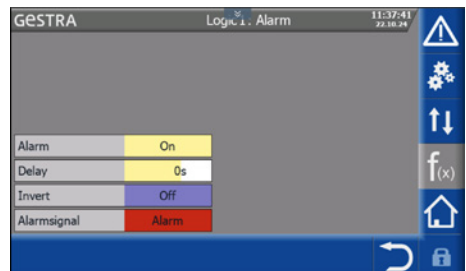
Enable = Not (Pump 1 failure and Pump 2 failure)

Other functions:



Logic / Alarm

Toggle between Logic and Alarm, e.g. to generate an alarm if neither pump is enabled.



Functions f(x) / Timers

Configuring a timer

Timers generate an output signal that depends on the time of day and day of the week.

This output signal can be used to enable a controller, for example.

The timers are week timers.



Open the “Timer” menu.

You can set up to four intervals and activate these on individual days of the week.

Tap Hours / Minutes / Seconds to set the desired time in each case.

■ Start / End

Enter the desired time in hours and minutes.

■ Mo / Tu / We / Th / Fr / Sa / Su

Tap the individual weekdays to activate/de-activate the set times. Weekdays highlighted yellow are active.

You can select individual days in each interval, independently from one another.



The individual intervals are governed by OR

If at least one interval is active, the output is also active.

Data exchange via Modbus TCP

The SPECTOR*control*Flow has a Modbus TCP server. This enables all values to be forwarded to a higher-level control system or control centre.

If configured accordingly, the setpoints and switches can also be written externally. This enables setpoints or enables to be defined externally.

Parameters

Modbus ID: 2

Port: 502

Modicon Modbus: based on 1

You can find the datapoint list online at www.gestra.com or you can request it from us.

Analogue values

Analogue values are transferred as unsigned integers with one decimal place. In other words, 347 = 34.7.

The status is transmitted along with every analogue signal. This is composed differently depending on the signal, but takes up eight bits for each value. Unused bits remain free.

Bit	Analogue input	Steam calculator	Quantity	Calculation	Controller
0	Group error	Group error			
1	Hardware error				
2					
3	HiHi alarm	HiHi alarm	HiHi alarm	HiHi alarm	
4	Hi switchpoint	Hi switchpoint	Pulse output	Hi switchpoint	Valve open / Pump 1 on
5	Lo switchpoint	Lo switchpoint		Lo switchpoint	Valve closed / Pump 2 on
6	LoLo alarm	LoLo alarm	LoLo alarm	LoLo alarm	
7					

Digital signals

With digital signals, the value and alarm are transmitted.

Example configuration for a steam flowrate calculator

Here, you can see an example configuration of a steam flowrate calculator.



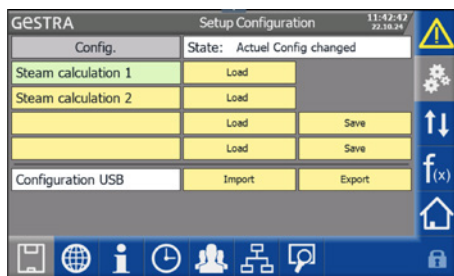
The SPECTORcontrol Flow comes with two preconfigured steam flowrate calculators that you can individually adapt to your on-site plant.

Preconfigured factory settings

See pages 84 and 85.

Loading the factory settings of the steam flowrate calculator

1. Open the “Setup Configuration” menu.
2. Load the desired factory setting.
 - Steam calculator 1
1 x pressure and temperature compensation
 - Steam calculator 2
2 x pressure and temperature compensation
3. Confirm the prompt. Your chosen factory settings (e.g. Steam calculator 1) are loaded, see display in the status bar.



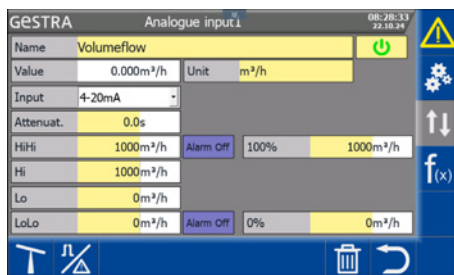
Reconfiguring the analogue inputs

1. Open the “Analogue input” menu.
2. You will then see three analogue inputs that have been configured at the factory.



All analogue inputs can be freely configured.

3. Select the desired analogue input, e.g. “Volume flow”, and open the “Analogue input 1” menu.



Example configuration for a steam flowrate calculator

4. Adapt the factory settings to suit your on-site plant or the connected equipment.

Note on damping

If input signals are subject to major fluctuations, they can be smoothed.

Note on the upper range limit (100%)

Set the upper range limit to the value of the connected equipment (see rating plate).

Note on alarm limits

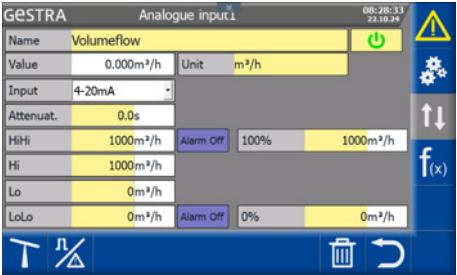
HiHi, Hi, Lo, LoLo

Set the alarm limits to the desired values.

5. Adapt all analogue inputs as described above.

Options

-  **Calibration**



Current and voltage inputs can be calibrated, see page 55.

-  **Delays**

You can change the time delays of the HiHi and LoLo limit values.

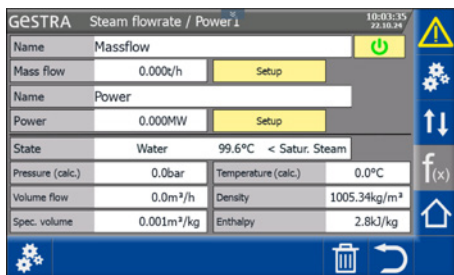
Setting range: 0 s to 255 s

Factory setting: 3 s

Example configuration for a steam flowrate calculator

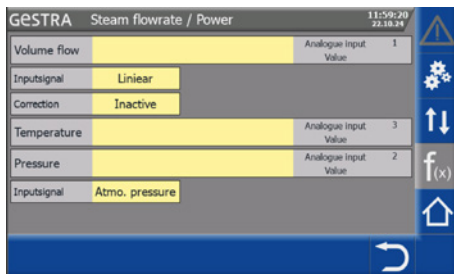
Opening and configuring Steam calculator 1

1. $f(x)$ >  Open the “Steam calculator” menu and tap one of the two steam calculators.
2. The values of the input signals and all calculations are shown in the “Steam calculator 1” menu.

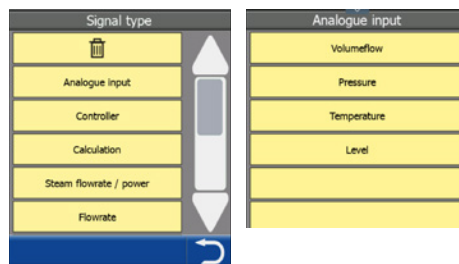


Change or delete the input signals for the “Steam calculator” as needed; otherwise, proceed with point 8.

3.  Open the input signals menu by tapping the Setup button in the toolbar.

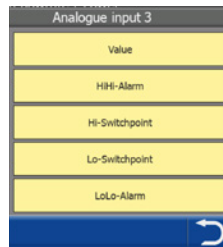


4. Tap the desired input signal (e.g. pressure). The “Signal type” list box then opens.
5. If the signal is not available in your plant, tap on the recycle bin to delete it. If it is at a different input, tap “Analogue input” and select the desired input.

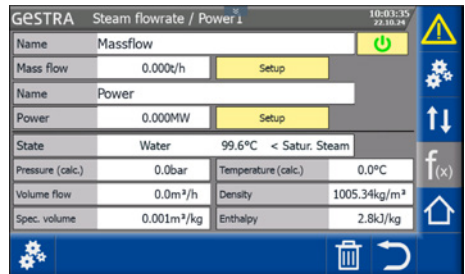


Example configuration for a steam flowrate calculator

6. Next, select the “Value” parameter for the new “Analogue input 1”.

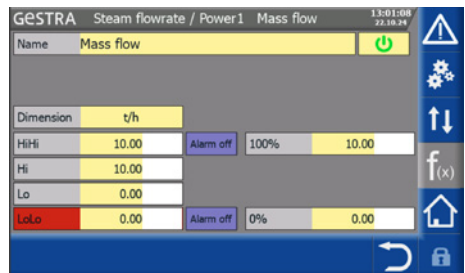


7.  Return to the “Steam calculator 1” menu.



Settings for mass flow and capacity in Steam calculator 1

8.  Tap the appropriate Setup button.
9. The relevant menu with the factory settings opens.
10. Make the necessary settings and name changes as desired.
11.  Return to the home screen.
12. Configuration of the steam calculator is now complete.



Example configuration for a steam flowrate calculator

Grouping the signals from the steam flowrate calculator in the “Cumulated quantity” menu

The “Cumulated quantity” menu shows the name, value and status of all signals (e.g. of the mass flow) from the steam flowrate calculator, see page 31.

In addition, you can open a graphic representation of the day and month view for each cumulated quantity.

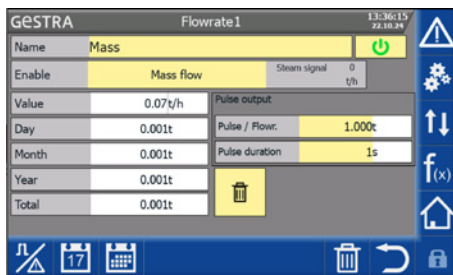
1.  Open the “Cumulated quantity” menu.

Setting range limits and alarms for cumulated quantities

2. Tap the desired quantity (e.g. mass) and open the “Cumulated quantity 1” menu.

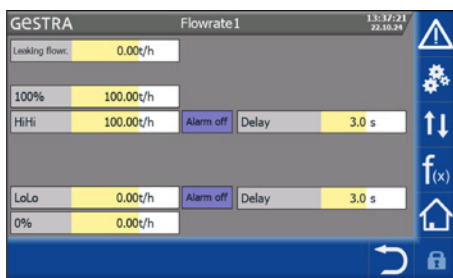
Options in the toolbar

- Daily and monthly view of the quantity.



3.  Open the settings menu and change the range limits and alarms as necessary based on your on-site plant.

4. Activate the alarms if necessary.
5. Repeat the settings for Cumulated quantity 2.



Example configuration for a steam flowrate calculator

Setting up graphic representation of signals in the “Datalog” menu

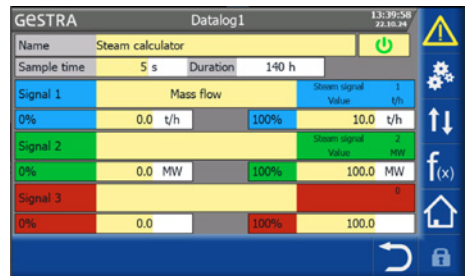
The signals from the steam flowrate calculator are represented graphically and evaluated in the “Datalog” menu.



You can set up graphic representation for up to three signals per datalog.

1.  Open the “Datalog” menu.

The factory-set steam flowrate calculator has two datalogs, see example.



Name		Steam calculator		13:39:58 22.05.20	
Sample time		5 s	Duration	140 h	
Signal 1	Mass flow	Steam signal Value	1	t/h	
0%	0.0 t/h	100%	10.0	t/h	
Signal 2	Steam signal Value	2	t/h		
0%	0.0 MW	100%	100.0	MW	
Signal 3	Steam signal Value	3	t/h		
0%	0.0	100%	100.0		

Adapting the existing datalogs

2. Tap the desired datalog (e.g. analogue inputs) and open the relevant menu.
3. The values of the analogue input signals are displayed in the coloured fields at the bottom of the screen.

4.  Open the “Datalog 2” menu and carry out the desired settings.
5.  Go back to the “Datalog analogue inputs” menu and check your settings.

Options in the Datalog 1 / 2 menu

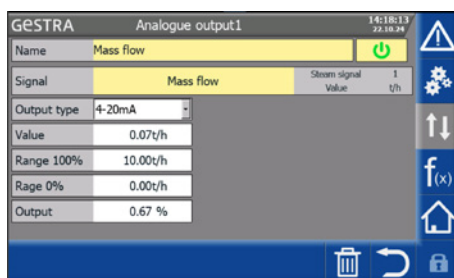
see page 37.

Example configuration for a steam flowrate calculator

Configuring the analogue outputs for the steam flowrate calculator

Using the analogue outputs, you can transfer the current steam calculator values to other control systems (e.g. a PLC controller).

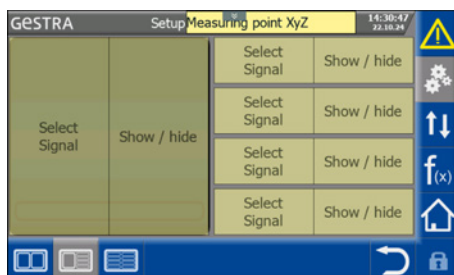
1.  >  Open the "Analogue output" menu.
2. Tap Analogue output 1 (e.g. "mass flow").
3. If necessary, reset the signal and type of output.



Adapting the appearance of the home screen

If you wish, you can choose one of three pre-configured views for the home screen.

1.  >  Open the "Home screen" menu.
2. Assign a new name to the steam calculator in the "Name" field if necessary.
3.  or  or  Select the desired view.
4.  Back to home screen.

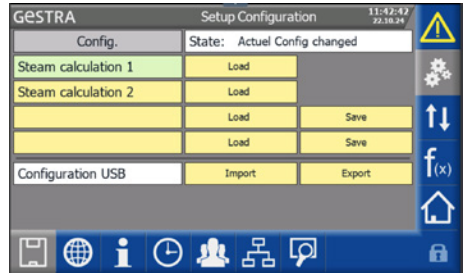


Example configuration for a steam flowrate calculator

Saving the newly configured steam flowrate calculator

When you have completed all settings, you can save your new configuration under a new name.

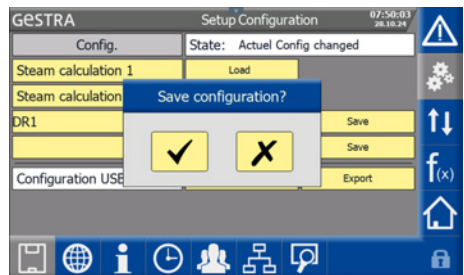
1.  Open the “Setup Configuration” menu.



2. Tap the empty field and assign a new name.



3.  Next, tap “Save” and select the tick to confirm when prompted.



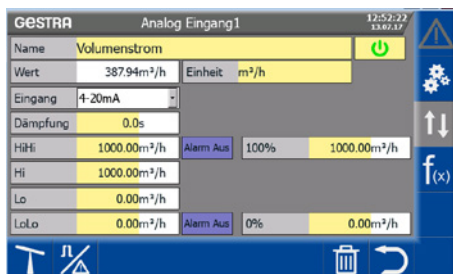
Example configuration of a continuous pump controller

Here, you can see an example configuration of the SPECTORcontrol Flow as a continuous pump controller.

You will find a detailed description of how to configure a controller on page 38 ff.

Configuring the analogue inputs for setting actual value parameters

1.  Open the "Analogue input" menu.
2. Select the desired analogue input.
3. Adapt the factory settings to suit your on-site plant or the connected equipment.
 - Select an input type (e.g. 4-20 mA).
 - Assign a name.
 - Select the desired unit (e.g. %) if a level electrode is connected.



Configuring the digital inputs for the continuous pump controller

For a continuous pump controller, you need to configure two digital inputs.

1.  Open the "Digital input" menu.
2. Tap empty field no. 1 and open the "Digital input 1" menu.
3. Enter a name, e.g. "P-controller".
4. Activate the alarm and set the other parameters for the alarm as follows:
 - Delay (in seconds)
 - Invert
 - Alarm signal
5.  Return to the "Digital input" menu.
6. Repeat the settings for the second digital input.



Example configuration of a continuous pump controller

Configuring the continuous pump controller

1.  >  Open the “Controller” menu.
2. Then tap the first empty input field.
3. A list box is shown.
4. Select the desired controller type, in this case the “Continuous pump controller”.
5. The “Continuous pump controller 1” menu opens.



6.  Tap the Setup button in the toolbar.
7. Enter a name for the controller.



8. Next, tap the empty “Actual value” field and select the following parameters:
 - Analogue input
 - Level (example)
 - Value
9. After the final parameter, “Value”, the set “Actual value” appears in the yellow field.
10.  Return to the “Continuous pump controller 1” menu.



Example configuration of a continuous pump controller

11.  Open the “Pump 1” menu.
12. Tap “Enable” and select the “Digital input” signal type.
13. From the subsequent list, select the desired digital input, e.g. “P-controller 1”.
14. From the list box that then opens, select the “Value” parameter.
15.  Open the “Pump 2” menu and repeat the enable settings as shown earlier.



16.  Return to the “Continuous pump controller 1” menu.
 17. Tap “Setpoint” and enter the desired setpoint.
 18. Enter the desired values for the following parameters, one after the other:
 - P = gain *
 - I = reset time *
 - Shutdown threshold = manipulated variable (yw) below which the pumps are shut down.
- * see page 9 (Specialist terms)



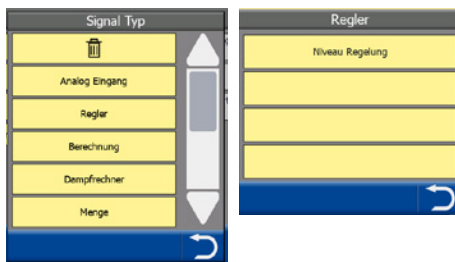
Example configuration of a continuous pump controller

Outputting the manipulated variable of the continuous pump controller at an analogue output

1.  >  Open the "Analogue output" menu.
2. Select an analogue output (e.g. mass flow).
3. If necessary, enter a new name for the analogue output.
4. Select the output type (e.g. 4-20 mA).



5. Tap "Signal" and select the "Controller" signal type.
6. From the subsequent list, select the desired controller, e.g. "Continuous pump controller 1".



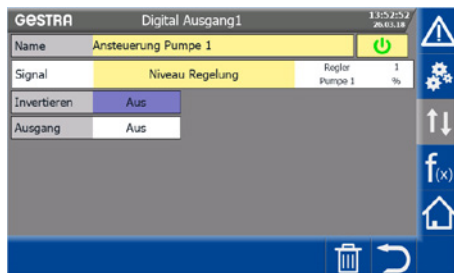
7. From the list box that then opens, select the "Value" parameter.
8. The configured Analogue output 1 is then displayed automatically.
9.  Return to the "Continuous pump controller 1" menu.
10. Set the next analogue output, as needed.



Example configuration of a continuous pump controller

Configuring the digital outputs of the continuous pump controller

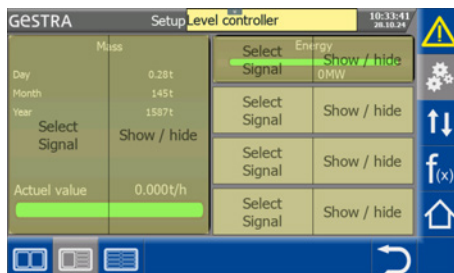
1.  >  Open the “Digital output” menu.
2. Tap empty field no. 1 and open the “Digital output 1” menu.
3. Enter a name, e.g. “pp1”.
4. Tap “Signal” and select the “Controller” signal type.
5. From the subsequent list, select the desired controller, e.g. “Continuous pump controller 1”.
6. Then select the “Pump x” parameter from the list box that opens.
7.  Return to the “Digital output” menu.
8. Repeat the settings for the next digital output and configure this for Pump 2.



Example configuration of a continuous pump controller

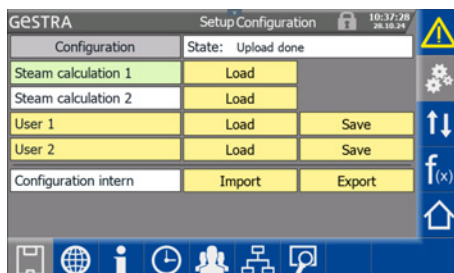
Adding the continuous pump controller to the home screen

1.  >  Open the “Home screen” menu.
2. If necessary, assign a new name in the “Name” field.
3. Tap “Select Signal” in the right or left half of the display.
4. Select the “Controller” signal type.
5. Next, select the desired controller, e.g. “Continuous pump controller 1” and the “Value” parameter.
6.  or  or 
Select the desired view.
7.  Return to the home screen with one steam flowrate calculator and the continuous controller on the display.



Saving the configured continuous pump controller

1.  Open the “Setup Configuration” menu.
2. Tap the empty field and assign a name.
3.  Next, tap “Save” and select the tick to confirm when prompted.
4. The continuous pump controller is now ready for operation.



Factory settings

Parameters for configuring Steam calculator 1

This configuration is for a steam calculator with pressure and temperature compensation.

The ranges must be replaced with the actual ranges!

If only pressure or temperature compensation is available, you must delete the input in question and also the signal in the steam calculator.

After you have made the necessary adjustments you can save the parameter settings in a user configuration.

Signal	Type	Reading	Range
Analogue input 1	4 - 20 mA	Volume flow	0 - 1000 m³/h
Analogue input 2	4 - 20 mA	Pressure	0 - 25 barg
Analogue input 3	Pt100	Temperature	0 - 300°C
Steam calculator 1	With pressure/temperature compensation	Mass flow	0 - 10 t/h
		Capacity	0 - 10 MW
Cumulated quantity 1	Mass flow	Mass	0 - 10 t/h
Cumulated quantity 2	Capacity	Work	0 - 10 MW
Datalog 1	Steam calculator	Mass flow	0 - 10 t/h
		Capacity	0 - 10 MW
Datalog 2	Analogue inputs	Volume flow	0 - 1000 m³/h
		Pressure	0 - 25 barg
		Temperature	0 - 300°C
Analogue output 1	4 - 20 mA	Mass flow	0 - 10 t/h
Analogue output 2	4 - 20 mA	Capacity	0 - 10 MW
Home screen	Signal 1 large	Mass (Cumulated quantity 1)	
Home screen	Signal 2 large	Capacity (Cumulated quantity 2)	

Fig. 13

Factory settings

Parameters for configuring Steam calculator 2

This configuration is for a steam calculator with pressure and temperature compensation.

The ranges must be replaced with the actual ranges!

If only pressure compensation is available, you must delete the input in question and also the signal in the steam calculator.

After you have made the necessary adjustments you can save the parameter settings in a user configuration.

Signal	Type	Reading	Range
Analogue input 1	4 - 20 mA	Volume flow 1	0 - 1000 m ³ /h
Analogue input 2	Pt100	Temperature 1	0 - 300°C
Analogue input 3	4 - 20 mA	Volume flow 2	0 - 1000 m ³ /h
Analogue input 4	Pt100	Temperature 2	0 - 300°C
Steam calculator 1	With temperature compensation	Mass flow	0 - 10 t/h
		Capacity	0 - 10 MW
Steam calculator 1	With temperature compensation	Mass flow	0 - 10 t/h
		Capacity	0 - 10 MW
Cumulated quantity 1	Mass flow 1	Mass measurement 1	0 - 10 MW
Cumulated quantity 2	Capacity 1	Work measurement 1	0 - 10 MW
Cumulated quantity 3	Mass flow 2	Mass measurement 2	0 - 10 t/h
Cumulated quantity 4	Capacity 2	Work measurement 2	0 - 10 MW
Datalog 1	Steam calculator 1	Mass flow	0 - 10 t/h
		Capacity	0 - 10 MW
Datalog 2	Steam calculator 2	Mass flow	0 - 10 t/h
		Capacity	0 - 10 MW
Analogue output 1	4 - 20 mA	Mass flow measurement 1	0 - 10 t/h
Analogue output 2	4 - 20 mA	Capacity measurement 1	0 - 10 MW
Analogue output 3	4 - 20 mA	Mass flow measurement 2	0 - 10 t/h
Analogue output 4	4 - 20 mA	Capacity measurement 2	0 - 10 MW
Home screen	Signal 1 large	Mass (Cumulated quantity 1)	
Home screen	Signal 2 large	Mass (Cumulated quantity 2)	

Fig. 14

Disposal

Dismantle the control unit and separate waste materials according to the material specifications. Electronic components (printed circuit boards) must be disposed of separately!

Dispose of the control unit in accordance with statutory waste disposal regulations.

Declaration of Conformity; Standards and Directives

You can find details on the conformity of the equipment and the relevant standards and directives, where applicable, in the Declaration of Conformity and associated certificates or approvals.

The valid Declaration of Conformity is available to download at www.gestra.com.

You can request the associated certificates and approvals by writing to the following address:

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28215 Bremen

Germany

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e-mail info@de.gestra.com

Web www.gestra.com

Modifications to the equipment not approved by us will invalidate the Declarations of Conformity, certificates and approvals.



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