

E-circulators

Installation and operating instructions

US



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Warning

Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

US

1. General description

Grundfos E-Circulator pumps are pumps fitted with frequency-controlled motors for single-phase mains connection.

The pumps are typically used as circulator pumps in large heating or cooling water systems with variable demands.

The series 1000 pumps have a built-in PI controller and can be connected to an external sensor enabling control of for instance pressure, differential pressure, temperature, differential temperature or flow in the system in which the pumps are installed. The pumps can also be set to uncontrolled operation, i.e. the pump performance can be set according to an external control.

Series 1000 Pump: The desired value (setpoint), e.g. the desired differential pressure if a differential pressure sensor has been installed, can be set directly on the pump control panel, via an input for external setpoint signal or by means of the Grundfos wireless remote control R100.

The Series 2000 incorporate a PI controller and a differential pressure sensor enabling control of the differential pressure across the pump.

The series 2000 pump desired head can be set directly on the pump control panel. At the same time, it is possible to choose between two different control modes, i.e. proportional pressure and constant pressure. The desired head can also be set via an input for external setpoint signal or by means of the Grundfos wireless remote control R100.

All other settings are made by means of the R100. Important parameters such as actual value of control parameter, power consumption, etc. can be read via the R100.

The pump incorporates

- inputs for external potential-free contacts for start/stop and digital function. The digital function enables external setting to max. curve or min. curve.
- an output for a potential-free fault signal.
- an input for bus communication.
Via the bus communication input, the pump can be controlled and monitored by a GRUNDFOS Pump Management System 2000, a building management system or another external control system.

2. Installation

Note: In order to maintain the UL/cUL approval, additional installation procedures must be followed, see page 24.

2.1 Motor cooling

To ensure sufficient cooling of motor and electronics, the following must be observed:

- Place the pump in such a way that sufficient cooling is ensured.
- The temperature of the ambient air must not exceed 104°F.
- Cooling fins and fan blades must be kept clean.

2.2 Outdoor installation

When installed outdoors, the pump must be provided with a suitable cover to avoid condensation on the electronic components, fig. 1.

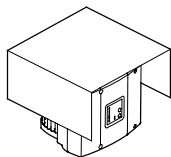
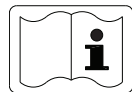


Fig. 1 Example of cover

For further installation, see installation and operating instructions for the standard pump.

2.3 Electrical connection

Note: The user or the installer is responsible for the installation of the correct earthing and protection according to valid national and local standards. All operations must be carried out by a qualified electrician.



Warning!

All electric supply circuits must be interrupted before working in the pump terminal box.



Warning

Never make any connections in the pump terminal box unless the electricity supply has been switched off for at least 5 minutes.

2.3.1 Protection against electric shock – indirect contact



Warning

The pump must be earthed and protected against indirect contact in accordance with local and national regulations.

Protective earth conductors must always have a yellow/green (PE) or yellow/green/blue (PEN) color marking.

2.3.2 Additional protection

If the pump is connected to an electric installation where an earth leakage circuit breaker is used as additional protection, this circuit breaker must be marked with the following symbol:



ELCB

Note: When an earth leakage circuit breaker is selected, the total leakage current of all the electrical equipment in the installation must be taken into account.

The leakage current of the motor can be found in section 19.2 *Leakage current*.

2.3.3 Motor protection

The pump requires no external thermal motor protection. The motor incorporates thermal protection against slow overloading and blocking (IEC 34-11: TP 211).

2.3.4 Overvoltage protection

The pump is overvoltage-protected through built-in varistors between phase-neutral and phase-earth.

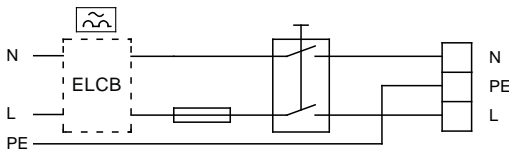
2.3.5 Supply voltage

1 x 208-230v 60Hz PE.

The supply voltage and frequency are marked on the pump nameplate. Please make sure that the motor is suitable for the electricity supply on which it will be used.

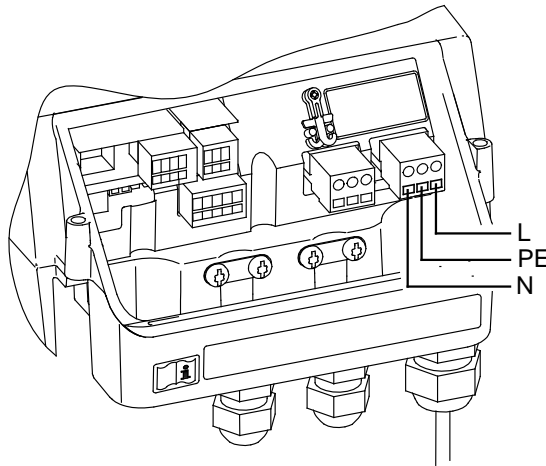
The wires in the pump terminal box must be as short as possible. Excepted from this is the protective earth conductor which must be so long that it is the last one to be disconnected in case the cable is inadvertently pulled out of the cable entry.

For maximum backup fuse, see section 19.1 Supply voltage.



TM02 0792 0101

Fig. 2 Example of a mains-connected pump with mains switch, back-up fuses and additional protection



TM02 0827 1304

Fig. 3 Mains connection

Warning



If the supply cable is damaged, it must be replaced by the manufacturer, the manufacturer's service partner or similarly qualified persons in order to avoid a hazard.

2.3.6 Start/stop of pump

The number of starts and stops via the mains voltage must not exceed 4 times per hour.

When the pump is switched on via the mains, it will start after approx. 5 seconds.

If a higher number of starts and stops is desired, the input for external start/stop must be used when starting/stopping the pump. When the pump is started/stopped via an external on/off switch, it will start immediately.

2.4 Other connections

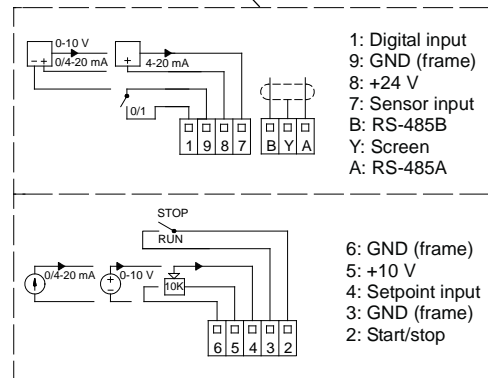
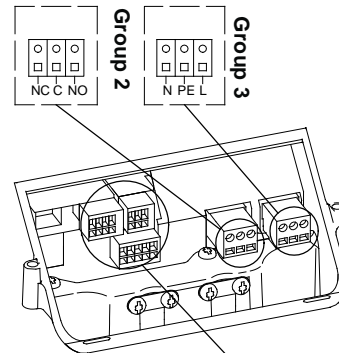
The connection terminals of external potential-free contacts for start/stop and digital function, external setpoint signal, sensor signal, GENIbus, fault signal relay and communication cable are shown in fig. 4.

Note: If no external on/off switch is connected, short-circuit terminals 2 and 3 using a short wire.

Note: As a precaution, the wires to be connected to the following connection groups must be separated from each other by reinforced insulation in their entire lengths:

1. **Inputs** (external start/stop, digital function, setpoint and sensor signals, terminals 1-9, and bus connection, B, Y, A).
All inputs (group 1) are internally separated from the mains-conducting parts by reinforced insulation and galvanically separated from other circuits.
All control terminals are supplied by protective extra-low voltage (PELV), thus ensuring protection against electric shock.
2. **Output** (fault signal relay, terminals NC, C, NO).
The output (group 2) is galvanically separated from other circuits. Therefore, the supply voltage or protective extra-low voltage can be connected to the output as desired.
3. **Mains supply** (terminals N, PE, L).

A galvanically safe separation must fulfill the requirements for reinforced insulation including creepage distances and clearances specified in EN 60 335.



Group 1

TM02 0795 0904

Fig. 4 Connection terminals

2.5 Signal cables

- Use shielded cables having a cross-sectional area of min. 0.5 mm² and max. 1.5 mm² for external on/off switch, digital input, setpoint and sensor signals.
- The shields of the cables must be connected to frame at both ends with good frame connection. They must be as close as possible to the terminals, fig. 5.

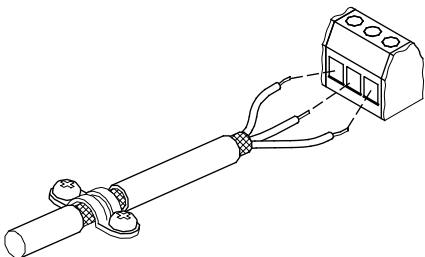


Fig. 5 Stripped cable with shield and wire connection

- Screws for frame connections must always be tightened whether a cable is fitted or not.
- The wires in the pump terminal box must be as short as possible.

2.6 Bus connection cable

2.6.1 New installations

For the bus connection a shielded 3-core cable having a cross-sectional area of min. 0.5 mm² and max. 1.5 mm² must be used.

- If the pump is connected to a unit with a cable clamp which is identical to the one on the pump, the screen must be connected to this cable clamp.
- If the unit has no cable clamp as shown in fig. 6, the screen is left unconnected at this end.

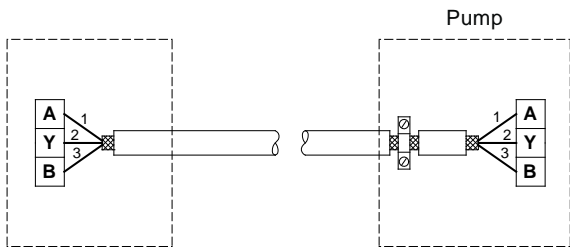


Fig. 6 Connection with shielded 3-core cable

2.6.2 Replacing an existing pump

- If a shielded 2-core cable is used in the existing installation, it must be connected as shown in fig. 7.

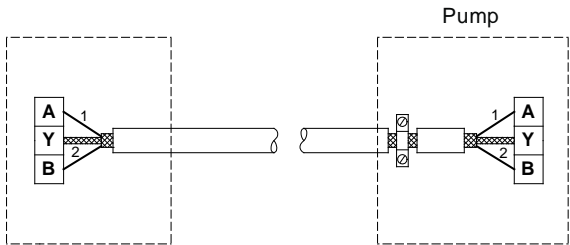


Fig. 7 Connection with shielded 2-core cable

If a shielded 3-core cable is used in the existing installation, follow the instructions in section 2.6.1 *New installations*.

3. E-circulator series 1000

3.1 Control modes

E-pumps can be set to two control modes, i.e.:

- **controlled**-operation or
- **uncontrolled**-operation.

In **controlled**-operation mode, the pump will adjust its performance to the desired setpoint for the control parameter (pressure, differential pressure, temperature, differential temperature or flow).

In **uncontrolled**-operation mode, the pump will operate according to the constant curve set.

Controlled operation Uncontrolled operation

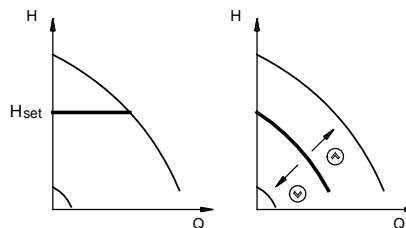


Fig. 8 Pump in controlled-operation mode (differential pressure control) and in uncontrolled-operation mode

The pumps have been factory-set to uncontrolled operation, see section 3.3 *Factory setting*.

3.2 Operating modes

The following operating modes can be selected:

- Stop,
- Min.,
- Normal (controlled or uncontrolled operation),
- Max.

The operating modes can all be set on the pump control panel.

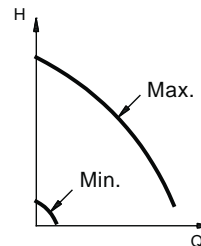


Fig. 9 Min. and max. curves

The min. curve can be used in periods in which a minimum flow is required.

The max. curve can for instance be used in connection with the venting procedure during installation.

If the electricity supply to the pump is disconnected, the pump setting will be stored.

The remote control R100 offers additional possibilities of setting and status displays, see section 5. *Setting by means of R100*.

3.3 Factory setting

The pumps have been factory-set to uncontrolled operation.

The setpoint value corresponds to 100% of the maximum pump performance (see data sheet for the pump).

Other pump settings are marked with **bold**-faced type under each individual display in sections 12.1 *Menu OPERATION* and 5.3 *Menu INSTALLATION*.

4. Setting by means of control panel



At high system temperatures, the pump may be so hot that only the buttons should be touched to avoid burns.

The pump control panel, fig. 10, incorporates the following:

- Buttons, Ⓜ and Ⓜ, for setpoint setting.
- Light fields, yellow, for indication of setpoint.
- Indicator lights, green (operation) and red (fault).

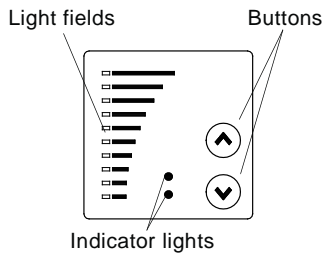


Fig. 10 Control panel for single-phase pumps

4.1 Setpoint setting

The desired setpoint is set by pressing the button Ⓜ or Ⓜ.

The light fields on the control panel will indicate the setpoint set. See examples in sections 4.1.1 and 4.1.2.

4.1.1 Pump in controlled-operation mode (differential pressure control)

Example:

Figure 11 shows that the light fields 5 and 6 are activated, indicating a desired setpoint of 3.1 psi with a sensor measuring range from 0 to 6 m. The setting range is equal to the sensor measuring range (see sensor nameplate).

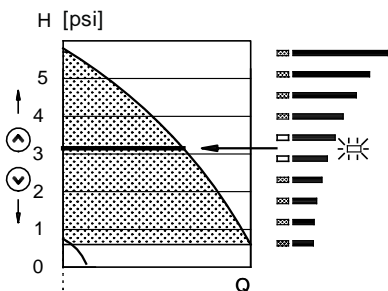


Fig. 11 Setpoint set to 3.1 psi (differential pressure control)

4.1.2 Pump in uncontrolled-operation mode

Example:

In uncontrolled-operation mode, the pump performance is set within the range from min. to max. curve, fig. 12.

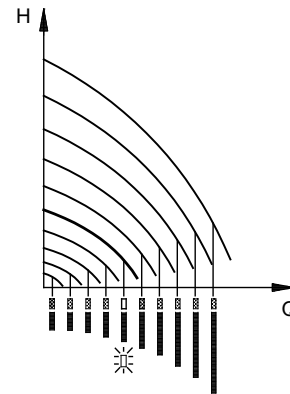


Fig. 12 Pump performance setting, uncontrolled-operation mode

4.2 Setting to max. curve duty

Press Ⓜ continuously to change to the max. curve of the pump (top light field flashes). When the top light field is on, Ⓜ must be pressed for 3 seconds before the light field starts flashing.

To return to uncontrolled or controlled operation, press Ⓜ continuously until the desired setpoint is indicated.

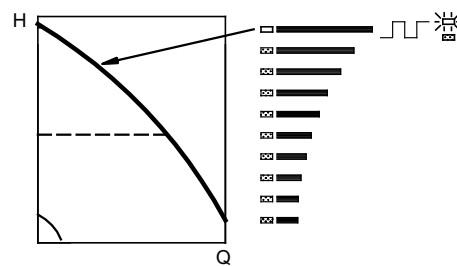


Fig. 13 Max. curve duty

4.3 Setting to min. curve duty

Press Ⓜ continuously to change to the min. curve of the pump (bottom light field flashes). When the bottom light field is on, Ⓜ must be pressed for 3 seconds before the light field starts flashing.

To return to uncontrolled or controlled operation, press Ⓜ continuously until the desired setpoint is indicated.

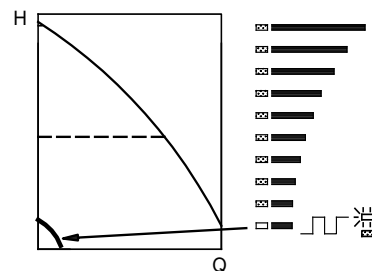


Fig. 14 Min. curve duty

4.4 Start/stop of pump

Stop the pump by continuously pressing Ⓜ until none of the light fields are activated and the green indicator light flashes.

Start the pump by continuously pressing Ⓜ until the desired setpoint is indicated.

TM00 7600 0304

TM00 7746 1304

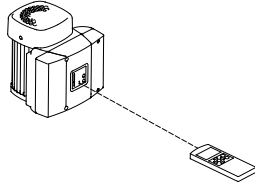
TM00 7345 1304

TM02 8987 1304

TM00 7346 1304

5. Setting by means of R100

The pump is designed for wireless communication with the Grundfos remote control R100.



TMO2 0936 0501

Fig. 15 R100 communicating with the pump via infra-red light

During communication, the R100 must be pointed at the control panel. When the R100 communicates with the pump, the red indicator light will flash rapidly.

The R100 offers additional possibilities of setting and status displays for the pump.

The displays are divided into four parallel menus, fig. 16:

0. GENERAL (see operating instructions for the R100)
1. OPERATION
2. STATUS
3. INSTALLATION

The number stated at each individual display in fig. 16 refers to the section in which the display is described.

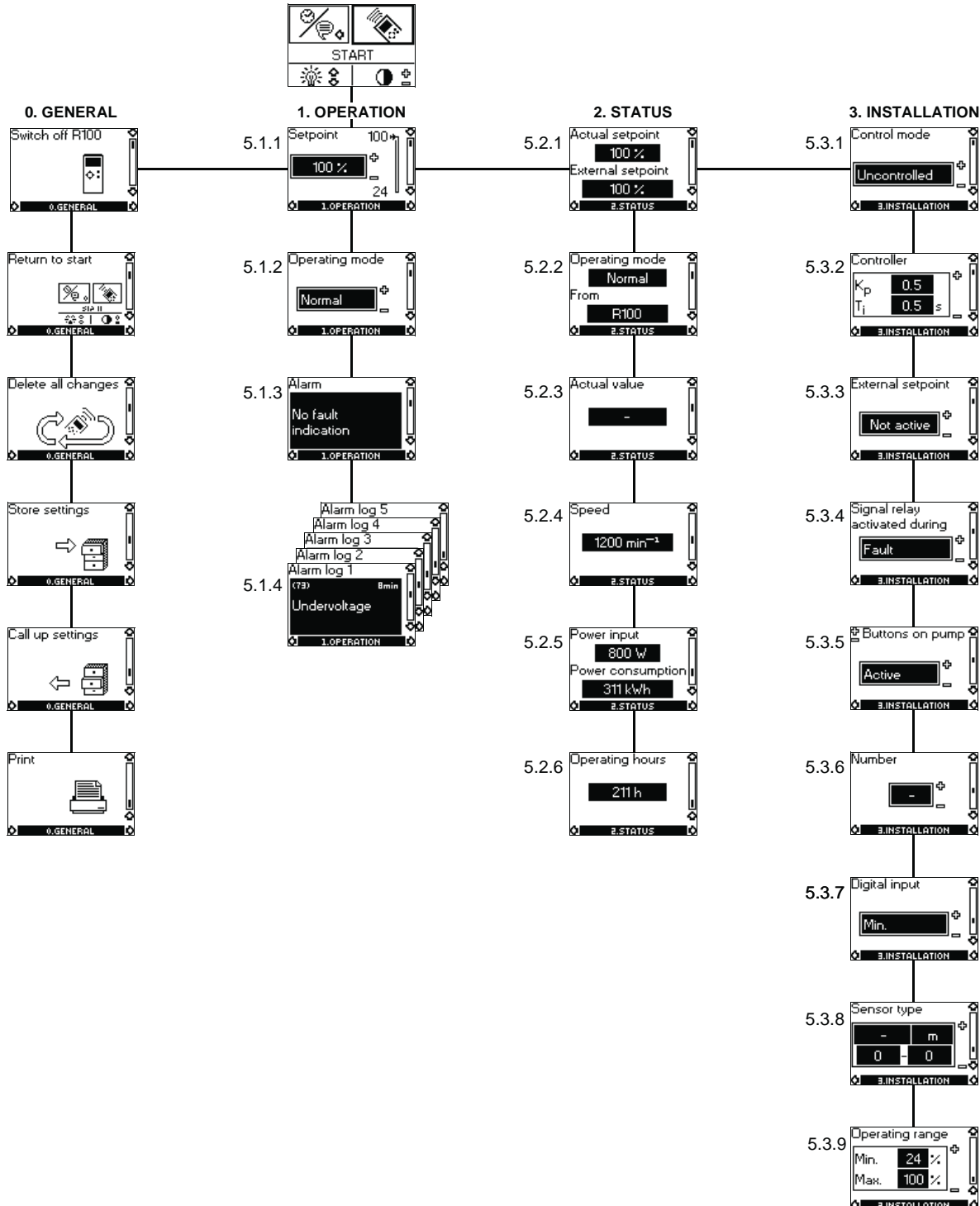
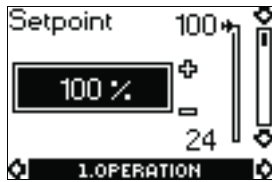


Fig. 16 Menu overview

5.1 Menu OPERATION

When communication between the R100 and the pump has been established, the first display in this menu will appear.

5.1.1 Setpoint setting



- Setpoint set
- Actual setpoint
- Actual value

In this display, the setpoint is set.

In **controlled**-operation mode, the setting range is equal to the sensor measuring range, e.g. 0 to 25 psi.

In **uncontrolled**-operation mode, the setpoint is set in % of the maximum performance. The setting range will lie between the min. and max. curves.

Select one of the following operating modes:

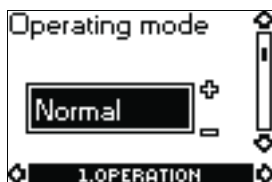
- Stop,
- Min. (min. curve),
- Max. (max. curve).

If the pump is connected to an external setpoint signal, the setpoint in this display will be the maximum value of the external setpoint signal, see section 7. *External setpoint signal*.

If the pump is controlled via external signals (Stop, Min. curve or Max. curve) or a bus, this will be indicated in the display if setpoint setting is attempted.

In this case, the number of possible settings will be reduced, see section 16. *Priority of settings*.

5.1.2 Setting of operating mode

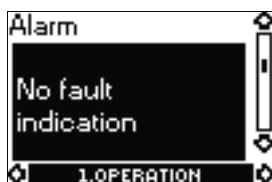


Select one of the following operating modes:

- Stop,
- Min.,
- **Normal** (duty),
- Max.

The operating modes can be selected without changing the setpoint setting.

5.1.3 Fault indications



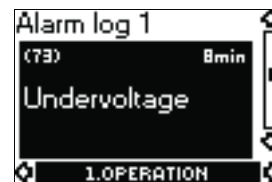
If the pump is faulty, the cause will appear in this display.

Possible causes:

- Too high motor temperature,
- Undervoltage,
- Overvoltage,
- Too many restarts (after faults),
- Overload,
- Sensor signal outside signal range,
- Setpoint signal outside signal range,
- Other fault.

A fault indication can be reset in this display if the cause of the fault has disappeared.

5.1.4 Alarm log



If faults have been indicated, the last five fault indications will appear in the alarm log. "Alarm log 1" shows the newest/latest fault.

The example shows the fault indication "Undervoltage", the fault code and the number of minutes the pump has been connected to the electricity supply after the fault occurred.

5.2 Menu STATUS

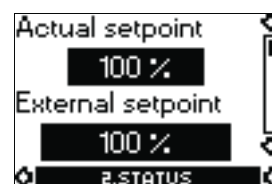
The displays appearing in this menu are status displays only. It is not possible to change or set values.

The displayed values are the values that applied when the last communication between the pump and the R100 took place. If a status value is to be updated, point the R100 at the control panel and press "OK".

If a parameter, e.g. speed, should be called up continuously, press "OK" constantly during the period in which the parameter in question should be monitored.

The tolerance of the displayed value is stated under each display. The tolerances are stated as a guide in % of the maximum values of the parameters.

5.2.1 Display of actual setpoint



Tolerance: ±2%

This display shows the actual setpoint and the external setpoint in % of the range from minimum value to the setpoint set, see section 7. *External setpoint signal*.

5.2.2 Display of operating mode



This display shows the actual operating mode (*Stop, Min., Normal* (duty) or *Max.*). Furthermore, it shows where this operating mode was selected (*R100, Pump, BUS* or *External*).

5.2.3 Display of actual value



The actually measured value of a connected sensor will appear in this display, e.g. 12 psi.

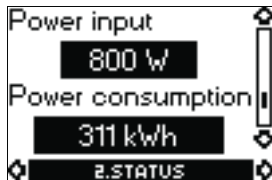
5.2.4 Display of actual speed



Tolerance: $\pm 5\%$

The actual pump speed will appear in this display.

5.2.5 Display of input power and power consumption



Tolerance: $\pm 10\%$

This display shows the actual pump input power from the mains supply. The power is displayed in W or kW.

The pump power consumption can also be read from this display. The value of power consumption is an accumulated value calculated from the pump's birth and it cannot be reset.

5.2.6 Display of operating hours



Tolerance: $\pm 2\%$

The value of operating hours is an accumulated value and cannot be reset.

5.3 Menu INSTALLATION

5.3.1 Selection of control mode



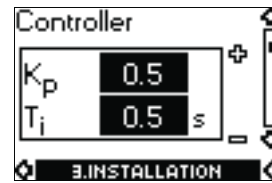
Select one of the following control modes (see fig. 8):

- *Controlled*,
- **Uncontrolled.**

The desired performance is set in section 5.1.1 *Setpoint setting*.

Note: If the pump is connected to a bus (see section 8. *Bus signal*), it is not possible to select the control mode via the R100.

5.3.2 Setting of controller



In this display, the gain (K_p) and the integral-action time (T_i) of the built-in PI controller can be set if the factory setting is not the optimum setting:

- The gain (K_p) is set within the range from 0.1 to 20.
- The integral-action time (T_i) is set within the range from 0.1 to 3600 s. If 3600 s is selected, the controller will function as a P controller.

Furthermore, it is possible to set the controller to inverse control (if the setpoint is increased, the speed will be reduced). In the case of inverse control, the gain (K_p) must be set within the range from -0.1 to -20.

Setting the PI controller:

For most applications, the factory setting of the controller constants K_p and T_i will ensure optimum pump operation. In the following cases, a change of the setting can be useful or necessary.

A change of the T_i setting can be useful:

- in a differential-pressure control system if the sensor is placed far away from the pump.

A change of the T_i setting, and in some cases the K_p setting, may be necessary:

- if the pump is controlled on the basis of temperature or differential temperature.
- If no sensor is connected to the pump, “-” will appear in the display.

The table below shows the recommended controller settings:

System/ application	K_p		T_i
	Heating system ¹⁾	Cooling system ²⁾	
	0.5		0.5
	0.5		L < 5 m: 0.5 L > 5 m: 3 L > 10 m: 5
	0.5		0.5
	0.5		0.5
	0.5	-0.5	10 + 5L
	0.5		10 + 5L
	0.5	-0.5	30 + 5L

- 1) Heating systems are systems in which an increase in pump performance will result in a **rise** in temperature at the sensor.
- 2) Cooling systems are systems in which an increase in pump performance will result in a **drop** in temperature at the sensor.

5.3.3 Selection of external setpoint signal



The input for external setpoint signal can be set to different signal types.

Select one of the following types:

- 0-10 V,
- 0-20 mA,
- 4-20 mA,
- **Not active.**

If *Not active* is selected, the setpoint set by means of the R100 or on the control panel will apply.

The setpoint set is the maximum value of the external setpoint signal, see section 7. *External setpoint signal*. The actual value of the external setpoint can be read from section 5.2.1 *Display of actual setpoint*.

5.3.4 Selection of fault, operating or ready signal relay



It can be selected in which situation the relay should be activated:

- **Fault** (fault indication),
- *Operation* (operating indication),
- *Ready* (ready indication).

See section 17. *Indicator lights and fault signal relay*.

5.3.5 Blocking of the buttons on the pump



The buttons ⊕ and ⊙ on the pump can be set to:

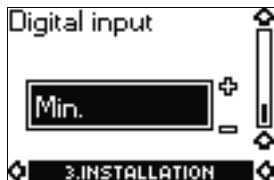
- **Active**,
- *Not active*.

5.3.6 Allocation of pump number



A number between 1 and 64 can be allocated to the pump. In the case of bus communication, a number must be allocated to each pump.

5.3.7 Selection of function for digital input



The digital input of the pump (terminal 1, fig. 4) can be set to different functions.

Select one of the following functions:

- **Min.** (min. curve),
- **Max.** (max. curve).

The selected function is activated by closing the contact between terminals 1 and 9 (fig. 4). See also section 6.2 *Digital input*.

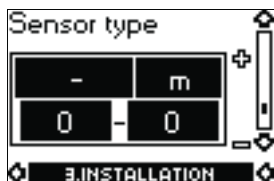
Min.:

When the input is activated, the pump is operating according to the min. curve.

Max.:

When the input is activated, the pump is operating according to the max. curve.

5.3.8 Setting of sensor



The setting of the sensor is only carried out in the case of controlled operation.

Select the following:

- Sensor output signal (0-10 V, 0-20 mA or 4-20 mA),
- sensor measuring unit (bar, mbar, m, kPa, psi, ft, m³/h, m³/s, l/s, gpm, °C, °F or %) and
- sensor measuring range.

5.3.9 Setting of min. and max. curves



Set the min. and max. curves in % of maximum performance if the operating range must be reduced, fig. 17.

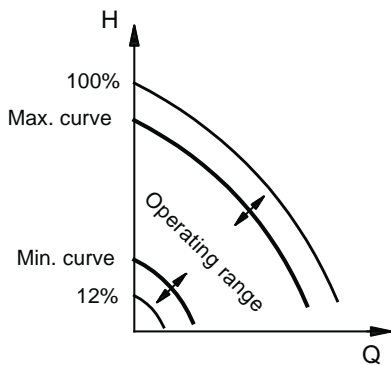


Fig. 17 Min. and max. curves.

Setting of the min. and max. curves in % of maximum performance.

- The max. curve can be adjusted within the range from maximum performance (100%) to min. curve.
- The min. curve can be adjusted within the range from max. curve to 12% of maximum performance. The pump has been factory-set to 24% of maximum performance.
- The operating range lies between the min. and max. curves.

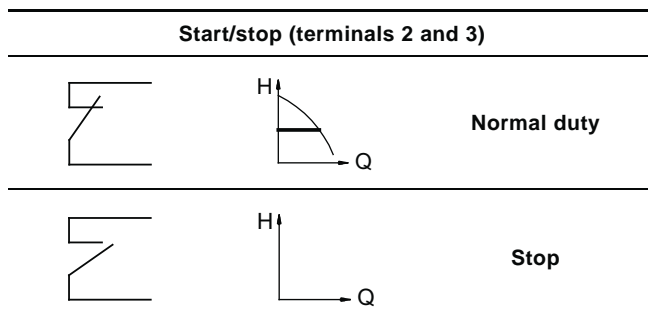
6. External forced-control signals

The pump has inputs for external signals for the forced-control functions:

- Start/stop of pump.
- Digital function.

6.1 Start/stop input

Functional diagram: Start/stop input:

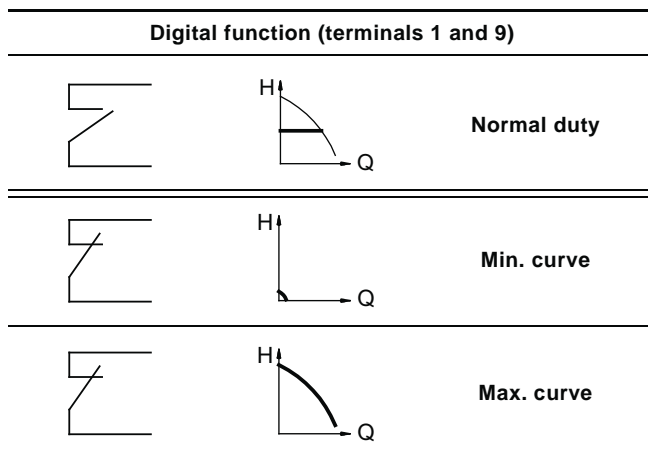


6.2 Digital input

By means of the R100, one of the following functions can be selected for the digital input:

- Min. curve.
- Max. curve.

Functional diagram: Input for digital function:



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7. External setpoint signal

By connecting an analog signal transmitter to the input for the setpoint signal (terminal 4), it is possible to remote-set the setpoint.

The actual external signal (0-10 V, 0-20 mA, 4-20 mA) must be selected via the R100, see section 5.3.3 Selection of external setpoint signal.

If uncontrolled operation is selected by means of the R100, the pump can be controlled by any controller.

In **controlled**-operation mode, the setpoint can be set externally within the range from the lower value of the sensor measuring range to the setpoint set on the pump or by means of the R100, fig. 18.

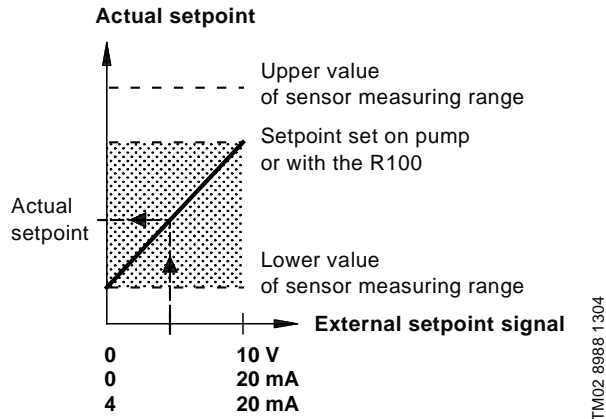


Fig. 18 Relation between the actual setpoint and the external setpoint signal in controlled-operation mode

Example: At a lower differential-pressure sensor value of 0 psi, a setpoint set of 20 psi and an external setpoint of 80%, the actual setpoint will be as follows:

$$\begin{aligned}
 H_{\text{actual}} &= (H_{\text{set}} - H_{\text{lower}}) \times \%_{\text{external setpoint}} + H_{\text{lower}} \\
 &= (20 - 0) \times 80\% + 0 \\
 &= 16 \text{ psi}
 \end{aligned}$$

In **uncontrolled**-operation mode, the setpoint can be set externally within the range from the min. curve to the setpoint set on the pump or by means of the R100, fig. 19.

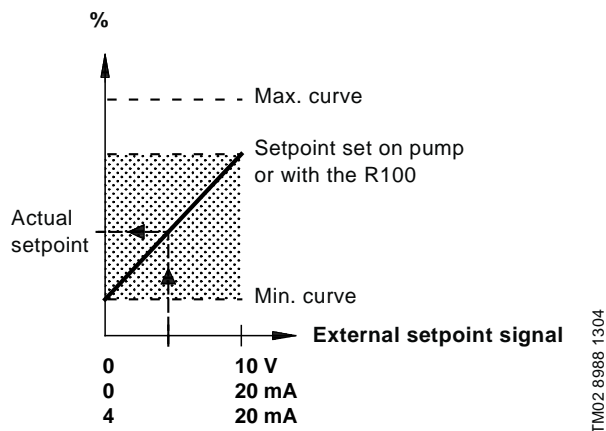


Fig. 19 Relation between the actual setpoint and the external setpoint signal in uncontrolled-operation mode

8. Bus signal

The pump enables serial communication via an RS-485 input. The communication is carried out according to the Grundfos bus protocol, GENibus protocol, and enables connection to a building management system or another external control system.

Via the bus signal, it is possible to remote-set pump operating parameters, like setpoint, operating mode, etc. At the same time, the pump can provide status information about important parameters, like actual value of control parameter, input power, fault indications, etc.

Contact Grundfos for further details.

Note: If a bus signal is used, the number of settings available via the R100 will be reduced.

9. E-circulator series 2000

9.1 Functions

Most functions can be selected by means of the pump control panel. However, some functions can only be selected via the R100 or via bus.

9.1.1 Control modes

The pump can be set to two primary control modes, i.e.

- **proportional** pressure and
- **constant** pressure.

Furthermore, the pump can be set to constant curve.

Proportional-pressure control:

The pump head is reduced at falling water demand and increased at rising water demand, see fig. 20.

Constant-pressure control:

The pump maintains a constant pressure, irrespective of water demand, see fig. 20.

Constant curve mode:

The pump is not controlled. The curve can be set within the range from min. curve to max. curve, see fig. 20.

The pumps have been factory-set to proportional pressure, see section 3.3 *Factory setting*. In most cases, this is the optimum control mode, and at the same time it consumes the least energy.

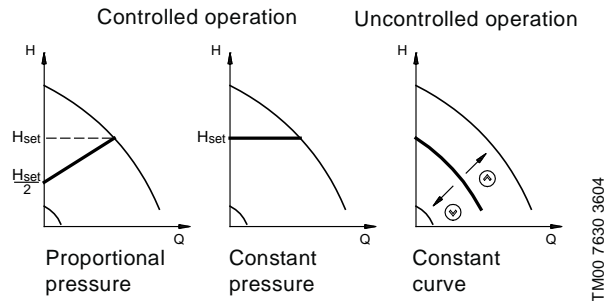




Fig. 20 Controlled and uncontrolled operation

Guide to the selection of control mode based on system type

System type	for instance ...	select this control mode
Relatively great head losses in the boiler, chiller or heat exchanger circuit and the distribution pipes	1. Two-pipe heating systems with thermostatic valves and:	Proportional pressure 
	<ul style="list-style-type: none"> • with a dimensioned pump head higher than 13 ft, • very long distribution pipes, • strongly throttled pipe balancing valves, • differential pressure regulators, • great head losses in those parts of the system through which the total quantity of water flows (e.g. boiler, chiller, heat exchanger and distribution pipe up to the first branching). 	
Relatively small head losses in the boiler, chiller or heat exchanger circuit and the distribution pipe	2. Primary circuit pumps in systems with great head losses in the primary circuit.	Constant pressure 
	1. Two-pipe heating or cooling systems with thermostatic valves and:	
	<ul style="list-style-type: none"> • with a dimensioned pump head lower than 6.5 ft, • dimensioned for natural circulation, • with small head losses in those parts of the system through which the total quantity of water flows (e.g. boiler, chiller, heat exchanger and distribution pipe up to the first branching) or • modified to a high differential temperature between flow pipe and return pipe (e.g. district heating). 	
	2. Underfloor heating systems with thermostatic valves.	
	3. One-pipe heating systems with thermostatic valves or pipe balancing valves.	
	4. Primary circuit pumps in systems with small head losses in the primary circuit.	

9.2 Operating modes

The following operating modes can be selected:

- Stop,
- Min.,
- Normal (proportional pressure, constant pressure or constant curve),
- Max.

The operating modes can all be set on the pump control panel.

9.2.1 Max. or min. curve duty

The pump can be set to operate according to the max. or min. curve, like an uncontrolled pump, see fig. 21.

This operating mode is available, irrespective of the control mode.

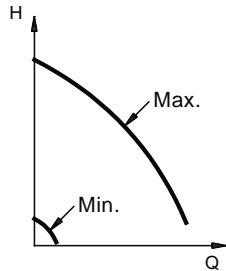


Fig. 21 Max. and min. curves

The min. curve can be used in periods in which a minimum flow is required.

The max. curve can for instance be used in connection with the venting procedure during installation.

If the electricity supply to the pump is disconnected, the pump setting will be stored.

The remote control R100 offers additional possibilities of setting and status displays, see section 5. *Setting by means of R100.*

9.3 Factory setting

The pumps have been factory-set to proportional pressure.

The head corresponds to 50% of the maximum pump head (see data sheet for the pump).

Many systems will operate satisfactorily with the factory setting, but most systems can be optimized by changing this setting.

Other pump settings are marked with **bold**-faced type under each individual display in sections 12.1 *Menu OPERATION* and 5.3 *Menu INSTALLATION*.

10. Setting the pump

For the setting of the pump, use:

- control panel.
- R100 remote control.
- bus communication (not described in detail in these instructions. Contact Grundfos).

11. Setting by means of control panel



At high system temperatures, the pump may be so hot that only the buttons should be touched to avoid burns.

The pump control panel, fig. 22, incorporates the following:

- Buttons, ⤴ and ⤵, for setpoint setting.
- Light fields, yellow, for indication of setpoint.
- Indicator lights, green (operation) and red (fault).

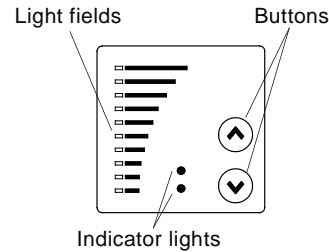


Fig. 22 Control panel

11.1 Setting of pump head

The pump head is set by pressing the button ⤴ or ⤵.

The light fields on the control panel will indicate the head set (setpoint). See the following examples.

Figure 23 shows that the light fields 5 and 6 are activated, indicating a desired head of 3 psi at maximum flow. The setting range lies between 1/4 and 3/4 of maximum head.

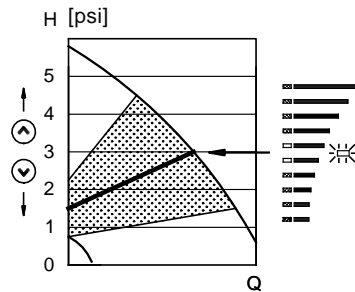


Fig. 23 Pump in proportional-pressure control mode

Figure 24 shows that the light fields 5 and 6 are activated, indicating a desired head of 3.1 psi. The setting range lies between 1/8 of maximum head and maximum head.

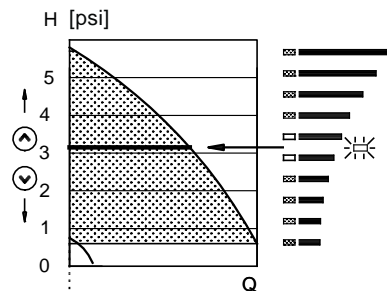


Fig. 24 Pump in constant-pressure control mode

11.2 Changeover between proportional pressure and constant pressure

When the buttons Ⓜ and Ⓟ are pressed simultaneously, the light fields will indicate the selected control mode, i.e. proportional pressure or constant pressure

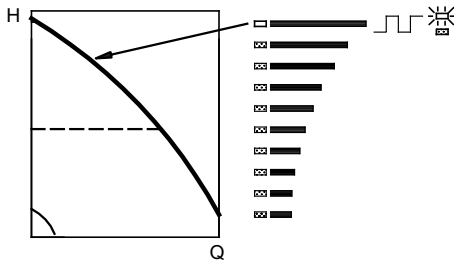
Light fields	Control mode
Top + bottom light fields flash	Proportional pressure
Middle light fields flash	Constant pressure

If the buttons are pressed for more than 5 seconds, the control mode will change over to constant pressure and proportional pressure respectively.

11.3 Setting to max. curve duty

Press Ⓜ continuously to change over to the max. curve of the pump (top light field flashes). When the top light field is on, Ⓜ must be pressed for 3 seconds before the light field starts flashing.

To change back, press Ⓟ continuously until the desired head is indicated.



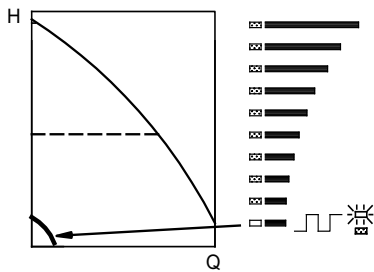
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Fig. 25 Max. curve duty

11.4 Setting to min. curve duty

Press Ⓟ continuously to change over to the min. curve of the pump (bottom light field flashes). When the bottom light field is on, Ⓟ must be pressed for 3 seconds before the light field starts flashing.

To change back, press Ⓜ continuously until the desired head is indicated.



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Fig. 26 Min. curve duty

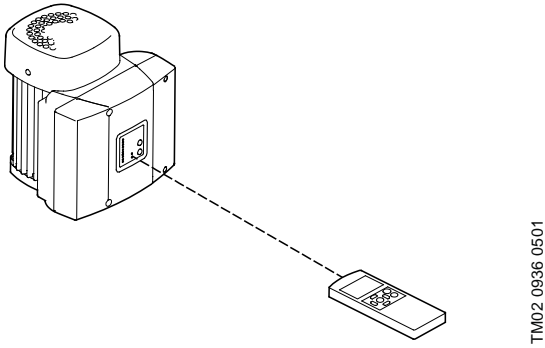
11.5 Start/stop of pump

Stop the pump by continuously pressing Ⓟ until none of the light fields are activated and the green indicator light flashes.

Start the pump by continuously pressing Ⓜ until the desired head is indicated.

12. Setting by means of R100

The pump is designed for wireless communication with the Grundfos remote control R100.



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Fig. 27 R100 communicating with the pump via infra-red light

During communication, the R100 must be pointed at the control panel. When the R100 communicates with the pump, the red indicator light will flash rapidly.

The R100 offers additional possibilities of setting and status displays for the pump.

The displays are divided into four parallel menus, fig. 28:

- 0. GENERAL (see operating instructions for the R100)
- 1. OPERATION
- 2. STATUS
- 3. INSTALLATION

The number stated at each individual display in fig. 28 refers to the section in which the display is described.

US

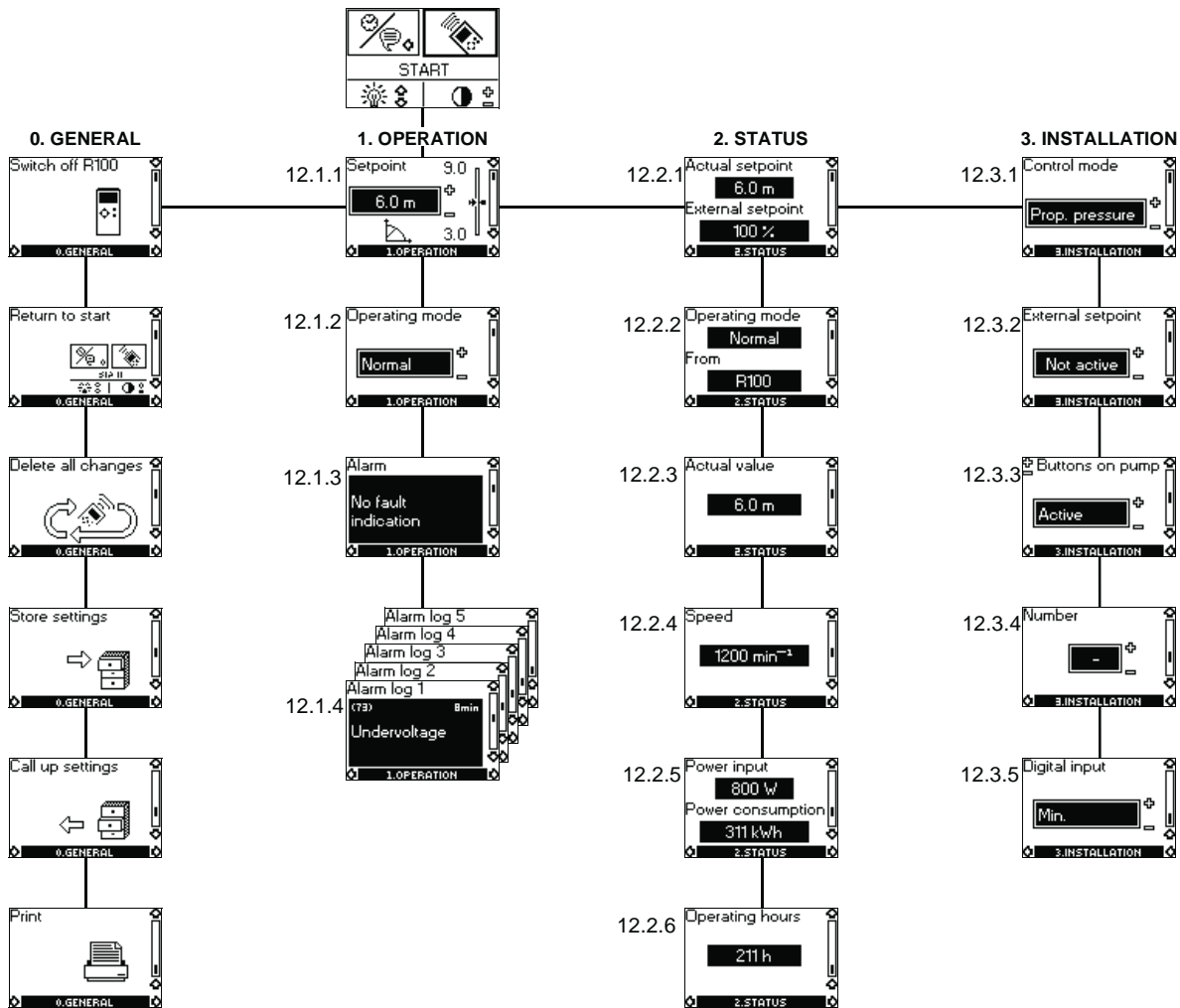
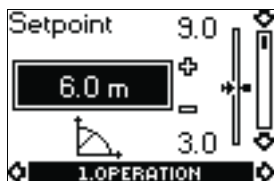


Fig. 28 Menu overview

12.1 Menu OPERATION

When communication between the R100 and the pump has been established, the first display in this menu will appear.

12.1.1 Setpoint setting



- Setpoint set
- Actual setpoint
- Actual head

In this display, the desired setpoint is set in [m].

In **proportional pressure** mode, the setting range is from ¼ of maximum head to ¾ of maximum head.

In **constant pressure** mode, the setting range is from 1/8 of maximum head to maximum head.

In **constant curve** mode, the setpoint is set in % of the maximum curve. The curve can be set within the range from min. curve to max. curve. Select one of the following operating modes:

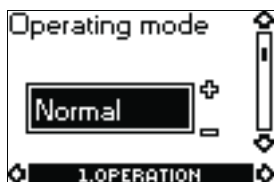
- Stop,
- Min. (min. curve),
- Max. (max. curve).

If the pump is connected to an external setpoint signal, the setpoint in this display will be the maximum value of the external setpoint signal, see section 7. *External setpoint signal*.

If the pump is controlled via external signals (Stop, Min. curve or Max. curve) or a bus, this will be indicated in the display if setpoint setting is attempted.

In this case, the number of possible settings will be reduced, see section 16. *Priority of settings*.

12.1.2 Setting of operating mode

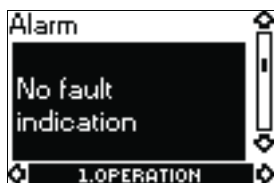


Select one of the following operating modes:

- Stop,
- Min.,
- **Normal** (duty),
- Max.

The operating modes can be selected without changing the setpoint setting.

12.1.3 Fault indications



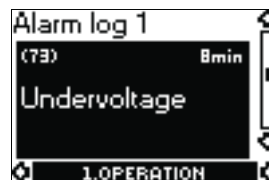
If the pump is faulty, the cause will appear in this display.

Possible causes:

- Too high motor temperature,
- Undervoltage,
- Overvoltage,
- Too many restarts (after faults),
- Overload,
- Sensor signal outside signal range,
- Setpoint signal outside signal range,
- Other fault.

A fault indication can be reset in this display if the cause of the fault has disappeared.

12.1.4 Alarm log



If faults have been indicated, the last five fault indications will appear in the alarm log. "Alarm log 1" shows the newest/latest fault.

The example shows the fault indication "Undervoltage", the fault code and the number of minutes the pump has been connected to the electricity supply after the fault occurred.

12.2 Menu STATUS

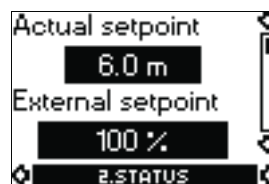
The displays appearing in this menu are status displays only. It is not possible to change or set values.

The displayed values are the values that applied when the last communication between the pump and the R100 took place. If a status value is to be updated, point the R100 at the control panel and press "OK".

If a parameter, e.g. speed, should be called up continuously, press "OK" constantly during the period in which the parameter in question should be monitored.

The tolerance of the displayed value is stated under each display. The tolerances are stated as a guide in % of the maximum values of the parameters.

12.2.1 Display of actual setpoint



Tolerance: ±2%

This display shows the actual setpoint and the external setpoint in % of the range from minimum value to the setpoint set, see section 14. *External setpoint signal*.

12.2.2 Display of operating mode



This display shows the actual operating mode (*Stop, Min., Normal* (duty) or *Max.*). Furthermore, it shows where this operating mode was selected (*R100, Pump, BUS* or *External*).

12.2.3 Display of actual value



The actually measured head will appear in this display.

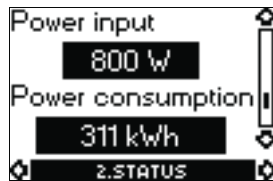
12.2.4 Display of actual speed



Tolerance: $\pm 5\%$

The actual pump speed will appear in this display.

12.2.5 Display of input power and power consumption



Tolerance: $\pm 10\%$

This display shows the actual pump input power from the mains supply. The power is displayed in W or kW.

The pump power consumption can also be read from this display. The value of power consumption is an accumulated value calculated from the pump's birth and it cannot be reset.

12.2.6 Display of operating hours

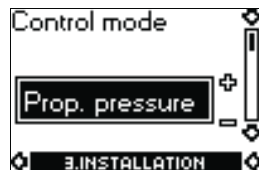


Tolerance: $\pm 2\%$

The value of operating hours is an accumulated value and cannot be reset.

12.3 Menu INSTALLATION

12.3.1 Selection of control mode



Select one of the following control modes (see fig. 20):

- **Prop. pressure** (proportional pressure),
- *Const. pressure* (constant pressure),
- *Const. curve* (constant curve).

The desired performance is set in section 12.1.1 *Setpoint setting*.

Note: If the pump is connected to a bus (see section 8. *Bus signal*), it is not possible to select the control mode via the R100.

12.3.2 Selection of external setpoint signal



The input for external setpoint signal can be set to different signal types. Select one of the following types:

- 0-10 V,
- 0-20 mA,
- 4-20 mA,
- **Not active**.

If *Not active* is selected, the setpoint set by means of the R100 or on the control panel will apply.

The setpoint set is the maximum value of the external setpoint signal, section 14. *External setpoint signal*. The actual value of the external setpoint can be read from section 12.2.1 *Display of actual setpoint*.

12.3.3 Blocking of the buttons on the pump



The buttons ⊕ and ⊖ on the pump can be set to:

- **Active**,
- *Not active*.

12.3.4 Allocation of pump number



A number between 1 and 64 can be allocated to the pump. In the case of bus communication, a number must be allocated to each pump.

12.3.5 Selection of function for digital input



The digital input of the pump (terminal 1, fig. 4) can be set to different functions.

Select one of the following functions:

- **Min.** (min. curve),
- *Max.* (max. curve).

The selected function is activated by closing the contact between terminals 1 and 9 (fig. 4).

See also section 13.2 *Digital input*.

Min.:

When the input is activated, the pump is operating according to the min. curve.

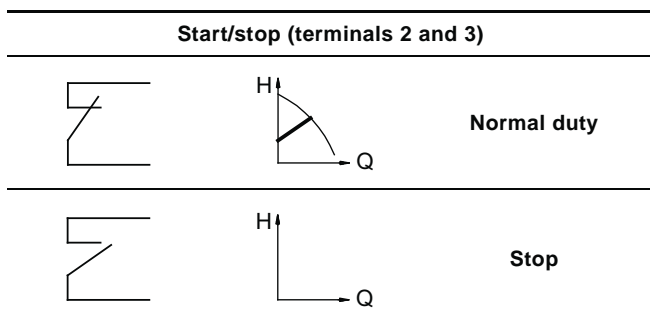
13. External forced-control signals

The pump has inputs for external signals for the forced-control functions:

- Start/stop of pump.
- Digital function.

13.1 Start/stop input

Functional diagram: Start/stop input:

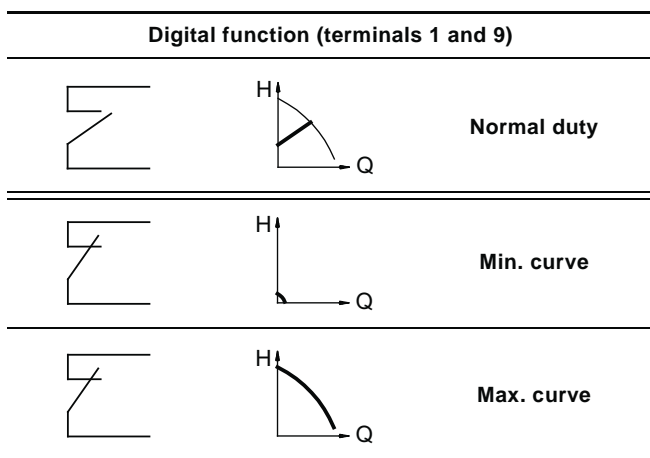


13.2 Digital input

By means of the R100, one of the following functions can be selected for the digital input:

- Min. curve.
- Max. curve.

Functional diagram: Input for digital function:



14. External setpoint signal

By connecting an analog signal transmitter to the input for the setpoint signal (terminal 4), it is possible to remote-set the head (external setpoint).

The actual external signal (0-10 V, 0-20 mA, 4-20 mA) must be selected via the R100, see section 12.3.2 Selection of external setpoint signal.

If constant curve duty is selected by means of the R100, the pump can be controlled by any controller.

In **proportional pressure** mode, the setpoint can be set externally within the range from 1/4 of maximum head to the setpoint set on the pump or by means of the R100, fig. 29.

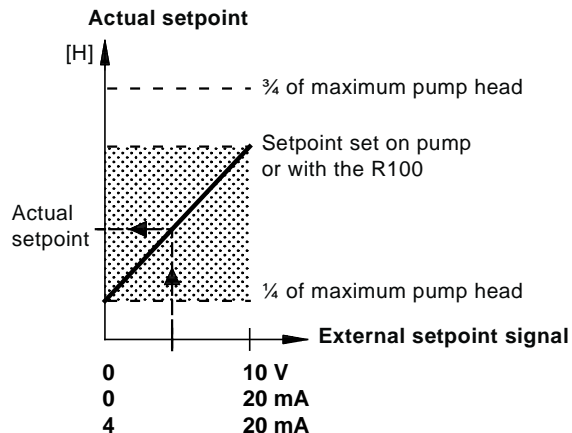


Fig. 29 Relation between the actual setpoint and the external setpoint signal in proportional-pressure mode

Example: At a maximum head of 12 psi, a setpoint of 6 psi and an external setpoint of 40%, the actual setpoint will be as follows:

$$\begin{aligned}
 H_{\text{actual}} &= (H_{\text{set}} - 1/4 H_{\text{max.}}) \times \%_{\text{external setpoint}} + 1/4 H_{\text{max.}} \\
 &= (6 - 12/4) \times 40\% + 12/4 \\
 &= 4.2 \text{ psi}
 \end{aligned}$$

In **constant pressure** mode, the setpoint can be set externally within the range from 1/8 of maximum head to the setpoint set on the pump or by means of the R100, fig. 30.

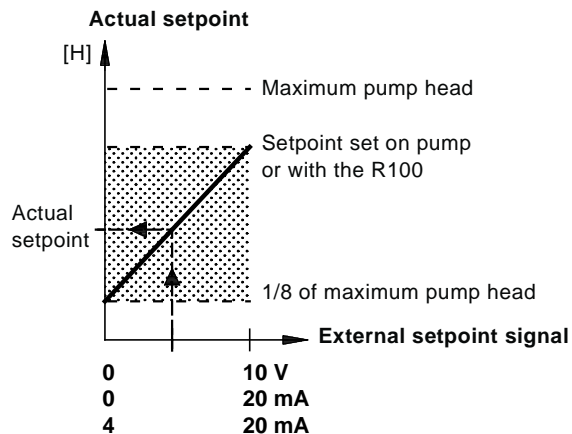


Fig. 30 Relation between the actual setpoint and the external setpoint signal in constant-pressure mode

Example: At a maximum head of 12 psi, a setpoint of 6 psi and an external setpoint of 80%, the actual setpoint will be as follows:

$$\begin{aligned}
 H_{\text{actual}} &= (H_{\text{set}} - 1/8 H_{\text{max.}}) \times \%_{\text{external setpoint}} + 1/8 H_{\text{max.}} \\
 &= (6 - 12/8) \times 80\% + 12/8 \\
 &= 5.1 \text{ psi}
 \end{aligned}$$

Max.:

When the input is activated, the pump is operating according to the max. curve.

In **constant curve** mode, the setpoint can be set externally within the range from the min. curve to the setpoint set on the pump or by means of the R100, fig. 31.

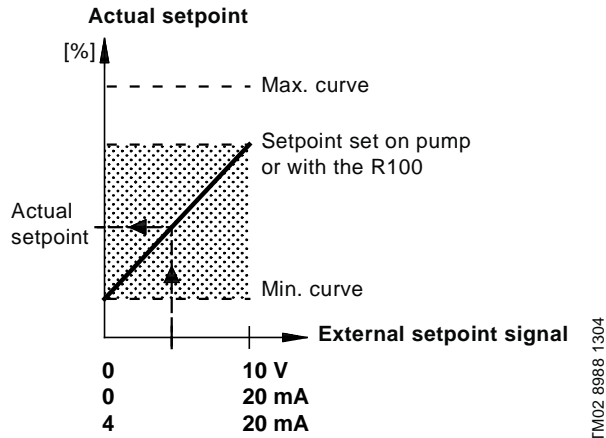


Fig. 31 Relation between the actual setpoint and the external setpoint signal in constant-curve mode

15. Bus signal

The pump enables serial communication via an RS-485 input. The communication is carried out according to the Grundfos bus protocol, GENIbus protocol, and enables connection to the GRUNDFOS Pump Management System 2000.

Via the bus signal, it is possible to remote-set pump operating parameters, like setpoint, operating mode, etc. Furthermore, it offers the possibility of controlling several E-pumps of the same type connected in parallel. At the same time, the pump can provide status information about important parameters, like actual value of control parameter, input power, fault indications, etc.

Via the bus input, the E-pumps can also be connected to a building management system or another external control system. Contact Grundfos for further details.

Note: If a bus signal is used, the number of settings available via the R100 will be reduced.

16. Priority of settings

The start/stop and digital inputs will influence the number of possible settings.

By means of the R100, the pump can always be set to max. curve duty or to stop.

If two or more functions are activated at the same time, the pump will operate according to the function with the highest priority.

The priority of the settings is as shown in the following tables:

Without bus signal		
Priority	Possible settings	
	Control panel on pump or R100	External signals
1	Stop	
2	Max. curve	
3		Stop
4		Max. curve
5	Min. curve	Min. curve
6	Setting of head	Setting of head

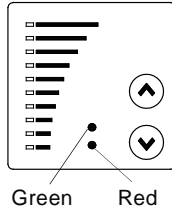
Example: If, via the digital input, the pump has been forced to operate according to the max. curve, the pump control panel and the R100 can only set the pump to stop.

With bus signal			
Priority	Possible settings		
	Control panel on pump or R100	External signals	Bus signal
1	Stop		
2	Max. curve		
3		Stop	Stop
4			Max. curve
5			Min. curve
6			Setting of head

Example: If, via the digital input, the pump has been forced to operate according to the max. curve, the pump control panel, the R100 and the bus signal can only set the pump to stop.

17. Indicator lights and fault signal relay

The operating condition of the pump is indicated by the green and red indicator lights on the pump control panel, fig. 32.



TM00 7600 0304

Fig. 32 Indicator lights on the pump control panel

The pump incorporates a fault signal relay with a potential-free changeover contact for external fault indication. The functions of the two indicator lights and the fault signal relay are as shown in the following table:

Indicator lights		Fault signal relay	Description
Fault (red)	Operation (green)		
Off	Off		The electricity supply has been switched off.
Off	Permanently on		The pump is operating.
Off	Flashing		The pump has been set to stop.
Permanently on	Off		The pump has stopped because of a fault. Restarting will be attempted (it may be necessary to restart the pump by resetting the fault indication).
Permanently on	Permanently on		The pump is operating, but it has been stopped because of a fault. If the cause is "sensor signal outside signal range", the pump will continue operating according to the max. curve and the fault indication cannot be reset until the signal is inside the signal range. If the cause is "setpoint signal outside signal range", the pump will continue operating according to the min. curve and the fault indication cannot be reset until the signal is inside the signal range.
Permanently on	Flashing		The pump has been set to stop, but it has been stopped because of a fault.

A fault indication can be reset in one of the following ways:

- By briefly pressing the button or on the pump. This will not change the setting of the pump. A fault indication cannot be reset by means of or if the buttons have been locked.
- By switching off the electricity supply until the indicator lights are off.
- By switching the external start/stop input off/on.
- By means of the R100, see section 5.1.3 *Fault indications*.

When the R100 communicates with the pump, the red indicator light will flash rapidly.

18. Megging

Note: Megging of an installation incorporating E-pumps is not allowed, as the built-in electronics may be damaged.

19. Technical data

19.1 Supply voltage

1 x 208-230V 60Hz PE.
Cable: 0.5 - 1.5 mm² / 14-12 AWG.
See nameplate.

Recommended fuse size

Motor sizes from 0.33 to 1.5 hp: Max. 10 A.
Standard as well as quick-blow or slow-blow fuses may be used.

19.2 Leakage current

Earth leakage current < 3.5 mA.
The leakage currents are measured in accordance with EN 60 355-1.

19.3 Inputs/output

Start/stop

External potential-free switch.
Voltage: 5 VDC.
Current: < 5 mA.
Screened cable: 0.5 - 1.5 mm² / 28-16 AWG.

Digital

External potential-free switch.
Voltage: 5 VDC.
Current: < 5 mA.
Screened cable: 0.5 - 1.5 mm² / 28-16 AWG.

Setpoint signals

- Potentiometer
0-10 VDC, 10 k Ω (via internal voltage supply).
Screened cable: 0.5 - 1.5 mm² / 28-16 AWG.
Maximum cable length: 100 m.
- Voltage signal
0-10 VDC, R_i > 10 k Ω .
Tolerance: +0%/–3% at maximum voltage signal.
Screened cable: 0.5 - 1.5 mm² / 28-16 AWG.
Maximum cable length: 500 m.
- Current signal
DC 0-20 mA/4-20 mA, R_i = 175 Ω .
Tolerance: +0%/–3% at maximum current signal.
Screened cable: 0.5 - 1.5 mm² / 28-16 AWG.
Maximum cable length: 500 m.
Maximum capacity of 24VDC supply for sensor: 40mA

Fault signal output

Potential-free changeover contact.
Maximum contact load: 250 VAC, 2 A.
Minimum contact load: 5 VDC, 10 mA.
Screened cable: 0.5 - 2.5 mm² / 28-12 AWG.
Maximum cable length: 500 m.

Bus input

Grundfos bus protocol, GENIbus protocol, RS-485.
Screened 3-core cable: 0.5 - 1.5 mm² / 28-16 AWG.
Maximum cable length: 500 m.

19.4 Other technical data

EMC (electromagnetic compatibility)

EN 61 800-3.
Residential areas - unlimited distribution, corresponding to CISPR 11, class B, group 1.
Industrial areas - unlimited distribution, corresponding to CISPR 11, class A, group 1.
Contact Grundfos for further information.

Enclosure class

Standard: IP 55 (IEC 34-5) (TEFC -Totally Enclosed Fan Cooled).

Insulation class

F (IEC 85).

Ambient temperature

- During operation: –4°F to 104°F.
- During storage/transport: –40°F to 140°F.

Relative air humidity

Maximum 95%.

Sound pressure level

<70 dB(A).

20. Disposal

Disposal of this product or parts of it must be carried out according to the following guidelines:

1. Use the local public or private waste collection service.
2. In case such waste collection service does not exist or cannot handle the materials used in the product, please deliver the product or any hazardous materials from it to your nearest Grundfos company or service workshop.

21. Installation in the USA and Canada

In order to maintain the UL/cUL approval, these additional installation procedures must be followed. The UL approval is according to UL508C.

21.1 Electrical installation

21.1.1 Conductors

Use 140/167°F (60/75°C) copper conductors only.

21.1.2 Torques

Power terminal, M4: 2.35 Nm.

Relay, M2.5: 0.5 Nm.

Input control, M2: 0.2 Nm.

21.1.3 Overload protection

Degree of overload protection provided internally by the drive, in percent of full-load current: 102%.

21.2 Before starting the pump

- The pump must always be connected to the power supply at least one hour prior to start.
- From then on the pump must always be connected to the power supply.

This procedure will help to avoid condensation in the terminal box.

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