# Control MPC

Installation and operating instructions

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GRUNDFOS

**Original installation and operating instructions**

These installation and operating instructions describe Grundfos Control MPC.

## CONTENTS



Read this document before installing the product. Installation and operation must comply with local regulations and accepted codes of good practice.

# 1. General information

## 1.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

**DANGER**

Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

**WARNING**

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

**CAUTION**

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

**SIGNAL WORD**

**Description of hazard**

Consequence of ignoring the warning.

- Action to avoid the hazard.

## 1.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

Observe these instructions for explosion-proof products.

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

## 2. Receiving the product

### 2.1 Transporting the product

Depending on size, the control cabinet is delivered in an open wooden box or wooden/cardboard box designed for transport by forklift truck or a similar vehicle.

### 2.2 Lifting the product

The control cabinet is equipped with eyebolts. See fig. 15.

The lifting point must always be above the centre of gravity of the control cabinet.

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**Fig. 1** Correct lifting of control cabinet

Use suitable lifting equipment that is in good condition and approved for the weight. The weight is stated on the packaging label of the control cabinet.

Do not use chains for lifting the control cabinet, as this may damage the control cabinet.

## 3. Installing the product

Before installing the product, check the following:

- The system corresponds to the order.
- All visible parts are intact.

### 3.1 Location

Install MPC in a well-ventilated room to ensure sufficient cooling of the control cabinet.

MPC is only designed for indoor installation. Do not expose the product to direct sunlight.

### 3.2 Mechanical installation

Install the pumps according to the installation and operating instructions supplied with the pumps.

### 3.3 Electrical installation

The electrical installation must be carried out by an authorised person in accordance with local regulations and the relevant wiring diagram.

- The electrical installation of the system must comply with enclosure class IP54.
- Make sure that the system is suitable for the power supply to which it is connected.
- Make sure that the wire cross-section corresponds to the specifications in the wiring diagram.

## 4. Starting up the product

After carrying out the mechanical and electrical installation described in sections *3.2 Mechanical installation* and *3.3 Electrical installation*, proceed as follows:

1. Switch on the power supply.
2. Wait for the first display to appear.
3. The first time CU 352 is switched on, a startup wizard guides the user through the basic settings.
4. Follow the instructions in each display.
5. When the wizard is completed, check that all pumps are set to "Auto" in the menu "Status".
6. Go to the menu "Operation".
7. Select operating mode "Normal" and press [OK].
8. The system is now ready for operation.

Grundfos can supply hydraulic data for CR, CRI, CRN, CRE, CRIE and CRNE pumps where GSC files can be downloaded to CU 352. Electrical data must be entered manually. All other pump types require manual entering of both hydraulic and electrical pump data. See section *8.7.43 Pump curve data (4.3.19)*.

# 5. Product introduction

TM05 3232 1012 - TM05 3233 1012

**Fig. 1** Control MPC

## 5.1 Product description

Grundfos Control MPC is mainly used for control and monitoring of booster and circulation systems.

Control MPC consists of a control cabinet with a built-in controller, CU 352.

The control cabinet contains all necessary components such as main switch, contactors, IO modules and cabling.

In systems with external frequency converters, the frequency converters can be installed in the cabinet.

The control cabinet is for wall or floor mounting.

## 5.2 Applications

Control MPC is mainly used for control and monitoring of pumps in these applications:

- booster systems
- circulation systems for heating, cooling and air-conditioning.

### 5.2.1 Pumps

Control MPC is designed for systems with these pumps:

- CR, CRE, CRI, CRIE, CRN, CRNE, CRIE
- NB, NBE, NBG, NBGE
- NK, NKE, NKG, NKGE
- TP
- TPE 3
- TPE Series 1000
- TPE Series 2000
- HS
- SP
- MAGNA, UPE Series 2000.

The main pumps of the system must be of the same type and size.

### 5.2.2 Control variant

Control MPC is divided into five groups based on the control variant:

| Control variant | Description |
|---|---|
| -E | Two to six pumps with integrated frequency converter (0.37 - 22 kW). |
| -EC | Two to six pumps connected to a Grundfos CUE frequency converter - one per pump. |
| Series 2000 | Two to six MAGNA, UPE, TPE 3 or TPE Series 2000 pumps |
| -F | Two to six pumps connected to a Grundfos CUE frequency converter. The speed-controlled operation alternates between the pumps. |
| -S | Two to six mains-operated pumps |

See also section *6. Overview of control variants*.

Control MPC includes software for pressure boosting, heating and cooling.

## 5.3 Identification

### 5.3.1 Nameplate

The nameplate is fitted on the base frame.

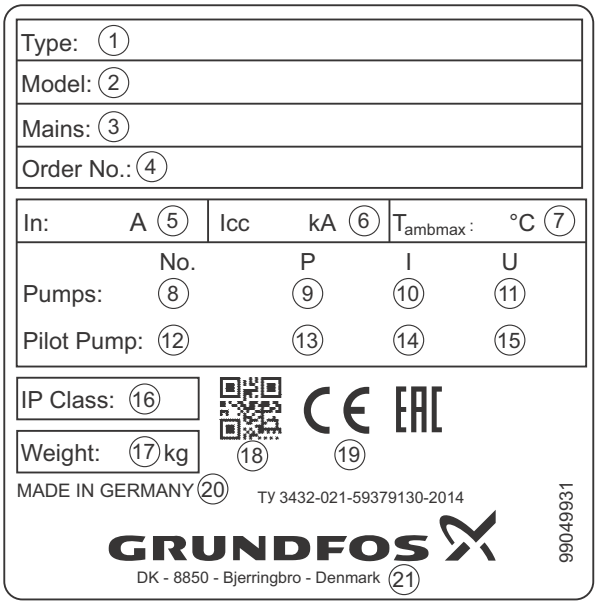



**Fig. 2** Nameplate

| Pos. | Description |
|---|---|
| 1 | Product type |
| 2 | Code for model |
| 3 | Main supply |
| 4 | Order No. |
| 5 | Rated current [A] |
| 6 | Circuit rated current [kA] |
| 7 | Maximum ambient temperature [°C] |
| 8 | Number of mains-operated pumps |
| 9 | Power [kW] of mains-operated pumps |
| 10 | Rated current [A] of mains-operated pumps |
| 11 | Rated voltage [V] of mains-operated pumps |
| 12 | Pilot pump |
| 13 | Power [kW] of pilot pump |
| 14 | Rated current [A] of pilot pump |
| 15 | Rated voltage [V] of pilot pump |
| 16 | Enclosure class |
| 17 | Weight [kg] |
| 18 | QR code |
| 19 | Approval marks |
| 20 | Country of origin |
| 21 | Company address |

### 5.3.2 Software label

The software label is placed on the back of the CU 352 control unit.

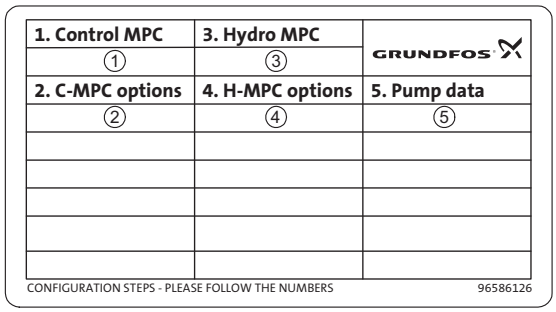



**Fig. 3** Software label

| Pos. | Description |
|---|---|
| 1 | Control MPC - GSC file number |
| 2 | Control MPC options - GSC file numbers |
| 3 | Hydro MPC - GSC file number* |
| 4 | Hydro MPC options - GSC file numbers* |
| 5 | Pump data - GSC file numbers** |

* Applies only to booster systems.

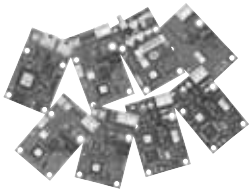
** Applies only to CR, CRI, CRN, CRE and CRIE pumps.

A GSC (Grundfos Standard Configuration) file is a configuration data file.

### 5.3.3 Type key

| Code | Example | Control MPC | E | 6x | 000A | DOL | U1 | W | A | O |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Type range** | | | | | | | | | |
| | **System type** | | | | | | | | | |
| E | All pumps with E motor | | | | | | | | | |
| EC | All pumps with CUE | | | | | | | | | |
| F | Fixed-speed pumps, 1 CUE | | | | | | | | | |
| EF | All VFD non CUE | | | | | | | | | |
| S | Fixed-speed pumps | | | | | | | | | |
| E2 | 2000 series | | | | | | | | | |
| | **Number of main pumps** | | | | | | | | | |
| | **Main pump current** | | | | | | | | | |
| | **Start method** | | | | | | | | | |
| E | Electronic | | | | | | | | | |
| DOL | Direct-on-line starter | | | | | | | | | |
| SD | Star-delta starter | | | | | | | | | |
| SST | Soft starter | | | | | | | | | |
| | **Voltage supply** | | | | | | | | | |
| U11 | 3 x 400 V, 50 Hz, PE | | | | | | | | | |
| U12 | 3 x 400 V, 60 Hz, PE | | | | | | | | | |
| U13 | 3 x 400 V, 50 Hz, N, PE | | | | | | | | | |
| U14 | 3 x 400 V, 60 Hz, N, PE | | | | | | | | | |
| U15 | 3 x 380 V, 50 Hz, PE | | | | | | | | | |
| U16 | 3 x 380 V, 50 Hz, N, PE | | | | | | | | | |
| UX | - | | | | | | | | | |
| | **Design** | | | | | | | | | |
| W | Wall mounting | | | | | | | | | |
| F | Floor standing | | | | | | | | | |
| O | Outdoor | | | | | | | | | |
| X | Customized | | | | | | | | | |
| | **Standard versions** | | | | | | | | | |
| A | **Standard version A**<br>O10: Dry-running protection, digital input (or O9)<br>O9: Dry-running protection, inlet-pressure sensor (or O10)<br>O1: Redundant primary sensor (prepared fo connection only)<br>O2: Show repair switches in wiring diagram | | | | | | | | | |
| B | **Standard version B**<br>O10: Dry-running protection, digital input (or O9)<br>O9: Dry-running protection, inlet-pressure sensor (or O10)<br>O1: Redundant primary sensor (prepared for connection only)<br>O2: Show repair switches in wiring diagram<br>O3: Emergency operation switch (mounted in panel) | | | | | | | | | |
| C | **Standard version C**<br>O10: Dry-running protection, digital input (or O9)<br>O9: Dry-running protection, inlet-pressure sensor (or O10)<br>O1: Redundant primary sensor (prepared for connection only)<br>O2: Show repair switches in wiring diagram<br>O12: Operation light pump (lamp in front door)<br>O11: Fault light pump (lamp in front door)<br>O16: Voltmeter (in front door)<br>O15: Ammeter (in front door) | | | | | | | | | |
| D | **Standard version D**<br>O10: Dry-running protection, digital input<br>O9: Dry-running protection, inlet-pressure sensor<br>O1: Redundant primary sensor<br>O2: Show repair switches in wiring<br>O3: Emergency operation switch<br>O4: IO 351B interface | | | | | | | | | |
| E | **Standard version E**<br>O7: Dry-running protection, electrode relay<br>O1: Redundant primary sensor<br>O2: Show repair switches in wiring diagram<br>O3: Emergency operation switch | | | | | | | | | |
| F | **Standard version F**<br>O8: Dry-running protection, vibration limit switch<br>O1: Redundant primary sensor<br>O2: Show repair switches in wiring diagram<br>O3: Emergency operation switch | | | | | | | | | |
| O | **Option**<br>See *5.3.4 Optional equipment* | | | | | | | | | |

### 5.3.4 Optional equipment

| Operating-panel options | | | | | Included in pre-defined Control MPC standard | | | |
|---|---|---|---|---|---|---|---|---|
| **Option** | | **Description** | **Location** | **Options (type key for Control MPC)** | **A** | **B** | **E** | **F** |
| **Redundant primary sensor** | - | The redundant primary sensor is visible on the wiring diagram.<br>**Note**: The redundant primary sensor is not included. | In the control cabinet | O1 | ● | ● | ● | ● |
| **Show repair switches in wiring diagram** | - | The repair switches are visible on the wiring diagram.<br>**Note**: Repair switches are not included. | In the control cabinet | O2 | ● | ● | ● | ● |
| **Emergency-operation switch** | - | The emergency-operation switch enables emergency operation if a fault occurs in the CU 352.<br>**Note**: The motor protection and the dry-running protection are not activated during emergency operation.<br>**Note**: One switch for each pump. | In the control cabinet | O3 | - | ● | ● | ● |
| **IO 351B interface** |  | This option features a factory-fitted and non-programmed IO 351B interface enabling exchange of additional digital in-/outputs, seven additional outputs, two additional analog inputs and three analog outputs.<br>**Note**: The CU 352 supports up to two IO 351B interfaces. | In the control cabinet | O4 | - | - | - | - |
| **Potential-free contacts** | - | Potential-free contacts are used to indicate that the pumps in the system are running or that an alarm is present. | In the control cabinet | O5 | - | - | - | - |
| **CIM - Communication interface modules** | | The CIM modules enable communication of operating data, such as measured values and setpoints, between Hydro MPC and a building-management system.<br>Note: CIM modules must be fitted by authorised staff. The CIM module enables transfer of data such as:<br>• operating mode<br>• setpoint<br>• control mode<br>• warnings and alarms<br>• power/energy consumption.<br>We offer the following CIM modules: | | O6 | ↓ | ↓ | ↓ | ↓ |
| • CIM 050 |  | GENIbus module | In the control cabinet | O6a | - | - | - | - |
| • CIM 110 | | LonWorks module | | O6b | - | - | - | - |
| • CIM 150 | | PROFIBUS DP Module | | O6c | - | - | - | - |
| • CIM 200 | | Modbus RTU Module | | O6d | - | - | - | - |
| • CIM 260 | | 3G/4G GRM Grundfos Remote Management | | O6e | - | - | - | - |
| • CIM 280 | | 3G/4G GRM Grundfos Remote Management | | O6f | - | - | - | - |
| • CIM 300 | | BACnet MS/TP Module | | O6g | - | - | - | - |
| • CIM 500 | | Ethernet module | | O6h | - | - | - | - |
| Dry-running protection - electrode relay | - | Electrode Relay mounted in panel.<br>**Note**: Order electrodes separately. | In the control cabinet | O7 | - | - | ● | - |
| Dry-running protection - vibration-limit switch | - | The vibration-limit switch is visible on the wiring diagram.<br>**Note**: Vibration-limit switch not included. | In the control cabinet | O8 | - | - | - | ● |

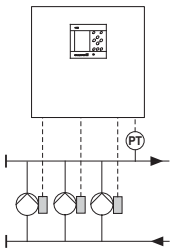
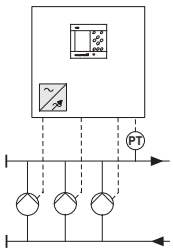
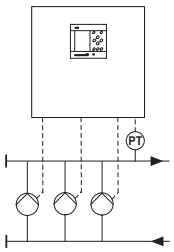
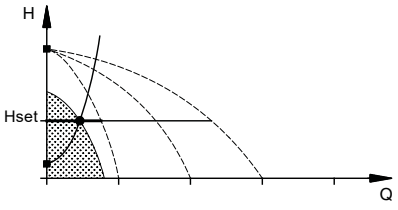
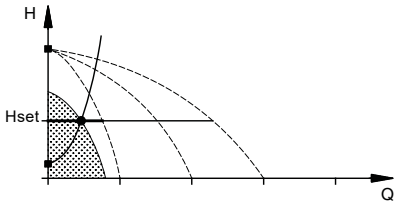
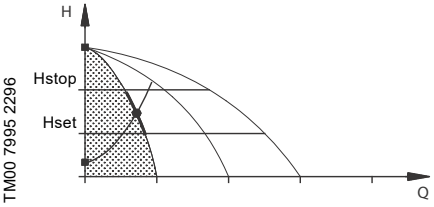
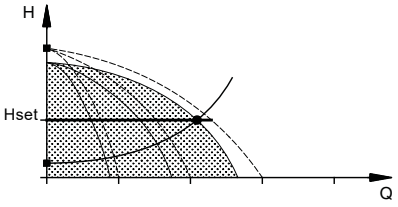
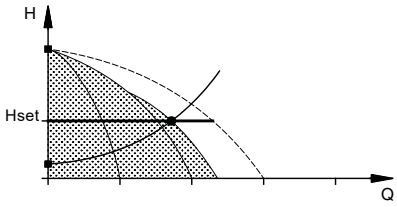
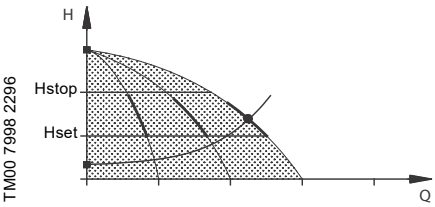
| Operating-panel options | | | | | Included in pre-defined Control MPC standard | | | |
|---|---|---|---|---|---|---|---|---|
| **Option** | | **Description** | **Location** | **Options (type key for Control MPC)** | **A** | **B** | **E** | **F** |
| Dry-running protection - inlet pressure sensor | - | The inlet-pressure sensor is visible on the wiring diagram.<br>**Note**: inlet-pressure switch not included. | In the control cabinet | O9 | ● | ● | - | - |
| Dry-running protection - digital input | - | Digital input is visible on the wiring diagram. | In the control cabinet | O10 | ● | ● | - | - |
| Fault light, pump |  | The fault light is on if a fault occurs in the pump.<br>**Note**: One fault light for each pump. | In door of control cabinet | O11 | - | - | - | - |
| Operating light, pump |  | The operating light when the relevant pumps is in operation.<br>**Note**: One operating light for each pump. | In door of control cabinet | O12 | - | - | - | - |
| Fault light, system |  | The fault light is on if a fault occurs in the system.<br>**Note**: Phase failure causes no fault indication. | In door of control cabinet | O13 | - | - | - | - |
| Operating light, system |  | The operating light is on when the system is in operation. | In door of control cabinet | O14 | - | - | - | - |
| Ammeter | - | An ammeter indicates the current of one phase per pump.<br>**Note**: One ammeter for each pump. | In door of control cabinet | O15 | - | - | - | - |
| Voltmeter | - | A voltmeter indicates the mains voltages between mains phases and between the neutral conductor, N, and the mains phases.<br>**Note**: One voltmeter for each pump. | In door of control cabinet | O16 | - | - | - | - |
| Pilot pump control | - | With this option the Control MPC is prepared for connection, meaning that it includes fuses and motor starter. The pilot pump is visible on the wiring diagram. | In the control cabinet | O17 | - | - | - | - |
| Main switch with door interlock | - | The cabinet door can only be opened if the main switch is in off position. | In the control cabinet | O18 | - | - | - | - |
| Main switch for neutral conductor | - | The main switch for switching off the neutral conductor is only used in connection with single-phase motors. Select this option according to the local rules for the installation site. As standard, the main switch does not switch off the neutral conductor. | In the control cabinet | O19 | - | - | - | - |
| Phase-failure monitoring | - | Protect the booster system against phase failure.<br>**Note**: A potential-free switch is available for external monitoring | In the control cabinet | O20 | - | - | - | - |
| Panel light and socket | - | The panel light is on when the door of the control cabinet is open.<br>Panel lights for 50 Hz are in accordance with EN 60529/10.91.<br>**Note**: The panel light and socket are to be connected to a separate power supply. | In the control cabinet | O21 | - | - | - | - |
| Transient-voltage protection | - | The transient-voltage protection protects the booster system against high-energy transients. | In the control cabinet | O22 | - | - | - | - |

| Operating-panel options | | | | | Included in pre-defined Control MPC standard | | | |
|---|---|---|---|---|---|---|---|---|
| **Option** | | **Description** | **Location** | **Options (type key for Control MPC)** | **A** | **B** | **E** | **F** |
| Lightning protection | - | The booster system can be protected against strokes of lightning. The lightning protection is in accordance with IEC 61024-1:1992-10, class B & C. Note: Additional earthing facilities must be arranged by the customer at the installation site. | In the control cabinet | O23 | - | - | - | - |
| Backup battery |  | The battery is connected to the CU352 as a backup in case the power supply is interrupted. | In the control cabinet | O24 | - | - | - | - |
| Ethernet | - | Ethernet entry outside the cabinet for easy connection. The Ethernet connection makes it possible to get easy and unlimited access to the setting and monitoring of the Hydro MPC from a remote PC. | Cable entry at the bottom of the cabinet | O25 | - | - | - | - |
| Beacon | - | The beacon is on in case of a system alarm. **Note**: Phase failure causes no alarm indication. | On top of the control cabinet, external | O26 | - | - | - | - |
| Audible alarm | - | The audible alarm sounds in case of a system alarm. | In the control cabinet | O27 | - | - | - | - |
| Motor filter (LC) | - | The motor filter is mounted in panel for CUE -/ EC systems. Control MPC uses Sinus filters as standard. Other types are on request. | In the control cabinet | O28 | - | - | - | - |

All options can be added to the predefined package choice
- • Included in the predefined package
- \- Not included in the predefined package.

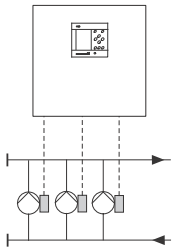
## 6. Overview of control variants

The examples below are based on booster systems.

| Systems with speed-controlled pumps | Systems with pumps connected to one CUE frequency converter | Systems with mains-operated pumps |
|---|---|---|
| **Control MPC-E/-EC** | **Control MPC-F** | **Control MPC-S** |
| E: Control MPC with three E-pumps.<br>EC: Control MPC with three pumps, each connected to a Grundfos CUE frequency converter. | Control MPC with three pumps connected to one Grundfos CUE frequency converter. The speed-controlled operation alternates between the pumps. | Control MPC with three mains-operated pumps. |
|  TM03 0993 0905 |  |  TM03 1265 1505 TM03 0999 0905 |
| One E-pump in operation. | One pump connected to a Grundfos CUE frequency converter in operation. | One mains-operated pump in operation. |
|  |  TM00 7995 2296 |  TM00 7995 2296 TM03 9204 3607 |
| Three E-pumps in operation. | One pump connected to a Grundfos CUE frequency converter and two mains-operated pumps in operation. | Three mains-operated pumps in operation. |
|  |  TM00 7996 2296 |  TM00 7998 2296 TM03 9203 3607 |
| • Control MPC-E/EC maintains a constant pressure through continuous adjustment of the speed of the pumps.<br>• The system performance is adjusted to the demand through cutting in/out the required number of pumps and through parallel control of the pumps in operation.<br>• Pump changeover is automatic and depends on load, operating hours and fault.<br>• All pumps in operation run at the same speed.<br>• The number of pumps in operation also depends on the energy consumption of the pumps. If only one pump is required, two pumps will be running at a lower speed if this results in a lower energy consumption. This requires that the differential pressure of the pump is measured and pump curve data are available for the controller. | • Control MPC-F maintains a constant pressure through continuous adjustment of the speed of the pump connected to the Grundfos CUE frequency converter. The speed-controlled operation alternates between the pumps.<br>• A pump connected to the Grundfos CUE frequency converter always starts first. If the pressure cannot be maintained by the pump, one or two mains-operated pumps will be cut in.<br>• Pump changeover is automatic and depends on load, operating hours and fault. | • Control MPC-S maintains an almost constant pressure through cutting in/out the required number of pumps.<br>• The operating range of the pumps lies between Hset and Hstop (cut-out pressure).<br>• Pump changeover is automatic and depends on load, operating hours and fault. |

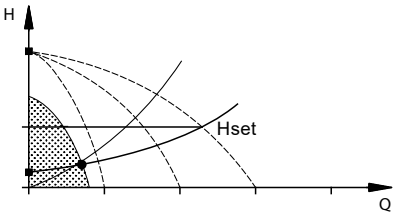
The example below is based on a circulation system.

| Control MPC Series 2000 |
|---|
| Control MPC with three E-pumps. |



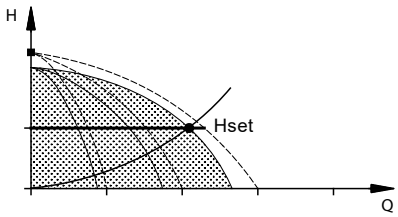
TM04 0213 5107

One E-pump in operation.




TM04 0211 5107

Three E-pumps in operation.

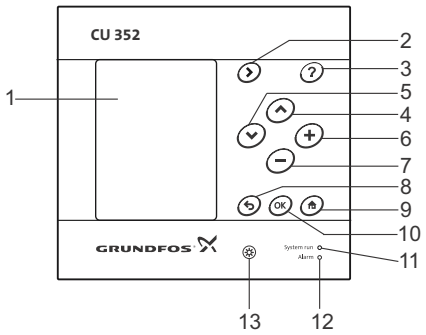



TM04 0212 5107

- Control MPC Series 2000 maintains a constant pressure through adjustment of the speed of the pumps connected.
- The performance is adjusted to the demand through cutting in/out the required number of pumps and through parallel control of the pumps in operation.
- Pump changeover is automatic and depends on load, operating hours and fault.
- All pumps in operation run at the same speed.
- The number of pumps in operation is also depending on the energy consumption of the pumps. If only one pump is required, two pumps will be running at a lower speed if this results in a lower energy consumption. This requires that the differential pressure of the pump is measured and pump curve data are available for the controller.

## 7. Operating panel

The operating panel in the front cover of the control cabinet features a display, a number of buttons and two indicator lights. The operating panel enables manual setting and monitoring of the performance of the system.




TM05 3043 0812

**Fig. 4** Operating panel

| Pos. | Description |
|---|---|
| 1 | Display |
| 2 | Right arrow |
| 3 | Help |
| 4 | Up |
| 5 | Down |
| 6 | Plus |
| 7 | Minus |
| 8 | Back |
| 9 | Home |
| 10 | OK |
| 11 | Indicator light, operation (green) |
| 12 | Indicator light, fault (red) |
| 13 | Brightness |

## 7.1 Display

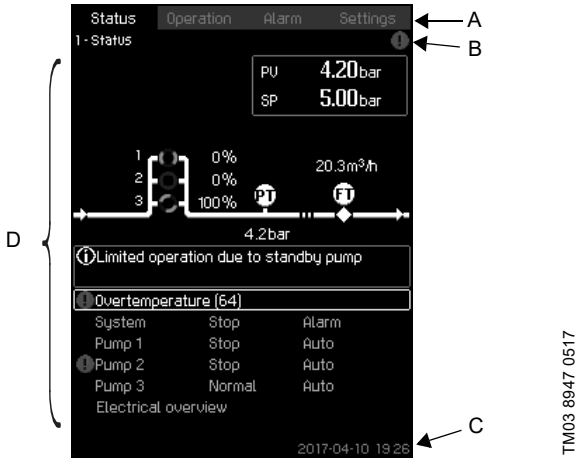



**Fig. 5** Display design

### 7.1.1 Menu line

The menu line (A) is illustrated in fig. 5.

The display has four main menus:

| | |
|---|---|
| **Status** | Indication of system status |
| **Operation** | Change of operating parameters such as setpoint |
| **Alarm** | Alarm log for fault finding |
| **Settings** | Change of settings (password option) |

### 7.1.2 Top line

The top line (B) is illustrated in fig. 5. It shows the following:

- the display number and title (left side)
- the selected menu (left side)
- the alarm symbol in case of alarm (right side)
- the warning symbol in case of warning (right side)
- the wrench symbol if a service language has been selected (right side).

### 7.1.3 Graphical illustration

The graphical illustration (D) may show a status, an indication or other elements, depending on the position in the menu structure.

The illustration may show the entire system or part of it as well as various settings.

### 7.1.4 Scroll bar

If the list of illustration elements exceeds the display, the [Up] and [Down] buttons appear in the scroll bar to the right. Move up and down in lists with these buttons.

### 7.1.5 Bottom line

The bottom line (C) shows the date and time.

## 7.2 Buttons and indicator lights

The buttons (2 to 10 in fig. 4) on CU 352 are active when they are on.

### 7.2.1 Arrow to the right (2)

Press [Right] to go to the next menu in the menu structure. If you press Right] when the menu "Settings" is highlighted, you will go to the menu "Status".

### 7.2.2 Help (3)

When [?] is on, a help text applying to the display will appear if you press the button.

Close the text by pressing [Back].

### 7.2.3 Up and down (4 and 5)

Move up and down in lists with the [Down] and [Up] buttons.

You can select a text with [OK] when it is in a box.

If a text is marked and you press [Up], the text above will be marked. If you press [Down], the text below will be marked.

If you press [Down] in the last line in the list, the first line will be marked.

If you press [Up] in the first line in the list, the last line will be marked.

### 7.2.4 Plus and minus (6 and 7)

Increase and reduce a value with [+] and [-]. Save with [OK].

### 7.2.5 Back (8)

Press [Back] to go one display back in the menu.

If you have changed a value and press [Back], the new value will not be saved. See also section *7.2.7 OK (10)*.

If you press [OK] before pressing [Back], the new value will be saved. See also section *7.2.7 OK (10)*.

### 7.2.6 Home (9)

Press [Home] to return to the menu "Status".

### 7.2.7 OK (10)

Use the [OK] button as an enter button.

The button is also used to start the setting of a value. If you have changed a value, press [OK] to save the change.

### 7.2.8 Indicator lights (11 and 12)

The operating panel incorporates a green and red indicator light.

The green indicator light will be on when the system is in operation and flash when the system has been set to stop.

The red indicator light will be on if there is an alarm or a warning. The fault can be identified from the alarm list.

### 7.2.9 Brightness (13)

You can change the brightness in the display with this button:

1. Press the [Brightness] button.
2. Adjust the brightness with [+] and [-].

### 7.2.10 Back light

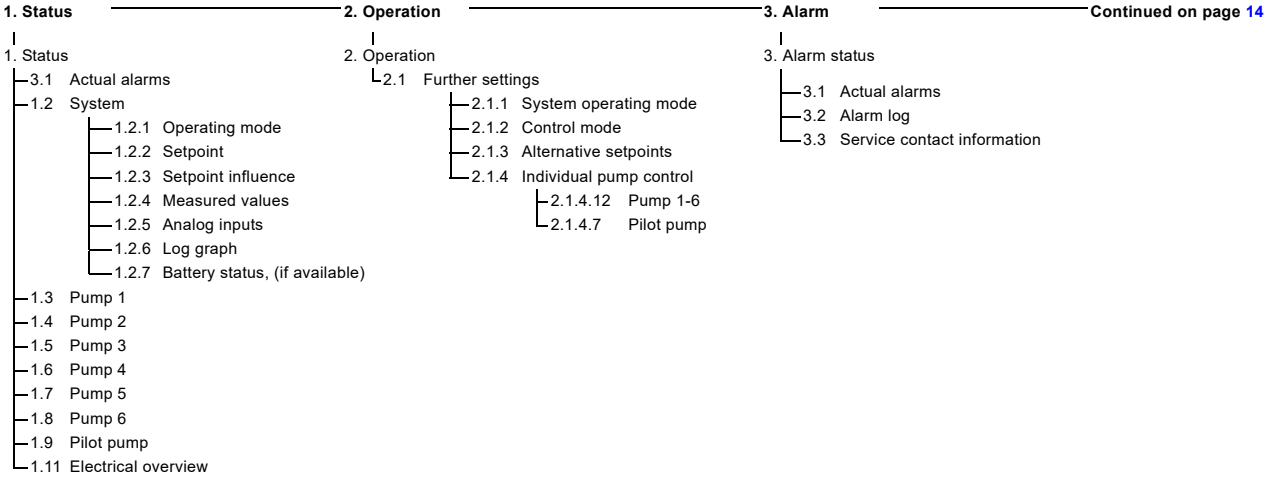
If no button is touched for 15 minutes, the back light of the display will be dimmed, and the first display in the menu "Status" will appear.

Press any button to re-activate the back light.

# 8. Functions

## 8.1 Tree of functions

The functions depend on the configuration of the system.




**Key to the four menus**

| **Status** |
|---|
| This menu shows alarms, status of the system and a graph of logged data.<br>Note**:** No settings can be made in this menu. |
| **Operation** |
| In this menu, you can set the basic parameters, such as setpoint, operating mode, control mode and individual pump control. |
| **Alarm** |
| This menu gives an overview of alarms and warnings. You can reset alarms and warnings in this menu. |
| **Settings** |
| In this menu, you can set various functions:<br>• Primary controllerPI controller, Alternative setpoints, External setpoint influence, Primary sensor, Secondary sensor, Clock program, Proportional pressure, S-system configuration, Setpoint ramp.<br>• Pump cascade controlMin. time between start/stop, Max. number of starts/hour, Number of standby pumps, Forced pump changeover, Pump test run, Pump stop attempt, Pump start and stop speed, Min. performance, Compensation for pump start-up time.<br>• Secondary functionsStop function, Pilot pump**, Soft pressure build-up, Emergency run, Digital inputs, Analog inputs, Digital outputs, Analog outputs*, Counter inputs, Min., max. and user-defined duty, Pilot pump curve data**, Pump curve data, Control source, Fixed inlet pressure, Flow estimation, Reduced operation, Multisensor settings.<br>• Monitoring functionsDry-running protection, Min. pressure, Max. pressure, External fault, Limit 1 exceeded, Limit 2 exceeded, Pumps outside duty range, Pressure relief, Log values, Fault, feedback sensor, Non-return valve.<br>• Functions, CU 352Display language, Units, Date and time, Password, Ethernet, GENIbus number Software status, Display 1, Display 2, Display 3. |

* If IO 351 is installed

** If pilot pump is enabled.

Continued from page 13

1 -> **4. Settings**

- 4.1 Primary controller
  - 4.1.1 PI controller
  - 4.1.2 Alternative setpoints
    - 4.1.2.1 Alternative setpoints 2-7
  - 4.1.3 External setpoint influence
    - 4.1.3.1 Input value to be influenced by
      - 4.1.3.2 Setting of influence function
  - 4.1.4 Primary sensor
  - 4.1.5 Secondary sensor
  - 4.1.6 Clock program
  - 4.1.7 Proportional pressure
  - 4.1.8 S-system configuration
  - 4.1.9 Setpoint ramp
- 4.2 Pump cascade control
  - 4.2.1 Min. time between start/stop
  - Max. number of starts/hour
  - 4.2.3 Standby pumps
  - 4.2.4 Forced pump changeover
  - 4.2.5 Pump test run
  - 4.2.7 Pump stop attempt
  - 4.2.8 Pump start and stop speed
  - 4.2.9 Min. performance
  - 4.2.10 Compensation for pump start-up time
- 4.3 Secondary functions
  - 4.3.1 Stop function
    - 4.3.1.1 Stop parameters
  - 4.3.2 Pilot pump
  - 4.3.3 Soft pressure build-up
  - 4.3.5 Emergency run
  - 4.3.7 Digital inputs
    - Function, DI1 (CU 352) - DI3, [10, 12, 14]
    - Function, DI1 (IO 351-41) - DI9, [10-46]
    - Function, DI1 (IO 351-42) - DI9, [10-46]
  - 4.3.8 Analog inputs
    - Setting, AI1 (CU 352), [51] - AI3, [51, 54, 57]
      - Function, AI1 (CU 352) - AI3 [51, 54, 57]
    - Setting, AI1 (IO 351-41), [57] - AI2 [57, 60]
      - Function, AI1 (IO 351-41) - AI2 [57, 60]
    - Setting, AI1 (IO 351-42), [57] - AI2 [57, 60]
      - Function, AI1 (IO 351-42) - A2 [57, 60]
  - 4.3.9 Digital outputs
    - DO1 (CU 352), [71] is signalling - DO2 [71, 74]
    - DO1 (IO 351-41), [77] is signalling - DO7 [77-88]
    - DO1 (IO 351-42), [77] is signalling - DO7 [77-88]
  - 4.3.10 Analog outputs
    - AO1 (IO 351-41) [18] - AO3 [18, 22, 26]
    - AO1 (IO 351-42) [18] - AO3 [18, 22, 26]
  - 4.3.11 Counter inputs
    - Volume counter, DI1 (IO 351-41), [10] - DI2[10, 12]
    - Volume counter, DI1 (IO 351-42), [10] - DI2[10, 12]
  - 4.3.14 Min., max. and user-defined duty
    - 4.3.14.1 Min. duty
    - 4.3.14.2 Max. duty
    - 4.3.14.3 Set user-defined duty
  - 4.3.18 Pilot pump curve data
  - 4.3.19 Pump curve data
    - 4.3.23 Flow estimation
  - 4.3.20 Control source
  - 4.3.22 Fixed inlet pressure
  - 4.3.23 Flow estimation
  - 4.3.24 Reduced operation
  - 4.3.25 Multisensor settings
  - 4.3.27 Differential sensor
  - 4.3.28 Customisable measured value type
- 4.4 Monitoring functions
  - 4.4.1 Dry-running protection
    - 4.4.1.1 Pressure/level switch
    - 4.4.1.2 Measurement, inlet pressure
    - 4.4.1.3 Measurement, tank level
  - 4.4.2 Min. pressure
  - 4.4.3 Max. pressure
  - 4.4.4 External fault
  - 4.4.5 Limit 1 exceeded
  - 4.4.6 Limit 2 exceeded
  - 4.4.7 Pumps outside duty range
  - 4.4.8 Pressure relief
  - 4.4.9 Log values
  - 4.4.10 Fault, feedback sensor
  - 4.4.11 Non-return valve
- 4.5 Functions, CU 352
  - Change language to the service language (English)
  - Run wizard again
  - 4.5.1 Display language
  - 4.5.2 Units
    - 4.5.2.1 Pressure
    - 4.5.2.2 Differential pressure
    - 4.5.2.3 Head
    - 4.5.2.4 Level
    - 4.5.2.5 Flow rate
    - 4.5.2.6 Volume
    - 4.5.2.7 Specific energy
    - 4.5.2.8 Temperature
    - 4.5.2.9 Power
    - 4.5.2.10 Energy
  - 4.5.3 Date and time
  - 4.5.4 Password
  - 4.5.5 Ethernet
  - 4.5.6 GENIbus number
  - 4.5.9 Software status
- 4.6 Status display menu

## 8.2 Overview

* Pilot pump needs to be activated via PC Tool.

## 8.3 Description of functions

The description of functions is based on the four main menus of the CU 352 control unit:

- Status
- Operation
- Alarm
- Settings.

The functions apply to all control variants unless otherwise stated.

## 8.4 Status (1)

This display is shown when the power is switched on, and it appears if the buttons of the operating panel remain untouched for 15 minutes.

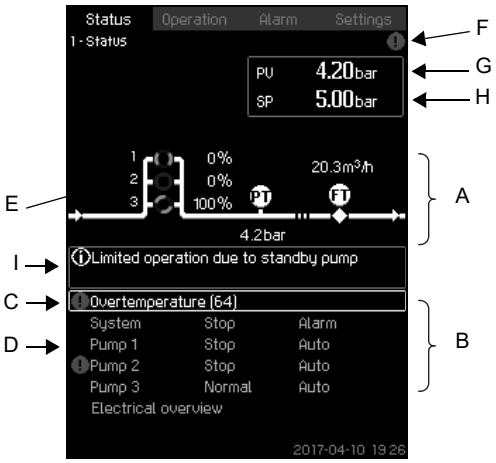



**Fig. 6** Status

**Description**

No settings can be made in this menu.

The actual value (process value, PV) of the control parameter, usually the outlet pressure, is shown in the upper right corner (G) together with the selected setpoint (SP) (H).

The upper half of the display (A) shows a graphic illustration of the pump system. The selected measuring parameters are shown with sensor symbol and actual value.

In MPC-E systems where the differential pressure across the pumps and pump curve data are known, the display shows the estimated flow rate when the flow rate and speed of the pumps are within a range where it is possible to estimate the flow rate.

≈ : This indicates that the flow rate is an estimated value.

The estimated flow rate may differ from a measured value.

In the middle of the display, an information field (I) is shown if any of the following events occurs:

- Limited operation due to standby pump
- Proportional-pressure influence active
- External setpoint influence active
- Alternative setpoint active
- Low flow boost active
- Pressure relief active
- Clock program active
- Remote-controlled via GENI (RS-485)
- Limited due to reduced operation
- Stopped due to low flow.

The lower display half (B) shows the following:

- the most recent active alarm, if any, and the fault cause with the fault code in brackets
- system status with actual operating mode and control source
- pump status with actual operating mode.

If a fault has occurred, the warning symbol or alarm symbol is shown in the line (C) together with the cause and fault code, for instance "Overtemperature (64)".

If the fault is related to one of the pumps, a warning or alarm symbol is also shown in front of the status line (D) of the pump in question. At the same time, the pump status indicator (E) changes colour to either yellow or red as described in the table below. The warning or alarm symbol is shown to the right in the top line of the display (F). As long as a fault is present, this symbol is shown in the top line of all displays.

To open a menu line, select the line with [Down] or [Up] and press [OK].

The display allows you to open status displays showing the following:

- actual alarms
- system status
- status of each pump.

**Description of pump status**

| Pump status indicator | Description |
|---|---|
| Rotating, green | The pump is running. |
| Permanently green | The pump is ready (not running). |
| Rotating, yellow | Warning. The pump is running. |
| Permanently yellow | Warning. The pump is ready (not running). |
| Permanently red | Alarm. The pump is stopped. |

### 8.4.1 Actual alarms (3.1)

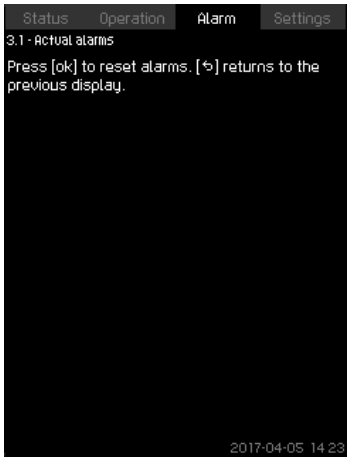



**Fig. 7** Actual alarms

**Description**

The display shows active unreset alarms and warnings.

For further information, see sections *8.6.2 Actual alarms (3.1)* and *8.6.3 Alarm log (3.2)*.

### 8.4.2 System (1.2)

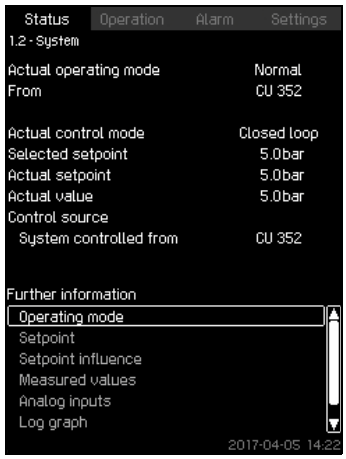



**Fig. 8** System

**Description**

The display shows the operational state of the system. Go to subdisplays for further details.

The display allows you to open the displays below:

- Operating mode
- Setpoint
- Setpoint influence
- Measured values
- Analog inputs
- Log graph
- Battery status.

### 8.4.3 Operating mode (1.2.1)

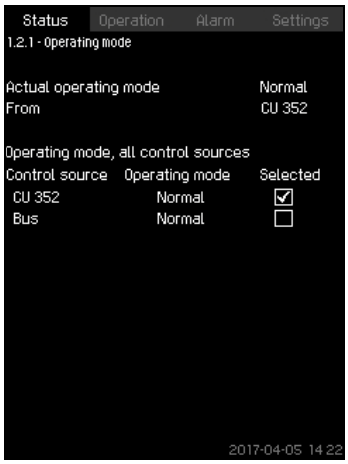



**Fig. 9** Operating mode

**Description**

The display shows the operating mode of the system and from where it is controlled.

**Operating modes**

The system has six operating modes:

1. Normal
   – The pumps adapt their performance to the requirement.
2. Max.
   – The pumps run at a constant high speed. Normally, all pumps run at maximum speed.
3. User-defined
   – The pumps run at a constant speed set by the user. It is usually is a performance between "Max." and "Min.".
4. Min.
   – The pumps run at a constant low speed. Normally, one pump is running at a speed of 70 %.
5. Stop
   – All pumps have been stopped.
6. Emergency run
   – The pumps run according to the setting made in display *8.7.27 Emergency run (4.3.5)*.

The performance required in these operating modes can be set in the menu "Settings":

- Max.
- Min.
- User-defined
- Emergency run.

See sections *8.7.38 Min., max. and user-defined duty (4.3.14)* and *8.7.27 Emergency run (4.3.5)*.

The actual operating mode can be controlled from four different sources:

- Fault
- External signal
- CU 352
- Bus.

**Control source**

You can set the system to remote control via an external bus (option). In this case, you must set a setpoint and an operating mode via the bus.

In the menu "Settings", you can select whether CU 352 or the external bus is to be the control source.

The status of this setting is shown in display "Operating mode".

### 8.4.4 Setpoint (1.2.2)

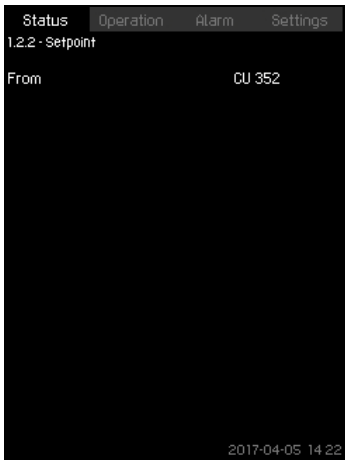



**Fig. 10** Setpoint

**Description**

The display shows the selected setpoint and whether it comes from CU 352 or an external bus.

It also shows all seven possible setpoints from CU 352, (for closed- and open-loop control). At the same time, the selected setpoint is shown.

As it is a status display, no settings can be made.

Setpoints can be changed in the menu "Operation" or "Settings". See section *8.7.3 Alternative setpoints (4.1.2)*.

### 8.4.5 Setpoint influence (1.2.3)

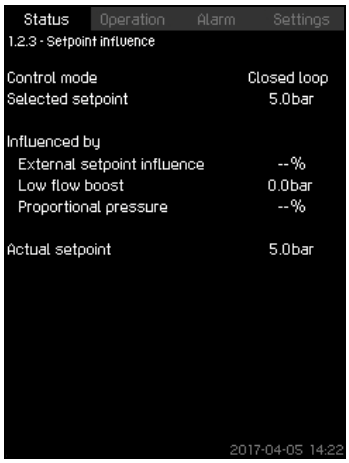



**Fig. 11** Setpoint influence

**Description**

The selected setpoint can be influenced by parameters. The parameters are shown as a percentage from 0 to 100 % or as a pressure measured in bar. They can only reduce the setpoint, as the influence in percentage divided with 100 is multiplied with the selected setpoint:

Actual setpoint (SP) = selected setpoint x influence (1) x influence (2) x etc.

The display shows the parameters influencing the selected setpoint and the percentage or value of influence.

You can set some of the possible parameters in the display *8.7.5 External setpoint influence (4.1.3)*. The parameter "Low flow boost" is set as a start/stop band as a percentage of the setpoint set in the display *8.7.24 Stop function (4.3.1)*. The parameter is set as a percentage in the display *8.7.10 Proportional pressure (4.1.7)*.

Finally, the resulting actual setpoint (SP) is shown.

### 8.4.6 Measured values (1.2.4)

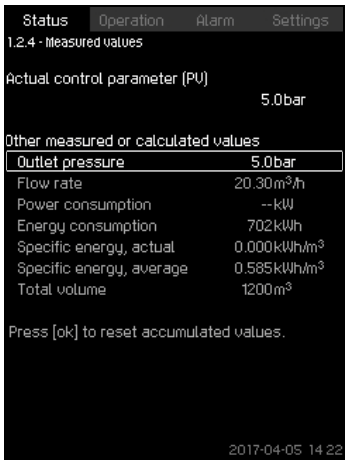



**Fig. 12** Measured values

**Description**

The display gives a general status of all measured and calculated parameters. In MPC-E systems with a flowmeter, the specific energy is shown as an average value and actual value (mean value over the last minute). The average value is based on the accumulated flow shown as total volume. The total volume and specific energy average can be reset in this display.

The lines "Power consumption" and "Energy consumption" are only shown in MPC-E systems.

### 8.4.7 Analog inputs (1.2.5)

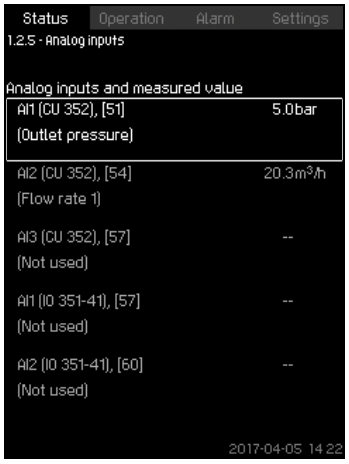



**Fig. 13** Analog inputs

**Description**

The display shows an overview of the analog inputs and the measured values of each input. See sections *8.7.30 Analog inputs (4.3.8)*, *8.7.31 Analog inputs (4.3.8.1 - 4.3.8.7)* and *8.7.32 Analog inputs and measured value (4.3.8.1.1 - 4.3.8.7.1)*.

### 8.4.8 Log graph (1.2.6)

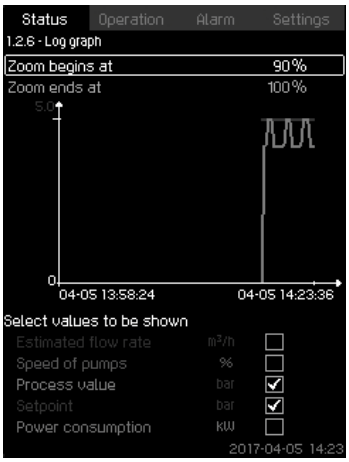



**Fig. 14** Log graph

**Description**

The display shows logged data stored in the controller. Select log values in the display *8.7.67 Log values (4.4.9)*. Various values can be shown, and the time scale can be changed.

**Setting via the operating panel**

Status > System > Log graph

1. Set as a percentage:
   - Zoom begins at
   - Zoom ends at
2. Select values to be shown.

### 8.4.9 Battery status (1.2.7)

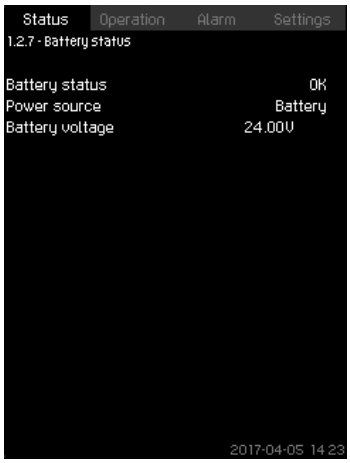



**Fig. 15** Battery status

**Description**

The display shows the status of the backup battery, if installed.

### 8.4.10 Pump 1-6, Pilot pump (1.3 - 1.10)

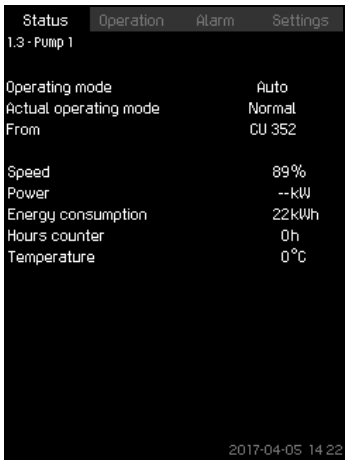



**Fig. 16** Pump 1

**Description**

The display shows the operational state of the individual pumps.

The displays for the pilot pump are only shown if such pumps are installed.

The pumps can have different operating modes:

- Auto

  Together with the other pumps in automatic operation, the pump is controlled by the PI controller which ensures that the system delivers the required performance.
- Manual

  The pump is not controlled by the PI controller. In manual operation, the pump has one of the following operating modes:
  - Max.: The pump runs at a set maximum speed. This operating mode can only be selected for variable-speed pumps.
  - Normal: The pump runs at a set speed.
  - Min.: The pump runs at a set minimum speed. This operating mode can only be selected for variable-speed pumps.
  - Stop: The pump has been forced to stop.

Besides information about the operating mode, you can read various parameters in the status display, such as these:

- Actual operating mode
- Control source
- Speed (only 0 or 100 % are shown for mains-operated pumps)
- Power (only MPC-E/-EC)
- Energy consumption (only MPC-E/-EC)
- Operating hours
- Temperature.

## 8.5 Operation (2)

In this menu, you can set the basic parameters, such as setpoint, operating mode, control mode and individual pump control.

### 8.5.1 Operation (2)

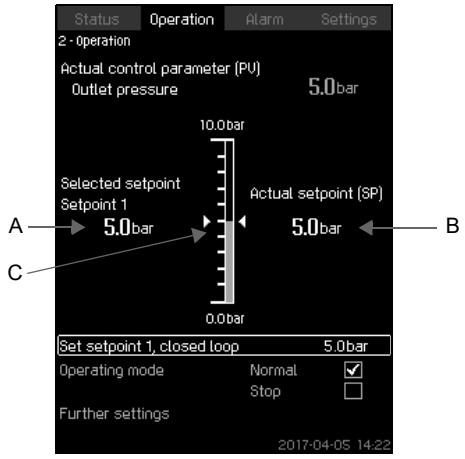



**Fig. 17** Operation

**Description**

The column shows the setting range. In closed-loop control, it corresponds to the range of the primary sensor, here 0-16 bar. In open-loop control, the setting range is 0-100 %.

At the left hand of the column, you can see the selected setpoint 1 (A), that is the value set in the display. At the right hand of the column, you can see the actual setpoint (B), that is the setpoint acting as reference for the PI controller. If no kind of external setpoint influence has been selected, the two values will be identical. The measured value (outlet pressure) is shown as the grey part of the column (C). See sections *8.7.5 External setpoint influence (4.1.3)* and *8.7.6 Setting of influence function (4.1.3.2)*.

Below the display is a menu line for setting of setpoint 1 and selection of operating mode, including the operating modes "Normal" and "Stop". You can select further settings: "System operating mode", "Control mode", "Alternative setpoints" and "Individual pump control".

**Setting range**

Setpoint:

| | |
|---|---|
| Closed-loop control: | Measuring range of the primary sensor |
| Open-loop control: | 0-100 % |

**Setting via the operating panel**

**Setpoint**

- Operation > Set setpoint 1, open loop / Set setpoint 1, closed loop.

Set the value.

**Operating mode**

- Operation

Select: Normal or Stop.

**Further settings**

- Operation > Further settings.

Select one of the settings below:

- System operating mode. See section *8.5.2 System operating mode (2.1.1)*.
- Control mode. See section *8.5.3 Control mode (2.1.2)*.
- Alternative setpoints. See section *8.5.4 Alternative setpoints (2.1.3)*.
- Individual pump control. See section *8.5.6 Pump 1-6 (2.1.4.1 - 2.1.4.6)*.

**Factory setting**

The setpoint is a value suitable for the system in question. The factory setting may have been changed in the startup menu.

### 8.5.2 System operating mode (2.1.1)

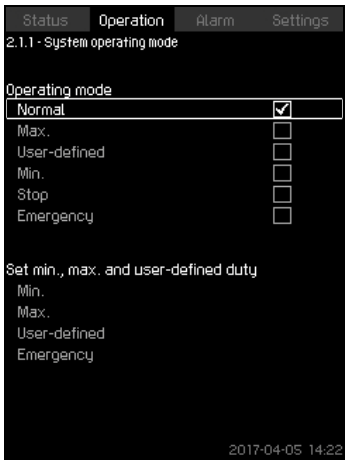



**Fig. 18** System operating mode

**Description**

The system can be set to six different operating modes. "Normal" is the typical setting. See section *8.4.3 Operating mode (1.2.1)*.

You can set the performance of the operating modes in this menu:

- Min.
- Max.
- User-defined
- Emergency.

**Setting range**

- Normal
- Max.
- Min.
- User-defined
- Stop
- Emergency.

**Setting via the operating panel**

- Operation > Further settings > System operating mode > Operating mode.

Select the desired line at the bottom of the display to set the performance for "Max.", "Min.", "User-defined" and "Emergency" run. See sections *8.7.38 Min., max. and user-defined duty (4.3.14)* and *8.7.27 Emergency run (4.3.5)*.

**Factory setting**

Normal.

### 8.5.3 Control mode (2.1.2)

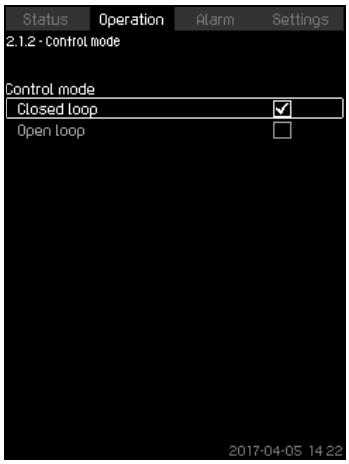


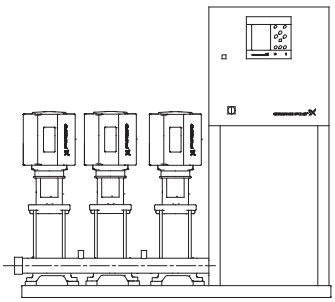

**Fig. 19** Control mode

**Description**

There are two control modes, namely closed and open loop.

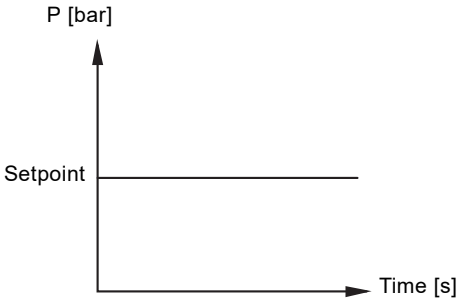
**Closed loop**

The typical control mode is "Closed loop" where the built-in PI controller ensures that the system reaches and maintains the selected setpoint. The performance is based on the setpoint set for closed loop. See figs 20 and 21.



TM03 2231 3905

**Fig. 20** Booster system controlled by built-in PI controller (closed loop)




TM03 2390 4105

**Fig. 21** Regulation curve for closed loop

**Setting via the operating panel**

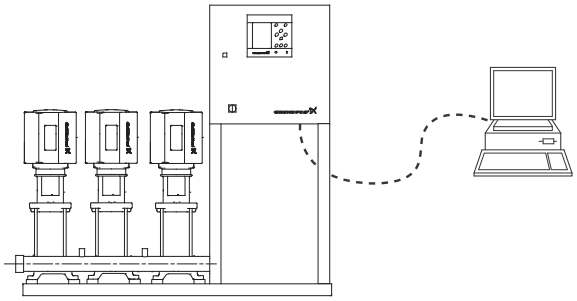
- Operation > Further settings > Control mode > Closed loop.

Set the setpoint. See sections *8.5.4 Alternative setpoints (2.1.3)* and *8.5.1 Operation (2)*.

**Open loop**

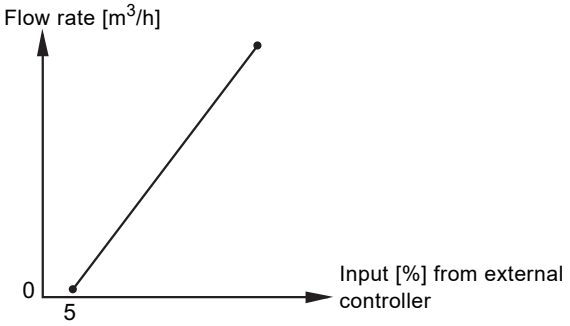
In open-loop control mode, the pumps run at a fixed speed. The pump speed is calculated from the performance set by the user (0-100 %). The pump performance in percentage is proportional with the flow rate.

Open-loop control mode is usually used when the system is controlled by an external controller which controls the performance via an external signal. The external controller could for instance be a building management system connected to the MPC system. In such cases MPC is like an actuator. See figs 22 and 23.



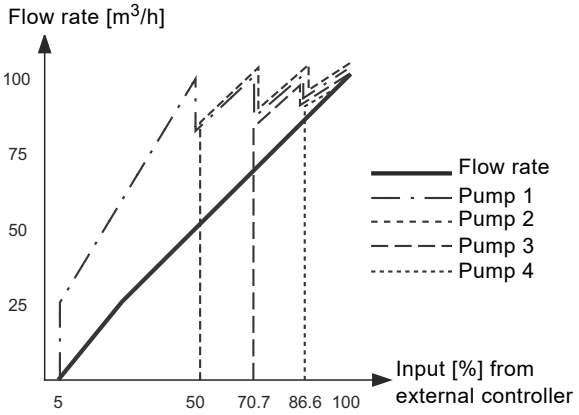
TM03 2232 3905

**Fig. 22** Booster system with external controller (open loop)




TM03 2391 3607

**Fig. 23** Regulation curve for open loop




TM03 9977 4807

**Fig. 24** Regulation curve for MPC-E system in open loop

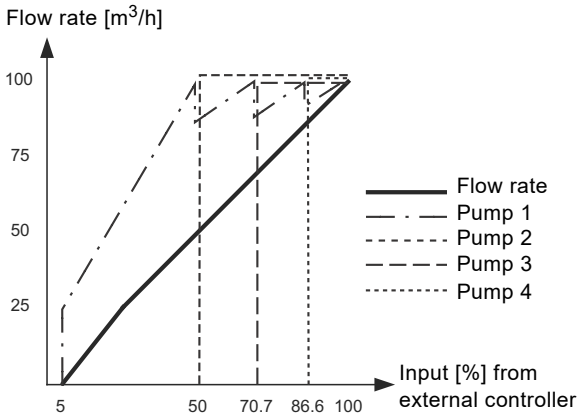



**Fig. 25** Regulation curve for MPC-F system in open loop

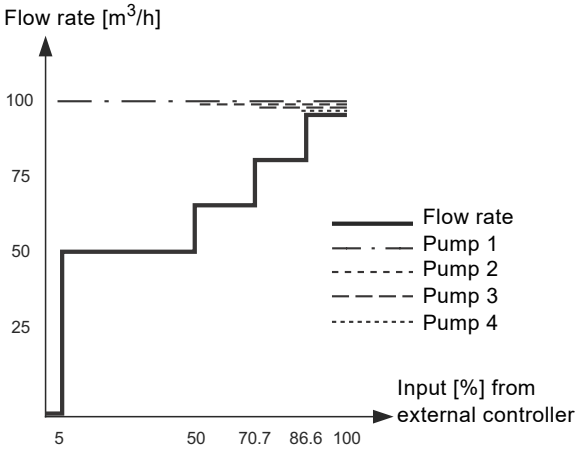



**Fig. 26** Regulation curve for MPC-S system in open loop

**Setting range**

These settings must be made in connection with open loop:

- Open loop
- Set setpoint 1, open loop
- External setpoint influence
- Normal.

**Setting via the operating panel**

Proceed as follows to set an external control source to control the system:

- Operation > Further settings > Control mode.
- Select: Open loop.

1. Press [Back] x 2.
2. Select: Stop
3. Set to 100 %: Set setpoint 1, open loop.
4. Settings > Primary controller > External setpoint influence > Go to setting of analog input.
5. Select analog input and range.
6. Select:

- Measured input value. Display 4.3.8.1.1 appears.
- Select: 0-100 % signal.

7. Press [Back].
8. Set the minimum and maximum sensor value.
9. Press [Back] x 2.
10. Select:

- Input value to be influenced by
- 0-100 % signal.

11. Press.
12. Select: Set the influence function. See also section *8.7.6 Setting of influence function (4.1.3.2)*.
13. Set the number of points.
14. Set for Point 1:

- External input value
- Reduce setpoint to

15. Repeat step 14 for all selected points.
16. Press [Back].
17. Set as seconds: Filter time.
18. Select: Enabled.
19. Press [Back] x 2.
20. Select:

- Operation
- Normal.

The booster system can now be controlled by an external controller.

**Factory setting**

Closed loop.

### 8.5.4 Alternative setpoints (2.1.3)

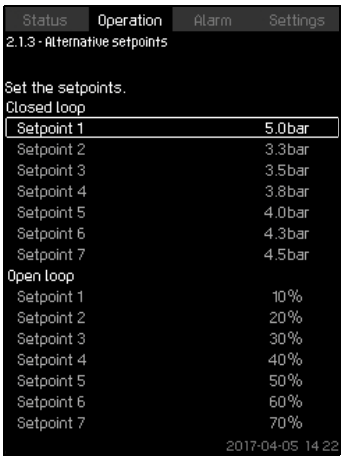



**Fig. 27** Alternative setpoints

#### Description

In addition to the primary setpoint 1 shown in display 2 in menu "Operation", you can set six alternative setpoints for closed-loop control mode. Furthermore, you can set seven setpoints for open-loop control mode.

You can activate one of the alternative setpoints by means of external contacts. See sections *8.7.3 Alternative setpoints (4.1.2)* and *8.7.4 Alternative setpoints 2-7 (4.1.2.1 - 4.1.2.7)*.

#### Setting range

The setting range of setpoints for closed-loop control mode depends on the range of the primary sensor. See section *8.7.7 Primary sensor (4.1.4)*.

In open-loop control mode, the setting range is 0-100 %.

#### Setting via the operating panel

- Operation > Further settings > Alternative setpoints.

Set the setpoint.

#### Factory setting

Setpoint 1 for closed-loop control mode is a value suitable for the system in question.

The alternative setpoints for closed-loop control mode are 3 bar.

All setpoints for open-loop control mode are 70 %.

### 8.5.5 Individual pump control (2.1.4)

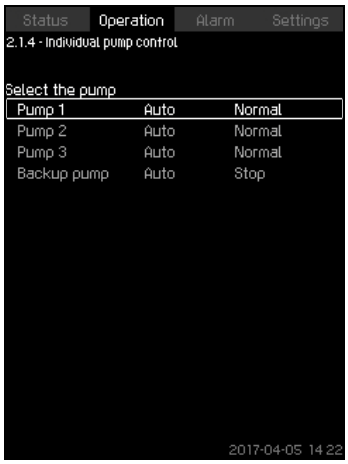



**Fig. 28** Individual pump control

#### Description

You can change the operating mode from automatic operation to one of the manual operating modes.

#### Auto

The pumps are controlled by the PI controller, ensuring that the system delivers the required performance.

#### Manual

The pump is not controlled by the PI controller, but set to one of the following manual operating modes:

- Max.
  - The pump runs at a set maximum speed. This operating mode can only be selected for variable-speed pumps.
- Normal
  - The pump runs at a set speed.
- Min.
  - The pump runs at a set minimum speed. This operating mode can only be selected for variable-speed pumps.
- Stop
  - The pump has been forced to stop.

Pumps in manual operation are not part of the normal pump cascade and speed control. The manual pumps are a 'disturbance' of the normal operation of the system.

If one or more pumps are in manual operation, the system may not be able to deliver the set performance.

There are two displays for the function. In the first display, select the pump to be set, and in the next display, select the operating mode.

#### Setting range

All pumps can be selected.

#### Setting via the operating panel

Operation > Further settings > Individual pump control.

### 8.5.6 Pump 1-6 (2.1.4.1 - 2.1.4.6)

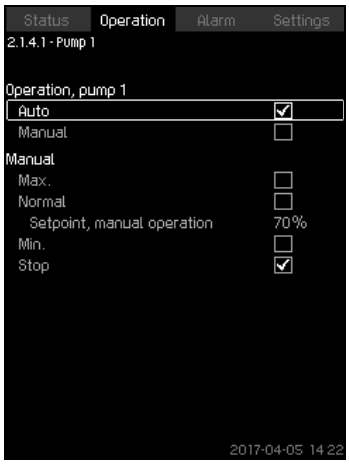



**Fig. 29** Pump 1-6

**Description**

The display is shown for the individual pumps and it allows you to set an operating mode.

**Setting range**

You can select "Auto" or "Manual" as well as the operating mode of the pump for manual operation - "Max.", "Normal", "Min." or "Stop". For mains-operated pumps, you can only select "Normal" or "Stop".

**Setting via the operating panel**

- Operation > Further settings > Individual pump control.

1. Select pump.
2. Select resetting: Auto or Manual.
3. Manual: Select operating mode.Normal: Set the setpoint.

**Factory setting**

Auto.

### 8.5.7 Operation, pilot pump (2.1.4.7)

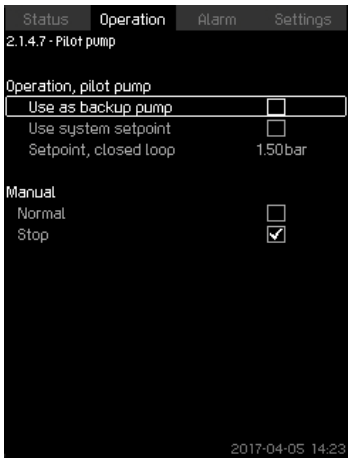



**Fig. 30** Operation, pilot pump

**Description**

The display is only shown in systems that have been configured with a pilot pump.

You can set the operating mode and setpoint for the pilot pump.

**Setting range**

**Auto**

Select this mode if the pilot pump is to be used as a backup pump. If the pilot pump is selected as a backup pump, it will start if the main pumps are running at 100 % speed and still cannot reach or maintain the setpoint.

The setpoint of the pilot pump can either be set to the same value as that of the main pumps by selecting "Use system setpoint" or to another value.

**Manual**

Max., Normal, Min., Stop.

**Setting via the operating panel**

- Operation > Further settings > Individual pump control > Pilot pump.

Select resetting: Auto or Manual.

**Auto**

1. Select if the pump is also to be used as backup pump (only possible if the system does not already incorporate a backup pump).
2. Select "Use system setpoint" or enter a setpoint.

**Manual**

1. Select operating mode.
2. Normal: Set the setpoint.

**Factory setting**

Auto.

Use system setpoint.

## 8.6 Alarm (3)

This menu gives an overview of alarms and warnings.

You can reset alarms.

### 8.6.1 Alarm status (3)


**Fig. 31** Alarm status

**Description**

A fault in the system or one of the components monitored can cause an alarm or a warning. Besides the fault signal via the alarm and warning signal relay and the red indicator light on CU 352, an alarm can also cause a change of operating mode, for instance from "Normal" to "Stop". A warning only causes a fault indication.

The table shows the possible causes of fault together with an alarm code, and whether they result in an alarm or a warning. It also shows to what operating mode the system will change in case of alarm, and whether restarting of the system and resetting of the alarm is manual or automatic.

The table also shows that the reaction to some of the fault causes mentioned can be set in the menu "Settings". See sections *8.7.26 Soft pressure build-up (4.3.3)* and *8.7.56 Monitoring functions (4.4)* to *8.7.66 Pressure relief (4.4.8)*.

| Fault | Warning Alarm | Change of operating mode to | Resetting of alarm, restarting | Set in the menu "Settings" | Alarm code |
|---|---|---|---|---|---|
| Water shortage | Warning | - | Man/auto | X | 206 |
| Water shortage | Alarm | Stop | Man/auto | X | 214 |
| Pressure high | Alarm | Stop | Man/auto | X | 210 |
| Pressure low | Warning | - | Man/auto | X | 211 |
| | Alarm | Stop | Man/auto | | |
| Pressure relief | Warning | - | Man/auto | X | 219 |
| Alarm, all pumps | Alarm | Stop | Auto | - | 203 |
| External fault | Warning | - | Man/auto | X | 3 |
| | Alarm | Stop | Man/auto | | |
| Dissimilar sensor signals | Warning | - | Auto | - | 204 |
| Fault, primary sensor | Alarm | Stop | Auto | - | 89 |
| Fault, sensor | Warning | - | Auto | - | 88 |
| Communication fault | Warning | - | Auto | - | 10 |
| Phase failure | Warning | - | Auto | - | 2 |
| Undervoltage, pump | Warning | - | Auto | - | 7, 40, 42, 73 |
| Overvoltage, pump | Warning | - | Auto | - | 32 |
| Overload, pump | Warning | - | Auto | - | 48, 50, 51, 54 |
| Motor temperature too high | Warning | - | Auto | - | 64, 65, 67, 70 |
| Other fault, pump | Warning | - | Auto | - | 76, 83 |
| Internal fault, CU 352 | Warning | - | Auto | - | 83, 157 |
| Internal fault, IO 351 | Alarm | Stop | Auto | - | 72, 83, 157 |
| VFD not ready | Warning | - | Auto | - | 213 |
| Fault, Ethernet | Warning | - | Auto | - | 231, 232 |
| Limit 1 exceeded | Warning/ alarm | - | Man/auto | X | 190 |
| Limit 2 exceeded | Warning/ alarm | - | Man/auto | X | 191 |
| Pressure buildup fault | Warning/ alarm | - | Man/auto | X | 215 |
| Pumps outside duty range | Warning | - | Man/auto | X | 208 |
| Fault, pilot pump | Warning | - | Auto | - | 216 |
| Multisensor fault | Alarm | - | Auto | - | 143 |
| Multisensor value exceeds limits | Warning | - | Auto | X | 87 |
| Signal fault, secondary sensor | Warning | - | Auto | X | 93 |
| Non-return valve fault | Warning | - | Man/auto | X | 209 |
| | Alarm | - | Man/auto | X | 209 |

### 8.6.2 Actual alarms (3.1)

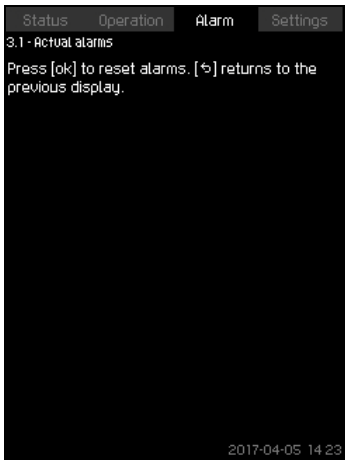



**Fig. 32** Actual alarms

**Description**

The submenu in the display "Alarm" shows the following:

- Warnings caused by faults that still exist.
- Warnings caused by faults that have disappeared, but the warning requires manual resetting.
- Alarms caused by faults that still exist.
- Alarms caused by faults that have disappeared, but the alarm requires manual resetting.

All warnings and alarms with automatic resetting are automatically removed from the menu when the fault has disappeared.

Alarms requiring manual resetting can be reset in this display by pressing [OK]. An alarm cannot be reset until the fault has disappeared.

For every warning or alarm, the following is shown:

- Whether it is a warning or an alarm.
- Where the fault occurred: System, Pump 1, Pump 2, etc.
- In case of input-related faults, the input is shown.
- The cause of the fault and the alarm code in brackets, such as "Water shortage (214)".
- When the fault occurred: Date and time.
- When the fault disappeared: Date and time. If the fault still exists, date and time are shown as "--...--".

The most recent warning or alarm is shown at the top of the display.

### 8.6.3 Alarm log (3.2)

The alarm log can store up to 24 warnings and alarms.

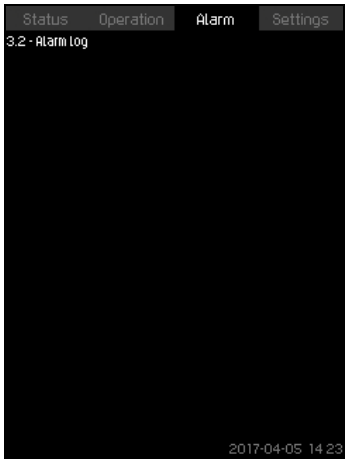



**Fig. 33** Alarm log

**Description**

The display shows warnings and alarms.

For every warning or alarm, the following is shown:

- Whether it is a warning or an alarm.
- Where the fault occurred: System, Pump 1, Pump 2, etc.
- In case of input-related faults, the input is shown.
- The cause of the fault and the alarm code in brackets, such as "Water shortage (214)".
- When the fault occurred: Date and time.
- When the fault disappeared: Date and time. If the fault still exists, date and time are shown as "--...--".

The most recent warning or alarm is shown at the top of the display.

### 8.6.4 Service contact information (3.3)

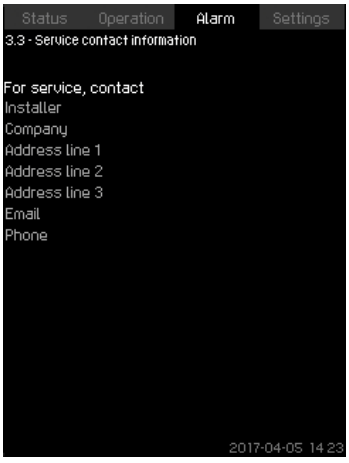



**Fig. 34** Service contact information

**Description**

The display shows the contact information of the installer if entered during commissioning.

## 8.7 Settings (4)

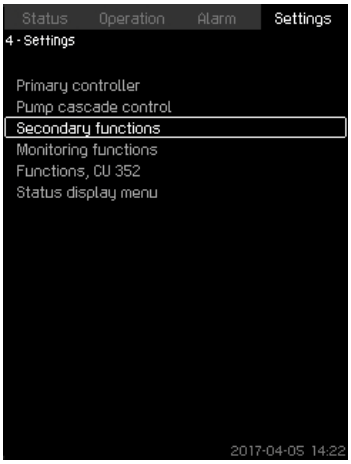



**Fig. 35** Settings

In the "Settings" menu, you can set the following functions:

- Primary controllerPI controller, Alternative setpoints, External setpoint influence, Primary sensor, Secondary sensor, Clock program, Proportional pressure, S-system configuration, Setpoint ramp.
- Pump cascade controlMin. time between start/stop, Max. number of starts/hour, Number of standby pumps, Forced pump changeover, Pump test run, Pump stop attempt, Pump start and stop speed, Min. performance, Compensation for pump start-up time.
- Secondary functionsStop function, Pilot pump, Soft pressure build-up, Digital inputs, Analog inputs, Digital outputs*, Analog outputs, Counter inputs, Emergency run, Min., max. and user-defined duty, Pump curve data, Control source, Fixed inlet pressure, Flow estimation, Reduced operation, Multisensor settings.
- Monitoring functionsDry-running protection, Min. pressure, Max. pressure, External fault, Limit 1 exceeded, Limit 2 exceeded, Pumps outside duty range, Pressure relief, Log values, Fault, feedback sensor, Non-return valve.
- Functions, CU 352Display language, Units, Date and time, Password, Ethernet, GENIbus number Software status, Display 1, Display 2, Display 3.
- The service language, British English, can be selected for service purposes. All these functions are usually set correctly when the system is switched on.

### 8.7.1 Primary controller (4.1)

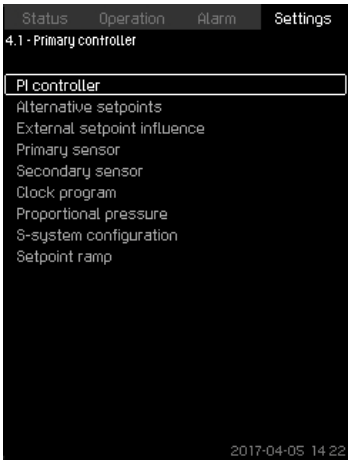



**Fig. 36** Primary controller

**Description**

In the menu, you can set the functions related to the primary controller. It is only necessary to make settings in this menu if the functionality is to be expanded with one of the functions below:

- PI controller
- Alternative setpoints
- External setpoint influence
- Primary sensor
- Secondary sensor
- Clock program
- Proportional pressure
- S-system configuration.

### 8.7.2 PI controller (4.1.1)

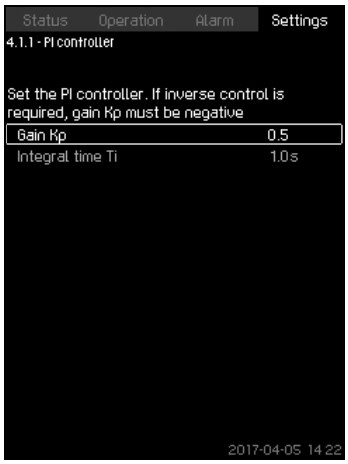



**Fig. 37** PI controller

**Description**

The system includes a standard PI controller which ensures that the pressure is stable and corresponds to the setpoint.

You can adjust the PI controller if a faster or slower reaction to changes of consumption is required.

To obtain a faster reaction, increase Kp and reduce Ti.

To obtain a slower reaction, reduce Kp and increase Ti.

**Setting range**

- "Gain Kp": - 30 to 30. **Note:** For inverse control, set Kp to a negative value.
- "Integral time Ti": 0.1 to 3600 seconds.

**Setting via the operating panel**

- Settings
- Primary controller
- PI controller.

1. Set "Gain Kp" and "Integral time Ti". **Note:** Usually it is not necessary to adjust Kp.

**Factory setting**

The setting of Kp and Ti depends on the system and application.

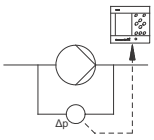
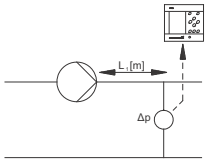
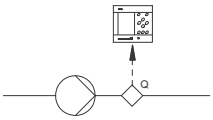
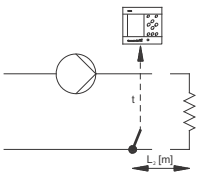
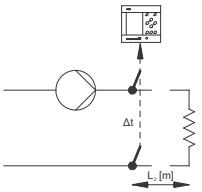
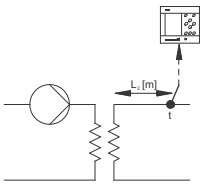
**PI controller settings for pressure boosting**

If the application has been set to pressure boosting in the startup wizard, the following values of Kp and Ti are set automatically:

- Kp: 0.5
- Ti: 1 second.

**PI controller settings for heating and cooling**

If another application than pressure boosting has been selected in the startup wizard, the values of Kp and Ti are set automatically according to the table below. As the system does not know the pipe length, the default parameters are set according to the table to a pipe length (L1 or L2) of 5 metres.

| System/application | Kp | | Ti [seconds] |
|---|---|---|---|
| | Heating system[1)] | Cooling system[2)] | |
|  | 0.5 | | 1 |
|  | 0.5 | | L1 < 5 m: 1<br>L1 > 5 m: 3<br>L1 > 10 m: 5 |
|  | 0.5 | | 1 |
|  | 0.5 | - 0.5 | 10 + 5L2 |
|  | 0.5 | | 10 + 5L2 |
|  | 0.5 | - 0.5 | 30 + 5L2 |

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

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

L1: Distance [m] between pump and sensor.

L2: Distance [m] between heat exchanger and sensor.

ΔP: Measurement of differential pressure.

Q: Measurement of flow rate.

t: Measurement of temperature.

Δt: Measurement of differential temperature.

### 8.7.3 Alternative setpoints (4.1.2)

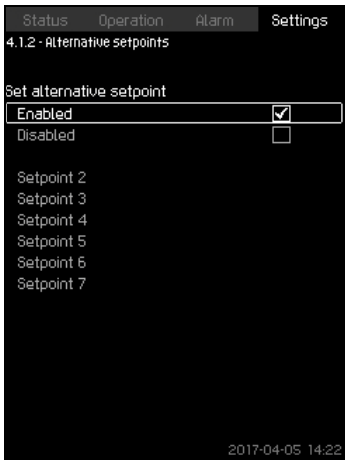



**Fig. 38** Alternative setpoints

**Description**

The function allows you to select up to six setpoints (2 to 7) as alternatives to the primary setpoint (1). The primary setpoint (1) is set in the menu "Operation".

Every alternative setpoint can be addressed manually to a separate digital input (DI). When the contact of the input is closed, the alternative setpoint applies.

If more than one alternative setpoint has been selected, and they are activated at the same time, CU 352 selects the setpoint with the lowest number.

**Setting range**

If the multisensor function is enabled, it will have higher priority than the alternative setpoint which will be overruled.

- Six setpoints, numbers 2 to 7.

**Factory setting**

No alternative setpoints have been selected.

### 8.7.4 Alternative setpoints 2-7 (4.1.2.1 - 4.1.2.7)

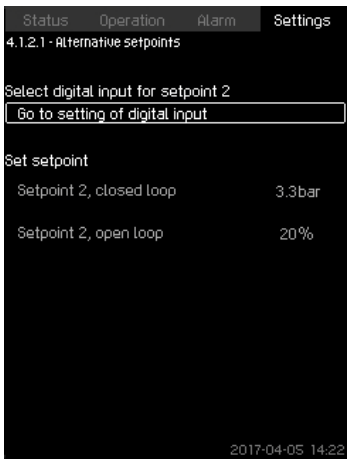



**Fig. 39** Alternative setpoints 2-7

For each alternative setpoint, select the digital input to activate the setpoint.

You can set a setpoint for closed loop and for open loop.

**Setting via the operating panel**

- Settings > Primary controller > Alternative setpoints.

1. Select alternative setpoint.
2. Select: Go to setting of digital input. Display *8.7.28 Digital inputs (4.3.7)* appears.
3. Set the input.
4. Press [Back].
5. Select the menu line of the setpoint (closed or open loop).
6. Set the setpoint. Set both setpoints if the system is to be controlled both in open and closed loop.

**Factory setting**

No alternative setpoints have been set.

### 8.7.5 External setpoint influence (4.1.3)

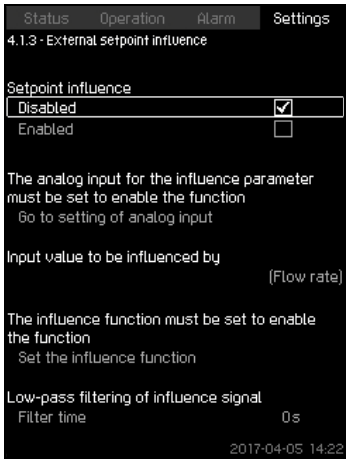



**Fig. 40** External setpoint influence

**Description**

The function allows you to adapt the setpoint by letting measuring parameters influence the setpoint. Typically an analog signal from a flow or temperature transmitter, or a similar transmitter. For an overview of transmitter types and possible positions, see installation and operating instructions for Control MPC.

As an example, the setpoint can be adapted to parameters that can influence the outlet pressure or temperature of the system. The parameters which influence the performance of the system are shown as a percentage from 0 to 100 %. They can only reduce the setpoint, as the influence as a percentage divided with 100 is multiplied with the setpoint:

Actual setpoint (SP) = selected setpoint x influence (1) x influence (2) x etc.

The influence values can be set individually.

A low-pass filter ensures smoothing of the measured value which influences the setpoint. This results in stable setpoint changes.

**Setting range**

- 0-100 % signal
- Inlet pressure
- Outlet pressure
- External pressure
- Diff. pressure, external
- Diff. pressure, pump
- Flow rate
- Tank level, outlet side
- Tank level, suction side
- Return-pipe temp., external
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- Differential temperature.

**Setting via the operating panel**

- Settings > Primary controller > External setpoint influence > Input value to be influenced by. A list of available parameters appears.

1. Select the parameter which is to influence the setpoint.
2. Press [Back].
3. Set the influence function. See section *8.7.6 Setting of influence function (4.1.3.2)*.
4. Set the number of points.
5. Set: External input value (Point 1).
6. Set as a percentage: Reduce setpoint to (Point 1).
7. Repeat steps 4 to 6 for all desired parameters.
8. Press [Back].
9. Set as seconds: Filter time.
10. Select: Enabled.

**Factory setting**

The function is disabled.

If the Multisensor function is enabled, it will have a higher priority than the External setpoint influence which will be overruled.

### 8.7.6 Setting of influence function (4.1.3.2)

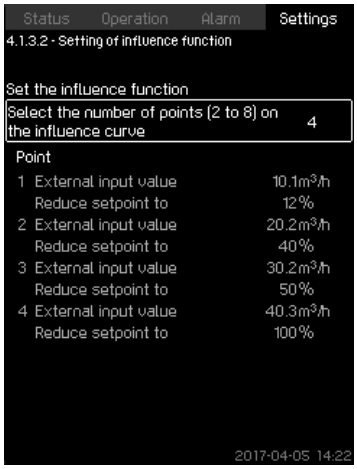



**Fig. 41** Setting of influence function

**Description**

You can select the relation between the measuring parameter which is to influence the setpoint and the desired influence as a percentage.

The relation is set by entering values in a table with maximum eight points by means of the operating panel.

Example:

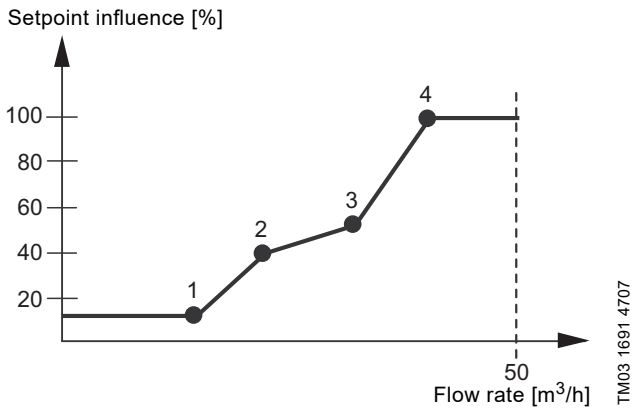



**Fig. 42** Relation between setpoint influence and flow rate

The control unit draws straight lines between the points. A horizontal line is drawn from the minimum value of the relevant sensor (0 $m^3/h$ in the example) to the first point. This is also the case from the last point to the sensor's maximum value (example 50 $m^3/h$).

**Setting range**

Two to eight points can be selected. Each point contains the relation between the value of the parameter which is to influence the setpoint and the influence of the value.

**Setting via the operating panel**

- Settings > Primary controller > External setpoint influence.

1. Set the influence function.
2. Set the number of points.
3. Set: External input value (Point 1).
4. Set as a percentage: Reduce setpoint to (Point 1).
5. Repeat steps 2 to 4 for all desired parameters.

**Factory setting**

The function is disabled.

### 8.7.7 Primary sensor (4.1.4)

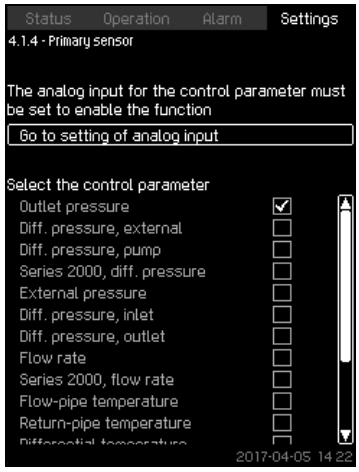



**Fig. 43** Primary sensor

**Description**

You can select the control parameter of the system and set the sensor to measure the value.

**Setting range**

- Outlet pressure
- Diff. pressure, external
- Diff. pressure, pump
- Series 2000, diff. pressure
- External pressure
- Diff. pressure, inlet
- Diff. pressure, outlet
- Flow rate
- Series 2000, flow rate
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- Return-pipe temp., external
- 0-100 % signal
- Not used.

**Setting via the operating panel**

- Settings > Primary controller > Primary sensor > Go to setting of analog input. Display *8.7.30 Analog inputs (4.3.8)* appears.

1. Select analog input (AI) for the primary sensor and set the parameters.
2. Press [Back].
3. Select control parameter for the primary sensor.

**Factory setting**

The primary parameter is the outlet pressure. The sensor is connected to AI1 (CU 352). Other primary parameters can be selected in the startup wizard.

### 8.7.8 Secondary sensor (4.1.5)

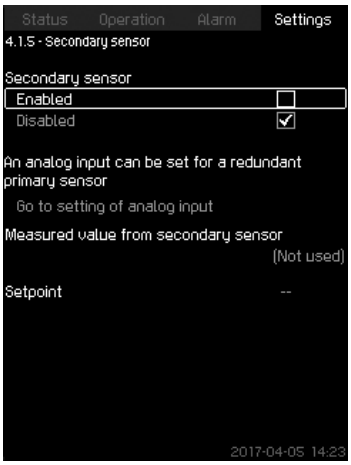



**Fig. 44** Secondary sensor

**Description**

The function is designed for optimising the constant-pressure control, where there is a high dynamic friction loss. The function enables the possibility of placing a primary sensor on the critical point in the system.

The sensor needs to be hardwired back to the controller, and will act as primary sensor hence utilising the normal "Setpoint" setting.

The "Secondary sensor" is then the "local" sensor placed on the booster manifold close to the control cabinet.

In case of a fault on the "Primary sensor", the "Secondary sensor" will automatically take over using its specified "Setpoint". The difference between the setpoint of the "Primary sensor" and the "Secondary sensor" is equal to the total pressure losses between the two sensors at maximum flow.

**Setting range**

- Enabled or Disabled function

1. Setting of analog input
2. Setting of "Measured value from secondary sensor"
3. Setting of "Setpoint"

**Setting via the operating panel**

- Settings > Primary controller > Secondary sensor

1. Enable the function.
2. Define the analog input used for "Secondary sensor".
3. Define "Measured value from secondary sensor".
4. Define "Setpoint" for "Secondary sensor" operation.

### 8.7.9 Clock program (4.1.6)

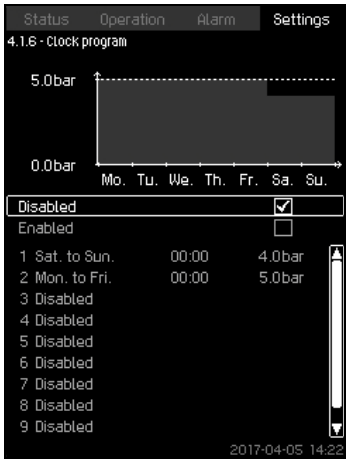



**Fig. 45** Clock program

**Description**

With the function, you can set setpoints and day and time for their activation. You can also set day and time for stop of the system.

If the clock program is disabled, the setpoint of the program will remain active.

If the Multisensor function is enabled, it will have a higher priority than the Clock program which will be overruled.

Minimum two events are required when activating the clock program: one to start the system and one to stop the system.

**Setting range**

- Activation and setting of event.

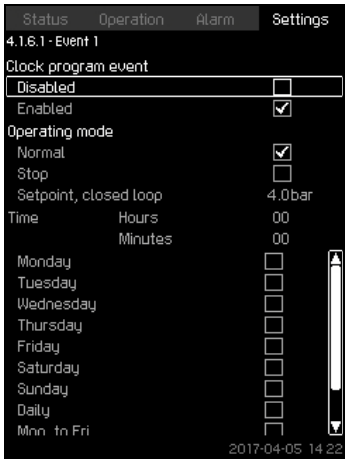



**Fig. 46** Event 1

**Setting via the operating panel**

- Settings > Primary controller > Clock program.

1. Enable the function.
2. Select and enable one of the ten events.
3. Select: Normal or Stop. Skip step 4 if you select "Stop".
4. Set: Setpoint, closed loop.
5. Set: Time, Hours, Minutes.
6. Select the day of week on which the settings are to be activated.
7. Select: Enabled.
8. Repeat steps 2 to 7 if several events are to be enabled. **Note:** Up to ten events can be set.
9. Press [Back].
10. Select: Enabled.

**Factory setting**

The function is disabled.

### 8.7.10 Proportional pressure (4.1.7)

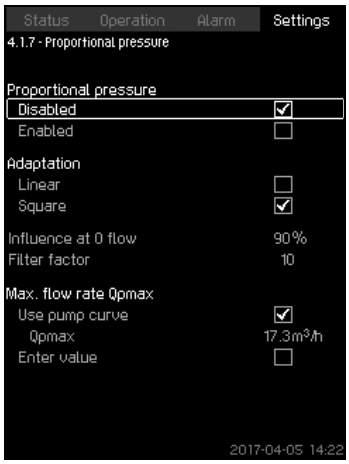



**Fig. 47** Proportional pressure

**Description**

The function can only be enabled in pressure-controlled systems and it automatically adapts the setpoint to the actual flow rate to compensate for flow-dependent dynamic losses. As many systems are designed with extra flow capacity, the estimated maximum flow rate (Qpmax) can be entered manually. In systems with CR pumps, the pump curves can be used to calculate the maximum flow rate at the selected setpoint. Set a filter factor to prevent fluctuation.

If the multisensor function is enabled, it will have a higher priority than the proportional pressure which will be overruled.

The adaptation can be linear or square. See fig. 47.

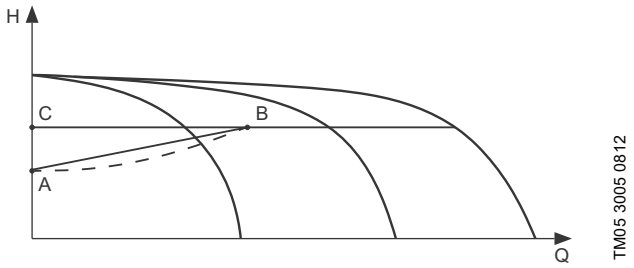



**Fig. 48** Proportional pressure

| Pos. | Description |
|---|---|
| A | Pressure at zero flow. Starting point of proportional-pressure control (influence at zero flow = x % of setpoint) |
| B | Qpmax |
| C | Setpoint |

The function has these purposes:

- to compensate for pressure losses
- to reduce the energy consumption
- to increase the comfort for the user.

**Setting range**

- Selection of control mode
- Influence at 0 flow
- Estimated flow rate
- Filter factor.

**Setting via the operating panel**

- Settings > Primary controller > Proportional pressure.

1. Select: Enabled.
2. Select:

- Adaptation
- Linear or Square.

3. Set: Influence at 0 flow.
4. Set: Filter factor.
5. Select: Use pump curve or Enter value.
6. Set "Qpmax" if you select "Enter value".

**Factory setting**

The function is disabled.

### 8.7.11 S-system configuration (4.1.8)

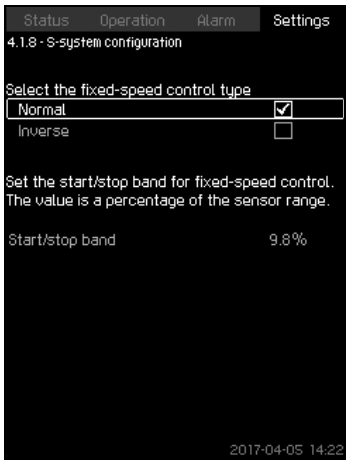



**Fig. 49** S-system configuration

#### Description

The function allows you to invert the control of mains-operated pumps (MPC-S). That is, to set whether pumps are to be started or stopped depending on the actual value.

A start/stop band must be set in order to use this function. See fig. 50.

#### Normal

A pump is stopped when the value becomes higher than Hset + start/stop band. And a pump is started when the value becomes lower than Hset. See fig. 50.

#### Inverse

A pump is started when the value becomes higher than Hset + start/stop band. And a pump is stopped when the value becomes lower than Hset. See fig. 50.

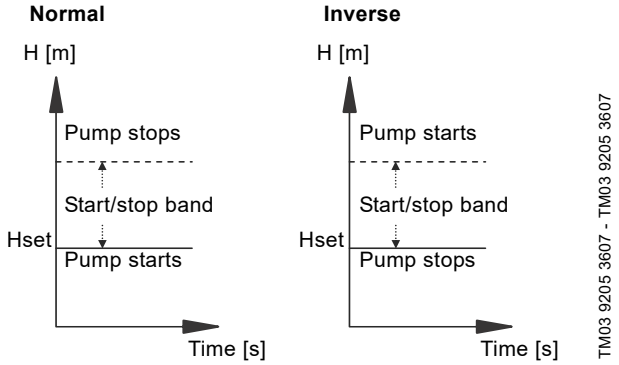



**Fig. 50** Normal and inverse control

#### Setting range

- Selection of configuration (normal or inverse).
- Start/stop band.

#### Setting via the operating panel

- Settings > Primary controller > S-system configuration.

1. Select: Normal or Inverse.
2. Set: Start/stop band.

#### Factory setting

Normal.

### 8.7.12 Setpoint ramp (4.1.9)

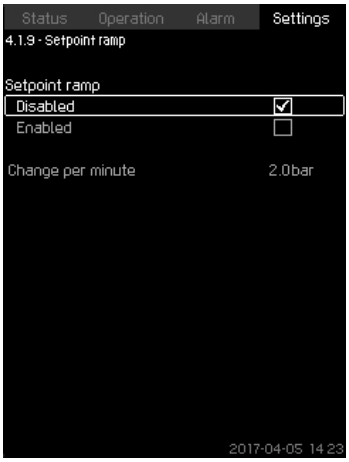



**Fig. 51** Setpoint ramp

#### Description

When the function is enabled, setpoint changes are affected by the setpoint ramp, and the setpoint changes gradually over a period of time.

"Proportional pressure" or "Setpoint influence" are not affected by this function.

If the multisensor function is enabled, it will have a higher priority than the setpoint ramp which will be overruled.

#### Setting range

The function can be enabled and "Change per minute" can be set.

#### Setting via the operating panel

- Settings > Primary controller > Setpoint ramp.

1. Select: Enabled.
2. Set: Change per minute.

#### Factory setting

The function is disabled.

### 8.7.13 Pump cascade control (4.2)

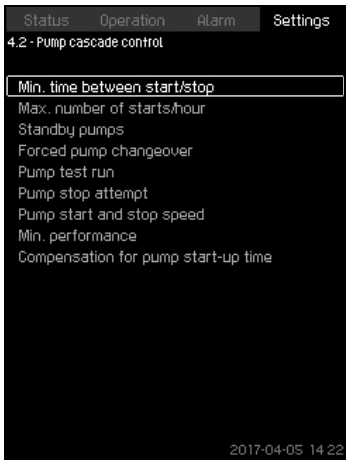



**Fig. 52** Pump cascade control

In the menu, you can set the functions connected to pump cascade control.

The following menus can be selected:

- Min. time between start/stop
- Max. number of starts/hour
- Standby pumps
- Forced pump changeover
- Pump test run
- Pilot pump
- Pump stop attempt
- Pump start and stop speed
- Min. performance
- Compensation for pump start-up time.

### 8.7.14 Min. time between start/stop (4.2.1)


**Fig. 53** Min. time between start/stop

**Description**

The function ensures a delay between the starting and stopping of one pump and the starting and stopping of another pump.

The purpose is to prevent hunting when pumps start and stop continuously.

**Setting range**

From 1 to 3600 seconds.

**Setting via the operating panel**

Settings > Pump cascade control > Min. time between start/stop.

**Factory setting**

The setting is done in the startup wizard and depends on the application.

### 8.7.15 Max. number of starts/hour (4.2.1)

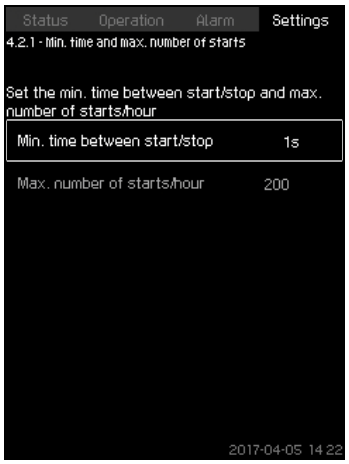



**Fig. 54** Max. number of starts/hour

**Description**

The function limits the number of pump starts and stops per hour for the complete system. It reduces noise emission and improves the comfort of systems with mains-operated pumps.

Each time a pump starts or stops, CU 352 calculates when the next pump is allowed to start/stop in order not to exceed the permissible number of starts per hour.

The function always allows pumps to be started to meet the requirement, but pump stops will be delayed, if needed, in order not to exceed the permissible number of starts per hour.

The time between pump starts must be between the minimum time between start and stop, see section *8.7.14 Min. time between start/stop (4.2.1)*, and 3600/n, n being the set number of starts per hour.

**Setting range**

1 to 1000 starts per hour.

**Setting via the operating panel**

- Settings > Pump cascade control > Max. number of starts/hour.

1. Set:

- Min. time between start/stop.
- Max. number of starts/hour.

**Factory setting**

| | |
|---|---|
| MPC-E: | 200 starts per hour |
| Other variants: | 100 starts per hour. |

This function has no influence on *8.7.24 Stop function (4.3.1)*.

### 8.7.16 Standby pumps (4.2.3)

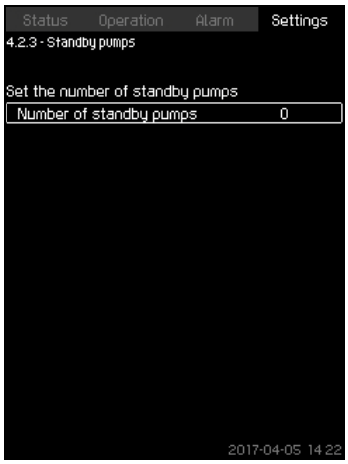



**Fig. 55** Standby pumps

#### Description

The function allows you to limit the maximum performance of the system, by selecting one or more pumps as standby pumps.

If a three-pump system has one standby pump, maximum two pumps are allowed to be in operation at a time.

If one of the two pumps in operation has a fault and has stopped, the standby pump will be started. The performance of the system is thus not reduced.

The status as standby pump alternates between all pumps.

#### Setting range

The number of possible standby pumps in a system is equal to the total number of pumps in the system minus 1.

#### Setting via the operating panel

- Settings > Pump cascade control > Standby pumps.
- Set: Set the number of standby pumps.

#### Factory setting

The number of standby pumps is set to zero. The function is disabled.

### 8.7.17 Forced pump changeover (4.2.4)

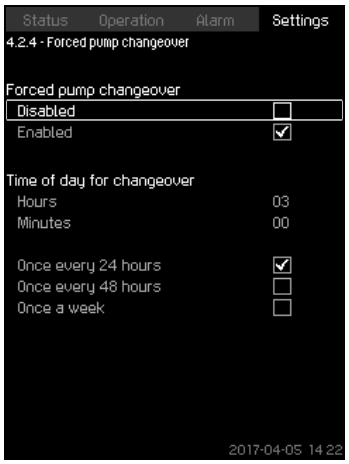



**Fig. 56** Forced pump changeover

#### Description

The function ensures that the pumps run for the same number of operating hours.

In certain applications, the requirement remains constant for long periods and does not require all pumps to run. In such situations, pump changeover does not take place naturally, and forced pump changeover may thus be required.

Once every 24 hours, CU 352 checks if any pump running has a larger number of operating hours than pumps that are stopped. If this is the case, the pump will be stopped and replaced by a pump with a lower number of operating hours.

#### Setting range

You can enable and disable the function. You can set the hour of the day at which the changeover is to take place.

#### Setting via the operating panel

- Settings > Pump cascade control > Forced pump changeover.

1. Select: Enabled.
2. Set: Time of day for changeover.
3. Select interval for pump changeover.

#### Factory setting

The function is enabled. The time is set to 03:00.

### 8.7.18 Pump test run (4.2.5)

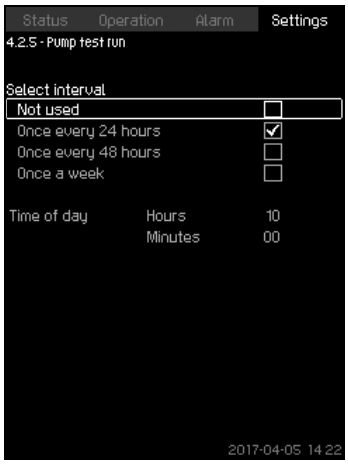



**Fig. 57** Pump test run

#### Description

The function is primarily used in situations where the forced pump changeover is disabled, and/or if the system is set to operating mode "Stop", for instance in a period when the system is not needed. In such situations, it is important to test the pumps regularly.

Advantages of this function:

- Pumps do not seize up during a long standstill due to deposits from the pumped liquid.
- The pumped liquid does not decay in the pump.
- Trapped air is removed from the pump.

The pumps start automatically one by one and run for 5 seconds.

Pumps in operating mode "Manual" are not included in the test run. If there is an alarm, the test run will not be carried out.

#### Setting range

- Time of day
- Day of week
- Include pilot pump.

#### Setting via the operating panel

- Settings > Pump cascade control > Pump test run.

1. Select interval.
2. Set:

- Time of day
- Minutes.

3. Select the day of week if you select "Once a week".
4. If the system is configured with a pilot or a backup pump, select "Include pilot pump".

#### Factory setting

The function is disabled.

### 8.7.19 Pump stop attempt (4.2.7)

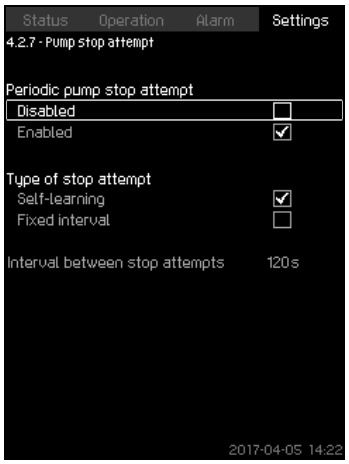



**Fig. 58** Pump stop attempt

#### Description

The function allows you to set automatic stop attempts of a pump when several pumps are running. It ensures that the optimum number of pumps is always running, in terms of energy consumption. See section *8.7.20 Pump start and stop speed (4.2.8)*. At the same time, the purpose is to avoid disturbances in connection with automatic stop of pumps.

Stop attempts can either take place with a fixed interval set under "Interval between stop attempts" or by self-learning. If self-learning is selected, the interval between stop attempts will be increased if repeated attempts to stop the pump fail.

#### Setting via the operating panel

- Settings > Pump cascade control > Pump stop attempt.

1. Select: Self-learning or Fixed interval.
2. Set "Interval between stop attempts" if you select "Fixed interval".
3. Select: Enabled.

#### Factory setting

The function is enabled, and "Self-learning" is selected.

### 8.7.20 Pump start and stop speed (4.2.8)

**Description**

The function controls the starting and stopping of pumps. There are two options:

1. Use calculated speed: This function ensures that the optimum number of pumps always run at a desired duty point, in terms of energy consumption. CU 352 estimates the pump data, which is required to calculate the optimal number of pumps and their speed. This requires that the differential pressure of the pump and the power of each pump are measured. The differential pressure can be measured either by a sensor or separate pressure sensors on the inlet and outlet side. If calculated speed has been selected, CU 352 ignores the percentages set.
2. Use fixed speed: The pumps are started and stopped at speeds set by the user.

**1. Use calculated speed**

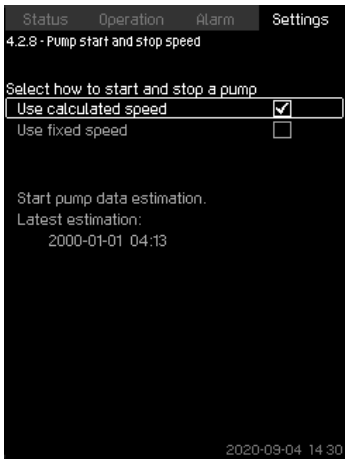



**Fig. 59** Use calculated speed

**Setting via the operating panel**

- Settings > Pump cascade control > Pump start and stop speed > Use calculated speed > Start pump data estimation.

**2. Use fixed speed**

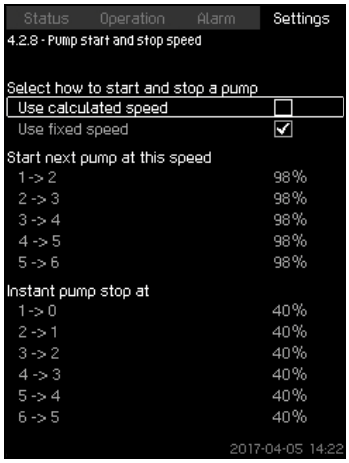



**Fig. 60** Use fixed speed

**Setting via the operating panel**

- Settings > Pump cascade control > Pump start and stop speed.
- Select: Use fixed speed.
- Set: Start next pump at this speed > 1 -> 2.

1. Set the speed as percentage.
2. Set the other pumps in the same way.
3. Select: Instant pump stop at > 1 -> 0.
4. Set the speed as percentage.
5. Set the other pumps in the same way.

**Factory setting**

The function is set to calculated speed.

### 8.7.21 Min. performance (4.2.9)

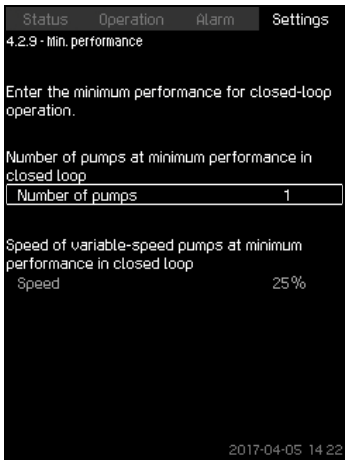



**Fig. 61** Min. performance

**Description**

The function ensures circulation in a system. Note that the stop function, if enabled, can influence this function. See section *8.7.24 Stop function (4.3.1)*. Examples:

- If zero pumps have been selected, the stop function can stop the pump if there is no or a very small consumption.
- If pumps have been selected, the stop function will not be active.

**Setting via the operating panel**

- Settings > Pump cascade control > Min. performance.

1. Set:

- Number of pumps
- Speed.

**Factory setting**

The number of pumps is set to zero. The speed in closed loop is set to 25 %.

### 8.7.22 Compensation for pump start-up time (4.2.10)

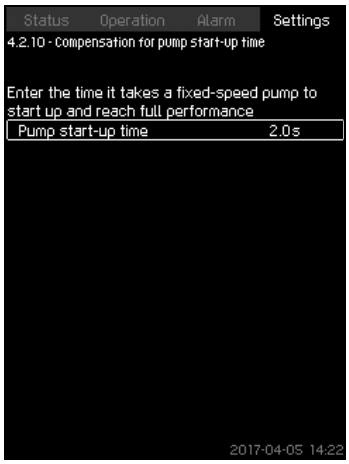



**Fig. 62** Compensation for pump start-up time

#### Description

The function is used for MPC-F systems only.

The purpose is to avoid disturbances when a mains-operated pump with fixed speed is started. The function compensates for the time it takes a mains-operated pump to reach its full performance after start. The startup time of the mains-operated pump must be known.

#### Setting via the operating panel

- Settings > Pump cascade control > Compensation for pump start-up time.
- Set: Pump start-up time

#### Factory setting

The startup time is set to zero seconds.

### 8.7.23 Secondary functions (4.3)

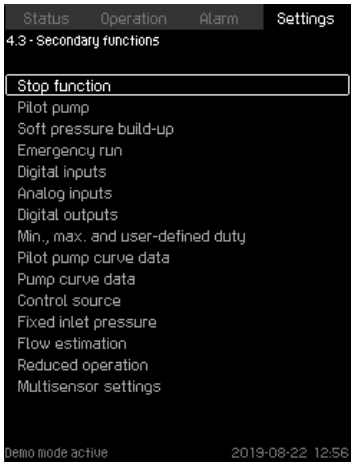



**Fig. 63** Secondary functions

#### Description

In the display, you can set functions that are secondary in relation to the normal operation of the system. Secondary functions are functions that offer additional functionality.

The display allows you to open these specific displays:

- *8.7.24 Stop function (4.3.1)*
- *8.7.25 Pilot pump (4.3.2)**
- *8.7.26 Soft pressure build-up (4.3.3)*
- *8.7.28 Digital inputs (4.3.7)*
- *8.7.30 Analog inputs (4.3.8)*
- *8.7.33 Digital outputs (4.3.9)*
- *8.7.35 Analog outputs (4.3.10)*
- *8.7.37 Counter inputs (4.3.11)*
- *8.7.27 Emergency run (4.3.5)*
- *8.7.38 Min., max. and user-defined duty (4.3.14)*
- *8.7.42 Pilot pump curve data (4.3.18)*
- *8.7.43 Pump curve data (4.3.19)*
- *8.7.47 Flow estimation (4.3.23)*
- *8.7.45 Control source (4.3.20)*
- *8.7.46 Fixed inlet pressure (4.3.22)*
- *8.7.47 Flow estimation (4.3.23)*
- *8.7.48 Reduced operation (4.3.24)*
- *8.7.49 Multisensor settings (4.3.25)*

* Pilot pump needs to be activated via PC Tool to be visible in *8.7.23 Secondary functions (4.3)* display.

### 8.7.24 Stop function (4.3.1)

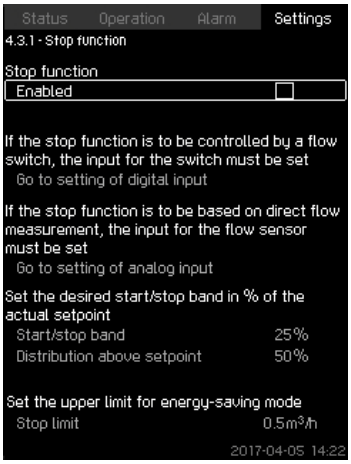



**Fig. 64** Stop function

#### Description

The function is typically used in constant-pressure applications and allows you to stop the last pump if there is no or a very small consumption.

Purpose of the function:

- to save energy
- to prevent heating of shaft seal faces due to increased mechanical friction as a result of reduced cooling by the pumped liquid
- to prevent heating of the pumped liquid.

When a pilot pump is connected to the system, the stop function parameters will be valid for the pilot pump and not the main pump as the pilot pump will be the last pump in operation.

The description of the stop function applies to all booster systems with variable-speed pumps. MPC-S systems will have on/off control of all pumps as described in section *6. Overview of control variants*.

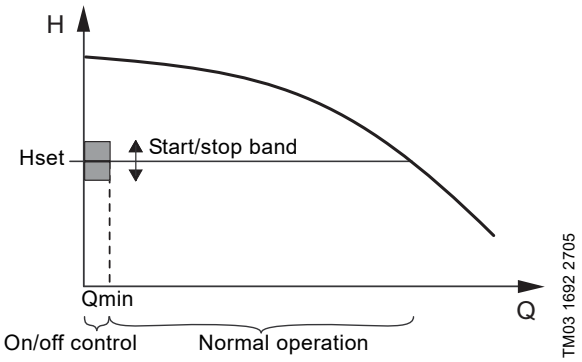



**Fig. 65** Start/stop band

When the stop function is enabled, the operation is continuously monitored to detect a low flow rate. When CU 352 detects no or a low flow rate (Q lower than Qmin), it changes from constant-pressure operation to on/off control of the last pump in operation.

Before stopping, the pump increases the pressure to a value corresponding to Hset plus (distribution above setpoint / 100) x start/stop band. The pump is restarted when the pressure is Hset minus (100-distribution above setpoint) / 100 x start/stop band. See fig. 66. The start/stop band can be distributed around the setpoint.

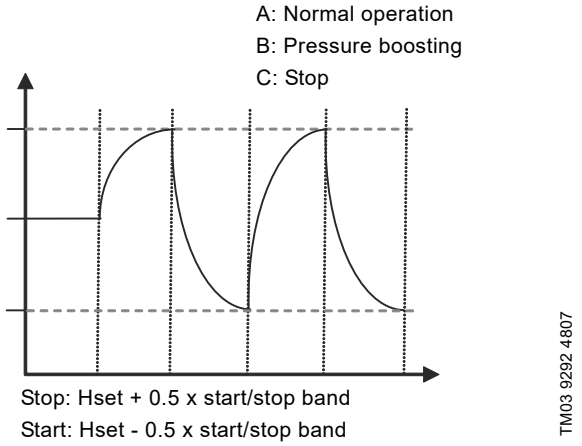



**Fig. 66** On/off operation

The flow rate is estimated by CU 352 when the pump is in the stop period. As long as the flow rate is lower than Qmin, the pump runs in on/off operation. If the flow rate is increased to above Qmin, the pump returns to normal operation, Hset. Hset is equal to the actual setpoint. See section *8.4.4 Setpoint (1.2.2)*.

#### Detection of low flow rate

Low flow rate can be detected in two ways:

- direct flow measurement with a flowmeter or flow switch
- estimation of flow rate by measurement of pressure and speed.

If the booster system is not connected to a flowmeter or flow switch, the stop function will use the estimating function.

If the detection of low flow rate is based on flow estimation, a diaphragm tank of a certain size and with a certain precharge pressure is required.

#### Diaphragm tank size

| Pump type | Recommended diaphragm tank size [litres] | | |
|---|---|---|---|
| | -E | -F | -S |
| CRI(E) 3 | 8 | 8 | 80 |
| CRI(E) 5 | 12 | 12 | 120 |
| CRI(E) 10 | 18 | 18 | 180 |
| CRI(E) 15 | 80 | 80 | 300 |
| CRI(E) 20 | 80 | 80 | 400 |
| CR(E) 32 | 80 | 80 | 600 |
| CR(E) 45 | 120 | 120 | 800 |
| CR(E) 64 | 120 | 120 | 1000 |
| CR(E) 95 | 180 | 180 | 1500 |
| CR(E) 125 | 180 | 180 | 1500 |
| CR(E) 155 | 180 | 180 | 1500 |

#### Precharge pressure

Hydro MPC-E and -F: 0.7 x the setpoint.

Hydro MPC-S: 0.9 x the setpoint.

During each flow estimation (every 2 minutes), the estimating function will disturb the outlet pressure by ± 10 % of the setpoint. If this disturbance is not acceptable, the stop function must be based on direct flow measurement with a flowmeter or flow switch.

The minimum flow rate can be set, that is the flow rate at which the booster system changes to on/off control of the last pump in operation.

If both a flowmeter and a flow switch are connected, the changeover to on/off control will be determined by the unit first indicating low flow rate.

**Setting range**

| | |
|---|---|
| Start/stop band: | 5-30 % |
| Minimum flow rate: | 2-50 % of the rated flow rate (Qnom) of one of the pumps. (It can only be set if direct flow measurement by means of flowmeter has been selected.) |
| Distribution above setpoint: | 0-100 %. |

**Setting via the operating panel**

**System without flow switch or flowmeter**

- Settings > Secondary functions > Stop function.
- Select: Enabled.

1. Set: Start/stop band.
2. Select: Go to setting of flow stop parameters.

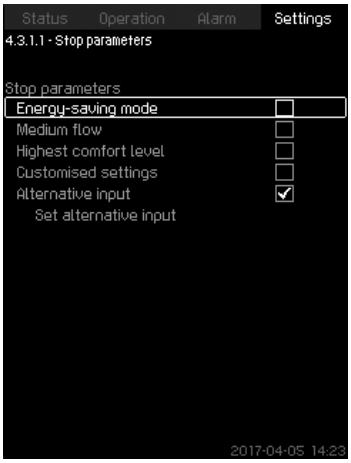



**Fig. 67** Stop parameters

3. Select one of the stop parameters. If you select "Customised settings", you must set the parameters shown in fig. 68. See the examples below.

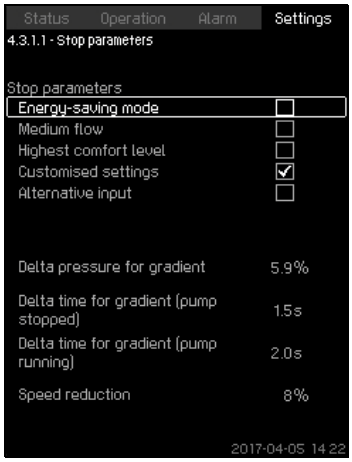



**Fig. 68** Customised settings

Rule of thumb: Speed reduction = 2 x delta pressure for gradient.

**Example 1: Increasing the stop limit, Qmin (high flow limit)**

- Increase "Delta pressure for gradient".
- Reduce "Delta time for gradient (pump stopped)".
- Reduce "Delta time for gradient (pump running)".
- Increase "Speed reduction".

| Example of increased stop limit | |
|---|---|
| **Parameter** | **Value** |
| Delta pressure for gradient | 6 % |
| Delta time for gradient (pump stopped) | 1.5 seconds |
| Delta time for gradient (pump running) | 2.0 seconds |
| Speed reduction | 10 % |

**Example 2: Reducing the stop limit, Qmin (low flow limit)**

- Reduce "Delta pressure for gradient".
- Increase "Delta time for gradient (pump stopped)".
- Increase "Delta time for gradient (pump running)".
- Reduce "Speed reduction".

| Example of reduced flow limit | |
|---|---|
| **Parameter** | **Value** |
| Delta pressure for gradient | 3 % |
| Delta time for gradient (pump stopped) | 15.0 seconds |
| Delta time for gradient (pump running) | 25.0 seconds |
| Speed reduction | 6 % |

The stop limit depends on the tank size.

**Alternative input**

If you select "Alternative input", the controller calculates the stop parameters based on the following inputs:

- system set-point
- total tank volume
- precharge pressure
- desired stop flow.

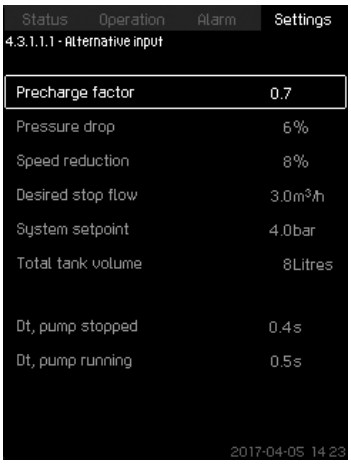



**Fig. 69** Alternative input

**System with flow switch**

Make the following additional settings:

1. Select: Go to setting of digital input. Display *8.7.28 Digital inputs (4.3.7)* appears.
2. Select the digital input where the flow switch is connected.
3. Select: Flow switch.
4. Press [Back].

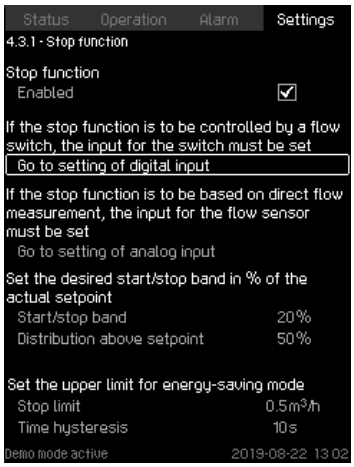



**Fig. 70** System with flow switch

An open contact indicates low flow.

**System with flowmeter**

Make the following additional settings:

1. Select: Go to setting of analog input. The display *8.7.30 Analog inputs (4.3.8)* appears.
2. Select the analog input where the flowmeter is connected.
3. Select: Flow rate.
4. Press [Back] x 2.

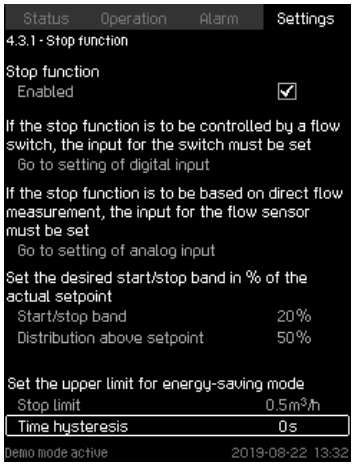



**Fig. 71** System with flowmeter

5. Set: Stop limit.

As standard, there is a 10-seconds detection hysteresis.

**Factory setting**

The function is enabled in pressure-boosting applications with the settings in the table.

| | |
|---|---|
| Start/stop band: | 25 % |
| Minimum flow rate: | 30 % of the rated flow rate of one pump |
| Distribution above setpoint: | 50 % |

The function is disabled in all other applications.

### 8.7.25 Pilot pump (4.3.2)

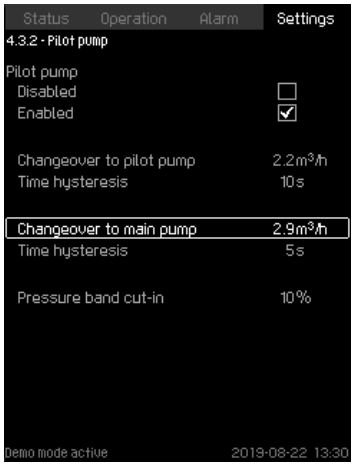



**Fig. 72** Pilot pump

**Description**

This function is used in constant-pressure applications to save energy in low flow situations. The pilot pump is typically Qnom 1/4 of the Qnom on the main pump, thus allowing the system to run to be more energy efficient at low flow.

Both cut-in and cut-out speed for pilot pump and main pump are calculated using the pump curve data.

The pilot pump needs to be activated using the PC Tool. We recommend to upload pump data for the pilot pump or go to menu and enter them manually.

1. Enable or disable the pilot pump.
2. Changeover to pilot pump
   Set the flow for the changeover from main pump to the pilot pump. Factory settings are 75 % of the pilot pump Qnom.
3. Time hysteresis
   Set the delay time for the changeover to a stable low flow before the changeover.
4. Changeover to main pump
   Set the flow for the changeover from pilot pump to the main pump. Factory settings are 95 % of the pilot pump Qnom.
5. Time hysteresis
   Set the delay time for the changeover to a stable low flow before the changeover.
6. Pressure band cut-in
   Set the pressure band in percentage of the setpoint. The pressure band is used for cut-in or cut-out of pumps
   – Main pumps cut-out when the pilot pump ramps up to a stable setpoint "+ or and" pressure band outlet pressure
   – Pilot pump cut-out when the main pumps ramps up to a stable setpoint "+ or and" pressure band outlet pressure
   – If the pilot pump is running at 100 % and the pressure band is below the setpoint-pressure band, the main pumps will cut in.

**Setting via the operating panel**

- Settings > Secondary functions > Pilot pump.

1. Enable pilot pump
   – Set: Changeover to pilot pump
   – Set: Time hysteresis
   – Set: Changeover to main pump
   – Set: Time hysteresis.
2. Set: Pressure band cut-in.

**Factory setting**

The function is disabled.

### 8.7.26 Soft pressure build-up (4.3.3)

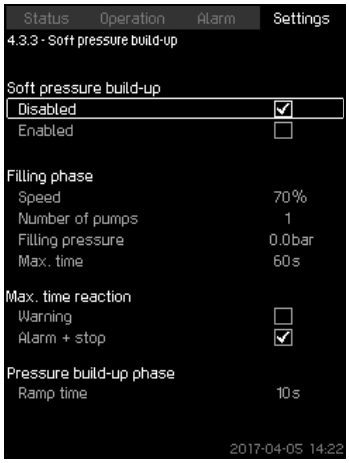



**Fig. 73** Soft pressure build-up

**Description**

The function is typically used in pressure-boosting applications and ensures a smooth startup of systems with for instance empty pipes.

The soft pressure build-up program will be disabled if the multisensor function is activated.

Startup takes place in two phases. See fig. 74.

1. Filling phase: The pipes are slowly filled with water. When the pressure sensor of the system detects that the pipes have been filled, phase two begins.
2. Pressure build-up phase: The system pressure is increased until the setpoint is reached. The pressure buildup takes place over a ramp time. If the setpoint is not reached within a given time, a warning or an alarm can be given, and the pumps can be stopped at the same time.

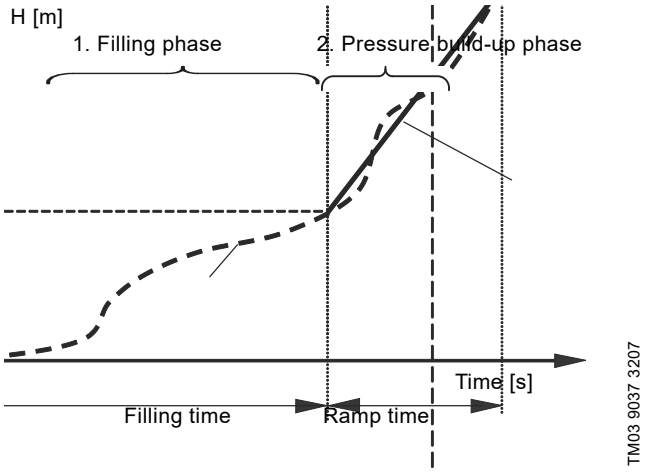



**Fig. 74** Filling and pressure buildup phases

**Setting range**

- Pump speed
- Number of pumps
- Filling pressure
- Maximum filling time
- Warning or Alarm + stop
- "Ramp time" for "Pressure build-up phase".

**Setting via the operating panel**

- Settings > Secondary functions > Soft pressure build-up.

1. Select and set:
- Speed
- Number of pumps
- Filling pressure
- Max. time.

2. Select: Warning or Alarm + stop.
3. Set: Ramp time.
4. Select: Enabled.

**Factory setting**

The function is disabled.

### 8.7.27 Emergency run (4.3.5)

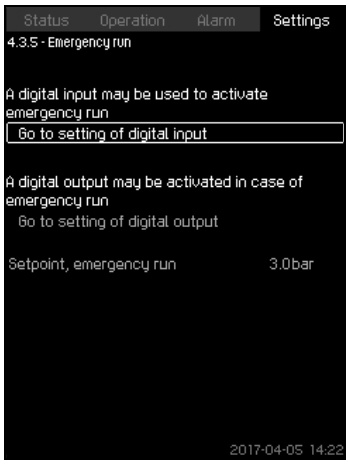



**Fig. 75** Emergency run

#### Description

The function is used in booster applications. When this function has been enabled, the pumps will keep running regardless of warnings or alarms. The pumps will run according to a setpoint set specifically for this function.

In case of sensor fault, both main and standby pumps will run at 100 % speed.

#### Setting range

- Setting of digital input (*8.7.28 Digital inputs (4.3.7)*).
- Setting of digital output (*8.7.33 Digital outputs (4.3.9)*).
- Setting of setpoint for emergency run.

#### Setting via the operating panel

- Settings > Secondary functions > Emergency run > Go to setting of digital input.

1. Select digital input.
2. Select: Emergency run.
3. Press [Back] x 2.
4. Select: Go to setting of digital output.
5. Select digital output.
6. Select: Emergency run.
7. Press [Back] x 2.
8. Set: Setpoint, emergency run.

When you have set this function described above, you can also enable it via the display *8.5.2 System operating mode (2.1.1)*.

### 8.7.28 Digital inputs (4.3.7)

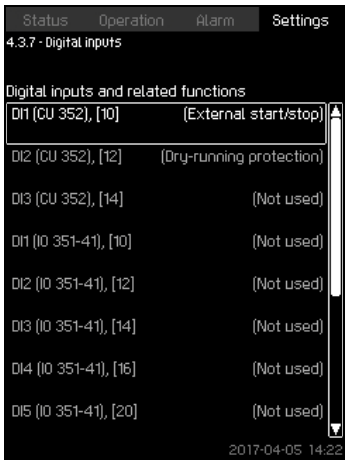



**Fig. 76** Digital inputs

#### Description

In the menu, you can set the digital inputs of CU 352. Each input, except DI1, can be activated and related to a certain function.

As standard, the system has three digital inputs. If the system incorporates an IO 351B module (option), the number of digital inputs is 12.

All digital inputs are shown so that their physical position in the system can be identified.

#### Example

DI1 (IO 351-41), [10]:

| | |
|---|---|
| DI1: | Digital input No 1 |
| (IO 351-41): | IO 351, GENIbus number 41 |
| [10]: | Terminal No 10 |

For further information on the connection of various digital inputs, see the wiring diagram supplied with the control cabinet.

#### Setting range

DI1 (CU 352) cannot be selected.

#### Setting via the operating panel

- Settings > Secondary functions > Digital inputs.

### 8.7.29 Functions of digital inputs (4.3.7.1)

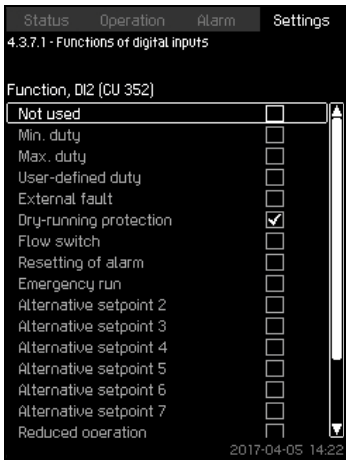



**Fig. 77** Functions of digital inputs

**Description**

A function can be related to the digital inputs.

**Setting range**

You can select one function in each display:

| Function | Contact activated | |
|---|---|---|
| Not used | | |
| Min. duty | = | Operating mode "Min." |
| Max. duty | = | Operating mode "Max." |
| User-defined duty | = | Operating mode "User-defined" |
| External fault | = | External fault |
| Dry-running protection | = | Water shortage |
| Flow switch | = | Flow |
| Resetting of alarm | = | Alarms are reset |
| Emergency run | = | Operating mode "Emergency run" |
| Fault, pilot pump | = | Fault |
| Alternative setpoint 2-7 | = | The setpoint is selected |
| Reduced operation | = | Activation of "Reduced operation" |
| Stop pump 1-6<br>Stop pilot pump | = | Forces the pump to stop |

In the display, you can only select pumps defined in the system.

See the relevant sections for further information about the functions.

Generally, a closed contact activates the function selected.

**Setting via the operating panel**

- Settings > Secondary functions > Stop function > Go to setting of digital input.

**Factory setting**

| Digital input | Function |
|---|---|
| DI1 (CU 352) [10] | External start/stop. Open contact = stop.<br>**Note:** Input No 1 cannot be changed. |
| DI2 (CU 352) [12] | Monitoring of water shortage (dry-running protection). Open contact = water shortage (if the system is supplied with this option). |

Monitoring of water shortage requires a pressure or level switch connected to the system.

### 8.7.30 Analog inputs (4.3.8)

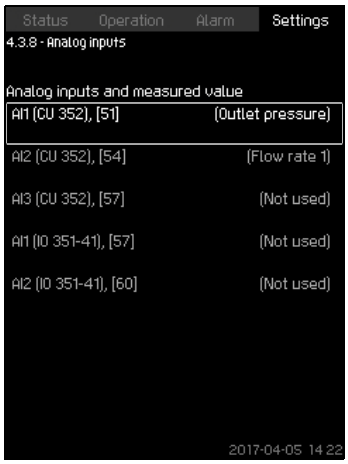



**Fig. 78** Analog inputs

**Description**

Each analog input can be activated and related to a certain function.

As standard, the system has three analog inputs and six inputs via bus (GENIbus). If the system incorporates an IO 351B module (option), the number of analog inputs is 5.

All analog inputs are shown so that their physical position in the system can be identified. A redundant primary sensor can be fitted as backup for the primary sensor in order to increase reliability and prevent stop of operation.

If two sensors are to be redundant, each must have a separate analog input.

**Example**

AI1 (CU 352) [51]:

| | |
|---|---|
| AI1: | Analog input No 1 |
| (CU 352): | CU 352 |
| [51]: | Terminal No 51 |

**Setting via the operating panel**

- Settings > Secondary functions > Stop function > Go to setting of analog input.

### 8.7.31 Analog inputs (4.3.8.1 - 4.3.8.7)

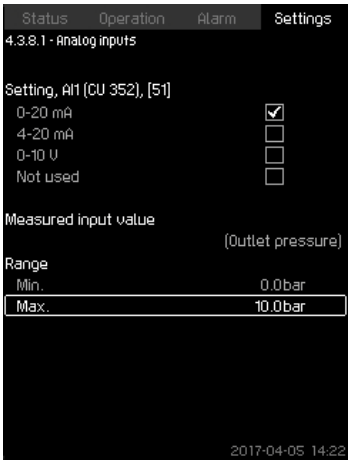



**Fig. 79** Analog inputs

**Description**

In the menu, you can set "Analog inputs". Each display is divided into three parts:

- Setting of input signal, for instance 4-20 mA
- "Measured input value", for instance "Outlet pressure"
- Measuring range of the sensor/signal transmitter, for instance 0-16 bar.

**Setting range**

You can set the following parameters in each display:

- Not used
- Range of input signal, 0-20 mA, 4-20 mA, 0-10 V
- Measured input value
- Sensor range.

**Setting via the operating panel**

- Settings > Secondary functions > Stop function > Go to setting of analog input.

If an analog input is deactivated, the display only shows the top part, that is the setting of the analog input.

If the input is activated, the middle part, "Measured input value", is shown. This makes it possible to relate a function to the analog input in another display. When the analog input has been related to a function, CU 352 will return to the display for setting of analog inputs.

**Factory setting**

| Pressure boosting | |
|---|---|
| **Analog input** | **Function** |
| AI1 (CU 352) [51] | Outlet pressure |

| Heating and cooling | |
|---|---|
| **Analog input** | **Function** |
| AI1 (CU 352) [51] | These are selected in the startup wizard |

### 8.7.32 Analog inputs and measured value (4.3.8.1.1 - 4.3.8.7.1)

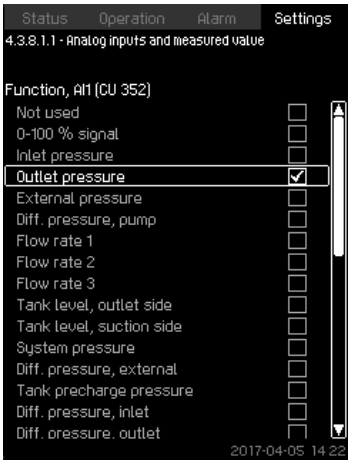



**Fig. 80** Analog inputs and measured value

**Description**

A function can be related to the individual analog inputs.

**Setting range**

You can select one function per analog input. For further details, see the installation and operating instructions for Control MPC.

- Not used
- 0-100 % signal
- Inlet pressure
- Outlet pressure
- External pressure
- Diff. pressure, pump
- Flow rate 1-3
- Tank level, outlet side
- Tank level, suction side
- System pressure
- Diff. pressure, external
- Tank precharge pressure
- Diff. pressure, inlet
- Diff. pressure, outlet
- Return-pipe temp., external
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- Power, pump 1-6
- Power, VFD
- Multisensor 1-6.

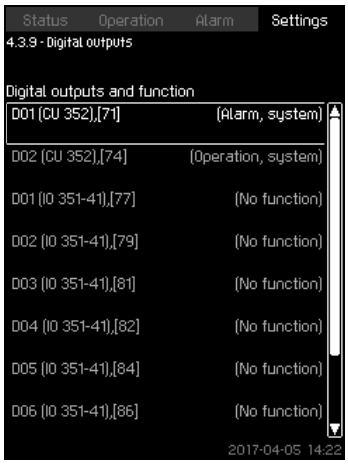
**Setting via the operating panel**

If more flow rates are used, the flow rate measured and shown is the sum of defined flow rates.

- Settings > Secondary functions > Go to setting of analog input.

1. Select analog input.
2. Select: Measured input value. Display 4.3.8.1.1 appears.
3. Select input.
4. Press [Back].
5. Set the minimum and maximum sensor value.

### 8.7.33 Digital outputs (4.3.9)




TM03 2333 4607

**Fig. 81** Digital outputs

**Description**

Each digital output can be activated and related to a certain function.

As standard, the system has two digital outputs.

If the system incorporates an IO 351B module (option), the number of digital outputs is 9.

All digital outputs are shown so that their physical position in the system can be identified.

**Example**

DO1 (IO 351-41) [71]:

| | |
|---|---|
| DO1 | Digital output No 1 |
| (IO 351-41) | IO 351B, GENIbus number 41 |
| [71] | Terminal No 71 |

For further information on the connection of various digital outputs, see the wiring diagram supplied with CU 352.

### 8.7.34 Function of digital outputs (4.3.9.1 - 4.3.9.16)

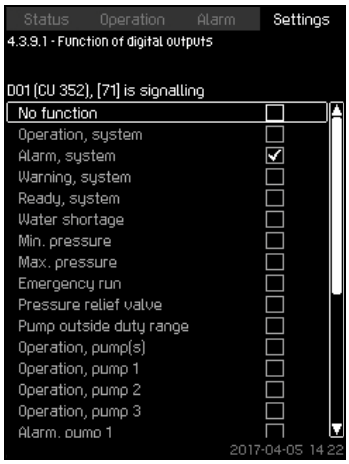



**Fig. 82** Function of digital outputs

**Description**

A function can be related to the individual outputs.

**Setting range**

You can select one function in each display:

- No function
- Operation, system
- Alarm, system
- Warning, system
- Ready, system
- Water shortage
- Min. pressure
- Max. pressure
- Emergency run
- Operation, pilot pump
- Pressure relief valve
- Pump outside duty range
- Operation, pump(s)
- Operation, pump 1-6
- Alarm, pump 1
- Alarm, limit 1 exceeded
- Warning, limit 1 exceeded
- Alarm, limit 2 exceeded
- Warning, limit 2 exceeded
- Reduced operation.

**Setting via the operating panel**

- Settings > Secondary functions > Stop function > Go to setting of digital input.

**Factory setting**

| Digital output | Function |
|---|---|
| DO1 (CU 352) [71] | Alarm, system |
| DO2 (CU 352) [74] | Operation, system |

### 8.7.35 Analog outputs (4.3.10)

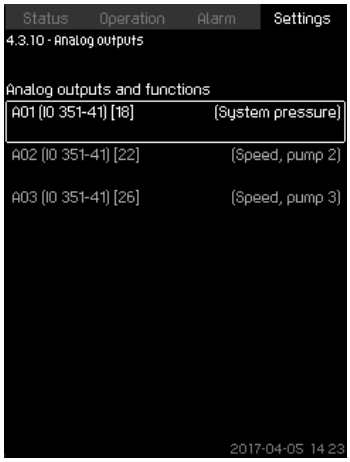



**Fig. 83** Analog outputs

This display only appears if an IO 351B module is installed.

**Description**

CU 352 does not have analog outputs as standard, but the system can be fitted with an IO 351B module with three analog outputs.

**Setting via the operating panel**

- Settings > Secondary functions > Analog outputs.

### 8.7.36 Output signal (4.3.10.1 - 4.3.10.3)

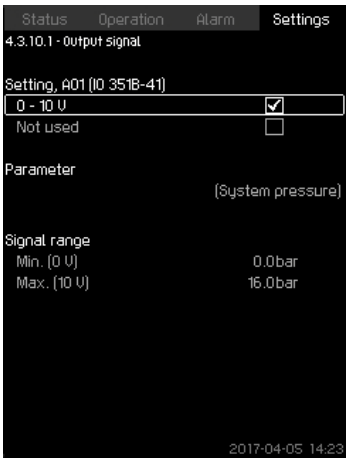



**Fig. 84** Output signal

**Description**

You can select the parameters below.

**Setting range**

- 0-100 % signal
- Flow rate 1-6
- Inlet pressure
- Outlet pressure
- External pressure
- Diff. pressure, pump
- Tank level, outlet side
- Tank level, suction side
- System pressure
- Diff. pressure, external
- Tank precharge pressure
- Diff. pressure, inlet
- Diff. pressure, outlet
- Return-pipe temp., external
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- System power
- Power, pump 1-6
- Power, pilot pump
- Power, VFD
- Speed, pump 1-6
- Speed, pilot pump
- Current, pump 1-6
- Current, pilot pump
- Specific energy

**Setting via the operating panel**

- Settings > Secondary functions > Go to setting of analog input.

1. Select analog output and range.
2. Select: Parameter. Display 4.3.10.2 appears.
3. Select output.
4. Press [Back].
5. Set: Signal range.

### 8.7.37 Counter inputs (4.3.11)

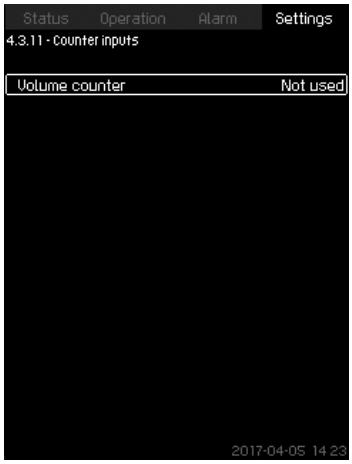



**Fig. 85** Counter inputs

**Description**

You can set CU 352 to accumulate a pumped volume from a digital water meter.

**Setting via the operating panel**

1. Select digital input for volume counter
2. Define unit (unit of volume per digital input pulse).
3. Define scaling of pulse counts.

This menu only appears if an IO 351B module is connected to CU 352.

### 8.7.38 Min., max. and user-defined duty (4.3.14)


**Fig. 86** Min., max. and user-defined duty

**Description**

The function allows you to let the pumps run in open loop at a set performance.

**Setting range**

CU 352 allows you to change between three operating modes:

1. *8.7.39 Min. duty (4.3.14.1)*.
2. *8.7.40 Max. duty (4.3.14.2)*.
3. *8.7.41 User-defined duty (4.3.14.3)*.

For each of these operating modes, you can set the number of operating pumps and the pump performance (speed).

### 8.7.39 Min. duty (4.3.14.1)

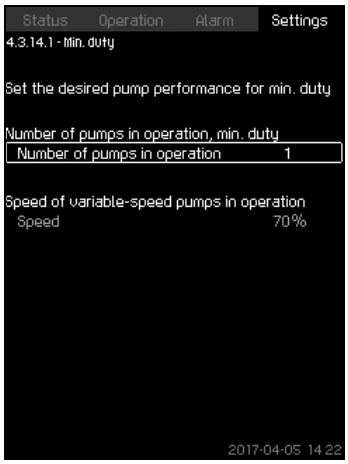



**Fig. 87** Min. duty

#### Description

In all systems, apart from MPC-S systems, minimum duty is only possible for variable-speed pumps. In MPC-S systems, you can only set the number of pumps running at 100 % speed.

#### Setting range

- Number of pumps in operation.
- Speed as percentage (25 to 100 %) for variable-speed pumps.

#### Setting via the operating panel

- Settings > Secondary functions > Min., max. and user-defined duty > Min. duty.

Select and set:

- Number of pumps in operation, min. duty.
- Speed.

#### Factory setting

| | |
|---|---|
| Number of pumps in operation during min. duty: | 1 |
| Speed as percentage for variable-speed pumps: | 70 |

### 8.7.40 Max. duty (4.3.14.2)

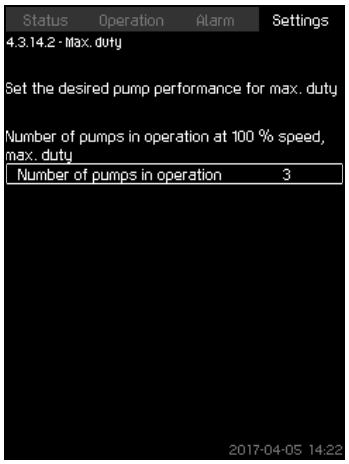



**Fig. 88** Max. duty

#### Description

The function allows you to set a number of pumps to run at maximum performance when the function is enabled.

#### Setting range

You can set the number of pumps to run in the operating mode "Max.". All pumps run at 100 % speed.

#### Setting via the operating panel

- Settings > Secondary functions > Min., max. and user-defined duty > Max. duty.

Select and set:

- Number of pumps in operation at 100 % speed, max. duty.

#### Factory setting

Number of pumps in operation during max. duty:

All pumps (except standby pumps).

### 8.7.41 User-defined duty (4.3.14.3)

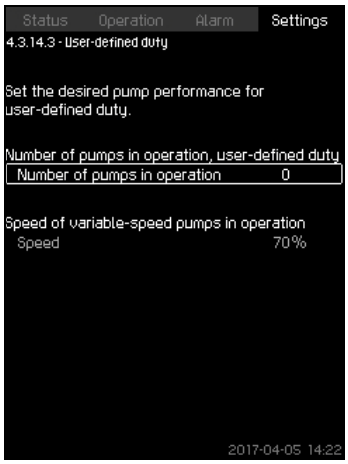



**Fig. 89** User-defined duty

**Description**

You can set a user-defined performance, typically a performance between minimum and maximum duty.

The function allows you to set a pump performance by selecting the number of pumps to run and the speed of variable-speed pumps.

This function primarily selects the variable-speed pumps. If the number of selected pumps exceeds the number of variable-speed pumps, mains-operated pumps are started too.

**Setting range**

- Number of pumps in operation.
- Speed as percentage for variable-speed pumps. **Note:** In systems with only variable-speed pumps, the speed can be set between 25 and 100 %; in systems with both variable-speed pumps and mains-operated pumps the speed can be set between 70 and 100 %.

**Setting via the operating panel**

- Settings > Secondary functions > Min., max. and user-defined duty > User-defined duty.

Select and set:

- Number of pumps in operation, user-defined duty.
- Speed.

**Factory setting**

The function is disabled as the following has been set:

Number of pumps in operation during user-defined duty: 00

### 8.7.42 Pilot pump curve data (4.3.18)

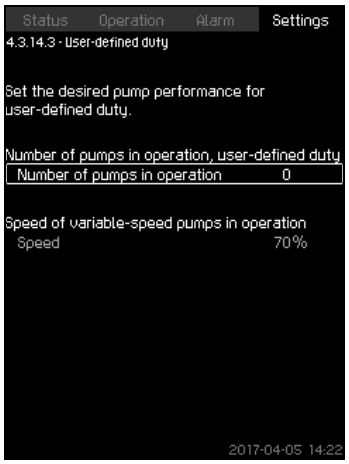



**Fig. 90** Pilot pump curve data

**Description:**

Pilot pump data is needed for the pilot pump function to work. The function uses the following data:

- Rated flow rate Qnom [$m^3/h$]
- Rated head Hnom [m]
- Max. head Hmax [m]
- Max. flow rate Qmax [$m^3/h$]
- Power, Q0, 100 % speed [kW]
- Power, Q0, 50 % speed [kW]
- Rated power Pnom [kW]

Grundfos can supply hydraulic data for CR, CRI, CRE and CRIE pumps where GSC files can be downloaded to CU 352.

All other pump types require manual entering of hydraulic pump data.

Enter the electrical data, Power, Q0, 100 % speed and Power, Q0, 50 % speed manually for all pump types, including CR, CRI, CRE and CRIE.

For Grundfos E-pumps, enter the data of input power (P1).

Read the data using the pump performance curves which can be found in Grundfos Product Center at www.grundfos.com. See the examples in fig. 88 to 91.

If Grundfos Product Center is not accessible, try to bring a pump into the three duty points:

- Power, Q0, 100 % speed
- Power, Q0, 50 % speed
- Rated power Pnom.

See section *8.7.44 How to read pump curve data* in Grundfos Product Center.

**Setting via the operating panel**

- Settings > Secondary functions > Pump curve data.
- Select and set:
  - Rated flow rate Qnom
  - Rated head Hnom
  - Max. head Hmax
  - Max. flow rate Qmax
  - Power, Q0, 100 % speed
  - Power, Q0, 50 % speed
  - Rated power Pnom.

### 8.7.43 Pump curve data (4.3.19)

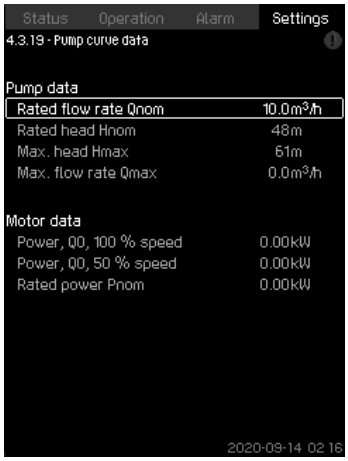



**Fig. 91** Pump curve data

**Description**

CU 352 has a number of functions using these pump data:

- Rated flow rate Qnom [$m^3$/h]
- Rated head Hnom [m]
- Max. head Hmax [m]
- Max. flow rate Qmax [$m^3$/h]
- Power, Q0, 100 % speed [kW]
- Power, Q0, 50 % speed [kW]
- Rated power Pnom [kW]
- VFD minimum speed [%]
- VFD maximum speed [%]

Grundfos can supply hydraulic data for CR, CRI, CRE and CRIE pumps where GSC files can be downloaded to CU 352.

All other pump types require manual entering of hydraulic pump data.

Enter the electrical data, Power, Q0, 100 % speed and Power, Q0, 50 % speed manually for all pump types, including CR, CRI, CRE and CRIE.

For Grundfos E-pumps, enter the data of input power (P1).

The VFD speed range is the range in which the VFD is operating, so if the minimum and maximum speeds are limited on the VFD, the values for the operating range have to be entered in these fields.

Only used for EF systems. It is not used for E and EC systems.

Read the data using the pump performance curves which can be found in Grundfos Product Center at www.grundfos.com. See the examples in figs 92 to 95.

If you cannot access Grundfos Product Center, try bringing a pump into the three duty points:

- Power, Q0, 100 % speed
- Power, Q0, 50 % speed
- Rated power Pnom.

Setting via the operating panel

- Settings > Secondary functions > Pump curve data.
- Select and set:
  - Rated flow rate Qnom
  - Rated head Hnom
  - Max. head Hmax
  - Max. flow rate Qmax
  - Power, Q0, 100 % speed
  - Power, Q0, 50 % speed
  - FD minimum speed
  - VFD maximum speed.

### 8.7.44 How to read pump curve data

Read the power values in displays 1.3 to 1.8, depending on the pump. See section *8.4.10 Pump 1-6, Pilot pump (1.3 - 1.10)*.

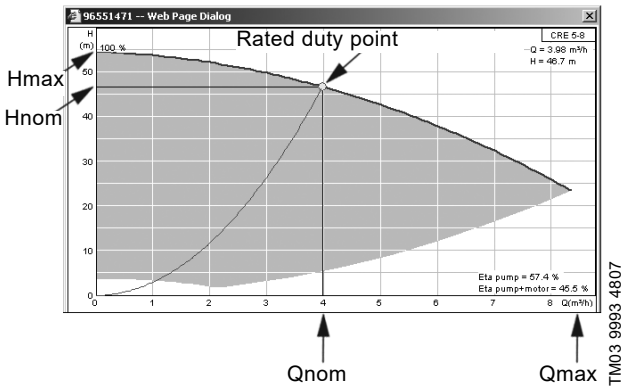



**Fig. 92** Reading of Qnom, Hnom, Hmax and Qmax (Grundfos Product Center)

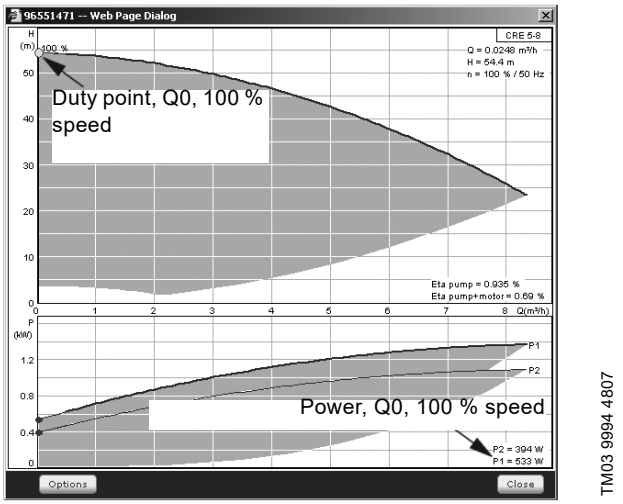
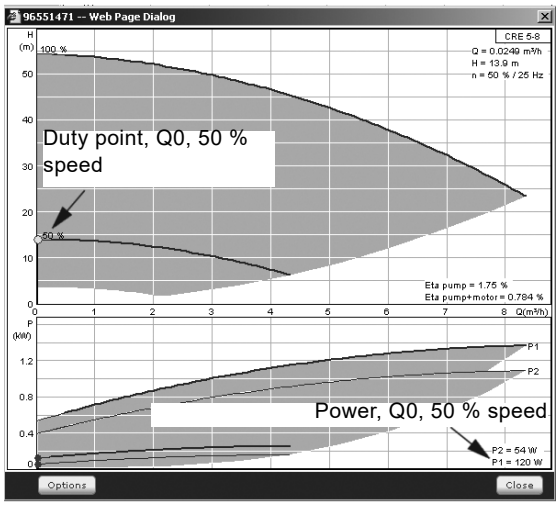
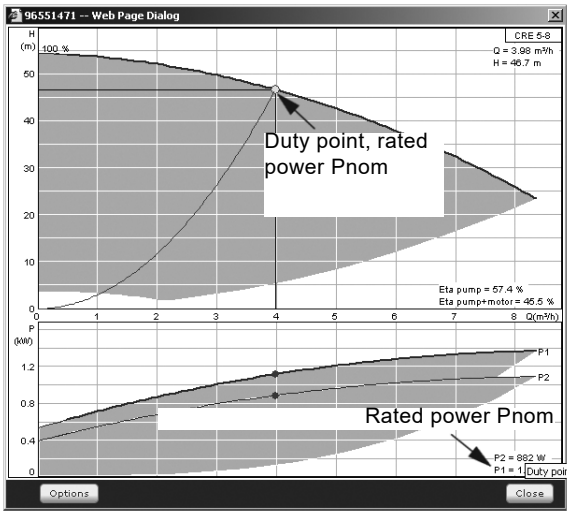



**Fig. 93** Reading of power, Q0, 100 % speed (Grundfos Product Center)




TM03 9995 4807

**Fig. 94** Reading of power, Q0, 50 % speed (Grundfos Product Center)




TM03 9996 4807

**Fig. 95** Reading of rated power Pnom (Grundfos Product Center)

Qnom and Hnom are the rated duty point of the pumps and usually the duty point with the highest efficiency.

**Setting via the operating panel**

- Settings > Secondary functions > Pump curve data.
- Select and set:
  - Rated flow rate Qnom
  - Rated head Hnom
  - Max. head Hmax
  - Max. flow rate Qmax
  - Power, Q0, 100 % speed
  - Power, Q0, 50 % speed
  - Rated power Pnom.

### 8.7.45 Control source (4.3.20)

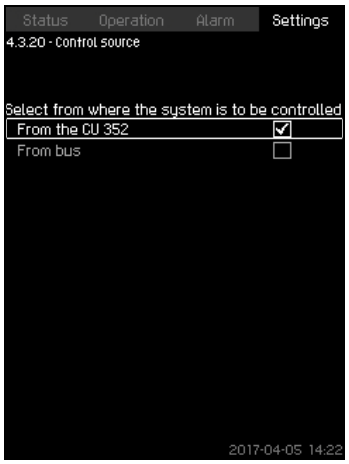



**Fig. 96** Control source

**Description**

The system can be remote-controlled via an external bus connection (option). See section *7. Click [Apply]*. For further information, see section *8.8 Data communication*.

Select the control source, that is either CU 352 or the external bus connection.

**Setting via the operating panel**

- Settings > Secondary functions > Control source.

**Factory setting**

The control source is CU 352.

### 8.7.46 Fixed inlet pressure (4.3.22)


**Fig. 97** Fixed inlet pressure

**Description**

The function is only used when no inlet-pressure sensor is fitted in the system and the inlet pressure is fixed and known.

If the booster system has a fixed inlet pressure, you can enter it in the display so that CU 352 can optimise the performance and control of the system.

**Setting range**

A fixed inlet pressure can be set, and the function can be enabled and disabled.

**Setting via the operating panel**

- Settings > Secondary functions > Fixed inlet pressure.
- Select: Enabled or Disabled.
- Set: Fixed inlet pressure.

**Factory setting**

The function is disabled.

### 8.7.47 Flow estimation (4.3.23)

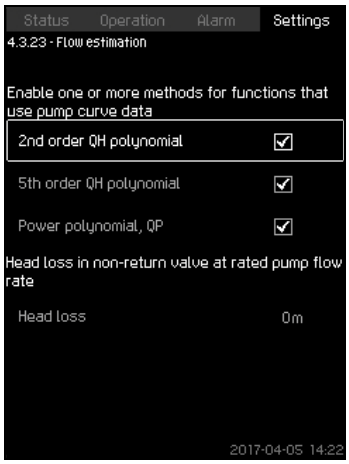



**Fig. 98** Flow estimation

#### Description

As described in section *8.7.43 Pump curve data (4.3.19)*, CU 352 can optimise operation according to performance curves and motor data. In this display, you can select the curve types which CU 352 uses for the optimisation if they are available.

At large flow rates, there may be a considerable head loss between the pump outlet flange and the pressure sensor. The loss is caused by non-return valves and pipe bends. To improve the flow estimation of the system, it is necessary to compensate for the difference between the measured and the actual differential pressure across the pump. This is done by entering the head loss in non-return valves and pipe bends at the rated flow rate of one pump.

#### Setting range

- 2nd order QH polynomial
- 5th order QH polynomial
- Power polynomial, QP
- Head loss.

It is possible to select several curve types, as CU 352 makes a priority based on the data available.

#### Setting via the operating panel

- Settings > Secondary functions > Flow estimation.

#### Factory setting

All polynomials are selected.

### 8.7.48 Reduced operation (4.3.24)

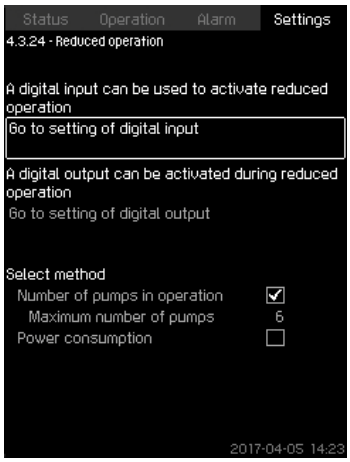



**Fig. 99** Reduced operation

#### Description

The function allows you to limit the number of pumps in operation, or for MPC-E systems, to limit power consumption. The limit is activated by a digital input.

#### Setting range

- Setting of digital input (*8.7.28 Digital inputs (4.3.7)*).
- Setting of digital output (*8.7.33 Digital outputs (4.3.9)*).
- Maximum number of pumps in operation.
- Maximum power consumption.

#### Setting via the operating panel

- Settings > Secondary functions > Reduced operation.

1. Select: Go to setting of digital input.
2. Select digital input.
3. Select: Reduced operation.
4. Press [Back] x 2.
5. Select: Go to setting of digital output.
6. Select digital output.
7. Select: Reduced operation.
8. Press [Back] x 2.
9. Set: Number of pumps in operation or Power consumption.

#### Factory setting

No digital input is selected (disabled).

### 8.7.49 Multisensor settings (4.3.25)

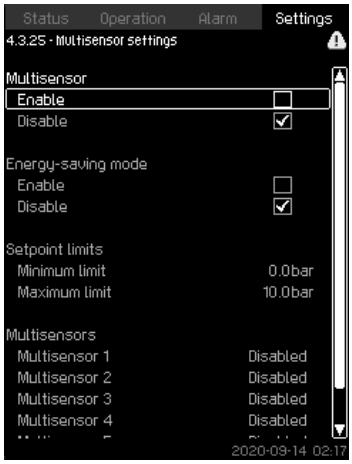



**Fig. 100**Multisensor settings

**Description**

The function is designed for controlling up to six different zones in a HVAC system with a defined differential-pressure band. If one of the "Multisensor" signals are outside the specific sensor limits (minimum or maximum), the function will influence the setpoint (SP) up or down to ensure that the specific sensor or zone is kept within its pressure band.

You can adjust the reaction of the setpoint influence by the means of dedicated "Setpoint alternation", Kp and Ti values.

In case more sensors are either under or above their limits, you can set a priority between the sensors. Furthermore, the system can optimise the actual setpoint if "Energy-saving mode" is activated by reducing the actual setpoint until the minimum limit of one of the multisensors is reached.

If the multisensor function is enabled, it will have higher priority and the following programs will be overruled:

- Clock program
- Proportional pressure
- Alternative setpoint
- External setpoint influence
- Setpoint ramp.

**Setting range**

- "Energy-saving mode": In this mode, the system ramps down the actual setpoint towards the minimum limit for one of the multisensors. If disabled, the function ensures that no sensor is above or below its limits.
- "Setpoint limits": The range with the function will operate the control setpoint up or down according to the "Multisensor" feedback.
- Multisensor list: Setup for each multisensor.

**Setting via the operating panel**

- Settings > Secondary functions > Multisensor settings.

1. Select: "Enable".
2. Set: "Number of sensors"
3. Enable "Energy-saving mode" if requested
4. Set: "Setpoint limits" (Select: "Minimum limit" or "Maximum limit").
5. Press "Multisensor settings" to set the individual settings for each multisensor.

### 8.7.50 Multisensor settings (4.3.25.1)

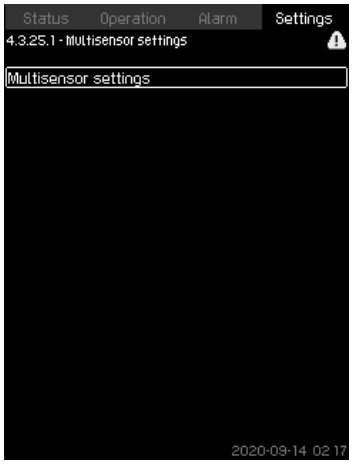



**Fig. 101**Multisensor settings

**Description**

Each "Multisensor" needs to be defined in order for the function to work correctly.

**Setting range**

- "Name"
- Sensor limits
- Sensor priority (1-6, High = 1)
- Filter factor [second] (time period where the remote sensor feedback signal is averaged over.)
- "Sensor source"

Local = AI

Bus = BUS communication

**Setting via the operating panel**

- Settings > Secondary functions > Multisensor settings > Multisensor settings.

### 8.7.51 Multisensor 1-6 (4.3.25.1.1)

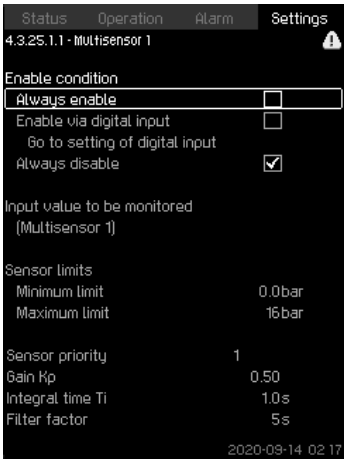



**Fig. 102**Multisensor 1-6

**Description**

Each "Multisensor" needs to be defined in order for the function to work correctly.

**Setting range**

- On-Off.

Always disable: the supervision parameter is disabled.

Always enable: the supervision parameter is enabled.

Enable via digital input: set the digital input to enable the supervision parameter.

- Input value to be monitored: select the input value to be monitored.
- Minimum limit for the selected input value.
- Maximum limit for the selected input value (is not shown in Energy saving mode).
- Gain Kp: - 30 to 30.
  Note that for inverse control, Kp must be set to a negative value.
- Integral time Ti: 0.0 to 3600 seconds.
- Sensor priority (1-6, High = 1).
- Filter time [seconds] (time period where the remote sensor feedback signal is averaged over.)

**Setting via the operating panel**

- Settings > Secondary functions > Multisensor settings > Multisensor 1-6.

1. Set On-Off.
   – Always disable
   – Always enable
   – Enable via digital input
     - Go to settings of digital input, set the digital input.
     - Press [Back] x 1.
2. Select the input value to be monitored.
3. Press [Back] x 1.
4. Set: Setpoint limits (select: minimum and maximum).
5. Set: Gain Kp and Integral time Ti.
6. Set: Sensor priority (1 = Highest).
7. Set: Filter factor.

### 8.7.52 Differential sensor (4.3.27)

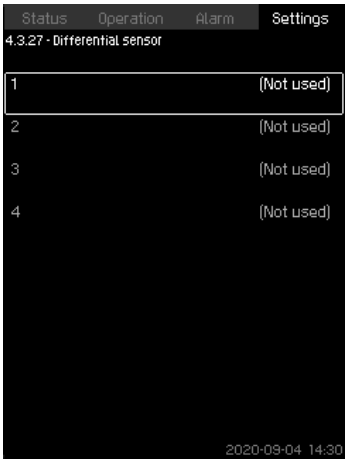



**Fig. 103**Differential sensor

**Description**

Up to four differential sensors can be configured for input and output values.

**Example**

Differential sensor 2

Differential sensor 3.

**Setting via the operating panel**

- Settings > Secondary functions > Differential sensor.

### 8.7.53 Differential sensor (4.3.27.1-4)

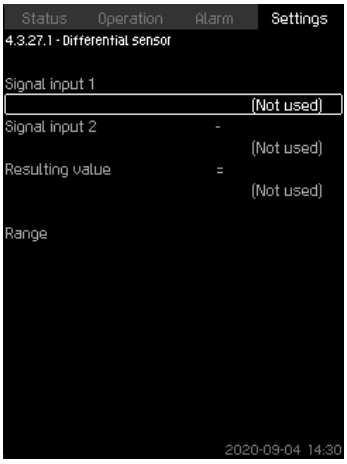



**Fig. 104**Differential sensor 1-4

**Description**

Customising the differential sensors.

**Setting range**

- "Signal input 1": select value for the minuend part of the differential sensor.
- "Signal input 2": select value for the subtrahend part of the differential sensor.
- "Resulting value": select value for the resulting differential sensor.
- "Range": set the range for the resulting differential sensor.

**Setting via the operating panel**

- Settings > Secondary functions > Differential sensor > Differential sensor 1-4.

1. Select signal input 1 value.
2. Select signal input 2 value.
3. Select "Resulting value".
4. Set differential sensor range.

### 8.7.54 Customisable measured value type (4.3.28)

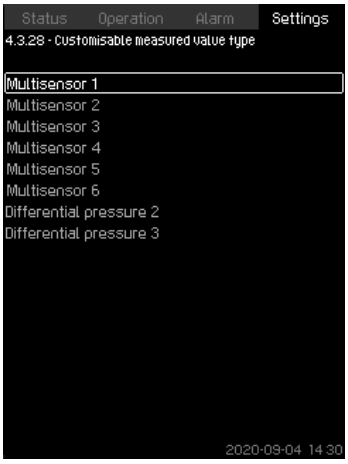



**Fig. 105**Customisable measured value type

**Description**

Up to 8 input value types can be customized in regard to name and physical quantity.

**Example**

Multisensor 1

Multisensor 2

Multisensor 3.

**Setting via the operating panel**

- Settings > Secondary functions > Customisable measured value type.

### 8.7.55 Customisable measured value type (4.3.28.1-8)

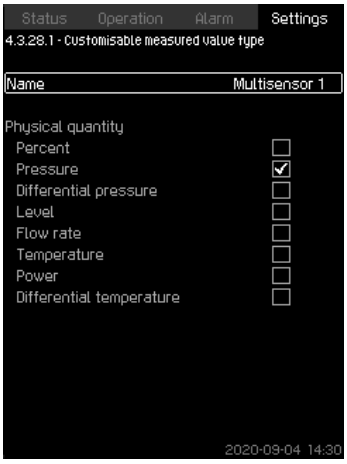



**Fig. 106**Customisable measured value type

**Description**

- "Name": Configure the name for the measured value.
- "Physical quantity": Set the type of physical values:
  - "Percent"
  - Pressure
  - Differential pressure
  - Level
  - Flow rate
  - Temperature
  - Power
  - Differential temperature.

**Setting via the operating panel**

- Settings > Secondary functions > Customisable measured value type 1-8.

1. Set "Name".
2. Select "Physical quantity".

### 8.7.56 Monitoring functions (4.4)

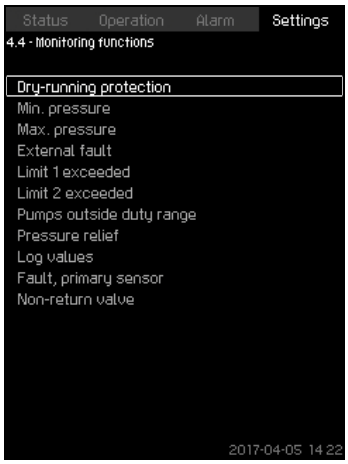



**Fig. 107**Monitoring functions

**Description**

The system has a series of functions that constantly monitor the operation of the system.

The primary purpose of the monitoring functions is to ensure that faults do not damage pumps or the system.

**Setting range**

- *8.7.57 Dry-running protection (4.4.1)*
- *8.7.61 Min. pressure (4.4.2)*
- *8.7.62 Max. pressure (4.4.3)*
- *8.7.63 External fault (4.4.4)*
- *8.7.64 Limit 1 exceeded (4.4.5 - 4.4.6)*
- *8.7.65 Pumps outside duty range (4.4.7)*
- *8.7.66 Pressure relief (4.4.8)*
- *8.7.67 Log values (4.4.9)*
- *8.7.68 Fault, feedback sensor (4.4.10)*.

**Setting via the operating panel**

- Settings > Monitoring functions.

### 8.7.57 Dry-running protection (4.4.1)

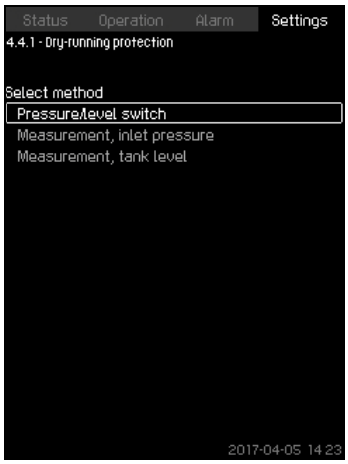



**Fig. 108**Dry-running protection

#### Description

Dry-running protection is one of the most important monitoring functions, as the bearings and the shaft seal may be damaged if the pumps run dry. We thus always recommend that you use dry-running protection.

The function is based on monitoring of the inlet pressure or the level in a possible tank or pit on the inlet side.

Level switches, pressure switches or analog sensors signalling water shortage at a set level can be used.

There are three different methods for detection of water shortage:

- Pressure switch on inlet manifold or float switch/electrode relay in the supply tank. See section *8.7.58 Pressure/level switch (4.4.1.1)*.
- Measurement of inlet pressure in the inlet manifold by means of an analog pressure transmitter. See section *8.7.59 Measurement, inlet pressure (4.4.1.2)*.
- Measurement of level in the supply tank by means of an analog level transmitter. See section *8.7.60 Measurement, tank level (4.4.1.3)*.

#### Setting via the operating panel

- Settings > Monitoring functions > Dry-running protection > Select method.

### 8.7.58 Pressure/level switch (4.4.1.1)

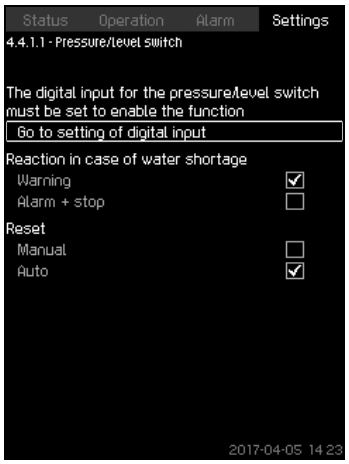



**Fig. 109**Pressure/level switch

#### Description

The function is primarily used in booster applications. Dry-running protection can take place by means of a pressure switch on the inlet manifold or a level switch in a tank on the inlet side.

When the contact is open, CU 352 registers water shortage after a time delay of approximately 5 seconds. You can set whether the indication is to be just a warning or an alarm stopping the pumps.

You can set restarting and resetting of alarms to be automatic or manual.

#### Setting range

- Selection of digital input for the function.
- Reaction in case of water shortage: Alarm + stop.
- Restarting: Manual or Auto.

#### Setting via the operating panel

- Settings > Monitoring functions > Dry-running protection > Pressure/level switch > Go to setting of digital input. Display *8.7.28 Digital inputs (4.3.7)* appears.

1. Set the input to dry-running protection.
2. Press [Back].
3. Select:

- Warning or Alarm + stop.
- Manual or Auto.

#### Factory setting

The setting is done in the startup wizard and depends on the application.

### 8.7.59 Measurement, inlet pressure (4.4.1.2)

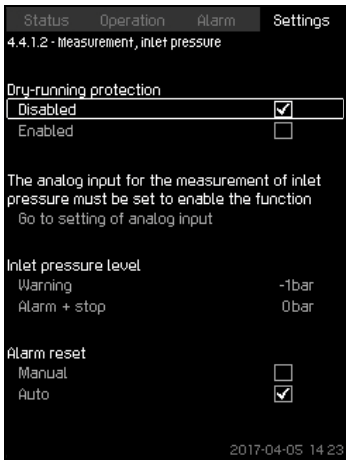



**Fig. 110** Measurement, inlet pressure

#### Description

Dry-running protection can take place by means of a pressure transmitter measuring the inlet pressure.

You can set two levels:

- Warning
- Alarm + stop.

You can set restarting and resetting of alarms to be automatic or manual.

#### Setting range

- Selection of analog input for the function.
- Inlet pressure level for "Warning".
- Inlet pressure level for "Alarm + stop".
- Restarting: Manual or Auto.

#### Setting via the operating panel

- Settings > Monitoring functions > Dry-running protection > Measurement, inlet pressure> Go to setting of analog input. Display *8.7.30 Analog inputs (4.3.8)* appears.

1. Select: Inlet pressure.
2. Press [Back].
3. Select: Enabled.
4. Select and set the level:

- Warning.
- Alarm + stop.

5. Select resetting: Manual or Auto.

If one of the levels is not required, the level value must be the minimum value of the inlet-pressure transmitter. This disables the function.

#### Factory setting

The setting is done in the startup wizard and depends on the application.

### 8.7.60 Measurement, tank level (4.4.1.3)

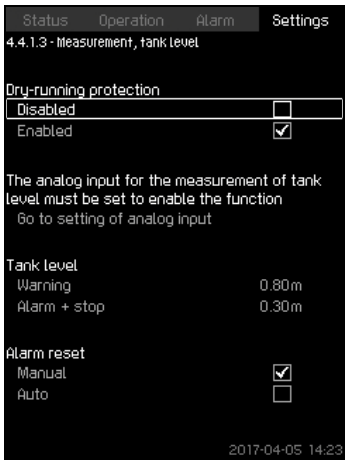



**Fig. 111** Measurement, tank level

#### Description

Dry-running protection can take place by means of a level transmitter measuring the level in a tank on the inlet side.

You can set two levels:

- Warning
- Alarm + stop.

You can set restarting and resetting of alarms to be automatic or manual.

#### Setting range

- Selection of analog input for the function.
- Tank level for "Warning".
- Tank level for "Alarm + stop".
- Restarting: Manual or Auto.

#### Setting via the operating panel

- Settings > Monitoring functions > Dry-running protection > Measurement, tank level > Go to setting of analog input. Display *8.7.30 Analog inputs (4.3.8)* appears.

1. Set the input to "Tank level, suction side".
2. Press [Back] x 3.
3. Select: Enabled.
4. Select and set the level:

- Warning.
- Alarm + stop.

5. Select alarm resetting: Manual or Auto.

#### Factory setting

The function is disabled.

### 8.7.61 Min. pressure (4.4.2)

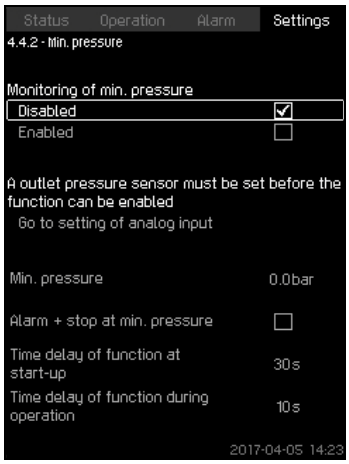



**Fig. 112** Min. pressure

#### Description

The outlet pressure will be monitored if the application is pressure boosting. In all other applications, the system pressure will be monitored. CU 352 will react if the pressure becomes lower than a set minimum level for an adjustable time.

The minimum pressure can be monitored if a fault indication is required in situations where the outlet pressure becomes lower than the set minimum pressure.

You can set whether the indication is to be just a warning or an alarm stopping the pumps. This may be desirable if the system is used for an irrigation system where a very low outlet pressure may be due to pipe fracture and thus an extraordinarily high consumption and a very low counterpressure. In such situations, it is desirable that the system stops and indicates alarm. This situation requires manual resetting of alarms.

You can set a startup delay ensuring that the system can build up pressure before the function is enabled. You can also set a time delay, that is for how long time the outlet pressure may be lower than the set minimum pressure before the alarm is activated.

#### Setting range

- Minimum pressure level within the range of the primary sensor.
- Activation of stop when the pressure falls below the minimum pressure.
- Time delay of function at start-up.
- Time delay of function during operation.

#### Setting via the operating panel

- Settings > Monitoring functions > Min. pressure > Enabled.

1. Select and set: Min. pressure.
2. Select: Alarm + stop at min. pressure.
3. Set:

- Time delay of function at start-up
- Time delay of function during operation.

#### Factory setting

The function is disabled.

### 8.7.62 Max. pressure (4.4.3)

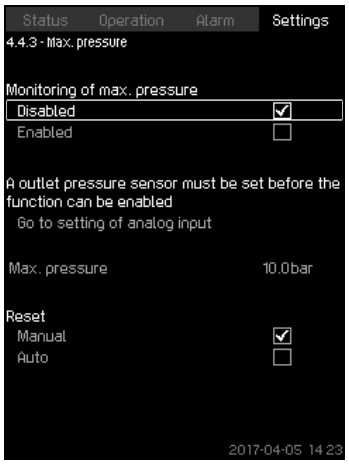



**Fig. 113** Max. pressure

#### Description

The outlet pressure will be monitored if the application is pressure boosting. In all other applications, the system pressure will be monitored. CU 352 will react if the pressure becomes higher than a set maximum level.

In certain installations, a too high outlet pressure may cause damage. It may therefore be necessary to stop all pumps for a short period if the pressure is too high.

You can set whether the system is to restart automatically after the pressure has dropped below the maximum level, or if the system must be reset manually. Restarting will be delayed by an adjustable time. See section *8.7.14 Min. time between start/stop (4.2.1)*.

#### Setting range

- Maximum pressure level within the range of the primary sensor.
- Manual or automatic restarting.

#### Setting via the operating panel

- Settings > Monitoring functions > Max. pressure > Enabled.

1. Set: Max. pressure.
2. Select resetting: Manual or Auto.

#### Factory setting

The function is disabled.

### 8.7.63 External fault (4.4.4)

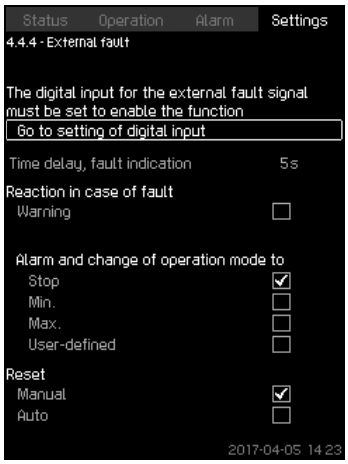



**Fig. 114** External fault

#### Description

The function is used when CU 352 is to be able to receive a fault signal from an external contact. In case of external fault, CU 352 indicates warning or alarm. In case of alarm, the system changes to another manual operating mode, for instance "Stop".

#### Setting range

- Selection of digital input for the function.
- Setting of time delay from closing of the contact until CU 352 reacts.
- Reaction in case of external fault: Warning or alarm and change of operating mode.
- Restarting after alarm: Manual or Auto.

#### Setting via the operating panel

- Settings > Monitoring functions > External fault > Go to setting of digital input. Display *8.7.28 Digital inputs (4.3.7)* appears.

1. Set the input to "External fault".
2. Press [Back].
3. Set: Time delay, fault indication.
4. If only a warning is required in case of external fault, select "Warning".If the system is to give alarm and change operating mode in case of external fault, select operating mode "Manual" or "Auto".

#### Factory setting

The function is disabled. If the function is enabled, the following values have been set from factory:

- Time delay: 5 seconds.
- Operating mode in case of alarm: Stop.
- Restarting: Manual.

### 8.7.64 Limit 1 exceeded (4.4.5 - 4.4.6)

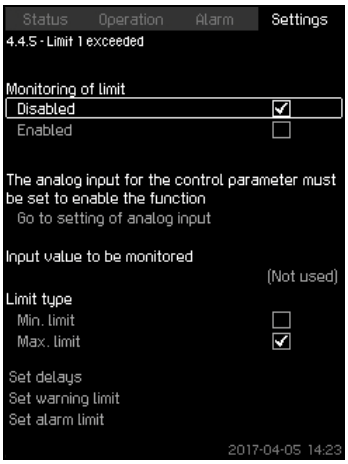



**Fig. 115** Limit 1 exceeded

#### Description

With the function, CU 352 can monitor set limits of analog values. It will react if the values exceed the limits. Each limit can be set as a maximum or minimum value. For each of the monitored values, a warning limit and an alarm limit must be defined.

The function allows you to monitor two different locations in a pump system at the same time, for instance the pressure at a consumer and the pump's outlet pressure. This ensures that the outlet pressure does not reach a critical value.

If the value exceeds the warning limit, a warning is given. If the value exceeds the alarm limit, the pumps will be stopped.

You can set a delay between the detection of an exceeded limit and the activation of a warning or an alarm. You can also set a delay for resetting a warning or an alarm.

A warning can be reset automatically or manually.

You can set whether the system is to restart automatically after an alarm, or if the alarm must be reset manually. Restarting can be delayed by an adjustable time. You can also set a startup delay ensuring that the system reaches a steady state before the function becomes active.

#### Setting range

- Selection of analog input for the function
- Input value to be monitored
- Limit type (Min. limit and Max. limit)
- Warning limit
- Alarm limit.

### Setting via the operating panel

Analog inputs must be correctly set before the function is enabled. See section *8.7.30 Analog inputs (4.3.8)*.

- Settings > Monitoring functions > Limit 1 exceeded / Limit 2 exceeded > Go to setting of analog input.

1. Select analog input.
2. Select: Input value to be monitored. Display 4.3.8.1.1 appears.
3. Select input.
4. Press [Back].
5. Set the minimum and maximum sensor value.
6. Press [Back] x 2.
7. Select: Input value to be monitored.
8. Select input.
9. Press [Back].
10. Select:

- Min. limit or Max. limit.
- Set delays.

11. Press [Back].
12. Select:

- Set warning limit
- Enabled.

13. Set limit.
14. Select resetting: Manual or Auto.
15. Press [Back].
16. Select:

- Set alarm limit
- Enabled.

17. Set limit.
18. Select resetting: Manual or Auto.
19. Press [Back].
20. Select: Enabled.

### Factory setting

The function is disabled.

## 8.7.65 Pumps outside duty range (4.4.7)

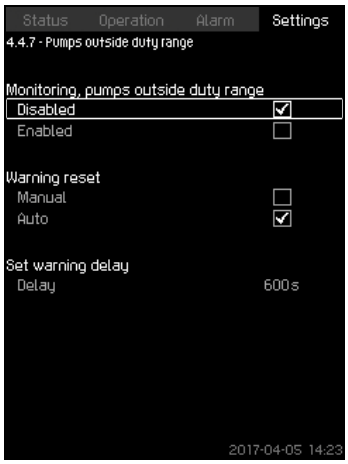



**Fig. 116** Pumps outside duty range

### Description

The function gives a warning if the duty point of the pumps moves outside the defined range. For instance, if the inlet pressure becomes lower than a minimum permissible value, thus causing a risk of cavitation for some pump types.

The warning is given with a set time delay. You can set whether the warning is to be reset automatically or manually when the duty point comes within the defined duty range. You can also set a relay output to be activated when the warning is given, and to be deactivated when the warning is reset.

This function requires that the outlet pressure and the inlet pressure (either measured or configured) or the differential pressure of the pumps is monitored, and that CU 352 contains valid pump data from either a GSC file or from manual input. See section *8.7.43 Pump curve data (4.3.19)*.

### Setting range

- Setting of manual or automatic resetting.
- Setting of warning delay.

### Setting via the operating panel

- Settings > Monitoring functions > Pumps outside duty range > Manual or Auto > Set warning delay.

### Factory setting

The function is disabled.

### 8.7.66 Pressure relief (4.4.8)

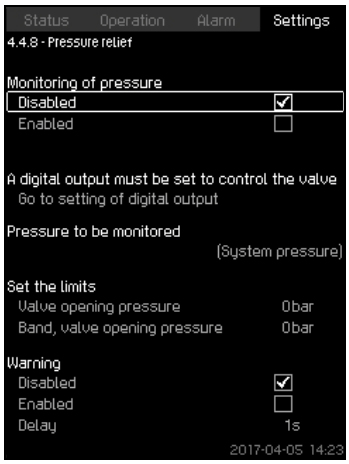



**Fig. 117** Pressure relief

**Description**

The purpose of the function is to reduce the pressure in the pipes by opening a solenoid valve if it exceeds a set limit. If the pressure is not reduced within a given time, the solenoid valve will be closed, and a warning can be given.

1: Solenoid valve opens.
2: Solenoid valve closes.
3: Solenoid valve opens.
4: Warning is activated.
5: Solenoid valve closes, and warning is reset.

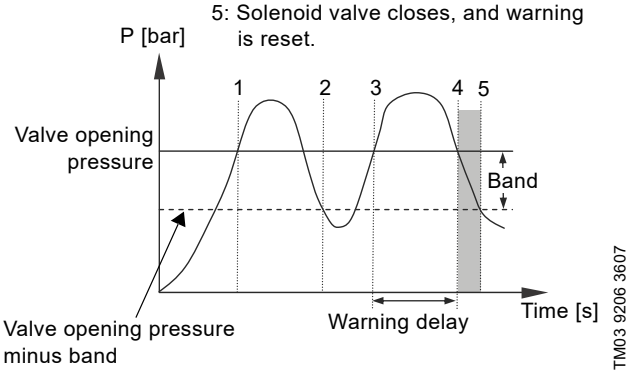



**Fig. 118** Pressure relief

**Setting range**

- Setting of digital output.
- Setting of pressure to be monitored.
- Setting of valve opening pressure.
- Setting of band for valve opening pressure.
- Setting of warning or alarm.

**Setting via the operating panel**

- Settings > Monitoring functions > Pressure relief > Go to setting of digital output.

1. Select digital output.
2. Select: Pressure relief valve.
3. Press [Back] x 2.
4. Select: Pressure to be monitored

- Select: Outlet pressure, System pressure or External pressure.

5. Press [Back].
6. Select and set:

- Valve opening pressure
- Band, valve opening pressure.

7. Select: Warning > Disabled or Enabled.
8. Set: Delay. (Only to be set if warning has been enabled).
9. Select: Enabled.

**Factory setting**

The function is disabled.

### 8.7.67 Log values (4.4.9)

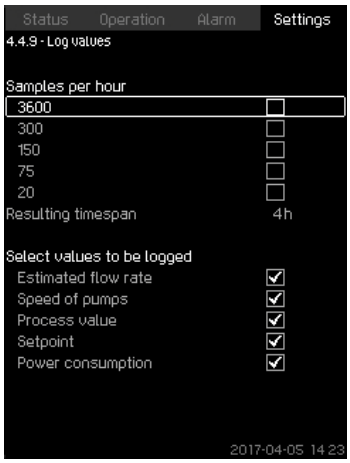



**Fig. 119** Log values

**Description**

Select the values to be logged and the number of samples per hour. The resulting timespan is shown. When the timespan has elapsed, old logged values will be deleted and overwritten by the new ones.

**Log values**

- Estimated flow rate (only if no flowmeter is installed)
- Speed of pumps
- Process value
- Setpoint
- Power consumption (MPC-E systems)
- Inlet pressure (if an inlet-pressure sensor is installed).

**Setting range**

Samples per hour: 1-3600.

**Setting via the operating panel**

- Settings > Monitoring functions > Log values.

1. Set: Samples per hour.
2. Select the values to be logged.

### 8.7.68 Fault, feedback sensor (4.4.10)

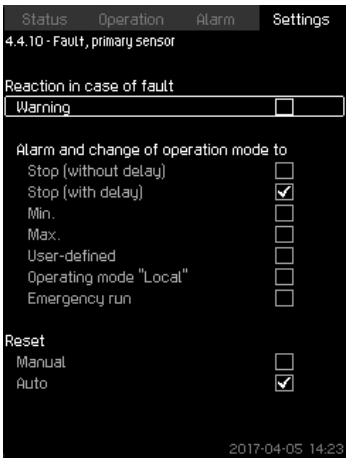



**Fig. 120** Fault, feedback sensor

**Description**

You can set how the system is to react if the primary sensor fails.

**Setting range**

- Stop (without delay)
- Stop (with delay)
- Min.
- Max.
- User-defined
- Operating mode "Local"
- Emergency run
- Reset: Manual or Auto.

**Setting via the operating panel**

- Settings > Monitoring functions > Fault, feedback sensor.

1. Select reaction in case of a fault in the primary sensor.
2. Select resetting: Manual or Auto.

### 8.7.69 Non-return valve (4.4.11)

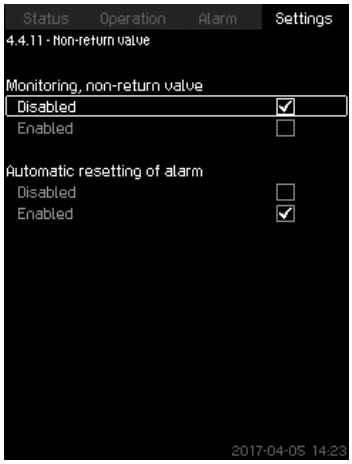



**Fig. 121** Non-return valve

**Description**

The function enables CU 352 to detect if a "Non-return valve" is leaking or faulty. A small leakage will after five accumulated incidents result in a warning. A faulty NRV will instantly result in an alarm and pump stop. In this case the motor is not able to overcome the backflow through the pump with the faulty NRV.

The function is only valid for a MPC-E system with MGE motors model G, H, I or J.

**Setting range**

- Monitoring, non-return valve: Enabled or Disabled.
- Automatic resetting of alarm: Enabled or Disabled.

**Setting via the operating panel**

- Settings > Monitoring functions > Non-return valve

1. Enable the function.
2. Select if "Automatic resetting of alarm" is to be "Disabled".

**Factory setting**

The function is "Enabled".

### 8.7.70 Controlled output 1-2(4.4.13-4.4.14)

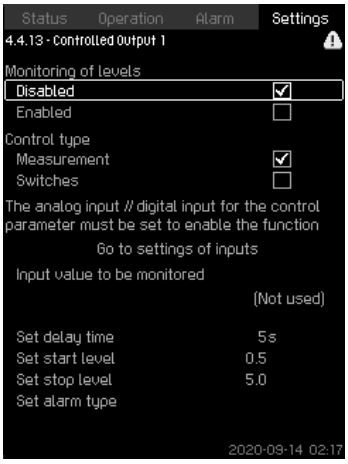



**Fig. 122**Controlled output 1-2

**Description**

With this function, CU 352 can monitor up to four different limits by a set of indicators (switches and/or analog values) and can activate a digital output. These four limits are Start, Stop, High and Low. The reaction of the digital output depends on the monitoring type, which can be Normal or Inverse. Inverse means that the function of the indicators (switches and/or analog values) works opposite to their function in Normal. For example, when Normal uses the "Tank filling" application, Inverse uses the "Tank emptying" application.

**Normal controlled output:**

1. Low: If the level drops below the Low limit, a warning occurs and activates the digital output "Controlled output, Low" and simultaneously activates the digital output "Controlled output", if it is not activated beforehand.
2. Start: If the level drops below the Start limit, the digital output "Controlled output" is activated.
3. Stop: If the level exceeds the Stop limit, the digital output "Controlled output" is deactivated.
4. High: If the level exceeds the High limit, a warning occurs and activates the digital output "Controlled output, High" and simultaneously deactivates the digital output "Controlled output", if it is not deactivated beforehand.


**Fig. 123**Controlled output

**Inverse controlled output:**

1. Low: If the level drops below the Low limit, a warning occurs and activates the digital output "Controlled output, Low" and simultaneously deactivates the digital output "Controlled output", if it is not deactivated beforehand.
2. Stop: If the level drops below the Stop limit, the digital output "Controlled output" is deactivated.
3. Start: If the level exceeds the Start limit, the digital output "Controlled output" is activated.
4. High: If the level exceeds the High limit, a warning occurs and activates the digital output "Controlled output" and simultaneously activates the digital output "Controlled output, High", if it is not activated beforehand.


**Fig. 124**Inverse controlled output

**Setting range**

1. Alarm type: select measurement or switches.
2. Set delay time: A delay can be set between the detection of an exceeded indicator and the activation of the digital output.
3. Set start level: set the start level for activating the output (hidden if Switches is selected).
4. Set stop level: set the stop level for deactivating the output (hidden if Switches is selected).
5. Set Alarm type: configure the alarm.

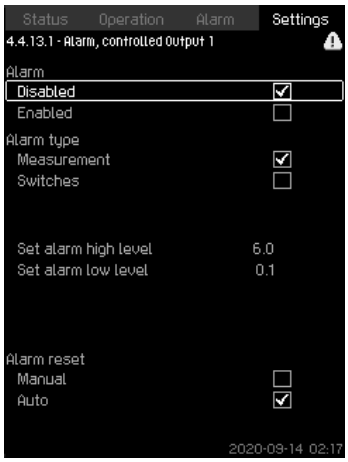



**Fig. 125**Alarm measurement

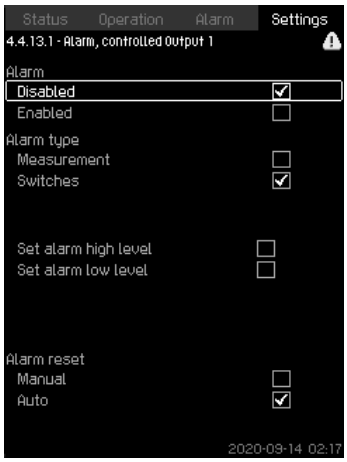



**Fig. 126**Alarm switches

**Setting via the operating panel**

- Settings > Monitoring functions > Controlled output 1/ Controlled output 2.

1. Select Alarm type.
2. Go to setting of analog / digital input.
3. Press [Back] x 2.
4. Select: Input value to be monitored.
5. Set delay time.
6. Set start level.
7. Set stop level.
8. Configure alarm type. Display 4.4.13.1-2 appears.

### 8.7.71 Functions, CU 352 (4.5)

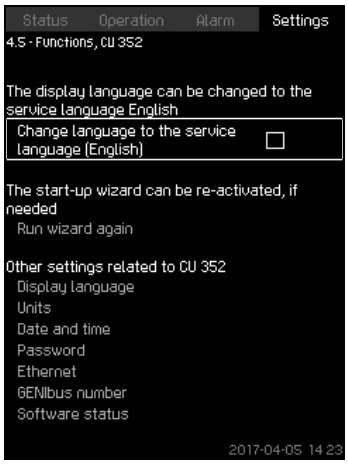



**Fig. 127**Functions, CU 352

**Description**

Make the basic settings of CU 352 in this submenu.

CU 352 comes with most of these settings, or they are made at startup and normally not to be changed.

The service language, British English, can be selected for service purposes. If no buttons are touched for 15 minutes, the display returns to the language selected at startup or to the language set in *Display language (4.5.1)*.

If the service language is selected, the wrench symbol is to the right in the top line of all displays.

**Setting range**

- Activation of service language, British English.
- Re-activation of startup wizard. (After startup, the wizard is inactive.)
- Selection of "Display language".
- Selection of display units.
- Setting of "Date and time".
- Selection of password for menu "Operation" and "Settings".
- Setting of "Ethernet" communication.
- Setting of "GENIbus number".
- Reading of "Software status".

### 8.7.72 Display language (4.5.1)


**Fig. 128**Display language

**Description**

Here you select the language for the CU 352 display.

**Setting range**

- English
- German
- Danish
- Spanish
- Finnish
- French
- Greek
- Italian
- Dutch
- Polish
- Portuguese
- Russian
- Swedish
- Chinese
- Korean
- Japanese
- Czech
- Turkish
- Hungarian
- Bulgarian
- Croatian
- Latvian
- Lithuanian
- Romania
- Slovak
- Slovenian
- Serbian Latin
- US English
- Indonesian
- Malay
- Estonian.

**Setting via the operating panel**

- Settings > Functions, CU 352 > Display language.

**Factory setting**

The display language is British English. It can be changed at startup.

### 8.7.73 Units (4.5.2)

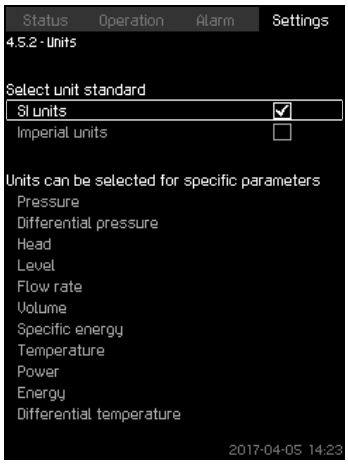



**Fig. 129**Units

**Description**

Here you can select units for the various parameters.

Select between SI and imperial units. You can also select other units for the individual parameters.

**Setting range**

| Parameter | Basic setting | | Possible units |
|---|---|---|---|
| | SI | Imperial | |
| Pressure | bar | psi | kPa, MPa, mbar, bar, m, psi |
| Differential pressure | m | psi | kPa, MPa, mbar, bar, m, psi |
| Head | m | ft | m, cm, ft, in |
| Level | m | ft | m, cm, ft, in |
| Flow rate | $m^3/h$ | gpm | $m^3/s$, $m^3/h$, l/s, gpm, $yd^3/s$, $yd^3/min$, $yd^3/h$ |
| Volume | $m^3$ | gal | l, $m^3$, gal, $yd^3$ |
| Specific energy | $kWh/m^3$ | Wh/gal | $kWh/m^3$, Wh/gal, Wh/kgal, BTU/gal, HPh/gal |
| Temperature | °C | °F | K, °C, °F |
| Differential temperature | K | K | K |
| Power | kW | HP | W, kW, MW, HP |
| Energy | kWh | kWh | kWh, MWh, BTU, HPh |

If units are changed from SI to imperial or vice versa, all individually set parameters will be changed to the basic setting in question.

**Setting via the operating panel**

- Settings > Functions, CU 352 > Units.

Set unit standard, measuring parameter and specific unit. See the example in fig. 130.

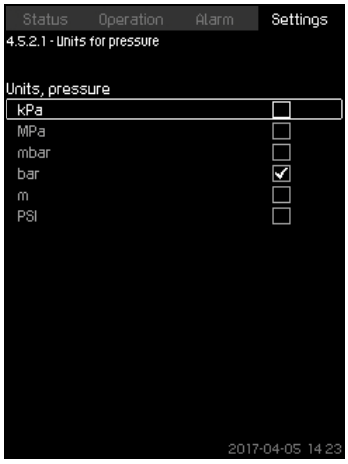



**Fig. 130**Example of selection of units

**Factory setting**

The setting is done in the startup wizard and depends on the application.

**8.7.74 Date and time (4.5.3)**

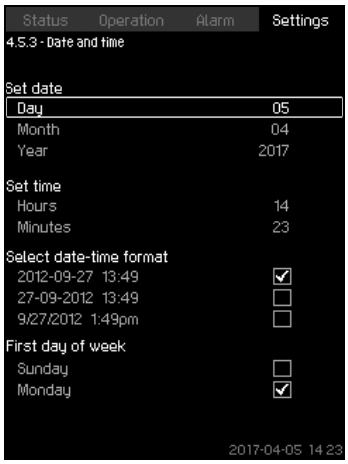



**Fig. 131**Date and time

**Description**

You can set date and time as well as how they are to be shown in the display.

The clock has a built-in rechargeable voltage supply which can supply the clock for up to 20 days if the voltage supply to the system is interrupted.

If the clock is without voltage for more than 20 days, it must be set again.

**Setting range**

The date can be set as day, month and year. The time can be set as a 24-hour clock showing hours and minutes.

There are three formats.

**Examples of format**

2012-09-27 13:49

27-09-2012 13:49

9/27/2012 1:49 pm

You can also select if Sunday or Monday is to be the first day of week.

**Setting via the operating panel**

- Settings > Functions, CU 352 > Date and time.

1. Select and set:

- Day, Month, Year, Hours, Minutes.

2. Select format.
3. Select "Sunday" or "Monday" under "First day of week".

**Factory setting**

Local time.

If the system has been without voltage for more than 20 days since it left the factory, the clock may have returned to the original setting: 01-01-2005 0:00.

Date and time may have been changed during the setting of system.

There is no automatic changeover to/from daylight-saving time.

### 8.7.75 Password (4.5.4)


**Fig. 132**Password

#### Description

You can limit the access to the menus "Operation" and "Settings" by means of a password. If the access is limited, it is not possible to view or set any parameters in the menus.

The password must consist of four digits and may be used for both menus.

If you have forgotten the password(s), contact Grundfos.

#### Setting via the operating panel

- Settings > Functions, CU 352 > Password.

1. Select the password to be enabled.
2. Select: Enter password. The first digit of the password is flashing.
3. Select digit. The second digit of the password is flashing.
4. Repeat these steps if it is necessary to enable the other password.

#### Factory setting

Both passwords are disabled. If a password is enabled, the factory setting will be "1234".

### 8.7.76 Ethernet (4.5.5)


**Fig. 133**Ethernet

#### Description

CU 352 is equipped with an Ethernet connection for communication with a computer, either directly or via the Internet. Ethernet is disabled by default, and a unique password needs to be set to enable Ethernet.

The "Ethernet security disclaimer" must be read and acknowledged before Ethernet can be enabled. See also section *8.8.1 Ethernet*.

#### Setting via the operating panel

- Settings > Functions, CU 352 > Ethernet.

1. Select "Ethernet security disclaimer". Display 4.4.5.1 appears.

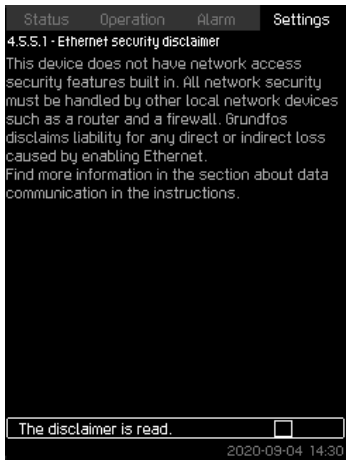



**Fig. 134**"Ethernet security disclaimer"

- Make sure the disclaimer is read.
- Set password:
  - minimum 8 characters
  - minimum 1 non-alphabetic character
  - minimum 1 upper case alphabetic character
  - minimum 1 lower case alphabetic character.
- Enable Ethernet.
- Configure IP settings.

### 8.7.77 GENIbus number (4.5.6)

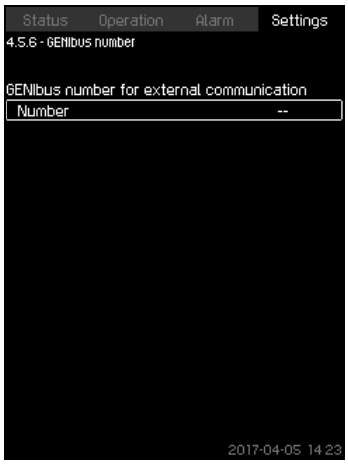



**Fig. 135**GENIbus number

**Description**

CU 352 can communicate with external units via an RS-485 interface (option). For further information, see fig. 139 and section *7. Click [Apply].*

Communication is carried out according to the Grundfos bus protocol, GENIbus, and enables connection to a building management system or another external control system.

Operating parameters, such as setpoint and operating mode, can be set via the bus signal. Furthermore, status about important parameters, such as actual value and input power, and fault indications can be read from CU 352.

Contact Grundfos for further information.

**Setting range**

The number can be set between 1 and 64.

**Setting via the operating panel**

- Settings > Functions, CU 352 > GENIbus number.

**Factory setting**

No number has been set.

### 8.7.78 Software status (4.5.9)

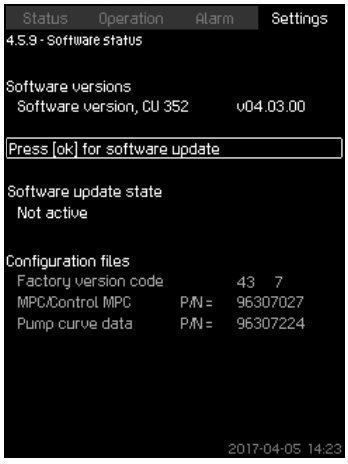



**Fig. 136**Software status

**Description**

The display shows the status of the software installed in CU 352. Furthermore, the version code and the product numbers of configuration files (GSC) read into the unit are shown. You can also upgrade the software version. Contact Grundfos for further information.

### 8.7.79 Status display menu (4.6)

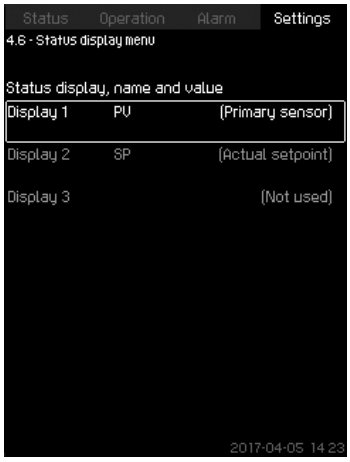



**Fig. 137**Status display menu

**Description**

In the main status menu, you can have up to three status values displayed.

In this menu, you can define each status value to be displayed and define a short name for the value.

PV = Process Value

SP = Setpoint

Q = Flow

**Setting range**

Name of each display value.

Function type for Display 1-3.

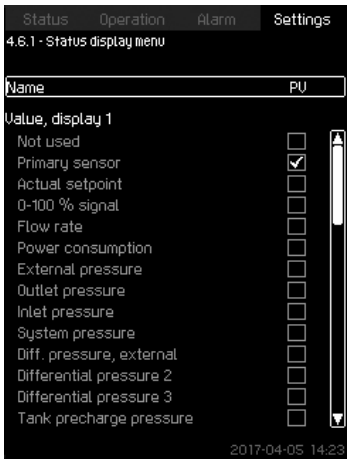



**Fig. 138**Status display menu (4.6.1)

**Setting in operating panel**

- Settings > Status display menu

1. Select display 1, 2 or 3, press [OK].
2. Define a name for display.
3. Select the value for the display 1, 2 or 3.

**Factory settings**

Display 1: PV, Primary sensor

Display 2: SP, Actual setpoint

## 8.8 Data communication

CU 352 is equipped with a hardware enabling communication with external units, such as a computer, via an external GENIbus or Ethernet connection.

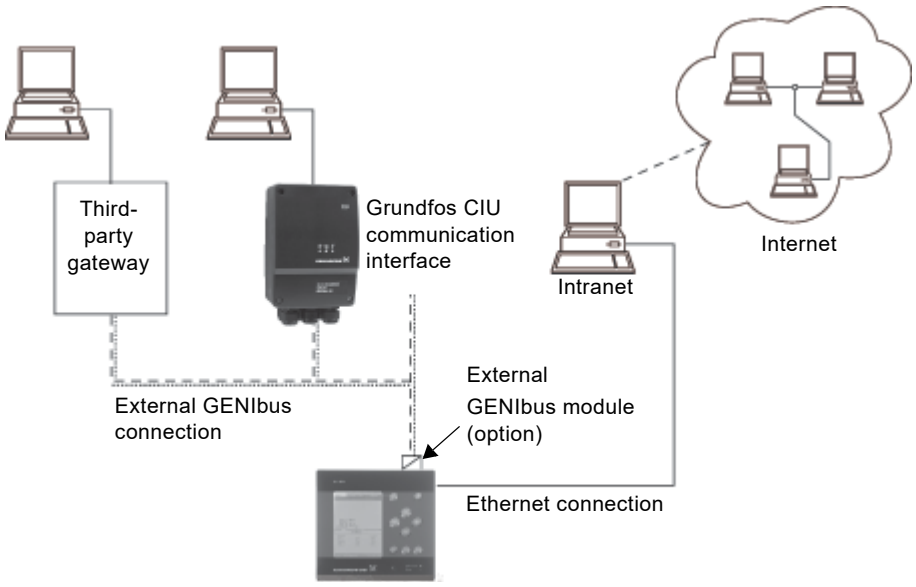



**Fig. 139**Data communication via external GENIbus and Ethernet connection

### 8.8.1 Ethernet

Ethernet is the most widely used standard for local networks (LAN). The standardisation of this technology has created some of the easiest and cheapest ways of creating communication between electric units, for instance between computers or between computers and control units.

The webserver of CU 352 makes it possible to connect a computer to CU 352 via an Ethernet connection. The user interface can thus be exported from CU 352 to a computer so that CU 352 and consequently the system can be monitored and controlled externally.

We recommend that you protect the connection to CU 352 according to your safety requirements in consultation with the system administrator.

In order to use the webserver, you must know the IP address of CU 352. All network units must have a unique IP address to communicate with each other. The IP address of CU 352 from factory is 192.168.0.102.

Alternatively to the factory-set IP address, it is possible to use a dynamic assignment of IP address. This is possible by activating a DHCP (Dynamic Host Configuration Protocol) in CU 352 or via the webserver. See the example in fig. 140.

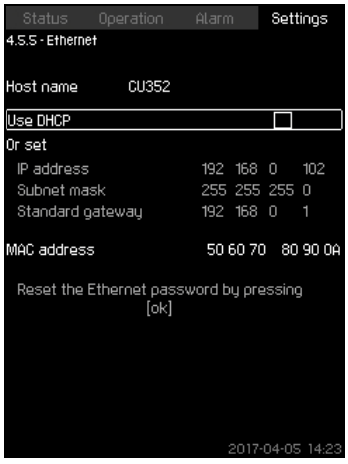



**Fig. 140**Example of setting of Ethernet

Dynamic assignment of an IP address for CU 352 requires a DHCP server in the network. The DHCP server assigns a number of IP addresses to the electric units and makes sure that two units do not receive the same IP address.

A standard internet browser is used for connection to the webserver of CU 352.

If you want to use the factory-set IP address, no changes are required in the display. Open the internet browser and enter the IP address of CU 352.

If you want to use dynamic assignment, you must enable the function by selecting "Use DHCP" and clicking [OK]. A check mark shows that the function has been enabled.

Open the internet browser and enter the host name of CU 352 instead of the IP address. The internet browser will now try to connect to CU 352. The host name can be read in the display, but can only be changed by either a GSC file (configuration file) or via a webserver. See section *Change of network setting* on page 73.

A host name is required to use DHCP.

This is the first display shown when connecting to CU 352.

TM03 2048 0517

**Fig. 141**Connection to CU 352

**Factory setting**

User name: admin

Password: admin

When you have entered the user name and password, an application starts up in CU 352, provided that a Java Applet has been installed on the computer. If this is not the case, but the computer is connected to the internet, then use the link on the screen to download and install the Java Applet.

The application on CU 352 exports the Java Applet to your browser and gives you access to user interfaces such as display and operating panel.

The Java Applet installation in the browser must be accepted by the user. You can now monitor and control CU 352 from a computer.

TM05 3236 0517

**Fig. 142**Network setting

**Change of network setting**

When connection to the webserver of CU 352 has been established, you can change the network setting.

TM03 2050 3505

**Fig. 143**Change of network setting

1. Click [>Network admin].
2. Enter the changes.
3. Click [Submit] to enable the changes.

**Administrator configuration**

TM03 2051 0517

**Fig. 144**Change of user name and password

1. Click [>Admin config].
2. Enter new user name if applicable.
3. Click [Apply].
4. Enter existing password.
5. Enter new password.
6. Repeat new password.
7. Click [Apply].

### 8.8.2 GENIbus

By installing a GENIbus module in CU 352, you can connect the system to an external network. The connection can take place via a GENIbus-based network or a network based on another fieldbus protocol via a gateway. See examples in fig. 139. For further information, contact Grundfos.

The gateway may be a Grundfos CIU communication interface or a third-party gateway. For further information on CIU, see Grundfos Product Center, or contact Grundfos.

## 9. Servicing the product

### 9.1 Maintaining the product

**WARNING**

**Electric shock**

Death or serious personal injury

- Switch off the power supply before you start any work on the product.
- Lock the main switch with a padlock to ensure that the power supply cannot be accidentally switched on.

### 9.2 CU 352

CU 352 is maintenance-free. Keep the unit clean and dry, and protect it against direct sunlight. For ambient temperature, see section *12. Technical data*.

## 10. Fault finding

**WARNING**

**Electric shock**

Death or serious personal injury

- Switch off the power supply for at least five minutes before you start any work on the product.
- Make sure that the power supply cannot be accidentally switched on.

| Fault | Possible cause | Remedy |
|---|---|---|
| The system has stopped and cannot restart. | The primary sensor is defective. | Replace the sensor.<br>Transmitters with 0-20 mA or 4-20 mA output signals are monitored by the system. |
| | The cable is broken or short-circuited. | Repair or replace the cable. |
| | The power supply is disconnected. | Connect the power supply. |
| | CU 352 is defective. | Contact Grundfos. |
| | The power supply is disconnected. | Connect the power supply. |
| | The main switch is switched off. | Switch on the main switch. |
| | The main switch is defective. | Replace the main switch. |
| | The motor protection is activated. | Contact Grundfos. |

## 11. Taking the product out of operation

Switch off the main switch to take the system out of operation.

**WARNING**

**Electric shock**

Death or serious personal injury

- Do not touch the conductors in front of the main switch as they are still energised.
- Lock the main switch with a padlock to ensure that the power supply cannot be accidentally switched on.

## 12. Technical data

### 12.1 Temperature

Ambient temperature: 0-40 °C.

### 12.2 Relative humidity

Maximum 95 %.

### 12.3 Electrical data

**Supply voltage**

See the nameplate of the system.

**Backup fuse**

See the wiring diagram supplied with the system.

**Digital inputs**

Open-circuit voltage: 24 VDC

Closed-circuit current: 5 mA, DC

Frequency range: 0-4 Hz

All digital inputs are supplied with PELV voltage (Protective Extra-Low Voltage).

**Analog inputs**

| | |
|---|---|
| Input current and voltage: | 0-20 mA<br>4-20 mA<br>0-10 V |
| Tolerance: | ± 3.3 % of full scale |
| Repetitive accuracy: | ± 1 % of full scale |
| Input resistance, current: | < 250 Ω |
| Input resistance, voltage, CU 352: | 50 kΩ ± 10 % |
| Input resistance, voltage, IO 351: | > 50 kΩ ± 10 % |
| Supply to sensor: | 24 V, maximum 50 mA, short-circuit protected |

All analog inputs are supplied with PELV voltage (Protective Extra-Low Voltage).

**Digital outputs (relay outputs)**

Maximum contact load: 240 VAC, 2 A

Minimum contact load: 5 VDC, 10 mA

All digital outputs are potential-free relay contacts.

Some outputs have a common C terminal. For further information, see the wiring diagram supplied with the system.

**Inputs for PTC sensor/thermal switch**

For PTC sensors to DIN 44082. Thermal switches can also be connected.

Open-circuit voltage: 12 VDC ± 15 %

Closed-circuit current: 2.6 mA, DC

Inputs for PTC sensors are electrically separated from the other inputs and outputs of the system.

### 12.4 Measuring parameters

#### 12.4.1 Transmitter types

The transmitter types in the table below can be used for the measurement of values in the system.

| Abbreviation | Transmitter |
|---|---|
| DPT | Differential-pressure transmitter |
| DTT | Differential-temperature transmitter |
| FT | Flow transmitter |
| LT | Level transmitter |
| PT | Pressure transmitter |
| TT | Temperature transmitter |

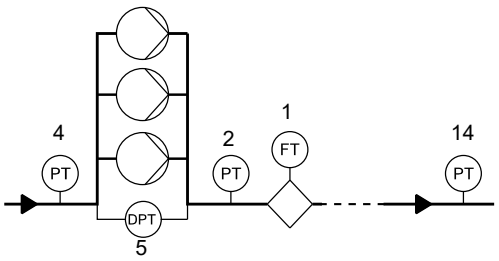
#### 12.4.2 Parameter list

The table below shows which measured values CU 352 can receive via its analog inputs. Figures 145 to 148 show where the values can be measured.

| Number | Parameter |
|---|---|
| 1 | Flow rate |
| 2 | Outlet pressure |
| 3 | Differential pressure, external |
| 4 | Inlet pressure |
| 5 | Differential pressure, pump |
| 6 | Differential pressure, inlet |
| 7 | Differential pressure, outlet |
| 8 | Tank level, outlet side |
| 9 | Tank level, inlet side |
| 10 | Return-pipe temperature, external |
| 11 | Flow-pipe temperature |
| 12 | Return-pipe temperature |
| 13 | Differential temperature |
| 14 | External pressure |
| 15 | Series 2000, differential pressure |
| 16 | Series 2000, flow rate |
| 17 | System pressure |
| Not shown | Ambient temperature* |
| Not shown | 0-100 % signal** |

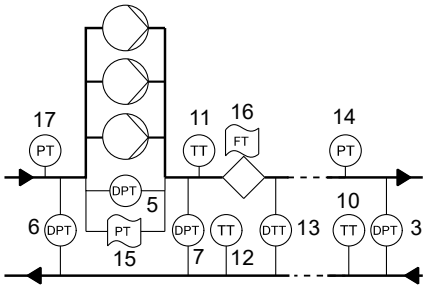
* The ambient temperature is typically the temperature in the room where Control MPC is located.

** A 0-100 % signal from an external controller. It can for instance be a 0-10 V signal.



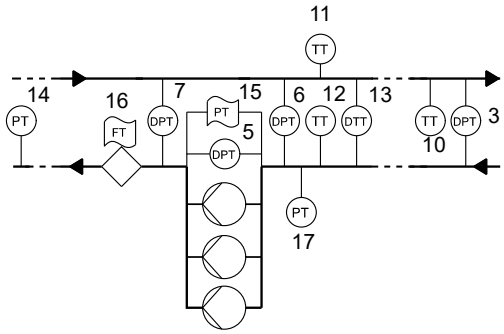

TM03 8823 3507

**Fig. 145**Pressure boosting



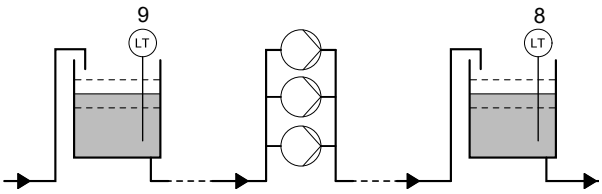

TM03 9964 4707

**Fig. 146**Heating and cooling, pumps in flow pipe




TM03 9965 4707

**Fig. 147**Heating and cooling, pumps in return pipe




TM03 8824 2607

**Fig. 148**Level monitoring

## 13. Related documents

Further information about Control MPC and pumps that can be controlled by Control MPC is available in Grundfos Product Center on Grundfos' homepage, www.grundfos.com.

## 14. Disposing of the product

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

The crossed-out wheelie bin symbol on a product means that it must be disposed of separately from household waste. When a product marked with this symbol reaches its end of life, take it to a collection point designated by the local waste disposal authorities. The separate collection and recycling of such products will help protect the environment and human health.

**YETKİLİ GRUNDFOS SERVİSLERİ**

| Firma | Adres | Telefon<br>Cep telefonu<br>Faks | İlgili Kişi<br>Eposta |
|---|---|---|---|
| GRUNDFOS POMPA KOCAELİ | GEBZE ORGANİZE SANAYİ BÖLGESİ. İHSAN DEDE CADDESİ.2.YOL 200.SOKAK.NO:204 GEBZE KOCAELİ | 0262 679 79 79<br>0553 259 51 63<br>0262 679 79 05 | EMRAH ŞİMŞEK<br>esimsek@grundfos.com |
| SUNPO ELEKTRİK ADANA | YEŞİLOBA MAH. 46003 SOK. ARSLANDAMI İŞ MERK. C BLOK NO:6/2-I SEYHAN ADANA | 0322 428 50 14<br>0533 461 71 14<br>0322 428 48 49 | LEVENT BAKIRKOL<br>sunpo-elektrik@hotmail.com |
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| KOÇYİĞİTLER ELEKTRİK BOBİNAJ ANTALYA | ORTA MAH. SERİK CAD. NO.116 SERİK ANTALYA | 0242 722 48 46<br>0532 523 29 34<br>0242 722 48 46 | BİLAL KOÇYİĞİT<br>kocyigitler@kocyigitlerbobinaj.com |
| TEKNİK BOBİNAJ BURSA | ALAADDİN BEY MH.624.SK MESE 5 İŞ MERKEZİ NO:26 D:10 NİLÜFER/BURSA | 0224 443 78 83<br>0507 311 19 08<br>0224 443 78 95 | GÜLDEN MÜÇEOĞLU<br>gulden@tbobinaj.com.tr |
| ASİN TEKNOLOJİ GAZİANTEP | MÜCAHİTLER MAHALLESİ 54 NOLU SOKAK.GÜNEYDOĞU İŞ MERKEZİ NO:10/A ŞEHİTKAMİL | 0342 321 69 66<br>0532 698 69 66<br>0342 321 69 61 | MEHMET DUMAN<br>mduman@asinteknoloji.com.tr |
| ARI MOTOR İSTANBUL | ORHANLI MESCİT MH.DEMOKRASİ CD.BİRMES SAN.SİT.A-3 BLOK NO:9 TUZLA İSTANBUL | 0216 394 21 67<br>0532 501 47 69<br>0216 394 23 39 | EMİN ARI<br>aycan@arimotor.com.tr |
| SERİ MEKANİK İSTANBUL | SEYİTNİZAM MAH. DEMİRCİLER SİT. 7.YOL . NO:6 ZEYTİNBURNU İSTANBUL | 0212 679 57 23<br>0532 740 18 02<br>0212 415 61 98 | TAMER ERÜNSAL<br>servis@serimekanik.com |
| DAMLA POMPA İZMİR | 1203/4 SOKAK NO:2/E YENİŞEHİR İZMİR | 0232 449 02 48<br>0532 277 96 44<br>0232 459 43 05 | NEVZAT KIYAK<br>nkiyak@damlapompa.com |
| ÇAĞRI ELEKTRİK KAYSERİ | ESKİ SANAYİ BÖLGESİ 3.CADDE NO;3-B KOCASİNAN-KAYSERİ | 0352 320 19 64<br>0532 326 23 25<br>0352 330 37 36 | ADEM ÇAKICI<br>kayseri.cagrielektrik@gmail.com |
| MAKSOM OTOMASYON SAMSUN | 19 MAYIS MAHALLESİ.642.SOKAK.NO:23 TEKKEKÖY SAMSUN | 0362 256 23 56<br>0532 646 61 42<br>- | MUSTAFA SARI<br>info@maksom.com |
| DETAY MÜHENDİSLİK TEKİRDAĞ | ZAFER MAHALLESİ ŞEHİT YÜZBAŞI YÜCEL KENTER CADDESİ 06/A BLOK NO:5-6 ÇORLU TEKİRDAĞ | 0282 673 51 33<br>0549 668 68 68<br>0282 673 51 35 | EROL KARTOĞLU<br>erol@detay-muhendislik.com |
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