## Contents

### Introduction to E-pumps
- Introduction
- Overview of functions
- Speed control of E-pumps
- E-pump applications

### Multistage E-pumps
- Introduction
- CRE, CRIE, CRNE pumps
- MTRE, SPKE, CRKE pumps
- CHIE pumps
- Overview of functions
- Control modes
- Setting by means of the control panel
- Setting by means of R100
- External forced-control signals
- Indicator lights and signal relay
- Further product documentation

### Single-stage E-pumps
- Introduction
- TPE, TPED Series 1000
- NKE and NBE pumps
- Overview of functions
- Control modes
- Setting by means of the control panel
- Setting by means of R100
- External forced-control signals
- Indicator lights and signal relay
- Further product documentation

### TPE, TPED Series 2000
- Introduction
- TPE, TPED Series 2000 pumps
- Overview of functions
- Control modes
- Setting by means of the control panel
- Setting by means of R100
- External forced-control signals
- Indicator lights and signal relay
- Further product documentation

### Single-phase MGE motors
- E-pumps with single-phase MGE motors

### Three-phase MGE motors
- E-pumps with three-phase MGE motors

### Three-phase MMGE motors
- E-pumps with three-phase MMGE motors

### EMC and proper installation
- EMC and proper installation

### Control of E-pumps connected in parallel
- Control of E-pumps connected in parallel

### Bus communication with E-pumps
- Bus communication with E-pumps

### Frequency-controlled operation
- Frequency converter, function and design

### Accessories
- Remote control, R100
- Potentiometer
- G10-LON
- G100
- EMC-filters for MMGE motors
- LiqTec
- Sensors
- Differential pressure sensor, HUBA Control, type 692
- Temperature sensor, TTA
- Differential temperature sensor, HONSBERG
- EMC-filter
- G10-LON
- G100
- LiqTec

### Further product documentation
- Sources of product documentation
- WinCAPS
- WebCAPS
Introduction

This data booklet deals with Grundfos pumps equipped with Grundfos MGE or MMGE motors. These motors are standard asynchronous motors with integrated frequency converter and controller - and in some cases the pumps are equipped with a factory mounted sensor. These pumps are referred to as E-pumps.

![Grundfos E-pumps](image1)

An E-pump is not just a pump, but a system which is able to solve application problems or save energy in a variety of pump installations. E-pumps are ideal as they can be installed instead of a non-controlled standard pump at no extra cost. All that is required is the mains connection and the fitting of the E-pump in the pipe system, and the pump is ready for operation.

The pump has been tested and pre-configured at the factory. The operator only has to specify the desired setpoint (pressure) and the system is operational.

In new installations, the E-pumps provide a number of advantages. The frequency converters integrated in the pumps have a built-in motor protection function which protects both motor and electronics against overload. This means that E-pump installations do not require motor protection, but only a normal short-circuit protection for the cable.

![Components of a Grundfos E-pump](image2)

Advantages of speed control

Adaptation of performance through frequency controlled speed control offers some obvious advantages:

**Energy conservation**
An E-pump uses only the energy required for a given pumping job. Compared to other control methods, frequency controlled speed control is the method offering the highest efficiency and thus the most efficient utilization of the energy. Depending on the application and pump type savings of up to 50% or more are realistic.

**Low operating costs**
The efficient utilization of the energy offers the customer an attractive reduction of his operating costs. This is seen in the form of lower daily energy costs, but also in the form of lower wear on pumps and system components which again reduces the need for replacements.

**Protection of the environment**
The efficient utilization of energy offers some environmental advantages in the form of less pollution. Pumps using less energy demand less power from the power stations.

**Increased comfort**
For the customer, controlled operation of the pumping system means increased comfort due to the automatic control and a lower noise level from pumps and pipework etc.
Grundfos E-pumps range

Grundfos E-pumps are available in three different functional groups:

1. Multistage CRE, CRIE, CRNE pumps with pressure sensor.
   Multistage CRE, CRIE, CRNE, MTRE, SPKE, CRKE, CHIE pumps without sensor.
2. Single-stage TPE, TPED Series 1000, NKE, NBE pumps without sensor.

As standard TPE, TPED Series 2000 pumps are supplied with differential pressure sensor enabling control of the differential pressure across the pump.

CRE, CRIE, CRNE is available with pressure sensor enabling control of the pressure after the pump.

The purpose of supplying the E-pumps with differential pressure sensor or pressure sensor is to make the installation and commissioning simple and quick. All other E-pumps are supplied without sensor.

E-pumps without sensor are used when uncontrolled operation (open loop) is required or when there is a wish to fit a sensor at a later stage in order to enable control on the basis of flow, temperature, differential temperature, pressure or differential pressure at some arbitrary point in the system.

Functions

The functions of the E-pumps depend on pump type and whether the pump is supplied with or without sensor.

The difference in functions is seen in the setting possibilities offered via the remote controller R100. As covered later, the menu structure of R100 will depend on the E-pump type in question.

The table on the right shows which functions are available for the different E-pump types. CRE, CRIE, CRNE with sensor and all the multistage pumps without sensor have the same menu structure in R100. All single-stage pumps without sensor, such as NBE, NKE and TPE, TPED Series 1000 have a separate menu structure. Finally, TPE, TPED Series 2000 have their own menu structure. The result is three totally different menu structures for the complete E-pumps range.
## Overview of functions

<table>
<thead>
<tr>
<th>Setting via control panel:</th>
<th>Setpoint</th>
<th>Start/stop</th>
<th>Max. Curve</th>
<th>Min. Curve</th>
<th>Alarm reset</th>
<th>Constant/proportional pressure</th>
<th>Operating mode: MIN, MAX, STOP</th>
<th>Flow in %</th>
<th>External control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting via R100:</td>
<td>Setpoint</td>
<td>Start/stop</td>
<td>Max. Curve</td>
<td>Min. Curve</td>
<td>Alarm reset</td>
<td>Constant/proportional pressure, constant curve</td>
<td>Controller constants Kp, Ti</td>
<td>External setpoint signal</td>
<td>Signal relay function</td>
</tr>
<tr>
<td>Reading via control panel:</td>
<td>Setpoint</td>
<td>Start/stop</td>
<td>Max. Curve</td>
<td>Min. Curve</td>
<td>Alarm reset</td>
<td>Controlled / Uncontrolled</td>
<td>External control</td>
<td>Stop function</td>
<td>Sensor range and signal</td>
</tr>
<tr>
<td>Reading via R100:</td>
<td>Setpoint</td>
<td>Start/stop</td>
<td>Max. Curve</td>
<td>Min. Curve</td>
<td>Alarm reset</td>
<td>Controlled / Uncontrolled</td>
<td>External control</td>
<td>Stop function</td>
<td>Sensor range and signal</td>
</tr>
</tbody>
</table>

### E-pump type

<table>
<thead>
<tr>
<th>CRE, CRE, CRNE, CRNE</th>
<th>CRE, CRE, SPRE, CRNE, CRNE, MTRE, CRNE, NRET, CHIE</th>
<th>TPE, TPED Series 1000, NBE, NRE, NKE without sensor</th>
<th>TPE, TPED Series 2000 with single-phase MGE</th>
<th>TPE, TPED Series 2000 with three-phase MMGE up to 7.5 kW</th>
<th>TPE, TPED Series 2000 with three-phase MMGE up to 11-22 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting via control panel:</td>
<td>Setpoint</td>
<td>Start/stop</td>
<td>Max. Curve</td>
<td>Min. Curve</td>
<td>Alarm reset</td>
</tr>
<tr>
<td>Setting via R100:</td>
<td>Setpoint</td>
<td>Start/stop</td>
<td>Max. Curve</td>
<td>Min. Curve</td>
<td>Alarm reset</td>
</tr>
<tr>
<td>Reading via control panel:</td>
<td>Setpoint</td>
<td>Start/stop</td>
<td>Max. Curve</td>
<td>Min. Curve</td>
<td>Alarm reset</td>
</tr>
<tr>
<td>Reading via R100:</td>
<td>Setpoint</td>
<td>Start/stop</td>
<td>Max. Curve</td>
<td>Min. Curve</td>
<td>Alarm reset</td>
</tr>
</tbody>
</table>

### Settings

- **Setpoint**
- **Start/stop**
- **Max. Curve**
- **Min. Curve**
- **Alarm reset**
- **Constant/proportional pressure**
- **Operating mode: MIN, MAX, STOP**
- **Flow in %**
- **External control**
Introduction to E-pumps

Fields of application

E-pumps can be used with advantage in many applications falling into one or more of the following three groups:

1. E-pumps will generally be very beneficial in all pump applications where there is a varying demand for pump performance. Using E-pumps will result in energy saving and/or improved comfort or process quality, depending on the application.

2. In some applications E-pumps will reduce the need for control valves or other pressure losing and costly components. In many cases E-pumps can reduce the total system investment.

3. E-pumps can also be a very good choice in applications where communication between the different units in the system, such as pumps, valves etc. - and an overall controller/computer system is required.
### Introduction to E-pumps

The table below shows the most common E-pump applications and which E-pump types can be used for which applications.

The use of E-pumps in a number of applications is described on page 11.

<table>
<thead>
<tr>
<th>Systems</th>
<th>Applications</th>
<th>E-pump type</th>
<th>CRE, CRIE, CRNE, SPKE, CRIE, CRNE, MTRE, CHIE without sensor</th>
<th>CRE, CRIE, CRNE with sensor</th>
<th>TPE, TPED Series 1000 without sensor</th>
<th>NBE, NKE without sensor</th>
<th>TPE, TPED Series 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating system</td>
<td>Main circulator pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Floor heating</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Mixing loops</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Boiler shunt</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Pressure holding system</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Exhaust gas exchanger</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Flow filter</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Domestic hot water production</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Domestic hot water recirculation</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Heat surface</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Heat recovery</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>District heating system</td>
<td>Circulator pump in substation</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Temperature shunt</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Lull heating</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Booster pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Boiler feeding</td>
<td>Feed pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Air conditioning</td>
<td>Primary circulator pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Secondary circulator pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Zone circulator pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Pressure holding system</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Dry cooler circulator pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Wet cooling tower pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Wet cooling tower internal circulator</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Heat recovery pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Pressure boosting</td>
<td>Boost up from break tank</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Boost down from roof tank</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Boost direct from mains</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Pumping out system (water works)</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Booster pump in mains</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Water treatment</td>
<td>Inlet booster pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Treated water supply pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Reverse osmosis booster pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Swimming pools</td>
<td>Circulator pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Filter pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Fontanels</td>
<td>Dry pit pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Commercial/industrial cooling</td>
<td>Brine primary circulator pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Brine secondary circulator pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Brine zone circulator pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Cooling surface pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Pressure holding system</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Dry cooler circulator pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Wet cooling tower pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Wet cooling tower internal circulator</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>Heat recovery pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Cleaning and washdown</td>
<td>Pressure boosting</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>CIP system</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Machine tooling</td>
<td>Coolant pump</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Temperature control units</td>
<td>Cooling of tooling or injection mould machines</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

1) UPE Series 2000 pumps can also be used if P1 < 2 kW and t (liquid) > 15 °C
2) Hydro 2000 ME systems are preferred.
Speed control of E-pumps

Adjustment of pump performance is a must in many applications today. No doubt the best performance adjustment is achieved by means of a frequency converter as this gives the following advantages:

- large energy savings
- enhanced comfort
- longer life for systems as well as for individual components
- no appreciable loss of efficiency
- reduced water hammer
- fewer starts/stops.

A Grundfos E-pump is a good choice when performance adjustment is required.

This chapter describes what happens to the performance and energy consumption of an E-pump when its speed is controlled by means of a frequency converter. The description includes:

- presentation of affinity equations
- presentation of the performance curves of speed controlled pumps
- presentation of the system characteristics of closed as well as open systems.

Affinity equations

The following affinity equations apply with close approximation to the change of speed of centrifugal pumps:

\[
\frac{Q_n}{Q_x} = \frac{n_n}{n_x}
\]

\[
\frac{H_n}{H_x} = \left(\frac{n_n}{n_x}\right)^2
\]

\[
\frac{P_n}{P_x} = \left(\frac{n_n}{n_x}\right)^3
\]

H = head in m,
Q = flow rate in m³/h
P = input power in kW
n = speed.

\(H_x, Q_x, \) and \(P_x\) are the appropriate variables for the speed \(n_x\). The approximated formulas apply on condition that the system characteristic remains unchanged for \(n_n\) and \(n_x\) and that it is based on the formula

\[H = k \times Q^2\]

(k = a constant), i.e. a parabola through 0.0 as appears from

The power equation furthermore implies that the pump efficiency is unchanged at the two speeds. In practice this is not quite correct. Finally, it is worth noting that the efficiencies of the frequency converter and the motor must also be taken into account if a precise calculation of the power saving resulting from a reduction of the pump speed is wanted.

From the formulas it appears that the pump flow \((Q)\) is proportional to the pump speed \((n)\). The head \((H)\) is proportional to the square of the speed \((n)\) whereas the power \((P)\) is proportional to the third power of the speed.

In practice, a reduction of the speed will result in a slight fall in efficiency. But this does not change the fact that there are often big power savings involved in controlling pump speed.

The formula for the calculation of the efficiency \((\eta)\) is:

\[\eta_x = 1 - (1 - \eta_n) \times \left(\frac{n_n}{n_x}\right)^{0.1}\]

When used the formula gives good approximation for speeds down to 40% of max. speed.
Performance curves of speed controlled pumps

Performance curves

The curve chart below shows a CRE 15-3. The top part of the chart shows the QH performance curves at different speeds. Curves for speeds between 100% and 50% are included at 10% intervals. Finally, a minimum curve at 25% is shown.

The bottom part of the chart shows P1 (input power from the mains). NPSH for the pump at maximum speed is shown in the same diagram.

Efficiency

The total efficiency of the E-pump \( \eta_{\text{total}} \) is calculated by multiplying the efficiency of the MGE with the pump efficiency.

\[
P_1 = \text{Input power, MGE motor}
\]

\[
P_2 = \text{Input power, pump}
\]

\[
P_H = \text{Hydraulic power}
\]

\[
\eta_{\text{MGE}}
\]

\[
\eta_{\text{pump}}
\]

\[
\eta_{\text{TOT}}
\]

Fig. 8 Efficiency of an E-pump

Fig. 9 shows the efficiency of the MGE and the pump part and finally the resulting efficiency of a CRE 15-3 with a 3 kW MGE motor. The curves are drawn as a function of flow Q and for three different speed values: 100%, 80% and 60%.

Assuming the situation shown in Fig. 9, with a duty point at 100% speed equal to \( Q = 17.4 \text{ m}^3/\text{h} \) and \( H = 32 \text{ m} \), the change in efficiency at 80 and 60% speed is shown in the following table:

<table>
<thead>
<tr>
<th>Speed</th>
<th>Q [m³/h]</th>
<th>H [m]</th>
<th>( P_1 ) [kW]</th>
<th>( P_2 ) [kW]</th>
<th>( P_H ) [kW]</th>
<th>( \eta_P ) [%]</th>
<th>( \eta_{\text{MGE}} ) [%]</th>
<th>( \eta_{\text{TOT}} ) [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>17.4</td>
<td>32</td>
<td>2.65</td>
<td>1.51</td>
<td>2.13</td>
<td>71.1</td>
<td>80.4</td>
<td>57.2</td>
</tr>
<tr>
<td>80%</td>
<td>14</td>
<td>21.1</td>
<td>1.47</td>
<td>1.14</td>
<td>1.34</td>
<td>70.5</td>
<td>77.6</td>
<td>54.7</td>
</tr>
<tr>
<td>60%</td>
<td>10.5</td>
<td>12</td>
<td>0.66</td>
<td>0.49</td>
<td>0.34</td>
<td>70.4</td>
<td>73.8</td>
<td>51.9</td>
</tr>
</tbody>
</table>

The pump efficiency \( \eta_{\text{MGE}} \) is reduced from 71.1% to 70.4%, meaning less than one % point drop in efficiency.

Due to the big drop in speed and shaft load the efficiency of the MGE is reduced in the range of 7% points resulting in an overall reduction of E-pump efficiency equal to 5.3% points.

Efficiency is important, but what counts is the power consumption as it directly influences the energy costs.

From table above appears that the power consumption \( P_1 \) drops from 2.65 kW down to 0.66 kW which is a 75% reduction. Assuming unchanged overall efficiency \( \eta_{\text{TOT}} \), the drop in \( P_1 \) would have been from 2.65 kW down to 0.6 kW resulting in an 77% reduction.

The conclusion is that the speed reduction is the most important factor with regard to energy saving, and that the drop in efficiency will only have minor influence on the possible savings achieved through speed control.
Introduction to E-pumps

**System characteristics**

The characteristic of a system indicates the head required of a pump to circulate a given quantity of water through the system. In the following, distinction is made between closed and open systems.

**Closed systems (circulation systems)**

In a closed system the liquid is flowing round in a closed circuit such as a radiator system. On condition that the system is fully vented and closed the pump in a closed system does not have to overcome any static pressure.

Head = friction loss in the entire closed system. In a closed system the system characteristic will be a parabola through the Q/H-point 0.0. The curve shows that the friction loss in the system increases squarely with the circulated quantity of water.

\[ H = k \times Q^2 \]

The variable "k" is a constant. The higher "k" is, the steeper the parabola will be, and vice versa, the lower "k" is, the flatter the parabola will be. "k" is determined by valve position and friction loss.

Fig. 10 shows system characteristics in a closed system (circulation system).

**Open systems (booster systems)**

In many pumping jobs in open systems there is a static head \( H_0 \) to overcome. This is the case in Fig. 11 where the pump is to pump from an open vessel up to a tank. \( H_0 \) is the level difference between the vessel the pump is pumping from and the tank into which the pump is to deliver the water.

Head = level difference + friction loss in the system.

The system characteristic will normally start in a point on the H-axis corresponding to the level difference. When this point has been reached, the characteristic will follow the line of a quadratic parabola

\[ H = H_0 + k \times Q^2 \]

where "k" represents the resistance in the system (pipes, fittings, valves etc.).

**Duty point**

The duty point in a pumping system is always the point of intersection between the system characteristic and the performance curve of the pump.

Fig. 12 shows the performance curve and the system characteristic of a closed and an open system, respectively.
Introduction to E-pumps

E-pump applications
As discussed earlier speed control of pumps is an efficient way of adjusting pump performance to the system.
In this section we will discuss the possibilities of combining speed-controlled pumps with PI-controllers and sensors measuring system parameters, such as pressure, differential pressure and temperature. On the following pages, the different options will be presented through examples.

Constant pressure control
A pump has to supply tap water from a break tank to different taps in a building.
The demand for tap water varies, and so does the system characteristic according to the required flow. To achieve comfort and energy savings, a constant supply pressure is recommended.

As appears from Fig. 13, the solution is a speed controlled pump with a PI-controller. The PI-controller compares the required pressure \( p_{\text{set}} \), with the actual supply pressure \( p_1 \), measured by a pressure transmitter PT.

If the actual pressure is higher than the setpoint, the PI-controller reduces the speed and consequently the performance of the pump, until \( p_1 = p_{\text{set}} \). Fig. 13 shows what happens, when the flow is reduced from \( Q_{\text{max}} \) to \( Q_1 \).

The controller reduces the speed of the pump from \( n_n \) to \( n_x \), in order to ensure that the required discharge pressure is \( p_2 = p_{\text{set}} \). The pump ensures that the supply pressure is constant in the flow range of \( 0 \cdot Q_{\text{max}} \). The supply pressure is independent of the level \( (h) \) in the break tank. If \( h \) changes, the PI controller adjusts the speed of the pump so that \( p_1 \) always corresponds to the setpoint.

Constant temperature control
Performance adjustment by means of speed control is suitable for a number of industrial applications. Fig. 14 shows a system with an injection moulding machine which has to be water cooled to ensure high quality production.

The pump will be operating at a fixed system characteristic. The controller will ensure that the actual flow \( Q_1 \) is sufficient to ensure that \( t_r = t_{\text{set}} \). The machine is cooled with water at 15°C from a cooling plant. To ensure that the moulding machine runs properly and is cooled sufficiently, the return pipe temperature has to be kept at a constant level; \( t_r = 20°C \). The solution is a speed-controlled pump, controlled by a PI-controller. The PI-controller compares the required temperature \( t_{\text{set}} \) with the actual return pipe temperature \( t_r \), which is measured by a temperature transmitter TT. This system has a fixed system characteristic and therefore the duty point of the pump is located on the curve between \( Q_{\text{min}} \) and \( Q_{\text{max}} \). The higher the heat loss in the machine, the higher the flow of cooling water needed to ensure that the return pipe temperature is kept at a constant level of 20°C.
Introduction to E-pumps

Constant differential pressure in a circulation system
Circulation systems (closed systems) are well-suited for speed-controlled pump solutions.

It is an advantage that circulation systems with variable system characteristic are fitted with a differential pressure controlled circulator pump, see Fig. 15.

Flow-compensated differential pressure control
The main function of the pumping system in Fig. 16 is to maintain a constant differential pressure across the control valves at the radiators. In order to do so, the pump must be able to overcome friction losses in pipes, heat exchangers, fittings, etc.

Fig. 15 shows a heating system consisting of a heat exchanger where the circulated water is heated up and delivered to three radiators by a speed-controlled pump. A control valve is connected in series at each radiator to control the flow according to the heat requirement.

The pump is controlled according to a constant differential pressure measured across the pump. This means that the pump system offers constant differential pressure in the Q-range of 0 - Q_{max} represented by the horizontal line in Fig. 15.

The circulator pump is controlled in a way that ensures that the pump head is increased in case of increased flow.

As mentioned earlier, the pressure loss in a system is proportional to the square of the flow. The best way to control a circulator pump in a system like the one shown in Fig. 16, is to allow the pump to deliver a pressure which increases when the flow increases.

When the flow demand is low, the pressure losses in the pipes, heat exchangers, fittings, etc. are low as well, and the pump only supplies a pressure equivalent to what the control valve requires, H_{set}+H_{f}. When the flow demand increases, the pressure losses increase in second power and therefore the pump has to increase the delivered pressure as shown in Fig. 16.
Introduction to E-pumps

Such a pumping system can be designed in two different ways:

- The differential pressure transmitter - DPT1 in Fig. 16 - is placed across the pump, and the system is running with flow-compensated differential pressure control.
- The differential pressure transmitter - DPT2 in Fig. 16 - is placed close to the radiators, and the system is running with differential pressure control.

The advantage of the first solution, which is equal to a TPE Series 2000 pump solution, is that the pump, the PI-controller, the speed control and the transmitter are placed close to one another, making the installation easy.

This solution makes it possible to get the entire system as one single unit: a TPE Series 2000 pump. In order to get the system up and running, pump curve data must be stored in the controller. These data are used to calculate the flow and likewise to calculate how much the setpoint $H_{set}$ has to be reduced at a given flow to ensure that the pump performance meets the requirements.

The second solution involves higher installation costs as the transmitter has to be fitted near the radiators and extra cabling is required. The performance of this system is more or less similar to the first system. The transmitter measures the differential pressure at the radiator and compensates automatically for the increase in required pressure in order to overcome the increase in pressure losses in the supply pipes, etc.
Multistage E-pumps

Introduction

Grundfos multistage E-pumps are fitted with a frequency-controlled standard Grundfos MGE or MMGE motor and built-in PI-controller for single-phase or three-phase mains connection.

Grundfos multistage E-pumps include the following pump types:

- CRE, CRIE, CRNE pumps with integrated pressure sensor
- CRE, CRIE, CRNE pumps without sensor
- MTRE pumps
- SPKE pumps
- CRKE pumps
- CHIE pumps

CRE, CRIE, CRNE pumps

CRE, CRIE, CRNE pumps come in two versions:

- CRE, CRIE, CRNE pumps with integrated pressure sensor
- CRE, CRIE, CRNE pumps without sensor.

All CRE, CRIE, CRNE pumps are vertical multistage centrifugal pumps. Due to the in-line design the pump can be installed in a horizontal one-pipe system where the suction and discharge ports are in the same horizontal plane and have the same pipe dimensions. This design provides a more compact pump design and pipework.

The pumps are available in various sizes and with various numbers of stages to provide the flow and the pressure required.

CRE, CRIE, CRNE pumps consist of two main components: The motor and the pump unit.

- The motor of CRE, CRIE, CRNE pumps is a standard Grundfos MGE or MMGE motor with built-in frequency converter designed to EN standards.
- The pump unit has optimised hydraulics as well as various types of connection, an outer sleeve, a top and various other parts.

CRE, CRIE, CRNE pumps without sensor can be connected to an external sensor enabling control of for instance pressure, differential pressure, temperature, differential temperature or flow.

Applications of CRE, CRIE, CRNE

CRE, CRIE, CRNE pumps are used in a wide variety of pumping systems where the performance and materials of the pump are required to meet specific demands.

Below is a list of four general fields of application:

Industry

- Pressure boosting in process water systems
- Washing and cleaning systems
- Cooling and air-conditioning systems (refrigerants)
- Boiler feed and condensate systems
- Machine tools
- Aquafarming
- Transfer of oils, alcohols, acids, alkalis, glycol and coolants.

Water supply

- Filtration and transfer at waterworks
- Distribution from waterworks
- Pressure boosting in mains
- Pressure boosting for industrial water supply.

Water treatment

- Ultra-filtration systems
- Reverse osmosis systems
- Softening, ionising, demineralizing systems
- Distillation systems
- Separators.

Irrigation

- Field irrigation (flooding)
- Sprinkler irrigation
- Drip-feed irrigation.

Fig. 17 CRE, CRIE and CRNE pumps
Multistage E-pumps

MTRE, SPKE, CRKE pumps

MTRE, SPKE and CRKE pumps are vertical multistage centrifugal pumps designed to be mounted on top of tanks with the chamber stack immersed in the pumped liquid.

The pumps are available in various sizes and with various numbers of stages to provide the flow and the pressure required.

The pumps consist of two main components: The motor and the pump unit.

- The motor is a standard Grundfos MGE or MMGE motor with built-in frequency converter designed to EN standards. For further information on MGE and MMGE motors, see page 57-65.
- The pump unit has optimised hydraulics as well as various types of connection, chambers, a top and various other parts.

MTRE, SPKE and CRKE pumps can be connected to an external sensor enabling control of for instance pressure, differential pressure, temperature, differential temperature or flow.

Applications of MTRE, SPKE, CRKE

The pumps are used in a wide variety of pumping systems where the performance and materials of the pump are required to meet specific demands.

Below is a list representing some general examples of applications:

- Spark machine tools
- Grinding machines
- Machining centres
- Cooling units
- Industrial washing machines
- Filtering systems.

CHIE pumps

CHIE pumps are horizontal, multistage centrifugal pumps with an axial suction port and a radial discharge port. All pumps have a through-going motor/pump shaft.

The pumps are available in various sizes and with various numbers of stages to provide the flow and the pressure required.

The pumps consist of two main components: The motor and the pump unit.

- The motor is a standard single-phase Grundfos MGE motor with built-in frequency converter designed to EN standards. For further information on single-phase MGE motors, see page 57-59.
- The pump unit has optimised hydraulics as well as union connections and various other parts.

CHIE pumps can be connected to an external sensor enabling control of for instance pressure, differential pressure, temperature, differential temperature or flow.

Applications of CHIE

The pumps are used in a wide variety of pumping systems where the performance of the pump is required to meet specific demands.

Below is a list representing some general examples of applications:

- Pressure boosting
- Water supply
- Water treatment
- Industrial washing and cleaning
- Heating and cooling in industrial processes
- Fertilizer systems
- Dosing systems.
### Overview of functions

<table>
<thead>
<tr>
<th>Function</th>
<th>E-pump type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CRE, CRIE, CRNE with sensor</td>
</tr>
<tr>
<td></td>
<td>CRE, CRIE, CRNE, SPKE, CRKE, MTRE, CHIE without sensor</td>
</tr>
<tr>
<td>Setting via control panel:</td>
<td></td>
</tr>
<tr>
<td>Setpoint</td>
<td>✗</td>
</tr>
<tr>
<td>Start/stop</td>
<td>✗</td>
</tr>
<tr>
<td>Max. Curve</td>
<td>✗</td>
</tr>
<tr>
<td>Min. Curve</td>
<td>✗</td>
</tr>
<tr>
<td>Alarm reset</td>
<td>✗</td>
</tr>
<tr>
<td>Constant/proportional pressure</td>
<td></td>
</tr>
<tr>
<td>Reading via control panel:</td>
<td></td>
</tr>
<tr>
<td>Setpoint</td>
<td>✗</td>
</tr>
<tr>
<td>Operating indication</td>
<td>✗</td>
</tr>
<tr>
<td>Fault indication</td>
<td>✗</td>
</tr>
<tr>
<td>Setting via R100:</td>
<td></td>
</tr>
<tr>
<td>Setpoint</td>
<td>✗</td>
</tr>
<tr>
<td>Start/stop</td>
<td>✗</td>
</tr>
<tr>
<td>Max. curve</td>
<td>✗</td>
</tr>
<tr>
<td>Min. curve</td>
<td>✗</td>
</tr>
<tr>
<td>Alarm reset</td>
<td>✗</td>
</tr>
<tr>
<td>Controlled / Uncontrolled</td>
<td>✗</td>
</tr>
<tr>
<td>Constant/proportional pressure, constant curve</td>
<td></td>
</tr>
<tr>
<td>Controller constants Up, Ti</td>
<td>✗</td>
</tr>
<tr>
<td>External setpoint signal</td>
<td>✗</td>
</tr>
<tr>
<td>Signal relay function</td>
<td>✗</td>
</tr>
<tr>
<td>Pump number (for Bus communication)</td>
<td>✗</td>
</tr>
<tr>
<td>Stop function</td>
<td>✗</td>
</tr>
<tr>
<td>Sensor range and signal</td>
<td>✗</td>
</tr>
<tr>
<td>Duty / Standby</td>
<td>✗</td>
</tr>
<tr>
<td>Operating range (min./max. speed)</td>
<td>✗</td>
</tr>
<tr>
<td>Reading via R100:</td>
<td></td>
</tr>
<tr>
<td>Setpoint</td>
<td>✗</td>
</tr>
<tr>
<td>Operating mode</td>
<td>✗</td>
</tr>
<tr>
<td>Actual sensor value</td>
<td>✗</td>
</tr>
<tr>
<td>Pump speed</td>
<td>✗</td>
</tr>
<tr>
<td>Actual power consumption</td>
<td>✗</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>✗</td>
</tr>
<tr>
<td>Running hours</td>
<td>✗</td>
</tr>
<tr>
<td>Setting via GENIbus:</td>
<td></td>
</tr>
<tr>
<td>Setpoint</td>
<td>✗</td>
</tr>
<tr>
<td>Start/stop</td>
<td>✗</td>
</tr>
<tr>
<td>Max. Curve</td>
<td>✗</td>
</tr>
<tr>
<td>Min. Curve</td>
<td>✗</td>
</tr>
<tr>
<td>Controlled / Uncontrolled</td>
<td>✗</td>
</tr>
<tr>
<td>Constant/proportional pressure, constant curve</td>
<td></td>
</tr>
<tr>
<td>Reading via GENIbus:</td>
<td></td>
</tr>
<tr>
<td>Setpoint</td>
<td>✗</td>
</tr>
<tr>
<td>Operating indication</td>
<td>✗</td>
</tr>
<tr>
<td>Pump status</td>
<td>✗</td>
</tr>
<tr>
<td>Additional functions:</td>
<td></td>
</tr>
<tr>
<td>Parallel operation</td>
<td>✗</td>
</tr>
<tr>
<td>Clock operation</td>
<td>✗</td>
</tr>
<tr>
<td>Settings via external signal:</td>
<td></td>
</tr>
<tr>
<td>Setpoint</td>
<td>✗</td>
</tr>
<tr>
<td>Start/stop</td>
<td>✗</td>
</tr>
<tr>
<td>Min./max. curve via digital input</td>
<td>✗</td>
</tr>
<tr>
<td>Min./max. curve, external fault, Flow switch via digital input</td>
<td></td>
</tr>
<tr>
<td>Readings via external signal:</td>
<td></td>
</tr>
<tr>
<td>Fault signal (relay)</td>
<td>✗</td>
</tr>
<tr>
<td>Fault, Operation or Ready signal (relay)</td>
<td>✗</td>
</tr>
</tbody>
</table>

Additional functions

1) Sensor fitted
2) Only three-phase pumps up to 7.5 kW.
Multistage E-pumps

Control modes

CRE, CRIE, CRNE pumps with integrated pressure sensor
CRE, CRIE and CRNE pumps with integrated pressure sensor are suitable for applications where you want to control the pressure after the pump, irrespective of the flow.

Signals of pressure changes in the piping system are transmitted continuously from the pressure sensor to the frequency converter connected to the motor. The pump responds to the signals by adjusting its performance up or down to compensate for the pressure difference between the actual and the desired (preset) pressure. As this adjustment is a continuous process, a constant pressure is maintained in the piping system.

CRE, CRIE and CRNE pumps with integrated pressure sensor can be set to:
• controlled (constant pressure) mode (factory setting)
  or
• uncontrolled (constant curve) mode.

In controlled mode the pump maintains a preset pressure after the pump, irrespective of the flow, see Fig. 20.

Besides normal duty (constant-pressure and constant-curve) the operating modes Stop, Min. or Max. are available.

In uncontrolled mode the pump can be set to pump according to a preset pump characteristic within the range from min. curve to max. curve, see Fig. 21.

Max. curve mode can be used in connection with the venting procedure during installation.

Min. curve mode can be used in periods in which a minimum flow is required.

If the supply voltage to the pump is disconnected, the settings will be stored.

CRE, CRIE, CRNE pumps with integrated pressure sensor are set to constant-pressure mode from factory. The setpoint value corresponds to 50% of the sensor measuring range.

E-pumps without sensor
E-pumps without sensor are suitable for applications where
• uncontrolled operation is required or
• you want to fit another sensor later in order to control the flow, temperature, differential temperature, liquid level, pH-value, etc. at some arbitrary point in the system.

These pumps can be set to two control modes, i.e. controlled or uncontrolled operation.

In controlled mode the pump will adjust its performance to the desired setpoint for the control parameter (pressure, differential pressure, temperature, differential temperature or flow), see Fig. 23.
Multistage E-pumps

In uncontrolled mode the pump will operate according to the constant curve set, see Fig. 24.

E-pumps without sensor have been factory-set to uncontrolled mode. The setpoint value corresponds to 100% of the maximum pump performance.

In addition to normal operation (controlled- or uncontrolled mode), the following operating modes can be selected: Stop, Min. or Max.

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

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

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

Setting by means of the control panel

The pump control panel incorporates the following:

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

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

Example: Pump in controlled mode (pressure control).

Fig. 26 shows that the light fields 5 and 6 are on, indicating a desired setpoint of 3 bar with a sensor measuring range from 0 to 6 bar. The setting is equal to the sensor measuring range.

Example: Pump in uncontrolled mode.

In uncontrolled mode the pump performance is set within the range from min. to max. curve.

Setting of max. curve duty

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

To change back, press " " continuously until the desired setpoint is indicated.
**Multistage E-pumps**

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

To change back, press "continent" continuously until the desired setpoint is indicated.

![Figure 29: Min. curve duty](image)

**Start/stop of pump**
Stop the pump by continuously pressing "continent" until none of the light fields are on and the green indicator light flashes.

Start the pump by continuously pressing "continent" until the desired setpoint is indicated.
Setting by means of R100

The communication via the Grundfos remote control R100 is effected by means of infra-red light. The pump transmitter and receiver unit is placed in the control panel.

Compared with the functionalities of the control panel on the pump, R100 offers additional possibilities of pump settings and status readings. The displays are divided into four parallel menus:

0. GENERAL
1. OPERATION
2. STATUS
3. INSTALLATION

This display applies only to three-phase CRE pumps up to 7.5 kW.
Multistage E-pumps

Displays in general
In the explanation of the function of the displays one or two display pictures are shown.

One display picture
Pumps with or without factory mounted sensors have the same function.

Two display pictures
Pumps with or without factory mounted sensors have different functions and factory settings.

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

Setpoint setting
With pressure sensor

Setpoint setting for E-pumps with pressure sensor
In controlled mode the setting range is equal to the sensor measuring range (in the example 0 to 6 bar).
In uncontrolled mode the setpoint is set in % of the maximum curve. The curve can be set within the range from min. curve to max. curve.

Setpoint setting for E-pumps without sensor
In uncontrolled mode the setpoint is set in % of the maximum performance. The setting range will lie between the min. and the max. curves.
In controlled mode the setting range is equal to the sensor measuring range.

Setpoint set
- Setpoint set
- Actual setpoint
- Actual value

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

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

Setting of operating mode
One of the following operating modes can be selected:
- Stop
- Minimum
- Normal (duty)
- Maximum.
The operating modes can be selected without changing the setpoint setting.

Fault indications
If the pump is faulty, the cause will appear in this display.
Possible cause:
- Too high motor temperature
- Undervoltage
- Overvoltage
- Too many restarts (after faults)
- Overload
- Sensor signal outside signal range
- Setpoint signal outside signal range
- External fault
- Duty standby communication error
- Other fault.
A fault indication can be reset in this display if the cause of the fault has disappeared.
Menu STATUS

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

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

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

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

Display of actual setpoint

- With pressure sensor
  - Actual setpoint: 3.0 bar
  - External setpoint: 100 %
  - Tolerance: ± 2%

- Without sensor
  - Actual setpoint: 100 %
  - External setpoint: 100 %
  - Tolerance: ± 2%

This display shows the actual setpoint and the external setpoint in % of the range from minimum value to the setpoint set.

Display of operating mode

This display shows the actual operating mode (Stop, Min., Normal (duty) or Max.). Furthermore, it shows where this operating mode was selected (R100, Pump, BUS, External or Stop func.). For further information about stop function, see Setting of stop function on page 25.

Display of actual value

- With pressure sensor
  - Actual value: 3.0 bar

- Without sensor
  - Actual value: -

The actually measured value of a connected sensor will appear in this display.

If no sensor is connected to the pump, “-” will appear in the display.

Display of actual speed

- Speed: 1200 min⁻¹

Tolerance: ± 5%

The actual pump speed will appear in this display.

Display of input power and power consumption

- Power input: 800 W
- Power consumption: 311 kWh

Tolerance: ± 10%

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

The pump power consumption can also be read from this display.

The value of power consumption is an accumulated value calculated from the pump’s birth and it cannot be reset.

Display of operating hours

- Operating hours: 211 h

Tolerance: ± 2%

The value of operating hours is an accumulated value and cannot be reset.
Multistage E-pumps

Menu INSTALLATION

Selection of control mode

With pressure sensor

- Controlled mode (constant pressure)
- Uncontrolled mode (constant curve).

The desired performance is set in Setpoint setting on page 21.

Without sensor

- Controlled mode
- Uncontrolled mode.

The desired performance is set in Setpoint setting on page 21.

Setting of controller

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

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

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

Setting of PI-controller

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

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

- if the pump is controlled on the basis of temperature or differential temperature.

The table below shows the recommended controller settings:

<table>
<thead>
<tr>
<th>System/application</th>
<th>Heating systems</th>
<th>Cooling systems</th>
<th>$T_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>L &lt; 5 m: 0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L &gt; 5 m: 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L &gt; 10 m: 5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

** Cooling systems are systems in which an increase in pump performance will result in a drop in temperature at the sensor.
Multistage E-pumps

Selection of external setpoint signal

The input for external setpoint signal can be set to different signal types.
Select one of the following types:
- 0 - 10 [V]
- 0 - 20 [mA]
- 4 - 20 [mA]
- Not active.
If "Not active" is selected, the setpoint set by means of R100 or on the control panel will apply.
The setpoint set is the maximum value of the external setpoint signal. The actual value of the external setpoint can be read from Display of actual setpoint on page 22.

Allocation of pump number

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

Selection of fault, operating or ready signal relay

Selection of fault, operating or ready signal relay can be selected according to the situation in which the relay should be activated:
- Fault (fault indication)
- Operation (operation indication)
- Ready (ready indication).

Locking the buttons on the pump

The buttons " Active" and " Not active" on the pump can be set to:
- Active
- Not active.

Selection of function for digital input

The digital input of the pump can be set to different functions.
Select one of the following functions:
- Min. (min. curve)
- Max. (max. curve)
- Ext. fault (external fault)
- Flow switch.

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

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

Ext. fault
When the input is activated, a timer is started. If the input is activated for more than 5 seconds, the pump is stopped and a fault is indicated. If the connection is disconnected for more than 5 seconds, the fault condition will cease and the pump can be restarted manually by resetting the fault indication.
The typical application will be detection of missing inlet pressure or water shortage by means of a pressure switch installed on the suction side of a pump.

Flow switch
When this function is active, the pump will be stopped when a connected flow switch detects a low flow.
It is only possible to use this function if the pump is connected to a pressure sensor.
When the input is activated for more than 5 seconds, the stop function incorporated in the pump will take over, see Selection of external setpoint signal on page 24.
Multistage E-pumps

Setting of stop function

When the stop function is active, the pump will be stopped at very low flows to avoid unnecessary power consumption. It is only possible to use this function if the pump is connected to a pressure sensor.

The stop function can be set to:
- **Active**,
- **Not active**.

There are two possibilities of low-flow detection:

1. By means of the built-in "low-flow detector" which automatically starts functioning if no flow switch is chosen/connected to the digital input. The pump will check the flow regularly by reducing the speed for a short time, thus checking the change in pressure. If there is no or a small change in pressure, the pump will detect a low flow.

2. By means of a flow switch connected to the digital input. When the input is activated for more than 5 seconds, the stop function of the pump takes over. Unlike the built-in low-flow detector, the flow switch measures the minimum flow at which the pump must stop. The pump will not check the flow regularly by reducing the speed.

When the pump detects a low flow, the speed will be increased until the stop pressure (actual setpoint + 0.5 x ∆H) is reached and the pump stops. When the pressure has fallen to the start pressure (actual setpoint – 0.5 x ∆H), the pump will restart.

∆H is factory-set to 10% of the actual setpoint.

∆H can be set within the range from 5% to 30% of actual setpoint.

**Note**: The non-return valve must be fitted immediately before the pump. If the non-return valve is fitted between pump and diaphragm tank, the pressure sensor must be fitted after the non-return valve.

---

Fig. 31  Difference between start and stop pressures

* ∆H is factory-set to 10% of the actual setpoint.
* ∆H can be set within the range from 5% to 30% of actual setpoint.

**Note**: The non-return valve must be fitted immediately before the pump. If the non-return valve is fitted between pump and diaphragm tank, the pressure sensor must be fitted after the non-return valve.

---

TM00 774 1896

TM00 774 1896

TM00 774 1896
Multistage E-pumps

Duty/standby

Note: This display applies only to three-phase CRE pumps up to 7.5 kW.

The “Duty/standby” function can be set to:
- Active
- Not active.

The “Duty/standby” function enables two CRE pumps in parallel to operate in duty/standby. This means that
- only one pump is operating at a time
- if a fault occurs in the operating pump, the idle pump (in standby) automatically starts up and a fault indication appears in the pump which was in duty
- the two pumps run alternately for 24 operating hours
- as the two pumps never operate at the same time both pump type, pump size and operation mode may differ.

The duty/standby function can be activated in the following way:
1. Connect one of the pumps to the voltage supply. Using R100, set the installation and operation menu on the pump.
   The display “Duty/standby” must be set to “Not active”.
2. In the display “Operating mode” set the pump to “Stop”.
3. Connect the idle pump to the voltage supply.
   Using R100, set the installation and operation menu of the other pump.
   The display “Duty/standby” must be set to “Active” and the operating mode to either: Min., Normal or Max.
4. The pump set to “Active” automatically searches for and sets the other pump’s duty/standby function to “Active”. If the active pump does not find the other pump, a fault indication appears.

Setting of min. and max. curves

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

External forced-control signals

The pump has inputs for external signals for the forced-control functions:
- Start/stop of pump.
- Digital function.

Start/stop input

Functional diagram: Start/stop input:

<table>
<thead>
<tr>
<th>Functional diagram: Start/stop input:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal duty</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Stop</td>
</tr>
</tbody>
</table>

Fig. 33 Min. and max. curve

- Set the min. and max. curves in % of maximum performance if the operating range must be reduced.
Digital input
By means of R100, one of the following functions can be selected for the digital input:

- Normal duty
- Min. curve
- Max. curve
- External fault
- Flow switch.

Functional diagram: Input for digital function:

<table>
<thead>
<tr>
<th>Digital function</th>
<th>Normal duty</th>
<th>Min. curve</th>
<th>Max. curve</th>
<th>External fault</th>
<th>Flow switch</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Diagram" /></td>
<td><img src="image5.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

External setpoint signal
Connecting an analogue signal to the input for the setpoint signal enables remote setting of the setpoint.

The actual external signal (0-5 V, 0-10 V, 0-20 mA, 4-20 mA) must be selected via R100.

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

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

**Example:** At a pressure-sensor value of 0 bar, a setpoint set of 5 bar and an external setpoint of 80%, the actual setpoint will be as follows:

\[
H_{\text{actual}} = (H_{\text{set}} - H_{\text{lower}}) \times \%_{\text{external setpoint}} + H_{\text{lower}}
\]

\[
H_{\text{actual}} = (5 - 0) \times 80\% + 0
\]

\[
H_{\text{actual}} = 4\text{bar}
\]

In uncontrolled mode the setpoint can be set externally within the range from the min. curve to the setpoint on the pump or by means of R100.

Actual setpoint

**Bus signal**

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

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

For information about Bus communication with multistage E-pumps, see page 72.

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

**Priority of settings**

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

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

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

The priority of the functions is shown in the following tables.

**Without bus signal**

<table>
<thead>
<tr>
<th>Priority</th>
<th>Possible settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stop</td>
</tr>
<tr>
<td>2</td>
<td>Max. curve</td>
</tr>
<tr>
<td>3</td>
<td>Stop</td>
</tr>
<tr>
<td>4</td>
<td>Max. curve</td>
</tr>
<tr>
<td>5</td>
<td>Min. curve</td>
</tr>
<tr>
<td>6</td>
<td>Setpoint setting</td>
</tr>
</tbody>
</table>

**With bus signal**

<table>
<thead>
<tr>
<th>Priority</th>
<th>Possible settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stop</td>
</tr>
<tr>
<td>2</td>
<td>Max. curve</td>
</tr>
<tr>
<td>3</td>
<td>Stop</td>
</tr>
<tr>
<td>4</td>
<td>Max. curve</td>
</tr>
<tr>
<td>5</td>
<td>Min. curve</td>
</tr>
<tr>
<td>6</td>
<td>Setpoint setting</td>
</tr>
</tbody>
</table>

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

**Indicator lights and signal relay**

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

The pump incorporates an output for a potential-free signal via an internal relay.

The signal output can be set to fault, operating or ready indication by means of R100, see Selection of fault, operating or ready signal relay on page 24.

The functions of the two indicator lights and the signal relay are as shown in the table on following page.

**Fig. 34** Control panels of the E-pumps.
Multistage E-pumps

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

- By briefly pressing the button " " or " " on the pump. This will not change the setting of the pump. A fault indication cannot be reset by means of " " or " " if the buttons have been locked.
- By switching off the electricity supply until the indicator lights are off.
- By means of R100.

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

**Megging**

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

### Further product documentation

In addition to this data booklet, Grundfos offers data booklets describing each of the following pump types.

<table>
<thead>
<tr>
<th>Pump type</th>
<th>Frequency</th>
<th>Publication number</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRE, CRIE, CRNE without sensor</td>
<td>50 Hz version</td>
<td>V7023751</td>
</tr>
<tr>
<td>CRE, CRIE, CRNE with pressure sensor</td>
<td>50 Hz version</td>
<td>V7023751</td>
</tr>
<tr>
<td>CRE, CRIE, CRNE without sensor</td>
<td>60 Hz version</td>
<td>96488672</td>
</tr>
<tr>
<td>CRE, CRIE, CRNE with pressure sensor</td>
<td>60 Hz version</td>
<td>96488672</td>
</tr>
<tr>
<td>MTRE</td>
<td>50/60</td>
<td>96513874</td>
</tr>
<tr>
<td>CHIE</td>
<td>50/60</td>
<td>V7131288</td>
</tr>
</tbody>
</table>

**Note:** All of the above data booklets are also available in the on-line product selection program, WebCAPS, on www.grundfos.com. For further information on WebCAPS, see page 91.
Single-stage E-pumps

Introduction
Grundfos single-stage E-pumps are fitted with a frequency-controlled standard MGE or MMGE motor and built-in PI-controller for single-phase or three-phase mains connection.
Grundfos single-stage E-pumps include the following pump types:
- TPE, TPED Series 1000
- NKE
- NBE.

Note: TPE, TPED is also available as a TPE, TPED Series 2000 E-pump, including a differential pressure sensor, see page 43.

TPE, TPED Series 1000

Fig. 35  TPE pumps without sensor

TPE, TPED Series 1000 are vertical single-stage centrifugal pumps.

Due to the in-line design the pump can be installed in a horizontal or vertical one-pipe system where the suction and discharge ports are in the same plane and have the same pipe dimensions. This design provides a more compact pump design and pipework.

The pumps are available in various sizes to provide the flow and the pressure required.

TPE, TPED Series 1000 consist of two main components: The motor and the pump unit.
- The motor is a Grundfos MGE (0.37 to 7.5 kW) or MMGE (11 to 22 kW) motor with built-in frequency converter designed to EN standards.
- The pump unit has optimised hydraulics, union or flanged connections, a top and various other parts.

TPE, TPED Series 1000 can be connected to an external sensor enabling control of for instance pressure, differential pressure, temperature, differential temperature or flow.

Applications of TPE, TPED Series 1000
TPE, TPED Series 1000 are used in a wide variety of pumping systems where the performance and materials of the pump are required to meet specific demands.

Below is a list of some general examples of application:
- District heating systems
- Heating systems
- Air-conditioning systems
- District cooling systems
- Water supply
- Industrial processes
- Industrial cooling.

NKE and NBE pumps

Fig. 36  NKE and NBE pumps

NKE and NBE pumps are horizontal single-stage volute pumps with axial suction port and radial discharge port.

NKE pumps are of the long coupled pump type and NBE pumps are of the close-coupled pump type.

The pumps are equipped with a three-phase MGE motor up to 5.5 kW, 4 pole and 7.5 kW, 2 pole. Above this power size MMGE motors are used.

Applications of NKE and NBE
The NKE and NBE series are multi-purpose E-pump ranges suitable for a variety of different applications demanding reliable and cost-efficient supply.

Below is a list of three general fields of application:

Water supply
- Filtration and transfer at waterworks
- Pressure boosting
- Public water supply.

Building utility
- District heating plants
- Cooling and air-conditioning systems (refrigerants)
- Washing and cleaning systems
- Fire protection systems
- Boiler feed and condensate systems.

Irrigation
- Field irrigation (flooding)
- Sprinkler irrigation
- Drip-feed irrigation.
Single-stage E-pumps

Overview of functions

<table>
<thead>
<tr>
<th>E-pump functions</th>
<th>E-pump type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Setting via control panel:</strong></td>
<td><strong>TPE, TPED Series 1000, NBE, NKE without sensor</strong></td>
</tr>
<tr>
<td>Setpoint</td>
<td>●</td>
</tr>
<tr>
<td>Start/stop</td>
<td>●</td>
</tr>
<tr>
<td>Max. Curve</td>
<td>●</td>
</tr>
<tr>
<td>Min. Curve</td>
<td>●</td>
</tr>
<tr>
<td>Alarm reset</td>
<td>●</td>
</tr>
<tr>
<td>Constant/proportional pressure</td>
<td>●</td>
</tr>
</tbody>
</table>

**Reading via control panel:**

| Setpoint | ● |
| Operating indication | ● |
| Fault indication | ● |

**Setting via R100:**

| Setpoint | ● |
| Start/stop | ● |
| Max. curve | ● |
| Min. curve | ● |
| Alarm reset | ● |
| Controlled / Uncontrolled | ● |
| Constant/proportional pressure, constant curve | ● |
| Controller constants Kp, Ti | ● |
| External setpoint signal | ● |
| Signal relay function | ● |
| Pump number (for Bus communication) | ● |
| Stop function | ● |
| Sensor range and signal | ● |
| Duty / Standby | ● |
| Operating range (min./max. speed) | ● |

**Reading via R100:**

| Setpoint | ● |
| Operating mode | ● |
| Actual sensor value | ● |
| Pump speed | ● |
| Actual power consumption | ● |
| Energy consumption | ● |
| Running hours | ● |

**Setting via GENIbus:**

| Setpoint | ● |
| Start/stop | ● |
| Max. Curve | ● |
| Min. Curve | ● |
| Controlled / Uncontrolled | ● |
| Constant/proportional pressure, constant curve | ● |

**Reading via GENIbus:**

| Setpoint | ● |
| Operating indication | ● |
| Pump status | ● |
| Additional functions: | ● |
| Parallel operation | ● |
| Clock program | ● |

**Settings via external signal:**

| Setpoint | ● |
| Start/stop | ● |
| Min./max. curve via digital input | ● |
| Min./max. curve, external fault, Flow switch via digital input | ● |

**Readings via external signal:**

| Fault signal (relay) | ● |
| Fault, Operation or Ready signal (relay) | ● |

**Additional functions:**

| Twin-head pump function | ● |

1) Only TPED pumps with MGE motors up to 7.5 kW.
Control modes

TPE, TPED Series 1000, NKE and NBE pumps can be set to the following two control modes:

- **controlled** mode (controlled operation) or
- **uncontrolled** mode (uncontrolled operation).

In **controlled** mode the pump will adjust its performance to the desired setpoint for the control parameter (pressure, differential pressure, temperature, differential temperature or flow), see Fig. 37.

![Fig. 37 Controlled operation - as an example constant differential pressure](image1)

In **uncontrolled** mode the pump will operate according to the constant curve set, see Fig. 38.

![Fig. 38 Uncontrolled operation](image2)

All TPE, TPED Series 1000, NKE and NBE pumps have been factory-set to **uncontrolled** mode. The setpoint value corresponds to 100% of the maximum pump performance.

For all single-stage E-pumps the additional operating modes can be selected:

- Stop,
- Max. curve
- Min. curve

![Fig. 39 Min. and max. curve](image3)

The max. curve can for instance be used in connection with the venting procedure during installation. The min. curve can be used in periods in which a minimum flow is required.

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

The remote control R100 offers additional possibilities of setting and status displays.

**Additional operating modes of TPED pumps (with MGE-motor up to 7.5 kW)**

TPED pumps are twin-head pumps with single- or three-phase MGE motor up to 7.5 kW. These pumps have a built in twin-head pump function which is activated from factory.

The two pump heads are connected with each other by means of a factory mounted multi-core cable enabling the function. The left pump head, see Fig. 40 a), is the master pump and the differential pressure sensor will be connected to this pump.

![Fig. 40 TPED pump with a) one sensor and b) with two sensors.](image4)

The twin-head pump function has two possible modes of operation:

**Alternating operation**

Pump operation alternates every 24 hours. If the duty pump stops due to a fault, the other pump will start up automatically and a fault indication will be given from the faulty pump.

**Standby operation**

The master pump is operating continuously. In order to prevent seizing-up, the other pump is started for 10 seconds every 24 hours. If the master pump stops due to a fault, the standby pump will start.

**Changing operating mode**

The operating mode is selected by means of a selector switch in each terminal box.

The selector switches enable changeover between the operating modes “alternating operation” and “standby operation”. The factory setting will be “alternating operation”.

The switches in the two terminal boxes must be set to the same position. If the switches are positioned differently, the operating mode will be “standby operation”.

**Note:** Both pumps should be set to the same setpoint and control mode. Different settings will result in different operation when changing between the two pumps.
Additional differential pressure sensor

The TPED pumps are supplied with one common differential pressure sensor mounted at and supplied from the master pump, see Fig. 40 a).

To ensure 100% back-up between the two heads of the twin-head pump, an additional differential pressure sensor can be mounted at the second pump head, see Fig. 40 b).

The additional sensor and a “Fitting kit for TPED with two sensors” can be found on page 80.

After mounting the additional sensor, the multi-core cable has to be modified - please see the installation and operating instruction TPE(D), NBE, NKE.

Setting by means of the control panel

The pump control panel incorporates the following:

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

Fig. 41 Control panels

Setpoint setting

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

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

Example: Pump in controlled mode (differential pressure control).

Fig. 42 Setpoint set to 3 bar, pressure-control mode

Setting of max. curve duty

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

To change back, press " button " continuously until the desired setpoint is indicated.

Fig. 44 Max. curve duty

Setting of min. curve duty

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

To change back, press " button " continuously until the desired setpoint is indicated.
Start/stop of pump

Stop the pump by continuously pressing " ⊘ " until none of the light fields are on and the green indicator light flashes.

Start the pump by continuously pressing " ⊘ " until the desired setpoint is indicated.
Setting by means of R100

The communication via the Grundfos remote control R100 is effected by means of infra-red light. The pump transmitter and receiver unit is placed in the control panel.

Compared with the functionalities of the control panel on the pump, R100 offers additional possibilities of pump settings and status readings. The displays are divided into four parallel menus:

0. GENERAL
1. OPERATION
2. STATUS
3. INSTALLATION
Single-stage E-pumps

Menu OPERATION

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

Setpoint setting

Setpoint 100

100 %

Setpoint set
Actual setpoint
Actual value

Setpoint setting

In this display, the setpoint is set.

In controlled mode the setting range is equal to the sensor measuring range, e.g. 0 to 25 metres.

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

Select one of the following operating modes:
• Stop
• Min. (min. curve)
• Max. (max. curve).

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

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

In this case, the number of possible settings will be reduced.

Setting of operating mode

Select one of the following operating modes:
• Stop
• Min.
• Normal (duty)
• Max.

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

Fault indications

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

Possible cause:
• Too high motor temperature
• Undervoltage
• Overvoltage
• Too many restarts (after faults)
• Overload
• Sensor signal outside signal range
• Setpoint signal outside signal range
• Other fault.

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

Alarm log

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

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

The time cannot be displayed for three-phase pumps as the software does not support this function.
Single-stage E-pumps

Menu STATUS

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

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

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

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

Display of actual setpoint

Tolerance: ± 2%

This display shows the actual setpoint and the external setpoint in % of the range from minimum value to the setpoint set.

Display of operating mode

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

Display of actual value

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

If no sensor is connected to the pump, “-” will appear in the display.

Display of actual speed

Tolerance: ± 5%

The actual pump speed will appear in this display.

Display of input power and power consumption

Tolerance: ± 10%

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

The pump power consumption can also be read from this display.

The value of power consumption is an accumulated value calculated from the pump’s birth and it cannot be reset.

Display of operating hours

Tolerance: ± 2%

The value of operating hours is an accumulated value and cannot be reset.
Single-stage E-pumps

Menu INSTALLATION

Selection of control mode

Select one of the following control modes:
- Controlled mode
- Uncontrolled mode.

The desired performance is set in Setpoint setting on page 36.

Note: if the pump is connected to a bus, it is not possible to select the control mode via R100.

Setting of controller

In this display, the gain ($K_p$) and the integral-action time ($T_t$) of the built-in PI-controller can be set if the factory setting is not the optimum setting:
- The gain ($K_p$) is set within the range from 0.1 to 20.
- The integral-action time ($T_t$) is set within the range from 0.1 to 3600 seconds. If 3600 seconds is selected, the controller will function as a P-controller.

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

Setting of PI-controller

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

A change of the $T_t$ setting can be useful:
- in a differential-pressure control system if the sensor is placed far away from the pump.

A change of the $T_t$ setting and in some cases the $K_p$ setting, may be necessary:
- if the pump is controlled on the basis of temperature or differential temperature.

The table below shows the recommended controller settings.

<table>
<thead>
<tr>
<th>System/ application</th>
<th>$K_p$</th>
<th>$T_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating systems</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Cooling systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L &lt; 5 m:</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>L &gt; 5 m:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>L &gt; 10 m:</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System/ application</th>
<th>$K_p$</th>
<th>$T_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating systems</td>
<td>0.5</td>
<td>−0.5</td>
</tr>
<tr>
<td>L &lt; 5 m:</td>
<td></td>
<td>10 + 5L</td>
</tr>
<tr>
<td>L &gt; 5 m:</td>
<td>0.5</td>
<td>10 + 5L</td>
</tr>
<tr>
<td>L &gt; 10 m:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Heating systems are systems in which an increase in pump performance will result in a rise in temperature at the sensor.
** Cooling systems are systems in which an increase in pump performance will result in a drop in temperature at the sensor.
Single-stage E-pumps

Selection of external setpoint signal

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

Select one of the following types:
- 0-5 [V] pumps with MMGE-motors only
- 0-10 [V]
- 0-20 [mA]
- 4-20 [mA]
- Not active.

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

The setpoint set is the maximum value of the external setpoint signal. The actual value of the external setpoint can be read from Display of actual setpoint on page 37.

Selection of fault, operating or ready signal relay

It can be selected in which situation the relay should be activated:
- Fault (fault indication)
- Operation (operation indication)
- Ready (ready indication).

Locking the buttons on the pump

The buttons "①" and "②" on the pump can be set to:
- Active
- Not active.

Allocation of pump number

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

Selection of function for digital input

The digital input of the pump can be set to different functions.

Select one of the following functions:
- Min. (min. curve),
- Max. (max. curve),
- Min.

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

Max.

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

Setting of sensor

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

Select the following:
- Sensor output signal (0-5 V*, 0-10 V, 0-20 mA or 4-20 mA),
- Sensor measuring unit (bar, mbar, m, kPa, psi, ft, m³/h, m³/s, l/s, gpm, °C, °F or %)
- Sensor measuring range.

* 0-5 V (pumps with MMGE motors only).
Single-stage E-pumps

Setting of min. and max. curves

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

Fig. 47 Min. and max. curve

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

External forced-control signals

The pump has inputs for external signals for the forced-control functions:
- Start/stop of pump.
- Digital function.

Start/stop input

Functional diagram: Start/stop input:

Digital input

By means of R100, one of the following functions can be selected for the digital input:
- Normal duty
- Min. curve
- Max. curve.

Functional diagram: Input for digital function:

External setpoint signal

Connecting an analogue signal to the input for the setpoint signal enables remote-setting of the setpoint.

The actual external signal (0-5 V (pumps with MMGE motors only), 0-10 V, 0-20 mA, 4-20 mA) must be selected via R100, see Selection of external setpoint signal on page 39.

If uncontrolled operation is selected by means of R100, the pump can be controlled by any controller. In controlled mode the setpoint can be set externally within the range from the lower value of the sensor measuring range to the setpoint set on the pump or by means of R100.

Actual setpoint

Upper value of sensor measuring range

Setpoint set on pump or via R100

Lower value of sensor measuring range

External setpoint signal

0 5 V (E-pumps with MMGE only)
0 10 V
0 20 mA
4 20 mA
Single-stage E-pumps

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

\[ H_{\text{actual}} = (H_{\text{set}} - H_{\text{lower}}) \times \% \text{external setpoint} + H_{\text{lower}} \]

\[ H_{\text{actual}} = (20 - 0) \times 80\% + 0 \]

\[ H_{\text{actual}} = 16 \text{metres} \]

In uncontrolled mode the setpoint can be set externally within the range from the min. curve to the setpoint on the pump or by means of R100.

Actual setpoint

Bus signal

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

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

For information about Bus communication with single-stage E-pumps, see page 72.

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

Priority of settings

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

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

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

The priority of the functions is shown in the following tables.

---

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

Indicator lights and signal relay

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

The pump incorporates an output for a potential-free signal via an internal relay.

The signal output can be set to fault, operating or ready indication by means of R100.

The functions of the two indicator lights and the signal relay are as shown in the table on following page.
Single-stage E-pumps

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

- By briefly pressing the button " " or " " on the pump. This will not change the setting of the pump. A fault indication cannot be reset by means of " " or " " if the buttons have been locked.
- By switching off the electricity supply until the indicator lights are off.
- By means of R100.

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

Meggings

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

<table>
<thead>
<tr>
<th>Indicator lights</th>
<th>Signal relay activated during:</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault (red)</td>
<td>Operation (green)</td>
<td>Fault</td>
</tr>
<tr>
<td>Off</td>
<td>Off</td>
<td>C NO NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td>Off</td>
<td>Permanently on</td>
<td>The pump is operating.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td>Off</td>
<td>Flashing</td>
<td>The pump has been set to stop.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td>Permanently on</td>
<td>Off</td>
<td>The electricity supply has been switched off.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td>Permanently on</td>
<td>Permanently on</td>
<td>The pump is operating, but it has been stopped because of a fault. Restarting will be attempted (it may be necessary to restart the pump by resetting the fault indication).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td>Permanently on</td>
<td>Flashing</td>
<td>The pump has been set to stop, but it has been stopped because of a fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
</tbody>
</table>

Further product documentation

In addition to this data booklet, Grundfos offers data booklets describing each of the following pump types.

<table>
<thead>
<tr>
<th>Pump type</th>
<th>Frequency</th>
<th>Publication number</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP, TPD, TPE, TPED</td>
<td>50 Hz</td>
<td>V7124417</td>
</tr>
<tr>
<td>TP, TPD, TPE</td>
<td>60 Hz</td>
<td>V7152685</td>
</tr>
<tr>
<td>NKE</td>
<td>50/60</td>
<td>V7153863</td>
</tr>
<tr>
<td>NBE</td>
<td>50/60</td>
<td>V7168999</td>
</tr>
</tbody>
</table>

Note: All of the above data booklets are also available on-line on WebCAPS on www.grundfos.com. For further information on WebCAPS, see page 91.
TPE, TPED Series 2000

Introduction

Grundfos TPE, TPED Series 2000 pumps are fitted with a frequency-controlled MGE or MMGE motor. The pumps have built in PI-controller and are equipped with a differential pressure sensor.

TPE, TPED Series 2000 pumps

TPE, TPED Series 2000 pumps with differential pressure sensor are vertical single-stage centrifugal pumps. Due to the in-line design the pump can be installed in a horizontal or vertical one-pipe system where the suction and discharge ports are in the same plane and have the same pipe dimensions. This design provides a more compact pump design and pipework.

The pumps are available in various sizes to provide the flow and the pressure required. The twin-head pump version, TPED series 2000, is only available with the MGE motor (0.75-7.5 kW)

TPE, TPED Series 2000 pumps consist of two main components: The motor and the pump unit.

- The motor is a Grundfos MGE (0.75 to 7.5 kW) or MMGE (11 to 22 kW) motor with built-in frequency converter designed to EN standards.
- The pump unit has optimised hydraulics, union or flanged connections, a top and various other parts.

Applications of TPE, TPED Series 2000

TPE, TPED Series 2000 pumps are used in a wide variety of pumping systems where the performance and materials of the pump are required to meet specific demands.

Below is a list of some general examples of application:

- Heating systems
- Refrigeration systems
- Building cooling systems
- Mixing loops.
## Overview of functions

### E-pump functions

<table>
<thead>
<tr>
<th>Setting via control panel:</th>
<th>Setting via R100:</th>
<th>Setting via GENIbus:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setpoint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start/Stop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Curve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. Curve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm reset</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant/proportional pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading via control panel:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setpoint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating indication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fault indication</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### E-pump type

<table>
<thead>
<tr>
<th>TPE, TPED Series 2000 with single-phase MGE</th>
<th>TPE, TPED Series 2000 with three-phase MGE up to 7.5 kW</th>
<th>TPE Series 2000 with three-phase MMGE 11-22 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting via control panel:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setpoint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start/Stop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Curve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. Curve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm reset</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant/proportional pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading via control panel:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setpoint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating indication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fault indication</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Operation mode: MIN, MAX, STOP

<table>
<thead>
<tr>
<th>Flow in %</th>
<th>External control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Setting via R100:

| Setpoint                     |                   |                     |
| Start/stop                   |                   |                     |
| Max. curve                   |                   |                     |
| Min. curve                   |                   |                     |
| Alarm reset                  |                   |                     |
| Controlled / Uncontrolled    |                   |                     |
| Constant/proportional pressure, constant curve |               |                     |
| Controller constants Kp, Ti  |                   |                     |
| External setpoint signal     |                   |                     |
| Signal relay function        |                   |                     |
| Pump number (for Bus communication) |               |                     |
| Stop function                |                   |                     |
| Sensor range and signal      |                   |                     |
| Duty / Standby               |                   |                     |
| Operating range (min./max. speed) |               |                     |

### Reading via R100:

| Setpoint                     |                   |                     |
| Operating mode               |                   |                     |
| Actual sensor value          |                   |                     |
| Pump speed                   |                   |                     |
| Actual power consumption     |                   |                     |
| Energy consumption           |                   |                     |
| Running hours                |                   |                     |

### Setting via GENIbus:

| Setpoint                     |                   |                     |
| Start/stop                   |                   |                     |
| Max. curve                   |                   |                     |
| Min. curve                   |                   |                     |
| Controlled / Uncontrolled    |                   |                     |
| Constant/proportional pressure, constant curve |               |                     |

### Reading via GENIbus:

| Setpoint                     |                   |                     |
| Operating indication         |                   |                     |
| Pump status                  |                   |                     |

### Additional functions:

| Parallel operation           |                   |                     |
| Clock program                |                   |                     |

---

**TPE, TPED Series 2000**

Overview of functions

- **E-pump functions**
  - Single-phase MGE for TPE, TPED Series 2000
  - Three-phase MGE up to 7.5 kW
  - Three-phase MMGE 11-22 kW

- **Setting via control panel**:
  - Setpoint
  - Start/Stop
  - Max. Curve
  - Min. Curve
  - Alarm reset
  - Constant/proportional pressure

- **Reading via control panel**:
  - Setpoint
  - Operating indication
  - Fault indication

- **Operation mode**:
  - MIN, MAX, STOP
  - Flow in %

- **Setting via R100**:
  - Setpoint
  - Start/Stop
  - Max. curve
  - Min. curve
  - Alarm reset
  - Controlled / Uncontrolled
  - Constant/proportional pressure, constant curve
  - Controller constants Kp, Ti
  - External setpoint signal
  - Signal relay function
  - Pump number (for Bus communication)
  - Stop function
  - Sensor range and signal
  - Duty / Standby
  - Operating range (min./max. speed)

- **Reading via R100**:
  - Setpoint
  - Operating mode
  - Actual sensor value
  - Pump speed
  - Actual power consumption
  - Energy consumption
  - Running hours

- **Setting via GENIbus**:
  - Setpoint
  - Start/Stop
  - Max. curve
  - Min. curve
  - Controlled / Uncontrolled
  - Constant/proportional pressure, constant curve

- **Reading via GENIbus**:
  - Setpoint
  - Operating indication
  - Pump status

- **Additional functions**:
  - Parallel operation
  - Clock program
## TPE, TPED Series 2000

### E-pump functions

<table>
<thead>
<tr>
<th>Settings via external signal:</th>
<th>TPE, TPED Series 2000 with single-phase MGE</th>
<th>TPE, TPED Series 2000 with three-phase MGE up to 7.5 kW</th>
<th>TPE Series 2000 with three-phase MMGE 11-22 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setpoint</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Start/stop</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Min./max. curve via digital input</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Min./max. curve, external fault, flow switch via digital input</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

### Additional functions

<table>
<thead>
<tr>
<th>Additional functions:</th>
<th>TPE, TPED Series 2000 with single-phase MGE</th>
<th>TPE, TPED Series 2000 with three-phase MGE up to 7.5 kW</th>
<th>TPE Series 2000 with three-phase MMGE 11-22 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twin-head pump function</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>
Control modes

TPE, TPED Series 2000 pumps with differential-pressure sensor can be set to the following three control modes:

• **proportional** pressure
• **constant** pressure
• **constant** curve.

In **proportional** pressure mode the pump will produce a proportionally increasing differential pressure across the pump at an increasing flow, see Fig. 50.

![Fig. 50 Proportional pressure mode](image)

In **constant-pressure** mode the pump maintains a constant differential pressure across the pump, irrespective of the flow, see Fig. 51.

![Fig. 51 Constant pressure mode](image)

In **constant-curve** mode the pump is not controlled. It can be set to pump according to a preset pump characteristic within the range from min. curve to max. curve, see Fig. 52.

![Fig. 52 Constant curve mode](image)

All TPE, TPED Series 2000 pumps are set to proportional pressure from factory. The head corresponds to 50% of the maximum pump head.

In most cases, the above is the optimum control mode for these pumps, especially as the pumps consume less energy.

Proportional pressure mode is chosen in systems with relatively large head losses in those parts of the system through which the total quantity of water flows.

**Operating modes**

In addition to proportional pressure, constant pressure and constant curve, the following operating modes can be selected:

• **Stop**
• **Max. curve**
• **Min. curve**.

Max. curve mode can be used in connection with the venting procedure during installation.

Min. curve mode can be used in periods requiring very low flow.

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

The remote control R100 offers additional possibilities of setting and status displays.

**Additional operating modes TPED Series 2000 pumps (with MGE motors up to 7.5 kW)**

TPED Series 2000 pumps are twin-head pumps with the single- or three-phase MGE motor up to 7.5 kW. These pumps have a built in twin-head pump function which is activated from factory.

The two pump heads are connected with each other by means of a factory mounted multi-core cable enabling the function. The left pump head, see Fig. 54 a), is the master pump and the differential pressure sensor will be connected to this pump.

![Fig. 54 TPED Series 2000 pump](image)
The twin-head pump function has two possible modes of operation:

**Alternating operation**

Pump operation alternates every 24 hours. If the duty pumps stops due to a fault, the other pump will start up automatically and a fault indication will be given from the faulty pump.

**Standby operation**

The master pump is operating continuously. In order to prevent seizing-up, the standby pump is started for 10 seconds every 24 hours. If the master pump stops due to a fault, the standby pump will start.

**Changing operating mode**

The operating mode is selected by means of a selector switch in each terminal box.

The selector switches enable changeover between the operating modes "alternating operation" and "standby operation". The factory setting will be "alternating operation".

The switches in the two terminal boxes must be set to the same position. If the switches are positioned differently, the operating mode will be "standby operation".

**Note:** Both pumps should be set to the same setpoint and control mode. Different settings will result in different operation when changing between the two pumps.

**Additional differential pressure sensor**

The TPED Series 2000 pumps are supplied with one common differential pressure sensor mounted at and supplied from the master pump, see Fig. 54 a).

To ensure 100% back-up between the two pump heads of the twin-head pump, an additional differential pressure sensor can be mounted at the second pump head, see Fig. 54 b).

The additional sensor and a "Fitting kit for TPED with two sensors" can be found on page 80.

After mounting the additional sensor, the multi-core cable has to be modified - please see the installation and operating instruction TPE(D) Series 2000.

---

**Setting by means of the control panel**

**TPE, TPED Series 2000 pumps with single-phase MGE and TPE Series 2000 pumps with MMGE (11 - 22 kW)**

The pump control panel incorporates the following:

- buttons " " and " " for setting of head (setpoint $H_{set}$) and control mode.
- Light fields, yellow, for indication of head and control mode.
- Indicator lights, green (operation) and red (fault).

![Control panel of MGE motor](image)

**Fig. 55** Control panel of MGE motor

**Setpoint setting**

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

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

**Example:** Pump in proportional-pressure control mode.

Fig. 56 shows that the light fields 5 and 6 are on, indicating a desired head of 3 metres at maximum flow. The setting range lies between 1/4 and 3/4 of maximum head.

![Pump in proportional-pressure control mode](image)

**Fig. 56** Pump in proportional-pressure control mode
Example: Pump in constant-pressure control mode.

Fig. 57 shows that the light fields 5 and 6 are activated, indicating a desired head of 3.1 metres. The setting range lies between 1/8 of maximum head and maximum head.

**Fig. 57** Pump in constant-pressure control mode

### Changeover between proportional pressure and constant pressure

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

<table>
<thead>
<tr>
<th>Light fields</th>
<th>Control mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top + bottom light fields flash</td>
<td>Proportional pressure</td>
</tr>
<tr>
<td>Middle light fields flash</td>
<td>Constant pressure</td>
</tr>
</tbody>
</table>

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

### Setting of min. curve duty

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

To change back, press " " continuously until the desired setpoint is indicated.

**Fig. 59** Min. curve duty

### Start/stop of pump

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

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

**Fig. 58** Max. curve duty
TPE, TPED Series 2000

Setting by means of the control panel

TPE, TPED Series 2000 pumps with three-phase MGE up to 7.5 kW

Fig. 60 Control panel

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 2</td>
<td>Buttons for setting.</td>
</tr>
<tr>
<td>3 and 5</td>
<td>Light fields for indication of:</td>
</tr>
<tr>
<td></td>
<td>• control mode, pos. 3,</td>
</tr>
<tr>
<td></td>
<td>• head, performance and operating mode, pos. 5.</td>
</tr>
<tr>
<td>4</td>
<td>Indicator lights</td>
</tr>
<tr>
<td></td>
<td>• for operating and fault indication and</td>
</tr>
<tr>
<td></td>
<td>• symbol for indication of external control.</td>
</tr>
</tbody>
</table>

Control mode setting

Description of function.

Change the control mode by pressing , pos. 2, according to the following cycle:

• constant pressure, , and
• proportional pressure, .

Setting of pump head

The pump head is set by pressing the button ” or ”.

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

Fig. 61 shows that the light fields 5 and 6 are on, indicating a desired head of 3 metres at maximum flow. The setting range lies between ⅛ and ⅜ of maximum head.

Fig. 62 shows that the light fields 5 and 6 are on, indicating a desired head of 3.1 metres. The setting range lies between 1/8 of maximum head and maximum head.

Setting to max. curve duty

To change over to the max. curve of the pump, press ” continuously until MAX illuminates, see Fig. 63.

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

Setting to min. curve duty

To change over to the min. curve of the pump, press ” continuously until MIN illuminates, see Fig. 64.

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

Fig. 61 Pump in proportional-pressure control mode

Fig. 62 Pump in constant-pressure control mode

Fig. 63 Max. curve duty

Fig. 64 Min. curve duty

Start/stop of pump

Stop the pump by continuously pressing ” until STOP illuminates. When the pump is stopped, the green indicator light will be flashing.

Start the pump by continuously pressing ” until the desired head is indicated.
Setting by means of R100

The communication via the Grundfos remote control R100 is effected by means of infra-red light. The pump transmitter and receiver unit is placed in the control panel.

Compared with the functionalities of the control panel on the pump, R100 offers additional possibilities of pump settings and status readings. The displays are divided into four parallel menus:

0. GENERAL
1. OPERATION
2. STATUS
3. INSTALLATION

![Communication via R100](image-url)
Menu OPERATION

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

Setpoint setting

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

In proportional-pressure mode the setting range is from 1/4 of maximum head to 3/4 of maximum head.

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

In constant-curve mode the setpoint is set in % of the maximum curve. The curve can be set within the range from min. curve to max. curve.

Select one of the following operating modes:

• Stop
• Min. (min. curve)
• Max. (max. curve).

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

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

In this case, the number of possible settings will be reduced.

Setting of operating mode

Select one of the following operating modes:

• Stop
• Min.
• Normal (duty)
• Max.

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

Fault indications

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

Possible cause:

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

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

Alarm log

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

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

The time cannot be displayed for three-phase pumps as the software does not support this function.
Menu STATUS

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

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

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

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

Display of actual setpoint

Tolerance: ± 2%

This display shows the actual setpoint and the external setpoint in % of the range from minimum value to the setpoint set.

Display of operating mode

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

Display of actual value

The actually measured head will appear in this display.

Display of actual speed

Tolerance: ± 5%

The actual pump speed will appear in this display.

Display of input power and power consumption

Tolerance: ± 10%

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

The pump power consumption can also be read from this display.

The value of power consumption is an accumulated value calculated from the pump’s birth and it cannot be reset.

Display of operating hours

Tolerance: ± 2%

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

Selection of control mode

Select one of the following control modes:
- Prop. pressure (proportional pressure)
- Const. pressure (constant pressure)
- Const. curve (constant curve).

The desired performance is set in Setpoint setting on page 51.

Note: If the pump is connected to a bus, it is not possible to select the control mode via R100.

Selection of external setpoint signal

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

Select one of the following types:
- 0-5 [V] (potentiometer) (pumps with MMGE motors only),
- 0-10 [V]
- 0-20 [mA]
- 4-20 [mA]
- Not active.

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

The setpoint set is the maximum value of the external setpoint signal. The actual value of the external setpoint can be read from Display of actual setpoint on page 52.

Locking the buttons on the pump

The buttons " " and " " on the pump can be set to:
- Active
- Not active.

Allocation of pump number

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

Selection of function for digital input

The digital input of the pump can be set to different functions.

Select one of the following functions:
- Min. (min. curve)
- Max. (max. curve).

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

Max.
When the input is activated, the pump is operating according to the max. curve.
External forced-control signals

The pump has inputs for external signals for the forced-control functions:
- Start/stop of pump
- Digital function.

Start/stop input

Functional diagram: Start/stop input:

<table>
<thead>
<tr>
<th>Start/stop</th>
<th>Digital function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal duty</td>
</tr>
<tr>
<td></td>
<td>Stop</td>
</tr>
</tbody>
</table>

Digital input

By means of R100, one of the following functions can be selected for the digital input:
- Normal duty
- Min. curve
- Max. curve.

Functional diagram: Input for digital function:

<table>
<thead>
<tr>
<th>Digital function</th>
<th>Normal duty</th>
<th>Minimum curve</th>
<th>Maximum curve</th>
</tr>
</thead>
</table>

External setpoint signal

Connecting an analogue signal transmitter to the input for the setpoint signal (terminal 4) enables remote setting of the setpoint.

The actual external signal (0-5 V (three-phase pumps only), 0-10 V, 0-20 mA, 4-20 mA) must be selected via R100.

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

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

Actual setpoint

Example: At a maximum head of 12 metres, a setpoint set of 6 metres and an external setpoint of 100%, the actual setpoint will be as follows:

\[
H_{\text{actual}} = (H_{\text{set}} - \frac{1}{4}H_{\text{max}}) \times \%_{\text{external setpoint}} + \frac{1}{4}H_{\text{max}}
\]

\[
H_{\text{actual}} = (6 - 12/4) \times 100\% + 12/4
\]

\[
H_{\text{actual}} = 6\text{metres}
\]
In constant-pressure mode the setpoint can be set externally within the range from 1/8 of maximum head to the setpoint on the pump or by means of R100.

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

\[
H_{\text{actual}} = (H_{\text{set}} - 1/8H_{\text{max}}) \times \%\text{external setpoint} + 1/8H_{\text{max}}
\]

\[
H_{\text{actual}} = (6 - 12/8) \times 80\% + 12/8 = 5.1\text{metres}
\]

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

**Bus signal**

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

Via the bus signal, it is possible to remote-set pump operating parameters, such as setpoint, operating mode, etc. Furthermore, it offers the possibility of controlling several TPE, TPED Series 2000 pumps at the same type connected in parallel. At the same time, the pump can provide status information about important parameters, such as actual value of control parameter, input power, fault indications, etc.

For information about Bus communication with TPE, TPED Series 2000, see page 72.

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

**Priority of settings**

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

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

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

The priority of the functions is shown in the following tables.

<table>
<thead>
<tr>
<th>Priority</th>
<th>Without bus signal</th>
<th>With bus signal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Possible settings</td>
<td>Possible settings</td>
</tr>
<tr>
<td></td>
<td>Control panel on pump or R100</td>
<td>Control panel on pump or R100</td>
</tr>
<tr>
<td>1</td>
<td>Stop</td>
<td>Stop</td>
</tr>
<tr>
<td>2</td>
<td>Max. curve</td>
<td>Max. curve</td>
</tr>
<tr>
<td>3</td>
<td>Stop</td>
<td>Stop</td>
</tr>
<tr>
<td>4</td>
<td>Max. curve</td>
<td>Max. curve</td>
</tr>
<tr>
<td>5</td>
<td>Min. curve</td>
<td>Min. curve</td>
</tr>
<tr>
<td>6</td>
<td>Set point setting</td>
<td>Set point setting</td>
</tr>
</tbody>
</table>

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

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

![Fig. 66 Indicator lights on the pump control panel](image)

The pump incorporates a fault signal relay with a potential-free changeover contact for external fault indication.

The functions of the two indicator lights and the fault signal relay are as shown in the table below.

<table>
<thead>
<tr>
<th>Indicator lights</th>
<th>Signal relay activated during:</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault (red)</td>
<td>Operation (green)</td>
<td>Fault signal relay</td>
</tr>
<tr>
<td>Off</td>
<td>Off</td>
<td>Permanently on</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C NO NC</td>
</tr>
<tr>
<td></td>
<td>The electricity supply has been switched off</td>
<td></td>
</tr>
<tr>
<td>Off</td>
<td>Permanently on</td>
<td>The pump is operating</td>
</tr>
<tr>
<td></td>
<td>C NO NC</td>
<td></td>
</tr>
<tr>
<td>Off</td>
<td>Flashing</td>
<td>The pump has been set to stop</td>
</tr>
<tr>
<td></td>
<td>C NO NC</td>
<td></td>
</tr>
<tr>
<td>Permanently on</td>
<td>Off</td>
<td>The pump has stopped because of a fault. Restarting will be attempted (it may be necessary to restart the pump by resetting the fault indication).</td>
</tr>
</tbody>
</table>

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

- By briefly pressing the button “” or “” on the pump. This will not change the setting of the pump. A fault indication cannot be reset by means of “” or “” if the buttons have been locked.
- By switching off the electricity supply until the indicator lights are off.
- By means of R100.

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

**Megging**

**Note:** Megging of an installation incorporating TPE, TPED Series 2000 pumps is not allowed, as the built-in electronics may be damaged.

**Further product documentation**

In addition to this “Grundfos E-pumps” data booklet, Grundfos offers data booklets describing each of the following pump types.

<table>
<thead>
<tr>
<th>Pump type</th>
<th>Frequency</th>
<th>Publication number</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP, TPD, TPE, TPED</td>
<td>50</td>
<td>V7124417</td>
</tr>
<tr>
<td>TP, TPD, TPE</td>
<td>60</td>
<td>V7152685</td>
</tr>
</tbody>
</table>

**Note:** All of the above data booklets are also available on-line on WebCAPS on www.grundfos.com. For further information on WebCAPS, see page 91.
E-pumps with single-phase MGE motors

Grundfos MGE 71 and MGE 80 motors

- have single-phase mains connection
- are three-phase, asynchronous squirrel cage induction motors designed to current IEC, DIN and VDE guidelines and standards. The motors incorporate a frequency converter and PI-controller
- are used for continuously variable speed control of Grundfos E-pumps
- are available in power sizes 0.25 to 0.75 kW 4 pole and 0.37 to 1.1 kW 2 pole.

Supply voltage
1 x 200-240 V ± 10%, 50/60 Hz, PE.

Back-up fuse
Motor sizes from 0.25 to 1.1 kW: Max. 10 A.
Standard as well as quick-blow or slow-blow fuses may be used.

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

Input/output
Start/stop
External potential-free switch.
Voltage: 5 VDC
Current: < 5 mA.
Screened cable (0.5 - 1.5 mm² / 28-16 AWG) must be used.

Digital input
External potential-free switch.
Voltage: 5 VDC
Current: < 5 mA.
Screened cable (0.5 - 1.5 mm² / 28-16 AWG) must be used.

Setpoint signals
- Potentiometer
  0-10 VDC, 10 kΩ (via internal voltage supply).
  Screened cable (cross section min. 0.5 mm² and max. 1.5 mm²).
  Maximum cable length: 100 m.
- Voltage signal
  0-10 VDC, Rₗ > 50 kΩ.
  Tolerance: +0%/-3% at maximum voltage signal.
  Screened cable (cross section min. 0.5 mm² and max. 1.5 mm²).
  Maximum cable length: 500 m.
- Current signal
  DC 0-20 mA/4-20 mA, Rₗ = 175 Ω.
  Tolerance: +0%/-3% at maximum current signal.
  Screened cable (cross section min. 0.5 mm² and max. 1.5 mm²).
  Maximum cable length: 500 m.

Sensor signals
- Voltage signal
  0-10 VDC, Rₗ > 50 kΩ (via internal voltage supply).
  Tolerance: +0%/-3% at maximum voltage signal.
  Screened cable (cross section min. 0.5 mm² and max. 1.5 mm²).
  Maximum cable length: 500 m.
- Current signal
  DC 0-20 mA/4-20 mA, Rₗ = 175 Ω.
  Tolerance: +0%/-3% at maximum current signal.
  Screened cable (cross section min. 0.5 mm² and max. 1.5 mm²).
  Maximum cable length: 500 m.
- Electricity supply to sensor:
  +24 VDC, max. 40 mA.

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

Bus input
Grundfos GENibus protocol, RS-485.
0.5 - 1.5 mm² screened 2-core cable.
Maximum cable length: 500 m.
Single-phase MGE motors

EMC (electromagnetic compatibility)

Emission:
Comply with the limits in EN 61 800-3 for the first environment (residential areas), unrestricted distribution, corresponding to CISPR11, group 1, class B.

Immunity:
Fulfil the requirements for both the first and the second environment according to EN 61 800-3.
For further information about EMC, see EMC and proper installation on page 66.

Enclosure class
Standard enclosure class: IP 55.

Insulation class
F (IEC 85).

Ambient temperature
During operation: –20°C to +40°C
During storage/transport: –40°C to +60°C.

Relative air humidity
Maximum 95%.

Sound pressure level

<table>
<thead>
<tr>
<th>Motor [kW]</th>
<th>Speed as stated on the nameplate [min⁻¹]</th>
<th>Sound pressure level [dB(A)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.37</td>
<td>1700-1800</td>
<td>1400-1500</td>
</tr>
<tr>
<td>0.55</td>
<td>1700-1800</td>
<td>1400-1500</td>
</tr>
<tr>
<td>0.75</td>
<td>1700-1800</td>
<td>1400-1500</td>
</tr>
<tr>
<td>1.1</td>
<td>2800-3000</td>
<td>1400-1500</td>
</tr>
</tbody>
</table>

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

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

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

Start/stop of pump
The number of starts and stops via the mains voltage must not exceed 4 times per hour. When the pump is switched on via the mains, it will start after approx. 5 seconds. If a higher number of starts and stops is desired, the input for external start/stop must be used when starting/stoppeing the pump. When the pump is started/stopped via an external on/off switch, it will start immediately.

Wiring diagram

1 x 200-240 V, +/- 10%, 50/60 Hz

![Wiring diagram](image)
Single-phase MGE motors

Other connections

The connection terminals of external potential-free contacts for start/stop and digital function, external setpoint signal, sensor signal, GENIbus and relay signal are shown in Fig. 68.

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

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

1. Inputs (external start/stop, digital function, setpoint and sensor signals, terminals 1-9, and bus connection, terminals B, Y, A).
   All inputs (group 1) are internally separated from the mains-conducting parts by reinforced insulation and galvanically separated from other circuits.
   All control terminals are supplied by protective extra-low voltage (PELV), thus ensuring protection against electric shock.

2. Output (relay signal, terminals NC, C, NO).
   The output (group 2) is galvanically separated from other circuits. Therefore, the supply voltage or protective extra-low voltage can be connected to the output as desired.

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

![Connection terminals](image)

**Fig. 68** Connection terminals
Three-phase MGE motors

E-pumps with three-phase MGE motors

Grundfos MGE 90, MGE 100, MGE 112 and MGE 132 motors
- have three-phase mains connection
- are three-phase, asynchronous squirrel cage induction motors designed to current IEC, DIN and VDE guidelines and standards. The motors incorporate a frequency converter and PI-controller
- are used for continuously variable speed control of Grundfos E-pumps
- are available in power sizes 0.55-5.5 kW, 4 pole and 0.75-7.5 kW, 2 pole.

Supply voltage
3 x 380-480 V ± 10%, 50/60 Hz, PE.

Back-up fuse
Motor sizes from 0.75 to 5.5 kW: Max. 16 A
Motor size 7.5 kW: Max. 32 A.
Standard as well as quick-blow or slow-blow fuses may be used.

Leakage current

<table>
<thead>
<tr>
<th>Motor size [kW]</th>
<th>Leakage current [mA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75 to 3.0</td>
<td>&lt; 3.5</td>
</tr>
<tr>
<td>4.0 to 5.5</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>5.5 kW, 1400-1800 min⁻¹</td>
<td>&lt; 10</td>
</tr>
</tbody>
</table>

The leakage currents are measured in accordance with EN 60 355-1.

Input/output
Start/stop
External potential-free switch.
Voltage: 5 VDC
Current: < 5 mA.
Screened cable (0.5 - 1.5 mm² / 28-16 AWG).

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

Setpoint signals
- Potentiometer
  0-10 VDC, 10 kΩ (via internal voltage supply).
  Screened cable (0.5 - 1.5 mm² / 28-16 AWG).
  Maximum cable length: 100 m.
- Voltage signal
  0-10 VDC, R> 50 kΩ.
  Tolerance: +0%/-3% at maximum voltage signal.
  Screened cable (0.5 - 1.5 mm² / 28-16 AWG).
  Maximum cable length: 500 m.
- Current signal
  DC 0-20 mA/4-20 mA, R=175 Ω.
  Tolerance: +0%/-3% at maximum current signal.
  Screened cable (0.5 - 1.5 mm² / 28-16 AWG).
  Maximum cable length: 500 m.

Sensor signals
- Voltage signal
  0-10 VDC, R> 50 kΩ (via internal voltage supply).
  Tolerance: +0%/-3% at maximum voltage signal.
  Screened cable (0.5 - 1.5 mm² / 28-16 AWG).
  Maximum cable length: 500 m.
- Current signal
  DC 0-20 mA/4-20 mA, R=175 Ω.
  Tolerance: +0%/-3% at maximum current signal.
  Screened cable (0.5 - 1.5 mm² / 28-16 AWG).
  Maximum cable length: 500 m.
- Maximum cable length: 500 m
- Electricity supply to sensor
  +24 VDC, max. 40 mA.

Signal output
Potential-free changeover contact.
Max. contact load: 250 VAC, 2 A
Min. contact load: 5 VDC, 10 mA
Screened cable, 0.5 - 1.5 mm² / 28-16 AWG.
Maximum cable length: 500 m.

Bus input
Grundfos GENIbus protocol, RS-485
Screened cable (0.5 - 1.5 mm² / 28-16 AWG).
Maximum cable length: 500 m.
Three-phase MGE motors

EMC (electromagnetic compatibility)

Emission:
Comply with the limits in EN 61 800-3 for the first environment (residential areas), unrestricted distribution, corresponding to CISPR11, group 1, class B.

Immunity:
Fulfil the requirements for both the first and the second environment according to EN 61 800-3.
For further information about EMC, see EMC and proper installation page 66.

Enclosure class
Standard: IP 55 (IEC34-5).

Insulation class
F (IEC 85).

Ambient temperature
During operation: –20°C to +40°C
During storage/transport: –40°C to +60°C.

Relative air humidity
Maximum 95%.

Sound pressure level

<table>
<thead>
<tr>
<th>Motor [kW]</th>
<th>Speed stated on the nameplate [min⁻¹]</th>
<th>Sound pressure level [dB(A)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75</td>
<td>1400-1500</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>65</td>
</tr>
<tr>
<td>1.1</td>
<td>1400-1500</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>65</td>
</tr>
<tr>
<td>1.5</td>
<td>1400-1500</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>70</td>
</tr>
<tr>
<td>2.2</td>
<td>1400-1500</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>70</td>
</tr>
<tr>
<td>3.0</td>
<td>1400-1500</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>70</td>
</tr>
<tr>
<td>4.0</td>
<td>1400-1500</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>75</td>
</tr>
<tr>
<td>5.5</td>
<td>1400-1500</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>80</td>
</tr>
<tr>
<td>7.5</td>
<td>2800-3000</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>80</td>
</tr>
</tbody>
</table>

Motor protection

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

Additional protection

If the motor is connected to an electric installation where an earth leakage circuit breaker is used as additional protection, this circuit breaker must be of the type:
• which is suitable for handling leakage currents and cutting-in with short pulse-shaped leakage.
• which trips out when alternating fault currents and fault currents with DC content, i.e. pulsating DC and smooth DC fault currents, occur.

For these pumps an earth leakage circuit breaker type B must be used.

This circuit breaker must be marked with the following symbols:

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

Start/stop of pump

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

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

If a higher number of starts and stops is desired, the input for external start/stop must be used when starting/stopping the pump.

When the pump is started/stopped via an external on/off switch, it will start immediately.

Motor [kW] | Speed stated on the nameplate [min⁻¹] | Sound pressure level [dB(A)] |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75</td>
<td>1400-1500</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>65</td>
</tr>
<tr>
<td>1.1</td>
<td>1400-1500</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>65</td>
</tr>
<tr>
<td>1.5</td>
<td>1400-1500</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>70</td>
</tr>
<tr>
<td>2.2</td>
<td>1400-1500</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>70</td>
</tr>
<tr>
<td>3.0</td>
<td>1400-1500</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>70</td>
</tr>
<tr>
<td>4.0</td>
<td>1400-1500</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>75</td>
</tr>
<tr>
<td>5.5</td>
<td>1400-1500</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>1700-1800</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>80</td>
</tr>
<tr>
<td>7.5</td>
<td>2800-3000</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>80</td>
</tr>
</tbody>
</table>
Three-phase MGE motors

Wiring diagram

3 x 380-480 V, +/- 10%, 50/60 Hz

External switch

Other connections

The connection terminals of external potential-free contacts for start/stop and digital function, external setpoint signal, sensor signal, GENIbus and relay signal are shown in Fig. 70.

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

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

1. Inputs (external start/stop, digital function, setpoint and sensor signals, terminals 1-9, and bus connection, terminals B, Y, A).
   All inputs (group 1) are internally separated from the mains-conducting parts by reinforced insulation and galvanically separated from other circuits.
   All control terminals are supplied by protective extra-low voltage (PELV), thus ensuring protection against electric shock.

2. Output (relay signal, terminals NC, C, NO).
   The output (group 2) is galvanically separated from other circuits. A maximum supply voltage of 250 V or protective extra-low voltage can be connected to the output as desired.

3. Mains supply (terminals L1, L2, L3, PE).
   A galvanically safe separation must fulfil the requirements for reinforced insulation including creepage distances and clearances specified in EN 60 335.

Fig. 70 Connection terminals
Three-phase MMGE motors

E-pumps with three-phase MMGE motors

Grundfos MMGE 160 M, MMGE 160 MX, MMGE 160 L and MMGE 180 M motors

• have three-phase mains connection
• are three-phase, asynchronous squirrel cage motors designed to current IEC, DIN and VDE guidelines and standards. The motors incorporate a frequency converter and PI-controller
• are used for continuously variable speed control of Grundfos E-pumps
• are available in power sizes 7.5 - 22 kW in 4 pole version and 11-22 kW in 2 pole version.

Supply voltage
3 x 380-415 V ± 10\%, 50/60 Hz, PE.

Back-up fuse

<table>
<thead>
<tr>
<th>Motor output up to [kW]</th>
<th>Max. [A]</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5</td>
<td>25</td>
</tr>
<tr>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td>15</td>
<td>35</td>
</tr>
<tr>
<td>18.5</td>
<td>50</td>
</tr>
<tr>
<td>22</td>
<td>50</td>
</tr>
</tbody>
</table>

Standard as well as quick-blow or slow-blow fuses may be used.

Leakage current

Leakage current > 30 mA.

The leakage currents are measured in accordance with EN 60 335-1.

Input/output

Start/stop

External potential-free switch.

Voltage: 5 VDC

Current: < 5 mA

Screened cable (cross-section min. 0.5 mm$^2$ and max. 1.5 mm$^2$).

Digital input

External potential-free switch.

Voltage: 5 VDC

Current: < 5 mA

Screened cable (cross-section min. 0.5 mm$^2$ and max. 1.5 mm$^2$).

Setpoint signals

• Potentiometer
  0-5 VDC, 10 kΩ (via internal voltage supply). Screened cable (cross section min. 0.5 mm$^2$ and max. 1.5 mm$^2$).
  Maximum cable length: 100 m.
• Voltage signal
  0-5 VDC/0-10 VDC, R$_i$ > 50 kΩ.
  Tolerance: +0%/-3% at maximum voltage signal.
  Screened cable (cross section min. 0.5 mm$^2$ and max. 1.5 mm$^2$).
  Maximum cable length: 500 m.
• Current signal
  DC 0-20 mA/4-20 mA, R$_i$ = 250 Ω.
  Tolerance: +0%/-3% at maximum current signal.
  Screened cable (cross section min. 0.5 mm$^2$ and max. 1.5 mm$^2$).
  Maximum cable length: 500 m.

Sensor signals

• Voltage signal
  0-5 VDC/0-10 VDC, R$_i$ > 50 kΩ (via internal voltage supply).
  Tolerance: +0%/-3% at maximum voltage signal.
  Screened cable: 0.5 - 1.5 mm$^2$
  Maximum cable length: 500 m.
• Current signal
  DC 0-20 mA/4-20 mA, R$_i$ = 250 Ω.
  Tolerance: +0%/-3% at maximum current signal
  Screened cable: 0.5 - 1.5 mm$^2$
  Maximum cable length: 500 m.
• Electricity supply to sensor:
  +24 VDC, max. 40 mA
  +5 VDC, max. 5 mA.

Signal output

Potential-free changeover contact.

Maximum contact load: 250 VAC, 2 A
Minimum contact load: 5 VDC, 10 mA

Screened cable: 0.5 - 2.5 mm$^2$

Maximum cable length: 500 m.

Bus input

Grundfos GENibus protocol, RS-485

0.5 - 1.5 mm$^2$ screened 2-core cable

Maximum cable length: 500 m.
Three-phase MMGE motors

EMC (electromagnetic compatibility)

Emission:
Comply with the limits of EN 61 800-3 for the second environment (industrial areas), unrestricted distribution, corresponding to CISPR11, group 2, class A.

If the MMGE motor is provided with an external EMC-filter, the limits for the first environment (residential areas), unrestricted distribution, corresponding to CISPR11, group 1, class B, are met.

Immunity:
Fulfil the requirements for both the first and the second environment according to EN 61 800-3.

For further information about EMC, see EMC and proper installation on page 66. For further information on EMC-filters, see page 78 and page 84.

Enclosure class
Standard: IP 54 (IEC 34-5).

Insulation class
F (IEC 85).

Ambient temperature
During operation: −20°C to +40°C
During storage/transport: −30°C to +60°C.

Relative air humidity
Maximum 95%.

Sound pressure level

<table>
<thead>
<tr>
<th>Motor [kW]</th>
<th>Speed stated on nameplate [min⁻¹]</th>
<th>Sound pressure level [dB(A)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5</td>
<td>1400-1500</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>1400-1500</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>74</td>
</tr>
<tr>
<td>11</td>
<td>1400-1500</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>75</td>
</tr>
<tr>
<td>15</td>
<td>1400-1500</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>75</td>
</tr>
<tr>
<td>18.5</td>
<td>1400-1500</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>75</td>
</tr>
<tr>
<td>22</td>
<td>1400-1500</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>2800-3000</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>3400-3600</td>
<td>78</td>
</tr>
</tbody>
</table>

Motor protection
The motor requires no external motor protection. The motor incorporates thermal protection against slow overloading and blocking.

Additional protection
If the motor is connected to an electric installation where an earth leakage circuit breaker is used as additional protection, this circuit breaker must be of the type:
• which is suitable for handling leakage currents and cutting-in with short pulse-shaped leakage.
• which trips out when alternating fault currents and fault currents with DC content, i.e. pulsating DC and smooth DC fault currents, occur.

For these pumps an earth leakage circuit breaker type B must be used.

This circuit breaker must be marked with the following symbols:

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

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

When the pump is switched on via the mains, it will start after approx. 5 seconds. If a higher number of starts and stops is desired, the input for external start/stop must be used when starting/stoping the pump. When the pump is started/stopped via an external on/off switch, it will start immediately.
Three-phase MMGE motors

Wiring diagram

3 x 380-415 V, +/- 10%, 50/60 Hz

Other connections

The connection terminals of external potential-free contacts for start/stop and digital function, external setpoint signal, sensor signal, GENIbus and relay signal are shown in Fig. 72.

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

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

1. Inputs (external start/stop, digital function, setpoint and sensor signals, terminals 1-8, and bus connection, terminals A, Y, B). All inputs (group 1) are internally separated from the mains-conducting parts by reinforced insulation and galvanically separated from other circuits. All control terminals are supplied by protective extra-low voltage (PELV), thus ensuring protection against electric shock.
2. Output (relay signal, terminals NC, NO, C). The output (group 2) is galvanically separated from other circuits. A maximum supply voltage of 250 V or protective extra-low voltage can be connected to the output as desired.

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

Fig. 72 Connection terminals

[Diagram showing wiring connections and terminal labels]
EMC and proper installation

General information

The growing use of electric/electronic controls and electronic equipment including PLCs and computers within all business areas require these products to fulfil the existing standards within EMC (ElectoMagnetic Compatibility). The equipment must be mounted properly.

This section deals with these issues.

What is EMC?

ElectoMagnetic Compatibility is an electric or electronic device's ability to function in a given electromagnetic environment without disturbing the surroundings and without being disturbed by other devices in the surroundings. EMC is normally split into emission and immunity.

Emission

Emission is defined as the electric or electromagnetic noise emitted by a device during operation and which can reduce the function of other devices or disturb various radio communications, including radio/TV.

Immunity

Immunity deals with a device's ability to function in spite of the presence of electric or electromagnetic noise, such as sparking noise from contactors or high-frequency fields from various transmitters, mobile phones, etc.

E-pumps and EMC

All Grundfos E-pumps are CE and C-tick marked indicating that the product is designed to meet the EMC requirements defined by the EU (European Union) and Australia / New Zealand.

EMC and CE

All E-pumps fulfil the EMC directive 89/336/EEC and are tested according to standard EN 61 800-3. All E-pumps are equipped with radio interference filter and varistors in the mains supply input, to protect the electronics against voltage peaks and noise present in the mains supply (immunity). At the same time, the filter will limit the amount of electrical noise which the E-pump emits to the mains supply network (emission). All remaining inputs included in the electronic unit will also be protected against peaks and noise which can damage or disturb the function of the unit.

On top of that, the mechanical and electronic designs are made in such a way that the unit can operate sufficiently under a certain level of radiated electromagnetic disturbance.

The limits which the E-pumps are tested against are listed in standard EN 61 800-3.

Where can E-pumps be installed?

All E-pumps with MGE motors can be used in both residential areas (first environment) and industrial areas (second environment) without any limitations.

E-pumps with MMGE motors are designed for industrial areas (second environment) only. If these pumps are used in residential areas, an additional EMC-filter between the E-pump and the power supply is required. For further information, see page 78.

What is meant by the first and the second environment?

The first environment (residential areas) includes establishments directly connected to a low-voltage power supply network which supplies domestic buildings.

The second environment (industrial areas) include establishments which are not connected to a low-voltage network that supplies domestic buildings. The level of electromagnetic disturbance can be expected to be much higher than in the first environment.
EMC and C-tick

All E-pumps marked with the C-tick logo fulfil the requirements for EMC in Australia and New Zealand.

The C-tick approval is based on the EN-standards and the units are therefore tested according to the European standard EN 61 800-3.

Only E-pumps with MGE-motors are marked with C-tick.

The C-tick only covers emission.

EMC and proper installation

With the CE and C-tick marks the E-pumps live up to and have been tested to meet specific EMC requirements. This, however, does not mean that E-pumps are immune to all the sources of noise to which they can be exposed in practice. In some installations the impact may exceed the level to which the product is designed and tested.

Furthermore, unproblematic operation in a noisy environment presupposes that the installation of the E-pump is made properly.

Below you will find a description of a correct E-pump installation.

Connection of mains supply in MGE

Practice shows that big cable loops are often made inside the terminal box to get some ‘spare cable’. Of course, this can be useful, however, with regard to EMC it is a poor solution as these cable loops will function as antennas inside the terminal box.

To avoid EMC problems, the mains supply cable and its individual conductors in the terminal box of the E-pump must be as short as possible. If required, spare cable can be established outside the E-pump.

Connecting sensor and equipment on other low-voltage inputs

All connections to control inputs (terminals 1-9) should be made with screened cables.

To obtain an efficient EMC protection the screen must be connected to earth/frame in both ends and be unbroken between the two connection places.

It is important that the screen is connected to earth/frame as direct as possible, i.e. by means of a metal cable bracket to encircle the screen completely, see Fig. 73.

To ensure a good connection between the cable bracket and earth/frame, any painting and surface treatment on the metal surfaces must be removed.

An intertwined screen at a length of a couple of cm (also called a pig’s tail) is a very bad closing as the pig’s tail can destroy the whole screen effect.

Connection to signal relay in E-pumps

Connection to relay (terminals NC, C, NO) should be made by means of a screened cable.

Provided the voltage used is low-voltage, the connection can be used together with the other control signals. Otherwise, a separate cable must be used.

Connection to GeniBus, A-Y-B

a) New installations

For the bus connection a screened 3-core cable must be used.

- If the E-pump is connected to an electronic unit, control panel, etc. with a cable clamp identical to the one on the E-pump, the screen must be connected to this cable clamp, see Fig. 74.
- If the unit or panel has no cable clamp as shown in Fig. 75, the screen is left unconnected at this end.

b) Replacing an existing pump

- If a screened 2-core cable is used in the existing installation, it must be connected as shown in Fig. 76. Make sure that the “pig’s tail” is as short as possible.
- If a screened 3-core cable is used in the existing installation, follow the instructions above for a) New installations.
EMC and proper installation

Connection in control panel
Control panels often contain contactors, relays, solenoid valves for pneumatics and other electromechanical components. These components and cables to and from these can be considered potential sources of noise and therefore, if possible, should be placed separately from any electronic equipment in the same panel. This means that a distance as long as possible should be kept to these, and the components should be screened against their influence.

Cable ducts should be divided so that cables to electronics and cables to contactors should be carried separately.

Back plate
Control panels are often made of metal and/or have a metal back plate. This back plate can therefore be used as reference for all screening, i.e. all screens are connected to this back plate via cable brackets.

When installing the cable brackets make sure that they have a good electrical connection to the metal back plate. Therefore, any painting and surface treatment must be removed.

Control signal from E-pumps to control panel
a) Unbroken control cable
An unbroken connection from the E-pump to the connection in the control panel is always preferable. Immediately after entry of the cable into the panel, remove a piece of insulation and connect the screen to the back plate via a cable bracket, see Fig. 77.

Connect the cable to the back plate of the control panel close to the final connection. The unscreened cable ends must be as short as possible.

b) Extension of control cable
If an extension of the screened control cable is required it must be made properly.

As Fig. 78 shows, both cable ends must be closed by a cable bracket to the common back plate and the unscreened cable ends must be as short as possible.

Other conditions of importance
Unscreened cable sections must be twisted pair cables and as short as possible.

Non-conductive panels
Control panels not made of metal and with metal back plate are generally a bad solution with regard to EMC.

In such cases, it is of great importance to be careful with the placing of the different types of unit and to keep distance between the noisy and sensitive units.

Cabling
Do not to place the control signal cables in the same bunch as the power cables. A distance of 10-20 cm between the two groups should be observed.
Control of E-pumps connected in parallel

As already described E-pumps represent a complete system consisting of pump, frequency converter, PI-controller and in some cases a sensor. E-pumps offer a closed loop control solution resulting in e.g. constant pressure in the system.

In some applications parallel pump operation is required for one or more of the following reasons:
- One pump cannot achieve the required performance (flow).
- Standby capacity is required to ensure reliability of supply.
- Overall efficiency needs to be improved in case of big variations in the flow demand.

The table below lists the different possibilities of parallel operation control:

<table>
<thead>
<tr>
<th>Parallel operation control possibilities</th>
<th>CRE, CRIE, CRNE with sensor</th>
<th>CRE, CRIE, CRNE, SPKE, CRXE, MTRE, CHIE without sensor</th>
<th>TPE, TPED Series 1000, NBE, NKE without sensor</th>
<th>TPE Series 2000</th>
<th>TPED Series 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in duty/standby function</td>
<td><img src="image" alt="Duty/Standby" /></td>
<td><img src="image" alt="Not active" /></td>
<td><img src="image" alt="In Installation" /></td>
<td><img src="image" alt="PMU2000" /></td>
<td><img src="image" alt="Control 2000/Delta Control 2000" /></td>
</tr>
<tr>
<td>Built-in alternating/standby function</td>
<td><img src="image" alt="PMU2000" /></td>
<td><img src="image" alt="" /></td>
<td><img src="image" alt="Control 2000/Delta Control 2000" /></td>
<td><img src="image" alt="PMU2000" /></td>
<td><img src="image" alt="Control 2000/Delta Control 2000" /></td>
</tr>
</tbody>
</table>

1) Applies only to three-phase CRE pumps up to 7.5 kW. See “Duty/standby” on page 26.
2) Applies only to TPED pumps with MGE up to 7.5 kW. See “Additional operating modes of TPED pumps” on page 32 and on page 46.

Some of the pumps in the E-pumps range have built-in control of two pumps in parallel:

**Duty/standby function for three-phase CRE pumps**

The “Duty/standby” function enables duty/standby operation of two CRE pumps connected in parallel. This means that:
- only one pump is operating at a time
- if a fault occurs in the operating pump, the idle pump (in standby) automatically starts up and a fault indication appears in the pump which was in operation
- the two pumps run alternately for 24 operating hours
- as the two pumps never operate at the same time both pump type, pump size and operating mode may differ.

The two pumps are connected by means of the GENIbus interface. The function is enabled by means of R100, see page 26.

CRE pumps running duty/standby in this way cannot use the GENIbus interface for remote communication.

**Note:** The function only applies for three-phase multi-stage pumps up to 7.5 kW.
**Control of E-pumps connected in parallel**

**Alternation / standby function for TPED Series 2000 pumps with MGE up to 7.5 kW**

All TPED Series 2000 pumps with MGE motor up to 7.5 kW have built-in alternation/standby function. The pumps are supplied with a special cable for the communication between the two pump heads. The function is activated from factory and “alternating” mode is selected as default, see page 32 and page 46.

**E-pumps controlled by external controllers**

E-pumps can be connected to control systems in the following two ways:


Both solutions enable parallel operation of several E-pumps of the same type and opens the possibility of communication with a Building Management System or other superior control system.

**TPE Series 2000 pumps controlled by PMU 2000**

Fig. 80 shows a pump system with three TPE Series 2000 pumps connected in parallel and controlled directly from a PMU 2000 via the Grundfos GENIbus. The PMU 2000 will cascade control the pumps according to the required pump performance and will offer a number of additional functions.

**E-pumps controlled by Control 2000 / Delta Control 2000**

All types of E-pumps connected in parallel can be controlled by a Control 2000 or a Delta Control 2000. The built-in PFU 2000 supplies the connected E-pumps with a common 0-10 V setpoint control signal and an individual start/stop command.

By means of R100 the E-pumps are set to “uncontrolled” operation or “constant curve” which means that control is carried out by Delta Control 2000/PFU 2000 (For further information about the setting of the pumps, see installation and operating instructions for Delta Control 2000).

Depending on the application, a suitable sensor (pressure, differential pressure, flow, temperature, differential temperature etc.) can be connected to Delta Control 2000.

The Control 2000 / Delta Control 2000 units are available with or without PMU 2000.

A PCU 2000 can also be connected to the GENIbus and...
communicate with a management system (SCADA). The PCU 2000 enables remote operating and fault indication for each individual pump. The PCU 2000 also enables external setpoint influence and system on/off.

A Control 2000 / Delta Control 2000 can only control one zone consisting of more pumps connected in parallel

The Control 2000 /Delta Control 2000 range consist of:

<table>
<thead>
<tr>
<th>Delta Control 2000, type...</th>
<th>Size</th>
<th>Number</th>
<th>Number of controlled pumps</th>
<th>Mode of operation</th>
<th>Please note</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME</td>
<td>Full-size</td>
<td>All</td>
<td>All</td>
<td>Speed control via frequency converter integrated in the motor.</td>
<td>All pumps in operation are running at the same speed (cascade control).</td>
</tr>
<tr>
<td>MEH</td>
<td>Half-size</td>
<td>2</td>
<td>2</td>
<td>Speed control via frequency converter integrated in the motor.</td>
<td>The two pumps are running at the same speed if both are in operation.</td>
</tr>
<tr>
<td></td>
<td>Full-size</td>
<td>The rest</td>
<td></td>
<td>Mains operation (start/stop).</td>
<td></td>
</tr>
<tr>
<td>MES</td>
<td>Full-size</td>
<td>1</td>
<td>1</td>
<td>Speed control via frequency converter integrated in the motor.</td>
<td>Mains operation (start/stop).</td>
</tr>
</tbody>
</table>

For further information, see data booklet for Hydro 2000 or Control 2000 / Delta Control 2000.
Bus communication with E-pumps

All Grundfos E-pumps are equipped with a field bus interface based on the RS485 hardware platform.

The bus is named GENIbus (Grundfos Electronics Network Intercommunication) and is a Grundfos developed bus with its own protocol. The GENIbus was first introduced in 1991 when Grundfos introduced the first pumps with integrated frequency converter and controller to the market.

Bus communication with E-pumps can take place in three different ways:

- Communication directly to Grundfos Pump Management System 2000 (only TPE Series 2000).
- Communication to other equipment like Building Management Systems (SCADA) via a Grundfos gateway and a standardised field bus e.g. Profibus.
- Communication to third party equipment via embedded Grundfos protocol software.

Communication to other equipment via a Grundfos gateway

E-pumps can communicate to management systems (SCADA) via a gateway which converts from the GENIbus to another field bus, like LONWorks, Profibus etc. Grundfos can offer two different gateways, G100 and G10.

**G100**

G100 can be connected to a Grundfos GENIbus system enabling data communication between a main network and any unit connected to the GENIbus. It is possible to connect 32 units to the GENIbus.

A unit may be a TPE pump or other Grundfos products with GENIbus interface. The main network may be another field bus or a radio, modem, PLC or a direct RS-232 connection.

G100 is available in four different versions:

- G100 with Interbus-S interface
- G100 with Profibus-DP interface
- G100 with Radio/Modem/PLC-interface (MODbus-RTU, COMLI)
- G100 basic version.

Communication G100 can communicate the following data points between the E-pumps and the management system:

<table>
<thead>
<tr>
<th>Data points</th>
<th>G100</th>
</tr>
</thead>
<tbody>
<tr>
<td>From management system (SCADA) to E-pump</td>
<td>Multistage E-pumps with or without sensor</td>
</tr>
<tr>
<td>Control mode</td>
<td>●</td>
</tr>
<tr>
<td>Setpoint 0-100%</td>
<td>●</td>
</tr>
<tr>
<td>Start/Stop</td>
<td>●</td>
</tr>
<tr>
<td>Max.</td>
<td>●</td>
</tr>
<tr>
<td>Min.</td>
<td>●</td>
</tr>
<tr>
<td>From E-pump to management system (SCADA)</td>
<td></td>
</tr>
<tr>
<td>Fault indication</td>
<td>●</td>
</tr>
<tr>
<td>Operating indication</td>
<td>●</td>
</tr>
<tr>
<td>Actual control mode</td>
<td>●</td>
</tr>
<tr>
<td>Actual head</td>
<td>●</td>
</tr>
<tr>
<td>Actual flow</td>
<td>●</td>
</tr>
<tr>
<td>Actual power consumption</td>
<td>●</td>
</tr>
<tr>
<td>Operating hours</td>
<td>●</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>●</td>
</tr>
<tr>
<td>Liquid temperature</td>
<td>●</td>
</tr>
<tr>
<td>Speed [rpm]</td>
<td>●</td>
</tr>
</tbody>
</table>

1) Control modes: Controlled/uncontrolled.
2) Control modes: Proportional pressure/constant pressure/constant curve.
3) Actual controlled value, depending of sensor type.

Communication directly to Grundfos Pump Management System 2000 (only TPE Series 2000)

As described above TPE Series 2000 pumps can be connected directly to PMU 2000 and PCU 2000 for multi-pump control and communication to management systems (SCADA).
Bus communication with E-pumps

**G10**
G10-LON interface is used for data transmission between a Local Operating Network (LON) and electronically controlled Grundfos pumps applying the Grundfos bus protocol GENIbus, like the E-pumps.

G10 is a point to point gateway, meaning that one G10 is needed per pump.

**Communication**
G10 can communicate the following data points between the E-pumps and the Management System:

<table>
<thead>
<tr>
<th>Data points</th>
<th>G10</th>
</tr>
</thead>
<tbody>
<tr>
<td>From management system (SCADA) to E-pump</td>
<td></td>
</tr>
<tr>
<td>Control mode</td>
<td>Multistage E-pumps with or without sensor</td>
</tr>
<tr>
<td>Setpoint 0-100%</td>
<td>●</td>
</tr>
<tr>
<td>Start/Stop</td>
<td>●</td>
</tr>
<tr>
<td>Min.</td>
<td>●</td>
</tr>
<tr>
<td>From E-pump to management system (SCADA)</td>
<td></td>
</tr>
<tr>
<td>Fault indication</td>
<td>●</td>
</tr>
<tr>
<td>Operating indication</td>
<td>●</td>
</tr>
<tr>
<td>Actual control mode</td>
<td>●</td>
</tr>
<tr>
<td>Actual head</td>
<td>●</td>
</tr>
<tr>
<td>Actual flow</td>
<td>●</td>
</tr>
<tr>
<td>Actual power consumption</td>
<td>●</td>
</tr>
<tr>
<td>Operating hours</td>
<td>●</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>●</td>
</tr>
<tr>
<td>Liquid temperature</td>
<td>●</td>
</tr>
<tr>
<td>Speed [rpm]</td>
<td>●</td>
</tr>
</tbody>
</table>

1) Control mode: Proportional pressure/constant pressure/constant curve.
2) Control modes: Constant pressure/constant flow/constant curve - depending of connected sensor type
3) Depending on connected sensor type. For a differential pressure sensor, had is indicated in [kPa]. If a flow sensor is connected, flow will be indicated in [m³/h] and if a temperature sensor is connected, liquid temperature will be indicated in [°C].

**Communication to third party equipment via embedded Grundfos protocol software**
Grundfos E-pumps can communicate to third party equipment/gateways, which have the Grundfos protocol software embedded.

Below is a list of companies supplying the equipment which can communicate with Grundfos E-pumps.

Contact Grundfos for further informations.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>XDriver</td>
<td>Andover Controls</td>
</tr>
<tr>
<td>Controlesta RCO</td>
<td>ELESTA</td>
</tr>
<tr>
<td>Metasys Modul INT-DX-GRNDFS</td>
<td>JOHNSON CONTROLS</td>
</tr>
<tr>
<td>SBM50/01 gateway</td>
<td>Kieback &amp; Peter</td>
</tr>
<tr>
<td>Universal-Gateway, BACnet</td>
<td>MBS (BACnet)</td>
</tr>
<tr>
<td>Gateway Compri HX</td>
<td>PRIVA</td>
</tr>
<tr>
<td>UnitPLUS gateway</td>
<td>Riccia &amp; Sohn</td>
</tr>
<tr>
<td>LS2-F660/P210, gateway</td>
<td>Saia-Burgess Controls</td>
</tr>
<tr>
<td>EYL 230</td>
<td>Sauter</td>
</tr>
<tr>
<td>PTM 5.32/5.216</td>
<td>Siemens Building Technologies</td>
</tr>
</tbody>
</table>
Frequency-controlled operation

Frequency converter, function and design

Frequency converter
As mentioned earlier speed control of pumps involves a frequency converter. So it will be relevant to have a closer look at what a frequency converter is, how it operates and finally to discuss related precautions involved in using a frequency converter.

Basic function and characteristics
It is a well-known fact that the speed of an asynchronous motor depends primarily on the pole number and the frequency of the supply voltage. The amplitude of the voltage supplied and the load on the motor shaft also influence the motor speed, however, not to the same degree. Consequently, changing the frequency of the supply voltage is an ideal method for asynchronous motor speed control. In order to ensure a correct motor magnetization it is also necessary to change the amplitude of the voltage.

Fig. 82 Displacement of motor torque characteristic

A frequency/voltage control results in a displacement of the torque characteristic whereby the speed is changed. Fig. 82 shows the motor torque characteristic (T) as a function of the speed (n) at two different frequencies/voltages. In the same diagram is also drawn the load characteristic of the pump. As it appears from the figure the speed is changed by changing frequency/voltage of the motor. The frequency converter changes frequency and voltage, so therefore we can conclude that the basic task of a frequency converter is to change the fixed supply voltage/frequency e.g. 3 x 400V/50 Hz into a variable voltage/frequency.

Components of the frequency converter
In principle, all frequency converters consist of the same functional blocks. As mentioned previously, the basic function is to convert the mains voltage supply into a new AC voltage with another frequency and amplitude.

First of all the frequency converter rectifies the incoming mains voltage and stores the energy in an intermediate circuit consisting of a capacitor. The resulting DC voltage is then converted to a new AC voltage with another frequency and amplitude. Because of the intermediate circuit in the frequency converter the frequency of the mains voltage has no direct influence on the output frequency and thus on the motor speed. It does not matter whether the frequency is 50 or 60Hz as the rectifier can handle both. Additionally, the incoming frequency will not influence the output frequency, as this is defined by the voltage/frequency pattern which is defined in the inverter. Keeping the above mentioned facts in mind, using a frequency converter in connection with asynchronous motors provides the following benefits:

- The system can be used in both 50 and 60 Hz areas without any modifications.
- The output frequency of the frequency converter is independent of the incoming frequency.
- The frequency converter can supply output frequencies which are higher than mains supply frequency - which makes oversynchronous operation possible.

Fig. 83 The main blocks, which a frequency converter consists of.

EMC-filter
This block is not part of the primary function of the frequency converter and therefore, in principle, could be left out. However, in order to meet the requirements of the EMC directive of the European Union or other local requirements the filter is necessary. The EMC filter ensures that the frequency converter does not send unacceptably high noise signals back to the mains thus disturbing other electronic equipment connected to the mains. At the same time the filter ensures that noise signals in the mains generated by other equipment do not enter the electronic components of the frequency converter causing damage or disturbances.

Rectifier
Single-phase MGE motors are equipped with a rectifier followed by a so-called PFC-circuit (PFC = Power Factor Correction). The purpose of this circuit is to ensure that the current input from the mains is sinusoidal and that the power factor is very close to 1.

The PFC-circuit is necessary in order to comply with EMC directive, standard EN 61000-3-2 stipulating the limits for harmonic current emissions. The detailed description of the PFC-circuit and its influence on its surroundings, see page 76.
In the three-phase MGE motors, the rectifier is a traditional rectifier without any power factor correction. This will result in a non-sinusoidal mains current. This subject will be covered later.

**Control circuit**

The control circuit block has two functions: It controls the frequency converter and at the same time it takes care of the entire communication between the product and the surroundings.

**The inverter**

The output voltage from a frequency converter is not sinusoidal as is the case for ordinary mains voltage. The voltage supplied to the motor consists of a number of square wave pulses - see Fig. 84.

The mean value of these pulses forms a sinusoidal voltage of the desired frequency and amplitude. The switching frequency can be from a few kHz and up to 20 kHz, depending on the type and size of the inverter.

To avoid noise generation in the motor windings a frequency converter with a switching frequency above the range of audibility (~16kHz) is preferable. This principle of inverter operation is called PWM (Pulse Width Modulation) control and it is the control principle, which is most common in frequency converters today. The motor current itself is almost sinusoidal. This is shown in Fig. 85 (a) indicating motor current (top) and motor voltage. In Fig. 85 (b) a section of the motor voltage is shown. This indicates how the pulse/pause ratio of the voltage changes.

**Special conditions regarding frequency converters**

When installing and using frequency converters, or pumps with integrated frequency converters, the installer and user must take account of the following. A frequency converter will behave differently on the mains supply side than a standard asynchronous motor. This is described in detail below.

**Non-sinusoidal power input, frequency converters supplied by three-phase supply**

A frequency converter designed as the one described above will not receive sinusoidal current from the mains. Among other things this will influence the dimensioning of mains supply cable, mains switch etc. Fig. 86 shows how mains current and voltage appear for:

a) three-phase, two-pole standard asynchronous motor

b) three-phase, two-pole standard asynchronous motor with frequency converter.

In both cases the motor supplies 3 kW to the shaft.

**Fig. 84** The voltage supplied to the motor consists of a number of square wave pulses.

![Fig. 84](image)

**Fig. 85**

a) indicates motor current (top) and motor voltage. 

b) indicates a section of the motor voltage.

**Fig. 86** Mains current and voltage for

a) a standard asynchronous motor and 

b) a three-phase MGE motor.
Frequency-controlled operation

A comparison of the current in the two cases shows the following differences, see Fig. 86.

- The current for the system with frequency converter is not sinusoidal.
- The peak current is much higher (approx. 52% higher) for the frequency converter solution.

This is due to the design of the frequency converter connecting the mains to a rectifier followed by a capacitor. The charging of the capacitor happens during short time periods in which the rectified voltage is higher than the voltage in the capacitor at that moment. As mentioned above the non-sinusoidal current results in other conditions at the mains supply side of the motor. For a standard motor without a frequency converter the relation between voltage \((U)\), current \((I)\) and power \((P)\) is as follows:

\[
P = \sqrt{3} \cdot U \cdot I \cdot \cos \phi
\]

where \((U)\) is the voltage between two phases and \((I)\) is the phase current, both effective values (RMS values), and \(\phi\) is phase displacement between current and voltage. In the example the following applies:

\[
U = 400 \text{ V}, I = 6.2 \text{ A}, \cos \phi = 0.83.
\]

The result is a power input of \(P = 3.57 \text{ kW}\).

The same formula cannot be used for the calculation of the power input in connection with motors with frequency converters. In fact, in this case, there is no safe way of calculating the power input, based on simple current and voltage measurements, as these are not sinusoidal. Instead, the power must be calculated by means of instruments and on the basis of instantaneous measurements of current and voltage.

If the power \((P)\) is known as well as the RMS value of current and voltage, the so-called power factor \((PF)\) can be calculated using this formula:

\[
PF = \frac{P}{\sqrt{3} \cdot U \cdot I}
\]

Unlike what is the case when current and voltage are sinusoidal, the power factor has no direct connection with the way in which current and voltage are displaced in time.

For MGE motors the following values are provided as a guideline to the power factor depending on motor size:

<table>
<thead>
<tr>
<th>Motor size</th>
<th>Power factor (PF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75 kW</td>
<td>0.67</td>
</tr>
<tr>
<td>1.1 kW</td>
<td>0.72</td>
</tr>
<tr>
<td>1.5 kW</td>
<td>0.74</td>
</tr>
<tr>
<td>2.2 kW</td>
<td>0.78</td>
</tr>
<tr>
<td>3.0 kW</td>
<td>0.84</td>
</tr>
<tr>
<td>4.0 kW</td>
<td>0.85</td>
</tr>
<tr>
<td>5.5 kW</td>
<td>0.85</td>
</tr>
<tr>
<td>7.5 kW</td>
<td>0.86</td>
</tr>
</tbody>
</table>

When measuring the input current in connection with installation and service of a system with frequency converter it is necessary to use an instrument that is capable of measuring "non-sinusoidal" currents. In general, current measuring instruments for frequency converters must be of a type measuring "True RMS".

Power input, frequency converters supplied by single-phase supply

Single-phase MGE motors are equipped with the so-called PFC-circuit, which generally speaking ensures sinusoidal power input from the mains. The PFC-circuit also ensures that the current is in phase with the voltage in order to achieve a power factor close to 1. When \(PF = 1\) the input current to the MGE motor will be as low as possible.

Fig. 87 shows the mains voltage and current for a 1.1 kW MGE motor with PFC-circuit. As appears the mains current is more or less sinusoidal and in phase with the voltage.

For comparison Fig. 88 shows current and voltage in Grundfos’ first generation of MGE motors without PFC-circuit. Note that the current has a very high peak value and runs over a very short time.

<table>
<thead>
<tr>
<th>Power input, P1</th>
<th>Cos (\phi), power factor (PF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75 kW</td>
<td>(0.67)</td>
</tr>
<tr>
<td>1.1 kW</td>
<td>(0.72)</td>
</tr>
<tr>
<td>1.5 kW</td>
<td>(0.74)</td>
</tr>
<tr>
<td>2.2 kW</td>
<td>(0.78)</td>
</tr>
<tr>
<td>3.0 kW</td>
<td>(0.84)</td>
</tr>
<tr>
<td>4.0 kW</td>
<td>(0.85)</td>
</tr>
<tr>
<td>5.5 kW</td>
<td>(0.85)</td>
</tr>
<tr>
<td>7.5 kW</td>
<td>(0.86)</td>
</tr>
</tbody>
</table>

\[
P = \frac{3}{\sqrt{3}} \cdot U \cdot I \cdot \cos \phi
\]
Frequency-controlled operation

The following table illustrates the difference between a single-phase MGE motor without and with PFC-circuit, respectively:

<table>
<thead>
<tr>
<th></th>
<th>MGE motor without PFC</th>
<th>MGE motor with PFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mains voltage</td>
<td>230 V</td>
<td>230 V</td>
</tr>
<tr>
<td>Power input, P1</td>
<td>1.57 kW</td>
<td>1.58 kW</td>
</tr>
<tr>
<td>Mains current RMS</td>
<td>13.1 A</td>
<td>7.1 A</td>
</tr>
<tr>
<td>Mains current, peak</td>
<td>48.2 A</td>
<td>11.1 A</td>
</tr>
<tr>
<td>Crest factor</td>
<td>3.7</td>
<td>1.56</td>
</tr>
<tr>
<td>Cos ϕ, power factor (PF)</td>
<td>0.53</td>
<td>0.97</td>
</tr>
</tbody>
</table>

As appears from the table, power factor and mains current are substantially better for an MGE motor with PFC-circuit.

Power factor and typical input mains current at rated load have the following values for the new single-phase MGE motor range:

<table>
<thead>
<tr>
<th>Motor P2</th>
<th>PF</th>
<th>Input current at rated voltage (230 V) and rated P2 at 2840 rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.37 kW</td>
<td>0.95</td>
<td>2.6 A</td>
</tr>
<tr>
<td>0.55 kW</td>
<td>0.96</td>
<td>3.8 A</td>
</tr>
<tr>
<td>0.75 kW</td>
<td>0.96</td>
<td>5.0 A</td>
</tr>
<tr>
<td>1.1 kW</td>
<td>0.97</td>
<td>7.1 A</td>
</tr>
</tbody>
</table>

As mentioned previously, the PFC-circuit is a result of the requirements of EN 61000-3-2 concerning limits for harmonic current emissions. EN 61000-3-2 is a harmonised standard under the EMC directive 89/336/EEC, and the purpose is to ensure that the mains are not “contaminated” by non-sinusoidal loads which have a tendency to distort the waveform of the mains voltage and furthermore cause unnecessarily high peak currents in the mains.

The requirements of EN 61000-3-2 can be summarised as follows:

- Class A products must comply with the limits for harmonic current emissions laid down by the standard.
- The standard is applicable to all equipment connected to the public mains supply network with an input current up to 16 A.

**Note:** Exempted from this are

- products with an input current lower than 75 W
- products exclusively designed for professional use with an input current exceeding 1 kW.

As appears the standard does NOT apply to professional equipment with an input current from the mains above 1 kW. In principle, this means that the standard does not apply to Grundfos’ 0.75 and 1.1 kW (P2) MGE motors as their input power from the mains exceeds 1 kW. Nevertheless, due to the obvious advantages of the PFC-circuit it has been decided that the entire range of single-phase E-pumps from 0.37 kW up to and including 1.1 kW must comply with the standard.

The PFC-circuit features the following advantages for the customer:

- Compliance with EN 61000-3-2 concerning harmonic current emissions.
- The pump current input is more or less sinusoidal and the power factor (PF) is very close to 1 (0.95 - 0.97).

In practical terms this means that

- the RMS-value of the current is 40 - 50% lower than for single-phase E-pumps without PFC-circuit
- cables with a lower cross-section can be used
- smaller fuses are required in the installation
- when connecting several pumps supplied by different phases in parallel, the current in the common neutral lead will be balanced so that the neutral lead current will never exceed the current in any one of the mains phases.

- The pump is less sensitive to variations in the mains voltage (the MGE motor can yield full power with the entire mains voltage supply range 200 - 240 V +/-10% corresponding to 180 - 264 V).

**Frequency converters and earth leakage circuit breakers (ELCB)**

Earth leakage circuit breakers are used increasingly as extra protection in electrical installations. If a frequency converter is to be connected to such an installation it must be ensured that the ELCB installed is of a type which will surely break - also if failure occurs on the DC side of the frequency converter.

The circuit breakers must be labelled as follows in order to ensure correct functioning:

- For single-phase MGE motors the ELCB circuit breaker must be labelled as follows:

  ![Single-Phase ELCB Label](image1)

- For three-phase MGE motors the ELCB circuit breaker must be labelled as follows:

  ![Three-Phase ELCB Label](image2)

Both types of earth leakage circuit breaker are available in the market today.
### Remote control, R100

R100 is used for wireless communication with the pump. The communication takes place by means of infrared light.

### Potentiometer

Potentiometer for setpoint setting and start/stop of the pump.

<table>
<thead>
<tr>
<th>Product</th>
<th>Product number</th>
</tr>
</thead>
<tbody>
<tr>
<td>External potentiometer with cabinet for wall mounting</td>
<td>625468</td>
</tr>
</tbody>
</table>

### G10-LON

The G10-LON interface is used in connection with data transmission between a Locally Operating Network (LON) and electronically controlled Grundfos pumps applying the Grundfos GENibus protocol.

For further information about G10-LON, see page 85.

<table>
<thead>
<tr>
<th>Product</th>
<th>Product number</th>
</tr>
</thead>
<tbody>
<tr>
<td>G10-LON interface</td>
<td>00605726</td>
</tr>
</tbody>
</table>

### G100

G100 can be connected to a GRUNDFOS GENibus system enabling data communication between a main network and any unit connected to the GENibus. It is possible to connect 32 units to the GENibus.

A unit may be any E-pump with the GENibus connection.

The main network may be another field bus or a radio, modem, PLC or a direct RS-232 connection.

G100 is available in four different versions:

<table>
<thead>
<tr>
<th>Product</th>
<th>Product number</th>
</tr>
</thead>
<tbody>
<tr>
<td>G100 with Interbus-S interface</td>
<td>96411134</td>
</tr>
<tr>
<td>G100 with Profibus-DP interface</td>
<td>96411135</td>
</tr>
<tr>
<td>G100 with Radio/Modem/PLC-interface (MODbus, COMLI)</td>
<td>96411136</td>
</tr>
<tr>
<td>G100 basic version</td>
<td>96411137</td>
</tr>
<tr>
<td>PC Tool G100 package(^1)</td>
<td>96415783</td>
</tr>
</tbody>
</table>

\(^1\) The PC Tool will be delivered with G100, but additional tools can be ordered.

For further information about G100, see page 86.

### EMC-filters for MMGE motors

<table>
<thead>
<tr>
<th>Product</th>
<th>Product number</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC-filter for MMGE motors 7.5 - 22 kW</td>
<td>96478309</td>
</tr>
</tbody>
</table>

For further information about EMC-filters, see page 84.
LiqTec

The LiqTec unit (module + sensor) protects pump and process against dry running.

Note: For motor temperature monitoring of E-pumps, the LiqTec must not be connected to the PTC sensor of the pump as the motor software provides protection against too high motor temperature. The LiqTec is mainly used in connection with the CRE, CRIE, CRNE pump types. The sensor is fitted in the pump head. The LiqTec is also suitable for other E-pump types. LiqTec is prepared for DIN rail mounting in control cabinet.

Enclosure class: IP X0.

For further information about LiqTec, see page 87.

<table>
<thead>
<tr>
<th>Dry-running protection</th>
<th>Pump type</th>
<th>Voltage [V]</th>
<th>LiqTec</th>
<th>Sensor ½”</th>
<th>Cable 5 m</th>
<th>Extension cable 15 m</th>
<th>Product number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CRE, CRIE, CRNE, MTRE, SPKE, CRKE, CHIE</td>
<td>200-240</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>96443674</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CRE, CRIE, CRNE, MTRE, SPKE, CRKE, CHIE</td>
<td>80-130</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>96463912</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>96443676</td>
</tr>
</tbody>
</table>
### Sensors

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Type</th>
<th>Supplier</th>
<th>Measuring range</th>
<th>Product number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure sensor</td>
<td>MBS 3000</td>
<td>Danfoss</td>
<td>0 - 2.5 bar</td>
<td>96478188</td>
</tr>
<tr>
<td>• Connection: G ½ A</td>
<td></td>
<td></td>
<td>0 - 4 bar</td>
<td>91072075</td>
</tr>
<tr>
<td>(DIN 16288 - B6kt)</td>
<td></td>
<td></td>
<td>0 - 6 bar</td>
<td>91072076</td>
</tr>
<tr>
<td>• Electrical connection: plug</td>
<td></td>
<td></td>
<td>0 - 10 bar</td>
<td>91072077</td>
</tr>
<tr>
<td>(DIN 43650)</td>
<td></td>
<td></td>
<td>0 - 16 bar</td>
<td>91072078</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 - 25 bar</td>
<td>91072079</td>
</tr>
<tr>
<td>Flowmeter</td>
<td>MAGFLO MAG 3100/5000</td>
<td>Siemens</td>
<td>1 - 5 m³ (DN 25)</td>
<td>ID8285</td>
</tr>
<tr>
<td></td>
<td>MAGFLO MAG 3100/5000</td>
<td>Siemens</td>
<td>3 - 10 m³ (DN 40)</td>
<td>ID8286</td>
</tr>
<tr>
<td></td>
<td>MAGFLO MAG 3100/5000</td>
<td>Siemens</td>
<td>6 - 30 m³ (DN 65)</td>
<td>ID8287</td>
</tr>
<tr>
<td>Temperature sensor</td>
<td>TTA (0) 25</td>
<td>Carlo Gavazzi</td>
<td>0°C to +25°C</td>
<td>96432591</td>
</tr>
<tr>
<td>Temperature sensor</td>
<td>TTA (-25) 25</td>
<td>Carlo Gavazzi</td>
<td>–25°C to +25°C</td>
<td>96430194</td>
</tr>
<tr>
<td>Temperature sensor</td>
<td>TTA (50) 100</td>
<td>Carlo Gavazzi</td>
<td>+50°C to +100°C</td>
<td>96432592</td>
</tr>
<tr>
<td>Temperature sensor</td>
<td>TTA (0) 150</td>
<td>Carlo Gavazzi</td>
<td>0°C to +150°C</td>
<td>96430195</td>
</tr>
<tr>
<td>Accessory for temperature sensor.</td>
<td>Protecting tube</td>
<td>Carlo Gavazzi</td>
<td>ø9 x 50 mm</td>
<td>96430201</td>
</tr>
<tr>
<td>All with ½ RG connection</td>
<td>Protecting tube</td>
<td>Carlo Gavazzi</td>
<td>ø9 x 100 mm</td>
<td>96430202</td>
</tr>
<tr>
<td></td>
<td>Cutting ring bush</td>
<td>Carlo Gavazzi</td>
<td></td>
<td>96430203</td>
</tr>
<tr>
<td>Temperature sensor, ambient</td>
<td>WR S2 tmg</td>
<td>Honsberg</td>
<td>–50°C to +50°C</td>
<td>96409362</td>
</tr>
<tr>
<td>temperature</td>
<td>(DK: Plesner)</td>
<td></td>
<td></td>
<td>96409363</td>
</tr>
<tr>
<td>Differential temperature sensor</td>
<td>ETSO</td>
<td>Honsberg</td>
<td>0°C to +20°C</td>
<td>96440089</td>
</tr>
<tr>
<td>Differential temperature sensor</td>
<td>ETSO</td>
<td>Honsberg</td>
<td>0°C to +50°C</td>
<td>96440089</td>
</tr>
</tbody>
</table>

**Danfoss pressure sensor kits consisting of..**

- Danfoss pressure transmitter, type MBS 3000, with 2 m screened cable
- Connection: G ½ A (DIN 16288 - B6kt)
- 5 cable clips (black)
- Instruction manual PT (00 40 02 12)

<table>
<thead>
<tr>
<th>Pressure range</th>
<th>Product number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4 bar</td>
<td>96428014</td>
</tr>
<tr>
<td>0 - 6 bar</td>
<td>96428015</td>
</tr>
<tr>
<td>0 - 10 bar</td>
<td>96428016</td>
</tr>
<tr>
<td>0 - 16 bar</td>
<td>96428017</td>
</tr>
<tr>
<td>0 - 25 bar</td>
<td>96428018</td>
</tr>
</tbody>
</table>

**HUBA differential pressure sensor kit consisting of..**

- 1 sensor incl. 1.5 m screened cable (7/16" connections)
- 1 original HUBA bracket (for wall mounting)
- 1 GRUNDFOS bracket (for mounting on motor)
- 2 M4 screws for mounting of sensor on bracket
- 1 M6 screw (self-cutting) for mounting on MGE 90/100
- 1 M8 screw (self-cutting) for mounting on MGE 112/132
- 2 capillary tubes (short/long)
- 2 brackets (1/4" - 7/16")
- 5 cable clips (black)

<table>
<thead>
<tr>
<th>Pressure range</th>
<th>Product number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 0.6 bar</td>
<td>485450</td>
</tr>
<tr>
<td>0 - 1 bar</td>
<td>485441</td>
</tr>
<tr>
<td>0 - 1.6 bar</td>
<td>485442</td>
</tr>
<tr>
<td>0 - 2.5 bar</td>
<td>485443</td>
</tr>
<tr>
<td>0 - 4 bar</td>
<td>485444</td>
</tr>
<tr>
<td>0 - 6 bar</td>
<td>485445</td>
</tr>
<tr>
<td>0 - 10 bar</td>
<td>96440089</td>
</tr>
</tbody>
</table>

**Fitting kit for TPED with two sensors**

96491010

**Note:** All sensors have 4-20 mA signal output.
Differential pressure sensor, HUBA Control, type 692

Product description
Differential pressure sensor made of DIN W.-Nr. 1.4305 INOX (Pos. 4) with anodized aluminium cover (Pos. 2), 7/16" UNF nickelled connections (Pos. 5) and black, screened cable (Pos. 1) embedded in the sensor. Supplied with angular bracket for mounting on motor and bracket for wall mounting.

Venting screws (Pos. 3) must not be loosened.

Materials of sensor housing parts in contact with the liquid: DIN W.-Nr. 1.4305 INOX and FPM; sensor diaphragm of ceramic material.

Supply voltage: 11-33 VDC.
Output signal: 4-20 mA.

Technical data

<table>
<thead>
<tr>
<th>HUBA Control Type 692</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grundfos product number</td>
</tr>
<tr>
<td>Pressure ranges/differential pressure [bar]</td>
</tr>
<tr>
<td>Supply voltage</td>
</tr>
<tr>
<td>Output signal</td>
</tr>
<tr>
<td>Load (Ω)</td>
</tr>
<tr>
<td>Max. overload on one side [bar]</td>
</tr>
<tr>
<td>Max. system pressure, P1 and P2 simultaneously [bar]</td>
</tr>
<tr>
<td>Rupture pressure [bar]</td>
</tr>
<tr>
<td>Measuring accuracy</td>
</tr>
<tr>
<td>Response time, t(0.9)</td>
</tr>
<tr>
<td>Liquid and ambient temperatures</td>
</tr>
<tr>
<td>Temperature sensitivity</td>
</tr>
<tr>
<td>Electrical connections</td>
</tr>
<tr>
<td>Short-circuit-proof</td>
</tr>
<tr>
<td>Protected against polarity reversal</td>
</tr>
<tr>
<td>Materials in contact with liquid</td>
</tr>
<tr>
<td>Enclosure class</td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>EMC (electromagnetic compatibility)</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Dimensional sketch

Installation
The HUBA sensor is mounted on a bracket. P2 is connected to the suction side of the pump (lowest pressure) and P1 to the discharge side of the pump (highest pressure). Do not turn the sensor connections. As far as E-pumps are concerned, the cable from the sensor is connected to pump terminals (7) and (8).

Wiring diagram
Temperature sensor, TTA

Product description

Temperature sensor with Pt100 temperature sensor mounted in a ø6 x 100 mm measuring tube made of stainless steel, DIN W.-Nr. 1.4571 and a 4-20 mA sensor built into a type B head DIN 43.729.

The connecting head is made of painted pressure die-cast aluminium with Pg 16 screwed connection, stain- less screws and neoprene rubber gasket.

The sensor is built into the system either by means of a cutting ring bush or by means of one of the two matching protecting tubes ø9 x 100 mm or ø9 x 50 mm, respectively.

The protecting tube has G 1/2 connection.

Cutting ring bush or protecting tube must be ordered separately.

Technical data

<table>
<thead>
<tr>
<th>Type</th>
<th>Product number</th>
<th>Measuring range</th>
<th>Measuring accuracy</th>
<th>Response time, t_{0.9} \ (0.9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTA (–25) 25</td>
<td>96430194</td>
<td>–25°C to 25°C</td>
<td>According to IEC 751, class B, 0.3°C at 0°C</td>
<td>28 secs.</td>
</tr>
<tr>
<td>TTA (0) 25</td>
<td>96432591</td>
<td>0°C to 25°C</td>
<td>with oil-filled protecting tube: 75 secs.</td>
<td></td>
</tr>
<tr>
<td>TTA (0) 150</td>
<td>96430195</td>
<td>0°C to 150°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TTA (50) 100</td>
<td>96432592</td>
<td>50°C to 100°C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Product number</th>
<th>Measuring range</th>
<th>Measuring accuracy</th>
<th>Response time, t_{0.9} \ (0.9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Product number</th>
<th>Measuring range</th>
<th>Measuring accuracy</th>
<th>Response time, t_{0.9} \ (0.9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Product number</th>
<th>Measuring range</th>
<th>Measuring accuracy</th>
<th>Response time, t_{0.9} \ (0.9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Product number</th>
<th>Measuring range</th>
<th>Measuring accuracy</th>
<th>Response time, t_{0.9} \ (0.9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Product number</th>
<th>Measuring range</th>
<th>Measuring accuracy</th>
<th>Response time, t_{0.9} \ (0.9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Product number</th>
<th>Measuring range</th>
<th>Measuring accuracy</th>
<th>Response time, t_{0.9} \ (0.9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
<tr>
<td>Type</td>
<td>Product number</td>
<td>Measuring range</td>
<td>Measuring accuracy</td>
<td>Response time, t_{0.9} \ (0.9)</td>
</tr>
</tbody>
</table>

Accessories

<table>
<thead>
<tr>
<th>Type</th>
<th>Product number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protecting tube ø9 x 50 mm</td>
<td>96430201</td>
<td></td>
</tr>
<tr>
<td>Protecting tube ø9 x 100 mm</td>
<td>96430202</td>
<td></td>
</tr>
<tr>
<td>Protecting tube ø9 x 100 mm</td>
<td>96430203</td>
<td></td>
</tr>
<tr>
<td>Cutting ring bush</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dimensional sketch

Connection of sensor

As far as E-pumps are concerned, the cable from the sensor is connected to pump terminals (7) and (8).
Differential temperature sensor, HONSBERG

Product description

The temperature sensors T1 and T2 measure the temperature in their respective location at the same time. Besides the temperature measurement, the T1 features an electronic unit calculating the temperature difference between T1 and T2 and transmitting the result as a 4-20 mA signal via a current amplifier. As the measured signal transmitted from the T2 is also a current signal, a relatively large distance is allowed between T2 and T1. As will appear from the figure on the right, it has no effect on the output signal ‘Iout’ which of the sensors that measures the highest temperature.

Thus, the current signal generated will always be positive between 4 and 20 mA.

Technical data

<table>
<thead>
<tr>
<th>Type</th>
<th>ETSD1-04-020 + K045</th>
<th>ETSD1-04-050 + K045</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product number</td>
<td>96409362</td>
<td>96409363</td>
</tr>
<tr>
<td>Measuring range: Temperature difference (T1-T2) or (T2-T1)</td>
<td>0°C to 20°C</td>
<td>0°C to 50°C</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>15–30 VDC</td>
<td></td>
</tr>
<tr>
<td>Output signal</td>
<td>4–20 mA</td>
<td></td>
</tr>
<tr>
<td>Measuring accuracy</td>
<td>± 0.3% FS</td>
<td></td>
</tr>
<tr>
<td>Repeatability</td>
<td>±1% FS</td>
<td></td>
</tr>
<tr>
<td>Response time, t(0.9)</td>
<td>2 minutes</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>–25°C to 85°C</td>
<td></td>
</tr>
<tr>
<td>Operating temperature of T1 and T2</td>
<td>–25°C to 105°C</td>
<td></td>
</tr>
<tr>
<td>Max. distance between T1 and T2</td>
<td>300 m with screened cable</td>
<td></td>
</tr>
<tr>
<td>Electrical connection</td>
<td>Between T1 and T2: M 12 x 1 plug (incl. in kit), output signal with DIN 43650-A plug type</td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>–45°C to 125°C</td>
<td></td>
</tr>
<tr>
<td>Short-circuit-proof</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Protected against polarity reversal</td>
<td>Yes, up to 40 V</td>
<td></td>
</tr>
<tr>
<td>Materials in contact with liquid</td>
<td>DIN W.-Nr. 1.4571 stainless steel</td>
<td></td>
</tr>
<tr>
<td>Enclosure class</td>
<td>IP 65</td>
<td></td>
</tr>
<tr>
<td>EMC (electromagnetic compatibility)</td>
<td>Emission: According to EN 50 081</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Immunity: According to EN 50 082</td>
<td></td>
</tr>
</tbody>
</table>

Installation

The two sensors must be fitted in such a way that the sensing elements are located in the middle of the flow of the liquid to be measured.

For tightening, use only the hexagon nut. The upper part of the sensors may be turned to any position suitable for the connection of cables.

The sensors have G 1/2 thread, see dimensional sketch. As far as E-pumps are concerned, the cable from sensor T1 is to be connected to pump terminals (7) and (8).

Wiring diagram

Use screened cable when distance > 3 m
Accessories

EMC-filter

If E-pumps with MMGE 7.5-22 kW are going to be used unrestricted in residential areas, an additional EMC-filter must be installed between the power supply and the E-pump.

For information regarding EMC, see “EMC and proper installation” on page 66.

Product number and content of kit

Product number:  96478309

Content of kit:
Filter in IP 54 aluminium cabinet

For connection to the motor terminal box:
• 1 reducer from M40 x 1.5 to M32 x 1.5
• 1 EMC nut M40 x 1.5
• 1 EMC cable gland M32 x 1.5.

Installation and operating instructions.

Technical data

Mains connection: 380 - 480 V, 50/60Hz
Maximum load: 50 A
Enclosure class: IP 54
Weight: 12 kg.

Mounting of EMC filter

Mount the filter on an even surface. See dimensional sketch below.

Wiring diagram

To meet CISPR 11, class B, group 1, the cable between filter and motor must be a screened cable, see figure below, pos. 1. The ends of the screened cable must be terminated with EMC cable glands to ensure correct functioning of the filter. The normal cable glands in the MMGE motor has to be exchanged with special EMC cable gland supply in this kit.

Make sure that the screened cable has at least the same current value as the mains cable, pos. 2.

The screened cable is not included in the kit.
Accessories

G10-LON

The G10-LON interface is used for data transmission between a Local Operating Network (LON) and electronically controlled Grundfos pumps applying the Grundfos GENIbus protocol, such as the E-pumps. G10 is a point to point gateway, meaning that one G10 is needed per pump.

![G10-LON Interface](image)

Electrical data

<table>
<thead>
<tr>
<th></th>
<th>Pump to G10-LON</th>
<th>G10 to LON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transceiver type</td>
<td>RS 485</td>
<td>FTT - 10</td>
</tr>
<tr>
<td>Recommended cable</td>
<td>Cable: screened, twisted-pair</td>
<td>Cable: twisted-pair cable, unscreened.</td>
</tr>
<tr>
<td>Cross section:</td>
<td>0.25 - 1 mm²</td>
<td></td>
</tr>
<tr>
<td>Max. cable length:</td>
<td>1200 m.</td>
<td></td>
</tr>
<tr>
<td>Transmission speed</td>
<td>9.6 kBits/sec.</td>
<td>78 kBits/sec.</td>
</tr>
<tr>
<td>Protocol</td>
<td>GENIbus</td>
<td>LonTalk®</td>
</tr>
<tr>
<td>Voltage supply</td>
<td>24 VAC/VDC +/-25%</td>
<td></td>
</tr>
<tr>
<td>Current consumption</td>
<td>Approx. 100 mA</td>
<td></td>
</tr>
<tr>
<td>Enclosure class</td>
<td>IP 42</td>
<td></td>
</tr>
<tr>
<td>Cable entries</td>
<td>3 x Pg7</td>
<td></td>
</tr>
</tbody>
</table>

Operating data

Ambient temperature: 0°C to 60°C
Storage temperature: -30°C to +70°C.

Service LED

The service LED on the front plate of the G10-LON interface is a light-emitting diode indicating various conditions of the LON network.

For further information, see the documentation files on the floppy disk supplied with the G10-LON interface.

LON Support files

A disk with the support files (.xif and .nx) is supplied with the LON-module.

Dimensions and connections

Dimensions are stated in mm.

![Dimensions and Connections](image)
G100

G100 can be connected to a Grundfos GENIbus system enabling data communication between a main network and any unit connected to the GENIbus. It is possible to connect 32 units to GENIbus.

A unit may be a TPE pump with GENIbus interface. The main network may be another field bus or a radio, modem, PLC or a direct RS-232 connection.

G100 is available in four different versions:
• G100 with Interbus-S interface
• G100 with Profibus-DP interface
• G100 with Radio/Modem/PLC-interface (MODbus-RTU, COMLI)
• G100 basic version.

Data logging

Besides the possibility of data communication, G100 also offers logging of up to 350,000 time-stamped data. Subsequently, the logged data can be transmitted to the main system or a PC for further analysis in a spreadsheet or similar program.

For the data logging, the "PC Tool G100 Data Log" software tool is used. The tool is part of the PC Tool G100 package which is supplied with G100.

Other features
• Four digital inputs.
• Stop of all pumps in case of failing communication with the management system (optional).
• Access code for modem communication (optional).
• Alarm log.

Dimensions

Technical data

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENIbus RS-485</td>
<td>Connection of up to 32 units</td>
</tr>
<tr>
<td>Service port RS-232</td>
<td>For direct connection to a PC or via radio modem</td>
</tr>
<tr>
<td>Digital inputs</td>
<td>4</td>
</tr>
<tr>
<td>Voltage supply</td>
<td>1 x 110-240 V, 50/60 Hz</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>–20°C to +60°C</td>
</tr>
<tr>
<td>Enclosure class</td>
<td>IP 20</td>
</tr>
<tr>
<td>Weight</td>
<td>1.8 kg</td>
</tr>
</tbody>
</table>

Accessories
• PC Tool G100 package (supplied with the product)
• G100 Support Files CD-ROM (supplied with the product).

Overview of protocols

<table>
<thead>
<tr>
<th>Main system</th>
<th>Software protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERBUS-S</td>
<td>PCP</td>
</tr>
<tr>
<td>PROFIBUS-DP</td>
<td>DP</td>
</tr>
<tr>
<td>Radio</td>
<td>Salt Control COMLI/MODbus</td>
</tr>
<tr>
<td>Modem</td>
<td>Salt Control COMLI/MODbus</td>
</tr>
<tr>
<td>PLC</td>
<td>Salt Control COMLI/MODbus</td>
</tr>
<tr>
<td>GSM mobile phone</td>
<td>SMS, UCP</td>
</tr>
</tbody>
</table>

Port 1

- GENI TxD
- GENI RxD
- POWER MNC
- POWER GENI
- DCD
- RTS
- TxD1
- RxD1
- TxD2
- RxD2

Port 2

- GENIbus DI Service
- Main system Software protocol
  - INTERBUS-S PCP
  - PROFIBUS-DP DP
  - Radio Salt Control COMLI/MODbus
  - Modem Salt Control COMLI/MODbus
  - PLC Salt Control COMLI/MODbus
  - GSM mobile phone SMS, UCP
LiqTec

Description
The LiqTec

- protects the pump against dry-running.
- protects the pump against too high liquid temperature (130°C ±5°C).
- can monitor the motor temperature if the PTC sensor in the motor has been connected.
- has a fail-safe design. If the sensor, sensor cable, electronic unit or power supply fails, the pump stops immediately.

Mounting the LiqTec sensor
The LiqTec can be fitted to a DIN rail to be incorporated in a control cabinet.

Electrical connection
Example of electrical connection, see page 89.

Calibration of sensor and controller
Follow the procedure on the next page.

Functions

1. Connection for dry-running sensor
Part number of dry-running sensor: 96556427.

2. Connection for external restarting

3. Motor PTC
Green light indicates OK or short-circuited terminals.
Red light indicates too high motor temperature. The alarm relay is activated.

4. Connection for PTC sensor
This input is not used in connection with E-pumps as the frequency converter protects the motor against overload.

5. Sensor indicator light
Red light indicates defective sensor or cable.
The alarm relay is activated.

6. Deactivation of the dry-running monitoring function
Press the button to deactivate the dry-running monitoring function. Red flashing light. The PTC monitoring function is still active.
Press the Restart button to reactivate the dry-running monitoring function.

7. High liquid temperature indicator light
Red light indicates too high liquid temperature (130°C ±5°C).
The alarm relay is activated.

8. Supply voltage
200-240 V, 50/60 Hz.

9. Dry-running indicator light
Green light indicates OK (liquid in pump).
Red light indicates dry running (no liquid in pump).
The alarm relay is activated.

10. Alarm/Run relay output
Potential-free changeover contact.
Maximum contact load: 250 V, 1 A, AC (inductive load).

11. Auto/Manual
Changeover between automatic and manual restarting.
The default setting is Man.
Changeover is carried out by means of a small screwdriver.
When Auto has been selected, the alarm indication will automatically be reset 10 to 20 seconds after detection of liquid.

12. Restart
Press the button to restart the pump. The button has no influence on the PTC monitoring.
Accessories

Calibration of sensor and controller

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check that the sensor is correctly connected to the controller, see page 89</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Before fitting the sensor in the pump, submerge the sensor into stagnant water. Any kind of container with water can be used. <strong>Note:</strong> It is important that the water is stagnant as the calibration will be misleading if the sensor is cooled by flowing water.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Keep the buttons, pos. 6 and 12, pressed for approx. 20 seconds.</td>
<td>All red indicator lights (except pos. 7) start flashing.</td>
</tr>
<tr>
<td>4</td>
<td>When the green indicator lights, pos. 3 and 9, are constantly on, stop pressing the buttons, pos. 6 and 12.</td>
<td>The calibration is completed.</td>
</tr>
</tbody>
</table>

Further information

Information related to IEC 60 730-1:
- Software class A
- Pollution degree 2
- Type 1

The LiqTec has been cURus approved according to UL 508.

Maximum pressure: 40 bar
Maximum liquid temperature: +130°C ±5°C
Maximum ambient temperature: +55°C
Power consumption: 5 Watt
Enclosure class: IP X0
Maximum cable length: 20 metres
Standard cable: 5 metres
Extension cable: 15 metres.
Connection of CRE pump to LiqTec

Digital input
The digital input must be set to "Ext. fault" by means of 
R100
Menu 5.3.6 in Installation and operating instructions.

Disposal
Disposal of this product or parts of it must be carried out 
according to the following guidelines:
1. Use the local public or private waste collection ser-
vice.
2. In case such waste collection service does not exist or 
cannot handle the materials used in the product, 
please deliver the product or any hazardous materi-
als from it to your nearest Grundfos company or serv-
ice workshop.

Note: After dry-running fault the pump must be 
restarted manually.
Sources of product documentation

In addition to the printed data booklet, Grundfos offers the following sources of product documentation:

- WinCAPS
- WebCAPS.

WinCAPS

WinCAPS is a Windows-based Computer-Aided Product Selection program containing information on more than 90,000 Grundfos products.

Available on CD-ROM in more than 15 languages, WinCAPS offers:

- detailed technical information
- selection of the optimum pump solution
- dimensional drawings of each pump
- detailed service documentation
- installation and operating instructions
- wiring diagrams of each pump.

Fig. 89 WinCAPS CD-ROM

Click on Catalogue and select a product from the extensive product catalogue.

Click on Sizing and select the most suitable pump for your application.
Further product documentation

WebCAPS

WebCAPS is a Web-based Computer Aided-Product Selection program and a web version of WinCAPS.

- detailed technical information
- dimensional drawings of each pump
- wiring diagrams of each pump.

Click Catalogue and select a product from the extensive product catalogue.
Click Replacement and select the right replacement pump based on the current installation.
Click Literature to select and download Grundfos documentation by browsing the product ranges or performing a specific search. The literature includes:
- Data booklets
- Installation and operating instructions
- Service instructions
Click Product search and select a product from the extensive product catalogue.
Click Service to find information on service kits and spare parts.
Click Units and select your preferred units of measurement:
- Default units
- SI units
- US units.
Click Language and select your preferred language.

Fig. 91 WebCAPS