LONworks for Grundfos pumps

CIM/CIU 100

Functional profile and user manual

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GRUNDFOS

Original functional profile and user manual.

CONTENTS

1. Symbols used in this document

Caution — ***If these safety instructions are not observed, it may result in malfunction or damage to the equipment!***

Note — ***Notes or instructions that make the job easier and ensure safe operation.***

2. Introduction

2.1 About this functional profile

This functional profile describes the CIM 100 (LON Communication Interface Module 100) and the CIU 100 (LON Communication Interface Unit 100) for the following Grundfos E-pumps and Hydro Multi-E:

- UPE Series 2000
- GRUNDFOS MAGNA/MAGNA3
- TPE Series 1000/2000
- CRE/CRNE/CRIE
- NBE
- NKE
- CHIE
- MTRE
- CUE
- Hydro Multi-E.

References in the following:

- The CIM 100 is referred to as "LON module".
- The CIU unit is referred to as "LON unit".
- The E-pumps, CUE, Hydro Multi-E, GRUNDFOS MAGNA and MAGNA3 are referred to as "E-Pump".

The data in this document are subject to change without prior notice. Grundfos cannot be held responsible for any problems caused directly or indirectly by using information in this functional profile.

2.2 Assumptions

This functional profile assumes that the reader is familiar with commissioning and programming LON devices. The reader should also have some basic knowledge of the anatomy of LON data communication.

2.3 Definitions and abbreviations

CIM 100	Communication Interface Module 100
CIU 100	Communication Interface Unit 100
CP	Configuration Properties
DRF	Device Resource Files
GENIbus	Proprietary Grundfos fieldbus standard
H	Pressure (Head)
LED	Light-Emitting Diode
LON	Local Operating Network
nci	Network configuration property input
nro	Read-only configuration property
nv	Network variable
nvi	Network variable input
nvo	Network variable output
Q	Flow
R100	Grundfos remote control
SCPT	Standard Configuration Property Type
SNVT	Standard Network Variable Type
UCPT	User-defined Configuration Property Type
UFPT	User-defined Functional Profile Type
UNVT	User-defined Network Variable Type

2.4 System diagram

The system diagram gives an overview of how to connect the CIM 100/CIU 100 to the E-pump that is to be connected to a LON network.

CIM 100

The CIM 100 solution is an add-on communication module that is to be fitted in a Grundfos pump, using a 10-pin connection. In this setup, the pump will supply power to the CIM 100. See fig. 1.

CIU 100

The CIU 100 solution is a box with a power supply module and a CIM 100 LON module. It can either be mounted on a DIN rail or on a wall. See fig. 2.

This solution is used for Grundfos Hydro Multi-E and E-pumps that do not support an internal, add-on communication module (CIM 100). The enclosure class is IP54.

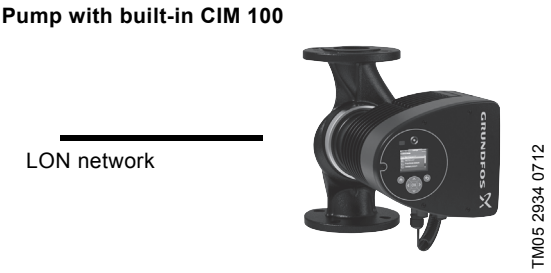

Fig. 1 Example of CIM 100 solution

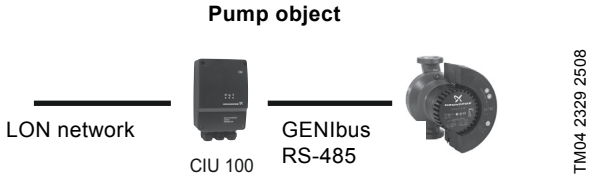

Fig. 2 Example of CIU 100 solution

3. Installation

The LON module is programmed on delivery.
This means that the application program will start when the power supply is switched on.

The customer has to install the network, including assignment of module addresses, and make the required bindings.

4. CIM 100 LON module

The LON module is designed using an FT 3150 neuron transceiver, an FT-X1 transformer and a 64 Kbyte flash memory which enables updating of software.

This functional profile is compliant with version 1.0 of "Pump Controller Object" from LonMark International.

The LON module has been certified to adhere to LonMark Application Layer interoperability guidelines 3.4.

Self-documentation strings are used. This means that an installation tool can access the relevant information via the network.

The XIF file can be found on the CD-ROM with this functional profile.

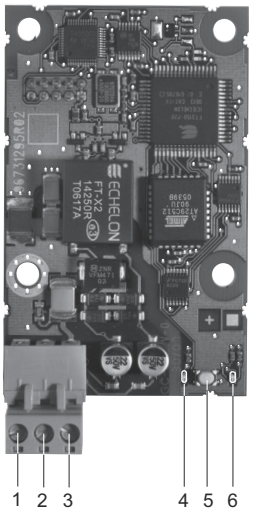

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Fig. 3 CIM 100 LON module

Pos.	Designation	Description
1	A	LON terminal A
2	B	LON terminal B
3	Screen	LON terminal for cable screen
4	LED1	Yellow service LED
5	Pin	Service pin (push-button)
6	LED2	Red/green status LED for internal communication between the CIM 100 and the E-pump

4.1 Connecting the LON module

Grundfos recommends to use a screened cable.

A LON network must be terminated. The termination depends on the network topology chosen.

Fitting the cable

Procedure:

See fig. 4.

1. Connect the conductors to terminal A (pos. 1).
2. Connect the conductors to terminal B (pos. 2).
3. Connect the twisted screen ends to terminal "Screen" (pos. 3).

Note

The screen must only be connected to the screen terminal of the CIM 100 LON module. See fig. 4, pos. 3.

The cable screen must never be connected to earth via the earth clamp. See fig. 4, pos. 4.

Note

The stripped part of the cable screen must be as short as possible to reduce the impedance at high frequencies.

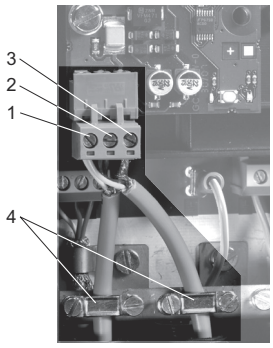

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Fig. 4 Connecting the LON module

Pos.	Description
1	LON terminal A
2	LON terminal B
3	LON terminal for cable screen
4	Earth clamp

4.2 Registration in a LON network

E-pumps with a CIM 100 LON module are registered by a LON network in one of these ways:

- Service pin
- Bar code label.

Service pin

When the service pin push-button of the module is activated, the module will send a unique 48 bit ID code (Neuron ID) which is registered in the LON network. See fig. 5.

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Fig. 5 Service pin

Bar code label

The Neuron ID on the module or on the enclosed bar code label is scanned and registered in the LON network. The bar code of the Neuron ID is in Code 128 format. The additional bar code label can be attached to the building installation plan.

4.3 LEDs

The CIM 100 LON module has two LEDs. See fig. 3.

- Yellow service LED (LED1)
- Red/green status LED (LED2) for internal communication between the CIM 100 and the E-pump.

4.3.1 LED1

The yellow LED on the CIM 100 functions as a service LED. When the E-pump is connected to the power supply, the service LED will flash once and then remain off if the installation has been made correctly. In case of deviations, see section *17. Fault finding* and Echelon documentation.

The WINK command is supported by the LON module.

When the LON module receives a WINK command, the service LED (LED1) will flash five times with 2-second intervals and a duty cycle of 50 %. After five flashes, the service LED (LED1) goes out. See fig. 6.

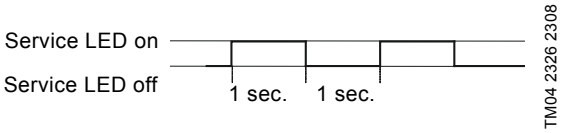

Fig. 6 Flashing pattern

This flashing pattern must not be confused with the flashing pattern of an unconfigured device which will flash with 1-second intervals and a duty cycle of 50 %.

In a standard installation, the service LED (LED1) is permanently off.

The use of a WINK command does not affect the operation of the LON module in any way.

4.3.2 LED2

Status	Description
Off.	The CIM 100 has been switched off.
Flashing red.	No internal communication between the CIM 100 and the E-pump.
Permanently red.	The CIM 100 does not support the connected E-pump.
Permanently green.	Internal communication between the CIM 100, and the E-pump is OK.

5. Considerations when installing the E-pump or Hydro Multi-E

Flow has duplicate readouts (nvoFlow, nvoFlowF). Both NVOs are active at all times.

For an E-pump with a maximum flow higher than 650 m^3/h, the nvoFlow will display the invalid value (655.35 m^3/h, 0xFFFF) for pump flows above this limit.

At the time of installation, it should be determined which of the flow NVOs to monitor.

For an E-pump with a maximum flow higher than 650 m^3/h, nvoFlowF should be used.

For an E-pump with a maximum flow lower than 650 m^3/h, nvoFlow should be used as it offers a higher resolution.

See description of the NVOs in section *11. Pump controller functional block details*.

For further details about the configuration, see the documentation for the relevant E-pump.

6. Power-on behaviour

A Grundfos LON module is designed to run with the following LON configuration:

- Node ID: 1
- Subnet ID: 1
- Domain ID: 00:00:00:00:00:00 (6 bytes).

The LON module will immediately start operating with these settings on the LON network when the power supply is first switched on. These settings can be changed with an installation tool (not supplied by Grundfos).

If the LON module is switched off and on (power cycle), the actual NV values in the LON module will be lost and reset to their default values. The NV default values can be found in section *11. Pump controller functional block details*.

CP values are preserved in the LON module over power cycles.

When switched on, the LON module will apply control mode as per the value of the CP nciControlMode. No other operation of the E-pump is applied until an update of any of the following NVs is received via the LON network:

- nviPumpSetpoint
- nviPumpOpMode
- nviOvdStop
- nviOvdPress
- nviOvdSpeed.

When an update is received, the LON module will start operating the E-pump.

The LON module will poll the following NVs immediately after power-on (if they are bound):

- nviPumpSetpoint
- nviPumpOpMode.

The LON module will continue to poll these NVs with 10-second intervals (if they are bound) until an update of any of the following NVs is received via the LON network:

- nviPumpSetpoint
- nviPumpOpMode
- nviOvdStop
- nviOvdPress
- nviOvdSpeed.

7. SNVT/UNVT details

Network variables of the node object are described in section *12. Node object functional block details*.

7.1 Network variable inputs

NV #	Name	SNVT type	SNVT index	Description
1	nviPumpSetpoint	SNVT_switch	95	Setpoint for normal operation
2	nviPumpOpMode	SNVT_hvac_mode	108	Requested operating mode
6	nviPumpOvdStop	SNVT_switch	95	Pump override stop command
7	nviOvdSpeed	SNVT_lev_percent	81	Override speed setpoint
8	nviOvdPress	SNVT_press	30	Override pressure setpoint
10	nviRemotePress	SNVT_press	30	Sensor input, remote differential-pressure sensor
11	nviRemoteFlow	SNVT_flow_p	161	Sensor input, remote flow sensor

7.2 Network variable outputs

NV #	Name	Send heartbeat	SNVT type	SNVT index	Description
3	nvoPumpCapacity	Yes	SNVT_lev_percent	81	Pump capacity as percent of maximum
4	nvoEffOpMode	Yes	SNVT_hvac_mode	108	Effective operating mode
5	nvoControlMode	Yes	SNVT_dev_c_mode	162	Effective device control mode
13	nvoPumpStatus	Yes	SNVT_dev_status	173	Pump status, diagnostic information
14	nvoPressure	No	SNVT_press	30	Pump pressure
15	nvoFlow	No	SNVT_flow_p	161	Pump flow
16	nvoSpeed	No	SNVT_rpm	102	Pump speed
17	nvoPumpOverride	No	SNVT_switch	95	Pump override active
18	nvoRuntime	No	SNVT_time_hour	124	Operating hours
19	nvoPumpFault	No	SNVT_dev_fault	174	Fault status
21	nvoFluidTemp	No	SNVT_temp_p	105	Liquid temperature
22	nvoPower	No	SNVT_power	27	Electrical power consumption in watt
23	nvoPowerK	No	SNVT_power_kilo	28	Electrical power consumption in kilowatt
24	nvoEnergyConsum	No	SNVT_elec_kwh	13	Total pump energy consumption

Note

NV # number is according to SFPTpumpController.

7.3 Manufacturer-defined network variables

Name	SNVT type	SNVT index	Description
nvoFlowF	SNVT_flow_f	53	Flow (floating point)
nvoRemoteFlow	SNVT_flow_f	53	Remote flow (floating point)
nvoRemotePress	SNVT_press	30	Remote pressure
nvoRemoteTemp	SNVT_temp	105	Remote temperature 1
nvoRemoteTemp2	SNVT_temp	105	Remote temperature 2
nvoEnergyConsumL	SNVT_elec_kwh_l	146	Energy consumption
nvoInletPressure	SNVT_press	30	Inlet pressure
nvoLevel	SNVT_length_f	54	Tank level
nvoAuxSensor	SNVT_lev_percent	81	Actual setpoint in %
nvoTotalOnTime	SNVT_time_hour	124	Total power-on time
nvoAlarmCode	SNVT_cont	8	Current system alarm code
nvoWarningCode	SNVT_cont	8	Current system warning code
nviGrundfosCmd	UNVT_GF_cmd		Request for sw/hw version
nvoGrundfosInfo	SNVT_str_asc	36	Sw/hw version according to nviGrundfosCmd
nvoPumpStatusOld	SNVT_state	83	Duplicate of nvoPumpStatus
nvoPumpFaultOld	SNVT_state	83	Duplicate of nvoPumpFault
nvoHeatEnergyCnt	SNVT_elec_kwh	146	Accumulated heat energy in total pump life time
nvoHeatPower	SNVT_power_kilo	28	Current heat power
nvoHeatTempDiff	SNVT_temp_p	105	Diff. temperature between forward and return pipes

8. SCPT/UCPT details

8.1 Configuration properties

SCPT name NV name Type or SNVT	SCPT index	Associated NVs	Description
SCPTmaxSendTime nciSndHrtBt SNVT_time_sec (107)	49	nv3, nv4, nv5, nv13	Maximum period of time that will elapse before the functional block automatically updates the associated network variables.
SCPTpumpCharacteristic nroPumpChar (structure)	233	Entire functional block	Maximum flow, maximum pressure and maximum speed of the pump define the pump characteristics.
SCPTlocation nciLocation SNVT_str_asc (36)	17	Entire functional block	Used to provide physical location of the device.
SCPTmaxFlowSetpoint nciFlowHighLim SNVT_flow_p (161)	237	Entire functional block	Used to limit the flow.
SCPTdeviceControlMode nciControlMode SNVT_dec_c_mode (162)	238	Entire functional block	Control mode for normal operation.
UCPT_Kp nciKp SNVT_multiplier (82)		Entire functional block	Gain for PI controller.
UCPT_Ti nciTi SNVT_time_sec (107)		Entire functional block	Integral time for PI controller.
UCPT_Ts nciTs SNVT_time_sec (107)		Entire functional block	Sample time for PI controller.

9. Application examples

9.1 Complete LON-based system

Any HVAC unit can use the pump object, either as an actuator where the pump speed is used to control the flow or pressure in the HVAC application, or the pump can be used as an intelligent device which can maintain a constant pressure in the system. In both cases, the pump can be monitored and manually controlled via the system.

In the following example, the pump is used as an intelligent device which is operating in PRESS_COMP control mode. The pump will automatically lower the pressure setpoint in proportion to the system flow. The unit changes the pump to minimum mode during the night via nviPumpOpMode and receives status of the pump operating mode from nvoEffOpMode. The HVAC unit uses nvoPumpStatus to retrieve status information from the pump. The controller can use this information to check pump faults and hardware overrides and whether the pump is running or not.

The pump is connected to a manual stop button which can be used to stop the pump. When the pump is stopped via nviPumpOvdStop, the HVAC unit can no longer control the pump via the normal setpoint.

The example also shows a local control and monitoring panel. Via this panel, the pump fault status as well as the pump flow and pressure can be viewed. Via this local control panel, it is possible to allocate a pressure setpoint to the pump. The pump will maintain a constant pressure which will override the HVAC unit.

The whole system is monitored via a main system.

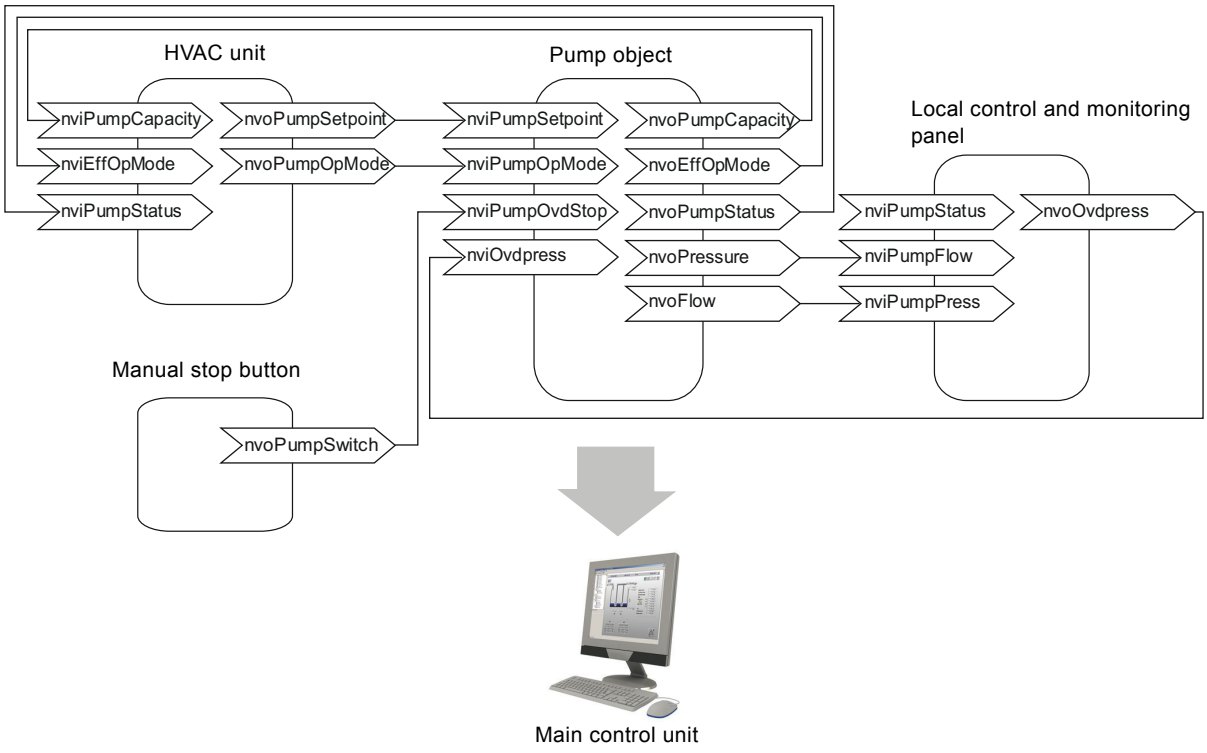

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Fig. 7 LON-based control system

9.2 Control with combined LON/AO/DO

It is possible to control the pump via analog and digital outputs (AO/DO), e.g. when using the Grundfos PMU 2000 / PFU 2000, and to combine this with the monitoring features of a LON system.

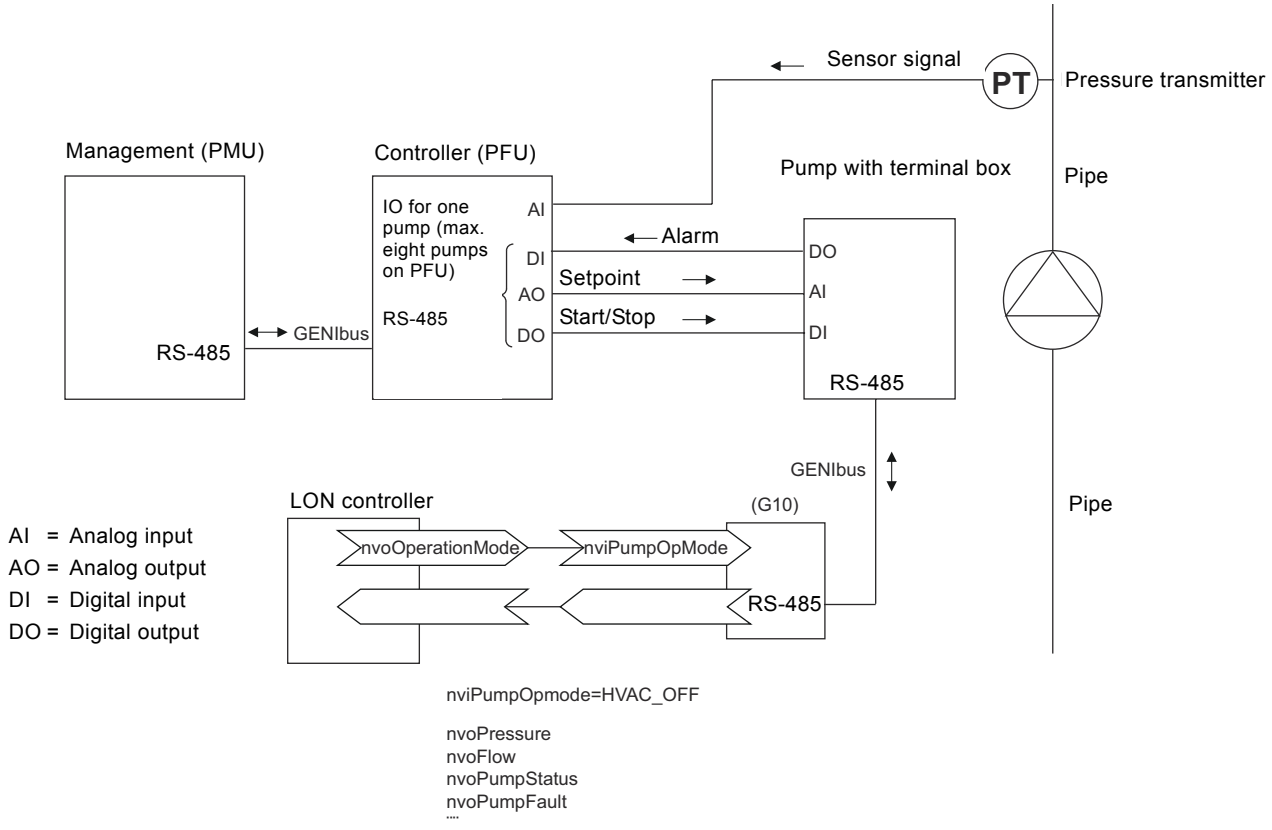


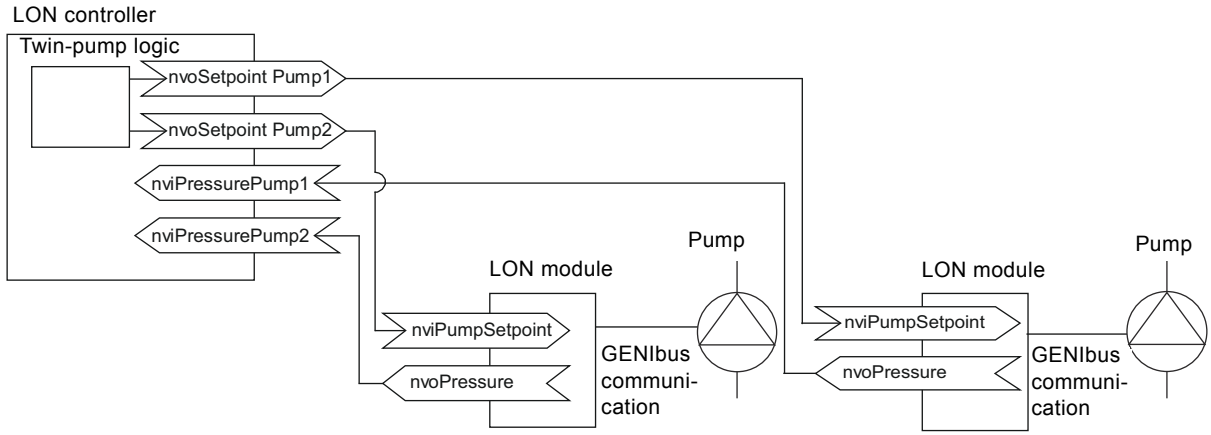
Fig. 8 Control with combined LON/AO/DO

The LON controller forces the pump to "local control" by setting nviPumpOpMode to HVAC_OFF. In this way, the pump can be controlled via the analog and digital inputs (AI/DI) on the pump if it has been set up to do so with the Grundfos R100 remote control.

Pump status as well as pressure and flow readings can still be obtained via LON.

9.3 Twin-head pump functionality with LON module and two single pumps

With the LON module, it is possible to use a twin-head pump setup for two single pumps as shown in fig. 9.



Logic for displaying system pressure:
System pressure = nviPressurePump1 or nviPressurePump2

Note: NOT system pressure = nviPressurePump1 + nviPressurePump2

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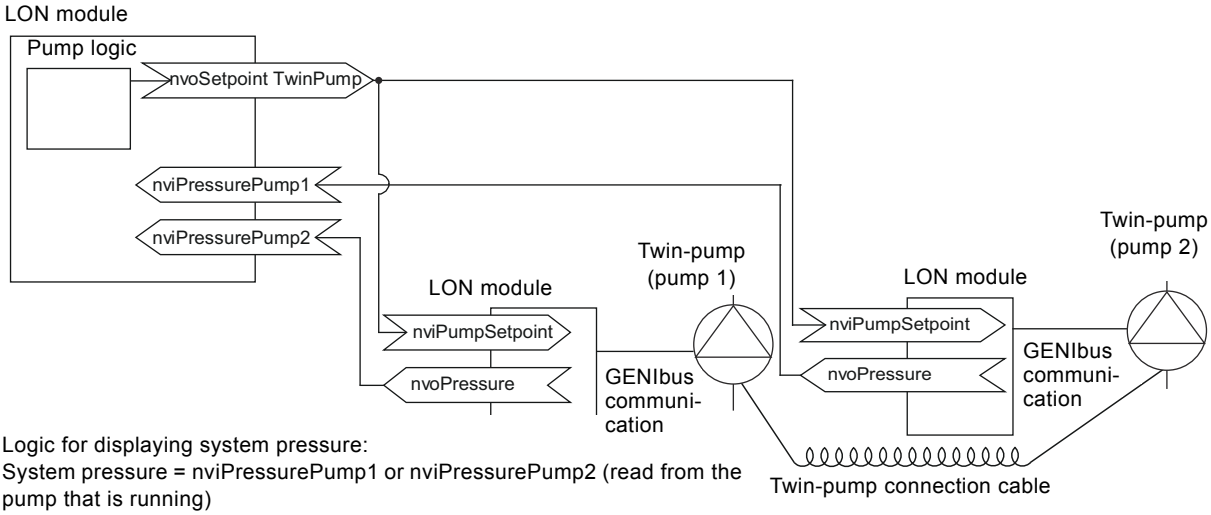
Fig. 9 Twin-head pump setup with LON module

The LON controller must handle all twin-head pump functionality (alternating or standby duty) and control the pumps as required.

9.4 Twin-head pump functionality with two LON modules and one twin-head pump

With two LON modules, it is possible of use a "real" twin-head pump as shown in fig. 10.



Logic for displaying system pressure:
System pressure = nviPressurePump1 or nviPressurePump2 (read from the pump that is running)

Note: NOT system pressure = nviPressurePump1 + nviPressurePump2

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Fig. 10 Twin-head pump setup with LON control

The LON controller must handle the twin-head pump as a normal pump. The setpoint output of the LON controller shall be bound to both LON modules controlling the two pump heads of the twin-head pump.

The twin-head pump will handle all twin-head pump functionality itself. Both heads of the twin-head pump will receive the setpoint via LON. The active pump head will react to the received setpoint.

10. Override functionality

The pump controller profile includes network variable inputs to manually override the operation of the pump. A valid value on any of these variable inputs changes the pump to override mode.

The pump will not return to normal setpoint control until all manual override inputs are invalid. The override priority can be seen in fig. 11.

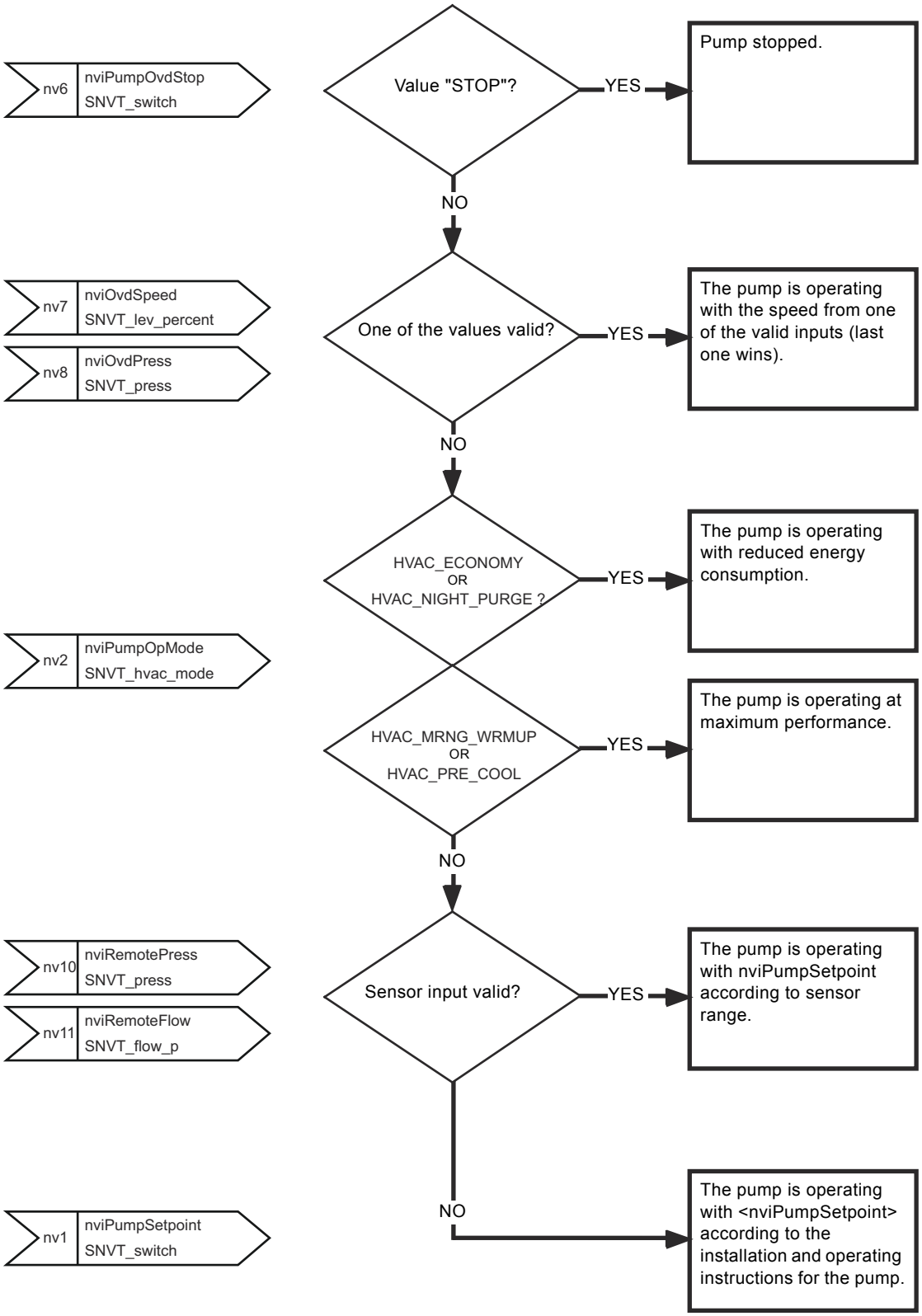

Fig. 11 Override functionality

11. Pump controller functional block details

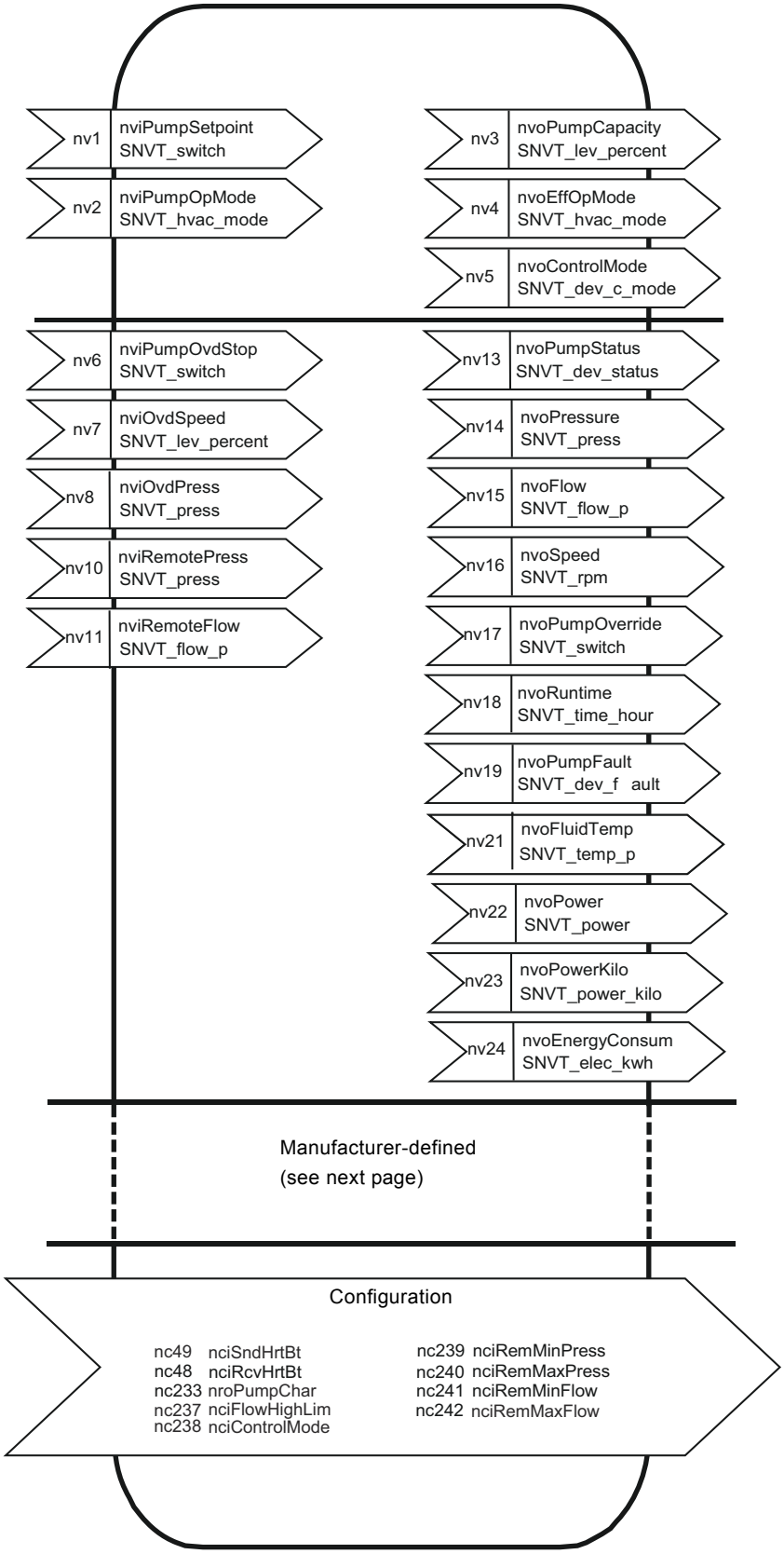

Fig. 12 Pump controller (standard part)

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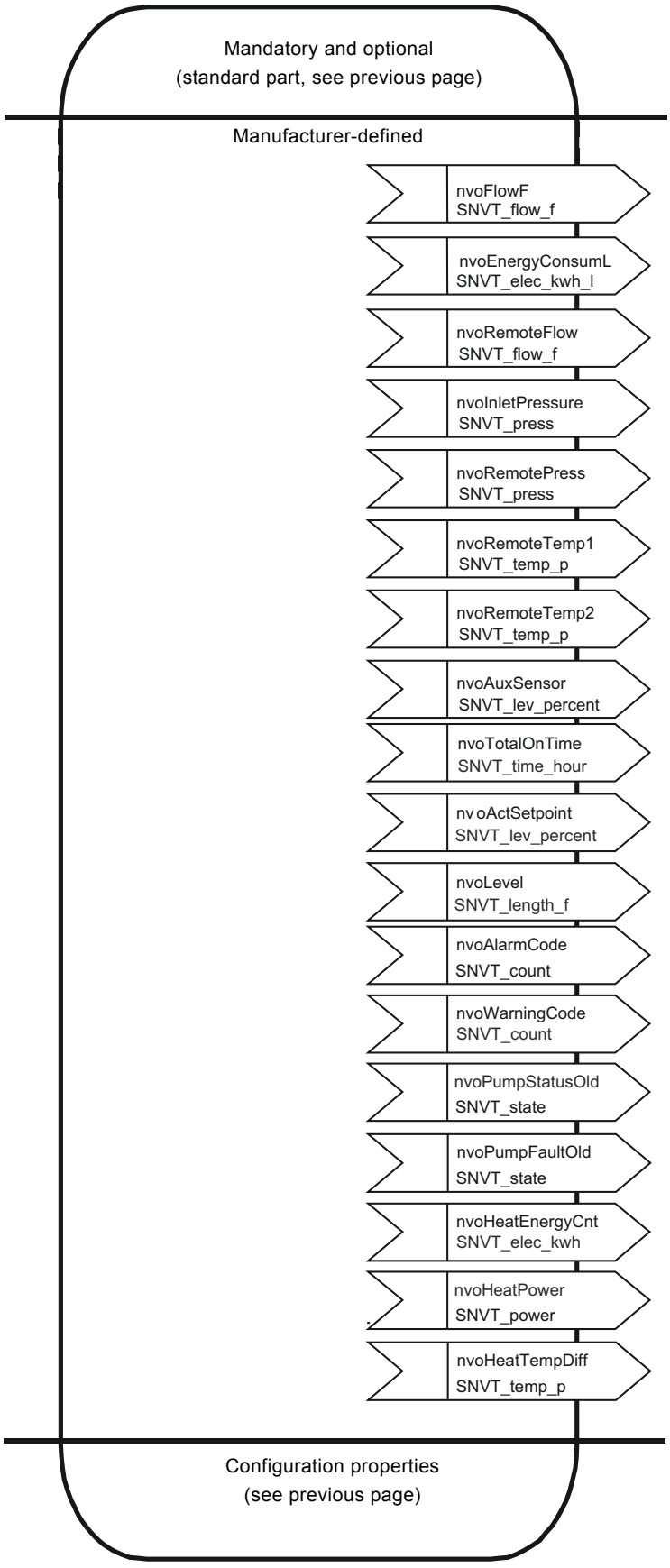

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Fig. 13 Pump controller (manufacturer-defined part)

11.1 Pump setpoint

`network input SNVT_switch nviPumpSetpoint;`

This network variable input provides start/stop control and a setpoint. The setpoint is given as a percentage of the effective maximum value (max. = 100 %). The setpoint value can represent the pump speed, pump pressure or pump flow, depending on the effective operating mode of the pump (nvoControlMode).

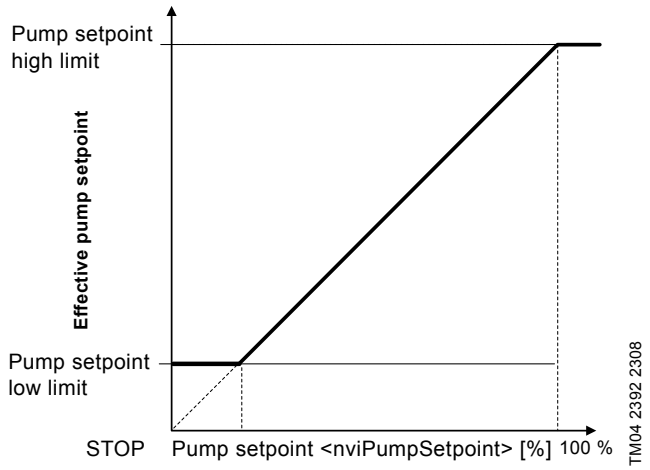


Fig. 14 Effective setpoint for closed-loop operation

$$X \cong \frac{\text{Pump setpoint low limit}}{\text{Pump setpoint high limit}} \times 100\ \%$$

or

$$X \cong \frac{\text{Remote sensor low value}}{\text{Remote sensor high value}} \times 100\ \%$$

Example

If the control mode is constant pressure (nvoControlMode = DCM_PRESS_CONST), and the setpoint limits for this control mode are 10 kPa and 100 kPa, "X" can be calculated to 10 %. This means that a setpoint value of 1 to 10 % provides a setpoint of 10 kPa (0 % stops the pump).
A setpoint value of 11 to 100 % provides a setpoint of 11 to 100 kPa.

Valid range

For n-state pumps:

State	Value	Equivalent percent	Requested speed
0	n/a	n/a	STOP
1	0	0 %	STOP
1	1 to (1/n) 200	0.5 % to (1/n) 100 %	Pump speed #1
1	1 + (1/n) 200 to (2/n) 200	0.5 % + (1/n) 100 % to (2/n) 100 %	Pump speed #2
1	1 + ((m-1)/n) 200 to (m/n) 200	0.5 % + ((m-1)/n) 100 % to (m/n) 100 %	Pump speed #m
1	1 + ((n-1)/n) 200 to 200	0.5 % + ((n-1)/n) 100 % to 100 %	Pump speed #n

For variable-speed pumps

State	Value	Equivalent percent	Requested speed
0		n/a	STOP
1	0	0 %	STOP
1	1 to 200	0.5 to 100 %	0.5 to 100 %
1	201 to 255	100 %	100 %

Default value

The pump will poll this network variable after power-up (if bound) to ensure a correct start-up value. It will keep polling the bound remote device with 10-second intervals until a valid value is received in any of the following network variables: nviPumpSetpoint, nviPumpOpMode, nviOvdPress, nviOvdSpeed, nviPumpOvdStop.

After power-up, a TPE Series 1000/2000 or CRE pump will operate with the setpoint (and operating mode) of the local settings of the pump until a valid input is given to any of the following network variables: nviPumpSetpoint, nviPumpOpMode, nviOvdPress, nviOvdSpeed, nviPumpOvdStop.

After power-up, a GRUNDFOS MAGNA or UPE Series 2000 pump will operate with the setpoint (and operating mode) of the remote settings of the pump until a valid input is given to any of the following network variables: nviPumpSetpoint, nviPumpOpMode, nviOvdPress, nviOvdSpeed, nviPumpOvdStop.

The default value for nviPumpSetpoint is State = 0, Value = 0.0.

Product availability

For product availability, see overview on page 36.

11.2 Requested pump operating mode

```
network input SNVT_hvac_mode nviPumpOpMode;
```

This network variable input is typically used by a supervisory controller to override the pump controller operating mode. If the requested mode is not supported by the unit, the unit will treat it as an invalid value (treated as HVAC_NUL).

When the mode is HVAC_AUTO, the nviPumpSetpoint defines the setpoint of the pump.
When the mode is HVAC_MRNG_WRMUP or HVAC_PRE_COOL, the pump operates at maximum capacity.

To save energy during the night, in the summer or under low-load conditions, the mode HVAC_ECONOMY or HVAC_NIGHT_PURGE can be used. In this mode, the pump operates at minimum capacity.

Valid range

Value	Identifier	Description
0	HVAC_AUTO	Normal operation: nviPumpSetpoint defines the effective setpoint.
2	HVAC_MRNG_WRMUP	Morning warm-up: maximum-capacity mode.
4	HVAC_NIGHT_PURGE	Night purge: minimum-capacity mode.
5	HVAC_PRE_COOL	Morning cool-down: maximum-capacity mode.
6	HVAC_OFF	The pump has been set to local mode via the network. In this mode, it cannot be controlled via the network, but it will continue to monitor its outputs.
13	HVAC_ECONOMY	Energy saving: minimum-capacity mode.
-1 (0xFF)	HVAC_NUL	Invalid value.

The LON module will poll this network variable after power-up (if bound) to ensure a correct start-up value. It will keep polling the bound remote device with 10-second intervals until a valid value is received in any of the following network variables: nviPumpSetpoint, nviPumpOpMode, nviOvdPress, nviOvdSpeed, nviPumpOvdStop.

After power-up, the pump will operate with the operating mode (and setpoint) of the local settings of the pump until a valid input is given to any of the following network variables: nviPumpSetpoint, nviPumpOpMode, nviOvdPress, nviOvdSpeed, nviPumpOvdStop.

Default value

The default value for nviPumpOpMode is HVAC_AUTO.

Product availability

For product availability, see overview on page 36.

11.3 Pump capacity

```
network output SNVT_lev_percent nvoPumpCapacity;
```

This network variable output provides the actual pump capacity as a percentage of the effective maximum-setpoint value (pump-specific setpoint high limit). A value of more than 100 % means that the pump is providing a value that is higher than the highest possible setpoint.

Valid range

-163.840 to 163.830 % (0.005 % or 50 ppm).

The value of 0x7FFF (163.835 %) represents invalid data and indicates that the capacity cannot be estimated.

When transmitted

This value is transmitted immediately when it has changed more than 0.5 % for nvoControlMode = DCM_SPEED_CONST or more than 2 % for other values of nvoControlMode.

Additionally, this network variable will be transmitted as a heartbeat output on a regular basis as specified by the maximum send time nciSndHrtBt configuration property.

Product availability

For product availability, see overview on page 36.

11.4 Actual setpoint

```
network output SNVT_lev_percent nvoActSetpoint;
```

This network variable output provides the actual pump setpoint as a percentage of the effective maximum-setpoint value (pump-specific setpoint high limit). This value makes it possible to monitor the influence that the control algorithm of e.g. proportional-pressure control has on the setpoint.

Valid range

-163.840 to 163.830 % (0.005 % or 50 ppm).

The value of 0x7FFF (163.835 %) represents invalid data and indicates that the actual setpoint cannot be estimated.

When transmitted

This value is transmitted immediately when it has changed more than 0.5 %.

Product availability

For product availability, see overview on page 36.

11.5 Effective operating mode

```
network output SNVT_hvac_mode nvoEffOpMode;
```

This network variable output provides the actual pump operating mode.

Valid range

Value	Identifier	Description
0	HVAC_AUTO	Normal operation: nviPumpSetpoint defines the effective setpoint.
2	HVAC_MRNG_WRMUP	Morning warm-up: maximum-capacity mode.
4	HVAC_NIGHT_PURGE	Night purge: minimum-capacity mode.
5	HVAC_PRE_COOL	Morning cool-down: maximum-capacity mode.
6	HVAC_OFF	The pump has been set to local mode via the network. In this mode, it cannot be controlled via the network, but it will continue to monitor its outputs.
13	HVAC_ECONOMY	Energy saving: minimum-capacity mode.
-1 (0xFF)	HVAC_NUL	Invalid value.

When transmitted

This value is transmitted immediately when it has changed.

Additionally, this network variable will be transmitted as a heartbeat output on a regular basis as specified by the maximum send time nciSndHrtBt configuration property.

Product availability

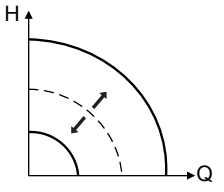
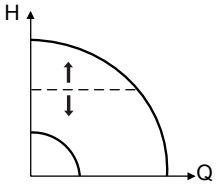
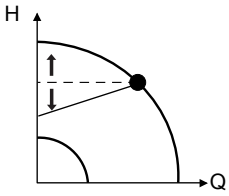
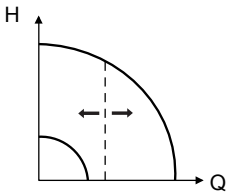
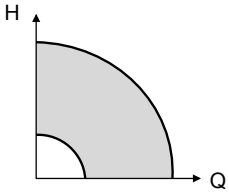
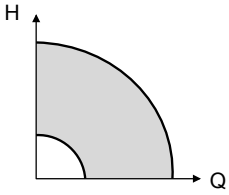
For product availability, see overview on page 36.

11.6 Effective device control mode

```
network output SNVT_dev_c_mode nvoControlMode;
```

This network variable output provides the actual control mode of the pump. The actual control mode is determined by nciControlMode, nviOvdSpeed, nviOvdPress, nviRemotePress or nviRemoteFlow. See fig. 11 in section *10. Override functionality*.

Valid range

Control mode	Description	
DCM_SPEED_CONST (0) The pump is operating in open-loop mode.	The E-pump setpoint will be interpreted as percentage of the maximum open-loop performance of the E-pump.	
DCM_PRESS_CONST (1) The pump is operating in constant-pressure mode.	The E-pump setpoint will be interpreted as pressure setpoint. The E-pump will maintain a constant pressure. If the pump is in local operation with a control mode which is not available via the LON, for instance "Constant level", the control mode will be mapped to DCM_PRESS_CONST on the LON. It will only be possible to select these special control modes from the pump display or via remote control when the LON module is in HVAC_OFF mode.	
DCM_PRESS_COMP (2) The pump is operating in compensated-pressure mode.	The E-pump setpoint will be interpreted as basic setpoint for the compensated-pressure mode (the black dot in the drawing). The E-pump will maintain a constant pressure, but automatically lower the actual pressure setpoint dependent on the flow (flow compensation, the straight line in the drawing).	
DCM_FLOW_CONST (3) The pump is operating in constant-flow mode.	The E-pump setpoint will be interpreted as flow setpoint. The E-pump will maintain a constant flow.	
DCM_TEMP_CONST (5) The pump is operating in constant-temperature mode.	The E-pump setpoint will be interpreted as temperature setpoint. The E-pump will maintain a constant temperature.	
DCM_PRESS_AUTO (7) The pump is operating in constant-pressure mode.	In this mode, the setpoint has no effect except for starting and stopping the E-pump. The actual pressure setpoint of the E-pump is chosen and optimised automatically by the E-pump to suit the needs of the installation in the most effective way.	

DCM_FLOW_CONST is only available for GRUNDFOS MAGNA pumps with a remote flow sensor connected via the LON network or TPE Series 1000 or CRE pumps with a flow sensor.

DCM_TEMP_CONST is only available for TPE Series 1000 or CRE pumps with a temperature sensor and for the MAGNA3 pump.

DCM_PRESS_AUTO is not available for all pumps.

For some TPE Series 1000 or CRE pumps, all control modes are not available at the same time. The control mode is determined by the sensor connected to the pump.

Maximum flow limit (nciFlowHighLim) can be enabled for MAGNA3 and TPE 2000 (versions H/I) pumps to limit the flow of the pump.

Control modes for TPE Series 1000 / CRE / CRNE / CRIE / NBE / NKE / CHIE / MTRE / CUE

Sensor type	SPEED_CONST	PRESS_CONST	PRESS_COMP	FLOW_CONST	TEMP_CONST	PRESS_AUTO
Pressure	●	●	-	-	-	-
Flow	●	-	-	●	-	-
Temperature	●	-	-	-	●	-

Control modes for TPE Series 2000 / UPE Series 2000 / GRUNDFOS MAGNA Series

Pump type	SPEED_CONST	PRESS_CONST	PRESS_COMP	FLOW_CONST	TEMP_CONST	PRESS_AUTO
TPE Series 2000	●	●	●	H	H	H
UPE Series 2000	●	●	●	-	-	-
MAGNA	●	●	●	-	3	●
MAGNA with LON pressure sensor	-	●	-	-	-	-
MAGNA with LON flow sensor	-	-	-	●	-	-

3: Only available on MAGNA3.

H: Only available on version H/I and later.

When transmitted

This value is transmitted immediately when it has changed.

Additionally, this network variable will be transmitted as a heartbeat output on a regular basis as specified by the maximum send time nciSndHrtBt configuration property.

Product availability

For product availability, see overview on page 36.

11.7 Pump override stop command

```
network input SNVT_switch nviPumpOvdStop;
```

This network variable input provides a manual override function to stop the pump, typically from a supervisory controller.
The value of "OVDSTOP" in the table below stops the pump and has a higher priority than the value of the pump setpoint nviPumpSetpoint, the two remote sensor inputs nviRemotePress and nviRemoteFlow, a value on nviPumpOpMode other than HVAC_AUTO and the two override setpoints nviOvdSpeed and nviOvdPress.

The manual override status of the pump controller is indicated in nvoPumpOverride.

Valid range

State	Value	Equivalent percent	Requested operation
0	n/a	n/a	NORMAL
1	0	n/a	NORMAL
1	1 to 255	n/a	OVDSTOP
0xFF	n/a	n/a	Invalid (NORMAL)

Default value

The default value is 0xFFFF (invalid value) in the state field. The value will be adopted at power-up.

Product availability

For product availability, see overview on page 36.

11.8 Override speed setpoint

```
network input SNVT_lev_percent nviOvdSpeed;
```

This network variable input provides an override request and a speed setpoint, typically from a supervisory controller. This speed setpoint is given as a percentage of the maximum speed of the pump. When a valid value is received and the pump override stop command is not active, the current pump setpoint (nviPumpSetpoint or nviOvdPress) will be overridden, and the pump will be controlled according to the given speed setpoint. The pump then operates in the DCM_SPEED_CONST mode.

Invalid values of all override setpoint inputs (nviOvdSpeed and nviOvdPress) and a normal status of the pump override stop command (nviPumpOvdStop) will change the pump back to NORMAL mode. The manual override status of the pump controller is indicated in the nvoPumpOverride network variable. The control flow can be seen from fig. 11.

Valid range

-163.840 to 163.830 % (0.005 % or 50 ppm).

The value of 0x7FFF (163.835 %) represents invalid data that must be interpreted as "no override requested".

A negative value will be interpreted as 0 %, and the nvoPumpStatus.pump_ctrl.setpt_out_of_range (setpoint out of range) will be set (1).

A value of more than 100 % will be interpreted as 100 %, and the nvoPumpStatus.pump_ctrl.setpt_out_of_range (setpoint out of range) will be set (1).

Default value

The default value is 0x7FFF (invalid value). The value will be adopted at power-up.

Product availability

For product availability, see overview on page 36.

11.9 Override pressure setpoint

```
network input SNVT_press nviOvdPress;
```

This network variable input provides an override request and a pressure setpoint, typically from a supervisory controller. When a valid value is received and the pump override stop command is not active, the current pump setpoint (nviPumpSetpoint or nviOvdSpeed) will be overridden, and the pump will be controlled according to the given pressure setpoint. The pump then operates in the DCM_PRESS_CONST mode.

Invalid values of all override setpoint inputs (nviOvdSpeed or nviOvdPress) and a normal status of the pump override stop command (nviPumpOvdStop) will change the pump back to NORMAL mode. The manual override status of the pump controller is indicated in the nvoPumpOverride network variable. The control flow can be seen from fig. 11.

Valid range

-3,276.8 to 3,276.7 kPa (0.1 kPa).

The value of 0x7FFF (3,276.7 kPa) represents invalid data that must be interpreted as "no override requested".

A value below the manufacturer-defined setpoint low-limit will be saturated to this value, and the nvoPumpStatus.pump_ctrl.setpt_out_of_range (setpoint out of range) will be set (1).

A value above the manufacturer-defined setpoint high-limit will be saturated to this value, and the nvoPumpStatus.pump_ctrl.setpt_out_of_range (setpoint out of range) will be set (1).

Default value

The default value is 0x7FFF (invalid value). The value will be adopted at power-up.

Product availability

For product availability, see overview on page 36.

11.10 Remote pressure sensor input

```
network input SNVT_press nviRemotePress;
```

This network variable input allows the use of a remote differential-pressure sensor on the network as the feedback signal to the pump controller.

This input will only have effect when the LON module is used with a GRUNDFOS MAGNA pump. For other pump types, this input will be ignored.

A valid value of the nviRemotePress variable will disable the internal feedback signal of the pump controller and activate the remote-sensor operating mode, thus forcing the pump to run in constant-pressure control mode. This is indicated by the nvoPumpStatus.pump_ctrl.remote_press (remote pressure sensor) being set (1).

The nvoPumpCapacity variable will indicate the value of the pressure signal from the sensor as a percentage of its maximum value. This makes it possible to compare the sensor value with the nviPumpSetpoint value.

The nvoPressure variable always indicates the differential pressure across the pump flanges measured or estimated by the pump controller. This may help analysing the behaviour of the system.

When using nviRemotePress, the pressure setpoint is given by nviPumpSetpoint. The ranging of both the setpoint and the feedback is given by the configuration properties: nciRemMinPress and nciRemMaxPress. These values are used instead of the pump setpoint high- and low-limits.

When using nviRemotePress, the internal PI controller of the pump can be adjusted by means of the configuration properties nciKp, nciTi and nciTs. These configuration properties, including nciRemMinPress and nciRemMaxPress, are associated with the nviRemotePress network variable and can be identified by their type in the installation tool.
For a description of the individual configuration properties, see section *8.1 Configuration properties*.

If the nviRemotePress variable receives an invalid value, or if the heartbeat (specified by nciRcvHrtBt) is missing, remote control is deactivated, and the pump controller will return to the control mode defined by nciControlMode.

Any valid value in the manual override inputs has higher priority than the remote-sensor control, and the pump controller will use the internal feedback signals.

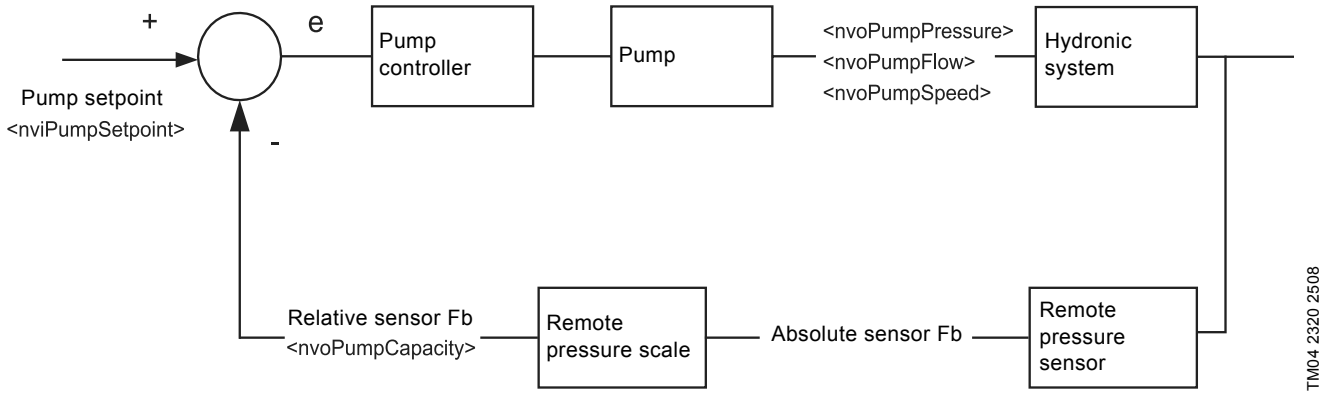


Fig. 15 Block diagram for remote pressure sensor

Valid range

-3,276.8 to 3,276.7 kPa (0.1 kPa).

The value of 0x7FFF (3,276.7 kPa) represents invalid data and can be interpreted as "not connected".

Default value

The default value is 0x7FFF (invalid value). The value will be adopted at power-up and if no update is received within the specified "receive heartbeat" time.

Product availability

For product availability, see overview on page 36.

11.11 Remote flow sensor input

```
network input SNVT_flow_p nviRemoteFlow;
```

This network variable input allows the use of a remote flow sensor on the network as the feedback signal to the pump controller.

This input will only have effect when the LON module is used with a GRUNDFOS MAGNA pump. For other pump types, this input will be ignored.

A valid value of the nviRemoteFlow variable will disable the internal feedback signal of the pump controller and activate the remote-sensor operating mode, thus forcing the pump to run in constant-flow control mode. This is indicated by the nvoPumpStatus.pump_ctrl.remote_flow (remote flow sensor) being set (1).

The nvoPumpCapacity variable will indicate the value of the flow signal from the sensor as a percentage of its maximum value. This makes it possible to compare the sensor value with the nviPumpSetpoint value.

The nvoFlow output variable always indicates the flow through the pump measured or estimated by the pump controller. This may help analysing the behaviour of the system.

When using nviRemoteFlow, the flow setpoint is given by nviPumpSetpoint. The ranging of both the setpoint and the feedback is given by the configuration properties: nciRemMinFlow and nciRemMinFlow). These values are used instead of the pump setpoint high- and low-limits.

When using nviRemoteFlow, the internal PI controller of the pump can be adjusted by means of the configuration properties nciKp, nciTi and nciTs. These configuration properties, including nciRemMinFlow and nciRemMaxFlow, are associated with the nviRemoteFlow network variable and can be identified by their type in the installation tool.
For a description of the individual configuration properties, see section *8.1 Configuration properties*.

If the nviRemoteFlow variable receives an invalid value, or if the heartbeat (specified by nciRcvHrtBt) is missing, remote control is deactivated, and the pump controller will return to the control mode defined by nciControlMode.

Any valid value in the manual override inputs has higher priority than the remote-sensor control, and the pump controller will use the internal feedback signals.

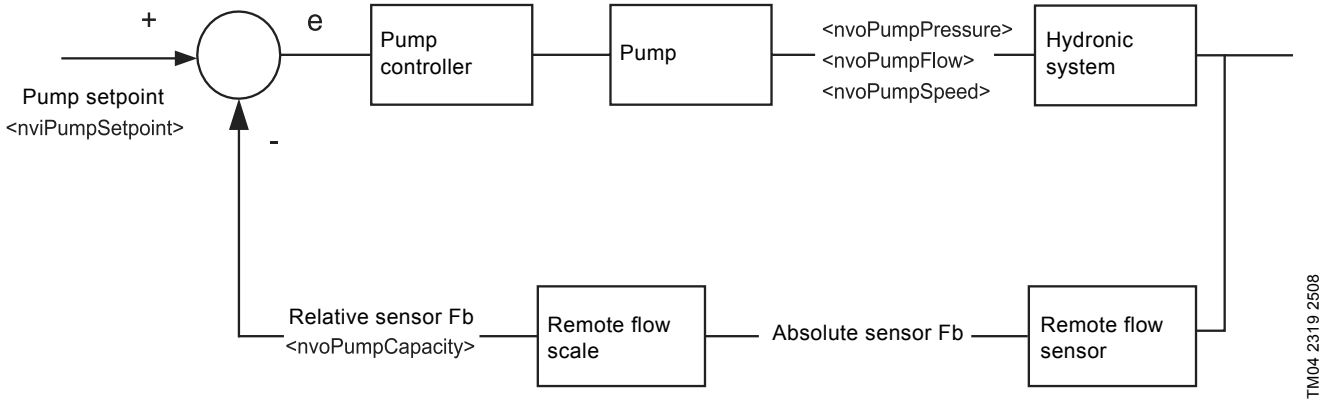


Fig. 16 Block diagram for remote flow sensor

Valid range

0 to 655.34 m^3/h (0.01 m^3/h).

The value of 0xFFFF (655.35 m^3/h) represents invalid data and can be interpreted as "not connected".

Default value

The default value is 0xFFFF (invalid value). The value will be adopted at power-up and if no update is received within the specified "receive heartbeat" time.

Product availability

For product availability, see overview on page 36.

11.12 Pump status, diagnostic information

```
network output SNVT_dev_status nvoPumpStatus;
```

```
network output SNVT_state nvoPumpStatusOld;
```

This network variable output provides detailed diagnostic information on the status of the pump controller. nvoPumpStatusOld holds information identical to nvoPumpStatus. It is added for backwards compatibility and is not recommended for new designs.

Valid range

The bits below are supported.

Bit no.	Bit name		Description
	nvoPumpStatus	nvoPumpStatusOld	
0	device_fault	Bit 0	A pump-related fault or warning has been detected. See section *11.23 Pump fault status* for detailed information. Some faults on UPE Series 2000 will be seen in this bit, but will not appear in nvoPumpFault due to their general nature.
1	supply_fault	Bit 1	A system-related fault or warning has been detected. See section *11.23 Pump fault status* for detailed information.
3	speed_low	Bit 3	The pump is operating at the lowest possible speed. Therefore, the requested performance is not possible.
4	speed_high	Bit 4	The pump is operating at the highest possible speed. Therefore, the requested performance is not possible.
6	setpt_out_of_range	Bit 6	This bit is set if any of the override variables are out of range.
8	local_control	Bit 8	The pump has been set to local mode by hardware override (push-buttons on pump, external STOP or with the R100).
10	running	Bit 10	The pump is running.
12	remote_press	Bit 12	The pump is using network pressure sensor.
13	remote_flow	Bit 13	The pump is using network flow sensor.

When transmitted

This value is transmitted immediately when it has changed.

Additionally, this network variable will be transmitted as a heartbeat output on a regular basis as specified by the maximum send time nciSndHrtBt configuration property.

Product availability

For product availability, see overview on page 36.

11.13 Pump pressure

```
network output SNVT_press nvoPressure;
```

This network variable output provides the pressure across the pump flanges as measured or estimated by the pump.

Valid range

-3,276.8 to 3,276.7 kPa (0.1 kPa).

The value of 0x7FFF (3,276.7 kPa) represents invalid data and indicates that the pressure cannot be measured/estimated.

When transmitted

This value is transmitted immediately when it has changed more than 2 KPa.

Product availability

For product availability, see overview on page 36.

11.14 Pump inlet pressure

```
network output SNVT_press nvoInletPressure;
```

This network variable output provides the system inlet pressure as measured by the pump.

If no inlet pressure sensor is available in the system, nvoInletPressure will display the invalid value.

Valid range

-3,276.8 to 3,276.6 kPa (0.1 kPa).

The value of 0x7FFF (3,276.7 kPa) represents invalid data and indicates that the pressure cannot be measured or that no inlet pressure sensor is connected.

When transmitted

This value is transmitted immediately when it has changed more than 2 kPa.

Product availability

For product availability, see overview on page 36.

11.15 Remote pressure

```
network output SNVT_press nvoRemotePress;
```

This network variable output provides the pressure measured somewhere in the system with a pressure sensor connected to the pump.

Valid range

-3,276.8 to 3,276.7 kPa (0.1 kPa).

The value of 0x7FFF (3,276.7 kPa) represents invalid data and indicates that the pressure cannot be measured or that no remote pressure sensor is connected.

When transmitted

This value is transmitted immediately when it has changed more than 2 KPa.

Product availability

For product availability, see overview on page 36.

11.16 Pump flow (standard range)

```
network output SNVT_flow_p nvoFlow;
```

This network variable output provides the flow through the pump as measured or estimated by the pump controller.

If the maximum pump flow is higher than 650 m^3/h, nvoFlowF should be used as it offers an extended range.

Section *5. Considerations when installing the E-pump or Hydro Multi-E* provides more information on the coherence of nvoFlow and nvoFlowF.

Valid range

0 to 655.34 m^3/h (0.01 m^3/h).

The value of 0xFFFF (655.35 m^3/h) represents invalid data and indicates that the flow cannot be measured/estimated or that the flow is higher than 650 m^3/h.

When transmitted

This value is transmitted immediately when it has changed significantly. The significance depends on the pump type.

- For UPE Series 2000, the value must change more than 0.2 m^3/h.
- For GRUNDFOS MAGNA, the value must change more than 0.3 m^3/h.
- For TPE Series 1000/2000, the value must change more than 0.5 m^3/h.

Product availability

For product availability, see overview on page 36.

11.17 Pump flow (extended range)

```
network output SNVT_flow_f nvoFlowF;
```

This network variable output provides the flow through the pump as measured or estimated by the pump.

If the maximum pump flow is lower than 650 m^3/h, nvoFlow should be used as it offers a higher resolution.

Section *5. Considerations when installing the E-pump or Hydro Multi-E* provides more information on the coherence of nvoFlow and nvoFlowF.

Valid range

-3.40282E38 to 3.40282E38 l/s.

If no flow sensor is available in the system, nvoFlowF will display a value of NaN (Not a Number).

When transmitted

This value is transmitted immediately when it has changed more than 1 l/s.

Product availability

For product availability, see overview on page 36.

11.18 Remote flow

```
network output SNVT_flow_f nvoRemoteFlowF;
```

This network variable output provides the flow measured somewhere in the system with a flow sensor connected to the pump.

Valid range

-3.40282E38 to 3.40282E38 l/s.

The value of 3.40282E38 l/s is not used as a physical representation of the flow, but represents invalid data and indicates that the flow cannot be measured or that no remote-flow sensor is connected.

If no remote-flow sensor is available in the system, nvoFlowF will display a value of NaN (Not a Number).

When transmitted

This value is transmitted immediately when it has changed more than 0.2 m^3/h.

Product availability

For product availability, see overview on page 36.

11.19 Pump speed

```
network output SNVT_rpm nvoSpeed;
```

This optional network variable output provides the pump speed.

Valid range

0 to 65,534 rpm (1 rpm).

The value of 0xFFFF (65,535 rpm) represents invalid data and indicates that the speed cannot be measured/estimated.

When transmitted

This value is transmitted immediately when it has changed more than 107 rpm.

Product availability

For product availability, see overview on page 36.

11.20 Pump override active

```
network output SNVT_switch nvoPumpOverride;
```

This optional network variable output provides the manual override status of the pump. This variable has the value "OVERRIDE" in the table below if the pump setpoint has been overridden by one of the variables: nviOvdSpeed, nviOvdPress or nviOvdStop.

Valid range

State	Value	Equivalent percent	Requested operation
0	0	0	NORMAL
1	200	100	OVERRIDE
0xFF	n/a	n/a	Invalid value

When transmitted

This value is transmitted immediately when it has changed.

Product availability

For product availability, see overview on page 36.

11.21 Runtime

`network output SNVT_time_hour nvoRuntime;`

This network variable output provides the total number of operating hours of the pump. After 65,535 hours, the counter is reset and will restart from zero (0).

Valid range

0 to 65,535 hours (1 hour), (2,730 days or 7.67 years).

When transmitted

This value is transmitted immediately when it has changed.

Product availability

For product availability, see overview on page 36.

11.22 Total ontime

`network output SNVT_time_hour nvoTotalOnTime;`

This network variable output provides the total number of hours the pump has been powered on. After 65,535 hours, the counter is reset and will restart from zero (0).

Valid range

0 to 65,535 hours (1 hour), (2,730 days or 7.67 years).

If this variable is not supported by the pump, a value of 0 is displayed.

When transmitted

This value is transmitted immediately when it has changed.

Product availability

For product availability, see overview on page 36.

11.23 Pump fault status

`network output SNVT_dev_fault nvoPumpFault;`

`network output SNVT_state nvoPumpFaultOld;`

This network variable output provides fault information about the pump, based on warnings and alarms from the pump. nvoPumpFaultOld holds information identical to nvoPumpFault. It is added for backwards compatibility and is not recommended for new designs.

Note

General faults and some overtemperature faults on UPE Series 2000 will not appear on nvoPumpFault, but only on the nvoPumpStatus.device_fault bit. Therefore, a fault monitoring strategy should always include monitoring of nvoPumpStatus.

For a description of nvoPumpStatus, see section *11.12 Pump status, diagnostic information*.

Both warnings and alarms will appear as faults in nvoPumpFault, except for warning and alarm codes corresponding to df_elect_failure and df_elect_failure_nf. For these, warnings will appear as df_elect_failure_nf, and alarms will appear as df_elect_failure.

Valid range

The valid range of SNVT_dev_fault. The following two tables show pump faults and their corresponding appearance on the R100 remote control.
If the LON module is unable to communicate with the pump for 30 seconds, the df_elect_failure bit is set. The fault is visible on the node object as well. See section *11. Pump controller functional block details*. This fault will not be visible when using the R100.

11.24 Heat energy metering

`network output SNVT_elec_kwh nvoHeatEnergyCnt;`

`network output SNVT_power_kilo nvoHeatPower;`

`network output SNVT_temp_p nvoHeatTempDiff;`

These data points are used for heat energy metering by the MAGNA3 and MGE model H pumps. In order to use the heat energy meter function at the pump, an external sensor has to be connected. Please note that this feature is not to be used for billing purposes.

`network output SNVT_elec_kwh nvoHeatEnergyCnt;`

Valid range

0 to 65,535 kWh (1 kWh).

The value of 0xFFFF (65,535 kWh) represents invalid data and indicates that the power consumption cannot be measured/estimated.

When transmitted

This value is transmitted immediately when it has changed.

Product availability

For product availability, see overview on page 36.

`network output SNVT_power_kilo nvoHeatPower;`

Valid range

0 to 6,553.4 kW (0.1 kW).

The value of 0xFFFF (6,553.5 kW) represents invalid data and indicates that the power cannot be measured/estimated or that the power is higher than 6,500 kW.

When transmitted

This value is transmitted immediately when it has changed more than 2 W.

Product availability

For product availability, see overview on page 36.

`network output SNVT_temp_p nvoHeatTempDiff;`

Valid range

-273.17 to +327.66 °C (0.01 °C).

The value of 0x7FFF (327.67 °C) represents invalid data and indicates that the temperature cannot be measured or that no remote temperature-sensor is connected.

When transmitted

This value is transmitted immediately when it has changed more than 1 °C.

Product availability

For product availability, see overview on page 36.

Pump faults, TPE Series 1000/2000 / CRE / CRNE / CRIE / NBE / NKE / CHIE / MTRE / CUE / GRUNDFOS MAGNA Series

Bit no.	Bit name		Description	Corresponding warning/alarm on the R100
	nvoPumpFault	nvoPumpFaultOld		
0	sf_voltage_low	Bit 0	Supply voltage is too low.	Undervoltage (40) Undervoltage transient (41) Cut-in fault (dV/dt) (42) Inrush fault (155)
1	sf_voltage_high	Bit 1	Supply voltage is too high.	Overvoltage (32)
2	sf_phase	Bit 2	Power missing phase.	Electronic DC-link protection activated (ERP) (14)
3	sf_no_fluid	Bit 3	No liquid in pump.	Dry running (57)
4	sf_press_low	Bit 4	System pressure is too low.	-
5	sf_press_high	Bit 5	System pressure is too high.	Turbine operation (29)
8	df_motor_temp	Bit 8	Motor temperature is too high.	Overtemperature (64) Motor temperature 1 (65) Temperature too high, internal frequency converter module (t_m) (67)
9	df_motor_failure	Bit 9	Motor has fatal failure.	External fault signal (3) Too many restarts (from standby mode per 24 hours) (4) Too many hardware shutdowns (short standbys per minute) (7) Overload (48) Overcurrent (i_line, i_dc, i_mo) (49) Motor protection function, general shutdown (mpf) (50) Motor protection function 3 sec. limit (54) Motor current protection activated (MCP) (55) Underload (56)
10	df_pump_blocked	Bit 10	Pump is blocked.	Blocked motor/pump (51)
11	df_elect_temp	Bit 11	Electronic temperature is too high.	
12	df_elect_failure_nf	Bit 12	Electronic non-fatal failure.	**Warning codes:** Hardware fault, type 1 (72) Hardware shutdown (HSD) (73) Internal communication fault (76) Communication fault, twin-head pump (77) Hardware fault, type 2 (80) Verification error, BE parameter area (EEPROM) (85) Electronic rectifier protection activated (ERP) (105) Electronic inverter protection activated (EIP) (106) Communication fault, internal frequency converter module (156) **Alarm and warning codes:** Verification error, FE parameter area (EEPROM) (83)
13	df_elect_failure	Bit 13	Electronic fatal failure.	CIM fault (Communication Interface Module) (not visible on the R100) (159) **Alarm codes:** Leakage current (1) Hardware fault, type 1 (72) Hardware shutdown (HSD) (73) Internal communication fault (76) Communication fault, twin-head pump (77) Hardware fault, type 2 (80) Verification error, BE parameter area (EEPROM) (85) Electronic rectifier protection activated (ERP) (105) Electronic inverter protection activated (EIP) (106) Communication fault, internal frequency converter module (156)
14	df_sensor_failure	Bit 14	Sensor failure.	Sensor fault (88) Signal fault, (feedback) sensor 1 (89) Signal fault, speed sensor (90) Setpoint signal outside range (96)

Pump faults, UPE Series 2000

Bit no.	Bit name		Description	Corresponding warning/alarm on the R100
	nvoPumpFault	nvoPumpFaultOld		
0	sf_voltage_low	Bit 0	Supply voltage is too low.	Undervoltage
1	sf_voltage_high	Bit 1	Supply voltage is too high.	Overvoltage
2	sf_phase	Bit 2	Power missing phase.	-
3	sf_no_fluid	Bit 3	No liquid in pump.	-
4	sf_press_low	Bit 4	System pressure is too low.	-
5	sf_press_high	Bit 5	System pressure is too high.	-
8	df_motor_temp	Bit 8	Motor temperature is too high.	Overtemperature
9	df_motor_failure	Bit 9	Motor has fatal failure.	-
10	df_pump_blocked	Bit 10	Pump is blocked.	Pump blocked
11	df_elect_temp	Bit 11	Electronic temperature is too high.	Overtemperature
12	df_elect_failure_nf	Bit 12	Electronic non-fatal failure.	-
13	df_elect_failure	Bit 13	Electronic fatal failure.	Communication fault between LON module and pump (not visible on the R100)
14	df_sensor_failure	Bit 14	Sensor failure.	Differential-pressure sensor defective

Additional fault information can be retrieved with the Grundfos R100 remote control.

When transmitted

This value is transmitted immediately when one of the bits has changed.

Product availability

For product availability, see overview on page 36.

11.25 Alarm code

```
network output SNVT_count nvoAlarmCode;
```

This network variable output provides the currently active alarm code from the pump.

In case of a common communication interface module fault (code 159), which is generated in the LON module solely, this will be displayed in nvoAlarmCode and override any alarm pending in the connected E-pump.

Valid range

See section *18. Grundfos alarm and warning codes*.

When transmitted

This value is transmitted immediately when it has changed.

Product availability

For product availability, see overview on page 36.

11.26 Warning code

```
network output SNVT_count nvoWarningCode;
```

This network variable output provides the currently active warning code from the pump.

Valid range

See section *18. Grundfos alarm and warning codes*.

When transmitted

This value is transmitted immediately when it has changed.

Product availability

For product availability, see overview on page 36.

11.27 Liquid temperature

```
network output SNVT_temp_p nvoFluidTemp;
```

This network variable output provides the pumped-liquid temperature.

Valid range

-273.17 to +327.66 °C (0.01 °C).

The value of 0x7FFF (327.67 °C) represents invalid data and indicates that the temperature cannot be measured.

When transmitted

This value is transmitted immediately when it has changed more than 1 °C.

Product availability

For product availability, see overview on page 36.

11.28 Remote temperature 1

```
network output SNVT_temp_p nvoRemoteTemp;
```

This network variable output provides the temperature measured somewhere in the system with a temperature sensor connected to the pump.

Valid range

-273.17 to +327.66 °C (0.01 °C).

The value of 0x7FFF (327.67 °C) represents invalid data and indicates that the temperature cannot be measured or that no remote temperature-sensor is connected.

When transmitted

This value is transmitted immediately when it has changed more than 1 °C.

Product availability

For product availability, see overview on page 36.

11.29 Remote temperature 2

```
network output SNVT_temp_p nvoRemoteTemp2;
```

This network variable output provides the temperature measured somewhere in the system with a temperature sensor connected to the pump.

Valid range

-273.17 to +327.66 °C (0.01 °C).

The value of 0x7FFF (327.67 °C) represents invalid data and indicates that the temperature cannot be measured or that no remote temperature-sensor is connected.

When transmitted

This value is transmitted immediately when it has changed more than 1 °C.

Product availability

For product availability, see overview on page 36.

11.30 Tank level

```
network output SNVT_length_f nvoLevel;
```

This network variable output provides the liquid level in the tank of the hydraulic system as measured by the pump.

Valid range

0 to 3.40282E38 m.

A value of NaN (Not a Number) represents invalid data and indicates that the level cannot be measured or that no level sensor is connected.

If no level sensor is available in the system, nvoLevel will display a value of NaN (Not a Number).

When transmitted

This value is transmitted immediately when it has changed more than 0.01 m.

Product availability

For product availability, see overview on page 36.

11.31 Auxiliary sensor input

```
network output SNVT_lev_percent nvoAuxSensor;
```

This network variable output enables the user to connect any kind of sensor to the product (e.g. a pH sensor), but the interpretation of 0 % and 100 % has to be managed somewhere else in the system.

Valid range

-163.840 to 163.830 % (0.005 % or 50 ppm).

The value of 0x7FFF (163.835 %) represents invalid data and indicates that no auxiliary sensor input is connected.

When transmitted

This value is transmitted immediately when it has changed more than 0.1 %.

Product availability

For product availability, see overview on page 36.

11.32 Power consumption in watts

```
network output SNVT_power nvoPower;
```

This optional network variable output provides the actual power being consumed by the pump.

Valid range

0 to 6,553.4 W (0.1 W).

The value of 0xFFFF (6,553.5 W) represents invalid data and indicates that the power cannot be measured/estimated or that the power is higher than 6,500 W.

When transmitted

This value is transmitted immediately when it has changed more than 2 W.

Product availability

For product availability, see overview on page 36.

11.33 Power consumption in kilowatts

```
network output SNVT_power_kilo nvoPowerKilo;
```

This optional network variable output provides the actual power being consumed by the pump.

Valid range

0 to 6,553.4 kW (0.1 kW).

The value of 0xFFFF (6,553.5 kW) represents invalid data and indicates that the power consumption cannot be measured/estimated.

When transmitted

This value is transmitted immediately when it has changed more than 0.2 kW.

Product availability

For product availability, see overview on page 36.

11.34 Energy consumption (standard range)

```
network output SNVT_elec_kwh nvoEnergyConsum;
```

This optional network variable output provides the accumulated energy consumption of the pump. After 65,535 kWh, the counter is reset and will restart from 0 kWh.

Valid range

0 to 65,535 kWh (1 kWh).

The value of 0xFFFF (65,535 kWh) represents invalid data and indicates that the power consumption cannot be measured/estimated.

When transmitted

This value is transmitted immediately when it has changed.

Product availability

For product availability, see overview on page 36.

11.35 Energy consumption (extended range)

```
network output SNVT_elec_kwh_l nvoEnergyConsumL;
```

This optional network variable output provides the accumulated electrical energy consumption of the pump.
After 214,748,364.6 kWh, the counter is reset and will restart from 0 kWh.

Valid range

-214,748,364.8 to 214,748,364.6 kWh (0.1 kWh).

The value of 0x7FFFFFFF (214,748,364.7 kWh) represents invalid data and indicates that the electrical energy consumption cannot be measured/estimated.

When transmitted

This value is transmitted immediately when it has changed.

Product availability

For product availability, see overview on page 36.

11.36 Send heartbeat

`network input SNVT_time_sec nciSndHrtBt;`

This network configuration property input sets the maximum period of time that will elapse before the functional block automatically updates the following network variables:

nv3, nvoPumpCapacity

nv4, nvoEffOpMode

nv5, nvoControlMode

nv13, nvoPumpStatus.

Valid range

0.0 to 6,553.4 sec. (0.1 sec.).

A value of 0xFFFF (6,553.5 sec.) represents invalid data and will disable the automatic update function.

A value of zero (0) will be used for the internal timer if the configured value is invalid. The value of zero (0) disables the "send heartbeat" function.

Default value

The default value is 0.0 (no automatic update).

Product availability

For product availability, see overview on page 36.

11.37 Receive heartbeat

`network input config SNVT_time_sec nciRcvHrtBt;`

This network configuration property input sets the maximum period of time that will elapse before the functional block automatically uses the default values for the following network variables:

nv10, nviRemotePress

nv11, nviRemoteFlow.

Valid range

0.0 to 6,553.4 sec. (0.1 sec.).

A value of 0xFFFF (6,553.5 sec.) represents invalid data and will disable the automatic update function.

A value of zero (0) will be used for the internal timer if the configured value is invalid. The value of zero (0) disables the "receive heartbeat" function.

Default value

The default value is 0.0 (no automatic update).

Product availability

For product availability, see overview on page 36.

11.38 Control mode for normal operation

`network input config SNVT_dev_c_mode nciControlMode;`

This network configuration property input defines the device control mode to be used for the normal operating mode.
For more details about the control modes, see section *11.6 Effective device control mode*.

Valid range

The valid range is the same as that of nvoControlMode.

Default value

The default control mode for a pump is DCM_PRESS_COMP (value = 2).

Product availability

For product availability, see overview on page 36.

11.39 Maximum flow limit

`Network input config SNVT_flow_p nciFlowHighLim;`

This configuration property defines the maximum limit of the flow of the pump. Applies to MAGNA3 and TPE 2000 version H and later only. It can be enabled in all control modes.

Valid range

The valid range is 0.0 to 655.34 m^3/h.

A value of 0xFFFF (655.35 m^3/h) represents invalid data and will disable the flow limit function.

Default value

The default value is 0xFFFF, i.e. disabled.

Product availability

Only available on MAGNA3.

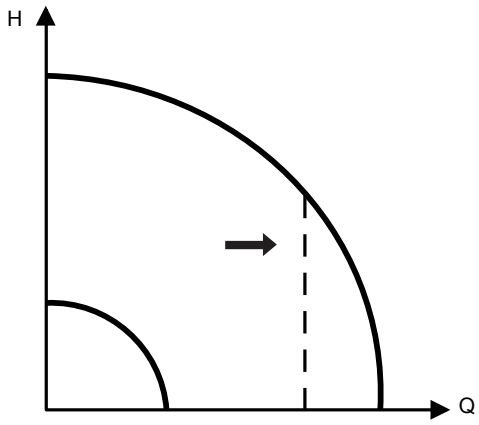


Fig. 17 Maximum flow limit

11.40 Pump characteristic

`network input config SCPTpumpCharateristic nroPumpChar;`

This read-only configuration property input provides the basic characteristic data for the pump.
For further technical details, see installation and operating instructions for the relevant pump or Hydro Multi-E.

The configuration parameter consists of three variables.

Valid range

The valid ranges of the supported pump characteristics are shown below.

Variable	Description	Valid range	Invalid value
SNVT_rpm	Maximum pump speed	0 to 65,535 rpm	0xFFFF (65,535 rpm)
SNVT_press	Maximum pump pressure	-3,276.8 to 3,276.6 kPa	0x7FFF (3,276.7 kPa)
SNVT_flow_p	Maximum pump flow	0 to 655.35 m^3/h	0xFFFF (655.35 m^3/h)

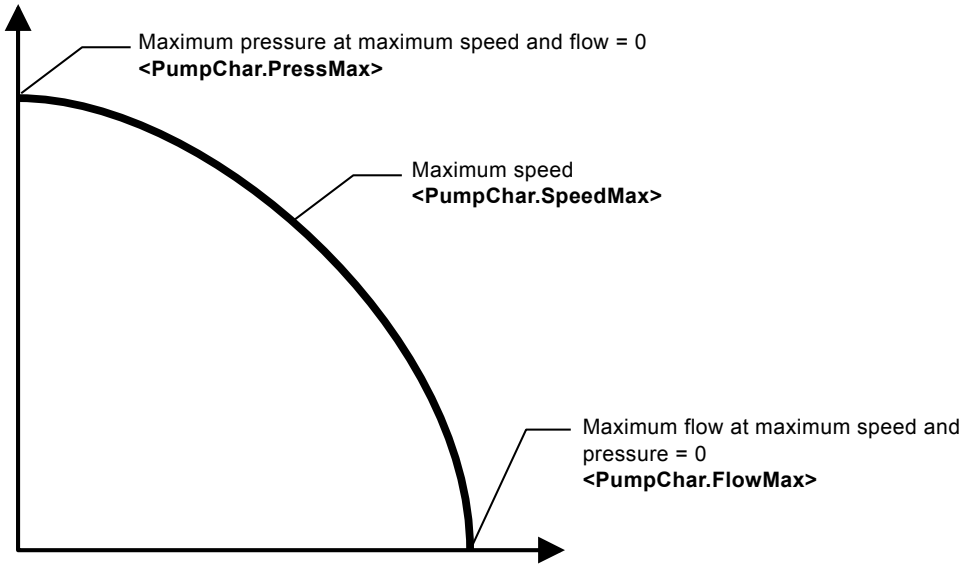


Fig. 18 Pump characteristics

Default value

nroPumpChar is a read-only property. The pump characteristic will be set according to the connected pump.

Product availability

For product availability, see overview on page 36.

11.41 Remote pressure-sensor minimum value

`SCPTminRemotePressureSetpoint cp_family nciRemMinPress;`

Basic network variable type for SCPTminRemotePressureSetpoint: SNVT_press.

This network configuration property input provides the minimum value for ranging the remote pressure sensor. Together with nciRemMaxPress, these range values replace the normal setpoint limits when the remote sensor is used.
See section *11.10 Remote pressure sensor input*.

Valid range

-3,276.8 to 3,276.7 kPa (0.1 kPa).

The value of 0x7FFF (3,276.7 kPa) represents invalid data.

Default value

The default value is 0x7FFF (invalid value).

SCPT reference

SCPTminRemotePressureSetpoint (239).

Product availability

For product availability, see overview on page 36.

11.42 Remote pressure-sensor maximum value

`SCPTmaxRemotePressureSetpoint cp_family nciRemMaxPress;`

Basic network variable type for SCPTmaxRemotePressureSetpoint: SNVT_press.

This network configuration property input provides the maximum value for ranging the remote pressure sensor. Together with nciRemMinPress, these range values replace the normal setpoint limits when the remote sensor is used.
See section *11.10 Remote pressure sensor input*.

Valid range

-3,276.8 to 3,276.7 kPa (0.1 kPa).

The value of 0x7FFF (3,276.7 kPa) represents invalid data.

Default value

The default value is 0x7FFF (invalid value).

SCPT reference

SCPTmaxRemotePressureSetpoint (240).

Product availability

For product availability, see overview on page 36.

11.43 Remote flow-sensor minimum value

```
SCPTminRemoteFlowSetpoint cp_family
nciRemMinFlow;
```

Basic network variable type for SCPTminRemoteFlowSetpoint: SNVT_flow_p.

This network configuration property input provides the minimum value for ranging the remote flow sensor. Together with nciRemMaxFlow, these range values replace the normal setpoint limits when the remote sensor is used.
See section *11.11 Remote flow sensor input*.

Valid range

0 to 655.34 m^3/h (0.01 m^3/h).

The value of 0xFFFF (655.35 m^3/h) represents invalid data.

Default value

The default value is 0xFFFF (invalid value).

SCPT reference

SCPTminRemoteFlowSetpoint (241).

Product availability

For product availability, see overview on page 36.

11.44 Remote flow-sensor maximum value

```
SCPTmaxRemoteFlowSetpoint cp_family
nciRemMaxFlow;
```

Basic network variable type for SCPTmaxRemoteFlowSetpoint: SNVT_flow_p.

This network configuration property input provides the maximum value for ranging the remote flow sensor. Together with nciRemMinFlow, these range values replace the normal setpoint limits when the remote sensor is used.
See section *11.11 Remote flow sensor input*.

Valid range

0 to 655.34 m^3/h (0.01 m^3/h).

The value of 0xFFFF (655.35 m^3/h) represents invalid data.

Default value

The default value is 0xFFFF (invalid value).

SCPT reference

SCPTmaxRemoteFlowSetpoint (242).

Product availability

For product availability, see overview on page 36.

11.45 Kp

```
UCPT_Kp cp_family nciKp;
```

Basic network variable type for SCPTminRemotePressureSetpoint: SNVT_multiplier.

This network configuration property input defines the value of Kp in the PI controller. The value is used when an external pressure or flow sensor is connected.
See section *11.10 Remote pressure sensor input* or *11.11 Remote flow sensor input*.

Valid range

0 to 25.4 (0.1).

The value of 0xFFFF (6,553.5) represents invalid data.

Default value

The default value is 0xFFFF (invalid value). The value will be adopted at power-up.

UCPT reference

UCPT_Kp (6).

Product availability

For product availability, see overview on page 36.

11.46 Ti

```
UCPT_Ti cp_family nciTi;
```

Basic network variable type for SCPTminRemotePressureSetpoint: SNVT_time_sec.

This network configuration property input defines the value of Ti in the PI controller. The value is used when an external pressure or flow sensor is connected.
See section *11.10 Remote pressure sensor input* or *11.11 Remote flow sensor input*.

Valid range

0.0 to 6,553.4 sec. (0.1 sec.).

The value of 0xFFFF (6,553.5 sec.) represents invalid data.

Default value

The default value is 0xFFFF (invalid value). The value will be adopted at power-up.

UCPT reference

UCPT_Ti (4).

Product availability

For product availability, see overview on page 36.

11.47 Ts

```
UCPT_Ts cp_family nciTs;
```

Basic network variable type for SCPTminRemotePressureSetpoint: SNVT_time_sec.

This network configuration property input defines the value of Ts in the PI controller. The value is used when an external pressure or flow sensor is connected.
See section *11.10 Remote pressure sensor input* or *11.11 Remote flow sensor input*.

Valid range

0.0 to 6,553.4 sec. (0.1 sec.).

The value of 0xFFFF (6,553.5 sec.) represents invalid data.

Default value

The default value is 0xFFFF (invalid value). The value will be adopted at power-up.

UCPT reference

UCPT_Ts (5).

Product availability

For product availability, see overview on page 36.

12. Node object functional block details

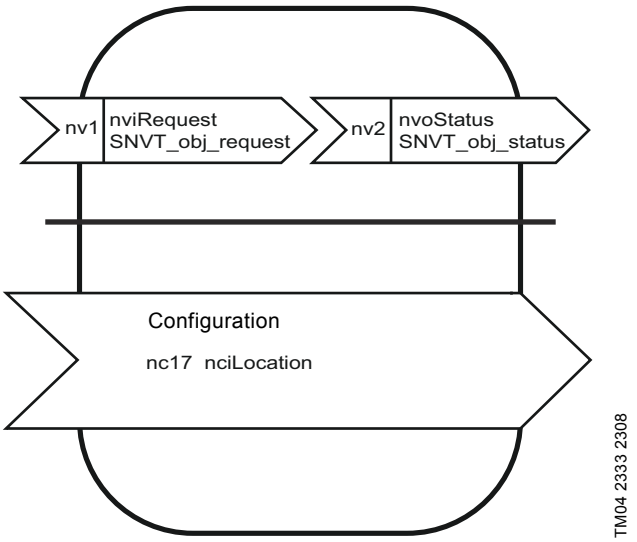


Fig. 19 Node object functional block

12.1 Object request

```
network input SNVT_obj_request nviRequest;
```

This network variable input provides the function to request a particular mode for a particular object within a node.

Valid range

The following values are supported.

No.	Request	Description
0	RQ_NORMAL	Enters the normal state. Cancels disabled state.
1	RQ_DISABLED	Disables functional block.
2	RQ_UPDATE_STATUS	Reports status of functional block (refer to nvoStatus).
5	RQ_REPORT_MASK	Reports status mask.
7	RQ_ENABLE	Enables functional block.
9	RQ_CLEAR_STATUS	Clears bits of nvoStatus after RQ_REPORT_MASK request.
10	RQ_CLEAR_ALARM	Resets alarms in the pump.

12.2 Object status

```
network output SNVT_obj_status nvoStatus;
```

This network variable output reports the status of any object within a node.

Bit no.	Status bit	Description
1	invalid_id	The requested ID is not implemented in this node.
2	invalid_request	Request for unimplemented function.
4	disabled	The function block is currently disabled.
12	electrical_fault	Electrical fault detected in pump.
13	unable_to_measure	The LON module is unable to communicate with the pump.
18	manual_control	The pump has been set to local control (push-buttons on pump, external STOP or with the R100) and is not controlled by the LON module.
19	in_alarm	The pump has an alarm.
21	report_mask	The node is reporting mask.

12.3 Location label

```
network input SNVT_str_asc nciLocation;
```

This configuration property input can be used to provide the location of the functional block (or device).

Valid range

Any NULL-terminated ASCII string of 31 bytes total length (including NULL).

Default value

The default value is an ASCII string containing all zeros ("\0").

13. Manufacturer-specific variables

13.1 Grundfos command

```
network input UNVT_GF_cmd nviGrundfosCmd;
```

This manufacturer-specific network variable input provides the function to request a particular information string from the E-pump. This string contains information about node software version and date which can be used when downloading new software to the node. The result from this command can be seen in nvoGrundfosInfo.

Valid range

No.	Command	Description
0	GF_NO_CMD	No command
1	GF_PRODUCT_VER	Product version (not used)
2	GF_PRODUCT_INFO	Product info
3	GF_SOFTWARE_VERSION	Software version
4	GF_SOFTWARE_DATE	Release date of software
5	GF_SOFTWARE_DEVELOPERS	Initials for software developers

13.2 Grundfos info

```
network output SNVT_str_asc nvoGrundfosInfo;
```

This manufacturer-specific network variable output provides the function to get an information string from the E-pump. This string contains information about node software version and date which can be used when downloading new software to the node. This string is the result from nviGrundfosCmd.

Valid range

Any NULL-terminated ASCII string of 31 bytes total length.

14. Product-specific network variables

Not all network variables are used with all pump types. The validity of a network variable depends on the pump connected to the LON module.

The following table gives an overview of network variables and their availability for the specific pumps.

Product availability

For product availability, see overview on page 36.

Product availability	UPE Series 2000	GRUNDFOS MAGNA Series	TPE Series 1000/2000 / CRE / CRNE / CRIE / NBE / NKE / CHIE / MTRE			CUE
			1-phase	3-phase 0.55 - 7.5 kW	3-phase 11-22 kW	
nviPumpSetpoint	●	●	●	●	●	●
nviPumpOpMode	●	●	●	●	●	●
nviPumpOvdStop	●	●	●	●	●	●
nviOvdSpeed	●	●	●	●	●	●
nviOvdPress	●	●	●	●	●	●
nviRemotePress	-	●	-	-	-	-
nviRemoteFlow	-	●	-	-	-	-
nvoPumpCapacity	●	●	●	●	●	●
nvoEffOpMode	●	●	●	●	●	●
nvoControlMode	●	●	●	●	●	●
nvoPumpStatus	●	●	●	●	●	●
nvoPumpStatusOld	●	●	●	●	●	●
nvoPressure	●	●	●	●	●	●
nvoFlow	●	●	●	●	●	●
nvoFlowF	●	●	●	●	●	●
nvoSpeed	●	●	●	●	●	●
nvoPumpOverride	●	●	●	●	●	●
nvoRuntime	●	●	●	●	●	●
nvoPumpFault	●	●	●	●	●	●
nvoPumpFaultOld	●	●	●	●	●	●
nvoFluidTemp	●	●	●	●	●	●
nvoPower	●	●	●	●	●	●
nvoPowerK	●	●	●	●	●	●
nvoEnergyConsum	●	●	●	●	●	-
nvoEnergyConsumL	●	●	●	●	●	●
nvoRemoteFlow	-	-	H	G	●	●
nvoRemotePress	-	3	H	G	●	●
nvoRemoteTemp1	-	-	H	G	●	●
nvoRemoteTemp2	-	3	H	I	●	●
nvoAuxSensor	-	-	H	G	●	●
nvoInletPress	-	-	H	G	●	●
nvoTotalOnTime	-	3	H	G	●	●
nvoLevel	-	-	H	G	●	●
nvoActSetpoint	-	●	●	●	●	●
nvoAlarmCode	-	●	●	●	●	●
nvoWarningCode	-	3	●	●	●	●
nvoHeatEnergyCnt	-	3	H	-	-	-
nvoHeatPower	-	3	H	-	-	-
nvoHeatTempDiff	-	3	H	-	-	-
nviGrundfosCmd	●	●	●	●	●	●
nciSndHrtBt	●	●	●	●	●	●
nroPumpChar	●	●	●	●	●	●
nciLocation	●	●	●	●	●	●
nciRcvHrtBt	-	●	-	-	-	-
nciControlMode	●	●	●	●	●	●
nciRemMinPress	-	●	-	-	-	-
nciRemMaxPress	-	●	-	-	-	-
nciRemMinFlow	-	●	-	-	-	-
nciRemMaxFlow	-	●	-	-	-	-

Product availability	UPE Series 2000	GRUNDFOS MAGNA Series	TPE Series 1000/2000 / CRE / CRNE / CRIE / NBE / NKE / CHIE / MTRE			CUE
			1-phase	3-phase 0.55 - 7.5 kW	3-phase 11-22 kW	
nciFlowHighLim	-	3	-	-	-	-
nciKp	-	●	-	-	-	-
nciTi	-	●	-	-	-	-
nciTs	-	●	-	-	-	-

3: Only available on MAGNA3.

G: Only available on model G and later versions.

H: Only available on model H and later versions.

I: Only available on model I and later versions.

15. Fitting a sensor

Applies to TPE Series 1000, CRE / CRNE / CRIE / NBE / NKE / CHIE / MTRE / CUE pumps.

When fitting a sensor to the pump, it is necessary to know the range limits for the SNVTs in this profile and the range for sensors connected to the pump.

The table below shows the maximum range for different types of sensors.

Sensor type	Unit	Range
Pressure	bar	0-32
	mbar	0-990
	mVs	0-330
	KPa	0-990
	psi	0-470
	ft	0-990
Flow	m^3/h	0-650
	m^3/s	0-0.1
	l/s	0-180
	gpm (US)	0-990
Temperature	C	-50-320
	F	-50-600
Other	%	0-100

If other sensor types than pressure sensors are fitted, it will not be possible to use the manual override variable nviOvdPress, but it will still be possible to use nviPumpOvdStop and nviOvdSpeed.

When using the LON module with a TPE Series 1000, CRE, NKE or NBE pump, only one of the network variable outputs nvoPressure, nvoFlow, nvoFluidTemp will be valid.

The table below shows the relationship between sensor type and validity of network variable.

Sensor type	nvoPressure	nvoFlow	nvoFluidTemp
Pressure	●	-	-
Flow	-	●	-
Temperature	-	-	●
Other	-	-	-

16. Device resource files

The LON module contains UNVTs and UCPTs. Therefore, Grundfos is supplying DRFs. If the DRFs are used, the right formatting and type definition will be achieved.

The DRFs can be found on the CD-ROM with this functional profile.

The files can be installed by copying them to for example

C:\LONWORKS\TYPES\USER\GRUNDFOS

Then use the ldrfcat.exe program to add the files.

Note ***For further information about how to install DRFs, see Echelon documentation.***

The following UNVTs and UCPTs are supported by the DRFs:

UNVT_GF_cmd

UCPT_Kp

UCPT_Ti.

17. Fault finding

Faults in a LON module can be detected by observing the status of the service LED (LED1) and the LED for internal communication (LED2). See the tables below.

When the LON module is working properly on the LON network, the yellow service LED (LED1) is permanently off.

When an E-pump is connected to the LON module, the LED for internal communication (LED2) is permanently green.

Note ***When the CIM/CIU 110 is connected to the power supply, the yellow service LED (LED1) will flash once.***

CIM 100 fitted in an E-pump

Fault (LED status)	Possible cause	Remedy
1. The service LED (LED1) remains off when the power supply is connected.	a) The CIM 100 has not been fitted correctly in the E-pump.	Fit the CIM 100 correctly in the E-pump.
	b) No power supply to the CIM 100.	Check the power supply to the E-pump.
	c) The CIM 100 is defective.	Replace the CIM 100.
2. The service LED (LED1) is permanently on.	a) The CIM 100 is defective.	Replace the CIM 100.
3. The service LED (LED1) flashes when the power supply is connected to the CIM 100, turns off, turns on again and remains permanently on.	a) The CIM 100 has no application software (application-less).	Try to download application software via a LON installation tool such as LonMaker.
	b) The CIM 100 is defective.	Replace the CIM 100.
4. The service LED (LED1) flashes every second.	c) The CIM 100 has not been installed.	Install the CIM 100 by means of a LON installation tool such as LonMaker.
5. The E-pump does not react to changes of settings, and the readout from the LON network is incorrect. The LED for internal communication (LED2) is permanently red.	a) The CIM 100 does not support the E-pump connected.	Contact the nearest Grundfos company.
	b) The LON application may be wrong, for instance CIM 110 software where CIM 100 software is required.	Download correct software via a LON installation tool such as LonMaker.
6. The E-pump does not react to changes of settings, and the readout from the LON network is incorrect. The LED for internal communication (LED2) is flashing red.	a) The cable between the CIM 100 and the E-pump is connected incorrectly or damaged.	Connect the cable correctly, or replace the cable.

CIM 100 fitted in the CIU 100

Fault (LED status)	Possible cause	Remedy
1. The service LED (LED1) remains off when the power supply is connected.	a) No power supply to the CIU 100.	Check the power supply to the CIU 100.
	b) The CIM 100 is defective.	Replace the CIM 100.
2. The service LED (LED1) is permanently on.	a) The CIM 100 is defective.	Replace the CIM 100.
3. The service LED (LED1) flashes when the power supply is connected to the CIM 100, turns off, turns on again and remains permanently on.	a) The CIM 100 has no application software (application-less).	Try to download application software via a LON installation tool such as LonMaker.
	b) The CIM 100 is defective.	Replace the CIM 100.
4. The service LED (LED1) flashes every second.	a) The CIM 100 has not been installed.	Install the CIM 100 by means of a LON installation tool such as LonMaker.
5. The E-pump does not react to changes of settings, and the readout from the LON network is incorrect. The LED for internal communication (LED2) is permanently red.	a) The CIM 100 does not support the E-pump connected.	Contact the nearest Grundfos company.
	b) The LON application may be wrong, for instance CIM 110 software where CIM 100 software is required.	Download correct software via a LON installation tool such as LonMaker.
6. The E-pump does not react to changes of settings, and the readout from the LON network is incorrect. The LED for internal communication (LED2) is flashing red.	a) The cable between the CIM 100 and the E-pump is connected incorrectly or damaged.	Connect the cable correctly, or replace the cable.

Note ***Fault finding in a LON network requires a special tool such as Honeywell Excelon (not supplied by Grundfos).***

18. Grundfos alarm and warning codes

Code	Description	Code	Description	Code	Description
1	Leakage current	32	Overvoltage	72	Hardware fault, type 1
2	Missing phase	33	Soon time for service (general service information)	73	Hardware shutdown (HSD)
3	External fault signal	35	Gas in pump head, deaerating problem	74	Internal supply voltage too high
4	Too many restarts	36	Discharge valve leakage	75	Internal supply voltage too low
5	Regenerative braking	37	Suction valve leakage	76	Internal communication fault
6	Mains fault	38	Vent valve defective	77	Communication fault, twin-head pump
7	Too many hardware shutdowns	40	Undervoltage	78	Fault, speed plug
8	PWM switching frequency reduced	41	Undervoltage transient	79	Functional fault, add-on module
9	Phase sequence reversal	42	Cut-in fault (dV/dt)	80	Hardware fault, type 2
10	Communication fault, pump	45	Voltage asymmetry	81	Verification error, data area (RAM)
11	Water-in-oil fault (motor oil)	48	Overload	82	Verification error, code area (ROM, FLASH)
12	Time for service (general service information)	49	Overcurrent (i_line, i_dc, i_mo)	83	Verification error, FE parameter area (EEPROM)
13	Moisture alarm, analog	50	Motor protection function, general shutdown (MPF)	84	Memory access error
14	Electronic DC-link protection activated (ERP)	51	Blocked motor/pump	85	Verification error, BE parameter area (EEPROM)
15	Communication fault, main system (SCADA)	52	Motor slip high	88	Sensor fault
16	Other	53	Kipped motor	89	Signal fault, (feedback) sensor 1
17	Performance requirement cannot be met	54	Motor protection function, 3 sec. limit	90	Signal fault, speed sensor
18	Commanded alarm standby (trip)	55	Motor current protection activated (MCP)	91	Signal fault, temperature 1 sensor
19	Diaphragm break (dosing pump)	56	Underload	92	Calibration fault, (feedback) sensor
20	Insulation resistance low	57	Dry running	93	Signal fault, sensor 2
21	Too many starts per hour	58	Low flow	94	Limit exceeded, sensor 1
22	Moisture switch alarm, digital	59	No flow	95	Limit exceeded, sensor 2
23	Smart trim gap alarm	60	Low input power	96	Setpoint signal outside range
24	Vibration	64	Overtemperature	97	Signal fault, setpoint input
25	Setup conflict	65	Motor temperature 1 (t_m or t_mo or t_mo1)	98	Signal fault, input for setpoint influence
26	Load continues even if the motor has been switched off	66	Temperature, control electronics (t_e)	99	Signal fault, input for analog setpoint
27	External motor protector activated (e.g. MP 204)	67	Temperature too high, internal frequency converter module (t_m)	104	Software shutdown
28	Battery low	68	External temperature/ water temperature (t_w)	105	Electronic rectifier protection activated (ERP)
29	Turbine operation (impellers forced backwards)	69	Thermal relay 1 in motor (e.g. Klixon)	106	Electronic inverter protection activated (EIP)
30	Change bearings (specific service information)	70	Thermal relay 2 in motor (e.g. thermistor)	110	Skew load, electrical asymmetry
31	Change varistor(s) (specific service information)	71	Motor temperature 2 (Pt100, t_mo2)	111	Current asymmetry

Code	Description	Code	Description	Code	Description
112	Cos φ too high	167	Signal fault, analog input 3	195	Limit exceeded, sensor 6
113	Cos φ too low	168	Signal fault, pressure sensor	196	Operation with reduced efficiency
120	Auxiliary winding fault (single-phase motors)	169	Signal fault, flow sensor	197	Operation with reduced pressure
121	Auxiliary winding current too high (single-phase motors)	170	Signal fault, water-in-oil (WIO) sensor	198	Operation with increased power consumption
122	Auxiliary winding current too low (single-phase motors)	171	Signal fault, moisture sensor	199	Process out of range (monitoring/ estimation/calculation/control)
123	Start capacitor, low (single-phase motors)	172	Signal fault, atmospheric pressure sensor	200	Application alarm
124	Run capacitor, low (single-phase motors)	173	Signal fault, rotor position sensor (Hall sensor)	201	External sensor input high
144	Motor temperature 3 (Pt100, t_mo3)	174	Signal fault, rotor origo sensor	202	External sensor input low
145	Bearing temperature high (Pt100), in general or top bearing	175	Signal fault, temperature 2 sensor (t_mo2)	203	Alarm on all pumps
146	Bearing temperature high (Pt100), middle bearing	176	Signal fault, temperature 3 sensor (t_mo3)	204	Inconsistency between sensors
147	Bearing temperature high (Pt100), bottom bearing	177	Signal fault, Smart trim gap sensor	205	Level float switch sequence inconsistency
148	Motor bearing temperature high (Pt100) in drive end (DE)	178	Signal fault, vibration sensor	206	Water shortage, level 1
149	Motor bearing temperature high (Pt100) in non-drive end (NDE)	179	Signal fault, bearing temperature sensor (Pt100), general or top bearing	207	Water leakage
152	Communication fault, add-on module	180	Signal fault, bearing temperature sensor (Pt100), middle bearing	208	Cavitation
153	Fault, analog output	181	Signal fault, PTC sensor (short-circuited)	209	Non-return valve fault
154	Communication fault, display	182	Signal fault, bearing temperature sensor (Pt100), bottom bearing	210	High pressure
155	Inrush fault	183	Signal fault, extra temperature sensor	211	Low pressure
156	Communication fault, internal frequency converter module	184	Signal fault, general-purpose sensor	212	Diaphragm tank precharge pressure out of range
157	Real-time clock out of order	185	Unknown sensor type	213	VFD not ready
158	Hardware circuit measurement fault	186	Signal fault, power meter sensor	214	Water shortage, level 2
159	CIM fault (Communication Interface Module)	187	Signal fault, energy meter	215	Soft pressure build-up timeout
160	GSM modem, SIM card fault	188	Signal fault, user-defined sensor	216	Pilot pump alarm
161	Sensor supply fault, 5 V	189	Signal fault, level sensor	217	Alarm, general-purpose sensor high
162	Sensor supply fault, 24 V	190	Limit exceeded, sensor 1 (e.g. alarm level in WW application)	218	Alarm, general-purpose sensor low
163	Measurement fault, motor protection	191	Limit exceeded, sensor 2 (e.g. high level in WW application)	219	Pressure relief not adequate
164	Signal fault, LiqTec sensor	192	Limit exceeded, sensor 3 (e.g. overflow level in WW application)	220	Fault, motor contactor feedback
165	Signal fault, analog input 1	193	Limit exceeded, sensor 4 (e.g. low level in WW/tank filling application	221	Fault, mixer contactor feedback
166	Signal fault, analog input 2	194	Limit exceeded, sensor 5	222	Time for service, mixer

Code	Description	Code	Description	Code	Description
223	Maximum number of mixer starts per hour exceeded	232	Ethernet: Auto-disabled due to misuse	241	Motor phase failure
224	Pump fault (due to auxiliary component or general fault)	233	Ethernet: IP address conflict	242	Automatic motor model recognition failed
225	Communication fault, pump module	234	Back-up pump alarm	243	Motor relay has been forced (manually operated/commanded)
226	Communication fault, I/O module	235	Gas detected	244	Fault, On/Off/Auto switch
227	Combi event	236	Pump 1 fault	245	Pump continuous runtime too long
228	User-defined event	237	Pump 2 fault	246	User-defined relay has been forced (manually operated/ commanded)
229	Water on floor	238	Pump 3 fault	247	Power-on notice (device/system has been switched off)
230	Network alarm	239	Pump 4 fault	248	Fault, battery/UPS
231	Ethernet: No IP address from DHCP server	240	Lubricate bearings (specific service information)		

Subject to alterations.

Argentina
Bombas GRUNDFOS de Argentina S.A.
Ruta Panamericana, ramal Campana
Centro Industrial Garín - Esq. Haendel y Mozart
AR-1619 Garín Pcia. de Buenos Aires
Pcia. de Buenos Aires
Phone: +54-3327 414 444
Telefax: +54-3327 45 3190

Australia
GRUNDFOS Pumps Pty. Ltd.
P.O. Box 2040
Regency Park
South Australia 5942
Phone: +61-8-8461-4611
Telefax: +61-8-8340 0155

Austria
GRUNDFOS Pumpen Vertrieb Ges.m.b.H.
Grundfosstraße 2
A-5082 Grödig/Salzburg
Tel.: +43-6246-883-0
Telefax: +43-6246-883-30

Belgium
N.V. GRUNDFOS Bellux S.A.
Boomsesteenweg 81-83
B-2630 Aartselaar
Tél.: +32-3-870 7300
Télécopie: +32-3-870 7301

Belarus
Представительство ГРУНДФОС в Минске
220125, Минск
ул. Шафарнянская, 11, оф. 56
Тел.: +7 (375 17) 286 39 72, 286 39 73
Факс: +7 (375 17) 286 39 71
E-mail: minsk@grundfos.com

Bosnia/Herzegovina
GRUNDFOS Sarajevo
Trg Heroja 16,
BiH-71000 Sarajevo
Phone: +387 33 713 290
Telefax: +387 33 659 079
e-mail: grundfos@bih.net.ba

Brazil
BOMBAS GRUNDFOS DO BRASIL
Av. Humberto de Alencar Castelo Branco, 630
CEP 09850 - 300
São Bernardo do Campo - SP
Phone: +55-11 4393 5533
Telefax: +55-11 4343 5015

Bulgaria
Grundfos Bulgaria EOOD
Slatina District
Iztochna Tangenta street no. 100
BG - 1592 Sofia
Tel. +359 2 49 22 200
Fax. +359 2 49 22 201
email: bulgaria@grundfos.bg

Canada
GRUNDFOS Canada Inc.
2941 Brighton Road
Oakville, Ontario
L6H 6C9
Phone: +1-905 829 9533
Telefax: +1-905 829 9512

China
GRUNDFOS Pumps (Shanghai) Co. Ltd.
50/F Maxdo Center No. 8 XingYi Rd.
Hongqiao development Zone
Shanghai 200336
PRC
Phone: +86 21 612 252 22
Telefax: +86 21 612 253 33

Croatia
GRUNDFOS CROATIA d.o.o.
Cebini 37, Buzin
HR-10010 Zagreb
Phone: +385 1 6595 400
Telefax: +385 1 6595 499
www.grundfos.hr

Czech Republic
GRUNDFOS s.r.o.
Čajkovského 21
779 00 Olomouc
Phone: +420-585-716 111
Telefax: +420-585-716 299

Denmark
GRUNDFOS DK A/S
Martin Bachs Vej 3
DK-8850 Bjerringbro
Tlf.: +45-87 50 50 50
Telefax: +45-87 50 51 51
E-mail: info_GDK@grundfos.com
www.grundfos.com/DK

Estonia
GRUNDFOS Pumps Eesti OÜ
Peterburi tee 92G
11415 Tallinn
Tel: + 372 606 1690
Fax: + 372 606 1691

Finland
OY GRUNDFOS Pumput AB
Mestarintie 11
FIN-01730 Vantaa
Phone: +358-(0)207 889 900
Telefax: +358-(0)207 889 550

France
Pompes GRUNDFOS Distribution S.A.
Parc d'Activités de Chesnes
57, rue de Malacombe
F-38290 St. Quentin Fallavier (Lyon)
Tél.: +33-4 74 82 15 15
Télécopie: +33-4 74 94 10 51

Germany
GRUNDFOS GMBH
Schlüterstr. 33
40699 Erkrath
Tel.: +49-(0) 211 929 69-0
Telefax: +49-(0) 211 929 69-3799
e-mail: infoservice@grundfos.de
Service in Deutschland:
e-mail: kundendienst@grundfos.de

HILGE GmbH & Co. KG
Hilgestrasse 37-47
55292 Bodenheim/Rhein
Germany
Tel.: +49 6135 75-0
Telefax: +49 6135 1737
e-mail: hilge@hilge.de

Greece
GRUNDFOS Hellas A.E.B.E.
20th km. Athinon-Markopoulou Av.
P.O. Box 71
GR-19002 Peania
Phone: +0030-210-66 83 400
Telefax: +0030-210-66 46 273

Hong Kong
GRUNDFOS Pumps (Hong Kong) Ltd.
Unit 1, Ground floor
Siu Wai Industrial Centre
29-33 Wing Hong Street &
68 King Lam Street, Cheung Sha Wan
Kowloon
Phone: +852-27861706 / 27861741
Telefax: +852-27858664

Hungary
GRUNDFOS Hungária Kft.
Park u. 8
H-2045 Törökbálint,
Phone: +36-23 511 110
Telefax: +36-23 511 111

India
GRUNDFOS Pumps India Private Limited
118 Old Mahabalipuram Road
Thoraipakkam
Chennai 600 096
Phone: +91-44 2496 6800

Indonesia
PT GRUNDFOS Pompa
Jl. Rawa Sumur III, Blok III / CC-1
Kawasan Industri, Pulogadung
Jakarta 13930
Phone: +62-21-460 6909
Telefax: +62-21-460 6910 / 460 6901

Ireland
GRUNDFOS (Ireland) Ltd.
Unit A, Merrywell Business Park
Ballymount Road Lower
Dublin 12
Phone: +353-1-4089 800
Telefax: +353-1-4089 830

Italy
GRUNDFOS Pompe Italia S.r.l.
Via Gran Sasso 4
I-20060 Truccazzano (Milano)
Tel.: +39-02-95838112
Telefax: +39-02-95309290 / 95838461

Japan
GRUNDFOS Pumps K.K.
Gotanda Metalion Bldg., 5F,
5-21-15, Higashi-gotanda
Shiagawa-ku, Tokyo
141-0022 Japan
Phone: +81 35 448 1391
Telefax: +81 35 448 9619

Korea
GRUNDFOS Pumps Korea Ltd.
6th Floor, Aju Building 679-5
Yeoksam-dong, Kangnam-ku, 135-916
Seoul, Korea
Phone: +82-2-5317 600
Telefax: +82-2-5633 725

Latvia
SIA GRUNDFOS Pumps Latvia
Deglava biznesa centrs
Augusta Deglava ielā 60, LV-1035, Rīga,
Tālr.: + 371 714 9640, 7 149 641
Fakss: + 371 914 9646

Lithuania
GRUNDFOS Pumps UAB
Smolensko g. 6
LT-03201 Vilnius
Tel: + 370 52 395 430
Fax: + 370 52 395 431

Malaysia
GRUNDFOS Pumps Sdn. Bhd.
7 Jalan Peguam U1/25
Glenmarie Industrial Park
40150 Shah Alam
Selangor
Phone: +60-3-5569 2922
Telefax: +60-3-5569 2866

Mexico
Bombas GRUNDFOS de México S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
Apodaca, N.L. 66600
Phone: +52-81-8144 4000
Telefax: +52-81-8144 4010

Netherlands
GRUNDFOS Netherlands
Veluwezoom 35
1326 AE Almere
Postbus 22015
1302 CA ALMERE
Tel.: +31-88-478 6336
Telefax: +31-88-478 6332
E-mail: info_gnl@grundfos.com

New Zealand
GRUNDFOS Pumps NZ Ltd.
17 Beatrice Tinsley Crescent
North Harbour Industrial Estate
Albany, Auckland
Phone: +64-9-415 3240
Telefax: +64-9-415 3250

Norway
GRUNDFOS Pumper A/S
Strømsveien 344
Postboks 235, Leirdal
N-1011 Oslo
Tlf.: +47-22 90 47 00
Telefax: +47-22 32 21 50

Poland
GRUNDFOS Pompy Sp. z o.o.
ul. Klonowa 23
Baranowo k. Poznania
PL-62-081 Przeźmierowo
Tel: (+48-61) 650 13 00
Fax: (+48-61) 650 13 50

Portugal
Bombas GRUNDFOS Portugal, S.A.
Rua Calvet de Magalhães, 241
Apartado 1079
P-2770-153 Paço de Arcos
Tel.: +351-21-440 76 00
Telefax: +351-21-440 76 90

Romania
GRUNDFOS Pompe România SRL
Bd. Biruintei, nr 103
Pantelimon county Ilfov
Phone: +40 21 200 4100
Telefax: +40 21 200 4101
E-mail: romania@grundfos.ro

Russia
ООО Грундфос
Россия, 109544 Москва, ул. Школьная 39
Тел. (+7) 495 737 30 00, 564 88 00
Факс (+7) 495 737 75 36, 564 88 11
E-mail grundfos.moscow@grundfos.com

Serbia
GRUNDFOS Predstavništvo Beograd
Dr. Milutina Ivkovića 2a/29
YU-11000 Beograd
Phone: +381 11 26 47 877 / 11 26 47 496
Telefax: +381 11 26 48 340

Singapore
GRUNDFOS (Singapore) Pte. Ltd.
25 Jalan Tukang
Singapore 619264
Phone: +65-6681 9688
Telefax: +65-6681 9689

Slovenia
GRUNDFOS d.o.o.
Šlandrova 8b, SI-1231 Ljubljana-Črnuče
Phone: +386 1 568 0610
Telefax: +386 1 568 0619
E-mail: slovenia@grundfos.si

South Africa
GRUNDFOS (PTY) LTD
Corner Mountjoy and George Allen Roads
Wilbart Ext. 2
Bedfordview 2008
Phone: (+27) 11 579 4800
Fax: (+27) 11 455 6066
E-mail: lsmart@grundfos.com

Spain
Bombas GRUNDFOS España S.A.
Camino de la Fuentecilla, s/n
E-28110 Algete (Madrid)
Tel.: +34-91-848 8800
Telefax: +34-91-628 0465

Sweden
GRUNDFOS AB
Box 333 (Lunnagårdsgatan 6)
431 24 Mölndal
Tel.: +46 31 332 23 000
Telefax: +46 31 331 94 60

Switzerland
GRUNDFOS Pumpen AG
Bruggacherstrasse 10
CH-8117 Fällanden/ZH
Tel.: +41-1-806 8111
Telefax: +41-1-806 8115

Taiwan
GRUNDFOS Pumps (Taiwan) Ltd.
7 Floor, 219 Min-Chuan Road
Taichung, Taiwan, R.O.C.
Phone: +886-4-2305 0868
Telefax: +886-4-2305 0878

Thailand
GRUNDFOS (Thailand) Ltd.
92 Chaloem Phrakiat Rama 9 Road,
Dokmai, Pravej, Bangkok 10250
Phone: +66-2-725 8999
Telefax: +66-2-725 8998

Turkey
GRUNDFOS POMPA San. ve Tic. Ltd. Sti.
Gebze Organize Sanayi Bölgesi
Ihsan dede Caddesi,
2. yol 200. Sokak No. 204
41490 Gebze/ Kocaeli
Phone: +90 - 262-679 7979
Telefax: +90 - 262-679 7905
E-mail: satis@grundfos.com

Ukraine
ТОВ ГРУНДФОС УКРАЇНА
01010 Київ, Вул. Московська 8б,
Тел.:(+38 044) 390 40 50
Фах.: (+38 044) 390 40 59
E-mail: ukraine@grundfos.com

United Arab Emirates
GRUNDFOS Gulf Distribution
P.O. Box 16768
Jebel Ali Free Zone
Dubai
Phone: +971 4 8815 166
Telefax: +971 4 8815 136

United Kingdom
GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard/Beds. LU7 4TL
Phone: +44-1525-850000
Telefax: +44-1525-850011

U.S.A.
GRUNDFOS Pumps Corporation
17100 West 118th Terrace
Olathe, Kansas 66061
Phone: +1-913-227-3400
Telefax: +1-913-227-3500

Uzbekistan
Представительство ГРУНДФОС в Ташкенте
700000 Ташкент ул.Усмана Носира 1-й тупик 5
Телефон: (3712) 55-68-15
Факс: (3712) 53-36-35

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