

AGE4 variable speed circulator

AGE4(D) high power

Installation and operating instructions

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EN: Compliance of the product with EU standards:

- Machinery directive (2006/42/EC).
Standard used: EN 809;
- Low Voltage (2014/35/EU).
Standard used: EN 60335-1; EN 60335-2-51;
- Electromagnetic compatibility (2014/30/EU)
Standard used: EN 55014-1; EN 55014-2; EN 61000-3-2; EN 61000-3-3;
- Ecodesign Directive (2009/125/EC)
Standard used: EN 16297-1:2012;
- Circulators: Commission Regulation No. 641/2009.
For EEI see nameplate.
Standard used: EN 16297-1:2012; EN 16297-2:2012;



English (EN) Installation and operating manual

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Symbols used in this manual:



Warning:

Safety precautions which, if ignored could cause personal injury or machine damage



Notes:

Tips that could ease pump handling.

1 GENERAL INFORMATION

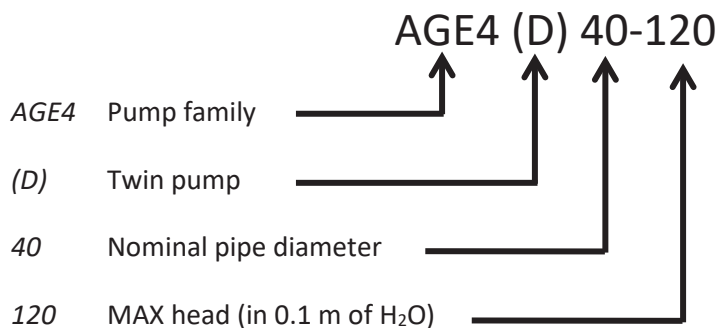
1.1 USES

The AGE4, AGE4 Z and the AGE4D wet rotor circulator are used for the circulation of liquid medium within systems for hot-water heating, air-conditioning and ventilation. They are designed as single or twin variable-speed pumping aggregates where the speed is regulated by electronic on board controller. The pump constantly measures pressure and flow and adjusts the speed according to the set pump mode.

	C
Start/stop input	✓
Relay output	2x
Max/min input	✓
0-10V input	✓
4-20mA input	✓
PWM input	✓
Modbus (RS485 or TCP/IP)	✓
Bacnet MS/TP	✓
Web server	✓

The main purpose of the twin pump is uninterrupted operation if one of the pumps fails. Common hydraulic housing is equipped with a change-over flap and two pump heads, separately connected to the electrical main.

1.2 PUMP LABELING



1.3 PUMP MAINTENANCE, SPARE PARTS AND DECOMMISSIONING

Pumps are designed to operate without maintenance for several years. This product and its components must be disposed of in an environmentally friendly manner. Use waste collection services, if this is not possible, contact the nearest Armstrong Pumps Service or authorized repairers.

2 SAFETY

These instructions should be studied carefully before installing or operating the pump. They are meant to help you with installation, use and maintenance and to ensure your safety. Installation should only be performed with regards to local standards and directives. Only qualified personnel should maintain and service these products. Failure in following these instructions can put the user safety at risk, can cause damage to the product and can void warranty. Safety functions are only guaranteed if the pump is installed, used and maintained as described in this manual.

3 TECHNICAL SPECIFICATIONS

3.1 STANDARDS AND PROTECTIONS

Pumps are made in according to the following standards and protections:

Protection class:	Insulation class:	Motor protection:
IP44	180 (H)	Thermal - built in

Installation specification		
Pump type	Nominal pressure	Fitting length [mm]
AGE4 (D) 32-120	Common hydraulics PN6 and 10	220
AGE4 (D) (Z) 40-80		220
AGE4 (D) (Z) 40-120		250
AGE4 (D) 40-180		250
AGE4 (D) (Z) 50-80		280
AGE4 (D) (Z) 50-120		280
AGE4 (D) 50-180		280
AGE4 (D) 65-80		340
AGE4 (D) 65-120		340
AGE4 (D) 65-180		340
AGE4 (D) 80-80		360
AGE4 (D) 80-120		360
AGE4 (D) 100-120		450

3.2 PUMP MEDIUM

Pump medium can be pure water or a mixture of pure water and glycol, which is appropriate for heating or chilled system. The medium must be free from aggressive or corrosive additives, free from mixtures of mineral oils and solid or fibrous particles. The pump should not be used for pumping flammable, corrosive media and in an corrosive atmosphere. Permanent magnet rotor inside the pump is prone to accumulating magnetic particles on its surface, which can lead to abrasion of bearings and rotor can or even blocking the rotor. Although the pump is built in a way that the effect of magnetic particles is minimal, failures of bearings, rotor cans and blocked rotors are not covered by the warranty. To ensure the pump is operating in optimal condition and eliminate any presence of magnetite in the system we recommend the use of magnetite filter.

3.3 TEMPERATURES AND AMBIENT HUMIDITY

Permitted ambient and media temperature:			
Ambient temperature [°C]	Medium temperature [°C]		Relative ambient humidity
	min.	max.	
Up to 25	-10	110	<95 %
Up to 30	-10	100	
Up to 35	-10	90	
Up to 40	-10	80	



- Medium temperature should be higher or the same as ambient temperature, so that the condensate does not gather on pump surface.



- Operation outside allowed conditions may shorten pump lifetime and void the warranty.

3.4 ELECTRICAL SPECIFICATION

3.4.1 POWER SUPPLY

Electrical ratings					
Pump	Rated voltage	Rated power [W]	Rated current [A]	Rated current (I _{MAX II}) [A]	Startup
AGE4 (D) 32-120	230 VAC ± 15 %, 47-63Hz Pumps can operate at reduced voltage with limited power (P=I _{MAX II} *U)	370	1.8	6	Build-in startup circuit.
AGE4 (D) (Z) 40-80		270	1.3	6	
AGE4 (D) (Z) 40-120		480	2.3	6	
AGE4 (D) 40-180		680	3.4	6	
AGE4 (D) (Z) 50-80		370	1.7	6	
AGE4 (D) (Z) 50-120		560	2.5	6	
AGE4 (D) 50-180		830	3.6	6	
AGE4 (D) 65-80		560	2.6	6	
AGE4 (D) 65-120		810	3.5	6	
AGE4 (D) 65-180		1550	5.4	6.6	
AGE4 (D) 80-80		800	3.5	6	
AGE4 (D) 80-120		1380	5.0	6	
AGE4 100-120		1550	5.4	6.6	

3.4.2 ELECTRICAL SPECIFICATIONS OF INPUTS, OUTPUTS AND COMMUNICATION

To see inputs, outputs and communication functions see chapter 5 Setup and operation. Detailed specifications about used protocols are described in communications manual.

3.4.2.1 DIGITAL INPUT (RUN, 0V)

Available on all AGE4 models

Electrical properties	
Resistance of the closed loop	100 Ω



- Only potential-free contact can be connected to this input.

3.4.2.2 ANALOG INPUTS AND OUTPUTS (SET1,SET2,SET3)

Electrical properties		
Input voltage	-1 - 32 VDC	When used as input.
Output voltage	0 - 12 VDC	When used as an output 5 mA load on individual output.
Input impedance	~100 kΩ	0.5 mA additional load for most configurations.
Input sink current	0 - 33 mA	Common sink on COM, if used as output.
Galvanic isolation	Voltage 4 kV up to 1 s, 275 V permanent.	

3.4.2.3 RELAY OUTPUT

Electrical properties		
Pump type	AGE4 with power rating < 850 W	AGE4 with power rating > 850 W
Rated current	3 A	8 A
MAX IIimum voltage	250 VAC, 30 VDC	250 VAC, 30 VDC
MAX IIimum power	300 VA	500 VA

3.4.2.4 ETHERNET

Electrical properties		
Connector	RJ-45, 10BASE-T, 10 Mbit/s.	
Services	-Web server (port 80) -Software update through web interface. - Modbusa RTU through TCP/IP	
Default IP address	192.168.0.245 (on twin model AGE4D, the second head IP is 192.168.0.246)	
Ethernet diagnostics	visual LED1 LED2	Slowly blinking if module is on. Lights up when the connection is established.

3.4.2.5 MODBUS

Modbus over Ethernet		
Server address	192.168.0.245:502	IP address is the same as for pump web server, port is fixed as 502
Device address	245	Default value, can be changed over Modbus
Data format and protocols	<ul style="list-style-type: none"> • Modbus TCP • Modbus RTU over TCP • Modbus UDP • Modbus RTU over UDP 	Protocol is automatically selected according to established connection and received request.

3.4.2.6 RS-485

RS-485		
Connector type	Screwless terminals	2+1 pins. See section 3.1 Terminals
Data protocol	- Modbus RTU - BACnet MS/TP	Only one at a time. Selectable over Web interface (tab "Network")
Bus wire configuration	Two-wire + common	Conductors: A, B and COM (Common). See section 3.1 Terminals
Communication transceiver	Integrated, 1/8 of standard load	Connect either via passive taps or daisy chain.
Maximum cable length	1200 m	See section 6.6 Termination
Line termination	Not present	Line termination is not integrated. For low speed/short distance, termination can be omitted. Otherwise, terminate the line externally on both ends.
Supported transmission speeds	Up to 38400 baud	See data for protocol used.
Start bits, data bits	1, 8	Fixed.
Visual diagnostics	LED2	Flashing yellow when data reception detected. Combined (OR) with Ethernet ACT function.
Maximum number of devices	256	1/8 nominal load enables 256 devices, protocol limit might be lower.
Isolation	Common ground (COM) with SET1, SET2 and SET3.	Bus shares common ground with other signals.

3.4.2.7 MODBUS RTU

Modbus RTU over RS-485		
Slave address	1-247	See section 6.5 Speed, parity and address. [default=245]
Maximum Modbus packet size	256 bytes	Including address (1) and CRC (2) bytes.
Supported baud rates	1200, 2400, 4800, 9600, 19200, 38400	Settable over Modbus register. Settable over Web interface (tab "Network"). [default=19200]
Stop bits	1 or 2	1 stop bit minimum, up to 2 when parity not enabled [default=1]
Parity bit	Even/odd/none	[default=Even]

3.4.2.8 BACNET

BACnet MS/TP over RS-485		
Device MAC address	1-127	Settable over Web interface (tab "Network") [default=1]
Maximum ADPU size	92 bytes	
Supported baud rates	9600, 19200, 38400	Settable over Web interface (tab "Network") [default=38400]

Modbus over Ethernet		
Server address	192.168.0.245:502	IP address is the same as for pump web server, port is fixed as 502
Device address	245	Default value, can be changed over Modbus
Data format and protocols	<input type="checkbox"/> Modbus TCP <input type="checkbox"/> Modbus RTU over TCP <input type="checkbox"/> Modbus UDP <input type="checkbox"/> Modbus RTU over UDP	Protocol is automatically selected according to established connection and received request.

Analog signals (SET1, SET2, SET3)		
Input voltage range	-1..32 VDC	When used as input.
Output voltage source range	0..12 V	When used as voltage output. 5 mA max. Load allowed per output.
Input resistance	~100 kΩ	0.5 mA load is added for most configurations.
Output current sink range	0..33 mA (4-20 mA)	Current sink to COM if configured as current output.
PWM input threshold	~3 V	5 mA current sink added.
PWM input frequency	0..10 kHz	
PWM out frequency	75 Hz	

Relay specifications	
Connection type	Screwless terminals
Rating	- 230 VAC, 3 A, AC1 - 32 VDC, 3 A

4 PUMP INSTALLATION

4.1 MECHANICAL INSTALLATION INTO SYSTEM PIPEWORK

The pump is packed in a double cardboard box to ensure protection during transport and handling in the plantroom. Once the box is open, use the plastic handles to lift the pump out of the box or lift it holding the drive heat sink.

Pumps are designed to be mounted on the pipework with connecting flanges using screws in each flanges holes to ensure water tightness between the pump and the mating pipework. The pump flanges are designed so the pump can be installed in PN6 or PN10 nominal pressure pipelines up to DN65. Because of the combined flange design, washers must be used on the pump side, when installing the pump.

For the pump to operate with minimal vibrations and noise, it should be installed into the pipework with its axis (or shaft) in horizontal position, as showed in figure 1.

The small rectangular openings at the base of the motor (showed on Fig.1, point A) are designed to prevent any condensation forming inside the motor. These should be left open and not covered (for examples, pump cladding should not covers them).

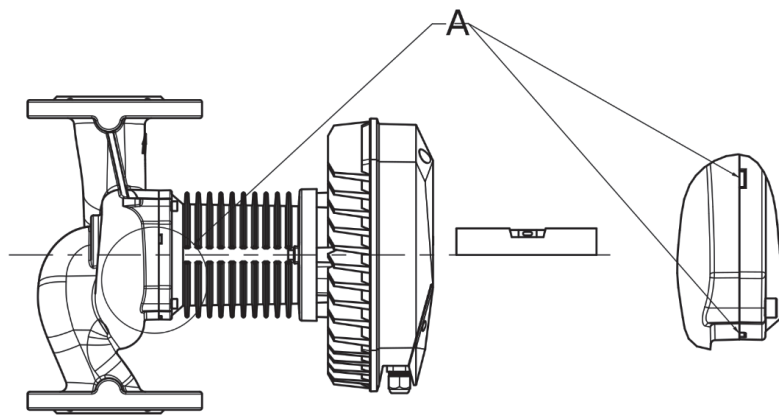


Fig.1

Desired controls orientation can be achieved by rotating the pump head (pump positions shown in figure 3). Pump head is mounted to hydraulic casting with four screws. By unscrewing those, the pump head can then be turned (Fig.2).

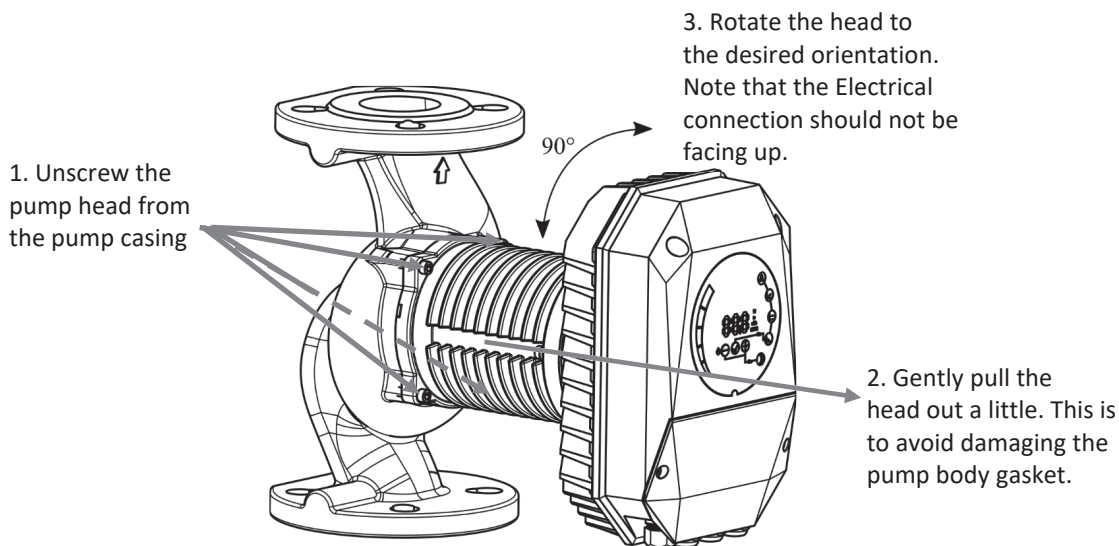


Fig.2

4.2 HYDRAULIC INSTALLATION INTO SYSTEM

The pump is designed to be installed into the pipework only in certain orientation, this is to avoid any air to be trapped inside the pump and risk of damaging the bearings or overheating the pump.

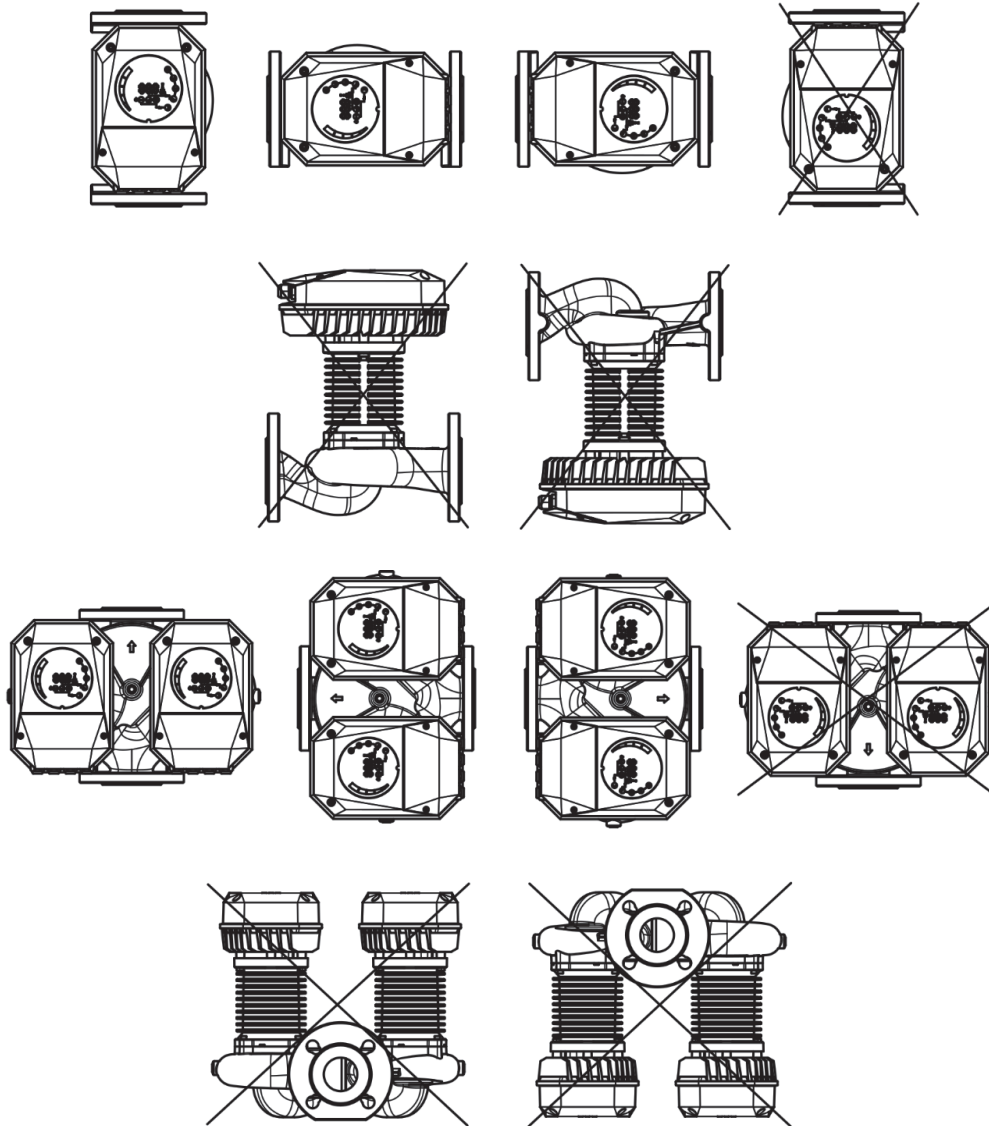


Fig.3

To ensure the pump delivers the required flow and pressure, the pipework designer should also consider a minimum length of pipework to be straight (without bends) for 5-10 D (D = rated pipe diameter) from the flanges on the inlet and the outlet side of the pump.

Ambient environment around the pump should be dry and illuminated as appropriate and the pump should not be in direct contact with any objects. Pump seals prevent dust and particles from entering in the pump as per the IP class rating. Make sure that the distribution box cover is mounted properly and that the cable glands are tightened and are sealing.

The Pump will provide the longest lifetime with ambient temperature within the limits specified and moderate medium temperature. Prolonged operation at elevated temperatures could increase wear. In general, aging of any rotating machine is accelerated by high power and high temperatures.



- Misconnection or overload could cause pump shutdown or even permanent damage.



- Pumps might be heavy. Ask for some assistance and help if needed,
- Pumps must not be used in the safety pipelines,
- Pumps should not be used as a holder during welding!
- When reassembling, care should be taken to ensure seal fit. Failing that, water could cause damage to pumps internal parts,
- Drains between pump motor housing and hydraulic housing must be left free (should not be thermally insulated), as it could interfere with cooling and condensate drainage
- Hot medium can cause burns! The motor can also reach temperatures that could cause injury.
- Motor housing should not be thermally insulated

4.3 ELECTRICAL INSTALLATION

Electrical connection is done with connector supplied with the pump (pumps with power < 200W) or with a built in connector for pumps with power rating above 200W (figure 4).

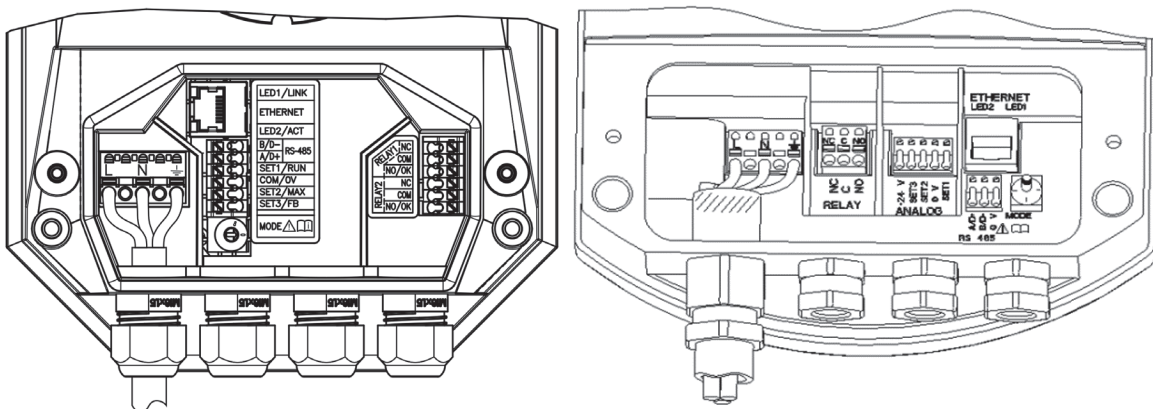


Fig.4

Markings	Descriptions
L	230 VAC, electric power supply
N	
PE	Safety ground

The pump has a built-in overcurrent fuse and protection, temperature protection and basic overvoltage protection. It doesn't need an additional thermal protection switch. The electrical power cables used should be capable of carrying rated electrical current and should be properly fused. Ground lead connection is essential for safety. It should be connected first. Grounding is only meant for pump safety. Pipes should be grounded separately.

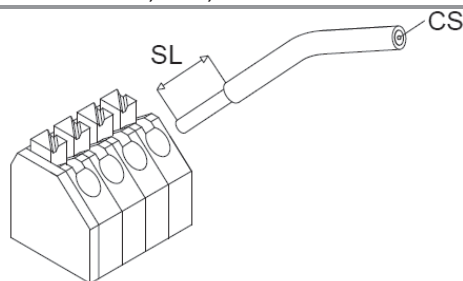


- Connection of the pump must be carried out by qualified personnel,
- Connection of the power cables must be done in a manner that ensures it is never in contact with the casing of the device, due to the high temperatures of the casing,
- This appliance cannot be used by children aged from 8 years and above and persons with reduced physical, sensory or mental capabilities or lack of experience and knowledge if they have been given supervision or instruction concerning use of the appliance in a safe way and understand the hazards involved,

4.4 BMS COMMUNICATION AND CONTROLS INSTALLATION

4.4.1 DIGITAL/ANALOG INPUTS/OUTPUTS, RELAY OUTPUT, MODBUS (RS-485) WIRING

Electrical properties	
Cross section (CS)	0,5 – 2 mm ² (14 – 22 AWG)
Strip length (SL)	7,5 – 8,5 mm



4.4.2 ETHERNET

The pump has a built in web server which allows you to access your pump directly via an Ethernet connection. The default IP address for accessing the pump via the port is 192.168.0.245 and 196.168.0.246 for the second head on a twin pump.

The web server uses HTML pages to set and view:

- Regulation mode settings
- Regulation parameters (power, RPM, head, flow)
- Relay settings
- External control inputs settings
- Current and previews error
- Pump statistics (power consumption, run time and other)

4.4.3 MODBUS RTU

Pump has built in MODBUS RTU connection through which the pump can be controlled and feedback data can be read using the RS 485 standard.

Modbus RTU allows us to set and view:

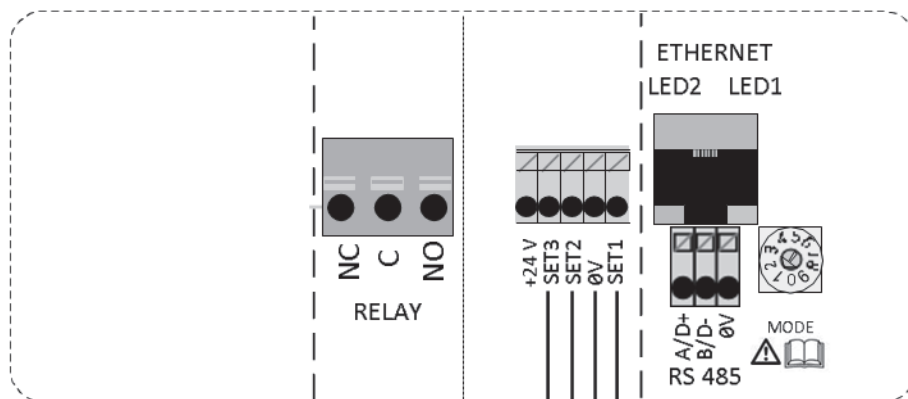
- Regulation mode settings,
- Regulation parameters (power, RPM, head, flow),
- Relay settings,
- External control inputs settings,
- Current and previews error,
- Pump statistics (power consumption, run time and other).

4.5 CONTROLS WIRING (I/O, SERIAL COMMUNICATION)

Terminal	
MODE	Mode selection rotary switch. Position read at power-on. Used to configure mode of operation for the circuit. See section 4.3 "Modem mode selection".
LED1 / LINK	Slowly blinking when module is powered. Blinking fast on Modbus Error Permanently lit when Ethernet link established.
Ethernet	10BASE-T RJ-45 connector.
LED2 / ACT	Indicates Ethernet activity or RS-485 activity.
B/D-	RS-485 negative data signal.
A/D+	RS-485 positive data signal.
SET1 / RUN	Control signal 1.
COM / 0V	RS-485 common and analog input common return.
SET2 / MAX	Control signal 2.
SET3 / FB	Control signal 3.
+24V	24 V, 50 mA output (only on some models)
NC	Normally closed relay contact. Opens when relay is active. C
	Relay common contact.
NO / OK	Normally open relay contact. Closes when relay is active.

Terminal layout with factory configuration

For all AGE4 with motor rated power > 200W



NOTE: To maintain pump IP (ingress protection), the network cable should be pulled through the gland inlet and then crimped to a connector.

4.6 WIRING CONSIDERATIONS

- All cables connected must be heat-resistant to at least +85 °C.
- All cables connected must be installed in accordance with EN 60204-1.
- All wires to the communications module must be connected to the terminals or cut. No loose wiring permitted.

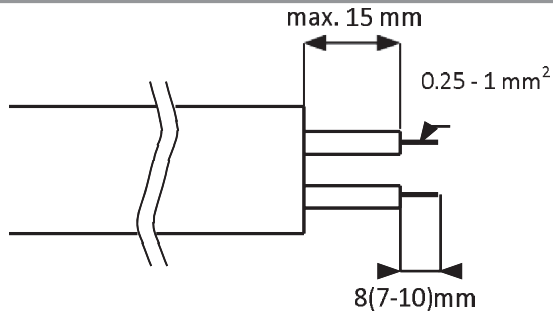


WARNING!

If voltages over 24 V AC/DC are possible on NO, C, NC terminals:

- Wires should be routed so no wire crosses the center barrier.
- Relay cable (NO, C, NC) must be separated from all other wiring with reinforced insulation. Cable outer layer must not be stripped longer than 15 mm. See “Cabling preparation” below.

Cabling preparation



Cable for the screwless terminals should be prepared as shown on the left.

Tools



2.4 mm wide flat-bladed screwdriver is needed to press the terminal spring while inserting the cable. Same tool is also used to rotate the Mode switch.

5 SETUP AND OPERATION

5.1 CONTROL AND FUNCTIONS

All pumps features the following:

- Display and local control panel - it allows the user to controls and see pump modes, parameters and on/off status.
- Digital input RUN – to put pump in RUN/STANDBY state.
- Relay outputs - to signalizes pumps status and pumps fault condition
- 10-step switch - it allows to change relays command, analog inputs/outputs settings and resetting the pumps communication and configuration.
- Analog inputs - to control the pump speed (Min and Max curve, 0 – 10 V, 4 – 20 mA,...).
- Analog outputs - are used for getting analog information about the pumps performance (errors, speed, mode, flow, head).
- Ethernet connection – to remotely control and view all pump functions and settings (pumps variables, digital inputs, error overview).
- RS485 connection – to connect the pumps of MODBUS RTU or BACnet MS/TP for control and feedback of all parameters and settings (pumps variables, analog inputs/outputs, error overview).






5.2 PRIORITY OF COMMANDS AND SETTINGS

Several signals will influence the pump operation. For this reason, settings have different priorities as shown in the table below. If two or more functions are active at the same time, the one with highest priority will take precedence.

Priority	Pump control panel and Ethernet settings	External signals ¹	Modbus control
1	Stop (OFF)		
2	Active night mode ²		
3	Maximum speed (Hi)		
4		Minimal curve	
5		Stop (RUN not active)	
6		Maximum speed (Hi) ³	Stop
7			Reference point
8		Reference point	
9	Reference point		

CONTROL VARIABLES

Pump will respond to external controls according to selected pump operating mode. Consult proper pump operating manual for explanation.

Symbol	Regulation mode	Module set point controls:
	Auto mode	- (RUN only)
	Proportional pressure	Maximum head
	Constant pressure	Maximum head
	Constant speed	Speed (RPM)
	Combined ⁵	- (Web interface only)
	Night mode ⁶	- (RUN only)

1 All inputs are not available in every mode of operation.

2 In night mode the external signals and Modbus stop signal become active. Due to the possibility of confusion we do not recommend using the night mode while using external signals.

3 Only available when pump is bus controlled.

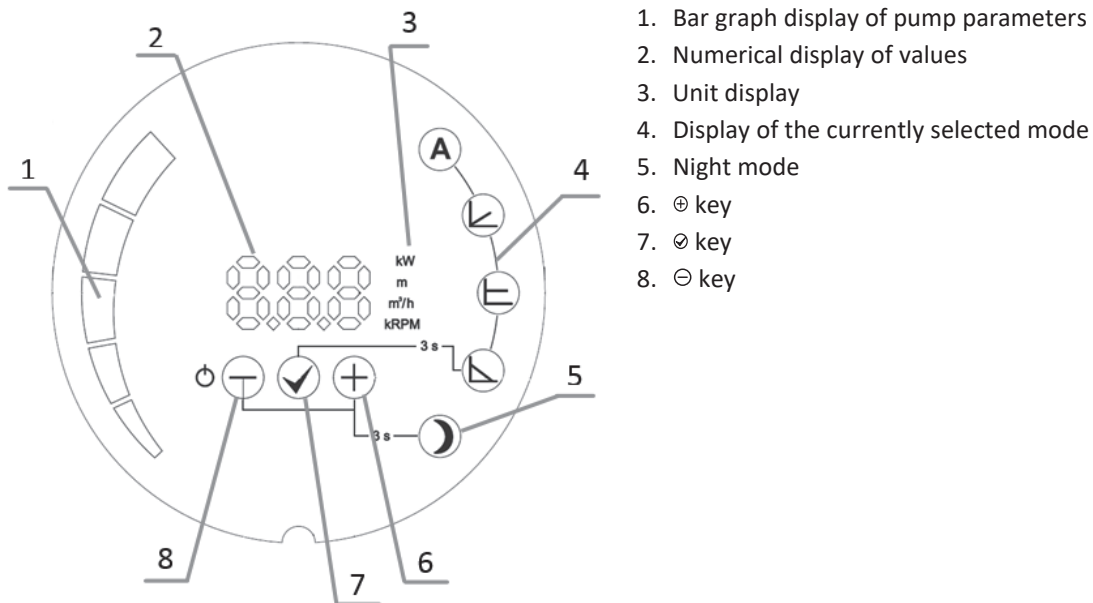
4 Not available when pump is bus controlled.

5 Multiple limits can be set. Not available on all pumps.

6 Night mode is not independent regulation mode.

5.2.1. DISPLAY PANEL

The display and local control panel can be used to control and overview pump modes, on/off control, pump parameters and errors. To see how pump modes work, see chaptre 5.2 Operation.



5.2.1.1 KEY FUNCTIONS

⊖ Key

Short press:

- Scrolling through parameters downwards when not changing parameter values,
- Scrolling through modes downwards when mode selection is selected,
- Changing parameters downwards when setting parameter values.

Long press:

- seconds together with ⊕ turns on night mode,
- seconds together with ⊕ locks pumps current operation,
- seconds to turn off pump,
- seconds together with ⊕ and ⊕ keys to restore pump to factory settings.

✓ Key

Short press:

- To confirm currently selected values of both mode and parameter.

Long press:

- seconds to trigger mode selection,
- seconds together with ⊖ locks pumps current operation,
- seconds together with long press on ⊖ and ⊕ keys to restore pump to factory settings.

⊕ Key

Short press:

- Scrolling through parameters upwards when not changing parameter values,
- Scrolling through modes upwards when mode selection is selected,
- Changing parameters upwards when setting parameter values.

Long press:

- seconds together with ⊖ puts the pump in night mode,
- seconds together with ⊖ and ⊗ keys to restore pump to factory settings.

5.2.1.2 TURNING ON AND OFF

On first start up the pump will operate with factory settings in automatic mode.

With subsequent start-ups, the pump will operate with the last settings that were set prior to its shut-down.

To switch the pump off, press and hold the ⊖ key for 5 seconds, until OFF is shown on the display. When the pump is switched off, the numerical display shows OFF.

To turn the pump on, press the ⊖ key briefly.

5.2.1.3 PUMP MODES AND PARAMETERS

For transition between modes, we hold the ⊗ key for 3 seconds and then select the mode in which we wish the pump to operate with ⊕ or ⊖ keys. We confirm the selection with the ⊗ key.

After confirming the mode, the parameter, which can be set, will automatically be displayed and blink (except for auto mode). If necessary, we set the parameter value with ⊕ and ⊖ keys, then confirm the setting with the ⊗ key or just press the ⊗ key to accept the given parameter.

We can scroll through the parameters within a mode with ⊕ and ⊖ keys. We select the parameter that can be adjusted (see individual mode) in the mode with the ⊗ key and set the desired value with ⊕ and ⊖ keys. We confirm the selected value with the ⊗ key.

5.2.1.4 PUMP OPERATION LOCK

For locking and unlocking the pump operating mode and parameters, hold ⊖ and ⊗ keys for 3 seconds. When the pump is locked, it is possible to turn the pump on and off, view parameters and reset the pump to factory settings that also unlocks the pump.

5.2.2 RELAYS OUTPUTS

Configuration	Function description
Fault	The relay is in active position only when the pump is powered up and an error is present.
Ready [Default]	The relay is in active position when the pump is powered up and no error is present. If an error occurs, relay will deactivate.
Run	The relay is in active position when the pump is powered up and running. If the pump is stopped or an error occurs, relay will deactivate.
No function	Relay is always in deactivated position.
Always on	Relay in active position



5.2.3 DIGITAL INPUT (START/RUN)

Inputs RUN/OV	Function description
Connected	Pump runs.
Disconnected	Pump in standby state.

5.2.4 ANALOG INPUT/OUTPUT (SET1, SET2, SET3)

Input/Output	Function	Function description
SET1	Run [Default - Mode 1]	Turning the pump on/off. By default activating with connection to SET3.
SET2	MAX/Min [Default - Mode 1]	Set the pump to MAX settings when SET1 is active and to min. settings when SET1 is inactive.
SET3	FB [Default - Mode 1]	10 V voltage output used for activating SET 1 and SET2 by connecting them to SET3.

5.2.5 10-STEP SWITCH

There is a mode selection rotary switch in the terminal box. It can be rotated by gently inserting a screwdriver into the arrow mark on top and rotating the switch to desired value.

Switch setting is used when the pump turns on! More details about different modes can be found in communications manual.

Mode switch position	Function	Description
0	Free configuration	Terminal functions are configured over Ethernet interface.
1	Mode 1 (2-10V control)	SET1 = RUN input SET2 = MAX speed input SET3 = FB (10.5 V) output, used to supply RUN and MAX inputs. External voltage source can also be used. RS-485 = Modbus interface.
2	Mode 2 (0-10V control)	SET1 = RUN input SET2 = SPEED input SET3 = FB (10.5 V) output, used to supply RUN and MAX inputs. External 5-24 V voltage source can also be used. RS-485 = Modbus interface
3..5	Reserved	Reserved for future or customer specific use.
6	Show relay configuration	LED1 and LED2 will show relay configuration.
7	Change relay configuration	Relay configuration will be increased (0->1, 1->2, 2->0) when electricity is turned on. LED1 and LED2 will show current relay configuration.
8	Twin reset to factory	Same as Mode 9, with exception of: module IP address is set to 192.168.0.246 Twin IP address is set to 192.168.0.245
9	Reset to factory	This mode will set communication interface to default values. Main purpose is to restore default settings. NOTE: <ul style="list-style-type: none"> • Disconnect any SET1, SET2 and SET3 connections when using this mode to prevent possible harm to controller. SET1, SET2, SET3 will output test voltages of 10 V, 7 V and 5 V respectively. RS-485 port is actively driven. Relay will cycle. This is used for testing purposes. • It is recommended that all module wires are disconnected to prevent possible harm to external controllers.

5.2.6 RESETTING PUMP TO FACTORY SETTINGS

For resetting the pump to factory default settings all three buttons (\oplus , \otimes , \ominus) must be held for 5 seconds. The pump will reset to automatic mode, delete previous duty head settings and power settings and unlock setting pump operation (if previously locked).

For resetting of pump communications and BMS I/O, follow the steps below:

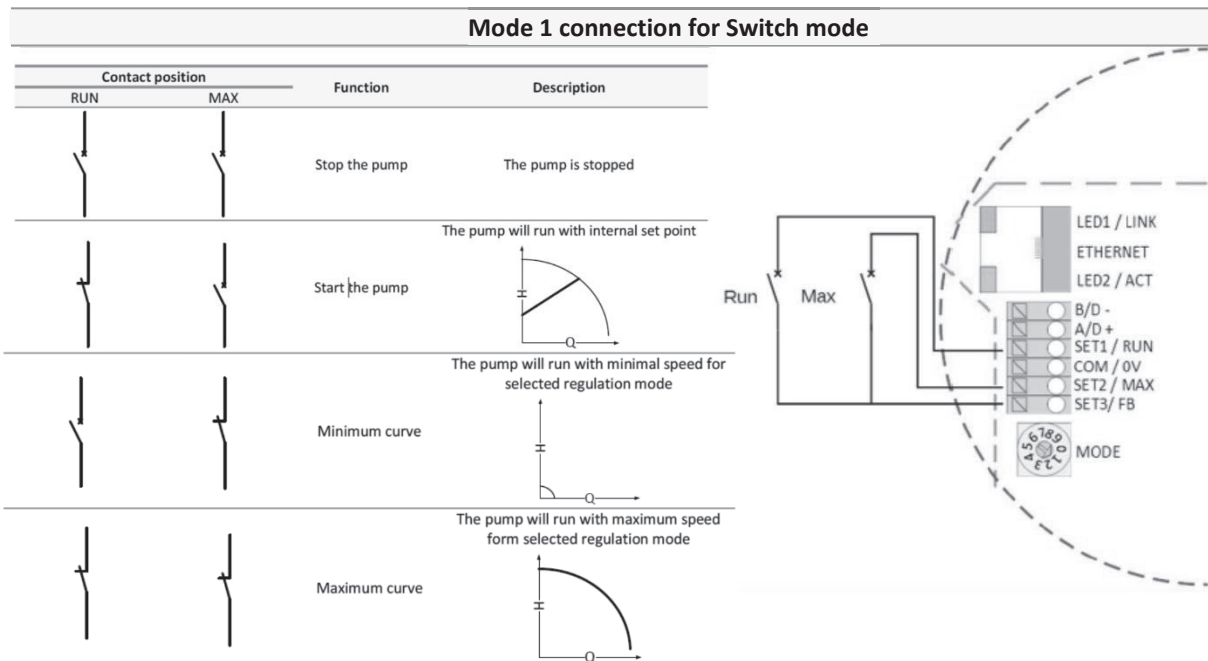
1. Disconnecting power from pump,
2. Set the 10-step switch to number 9⁴ (or 8 for left twin pump),
3. Turning the pump on and off again,
4. Setting the 10-step switch to number 1,
5. Turning the pump on.

5.3 MODE 1 (2..10V)

Mode 1 is most often used mode of operation. It has 2 pre-prepared inputs that can be used for either digital control or with analog control voltages. Additional 10.5V output provides voltage feedback for analog or digital control.

Terminals	Signal function
SET1 / RUN	RUN input Signal load 0.5 mA.
COM / 0V	Common ground for voltage input.
SET2 / MAX	MAX input. Signal load 0.5 mA
_____	SET3 / FB 10.5 V feedback voltage for SET1 and SET2.

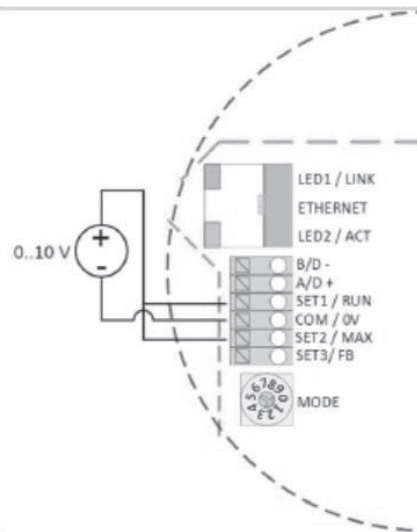
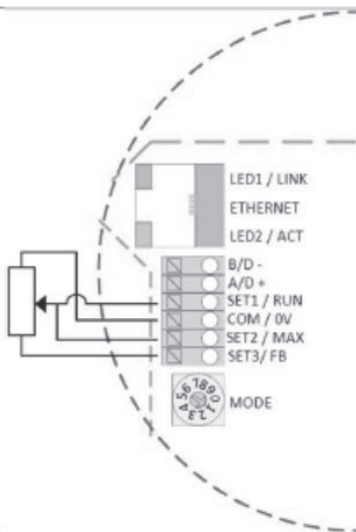
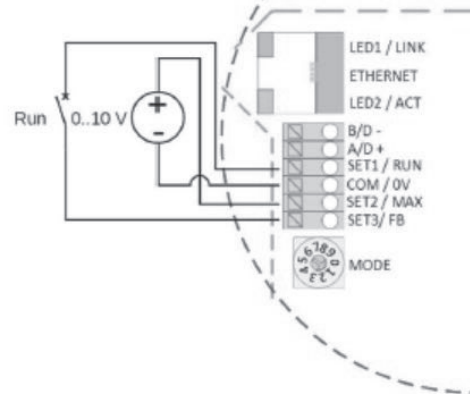
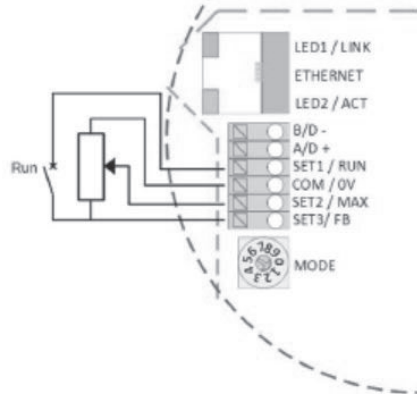
DIGITAL (SWITCH) CONTROL



⁴ This also sets up the right twin pump.

ANALOG CONTROL

Mode 1 connection configurations (analog)



RUN voltage	MAX voltage	Function
< 2 V	< 1 V	Pump stopped
> 3 V	< 1 V	Internal regulation
< 2 V	2..10 V	Minimum curve

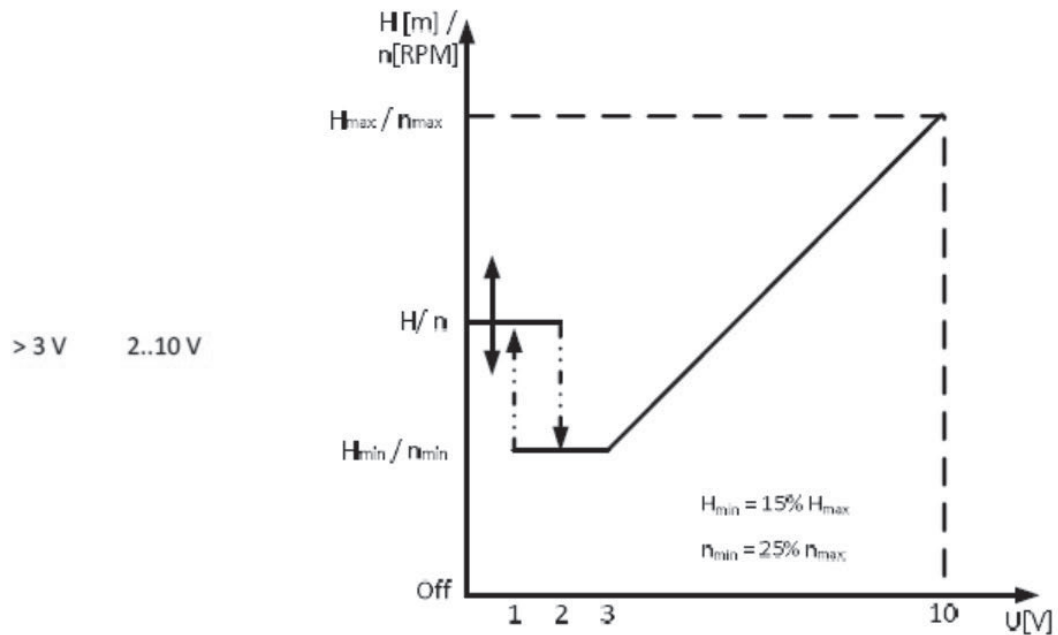


Figure 1: External 2..10 V transfer curve for Mode 1

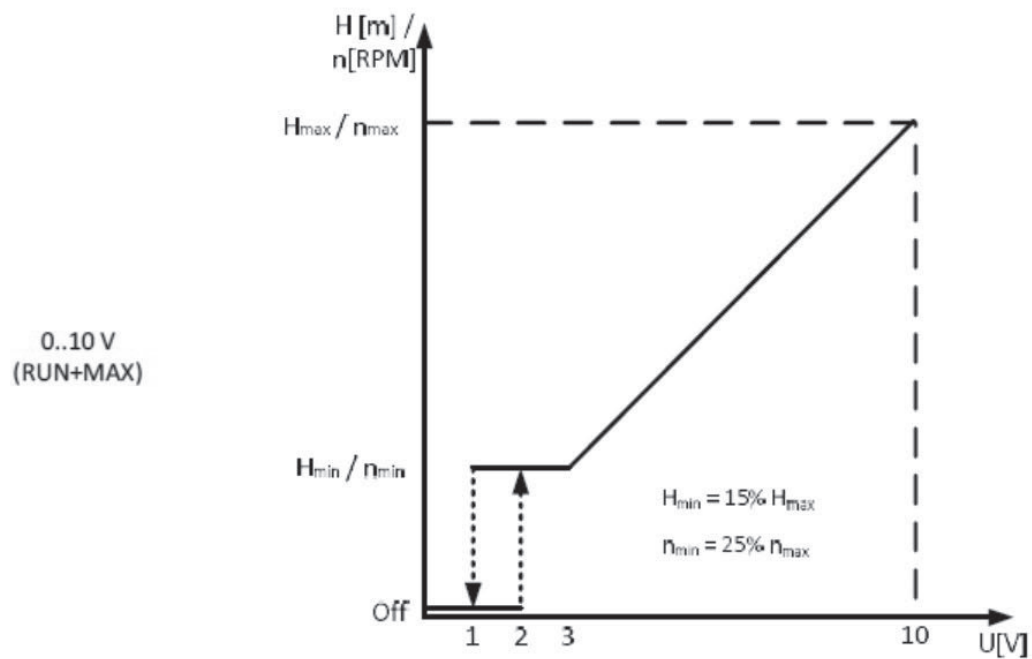


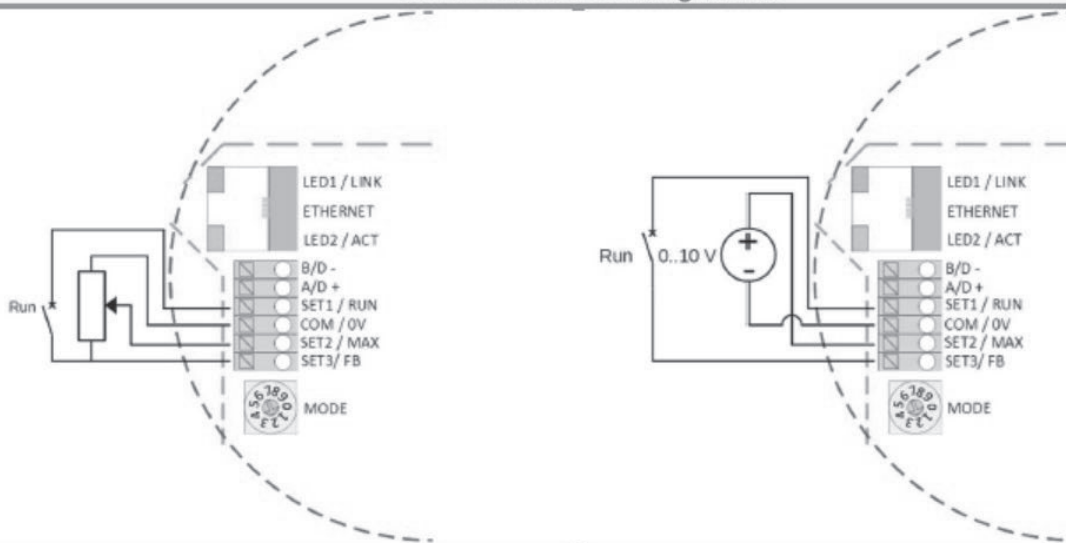
Figure 2: External 0..10 V transfer curve for Mode 1

5.4 MODE 2 (0..10V)

Mode 2 is used for external 0..10 V voltage control.

Terminal designation	Signal function
SET1 / RUN	RUN input. Signal load 0.5 mA.
COM / 0V	Common ground for voltage input.
SET2 / MAX	SPEED input. Signal load 0.5 mA
SET3 / FB	10.5 V feedback voltage for SET1 and SET2.

Mode 2 connection configurations



RUN voltage	MAX voltage	Function
< 2 V	0..10 V	Pump stopped.

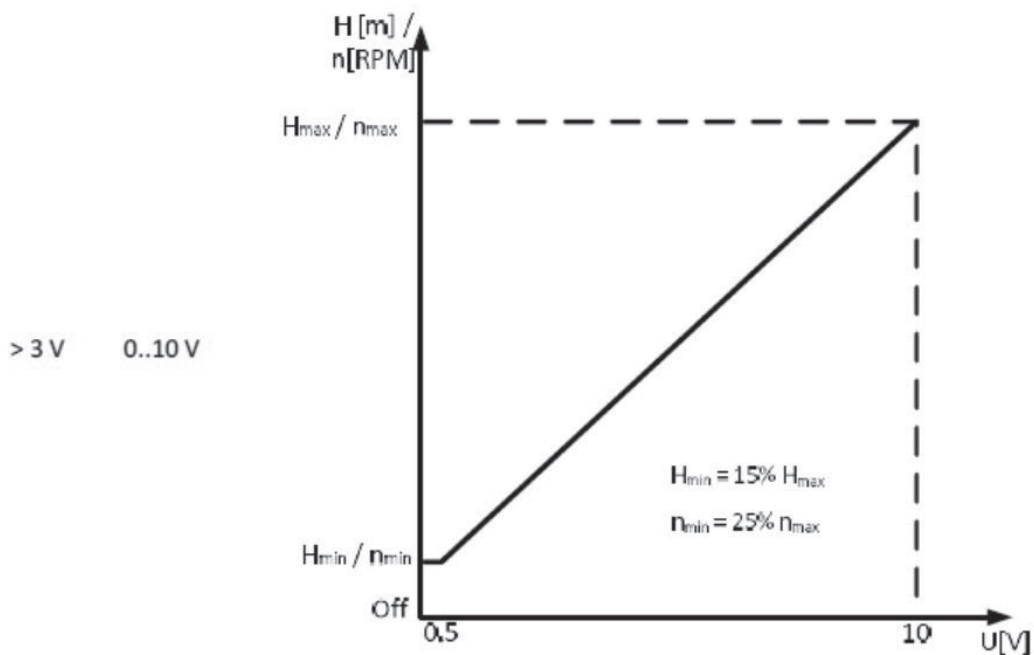












Figure 3: External 0..10 V transfer curve for Mode 2

5.5 RELAYS OUTPUT



Terminal designation	Terminal description
MODE	Mode selection rotary switch. Used to show and configure mode of operation for relay.
LED1 / LINK	Slowly blinking when module is powered, permanently lit when link established ⁷ .
LED2 / ACT	Flashing when data reception detected. Combined (OR) with RS-485 data reception ⁷
NC	Normally closed relay contact. Opens when relay is active.
C	Relay common contact.
NO / OK	Normally open relay contact. Closes when relay is active.

The module contains one or two status relays, used to signal pump operation or malfunction. See table below for functionality.

Relay configuration	Output status	Description	Relay position	LED status ⁷	
				LED 1	LED 2
0	Error [default for Relay 1]	Only active when the pump is powered up and detects a problem with operation.			
1	Ready [default for Relay 2]	The relay signal is active when the pump is ready for operation.			
2	Operation	The relay signal is active as long as the pump is operating. If the pump comes to a stop or an error occurs, relay will deactivate.			
-	Relay output not active.				

Relay configuration number can be modified by either the web interface, Modbus register 012 (relay 1), 017 (relay 2) or the Mode switch.

⁷ When mode Mode 6 or Mode 7 is selected, LED1 and LED2 will show relay configuration. See section "4.3 Module mode selection"

LED is on 
LED is off 

5.6 PUMP OPERATION

The pump can operate in 5 different modes. We can set the pump in the most appropriate mode, depending on the system where the pump operates.

The pump modes:

- Automatic mode (factory default),
- Proportional pressure,
- Constant pressure,
- Constant speed,
- Combined mode (all mode indicators are off)

A Automatic mode

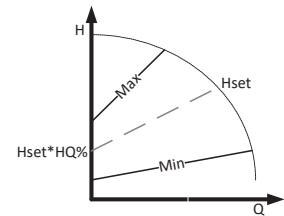
In automatic mode the pump automatically sets the operating pressure, depending on the hydraulic system. By doing so, the pump finds the optimal operating position.

This mode is recommended in most systems.

The parameters cannot be set; they can only be scrolled through.

B Proportional pressure

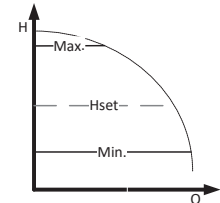
The pump maintains the pressure with relation to the current flow. The pressure is equal to the set pressure (Hset on the drawing) at Maximum power; at 0 flow it is equal to HQ % (default 50%, HQ % can be set on the pump web interface) of the set pressure. In between, the pressure changes linearly, relative to the flow. In regulated mode we can only set the pump pressure (Hset on the drawing). We can only scroll through the other parameters.



C Constant pressure

The pump maintains the currently set pressure (Hset on the drawing), from 0 flow to MAXimum power, where the pressure begins to drop.

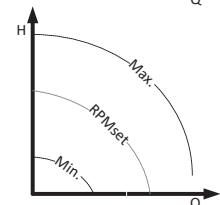
At constant pressure, we can only set the pressure (Hset on the drawing) which the pump will maintain. We can only scroll through the other parameters.



D Constant speed

The pump operates with the currently set speed (RPMset on the drawing).

In the unregulated mode, we can only set the speed at which the pump will operate. We can only scroll through the other parameters.



Combined mode

Multiple limits can be set only over the web interface. None of the other modes are on.

E Night mode

When the pump is operating in night mode, it automatically switches between the current mode and night mode. Switch occurs based on the temperature of the medium. While in night mode its icon is turned on and the pump operates in chosen mode. If the pump senses drop in temperature of the medium for 15 -20 °C (in time frame of 2 hours), icon starts to blink and the pump switches to night mode. When the temperature of the medium rises, blinking stops and the pump goes back to previously chosen operation mode.

Night mode can only work in compliment to other modes and is not a mode that can run by itself.

Twin pump operation

Twin pumps have double hydraulic housing with integrated check valve, which automatically turns based on flow, and two separated motors. AGE4D pumps do not have a control logic that ensures the continuous operation of at least one pump - the control logic must be carried out by the customer / user himself. It is recommended that the control logic exchanges pumps for operation with time interval of ≤ 24 h.

AGE4D pumps communicate with each other and have the following features:

- Alternating operation [**default setting**] – One pump is operating while the other one is on standby. Pumps switch their role every 24 hours or when an error occurs on one pump.
- Backup operation – One pump operates constantly and the other one is on standby. If an error occurs on the operating pump the one on standby will automatically start working. This mode can be set up by turning off the pump that we wish to be on standby.
- Parallel operation – Both pumps work at the same time with the same settings of constant pressure. This mode is used when greater flow than one single pump can output is needed. When the first pump hits its flow limit the second one turns on and compliments the first to reach desired flow. This mode is activated when we set both pumps to constant pressure mode. Night mode is not recommended.

5.7 PUMP REMOTE CONTROL OVER RS 485 COMMUNICATION BUS

5.6.1 RS-485 RELATED INTERFACE

Designation	Description
MODE	Can be used to reset network configuration
LED2 / ACT	Indicates Ethernet or RS-485 activity.
B/D-	RS-485 negative data signal.
A/D+	RS-485 positive data signal.
COM/0V	RS-485 common and analog input common (ground).

5.6.2 PROTOCOLS SUPPORTED

- Modbus RTU or BACnet MS/TP [default]

NOTE: Selectable over Web interface. Only single protocol can run at a time.

5.6.3 BUS TOPOLOGY

RS-485 Connection can be made in either daisy chain style (if cabling allows such a connection) or a limited length passive tap. Schematic example in figure below.

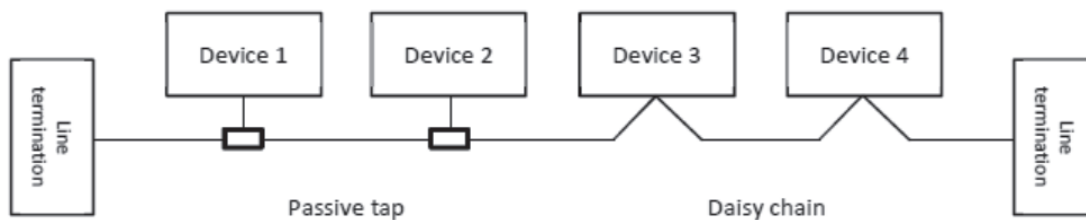


Figure 6: Example of network

- Up to 32 single load devices can be connected to one RS-485 system without using a repeater. As this module is a 1/8 load device, up to 256 modules can be connected to the bus. Repeaters can be used to extend the maximum transmission distance and increase device count if needed.
- A screened, twisted-pair cable should be used. The cable screen should be connected to the COM terminal and connected to safety ground at one point.

NOTE: In some cases, better performance is achieved if no COM connection is made. Device can operate with 2 wire connection.

- The pump contains neither termination nor bias circuitry. RS-485 wiring should be externally terminated if needed. For short wiring and/or low baud rate, interface can operate without termination. However, it is recommended that termination (100-150 ohm resistor) is added on both ends of bus wiring. There are wiring length limits regarding to speed and termination:

Maximum speed [baud]	Maximum cable length [m]
38400	1200, terminated cable
9600	1200
19200	500
38400	250

NOTE: Any branch/derivative cable is considered unterminated. Keep them short, below 250m combined for maximum speed and reliability.

5.6.4 SERIAL COMMUNICATION DEFAULT SETTING (SPEED, PARITY AND ADDRESS)

MODBUS RTU: By default, each device is set to 19200-E-1 (even parity), address 245. Setup the registers to configure each device before connecting it to existing network. Otherwise you can power each device one by one, configuring the settings before adding another one.

BACNET MST/TP: By default, each device is set to 38400 baud, MAC 1. Use web interface to modify configuration.

5.8 BMS COMMUNICATION OVER MODBUS

5.7.1 MODBUS RTU OVER RS-485

AGE4 pump is a Modbus RTU slave. Typically, only one master device is connected to the serial bus, and one or several slaves are also connected to the bus.

5.7.2 MODBUS OVER ETHERNET

Modbus device is available at port 502. Default address is thus 192.168.0.245:502. Supported protocols are Modbus TCP, Modbus RTU over TCP, Modbus UDP and Modbus RTU over UDP. The protocol is automatically recognized according to received packet and no additional configuration is needed.

NOTE: Device ID equals slave address. Controller requests must match this value [245 by default].

5.7.3 REGISTER OVERVIEW

AGE4 Modbus RTU registers are grouped in the following register blocks:

Start address	Register block	Readable/Writeable	Description
001	BMS module configuration	R/W	Configuration of the BMS module
021	BMS module status	R	Status registers of BMS module
101	AGE4 Pump control	R/W	Pump control registers
201	AGE4 Pump status	R	Status data of AGE4 pump
301	AGE4 Pump data	R	Measured data from AGE4 pump

All addresses contain 16 bit (one Word) registers. Some are bit interpreted while others are combined for a 32 bit value.

NOTE: All register addresses are 1-based. Address 001 is thus transmitted over bus as 0x0000.

5.7.4 CONTROL REGISTERS

Registers in this block are read with either function codes 0x03 or 0x04. They can be written as holding registers with function codes 0x06 and 0x10.

NOTE: All values in this block are stored in nonvolatile memory immediately after write.

NOTE: See section "4.3 Module mode selection" and use Mode 8 or 9 to restore default settings if you cannot access the controller after writing to these registers.

Address	Register name	Range	Resolution	Description
001	SlaveDelay	0..10000	1 ms	Delay in milliseconds for slave reply. This delay will be added to every Modbus reply [default = 0].
002	RESERVED			
003	ModbusAddress	1..247	1	Modbus slave/device address [default = 245].
004	BitRate	0..5	1	RS-485 transmission speed enumeration. 0 = 1200 baud 1 = 2400 baud 2 = 4800 baud 3 = 9600 baud 4 = 19200 baud [default] 5 = 38400 baud 6 = 57600 baud (optional)
005..008	RESERVED			
009	Parity	0..2	1	Parity setting to be used for communication. 0 = No parity 1 = Even parity [default] 2 = Odd parity
010	StopBits	1..2	2	Stop bits used for communication. 2 stop bits will only be used when "Parity" is set to 0. 1 = 1 stop bit [default] 2 = 2 stop bits
011	RESERVED			
012	Relay1Control	0..2	1	Configures module relay 1 output. 0 = indicates fault 1 = indicates pump ready 2 = indicates pump operation See section "5 Relay output".
013	ErrorDelay	0..30	1	Error codes and error outputs (relay, register 201.10) will be delayed by ErrorDelay seconds.
014	SET1Type		1	Configuration for SET1 terminal. 0 = "NO FUNCTION" 1 = "RUN input 2-3V" 2 = "MAX input 0-10V" 3 = "MAX input 2-10V" 4 = "RUN input 4-6mA" 5 = "MAX input 0-20mA" 6 = "MAX input 4-20mA" 7 = "FB output 10.5V" 8 = "FLOW output 2-10V" 9 = "FLOW output 4-20mA" 10 = "RPM output 2-10V" 11 = "RPM output 4-20mA" 12 = "ERROR output 10-0V" 13 = "ERROR output 20-0mA"
015	SET2Type		1	Configuration for SET2 terminal. See enumeration for register 014
016	SET3Type		1	Configuration for SET3 terminal. See enumeration for register 014
017	Relay2Control	0..2	1	Configures of relay 2 output. 0 = indicates fault 1 = indicates pump ready 2 = indicates pump operation

5.7.5 BMS MODULE STATUS REGISTERS

Registers in this block are read with either function codes 0x03 or 0x04. They are read-only. This block can be used for various kinds of fault finding.

Address	Register name	Resolution	Description
021..022	RESERVED		
023	SoftwareVersion		BMS Module software version
024..029	RESERVED		
030	ProductVersion		Product version [32x for BMS module, x denotes hardware revision]
031	RESERVED		
032	SoftwareVersion		BMS Module software version

5.7.6 PUMP CONTROL REGISTERS

Registers in this block are read with either function codes 0x03 or 0x04. They can be written as holding registers with function codes 0x06 and 0x10.

Address	Register name	Range	Description
101	ControlReg	b0: RemoteAccess	Control bit that sets local or remote control. Setting this bit will enable pump control over Modbus. 0 = Local 1 = Remote (controlled by Modbus master).
		b1: OnOffReq	Control bit that switches the pump on or off. 0 = Off (stop) 1 = On (start).
		b2..3: RESERVED	-
		b4:	Control bit saves values in register block as default. 0 = No save 1 = Save as default. This value will be reverted back to 0 when set.
		b5..15: RESERVED	-
102	AltControlMode		Alternative Control mode. Use of register 108 is preferred. Sets the control mode enumeration. 0 = ConstantRPM 1 = ConstantRPM 3 = ConstantHead 4 = ConstantHead 5 = ConstantHead 6 = ProportionalHead 128 = AutoHeadMode NOTE: values outside this range reserved.
103	OperationMode		RESERVED
104	SetPoint	0.. 10000	Sets desired pump set point. 0 will stop the pump. 10000 will set the pump to maximum output for desired mode. Values outside of valid range will cause the pump to operate with front panel set values.

105	RelayControl	0..2	Configures relay output. 0 = indicates fault 1 = indicates pump ready 2 = indicates pump operation See section "5 Relay output".
106..107	RESERVED		
108	ControlMode	0..3	Sets the pump control mode. 0 = AutoHeadMode (Automatic head mode) 1 = ProportionalHead (Head proportional to flow) 2 = ConstantHead (Head is kept constant) 3 = ConstantRPM (Speed is kept constant) NOTE: values outside this range reserved. See section "4.2 Control variables" for exact parameter to be controlled.

5.7.7 PUMP STATUS REGISTERS

Registers in this block can be read by means of function codes 0x03 and/or 0x04. They are read-only.

Address	Register name	Description
201	StatusReg	
	b0..b5: RESERVED	-
	b6: Rotation	Indicates if the pump is rotating (running) or not. 0 = No rotation 1 = Rotation.
	b7: RESERVED	
	Bit 8: AccessMode	Indicates if the pump is locally or remotely controlled. 0 = Local (a source with higher priority controls the pump) 1 = Remote (controlled by Modbus master).
	Bit 9: IsOn	Indicates if the pump is on or off. 0 = Off 1 = On It not necessarily indicate rotation as an error might stop the pump.
	Bit 10: Error	Indicates if there is a problem with proper operation. 0 = No problem 1 = Error present. Pump might still run.
	Bit 11: RESERVED	-
	Bit 12: RESERVED	-
	Bit 13: NearMaxSpeed	Indicates if the pump is running near maximum speed. 0 = No 1 = Yes. This flag is set when power or speed is over 95% of rated maximum.
	Bit 14: RESERVED	-
	Bit 15: NearMinSpeed	Indicates if the pump is running near minimum speed. 0 = No 1 = Yes. This flag is set when speed falls below 1/3 of rated maximum.

202	RESERVED	(TBD)
203	ControlMode	Indicates the actual control mode. 0 = ConstantRPM 1 = ConstantRPM 3 = ConstantHead 4 = ConstantHead 5 = ConstantHead 6 = ProportionalHead 128 = AutoHeadMode.
204	RESERVED	
205	ErrorCode1	Current first error code. 0 - when pump is operating without problems. This value will always be non-zero when there is an error present. See section "11.1 Error codes" for code details.
206	ErrorCode2	Second error code. Non-zero when there is more than one error. See section "11.1 Error codes" for code details.
207	ErrorCode3	Third error code. Non-zero when there is more than two errors. See section "11.1 Error codes" for code details.
208	ControlMode	Indicates the actual control mode. 0 = AutoHeadMode (Automatic head mode) 1 = ProportionalHead (Head proportional to flow) 2 = ConstantHead (Head is kept constant) 3 = ConstantRPM (Speed is kept constant). NOTE: values outside this range reserved. See section "4.2 Control variables" for exact parameter to be controlled.

5.7.8 PUMP DATA REGISTERS

Registers in this block can be read by means of function codes 0x03 and/or 0x04. They are read-only.

Modbus address	Register name	Range	Resolution	Description
301	Head		0.01 m	Pump head estimation in meters of water column.
302	Flow		0.1 m ³ /h	Pump flow estimation.
303	Efficiency		0.01 %	Estimated pump efficiency.
304	Speed		1 rpm	Motor speed.
305	Frequency		0.1 Hz	Motor frequency [100.0 Hz for 3000 rpm and 4 pole motor].
306..307	RESERVED			
308	ActualSetPoint	0..10000	0.01 %	Indicates actual set point of the pump. (-1 for internal pump regulation). tbd
309..311	RESERVED			
312	PowerHI	0..2 ³²	1 W	Total power consumption of the system.
313	PowerLO			
314..317	RESERVED			
318	CircuitTemp	-5500..16000	0.01 °C	Power electronics hotspot temperature.
319	MotorTemp	-5500..16000	0.01 °C	Motor compartment temperature.
320..321	RESERVED			

322	LiquidTemp	-5500.. 16000	0.01 °C	Liquid temperature.
323..326	RESERVED			
327	OperationTimeHI		1 hour	Total operation time (above zero speed) of the pump. ⁸
328	OperationTimeLO			
329	TotalPoweredTimeHI		1 hour	Total power-on time of the module. ⁸
330	TotalPoweredTimeLO			
331	RESERVED			
332	EnergyHI		1 kWh	Total energy consumption of the system. ⁸
333	EnergyLO			

⁸ Not available on all models.

5.8 BMS COMMUNICATION OVER BACNET

5.8.1 BACNET OVER RS-485

AGE4 pumps BMS module with BACnet support
Product name: NMTC Module
Application software: 2.286_BACNET
BACnet protocol revision: 19

Document date: 14 June 2021
Product model number: 321
Application firmware revision: 2.286_BACNET

The AGE4 pumps enables BACnet MS/TP communication with compatible pumps.

BACnet Standardized Device Profile (Annex L):

- | | |
|---|--|
| <input type="checkbox"/> BACnet Operator Workstation (B-OWS) | <input type="checkbox"/> BACnet Advanced Operator Workstation (B-AWS) |
| <input type="checkbox"/> BACnet Operator Display (B-OD) | <input type="checkbox"/> BACnet Building Controller (B-BC) |
| <input type="checkbox"/> BACnet Advanced Application Controller (B-AAC) | <input checked="" type="checkbox"/> BACnet Application Specific Controller (B-ASC) |
| <input type="checkbox"/> BACnet Smart Sensor (B-SS) | <input type="checkbox"/> BACnet Smart Actuator (B-SA) |

BACnet Interoperability Building Blocks Supported (Annex K):

Name	BACnet BIBB
ReadProperty	DS-RP-B
WriteProperty	DS-WP-B

Device management services:

Name	BACnet BIBB
Who-is/I-am	DM-DDB-A
	DM-DDB-B
Who-has/I-have	DM-DOB-B

NOTE: Segmentation is not supported, dynamically creatable objects are not supported.

5.8.1 DATA LINK LAYER OPTIONS

MS/TP master (Clause 9), baud rate(s):

Baud Rate
9600
19200
38400 [default]

Configuration over Web interface (see tab “Net”), to reset to default, see section “ 5.2.5”

DEVICE ADDRESS BINDING: Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) Yes No

NETWORKING OPTIONS: None

SECURITY OPTIONS: Non-secure Device - is capable of operating without BACnet Network Security

CHARACTER SETS SUPPORTED:

ISO 10646 (UTF-8) IBM/Microsoft DBCS ISO 8859-1
 ISO 10646 (UCS-2) ISO 10646 (UCS-4) JIS X 0208 ANSI X3.4

5.8.2 DATA LINK LAYER OPTIONS

Data sharing services:

Name	BACnet BIBB
ReadProperty	DS-RP-B
ReadPropertyMultiple	DS-RPM-B
WriteProperty	DS-WP-B
WritePropertyMultiple	DS-WPM-B
SubscribeCOV	DS-COV-B

Device management services:

Name	BACnet BIBB
Who-is/I-am	DM-DDB-A DM-DDB-B
Who-has/I-have	DM-DOB-B
DeviceCommunicationControl	DM-DCC-B

NOTE: Segmentation is not supported.

Object types supported
<ul style="list-style-type: none">• Device• Binary output• Analog input• Binary input• Analog output

NOTE: Dynamically creatable objects are not supported.

5.8.2 ANALOG INPUTS (OBJECT TYPE 0)

NOTE: Values are read-only

Instance	Object Name	Unit	Description
AI.0	ActualSetPoint	%	Currently active Setpoint <ul style="list-style-type: none"> - 100% represents maximum - Pump performance depending on Control Mode - <0% indicates user control
AI.1	ActualOperatingMode	-	Current pump operating mode <ul style="list-style-type: none"> - Mirrors AO.1 when remotely controlled - See AO.1 for possible values
AI.2	Head	ft (H ₂ O)	Estimated pump head
AI.3	Flow	GPM	Estimated flow
AI.4	Power	W	Electrical power of the pump
AI.5	Speed	RPM	Motor speed
AI.6	MotorTemperature	°F	Medium or motor temperature
AI.7	HeatsinkTemperature	°F	Controller temperature
AI.8	HMax	ft (H ₂ O)	Maximum pump head
AI.9	QMax	GPM	Maximum pump flow
AI.10	PMax	W	Rated pump power
AI.11	RPMMax	W	Maximum motor speed
AI.12	OperatingHours	h	Time active (not implemented = 0)
AI.13	EnergyConsumed	kWh	Total electrical energy (not implemented = 0)
AI.14	ActiveErrorCode	-	Currently active error. 0 = pump is operating without problems. This value will always be non-zero when there is an error present. See section "11.1 Error codes" for code details.

5.8.3 ANALOG OUTPUTS (OBJECT TYPE 1)

Instance	Object Name	Unit	Description
AO.0	BusSetPoint	%	Requested Setpoint <ul style="list-style-type: none"> - 100% represents maximum - 0% stops the pump - Set B0.0 to enable
AO.1	BusOperatingMode	-	Requested pump operating mode <ul style="list-style-type: none"> - 0: Auto mode (only on/off) - 1: Proportional pressure, setpoint controls peak head - 2: Constant pressure, setpoint controls head - 3: Constant RPM, setpoint controls speed. - Other values reserved - Set B0.0 to enable

5.8.3 BINARY INPUTS (OBJECT TYPE 3)

NOTE: Values are read-only

Instance	Object Name	Unit	Description
BI.0	RemoteAccessActive	-	Indicates remote control 0 = Local 1 = Remote (Bus control).
BI.1	NearMinimumSpeed	-	Indicates if the pump is running near minimum speed. 0 = No 1 = Yes. This flag is set when speed falls below 1/3 of rated maximum.
BI.2	NearMaximumSpeed	-	Indicates if the pump is running near maximum speed. 0 = No 1 = Yes. This flag is set when power or speed is over 95% of rated maximum.

5.8.3 BINARY OUTPUTS (OBJECT TYPE 4)

Instance	Object Name	Unit	Description
BO, 0	RemoteAccessEnable	-	Control bit that sets local or remote control. Setting this bit will enable pump control over BACnet. 0 = Local 1 = Remote
BO, 1	ResetFaults	-	Setting to 1 will try to clear any pending faults (not needed as faults are auto cleared) 0 = No reset 1 = Trigger reset
BO, 2	SaveConfiguration	-	Write analog outputs to non-volatile memory. After next power cycle, pump will start with saved configuration. 0 = No reset 1 = Trigger save

There are several possible connection configurations. Not all functions can be used simultaneously due to limited amount of outputs, inputs and inlet glands.

Typical configurations

- on/off + 0..10V
- on/off + 0..10 V + relay outputs
- on/off + 0..10 V + relay outputs + MODBUS RTU
- on/off + Modbus RTU + Relay outputs
- Modbus RTU + Relay outputs
- on/off + BACnet MS/TP
- on/off + BACnet MS/TP + Relay outputs

6 ERROR AND TROUBLESHOOTING

If pump failure occurs, the error code will appear on the display.

Error code	Description	Probable cause
E1x Load errors		
E10 (drY)	Low motor load	Low load detected. Pump is running dry.
E11	High motor load	Motor might be faulty or viscous medium is present.
E2x Protection active		
E22 (hot)	Converter temperature limit	Circuit is too hot and power was reduced to less than 2/3 of rated power.
E23	Converter temperature protection	Circuit is too hot to run, pump stopped
E24	Converter overcurrent	Hardware overcurrent protection triggered.
E25	Overvoltage	Line voltage is too high
E26	Undervoltage	Line voltage is too low for proper operation.
E27	PFC Overcurrent	Power correction circuit current cannot be controlled
E3x Pump errors		
E31	Software motor protection active.	Average motor current was too high, pump load is much higher than expected
E4x Device specific error codes		
E40	General frequency converter error	Electrical circuitry did not pass self-test.
E42 (LEd)	LED faulty	One of the display segment diodes is faulty (open/short)
E43 (con)	Communications failed	Display board does not detect proper connection to main board, but power supply is present
E44	DC link current offset	Voltage on DC link shunt (R34) not in expected range
E45	Motor temperature outside limits	During MFG. TEST, this is 10 kΩ, 1% resistor for 10 °C..30 °C During operation, expected values are -55 °C..150 °C
E46	Circuit temperature outside limits	During MFG. TEST, this is 0 °C..50 °C. During operation, expected values are -55 °C..150 °C
E47	Voltage reference outside limits.	Comparison between internal references does not match
E48	15V outside limits	15V power supply is not 15V.
E49	Test SW	Pump has to be reprogramed.
E5x Motor error codes		
E51	Motor parameters out of range	Motor does not behave as expected
E52	Thermal protection active	Motor temperature is too hot to operate.
E53	Invalid model selected	Pump model not valid or out of reach.
	Pump is non-responsive	Turn power on and off.
	Pump doesn't work	Check electrical installation and fuse.

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