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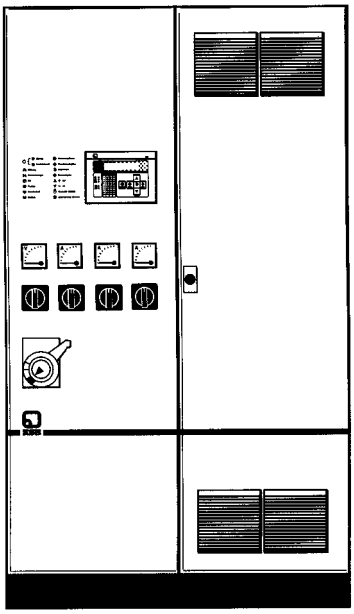
Системы управления, регулирования KSB. Техническое описание

Hyamaster® ISB



Standardised single and multiple pump control systems with continuous speed control via one or two frequency inverters for up to 8 pump drivers with three-phase motors

Fields of Application

- Industry: Process loops, industrial water supply, cooling, lubrication and other process engineering applications. Water extraction, water treatment, water supply, waste water disposal.
- District heating: cogeneration plants, heat transfer stations

Performance Data

Number of pumps: 1 to 8 pumps, different pump sizes possible.
Motor ratings: up to 400 kW
Number of frequency inverters: 1 or 2
Mains voltages: 3 x 400 V ± 10 %
3 x 500 V ± 10 %
Mains frequency: 50 Hz

Functional Description

The Hyamaster ISB control system is specially designed for pumps with three-phase motors. It consists of the electronic control and monitoring unit and all necessary power components such as main switch, frequency inverter, contactors, fuses. All components are installed in a control cabinet. The design is based on a modular concept, thus achieving the necessary flexibility to provide solutions for all applications that occur. A manual-0-automatic switch for each pump provides for both manual and automatic operation.

Closed loop control: Transmitters installed in the plant transfer the current plant data to the control unit. This unit continuously compares the actual value with the set values and provides for continuously variable correction of any deviations.

Open loop control: The open and closed loop control system integrates process-related optimisations such as startup and shutdown of additional pumps and standby control which will be performed automatically depending on the process conditions. Pump change-over, periodic check of operation, and changing of set value can be freely selected using a realtime clock.

Monitoring: The components are monitored automatically by the electronic control system. In the event of any malfunctions, the process is maintained in operation as far as possible and the malfunction is reported and recorded.

Low load operation: Pumps with different performance characteristics, e.g. jockey or low load pumps, can be connected upstream of the main pumps in several combinations or can be operated in connection with the main pumps on a separate frequency inverter, if necessary.
The bad-value evaluation of a maximum of 3 measuring points assures optimum plant supply.

Control Modes

- Pressure / differential pressure
- Pressure / differential pressure (flow-dependent set value)
- Flow
- Level
- Temperature / differential temperature (related to ambient temperature)
- Temperature / differential temperature (related to pressure / differential pressure)
- Bad-value evaluation of a maximum of 3 measuring points (optimum plant supply)

Designation

Hyamaster ISB 8 – 300 / 2

Type series
Industry standard
Number of pumps
Rating of the largest motor: kW x 10 (example: 30 kW)
Number of frequency inverters

Variants on request

- Motor ratings
- Number of frequency inverters
- Voltage
- Enclosure
- Customer specification
- Hyamaster SPS with Siemens programmable logic controller Simatic S7 for systems with bus connection and more complex control tasks

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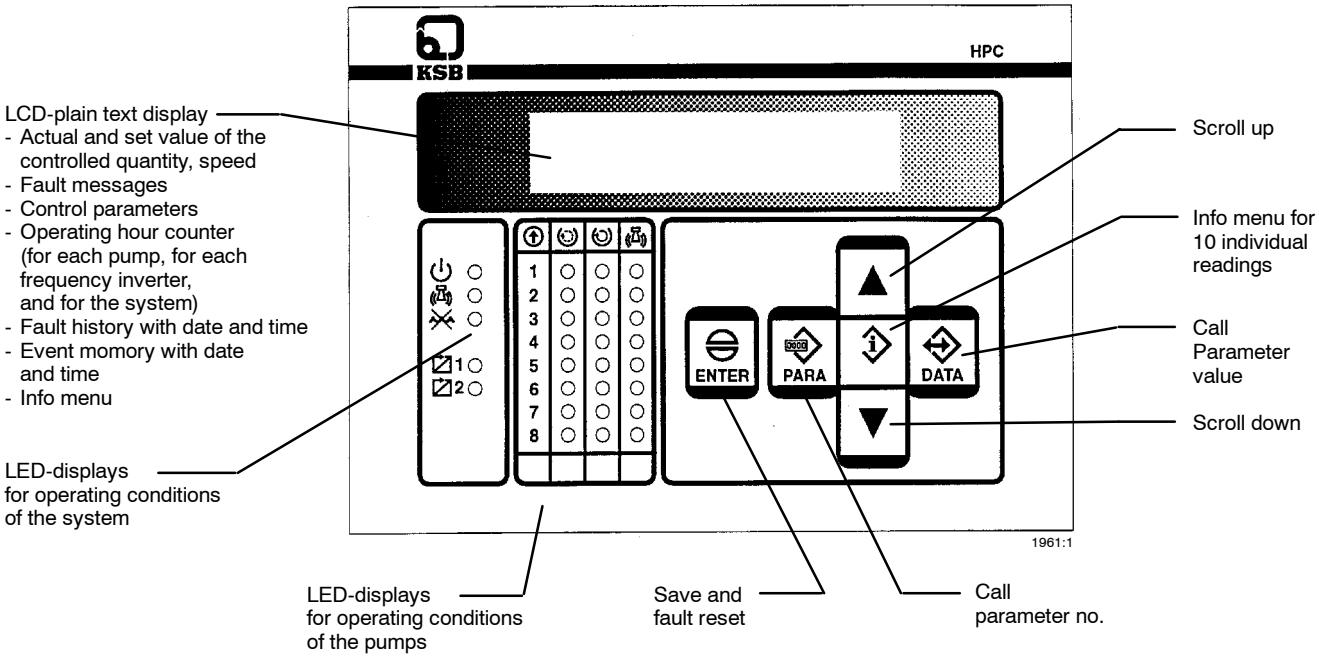
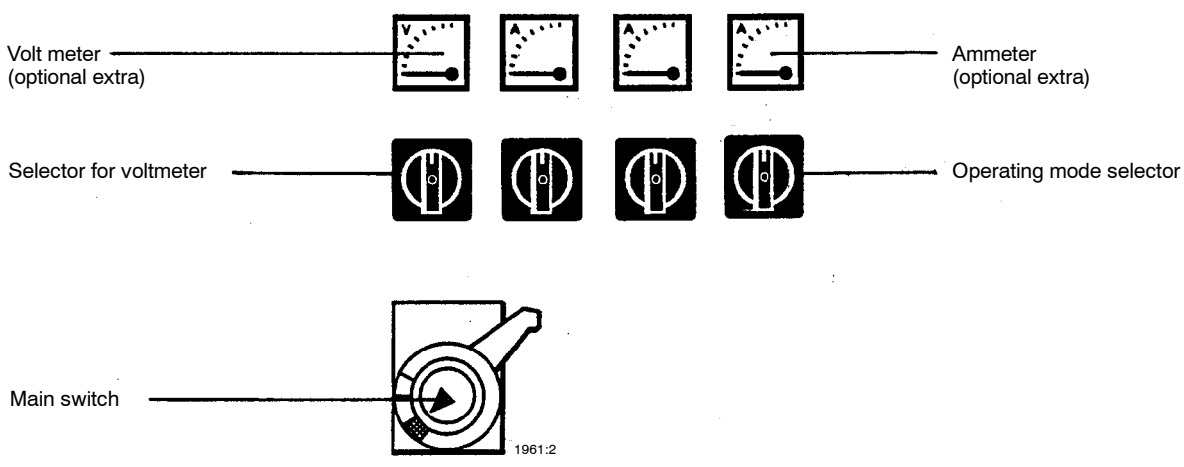
General Member of European Foundation for Quality Management

Display and operation on location



The electronic control unit is a powerful microcontroller based device for control and monitoring jobs with integrated display and manual control features.

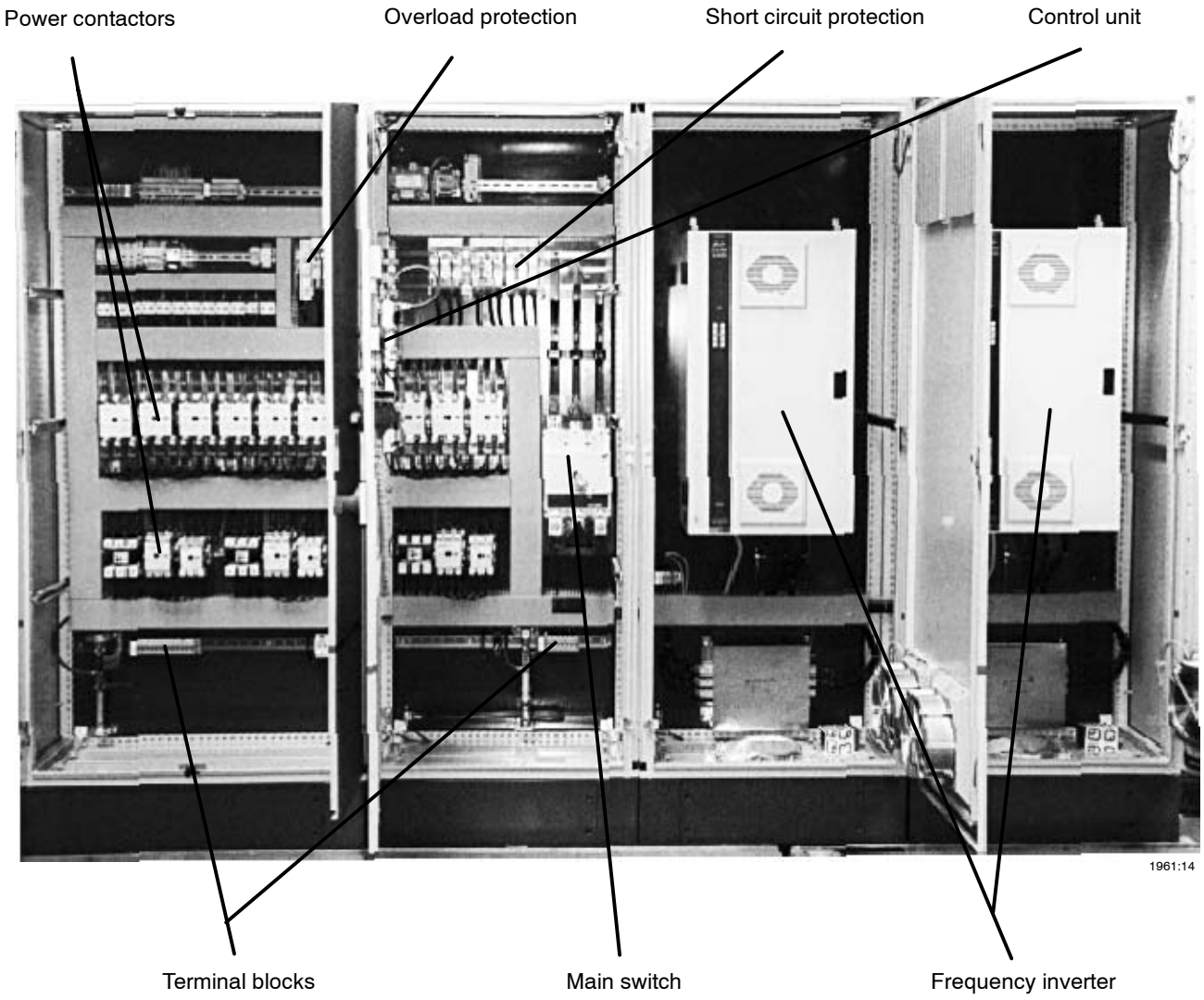
The **LCD plain text display** clearly shows the current system information. **Parameter setting** is menu-controlled via the keypad. The parameters are stored in non-volatile memory to prevent loss of data in case of a power failure. The **LED displays** show stand-by mode, operation or malfunction of the pumps and operation of the frequency inverters.



Equipment example for 3 pumps

An **operating mode selector** is assigned to each pump, thus enabling an individual pump to be excluded from the automatic process. The pump can be operated **manually** on the mains.

This manual operation is purely electromechanical without any electronic control system. This increases reliability, e.g. in the event of failure of the feedback value transmitter.



Control cabinet Hyamaster ISB
for 3 pumps with 75 kW each and 2 frequency inverters

The control system is completely equipped and wired. The steel sheet housing complies with enclosure IP 54 with internal components in IP 41. The components are selected under consideration of pump-specific requirements and with a view to the highest possible reliability. The control system is designed according to DIN VDE 0660, part 500 / DIN EN 60439, part 1; DIN VDE 0113 / part 1 / DIN EN 60204 / part 1, DIN VDE 0470 / IEC 70/ VBG 4; EN 50081 and EN 50082.

The frequency inverter is the control element for speed adjustment of the pump motor. The variable pump performance curve generated in this way allows for continuously variable and therefore optimal operation throughout the entire control range. All the frequency inverters used in the Hyamaster ISB system have been adapted to the most varying pump designs with a view to noise level, mains feedback, radio interference level etc.

Basic Equipment

Housing and Internal Parts

- Steel sheet housing, colour to RAL 7032, IP 54, for indoor installation without base
- Main switch (load switch) to be operated from the front, can be locked
- Ventilation of control cabinet with filter fan (including thermostat)
- Protective devices (fuses, motor protection)
- Frequency inverter
- Control transformer; control voltage 230 V AC, 24 V DC
- Electronic control equipment (installed in front panel)
- Manual-0-automatic switch for each pump (installed in front panel)

Analogue input connections

- Feedback value 1 (controlled quantity) 0/2 - 10 V or 0/4-20 mA, resistance KTY 10
- Feedback value 2 (overlay quantity – e.g. flow rate, reproduction of pipeline curve etc.) 0/2 - 10 V or 0/4-20 mA, resistance KTY 10
- External set value 0/2-10 V or 0/4-20 mA, resistance KTY 10

Digital input connections

- Automatik-on-off, 24 V DC
- PTC resistor or clixon cut-out under automatic operation
- Dry run protection under automatic operation, off-load voltage 24 V DC
- Change-over to second parameter set 24 V DC
- Remote reset of general fault message contact via impulse, 24 V DC
- Peak load release 1-7 pumps, 24 V DC
- External pump change-over via impulse, 24 V DC

Digital output connections

- Relay output connections 250 V AC, 1 A (zero potential)
- General fault message as change-over contact
- Control unit operational message as change-over contact

Interfaces

RS 232/485, D-Sub 9 female

Auxiliary energy

- for transmitter 24 V DC, max. 100 mA

Safety concept for the complete system

Monitoring the pumps and the hydraulic system

- Overcurrent monitoring
- Full motor protection with PTC resistors or bimetal switches for automatic operation, monitoring and message for manual operation
- Dry run protection

Reaction in case of faults

- Change-over to standby pump in case of failure of one pump set.
- On failure of a frequency inverter: change-over to mains operation of the motors or shut-down of all pumps or change-over to second frequency inverter (if available)
- Measuring signal monitoring with Life-Zero (4-20 mA) or (2-10 V)
  If the measuring signal fails:
  Message, fault contact, maintaining the pump speed or shutdown of the system (user-definable)

Protective measures to prevent malfunction

- Pump change-over periods can be defined by the user
- Intervals for periodic check of operation can be defined by the user

Optional Extras

Display and Operation (Installed on front panel)

- Operating hour counter for each pump
- Ammeter for each pump
- Signal lamps for operation and fault including thermistor relay for each pump
- Signal lamps for operation and fault for each frequency inverter
- Manual speed adjustment via potentiometer
- Voltmeter with phase change-over
- Phase lamps
- Lockable front frame with transparent window (IP 54)
- Frequency inverter display

Remote transmission on terminal blocks (DDC-messages)

- Operation and fault for each pump, zero-potential, max. 230 V, max. 1 A
- Operation and fault for each frequency inverter, zero-potential, max. 230 V, max. 1 A
- Position report of manual-zero-automatic switch for each pump, zero-potential, max. 230 V, max. 1 A
- Repair switch for each pump (at the pump)
- Buffer amplifier for analogue input/output:
  Feedback value 1, feedback value 2, external set value
- Remote interference option: automatic-off and remote-on-off for mains operation of each pump

Internal parts in control cabinet

- Double marking of component
- Light and socket connected before the main switch for each control field
- Lightning (overvoltage) protection of power input
- Mains monitoring: phase failure/phase inversion; under-/overvoltage
- Mains monitoring: voltage asymmetry
- Control cabinet heating with thermostat
- Wire marking with terminal number
- Wiring layout matched to circuit diagram layout

Variants on request

- Other voltages
- Higher powers
- Additional DDC messages
- Higher enclosures
- Soft starter
- Different motor ratings
- Motor gate valve control
- Component specifications

Notes for Planning

Caution **Special VDE guidelines and regulations of the local energy supply companies as well as local requirements must be adhered to.**

Measurement and control lines

Actual value transmitter (type 16D)	3 x 0.75 mm^2	shielded	max. 100 m
Actual value transmitter (other)	... x 0.75 mm^2	shielded	max. 100 m
PTC resistor (per motor)	2 x 0.75 mm^2	shielded	
DDC lines, digital (24 V, DC)	... x 0.75 mm^2	shielded	
DDC lines, digital (220 V, AC)	... x 0.75 mm^2		
DDC lines, analogue (0/2-10 V or 0/4-20 mA)	... x 0.75 mm^2	shielded	max. 100 m

Motor power cables for standardised motors 3 ~ 400 V/50 Hz

(M) kW	≈ A	Minimum cross-section mm^2	Starting	Minimum design-base cross sections
1.1 - 4	2.6 - 8.5	4 x 1.5	direct	DIN VDE 0100, part 430, supplement 1; current-carrying capacity of PVC-insulated cables and conductors, type of installation B 2 for an ambient temperature of 30 °C.
5.5 - 7.5	11.5 - 15.5	2 x 4 x 1.5	Y Δ	
11	22.5	2 x 4 x 2.5		
15 - 18.5	30 - 36	2 x 4 x 4		
22	43	2 x 4 x 6		
30	58	2 x 4 x 10		
37 - 45	72 - 85	2 x 4 x 16		
55	104	2 x 4 x 25		
75	142	2 x 4 x 35		
90	169	2 x 4 x 50		
110 -	on request			

Shielding of the motor power cables is required for observing the radio-interference suppression level, e.g. type NYCY or NYCWY. For cable lengths of 15 m and less, normal installation cables can be routed through steel armoured conduit or flexible metal tubing. Ducts and tubing made of plastic are unsuitable.

Total rated power

Total rated power = Motor rating x number of motors (incl. standby units, if any)

Heat losses

The heat losses generated by the frequency inverters dissipate into the **control unit room** via filter fans. It may be necessary to extract some or all that heat from the room. The relevant heat generation can amount to roughly 3-5 % of the motor rating.

Control cabinet dimensions

Hyamaster ISB with one frequency inverter

(M) kW	with 2 pumps W H D mm	with 3 pumps W H D mm	with 4 pumps W H D mm	up to 8 pumps
1.1 - 4	600 800 250	600 1000 250	600 1000 250	on request
5.5 - 7.5	800 1000 300	800 1200 300	800 1200 300	on request
11 - 15	800 1800 400	800 1800 400	1200 1800 400	on request
18.5	800 1800 400	800 1800 400	1200 1800 400	on request
22 - 30	1200 1800 400	1200 1800 400	1800 2000 500	on request
37	1200 1800 400	1200 1800 400	on request	on request
45	1800 2000 500	1800 2000 500	on request	on request
55 - 75	1800 2000 500	2000 2000 500	on request	on request
90	2000 2000 600	2000 2000 600	on request	on request
110	on request	on request	on request	on request

Hyamaster ISB with two frequency inverters

(M) kW	with 2 pumps W H D mm	with 3 pumps W H D mm	with 4 pumps W H D mm	up to 8 pumps
1.1 - 4	800 1200 300	800 1200 300	800 1200 300	on request
5.5 - 7.5	1200 1800 400	1200 1800 400	1200 1800 400	on request
11 - 15	1200 1800 400	1200 1800 400	on request	on request
18.5 - 22	1600 1800 400	1600 1800 400	on request	on request
30 - 37	1600 1800 400	1800 2000 500	on request	on request
45	1800 2000 500	2000 2000 500	on request	on request
55 - 75	2400 2000 500	2800 2000 500	on request	on request
90	on request	on request	on request	on request

Accessories

Pressure transmitter

	Measuring range (bar)	Max. pressure (bar)
Auxiliary energy 24 V DC (available from open and closed loop control unit) Analogue output; 4 - 20 mA; two-conductor cable, max. working resistance 600 Ohm Ambient temperature -20 °C to +70 °C Pressure connection via olive-ring pipe union for 6 mm pipe Product temperature -20 °C to +100 °C	0 - 1 0 - 2.5 0 - 4 0 - 6 0 - 10 0 - 16	25

Pressure / Differential pressure transmitter

	Measuring range (bar)	Max. pressure (bar)
(Wall mounted) Auxiliary energy 24 V DC (available from open and closed loop control unit) Analogue output; 4-20 mA; three-conductor cable, max. working resistance 500 Ohm Ambient temperature -10°C to + 50 °C Pressure connection via olive-ring pipe union for 6 mm pipe Max. product temperature +70°C	0 - 1 0 - 2.5 0 - 4 0 - 6 0 - 10 0 - 16	16 25 25 25 25 25

Flow rate transmitter

	Measuring range (m^3/h)	DN	PN
Magnetic-inductive measuring principle (MIF): Compact design Auxiliary energy 230 V AC Analogue output; 0/4-20 mA; adjustable, max. working resistance 750 Ohm Pulse output; adjustable; 0-1000 pulses/unit Conductivity of medium handled ≧ 5 µ s/cm Flanged connection Ambient temperature -10°C to + 60 °C Product temperature -25°C to +130 °C	12 24 36 60 120 180 240 420 600 1080 1800	25 32 40 50 65 80 100 125 150 200 250	30 30 30 30 30 30 16 16 16 10 10
Ultrasonic measuring principle: - Measurement pick-up Flanged connection Product temperature - 20 °C to +100 °C - Measuring transducer (wall mounted) Auxiliary energy 230 V AC Analogue output 0/4-20 mA, max. working resistance 1000 Ohm Frequency output 0 - 3.3 kHz Pulse output 0 - 15 Hz	18 30 45 75 100 180 260 700 1500 2000	32 40 50 65 80 100 125 150 200 250	40 40 50 16 16 16 16 16 16 16

Flow control device

	Setting range (cm/s)	
Calorimetric measuring principle, for dry running protection incl. transducer - Measurement pick-up Sensor connection G 1/2 A Product temperature -25 °C to +80 °C - Measuring transducer (mounted in control cabinet) Auxiliary energy 230 V AC Zero-potential output; one change-over contact; max. 230 V, max. 1 A	ca. 3 - 300	

Accessories

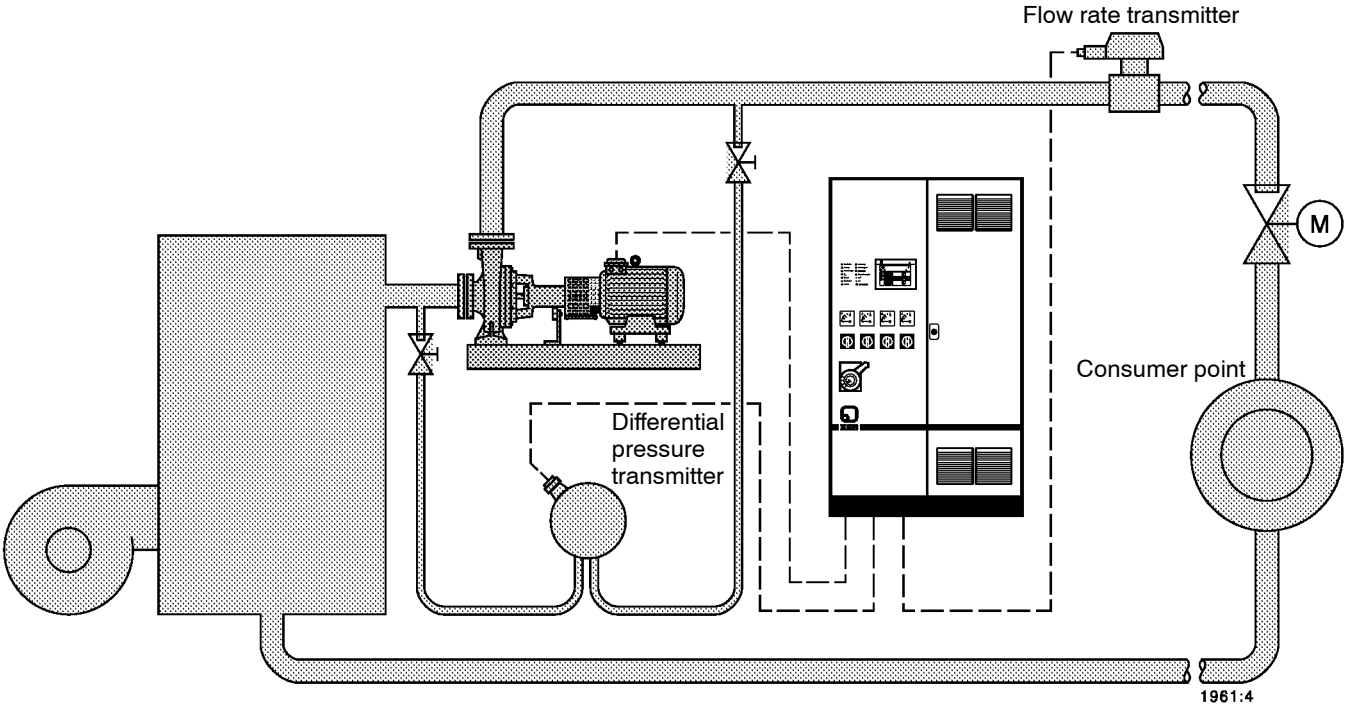
Level transmitter

	Measuring range (mm)	
Capacitive measuring principle Auxiliary energy 24 V DC (available from open and closed loop control unit) Analogue output; 4-20 mA; two-conductor cable, max. working resistance 600 Ohm Threaded connection G 1 1/2 A Ambient temperature -10 °C to +60 °C Product temperature -50 °C to +100 °C Bar electrode made of steel; fully insulated	1000 to 4000 (please indicate required bar length in the purchase order)	
	Measuring range (bar)	
Hydrostatic measuring principle Auxiliary energy 24 V DC (available from open and closed loop control unit) Analogue output; 4-20 mA; two-conductor cable, max. working resistance 600 Ohm Threaded connection G 1 1/2 A Pressure transmitter for vertical installation Length of connecting pipe: 1 m to 20 m Ambient temperature -20°C to + 60 °C Product temperature -20°C to +80°C	0 - 0.1 to 0 - 20 (Please indicate required measuring range and length of connecting pipe in the purchase order)	

Temperature sensor

	Measuring range (°C)	
Clip-on sensor	0 to +120	
Immersion-type sensor with 100 mm stainless steel immersion sleeve ∅ 15 R 1/2 A Max. test pressure 25 bar	0 to+120	
Immersion-type sensor with transducer with 160 mm stainless steel protective sleeve ∅ 9 PN 16	-20 to +350	

Example: Heat / District heat supply system with DFS curve

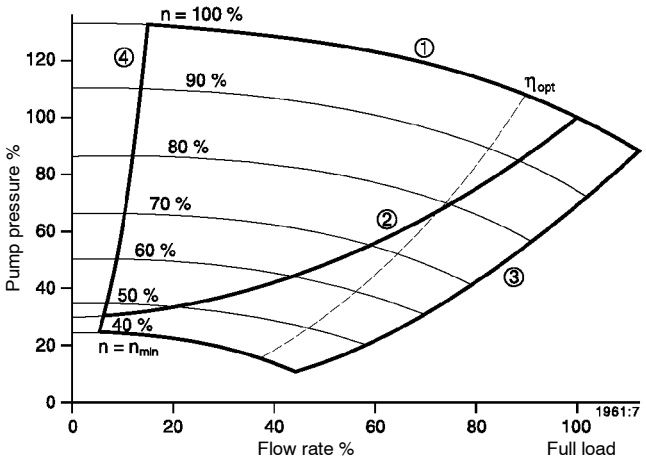


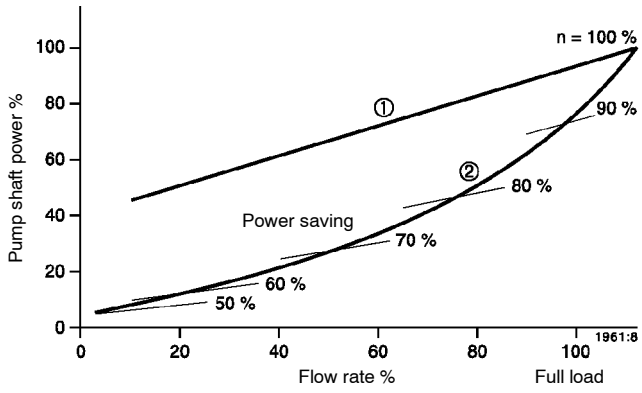
Control task:

Maintaining the differential supply pressure at all bad-value points, even with changing operating conditions and interferences, without requiring measuring points at the far end of the heating system.

In many heat / district heat supply systems, it is difficult to detect bad-value points (points where the supply pressure is too low at times) in the piping system. The **DFS** curve (**d**ifferential pressure control with **f**low-dependent **s**et point adjustment) allows optimised control without information about bad-value points.

With the help of differential pressure and flow rate measurements, the flow-dependent influence of pipe friction losses is compensated. The pumps are in continuously variable operation from low-load operation with small pump heads to full-load operation with high heads. The feedback signals can be tapped in the pumping station, obviating the complex and defect-prone transmission of measurements taken at the bad-value points.





η_{opt} Optimum pump efficiency curve

① Pump characteristic curve at fixed speed (n = 100 %)

② Duty point curve of pump in controlled operation on frequency inverter (n = variable)

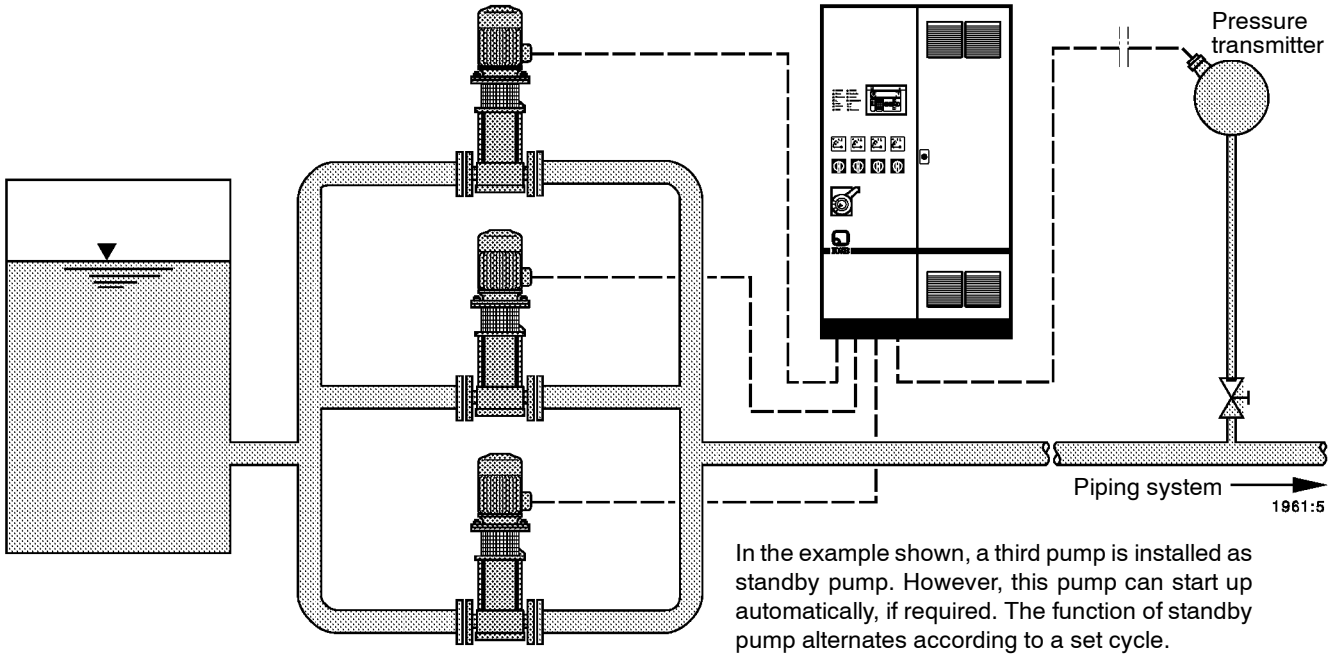
③ Limit for continuous operation (max.)

④ Operating limit (min)

① Pump power input curve at fixed speed (n = 100 %)

② Pump power input curve for controlled operation at frequency inverter (n = variable)

Example: Supply system with peak-load operation



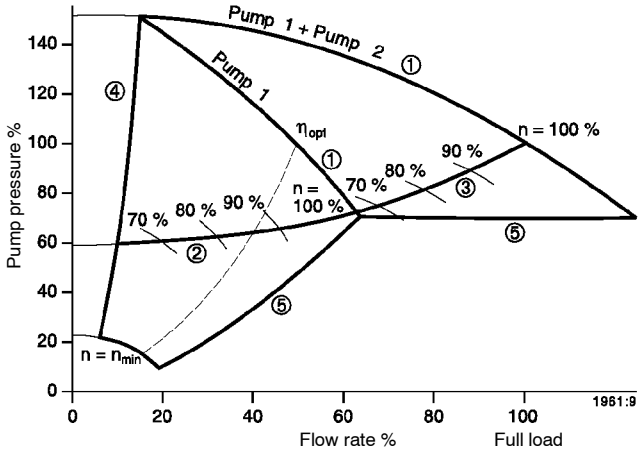
In the example shown, a third pump is installed as standby pump. However, this pump can start up automatically, if required. The function of standby pump alternates according to a set cycle.

Control task:

Maintaining constant pressure at a point of reference despite widely differing and fluctuating consumption.

Splitting the total flow rate onto several pumps allows a proportionate reduction in pump and frequency inverter power. Efficiencies in part-load operation are higher than when using a full-load pump. Pressure is kept constant by infinitely variable speed adjustment of one pump.

This base-load pump provides the required flows up to its max. capacity. For higher consumption, a peak-load pump is switched on automatically. Pressure, however, is still controlled by the base-load pump. Pressure deviations, which occur when the peak-load pumps are switched on or off, generally do not affect the process.



η_{opt} Optimum pump efficiency curve

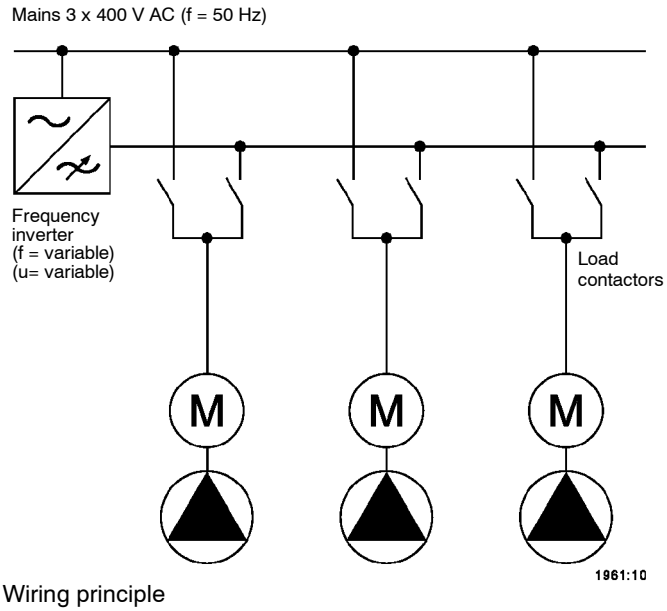
① Pump characteristic curve at fixed speed (n = 100 %)

② Duty point curve of pump in controlled operation at base load on frequency inverter (n = variable)

③ Duty point curve for controlled operation with
1 peak-load pump directly connected to the mains (n = 100 %)
1 base-load pump connected to a frequency inverter (n = variable)

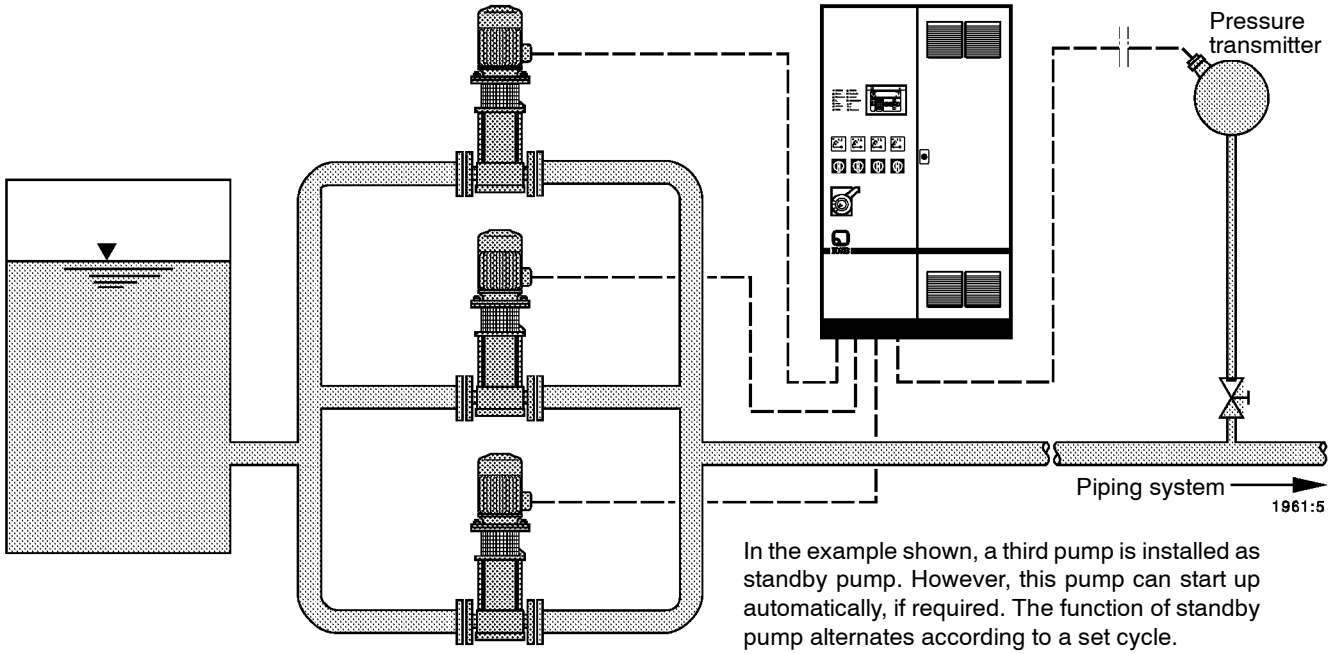
④ Limit for continuous operation (min)

⑤ Operating limit (max)



Wiring principle

Example: Supply system with two frequency inverters



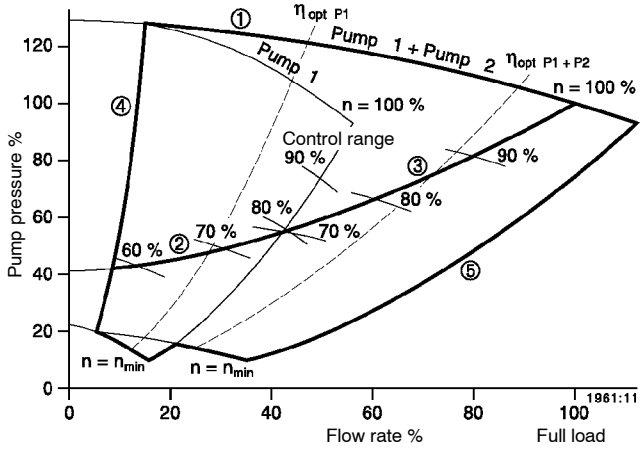
In the example shown, a third pump is installed as standby pump. However, this pump can start up automatically, if required. The function of standby pump alternates according to a set cycle.

Control task:

Maintaining constant pressure at a point of reference, even with changing operating conditions and interferences.

In conventional pumping systems, unwanted pressure fluctuations occur, due to changes in inlet pressures, quantities tapped and pressure losses in the supply system, which are compensated by a high-level distributing tank.

In the present expample, the Hyamaster ISB takes on the function of the high-level tank in maintaining a constant supply pressure at a point of reference. Two pump sets with one frequency inverter each, running both in single and parallel operation, cover the entire flow range from minimum flow to full load. The pumps operate in the best-efficiency range. The second frequency inverter also serves as a standby unit.



η_{opt} Optimum pump efficiency curve

① Pump characteristic curve at fixed speed (n = 100 %)

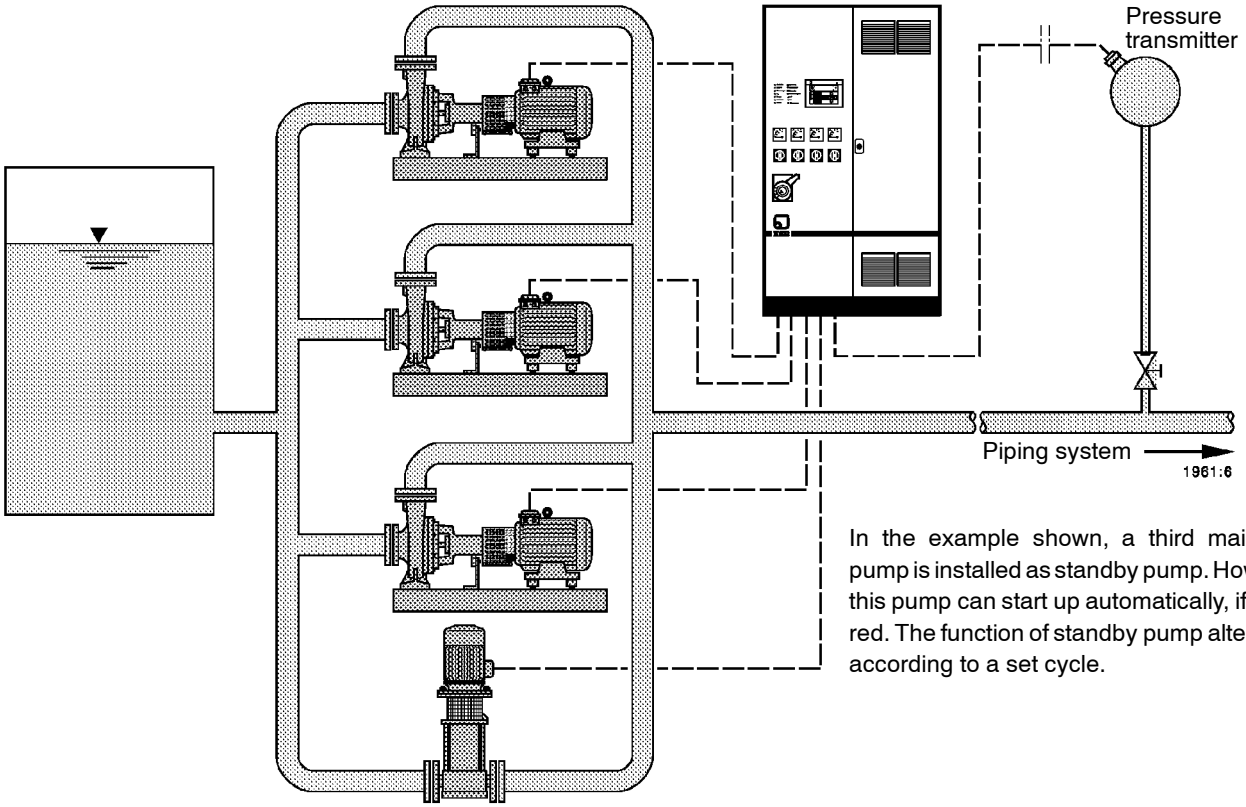
② Duty point curve of pump in controlled operation at base load on frequency inverter (n = variable)

③ Duty point curve of two parallel pumps in controlled operation at peak load on two frequency inverters (n = variable)

④ Limit for continuous operation (min)

⑤ Operating limit (max)

Example: Low-load and main-load pumps with up to 2 frequency inverters



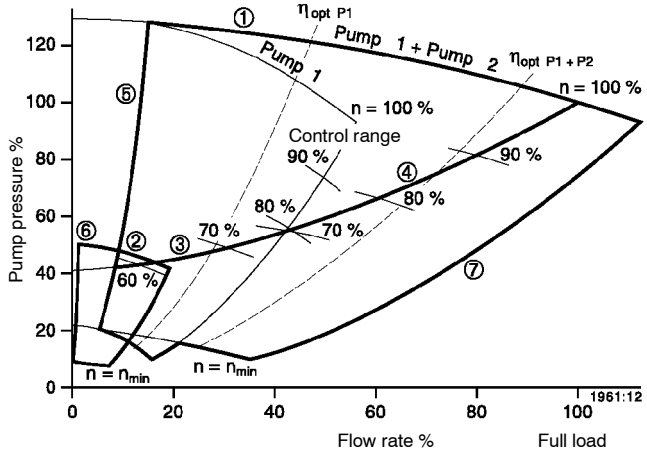
In the example shown, a third main-load pump is installed as standby pump. However, this pump can start up automatically, if required. The function of standby pump alternates according to a set cycle.

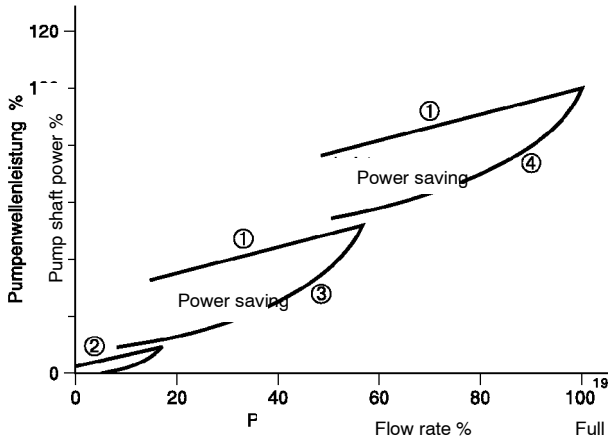
Control task:

Optimising the low-load operation of the hydraulic system.

Even at low speeds, continuously speed-controlled pumps require a certain minimum flow rate. In many cases, however, these minimum flows are much too high. To avoid pump damage in the long run, the flow rate must not fall below this limit in continuous pump operation. In the low-load range below this limit, a hydraulic bypass is normally used.

However, the flow routed through this bypass cannot be used. A low-load pump which is rated for this flow range and operates at optimum efficiency, can expand the control range of the entire system to include this low-load range.





η_{opt} Optimum pump efficiency curve

① Pump characteristic curve at fixed speed (n = 100 %)

② Characteristic curve of low-load pump (n = 100 %)

③ Duty point curve of main-load pump in controlled operation at base load on frequency inverter (n = variable)

④ Duty point curve of two parallel main-load pumps in controlled operation at peak load with two frequency inverters (n = variable)

⑤ Limit for continuous operation (min), main-load pump

⑥ Limit for continuous operation (min), low-load pump

⑦ Operating limit (max)

① Pump power input curve at fixed speed (n = 100 %)

② Power curve curve of low-load pump (n = 100 %)

③ Power curve of pump in controlled operation at base load with 1 main-load pump on frequency inverter (n = variable)

④ Power curve of pump in controlled operation at peak load with 2 main-load pumps in parallel on two frequency inverters (n = variable)

Hyatronic N

Pump control system for level-dependent starting and stopping of up to six pumps Level detection optionally via float switches, digital switches or analog transmitter (4..20 mA)

Applications

Level-dependent control of up to six pumps in irrigation and drainage duties, e.g.:

- Lifting units
- Collecting tanks
- Lifting stations
- Waste water treatment plants
- Biological filtering systems
- And many more

Operating data/technical specifications

For pumps with power ratings from 0.55 to 22 kW
(higher ratings on request)
For up to 6 pumps (usually 3 pumps)
4-wire or 5-wire system

Mains voltage	3~400 V, 50 Hz
(other voltages on request)	
Max. voltage fluctuations	+6/-10% to IEC 38
Ambient temperature	0 to +45 °C max.

Designation

Hyatronic N 3 -185 / 54

Control unit
Number of pumps (1 to 6)
Power rating (in kW x 10)
Enclosure IP 54/42/00
Always EMC class B

Function

Hyatronic N is a level-dependent pump control and monitoring unit with display for controlling up to six pumps.
Liquid levels can be detected either via float switches, digital transmitter or analog transmitter (4..20 mA). Pumps are sequenced in as a function of liquid level.
Hyatronic N can be used in tank draining and filling processes.
The ATEX-compliant variant of the control unit can be used for pumps in potentially explosive atmospheres. In this case, the control unit must be installed outside the potentially explosive atmosphere.
Other functions of Hyatronic N:

- Automatic pump changeover for even distribution of operating hours among the pumps connected in base load operation
- Automatic pump changeover in the case of a pump fault to ensure maximum availability and operating reliability
- Automatic stand-by function
- Automatic time-of-day based functional check run to prevent pump seizure
- Manual emergency operation
- Lack-of-water monitoring in filling mode
- Automatic restart after power failure or lack of water with user-definable time delay
- Display of faults in plain text
- Optional: individual signals
- And many more

Certification

Certified quality management to ISO 9001

Operation and display

1 Control unit
The control unit is based on a PLC which performs all control, monitoring and signalling functions and is equipped with a display for convenient operation.

Volt-free signals provided as a standard:
General fault message
General "System Operational" message

Optional volt-free signals:
Operation per pump
Fault per pump

2 Operating mode selector switch
Via the operating mode selector switch, the user can assign the following operating modes to the individual pumps:

Automatic	Either of the following operating modes is assigned to the individual pumps as required: – Base load operation directly on mains power – Peak load operation directly on mains power – Stand-by mode
Zero	The pump is switched off and is not available for automatic operation
Manual	The pump runs directly on mains power and is not available for automatic operation

3 Master switch (emergency OFF)
The control unit is equipped with a master switch for switching the system on or off (emergency OFF under load).

4 Control cabinet
The control cabinet is designed for wall or floor mounting, depending on the power rating/number of pumps. It contains the ready-wired power components (fuses, contactors, overcurrent trip, connection option for a winding monitoring device, e.g. TCB, PTC resistors)

5 Plain-text display
Graphical display for indicating the operating status and any active messages.

Basic equipment

Housing and internal equipment
Design is to DIN EN 60204-1 (VDE 0113-1), DIN EN 60439–1 (VDE 0660-600-1), DIN EN 61439-2 (VDE 0660-600-2), DIN EN 61000-6-2 (VDE 0839-6-2) and DIN EN 61000-6-3 (VDE 0839-6-3).

Description:
- Steel sheet housing RAL 7035, for indoor installation, enclosure IP 54
- Master switch (power circuit breaker), lockable
- 400 V / 230 V AC control transformer
- Modular PLC, top hat rail mounted
- Door-mounted display
- Door-mounted operating mode selector switch
- Motor protection switch or motor protection relay with fuses per pump
- Contactor combination per pump
- Terminal strips for connecting mains, motor, sensors and inputs/outputs for connection to the building management system (BMS)
- Cable entries and exits below (lateral entries/exits also available on option).

Control unit functions and display

Standard design:
- Operational availability and general fault message are displayed.
- Live-zero monitoring of measuring signals (if analog)
- Changeover in case of pump failure to pump available for operation
- Motor overcurrent monitoring
- Menu-driven display
- Activation and time selection of timer-controlled pump changeover
- Limitation of max. number of pumps running (e.g. for reduced emergency power supply)
- Activation and time selection of timer-controlled functional check run
- Display of all operating parameters

Optional analog inputs for analog level detection:
The PLC supplies power to all transmitters.
Two analog inputs are provided. Via the respective terminal, the input can be used for voltage or current input.
- Voltage: Ru = 200 kOhm
- Current: Ri = 250 Ohm

Digital inputs:
The PLC supplies power to all digital inputs.
- Automatic system ON/OFF
- Remote acknowledgement
- External pump changeover
- External functional check run
- Dry running monitoring
- Level 1 to 6

Digital outputs:
Relay outputs 230 V, 1 A
- General fault message
- General "System Operational" message

Overall safety concept
Monitoring the pumps and the hydraulic system
- Overcurrent monitoring
- Full motor protection by PTC resistors or bimetal switches in manual or automatic operation
- Dry running protection

Fault response
- Changeover to stand-by pump if a pump set fails
- Live-zero monitoring of measuring signal (4-20 mA) for analog level detection

If the feedback value transmitter fails, a fault is signalled and the system is switched off.

Protective measures to prevent fault conditions
- Enable pump changeover
- Enable functional check run

Variants on request
- Other voltages
- Higher power ratings
- Additional volt-free signals for connection to the building management system (BMS)
- Higher types of protection
- Soft starters
- Other components (specified brands)

Supplementary equipment (options)
- Ammeter per pump
- Voltmeter with phase changeover for the complete system
- Operating hours counter for each pump
- Control cabinet light with socket
- Connection to modem (transmission of 4 digital messages)
- Further options on request

BMS signals connected to terminal strip

Volt-free, max. 230 V, 1 A

Hyamaster® SPS

Intelligent single and multiple pump control system with continuous speed control by frequency inverter, with PLC SIMATIC® S7

Fields of Application

- Industry: process loops, industrial water supply, cooling, lubrication and other process engineering applications.
- Energy supply: cogeneration plants, heat transfer stations, district heating.
- Water management: water extraction, water treatment, water supply, waste water disposal.

Performance Data

Number of pumps: standard:
1 to 4, different pump sizes possible.
Motor ratings: up to 650 kW
Number of frequency inverters: 1 to 4
Mains voltages: 3 x 400 V ± 10 %
3 x 500 V ± 10 %
3 x 690 V ± 10 %
Mains frequency: 50 Hz/60 Hz

Functional Description

The Hyamaster SPS control system is specially designed for pumps with three-phase motors of all designs and makes. It consists of a programmable logic controller (**S**peicher **P**rogammierbare **S**teuerung, **SPS**) with **o**perator **p**anel (**OP**) and all necessary power components such as master switch, frequency inverter, contactors, fuses and control voltage transformer. All components are installed in a control cabinet. A characteristic feature of the Hyamaster SPS control system is its high flexibility. Both during commissioning and operation, parameters can be set without an external programming device, by entering them on the operator panel OP7. The wide selection of well-proven functions for a large variety of problems which sometimes only emerge in the everyday operation of the pumping system are activated by simply setting the requisite parameters. Complicated and thus expensive modifications critical to the operation of the system are not required.
The modular design of both software and hardware ensures:

- reliable solutions for all situations occurring in hydraulic systems.
- high availability
- adaptation to changing system requirements
- manual and automatic operation via OP7 and field bus.

Hyamaster SPS

- uses two independent PI controllers and optimized switching algorithms to control:
  - pressure
  - flow rate
  - temperature
  - differential pressure
  - liquid level
  - differential temperature

  Additional functions, e.g.: combination of different controlled variables, bad-value selection and redundancies are possible.
- effects self-optimizing control of:
  - start-up and shutdown of additional pumps
  - pump changeover
  - function check
- monitors automatically; the process is kept up in the best possible way.
  - performance range monitoring
  - lack of water
  - fault behaviour
  - overload
- communicates via field bus and/or volt-free contacts
  - operation and fault, pumps and frequency inverters
  - 4 analog standardized signal inputs
  - controller operational message
  - remote acknowledgement, etc.
  - general fault message

Hyamaster SPS 4 - 300 / 4 FU / A / IP 42
Number of pumps (1-4)
Motor rating x 10
1 to 4 frequency inverters
Radio interference suppression level
EN 55011 (none / A / B)
Enclosure IP (00 / 42 / 54)

Other Variants on Request

- Motor rating
- Number of frequency inverters
- Voltage
- Enclosure
- Customer specification
- Teleservice
- Number of pumps
- Additional control functions e.g. for additional auxiliary pumps, valves, etc.

TÜV CERT DIN EN ISO 9001

General Member of European Foundation for Quality Management

Operator Panel

The LCD plain text display of the Operator Panel (OP7) shows operating status, parameters, help texts and faults in various levels. The first and the last function key, respectively, serve to page up and down within a level.

As an option, the operator panel OP7 can also be installed directly in a control room, so that the Hyamaster SPS with manual and automatic operating mode, with operation and fault messages and parameterization can be monitored and operated directly at the OP7. Maximum cable length without RS 485 Reapeter: approx. 50 m.

Display Levels

The plain text display is organized in levels.

Entry level

- Unacknowledged faults
- Operating status messages

Display level

- Control mode selected for the pumps, i.e. manual, 0, automatic
- Pump operating mode i.e. OFF, direct, frequency inverter 1, frequency inverter 2, etc.
- Feedback values and set values, parameter sets 1 and 2
- Rotational speed of frequency inverter operated pumps
- Set-value analysis, parameter sets 1 and 2
- Analog values (feedback values of analog inputs)
- Works and order number
- Software versions
- Time and date
- Operating hours counter of pumps and frequency inverters

Menu level

- Pump menu
- Quick menu
- Fault menu
- Operating status message menu
- Parameter menu

Fault level

- Any faults registered are displayed in plain text.

Basic Equipment of Control Cabinet

Housing and internal equipment
- Steel sheet housing: Colour: RAL 7032
- Type of protection IP 54 for indoor installation, internal equipment in type of protection IP 42
- Ventilation of control cabinet by filter fan
- Lockable master switch, operated from the front
- Current distribution and protection by fuses-overload contactors
- Frequency inverter(s)
- Control transformer 400/230V AC
- PLC modules and display module incl. 24V DC power supply unit (max. 100 mA available, e.g. for supplying a pressure / differential pressure transmitter).

Analog inputs
- 4 analog inputs 0/4-20 mA; 0/2-10V

Digital inputs (24 VDC)
- Automatic ON/OFF
- Monitoring lack of medium
- Changeover to second parameter set
- Remote acknowledgement
- Pump changeover
- Peak-load limitation

Digital outputs (relay, max. 230 V AC/1A)
- General fault message (NC contact)
- General "system operational" message

Auxiliary energy
- for transmitter 24 V DC, max. 200 mA

Overall safety concept

Monitoring the pumps and the hydraulic system
- Overcurrent monitoring
- Full motor protection by PTC resistors or bimetall switches for automatic control mode, monitoring and message for manual control mode
- Dry-running protection

Fault response
- Pump failure: changeover to standby pump
- Frequency inverter failure: changeover to direct operation, or shutdown of all pumps or changeover to second frequency inverter (if available)
- Monitoring of measuring signal: live-zero (4-20 mA) or (2-10 V)
  If measuring signal fails:
  message, fault contact, hold pump speed or shut down system (user-definable)

Protective measures to prevent fault conditions
- Pump changeover time freely selectable
- Function check time freely selectable

Operating modes
Manual operating mode per pump in direct (i.e. mains) or frequency inverter controlled operation via operator panel OP7, menu-driven, or via data busHand operating mode per pump in direct (i.e. mains) operation (frequency inverter operation if direct operation is not provided for). In this case the pumps are operated electromechanically, to ensure emergency operation in the event of a PLC failure.

Optional Extras

Displays and operating facilities (on front panel)
- Operating hours counter per pump (in addition to software counter)
- Ammeter per pump
- Manual speed adjustment at control panel of frequency inverter (in addition to manual operating mode via operator panel OP7)
- Voltmeter with phase changeover
- Phase lamps
- Lockable front frame with transparent window (IP 54)
- Frequency inverter display
- Gate / butterfly valve control per pump
- Control of bypass valve
- Hand-0-automatic switch per pump

Remote transmission on terminal blocks (DDC messages)
- Operation and fault per pump, volt-free, max. 230 V, max. 1 A
- Operation and fault per frequency inverter, volt-free, max. 230 V, max. 1 A
- Position message of hand-0-automatic switch per pump, volt-free, max. 230 V, max. 1 A
- Repair switch per pump (on the pump)
- Isolating amplifier for analog inputs and outputs: Feedback value 1, Feedback value 2, external set value

Remote transmission by data bus (DP bus)
Messages to control room (Send)
- Operation and fault per pump and frequency inverter
- Control modes and operating modes per pump
- Measuring signals, set values and rotational speeds
- Operating status and fault messages of the system as a whole

Commands from control room (Receive)
- Automatic, manual pump operation, direct (i.e. mains) or frequency inverter controlled, with remote speed control or stopping
- Remote acknowledgement, system start-stop
- Remote measuring signals and remote set point setting
- Commands concerning the system as a whole

Internal control cabinet elements
- Double marking of electrical components
- Light and socket connected before master switch per switchboard section
- Lightening (overvoltage) protection of power input
- Mains monitoring: phase failure/inversion, under-/ overvoltage
- Control cabinet heater with thermostat
- Wire marking with terminal number
- Wiring layout matched to circuit diagram layout

Variants on request
- Other voltages
- Higher power ratings
- Additional DDC messages
- Higher types of protection
- Soft starter
- Different motor ratings
- Component specifications
- Additional functions

Notes for Planning

Caution Special VDE guidelines and regulations of the local energy supply companies as well as local regulations must be adhered to.

Measuring and control line	Cross-sectional area	Version	
Feedback value transmitter (16 D)	3 x 0.75 mm^2	shielded	
Other feedback value transmitters	.. x 0.75 mm^2	shielded	
PTC resistor (per motor)	2 x 0.75 mm^2	shielded	
DDC lines (24 V DC)	.. x 0.75 mm^2	shielded	
DDC lines (230 V AC)	.. x 0.75 mm^2		
DDC lines, analog (0/2-10V or 0/4-20mA)	.. x 0.75 mm^2	shielded	

Motor power cables for standardized motors 3 ~ 400 V/50 Hz

(M) kW	≈ A	Minimum cross-section mm^2	Starting method	Version Minimum cross-sections
1.1 - 4	2.6 - 8.5	4 x 1.5	d.o.l.	DIN VDE 0100, Part 430, supplement 1; current-carrying capacity of PVC-insulated cables and conductors, type of installation B 2 for an ambient temperature of 30 °C
5.5 - 7.5	11.5 - 15.5	2 x 4 x 1.5	Y Δ	
11	22.5	2 x 4 x 2.5		
15 - 18.5	30 - 36	2 x 4 x 4		
22	43	2 x 4 x 6		
30	58	2 x 4 x 10		
37 - 45	72 - 85	2 x 4 x 16		
55	104	2 x 4 x 25		
75	142	2 x 4 x 35		
90	169	2 x 4 x 50		
110 -	on request			

The motor cable must be shielded to ensure compliance with EMC specifications concerning emissions. The motor must be earthed separately.

Total rated power

Total rated power = Motor rating x number of motors (incl. standby units, if any)

Heat Losses

The heat losses generated by the frequency inverters are dissipated into the **control unit room** by filter fans. It may be necessary to extract some or all that heat from the room. Heat losses amount to roughly 3 - 5 % of the rated motor power.

Control Cabinet Dimensions (for Planning only)

Hyamaster SPS with one frequency inverter

(M) kW	with 2 pumps W H D mm	with 3 pumps W H D mm	with 4 pumps W H D mm
1.1 - 4	800 1000 300	800 1000 300	800 1000 300
5.5 - 7.5	800 1000 300	800 1200 300	800 1200 300
11 - 15	800 1800 400	800 1800 400	1200 1800 400
18.5 - 22	800 1800 400	800 1800 400	1200 1800 400
30 - 45	1200 1800 400	1200 1800 400	1800 2000 500
55 - 75	1800 2000 500	2000 2000 500	on request
90	2000 2000 600	2000 2000 600	on request
110	on request	on request	on request

Control cabinet dimensions Hyamaster SPS with 3 or 4 frequency inverters on request

Hyamaster SPS with two frequency inverters

(M) kW	with 2 pumps W H D mm	with 3 pumps W H D mm	with 4 pumps W H D mm
1.1 - 4	800 1200 300	800 1200 300	800 1200 300
5.5 - 7.5	1200 1800 400	1200 1800 400	1200 1800 400
11 - 15	1200 1800 400	1200 1800 400	on request
18.5 - 22	1600 1800 400	1600 1800 400	on request
30 - 37	1600 1800 400	1800 2000 500	on request
45	1800 2000 500	2000 2000 500	on request
55 - 75	2400 2000 500	2800 2000 500	on request
90	on request	on request	on request

Accessories

Pressure transmitter

	Measuring range (bar)	Max. pressure (bar)
Auxiliary energy 24 V DC (available from PLC power supply unit) Analog output; 4 - 20 mA; 2-wire design; max. working resistance 600 Ohm Ambient temperature -20 °C to +70 °C Pressure connection via olive-ring pipe union for 6 mm pipe Product temperature -20 °C to +100 °C	0 - 1 0 - 2.5 0 - 4 0 - 6 0 - 10 0 - 16	25

Pressure/Differential pressure transmitter

	Measuring range (bar)	Max. pressure (bar)
(Wall-mounted) Auxiliary energy 24 V DC (available from PLC power supply unit) Analog output; 4 - 20 mA; 3-wire design; max. working resistance 500 Ohm Ambient temperature -10 °C to +50 °C Pressure connection via olive-ring pipe union for 6 mm pipe Max. product temperature +70 °C	0 - 1 0 - 2.5 0 - 4 0 - 6 0 - 10 0 - 16	16 25 25 25 25 25

Flow rate transmitter

	Max. measuring range (m^3/h)	DN	PN
Magnetic-inductive measuring principle (MIF): Compact design Auxiliary energy 230 V AC Analog output; 0/4 - 20 mA; adjustable; max. working resistance 750 Ohm Pulse output; adjustable; 0 - 1000 pulses/unit Conductivity of medium handled ≧ 5 μ s/cm Flanged connection Ambient temperature -10 °C to +60 °C Product temperature -25 °C to +130 °C	12 24 36 60 120 180 240 420 600 1080 1800	25 32 40 50 65 80 100 125 150 200 250	30 30 30 30 30 30 16 16 16 10 10
Ultrasonic measuring principle: - Measurement pick-up Flanged connection Product temperature - 20 °C to +100 °C - Measuring transducer (wall-mounted) Auxiliary energy 230 V AC Analog output 0/4 -20 mA; max. working resistance 1000 Ohm Frequency output 0 - 3.3 kHz Pulse output 0 - 15 Hz	18 30 45 75 100 180 260 700 1500 2000	32 40 50 65 80 100 125 150 200 250	40 40 50 16 16 16 16 16 16 16

Flow control unit

	Setting range (cm/s)	
Calorimetric measuring principle, for dry-running protection incl. transducer - Measurement pick-up Sensor connection G 1/2 A Product temperature -25 °C to +80 °C - Measuring transducer (mounted in control cabinet) Auxiliary energy 230 V AC Volt-free output; one change-over contact; max. 230 V, max. 1 A	approx. 3 - 300	

Accessories

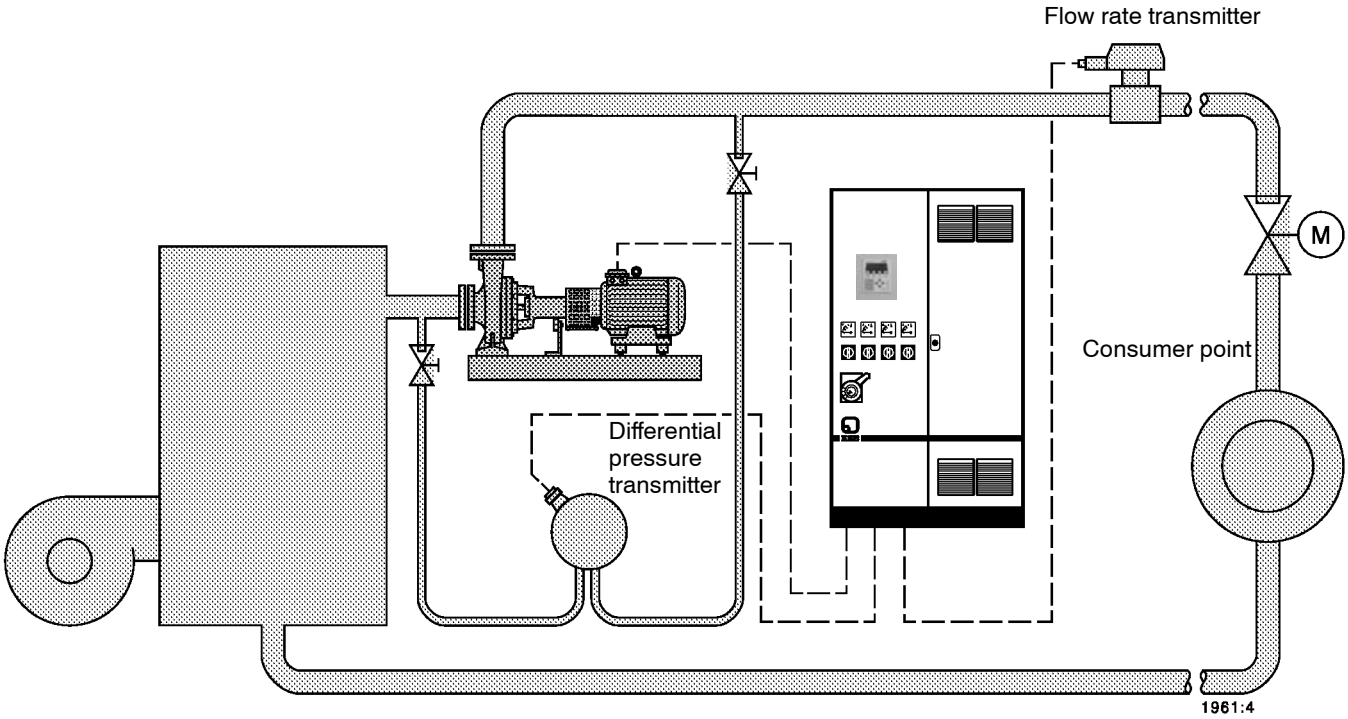
Level transmitter

	Measuring range (mm)	
Capacitive measuring principle Auxiliary energy 24 V DC (available from control system) Analog output; 4 - 20 mA; 2-wire design; max. working resistance 600 Ohm Threaded connection G 1 1/2 A Ambient temperature -10 °C to +60 °C Product temperature -50 °C to +100 °C Bar electrode: made of steel; fully insulated	1000 to 4000 (Please indicate required bar length in purchase order)	
	Measuring range (bar)	
Hydrostatic measuring principle Auxiliary energy 24 V DC (available from control system) Analog output; 4 - 20 mA; 2-wire design; max. working resistance 600 Ohm Threaded connection G 1 1/2 A Pressure sensor for vertical installation Length of connecting pipe: 1 - 20 m Ambient temperature -20 °C to +60 °C Product temperature -20 °C to +80 °C	0 - 0.1 to 0 - 20 Please indicate required measuring range and length of connecting pipe in purchase order)	

Temperature sensor

	Measuring range (°C)	
Clip-on sensor	0 to +120	
Immersion-type sensor with 100 mm stainless steel immersion sleeve ∅ 15 R 1/2 A max. test pressure 25 bar	0 to +120	
Immersion-type sensor with transducer with 160 mm stainless steel protective sleeve ∅ 9 PN 16	-20 to +350	

Example: Heat-/District heat supply system with DFS curve



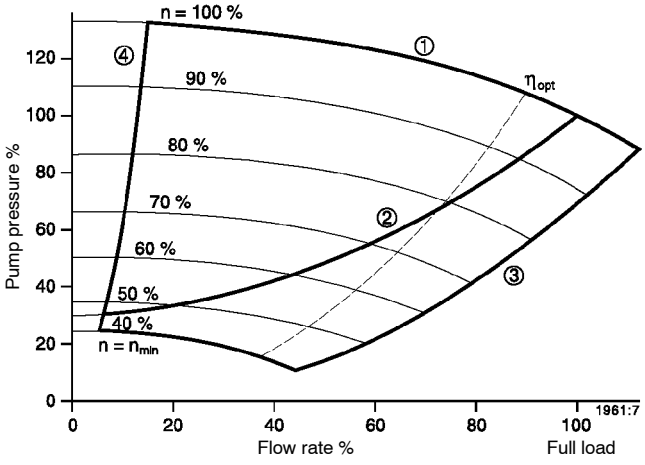
Control task:

Maintaining the differential supply pressure at all bad-value points, even with changing operating conditions and interferences, without requiring measuring points at the far end of the heating system.

In many heat / district heat supply systems, it is difficult to detect bad-value points (points where the supply pressure is too low at times) in the piping system. The **DFS** curve (**d**ifferential pressure control with **f**low-dependent **s**et point adjustment) allows optimized control without information about bad-value points.

With the help of differential pressure and flow rate measurements, the flow-dependent influence of pipe friction losses is compensated. The pumps are in continuously variable operation from low-load operation with small pump heads to full-load operation with high heads. The feedback signals can be tapped in the pumping station, obviating the complex and defect-prone transmission of measurements taken at the bad-value points.

In a later extension, the differential pressure signal of the bad-value points can be determined via the bus. In this case, control by DFS curve serves as a back-up operating mode if there is a fault in bus communication. This makes for a considerable increase in the operating reliability of the pumping station.



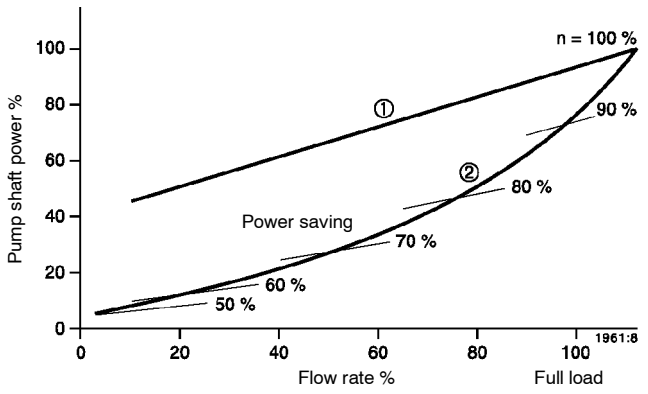
η_{opt} Optimum pump efficiency curve

① Pump characteristic curve at fixed speed (n = 100 %)

② Duty point curve of pump in controlled operation on frequency inverter (n = variable)

③ Limit for continuous operation (max)

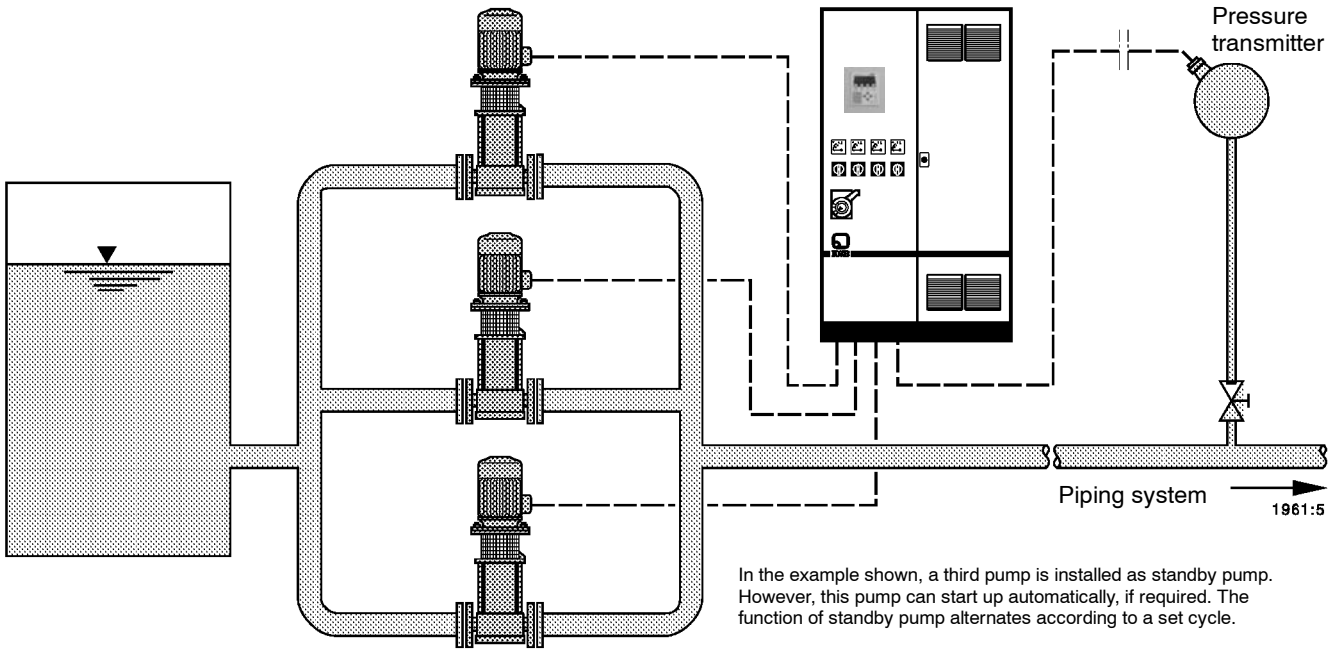
④ Operating limit (min)



① Power input curve at fixed speed (n = 100 %)

② Pump power input curve for controlled operation at frequency inverter (n = variable)

Example: Supply system with peak-load operation



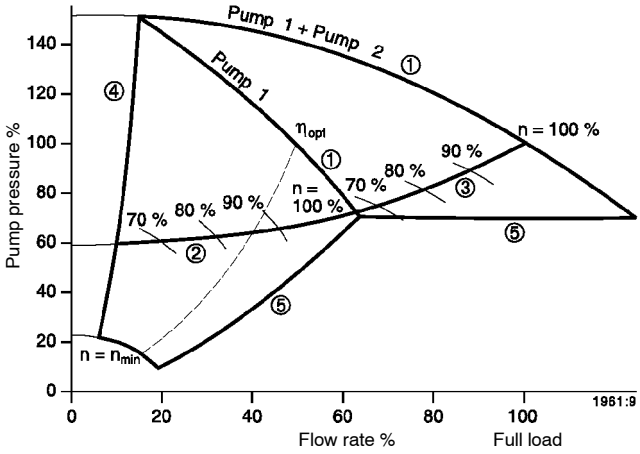
In the example shown, a third pump is installed as standby pump. However, this pump can start up automatically, if required. The function of standby pump alternates according to a set cycle.

Control task:

Maintaining constant pressure at a point of reference despite widely differing and fluctuating consumption.

Splitting the total flow rate onto several pumps allows a proportionate reduction in pump and frequency inverter power. Efficiencies in part-load operation are higher than when using a full-load pump.

Pressure is kept constant by infinitely variable speed adjustment of one pump. This base-load pump provides the required flows up to its max. capacity. For higher consumption, a peak-load pump is switched on automatically. Pressure, however, is still regulated by the base-load pump. Pressure deviations, which occur when the peak-load pumps are switched on or off, generally do not affect the process.



η_{opt} Optimum pump efficiency curve

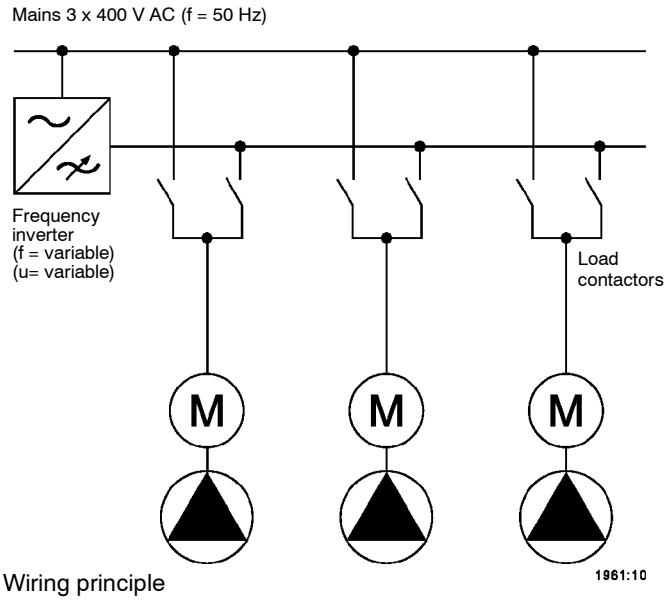
① Pump characteristic curve at fixed speed (n = 100 %)

② Duty point curve of pump in controlled operation at base load on frequency inverter (n = variable)

③ Duty point curve for controlled operation with 1 peak-load pump directly connected to the mains (n = 100 %) and 1 base-load pump connected to a frequency inverter (n = variable)

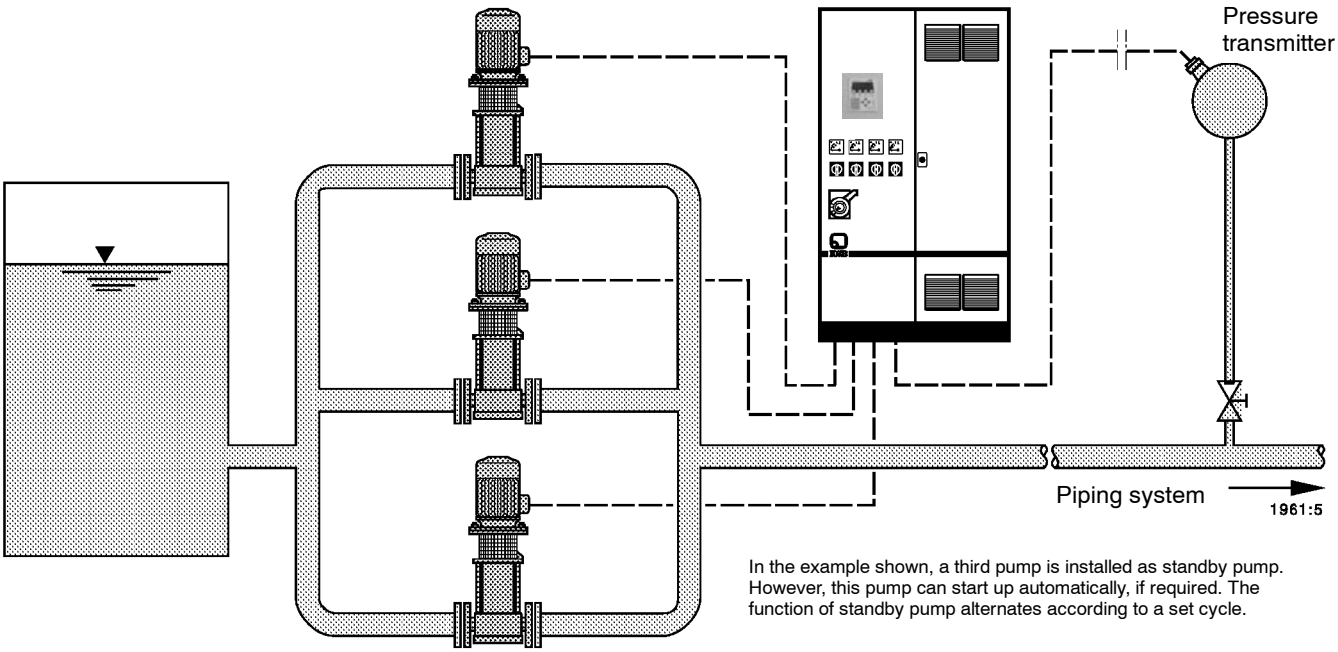
④ Limit for continuous operation (min)

⑤ Operating limit (max)



Wiring principle

Example: Supply system with two frequency inverters



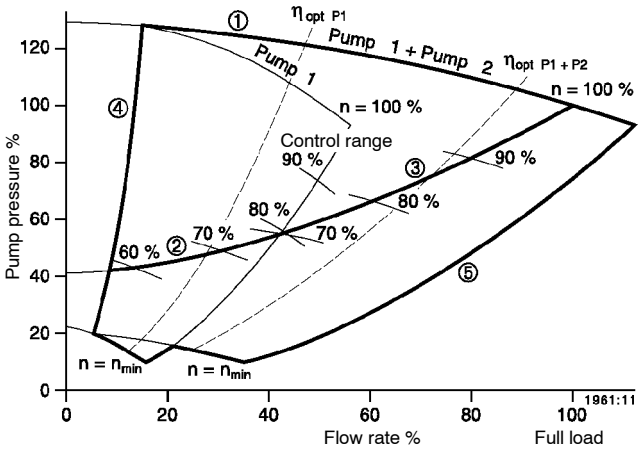
In the example shown, a third pump is installed as standby pump. However, this pump can start up automatically, if required. The function of standby pump alternates according to a set cycle.

Control task:

Maintaining constant pressure at a point of reference, even with changing operating conditions and interferences.

In conventional pumping systems, unwanted pressure fluctuations occur, due to changes in inlet pressures, quantities tapped and pressure losses in the supply system, which are compensated by a high-level distributing tank.

In the present expample, the Hyamaster SPS takes on the function of the high-level tank in maintaining constant supply pressure at a point of reference. Two pump sets with one frequency inverter each, running both in single and parallel operation, cover the entire flow range from minimum flow to full load. The pumps operate in the best-efficiency range. The second frequency inverter also serves as a standby unit.
In this case, the second pump is in direct (i.e. mains) operation as a peak-load pump. The set value is then increased in accordance with the operating limit (max.) of one pump, so that the pumps run reliably within the allowable control range again.



η_{opt} Optimum pump efficiency curve

① Pump characteristic curve at fixed speed (n = 100 %)

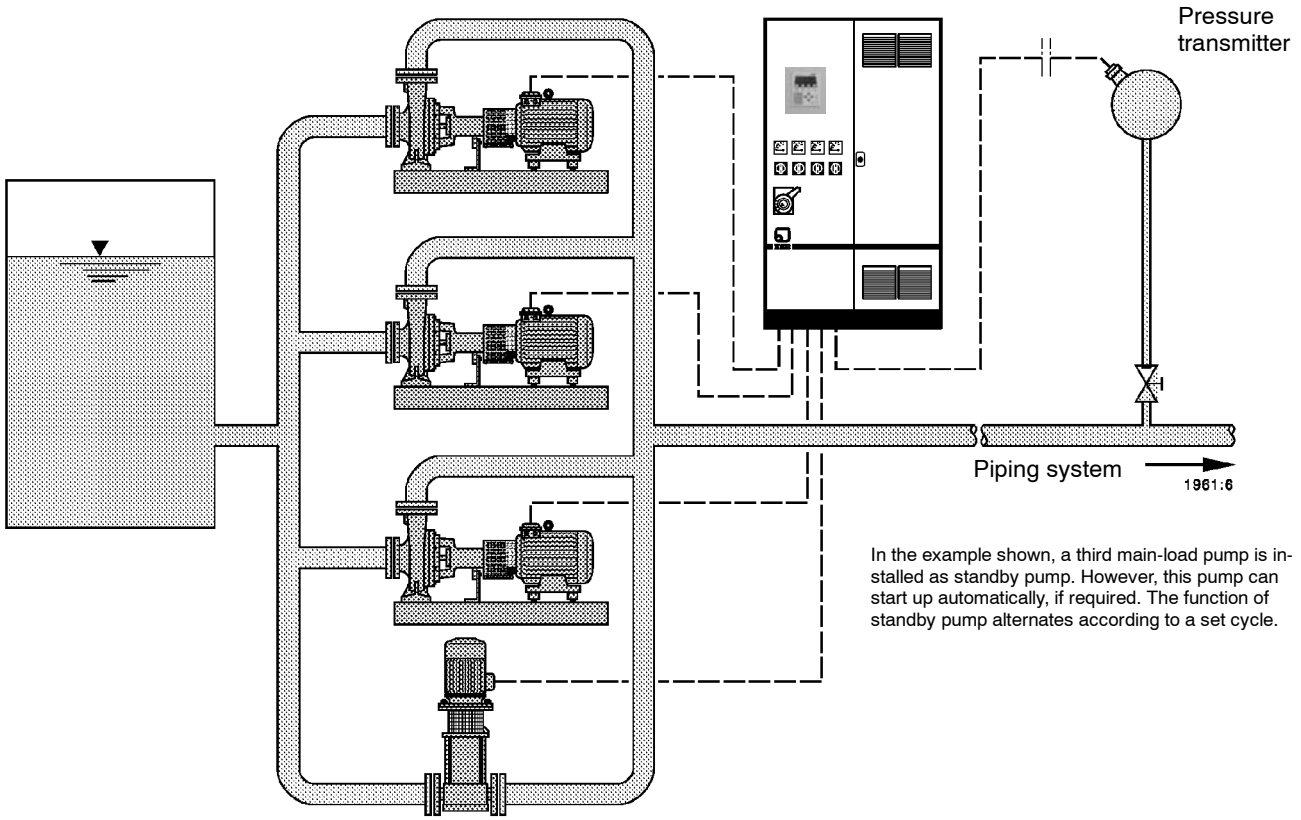
② Duty point curve of pump in controlled operation at base load on frequency inverter (n = variable)

③ Duty point curve of two parallel pumps in controlled operation at peak load on two frequency inverters (n = variable)

④ Limit for continuous operation (min)

⑤ Operating limit (max)

Example: Low-load and main-load pumps with 2 frequency inverters



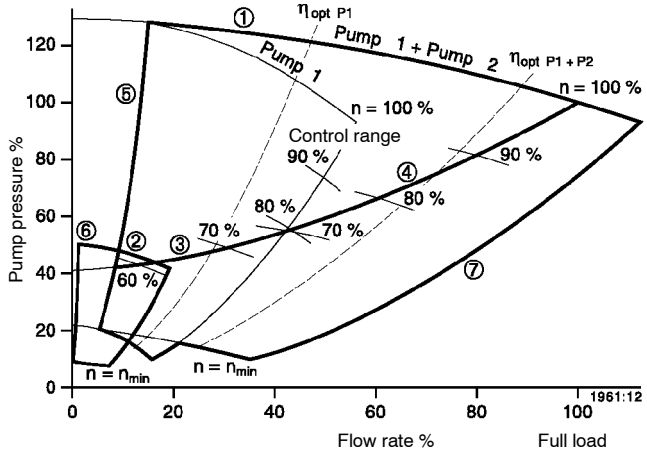
In the example shown, a third main-load pump is installed as standby pump. However, this pump can start up automatically, if required. The function of standby pump alternates according to a set cycle.

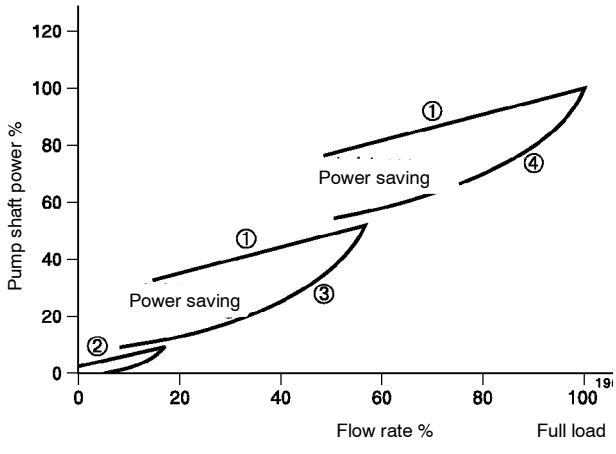
Control task:

Optimizing the low-load operation of the hydraulic system.

Even at low speeds, continuously speed-controlled pumps require a certain minimum flow rate ⑤. In many cases, however, these minimum flows are much too high. To avoid pump damage in the long run, the flow rate must not fall below this limit in continuous pump operation.

In the low-load range below this limit, a hydraulic bypass is normally used.However, the flow routed through this bypass cannot be used. A low-load pump which is rated for this flow range and operates at optimum efficiency, can expand the control range of the entire system to include this low-load range.





η_{opt} Optimum pump efficiency curve

① Pump characteristic curve at fixed speed (n = 100 %)

② Characteristic curve of low-load pump (n = 100 %)

③ Duty point curve of main-load pump in controlled operation at base load on frequency inverter (n = variable)

④ Duty point curve of two parallel main-load pumps in controlled operation at peak load with two frequency inverters (n = variable)

⑤ Limit for continuous operation (min), main-load pump

⑥ Limit for continuous operation (min), low-load pump

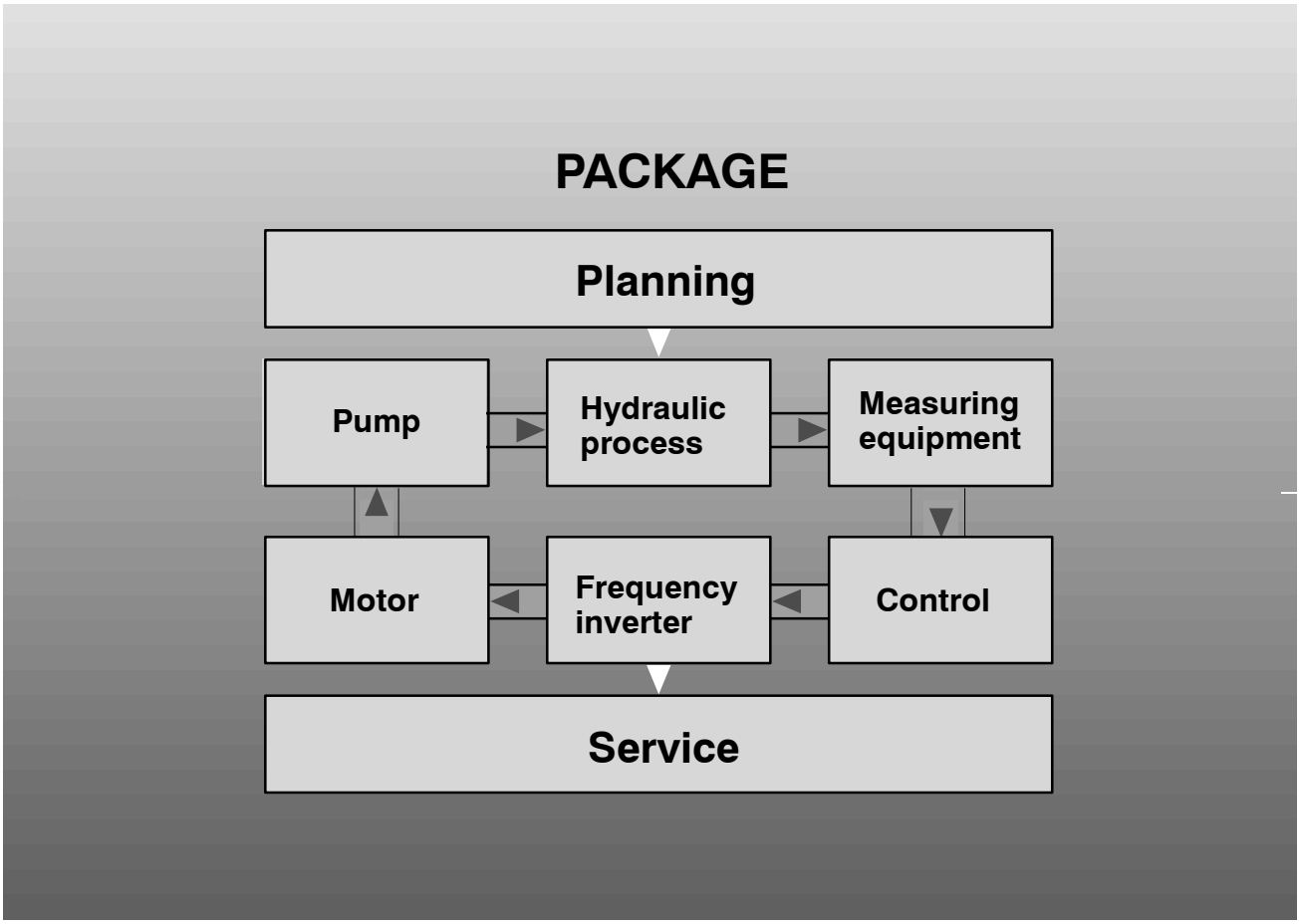
⑦ Operating limit (max)

① Pump power input curve at fixed speed (n = 100 %)

② Power input curve of low-load pump (n = 100 %)

③ Power curve of pump in controlled operation at base load with 1 main-load pump on frequency inverter (n = variable)

④ Power curve of pump for controlled operation at peak load with 2 main-load pumps in parallel on two frequency inverters (n = variable)



KSB offers a comprehensive service package comprising system planning of pumps, valves and switchgear, delivery, installation and commissioning as well as technical support during system operation.

Automatic Control Unit

Controlmatic E

Type Series Booklet

KSB

Building Services: Water Supply

Automatic Control Units

Controlmatic E

Main applications

- Pressure-controlled starting, stopping and monitoring of small pumps in water supply systems

Can be used with the following pumps (⇨ Page 6)

Type series	Size	Connection
Multi Eco	33 E, 34 E, 35 E, 36 E, 65 E	G 1
Ixo	45 E, 55 E, 65 E, 48 E, 58 E	G $1^1/_4$
S 100D	1/7, 1/9, 1/12, 1/14, 1/16, 2/7, 2/11, 2/15, 2/18, 4/4, 4/6, 4/9, 4/12, 7/5, 7/7, 7/9	G $1^1/_4$

Fluids handled

- Drinking water
- Service water
- Stormwater
- Fire-fighting water
- Cooling water

Operating data

Operating properties

Characteristic		Value
Flow rate	Q	Up to 10 m³/h (2.77 l/s)
Minimum flow rate	Q_{min}	0.1 m³/h
Start-up pressure (adjustable)	p	1.5 - 2.6 bar

Designation

Example: Controlmatic E

Key to the designation

Code	Description
Controlmatic	Type series
E	Single-phase AC

Configuration and function

Design of Controlmatic E

1	Housing	5	Green signal lamp - Energised
2	Pressure gauge	6	Amber signal lamp - Pump running
3	Plug socket (IP44)	7	Red signal lamp - Fault or lack of water
4	Power cable with shockproof plug		

Function

The pump can be connected via the plug socket (3) of the automatic control unit. Once the power cable with shockproof plug (4) has been connected to the power supply, the automatic control unit is ready for operation. The green signal lamp (5) is lit. When a shut-off valve in the piping is opened, the system pressure decreases and the pump is started up. The system pressure is indicated at the pressure gauge (2). The pump starts to deliver fluid and the amber signal lamp (6) is lit. When the tap has been closed and the flow rate is zero, the pump is stopped after 10 seconds.

Protective functions

- The pump is protected against dry-running by simultaneous monitoring of pressure and flow rate. If there is a lack of water, the automatic control unit stops the pump and the red signal lamp (7) is lit.

Materials

Overview of materials used

Component	Material
Housing	Polyamide
Membrane	Elastomer

Product benefits

- Easily connected to power supply by shockproof plug
- The pump is started and stopped automatically by simultaneous monitoring of pressure and flow rate.
- Variety of use due to user-definable start-up pressure (1.5 - 2.6 bar)
- Dry-running protection by stopping the motor
- User-friendly due to integrated pressure indication

Certifications

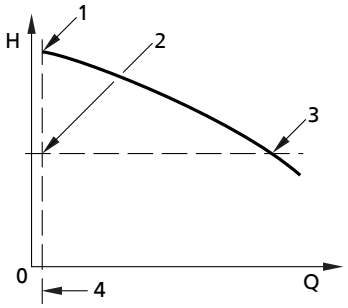
Designation	Valid in:	Note
ACS	France	French drinking water approval

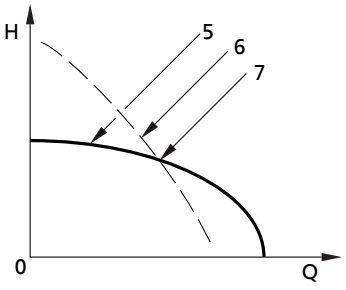
Selection information

- System pressures ≥ 10 bar may damage the automatic control unit and must be avoided by all means.
- The start-up pressure of the automatic control unit must always be lower than the maximum pressure at zero flow.
- Minimum flow rate: 0.1 m³/h
- The start-up pressure has been set to 1.5 bar.

Maximum pressure capability:

- $Pressure_{suction\ side}$ + $pressure_{max.\ pump}$ (at zero flow) ≤ 10 bar
- If in doubt about the suction side pressure:
  - **either** add a safety margin of 3 bar to the nominal pressure
    ($Pressure_{suction\ side}$ + 3 bar) + [$Pressure_{max.\ pump}$ (at zero flow)] ≤ 10 bar
  - **or** fit a pressure reducer (stabiliser) between the pump and the automatic control unit or on the pump's suction side, to prevent excessive pressure.
- If pressure surges are to be expected in the system as a result of quick-closing valves (e.g. solenoid valves) please contact KSB to check the unit's suitability for the specific application.



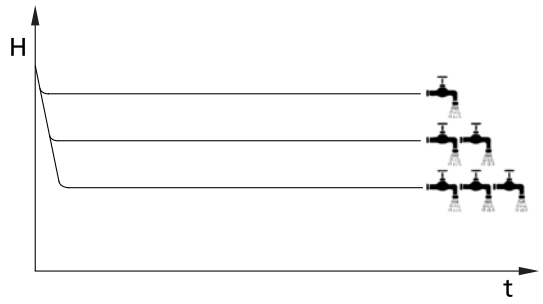


H/Q diagrams

1	Minimum flow rate	5	Curve to be selected
2	Minimum start-up pressure	6	Curve to be avoided
3	Pump start-up point	7	Maximum operating point
4	Pump stop point		

Pressure curve

Unlike domestic water supply systems with accumulators, pumps operated with automatic control units maintain a characteristically constant pressure at any flow rate.



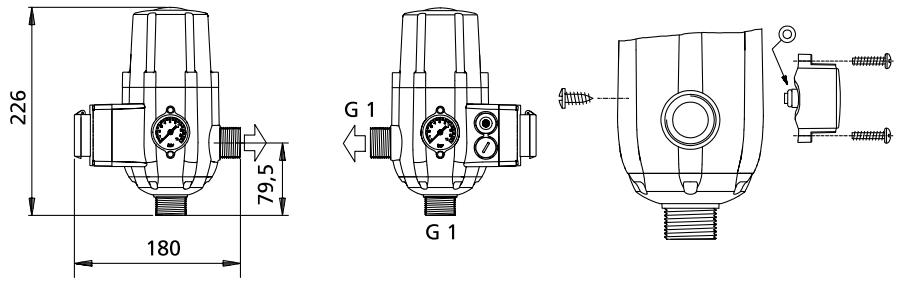
Pressure curves

Technical data

Selection table

Description	Value
Maximum operating pressure	10 bar[1)]
Flow rate	10 m³/h (2.77 l/s)
Enclosure	IP 44
Maximum ambient temperature	0 to 60 °C
Maximum fluid temperature	0 to 60 °C
Mains voltage	1~230 V, 50/60 Hz
Maximum current requirement	10 A
Protection against lack of water	Yes
Restart after lack of water	Manual
Weight	1.3 kg
Mat. No.	90053395

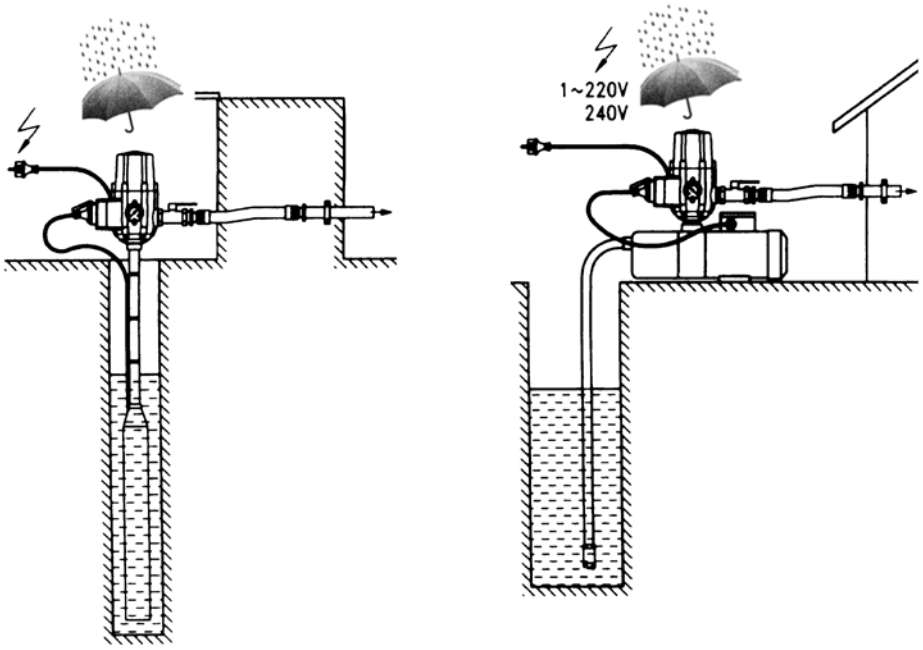
Dimensions



Dimensions [mm] - The pressure gauge can be fitted in two different positions.

1) The automatic control unit must be protected against any pressures exceeding the maximum operating pressure. Otherwise, the automatic control unit might be damaged!

Notes on installation



Typical installation positions

NOTE! The automatic control unit is not suitable for outdoor installation and must be protected from weather.

Accessories

Connnection parts

Connnection parts

Description		Connection	Mat. No.	[kg]
Connection part made of brass for Controlmatic	for Multi Eco type series (1 piece)	Rp 1 / G 1	39019415	0.2
	for Ixo, S 100D type series (1 piece)	Rp 1¼ / G 1	39019530	0.2

Automatic Control Unit

Cervomatic EDP.2

Type Series Booklet

Water Supply

Automatic Control Units

Cervomatic EDP.2

Main applications

Control and monitoring unit for small pump sets.
Can be used in the following applications:

- Spray irrigation systems
- Irrigation systems
- Rainwater harvesting
- Water supply systems

Fluids handled

For handling clean to turbid water not containing aggressive, abrasive or solid substances.

- River, lake and groundwater

Operating data

Operating properties

Characteristic		Value
Flow rate	Q	Up to 15 m³/h (4.17 l/s)
Operating pressure	p	10 bar
Fluid temperature	t	0 to 40 °C

Designation

Example: Cervomatic EDP.2

Key to the designation

Code	Description
Cervomatic	Type series
E	Single-phase AC
D	Three-phase current
P	Electrical protection
.2	Product version

Function

Ensures gentle system operation by:

- Pressure-dependent pump start
- Pressure-dependent or flow-dependent stop of the pump
- Integrated dry running protection
- Integrated overload protection

Operating modes

The unit offers two different operating modes which can be selected during parameterisation:

On/off mode:

- The pump set is started when the pressure in the pipe drops
- The pump set is stopped when flow in the pipe is interrupted

Pressure-dependent mode:

- The pump set is started when the pressure in the pipe drops
- The pump set is stopped when the set pressure in the pipe is exceeded

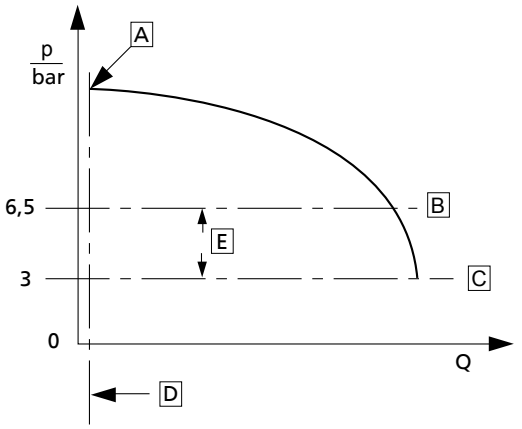
Further functions:

- Integrated dry running protection of the pump
- Integrated overload protection

The lift check valve required for pressure maintenance is not integrated in the automatic control unit. It must be installed in the pipe in addition. (⇨ Page 6)

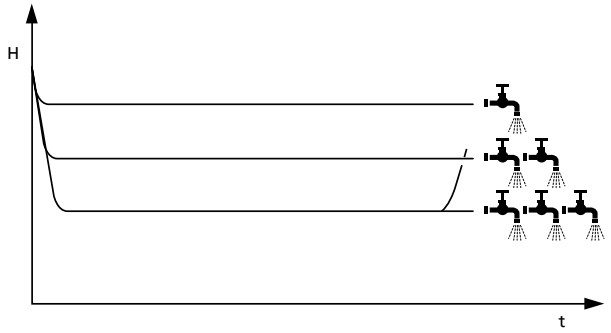
Pressure curve

The start pressure is set to 3 bar at the factory and can be decreased to 1 bar or increased to 6.5 bar if necessary.
For further information, refer to the operating manual.



Start-up range

A	Shutoff head
B	$p_{E\ max}$
C	p_E Factory setting
D	Pump set is stopped at Q < 2 l/s
E	Pump start



System pressure in relation to withdrawn fluid quantities

H	Pump head
t	Time

Product benefits

- The pump is started and stopped automatically by simultaneous monitoring of pressure and flow rate.
- Constant pressure depending on the flow rate by simultaneous monitoring of pressure and flow rate
- Dry-running protection by stopping the motor
- Digital indication of (actual and set) pressure
- Extremely straightforward menu-controlled setting of parameters
- Pressure-dependent pump start
- Pressure-dependent or flow-dependent stop of the pump

Materials

Overview of available materials

Component	Material
Housing	Polyamide
Membrane	Elastomer
Built-in components	EPDM, NR, Noryl, ceramics

Technical specifications

Selection table

Characteristic	Value
Range of start pressure (on/off mode)	1 - 5 bar
Minimum flow (on/off mode)[1)]	2 l/min
Maximum start pressure (pressure-dependent mode)	6.5 bar
Maximum stop pressure (pressure-dependent mode)	7 bar
Maximum operating pressure	10 bar
Burst pressure[2)]	40 bar
Flow rate	15 m^3/h (4.17 l/s)
Enclosure	IP 54
Ambient temperature	0 to 50 °C
Fluid temperature	0 to 40 °C
Mains voltage	1~230 V, 50/60 Hz 3~230 V, 50/60 Hz 3~400 V, 50/60 Hz
Maximum current requirement	10 A (16 A for short periods)
Protection against lack of water	Yes
Restart after detected lack of water	ART system (**A**utomatic **R**eset **T**est) ▪ One restart attempt after 5.5 minutes ▪ In the case of persisting lack of water: restart attempt repeated every 30 minutes for a period of 24 hours ▪ In the case of permanent lack of water: pump is permanently stopped until the problem is remedied
Inlet tank monitoring	Optional
Weight [kg]	2.5
Mat. No.	01185581

1) The pump set is stopped when the actual flow is lower than the minimum flow.

2) The control unit must be protected at all times against excess pressure (incl. system-induced surge pressures) exceeding the permissible maximum burst pressure of pB = 40 bar. If in doubt about the maximum suction-side pressure, either add a safety margin of 5 bar to the nominal pressure, or install a pressure reducer between the pump set and the unit or on the pump set's suction side. In addition, a lift check valve must be installed on the pump set's suction side.

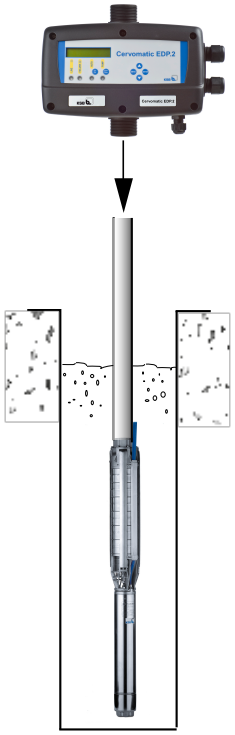
For use with the following pumps:

Selection table[3)]

Type series	Multi Eco	Ixo	S 100 D UPA 100 C UPA 150 C
Size	33 E/D, 34 E/D, 35 E/D, 36 E/D, 65 E/D	45 E/D, 55 E/D, 65 E/D, 48 E/D, 58 E/D	1/7, 1/9, 1/12, 1/14, 1/16, 2/7, 2/11, 2/15, 2/18, 4/4, 4/6, 4/9, 4/12, 7/5, 7/7, 7/9
	 Rp1 connection	 G 1 1/4 connection	 G 1 1/4 connection

Installation examples

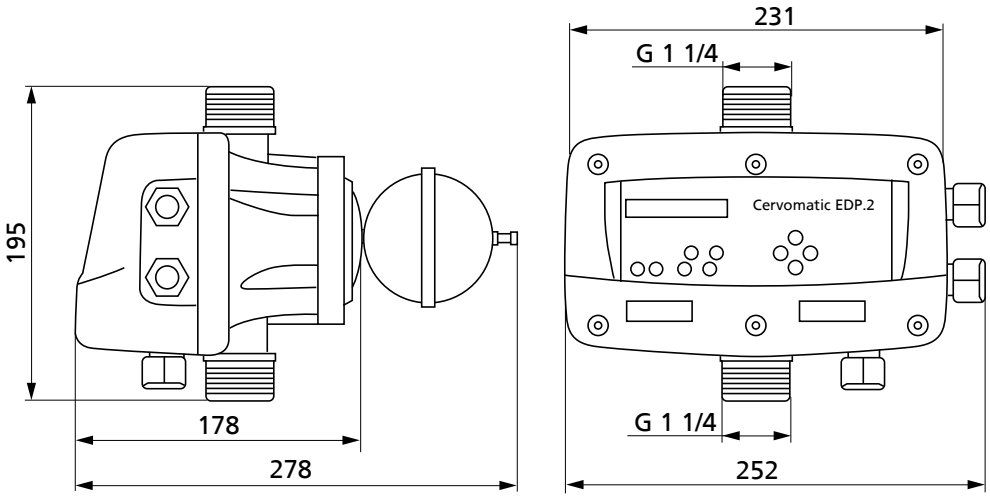
Selection table

Cervomatic EDP.2 with Multi Eco	Cervomatic EDP.2 with S 100D Cervomatic EDP.2 with Ixo
 Use screwed pump unions for installation! (⇨ Page 6)	

3) Accessories required

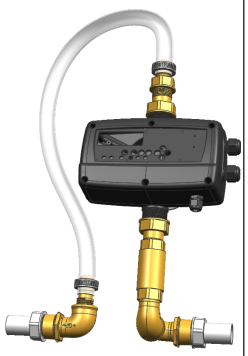
Dimensions

Dimensions in mm



Accessories

Optional accessories

Illustration	Description	[kg]	Mat. No.
	2 **screwed pump unions** G1 to G 1 1/4 (union nut)	0.3	00136434
	**Pipe adapter set** for installing the unit in horizontal pipes	0	01198308
	**Check valve,** for using the unit in combination with pumps without integrated swing check valve	0.6	00410207

LevelControl

Level control unit

BasicUnit
CompactUnit
SwitchgearUnit

Product description

LevelControl:

- Can be integrated in an on-site control cabinet (BasicUnit)
- Can be used for controlling and monitoring one or two pumps
- Can be used for tank draining applications
- ATEX-compliant model can be operated in potentially explosive atmospheres

Applications

In waste water engineering and lifting/pumping stations in applications such as drainage, dewatering, water extraction, liquid transport and disposal. Other applications on request.

Level Control can be used with the following pumps:

- Ama-Drainer
- Rotex
- MK
- Ama-Porter
- Amarex N
- Amarex KRT
- Compacta
- Ama-Porter CK
- Other pumps on request

Operating modes

CompactUnit and SwitchgearUnit are equipped with one selector switch (manual-0-automatic) per pump.

On the BasicUnit, selector switches can be connected for every pump.

”0” position: The pump is switched off and non-operational.

”Automatic” position: If the switches are set to ”Automatic”, the pumps will be started and stopped by the control unit as a function of the liquid level.

”Manual” (H) position: The pump can be started up manually by turning the switch to ”manual” mode (non-locking).

Designation

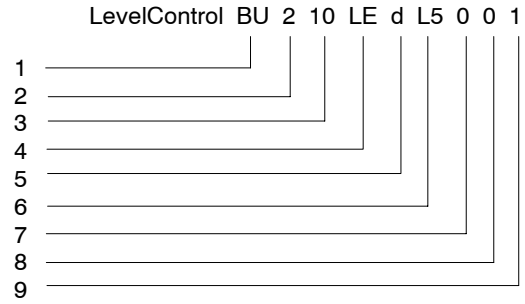


Fig. 1: Designation

1 Type series

2 Number of pumps

3 Maximum output current per pump [A]:
10, 14, 18, 25, 40, 63

4 Sensors:
LE = level switch, analog sensor (4..20 mA)
H03 = pressure sensor for 0 to 3.5 m
H10 = pressure sensor for 0 to 10.5 m
A03 = pressure sensor for 0 to 3.5 m with compressor for bubbler system
A10 = pressure sensor for 0 to 10.5 m with compressor for bubbler system
X1 = 1 level switch in potentially explosive atmosphere
X2 = 2 level switches in potentially explosive atmosphere
X3 = 3 level switches in potentially explosive atmosphere
X4 = 4 level switches in potentially explosive atmosphere

5 Motor starting method:
d = direct starting
sd = star-delta starting

6 Mains type:
L5 = three-phase
L35 = single- or three-phase

7 ATEX functions:
1 = yes
0 = no

8 Field bus (in preparation):
L = Lonbus
P = Profibus
M = ModBus
0 = without

9 Language version
1 = German, English, French, Dutch

Ordering key

The information listed below is required for ordering. Only one option can be selected for each feature. The codes of the individual options are reflected in the unit designation (see left):

Type series BU

Order information	Options
Number of pumps	-
Maximum output current per pump [A]	-
Sensors	LE, H03, H10
Motor starting method	-
Mains type	-
ATEX functions	0
Field bus	0
Language version	1

Table 1: Ordering key for type series BU

Type series CU

Order information	Options
Number of pumps	1, 2
Maximum output current per pump [A]	10
Sensors	LE, H03, H10, X1, X2, X3, X4
Motor starting method	d
Mains type	L35
ATEX functions	0, 1
Field bus	0
Language version	1

Table 2: Ordering key for type series CU

Type series SU

Order information	Options
Number of pumps	1, 2
Maximum output current per pump [A]	10, 14, 18, 25, 40, 63
Sensors	LE, H03, H10, A03, A10, X1, X2, X3, X4
Motor starting method	d, sd
Mains type	L5
ATEX functions	0, 1
Field bus	0
Language version	1

Table 3: Ordering key for type series SU

Technical data

Characteristics		LevelControl BU	LevelControl CU	LevelControl SU
Rated voltage		3~ 400 V AC +/- 10 %, 1~ 230 V AC	3~ 400 V AC +/- 10 %, 1~ 230 V AC	3~ 400 V AC +/- 10 %, 1~ 230 V AC
Mains frequency		50/60 Hz	50/60 Hz	50/60 Hz
Rated insulation voltage		500 V AC	500 V AC	500 V AC
Rated power per motor		with internal current transformers: up to 4 kW	Direct starting: up to 4 kW	Direct or star-delta starting: 0.37 to 22 kW.
		with external current transformers: any power		
Rated current per motor		with internal current transformers: max. 10 A	max. 10 A	1.0 to 63 A
		with external current transformers: any current	max. 10 A	1.0 to 63 A
Enclosure		IP 20	IP 54	IP 54
Material	Housing	Plastic	Plastic	Sheet steel
	Housing cover	PBT, glass fibre reinforced	Plastic	Sheet steel

Table 4: Technical data

Functions

Control

- Tank drainage
- Even distribution of pump operating hours
- Automatic pump changeover after every pump start or as a function of operating hours
- Pump start-up and shutdown in response to service demand
- Pump changeover in the case of a pump fault
- Periodic check of operation
- Sequenced starting/stopping if both pumps have to be started or stopped, to prevent pressure surges and reduce starting currents
- Freely selectable automatic re-start after fault
- Adjustable after-run time (slurp mode, forced drainage)
- Variable stop delay to prevent deposits in the tank

Tank drainage can be realized by means of level switches or an analog sensor.

Monitoring

- Internal mains-independent alarm buzzer
- High-water alert
- Operational availability
- General "System Operational" message
- General fault message
- Phase monitoring
- Overload detection per pump
- Thermal monitoring of pump motors
- Sensor fault / Live zero
- Fault / Warning per pump
- Low-load detection
- Archiving of data of the last 30 faults
- Monitoring of service interval

Information displayed

- Water level
- Alerts and warnings in plain text
- "Pump operational" and "Pump running" messages per pump
- Status information
- Operating hours per pump
- Operating hours per system
- Motor current per pump
- Mains voltage
- Mains frequency
- Effective power per pump
- Rotary field direction of mains supply
- Starts per pump
- Parameterization / Settings
- Electronic name plate
- Languages: German, English, French, Dutch

Operation

Operating option	BU	CU	SU
KSB control panel	optional	x	x
RS232 interface	x	x	x
Selector switch	site-supplied	x	x
Master switch	site-supplied	without	x

Table 5: Operating options

Communication

RS232 interface

Accessories/Options

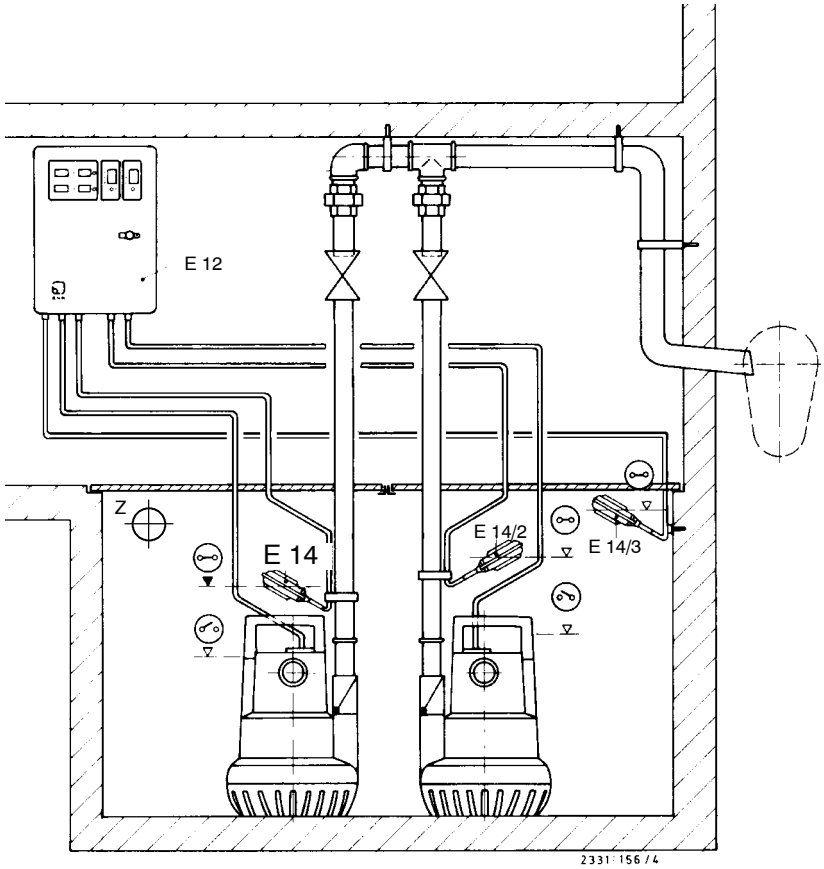
Accessories/Option	BU	CU	SU
Control panel	x	—	—
Ammeter 6, 10, 15, 25 or 40 A	—	—	x
Voltmeter with integrated changeover switch 500 V	—	—	x
Flashlight 12 V DC, IP 65	—	—	x
Horn 12 V DC, IP 33	—	—	x
PTC thermistor relay with automatic reset	—	—	x
Control cabinet heating	—	x	x

Table 6: Accessories/Options

Application example: Waste water disposal, level control via three float switches

Ama-Drainer 301 NE/303 NE with LevelControl

- Disposal of heavily contaminated, fibre-containing waste water in an industrial business.
- Two submersible motor pumps installed in a site-supplied sump are controlled as a function of the liquid level in the sump.
- Control of the Ama-Drainer pumps is effected by LevelControl.
- Two float switches detect base load and peak load conditions. A third float switch is used to detect high water.



E12	Control unit
E14	Float switch Base load
E14/2	Float switch Peak load
E14/3	Float switch High water
Z	Inflow

Fig. 2: Ama-Drainer pumps with LevelControl

Operating principle in automatic mode

- The fluid to be handled flows into the pump sump. When the fluid reaches the start-up level of the "base load" float, pump 1 is started up.
- When the liquid level drops again and falls below the stop level of the "base load" float, pump 1 is stopped.
- As the liquid level rises again, the start-stop cycle starts again. This time, however, pump 2 is started up (pump changeover), provided both selector switches have been set to "automatic" mode. Pump changeover is effected after each switching cycle.

06.10.2006

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