KS 94 Aqua

Pressure controller for drinking water networks

Prevents pressure peaks

Drastic reduction of pipe bursts

Lower energy consumption

Less maintenance requirements

Messages in plain text

Emergency operation with sensor fault

PROFIBUS-DP or Interbus connection

expert line

PROFILE

By means of a modern control concept, a continuous steady pressure can be maintained in public water supply networks. Furthermore, seemingly unavoidable pressure peaks (water hammer) are prevented reliably. With the systems installed so far, the number of damaged or ruptured pipes was reduced drastically to 10% of the previous value. This is achieved with a compact, specially configured KS 94 universal controller, connected to a flow meter, a pressure sensor, and to the pumps. Due to the precise and sensitive control loop, energy consumption is reduced as well as the outlay for maintenance of the pumps, fittings, and actuators.

DESCRIPTION

Pumps 1 to 3 are operated in such a way that the pressure is always maintained at a constant value, e.g. 5 bar (± 0,05 bar). For this, pump P1 operates for flows between 0 and $LimH1$. If $LimH1$ is reached, pump P2 is started, and both pumps are operated for a flow of Q/2. If a flow of $LimH2$ is reached (only in case of an unusually high demand, e.g. for fire fighting), pumps 1 and 2 are switched off, and the total flow is provided by pump P3. The purpose is to ensure that every pump is operated in its most efficient delivery range.

The activated pumps maintain the network pressure at the required value for the corresponding delivery flow. For this, the analog output of the KS 94 controller is used to control the frequency converter for pump speed.

Depending on the instantaneous flow, the pressure setpoint is increased automatically, thus preventing water hammer in the pipes.

The constantly changing pressure setpoint is determined automatically by the controller from the measured flow and pressure values. If the pressure falls below an (adjustable) minimum value $LimL3$, a fault in the network is assumed, and a relay generates an alarm signal.

FRONT INTERFACE AND ENGINEERING TOOL

By means of a PC or laptop connected to the controller's front interface, it is possible to display the trend values of flow and pressure over time, thus enabling the system's operation to be monitored.

Reservoir
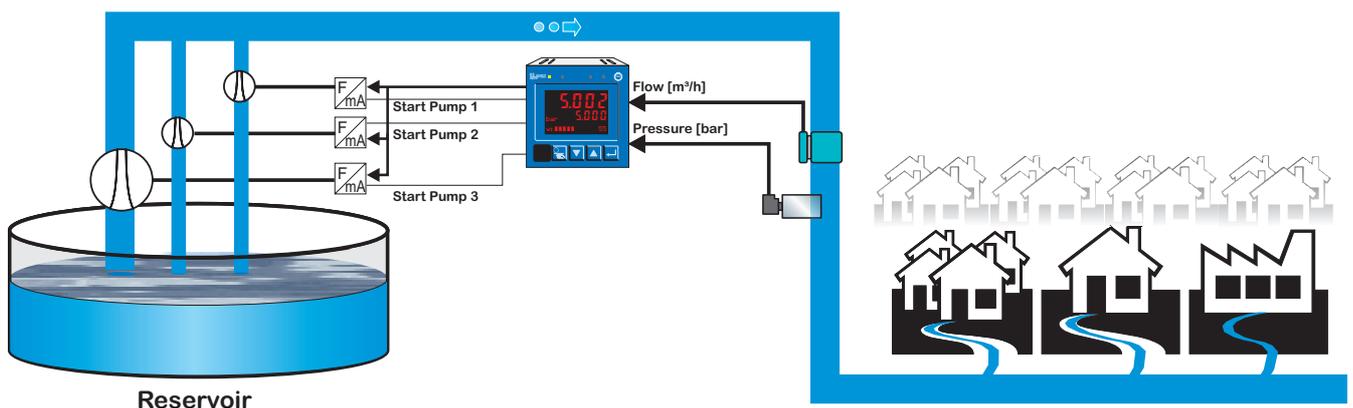
DISPLAY

The „day & night" display is equally suitable for poor lighting conditions and strong sunlight, and not only indicates setpoint, process value and output value, but also provides messages in plain text, e.g. which pumps are in operation, possible disturbances, etc.

Display of process pressure, setpoint, and output value. Control via Pump 1, setpoint adjustment via ▲ and ▼.

Start of Pump 2 has been triggered.

Pressure setpoint has been increased automatically.

Switchover to Pump 3. Display via yellow LED and message in plain text.

Signal for sensor fault. Output value goes to 50% and can be changed via front-panel keys (emergency operation).

PARAMETER LEVEL

Pressing the ▭ key opens the extended Operating and Parameter Levels. The various signals and parameters are selected by means of the ▲ and ▼ keys (see table).

| Symbol	Meaning	Default
INP6	Actual measured flow-	-
LimH1	Cut-in value for pump 2	20 m³/h
LimH2	Switchover to main pump 3	45 m³/h
LimL3	Min. pressure monitor (pressure loss)	2.0 bar
Ymin	Lowest output value	2 %
Xp1	Controller proportional band	
Tn1	Controller integral action time	
m6	Max. value of flow transmitter	50 m³/h

Interlock

Via digital input di2 it is possible to disable parameter adjustments in the extended Operating Level. A good solution is to connect a switch-key to di2, thus preventing unauthorized changes.

Alarm

Relay OUT4 is used to signal a pressure sensor fault and if the pressure falls below the minimum level LimL3. The relay is configured to give an alarm in case of a power outage (fail safe).

Connecting diagram of KS 94 Aqua
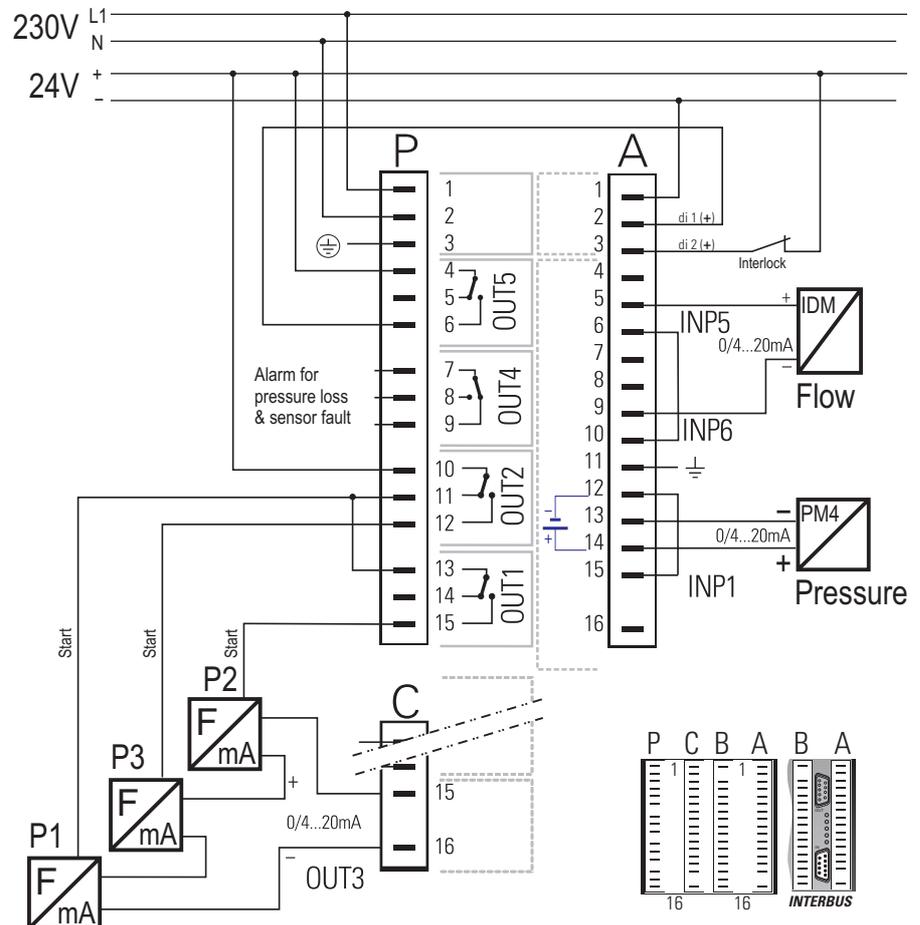
TECHNICAL DATA

INPUTS

Input INP1 (pressure)
Universal input, configured for 4...20 mA
Limiting frequency: fg = 1hz
Measurement cycle: 200 ms

Meas. span	Error	Resolution
4...20 mA	0,1 %	0,8 µA

Input resistance: 50 Ω
Input circuit monitor for 4...20 mA
Triggered, if input signal ≤ 2 mA

Integrated transmitter supply

Used to energize a 2-wire transmitter, galvanically isolated. Output: =17,5 VDC / 22 mA

INPUT INP5 (FLOW)

Differential amplifier input:
Max. 2 inputs cascadable, if there is another galvanic connection between the units. Else max. 6 inputs can be cascaded.

Direct voltage & current

Technical data as for INP1, except limiting frequency: fg = 0,25 Hz
Measurement cycle: 800 ms

INPUT INP6 (FLOW)

Potentiometric transducer or standard signal 0/4...20 mA
Configured for 4...20 mA
Technical data as for INP1

CONTROL INPUTS DI1, DI2

Optocoupler
Nominal supply: 24 VDC external
Current sink (IEC 1131, Type 1)
Logic "0" = -3...5 VLogic "1" = 15...30V
Current demand approx. 5 mA
Digital inputs are galvanically isolated from the other inputs/outputs and from the supply voltage.
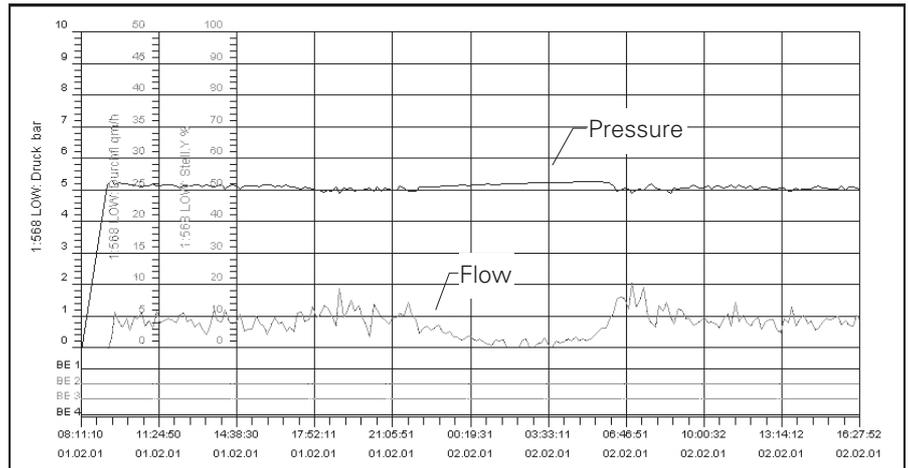
OUTPUTS

Relay outputs OUT1, OUT2, OUT4, OUT5

Potential-free switchover contacts
Contact rating:
Max. 500 VA, 250 V, 2A at 48...62 Hz, resistive load
Min. 12 V, 10 mA AC/DC

Note:

If the relays operate external contactors, these must be fitted with RC snubber circuits to prevent excessive switch-off voltage peaks.

Trend recording of flow and pressure during a 24-hour period.
The recording was made at the high-level reservoir in Eggenfelden, Bavaria.

CONTINUOUS OUTPUT OUT3

Control of the frequency converter
Galvanically isolated
Configurable for 0/4...20 mA
Control range: 0...approx. 22 mA
Resolution: 6 µA ≙ 12 bits
Load: 600 Ω
Load effect: < 0,1%
Limiting frequency: approx. 1 Hz

POWER SUPPLY

AC supply

90...260 VAC
Frequency: 48...62 Hz
Power consumption: approx. 10 VA

Behaviour after power failure

Configuration, parameter settings and setpoints: permanent EEPROM storage

REAR BUS INTERFACE (OPTION B)

PROFIBUS-DP INTERFACE

➢ See data sheet 9499 737 37213

INTERBUS INTERFACE

➢ See data sheet 9498 737 36713

ENVIRONMENTAL CONDITIONS

Permissible temperatures

For specified accuracy: 0...55°C
For operation: 0...60°C
Storage and transport: -20...60 °C

Climatic category

KUF to DIN 40 040.
Relative humidity: 75% yearly average, no condensation

Shock and vibration

Vibration test Fc

To DIN 68-2-6 (10...150 Hz)
Unit in operation: 1g or 0,075 mm
Unit not in operation: 2g or 0,15 mm

Shock test Ea

To DIN IEC 68-2-27 (15g, 11 ms)

ELECTROMAGNETIC COMPATIBILITY

Complies with EN 50 081-1 and EN 50 082-2 for unrestricted use within rural and industrial areas.

Electrostatic discharge

Test to EN 61 000-4-28 kV air discharge
4 kV contact discharge

High-frequency interference

Test to EN 61 000-4-3
80...1000 MHz, 10 V/m
Effect: ≤1%

HF interference on leads

Test to EN 61 000-4-60,15...80 MHz, 10 V
Effect: ≤1%

Low-frequency magnetic field

Test to EN 61 000-4-8
No effect with 50 Hz, 30 A/m

Fast pulse trains (Burst)

Test to EN 61 000-4-42 kV applied to leads for supply voltage and signal leads

High-energy single pulses (Surge)

Test to EN 61 000-4-5
Test voltage applied to the following leads:
Supply leads:
1 kV symmetric, 2 kV asymmetric
Signal leads:
0,5 kV symmetric, 1 kV asymmetric

GENERAL

Housing

Plug-in module, inserted from front.
Material: Makrolon 9415 flame-retardant,
self-extinguishing
Flammability class: UL 94 VO

Protection mode

(to IEC 529, DIN 40 050)
Front: IP 65
Housing: IP 20
Terminals: IP 00

Safety tests

According to EN 61 010-1 (VDE 0411-1)
Overvoltage category III
Contamination class 2
Working voltage range 300 V AC
Protection class I

CE marking

The controller meets the European requirements regarding „Electromagnetic Compatibility" and „Low-voltage equipment" (see also „Safety tests")

Electrical connections

Flat-pin connectors to DIN 46 244 for
1 x 6,3 mm or 2 x 2,8 mm

Mounting method

Panel mounting with two fixing clamps
each at top/bottom

Mounting position

Not critical
Weight: Max. 1,5 kg with all options

Accessories

3-language operating and safety instructions (GB/D/F)
4 fixing clamps
(Operating manual can be ordered separately)

ORDERING DATA

Description	Order no.	
KS 94 Aqua	9407-933-01092-036	CONF-094-00485
KS 94 Aqua Profibus-DP	9407-933-31092-036	CONF-094-00485
KS 94 Aqua InterBus S	9407-933-41092-036	CONF-094-00485
Pressure sensor PM4, process coupling G1/2 A, DIN 16 288, HART protocol, measuring span 0...16 barr	9404-218-04111	
Engineering Tool ET/KS94	9407-999-01801	
Simulation software SIM/KS 94 with trend module (ET/KS 94 and SIM/KS 94 are required for trend display!))	9407-999-03801	
PC adapter for connecting the Engineering Too	9407-998-00001	