

HYDROPHORE SYSTEMS CONTROLLERS

models DHC-02

- Internal power supply 12 V DC for the transmitter
- programmable levels, time delays and pump switching on and off algorithm
- ✓ Inputs:
 - 1 current input 4-20mA from pressure transmitter
 - 4 inputs from PTC for the temperature protection of the pumps (1.6k Ω)
 - 1 discreet input type “dry contact” for permission/prohibition of the control
- ✓ Outputs:
 - 4 6A/250V SPDT relay outputs for pump engines control
 - 1 voltage output 0-10V for frequency control
- ✓ Display:
 - 4 digit green LED display for process variable value (PV)
 - 4 green LEDs for relay outputs condition
 - 4 red LEDs for PTC input condition
- ✓ Mounting:
 - Dimensions - 45 x 75 x 110 mm (model DHC-02); 48 x 96 x 135 mm (model DHC-03)
 - Mounting - DIN-rail mountable (model DHC-02); panel mountable (model DHC-03)
 - Power supply – 90÷250V AC, <10 VA



GENERAL DESCRIPTION

The controller is designed for pump control permission/prohibition and pressure control in hydrophore systems. The currently measured pressure value and the condition (switched on, switched off, temperature protection) of the pumps are visualized on the display. The number of the active pumps (up to 4) could be set via key operations. The interval in which each pump is on is saved in the nonvolatile memory of the controller. The device switches on the pumps and controls the time in which they are on in order for them to work for equal time intervals.

Each of the four resistive inputs of the controller is connected to a pump’s PTC temperature protection. If the temperature protection of a pump is activated the controller switches off this pump.

The discreet input type “dry contact” permits/prohibits the pump control. Through the galvanic isolated voltage output one (or more) of the pumps could be frequency controlled. The output voltage controls the frequency inverter of the pump.

OPERATING PRINCIPLE

The following parameters have to be set for the correct operation of the controller:

No	Prompt	Description
1	pnt	Decimal point position
2	rb	Beginning of the pressure range
3	rE	End of the pressure range
4	nopu	Number active pumps
5	SP	Pressure set point
6	hiSt	Hysteresis
7	delt	Change of the output
8	ti 1	Time 1 (for switching on/off of a pump)
9	ti 2	Time 2 (for switching on/off of a pump)
10	ti 3	Time 3 (for switching on/off of a pump)
11	Hi	Analogue output upper limit
12	Lo	Analogue output lower limit
13	coEF	Proportional coefficient

Pumps control action:

The way the voltage output changes its value could be given by the expression:

$$u(t) = A + B$$

where:

$u(t)$ - the value of the voltage output (0-10V)

A - proportional part. It is a function of the difference between the Set point (SP) and the measured pressure.

B - integral part.

The proportional part A could be given by the expression:

$$A = \text{coEF} * (\text{Set point} - \text{Pressure}) / \text{PressureRange} * \text{OutputRange}$$

The proportional coefficient coEF could be set within the 0.0 - 99.99 range. The expression

$$\text{coEF} * (\text{Set point} - \text{Pressure}) / \text{PressureRange}$$

is without dimension. Multiplying this expression with the voltage output range (OutputRange) is in order to transform the value into the units of the voltage output. The bigger the difference between the set point and the measured pressure is the greater the value of the proportional part A is. If the value of coEF is set to 0.00 the whole proportional part of the expression is 0.

Integral part of the expression - B:

The change of the voltage output (**delt**) should be set in percents of the voltage output range. This is the change of the voltage output if there is a difference between the set point and the measured pressure.

If the measured pressure is lower than the set point, the integral part of the expression will be increased every 0.5 seconds with:

$$\text{delta} = \text{delt} * \text{OutputRange} / 100$$

If the measured pressure is higher than the set point, the integral part of the expression will be decreased every 0.5 seconds with the same number.

If **delt** is set to zero there will be no change in the integral part of the expression.

When the power supply is on and if the digital input type “dry contact” for control action permission is “closed” the frequency controlled pump is switched on. The voltage output works as described above.

Pumps control action examples:

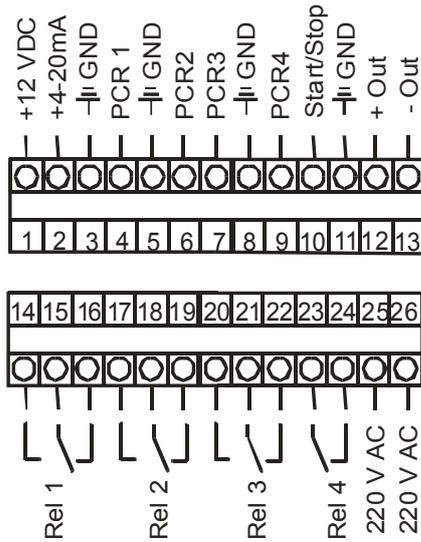
Example 1: If the measured pressure is lower than the set point minus hysteresis magnitude. No pumps are switched on at the beginning.

- Uout increases
- Uout becomes bigger than the low limit level Lo. The frequency controlled pump is switched on.
- Uout increases. Uout reaches the high limit level Hi. One of the other three pumps is switched on. Time t1 starts running.
- Time t1 runs out. A third pump is switched on. Time t2 starts running. (three pumps are switched on and one is off)
- Time t2 runs out. The last (fourth) pump is switched on.

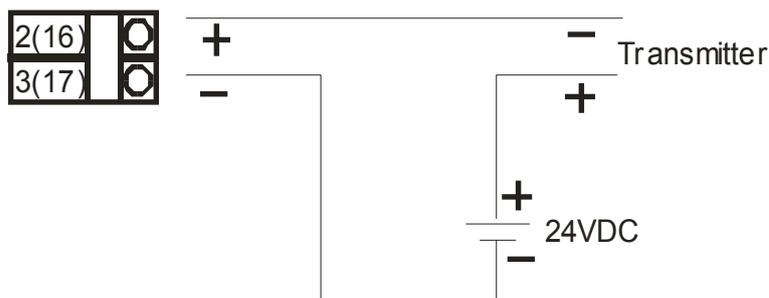
Example 2: The measured pressure is lower than the set point. All pumps are switched on and the pressure reaches the set point.

- Uout starts reducing
- Uout becomes smaller than the low limit level Lo. One of the pumps is switched off (not the frequency controlled one). Time t1 starts running.
- Time t1 runs out. One of the other “non-frequency controlled” pumps is switched off. At this point two of the pumps are switched on and two are off. Time t2 starts running.
- Time t2 runs out. The last “non-frequency controlled” pump is switched off. Only the frequency controlled pump is switched on. Time t3 starts running.
- After time t3 runs out the last pump (frequency controlled) is switched off.

CONNECTION DIAGRAM

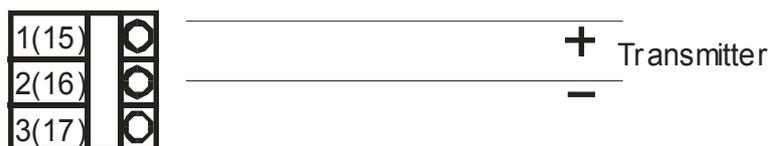


Terminal No.	Description
1	"+" 12 VDC
2	"+" 4-20mA
3	GND
4	One of the leads of the motor 1 PTC temperature protection
5	GND
6	One of the leads of the motor 2 PTC temperature protection
7	One of the leads of the motor 3 PTC temperature protection
8	GND
9	One of the leads of the motor 4 PTC temperature protection
10, 11	Discreet input type "dry contact" for Permission/Prohibition of the control action
12,13	Voltage output (12 - "+", 13 - "-") (terminal 13 is galvanic isolated from the common GND)
14,15	Relay output 1 NO contact
15,16	Relay output 1 NC contact
17,18	Relay output 2 NO contact
18,19	Relay output 2 NC contact
20,21	Relay output 3 NO contact
21,22	Relay output 3 NC contact
23,24	Relay output 4 NO contact
25,26	Power supply 220 V DC



Passive current input connection with external power supply

The connection of the current input (terminal 2 and GND) is with external power supply and is shown above.



Using internal power supply

KEY OPERATIONS

Basic display mode:

When the controller is switched on, the device version is shown on the display for 1.5 seconds. The version could be:

“v0-4” – all pumps are without frequency control

“v1-3” – only the first pump is with frequency control

“v4-0” – all pumps are frequency controlled

After that the controller enters its basic display mode. The currently measured pressure is visualized on the display. Prompt “Err” is visualized on the display if there is an error in the input circuit.

LEDs P1, P2, P3 and P4 correspond to the relay outputs condition. Blinking LED Px indicates error in the corresponding discreet input (dry contact). LEDs F1, F2, F3 and F4 correspond to the PTC temperature protection condition. If the protection is switched on the corresponding LED is on. Blinking LED indicates circuit break down.

If button MODE is pressed while the controller is in its basic display mode prompt SP is visualized on the display. Press MODE again to view the currently set value for the set point. In this mode the value of the set point can not be changed. Press MODE again to enter the normal working mode again.

CONFIGURING THE CONTROLLER

All parameter changes could be performed after the correct identification of a password.

Password entering: Press MODE and ENT buttons or ENT and “^” buttons simultaneously. Prompt 0000 appears on the display. Using the “<” and “^” buttons enter the password. Press ENT. After the correct identification of the password prompt PASS appears on the display. Press the MODE button to begin the parameter’s configuration.

Use “<” and “^” buttons to change the parameter’s value as desired. Press ENT to save the new value or MODE to switch to the next parameter. Prompt corresponding to the next parameter is visualized on the display first. Press MODE to view the currently set value for this parameter. The controller enters its normal operating mode after the last parameter is viewed.

Depending on the different controller configurations the parameters are dynamically deactivated in the different submenus. All parameters are shown below (some of them may not be visible depending on the current configuration).

Setting Pressure range and Number of active pumps

Press MODE and ENT simultaneously and enter the **2222** password.

Prompt	Description	Units	Range
pnt	Decimal point position	-	-
rb	Beginning of the measuring range – pressure corresponding to 4 mA	transmitter dependable	-999 ÷ 9999
rE	End of the measuring range – pressure corresponding to 20 mA	transmitter dependable	-999 ÷ 9999
nopu	Number of active pumps	-	1, 2, 3 or 4

Setting the set point and hysteresis

Press MODE and ENT simultaneously and enter the **1111** password.

Prompt	Description	Units	Range
SP	Pressure set point	Physical units	-999 ÷ 9999
hiSt	Hysteresis	Physical units	-999 ÷ 9999

Setting the time for pumps action, control action parameters and output limit levels

Press MODE and ENT simultaneously and enter the **3333** password.

Prompt	Description	Units	Range
delt	Percents of the output voltage with which the integral part of the control action is changed. From 0%(0VDC) up to 99.99%(10VDC)	seconds	1 ÷ 99.99
ti 1	Time 1 (see operating principle)	seconds	1 ÷ 9999
ti 2	Time 2 (see operating principle)	seconds	1 ÷ 9999
ti 3	Time 3 (see operating principle)	seconds	1 ÷ 9999
Lo	Voltage output value. When the output falls below this value the pumps are switched on	% from the output range	0 ÷ 100.0
Hi	Value of the voltage output above which the other pumps start switching on	% from the output range	0 ÷ 100.0
coEF	Proportional coefficient	amplification times	0 ÷ 99.99

Viewing the statistics for time in which the pumps were on and resetting the counters

Press “^” and ENT simultaneously and enter the **1111** password.

Prompt	Description	Units	Range
t1	Time in which pump 1 was switched on	hours	1 ÷ 9999
t2	Time in which pump 2 was switched on	hours	1 ÷ 9999
t3	Time in which pump 3 was switched on	hours	1 ÷ 9999
t4	Time in which pump 4 was switched on	hours	1 ÷ 9999
t1CL	Press ENT to reset the value of the first counter	-	-
t2CL	Press ENT to reset the value of the second counter	-	-
t3CL	Press ENT to reset the value of the third counter	-	-
t4CL	Press ENT to reset the value of the fourth counter	-	-