c. Do not switch off the rotary pump until full de-aeration of the system – it means till air bubbles stop appearing in the overflow pipe. Subsequently, fully open the drain valve, to which a forcing hose is connected and observe whether air bubbles come out the overflow hose.

d. When air bubbles stop appearing in the overflow pipe, close the upper discharge valve and continue pumping of the heat transfer fluid to the system, to reach required system overpressure of p = 2.5 bar, which is measured by the manometer. When the required overpressure is reached, close the lower discharge valve, switch off the rotary pump and open the ball valve under the circulation pump.

e. Insert the controller plug into the ~230V mains socket and switch on the solar collector pump in the manual mode. Do the following steps in order to switch on the pump in a manual mode:
- Switch on the controller with the button (⏻) - CAUTION!! this will calibrate the temperature sensors.
- Enter into MENU pressing the button (MENU)
- Using the arrow buttons (△) or (▽) choose the option „Manual control" and confirm by pressing the button (OK).
- Switch off the pump P manually changing the option **„Off"** to **„On"**.

f. Remaining air should be removed automatically by opening the manual valve in the upper part of the air separator..

g. In case the pressure measured by the manometer is below 1.5 bar, fill in the system to reach required system overpressure of p = 2.5 bar.

h. Set the required flow rate of the heat transfer fluid – to do this, choose the option "pump parameters".

i. Entering the Maximal option will cause start up of the pump on and will display the additional option "Current". While in the Maximal option, input

j. the proper value calculated for the number of solar collectors (count 1.5 l/min per each flat plate collector or 1.0 l/min per each tube collector).

k. Return to the normal working mode of the controller by triple pressing the button (ESC).

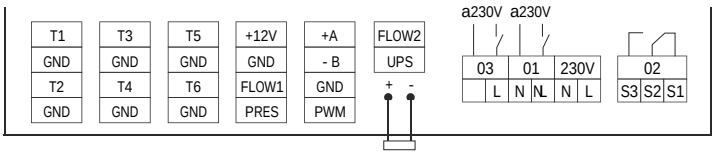
4 SIGNALLING OF THE FUNCTIONING OF THE PUMP

diode	no signal	pump does not work, power failure on the 3-wire cable (check the pump connection – 3-wire cable 230V, check the controller)
	flashing green light	pump does not work, PWM power failure on 2-wire cable, 230V power on 3-wire cable (check the pump connection – 2-wire cable PWM, check the controller, check the setting PUMP TYPE->PUMP ST7 PWM2 in the controller)
	solid green light	pump works properly
	red light	pump failure
	green + red light	pump failure

5 G422 ELECTRONIC CONTROLLER

The controller is an independent control block designed to control circulation pumps and other devices, which are a part of the solar collector system. The G422 controller has 4 temperature sensors, which depending on the selection of one of various possible controller programs, should be placed in appropriate temperature measurement locations indicated on the diagram of the respective installation scheme (see: G422 independent control block operation manual).

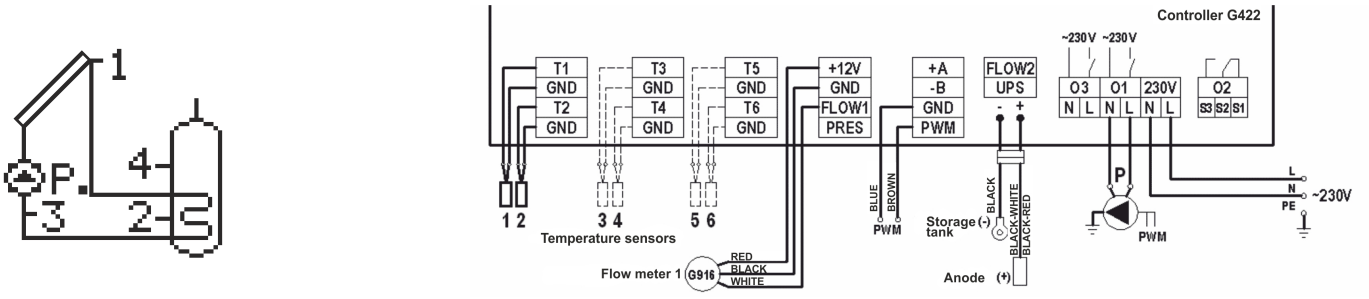
Back view **Front view**



Input / Output	Description
230V~	Connection to 230V~/50Hz mains
O1	Main pump output – **Maximum current intensity: 2A**
O2	Relay output - potential-free output (changeover contact) – **Maximum current intensity: 4A** – S1-S2 – NC (normally closed), – S2-S3 – NO (normally open)
O3	Relay output – potential output – **Maximum current intensity 4A**
O4	Output voltage of 230V ~ bridged inside the controller. This output can be bridged on the outside with the output of a changeover contact O2 to get a switched power supply to control for example a three-way valve
T1, T2, T3, T4,	Temperature sensors' input – NTC10kΩ
5-8	FS-300A control unit and pressure sensor (NO) input 5.....+12V.....red wire 6.....GND..... black wire / **PRESSURE SENSOR** 7.....+FRQ.....white wire 8..... **PRESSURE SENSOR**

Input / Output	Description
9 - 10	Communication input RS485 to connect a computer or other device 9.....+A 10.....-B
11 - 12	PWM control input to control ST7PWM2 pump 11.....PWM - 12.....PWM +

Fig. 5. Schematic and electric diagram of the installation no. 1



ATTENTION!!! Dashed lines refer to optional sensors than can be installed but are not required for correct operation of the controller (schematic and electric diagram of the installation no. 1).

Description of the G422 controller

Controller is equipped with an LCD screen and 7 buttons. After correct electric connection, switch on the controller by pressing the button (⏻).
In normal operation of the controller the screen displays:

- Current program number and diagram of the installation,
- Current date and time,
- Current temperatures in respective measurement locations (a lack of the sensor is indicated by displaying "- - -" message, and damage of the sensor by displaying "Err" message)
- During pump operation (symbol of the pump is flashing) alternating message are displayed: temporary power of solar collectors, flow of the heat fluid, power absorption by the pump of the solar collectors

Pressing the button (MENU) swill cause entry into the general controller menu.

- Using directional buttons (△) and (▽) select the desired option and confirm by pressing the button (OK).

Description of control parameters for first version of the program

Parameter	Description	Range
Solar collector type	Selection of a type of the solar collector	flat / tube
Difference between temperatures T1,T2 – pump ON	Difference between temperatures (T1-T2) to switch on the solar collectors pump P.	4 – 15 °C
Maximum temperature T2 to switch off the collectors pump	Maximum permissible temperature of the heater above which the solar collectors pump will be switched off.	10 – 85 °C
Speed regulation of collectors pump	Optional variable speed control of the solar collector pump.	YES / NO
Protection against overheat of the collectors	Optional protection against overheat of the solar collectors.	YES / NO
Maximum temperature T2 to switch off the protection against the overheat	Maximum permissible temperature of the heater above which the solar collectors pump will be switched off for preheating option.	60 – 85 °C
Protection against freezing of the collectors	Optional protection against freezing of the solar collectors.	YES / NO

Alarms indicated by the controller

Temperature sensor error
The controller checks whether temperature sensors have been connected. If a temperature sensor gets damaged, a cable gets broken, a sensor gets disconnected, the controller will raise sensor alarm. During an alarm all the outputs are disconnected. Moreover, when the controller displays the main screen, the alarm might be signaled by sound. In the alarm mode it is possible to browse the menu, configure parameters or manually control external devices. Information on which sensor raises alarm is available on the main screen. Next to the sensor marking, "Err" will be displayed instead of temperature. If the controller raises sensor alarm it should be checked whether the system has been assembled correctly, the sensor have been correctly connected and whether the temperature system is not damaged.
Lack of required flow
The controller checks heat carrier flow (option of cooperation with an electronic FS-300A flow meter switched on - the flow / rotameter option)
Measurement: Electr. FS-300A. Lack of flow is controlled in two steps.

- **1st step** – (when there is no flow for 20 seconds) the controller generates a sound and displays the following message: **LACK OF REQUIRED FLOW. CHECK AND ADJUST.** Once you accept the message with the (OK) key, the message will disappear and the sound will no longer be emitted.
- **2nd step** – (when there is no flow for 5 minutes) the controller switches solar collector pump off and displays the following message: **NO FLOW, PUMP DAMAGE, AIR-LOCKED INSTALLATION, BLOCKED FLOW.** Once the user accepts this message with the (OK) key, the solar collector pump will be switched on again. If there still is no flow, the alarm will go on in cycles.

Lack of required pressure
The controller is equipped with a pressure control of the heat carrier. The pressure drop is indicated by a sound and the following message: LACK OF REQUIRED PRESSURE. By removing the cause of the pressure lack and pressing the key (OK) the alarm will be switched off.
ATTENTION!!! All options are described in details in the separate manual of the controller.