

Pumped irrigation controller

CLONK

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1 Setup

1.1 Compatibility

This controller will work with a wide range of pumps, valves and flow meters. The compatibility requirements are outlined below.

Valves

- 24V AC non-latching valves

Flow meter

- Flow meter must output a pulse for a set volume. Volume per pulse can be changed in CONFIGURE mode. See Section 1.3.

Pump

- Pump should be connected to controller through 24V no-volt-release machine actuator.

1.2 Installation

The control unit is compatible with standard DIN rails and should be mounted accordingly. A 24V AC power supply (not

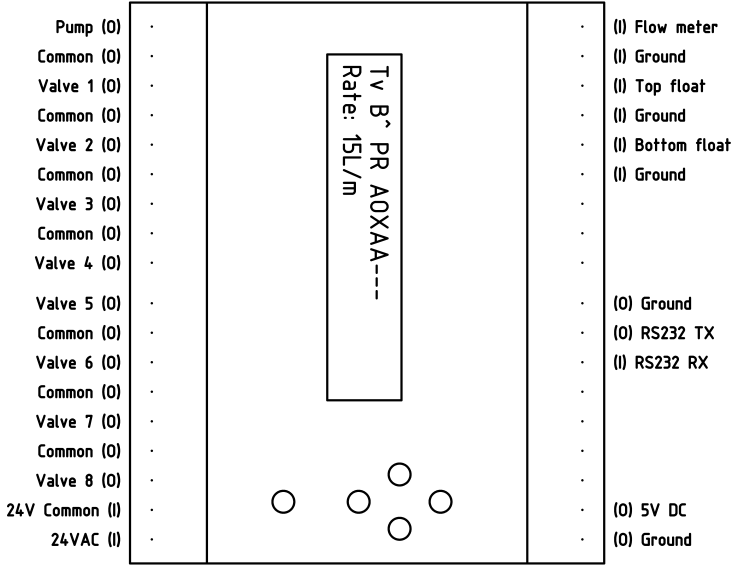


Figure 1.1: Terminal block diagram where (O) denotes an OUTPUT and (I) denotes an INPUT.

supplied) will also be required.

The terminal block arrangement is shown in Figure 1.1.

1.3 Configuration

After a reset or power cycle the control unit gives the operator 3 seconds to enter CONFIGURE mode. Press any button to do so; if no button is pressed the control unit will enter RUN mode. Once in RUN mode, a reset or power cycle is necessary to return to CONFIGURE.

The control unit will retain all parameters, even after a power cycle. If you wish to return to factory conditions, you must enter CONFIGURE mode, select FACTORY RESET and then cycle the power.

CONFIGURE mode allows the operator to change a number of settings on the control unit. The settings include:

- PROGRAM TYPE - Choose between delivering a volume or time-based allocation to each valve. Default: TIME.
- NUMBER OF VALVES - Choose the number of valves connected. Default: 8.
- VALVE ALLOCATION - Choose the allocation for each valve. Default: 1 minute or 10 L depending on PROGRAM TYPE.
- PULSE VOLUME - Specify the volume per pulse from your system's flow meter. Default: 1L.
- NO-FLOW RATE - Specify the minimum pumped volume per minute required to protect your system's pump as described in Section 2.2.2. If set to 0L per minute this protection mechanism is deactivated. Default: 0L.

- **MASTER VALVE** - Specify whether Valve 1 should operate as a master valve. Default: OFF.
- **FIRMWARE** - Displays the current firmware version.
- **FACTORY RESET** - Returns all the above parameters to their default values. Can also be achieved by holding down the **SELECT** key for five seconds when the controller gives the option to enter **CONFIGURE** mode. Operator must cycle the power after selecting this option.
- **EXIT** - Save all changes and return to **RUN** mode.

1.3.1 Factory reset

In the event that the controller needs the user-set parameters to be reset to their factory specifications this can be done by entering **CONFIGURE** mode and finding the correct entry in the settings list or by holding down the **SELECT** key for five seconds when the controller gives the option to enter **CONFIGURE** mode. Operator must cycle the power after opting for a factory reset.

2 Operation

This controller is intended to operate with a system consisting of a tank, two float switches, a pump, a set of valves and a flow meter. Each valve can be given an individual allocation measured in either litres or seconds. A number of pump protection measures exist to avoid running the pump dry.

A master valve can be turned on by changing the settings as described in Section 1. If master valve has been turned on, every time the pump is activated, Valve 1 will also activate.

2.1 Normal operation

The steps of operation are as below:

1. The controller does not start pumping until both float switches register HIGH indicating that the tank is full.
2. Once pumping has started each valve sequentially delivers its allocation.
3. When both float switches register LOW the tank is empty and the pump switches off.
4. After the tank has refilled and both float switches register HIGH again, pumping restarts on the same valve and the remainder of that valve's allocation is delivered.

2.2 Pump protection

Pump protection is mainly about ensuring that adequate flow is being made in order for the pump to run under its intended operational parameters.

2.2.1 Tank level

The controller will not run if the bottom float switch registers empty. This float switch should have been placed so that the pump intake is fully submerged as described in Section 1. This will ensure that there is sufficient water in the tank for the pump to run.

2.2.2 Flow rate

Integrating a flow meter allows the controller to measure flow rate through the pump and de-allocate a particular valve if the minimum flow rate is not being met while delivering to that valve. If there is a blockage on one valve, reducing the flow to below the minimum flow rate, only this valve will be de-allocated. However, if there is a systemic issue, such as a blockage at the inlet, each valve will be sequentially de-allocated as they each fail to reach the minimum flow rate. After all valves have been de-allocated the controller will turn off the pump, stop all operations and display an error message. See Section 4 for more information on error states.

The minimum allowable flow rate can be set by the user in the configuration menu as described in Section 1.

3 Output formats

3.1 Screen outputs

The screen is designed to display the current state of the system at a glance. The screen can be divided

3.1.1 Pump and float switch states

The top-left of the screen displays information about the float switches and pump state. It is formatted as follows:

T∨B∧PR

The T denotes the top float switch and the next symbol, either \wedge or \vee , represents whether the switch is HIGH or LOW respectively). B gives the same information about the bottom float switch.

The final symbol, P, gives information about the pump state and is either running, R, or stopped, S.

3.1.2 Valve states

The top-right of the screen displays information about the valve states. It is formatted as follows:

AOXAA- -

Each valve is given represented by a symbol in this section of the screen. The symbol's position corresponds to the valve terminal position on the controller ie the left-most symbol corresponds to the left most valve terminal on the controller.

O denotes OPEN. An O symbol means that this particular valve is currently in an OPEN state and is allowing flow.

M denotes MASTER. An M symbol means that this particular valve is the master valve but not currently OPEN. Valve 1 is the designated master valve if a master valve has been configured.

A denotes ALLOCATION. An A symbol means that this particular valve has a non-zero allocation but is currently in the closed position.

X denotes BLOCKED. An X symbol means that the flow rate on this particular valve has not reached the minimum flow rate specified during setup and the controller has deallocated it in order to protect the pump. Check for a blockage or faulty valve on this valve's circuit. See Section 4.3: Error 3.

- denotes UN-ALLOCATED. This valve was not given an allocation during setup. See Chapter 1 for instructions on how to specify each valve's allocation.

3.1.3 System statistics

The bottom line of the screen displays some statistics about the whole system. It alternates between displaying a short term FLOW RATE and the TOTAL VOLUME PUMPED since the controller was last reset. Units are in litres per minute and litres respectively.

3.1.4 Error states

If the controller enters an error state, the controller will stop the pump, close all valves and will display an error number on the screen alongside a brief description of the problem. More information on each error message can be found in Section 4.

3.2 Serial outputs

All controller operations are accompanied by an output over the serial bus. 9600 baud is used for all serial communications. The serial codes follow the general pattern:

`%08lu%c%c%c, millis(), 'A', 'B', 'C'`

All fields are fixed length and undelimited.

This table gives a short description for each serial output.

Code	Description	Parameters
IAA	Info start	
IFR	Info factory reset	
IES	Info end setup	
IGV	Info globals valid	
IVP	Info volume pumped (total)	uint32_t total_volume_pumped
INV	Info new valve	int16_t valve_ID
IOV	Info open valve	int16_t valve_ID
IOM	Info open master valve	int16_t valve_ID
ICV	Info close valve	int16_t valve_ID
ICM	Info close master valve	int16_t valve_ID
IDV	Info deallocate valve	int16_t valve_ID
IPR	Info pump running	
IPP	Info pump stop	
IFT	Info top float switch	int16_t switch_state
IFB	Info bottom float switch	int16_t switch_state
WCF	Warning closed flow	
IS0	Info status 0	int16_t num_valves
IS1	Info status 1	char use_volume_alloc
IS2	Info status 2	uint32_t volume_per_pulse
IS3	Info status 3	uint32_t pump_no_flow_rate
IS4	Info status 4	uint32_t milliseconds_per_pulse
IS5	Info status 5	char use_master_valve
IS6	Info status 6	int16_t valve_ID,
		uint32_t valves[i].vol_allocation
IS7	Info status 7	int16_t valve_ID,
		uint32_t valves[i].time_allocation
IS8	Info status 8	int16_t valve_ID, char is_master
IS9	Info status 9	int16_t valve_ID,
		char valves[i].is_open
		(O: open, S: shut)
E01	Error 01	
E02	Error 02	
E03	Error 03	
E04	Error 04	

4 Trouble-shooting

4.1 Error 1

One or more of the configuration variables is not in the valid range. This could be due to the controller's memory being corrupt or the user entering invalid configuration variables.

Suggestions

1. Restart the controller, enter `CONFIGURE` mode, make sure all variables are reasonable and then try `RUN` mode again.
2. Factory reset the controller. To do this restart the controller, enter `CONFIGURE` mode, scroll to `FACTORY RESET`, select `ENTER` and then power cycle the controller.

4.2 Error 2

The top float switch has registered `FULL` while the bottom float switch was registering `EMPTY`.

Suggestions

1. Float switches have been connected incorrectly. The top switch has been wired into the controller as the bottom float switch. Interchange the float switch terminals at the controller.

2. Faulty switches or connections. Check all connections and switches. Replace as necessary.

4.3 Error 3

All valves have zero allocation.

Suggestions

1. Stations were all given an allocation of 0L or 0s during CONFIGURE. Restart the controller, enter CONFIGURE mode and adjust the allocations as desired.
2. Stations are deallocated if minimum flow requirements are not being met in order to protect your pump. If there is a system-wide issue, all stations will be sequentially deallocated as each station fails to meet flow requirements. This may indicate an issue with either the pump, the flow meter or a blockage somewhere before the valves. Restart the controller and inspect your setup looking for pump failures or a blockage. If no issues can be found, check the flow meter and its connections with the controller.

4.4 Error 4

Low flow has been detected on every allocated valve. This error is thrown when time-allocation is used in combination with a low threshold for minimum flow rate.

Suggestions

1. The system will throw this error if minimum flow requirements are not being met in order to protect your pump. This may indicate an issue with either the pump, the flow meter or a blockage somewhere before the valves. Restart the controller and inspect your setup looking for pump failures or a blockage. If no issues can be found, check the flow meter and its connections with the controller.
2. The no-flow safety threshold may be too high. Enter CONFIGURE mode and set NO-FLOW RATE to a lower value.
3. If a no-flow safety threshold is not required in your application, enter CONFIGURE mode and set NO-FLOW RATE to 0 L/m.