

Pumped irrigation controller

CLONK

2022

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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

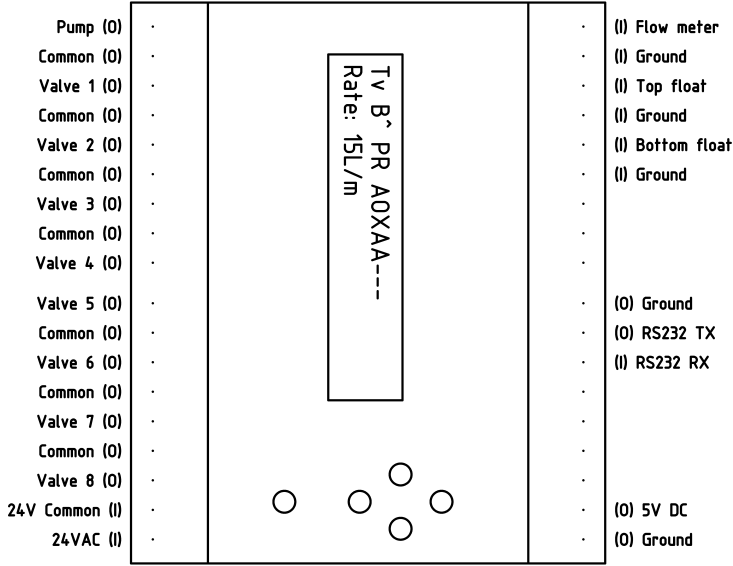


Figure 1.1: Terminal block diagram where (O) denotes an OUTPUT and (I) denotes an INPUT.

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 Outputs

3.1 Screen

In RUN mode the screen displays the time and some system statistics. Use the UP and DOWN arrows to scroll through the available outputs.

3.1.1 Faults

The heirachy of faults is as follows from least to most serious:

Alarms

When an alarm occurs the current alarm code will be displayed in the top left of the screen but normal operation will continue. The alarm lamp and the alarm terminal will also be turned on. See Chapter 4 for details on different alarm codes.

Warnings

When a warning occurs the controller will display the warning code on the screen and turn off all pumps and stations. The alarm lamp and the alarm terminal will also be turned on. If the warning resolves, normal operation will resume. The configuration menus can still be accessed from a warning state. See Chapter 4 for details on different warning codes.

Errors

When an error occurs the controller will display the error code on the screen and turn off all pumps and stations. The alarm lamp and the alarm terminal will also be turned on. The controller cannot recover from an error without human intervention. See Chapter 4 for details on different error codes.

3.2 Serial

All controller operations are accompanied by an output over the serial bus. 19200 baud is used for all serial communications. The serial codes follow the general pattern:

HH-MM-SS.mmm->ABC

where 'HH-MM-SS.mmm' is the controller's current time and 'ABC' is the serial code. All fields are fixed length and unlimited.

Table 3.1 gives a short description for each serial output.

Table 3.1: Serial messages

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
IOV	Info open valve	int16_t valve_ID
IOM	Info open master valve	int16_t valve_ID

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Table 3.1: Serial messages (Continued)

Code	Description	Parameters
ICV	Info close valve	int16_t valve_ID
ICM	Info close master valve	int16_t valve_ID
IPR	Info pump start	
IPP	Info pump stop	
IFT	Info top float switch	int16_t switch_state
IFB	Info bottom float switch	int16_t switch_state
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)
Axx	Alarm xx	
Wxx	Warning xx	
Exx	Error xx	

3.3 Modbus

Most controller statistics can be read over modbus and most configuration parameters can be written. Modbus parameters are described in Table 3.2 and the registers are as describe in Table 3.3. The final column of Table 3.3 indicates if the register

is read-only or can also be written to.

Table 3.2: Modbus parameters

Detail	Value
Address	1
Baud rate	19200
Endianness	Big endian

Table 3.3: Modbus registers

Register	Description	RW
0	REGISTER HASH	R
1	RESET COUNT	R
2	CURRENT WARNINGS	R
3	CURRENT ERROR	R
4	OVERFLOW COUNT	R
5	NO FLOW COUNT	R
6	TANK VOLUME HIGH WORD	R
7	TANK VOLUME LOW WORD	R
8	DAM VOLUME HIGH WORD	R
9	DAM VOLUME LOW WORD	R
10	TANK FLOW RATE HIGH WORD	R
11	TANK FLOW RATE LOW WORD	R
12	DAM FLOW RATE HIGH WORD	R
13	DAM FLOW RATE LOW WORD	R
14	STATIONS HIGH FLOW	R
15	STATIONS LOW FLOW	R
16	STATIONS ALLOCATED	R
17	TANK STATE	R
18	DAM STATE	R
19	IS WINTER	R

Continued on next page

Table 3.3: Modbus registers (Continued)

Register	Description	RW
20	RTC FLAGS	R
21	RTC TEMP	R
22	STATION VOLUME TOTAL HIGH WORD 1	R
23	STATION VOLUME TOTAL LOW WORD 1	R
24	STATION VOLUME TOTAL HIGH WORD 2	R
25	STATION VOLUME TOTAL LOW WORD 2	R
26	STATION VOLUME TOTAL HIGH WORD 3	R
27	STATION VOLUME TOTAL LOW WORD 3	R
28	STATION VOLUME TOTAL HIGH WORD 4	R
29	STATION VOLUME TOTAL LOW WORD 4	R
30	STATION VOLUME TOTAL HIGH WORD 5	R
31	STATION VOLUME TOTAL LOW WORD 5	R
32	STATION VOLUME TOTAL HIGH WORD 6	R
33	STATION VOLUME TOTAL LOW WORD 6	R
34	STATION VOLUME TOTAL HIGH WORD 7	R
35	STATION VOLUME TOTAL LOW WORD 7	R
36	STATION VOLUME TOTAL HIGH WORD 8	R
37	STATION VOLUME TOTAL LOW WORD 8	R
38	STATION VOLUME TOTAL HIGH WORD 9	R
39	STATION VOLUME TOTAL LOW WORD 9	R
40	STATION VOLUME TOTAL HIGH WORD 10	R
41	STATION VOLUME TOTAL LOW WORD 10	R
42	STATION VOLUME TOTAL HIGH WORD 11	R
43	STATION VOLUME TOTAL LOW WORD 11	R
44	STATION VOLUME TOTAL HIGH WORD 12	R
45	STATION VOLUME TOTAL LOW WORD 12	R
46	STATION VOLUME TOTAL HIGH WORD 13	R
47	STATION VOLUME TOTAL LOW WORD 13	R
48	STATION TIME TOTAL HIGH WORD 1	R
49	STATION TIME TOTAL LOW WORD 1	R
50	STATION TIME TOTAL HIGH WORD 2	R
51	STATION TIME TOTAL LOW WORD 2	R
52	STATION TIME TOTAL HIGH WORD 3	R
53	STATION TIME TOTAL LOW WORD 3	R

Continued on next page

Table 3.3: Modbus registers (Continued)

Register	Description	RW
54	STATION TIME TOTAL HIGH WORD 4	R
55	STATION TIME TOTAL LOW WORD 4	R
56	STATION TIME TOTAL HIGH WORD 5	R
57	STATION TIME TOTAL LOW WORD 5	R
58	STATION TIME TOTAL HIGH WORD 6	R
59	STATION TIME TOTAL LOW WORD 6	R
60	STATION TIME TOTAL HIGH WORD 7	R
61	STATION TIME TOTAL LOW WORD 7	R
62	STATION TIME TOTAL HIGH WORD 8	R
63	STATION TIME TOTAL LOW WORD 8	R
64	STATION TIME TOTAL HIGH WORD 9	R
65	STATION TIME TOTAL LOW WORD 9	R
66	STATION TIME TOTAL HIGH WORD 10	R
67	STATION TIME TOTAL LOW WORD 10	R
68	STATION TIME TOTAL HIGH WORD 11	R
69	STATION TIME TOTAL LOW WORD 11	R
70	STATION TIME TOTAL HIGH WORD 12	R
71	STATION TIME TOTAL LOW WORD 12	R
72	STATION TIME TOTAL HIGH WORD 13	R
73	STATION TIME TOTAL LOW WORD 13	R
74	STATION ACTIVATION COUNT 1	R
75	STATION ACTIVATION COUNT 2	R
76	STATION ACTIVATION COUNT 3	R
77	STATION ACTIVATION COUNT 4	R
78	STATION ACTIVATION COUNT 5	R
79	STATION ACTIVATION COUNT 6	R
80	STATION ACTIVATION COUNT 7	R
81	STATION ACTIVATION COUNT 8	R
82	STATION ACTIVATION COUNT 9	R
83	STATION ACTIVATION COUNT 10	R
84	STATION ACTIVATION COUNT 11	R
85	STATION ACTIVATION COUNT 12	R
86	STATION ACTIVATION COUNT 13	R
87	SET NORMAL FLOW	RW

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Table 3.3: Modbus registers (Continued)

Register	Description	RW
88	MANUAL STATE REQUEST	RW
89	ALL VALVE VOLUME ALLOCATION	RW
90	ALL VALVE TIME ALLOCATION	RW
91	CONTROLLER RESET	RW
92	MASTER VALVE	RW
93	INVERT INPUT LOGIC	RW
94	MODBUS ADDRESS	RW
95	MODBUS BAUD	RW
96	WINTER START HIGH WORD	RW
97	WINTER START LOW WORD	RW
98	WINTER STOP HIGH WORD	RW
99	WINTER STOP LOW WORD	RW
100	DAM START TIME	RW
101	DAM STOP TIME	RW
102	TANK LITRES PER PULSE	RW
103	DAM LITRES PER PULSE	RW
104	TANK PRIME TIME	RW
105	DAM PRIME TIME	RW
106	TANK NO FLOW RATE	RW
107	DAM NO FLOW RATE	RW
108	TANK NORMAL FLOW RATE	RW
109	DAM NORMAL FLOW RATE	RW
110	DAM VOLUME ALLOCATION HIGH WORD	RW
111	DAM VOLUME ALLOCATION LOW WORD	RW
112	DAM USE VOLUME ALLOCATION	RW
113	CONTROLLER FLAGS	RW
114	CONTROLLER MODE	RW
115	VALVES VOLUME ALLOCATION 1	RW
116	VALVES VOLUME ALLOCATION 2	RW
117	VALVES VOLUME ALLOCATION 3	RW
118	VALVES VOLUME ALLOCATION 4	RW
119	VALVES VOLUME ALLOCATION 5	RW
120	VALVES VOLUME ALLOCATION 6	RW
121	VALVES VOLUME ALLOCATION 7	RW

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Table 3.3: Modbus registers (Continued)

Register	Description	RW
122	VALVES VOLUME ALLOCATION 8	RW
123	VALVES VOLUME ALLOCATION 9	RW
124	VALVES VOLUME ALLOCATION 10	RW
125	VALVES VOLUME ALLOCATION 11	RW
126	VALVES VOLUME ALLOCATION 12	RW
127	VALVES VOLUME ALLOCATION 13	RW
128	VALVES TIME ALLOCATION 1	RW
129	VALVES TIME ALLOCATION 2	RW
130	VALVES TIME ALLOCATION 3	RW
131	VALVES TIME ALLOCATION 4	RW
132	VALVES TIME ALLOCATION 5	RW
133	VALVES TIME ALLOCATION 6	RW
134	VALVES TIME ALLOCATION 7	RW
135	VALVES TIME ALLOCATION 8	RW
136	VALVES TIME ALLOCATION 9	RW
137	VALVES TIME ALLOCATION 10	RW
138	VALVES TIME ALLOCATION 11	RW
139	VALVES TIME ALLOCATION 12	RW
140	VALVES TIME ALLOCATION 13	RW
141	NUMBER OF VALVES	RW
142	RESERVED 1	
143	RESERVED 2	
144	EPOCH TIME HIGH WORD	RW
145	EPOCH TIME LOW WORD	RW

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.