

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 digital pulse for a set volume. Volume per pulse can be changed as detailed in Section 1.3.
- Digital pulses should have a frequency of less than 20Hz.

1.2 Installation

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

The terminal block arrangement is shown in Figure 1.1.

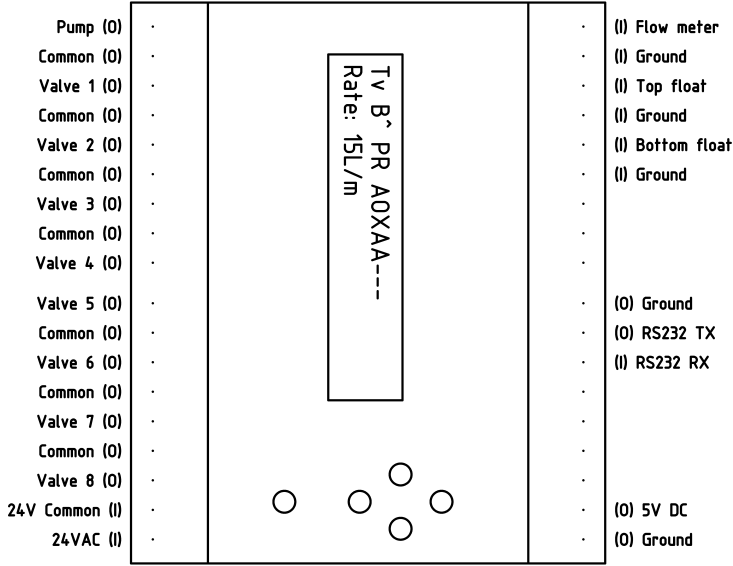


Figure 1.1: Terminal block diagram where (O) denotes an OUTPUT and (I) denotes an INPUT.

1.3 Configuration

CONFIGURATION mode allows the user to set a wide range of operational parameters.

- **Set time**
The controller's time.
- **Allocation type**
Each pump can be run with either VOLUME allocations or TIME allocations.
- **Number of valves**
This is the number of valves connected to the TANK. Not all valves have to be allocated.
- **Valve allocation**
This is the VOLUME or TIME each valve will be individually allocated. The allocation units can be changed in Allocation type.
- **Configure dam pump**
This is the start time (24hr clock) of the dam pump and either the volume to deliver (if using VOLUME allocations) or the stop time (if using TIME allocations).
- **Schedule winter**
This schedules WINTER mode. WINTER mode deactivates the dam pump between the dates selected.
- **Pulse volume**
This sets the volume per pulse for each flow meter.
- **No-flow rate**
This sets to minimum flow rate required to avoid the

pump running dry. Each pump's rate can be set individually. Set to 0kL/hr to de-activate this protection.

- **Safe flow rate**
This sets an expected flow rate for the system. Flow rates measured at 25% above or below this value will trigger high and low flow alarms respectively (see Sections 4.1.2 & 4.1.3). Each pump's rate can be set individually. Set to 0kL/hr to de-activate this protection.
- **Master valve**
This allows the use of a master valve. If activated, Valve 1 will be set as the master valve.
- **Firmware**
Displays the firmware version.
- **Alarm reset**
Resets all alarms.
- **Factory reset**
Returns the controller to factory conditions.
- **Save & exit**
Saves all updated variables and returns to PAUSE mode.

2 Operation

2.1 Run mode

2.1.1 Dam pump

The dam pump moves water from the DAM reservoir into the TANK. This will begin pumping every day at its configured start time. It will stop pumping when it reaches its daily VOLUME allocation or its configured stop time. The allocation mode, amounts and times can all be changed in the CONFIGURATION menu as detailed in Section 1.3.

WINTER mode sets the dam pump's daily allocations to zero for the duration of WINTER. These dates are configurable in the CONFIGURATION menu.

The DAM PUMP will not run if the TANK's float switches are currently registering full.

2.1.2 Tank pump

The TANK receives water from the DAM. When the float switches in the TANK register full the TANK PUMP activates and starts delivering each valve its allocation sequentially. This will continue until the TANK's float switches register empty. When

Figure 2.1: System diagram

this happens the TANK PUMP will deliver the remainder of that valve's allocation next time the TANK registers full.

The TANK PUMP can deliver either VOLUME or TIME allocations to each station. Each station's allocation is individually configurable in the CONFIGURATION menu.

2.2 Manual mode

MANUAL mode allows the user to turn on all stations including pumps. MANUAL mode is limited to five (5) stations turned on at any one time in order to protect the controller. No other protections exist inside manual mode.

3 Outputs

3.1 Screen

In RUN mode the screen displays the time, system statistics and relevant alarm codes. 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 4.1 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 4.2 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 4.3 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

Continued on next page

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

Continued on next page

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

Continued on next page

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 Alarms

Alarms only occur in RUN mode and the code is displayed in the top left of the screen. All alarms will activate the alarm lamp and alarm terminal on the controller.

4.1.1 Alarm 1 - Overflow

An overflow alarm indicates that the TANK is currently overflowing. This will turn off the DAM pump (if running) and turn on the TANK pump.

4.1.2 Alarm 2 - Slow flow

A slow flow alarm indicates that one or more of the stations is flowing slower than the SAFE FLOW RATE. This may indicate a blockage on that station. The slow flow station will be indicated by a slow flash on that station's allocation lamp. No actions are taken by the controller.

4.1.3 Alarm 3 - Fast flow

A fast flow alarm indicates that one or more of the stations is flowing faster than the SAFE FLOW RATE. This may indicate a leak on that station. The fast flow station will be indicated by a fast flash on that station's allocation lamp. This station will be

de-activated and will not be turned on again until alarms have been cleared from the CONFIGURATION menu.

4.1.4 Alarm 4 - High pulse

A high pulse alarm indicates that the pulse rate of one or more of the flow meters is approaching the controller's hardware limitations. Flow rates and flow counts at or above this rate may be inaccurate.

4.2 Warnings

Warnings turn off all pumps and stations to avoid unpredictable behaviour. The warning message will be displayed on the screen. Menus can still be accessed by holding LEFT.

4.2.1 Warning 1 - Float switches

A float switch has been activated before one of the lower switches has been.

Suggestions

1. Float switches have been connected incorrectly. Check all float switch terminals at the controller and verify that the corresponding controller lamp responds to each float switch.
2. Faulty switches or connections. Check all connections and switches. Replace as necessary.

4.2.2 Warning 2 - Clock failure

The controller's internal clock has failed. Please contact supplier.

Suggestions

1. Factory reset the controller. To do this, hold down the LEFT key, press RESET and continue to hold LEFT for 5 seconds.
2. Contact the supplier.

4.2.3 Warning 3 - I2C2 failure

The controller's internal communications have failed. Please contact supplier.

Suggestions

1. Factory reset the controller. To do this, hold down the LEFT key, press RESET and continue to hold LEFT for 5 seconds.
2. Contact the supplier.

4.2.4 Warning 3 - I2C3 failure

The controller's internal communications have failed. Please contact supplier.

Suggestions

1. Factory reset the controller. To do this, hold down the LEFT key, press RESET and continue to hold LEFT for 5 seconds.
2. Contact the supplier.

4.2.5 Warning 5 - No allocations

All stations have an allocation of zero units. This could be a configuration problem or could indicate a leak. Stations are de-queued if fast flow is detected on that station. The SAFE FLOW RATE is used to decide if a station's flow rate is safe and is settable in the CONFIGURATION menu. If there is a system-wide issue, all stations will be sequentially de-queued as each station fails to flow safely.

Suggestions

1. Stations were all given an allocation of zero units by the user. Enter CONFIGURE mode by holding down the LEFT button. Adjust the allocations as required.
2. The FLOW FLOW RATE is too low for this system. Enter CONFIGURE mode by holding down the LEFT button. Increase the SAFE FLOW RATE until it matches your system's normal flow rate.
3. The system is flowing faster than the SAFE FLOW RATE on every valve. This indicates a leak between the pump and the valves.
4. To deactivate SAFE FLOW RATE protection, enter CONFIGURE mode and set SAFE FLOW RATE to 0 L/m.

4.2.6 Warning 6 - No flow

The flow rate on at least one of the pumps is less than the NO-FLOW RATE. The NO-FLOW RATE is settable in the CONFIGURATION menu and should be the minimum flow rate at which the pump can safely run. This warning can be cleared in the menu under CLEAR ALL ALARMS.

Suggestions

1. The NO-FLOW RATE may be too high. Consult the pump's specifications, enter CONFIGURE mode and set NO-FLOW RATE to the correct value.
2. The VOLUME PER PULSE for your flow meter may be too low. Consult the flow meter's specifications, enter CONFIGURE mode and set VOLUME PER PULSE to the correct value.
3. The controller is not receiving pulses from the flow meter. Check all controller input terminals.
4. The measured flow rate is below the NO-FLOW RATE. Check for blockages, pump failures and flow meter failures.
5. To deactivate NO-FLOW RATE protection, enter CONFIGURE mode and set NO-FLOW RATE to 0 L/m.

Q

4.2.7 Warning 7 - Invalid configuration

One or more of the configuration variables is not in the valid range. This could be due to the user entering invalid configuration variables or a corrupt memory error.

Suggestions

1. Enter CONFIGURE mode by holding down the LEFT button. Ensure all variables are reasonable and then enter RUN mode again.
2. Factory reset the controller.

4.3 Errors

Errors are faults which do not allow the controller to operate. These are usually serious hardware faults.

4.3.1 Error 1 - Memory failure

The controller's internal memory has failed. Please contact supplier.

Suggestions

1. Factory reset the controller. To do this, hold down the LEFT key, press RESET and continue to hold LEFT for 5 seconds.
2. Contact the supplier.