

INSTALLATION MANUAL

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1 INTRODUCTION

This manual provides instructions for installation, setup and tuning of the AeroPAK-1 and AeroPAK-2 Dissolved Oxygen Controllers. AeroPAK provides closed-loop Dissolved Oxygen control for up to two aeration basins with 2 blowers each.

For additional information on the operation of the AeroPAK controller, refer to IB-AEROPAK-OP.

The available displays in the controller are listed below:

Operating displays (per basin)

- Dissolved Oxygen control loop
- Dissolved Oxygen real-time trend
- Water Flow indication (flow-paced with DO trim only)
- Parameter Display – DO and influent flow

Maintenance Displays

- Blower status, runtime & cycles (per basin)
- Analog input values (voltage & engineering units)
- Analog output values (current & percent)
- Digital inputs status (open/closed)
- Digital outputs status (open/closed)

Setup displays (per basin)

- Control strategy type
 - Dissolved oxygen only
 - Flow-paced with dissolved oxygen trim
- Dissolved oxygen span - ppm
- Low DO alarm limit
- Influent flow span
- Influent flow engineering units
- Number of blowers

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2 SYSTEM DESCRIPTION

AeroPAK provides closed-loop dissolved oxygen control for basins using diffused aeration and centrifugal blowers with Variable Speed Drives (VFD) or dampers. AeroPAK-1 provides control for a single basin with up to two blowers. AeroPAK-2 supports control for up to two basins with two blowers each, with independent parameters for each basin. Multiple AeroPAK controllers can be networked and connected to an HMI package for graphical operations, data acquisition and alarm/event logging.

The AeroPAK controller allows selection of either basic Dissolved Oxygen control, or flow-paced control with dissolved oxygen trim. When basic DO control is selected, the controller receives the dissolved oxygen signal from the DO analyzer, compares it to the local setpoint and generates an air demand output which is sent to the VFD on the blower motor or the air discharge valves. If there are two blowers the output signal is identical for both. A deadtime compensation function is provided that can be used to compensate for the delay between air injection and change in DO reading. Start/stop contacts and run status contacts are provided for each blower. The air demand signal determines whether one or both blowers are required.

When the flow-paced strategy is selected, the controller receives a flow signal representing the influent flow to the basin. The flow signal is used as a multiplicative feed forward signal to adjust the amount of air to the basin in a linear relationship to the current Dissolved Oxygen controller output signal. As the influent flow into the basin increases, the amount of air into the basin is increased proportionally, eliminating the delay between process measurement and correction normally associated with DO-only control.

In either strategy, the dissolved oxygen loop will switch to manual mode and track a predetermined output value on loss of the DO signal. With the flow-paced strategy, loss of the flow signal will cause the controller to operate with the basic DO control strategy. This ensures continued aeration in the event of field sensor failure.

The basic control strategies are shown on the following page.

The AeroPAK strategy provides a blower control, or Blower Lead/Lag, function that determines the order in which the blowers will start and run. Blowers are assigned a lead or lag designation by the control strategy; the first blower to start when both are off becomes the lead blower. If the lead blower is not capable of supplying sufficient air to meet the DO requirements, the controller starts the lag (second) blower. Blowers are alternated based on actual run time (default is 24 hours of run time), or when both blowers are running. The lead/lag assignments to the blowers are switched when both blowers are running to avoid a break in air service to the basin. The blower which was started as the lead blower will be stopped first as air demand decreases, and will become the lag blower.

To ensure constant aeration, the AeroPAK will automatically start the lag blower on failure of the lead blower (loss of Run contact). Note that AeroPAK requires run contacts to be installed on the blowers for correct operation.

An AeroPAK-1 controller can be field upgraded to AeroPAK-2 with support for two basins. The controller automatically detects the analog option card and allows access to the setup screens for the second basin (see Appendix B).

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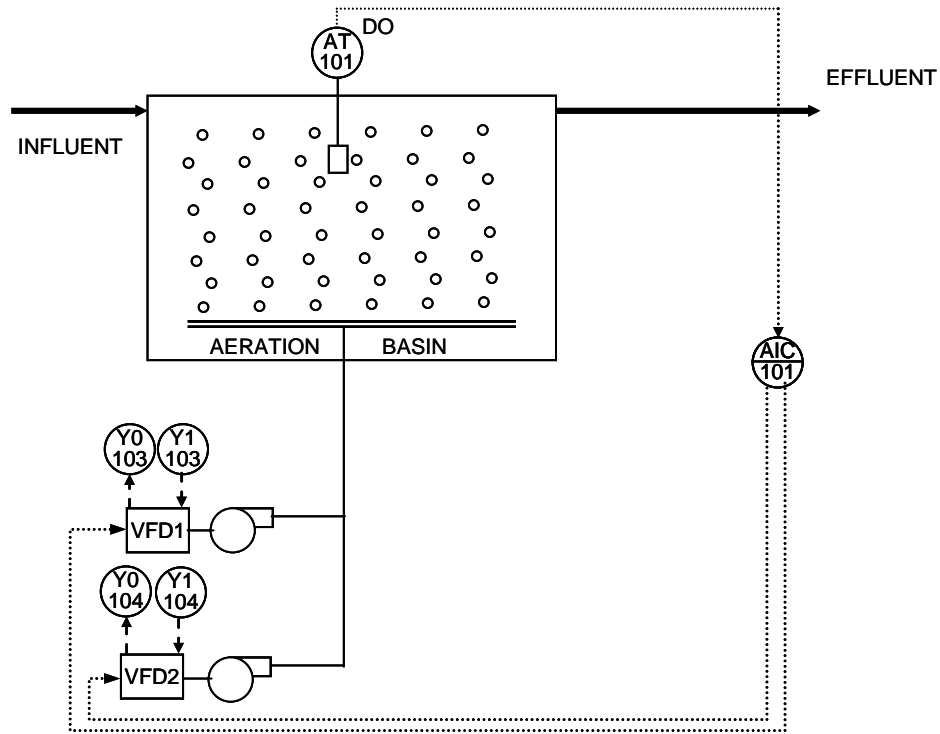


Figure 2-1 Basic DO control (single basin, 2 blowers with VFD)

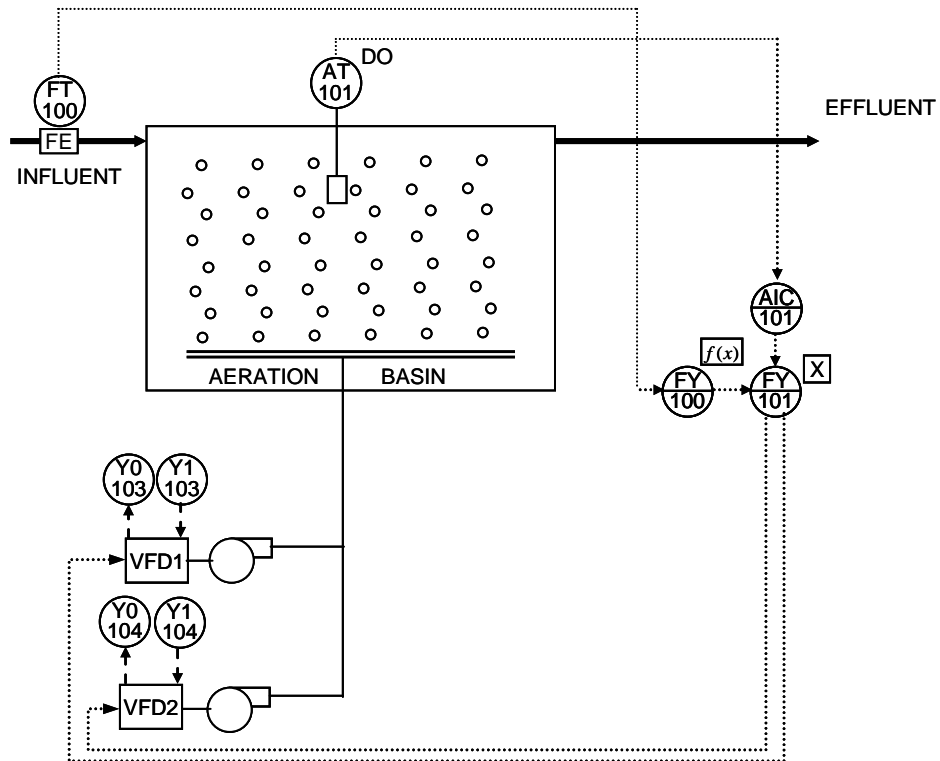


Figure 2-2 Flow-paced control with DO trim (single basin, 2 blowers with VFD)

INSTALLATION MANUAL**4 POWER AND SIGNAL WIRING**

This section contains the input and output list and the wiring diagram for the on-board terminations and remote terminal boards (AeroPAK-2). For mounting details and dimensions refer to Appendix A of this document.

4.1 Controller I/O

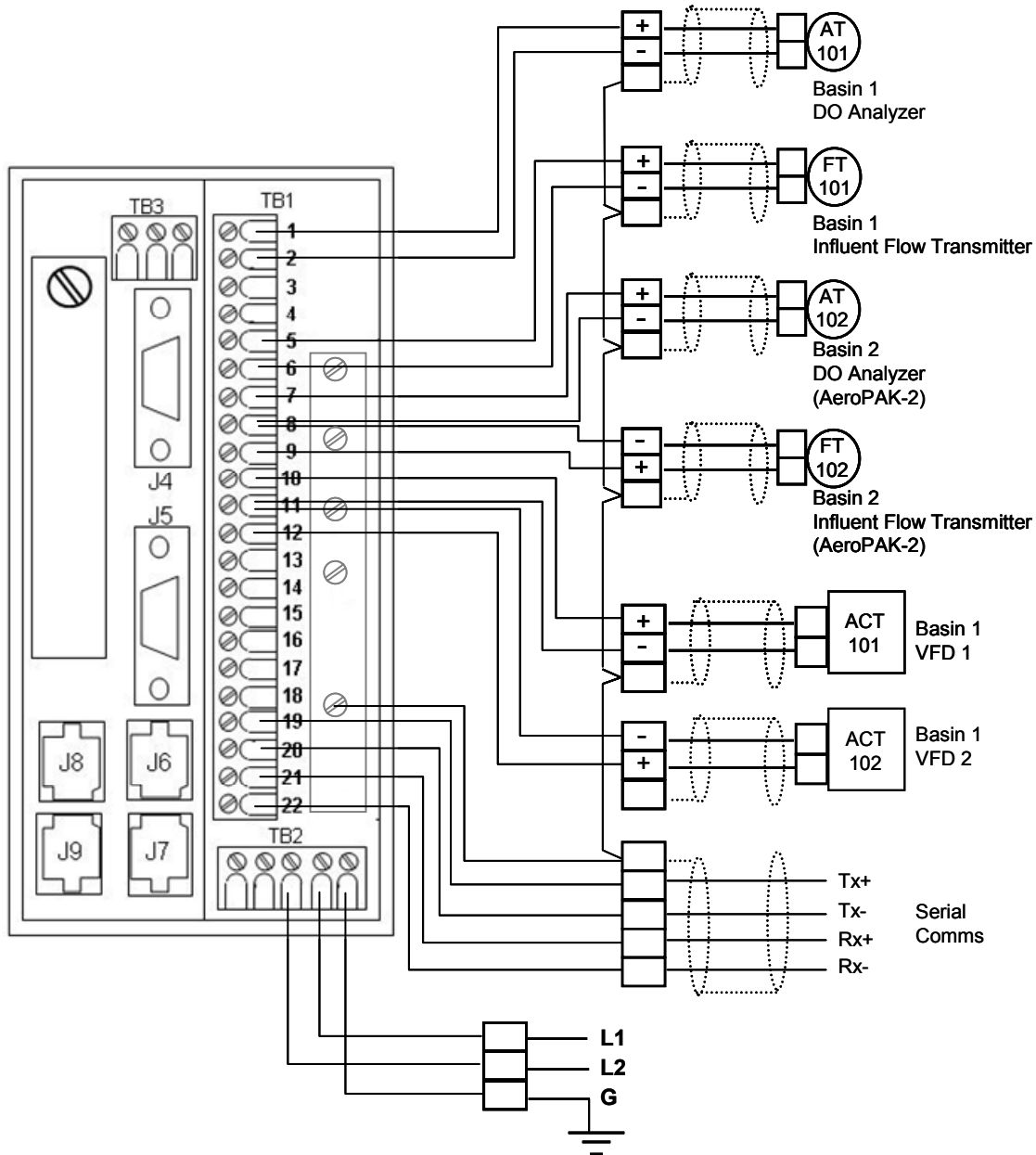
The AeroPAK controllers include the following inputs and outputs. Note that numbering begins with “0” and that digital inputs 0 and 1 (built in) are not used.

Position	Signal Type	Variable	Source/Destination
Analog Input 0	4-20mA	Dissolved Oxygen, Basin 1	DO transmitter
Analog Input 1	4-20mA	Influent Flow, Basin 1	Flow transmitter
Analog Input 2	4-20mA	Dissolved Oxygen, Basin 2	DO transmitter, basin 2 (AeroPAK-2)
Analog Input 3	4-20mA	Influent Flow, Basin 2	Flow transmitter, basin 2 (AeroPAK-2)
Analog Output 0	4-20mA	Oxygen demand	Basin 1 VFD or Air Handler 1
Analog Output 1	4-20mA	Oxygen demand	Basin 1 VFD or Air Handler 2
Analog Output 2	4-20mA	Oxygen demand	Basin 2 VFD or Air Handler 1 (AeroPAK-2)
Analog Output 3	4-20mA	Oxygen demand	Basin 2 VFD or Air Handler 2 (AeroPAK-2)
Built-In Communication Port	DataLink	Serial communication	Communication to PC
Digital input 2	120V ac	Basin 1 Blower 1 Status	Basin 1 VFD or Air Handler 1
Digital input 3	120V ac	Basin 1 Blower 2 Status	Basin 1 VFD or Air Handler 2
Digital input 4	120V ac	Basin 2 Blower 1 Status	Basin 2 VFD or Air Handler 1
Digital input 5	120V ac	Basin 2 Blower 2 Status	Basin 2 VFD or Air Handler 2
Digital output 10	24V dc	Basin 1 Blower 1 Start/Stop	Basin 1 VFD or air handler 1
Digital output 11	24V dc	Basin 1 Blower 2 Start/Stop	Basin 1 VFD or air handler 2
Digital output 12	24V dc	Basin 2 Blower 1 Start/Stop	Basin 2 VFD or air handler 1
Digital output 13	24V dc	Basin 2 Blower 2 Start/Stop	Basin 2 VFD or air handler 2
Digital output 14	24V dc	Basin 1 DO High/Low	Alarm panel
Digital output 15	24V dc	Basin 1 Influent Loss of Signal	Alarm panel
Digital output 16	24V dc	Basin 2DO High/Low	Alarm panel
Digital output 17	24V dc	Basin 2 Influent Loss of Signal	Alarm panel

4.2 Power and Signal Wiring

AeroPAK-1 and AeroPAK-2 use the standard rear terminations and 16 DI/DO option board. AeroPAK-2 adds the Analog Option Board for the outputs to Basin 2 blowers. Refer to Appendix A, Mounting Drawings, for information on connecting the analog and digital option boards to the main controller.

4.2.1 Standard Rear Terminals



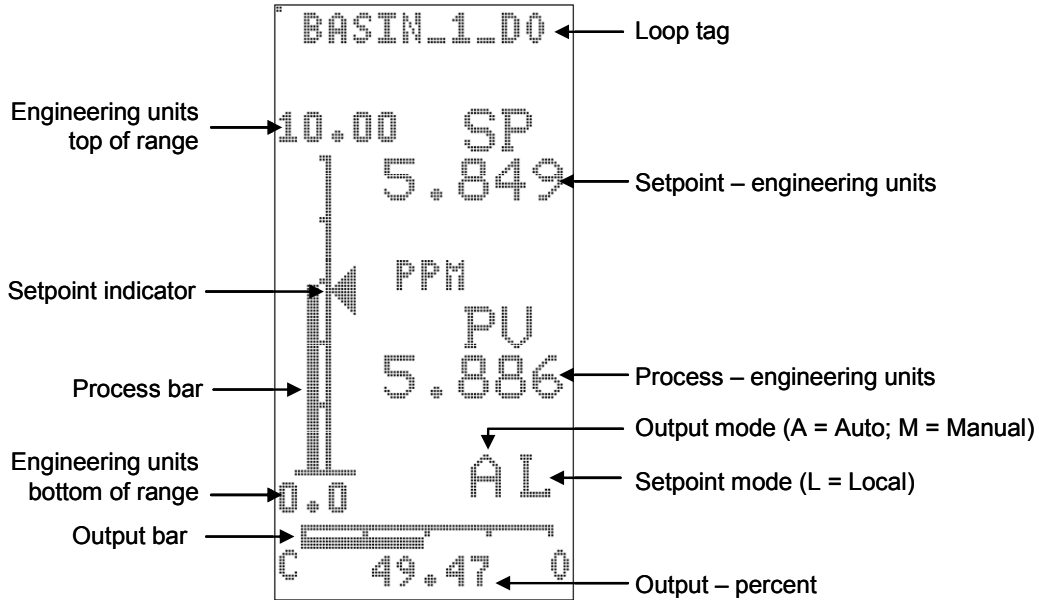
Note: The standard rear terminal board has the appropriate resistors on ANI0 and ANI1. If the input signal is voltage, the resistors should be removed.

The screw terminals on the back of the instrument are designed for 12 - 24 AWG wire. It is important that the wire be stripped to expose 1/2 inch of conductor before installation.

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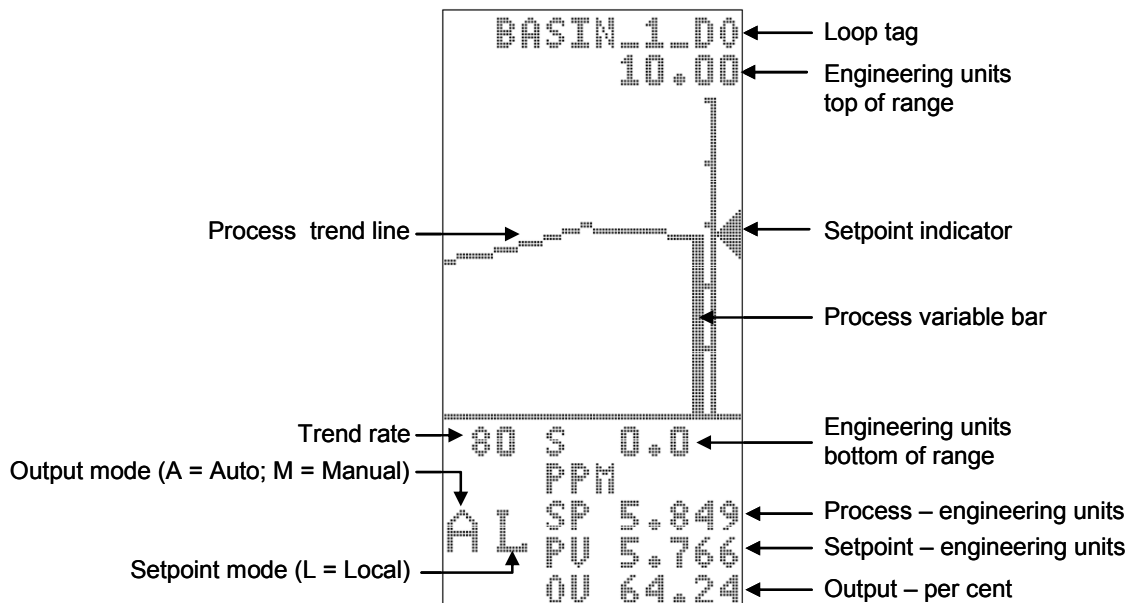
5.2.2 Dissolved Oxygen Control Display

The Dissolved Oxygen loop operating display includes the loop tag, three digital readouts (setpoint, output and process), a vertical process bargraph with control range upper and lower limits, a setpoint indicator, a horizontal output bar, the output mode and the setpoint status. Process measurement Engineering units are also displayed.



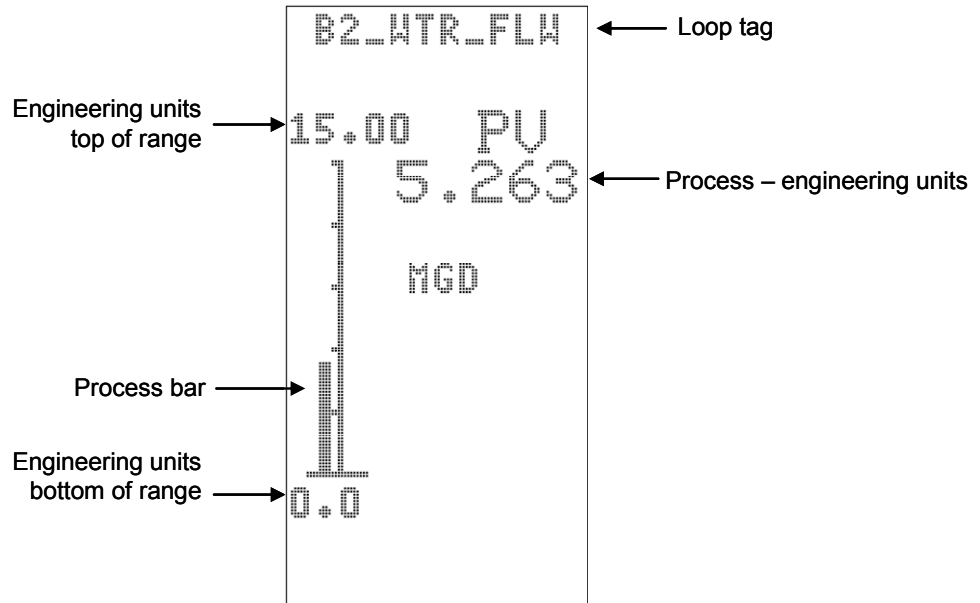
5.2.3 Dissolved Oxygen Trend Display

The Trend line consists of 40 samples in real-time. The Trend Rate is a function of 40 samples multiplied by the configured number of seconds. The default is 2 second sample intervals, for a trend duration of 80. Oldest values exit the screen on the left.



5.2.4 Water Flow Indicator Display

This display is only available if the Flow-paced control strategy with DO trim is selected. The flow value is shown in MGD (million gallons/day) or M3/D (cubic meters/day), according to the selection made during setup.



5.2.5 Input Indicator Display

This display provides large-character readout of Dissolved Oxygen. It also provides digital readout of influent flow if this signal is present. No operation activities are possible from this display.



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6.1 Control Strategy Selection

Press the NEXT (F3) button

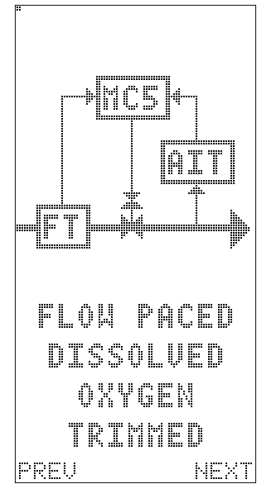
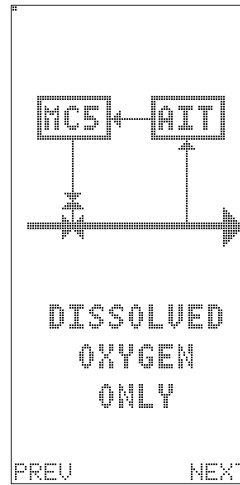


The basic Dissolved Oxygen control strategy appears.



Press the UP or DOWN arrow button

The display toggles between the basic Dissolved Oxygen strategy and the Flow-paced with DO Trim strategy

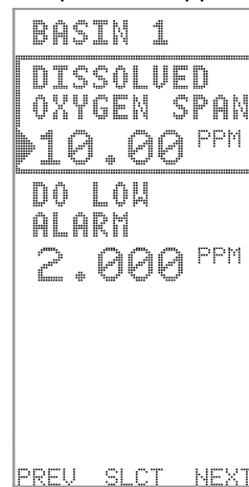


6.2 Dissolved Oxygen Setup

With the desired control strategy on the display, press the F3 (NEXT) button to accept the strategy



The DO input setup screen appears

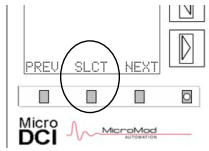


If DISSOLVED OXYGEN SPAN is not outlined by the cursor box, press the UP or DOWN button to move the cursor

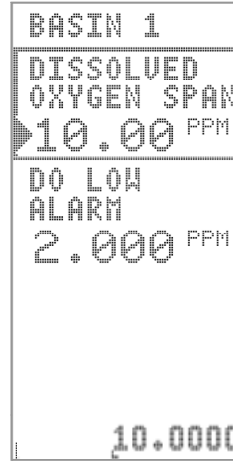


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Press the F2 (SLCT) button to edit the DO span



The default DO span appears on the bottom line of the display. This value represents the full span of the dissolved oxygen input. The factory default value is 10.0 PPM (parts per million).



Default DO span



Press the RIGHT or LEFT arrow button to shift the default value to the right or left.



The UP and DOWN arrow keys will modify the value of the right-most digit



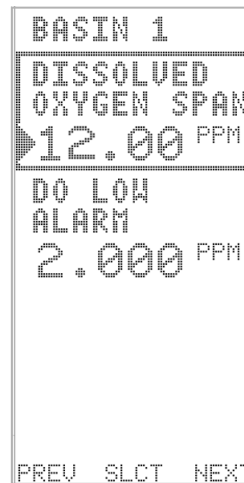
If a change is required, use the UP and DOWN arrow buttons to enter the new value for the DO input span



Press the F3 button to accept the new value



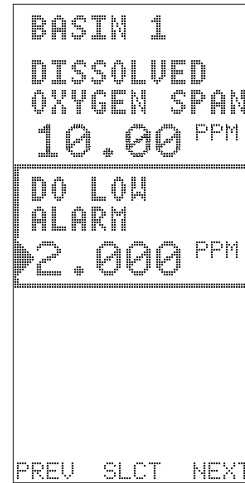
The new span appears in the highlighted box (value shown is example only)



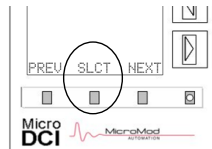
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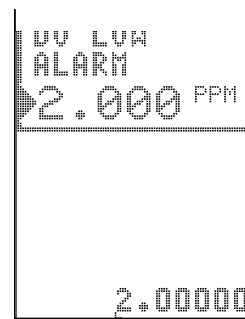
Press the DOWN button to move the cursor to DO LOW ALARM



Press the F2 (SLCT) key to select the value for editing



The default trip point appears on the bottom line of the display. This value represents the trip point for the low DO alarm. The factory default value is 2.0 PPM (parts per million).



If a change is required, use the LEFT, RIGHT, UP and DOWN arrow buttons to enter the new value for the alarm trip point.

The LEFT and RIGHT buttons shift the position of the value. The UP and DOWN buttons change the value.

Press the F3 button to accept the new value



The new trip point appears in the highlighted box

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8.2 View Blower Status

The AeroPAK controller provides a Maintenance display indicating the total run time and on/off cycles of each blower. If there are two blowers, this display also indicates which is the Lead blower and which is the Lag blower.

The lead blower starts and runs first. If the Lead blower is not capable of supplying sufficient air to meet the DO requirements, the second or Lag blower will be started. Blowers are alternated whenever the lag blower is started or whenever the lead blower has been running for a specified time (alternate timer). The alternate timer is reset if the blowers alternate as a result of the lag blower starting. The alternate timer has a default value of 24 hours.

For basins with two blowers, the following table shows the lead/lag on/off conditions:

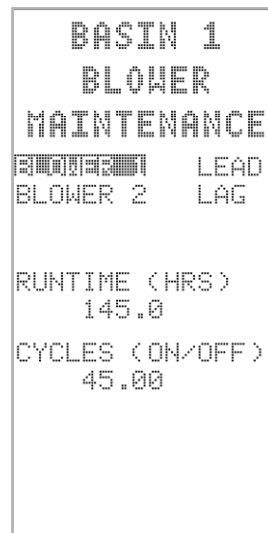
LEAD Start	No blowers currently running, and Measured DO < setpoint, and DO demand output > 10%, and LEAD blower start delay timer expired
LAG Start	LEAD blower currently running, and Measured DO < setpoint, and DO demand output > 90%, and LAG blower start delay timer expired
LAG Stop	Both blowers currently running, and Measured DO > setpoint, and DO demand output < 50%
LEAD Stop	Measured DO > setpoint, and DO demand < 10%

Blower status is indicated per basin.

From any operating display, press the F2 button to advance to the BLOWER MAINTENANCE display



The display indicates the current LEAD and LAG blower. The Runtime and Cycles displayed are associated with the highlighted blower.



Press the UP or DOWN button

The highlighted cursor switches between Blower 1 and Blower 2. The Runtime and Cycles displayed below change according to the selected blower.

8.3 View and Verify Actual I/O Values

The AeroPAK controller provides a Maintenance display showing the input and output signal values at the terminals to verify whether the controller is actually receiving or sending the correct voltage/current.

From any operating display, press the F2 button to advance to the MAINTENANCE display



The highlighted cursor indicates which inputs or outputs are displayed on the screen below the menu. They are displayed with their actual voltage or current values and their engineering unit values.

```

MAINTENANCE
XXXXXXXXXXXX
ANALOG OUTPUTS
DISCRETE INPUTS
DISCRETE OUTPUTS

ANI0
 3.306 V
 5.766 PPM
ANI1
 2.401 V
 5.254 MGD
ANI2
 3.302 V
 5.756 PPM
ANI3
 2.402 V
 5.756 MGD
    
```



Press the UP or DOWN button

The highlighted cursor scrolls through the ANALOG INPUTS, ANALOG OUTPUTS, DISCRETE INPUTS and DISCRETE OUTPUTS. The tag, I/O point and variable are listed in the table below.

TAG	Input / Output	AeroPAK-1	AeroPAK-2
AIN0	Analog Input 1	Dissolved Oxygen	Basin 1 Dissolved Oxygen
AIN1	Analog Input 2	Influent flow (if present)	Basin 1 influent flow (if present)
AIN2	Analog Input 3	Not present	Basin 2 Dissolved Oxygen
AIN3	Analog Input 4	Not present	Basin 2 influent flow (if present)
ANO0	Analog Output 1	DO demand, Blower 1	DO demand, Basin 1 – Blower 1
ANO1	Analog Output 2	DO demand, Blower 2	DO demand, Basin 1 – Blower 2
ANO2	Analog Output 3	Not used	DO demand, Basin 2 – Blower 1
ANO3	Analog Output 4	Not used	DO demand, Basin 2 – Blower 2
CCI2	Digital Input 1	Blower 1 Run contact	Basin 1, Blower 1 Run contact
CCI3	Digital Input 2	Blower 2 Run contact	Basin 1, Blower 2 Run contact
CCI4	Digital Input 3	Not used	Basin 2, Blower 1 Run contact
CCI5	Digital Input 4	Not used	Basin 2, Blower 2 Run contact
CCO10	Digital Output 1	Blower 1 Start/Stop contact	Basin 1, Blower 1 Start/Stop contact
CCO11	Digital Output 2	Blower 2 Start/Stop contact	Basin 1, Blower 2 Start/Stop contact
CCO12	Digital Output 3	Not used	Basin 2, Blower 1 Start/Stop contact
CCO13	Digital Output 4	Not used	Basin 2, Blower 2 Start/Stop contact
CCO14	Digital Output 5	DO Alarm	Basin 1 DO Alarm
CCO15	Digital Output 5	Loss of Influent Alarm	Basin 1 Loss of Influent Alarm
CCO16	Digital Output 5	Not used	Basin 2 DO Alarm
CCO17	Digital Output 5	Not used	Basin 2 Loss of Influent Alarm

Subject to resolution of any problems encountered with field device wiring and installation, power feed and ground connections, controller installation, and blower operation the system is now ready for release to the owner.