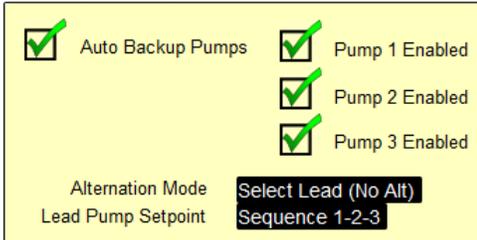


# ICL Three Pump Controller

## Pump Operation

The number of pumps that the program controls can be selected by enabling only the ones that are currently installed and in service. The enable/disable setting can be used to take a pump out of service and cause the program to not use or alarm on that pump. These settings are on the “Station Configuration” screen in the Web User Interface in the “Pump Setup” section.

### Pump Setup



Auto Backup Pumps     Pump 1 Enabled  
 Pump 2 Enabled  
 Pump 3 Enabled

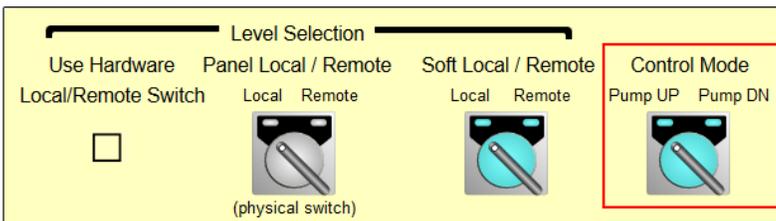
Alternation Mode: Select Lead (No Alt)  
Lead Pump Setpoint: Sequence 1-2-3

The enabled pumps are displayed on the “Station” screen. Pumps that are not enabled will not appear.

## Pump Control

The controller can be setup to control as a “Pump Up / Fill” or “Pump Down / Drain” type. The setting for Pump Up or Pump Down is on the “Station Configuration” screen in the Web User Interface.

### Control Switches



Level Selection

Use Hardware    Panel Local / Remote    Soft Local / Remote    Control Mode

Local/Remote Switch    Local Remote    Local Remote    Pump UP    Pump DN

    (physical switch)        

Click on the blue oval “targets” at the top of the switch to change the mode.

Using the “Pump Up” setting will cause the pumps to come on at low levels and go off at high levels, and using the “Pump Down setting” will cause the pumps to come on at high levels and go off at low levels. The pump station graphics as well as all associated setpoints will automatically be displayed according to the selected mode, showing only the appropriate settings for the selected mode.

The setpoints that will determine when pumps will come on and go off are on the “Station” screen.

### Level Control Setpoints

	Day	Night
Lead OFF	25.0	27.0
Lag OFF	23.0	25.0
Sby OFF	22.0	24.0
Lead ON	15.0	17.0
Lag ON	13.0	15.0
Sby ON	11.0	13.0

These setpoints are also on the “Setpoint” screen, where a complete list of all setpoints, are shown. The setpoint values can also be edited here.

### Level Control Setpoints

Day				Night			
Pump Up		Pump Down		Pump Up		Pump Down	
Lead OFF	25.0	Sby ON	26.0	Lead OFF	27.0	Sby ON	28.0
Lag OFF	23.0	Lag ON	24.0	Lag OFF	25.0	Lag ON	26.0
Sby OFF	22.0	Lead ON	23.0	Sby OFF	24.0	Lead ON	25.0
Lead ON	15.0	Sby OFF	16.0	Lead ON	17.0	Sby OFF	18.0
Lag ON	13.0	Lag OFF	14.0	Lag ON	15.0	Lag OFF	16.0
Sby ON	11.0	Lead OFF	12.0	Sby ON	13.0	Lead OFF	14.0

### Night and Day Control Periods:

Two sets of level control setpoints are provided, in case different control setpoints are needed during day and night time periods.

The setpoints that control when the night time period starts and ends are located on the “Setpoints” screen. Any time period outside of the night period is automatically in the day time period, so only setpoints for the night period are necessary. If all of the hour and minute setpoints are set to zero, the night/day feature is disabled and the day setpoints will always be used.

### Time Control Setpoints

PLC Startup Delay	10	(Sec)	(Pump Inhibit)
Night Start Hour	0	Night End Hour	0
Night Start Minute	0	Night End Minute	0
Military Time 0:0 to 23:59			

For example, these are all valid settings:

Night period set to 6:30 PM to 11:00 PM

Start Hour = 18 (6 PM)

Start Minute = 30

End Hour = 22 (11 PM)

End Minute = 0

Night period set to 10:00 PM to 6:00 AM

Start Hour = 22 (10 PM)

Start Minute = 0

End Hour = 6 (6 AM)

End Minute = 0

The current period that the controller is using (and the current set of pump control setpoints) is displayed on the “Station” screen and will update automatically when the period changes.

### Active Time Period

Daytime Control

## **Normal Pump Operation**

Note that the pumps should be placed in HOA Off (or Hand if necessary) at the pump control panel while setting up the system to avoid starting and stopping the pumps based on settings that are not completely set up.

This application refers to the 3 pumps as “Lead”, “Lag”, and “Sby”, where “Sby” is short for standby. The Lead pump is always called first, then the Lag, then the Sby, provided that the water level is moving past each start setpoint one at a time. If the level is already at a point where 2 pumps or all 3 pumps are required, each call will be delayed by the value in seconds contained in the “Sequential Start Delay” setpoint.

When stopping the pumps, the pumps are stopped in the same order. If the level is already at a point where more than 1 pump is to be stopped, each pump stop will be delayed by the value in seconds contained in the “Sequential Stop Delay” setpoint.

The Sequential Start and Stop delays are there to prevent more than one pump starting or stopping at the same time to avoid excessive pressure changes, etc. Setting the setpoints for either of these to zero will disable that feature.

### **Pump calls are retained:**

If a pump is called to run then it will remain being called until the level passes the stop setpoint. If the controller is power cycled or rebooted when the pump is required by level, it will still be required by level once the controller is back up and operating, as long as the level is still not beyond stop setpoint. The same is true if the pump is not required by level and the controller is power cycled or rebooted. In other words, the current pump call requirements are remembered/retained when the controller is not running.

## **Pump Stop Conditions**

There are several conditions that will stop a pump and not allow it to be called to run by the controller:

1. *The panel HOA switch (a physical switch mounted on the pump control panel) not in the “Auto” position.* If the pump is to be controlled by the panel HOA switch, then “Hand” or “Off” must be used at the panel switch. The controller will only energize its digital output that calls the pump to run if the panel HOA is in the “Auto” position.
2. *The “Scada HOA” switch is in the Off position.* There is a Scada HOA switch for each enabled pump on the “Station” screen. This switch only has an effect if the panel HOA is in the auto position. It can be used to stop the pump (Off position), start the pump (Hand position), or have the controller control the pump automatically by level (Auto position).
3. *Pump not available.* The pump will become “not available” if:
  - a. The panel HOA switch is not in the auto position as mentioned in #1 above.
  - b. The pump has a fail condition. There is more information on fail conditions in the “Alarms” section of this document.
  - c. The pump is not enabled on the “Station Configuration” screen.

## **Pump Start / Stop Delays**

When a pump is required to start or stop by the controller, there are conditions that may delay the action for a setpoint period of time (in seconds). These are listed below:

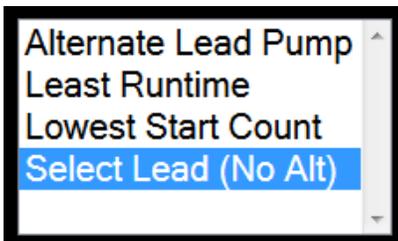
1. *Pump Restart Delay.* Whenever a pump is stopped by the controller, a timer is started that must elapse before the pump can be restarted.
2. *Pump Sequential Start Delay.* Whenever a pump is called to run by the controller, a timer is started that must elapse before another pump can be started. This is to prevent more than one pump coming on a time.
3. *Pump Sequential Stop Delay.* Whenever a pump is stopped by the controller, a timer is started that must elapse before another pump can be stopped. This is to prevent more than one pump going off a time.

## **Pump Backup**

Any time a pump is required to run by level and is not available (see “Pump Stop Conditions #3” above), a pump should be called on in its place as long as at least one other pump is available. The new pump will be controlled by the same level setpoints as the one it is replacing, and will be alternated in the same way as the one it is replacing. If the original pump becomes available and the alternation method is set “Alternate Lead Pump”, the new pump is already set as the lead pump and will remain being called until the alternation sequence changes. If the original pump becomes available and “Select Lead” is being used instead of automatic alternation, then the new pump will stop and the original pump will start in order to maintain the set sequence.

## **Pump Alternation**

There are 3 modes of automatic pump alternation, and a 4<sup>th</sup> mode to set a specific call sequence, available on the Station screen:



All of the automatic alternation modes work by changing the lead pump each time all of the pumps are off (no longer required by level).

1. “Alternate Lead Pump” will change the lead pump to the next pump in line. When the last pump (for example, pump 3 and 3 pumps are in service) is lead and alternation is again required, the first pump will be the next lead. The rest of the sequence will follow according to this table:  
1 as Lead – Sequence is 1-2-3.  
2 as Lead – Sequence is 2-3-1.  
3 as Lead – Sequence is 3-1-2.
2. “Least Runtime” will always call the pump with the least amount of runtime hours as the lead pump.
3. “Lowest Start Count” will always call the pump with the lowest number of starts.

4. "Select Lead" will use the selected sequence, and not automatically alternate the pumps.
  - Sequence is 1-2-3.
  - Sequence is 2-3-1.
  - Sequence is 3-1-2.

Pump backup is still active in all cases, as long as at least 1 other pump is available.

### The Level System

There are 4 analog "Universal Input" type inputs on the controller that can be used for a wide array of the industrial type signals such as 4-20mA, Resistance, Temperature probes, etc. This application expects there to be at least 1 pressure/level transmitter at the first analog input, unless a remote level (via communications) is being used. The remaining analog inputs can be used for whatever the situation requires, such as a flow meter.

### Level Backup

The application is set up to automatically backup a failed level signal with the signal at the first analog input or the second analog input, depending on whether or not a remote signal is being used.

*Remote Mode:* The level signal at analog input 1 will be used as a backup if the remote level fails.

*Local Mode:* The level signal at analog input 2 will be used as a backup if the 1<sup>st</sup> level signal fails.

The Remote / Local mode is set by a switch on the station configuration page of the web user interface. The level backup feature can be enabled or disabled there also. **If the analog signal that will normally be used as a backup is needed for another purpose, then the level backup feature should be disabled.**

#### Control Switches

#### Level Setup

The level signal will go into a fail condition if the value goes out of the specified range. The range is in engineering units, and is settable with maximum (high) and minimum (low) setpoints. The signal must be out of range for the specified period of time which is setpoint value in seconds. These setpoints are located on the "Setpoints" screen in the WUI.

#### Level Alarm Setpoints

High Level	33.0	Feet
Low Level	2.0	Feet
Level 1 Fail High	40.0	Feet
Level 1 Fail Low	-2.0	Feet
Level 2 Fail High	40.0	Feet
Level 2 Fail Low	-2.0	Feet

#### Alarm Delay Setpoints

Pump 1 Fail to Run Delay	10	(Sec)
Pump 2 Fail to Run Delay	10	(Sec)
Pump 3 Fail to Run Delay	10	(Sec)
Pump 1 Interlock Input Delay	10	(Sec)
Pump 2 Interlock Input Delay	10	(Sec)
Pump 3 Interlock Input Delay	10	(Sec)
Level 1 Fail Delay	5	(Sec)
Level 2 Fail Delay	5	(Sec)

The remote level will go into a fail condition if there is a communication failure with the remote device.

Whichever source that is currently being used (as primary or backup) to control the pumps is stored as the “**Control Level**”, and is the value shown on the “Station” screen as text at the top of the tank/sump as well as the visual level that goes up and down in the tank/sump.

An alarm is activated to indicate if no levels are available. In that case no pumps will be called to run unless floats are installed and enabled to call pumps (redundant on). See the “Float Control” section further on in this document for more detail on how the float system operates.

### Level Input Scaling

The 4 level inputs and the remote level can be scaled according the required application scaling. For example, if a 15 PSI transducer is being used to represent the tank level, then the scaling would be set to **4-20mA = 34.65** feet (1 PSI = 2.31 feet of water, and  $15 \times 2.31 = 34.65$ ). This is the default scaling for analog inputs 1 and 2 as shown below.

The analog input scaling setup is on the “Analog Input Scaling” screen.

Analog Input Names	Analog Input Scaling	Remote Level Scaling
Remote Level	Level 1 In High 20000.00 In Low 4000.00 Out High 34.60 Out Low 0.00	Use Remote Scaling <input type="checkbox"/> Remote Level In High 20000.00 Remote Level In Low 4000.00 Remote Level Out High 34.60 Remote Level Out Low 0.00
Level 1	Level 2 In High 20000.00 In Low 4000.00 Out High 34.60 Out Low 0.00	
Level 2	Universal 3 In High 20000.00 In Low 4000.00 Out High 100.00 Out Low 0.00	
Universal 3	Universal 4 In High 20000.00 In Low 4000.00 Out High 100.00 Out Low 0.00	
Universal 4		

“Use Remote Scaling” will tell the controller to scale the received (via communication) value. If the received value is already scaled to some engineering units (such as feet) then un-check the “Use Remote Scaling” check box.

## Float Control

“Float” refers to a ball float in the tank or sump that will rise as water rises. Floats can be used as a backup to a level sensor to generate alarms and control pumps. A “normally open” and “normally closed” condition refers to whether the internal contacts are open or closed with the float is hanging (not being lifted by water). The controller expects the floats to be configured as:

High Floats – Normally open (contacts close as water level rises).

Low Floats – Normally closed (contacts close as water level falls)

This makes it so that the controller gets a high float indication when the level is high, and a low float indication when the level is low.

If the floats come in a different normally open configuration, then the state can be reversed in the web user interface on the “Station Configuration” screen:

**Float Setup**

	Installed	Reverse	Redundant ON	Redundant OFF	Alarm	Number of Pumps to Call (Redundant ON)
Float 1 (High High)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	2
Float 2 (High)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	1
Float 3 (Low)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Float 4 (Low Low)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

Redundant ON – If this is selected for a float then pumps will be called when the float is indicating a high or low condition, depending on whether the control mode is set to Pump Up or Pump Down. The picture above shows the settings for a Pump Down mode, where the pumps would normally be started on a rising level. The number of pumps that get started when the float is active are set here also. If the Redundant ON box is checked then the set number of pumps will be started when the float is active.

Redundant OFF – If this is selected for a float then pumps will be stopped when the float is indicating a high or low condition, depending on whether the control mode is set to Pump Up or Pump Down. The picture above shows the settings for Pump Down mode where the pumps would normally be stopped on a falling level. If the Redundant OFF box is checked then all pumps that are currently called will be stopped when the float is active.

Alarm checkbox – This will cause an alarm to be generated any time a float becomes active.

If floats are expected to control the pumps, then at least two should be installed. This is because one float will start the pump and another will stop the pump. This is so that pump cycling does not occur as it would with only one float.

## **Alarms**

All of the system alarms are listed below.

**High Level Alarm**

**Low Level Alarm**

**Analog Input 1 Fail**

**Analog Input 2 Fail**

**Remote Level Comm Fail**

**No Level Available**

**Pump 1 Fail To Run**

**Pump 2 Fail To Run**

**Pump 3 Fail To Run**

**Pump 1 Fail By Interlock**

**Pump 2 Fail By Interlock**

**Pump 3 Fail By Interlock**

**Pump 1 Not Available**

**Pump 2 Not Available**

**Pump 3 Not Available**

**Float 1 High High**

**Float 2 High**

**Float 3 Low**

**Float 4 Low Low**

*High and Low Level Alarm* – These alarms will activate when the level is above or below the associated setpoint. There are no time delay setpoints for these alarms.

*Analog Input 1 and 2 Fail* – These are meant to catch an issue at the hardware / physical input level such as a non-existent connection at the analog input, or a bad transducer device. An alarm will be activated when the level is above or below the associated setpoints for the specified time period. These alarms can be configured to automatically clear when the level reading is restored, or to require a manual reset (via the “Latched Alarm Reset” button).

*Remote Level Comm Fail* – This will alarm activate if a communication fail is issued by the communication system. The communications to a remote controller is not set up by default and has to be set up by the integrator before deploying the controller.

*No Level Available* – This alarm is activated if there are Analog Input Fail alarms for both the primary and backup levels, or if level backup is disabled and the primary level is failed.

*Pump Fail To Run* – This alarm is activated if the controller turns on a digital output in an attempt to start a pump and no pump running signal is received from that pump within the specified time period.

*Pump Fail By Interlock* – Two digital inputs are provided for each pump, that are dedicated as interlock inputs. An Interlock condition tells the controller that something external to the controller is happening, such as a high pressure switch, and the pump should be stopped. The alarm will be activated and the pump will be stopped when either of the two designated interlock inputs are on for the specified time period.

*Pump Not Available* – A pump is considered “not available” under any of the following conditions. A pump that is not available will not be called to run by the controller but will be backed up by another pump as long as at least 1 other pump is available.

- a. The pump control panel HOA switch is not in the auto position.
- b. The pump has a fail condition.
- c. The pump is not enabled on the “Station Configuration” screen.

*Float Alarms* – If a float is enabled to alarm then an alarm will become active when the float becomes active. There are no time delay setpoints for these alarms.

**Alarm Acknowledging and Latched Alarm Reset**

The “Station” screen has an alarm summary at the bottom of the page:

Alarm	Group	Last Alarm Time	Last Ack'd Time	
Pump 3 Not Available	Alarms	10/16/2014 14:21:51		<a href="#">Ack</a>
Pump 2 Not Available	Alarms	10/16/2014 14:21:51	10/16/2014 14:55:30	
				<a href="#">Ack All</a>

[Ack All / Silence Common Alarm](#)  
[Latched Alarm Reset](#)



Station Common Alarm

Alarms that have not been acknowledged will show up in yellow text with a red background.

Alarms that are still active but have been acknowledged will show in blue text with a yellow background.

In the summary table an [Ack](#) (Acknowledge) text button and an [Ack All](#) text button are provided. On the right side of the summary are two more text buttons are provided that have specific tasks.

The “[Ack All / Silence Common Alarm](#)” text button will do the same as the [Ack All](#) button in the summary table (acknowledge all alarms), but will also turn off the Common Alarm output.

The “[Latched Alarm Reset](#)” text button will reset all latched alarms.

Latched Alarms:

**Pump Fail To Run**

**Analog Input Fail** (if the alarm is not configured to “auto clear” when the level is restored)

**Level Setup**

<input checked="" type="checkbox"/> Auto Backup Level	Level Engr Units <input type="text" value="Feet"/>
<input checked="" type="checkbox"/> Level 1 Fail Alarm Enable	<input type="checkbox"/> Level 1 Fail Auto Clear
<input checked="" type="checkbox"/> Level 2 Fail Alarm Enable	<input type="checkbox"/> Level 2 Fail Auto Clear

## The Common Alarm Output

Digital Output 10 is dedicated for use as a common alarm indication. A horn or light can be wired to this output. The common alarm will come on anytime a new alarm is activated and remain on until the "[Ack All / Silence Common Alarm](#)" text button is pushed.

The common alarm digital output can be configured to flash, as well as what the flash rate will be. This configuration is on the "Station Configuration" screen.

### Common Alarm

<input type="checkbox"/>	Flash
<input type="text" value="2"/>	Flash Rate (Secs)

Note that this flash rate applies only to the common alarm physical output, and not the flashing red light on the Station screen. The light on the station screen always flashes but has no association with the flashing output.

