

# IPS controller 4000

Integrated pumping  
system for variable  
primary application

---

## Installation and operating instructions

File No: 90.97  
Date: DECEMBER 15, 2015  
Supersedes: NEW  
Date: NEW

—

—

—

—

# CONTENTS

<b>1.0</b>	IPS controllers 4000	4
<b>1.1</b>	Installation instructions	4
<b>1.2</b>	Environmental limits	4
<b>1.3</b>	Field devices installation instructions	4
<b>1.4</b>	Building automation system (BAS) connection	4
<b>2.0</b>	IPS 4000 function displays	5
<b>3.0</b>	Operation displays	6
<b>4.0</b>	Setup displays	13
<b>5.0</b>	IPS 4000 control system service lifecycle	23

Armstrong Integrated pumping system controllers, IPS controllers 4000, are completely factory-assembled, tested, and shipped to the job site as integral units ready to receive incoming power supply. These instructions describe the procedures to be followed during installation, commissioning and operation to ensure optimum performance and reliability. When contacting the factory for assistance, please provide the unit serial number and other pertinent data, such as IPS model no.

## 1.0 IPS CONTROLLERS 4000

### 1.1 INSTALLATION INSTRUCTIONS

**Incoming supply - stand-alone IPS controllers (no rack):** The incoming power supply should be brought in through the bottom of the panel adjacent to the main terminals. Note that this is the only electrical connection required at the panel.

The power supply voltage is 100-240 VAC / 50-60 Hz as standard. Please refer to the wiring diagram supplied with the unit for instructions on connecting power to the IPS controller.

**Incoming supply - IPS system on rack:** The incoming power supply to the IPS controller is achieved through a transformer in the main enclosure of the whole IPS system rack. No power connection is required.

**NOTE:** All electrical wiring should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

### 1.2 ENVIRONMENTAL LIMITS

**Operation temperature range:** 0°C to 50°C (32°F to 122°F)  
(must not be exposed to direct sunlight)

**Operation humidity range:** (10% - 85%) non-condensing

**Ambient air temperature for storage:** -20°C to 70°C  
(-4°F to 158°F)

### 1.3 FIELD DEVICES INSTALLATION INSTRUCTIONS

Prior to using the display to configure the IPS controller, make sure all the field installed devices such as DP sensors, flow sensors, DP switches are properly installed and wired to the IPS controller as per wiring diagrams provided.

### 1.4 BUILDING AUTOMATION SYSTEM (BAS) CONNECTION

When the IPS controller is provided with a serial port to communicate serially to the BAS, the possible communication protocols are Modbus, LonWorks or BACnet. Refer to wiring diagrams supplied with the unit for wiring instructions. IPS controller can also communicate to the BAS through a hard wired option. Please refer to the IPS controller generic terminal block diagram for the different parameters and data points communicated to the BAS. For more information please contact your local Armstrong representative or Armstrong factory service department.

## 2.0 IPS 4000 FUNCTION DISPLAYS

The IPS 4001 / 4002 / 4003 controllers displays are divided in two set of displays: Operation and Setup. The Operation displays are used by the operators to monitor and control the IPS. The Setup screens are used to set, view, save, and restore the system specific settings (i.e. number of pumps, chillers/boilers, sensor range, etc.).

### OPERATION DISPLAYS:

- Main menu
- System overview
- Zone overview
- Pump overview
- Sensorless overview
- Pump control
- Bypass valve overview
- Auto bypass reset
- Login
- Alarm overview
- Diagnostics

### SETUP DISPLAYS:

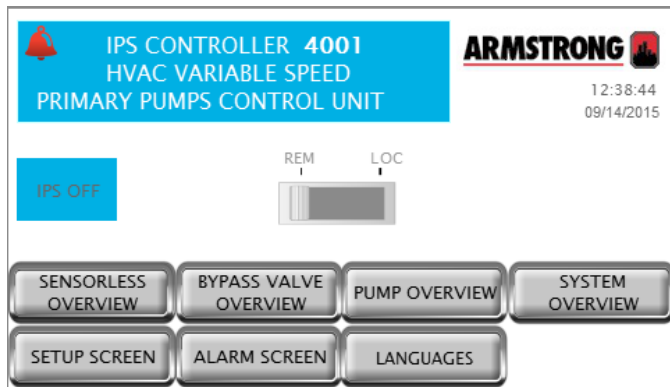
The setup displays are divided in three levels each with different level of access. Level 0 setup displays are for viewing only and no adjustments can be made. Level 1 setup displays can be used for changing the system setup and restoring the system factory defaults. Level 2 setup displays can be used for changing the system setup, and saving and restoring the system factory defaults. To access Level 1 and 2 an operator need to enter the proper password (please contact Armstrong factory service department).

The list of setup/default displays for every level is as follow:

- System setup
- Zone setup
- Zone 1 to 12 setup
- Sensorless setup
- Pump setup
- Speed setup
- Staging setup
- PID setup
- BAS setup
- Clock setup
- Bypass valve setup
- System valves setup
- VFD readout setup
- Chiller/boiler 1 to 6 setup
- Flow setup

### 3.0 OPERATION DISPLAYS

#### 3.1.0 MAIN MENU



#### Description

This is the screen the operator sees when powering up the unit. It indicates status of the system's most important variables, and also provides a means for the user to navigation to all system screens

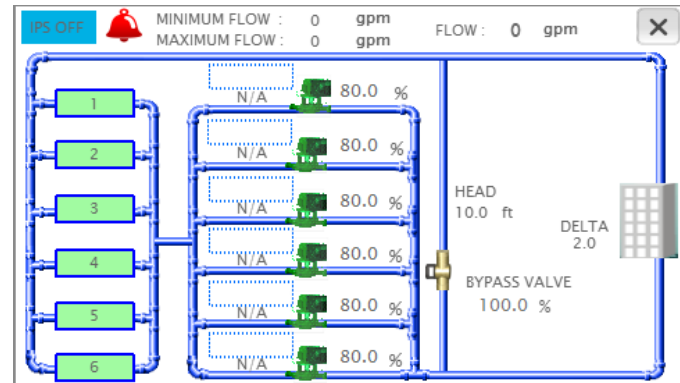
#### Data

IPS status	Indicates if the IPS is on or off
Alarm	If there is an alarm in the system, a red bell appears at the top left corner

#### Buttons

REM - LOC	Slider button that allows changing the IPS mode to remote or local. Local will turn on the IPS immediately. Remote causes the IPS to follow the BAS signal (hard wired or serial communication) to turn on or off
ZONE OVERVIEW	Changes the screen to Zone Overview. Not available if the vFD type is IVS sensorless
BYPASS VALVE OVERVIEW	Changes the current screen to Bypass valve Overview
SYSTEM OVERVIEW	Changes the current screen to System Overview
SENSORLESS OVERVIEW	Changes the current screen to Sensorless Overview. Only available if the sensorless control is enabled
SETUP SCREEN	Navigates to the setup menu level zero screen
PUMP OVERVIEW	Navigates to the Pump Overview screen
ALARM SCREEN	Shows the alarm screen. If there is an active alarm, this button turns red

#### 3.1.1 SYSTEM OVERVIEW



#### Description

Shows a detailed view of the system. The screen adapts to the configuration of the system by showing the number of pumps and chillers/boilers, the system flow, bypass valve, zone PVs or head and flow. Press the **x** on the top right corner to go back to the previous screen

#### Data

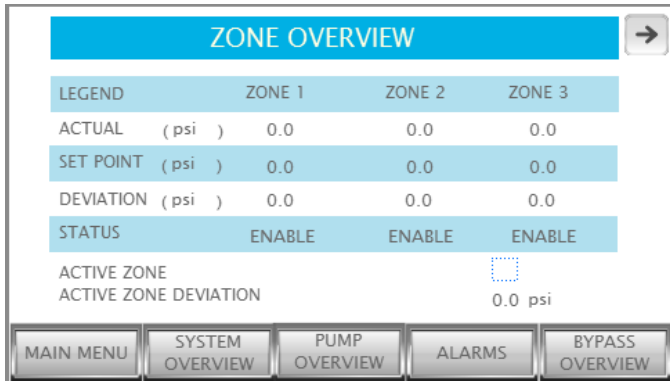
Chiller/boiler 1 to 6 status	The icons show the device status: grey - stopped green - running
Pump 1 to 6 status	The pump icons shows the pump status: grey - stopped green - running red - alarm
Pump 1 to 6 mode	Shows each pump mode: Hand, Off or Auto
Pump 1 to 6 duty	Shows each pump duty: Duty1, Duty2, Duty3, Duty4, Duty5, Duty6 or Stand-by
Pump 1 to 6 speed	Shows each pump speed in percentage
ACTIVE ZONE	Indicates which zone is assigned as Active. Not visible if the vFD type is IVS sensorless
DEVIATION	Indicates the active zone deviation. Not visible if the vFD type is IVS sensorless
SETPOINT	Indicates the active zone setpoint in the chosen units. Not visible if the vFD type is IVS sensorless and also system valves control is disabled
MAX OPEN VLV	Indicates the opening of the driving system valve. Not visible if the vFD type is IVS sensorless and also system valves control is disabled
FLOW	Indicates both sensor and sensorless flow values in the system based on the selection
HEAD	Indicates the total head in the system. Only visible if the vFD type is IVS sensorless

<b>DELTA</b>	Indicates how far from the control curve the pump(s) are operating. The IPS regulates the pump speed to achieve an error of zero
<b>IPS STATUS</b>	Indicates whether the IPS is ON or OFF
<b>ALARM</b>	A red bell indicates an Alarm in the system
<b>BYPASS VALVE</b>	Indicates valve position in percentage (100% means fully open)
<b>MINIMUM FLOW</b>	Indicates the rated minimum chiller/boiler flow. Updates dynamically based on number of chillers/boilers enabled
<b>MAXIMUM FLOW</b>	Indicates the rated maximum chiller/boiler flow. Updates dynamically based on number of chillers/boilers enabled

**Buttons**

<b>Pump 1 to 6 icon</b>	Touching a pump icon brings up the corresponding pump control screen
-------------------------	--

**3.1.2 ZONE OVERVIEW**



**Description**

Shows an overview of the system zones. If there are more than 3 zones, use the grey arrows to scroll. This screen is not available if the VFD type is IVS sensorless

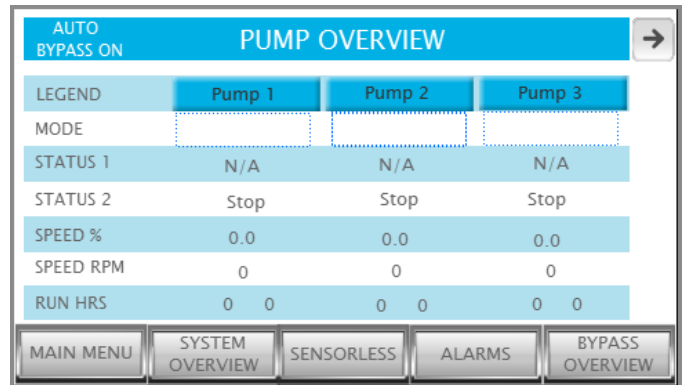
**Data**

<b>ACTUAL</b>	Indicates the present value of the zone sensor in the selected units
<b>SETPOINT</b>	Indicates the setpoint of the zone in the selected units
<b>DEVIATION</b>	Indicates the zone deviation in the selected units
<b>STATUS</b>	Indicates whether the zone is enabled or disabled
<b>ACTIVE ZONE</b>	Indicates which zone is assigned as active
<b>ACTIVE ZONE DEVIATION</b>	Indicates the active zone deviation in the selected units

**Buttons**

<b>MAIN MENU</b>	Navigates to the main menu
<b>SYSTEM OVERVIEW</b>	Changes the current screen to System Overview
<b>PUMP OVERVIEW</b>	Changes the current screen to Pump Overview
<b>ALARMS</b>	Shows the alarm screen. If there is an active alarm, this button turns red
<b>BYPASS OVERVIEW</b>	Changes the current screen to Bypass Overview

**3.1.3 PUMP OVERVIEW**



**Description**

Allows monitoring pump information. If there are more than 3 pumps, scroll using the arrows on the top corners

**Data**

<b>Pump 1 to 6 mode</b>	Shows each pump mode: Hand, Off or Auto
<b>Pump 1 to 6 status 1</b>	Shows each pump duty: Duty1, Duty2, Duty3, Duty4, Duty5, Duty6 or Stand-by
<b>Pump 1 to 6 status 2</b>	Shows if the pump is running or stopped
<b>Pump 1 to 6 speed %</b>	Shows each pump speed in percentage
<b>Pump 1 to 6 speed RPM</b>	Shows each pump speed in RPM
<b>Run HRS</b>	Shows the total pump run time in hours
<b>AUTO BYPASS ON</b>	If the pumps are in auto bypass, the AUTO BYPASS ON label appears on the top left corner. Touching this label brings up the auto bypass reset screen

Buttons	
Pump 1 to 6	Touching a pump button brings up the corresponding pump control screen. If the corresponding pump is in alarm, this button changes to red color
MAIN MENU	Navigates to the main menu
SYSTEM OVERVIEW	Changes the current screen to System Overview
SENSORLESS OVERVIEW	Changes the current screen to Sensorless Overview. Only available if the vFD type is ivs sensorless
ZONE OVERVIEW	Navigates to the Zone Overview screen. Not available if the vFD type is ivs sensorless.
ALARMS	Shows the alarm screen. If there is an active alarm, this button turns red
BYPASS OVERVIEW	Changes the current screen to Bypass Overview
Scroll arrows	If there are more than 3 pumps in the system, use the grey arrow buttons to scroll

TOTAL FLOW	Indicates the system flow in the selected units
TOTAL HEAD	Indicates the system head in the selected units

Buttons	
Pump 1 to 6	Touching a pump button brings up the corresponding pump control screen. If the corresponding pump is in alarm, this button changes to red color
MAIN MENU	Navigates to the main menu
SYSTEM OVERVIEW	Changes the current screen to System Overview
PUMP OVERVIEW	Changes the current screen to Pump Overview
ALARMS	Shows the Alarm Screen. If there is an active alarm, this button turns red
BYPASS OVERVIEW	Changes the current screen to Bypass Overview
Scroll arrows	If there are more than 3 pumps in the system, use the grey arrow buttons to scroll

### 3.1.4 SENSORLESS OVERVIEW

SENSORLESS OVERVIEW			
LEGEND	Pump 1	Pump 2	Pump 3
MODE			
STATUS 1	N/A	N/A	N/A
STATUS 2	Stop	Stop	Stop
FLOW (gpm)	0	0	0
HEAD (ft)	0.0	0.0	0.0
TOTAL FLOW:	0 gpm	TOTAL HEAD:	0.0 ft
MAIN MENU	SYSTEM OVERVIEW	PUMP OVERVIEW	ALARMS
			BYPASS OVERVIEW

#### Description

This screen is only available when the vFD type is ivs sensorless, it complements the Pump Overview screen. If there are more than 3 pumps, scroll using the arrows on the top corners

#### Data

Pump 1 to 6 mode	Shows each pump mode: Hand, Off or Auto
Pump 1 to 6 status 1	Shows each pump duty: Duty1, Duty2, Duty3, Duty4, Duty5, Duty6 or Stand-by
Pump 1 to 6 status 2	Shows if the pump is running or stopped
FLOW	Indicates the current flow of that pump in the selected units
HEAD	Indicates the current head of that pump in the selected units

### 3.1.5 PUMP 1 TO 6 CONTROL

PUMP 1 CONTROL			
MODE		SPEED (%)	100.0
STATUS 1	N/A	SPEED (RPM)	100
STATUS 2	Stop	HAND SPD (%)	100.0
PUMP ALM	No	CURRENT (A)	100.0
DRV FAULT	No	VOLTS (VAC)	100.0
RUN HRS	00000	POWER (kW)	100.0
LEAD PUMP SWITCH	0 DAYS	AUTO BYPASS ON	
		ACT	REF
		SPEED (%)	

#### Description

This screen allows control of each pump and shows more detailed information. Press the x on the top right corner to go back to the previous screen

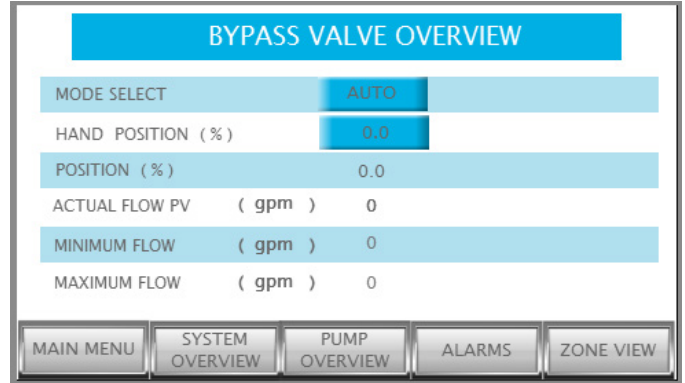
#### Data

MODE	Shows pump mode: Hand, Off or Auto
STATUS 1	Shows pump duty: Duty1, Duty2, Duty3, Duty4, Duty5, Duty6 or Stand-by
STATUS 2	Shows if the pump is running or stopped
PUMP ALM	Indicates if there is a pump alarm
DRV FAULT	Indicates if the vFD is reporting a fault



<b>RUN HRS</b>	Indicates the pump total run time in hours. Touching the RUN HRS label opens a dialog window to confirm resetting the total run hours
<b>LEAD PUMP SWITCH</b>	Indicates the remaining time in days or hours to switch the Duty1 (Lead) pump
<b>SPEED (%)</b>	Shows pump speed in percentage
<b>SPEED (RPM)</b>	Shows pump speed in RPM
<b>CURRENT (A)</b>	Shows the VFD current
<b>VOLTS (VAC)</b>	Shows the VFD AC voltage
<b>POWER (KW)</b>	Shows the VFD power in kW
<b>SPEED BARS</b>	Show the pump speed reference and actual speed in a graphical manner
<b>AUTO BYPASS ON</b>	If the pump is in auto bypass, the AUTO BYPASS ON label appears on the bottom of the screen. Touching this label brings up the auto bypass reset screen
<b>Alarm</b>	If there is a pump alarm, a red bell appears at the top right corner
<b>Buttons</b>	
<b>LEAD</b>	Assigns the pump as Duty1 or Lead
<b>HAND</b>	Changes the pump mode to hand. If the IPS is on, the pump will start immediately and run at the hand speed (see below)
<b>OFF</b>	Changes the pump mode to off. The pump will stop immediately and it will be excluded from the duty rotation
<b>AUTO</b>	Changes the pump mode to auto. The pump will be assigned a duty status and it will run according to the IPS control algorithm
<b>HAND SPEED</b>	If the pump is placed in hand, it will run at the hand speed entered

### 3.1.6 BYPASS VALVE OVERVIEW



#### Description

This screen allows monitoring of the Bypass Valve Overview feature

#### Data

<b>POSITION (%)</b>	Indicates valve position in percentage (100% means fully open)
<b>ACTUAL FLOW PV</b>	Displays system flow. Obtained from flow meter or from sensorless readout depending on the selection
<b>MINIMUM FLOW</b>	Indicates rated minimum chiller/boiler flow. Updates dynamically based on number of chillers/boilers enabled
<b>MAXIMUM FLOW</b>	Indicates rated maximum chiller/boiler flow. Updates dynamically based on number of chillers/boilers enabled

#### Buttons

<b>MODE SELECT</b>	Allows user to select the operation mode <b>MANUAL</b> or <b>AUTO</b>
<b>HAND POSITION</b>	If <b>MANUAL</b> mode is selected, the user can enter the desired valve position
<b>MAIN MENU</b>	Navigates to the main menu
<b>SYSTEM OVERVIEW</b>	Changes the current screen to System Overview
<b>PUMP OVERVIEW</b>	Changes the current screen to Pump Overview
<b>ALARMS</b>	Shows the alarm screen. If there is an active alarm, this button turns red
<b>ZONE OVERVIEW</b>	Changes the current screen to Zone Overview
<b>MAIN MENU</b>	Navigates to the main menu

### 3.1.7 AUTO BYPASS RESET



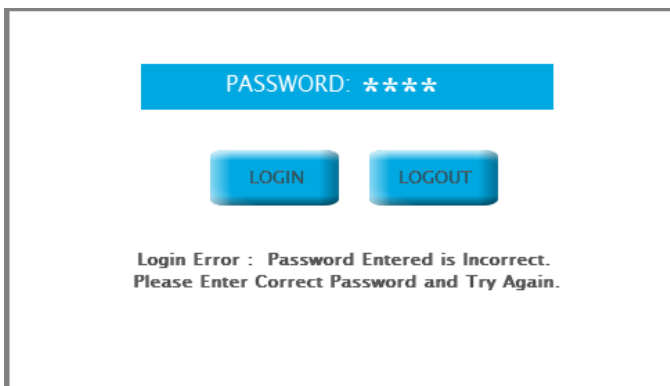
#### Description

This screen allows the operator to reset the pump auto bypass condition. Press the **x** on the top right corner to go back to the previous screen

#### Buttons

YES	Resets the auto bypass. If the conditions that caused the auto bypass don't exist anymore, the pumps will resume normal operation
NO	Closes the auto bypass reset screen and returns to the previous screen

### 3.1.8 LOGIN SCREEN



#### Description

This screen allows the operator to login to the desired level by providing the appropriate password

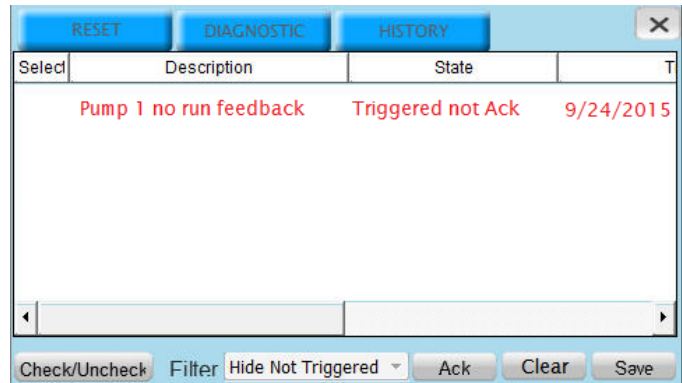
#### Data

PASSWORD	Shows the encoded password. Touching it brings up a numeric keypad to enter the password
----------	--

#### Buttons

LOGIN	If the password entered is valid, touching this button will change the screen to the setup menu of the corresponding level
LOGOUT	Changes the screen back to the main menu

### 3.1.9 ALARM SCREENS



#### Description

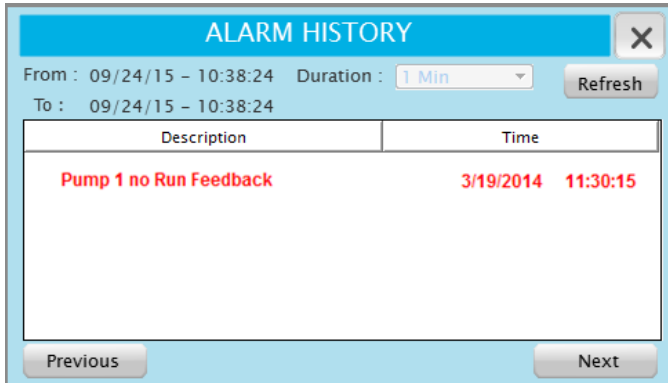
This screen shows the current alarms in the system. Press the **x** on the top right corner to go back to the previous screen

#### Data

Select	Select the alarm in order to be acknowledged and reset
Description	Shows the description of the alarm. The possible alarms are shown below in section 1.2.1
State	Provides information about two alarm conditions: <ol style="list-style-type: none"> <li>1 Triggered or Not Triggered (Triggered means that the condition that generates the alarm is still present, the alarm can be acknowledged but not reset)</li> <li>2 Acknowledged or Not Acknowledged</li> </ol>

#### Buttons

RESET	Resets the alarms. In order to clear from the list see <b>Reset</b> button below
DIAGNOSTIC	Brings up the PLC diagnostics screen
HISTORY	Brings up the alarm history screen
Check/Uncheck	Selects/unselect the alarms. Only selected alarms can be acknowledged and cleared from the list
FILTER	Not used
ACK	Acknowledges the selected alarms
Clear	Clears the selected alarms that are not triggered
Save	Not used



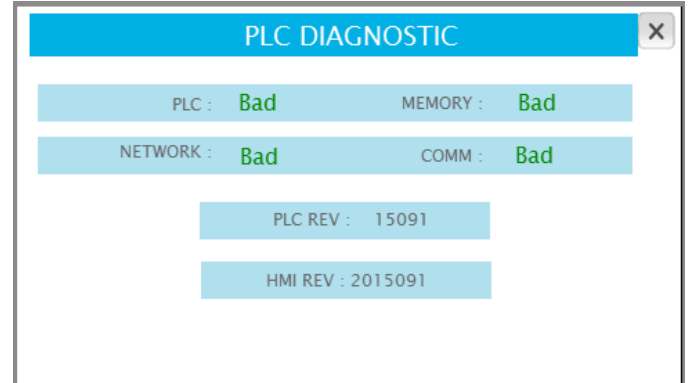
**Description**

This screen shows the alarms history. Press the **x** on the top right corner to go back to the previous screen

**Data**

<b>Description</b>	Shows the description of the alarm. The possible alarms are shown below in section 1.2.1
<b>Time</b>	Shows the time of occurrence of each alarm
<b>Buttons</b>	
<b>REFRESH</b>	Refreshes the alarm list
<b>Duration</b>	Drop down menu that allows to filter the list of alarms based on time of occurrence
<b>Previous</b>	Shows alarm history from the previous period selected in the duration dropdown menu
<b>Next</b>	Shows alarm history from the next period selected in the duration dropdown menu

**3.1.10 PLC DIAGNOSTIC**



**Description**

This screen shows the current state of the PLC and the software revisions installed. Press the **x** on the top right corner to go back to the previous screen

**Data**

<b>PLC</b>	Indicates if the PLC is working properly
<b>NETWORK</b>	Indicates if the PLC network is working properly
<b>MEMORY</b>	Indicates if the PLC memory is working properly
<b>COMM</b>	Indicates if the serial communication port of the PLC is working properly
<b>PLC REV</b>	Indicates the software revision installed on the PLC
<b>HMI REV</b>	Indicates the software revision installed on the HMI

### 3.2.1 ALARMS

Alarm	Description	Possible causes
Pump n alarm	Indicates that pump n is in alarm	Any pump alarm will trigger this alarm
Pump n run feedback alarm	Indicates that the PLC didn't detect the pump run feedback after commanding the pump to start	<ul style="list-style-type: none"> <li>▪ VFD not configured for serial communication</li> <li>▪ Loose or broken wire from VFD</li> <li>▪ Incorrect VFD type selected on IPS</li> <li>▪ Impeller is stuck</li> </ul>
Pump n no flow alarm	Indicates that the PLC didn't detect flow (DP switch not closed) after commanding the pump to start	<ul style="list-style-type: none"> <li>▪ DP switch not correctly adjusted</li> <li>▪ Loose or broken wire</li> <li>▪ Damaged PLC digital input</li> <li>▪ Impeller is stuck</li> </ul>
Pump n drive fault alarm	Indicates that the pump VFD is reporting a fault	VFD over current or other problem. Check VFD local display
DP transmitter fail alarm	Indicates that the DP transmitter is out of range	<ul style="list-style-type: none"> <li>▪ Connection to transmitter is short or open circuited</li> <li>▪ Damaged PLC analog input</li> <li>▪ Loose or broken wire from transmitter</li> <li>▪ Damaged transmitter</li> </ul>
Flow transmitter fail alarm	Indicates that the flow transmitter is out of range	<ul style="list-style-type: none"> <li>▪ Connection to transmitter is short or open circuited</li> <li>▪ Damaged PLC analog input</li> <li>▪ Loose or broken wire from transmitter</li> <li>▪ Damaged transmitter</li> </ul>
Zone n transmitter alarm	Indicates that the zone transmitter is out of range	<ul style="list-style-type: none"> <li>▪ Connection to transmitter is short or open circuited</li> <li>▪ Damaged PLC analog input</li> <li>▪ Loose or broken wire from transmitter</li> <li>▪ Damaged transmitter</li> </ul>
All zones transmitter alarm	Indicates that all zones transmitters are out of range	All zone sensors are in alarm
Pump n flow deviation alarm	Indicates that the sensorless flow of the pump is 20% off the average of the running pumps	<ul style="list-style-type: none"> <li>▪ There is a problem with the sensorless mapping of the VFD</li> <li>▪ Air in the system</li> <li>▪ A manual valve is obstructing the flow</li> </ul>
Chiller/boiler flow below minimum alarm	Indicates system flow is less than chiller/boiler total minimum set value	<ul style="list-style-type: none"> <li>▪ Incorrect calibration of flow meter</li> <li>▪ Bypass valve not open</li> <li>▪ Flow obstruction in the pipe</li> </ul>
Chiller/boiler flow above maximum alarm	Indicates system flow is greater than chiller/boiler total maximum set value	<ul style="list-style-type: none"> <li>▪ Incorrect calibration of flow meter</li> <li>▪ Bypass valve not close</li> <li>▪ Incorrect design sensorless data</li> </ul>

### 4.0 SETUP DISPLAYS

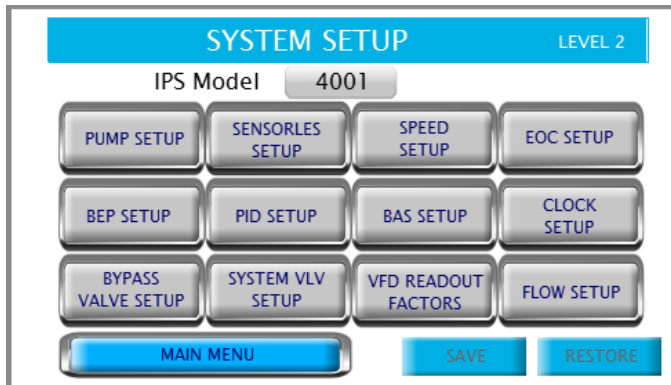
The setup displays allow viewing, modifying, saving and restoring system parameters. There are 3 levels of password protected access:

Level	Actions allowed
Level 0	<ul style="list-style-type: none"> <li>View only</li> </ul>
Level 1	<ul style="list-style-type: none"> <li>Modify all parameters</li> <li>Restore previously saved default values (factory defaults); except Pump PID and BAS parameters</li> </ul>
Level 2	<ul style="list-style-type: none"> <li>Modify all parameters</li> <li>Save changes</li> <li>Restore previously saved default values (factory defaults)</li> </ul>

The following sections list and describe each setup screen. Only Level 2 screens are shown, however each level has the same screens with their respective level restrictions.

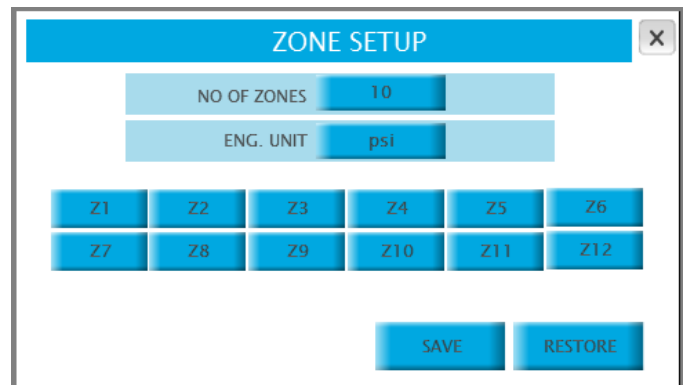
BAS SETUP	Navigates to the BAS setup screen
CLOCK SETUP	Navigates to the clock setup screen
BYPASS VALVE SETUP	Navigates to the bypass valve setup screen
SYSTEM VLV SETUP	Navigates to the system valves setup screen
VFD READOUT FACTORS	Navigates to the vfd readout factors setup screen
FLOW SETUP	Navigates to the flow setup screen
MAIN MENU	Returns to the main menu. User must login again to return to the level 1 & level 2 setup menu
SAVE	Saves all the current setup parameters as default. Only available in level 2
RESTORE	Restores all the default parameters as default. Only available in level 1 & 2
IPS model	Selects the IPS model: 4001, 4002 or 4003. Only available in level 1 & 2

#### 4.1.0 LEVEL 2 SETUP MENU



Description	
This screen allows navigation to each of the setup screens	
Button	
PUMP SETUP	Navigates to the pump setup screen
ZONE SETUP	Navigates to the zone setup screen. Not available if the vfd type on pump setup screen is ivs sensorless
SENSORLESS SETUP	Navigates to the sensorless setup screen. Not available only if the vfd type on pump setup screen is ivs sensorless
SPEED SETUP	Navigates to the pump speed setup screen
EOC SETUP	Navigates to the end of curve (EOC) protection screen
BEP SETUP	Navigates to the duty speed staging setup screen
PID SETUP	Navigates to the PID setup screen

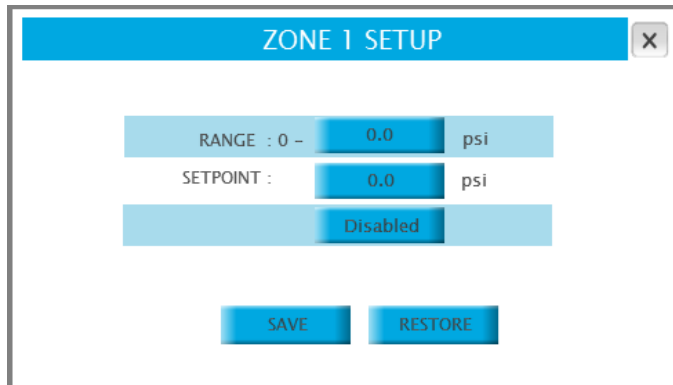
#### 4.1.1 ZONE SETUP



Parameter: NO OF ZONES	
Range:	Function:
1-12	Indicates how many zones will be used to control the system, typically one zone per area of the building
Parameter: ENG. UNIT	
Options:	Function:
PSI	DP sensors in PSI are used
FT	DP sensors in FT are used
kPa	DP sensors kPa PSI are used
M	DP sensors in M are used
BAR	DP sensors in BAR are used
°F	Temperature sensors in °F are used
°C	Temperature sensors in °C are used

<b>Button: SAVE</b>	
Range:	Function:
N/A	Saves current parameters as default. Only available in level 2
<b>Button: RESTORE</b>	
Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

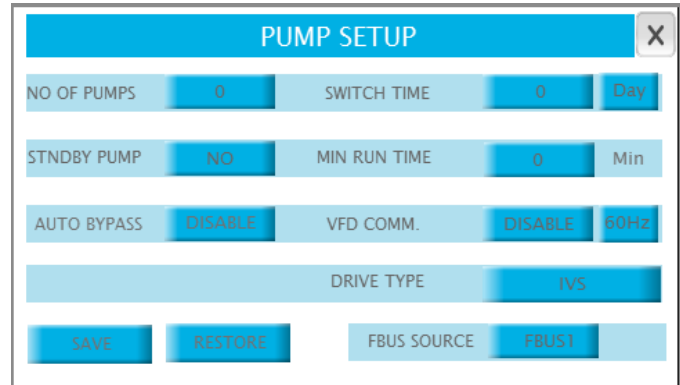
#### 4.1.2 ZONE 1 TO 12 SETUP



There is one screen per zone

<b>Parameter: RANGE</b>	
Range:	Function:
0.0-999.9 (PSI, FT, kPa, M, BAR, °F, °C)	Indicates the range of the DP or Temperature sensor of the zone
<b>Parameter: SETPOINT</b>	
Range:	Function:
0.0-999.9 (PSI, FT, kPa, m, BAR, °F, °C)	Indicates the setpoint of the zone. The IPS uses this value to determine the pump speed
<b>Parameter: SETPOINT</b>	
Option:	Function:
Disable	The zone is disabled, it won't be used to determine the active zone and pump speed
Enable	The zone is enabled, it will be used to determine the active zone and pump speed
<b>Button: SAVE</b>	
Range:	Function:
N/A	Saves current parameters as default. Only available in level 2
<b>Button: RESTORE</b>	
Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

#### 4.1.3 PUMP SETUP



<b>Parameter: NO OF ZONES</b>	
Range:	Function:
1-6	Indicates how many pumps are installed in the system
<b>Parameter: STNDBY PUMP</b>	
Options:	Function:
NO	All pumps in the system are duty
YES	One of the pumps in the system will be assigned as standby, it will only operate if a duty pump fails and there is no other duty pump to replace it. Rotation of duty 1 pump also rotates the standby pump to achieve even hours of operation
<b>Parameter: AUTO BYPASS</b>	
Options:	Function:
DISABLE	Auto bypass function is disabled
ENABLE	When a pump fails (due to no run feedback, vfd fault or communication), the IPS will determine if there is another pump available to replace the faulty pump. If there is no pump available, a digital output will mechanically bypass the vfd and energize the pump motor directly. All pumps running at that moment will be bypassed
<b>Parameter: SWITCH TIME</b>	
Range:	Function:
1-999 (Days, Hours)	Indicates how often the lead (duty 1) pump will rotate among the duty pumps
<b>Parameter: MIN RUN TIME</b>	
Range:	Function:
1-999 minutes	Indicates what is the minimum time the lead (duty 1) pump will run once it is started

Parameter: VFD COMM.	
Options:	Function:
DISABLE	No serial communication to VFDs. The IPS will use hardwired connections
ENABLE	The IPS uses serial communication to the VFDs. Select if the VFD power is 50 or 60 hz. The available VFDs are listed below

Parameter: DRIVE TYPE	
Options:	Function:
IVS	Serial communication to Armstrong IVS drive
ACH 550	Serial communication to ABB ACH 550 drive
FC 102	Serial communication to Danfoss FC102 drive
E7	Serial communication to Yaskawa E7 drive
IVS (SENSORLESS)	Serial communication to Armstrong IVS drive configured for sensorless operation. By selecting this option the IPS4000 will operate in parallel sensorless mode

\*NOTE: The IPS4000 is configured to communicate to the drives with the following parameters: Modbus RTU, 19200 baud, no parity, 8 bits 1 stop bit

Parameter: FBUS SOURCE	
Options:	Function:
FBUS1	This is the default. The PLC utilizes the field card in the fieldbus card slot to communicate with the VFDs
FBUS2	The PLC utilizes port J26 FBUS2 to communicate with the VFDs. This option can be used if the field card is damaged (this option is not available for IPS4003)

Button: SAVE	
Range:	Function:
N/A	Saves current parameters as default. Only available in level 2

Button: RESTORE	
Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

Parameter: MIN SPEED	
Range:	Function:
0.0-100.0%	The minimum speed the pumps will be allowed to run in Auto or Hand mode

Parameter: MAX SPEED	
Range:	Function:
0.0-100.0%	The maximum speed the pumps will be allowed to run in Auto or Hand mode

Parameter: DEFAULT SPEED	
Range:	Function:
0.0-100.0 %	Indicates the speed the pumps will run at if all zone sensors fail. It does not apply in sensorless mode

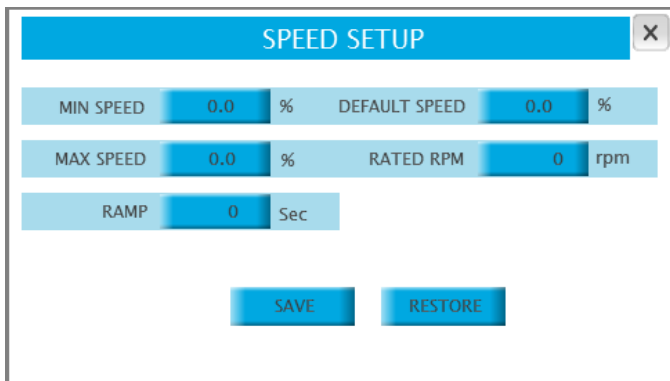
Parameter: RATED RPM	
Range:	Function:
0-9999 RPM	The pump rated RPM as indicated on the motor nameplate

Parameter: RAMP	
Range:	Function:
1-999 SEC	Indicates the amount of time it will take the pumps to increase their speed from 0% to 100% or to decrease their speed from 100% to 0%

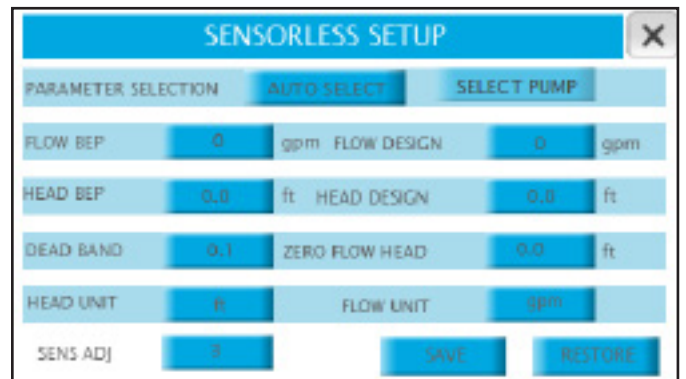
Button: SAVE	
Range:	Function:
N/A	Saves current parameters as default. Only available in level 2

Button: RESTORE	
Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

#### 4.1.4 SPEED SETUP



#### 4.1.5 SENSORLESS SETUP



Parameter: FLOW BEP	
Range:	Function:
0-20000	Flow at BEP (Best Efficiency Point) for one pump. It is used in conjunction with <b>head BEP</b> to stage pumps on and off in order to maintain the system operating efficiently. For more information please contact your local Armstrong representative

Parameter: HEAD BEP	
Range:	Function:
0.0-9999.9	Head at BEP (Best Efficiency Point) for one pump. It is used in conjunction with <b>flow BEP</b> to stage pumps on and off in order to maintain the system operating efficiently. For more information please contact your local Armstrong representative

Parameter: DEAD BAND	
Range:	Function:
0.0 to 1.0	It is used to prevent constant staging of pumps. For more information please contact your local Armstrong representative

Parameter: HEAD UNIT	
Options:	Function:
FT	The drive sensorless head is programmed in ft
PSI	The drive sensorless head is programmed in psi
kPa	The drive sensorless head is programmed in kPa
m	The drive sensorless head is programmed in m
BAR	The drive sensorless head is programmed in bar

Parameter: SENS ADJ	
Range:	Function:
0 - 5	It is used to adjust the sensorless mapping of the vfd. For more information please contact your local Armstrong representative

Parameter: FLOW DESIGN	
Range:	Function:
0 - 20000	Pump Design Flow. It is used to determine the system control curve

Parameter: HEAD DESIGN	
Range:	Function:
0.0 - 9999.9	Pump Design Head. It is used to determine the system control curve

Parameter: ZERO FLOW HEAD	
Range:	Function:
0.0 - 9999.9	Pump Head at zero flow. It is used to determine the system control curve

Parameter: FLOW UNIT	
Options:	Function:
gpm	The drive sensorless flow is programmed in gpm
L/s	The drive sensorless flow is programmed in L/s
m <sup>3</sup> /h	The drive sensorless flow is programmed in m <sup>3</sup> /h

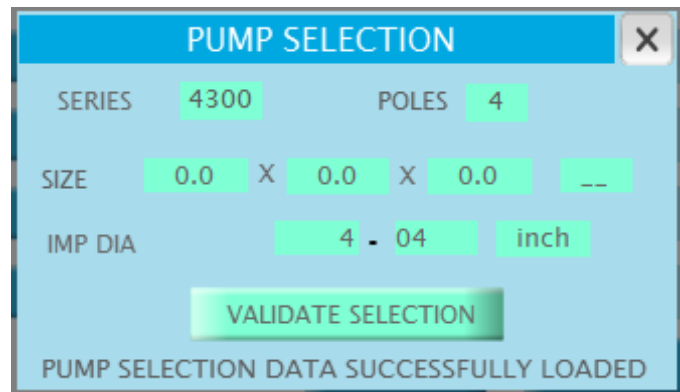
Button: AUTO SELECT	
Options:	Function:
AUTO SELECT	Opens up the <b>pump selection</b> popup window (see below) to allow user to enter pump selection data and automatically populate the sensorless operation parameters
MANUAL SELECT	By selecting this option, the user manually enters data on the sensorless operation parameters

Button: SELECT PUMP	
Options:	Function:
N/A	When in <b>auto select</b> mode (see button above), this buttons opens up the <b>pump selection</b> popup window if it is necessary to edit the pump selection data

Button: SAVE	
Range:	Function:
N/A	Saves current parameters as default. Only available in level 2

Button: RESTORE	
Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

#### 4.1.5.1 PUMP SELECTION



Parameter: SERIES	
Options:	Function:
4300	Selects pump series 4300
4302	Selects pump series 4302

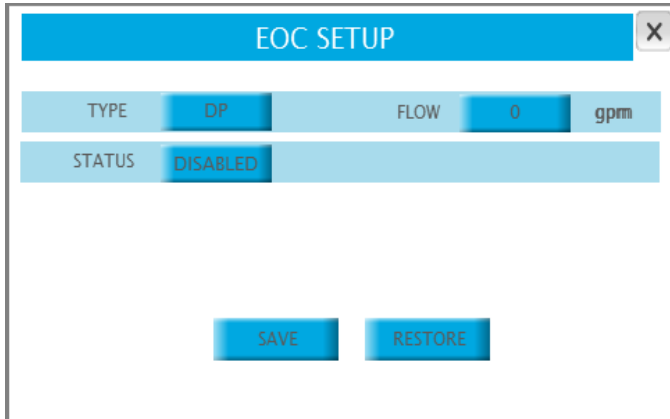
Parameter: POLES	
Range:	Function:
2 to 8	Select the pump number of poles

Parameter: SIZE	
Range:	Function:
N/A	Enter the pump size: Suction, Discharge and Nominal Impeller size. Then select whether the pump is low (L) or high (H) flow



<b>Parameter: IMP DIA</b>	
Range:	Function:
N/A	Enter the pump impeller diameter and units (inch or mm)
<b>Button: VALIDATE SELECTION</b>	
Range:	Function:
N/A	Based on the pump data entered, selects pump design and BEP data and populates the corresponding parameters on the <b>sensorless setup screen</b> . If the pump data entered is invalid an error message is displayed

4.1.6 EOC SETUP

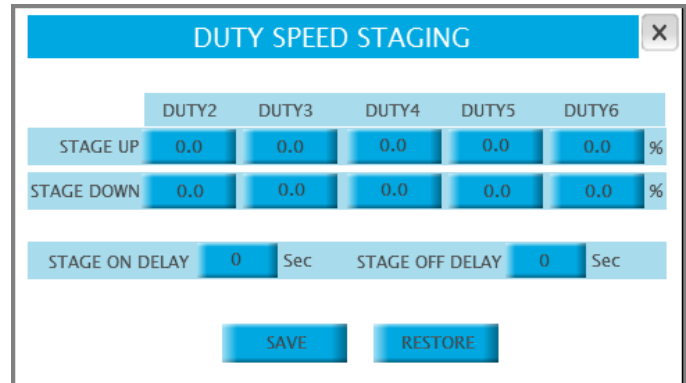


<b>Parameter: TYPE</b>	
Options:	Function:
DP	EOC (End of Curve) protection is achieved with a DP sensor
FLOW	EOC protection is achieved with a flow sensor or with the sensorless flow if available
<b>Parameter: STATUS</b>	
Options:	Function:
DISABLED	EOC protection is disabled
ENABLED	EOC protection is enabled. If the DP or flow of one pump exceeds the EOC setpoint (see below), the next lag pump will be immediately staged on
<b>Parameter: RANGE</b>	
Range:	Function:
0 – 999.9	Indicates the range of the DP sensor in engineering units. This value corresponds to the sensor’s 20mA output

<b>Parameter: FLOW</b>	
Range:	Function:
0 – 20000	Indicates the pump’s flow EOC setpoint. If the reading from the sensor exceeds this value, the next lag pump is staged on

<b>Parameter: DP</b>	
Range:	Function:
0–20000	Indicates the pump’s DP EOC setpoint. If the reading from the sensor combined with the pump speed is below this value, the next lag pump is staged on
<b>Button: SAVE</b>	
Range:	Function:
N/A	Saves current parameters as default. Only available in level 2
<b>Button: RESTORE</b>	
Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

4.1.7 STAGING SETUP



<b>Parameter: STAGE UP DUTY2</b>	
Range:	Function:
0.0 – 100.0%	Determines the Duty1 pump speed at which the Duty2 pump will be staged on. (Not available for IVS sensorless drives)

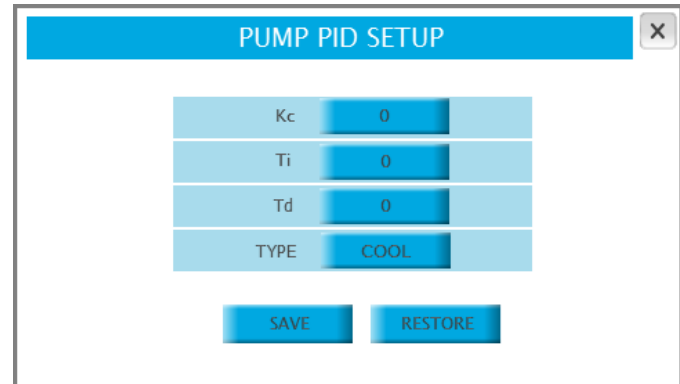
<b>Parameter: STAGE UP DUTY3</b>	
Range:	Function:
0.0 – 100.0 %	Determines the Duty1 pump speed at which the Duty3 pump will be staged on. (Not available for IVS sensorless drives)

<b>Parameter: STAGE UP DUTY4</b>	
Range:	Function:
0.0 – 100.0 %	Determines the Duty1 pump speed at which the Duty4 pump will be staged on. (Not available for IVS sensorless drives)

<b>Parameter: STAGE UP DUTY5</b>	
Range:	Function:
0.0 – 100.0 %	Determines the Duty1 pump speed at which the Duty5 pump will be staged on. (Not available for IVS sensorless drives)

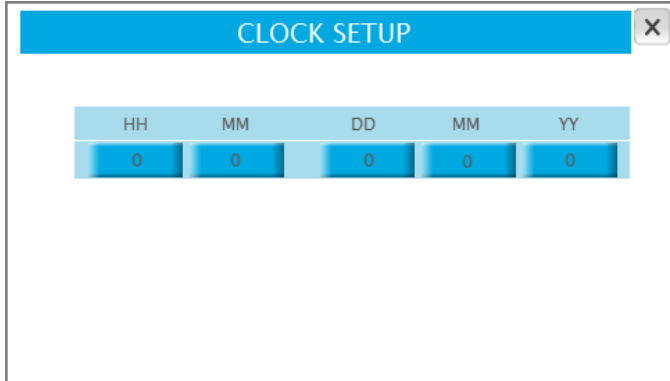
<b>Parameter: STAGE UP DUTY6</b>	
<b>Range:</b>	<b>Function:</b>
0.0 – 100.0 %	Determines the Duty1 pump speed at which the Duty6 pump will be staged on. (Not available for IVS sensorless drives)
<b>Parameter: STAGE DOWN DUTY2</b>	
<b>Range:</b>	<b>Function:</b>
0.0 – 100.0 %	Determines the Duty1 pump speed under which the Duty2 pump will be staged off. (Not available for IVS sensorless drives)
<b>Parameter: STAGE DOWN DUTY3</b>	
<b>Range:</b>	<b>Function:</b>
0.0 – 100.0 %	Determines the Duty1 pump speed under which the Duty3 pump will be staged off. (Not available for IVS sensorless drives)
<b>Parameter: STAGE DOWN DUTY4</b>	
<b>Range:</b>	<b>Function:</b>
0.0 – 100.0 %	Determines the Duty1 pump speed under which the Duty4 pump will be staged off. (Not available for IVS sensorless drives)
<b>Parameter: STAGE DOWN DUTY5</b>	
<b>Range:</b>	<b>Function:</b>
0.0 – 100.0 %	Determines the Duty1 pump speed under which the Duty5 pump will be staged off. (Not available for IVS sensorless drives)
<b>Parameter: STAGE DOWN DUTY6</b>	
<b>Range:</b>	<b>Function:</b>
0.0 – 100.0 %	Determines the Duty1 pump speed under which the Duty6 pump will be staged off. (Not available for IVS sensorless drives)
<b>Parameter: STAGE ON DELAY</b>	
<b>Range:</b>	<b>Function:</b>
0.0 – 999 sec	Determines the time delay before staging on the next lag pump once the conditions are met. It applies to all drives, including IVS sensorless
<b>Parameter: STAGE OFF DELAY</b>	
<b>Range:</b>	<b>Function:</b>
0.0 – 999 sec	Determines the time delay before staging off the last lag pump once the conditions are met. It applies to all drives, including IVS sensorless
<b>Button: SAVE</b>	
<b>Range:</b>	<b>Function:</b>
N/A	Saves current parameters as default. Only available in level 2
<b>Button: RESTORE</b>	
<b>Range:</b>	<b>Function:</b>
N/A	Restores default parameters. Only available in levels 1 & 2

#### 4.1.8 PID SETUP



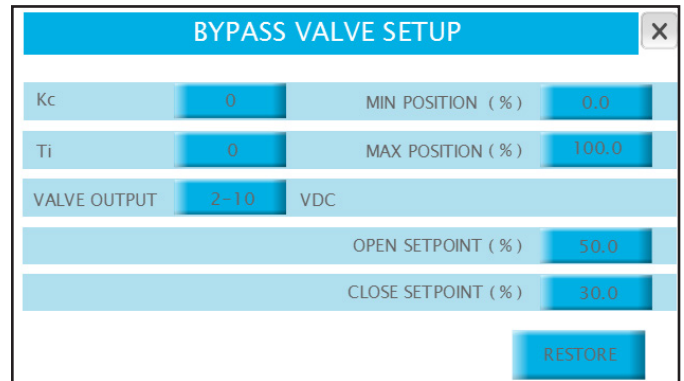
<b>Parameter: Kc</b>	
<b>Range:</b>	<b>Function:</b>
0–9999	Determines the pump speed control PID loop gain. Smaller values correspond to a more responsive controller
<b>Parameter: Ti</b>	
<b>Range:</b>	<b>Function:</b>
0–999	Determines the pump speed control PID loop integral time. Larger values correspond to more iterations and reduction of steady state error
<b>Parameter: Td</b>	
<b>Range:</b>	<b>Function:</b>
0–999	Not used
<b>Parameter: TYPE</b> (Only appears when zone units are set on temperature)	
<b>Options:</b>	<b>Function:</b>
COOL	Active zone is the zone with the largest deviation. Pump speed increases if the zone temperature increases
HEAT	Active zone is the zone with the smallest deviation. Pump speed decreases if the zone temperature increases
<b>Button: SAVE</b>	
<b>Range:</b>	<b>Function:</b>
N/A	Saves current parameters as default. Only available in level 2
<b>Button: RESTORE</b>	
<b>Range:</b>	<b>Function:</b>
N/A	Restores default parameters. Only available in levels 1 & 2

4.1.9 CLOCK SETUP



<b>Parameter: HH</b>	
Range:	Function:
0 – 24	Sytem clock hour
<b>Parameter: MM</b>	
Range:	Function:
0 – 60	Sytem clock minute
<b>Parameter: DD</b>	
Range:	Function:
1 – 31	Sytem clock day
<b>Parameter: MM</b>	
Range:	Function:
1 – 12	Sytem clock month
<b>Parameter: YY</b>	
Range:	Function:
00 – 99	Sytem clock year

4.1.10 BYPASS VALVE SETUP



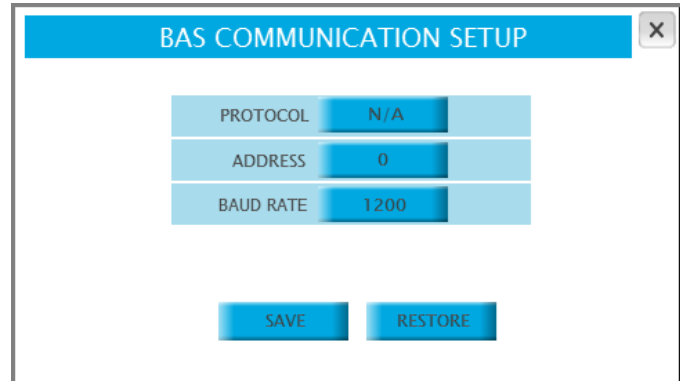
<b>Parameter: Kc</b>	
Range:	Function:
0 – 9999	Determines the valve control PID loop gain. Smaller values correspond to a more responsive controller
<b>Parameter: Ti</b>	
Range:	Function:
0 – 999	Determines the valve control PID loop integral time. Larger values correspond to more iterations and reduction of steady state error
<b>Parameter: VALVE OUTPUT</b>	
Options:	Function:
0 – 10 VDC	0 VDC commands the valve as fully closed. 10 VDC as fully open
2 – 10 VDC	2 VDC commands the valve as fully closed. 10 VDC as fully open
<b>Parameter: MINIMUM POSITION</b>	
Range:	Function:
0.0 – 100.0	Minimum position the valve is allowed to
<b>Parameter: MAXIMUM POSITION</b>	
Range:	Function:
0.0 – 100.0	Maximum position the valve is allowed to
<b>Parameter: OPEN SETPOINT</b>	
Range:	Function:
0.0 – 100.0	When system flow is under the chiller/boiler minimum and the bypass valve is open at this percentage (or above), the pumps will ramp up to maximum speed
<b>Parameter: CLOSE SETPOINT</b>	
Range:	Function:
0.0 – 100.0	When the system flow is under the chiller/boiler minimum and the bypass valve is closing and reaches this percentage (or below) the pumps return to their normal speed

<b>Button: SAVE</b>	
Range:	Function:
N/A	Saves current parameters as default. Only available in level 2

<b>Button: RESTORE</b>	
Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

#### 4.1.11 BAS COMMUNICATION SETUP



<b>Parameter: PROTOCOL</b>	
Options:	Function:
N/A	No BAS protocol is selected
Modbus	Selects Modbus RTU
Lonworks	Selects Lonworks
BACnet	Selects BACnet

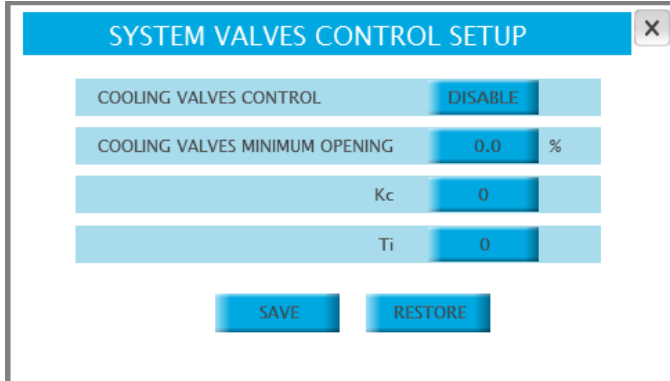
<b>Parameter: ADDRESS</b>	
Range:	Function:
0-127	Selects the IPS BAS address. Only applies to Modbus protocol

<b>Parameter: BAUD RATE</b>	
Options:	Function:
1200	Selects 1200 as baud rate. Only applies to Modbus protocol
2400	Selects 2400 as baud rate. Only applies to Modbus protocol
4800	Selects 4800 as baud rate. Only applies to Modbus protocol
9600	Selects 9600 as baud rate. Only applies to Modbus protocol
19200	Selects 19200 as baud rate. Only applies to Modbus protocol

<b>Button: SAVE</b>	
Range:	Function:
N/A	Saves current parameters as default. Only available in level 2

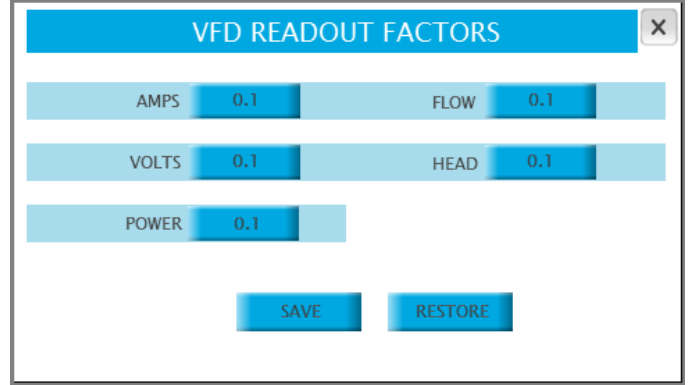
<b>Button: RESTORE</b>	
Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

4.1.12 SYSTEM VALVES CONTROL SETUP



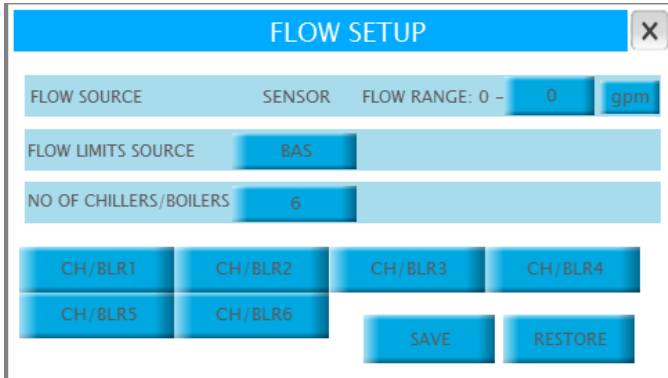
Parameter: COOLING VALVES CONTROL	
Options:	Function:
DISABLED	System valves control is disabled
ENABLED	System valves control is enabled. The PLC will modify the active zone setpoint in order to maintain the system valve with the maximum opening at setpoint
Parameter: COOLING VALVES MINIMUM OPENING	
Range:	Function:
0.0 – 100.0%	Indicates the setpoint for the minimum opening of the system valves
Parameter: Kc	
Range:	Function:
0–9999	Determines the system valves control PID loop gain. Smaller values correspond to a more responsive controller
Parameter: Ti	
Range:	Function:
0–999	Determines the system valves control PID loop integral time. Larger values correspond to more iterations and reduction of steady state error
Button: SAVE	
Range:	Function:
N/A	Saves current parameters as default. Only available in level 2
Button: RESTORE	
Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

4.1.13 VFD READOUT SETUP



Parameter: AMPS	
Options:	Function:
0.1	The current value read from the vFD is divided by 10
1	The current value read from the vFD is not scaled
10	The current value read from the vFD is multiplied by 10
Parameter: VOLTS	
Options:	Function:
0.1	The voltage value read from the vFD is divided by 10
1	The voltage value read from the vFD is not scaled
10	The voltage value read from the vFD is multiplied by 10
Parameter: POWER	
Options:	Function:
0.1	The kW value read from the vFD is divided by 10
1	The kW value read from the vFD is not scaled
10	The kW value read from the vFD is multiplied by 10
Parameter: FLOW	
Options:	Function:
0.1	The flow value read from the vFD is divided by 10
1	The flow value read from the vFD is not scaled
10	The flow value read from the vFD is multiplied by 10
Parameter: HEAD	
Options:	Function:
0.1	The head value read from the vFD is divided by 10
1	The head value read from the vFD is not scaled
10	The head value read from the vFD is multiplied by 10
Button: SAVE	
Range:	Function:
N/A	Saves current parameters as default. Only available in level 2
Button: RESTORE	
Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

4.1.14 FLOW SETUP



**Parameter: FLOW SOURCE** (read only)

Options:	Function:
SENSOR	Indicates that the flow is obtained from a sensor. This parameter is automatically set based on the vfd type selected on the <b>pump setup</b> screen
SENSORLESS	Indicates that the flow is obtained from sensorless vfd's. This parameter is automatically set based on the vfd type selected on the <b>pump setup</b> screen

**Parameter: FLOW RANGE**

Range:	Function
0 – 20000	Indicates the range of the flow sensor in engineering units. This value corresponds to the sensor's 20mA output. Note: this parameter only appears when <b>flow source</b> is <b>sensor</b>

**Parameter: FLOW LIMITS SOURCE**

Options:	Function:
LOCAL	Select <b>LOCAL</b> to manually setup the number of available chillers or boilers and enter flow limits of each unit on the corresponding chiller popup screens. IPS4000 uses digital inputs to determine which chillers/boilers are enabled.
BAS	Select ' <b>BAS</b> ' for automatic selection of chiller/boiler minimum and maximum flow obtained from BAS

**Parameter: NO OF CHILLERS/BOILERS**

Range:	Function:
1–6	Indicates number of chillers/boilers installed in the system.

**FLOW ENG. UNIT**

Options:	Function:
gpm	Flow sensor in gpm are used
L/s	Flow sensor in L/s are used
m <sup>3</sup> /h	Flow sensor m <sup>3</sup> /h are used

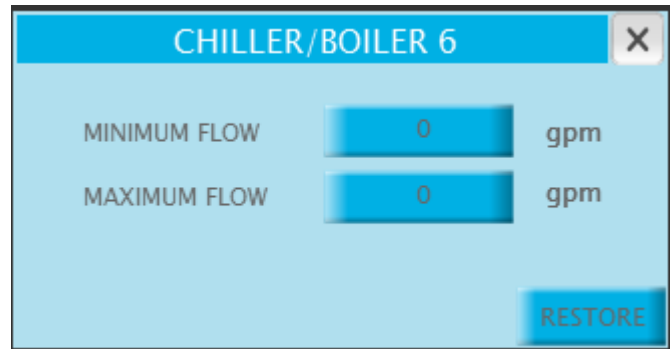
**Button: SAVE**

Range:	Function:
N/A	Saves current parameters as default. Only available in level 2

**Button: RESTORE**

Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

4.1.15 CHILLER/BOILER 1 TO 6 SETUP



There is one popup screen per chiller/boiler. Only accesible when **FLOW LIMITS SOURCE** is set to **LOCAL**

**Parameter: MINIMUM FLOW**

Range:	Function:
0–20000	Rated minimum flow across that particular chiller or boiler

**Parameter: MAXIMUM FLOW**

Range:	Function:
0–20000	Rated maxium flow across that particular chiller or boiler

**Button: SAVE**

Range:	Function:
N/A	Saves current parameters as default. Only available in level 2

**Button: RESTORE**

Range:	Function:
N/A	Restores default parameters. Only available in levels 1 & 2

## 5.0 IPS 4000 CONTROL SYSTEM SERVICE LIFECYCLE

MANUFACTURER'S SUGGESTED MAINTENANCE SCHEDULE AND COMPONENT LIFE		YEAR AFTER INSTALLATION									
		1	2	3	4	5	6	7	8	9	10
<b>SOFTWARE AND SETTINGS</b>	<b>MAINTENANCE</b>										
All firmware	As required by manufacturer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Optimization logic & control programming	As service packs as released by Armstrong	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>PANELS &amp; PC/TOUCHSCREEN</b>											
Integrated PC & touchscreen	Replace PC & touchscreen					✓					
PLCS	Check and confirm voltage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PLCS and associated components	Replace										✓
Power supply	Check and confirm voltage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Power supply	Replace on failure										
Panel integrity (gasket, terminals, glands...)	Inspect and repair as needed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Panel filter (when included)	Inspect and clean as needed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>SENSORS</b>											
Water temperature sensor(s)	Confirm accuracy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water temperature sensor(s)	Full calibration			✓			✓			✓	
Water flow sensor	Confirm accuracy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water flow sensor	Full calibration			✓			✓			✓	
Pressure differential sensor(s)	Confirm accuracy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pressure differential sensor(s)	Full calibration			✓			✓			✓	

### NOTES

- As with any system the component life expectancy varies according to usage and operating conditions.
- Components operating inside of a clean and weather controlled environment will typically last longer than components exposed to the elements or otherwise operating in dirty environments.
- Component life expectancy also varies according to the power quality (absence of harmonic distortion) and consistency of voltage supplied to the device.

**TORONTO**

23 BERTRAND AVENUE  
TORONTO, ONTARIO  
CANADA  
M1L 2P3  
+1 416 755 2291

**BUFFALO**

93 EAST AVENUE  
NORTH TONAWANDA, NEW YORK  
U.S.A.  
14120-6594  
+1 716 693 8813

**BIRMINGHAM**

HEYWOOD WHARF, MUCKLOW HILL  
HALESOWEN, WEST MIDLANDS  
UNITED KINGDOM  
B62 8DJ  
+44 (0) 8444 145 145

**MANCHESTER**

WOLVERTON STREET  
MANCHESTER  
UNITED KINGDOM  
M11 2ET  
+44 (0) 8444 145 145

**BANGALORE**

#59, FIRST FLOOR, 3RD MAIN  
MARGOSA ROAD, MALLESWARAM  
BANGALORE, INDIA  
560 003  
+91 (0) 80 4906 3555

**SHANGHAI**

NO. 1619 HU HANG ROAD, XI DU TOWNSHIP  
FENG XIAN DISTRICT, SHANGHAI  
P.R.C.  
201401  
+86 21 3756 6696

**SÃO PAULO**

RUA JOSÉ SEMIÃO RODRIGUES AGOSTINHO,  
1370 GALPÃO 6  
EMBU DAS ARTES  
SAO PAULO, BRAZIL  
+55 11 4781 5500

ARMSTRONG FLUID TECHNOLOGY  
ESTABLISHED 1934

ARMSTRONGFLUIDTECHNOLOGY.COM

**MAKING  
ENERGY  
MAKE  
SENSE™**