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Owner's Manual

PCA300

140 LPM/37 GPM

4.5 BAR/65 PSI

Version 1.0.3

1. Cautions and Warnings:

1.1. Intended Use

The PCA300 pump system is designed for ultrapure fluid and chemical dispense and transfer in industrial production machines and equipment. Only qualified personnel shall install the PCA300 system into equipment. All safety precautions must be followed during the installation and use of the PCA300 system.

Equipment marked with this warning symbol has the following hazards.

ELECTRIC SHOCK HAZARD:
To reduce risk of electric shock.

- Connect only to grounded power source.
- Disconnect power before servicing.
- Wait 60 seconds to allow for capacitor discharge.
- 340 VDC,16 amps, 2.3 KW

BURN HAZARD

Heat may transfer to exterior surfaces when pumps operate. To avoid severe burns, do not touch hot fluid or equipment.

HIGH MAGNETIC FIELD STRENGTH PRESENT

Pump contains several large magnets that might influence pacemakers. Keep distance from pacemakers and handle pump components with care.

TOXIC CHEMICALS MAY BE PRESENT

If system has been used to pump chemicals, use the proper personal protective equipment (PPE) when handling. Reference Safety Data Sheet (SDS) for information specific to your chemicals.

HAZARDOUS CHEMICALS MAY BE PRESENT

If system has been used to pump chemicals, use the proper personal protective equipment (PPE) when handling. Reference Safety Data Sheet (SDS) for information specific to your chemicals

PRESSURIZED MATERIAL MAY BE PRESENT

Pumps in use contain pressurized materials. Eliminate liquid and air pressure via shut off valves before pump is serviced or removed from the system.

MOVING PARTS HAZARDS

Pump contains moving parts. Do not open or disassemble pump.

2. Technical Specifications

2.1. System Components

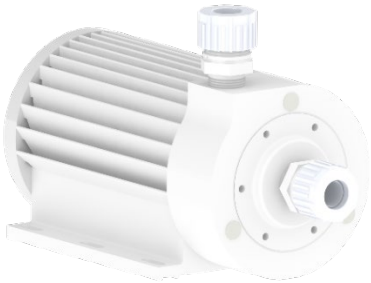



Table 1			
System Components			
Item	Component	Characteristics	Values
1	PCA300 Pump	Materials in flow path	PTFE/PFA
		Sealing Features	Tongue and Groove
		Max Flow	140 LPM
		Max Diff.-Pressure	65 PSI
		Max Pressure	150 PSI
		Max Fluid Temp	90°C
		Thermal Protection	110°C (Internal Temperature Sensor)
		Housing	ETFE coated Aluminum Water Resistant (IP66)
		Max RPM (230 VAC)	5500 RPM
		Noise Level	70 dBA
		Cables	ETFE Jacket/PTFE Insulation
2	PCA300 Controller	Voltage/ Max Current (Controller Power Input)	1X 230 VAC, 50/60 Hz, 16 A
		Voltage/Max Current (48 VDC Input)	48 VDC, 20 A
		Interface (Serial I/O)	RS232 (Use with Service Software/Command Line)
		Interface (Digital & Analog I/O)	PLC (PLC module not included)
		Pump Connections (Output Power)	Cable 1: Power Cable 2: Sensors
		Thermal Protection	80°C (Internal temperature sensor)
3	Recommended 48 VDC, 750 W Power Supply	Voltage/Max Current	100-240 VAC, 50/60 Hz, 10 A
4	Air Cooling Module	Material Inlet Pressure Cooling Medium Connection	Polypropylene/ FKM 1-3 Bar Compressed Air ¼ NPT

2.2. General Environmental Conditions

Table 2	
Environmental Conditions	
Usage	Indoor Use
Altitude	Up 2000 m
Operating ambient temperature	0-40°C
Maximum Humidity	80%
AC Mains supply fluctuations	±10% of nominal voltage
Transient overvoltage's typically present on the mains supply	Surge immunity according to EN61000-4-5
Pollution degree	2

2.3. Sealing and Material Compatibility

2.3.1. Material Compatibility

All fluid path materials are PTFE or PFA

2.3.2. Sealing Methods

The method for sealing components of the fluid path is with PTFE tongue and groove seals.

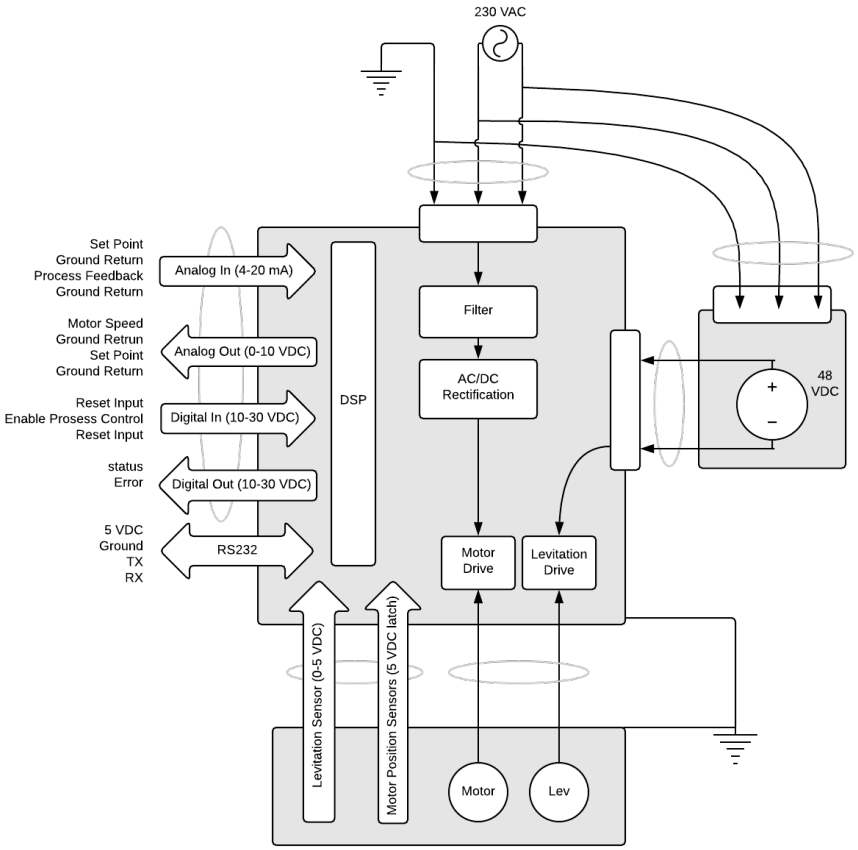
2.3.3. Lifting the Pump

The pump should be lifted using the center of the product as shown in image. Where available make use of rolling cart for transportation. Do not carry pump by liquid connections.

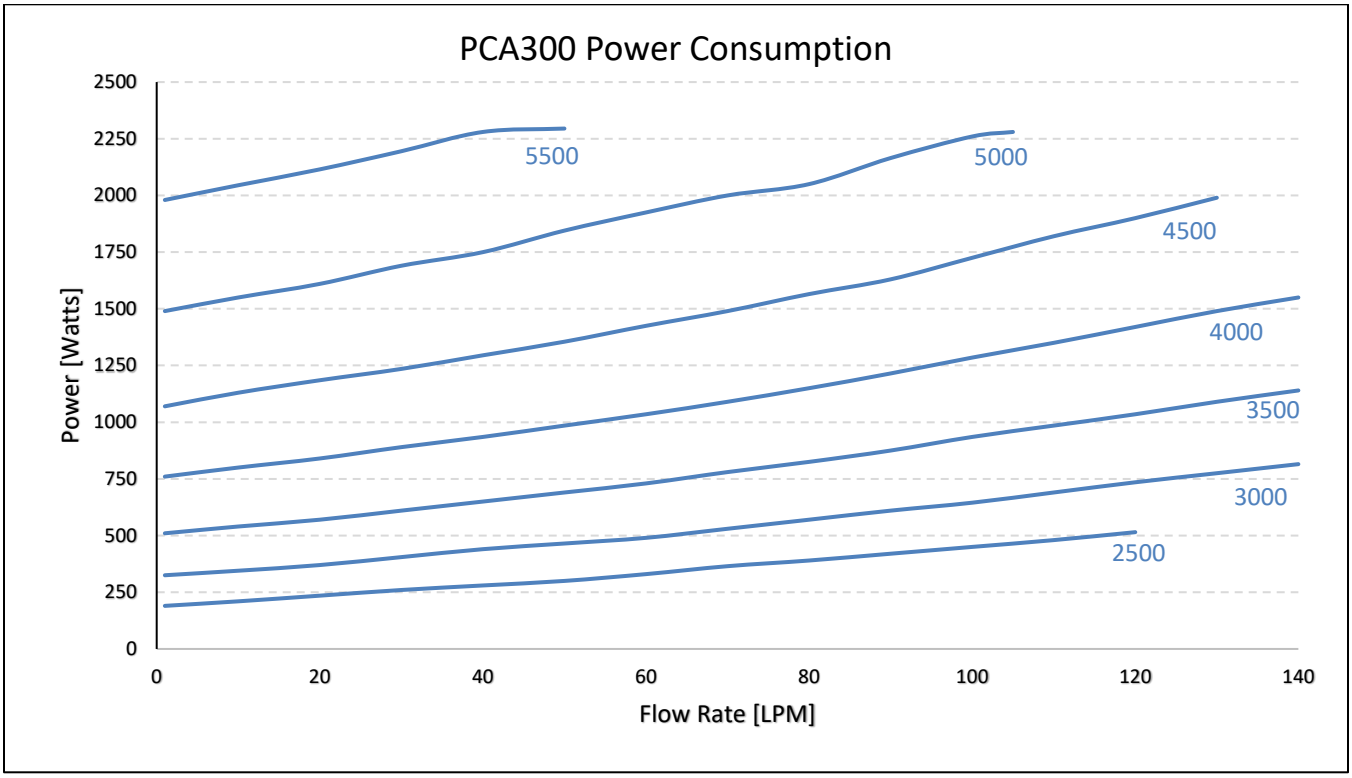
2.4. Electrical Set up

2.4.1. Block Diagram

- Below is a simple block diagram showing how components connect together. There are 3 items in the figure below: pump, controller, and 48 VDC power supply.
- Both the 48 VDC power supply and the controller can be powered off of the same AC power.
- Pump can be controlled by PLC inputs or by RS232 connection to a computer interface.

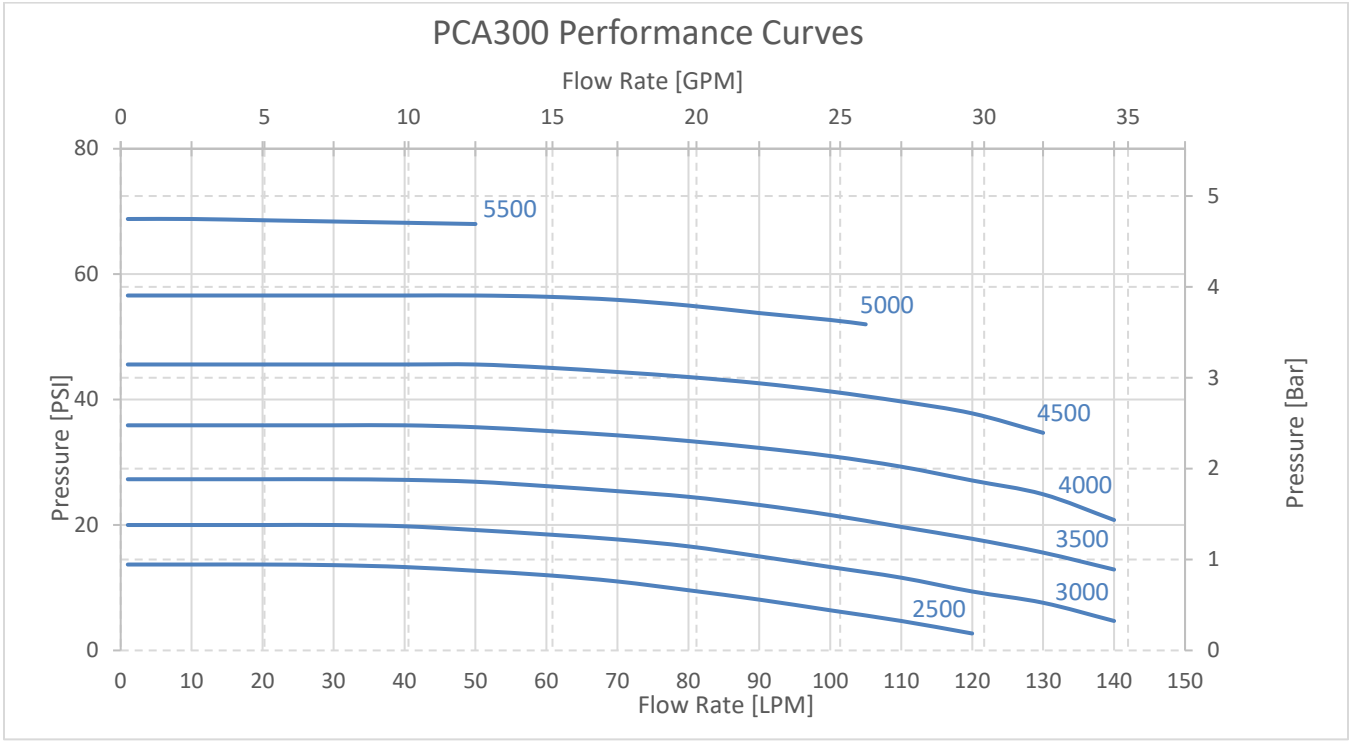


2.5. Power Consumption

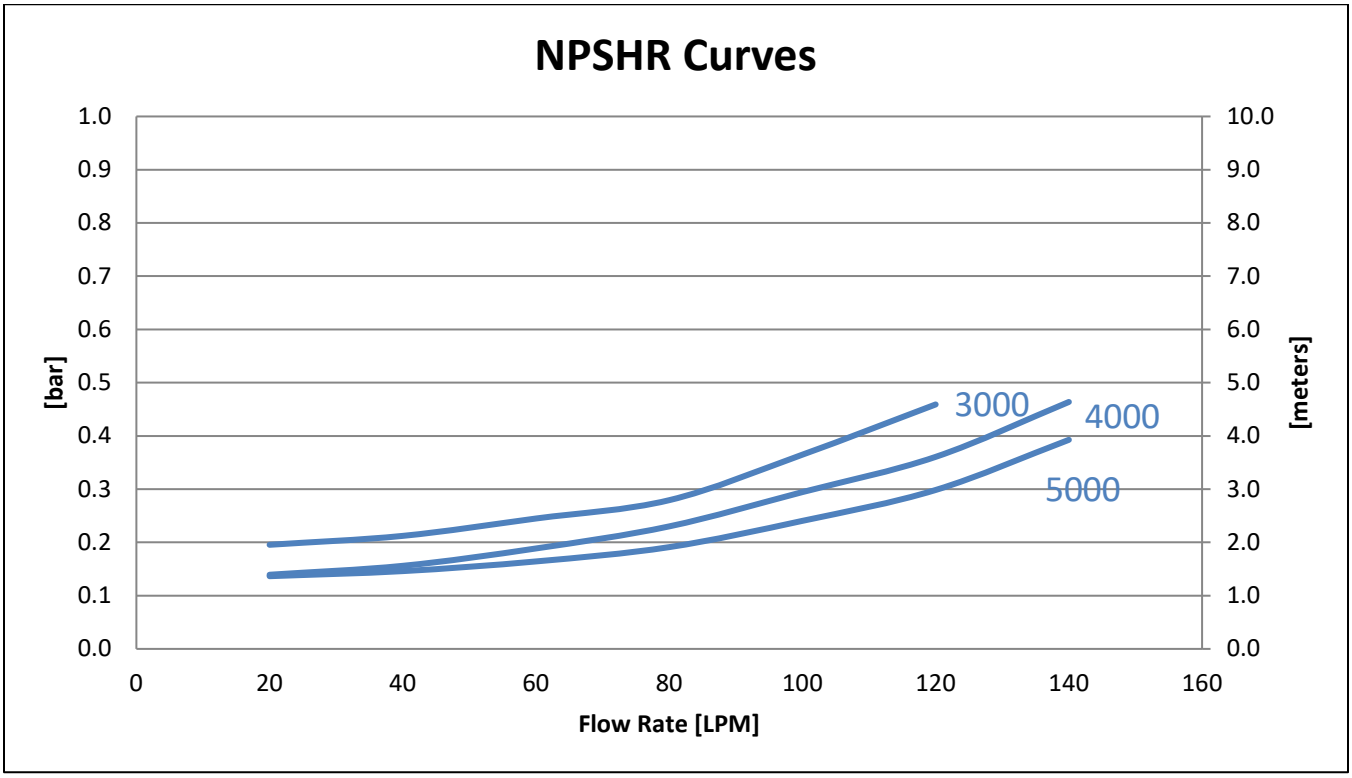


2.6. Hydraulic Specifications

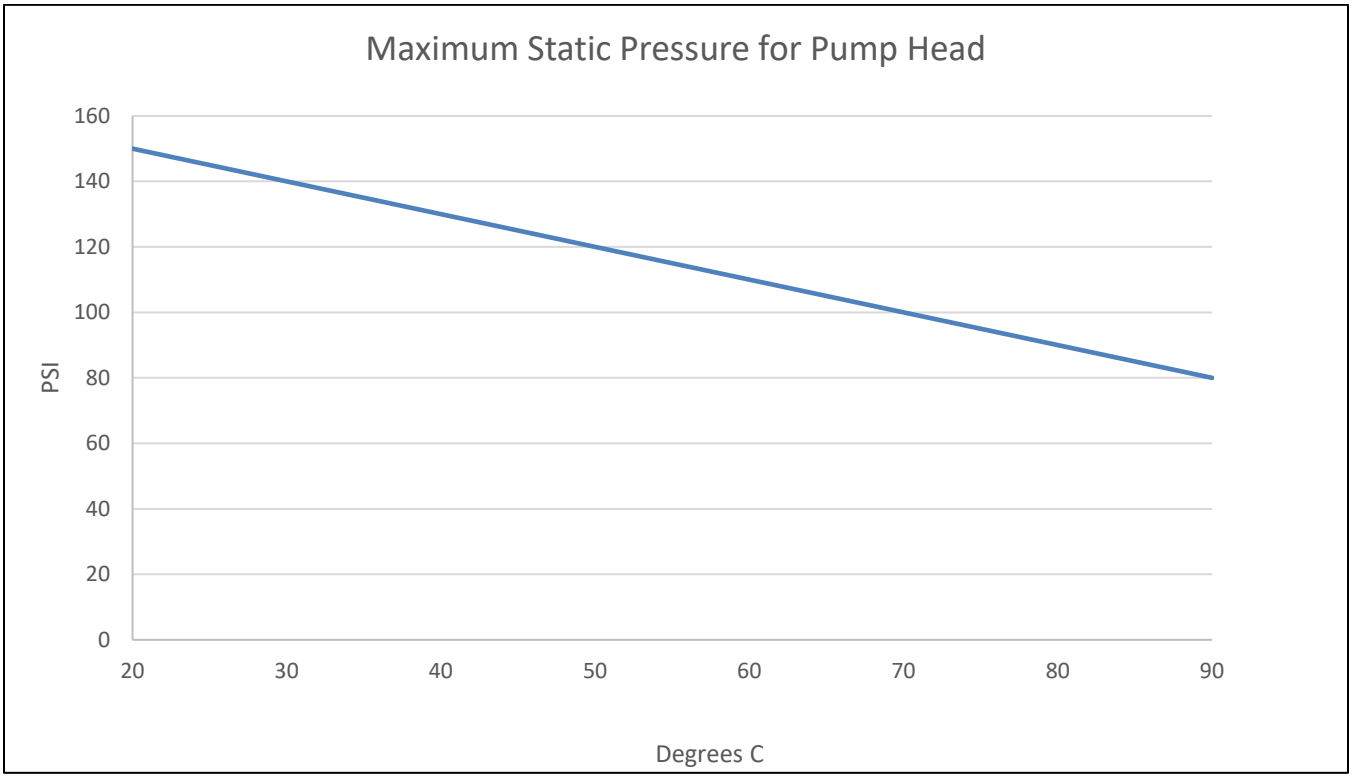
2.6.1. Pump Performance Curves



2.6.2. NPSH3

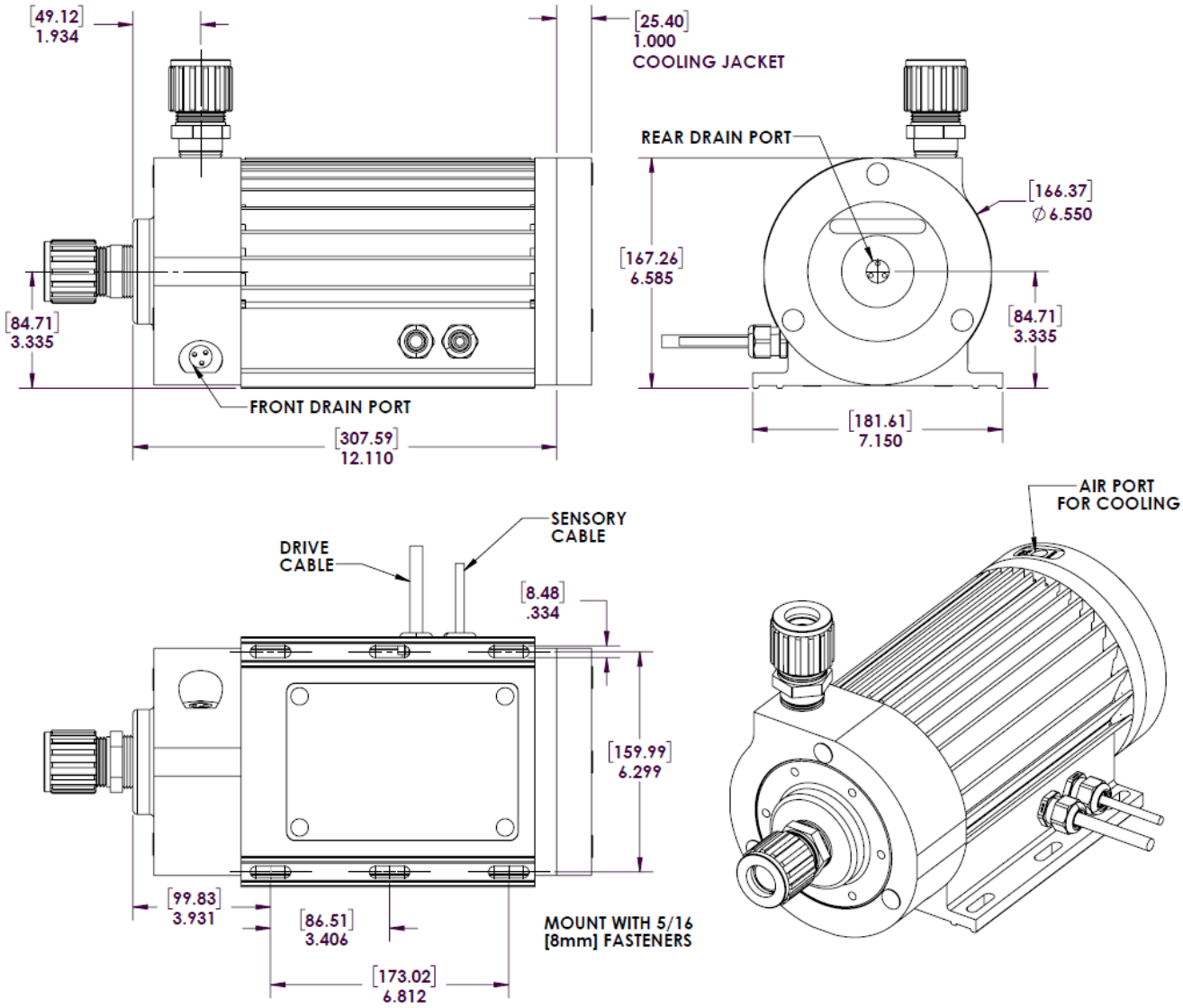


2.6.3. Maximum Allowable Head vs Fluid Temperature



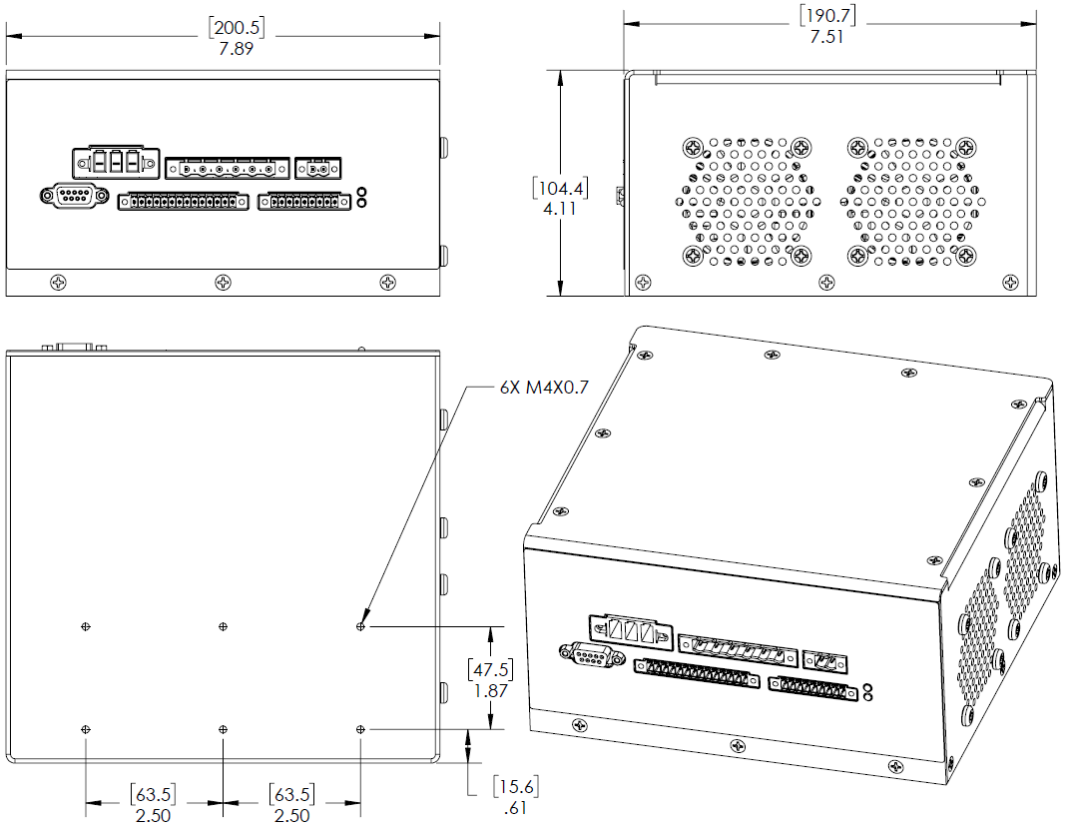
2.7. Pump Dimensions

Pump should be mounted to a solid, non-ferrous, and level surface. Pump can be mounted by fastening the pump feet with bolts or fasteners. Pump must be mounted in a horizontal configuration. Figure below has the cooling module attached. Review section 3 to determine when a cooling jacket is required.



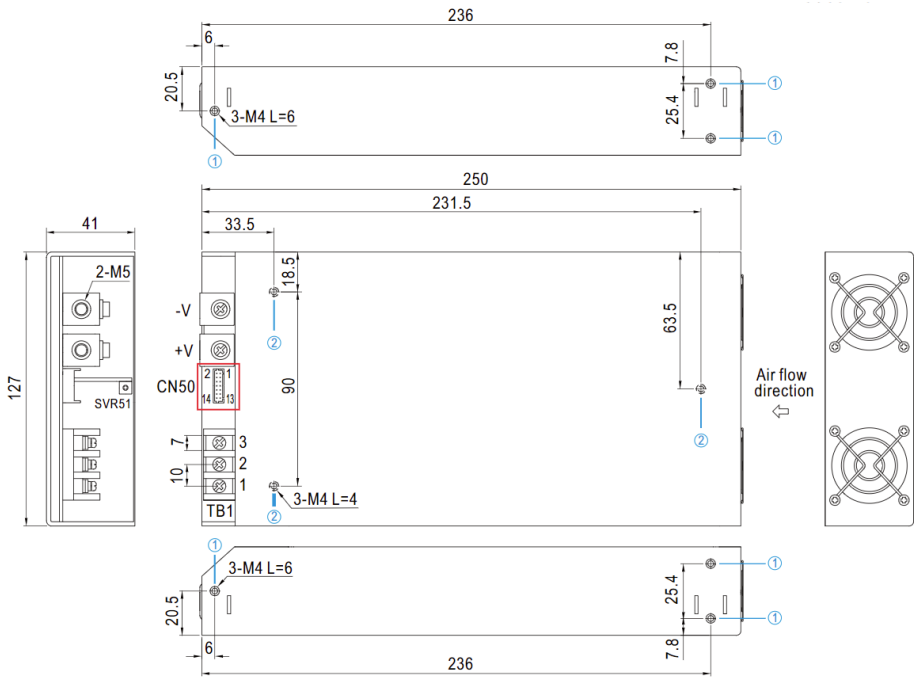
2.8. Controller Dimensions

2.8.1. The figure below gives the basic dimensions for the controller.



2.9. Recommended 48 VDC power supply

The PCA300 system requires an external 48VDC power supply with capability of suppling 20 amps.



(Units in mm)

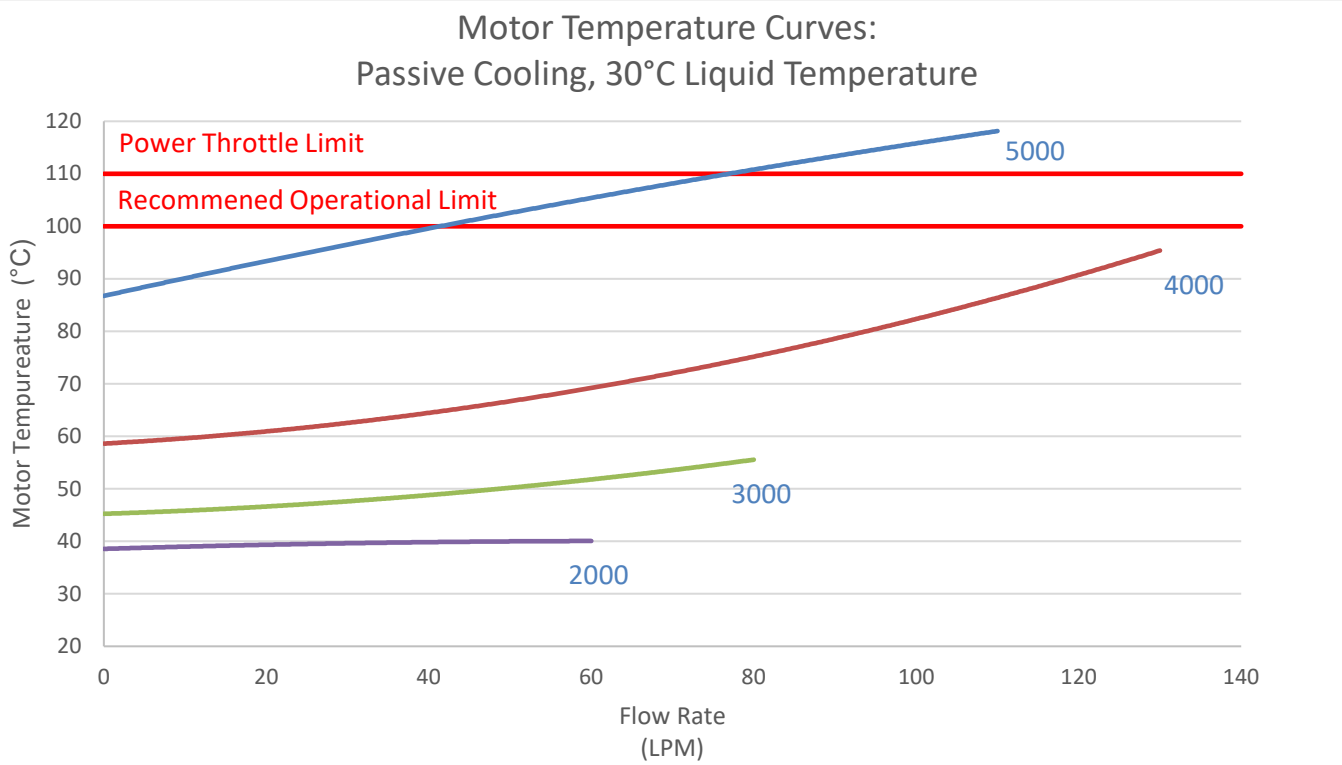
3. Thermal Management

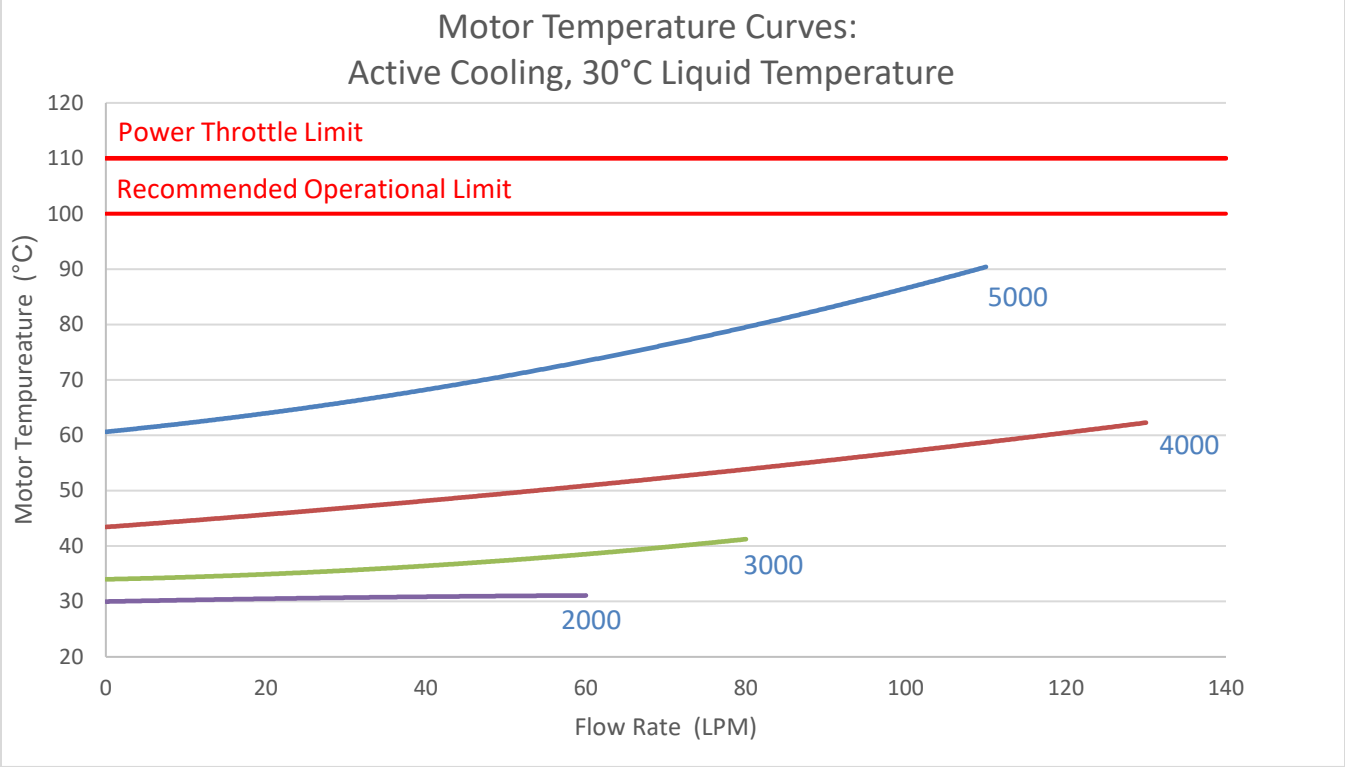
3.1. Temperature Monitoring

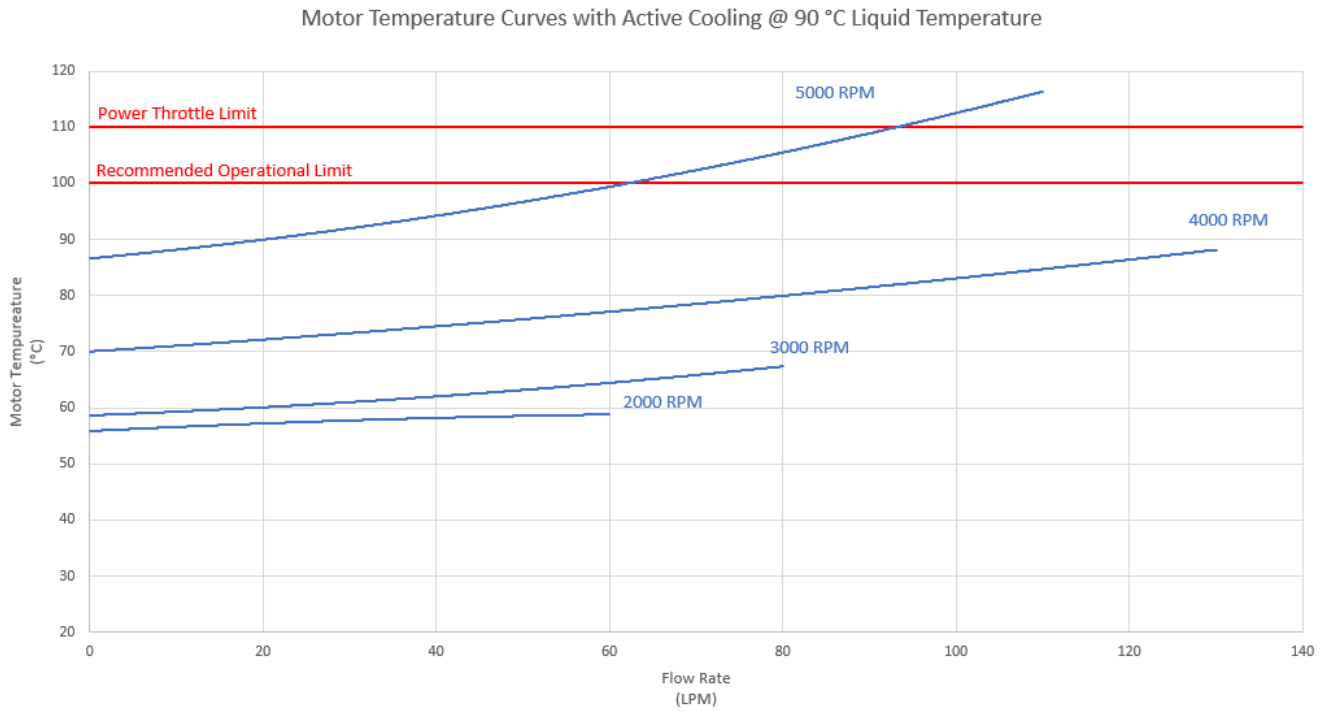
Temperatures of the controller and of the pump are continuously monitored with internal sensors to ensure safety of user and equipment. If the controller temperature ever reaches 80°C, the controller will report an alarm and shut off pump operation. Pump will not restart automatically once the controller has cooled. A warning will be provided if the controller reaches a temperature of 55°C.

If the pump internal temperature reaches 110°C, the controller will report a warning, but the pump operation will remain unchanged. The user may clear a warning once the pump temperature has cooled to 105°C without stopping the pump. Once the pump reaches 110°C, the controller will start to throttle down power to maintain pump temperature from climbing higher. If the pump temperature reaches 120°C, the controller will report an alarm and shut off pump operation. The pump will not restart automatically once temperature is in acceptable range.

3.2. Pump Temperature Curves




Motor Temperature Curves:
Active Cooling, 30°C Liquid Temperature
Power Throttle Limit
Recommended Operational Limit
5000
4000
3000
2000
Motor Tempureature (°C)
Flow Rate (LPM)
120
110
100
90
80
70
60
50
40
30
20
0
20
40
60
80
100
120
140


Motor Temperature Curves with Active Cooling @ 90 °C Liquid Temperature
Power Throttle Limit
Recommended Operational Limit
5000 RPM
4000 RPM
3000 RPM
2000 RPM
Motor Tempureature (°C)
Flow Rate (LPM)
120
110
100
90
80
70
60
50
40
30
20
0
20
40
60
80
100
120
140

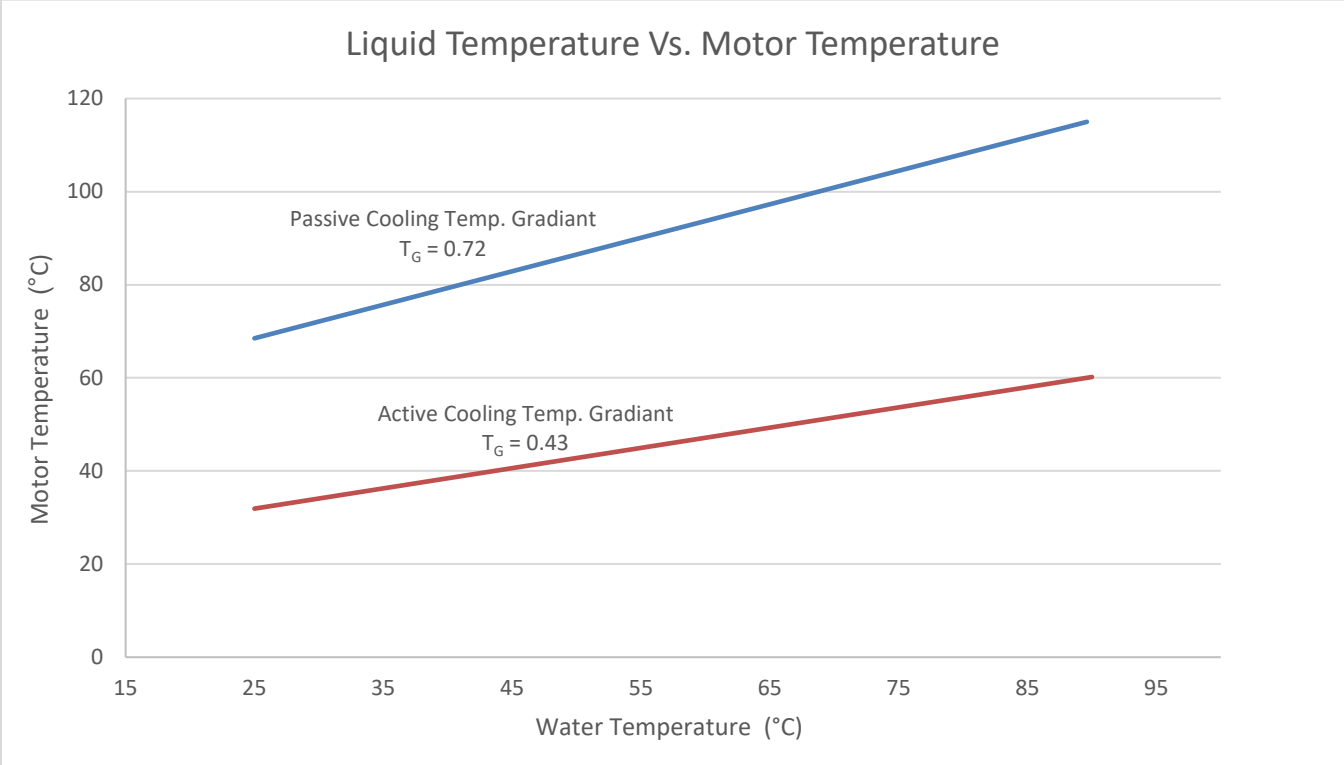
3.2.1. Influence of Liquid Temperature on Pump Temperature.

Motor temperature is affected by the temperature of the liquid being pumped. The motor temperature at any liquid temperature can be estimated by using information in the graph found in section 3.2, the graph below, and the following equation.

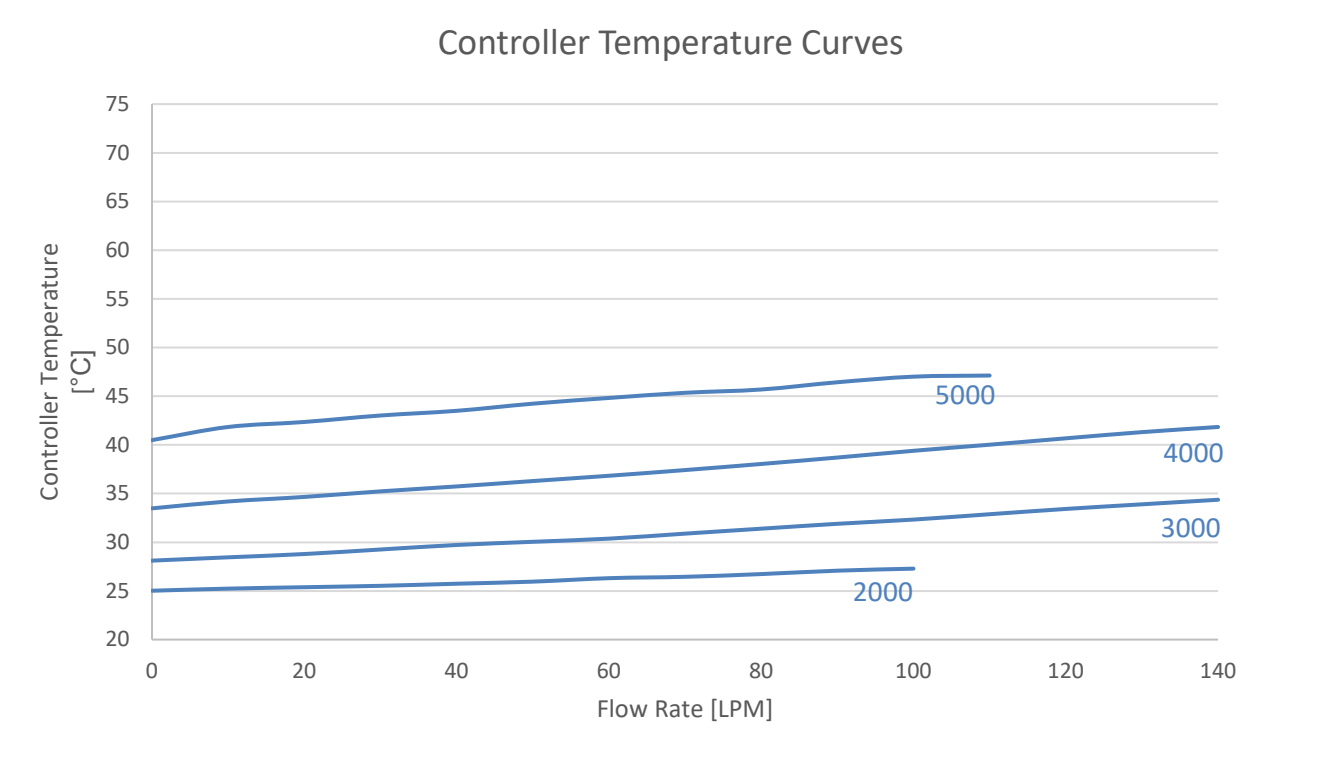
$$T_{motor} = Motor_{Temp} + (T_{Liquid} - 30) * T_G + (T_{Ambient} - 20)$$

Where

T_{motor}	=	*Estimated motor temperature*
$Motor_{Temp}$	=	*Temperature of Motor found in graph located in section 3.2.*
T_{Liquid}	=	*Temperature of the liquid in °C at which motor temperature is wished to be estimated.*
T_G	=	*Temperature Gradient found on graph located below.*
$T_{Ambient}$	=	*Ambient temperature in °C at which motor temperature is wished to be estimated.*



3.3. Controller Temperature



4. Equipment Installation

4.1. Electrical Equipment Installation

4.1.1. Warnings


ELECTRIC SHOCK HAZARD:
Hazardous Voltage may be present. To reduce risk of electric shock.

- Connect only to grounded power source.
- Disconnect power before servicing.
- Wait 60 seconds to allow for capacitor discharge.

ELECTRIC SHOCK HAZARD:

- Controller and power supply should be placed in a spill protected environment (such as a protected electronic cabinet).
- The controller must be connected to earth ground.

Since hazardous voltage may be present, always disconnect the electrical power before servicing any of the connections on the controller or power supply. It is recommended that the controller and the external power supply be installed inside a cabinet where untrained personnel are prohibited access.

4.1.2. Mechanical Connections

Mount the Controller and 48 VDC power supply to 35 mm din-rail inside the electrical cabinet. Din-rail clips can be mounted to the bottom of the controller and 48 VDC power supplies. It is recommended that controller and the 48 VDC power supply be mounted near to each other.

4.1.3. Electrical Connections

The PCA300 system requires two power sources to function. The first power source is AC mains directly to the controller. The second power source is a 48-voltage provided by external power supply. If both power supplies are powered from the same AC main circuit, it is recommended that the circuit contains an external 20-amp rated circuit breaker. It is recommended that the circuit-breaker be placed near the equipment. All electrical wiring insulation shall, at a minimum, be rated for 60°C. Follow the directions below to make the necessary electrical connections.

1. Ensure din rail clips are mounted to controller and 48 VDC power supply
2. Ensure din rail is properly earth grounded.
3. Mount controller and 48 VDC to din rail.
4. Connect output of 48 VDC power supply to 48 input connectors with minimum 12-gauge wire (wire not supplied with equipment). Ensure wires are wired correctly to plug connector per Table 3.
5. Connect the sensor and power cables from the pump to the controller. Ensure cables are wired to the plug connectors correctly per Table 3.
6. Connect PLC connector with desired wiring configuration; ensure cables are wired to the plug connectors correctly per Table 4 (or if using PCA300 interface software connect RS232 connector.)
7. Connect controller AC power input connector into the controller and AC power input to the 48 VDC power supply screw terminals. Ensure cables are wired to the plug connectors correctly per Table 3.
8. Ensure all screw terminals are routinely tightened.

The controller connections consist of 6 connections shown in image below: (Pin 1 starting on the left).

TABLE 3 Controller connections		
Controller 230 VAC MAINS  Pin 1 → LIVE Pin 2 → NEUTRAL Pin 3 → GROUND *Cable for MAINS power source must contain minimum of 12-gauge conductors.	Pump Drive  Pin 1 → RED Pin 2 → WHITE Pin 3 → BLACK Pin 4 → DRAIN Pin 5 → BLUE Pin 6 → BROWN *Connectors work best when conductor insulation is stripped back 0.25 inches [6 mm].	EXTERNAL 48 VDC INPUT  Pin 1 → NEGITIVE Pin 2 → POSITIVE *Cable from 48 VDC power supply must contain minimum of 12-gauge conductors.
RS232 Serial Interface  To communicate with the controller using the software PCA300 Interface a USB to Serial Adapter is required. See Section 6.2 for details on the PCA300 Interface. To be sourced separately.	PLC Interface  See TABLE 4 *Wire not provided. 14-30 AWG.	Pump Signal  Pin 1 →ORANGE(A) Pin 2 →RED(B) Pin 3 →BLACK (Motor temp) Pin 4 →BROWN(5V) Pin 5 →BLUE (Sensor GND) Pin 6 →GREEN(U) Pin 7 →WHITE(V) Pin 8 →YELLOW(W) Pin 9 →DRAIN

TABLE 4

PLC Interface Connections

Pinouts	Function	Connection	Conditions	Notes
Pin 1	Reset	Digital Input 1	If Digital Input Reference Voltage is low then: • High Signal = True • Low Signal = False. If Digital Input Reference Voltage is high then: • Low Signal = True • High Signal = False Input voltage range for high signal is 10-30 VDC.	Send Error Reset for 1 second when an error occurs, then turn off. If an error occurred that cause the pump to stop then turn off enable pump signal before clearing the error.
Pin 2	Process Mode	Digital Input 2		Turn on process mode signal before enabling the pump and the pump will enter process mode which does a closed loop control on the process input relative to the setpoint input.
Pin 3	Enable	Digital Input 3		Turn on enable signal to operate pump. If no errors are present then pump will start operation at minimum speed. Status signal will turn on when system starts up.
Pin 4	Digital Input Ref	Digital Input Reference		
Pin 5	Set Point	Analog Input 1 +	4-20 mA current loop input. Where signal + is current input, and signal – is the return signal. Input impedance is ohms.	If not in process mode then input sets the pump speed with 4 mA= minimum speed and 20 mA = maximum speed. When in process mode then input sets the target value for the process loop.
Pin 6		Analog Input 1 -		
Pin 7	Process Input	Analog Input 2 +		Sensor input for process loop.
Pin 8		Analog Input 2 -		
Pin 9	Status Pin 1	Digital Output 1	Relay style output. Relay is True (1) when closed and False (0) when open, or no connection. Relay is rated for 10-30 VDC and 50ma.	If enable digital input (Pin 3) is high, the combined values of Pin-9 and Pin-10 signify the following states:
Pin 10	Status Pin 2	Digital Output 2		
Pin 11	Digital Output Ref	Digital Output Common		
Pin 12	RPM	Analog Output 1	0-10 VDC analog output signals. Where 0 VDC = 0% signal and 10 VDC = 100% signals.	When pump is operational then signal indicates pump speed as a percentage from min to max speed. 0 VDC = 0 RPM; 10 VDC = 5500 RPM
Pin 13	Process Output	Analog Output 2		This output echoes out the process signal input even if process control is not enabled.
Pin 14	Analog Output Reference	Analog Output Common		

Pin 9	Pin 10	Pump State
0	0	Error/Alarm
0	1	Ready
1	0	Warning/Deviation
1	1	Running

4.2. Installation of the Pump

4.2.1. Overview of the Pump

The pump consists of two main parts, the motor and the pump housing. The motor levitates and rotates the impeller creating a pressure differential between the inlet and the outlet of the pump housing. The pump housing contains and directs the fluid from the inlet to the outlet.

4.2.1.1. Pump Cables

The motor is controlled by the power cable and the signal cable. When the motor is installed the cables should maintain a minimum bend radius of 3". Cables can be routed separately or together from the motor to the controller.

4.2.1.2. Pump Inlet

Pump inlet can be a number of different fitting depending on the ordering instructions. Recommended tube size for pump inlet is 1". Using smaller tube sizes on the inlet may increase cavitation and reduce flow.

4.2.1.3. Pump Outlet

Pump outlet can be a number of different fittings. Recommended tube sizing for pump outlet is 1". Using smaller sizes may result in reduced flow.

4.2.1.4. Pump Mounting

Pump should be mounted with four fasteners to a non-ferrous surface. Pump should be installed on a level horizontal surface. For appropriate cooling, there should be 1" of air flow all around the pump. See section 2.7 for mounting hole dimensions.

4.2.1.5. Operating the Pump Dry

In some cases, a user may want to run the pump dry before running it with fluid in it. It is recommended that when operating the pump dry that the max pump speed be kept below 3000 RPM.

5. Air-Cooling Module

5.1. Overview

There are operation applications in which the pump will require additional cooling by external forced air. These parameters might include pumping higher temperature fluid, recirculation, high pressure applications, etc. To understand whether the application needs to be cooled with forced air, review section 3 details.

5.2. Installation of Air-Cooling Module

1.
Remove the three fastener cover caps and 5/8-inch length, 10-32 fasteners from back of pump.

2.
Ensure the two O-rings are seated in their corresponding grooves on the air-cooling module.

3.
Place air-cooling module on back of pump and secure with 1.5-inch length 10-32 fasteners.

4.
Replace fastener cover caps over fasteners and plumb air supply into air-cooling module using ¼ NPT adapter. Apply 15-30 PSI (1- Bar) of air pressure.

6. PCA300 System Operation

6.1. Overview

Once installation is complete, the system can be powered on. Power on the 48 VDC power supply and the pump controller's VAC power, power sequence doesn't matter. If the 48 VDC power supply is slow to turn on relative to the pump controller an error/warning may occur. If warning does occur then send reset signal from PLC interface or send clear errors command from PCA300 Interface software. Note: During power-up some relays in the controller will activate and make an audible sound.

The system can be operated from two different interfaces; the PCA300 Interface Software or the PLC Interface. Do not operate the pump from both the PLC interface and the PCA300 Interface Software at the same time. If running the PLC interface, PCA300 Interface Software can be used to monitor the current status of the pump.

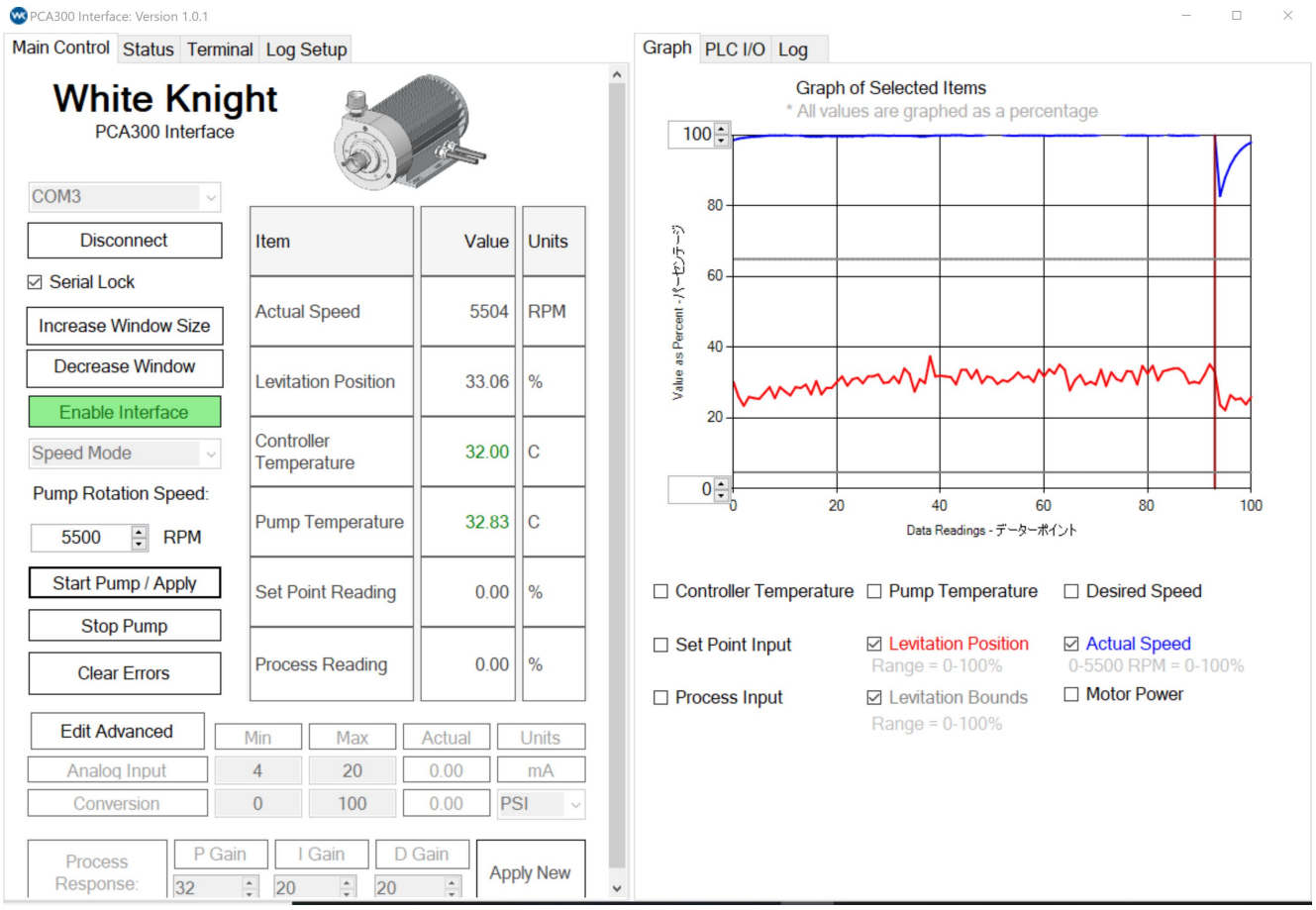
6.2. PCA300 Interface Software

The PCA300 Interface Software (GUI) requires Windows XP or newer. The GUI is mainly for testing and troubleshooting. It can also be used as the primary operative interface if needed. The GUI can control the pump in either speed control mode or process mode. After installing the GUI and the pump is connected to the controller via the serial port, follow the subsequent directions for each control mode.

6.2.1. Using the controller via the PCA300 Interface Software.

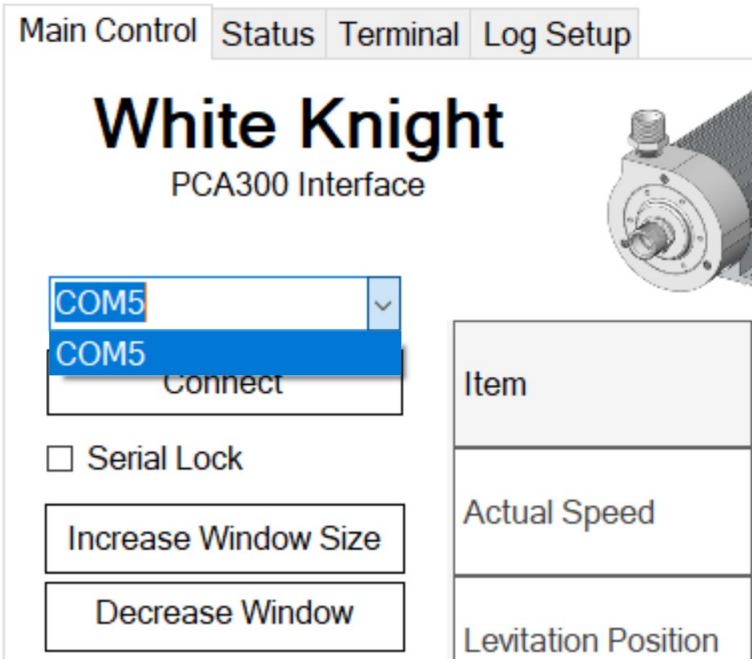
6.2.1.1. Install PCA300 Interface Software and open program.

Once the PCA300 Interface Software has been opened, the window shown below will appear.



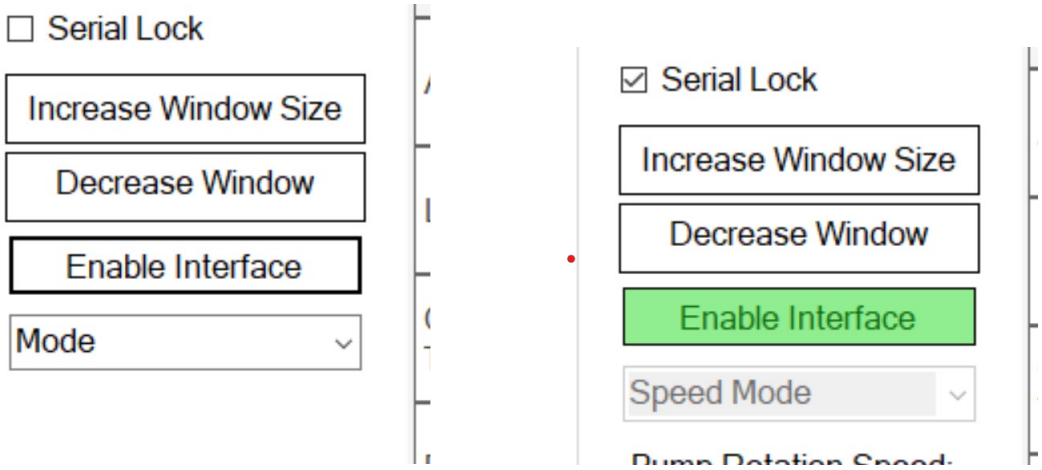
6.2.2. Connect to the controller

Select the drop-down menu above the “Connect” button to select the serial port that is communicating with the controller. The software will automatically select an active port, for verification/selection consult “device manager” on your pc for available ports. Once the correct port is selected, click the “Connect” button.



6.2.2.1. Enable the PCA300 Interface

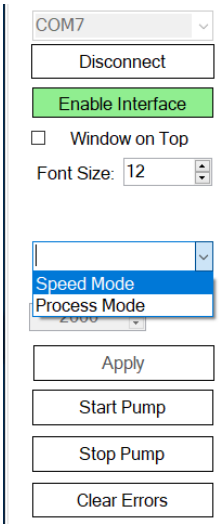
By default, the controller is in monitoring status. In order to control the pump from the GUI, the interface must be enabled. Clicking the “Enable Interface” button will allow the controller to receive commands from the interface. Once the “Enable Interface” button has been clicked, it will turn green, informing the user that the controller is ready to be controlled by the GUI.



Interface is not enabled. Interface is enabled.

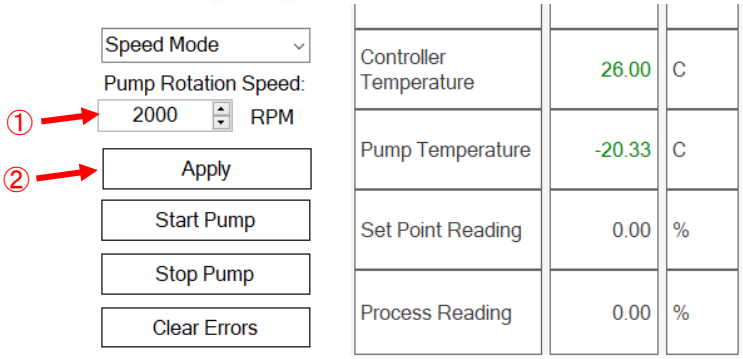
6.2.2.2. Choose Type of Control

The pump can be run by two types of control. Speed control mode regulates motor speed to specified RPM. Process Control Mode uses feedback from a flow or pressure sensor signal to auto adjust motor speed to regulate specified flow or pressure set point. Use the drop-down menu to specify the type of control.



6.2.3. Speed Control

1. To control the pump in “Speed Control” mode, type in the desired speed into the “Pump Rotation Speed” box and click “Apply”.

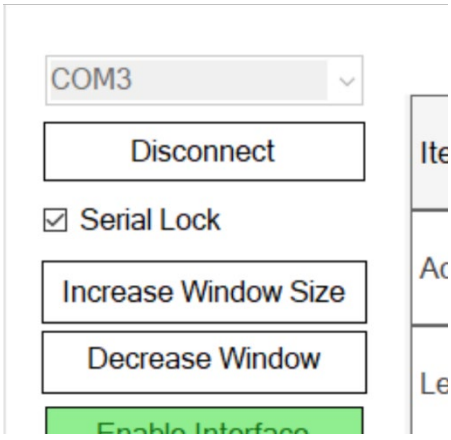


2. Start the pump by clicking the “Start Pump” button. The pump will ramp up to the speed in the “Pump Rotation Speed” box and hold there independent of flow or pressure on the pump. If a different rotation speed is desired, it is not necessary to stop the pump first, the number in the “Pump Rotation Speed” can be changed while the pump is operating. The pump will only go to the new desired speed once the “Apply” button has been clicked. Stop the pump by clicking the “Stop Pump” button. This will completely de-energize the pump.

3. If there is a desire to have the pump not rotate but still have the impeller levitate, then enter “0” into “Pump Rotation Speed” and this will permit the pump to stop rotating but the impeller will still be centered in the pump housing.

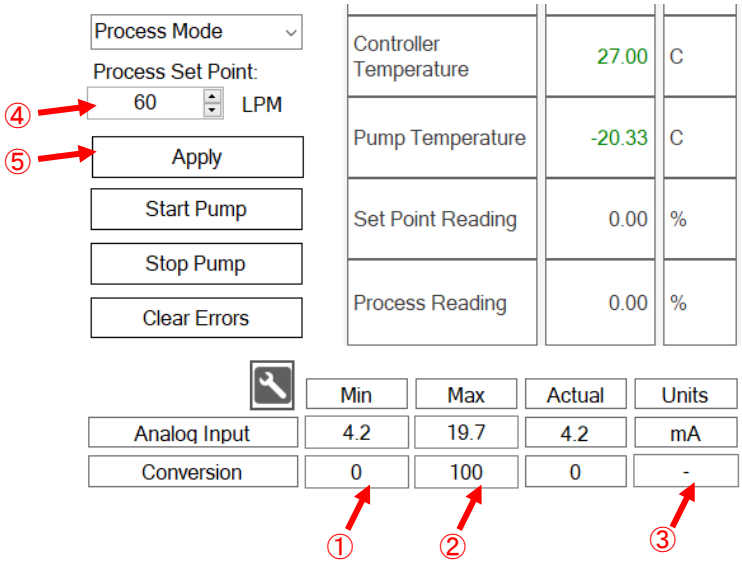
   The slowest speed besides 0 the pump can turn at is 100 RPMs. If a speed below that is selected the pump will select a 0 RPM speed.

4. For continued operation without the application running, the “serial lock” box must be checked. This will effectually lock out PLC control.

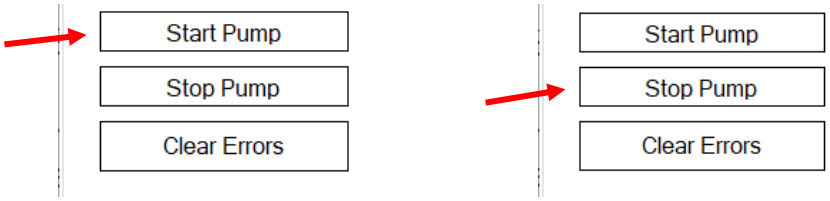


6.2.4. Process Control

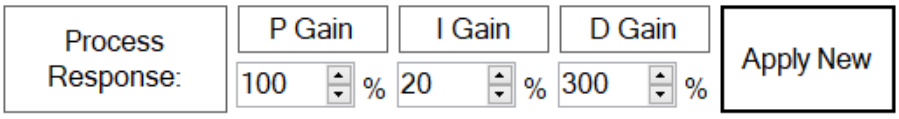
1. Click the “Edit button” to type in the conversion rate of mA to units of the external sensor. Type in desired set point on the “Process Set Point” box and click “Apply”.



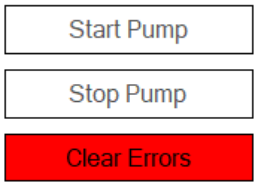
2. Start the pump by clicking the “Start Pump” button. The pump will adjust the motor speed until feedback from the sensor matches the set point. If a different set point is desired, it is not necessary to stop the pump first, the number in the “Process Set Point” can be changed while the pump is operating. The pump will only go to the new desired set point once the “Apply” button has been clicked. Stop the pump by clicking the “Stop Pump” button. This will completely de-energize the pump.



3. How aggressively and accurately the pump can be controlled to a set point can be tuned using the process control PID parameters. These parameters can be different for every system.



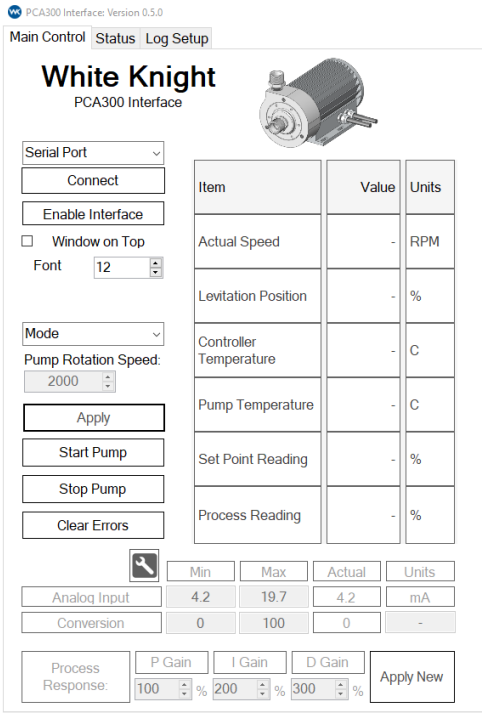
4. If an error occurs during operation, the pump will shut down or stop and the “Clear Errors” button will turn red. Before the pump can be restarted the errors must be cleared. To clear the errors, click the “Clear Errors” button. The “Clear Errors” button’s return to white signifies that the all errors are cleared and the pump can be restarted. It is recommended to investigate and troubleshoot all errors before restarting the pump.



6.2.5. Controller Feedback to Interface

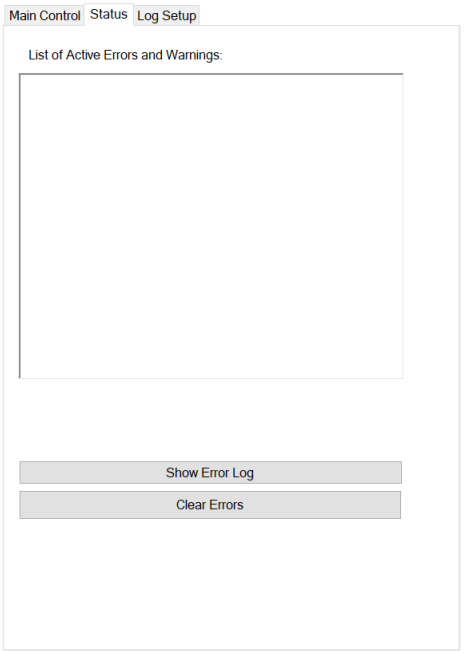
6.2.5.1. Main Control Tab

The Main Control Tab has buttons to command the pump as well as some data the controller is reporting back. This section focuses on the data reported. For command buttons refer to section 6.2.1-6.2.3.



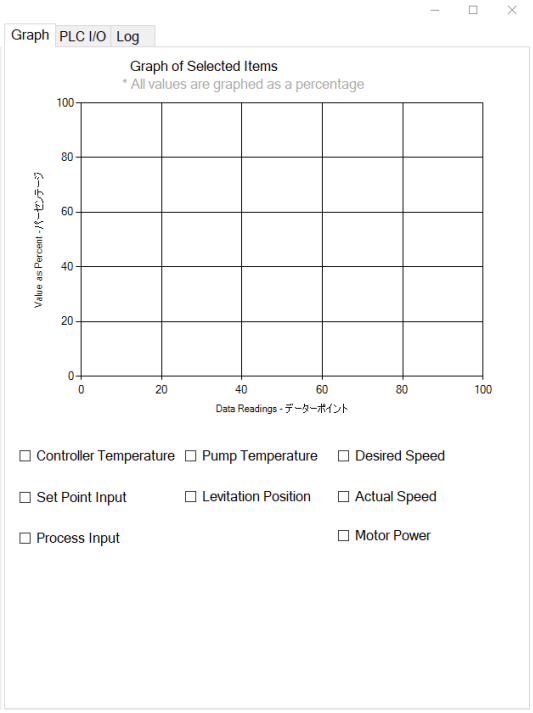
6.2.5.2. Status Tab

The Status Tab shows the various alarms and errors that are currently in effect on the controller. The “Show Error Log” button displays a list of events that have been triggered.



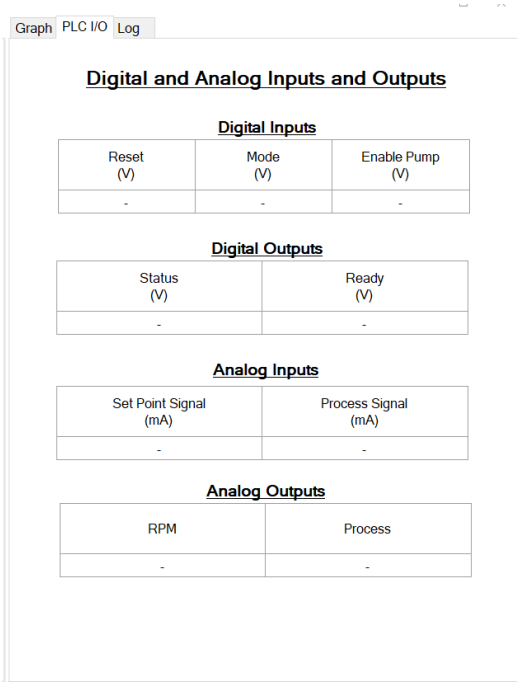
6.2.5.3. Graph Tab

The Graph Tab has a graph that will chart various variables vs. time. In order to compare multiple variables on the same graph, all values have been converted to a percentage from 0 to 100 percent. The Y-axis of the graph can be scaled and the desired variables can be chosen by checking or unchecking the boxes.



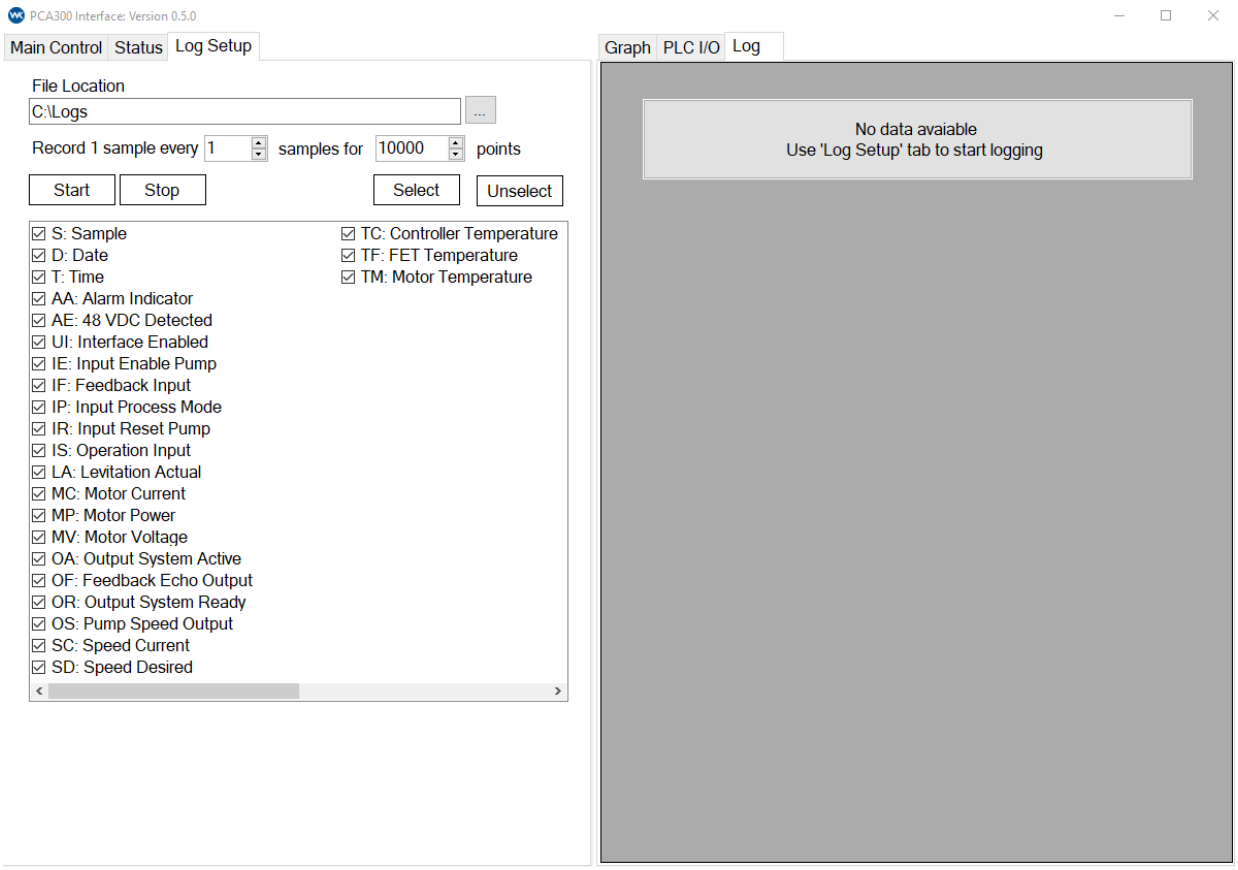
6.2.5.4. PLC I/O Tab

The PLC I/O tab reports the values on each of the pins of the PLC interface.



6.2.5.5. Log Set and Log Tabs

The data collected by the PCA300 Interface can be logged over a period of time. Data is collected from the controller at approximately 5 points per second. Use the Log Setup Tab to create a file location and select the desired data to log. Click the “Start Logging” button. Once the desired number of data points have been collected, click the “Stop Logging” button.



6.3. PLC Interface

Operating the system with a PLC will require the PLC to transmit and receive digital and analog signals through the PLC Interface connection. Review Table 4 for the pinouts to run in either Speed Control Mode or Process Control Mode. The process mode PID control cannot be modified from the PLC Interface.

6.4. Command Line Interface

Limited control is available to the user via an RS232 interface of the PCA300 controller. Basic functions can be controlled and monitored through this communication port. This application note will provide setup requirements and basic examples, as well as lists of available commands, data interpretations, and error lists.

This application note assumes some basic understanding of serial communication and in-depth examples of configuring/setup are not within the scope of this document. Please consult White Knight Fluid Handling application engineers for more information.

6.4.1. Setup Requirements:

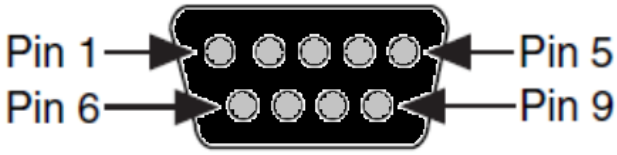
6.4.1.1. Serial Communications configuration:

Serial communication is built as an RS232 full-duplex configuration routed externally to a DB9 female connector. There are many devices capable of meeting serial settings that will suffice to control the pump. Please consult datasheets for your intended application components to determine interoperability.

6.4.1.2. Serial settings:

Baud rate: 57600 Baud
Data bits: 8
Flow Control: None
Parity bit: None
Stop bits: 1

Pinout for RS232 connection:		
pin	Moniker	Description
1	-	
2	TX	Transmit
3	RX	Receive
4	-	
5	GND	Ground
6	-	
7	-	
8	-	
9	-	

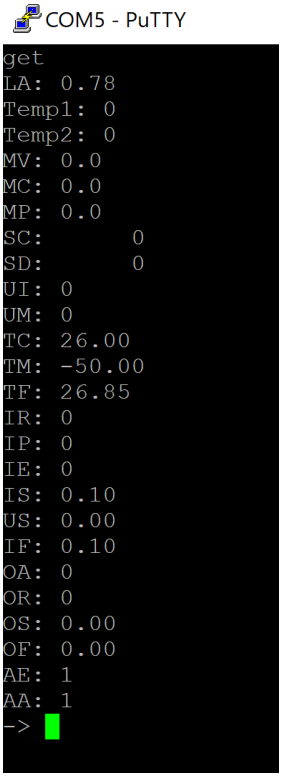


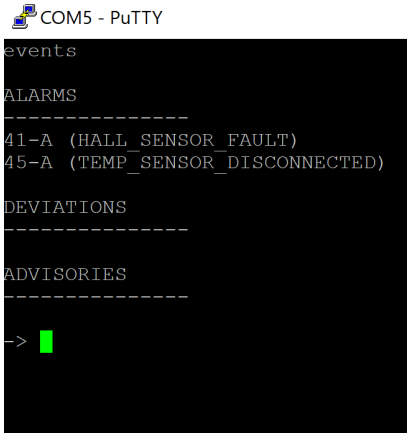
Command Controls:

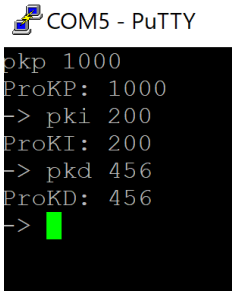
Once serial communication is established a defined list of controls and monitoring features are available for the user to execute. Table 5 details available commands. The command “get” is of particular import as it must be called at least every 500 ms in order to maintain serial control.

Table 5	
Command List	
Command	**Description**
"events"	Prints all ALARMS, DEVIATIONS, and ADVISORIES.
"clearevents"	Clears all ALARMS, DEVIATIONS, and ADVISORIES. If errors persist after command, the problem still exists
"eventlog"	Prints last 100 ALARMS, DEVIATIONS, ADVISORIES, and RECORDS. See error table in user manual for error descriptions.
"temp"	Prints the temperature of Controller, Motor, and FET (Levitation control) in degrees Celsius.
"plc"	Prints PLC interface states (see user manual for descriptions).
"senpwr"	Prints Hall effect sensor voltage.
"line"	Prints ACMains input voltage and current.
"motorPower"	Prints motor voltage, current, and power.
"runtime"	Prints pump runtime in days, hours, minutes.
"gui"	Command to initiate GUI control (send “gui 1” to enable “gui 0” to disable).
“guilock”	Command to maintain GUI control even if serial communication is not present.
"processcon"	Command to initiate GUI process mode.
"speedcon"	Command to initiate GUI speed mode (default).
"start"	Starts pump.
"stop"	Stop pump.
"set"	Set pump speed (limited to 100-5500 rpm).
"proset"	Set process mode setpoint (in mA).
"speed"	Get pump RPM.
"pkp"	Set process control P constant.
"pki"	Set process control I constant.
"pkd"	Set process control D constant.
"get"	Prints current datapoints (this must be called at least every 500 ms to keep serial control active). See table 6 for data output list.
“alarmflags”	Prints a 32-bit hexadecimal number representing various alarm flag statuses (see Table 7). Note: The output is a string and needs to be changed to hexadecimal number.
“deviationflags”	Prints a 32-bit hexadecimal number representing various deviation flag statuses (see Table 8). Note: The output is a string and needs to be changed to hexadecimal number.

6.4.1.3. Example of basic communication request (via serial console):







Pseudo-code example of control application:

Sendcommand("gui 1"); //enable serial control

Sendcommand("speedcon"); //enable speed control mode

Sendcommand("set 4000"); //set rpm 4000

Sendcommand("start"); //start pump

While(1)

{

Callevery500ms("get"); //every 500 ms update data list and maintain control.

}

Table 6	
Data output list from "get" command	
Moniker	**Description**
LA	lateral position (0-100)
LT	approximate top position
LB	approximate bottom position
Temp1	temp register
Temp2	temp register
MV	Motor Voltage
MC	Motor Current
MP	Motor Power
SC	Pump RPM
SD	RPM setpoint
UI	Serial Mode Enabled Flag state
UM	GUI process mode Flag state
UL	GUI Lock mode Enabled Flag state
TC	Controller temperature
TM	Motor temperature
TF	Levitation Control (FET) temperature
IR	PLC Reset IO state
IP	PLC Process IO state
IE	PLC Enable IO state
IS	PLC Control setpoint (mA)
US	GUI process control setpoint(mA)
IF	PLC process feedback(mA)
OA	PLC System Active IO state
OR	PLC System Ready IO state
OS	PLC RPM Output (voltage scaled)
OF	PLC Process Output voltage
AE	48 Volt flag state
AA	Active Alarm flag state
WA	Types of available errors (1 advisories, 2 deviation, 3 error)

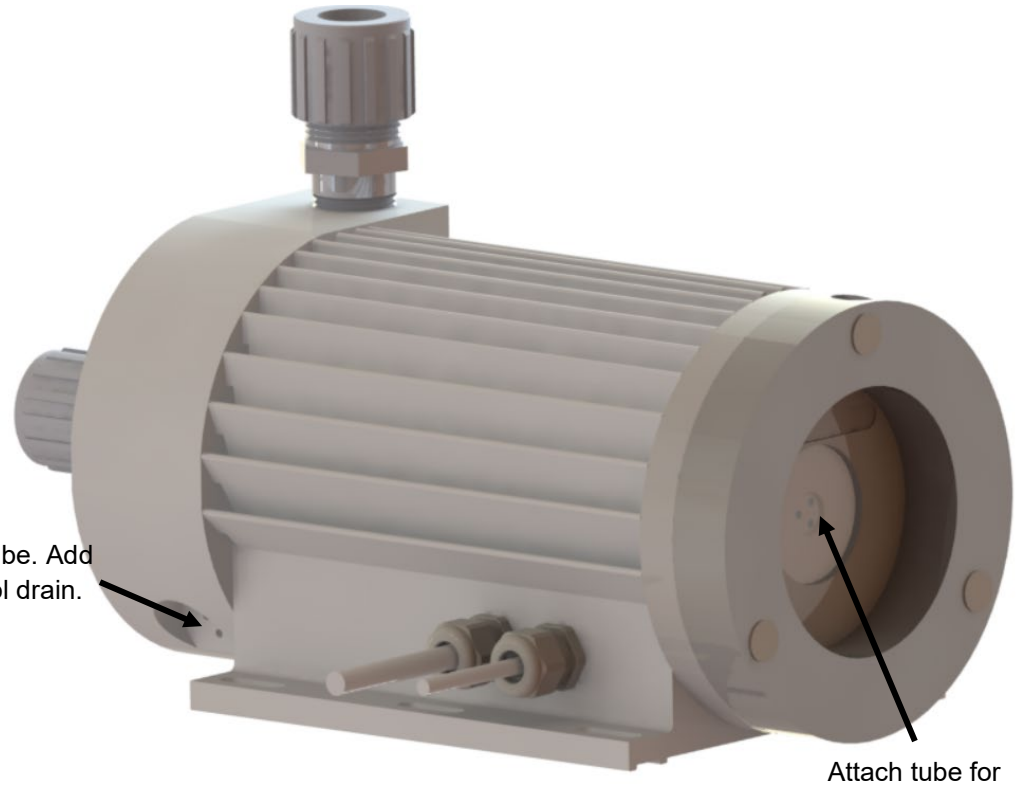
Table 7		
Alarm flags and corresponding bit positions as presented in the 32-bit number response to the “alarmflags” command.		
Bit Position	Alarm Flag	Error Code
0	SOFTWARE_CURRENT_FAULT	21
1	HARDWARE_CURRENT_FAULT	22
2	CONTROLLER_TEMP_FAULT	11
3	BUS_OVERVOLTAGE_FAULT	31
4	BUS_UNDERVOLTAGE_FAULT	32
5	BUS_VOLTAGE_DETECT_FAULT	33
6	MOTOR_VELOCITY_FAULT	71
7	HALL_SENSOR_FAULT	41
8	MOTOR_DRIVE_FAULT	72
9	AC_POWER_LOSS	34
10	HOT_COMMUNICATION_FAULT	61
11	HOT_SOFTWARE_MISMATCH	51
12	COLD_COMMUNICATION_FAULT	62
13	PUMP_OVER_TEMP	12
14	MOTOR_STALL	19
15	TEMP_SENSOR_DISCONNECTED	45
16	FET_OVER_TEMP	16
17	PRO_FDBCK_DISCONNECTED	48
18	CONTROL_SP_DISCONNECTED	49
19	LEV_CONTROL_LOSS	82
20	NO_EXTERNAL_48V_POWER	83
21	48V_EXCESSIVE_CURRENT	85
22	POS_SENSE_COMM_ERROR	63
23	SOFTWARE_ERROR	199
24-31	Reserved	

Table 8		
Deviation flags and corresponding bit positions as presented in the 32-bit number response to the “deviationflags” command.		
Bit Position	Deviation Flag	Error Code
0	HALL_SENSOR_FAULT	43
1	GATE_UNDER_VOLTAGE_FAULT	73
2	POWER_LIMITED	75
3	POWER_LIMITED_TEMP	76
4	PROCESS_CONTROL_LOSS	91
5	CONTROLLER_TEMP_WARNING	18
6	PUMP_HOT_TEMP	14
7	FET_HOT_TEMP	17
8	AIR_IN_PUMP	84
9-31	Reserved	

7. Maintenance

7.1. Drain in Place

Pump can be installed with drain and air hoses to enable drain and dry sequence during process or before pump is uninstalled from tool.



7.2. Decontamination Process

PRINT COMPLETED DECONTAMINATION CERTIFICATION. IT MUST BE INCLUDED IN YOUR RMA SHIPMENT.

- White Knight products are designed for use with caustic and otherwise dangerous liquids. Handle every product as if it contains dangerous chemicals whether or not it actually does.
- Only those with adequate safety training should attempt to handle used pumps.
- Wear adequate safety gear appropriate for chemicals that have been in the pump.
- Review relevant Material Safety Data Sheets (MSDS) before handling the pump.
- Review emergency numbers for use in event of an accident.
- Prepare Ph papers, showers, antidotes, clean-up equipment, neutralizers, and other safety devices used to detect. Neutralize or minimize effects of chemicals described in appropriate MSDS documents.

7.2.1. Rinse with DI Water

Circulate DI water through pump for twenty minutes before disassembly and/or double bagging for shipment. If pump is nonfunctional, force minimum 10 lpm DI water from inlet to outlet for 40 minutes before shipment preparations.

7.2.2. Remove pump from station

1. Isolate the electrical power of the controller and power supply.
2. Disconnect pump power cable and pump sensor cable.
3. Disconnect liquid tubing connectors from front of pump.
4. Plug fittings with plug or cap recommended by connector supplier.
5. Remove bolts securing pump.
6. Remove pump from station.
7. Drain pump by removing both drain plugs (back and base of head) hold at an angle till water stops flowing.
8. Blow pump out with CDA to get remaining DI out of pump.

7.2.3. Return Pump to White Knight

1. Rinse pump with DI water as described in sections 7.2.-7.2.1 after removing from its station.
2. Drain remaining DI water from the pump inlet and outlet liquid tubing connections.
3. Plug liquid inlet and outlets with plug or cap recommended by connector supplier.
4. Dry the pump, double bag it, and seal it in thick polyethylene bags.
5. Return the pump to its original packaging.
6. Include all the pump components.
7. Include MSDS for the chemical that the pump was handling in the box with the pump.
8. Obtain RMA number from White Knight and write the RMA number on the outside of the box.
9. Ship to White Knight following all rules, regulations, and laws regarding shipment of dangerous materials. Ship freight pre-paid. No collect shipments will be accepted. Unauthorized use of White Knight shipping accounts will result in the adding of freight to the bill in addition to a service charge.

7.3. Rebuild Process

The PCA300 system must be rebuilt at White Knight Fluid Handling. Do not open or disassemble the pump or controller. Strong magnets will pose a safety hazard when not handled properly.

8. Troubleshooting

Table 9		
Error codes		
Error Code	**Type**	**Description**
11	ALARM	CONTROLLER OVERHEAT CONDITION
12	ALARM	PUMP OVERHEAT CONDITION
14	WARN	PUMP APPROACHING OVERHEAT CONDITION
16	ALARM	LEVITATION GATE OVERHEAT CONDITION
17	WARN	LEVITATION GATE APPROACHING OVERHEAT CONDITION
18	WARN	CONTROLLER APPROACHING OVERHEAT CONDITION
19	ALARM	MOTOR STALLED
21	ALARM	SOFTWARE CURRENT FAULT
22	ALARM	HARDWARE CURRENT FAULT
31	ALARM	DC BUS VOLTAGE TOO HIGH
32	ALARM	DC BUS VOLTAGE TOO LOW
33	ALARM	DC BUS VOLTAGE DETECT FAULT
34	ALARM	AC POWER LOSS
35	RECORD	POWER ON
41	ALARM	MOTOR HALL SENSOR FAULT
43	WARN	MOTOR HALL SENSOR FAULT
45	ALARM	PUMP TEMPERATURE SENSOR DISCONNECTED
48	ALARM	PROCESS FEEDBACK DISCONNECTED
49	ALARM	PLC CONTROL SET POINT DISCONNECTED
51	ALARM	HOT SOFTWARE VERSION MISMATCH
52	RECORD	RESET TO DEFAULT SETTINGS
61	ALARM	HOT COMMUNICATIONS FAULT
62	ALARM	COLD COMMUNICATIONS FAULT
63	ALARM	LEVITATION COMMUNICATION FAULT
71	ALARM	MOTOR VELOCITY FAULT
72	ALARM	MOTOR DRIVE FAULT
73	WARN	MOTOR GATE UNDERVOLTAGE FAULT
75	WARN	POWER LIMITED
76	WARN	POWER LIMITED DUE TO OVERHEAT CONDITION
82	ALARM	LEVITATION CONTROL LOSS
83	ALARM	NO EXTERNAL 48V POWER
84	WARN	AIR IN PUMP
85	ALARM	EXCESSIVE CURRENT ON 48V BUS
91	WARN	PROCESS CONTROL LOSS
199	ALARM	SOFTWARE ERROR

8.1. Troubleshooting with software

When Alarms are triggered, the particular alarm will be listed in the Status Tab in the PCA300 Interface. Errors can be cleared by clicking the “Clear Errors” button in either the Status Tab or the Main Control Tab.

8.2. Troubleshooting with LEDs

When the controller is powered, the green LED will turn on. When powering down, the green LED will stay on until the controller deenergizes. Please be patient, as it may take up to 60 seconds for the controller to deenergize.

When the controller has an error, the red LED will blink to indicate what errors and warnings have occurred. The blinking indicates the error number. Error numbers are two digits long. Error codes are identified by the duration of the pause; there are short, medium, and long pauses on the red blinking LED when an error occurs. A long pause indicates the start of the error code, then short blinks will count out the first digit. A medium pause will indicate the break between the first and second digit. The second digit will be counted out with subsequent short blinks. More than one error can be indicated by the blinks. Note all errors until error codes repeat.

Some errors/warnings may require the pump to shut down; other errors are warnings of pump/controller conditions that could cause problems in the future. Errors/warnings can be cleared using the PLC digital reset input, or in the test serial interface by pressing the clear errors button. Errors will not clear if error condition is still present.

9. Technical Support

For technical support please contact:

White Knight
187 E. 670 S., Kamas, UT 84036
435.783.6040 888.796.2476
tech.support@wkfluidhandling.com

10. Appendix

10.1. Ordering Instructions

See www.wkfluidhandling.com

10.2. Regulatory Status

CE Marking

Machinery Directive 2006/42/EC

The PCA300 system is designed to the following standards.

EN809	Pumps and pump units for liquids - Common safety requirements
EN12162	Liquid pumps - Safety requirements - Procedure for hydrostatic testing
ISO12100	Safety of machinery — Risk assessment

Low Voltage Drive Directive 2014/35/EU

The PCA300 system is designed to the following standards.

EN61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements
ISO12100	Safety of machinery — Risk assessment

Electromagnetic Compatibility Directive 2014/30/EU

The PCA300 system was tested and confirmed to the following standards at a certified laboratory with the following standards:

EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use – EMC requirements

ETL Safety Certification and Marking

PCA300 Pump System are tested by the US national recognized laboratory Intertek according to the following safety standards:

UL 61010-1:2012 Ed.3+R:19 Jul2019	Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements
CSA C22.2#61010-1-12:2012 Ed.3+U1; U2	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use Part 1: General Requirements
CSA C22.2#61010-2-201:2018 Ed.2	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-201: Particular Requirements for Control Equipment

ETL control number for the listing is 104373764MIN-003.

White Knight Support

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