PUMPSMART®

CONTROL SOLUTIONS

PS200

Version 4.0

Configuration & Operation Guide

PUMPSMART®
CONTROL SOLUTIONS

PumpSmart

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Index

GETTING STARTED

How to use this guide

This guide has been organized to make setting-up and configuration of the PumpSmart PS200 easy. Set-up has been divided into three main sections that include all the information needed to get up-and-running. The three sections are:

- **Single Pump** - Where one pump is used with a single process instrument to control on pressure, flow, level, or temperature.
- **Multi-Pump** - Where several pumps are used in a coordinated fashion to meet a pressure, flow, level, or temperature setpoint.
- **Speed Control** - Where a speed setpoint or signal is used to control PumpSmart.

Each section has been laid out to speed you through the configuration process, while providing enough background information to help understand the process.

1. Step Number - The step number helps to keep track of where you are in the configuration process when used in conjunction with the process map.
2. Process Map - The process map is a visual guide of what needs to be done in the step.
3. Background Information - This information explains what the upcoming steps are and why they are being performed. Examples are provided to assist in understanding the concept.
4. Special Notes - These highlighted sections contain comments that are important to the configuration process.
5. Key Step - The key step box details the actual parameter that must be entered into PumpSmart. It includes the basic keys necessary to input the information.
6. Keypad View - The keypad view shows what you will see as you perform the configuration outlined in the Key Step.

Following the initial configuration steps, are sections related to tuning the PumpSmart PS200 once its running, enabling additional options and features, and troubleshooting if you are having problems.

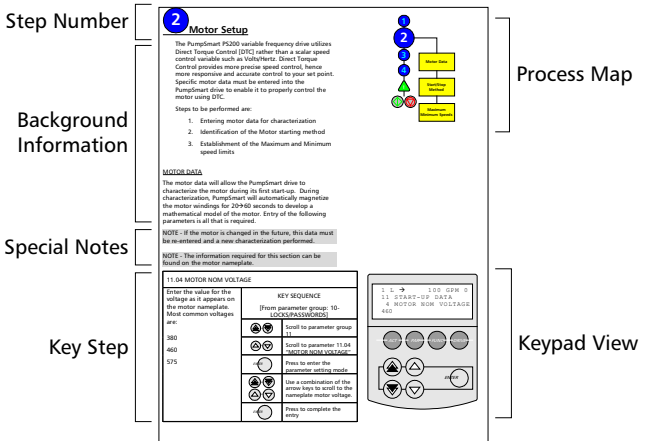


Figure A - Typical Configuration Page

Language Selection

The PumpSmart PS200 drive display supports the following languages:

English
English (American) - Default
French (Francais)
German (Deutsch)
Italian (Italiano)
Portuguese
Spanish (Espanol)

Language selection may be performed using parameter 11.01 LANGUAGE, see OPTIONS & FEATURES for further details.

GETTING STARTED

PumpSmart Keypad

The PumpSmart keypad serves as the primary means of configuring and operating the drive. It consists of a four-line display and 16 pushbutton keys. After configuration, all of the drive parameters can be saved to the keypad.

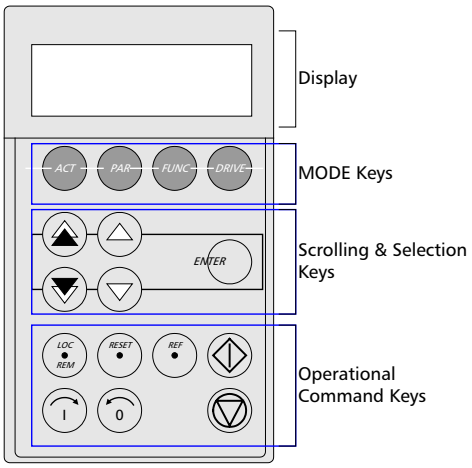


Figure B - PumpSmart Keypad

Basic Configuration

Configuring a typical parameter would involve the following key-strokes:

TYPICAL PARAMETER ENTRY KEY SEQUENCE	
PAR	Press the Parameter Mode key to enter parameter setting mode.
	Use the double arrow keys to scroll through Parameter Groups.
	Use the single arrow keys to scroll through Parameters in each group.
ENTER	Press to enter the parameter setting mode
	Use a combination of the arrow keys to scroll through selections or enter values. Double arrow keys are used for fast scrolling, while single arrow keys are for slow scrolling.
ENTER	Press to complete parameter entry

For more detail into using the PumpSmart keypad, see the Appendix section entitled:

KEYPAD USE

GETTING STARTED

Before you Start

Before you begin to field-program your PumpSmart PS200 drive, the following activities are expected to have been completed:

- Pump has been installed, aligned, and prepared for start-up
- PumpSmart drive has been mounted properly *[Refer to the hardware manual for installation details]*
- Power has been properly wired to the drive and from the drive to the motor.
- Process transmitter(s) and optional appurtenances have been installed and correctly wired.

If these steps have not been completed, please stop and complete them before proceeding.

Once these steps are completed, select the configuration section that applies (SINGLE PUMP, MULTI-PUMP, SPEED CONTROL) and begin with Step 1.

SINGLE PUMP PROCESS

SINGLE PUMP-PROCESS

This section is devoted to starting your PumpSmart PS200 in single pump process control mode. In this mode, a single pump is connected to your system with a transmitter (pressure, level, flowmeter, etc.) wired to the PS200 to provide process condition feedback.

Step	Description	Parameters
	Single-Pump Overview	
1	**Locks/Passwords**	10.02
2	**Motor Setup** Drive data for the First Motor Run ID is entered here in addition to start/stop methods, and MAX and MIN drive speeds	12.01 11.04 11.05 11.07 11.08 14.01 14.02
3	**Operating Mode & Units** Selects the mode of operation and the primary process transmitter setup.	11.03 15.01 16.03 16.04
4	**Setpoint**	
!	**Pump Protection Limit**	25.01 25.02
	Start/Stop	

	CHECK & GO STEP
Some parameters may not need to be changed from the default parameters allowing you to speed through the set-up process. These parameters have been marked with a check mark.	

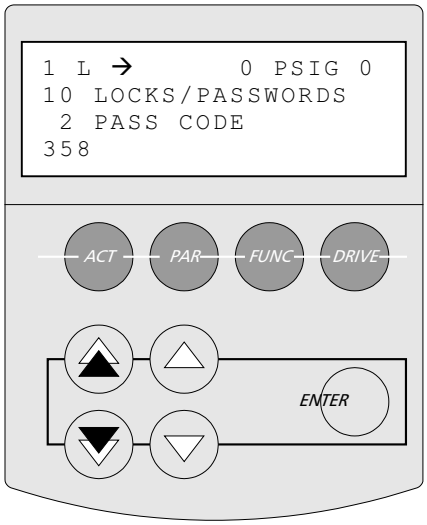
SINGLE PUMP PROCESS

1 Locks and Passwords

Operating parameters on the PumpSmart PS200 are protected by a 3-digit passcode to prevent casual users or unauthorized users from inadvertently changing the operating and protection limits that have been set. All PS200 units utilize the same passcode; it cannot be changed by the user/owner.

When the PS200 keypad is locked, functionality is limited to starting, stopping, and changing the operating setpoint.

10.02 PASS CODE		
To open the Parameter lock, scroll to parameter 10.02 and enter the passcode 358. The display value will automatically return to 0 after the three-digit code has been entered. To check on the status of the parameter lock: scroll to parameter 10.01. After correctly entering the passcode, it will read "OPEN"	KEY SEQUENCE *[From parameter group: 99 INFORMATION]*	
	PAR	Press to enter parameter mode
	▲ ▼	Scroll to parameter group 10 LOCKS / PASSWORDS
	▲ ▽	Scroll to parameter 10.02 PASS CODE
	ENTER	Press to enter the parameter setting mode
	▲ ▼ ▲ ▽	Use a combination of the arrow keys to scroll to the number 358.
	ENTER	Press to complete the passcode entry

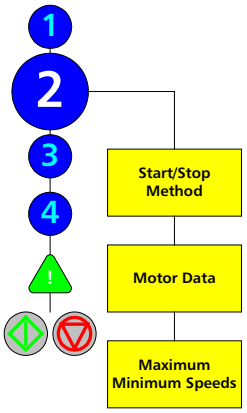


Single Pump Application Macro

The Single Pump Application Macro is the default setting on new PumpSmart units. If you are re-applying this unit from some other application, check parameter 11.02 APPLICATION MACRO and make sure it is set to SINGLE PUMP.

SINGLE PUMP PROCESS

2 Motor Setup



The PumpSmart PS200 variable frequency drive utilizes Direct Torque Control [DTC] rather than a scalar speed control variable such as Volts/Hertz. Direct Torque Control provides more precise speed control, hence more responsive and accurate control to your set point. Specific motor data must be entered into the PumpSmart drive to enable it to properly control the motor using DTC.

Steps to be performed are:

1. Identification of the Motor starting method
2. Entering motor data for characterization
3. Establishment of the Maximum and Minimum speed limits

START/STOP OPTIONS

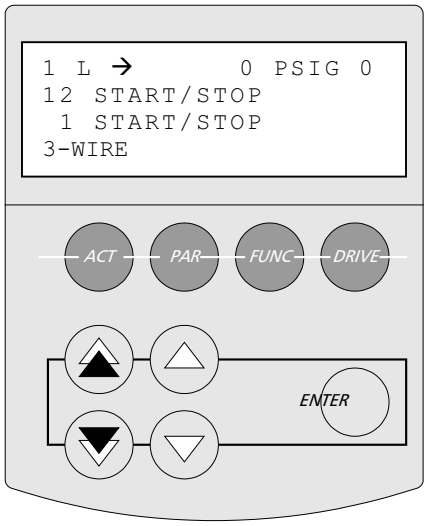
The PumpSmart PS200 has three ways to start and stop:

Two-wire / HOA - This is the default start/stop method and is common to "RUN/STOP" switch configurations. This setting is also used when starting/stopping the PS200 through the keypad [i.e. no external switch] or when an manual override switch is desired

Three-wire pulse start/pulse stop

Fieldbus control - PumpSmart may be remotely started through a DCS system. This option does require the optional Fieldbus communication module. Refer to the FIELDBUS CONTROL option for further details.

12.01 START/STOP		
If you are using a two-wire start-stop method or the keypad only, skip this step and proceed to the next step (Motor Data), otherwise select: • 3 WIRE, or • FIELDBUS	KEY SEQUENCE *[From parameter group: 10 LOCKS / PASSWORDS]*	
		Scroll to parameter group 12 START/STOP. Parameter 12.01 will be the first selection
		Press to enter the parameter setting mode
		Use the arrow keys to scroll to the desired parameter [Example shown - 3 WIRE]
		Press to complete the entry



NOTE - If you are using a 3-Wire Start/Stop, you may see a "No Motor Data" fault prior to making this entry. This fault may be cleared by pressing the "Reset" button after parameter 12.01 has been set to 3-WIRE.

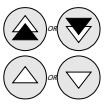
SINGLE PUMP PROCESS

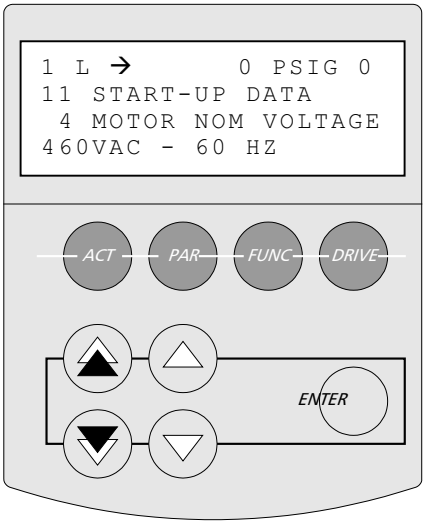
MOTOR DATA

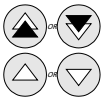
The motor data will allow the PumpSmart drive to characterize the motor prior to its first start-up. During characterization, PumpSmart will automatically magnetize the motor windings for 20 - 60 seconds to develop a mathematical model of the motor. Entry of the following parameters is all that is required.

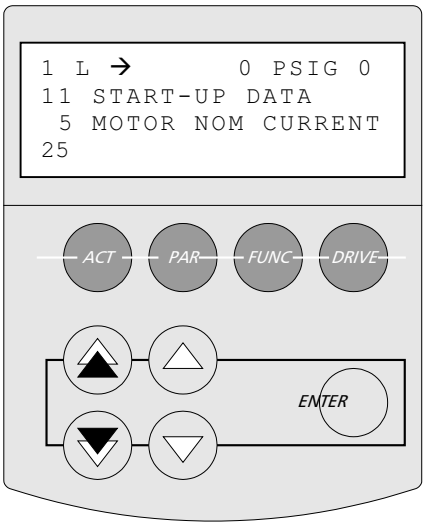
NOTE - If the motor is changed in the future, this data must be re-entered and a new characterization will be performed.

NOTE - The information required for this section can be found on the motor nameplate.

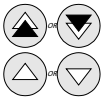
11.04 MOTOR NOM VOLTAGE		
Enter the value for motor voltage and frequency as found on the motor nameplate. Available selections are 208 VAC - 60HZ 220 VAC - 50 Hz 220 VAC - 60 Hz 230 VAC - 60 Hz 380 VAC - 50 Hz 415 VAC - 50 Hz 460 VAC - 60 Hz (default) 575 VAC - 60 Hz OTHER *Selecting OTHER will require entry in parameters 11.06 MOTOR NOM FREQ and 11.12 OTHER MOTOR VOLT.*	KEY SEQUENCE [From parameter group: 12 START / STOP]	
		Scroll to parameter group 11 START-UP DATA
		Scroll to parameter 11.04 MOTOR NOM VOLTAGE
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate motor voltage.
		Press to complete the entry

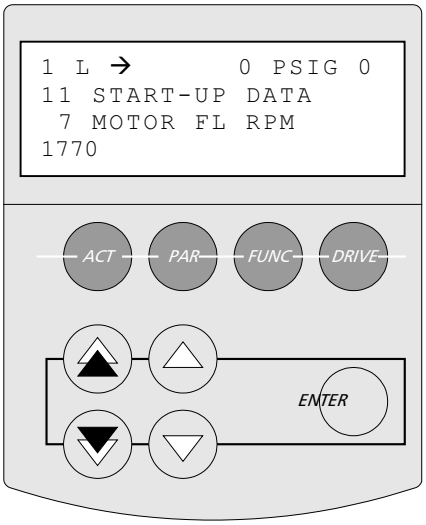


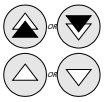
11.05 MOTOR NOM CURRENT		
Enter the actual full load amps (FLA) of the motor here. Refer to the motor nameplate for the correct value.	KEY SEQUENCE *[From parameter: 11.04 MOTOR NOM VOLTAGE]*	
		Scroll to parameter 11.05 MOTOR NOM CURRENT
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate motor current.
		Press to complete the entry

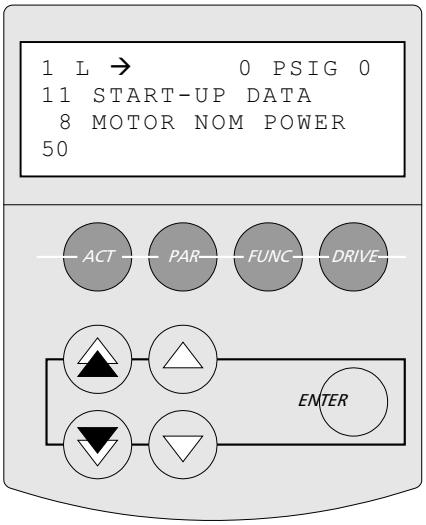


SINGLE PUMP PROCESS

11.07 MOTOR FL RPM		
Enter the full load RPM of the motor. Please note this is the nameplate value of the full load RPM and not the nominal speed of the motor. *For Example: An 1800 RPM motor might have a full load RPM of 1770 RPM*	KEY SEQUENCE *[From parameter: 11.05 MOTOR NOM CURRENT]*	
		Scroll to parameter 11.07 MOTOR FL RPM
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate full load speed.
		Press to complete the entry



11.08 MOTOR NOM POWER		
Enter the nominal power (HP or kW) of the motor as found on the motor nameplate. *If you are using the Default language of ENGLISH(AM), then the units of entry will be Horsepower. Otherwise kW will be the units of entry.*	KEY SEQUENCE *[From parameter: 11.07 MOTOR FL RPM]*	
		Scroll to parameter 11.08 MOTOR NOM POWER
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate power.
		Press to complete the entry



SINGLE PUMP PROCESS

	**ID MAGN REQ**
This warning is normal, proceed on to the step INDENTIFICATION RUN	

IDENTIFICATION RUN

PumpSmart uses specific motor detail to create a mathematical motor model. This model enables more accurate motor control and is created with the motor data you have just entered and by magnetizing the motor for 20 to 60 seconds at zero speed. This is called a First Start ID Run.

Once all the motor data has been entered, the following warning will be displayed:

ID MAGN REQ

This warning indicates that a First Start ID Run is required before the pump may be operated. Now is a good time to perform this run.

With the motor connected to the drive and the keypad in Local (L) mode, press the START button. FOLLOW ALL STANDARD SAFETY PRACTICES FOR STARTING MACHINERY.

NOTE
ALLOW THE FIRST START ID RUN TO COMPLETE BEFORE STOPPING/RESETTING THE DRIVE. Although the motor may not appear to respond to the start command, it has. A warning message “ID MAGN” will be displayed during the ID. Once the ID run is complete, the message "ID DONE" will be displayed.

NOTE - If the motor is changed in the future, a First Start ID Run must be performed again to maintain the accuracy of the PumpSmart control.

Once the First Start ID Run has been completed, the following message will appear:

ID DONE

Once this appears, proceed on to the next step DRIVE OPERATION LIMITS.

E-Stop/Permissive

The PS200 will not operate unless the E-Stop/Permissive switch [DI1L] is closed. This includes performing the First Start ID Run. If not closed a warning message will appear on the keypad display:

RUN DISABLED

See Appendix A-4, Instrument Wiring, for details on wiring this switch.

NOTE:
The E-Stop/Permissive switch can not be defeated through parameter setting. If your application does not use an E-Stop / Permissive switch, DI1L can be bypassed physically inside the PumpSmart unit. Refer to Appendix A-4, Instrument Wiring, for details.

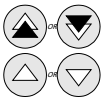
SINGLE PUMP PROCESS

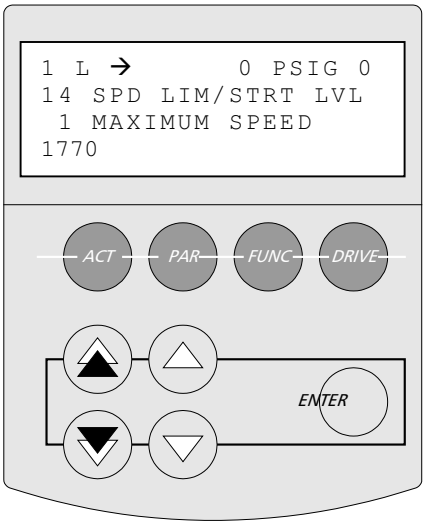
DRIVE OPERATION LIMITS

Drive operation limits safe-guard the pump and drive system from operating in unstable over-speed and/or low-speed conditions.

Maximum Speed - The PumpSmart System will adjust the speed of the motor to achieve the desired operating setpoint. Although the PumpSmart system can drive the motor to 2-3 times its nameplate speed, this is generally impractical for several reasons. First, unless the pump and motor are designed for overspeed operation, they could prematurely wear or even catastrophically fail. Second, centrifugal pumps generate pressure by the square of the speed and overspeed operation may overpressure the pump or surrounding piping system.

The maximum speed setting should never be set over the full load RPM of the motor or the pump manufacturers stated maximum speed of the pump.

14.01 MAXIMUM SPEED		
Enter the maximum speed that the pump, motor, and system can operate at. In most cases, the maximum speed will be the same as the previously entered full load RPM. MAX SPEED ≤ Full Load Motor RPM and ≤ Pump maximum speed *The default value is the speed set in parameter 11.07 MOTOR FL RPM*	KEY SEQUENCE *[From parameter group: 11 START UP DATA]*	
		Scroll to parameter group14, SPD LIM/STRT LVL. Parameter 14.01 will be the first selection.
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the maximum speed.
		Press to complete the entry



Minimum Speed - As the demand on the pump decreases, PumpSmart will decrease the pump speed to match the new demand. This Minimum Speed parameter sets the minimum speed that the pump can operate at. It is also used to define the safe speed to run the pump during a pump protection fault. The default value for minimum speed is 25% of 11.07 MOTOR FL RPM.

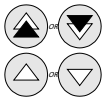
When determining a minimum speed, consider the following:

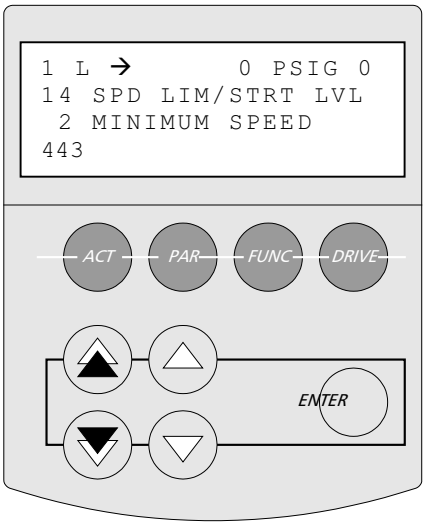
- Motor Minimum Speed [Turndown ratio] - Due to motor loading and thermal effects, the motor minimum speed on centrifugal pumps should not be less than 1/10th its full-load speed.

SINGLE PUMP PROCESS

Example – if full load rpm = 3550, set min speed to 355. Use greater than 10% if either of the following conditions exist:

- Pump Minimum Speed - Some pumps have minimum speed requirements, such as multistage pumps (>2 stages) and sleeve bearing pumps. Consult your pump operation manual to see if there is a minimum speed limit for your pump. **Note - 1& 2 stage pumps do not normally have minimum speed requirements.**
- Static Head Conditions (minimum flow) - The minimum speed should be set to assure that the pump generates enough head to overcome static resistance. In some cases, this can cause overheating and possible vaporization of the liquid in the pump casing.

14.02 MINIMUM SPEED		
Enter the minimum speed that the pump and motor can safely operate at. Consider- • Turndown ratio • Pump minimum speed • Minimum flow *The default value is 25% of the speed set in parameter 11.07 MOTOR FL RPM*	KEY SEQUENCE *[From parameter group: 14.01 MAXIMUM SPEED]*	
		Scroll to parameter 14.02 MINIMUM SPEED
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the minimum speed.
		Press to complete the entry



NOTES

The default settings of the PumpSmart drive will stop the pump if the process demand requires the pump to operate below the minimum speed. A LOW DEMAND Fault will be displayed in this case. A delay can be set for up to 30 minutes (1800 sec) before shutting down. Alternatively the drive may be set to operate at a minimum speed until it is manually shut-off. If the process condition clears while operating at minimum speed, PumpSmart will resume normal operation. See the OPTIONS section for further details.

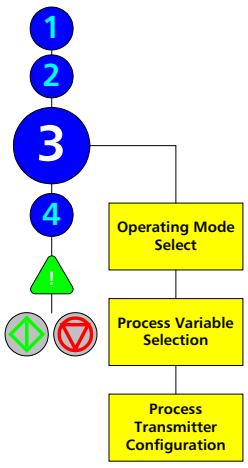
If PumpSmart shuts-down due to a pump protect fault, it can be configured to try and restart multiple times before shutting down completely. The interval between these times can be adjusted for up to 250 seconds. The default value is 60 seconds. The AUTO RESTART and ERROR RESET features must be set to "ON" See the OPTIONS section for further details.

Once the PumpSmart unit shuts down completely, it must be manually restarted.

SINGLE PUMP PROCESS

3 Select Operating Mode and Units

In this section, the operating mode is selected and the primary process transmitter is configured.

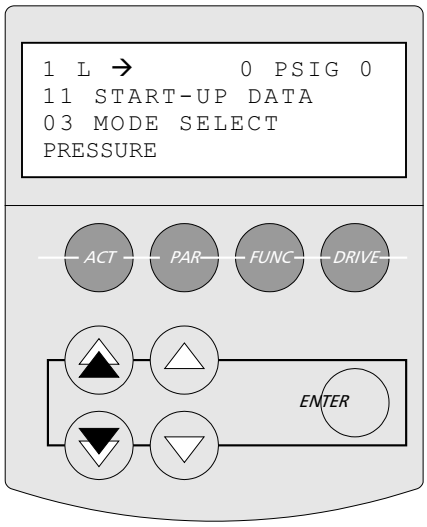


OPERATING MODE

There are four modes for operating the PumpSmart PS200: Pressure, Flow, Level, or Temperature/Other. This selection pre-selects the defaults for units and PI control settings [See TUNING].

- Pressure – PumpSmart will work to maintain a pressure setpoint based on a pressure transmitter signal.
- Flow – PumpSmart will work to maintain a flow setpoint based on a flowmeter signal.
- Level – used to maintain a defined tank level based on a level transmitter feedback, although a pressure transmitter at the pump suction can also be used. PumpSmart can control the level in either a suction or discharge tank.
- Temperature/OTHER – used to maintain defined temperature of a process stream based on a temperature transmitter signal. Also use this selection if a 4-20 ma signal from a different type of transmitter is used.

11.03 MODE SELECT		
Select the control mode for your application. If the control mode is PRESSURE, skip to the next step (Process Variable selection). Options: Pressure Flow Level Temperature/Other	KEY SEQUENCE *[From parameter group: 14.02 MINIMUM SPEED]]*	
		Scroll to parameter group 11 START-UP DATA
		Scroll to parameter 11.03 "OPERATING MODE"
		Press to enter the parameter setting mode
		Scroll to selection *Example – Pressure*
		Press to complete the entry



SINGLE PUMP PROCESS

PROCESS VARIABLE SELECTION

The process variable unit selection identifies what units your operating mode is in. This parameter sets the units that are used in the actual signal and setpoint display. The defaults are shown for ENGLISH [AM] selection.

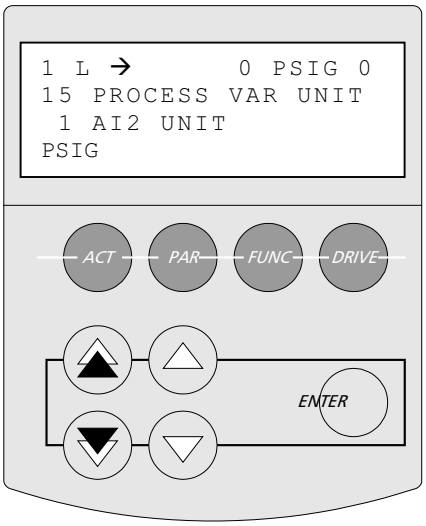
Operating Mode	Available Units Selection
Pressure	PSIG [default] BAR FT– Feet M– Meters %
Flow	GPM – Gallons Per Minute [default] M3Hr – Cubic meters per hour LBM/SEC - Pounds mass per second LBM/HR - Pounds mass per hour KG/HR - Kilograms per hour %
Level	PSIG BAR FT-Feet [default] IN - Inches CM - Centimeters M– Meters %
Temperature	°F – Degrees Fahrenheit [default] °C – Degrees Celsius

AI2 refers to the Analog Input channel No. 2. This is where your primary process transmitter should be physically connected

NOTE - If you are using a differential pressure flowmeter, please see the OPTIONS & FEATURES section for assistance in selecting the correct process variable.

15.01 AI2 UNIT

Select the proper units of the operating mode. Skip to the next step if the default unit is okay, otherwise select: BAR LBM/HR GPM KG/HR PSIG FT (Default) IN M3/HR CM LBM/SEC M % °F °C	KEY SEQUENCE *[From parameter group 11.03 MODE SELECT]*	
		Scroll to parameter group 15 PROCESS VAR UNIT. Parameter 15.01 will be the first selection
		Press to enter the parameter setting mode
		Scroll to the appropriate measurement units. Example shown is PSIG
		Press to complete the entry



NOTE - FOR PRESSURE/LEVEL MODES

If units of FT, IN, M or CM are used and Specific Gravity [SG] is other than 1.0, parameter 17.04 must be completed. See Options & Features.

NOTE - FOR PRESSURE/LEVEL MODES
If units of FT, IN, M or CM are used, Specific Gravity [SG] must be constant. If SG varies widely, use units of PSIG or Bar.

SINGLE PUMP PROCESS

PROCESS TRANSMITTER CONFIGURATION

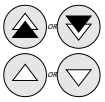
The primary process transmitter is the device that will measure your process conditions. The PS200 requires information to properly scale the 4-20 mA signal that the transmitter sends.

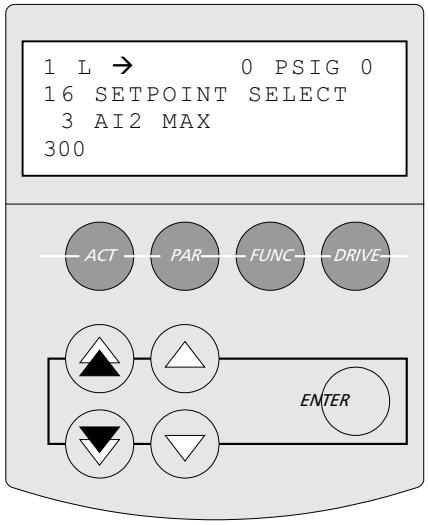
AI2 MAX - This refers to the process value that your transmitter is calibrated to at its max signal [20 mA]. Refer to your transmitter calibration sheet, or the instrument nameplate, for this value.

Example - a direct reading flowmeter [e.g. magmeter, vortex flowmeter, etc…] that has a range of 0 - 2000 GPM would be calibrated such that at 2000 GPM, the output of the transmitter would be 20 mA. Parameter 16.03 would be set to 2000 in this case. The units of 16.03 are the same as selected in parameter 15.01.

NOTES

Differential pressure flowmeters [e.g. orifice plate, venturi] do not produce 4-20 mA signals that are linear with the flow-rate. PumpSmart refers to this as a QUADRATIC input -- Refer to the section DIFFERENTIAL PRESSURE FLOWMETERS in the options section for proper setup.

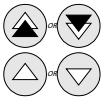
16.03 AI2 MAX		
Enter the reading of the primary process transmitter that corresponds to its 20 mA signal. Units are the same as entered in 15.01.	KEY SEQUENCE *[From parameter group: 15.01 AI2 UNIT]*	
		Scroll to parameter group 16 SETPOINT SELECT
		Scroll to parameter 16.03 AI2 MAX
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the correct value. Example shown - 300 PSIG
		Press to complete the entry

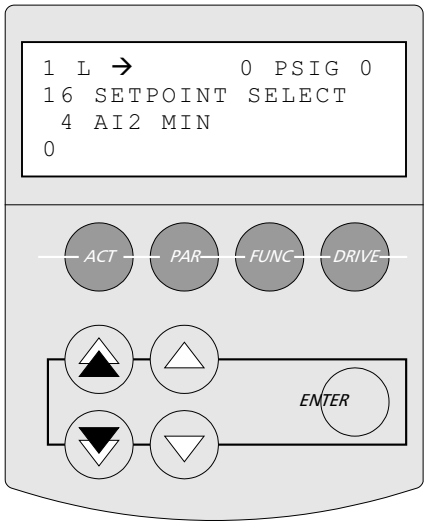


SINGLE PUMP PROCESS

AI2 MIN - This is the process value that corresponds to the transmitter's minimum signal [4 mA]. This value is normally zero on a pressure or flow transmitter. Refer to your transmitter calibration sheet, or the instrument nameplate, for this value.

NOTE - Most pressure and flow transmitters are configured for a reading of 0 [PSIG, GPM, etc…] at 4 mA. If so, this step may be omitted since the default of parameter 16.04 is 0.

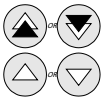
16.04 AI2 MIN		
Enter the reading of the primary process transmitter that corresponds to its 4-mA signal. If your transmitter signal is zero (0) at 4mA, skip to the next section (Enter Setpoint). Units are the same as entered in 15.01.	KEY SEQUENCE *[From parameter group: 16.03 AI2 MAX]*	
		Scroll to parameter 16.04 AI2 MIN
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the correct value. Example shown - 0 PSIG
		Press to complete the entry

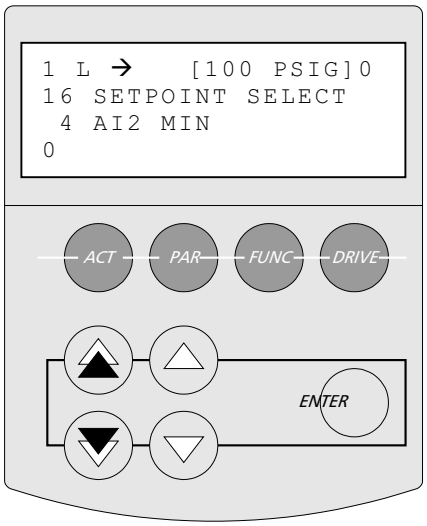


SINGLE PUMP PROCESS

4 Enter Setpoint

The final step before starting the PumpSmart system in a basic process control mode is to enter the operating setpoint.

SETPOINT		
Enter the operating setpoint.	KEY SEQUENCE	
		Press REF button to highlight the setpoint value
		Use a combination of the arrow keys to scroll to the desired setpoint. Example shown is 100 PSIG.
		Press to complete the entry



NOTE(S) -

There are alternative ways to enter the setpoint. Refer to the OPTIONS AND FEATURES section for configuration detail.

Remote setpoint – An analog input signal may be used to send setpoints to the PumpSmart unit from a remote location.

Variable Setpoint- A second process transmitter [2-10VDC or 4-20 mA] may be used to vary the setpoint. The setpoint can be linear, inverse linear, or offset, to this signal. See OPTIONS & FEATURES for details.

Multiple setpoint - The PumpSmart system can be programmed with two setpoints and the drive can toggle between the two setpoints based upon a digital switch [e.g. flow switch, level switch, manual switch, etc…]. Multiple setpoints can be set through either the keypad, Analog Input or via the DCS.

DCS Fieldbus - The setpoint can be programmed and changed remotely by way of digital communication from a DCS system with optional bus communication modules. Modules are available for Modbus, Profibus, Device Net, Interbus-S, Modbus Plus, ControlNet, and Ethernet.

SINGLE PUMP PROCESS

Recommended Option: Pump Protection Limit

The Pump Protection Limit adds significant protection to the PumpSmart PS200 system. With the pump protection limit enabled, the PS200 system will be able to provide dry run (loss of, or blocked suction) protection in pressure and flow control. It will also be able to provide run-out flow protection when in pressure control mode.

The pump protection limit works by identifying conditions where the pump is unable to meet the protection limit when at maximum speed.

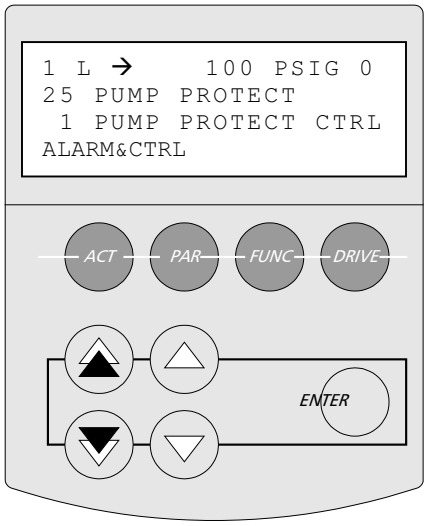
The first step in enabling the Pump Protection function is to select how you would prefer PumpSmart to respond if the protection limit conditions occur. There are three options:

1. ALARM & CONTROL [Recommended]- In this response, PumpSmart will issue a warning and then either shut down or reduce speed depending upon your settings. These settings may be found in the OPTIONS & FEATURES section under MINIMUM SPEED OPTIONS.
2. ALARM only - In this response, PumpSmart will simply issue an alarm/warning, but continue to operate. The alarm only mode may result in damage to the pump if a protection limit fault occurs and no manual intervention is taken.
3. DISABLED (Default Setting) - In this response, there is no protection limit functionality. If a closed suction valve (or similar) condition exists, there may be damage to the pump, and there will be no alarm warning the user.

TORQUE PUMP PROTECT

In level or temperature control, it is recommended to use the Torque Pump Protect function, which provides dry run, min-flow, and run-out protection, based upon operating load limits.

25.01 PUMP PROTECT CTRL		
Select the how PumpSmart should respond in the event a Protection Limit condition exists. Options- DISABLED (Default) ALARM ALARM & CTRL *We highly recommend ALARM & CTRL*	KEY SEQUENCE	
		Scroll to parameter 25.01 PUMP PROTECT CTRL
		Press to enter the parameter setting mode
		Use the arrow key to scroll to the desired response. Example shown is ALARM & CTRL.
		Press to complete the entry



NOTE - The PumpSmart keypad will display an alarm or fault message "Pump Protect" when the protection limit condition exists. The Pump Protection feature may also be configured to warn via DCS [optional Fieldbus module] or sonic or visual alarms through the digital relay output. See OPTIONS for details.

SINGLE PUMP PROCESS

The next step is setting the protection limit. This setting should be just below your minimum acceptable setpoint value. PumpSmart Control Solutions recommends 2-3% below your setpoint for initial settings.

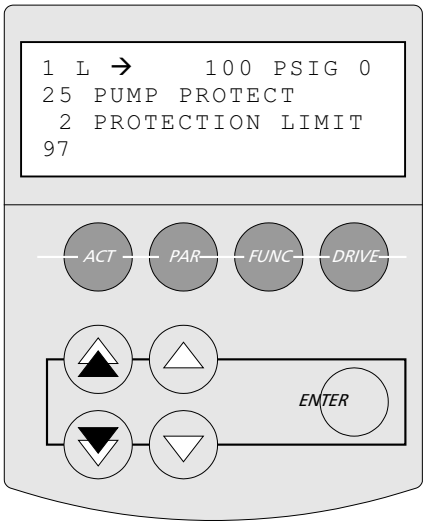
The Pump Protection Limit is expressed in terms of % of setpoint.

Example - If you had a setpoint of 100 PSIG (or GPM, or Ft, etc…) the recommended protection limit would be 97%. The Pump Protection warning/fault would occur if the pump was at maximum speed and pressure fell below 97 PSIG.

If operating in flow control, the protection limit will protect against minimum flow faults. In this case, the protection limit will be set much lower.

Example - If you had a setpoint of 100 GPM and a recommended minimum flow of 60 GPM, the protection limit would be 60%. The Pump Protection warning/fault would occur if the pump was at maximum speed and flow fell below 60 GPM.

25.02 PROTECTION LIMIT		
Enter the pump protection limit as a percentage of the setpoint. Example: From the above example, the entry would be "97".	KEY SEQUENCE *[From parameter: 25.01 PUMP PROTECT CTRL]*	
	PAR	Press PAR button to enter to the Actual Signal screen
		Press the double arrow key to go to parameter group 25, PUMP PROTECT
		Press the single arrow key to go to parameter 25.02, PROTECTION LIMIT
	ENTER	Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the desired protection limit. Example shown is 97%.
	ENTER	Press to complete the entry



NOTE - A delay can be set so that the PumpSmart PS200 waits to respond if the process variable falls below the protection limit. This will prevent the PumpSmart unit from shutting down prematurely due to momentary system upsets. See the OPTIONS section for further detail.

SINGLE PUMP PROCESS

Recommended Step: Parameter Upload

See KEYPAD USE

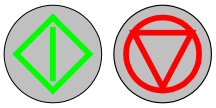
Save your parameters in the keypad. In the unlikely event that the PS200 parameters are lost, the keypad can be used to restore the configuration. It can also be used to program sister units that use the same or similar program settings.

Recommended Option: Drive Locking

See OPTIONS & FEATURES

The keypad can "locked" to prevent unauthorized personnel from making operational changes or changes to the parameter groups. See LOCKING in OPTIONS & FEATURES.

SINGLE PUMP PROCESS



Starting & Stopping

The PumpSmart system is now ready to start. Starting and stopping the PumpSmart unit is possible through the keypad when in local control.

NOTE - The drive can also be started using a 2 or 3 wire switch or through a Fieldbus command. Press the LOC-REM button until "R" is displayed in the upper left status row. You are now ready to start from a remote location.

KEY SEQUENCE	
	Press LOC/REM button until "L" is displayed in the status row
	Press to start
	Press to stop

E-Stop/Permissive

The PS200 will not operate unless the E-Stop/Permissive switch [DI1L] is closed. If not closed a warning message will appear on the keypad display:

```
RUN DISABLED
```

See Appendix A-4, Instrument Wiring, for details on wiring this switch.

NOTE:
The E-Stop/Permissive switch can not be defeated through parameter setting. If your application does not use an E-Stop / Permissive switch, DI1L can be bypassed physically inside the PumpSmart unit. Refer to Appendix A-4, Instrument Wiring, for details.

Jogging the Motor for Rotation

To check for proper motor rotation, scroll to parameter 12.09 MOTOR JOG and selecting JOG. Once selected, PumpSmart will turn the motor at 60 RPM for 10 seconds.

If rotation is reversed, the position of two leads must be changed either at the drive output (U_2, V_2, W_2) or at the motor (T_1, T_2, T_3). Refer to the Quick Reference Installation drawings in the appendix.

MULTI PUMP-PROCESS CONFIGURATION

The PumpSmart PS200 system can control up to four pumps in a coordinated fashion to meet system demand and maximize pump performance and reliability. This is referred to as MULTI-PUMP operation.

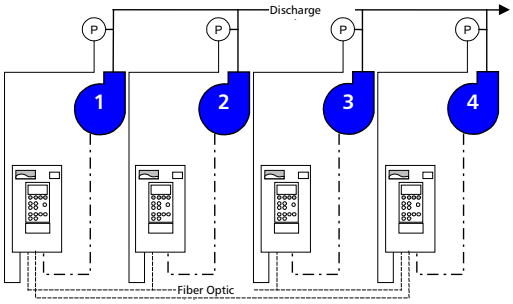
Step	Description	Parameters
	Multi-Pump Overview	
1	**Locks/Passwords & Operating Macro** This section details the parameter lock function and the selection of the Multi-pump operating macro-program.	10.02 11.02
2	**Motor Setup** Drive data for the First Motor Run ID is entered here in addition to start/stop methods, and MAX and MIN drive speeds	12.01 11.04 11.05 11.07 11.08 14.01 14.02
3a	**Operating Mode & Units** Selects the mode of operation and the primary process transmitter setup.	11.03 15.01 16.03 16.04
3b	**Multi-pump Settings** Selects how the multiple pumps will work together to satisfy the system demand.	22.01 22.02 22.03 22.04 22.07 22.08 22.13
4	**Setpoint**	
!	**Pump Protection** Protect the pump from operation below minimum flow or dry running using Secondary Protection or PumpSmart TPP.	25.06
	Configuration Additional Drives	22.09 17.21
	Start/Stop	

	CHECK & GO STEP
Some parameters may not need to be changed from the default parameters allowing you to speed through the set-up process. These parameters have been marked with a check mark.	

MULTI PUMP-PROCESS CONFIGURATION

Overview - Multi-Pump Applications

The following is an overview of the different Multi-pump applications:



Typical Multi-Pump configuration

SYNCHRONOUS

In synchronous mode, a lead drive starts initially and regulates to the set point. If the unit is unable to meet the setpoint conditions, the lead PS200 will start a second PS200 pump and regulate both units to the same speed to meet the setpoint. If the setpoint conditions are still not met a third and fourth pump can be started and similarly be regulated to the same speed. Similarly, when demand drops, PumpSmart will de-stage pumps that are no longer required to meet the setpoint.

PumpSmart can automatically switch between lead and lag pumps to ensure that they all wear evenly.

MULTI-CONTROLLER

In multi-controller mode, a lead drive starts initially and regulates to the setpoint. If this unit is unable to meet the setpoint conditions, it will start a second PS200 pump. The lead PS200 will continue at maximum speed while the lagging drive will regulate speed to meet the setpoint. If demand is still not met, the lead drive will start a third, and if required a fourth, pump to meet the demand. In each case the last PS200 drive/pump started will regulate to the setpoint. When demand drops, PumpSmart will de-stage pumps that are no longer required to meet the setpoint.

As with SYNCHRONOUS, it is possible to use dissimilar pumps in this mode, however caution should be exercised to ensure pump head curves are similar to prevent operation at shut-off or check valve chatter on the lower head pump(s).

PumpSmart can automatically switch between lead and lag pumps to ensure that they all wear evenly.

BACKUP

In cases where a backup pump exists and each pump is sized to handle all the anticipated process demands, backup mode may be used to provide automatic lead-lag switching to provide uniform wear. In addition, in the event of a Pump Protection or VFD fault, the backup unit will be automatically started.

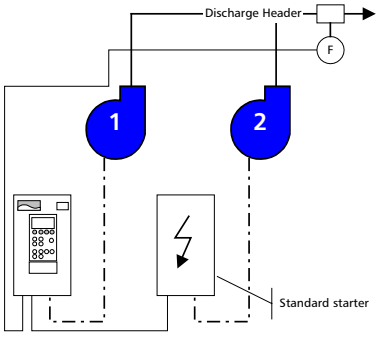
MULTI PUMP-PROCESS CONFIGURATION

CONSTANT SLAVE

In constant slave mode, one PumpSmart PS200 can be used in combination with conventional fixed speed pumps to meet varying demands. The PS200 will signal the constant speed pumps to turn on during periods of peak demand. The PS200 unit will then regulate speed to "trim" to the setpoint. This configuration reduces the number of required PumpSmart PS200 units to one. When demand drops, PumpSmart will stop the lagging pump.

Up to three constant speed pumps may be used with the PS200 system.

In constant slave mode, the PS200 is always the lead pump and the constant speed pump is always the lag pump.



Constant Slave Configuration

NOTE
It is possible to use dissimilar pumps in any of the above Multi-Pump modes. Caution should be exercised however to ensure that pump head curves are similar to prevent operation at shut-off or check valve chatter on the lower head pump(s).

IT IS RECOMMENDED THAT ALL PUMPS BE IDENTICAL IN PERFORMANCE

What's Lead and What's Lag?

A LEAD pump is the pump that runs before all others are activated. This may sometimes be referred to as the *PRIMARY* unit.

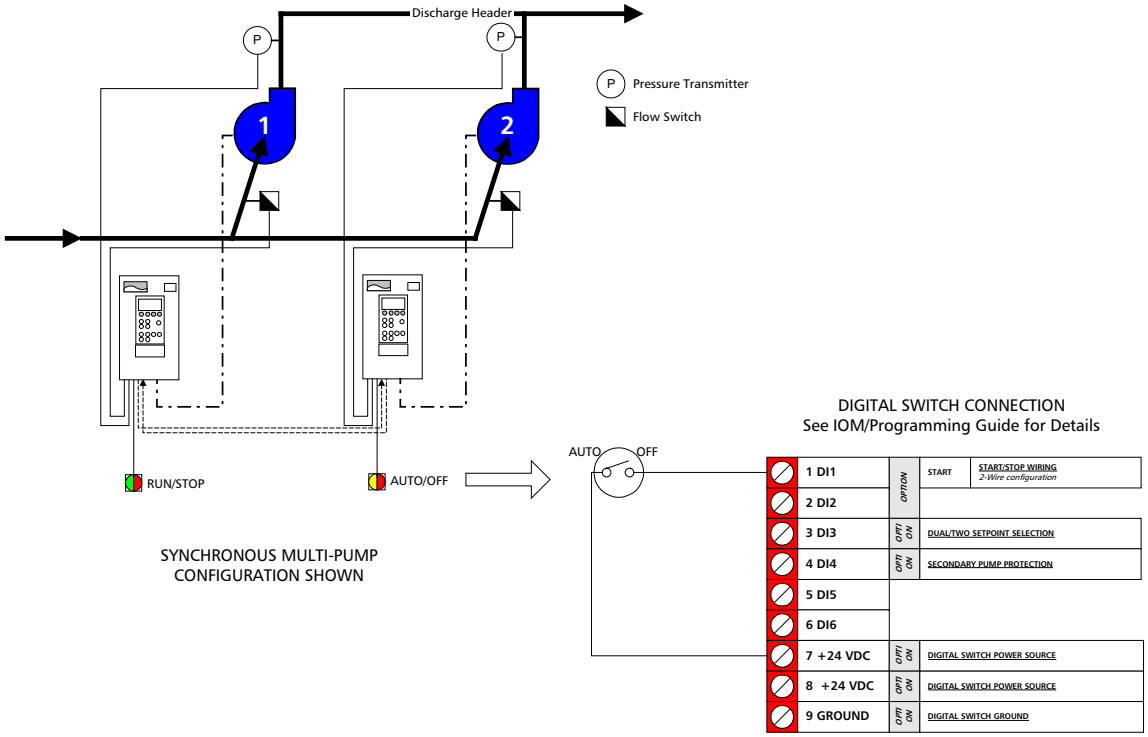
A LAG pump starts only when the demand on the system becomes greater than what the lead pump can handle. This is sometimes called the *BACKUP* or *SECONDARY* unit.

LEAD's and LAG's can be switched to allow for uniform wear. See OPTIONS & FEATURES for details.

MULTI PUMP-PROCESS CONFIGURATION

Note - Multi-Pump Wiring

When installing and wiring a multi-pump system, each lag/slave unit **MUST** include a two-wire "OFF-AUTO" switch or a 3-wire pulse start/stop in addition to the E-Stop/Permissive switch. When starting a multi-pump system, all slave units must be set to "AUTO" or pulse start and the keypad set in REMOTE.



SYNCHRONOUS MULTI-PUMP CONFIGURATION SHOWN

MULTI PUMP-PROCESS CONFIGURATION

1 Locks & Multi-Pump Application Macro

LOCKS & PASSWORDS

Operating parameters on the PumpSmart PS200 are protected by a 3-digit passcode to prevent casual users or unauthorized users from inadvertently changing the operating and protection limits that have been set. All PS200 units utilize the same passcode; it cannot be changed by the user/owner.

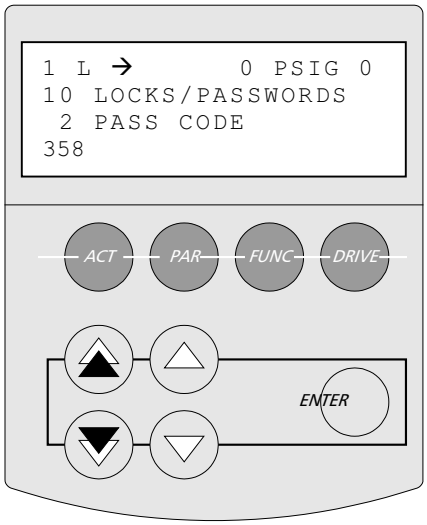
When the PS200 keypad is locked, functionality is limited to starting, stopping, and changing the operating setpoint.

Where to start…

This configuration guide is structured to program the MASTER drive first, and then program the SLAVE drives using the upload/download function on the PumpSmart keypad. In multi-pump applications, any PS200 can be the MASTER. The MASTER drive will control the staging and de-staging of the SLAVE pumps.

Select one pump to be your MASTER and start configuration it first.

10.02 PASS CODE		
To open the Parameter lock, scroll to parameter 10.02 and enter the passcode 358. The display value will automatically return to 0 after the three-digit code has been entered. To check on the status of the parameter lock; scroll to parameter 10.01. After correctly entering the passcode, it will read "OPEN"	KEY SEQUENCE *[From parameter group: 99 INFORMATION]*	
	PAR	Press to enter parameter mode
	▲ ▼	Scroll to parameter group 10 LOCKS / PASSWORDS
	▲ ▼	Scroll to parameter 10.02 PASS CODE
	ENTER	Press to enter the parameter setting mode
	▲ ▼ ▲ ▼	Use a combination of the arrow keys to scroll to the number 358.
	ENTER	Press to complete the passcode entry

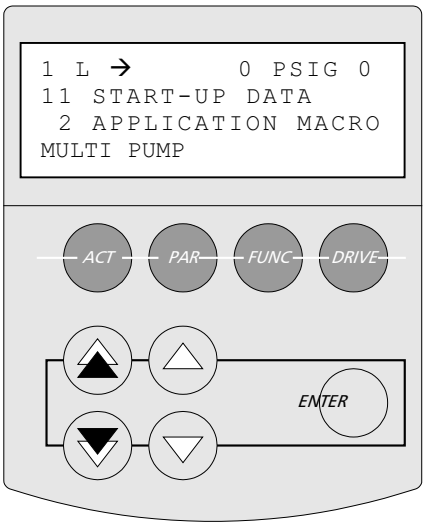


MULTI PUMP-PROCESS CONFIGURATION

MULTI-PUMP APPLICATION MACRO

The default application macro on the PumpSmart PS200 is SINGLE PUMP; parameter 11.02 needs to be set to MULTI PUMP.

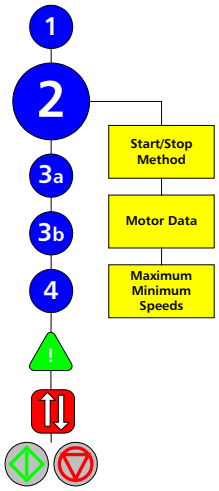
11.02 APPLICATION MACRO		
Select the multi-pump application macro.	KEY SEQUENCE *[From parameter group 10.02 LOCKS.PASSWORDS]*	
		Scroll to parameter group 11 START-UP DATA
		Scroll to parameter 11.02 APPLICATION MACRO
		Press to enter the parameter setting mode
		Scroll to the MULTI PUMP selection
		Press to complete the entry



MULTI PUMP-PROCESS CONFIGURATION

2 Motor Setup

The PumpSmart PS200 variable frequency drive utilizes Direct Torque Control [DTC] rather than a scalar speed control variable such as Volts/Hertz. Direct Torque Control provides more precise speed control, hence more responsive and accurate control to your set point. Specific motor data must be entered into the PumpSmart drive to enable it to properly control the motor using DTC.



Steps to be performed are:

1. Identification of the Motor starting method
2. Entering motor data for characterization
3. Establishment of the Maximum and Minimum speed limits

START/STOP OPTIONS

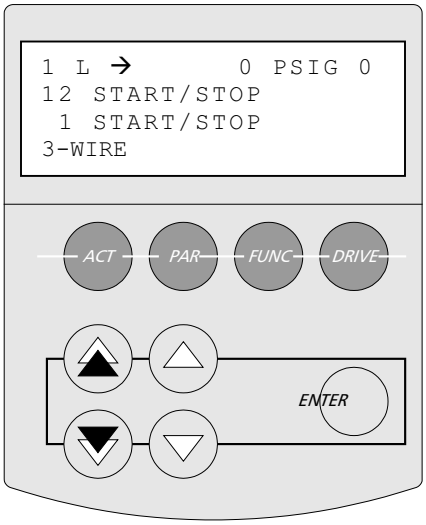
The PumpSmart PS200 has three ways to start and stop:

Two-wire / HOA - This is the default start/stop method and is common to "RUN/STOP" switch configurations.

Three-wire pulse start/pulse stop

Fieldbus control - PumpSmart may be remotely started through a DCS system. This option does require the optional Fieldbus communication module. Refer to the FIELDBUS CONTROL option for further details.

12.01 START/STOP		
If you are using a two-wire start-stop method or the keypad only, skip this step and proceed to the next step (Drive Operation Limits), otherwise select: • 3 WIRE, or • FIELDBUS	KEY SEQUENCE *[From parameter: 11.02 APPLICATION MACRO]*	
		Scroll to parameter group 12 START/STOP. Parameter 12.01 will be the first selection
		Press to enter the parameter setting mode
		Use the arrow keys to scroll to the desired parameter [Example shown - 3 WIRE]
		Press to complete the entry



NOTE - If you are using a 3-Wire Start/Stop, you may see a "No Motor Data" fault prior to making this entry. This fault may be cleared by pressing the "Reset" button after parameter 12.01 has been set to 3-WIRE.

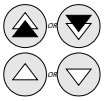
MULTI PUMP-PROCESS CONFIGURATION

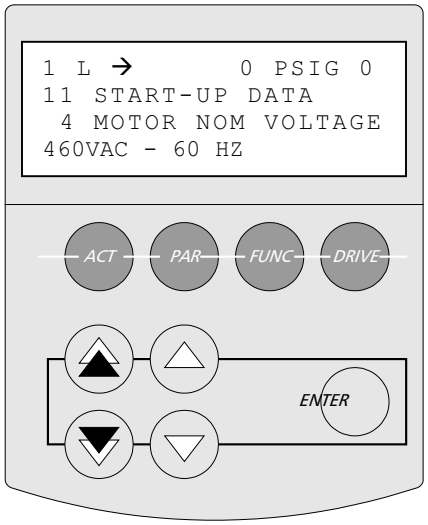
MOTOR DATA

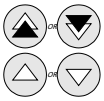
The motor data will allow the PumpSmart drive to characterize the motor during its first start-up. During characterization, PumpSmart will automatically magnetize the motor windings for 20 - 60 seconds to develop a mathematical model of the motor. Entry of the following parameters is all that is required.

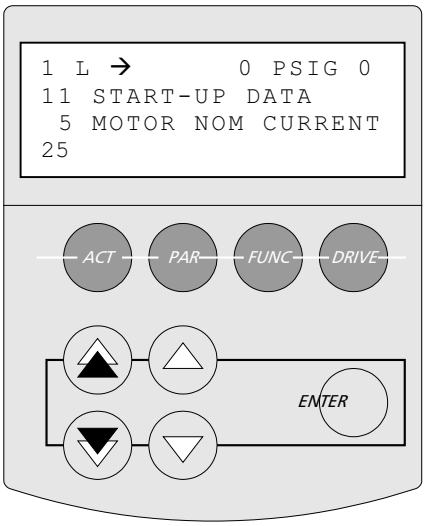
NOTE - If the motor is changed in the future, this data must be re-entered and a new characterization will be performed.

NOTE - The information required for this section can be found on the motor nameplate.

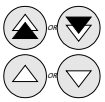
11.04 MOTOR NOM VOLTAGE		
Enter the value for motor voltage and frequency. Available selections are 208 VAC - 60 Hz 220 VAC - 50 Hz 220 VAC - 60 Hz 230 VAC - 60 Hz 380 VAC - 50 Hz 415 VAC - 50 Hz 460 VAC - 60 Hz (default) 575 VAC - 60 Hz OTHER *Selecting OTHER will require entry in parameters 11.06 MOTOR NOM FREQ and 11.12 OTHER MOTOR VOLT.*	KEY SEQUENCE [From parameter group: 12 START/STOP]	
		Scroll to parameter group 11 START UP DATA
		Scroll to parameter 11.04 "MOTOR NOM VOLTAGE"
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate motor voltage.
		Press to complete the entry

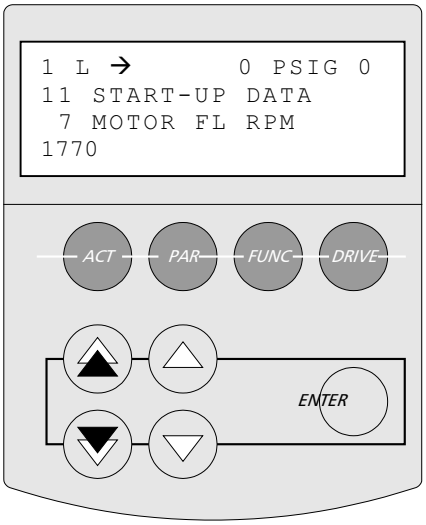


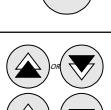
11.05 MOTOR NOM CURRENT		
Enter the actual full load amps (FLA) of the motor here. Refer to the motor nameplate for the correct value.	KEY SEQUENCE *[From parameter: 11.04 MOTOR NOM VOLTAGE]*	
		Scroll to parameter 11.05 "MOTOR NOM CURRENT"
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate motor current.
		Press to complete the entry

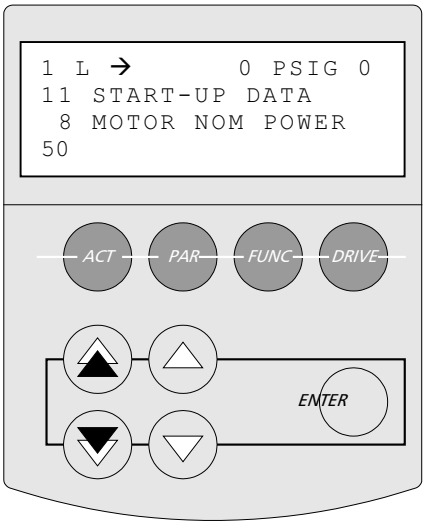


MULTI PUMP-PROCESS CONFIGURATION

11.07 MOTOR FL RPM		
Enter the full load RPM of the motor. Please note this is the nameplate value of the full load RPM and not the nominal speed of the motor. *For Example: An 1800 RPM motor might have a full load RPM of 1770 RPM*	KEY SEQUENCE *[From parameter: 11.05 MOTOR NOM CURRENT]*	
		Scroll to parameter 11.07 "MOTOR FL RPM"
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate full load speed.
		Press to complete the entry



11.08 MOTOR NOM POWER		
Enter the nominal power (HP or kW) of the motor as found on the motor nameplate. *If you are using the Default language of ENGLISH(AM), then the units of entry will be Horsepower. Otherwise kW will be the units of entry.*	KEY SEQUENCE *[From parameter: 11.07 MOTOR FL RPM]*	
		Scroll to parameter 11.08 "MOTOR NOM POWER"
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate power.
		Press to complete the entry



MULTI PUMP-PROCESS CONFIGURATION

ID MAGN REQ

This warning is normal, proceed on to the step INDENTIFICATION RUN

IDENTIFICATION RUN

PumpSmart uses specific motor detail to create a mathematical motor model. This model enables more accurate motor control and is created with the motor data you have just entered and by magnetizing the motor for 20 to 60 seconds at zero speed. This is called a First Start ID Run.

Once all the motor data has been entered, the following warning will be displayed:

ID MAGN REQ

This warning indicates that a First Start ID Run is required before the pump may be operated. Now is a good time to perform this run.

With the motor connected to the drive and the keypad in Local (L) mode, press the START button. FOLLOW ALL STANDARD SAFETY PRACTICES FOR STARTING MACHINERY.

NOTE
ALLOW THE FIRST START ID RUN TO COMPLETE BEFORE STOPPING/RESETTING THE DRIVE. Although the motor may not appear to respond to the start command, it has. A warning message "ID MAGN" will be displayed during the ID. Once the ID run is complete, the message "ID DONE" will be displayed.

NOTE - If the motor is changed in the future, a First Start ID Run must be performed again to maintain the accuracy of the PumpSmart control.

Once the First Start ID Run has been completed, the following message will appear:

ID DONE

Once this appears, proceed on to the next step, DRIVE OPERATION LIMITS.

E-Stop/Permissive

The PS200 will not operate unless the E-Stop/Permissive switch [DI1L] is closed. This includes performing the First Start ID Run. If not closed a warning message will appear on the keypad display:

RUN DISABLED

See Appendix A-4, Instrument Wiring, for details on wiring this switch.

NOTE:
The E-Stop/Permissive switch can not be defeated through parameter setting. If your application does not use an E-Stop / Permissive switch, DI1L can be bypassed physically inside the PumpSmart unit. Refer to Appendix A-4, Instrument Wiring, for details.

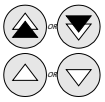
MULTI PUMP-PROCESS CONFIGURATION

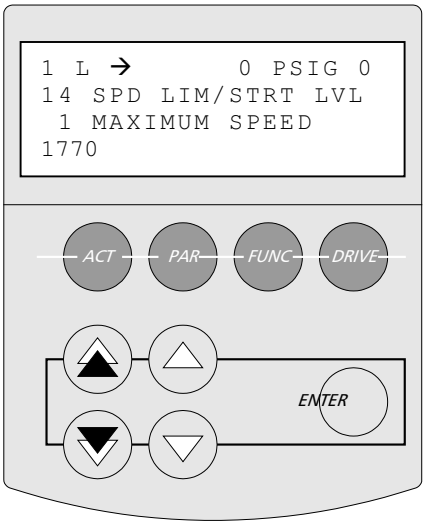
DRIVE OPERATION LIMITS

Drive operation limits safe-guard the pump and drive system from operating in unstable over-speed conditions and low-speed conditions.

Maximum Speed - The PumpSmart System will adjust the speed of the motor to achieve the desired operating setpoint. Although the PumpSmart system can drive the motor to 2-3 times its nameplate speed, this is impractical for several reasons. First, unless the pump and motor are designed for overspeed operation, they could prematurely wear or even catastrophically fail. Second, centrifugal pumps generate pressure by the square of the speed and overspeed operation may overpressure the pump or surrounding piping system.

The maximum speed setting should never be set over the full load RPM of the motor or the pump manufacturers stated maximum speed of the pump.

14.01 MAXIMUM SPEED		
Enter the maximum speed that the pump, motor, and system can operate at. In most cases, the maximum speed will be the same as the previously entered FULL LOAD RPM. MAX SPEED ≤ Full Load Motor RPM and ≤ Pump maximum speed *The default value is the speed set in parameter 11.07 MOTOR FL RPM*	KEY SEQUENCE *[From parameter group: 11 START-UP DATA]*	
		Scroll to parameter group14, SPD LIM/STRT LVL. Parameter 14.01 will be the first selection.
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the maximum speed.
		Press to complete the entry



Minimum Speed - As the demand on the pump decreases, PumpSmart will decrease the pump speed to match the new demand. This Minimum Speed parameter sets the minimum speed that the pump can operate at. It is also used to define the safe speed to run the pump during a pump protection fault. The default value for minimum speed is 25% of 11.07 MOTOR FL RPM

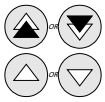
When determining a minimum speed, consider the following:

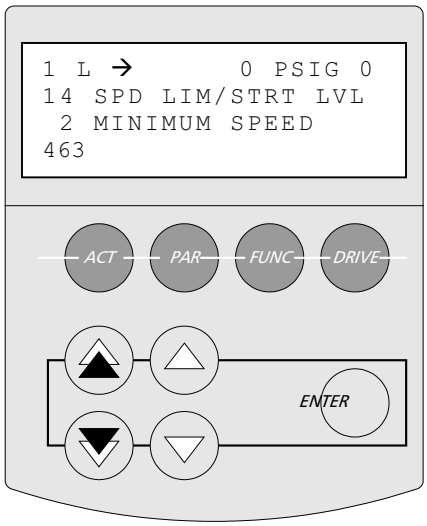
- Motor Minimum Speed [Turndown ratio] - Due to motor loading and thermal effects, the motor minimum speed on centrifugal pumps should not be less than 1/10th its full-load speed.

MULTI PUMP-PROCESS CONFIGURATION

Example – if full load rpm = 3550, set min speed to 355. Use greater than 10% if either of the following conditions exist.

- Pump Minimum Speed - Some pumps have minimum speed requirements, such as multistage pumps (>2 stages) and sleeve bearing pumps. Consult your pump operation manual to see if there is a minimum speed limit for your pump. **Note - 1& 2 stage pumps do not normally have minimum speed requirements.**
- Static head conditions (minimum flow) - The minimum speed should be set to assure that the pump generates enough head to overcome the static resistance. In some cases, this can cause overheating and possible vaporization of the liquid in the pump casing.

14.02 MINIMUM SPEED		
Enter the minimum speed that the pump and motor can safely operate at. Consider- • Turndown ratio • Pump minimum speed • Minimum flow *The default value is 25% of the speed set in parameter 11.07 MOTOR FL RPM*	KEY SEQUENCE *[From parameter: 14.01 MAXIMUM SPEED]*	
		Scroll to parameter 14.02 MINIMUM SPEED
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the minimum speed.
		Press to complete the entry



NOTES

The default settings of the PumpSmart drive will stop the pump if the process demand requires the pump to operate below the minimum speed. A LOW DEMAND Fault will be displayed in this case. A delay can be set for up to 30 minutes (1800 sec) before shutting down. Alternatively the drive may be set to operate at a minimum speed until it is manually shut-off. If the process condition clears while operating at minimum speed, PumpSmart will resume normal operation. See the OPTIONS section for further details.

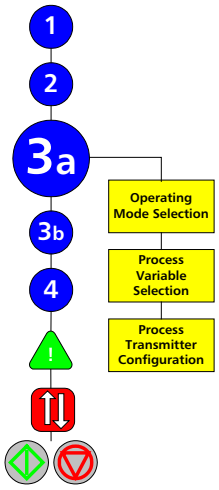
If PumpSmart shuts-down due to a pump protect fault, it can be programmed to try and restart multiple times before shutting down completely. The interval between these times can be adjusted for up to 250 seconds. The default value is 60 seconds. The AUTO RESTART and ERROR RESET features must be set to "ON". See the OPTIONS section for further details.

Once PumpSmart exhausts the selected number of reset attempts, the unit shuts down completely and must be manually restarted.

MULTI PUMP-PROCESS CONFIGURATION

3a Select Operating Mode , Units, and Transmitter Configuration

In this section the operating mode is selected and the process transmitter is configured.

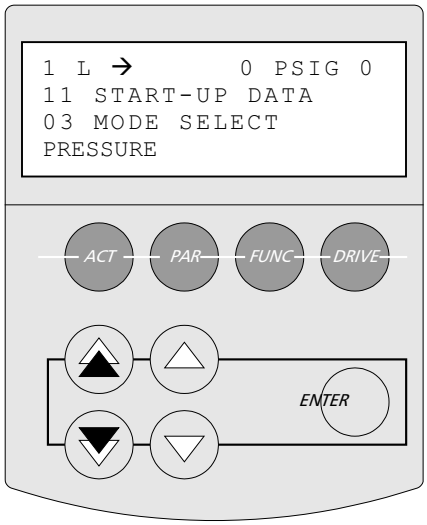


OPERATING MODE

There are four modes for operating the PumpSmart PS200; Pressure, Flow, Level, or Temperature/Other. This selection sets the defaults for units and PI control settings [See TUNING].

- Pressure – PumpSmart will work to maintain a pressure setpoint based on a pressure transmitter signal.
- Flow – PumpSmart will work to maintain a flow setpoint based on a flowmeter signal.
- Level – Used to maintain a defined tank level based on a level transmitter feedback, although a pressure transmitter at the pump suction can also be used. PumpSmart can control the level in either a suction or discharge tank.
- Temperature/OTHER – used to maintain defined temperature of a process stream based on a temperature transmitter signal. Also use this selection if a 4-20 ma signal from a different type of transmitter is used.

11.03 MODE SELECT		
Select the control mode of your application. If the control mode is PRESSURE, skip to the next step (Process Variable selection). Options: Pressure Flow Level Temperature/Other	KEY SEQUENCE *[From parameter group: 14SPD LIM/STRT LVL]*	
	▲ ▼	Scroll to parameter group 11 START-UP DATA
	▲ ▼	Scroll to parameter 11.03 OPERATING MODE
	ENTER	Press to enter the parameter setting mode
	▲ ▼	Scroll to desired mode
	ENTER	Press to complete the entry



MULTI PUMP-PROCESS CONFIGURATION

PROCESS VARIABLE SELECTION

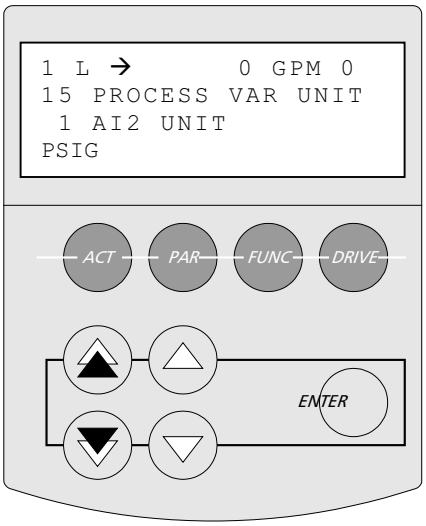
The process variable unit selection identifies what units your operating mode is in. This parameter sets the units that are used in the actual signal and setpoint display. The defaults are shown for ENGLISH [AM] selection.

Operating Mode	Available Units Selection
Pressure	PSIG [default] BAR FT– Feet M– Meters %
Flow	GPM – Gallons Per Minute [default] M3Hr – Cubic meters per hour LBM/SEC - Pounds mass per second LBM/HR - Pounds mass per hour KG/HR - Kilograms per hour %
Level	PSIG BAR FT-Feet [default] IN - Inches CM - Centimeters M– Meters %
Temperature	°F – Degrees Fahrenheit [default] °C – Degrees Celsius

AI2 refers to the Analog Input channel No. 2. This is where your primary process transmitter should be physically connected

NOTE - If you are using a differential pressure flowmeter, please see the OPTIONS & FEATURES section for assistance in selecting the correct process variable.

15.01 AI2 UNIT	
Select the proper units of the operating mode. Skip to the next step if the default unit is okay, otherwise select: BAR % GPM FT PSIG IN (Default) CM M3/HR M LBM/SEC °F LBM/HR °C KG/HR	KEY SEQUENCE *[From parameter 11.03 MODE SELECT]* Scroll to parameter group 15 PROCESS VAR UNIT. Parameter 15.01 will be the first selection Press to enter the parameter setting mode Scroll to the appropriate measurement units. Example shown is PSIG Press to complete the entry



NOTE - FOR PRESSURE/LEVEL MODES
If units of FT, IN, M or CM are used and Specific Gravity [SG] is other than 1.0, parameter 17.04 must be completed. See Options & Features.

NOTE - FOR PRESSURE/LEVEL MODES
If units of FT, IN, M or CM are used, Specific Gravity [SG] must be constant. If SG varies widely, use units of PSIG or Bar.

MULTI PUMP-PROCESS CONFIGURATION

PROCESS TRANSMITTER CONFIGURATION

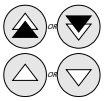
The primary process transmitter is the device that will measure your process conditions using a 4-20 mA signal. The PS200 requires information to properly scale this signal.

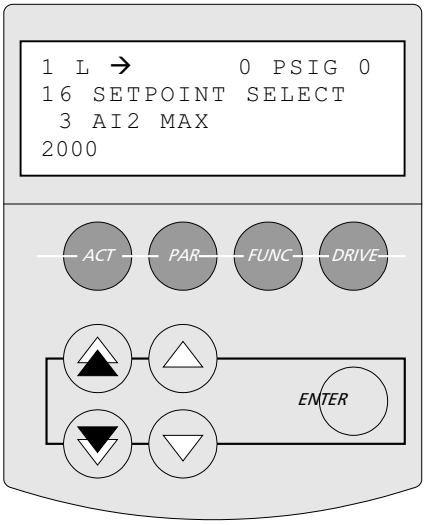
AI2 MAX - This refers to the process value that your transmitter is calibrated to at its max signal [20 mA]. Refer to your transmitter calibration sheet, or the instrument nameplate, for this value.

Example - a direct reading flowmeter [e.g. magmeter, vortex flowmeter, etc…] that has a range of 0 - 2000 GPM would be calibrated such that at 2000 GPM, the output of the transmitter would be 20 mA. Parameter 16.03 would be set to 2000 in this case. The units of 16.03 are the same as selected in parameter 15.01, although they are not displayed

NOTES

Differential pressure flowmeters [e.g. orifice plate, venturi] do not produce 4-20 mA signals that are linear with the flow-rate. PumpSmart refers to this as a QUADRATIC input -- Refer to the section DIFFERENTIAL FLOWMETERS in the options section for proper setup.

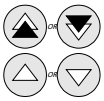
16.03 AI2 MAX		
Enter the reading of the primary process transmitter that corresponds to its 20 mA signal. Units are the same as entered in 15.01	KEY SEQUENCE *[From parameter group: 15.01 AI2 UNIT]*	
		Scroll to parameter group 16 SETPOINT SELECT
		Scroll to parameter 16.03 AI2 MAX
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the correct value. Example shown - 2000 GPM
		Press to complete the entry

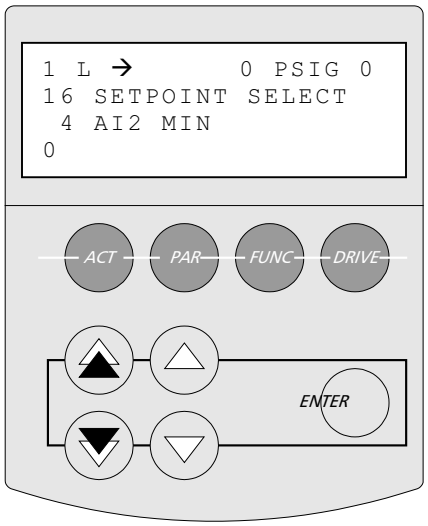


MULTI PUMP-PROCESS CONFIGURATION

AI2 MIN - This is the process value that corresponds to the transmitter's minimum signal [4 mA]. This value is normally zero on a pressure or flow transmitter Refer to your transmitter calibration sheet, or the instrument nameplate, for this value.

NOTE - Most pressure and flow transmitters are configured for a reading of 0 [PSIG, GPM, etc…] at 4 mA. If so, this step may be omitted since the default of parameter 16.04 is 0.

16.04 AI2 MIN		
Enter the reading of the primary process transmitter that corresponds to its 4 mA signal. If your transmitter signal is zero (0) at 4mA, skip to the next section (Multi-Pump Control Settings). Units are the same as entered in 15.01.	KEY SEQUENCE *[From parameter group: 16.03 AI2 MAX]*	
		Scroll to parameter 16.04 AI2 MIN
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the correct value. Example shown - 0 GPM
		Press to complete the entry

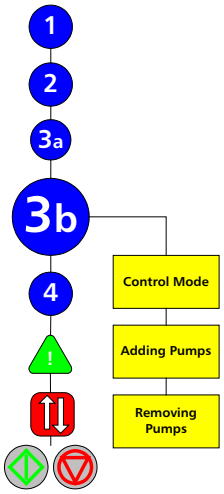


MULTI PUMP-PROCESS CONFIGURATION

3b Multi-pump Control Settings

This section configures the PumpSmart PS200 as to how the multiple pumps will be sequenced. There are three main steps:

1. Selection of operating mode
2. Adding pumps (staging)
3. De-staging pumps.

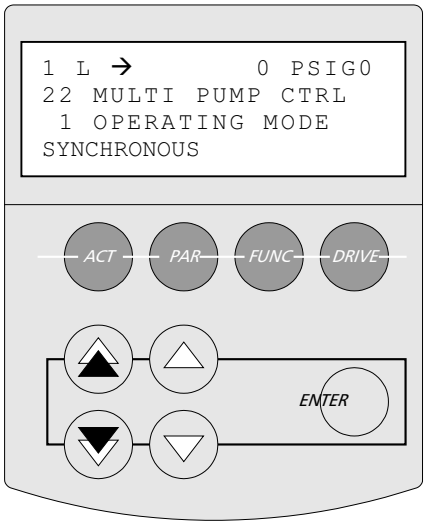


22.01 MULTI-PUMP CONTROL MODE -

Refer to the Multi-Pump Overview section for help with determining which operating mode you want to use.

The most common multi-pump control mode is SYNCHRONOUS, where lead and lag drives will operate at the same speed.

22.01 OPERATING MODE		
Select the multi-pump operating mode. If your desired operation is SYNCHRONOUS, skip to the next step. Options: SYNCHRONOUS (Default) MULTICONTROL CONSTANT SLV (Slave) BACKUP	KEY SEQUENCE *[From parameter group 16.04 AI2 MIN]*	
		Scroll to parameter group 22, MULTI PUMP CTRL. Parameter 22.01 will be the first selection
		Press to enter the parameter setting mode
		Scroll to the desired control mode.
		Press to complete the entry



CONSTANT SLAVE MODE (ONLY)

In Constant Slave mode, the PumpSmart unit activates the constant speed slave pump using relay output(s) (e.g. RO1, RO2 and/or RO3) These relay's must be configured using parameter group 19. See OPTIONS for further details.

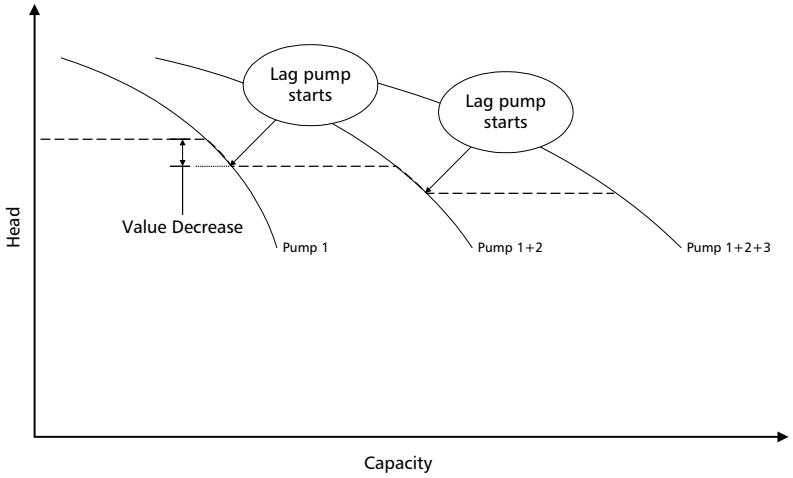
BACKUP MODE

If backup mode is selected, skip to the setup of parameter 22.13 TX CONFIG.

MULTI PUMP-PROCESS CONFIGURATION

Adding Pumps (staging)

PumpSmart will start a lag pump when it is unable to maintain the process setpoint with the current pumps. It does this by starting a lag pump when the process variable [e.g. pressure, flow, level] drops by a prescribed amount, referred to as VALUE DECREASE.



22.02 VALUE DECREASE - The above figure shows a constant pressure system where Pump 2 is started when Pump 1 cannot maintain the constant pressure and it drops by the amount shown as VALUE DECREASE.

Considerations for VALUE DECREASE:

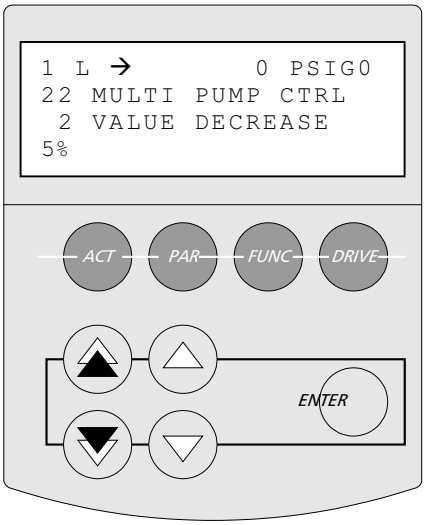
- Goulds recommends an initial value of 5% of your setpoint.

  Example - If the operating setpoint is 200 PSIG and a 5% VALUE DECREASE is entered into parameter 22.02, then a lag pump would be activated when the actual process condition reaches 190 PSIG.

- Try to avoid setting the VALUE DECREASE too close to your setpoint; It may start the lag pump unnecessarily, causing frequent cycling of pumps.

MULTI PUMP-PROCESS CONFIGURATION

22.02 VALUE DECREASE		
Enter the percentage the process variable can decrease before activating a lag unit. Value is in % of setpoint *Default - 5% of setpoint*	KEY SEQUENCE *[From parameter group 22.01 MODE]*	
		Scroll to parameter 22.02 VALUE DECREASE
		Press to enter the parameter setting mode
		Set the desire value. *Note- the double arrows may be used for large values.* *Example shown is 5%*
		Press to complete the entry



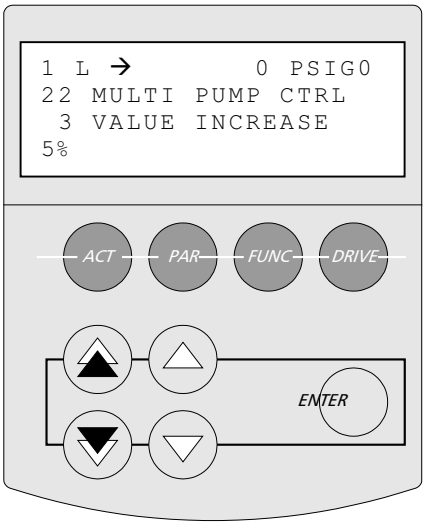
22.03 VALUE INCREASE - As shown in previous figure, the actual process setting will decrease by the VALUE DECREASE with each additional pump that is added. To compensate for this the VALUE INCREASE parameter increases the setpoint for each pump that is added.

Required Setpoint = Original Setpoint - VALUE DECREASE + VALUE INCREASE

Example - If the original setpoint was 200 PSIG and the VALUE DECREASE was 5%, a second pump would be activated at 190 PSIG. A VALUE INCREASE of 5% would result in both pumps continuing to maintain constant pressure of 200 PSIG.

The VALUE INCREASE can be set higher than the VALUE DECREASE to compensate for added frictional losses that occur with increased flow.

22.03 VALUE INCREASE		
Enter the percentage the setpoint should increase with each additional pump Value is in % of setpoint. *Default - Value selected in 22.02 VALUE DECREASE*	KEY SEQUENCE *[From parameter group 22.02 VALUE DECREASE]*	
		Scroll to parameter 22.03 VALUE INCREASE
		Press to enter the parameter setting mode
		Set the desire value. *Note- the double arrows may be used for large values.* *Example shown is 5%*
		Press to complete the entry



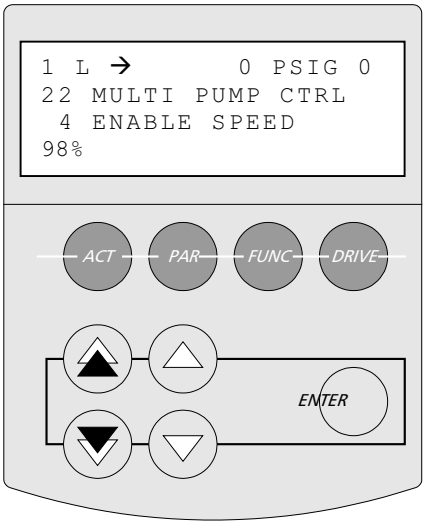
MULTI PUMP-PROCESS CONFIGURATION

22.04 ENABLE SPEED - The lag pump will only start if the start value [SETPOINT-VALUE DECREASE] is met and the lead pump has reached a pre-determined speed based upon the ENABLE SPEED setting.

Normally the ENABLE SPEED should be set 98% of the MAXIMUM SPEED [parameter 14.01].

Example- If MAXIMUM SPEED is set at 3550 RPM, then an enable speed of 97% would enable the multi-pump sequencing at speeds above 3443 RPM.

22.04 ENABLE SPEED		
Enter the minimum speed that the Lead pump must be at before multi-pump operation is allowed. Generally set to 98% of MAXIMUM SPEED. This is the default setting.	KEY SEQUENCE *[From parameter group 22.03 VALUE INCREASE]*	
		Scroll to parameter 22.04 ENABLE SPEED
		Press to enter the parameter setting mode
		Set the desire value. *Note- the double arrows may be used for large values. Example shown is 98%.*
		Press to complete the entry



REMOVING (DE-STAGING) PUMPS

As the system demand decreases, the need for additional pumps will also decrease. The SYNC parameters identify when pumps are de-staged (shutdown) in normal multi-pump control.

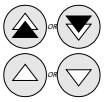
The primary consideration here is to ensure that when a lag pump is shutdown, the remaining pumps are capable of meeting the setpoint demand. The SYNC settings define how much of a speed decrease will occur before one pump can be de-staged. Goulds recommends the following for SYNC settings:

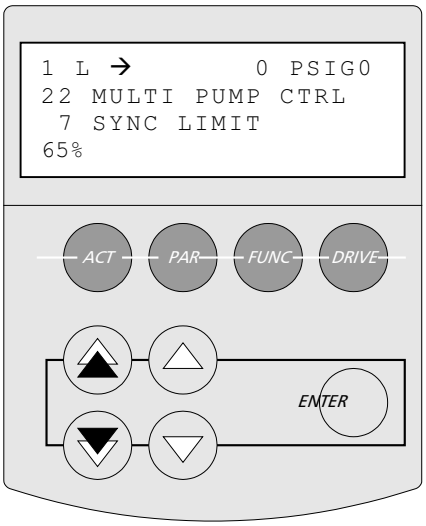
Number of Pumps:		1	2	3	4
Synchronous or Constant Slave	22.07 SYNC LIMIT	65% of MAXIMUM SPEED *e.g. If MAXIMUM SPEED = 3550 RPM, then SYNC LIMIT in RPM = 2308*			
	22.08 SYNC WINDOW	NOT USED	NOT USED	14% of MAXIMUM SPEED	7% of MAXIMUM SPEED
Multi-controller	22.07 SYNC LIMIT	35% of MAXIMUM SPEED *e.g. If MAXIMUM SPEED = 3550 RPM, then SYNC LIMIT in RPM = 1242*			
	22.08 SYNC WINDOW	NOT USED			

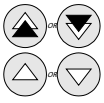
Table 1 - SYNC Settings

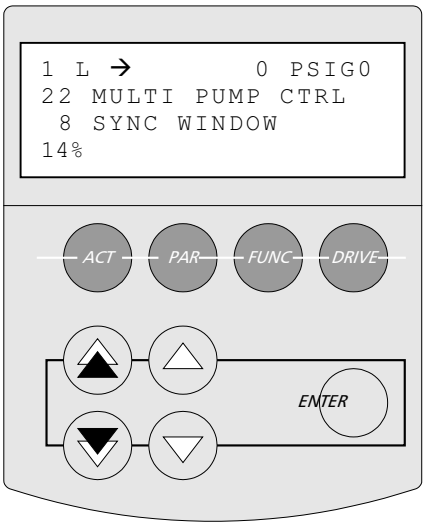
MULTI PUMP-PROCESS CONFIGURATION

If during the operation, a lag pump shuts off and then is restarted shortly after, consider lowering the SYNC LIMIT or decreasing the SYNC WINDOW (if more than 2 pumps).

22.07 SYNC LIMIT		
Enter the speed at which the first LAG pump will turn off. Values may range between 0 - 100 % Recommended values are automatically set based upon Multi-Pump Mode selection.	KEY SEQUENCE *[From parameter group: 22.04 ENABLE SPEED]*	
		Scroll to parameter 22.07 SYNC LIMIT
		Press to enter the parameter setting mode
		Use the arrow key to scroll to the correct speed selection
		Press to complete the entry



22.08 SYNC WINDOW		
Enter the speed steps that the 2nd and 3rd LAG pumps will be shut-off at. If you do not have 3 or 4 pumps, skip to the next section (Setpoint). Values may range between 0 - 14 % *Default - 14% of MAXIMUM SPEED*	KEY SEQUENCE *[From parameter group: 22.07 SYNC LIMIT]*	
		Scroll to parameter 22.08 SYNC WINDOW
		Press to enter the parameter setting mode
		Use the arrow key to scroll to the correct speed selection
		Press to complete the entry



MULTI PUMP-PROCESS CONFIGURATION

TRANSMITTER CONFIGURATION

There are three ways to wire the process transmitter into PumpSmart and depending upon the method chosen parameter 22.13 TX CONFIG will require setting. The following options are available:

TRANSMITTER on ALL DRIVES

In this selection, each PumpSmart unit has its own process transmitter wired directly into the drive. In the event a process transmitter fails, the remaining units will continue to control to the setpoint.

This method is pre-selected when PRESSURE is selected in parameter 11.03 MODE SELECT.

This method should not be used on FLOW (Volumetric or Mass) applications.

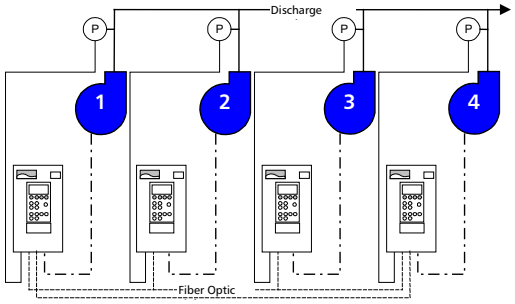


Figure 1 - Typical Multi-Pump Configuration
TX ALL DRIVES – Where each PS200 has it's own pressure transmitter

TRANSMITTER with ONE AI

One process transmitter can be shared between multiple PumpSmart units. In this case, the drives would be wired in series to form a loop with the transmitter signal cable.

Although the onboard power supply of PumpSmart can still provide power to the transmitter, an external power supply should also be considered to provide uninterrupted service if the drive supplying the loop power is disconnected from the main power.

This method is pre-selected when FLOW, LEVEL, or TEMPERATURE is selected in parameter 11.03 MODE SELECT. It may also be used for PRESSURE applications.

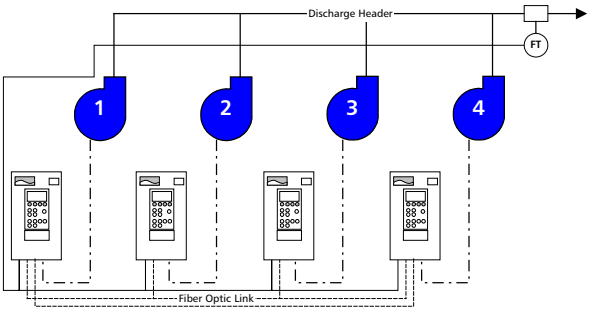


Figure 2 - Single Process Transmitter Configuration
TX ONE AI – Where each PS200 is wired in series with a single process transmitter.

TRANSMITTER from ONE MASTER drive

PumpSmart can also transmit the process transmitter signal to all of the slave drives via the fiber-optic cables that link all the drives. In this configuration, the 4-20 mA signal is wired into the master drive and parameter 22.13 TX CONFIG is set to TX ONE MASTER.

This configuration makes wiring very simple, however in the event a lag drive is disconnected from the main power, the remaining lag drives will lose the process signal as well.

This method may be used for all control modes.

NOTE – setting parameter 22.13 TX CONFIG is not required for CONSTANT SLAVE applications.

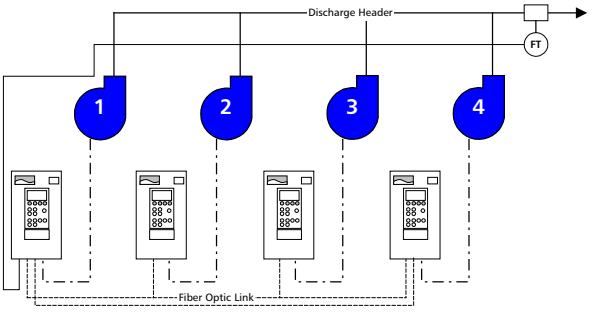
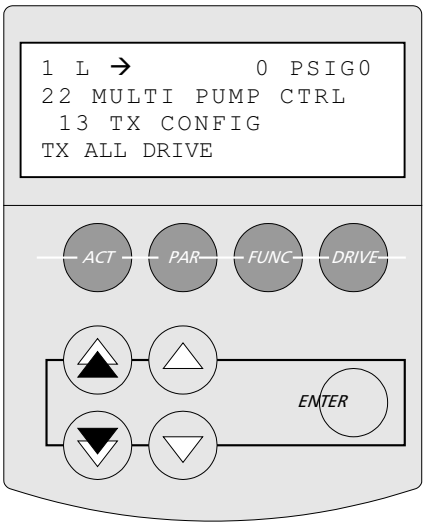


Figure 3 - Single Process Transmitter Configuration
TX ONE MASTER – Where the process transmitter is wired into the MASTER PS200 and the process signal is communicated to the slave PS200 units via the fiber optic cable..

MULTI PUMP-PROCESS CONFIGURATION

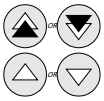
22.13 TX CONFIG		
Select how you have wired in your process transmitter(s). TX ALL DRIVE – Each drive has a transmitter TX ONE AI – Each PS200 is wired in series with the transmitter. TX ONE MASTER – The transmitter signal is sent digitally through the fiber optic cables. *The default is based upon the selection made in 11.03 MODE SELECT*	KEY SEQUENCE *[From parameter group: 22.08 SYNC WINDOW]*	
		Scroll to parameter 22.13 TX CONFIG
		Press to enter the parameter setting mode
		Use the arrow key to scroll to the correct transmitter selection
		Press to complete the entry

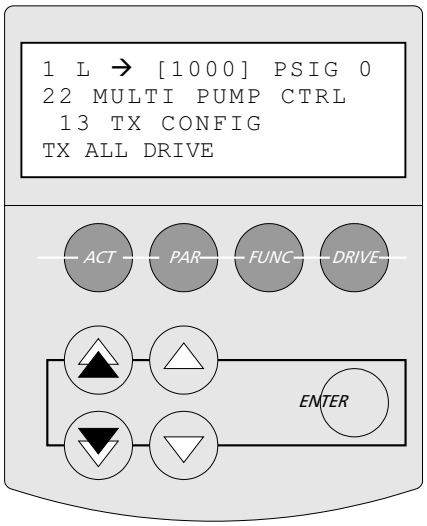


MULTI PUMP-PROCESS CONFIGURATION

4 Enter Setpoint

The setpoint is the value that the PumpSmart PS200 will work to maintain.

SETPOINT		
Enter the operating setpoint.	KEY SEQUENCE	
		Press REF button to highlight the setpoint value
		Use a combination of the arrow keys to scroll to the desired setpoint. Example shown is 1000 PSIG.
		Press to complete the entry



NOTES –

PumpSmart will communicate the setpoint to the slave drives automatically after they are programmed.

There are alternative ways to enter the setpoint. Refer to the OPTIONS AND FEATURES section for configuration detail.

Remote setpoint – An analog input signal may be used to send setpoints to the PumpSmart unit from a remote location.

Variable Setpoint- A second process transmitter [2-10VDC or 4-20 mA] may be used to vary the setpoint. The setpoint can be linear, inverse linear, or offset, to this signal. See OPTIONS & FEATURES for details.

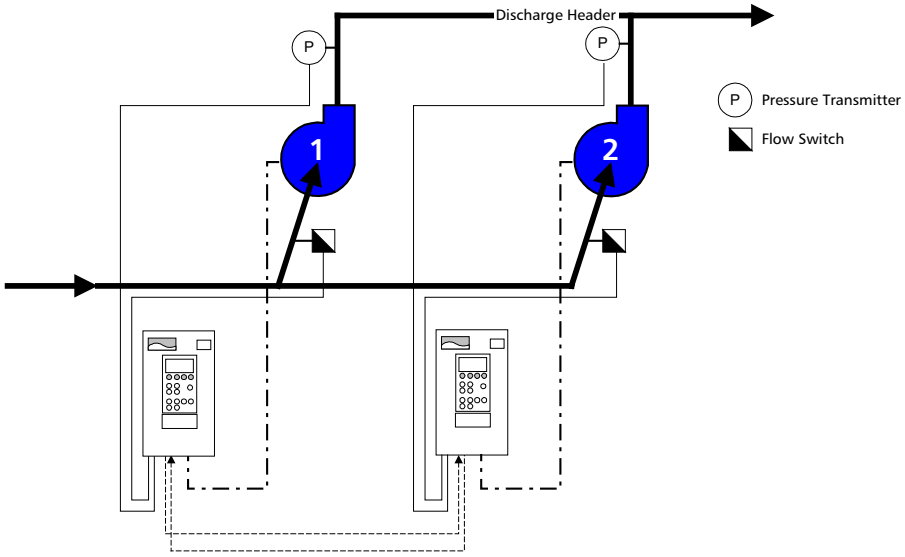
Multiple setpoint - The PumpSmart system can be programmed with two setpoints and the drive can toggle between the two setpoints based upon a digital switch [e.g. flow switch, level switch, manual switch, etc…]. Multiple setpoints can be set through either the keypad, Analog Input or via the DCS.

DCS Fieldbus - The setpoint can be programmed and changed remotely by way of a digital communication from a DCS system with optional bus communication modules. Modules are available for Modbus, Profibus, Device Net, Interbus-S, Modbus Plus, ControlNet, and Ethernet.

MULTI PUMP-PROCESS CONFIGURATION

Recommended Option: Secondary Protection

To provide protection from dry-running or operating against a closed discharge valve in multi-pump mode, the PumpSmart secondary protection feature may be used. In this case, additional process condition inputs (e.g. level switch, pressure switch, flow switch, etc…) are used to alert PumpSmart of conditions that require the protection of the pump. Alternatively, PumpSmart TPP may also be used. See the Options & Features Section for details.



Typical Secondary Protection Configuration

In the above example, a 2-unit Multi-Pump application is being controlled by pressure. Flow switches are added to each pump installation and wired into its respective PumpSmart controller.

Once wired, parameter 25.06 SECONDARY PROTECT A must be set to ALARM or ALARM AND CONTROL. The response being:

1. ALARM & CONTOL- In this response, PumpSmart will issue a warning and then either shut down or reduce speed depending on the settings of parameter 14.05 CONFIG SPEED MIN. At this point the pump will behave similar to the description in MINIMUM SPEED. Alarm & Control is the recommended setting.
2. ALARM only - In this response, PumpSmart will simply issue an alarm/warning, but continue to operate. The alarm only mode may result in damage to the pump if a protection limit fault occurs.

TORQUE PUMP PROTECT

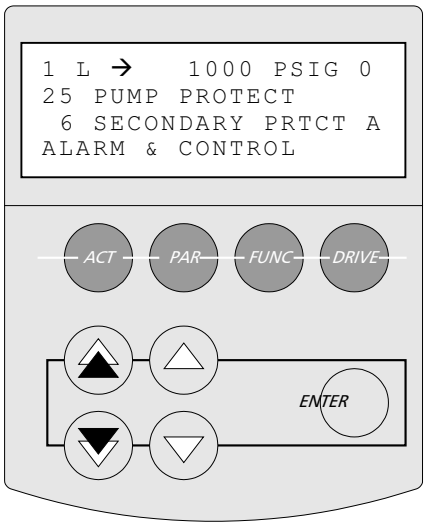
PumpSmart TPP can also be used to provide protection against operation below minimum flow, dry-running, and run-out conditions.

SEE OPTIONS & FEATURES SECTION

MULTI PUMP-PROCESS CONFIGURATION

NOTE – For Multi-Pump applications with a common suction header, one flow switch may be wired in series to the other PS200 units. For Multi-Pump systems with individual suction sources, a separate flow switch is required for each pump to enable protection.

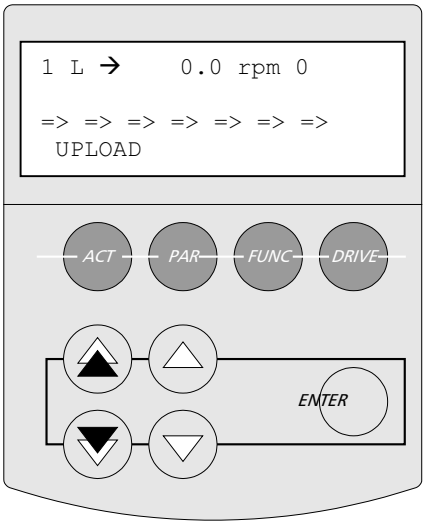
25.06 SECONDARY PROTECT A		
Secondary protect utilizes a process switch into connection DI-4 to warn of no-flow conditions. Once wired, select: ALARM & CONTROL ALARM	KEY SEQUENCE *[From parameter group 22.13 TX CONFIG]*	
		Scroll to parameter group 25 PUMP PROTECT
		Scroll to parameter group 25.06 SECONDARY PROTECT A
		Press to enter the parameter setting mode
		Scroll to the desired response mode
		Press to complete the entry



Program Lag Units

Once the first PumpSmart drive is programmed, the remaining drives can be quickly programmed by uploading the parameters that have just been entered into the PumpSmart keypad, downloading the parameters into the remaining drives and adjusting a few parameters.

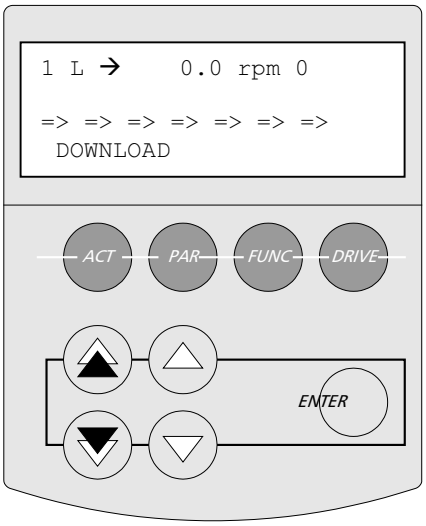
UPLOAD DRIVE PARAMETERS		
Uploading the drive parameters to the keypad allows additional identical drives to be quickly programmed.	KEY SEQUENCE	
	FUNC	Press to enter the Function Mode selection screen
	OR	Use the arrows to scroll to UPLOAD
	ENTER	Press to upload the drive parameters to the keypad



With the drive parameters successfully loaded to the keypad, remove it from the drive and connect it to the next drive in place of the original keypad. Using the same basic process as uploading the parameters, download the parameters to the new drive, and replace the original keypad.

NOTE - The drive to be downloaded must be set in the Multipump Macro (Parameter 11.02 APPLICATION MACRO) prior to performing the download.

DOWNLOAD DRIVE PARAMETERS		
	KEY SEQUENCE	
	FUNC	Press to enter the Function Mode selection screen
	OR	Use the arrows to scroll to DOWNLOAD
	ENTER	Press to download the drive parameters to the keypad



MULTI PUMP-PROCESS CONFIGURATION

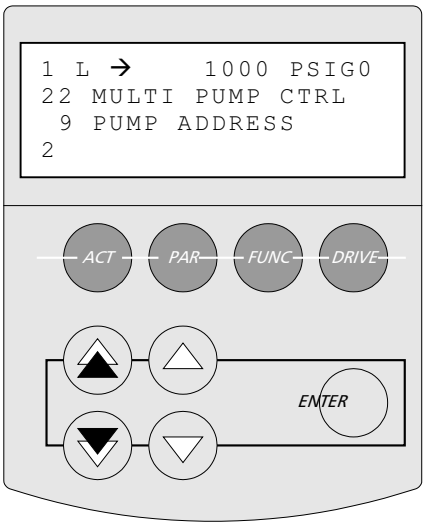
Most drive parameters do not need to be changed. A mandatory change to parameter 22.09 PUMP ADDRESS is required to identify the different drives to each other.

It is recommended that parameter settings be verified after completion of each download.

⚠	If the motors on the drive are not exactly the same, repeat Step 2 - MOTOR DATA entry, and enter the correct motor information.

⚡	**ID MAGN REQ** Each slave drive must have a First Start ID Run performed before the pump can be started.

22.09 PUMP ADDRESS		
The PUMP ADDRESS tells the drives in multi-pump control which they are.	KEY SEQUENCE *[From parameter group: 24.06 SEC PROTECT A]*	
	PAR	Press to enter parameter mode
	▲▼	Scroll to parameter group 22 MULTI PUMP CTRL
	▲▼	Scroll to parameter 22.09 PUMP ADDRESS
	ENTER	Press to enter the parameter setting mode
	▲▼	Use the arrow keys to identify the pump (#2-#4)
	ENTER	Press ENTER to complete the addressing



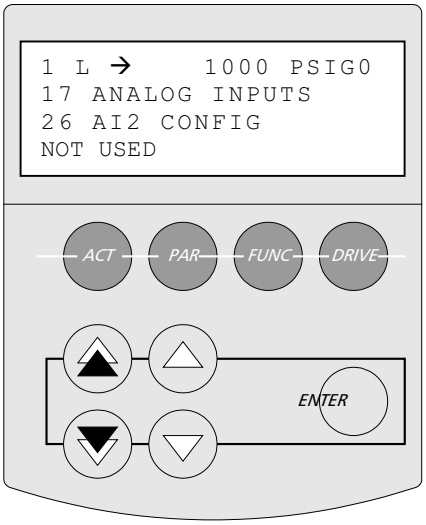
MULTI PUMP-PROCESS CONFIGURATION

ANALOG INPUT 2 CONFIGURATION

If you configured PumpSmart to automatically communicate the process signal over its' fiber-optic link (TX ONE MASTER), then each slave drive must be informed that the Analog Input channel 2 is not being used.

If TX ALL DRIVES or TX ONE AI is selected from parameter 22.13 TX CONFIG, skip this step.

17.21 AI2 CONFIG		
If TX ONE MASTER was selected in parameter 22.13 TX CONFIG, set to NOT USED.	KEY SEQUENCE *[From parameter group: 22.09 PUMP ADDRESS]*	
		Scroll to parameter group 17 ANALOG INPUTS
		Scroll to parameter 17.21 AI2 CONFIG
		Press to enter the parameter setting mode
		Use the arrow keys to select transmitter configuration
		Press ENTER to complete the addressing



Recommended Step: Parameter Upload

See KEYPAD USE

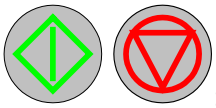
Save your parameters to each individual keypad. In the unlikely event that the PS200 parameters are lost, the keypad can be used to restore the configuration.

Recommended Option: Drive Locking

See OPTIONS & FEATURES

The keypad can "locked" to prevent unauthorized personnel from making operational changes or changes to the parameter groups. See LOCKING in OPTIONS & FEATURES.

MULTI PUMP-PROCESS CONFIGURATION



Starting & Stopping

The PumpSmart system is now ready to start. Since all drives should be configured with an external start/stop switch, place all drives in “REMOTE”. Press the LOC-REM button until "R" is displayed in the upper left status row on all of the drives. You are now ready to start from a remote location.

KEY SEQUENCE	
	Press LOC/REM button until "R" is displayed in the status row on all of the LAG drives.
START	Enable the lead unit using the external start/stop switch.
OFF-AUTO	Enable all the lag units using the external Start/Stop switch.
STOP	Stop the lead or lag units using the external start/stop switch.

NOTE - When shutting down the system, all drive external switches must be set to off.

E-Stop/Permissive

The PS200 will not operate unless the E-Stop/Permissive switch [DI1L] is closed. If not closed a warning message will appear on the keypad display:

```
RUN DISABLED
```

See Appendix A-4, Instrument Wiring, for details on wiring this switch.

NOTE:
The E-Stop/Permissive switch can not be defeated through parameter setting. If your application does not use an E-Stop / Permissive switch, [DI1L] can be bypassed physically inside the PumpSmart unit. Refer to Appendix A-4, Instrument Wiring, for details.

Jogging the Motor for Rotation

To check for proper motor rotation, scroll to parameter 12.09 MOTOR JOG and selecting JOG. Once selected, PumpSmart will turn the motor at 60 RPM for 10 seconds.

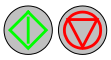
For Multi-Pump units, the motor jog function should be done in Local Mode

If rotation is reversed, the position of two leads must be changed either at the drive output (U_2, V_2, W_2) or at the motor (T_1, T_2, T_3). Refer to the quick Reference Installation drawings in the appendix.

SPEED CONTROL CONFIGURATION

An external PID controller can be used to feed the PS200 with a reference speed signal in lieu of the standard single pump operating modes. In this set-up, the drive output frequency will be directly proportional to the reference signal. A speed setpoint can also be input via the keypad or Fieldbus. Limited pump protection can be enabled with optional sensors.

	Operating in speed control disables the PumpSmart Pump Protection Limit and reduces the inherent protection capabilities of the system.

Step	Description	Parameters
	Speed Control Overview	
	**Locks/Passwords**	10.02 11.02
	**Motor Setup** Drive data for the First Motor Run ID is entered here in addition to start/stop methods, and MAX and MIN drive speeds	12.01 11.04 11.05 11.07 11.08 14.01 14.02
	**Speed Control Setup** Selects the units of operation and the operational limits	16.02 16.03 16.04
	**Setpoint**	
	**Pump Protection** Protect the pump from operation below minimum flow or dry running using Secondary Protection or PumpSmart TPP.	25.06
	**Start/Stop**	

	**CHECK & GO STEP**
Some parameters may not need to be changed from the default parameters allowing you to speed through the set-up process. These parameters have been marked with a check mark.	

SPEED CONTROL CONFIGURATION

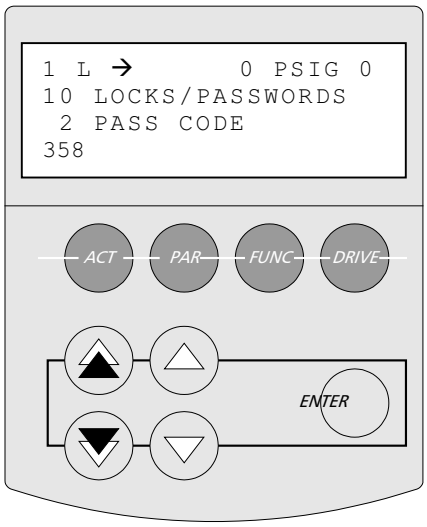
1 Locks/Passwords and Operating Mode

LOCKS AND PASSWORDS

Operating parameters on the PumpSmart PS200 are protected by a 3-digit passcode to prevent casual users or unauthorized users from inadvertently changing the operating and protection limits that have been set. All PS200 units utilize the same passcode; it cannot be changed by the user/owner.

When the PS200 keypad is locked, functionality is limited to starting, stopping, and changing the operating setpoint.

10.02 PASS CODE		
To open the Parameter lock, scroll to parameter 10.02 and enter the passcode 358. The display value will automatically return to 0 after the three-digit code has been entered. To check on the status of the parameter lock; scroll to parameter 10.01. After correctly entering the passcode, it will read "OPEN"	KEY SEQUENCE *[From parameter group: 99 INFORMATION]*	
	PAR	Press to enter parameter mode
		Scroll to parameter group 10 LOCKS / PASSWORDS
		Scroll to parameter 10.02 PASS CODE
	ENTER	Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the number 358.
	ENTER	Press to complete the passcode entry

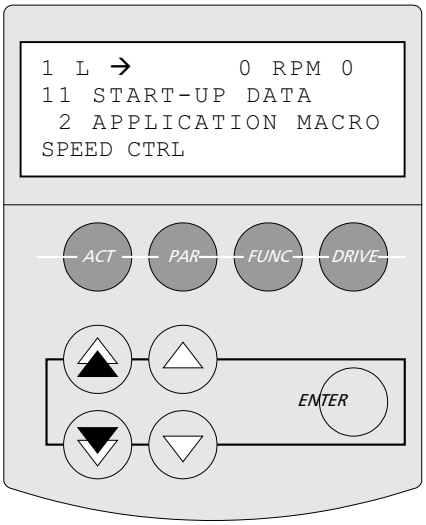


SPEED CONTROL CONFIGURATION

SPEED CONTROL APPLICATION MACRO

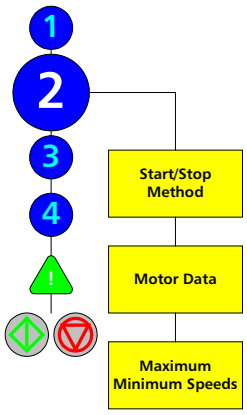
The speed control application must be selected from Parameter 11.02.

11.02 APPLICATION MACRO		
Select SPEED CTRL for manual speed control entry, or PID/Fieldbus entry.	KEY SEQUENCE *[From parameter group: 10.02 LOCKS/PASSWORDS]*	
		Press to scroll to parameter group 11, START-UP DATA
		Use the arrow key to scroll to parameter 11.02 APPLICATION MACRO.
		Press to enter the parameter setting mode
		Use the arrow keys to scroll to speed control
		Press to complete the entry



SPEED CONTROL CONFIGURATION

2 Motor Setup



The PumpSmart PS200 variable frequency drive utilizes Direct Torque Control [DTC] rather than a scalar speed control variable such as Volts/Hertz. Direct Torque Control provides more precise speed control, hence more responsive and accurate control to your set point. Specific motor data must be entered into the PumpSmart drive to enable it to properly control the motor using DTC.

Steps to be performed are:

1. Identification of the Motor starting method
2. Entering motor data for characterization
3. Establishment of the Maximum and Minimum speed limits

START/STOP OPTIONS

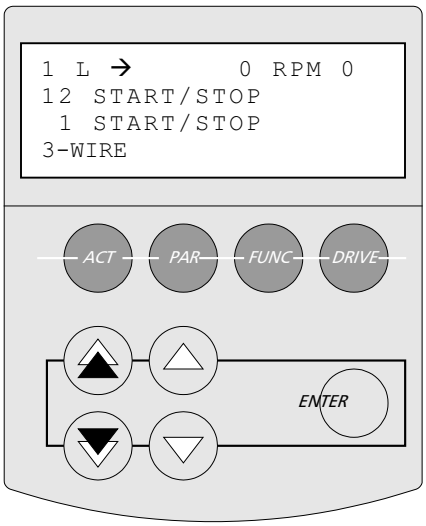
The PumpSmart PS200 has three ways to start and stop:

Two-wire / HOA - This is the default start/stop method and is common to "RUN/STOP" switch configurations. This setting is also used when starting/stopping the PS200 through the keypad [i.e. no external switch] or when an manual override switch is desired

Three-wire pulse start/pulse stop

Fieldbus control - PumpSmart may be remotely started through a DCS system. This option does require the optional Fieldbus communication module. Refer to the FIELDBUS CONTROL option for further details.

12.01 START/STOP		
If you are using a two-wire start-stop method or the keypad only, skip this step and proceed to the next step (Drive Operation Limits), otherwise select: • 3 WIRE, or • FIELDBUS	KEY SEQUENCE *[From parameter group: 11 START-UP DATA]*	
		Scroll to parameter group 12 START/STOP. Parameter 12.01 will be the first selection
		Press to enter the parameter setting mode
		Use the arrow keys to scroll to the desired parameter [Example shown - 3 WIRE]
		Press to complete the entry



NOTE - If you are using a 3-Wire Start/Stop, you may see a "No Motor Data" fault prior to making this entry. This fault may be cleared by pressing the "Reset" button after parameter 12.01 has been set to 3-WIRE.

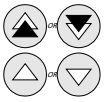
SPEED CONTROL CONFIGURATION

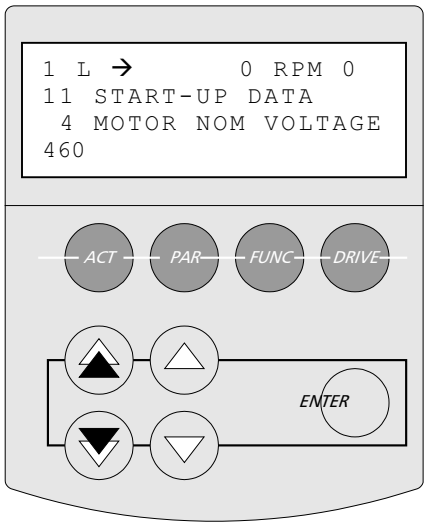
MOTOR DATA

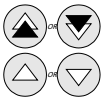
The motor data will allow the PumpSmart drive to characterize the motor during its first start-up. During characterization, PumpSmart will automatically magnetize the motor windings for 20 - 60 seconds to develop a mathematical model of the motor. Entry of the following parameters is all that is required.

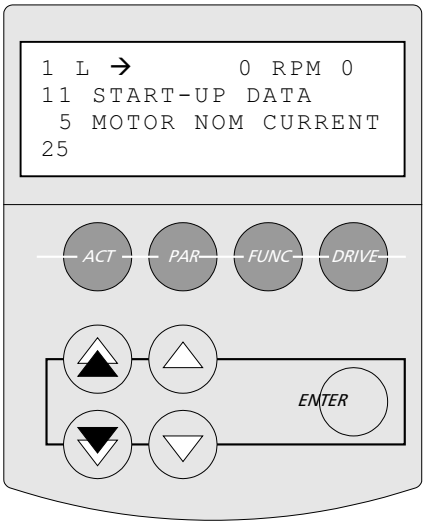
NOTE - If the motor is changed in the future, this data must be re-entered and a new characterization will be performed.

NOTE - The information required for this section can be found on the motor nameplate.

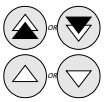
11.04 MOTOR NOM VOLTAGE		
Enter the value for motor voltage and frequency. Available selections are 208 VAC - 60 Hz 220 VAC - 50 Hz 220 VAC - 60 Hz 230 VAC - 60 Hz 380 VAC - 50 Hz 415 VAC - 50 Hz 460 VAC - 60 Hz (default) 575 VAC - 60 Hz OTHER *Selecting OTHER will require entry in parameters 11.06 MOTOR NOM FREQ and 11.12 OTHER MOTOR VOLT.*	KEY SEQUENCE *[From parameter group: 12 START/STOP]*	
		Scroll to parameter 11.04 "MOTOR NOM VOLTAGE"
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate motor voltage.
		Press to complete the entry

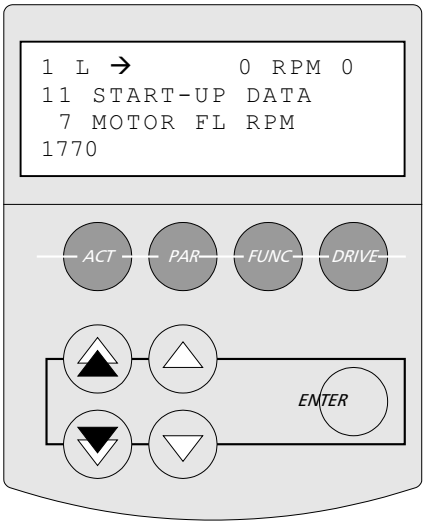


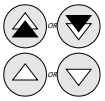
11.05 MOTOR NOM CURRENT		
Enter the actual full load amps (FLA) of the motor here. Refer to the motor nameplate for the correct value.	KEY SEQUENCE *[From parameter group: 11.04 MOTOR NOM VOLTAGE]*	
		Scroll to parameter 11.05 "MOTOR NOM CURRENT"
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate motor current.
		Press to complete the entry

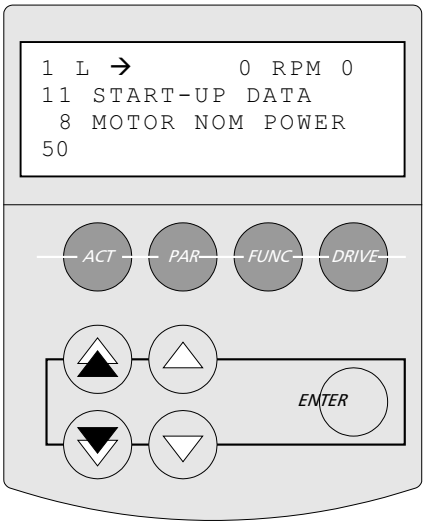


SPEED CONTROL CONFIGURATION

11.07 MOTOR FL RPM		
Enter the full load RPM of the motor. Please note this is the nameplate value of the full load RPM and not the nominal speed of the motor. *For Example: An 1800 RPM motor might have a full load RPM of 1770 RPM*	KEY SEQUENCE *[From parameter group: 11.05 MOTOR NOM CURRENT]*	
		Scroll to parameter 11.07 "MOTOR FL RPM"
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate full load speed.
		Press to complete the entry



11.08 MOTOR NOM POWER		
Enter the nominal power (HP or kW) of the motor as found on the motor nameplate. *If you are using the Default language of ENGLISH(AM), then the units of entry will be Horsepower. Otherwise kW will be the units of entry.*	KEY SEQUENCE *[From parameter group: 11.07 MOTOR FL RPM]*	
		Scroll to parameter 11.08 "MOTOR NOM POWER"
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the nameplate power.
		Press to complete the entry



SPEED CONTROL CONFIGURATION

	**ID MAGN REQ**
This warning is normal, proceed on to the step INDENTIFICATION RUN	

IDENTIFICATION RUN

PumpSmart uses specific motor detail to create a mathematical motor model. This model enables more accurate motor control and is created with the motor data you have just entered and by magnetizing the motor for 20 to 60 seconds at zero speed. This is called a First Start ID Run.

Once all the motor data has been entered, the following warning will be displayed:

ID MAGN REQ

This warning indicates that a First Start ID Run is required before the pump may be operated. Now is a good time to perform this run.

With the motor connected to the drive and the keypad in Local (L) mode, press the START button. FOLLOW ALL STANDARD SAFETY PRACTICES FOR STARTING MACHINERY.

NOTE
ALLOW THE FIRST START ID RUN TO COMPLETE BEFORE STOPPING/RESETTING THE DRIVE. Although the motor may not appear to respond to the start command, it has. A warning message “ID MAGN” will be displayed during the ID. Once the ID run is complete, the message "ID DONE" will be displayed.

NOTE - If the motor is changed in the future, a First Start ID Run must be performed again to maintain the accuracy of the PumpSmart control.

Once the First Start ID Run has been completed, the following message will appear:

ID DONE

Once this appears, proceed on to the next step, DRIVE OPERATION LIMITS.

E-Stop/Permissive

The PS200 will not operate unless the E-Stop/Permissive switch [DI1L] is closed. This includes performing the First Start ID Run. If not closed a warning message will appear on the keypad display:

RUN DISABLED

See the Appendix A-4, Instrument Wiring, for details on wiring this switch.

NOTE:
The E-Stop/Permissive switch can not be defeated through parameter setting. If your application does not use an E-Stop / Permissive switch, [DI1L] can be bypassed physically inside the PumpSmart unit. Refer to Appendix A-4, Instrument Wiring, for details.

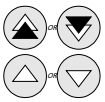
SPEED CONTROL CONFIGURATION

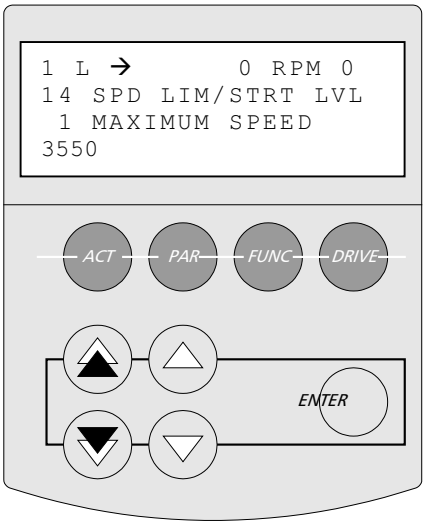
DRIVE OPERATION LIMITS

Drive operation limits safe-guard the pump and drive system from operating in unstable over-speed and/or low-speed conditions.

Maximum Speed - The PumpSmart System will adjust the speed of the motor to achieve the desired speed setpoint. Although the PumpSmart drive can drive the motor to 2-3 times its nameplate speed, this is impractical for several reasons. First, unless the pump and motor are designed for overspeed operation, they could prematurely wear or even catastrophically fail. Second, centrifugal pumps generate pressure by the square of the speed and overspeed operation may overpressure the pump and surrounding piping system.

The maximum speed setting should never be set over the full load RPM of the motor or the pump manufacturers stated maximum speed of the pump.

14.01 MAXIMUM SPEED		
Enter the maximum speed that the pump, motor, and system, can operate at. In most cases, the maximum speed will be the same as the previously entered full load RPM. MAX SPEED ≤ Nominal Motor RPM and ≤ Pump maximum speed *The default value is the speed set in parameter 11.07 MOTOR FL RPM*	KEY SEQUENCE *[From parameter group: 11 START-UP DATA]*	
		Scroll to parameter group14, SPD LIM/STRT LVL. Parameter 14.01 will be the first selection.
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the maximum speed.
		Press to complete the entry



Minimum Speed - The Minimum Speed parameter sets the minimum speed that the pump can operate at. It is also used to define the safe speed to run the pump during a secondary pump protection fault if the pump protection is programmed this way. The default value for minimum speed is 25% of 11.07 MOTOR FL RPM

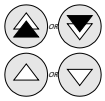
When determining a minimum speed, consider the following:

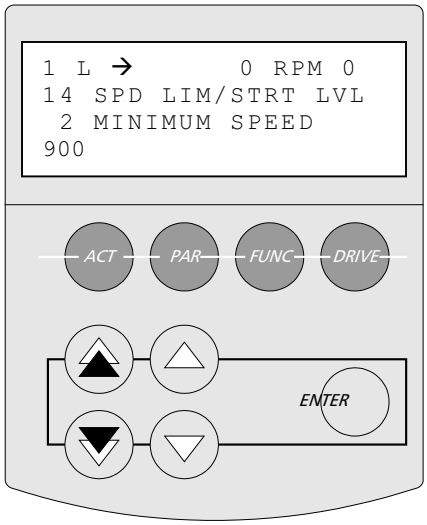
- Motor Minimum Speed [Turndown ratio] - Due to motor loading and thermal effects, the motor minimum speed on centrifugal pumps should not be less than 1/10th its full-load speed

  Example – if full load rpm = 3550, set min speed to 355. Use greater than 10% if either of the following conditions exist:

SPEED CONTROL CONFIGURATION

- Pump Minimum Speed - Some pumps have minimum speed requirements, such as multistage pumps (>2 stages) and sleeve bearing pumps. Consult your pump operation manual to see if there is a minimum speed limit for your pump. **Note - 1& 2 stage pumps do not normally have minimum speed requirements.**
- Static head conditions (minimum flow) - The minimum speed should be set to assure that the pump generates enough head to overcome the static resistance. In some cases, this can cause overheating and possible vaporization of the liquid in the pump casing.

14.02 MINIMUM SPEED		
Enter the minimum speed that the pump and motor can safely operate at. Consider- • Turndown ratio • Pump minimum speed • Minimum flow *The default value is 25% of the speed set in parameter 11.07 MOTOR FL RPM*	KEY SEQUENCE *[From parameter group: 14.01 MAXIMUM SPEED]*	
		Scroll to parameter 14.02 MINIMUM SPEED
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the minimum speed.
		Press to complete the entry



NOTES

If the speed signal drops below the minimum speed setting, the drive will operate at minimum speed until it is manually shut-off. If the speed signal increases above the minimum speed setting, PumpSmart will resume normal operation at the speed signal reference.

SPEED CONTROL CONFIGURATION

3 Speed Control Setup

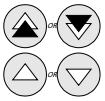
SPEED SIGNAL CONFIGURATION

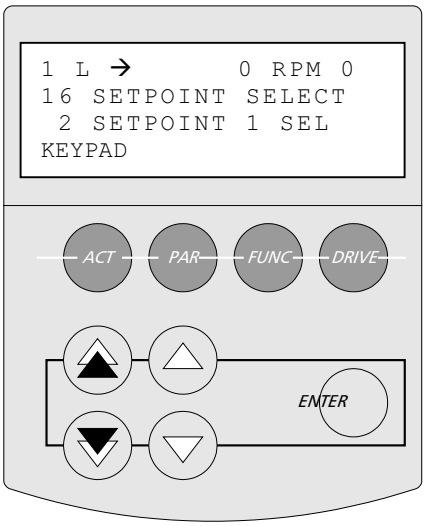
In speed control, the desired running speed may be selected in one of three ways:

- Keypad entry
- Speed signal (4-20ma) via Analog Input AI-2 (Default)
- Fieldbus control

The following details the use of a speed signal to set the operating speed of the pump. If you are using Fieldbus control to do this, please refer to OPTIONS & FEATURES.

SIGNAL SOURCE – Using parameter 16.02, select where the speed signal will originate.

16.02 SETPOINT 1 SEL		
Select the speed signal source. Options: Keypad (default) – A manually entered value Analog Input – A 4-20mA signal is sent to PumpSmart (Via AI-2) Fieldbus – An operating speed is issued from DCS via a digital bus.	KEY SEQUENCE *[From parameter group: 14.02 MINIMUM SPEED]*	
		Scroll to parameter group 16 SETPOINT SELECT
		Scroll to parameter 16.02 SETPOINT 1 SEL
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the correct value. Example shown – ANALOG INPUT
		Press to complete the entry



NOTE - SETTING AI2 MAX (16.03) AND AI2 MIN (16.04) IS STILL REQUIRED IF USING KEYPAD OR FIELDBUS CONTROL

If you are using an analog speed signal to set the operating speed of the pump, signal MAX and MIN settings are required to properly scale the signal.

Analog Input AI-2 is the default channel for receiving an analog input speed signal. This channel is designed to accept a 4-20 mA current signal. In this case, setting of parameters 16.03 AI2 MAX and 16.04 AI2 MIN is required.

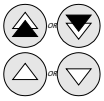
AI2 MAX - This refers to the speed value that corresponds to the max signal [20 mA].

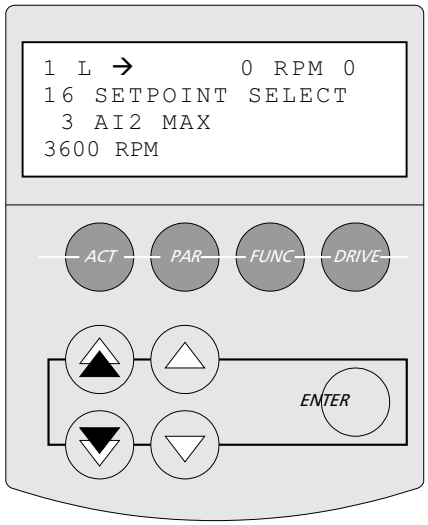
Example- if you want your process to run at 3600 RPM when the 4-20 mA speed signal is 20 mA, then you would enter in 3600 into parameter 16.03

Example (2) - If you are using Keypad or Fieldbus speed entry method, a value here would limit the entry value. If the AI-2

SPEED CONTROL CONFIGURATION

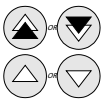
MAX parameter was set at 3000, then a keypad speed entry of 3600 would not be permitted.

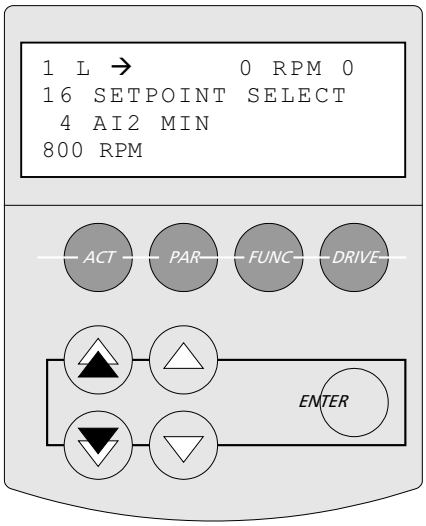
16.03 AI2 MAX		
Enter the speed value that corresponds to a 20 mA signal. Units are in RPM	KEY SEQUENCE *[From parameter group: 16.02 SETPOINT 1 SEL]*	
		Scroll to parameter 16.03 AI2 MAX
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the correct value. Example shown - 3600 RPM
		Press to complete the entry



AI2 MIN - This refers to the speed value that corresponds to the minimum signal [4 mA].

Example- If you want your process to run at 800 RPM when the 4-20 mA speed signal is 4 mA, then you would enter in "800" into parameter 16.04

16.04 AI2 MIN		
Enter the speed value that corresponds to a 4 mA signal Units are in RPM *Default value is 0*	KEY SEQUENCE *[From parameter group: 16.03 AI2 MAX]*	
		Scroll to parameter 16.04 AI2 MIN
		Press to enter the parameter setting mode
		Use a combination of the arrow keys to scroll to the correct value. Example shown - 800 RPM
		Press to complete the entry



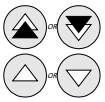
NOTE

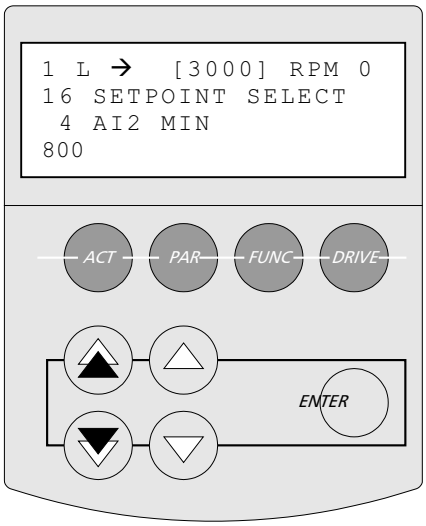
A 2-10VDC or 4-20 mA input signal may be used to set a speed setpoint remotely. Reference ANALOG INPUT CONFIGURATION in the OPTIONS & FEATURES section.

SPEED CONTROL CONFIGURATION

4 Enter Setpoint

This step is only required if you are using the Keypad for entry of a running speed. If you are using a speed signal or Fieldbus control, skip this section.

SETPOINT		
Enter the operating setpoint.	KEY SEQUENCE	
		Press REF button to highlight the setpoint value
		Use a combination of the arrow keys to scroll to the desired setpoint. Example shown is 3000 RPM.
		Press to complete the entry



NOTES -

There are several alternate ways to enter a speed setpoint. Refer to the OPTIONS AND FEATURES section for configuration detail.

Remote setpoint - A analog signal (e.g. 4-20 mA) may be used to send a speed signal to the PumpSmart unit from a remote location via Analog Input.

Multiple setpoint - The PumpSmart system can be programmed with two speed setpoints and the drive can toggle between the two setpoints based upon a digital switch [e.g. flow switch, level switch, manual switch, etc…]. Multiple setpoints can also be set through either the keypad, Analog Input, or via the DCS.

DCS Fieldbus - The speed setpoint can be programmed and changed remotely by way of digital communication from a DCS system with optional bus communication modules. Modules are available for Modbus, Profibus, Device Net, Interbus-S, Modbus Plus, ControlNet, and Ethernet.

If using a remote setpoint (through Analog Input or DCS) the speed signal must be sent prior to starting the unit.

SPEED CONTROL CONFIGURATION

Recommended Option: Secondary Protection

To provide protection from dry-running or operating against a closed discharge valve in multi-pump mode, the PumpSmart secondary protection feature may be used. In this case, additional process condition inputs (e.g. level switch, pressure switch, flow switch, etc…) are used to alert PumpSmart of conditions that require the protection of the pump. Alternatively, PumpSmart TPP may also be used. See the Options & Features Section for details.

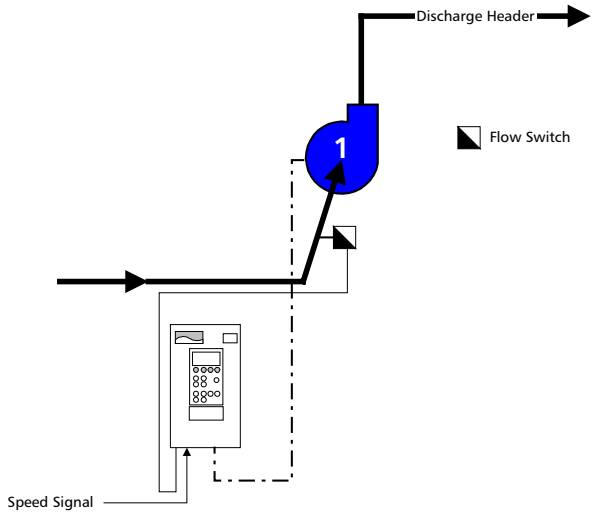


Figure C - Speed Control Secondary Protection

In the above example, a unit is being controlled by an external speed signal. A flow switch is added to the pump installation and wired into the PumpSmart controller. This provides dry run and shutoff protection.

Once wired, parameter 25.06 SECONDARY PROTECT A must be set to ALARM or ALARM AND CONTROL. The response being:

1. ALARM & CONTROL- In this response, PumpSmart will issue a warning and then either shut down or reduce speed depending on your settings. If the PumpSmart controls to minimum speed on a secondary protection fault, and the fault is reset, the unit will resume normal operation. If the fault is not reset, PumpSmart will continue to operate at MINIMUM SPEED until it is manually shut-down or the flow condition clears.

   If parameter 14.05 CONFIG SPEED MIN is set to SPD=0, PumpSmart will control by shutting down and will remain off until the fault is RESET and the drive is manually restarted. If parameter 12.02 AUTO RESTART is set to “on”, the drive will automatically RESTART once the fault is reset.

   Alarm & Control is the recommended setting.

TORQUE PUMP PROTECT

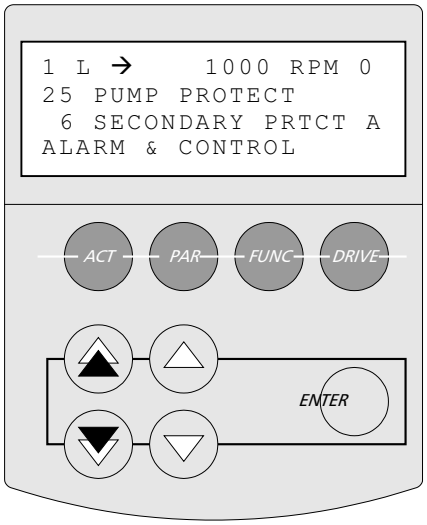
PumpSmart TPP can also be used to provide protection against operation below minimum flow, dry-running, and run-out conditions.

SEE OPTIONS & FEATURES SECTION

SPEED CONTROL CONFIGURATION

2. ALARM only - In this response, PumpSmart will simply issue an alarm/warning, but continue to operate. The alarm only mode may result in damage to the pump if a protection limit fault occurs.

25.06 SECONDARY PRTCT A		
Secondary Protect A utilizes a process switch into connection DI-4 to warn of no-flow conditions. Once wired, select: ALARM & CONTROL ALARM	KEY SEQUENCE *[From parameter group 16.04 AI2 MIN]*	
		Scroll to parameter group 25 PUMP PROTECT
		Scroll to parameter group 25.06 SECONDARY PRTCT A
		Press to enter the parameter setting mode
		Scroll to the desired response mode
		Press to complete the entry



Recommended Step: Parameter Upload

See KEYPAD USE

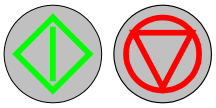
Save your parameters in the keypad. In the unlikely event that the PS200 parameters are lost, the keypad can be used to restore the configuration. It can also be used to program sister units that use the same or similar program settings.

Recommended Option: Drive Locking

See OPTIONS & FEATURES

The keypad can be "locked" to prevent unauthorized personnel from making operational changes or changes to the parameter groups. See LOCKING in OPTIONS & FEATURES.

SPEED CONTROL CONFIGURATION



Starting & Stopping

The PumpSmart system is now ready to start. Starting and stopping the PumpSmart unit is possible through the keypad when in local control.

NOTE - The drive can also be started using a 2 or 3 wire switch or through a Fieldbus command. To start, press the LOC-REM button until "R" is displayed in the upper left status row. You are now ready to start from a remote location.

KEY SEQUENCE	
	Press LOC/REM button until "L" is displayed in the status row
	Press to start
	Press to stop

Jogging the Motor for Rotation

Once the ID MAGN has been completed, jogging the motor to check for rotation may be performed by scrolling to parameter 12.09 MOTOR JOG and selecting JOG. Once selected, PumpSmart will turn the motor at 60 RPM for 10 seconds.

If rotation is reversed, the position of two leads must be changed either at the drive output (U_2, V_2, W_2) or at the motor (T_1, T_2, T_3). Refer to the Quick Reference Installation drawings in the appendix.

OPTIONS & FEATURES

OPTIONS & FEATURES

Analog Input Configuration

The PumpSmart PS200 Analog Input default settings may be altered if required.

Parameter	Name	Value/Range	NOTES
17.20	AI1 CONFIG	PROC TRANS 2	Used for creating offsets with a second process transmitter
		EXT SETPOINT	Used for remotely inputting an operating setpoint using an analog signal or a variable setpoint using a second process transmitter.
		VIBRATION 2	Used for vibration signal #2
		CONDITION 2	Used for general condition signal #2
		SPD CTRL REF	Used for speed control mode when external speed signal is present.
		PWM SIGNAL	Used if a flow or pressure transmitter is required for the Pump Wear Monitor.
		NOT USED *[default]*	Default setting
17.21	AI2 CONFIG	PROC TRANS 1	Default setting.
		SPD CTRL REF	Used for speed control mode when external speed signal is present
		NOT USED	Default for Speed Control mode
17.22	AI3 CONFIG	VIBRATION 1	Used for Vibration signal #1
		CONDITION 1	Used for general condition signal #1
		PWM SIGNAL	Used if a flow or pressure transmitter is required for the Pump Wear Monitor.
		PROC TRANS 2	Used for creating offsets with a second process transmitter
		EXT SETPOINT	Used for remotely inputting an operating setpoint using an analog signal or a variable setpoint using a second process transmitter.
		NOT USED	Default setting

NOTES(s):

Analog input channel AI1 is a 2-10 VDC input - 4-20 mA signals may be used if converted to 2-10 VDC signals using a 500 Ohm resistor bridging the input. Resistors should be ± 1% 1/4 W.

Analog input channels AI2 & AI3 are 4-20 mA inputs

OPTIONS & FEATURES

Analog Outputs

The PumpSmart PS200 has two 4-20 mA analog outputs as standard, with an additional two outputs available with the optional RAIO-01 module. These outputs may be configured by the user to output from a selection of eleven actual signals. Parameter group 20 is used to configure these outputs. Reference the detailed wiring diagrams in the appendix.

Parameter	Name	Value/Range	Note
20.01	ANALOG OUT 1	NOT USED *[default]* SPEED FREQUENCY CURRENT TORQUE POWER VIBR LVL 1 VIBR LVL 2 COND LVL 1 COND LVL 2 PROC VAR ENERGY SAVNG	*Refer to Appendix A-3 PARAMETER LISTING for default scaling values for each selection.*
20.06	ANALOG OUT 2	NOT USED *[default]* SPEED FREQUENCY CURRENT TORQUE POWER VIBR LVL 1 VIBR LVL 2 COND LVL 1 COND LVL 2 PROC VAR ENERGY SAVNG	*Refer to Appendix A-3 PARAMETER LISTING for default scaling values for each selection.*
20.11	XT ANALOG OUT AI1 *Note – This selection requires the optional RAIO-01 module AND parameter 30.02 AI/O MODULE set to slot # module is mounted in.*	NOT USED *[default]* SPEED FREQUENCY CURRENT TORQUE POWER VIBR LVL 1 VIBR LVL 2 COND LVL 1 COND LVL 2 PROC VAR ENERGY SAVNG	*Refer to Appendix A-3 PARAMETER LISTING for default scaling values for each selection.*
20.16	XT ANALOG OUT AI2 *Note – This selection requires the optional RAIO-01 module AND parameter 30.02 AI/O MODULE set to slot # module is mounted in.*	NOT USED *[default]* SPEED FREQUENCY CURRENT TORQUE POWER VIBR LVL 1 VIBR LVL 2 COND LVL 1 COND LVL 2 PROC VAR ENERGY SAVNG	*Refer to Appendix A-3 PARAMETER LISTING for default scaling values for each selection.*
26.03	SAVINGS SCALE	0-999999 10000 *[default]*	If ENERGY SAVNG is selected as an output, this parameter must be set to scale the signal. 4 mA = $0.00 and 20 mA equals this amount. For example 20 mA = $10,000.

OPTIONS & FEATURES

Analog I/O Extension

If there are insufficient channels available on the PumpSmart drive for either vibration or general conditions, additional channels can be added using the optional RAIO-01 module. This module adds two analog inputs and outputs.

Parameter	Name	Value/Range	NOTES
18.01 18.02	XT AI1 CONFIG XT AI2 CONFIG	CONDITION 1 CONDITION 2 VIBRATION 1 VIBRATION 2 NOT USED *[default]*	
30.02	AI/O MODULE	NO [default] RAIO - Slot 1 RAIO - Slot 2	This parameter setting acknowledges the presence and location of the RAIO-01 module.

Auto Restart

The PumpSmart drive can be configured to start automatically following a power failure. Changing the value to ON will enable auto-restart. Selecting OFF disables the auto-restart.

AUTO RESTART is also used with ERROR RESET for automatic restarts following a shutdown due to a pump protect fault. AUTO RESTART will also restart the pump once a secondary protection fault is reset. See "Minimum Speed Options".

Parameter	Name	Value/Range	Note
12.02	AUTO RESTART	OFF *[default]* ON	OFF

Condition Monitoring

The PS200 can monitor the mechanical condition of the pump and issue alarms and/or stop the pump in the event of an undesired operating condition. Monitoring is performed via the analog input channels that are available on the drive and through the optional RAIO-01 Analog I/O Extension module.

The PS200 may accommodate up to four (4) 4-20 mA signals for use as condition monitors. Two of these signals are dedicated for vibration (Overall-RMS) and two are general signals scaled as a percentage of the transmitters full range.

	Primary	Secondary
Bearing Vibration *(IPS RMS)*	VIBRATION 1	VIBRATION 2
General Condition *(% of 20mA Signal)*	CONDITION 1	CONDITION 2

The general condition signals could be bearing housing temperature, additional vibration signals, or auxiliary process conditions.

BEARING VIBRATION

Monitoring of overall pump vibration may be accomplished on the PS200 using the optional STI Vibration Transmitter. This transmitter sends a 4-20 mA signal which corresponds to an overall RMS vibration of 0-1 Inches Per Second (IPS). Connection of the transmitter may be made into any open input channel, except AI-2. See the appendix for complete wiring details.

Default settings on the PS200 result in a WARNING issued at .16 IPS, and an ALARM at .22 IPS. These levels may be adjusted up or down through parameters 23.05 and 23.06 respectively.

BEARING VIBRATION (CONT.)

A WARNING is a basic visual notification on the PumpSmart keypad display. An ALARM will also display on the PumpSmart keypad display, but may also be configured to shut the pump down. Relay outputs [RO1, RO2, RO3] can also be configured to activate an external sonic or visual alarm.

OPTIONS & FEATURES

Parameter	Name	Value/Range	NOTES
23.01	VIBRATION ALARM	NOT SEL *[default]* ALARM FAULT	Selecting ALARM will configure PumpSmart to issue a Keypad or DCS notice and will trigger a Relay Output (if configured). If FAULT is selected, the drive will also stop the pump.
23.02	VIBRATION WARNING	NOT SEL *[default]* WARNING	Selecting WARNING will configure PumpSmart to issue a Keypad or DCS notice and will trigger a Relay Output (if configured). No further action is taken.
23.03	SENSOR 1 MAX VAL	0-2.00 IPS 1.00 IPS *[default]*	No change to this parameter is normally required if using the STI CMCP420VT vibration transmitter from Goulds Pumps
23.04	SENSOR 2 MAX VAL	0-2.00 IPS 1.00 IPS *[default]*	No change to this parameter is normally required if using the STI CMCP420VT vibration transmitter from Goulds Pumps
23.05	WARNING LIMIT	0-1.00 IPS .16 IPS *[default]*	PumpSmart will issue a warning, based on parameter setting 23.02, on the Keypad if this value has been exceeded for 20 seconds.
23.06	ALARM LIMIT	0-1.00 IPS .22 IPS *[default]*	PumpSmart will issue a alarm, based on parameter setting 23.01, on the Keypad if this value has been exceeded for 20 seconds.

GENERAL CONDITION

General conditions are configured in the same basic fashion as the 4-20 mA vibration transmitters. Any open analog input channel, except AI2, may be used for GENERAL CONDITION.

Example: If a pump is being operated in basic single pump process, then the primary process transmitter is wired through analog input channel AI2. If no vibration transmitter is being used, the GENERAL CONDITION transmitter (e.g. temperature) could be wired into AI3 and configured as such in PumpSmart.

Parameter	Name	Value/Range	NOTES
17.20 17.22 18.01 18.02	AI1 CONFIG AI3 CONFIG XT AI1 CONFIG XT AI2 CONFIG	CONDITION 1 CONDITION 2	Any unused analog input channel (exception AI2) may be used for the CONDITION signal. The optional RAIO-01 AI module is required for XTAI1 and XTAI2.
23.09 23.13	COND 1WARN LIMIT COND 2 WARN LIMIT	0-100%	PumpSmart will issue a warnings based on these parameter settings. The warning value is based upon the percentage of full scale of the transmitter.
23.10 23.14	COND 1 ALARM LIMIT COND 2 ALARM LIMIT	0-100%	PumpSmart will issue alarms and/or faults based on these parameter settings. The alarm value is based upon the percentage of full scale of the transmitter.
23.07 23.11	COND 1 ALARM COND 2 ALARM	DISABLED *[default]* ALARM FAULT	Selecting ALARM will configure PumpSmart to issue a Keypad or DCS notice and will trigger a Relay Output (if configured). If FAULT is selected, the drive will also stop the pump.
23.08 23.12	COND 1 WARNING COND 2 WARNING	DISABLED *[default]* WARNING	Selecting WARNING will configure PumpSmart to issue a Keypad or DCS notice and will trigger a Relay Output (if configured). No further action is taken.

OPTIONS & FEATURES

Critical Speed Windows

The PumpSmart PS200 can be configured to avoid certain operating speed ranges, or windows to avoid undesirable resonances while in the Speed Control Macro. These resonances, or critical speeds, are more common to multistage pumps such as vertical turbine pumps.

Refer to the pump's manufacturer to determine if the pump being controlled by PumpSmart has a critical speed within your defined operating speed range (between 14.01 MAX SPEED and 14.02 MIN SPEED).

If the function is selected, PumpSmart will respond in the following manner when confronted with operation within the critical speed window:

- If the commanded speed falls within the critical speed bandwidth and the drive is accelerating it will run at a speed just below the critical speed window until the commanded speed rises above the window.
- If the commanded speed falls within the critical speed bandwidth and the drive is decelerating it will run at a speed just above the critical speed window until the commanded speed falls below the window.

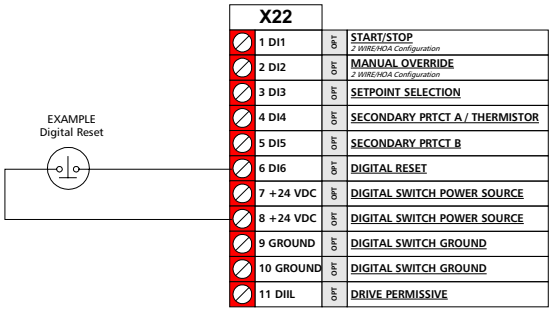
Parameter	Name	Value/Range	Note(s)
14.10	CRITICAL SPEED 1	0 – 9999 RPM *0- Disabled [default]*	Refer to the pump manufacturer for first critical speed.
14.11	CRITICAL SPEED 2	0 – 9999 RPM *0- Disabled [default]*	Refer to the pump manufacturer for second critical speed.
14.12	NCR WIDTH	0 – 1000 RPM *0- [default]*	This is the total critical speed bandwidth (½ above and ½ below) of the value set for Critical Speed 1 and 2.

Digital Fault Reset

There are several ways faults can be reset on the PumpSmart PS200. Methods include reset via the Keypad, by Fieldbus, or by an external digital input. For external digital reset, a momentary contact (single pole N.O.) switch is wired into Digital input 6. Faults are reset when DI6 is closed.

- PUMP FAULTS resets the following pump related faults: Pump Protect, Low Demand, Dry Run, Min Flow, Vibration 1 and 2, Condition 1 and 2 and Process Sensor.
- VFD FAULTS resets all VFD related faults including a keypad fault.
- BOTH resets both Pump and VFD related faults.

Parameter	Name	Value/Range	Note(s)
24.04	DIGIT RST CONFIG	PUMP FAULTS VFD FAULTS BOTH *[default]*	Fault reset (if faulted condition has been corrected) upon closure of DI6.



OPTIONS & FEATURES

Differential Pressure Flowmeter

If a differential pressure flowmeter that does not output flow directly is used, the analog inputs must be configured as QUADRATIC and the K value of the flowmeter and specific gravity of the fluid entered.

Either Analog Input 1 [AI1] or Analog Input 2 [AI2] could be used. AI1 is used if a flow signal is being used for the variable setpoint or offset features [See *Setpoints*]. AI2 is used if the operating mode is FLOW CONTROL and a dP flowmeter is being used as the process control instrument [this is the most common configuration].

NOTE: Both AI1 and AI2 can be configured for a differential pressure type flowmeter [quadratic] however the K value and specific gravity of the two meters must be identical.

Parameter	Name	Value/Range	Note(s)
17.01	AI1 SENSOR	LINEAR *[default]* QUADRATIC	Change to Quadratic for dP flowmeter.
17.02	AI2 SENSOR	LINEAR *[default]* QUADRATIC	Change to Quadratic for dP flowmeter.
17.03	K-DP FLOWMETER	0-1000	K values may be provided by the flowmeter manufacturer. To calculate the "K" value, refer to the equations provided below
17.04	SPECIFIC GRAVITY	0.0-10	Enter the process specific gravity here.
15.01 OR 15.02	AI2 UNIT or AI1 UNIT	PSIG BAR FT M	Depending upon where the dP flowmeter is being used, the units of parameter(s) 15.01 and 15.02 need to be changed. Note parameter 11.03, Mode Select, must be set to pressure. If the dP flowmeter is being used as the primary process flowmeter [AI2], then 15.01 must be in units of pressure. If the dP flowmeter is being used for variable setpoints [AI1], then 15.02 must be changed to units of pressure. If both AI1 and AI2 are using a dP flowmeter [again…they must be identical and on identical services], then both 15.01 and 15.02 must be in units of pressure. PumpSmart will display the actual signal in terms of flow; If PSIG or FT are used, flow will be read as GPM. If BAR or Meters are used, flow will be displayed as M3HR.
16.03 16.06 16.04 16.07	AI2 MAX AI1 MAX AI2 MIN AI1 MIN	0-9999 0-9999	Refer to the Pump Programming sections or Appendix A parameter listing for details on setting up FULL SCALE VALUES.

CALCULATING "K" VALUE

The general equation for calculating the "K" value of a differential pressure flowmeter is:

$$K = Q / P^{0.5}$$

Where:

Q is the flow corresponding to full-scale dP (20mA) in GPM or M3/Hr for the pumped liquid.

P is the full-scale differential pressure, in Ft or M, based on a specific gravity of 1.0. Refer to the manufacturers literature or transmitter nameplate for these values.

NOTE – Units must correspond (i.e. Ft must be used with GPM. M must be used with M3/Hr). Conversion is required even if parameters 16.03 or 16.06 are set to PSI or BAR. Common conversions:

Ft = PSI x 2.31
M = BAR x 10.2114

NOTE(s)

The PumpSmart software uses only one "K" constant, therefore; if two DP flowmeters are used (17.01 and 17.02 are both quadratic) both flowmeters must have the same K value setting.

Differential pressure flowmeters are not suitable for services where the specific gravity of the fluid varies widely. Use a direct reading type [e.g. Magnetic] flowmeter in these cases.

Example: In this example calculation, a 3" orifice plate flowmeter is being used with a differential pressure transmitter. The orifice plate is rated for 16-225 GPM and the dP pressure transmitter is scaled for 0-2.58 Ft. The Resulting "K" value would be:

$$K = 225/(2.58)^{0.5} = 140.07$$

Note: The dP transmitter full scale value (20 mA) corresponds to a flow of 225 GPM.

Energy Savings Information

PumpSmart can calculate the energy savings as compared to a constant speed pump application. To enable this function to perform properly, local energy costs and comparative application information must be entered.

Enter the local energy cost in $ (local currency) per kWh into parameter 26.01and then enter the nominal power rating of a comparable fixed speed unit into parameter 26.02. To find this, look at the pump performance curve and enter the power for the rated operating point.

Example - If your power cost is $0.06 per kWh, enter a value of .06 into parameter 26.01.

Parameter	Name	Value/Range	Note(s)
26.01	$/kWh	0-1.00 0 *[default]*	
26.02	BASELINE POWER	0-1000 Hp 0 *[default]*	
26.05	ENERGY SAVE RESET	DISABLED [*[default]* RESET	Allows resetting of savings to zero.

One of the benefits of using PumpSmart is its ability to automatically shut off the pump when not required. Parameter 26.04 SAVINGS OPTION #2 allows the savings of using PumpSmart to be tracked during automatic shutdown.

OPTIONS & FEATURES

External Control Board Power Supply

In multipump applications where a pump or motor is taken out of service or the main power supply can be interrupted the PS200 main control board (RMIO) can be powered by an external 24 VDC supply to permit operation of the remaining PS200's. This will allow the main input voltage to be disconnected and the unit taken out of service. The fiber optic communication module (RDCO) needs to be powered to maintain communication between drives.

NOTE (S)

Multi-pump drives may be configured to revert to single pump operation [AUTO CTRL] in the event of a communication loss. Refer to parameter 22.11 CH2 COM LOS CTRL.

Parameter 11.13 is in the Advanced Parameter group and is accessible by User Pass Code 564.

Parameter	Name	Value/Range	Note(s)
11.13	CTRL BOARD SUPPLY	INTERNAL 24 VDC *[default]* EXTERNAL 24 VDC	

Fieldbus Control

The PumpSmart PS200 may be integrated into existing Distributive Control Systems [DCS] in two ways; analog input/output signals and via optional Fieldbus control modules. The use of analog I/O signals decreases the amount of information that can be exchanged between PumpSmart and the DCS system, although may be sufficient in some cases (See Analog Outputs). The use of Fieldbus control modules allows selected PumpSmart parameters and operating signals to be accessed and modified.

Fieldbus control modules are available in numerous communication protocols, including: DeviceNet, Modbus, and Profibus.

With the control module installed, set parameter 30.01 FIELDBUS to FIELDBUS. If a Modbus Adapter (RMBA) is used, set 30.01 FIELDBUS to STD MODBUS. For FIELDBUS selection, parameter Groups 31 MODULE TYPE, 90 D SET REC ADDR and 92 D SET TR ADDR are opened. For Std Modbus selection, parameter Groups 52 STD MODBUS, 90 D SET REC ADDR AND 92 D SET TR ADDR are opened. These parameter groups define the addresses and data sets that are exchanged between PumpSmart and the DCS. The optional Fieldbus module is installed in option Slot 1 of the drive.

Refer to the ABB Hardware Manual and Control Module manual that accompanies each Fieldbus module. Also refer to the parameter listing in Appendix A-3 for Group 3 Status Words and PumpSmart Word and Bit Breakdown.

Parameter	Name	Value/Range	Note(s)
30.01	FIELDBUS	NO *[default]* FIELDBUS ADVANT STD MODBUS CUSTOM	
31.01	MODULE TYPE		This parameter configures the module automatically by the fieldbus adapter. No action is required by the user unless changes to the default settings are desired.
90	D SET REC ADDR		Parameter group is opened once Parameter 30.01 is changed to Fieldbus or Std Modbus
92	D SET TR ADDR		Parameter group is opened once Parameter 30.01 is changed to Fieldbus or Std Modbus
52	STD MODBUS		This Group is opened once 30.01 is set to Std Modbus.

OPTIONS & FEATURES

Any parameter changes that are made using a Fieldbus control system must be saved to the drive.

Parameter	Name	Value/Range	Note(s)
10.04	PARAMETER SAVE	DONE *[default]* SAVE	Parameters that are manually entered through the keypad are automatically saved, only parameters entered through a Fieldbus connection must be saved. To save, select SAVE and press the ENTER key or write to parameter 10.04 using digital communication to SAVE.

Language

The PumpSmart system fully supports 6 languages; English (AM), French, German, Italian, Portuguese and Spanish. Portions of the PumpSmart parameters are also available in Dutch, Danish, Finnish, Swedish, Czech, and Polish.

English(AM) refers to American English and is the default language. Units of power are in HP. English without the (AM) notation refers to British English, with units of power in kW.

Parameter	Name	Value/Range	Note(s)
11.01	LANGUAGE	ENGLISH ENGLISH(AM) DEUTSCH ITALIANO ESPANOL PORTUGUESE NEDERLANDS FRANCAIS DANSK SUOMI SVENSKA CESKY POLSKI	ENGLISH (AM) is default setting

Lead-Lag Switching

Automatically alternating the Lead-Lag responsibilities of the drives in multi-pump control may be accomplished by setting the parameter 22.05 SWITCH LEAD LAG to the desired switching period. The lead-lag switch will occur based upon the number of hours the unit has been running.

NOTE - This function may be tested by setting the value to 0.1 hr (6 minutes).

Parameter	Name	Value/Range	Note(s)
22.05	SWITCH LEAD	0-4000 Hours 48 *[default]*	This is the number of hours that a pump is running before switching the LEAD designation to the next pump. Setting "0" disables the switching function, including automatic switching during a drive or pump protection fault.
22.12	MANUAL SWITCH	1 2 3 4 DISABLED *[default]*	This parameter manually switches the lead status to the selected pump. This function is through the MASTER drive keypad only.

OPTIONS & FEATURES

Locking(see also PERMISSIVE)

The PS200 has two levels of keypad locking; LOCAL LOCK and PARAMETER LOCK.

1. PARAMETER LOCK - In parameter lock, parameters may be viewed, however they cannot be changed. Starting, Stopping, setpoint changes and drive fault resets may still be performed using the keypad.
2. LOCAL LOCK - In local lock, starting and stopping are prevented. Resetting of drive faults is still possible.

To change the drive parameters, including 10.03 LOCAL LOCK, the parameter lock must be opened. To open the parameter lock, go to parameter 10.02 PASS CODE and scroll to the number 358 and press ENTER. Parameter 10.01 PARAMETER LOCK will read OPEN.

NOTE - If power to the drive is lost [power failure, disconnect, etc…] parameter 10.01 PARAMETER LOCK will automatically reset to LOCKED.

Parameter	Name	Value/Range	Note(s)
10.01	PARAMETER LOCK	LOCKED *[default]* OPEN	This parameter displays the status of the parameter lock and can be used to lock the parameters when necessary. To OPEN the parameter lock, use parameter 10.02.
10.02	PASS CODE	-0-	Using the arrow keys, scroll to the number "358" and press enter. This will open the parameter lock. Note - The number entry will disappear once ENTER has been pressed.
10.03	LOCAL LOCK	OFF *[default]* ON	This parameter disables local control of the drive (Start/Stop).

It is not possible to stop the drive through the keypad with LOCAL LOCK set to ON.

- Use LOCAL LOCK only with a remote (external) stop/start method.
- Keypad must be set in REMOTE before enabling LOCAL LOCK.

Low NPSH/Cavitation protection

The PS200 can protect against cavitation and low NPSHA conditions by reducing the pump-speed as suction pressure decreases. This requires an additional pressure or level transmitter mounted on the suction side of the pump. See *Setpoints, Multi-Variable* for details on setting up this functionality.

A second way to protect against low NPSHA is to use a pressure (or level) switch on the suction side of the pump. The switch is then wired to a digital input on the PumpSmart drive and configured to either toggle to a lower setpoint, or shut-off completely. See *Setpoints-Dual* or *Secondary Protection* for details on setting up this functionality.

OPTIONS & FEATURES

Manual Override

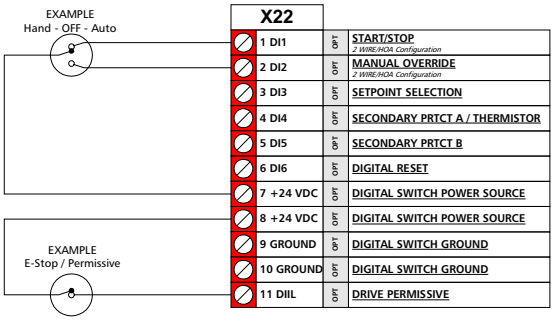
Manual Override can be used to disable the PumpSmart control algorithm and operate the pump at a preset speed. PumpSmart may be placed into manual override through DI-2 (e.g. Hand-Off-Auto switch or separate Manual Override switch) or through selection via keypad entry. When in Manual Override the keypad will display the message "WARNING MANUAL OVERRIDE."

When parameter 12.01 START/STOP is set to 2 WIRE/HOA and DI-2 is closed, PumpSmart will disable the control and protection algorithms and operate at the speed set in parameter 12.07 MANUAL OVERRIDE RPM.

!	**!! WARNING !!** Placing the drive in Manual Override disables ALL Pump Protection functionality except E-stop/permissive and Keypad failure. Ensure that operating conditions are satisfactory for safe and reliable pump operation before enabling the manual override function.

NOTE: When using a Digital Input to enable the manual override function, PumpSmart looks solely at the state of DI-2 and DI1L. The state of DI-1 does not effect the enabling of the manual override function.

Parameter	Name	Value/Range	Notes
12.06	MANUAL OVERRIDE	OFF *[default]* ON	PumpSmart may be placed in MANUAL OVERRIDE through keypad selection in this parameter.
12.07	MANUAL OVERRIDE RPM	0 to 3600 RPM 14.02 MIN SPEED *[default]*	The default value is pre-populated based upon the entry 14.02 MINIMUM SPEED. This value may be changed to any speed within the set minimum and maximum operating speeds.



Minimum Speed Options

When the PumpSmart PS200 reaches the minimum speed that is set in parameter 14.02 MINIMUM SPEED, it can be programmed to stay at that minimum speed indefinitely, or to shut-down. This reaction applies to conditions where PumpSmart is trying to regulate to a setpoint, when it faults due to a secondary protect condition, or there is little or no process demand.

If the parameter 14.05 CONFIG SPEED MIN is set to SPD=MINSPD, the drive will stay at minimum speed until the process demand increases, it is shutdown manually, or a fault occurs forcing it to shutdown. If it is operating at minimum speed due to a Secondary Protect fault, it will stay at minimum speed until the fault is reset.

If a Pump Protect condition exists and CONFIG SPEED MIN is set to SPD=MINSPD, PumpSmart will try to reset the fault while at minimum speed if parameter 12.02 AUTO RESTART is set to "ON" and parameter 25.04 ERROR RESET is set for the desired number of attempts. If the fault has not cleared after the selected number of resets has been attempted, the pump will be shut down. If parameter 25.04 ERROR RESET = 0, the pump will be shut down upon a Pump Protect fault.

If parameter 14.05 CONFIG SPD MIN is set to SPD=0, the drive will stop the pump for Pump Protect and Secondary Protect faults. The reaction to stop the pump when at minimum speed can be delayed for up to 1800 seconds by programming parameter 14.06 STP DELAY MIN SPD.

OPTIONS & FEATURES

If a pump protect condition exists and/or the pump stops due to CONFIG SPEED MIN, it will try to restart a number of times before shutting off completely. The number of restarts and the period between these restarts can be modified. Note parameter 12.02 AUTO RESTART and 25.04 ERROR RESET must be set for this function to work.

Parameter	Name	Value/Range	Notes
14.05	CONFIG SPEED MIN	SPD=MINSPD SPD=0 *[default]*	Selecting SPD=MINSPD will result in the drive staying at minimum speed until it is manually shut-off, process demand increases, a secondary protection fault is cleared, or a pump protection fault forces it to shutdown. If SPD=0 is selected, the drive will stop.
14.06	STP DELAY MIN SPD	0-1800s 0 *[default]*	This parameter enables the drive to remain at minimum speed in low demand or secondary protect conditions for a period (up to 1800 seconds) before shutting down.
14.07	RESTART VALUE	0.0-150% 0 *[default]*	If the drive is shutdown by CONFIG SPEED MIN (14.05) due to no system demand (pressure control and level control modes only) the drive will sleep until the process actual value drops below a set restart value (14.07) for longer than the restart delay (14.08). If operating in inverse mode (21.01) the drive will sleep until the process variable rises above the restart value. Wake-up level in % of setpoint value = 0 – 150%. Default is 0%. To disable the Restart Value function enter "0%".
14.08	RESTART DELAY	0-1800S 0 *[default]*	This is the length of time the drive waits between attempting restarts
12.02	AUTO RESTART	OFF *[default]* ON	This enables the drive to restart on its own following a power failure or ERROR RESET.
25.04	ERROR RESET	1-19 0 *[default]*	If the PumpSmart unit faults on Pump Protection, this parameter will reset the fault up to the selected number of times before completely shutting off the drive.
25.05	RESET DELAY	0-250 seconds 60 *[default]*	The automatic reset of protection faults can be delayed.

OPTIONS & FEATURES

Motor Thermal Protection

The motor can be protected against overheating by the motor thermal protection function. The default method of protection is a motor temperature thermal model created by the PS200. The PS200 calculates the temperature of the motor assuming an ambient temperature of 30 C (86 F) when power is applied to the PS200. The thermal model can be User adjusted if the ambient temperature exceeds 30 C (86 F). Refer to your PumpSmart Applications group for guidance.

NOTE - Parameters 24.05 and 24.06 are in the Advanced Parameter Group accessible by User Pass Code 564.

Parameter	Name	Value/Range	Notes
24.05	MOTOR THERM PROT	WARNING *[default]* FAULT NO	This parameter defines the reaction of PumpSmart when it calculates a potential motor thermal fault. FAULT will shut the pump down. NO will result in no warning or fault shutdown.
24.06	MOTOR THERM PMODE	DTC *[default]* USER MODE THERMISTOR	This defines how PumpSmart will determine a motor thermal fault. DTC uses the ABB DTC control algorithm while THERMISTOR uses a physical thermistor placed in the motor.

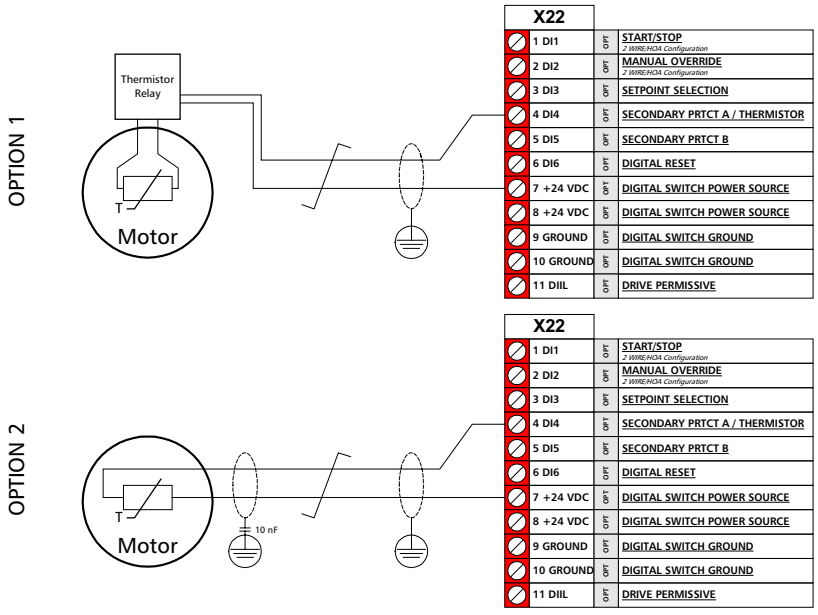
An alternate method of detecting motor overheating is by use of a motor thermistor. The thermistor or a break contact of a thermistor relay is connected between the PS200 internal +24 VDC voltage supply and digital input 4 (DI4). Under normal motor temperature operation the thermistor resistance should be less than 1.5kohm (current 5 mA). The PS200 will warn the user or fault (see parameter 24.05) if the thermistor resistance exceeds 4 kOhm. If using a motor thermistor, parameter 25.06 Secondary Protect A must be set to "Thermistor".

NOTE - Parameter 24.06 Motor Thermal P Mode will automatically update to the Thermistor setting.

Parameter	Name	Value/Range	Notes
25.06	SECONDARY PRTCT A	DISABLED *[default]* ALARM & CTRL THERMISTOR	Select THERMISTOR when a motor thermistor is wired at DI4

!! WARNING !!

According to IEC664, the connection of the motor thermistor to a digital input requires double or reinforced insulation between motor live parts and the thermistor. Reinforced insulation entails a clearance and creeping distance of 8 mm (0.31 in) for 400/500 VAC input voltages. If the thermistor assembly does not fulfill the requirement, the other I/O terminals of the drive must be protected against contact, or a thermistor relay must be used to isolate the thermistor from the digital input.



OPTIONS & FEATURES

Permissive

The PS200 digital input DIIL has been configured as a drive permissive switch and must be closed in order for the drive to run. There is no parameter entry available to defeat this permissive. If the switch is open, a warning "RUN DISABLED" will appear on the keypad display.

If your operating requirements do not require drive permissive switches, DIIL may be wired as permanently closed.

Priming Delay

This feature is designed to allow self-priming pumps sufficient time to prime themselves before the PumpSmart Pump Protection logic becomes active. The delay period is applied only if the pump is being started from a zero-speed condition. Once the priming delay is complete, the PROTECTION DELAY (25.03) becomes active, if set.

Parameter	Name	Value/Range	Notes
14.09	PRIMING DELAY	0-6000 Seconds 0 *[default]*	

Pump Wear Monitor PWM [1]

The PS200 can detect decreases in pump performance due to wear and/or blockage of the hydraulic passageways of the impeller and casing. When a decrease in performance is detected, PumpSmart can issue a warning so that refurbishment of the pump can be planned appropriately. The performance monitoring is not affected by changes in the system resistance (e.g. closing of discharge valve) or changes in suction pressure.

When the PWM option is selected, PumpSmart will perform a performance characterization of the pump by increasing speed and monitoring the process condition over the range of possible operating conditions. The characterization results are best when the system is in a normal operating condition. When performing a baseline check, the pump should be at or near its normal operating conditions with system temperature relatively stable.

NOTE – Normal process control is suspended during the PWM characterization. The characterization takes approximately 2 minutes to complete. During this process, a warning message "BASELINE RUN" will be displayed on the keypad.

Parameter	Name	Value/Range	Notes
27.01	PMP PERF BASELINE	1ST BASELINE *[default]* NEW BASELINE	Selecting NEW BASELINE will result in a new PWM characterization being performed. Selection of this parameter is not required for initial characterizations.
27.02	PMP WEAR MONITOR	DISABLED *[default]* 10% DEGRADED 15% DEGRADED 20% DEGRADED 25% DEGRADED	Selecting a degradation level engages the PWM and automatically begins a characterization.
27.23	HRS BTWN PWM CHK	0-9999 24 HRS *[default]*	This parameter defines the period of time between wear checks. During a check, PumpSmart will increase and decrease speed by approximately ±5% of process variable for several seconds before returning to normal PI Control.

PWM Limitations – The following conditions are required for accurate PWM operation.

1. Specific gravity changes must be less than ± 5% unless a pressure transmitter is used.
2. Viscosity changes must be less than ± 5%.
3. A pressure or flow transmitter that is directly related to the discharge conditions of the pump is required. This is most common in pressure/flow operating modes. If an application does not have a pressure/flow transmitter (e.g. Level applications), one can be provided and configured using any available analog input.

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[1] *US Patent No(s). 6648606 & 6564627*

OPTIONS & FEATURES

Regulation Mode

The regulation mode can either be NORMAL or INVERSE. The common selection is NORMAL, where the drive anticipates an increase in the process condition when pump speed is increased. If the regulation mode is set to INVERSE, the process condition is expected to increase with a decrease in pump speed.

EXAMPLE – If a PumpSmart unit is trying to control the level in a suction-side tank or sump, the regulation mode would be set to INVERSE. As the level in the sump increased, PumpSmart would respond by increasing pump speed to maintain a constant level.

Parameter	Name	Value/Range	Notes
21.01	REGULATION MODE	NORMAL *[default]* INVERSE	Inverse is normally used for control of suction side systems.

Relay Outputs

The PS200 has three relay outputs that are configurable for different operating and fault conditions. Relays will revert to original states once warnings or faults are reset or cleared.

Relay Output Technical Information

Switching capacity	8A at 24 VDC or 250 VAC 0.4 at 120 VDC
Maximum continuous current	2 A RMS

Refer to the ACS800 Hardware Manual for complete technical details.

Parameter	Name	Value/Range	NOTES
19.01	RELAY R01 OUTPUT	NOT USED	Default for RO3
19.04	RELAY R02 OUTPUT	RUNNING	Default for RO2
19.07	RELAY R03 OUTPUT	READY	Default for RO1
		VFD FAULT	A VFD related warning or fault has occurred
		PUMP FAULTS	A general pump warning or fault has occurred
		ALL FAULTS	Both Pump and VFD warnings and faults
		LOW PMP PERF	Pump Performance has degraded
		SECND PRTECT A	Secondary Protect A activation
		SECND PRTECT B	Secondary Protect B activation
		HIGH VIBRAT	High vibration alarm/fault
		PUMP PROTECT	Pump protection activation
		START SLAVE	Used with multi-pump macro only
		HI CONDITION 1	Condition 1 protection activation
		HI CONDITION 2	Condition 2 protection activation
		PROC TX ERR	Process transmitter protection activation

NOTE – When using relay outputs to activate constant speed pumps in a multi-pump application, the slave pumps 1, 2, and 3 must utilize relay outputs RO1, RO2, and RO3 accordingly (Slave 1 → RO1). Sequence logic is affected by these selections.

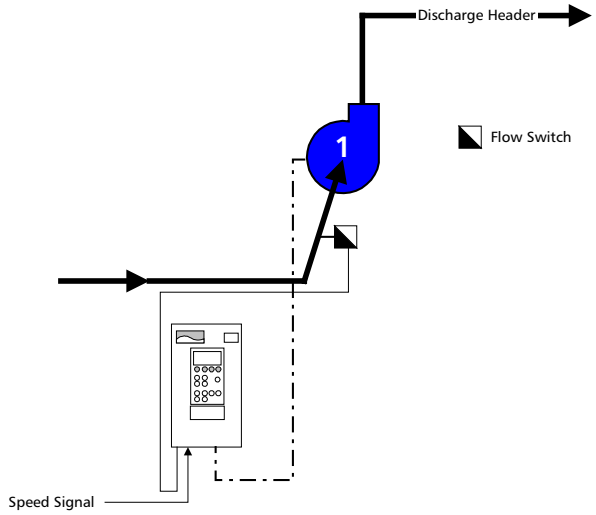
Restart Options

See MINIMUM SPEED OPTIONS

OPTIONS & FEATURES

Secondary Protection

To provide protection from dry-running and operating against a closed discharge valve in pressure, level, temperature, and speed control modes, the PumpSmart secondary protection feature may be used. This feature may also be used to provide inter-lock capabilities, such as for lubrication system starting. In these cases, additional system condition inputs (e.g. level switch, pressure switch, flow switch, etc…) are used to alert PumpSmart of conditions that require protection of the pump.



Speed Control Secondary Protection

In the above example, a unit is being controlled by an external speed signal. A flow switch is added to the pump installation and wired into the PumpSmart controller. This provides dry run and shutoff protection.

Once wired, parameter 25.06 SECONDARY PROTECT A or 25.07 SECONDARY PROTECT B must be set to ALARM or ALARM AND CONTROL. The response being:

1. ALARM & CONTOL- In this response, PumpSmart will issue a warning and then either shut down or reduce speed depending on your settings. At this point the pump will behave similar to the description in MINIMUM SPEED. Alarm & Control is the recommended setting.
2. ALARM only - In this response, PumpSmart will simply issue an alarm/warning, but continue to operate. The alarm only mode may result in damage to the pump if a protection limit fault occurs.

Parameter	Name	Value/Range	Notes
25.06 25.07	SECONDARY PROTECT A SECONDARY PROTECT B	DISABLED *[default]* ALARM & CONTROL ALARM	

OPTIONS & FEATURES

Sensor Failure

In the event of a process transmitter failure, PumpSmart has been configured to run the pump at an average speed of the minute preceding the instrument failure. This functionality can be disabled, or configured to result in a drive fault.

A sensor failure is determined by:

AI-1 Signal	<1.5 VDC or >10.1 VDC [<3 mA or > 20.2 mA]
AI-2 Signal	<3 mA or > 20.2 mA
Vibration Sensor(s)	<3 mA or > 20.2 mA
Keypad	Communication with keypad interrupted

Optional fault responses:

LAST SPEED - PumpSmart will average the pump speed of the 60 seconds prior to the instrument failing and run at the calculated speed and issue a warning message.

DISABLED - No protection is provided and PumpSmart will attempt to run as close to the failed sensor signal as possible. Warning if the transmitter fails low the pump may accelerate to Maximum Speed (14.01).

FAULT - Upon sensing an instrument failure, PumpSmart will trip (stop) the drive and issue a fault message

Parameter	Name	Value/Range	Notes
24.01	PROC SENSOR FAILURE	DISABLED FAULT LAST SPEED*[default]*	Applies to process transmitter inputs and analog setpoint inputs. Failure messages indicate which transmitter is failing based upon input channel setup: EXT SP – Setpoint input failure PROC XT1 – Primary process input PROC XT2 – Secondary process input SPD REF – External speed ref input
24.02	COND SENSR FAILURE	DISABLED WARNING *[default]*	Applies to either single or double condition sensor applications. Fault messages: COND 1–General condition sensor 1 COND 2–General condition sensor 2 VIB 1 – Vibration transmitter 1 VIB 2 – Vibration transmitter 2 PWM – Pump Wear Monitor
24.03	KEYPAD FAILURE	DISABLED FAULT LAST SPEED*[default]*	Fault message - "PANEL LOSS"

OPTIONS & FEATURES

Setpoints, Dual

The PumpSmart PS200 can toggle between two fixed setpoints or one fixed point and a variable setpoint. The toggling between setpoints may be accomplished using a digital switch or through a Fieldbus command.

Parameter	Name	Value/Range	Notes
16.01	SET1/SET2 SELECT	SETPOINT 1 *[default]* DI3 FIELDBUS	This parameter defines the source that toggles the PumpSmart unit between Setpoint 1 or Setpoint 2. Setpoint 1 [default] indicates that only setpoint 1 is being used. DI3 is a digital input where "0" (Open) selects Setpoint 1 and "1" (Closed) selects Setpoint 2.
16.02 16.05	SETPOINT 1 SEL SETPOINT 2 SEL	KEYPAD *[default]* ANALOG INPUT FIELDBUS	This selects where the value for Setpoint-1or 2 is coming from. KEYPAD - a number [e.g. 100] will be manually entered via the keypad. ANALOG INPUT - The setpoint is entered using a signal through a configured analog input channel to establish the setpoint. Selecting ANALOG INPUT will require entry of parameters 16.03-16.04 and 17.20 or 17.22 (dependent upon input channel configuration)

EXAMPLE - An application requires 150 GPM for a wash-down application in one case and 100 GPM in another case. PumpSmart could be setup as follows:

Parameter	*Value*	*Notes*
16.01	*DI3*	*A switch would be wired into DI3 to toggle between setpoint 1 and setpoint 2*
16.02	*KEYPAD*	*The setpoint would be manually entered using the PumpSmart keypad. When the switch [DI3] is set to "0" (Open), the setpoint would be entered as "150" using the keypad "REF" button.*
16.05	*KEYPAD*	*The setpoint would be manually entered using the PumpSmart keypad. When the switch [DI3] is set to "1" (Closed), the setpoint would be entered as "100" using the keypad "REF" button.*

OPTIONS & FEATURES

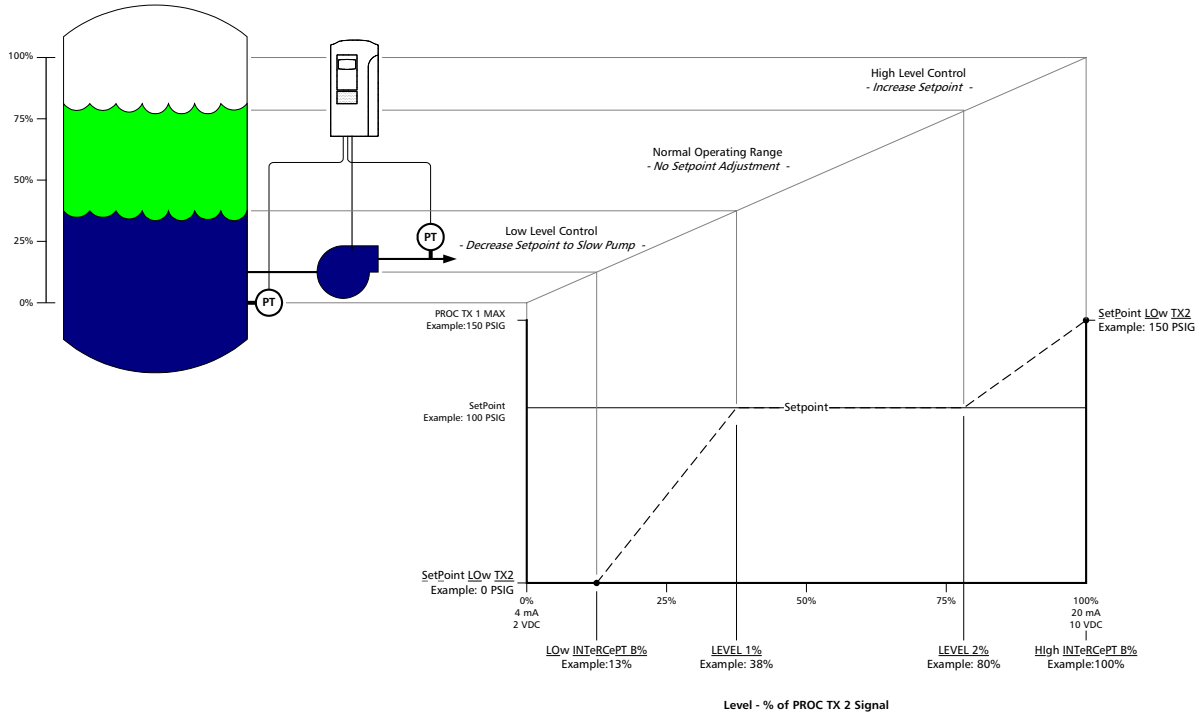
Setpoints, MultiVariable Control

The MultiVariable Control function can be used to vary the setpoint using a second process transmitter's 4-20 mA signal into AI-1 or AI-3. This might be used in blending applications, or in situations where suction pressure varies and cavitation control is sought.

EXAMPLE – A pump configured for constant pressure draws from a tank. The level in the tank varies greatly, and occasionally drops enough that the pump begins to cavitate. Although the PumpSmart protection functionality will ultimately protect the pump by sending it to minimum speed or shutting it down, the use of the Multi-Variable Control feature would allow for continued pumping, albeit at a reduced rate.

A suction pressure transmitter would need to be added and wired into AI1 or AI3. Then this signal would be configured such that when the suction pressure is sufficient, the PumpSmart unit would run to the entered setpoint. When the suction pressure dropped below a certain value, it would scale the setpoint back.

When configuring the MultiVariable Control function, it is helpful to plot how you want your setpoint to behave in relation to the analog input signal:



EXAMPLE – In the above diagram, the setpoint is 100PSIG. When the second process transmitter (TX2) is below 38% of its signal, it will begin to scale back the setpoint linearly from 100 PSIG to 0 PSIG (occurs at 13% of its signal). When the second process transmitter (TX2) reaches 79% of its signal, it will increase the setpoint linearly from 100 PSIG to 150 PSIG at 100% of signal

% TX	*Analog Input Signal AI-1or AI-3*		*Resulting Setpoint (PSIG)*
0	*2 VDC*	*4mA*	*0*
13	*3.04*	*6.1*	*0*
25	*4.00*	*8.0*	*50*
38	*5.04*	*10.0*	*100*
80	*8.40*	*16.8*	
90	*9.20*	*18.4*	*125*
100	*10.00*	*20*	*150*

Parameter Setting	*TX2 Example*
21.02 MULTIVAR CTRL	*ON*
21.03 LEVEL 1%	*38%*
21.04 SP LO TX2	*0 PSIG*
21.05 LO INTRCPT B%	*13%*
21.06 LEVEL 2%	*80%*
21.07 SP HI TX2	*150 PSIG*
21.08 HI INTRCPT B%	*100%*

OPTIONS & FEATURES

The Analog Input for the second process transmitter must be configured using parameter group 16 prior to enabling the MultVariable Control functionality:

Parameter	Name	Value/Range	Default
16.06 or 16.08	AI1 MAX AI3 MAX	Range: 0-9999	Enter the process value that corresponds to a 20mA or 10 VDC signal as read from the second process transmitter.
16.07 or 16.09	AI1 MIN AI3 MIN	Range: 0-999 0 *[default]*	Enter the process value that corresponds to a 4mA or 2 VDC signal as read from the second process transmitter.

NOTE – Analog input configuration parameter(s) 17.20 or 17.22 must be set to PROC TRANS 2 and parameter(s) 15.02 or 15.03 AI UNIT should be set to the proper units for the second process transmitter.

MultiVariable set-up is performed via parameter group 21:

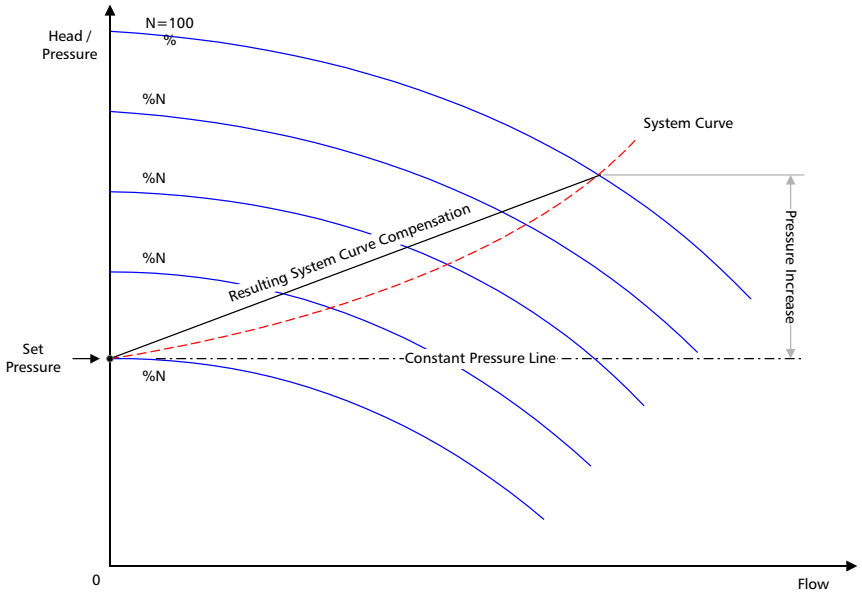
Parameter	Name	Value/Range	Notes
21.02	MULTIVAR CTL	OFF *[default]* ON	Set to "ON" to enable the Multi-variable functionality
21.03	LEVEL 1%	0-100%	This defines the lower limit of the second process condition at which setpoint adjustment will occur. This value is expressed as a percentage of the 4-20mA or 2-10VDC signal of the second process transmitter. *Example: 25% = 8 mA or 4 VDC*
21.04	SP LO TX2	+ - 20,000 0 *[default]*	This is the desired setpoint when at a level defined by LO INTRCPT B%. This value is expressed in the same units as the setpoint.
21.05	LO INTRCPT B%	0 – 100% 0 *[default]*	This defines the level of PROC TX 2 at which the setpoint, SP LO TX 2 occurs at. This value is expressed as a percentage of the PROC TX2 full scale.
21.06	LEVEL 2%	0-100%	This defines the upper limit of the second process condition at which setpoint adjustment will occur. This value is expressed as a percentage of the 4-20mA or 2-10VDC signal of the second process transmitter.
21.07	SP HI TX2	+ - 20,000 0 *[default]*	This is the desired setpoint when at a level defined by HI INTRCPT B%. This value is expressed in same units as the setpoint.
21.08	HI INTRCPT B%	0 – 100% 0 *[default]*	This defines the level of PROC TX 2 at which the setpoint, SP HI TX 2 occurs at. This value is expressed as a percentage of the PROC TX2 full scale.

OPTIONS & FEATURES

Setpoints, System Curve Compensation

The PS200 system can automatically compensate for system friction losses due to increased flow in single pump operation or multi-pump backup modes. Tables are available in most pump catalogs to assist in determining the amount of friction loss that can be expected for various pipe sizes and flow rates on simple systems.

The diagram below illustrates a typical system curve in relation to pump speed.



In this case the system pressure setpoint is shown at shutoff and the increase in setpoint pressure is shown for increasing flow.

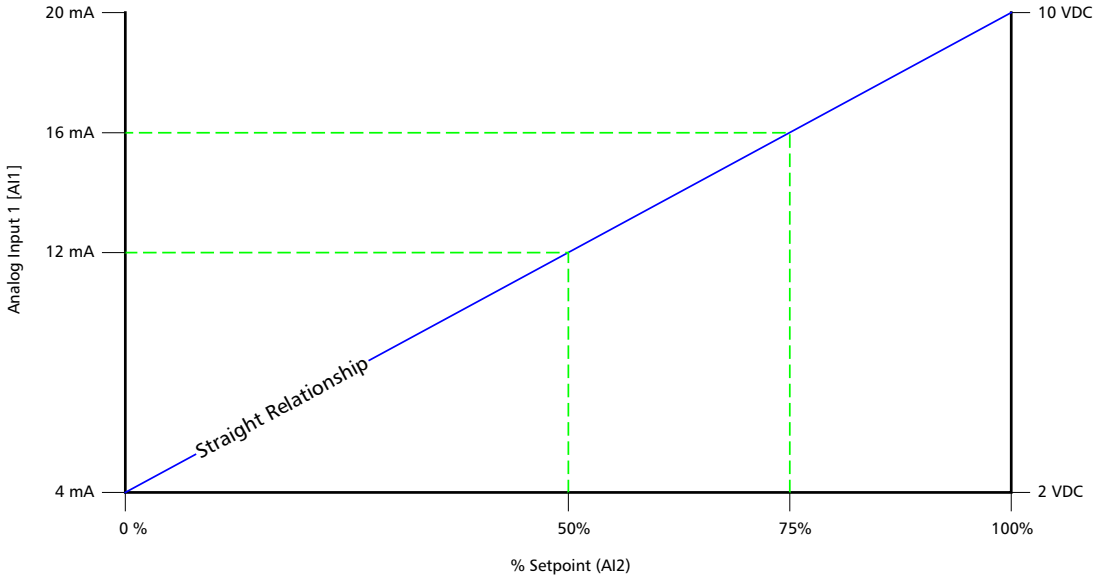
EXAMPLE - If the setpoint is 150 Ft [65 PSIG @ 1.0 SG] and the system resistance increase 10 Ft at the maximum flow rate, or roughly 7% of the setpoint, parameter 21.08 would be set as "7"

Parameter	Name	Value/Range	Notes
21.09	PRESS INCR SPEED	0-3600 RPM 1200 RPM *[default]*	This is the speed at which system curve compensation begins. At speeds below this, no compensation for increased resistance is made.
21.10	PRESS INCR %	0-100% 0% *[default]*	This is the amount that PumpSmart will have increased the setpoint at maximum speed.

OPTIONS & FEATURES

Setpoints, Variable

Variable setpoints are possible with the PumpSmart PS200 system using a 2-10 VDC or 4-20 mA input signal. The signal affects only the setpoint. Motor speed continues to be varied by the primary transducer reading the demand change. A example application is sending a setpoint from a control room to the PumpSmart unit using a 2-10VDC or 4-20 mA signal.



The effect is a straight relationship with the maximum setpoint value corresponds to the maximum signal [i.e. 20 mA or 10 VDC] while the minimum setpoint value corresponds to the minimum signal [4mA or 2 VDC].

Parameter	Name	Value/Range	NOTES
16.02	SETPOINT 1 SEL	KEYPAD *[default]* ANALOG INPUT FIELDBUS	Change to ANALOG INPUT if using an analog signal. Select FIELDBUS if a variable setpoint is being introduced through a DCS system
16.03	AI-2 MAX	Range: 0-9999 100 *[default]*	Enter the process value that corresponds to a 20mA or 10 VDC signal as read from AI-2
16.04	AI-2 MIN	Range: 0-999 0 *[default]*	Enter the process value that corresponds to a 4mA or 2 VDC signal as read from AI2

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Stall Function (Locked Rotor Protection)

The stall function selects how the motor will react in a locked rotor condition. A locked rotor condition can occur if operating the pump in reverse rotation (threaded impeller spins off), binding of parts (due to misalignment) or foreign debris.

NOTE - The Stall function can be found in the Advanced Parameter section accessible by the 564 User Pass Code.

Parameter	Name	Value/Range	Notes
24.11	STALL FUNCTION	Warning Fault No [default]	PS200 reaction when a locked rotor condition occurs for the stall time
24.12	STALL FREQ HI	0.5 – 50 HZ 20 HZ [default]	Default setting recommended
24.20	STALL TIME	10 – 400 sec 20 sec [default]	Recommended setting is 10 sec

Stop Function

Parameter 12.08 selects how the motor will stop when the stop button is pushed. If a fault occurs the PS200 will coast stop.

Parameter	Name	Value/Range	Notes
12.08	STOP FUNCTION	RAMP STOP *[default]* COAST STOP	Selects how the motor will stop.

Test Run

The TEST RUN capability allows the PumpSmart system to run periodically if it has been inactive. The most common circumstance for which Test Run would be applied is when a standby pump is infrequently used; the test run would allow lubrication of bearings and help verify if the unit is ready for operation. The TEST RUN DELAY sets the interval that automatic test runs will occur at.

Test runs are set for 20 seconds and cannot be changed. If Automatic test run is selected, the test run is at 50% of maximum speed.

NOTE – Once manual test is selected and the test is complete, parameter 12.03 will return to NOT SEL.

Parameter	Name	Value/Range	Notes
12.02	AUTO RESTART	OFF *[default]* ON	Must be set to ON for automatic test run function to operate.
12.03	TEST RUN	NOT SEL *[default]* AUTOMATIC MANUAL	
12.04	TEST SPEED % (FL)	0-100% 25% *[default]*	The speed, as a percent of maximum speed, which the test run will occur at if MANUAL is selected.
12.05	TEST RUN DELAY	0.1-3600 hours 1000 Hrs *[default]*	This is the period of pump inactivity before the test run will begin.

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Torque Based Pump Protection [TPP][2]

The PumpSmart Torque Based Pump Protection logic protects the pump from operating in underloaded conditions [e.g. dry-run, minimum flow] or in overloaded conditions [e.g. run-out] without the need for external sensors to monitor the system. The PumpSmart TPP monitors the torque of the pump and compares it to underload and overload setpoints. A key feature of the PumpSmart TPP is its ability to compensate for changes in speed and mechanical losses [e.g. mechanical seal drag].

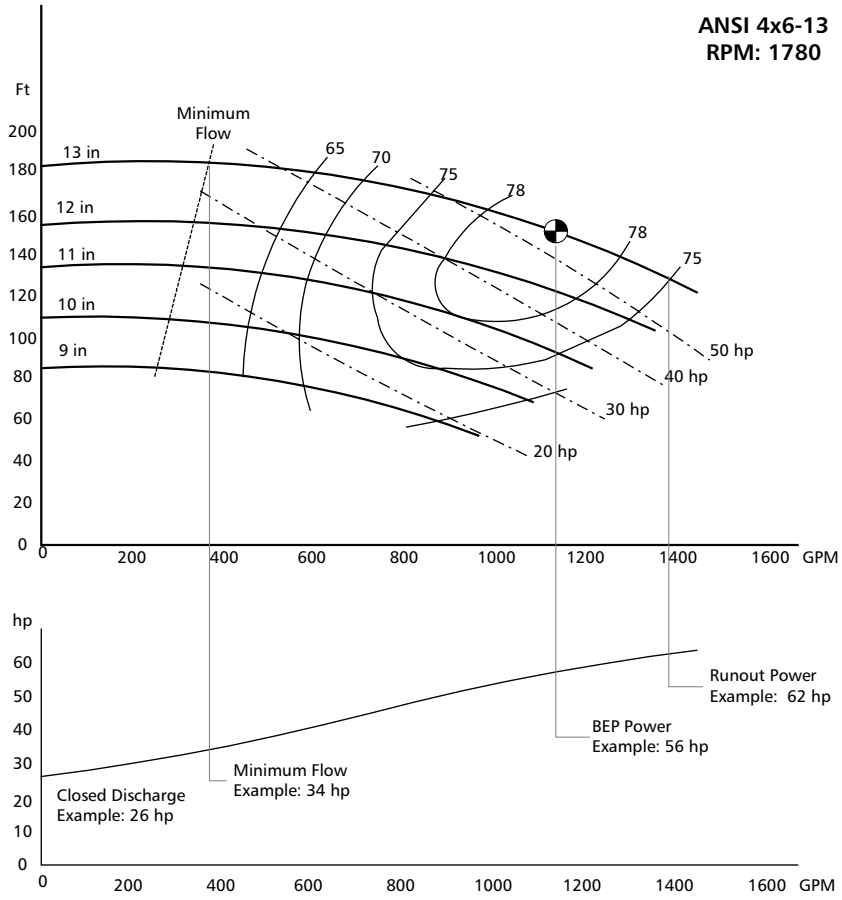
There are three steps to enabling PumpSmart TPP:

1. Determining the Reference Operating Point
2. Establishing underload and overload setpoints
3. Entering mechanical load offsets

REFERENCE OPERATING POINT

The reference operating point serves as the reference torque from which the underload and overload conditions are compared to. This point is normally the Best Efficiency Point [BEP] of the pump at its maximum speed. The PumpSmart logic will calculate the reference operating point based upon the BEP power and speed.

The following chart depicts a typical ANSI pump performance and power curve:



NOTE - Application of the Torque Pump Protect functionality is limited to pumps having power curves that are constantly rising from a closed valve operating condition. These pumps are typically with specific speeds of 2000 or under.

[2] *Patent Pending*

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The BEP may easily be determined two ways; interpolation of the performance curves or calculation using the basic equation of:

$$P_{BEP} = \frac{Q_{GPM} \times H_{FT}}{3960 \times \text{Efficiency}} \times \text{S.G.}$$

If the power is interpolated from the performance curve, specific gravity (SG) and viscosity must be accounted for.

NOTE - PumpSmart TPP assumes that specific gravity and viscosity remain constant during operation. It is recommended that these fluctuations do not exceed + - 5%.

The power at BEP is only useful if the speed is also known. The speed is used for factoring the reference point and setpoints according to the Affinity Laws.

Parameter	Name	Value/Range	Note
25.08	BEP POWER	0-9999	This is the power at the Best Efficiency Point of the pump (at installed impeller diameter) with specific gravity and viscosity effects considered. The default of this entry is 90% of the motor power, as defined by 11.08 MOTOR NOM POWER
25.10	BEP SPEED	0-9999	This is the speed that the BEP POWER is expressed. The default value for this entry is 11.07 MOTOR FL RPM. This value should be based upon your performance curve calculations.

ESTABLISHING LOAD SETPOINTS

There are three general conditions that the PumpSmart TPP logic can protect against; Operation below minimum flow, dry running, and run-out conditions. Conditions such as cavitation will also be identified, however the response of the PumpSmart system to these conditions will be based upon how severe their impact is on the pump loading.

The first underload setpoint to set is Minimum Flow. The MINIMUM FLOW TORQUE is expressed as a percentage (%) of the BEP Power. The load at minimum flow may be determined prior to operation by graphical interpolation of the pump performance curve. PumpSmart parameter 25.18 CALC TEST TRQ% may also be used when the pump is operating. This parameter will display the current torque, as a percentage of the speed corrected BEP torque, and may be used directly to set 25.12 MIN FLOW TORQUE.

Example: An ANSI 4x6-13 operating on water has a BEP POWER of 56 HP when at 1780 RPM. The minimum flow power is estimated at 34 HP at 1780 RPM. The MIN FLOW TORQUE setpoint would be 34HP/56 HP, or 61%. This value could be verified by checking parameter 25.18 CALC TEST TRQ% when running the pump at 1780 RPM and throttling it to minimum flow.

The second underload setpoint identifies Dry Running conditions. A dry run condition could be operating with no fluid in the suction, or in a severely cavitating state. Dry run conditions can normally be estimated as 10% below the power at shut-off (zero flow). This value can be estimated by interpolating the pump performance curve.

!! WARNING !!

Do not attempt to determine the dry running setpoint by operating the pump in dry-run or severe cavitation states. Permanent damage or failure to the pump may occur.

Example: An ANSI 4x6-13 operating on water has a BEP POWER of 56 HP when at 1780 RPM. The power at shut-off is estimated at 26 HP when at 1780 RPM. The DRY RUN TORQUE setpoint would be (26HP/56 HP) x 0.9, or 42%

The last setpoint to configure is the run-out load. In this condition, pump power is increasing as the pump runs out in flow. PumpSmart can identify this condition and slow the pump down to an acceptable loading condition. This condition may be determined through performance curve interpolation, calculation, or through actual operation at the run-out condition.

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Parameter	Name	Value/Range	Note
25.11	MIN FLOW CTRL	DISABLED *[default]* WARNING ALARM & CTRL	Selects the response of the drive to a minimum flow condition. Warning will issue a keypad warning and effect relay change (if configured). Alarm & Control will slow the pump to minimum speed or fault (depending how configured) and attempt resets according to parameter 25.04 ERROR RESET
25.12	Min Flow Torque	0-200% 0 %[default]	The load, as percentage of BEP loads, when at a minimum flow condition.
25.13	Dry Run Ctrl	DISABLED *[default]* WARNING FAULT	Selects the response of the drive to a dry-running condition. Warning will issue a keypad warning and effect relay change (if configured). Fault will shut the pump down until it is manually reset.
25.14	Dry Run Torque	0-200% 0 %[default]	The load, as percentage of BEP load, when at a dry run condition.
25.15	Runout Ctrl	DISABLED *[default]* WARNING ALARM & CTRL	Selects the response of the drive to a run-out condition. Warning will issue a keypad warning and effect relay change (if configured). Alarm & control will decrease pump speed so as not to exceed the runout torque limit. If the unit reaches Minimum Speed it will attempt resets according to parameter 25.04 Error Reset.
25.16	Runout Torque	0-201% 201 % *[default]*	The load, as percentage of BEP load, when at a run-out condition.
25.17	Runout Ramp	5-100 seconds 20 seconds *[default]*	The deceleration ramp rate when decreasing speed due to a run-out condition.
25.18	Calc Test Trq	%	The current load, as a percentage of the speed corrected BEP load.

MECHANICAL POWER OFFSETS

The hydraulic power in a centrifugal pump at varying speeds can normally be determined using the pump Affinity Laws. At reduced speeds, this estimation may be affected by mechanical losses. The mechanical offset parameter allows for such losses to be accounted for.

The mechanical power offset is expressed as hp or kW, depending upon the language selection. It is applied when the pump is being operated at speeds below 1/3 of its full speed.

Parameter	Name	Value/Range	Note
25.09	Pwr Offset	-20.0 to 20.0	The power offset is used to correct the load setpoints when at low speeds. The units are the same as expressed in 11.01 LANGUAGE.

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Mechanical seal losses are the most common form of offset. The following table may be used as a starting point:

RPM	Nominal Mechanical Seal Size per Pump Shaft Diameter (in)													
	Single Inside Seal Losses Hp (kW)							Double Inside Seal Losses Hp (kW)						
	1.375	1.75	2.125	2.50	2.75	3.00	3.75	1.375	1.75	2.125	2.50	2.75	3.00	3.75
3560	0.38 (0.28)	0.44 (0.33)	0.52 (0.39)	0.62 (0.46)	0.70 (0.52)	-	-	0.68 (0.51)	0.8 (0.60)	0.94 (0.70)	1.12 (0.84)	1.25 (0.93)	-	-
2900	0.31 (0.23)	0.36 (0.27)	0.43 (0.32)	0.51 (0.38)	0.57 (0.43)	-	-	0.56 (0.42)	0.65 (0.48)	0.77 (0.57)	0.91 (0.68)	1.02 (0.76)	-	-
1780	0.19 (0.14)	0.22 (0.16)	0.26 (0.19)	0.31 (0.23)	0.35 (0.26)	0.39 (0.29)	0.54 (0.40)	0.34 (0.25)	0.40 (0.30)	0.47 (0.35)	0.56 (0.42)	0.63 (0.47)	0.70 (0.52)	0.96 (0.72)
1470	0.16 (0.12)	0.18 (0.13)	0.22 (0.16)	0.26 (0.19)	0.29 (0.22)	0.32 (0.24)	0.44 (0.33)	0.28 (0.21)	0.33 (0.25)	0.39 (0.29)	0.46 (0.34)	0.52 (0.39)	0.58 (0.43)	0.80 (0.60)
1180	-	0.15 (0.11)	0.17 (0.13)	0.21 (0.16)	0.23 (0.17)	0.26 (0.19)	0.35 (0.26)	-	0.26 (0.19)	0.31 (0.23)	0.37 (0.28)	0.42 (0.31)	0.46 (0.34)	0.64 (0.48)
960	-	0.12 (0.09)	0.14 (0.10)	0.17 (0.13)	0.19 (0.14)	0.21 (0.16)	0.29 (0.22)	-	0.22 (0.16)	0.25 (0.19)	0.31 (0.23)	0.34 (0.25)	0.38 (0.28)	0.52 (0.39)
885	-	-	-	-	-	0.19 (0.14)	0.27 (0.20)	-	-	-	-	-	0.35 (0.26)	0.48 (0.52)
740	-	-	-	-	-	0.16 (0.12)	0.22 (0.16)	-	-	-	-	-	0.29 (0.22)	0.40 (0.30)

For between bearing pumps, double the above values.

If the pump operation requires the pump minimum speed to operate below 33% of nameplate speed than it is recommended the final Power Offset value be determined by viewing the value of parameter 25.18 CALC TEST TORQ% while the pump is operating. The procedure is as follows:

1. Check the value of 25.18 CALC TEST TRQ % while operating at the normal process setpoint.
2. Next reduce the pump speed to 14.02 MINIMUM SPEED. To do this in single pump and multipump use the manual override feature (parameters 12.06/12.07). Check the value of 25.18 CALC TEST TRQ % again. Important: do not change any valve or system settings during this process.
3. If the value of 25.18 CALC TEST TRQ % is greater than in Step 1 increase the power offset value until the Calc Test Trq % has approximately the same value as in Step 1.
4. Return the PS200 to normal process control by setting parameter 12.06 MANUAL OVERRIDE to OFF.

Note: for some large hp motors the value of 25.18 CALC TEST TRQ % as viewed in step 3 may be less than in Step 1. In this case a small negative value of power offset should be used.

Helpful Hint: To avoid nuisance trips during system transients, set up a response delay using 25.03 PROTECTION DELAY.

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Tuning

If the pump appears to oscillate in speed (i.e. hunting), cannot maintain a uniform setpoint, has a constant setpoint offset, or shuts off too quickly or too slowly it may need to have the integral time or proportional gain settings tuned to the system.

When an operating mode is selected [i.e., flow, pressure, level etc.] PumpSmart engages factory default settings for the rate that the drive adjusts to meet the setpoint demand. In many cases these settings will not require adjustment. The most common exceptions are complex systems, process instruments with slow response times, large full-scale value compared to setpoint or level control applications where variables such as tank size have a significant effect on tuning response.

When the PumpSmart system is adjusting speed to meet the setpoint, it does so using a Proportional Gain and Integral Time (PI) setting. The proportional gain setting adds corrective action that is proportional to the difference between the setpoint and the process condition. This difference is commonly referred to as error. A low gain setting will yield a small corrective action that may stabilize at a position that is offset from the setpoint. Conversely, if the gain setting is too high, speed oscillations may occur.

The integral time setting makes corrective actions to compensate for the offset created by the proportional control. The corrective action of the integral function accounts for the error present over a period of time (Integral Time). The smaller the Integral time, the faster speed adjustments are made, at the risk of speed oscillations occurring. If the Integral time is set too long, prolonged offsets are likely.

It is important to note that the final values for the Proportional gain and Integral time should be determined not only for system changes but also for startup conditions. For example, a system tuned for system operating changes may be out of tune during startup conditions.

NOTE - Air in the system may cause a condition that looks like oscillation or hunting. Be sure all air is purged from the system before attempting tuning.

ACCEL TIME

ACCELeration TIME is the rate at which motor speed is increased when a control correction is required. ACCEL TIME is expressed as the time, in seconds, it would take to reach maximum speed (parameter 14.01) from zero speed. In Single Pump and Multipump, the drive response can be made slower by increasing the ACCEL TIME

Parameter	Name	Value/Range	Notes
13.01	ACCEL TIME	0-1800 Seconds *5 [default]*	

DECEL TIME

DECELeration TIME is the rate at which motor speed is decreased when a control correction is required or upon shutting down. DECEL TIME is expressed as the time, in seconds, it would take to reach zero speed from maximum speed (parameter 14.01). As with ACCEL TIME, drive response may be slowed using this parameter.

Parameter	Name	Value/Range	Notes
13.02	DECEL TIME	0-1800 Seconds *5 [default]*	

PROPORTIONAL GAIN

The PROPORTIONAL GAIN setting adds corrective action that is proportional to the error. A low gain setting will yield a small corrective action that may stabilize at a position that is offset from the setpoint. A high gain setting may result in speed oscillations.

Parameter	Name	Value/Range	Notes
13.03	P - GAIN	0-100	Pressure *[default]*- 0.5 Flow *[default]*- 0.2 DP / Flow [Quadratic] - 0.5 Level & Temp *[default]* - 2.5

INTEGRAL TIME

The integral time setting compensates for offset between the process variable and the setpoint. The integral time produces a rate of change in output speed that is proportional to the deviation in process variable from the

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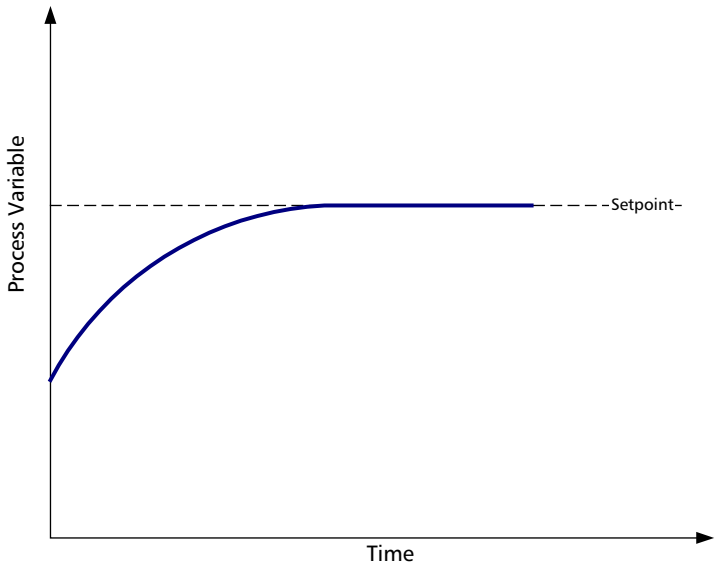
setpoint. The smaller the integral time the faster the speed adjustments are made. If the integral time is set too short speed oscillations may occur, if set too long a prolonged time period is likely prior to achieving the setpoint value.

Parameter	Name	Value/Range	Notes
13.04	I - Time	0-320 Sec	Pressure *[default]*- 0.75 Flow *[default]*- 1.75 DP / Flow [Quadratic] - 3.0 Level & Temp *[default]*- 0.75

RECOMMENDED GUIDELINES

Although there is no tuning procedure that will give optimum results for every system, there are certain guidelines that will facilitate the tuning process in the event the default settings require adjustment. The following figures show both normally tuned systems and improperly tuned systems. The first two figures "Normally Tuned" and "Tuned" show examples of properly tuned systems. Note the second figure, "Tuned" has a better dynamic response then the first system, but at the expense of a small overshoot in the setpoint. The last two figures show examples of poorly tuned systems that result in an unstable undesirable response.

- Normally the default settings for FAST ACCEL and FAST DECEL do not require adjustment unless the drive response during ramp up or ramp down to the setpoint is unsatisfactory for the particular process.
- If the default settings result in an unsatisfactory drive response the following rules of thumb can be applied:
  - If rapid oscillations occur about the setpoint try increasing the value of the integral time (parameter 13.04) first. If the oscillations still continue or the time to drop to the setpoint is too long the proportional gain (parameter 13.03) should also be lowered.
  - If the amount of overshoot is unacceptable increase the integral time and lower the proportional gain.
  - If there is a low offset in the setpoint the proportional gain should be increased.
  - If there is a lengthy time period before achieving the final setpoint the integral time should be decreased.
  - In level control applications if speed oscillations occur increase the integral time.
- Once the tuning is fairly close several iterations between the values of proportional gain and integral time may be required to obtain optimum results.
- It is important to note that the final values for the proportional gain and integral time should be determined not only for system changes but also for startup conditions.



Normally tuned system: This system has appropriate gain and integration times resulting in a smooth transition towards the setpoint.

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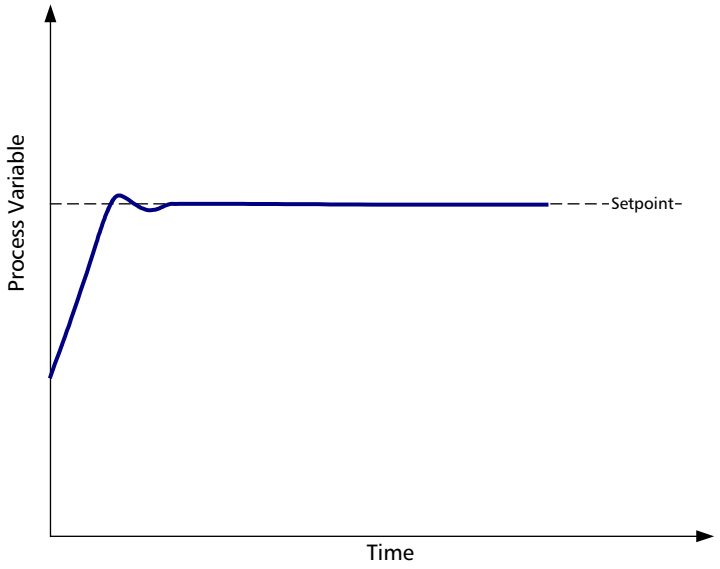
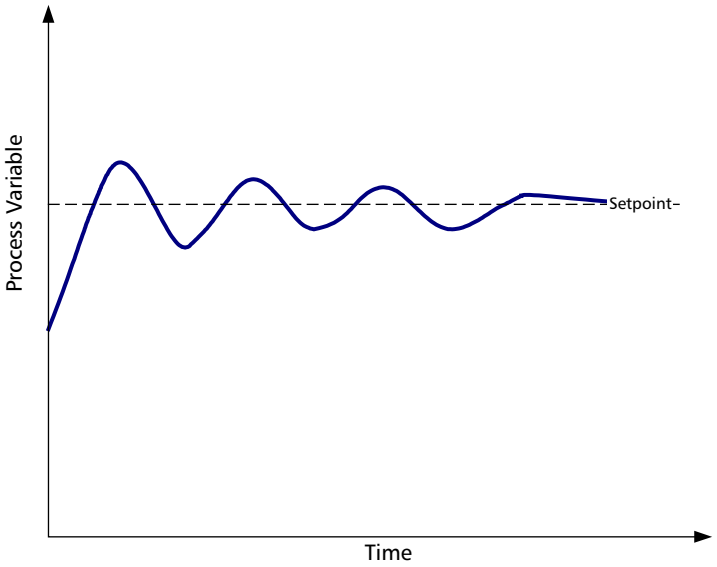
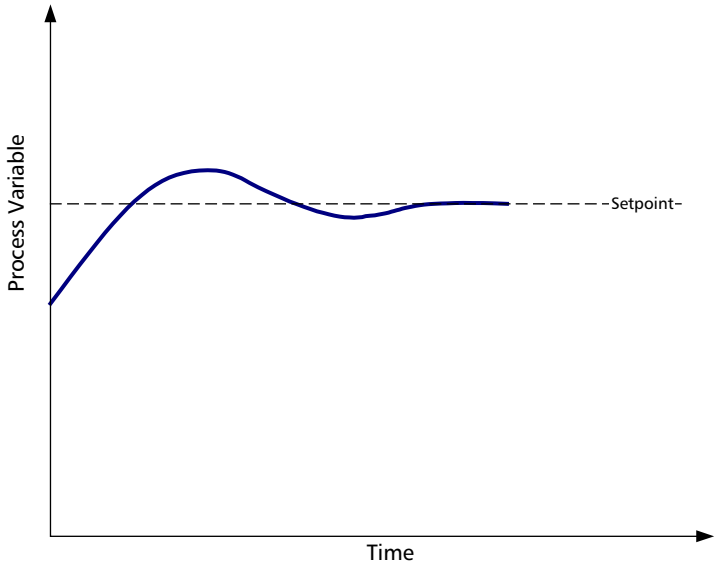


Tuned system: This system tuning is also acceptable. There is a slight overshoot to the setpoint, however the response rate is better than the previous "Normally Tuned" system.



Over-Compensated system: In this case, the drive is over-compensating to the error in the setpoint resulting in an oscillation. The proportional gain is too high and the integration time is too short.

OPTIONS & FEATURES



Under-Compensated system: In this case, the drive is under-compensating to the error in the setpoint. The integration time in this case is too long.

DERIVATIVE RESPONSE

NOTE - The Derivative function can be found in the Advanced Parameter section accessible by the 564 User Pass Code.

Derivative action completes the PID controller capability and is useful in systems where there is a sudden change in process variable. Derivative action will respond to a sudden change in process variable with a response similar to a high proportional gain but after this initial response behaves similar to a PI controller. Derivative action will respond to a sudden change in process variable faster then by just using PI control. In most pump applications PI control will be sufficient. However, PID control may be very useful in some level and temperature control applications.

Parameter	Name	Value/Range	Notes
13.05	D - TIME	0-10 sec *0 [default]*	Defines the derivation time of the PID controller.
13.06	PID DERIV FILTER	0.4-10 sec *1 [default]*	Defines the time constant of the filter used to smooth the derivative component of the process PID controller

APPENDIX A-1 KEYPAD USE

KEYPAD USE

Programming and operation of the PumpSmart PS200 may be done completely through the keypad located on the front of the controller. PumpSmart PS200 is programmable through a set of user friendly parameters. This section describes the operation of the PumpSmart keypad to program parameters, review actual signals and control the PS200. The following is an overview of its use.

The keypad has five different display modes:

- Identification display
- Actual Signal Display Mode
- Parameter Mode
- Function Mode
- Drive Selection Mode.

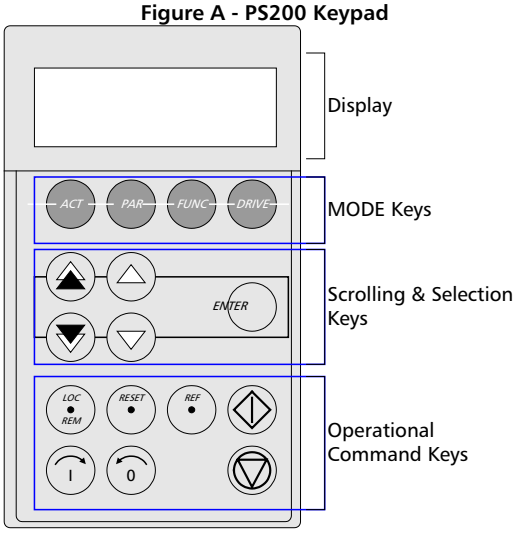
IDENTIFICATION DISPLAY

When the panel is connected for the first time or power is applied to the PS200, the identification display appears as shown below:

```
ACS800 0006_5SR
ITT Goulds  PS200
ID - Number 1
```

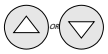
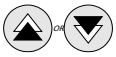
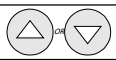
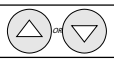
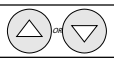
After two seconds the display will clear and the actual signals display mode will appear.

Figure A - PS200 Keypad



APPENDIX A-1 KEYPAD USE

Table 1 - Mode Key Overview

Key	Description	Key function		Screen Display	
ACT	ACTUAL DISPLAY Displays current process/drive conditions or faults	Select between actual signal and fault displays.		Status Row - Actual Signals- Actual signals- Actual signals-	1 L → 0.0 RPM 0 FLOW ACTUAL 0.0 GPM PUMP SPEED 0.0 RPM ENERGY SAVINGS $0
		Scroll through the recent fault listings and actual signals		Status row- Fault ID- Fault Description- Fault time-	1 L → 0.0 RPM 0 1 LAST FAULT +PANEL LOST 20 H 49 MIN 56 S
		Enter the selection mode. Accept new arameter.			
PAR	PARAMETER MODE Displays parameter settings	Parameter group selection Fast Scroll		Status Row - Parameter group- Parameter no.- Value-	1 L → 0.0 RPM 0 10 LOCKS/PASSWORDS 02 PASSCODE 358
		Parameter selection Slow scroll			
		Enter selection mode Accept new parameter			
FUNC	FUNCTION MODE Program upload / download and contrast setting	Row selection		Status Row - Selectable func.- Selectable func.- Selectable func.-	1 L → 0.0 RPM 0 UPLOAD <=<= DOWNLOAD =>=> CONTRAST
		Function start			
DRIVE	DRIVE MODE Drive identification	Drive/ID selection		Base Device - PS200 Label- SW Version- Drive No.-	ACS800 0006_5SR ITT GOULDS PS200 REV 4.0 ID - NUMBER1
		Enter change mode Accept new value			

APPENDIX A-1 KEYPAD USE

ACTUAL SIGNAL DISPLAY MODE

This mode includes two displays:

1. Actual signal display
2. Fault history display.

During normal operation, the actual signal display appears and displays up to three process and/or drive conditions. There are approximately 43 different signals that can be selected from. A complete listing of PS200 Actual Signals can be found in Appendix A.

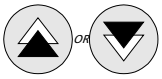
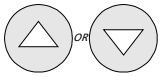
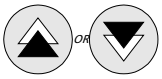
A typical Actual Signal display might be:

Status Row -	1 L → 100 GPM 0
Actual Signal 2.02 -	Flow Actual 100 GPM
Actual Signal 2.07 -	Pump speed 3325 RPM
Actual Signal 2.12 -	Energy Savings $1325

If the PumpSmart PS200 is in a fault condition the Fault Display will be shown first. The Fault Display includes a history of the 64 most recent faults that have occurred. The name of the fault and total power-on time is displayed. When a fault or warning occurs in the PS200, the message will be displayed immediately. **To display an active fault press the ACT key. To reset a fault press the Reset key.**

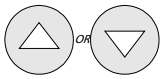
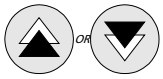
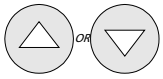
An Active Fault warning does not prevent the viewing and setting of parameters. The Active Fault warning will remain until the condition that caused the fault has been cleared and the RESET key has been pressed.

Table 2 - How to display a fault and reset the fault history

Step	Function/Description	Key Sequence	Display after key is pressed
1	Press the ACT key to enter the Actual Signal display mode If an active fault exists, it will be displayed first.		1 L → 0.0 RPM 0 FLOW ACTUAL 0.0 GPM PUMP SPEED 0.0 RPM FLOW REF 0.0 GPM
2	Press the double arrow key to enter the Fault History Display.		1 L → 0.0 RPM 0 1 LAST FAULT +PANEL LOST 20 H 49 MIN 56 S
3	To select (scroll) through the fault history list, use the single arrow keys. To clear all the faults from the Fault History, press the RESET key.	 	1 L → 0.0 RPM 0 2 LAST FAULT +OVERCURRENT 12 H 49 MIN 10 S 1 L → 0.0 RPM 0 2 LAST FAULT +PANEL LOST H 49 MIN 56 S
4	To return to the Actual Signal display mode, press the double-arrow keys.		1 L → 0.0 RPM 0 FLOW ACTUAL 0.0 GPM PUMP SPEED 0.0 RPM FLOW REF 0.0 GPM

APPENDIX A-1 KEYPAD USE

Table 3 – Changing the displayed signals

Step	Function/Description	Key Sequence	Display after key is pressed
1	Press the ACT key to enter the Actual Signal display mode		1 L → 0.0 RPM 0 FLOW ACTUAL 0.0 GPM PUMP SPEED 0.0 RPM FLOW REF 0.0 GPM
2	Using the arrow keys, move the blinking cursor to the line that is to changed		1 L → 0.0 RPM 0 FLOW ACTUAL 0.0 GPM PUMP SPEED 0.0 RPM FLOW REF 0.0 GPM
3	Press the ENTER key to enter the ACTUAL SIGNALS parameter groups.		1 L → 0.0 RPM 0 1 VFD ACTUAL SIGNALS 02 MOTOR SPEED 0.0 RPM
4	Press the double arrow key to toggle between parameter group 01 VFD ACTUAL SIGNALS and group 02 PUMP ACTUAL SIGNALS		1 L → 0.0 RPM 0 2 PUMP ACTUAL SIGNALS 01 FLOW REF 0.0 GPM
5	Use the arrow keys to scroll through the available selections.		1 L → 0.0 RPM 0 2 PUMP ACTUAL SIGNALS 12 ENERGY SAVINGS 0.00 $
6	Press and hold ENTER to accept the selection. Display will revert back to the normal display mode with selected parameter shown.		1 L → 0.0 rpm 0 Flow Actual 0.0 GPM Pump speed 0.0 RPM Energy Savings $0.00

NOTE - When parameter changes are made that will affect the ACTUAL SIGNAL display (e.g. unit changes), pressing the ACT key will update the display.

APPENDIX A-1 KEYPAD USE

PARAMETER MODE

The parameter mode is used to enter/change the PS200 programming parameters.

NOTE - The user password must be entered prior to attempting to write to a parameter. If not entered, the following warning will be displayed:

```
**WARNING**
WRITE ACCESS DENIED
PARAMETER SETTING NOT POSSIBLE
```

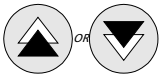
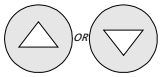
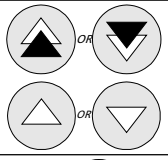
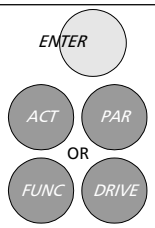
NOTE - Some parameters may not be changed while the pump is operating. If the above message is displayed and the parameter lock is OPEN, stop the pump and then make the desired parameter change.

A typical Keypad display is shown below for parameter 11.06.

Status Row -	1 L → 100 GPM 0
Parameter Group -	11 START-UP DATA
Parameter number and name -	06 MOTOR NOM FREQ
Parameter value -	60 HZ

For a listing and description of the PS200 parameters refer to the Appendix A-3.

Table 4 - How to select a parameter and change the value

Step	Function/Description	Key Sequence	Display after key is pressed
1	Enter the Parameter Mode Selection		1 L → 0.0 rpm 0 99 INFORMATION 01 SOFTWARE VERSION REV 4.00
2	To select another parameter group While holding the arrow down, only the group name and number are displayed. When the key is released, name, number and value of the first parameter in the group is displayed		1 L → 0.0 rpm 0 10 LOCKS/PASSWORDS 1 L → 0.0 rpm 0 10 LOCKS/PASSWORDS 01 PARAMETER LOCK LOCKED
3	To select an index. While holding the arrow down, only the group name and number are displayed. When the key is released, name, number and value of the first parameter in the group is displayed		1 L → 0.0 rpm 0 10 LOCKS/PASSWORDS 01 PARAMETER LOCK 1 L → 0.0 rpm 0 10 LOCKS/PASSWORDS 02 PASSCODE 0
4	To enter the parameter setting mode		1 L → 0.0 rpm 0 10 LOCKS/PASSWORDS 02 PASSCODE [0]
5	To change the parameter Double arrows – fast change Single arrows – slow change		1 L → 0.0 rpm 0 10 LOCKS/PASSWORDS 02 PASSCODE [358]
6	To send and save a new value to the drive *Note - In this example, the passcode automatically returns to zero after successfully entering the passcode.* *To cancel the new setting and keep the original value press one of the mode keys PRIOR to pressing the ENTER key.* *The selected Keypad Mode is entered*		1 L → 0.0 rpm 0 10 LOCKS/PASSWORDS 02 PASSCODE 0 1 L → 0.0 rpm 0 10 LOCKS/PASSWORDS 02 PASSCODE 0

APPENDIX A-1 KEYPAD USE

FUNCTION MODE

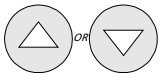
The function mode is used to:

1. Upload parameters,
2. Download parameters
3. Set the contrast of the keypad.

Uploading/Downloading - The PS200 allows the user to store all programmed parameters to the flash memory of the keypad, which can be used to download to the drive. Parameter upload will copy existing parameters from the PS200 drive to the keypad. Parameter download will copy parameters stored in the keypad to the PS200 drive. This feature serves two purposes: 1) Provides a backup of your settings in the event that settings are inadvertently changed or if a drive or component failure occurs and reprogramming is required, 2) If you have more than one PS200 with the same or similar programming, you can program one unit, upload the keypad, then move the keypad to a sister unit to download all of your settings. Any unique setting can then be adjusted if necessary. The table below shows how to select and perform an upload or download.

Note: The drive to be downloaded must be set in the same Application Macro (parameter 11.02) as the drive which had the upload. It is recommended that parameter settings be verified after completion of each download.

Table 5 Typical Function Selection

Step	Function/Description	Key Sequence	Display after key is pressed
1	Enter the Function Mode Selection		1 L → 0.0 rpm 0 UPLOAD <=<= DOWNLOAD =>=> CONTRAST
2	To select a function.		1 L → 0.0 rpm 0 UPLOAD <=<= DOWNLOAD =>=> CONTRAST
3	To activate the selected function		1 L → 0.0 rpm 0 => => => => => => => DOWNLOAD
4	Loading Complete - The display will return to the Actual Signals display mode.		1 L → 0.0 rpm 0 FREQ 0.00 Hz CURRENT 0.00 A POWER 0.0 %

If downloading is attempted before uploading is performed the following warning will be displayed:

```
WARNING
NOT UPLOADED
DOWNLOADING NOT POSSIBLE
```

The parameters can be uploaded and downloaded only if the software version of the source drive is the same as the software version of the destination drive. Otherwise the following warning will be displayed:

```
**WARNING**
DRIVE INCOMPATIBLE
DOWNLOADING NOT POSSIBLE
```

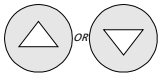
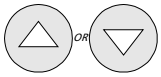
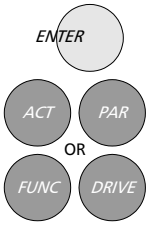
NOTE- the drive must be stopped during the downloading process. If the PS200 is running and downloading is selected the following warning is displayed:

```
**WARNING**
DRIVE IS RUNNING
DOWNLOADING NOT POSSIBLE
```

Setting the Contrast – if the control panel display is not clear enough, the contrast can be reset as shown in the following table.

APPENDIX A-1 KEYPAD USE

Table 6 - How to set the contrast of the display

Step	Function/Description	Key Sequence	Display after key is pressed
1	To enter the Function Mode Selection		1 L → 0.0 rpm 0 UPLOAD <=<= DOWNLOAD =>=> CONTRAST 0
2	To select a function.		1 L → 0.0 rpm 0 UPLOAD <=<= DOWNLOAD =>=> CONTRAST 0
3	To enter the contrast setting mode		1 L → 0.0 rpm 0 CONTRAST [0]
4	To set the contrast		1 L → 0.0 rpm 0 CONTRAST [7]
5	To send a new value to the drive To cancel the new setting and keep the original value press one of the mode keys PRIOR to pressing the ENTER key. The selected Keypad Mode is entered		1 L → 0.0 rpm 0 UPLOAD <=<= DOWNLOAD =>=> CONTRAST 7 1 L → 0.0 rpm 0 UPLOAD <=<= DOWNLOAD =>=> CONTRAST 0

DRIVE SELECTION MODE

In normal use the features in Drive Selection Mode are not required for the PS200. The software release date can be found by pressing the DRIVE key. The display will appear as follows:

```
ACS800 0006_5SR
ITT GOULDS PS200
VERSION 4.00
ID - NUMBER1
```

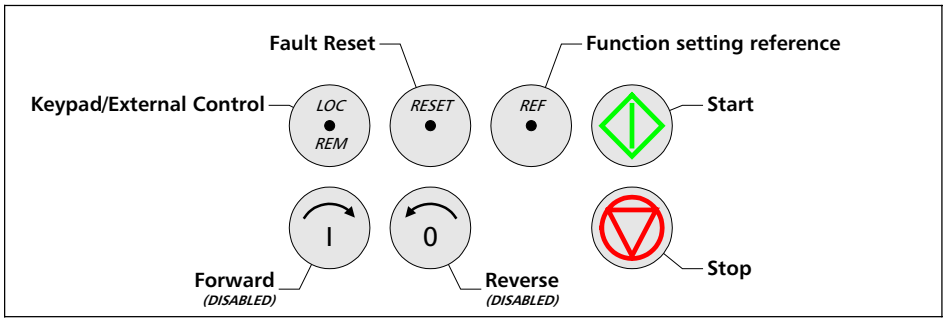
The software version and date can be found in parameters 99.01 and 99.02, respectively.

APPENDIX A-1 KEYPAD USE

OPERATIONAL COMMANDS

Operational commands control the operation of the PS200 these include starting and stopping the PS200 and adjusting the setpoint. The Setpoint value is used for controlling the process variable (speed, pressure, flow, level or temperature).

Figure B - Operational commands of the keypad

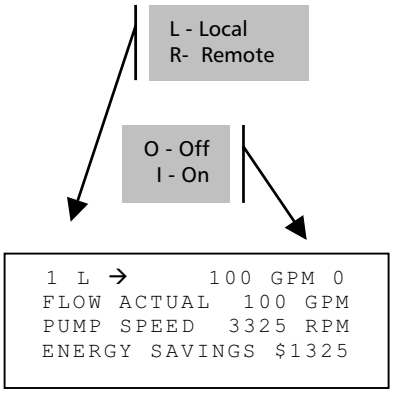


All operational commands such as start, stop and Setpoint can be given pressing the appropriate key on the keypad when the control location is local. This is indicated by an L (Local Control) in the upper left hand corner of the status row.

Remote control is indicated by an R in the upper left hand corner of the status row. This indicates a start/stop command given by an external source such as 2 wire or 3 wire start/stop. When in remote control the Setpoint can be changed from the keypad but the start/stop commands must be given by the external source.

An empty field in the upper left hand corner of the status row indicates external control from an overriding system such as a Digital Communication System. Operational commands cannot be given from the keypad when in external control.

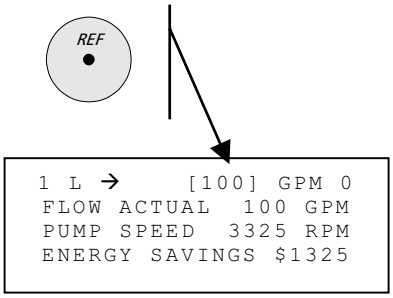
The control is changed between Local and External/Remote control by pressing the LOC/REM key on the keypad.



SETTING THE SETPOINT VIA THE KEYPAD

Press the REF to enter the setpoint setting mode. A bracket appears in the upper right corner of the status row. Use the double arrows for a fast change of the setpoint and the single arrows for a slow change. Once the value is set, press the enter key to enable it (the bracket disappears).

Note the Direction commands (← →) shown on the keypad have been disabled in the PS200 to prevent inadvertent changes in rotation.



APPENDIX A-2 FAULT TRACING

FAULT TRACING

This section explains the PS200 fault tracing procedure using the keypad.

	**!! WARNING !!** All electrical installation and maintenance work described in this section should only be undertaken by a qualified electrician.

The PumpSmart PS200 is equipped with advanced protection features that continuously guard the unit against damage and down time due to incorrect operating conditions and electrical and mechanical malfunctions.

All Warning and Fault messages are presented in tables below and include information on the cause and remedy for each case. Most Warning and Fault conditions can be identified and cured with this information. If not, contact an ITT - Goulds Pumps service representative.

Do not attempt any measurement, parts replacement or other service procedure not described in the installation or programming guide. Such action will void guarantee, endanger correct operation, and increase downtime and expense.

The Warning message will disappear when any of the keypad keys are pressed. The Warning will reappear in one minute if conditions remain unchanged. If the frequency converter is operated with the keypad detached, the red LED in the keypad mounting platform indicates Fault condition.

Fault Resetting

An active fault can be reset either by pressing the keypad ***RESET*** key, by digital input or Fieldbus, or switching the supply voltage off for a while. When the fault has been removed, the motor can be started.

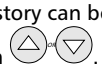
A digital fault reset is available. Refer to the Options and Features section.

	**!! WARNING !!** If an external source for start command is selected and it is ON and parameter 12.02 AUTO RESTART is set to ON, the PS200 will start immediately after fault reset. If the fault has not been removed, the PS200 will trip again

Fault History

When a Fault is detected, it is stored in the Fault History. The last 64 Faults and Warnings are stored with the time the Fault was detected.

	**!! WARNING !!** After a fault reset, the drive will start if the start signal is on and parameter 12.02 AUTO RESTART is set to ON. Before the reset, switch off the external start signal or ensure that it is safe to start

The Fault History can be viewed by pressing  in the Actual Signal Display Mode. The Fault History can then be scrolled with  . To exit the Fault History press  . The Fault History can be cleared by pressing the *RESET* key.

Fault and Warning Messages

The following Tables show the warning and fault messages.

APPENDIX A-2 FAULT TRACING

Table A- 1 PS200 Warning Messages

WARNING	CAUSE	WHAT TO DO
AMBIENT TEMP	I/O Control board temperature is lower than -5°C (23° F) or exceeds 82° C (180° F).	• Check air flow and fan operation.
ACS800 TEMPERATURE	The PS200 internal temperature is excessive. A warning is given if inverter module temperature exceeds 115 ° C (239° F.)	• Check ambient conditions. • Check air flow and fan operation. • Check heatsink fins for dust pick-up. • Check motor power against unit power.
BASELINE RUN	PumpSmart is performing a baseline run for the Pump Wear Monitor. The drive will automatically ramp up speed while performing the check (approximately 1-2 minutes).	• Allow baseline run to complete automatically. • If required, the pump may be shut-off using the keypad stop (local mode), externally wired stop switch, or the E-Stop switch.
COND 1 HI WRN **COND 2 HI WRN**	The signal level for General Condition Sensor 1 or 2 has exceeded **23.09/13** COND 1/2 WARN LIMIT.	• Investigate cause of condition • Check parameter settings of **23.09** COND 1 WARN LIMIT or **23.13** COND 2 WARN LIMIT
COND 1 HI ALM **COND 2 HI ALM**	The signal level for General Condition Sensor 1 or 2 has exceeded **23.10/14** COND 1/2 ALARM LIMIT.	• Investigate cause of condition • Check parameter settings of **23.10** COND 1 ALARM LIMIT or **23.14** COND 2 ALARM LIMIT
COMM MODULE (programmable Fault Function)	Cyclical communication between PS200 and Fieldbus/PS200 Master is lost. The fault function is in use in remote control when the control place used is controlled from communication module.	• Check the status of communication module. See the appropriate Fieldbus Manual. • Check parameter settings of Group **51, 52**, 90 & 92. • Check connections between control system and adapter module. • Check if the bus master is not communicating or configured. • Check that parameter 30.01 Fieldbus **or Standard Modbus is selected.**
COND 1/2 ERR **VIB 1/2 ERR** **PWM ERR** Programmable Function 24.02	The analog signal at the vibration transmitter(s) or the general condition transmitter(s) has fallen below the allowed value or 3 mA (1.5 V) or has exceeded 20.2 mA (10.1 V) **for 2 sec**. Activation is dependent upon analog input channel configuration.	• Check for proper analog control signal levels. Refer to Actual Signal Group I (1.**18**/1.**19**/1.**20**/1.**38**/1.**39**) to identify which analog input is affected. Check the control wiring. Check if the vibration transmitter is defective.
DC OVERVOLT	Intermediate circuit DC voltage is excessive. DC overvoltage trip limit is 1.3 • ^{U}1max, where ^{U}1max is the maximum value of the input power line voltage range. For 400 V units, ^{U} 1max is 415V. For 500 V units, ^{U} 1max is 500 V. The actual voltage in the intermediate circuit corresponding to the input power line voltage trip level is 728 VDC. for 400 V units and 877 VDC for 500 V units.	• Check that the overvoltage controller is on Parameter **25.22**. • Check mains for static or transient overvoltages. • Check Braking Chopper and Resistor (if used). • Check deceleration time. • Use Coasting for Stop Function (12.08). • Retrofit the frequency converter with a Braking Chopper and a Braking Resistor.
DC UNDERVOLT	Intermediate circuit DC voltage is not sufficient. This can be caused by a missing mains phase, a blown fuse or a rectifier bridge internal fault. DC undervoltage trip limit is 0.65 • ^{U} 1min, where ^{U} 1min is the minimum value of the mains voltage range. For 400 V and 500 V units, ^{U}1 min is 380V. The actual voltage in the intermediate circuit corresponding to the mains voltage trip level is 334 VDC	• Check input power supply and fuses.
DRIVE IS RUNNING DOWNLOADING NOT POSSIBLE	Downloading is not possible while motor is running.	• Stop the motor. Perform the downloading.
EARTH FAULT (programmable Fault Function 24.18)	The load on the incoming power distribution system is out of balance. This can be caused by a ground fault in the motor, motor cable or an internal malfunction.	• Check motor. • Check motor cable. • Check there are no power factor correction capacitors or surge absorbers in the motor cable connected to the drive output.
DOWNLOAD FAILED	Download function of the keypad failed. No data was copied from the Keypad to the PS200.	• Retry (there might be interference on the link). Contact an ABB representative.
DRIVE INCOMPATIBLE DOWNLOADING NOT POSSIBLE	Program versions in the Keypad and in the PS200 do not correspond. It is not possible to copy data from Keypad to the PS200.	• Check the program versions (see Parameter Group 99 information).
DRY RUN (programmable Fault Function 25.13)	The pump is operating in a dry running condition (loss of suction).	• Open the suction valve • Check tank level • Check suction line or conditions (debris, clogged strainer, check valve not opened). • Check setting of parameter 25.14
I/O CONFIG	An input or output of an optional I/O extension module has been selected as a signal interface in the application program but the communication to the appropriate I/O extension module has not been set accordingly.	• Check fault function description (parameter **24.22** and parameter 30.02 OPTION MODULES. Correct settings where necessary).

APPENDIX A-2 FAULT TRACING

WARNING	CAUSE	WHAT TO DO
ID DONE	The PS200 has performed the motor identification magnetization and is ready for operation. This warning belongs to the normal start-up procedure.	• Continue drive operation.
ID MAGN	Motor identification magnetization is on. This warning belongs to the normal start-up procedure.	• Wait until the drive indicates that motor identification is completed.
ID MAGN REQ	Motor identification is required. This warning belongs to the normal start-up procedure.	• To start the ID magnetization: • Press the Start key.
ID NBR CHANGED	The ID number of the drive has been changed from 1 in Drive Selection Mode (the change is not shown on the display).	• To change the ID number back to 1 go to Drive Selection Mode by pressing **DRIVE**. Press **ENTER**. Set the ID number to 1. Press **ENTER.**
ID RUN FAIL	The Motor ID Run is not completed successfully.	• Check the maximum speed (Parameter 14.01) It should be at least 80% of the nominal speed of the motor (Parameter 11.07).
ID RUN SEL	Motor Identification Run is selected, and the drive is ready to start the ID Run. This warning belongs to the ID Run procedure.	• Press Start key to start the Identification Run.
ID RUNNING	Motor Identification Run is on.	• Wait until the drive indicates that Identification Run is completed.
INV OVERLOAD	Inverter overload condition; i.e., load is higher than 200% of I_{2hd} 2 seconds every 15 second or 150% of I_{2hd} 1 minute every 10 minutes. Indication to the supervisory system is given.	• Check Torque and Current limit settings. • Check ramp time setting (13.01 to 13.02) and Fieldbus RATE signal. • Check brake operation.
KEYPAD FAIL (programmable Fault Function 24.03)	A Keypad or Drives Window selected as active control location for the PS200 has ceased communicating.	• Check Keypad connector. • Re-insert Keypad mounting platform. • Check Keypad Fail Fault Function parameters. • Check Drives Window connection.
LINK or HWCP	The fiber optic link to the NINT board is faulty or the change rate of the output current has exceeded the hardware overcurrent limit.	• Check fiber optic cables between NINT and NGDR boards. • Check motor load. • Check acceleration time. • Check motor and motor cable. • Check that there are no power factor correction capacitors or surge absorbers in the motor cable connected to the drive output.
LOCAL CTRL LOSS	Keypad or Drives Window selected as active control location has ceased communicating.	• Check Keypad connector. • Reinsert Keypad in the mounting platform. • Check Drives Window connection.
LOW DEMAND	The setpoint value requires regulation below minimum speed.	• Check for closed valve (downstream). • Wait until demand is re-established (see Sleep Function parameter 14.07).
LOW PERFORM	The Pump Wear Monitor (PWM) has determined that hydraulic wear in the pump has exceeded the set threshold	• Inspect pump casing and/or impeller for wear or internal blockage • Reset pump front clearance • Re-run baseline characterization if hydraulic components have been changed
MACRO CHANGE	Macro is restoring or user Macro is being saved.	• Please wait.
MANUAL OVERRIDE	Manual override function has been enabled. Either through keypad or closure of DI-2	• Check state of digital input-2 • Check parameter 12.06 Manual Override • If using a 3-wire start/stop method, change parameter 12.01 start/stop to 3-wire
MIN FLOW (programmable Fault Function 25.11)	The pump is operating below the safe continuous flow rate.	• Open the discharge check valve • Check discharge line for blockages (debris, check valve not opened). • Check setting of parameter 25.12.
MOTOR PHASE (programmable Fault Function 24.17)	One of the motor phases is lost. This can be caused by a fault in the motor, the motor cable, a thermal relay (if used) or an internal fault.	• Check motor and motor cable. • Check thermal relay (if used). • Check MOTOR PHASE Fault Function parameters. Disable this protection.
MOTOR STALL (programmable Fault F unction 24.11 - 24.13)	Motor is operating in the stall region. This can be caused by excessive load, locked rotor or insufficient motor power.	• Check if pump shaft has seized. • Check motor load and the PS200 ratings. • Check MOTOR STALL Fault Function parameters.
MOTOR STARTS	Motor Identification Run starts. This warning belongs to the IR Run procedure.	• Wait until the drive indicates that motor identification is completed.
MOTOR TEMP (programmable Fault Function 24.05, 24.08	Motor temperature is too high (or appears to be too high). This can be caused by excessive load, insufficient motor power, inadequate cooling or incorrect start-up data.	• Check motor ratings, load and cooling. • Check start-up data. • Check MOTOR TEMP Fault Function parameters.

APPENDIX A-2 FAULT TRACING

WARNING	CAUSE	WHAT TO DO
NO COMMUNICATION (X)	Cabling problem or a hardware malfunction on the Panel Link	• Check Panel Link connections. • Press RESET key. The panel reset may take up to half a minute, please wait.
	(4) = Panel type not compatible with version of the drive application program.	• Check panel type and version of the drive application program. The panel type is printed on the cover of the panel. The application program version is stored in parameter 99.01.
NO FREE ID NUMBERS ID NUMBER SETTING NOT POSSIBLE	All identification numbers are in use in the Panel Link.	• The amount of stations on the Panel Link is 31. No additional drives can be connected.
NO MTR DATA	Motor data is not given or motor data does not match with inverted data.	• Check the motor data given by Parameters 11.04-11.08. • If using a 3-wire start/stop method change parameter 12.01 to 3-Wire.
NO PMP 1 COMM - WARNING	Warning message will display in multi-pump macro when follower pumps (2 – 4) do not receive data from the Master pump within four seconds.	• Check the fiber optic DDCS link at CH 2 is wired properly. • Check that the fiber optic cables are not damaged. • Check that all pumps have been configured for multi-pump operation. • Check for non-functioning keypad(s). • Check for faulty RDCO module.
NOT UPLOADED DOWNLOADING NOT POSSIBLE	No upload function has been performed. It is not possible to download data from the Keypad to the PS200.	• Perform the Upload function. PS200 Programming Manual.
OVERCURRENT	Output current is excessive. The software overcurrent trip limit 2x Ihd. Where Ihd is the heavy duty use current of the ACS800.	• Check motor load. • Check acceleration time. • Check motor and motor cable (including phasing). • Check there are no power factor correction capacitors or surge absorbers in the motor cable connected to the drive output.
OVERFREQ	Motor is turning faster than the highest allowed speed. This can be caused by an incorrectly set minimum/maximum speed, insufficient braking torque or changes in the load when using torque reference. The trip level is 40 Hz over the operating range absolute maximum speed limit (Direct Torque Control mode active) or frequency limit (Scalar Control active). The operating range limits are set by Parameter 14.01 (DTC mode) 14.03 (Scalar mode).	• Check minimum/maximum speed settings. • Check adequacy of motor braking torque. • Check applicability of torque control. • Check the need for a Braking Chopper and Resistor(s).
OVERSPEED	Motor is turning faster than the highest allowed speed set with Parameter 14.01 OVERSPEED LIM. This can be caused by an incorrectly set minimum/maximum speed, insufficient braking torque or changes in the load when using torque reference.	• Check minimum/maximum speed settings. • Check adequacy of motor braking torque. • Check applicability of torque control. • Check if braking chopper and resistor (s) are needed.
PARAM LOCK	This message will display when any parameter is attempted to be changed and a password is not entered.	• The user must enter the password and open the parameter lock prior to changing parameters.
PPCC LINK	The fiber optic link to the NINT board is faulty.	• Check the fiber optic cables connected to the power plates.
PUMP PROTECT – ALARM OR FAULT Programmable Fault Function 25.01	The actual process value is lower than protection limit (25.02) for protection delay (25.03) and the PS200 is at max speed (14.01) for the protection delay.	• Open the suction valve. • Open the discharge valve. • Check suction conditions (dry running, low level). • Check suction line for blockages (clogged strainer, debris, check valve not open). • Check discharge line for blockages (debris, check valve not open). • Check if flow rate is excessive (cavitation condition). • Check for operation below minimum flow.
EXT SP ERR **PROC XT1 ERR** **PROC XT2 ERR** **SPD REF ERR** **- ALARM OR FAULT** Programmable Fault Function 24.01	The process transmitter(s) or external setpoint signal value has fallen below 1.5V (AI1) or 3 mA (AI2/3) or has exceeded 10.1V or 20.2 mA for 2 seconds. Activation is dependent upon analog input channel configuration.	• Check for proper analog control signal levels. Refer to Actual Signal Group I (1.18/1.19/1.20) to identify which analog input is affected. Check the control wiring. Check if the transmitter is defective.
REPLACE FAN	Running time of the inverter cooling fan has exceeded its estimated life time	• Change the fan. Reset fan run time counter.
RUN DISABLED	E-Stop/Permissive switch has not been closed	• Reset or enable the E-Stop or permissive switch. • If no E-stop is required, this function may be disabled by wiring DI1L closed inside the drive. See the Appendix A-4, Instrument Wiring, for details.

APPENDIX A-2 FAULT TRACING

WARNING	CAUSE	WHAT TO DO
RUNOUT Programmable WARNING Function 25.15	The pump is operating at an excessive flow rate.	• Check if discharge valves are opened excessively • Check system resistance curve • Check setting of parameter 25.16
SECND PROTECT A **SECND PROTECT B– ALARM OR FAULT** Programmable Fault Function 25.06 and 25.07	Loss of digital input 4 (DI4) or digital input 5 (DI5) for protection delay (25.03).	• Instrumentation wired to digital input 4 or 5 (pressure switch, level switch, flow switch, temperature switch., etc) has tripped. • If Level Switch, Pressure Switch or Flow Switch is used at DI4/DI5: - Open the suction valve. - Check suction conditions (dry running, low level). - Check suction line for blockages (clogged strainer, debris, check valve not open). • If Flow Switch is used at DI4/DI5: - Open the discharge valve. - Check discharge line for blockages (debris, check valve not open). • If Temperature Switch is used at DI4/DI5: - Check for excessive process temperature.
SHORT CIRC	Short circuit in the motor cable or motor. Output bridge of the inverter is faulty.	• Check the motor and motor cable. • Check that there are no power factor correction capacitors or surge absorbers in the motor cable connected to the drive output. • Consult PumpSmart Applications Group
SLEEP MODE - WARNING Programmable Function 14.07/14.08	If the drive is shutdown by CONFIG SPEED MIN (14.05) (pressure or level control) the drive will SLEEP until the process actual value drops below a set restart value (14.07) for longer than the restart delay (14.08). If operating in inverse mode (21.01) the drive will sleep until the process variable rises above the restart value.	• Wait until the process actual value drops below the Restart Value or above Restart Value if set to Inverse Mode (21.01). • To disable the Restart Value function enter "0%".
START INHIBIT	Optional start inhibit hardware logic is activated.	• Check the start inhibit circuit (NGPS board).
SUPPLY PHASE	Intermediate circuit DC voltage is oscillating. This can be caused by a missing input power line phase, a blown fuse or a rectifier bridge internal fault. A trip occurs when the DC voltage ripple is 13 percent (%) of the DC voltage.	• Check input power line fuses. • Check for mains supply imbalance.
SYNCHRO SPEED	The value of the motor nominal speed set to parameter 11.07 is not correct. The value is too near the synchronous speed of the motor. The tolerance is 0.1%.	• Check full load speed from motor rating plate and set parameter 11.07 accordingly.
THERMAL MODE	Motor thermal protection mode is set to DTC for a high-power motor.	• See parameter 24.05.
UNDERLOAD (programmable Fault Function 24.14 - 24.16)	Motor load is too low. This can be caused by a release mechanism in the driven equipment.	• Check for a problem in the driven equipment. • Check UNDERLOAD Fault Function parameters.
UPLOAD FAILED	Upload function of the keypad failed. No data was copied form the PS200 to the Keypad.	• Retry (there might be interference on the link). Contact an ITT/Goulds representative.
VFD TEMP	The PS200 internal temperature is excessive. The trip level of inverter module temperature is 125° C (257° F).	• Check ambient conditions. • Check air flow and fan operation. • Check heatsink fins for dust pick-up. • Check motor power against unit power.
VIBRATN ALM – ALARM OR FAULT Programmable Fault Function 23.01	The vibration level at Vibration Sensor #1 and/or Vibration Sensor #2 is above the Vibration Alarm Limit (23.06) for longer than 20 seconds.	• Refer to the pump manual for possible causes. • Check parameter value settings 23.03, 23.04, 23.06.
VIBRATN WRN – WARNING Programmable Fault Function 23.02	The vibration level at Vibration Sensor #1 and/or Vibration Sensor #2 is above the Vibration Warning Limit (23.05) for longer than 20 seconds.	• Refer to the pump manual for possible causes. • Check parameter value settings 23.03, 23.04, 23.05.
WRITE ACCESS DENIED PARAMETER SETTING NOT POSSIBLE	Certain parameters do not allow changes while motor is running. If tried, no change is accepted, and a warning is displayed. Parameter lock is on.	• Stop the motor. Change the parameter value. • Open the parameter lock (see Parameter 10.01 PARAMETER LOCK
WRITE PROTECT	Warning message will display if drive is running and certain parameters such as motor data (11.04-11.08) are attempted to be changed.	• In order to change these parameters the PS200 must first be shutdown.

APPENDIX A-3 PARAMETER LISTING

PUMPSMART ACTUAL SIGNALS

Speed Control	Single Pump	Multi-pump	Group 01	VFD ACTUAL SIGNALS	Description
X	X	X	1.02	MOTOR SPEED	Calculated motor speed , RPM
X	X	X	1.03	MOTOR FREQUENCY	Calculated VFD output frequency, Hz
X	X	X	1.04	MOTOR CURRENT	Measured Motor Current, A
X	X	X	1.05	MOTOR TORQUE	Calculated Motor Torque, %. 100% is the motor nominal torque
X	X	X	1.06	MOTOR POWER	Motor Power, %. 100% is the motor nominal power
X	X	X	1.07	DC BUS VOLTAGE	Measured intermediate circuit voltage, V
X	X	X	1.08	MAINS VOLTAGE	Calculated supply voltage, V
X	X	X	1.09	MOTOR VOLTAGE	Calculated motor voltage, V
X	X	X	1.10	VFD TEMP	VFD Temp, Deg C
X	X	X	1.14	OP HRS SINCE RST	Elapsed time counter; runs when the RMIO board is powered, Hrs (since last reset). Re-settable by parameter 26.05.
X	X	X	1.15	KWH SINCE RST	kWh counter, kWh (since last reset). Re-settable by parameter 26.05.
X	X	X	1.17	DI7-1 STATUS	Status of digital inputs. Example: 1000000= DI 1L is on, DI1-DI6 are off
X	X	X	1.18	AI1[V]	Value of analog input 1, V
	X	X	1.19	AI2[MA] PROC FDBK	Value of analog input 2, mA
X	X	X	1.20	AI3[MA]	Value of analog input 3, mA
X	X	X	1.21	RO3-1 STATUS	Status of relay outputs. Example: 0000001=RO1 is energized, RO2 & RO3 are de-energized
X	X	X	1.22	AO1[MA]	Value of analog output 1, mA
X	X	X	1.23	AO2[MA]	Value of analog output 2, mA
X	X	X	1.28	XT AO1 [MA]	Value of analog output 1, mA of the Analog I/O Module (RAIO-01) – optional
X	X	X	1.29	XT AO2 [MA]	Value of analog output 2, mA of the Analog I/O Module (RAIO-01) – optional
X	X	X	1.37	MOTOR TEMP EST	Estimated motor temperature, Deg C
X	X	X	1.38	XT AI1 [MA]	Value of analog input from AI1, mA of the Analog I/O Module (RAIO-01) – optional
X	X	X	1.39	XT AI2 [MA]	Value of analog input from AI2, mA of the Analog I/O Module (RAIO-01) – optional
X	X	X	1.43	MOTOR RUN TIME	Motor run time counter, Hrs (since last reset). The counter runs when the inverter modulates. Re-settable by parameter 26.05.
X	X	X	1.44	FAN ON-TIME	Fan Operating hrs. Resettable by parameter 145.13 if fan is replaced.

Speed Control	Single Pump	Multi-pump	Group 02	PUMP ACTUAL SIGNALS	Description
	X	X	2.01	Flow Ref	Setpoint for flow control (if parameter 15.01AI2 UNIT is Gpm, M3/hr, Kg/hr, lbm/sec or lbm/min)
	X	X	2.02	Flow Actual	Actual flow feedback (if parameter 15.01AI2 UNIT is Gpm, M3/hr,Kg/hr, lbm/sec or lbm/min)
	X	X	2.03	Press Ref	Setpoint used for pressure or level control (if parameter 15.01AI2 UNIT is Psig, Bar, M, Ft, In or Cm)
	X	X	2.04	Press Actual	Actual pressure or level feedback (if parameter 15.01AI2 UNIT is Psig, Bar, M, Ft, In or Cm)
	X	X	2.05	Process Temp Ref	Setpoint used for temperature control (if parameter 15.01AI2 UNIT is F deg or C deg)
	X	X	2.06	Process Temp Act	Actual temperature feedback (if parameter 15.01AI2 UNIT is F deg or C deg)
X	X	X	2.07	Pump Speed	Actual speed of motor, Rpm
	X	X	2.08	Specific Gravity	Specific Gravity of pumped liquid.
X	X	X	2.09	Wire to Water Power	Overall hp includes pump, motor and VFD,
X	X	X	2.10	Setpoint #1	Setpoint #1; unit determined by parameter 15.01AI2 UNIT
X	X	X	2.11	Setpoint #2	Setpoint #2; unit determined by parameter 15.01AI2 UNIT
X	X	X	2.12	Energy Savings	Calculated PS200 savings (option 1 or 2) since last reset. Savings are compared to conventional system ($ or Euro). Re-settable by parameter 26.05.
X	X	X	2.13	Vibration Lvl #1	Vibration level (in/sec or mm/sec)
X	X	X	2.14	Vibration Lvl #2	Vibration level (in/sec or mm/sec)
X	X	X	2.15	Condition Lvl #1	Condition level in % of sensor FS value
X	X	X	2.16	Condition Lvl #2	Condition level in % of sensor FS value
X	X	X	2.17	Proc XT2	Current value of Process Transmitter 2 (Multivariable Control Feature)
X	X	X	2.18	PWM Signal	Current value of PWM Transmitter (Pump Wear Monitor)

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	**Group 03**	**STATUS WORDS**	Description
x	x	x	3.01	Main Ctrl Word	Digital communication Control Word as received from control system
x	x	x	3.02	Main Status Word	Drive status word that is issued to control system
x	x	x	3.03	Aux Status Word	Not Used PS200 Logic
x	x	x	3.04	Limit Word 1	Not Used PS200 Logic
x	x	x	3.05	Fault Word 1	Drive Fault Words
x	x	x	3.06	Fault Word 2	Drive Fault Words
x	x	x	3.07	System Fault	System Fault Words
x	x	x	3.08	Alarm Word 1	Drive Alarm Words
x	x	x	3.09	Alarm Word 2	Drive Alarm Words
x	x	x	3.10	PS Alarm Words	PumpSmart Pump Protection Alarms
x	x	x	3.11	PS Condition Words	PumpSmart condition monitoring words

Group 03 Parameter	STATUS WORD BIT	NAME	VALUE	Description
3.01 MAIN CTRL WORD	0	Reserved		
	1	ENABLE	1	Enabled
			0	Coast to stop
	2	Reserved		
	3	START/STOP	1	Start
			0	Stop according to parameter 12.08 STOP FUNCTION
	4	Reserved		
	5	Reserved		
	6	Reserved		
	7	Reserved		
	8	RESET FAULT	0→1	Reset drive / pump fault
	9 - 15	Reserved		

Group 03 Parameter	STATUS WORD BIT	NAME	VALUE	Description
3.02 MAIN STATUS WORD	0	READY	1	Ready to start
			0	Initialising or initialising error
	1	ENABLE	1	Enabled
			0	Coast to stop
	2	Reserved		
	3	RUNNING	1	Running with selected Setpoint
			0	Stopped
	4	Reserved		
	5	REMOTE	1	Drive in remote mode
			0	Drive in local mode
	6	Reserved		
	7	AT_SETPOINT	1	Drive at Setpoint
			0	Drive not at Setpoint
	8	FAULTED	1	A fault is active
			0	No faults active
	9	WARNING	1	A warning is active
			0	No warning are active
	10	LIMIT	1	Drive at a limit
			0	Drive not at a limit
	11-15	Reserved		

APPENDIX A-3 PARAMETER LISTING

Group 03 Parameter	STATUS WORD BIT	NAME	Description
3.05 FAULT WORD 1	0	SHORT CIRCUIT	For possible causes and remedies, refer to the section FAULT TRACING
	1	OVERCURRENT	
	2	DC OVERVOLT	
	3	ACS800 TEMP	
	4	EARTH FAULT	
	5	THERMISTOR	
	6	MOTOR TEMP	
	7	SYSTEM_FAULT	A Fault is indicated by the system fault word (Actual Signal 3.07)
	8	UNDERLOAD	For possible causes and remedies, refer to the section FAULT TRACING
	9	OVERFREQ	
	10-15	Reserved	

Group 03 Parameter	STATUS WORD BIT	NAME	Description
3.06 FAULT WORD 2	0	SUPPLY PHASE	For possible causes and remedies, refer to the section FAULT TRACING
	1	NO MOTOR DATA	
	2	DC UNDERVOLT	
	3	Reserved	
	4	RUN DISABLED	For possible causes and remedies, refer to the section FAULT TRACING
	5	ENCODER FLT	
	6	I/O COMM	
	7	CTRL B TEMP	
	8	EXTERNAL FLT	
	9	OVER SWFREQ	Switching overfrequency fault
	10-15	AI<MIN FUNC	For possible causes and remedies, refer to the section FAULT TRACING
		PPCC LINK	
		COMM MODULE	
		PANEL LOSS	
		MOTOR STALL	
		MOTOR PHASE	

Group 03 Parameter	STATUS WORD BIT	NAME	Description
3.08 ALARM WORD 1	0	START INHIBIT	For possible causes and remedies, refer to the section FAULT TRACING
	1	Reserved	
	2	THERMISTOR	For possible causes and remedies, refer to the section FAULT TRACING
	3	MOTOR TEMP	
	4	ACS800 TEMP	
	5	ENCODER ERR	
	6	T MEAS ALM	
	7-11	Reserved	
	12	COMM MODULE	For possible causes and remedies, refer to the section FAULT TRACING
	13	Reserved	
	14	EARTH FAULT	
	15	Reserved	

APPENDIX A-3 PARAMETER LISTING

Group 03 Parameter	STATUS WORD BIT	NAME	Description
3.09 ALARM WORD 2	0	Reserved	For possible causes and remedies, refer to the section FAULT TRACING
	1	UNERLOAD	For possible causes and remedies, refer to the section FAULT TRACING
	2-3	Reserved	
	4	ENCODER	For possible causes and remedies, refer to the section FAULT TRACING
	5-6	Reserved	
	7	PWFAIL FILE	Error in restoring POWERFAIL.ddf
	8	ALM (OS_17)	Error in restoring POWERDOWN.ddf
	9	MOTOR STALL7121	For possible causes and remedies, refer to the section FAULT TRACING
	10	AI<MIN FUNC	
	11-12	Reserved	
	13	PANEL LOSS	For possible causes and remedies, refer to the section FAULT TRACING
	14-15	Reserved	

Group 03 Parameter	STATUS WORD BIT	NAME	Description
3.10 PS ALARM WORDS	0	PUMP PROTECT WARN	For possible causes and remedies, refer to the section FAULT TRACING
	1	LOW DEMAND WARN	
	2	DRY RUN	
	3	MIN FLOW	
	4	RUNOUT FLOW	
	5	LOW PERFORM	
	6	VFD FAULT	
	7	VIBRATION WARN	
	8	VIBRATION ALARM	
	9	CONDITION WARN	
	10	CONDITION ALARM	
	11	BASELINE RUN	
	12	TX/AI ERR	
	13	SECONDARY PRTCT A WARN	
	14	SECONDARY PRTCT B WARN	

Group 03 Parameter	**STATUS WORD BIT**	**NAME**	**Description**
3.11 PS ALARM WORDS	0	LOW PERFORM	For possible causes and remedies, refer to the section FAULT TRACING
	1	BASELINE RUN	
	2	VIBRATION WARN	
	3	VIBRATION FAULT	
	4	COND 1 WARN	
	5	COND 1 ALARM	
	6	COND 2 WARN	
	7	COND 2 ALARM	
	8	SECONDARY PRTCT A FAULT	
	9	SECONDARY PRTCT B FAULT	
	10	PUMP PROTECT FAULT	
	11	VFD FAULT	
	12	LOW DEMAND FAULT	
	13	NO PUMP 1 COM	
	14	MOTOR TEMP	

APPENDIX A-3 PARAMETER LISTING

PUMPSMART CONFIGURATION PARAMETERS

The following pages detail the parameters most commonly used for the configuration of your PumpSmart system. Basic configuration parameters may be accessed using the passcode 358 entered into parameter 10.02 PASS CODE. More advanced parameters are shown with asterisks (**) following the parameter ID and may be accessed using the passcode 564.

Speed Control	Single Pump	Multi-pump	Group 10	LOCKS/PASSWORDS	Description
X	X	X	10.01	PARAMETER LOCK	Selects the state of the parameter lock. The lock prevents parameters from being changed.
				OPEN	The lock is open. Parameter values can be changed.
				LOCKED *[default]*	Parameter values cannot be changed from the keypad. The lock can be opened by entering the valid password in parameter 10.02. When the keypad is locked the PS200 keypad functionality is limited to starting, stopping and changing the setpoint.
X	X	X	10.02	PASS CODE	Password setting 358 opens the lock and returns the value to zero on the display. The password relocks when power is disconnected. Range = 0 -30000. To re-lock the keypad reset parameter 10.01 to "Locked".
X	X	X	10.03	LOCAL LOCK	Disables local control on the keypad. **Warning** - Before activating, ensure that the control panel is not needed for stopping the drive.
				OFF *[default]*	Local control allowed
				ON	Local control disabled
X	X	X	10.04	PARAMETER SAVE	Saves the parameter values to the permanent memory.
				DONE *[default]*	Parameters entered via the keypad are automatically saved. Parameters are not automatically saved when altered through the Fieldbus connection.
				SAVE	Used for manually saving parameters that have been altered through the Fieldbus connection.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 11	START UP DATA	Description
X	X	X	11.01	LANGUAGE	Selects the display language
				ENGLISH	British English. If selected the unit of power is kW.
				ENGLISH (AM) *[default]*	American English. If selected the unit of power is hp.
				DEUTSCH	German (full translation)
				ITALIANO	Italian (full translation)
				ESPANOL	Spanish (full translation)
				PORTUGUES	Portuguese (full translation)
				NEDERLANDS	Dutch (partial translation)
				FRANCAIS	French (full translation)
				DANSK	Danish (partial translation)
				SUOMI	Finnish (partial translation)
				SVENSKA	Swedish (partial translation)
				CESKY	Czech (partial translation)
				POLSKI	Polish (partial translation)
X	X	X	11.02	APPLICATION MACRO	Selects the application macro
				SINGLE PUMP *[default]*	One PS200 regulating to a setpoint
				MULTI PUMP	Backup, Constant Slave or two to four PS200's regulating to a setpoint
				SPEED CONTRL	PS200 follows a speed Setpoint only. Pump protect fault function is inactive.
	X	X	11.03	MODE SELECT	Sets the control parameter. Pre-selects default values for parameters 13.01 – 13.06. Not applicable to the Speed Ctrl macro.
				PRESSURE (DEFAULT)	Control parameter is Pressure.
				FLOW	Control parameter is Flow.
				LEVEL	Control parameter is Level.
				TEMPERATURE	Control parameter is Temperature.
X	X	X	11.04	MOTOR NOM VOLTAGE	Defines the motor voltage. Equal to the value on the motor nameplate. Selections are: 460VAC– 60Hz (default), 220VAC-50Hz, 208VAC-60Hz, 220VAC-60Hz, 230VAC-60Hz, 380VAC-50Hz, 415VAC-50Hz, 575VAC-60Hz and Other.
X	X	X	11.05	MOTOR NOM CURRENT	Defines the motor current. Equal to the value on the motor nameplate.
X	X	X	11.06	MOTOR NOM FREQ	Visible only if "Other" is selected in 11.04. Defines the motor nominal frequency. Equal to the value on the motor nameplate.
				60 HZ	Nominal frequency is 60 Hz – This parameter is automatically populated by selection in 11.04. If "Other" is selected in 11.04 user makes manual selection for 11.06.
				50 HZ	Nominal frequency is 50 Hz - This parameter is automatically populated by selection in 11.04. If "Other" is selected in 11.04 user makes manual selection for 11.06.
X	X	X	11.07	MOTOR FL RPM	Defines the motor FL speed. Equal to the value on the motor nameplate.
X	X	X	11.08	MOTOR NOMINAL POWER	Defines the motor power (hp). Equal to the value on the nameplate.
X	X	X	11.09 **	MOTOR CTRL MODE	Default is DTC. Other Options is Scalar
X	X	X	11.10 **	MOTOR ID RUN	Selects the type of motor identification. During the identification, the drive will identify the characteristics of the motor for optimum motor control.
				NO *[default]*	Default ID Run style. Motor will not rotate during ID MAGN.
				STD	Best ID run for accuracy. Motor must be uncoupled. Motor does rotate at full speed for approximately 1 minute. Not available if parameter 11.09 MOTOR CTRL MODE is SCALAR.
				REDUCED	Alternate ID run if motor is coupled. Motor does rotate at partial speed for approximately 1 minute. Not available if parameter 11.09 MOTOR CTRL MODE is SCALAR

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 11	START UP DATA	Description
X	X	X	11.11**	APPLIC RESTORE	Restores the original defaults of the application macro
				NO *[default]*	No restoring
				YES	Restoring
X	X	X	11.12	OTHER MOTOR VOLT	Visible if "Other" is selected in 11.04. The User inputs the voltage value.
X	X	X	11.13**	CTRL BOARD SUPPLY	Defines the source of the control board power
				INTERNAL 24 *[default]*	Uses internal power supply for control board
				EXTERNAL 24	Optional control board powering method.

Speed Control	Single Pump	Multi-pump	Group 12	START/STOP	Description
X	X	X	12.01	START/STOP	Defines the connections and source of the start/stop commands
				2 WIRE /HOA *[default]*	Start/Stop through DI1. 0 = stop, 1 = start. Manual override through DI-2. 0 = No, 1 = override. After a fault reset, the drive will restart only if auto restart (12.02) is set to on. If auto restart is off the start signal must be removed and reapplied.
				3 WIRE	Pulse start through digital input DI1. 0>1: Start. Pulse stop through digital input 2 DI2. 1>0: Stop.
				FIELDBUS	Start via Fieldbus control word
X	X	X	12.02	AUTO RESTART	Selects whether the PS200 will automatically restart after a power failure.
				OFF *[default]*	Not selected
				ON	Selected. The PS200 will automatically restart if conditions permit.
X	X	X	12.03	TEST RUN	Selects when the drive will perform a test run
				NOT SEL *[default]*	Not selected
				AUTOMATIC	If selected and the drive has not run for the test delay (12.05) the drive will start and run at 50% of maximum speed (14.01) for 20 seconds and shutdown. Auto Restart 12.02 must be on.
				MANUAL	Once manual is selected the drive will start and run at test speed for 20 seconds and shutdown. Once the manual test is complete this parameter will return to "NOT SEL".
X	X	X	12.04	TEST SPEED % (FL)	Selects the speed the test runs at in manual test mode (12.03)
				0 – 100%	Setting range. Default is 25% of maximum speed (14.01).
X	X	X	12.05	TEST RUN DELAY	Selects how long after the drive is idle before it will do a test run
				0.1 – 3600 HR	Setting range. Default is 1000 Hr.
	X	X	12.06	MANUAL OVERRIDE	Disables the control algorithm and pump protection parameters 23.01, 23.07, 23.11, 24.01, 25.01, 25.06, 25.07, 25.11, 25.13, and 25.15. Will NOT override E-Stop/Permissive function.
				OFF *[default]*	Not selected
				ON	Selected
X	X	X	12.07	MANUAL OVERRIDE RPM	Initial default is 14.02 MINIMUM SPEED. Saves the last manual override speed for HOA function. Updates to the current process speed when 12.06 MANUAL OVERRIDE turned-on. Does not update if using an external switch to engage override (hand) function.
				0 - 3600 RPM	Setting range
X	X	X	12.08	STOP FUNCTION	Selects how the motor should stop during normal shutdown.
				RAMP *[default]*	Pump shuts down using the ramp rate defined in 13.02 DECEL TIME
				COAST	Power is cut immediately to motor allowing it to coast to a stop.
X	X	X	12.09	MOTOR JOG	Jogs motor for 10 sec @ 60 rpm to check for motor rotation.
				DISABLED *[default]*	Motor jog is not active.
				JOG	Jogs motor for 10 sec at 60 rpm. After jog is complete this parameter setting returns to disabled.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 13	RAMPS	Description
X	X	X	13.01	ACCEL TIME	Defines the fast acceleration time (Range = 0 – 1800 sec). Default = 5 sec. Pre-populated by setting of 11.03 MODE SELECT.
X	X	X	13.02	DECEL TIME	Defines the fast deceleration time (Range = 0 – 1800 sec). Default = 5 sec. Pre-populated by setting of 11.03 MODE SELECT.
	X	X	13.03	P-GAIN	Defines the proportional gain for the PID regulator (range 0 – 100). Defaults based on control modes are Pressure= 0.5, Flow= 0.2, Pressure/Flow quadratic= 0.5, Level/Temperature= 2.5. Pre-populated by setting of 11.03 MODE SELECT.
	X	X	13.04	I-TIME	Defines the integral time for the PID regulator (range 0 – 320). Defaults based on control modes are Pressure= 0.75, Flow= 1.75, Pressure/Flow quadratic= 3.0, Level/Temperature= 0.75. Pre-populated by setting of 11.03 MODE SELECT.
	X	X	13.05**	D-TIME	Defines the derivation time of the PID regulator (range = 0 – 10 sec). Default = 0 deactivates the "D" time
	X	X	13.06**	PID DERIV FILTER	Defines the constant of the filter used to smooth the derivation component of the process PID regulator (range = 0.04 – 10 sec). Default is 1 sec.
	X	X	13.07**	PID INTEGRATION	Activates the integration function of the PID regulator. Choices are 'ON" (default) and "OFF".

Speed Control	Single Pump	Multi-pump	Group 14	SPD LIM/STRT LVL	Description
X	X	X	14.01	MAXIMUM SPEED	Defines the allowable maximum speed. Default setting is parameter 11.07 MOTOR FL RPM.
X	X	X	14.02	MINIMUM SPEED	Defines the minimum speed range. Default setting is 25% of parameter 11.07 MOTOR FL RPM.
X	X	X	14.03	MAXIMUM FREQUENCY	Defines the maximum allowable frequency when operating in scalar mode. This parameter is not shown unless parameter 11.09 MOTOR CTRL MODE is set to SCALAR. Default setting is parameter 11.06 MOTOR NOM FREQ.
X	X	X	14.04	MINIMUM FREQUENCY	Defines the minimum allowable frequency when operating in scalar mode. This parameter is not shown unless parameter 11.09 MOTOR CTRL MODE is set to SCALAR. Default setting is 25% of parameter 11.06 MOTOR NOM FREQ.
X	X	X	14.05	CONFIG SPEED MIN	Defines the reaction of the drive when the PS200 tries to regulate at a speed at or below 14.02 MINIMUM SPEED.
				SPD = MINSPD	The PS200 will stay at this speed until the transient clears or unit is manually shutdown; unless a fault occurs.
				SPD = 0 *[default]*	The drive will stay at minimum speed until 14.06 STP DELAY MIN SPD times-out and then it will shutdown.
	X	X	14.06	STP DELAY MIN SPD	The time period the drive will stay at 14.05 MINIMUM SPEED before stopping. Range = 0 –1800 sec. (Single pump macro default = 0 sec, Multi-pump macro default =3 sec). Functions when 14.05 is set to SPD=0. Becomes active if setpoint would result in regulation below min speed, closed valve condition in pressure control and Secondary Protect A & B.
	X	X	14.07	RESTART VALUE	If the drive is shutdown by 14.05 CONFIG SPEED MIN due to no system demand (pressure control only) the drive will sleep until the process actual value drops below a set 14.07 RESTART VALUE for longer than 14.08 RESTART DELAY. If operating in inverse mode (21.01) the drive will sleep until the process variable rises above the restart value. Wake-up level in % of setpoint value = 0 – 150%. To disable the Restart Value function in <u>both</u> normal and inverse settings enter "0%". 12.02 AUTO RESTART does not influence the restart function. Default = 0.
	X	X	14.08	RESTART DELAY	Time delay for 14.07 RESTART VALUE. Range = 0 –1800 sec. Default = 0 seconds
X	X	X	14.09	PRIMING DELAY	Setting range is 0-6000 sec. When the drive is starting from 0 RPM this parameter delays pump protection faults (23.01,07,11, 25.01,06, 07, 11,13, 15) for the setting time. Default is "0". Once the priming delay time is complete, 25.03 PROTECTION DELAY becomes functional. During the priming delay the pump runs at 14.01 MAXIMUM SPEED since it cannot achieve the setpoint.
X			14.10	CRITICAL SPEED 1	Value range: 0-9999 Rpm. Default is "0". If setting of CRITICAL SPEED 1 = "0" then the Critical Speed functionality is disabled.
X			14.11	CRITICAL SPEED 2	Value range: 0-9999 rpm. Default is "0". If setting of CRITICAL SPEED 2 = "0" then the Critical Speed functionality is disabled.
X			14.12	NCR WIDTH	Value Range: 0-1000 Rpm. Default is "0". This is the total critical speed bandwidth (½ above and ½ below) of the value set for Critical Speed 1 and 2. If the setpoint falls in the critical speed zone the drive runs at a setpoint just above or below the critical speed envelope if slowing down or ramping up to the setpoint, respectively.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 15	PROCESS VAR UNIT	Description
X	X	X	15.01	AI2 UNIT RPM % HZ BAR GPM PSIG *[default]* M3/HR FT M F DEG C DEG LBM/SEC LBM/MIN KG/HR IN CM	Selects the units (default is pressure) for the primary process transmitter feedback located at AI2. In speed control macro default unit is rpm.
X	X	X	15.02	AI1 UNIT NONE *[default]* RPM % HZ BAR GPM PSIG M3/HR FT M F DEG C DEG LBM/SEC LBM/MIN KG/HR IN CM	Selects the units for transmitter feedback at AI1 (when used).
X	X	X	15.03	AI3 UNIT NONE *[default]* RPM % HZ BAR GPM PSIG M3/HR FT M F DEG C DEG LBM/SEC LBM/MIN KG/HR IN CM	Selects the units for transmitter feedback at AI3 (when used).

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 16	SETPOINT SELECT	Description
X	X	X	16.01	SET1/SET2 SELECT	Defines the source from which the drive reads the signal that selects the setpoint.
				SETPOINT 1 *[default]*	Setpoint 1 is being used only
				DI3	Digital Input 3 selects setpoint 1 or setpoint 2. 0pen = Setpoint 1, Closed = Setpoint 2
				FIELDBUS	The setpoint is sent via Fieldbus control word.
X	X	X	16.02	SETPOINT 1 SELECT	Selects the signal source for Setpoint1.
				KEYPAD *[default]*	The setpoint is selected from the keypad
				ANALOG INPUT	The setpoint is selected by an analog input (AI1, AI2 or AI3).
				FIELDBUS	The setpoint is selected via Fieldbus control word
X	X	X	16.03	AI2 MAX	For single pump and multi-pump macros this parameter defines the full-scale feedback (20 mA setting) of the primary process transmitter at AI2. This parameter also correlates to the maximum value of Setpoint(s) 1 and 2. For the Speed Control macro this parameter scales the maximum (20 mA or keypad) speed setting. Note when units are in Ft, M, In or Cm: AI2 Max is always based on a specific gravity = 1 regardless of setting for parameter 17.04. Actual pressure signals in Ft, M, In or Cm are corrected for specific gravity by the firmware. Signal can be quadratic or linear.
X	X	X	16.04	AI2 MIN	For single pump and multi-pump macros this parameter defines the value (normally zero) of the 4 mA setting for the primary process transmitter at AI2. This parameter also correlates to the minimum value of Setpoint(s) 1 and 2. For the Speed Control macro this parameter scales the value (normally zero) of the 4 mA or keypad speed setting. Note when units are in Ft, M, In or Cm: AI2 Min is always based on a specific gravity = 1 regardless of setting for parameter 17.04. Actual pressure signals in Ft, M, In or Cm are corrected for specific gravity by the firmware. Signal can be quadratic or linear.
X	X	X	16.05	SETPOINT 2 SELECT	Selects the signal source for Setpoint1 (setpoint #2)
				KEYPAD *[default]*	The setpoint is selected from the keypad
				ANALOG INPUT	The setpoint is selected by an analog input (AI1, AI2 or AI3).
				FIELDBUS	The setpoint is selected via Fieldbus control word
X	X	X	16.06	AI1 MAX	Defines the full-scale value for a 10 VDC/20 mA signal when a PWM transmitter or Second Process Transmitter is used at AI1. Note when units are in Ft, M, In or Cm: AI1 Max is always based on a specific gravity =1 regardless of setting for parameter 17.04. Actual pressure signals in Ft, M, In or Cm are corrected for specific gravity by the firmware. Signal can be quadratic or linear.
X	X	X	16.07	AI1 MIN	Defines the minimum value for a 2 VDC/4 mA signal when a PWM transmitter or Second Process Transmitter is used at AI1. Note when units are in Ft, M, In or Cm: AI1 Min is always based on a specific gravity =1 regardless of setting for parameter 17.04. Actual pressure signals in Ft, M, In or Cm are corrected for specific gravity by the firmware. Signal can be quadratic or linear.
X	X	X	16.08	AI3 MAX	Defines the full-scale value for a 20-mA signal when a PWM transmitter or Second Process Transmitter is used at AI3. Note when units are in Ft, M, In or Cm: AI3 Max is always based on a specific gravity =1 regardless of setting for parameter 17.04. Actual pressure signals in Ft, M, In or Cm are corrected for specific gravity by the firmware. Linear signal only.
X	X	X	16.09	AI3 MIN	Defines the minimum value for a 4-mA signal when a PWM transmitter or Second Process Transmitter is used at AI3. Note when units are in Ft, M, In or Cm: AI3 Min is always based on a specific gravity =1 regardless of setting for parameter 17.04. Actual pressure signals in Ft, M, In or Cm are corrected for specific gravity by the firmware. Linear signal only.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 17	ANALOG INPUTS	Description
X	X	X	17.01	AI1 SENSOR	Determines if the transmitter feedback from AI1 is linear or quadratic. If quadratic, the transmitter type for AI1 must be a differential pressure transmitter.
				LINEAR *[default]*	The feedback signal from AI1 has a linear relationship.
				QUADRATIC	Quadratic is selected only for differential pressure type flowmeters such as orifice plates or venturi meters.
X	X	X	17.02	AI2 SENSOR	Determines if the primary process transmitter feedback from AI2 is linear or quadratic. If quadratic, the transmitter type for AI2 must be a differential pressure transmitter.
				LINEAR *[default]*	The feedback signal from AI2 has a linear relationship.
				QUADRATIC	Quadratic is selected only for differential pressure type flowmeters such as orifice plates or venturi meters.
	X	X	17.03	K – DP FLOWMETER	The flow constant is used for differential pressure flowmeters. Use only when 17.01 or 17.02 is quadratic. The flow constant K is calculated as follows: When units for 16.03 or 16.06 is Ft: K = GPM/ (Ft)0.5 When units for 16.03 or 16.06 is M: K = M3/Hr/ (M) 0.5 When units for 16.03 or 16.06 is PSI: K = GPM/ (PSI x 2.31)0.5 When units for 16.03 or 16.06 is Bar: K = M3/Hr/ (Bar x 10.2114)0.5 Important when calculating "K": Flow = full-scale flow corresponding to the 20 mA DP. Pressure (Ft, M, PSI or Bar) is the full-scale (20-mA) differential pressure (DP) basis water. Note; the software uses only one "K" constant, therefore; if two DP flowmeters are used (17.01 and 17.02 are both quadratic) both flowmeters must have the same K value setting range = 0 – 1000.
	X	X	17.04	SPECIFIC GRAVITY	Specific Gravity of the pumped liquid. Used when 17.01 or 17.02 is quadratic or units for 15.01 or 15.02 are in Ft, M, In or Cm. Setting range = 0 – 10.
X	X	X	17.05	MINIMUM AI1	Defines the minimum value for analog input AI1.
				0VDC	Do not use. A 0VDC signal will activate a Sensor Failure fault function unless 24.01 and 24.02 are disabled.
				2VDC *[default]*	2VDC is selected as the minimum value
				TUNED VALUE	Select tuned value after the tune function has been completed. This will select the tuned value for the minimum value of AI1.
				TUNE	This parameter sets the minimum value of the signal to be applied to AI1. When tune is selected and enter is pressed the tuned value for AI1 is set to the actual AI1 value when the tune function was activated. This function is useful for zeroing out any system hysteresis.
X	X	X	17.06**	MAXIMUM AI1	Defines the maximum value for analog input AI1.
				10VDC *[default]*	Maximum scaled setting is at 10 VDC
				TUNED VALUE	Select tuned value after the tune function has been completed. This will select the tuned value for the maximum value of AI1.
				TUNE	This parameter sets the maximum value of the signal to be applied to AI1. When TUNE is selected and ENTER is pressed the tuned value for AI1 is set to the actual AI1 value when the tune function was activated. This function is useful for zeroing out any system hysteresis.
X	X	X	17.07 **	SCALE AI1	Scales AI1. Default = 100%
X	X	X	17.08**	FILTER AI1	Defines the filter time constant for AI1. Default is 0.1 sec. Note the signal is also filtered due to the signal interface hardware (10ms time constant). This cannot be changed by any parameter.
X	X	X	17.09**	INVERT AI1	Activates/deactivates the inversion of analog input signal AI1.
				NO	No inversion
				YES	Inversion is active. The maximum value of the analog input signal (10V/20 mA) corresponds to AI1 MIN (16.07) and the minimum value of the analog input signal (2V/4mA) corresponds to AI1 MAX (16.06)
X	X	X	17.10	MINIMUM AI2	Defines the value for analog input AI2.
				0 MA	Do not use. A 0-mA signal will activate a Sensor Failure fault function unless 24.01 and 24.02 are disabled.
				4 MA *[default]*	4 mA is selected as the minimum value
				TUNED VALUE	Select tuned value after the tune function has been completed. This will select the tuned value for the minimum value of AI2.
				TUNE	This parameter sets the minimum value of the signal to be applied to AI2. When tune is selected and enter is pressed the tuned value for AI2 is set to the actual AI2 value when the tune function was activated. This function is useful for zeroing out any system hysteresis.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 17	ANALOG INPUTS	Description
X	X	X	17.11**	MAXIMUM AI2	Defines the maximum value for analog input AI2.
				20 MA *[default]*	Maximum scaled setting is at 20 MA
				TUNED VALUE	Select tuned value after the tune function has been completed. This will select the tuned value for the maximum value of AI2.
				TUNE	This parameter sets the maximum value of the signal to be applied to AI2. When TUNE is selected and ENTER is pressed the tuned value for AI2 is set to the actual AI2 value when the tune function was activated. This function is useful for zeroing out any system hysteresis.
X	X	X	17.12**	SCALE AI2	Scales AI2. Default = 100%
X	X	X	17.13**	FILTER AI2	Defines the filter time constant for AI2. Default is 0.1 sec. Note the signal is also filtered due to the signal interface hardware (10ms time constant). This cannot be changed by any parameter.
X	X	X	17.14**	INVERT AI2	Activates/deactivates the inversion of analog input signal AI2.
				NO	No inversion
				YES	Inversion is active. The maximum value of the analog input signal (20 mA) corresponds to 16.04 AI2 MIN and the minimum value of the analog input signal (4mA) corresponds to 16.03 AI2 MAX
X	X	X	17.15	MINIMUM AI3	Defines the value for analog input AI3.
				0 MA	Do not use. A 0-mA signal will activate a Sensor Failure fault function unless 24.01 and 24.02 are disabled.
				4 MA *[default]*	4 mA is selected as the minimum value.
				TUNED VALUE	Select tuned value after the tune function has been completed. This will select the tuned value for the minimum value of AI3.
				TUNE	This parameter sets the minimum value of the signal to be applied to AI3. When tune is selected and enter is pressed the tuned value for AI3 is set to the actual AI3 value when the tune function was activated. This function is useful for zeroing out any system hysteresis.
X	X	X	17.16**	MAXIMUM AI3	Defines the maximum value for analog input AI3.
				20 MA *[default]*	Maximum scaled setting is at 20 MA
				TUNED VALUE	Select tuned value after the tune function has been completed. This will select the tuned value for the maximum value of AI3.
				TUNE	This parameter sets the maximum value of the signal to be applied to AI3. When TUNE is selected and ENTER is pressed the tuned value for AI3 is set to the actual AI3 value when the tune function was activated. This function is useful for zeroing out any system hysteresis.
X	X	X	17.17**	SCALE AI3	Scales AI3. Default = 100%
X	X	X	17.18**	FILTER AI3	Defines the filter time constant for AI3. Default is 0.1 sec. Note the signal is also filtered due to the signal interface hardware (10ms time constant). This cannot be changed by any parameter.
X	X	X	17.19**	INVERT AI3	Activates/deactivates the inversion of analog input signal AI3.
				NO	No inversion
				YES	Inversion is active. The maximum value of the analog input signal (20 mA) corresponds to 16.09 AI2 MIN and the minimum value of the analog input signal (4mA) corresponds to 16.08 AI2 MAX
X	X	X	17.20	AI1 CONFIG	Defines the configuration for AI1
				PROC TRANS 2	Used with offset feature.
				EXT SETPOINT	Used when fixed or variable setpoint is sent via an external source in single pump or multi-pump.
				VIBRATION 2	Used when Vibration 2 is selected
				CONDITION 2	Used when Condition 2 is selected
				SPD CTRL REF	Used in Speed Macro when an external speed Setpoint is present.
				PWM SIGNAL	Used when the Pump Wear Monitor is selected.
				NOT USED *[default]*	AI1 not used
X	X	X	17.21	AI2 CONFIG	Defines the configuration for AI2
				PROC TRANS 1	Default setting for single pump and multi-pump
				SPD CTRL REF	Used in Speed Macro when an external speed Setpoint is present.
				NOT USED	AI2 not used (Default for Speed Macro)
X	X	X	17.22	AI3 CONFIG	Defines the configuration for AI3 (MUST BE A LINEAR SIGNAL).
				VIBRATION 1	Used when Vibration 1 is selected
				CONDITION 1	Used when Condition 1 is selected
				PWM SIGNAL	Used when the Pump Wear Monitor is selected.
				PROC TRANS 2	Used with offset feature.
				EXT SETPOINT	Used when fixed or variable setpoint is sent via an external source in single pump or multi-pump.
				NOT USED *[default]*	AI3 not used

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 18	AI EXT MODULE	Description
X	X	X	18.01	XTAI1	Selections are VIB 1, VIB 2, COND 1 or COND 2. Default is "Not Used". (MUST BE A LINEAR SIGNAL)
X	X	X	18.02	XTAI2	Selections are VIB 1, VIB 2, COND 1 or COND 2. Default is "Not Used". (MUST BE A LINEAR SIGNAL)
X	X	X	18.03	MINIMUM XT AI1	Defines the value for analog input XT AI1. Note: parameter 30.02 AI/O EXT MODULE must be set to RAIO Slot 1 or Slot 2.
				0 MA	Do not use. A 0-mA signal will activate a Sensor Failure fault function unless 24.01 and 24.02 are disabled.
				4 MA *[default]*	4 mA is selected as the minimum value.
				TUNED VALUE	Select tuned value after the tune function has been completed. This will select the tuned value for the minimum value of XT AI1.
				TUNE	This parameter sets the minimum value of the signal to be applied to XT AI1. When tune is selected and enter is pressed the tuned value for XT AI1 is set to the actual XT AI1 value when the tune function was activated. This function is useful for zeroing out any system hysteresis.
X	X	X	18.04**	MAXIMUM XT AI1	Defines the maximum value for analog input XT AI1.
				20 MA *[default]*	Maximum scaled setting is at 20 MA
				TUNED VALUE	Select tuned value after the tune function has been completed. This will select the tuned value for the maximum value of XT AI1.
				TUNE	This parameter sets the maximum value of the signal to be applied to XT AI1. When TUNE is selected and ENTER is pressed the tuned value for XT AI1is set to the actual XT AI1 value when the tune function was activated. This function is useful for zeroing out any system hysteresis.
X	X	X	18.05**	SCALE XT AI1	Scales XT AI1. Default = 100%
X	X	X	18.06**	FILTER XT AI1	Defines the filter time constant for XT AI1. Default is 0.1 sec. Note the signal is also filtered due to the signal interface hardware (10ms time constant). This cannot be changed by any parameter.
X	X	X	18.07**	INVERT XT AI1	Activates/deactivates the inversion of analog input signal XT AI1.
				NO	No inversion
				YES	Inversion is active. The maximum value of the analog input signal (20 mA) corresponds to the minimum vibration or condition level and the minimum value of the analog input signal (4 mA) corresponds to the maximum vibration or condition value.
X	X	X	18.08	MINIMUM XT AI2	Defines the value for analog input XT AI2. Note: parameter 30.02 AI/O EXT MODULE must be set to RAIO Slot 1 or Slot 2.
				0 MA	Do not use. A 0-mA signal will activate a Sensor Failure fault function unless 24.01 and 24.02 are disabled.
				4 MA *[default]*	4 mA is selected as the minimum value.
				TUNED VALUE	Select tuned value after the tune function has been completed. This will select the tuned value for the minimum value of XT AI2.
				TUNE	This parameter sets the minimum value of the signal to be applied to XT AI2. When tune is selected and enter is pressed the tuned value for XT AI2 is set to the actual XT AI2 value when the tune function was activated. This function is useful for zeroing out any system hysteresis.
X	X	X	18.09**	MAXIMUM XT AI2	Defines the maximum value for analog input XT AI2.
				20 MA *[default]*	Maximum scaled setting is at 20 MA
				TUNED VALUE	Select tuned value after the tune function has been completed. This will select the tuned value for the maximum value of XT AI2.
				TUNE	This parameter sets the maximum value of the signal to be applied to XT AI2. When TUNE is selected and ENTER is pressed the tuned value for XT AI2 is set to the actual XT AI2 value when the tune function was activated. This function is useful for zeroing out any system hysteresis.
X	X	X	18.10**	SCALE XT AI2	Scales XT AI2. Default = 100%
X	X	X	18.11**	FILTER XT AI2	Defines the filter time constant for XT AI2. Default is 0.1 sec. Note the signal is also filtered due to the signal interface hardware (10ms time constant). This cannot be changed by any parameter.
X	X	X	18.12**	INVERT XT AI2	Activates/deactivates the inversion of analog input signal XT AI2.
				NO	No inversion
				YES	Inversion is active. The maximum value of the analog input signal (20 mA) corresponds to the minimum vibration or condition level and the minimum value of the analog input signal (4 mA) corresponds to the maximum vibration or condition value.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 19	RELAY OUTPUTS	Description
X	X	X	19.01 19.04	RELAY RO# OUTPUT	Selects the PS200 status to be indicated through relay output 1or 2 (RO1,RO2). The relay energizes when the status meets the setting. Relay warnings are reset automatically, faults must be manually reset (unless reset by 25.04 ERROR RESET).
				READY *[default 19.01]*	The output indicates that power is supplied to the drive and it is awaiting a start command.
				RUNNING *[default 19.04]*	The output indicates the drive is running.
				VFD FAULT	A VFD related warning or fault has occurred (includes keypad fault).
				PUMP FAULT	A general pump related warning or fault has occurred e.g. pump protect, Low demand, secondary pump protect A or B, vibration 1 or 2 Fault, condition 1 or 2 fault, min flow fault, dry run fault, Runout or process or condition sensor fault.
				ALL FAULTS	Both VFD and pump related warning or faults are identified
				LOW PMP PERF	The pump performance has degraded past the value set in parameter 27.02.
				SECND PRTECT A	The secondary protection A warning or fault function has been activated. DI4 is low for the 25.03 PROTECTION DELAY setting. Closed = NORMAL, Open = SECONDARY PROTECT A fault function is active.
				SECND PRTECT B	The SECONDARY PROTECTION B warning or fault function has been activated. DI5 is low for the 25.03 PROTECTION DELAY setting. Closed = NORMAL, Open = SECONDARY PROTECT B fault function is active.
				HIGH VIBRAT	Vib #1 or Vib #2 has exceeded the limit (23.05/23.06) for 20 seconds or longer.
				PUMP PROTECT	The pump protection or low demand warning or fault function has been activated. DI4 is low for 25.03 PROTECTION DELAY
				START SLAVE	Used in multipump macro to start slave pump 1 only.
				HI CONDITION 1	Condition 1 has exceeded the limit (23.09/23.10) for 20 seconds or longer.
				HI CONDITION 2	Condition 2 has exceeded the limit (23.13/23.14) for 20 seconds or longer.
				PROC TX ERR	The process transmitter ProcTX1, Proc TX2, Spd Ctrl Ref or Ext Setpoint has been triggered by 24.01. If warnings clear relay resets; faults require manual reset.
X	X	X	19.02**	RO1 TON DELAY	Defines the operation delay for relay output RO1. Setting Range 0-3600 sec. Default =0 sec.
X	X	X	19.03**	RO1 TOFFDELAY	Defines the release delay for relay output RO1. Setting Range 0-3600 sec. Default =0 sec.
X	X	X	19.05**	RO2 TON DELAY	Defines the operation delay for relay output RO2. Setting Range 0-3600 sec. Default =0 sec.
X	X	X	19.06**	RO2 TOFFDELAY	Defines the release delay for relay output RO2. Setting Range 0-3600 sec. Default =0 sec.
X	X	X	19.07	RELAY RO3 OUTPUT	Selects the PS200 status to be indicated through relay output 3 (RO3). The relay energizes when the status meets the setting. Relay warnings are reset automatically, faults must be manually reset (unless reset by 25.04 ERROR RESET).
				NOT USED *[default]*	The output is not used
				READY	The output indicates that power is supplied to the drive and it is awaiting a start command.
				RUNNING	The output indicates the drive is running.
				VFD FAULT	A VFD related warning or fault has occurred (includes keypad fault).
				PUMP FAULT	A general pump related warning or fault has occurred e.g. pump protect, Low demand, secondary pump protect A or B, vibration 1 or 2 Fault, condition 1 or 2 fault, min flow fault, dry run fault, Runout or process or condition sensor fault.
				ALL FAULTS	Both VFD and pump related warning or faults are identified
				LOW PMP PERF	The pump performance has degraded past the value set in parameter 27.02.
				SECND PRTECT A	The secondary protection A warning or fault function has been activated. DI4 is low for the 25.03 PROTECTION DELAY setting. Closed = NORMAL, Open = SECONDARY PROTECT A fault function is active.
				SECND PRTECT B	The SECONDARY PROTECTION B warning or fault function has been activated. DI5 is low for the 25.03 PROTECTION DELAY setting. Closed = NORMAL, Open = SECONDARY PROTECT B fault function is active.
				HIGH VIBRAT	Vib #1 or Vib #2 has exceeded the limit (23.05/23.06) for 20 seconds or longer.
				PUMP PROTECT	The pump protection or low demand warning or fault function has been activated. DI4 is low for 25.03 PROTECTION DELAY
				START SLAVE	Used in multipump macro to start slave pump 3 only.
				HI CONDITION 1	Condition 1 has exceeded the limit (23.09/23.10) for 20 seconds or longer.
				HI CONDITION 2	Condition 2 has exceeded the limit (23.13/23.14) for 20 seconds or longer.
				PROC TX ERR	The process transmitter ProcTX1, Proc TX2, Spd Ctrl Ref or Ext Setpoint has been triggered by 24.01. If warnings clear relay resets; faults require manual reset.
X	X	X	19.08**	RO3 TON DELAY	Defines the operation delay for relay output RO3. Setting Range 0-3600 sec. Default =0 sec.
X	X	X	19.09**	RO3 TOFFDELAY	Defines the release delay for relay output RO3. Setting Range 0-3600 sec. Default =0 sec.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 20	ANALOG OUTPUTS	Description
X	X	X	20.01	ANALOG OUTPUT 1	Connects a PS200 signal to analog output 1 (AO1)
				NOT USED *[default]*	Not in use
				SPEED	Motor speed. 20 mA = motor full load speed (11.07)
				FREQUENCY	Output frequency. 20 mA = motor nominal frequency (11.06)
				CURRENT	Output current. 20 mA = motor nominal current (11.05)
				TORQUE	Motor torque. 20 mA = 100% of motor nominal rating.
				POWER	Motor Power. 20 mA = 100% of motor power rating.
				VIBR LVL 1	Vibration level 1. 20 mA = Vib #1 max value (23.03)
				VIBR LVL 2	Vibration level 2. 20 mA = Vib #2 max value (23.04)
				PROC VAR	Actual value of process variable AI2. 20 mA = Setpoint 1 Max (16.03)
				ENERGY SAVING	Calculated energy savings (option 1 or 2) over a conventional fixed speed system. 20 mA = Savings scale (26.03).
				COND LVL 1	Condition Level 1. 20 mA = 100% of Sensor FS value
				COND LVL 2	Condition Level 2. 20 mA = 100% of Sensor FS value
X	X	X	20.02**	INVERT AO1	Inverts the AO1 signal. The analog signal is at the minimum level when the indicated drive signal is at its maximum level and vice versa. (Default = No)
X	X	X	20.03**	MINIMUM AO1	Defines the minimum value of AO1. Default = 4 mA
X	X	X	20.04**	FILTER AO1	Defines the filtering time constant for AO1. Default = 0.1 s.
X	X	X	20.05**	SCALE AO1	Scales AO1 signal. Default = 100%.
X	X	X	20.06	ANALOG OUTPUT 2	Connects a PS200 signal to analog output 2 (AO2)
				NOT USED *[default]*	Not in use
				SPEED	Motor speed. 20 mA = motor full load speed (11.07)
				FREQUENCY	Output frequency. 20 mA = motor nominal frequency (11.06)
				CURRENT	Output current. 20 mA = motor nominal current (11.05)
				TORQUE	Motor torque. 20 mA = 100% of motor nominal rating.
				POWER	Motor Power. 20 mA = 100% of motor power rating.
				VIBR LVL 1	Vibration level 1. 20 mA = Vib #1 max value (23.03)
				VIBR LVL 2	Vibration level 2. 20 mA = Vib #2 max value (23.04)
				PROC VAR	Actual value of process variable AI2. 20 mA = Setpoint 1 Max (16.03)
				ENERGY SAVING	Calculated energy savings (option 1 or 2) over a conventional fixed speed system. 20 mA = Savings scale (26.03).
				COND LVL 1	Condition Level 1. 20 mA = 100% of Sensor FS value
				COND LVL 2	Condition Level 2. 20 mA = 100% of Sensor FS value
X	X	X	20.07**	INVERT AO2	Inverts the AO2 signal. The analog signal is at the minimum level when the indicated drive signal is at its maximum level and vice versa. (Default = No)
X	X	X	20.08**	MINIMUM AO2	Defines the minimum value of AO2. Default = 4 mA
X	X	X	20.09**	FILTER AO2	Defines the filtering time constant for AO2. Default = 0.1 s.
X	X	X	20.10**	SCALE AO2	Scales AO2 signal. Default = 100%.
X	X	X	20.11	XT ANALOG OUT 1	Connects a PS200 signal to analog output 1 (AO3). Note: parameter 30.02 AI/O Ext Module must be set to RAIO Slot 1 or Slot 2.
				NOT USED *[default]*	Not in use
				SPEED	Motor speed. 20 mA = motor full load speed (11.07)
				FREQUENCY	Output frequency. 20 mA = motor nominal frequency (11.06)
				CURRENT	Output current. 20 mA = motor nominal current (11.05)
				TORQUE	Motor torque. 20 mA = 100% of motor nominal rating.
				POWER	Motor Power. 20 mA = 100% of motor power rating.
				VIBR LVL 1	Vibration level 1. 20 mA = Vibrat 2Max Val (23.03)
				VIBR LVL 2	Vibration level 2. 20 mA Vibrat 2 Max Val (23.04)
				PROC VAR	Actual value of process variable AI2. 20 mA = AI2 Max (16.03)
				ENERGY SAVING	Calculated energy savings (option 1 or 2) over a conventional fixed speed system. 20 mA = Savings scale (26.03).
				COND LVL 1	Condition Level 1. 20 mA = 100% of Sensor FS value
				COND LVL 2	Condition Level 2. 20 mA = 100% of Sensor FS value

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 19	ANALOG OUTPUTS	Description
X	X	X	20.12**	INVERT XT AO1	Inverts the XT AO1 signal. The analog signal is at the minimum level when the indicated drive signal is at its maximum level and vice versa. (Default = No)
X	X	X	20.13**	MINIMUM XT AO1	Defines the minimum value of XT AO1. Default = 4 mA
X	X	X	20.14**	FILTER XT AO1	Defines the filtering time constant for XT AO1. Default = 0.1 s.
X	X	X	20.15**	SCALE XT AO1	Scales XT AO1 signal. Default = 100%.
X	X	X	20.16	XT ANALOG OUT 2	Connects a PS200 signal to analog output 2 (AO4). Note: parameter 30.02 AI/O Ext Module must be set to "YES".
				NOT USED *[default]*	Not in use
				SPEED	Motor speed. 20 mA = motor full load speed (11.07)
				FREQUENCY	Output frequency. 20 mA = motor nominal frequency (11.06)
				CURRENT	Output current. 20 mA = motor nominal current (11.05)
				TORQUE	Motor torque. 20 mA = 100% of motor nominal rating.
				POWER	Motor Power. 20 mA = 100% of motor power rating.
				VIBR LVL 1	Vibration level 1. 20 mA = Vib #1 max value (23.01)
				VIBR LVL 2	Vibration level 2. 20 mA = Vib #2 max value (23.02)
				PROC VAR	Actual value of process variable AI2. 20 mA = Reference 1 Max (16.03)
				ENERGY SAVING	Calculated energy savings (option 1 or 2) over a conventional fixed speed system. 20 mA = Savings scale (26.03).
				COND LVL 1	Condition Level 1. 20 mA = 100% of Sensor FS value
				COND LVL 2	Condition Level 2. 20 mA = 100% of Sensor FS value
X	X	X	20.17**	INVERT XT AO2	Inverts the XT AO2 signal. The analog signal is at the minimum level when the indicated drive signal is at its maximum level and vice versa. Default = No
X	X	X	20.18**	MINIMUM XT AO2	Defines the minimum value of XT AO2. Default = 4 mA
X	X	X	20.19**	FILTER XT AO2	Defines the filtering time constant for XT AO2. Default = 0.1 s.
X	X	X	20.20**	SCALE XT AO2	Scales XT AO2 signal. Default = 100%.

Speed Control	Single Pump	Multi-pump	Group 21	REG/MULTVAR	Description
	X	X	21.01	REGULATION MODE	Selects the type of PS200 control with falling process variable signal.
				NORMAL *[default]*	Increases the output speed with falling process variable signal. For level control applications the tank is on the discharge side.
				INVERSE	Decreases the output speed with falling process variable signal. For level control applications the tank is on the suction side.
	X	X	21.02	MULTIVAR CTL	Selects the PS200 Multivariable Control feature. Utilizes one auxiliary process transmitter to offset the setpoint.
				OFF *[default]*	Disables Multivariable control
				ON	Multivariable control is active
	X	X	21.03	LEVEL 1 %	Process Transmitter 2 Low value offset @ A%. Below this % is where offset begins for Tx2. Default = 0%. Range: 0 – 100%.
	X	X	21.04	SPT LO TX2	Setpoint corresponding to the LO INTRCPT B%. Default = 0.0. Range: + - 20,000
	X	X	21.05	LO INTRCPT B%	Process Transmitter 2 Low value offset @ B%. This is TX2 % corresponding to SPT LO TX2. Default = 0%. Range: 0 – 100%.
	X	X	21.06	LEVEL 2%	Process Transmitter 2 High value offset @ A%. Above this % is where offset begins for Tx2. Default = 100%. Range: 0 – 100%.
	X	X	21.07	SPT HI TX2	Setpoint corresponding to the HI INTRCPT B%. Default = 0.0. Range: + - 20,000
	X	X	21.08	HI INTRCPT B%	Process Transmitter 2 Low value offset @ B%. This is TX2 % corresponding to SPT HI TX2. Default = 100%. Range: 0 – 100%.
	X	X	21.09	PRESS INCR SPEED	Sets the speed for which additional pressure is added to compensate for system frictional losses at increased flow. Setting range = 0 –3600 rpm. Used for single pump and backup modes only. Default = 1200 Rpm.
	X	X	21.10	PRESS INCR %	The amount, in % of setpoint, which is added to the setpoint to compensate for frictional losses with increases in speed. Setting range = 0 – 100%. Used for single pump and backup modes only. Note the full setpoint increase (%) is achieved at maximum speed (14.01). Default = 0.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 22	MULTIPUMP CTRL	Description
		X	22.01	MODE	Selects how multiple PS200 units operate together to satisfy the setpoint.
				SYNCHRONOUS *[default]*	Lag pumps start as needed and all pumps regulate to the setpoint at the same speed. Note: pumps must be identical.
				MULTICONTROL	Lag pump start as needed. The last lag pump to start regulates to the setpoint; the remaining pumps operate at maximum speed (14.01).
				CONSTANT SLV	The master unit starts up to three fixed speed slave units when needed. See RO1, RO2 and RO3 settings (parameters 19.01, 19.04 and 19.07).
				BACKUP	This is similar to single pump control but automatically starts the backup unit if the primary unit fails. Parameters 22.02, 22.03, 22.04, 22.06, 22.07, and 22.08 are nonfunctional with "Backup". Note parameters 21.01 through 21.10 are functional with "Backup".
		X	22.02	VALUE DECREASE	Defines how much the setpoint can drop before the next lag pump is started. Setting range = 0 – 100% of setpoint. Used for multi-control, synchronous control and slave modes only. Default = 5%.
		X	22.03	VALUE INCREASE	Defines the increase in setpoint when a lag pump starts. This value is cumulative with each lag pump that turns on. Setting range = 0 – 100% of setpoint. Used for multi-control, synchronous control and slave modes only. The default setting for 22.03 is equal to the value set in 22.02. Default = 5%.
		X	22.04	ENABLE SEQUENCE	Defines the speed the drive must be at before multi-pump operation is allowed. Setting range = 0 – 100%. Applies to synchronous, multi-control and slave modes only. Default = 98% of 14.01 MAXIMUM SPEED.
		X	22.05	SWITCH LEAD	Defines the time the lead unit will run before a new unit is deemed the lead unit. Note if set to zero the switching function is disabled (including switching during a fault). Setting range 0 – 4000 hrs. Default setting is 48 hrs.
		X	22.06	SYNC ENABLE	Selects if Sync Limit (22.07) and Sync Window (22.08) are used to stop the lag pumps. Used for synchronous only.
				NO *[default]*	Disabled
				YES	Enabled
		X	22.07	SYNC LIMIT	Selects the speed at which lag pump #1 should be turned off. Setting range = 0 – 100% of parameter 14.01 MAXIMUM SPEED. Applies to synchronous, multi-control, and slave mode. Default is 65% of parameter 14.01 MAXIMUM SPEED for synchronous and 35% for multi-control.
		X	22.08	SYNC WINDOW	The speed step above the sync limit (22.07) used to turn off lag pump #2. Twice the Sync Window is the speed step at which lag pump #3 is turned off. Setting range = 0 –100% of parameter 14.01 MAXIMUM SPEED. Used for synchronous and slave modes only. Default is 14% of parameter 14.01 MAXIMUM SPEED.
		X	22.09	PUMP ADDRESS	Defines the pump address for multi-pump systems. Address range = 1 –4 where address 1 is designated as the master.
		X	22.10**	M/F COMM L DELAY	The time delay before a M/F Comm Loss is declared. Default = 4 sec. This parameter cannot be changed.
		X	22.11**	CH2 COM LOS CTRL	Defines the reaction of the drive in the event a fiber-optic communication loss occurs. Access using pass code 564.
				COAST STOP *[default]*	Pump stops, coast stop.
				RAMP STOP	Pump stops, ramp stop.
				AUTO CTRL	Pumps operate similar to single pump mode and regulate to set point. Not valid if using 22.13 TX ONE MASTER.
				LAST SPEED	Pumps run at average speed during last minute of operation. Can be used with 22.13 TX one master setting.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 22	MULTIPUMP CTRL	Description
		X	22.12	MANUAL SWITCH	Selections are DISABLED *[default]*, 1, 2, 3 and 4. Manual switch of lead-lag pumps; after manual switch occurs this parameter returns to disabled. Manual switch shall function through the master keypad.
		X	22.13	TX CONFIG	Applies to Synchronous Control, Multi-control and Backup only. Defines if lag pumps have their own transmitter.
				TX ALL DRIVES	Default when parameter 11.03 MODE SELECT is set to pressure. Each pump has its own transmitter. This selection can be used for pressure control only.
				TX ONE AI	Default when parameter 11.03 MODE SELECT is set for level, flow or temperature. Only one transmitter is used. The transmitter must be wired in series to the other drives. Parameters 22.04, 22.07 and 22.08 function normally. Can be used for all selections in parameter 11.03 MODE SELECT.
				TX ONE MASTER	Used for pressure, level, flow or temperature where one transmitter is used. The transmitter signal is transmitted via fiber optic cables to other drives. Parameters 22.04, 22.07 and 22.08 function normally.

Speed Control	Single Pump	Multi-pump	Group 23	CONDITION SETUP	Description
X	X	X	23.01	VIBRATION ALARM	Vibration level is above 23.06 VIB ALARM LIMIT for 20 seconds or longer.
				NOT SEL *[default]*	Protection is inactive
				ALARM	The PS200 displays the message "VIBRATN ALM". Relay output(s) may be configured to change. No further action is taken.
				FAULT	The PS200 stops the pump. A vibration fault message is displayed. Relay output(s) may be configured to change
X	X	X	23.02	VIBRATION WARNING	The vibration level is above 23.05 VIB WARN LIMIT for greater than 20 sec.
				NOT SEL *[default]*	Protection is inactive
				WARNING	The PS200 displays the message "VIBRATN WRN". Relay output(s) may be configured to change. No further action is taken.
X	X	X	23.03	VIBRAT 1 MAX VAL	Full scale vibration feedback (20 mA) for Vib #1. Setting range = 0 – 2.00 in/s (50.8 mm/s). Default = 1.0 in/sec (25.4 mm/sec). Note: parameter 30.02 AI/O EXT MODULE must be set to "YES" if RAIO-01 module is used.
X	X	X	23.04	VIBRAT 2 MAX VAL	Full scale vibration feedback (20 mA) for Vib #2. Setting range = 0 – 2.00 in/s (50.8 mm/s). Default = 1.0 in/sec (25.4 mm/sec). Note: parameter 30.02 AI/O Ext Module must be set to "yes" if RAIO-01 module is used.
X	X	X	23.05	VIB WARN LIMIT	Vibration warning limit. Setting range = 0 – 1.00 in/sec (25.4 mm/sec). Default = 0.16 in/sec (4.06 mm/sec)
X	X	X	23.06	VIB ALARM LIMIT	Vibration alarm limit. Setting range = 0 – 1.00 in/sec (25.4 mm/sec). Default = 0.22 in/sec (5.59 mm/sec)
X	X	X	23.07	COND 1 ALARM	% Setting is above 23.10 setting for greater than 20 sec). Note: 30.02 AI/O EXT MODULE must be set to "yes" if used.
				DISABLED *[default]*	Protection is inactive. Default
				ALARM	The PS200 displays the message "COND 1 HIGH". Relay output(s) may be configured to change. No further action is taken.
				FAULT	The PS200 stops the pump and displays the message "COND 1 HIGH". Relay output(s) may be configured to change
X	X	X	23.08	COND 1 WARNING	% Setting is above 23.09 COND 1 WARN LIMIT for greater than 20 sec. Note: 30.02 AI/O EXT MODULE must be set to "YES" if RAIO-01 module is used.
				DISABLED *[default]*	Protection is inactive. Default
				WARNING	The PS200 displays the message "COND 1 HIGH". Relay output(s) may be configured to change. No further action is taken.
X	X	X	23.09	COND 1 WARN LIMIT	Range is 0 – 100% of FS sensor value. This is the lower warning limit. Default is 100%
X	X	X	23.10	COND 1 ALRM LIMIT	Range is 0 – 100% of FS sensor value. This is the upper alarm limit Default is 100%
X	X	X	23.11	COND 2 ALARM	% Setting is above 23.14 COND 2 ALRM LIMIT for greater than 20 sec. Note: parameter 30.02 AI/O EXT MODULE must be set to "YES" if RAIO-01 module is used.
				DISABLED *[default]*	Protection is inactive. Default
				ALARM	The PS200 displays the message "COND 2 HIGH". Relay output(s) may be configured to change. No further action is taken.
				FAULT	The PS200 stops the pump and displays the message "COND 2 HIGH". Relay output(s) may be configured to change.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 23	CONDITION SETUP	Description
X	X	X	23.12	COND 2 WARNING	% Setting above 23.13 for greater than 20 sec. Note: parameter 30.02 AI/O EXT MODULE must be set to "YES" if RAIO-01 module is used.
				DISABLED *[default]*	Protection is inactive. Default
				WARNING	The PS200 displays the message "COND 2 HIGH". Relay output(s) may be configured to change. No further action is taken.
X	X	X	23.13	COND 2 WARN LIMIT	Range is 0 – 100% of FS sensor value. This is the lower warning limit. Default is 100%
X	X	X	23.14	COND 2 ALRM LIMIT	Range is 0 – 100% of FS sensor value. This is the upper alarm limit. Default is 100%

Speed Control	Single Pump	Multi-pump	Group 24	FAULT FUNCTIONS	Description
X	X	X	24.01	PROC SNSR FAILURE	Selects the PS200 reaction when Ext SP, Proc XT1, Spd Ref or Proc XT2 analog signal falls below 1.5V / 3 mA or above 10.1V / 20.2 mA for 2 seconds. The sensor failure warning is identified as to which particular sensor has failed based on the analog input configuration settings given in parameters 17.20, 17.21 and 17.22.
				DISABLED	Protection is inactive
				FAULT	The drive trips on fault and the motor coasts to a stop. A fault message is generated "EXT SP, PROC XT1, SPD REF or PROC XT2" Err.
				LAST SPEED *[default]*)	The drive generates a warning "EXT SP, PROC XT1, SPD REF or PROC XT2 ERR" and freezes the speed to the average speed the drive was operating at over the last 60 seconds.
X	X	X	24.02	COND SNSR FAILURE	Selects how the PS200 will react when Cond 1, Cond 2, Vib 1, Vib 2 or PWM signal falls below 1.5V / 3 mA or above 10.1V / 20.2 mA for 2 seconds. The sensor failure warning is identified as to which particular sensor has failed based on the analog input configuration settings given in parameters 17.20, 17.22, 18.01 and 18.02.
				DISABLED	Protection is inactive
				WARNING *[default]*	The PS200 generates a warning "COND 1, COND 2, VIB 1, VIB 2 or PWM SGNL ERR".
X	X	X	24.03	KEYPAD FAILURE	Selects how the PS200 will react to a keypad communication break.
				DISABLED	Protection is inactive
				FAULT	The drive trips on fault and the motor coasts to a stop. A fault message is generated "PANEL LOSS". If an external start/stop switch is used and the reference is sent via analog input, no fault will occur if the keypad fails.
				LAST SPEED *[default]*	The drive generates a warning "PANEL LOSS" and freezes the speed to the average speed the drive was operating at over the last 60 seconds.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 24	FAULT FUNCTIONS	Description
X	X	X	24.04	DIGIT RST CONFIG	Allows drive faults to be reset using an external switch wired into DI6 if condition that caused the fault has been corrected.
				PUMP FAULTS	Resets pump faults: PUMP PROTECT, LOW DEMAND, DRY RUN, MIN FLOW, VIB 1 AND 2, COND 1 and 2 and PROCESS SENSOR.
				VFD FAULTS	Resets a keypad fault or VFD fault
				BOTH *[default]*	Resets both Pump faults and VFD faults.
X	X	X	24.05**	MOTOR THERM PROT	Selects how the drive reacts when the motor overtemperature is detected by the function defined by parameter 24.06 MOTOR THERM P MODE. Default = WARNING. Other choices: FAULT, NOT SELECTED.
X	X	X	24.06**	MOTOR THERM P MODE	Selects the thermal protection mode of the motor. When overtemperature is detected the drive reacts as defined by parameter 24.05 MOTOR THERM PROT. Default = DTC. Other choices: USER MODE and THERMISTOR. Thermistor is wired into DI-4. Automatically updates to THERMISTOR when thermistor is selected in parameter 25.06.
X	X	X	24.07**	MOTOR THERM TIME	Defines the thermal time constant for the user defined thermal model.
X	X	X	24.08**	MOTOR LOAD CURVE	Defines the load curve together by parameters 24.09 ZERO SPEED LOAD and 24.10 BREAK POINT. The load curve is used in the user defined thermal model.
X	X	X	24.09**	ZERO SPEED LOAD	Defines the load curve together by 24.08 and 24.10.
X	X	X	24.10**	BREAK POINT	Defines the load curve together by 24.08 and 24.09.
X	X	X	24.11**	STALL FUNCTION	Selects how the drive reacts to a motor stall condition. Default = NOT SEL. Other choices: WARNING, FAULT.
X	X	X	24.12**	STALL FREQ HI	Defines the frequency limit for the stall function.
X	X	X	24.13**	STALL TIME	Defines the time for the stall function.
X	X	X	24.14**	UNDERLOAD FUNC	Selects how the drive reacts to underload. Default = NOT SEL. Other choices: WARNING or FAULT.
X	X	X	24.15**	UNDERLOAD TIME	Time limit for the underload function.
X	X	X	24.16**	UNDERLOAD CURVE	Selects the load curve for the underload function.
X	X	X	24.17**	MOTOR PHASE LOSS	Activates the motor phase loss supervisory function. Default = NOT SEL. Other choices: FAULT.
X	X	X	24.18**	GROUND FAULT	Selects how the drive reacts when an earth fault is detected in the motor or the motor cable. Default = FAULT. Other choice: WARNING.
X	X	X	24.19**	COMM FLT FUNC	Selects how the drive reacts in a fieldbus comm break i.e; if the drive fails to receive the main ref data set or the aux ref data set. The time delays are given by parameters 24.20 and 24.21. Default = LAST SPEED. Other choices: NOT SELECTED, FAULT.
X	X	X	24.20**	MAIN REF DS T-OUT	Defines the time delay for the main ref data set supervision. Default = 3 Sec
X	X	X	24.21**	AUX DS T- OUT	Defines the time delay for the aux ref data set supervision. Default = 3 Sec
X	X	X	24.22**	IO CONFIG FUNC	Selects how the drive reacts in case of improper selection of the I/O. Default = NOT SEL. Other choice: WARNING.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 25	PUMP PROTECT	Description
	X	X	25.01	PUMP PROTECT CTRL	Actual process value is lower than 25.02 PROTECTION LIMIT for 25.03 PROTECTION DELAY and the PS200 is at maximum speed for the protection delay.
				DISABLED *[default]*	Protection is disabled
				ALARM	The PS200 generates a warning only "PUMP PROTECT". Relay outputs may be configured to changed. No other action is taken.
				ALARM AND CONTROL	The PS200 generates a warning "Pump Protect" and controls according to the setting of 14.05 CONFIG SPEED MIN.
	X	X	25.02	PROTECTION LIMIT	This is the value, in % of the setpoint, at which 25.01 PUMP PROTECT CTRL activates when pump is at max speed for the protection delay. Setting range: 0 – 100% of setpoint. The default setting is 97%.
X	X	X	25.03	PROTECTION DELAY	This is the period prior to the activation of 25.01 PUMP PROTECT CTRL. Also applies to SECONDARY PROTECT A/B, MIN FLOW, DRY RUN and RUNOUT CTRL. Setting = 0 – 200 sec. Default: 0 seconds.
X	X	X	25.04	ERROR RESET	Indicates number of fault resets. Parameter 12.02 AUTO RESTART must be set to "ON". Selection range is 0 – 19. Default is "0". When set to "0" ERROR RESET is disabled. Time between resets is set by 25.05 RESET DELAY. Manual intervention is required if fault is still active after set number of resets has been achieved. The drive reaction to the fault will be according to 14.05 CONFIG SPEED MIN. Reset action is applicable to parameters 25.01, 25.11 and 25.15.
X	X	X	25.05	RESET DELAY	The period of time that the PS200 will wait after an alarm and control condition before attempting an error reset. Setting Range: 250 sec. Default: 60 sec.
X	X	X	25.06	SECONDARY PROTECT A	Loss of digital input 4 (DI4) for 25.03 PROTECTION DELAY.
				DISABLED *[default]*	Protection is disabled
				ALARM	The PS200 generates a warning only "SECONDARY PROTECT A". Relay outputs may be configured to change. No other action is taken.
				ALARM AND CONTROL	The PS200 generates a warning "SECONDARY PROTECT A"and controls according to the setting of 14.05 CONFIG SPEED MIN. Parameter 12.02 AUTO RESTART must be set to "ON" to automatically restart once fault has been reset.
				THERMISTOR	Allows the use of a motor thermistor at DI4. Parameter 24.06 MOTOR THERM P MODE is automatically updated to "THERMISTOR".
X	X	X	25.07	SECONDARY PROTECT B	Loss of digital input 5 (DI5) for 25.03 PROTECTION DELAY.
				DISABLED *[default]*	Protection is disabled
				ALARM	The PS200 generates a warning only "SECONDARY PROTECT B". Relay outputs may be configured to change. No other action is taken.
				ALARM AND CONTROL	The PS200 generates a warning "SECONDARY PROTECT B" and controls according to the setting of 14.05 CONFIG SPEED MIN. Parameter 12.02 AUTO RESTART must be set to "ON" to automatically restart once fault has been reset.
X	X	X	25.08	BEP POWER	Value range setting is 0 – 9999. Defines the power at best efficiency point of the pump. The default is 90% of the 11.08 MOTOR NOM POWER.
X	X	X	25.09	PWR OFFSET	Value range setting is -20.0 to +20.0. This is a mechanical power loss offset value (e.g. seal losses). Default = 0.
X	X	X	25.10	BEP SPEED	Value range setting is 0 – 9999. Defines the pump speed associated with the BEP power. The default is 11.07 MOTOR FL RPM.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 25	PUMP PROTECT	Description
X	X	X	25.11	MIN FLOW CTRL	If enabled and the actual torque is less than the min flow torque (corrected for speed) for 25.03 PROTECTION DELAY, a minimum flow condition is detected.
				DISABLED *[default]*	Protection is disabled.
				WARNING	The PS200 displays the message "MIN FLOW WARNING". Relay outputs may be configured to change. No other action is taken.
				ALARM AND CONTROL	The PS200 displays the message "MIN FLOW" and controls according to the setting of 14.05 CONFIG SPD MIN. The fault is re-settable if 25.04 ERROR RESET is active. Parameter 12.02 AUTO RESTART must be set to "ON" to automatically restart once the fault has been reset.
X	X	X	25.12	MIN FLOW TORQUE	This is the minimum flow torque expressed as a % of the BEP torque. If the actual torque is less than minimum flow torque (corrected for speed) for 25.03 PROTECTION DELAY, a MIN FLOW FAULT is issued and the unit reacts according to 14.05 CONFIG SPEED MIN. This fault is re-settable if 25.04 ERROR RESET is active. Value range setting is 0 – 200%. Default: 0%
X	X	X	25.13	DRY RUN CTRL	If enabled and the actual torque is less than the dry run torque (corrected for speed) for 25.03 PROTECTION DELAY, a dry run condition is detected. MINIMUM FLOW CTRL must also be enabled for DRY RUN CTRL to be enabled.
				DISABLED *[default])*	Protection is disabled.
				WARNING	The PS200 generates a dry run warning only; no other action is taken.
				FAULT	The drive faults and the motor coasts to a stop. A fault message is generated "DRY RUN". This fault is not resettable by 25.04 ERROR RESET.
X	X	X	25.14	DRY RUN TORQUE	This value is expressed as a % of BEP torque. If actual torque is less than the dry run torque (corrected for speed) for 25.03 PROTECTION DELAY, a DRY RUN FAULT is issued and the unit is shut down. This fault is not resettable by 25.04 ERROR RESET). Value range setting is 0 – 200%. Default: 0%.
X	X	X	25.15	RUNOUT CTRL	If enabled and the actual torque is greater than the runout torque (corrected for speed) for 25.03 PROTECTION DELAY, a runout condition is indicated.
				DISABLED *[default]*	Protection is disabled.
				WARNING	The PS200 displays the message "RUNOUT". Relay outputs may be configured to change. No other action is taken.
				ALARM AND CONTROL	The drive will issue a warning and decrease speed enough so the actual torque is equal to the runout torque (corrected for speed). The runout ramp can be adjusted by setting of 25.17 RUNOUT RAMP. This warning is resettable by 25.04 ERROR RESET and 25.05 RESET DELAY but only if the unit has reached 14.02 MIN SPEED.
X	X	X	25.16	RUNOUT TORQUE	This value is expressed as a % of BEP torque. If actual torque is greater than Runout Torque (corrected for speed) for 25.03 PROTECTION DELAY, a Runout Warning will be issued and the unit will decrease speed so the actual torque is equal to the Runout Torque (corrected for speed). Value range setting is 0 – 201%. Default: 201%.
X	X	X	25.17	RUNOUT RAMP	Deceleration ramp rate during a Runout warning. Default is 20 seconds. Range equals 5 – 100 seconds.
X	X	X	25.18	CALC TEST TRQ %	Actual Torque/ Corr BEP Trq expressed as a %. This is the operating % which is compared to the 25.12, 25.14 and 25.16 settings. Useful during setup. Viewable only and write protected.
X	X	X	25.19	CORR BEP TRQ %	The operating CORR BEP TRQ %. Viewable only and write protected.
X	X	X	25.20**	MAXIMUM CURRENT	Defines the allowed maximum motor current in % of rated heavy duty use output current.
X	X	X	25.21**	MAXIMUM TORQUE	Defines the maximum torque limit of the drive
X	X	X	25.22**	OVERVOLTAGE CONTROL	Activates (default)/deactivates the overvoltage control of the intermediate DC link.
X	X	X	25.23**	UNDERVOLTAGE CONTROL	Activates (default)/deactivates the undervoltage control of the intermediate DC link.
X	X	X	25.24**	P MOTORING LIM	Defines the allowed maximum power fed by the inverter to the motor.
X	X	X	25.25**	P GENERATING LIM	Defines the allowed maximum power fed by the motor to the inverter.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 26	ENERGY SAVINGS	Description
X	X	X	26.01	$/KWHR	Cost of energy in local currency. Setting range = 0.000 - 1.000
X	X	X	26.02	BASELINE POWER	Baseline HP for a conventional fixed speed system. Setting range = 0 – 1000 hp.
X	X	X	26.03	SAVINGS SCALE	This parameter scales the analog output when ENERGY SAVINGS is selected as an analog output. Setting Range = 0 – 999999. Default = 10,000.
X	X	X	26.04	ENERGY SAVE METHD	Selections: Savings Op 1 (default), Savings Op 2
X	X	X	26.05	ENERGY SAVE RESET	Selections: Disabled (default), Reset (note after resetting, parameter 26.05 returns to disabled.
X	X	X	26.06	KWH AT RESET	Total kWh since last reset. Add to parameter 1.15 KWH SINCE RST to obtain total kWh. Viewable only.
X	X	X	26.07	OP HRS AT RESET	Total Op Hrs since last reset. Add to parameter 1.14 OP HRS SINCE RST to obtain total hrs RMIO board has been powered. Viewable only.

Speed Control	Single Pump	Multi-pump	Group 27	PWM CHK	Description
X	X	X	27.01	PMP PERF BASELINE	The PS200 collects baseline performance data for comparison to the running time performance of the pump.
				1ST BASELINE *[default]*	Default. The PS200 collects initial baseline data during first time startup only if parameter 27.02 PMP WEAR MONITOR is enabled.
				NEW BASELINE	A new baseline is taken whenever this setting is selected and 27.02 PMP WEAR MONITOR is enabled. For example a new baseline would be desirable if the pump has been repaired. After the new baseline data is taken this parameter setting returns to 1st Baseline.
X	X	X	27.02	PMP WEAR MONITOR	If enabled, the Pump Wear Monitor displays the message "LOW PERFORM" when the pump hydraulic performance has degraded past the threshold value selected in 27.02. Relay outputs may be configured to change.
				DISABLED	Default. The pump wear monitor is disabled.
				10%	Warning given if the pump performance has degraded 10%.
				15%	Warning given if the pump performance has degraded 15%.
				20%	Warning given if the pump performance has degraded 20%.
				25%	Warning given if the pump performance has degraded 25%.
X	X	X	27.03	PV AT 25% SPD	Parameter used for PWM – viewable only.
X	X	X	27.04	SPD AT 25% SPD	Parameter used for PWM – viewable only.
X	X	X	27.05	TQ AT 25% SPD	Parameter used for PWM – viewable only.
X	X	X	27.06	PV AT 40% SPD	Parameter used for PWM – viewable only.
X	X	X	27.07	SPD AT 40% SPD	Parameter used for PWM – viewable only.
X	X	X	27.08	TQ AT 40% SPD	Parameter used for PWM – viewable only.
X	X	X	27.09	PV AT 55% SPD	Parameter used for PWM – viewable only.
X	X	X	27.10	SPD AT 55% SPD	Parameter used for PWM – viewable only.
X	X	X	27.11	TQ AT 55% SPD	Parameter used for PWM – viewable only.
X	X	X	27.12	PV AT 70% SPD	Parameter used for PWM – viewable only.
X	X	X	27.13	SPD AT 70% SPD	Parameter used for PWM – viewable only.
X	X	X	27.14	TQ AT 70% SPD	Parameter used for PWM – viewable only.
X	X	X	27.15	PV AT 85% SPD	Parameter used for PWM – viewable only.
X	X	X	27.16	SPD AT 85% SPD	Parameter used for PWM – viewable only.
X	X	X	27.17	TQ AT 85% SPD	Parameter used for PWM – viewable only.
X	X	X	27.18	PV AT MAX SPD	Parameter used for PWM – viewable only.
X	X	X	27.19	SPD AT MAX SPD	Parameter used for PWM – viewable only.
X	X	X	27.20	TQ AT MAX SPD	Parameter used for PWM – viewable only.
X	X	X	27.21	SPD SET 2	Parameter used for PWM – viewable only.
X	X	X	27.22	TQ SET 2	Parameter used for PWM – viewable only.
X	X	X	27.25	HRS BTWN PWM CHK	Time between checks for hydraulic degradation due to wear. Default = 24 hrs. User adjustable parameter.
X	X	X	27.26	HRS SINCE PWM CHK	Time since last check for hydraulic degradation due to wear. This parameter updates every 12 hrs. Viewable only.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 30	OPTION MODULES	Description
X	X	X	30.01	FIELDBUS	Activates the optional external DCS and selects the interface. Refer to the ABB IOM chapter on Fieldbus control.
				NO *[default]*	No Fieldbus communication
				FIELDBUS	The drive communicates with a Fieldbus adapter module in option Slot 1 or via CH 0 Fieldbus adapter link. Note when "Fieldbus" is selected Parameter Groups 31, 90 and 92 are unlocked.
				ADVENT	The drive communicates with an ABB Advent OCS System via channel 0 on the RDCO board. Note when "Advent" is selected, parameter Groups 31, 90, and 92 are unlocked.
				STD MODBUS	The drive communicates with a Modbus controller via the Modbus Adapter Module (RMBA) in option Slot 1 of the drive. Note when "Std Modbus" is selected, parameter Groups 31, 52, 90, and 92 are unlocked.
X	X	X	30.02	AI/O EXT MODULE	Activates the communication to an optional RAIO-01 I.O analog extension module. Required for XTAI1, XTAI2 and/or analog outputs 3 and 4
				NO *[default]*	No RAIO analog extension module is active
				RAIO SLOT 1 RAIO SLOT 2	An RAIO analog extension module is connected and active in Slot 1. An RAIO analog extension module is connected and active in Slot 2.
X	X	X	30.03	COMM PROFILE	This parameter becomes visible if FIELDBUS or STD MODBUS is selected in 30.01 FIELDBUS. This defines the profile on which the communication with the fieldbus is based. Default: CSA2.8/3.0. Other choices are ABB DRIVES and GENERIC. For LonWorks, use GENERIC setting.
X	X	X	30.04**	EXT AI1 FUNC.	Default = UNIPOLAR, Other choice is BIPOLAR
X	X	X	30.05**	EXT AI2 FUNC.	Default = UNIPOLAR, Other choice is BIPOLAR

Speed Control	Single Pump	Multi-pump	Group 31	FIELDBUS SETUP	Description
X	X	X	31.01	MODULE TYPE	This parameter configures the module type automatically by the fieldbus adapter. No action is required unless changes to default settings are desired. Refer to the fieldbus manual. This parameter becomes visible when "FIELDBUS" is selected in parameter 30.01 FIELDBUS.

Speed Control	Single Pump	Multi-pump	Group 50	MOTOR CONTROL	**Speed Controller & Other Motor Variables** *These functions are not used when in Scalar Mode*
X	X	X	50.01**	GAIN	Defines a relative gain for the speed controller. Great gain may cause speed oscillation.
X	X	X	50.02**	INTEGRATION TIME	Defines an integration time for the speed controller.
X	X	X	50.03**	DERIVATION TIME	Defines a derivation time for the speed controller.
X	X	X	50.04**	ACC COMPENSATION	Defines a derivation time for acceleration compensation.
X	X	X	50.05**	SLIP GAIN	Defines the slip gain for the motor slip compensation control.
X	X	X	50.06**	AUTOTUNE RUN	Start automatic tuning of the speed controller. Default = NO.
X	X	X	50.07**	FLUX OPTIMIZATION	Activates/Deactivates the flux optimization function. Default = NO.
X	X	X	50.08**	FLUX BREAKING	Activates/Deactivates the flux breaking function. Default = YES.
X	X	X	50.09**	MOTOR SP FILT TIME	Defines a filter time constant for the actual signal speed.
X	X	X	50.10**	TORQUE ACT FILT TIM	Defines a filter time constant for the actual signal torque.
X	X	X	50.11**	RESET RUN TIME	Resets the motor running time counter. Default = NO.
X	X	X	50.12**	START FUNCTION	Selects the motor starting method. Default = DC MAGN. Other choices: CONSTANT DC MAGN, AUTO.
X	X	X	50.13**	CONST MAGN TIME	Defines the magnetizing time in the constant magnetizing mode
X	X	X	51.03**	IR-COMPENSATION	Defines the relative output voltage boost at zero speed (IR Compensation). Useful in applications with high breakaway torque. Used in Scalar Control only.
X	X	X	51.05**	HEX FIELD WEAKEN	NO (default), YES

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 52	STD MODBUS	Settings for standard Modbus (RMBA) Link. See chapter on fieldbus control in ABB manual. *Group 52 is unlocked when Std Modbus is selected in parameter 30.01*
X	X	X	52.01	STATION NUMBER	Defines the address of the device. Two units with the same address are not allowed on-line. 1 – 247 Default =1
X	X	X	52.02	BAUD RATE	Defines the transfer rate of the link. 600 (default), 1200, 2400, 4800, 9600 and 19200 bit/sec
X	X	X	52.03	PARITY	Defines the use of parity and stop bit(s). The same setting must be used on all on-line stations.
				ODD	Odd parity indication, one stopbit (Default)
				EVEN	Even parity indication, one stopbit
				NONE1STOPBIT	No parity bit, one stop bit
				NONE2STOPBIT	No parity bit, two stop bits

Speed Control	Single Pump	Multi-pump	Group 70	DDCS CONTROL	Description *Settings for fiber optic channels 0, 1, and 3*
X	X	X	70.01**	CHANNEL 0 ADDR	Defines the node address for channel 0.No two nodes on-line may have the same address.
X	X	X	70.02**	CHANNEL 3 ADDR	Defines the node address for channel 3.No two nodes on-line may have the same address.
X	X	X	70.03**	CHANNEL 1 BAUD RATE	Default: 2 mbits/sec
X	X	X	70.04**	DDCS CH 0 HW CONN	Default: RING

Speed Control	Single Pump	Multi-pump	Group 90	D SET REC ADDR	Description *Addresses of the parameters into which the received Fieldbus data are written. Refer to the Fieldbus Control section of the ABB manual and specific Fieldbus adapter manual for details on Fieldbus addressing.*
X	X	X	90.01	MAIN DS REF2	Selects the address into which the value of Fieldbus reference Ref 2 is written.
X	X	X	90.02	AUX DS REF3	Selects the address into which the value of Fieldbus reference Ref 3 is written.
X	X	X	90.03	AUX DS REF4	Selects the address into which the value of Fieldbus reference Ref 4 is written.
X	X	X	90.04	AUX DS REF5	Selects the address into which the value of Fieldbus reference Ref 5 is written.
X	X	X	90.05	MAIN DS SOURCE	Defines the data set from which the PS200 reads the control word, reference Ref 1 and reference Ref 2.
X	X	X	90.06	AUX DS SOURCE	Defines the data set from which the PS200 reads, references Ref 3, Ref 4 and Ref 5.

Speed Control	Single Pump	Multi-pump	Group 92	D SET TR ADDR	Description *Main and auxiliary data sets which the PS200 sends to the Fieldbus master station. Refer to the Fieldbus Control section of the ABB manual and specific Fieldbus adapter manual for details on Fieldbus addressing.*
X	X	X	92.01	MAIN DS STATUS WORD	Stores the address from which the Main Status Word is read from. This is a fixed value and is not visible or accessible to the user.
X	X	X	92.02	MAIN DS ACT1	Selects the address from which the Actual Signal 1 is read to the main data set.
X	X	X	92.03	MAIN DS ACT2	Selects the address from which the Actual Signal 2 is read to the main data set.
X	X	X	92.04	AUX DS ACT3	Selects the address from which the Actual Signal 3 is read to the auxiliary data set.
X	X	X	92.05	AUX DS ACT4	Selects the address from which the Actual Signal 4 is read to the auxiliary data set.
X	X	X	92.06	AUX DS ACT5	Selects the address from which the Actual Signal 5 is read to the auxiliary data set.

APPENDIX A-3 PARAMETER LISTING

Speed Control	Single Pump	Multi-pump	Group 97	MODEL TUNING	Description
X	X	X	97.01**	ZER _COEF1	
X	X	X	97.02**	ZER_GAIN	
X	X	X	97.03**	MOT_COEF	
X	X	X	97.04**	GEN_COEF	
X	X	X	97.05**	MG_COEF	
X	X	X	97.06**	CABLE LENGTH	10 m
X	X	X	97.07**	ZERO SPEED LIMIT	120 rpm
X	X	X	97.08**	SP ACT FILT TIME	8 ms
X	X	X	97.09**	PPCC FAULT MASK	No
X	X	X	97.10**	LONG DIST MOD	Off
X	X	X	97.11**	FREE DIRECT MAGN	Off
X	X	X	97.13**	AMB TEMP FUNC	Yes
X	X	X	97.14**	FREQ TRIP MARGIN	50 Hz

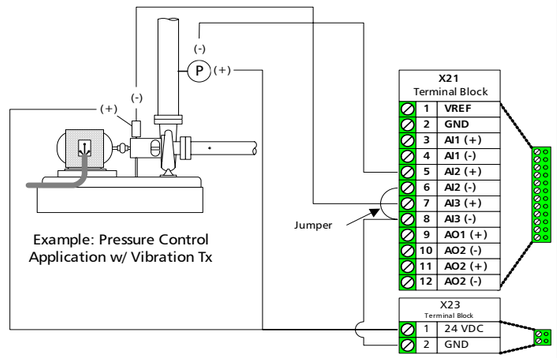
Speed Control	Single Pump	Multi-pump	Group 99	INFORMATION	Description
X	X	X	99.01	SOFTWARE VERSION 4.0	Version of the software loaded to the PS200
X	X	X	99.02	SOFTWARE DATE: DAY-MONTH-YEAR	Software Release Date (e.g.: 022803)

APPENDIX A-3 PARAMETER LISTING

APPENDIX A-4 BASIC INSTRUMENT WIRING

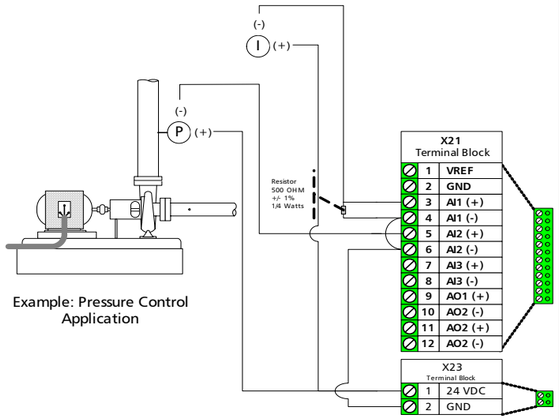
Multiple Transmitters/Jumpers

JUMPERS
When PumpSmart is powering a process transmitter, The power supply ground must be connected to the negative terminal (-) of each transmitter. Rather than run separate wires from the ground connection [X23-2], use smaller "jumpers".
Jumper size: 16-20 Guage



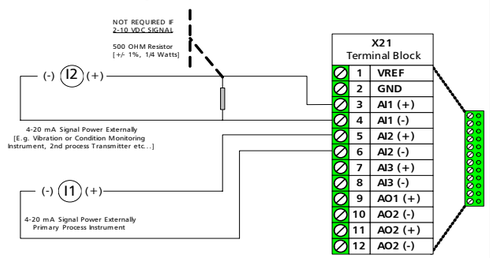
Example: Pressure Control Application w/ Vibration Tx

OPTION - 2nd 4-20 mA Process Transmitter OR external signal for Variable Setpoint Control Connected at AI1

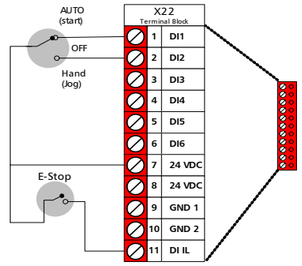


Example: Pressure Control Application

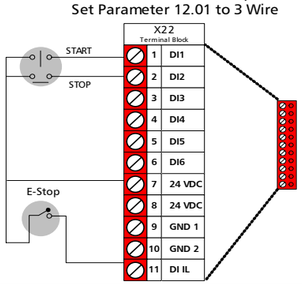
Externally Powered Instruments



OPTION: 2-Wire Start/Stop or Hand - off - Auto (HOA)
Set Parameter 12.01 to 2wire/HOA



OPTION: 3-Wire Start/Stop
Set Parameter 12.01 to 3 Wire

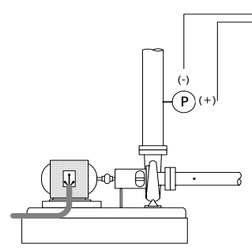


PS200 - Basic Wiring

Instruments Powered By PumpSmart

!! NOTE !!
All instrumentation shielding must be terminated at grounding lugs provided by the PS200. Do not terminate Shielding at sensor end.

Expose the shield of the control wire cable and slide a conductive clamp onto the cable. Connect clamp to the grounding lugs



Example: Pressure Control Application

Example
2 Wire START/STOP

!! NOTE !!
DIIL Must be closed for the drive to operate. If your application does not require an E-Stop/Drive Permissive, DIIL may be bypassed by jumping DIIL to X22 connections #7 or #8

X21 Terminal Block

1	VREF	OPTION	**AI REFERENCE VOLTAGE** Used for AI1 2-10VDC Signals 10 mA Maximum
2	GND		
3	AI1 (+)	OPTION	**2-10 VDC ANALOG INPUT (1)** 4-20mA transmitters may be used with 500 ohm resistor. *OPTION - Input assigned in parameter 17.20*
4	AI1 (-)		
5	AI2 (+)		**4-20 mA ANALOG INPUT (2)** **Proc Trans 1-Primary Control Instrument** *OPTION - Input assigned in parameter 17.21*
6	AI2 (-)		
7	AI3 (+)	OPTION	**4-20 mA ANALOG INPUT (3)** *OPTION - Input assigned in parameter 17.22*
8	AI3 (-)		
9	AO1 (+)	OPTION	**4-20 mA ANALOG OUTPUT (1)** *OPTION -Output assigned in parameter 20.01*
10	AO1 (-)		
11	AO2 (+)	OPTION	**4-20 mA ANALOG OUTPUT (2)** *OPTION -Output assigned in parameter 20.06*
12	AO2 (-)		

X22 Terminal Block

1	DI1	OPTION	**2 & 3 -WIRE START/STOP**	
2	DI2	OPTION	**3-WIRE START/STOP**	
3	DI3	OPTION	**DUAL SETPOINT**	0-Open, Setpoint 1 [REF 1] 1-Closed, Setpoint 2 [REF 2]
4	DI4	OPTION	**SECONDARY PUMP PROTECT A**	0 - Secondary Protect (Open) 1 - Normal (Closed)
5	DI5	OPTION	**SECONDARY PUMP PROTECT B**	0 - Secondary Protect (Open) 1 - Normal (Closed)
6	DI6	OPTION	**FAULT RESET**	
7	24 VDC		**DI Reference Voltage** 100 mA Max	
8	24 VDC			
9	GND 1		**DI GROUND**	
10	GND 2		**DI GROUND**	
11	DI IL	OPTION	**E STOP/DRIVE PERMISSIVE**	

X23 Terminal Block

1	24 VDC		***PROCESS TRANSMITTER POWER*** *24VDC 250 mA Maximum*
2	GND		

X25 Terminal Block

1	RO1 NC	OPTION	**ASSIGNABLE RELAY [RO1]** The output of this relay is assignable from parameter 19.01 *Default : Ready*
2	RO1 COM		
3	RO1 NO		

X26 Terminal Block

1	RO2 NC	OPTION	**ASSIGNABLE RELAY [RO2]** The output of this relay is assignable from parameter 19.04 *Default : Running*
2	RO2 COM		
3	RO2 NO		

X27 Terminal Block

1	RO3 NC	OPTION	**ASSIGNABLE RELAY [RO3]** The output of this relay is assignable from parameter 19.07 *Default : Not Used*
2	RO3 COM		
3	RO3 NO		

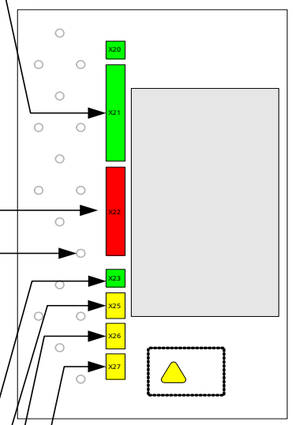
SHIELD
Grounding Clamp
Shielded control wire

17.20 AI1 CONFIG
PROC TRANS 2 - Secondary process transmitter
EXT SETPOINT - External setpoint input
VIBRATION 2 - Vibration transmitter 2
CONDITION 2 - General condition transmitter 2
SPD CTRL REF - Speed signal reference
PWM SIGNAL - Pump Wear Monitor input
NOT USED

17.21 AI2 CONFIG
PROC TRANS 1 - Primary process transmitter
SPD CTRL REF - Speed signal reference
NOT USED

17.22 AI3 CONFIG
VIBRATION 1 - Vibration transmitter 1
CONDITION 1 - General condition transmitter 1
EXT SETPOINT - External Setpoint input
PWM SIGNAL - Pump Wear Monitor input
PROC TRANS 2 - Secondary process transmitter
NOT USED

20.01 AO1 CONFIG
20.06 AO2 CONFIG
NOT USED
SPEED - Motor Speed (RPM)
FREQUENCY - Motor frequency (Hz)
CURRENT - Current (A)
TORQUE - Torque (%)
POWER - Power (%)
VIBR LVL 1 - Vibration level 1 (IPS)
VIBR LVL 2 - Vibration level 2 (IPS)
PROC VAR - Process variable
ENERGY SAVING - Energy Savings ($)
COND LVL 1 - General condition signal 1
COND LVL 2 - General condition signal 2



View of I/O Connection Board (RMIO) (Simplified Representation)

19.01 RELAY R01 OUTPUT
19.04 RELAY R02 OUTPUT
19.07 RELAY R03 OUTPUT

READY
RUNNING
VFD FAULT
PUMP FAULT
ALL FAULTS
LOW PUMP PERF
SECONDARY PROTECT A/B
HIGH VIBRATION 1 & 2
PUMP PROTECT
START SLAVE
HIGH CONDITION 1 & 2
PROC TX ERR
NOT USED

PUMPSMART CONTROL SOLUTIONS

PS200 Basic Wiring ACS 800 V4.0			
B05026A	SHEET 1 OF 1	REV 0	Issue -
Drawing is not to scale Dimensions in inches [mm]	Drawn: AI 060204		
	Checked: Tony Stavale		

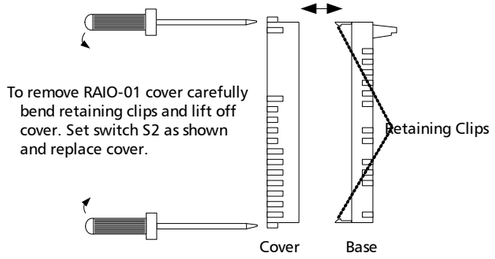
APPENDIX A-5 QUICK REFERENCE INSTALLATION DRAWINGS

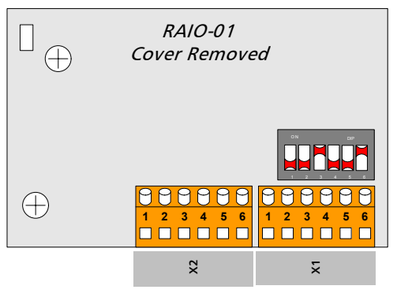
PS200 RAIO-01 Analog I/O Module Extension Module

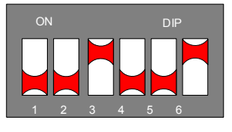
Used for additional vibration transmittersand/ general condition monitoring transmitters

Mounting of RAIO-01 Module

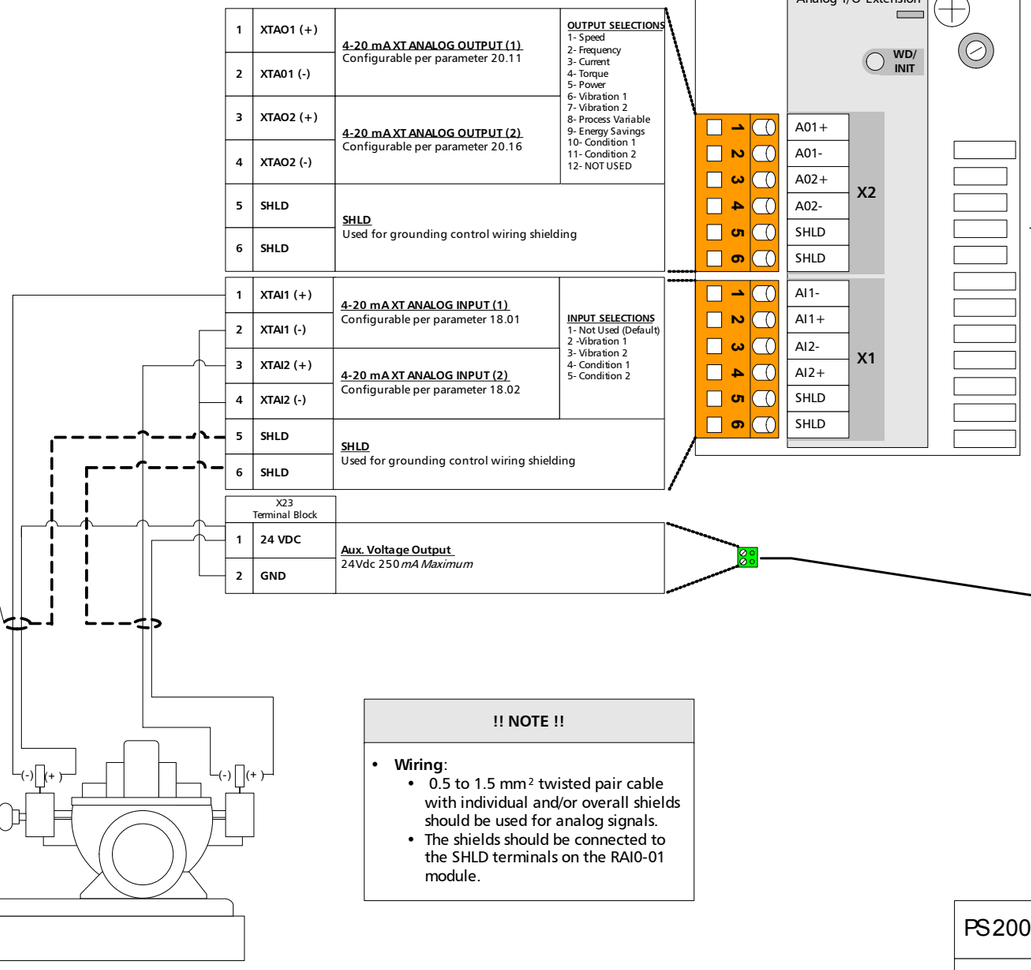
- Set configuration switch S2 (see below) before mounting module in slot.
- Install RAIO-01 into an available slot (slot 1 or slot 2) until the retaining clips lock the module in place. Fasten the two screws to the standoffs (refer to RAIO-01 User Manual). Set parameter 30.02 AI/O Ext module to installed slot number.







Configuration Switch S2



Example: Double Suction Pump With 2 Vibration Transmitters

!! NOTE !!

- **Wiring**:
  - 0.5 to 1.5 mm² twisted pair cable with individual and/or overall shields should be used for analog signals.
  - The shields should be connected to the SHLD terminals on the RAI0-01 module.

View of Drive Interior
(Simplified Representation)

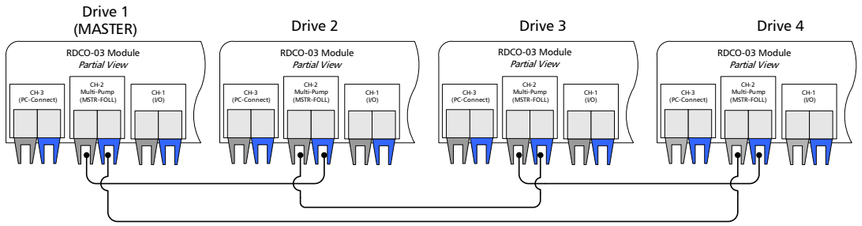
PS200 Analog I/O Extension Module V4.0			
B05028A	SHEET 1 OF 1	REV 0	Issue -
Drawing is not to scale Dimensions in inches [mm]	Drawn: AI 060204		
	Checked: Tony Stavale		

APPENDIX A-5 QUICK REFERENCE INSTALLATION DRAWINGS

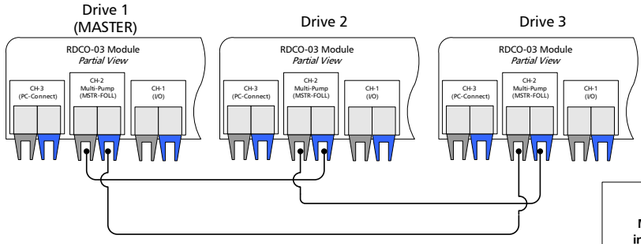
PS200 - ACS800 Multi-Pump Connections

Fiber-Optic Connections between PS200 Controllers
SYNCHRONOUS MULTI-CONTROLLER AND BACKUP MODES ONLY

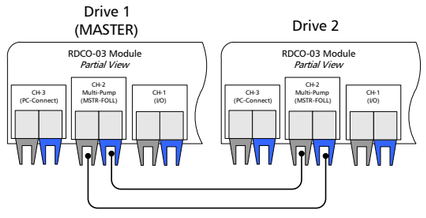
4-Drive Arrangement



3-Drive Arrangement



2-Drive Arrangement



The RDCO-03 DDCS COMMUNICATION MODULE is to be mounted in the DDCS slot and affixed with (2) screws provided

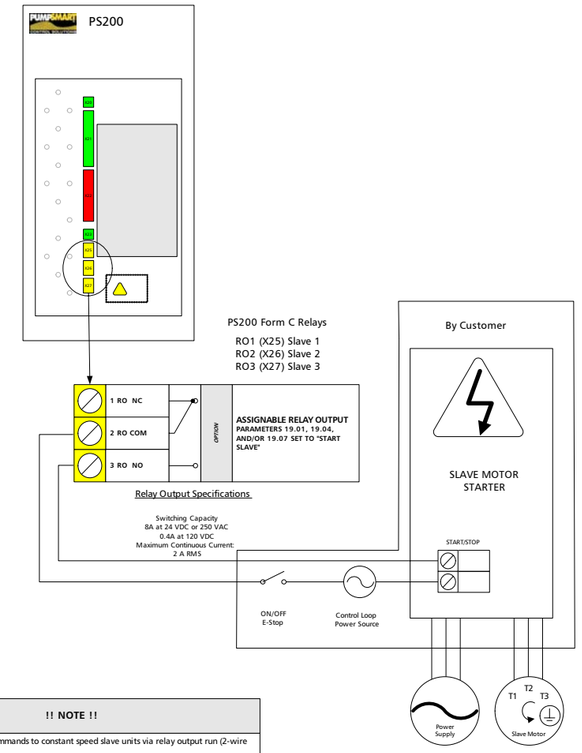
Fiber Optic Cables
-Light colored connector to light colored receptical.
-Dark colored connector to dark colored receptical
-MINIMUM BEND RADIUS: 2 Inches

Extra cable may be looped and stored within the drive. Maintain minimum bend radius.
Fiber optic cable ends are not the same color.

Fiber Optic Cable Kit Part Numbers

2 Pumps - 800MP2
3 Pumps - 800MP3
4 Pumps - 800MP4

Constant Speed Slave Pump Wiring
ONE PUMPSMART UNIT WITH UP TO THREE CONSTANT SPEED PUMPS/STARTERS



!! NOTE !!

- PumpSmart issues run commands to constant speed slave units via relay output run (2-wire start/stop).
- Control loop must be powered (e.g. 24 VDC or 120 VAC.
- The default starting order for multiple constant speed slave units is:
  - RO1 - Starts/stops first constant speed slave pump. Destages pump using the 22.07 SYNC LIMIT.
  - RO2 - Starts/stops the second constant speed slave pump. Destages this pump using 22.07 SYNC LIMIT and 22.08 SYNC WINDOW
  - RO3 - Starts/stops the third constant speed slave pump. Destages this pump using 22.07 SYNC LIMIT and 2x 22.08 SYNC WINDOW

PS200 ACS800 Multipump Connections V4.0			
B05027A	SHEET 1 OF 1	REV 0	Issue -
Drawing is not to scale Dimensions in inches [mm]	Drawn: AI 060204		
	Checked: Tony Stavale		

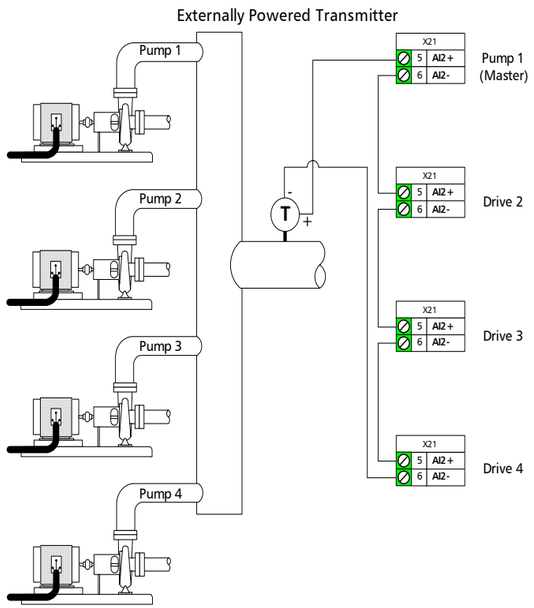
APPENDIX A-5 QUICK REFERENCE INSTALLATION DRAWINGS

PS200 - Multipump Wiring Transmitter Wiring- ACS 800

Synchronous - Multi-Controller - Backup

TX ONE AI

One transmitter shared between all drives



NOTES

In this configuration, a single process transmitter signal is wired in series with all the PumpSmart drives.

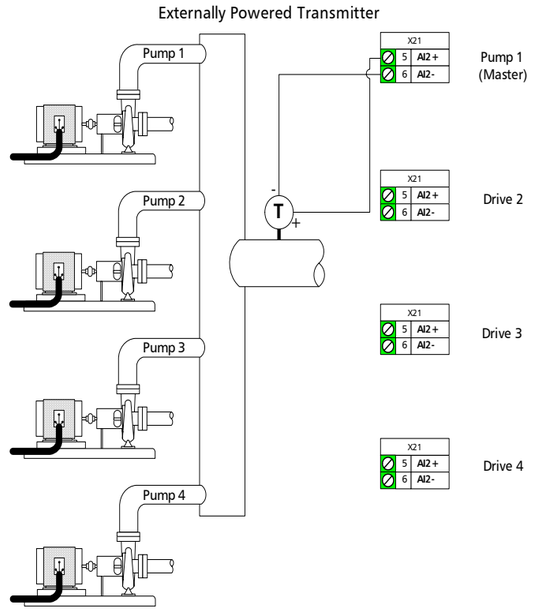
- Parameter 22.13 must be set to TX ONE AI
- Communication connections must be made between drives.

Consideration(s)

- If one PumpSmart drive loses power, the signal will still be transmitted through to the other drives.
- If the transmitter is loop powered by PumpSmart, the signal will cease if the power to the PumpSmart unit is turned off.

TX ONE MASTER

One transmitter signal shared via Fiber Optic cables



NOTES

In this configuration, a single process transmitter signal is shared with the other PumpSmart drives using the communication connections.

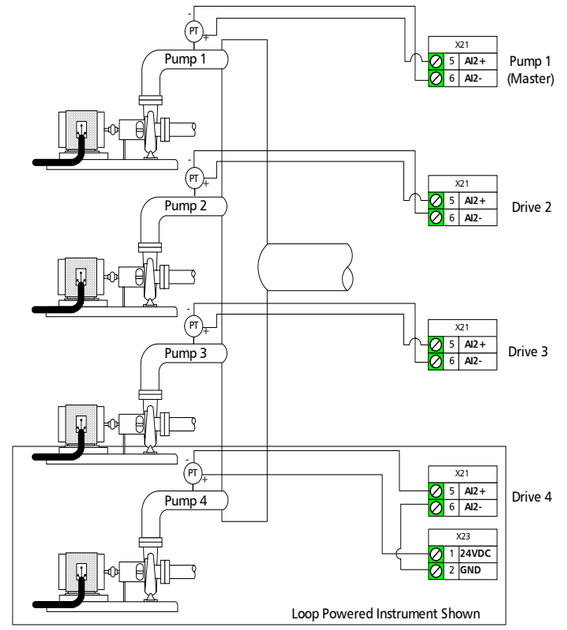
- Parameter 22.13 must be set to TX ONE MASTER
- Communication connections must be made between drives.

Consideration(s)

- If one PumpSmart drive loses power, the signal will Not be transmitted through to the other drives.
- If the transmitter is loop powered by PumpSmart, the signal will cease if the power to the PumpSmart unit is turned off.

TX ALL DRIVES

Transmitter on each drive/pump



NOTES

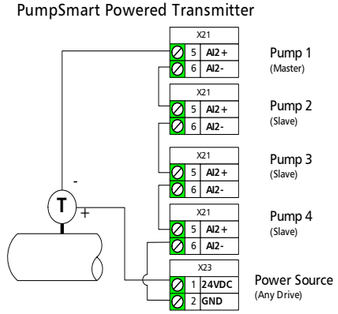
In this configuration, each PumpSmart drive is wired with a process transmitter (pressure only)

- Parameter 22.13 must be set to TX ALL DRIVES
- Communication connections must be made between drives.

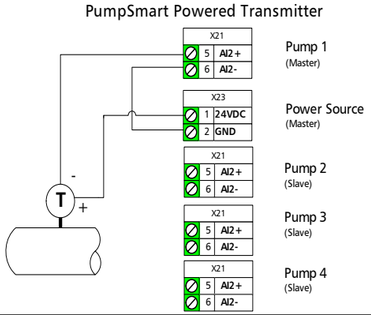
Consideration(s)

- If one drive is powered off, each other drive will continue to receive the process signal

PumpSmart Powered Transmitter



PumpSmart Powered Transmitter



PS200 ACS800 Multipump Transmitter Wiring V4.0			
B05029A	SHEET 1 OF 1	REV 0	Issue -
Drawing is not to scale Dimensions in inches [mm]	Drawn: AI 060204		
	Checked: Tony Stavale		

PS200 - Basic Wiring

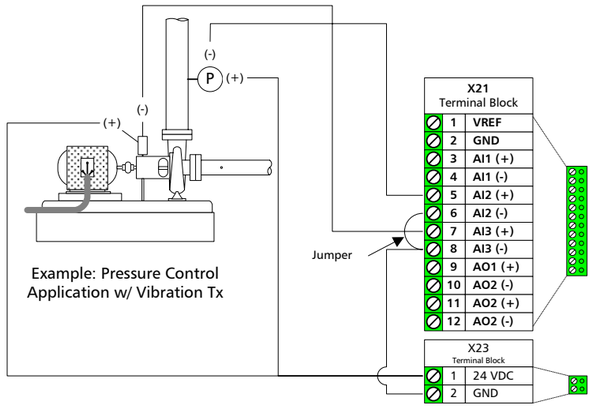
Instruments Powered By PumpSmart

Multiple Transmitters/Jumpers

JUMPERS

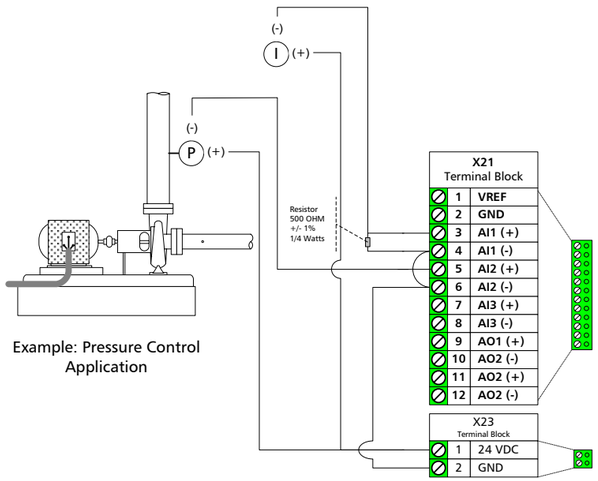
When PumpSmart is powering a process transmitter, The power supply ground must be connected to the negative terminal (-) of each transmitter. Rather than run separate wires from the ground connection [X23-2], use smaller "jumpers".

Jumper size: 16-20 Guage



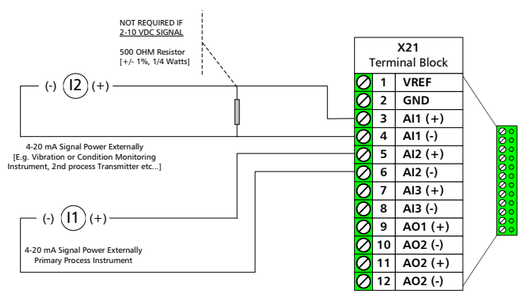
Example: Pressure Control Application w/ Vibration Tx

OPTION - 2nd 4-20 mA Process Transmitter OR external signal for Variable Setpoint Control Connected at AI1



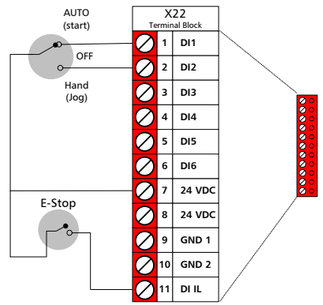
Example: Pressure Control Application

Externally Powered Instruments



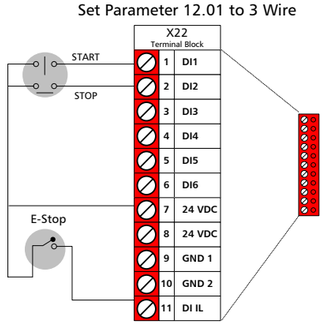
OPTION: 2-Wire Start/Stop or Hand - off - Auto (HOA)

Set Parameter 12.01 to 2wire/HOA



OPTION: 3-Wire Start/Stop

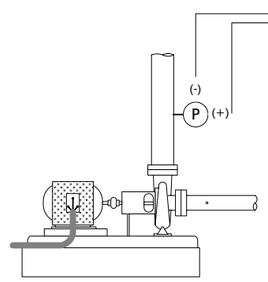
Set Parameter 12.01 to 3 Wire



!! NOTE !!

All instrumentation shielding must be terminated at grounding lugs provided by the PS200. Do not terminate Shielding at sensor end.

Expose the shield of the control wire cable and slide a conductive clamp onto the cable. Connect clamp to the grounding lugs



Example: Pressure Control Application

Example
2 Wire START/STOP

E-Stop

!! NOTE !!

DIIL Must be closed for the drive to operate. If your application does not require an E-Stop/Drive Permissive, DIIL may be bypassed by jumping DIIL to X22 connections #7 or #8

X21 Terminal Block

1	VREF	OPTION	**AI REFERENCE VOLTAGE** Used for AI1 2-10VDC Signals 10 mA Maximum
2	GND		
3	AI1 (+)	OPTION	**2-10 VDC ANALOG INPUT (1)** 4-20mA transmitters may be used with 500 ohm resistor. *OPTION - Input assigned in parameter 17.20*
4	AI1 (-)		
5	AI2 (+)		**4-20 mA ANALOG INPUT (2)** **Proc Trans 1-Primary Control Instrument** *OPTION - Input assigned in parameter 17.21*
6	AI2 (-)		
7	AI3 (+)	OPTION	**4-20 mA ANALOG INPUT (3)** *OPTION - Input assigned in parameter 17.22*
8	AI3 (-)		
9	AO1 (+)	OPTION	**4-20 mA ANALOG OUTPUT (1)** *OPTION -Output assigned in parameter 20.01*
10	AO1 (-)		
11	AO2 (+)	OPTION	**4-20 mA ANALOG OUTPUT (2)** *OPTION -Output assigned in parameter 20.06*
12	AO2 (-)		

X22 Terminal Block

1	DI1	OPTION	**2 & 3 -WIRE START/STOP**	
2	DI2	OPTION	**3-WIRE START/STOP**	
3	DI3	OPTION	**DUAL SETPOINT**	0-Open, Setpoint 1 [REF 1] 1-Closed, Setpoint 2 [REF 2]
4	DI4	OPTION	**SECONDARY PUMP PROTECT A**	0 - Secondary Protect (Open) 1 - Normal (Closed)
5	DI5	OPTION	**SECONDARY PUMP PROTECT B**	0 - Secondary Protect (Open) 1 - Normal (Closed)
6	DI6	OPTION	**FAULT RESET**	
7	24 VDC		**DI Reference Voltage** 100 mA Max	
8	24 VDC			
9	GND 1		**DI GROUND**	
10	GND 2		**DI GROUND**	
11	DI IL	OPTION	**E STOP/DRIVE PERMISSIVE**	

X23 Terminal Block

1	24 VDC		***PROCESS TRANSMITTER POWER*** *24VDC 250 mA Maximum*
2	GND		

X25 Terminal Block

1	RO1 NC	OPTION	**ASSIGNABLE RELAY [RO1]** The output of this relay is assignable from parameter 19.01 *Default : Ready*
2	RO1 COM		
3	RO1 NO		

X26 Terminal Block

1	RO2 NC	OPTION	**ASSIGNABLE RELAY [RO2]** The output of this relay is assignable from parameter 19.04 *Default : Running*
2	RO2 COM		
3	RO2 NO		

X27 Terminal Block

1	RO3 NC	OPTION	**ASSIGNABLE RELAY [RO3]** The output of this relay is assignable from parameter 19.07 *Default : Not Used*
2	RO3 COM		
3	RO3 NO		

SHIELD

Grounding Clamp

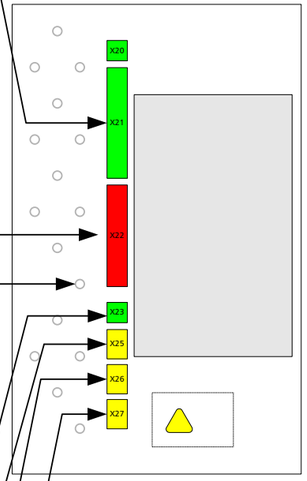
Shielded control wire

17.20 AI1 CONFIG
PROC TRANS 2 - Secondary process transmitter
EXT SETPOINT - External setpoint input
VIBRATION 2 - Vibration transmitter 2
CONDITION 2 - General condition transmitter 2
SPD CTRL REF - Speed signal reference
PWM SIGNAL - Pump Wear Monitor input
NOT USED

17.21 AI2 CONFIG
PROC TRANS 1 - Primary process transmitter
SPD CTRL REF - Speed signal reference
NOT USED

17.22 AI3 CONFIG
VIBRATION 1 - Vibration transmitter 1
CONDITION 1 - General condition transmitter 1
EXT SETPOINT - External Setpoint input
PWM SIGNAL - Pump Wear Monitor input
PROC TRANS 2 - Secondary process transmitter
NOT USED

20.01 AO1 CONFIG
20.06 AO2 CONFIG
NOT USED
SPEED - Motor Speed (RPM)
FREQUENCY - Motor frequency (Hz)
CURRENT - Current (A)
TORQUE - Torque (%)
POWER - Power (%)
VIBR LVL 1 - Vibration level 1 (IPS)
VIBR LVL 2 - Vibration level 2 (IPS)
PROC VAR - Process variable
ENERGY SAVING - Energy Savings ($)
COND LVL 1 - General condition signal 1
COND LVL 2 - General condition signal 2



View of I/O Connection Board (RMIO) (Simplified Representation)

19.01 RELAY R01 OUTPUT
19.04 RELAY R02 OUTPUT
19.07 RELAY R03 OUTPUT

READY
RUNNING
VFD FAULT
PUMP FAULT
ALL FAULTS
LOW PUMP PERF
SECONDARY PROTECT A/B
HIGH VIBRATION 1 & 2
PUMP PROTECT
START SLAVE
HIGH CONDITION 1 & 2
PROC TX ERR
NOT USED

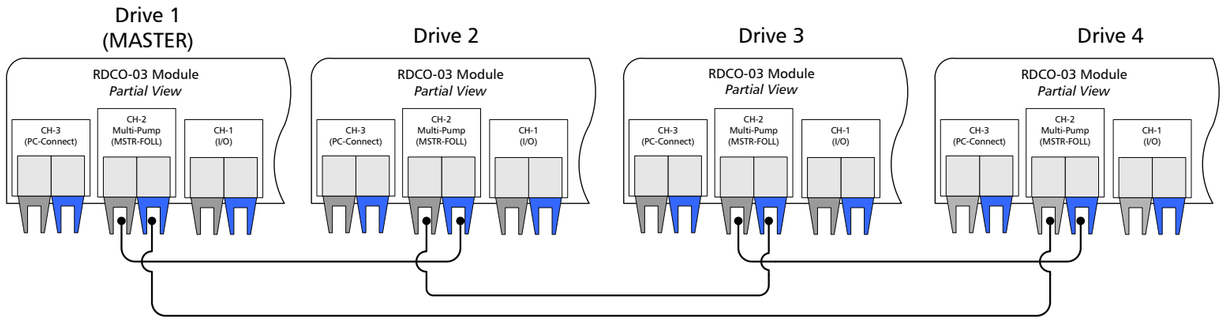
PS200 Basic Wiring ACS 800 V4.0			
B05026A	SHEET 1 OF 1	REV 0	Issue -
Drawing is not to scale Dimensions in inches [mm]	Drawn: AI 060204		
	Checked: Tony Stavale		

PS200 - ACS800 Multi-Pump Connections

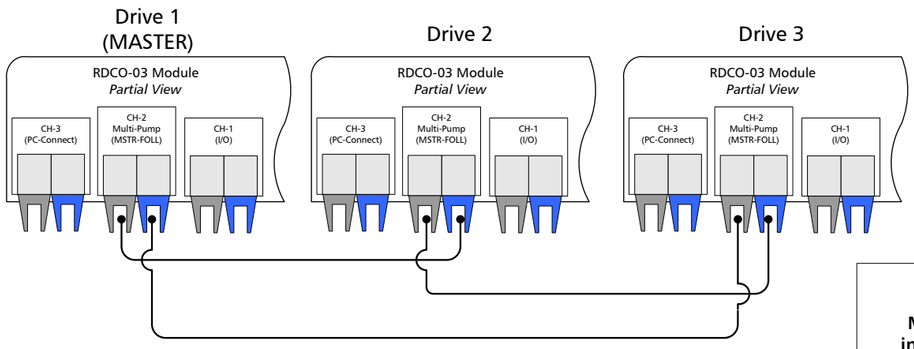
Fiber-Optic Connections between PS200 Controllers

SYNCHRONOUS MULTI-CONTROLLER AND BACKUP MODES ONLY

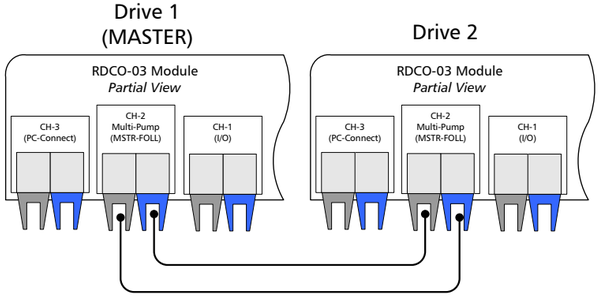
4-Drive Arrangement



3-Drive Arrangement



2-Drive Arrangement



The RDCO-03 DDCS COMMUNICATION MODULE is to be mounted in the DDCS slot and affixed with (2) screws provided

Fiber Optic Cables

-Light colored connector to light colored receptical.
-Dark colored connector to dark colored receptical
-MINIMUM BEND RADIUS: 2 Inches

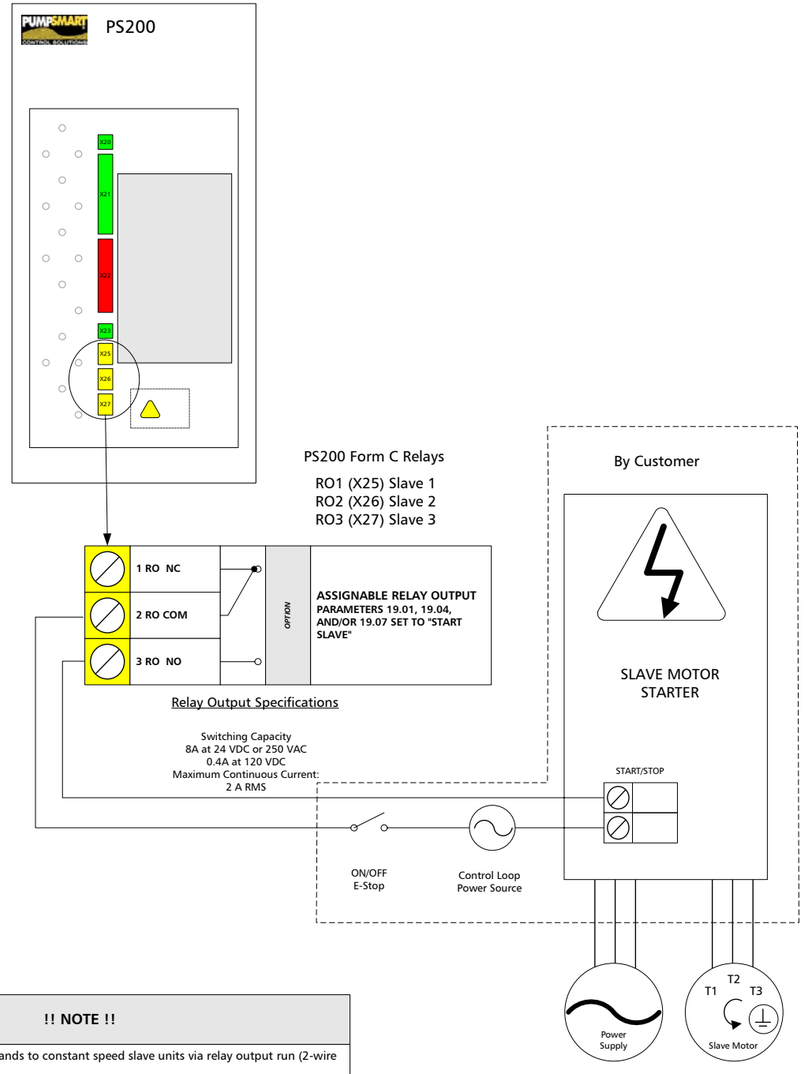
Extra cable may be looped and stored within the drive. Maintain minimum bend radius.
Fiber optic cable ends are not the same color.

Fiber Optic Cable Kit Part Numbers

2 Pumps - 800MP2
3 Pumps - 800MP3
4 Pumps - 800MP4

Constant Speed Slave Pump Wiring

ONE PUMPSMART UNIT WITH UP TO THREE CONSTANT SPEED PUMPS/STARTERS



!! NOTE !!

PumpSmart issues run commands to constant speed slave units via relay output run (2-wire start/stop).
Control loop must be powered (e.g. 24 VDC or 120 VAC.
The default starting order for multiple constant speed slave units is:
RO1 - Starts/stops first constant speed slave pump. Destages pump using the 22.07 SYNC LIMIT.
RO2 - Starts/stops the second constant speed slave pump. Destages this pump using 22.07 SYNC LIMIT and 22.08 SYNC WINDOW
RO3 - Starts/stops the third constant speed slave pump. Destages this pump using 22.07 SYNC LIMIT and 2x 22.08 SYNC WINDOW

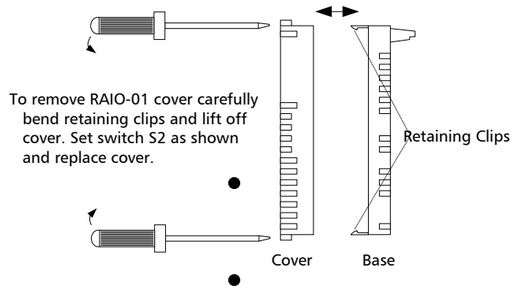
PS 200 ACS 800 Multipump Connections V4.0			
B05027A	SHEET 1 OF 1	REV 0	Issue -
Drawing is not to scale Dimensions in inches [mm]	Drawn: AI 060204		
	Checked: Tony Stavale		

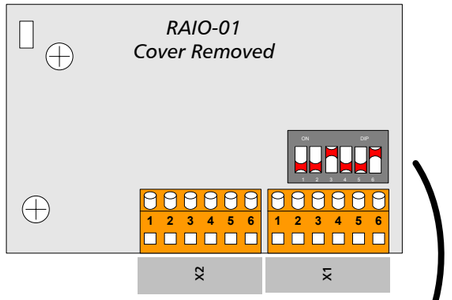
PS200 RAIO-01 Analog I/O Module Extension Module

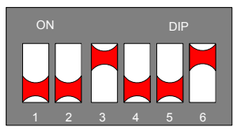
Used for additional vibration transmitters and/ general condition monitoring transmitters

Mounting of RAIO-01 Module

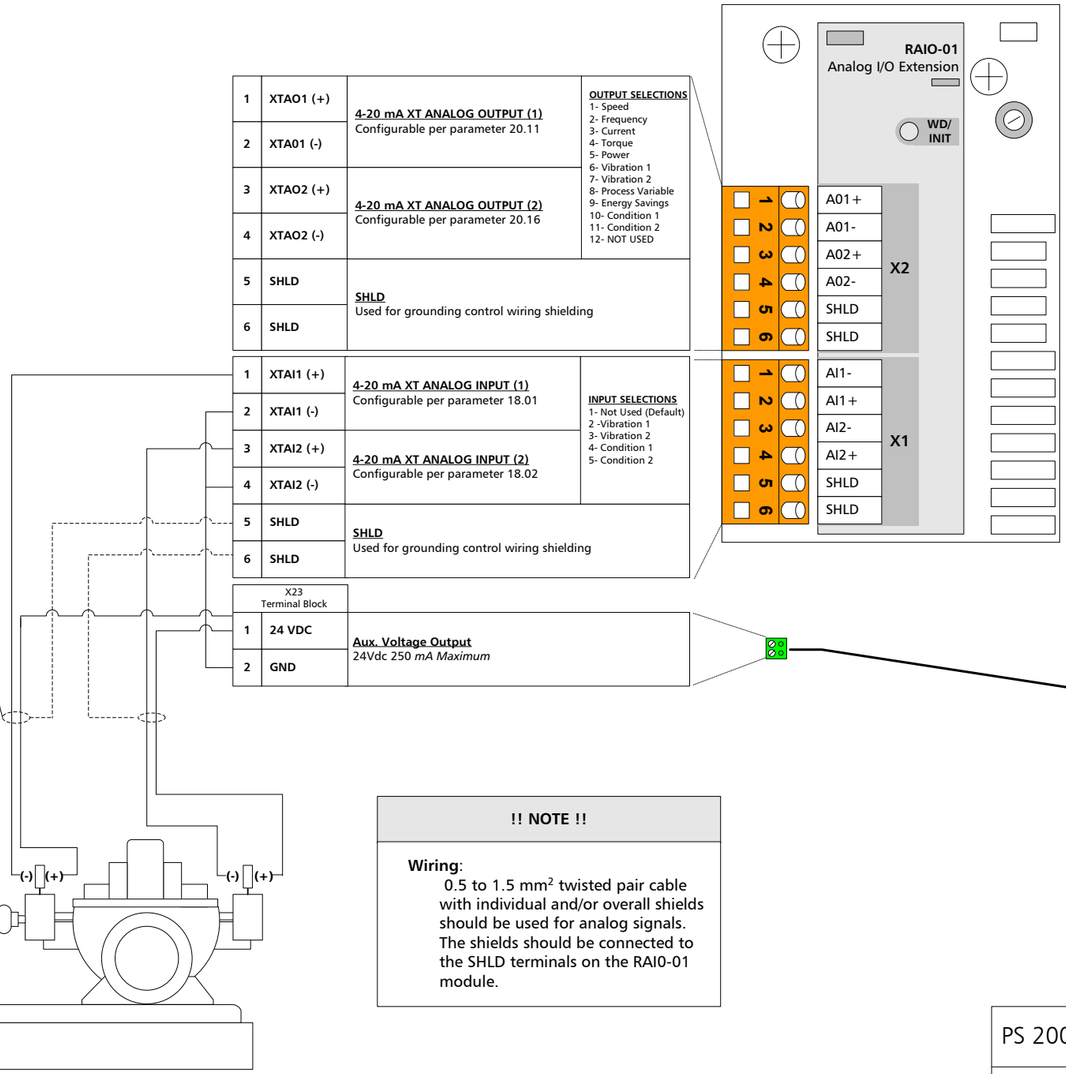
Set configuration switch S2 (see below) before mounting module in slot.
Install RAIO-01 into an available slot (slot 1 or slot 2) until the retaining clips lock the module in place. Fasten the two screws to the standoffs (refer to RAIO-01 User Manual). Set parameter 30.02 AI/O Ext module to installed slot number.







Configuration Switch S2



Example: Double Suction Pump With 2 Vibration Transmitters

View of Drive Interior
(Simplified Representation)

!! NOTE !!

Wiring:
0.5 to 1.5 mm² twisted pair cable with individual and/or overall shields should be used for analog signals. The shields should be connected to the SHLD terminals on the RAI0-01 module.

PS 200 Analog I/O Extension Module V4.0			
B05028A	SHEET 1 OF 1	REV 0	Issue -
Drawing is not to scale Dimensions in inches [mm]	Drawn: AI 060204		
	Checked: Tony Stavale		

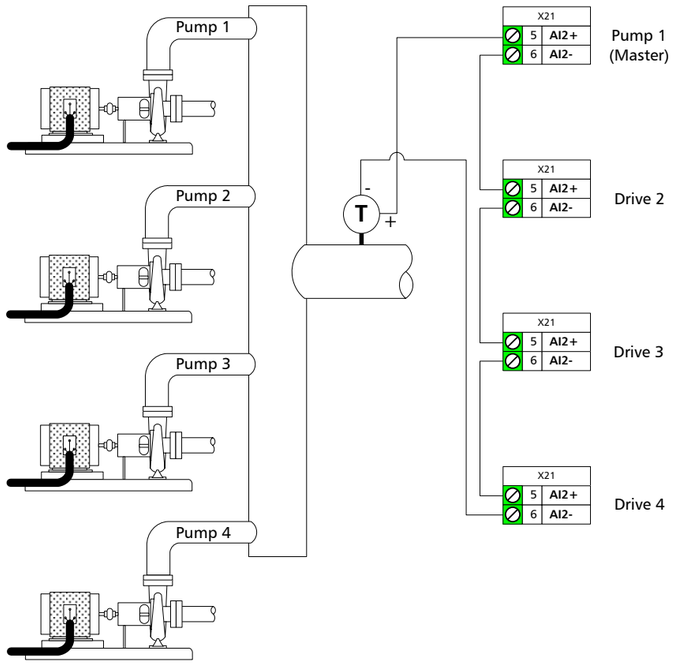
PS200 - Multipump Wiring Transmitter Wiring- ACS 800

Synchronous - Multi-Controller - Backup

TX ONE AI

One transmitter shared between all drives

Externally Powered Transmitter



NOTES

In this configuration, a single process transmitter signal is wired in series with all the PumpSmart drives.

Parameter 22.13 must be set to TX ONE AI

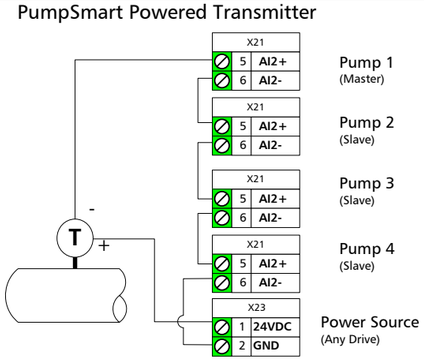
Communication connections must be made between drives.

Consideration(s)

If one PumpSmart drive loses power, the signal will still be transmitted through to the other drives.

If the transmitter is loop powered by PumpSmart, the signal will cease if the power to the PumpSmart unit is turned off.

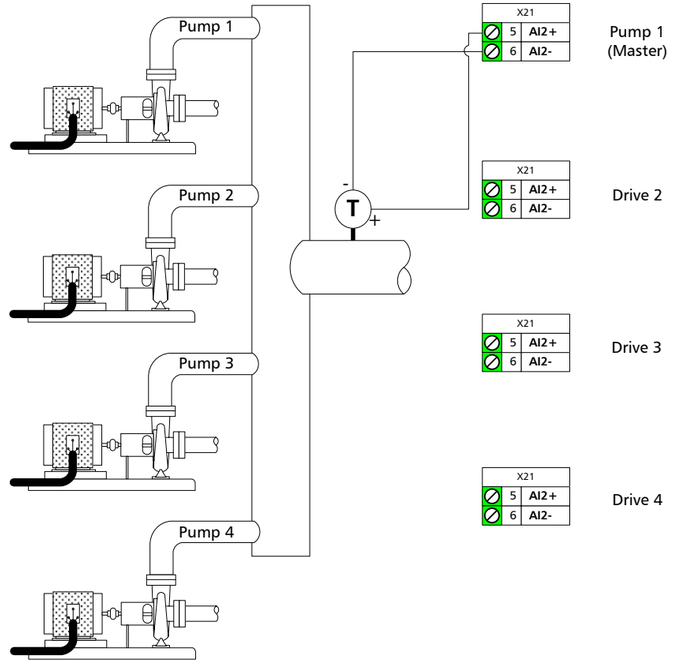
PumpSmart Powered Transmitter



TX ONE MASTER

One transmitter signal shared via Fiber Optic cables

Externally Powered Transmitter



NOTES

In this configuration, a single process transmitter signal is shared with the other PumpSmart drives using the communication connections.

Parameter 22.13 must be set to TX ONE MASTER

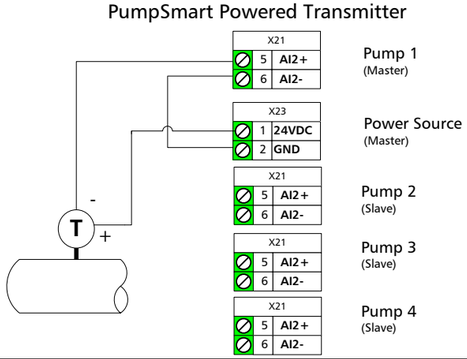
Communication connections must be made between drives.

Consideration(s)

If one PumpSmart drive loses power, the signal will Not be transmitted through to the other drives.

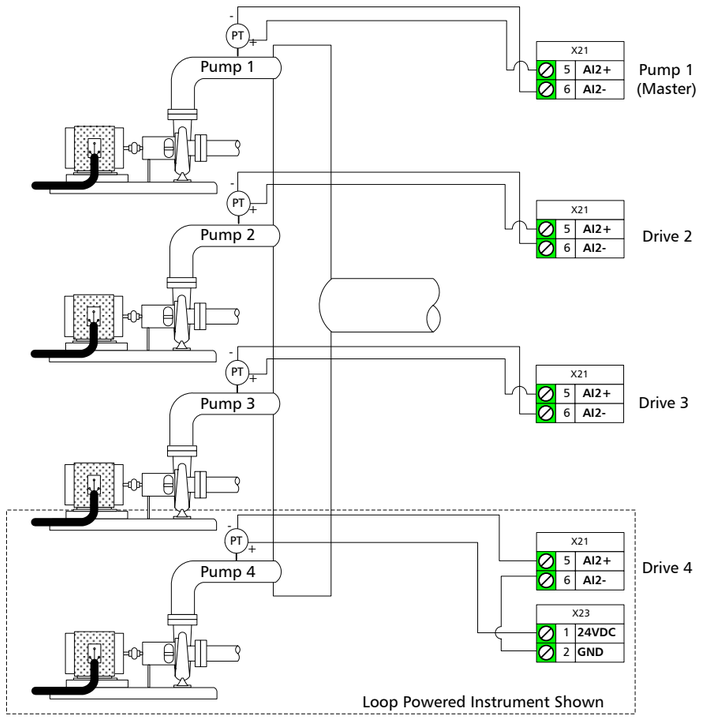
If the transmitter is loop powered by PumpSmart, the signal will cease if the power to the PumpSmart unit is turned off.

PumpSmart Powered Transmitter



TX ALL DRIVES

Transmitter on each drive/pump



NOTES

In this configuration, each PumpSmart drive is wired with a process transmitter (pressure only)

Parameter 22.13 must be set to TX ALL DRIVES

Communication connections must be made between drives.

Consideration(s)

If one drive is powered off, each other drive will continue to receive the process signal

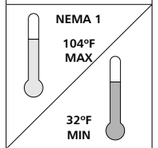
PS 200 ACS 800 Multipump Transmitter Wiring V4.0			
B05029A	SHEET 1 OF 1	REV 0	Issue -
Drawing is not to scale Dimensions in inches [mm]	Drawn: AI 060204		
	Checked: Tony Stavale		

PS200 INSTALLATION QUICK REFERNCE - Wall Mount Units (ACS 800-U1)

NEMA 1 / NEMA 12

NO DIRECT SUNLIGHT

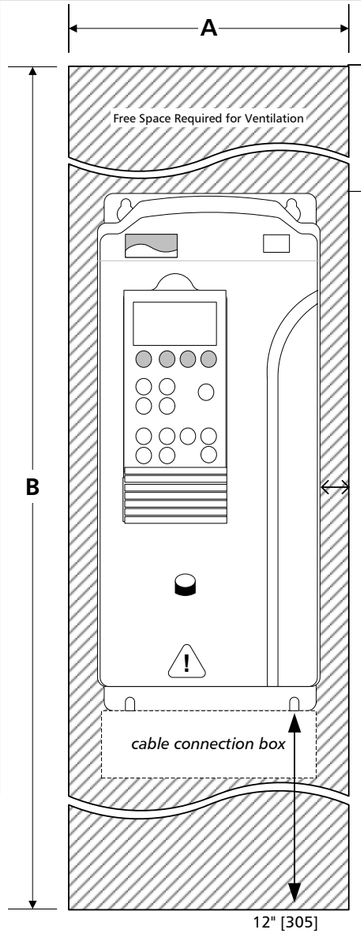
3300 Ft
NEMA 1

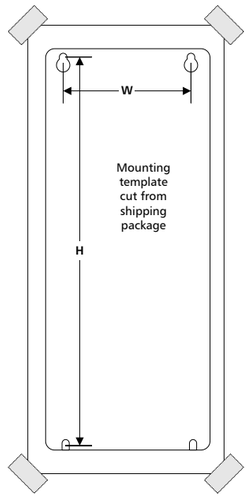


5-95% RELATIVE HUMIDITY
NO CONDENSATION
NO CORROSIVE GASES

Refer to Hardware Manual Technical Data for application guidelines outside of the above listed limits

IP21~NEMA1
IP55~NEMA 12

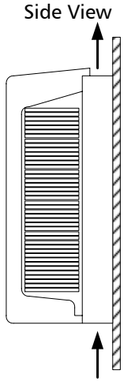




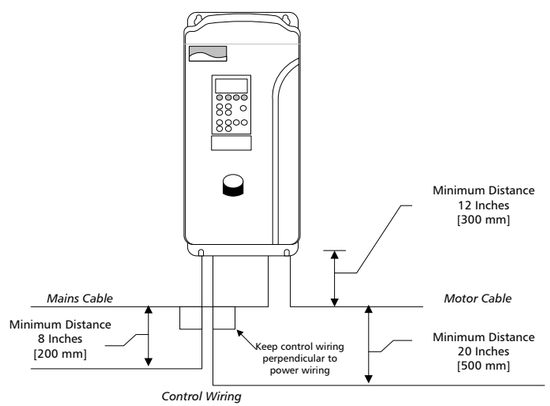
Frame Size	NEMA1 Free Space Requirements		NEMA 1/12 Drill Pattern	
	A Inches [mm]	**B** Inches [mm]	**H** Inches [mm]	**W** Inches [mm]
R2	10.5 [266]	34.5 [876]	14.17 [360]	4.92 [125]
R3	10.8 [274]	36.4 [925]	16.06 [408]	4.92 [125]
R4	13.5 [343]	39.2 [996]	18.70 [475]	8.39 [213]
R5	14.5 [368]	43.6 [1107]	23.15 [588]	9.37 [238]
R6	15.8 [401]	47.5 [1207]	26.57 [675]	10.35 [263]

For NEMA 12 Free Space Requirement is 2" (50) Around Drive Perimeter

Cooling Air Flow
Side View



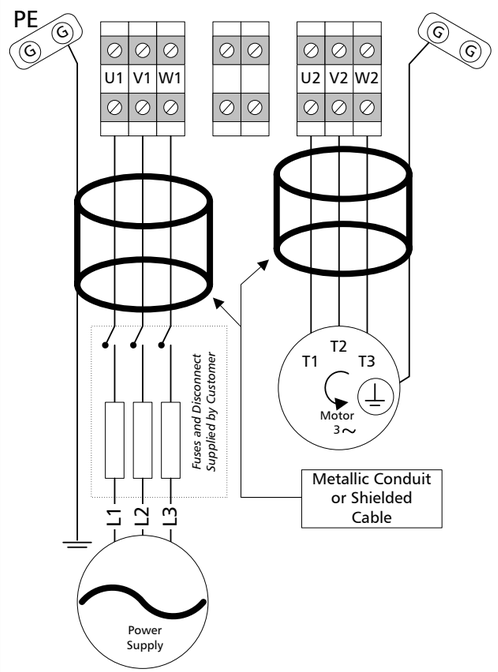
Control/Power Wiring Layout



!WARNING!
Review the entire hardware manual prior to installation

The information provided on this sheet is for installation reference only. Please refer to ACS800 Installation Manual for additional installation details

Mains / Power Wiring



General Notes:
1- 360º Grounded terminations are required
2. Ultra-rapid fuses are required to protect drive. Fuse operating time is to be less than 0.5 sec.
Refer to Technical Data section for details

PUMPSMART® CONTROL SOLUTIONS

*NEMA1 Only

Frame Size	230 VAC - Single Phase	230 VAC - Three Phase	380 VAC	460 VAC	575 VAC	U1/V1/W1 - U2/V2/W2		Earthing PE	
	NEMA 1, 12 HP	NEMA 1, 12 HP	NEMA 1, 12 kW	NEMA 1, 12 HP	NEMA 1, 12 HP	Max. Wire Size AWG	Tightening Torque Lbf-Ft	Max. Wire Size AWG	Tightening Torque Lbf-Ft
R2	1 1.5	2 3	2.2 3 4 5.5	3 5 7.5 10		6	0.9--1.1	8	1.1
R3	2 3 5	5 7.5 10	7.5 11 15	15 20 25		6	0.9--1.1	8	1.1
R4	7.5 10	15 20	18.5 22	30 40	7.5 10/15 20/25/30	4	1.5--3.0	5	2.2
R5		25 30 40	30 37 45	50 60 75	40 50	2/0	11.1	2/0	11.1
R6		50* 60* 75*	55 75 90	100 125 150	60 75 100	350 MCM	14.8 29.5	4/0	5.9

Frame Size	Basic Drive Dimensions NEMA 1 / IP21				Basic Drive Dimensions NEMA 12 / IP55			
	Height Inches [mm]	**Width** Inches [mm]	**Depth** Inches [mm]	**Weight** Lbm [kg]	**Height** Inches [mm]	**Width** Inches [mm]	**Depth** Inches [mm]	**Weight** Lbm [kg]
R2	15.96 [405]	6.50 [165]	8.90 [226]	20 [9]	20.8 [528]	10.35 [263]	9.49 [242]	34 [16]
R3	18.54 [471]	6.81 [173]	10.43 [265]	26 [12]	20.8 [528]	10.35 [263]	10.74 [273]	41 [19]
R4	23.87 [606]	9.45 [240]	10.79 [274]	57 [26]	30.49 [774]	14.84 [377]	10.94 [278]	71 [32]
R5	29.09 [739]	10.43 [265]	11.26 [286]	82 [37]	30.49 [774]	14.84 [377]	12.14 [308]	110 [50]
R6	34.65 [880]	11.81 [300]	15.75 [400]	148 [67]	36.34 [923]	16.54 [420]	16.54 [420]	170 [77]

Installation Checklist

MECHANICAL

1. Check that the ambient operating conditions are suitable [Technical Data].
2. Check that the unit is mounted properly on a vertical non-flammable wall [Mechanical Installation]
3. Check that cooling air flows freely
4. Check the applicability of the motor and the driven equipment [Electrical Installation]

ELECTRICAL

5. If the PS200 is connected to an ungrounded power system or a high resistance grounded power system (over 30 Ohms), check that the EMC filter capacitors are disconnected.
6. The capacitors are reformed if stored over 1 year.
7. Check that the drive is grounded properly
8. Check that the input voltage matches the drive nominal input voltage
9. Check that the input power connections at U1, V1, and W1 are OK
10. Check that the appropriate line fuses are installed
11. Check that motor connections at U2, V2, and W2 are okay
12. Check the motor cable routing
13. Check that there are no power factor compensation capacitors connected between the drive and the motor.
14. Review and check that control connections inside the drive are properly wired [See control wiring diagrams].
15. Check that there are no tools or foreign objects left inside the drive.
16. With bypass connection, check that input line voltage cannot be applied to the output of the PumpSmart PS200.
17. Drive, motor connection box and other covers are in place.

PS 200 Installation Quick Reference ACS 800 Wall Mount units

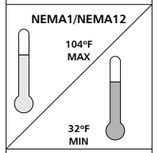
Drawing is not to scale Dimensions in inches [mm]	Drawn: AI 091003 Checked: Tony Stavale	SHEET 1 OF 1	B04933A	REV 1	Issue -

PS200 UL INSTALLATION QUICK REFERENCE - Floor Mount Units (ACS 800-U2 , ACS 800-02 and ACS 800-U7)

NEMA1 / NEMA12

NO DIRECT SUNLIGHT

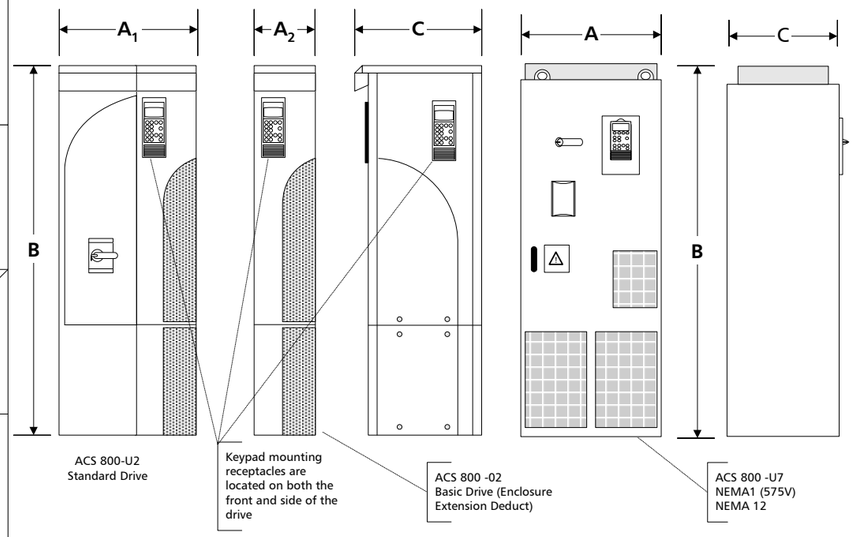
3300 Ft
NEMA1/NEMA12



5-95% RELATIVE HUMIDITY
NO CONDENSATION
NO CORROSIVE GASES

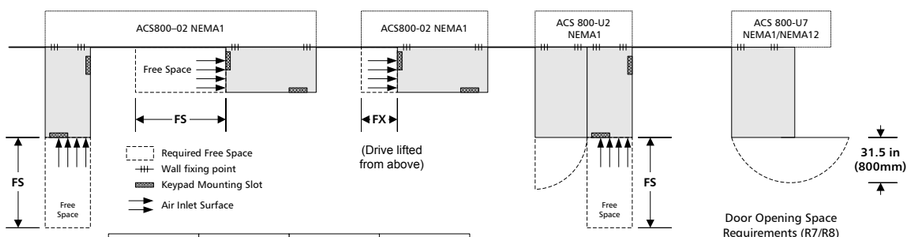
Refer to Hardware Manual Technical Data for application guidelines outside of the above listed limits

NEMA1 / NEMA12



Frame Size	ACS 800-U2 and 02 NEMA 1 Dimensions				Weight	
	A_1 Inches [mm]	A_2 Inches [mm]	B Inches [mm]	C Inches [mm]	Basic Lbm [kg]	Std Lbm [kg]
R7	23.7 [605]	9.8 [249]	59.3 [1506]	20.7 [526]	220 [100]	430 [195]
R8	31.2 [792]	13.6 [345]	79.7 [2024]	24.5 [622]	507 [230]	827 [375]

Frame Size	ACS800-U7 Dimensions				Weight
	A Inches (mm)	B Inches (mm) NEMA1	B Inches (mm) NEMA12	C Inches (mm)	Std Lb (kg)
R7	32.9 (836)	84.2 (2139)	91.1 (2314)	27.3 (693)	900 (410)
R8					1100 (500)



Frame Size	FS[1] Inches [mm]	FX[1,2] Inches [mm]	Free Space Above Unit Inches (mm)
R7	20 [500]	7.9 [200]	7.9 [200]
R8	24 [600]	12 [300]	12 [300]

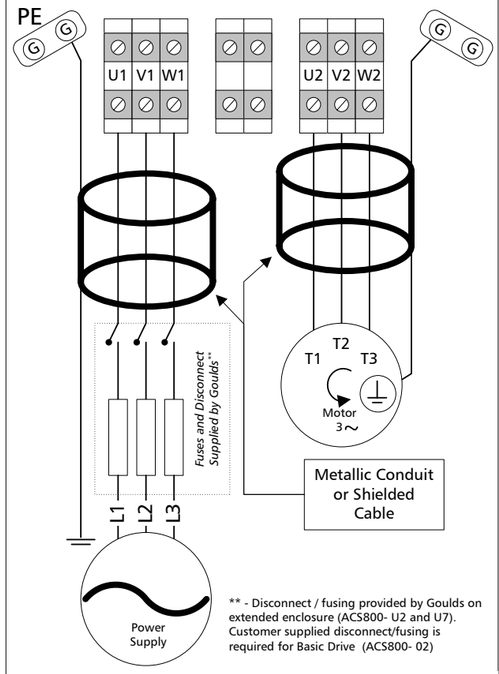
[1] - Does not include room for installer
[2] - Additional space may be required for fan/ capacitor replacement

!WARNING!

Review the entire hardware manual prior to installation

The information provided on this sheet is for installation reference only. Please refer to ACS800 Installation Manual for additional installation details

Mains / Power Wiring Schematic

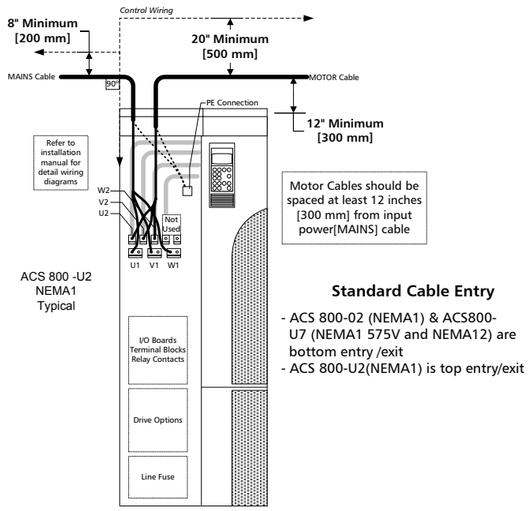


** - Disconnect / fusing provided by Goulds on extended enclosure (ACS800- U2 and U7). Customer supplied disconnect/fusing is required for Basic Drive (ACS800- 02)

General Notes:

1- 360° Grounded terminations are required
2. Standard T/L type fuses or Ultra-rapid fuses are required to protect drive. Fuse operating times should be less than 0.5 sec Refer to Technical Data Section for details

PUMPSMART® CONTROL SOLUTIONS



Motor Cables should be spaced at least 12 inches [300 mm] from input power[MAINS] cable

Standard Cable Entry

- ACS 800-02 (NEMA1) & ACS800-U7 (NEMA1 575V and NEMA12) are bottom entry /exit
- ACS 800-U2(NEMA1) is top entry/exit

Copper cables with concentric copper shield	
Max. Load Current A	Cable Type AWG/ Kcmil
224	250MCM or 2x1
251	300MCM or 2x1/0
273	350MCM or 2x2/0
295	400MCM or 2x2/0
334	500MCM or 2x3/0
370	600MCM or 2x4/0 or 3x1/0
405	700MCM or 2x4/0 or 3x2/0
449	2x250MCM or 3x2/0
502	2x300MCM or 3x3/0
546	2x350MCM or3x4/0
590	2x400MCM or3x4/0
669	2x500MCM or 3x250MCM
739	2x600MCM or 3x300MCM
810	2x700MCM or 3x350MCM
884	3x400MCM or 4x250MCM
1003	3x500MCM or 4x300MCM
1109	3x600MCM or 4x400MCM
1214	3x700MCM or 4x500MCM

Input and Motor Cable terminal sizes (per phase) and tightening torques are given below. Two hole cable lugs (1/2 inch diameter) can be used for U2/U7 models. For 02 models one hole cable lugs (½ inch diameter) can be used.The maximum allowed width of the cable lug is 1.5 inches

FRAME SIZE	U1,V1,W1,U2,V2,W2		EARTHING PE			
	SCREW SIZE	TIGHTENING TORQUE lbf ft	SCREW SIZE		TIGHTENING TORQUE Nm	
			ACS 800-U2/02	ACS 800-U7	ACS 800-U2/02	ACS 800-U7
R7	½ inch	37...55	5/16 inch	3/8 inch	11...16	22...32
R8	½ inch	37...55	5/16 inch	3/8 inch	11...16	22...32

Installation Checklist

MECHANICAL

1. Check that the ambient operating conditions are suitable [Technical Data].
2. Check that the unit is mounted properly on a vertical non-flammable wall [Mechanical Installation]
3. Check that cooling air flows freely
4. Check the applicability of the motor and the driven equipment [Electrical Installation]

ELECTRICAL

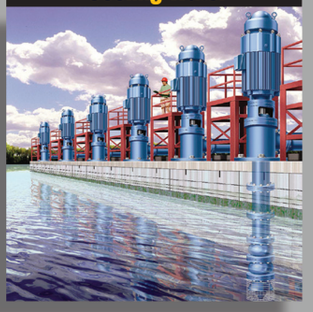
5. If the PS200 is connected to an ungrounded power system or a high resistance grounded power system (over 30 Ohms), check that the EMC filter capacitors are disconnected.
6. The Capacitors are reformed if stored over 1 year.
7. Check that the drive is grounded properly
8. Check that the input voltage matches the drive nominal input voltage
9. Check that the input power connections at U1, V1, and W1 are OK
10. Check that the appropriate line fuses are installed
11. Check that motor connections at U2, V2, and W2 are okay
12. Check the motor cable routing
13. Check that there are no power factor compensation capacitors connected between the drive and the motor.
14. Review and check that control connections inside the drive are properly wired [See control wiring diagrams].
15. Set the fan voltage transformer and NEMA 12 Fan Transformer (if present)
16. Check that there are no tools or foreign objects left inside the drive.
17. With bypass connection, check that input line voltage cannot be applied to the output of the PumpSmart PS200.
18. Drive, motor connection box and other covers are in place.

PS 200 UL Installation Quick Reference ACS 800-U2/02/U7 Floor Mount units

Drawing is not to scale Dimensions in inches [mm]	Drawn: AI 091003	SHEET 1 OF 1	B04934A	REV 1	Issue -
	Checked: Tony Stavale				

APPLICATION FLEXIBILITY

Cooling Water



- Pressure or Temp Control
- Multi-Pump Sequencing
- Auto Load Sharing
- Eliminate Control Valves

Transfer & Loading

- Flow Control
- Auto Shut Off
- No Dry Run/Cavitation
- Total Protection for Mag Drive Pumps

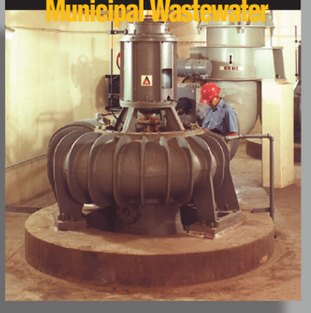
Paper Stock

- Fan, Broke, Liquor, Digester
- Control Level, Pressure, Flow
- Improved Headbox Control

Reboiler & Bottoms Pumps

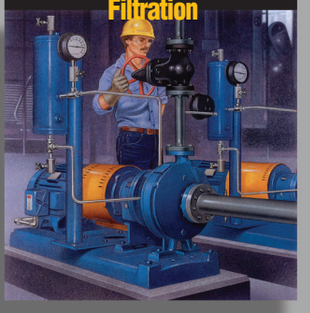
- Increase Drain Down
- Control Suction Level
- Control Cavitation
- Eliminate Control Valves

Municipal Wastewater



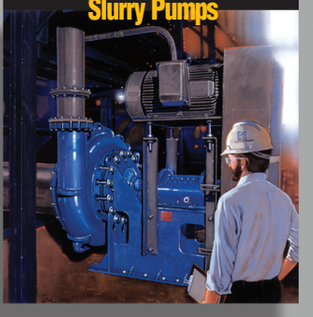
- Handle Wide Load Swings
- Multi-Pump Control
- Remote Diagnostics
- Reduce HP Requirements

Filtration



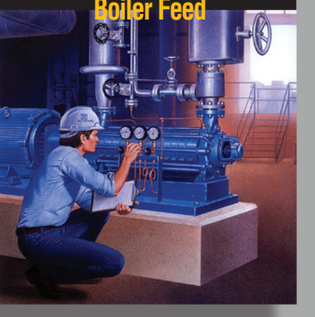
- Maintain Constant Flow as Filters Clog
- Fewer Filter Changes
- No Flow Protection

Slurry Pumps



- Control Pump Output
- Run Slower
- Run in Pump Sweet Spot
- Reduce Pump Wear

Boiler Feed



- Level Control
- Reduce Recirculation
- Eliminate Valves
- Reduce Horsepower

OTHER PRODUCTS FROM PUMPSMART CONTROL SOLUTIONS

PF700

- 3-200 HP
- Advanced pump protection
- Allen Bradley Powerflex 700 drive

PS10/20

- PumpSmart Protection for fixed speed applications
- 110-575 AC voltages up to 999 FLA motor sizes

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