OptiPump
Pump Jack Pump-Off Controller

AID Advanced Industrial Devices

Firmware Version
3.03

Manual Revision
1.0.0

User Operation and Configuration Manual

Table of Contents

! CAUTION !

Always verify that the power has been disconnected from both the Pump Master OptiPump controller and the Fuji MEGA variable frequency drive before making changes to the wiring.

<div style="border:1px solid red;">

Failure to do so may result in severe injury or death!

</div>

High DC voltages may still be present for a period of time after main power has been removed from the variable frequency drive. Take note of the red **Charge** LED, labeled CRG, located on the drive. Depending on the size of the drive, the LED may be visible through the front cover. The LED will go dark when the DC bus has been discharged. Until then, potentially dangerous voltages may still be present for several minutes after disconnecting power.

You should always verify that terminals are no longer powered by using a properly working and tested multimeter.

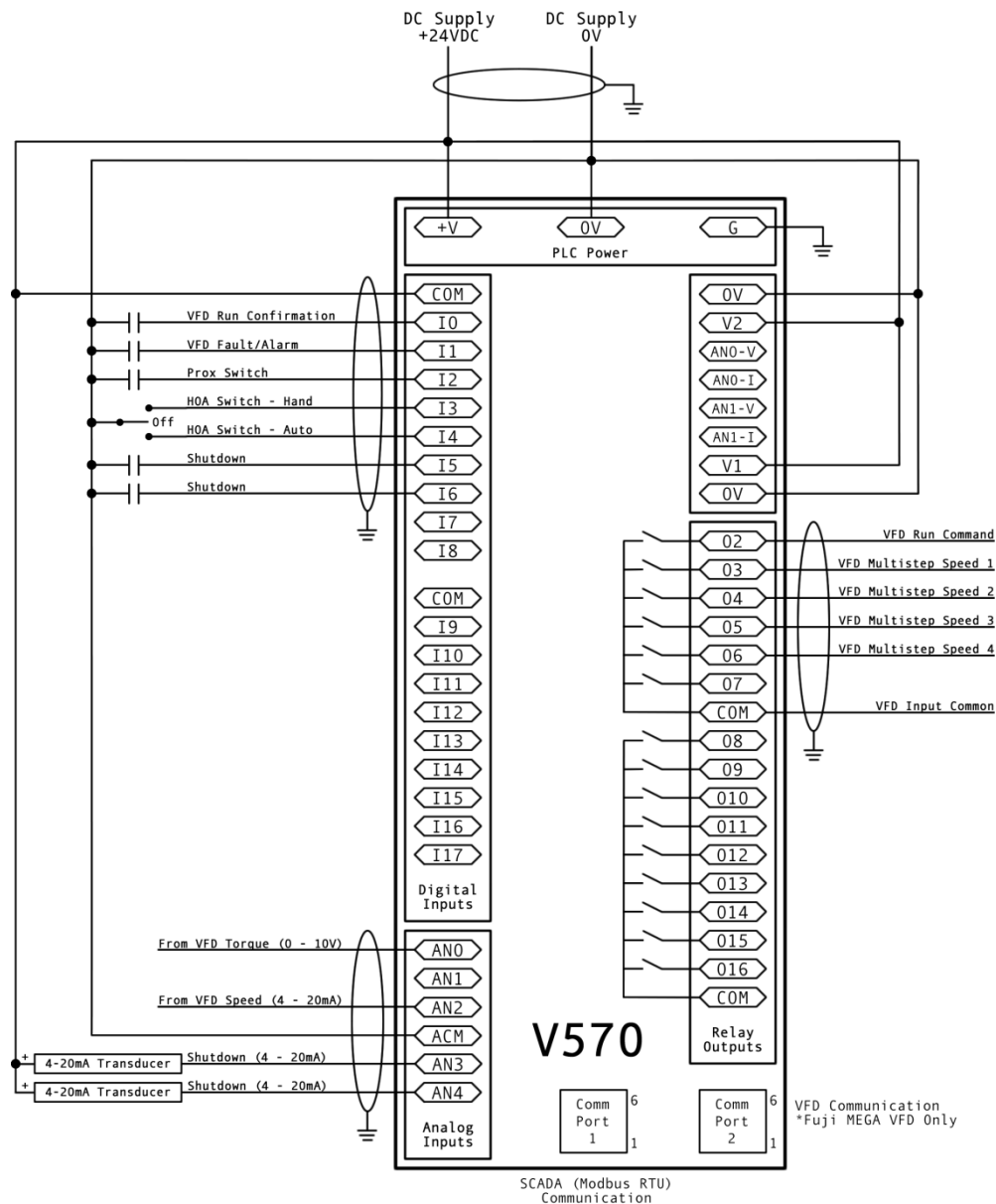The OptiPump Pump Jack controller is available in two different screen sizes.

5.7" Version

Technical Specifications (5.7" Screen)	
Display	5.7" 64K color touchscreen QVGA (320x240) TFT
Digital Inputs	7 total 5 dedicated for operations 2 general purpose for field devices
Analog Inputs	4 total 2 dedicated for operations (10-bit) 2 general purpose, 4-20 mA for field devices (12-bit)
Data Storage	Full-size SD card
Battery-Backed Memory	7 years typical at 25°C Replaceable without opening controller
Date, Time, and Supervisor	Battery-Backed Real-Time Clock and Watchdog
Power Supply Voltage	24 VDC 20.4 VDC to 28.8 VDC with less than 10% ripple
Power Supply Current	320 mA maximum at 24 VDC
Power Consumption	6.5 Watt
Temperature	Operation: 0 °C to +50 °C (32 °F to 122 °F) Storage: -20 °C to +60 °C (-4 °F to 140 °F)
Humidity	5 % to 95 % (non-condensing)
Physical	7.75" x 5.77" x 2.7" (197 mm x 146.6 mm x 68.5 mm) 26.4 oz (750 gm)
Mounting	IP 65/NEMA 4X for front panel

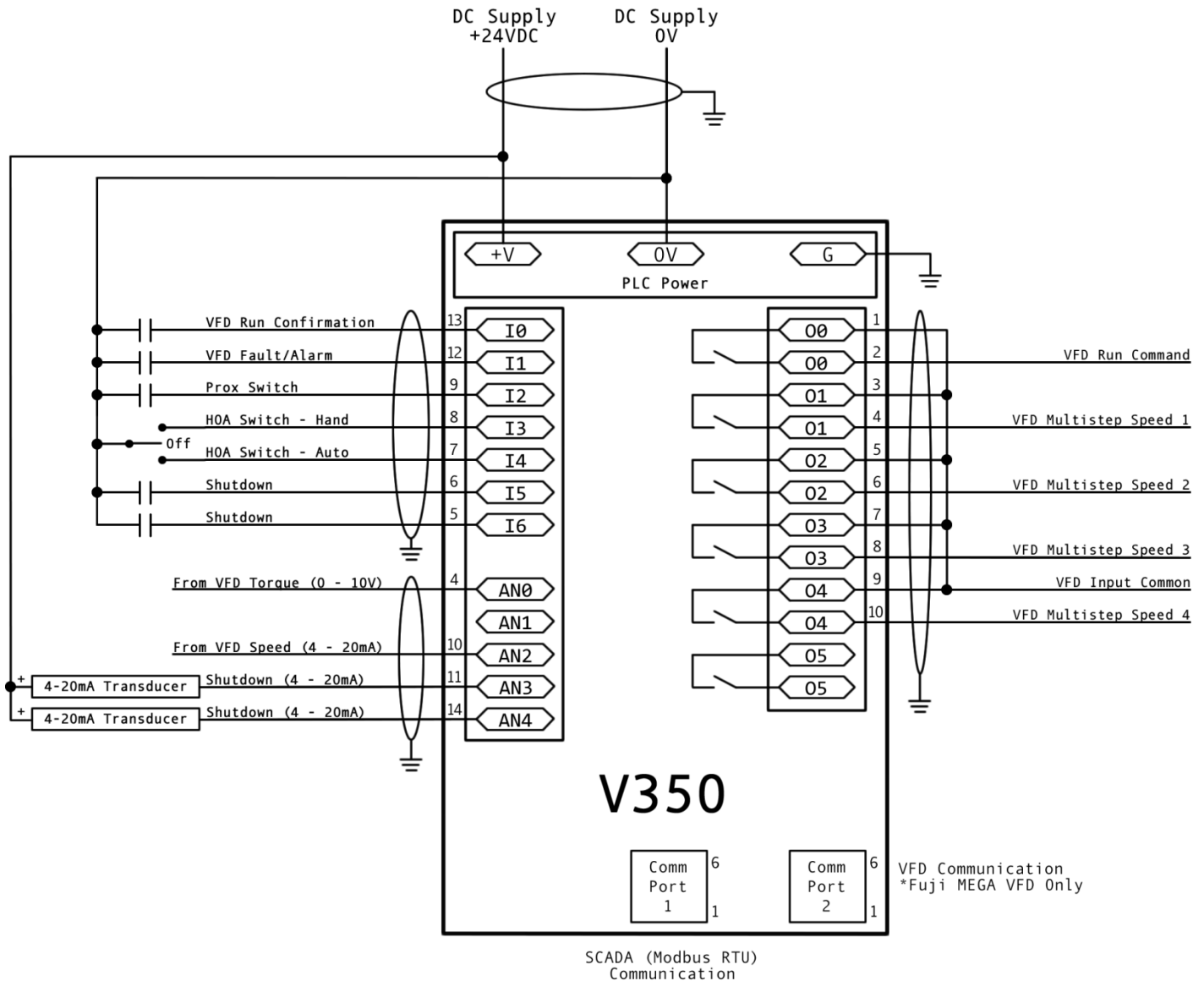| Technical Specifications (3.5" Screen)	
Display	3.5" 65,536 color touchscreen QVGA (320x240) TFT
Digital Inputs	7 total 5 dedicated for operations 2 general purpose for field devices
Analog Inputs	4 total 2 dedicated for operations (10-bit) 2 general purpose, 4-20 mA for field devices (10-bit)
Data Storage	Micro SD card
Battery-Backed Memory	7 years typical at 25°C CR2450, coin-type 3V
Date, Time, and Supervisor	Battery-Backed Real-Time Clock and Watchdog
Power Supply Voltage	24 VDC 20.4 VDC to 28.8 VDC with less than 10% ripple
Power Supply Current	207 mA maximum at 24 VDC
Power Consumption	5 Watt
Temperature	Operation: 0 °C to +50 °C (32 °F to 122 °F) Storage: -20 °C to +60 °C (-4 °F to 140 °F)
Humidity	10 % to 95 % (non-condensing)
Physical	4.92" x 4.49" x 2.59" (109 mm x 114.1 mm x 66 mm) 11.18 oz (317 gm)
Mounting	IP 65/66/NEMA 4X for front panel

Please note that all wiring to and from the controller should be shielded in order to reduce any potential for electrical interference. Using unshielded wiring may result in erratic and unpredictable behavior.

5.7" Version

DC Supply +24VDC
DC Supply 0V

+V | 0V | G
PLC Power

COM
VFD Run Confirmation — I0
VFD Fault/Alarm — I1
Prox Switch — I2
HOA Switch - Hand — I3
Off
HOA Switch - Auto — I4
Shutdown — I5
Shutdown — I6
I7
I8
COM
I9
I10
I11
I12
I13
I14
I15
I16
I17
Digital Inputs

From VFD Torque (0 - 10V) — AN0
AN1
From VFD Speed (4 - 20mA) — AN2
ACM
+ 4-20mA Transducer Shutdown (4 - 20mA) — AN3
+ 4-20mA Transducer Shutdown (4 - 20mA) — AN4
Analog Inputs

V570

0V
V2
AN0-V
AN0-I
AN1-V
AN1-I
V1
0V

02 — VFD Run Command
03 — VFD Multistep Speed 1
04 — VFD Multistep Speed 2
05 — VFD Multistep Speed 3
06 — VFD Multistep Speed 4
07
COM — VFD Input Common
08
09
010
011
012
013
014
015
016
COM
Relay Outputs

Comm Port 1 6 1
Comm Port 2 6 1 VFD Communication *Fuji MEGA VFD Only

SCADA (Modbus RTU) Communication

NOTE:
All wiring to/from the PLC should be shielded in order to reduce electrical interference. Failure to do so, may result in erratic and unpredictable behavior.

DC Supply
+24VDC

DC Supply
0V

+V   0V   G

PLC Power

VFD Run Confirmation	13	I0
VFD Fault/Alarm	12	I1
Prox Switch	9	I2
HOA Switch - Hand	8	I3
Off HOA Switch - Auto	7	I4
Shutdown	6	I5
Shutdown	5	I6

From VFD Torque (0 - 10V)   4   AN0

AN1

From VFD Speed (4 - 20mA)   10   AN2

4-20mA Transducer   Shutdown (4 - 20mA)   11   AN3

4-20mA Transducer   Shutdown (4 - 20mA)   14   AN4

1   O0
2   O0   VFD Run Command
3   O1
4   O1   VFD Multistep Speed 1
5   O2
6   O2   VFD Multistep Speed 2
7   O3
8   O3   VFD Multistep Speed 3
9   O4   VFD Input Common
10   O4   VFD Multistep Speed 4
O5
O5

V350

Comm
Port
1
6
1

Comm
Port
2
6
1

VFD Communication
*Fuji MEGA VFD Only

SCADA (Modbus RTU)
Communication

NOTE:
All wiring to/from the PLC should be shielded in order to reduce
electrical interference. Failure to do so, may result in erratic and
unpredictable behavior.

The OptiPump system uses a proximity switch to indicate the top-of-stroke for the pump-jack. The mounting method used for the proximity switch can vary widely based on the location and available hardware.

There are only two requirements for mounting of the proximity switch. The proximity switch must:

1. Close and reopen at the top-of-stroke.
2. Close and reopen only one time per stroke.

If the only mounting position available for the proximity switch results in occasional multiple closures in quick succession, the *System* parameter *Prox Ignore Time* can be used to ignore closures for a chosen number of seconds after the first closure.

The images below provide some examples of how the proximity switch can be mounted.

Proximity switch mounted on a scrap piece of railing on the pump-jack skid/frame.

Proximity switch mounted just below the beam on the rear of the beam bearing.

The head of a bolt on the bearing provides enough distance from the large, flat area of the bearing, which results in a quick closure and reopening of the proximity switch contacts at the top of the stroke.

With the proximity switch mounted just behind the main beam bearing, the contacts will engage at the top of the stroke, when the rear of the beam is at its lowest point. This mounting method is easiest on shorter pump-jacks.

If the proximity switch contacts engage before the top of the stroke is reached, it must be repositioned. However, if the proximity switch contacts engage just slightly after the pump-jack begins the down-stroke, the system will still function, but the calculated pump fillage may be slightly affected. It is recommended that the pump fillage calibration procedure be run in order to compensate for the placement of the proximity switch.

The OptiPump controller uses a color touchscreen interface to display information and interact with a local user. The touchscreen uses resistive sensing elements which work well for users with bare fingers, wearing gloves or when using a stylus. To select an option on the screen, the user need only lightly touch the button or area indicated.
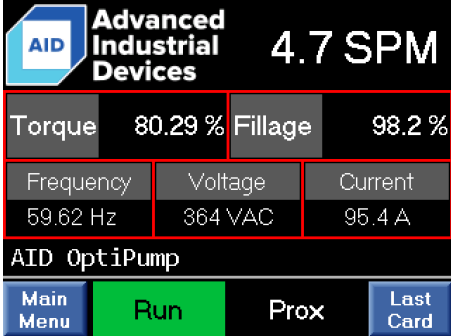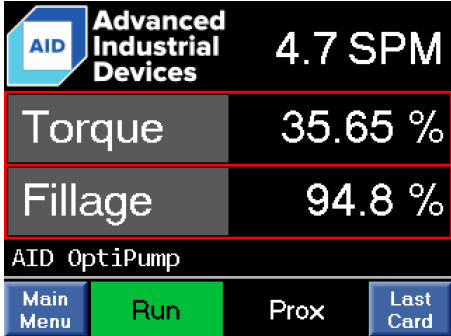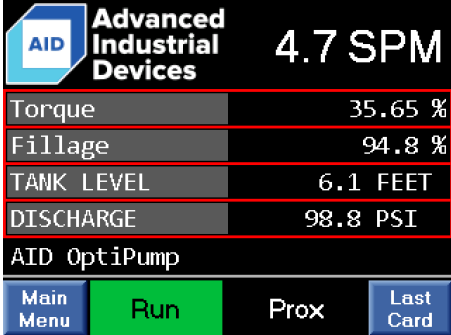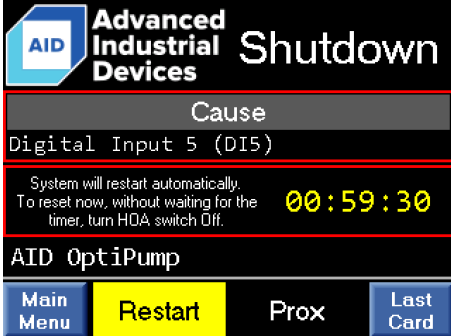
Note:
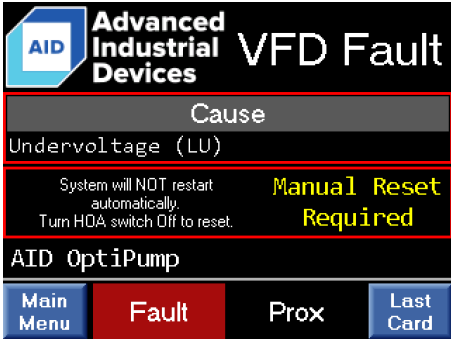
During periods of user inactivity, the OptiPump controller will turn off the display, very similar to a blank screensaver on a desktop or laptop computer. If the pump-jack is running and the display is black, simply lightly touching anywhere on the screen will enable the local display again. The time for this feature can be adjusted, or disabled, using *System* parameter *Scrn Saver Time*.

User Interface Navigation Overview
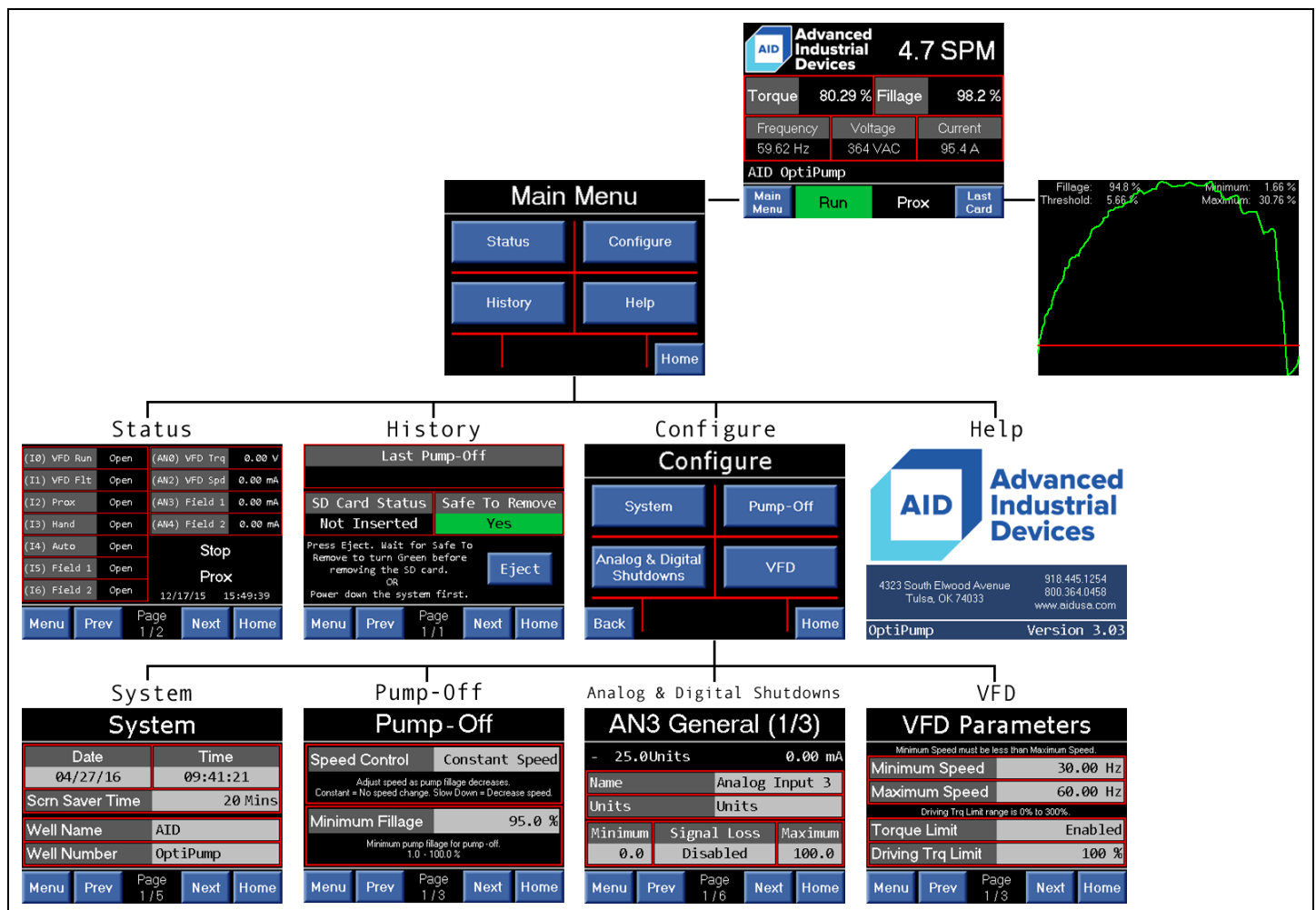
The Home screen is the default screen displayed by the OptiPump controller. It provides a general overview of the system and its performance. Most screens within the controller have a button labeled Home. So if you ever get lost in the settings, just remember that you can press the Home button to find your way home, and start over.

	Home (VFD Communication) When used with a Fuji MEGA VFD, the OptiPump controller can display additional VFD related information. This is the default configuration for OptiPump VFD packages provided by Advanced Industrial Devices. Measured pump strokes per minute (SPM) will always be displayed in the upper right-hand corner of the screen. The current values for measured VFD torque, calculated pump fillage, and VFD output frequency, voltage and current, are shown in the Red boxes.
	Home (Basic, No VFD Communication) Measured pump strokes per minute (SPM) will always be displayed in the upper right-hand corner of the screen. The current values for both measured drive torque and estimated pump fillage are shown in the Red boxes.
	Home (Analog Inputs Configured, No VFD Communication) When one or both of the analog inputs have been configured as monitors or shutdowns, they will also be displayed. The monitors for *Torque* and *Pump Fillage* shrink and the analog inputs are displayed below them using the supplied names and units.
	Home (Restart Mode after Shutdown) When the system enters the shutdown state, the Home screen temporarily changes by removing the monitors and displays information about the shutdown instead. If the shutdown is configured for a timed restart (or a pump-off), a countdown to automatic restart will be shown. For manual restart shutdowns, the message "Manual Reset Required" will be shown, as in the next example of a VFD fault.

	Home (Manual Restart Mode after VFD Fault)
Advanced Industrial Devices VFD Fault Cause Undervoltage (LU) System will NOT restart automatically. Turn HOA switch Off to reset. Manual Reset Required AID OptiPump Main Menu · Fault · Prox · Last Card	When the system detects a VFD fault, the Home screen temporarily changes by removing the monitors and displays information about the fault instead. If the fault is configured for an automatic/timed restart, a countdown to automatic restart will be shown, as in the previous Shutdown screen example. If the fault is configured for manual restart, the message "Manual Reset Required" will be shown.

The **System** parameters, **Well Name** and **Well Number**, are displayed below the red monitor boxes.

The Main Menu and Last Card buttons allow the user to exit the Home screen and show the Main Menu or view the last torque card that was generated.
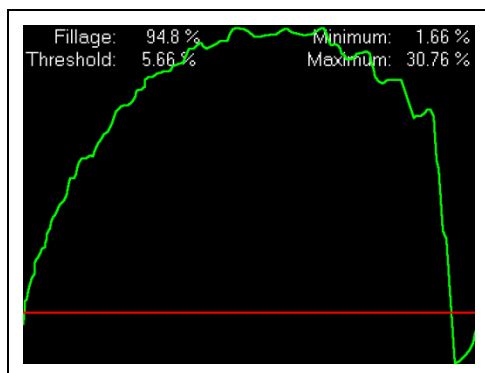
The system status indicators are located at the bottom of the Home screen between the Main Menu and Last Card buttons. These indicators allow the user to quickly get an overview of what state the system is in and whether or not the proximity switch is functioning correctly.

Run/Operation Status		Proximity Switch Status	
Stop	System is currently stopped.	Proximity switch is open.	**Prox**
Run	System is currently running in either Hand or Auto.	Proximity switch is closed.	**Prox**
Restart	System is currently shutdown due to pump-off, analog or digital input or VFD fault, and is waiting for an automatic/timed restart.	Proximity switch has failed to close in the last 100 seconds while the system was running.	**Prox Fail**
Shutdown	System is currently shutdown due to analog input, and requires a manual restart.		
Fault	System is currently down due to a VFD fault, and requires a manual restart.		

This screen provides a plot of the position (x-axis) versus torque data recorded (y-axis) during the last stroke. The card statistics (Fillage, Threshold, Minimum and Maximum torques) are also displayed at the top of the screen. The recorded torque values are displayed in green, and the threshold line is displayed in red. The last torque card recorded is very useful in helping to properly tune the pump-off detection.

Note: Only the down-stroke torque is recorded. The left-most position (x-axis) is bottom-of-stroke, and the right-most position (x-axis) is top-of-stroke.

The card on screen will automatically update when a new set of recorded data is available – this usually occurs just after the bottom-of-stroke is reached.

When you are finished viewing the card, touch anywhere on the screen to return to the Home screen.

Status

The status screen provides detailed information regarding the current input/output states, program version, and the real-time clock (RTC) date and time, as well as the same system status indicators available on the Home screen. This screen can be very useful in helping to troubleshoot field devices and wiring.

Due to the slightly different output terminals between the 5.7" and 3.5" devices, the status screens vary slightly. Notice that the VFD Fwd output is marked (O2) in the 5.7" version, and marked (O0) in the 3.5" version. Pay close attention to the indicated terminals names and numbers during installation and when troubleshooting.

5.7" Version

Status Screen 1/2   **Status Screen 2/2**

Menu – Return to the Main Menu

Prev – Display the previous page

Next – Display the next page

Home – Return to the Home Screen

Status Screen 1/2   **Status Screen 2/2**

(I0) VFD Run Open   (AN0) VFD Trq   0.00 V
(I1) VFD Flt Open   (AN2) VFD Spd   0.00 mA
(I2) Prox   Open   (AN3) Field 1   0.00 mA
(I3) Hand   Open   (AN4) Field 2   0.00 mA
(I4) Auto   Open
(I5) Field 1 Open   **Stop**
(I6) Field 2 Open   **Prox**
                     06/27/17   23:19:37
Menu Prev Page 1/2 Next Home
	(O0) VFD Fwd Open **AID Advanced Industrial Devices**
	(O1) VFD X1 Open **OptiPump**
	(O2) VFD X2 Open **Version 3.03**
	(O3) VFD X3 Open **Stop**
	(O4) VFD X4 Open **Prox**
	                     06/27/17 23:20:37
	Menu Prev Page 2/2 Next Home

Menu – Return to the Main Menu

Prev – Display the previous page

Next – Display the next page

Home – Return to the Home Screen

History

The date and time of the last pump-off shutdown is recorded at the top of the screen. When the system detects a new pump-off shutdown, the date and time of the last pump-off is automatically updated.

The OptiPump controller can record 640,000 torque cards on the available SD card in 64 comma-separated values (CSV) files. These files can be easily imported in to Microsoft Excel or other data analysis software.

Note: Always make sure power has been turned off or the **Eject** button has been pressed prior to removing the SD card from the PLC. Failure to do so may result in corrupted data on the SD card. After pressing the **Eject** button, wait until the *Safe To Remove* status changes to Yes before removing the SD card.

SD Card Status	Description
Not Inserted	SD card is not inserted into the PLC. No data logging will occur.
Read-Only	SD card is inserted into the PLC, but the write-protect switch is in the Locked position. No data logging will occur.
Write Enabled	SD card is inserted into the PLC, and normal data logging will occur.
Write Disabled	SD card is inserted into the PLC, the write-protect switch is in the Unlocked position, but writing has been disabled via the **Eject** button.

Motor Auto-Tune

Regardless of whether or not VFD communication is enabled, the motor auto-tune procedure should be run. Auto-tuning allows the VFD to more accurately measure and calculate values associated with pump operation and increase the amount of torque generated. Optimal motor and pump operation will be achieved after performing the auto-tune procedure with accurate motor information. Accurate motor information (from the nameplate) is critical for this process.

<div style="border:2px solid black; text-align:center; color:red; font-size:large;">

The HOA switch must be in the Off position and the motor completely stopped before attempting this procedure.

</div>

If the OptiPump controller is not used with VFD communication enabled, please refer to the auto-tuning information included with the panel. When the OptiPump controller is used in conjunction with a Fuji MEGA VFD and communication is enabled, the auto-tuning procedure is run from the OptiPump controller, *NOT* the Fuji MEGA VFD keypad.

In order to begin the process, collect the following information from the motor nameplate:

Rated Speed RPM	Capacity/Size in Horsepower	Full-Load Amps

Navigate to the **Motor Auto-Tune** screen on the OptiPump controller from the Home screen by pressing the **Main Menu** button, then the **Configure** button, followed by the **VFD** button. The **Motor Auto-Tune** page is the last page of the **VFD** configuration section.
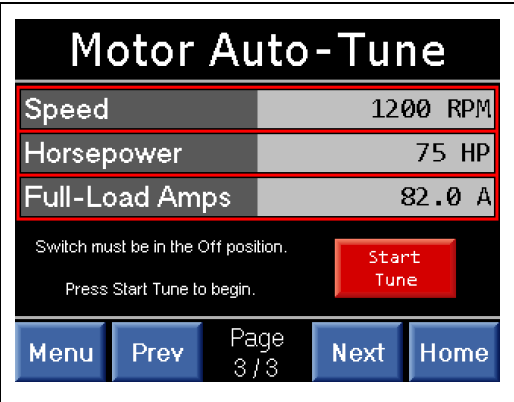
Begin entering the motor nameplate information.

For the motor speed, the nameplate will indicate the full-load speed in RPM, which includes slip. This value will be slightly smaller than the speed selected for the **Speed** parameter. For example, if the motor nameplate indicates a full-load speed of 1140 RPM, then choose 1200 RPM for the auto-tune. Simply touching the **Speed** value will cycle through the available values.

Once the speed has been determined and set, enter the motor capacity/size in horsepower into the **Horsepower** parameter and the full-load amps into the **Full-Load Amps** parameter. These two values are entered directly using the numeric touchscreen keypad.

With the HOA switch in the Off position, press the **Start Tune** button. The status message will indicate that the auto-tune process is ready to start, and to turn the HOA switch to the Hand position to begin. If the status message does not change, the HOA switch was not in the Off position when the **Start Tune** button was pressed.

Turn the HOA switch to the Hand position. The auto-tune command will be sent to the VFD and the status message will indicate that the VFD is executing the auto-tune process. This process will take approximately 30 seconds to complete, and the motor will make a series of "buzzing", "beeping" and "growling" sounds during this time while the winding characteristics are being measured. The motor should not spin during this time.

If the auto-tune process completes successfully, the status message will indicate success and wait until the HOA switch is turned back to the Off position.

Turn the HOA switch back to the Off position. This completes the auto-tune procedure.

Note:
In the event the auto-process results in a VFD fault, the status message will indicate that a fault has occurred. The HOA switch should be left in the Hand position, and the user should return to the Home screen by pressing the Home button in order to ascertain which fault has occurred. Do *NOT* turn the HOA switch back to the Off position before the fault information has been determined, as this will clear the fault.

Pump Fillage Calibration

Variations in pump design and placement of the proximity switch can result in a calculated pump fillage that is skewed from a known pump fillage. Performing a pump fillage calibration will correct for any of these variations and/or misplacements, and will result in a much more accurate representation of down-hole performance.

To perform the calibration process, first run the system with the HOA switch in the Hand position at a constant speed until fluid has reached the surface.

Once fluid has reached the surface, navigate to the ***Fillage Calibration*** screen on the OptiPump controller from the Home screen by pressing the Main Menu button, then the Configure button, followed by the Pump-Off button. The ***Fillage Calibration*** page is the last page of the ***Pump-Off*** configuration section.

Enter the known pump fillage value in the ***Known Fillage*** parameter by touching the current percentage value. The new value is entered directly using the numeric touchscreen keypad.

With the system still running, and the HOA switch in the Hand position, press the Start Calibration button. The status message below the button will change to indicate that the process is currently calibrating. The process will take approximately 10 strokes to correctly account for any pump and setup variations. During this time, the monitor values on the left side of the screen will change rapidly.

<div style="border:2px solid black; padding:10px; text-align:center; color:red; font-size:large;">
Do NOT change the speed of the system while running the pump fillage calibration process. If the speed is changed during the calibration process, perform the process again.
</div>

Once the process has successfully completed, the status message will change to indicate that the controller has successfully calibrated the pump fillage. This message will be shown for several seconds, then reset back to ready-to-calibrate state.

This completes the pump fillage calibration process. Return to the Home screen and verify that the calculated pump fillage more closes matches the known pump fillage value used to calibrate the system.
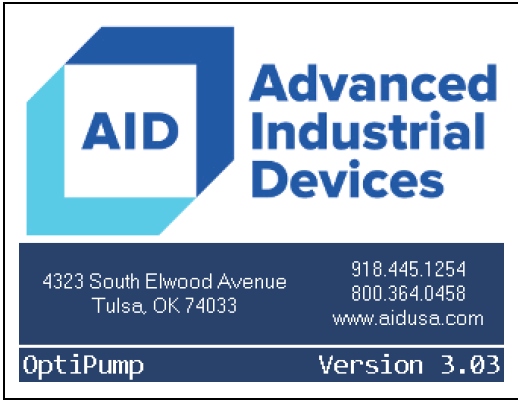
The Help screen provides contact information for both sales and support of the OptiPump controller and/or drive package.

If you ever have any question during the initial setup, normal operation, or while troubleshooting, please contact us, and we'll be happy to help.

The OptiPump name and currently installed program version are displayed at the bottom of the screen. Keep this information handy, as it will help our support engineers quickly troubleshoot and answer any questions you may have.

System Parameters

Name	Default	Minimum	Maximum	Units
	Summary			
Date	N/A	N/A	N/A	N/A
	Current real-time clock (RTC) date. The date and time information are used to record the last shutdown and in the SD card logging.			
Time	N/A	N/A	N/A	N/A
	Current real-time clock (RTC) time. The date and time information are used to record the last shutdown and in the SD card logging.			
Scrn Saver Time	20	1 (0 Disables)	99	Minutes (Mins)
	Time since the last user action before the screen saver starts.			
Well Name	GPS	0	15	Characters
	Name of the well site. This text is displayed in combination with the **Well Number** on the Home screen and at the top of each of the logged CSV files.			
Well Number	OptiPump	0	15	Characters
	Number of the well site. This text is displayed in combination with the **Well Name** on the Home screen and at the top of each of the logged CSV files.			
Stroke Length	36	1	300	Inches
	Length of the pump stroke. This can be measured by the difference between the bottom-of-stroke and top-of-stroke distances on the polished rod.			
Prox Ignore Time	2.00	0.01	99.99	Seconds (Secs)
	Ignore additional proximity switch closures for a chosen number of seconds after the first closure. Used to ignore false detections, depending on how the proximity switch is mounted.			

System Parameters, Continued…

Name	Default	Minimum	Maximum	Units
	Summary			
Trq In (AN0) Min	0.00	-300.00	300.00	Percentage (%)
	Minimum torque value for Analog Input 0 at 0 VDC.			
Trq In (AN0) Max	200.00	-300.00	300.00	Percentage (%)
	Maximum torque value for Analog input 0 at 10 VDC.			
SCADA Com Port Type	(1) RS485	(0) RS232 (1) RS485		None
	Communication port type for Modbus RTU SCADA. If this value is changed, be sure to also check the DIP switch positions on the back of the controller. The controller must be power-cycled or rebooted before the change will take effect.			
SCADA Com Baud Rate	(0) 9600	(0) 9600 (1) 19200 (2) 38400 (3) 57600 (4) 115200		bps
	Communication port baud rate for Modbus RTU SCADA. The controller must be power-cycled or rebooted before the change will take effect.			
SCADA Com Slv Addr	1	1	255	None
	Modbus RTU SCADA slave address for the controller. The controller must be power-cycled or rebooted before the change will take effect.			
VFD Com Communication	(1) Enabled	(0) Disabled (1) Enabled		None
	Enables support for Modbus RTU serial communication with the Fuji MEGA VFD. The controller must be power-cycled or rebooted before the change will take effect.			

System Parameters, Continued…

Name	Default	Minimum	Maximum	Units
	Summary			
VFD Com Baud Rate	(0) 9600	(0) 9600 (1) 19200 (2) 38400 (3) 57600 (4) 115200		bps
	RS485 communication port baud rate for Modbus RTU serial communication with the Fuji MEGA VFD. This value must match the setting of parameter Y14 of the VFD and the controller must be power-cycled or rebooted before the change will take effect.			
VFD Com Slave Address	1	1	255	None
	Modbus RTU slave address of the Fuji MEGA VFD serially connected to the controller. This value must match the value of parameter Y11 of the VFD. The controller must be power-cycled or rebooted before the change will take effect.			

Analog & Digital Shutdowns Parameters

Name	Default	Minimum	Maximum	Units
	Summary			
AN3 Name	Analog Input 3	0	15	Characters
	Name displayed on the Home screen.			
AN3 Units	Units	0	5	Characters
	Engineering units used for display. This does not provide unit conversions. The units are just 5 characters of text displayed beside the value for the analog input.			
AN3 Minimum	0.0	-3276.8	3276.7	Set by *AN3 Units*
	Value used for scaling at 4 mA.			
AN3 Maximum	100.0	-3276.8	3276.7	Set by *AN3 Units*
	Value used for scaling at 20 mA.			

Analog & Digital Shutdowns Parameters, Continued…

Name	Default	Minimum	Maximum	Units
	Summary			
AN3 Signal Loss	(0) Disabled	(0) Disabled (1) Enabled		None
	Shutdown on signal-loss, if detected. A signal-loss is defined as having 3.00 mA or less on the analog input for 5 seconds while the system is running. This is a non-restartable shutdown.			
AN3 Function	(0) Disabled	(0) Disabled (1) Monitor (2) Shutdown		None
	How to handle the analog input. **Monitor** will only display on the Home screen. **Shutdown** will display and enable shutdown detection.			
AN3 Detection	(0) Low	(0) Low (1) High (2) Low & High		None
	Detect low, high, or low and high shutdowns when the analog input **Function** is set to **Shutdown**.			
AN3 Restart Type	(0) Manual	(0) Manual (1) Timed		None
	Determine if the analog input low or high shutdown requires a manual restart by an operator, or if the controller can automatically restart after the automatic/timed **Restart Delay** time expires.			
AN3 Restart Delay	01:00:00	00:00:01	99:59:59	
	Time to wait until automatic restart after shutdown when the **Restart Type** is set to **Automatic/Timed**.			
AN3 Shutdown Low	10.0	-3276.8	3276.7	Set by **AN3 Units**
	The scaled analog input value must be equal to or less than this setpoint value for the set start and detection delay time in order to shut down on low detection.			
AN3 Shutdown Low Start Delay	00:05:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore low shutdown detection at start-up.			

Analog & Digital Shutdowns Parameters, Continued…

Name	Default	Minimum	Maximum	Units
	Summary			
AN3 Shutdown Low Detection Delay	00:01:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore low shutdown detection after the ***Start Delay*** has expired.			
AN3 Shutdown High	100.0	-3276.8	3276.7	Set by ***AN3 Units***
	The scaled analog input value must be equal to or greater than this setpoint value for the set start and detection delay time in order to shut down on high detection.			
AN3 Shutdown High Start Delay	00:05:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore high shutdown detection at start-up.			
AN3 Shutdown High Detection Delay	00:01:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore high shutdown detection after the start delay has expired.			
AN4 Name	Analog Input 4	0	15	Characters
	Name displayed on the Home screen.			
AN4 Units	Units	0	5	Characters
	Engineering units used for display. This does not provide unit conversions. The units are just 5 characters of text displayed beside the value for the analog input.			
AN4 Minimum	0.0	-3276.8	3276.7	Set by ***AN4 Units***
	Value used for scaling at 4 mA.			
AN4 Maximum	100.0	-3276.8	3276.7	Set by ***AN4 Units***
	Value used for scaling at 20 mA.			

Analog & Digital Shutdowns Parameters, Continued…

Name	Default	Minimum	Maximum	Units
	Summary			
AN4 Signal Loss	(0) Disabled	(0) Disabled (1) Enabled		None
	Shutdown on signal-loss, if detected. A signal-loss is defined as having 3.00 mA or less on the analog input for 5 seconds while the system is running. This is a non-restartable shutdown.			
AN4 Function	(0) Disabled	(0) Disabled (1) Monitor (2) Shutdown		None
	How to handle the analog input. **Monitor** will only display on the Home screen. **Shutdown** will display and enable shutdown detection.			
AN4 Detection	(0) Low	(0) Low (1) High (2) Low & High		None
	Detect low, high, or low and high shutdowns when the analog input **Function** is set to **Shutdown**.			
AN4 Restart Type	(0) Manual	(0) Manual (1) Timed		None
	Determine if the analog input low or high shutdown requires a manual restart by an operator, or if the controller can automatically restart after the timed **Restart Delay** time expires.			
AN4 Restart Delay	01:00:00	00:00:01	99:59:59	
	Time to wait until automatic restart after shutdown when the **Restart Type** is set to **Automatic/Timed**.			
AN4 Shutdown Low	10.0	-3276.8	3276.7	Set by **AN4 Units**
	The scaled analog input value must be equal to or less than this setpoint value for the set start and detection delay time in order to shut down on low detection.			

Analog & Digital Shutdowns Parameters, Continued…

Name	Default	Minimum	Maximum	Units
	Summary			
AN4 Shutdown Low Start Delay	00:05:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore low shutdown detection at start-up.			
AN4 Shutdown Low Detection Delay	00:01:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore low shutdown detection after the **Start Delay** has expired.			
AN4 Shutdown High	100.0	-3276.8	3276.7	Set by **AN4 Units**
	The scaled analog input value must be equal to or greater than this setpoint value for the set start and detection delay time in order to shut down on high detection.			
AN4 Shutdown High Start Delay	00:05:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore high shutdown detection at start-up.			
AN4 Shutdown High Detection Delay	00:01:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore high shutdown detection after the **Start Delay** has expired.			
I5 Name	Digital Input 5	0	15	Characters
	Name displayed on the Home screen.			
I5 Contact Type	(0) Normally Open	(0) Normally Open (1) Normally Closed		None
	The unpowered state of the contacts used to trigger a shutdown. Commonly stated as "Normally Open, Closed to Kill" or "Normally Closed, Open to Kill".			
I5 Shutdown Restart Type	(0) Manual	(0) Manual (1) Timed		None
	Determine if the digital input shutdown requires a manual restart by an operator, or if the controller can automatically restart after the automatic/timed **Restart Delay** time expires.			

Analog & Digital Shutdowns Parameters, Continued…

Name	Default	Minimum	Maximum	Units
	Summary			
I5 Shutdown Restart Delay	01:00:00	00:00:01		99:59:59
	Time to wait until automatic/timed restart after shutdown when the *Restart Type* is set to *Automatic/Timed*.			
I5 Shutdown Start Delay	00:05:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore shutdown detection at start-up.			
I5 Shutdown Detection Delay	00:01:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore shutdown detection after the *Start Delay* has expired.			
I6 Name	Digital Input 6	0	15	Characters
	Name displayed on the Home screen.			
I6 Contact Type	(0) Normally Open	(0) Normally Open (1) Normally Closed		None
	The unpowered state of the contacts used to trigger a shutdown. Commonly stated as "Normally Open, Closed to Kill" or "Normally Closed, Open to Kill".			
I6 Shutdown Restart Type	(0) Manual	(0) Manual (1) Timed		None
	Determine if the digital input shutdown requires a manual restart by an operator, or if the controller can automatically restart after the automatic/timed *Restart Delay* time expires.			
I6 Shutdown Restart Delay	01:00:00	00:00:01		99:59:59
	Time to wait until automatic/timed restart after shutdown when the *Restart Type* is set to *Automatic/Timed*.			
I6 Shutdown Start Delay	00:05:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore shutdown detection at start-up.			

Analog & Digital Shutdowns Parameters, Continued…

Name	Default	Minimum	Maximum	Units
	Summary			
I6 Shutdown Detection Delay	00:01:00	00:00:01	99:59:59	HH:MM:SS
	Time to ignore shutdown detection after the **Start Delay** has expired.			

Pump-Off Parameters

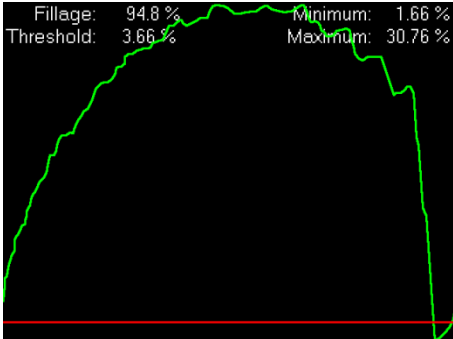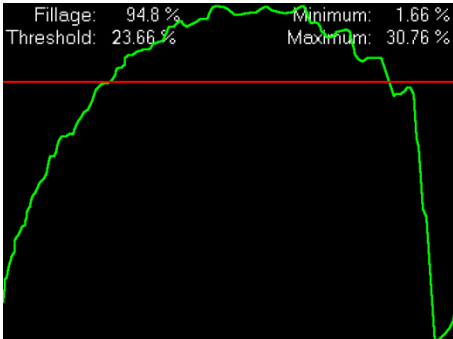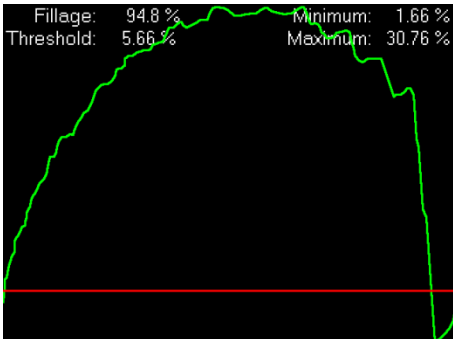| Name	Default	Minimum	Maximum	Units
	Summary			
Speed Control	(0) Constant Speed	(0) Constant Speed (1) Slow Down		None
	In Constant Speed mode, the controller will not attempt to control the speed of the pump as the pump fillage decreases. It will run at a fixed speed (usually set by the speed knob on the panel) until the Minimum Fillage and Fillage Violation conditions are met. In Slow Down mode, the controller linearly decreases the speed of the pump as the pump fillage decreases. The pump runs at maximum speed for 100% pump fillage and greater and minimum speed at the value of the Minimum Fillage. In the Slow Down mode, speed changes take place every 6 strokes.			
Minimum Fillage	95.0	1.0	100.0	Percentage (%)
	This is the minimum allowed pump fillage when in the automatic mode. The controller will maintain a pump fillage between 100% and this value when **Speed Control** is set to **Slow Down**.			
Fillage Violations	5	1	100	Strokes
	The number of pump fillage calculations, in a row, less than or equal to the **Minimum Fillage** that will trigger a pump-off condition. If a pump fillage calculation results in a value greater than the **Minimum Fillage**, the number of fillage violations resets to 0.			
Restart Time	00:01:00	00:00:01	99:59:59	HH:MM:SS
	Time to wait until automatic restart after a pump-off condition.			

Pump-Off Parameters, Continued…

Name	Default	Minimum	Maximum	Units
Summary				
Detect Threshold	4.00	0.01	100.00	Percentage (%)
The detection threshold is used to filter out mechanical noise and proximity switch position errors at the top-of-stroke, by increasing the point where the detection algorithm works. The detection threshold value is a torque percentage that is added to the minimum torque recorded. See the graphic below for recommendations.				

Detection Threshold Too Low

Here, the detection threshold has been set too low, at a value of 2.00%. This value is added to the minimum torque value of 1.66%, resulting in a final detection threshold of 3.66%. The green torque line crosses the threshold line in *two* places in the lower right corner.

Detection Threshold Too High

In this example, the detection threshold is set at 22.00%, resulting in a final detection threshold of 23.66%. The green torque line peak that is located just below the threshold line on the right, is treated as mechanical noise, and is ignored. This results in a pump fillage calculation that is incorrect.

Optimal Detection Threshold

The optimal detection threshold (4.00% in this example) sets the threshold line just high enough (5.66%) to ignore the small dip in the green torque line in the lower right, but high enough that the threshold line crosses the green torque line only once on the right half of the card.

Known Fillage	100.0	50.0	100.00	Percentage (%)
The known pump fillage used when performing the pump fillage calibration. For further information, see the Pump Fillage Calibration section.				

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