SC5000

INSTRUCTION MANUAL

MOTOR PROTECTION ELECTRONICS, LLC

2464 Vulcan Road
Apopka, Florida 32703

Phone: (407) 299-3825
Website: www.mpelectronics.com

STATION CONTROLLER SC5000 INTRODUCTION

Revision Date: 12-30-22

CONTROL MODES

- Level Control Mode
- Flow Control Mode
- Pressure Control Mode
- Booster Control Mode

STANDARD I / O

- Ethernet Port ENET1 with Modbus TCP Protocol - for connection to: SCADA System
  Ethernet Port ENET2 with Modbus TCP Protocol - for connection to: SC5000-CTS-HMI
  RS232 Port COM1 with Modbus RTU Protocol - for connection to: SC5000-LED-HMI
- 1 USB Host Port for Backup and Restore of Setup Parameters
- 1 Analog Output, Isolated 4-20mA (AOX1)
  May be Assigned to Application Specific Functions
- 2 Analog Inputs, Isolated 4-20mA (AIX1 - AIX2)
  May be Assigned to Application Specific Functions
- 12 Relay Outputs (ROX1 - ROX12)
  May be Assigned to Application Specific Functions
- 30 Discrete Inputs (D1 - D30)
  May be Assigned to Application Specific Functions

OPTIONAL I / O

- 6 Analog Outputs, Isolated 4-20mA (AO1 - AO6)
  May be Assigned to Application Specific Functions
- 8 Analog Inputs, Isolated 4-20mA (A1 - A8)
  May be Assigned to Application Specific Functions
- 3 Discrete Pulse Capture Inputs, Isolated (DPC1 - DPC3)
  Discrete Pulse Capture Input DPC1 - Assigned Function of: Pulse Flow Meter PFM1
  Discrete Pulse Capture Input DPC2 - Assigned Function of: Pulse Flow Meter PFM2
  Discrete Pulse Capture Input DPC3 - Assigned Function of: Pulse Flow Meter PFM3

SPECIFICATIONS

- Input Power: 24 VDC ±10%, 0.6 A max
- Dimensions (Width x Height x Depth): 10.340” x 6.750” x 6.208”
- Ambient Operating Temperature: -20°C to +65°C (-4°F to +149°F)
- Color: White with Blue Graphics
- Discrete Inputs: ±6 V, 60 Hz Square Wave ±0.6mA max, Transient Protected
- Relay Outputs: 8 A @ 120 VAC Resistive
- Analog Outputs: Isolated 4-20mA, Transient Protected, Maximum Load: 900Ω
- Analog Inputs: Isolated 4-20mA, 100 Ω Load, Transient Protected
- Pulse Capture Inputs: Isolated, Transient Protected
  Maximum Pulse Frequency: 60kHz (with Duty Cycle Between 40% - 60%)
  Power Supply Options: +5 VDC, +12 VDC, or +24 VDC
  Pull Up or Pull Down Resistor Supplied with Controller: 5.1 KΩ

STATION CONTROLLER SC5000
ORDERING INFORMATION

Revision Date: 12-30-22

CONTROLLER

Part Number: SC5000 - X X X X X

Standard I/O:
2 Ethernet Ports: ENET1 & ENET2
1 RS232 Port: COM1
1 USB Host Port: USB
2 Analog Inputs: AIX1 & AIX2
1 Analog Output: AOX1
30 Discrete Inputs: D1 - D30
12 Relays Outputs: ROX1 - ROX12

Additional Analog Outputs:
0 = None
1 = AO1
2 = AO1 - AO2
: :
6 = AO1 - AO6

Additional Analog Inputs:
0 = None
1 = A1
2 = A1 - A2
: :
8 = A1 - A8

Discrete Pulse Capture Input DPC1:
Blank = None
A = +5 VDC Power Supply
B = +12 VDC Power Supply
C = +24 VDC Power Supply

Discrete Pulse Capture Input DPC2:
Blank = None
A = +5 VDC Power Supply
B = +12 VDC Power Supply
C = +24 VDC Power Supply

Discrete Pulse Capture Input DPC3:
Blank = None
A = +5 VDC Power Supply
B = +12 VDC Power Supply
C = +24 VDC Power Supply

OPERATOR INTERFACE

Part Number: SC5000 - XXX - HMI

OPERATOR INTERFACE with Communication Cable:
CTS = Color Touchscreen HMI See Section W
LED = 5 Digit Numerical LED HMI See Section X

POWER SUPPLY

Part Number: SC5000 - PS24

24 VDC 3.8A 35mm DIN Rail Mount

Revision Date: 12-30-22

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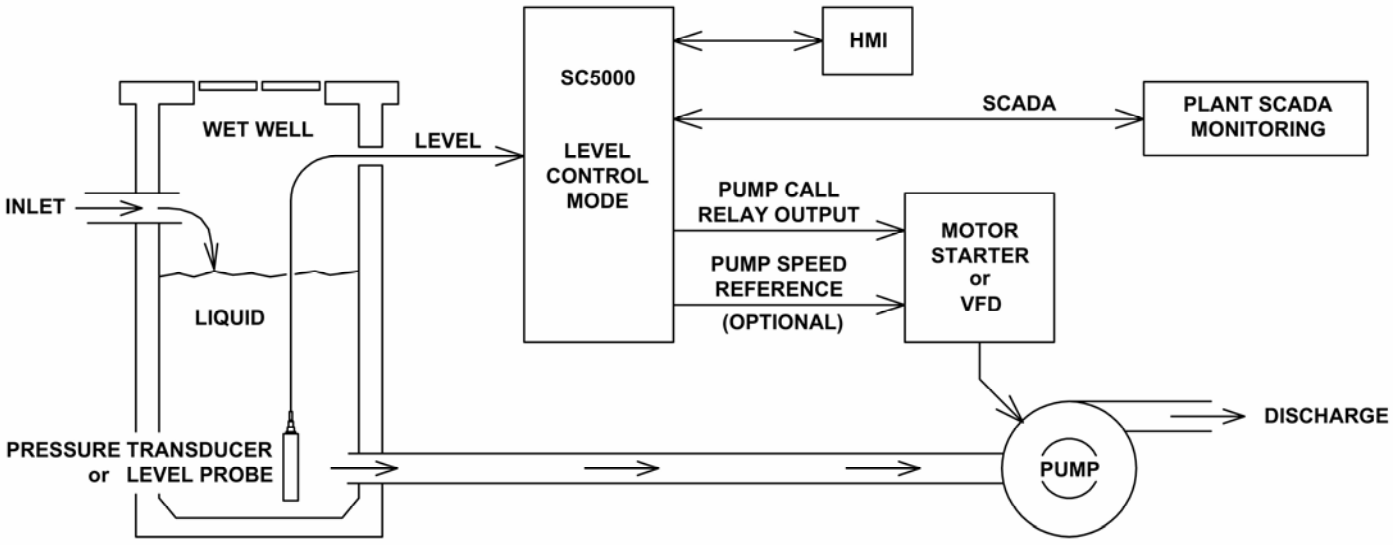

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SECTION 1
LEVEL CONTROL

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LEVEL CONTROL

DESCRIPTION OF FEATURES

Introduction

With the Master Control Mode (Parameter P.091) set for “Level Control” the SC5000 will function as a lift station level controller, and all logic pertaining to “Flow Control”, “Pressure Control” and “ Booster Control” will be disabled. In the “Level Control” mode, a variety of control options are available in the setup menu that make the Controller customizable for a large number of applications. It can manage up to 6 pumps and can perform in either a Pump Up or a Pump Down application. With optional Analog Outputs, it can provide a pump speed reference for VFD speed control. The logic in the Controller turns the pumps on or off based on a comparison of the Level Input with the Pump On / Off Level setup parameters. The Controller’s logic alternates the pumps, performs Lag Pump Delays, and provides High Level and Low Level alarms. It has parameters in the menu that allow the operator to set the Number of Pumps Present, the Maximum Number of Pumps Allowed to Run At the Same Time, and the Maximum Number of Pumps Allowed to Run While On a Generator.

HMI Features

SC5000-CTS-HMI

The **SC5000-CTS-HMI** is a **C**olor **T**ouch **S**creen HMI programmed with screens that shows the Wet Well Level, the Pump Call to Run status, the High Level and Low Level alarm status, Parameter Security Write Access status, Fault Codes, and allows an operator to perform Level Simulation. All Setup Parameters for LEVEL CONTROL and I/O Setup are made available on its display screens for the operator to view or change.

SC5000-LED-HMI

The **SC5000-LED-HMI** is a 5 digit numerical LED HMI that shows the Wet Well Level, the Pump Call to Run status, the High Level and Low Level alarm status, Parameter Security Write Access status, Fault indicator that shows when a Fault Code is present, and TX and RX communication activity status. An operator may also perform Level Simulation and reset of any Fault Codes. All Setup Parameters for LEVEL CONTROL and I/O Setup are made available in its menu for the operator to view or change.

Level Input Select

The Level Input Select (Parameter P.133) allows for the selection of one of the following level input sources: Either one or two analog 4-20mA inputs (Pressure Transducers), a conductance type Level Probe, Float Switches, or a Remote Level Control value set through the SCADA system. See Parameter P.133 on page 1-8.

Pump Alternation

Automatic Alternation

In the Level Control Mode the Pump Alternation Sequence Mode is menu selectable and may be set for one of the following: Standard Alternation, Pump 1 Always Lead, Split Alternation - 2&4, Split Alternation - 3&3, or Split Alternation - 4&2. For all of the Alternation Sequence Modes, the alternation of the pumps will be “First On First Off”. With one of the Split Alternation modes selected, the pumps are divided into two groups, Group 1 and Group 2. Where each group of pumps have their own alternation logic. With Split Alternation selected, there is the option of permitting or not permitting Group 1 pumps from running along with pumps from Group 2. See page 1-7.

See the alternation sequence diagrams on pages 1-13, 1-14 & 1-15.

Manual Pump Call Sequence

When manual control over the pump call sequence is desired, the operator can use the Forced Lead Pump Position feature for each Group of pumps to set the Lead Pump Position. This sets the order that the pumps are called in. The Lead Pump Position may also be set using a Lead Pump Selector switch for each Group that is connected to Discrete Inputs assigned to Functions 31 - 36. See page 1-7.

See connection diagrams on page A-12.

Time Based Alternation

The Controller also supports time based alternation for both Groups 1 and 2. The time based alternation logic may be triggered to alternate by an Internal Time Clock or from an External Time Clock. The Internal Time Clock alternation period is menu selectable. The External Time Clock may be either a hardware device connected to a Discrete Input on the Controller, or it may be part of a SCADA system’s logic, where the SCADA system would set a bit to force the alternation of the pumps. See page 1-7.

LEVEL CONTROL

VFD Speed Control

The VFD Speed Control logic, with optional Analog Outputs, performs proportional control of the pump speed (see Ordering Information on page i-3). The Level versus Pump Speed Curve is established using the following setup parameters: Level at 100% Speed, Level at Minimum Speed and the Minimum Speed setting. With these three parameters, along with the Pump On/Off Level Control parameters, the control range in the wet well that the pumps operate is established. Also provided is a Pump Start Speed Boost feature that may be used ensure that the Check Valve opens upon the start of a pump. See page 1-16.

Flush Cycle

The Flush Cycle feature can be setup to periodically flush the sludge build up from the bottom of the wet well and from the discharge pipe. It does this by maximizing the lift station's discharge flow rate. The flow rate is maximized by allowing the wet well to fill up to the Flush Cycle Start Level, and then by pumping the wet well down to the Flush Cycle Stop Level, with all available pumps running. The Flush Cycle Start Level and the Flush Cycle Stop Level are menu selectable. The Flush Cycle logic may be triggered to start by either an Internal Time Clock or from an External Time Clock. When using the Internal Time Clock, the Delay Between Flush Cycles is menu selectable. If an External Time Clock is used, it may be either a hardware device connected to a Discrete Input on the Controller, or it may be part of a SCADA system's logic, where the SCADA system would set a bit to force the start of the Flush Cycle. The Flush Cycle menu also provides the means to manually start or stop the Flush Cycle. See page 1-17.

Flow Calculator

The Flow Calculator feature provides the following data: Latest Inflow Rate, Inflow Totalizer (with remote reset), Pump 1 - 6 Outflow Rate, Average Daily Inflow Total and has available the Last 7 Days of Daily Inflow Totals. The Flow Calculator's Start New Day command may be setup to be triggered by either an Internal 24 hour Time Clock or from an External 24 hour Time Clock. The External Time Clock may be either a hardware device connected to a Discrete Input on the Controller, or it may be part of a SCADA system's logic where the SCADA system sets the Start New Day bit once each day. See pages 1-18 through 1-23.

LEVEL CONTROL

Discrete Inputs

30 Discrete Inputs (D1 - D30) that may be setup to perform the following Functions:

- Level Probe Inputs
- Pump Disable Inputs
- All Pump Disable - Phase Monitor Input
- On Generator - Limits number of pumps allowed to run
- Toggle Between ALM1 & ALM2 for Level Input selection
- Start Flush Cycle - External Time Clock Input
- External Alternation - External Time Clock Input
- Sequence Inputs - Lead Pump Selector Switch Inputs
- Call Pump Last Inputs
- Flow Calculator - Start New Day Time Clock Input
- Pump Cutoff Low-Low Level Input
- Pump Cutoff High-High Level Input
- High and Low Level Alarm Inputs
- Float Control - Float Switch Backup Inputs
- Collection of Discrete Input Data for SCADA

Relay Outputs

12 Relay Outputs (ROX1 - ROX12) that may be setup to perform the following Functions:

- Up to Six Pump Call to Run Outputs
- High or Low Level Alarm Outputs
- SCADA Remote Control Outputs

Analog Inputs

2 Standard Analog Inputs (AIX1 - AIX2) and up to 8 more Optional Analog Inputs (A1 - A8).
The Analog Inputs may be setup to perform one of the following Functions:

- Analog Level Meter ALM1 or ALM2
- Analog Flow Meter AFM1, AFM2 or AFM3
- Analog Pressure Meter APM1 or APM2
- Analog Current Meter ACMA, ACMB or ACMC
- Collection of Analog Input Data for SCADA

Analog Outputs

1 Standard Analog Output (AOX1) and up to 6 more Optional Analog Outputs (AO1 - AO6).
The Analog Outputs may be setup to perform one of the following Functions:

- Analog Signal for Pumps 1 - 6 Speed Reference
- Analog Signal for Pumps Speed Reference any Pump (Always Active)
- Analog Signal that is a Copy of Wet Well Level

Discrete Pulse Counter Inputs

Option for up to 3 Discrete Pulse Counter Inputs (DPC1 - DPC3) that may be used to perform the following:

- Discrete Pulse Counter Input for Pulse Flow Meter PFM1, PFM2 or PFM3

LEVEL CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters
Master Control Mode				
P.091	1		40091	Master Control Mode 1 = Level Control **Must Be Set On "1" for Level Control** 2 = Flow Control 3 = Pressure Control 4 = Booster Control
Pump Setup				
P.092	6		40092	Number of Pumps Present 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps
P.093	6		40093	Maximum Number of Pumps Allowed to Run at the Same Time 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps
P.094	6		40094	Maximum Number of Pumps Allowed to Run While On Generator 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps Note: Must Connect Transfer Switch Contact to Discrete Input assigned to Function 18.

User / Operator Info.	SCADA		
Parameter	Register Address	Description of Data	
Elapsed Time Meter Data			
Etd.1	41891	Pump 1 - Elapsed Time Meter (hours and 1/10 hours)	Range: 0.0 - 6553.5 hours
Etd.2	41892	Pump 2 - Elapsed Time Meter (hours and 1/10 hours)	Range: 0.0 - 6553.5 hours
Etd.3	41893	Pump 3 - Elapsed Time Meter (hours and 1/10 hours)	Range: 0.0 - 6553.5 hours
Etd.4	41894	Pump 4 - Elapsed Time Meter (hours and 1/10 hours)	Range: 0.0 - 6553.5 hours
Etd.5	41895	Pump 5 - Elapsed Time Meter (hours and 1/10 hours)	Range: 0.0 - 6553.5 hours
Etd.6	41896	Pump 6 - Elapsed Time Meter (hours and 1/10 hours)	Range: 0.0 - 6553.5 hours

LEVEL CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Level Alarms				
LoAL	2.0 feet		40101	Low Level Alarm — Range: 0.0 - 231.0 feet Notes: 1. This sets the level at which the Low Level Alarm will be activated. 2. To disable the Low Level Alarm see Parameter P.151. 3. The Low Level Alarm operation is delayed for 90 seconds after power is applied. 4. The Low Level Alarm does not act as a redundant pump off (for Pump Down). 5. A Float Switch connected to a Discrete Input assigned to either Functions 59 or 61 will also activate the Low Level Alarm. 6. Upon a Low Level Alarm, the contacts of a relay programmed for Function 7 will close.
The "Low Level Alarm" status is available from Modbus Coil 47 (Register 40003 Bit 14).				
HIAL	10.0 feet		40102	High Level Alarm — Range: 0.5 - 231.0 feet Notes: 1. This sets the level at which the High Level Alarm will be activated. 2. The High Level Alarm operation is delayed for 10 seconds after power is applied. 3. The High Level Alarm does not act as a redundant pump off (for Pump Up). 4. A Float Switch connected to a Discrete Input assigned to Functions 60, 62 or 70 will also activate the High Level Alarm. 5. Upon a High Level Alarm, the contacts of a relay programmed for Function 8 will close.
The "High Level Alarm" status is available from Modbus Coil 48 (Register 40003 Bit 15).				
Pump On / Off Levels				
1PoFF	3.0 feet		40103	1st Pump Off Level — Range: 0.2 - 231.0 feet
1Pon	6.0 feet		40104	1st Pump On Level — Range: 0.2 - 231.0 feet
2PoFF	3.5 feet		40105	2nd Pump Off Level — Range: 0.2 - 231.0 feet
2Pon	6.5 feet		40106	2nd Pump On Level — Range: 0.2 - 231.0 feet
3PoFF	4.0 feet		40107	3rd Pump Off Level — Range: 0.2 - 231.0 feet
3Pon	7.0 feet		40108	3rd Pump On Level — Range: 0.2 - 231.0 feet
4PoFF	4.5 feet		40109	4th Pump Off Level — Range: 0.2 - 231.0 feet
4Pon	7.5 feet		40110	4th Pump On Level — Range: 0.2 - 231.0 feet
5PoFF	5.0 feet		40111	5th Pump Off Level — Range: 0.2 - 231.0 feet
5Pon	8.0 feet		40112	5th Pump On Level — Range: 0.2 - 231.0 feet
6PoFF	5.5 feet		40113	6th Pump Off Level — Range: 0.2 - 231.0 feet
6Pon	8.5 feet		40114	6th Pump On Level — Range: 0.2 - 231.0 feet

LEVEL CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Pump Alternation Setup				
P.122	1		40122	Alternation Sequence Mode 1 = Standard Alternation: Group 1: Pumps 1 - 6 See page 1-13. 2 = Pump 1 Always Lead: Group 1: Pump 1 Group 2: Pumps 2 - 6 See page 1-13. 3 = Split Alternation - 2&4: Group 1: Pumps 1 - 2 Group 2: Pumps 3 - 6 See page 1-14. 4 = Split Alternation - 3&3: Group 1: Pumps 1 - 3 Group 2: Pumps 4 - 6 See page 1-14. 5 = Split Alternation - 4&2: Group 1: Pumps 1 - 4 Group 2: Pumps 5 - 6 See page 1-15. Also see: Alternation Sequence Modifier A (Parameter P.124) below.
P.124	0		40124	Alternation Sequence Modifier A 0 = Group 1 Pump(s) Are Allowed To Run With Pumps From Group 2 1 = Group 1 Pump(s) Not Allowed To Run With Pumps From Group 2 (Pump(s) in Group 1 are turned off before starting Pumps in Group 2) Note: This applies when Parameter P.122 = 2, 3, 4, or 5
P.129	0		40129	Forced Lead Pump Position - Group 1 0 = Normal Alternation X = Pump X as Lead Note: This applies to Group 1 when Parameter P.122 = 1, 3, 4, or 5
P.130	0		40130	Forced Lead Pump Position - Group 2 0 = Normal Alternation X = Pump X as Lead Note: This applies to Group 2 when Parameter P.122 = 2, 3, 4, or 5
P.131	0		40131	Time Based Alternation - Group 1 Range: 0 - 65535 minutes 0 = Disabled 60 = 1 hour 480 = 8 hours 1440 = 24 hours Note: Group 1 may be triggered to alternate by using the Internal Time Clock setup using Parameter P.131, or it can also be triggered by an External Time Clock, which may be either a hardware device connected to a Discrete Input setup to perform Function 21, or it may be triggered to alternate by having the SCADA system set Bit 14 in Register 40006.
P.132	0		40132	Time Based Alternation - Group 2 Range: 0 - 65535 minutes 0 = Disabled 60 = 1 hour 480 = 8 hours 1440 = 24 hours Note: Group 2 may be triggered to alternate by using the Internal Time Clock setup using Parameter P.132, or it can also be triggered by an External Time Clock, which may be either a hardware device connected to a Discrete Input setup to perform Function 22, or it may be triggered to alternate by having the SCADA system set Bit 15 in Register 40006.
Pump Alternation Status				
Ad.01	-	-	41888	Current Lead Pump - Group 1 Shows the number of the current Lead Pump.
Ad.02	-	-	41889	Current Lead Pump - Group 2 Shows the number of the current Lead Pump.

LEVEL CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Level Input Setup				
P.133	1		40133	Level Input Select 1 = Analog Level Meter - ALM1 - Single or Dual Transducers 2 = Analog Level Meter - ALM2 - Single or Dual Transducers 3 = Analog Level Meter - ALM1 - Dual Transducers 4 = Analog Level Meter - ALM2 - Dual Transducers 5 = Level Probe Meter - LPM1 - Level Probe 6 = Float Switch Inputs 7 = Remote Level Control Input Selection 1 - Level Input is Manually switched from ALM1 to ALM2. See Section M. Selection 2 - Level Input is Manually switched from ALM2 to ALM1. See Section M. Selection 3 - Level Input is Automatically switched from ALM1 to ALM2. See Section M. Selection 4 - Level Input is Automatically switched from ALM2 to ALM1. See Section M. Selection 5 - Level Probe with 10 Electrodes Connected to 10 Discrete Inputs. See Section L. Selection 6 - Float Switches as the primary (and only) Level Input. See pages 1-27 and 1-28. Selection 7 - Remote Level Control Input written through SCADA to Parameter rc.02. See page 1-12.
Level Input Data - Touchscreen HMI Display				
Ld.01	-	-	42143	Level Input Data - For Numerical Display of Level Note: This is the value of the Level input selected on Parameter P.133 scaled into feet and 1/10 of feet for numerical display on an HMI.
Ld.02	-	-	42144	Level Input Data - For Bar Graph Display of Level Note: This is the value of the Supply Level Input selected on Parameter P.133 scaled for display on a bar graph. It is scaled to a range of 0 - 4095. The Bar Graph Display scaling setup on the HMI device must be set for 0 - 4095.
Ld.03	-	-	42145	Level Input Source Status 1 = Analog Level Meter - ALM1 2 = Analog Level Meter - ALM2 3 = Level - Simulated 4 = Level Probe Meter - LPM1 5 = Float Switch Inputs 6 = Remote Level Control Input

LEVEL CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Station Control Setup				
P.149	1		40149	Pump Up or Down Mode 1 = Pump Down - Empty a Tank 2 = Pump Up - Fill a Tank Note: When Parameter P.149 is changed the following new default setup parameters will be loaded: All Pump On/Off Levels VFD - Level at Minimum Speed VFD - Level at 100% Speed
P.150	5 sec.		40150	Lag Pump Delay Range: 1 - 100 seconds Note: This is the minimum time period between the calling of pumps to run. It is also used to delay the turning on of the replacement pump when an operating pump is suddenly disabled, or when a time based alternation of the pumps is performed.
P.151	1		40151	Low Level Alarm Disable 0 = Disable Low Level Alarm 1 = Enable Low Level Alarm Notes: 1. This only disables Low Level Alarms generated from the Analog Level Input, or the Level Probe Input being below the Level Alarm setting on Parameter LoAL, not Low Level Alarms generated from Float Switch inputs assigned Functions 59 or 61. 2. This feature does not operate when the Float Switch Inputs are selected as the primary Level Input Source (Parameter P.133 = 6).
P.153	10 sec.		40153	Pump Re-enable Delay - Pump Cutoff Low-Low Level Range: 1 - 600 sec. Notes: 1. This is only used in the Pump Down Mode (Parameter P.149 = 1). 2. While the Low-Low Level Float Switch is closed no pump operation will be allowed. 3. A Low-Low Level Float Switch must be connected to a Discrete Input assigned to Function 59. 4. The Delay starts timing out when the Discrete Input opens. When the Re-enable Delay expires the Pump Cutoff Low-Low Level feature will no longer prevent pump operation. 5. While the Pump Cutoff Low-Low Level input is closed the Low Level Alarm will be active. The contacts of a relay assigned to the Low Level Alarm (Function 7) will also be close. Also, Fault Code 1041 will be generated.
Activates the “Pump Cutoff Active Low-Low Level”. Status is available from Modbus Coil 131 (Register 40009 Bit 2). Also activates the “Low Level Alarm”. Status is available from Modbus Coil 47 (Register 40003 Bit 14).				
P.154	10 sec.		40154	Pump Re-enable Delay - Pump Cutoff High-High Level Range: 1 - 600 sec. Notes: 1. This is only used in the Pump Up Mode (Parameter P.149 = 2). 2. While the High-High Level Float Switch is closed no pump operation will be allowed. 3. A High-High Level Float Switch must be connected to a Discrete Input assigned to Function 60. 4. The Delay starts timing out when the Discrete Input opens. When the Re-enable Delay expires the Pump Cutoff High-High Level feature will no longer prevent pump operation. 5. While the Pump Cutoff High-High Level input is closed the High Level Alarm will be active. The contacts of a relay assigned to the High Level Alarm (Function 8) will also be close. Also, Fault Code 1042 will be generated.
Activates the “Pump Cutoff Active High-High Level”. Status is available from Modbus Coil 132 (Register 40009 Bit 3). Also activates the “High Level Alarm”. Status is available from Modbus Coil 48 (Register 40003 Bit 15).				

LEVEL SIMULATION - Analog Level Input

The Level Simulation feature is provided to allow an operator to temporarily take manual control of the Level Input used by the Controller to control the pumps and provide high and low level alarms.

The Level Simulation discussed here is what is used when the “Level Input Select” (Parameter P.133) is set for either one of the “Analog Level Meters” (ALM1 or ALM2) or for “Remote Level Control Input” (rc.02), (where Parameter P.133 = 1, 2, 3, 4 or 7).

The Level Simulation starts from the actual level displayed prior to entering the Level Simulation mode.

If you do not exit the Level Simulation mode, normal operation will resume automatically 60 seconds after the last time a new value was entered for the simulated level.

When performing Level Simulation using the SC5000-CTS-HMI (connected to Ethernet Port ENET2) or when using the SC5000-LED-HMI (connected to Serial Port COM1), the operator is permitted to perform Level Simulation even if the “Parameter Write Access” is “LOCKED”. However, when performing Level Simulation through Ethernet Port ENET1 the “Parameter Write Access” must be “UNLOCKED”. ENET1 is intended for connection to a SCADA system, rather than a local HMI, therefore the additional security is necessary. See Page G-1.

Level Simulation - Using the SC5000-CTS-HMI (Color Touch Screen HMI)

On the SC5000-CTS-HMI the Level Simulation feature may be found on the screen for “Station Status”. It is comprised of a touch-button labeled “Push To Start Level Simulation” and the numerical entry screen that pops up when the Numerical Level Display (Parameter rc.01) is pressed.

To Start Level Simulation: Touch the “Push To Start Level Simulation” touch-button.

To Change Simulated Level: Touch the Numerical Level Display and enter the desired value.

To End Level Simulation: Touch the “Level Simulation Active” touch-button.

Level Simulation - Using the SC5000-LED-HMI

On the SC5000-LED-HMI the Level Simulation mode is entered by pressing the push-button labeled “LEVEL SIMULA.”. Changes to the simulated level are made by pressing either the Up or the Down push-buttons.

To Start Level Simulation: Press the “LEVEL SIMULA.” push-button.

To Increase Simulated Level: Push the Up push-button.

To Decrease Simulated Level: Push the Down push-button.

To End Level Simulation: Press the “LEVEL” push-button.

User / Operator Info.	SCADA	
Parameter	Register Address	Description of Parameter
rc.01	42001	Level Simulation - Simulated Level Input
To activate the Level Simulation mode set Modbus Coil 103 (Register 40007 Bit 6).		

LEVEL SIMULATION - Level Probe Input

The Level Simulation feature is provided to allow an operator to temporarily take manual control of the Level Input used by the Controller to control the pumps and provide high and low level alarms.

The Level Simulation discussed here is what is used when the “Level Input Select” (Parameter P.133) is set for the “Level Probe Meter” (LPM1) (Parameter P.133 = 5). The operator’s changes to the simulated level are made in increments equal to the “Level Probe Meter Electrode Spacing” (Parameter P.520).

The Level Simulation starts from the actual level displayed prior to entering the Level Simulation mode.

If you do not exit the Level Simulation mode, normal operation will resume automatically 60 seconds after the last time a new value was entered for the simulated level.

When performing Level Simulation using the SC5000-CTS-HMI (connected to Ethernet Port ENET2) or when using the SC5000-LED-HMI (connected to Serial Port COM1), the operator is permitted to perform Level Simulation even if the “Parameter Write Access” is “LOCKED”. However, when performing Level Simulation through Ethernet Port ENET1 the “Parameter Write Access” must be “UNLOCKED”. ENET1 is intended for connection to a SCADA system, rather than a local HMI, therefore the additional security is necessary. See Page G-1.

Level Simulation - Using the SC5000-CTS-HMI (Color Touchscreen HMI)

On the SC5000-CTS-HMI the Level Simulation feature may be found on the screen for “Station Status”. It is comprised of a touch-button labeled “Push To Start Level Simulation” and a touch-button for “UP” and a touch-button for “DN” (Down).

To Start Level Simulation: Touch the “Push To Start Level Simulation” touch-button.

To Increase Simulated Level: Touch the “UP” touch-button.

To Decrease Simulated Level: Touch the “DN” touch-button.

To End Level Simulation: Touch the “Level Simulation Active” touch-button.

Level Simulation - Using the SC5000-LED-HMI

On the SC5000-LED-HMI the Level Simulation mode is entered by pressing the push-button labeled “LEVEL SIMULA.”. Changes to the simulated level are made by pressing either the Up or the Down push-buttons.

To Start Level Simulation: Press the “LEVEL SIMULA.” push-button.

To Increase Simulated Level: Push the Up push-button.

To Decrease Simulated Level: Push the Down push-button.

To End Level Simulation: Press the “LEVEL” push-button.

To activate the Level Simulation mode set Modbus Coil 104 (Register 40007 Bit 7).
To decrease the Simulated Level set Modbus Coil 105 (Register 40007 Bit 8).
To increase the Simulated Level set Modbus Coil 106 (Register 40007 Bit 9).

REMOTE LEVEL CONTROL

The Remote Level Control feature is provided to allow an operator to have manual remote control, through a SCADA system, of the Level Input used by the Controller to control the pumps. The Remote Level Control feature also allows a SCADA system to send the Controller the Remote Level Control Input value from some remote location.

This feature requires that the “Level Input Select” (Parameter P.133) be set on “Remote Level Control Input” (Parameter P.133 = 7).

With a SCADA system connected to Ethernet Port ENET1, writing to the “Remote Level Control Input” (Parameter rc.02) is not permitted when the “Parameter Write Access” for ENET1 is “LOCKED”. It must be “UNLOCKED” to remotely change the Level Input value.

Using the SC5000-CTS-HMI, connected to Ethernet Port ENET2, to write to the “Remote Level Control Input” (Parameter rc.02) is permitted even if the “Parameter Write Access” for ENET2 is “LOCKED”.

Using the SC5000-LED-HMI, connected to RS232 Port COM1, to write to the “Remote Level Control Input” (Parameter rc.02) is permitted even if the “Parameter Write Access” for COM1 is “LOCKED”.

See details about the “Default Remote Level” (Parameter E.015), and the “Remote Control Command Canceling Delays” (Parameters E.011, E.012 and E.013) on page E-2.

User / Operator Info.	SCADA	
Parameter	Register Address	Description of Parameter
rc.02	42002	Remote Level Control Input

ALTERNATION SEQUENCE MODE

STANDARD ALTERNATION — Parameter P.122 = 1

Unless there is some special circumstance that requires a more complicated pump call sequence, this is the sequence that should be used.

The pumps will be Alternated “First On First Off”.

Discrete Inputs assigned the Function of “Pump Disable” (Functions 11 - 16) inputs may be used to disable pumps so that they will not be called to run.

Discrete Inputs assigned the Function of “Call Pump Last” (Functions 41 - 46) may be used to assign pumps to standby status, where they will only be called to run if no other pumps are available.

Discrete Inputs assigned the Function of “Sequence Input” (Functions 31 - 36) may be used to set the lead pump.

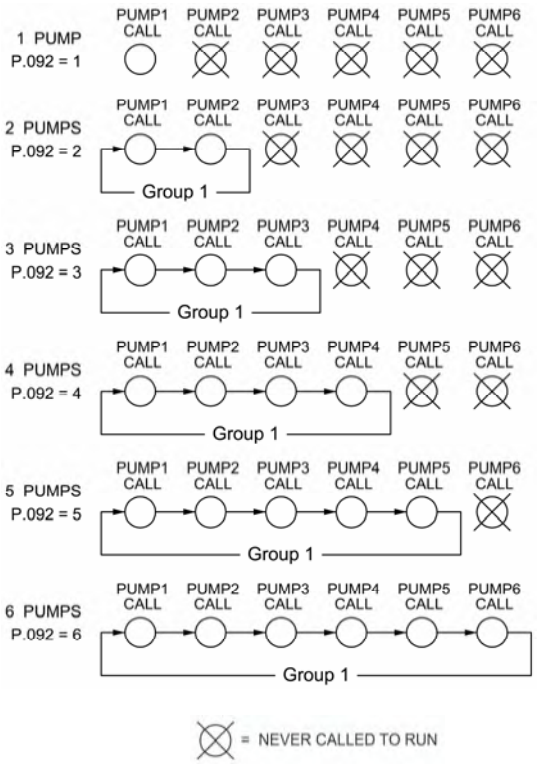
The “Forced Lead Pump Position - Group 1” (Parameter P.129) may be used to set the lead pump.

“Time Based Alternation - Group 1” (Parameter P.131) may be setup to force an alternation using an Internal Time Clock.

A Discrete Input assigned the Function of “External Alternation - Group 1” (Function 21) may be connected to an External Time Clock and used to force an alternation.

A SCADA system may initiate an alternation by momentarily setting Modbus Coil 95 (Register 40006, Bit 14).

Movement of Lead Pump Upon Alternation



PUMP 1 ALWAYS LEAD — Parameter P.122 = 2

This sequence is used when it is required that pump 1 always be lead pump.

The pumps in Group 2 will be Alternated “First On First Off”.

“Alternation Sequence Modifier A” (Parameter P.124) is provided to set whether or not pump 1 stays on when pumps from Group 2 are called to run.

Discrete Inputs assigned the Function of “Pump Disable” (Functions 11 - 16) inputs may be used to disable pumps so that they will not be called to run.

Discrete Inputs assigned the Function of “Sequence Input” (Functions 32 - 36) may be used to set the lead pump of Group 2.

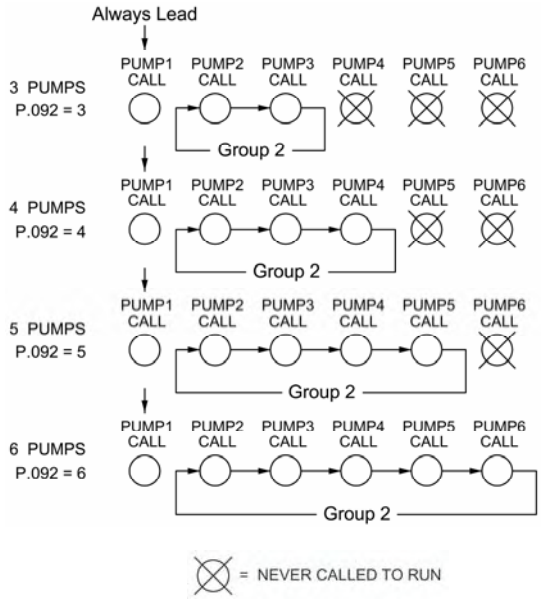
The “Forced Lead Pump Position - Group 2” (Parameter P.130) may be used to set the lead pump.

“Time Based Alternation - Group 2” (Parameter P.132) may be setup to force an alternation using an Internal Time Clock.

A Discrete Input assigned the Function of “External Alternation - Group 2” (Function 22) may be connected to an External Time Clock and used to force an alternation.

A SCADA system may initiate an alternation by momentarily setting Modbus Coil 96 (Register 40006, Bit 15).

Movement of Lead Pump Upon Alternation



ALTERNATION SEQUENCE MODE

SPLIT ALTERNATION - 2 & 4 Parameter P.122 = 3

This sequence is used when it is required that pumps be alternated in two separate groups as shown in the adjacent diagram.

The pumps in Groups 1 and 2 will be Alternated “First On First Off”.

“Alternation Sequence Modifier A” (Parameter P.124) is provided to set whether or not pumps in Group 1 stay on when pumps from Group 2 are called to run.

Discrete Inputs assigned the Function of “Pump Disable” (Functions 11 - 16) inputs may be used to disable pumps so that they will not be called to run.

Discrete Inputs assigned the Function of “Sequence Input” (Functions 31 - 36) may be used to set the lead pump.

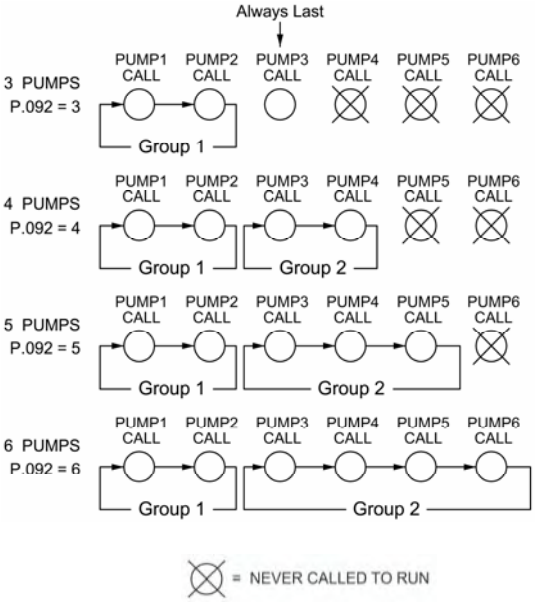
The “Forced Lead Pump Position - Group 1(2)” (Parameters P.129 and P.130) may be used to set the lead pump in each Group.

“Time Based Alternation - Group 1(2)” (Parameters P.131 and P.132) may be setup to force an alternation using Internal Time Clocks.

A Discrete Input assigned the Function of “External Alternation - Group 1(2)” (Functions 21 and 22) may be connected to External Time Clocks and used to force an alternation.

A SCADA system may initiate an alternation by momentarily setting Modbus Coils 95 or 96 (Register 40006, Bit 14 or Bit 15).

Movement of Lead Pump Upon Alternation



SPLIT ALTERNATION - 3 & 3 Parameter P.122 = 4

This sequence is used when it is required that pumps be alternated in two separate groups as shown in the adjacent diagram.

The pumps in Groups 1 and 2 will be Alternated “First On First Off”.

“Alternation Sequence Modifier A” (Parameter P.124) is provided to set whether or not pumps in Group 1 stay on when pumps from Group 2 are called to run.

Discrete Inputs assigned the Function of “Pump Disable” (Functions 11 - 16) inputs may be used to disable pumps so that they will not be called to run.

Discrete Inputs assigned the Function of “Sequence Input” (Functions 31 - 36) may be used to set the lead pump.

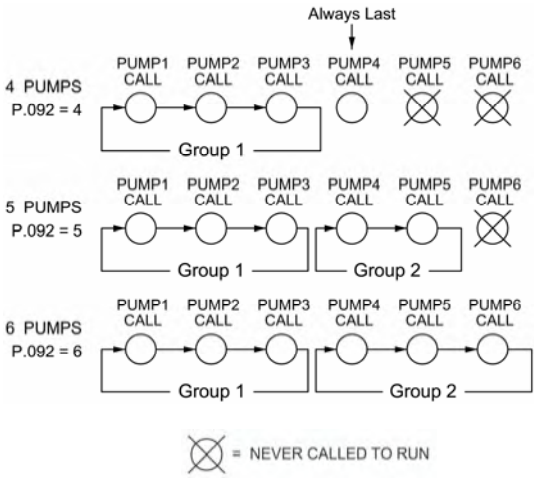
The “Forced Lead Pump Position - Group 1(2)” (Parameters P.129 and P.130) may be used to set the lead pump in each Group.

“Time Based Alternation - Group 1(2)” (Parameters P.131 and P.132) may be setup to force an alternation using Internal Time Clocks.

A Discrete Input assigned the Function of “External Alternation - Group 1(2)” (Functions 21 and 22) may be connected to External Time Clocks and used to force an alternation.

A SCADA system may initiate an alternation by momentarily setting Modbus Coils 95 or 96 (Register 40006, Bit 14 or Bit 15).

Movement of Lead Pump Upon Alternation



ALTERNATION SEQUENCE MODE

SPLIT ALTERNATION - 4 & 2 Parameter P.122 = 5

This sequence is used when it is required that pumps be alternated in two separate groups as shown in the adjacent diagram.

The pumps in Groups 1 and 2 will be Alternated “First On First Off”.

`“Alternation Sequence Modifier A” (Parameter P.124) is provided to set whether or not pumps in Group 1 stay on when pumps from Group 2 are called to run.

Discrete Inputs assigned the Function of “Pump Disable” (Functions 11 - 16) inputs may be used to disable pumps so that they will not be called to run.

Discrete Inputs assigned the Function of “Sequence Input” (Functions 31 - 36) may be used to set the lead pump.

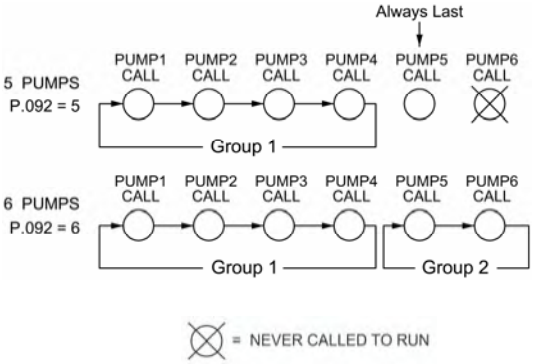
The “Forced Lead Pump Position - Group 1(2)” (Parameters P.129 and P.130) may be used to set the lead pump in each Group.

“Time Based Alternation - Group 1(2)” (Parameters P.131 and P.132) may be setup to force an alternation using Internal Time Clocks.

A Discrete Input assigned the Function of “External Alternation - Group 1(2)” (Functions 21 and 22) may be connected to External Time Clocks and used to force an alternation.

A SCADA system may initiate an alternation by momentarily setting Modbus Coils 95 or 96 (Register 40006, Bit 14 or Bit 15).

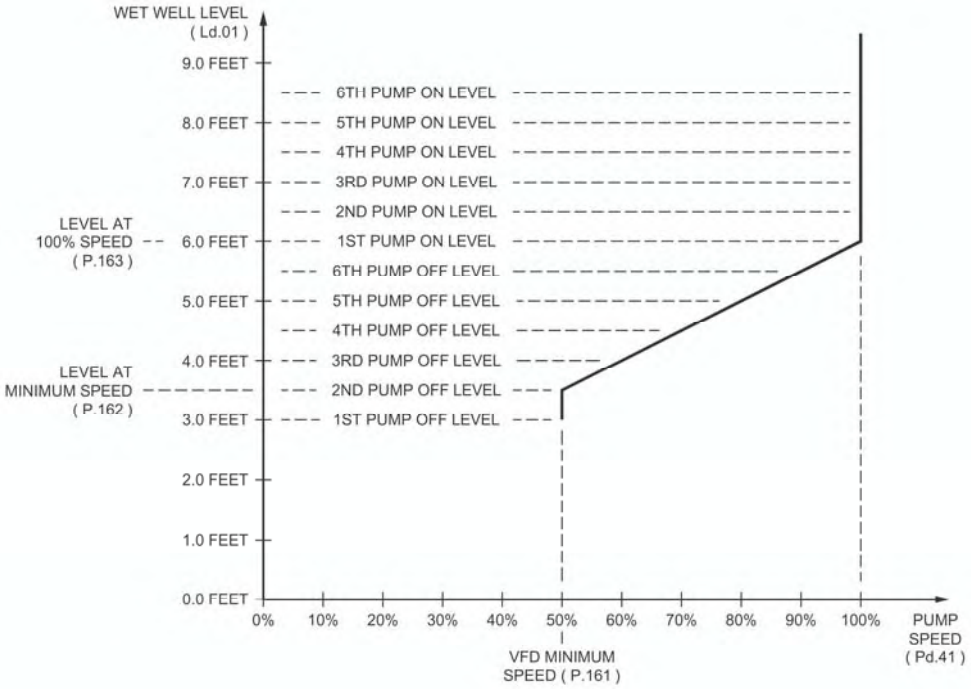
Movement of Lead Pump Upon Alternation



VARIABLE FREQUENCY DRIVE SPEED CONTROL OPTION SETUP

Pump Speed Versus Wet Well Level

Pump Down Application - Example Shown With All Setup Parameters Set On Their Default Values



User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
VFD Speed Reference Setup				
P.161	50%		40161	VFD - Minimum Speed (Percent of Full Speed) Range: 0% - 95%
P.162	3.5 feet		40162	VFD - Level at Minimum Speed Range: 0.1 - 231.0 feet
P.163	6.0 feet		40163	VFD - Level at 100% Speed Range: 0.1 - 231.0 feet
P.164	0 sec.		40164	Pump Start Speed Boost Time Range: 0 - 60 seconds Note: Set for 0 seconds to Disable Feature. See Note 6 below.
P.165	100%		40165	VFD - Speed of Pump Under Remote Control Range: 0% - 100%
Pump Speed Reference Data				
Pd.41	-		41877	Pump Speed Reference Data Range: 0.0 - 100.0 percent Note: This parameter is the Calculated Pump Speed Reference as a percent of full speed.

Notes:

1. A drawing should be made similar to the one above in order to coordinate the Pump Call On and Off Levels with the Pump Speed Versus Level Curve.
2. For each application there is usually a Minimum Speed, below which pump operation is undesirable.
3. The Minimum Speed may be set on either the Pump Controller using Parameter P.161 or on the VFD, but not on both.
4. For cases where some pumps are operated on a VFD, and others are operated at full speed, care should be taken to setup the system so that the speed of the pumps on VFDs are not allowed to go unacceptably low while being run with the other pumps at full speed.
5. Care should be taken not to set the Level At 100% Speed parameter and the Level At Minimum Speed Parameters too close together. The Fault Indicator on the front of the controller will be turned on if these two Parameters are set too close together, or are accidentally switched around. See Fault Code 1017 on the Fault Code Table, on page F-2.
6. Pump Start Speed Boost Time - This feature causes the Speed Reference of all pumps to temporarily increase to 100% when a pump is called, and each time an additional pump is called. The pump speed stays at 100%, for the time set on the Parameter P.164. The pump speed then returns to normal. This feature may be used in cases where a pump is started at a speed that is significantly less than 100%, to ensure that the Check Valve opens.

FLUSH CYCLE

The Flush Cycle is provided to periodically flush the sludge build up from the bottom of the wet well and from the discharge pipe. This is done by periodically maximizing the lift station's discharge flow rate.

Flush Cycle Steps:

1. Upon the start of the Flush Cycle, normal pump operation is suspended (all pumps turned off).
2. It then waits for the level to rise to the "Flush Cycle Start Level" set on Parameter P.173.
3. Upon reaching the "Flush Cycle Start Level" all available pumps are turned on with a delay in between.
4. The pumps stay on until the level reaches the "Flush Cycle Stop Level" set on Parameter P.174.
5. At the "Flush Cycle Stop Level" all pumps are turned off and normal pump control resumes.

Automatically Starting Flush Cycle:

A. Internal Time Delay - Expiration of the "Delay Between Flush Cycles" set on Parameter P.172.

B. External Time Clock - Closure of a Discrete Input that is assigned Function 20.

Manually Starting / Stopping Flush Cycle:

Start - On the SC5000-CTS-HMI (Color Touchscreen HMI) - Press the "Start Cycle" pushbutton.
On the SC5000-LED-HMI - Press & hold the LEVEL push-button until the "LEVEL" indicator starts to flash. To start the cycle through SCADA - Momentarily set Modbus Coil 90 (Register 40006 Bit 9).

Stop - On the SC5000-CTS-HMI - Press the "Stop Cycle" pushbutton.
On the SC5000-LED-HMI - Press & hold the LEVEL push-button until the "LEVEL" indicator stops flashing. To stop the cycle through SCADA - Momentarily set Modbus Coil 91 (Register 40006 Bit 10).

Notes:

1. The Flush Cycle Feature only works in the "Pump Down" mode (Parameter P.149 = 1).
2. Use of an External Time Clock to start the Flush Cycle may be preferred, because it would provide control over when the Flush Cycle occurs.
3. Where VFDs are used the analog Speed Reference will be forced to 100% during the pump down.
4. The number of pumps called to run by the Flush Cycle logic is always limited by the following:
   A. The setting on Maximum Number of Pumps Allowed to Run At the Same Time (Parameter P.093).
   B. The closing of Discrete Inputs that are assigned as the Pump Disable inputs (Functions 11 - 16).
5. If the Flush Cycle is active, the closing of a Discrete Input assigned as the All Pump Disable input (Function 17), will abort the Flush Cycle.
6. All backup systems and level alarms must be setup so that they do not activate within the Flush Cycle operating range set on Parameters P.173 and P.174.
7. If the Flush Cycle is active, the closing of a Discrete Input assigned as the Pump Cutoff - Low-Low Level input (Function 59), will abort the Flush Cycle. Therefore, the Flush Cycle Stop Level must be set higher than the Low-Low Level Float Switch.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Flush Cycle Setup				
P.171	0		40171	Flush Cycle Mode 0 = Flush Cycle Disabled 1 = Flush Cycle Enabled
P.172	1440 min		40172	Delay Between Flush Cycles Range: 1 - 65,535 minutes
P.173	9.5 feet		40173	Flush Cycle Start Level Range: 0.2 - 231.0 feet
P.174	2.5 feet		40174	Flush Cycle Stop Level Range: 0.2 - 231.0 feet
Flush Cycle Status				
Pd.51	-		41878	Time Remaining On Internal Time Delay minutes
Flush Cycle Active Status - Modbus Coil 92 (Register 40006 Bit 11).				
Flush Cycle Active Status - Waiting For Well to Fill Up - Modbus Coil 93 (Register 40006 Bit 12).				
Flush Cycle Active Status - Calling All Pumps to Run - Modbus Coil 94 (Register 40006 Bit 13).				

FLOW CALCULATOR

Latest Inflow Rate 65,535 gallons / minute

Parameter: Fd.01

Display Range: 0 - 65,535

Inflow Totalizer 4,294,967,295 gallons

Flow Total since the last Inflow Totalizer Reset.

Parameters: Fd.02

Display Range: 0 - 4,294,967,295

To Reset Inflow Totalizer: Momentarily set Modbus Coil 242 (Register 40016 Bit 1).

Pump 1 - Outflow Rate 65,535 gallons / minute

Parameter: Fd.04

Pump 2 - Outflow Rate 65,535 gallons / minute

Parameter: Fd.05

Pump 3 - Outflow Rate 65,535 gallons / minute

Parameter: Fd.06

Pump 4 - Outflow Rate 65,535 gallons / minute

Parameter: Fd.07

Pump 5 - Outflow Rate 65,535 gallons / minute

Parameter: Fd.08

Pump 6 - Outflow Rate 65,535 gallons / minute

Parameter: Fd.09

Display Range: 0 - 65,535

To Reset Pump 1 - 6 Outflow Rates: Momentarily set Modbus Coil 243 (Register 40016 Bit 2).

Average Daily Inflow Total 4,294,967,295 gallons / day

Flow Totals from the Last 7 days Averaged Together.

Parameters: Fd.10

Display Range: 0 - 4,294,967,295

Data Used to Calculate the **Average Daily Inflow Total**

Current Day 4,294,967,295

Parameters: Fd.12

Daily Inflow Totals gallons / day

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	4,294,967,295	4,294,967,295	4,294,967,295	4,294,967,295	4,294,967,295	4,294,967,295	4,294,967,295
Parameters:	Fd.14	Fd.16	Fd.18	Fd.20	Fd.22	Fd.24	Fd.26

Newest Complete Day's Data

Display Range: 0 - 4,294,967,295

Oldest Complete Day's Data

FLOW CALCULATOR SETUP

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Flow Calculator Setup				
P.175	0		40175	Flow Calculator Mode 0 = Flow Calculator Disabled - All Flow Data is Reset to Zero 1 = Flow Calculator Enabled - Internal Time Clock 2 = Flow Calculator Enabled - External Time Clock Note: When an External Time Clock is used (Parameter P.175 = 2), the "Start New Day" command must be signaled once each day by closing a Discrete Input assigned to "Start New Day" Function 47, or by momentarily setting Modbus Coil 241 (Register 40016 Bit 0).
P.176	79.0 Square Feet		40176	Surface Area of Wet Well Range: 2.0 - 2,000.0 Square Feet Note: See "Surface Area Calculation" on page 1-23.
P.177	20 Minutes		40177	Delay Before Forcing On Additional Pump(s) Range: 4 - 60 Minutes Note: The "Latest Inflow Rate" can only be updated while all pumps are off, so the station must periodically pump all the way down, and turn off all pumps. Parameter P.177 is provided to set the "Delay Before Forcing On Additional Pump(s)". When this delay expires an additional pump or pumps are called to run, and the wet well is pumped down. After calling the first additional pump, there is a 4 minute delay before another is called.
P.178	20 Minutes		40178	Latest Inflow Rate Reset Delay Range: 1 - 100 Minutes Note: The "Latest Inflow Rate" can only be updated while the level is rising, so in cases where the flow into the station drops from a significant amount of inflow to near zero inflow, the Flow Calculator will be left with a "Latest Inflow Rate" that is too high. To prevent the Flow Totalizer from continuing to operate with an invalid "Latest Inflow Rate", logic is provided to reset the "Latest Inflow Rate" to zero when the delay set on this parameter expires. Parameter P.178 must be set for the longest time expected (under low flow conditions), that it will take to for the level to rise one foot when a Pressure Transducer is used for level measurement, or the distance between electrodes when a Level Probe is used.

Notes:

1. In order for the Flow Calculator to measure the Latest Inflow Rate the lift station must regularly pump down and turn off all pumps. Using the delay setting on Parameter P.177 the Flow Calculator will automatically bring on additional pumps, pump down the wet well and turn off all pumps so that it can measure the Latest Inflow Rate.
2. The Flow Calculator requires the following setting to operate:
   The "Master Control Mode" must be set for "Level Control", (Parameter P.091 = 1).
   The "Pump Up or Down Mode" must be set for "Pump Down - Empty a Tank", (Parameter P.149 = 1).
   The "Level Input Source" must be set for one of the following:
   "Analog Level Meter" (Parameter P.133 = 1, 2, 3, or 4)
   "Level Probe Meter" (Parameter P.133 = 5)
3. The "Average Daily Flow Total" is not valid until after 7 days of operation with Parameter P.175 = 1, or 2.
4. All flow data is erased when Parameter P.175 is set to "0".
5. While in the process of updating the "Latest Inflow Rate", if the level rises too fast, the logic will abort the measurement and keeps the previously determined value. It is considered too fast if the rise rate produces a "Latest Inflow Rate" of more than 65,535 gallons / minute. If this occurs the "Level Rising Too Fast" status is set for 10 seconds, then cleared. The "Level Rising Too Fast" status may be viewed from Modbus Coil 244 (Register 40016 Bit 3).

FLOW CALCULATOR DATA

Latest Inflow Rate - The Most Recently Determined Flow Rate into the Lift Station

The Flow Calculator determines the "Latest Inflow Rate" of liquid flowing into the lift station by observing how long it takes for the wet well level to rise a "known distance", while all pumps are off. Knowing the surface area of the wet well (Parameter P.176), the volume of liquid per minute flowing into the wet well is calculated. The "known distance" used in the calculation is a change in level of one foot when an Analog Level Input is used (Level Input Source: Parameter P.133 = 1, 2, 3, or 4), or the distance between electrodes (Parameter P.520) when using Level Probe Inputs (Level Input Source: Parameter P.133 = 5). The "Latest Inflow Rate", in gallons / minute, may be viewed from Parameter Fd.01.

Inflow Totalizer - The Inflow Total since the last "Inflow Totalizer Reset"

The Flow Calculator keeps a running total of how much liquid flows into the lift station, since the last "Inflow Totalizer Reset", which resets the totalizer to zero. The Inflow Totalizer value must be read and recorded at some consistent interval (daily, weekly, monthly) and then reset back to zero. The Inflow Totalizer value is in gallons and may be viewed from Parameters Fd.02. To reset the Inflow Totalizer momentarily set Modbus Coil 242 (Register 40016 Bit 1).

Pump 1 - 6 Outflow Rate - The Most Recently Determined Outflow Rate of Each Pump

The Flow Calculator also determines and updates the "Pump Outflow Rate" of each pump whenever it completes a pumping cycle by itself. This is done by first calculating the volume of liquid in the wet well between the level where the pump was turned on and where it was turned off, and then adding to it what had flowed into the wet well while the pump was running ("Latest Inflow Rate" multiplied by the "Pump Run Cycle Time"). This total volume of liquid is then divided by the "Pump Run Cycle Time" to arrive at the "Pump Outflow Rate". The most recent "Pump Outflow Rate" of each pump in gallons / minute, may be viewed from Parameters Fd.04 - Fd.09. To Reset to zero momentarily set Modbus Coil 243 (Register 40016 Bit 2).

Average Daily Inflow Total - The Inflow Totals from the Last 7 days Averaged Together

The Flow Calculator uses the "Latest Inflow Rate" to keep a running total of how much liquid flows into the lift station during a 24 hour period. This is done for each 24 hour period. The flow totals from the previous 7 days are all kept stored. These flow totals are added together and divided by 7. The "Average Daily Inflow Total", in gallons / day may be viewed from Parameters Fd.10.

Parameter	Register Address	Data Description	
Flow Calculator - Latest Inflow Rate			
Fd.01	42101	Flow Calculator - Latest Inflow Rate (gallons / minute)	Display Range: 0 - 65,535
Flow Calculator - Inflow Totalizer			
Fd.02	42102	Least Significant of 32-Bit Number	Flow Calculator - Inflow Totalizer (gallons)
	42103	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Inflow Totalizer Reset - To Reset Inflow Totalizer to zero momentarily set Modbus Coil 242 (Register 40016 Bit 1).			
Flow Calculator - Pump 1 - 6 Outflow Rate			
Fd.04	42104	Flow Calculator - Pump 1 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Fd.05	42105	Flow Calculator - Pump 2 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Fd.06	42106	Flow Calculator - Pump 3 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Fd.07	42107	Flow Calculator - Pump 4 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Fd.08	42108	Flow Calculator - Pump 5 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Fd.09	42109	Flow Calculator - Pump 6 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Pump Data Reset - To Reset Pump 1 - 6 Outflow Rate to zero momentarily set Modbus Coil 243 (Register 40016 Bit 2).			
Flow Calculator - Average Daily Inflow Total			
Fd.10	42110	Least Significant of 32-Bit Number	Flow Calculator - Average Daily Inflow Total (gallons)
	42111	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295

FLOW CALCULATOR DATA

Daily Inflow Total - Current Day

This is inflow data that is currently being collected. It is the total of the inflow that has been collected, since the last "Start New Day" command. Upon receiving the "Start New Day" command, the Flow Calculator will move the value into "Daily Inflow Total - Day 1", reset itself back to zero, and then start collecting inflow data for the next 24 hour period. It may be viewed in gallons from Parameter Fd.12.

Daily Inflow Totals - Day 1 - 7

Each of the Daily Inflow Totals are the total of the inflow that was collected during a 24 hour period one day in the previous week. Upon receiving the "Start New Day" command signal, the Flow Calculator will move all of the values down one position in the data table shown below. The oldest day's data is discarded. The values may be viewed in gallons / day from the Parameters shown below.

Parameter	Register Address		Data Description
Flow Calculator - Daily Inflow Total - Current Day			
Fd.12	42112	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Current Day (gallons)
	42113	Most Significant of 32-Bit Number	Collects Current Day's Data Display Range: 0 - 4,294,967,295
Flow Calculator - Daily Inflow Totals - Day 1 - 7			
Fd.14	42114	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 1 (gallons / day)
	42115	Most Significant of 32-Bit Number	Newest Complete Day's Data Display Range: 0 - 4,294,967,295
Fd.16	42116	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 2 (gallons / day)
	42117	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.18	42118	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 3 (gallons / day)
	42119	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.20	42120	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 4 (gallons / day)
	42121	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.22	42122	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 5 (gallons / day)
	42123	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.24	42124	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 6 (gallons / day)
	42125	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.26	42126	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 7 (gallons / day)
	42127	Most Significant of 32-Bit Number	Oldest Complete Day's Data Display Range: 0 - 4,294,967,295

FLOW CALCULATOR DATA

Pump 1 - 6 Run Cycle Time

This is the most recently determined pump run time of a respective pump, while it is running by itself. This is done by determining how long it takes to pump down from the "1st On Level" to the "1st Off Level". This information is used in the calculation of the "Pump Outflow Rate". The most recent "Pump Run Cycle Time" of each pump may be viewed in minutes from Parameters Fd.28 - Fd.33. To Reset to zero momentarily set Modbus Coil 243 (Register 40016 Bit 2).

Internal Time Clock - Hours and Minutes Elapsed Since the Start of a New Day

This clock keeps track of how much time has elapsed since the last signal to a "Start New Day". The time may be viewed from Parameters Fd.34 and Fd.35.

With the Flow Calculator Mode (Parameter P.175) = 1, the Internal Time Clock will run and the signal to "Start New Day" will be automatically issued when it gets to 24 hours, the Time Clock is also reset to zero at that time.

With the Flow Calculator Mode (Parameter P.175) = 2, the Internal Time Clock will run, but not issue the "Start New Day" signal. The signal to "Start New Day" must be initiated externally, once each day by an External Time Clock by one of the following ways:

1. By using an External Time Clock to close a Discrete Input programmed for the "Start New Day", Function 47. The Internal Time Clock will also be reset to zero.
2. By programming the SCADA system to send the signal to "Start New Day" by momentarily setting Modbus Coil 241 (Register 40016 Bit 0). The Internal Time Clock will also be reset to zero.

Time Measuring the Latest Inflow Rate

This is the time it takes for the wet well to rise 0.5 foot using the Analog Level Input (Parameter P.133 = 1, 2, 3, or 4) or if Level Probe Inputs are used for the Level Input (Parameter P.133 = 5), then it is the time it takes for the wet well to rise 1 Electrode spacing. It may be viewed in minutes from Parameters Fd.36.

Parameter	Register Address	Data Description
		Flow Calculator - Pump 1 - 6 Run Cycle Time
Fd.28	42128	Flow Calculator - Pump 1 Run Cycle Time (minutes) Display Range: 0.00 - 655.35
Fd.29	42129	Flow Calculator - Pump 2 Run Cycle Time (minutes) Display Range: 0.00 - 655.35
Fd.30	42130	Flow Calculator - Pump 3 Run Cycle Time (minutes) Display Range: 0.00 - 655.35
Fd.31	42131	Flow Calculator - Pump 4 Run Cycle Time (minutes) Display Range: 0.00 - 655.35
Fd.32	42132	Flow Calculator - Pump 5 Run Cycle Time (minutes) Display Range: 0.00 - 655.35
Fd.33	42133	Flow Calculator - Pump 6 Run Cycle Time (minutes) Display Range: 0.00 - 655.35
		Pump Data Reset - To Reset Pump 1 - 6 Run Cycle Time to zero momentarily set Modbus Coil 243 (Register 40016 Bit 2).
		Flow Calculator - Internal Time Clock
Fd.34	42134	Flow Calculator - Internal Time Clock - Minutes Since the Start of a New Day The time (minutes) elapsed since the signal to "Start New Day" Also see: Parameter Fd.35 Display Range: 0 - 60
Fd.35	42135	Flow Calculator - Internal Time Clock - Hours Since the Start of a New Day The time (hours) elapsed since the signal to "Start New Day" Also see: Parameter Fd.34 Display Range: 0 - 65535
		Flow Calculator - Time Measuring the Latest Inflow Rate
Fd.36	42136	Flow Calculator - Time Measuring the Latest Inflow Rate (minutes) Display Range: 0.00 - 655.35

FLOW CALCULATOR - Surface Area Calculation

Rectangular Wet Well

Area = Length x Width Where Length & Width Measurements are in: Feet

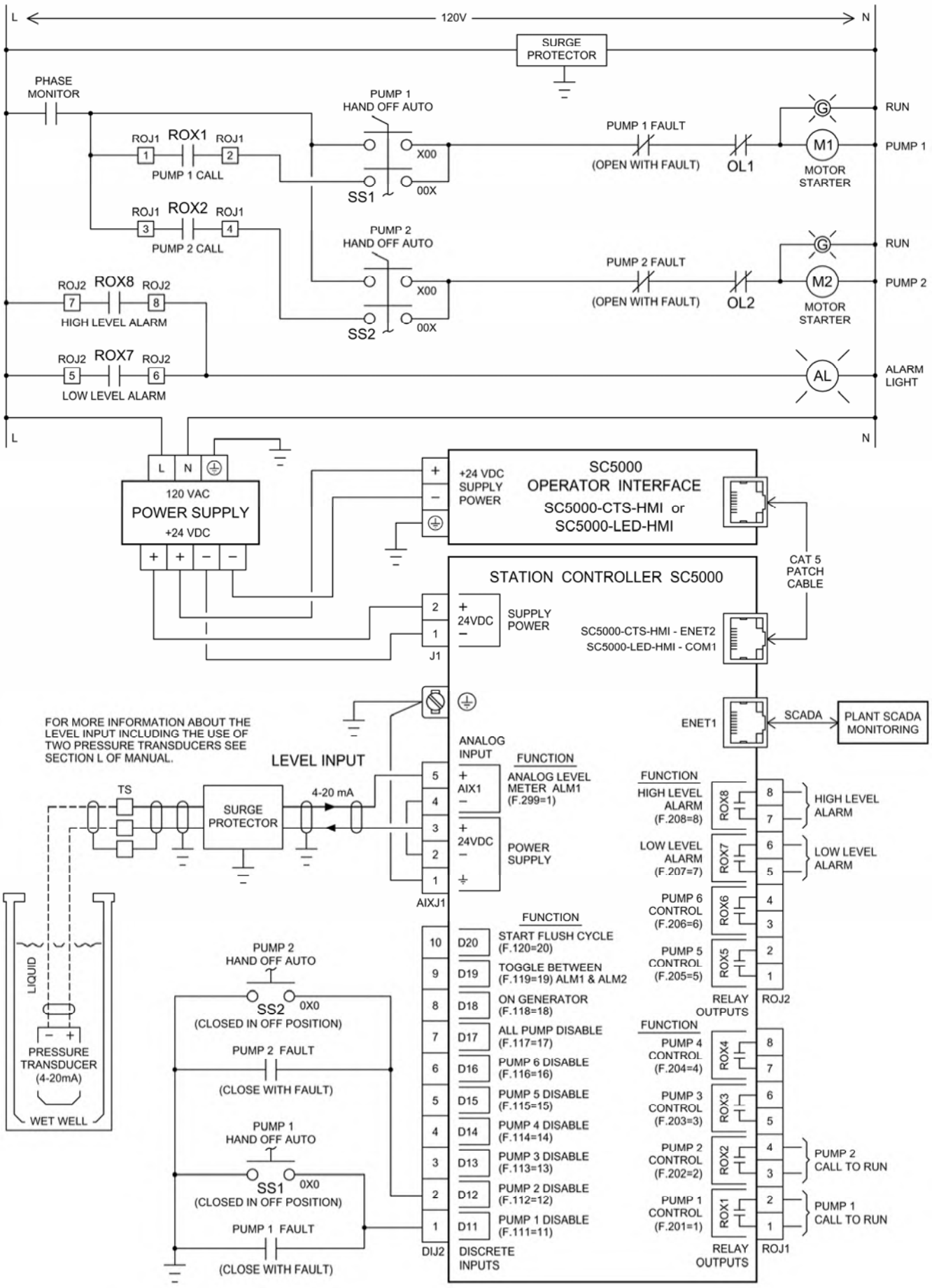
Circular Wet Well

$$\text{Area} = \pi \left[\frac{1}{2} \text{Diameter} \right]^2$$ Where Diameter is in: Feet

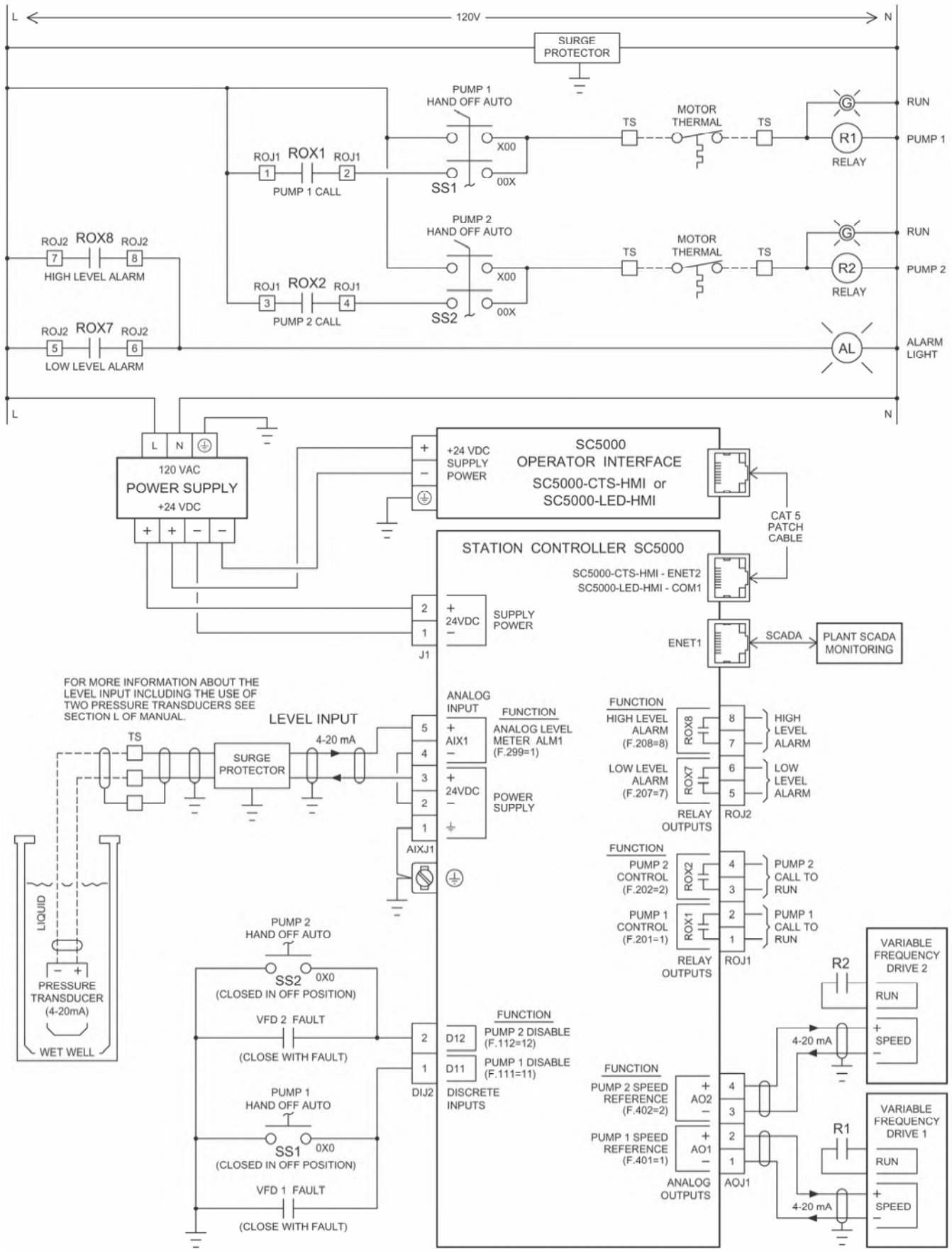
Area = 3.14159 x 1/2 Diameter x 1/2 Diameter

$\pi = 3.14159$

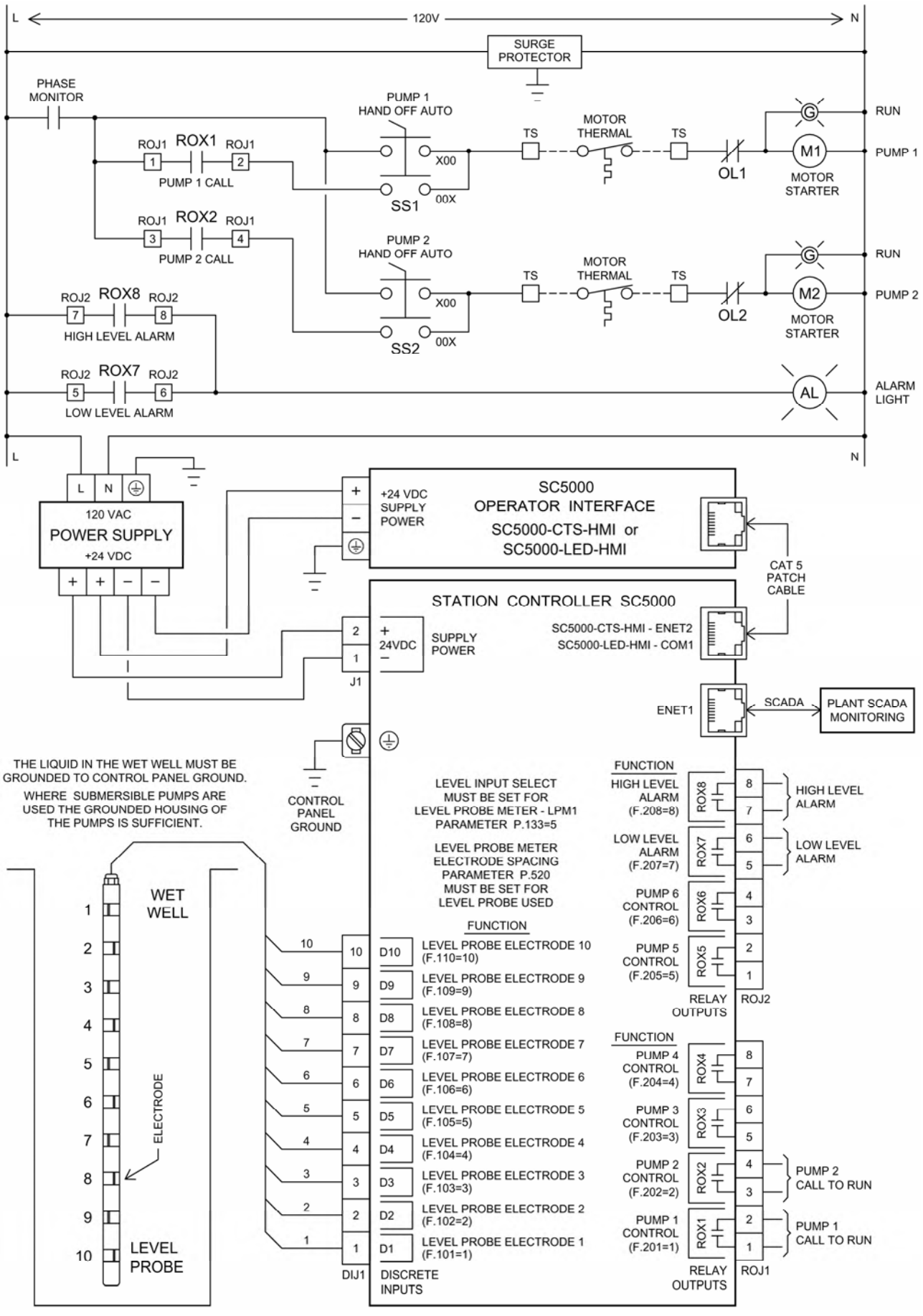
LEVEL CONTROL EXAMPLE - ANALOG LEVEL INPUT



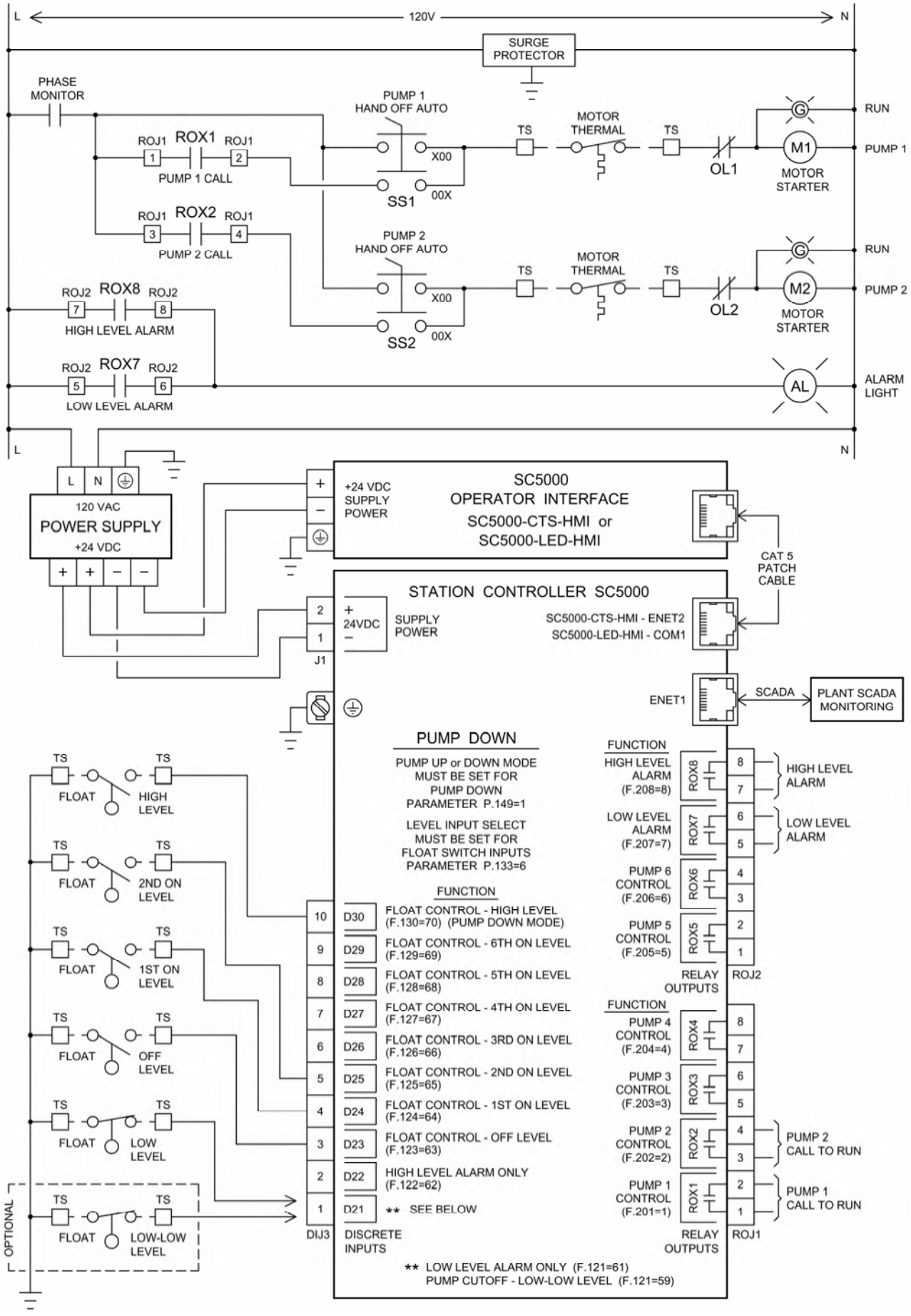
LEVEL CONTROL EXAMPLE - ANALOG LEVEL INPUT - With VFDs



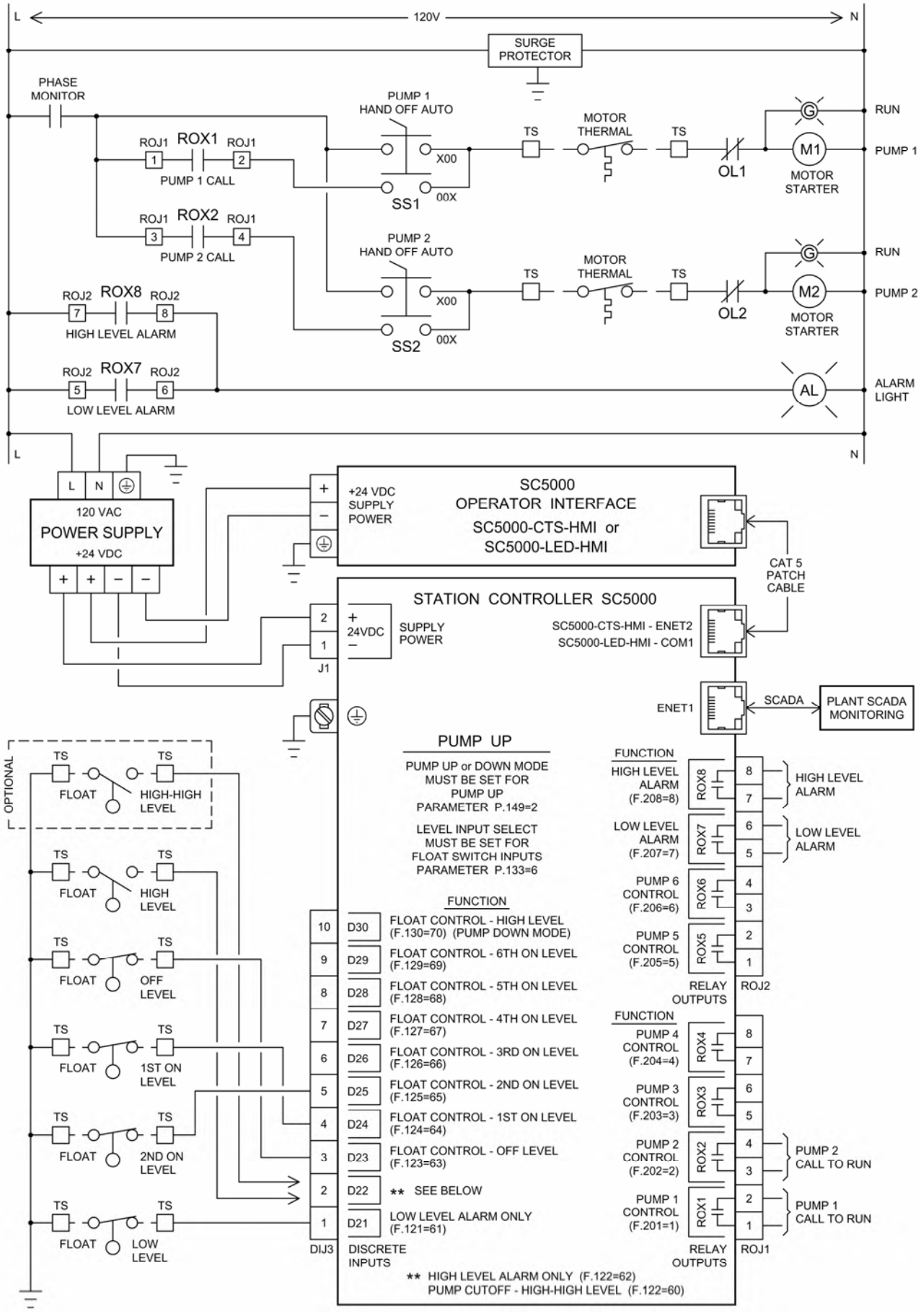
LEVEL CONTROL EXAMPLE - LEVEL PROBE INPUT



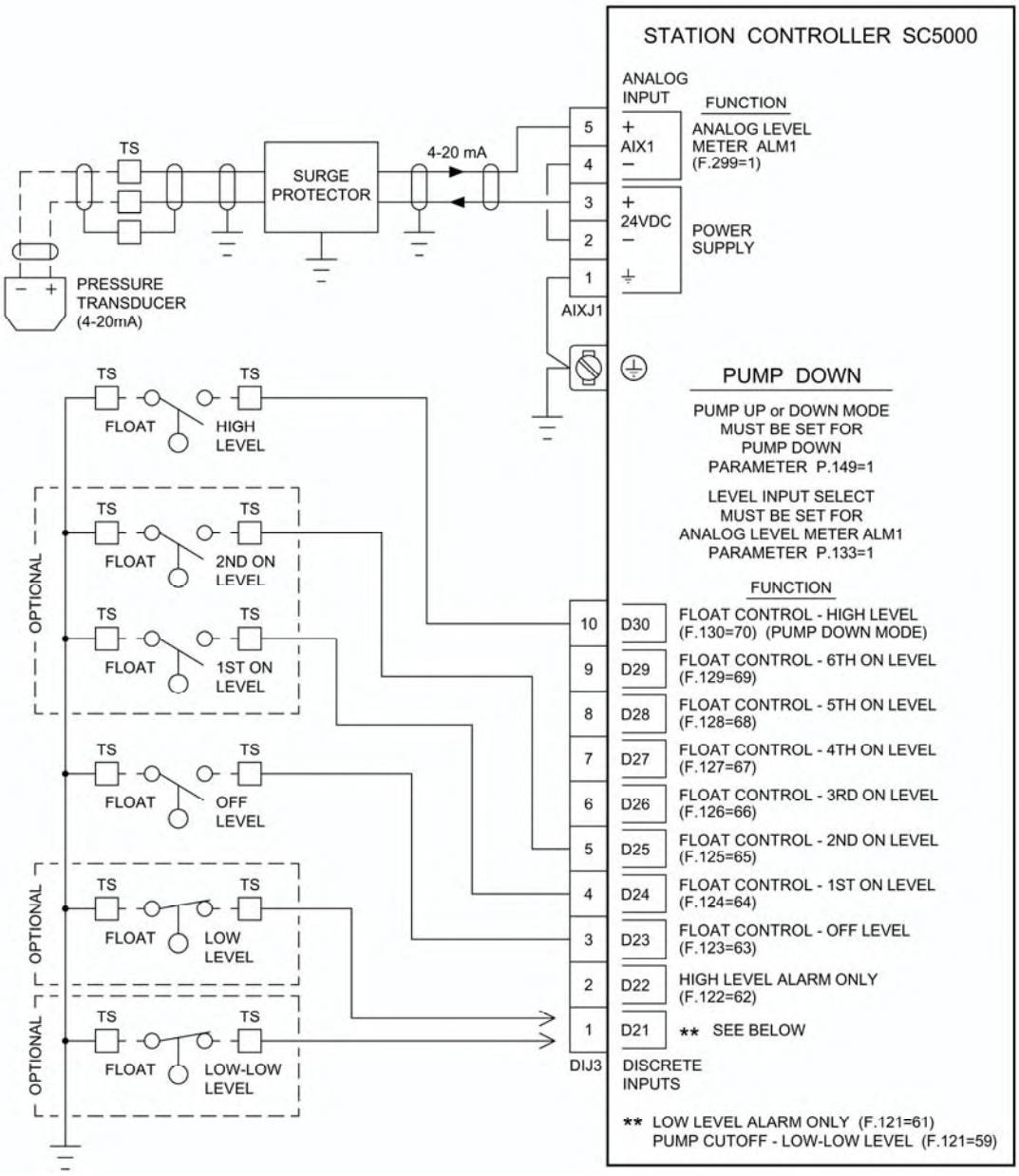
LEVEL CONTROL EXAMPLE - FLOAT CONTROL - PUMP DOWN



LEVEL CONTROL EXAMPLE - FLOAT CONTROL - PUMP UP



FLOAT BACKUP EXAMPLE - PUMP DOWN



Notes:

This example shows a Pump Down Application (Parameter P.149 = 1) where an Analog Level Input is the primary level input for level control and where two or more Discrete Inputs are connected to floats and used for backup pump control.

A simple two float backup system can be made using a “Float Control - Off Level” (Function 63) and a “Float Control - High Level” (Function 70).

High Level input

For Float Control of the pumps upon High Level - Assign the High Level Float Input to “Float Control - High Level” (Function 70). Upon closure all available pumps will be called to run, provided the Off Level float input is closed.

For Alarm Only - A High Level Float Input may be assigned to “High Level Alarm Only” (Function 62). This Function is not recommended because it only activates the High Level Alarm and does not provide backup control of the pumps.

Low Level input

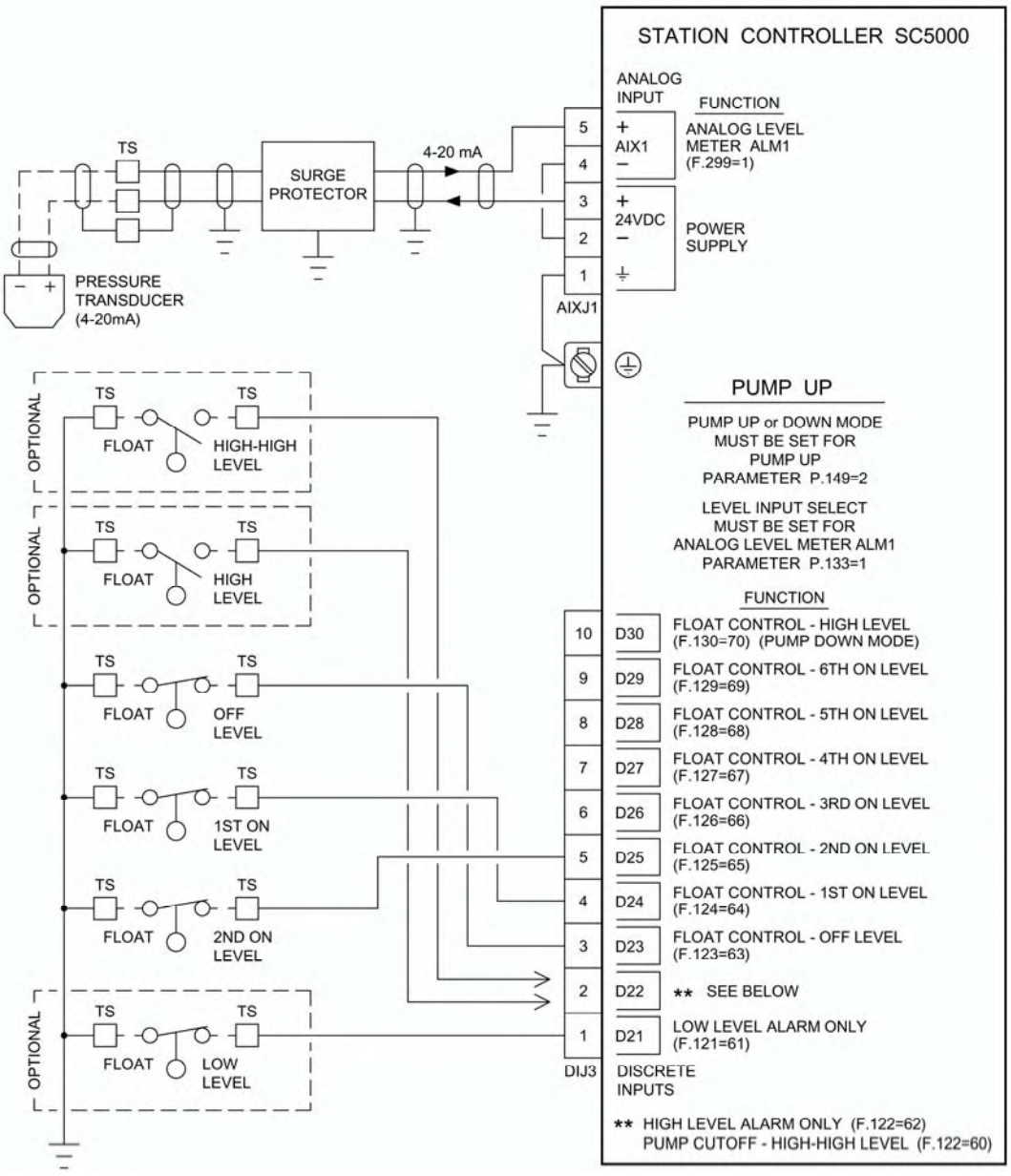
For Pump Cutoff upon Low-Low Level - Assign the Discrete Input to “Pump Cutoff - Low-Low Level” (Function 59). Upon closure all pump operation will be disabled. When the Low-Low Level Float input opens, a delay prevents the immediate calling of the pumps. This delay is set on Parameter P.153.

For Alarm Only - Assign the Discrete Input to “Low Level Alarm Only” (Function 61).

Float Type - For Pump Down applications the Off, 1st, 2nd, 3rd, 4th , 5th , 6th On, and High floats must be Normally Open float switches that close as the level rises above the float. The Low Level or Low-Low Level float must be a Normally Closed float that opens as the level rises above the float.

The FAULT light comes on and Fault Code 1050 is generated, when a pump is called to run by the Float Backup system.

FLOAT BACKUP EXAMPLE - PUMP UP



Notes:

This example shows a Pump Up Application (Parameter P.149 = 2) where an Analog Level Input is the primary level input for level control and where three or more Discrete Inputs are connected to floats and used for backup pump control.

High Level input

For Pump Cutoff upon High-High Level - Assign the Discrete Input to “Pump Cutoff - High-High Level” (Function 60). Upon closure all pump operation will be disabled. When the High-High Level Float input opens, a delay prevents the immediate calling of the pumps. This delay is set on Parameter P.154.

For Alarm Only - A High Level Float Input may be assigned to “High Level Alarm Only” (Function 62). This Function only activates the High Level Alarm and does not provide Pump Cutoff.

Low Level input

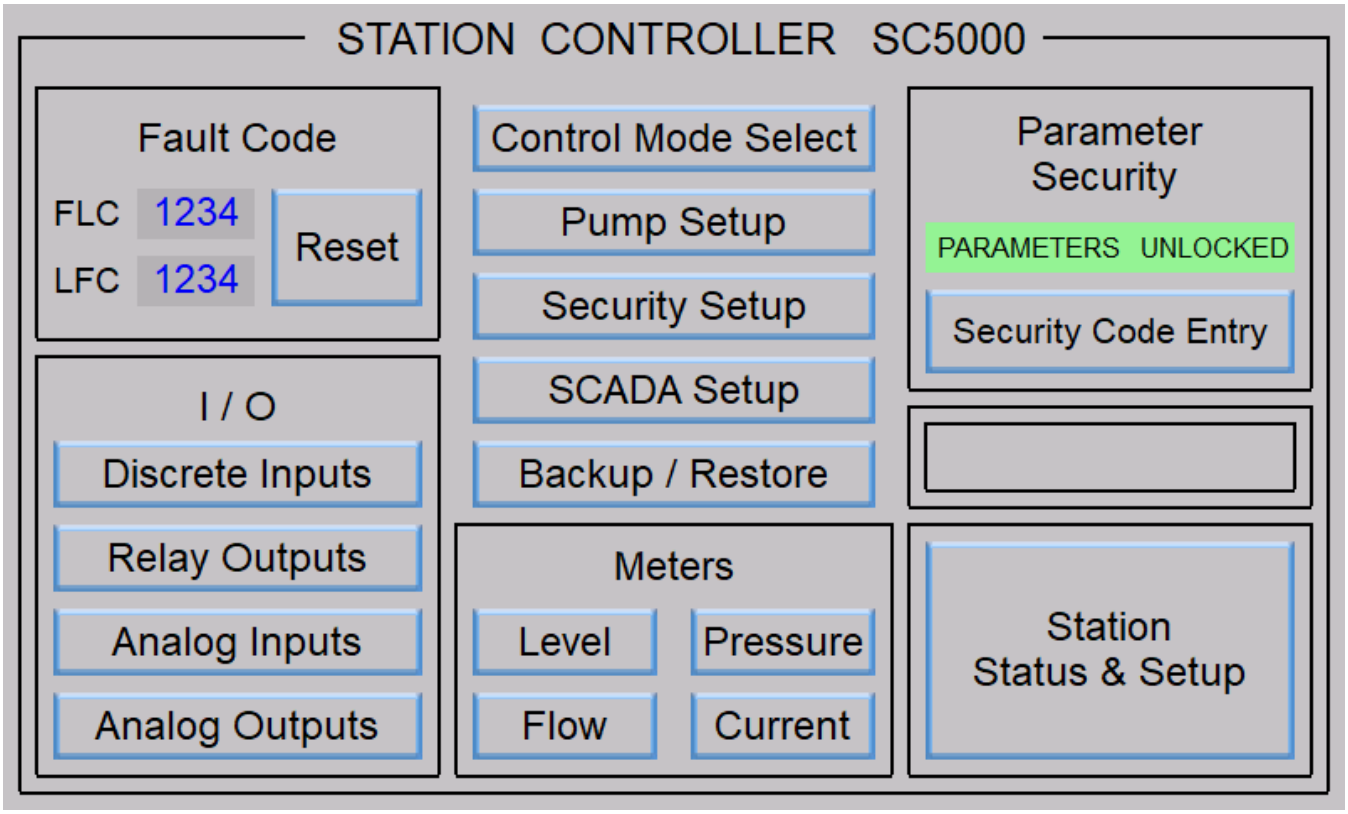
For Alarm Only - Assign the Discrete Input to “Low Level Alarm Only” (Function 61). This Function only activates the Low Level Alarm.

Float Type - For Pump Up applications the Off, 1st, 2nd, 3rd, 4th , 5th , 6th On, and Low float must be Normally Closed float switches that open as the level rises above the float. The High Level or High-High Level float must be a Normally Open float that closes as the level rises above the float.

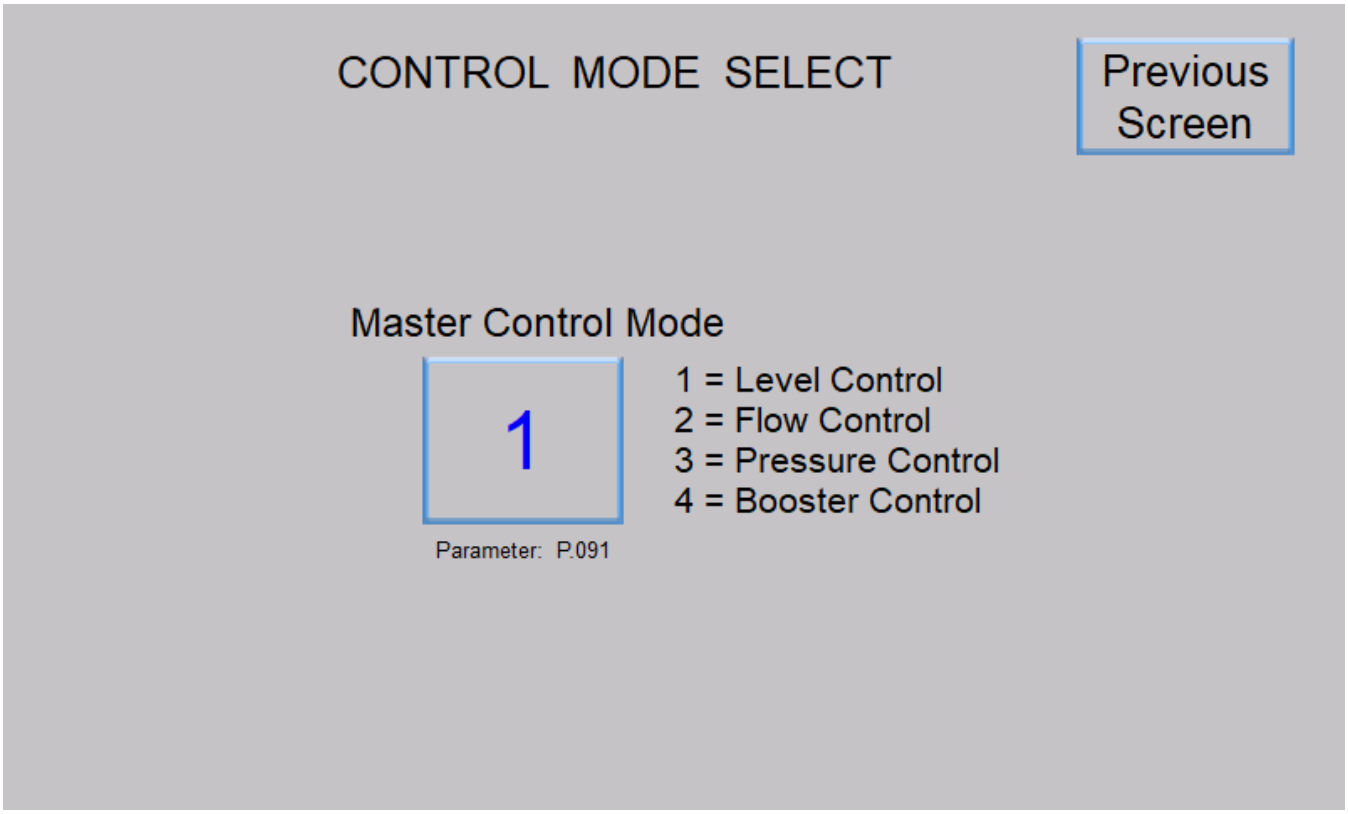
The FAULT light comes on and Fault Code 1050 is generated, when a pump is called to run by the Float Backup system.

LEVEL CONTROL - Touchscreen HMI SCREENS

Main Screen

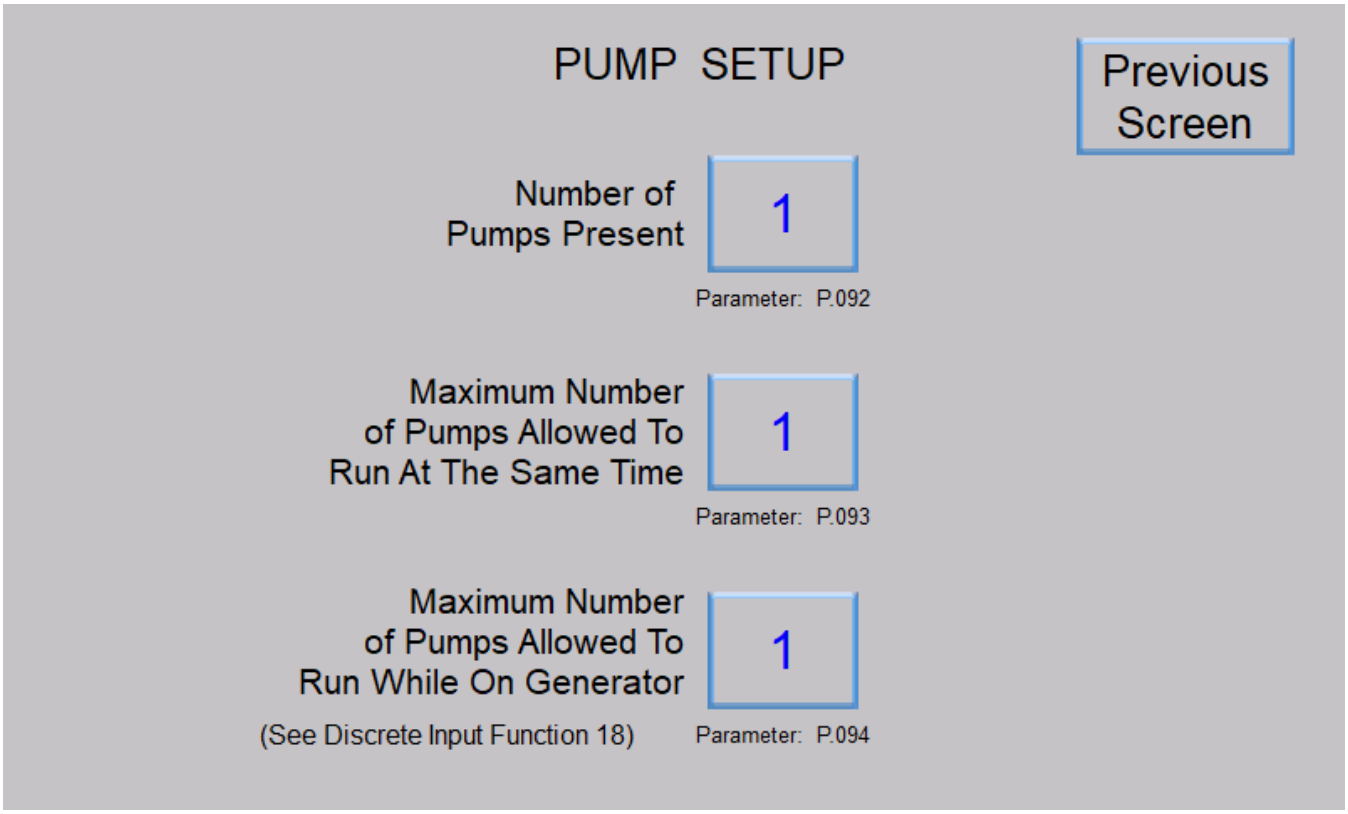


Control Mode Select

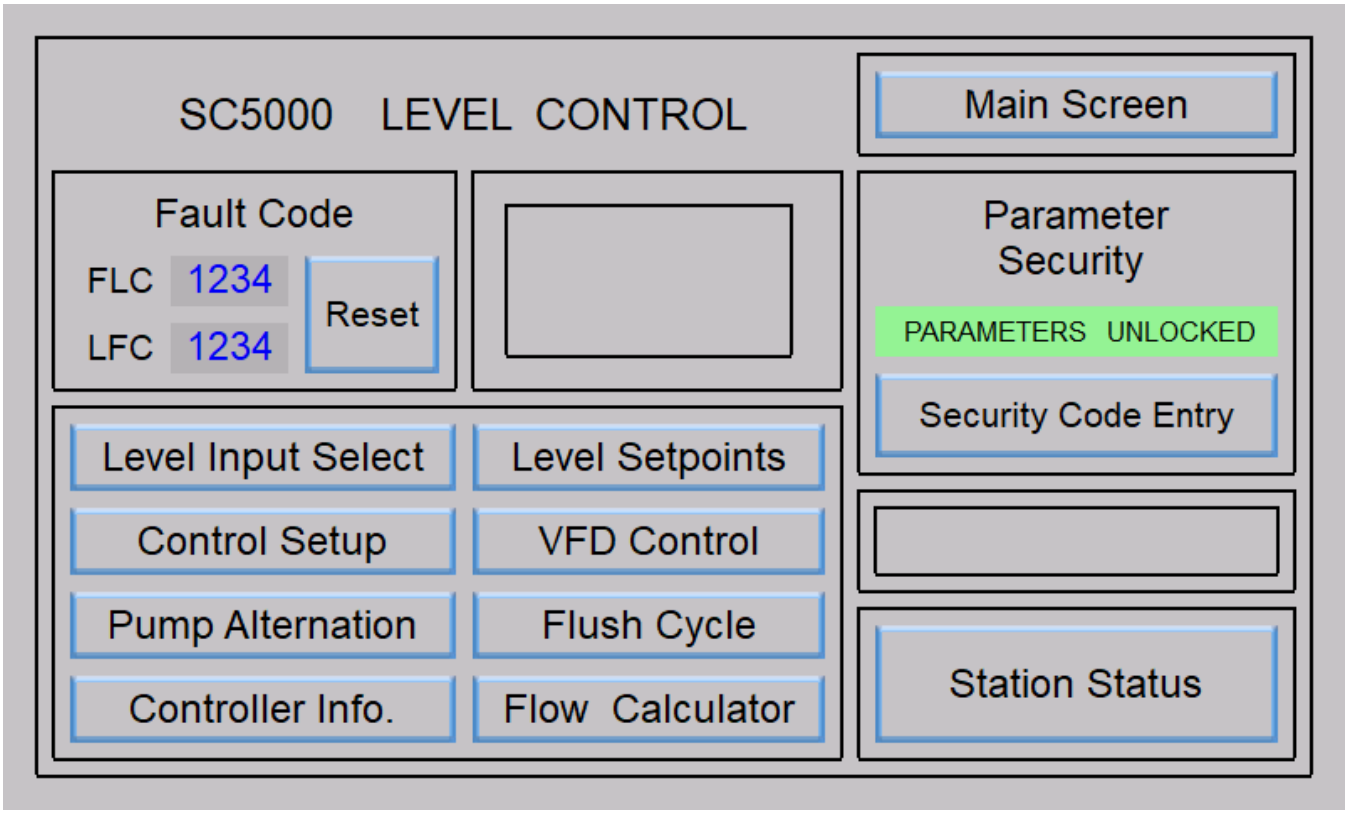


LEVEL CONTROL - Touchscreen HMI SCREENS

Pump Setup

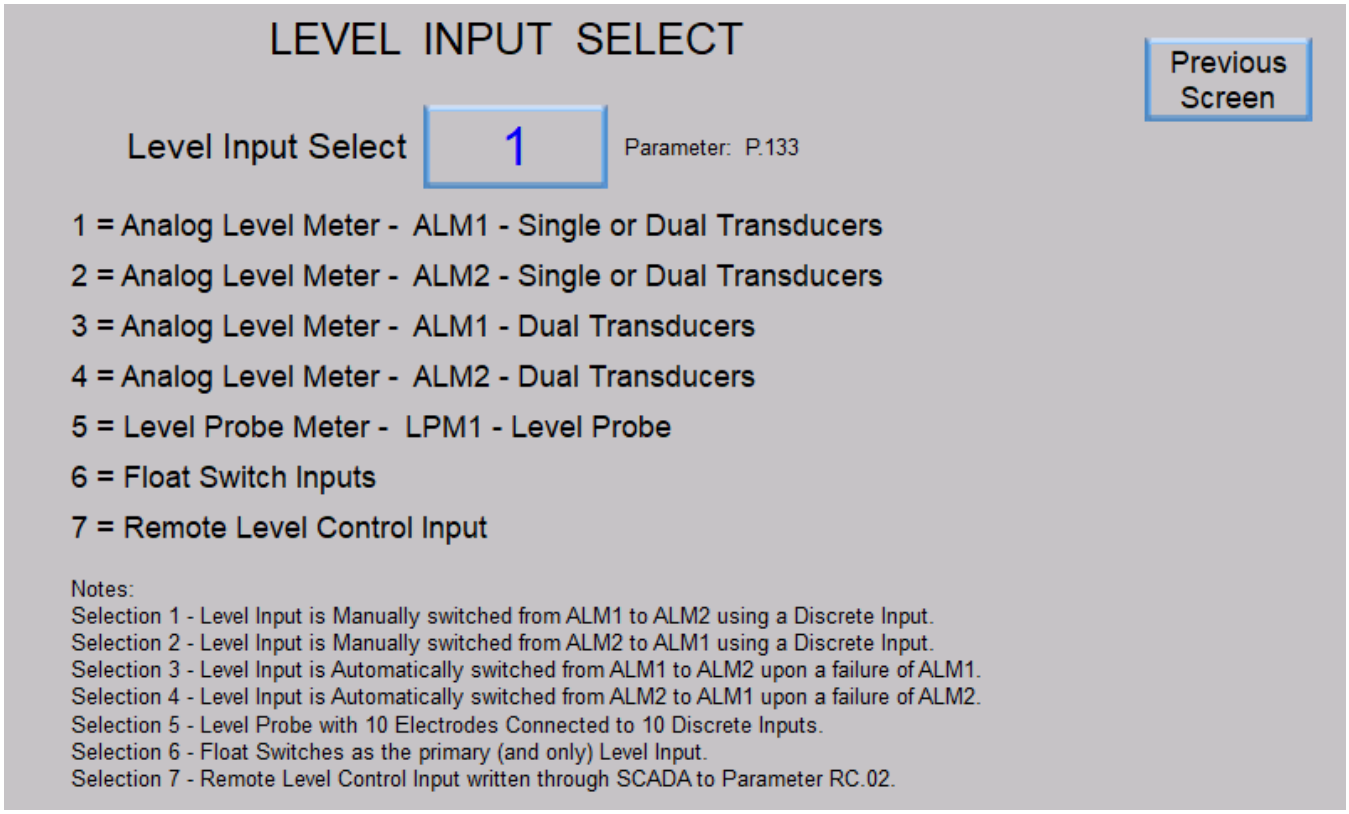


Level Control Main Screen

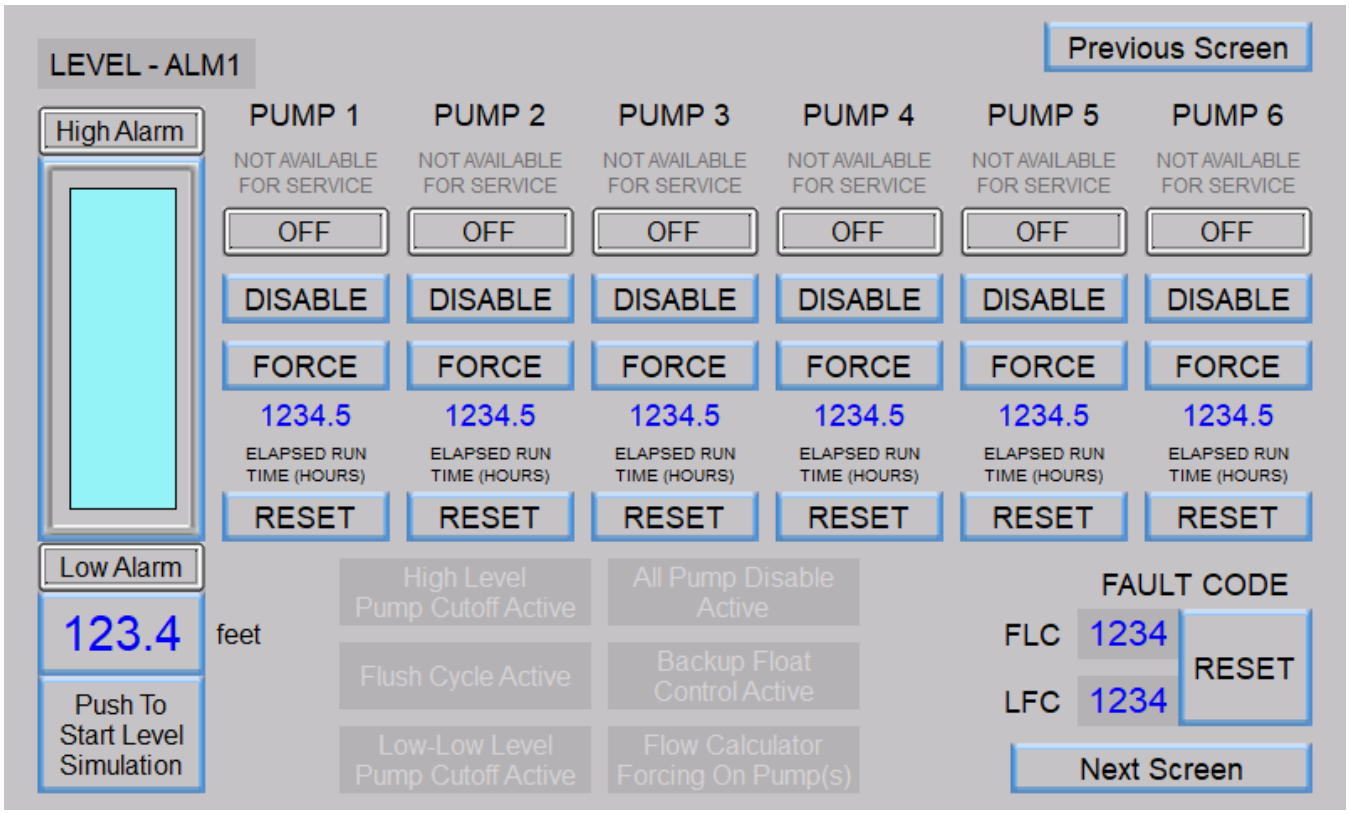


LEVEL CONTROL - Touchscreen HMI SCREENS

Level Input Select

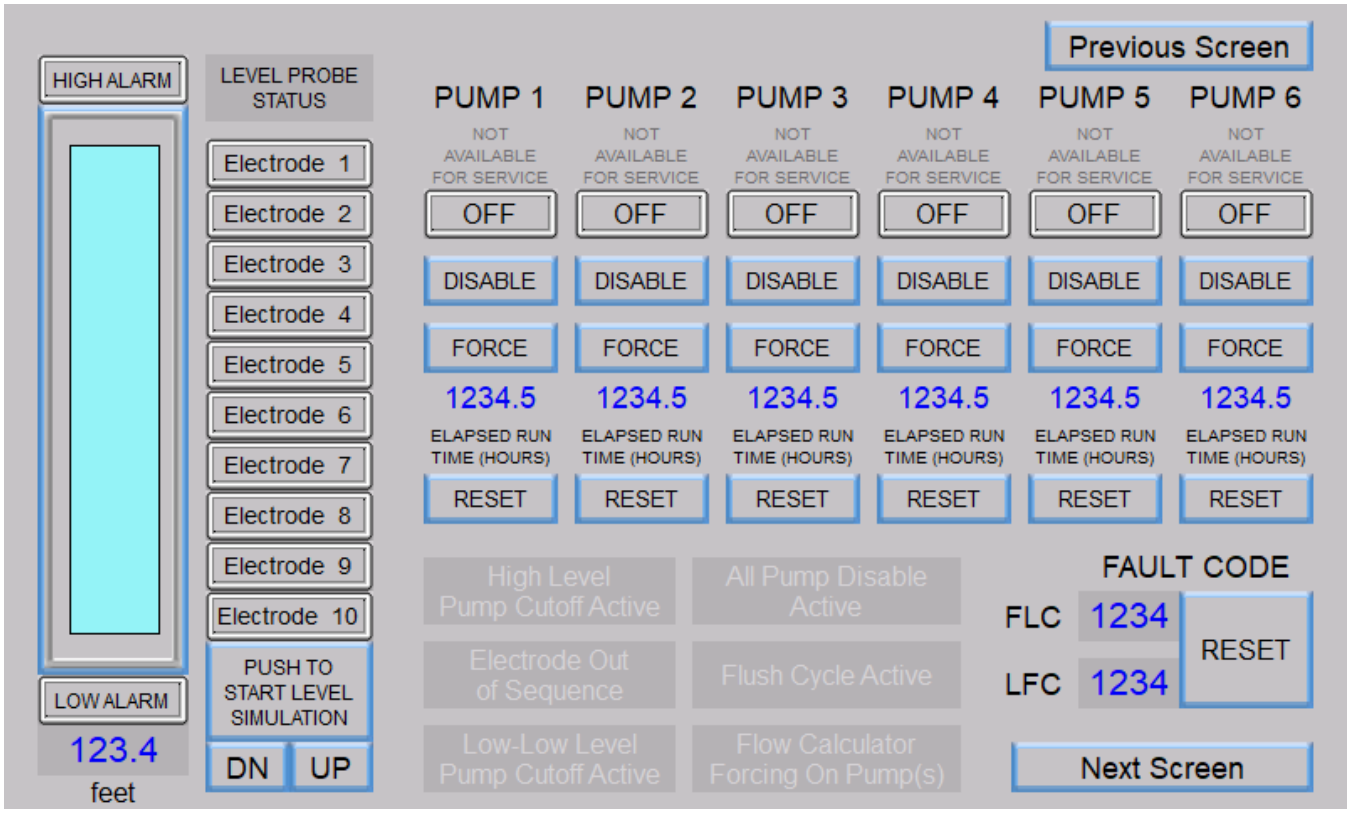


Station Status - Analog Level Input - Parameter P.133 = 1, 2, 3 or 4

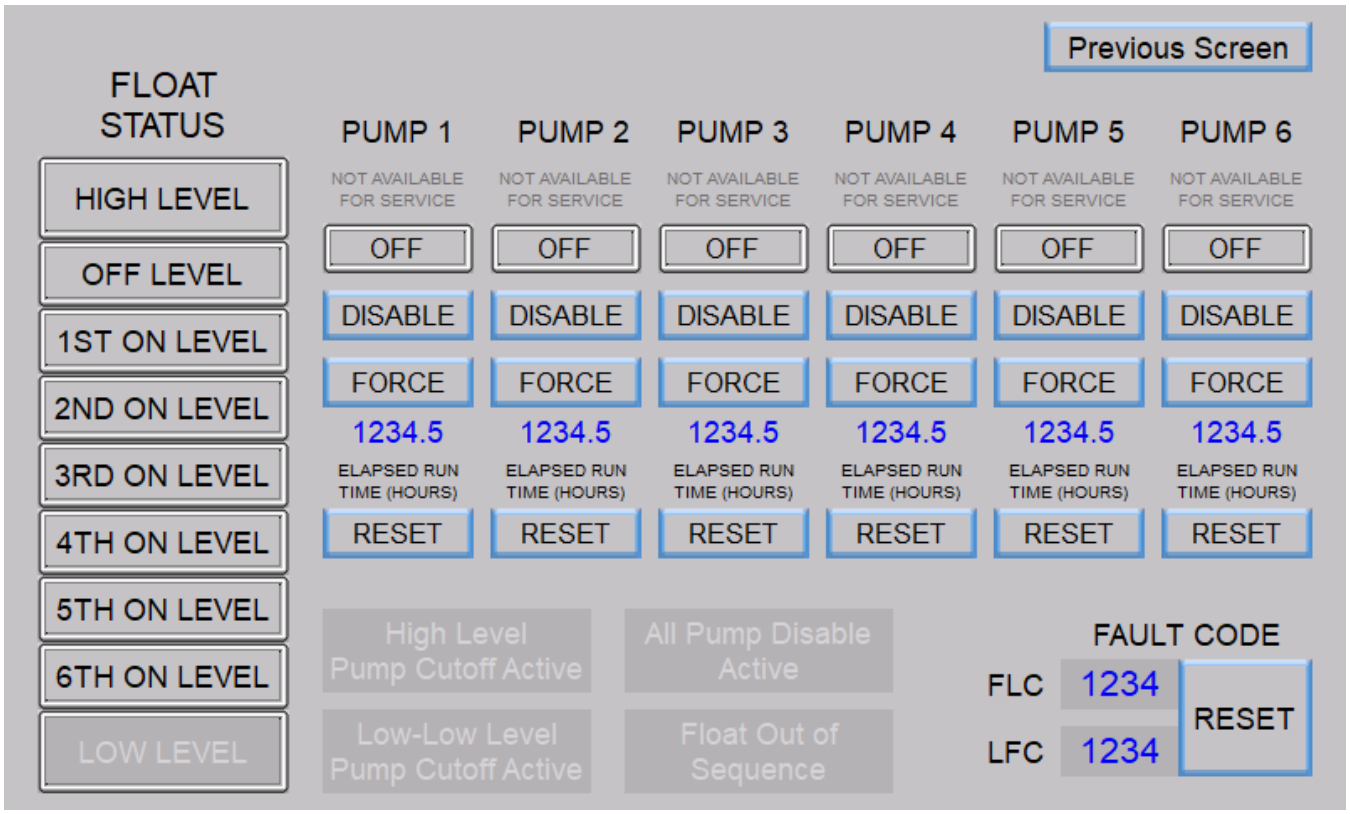


LEVEL CONTROL - Touchscreen HMI SCREENS

Station Status - Level Probe Input - Parameter P.133 = 5

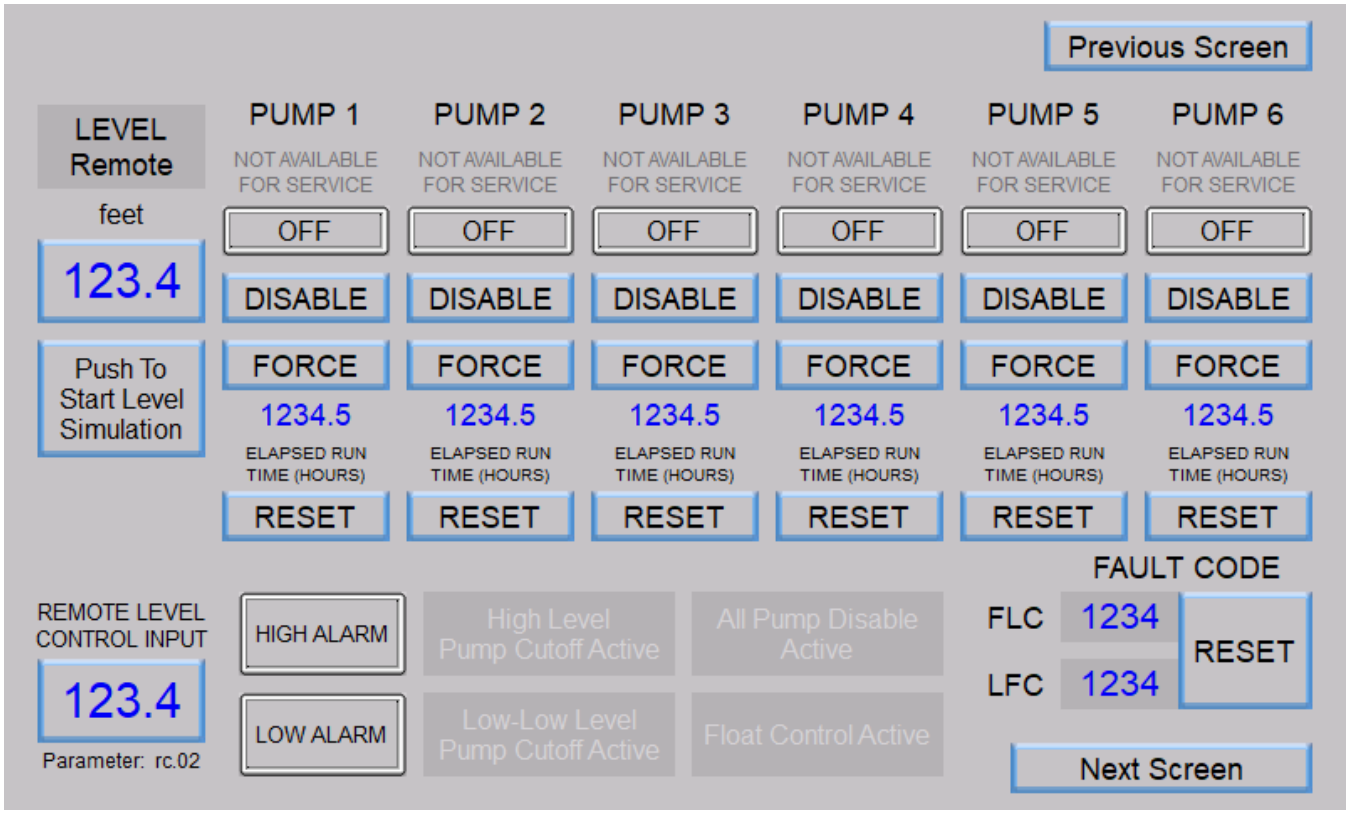


Station Status - Float Switch Inputs - Parameter P.133 = 6

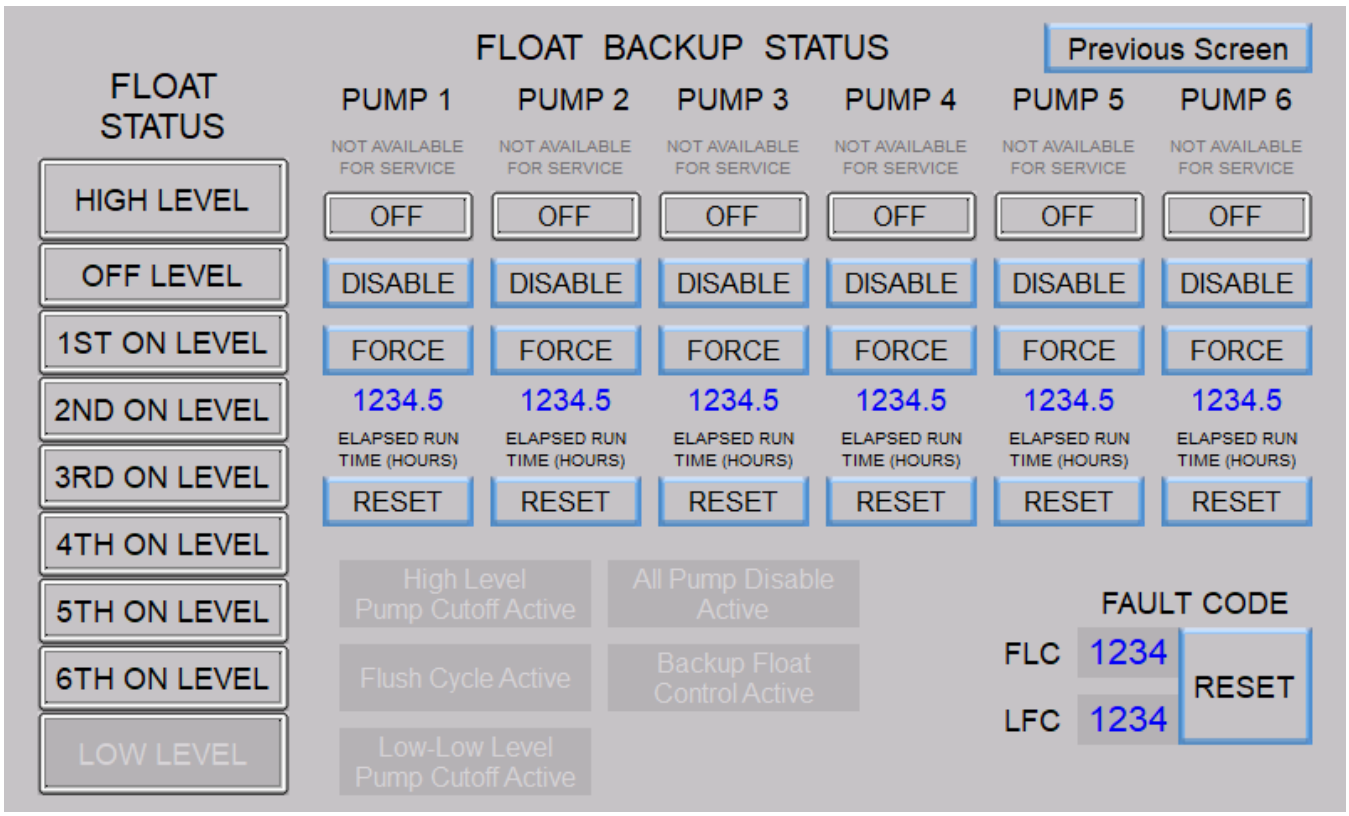


LEVEL CONTROL - Touchscreen HMI SCREENS

Station Status - Remote Level Control Input - Parameter P.133 = 7

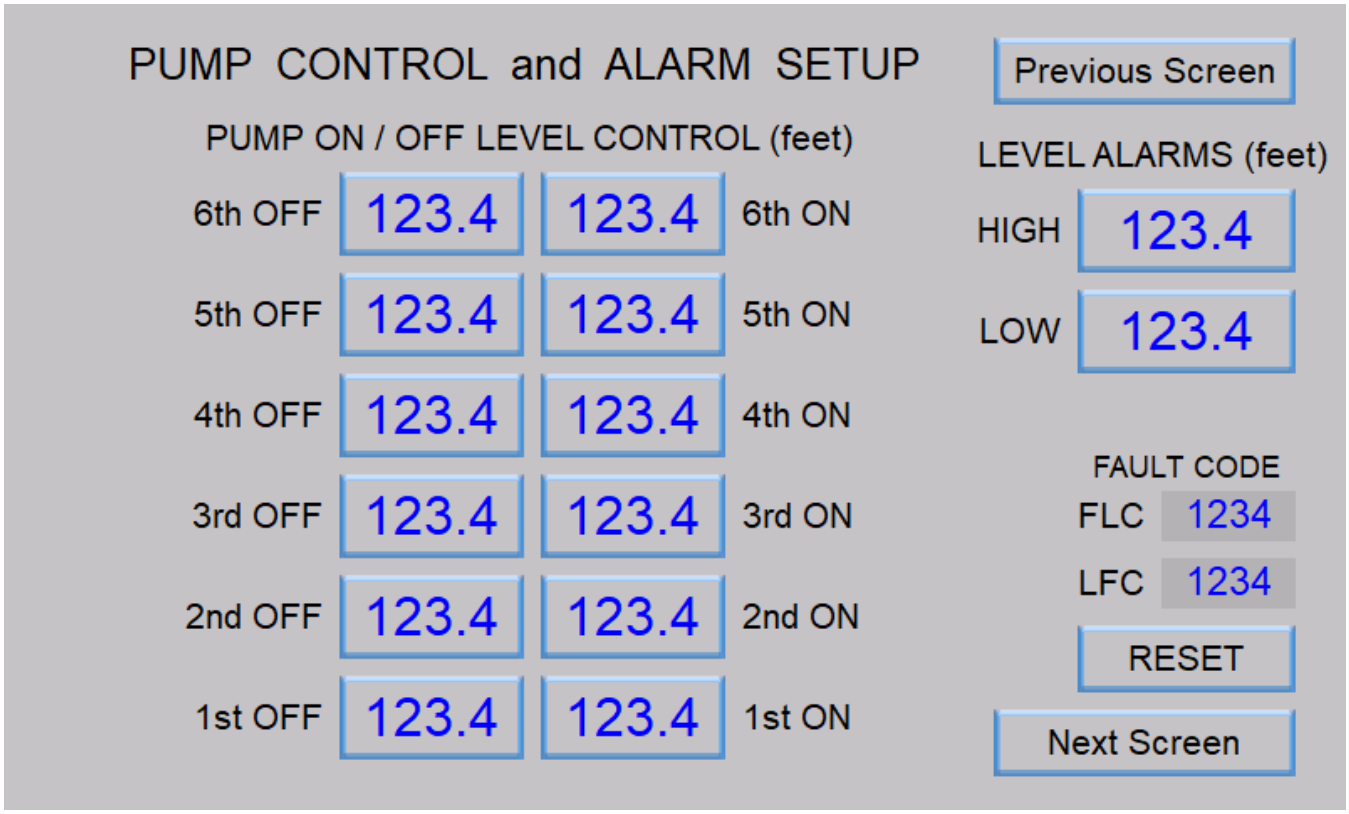


Station Status - Float Backup - Parameter P.133 = 1, 2, 3, 4 or 7

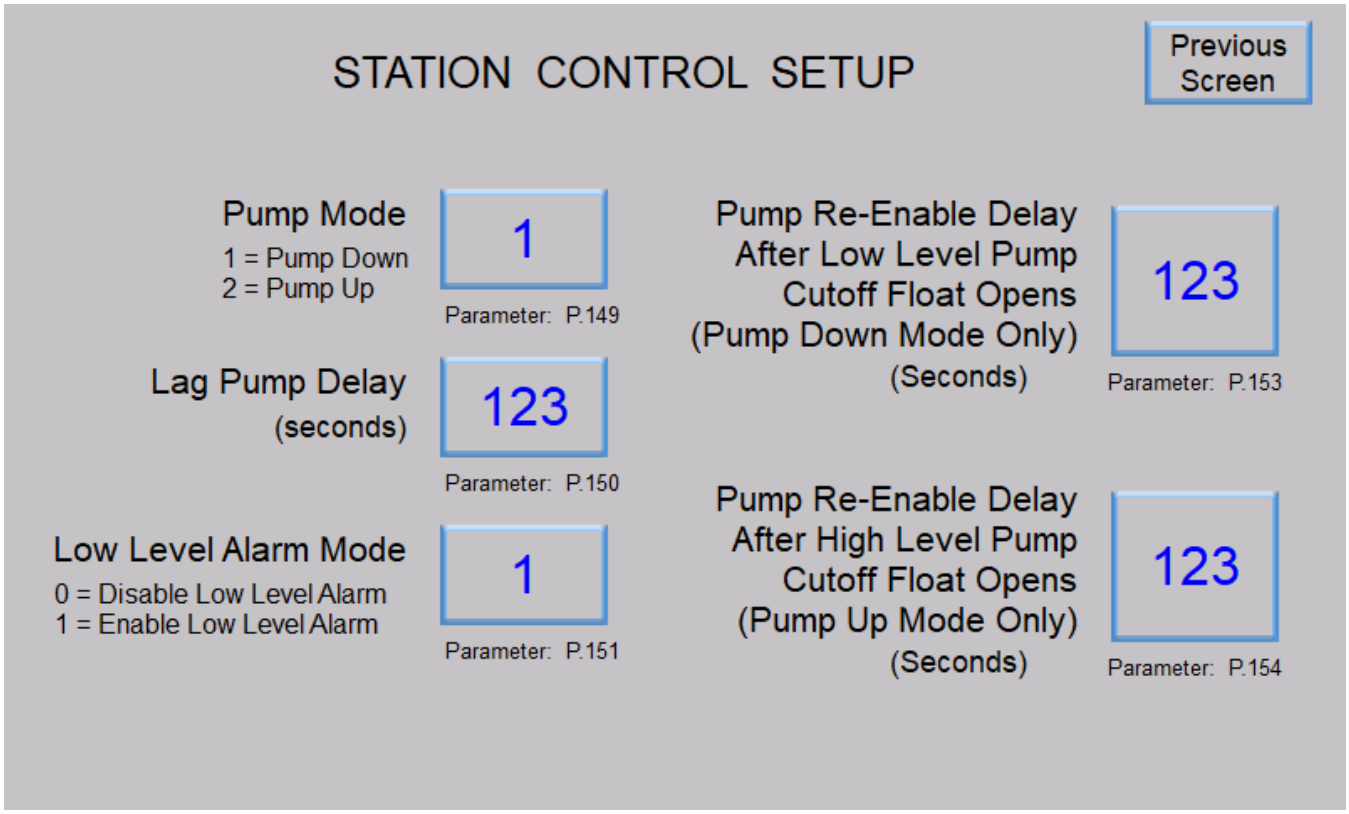


LEVEL CONTROL - Touchscreen HMI SCREENS

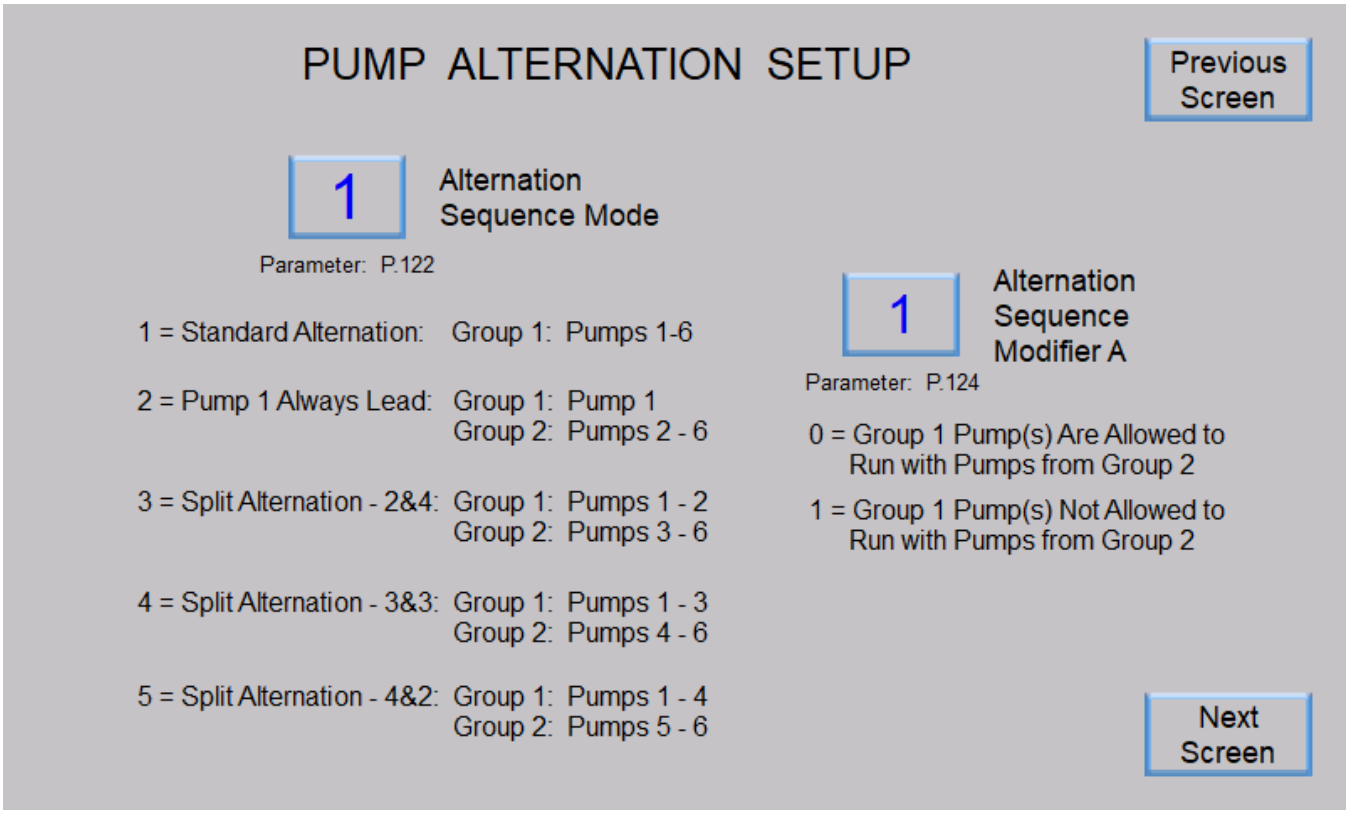
Pump Control & Alarm Setup - Level Setpoints



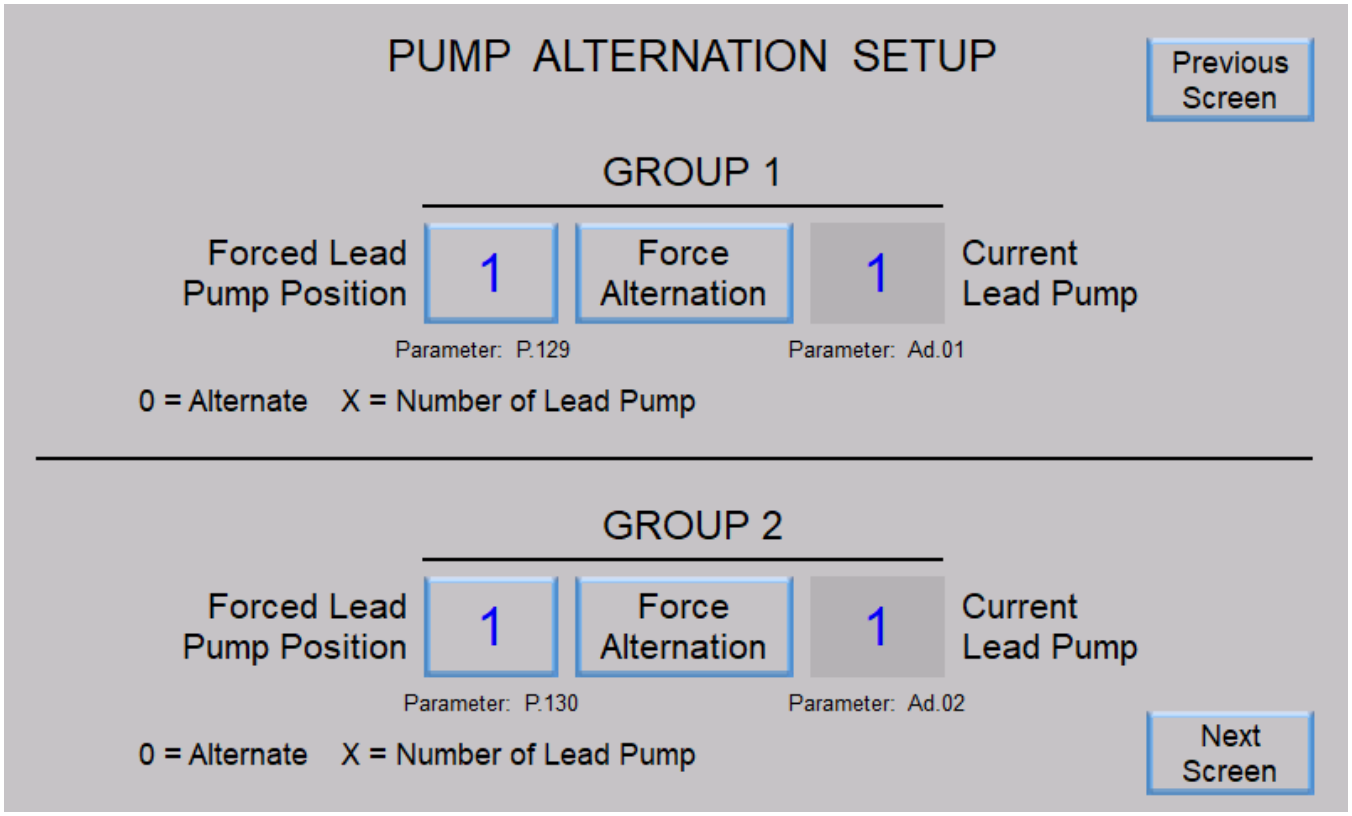
Station Control Setup



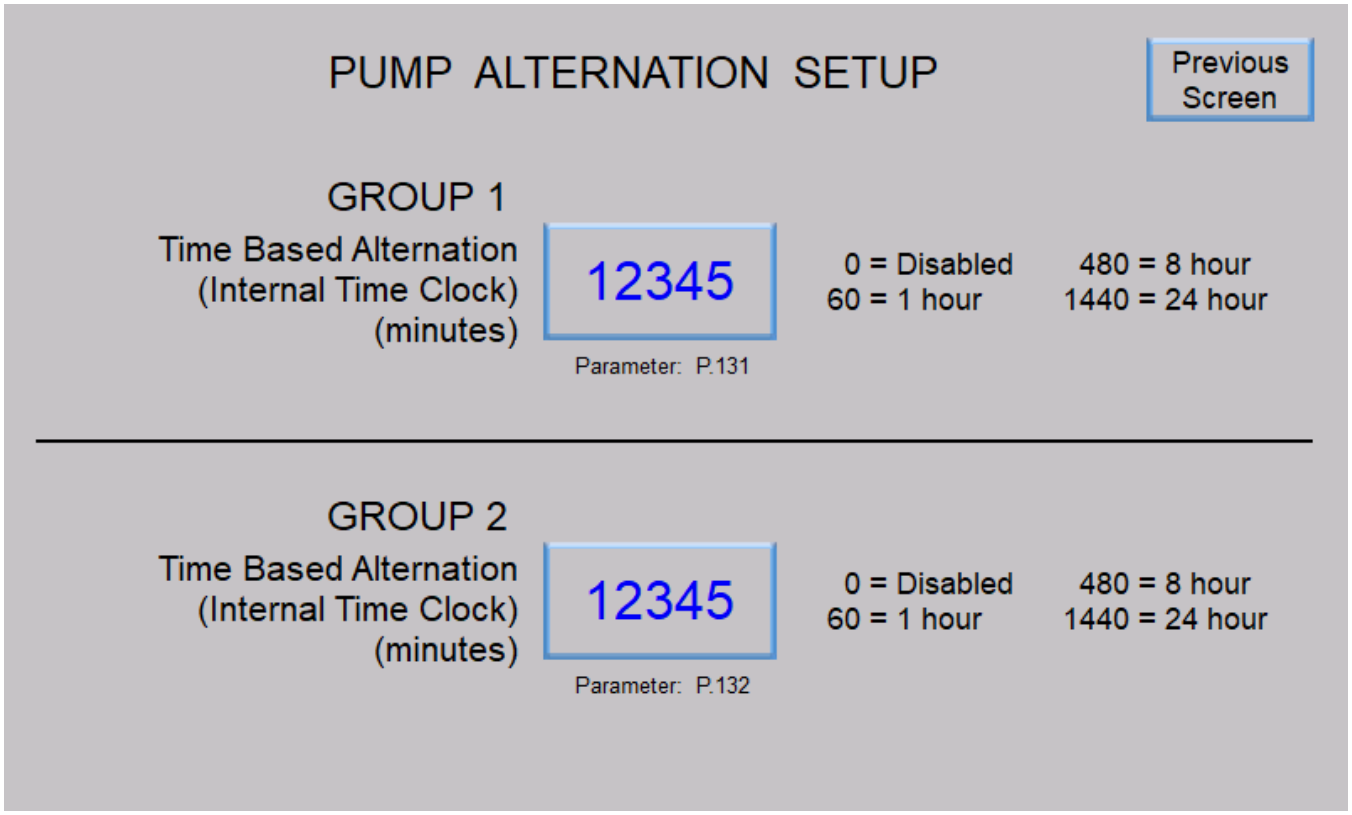
Pump Alternation Setup



Pump Alternation Setup

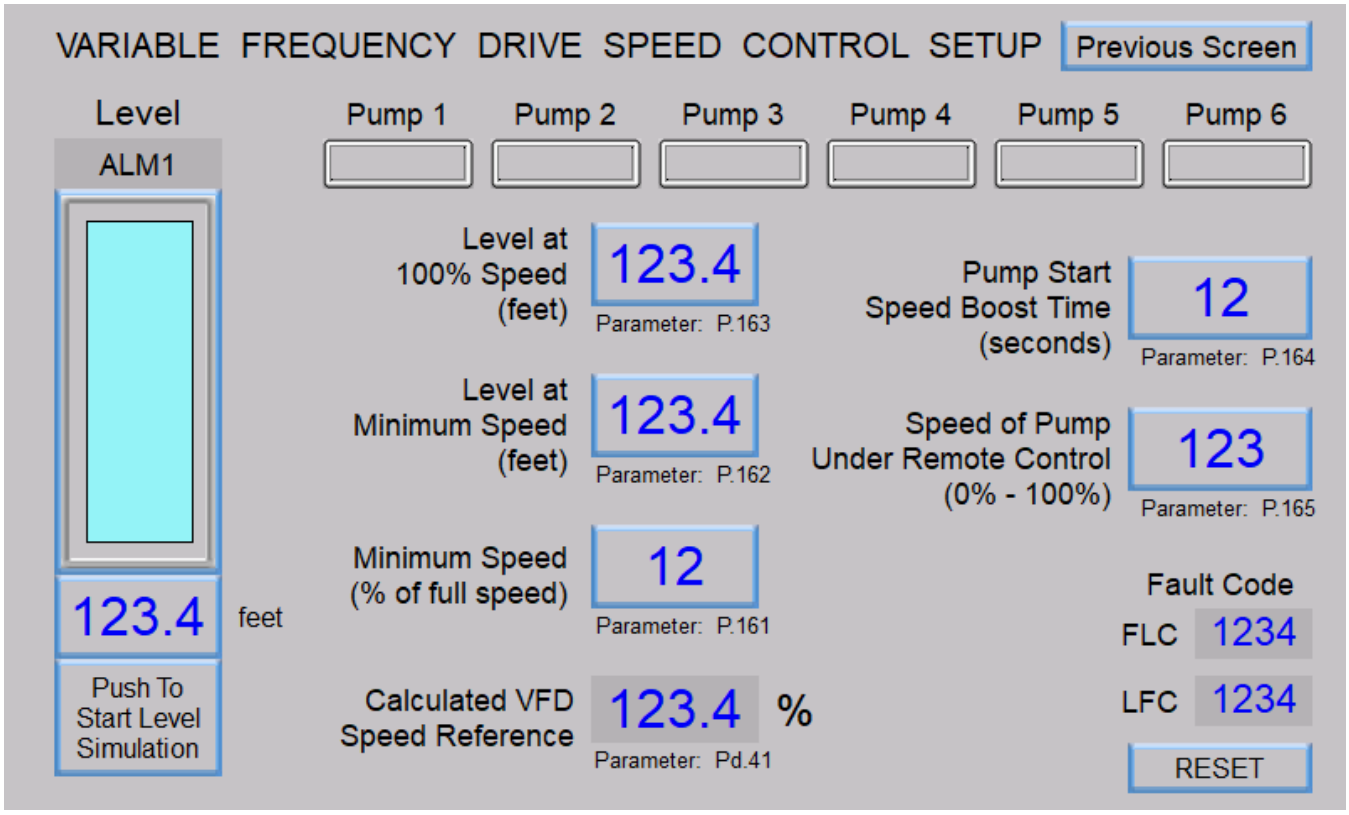


Pump Alternation Setup

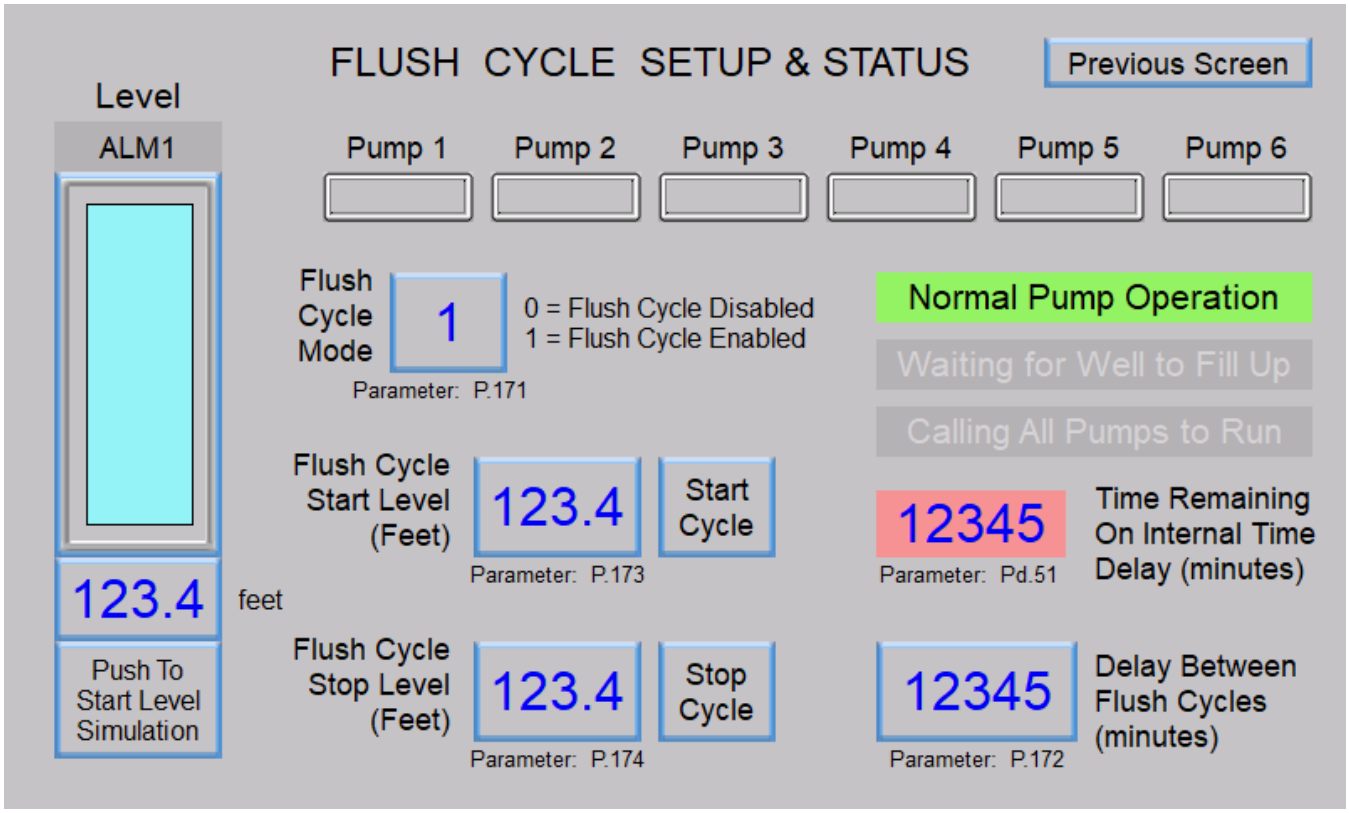


LEVEL CONTROL - Touchscreen HMI SCREENS

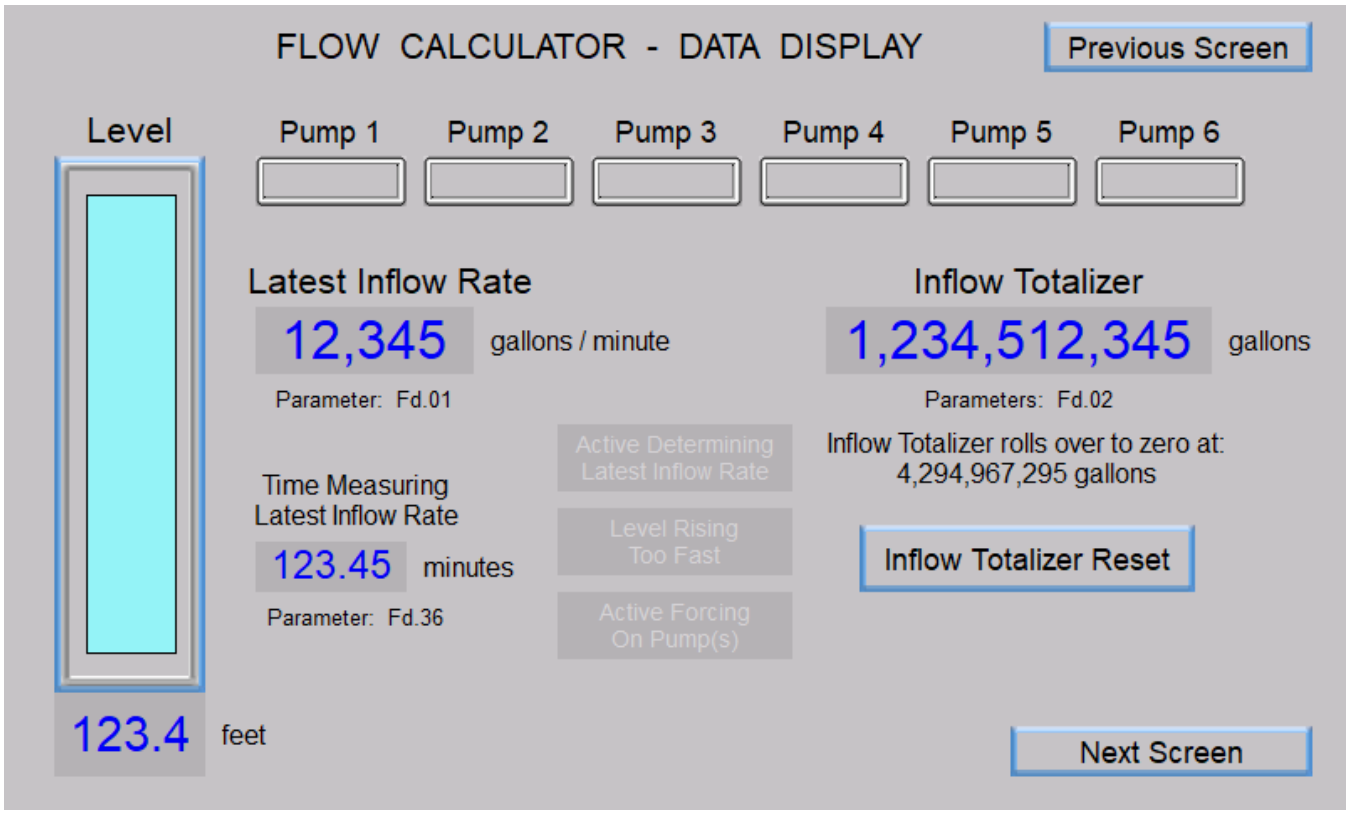
VFD Control Setup



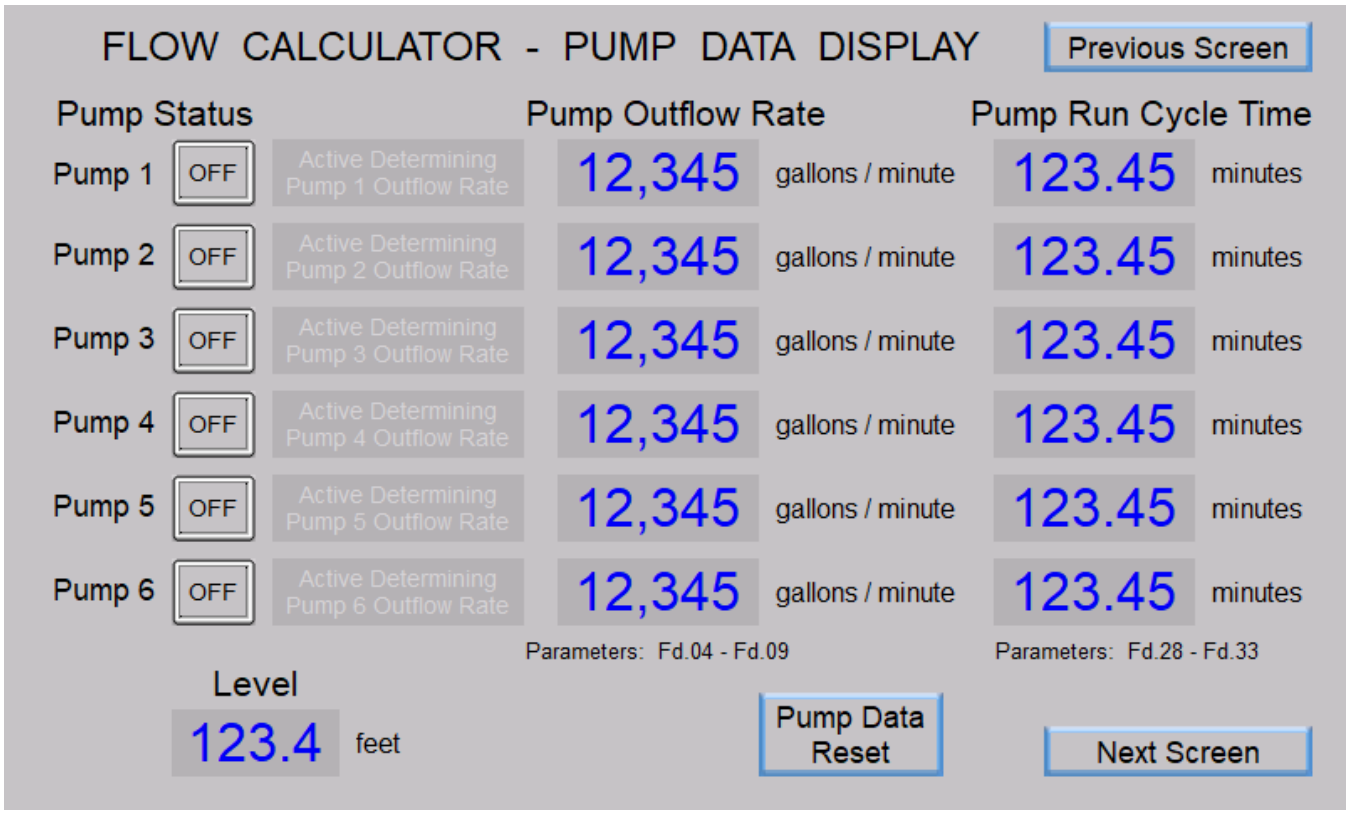
Flush Cycle Setup



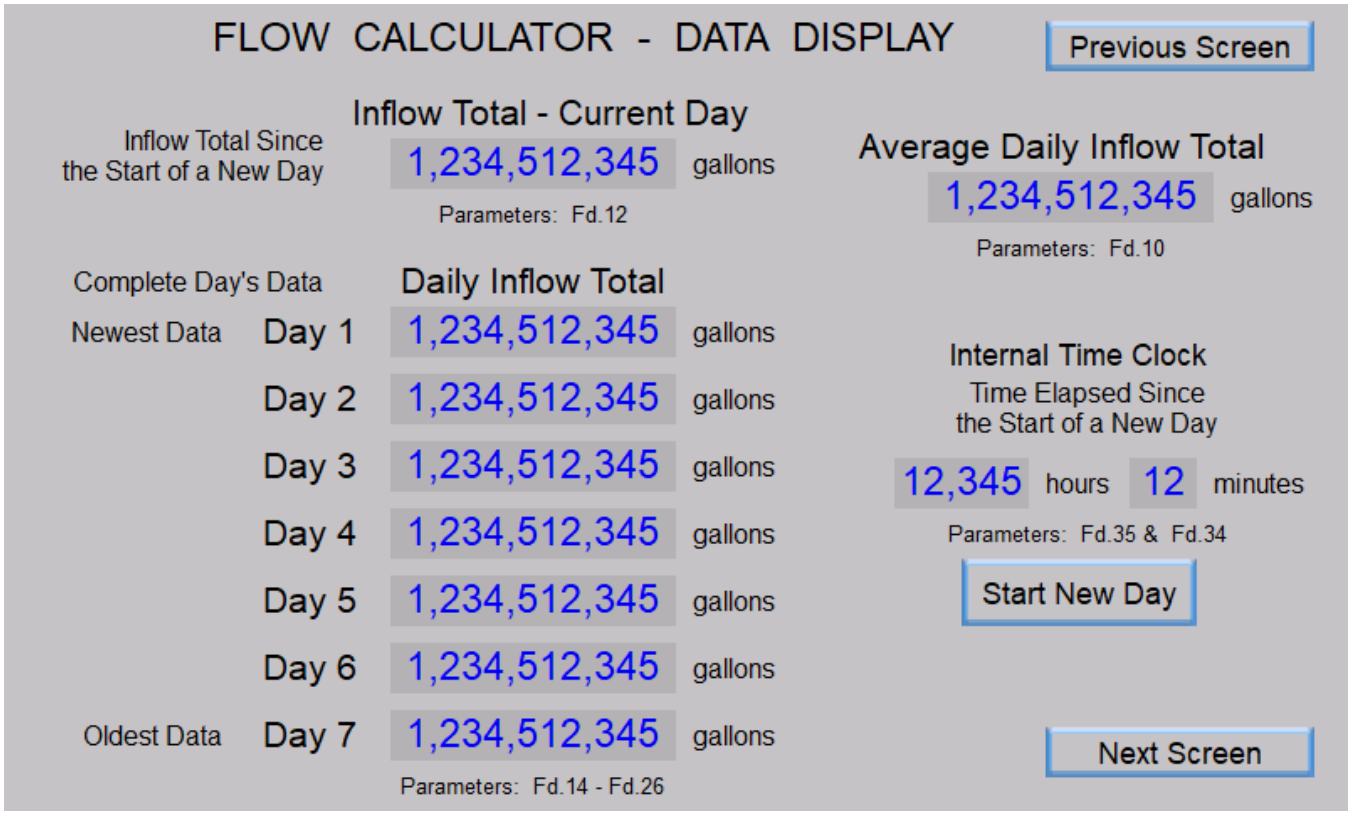
Flow Calculator Data Display



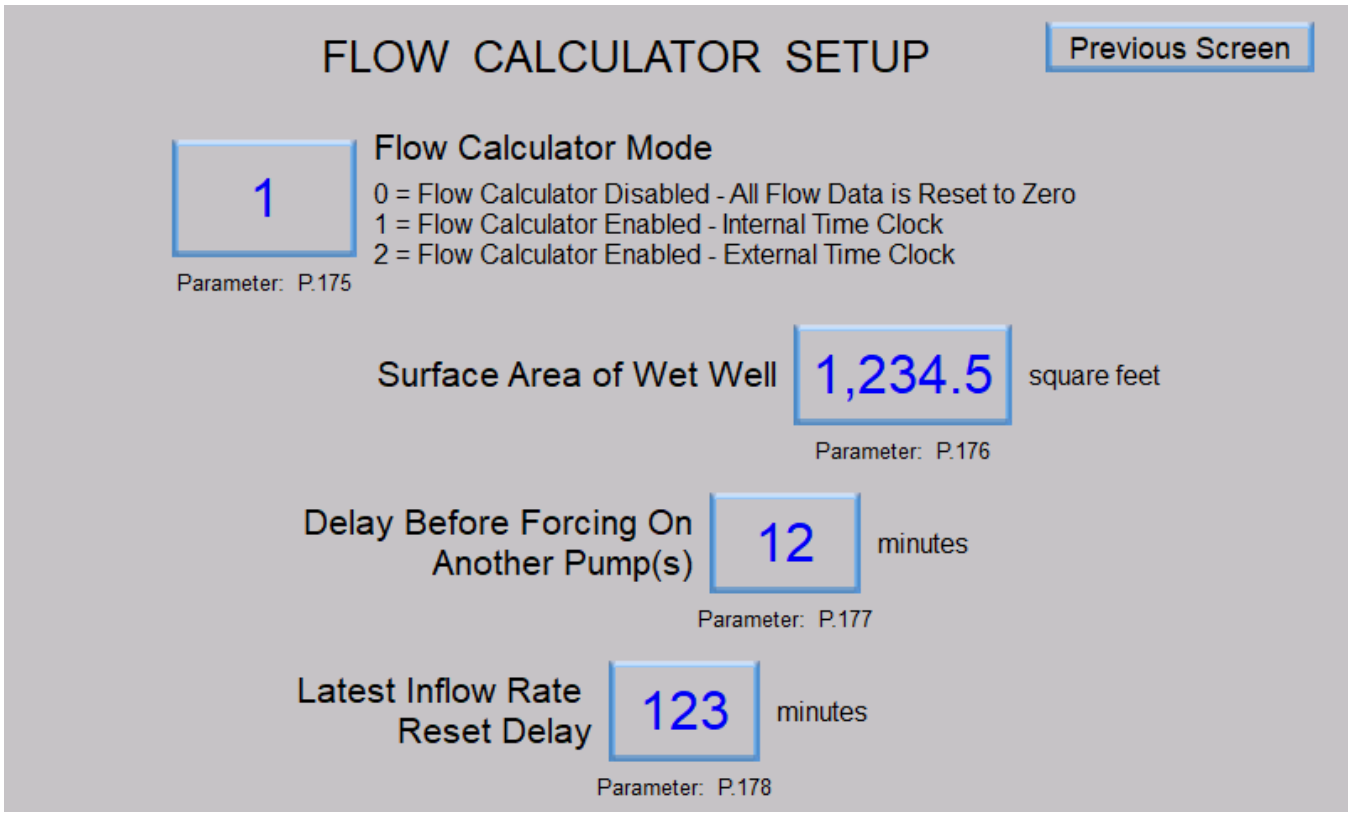
Flow Calculator Data Display



Flow Calculator Data Display



Flow Calculator Setup



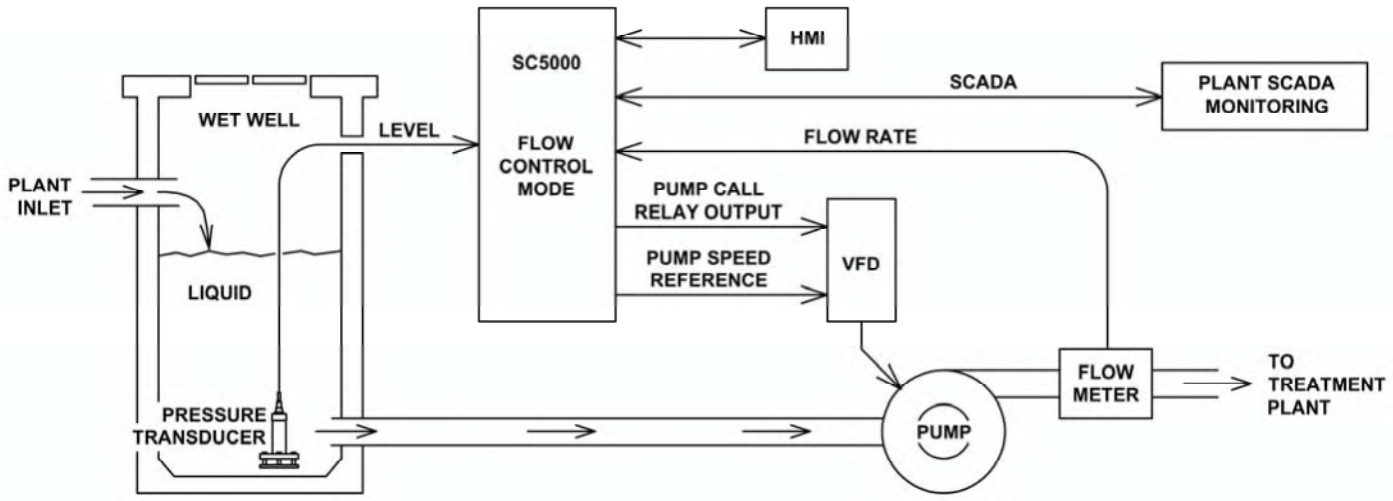
Revision Date: 5-9-23

SC5000

INSTRUCTION MANUAL

SECTION 2

FLOW CONTROL



MOTOR PROTECTION ELECTRONICS, LLC

2464 Vulcan Road
Apopka, Florida 32703

Phone: (407) 299-3825
Website: www.mpelectronics.com

SECTION 2
FLOW CONTROL

TABLE OF CONTENTS

FLOW CONTROL

DESCRIPTION OF FEATURES

General Description

With the Master Control Mode (Parameter P.091) set for “Flow Control” the SC5000 will function as a Flow Controller, and all logic pertaining to “Level Control”, “Pressure Control” and “ Booster Control” will be disabled.

In the Flow Control Mode, a PID Controller (Proportional, Integral, Derivative) is provided to regulate the pump speed in order to maintain the Flow Rate at the Flow Rate Setpoint.

The Flow Control logic also determines the number of pumps required to run in order to maintain the Flow Rate at the Flow Rate Setpoint.

The Flow Control logic also alternates the pumps and provides a First Pump Start Delay, Lag Pump Delay, Number of Pumps Required at Startup, Low Level Alarm, High Level Alarm, Low Flow Rate Alarm, High Flow Rate Alarm, and Pump Cutoff upon Low Level. It also has parameters in the menu that allow the operator to set the Number of Pumps Present, the Maximum Number of Pumps Allowed to Run At the Same Time, and the Maximum Number of Pumps Allowed to Run While On a Generator.

The Flow Control Mode requires that each pump have its own VFD.

The Flow Control Mode also requires that the Controller be ordered with an optional Analog Output for each pump for the VFD speed reference (see Ordering Information).

HMI Features

The **SC500-CTS-HMI** is a **C**olor **T**ouch **S**creen HMI programmed with screens that show the Wet Well Level, Flow Rate, Pump Speed Reference, Pump Run Status, Pump Available for Service indication, High Level and Low Level alarms, High Flow Rate and Low Flow Rate alarms, Flow Rate Setpoint Override Active indication, Level Too Low For Pump Operation alarm, Low-Low Level Pump Cutoff Active alarm, Elapsed Run Time meters for each pump, and any Fault Codes that may be present. All the control and alarm settings are made readily available to the operator for viewing or changing. An operator may also perform Level Simulation, reset the Elapsed Run Time meters, and reset any Fault Codes.

Flow Rate Setpoint

The Flow Rate Setpoint (Parameter P.405) must be set by the operator for the desired flow rate that the liquid should be pumped at as it leaves the lift station.

At startup, the Flow Control logic will bring on the Number of Pumps Required at Startup (Parameter P.431). If number of pumps called at startup are unable to bring the Flow Rate up to the Flow Rate Setpoint, then an another pump will be started. If the setpoint is still not reached, then the control logic will call another pump to run and then another until the Flow Rate Setpoint is met. Additionally, the logic will turn off any unneeded pumps.

The PID Controller will follow what is set on the Flow Rate Setpoint as it regulates the Flow Rate, except when the supply liquid level is either low or high. In either case the Controller may be setup to not strictly following the setpoint, but rather decrease the Flow Rate if the supply liquid level is low, or increase the Flow Rate if the supply liquid level is high and follow the Flow Rate Setpoint when the liquid level returns to the normal range.

First Pump Start Delay

After power is applied to the Controller and after all the initial conditions are satisfied and the First Pump Start Delay (Parameter P.429) has expired, the Number of Pumps Required at Startup (Parameter P.431) will be started, and the Lag Pump Delay (Parameter P.430) will set the minimum time period between each pump call. The following are the initial conditions which must first be met for the First Pump Start Delay to begin timing out:

There must be an adequate supply of liquid in the wet well. The liquid level must be at or above what is set on the Pump Operation Enable Level (Parameter P.426).

The “All Pump Disable” Discrete Input (Discrete Input Function 17) must be open.

The “Pump Cutoff Low-Low Level” Discrete Input (Discrete Input Function 59) must be open and the delay set on the pump Re-enable Delay (Parameter P.153) must have expired.

At least one pump must be available for service (Not having its Pump Disable Discrete Input closed (Discrete Input Functions 11 - 16).

After all of the above conditions are met and the First Pump Start Delay times out, the first pump will be started.

FLOW CONTROL

Lag Pump Delay

The Lag Pump Delay (Parameter P.430) sets the minimum time period between the calling of pumps to run at startup. It is also used to delay the turning on of the replacement pump when an operating pump is suddenly disabled, or when a time based alternation of the pumps is performed.

Number of Pumps Required at Startup

The Number of Pumps Required at Startup (Parameter P.431) sets the minimum number of pumps that are initially turned on in order to meet the Flow Rate Setpoint. When the First Pump Start Delay (Parameter P.429) expires, the first of the required pumps will be turned on and each additional required pump will wait for the Lag Pump Delay (Parameter P.430) to expire.

Pump Turn On and Off

Operating Principal

After the Number of Pumps Required at Startup (Parameter P.431) are started, the Flow Control logic will then control the number of additional pumps that are required to run in order to maintain the Flow Rate at the Flow Rate Setpoint. The control logic determines when an additional pump is needed and when to turn off an unneeded pump based on the following operating principal:

> The number of pumps required to run is regulated so that the PID Controller does not drive the pump speed reference significantly higher than or lower than a predetermined pump speed range.

See the Flow Rate Versus Pump Speed graph on page 2-12.

Turning On Pumps

If at some point conditions in the system require that the pump speed be increased in order to maintain the Flow Rate Setpoint, then the pump speed reference will be increased as needed. If the pump speed reference were to be increased to the point that it were equal to or greater than what is set on the Pump Speed Upper Threshold (Parameter P.414), then one additional pump would be turned on, after the delay set on the Delay To Turn On One Pump (Parameter P.415) expires. This may be repeated again and again until all the available pumps are called to run, or until the pump speed becomes lower than the Pump Speed Upper Threshold (Parameter P.414).

Turning Off Pumps

If at some point in time the conditions in the system were to change such that a lower pump speed were required to maintain the Flow Rate Setpoint, then the pump speed reference would be decreased as needed. If the pump speed reference were to be decreased to the point were it was equal to or less than what is set on the Pump Speed Lower Threshold (Parameter P.416), then one of the pumps would be turned off, after the delay set on the Delay To Turn Off One Pump (Parameter P.417) expires. This may be repeated again and again until all but one pump is left running, or until the pump speed becomes higher than the Pump Speed Lower Threshold (Parameter P.416).

Pump Operation Enable / Disable

The pump operation in the Flow Control Mode requires that there be an adequate supply of liquid in the wet well. The following two parameters provide the operator with control over how low the supply liquid level is allowed to drop before turning off all the pumps and at what level pumping should be allowed to resume:

Pump Operation Enable Level

To allow any pumps to start, the liquid level must first rise up to or be above what is set on the Pump Operation Enable Level (Parameter P.426).

Pump Operation Disable Level

If the liquid level falls below what is set on the Pump Operation Disable Level (Parameter P.427) then all the pumps will be turned off.

Alarm Status

When pump operation is disabled, based on Parameters P.426 and P.427, the “Supply Level Too Low for Pump Operation” alarm status bit will be set and may be read from Modbus Coil 258 (Register 40017 Bit 1).

FLOW CONTROL

Controlling Setpoint

There are times when strictly following the Flow Rate Setpoint may be undesirable, the Flow Control logic has a Flow Rate Setpoint Override feature that allows the PID Controller to not directly following the Flow Rate Setpoint, but rather follow the Controlling Setpoint. Where the Controlling Setpoint is allowed to deviate from the Flow Rate Setpoint based on the settings on Parameters P.420, 421, 423, 424 & P.428.

The current value of the Controlling Setpoint may be viewed from Parameter Fd.54.

See the description of the Flow Rate Setpoint Override feature below.

Flow Rate Setpoint Override

Controlling Setpoint - Start Up

At start up, the PID Controller is sent a Controlling Setpoint (Parameter Fd.54) that is slowly increased until it equals the Flow Rate Setpoint (Parameter P.405). The rate of the increase is set by the Flow Rate Ramp Rate (Parameter P.428).

See the Controlling Setpoint Versus Time After Start Up graph on page 2-14.

Controlling Setpoint - Normal Level

After start up, under normal conditions the PID Controller keeps the Flow Rate at or near what is set on the Flow Rate Setpoint (Parameter P.405) as entered by the operator, as long as the wet well level stays within an acceptable range.

See the Controlling Setpoint Versus Wet Well Level graph on page 2-13.

Controlling Setpoint - High Level

If the wet well level is high and at risk of an overflow, then the Flow Rate of the liquid being pumped out of the station will need to be increased above what is set on the Flow Rate Setpoint.

This is done by setting the Flow Rate Setpoint Override High Level (Parameter P.420) to the liquid level above which the Flow Rate should be increased. Additionally, the Controlling Setpoint Upper Limit (Parameter P.421) will need to be set to the maximum Flow Rate that should be allowed.

To disable the Flow Rate Setpoint Override High Level feature set Parameter P.420 to 231.0 feet.

Controlling Setpoint - Low Level

If the wet well level is low and at risk of running out of liquid to pump, then the Flow Rate of the liquid being pumped out of the station may need to be decreased below what is set on the Flow Rate Setpoint.

This is done by setting the Flow Rate Setpoint Override Low Level (Parameter P.423) to the liquid level below which the Flow Rate will need to be decreased. Additionally, the Controlling Setpoint Lower Limit (Parameter P.424) should be set to the minimum Flow Rate that should be allowed.

To disable the Flow Rate Setpoint Override Low Level feature set Parameter P.423 to 1.0 feet.

Alarm Status

If it becomes necessary to override what is set on the Flow Rate Setpoint, then the “PID Controller Setpoint Override Active” alarm status bit will be set. Its status may be read from Modbus Coil 257 (Register 40017 Bit 0).

FLOW CONTROL

Pump Alternation

Automatic Alternation

In the Flow Control Mode the pump Alternation Sequence Mode (Parameter P.122) is fixed to always be in the Standard Alternation mode, and the pumps will be Alternated “First On First Off”. See page 2-8.

See the alternation sequence diagram on page 2-16.

Manual Pump Call Sequence

When manual control over the pump call sequence is desired, the operator can use the Forced Lead Pump Position feature (Parameter P.129) to set the Lead Pump Position. This sets the order the pumps are called in. The Lead Pump Position may also be set using a Lead Pump Selector switch that is connected to Discrete Inputs assigned to Functions 31 - 36. See page 2-8.

See connection diagrams on page A-13.

Time Based Alternation

Time Based Alternation is also available in the Flow Control Mode. The Time Based Alternation logic may be triggered by an Internal Time Clock or from an External Time Clock. The Internal Time Clock alternation period is menu selectable (Parameter P.131). The External Time Clock may be triggered to alternate from either a External Time Clock connected to a Discrete Input on the Controller (set for Function 21), or it may be part of a SCADA system’s logic, where the SCADA system would set Modbus Coil 95 (Register 40006 Bit 14) to force the alternation of the pumps. See page 2-8.

Pump Cutoff Low-Low Level

The Pump Operation Enable / Disable feature (setup on Parameters P.424 and P.425) monitors the Analog Level Input to determine if there is an adequate supply of liquid in the wet well. By using a Low-Low Level Float Switch connected to a Discrete Input a redundant pump cut off may also be implemented. This Pump Cutoff Low-Low Level feature also includes a Re-enable Delay to prevent the short cycling of the pumps.

The Low-Low Level Float Switch must be connected to a Discrete Input assigned to Function 59.

The Re-enable Delay (Parameter P.153) starts timing out when the Discrete Input opens. When the Re-enable Delay expires the Pump Cutoff Low-Low Level feature will no longer prevent pump operation.

The “Pump Cutoff Active Low-Low Level” status is available from Modbus Coil 131 (Register 40009 Bit 2).

While the Pump Cutoff Low-Low Level input is closed, the Low Level Alarm will also be activated. The contacts of a relay assigned to the Low Level Alarm (Function 7) will also close.

Level Input Select

The Flow Control Mode requires an analog 4-20mA Level Input be provided to monitor the liquid level in the wet well. The default Level Input is connected to Analog Level Meter ALM1. If a second or backup Level Input is desired then it must be connected to Analog Level Meter ALM2. The Level Input Select (Parameter P.133) allows for the selection between two Analog Level Meters ALM1 or ALM2 as the Level Input source (each Level Meter must be connected to its own Pressure Transducer). The second analog 4-20mA Level Input may be either manually or automatically switched into service as the controlling Level Input. See Section M.

Flow Rate Input Select

The Flow Control Mode requires that a Flow Rate Input be provided to the Controller to monitor the Flow Rate. The Flow Rate Input Select (Parameter P.401) is provided to allow for the selection one of three Analog Flow Meters AFM1, AFM2 or AFM3, or from one of three Pulse Flow Meters PFM1, PFM2 or PFM3. Before use, the selected Flow Meter must be setup and calibrated to match the calibration of the field device (Flow Meter) that measures the Flow Rate. See page 2-10.

FLOW CONTROL

Discrete Inputs

30 Discrete Inputs (D1 - D30) that may be setup to perform the following Functions:

- Pump Disable Inputs
- All Pump Disable - Phase Monitor Input
- On Generator - Limits number of pumps allowed to run
- Switch Between ALM1 & ALM2 for Level Input selection
- External Alternation - External Time Clock Input
- Sequence Inputs - Lead Pump Selector Switch Inputs
- Call Pump Last Inputs
- Pump Cutoff Low-Low Level Input
- High and Low Level Alarm Inputs
- Collection of Discrete Input Data for SCADA

Relay Outputs

12 Relay Outputs (ROX1 - ROX12) that may be setup to perform the following Functions:

- Up to Six Pump Call to Run Outputs
- High or Low Level Alarm Outputs
- High or Low Flow Rate Alarm Outputs
- SCADA Remote Control Outputs

Analog Inputs

2 Standard Analog Inputs (AIX1 - AIX2) and up to 8 more Optional Analog Inputs (A1 - A8).
The Analog Inputs may be setup to perform one of the following Functions:

- Analog Level Meter ALM1 or ALM2
- Analog Flow Meter AFM1, AFM2 or AFM3
- Analog Pressure Meter APM1 or APM2
- Analog Current Meter ACMA, ACMB or ACMC
- Collection of Analog Input Data for SCADA

Analog Outputs

1 Standard Analog Output (AOX1) and up to 6 more Optional Analog Outputs (AO1 - AO6).
The Analog Outputs may be setup to perform one of the following Functions:

- Analog Signal for Pumps 1 - 6 Speed Reference
- Analog Signal for Pumps Speed Reference any Pump (Always Active)
- Analog Signal that is a Copy of Wet Well Level

Pulse Counter Inputs

Option for up to 3 Pulse Counter Inputs (DPC1 - DPC3) that may be used to perform the following:

- Pulse Counter Input for Pulse Flow Meter PFM1, PFM2 or PFM3

FLOW CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Master Control Mode				
P.091	1		40091	Master Control Mode 1 = Level Control 2 = Flow Control **Must Be Set On "2" for Flow Control** 3 = Pressure Control 4 = Booster Control
Pump Setup				
P.092	6		40092	Number of Pumps Present 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps
P.093	6		40093	Maximum Number of Pumps Allowed to Run at the Same Time 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps
P.094	6		40094	Maximum Number of Pumps Allowed to Run While On Generator 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps Note: Must Connect Transfer Switch Contact to Discrete Input assigned to Function 18.

User / Operator Info.	SCADA	
Parameter	Register Address	Description of Data
Elapsed Time Meter Data		
Etd.1	41891	Pump 1 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.2	41892	Pump 2 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.3	41893	Pump 3 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.4	41894	Pump 4 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.5	41895	Pump 5 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.6	41896	Pump 6 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours

FLOW CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Pump Alternation Setup				
P.122	1	1	40122	Alternation Sequence Mode 1 = Standard Alternation of Pumps 1 - 6 See page 2-17. Note: With the Master Control Mode set on Flow Control the Alternation Sequence Mode will be fixed on Standard Alternation.
P.129	0		40129	Forced Lead Pump Position 0 = Normal Alternation X = Pump X as Lead
P.131	0		40131	Time Based Alternation Range: 0 - 65535 minutes 0 = Disabled 60 = 1 hour 480 = 8 hours 1440 = 24 hours Note: Pump Alternation may be triggered using the Internal Time Clock setup using Parameter P.131, or it can also be triggered by an External Time Clock, which may be either a hardware device connected to a Discrete Input setup to perform Function 21, or it may be triggered by having the SCADA system set Bit 14 in Register 40006.
Pump Alternation Status				
Ad.01	-	-	41888	Current Lead Pump Shows the number of the current Lead Pump.

FLOW CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Level Input Setup				
P.133	1		40133	Level Input Select 1 = Analog Level Meter - ALM1 - Single Transducer 2 = Analog Level Meter - ALM2 - Single Transducer 3 = Analog Level Meter - ALM1 & ALM2 - Dual Transducers - Manual Switching 4 = Analog Level Meter - ALM1 & ALM2 - Dual Transducers - Automatic Switching Selection 1 - Level Input is from ALM1. See Section M. Selection 2 - Level Input is from ALM2. See Section M. Selection 3 - Level Input is Manually switched from ALM1 to ALM2. See Section M. Selection 4 - Level Input is Automatically switched from ALM1 to ALM2. See Section M.
Level Input Data				
Ld.01	-	-	42143	Level Input Data - For Numerical Display Note: This is the value of the Level input selected on Parameter P.133 scaled into feet and 1/10 of feet for numerical display.
Ld.02	-	-	42144	Level Input Data - For Bar Graph Display of Level Note: This is the value of the Supply Level Input selected on Parameter P.133 scaled for display on a bar graph. It is scaled to a range of 0 - 4095. The Bar Graph Display scaling setup on the HMI device must be set for 0 - 4095.
Ld.03	-	-	42145	Level Input Source Status 1 = Analog Level Meter - ALM1 2 = Analog Level Meter - ALM2 3 = Level - Simulated

FLOW CONTROL

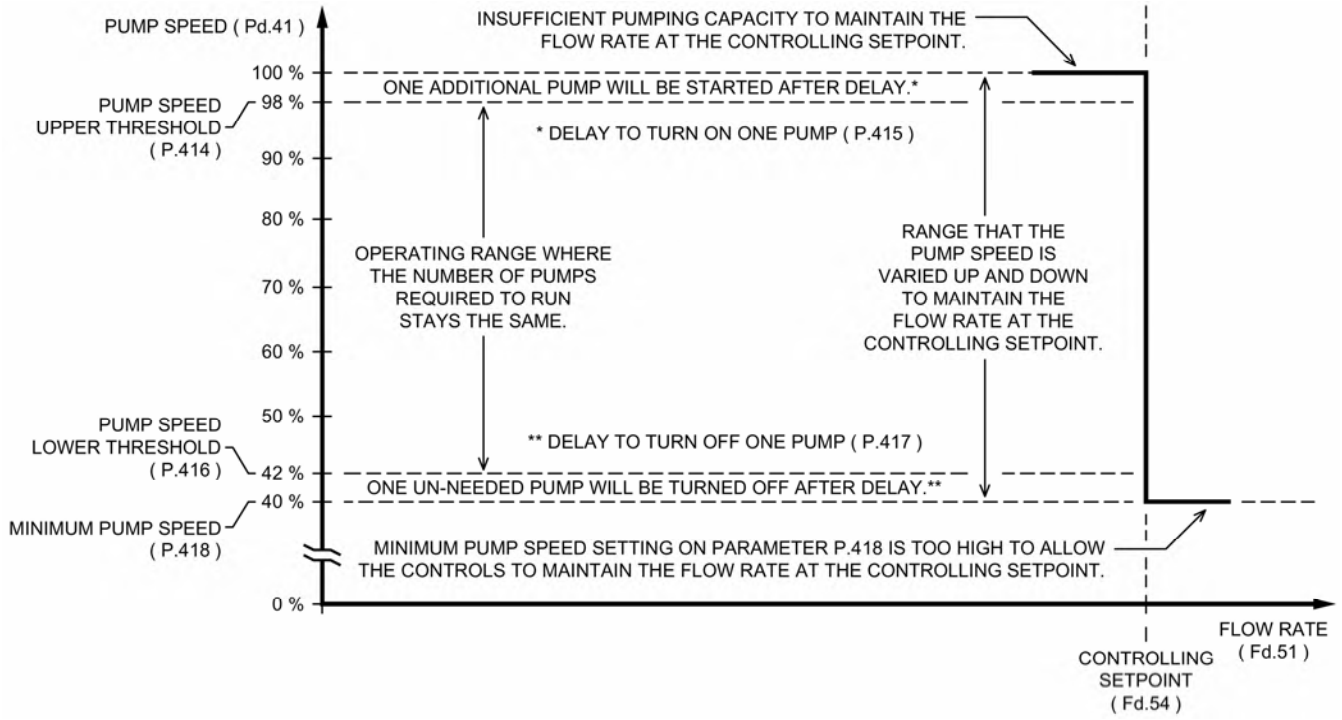
User / Operator Info.			SCADA		
Parameter	Default Value	Current Value	Register Address		Description of Parameters and SCADA Notes
Flow Rate Input Setup					
P.401	1		40401		Flow Rate Input Select 1 = Analog Flow Meter AFM1 - See page K-1. 2 = Analog Flow Meter AFM2 - See page K-2. 3 = Analog Flow Meter AFM3 - See page K-3. 4 = Pulse Flow Meter PFM1 - See page J-1. 5 = Pulse Flow Meter PFM2 - See page J-2. 6 = Pulse Flow Meter PFM3 - See page J-3. Note: This parameter establishes which Flow Meter's Flow Rate will be used as the Process Variable (PV) that goes into the PID Controller used for Flow Control. The Flow Rate data selected here is available to be read from Parameter Fd.51.
P.403	1,000 gallons / minute		40403	Least Significant of 32-Bit Number	Flow Rate Input Bar Graph Span Range: 30 - 107,000,000 gallons / minute Note: This parameter sets the span of the Flow Rate Data for Parameter Fd.53.
			40404	Most Significant of 32-Bit Number	
Flow Rate Input Data					
Fd.51	-	-	42151	Least Significant of 32-Bit Number	Flow Rate Input Data - For Numerical Display Note: This is the Flow Rate data selected by Parameter P.401.
			42152	Most Significant of 32-Bit Number	
Fd.53	-	-	42153		Flow Rate Input Data - For Bar Graph Display Note: This is the value of the Flow Rate input selected on Parameter P.401 scaled for display on a bar graph. It is scaled to a range of 0 - 40 by using the Flow Rate Input Bar Graph Span (Parameter P.403). The Bar Graph Display scaling setup on the HMI device must be set for 0 - 40.

FLOW CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Flow Rate Setpoint				
P.405	600 gpm		40405	Flow Rate Setpoint (SP) Range: 30 - 65,000 gpm Note: This is the parameter that sets the desired flow rate of the liquid being pumped out of the lift station.
Fd.54	-	-	42154	Controlling Setpoint Note: During normal operation the Controlling Setpoint is set equal to the Flow Rate Setpoint. However, to prevent the wet well from either overflowing or being pumped down too low, the Controller's logic increases or decrease the value of the Controlling Setpoint as needed, based on what is set on Parameters P.420 - P.424 & P.428.
While the Controlling Setpoint is lower or higher than the Flow Rate Setpoint, the "PID Controller Setpoint Override Active" status bit will be set. Its status may be read from Modbus Coil 257 (Register 40017 Bit 0).				
PID Controller Tuning				
P.411	6.40		40411	Controller Gain (Kc) Range: 0.01 - 30.00 Note: This parameter is used to tune the proportional component of the PID Controller's Pump Speed Reference output.
P.412	0.02 minutes / repeat		40412	Integral Time (Ti) Range: 0.01 - 60.00 minutes / repeat Note: This parameter is used to tune the integral component of the PID Controller's Pump Speed Reference output. Changes to this parameter may result in significant changes to the Pump Speed Reference. Therefore, it is recommended that only small changes are made to this parameter while the system is in operation.
P.413	0.00 minutes		40413	Derivative Time (Td) Range: 0.00 - 2.00 minutes Note: This parameter is used to tune the derivative component of the PID Controller's Pump Speed Reference output.
Pump Speed Reference Data				
Pd.41	-		41877	Pump Speed Reference Data Range: 0.0 - 100.0 percent Notes: 1. The Pump Speed Reference is determined by the PID Controller and is sent to the VFDs, as a 4-20mA signal, to control the pump speed 2. All operating pumps receive the same Speed Reference. 3. Parameter Pd.41 is the Pump Speed Reference as a percent of full speed.

FLOW CONTROL

Turning On / Off Pumps

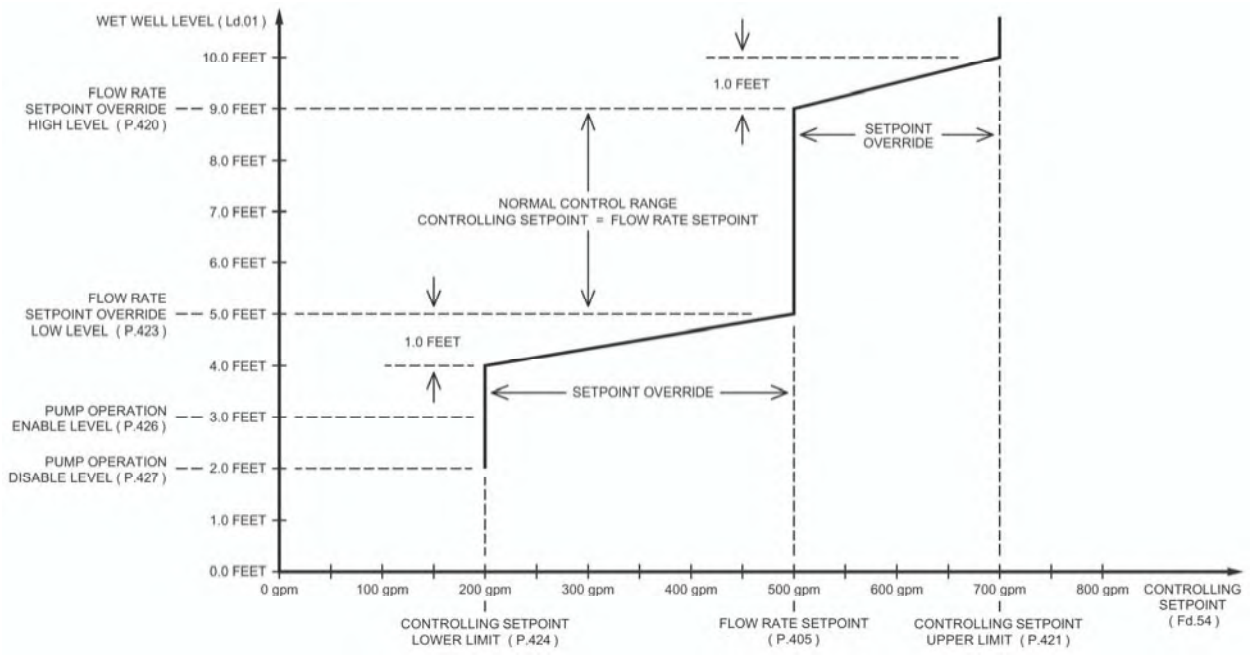


User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Turning On of Pumps				
P.414	98.0 %		40414	Pump Speed Upper Threshold Range: 30.0% - 100.0% of Full Speed Note: When the Pump Speed Reference has increased to where it is greater than or equal to what is set on this parameter, the **Delay To Turn On One Pump** (Parameter P.415) is started. When the delay expires an additional pump will be turned on.
P.415	10 sec.		40415	Delay To Turn On One Pump Range: 1 - 600 seconds Note: This delay starts when the Pump Speed Reference has increased to where it is greater than or equal to the **Pump Speed Upper Threshold** (Parameter P.414). When the delay expires an additional pump will be turned on.
Turning Off of Pumps				
P.416	42.0 %		40416	Pump Speed Lower Threshold Range: 10.0% - 90.0% of Full Speed Note: When the Pump Speed Reference has decreased to where it is less than or equal to what is set on this parameter, the **Delay To Turn Off One Pump** (Parameter P.417) is started. When the delay expires one pump will be turned off. This parameter must be set higher than or equal to the **Minimum Pump Speed** (Parameter P.418).
P.417	10 sec.		40417	Delay To Turn Off One Pump Range: 1 - 600 seconds Note: This delay starts when the Pump Speed Reference has decreased to where it is less than or equal to the **Pump Speed Lower Threshold** (Parameter P.416). When the delay expires one pump will be turned off.
Minimum Pump Speed				
P.418	40%		40418	Minimum Pump Speed Range: 0% - 95% of full speed Note: For each application there is usually a minimum speed, below which pump operation is undesirable. This parameter sets the minimum pump speed allowed. With the **Minimum Pump Speed** set on Parameter P.418, care must be taken that there is not also a minimum speed set on the VFDs.

FLOW CONTROL

Controlling Setpoint Versus Wet Well Level

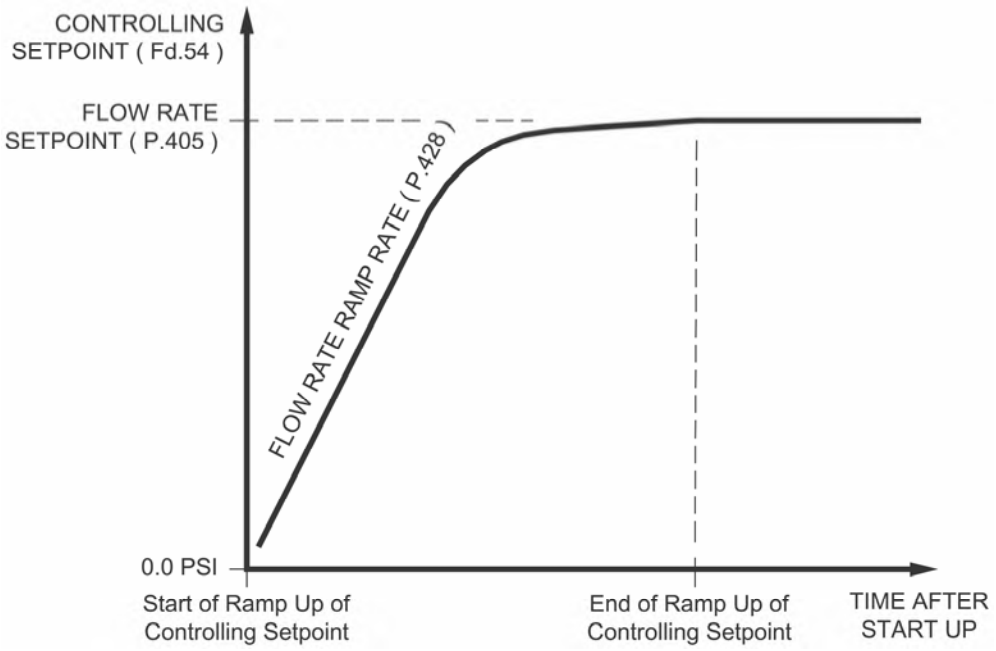
Pumping Application - Example Shown With All Setup Parameters Set On Their Default Values



User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Flow Rate Setpoint Override - High Level				
P.420	9.0 feet		40420	Flow Rate Setpoint Override High Level — Range: 1.0 - 231.0 feet Note: This is the wet well level at which the **Controlling Setpoint** will be temporally increased above the **Flow Rate Setpoint** as needed to prevent the wet well level from continuing to rise. The logic is allowed to increase the Controlling Setpoint up to the Controlling Setpoint Upper Limit (Parameter P.421), but no higher.
P.421	700 gpm		40421	Controlling Setpoint Upper Limit — Range: 30 - 65,000 gpm Note: This sets the upper limit of what the setpoint override logic is allowed to increase the **Controlling Setpoint** to, when the wet well level rises above what is set on Parameter P.420.
Flow Rate Setpoint Override - Low Level				
P.423	5.0 feet		40423	Flow Rate Setpoint Override Low Level — Range: 1.0 - 231.0 feet Note: This is the wet well level at which the **Controlling Setpoint** will be temporally decreased below the **Flow Rate Setpoint** as needed to prevent the wet well level from continuing to lower. The logic is allowed to decrease the Controlling Setpoint down to the Controlling Setpoint Lower Limit (Parameter P.424), but no lower.
P.424	200 gpm		40424	Controlling Setpoint Lower Limit — Range: 30 - 65,000 gpm Note: This sets the lower limit of what the setpoint override logic is allowed to decrease the **Controlling Setpoint** to, when the wet well level drops below what is set on Parameter P.423.
The "PID Controller Setpoint Override Active" status bit may be read from Modbus Coil 257 (Register 40017 Bit 0).				
Pump Operation Enable / Disable				
P.426	3.0 feet		40426	Pump Operation Enable Level — Range: 0.1 - 231.0 feet Note: This is the supply liquid level, in the wet well, at which the operation of all available pumps will be enabled to run as needed to meet the **Controlling Setpoint**.
P.427	2.0 feet		40427	Pump Operation Disable Level — Range: 0.1 - 231.0 feet Note: This is the supply liquid level, in the wet well, at which all pump operation is disabled and all pumps turned off in order to prevent the supply level from continuing to lower.
The "Supply Level Too Low for Pump Operation" status bit may be read from Modbus Coil 258 (Register 40017 Bit 1).				

FLOW CONTROL

Flow Rate Controlling Setpoint - During Start Up



Start Up

During start up, the Flow Control logic slowly ramps up the Controlling Setpoint (Parameter Fd.54), following the curve shown above. The Flow Rate Ramp Rate (Parameter P.428) is provided to set the start up ramp rate.

During start up, with an adequate Supply Level, the Controlling Setpoint (Parameter Fd.54) that is sent to the PID Controller is slowly ramped up until it matches the Flow Rate Setpoint (Parameter P.405).

However, if the Supply Level is below what is set on the Flow Rate Setpoint Override Low Level (Parameter P.423), the control logic will limit the Controlling Setpoint (Fd.54) as shown in the graph on page 2-13.

Also, if the Supply Level is above what is set on the Flow Rate Setpoint Override High Level (Parameter P.420), the control logic will increase the Controlling Setpoint (Fd.54) as shown in the graph on page 2-13.

The decrease in the ramp rate at the end of the curve shown above, is to reduce the overshooting of the Flow Rate Setpoint at start up.

At start up, if the Flow Rate is excessively overshooting the Flow Rate Setpoint, reduce the setting on the Flow Rate Ramp Rate (Parameter P.428), until the overshooting is within acceptable limits.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Flow Rate Ramp Rate				
P.428	10.0 gpm / sec		40428	Flow Rate Ramp Rate — Range: 1.0 - 6500.0 gpm / sec Note: Parameter P.428 sets the initial rate at which the control logic is allowed to change the Flow Rate's Controlling Setpoint (Parameter Fd.54). Parameter P.428 must be set so that during start up the Flow Rate does not overshooting of the Flow Rate Setpoint beyond the acceptable limit.
At startup or at any time the Setpoint Override logic keeps the Controlling Setpoint from being equal to the Flow Rate Setpoint, the "PID Controller Setpoint Override Active" status bit will be set. Its status may be read from Modbus Coil 257 (Register 40017 Bit 0).				

FLOW CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
First Pump Start Delay				
P.429	10 sec.		40429	First Pump Start Delay — Range: 1 - 180 seconds Notes: The First Pump Start Delay period starts when all the following conditions are met: 1. Power is applied to Controller. 2. The Wet Well Level is at or above the Pump Operation Enable Level (Parameter P.426). 3. The "All Pump Disable" discrete input (Discrete Input Function 17) is open. 4. The "Pump Cutoff Low-Low Level" discrete input (Discrete Input Function 59) is open and the delay set on the pump Re-enable Delay (Parameter P.153) has expired. 5. At least one Pump is available for service and has its "Pump Disable" discrete input (Discrete Input Functions 11 - 16) open.
Lag Pump Delay				
P.430	5 sec.		40430	Lag Pump Delay — Range: 1 - 100 seconds Note: This is the minimum time period between the calling of pumps to run at startup. It is also used to delay the turning on of the replacement pump when an operating pump is suddenly disabled, or when a time based alternation of the pumps is performed.
Number of Pumps Required at Startup				
P.431	1		40431	Number of Pumps Required at Startup — Range: 1 - 6 Note: This is the minimum number of pumps that are initially turned on in order to meet the Flow Rate Setpoint. When the First Pump Start Delay (Parameter P.429) expires, the first required pump will be turned on and each additional required pump will wait for the Lag Pump Delay (Parameter P.430) to expire.
Re-enable Delay - Pump Cutoff Low-Low Level				
P.153	10 sec.		40153	Re-enable Delay - Pump Cutoff Low-Low Level — Range: 1 - 600 seconds Notes: 1. While the Low-Low Level Float Switch is closed no pump operation will be allowed. 2. A Low-Low Level Float Switch must be connected to a Discrete Input assigned to Function 59. 3. The Delay starts timing out when the Discrete Input opens. When the Re-enable Delay expires the Pump Cutoff Low-Low Level feature will no longer prevent pump operation. 4. While the Pump Cutoff Low-Low Level input is closed the Low Level Alarm will be active. The contacts of a relay assigned to the Low Level Alarm (Function 7) will also be close. Also, Fault Code 1041 will be generated.
The "Pump Cutoff Active Low-Low Level" status is available from Modbus Coil 131 (Register 40009 Bit 2). The "Low Level Alarm" status is available from Modbus Coil 47 (Register 40003 Bit 14).				

FLOW CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Pump Speed Acceleration / Deceleration Rate				
P.166	30 sec.		40166	Pump Speed Acceleration Rate Range: 1 - 100 seconds / 100% speed Notes: 1. When a pump is turned on, this is the rate at which the pump's Speed Reference will be increased until it matches the Pump Speed Reference produced by the PID Controller (Parameter Pd.41). This is also the rate at which a pump's Speed Reference will follow increases of the Pump Speed Reference produced by the PID Controller. 2. The setting on Parameter P.166 is the time required for a pump's Speed Reference to go from 0% - 100%. 3. The Controller performs the Acceleration of the pump speed of the individual pumps. Therefore, the Accel Parameter on the VFDs should be set to a value less than or equal to what is set on Parameter P.166.
P.167	30 sec.		40167	Pump Speed Deceleration Rate Range: 1 - 100 seconds / 100% speed Notes: 1. When a pump is turned off, this is the rate at which the pump's Speed Reference will be decreased to 0% speed. This is also the rate at which a pump's Speed Reference will follow decreases of the Pump Speed Reference produced by the PID Controller. 2. The setting on Parameter P.167 is the time required for a pump's Speed Reference to go from 100% - 0%. 3. When a pump is turned off, the pump's Control Relay contact will be kept closed during the Deceleration of the pump to 0% speed, then the contact will be opened. 4. The Controller performs the Deceleration of the pump speed of the individual pumps. Therefore, the Decel Parameter on the VFDs should be set to a value less than or equal to what is set on Parameter P.167.
Level Alarms				
P.101	2.0 feet		40101	Low Level Alarm Range: 0.0 - 231.0 feet Notes: 1. This sets the level at which the Low Level Alarm will be activated. 2. The Low Level Alarm operation is delayed for 90 seconds after power is applied. 3. The Low Level Alarm does not act as a redundant pump off. 4. A Float Switch connected to a Discrete Input assigned to either Function 59 or 61 will also activate the Low Level Alarm. 5. Upon a Low Level Alarm, the contacts of a relay assigned to Function 7 will close.
The "Low Level Alarm" status is available from Modbus Coil 47 (Register 40003 Bit 14).				
P.102	10.0 feet		40102	High Level Alarm Range: 0.1 - 231.0 feet Notes: 1. This sets the level at which the High Level Alarm will be activated. 2. The High Level Alarm operation is delayed for 10 seconds after power is applied. 3. A Float Switch connected to a Discrete Input assigned to Function 62 will also activate the High Level Alarm. 4. Upon a High Level Alarm, the contacts of a relay assigned to Function 8 will close.
The "High Level Alarm" status is available from Modbus Coil 48 (Register 40003 Bit 15).				
Flow Rate Alarms				
P.437	100 gallons / minute		40437	Low Flow Rate Alarm Range: 10 - 65,535 gallons / minute Notes: 1. This sets the Flow Rate at which the Low Flow Rate Alarm will be activated. 2. Upon a Low Flow Rate Alarm, the contacts of a relay assigned to Function 9 will close.
The "Low Flow Rate Alarm" status is available from Modbus Coil 269 (Register 40017 Bit 12).				
P.439	900 gallons / minute		40439	High Flow Rate Alarm Range: 10 - 65,535 gallons / minute Notes: 1. This sets the Flow Rate at which the High Flow Rate Alarm will be activated. 2. Upon a High Flow Rate Alarm, the contacts of a relay assigned to Function 10 will close.
The "High Flow Rate Alarm" status is available from Modbus Coil 270 (Register 40017 Bit 13).				

PUMP ALTERNATION SEQUENCE

STANDARD ALTERNATION

Parameter P.122 = 1

With the Master Control Mode set on Flow Control the Alternation Sequence Mode will be fixed on Standard Alternation (Parameter P.122 = 1).

The pumps will be Alternated “First On First Off”.

Discrete Inputs assigned the Function of “Pump Disable” (Functions 11 - 16) inputs may be used to disable pumps so that they will not be called to run.

Discrete Inputs assigned the Function of “Call Pump Last” (Functions 41 - 46) may be used to assign pumps to standby status, where they will only be called to run if no other pumps are available.

Discrete Inputs assigned the Function of “Sequence Input” (Functions 31 - 36) may be used to set the lead pump.

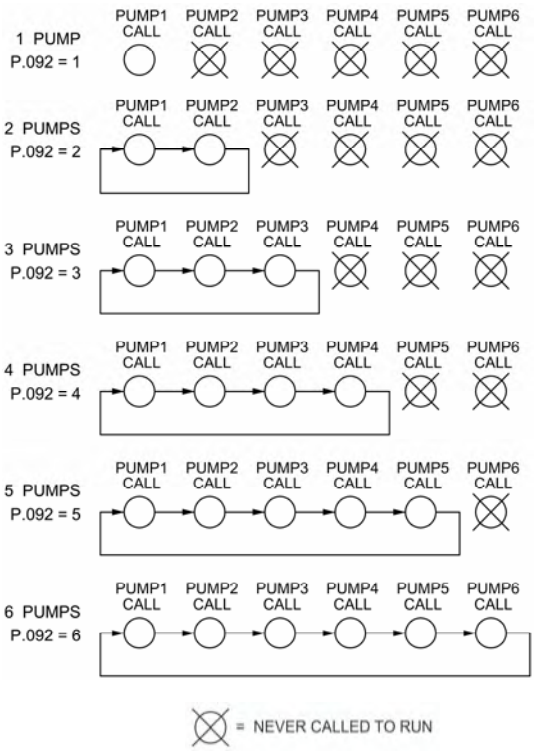
The “Forced Lead Pump Position” (Parameter P.129) may be used to set the lead pump.

“Time Based Alternation” (Parameter P.131) may be setup to force an alternation using an Internal Time Clock.

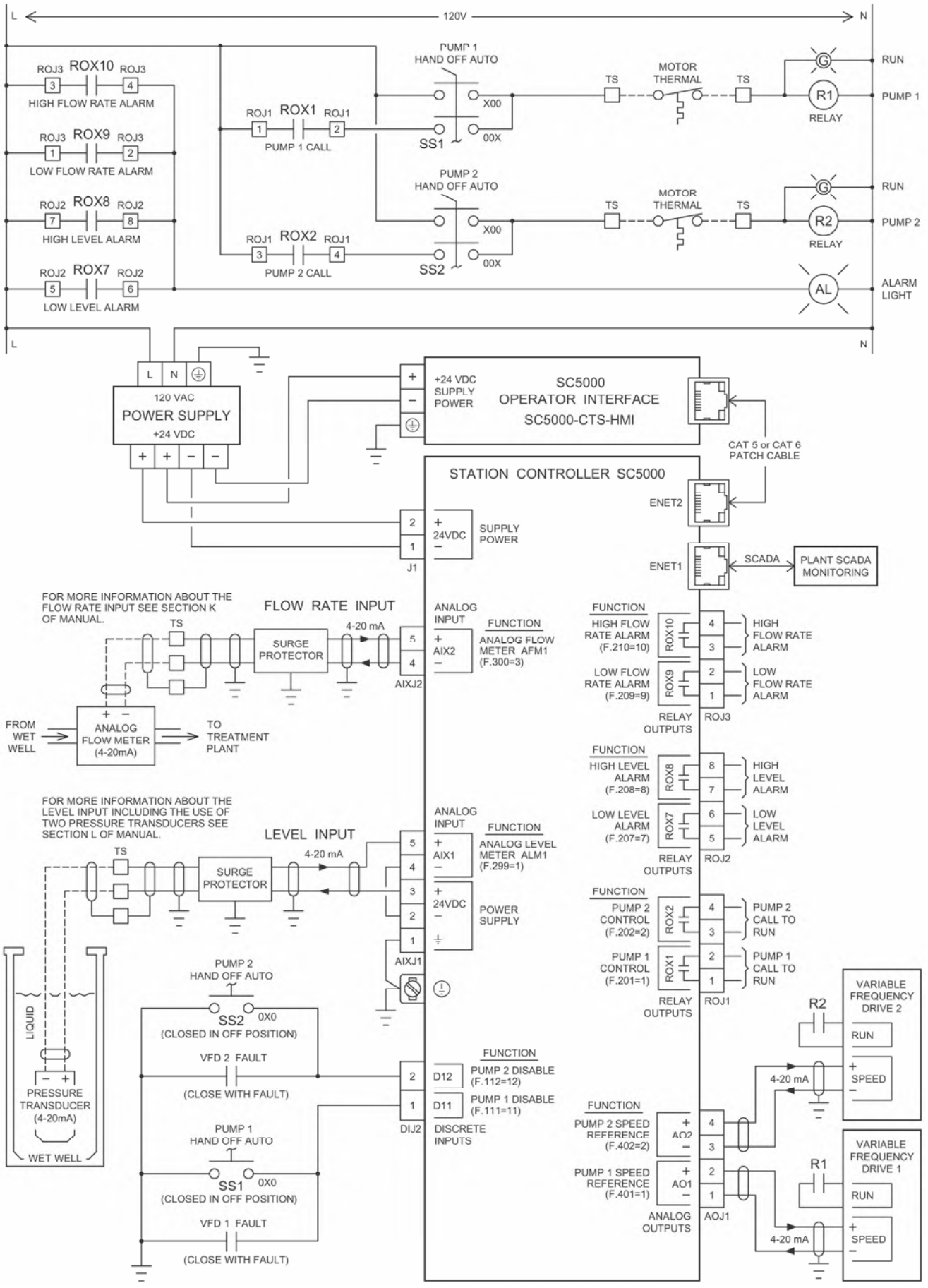
A Discrete Input assigned the Function of “External Alternation” (Function 21) may be connected to an External Time Clock and used to force an alternation.

A SCADA system may initiate an alternation by momentarily setting Modbus Coil 95 (Register 40006, Bit 14).

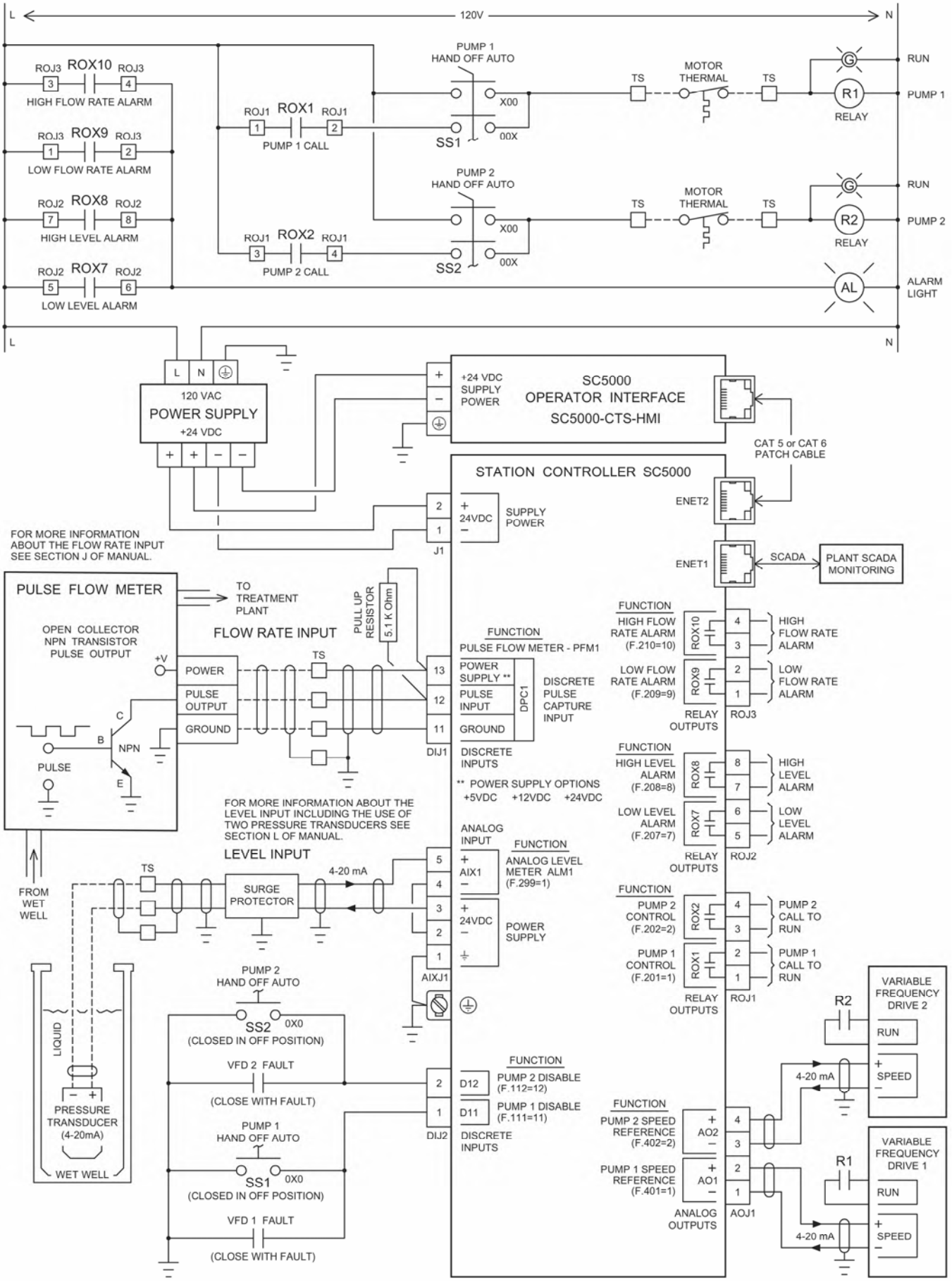
Movement of Lead Pump Upon Alternation



FLOW CONTROL EXAMPLE - ANALOG FLOW RATE INPUT

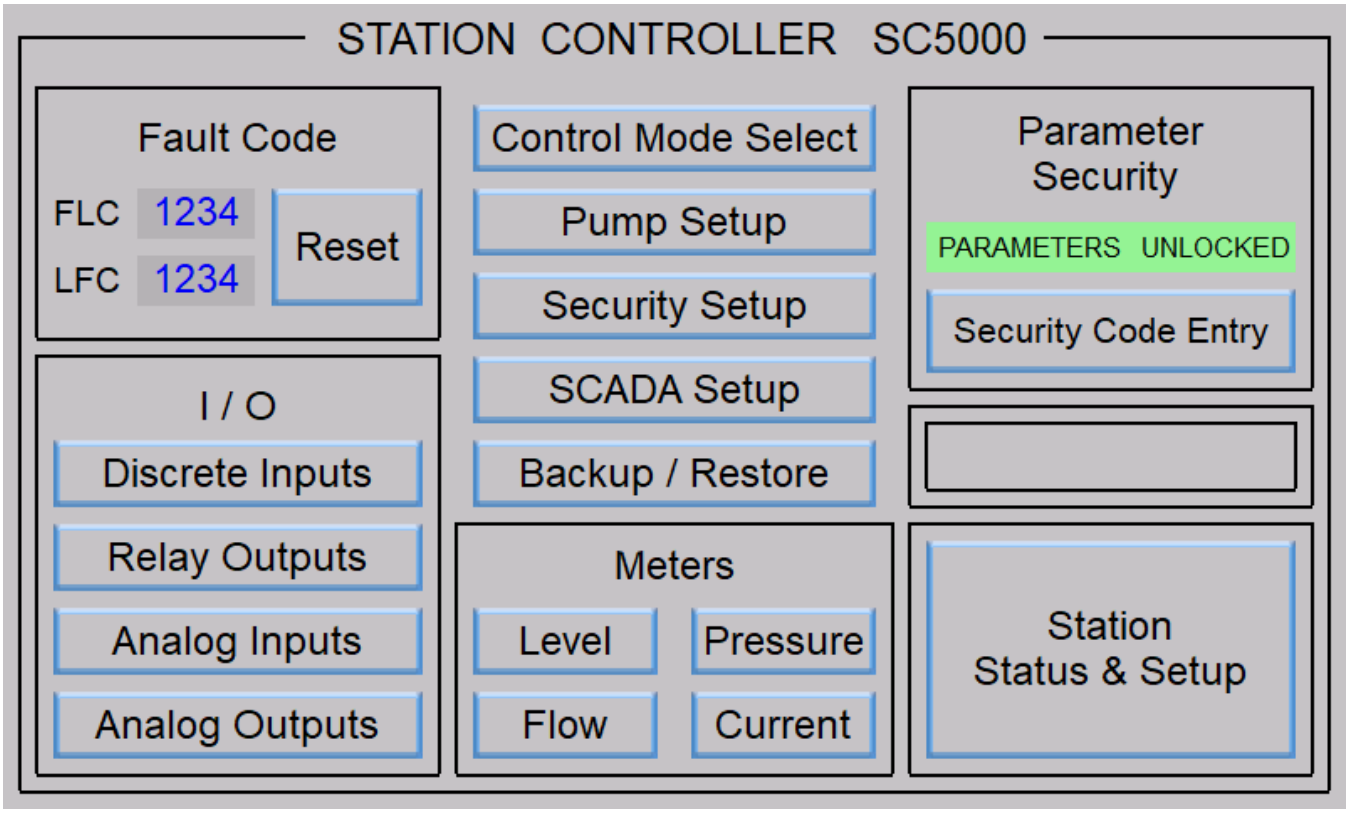


FLOW CONTROL EXAMPLE - PULSE FLOW RATE INPUT

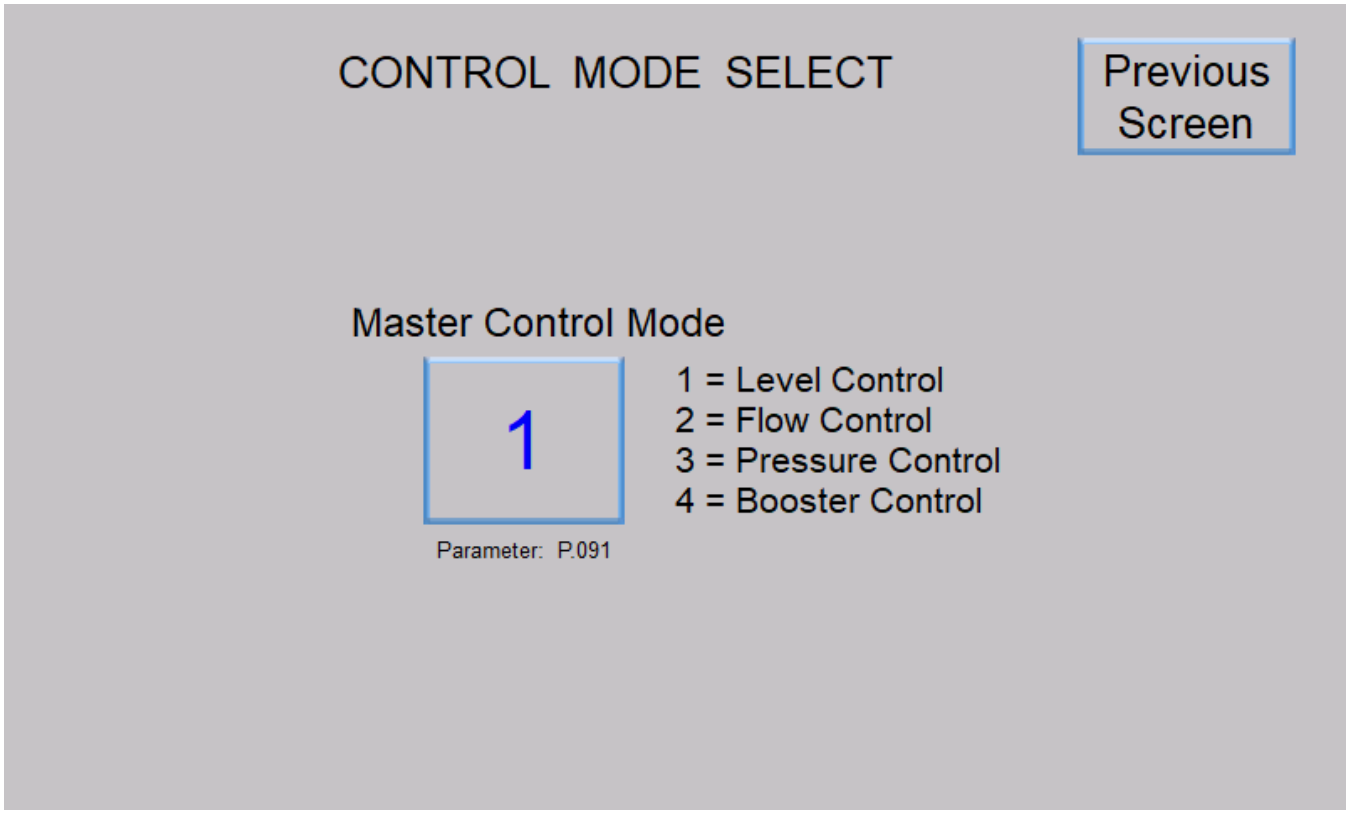


FLOW CONTROL - Touchscreen HMI SCREENS

Main Screen

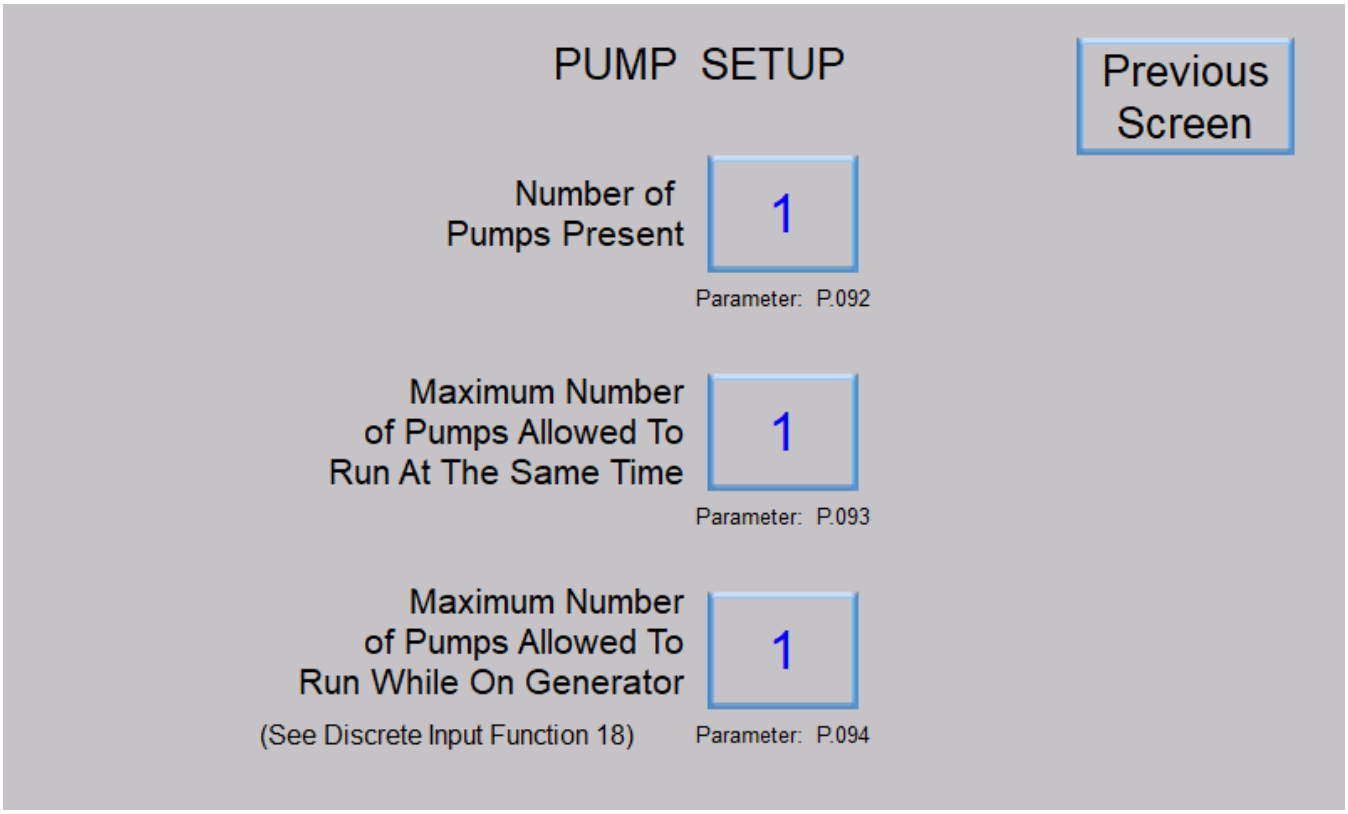


Control Mode Select

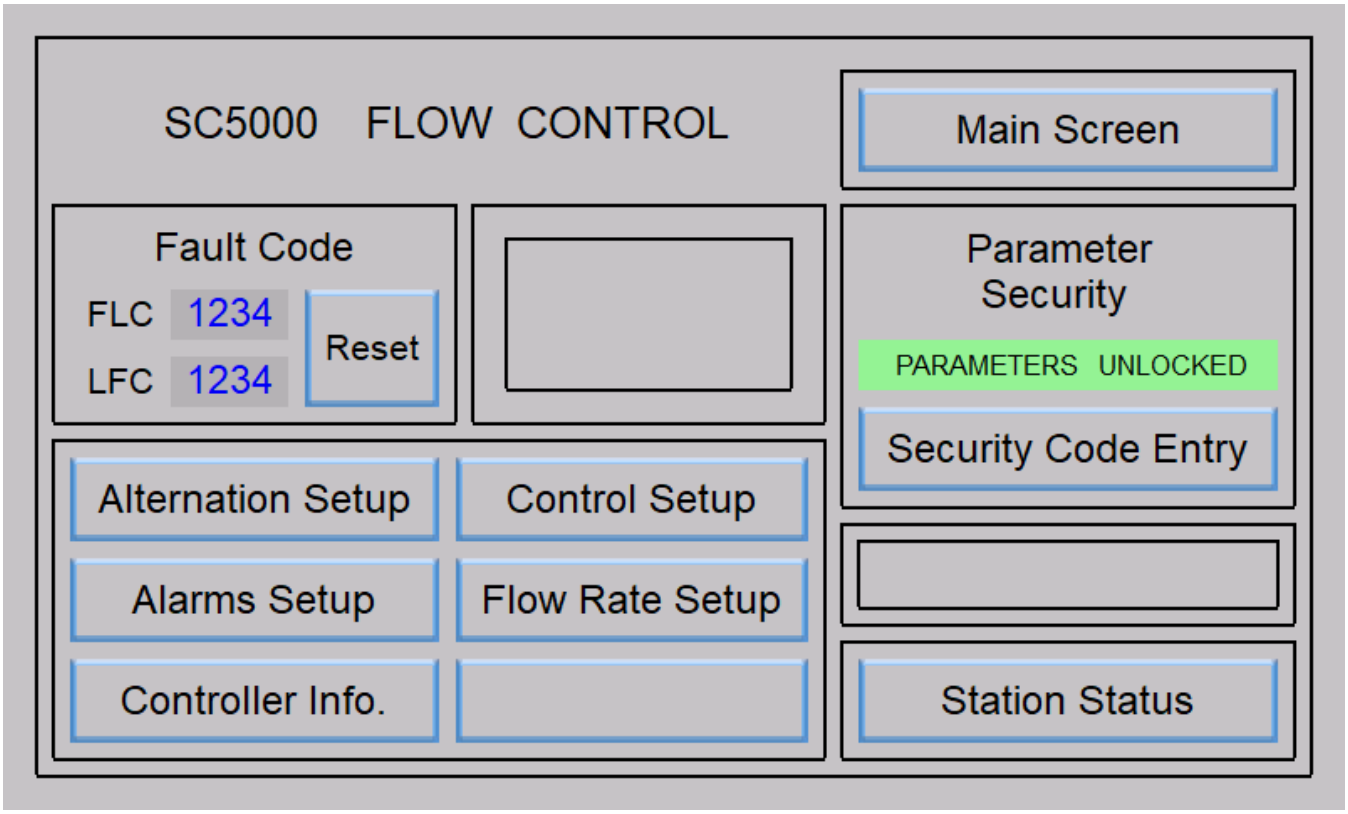


FLOW CONTROL - Touchscreen HMI SCREENS

Pump Setup

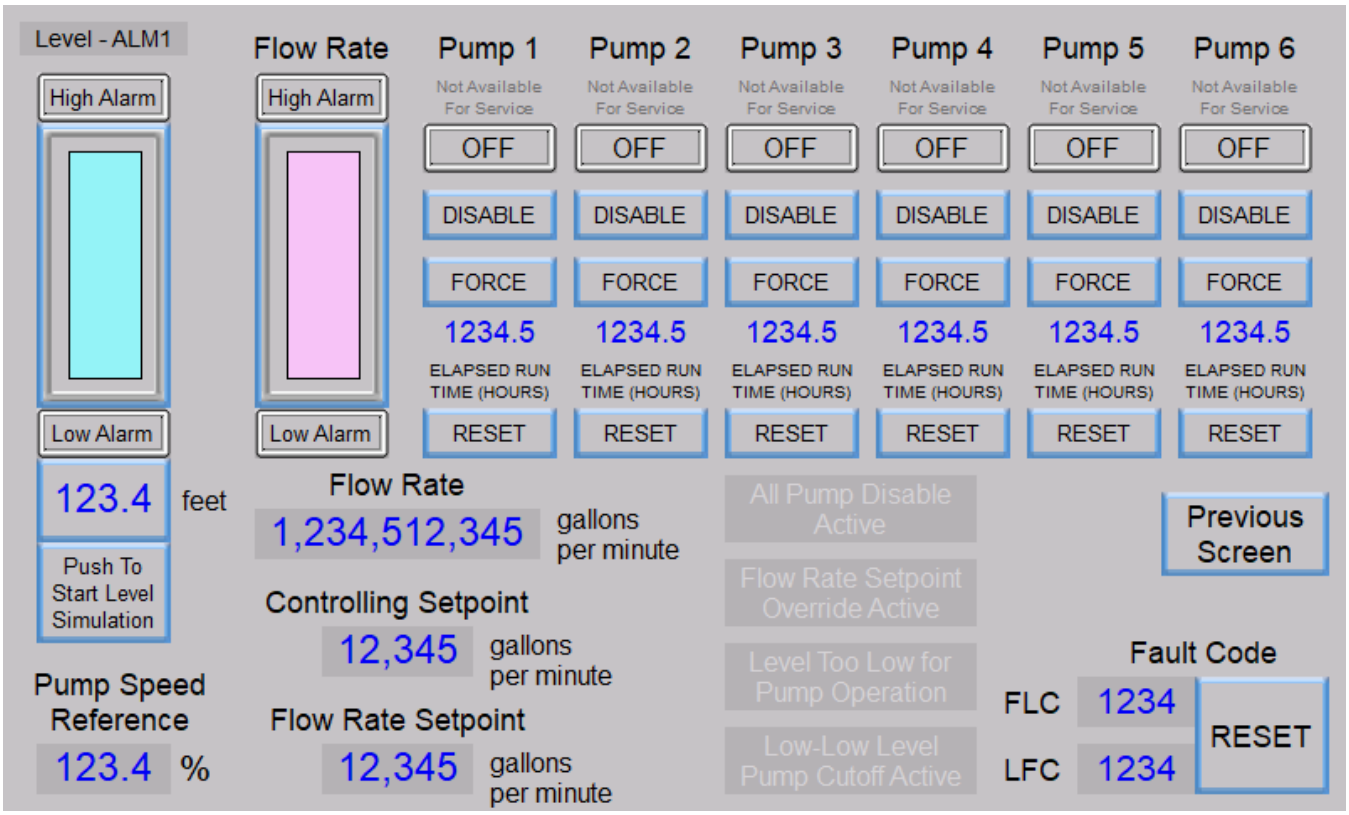


Flow Control Main Screen

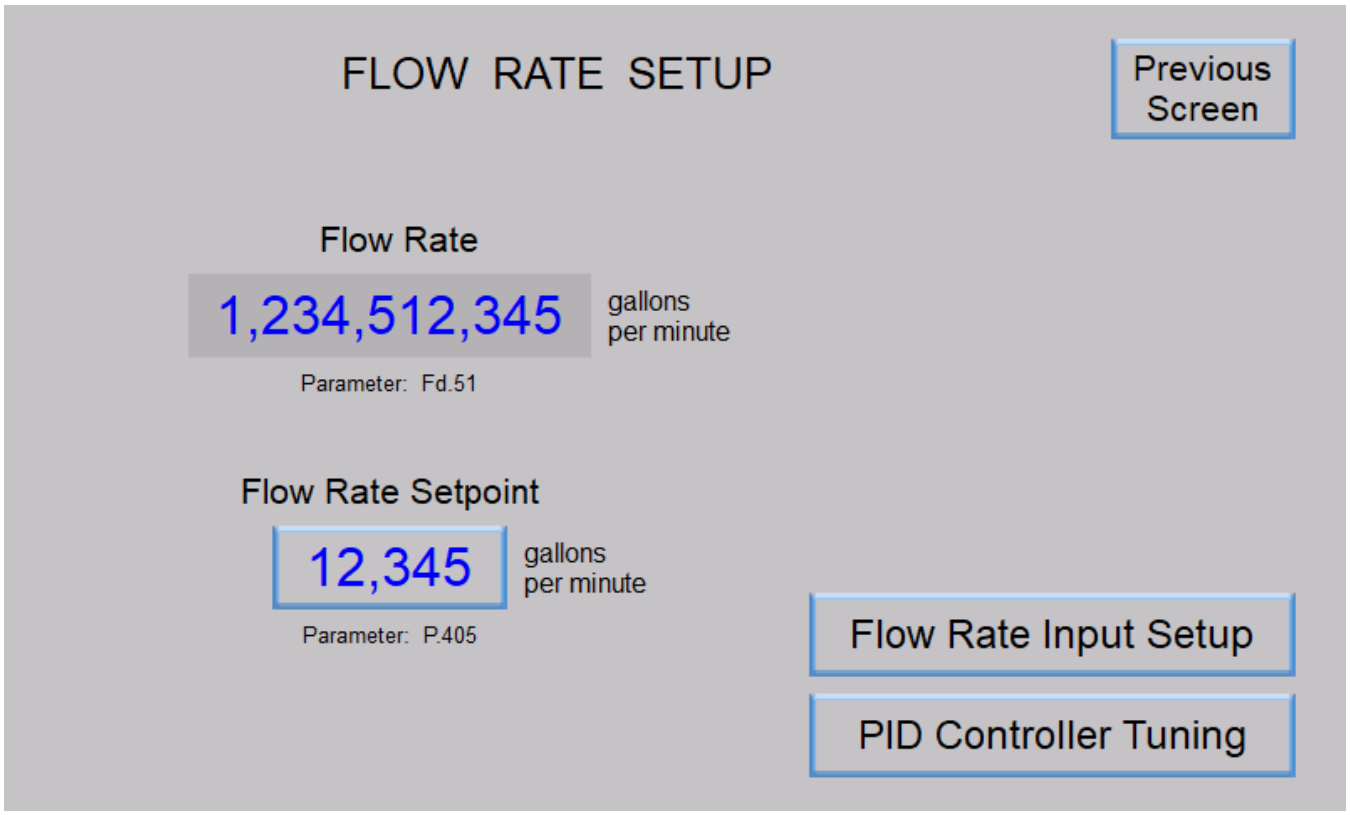


FLOW CONTROL - Touchscreen HMI SCREENS

Station Status

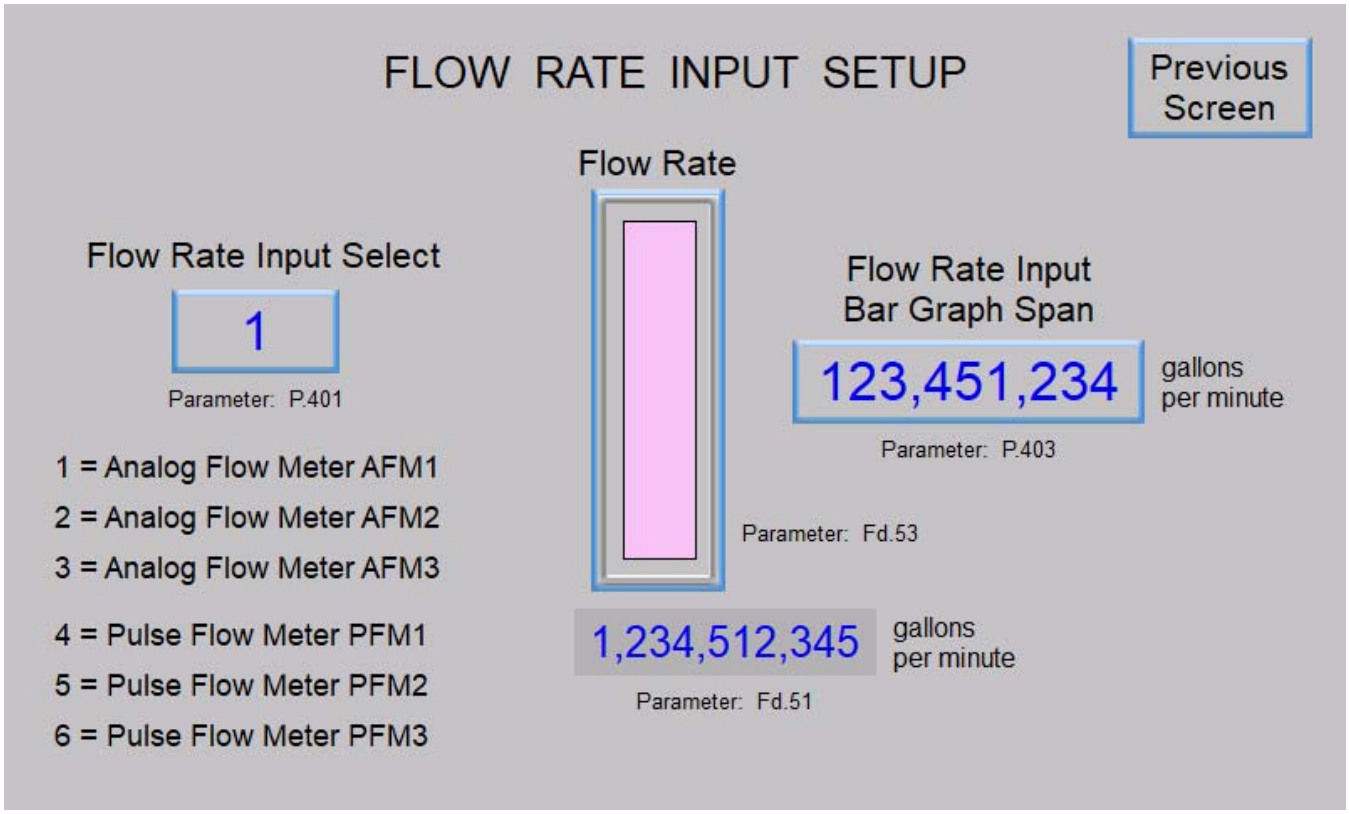


Flow Rate Setup

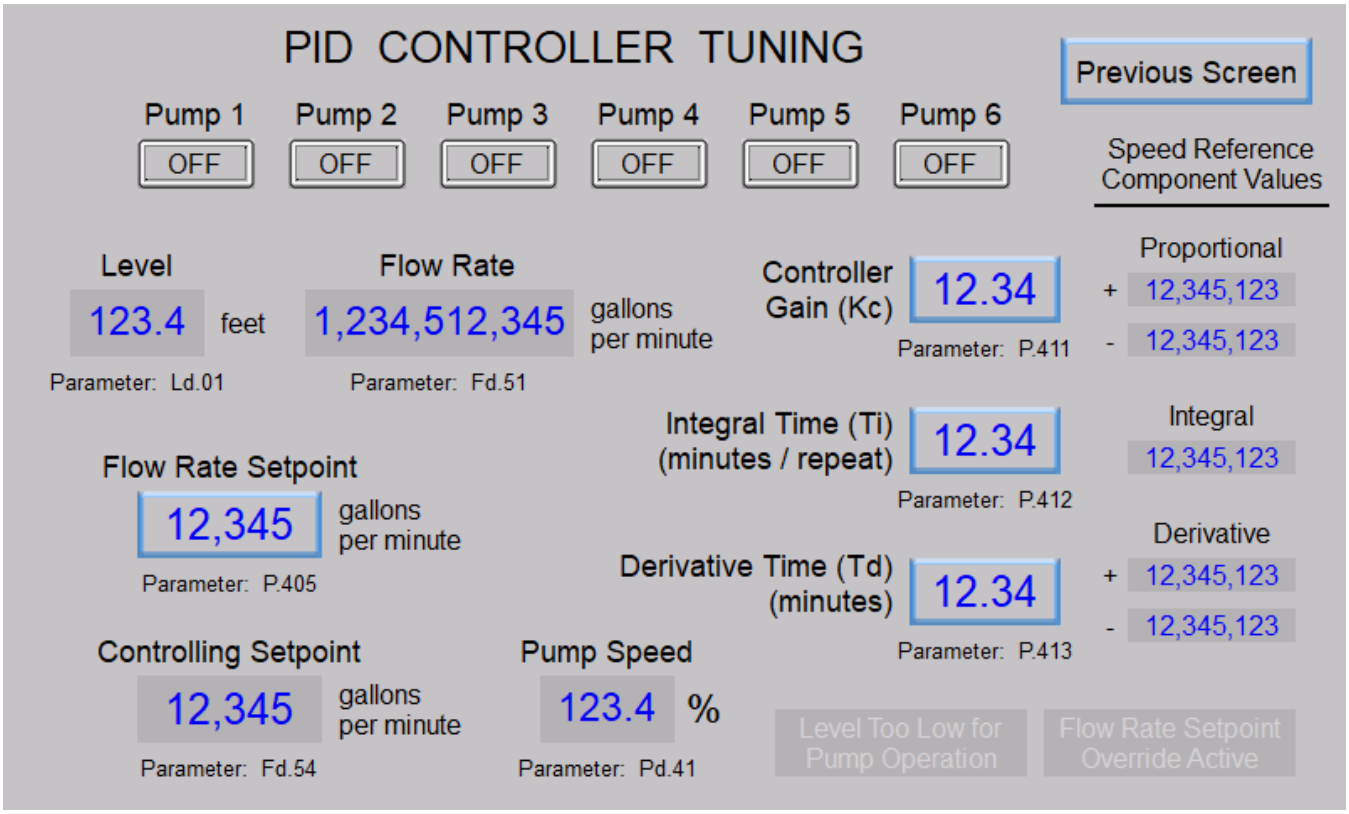


FLOW CONTROL - Touchscreen HMI SCREENS

Flow Rate Input Setup

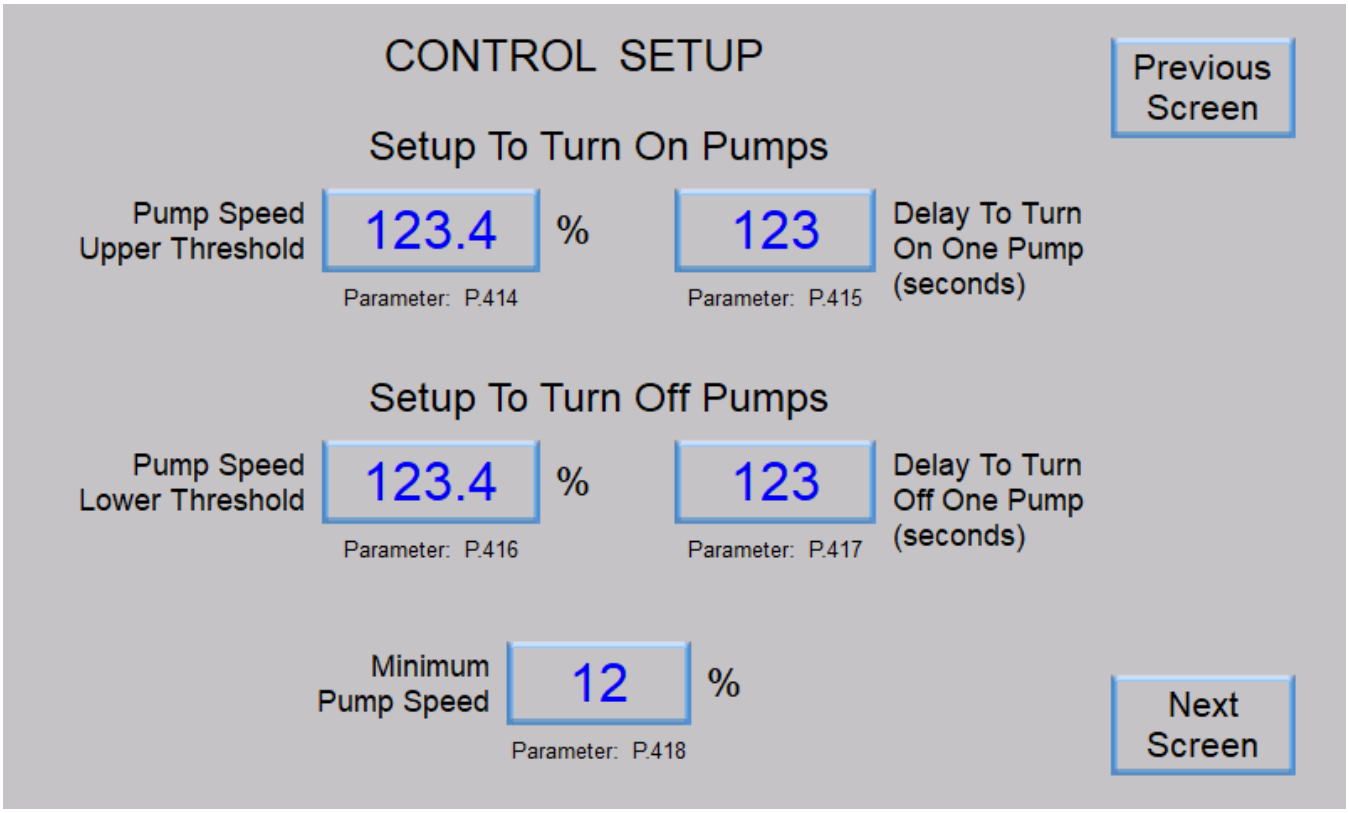


PID Controller Tuning

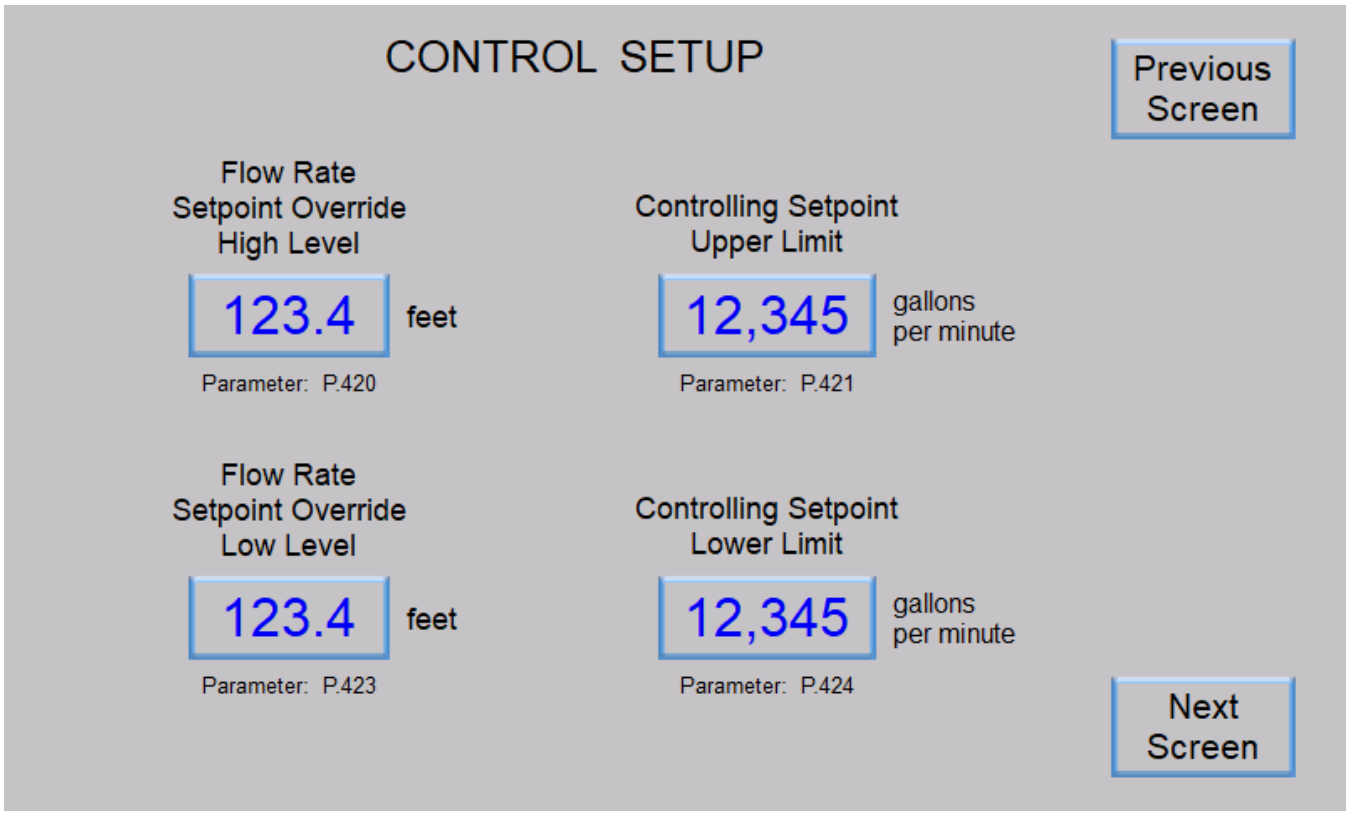


FLOW CONTROL - Touchscreen HMI SCREENS

Control Setup

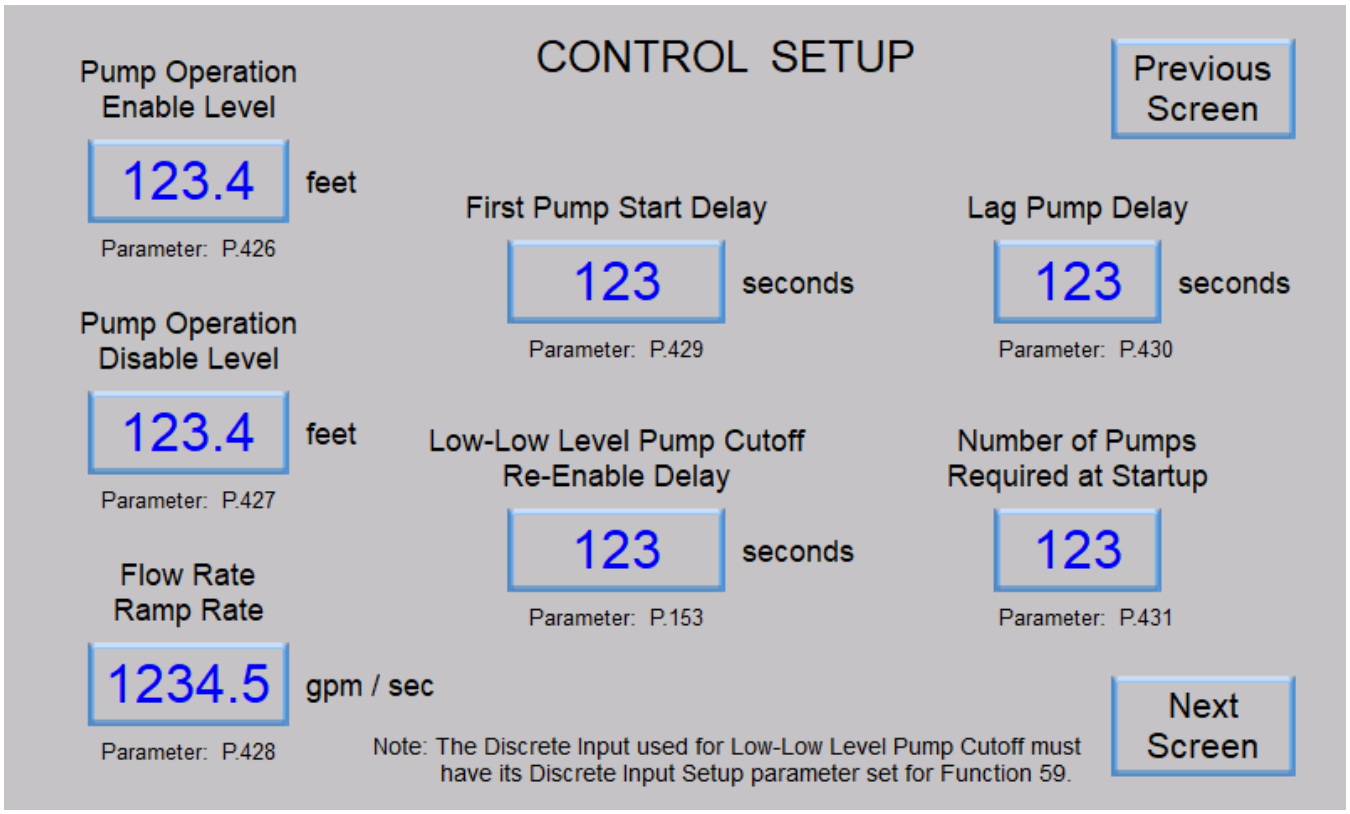


Control Setup

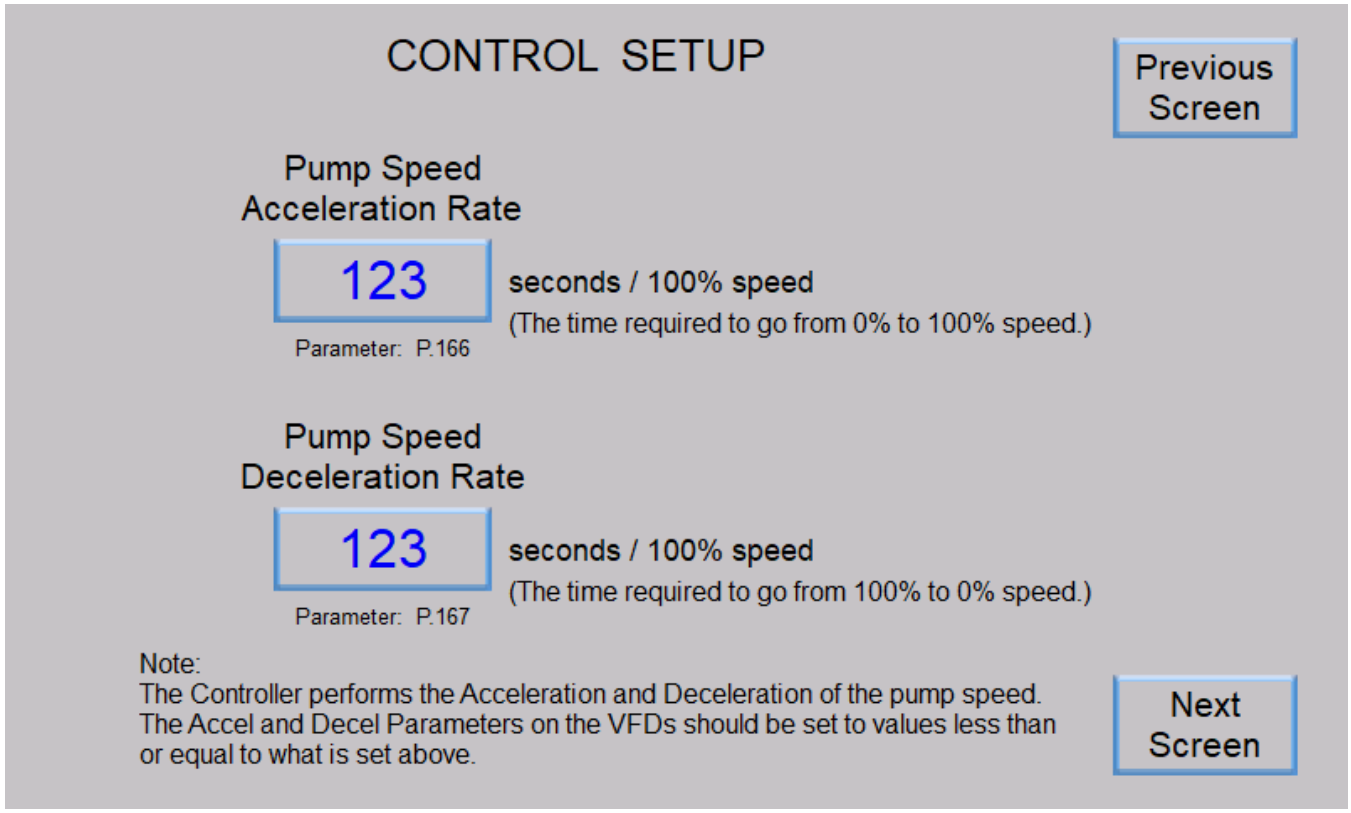


FLOW CONTROL - Touchscreen HMI SCREENS

Control Setup

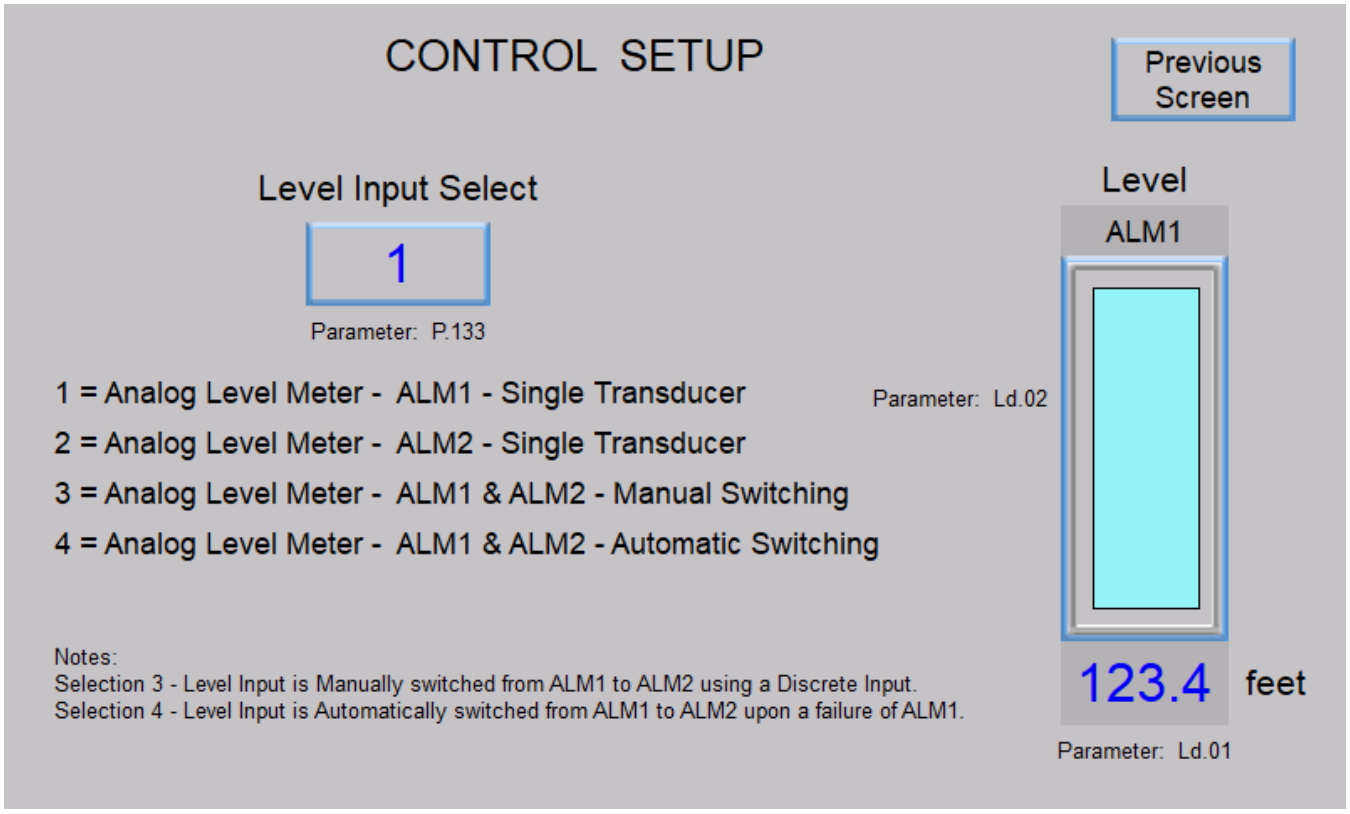


Control Setup

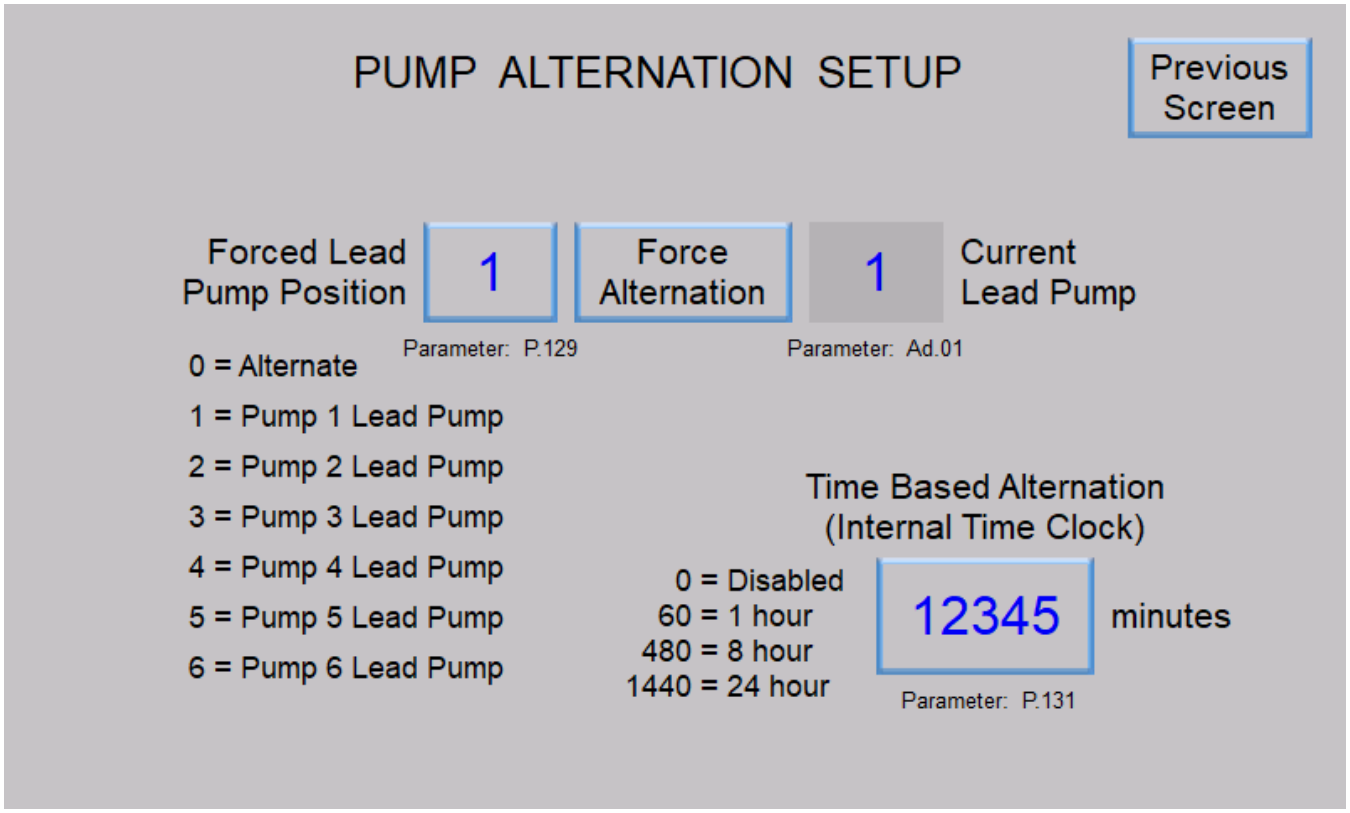


FLOW CONTROL - Touchscreen HMI SCREENS

Control Setup

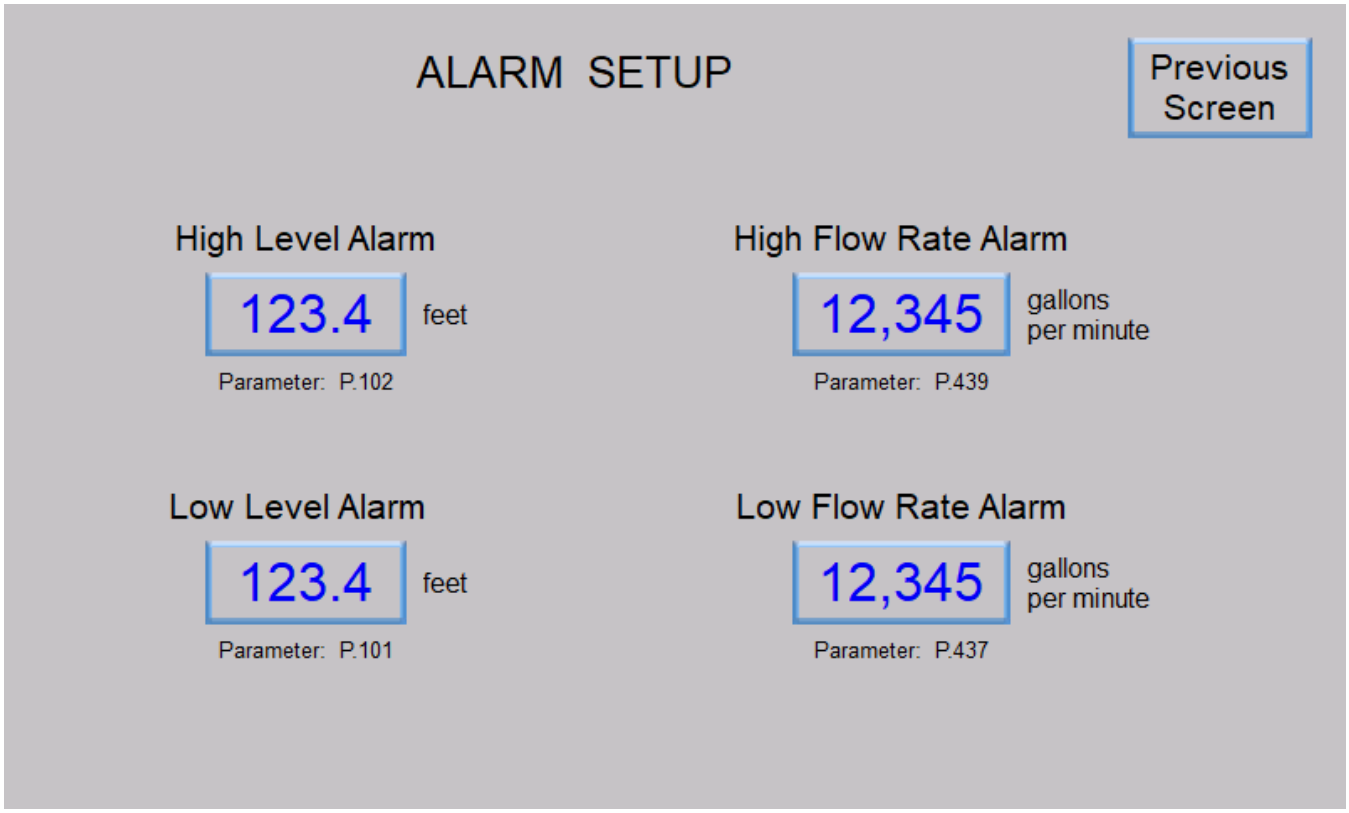


Pump Alternation Setup



FLOW CONTROL - Touchscreen HMI SCREENS

Alarm Setup



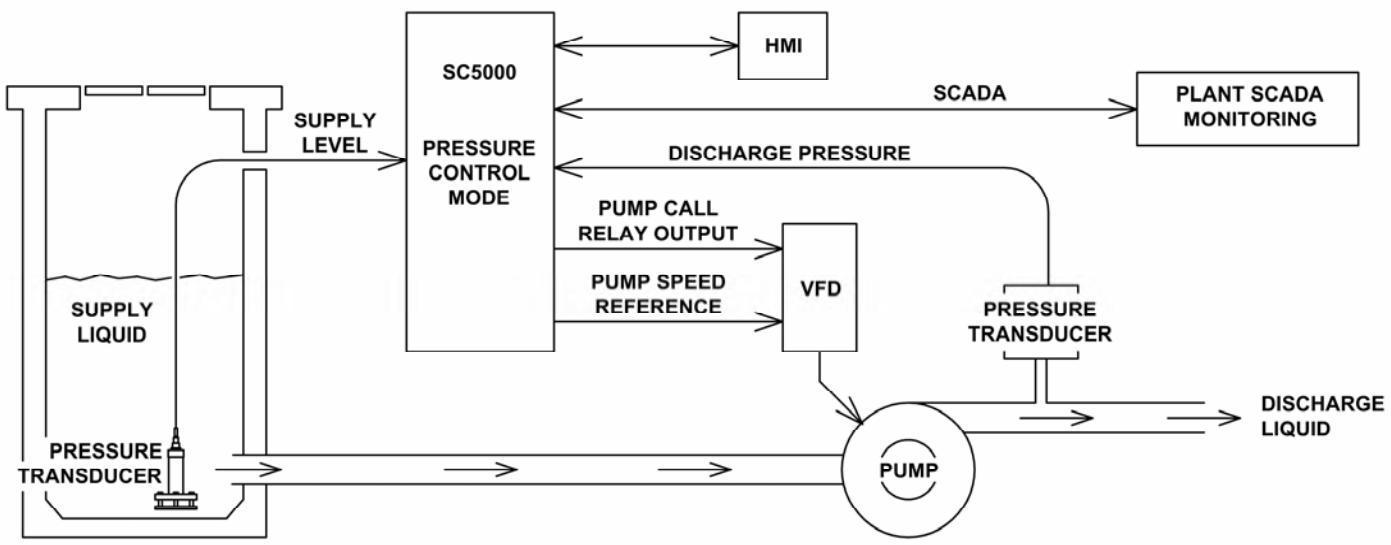
Revision Date: 5-9-23

SC5000

INSTRUCTION MANUAL

SECTION 3

PRESSURE CONTROL



MOTOR PROTECTION ELECTRONICS, LLC

2464 Vulcan Road
Apopka, Florida 32703

Phone: (407) 299-3825
Website: www.mpelectronics.com

SECTION 3
PRESSURE CONTROL

TABLE OF CONTENTS

PRESSURE CONTROL

DESCRIPTION OF FEATURES

General Description

With the Master Control Mode (Parameter P.091) set for “Pressure Control” the SC5000 will function as a Pressure Controller, and all logic pertaining to “Level Control”, “Flow Control” and “ Booster Control” will be disabled.

In the Pressure Control Mode, a PID Controller (Proportional, Integral, Derivative) is provided to regulate the pump speed in order to maintain the Discharge Pressure at the Discharge Pressure Setpoint.

The Pressure Control logic also determines the number of pumps required to run in order to maintain the Discharge Pressure at the Discharge Pressure Setpoint.

The Pressure Control logic also alternates the pumps and provides a First Pump Start Delay, Lag Pump Delay, Number of Pumps Required at Startup, Low Level Alarm, High Level Alarm, Low Discharge Pressure Alarm, High Discharge Pressure Alarm, and Pump Cutoff upon Low Level. It also has parameters in the menu that allow the operator to set the Number of Pumps Present, the Maximum Number of Pumps Allowed to Run At the Same Time, and the Maximum Number of Pumps Allowed to Run While On a Generator.

The Pressure Control Mode requires that each pump have its own VFD.

The Pressure Control Mode also requires that the Controller be ordered with an optional Analog Output for each pump for the VFD speed reference (see Ordering Information).

HMI Features

The **SC500-CTS-HMI** is a **C**olor **T**ouch **S**creen HMI programmed with screens that show the Supply Level, Discharge Pressure, Pump Speed Reference, Pump Run Status, Pump Available for Service indication, High Supply Level and Low Supply Level alarms, High Discharge Pressure and Low Discharge Pressure alarms, Discharge Pressure Setpoint Override Active indication, Supply Level Too Low For Pump Operation alarm, Low-Low Level Pump Cutoff Active alarm, Elapsed Run Time meters for each pump, and any Fault Codes that may be present. All the control and alarm settings are made readily available to the operator for viewing or changing. An operator may also perform Level Simulation, reset the Elapsed Run Time meters, and reset any Fault Codes.

Discharge Pressure Setpoint

The Discharge Pressure Setpoint (Parameter P.445) must be set by the operator for the desired Discharge Pressure that the liquid should be pumped at as it leaves the pumping station.

At startup, the Pressure Control logic will bring on the Number of Pumps Required at Startup (Parameter P.470). If number of pumps called at startup are unable to bring the Discharge Pressure up to the Discharge Pressure Setpoint, then an another pump will be started. If the setpoint is still not reached, then the control logic will call another pump to run and then another until the Discharge Pressure Setpoint is met. Additionally, the logic will turn off any unneeded pumps.

The PID Controller will follow what is set on the Discharge Pressure Setpoint as it regulates the Discharge Pressure, except when the supply liquid level is low. In this case the Controller may be setup to not strictly following the setpoint, but rather decrease the Discharge Pressure when the supply liquid level is low, and follow the Discharge Pressure Setpoint when the supply liquid level returns to the normal range.

First Pump Start Delay

After power is applied to the Controller and after all the initial conditions are satisfied and the First Pump Start Delay (Parameter P.468) has expired, the Number of Pumps Required at Startup (Parameter P.470) will be started, and the Lag Pump Delay (Parameter P.469) will set the minimum time period between each pump call. The following are the initial conditions which must first be met for the First Pump Start Delay to begin timing out:

There must be an adequate supply of liquid in the well or tank that the pumps are drawing from. The liquid level must be at or above what is set on the Pump Operation Enable Supply Level (Parameter P.459).

The “All Pump Disable” Discrete Input (Discrete Input Function 17) must be open.

The “Pump Cutoff Low-Low Level” Discrete Input (Discrete Input Function 59) must be open and the delay set on the pump Re-enable Delay (Parameter P.153) must have expired.

At least one pump must be available for service (Not having its Pump Disable Discrete Input closed (Discrete Input Functions 11 - 16).

After all of the above conditions are met and the First Pump Start Delay times out, then the first pump will be started.

PRESSURE CONTROL

Lag Pump Delay

The Lag Pump Delay (Parameter P.469) sets the minimum time period between the calling of pumps to run at startup. It is also used to delay the turning on of the replacement pump when an operating pump is suddenly disabled, or when a time based alternation of the pumps is performed.

Number of Pumps Required at Startup

The Number of Pumps Required at Startup (Parameter P.470) sets the minimum number of pumps that are initially turned on in order to meet the Discharge Pressure Setpoint. When the First Pump Start Delay (Parameter P.468) expires, the first of the required pumps will be turned on and each additional required pump will wait for the Lag Pump Delay (Parameter P.469) to expire.

Pump Turn On and Off

Operating Principal

After the Number of Pumps Required at Startup (Parameter P.470) are started, the Pressure Control logic will then control the number of additional pumps that are required to run in order to maintain the Discharge Pressure at the Discharge Pressure Setpoint. The control logic determines when an additional pump is needed and when to turn off an unneeded pump based on the following operating principal:

> The number of pumps required to run is regulated so that the PID Controller does not drive the pump speed reference significantly higher than or lower than a predetermined pump speed range.

See the Discharge Pressure Versus Pump Speed graph on page 3-12.

Turning On Pumps

If at some point conditions in the system require that the pump speed be increased in order to maintain the Discharge Pressure Setpoint, then the pump speed reference will be increased as needed. If the pump speed reference were to be increased to the point that it were equal to or greater than what is set on the Pump Speed Upper Threshold (Parameter P.454), then one additional pump would be turned on, after the delay set on the Delay To Turn On One Pump (Parameter P.455) expires. This may be repeated again and again until all the available pumps are called to run, or until the pump speed becomes lower than the Pump Speed Upper Threshold (Parameter P.454).

Turning Off Pumps

If at some point in time the conditions in the system were to change such that a lower pump speed were required to maintain the Discharge Pressure Setpoint, then the pump speed reference would be decreased as needed. If the pump speed reference were to be decreased to the point were it was equal to or less than what is set on the Pump Speed Lower Threshold (Parameter P.456), then one of the pumps would be turned off, after the delay set on the Delay To Turn Off One Pump (Parameter P.457) expires. This may be repeated again and again until all but one pump is left running, or until the pump speed becomes higher than the Pump Speed Lower Threshold (Parameter P.456).

Pump Operation Enable / Disable

The pump operation in the Pressure Control Mode requires that there be an adequate supply of liquid in the well or tank. The following two parameters provide the operator with control over how low the supply liquid level is allowed to drop before turning off all the pumps and at what level pumping should be allowed to resume:

Pump Operation Enable Supply Level

To allow any pumps to start, the liquid level must first rise up to or be above what is set on the Pump Operation Enable Supply Level (Parameter P.459). See page 3-13.

Pump Operation Disable Supply Level

If the liquid level falls below what is set on the Pump Operation Disable Supply Level (Parameter P.460) then all the pumps will be turned off. See page 3-13.

Alarm Status

When pump operation is disabled, based on Parameters P.459 and P.460, the “Supply Level Too Low for Pump Operation” alarm status bit will be set and may be read from Modbus Coil 258 (Register 40017 Bit 1).

PRESSURE CONTROL

Controlling Setpoint

At start up, the PID Controller is sent a Controlling Setpoint (Parameter Pd.31) that is slowly increased until it equals the Discharge Pressure Setpoint (Parameter P.445). The rate of the increase is set by the Discharge Pressure Ramp Rate (Parameter P.465). See the graph on page 3-15.

After start up, as long as the Supply Level remains in the normal range (above what is set on Parameter P.462), the Controlling Setpoint will be kept equal to the Discharge Pressure Setpoint and the PID Controller will regulate the pump speed to keep the Discharge Pressure at or near what is set on the Discharge Pressure Setpoint (Parameter P.445).

During start up or at any time, if the Supply Level becomes low (below what is set on Parameter P.462), then the value of the Controlling Setpoint will be ramped down along the linear slope established by Parameters P.461, P.462, P.463 and P.445. See the graph on page 3-14.

If while the pumps are operating and the Discharge Pressure Setpoint is changed by an operator, then the Controlling Setpoint will be ramped up or down to the new value of the Discharge Pressure Setpoint using the Discharge Pressure Ramp Rate (Parameter P.465).

While the Controlling Setpoint is being ramped up or down to the Discharge Pressure Setpoint, the “PID Controller Setpoint Override Active” status bit will be set and may be read from Modbus Coil 257 (Register 40017 Bit 0).

Pump Alternation

Automatic Alternation

In the Pressure Control Mode the pump Alternation Sequence Mode (Parameter P.122) is fixed to always be in the Standard Alternation, and the pumps will be Alternated “First On First Off”. See page 3-8.

See the alternation sequence diagram on page 3-18.

Manual Pump Call Sequence

When manual control over the pump call sequence is desired, the operator can use the Forced Lead Pump Position feature (Parameter P.129) to set the Lead Pump Position. This sets the order the pumps are called in. The Lead Pump Position may also be set using a Lead Pump Selector switch that is connected to Discrete Inputs assigned to Functions 31 - 36. See page 3-8.

See connection diagrams on page A-13.

Time Based Alternation

Time Based Alternation is also available in the Pressure Control Mode. The Time Based Alternation logic may be triggered by an Internal Time Clock or from an External Time Clock. The Internal Time Clock alternation period is menu selectable (Parameter P.131). The External Time Clock may be triggered to alternate from either a External Time Clock connected to a Discrete Input on the Controller (set for Function 21), or it may be part of a SCADA system’s logic, where the SCADA system would set Modbus Coil 95 (Register 40006 Bit 14) to force the alternation of the pumps. See page 3-8.

Pump Cutoff Low-Low Level

The Pump Operation Enable / Disable feature (setup on Parameters P.459 and P.460) monitors the Analog Supply Level Input to determine if there is an adequate supply of liquid in the well or tank. By using a Low-Low Level Float Switch connected to a Discrete Input a redundant pump cut off may also be implemented. This Pump Cutoff Low-Low Level feature also includes a Re-enable Delay to prevent the short cycling of the pumps.

The Low-Low Level Float Switch must be connected to a Discrete Input assigned to Function 59.

The Re-enable Delay (Parameter P.153) starts timing out when the Discrete Input opens. When the Re-enable Delay expires the Pump Cutoff Low-Low Level feature will no longer prevent pump operation.

The “Pump Cutoff Active Low-Low Level” status is available from Modbus Coil 131 (Register 40009 Bit 2).

While the Pump Cutoff Low-Low Level input is closed, the Low Level Alarm will also be activated. The contacts of a relay assigned to the Low Level Alarm (Function 7) will also close.

PRESSURE CONTROL

Supply Level Input Select

The Pressure Control Mode requires an analog 4-20mA Level Input be provided to monitor the liquid level in the wet well. The default Level Input is connected to Analog Level Meter ALM1. If a second or backup Level Input is desired then it must be connected to Analog Level Meter ALM2. The Level Input Select (Parameter P.133) allows for the selection between two Analog Level Meters ALM1 or ALM2 as the Level Input source (each Level Meter must be connected to its own Pressure Transducer). The second analog 4-20mA Level Input may be either manually or automatically switched into service as the controlling Level Input. See Section M.

Discharge Pressure Input Select

The Pressure Control Mode requires that an analog Discharge Pressure Input be provided to the Controller to monitor the Discharge Pressure. The Discharge Pressure Input Select (Parameter P.441) is provided to allow for the selection one of two Analog Pressure Meters APM1, or APM2. See Section N.

PRESSURE CONTROL

Discrete Inputs

30 Discrete Inputs (D1 - D30) that may be setup to perform the following Functions:

- Pump Disable Inputs
- All Pump Disable - Phase Monitor Input
- On Generator - Limits number of pumps allowed to run
- Switch Between ALM1 & ALM2 for Level Input selection
- External Alternation - External Time Clock Input
- Sequence Inputs - Lead Pump Selector Switch Inputs
- Call Pump Last Inputs
- Pump Cutoff Low-Low Level Input
- High and Low Level Alarm Inputs
- Collection of Discrete Input Data for SCADA

Relay Outputs

12 Relay Outputs (ROX1 - ROX12) that may be setup to perform the following Functions:

- Up to Six Pump Call to Run Outputs
- High or Low Supply Level Alarm Outputs
- High or Low Discharge Pressure Alarm Outputs
- SCADA Remote Control Outputs

Analog Inputs

2 Standard Analog Inputs (AIX1 - AIX2) and up to 8 more Optional Analog Inputs (A1 - A8).
The Analog Inputs may be setup to perform one of the following Functions:

- Analog Level Meter ALM1 or ALM2
- Analog Flow Meter AFM1, AFM2 or AFM3
- Analog Pressure Meter APM1 or APM2
- Analog Current Meter ACMA, ACMB or ACMC
- Collection of Analog Input Data for SCADA

Analog Outputs

1 Standard Analog Output (AOX1) and up to 6 more Optional Analog Outputs (AO1 - AO6).
The Analog Outputs may be setup to perform one of the following Functions:

- Analog Signal for Pumps 1 - 6 Speed Reference
- Analog Signal for Pumps Speed Reference any Pump (Always Active)
- Analog Signal that is a Copy of Wet Well Level

Pulse Counter Inputs

Option for up to 3 Pulse Counter Inputs (DPC1 - DPC3) that may be used to perform the following:

- Pulse Counter Input for Pulse Flow Meter PFM1, PFM2 or PFM3

PRESSURE CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Master Control Mode				
P.091	1		40091	Master Control Mode 1 = Level Control 2 = Flow Control **Must Be Set On "3" for Pressure Control** 3 = Pressure Control 4 = Booster Control
Pump Setup				
P.092	6		40092	Number of Pumps Present 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps
P.093	6		40093	Maximum Number of Pumps Allowed to Run at the Same Time 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps
P.094	6		40094	Maximum Number of Pumps Allowed to Run While On Generator 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps Note: Must Connect Transfer Switch Contact to Discrete Input assigned to Function 18.

User / Operator Info.	SCADA	
Parameter	Register Address	Description of Data
Elapsed Time Meter Data		
Etd.1	41891	Pump 1 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.2	41892	Pump 2 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.3	41893	Pump 3 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.4	41894	Pump 4 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.5	41895	Pump 5 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.6	41896	Pump 6 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours

PRESSURE CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Pump Alternation Setup				
P.122	1	1	40122	Alternation Sequence Mode 1 = Standard Alternation of Pumps 1 - 6 See page 3-18. Note: With the Master Control Mode set on Pressure Control the Alternation Sequence Mode will be fixed on Standard Alternation.
P.129	0		40129	Forced Lead Pump Position 0 = Normal Alternation X = Pump X as Lead
P.131	0		40131	Time Based Alternation Range: 0 - 65535 minutes 0 = Disabled 60 = 1 hour 480 = 8 hours 1440 = 24 hours Note: Pump Alternation may be triggered using the Internal Time Clock setup using Parameter P.131, or it can also be triggered by an External Time Clock, which may be either a hardware device connected to a Discrete Input setup to perform Function 21, or it may be triggered by having the SCADA system set Bit 14 in Register 40006.
Pump Alternation Status				
Ad.01	-	-	41888	Current Lead Pump Shows the number of the current Lead Pump.

PRESSURE CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Supply Level Input Setup				
P.133	1		40133	Level Input Select 1 = Analog Level Meter - ALM1 - Single Transducer 2 = Analog Level Meter - ALM2 - Single Transducer 3 = Analog Level Meter - ALM1 & ALM2 - Dual Transducers - Manual Switching 4 = Analog Level Meter - ALM1 & ALM2 - Dual Transducers - Automatic Switching Selection 1 - Level Input is from ALM1. See Section M. Selection 2 - Level Input is from ALM2. See Section M. Selection 3 - Level Input is Manually switched from ALM1 to ALM2. See Section M. Selection 4 - Level Input is Automatically switched from ALM1 to ALM2. See Section M.
Supply Level Input Data				
Ld.01	-	-	42143	Supply Level Input Data - For Numerical Display of Level Note: This is the value of the Supply Level Input selected on Parameter P.133 scaled into feet and 1/10 of feet for numerical display.
Ld.02	-	-	42144	Supply Level Input Data - For Bar Graph Display of Level Note: This is the value of the Supply Level Input selected on Parameter P.133 scaled for display on a bar graph. It is scaled to a range of 0 - 4095. The Bar Graph Display scaling setup on the HMI device must be set for 0 - 4095.
Ld.03	-	-	42145	Level Input Source Status 1 = Analog Level Meter - ALM1 2 = Analog Level Meter - ALM2 3 = Level - Simulated

PRESSURE CONTROL

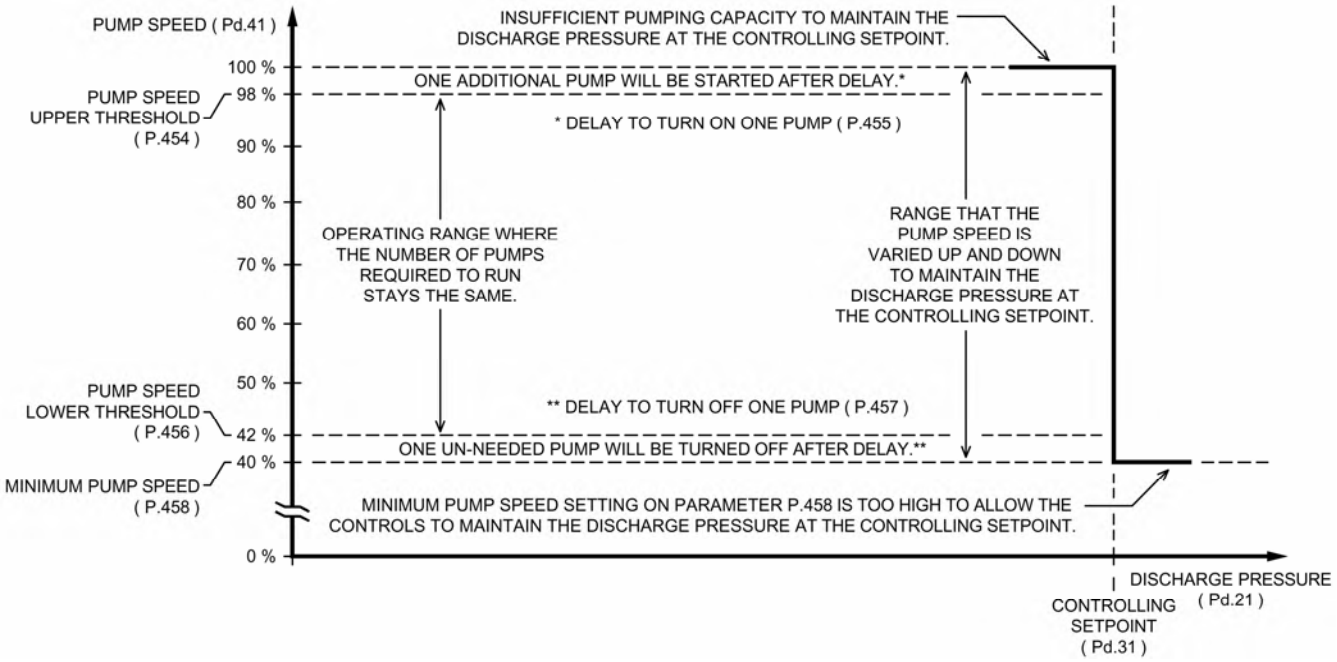
User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Discharge Pressure Input Setup				
P.441	1		40441	Discharge Pressure Input Select 1 = Analog Pressure Meter APM1 2 = Analog Pressure Meter APM2 Note: This parameter establishes which Analog Pressure Meter's data will be used as the Process Variable (PV) that goes into the PID Controller used for Discharge Pressure Control. The Discharge Pressure data selected here is available to be read from Parameters Pd.21 and Pd.22. See pages N-1 and N-2.
P.442	100.0 psi		40442	Discharge Pressure Input Bar Graph Span Note: This parameter sets the span of the Discharge Pressure Bar Graph for Parameter Pd.22.
Discharge Pressure Input Data				
Pd.21	-	-	42231	Discharge Pressure Input Data - For Numerical Display of Pressure Note: This is the value of the pressure data selected on Parameter P.441 scaled into psi for numerical display.
Pd.22	-	-	42232	Discharge Pressure Input Data - For Bar Graph Display of Pressure Note: This is the value of the pressure data selected on Parameter P.441 scaled for display on a bar graph. It is scaled to a range of 0 - 4095 by using the "Discharge Pressure Input Bar Graph Span" (Parameter P.442). The Bar Graph Display scaling setup on the HMI device must be set for 0 - 4095.

PRESSURE CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Discharge Pressure Setpoint				
P.445	30.0 psi		40445	Discharge Pressure Setpoint (SP) Range: 3.0 - 300.0 psi Note: This is the parameter that sets the desired Discharge Pressure of the liquid being pumped.
Pd.31	-	-	42233	Controlling Setpoint Note: To ensure a smooth stable control of the Discharge Pressure during startup, the value of the Controlling Setpoint (Parameter Pd.31) sent to the PID Controller is ramped up to the value set on the Discharge Pressure Setpoint (Parameter P.445), using the ramp rate set on the Discharge Pressure Ramp Rate (Parameter P.465). If the Supply Level becomes low at startup or at any time (below what is set on Parameter P.462), then the value of the Controlling Setpoint will be ramped down along the linear slope established by Parameters P.461, P.462, P.463 and P.445, as shown on page 3-14. The rate at which it is ramped down (or up) the slope is set on the Discharge Pressure Ramp Rate (Parameter P.465), as shown on page 3-15.
At startup or at any time the Setpoint Override logic keeps the Controlling Setpoint from being equal to the Discharge Pressure Setpoint, the "PID Controller Setpoint Override Active" status bit will be set. Its status may be read from Modbus Coil 257 (Register 40017 Bit 0).				
PID Controller Tuning				
P.447	6.40		40447	Controller Gain (Kc) Range: 0.01 - 30.00 Note: This parameter is used to tune the proportional component of the PID Controller's Pump Speed Reference output.
P.448	0.02 minutes / repeat		40448	Integral Time (Ti) Range: 0.01 - 60.00 minutes / repeat Note: This parameter is used to tune the integral component of the PID Controller's Pump Speed Reference output. Changes to this parameter may result in significant changes to the Pump Speed Reference. Therefore, it is recommended that only small changes are made to this parameter while the system is in operation.
P.449	0.00 minutes		40449	Derivative Time (Td) Range: 0.00 - 2.00 minutes Note: This parameter is used to tune the derivative component of the PID Controller's Pump Speed Reference output.
Pump Speed Reference Data				
Pd.41	-		41877	Pump Speed Reference Data Range: 0.0 - 100.0 percent Notes: 1. The Pump Speed Reference is determined by the PID Controller and is sent to the VFDs, as a 4-20mA signal, to control the pump speed 2. All operating pumps receive the same Speed Reference. 3. Parameter Pd.41 is the Pump Speed Reference as a percent of full speed.

PRESSURE CONTROL

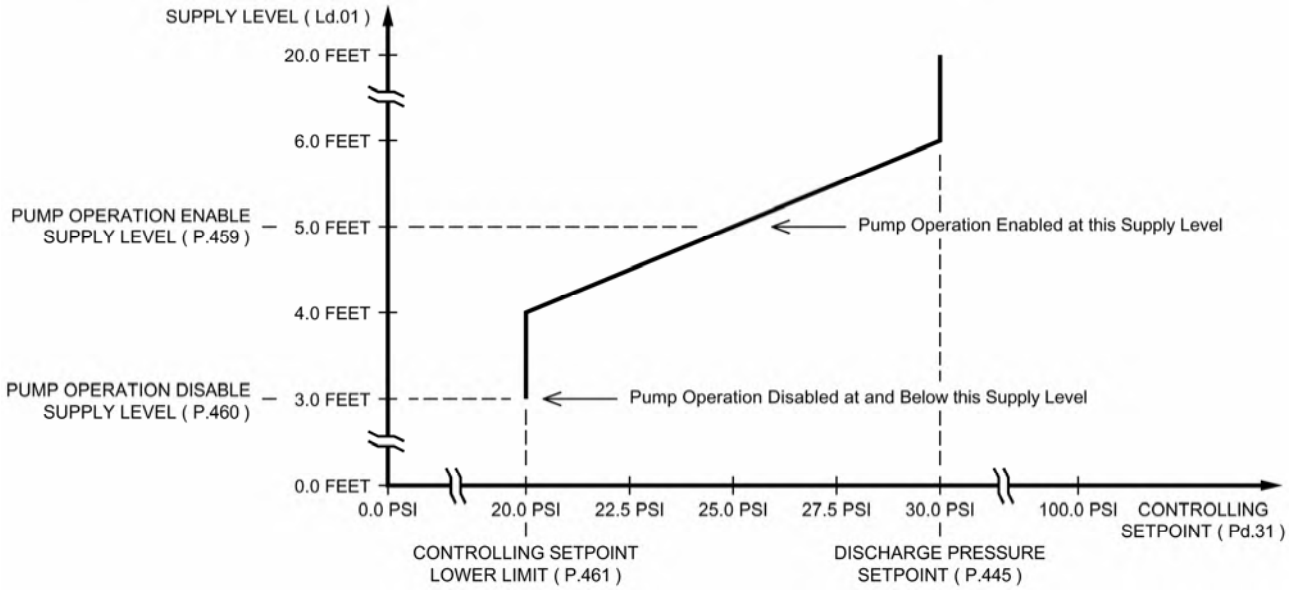
Turning On / Off Pumps



User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Turning On of Pumps				
P.454	98.0 %		40454	Pump Speed Upper Threshold Range: 30.0% - 100.0% of Full Speed Note: When the Pump Speed Reference has increased to where it is greater than or equal to what is set on this parameter, the **Delay To Turn On One Pump** (Parameter P.455) is started. When the delay expires an additional pump will be turned on.
P.455	10 sec.		40455	Delay To Turn On One Pump Range: 1 - 600 seconds Note: This delay starts when the Pump Speed Reference has increased to where it is greater than or equal to the **Pump Speed Upper Threshold** (Parameter P.454). When the delay expires an additional pump will be turned on.
Turning Off of Pumps				
P.456	42.0 %		40456	Pump Speed Lower Threshold Range: 10.0% - 90.0% of Full Speed Note: When the Pump Speed Reference has decreased to where it is less than or equal to what is set on this parameter, the **Delay To Turn Off One Pump** (Parameter P.457) is started. When the delay expires one pump will be turned off.
P.457	10 sec.		40457	Delay To Turn Off One Pump Range: 1 - 600 seconds Note: This delay starts when the Pump Speed Reference has decreased to where it is less than or equal to the **Pump Speed Lower Threshold** (Parameter P.456). When the delay expires one pump will be turned off.
Minimum Pump Speed				
P.458	40%		40458	Minimum Pump Speed Range: 0% - 95% of full speed Note: For each application there is usually a minimum speed, below which pump operation is undesirable. This parameter sets the minimum pump speed allowed. With the **Minimum Pump Speed** set on Parameter P.458, care must be taken that there is not also a minimum speed set on the VFDs.

PRESSURE CONTROL

Pump Operation Enable / Disable



Supply Level Required to Enable Pump Operation

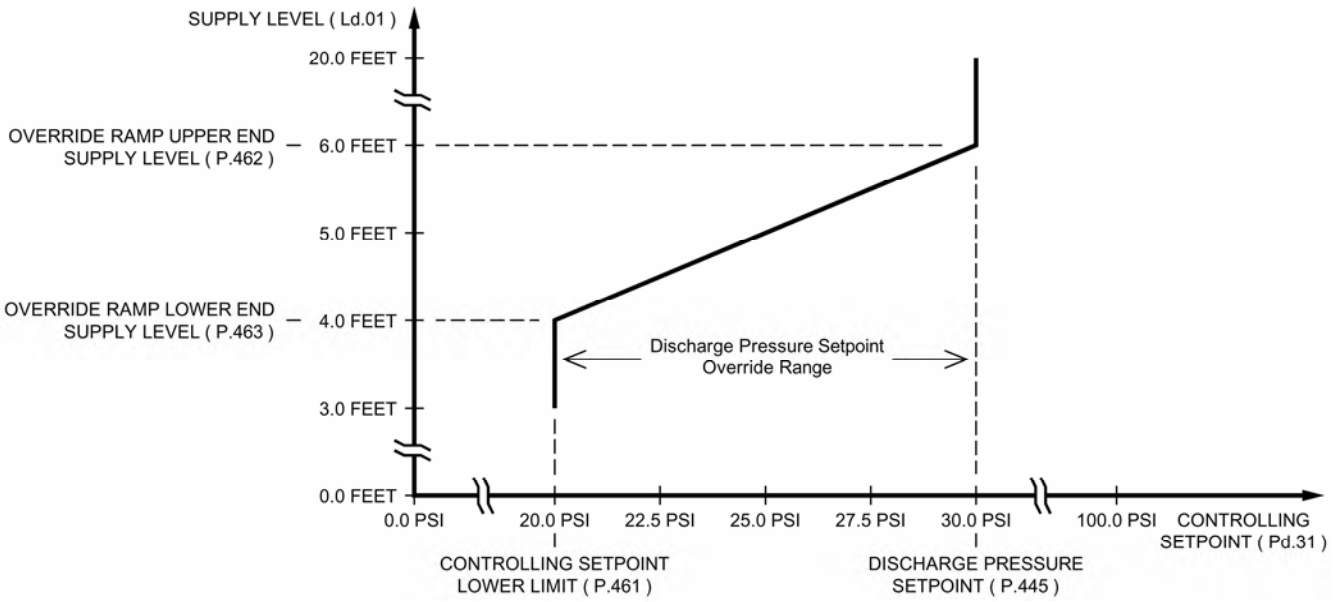
For cases where it is desirable to continue pumping, even when the Supply Level is low, the Controller has a Discharge Pressure Setpoint Override feature. The logic of the feature allows the operator to setup the Controller to continue pumping at a lower Discharge Pressure during a low Supply Level condition.

The purpose of the graph above is to point out the relationship between the Pump Operation Enable and Disable Parameters (P.459 and P.460) and the Discharge Pressure Setpoint Override Ramp, which will be discussed on the next page.

The Pump Operation Enable Supply Level (Parameter P.459) may be located higher or lower than what is shown above, but it must always be set higher than the Pump Operation Disable Supply Level (Parameter P.460).

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Pump Operation Enable / Disable				
P.459	5.0 feet		40459	Pump Operation Enable Supply Level — Range: 0.1 - 231.0 feet Note: This is the supply liquid level at which the operation of all available pumps will be enabled to run as needed to meet the **Discharge Pressure Setpoint**.
P.460	3.0 feet		40460	Pump Operation Disable Supply Level — Range: 0.1 - 231.0 feet Note: This is the supply liquid level at which all pump operation will be disabled and all pumps will be turned off in order to prevent the level from continuing to lower.
When pump operation is disabled, based on Parameters P.459 and P.460, the “Supply Level Too Low for Pump Operation” status bit will be set, and may be read from Modbus Coil 258 (Register 40017 Bit 1).				

Discharge Pressure Setpoint Override - Upon Low Supply Level



Discharge Pressure Setpoint Override - Upon a Low Supply Level

Upon a low Supply Level condition, where the Supply Level is lower that what is set on Parameter P.462, the Setpoint Override logic will ramp down the Controlling Setpoint as shown in the graph above. This is done to prevent the Supply Level from becoming so low that all pumping would need to be stopped.

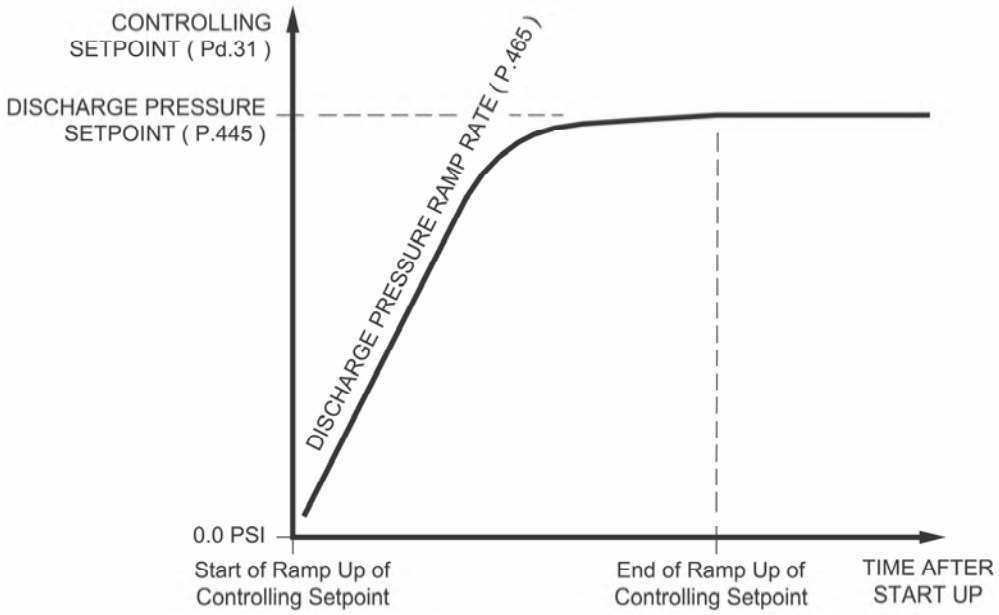
Upon a low Supply Level condition the Controlling Setpoint Override logic makes the Controlling Setpoint (Pd.31) lower (or much lower) than the Discharge Pressure Setpoint (P.445). Then the PID Controller responds by ramping down the Pump Speed Reference (Pd.41). The reduced pump speed may prevent the Supply Level from going any lower or at least slow down the decline in Supply Level.

If the low Supply Level condition requires that the Pump Speed Reference (Pd.41) be decreased to the point where it is less than or equal to Parameter P.456, for the time set on Parameter P.457, then the control logic will turn off one or more of the pumps. See Parameters P.456 and P.457 on page 3-12.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Controlling Setpoint Lower Limit				
P.461	20.0 psi		40461	Controlling Setpoint Lower Limit Range: 3.0 - 300.0 psi Note: Parameter P.461 sets the lowest value that the Setpoint Override logic is allowed to make the Controlling Setpoint.
Override Ramp Upper End Supply Level				
P.462	6.0 feet		40462	Override Ramp Upper End Supply Level Range: 0.1 - 231.0 feet Note: Parameter P.462 sets the Supply Level that corresponds to where the Setpoint Override logic makes the Controlling Setpoint equal to the Discharge Pressure Setpoint (Parameter P.445).
Override Ramp Lower End Supply Level				
P.463	4.0 feet		40463	Override Ramp Lower End Supply Level Range: 0.1 - 231.0 feet Note: Parameter P.463 sets the Supply Level that corresponds to where the Setpoint Override logic makes the Controlling Setpoint equal to the Controlling Setpoint Lower Limit (Parameter P.461).
At startup or at any time the Setpoint Override logic keeps the Controlling Setpoint from being equal to the Discharge Pressure Setpoint, the "PID Controller Setpoint Override Active" status bit will be set. Its status may be read from Modbus Coil 257 (Register 40017 Bit 0).				

PRESSURE CONTROL

Discharge Pressure Controlling Setpoint - During Start Up



Start Up

During start up, the Pressure Control logic slowly ramps up the Controlling Setpoint (Parameter Pd.31), following the curve shown above. The Discharge Pressure Ramp Rate (Parameter P.465) is provided to set the start up ramp rate.

During start up, with an adequate Supply Level, the Controlling Setpoint (Parameter Pd.31) that is sent to the PID Controller is slowly ramped up until it matches the Discharge Pressure Setpoint (Parameter P.445).

However, if the Supply Level is below what is set on the Override Ramp Upper End Supply Level (Parameter P.462), the control logic will limit the Controlling Setpoint (Pd.31) as shown in the graph on page 3-14.

During start up, for the first 80% of the way to the Discharge Pressure Setpoint, the Controlling Setpoint is increased at the rate set on the Discharge Pressure Ramp Rate (Parameter P.465). Then for the last 20% of the way to the Discharge Pressure Setpoint, the ramp rate is slowly decreased as shown above.

The decrease in the ramp rate at the end of the curve shown above, is to reduce the overshooting of the Discharge Pressure Setpoint at start up.

At start up, if the Discharge Pressure is excessively overshooting the Discharge Pressure Setpoint, reduce the setting on the Discharge Pressure Ramp Rate (Parameter P.465) until the overshooting is within acceptable limits.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Discharge Pressure Ramp Rate				
P.465	0.85 psi /sec		40465	Discharge Pressure Ramp Rate — Range: 0.10 - 10.00 psi / sec Note: Parameter P.465 sets the initial rate at which the control logic is allowed to change the Discharge Pressure's Controlling Setpoint (Parameter Pd.31). Parameter P.465 must be set so that during start up the Discharge Pressure does not overshooting of the Discharge Pressure Setpoint beyond the acceptable limit.
At startup or at any time the Setpoint Override logic keeps the Controlling Setpoint from being equal to the Discharge Pressure Setpoint, the "PID Controller Setpoint Override Active" status bit will be set. Its status may be read from Modbus Coil 257 (Register 40017 Bit 0).				

PRESSURE CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
First Pump Start Delay				
P.468	10 sec.		40468	First Pump Start Delay — Range: 1 - 180 seconds Notes: The First Pump Start Delay period starts when all the following conditions are met: 1. Power is applied to Controller. 2. The Supply Level is at or above the Pump Operation Enable Supply Level (Parameter P.459). 3. The "All Pump Disable" discrete input (Discrete Input Function 17) is open. 4. The "Pump Cutoff Low-Low Level" discrete input (Discrete Input Function 59) is open and the delay set on the pump Re-enable Delay (Parameter P.153) has expired. 5. At least one Pump is available for service and has its "Pump Disable" discrete input (Discrete Input Functions 11 - 16) open.
Lag Pump Delay				
P.469	5 sec.		40469	Lag Pump Delay — Range: 1 - 100 seconds Note: This is the minimum time period between the calling of pumps to run at startup. It is also used to delay the turning on of the replacement pump when an operating pump is suddenly disabled, or when a time based alternation of the pumps is performed.
Number of Pumps Required at Startup				
P.470	1		40470	Number of Pumps Required at Startup — Range: 1 - 6 Note: This is the minimum number of pumps that are initially turned on in order to meet the Discharge Pressure Setpoint. When the First Pump Start Delay (Parameter P.468) expires, the first required pump will be turned on and each additional required pump will wait for the Lag Pump Delay (Parameter P.469) to expire.
Re-enable Delay - Pump Cutoff Low-Low Level				
P.153	10 sec.		40153	Re-enable Delay - Pump Cutoff Low-Low Level — Range: 1 - 600 seconds Notes: 1. While the Low-Low Level Float Switch is closed no pump operation will be allowed. 2. A Low-Low Level Float Switch must be connected to a Discrete Input assigned to Function 59. 3. The Delay starts timing out when the Discrete Input opens. When the Re-enable Delay expires the Pump Cutoff Low-Low Level feature will no longer prevent pump operation. 4. While the Pump Cutoff Low-Low Level input is closed the Low Level Alarm will be active. The contacts of a relay assigned to the Low Level Alarm (Function 7) will also be close. Also, Fault Code 1041 will be generated.
The "Pump Cutoff Active Low-Low Level" status is available from Modbus Coil 131 (Register 40009 Bit 2). The "Low Level Alarm" status is available from Modbus Coil 47 (Register 40003 Bit 14).				

PRESSURE CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Pump Speed Acceleration / Deceleration Rate				
P.166	30 sec.		40166	Pump Speed Acceleration Rate Range: 1 - 100 seconds / 100% speed Notes: 1. When a pump is turned on, this is the rate at which the pump's Speed Reference will be increased until it matches the Pump Speed Reference produced by the PID Controller (Parameter Pd.41). This is also the rate at which a pump's Speed Reference will follow increases of the Pump Speed Reference produced by the PID Controller. 2. The setting on Parameter P.166 is the time required for a pump's Speed Reference to go from 0% - 100%. 3. The Controller performs the Acceleration of the pump speed of the individual pumps. Therefore, the Accel Parameter on the VFDs should be set to a value less than or equal to what is set on Parameter P.166.
P.167	30 sec.		40167	Pump Speed Deceleration Rate Range: 1 - 100 seconds / 100% speed Notes: 1. When a pump is turned off, this is the rate at which the pump's Speed Reference will be decreased to 0% speed. This is also the rate at which a pump's Speed Reference will follow decreases of the Pump Speed Reference produced by the PID Controller. 2. The setting on Parameter P.167 is the time required for a pump's Speed Reference to go from 100% - 0%. 3. When a pump is turned off, the pump's Control Relay contact will be kept closed during the Deceleration of the pump to 0% speed, then the contact will be opened. 4. The Controller performs the Deceleration of the pump speed of the individual pumps. Therefore, the Decel Parameter on the VFDs should be set to a value less than or equal to what is set on Parameter P.167.
Supply Level Alarms				
P.101	2.0 feet		40101	Low Level Alarm Range: 0.0 - 231.0 feet Notes: 1. This sets the level at which the Low Level Alarm will be activated. 2. The Low Level Alarm operation is delayed for 90 seconds after power is applied. 3. The Low Level Alarm does not act as a redundant pump off. 4. A Float Switch connected to a Discrete Input assigned to either Function 59 or 61 will also activate the Low Level Alarm. 5. Upon a Low Level Alarm, the contacts of a relay assigned to Function 7 will close.
The "Low Level Alarm" status is available from Modbus Coil 47 (Register 40003 Bit 14).				
P.102	10.0 feet		40102	High Level Alarm Range: 0.1 - 231.0 feet Notes: 1. This sets the level at which the High Level Alarm will be activated. 2. The High Level Alarm operation is delayed for 10 seconds after power is applied. 3. A Float Switch connected to a Discrete Input assigned to Function 62 will also activate the High Level Alarm. 4. Upon a High Level Alarm, the contacts of a relay assigned to Function 8 will close.
The "High Level Alarm" status is available from Modbus Coil 48 (Register 40003 Bit 15).				
Discharge Pressure Alarms				
P.393	20.0 psi		40393	Low Discharge Pressure Alarm Range: 0.0 - 300.0 psi Note: Upon a Low Discharge Pressure Alarm, the contacts of a relay assigned to Function 13 will close.
The "Low Discharge Pressure Alarm" status is available from Modbus Coil 267 (Register 40017 Bit 10).				
P.394	70.0 psi		40394	High Discharge Pressure Alarm Range: 0.1 - 300.0 psi Note: Upon a High Discharge Pressure Alarm, the contacts of a relay assigned to Function 14 will close.
The "High Discharge Pressure Alarm" status is available from Modbus Coil 268 (Register 40017 Bit 11).				

PUMP ALTERNATION SEQUENCE

STANDARD ALTERNATION

Parameter P.122 = 1

With the Master Control Mode set on Pressure Control the Alternation Sequence Mode will be fixed on Standard Alternation (Parameter P.122 = 1).

The pumps will be Alternated “First On First Off”.

Discrete Inputs assigned the Function of “Pump Disable” (Functions 11 - 16) inputs may be used to disable pumps so that they will not be called to run.

Discrete Inputs assigned the Function of “Call Pump Last” (Functions 41 - 46) may be used to assign pumps to standby status, where they will only be called to run if no other pumps are available.

Discrete Inputs assigned the Function of “Sequence Input” (Functions 31 - 36) may be used to set the lead pump.

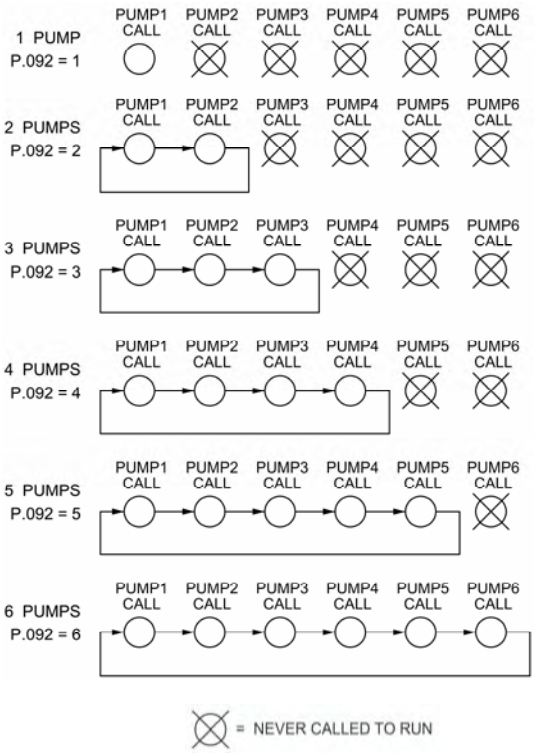
The “Forced Lead Pump Position” (Parameter P.129) may be used to set the lead pump.

“Time Based Alternation” (Parameter P.131) may be setup to force an alternation using an Internal Time Clock.

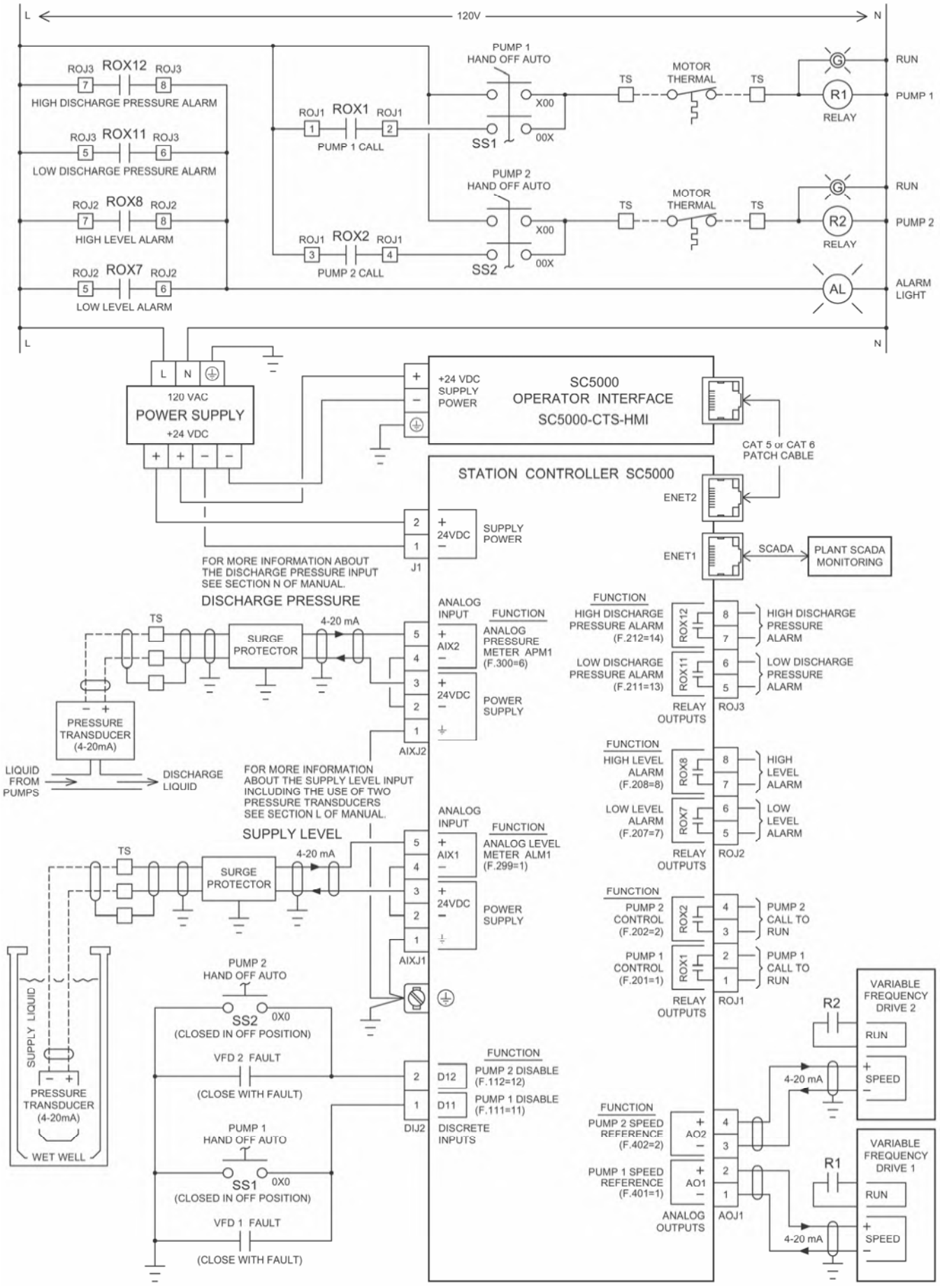
A Discrete Input assigned the Function of “External Alternation” (Function 21) may be connected to an External Time Clock and used to force an alternation.

A SCADA system may initiate an alternation by momentarily setting Modbus Coil 95 (Register 40006, Bit 14).

Movement of Lead Pump Upon Alternation

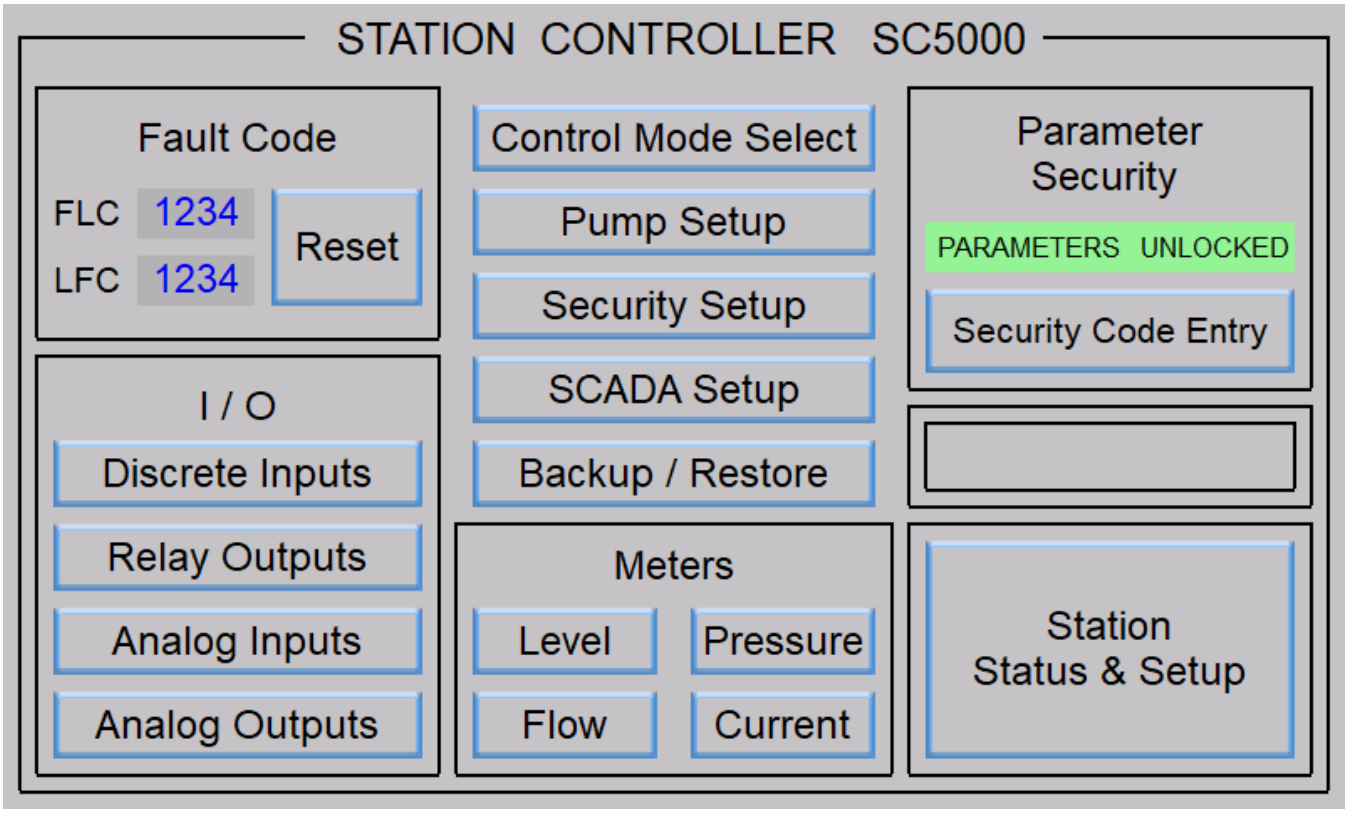


PRESSURE CONTROL EXAMPLE

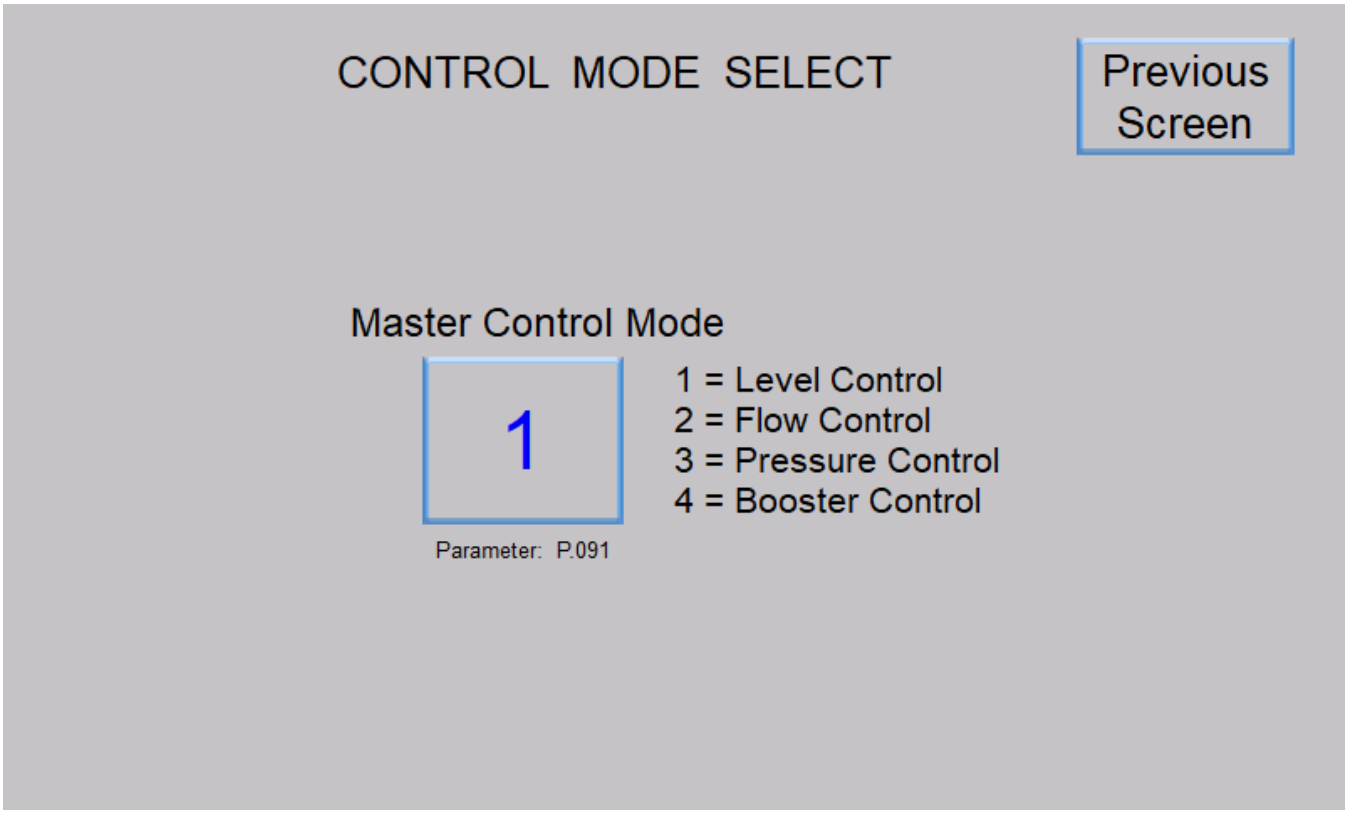


PRESSURE CONTROL - Touchscreen HMI SCREENS

Main Screen

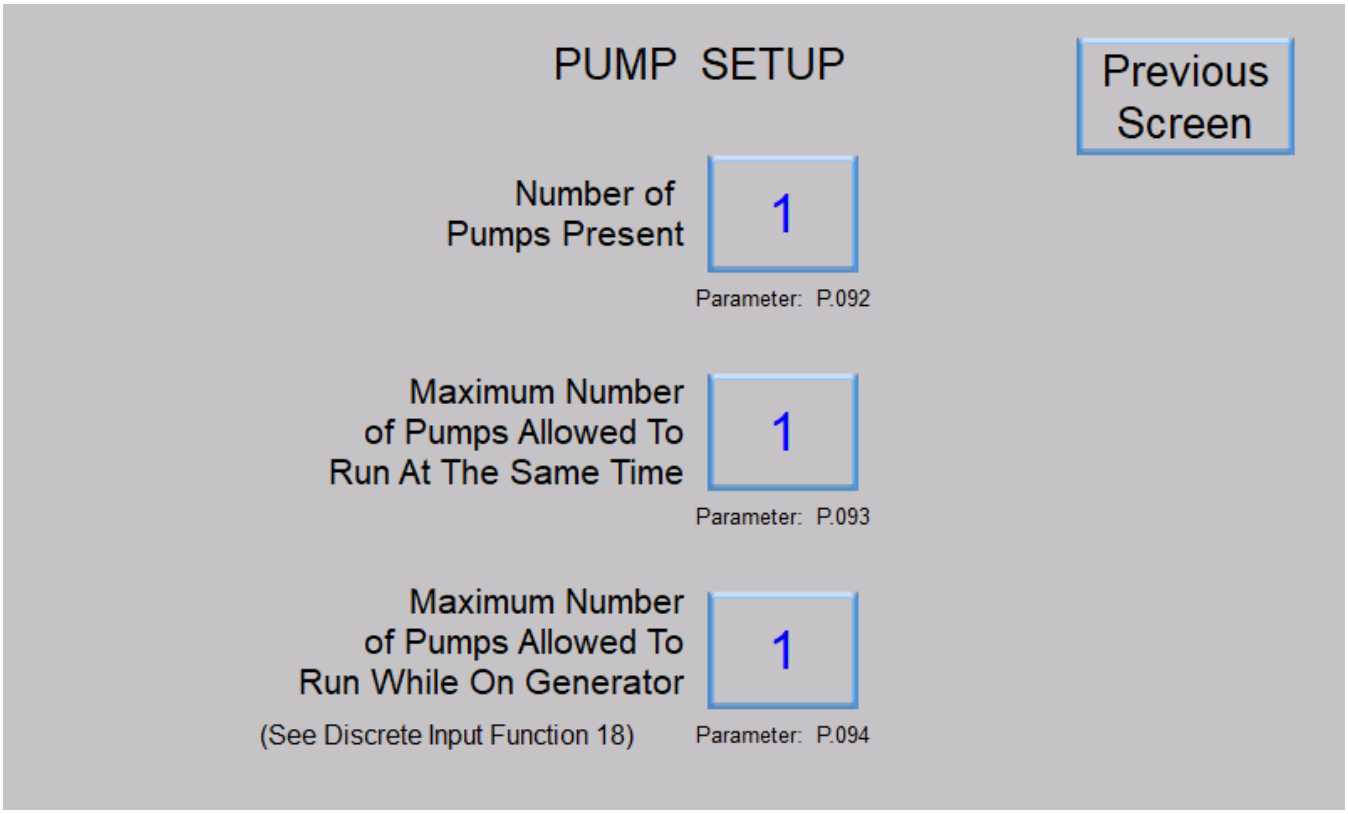


Control Mode Select

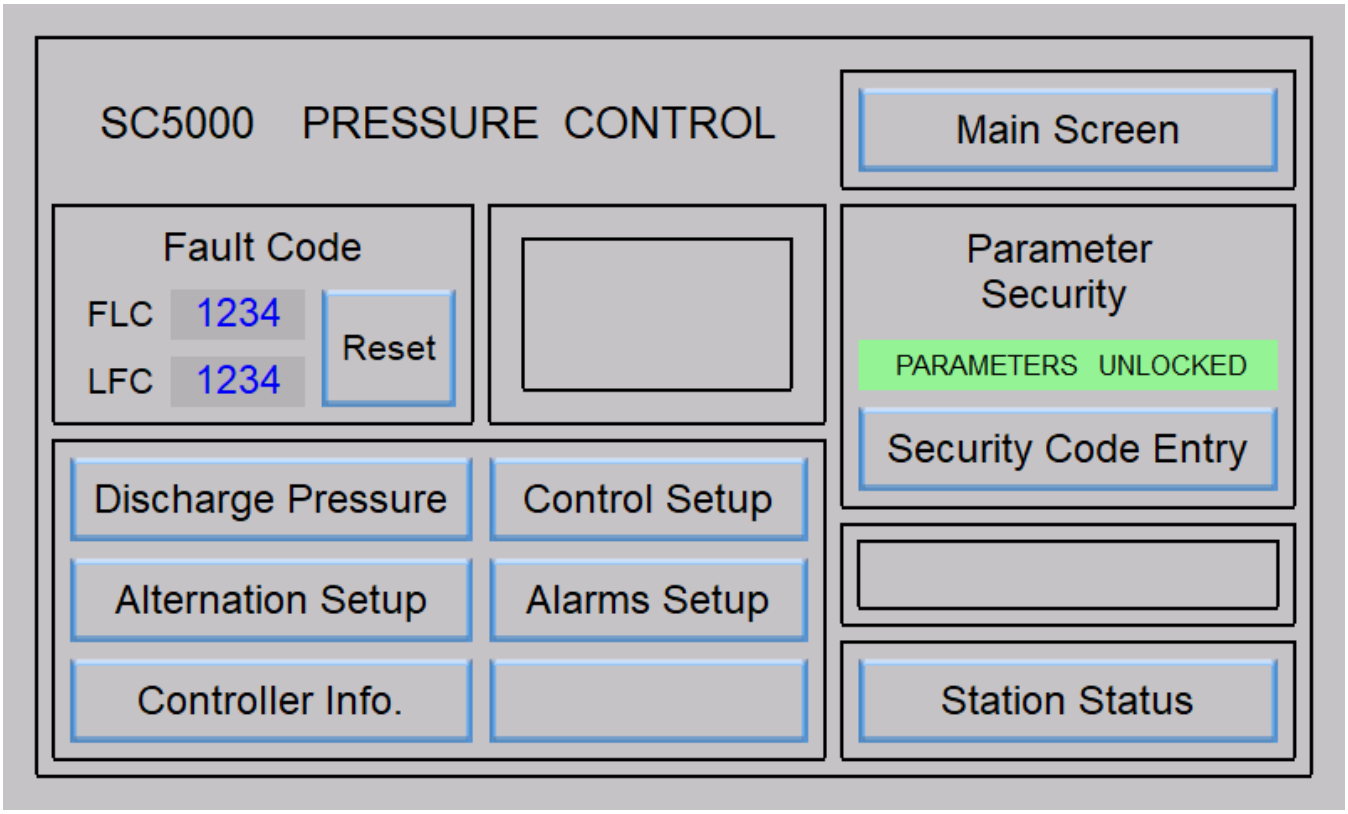


PRESSURE CONTROL - Touchscreen HMI

Pump Setup

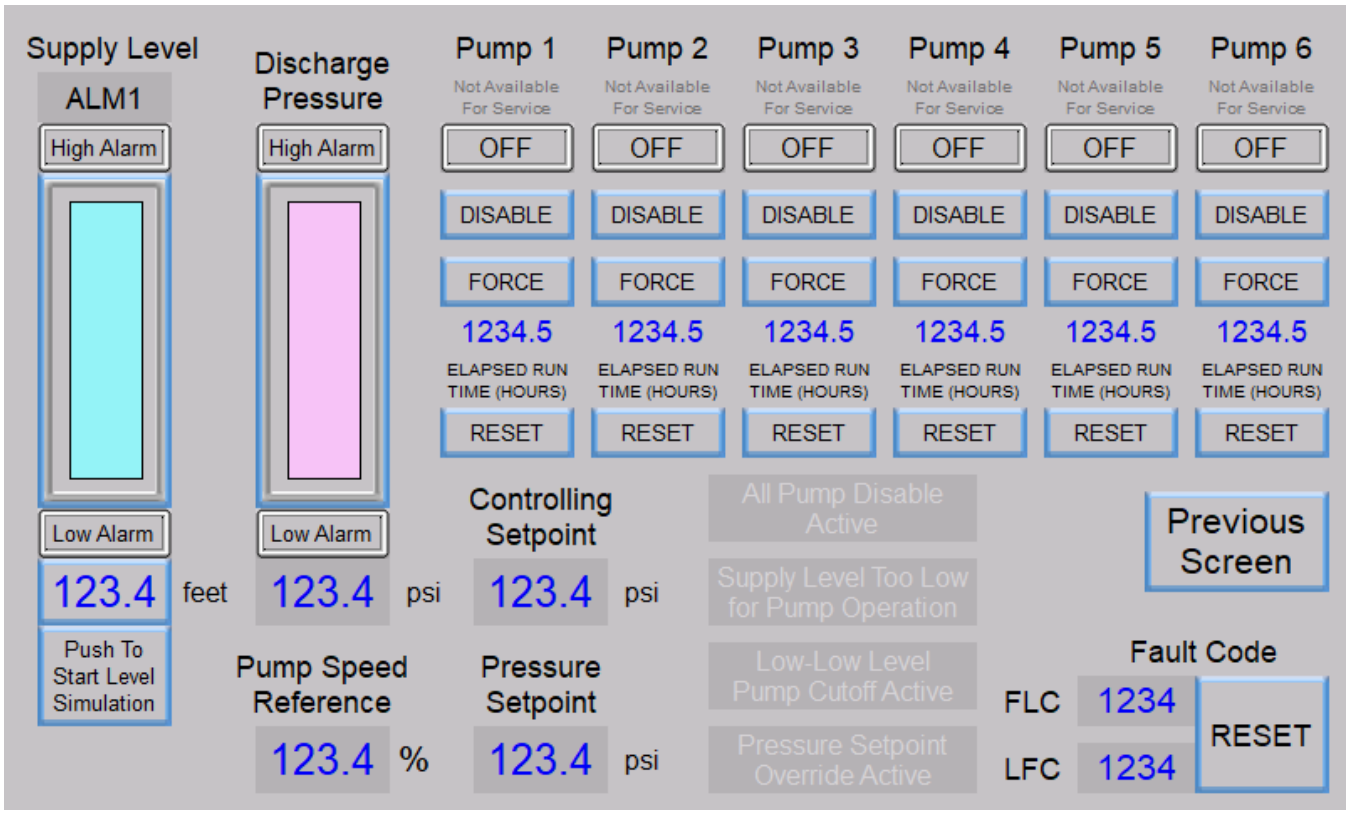


Pressure Control Main Screen

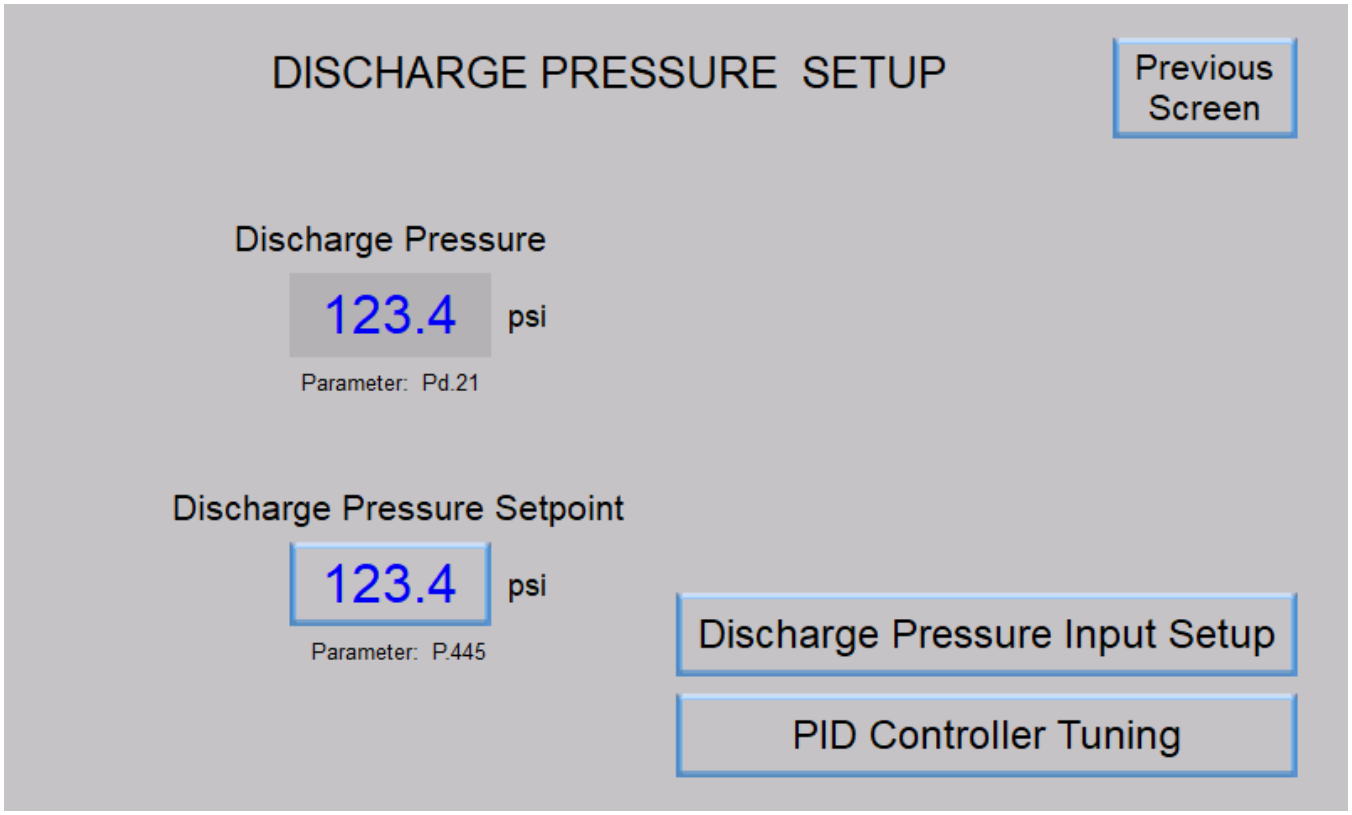


PRESSURE CONTROL - Touchscreen HMI SCREENS

Station Status

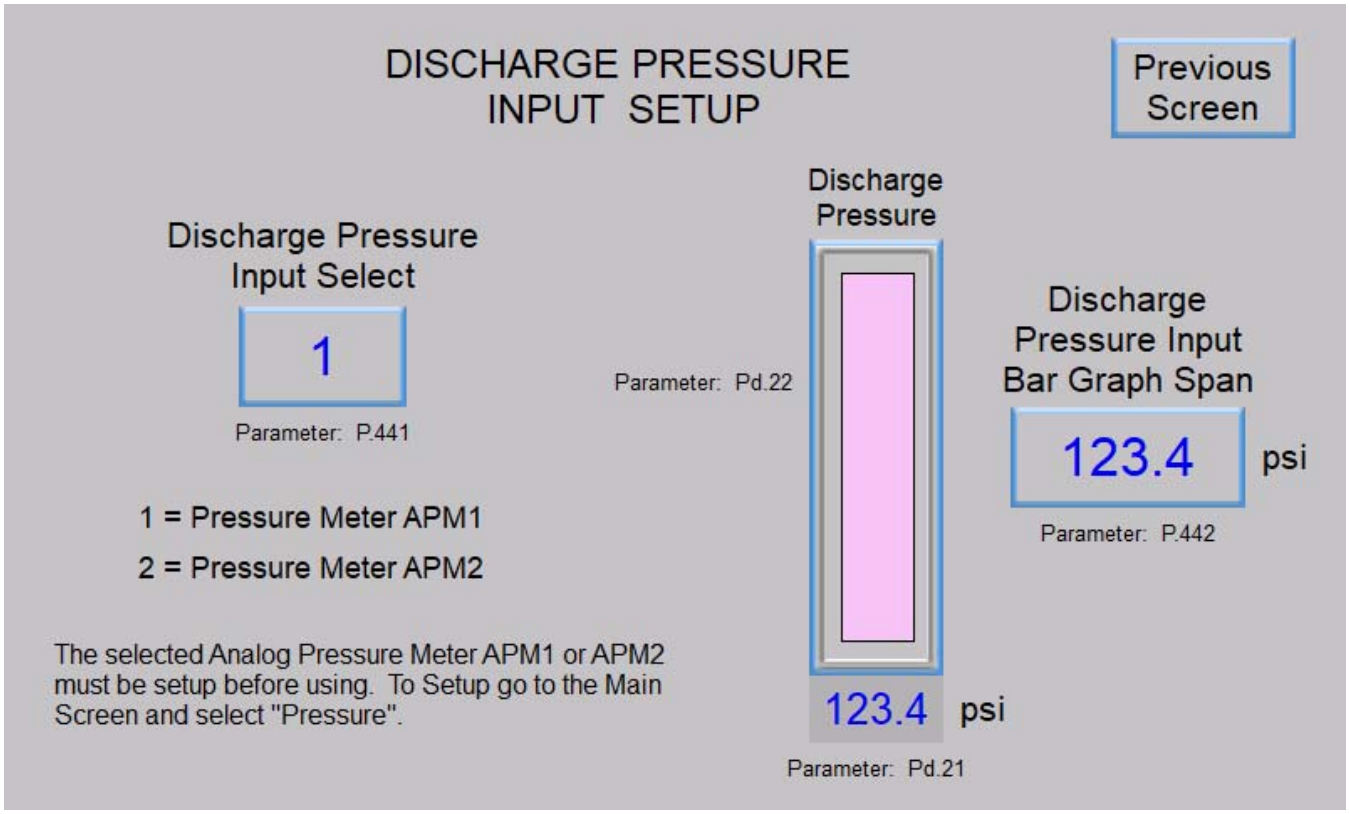


Discharge Pressure Setup

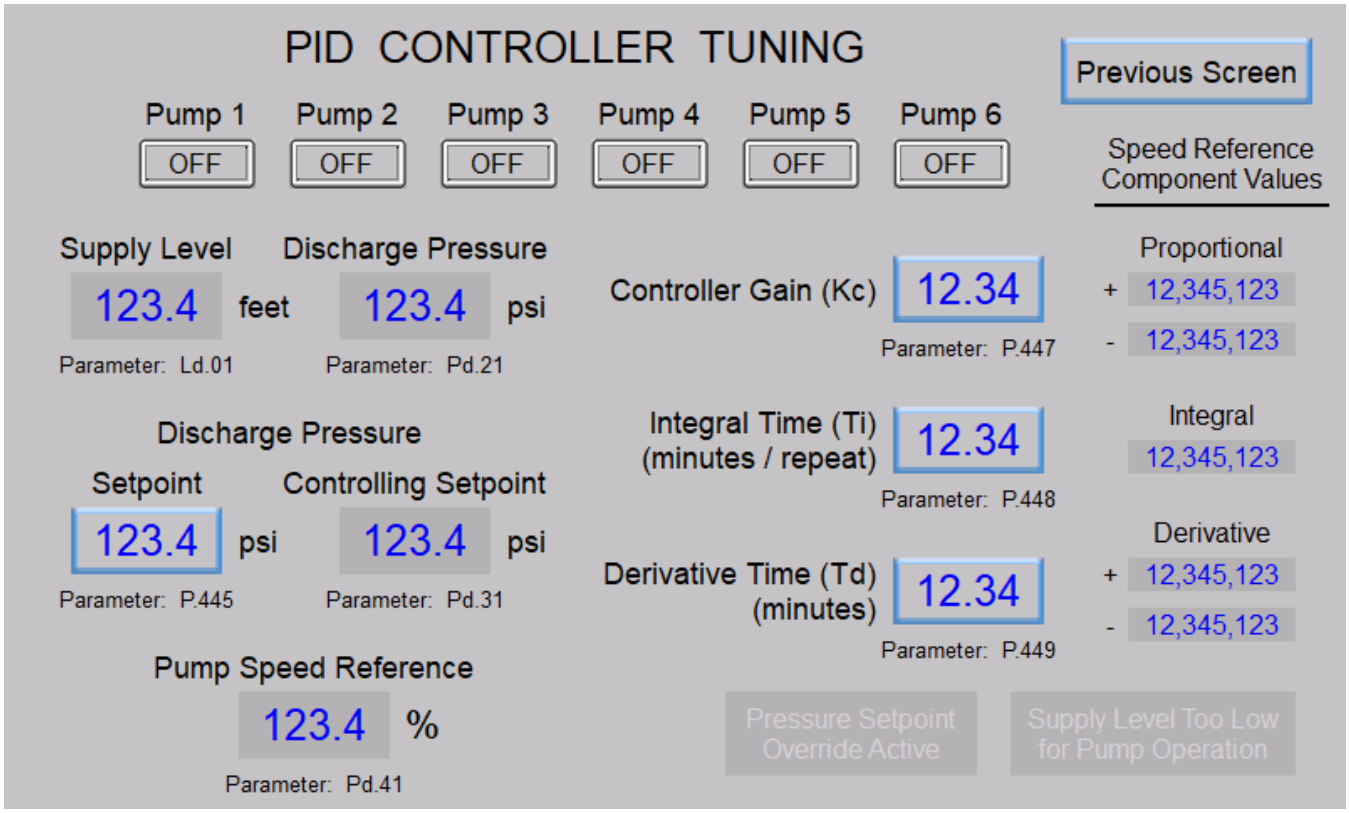


PRESSURE CONTROL - Touchscreen HMI SCREENS

Discharge Pressure Input Setup

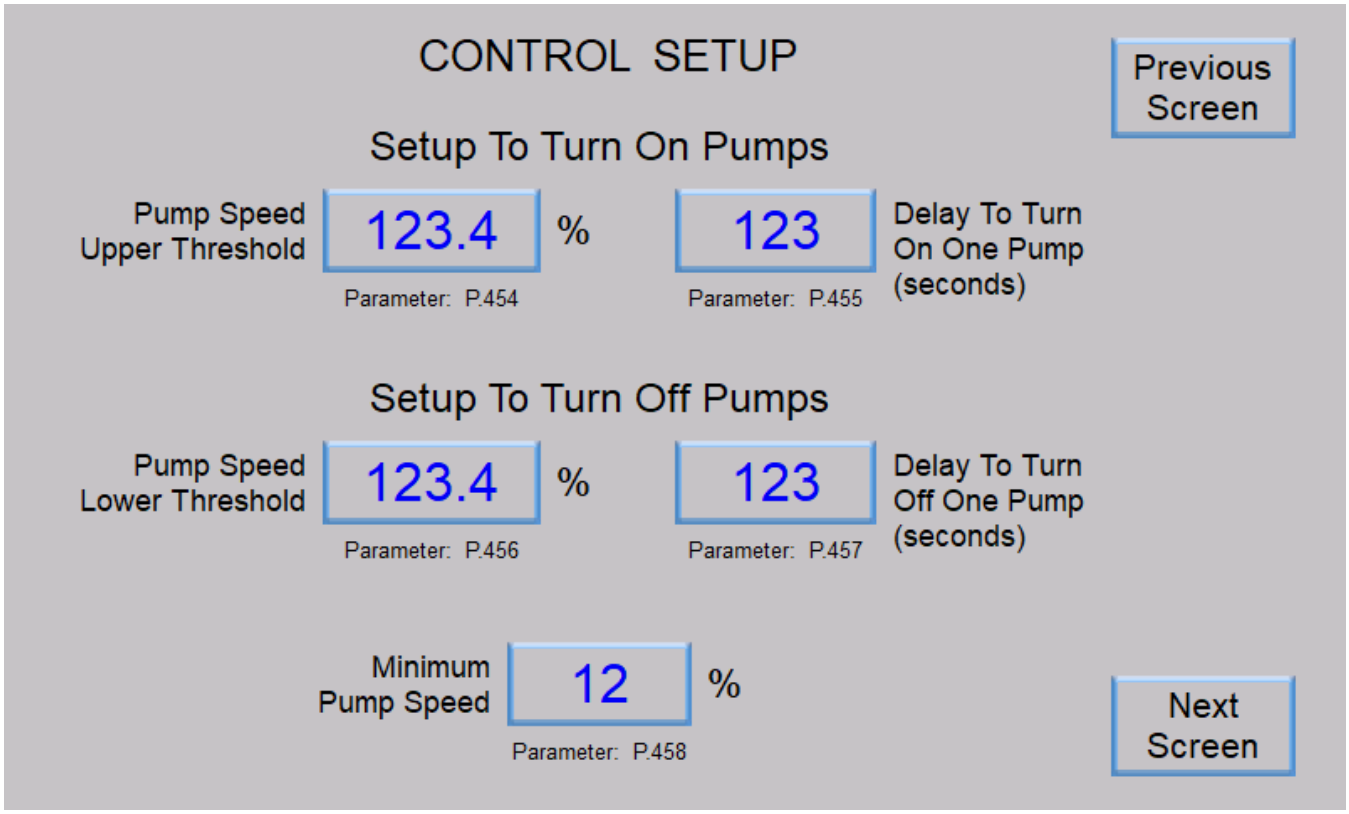


PID Controller Tuning

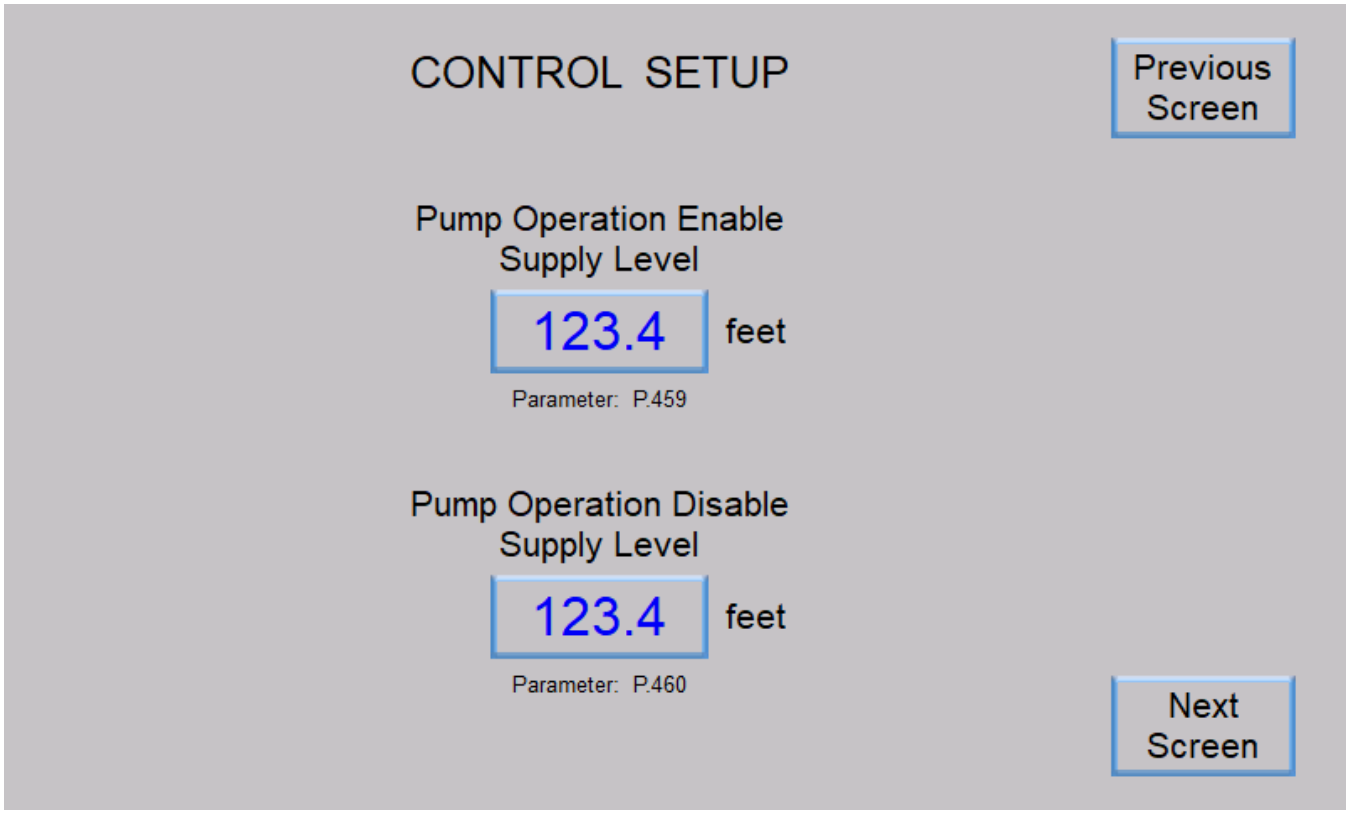


PRESSURE CONTROL - Touchscreen HMI SCREENS

Control Setup

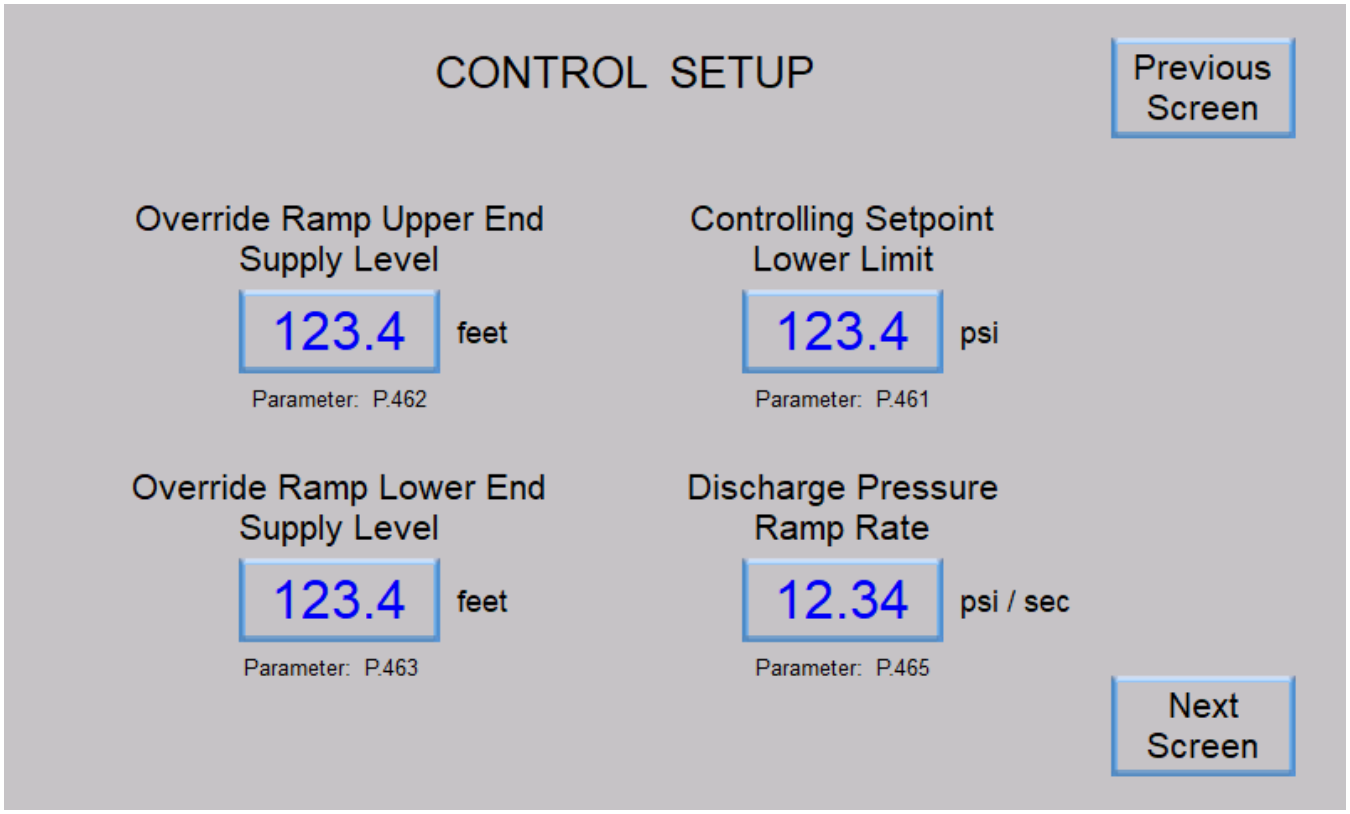


Control Setup

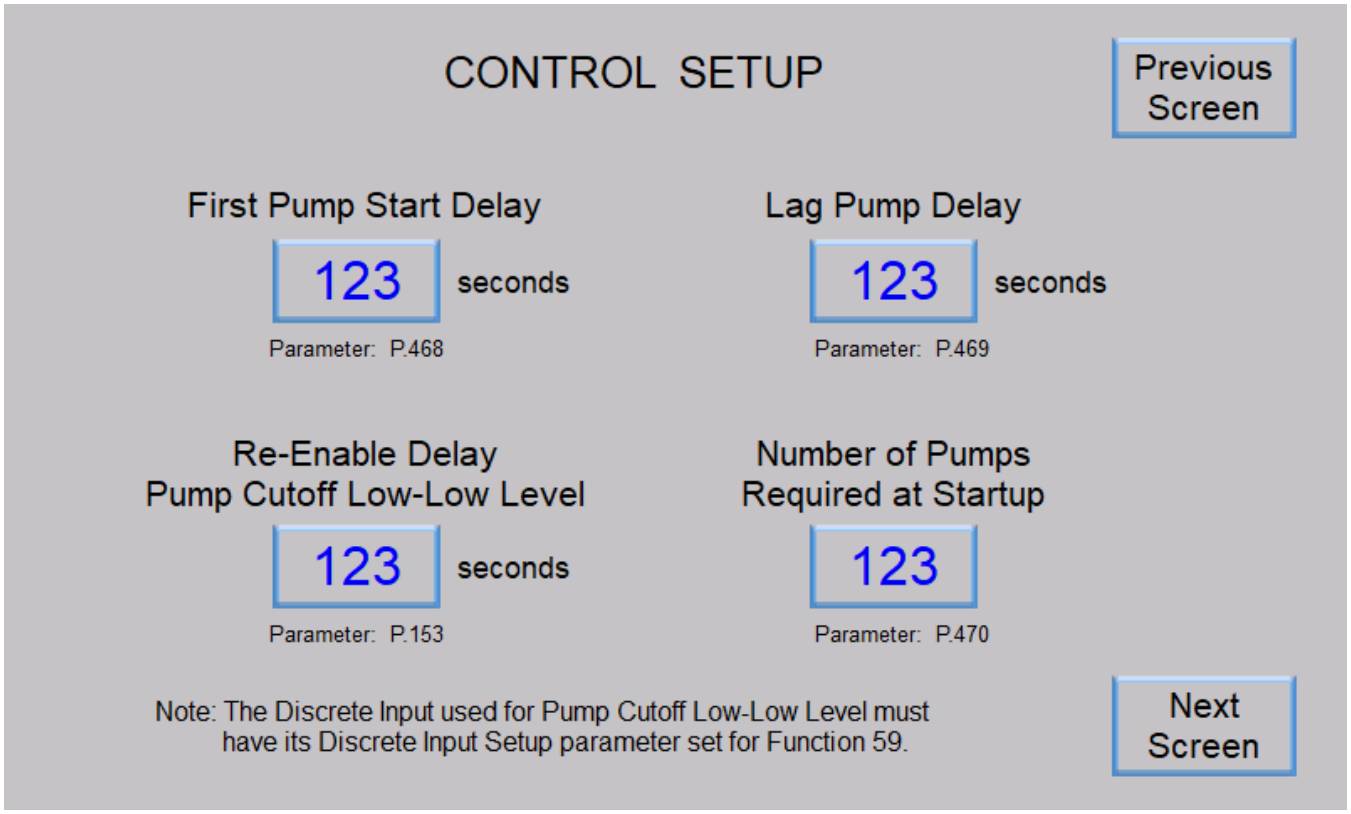


PRESSURE CONTROL - Touchscreen HMI SCREENS

Control Setup

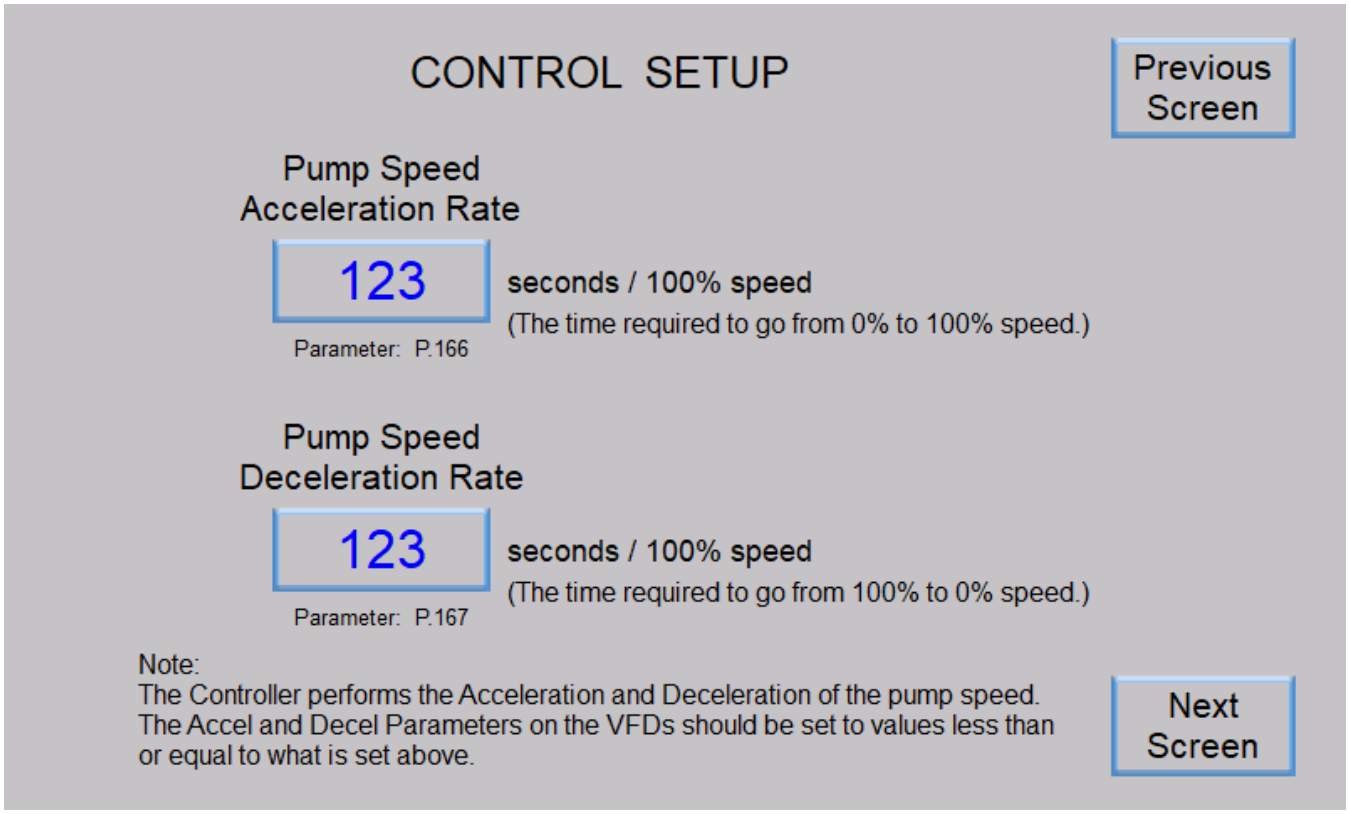


Control Setup

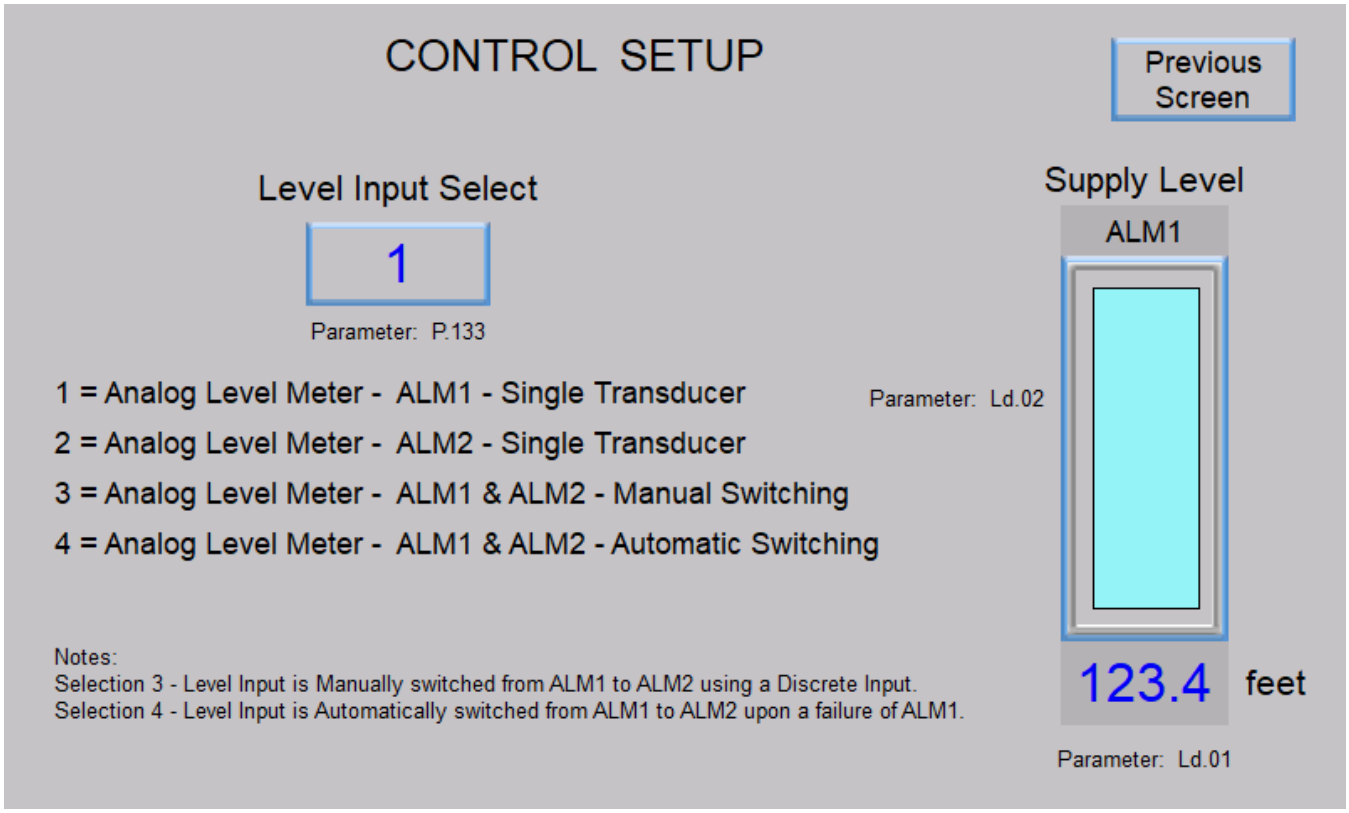


PRESSURE CONTROL - Touchscreen HMI SCREENS

Control Setup

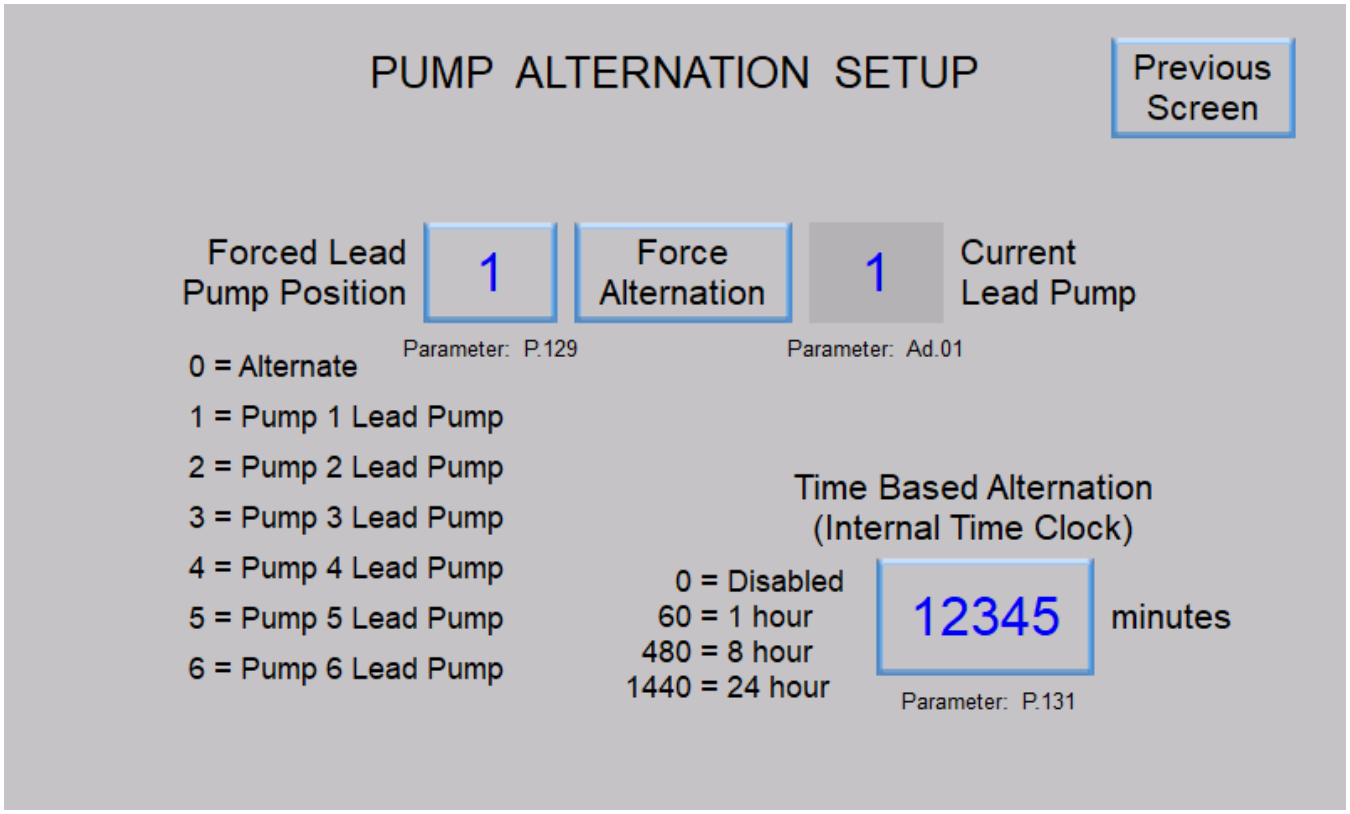


Control Setup

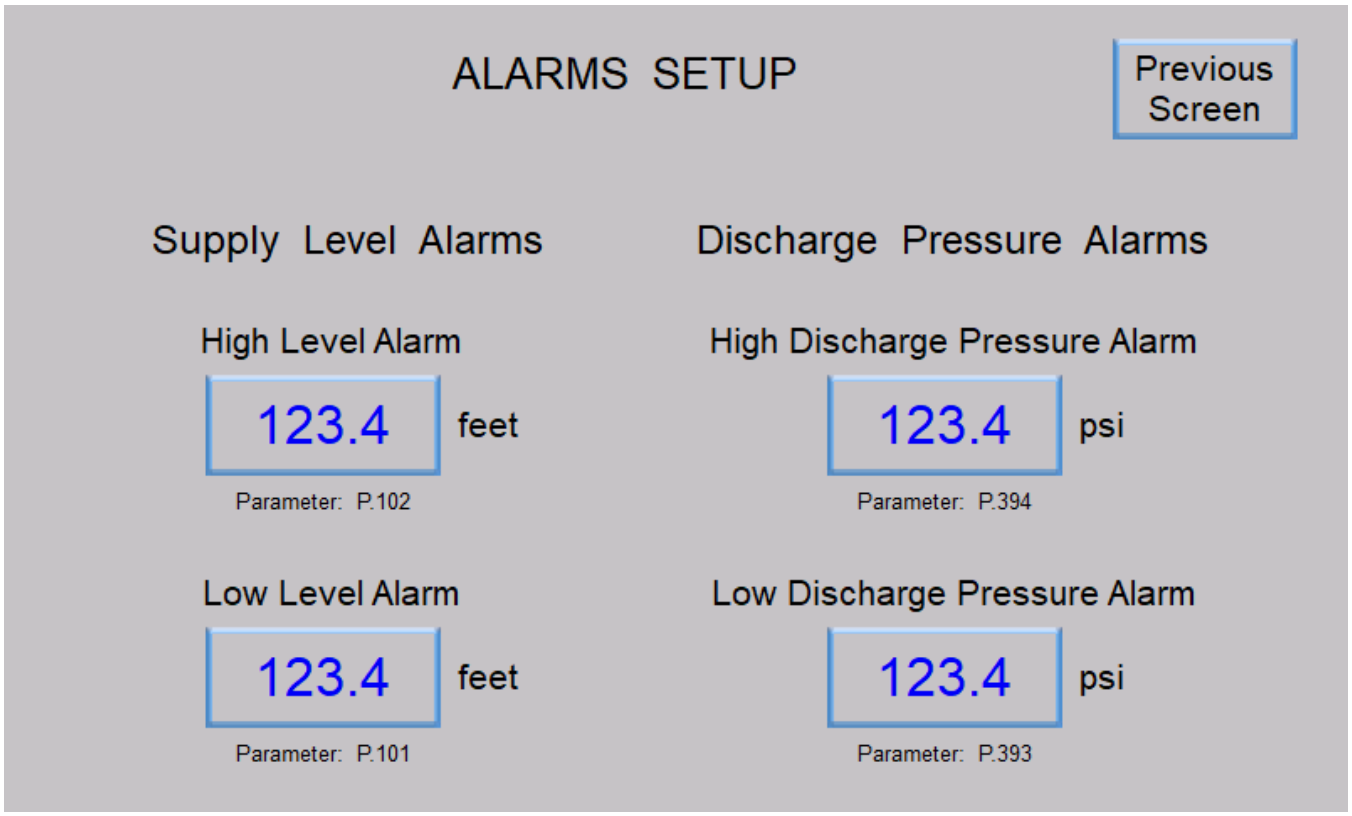


PRESSURE CONTROL - Touchscreen HMI SCREENS

Pump Alternation Setup



Alarms Setup



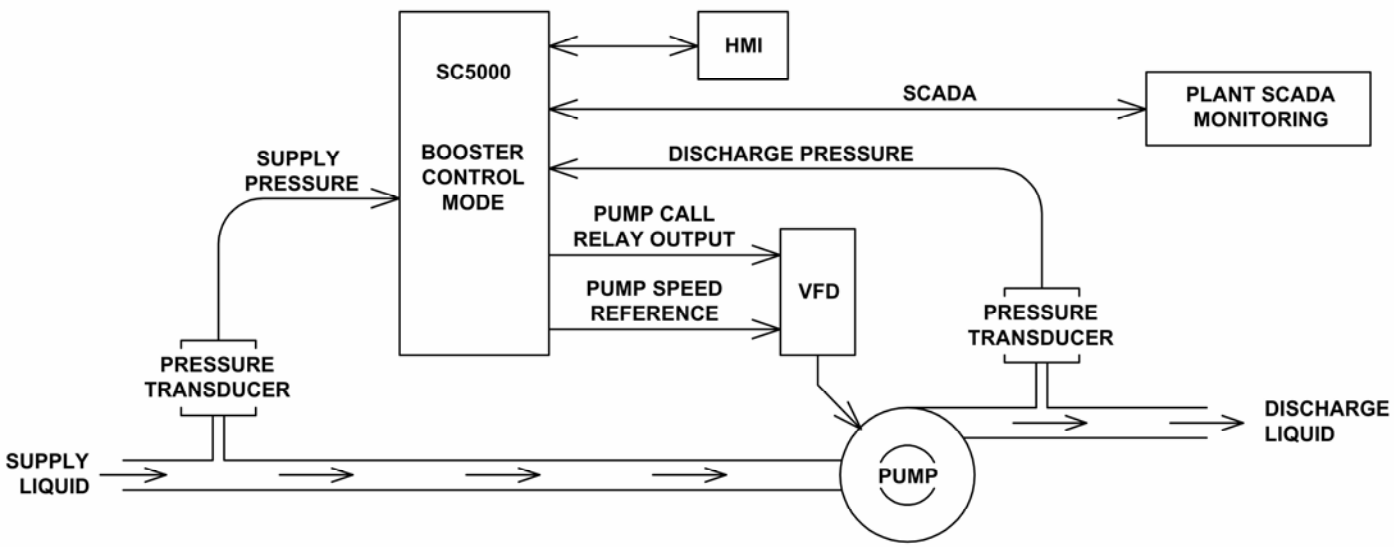
Revision Date: 5-9-23

SC5000

INSTRUCTION MANUAL

SECTION 4

BOOSTER CONTROL



MOTOR PROTECTION ELECTRONICS, LLC

2464 Vulcan Road
Apopka, Florida 32703

Phone: (407) 299-3825
Website: www.mpelectronics.com

SECTION 4
BOOSTER CONTROL

TABLE OF CONTENTS

BOOSTER CONTROL

DESCRIPTION OF FEATURES

General Description

With the Master Control Mode (Parameter P.091) set for “Booster Control” the SC5000 will function as a Booster Controller, and all logic pertaining to “Level Control”, “Flow Control” and “ Pressure Control” will be disabled.

In the Booster Control Mode, a PID Controller (Proportional, Integral, Derivative) is provided to regulate the pump speed in order to maintain the Discharge Pressure at the Discharge Pressure Setpoint.

The Booster Control logic also determines the number of pumps required to run in order to maintain the Discharge Pressure at the Discharge Pressure Setpoint.

The Booster Control logic also alternates the pumps and provides a First Pump Start Delay, Lag Pump Delay, Number of Pumps Required at Startup, Low Supply Pressure Alarm, High Supply Pressure Alarm, Low Discharge Pressure Alarm, and High Discharge Pressure Alarm. It also has parameters in the menu that allow the operator to set the Number of Pumps Present, the Maximum Number of Pumps Allowed to Run At the Same Time, and the Maximum Number of Pumps Allowed to Run While On a Generator.

The Booster Control Mode requires that each pump have its own VFD.

The Booster Control Mode also requires that the Controller be ordered with an optional Analog Output for each pump for the VFD speed reference (see Ordering Information).

HMI Features

The **SC500-CTS-HMI** is a **C**olor **T**ouch **S**creen HMI programmed with screens that show the Supply Pressure, Discharge Pressure, Pump Speed Reference, Pump Run Status, Pump Available for Service indication, High Supply Pressure and Low Supply Pressure alarms, High Discharge Pressure and Low Discharge Pressure alarms, Discharge Pressure Setpoint Override Active indication, Supply Pressure Too Low For Pump Operation alarm, Elapsed Run Time meters for each pump, and any Fault Codes that may be present. All the control and alarm settings are made readily available to the operator for viewing or changing. An operator may also reset the Elapsed Run Time meters, and reset any Fault Codes.

Discharge Pressure Setpoint

The Discharge Pressure Setpoint (Parameter P.489) must be set by the operator for the desired Discharge Pressure that the liquid should be pumped at as it leaves the pumping station.

At startup, the Booster Control logic will bring on the Number of Pumps Required at Startup (Parameter P.516). If number of pumps called at startup are unable to bring the Discharge Pressure up to the Discharge Pressure Setpoint, then an another pump will be started. If the setpoint is still not reached, then the control logic will call another pump to run and then another until the Discharge Pressure Setpoint is met. Additionally, the logic will turn off any unneeded pumps.

The PID Controller will follow what is set on the Discharge Pressure Setpoint as it regulates the Discharge Pressure, except when the Supply Pressure is low. In this case the Controller will not strictly following the setpoint, but rather decrease the Discharge Pressure while the Supply Pressure is low, and follow the Discharge Pressure Setpoint when the Supply Pressure returns to the normal range.

First Pump Start Delay

After power is applied to the Controller and after all the initial conditions are satisfied and the First Pump Start Delay (Parameter P.514) has expired, the Number of Pumps Required at Startup (Parameter P.516) will be started, and the Lag Pump Delay (Parameter P.515) will set the minimum time period between each pump call. The following are the initial conditions which must first be met for the First Pump Start Delay to begin timing out:

The Supply Pressure must be at or above the Pump Operation Enable Supply Pressure (Parameter P.503) and the Pump Operation Enable Delay (Parameter P.504) must have expired.

The “All Pump Disable” Discrete Input (Discrete Input Function 17) must be open.

At least one pump must be available for service (Not having its Pump Disable Discrete Input closed (Discrete Input Functions 11 - 16).

After all of the above conditions are met and the First Pump Start Delay times out, then the first pump will be started.

BOOSTER CONTROL

Lag Pump Delay

The Lag Pump Delay (Parameter P.515) sets the minimum time period between the calling of pumps to run at startup. It is also used to delay the turning on of the replacement pump when an operating pump is suddenly disabled, or when a time based alternation of the pumps is performed.

Number of Pumps Required at Startup

The Number of Pumps Required at Startup (Parameter P.516) sets the minimum number of pumps that are initially turned on in order to meet the Discharge Pressure Setpoint. When the First Pump Start Delay (Parameter P.514) expires, the first of the required pumps will be turned on and each additional required pump will wait for the Lag Pump Delay (Parameter P.515) to expire.

Pump Turn On and Off

Operating Principal

After the Number of Pumps Required at Startup (Parameter P.516) are started, the Booster Control logic will then control the number of additional pumps that are required to run in order to maintain the Discharge Pressure at the Discharge Pressure Setpoint. The control logic determines when an additional pump is needed and when to turn off an unneeded pump based on the following operating principal:

> The number of pumps required to run is regulated so that the PID Controller does not drive the pump speed reference significantly higher than or lower than a predetermined pump speed range.

See graph on page 4-11.

Turning On Pumps

If at some point conditions in the system require that the pump speed be increased in order to maintain the Discharge Pressure Setpoint, then the pump speed reference will be increased as needed. If the pump speed reference were to be increased to the point that it were equal to or greater than what is set on the Pump Speed Upper Threshold (Parameter P.498), then one additional pump would be turned on, after the delay set on the Delay To Turn On One Pump (Parameter P.499) expires. This may be repeated again and again until all the available pumps are called to run, or until the pump speed becomes lower than the Pump Speed Upper Threshold (Parameter P.498).

Turning Off Pumps

If at some point in time the conditions in the system were to change such that a lower pump speed were required to maintain the Discharge Pressure Setpoint, then the pump speed reference would be decreased as needed. If the pump speed reference were to be decreased to the point were it was equal to or less than what is set on the Pump Speed Lower Threshold (Parameter P.500), then one of the pumps would be turned off, after the delay set on the Delay To Turn Off One Pump (Parameter P.501) expires. This may be repeated again and again until all but one pump is left running, or until the pump speed becomes higher than the Pump Speed Lower Threshold (Parameter P.500).

Pump Operation Enable / Disable

The pump operation in the Booster Control Mode requires that there be adequate supply liquid pressure. The following two parameters provide the operator with control over how low the supply liquid pressure is allowed to drop before turning off all the pumps and at what pressure pumping should be allowed to resume:

See graph on page 4-12.

Pump Operation Enable Supply Pressure

To allow any pumps to start, the Supply Pressure (Parameter Pd.11) must first rise up to or be above what is set on the Pump Operation Enable Supply Pressure (Parameter P.503), and the Pump Operation Enable Delay (Parameter P.504) must have timed out.

Pump Operation Disable Supply Pressure

If the Supply Pressure (Parameter Pd.11) falls below what is set on the Pump Operation Disable Supply Pressure (Parameter P.505), and the Pump Operation Disable Delay (Parameter P.506) expires, then all the pumps will be turned off.

Alarm Status

When pump operation is disabled, based on Parameters P.505 and P.506, the “Supply Pressure Too Low for Pump Operation” alarm status bit will be set and may be read from Modbus Coil 259 (Register 40017 Bit 2).

BOOSTER CONTROL

Controlling Setpoint

At start up, to ensure the smooth stable control of the Discharge Pressure, the PID Controller is sent a gradually increasing Setpoint (the Controlling Setpoint (Parameter Pd.31)) that slowly increases to equal the Discharge Pressure Setpoint (Parameter P.489). The rate of the increase is set by the operator on the Discharge Pressure Ramp Rate (Parameter P.511). See the graph on page 4-14.

After start up, as long as the Supply Pressure remains in the normal range (above what is set on Parameter P.508), the Controlling Setpoint will be kept equal to the Discharge Pressure Setpoint and the PID Controller will regulate the pump speed to keep the Discharge Pressure at or near what is set on the Discharge Pressure Setpoint.

During start up or at any time, if the Supply Pressure becomes low (below what is set on Parameter P.508), then the value of the Controlling Setpoint will be ramped down along the linear slope established by Parameters P.507, P.508, P.509 and P.489. See the graph on page 4-13.

If while the pumps are operating and the Discharge Pressure Setpoint is changed by an operator, then the Controlling Setpoint will be ramped up or down to the new value of the Discharge Pressure Setpoint using the Discharge Pressure Ramp Rate (Parameter P.511).

While the Controlling Setpoint is being ramped up or down to the Discharge Pressure Setpoint, the “PID Controller Setpoint Override Active” status bit will be set and may be read from Modbus Coil 257 (Register 40017 Bit 0).

Pump Alternation

Automatic Alternation

In the Booster Control Mode the pump Alternation Sequence Mode (Parameter P.122) is fixed to always be in the Standard Alternation, and the pumps will be Alternated “First On First Off”. See page 4-7.

See the alternation sequence diagram on page 4-16.

Manual Pump Call Sequence

When manual control over the pump call sequence is desired, the operator can use the Forced Lead Pump Position feature (Parameter P.129) to set the Lead Pump Position. This sets the order the pumps are called in. The Lead Pump Position may also be set using a Lead Pump Selector switch that is connected to Discrete Inputs assigned to Functions 31 - 36. See page 4-7.

See connection diagrams on page A-13.

Time Based Alternation

Time Based Alternation is also available in the Booster Control Mode. The Time Based Alternation logic may be triggered by an Internal Time Clock or from an External Time Clock. The Internal Time Clock alternation period is menu selectable (Parameter P.131). The External Time Clock may be triggered to alternate from either a External Time Clock connected to a Discrete Input on the Controller (assigned to Function 21), or it may be part of a SCADA system’s logic, where the SCADA system would set Modbus Coil 95 (Register 40006 Bit 14) to force the alternation of the pumps. See page 4-7.

Supply Pressure Input Select

The Booster Control Mode requires that an analog Supply Pressure Input be provided to the Controller to monitor the Supply Pressure. The Supply Pressure Input Select (Parameter P.481) is provided to allow for the selection of either Analog Pressure Meter APM1, or APM2. See Section N.

Discharge Pressure Input Select

The Booster Control Mode requires that an analog Discharge Pressure Input be provided to the Controller to monitor the Discharge Pressure. The Discharge Pressure Input Select (Parameter P.485) is provided to allow for the selection of either Analog Pressure Meter APM1, or APM2. See Section N.

BOOSTER CONTROL

Discrete Inputs

30 Discrete Inputs (D1 - D30) that may be setup to perform the following Functions:

- Pump Disable Inputs
- All Pump Disable - Phase Monitor Input
- On Generator - Limits number of pumps allowed to run
- External Alternation - External Time Clock Input
- Sequence Inputs - Lead Pump Selector Switch Inputs
- Call Pump Last Inputs
- Collection of Discrete Input Data for SCADA

Relay Outputs

12 Relay Outputs (ROX1 - ROX12) that may be setup to perform the following Functions:

- Up to Six Pump Call to Run Outputs
- High or Low Supply Pressure Alarm Outputs
- High or Low Discharge Pressure Alarm Outputs
- SCADA Remote Control Outputs

Analog Inputs

2 Standard Analog Inputs (AIX1 - AIX2) and up to 8 more Optional Analog Inputs (A1 - A8).
The Analog Inputs may be setup to perform one of the following Functions:

- Analog Flow Meter AFM1, AFM2 or AFM3
- Analog Pressure Meter APM1 or APM2
- Analog Current Meter ACMA, ACMB or ACMC
- Collection of Analog Input Data for SCADA

Analog Outputs

1 Standard Analog Output (AOX1) and up to 6 more Optional Analog Outputs (AO1 - AO6).
The Analog Outputs may be setup to perform one of the following Functions:

- Analog Signal for Pumps 1 - 6 Speed Reference
- Analog Signal for Pumps Speed Reference any Pump (Always Active)

Pulse Counter Inputs

Option for up to 3 Pulse Counter Inputs (DPC1 - DPC3) that may be used to perform the following:

- Pulse Counter Input for Pulse Flow Meter PFM1, PFM2 or PFM3

BOOSTER CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Master Control Mode				
P.091	1		40091	Master Control Mode 1 = Level Control 2 = Flow Control **Must Be Set On "4" for Booster Control** 3 = Pressure Control 4 = Booster Control
Pump Setup				
P.092	6		40092	Number of Pumps Present 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps
P.093	6		40093	Maximum Number of Pumps Allowed to Run at the Same Time 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps
P.094	6		40094	Maximum Number of Pumps Allowed to Run While On Generator 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps Note: Must Connect Transfer Switch Contact to Discrete Input assigned to Function 18.

User / Operator Info.	SCADA	
Parameter	Register Address	Description of Data
Elapsed Time Meter Data		
Etd.1	41891	Pump 1 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.2	41892	Pump 2 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.3	41893	Pump 3 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.4	41894	Pump 4 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.5	41895	Pump 5 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours
Etd.6	41896	Pump 6 - Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours

BOOSTER CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Pump Alternation Setup				
P.122	1	1	40122	Alternation Sequence Mode See page 4-17. 1 = Standard Alternation of Pumps 1 - 6 Note: With the Master Control Mode set on Booster Control the Alternation Sequence Mode will be fixed on Standard Alternation.
P.129	0		40129	Forced Lead Pump Position 0 = Normal Alternation X = Pump X as Lead
P.131	0		40131	Time Based Alternation Range: 0 - 65535 minutes 0 = Disabled 60 = 1 hour 480 = 8 hours 1440 = 24 hours Note: Pump Alternation may be triggered using the Internal Time Clock setup using Parameter P.131, or it can also be triggered by an External Time Clock, which may be either a hardware device connected to a Discrete Input setup to perform Function 21, or it may be triggered by having the SCADA system set Bit 14 in Register 40006.
Pump Alternation Status				
Ad.01	-	-	41888	Current Lead Pump Shows the number of the current Lead Pump.

BOOSTER CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Supply Pressure Input Setup				
P.481	1		40481	Supply Pressure Input Select 1 = Analog Pressure Meter APM1 2 = Analog Pressure Meter APM2 Note: This parameter establishes which Analog Pressure Meter's data will be used as the Supply Pressure. The Supply Pressure data selected here is available to be read from Parameters Pd.11 and Pd.12. See Section N.
P.482	100.0 psi		40482	Supply Pressure Bar Graph Span Note: This parameter sets the span of the Supply Pressure Bar Graph for Parameter Pd.12.
Supply Pressure Data				
Pd.11	-	-	42229	Supply Pressure Data - For Numerical Display of Supply Pressure Note: This is the value of the Supply Pressure data selected on Parameter P.481 scaled into psi for numerical display.
Pd.12	-	-	42230	Supply Pressure Data - For Bar Graph Display of Supply Pressure Note: This is the value of the Supply Pressure data selected on Parameter P.481 scaled for display on a bar graph. It is scaled to a range of 0 - 4095 by using the "Supply Pressure Bar Graph Span" (Parameter P.482). The Bar Graph Display scaling setup on the HMI device must be set for 0 - 4095.

BOOSTER CONTROL

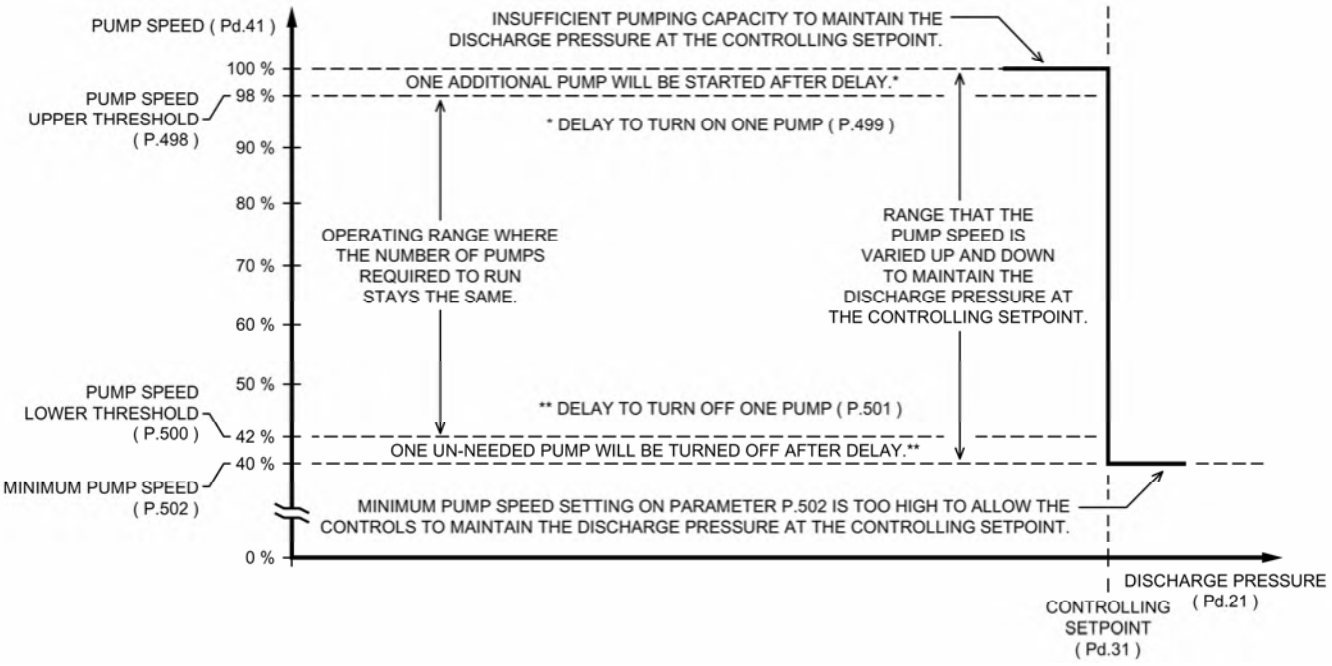
User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Discharge Pressure Input Setup				
P.485	2		40485	Discharge Pressure Input Select 1 = Analog Pressure Meter APM1 2 = Analog Pressure Meter APM2 Note: This parameter establishes which Analog Pressure Meter's data will be used as the Discharge Pressure. The Discharge Pressure data selected here is available to be read from Parameters Pd.21 and Pd.22. See Section N.
P.486	100.0 psi		40486	Discharge Pressure Bar Graph Span Note: This parameter sets the span of the Discharge Pressure Bar Graph for Parameter Pd.22.
Discharge Pressure Input Data				
Pd.21	-	-	42231	Discharge Pressure Data - For Numerical Display of Discharge Pressure Note: This is the value of the Discharge Pressure data selected on Parameter P.485 scaled into psi for numerical display.
Pd.22	-	-	42232	Discharge Pressure Data - For Bar Graph Display of Discharge Pressure Note: This is the value of the Discharge Pressure data selected on Parameter P.485 scaled for display on a bar graph. It is scaled to a range of 0 - 4095 by using the "Discharge Pressure Bar Graph Span" (Parameter P.486). The Bar Graph Display scaling setup on the HMI device must be set for 0 - 4095.

BOOSTER CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Discharge Pressure Setpoint				
P.489	60.0 psi		40489	Discharge Pressure Setpoint (SP) Range: 3.0 - 300.0 psi Note: This is the parameter that sets the desired Discharge Pressure of the liquid being pumped.
Pd.31	-		42233	Controlling Setpoint Note: To ensure a smooth stable control of the Discharge Pressure during startup, the value of the Controlling Setpoint (Parameter Pd.31) sent to the PID Controller is ramped up to the value set on the Discharge Pressure Setpoint (Parameter P.489), using the ramp rate set on the Discharge Pressure Ramp Rate (Parameter P.511). If while in operation, the Supply Pressure becomes low (below what is set on Parameter P.508), then the value of the Controlling Setpoint will be ramped down along the linear slope established by Parameters P.507, P.508, P.509 and P.489, as shown on page 4-13. The rate at which it is ramped down (or up) the slope is set on the Discharge Pressure Ramp Rate (Parameter P.511), as shown on page 4-14.
At startup or at any time the Setpoint Override logic keeps the Controlling Setpoint from being equal to the Discharge Pressure Setpoint, the "PID Controller Setpoint Override Active" status bit will be set. Its status may be read from Modbus Coil 257 (Register 40017 Bit 0).				
PID Controller Tuning				
P.491	1.60		40491	Controller Gain (Kc) Range: 0.01 - 30.00 Note: This parameter is used to tune the proportional component of the PID Controller's Pump Speed Reference output.
P.492	0.02 minutes / repeat		40492	Integral Time (Ti) Range: 0.01 - 60.00 minutes / repeat Note: This parameter is used to tune the integral component of the PID Controller's Pump Speed Reference output. Changes to this parameter may result in significant changes to the Pump Speed Reference. Therefore, it is recommended that only small changes are made to this parameter while the system is in operation.
P.493	0.00 minutes		40493	Derivative Time (Td) Range: 0.00 - 2.00 minutes Note: This parameter is used to tune the derivative component of the PID Controller's Pump Speed Reference output.
Pump Speed Reference Data				
Pd.41	-		41877	Pump Speed Reference Data Range: 0.0 - 100.0 percent Notes: 1. The Pump Speed Reference is determined by the PID Controller and is sent to the VFDs, as a 4-20mA signal, to control the pump speed 2. All operating pumps receive the same Speed Reference. 3. Parameter Pd.41 is the Pump Speed Reference as a percent of full speed.

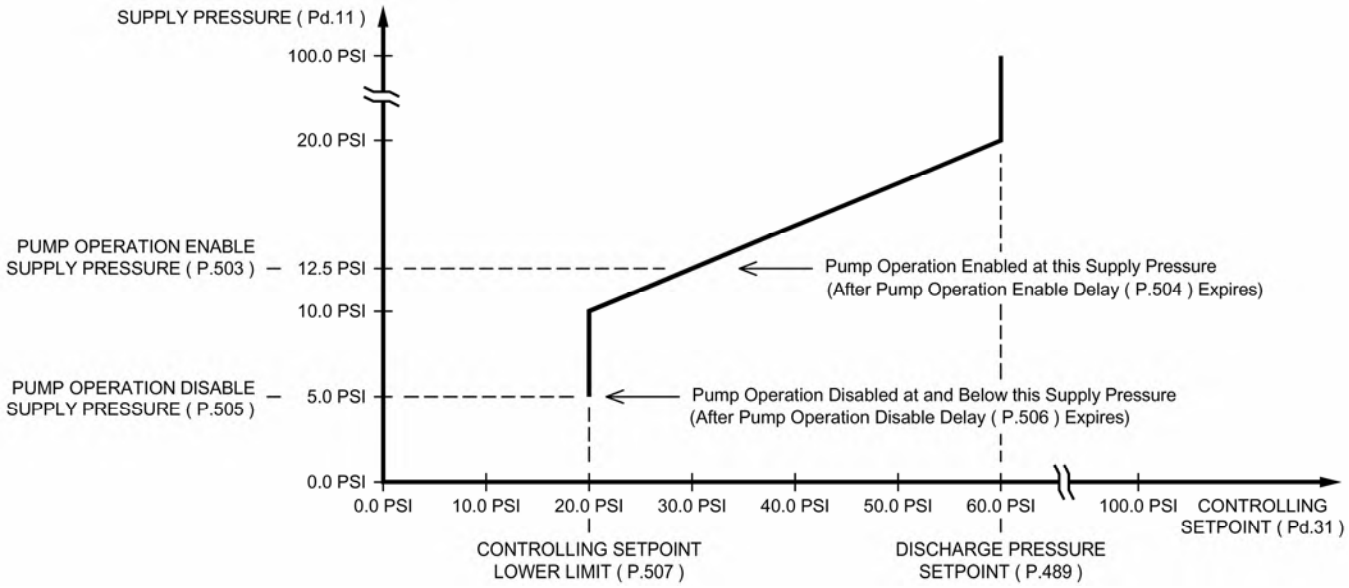
BOOSTER CONTROL

Turning On / Off Pumps



User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Turning On of Pumps				
P.498	98.0 %		40498	Pump Speed Upper Threshold Range: 30.0% - 100.0% of Full Speed Note: When the Pump Speed Reference has increased to where it is greater than or equal to what is set on this parameter, the **Delay To Turn On One Pump** (Parameter P.499) is started. When the delay expires an additional pump will be turned on.
P.499	10 sec.		40499	Delay To Turn On One Pump Range: 1 - 600 seconds Note: This delay starts when the Pump Speed Reference has increased to where it is greater than or equal to the **Pump Speed Upper Threshold** (Parameter P.498). When the delay expires an additional pump will be turned on.
Turning Off of Pumps				
P.500	42.0 %		40500	Pump Speed Lower Threshold Range: 10.0% - 90.0% of Full Speed Note: When the Pump Speed Reference has decreased to where it is less than or equal to what is set on this parameter, the **Delay To Turn Off One Pump** (Parameter P.501) is started. When the delay expires one pump will be turned off.
P.501	10 sec.		40501	Delay To Turn Off One Pump Range: 1 - 600 seconds Note: This delay starts when the Pump Speed Reference has decreased to where it is less than or equal to the **Pump Speed Lower Threshold** (Parameter P.500). When the delay expires one pump will be turned off.
Minimum Pump Speed				
P.502	40%		40502	Minimum Pump Speed Range: 0% - 95% of full speed Note: For each application there is usually a minimum speed, below which pump operation is undesirable. This parameter sets the minimum pump speed allowed. With a **Minimum Pump Speed** set on Parameter P.502, care must be taken that there is not also a minimum speed set on the VFDs.

Pump Operation Enable / Disable



Supply Pressure Required to Enable Pump Operation

Due to the risk of a Low Supply Pressure condition causing cavitation of the pumps, the control logic always monitors the Supply Pressure looking for a Low Supply Pressure condition.

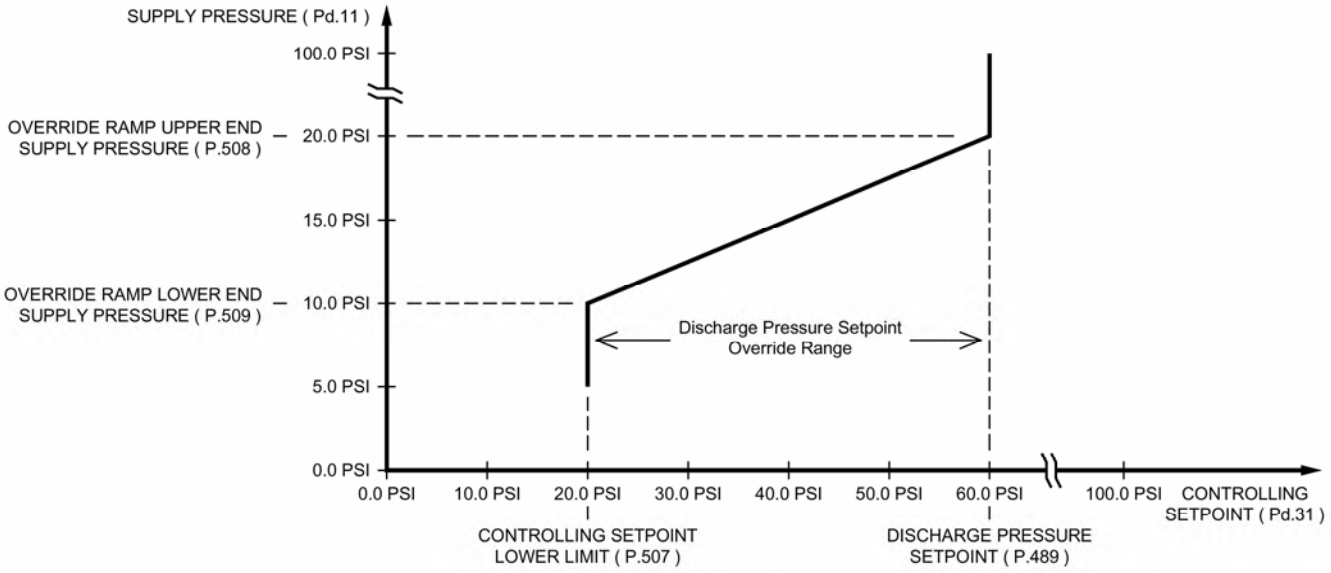
To prevent cavitation of the pumps it is critical to select values for Parameters P.503 and P.505 which ensure that there is always an adequate Supply Pressure.

The purpose of the graph above is to point out the relationship between the Pump Operation Enable and Disable Parameters (P.503 and P.505) and the Discharge Pressure Setpoint Override Ramp, which will be discussed on the next page.

The Pump Operation Enable Supply Pressure (Parameter P.503) may be located higher or lower than what is shown above, but it must always be set higher than the Pump Operation Disable Supply Pressure (Parameter P.505).

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Pump Operation Enable				
P.503	12.5 psi		40503	Pump Operation Enable Supply Pressure Range: 3.0 - 300.0 psi Note: This is the Supply Pressure at which pump operation will be enabled and the first pump started, after the delay set on the **Pump Operation Enable Delay** (Parameter P.504) expires.
P.504	10 sec.		40504	Pump Operation Enable Delay Range: 1 - 300 seconds Note: This delay starts when the Supply Pressure has risen enough to be greater than or equal to the **Pump Operation Enable Supply Pressure** (Parameter P.503).
Pump Operation Disable				
P.505	5.0 psi		40505	Pump Operation Disable Supply Pressure Range: 3.0 - 300.0 psi Note: This is the Supply Pressure at or below which all pumps will be turned off, after the delay set on the **Pump Operation Disable Delay** (Parameter P.506) expires.
P.506	10 sec.		40506	Pump Operation Disable Delay Range: 1 - 300 seconds Note: This delay starts when the Supply Pressure has decreased to where it is less than or equal to the **Pump Operation Disable Supply Pressure** (Parameter P.505).
When pump operation is disabled, based on Parameters P.505 and P.506, the "Supply Pressure Too Low for Pump Operation" status bit will be set. Its status may be read from Modbus Coil 259 (Register 40017 Bit 2).				

Discharge Pressure Setpoint Override - Upon Low Supply Pressure



Discharge Pressure Setpoint Override - Upon a Low Supply Pressure

Upon a low Supply Pressure condition, where the Supply Pressure is lower that what is set on Parameter P.508, the Setpoint Override logic will ramp down the Controlling Setpoint as shown in the graph above. This must be done to prevent the Supply Pressure from becoming too low, risking cavitation of the pumps.

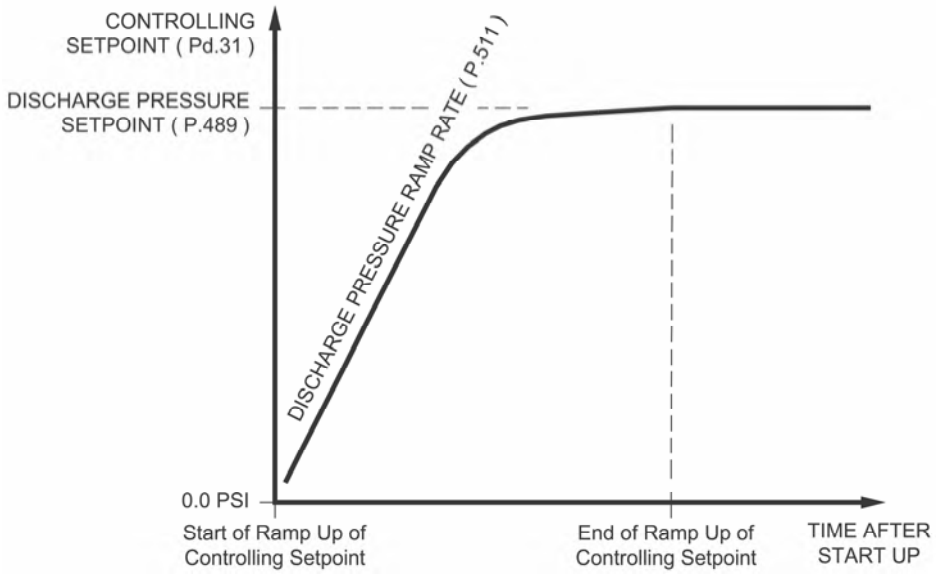
Upon a low Supply Pressure condition the Discharge Pressure Setpoint Override logic makes the Controlling Setpoint (Pd.31) lower (or much lower) than the Discharge Pressure Setpoint (P.489). Then the PID Controller responds by ramping down the Pump Speed Reference (Pd.41). The reduced pump speed would then allow the Supply Pressure to either rise or to not go any lower.

If the low Supply Pressure condition requires that the Pump Speed Reference (Pd.41) be decreased to the point where it is less than or equal to Parameter P.500, for the time set on Parameter P.501, then the control logic will turn off one or more of the pumps. See Parameters P.500 and P.501 on page 4-11.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Controlling Setpoint Lower Limit				
P.507	20.0 psi		40507	Controlling Setpoint Lower Limit — Range: 3.0 - 300.0 psi Note: Parameter P.507 sets the lowest value that the Setpoint Override logic is allowed to make the Controlling Setpoint.
Override Ramp Upper End Supply Pressure				
P.508	20.0 psi		40508	Override Ramp Upper End Supply Pressure — Range: 3.0 - 300.0 psi Note: Parameter P.508 sets the Supply Pressure that corresponds to where the Setpoint Override logic makes the Controlling Setpoint equal to the Discharge Pressure Setpoint (Parameter P.489).
Override Ramp Lower End Supply Pressure				
P.509	10.0 psi		40509	Override Ramp Lower End Supply Pressure — Range: 3.0 - 300.0 psi Note: Parameter P.509 sets the Supply Pressure that corresponds to where the Setpoint Override logic makes the Controlling Setpoint equal to the Controlling Setpoint Lower Limit (Parameter P.507).
At startup or at any time the Setpoint Override logic keeps the Controlling Setpoint from being equal to the Discharge Pressure Setpoint, the "PID Controller Setpoint Override Active" status bit will be set. Its status may be read from Modbus Coil 257 (Register 40017 Bit 0).				

BOOSTER CONTROL

Discharge Pressure Controlling Setpoint - During Start Up



Start Up

During start up, the volume being pumped must not be increased too quickly, as this may cause the Supply Pressure to drop too low. To prevent this issue, the Booster Control logic slowly ramps up the Discharge Pressure Controlling Setpoint during start up. The Discharge Pressure Ramp Rate (Parameter P.511) is provided to set the start up ramp rate.

During start up, with adequate Supply Pressure, the Controlling Setpoint (Parameter Pd.31) that is sent to the PID Controller is slowly ramped up until it matches the Discharge Pressure Setpoint (Parameter P.489), following the curve shown above.

However, if during startup the Supply Pressure drops below what is set on the Override Ramp Upper End Supply Pressure (Parameter P.508), the control logic will reduce the Controlling Setpoint (Pd.31) as shown in the graph on page 4-13.

During start up, for the first 80% of the way to the Discharge Pressure Setpoint, the Controlling Setpoint is increased at the rate set on the Discharge Pressure Ramp Rate (Parameter P.511). Then, for the last 20% of the way to the Discharge Pressure Setpoint, the ramp rate is slowly decreased, as shown above.

The decrease in the ramp rate at the end of the curve shown above, is to reduce the overshooting of the Discharge Pressure Setpoint at start up.

At start up, if the Discharge Pressure is excessively overshooting the Discharge Pressure Setpoint, reduce the setting on the Discharge Pressure Ramp Rate (Parameter P.511), until the overshooting is within acceptable limits.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Discharge Pressure Ramp Rate				
P.511	1.00 psi /sec		40511	Discharge Pressure Ramp Rate — Range: 0.10 - 10.00 psi / sec Note: Parameter P.511 sets the initial rate at which the control logic is allowed to change the Discharge Pressure's Controlling Setpoint (Parameter Pd.31). Parameter P.511 must be set so that during start up the Supply Pressure is not made to drop too low. The ramp rate setting may be further decreased in order to reduce the overshooting of the Discharge Pressure Setpoint at start up.
At startup or at any time the Setpoint Override logic keeps the Controlling Setpoint from being equal to the Discharge Pressure Setpoint, the "PID Controller Setpoint Override Active" status bit will be set. Its status may be read from Modbus Coil 257 (Register 40017 Bit 0).				

BOOSTER CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
First Pump Start Delay				
P.514	10 sec.		40514	First Pump Start Delay — Range: 1 - 180 seconds Note: The First Pump Start Delay period starts when all the following conditions are met: 1. Power is applied to Controller. 2. The Supply Pressure is at or above the Pump Operation Enable Supply Pressure (Parameter P.503) and the Pump Operation Enable Delay (Parameter P.504) has expired. 3. The "All Pump Disable" discrete input (Discrete Input Function 17) is open. 4. At least one Pump is available for service and has its "Pump Disable" discrete input (Discrete Input Functions 11 - 16) open.
Lag Pump Delay				
P.515	5 sec.		40515	Lag Pump Delay — Range: 1 - 100 seconds Note: This is the minimum time period between the calling of pumps to run at startup. It is also used to delay the turning on of the replacement pump when an operating pump is suddenly disabled, or when a time based alternation of the pumps is performed.
Number of Pumps Required at Startup				
P.516	1		40516	Number of Pumps Required at Startup — Range: 1 - 6 Note: This is the minimum number of pumps that are initially turned on in order to meet the Discharge Pressure Setpoint. When the First Pump Start Delay (Parameter P.514) expires, the first required pump will be turned on and each additional required pump will wait for the Lag Pump Delay (Parameter P.515) to expire.

BOOSTER CONTROL

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Pump Speed Acceleration / Deceleration Rate				
P.166	30 sec.		40166	Pump Speed Acceleration Rate Range: 1 - 100 seconds / 100% speed Notes: 1. When a pump is turned on, this is the rate at which the pump's Speed Reference will be increased until it matches the Pump Speed Reference produced by the PID Controller (Parameter Pd.41). This is also the rate at which a pump's Speed Reference will follow increases of the Pump Speed Reference produced by the PID Controller. 2. The setting on Parameter P.166 is the time required for a pump's Speed Reference to go from 0% - 100%. 3. The Controller performs the Acceleration of the pump speed of the individual pumps. Therefore, the Accel Parameter on the VFDs should be set to a value less than or equal to what is set on Parameter P.166.
P.167	30 sec.		40167	Pump Speed Deceleration Rate Range: 1 - 100 seconds / 100% speed Notes: 1. When a pump is turned off, this is the rate at which the pump's Speed Reference will be decreased to 0% speed. This is also the rate at which a pump's Speed Reference will follow decreases of the Pump Speed Reference produced by the PID Controller. 2. The setting on Parameter P.167 is the time required for a pump's Speed Reference to go from 100% - 0%. 3. When a pump is turned off, the pump's Control Relay contact will be kept closed during the Deceleration of the pump to 0% speed, then the contact will be opened. 4. The Controller performs the Deceleration of the pump speed of the individual pumps. Therefore, the Decel Parameter on the VFDs should be set to a value less than or equal to what is set on Parameter P.167.
Supply Pressure Alarms				
P.391	5.0 psi		40391	Low Supply Pressure Alarm Range: 0.0 - 300.0 psi Note: Upon a Low Supply Pressure Alarm, the contacts of a relay assigned to Function 11 will close.
The "Low Supply Pressure Alarm" status is available from Modbus Coil 265 (Register 40017 Bit 8).				
P.392	50.0 psi		40392	High Supply Pressure Alarm Range: 0.1 - 300.0 psi Note: Upon a High Supply Pressure Alarm, the contacts of a relay assigned to Function 12 will close.
The "High Supply Pressure Alarm" status is available from Modbus Coil 266 (Register 40017 Bit 9).				
Discharge Pressure Alarms				
P.393	20.0 psi		40393	Low Discharge Pressure Alarm Range: 0.0 - 300.0 psi Note: Upon a Low Discharge Pressure Alarm, the contacts of a relay assigned to Function 13 will close.
The "Low Discharge Pressure Alarm" status is available from Modbus Coil 267 (Register 40017 Bit 10).				
P.394	70.0 psi		40394	High Discharge Pressure Alarm Range: 0.1 - 300.0 psi Note: Upon a High Discharge Pressure Alarm, the contacts of a relay assigned to Function 14 will close.
The "High Discharge Pressure Alarm" status is available from Modbus Coil 268 (Register 40017 Bit 11).				

PUMP ALTERNATION SEQUENCE

STANDARD ALTERNATION

Parameter P.122 = 1

With the Master Control Mode set on Booster Control the Alternation Sequence Mode will be fixed on Standard Alternation (Parameter P.122 = 1).

The pumps will be Alternated “First On First Off”.

Discrete Inputs assigned the Function of “Pump Disable” (Functions 11 - 16) inputs may be used to disable pumps so that they will not be called to run.

Discrete Inputs assigned the Function of “Call Pump Last” (Functions 41 - 46) may be used to assign pumps to standby status, where they will only be called to run if no other pumps are available.

Discrete Inputs assigned the Function of “Sequence Input” (Functions 31 - 36) may be used to set the lead pump.

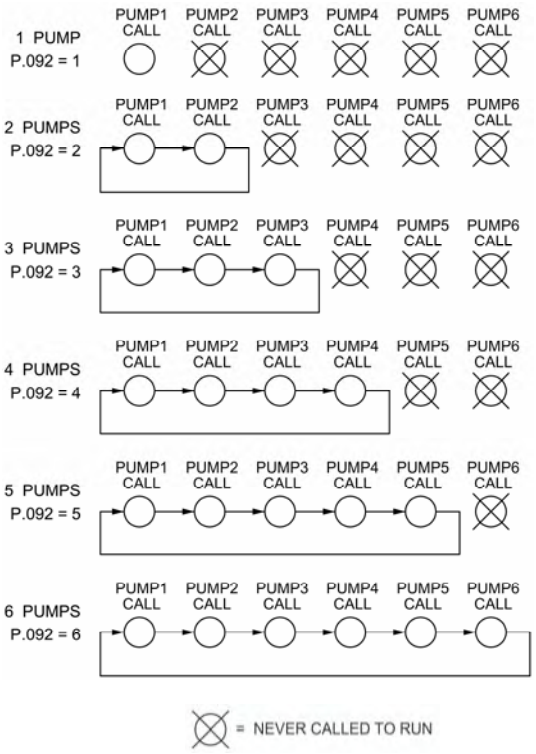
The “Forced Lead Pump Position” (Parameter P.129) may be used to set the lead pump.

“Time Based Alternation” (Parameter P.131) may be setup to force an alternation using an Internal Time Clock.

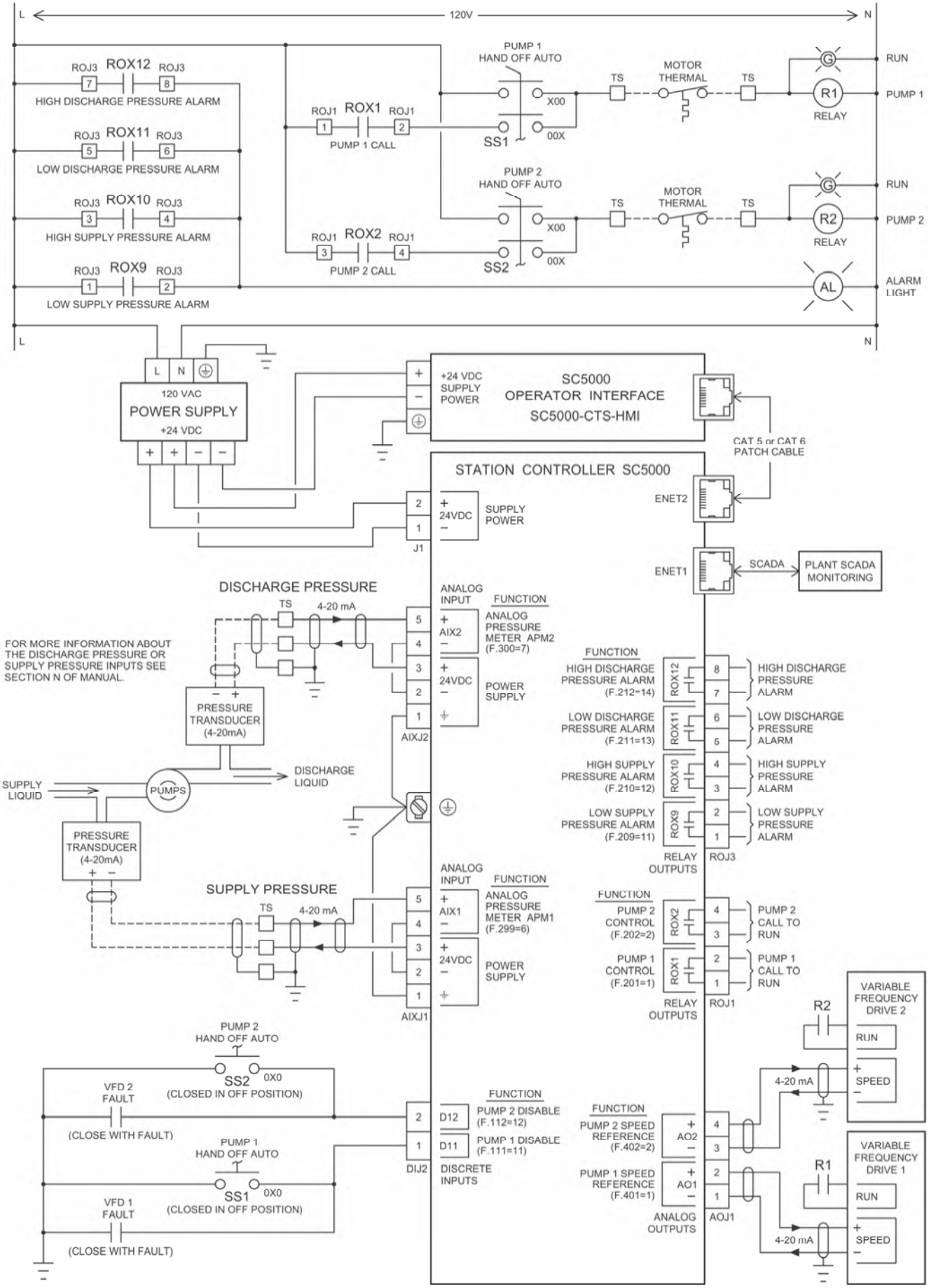
A Discrete Input assigned the Function of “External Alternation” (Function 21) may be connected to an External Time Clock and used to force an alternation.

A SCADA system may initiate an alternation by momentarily setting Modbus Coil 95 (Register 40006, Bit 14).

Movement of Lead Pump Upon Alternation

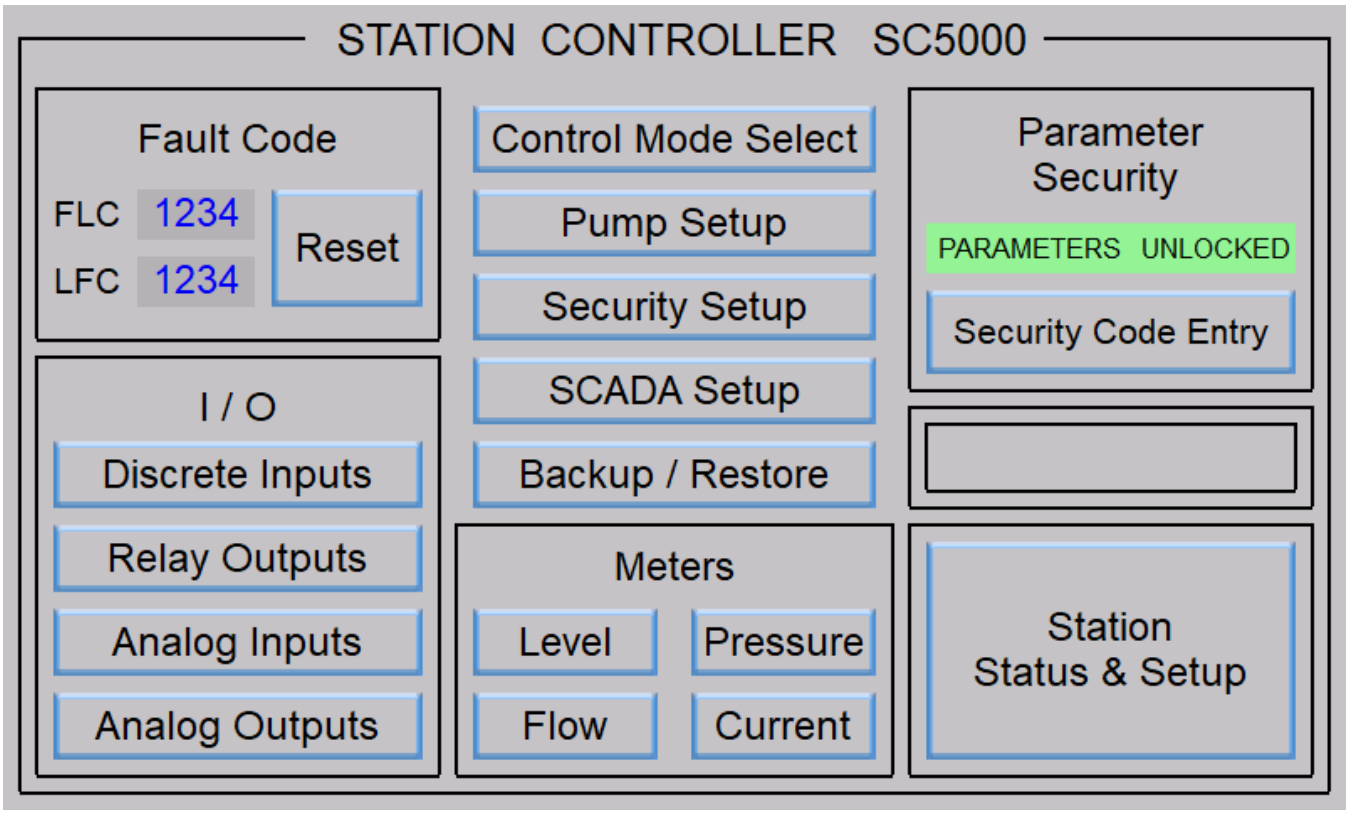


BOOSTER CONTROL EXAMPLE

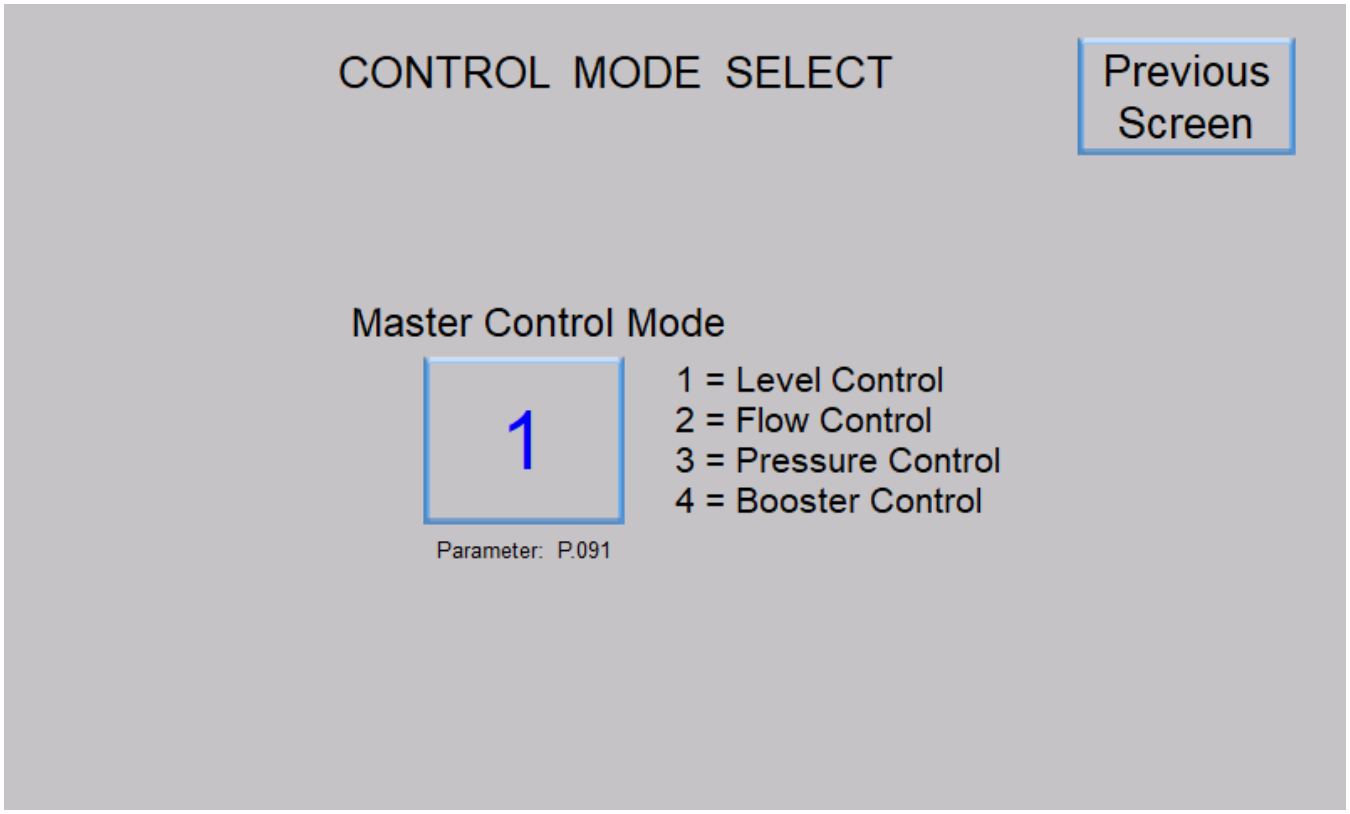


BOOSTER CONTROL - Touchscreen HMI SCREENS

Main Screen

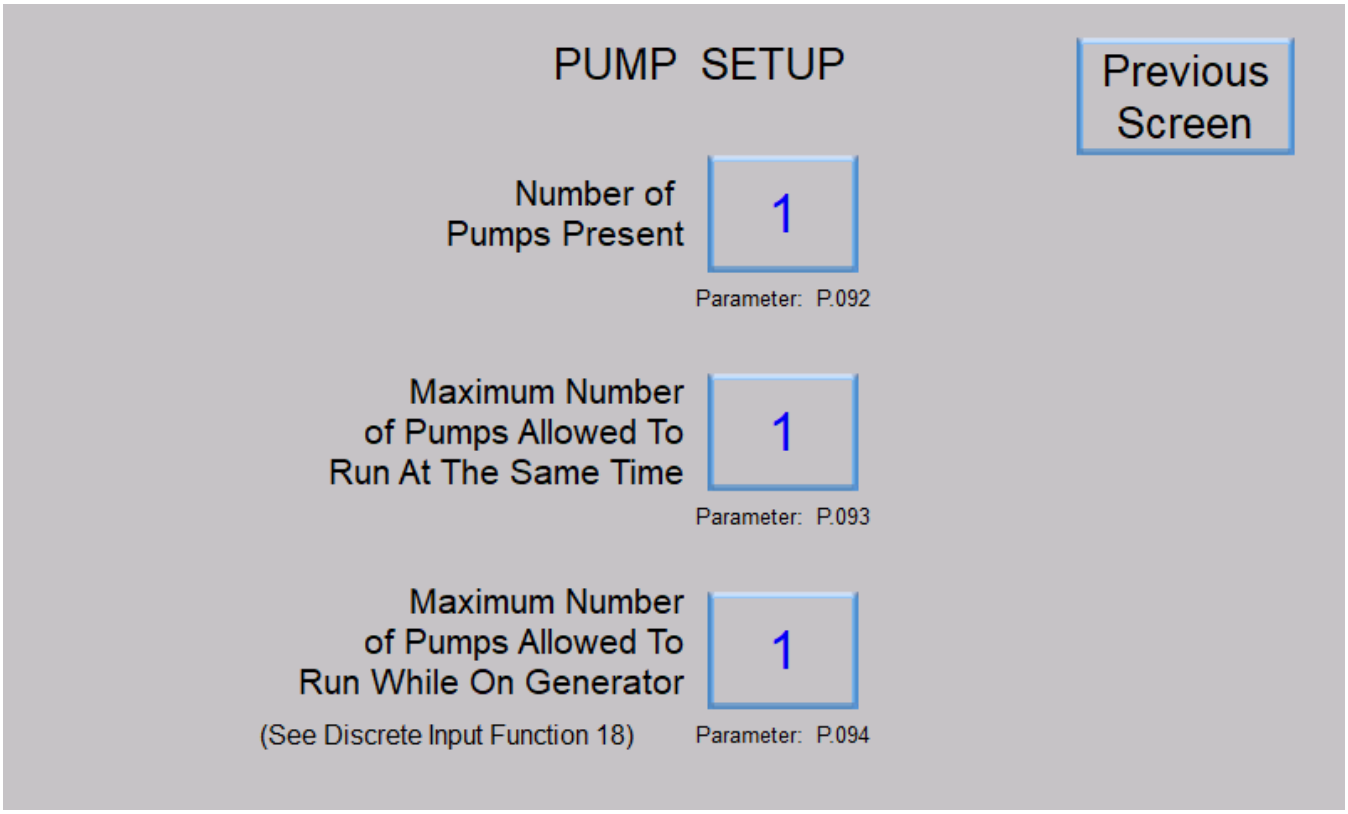


Control Mode Select

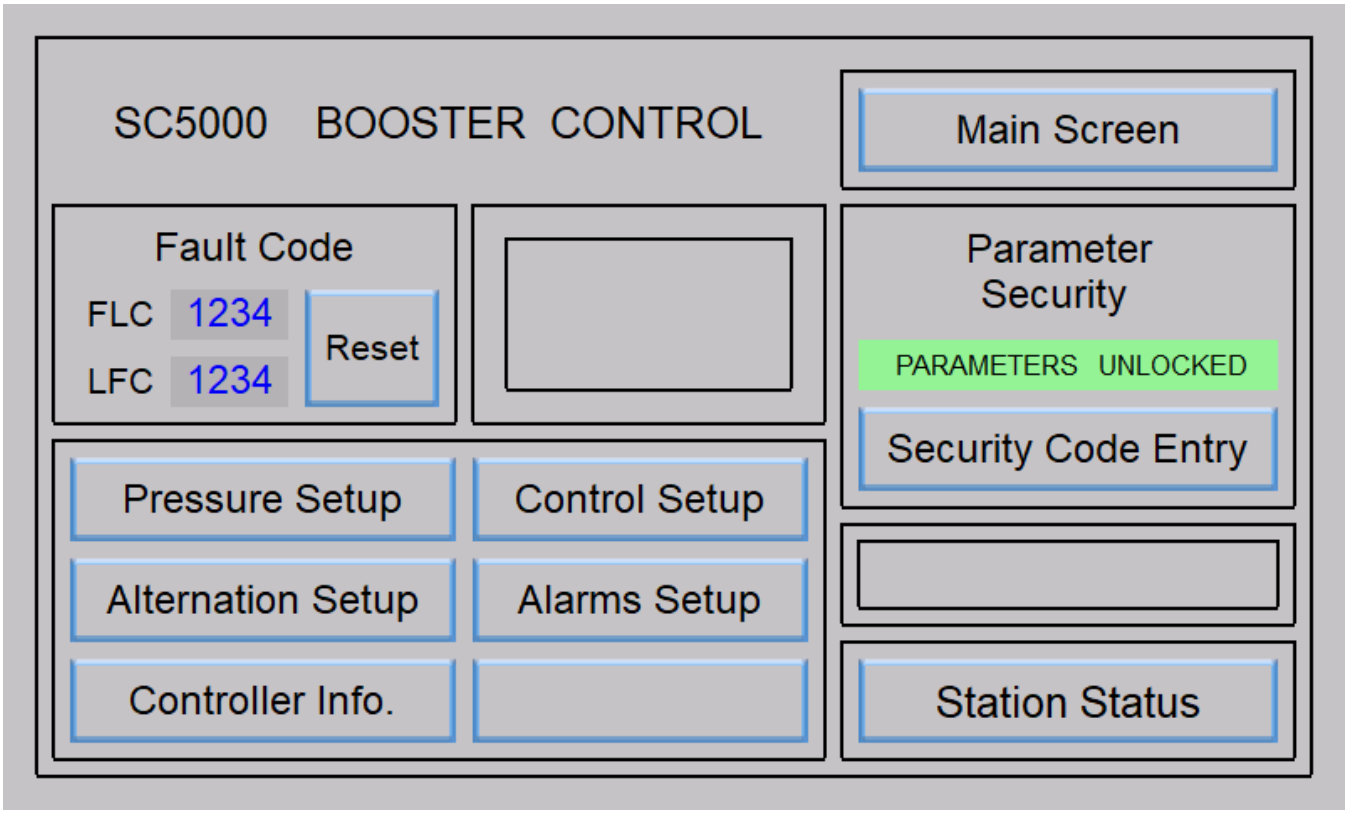


BOOSTER CONTROL - Touchscreen HMI

Pump Setup

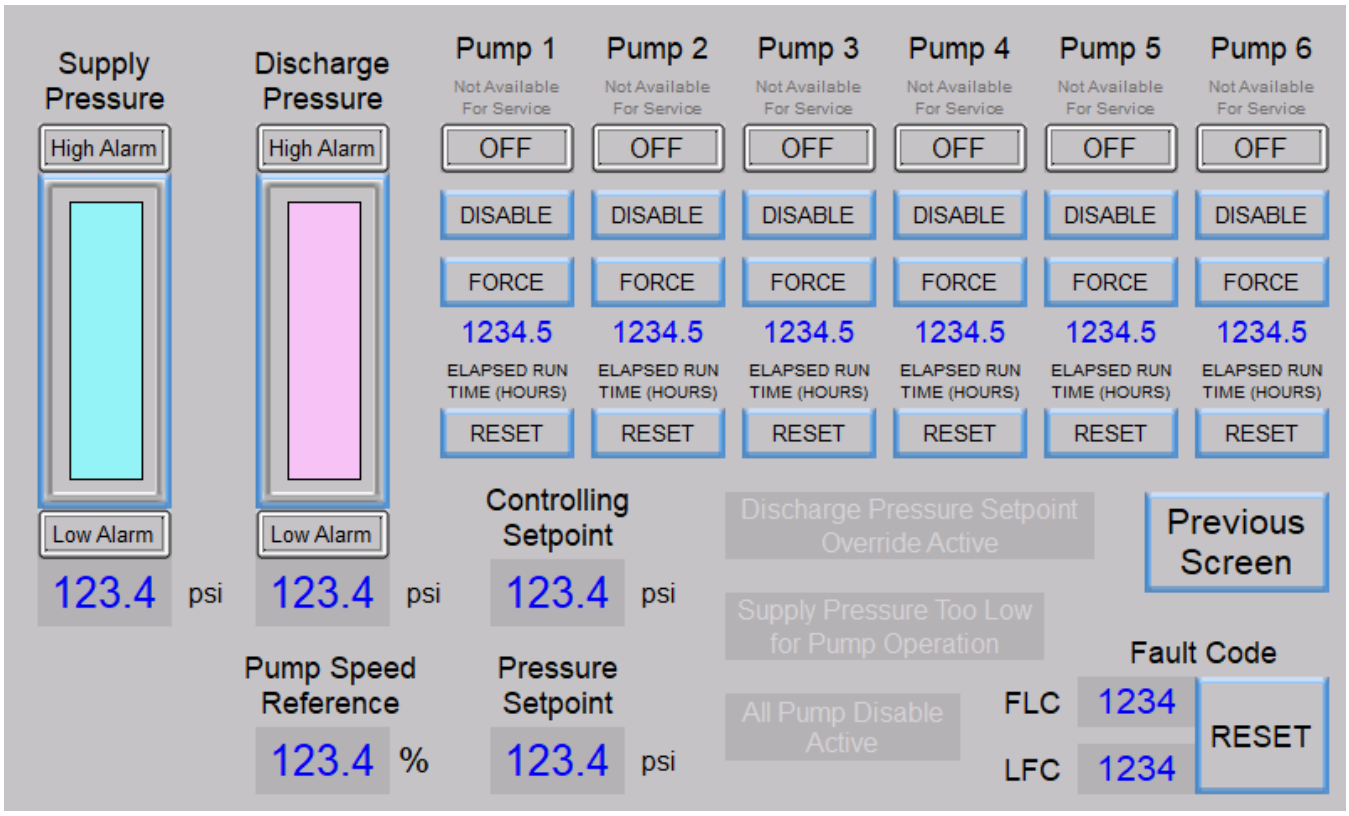


Booster Control Main Screen

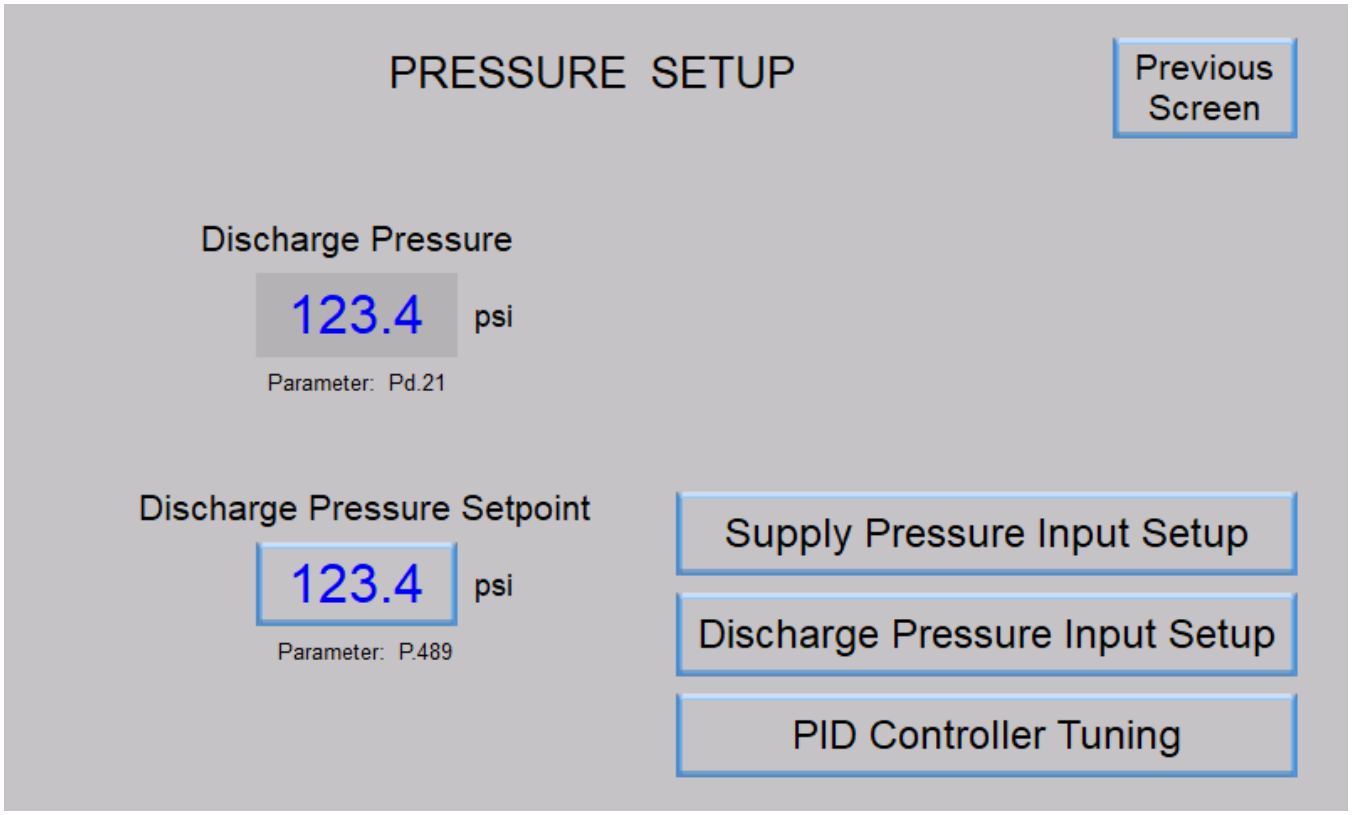


BOOSTER CONTROL - Touchscreen HMI SCREENS

Station Status

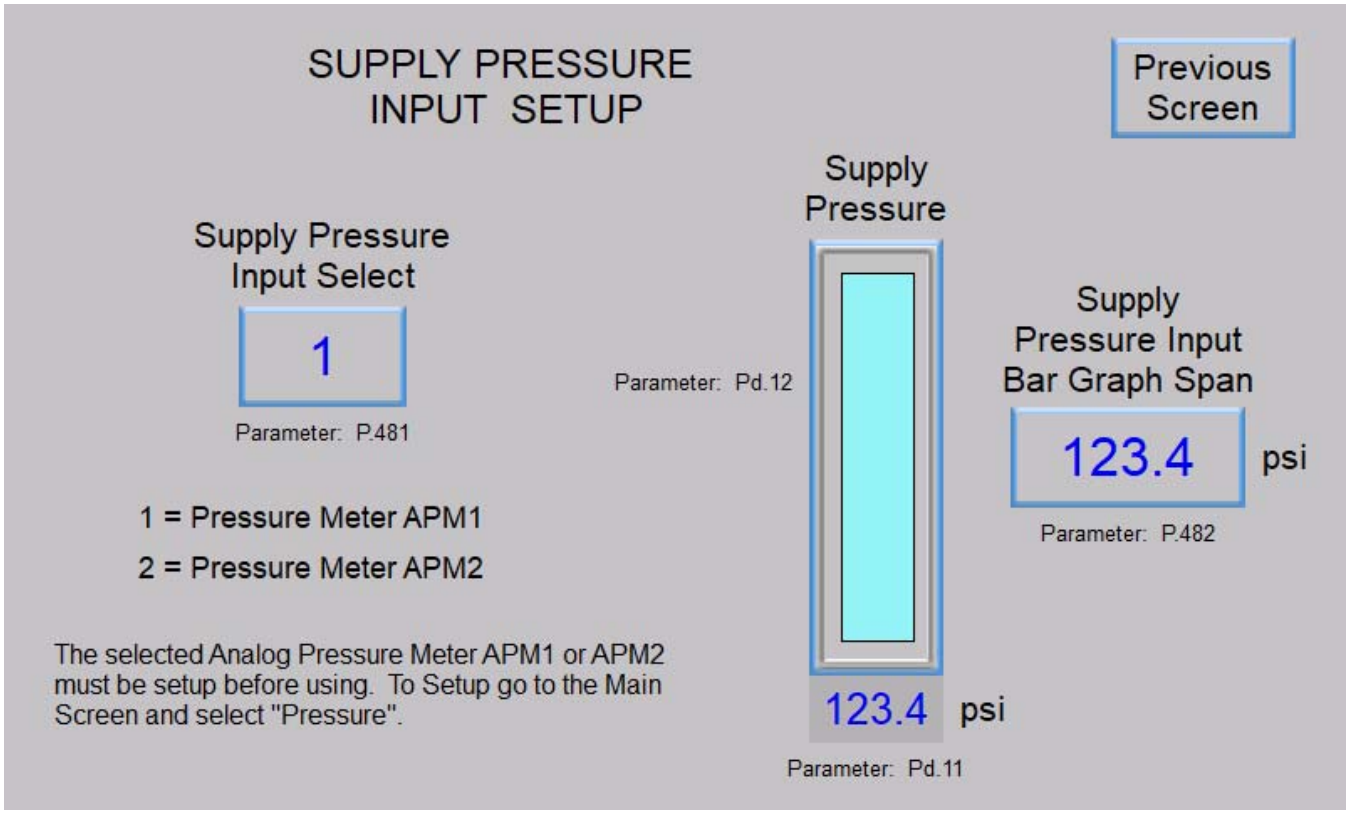


Pressure Setup

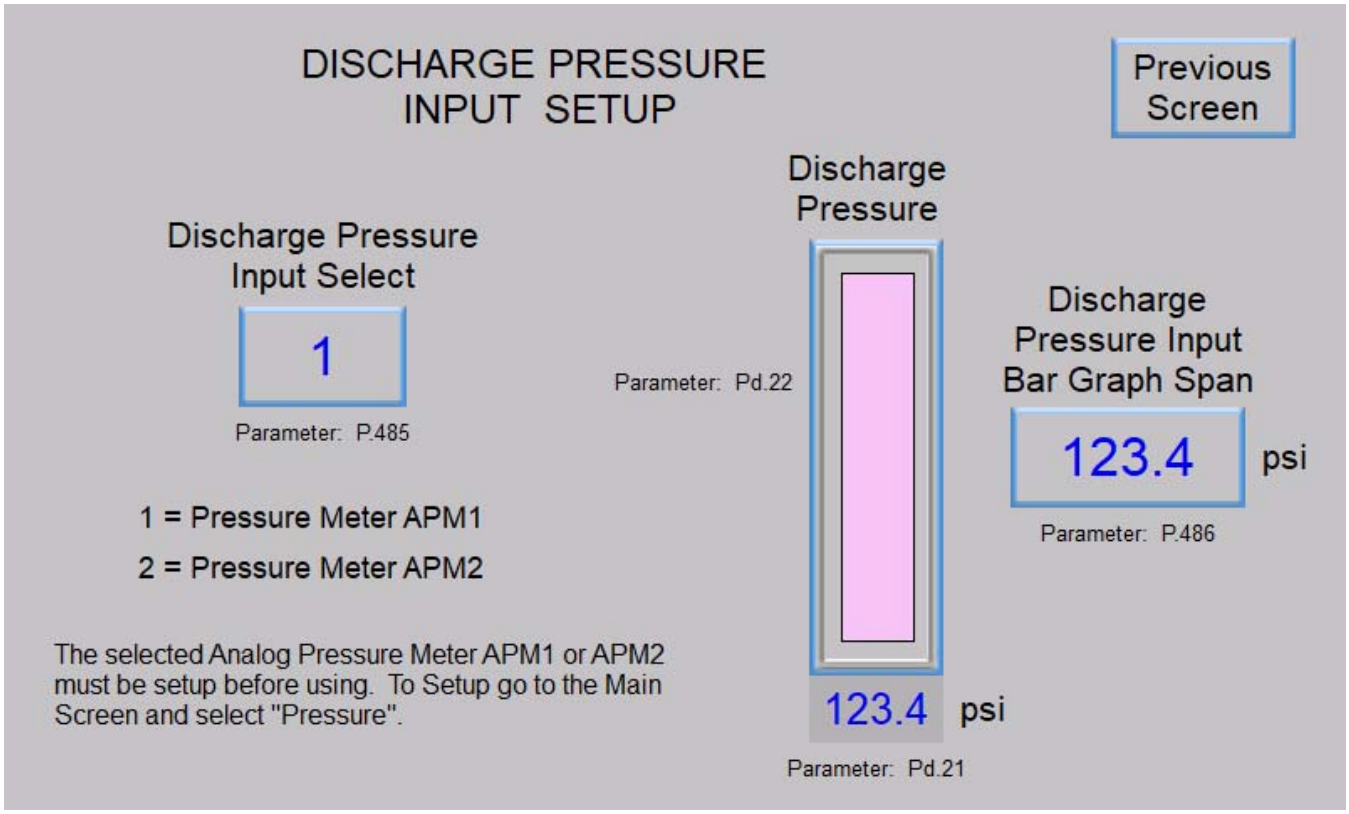


BOOSTER CONTROL - Touchscreen HMI SCREENS

Supply Pressure Input Setup

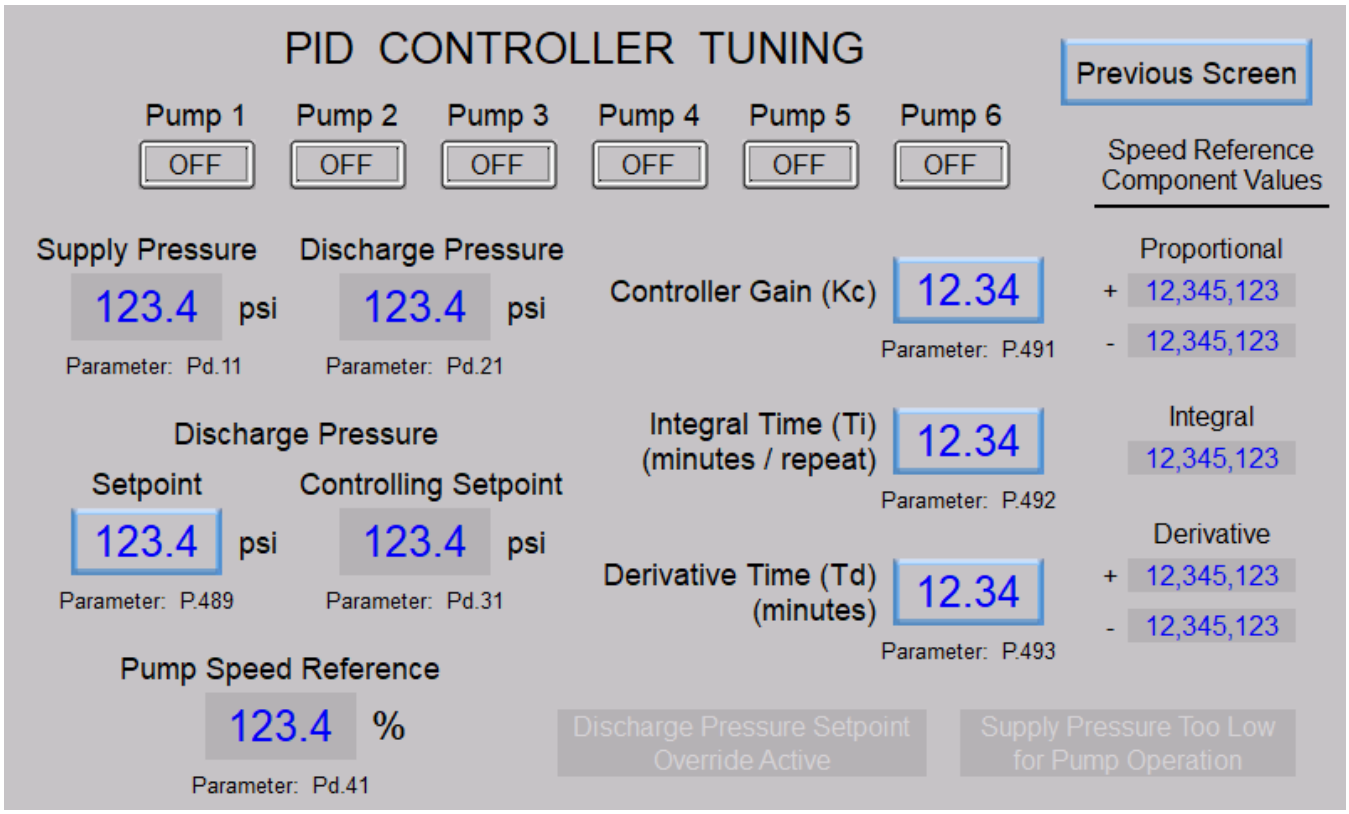


Discharge Pressure Input Setup

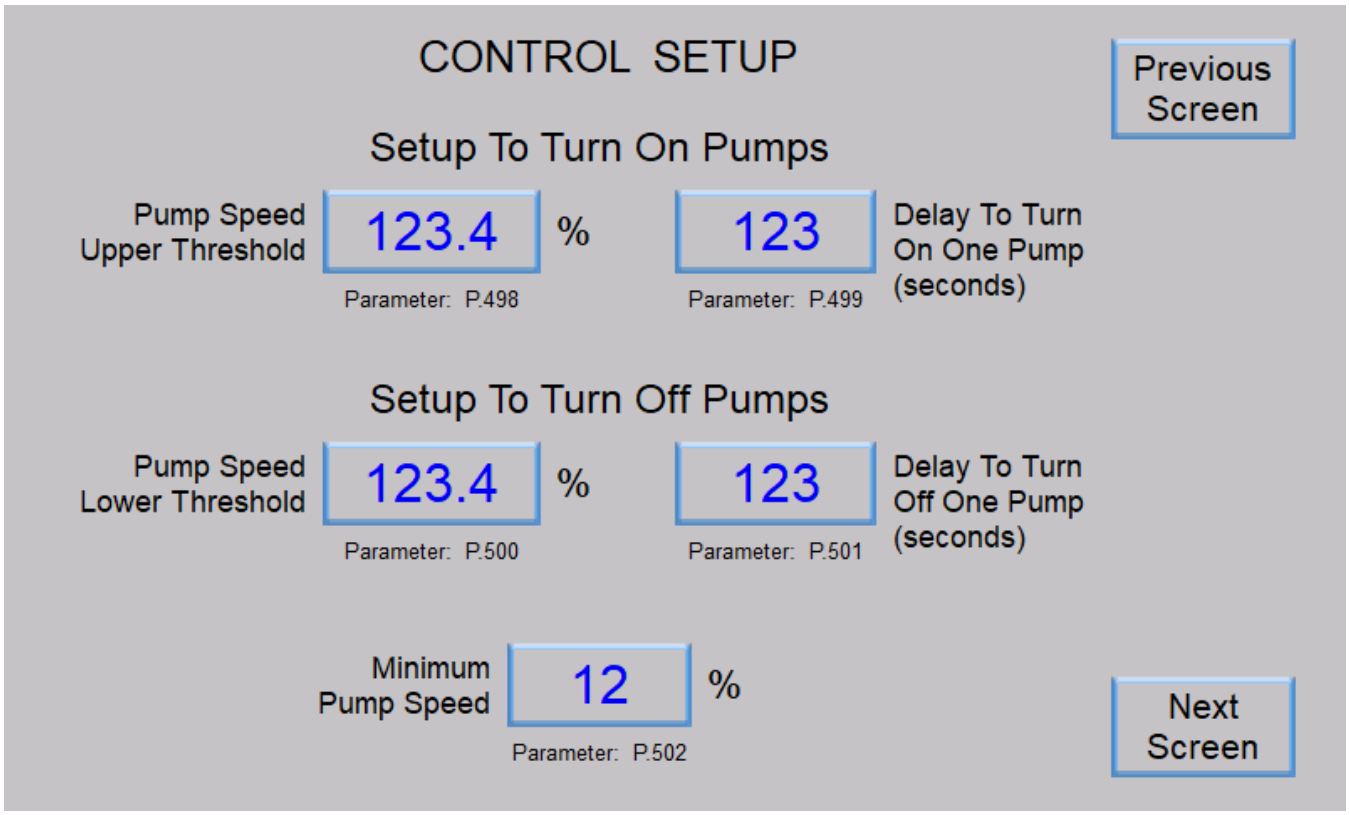


BOOSTER CONTROL - Touchscreen HMI SCREENS

PID Controller Tuning

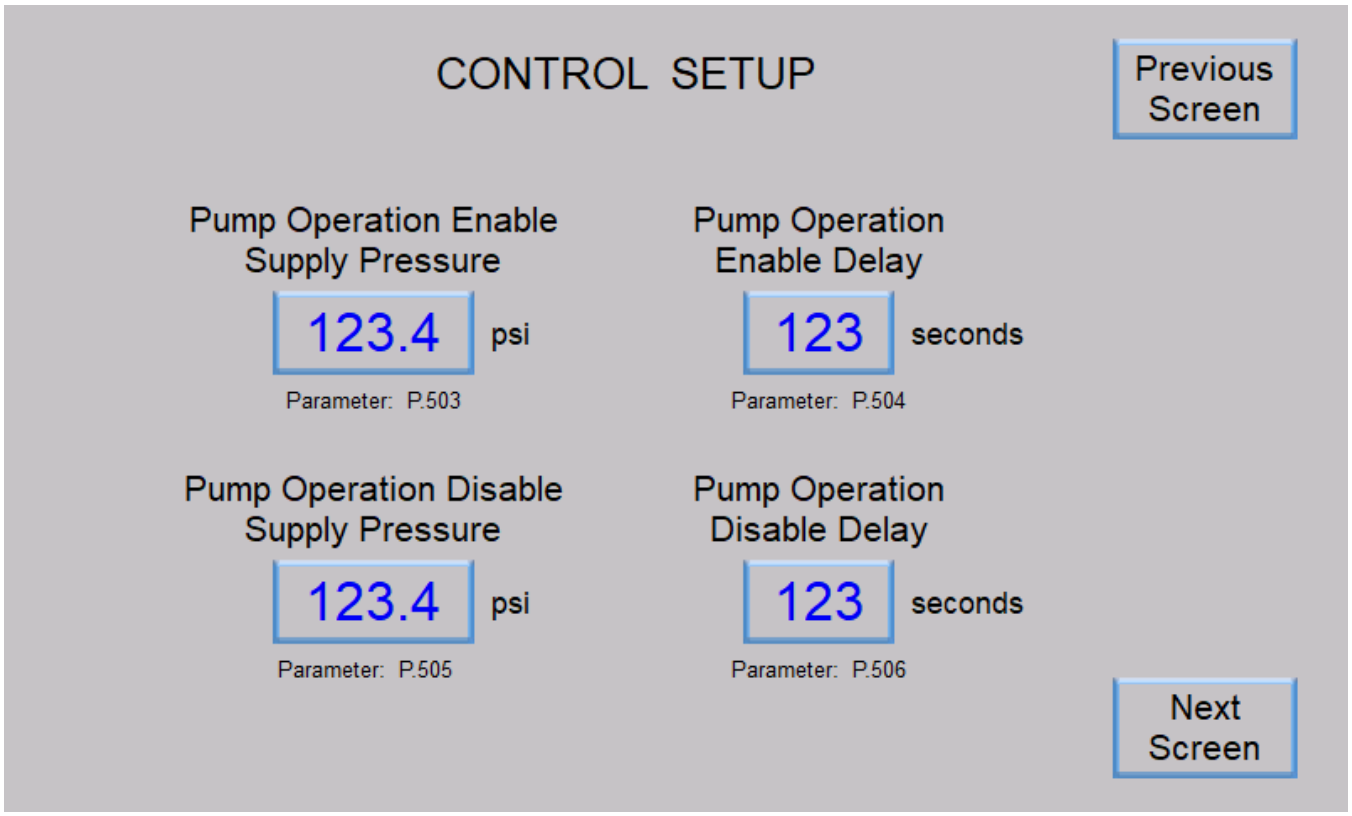


Control Setup

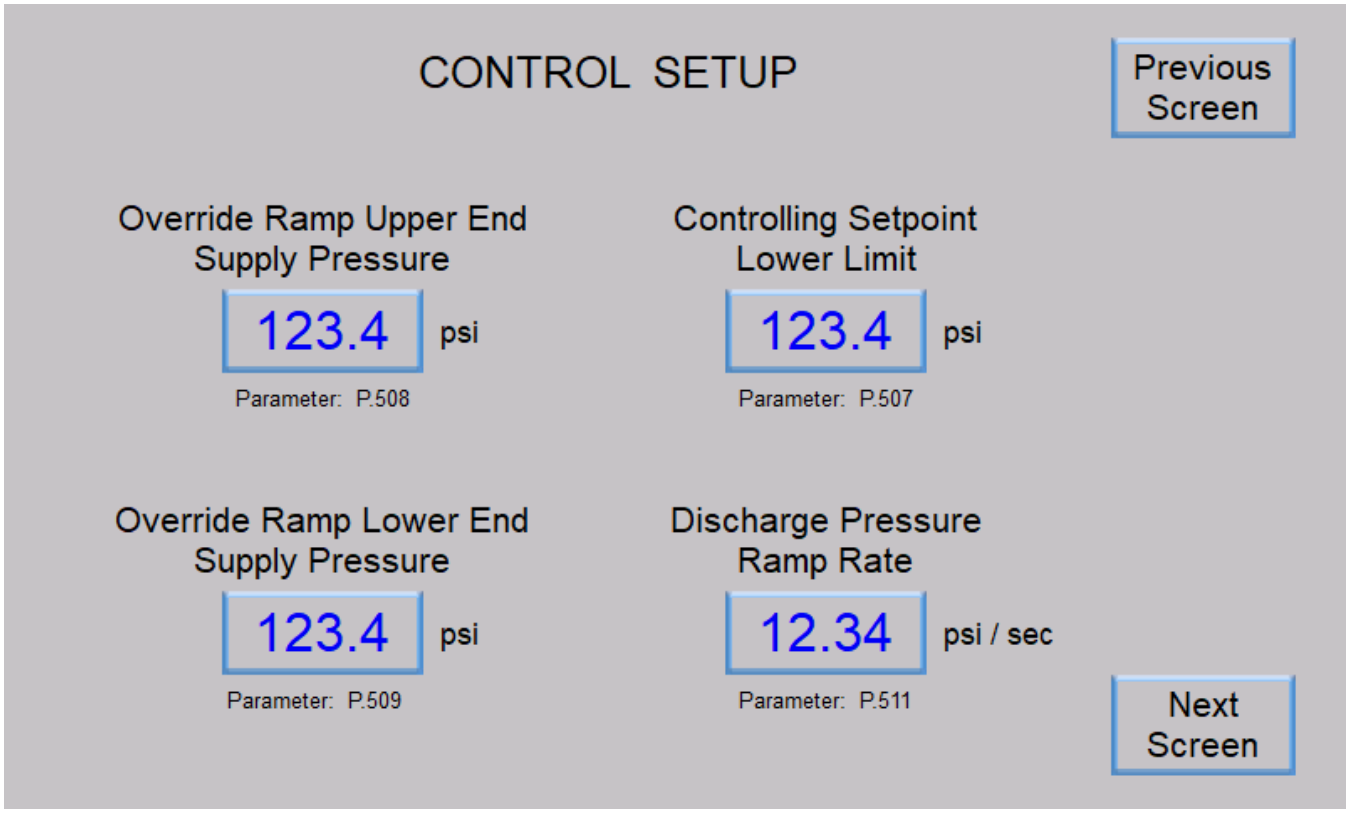


BOOSTER CONTROL - Touchscreen HMI SCREENS

Control Setup

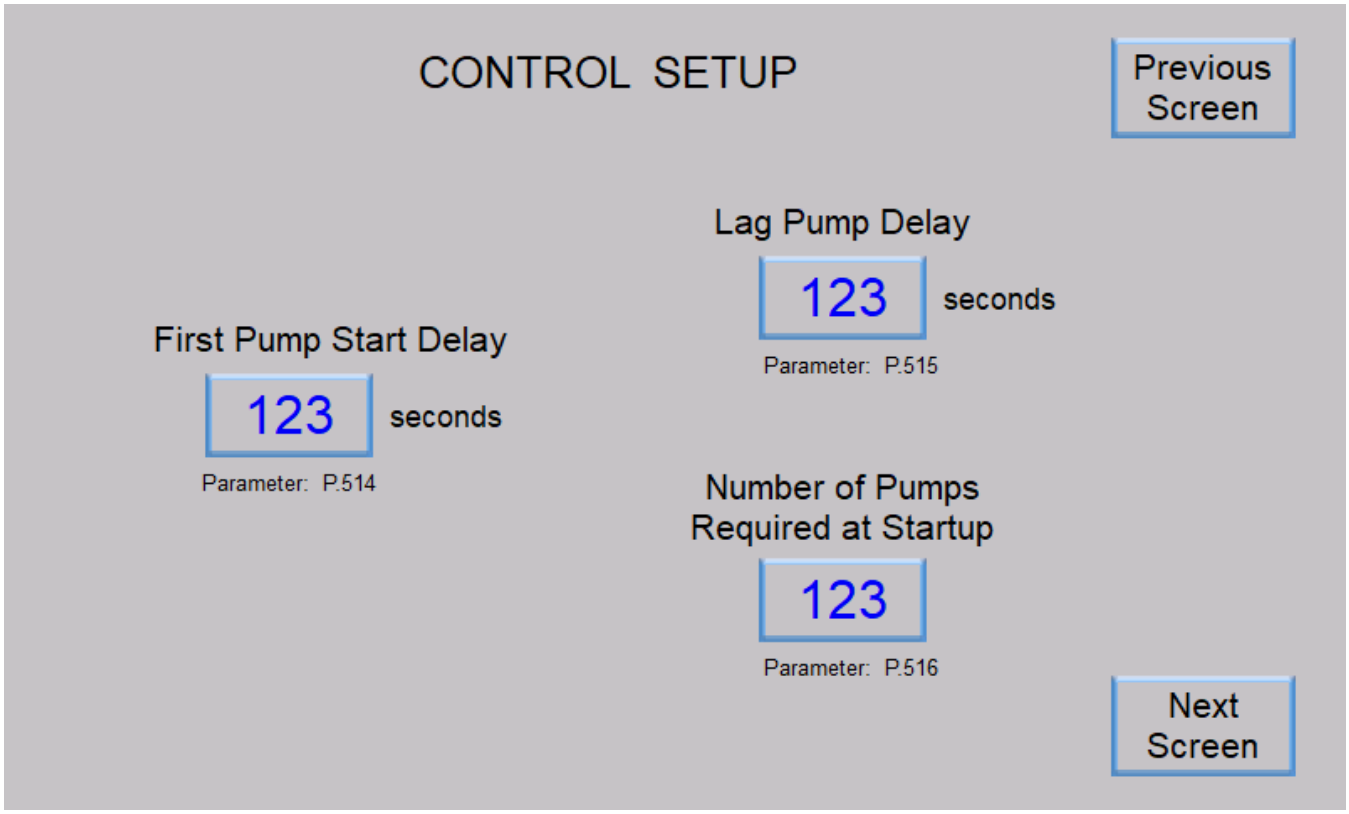


Control Setup

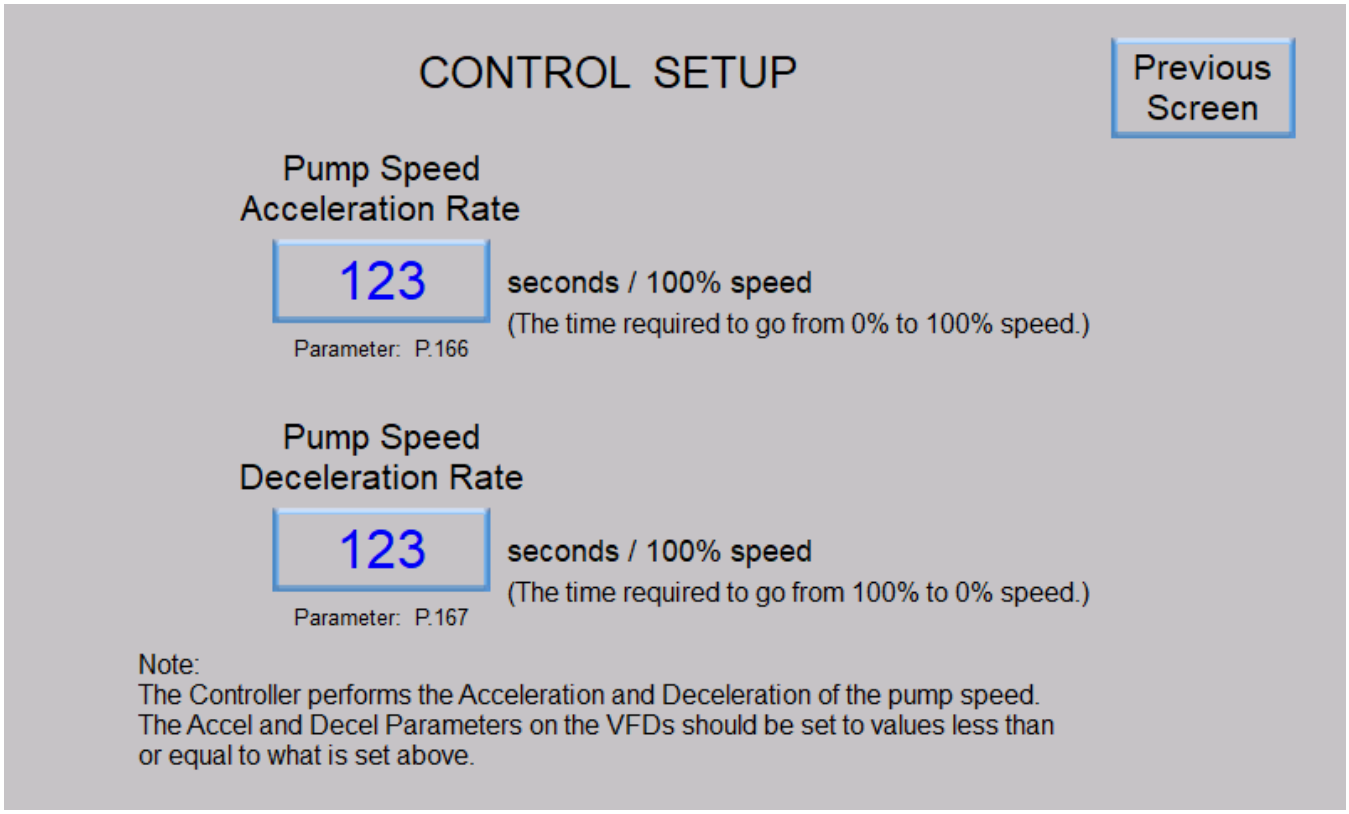


BOOSTER CONTROL - Touchscreen HMI SCREENS

Control Setup

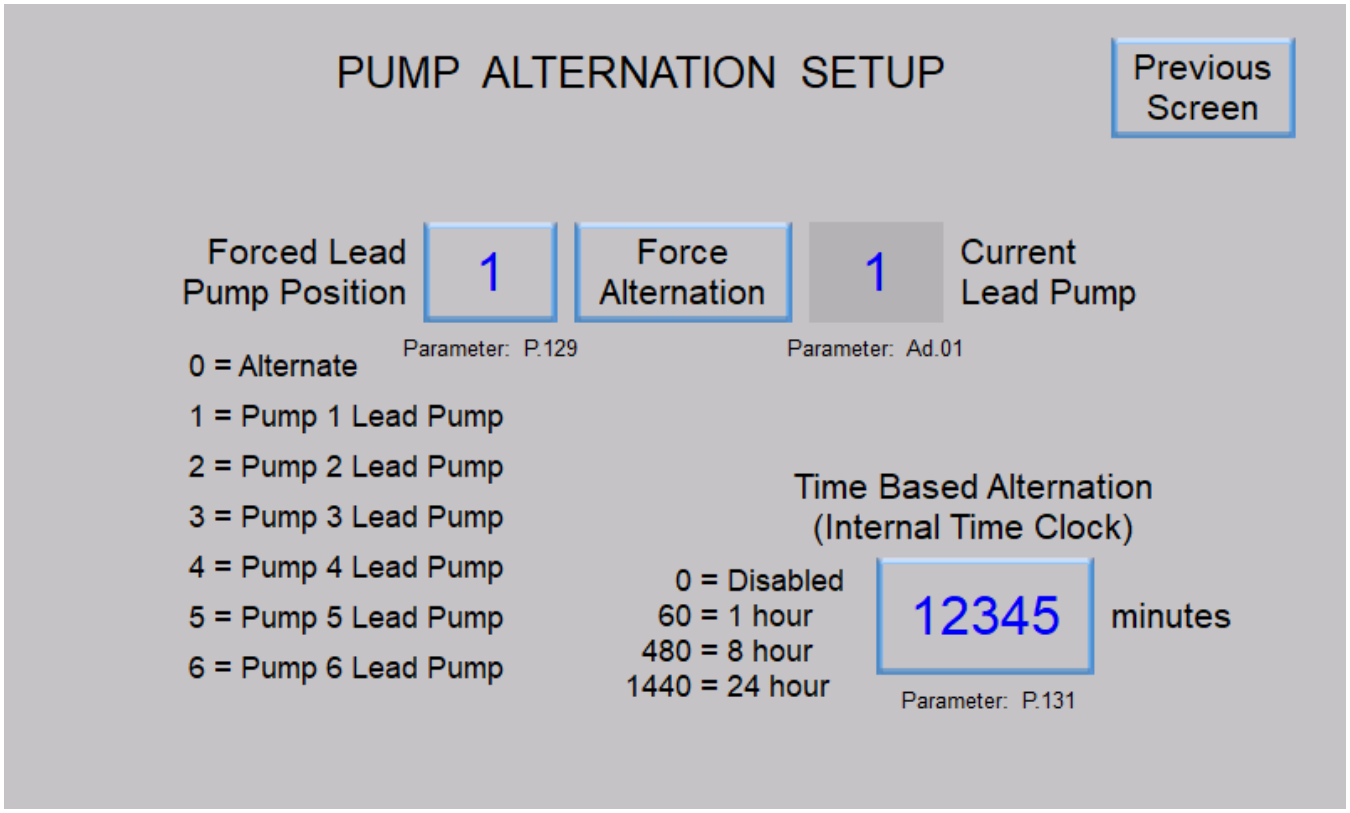


Control Setup

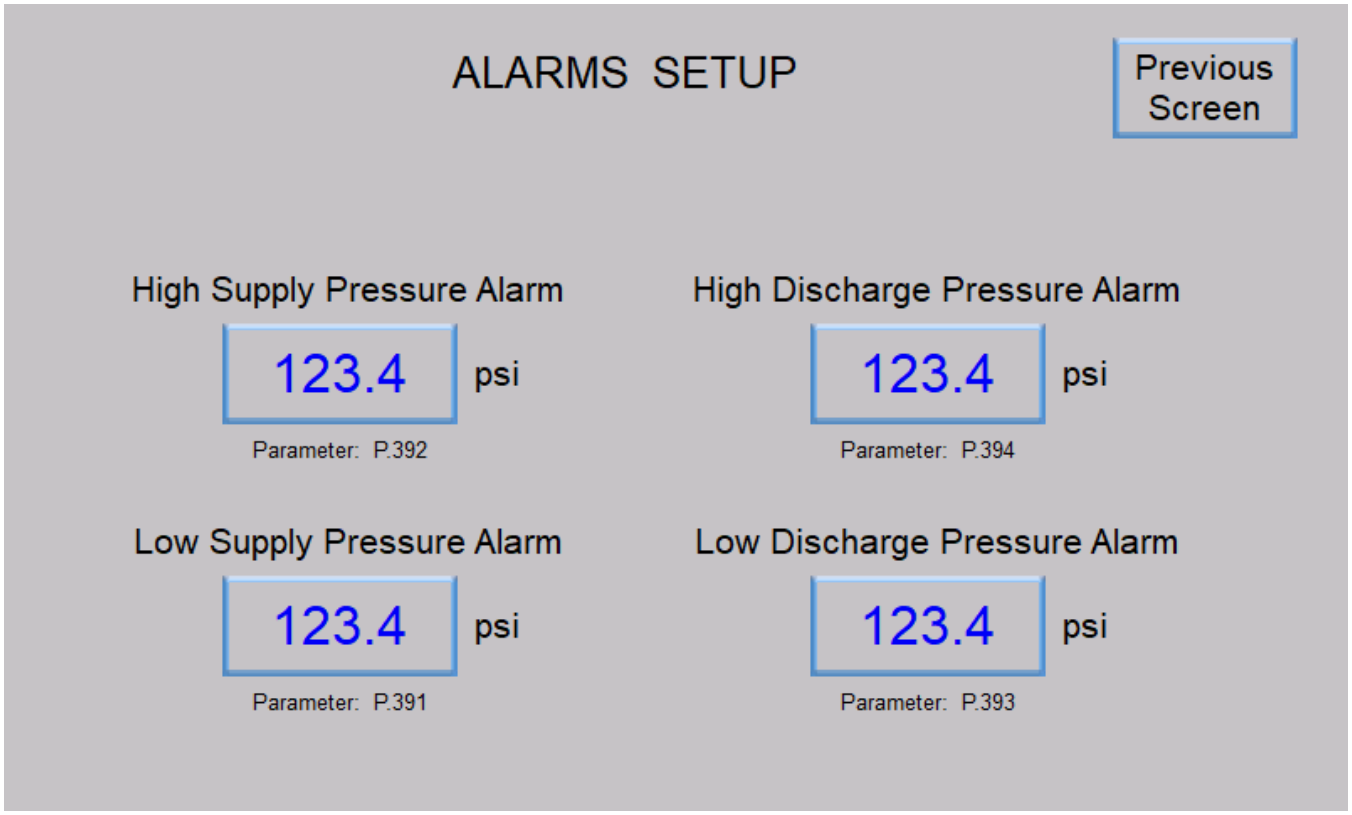


BOOSTER CONTROL - Touchscreen HMI SCREENS

Pump Alternation Setup



Alarms Setup



SECTION A
DISCRETE INPUTS

Revision Date: 12-30-22

DESCRIPTION OF OPERATION

Introduction

Discrete Inputs D1 - D30 are provided to allow for the connection of relay contacts, switch contacts or Level Probe inputs to the Controller to provide either a Control Function or to provide the input's status to SCADA or to do both. For Terminal Block numbers see page A-11.

Test Signal

Each of the Discrete Inputs send out a low voltage (+/- 6 V), low current (0.6 mA), AC (60 Hz) square wave as a Test Signal to determine the status of the input, either Open or Closed. No external power supply is required for the Discrete Inputs, they are self powered by the Test Signal which each Discrete Input sends out. The Status of the analog Test Signal for each of the Discrete Inputs may be viewed from Parameters A.101 - A.130. See page A-9.

Signal Common

The Signal Common for the Discrete Inputs is the Control Panel Ground. The Controller's Ground Terminal must be connected to the Control Panel Ground.

Operation

Relay Contacts or Switch Contacts

When a Discrete Input is used to determine the status of relay contacts or switch contacts, one side of the contacts must be connected to the Control Panel Ground and the other side of the contacts must be connected to a Discrete Input on the Controller.

If the relay contacts or switch contacts are open, then the Discrete Input's Test Signal has no path to the Control Panel Ground, and the input is considered Open.

If the relay contacts or switch contacts are closed, then the Discrete Input's Test Signal does have a path to the Control Panel Ground, and the input is considered Closed.

Level Probe

When a Discrete Input is used to determine liquid level and is connected to a Level Probe Electrode, the liquid must be grounded to the Control Panel Ground.

If the Level Probe Electrode is not touching the liquid (out of the liquid), then the Discrete Input's Test Signal has no path to Control Panel Ground, and the input is considered Open.

If the Level Probe Electrode is touching the liquid, then the Discrete Input's Test Signal does have a path to Control Panel Ground, and the input is considered Closed.

Please note that the Controller's Discrete Inputs are designed to read sewage very effectively but will not reliably read storm water or well water.

Sensitivity

The Sensitivity of the Discrete Inputs can be changed by the operator in groups of 10 inputs as shown:

Discrete Input Sensitivity: D1 - D10 Parameter F.141
Discrete Input Sensitivity: D11 - D20 Parameter F.142
Discrete Input Sensitivity: D21 - D30 Parameter F.143

The Standard Sensitivity (the default) setting is 100 which is the best setting for reading relay and switch contracts, and is also the best setting to reliably read typical sewage.

When Discrete Inputs are connected to a Level Probe, it may be necessary to increase the sensitivity. For extra sensitivity while reading light sewage, the Sensitivity Parameter of the Discrete Inputs connected to the Level Probe, can be changed to 150 or higher. See page A-8.

DESCRIPTION OF OPERATION

Determining Status

To determine the status of the Discrete Inputs the Test Signal sent out by each Discrete Input is measured and its analog value is compared to the setting of the respective Sensitivity Parameter (F.141, F.142 or F.143, See page A-8).

If the Test Signal is lower than the Sensitivity setting then the Discrete Input is considered Closed or “1”.

If the Test Signal is higher than the Sensitivity setting then the Discrete Input is considered Open or “0”.

The following show the normal range of the Test Signal values of Discrete Inputs connected to relay or switch contacts or to Level Probe Electrodes in typical sewage:

Test Signal of Open Discrete Input: 240 - 255. Test Signal of Closed Discrete Input: 55 - 70.

Status

The status of the Discrete Input Test Signals are available from Parameters A.101 - A.130. See page A-9.

The status of the Discrete Inputs as a discrete value (“0” or “1”) may be read by SCADA from Modbus Coils 1 - 30 (Register 40001 Bits 0 - 15 and Register 40002 Bits 0 - 13). See page A-10.

For Discrete Input Status on the SC5000-CTS-HMI see HMI screens on pages A-14 & A-15.
For Discrete Input Status on the SC5000-LED-HMI see Parameters n.01 - n.30 on page X-19.

Functions

The Discrete Inputs are assigned default Functions from the factory, but they may be changed by the operator using Parameters F.101 - F.130. If no Function is desired then the respective Parameter must be set for Function “0”.

While each of the Discrete Inputs may be assigned to perform a Function, if a Function is assigned to more than one input, the Fault indicator will come on and Fault Code 1018 will be generated. Function “0” is the exception to this rule. Any or all of the Discrete Inputs may be assigned Function “0”.

See page A-7 and see “DISCRETE INPUT FUNCTIONS” below for a description of each of the Functions.

DISCRETE INPUT FUNCTIONS

Collect Discrete Data for SCADA - Function 0

All of the Discrete Inputs collect data for SCADA, regardless of the Function assigned to them, but when a Discrete Input is assigned the Function of “Collect Discrete Data for SCADA” (Function 0) no other action (no Control Function) is performed by the Controller.

The status of all the Discrete Inputs may be read from Modbus Coils 1 - 30 (Register 40001 Bits 0 - 15 and Register 40002 Bits 0 - 13).

Level Probe Electrode 1 (2, 3, 4, 5, 6, 7, 8, 9, 10) - Functions 1 - 10

In the Level Control Mode only (Parameter P.091 = 1), the “Level Probe Electrodes 1 (2, 3, 4, 5, 6, 7, 8, 9, 10)” provide the liquid level status to a feature of the Controller called the “Level Probe Meter LPM1”.

To be used by the Controller to perform Level Control, the “Level Probe Meter LPM1” must be selected as the Level Input, by setting the “Level Input Select” parameter to “Level Probe Meter - LPM1” (Parameter P.133 = 5).

The “Level Probe Meter LPM1” requires connection to a Level Probe (having 10 Electrodes) using 10 Discrete Inputs assigned the Functions of “Level Probe Input - Electrode 1 - 10” (Functions 1 - 10).

The “Level Probe Meter LPM1” must be enabled and the Electrode Spacing must be established.

See Section L and page 1-26.

Pump 1 (2, 3, 4, 5, 6) Disable - Functions 11 - 16

When a Discrete Input assigned the Function of “Pump 1 (2, 3, 4, 5, 6) Disable” (Functions 11 - 16) is closed, the logic in the Controller considers the pump Disabled or not available for service and will not call the pump to run.

When a pump is Disabled the logic in the Controller will skip it in the pump call sequence and call the next available pump in its place.

With the Discrete Input Pump Disable Mode (Parameter F.145) set on “1” the Pump Disable Functions act to disable the respective pump when the Discrete Input is open rather than closed. See page A-8.

Discrete Inputs assigned Functions 11 - 16 are typically connected to pump fault contacts or pump out of service contacts such as contacts on an HOA switch that closes in the Off and Hand position. Pump fault contacts and pump out of service contacts may also be combined.

DISCRETE INPUT FUNCTIONS

All Pump Disable - Function 17

When the Discrete Input assigned the Function of “All Pump Disable” (Function 17) is closed, all pump operation will be disabled (not allowed to run), and Fault Code 1031 will be generated.

When the “All Pump Disable” Discrete Input opens, a 10 second Start Up Delay must first expire before the Controller will enable any pump operation. If a pump is turned on after the Start Up Delay, the Lag Pump Delay (Parameter P.150) must first expire before another pump is called to run, and before each additional pump is called to run.

A Discrete Input assigned Function 17 is typically connected to Phase Monitor contacts that are closed during a fault condition.

On Generator - Function 18

In cases where the Emergency Generator is not sized large enough to run all the available pumps, closing a Discrete Input assigned the Function of “On Generator” (Function 18) will limit the number of pumps called to run to the “Maximum Number of Pumps Allowed to Run While On Generator” (Parameter P.094).

A Discrete Input assigned Function 18 must be connected to contacts from the Generator Transfer Switch that close when on emergency power.

Toggle Between ALM1 & ALM2 for Level Input - Function 19

The Controller has available two Analog Level Meters ALM1 and ALM2 that may be setup and used to provide a Level Input to the Controller’s Control Logic. Each of the Level Meters must have their own Analog Level Input, typically from two Pressure Transducers. However, the Level Control Logic can only use one Level Input at a time.

A Discrete Input assigned the Function of “Toggle Between ALM1 & ALM2 for Level Input” (Function 19) may be used to manually toggle from ALM1 to ALM2 or from ALM2 to ALM1.

The setting on the “Level Input Select” (Parameter P.133) will determine the following operation:

Level Input Select = 1 - Manually switches from ALM1 to ALM2 when Discrete Input closes.
Level Input Select = 2 - Manually switches from ALM2 to ALM1 when Discrete Input closes.

A Discrete Input assigned Function 19 is typically connected to contacts from a selector switch, or from relay logic. See Section M.

Start Flush Cycle - Function 20

In the Level Control Mode only (Parameter P.091 = 1), when a Discrete Input assigned the Function of “Start Flush Cycle” (Function 20) is closed the Flush Cycle will start.

A Discrete Input assigned Function 20 is typically connected to output contacts from an External Time Clock. See page 1-17.

External Alternation - Group 1 - Function 21

Each time the Discrete Input assigned the Function of “External Alternation - Group 1“ (Function 21) transitions from open to closed, alternation of the pumps in Group 1 will occur. If no pumps were running when the Discrete Input is closed, the alternation of the designated lead pump will still occur.

A Discrete Input assigned Function 21 is typically connected to output contacts from an External Time Clock.

External Alternation - Group 2 - Function 22

In the Level Control Mode only (Parameter P.091 = 1), each time the Discrete Input assigned the Function of “External Alternation - Group 2“ (Function 22) transitions from open to closed, alternation of the pumps in Group 2 will occur. If no pumps were running when the Discrete Input is closed, the alternation of the designated lead pump will still occur.

A Discrete Input assigned Function 22 is typically connected to output contacts from an External Time Clock.

Sequence Input 1 (2, 3, 4, 5, 6) - Functions 31 - 36

When a Discrete Input assigned the Function of “Sequence Input 1 (2, 3, 4, 5, 6)” (Functions 31 - 36) is closed, the order that the pumps are called to run is fixed so that the selected pump is always the lead pump in the Group or Groups. Where the “Alternation Sequence Mode” (Parameter P.122) establishes the grouping of pumps into either one or two groups. See page A-12 & A-13.

Discrete Inputs assigned Functions 31 - 36 must be connected to contacts on either one or two lead selector switches.

DISCRETE INPUT FUNCTIONS

Call Pump 1 (2, 3, 4, 5, 6) Last - Functions 41 - 46

When a Discrete Input assigned the Function of “Call Pump 1 (2, 3, 4, 5, 6) Last” (Functions 41 - 46) is closed, it assigns the respective pump to standby status, where it will always be called to run last in its Group.

If more than one (but not all) of the pumps are assigned to standby status, they will be available to run if needed, but always after the pumps not assigned to standby status.

If all the pumps are assigned to standby status, then alternation will occur normally, as though none of them were assigned to standby status.

Discrete Inputs assigned Functions 41 - 46 are typically connected to relay logic contacts that close when it is imperative that the respective pump only run if necessary.

Flow Calculator - Start New Day - Function 47

In the Level Control Mode only (Parameter P.091 = 1), the Flow Calculator Mode (Parameter P.175) set for “External Time Clock”, the Flow Calculator logic will not issue the “Start New Day” command, it must be initiated externally once each day by an External Time Clock connected to a Discrete Input assigned Function 47.

A Discrete Input assigned the Function of “Flow Calculator - Start New Day” (Function 47) is typically connected to output contacts from an External Time Clock that is programmed to close its output contacts once every 24 hours. See page 1-18.

Pump Cutoff - Low-Low Level (Pump Down Mode) - Function 59

When a Discrete Input assigned the Function of “Pump Cutoff - Low-Low Level“ (Function 59) is closed, the Low Level Alarm will be activated, pump operation will be disabled and Fault Code 1041 will be generated.

This feature will only operate in the Pump Down Mode (Parameter P.149 = 1).

Pump operation will not be re-enabled until the Low-Low Level input opens and the Pump Re-enable Delay - Pump Cutoff Low-Low Level (Parameter P.153) expires.

If an Output Relay (ROX1 - ROX12) is assigned Function 7, then the Output Relay’s contacts will be closed.

The status of the Low Level Alarm may be read from Modbus Coil 47 (Register 40003 Bit 14).

The status of the “Pump Cutoff Active Low-Low Level” may be read from Modbus Coil 131 (Register 40009 Bit 2).

A Discrete Input assigned Function 59 is typically connected to a Float Switch that closes upon a Low-Low Level condition.

Pump Cutoff - High-High Level (Pump Up Mode) - Function 60

In the Level Control Mode only (Parameter P.091 = 1), when a Discrete Input assigned the Function of “Pump Cutoff - High-High Level“ (Function 60) is closed, the High Level Alarm will be activated, pump operation will be disabled and Fault Code 1042 will be generated.

This feature will only operate in the Pump Up Mode (Parameter P.149 = 2). See page 1-9.

Pump operation will not be re-enabled until the High-High Level input opens and the Pump Re-enable Delay - Pump Cutoff High-High Level (Parameter P.154) expires. See page 1-9.

If an Output Relay (ROX1 - ROX12) is assigned Function 8, then the Output Relay’s contacts will be closed.

The status of the High Level Alarm may be read from Modbus Coil 48 (Register 40003 Bit 15).

The status of the “Pump Cutoff Active High-High Level” may be read from Modbus Coil 132 (Register 40009 Bit 3).

A Discrete Input assigned Function 60 is typically connected to a Float Switch that closes upon a High-High Level condition.

DISCRETE INPUT FUNCTIONS

Low Level Alarm Only - Function 61

When a Discrete Input assigned the Function of “Low Level Alarm Only“ (Function 61) is closed, the Low Level Alarm will be activated but pump operation will not be disabled. Also see Function 59.

If an Output Relay (ROX1 - ROX12) is assigned Function 7 then the Output Relay’s contacts will be closed.

The status of the Low Level Alarm may be read from Modbus Coil 47 (Register 40003 Bit 14).

A Discrete Input assigned Function 61 is typically connected to a Float Switch that closes upon a Low Level condition.

High Level Alarm Only - Function 62

When a Discrete Input assigned the Function of “High Level Alarm Only“ (Function 62) is closed, the High Level Alarm will be activated. Also see Function 60.

If an Output Relay (ROX1 - ROX12) is assigned Function 8, then the Output Relay’s contacts will be closed.

The status of the High Level Alarm may be read from Modbus Coil 48 (Register 40003 Bit 15).

A Discrete Input assigned Function 62 is typically connected to a Float Switch that closes upon a High Level condition.

Float Control - Off Level - Function 63

In the Level Control Mode only (Parameter P.091 = 1), when a Discrete Input assigned the Function of “Float Control - Off Level“ (Function 63) closes, the Float Control logic will arm itself and be ready to latch in one pump call for each of the “Float Control - 1st , 2nd, 3rd, 4th, 5th, 6th On Level“ inputs that close.

As the “Float Control - 1st , 2nd, 3rd, 4th, 5th, 6th On Level“ inputs open, the pump calls remain latched until the Off Level input also opens, then the latch is broken on all the pump calls, and the pumps are turned off.

A Discrete Input assigned Function 63 is typically connected to a Float Switch that closes as the liquid level arrives at the Off Level.

For Float Control examples see pages 1-27 & 1-28. For Float Backup examples see pages 1-29 & 1-30.

Float Control - 1ST On Level - Function 64

In the Level Control Mode only (Parameter P.091 = 1), when a Discrete Input assigned the Function of “Float Control - 1ST On Level“ (Function 64) closes, the Float Control logic will issue one pump call.

A Discrete Input assigned Function 64 is typically connected to a Float Switch that closes as the liquid level arrives at the 1ST On Level.

For Float Control examples see pages 1-27 & 1-28. For Float Backup examples see pages 1-29 & 1-30.

Float Control - 2ND On Level - Function 65

In the Level Control Mode only (Parameter P.091 = 1), when a Discrete Input assigned the Function of “Float Control - 2ND On Level“ (Function 65) closes, the Float Control logic will issue one pump call.

A Discrete Input assigned Function 65 is typically connected to a Float Switch that closes as the liquid level arrives at the 2ND On Level.

For Float Control examples see pages 1-27 & 1-28. For Float Backup examples see pages 1-29 & 1-30.

Float Control - 3RD On Level - Function 66

In the Level Control Mode only (Parameter P.091 = 1), when a Discrete Input assigned the Function of “Float Control - 3RD On Level“ (Function 66) closes, the Float Control logic will issue one pump call.

A Discrete Input assigned Function 66 is typically connected to a Float Switch that closes as the liquid level arrives at the 3RD On Level.

For Float Control examples see pages 1-27 & 1-28. For Float Backup examples see pages 1-29 & 1-30.

Float Control - 4TH On Level - Function 67

In the Level Control Mode only (Parameter P.091 = 1), when a Discrete Input assigned the Function of “Float Control - 4TH On Level“ (Function 67) closes, the Float Control logic will issue one pump call.

A Discrete Input assigned Function 67 is typically connected to a Float Switch that closes as the liquid level arrives at the 4TH On Level.

For Float Control examples see pages 1-27 & 1-28. For Float Backup examples see pages 1-29 & 1-30.

DISCRETE INPUT FUNCTIONS

Float Control - 5TH On Level - Function 68

In the Level Control Mode only (Parameter P.091 = 1), when a Discrete Input assigned the Function of “Float Control - 5TH On Level“ (Function 68) closes, the Float Control logic will issue one pump call.

A Discrete Input assigned Function 68 is typically connected to a Float Switch that closes as the liquid level arrives at the 5TH On Level.

For Float Control examples see pages 1-27 & 1-28. For Float Backup examples see pages 1-29 & 1-30.

Float Control - 6TH On Level - Function 69

In the Level Control Mode only (Parameter P.091 = 1), when a Discrete Input assigned the Function of “Float Control - 6TH On Level“ (Function 69) closes, the Float Control logic will issue one pump call.

A Discrete Input assigned Function 69 is typically connected to a Float Switch that closes as the liquid level arrives at the 6TH On Level.

For Float Control examples see pages 1-27 & 1-28. For Float Backup examples see pages 1-29 & 1-30.

Float Control - High Level (Pump Down Mode) - Function 70

In the Level Control Mode only (Parameter P.091 = 1), when a Discrete Input assigned the Function of “Float Control - High Level (Pump Down Mode)” (Function 70) is closed, the High Level Alarm will be activated.

Function 70 may only be used in the “Pump Down Mode”, not when in the “Pump Up Mode”.

If the “Float Control - Off Level“ (Function 63) input is closed, closure of the “Float Control - High Level” (Function 70) will cause the Float Control logic to issue a pump call to run for all available pumps, with a Lag Pump Delay between each pump call.

To form a two float backup system, the “Float Backup - 1st , 2nd, 3rd, 4th, 5th, 6th On Level“ inputs may be replaced with the High Level input assigned Function 70. The two float backup system also requires the use of a “Float Control - Off Level“ (Function 63).

If an Output Relay (ROX1 - ROX12) is assigned Function 8, then the Output Relay’s contacts will be closed.

The status of the High Level Alarm may be read from Modbus Coil 48 (Register 40003 Bit 15).

A Discrete Input assigned Function 70 is typically connected to a Float Switch that closes upon a High Level condition.

For Float Control example see page 1-27.

DISCRETE INPUT SETUP

User / Operator Info.			SCADA	Description of Parameters and SCADA Notes
Parameter	Default Value	Current Value	Register Address	

Discrete Input Setup

Setup				Discrete Input
F.101	1		40601	Discrete Input - D1
F.102	2		40602	Discrete Input - D2
F.103	3		40603	Discrete Input - D3
F.104	4		40604	Discrete Input - D4
F.105	5		40605	Discrete Input - D5
F.106	6		40606	Discrete Input - D6
F.107	7		40607	Discrete Input - D7
F.108	8		40608	Discrete Input - D8
F.109	9		40609	Discrete Input - D9
F.110	10		40610	Discrete Input - D10
F.111	11		40611	Discrete Input - D11
F.112	12		40612	Discrete Input - D12
F.113	13		40613	Discrete Input - D13
F.114	14		40614	Discrete Input - D14
F.115	15		40615	Discrete Input - D15
F.116	16		40616	Discrete Input - D16
F.117	17		40617	Discrete Input - D17
F.118	18		40618	Discrete Input - D18
F.119	19		40619	Discrete Input - D19
F.120	20		40620	Discrete Input - D20
F.121	61		40621	Discrete Input - D21
F.122	62		40622	Discrete Input - D22
F.123	63		40623	Discrete Input - D23
F.124	64		40624	Discrete Input - D24
F.125	65		40625	Discrete Input - D25
F.126	66		40626	Discrete Input - D26
F.127	67		40627	Discrete Input - D27
F.128	68		40628	Discrete Input - D28
F.129	69		40629	Discrete Input - D29
F.130	70		40630	Discrete Input - D30

Function of Input: **Connect To:**

0 = Collect Discrete Data for SCADA ..... Telemetry Contact

1 = Level Probe Electrode 1 ..... Level Probe
2 = Level Probe Electrode 2 ..... Level Probe
3 = Level Probe Electrode 3 ..... Level Probe
4 = Level Probe Electrode 4 ..... Level Probe
5 = Level Probe Electrode 5 ..... Level Probe
6 = Level Probe Electrode 6 ..... Level Probe
7 = Level Probe Electrode 7 ..... Level Probe
8 = Level Probe Electrode 8 ..... Level Probe
9 = Level Probe Electrode 9 ..... Level Probe
10 = Level Probe Electrode 10 ..... Level Probe

11 = Pump 1 Disable ..... HOA and Fault Logic
12 = Pump 2 Disable ..... HOA and Fault Logic
13 = Pump 3 Disable ..... HOA and Fault Logic
14 = Pump 4 Disable ..... HOA and Fault Logic
15 = Pump 5 Disable ..... HOA and Fault Logic
16 = Pump 6 Disable ..... HOA and Fault Logic

17 = All Pump Disable ..... Phase Monitor
18 = On Generator ..... Automatic Transfer Switch
19 = Toggle Between ALM1 & ALM2 for Level Input .... Select Switch
20 = Start Flush Cycle ..... External Time Clock

21 = External Alternation - Group 1 ..... External Time Clock
22 = External Alternation - Group 2 ..... External Time Clock

31 = Sequence Input 1 ..... Lead Select Switch - 1 as Lead
32 = Sequence Input 2 ..... Lead Select Switch - 2 as Lead
33 = Sequence Input 3 ..... Lead Select Switch - 3 as Lead
34 = Sequence Input 4 ..... Lead Select Switch - 4 as Lead
35 = Sequence Input 5 ..... Lead Select Switch - 5 as Lead
36 = Sequence Input 6 ..... Lead Select Switch - 6 as Lead

41 = Call Pump 1 Last ..... Logic Contact
42 = Call Pump 2 Last ..... Logic Contact
43 = Call Pump 3 Last ..... Logic Contact
44 = Call Pump 4 Last ..... Logic Contact
45 = Call Pump 5 Last ..... Logic Contact
46 = Call Pump 6 Last ..... Logic Contact

47 = Flow Calculator - Start New Day ..... External Time Clock

Pump Cutoff & Alarm

59 = Pump Cutoff - Low-Low Level (Pump Down Mode).... Float Switch
60 = Pump Cutoff - High-High Level (Pump Up Mode) ..... Float Switch

Alarm Only

61 = Low Level Alarm Only ..... Float Switch
62 = High Level Alarm Only ..... Float Switch

Pump Control & Alarm

63 = Float Control – Off Level ..... Float Switch
64 = Float Control – 1ST On Level ..... Float Switch
65 = Float Control – 2ND On Level ..... Float Switch
66 = Float Control – 3RD On Level ..... Float Switch
67 = Float Control – 4TH On Level ..... Float Switch
68 = Float Control – 5TH On Level ..... Float Switch
69 = Float Control – 6TH On Level ..... Float Switch
70 = Float Control – High Level (Pump Down Mode).....Float Switch

Notes:

1. Any Discrete Input may be set for Function “0” when the input is used only to collect data for SCADA and no other Function is desired.
2. The status of the Discrete Inputs may be read as a “0” or “1” from Modbus Coils 1 - 30 (Register 40001 Bits 0 - 15 and Register 40002 Bits 0 - 13). See page A-10.
3. For a description of the Functions see pages A-2 - A-6.
4. Pump 1(2,3,4,5,6) Disable logic may be inverted using Parameter F.145. See page A-8.

DISCRETE INPUT SETUP

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters
Discrete Input Setup				
F.141	100		40641	Discrete Input Sensitivity - D1 - D10 Range: 90 - 210 100 = Standard Sensitivity 150 = Extra Sensitive
F.142	100		40642	Discrete Input Sensitivity - D11 - D20 Range: 90 - 210 100 = Standard Sensitivity 150 = Extra Sensitive
F.143	100		40643	Discrete Input Sensitivity - D21 - D30 Range: 90 - 210 100 = Standard Sensitivity 150 = Extra Sensitive
Pump Disable Setup				
F.145	0		40645	Discrete Input Pump Disable Mode 0 = Disable Pump with Closed Discrete Input 1 = Disable Pump with Open Discrete Input Note: This parameter only applies to Discrete Inputs that are assigned to be Pump Disable Inputs (Function 11 - 16).

DISCRETE INPUT STATUS

User / Operator Info. Parameter	SCADA Register Address	Description of Parameters and SCADA Notes
Discrete Input Analog Test Signal Status		
A.101	41801	Discrete Input - D1
A.102	41802	Discrete Input - D2
A.103	41803	Discrete Input - D3
A.104	41804	Discrete Input - D4
A.105	41805	Discrete Input - D5
A.106	41806	Discrete Input - D6
A.107	41807	Discrete Input - D7
A.108	41808	Discrete Input - D8
A.109	41809	Discrete Input - D9
A.110	41810	Discrete Input - D10
A.111	41811	Discrete Input - D11
A.112	41812	Discrete Input - D12
A.113	41813	Discrete Input - D13
A.114	41814	Discrete Input - D14
A.115	41815	Discrete Input - D15
A.116	41816	Discrete Input - D16
A.117	41817	Discrete Input - D17
A.118	41818	Discrete Input - D18
A.119	41819	Discrete Input - D19
A.120	41820	Discrete Input - D20
A.121	41821	Discrete Input - D21
A.122	41822	Discrete Input - D22
A.123	41823	Discrete Input - D23
A.124	41824	Discrete Input - D24
A.125	41825	Discrete Input - D25
A.126	41826	Discrete Input - D26
A.127	41827	Discrete Input - D27
A.128	41828	Discrete Input - D28
A.129	41829	Discrete Input - D29
A.130	41830	Discrete Input - D30

Notes:

1. Each of the Discrete Inputs send out a low voltage (+/- 6 V), low current (0.6 mA), AC (60 Hz) square wave as a Test Signal to determine the status of the input, either Open or Closed. The Status of the Test Signals for each of the Discrete Input (as an analog value) may be viewed from Parameters A.101 - A.130.
2. The Controller compares each of the Test Signal analog values with the Discrete Input Sensitivity set on Parameters F.141 - F.143. Each Discrete I/O Board, having 10 Discrete Inputs each, has its own Discrete Input Sensitivity setting (Parameters F.141 - F.143). See page A-8.

   The Discrete Input is considered to be:

   Open - When the Test Signal is above the Sensitivity setting.

   Closed - When the Test Signal is below the Sensitivity setting.
3. Each Discrete I/O Board generates its own 60 Hz square wave Clock Signal that is used to generate the Discrete Input Test Signals for its 10 inputs. The analog values of these Clocks are available to be viewed from Parameters A.141 - A.143. See below.
4. The status of all the Discrete Inputs as a discrete value may also be read from Modbus Coils 1 - 30 (Register 40001 Bits 0 - 15, & Register 40002 Bits 0 - 13). See page A-10.

Parameter	Register Address	Data Description
A.141	41841	Clock Signal for Discrete Inputs: D1 - D10
A.142	41842	Clock Signal for Discrete Inputs: D11 - D20
A.143	41843	Clock Signal for Discrete Inputs: D21 - D30

DISCRETE INPUT STATUS

SCADA Register Address	Description of Register Contents (Where a Modbus Coils are represented by a Bit in a Register)

40001

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Coil
D16 - Discrete Input Status	D15 - Discrete Input Status	D14 - Discrete Input Status	D13 - Discrete Input Status	D12 - Discrete Input Status	D11 - Discrete Input Status	D10 - Discrete Input Status	D9 - Discrete Input Status	D8 - Discrete Input Status	D7 - Discrete Input Status	D6 - Discrete Input Status	D5 - Discrete Input Status	D4 - Discrete Input Status	D3 - Discrete Input Status	D2 - Discrete Input Status	D1 - Discrete Input Status	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit

40002

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	Coil
Spare	Spare	D30 - Discrete Input Status	D29 - Discrete Input Status	D28 - Discrete Input Status	D27 - Discrete Input Status	D26 - Discrete Input Status	D25 - Discrete Input Status	D24 - Discrete Input Status	D23 - Discrete Input Status	D22 - Discrete Input Status	D21 - Discrete Input Status	D20 - Discrete Input Status	D19 - Discrete Input Status	D18 - Discrete Input Status	D17 - Discrete Input Status	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit

HMI Display of Discrete Input Discrete Status

SC5000-CTS-HMI

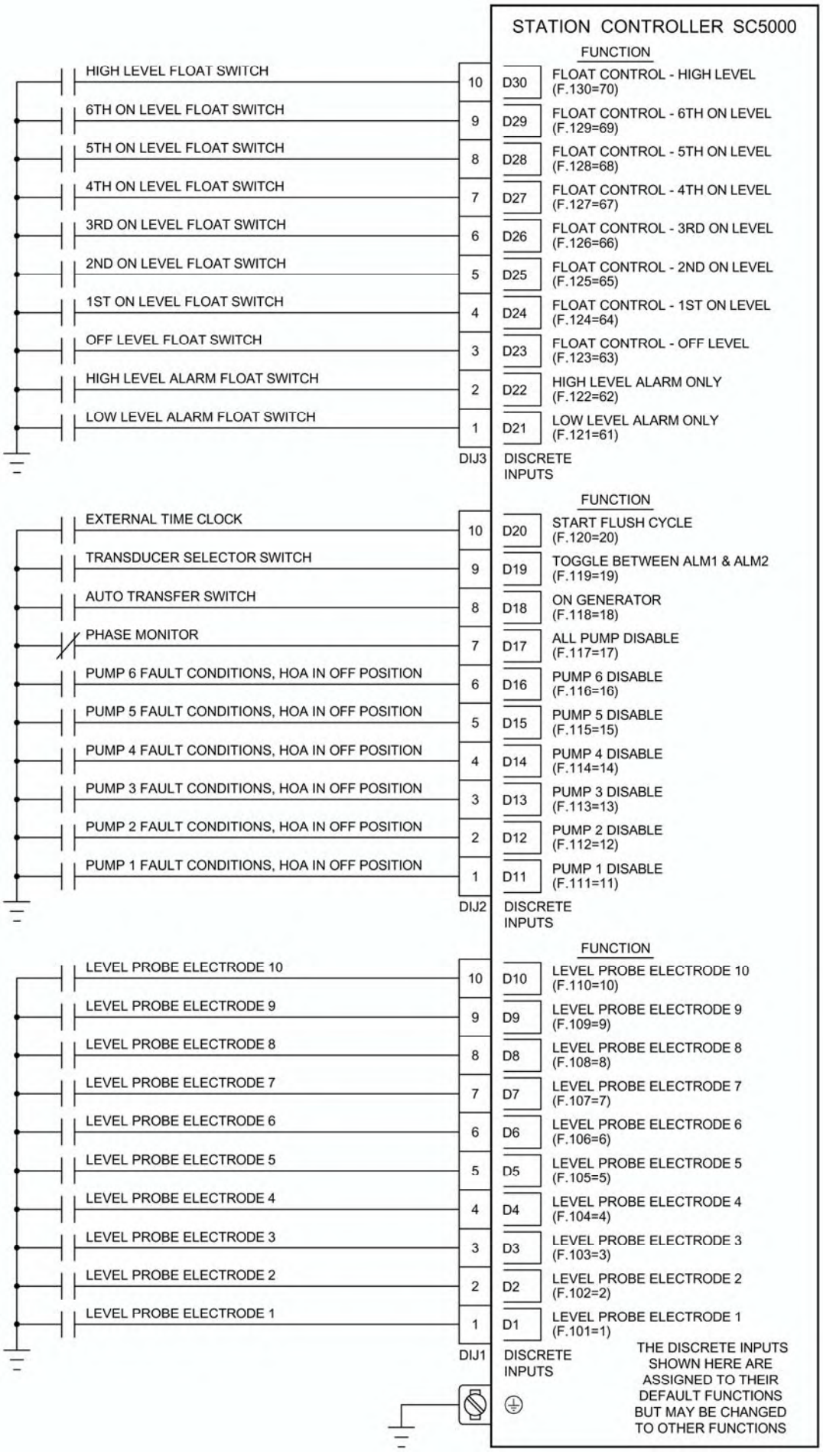
The **SC5000-CTS-HMI** shows the Discrete Status of the Discrete Inputs on the Discrete Input screens on the HMI. See pages A-14 - A-15.

SC5000-LED-HMI

The **SC5000-LED-HMI** shows the Discrete Status of the Discrete Inputs on Parameters n.01 - n.30 in the Menu. See page X-19.

DISCRETE INPUTS

Connection Diagram

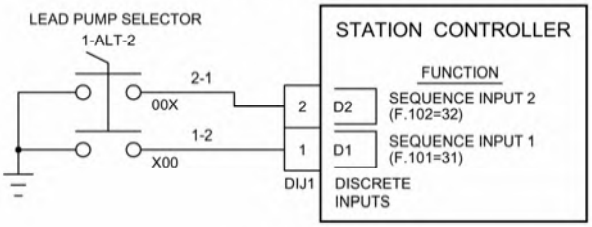


DISCRETE INPUT - LEAD PUMP SELECTOR SWITCH EXAMPLES

LEVEL CONTROL MODE - Parameter P.091 = 1

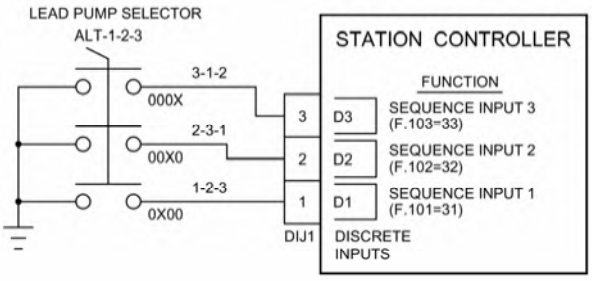
DUPLEX - STANDARD ALTERNATION

NUMBER OF PUMPS PRESENT: P.092 = 2
ALTERNATION SEQUENCE MODE: P.122 = 1



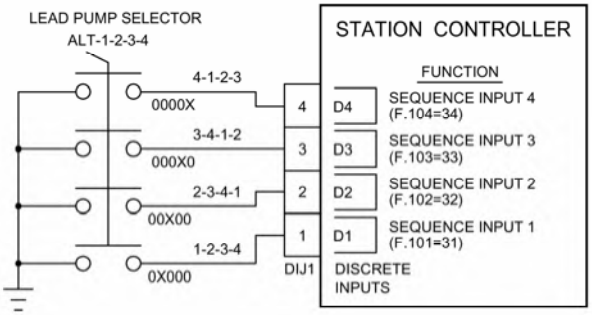
TRIPLEX - STANDARD ALTERNATION

NUMBER OF PUMPS PRESENT: P.092 = 3
ALTERNATION SEQUENCE MODE: P.122 = 1



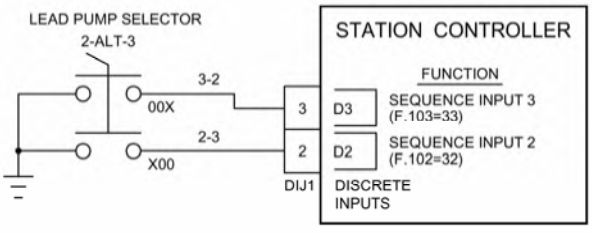
QUADRAPLEX - STANDARD ALTERNATION

NUMBER OF PUMPS PRESENT: P.092 = 4
ALTERNATION SEQUENCE MODE: P.122 = 1



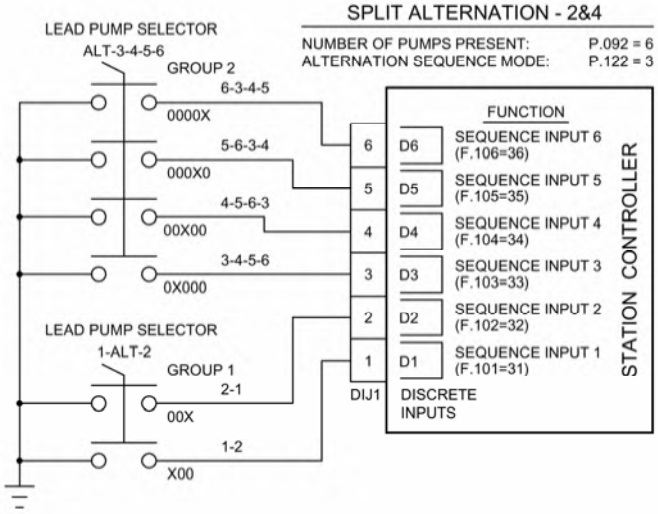
TRIPLEX - PUMP 1 ALWAYS LEAD

NUMBER OF PUMPS PRESENT: P.092 = 3
ALTERNATION SEQUENCE MODE: P.122 = 2



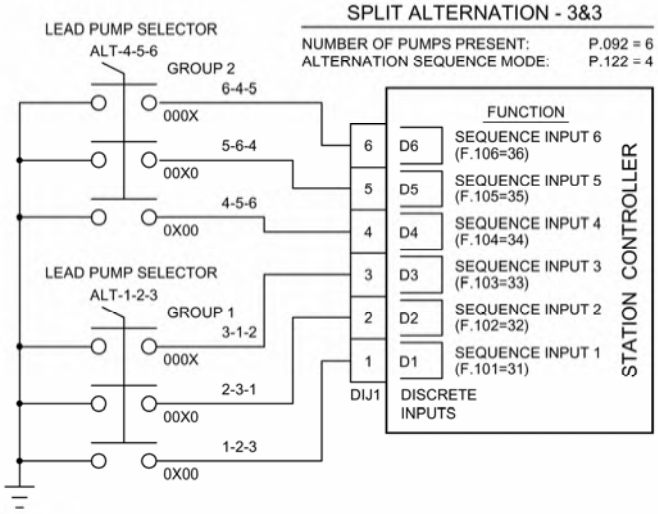
SPLIT ALTERNATION - 2&4

NUMBER OF PUMPS PRESENT: P.092 = 6
ALTERNATION SEQUENCE MODE: P.122 = 3



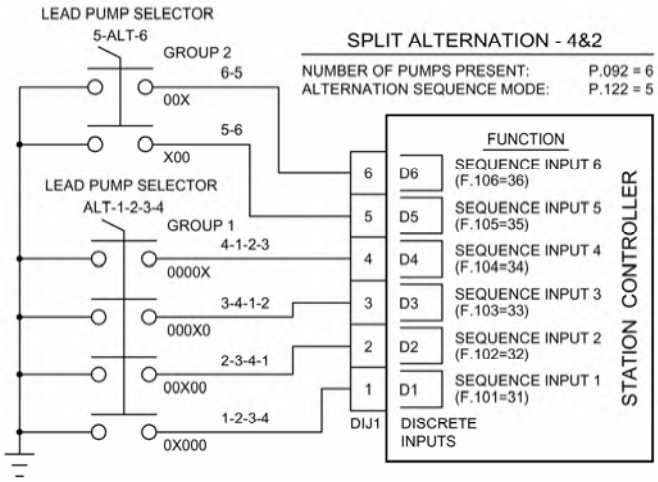
SPLIT ALTERNATION - 3&3

NUMBER OF PUMPS PRESENT: P.092 = 6
ALTERNATION SEQUENCE MODE: P.122 = 4



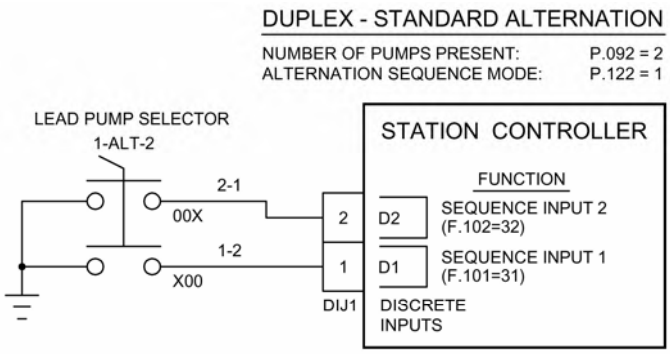
SPLIT ALTERNATION - 4&2

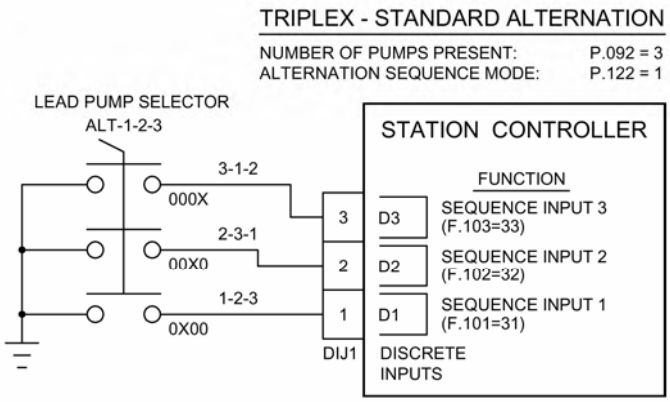
NUMBER OF PUMPS PRESENT: P.092 = 6
ALTERNATION SEQUENCE MODE: P.122 = 5

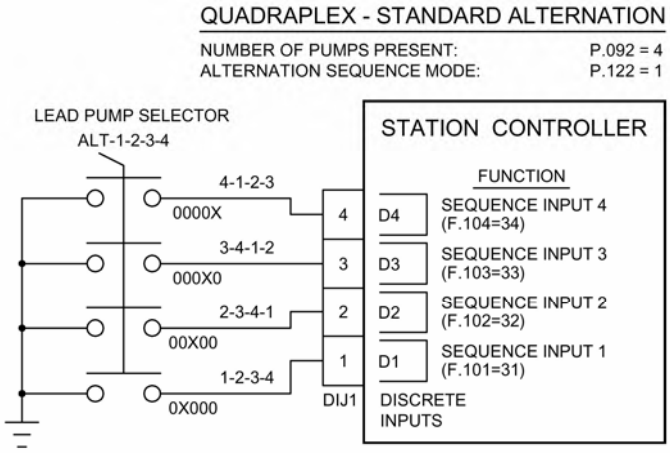


DISCRETE INPUT - LEAD PUMP SELECTOR SWITCH EXAMPLES

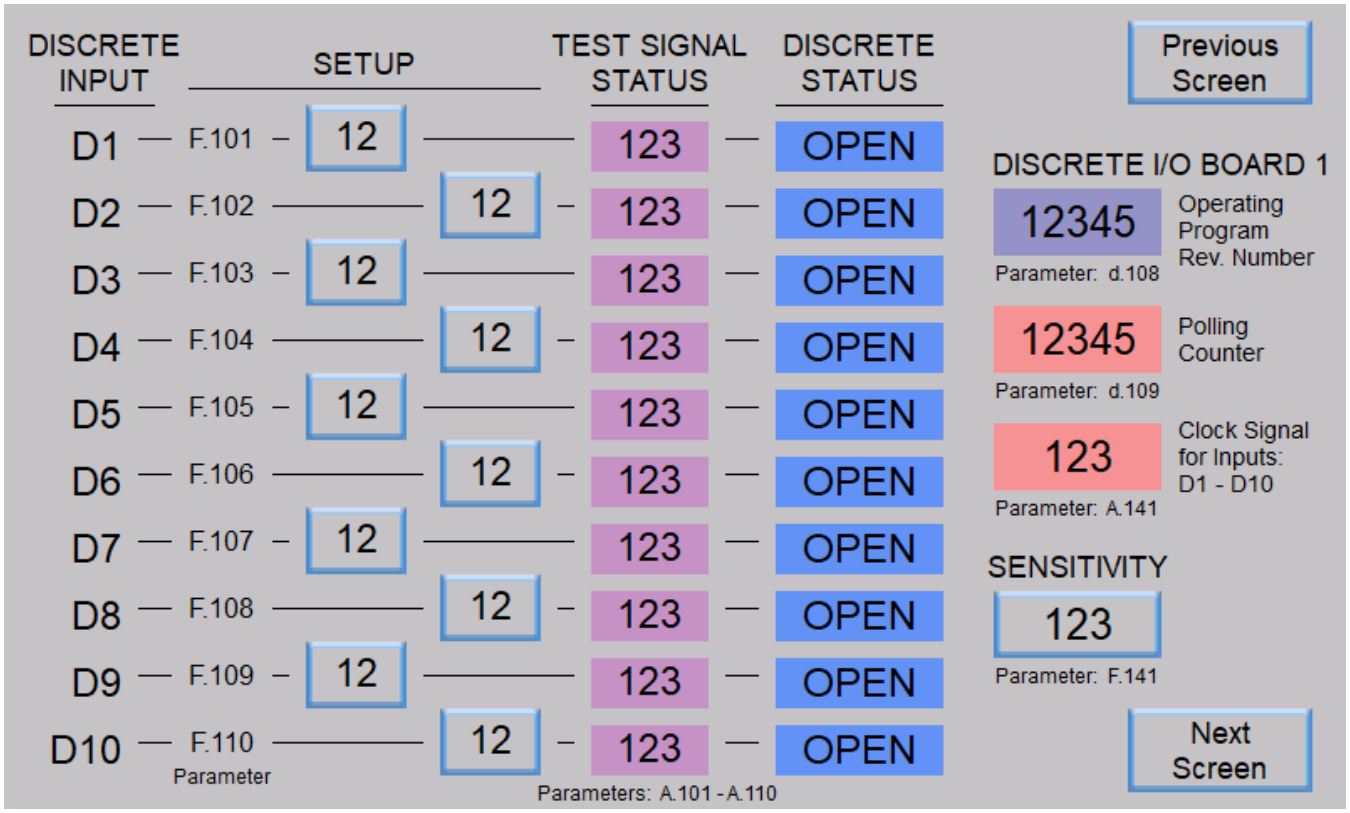
FLOW CONTROL MODE - Parameter P.091 = 2
PRESSURE CONTROL MODE - Parameter P.091 = 3
BOOSTER CONTROL MODE - Parameter P.091 = 4

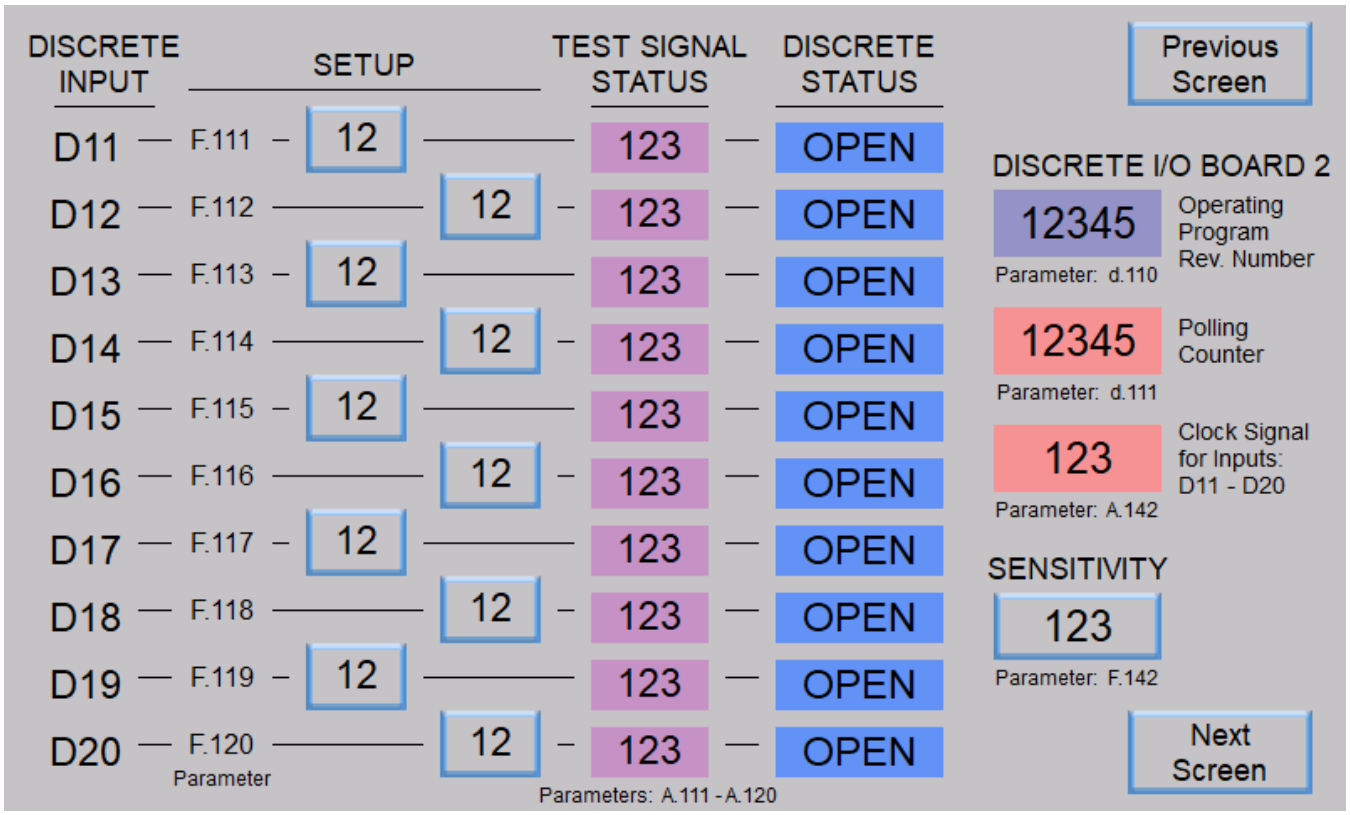




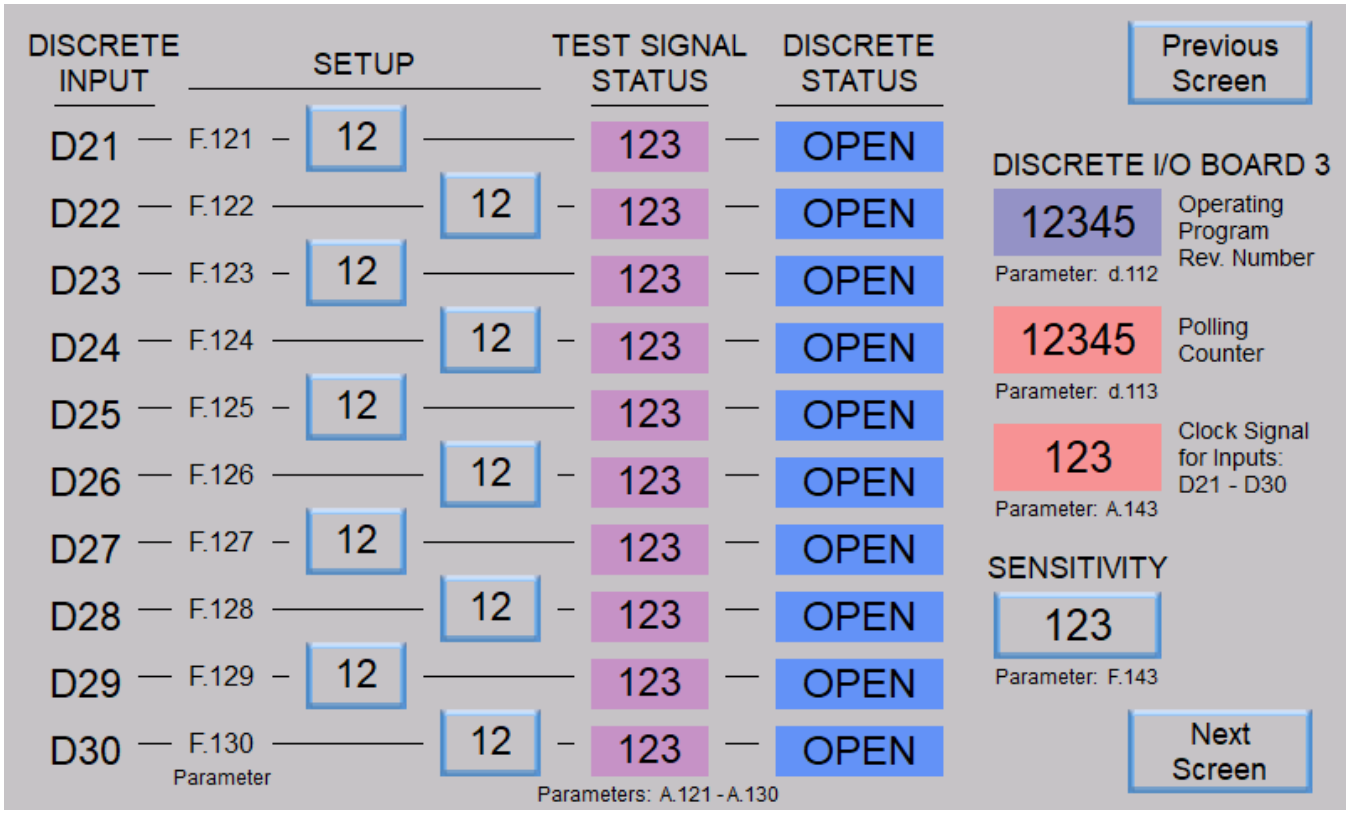


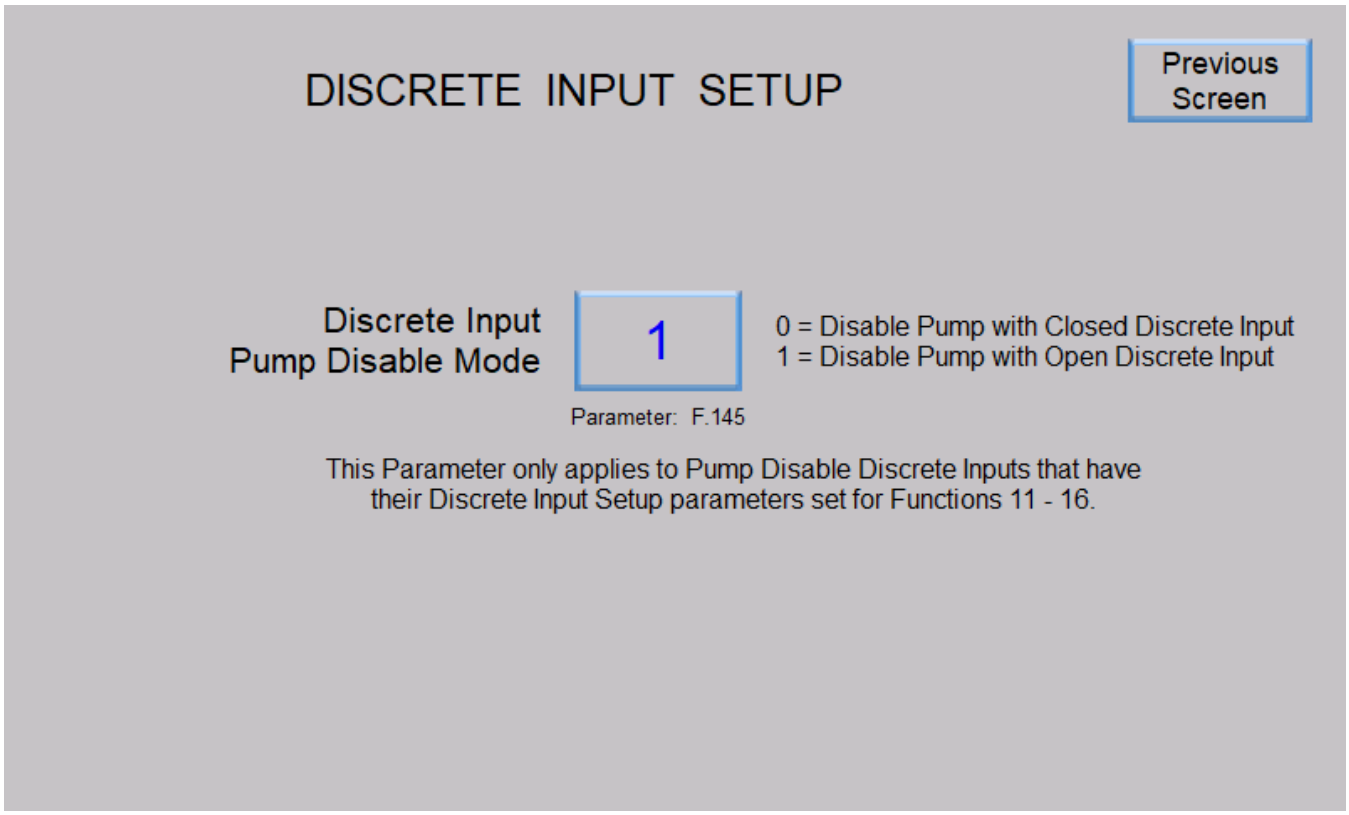
DISCREET INPUTS - Touchscreen HMI SCREENS





DISCREET INPUTS - Touchscreen HMI SCREENS





SECTION B
RELAY OUTPUTS

Revision Date: 12-30-22

DESCRIPTION OF OPERATION

Introduction

Relay Outputs ROX1 - ROX12 are provided to perform a variety of Control or Alarm Functions that may be assigned to them by the operator.

The Relay Outputs have Dry Contacts that are rated for 8 A @ 120 VAC Resistive.

For Terminal Block numbers see page B-4.

Remote Control

Relay Outputs that are assigned the Function of “Remote Control” (Function 0) may be controlled remotely by SCADA.

Also, the “RELAY OUTPUT SETUP & STATUS” screens on the SC5000-CTS-HMI have “REMOTE CONTROL” push-buttons that allow the operator to manually control any of the Relay Outputs set for “Remote Control” (Function 0).

See the description of “Remote Control” (Function 0) below.

Relay Testing

To test a Relay Output and the connected Control Panel features temporarily assign the Function of the relay to “Remote Control” (Function 0), perform the testing and then set it back to the correct Function for the application. There is a “REMOTE CONTROL” push-button on the SC5000-CTS-HMI for each Relay Output.

Status

The Status of the Relay Outputs may be read from Modbus Coils 49 - 60 (Register 40004 Bits 0 - 11).

When a Relay Output’s contacts are closed the respective Modbus Coil or Bit will show a “1”.

When a Relay Output’s contacts are open the respective Modbus Coil or Bit will show a “0”.

For Relay Output Status on the SC5000-CTS-HMI see HMI screens on pages B-5 & B-6.
For Relay Output Status on the SC5000-LED-HMI see Parameters ro.01 - ro.12 on page X-20.

Functions

Many of the Relay Outputs are assigned default Functions from the factory, but they may be changed by the operator using Parameters F.201 - F.212.

See page B-3 and see “RELAY OUTPUT FUNCTIONS” below for a description of each of the Functions.

RELAY OUTPUT FUNCTIONS

Remote Control - Function 0

Relay Outputs that are assigned the Function of “Remote Control” (Function 0) may be controlled remotely by writing to Modbus Coils 65 - 76 (Register 40005 Bits 0 - 11).

When the respective Modbus Coil or Bit is set to “1” the Relay Output contacts close.

When the respective Modbus Coil or Bit is cleared to “0” the Relay Output contacts open.

Upon loss of communication with the SCADA system the Relay Output Control Commands will be canceled, after a delay. See the “Remote Control Command Canceling Delay” (Parameters E.011 - E.013) on page E-2.

Pump 1 (2, 3, 4, 5, 6) Control - Functions 1 - 6

Relay Outputs assigned the Function of “Pump 1 (2, 3, 4, 5, 6) Control” (Functions 1 - 6) provides contacts to turn on and off the pumps.

Low Level Alarm - Function 7

A Relay Output assigned the Function of “Low Level Alarm” (Function 7) provides contacts that closes upon a Low Level Alarm condition.

RELAY OUTPUT FUNCTIONS

High Level Alarm - Function 8

A Relay Output assigned the Function of “High Level Alarm” (Function 8) provides contacts that closes upon a High Level Alarm condition.

Low Flow Rate Alarm - Function 9

A Relay Output assigned the Function of “Low Flow Rate Alarm” (Function 9) provides contacts that closes upon a Low Flow Rate Alarm condition.

High Flow Rate Alarm - Function 10

A Relay Output assigned the Function of “High Flow Rate Alarm” (Function 10) provides contacts that closes upon a High Flow Rate Alarm condition.

Low Supply Pressure Alarm - Function 11

A Relay Output assigned the Function of “Low Supply Pressure Alarm” (Function 11) provides contacts that closes upon a Low Supply Pressure Alarm condition.

High Supply Pressure Alarm - Function 12

A Relay Output assigned the Function of “High Supply Pressure Alarm” (Function 12) provides contacts that closes upon a High Supply Pressure Alarm condition.

Low Discharge Pressure Alarm - Function 13

A Relay Output assigned the Function of “Low Discharge Pressure Alarm” (Function 13) provides contacts that closes upon a Low Discharge Pressure Alarm condition.

High Discharge Pressure Alarm - Function 14

A Relay Output assigned the Function of “High Discharge Pressure Alarm” (Function 14) provides contacts that closes upon a High Discharge Pressure Alarm condition.

RELAY OUTPUT SETUP

User / Operator Info.			SCADA	Description of Parameters and SCADA Notes
Parameter	Default Value	Current Value	Register Address	

Relay Output Setup

Setup				Relay Output
F.201	1		40651	Relay Output - ROX1
F.202	2		40652	Relay Output - ROX2
F.203	3		40653	Relay Output - ROX3
F.204	4		40654	Relay Output - ROX4
F.205	5		40655	Relay Output - ROX5
F.206	6		40656	Relay Output - ROX6
F.207	7		40657	Relay Output - ROX7
F.208	8		40658	Relay Output - ROX8
F.209	0		40659	Relay Output - ROX9
F.210	0		40660	Relay Output - ROX10
F.211	0		40661	Relay Output - ROX11
F.212	0		40662	Relay Output - ROX12

Function of Relay Output:

0 = Remote Control

1 = Pump 1 Control
2 = Pump 2 Control
3 = Pump 3 Control
4 = Pump 4 Control
5 = Pump 5 Control
6 = Pump 6 Control

7 = Low Level Alarm
8 = High Level Alarm

9 = Low Flow Rate Alarm
10 = High Flow Rate Alarm

11 = Low Supply Pressure Alarm
12 = High Supply Pressure Alarm

13 = Low Discharge Pressure Alarm
14 = High Discharge Pressure Alarm

Notes:

1. Output Relays set for Function 0 may be Remotely Controlled by writing to Modbus Coils 65 - 76 (Register 40005 Bits 0 - 11).
2. Output Relay's status may be read from Modbus Coils Modbus Coils 49 - 60 (Register 40004 Bits 0 - 11).

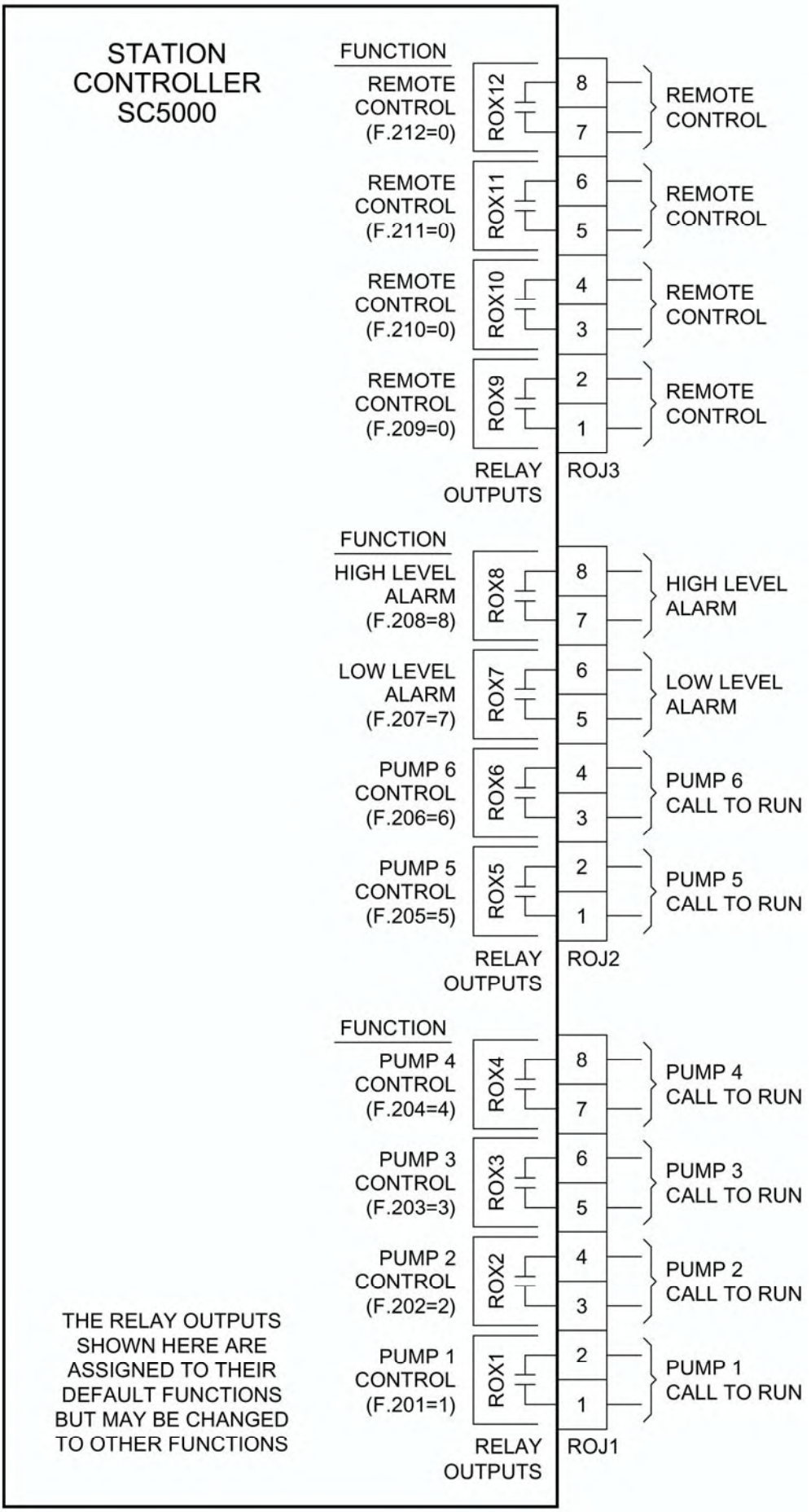
RELAY OUTPUT STATUS & REMOTE CONTROL

SCADA Register Address	Description of Register Contents (Where a Modbus Coils are represented by a Bit in a Register)																
40004	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	Coil
	Spare	Spare	Spare	Spare	ROX 12 Relay Status	ROX 11 Relay Status	ROX 10 Relay Status	ROX 9 Relay Status	ROX 8 Relay Status	ROX 7 Relay Status	ROX 6 Relay Status	ROX 5 Relay Status	ROX 4 Relay Status	ROX 3 Relay Status	ROX 2 Relay Status	ROX 1 Relay Status	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40005	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	Coil
	Spare	Spare	Spare	Spare	ROX 12 Relay Remote Control	ROX 11 Relay Remote Control	ROX 10 Relay Remote Control	ROX 9 Relay Remote Control	ROX 8 Relay Remote Control	ROX 7 Relay Remote Control	ROX 6 Relay Remote Control	ROX 5 Relay Remote Control	ROX 4 Relay Remote Control	ROX 3 Relay Remote Control	ROX 2 Relay Remote Control	ROX 1 Relay Remote Control	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit

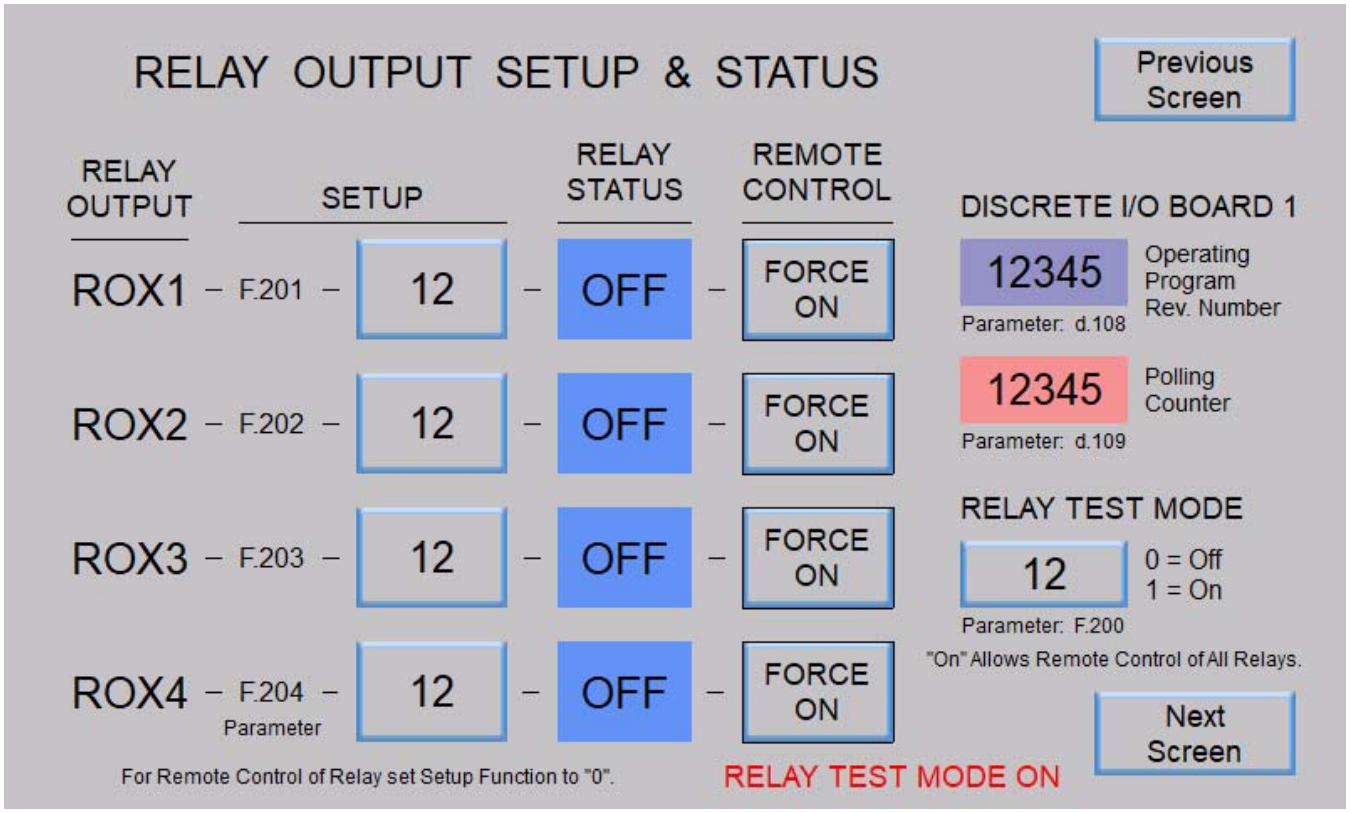
For Relay Output Status on the SC5000-CTS-HMI see HMI screens on pages B-5 & B-6.
For Relay Output Status on the SC5000-LED-HMI see Parameters ro.01 - ro.12 on page X-20.

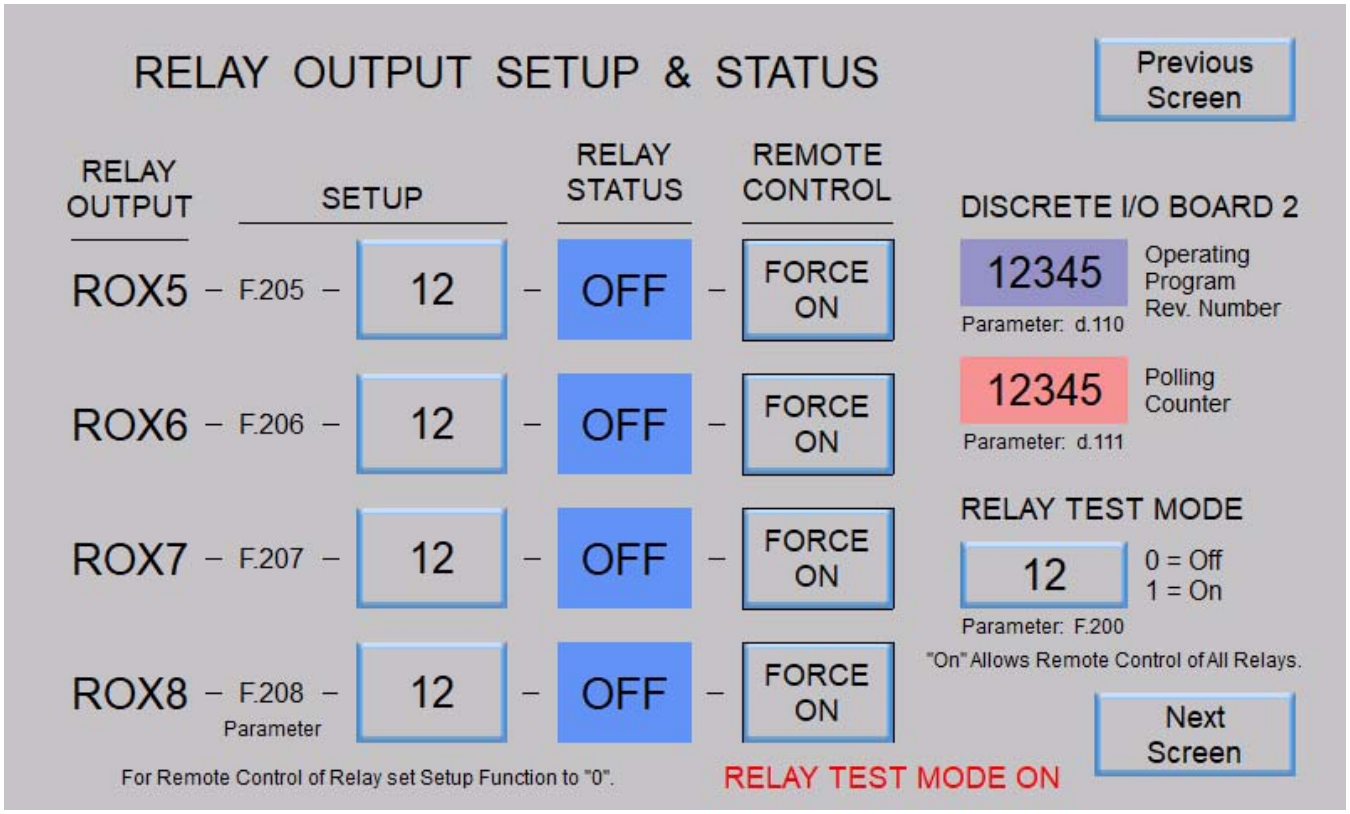
RELAY OUTPUTS

Connection Diagram

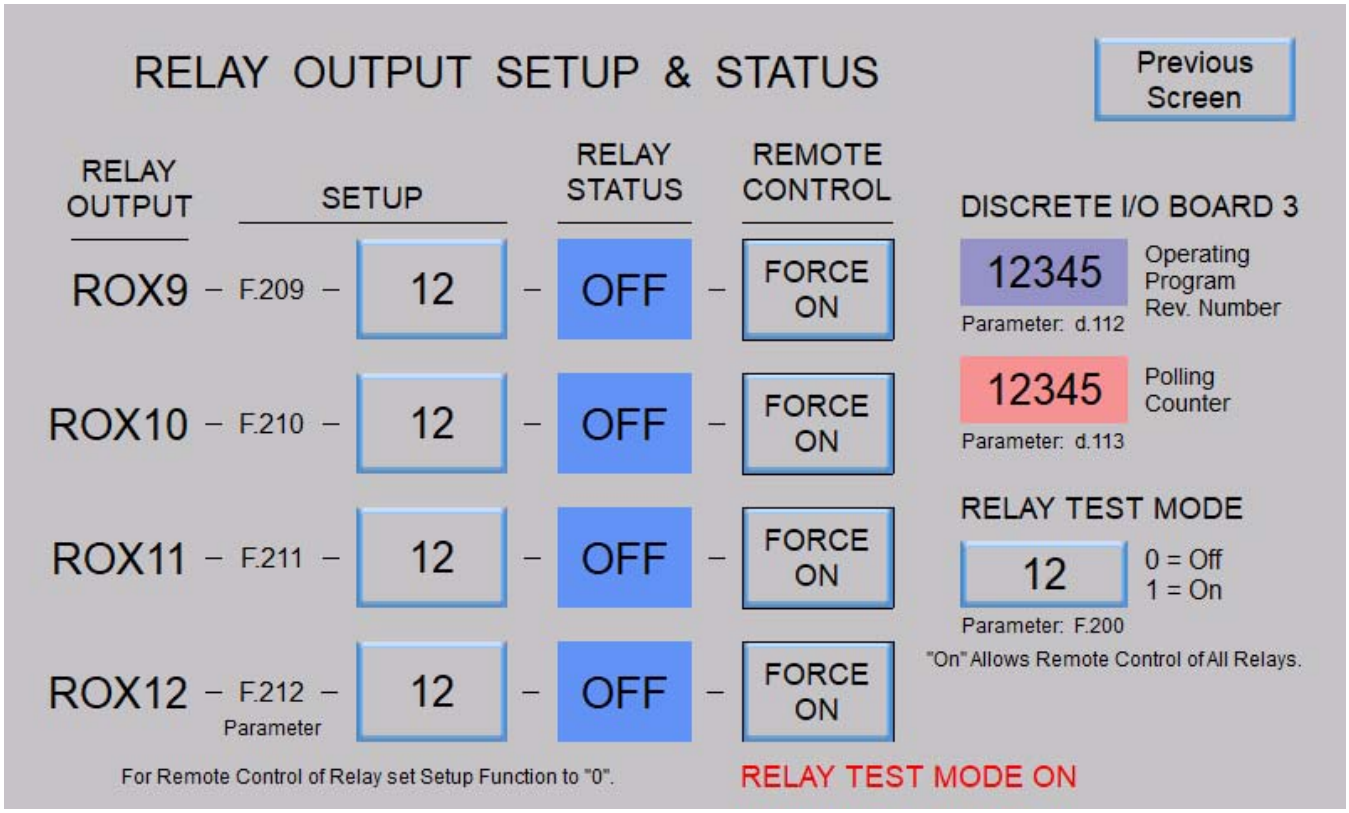


RELAY OUTPUTS - Touchscreen HMI SCREENS





RELAY OUTPUTS - Touchscreen HMI SCREENS



SECTION C
ANALOG INPUTS

Revision Date: 12-30-22

DESCRIPTION OF OPERATION

Introduction

Analog Inputs AIX1, AIX2 & A1 - A8 are provided to allow for the connection of 4-20 mA Analog Input signals to the Analog Meters on the Controller, or to provide the Analog Input data to SCADA or to do both.

The Analog Inputs are Isolated and Transient Protected. They have a 100 Ω input load resistor and use a 12-bit Analog to Digital Converter to measure the input signal.

The Analog Inputs are factory calibrated to have the following Analog Input Status values:

819 @ 4.0 mA 4095 @ 20 mA

For Terminal Block numbers see page C-6.

Functions

The Analog Inputs may be assigned the Function of collecting Analog Input data and sending it to one of the many Analog Meters on the Controller, or only to make the data available to be read by SCADA.

See the “ANALOG INPUT FUNCTIONS” below for a description of each of the Functions. Also see Parameters F.299 - F.308 on page C-3.

Status

The Analog Input Status values may be read from Parameters A.299 - A.308. See page C-3.

Calibration

The Analog Inputs may be re-calibrated in the field using Parameters C.301 - C.320. See pages C-4 & 5.

ANALOG INPUT FUNCTIONS

Collect Analog Data for SCADA - Function 0

Analog Inputs that are assigned the Function of “Collect Analog Data for SCADA” (Function 0), only collect data for SCADA and do not perform any other Function in the Controller.

Analog Level Meter ALM1 - Function 1

An Analog Input assigned the Function of “Analog Level Meter ALM1” (Function 1) collects analog data and sends it to the “Analog Level Meter ALM1” for display or for use by the Controller to perform Level Control.

See Section M.

Analog Level Meter ALM2 - Function 2

An Analog Input assigned the Function of “Analog Level Meter ALM2” (Function 2) collects analog data and sends it to the “Analog Level Meter ALM2” for display or for use by the Controller to perform Level Control.

See Section M.

Analog Flow Meter AFM1 - Function 3

An Analog Input assigned the Function of “Analog Flow Meter AFM1” (Function 3) collects analog data and sends it to the “Analog Flow Meter AFM1” for display or for use by the Controller to perform Flow Control.

See Section K.

ANALOG INPUT FUNCTIONS

Analog Flow Meter AFM2 - Function 4

An Analog Input assigned the Function of “Analog Flow Meter AFM2” (Function 4) collects analog data and sends it to the “Analog Flow Meter AFM2” for display or for use by the Controller to perform Flow Control.

See Section K.

Analog Flow Meter AFM3 - Function 5

An Analog Input assigned the Function of “Analog Flow Meter AFM3” (Function 5) collects analog data and sends it to the “Analog Flow Meter AFM3” for display or for use by the Controller to perform Flow Control.

See Section K.

Analog Pressure Meter APM1 - Function 6

An Analog Input assigned the Function of “Analog Pressure Meter APM1” (Function 6) collects analog data and sends it to the “Analog Pressure Meter APM1” for display or for use by the Controller to perform Pressure Control or Booster Control.

See Section N.

Analog Pressure Meter APM2 - Function 7

An Analog Input assigned the Function of “Analog Pressure Meter APM2” (Function 7) collects analog data and sends it to the “Analog Pressure Meter APM2” for display or for use by the Controller to perform Pressure Control or Booster Control.

See Section N.

Analog Current Meter (Phase A) ACMA - Function 8

An Analog Input assigned the Function of “Analog Current Meter (Phase A) ACMA” (Function 8) collects analog data and sends it to the “Analog Current Meter (Phase A) ACMA” for display.

See Section O.

Analog Current Meter (Phase B) ACMB - Function 9

An Analog Input assigned the Function of “Analog Current Meter (Phase B) ACMB” (Function 9) collects analog data and sends it to the “Analog Current Meter (Phase B) ACMB” for display.

See Section O.

Analog Current Meter (Phase C) ACMC - Function 10

An Analog Input assigned the Function of “Analog Current Meter (Phase C) ACMC” (Function 10) collects analog data and sends it to the “Analog Current Meter (Phase C) ACMC” for display.

See Section O.

ANALOG INPUT SETUP & STATUS

Analog Input Setup

User / Operator Info.			SCADA	Description of Parameters and SCADA Notes
Parameter	Default Value	Current Value	Register Address	
Setup				**Analog Input**
F.299	1		40669	Analog Input - AIX1
F.300	2		40670	Analog Input - AIX2
F.301	0		40671	Analog Input - A1
F.302	0		40672	Analog Input - A2
F.303	0		40673	Analog Input - A3
F.304	0		40674	Analog Input - A4
F.305	0		40675	Analog Input - A5
F.306	0		40676	Analog Input - A6
F.307	0		40677	Analog Input - A7
F.308	0		40678	Analog Input - A8

Function of Input:

0 = Collect Analog Data for SCADA

1 = Analog Level Meter ALM1
2 = Analog Level Meter ALM2
3 = Analog Flow Meter AFM1
4 = Analog Flow Meter AFM2
5 = Analog Flow Meter AFM3
6 = Analog Pressure Meter APM1
7 = Analog Pressure Meter APM2
8 = Analog Current Meter (Phase A) ACMA
9 = Analog Current Meter (Phase B) ACMB
10 = Analog Current Meter (Phase C) ACMC

Notes:

1. Any Analog Input may be set for Function “0” when the input is used only to collect data for SCADA and no other Function is desired.
2. In addition to collecting data for SCAD, Functions 1 - 10 also send the analog data to one of the Analog Meters on the Controller.

Analog Input Status

Status				Analog Input
A.299	-	-	41849	Analog Input - AIX1
A.300	-	-	41850	Analog Input - AIX2
A.301	-	-	41851	Analog Input - A1
A.302	-	-	41852	Analog Input - A2
A.303	-	-	41853	Analog Input - A3
A.304	-	-	41854	Analog Input - A4
A.305	-	-	41855	Analog Input - A5
A.306	-	-	41856	Analog Input - A6
A.307	-	-	41857	Analog Input - A7
A.308	-	-	41858	Analog Input - A8

Note:

Parameters A.299 - A.308 are 12-bit Analog to Digital Converter input values that are conditioned and factory calibrated to the following values:

819 @ 4.0 mA 4095 @ 20 mA

ANALOG INPUT CALIBRATION

User / Operator Info.	SCADA			
Parameter	Register Address	Description of Register Contents		
Analog Input Calibration				
C.301	**40031**	Analog Input (AIX1)	Zero Calibration	Also see the Analog Input - AIX1 Status Parameter A.299.
C.302	**40032**		Span Calibration	
C.303	**40033**	Analog Input (AIX2)	Zero Calibration	Also see the Analog Input - AIX2 Status Parameter A.300.
C.304	**40034**		Span Calibration	
C.305	**40035**	Analog Input (A1)	Zero Calibration	Also see the Analog Input - A1 Status Parameter A.301.
C.306	**40036**		Span Calibration	
C.307	**40037**	Analog Input (A2)	Zero Calibration	Also see the Analog Input - A2 Status Parameter A.302.
C.308	**40038**		Span Calibration	
C.309	**40039**	Analog Input (A3)	Zero Calibration	Also see the Analog Input - A3 Status Parameter A.303.
C.310	**40040**		Span Calibration	
C.311	**40041**	Analog Input (A4)	Zero Calibration	Also see the Analog Input - A4 Status Parameter A.304.
C.312	**40042**		Span Calibration	
C.313	**40043**	Analog Input (A5)	Zero Calibration	Also see the Analog Input - A5 Status Parameter A.305.
C.314	**40044**		Span Calibration	
C.315	**40045**	Analog Input (A6)	Zero Calibration	Also see the Analog Input - A6 Status Parameter A.306.
C.316	**40046**		Span Calibration	
C.317	**40047**	Analog Input (A7)	Zero Calibration	Also see the Analog Input - A7 Status Parameter A.307.
C.318	**40048**		Span Calibration	
C.319	**40049**	Analog Input (A8)	Zero Calibration	Also see the Analog Input - A8 Status Parameter A.308.
C.320	**40050**		Span Calibration	

See page C-5 for Calibration Procedures.

ANALOG INPUT CALIBRATION PROCEDURE

Zero Calibration

1. First apply 4.0 mA to the respective Analog Input.
2. Then while monitoring the respective Analog Input's Status Parameter make it read 819.

Using the SC5000-CTS-HMI

When using the SC5000-CTS-HMI, while on the HMI screen for calibration of the input, while monitoring the respective Analog Input's Status Parameter (A.299 - A.308), increase or decrease the Zero Calibration Parameter (C.301, C.303, C.305, C.307, C.309, C.311, C.313, C.315, C.317 or C.319) using the "+" or "-" buttons, until the Analog Input's Status Parameter reads 819.

See example HMI screen on page C-8.

Using the SC5000-LED-HMI

When using the SC5000-LED-HMI, while displaying (in the menu) the Zero Calibration Parameter (C.301, C.303, C.305, C.307, C.309, C.311, C.313, C.315, C.317 or C.319) press the Up or Down push-buttons, until it reads 819.

Note: While viewing the Zero Calibration Parameter, the Analog Input's Status Parameter (A.299 - A.308) is actually being viewed.

See page X-24.

Span Calibration

1. First apply 20 mA to the respective Analog Input.
2. Then while monitoring the respective Analog Input's Status Parameter make it read 4095.

Using the SC5000-CTS-HMI

When using the SC5000-CTS-HMI, while on the HMI screen for calibration of the input, while monitoring the respective Analog Input's Status Parameter (A.299 - A.308), increase or decrease the Span Calibration Parameter (C.302, C.304, C.306, C.308, C.310, C.312, C.314, C.316, C.318 or C.320) using the "+" or "-" buttons, until the Analog Input's Status Parameter reads 4095.

See example HMI screen on page C-8.

Using the SC5000-LED-HMI

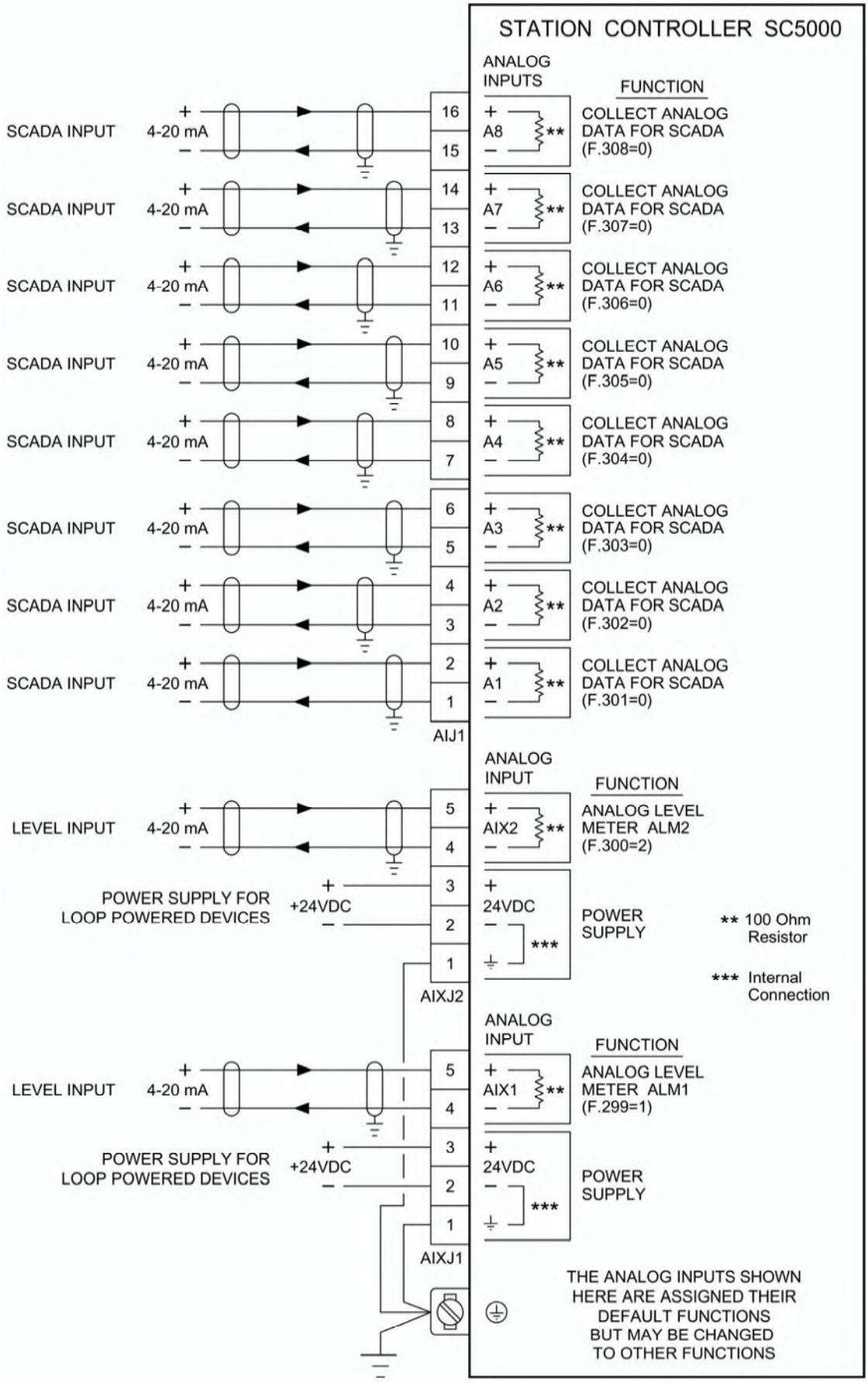
When using the SC5000-LED-HMI, while displaying (in the menu) the Span Calibration Parameter (C.302, C.304, C.306, C.308, C.310, C.312, C.314, C.316, C.318 or C.320) press the Up or Down push-buttons, until it reads 4095.

Note: While viewing the Span Calibration Parameter, the Analog Input's Status Parameter (A.299 - A.308) is actually being viewed.

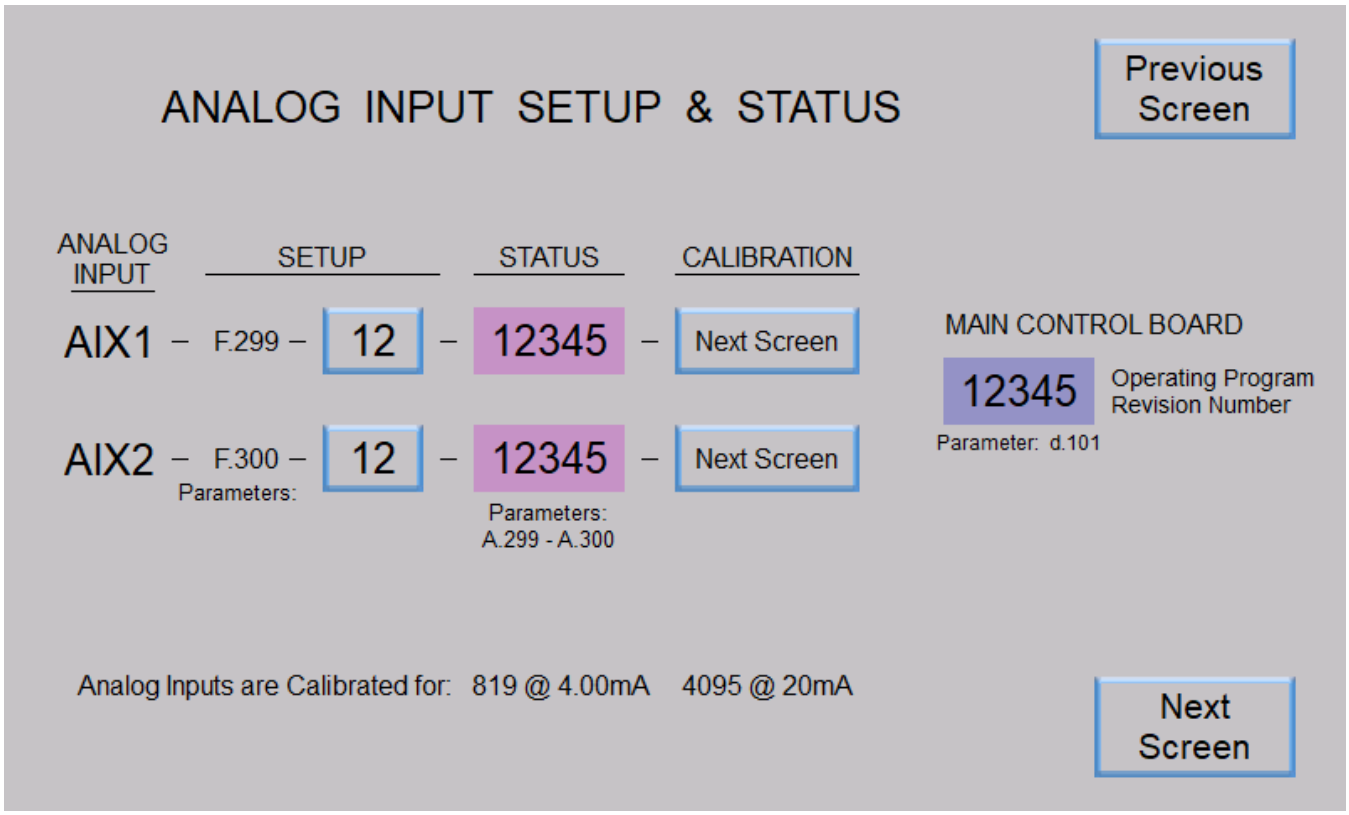
See page X-24.

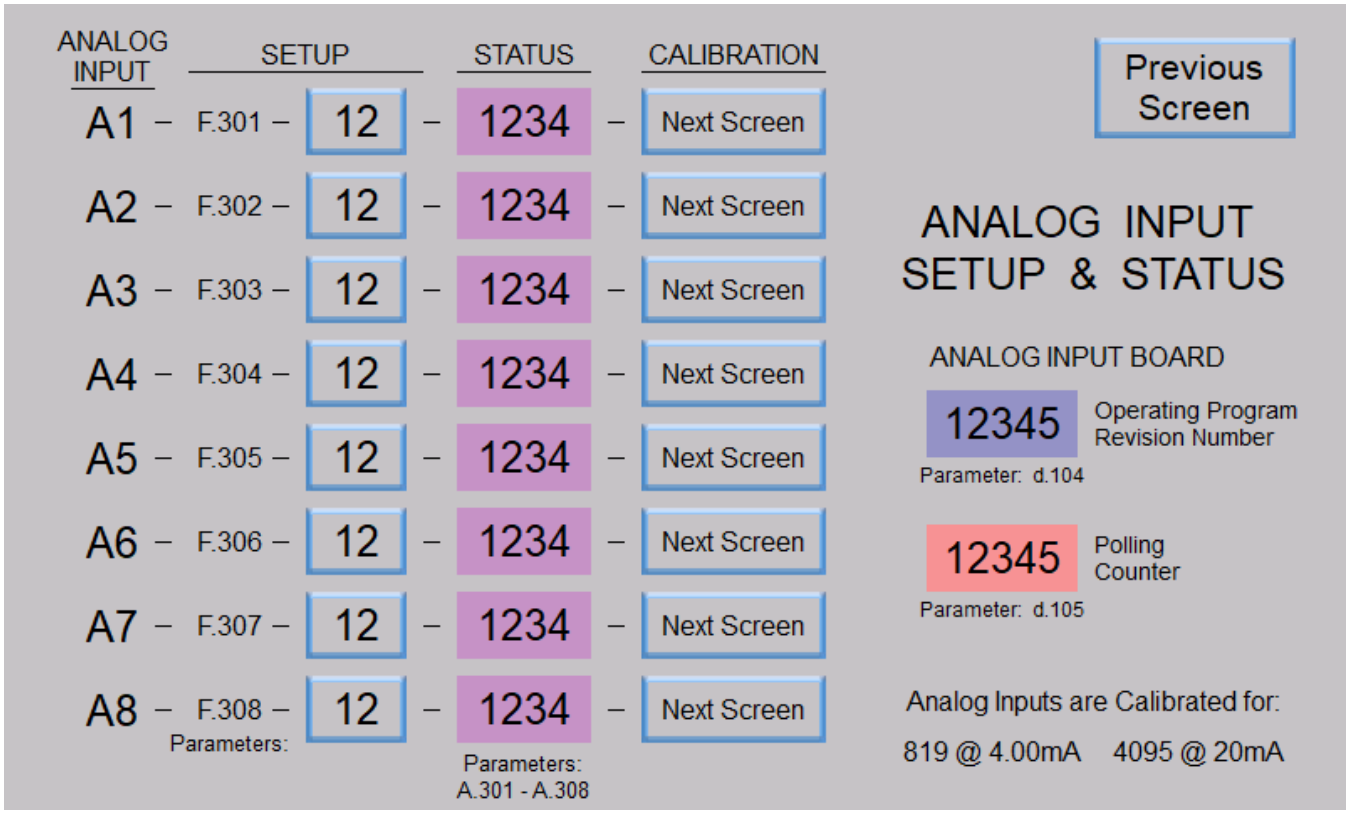
ANALOG INTPUTS

Connection Diagram



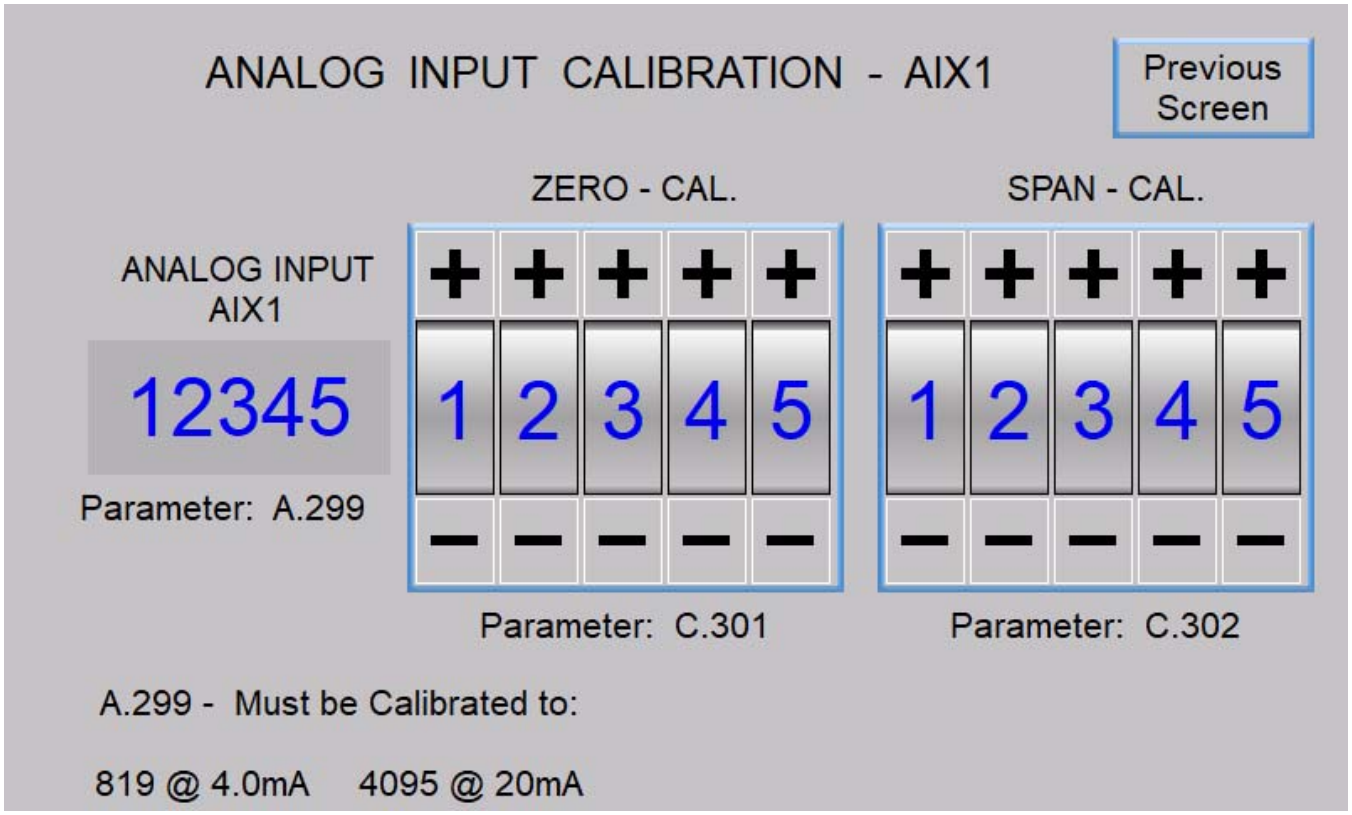
ANALOG INPUTS - Touchscreen HMI SCREENS





ANALOG INPUTS - Touchscreen HMI SCREENS

Analog Input Calibration - Typical of Analog Inputs A1X1 - A1X2 and A1 - A8



SECTION D
ANALOG OUTPUTS

Revision Date: 5-9-22

DESCRIPTION OF OPERATION

Introduction

Analog Outputs AOX1 & AO1 - AO6 are provided to send 4-20 mA analog data to external devices such as Variable Frequency Drives or to a Local Level Display or Telemetry device.

The Analog Outputs are Isolated, Transient Protected and use a 12-bit Digital to Analog Converter to produce the reference signal for the 4-20 mA Analog Output.

The Analog Outputs are factory calibrated to have the following Analog Output Status values:

819 @ 4.0 mA 4095 @ 20 mA

For Terminal Block numbers see page D-5.

Functions

Using Parameters F.400 - F.406, each Analog Output must be assigned a Function that determines what data is sent to the Analog Output to control the value of its output. See page D-2 and see "ANALOG OUTPUT FUNCTIONS" below for a description of each of the Functions.

Status

The Analog Outputs Status values may be read from Parameters A.400 - A.406. See page D-2.

Calibration

The Analog Outputs may be re-calibrated in the field using Parameters C.401 - C.414. See pages D-3 & 4.

ANALOG OUTPUT FUNCTIONS

No Function - Function 0

Analog Outputs that are assigned the Function of "No Function" (Function 0), will not perform any Function and will have their output turned off.

Pump 1 - 6 Speed Reference - Functions 1 - 6

Analog Outputs assigned the Functions of "Pump 1 - 6 Speed Reference" (Functions 1 - 6) provide the Speed Reference to Pumps 1 - 6 Variable Frequency Drives.

With these Functions, the Analog Outputs are only active providing the speed reference when the respective pump is called to run. When a pump is not called to run the respective Analog Output sends out 4 mA.

With these Functions, a 4 mA output represents a speed reference of 0 percent (0 Hz) and a 20 mA output represents a speed reference of 100 percent (60 Hz).

The setting on the "Master Control Mode" (Parameter P.091) (Level Control, Flow Control, Pressure Control or Booster Control) will determine which additional setup parameters must also be setup to control the "Pump 1 - 6 Speed Reference".

Pump X Speed Reference - Function 7

An Analog Output assigned the Function of "Pump X Speed Reference" (Function 7) provides a Speed Reference to any of the pump's Variable Frequency Drives.

With this Function, the Analog Output is always active even if no pumps are called to run.

With this Function, a 4 mA output represents a speed reference of 0 percent (0 Hz) and a 20 mA output represents a speed reference of 100 percent (60 Hz).

The setting on the "Master Control Mode" (Parameter P.091) (Level Control, Flow Control, Pressure Control or Booster Control) will determine which additional setup parameters must also be setup to control the "Pump X Speed Reference".

Local Analog Level Display - Function 8

The Analog Output from the "Local Analog Level Display" (Function 8) is a copy of the "Level Input Data" (Parameter Ld.01). It represents the Level currently being used by the Controller to perform Level Control. It provides analog Level data to a Local Analog Level Display or Telemetry Device.

The Span of the Analog Output from Function 8 must match the Span of the external Local Analog Level Display or Telemetry Device. To make them match set the "Local Analog Level Display - Span" (Parameter F.407) so that it matches the Span set on the external Local Analog Level Display or Telemetry Device.

Analog Output Function 8 is only applicable in the "Level Control Mode" (Parameter P.091 = 1).

For more information see Parameter Ld.01 on page 1-8 and Parameter F.407 on page D-2.

ANALOG OUTPUTS

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes

Analog Output Setup

Setup				Analog Output
F.400	8		40690	Analog Output - AOX1
F.401	1		40691	Analog Output - AO1
F.402	2		40692	Analog Output - AO2
F.403	3		40693	Analog Output - AO3
F.404	4		40694	Analog Output - AO4
F.405	5		40695	Analog Output - AO5
F.406	6		40696	Analog Output - AO6

Function of Analog Output:

0 = No Function

1 = Pump 1 Speed Reference
2 = Pump 2 Speed Reference
3 = Pump 3 Speed Reference
4 = Pump 4 Speed Reference
5 = Pump 5 Speed Reference
6 = Pump 6 Speed Reference

7 = Pump X Speed Reference

8 = Local Analog Level Display

Notes:

1. The “No Function” (Function 0) turns off the Analog Output.
2. The “Pump 1 - 6 Speed Reference” (Functions 1 - 6) are active only when the respective pump is called to run.
3. The “Pump X Speed Reference” (Function 7) is always active.
4. The “Local Analog Level Display” (Function 8) is a copy of the “Level Input Data”. See Parameter F.407 below.

F.407	23.1 feet		40697	Local Analog Level Display - Span Range: 0.2 - 231.0 feet

Note: One of the Controller’s Analog Outputs may be assigned to perform the Function of “Local Analog Level Display” (Function 8) which sends the Level Input Data from Parameter Ld.01 to an external 4-20mA device (Local Analog Level Display or Telemetry Device).

Parameter F.407 is used to scale the 4-20mA output signal so that the Local Analog Level Display will correctly display the level in feet and 1/10 of feet.

The Span of the Analog Output assigned to perform Function 8 must match the Span of the external Local Analog Level Display or Telemetry Device. To make them match set Parameter F.407 so that it matches the Span set on the external Local Analog Level Display or Telemetry Device.

This Feature is only applicable in the “Level Control Mode” (Parameter P.091 = 1).

Analog Output Status

Status				Analog Output
A.400	-	-	41870	Analog Output - AOX1
A.401	-	-	41871	Analog Output - AO1
A.402	-	-	41872	Analog Output - AO2
A.403	-	-	41873	Analog Output - AO3
A.404	-	-	41874	Analog Output - AO4
A.405	-	-	41875	Analog Output - AO5
A.406	-	-	41876	Analog Output - AO6

Note:

Parameters A.400 - A.406 provide the status of the control values that are sent to the 12-bit Digital to Analog Converters that provide the reference signals to the Analog Outputs.

They are factory calibrated to the following:

819 @ 4.0 mA 4095 @ 20 mA

ANALOG OUTPUTS

User / Operator Info. Parameter	SCADA Register Address	Description of Register Contents		
Analog Output Calibration				
C.401	**40071**	Analog Output (AOX1)	Zero Calibration	Also see the Analog Output - AOX1 Status Parameter A.400.
C.402	**40072**		Span Calibration	
C.403	**40073**	Analog Output (AO1)	Zero Calibration	Also see the Analog Output - AO1 Status Parameter A.401.
C.404	**40074**		Span Calibration	
C.405	**40075**	Analog Output (AO2)	Zero Calibration	Also see the Analog Output - AO2 Status Parameter A.402.
C.406	**40076**		Span Calibration	
C.407	**40077**	Analog Output (AO3)	Zero Calibration	Also see the Analog Output - AO3 Status Parameter A.403.
C.408	**40078**		Span Calibration	
C.409	**40079**	Analog Output (AO4)	Zero Calibration	Also see the Analog Output - AO4 Status Parameter A.404.
C.410	**40080**		Span Calibration	
C.411	**40081**	Analog Output (AO5)	Zero Calibration	Also see the Analog Output - AO5 Status Parameter A.405.
C.412	**40082**		Span Calibration	
C.413	**40083**	Analog Output (AO6)	Zero Calibration	Also see the Analog Output - AO6 Status Parameter A.406.
C.414	**40084**		Span Calibration	

See page D-4 for Calibration Procedures.

ANALOG OUTPUT CALIBRATION PROCEDURE

Zero Calibration

1. First the respective Analog Output Control Value must be forced to a value of 819.

   Using the SC5000-CTS-HMI

   When using the SC5000-CTS-HMI, while on the HMI screen for calibration of the output, press the "FORCE 4.0 mA OUTPUT" button.

   See example HMI screen on page D-7.

   Using the SC5000-LED-HMI

   When using the SC5000-LED-HMI, this step is done automatically while viewing (in the menu) the Zero Calibration Parameter (C.401, C.403, C.405, C.407, C.409, C.411 or C.413).

   See page X-25.

2. Then using the Zero Calibration Parameter make the measured Analog Output 4.0mA.

   Using the SC5000-CTS-HMI

   When using the SC5000-CTS-HMI, while on the HMI screen for calibration of the output, increase or decrease the Zero Calibration Parameter (C.401, C.403, C.405, C.407, C.409, C.411 or C.413), using the "+" or "-" buttons until the measured (with an Amp Meter) Analog Output reads 4.0mA.

   See example HMI screen on page D-7.

   Using the SC5000-LED-HMI

   When using the SC5000-LED-HMI, while displaying (in the menu), the Zero Calibration Parameter (C.401, C.403, C.405, C.407, C.409, C.411 or C.413), press the Up or Down pushbuttons until the measured (with an Amp Meter) Analog Output reads 4.0mA.

   See page X-25.

Span Calibration

1. First the respective Analog Output Control Value must be forced to a value of 4095.

   Using the SC5000-CTS-HMI

   When using the SC5000-CTS-HMI, while on the HMI screen for calibration of the output, press the "FORCE 20 mA OUTPUT" button.

   See example HMI screen on page D-7.

   Using the SC5000-LED-HMI

   When using the SC5000-LED-HMI, this step is done automatically while viewing (in the menu) the Span Calibration Parameter (C.402, C.404, C.406, C.408, C.410, C.412 or C.414).

   See page X-25.

2. Then using the Span Calibration Parameter make the measured Analog Output 20mA.

   Using the SC5000-CTS-HMI

   When using the SC5000-CTS-HMI, while on the HMI screen for calibration of the output, increase or decrease the Span Calibration Parameter (C.402, C.404, C.406, C.408, C.410, C.412 or C.414), using the "+" or "-" buttons until the measured (with an Amp Meter) Analog Output reads 20mA.

   See example HMI screen on page D-7.

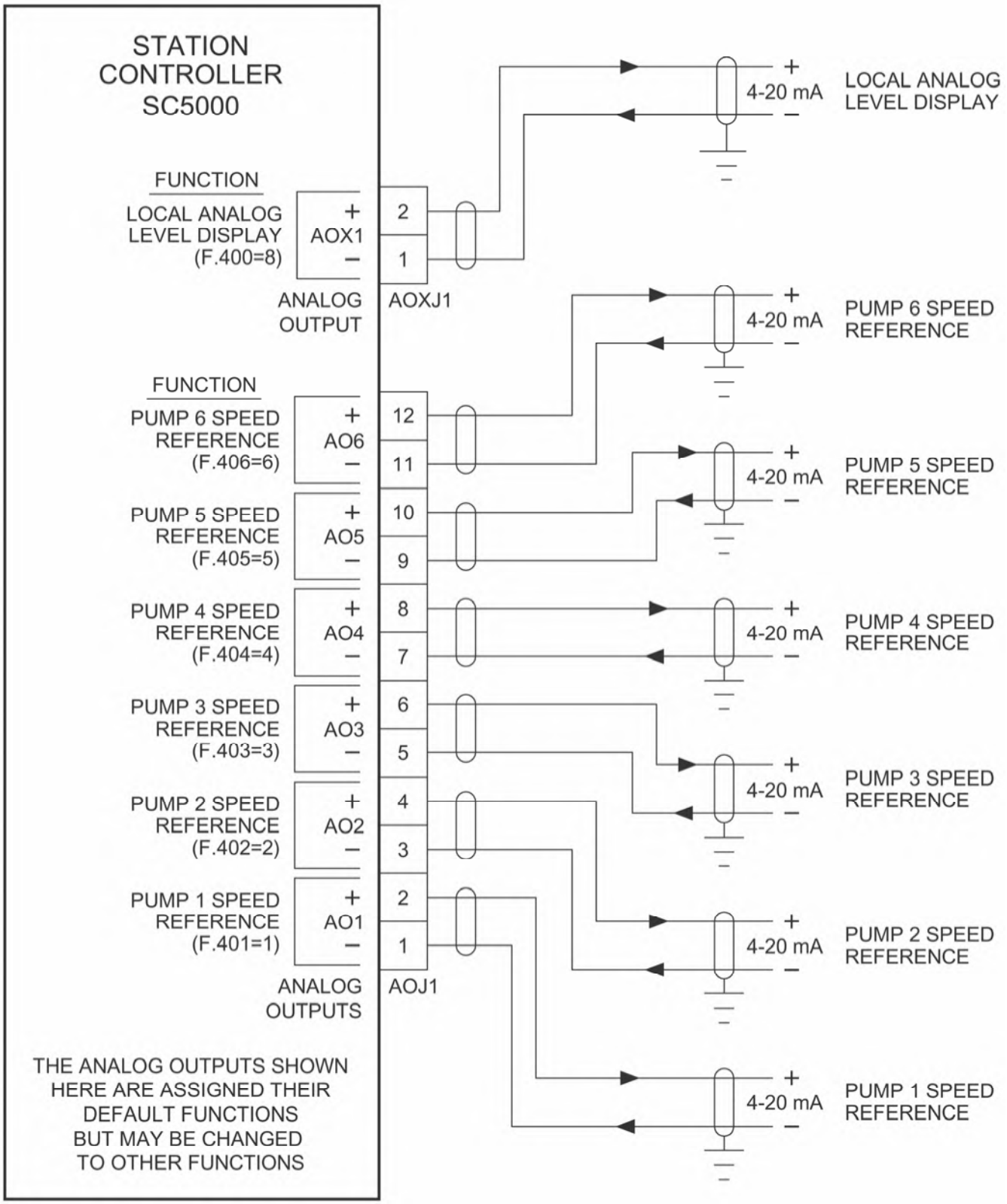
   Using the SC5000-LED-HMI

   When using the SC5000-LED-HMI, while displaying (in the menu), the Span Calibration Parameter (C.402, C.404, C.406, C.408, C.410, C.412 or C.414), press the Up or Down pushbuttons until the measured (with an Amp Meter) Analog Output reads 20mA.

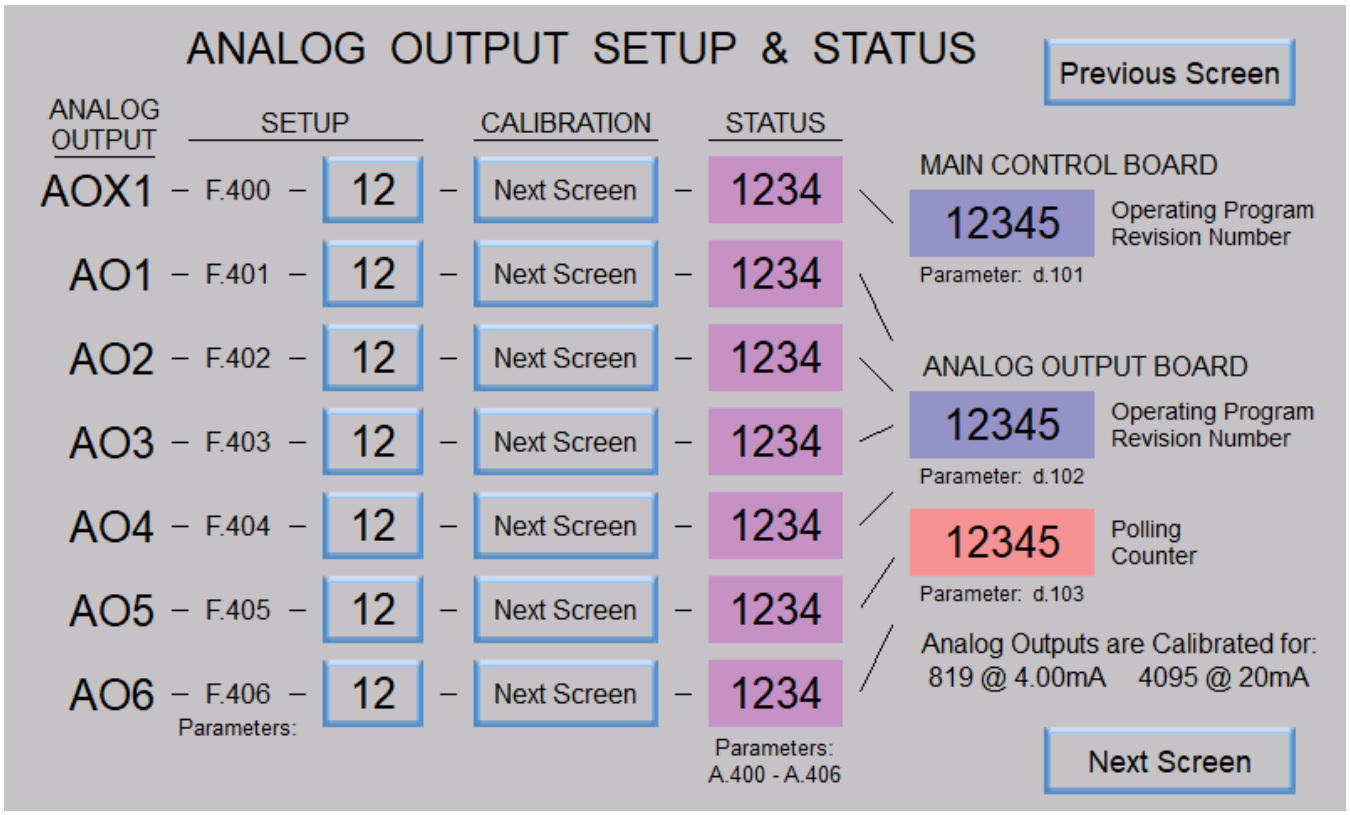
   See page X-25.

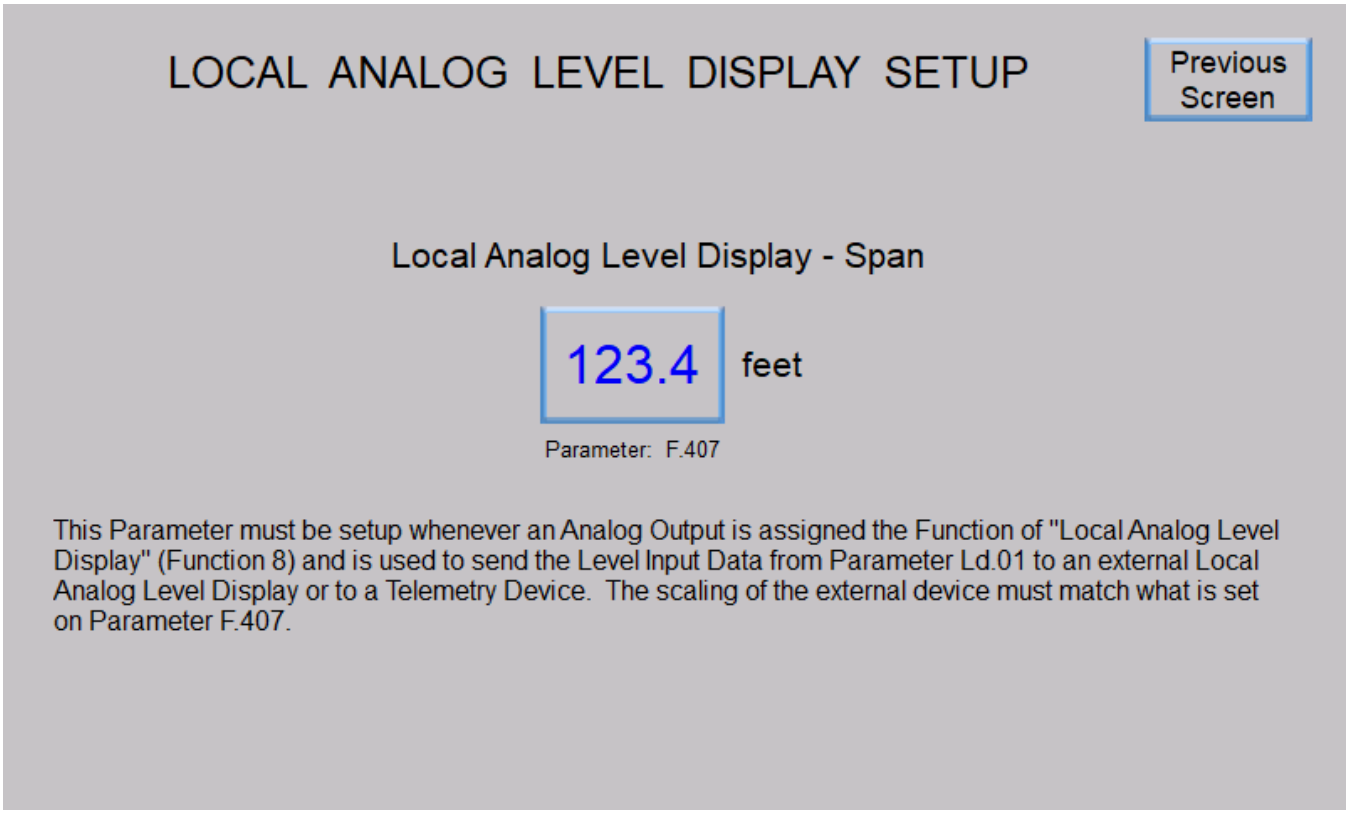
ANALOG OUTPUTS

Connection Diagram



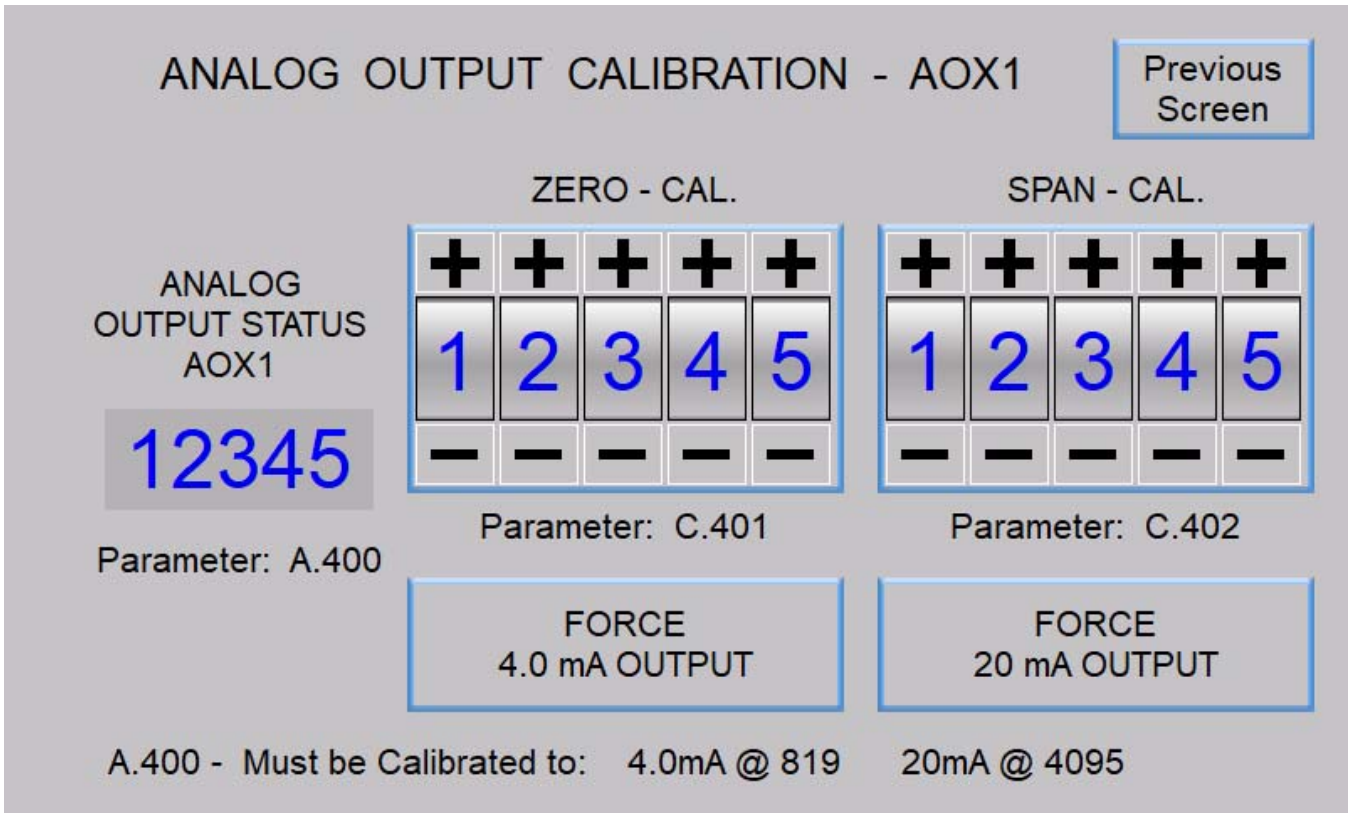
ANALOG OUTPUTS - Touchscreen HMI SCREENS





ANALOG OUTPUTS - Touchscreen HMI SCREENS

Analog Output Calibration - Typical of Analog Outputs AOX1 and AO1 - AO6



SECTION E
COMMUNICATION PORTS

Revision Date: 12-30-22

DESCRIPTION OF OPERATION

Ethernet Port ENET1 uses the Modbus TCP protocol and is for connection to a SCADA system.

Ethernet Port ENET2 uses the Modbus TCP protocol and is for connection to the SC5000-CTS-HMI. (Where the SC5000-CTS-HMI is a Color Touchscreen Interface.)

RS232 Port COM1 uses the Modbus RTU protocol and is for connection to the SC5000-LED-HMI. (Where the SC5000-LED-HMI is an LED 5 digit Numerical Interface intended for use in Level Control applications in non-temperature controlled control panels.)

The Controller's Communication Ports operate as Modbus Slaves, where all communication is initiated by the device connected to them, which must be a Modbus Master.

MODBUS Functions Supported

Function Code	Function Description	Notes
01	Read Coil Status	
02	Read Input Status	
03	Read Holding Registers	
04	Read Input Registers	
05	Force Single Coil	
06	Preset Single Register	
08	Diagnostics - Sub-function 00 (Return Query Data)	
15	Force Multiple Coils	Limited to 104 Coils
16	Preset Multiple Registers	Limited to 35 Registers

Notes:

1. The Controller has a "Parameter Security" feature that guards the Controller's Setup Parameters from unauthorized tampering. If the Parameter Security is locked, the entry of a 48 bit Security Code is required in order to gain Write Access to the Setup Parameters.
2. Security Code entry is not required to simply view the Parameters, but if they are locked, entry of the Security Code is required to change them.
3. Each of the three Communication Ports have their own Parameter Security that may be locked or unlocked individually to gain Write Access through the respective Communication Port.
4. For Ethernet Port ENET1 (connected to SCADA), Parameter Security, if locked, provides Write Access protection for the Modbus Registers (Setup Parameters) and also protects the Modbus Coils (Control Bits).
5. For Ethernet Port ENET2 and RS232 Port COM1 (connected to a local HMI), Parameter Security, if locked, provides Write Access protection for the Modbus Registers (Setup Parameters), but always allows Write Access to all Modbus Coils (Control Bits).
6. Ethernet Port ENET1 also has a "Parameter Security Alert" feature that detects an Unusually High Number of Entries (100 or more) into the Security Code Entry Parameters (SCE1, SCE2 and SCE3) and locks out any further attempts to write to Parameters SCE1, SCE2 and SCE3.
7. The Controller will always allow a reset of Fault Codes, even if the respective Communication Port is locked.
8. For a detailed description of "Parameter Security" see Section G.

REMOTE CONTROL COMMAND CANCELING

Remote control commands should (in most applications) be automatically canceled upon a loss of communication with either the SCADA system or the local HMI device. This requires that there be a delay before canceling the remote control commands that is longer than the interval between polling events. Therefore, each of the Communication Ports has its own "Remote Control Command Canceling Delay" Parameter (E.011 - E.013) where an operator may set the delay.

The Following Occurs when one of the Communication Ports stops being poled by its Master and when the respective Remote Control Canceling Delay has expired:

The value entered as the Default Remote Level (Parameter E.015) is copied into the Remote Level Control Input (Parameter rc.02).

Pump 1-6 Force On - All Pump Force On Commands are Canceled.

Pump 1-6 Disable - All Pump Disable Commands are Canceled.

Relays ROX1 - ROX12 Remote Control - All Relay Remote Control Commands are Canceled.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Remote Control Command Canceling Delays				
E.011	60 sec.		40181	Remote Control Command Canceling Delay - Ethernet Port - ENET1 Delay Range: 1 - 65535 seconds Set to "0" to disable the Remote Control Command Canceling feature. See Note 3.
E.012	60 sec.		40182	Remote Control Command Canceling Delay - Ethernet Port - ENET2 Delay Range: 1 - 65535 seconds Set to "0" to disable the Remote Control Command Canceling feature. See Note 3.
E.013	60 sec.		40183	Remote Control Command Canceling Delay - RS232 Port - COM1 Delay Range: 1 - 65535 seconds Set to "0" to disable the Remote Control Command Canceling feature. See Note 3.
Default Remote Level				
E.015	0.0 feet		40185	Default Remote Level Range: 0.0 - 231.0 feet See Note 4.

Notes:

1. Each Ethernet Port has its own separate "Remote Control Command Canceling Delay". The delay for each port is reset and restarted each time a successful polling event occurs through that port.
2. Each of the delays must be set long enough so that it will not time out between polling events of the port.
3. It may be desirable to not cancel the remote control commands upon a loss of communication through one of the ports. In this case set the Remote Control Command Canceling Delay Parameter to "0" for that port, so that a loss of communication through that port will not initiate the canceling of the remote control commands.
4. The "Default Remote Level" (Parameter E.015) is only used when the Controller is operating in the "Level Control Mode" (Parameter P.091 = 1) and when the "Level Input Select" is set for "Remote Level Control" (Parameter P.133 = 7).
5. Upon loss of power, all remote control commands will be canceled. When power is restored the Default Remote Level (Parameter E.015) will be copied to the Remote Control Level Input (Parameter rc.02).

ETHERNET PORT - ENET1 - For Connection to a SCADA System

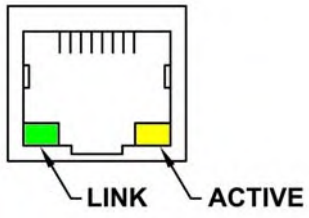
Description

The Ethernet Port has the following features:

- Protocol Supported: Modbus TCP
- IEEE 802.3 Compliant
- Auto-negotiation of Communication Speed: 10 or 100 Mbps
- Auto-negotiation of Duplex Mode: Half or Full Duplex
- Link, and Active status LED indicators

LED Indicator	OFF	ON
LINK (Green)	Not Linked	Linked
ACTIVE (Yellow)	Idle	Active Communication

RJ45 Connector



User / Operator Info.		Scada	
Parameter	**Default Value**	**Register Address**	**Parameter Definitions**
Ethernet Port ENET1 Setup			
E.101	2	40200	Protocol 2 = Modbus TCP
E.114 - E.111	192 . 168 . 80 . 12 (E.114 . E.113 . E.112 . E.111)	40204-40201	IP Address Range: 0 - 255 Identifier for the device on an IP network.
E.144 - E.141	255 . 255 . 255 . 0 (E.144 . E.143 . E.142 . E.141)	40226-40223	Subnet Mask Range: 0 - 255 Range of IP addresses that can be Directly connected in the network.
E.154 - E.151	192 . 168 . 80 . 1 (E.154 . E.153 . E.152 . E.151)	40230-40227	Default Gateway Range: 0 - 255 A node on the network that serves as an entrance to another network when no direct connection exists.
E.161	502	40232	Port Number Range: 1 - 65,535
Ethernet Port ENET1 MAC Address			
E.176 - E.171	0 : 80 : 194 : 219 : XXX : XXX (E.176 : E.175 : E.174 : E.173 : E.172 : E.171)	40222-40217	MAC Address Unique number that identifies each field device. It is set at the factory, and should not be changed.

Note:
The Ethernet Port reads the setup values upon power up; any changes to the above settings require that the power to be cycled before the new values are used.

ETHERNET PORT - ENET2 - For Connection to the SC5000-CTS-HMI

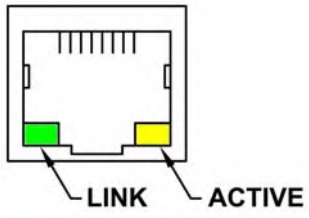
Description

The Ethernet Port has the following features:

- Protocol Supported: Modbus TCP
- IEEE 802.3 Compliant
- Auto-negotiation of Communication Speed: 10 or 100 Mbps
- Auto-negotiation of Duplex Mode: Half or Full Duplex
- Link, and Active status LED indicators

LED Indicator	OFF	ON
LINK (Green)	Not Linked	Linked
ACTIVE (Yellow)	Idle	Active Communication

RJ45 Connector



User / Operator Info.		Scada	
Parameter	**Default Value**	**Register Address**	**Parameter Definitions**
Ethernet Port ENET2 Setup			
E.201	2	40250	Protocol 2 = Modbus TCP
E.214 - E.211	192 . 168 . 80 . 12 (E.214 . E.213 . E.212 . E.211)	40254-40251	IP Address Range: 0 - 255 Identifier for the device on an IP network.
E.244 - E.241	255 . 255 . 255 . 0 (E.244 . E.243 . E.242 . E.241)	40276-40273	Subnet Mask Range: 0 - 255 Range of IP addresses that can be Directly connected in the network.
E.254 - E.251	192 . 168 . 80 . 1 (E.254 . E.253 . E.252 . E.251)	40280-40277	Default Gateway Range: 0 - 255 A node on the network that serves as an entrance to another network when no direct connection exists.
E.261	502	40282	Port Number Range: 1 - 65,535
Ethernet Port ENET2 MAC Address			
E.276 - E.271	0 : 80 : 194 : 219 : XXX : XXX (E.276 : E.275 : E.274 : E.273 : E.272 : E.271)	40272-40267	MAC Address Unique number that identifies each field device. It is set at the factory, and should not be changed.

Note:
The Default Setup Values (shown above) are used to connect with the Local Touchscreen HMI. They are set at the factory to match the setup of the SC5000-CTS-HMI and can not be changed in the field using the SC5000-CTS-HMI.

RS232 PORT - COM1 - For Connection to the SC5000-LED-HMI

Description

The RS232 Port COM1 has the following features:

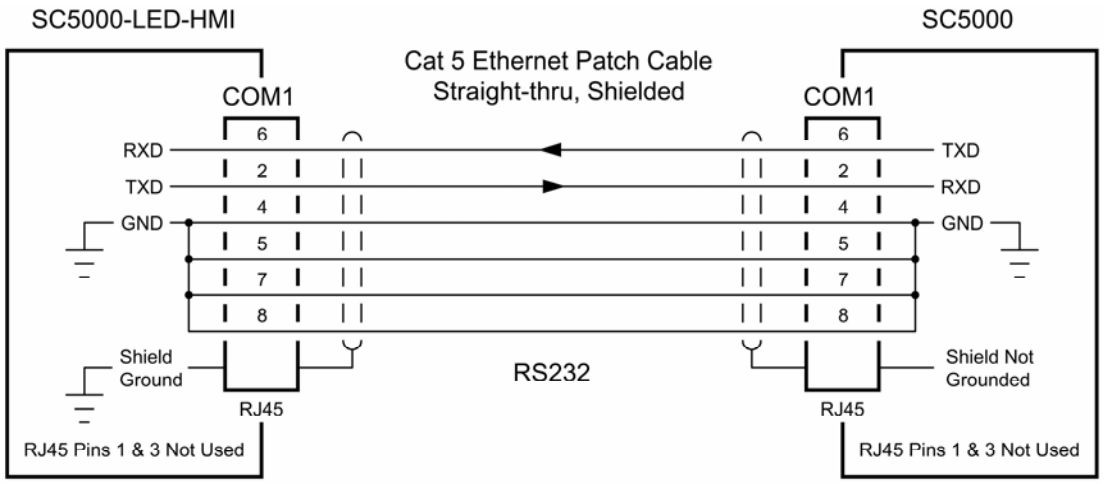
- Protocol Supported: Modbus RTU
- Connector: RJ45 for use with a Shielded CAT5 Patch Cable
- Setup Parameters: Factory set to match the SC5000-LED-HMI

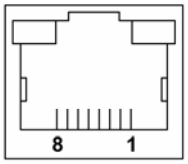
Factory Settings:

Baud Rate: 9600 bps
Parity Mode: No Parity
Stop Bits: 1

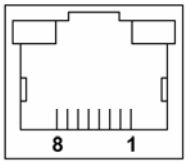
User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
RS232 Port COM1 Slave Address Setup				
E.347	1		40347	Slave Address - COM1 Range: 1 - 247 Note: COM1 will always respond to what is set on Parameter E.347. COM1 will also always respond to Modbus request using the Slave Address "1". (The SC5000-LED-HMI uses Slave Address "1" to communicate with the SC5000.)

Connection Diagram



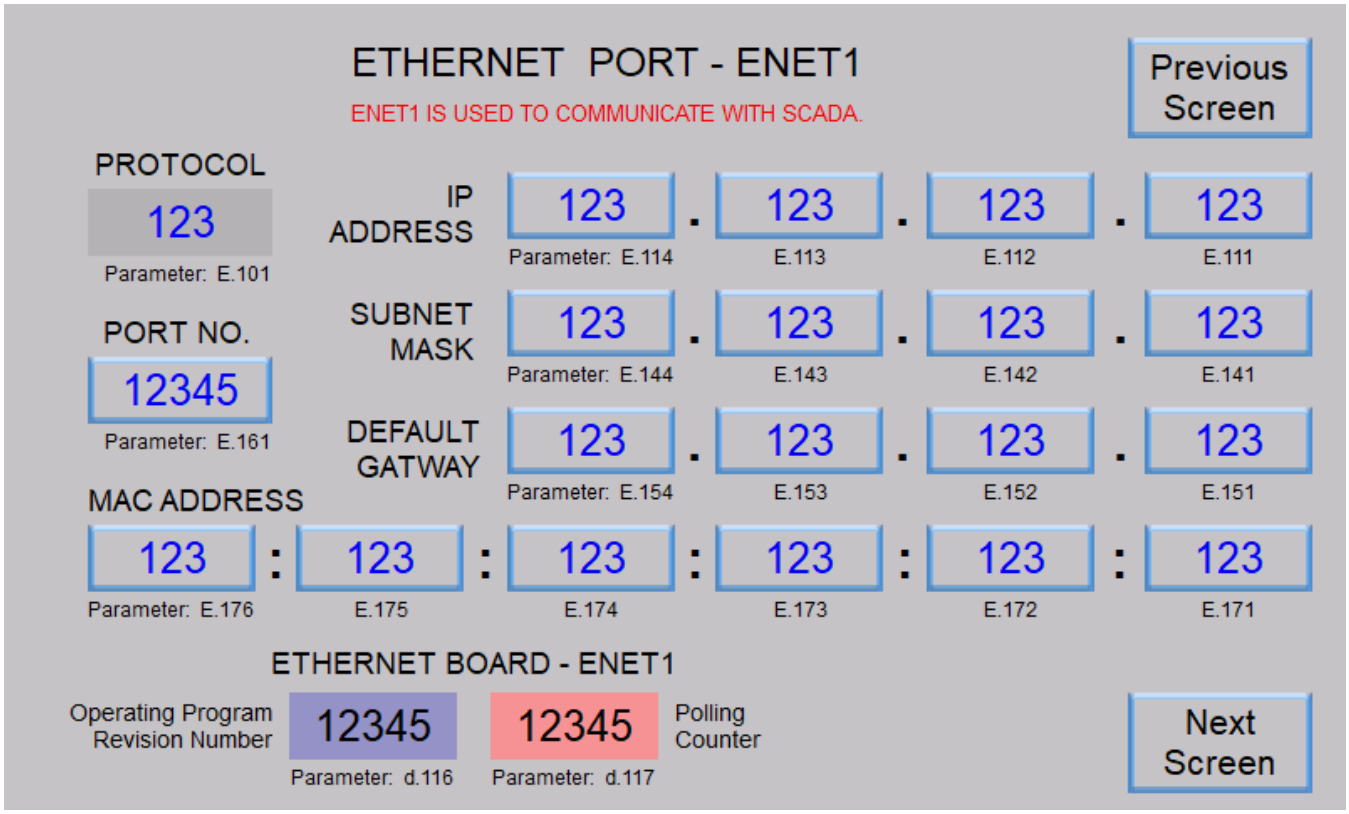


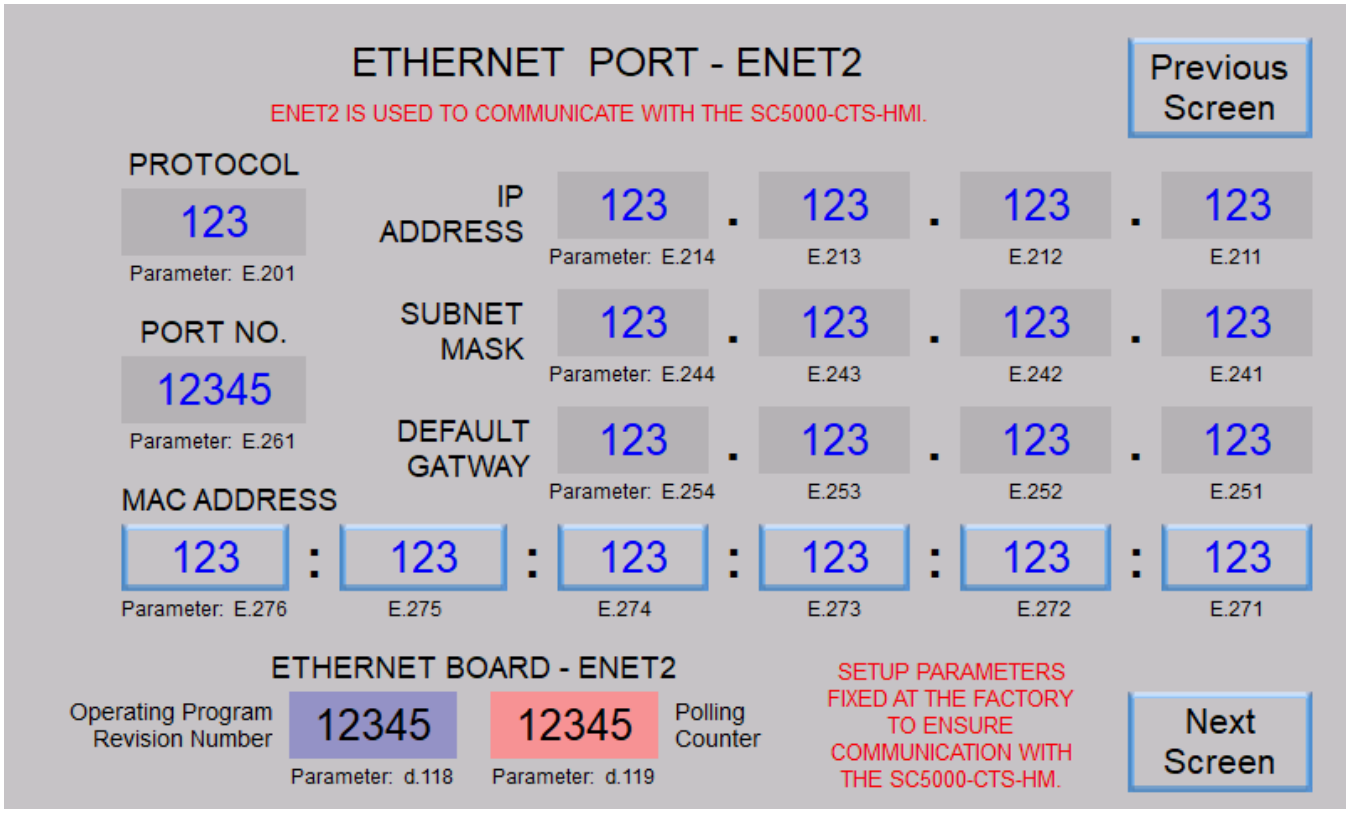
RJ45 Connector



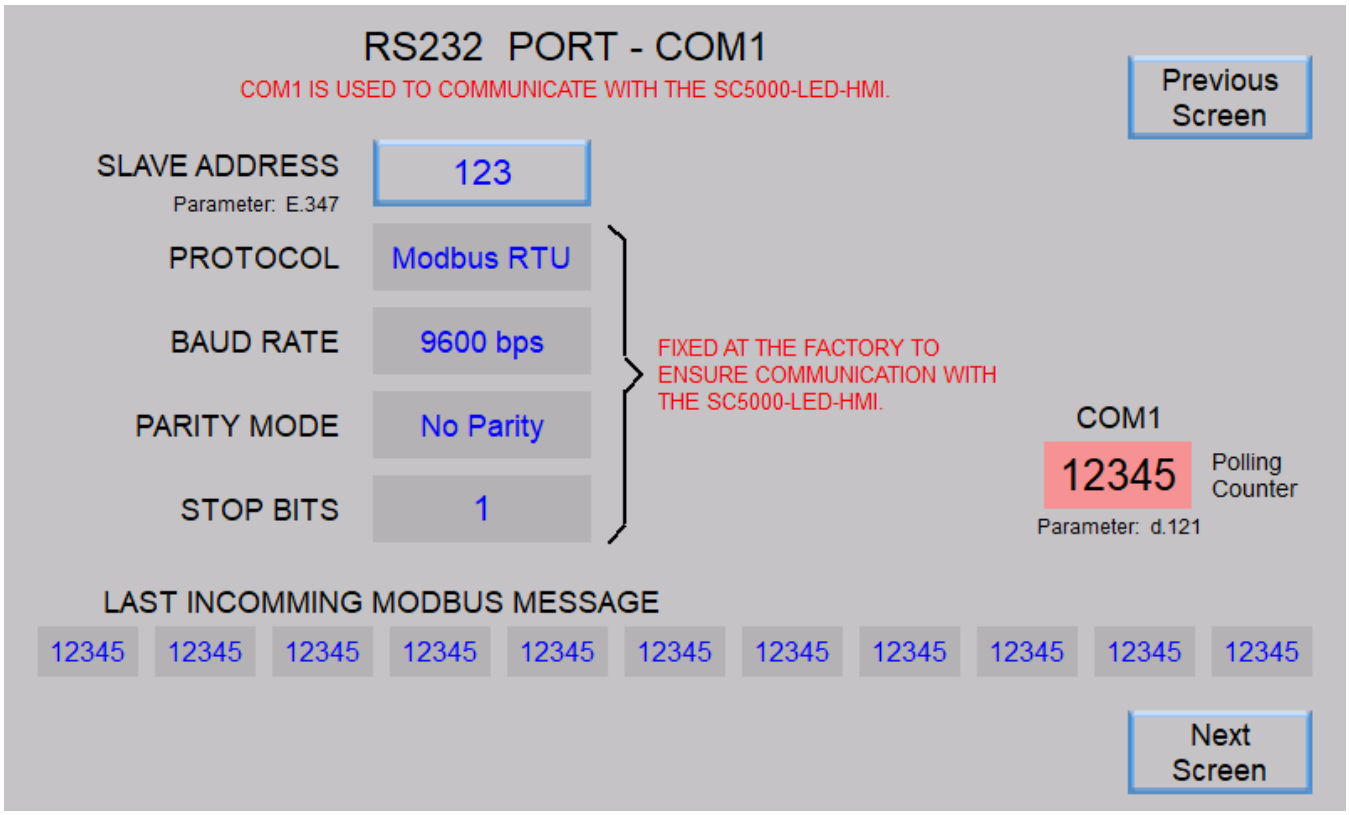
RJ45 Connector

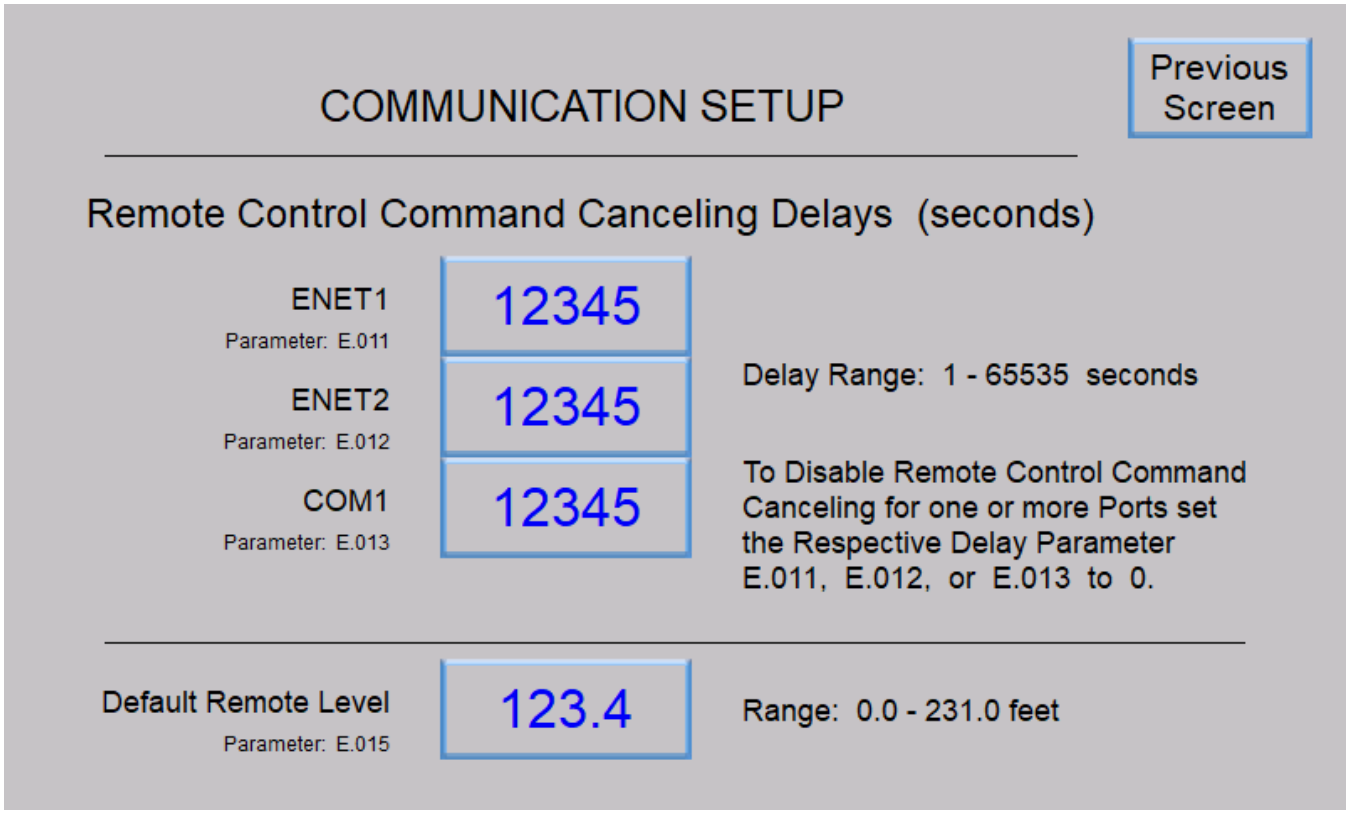
COMMUNICATION PORTS - Touchscreen HMI SCREENS





COMMUNICATION PORTS - Touchscreen HMI SCREENS





SECTION F
FAULT CODES

Revision Date: 12-30-22

Fault Indication

The Fault indicator on the front of the SC5000 shows when there is something wrong with the system, and that there is a non-zero Fault Code present in Parameter FLC. Please see the Fault Code Table below.

Fault Code

The current Fault Code may be viewed from Parameter FLC.

Last Fault Code

The Last Fault Code may be viewed from Parameter LFC. It is a copy of the last non-zero Fault Code that was present in Parameter FLC.

Parameter	SCADA Register Address	Data Description
FLC	42499	Fault Code — See Fault Code Table below. Note: Parameter FLC automatically returns to zero when the fault clears. (Except for the latching fault codes: 1001 - 1009 & 1051 - 1056.)
LFC	42500	Last Fault Code — See Fault Code Table below. Note: Parameter LFC is a copy of the last fault code that was shown on Parameter FLC.
The latching fault codes and the Last Fault Code LFC may be reset by momentarily setting Modbus Coil 305 (Register 40020 Bit 0).		

Parameters FLC and LFC may be viewed and reset on various SC5000-CTS-HMI screens.

Parameters FLC and LFC may also be viewed in the SC5000-LED-HMI menu and may be reset by pressing the down push-button while viewing either FLC or LFC.

FAULT CODE TABLE

Fault Code	Description of Condition
0	Normal
1001	Level Probe Fault - Electrodes Covered Out of Sequence - Electrode 1 Covered before Electrode 2
1002	Level Probe Fault - Electrodes Covered Out of Sequence - Electrode 2 Covered before Electrode 3
1003	Level Probe Fault - Electrodes Covered Out of Sequence - Electrode 3 Covered before Electrode 4
1004	Level Probe Fault - Electrodes Covered Out of Sequence - Electrode 4 Covered before Electrode 5
1005	Level Probe Fault - Electrodes Covered Out of Sequence - Electrode 5 Covered before Electrode 6
1006	Level Probe Fault - Electrodes Covered Out of Sequence - Electrode 6 Covered before Electrode 7
1007	Level Probe Fault - Electrodes Covered Out of Sequence - Electrode 7 Covered before Electrode 8
1008	Level Probe Fault - Electrodes Covered Out of Sequence - Electrode 8 Covered before Electrode 9
1009	Level Probe Fault - Electrodes Covered Out of Sequence - Electrode 9 Covered before Electrode 10
1011	Setup Fault - Pump On/Off Level Control - 1st Pump Off Level and 1st Pump On Level are too close together (minimum of: 0.5 feet apart), or they are upside down.
1012	Setup Fault - Pump On/Off Level Control - 2nd Pump Off Level and 2nd Pump On Level are too close together (minimum of: 0.5 feet apart), or they are upside down.
1013	Setup Fault - Pump On/Off Level Control - 3rd Pump Off Level and 3rd Pump On Level are too close together (minimum of: 0.5 feet apart), or they are upside down.

FAULT CODE TABLE

Fault Code	Description of Condition
0	Normal
1014	Setup Fault - Pump On/Off Level Control - 4th Pump Off Level and 4th Pump On Level are too close together (minimum of: 0.5 feet apart), or they are upside down.
1015	Setup Fault - Pump On/Off Level Control - 5th Pump Off Level and 5th Pump On Level are too close together (minimum of: 0.5 feet apart), or they are upside down.
1016	Setup Fault - Pump On/Off Level Control - 6th Pump Off Level and 6th Pump On Level are too close together (minimum of: 0.5 feet apart), or they are upside down.
1017	Setup Fault - VFD Speed Reference - Level at Minimum Speed and Level at 100% Speed are too close together (minimum of: 0.5 feet apart), or they are upside down.
1018	Setup Fault - More than one Discrete Input is assigned to the same Function.
1019	Setup Fault - More than one Analog Input is assigned to the same Function.
1031	All Pump Disable - Discrete Input assigned Function 17 is closed (Typically connected to Phase Monitor).
1041	Pump Cutoff Low-Low Level Active - Discrete Input assigned Function 59 is closed.
1042	Pump Cutoff High-High Level Active - Discrete Input assigned Function 60 is closed.
1050	Float Backup Control Active Calling Pump(s) to Run. Note: This Fault is disabled if the Level Input Source is set for Float Switch Inputs (Parameter P.133 = 6).
1051	Float Control Fault - Float Out of Sequence - 1st On Level Float input closed before Off Level Float input.
1052	Float Control Fault - Float Out of Sequence - 2nd On Level Float input closed before 1st On Level Float input.
1053	Float Control Fault - Float Out of Sequence - 3rd On Level Float input closed before 2nd On Level Float input.
1054	Float Control Fault - Float Out of Sequence - 4th On Level Float input closed before 3rd On Level Float input.
1055	Float Control Fault - Float Out of Sequence - 5th On Level Float input closed before 4th On Level Float input.
1056	Float Control Fault - Float Out of Sequence - 6th On Level Float input closed before 5th On Level Float input.
1081	Hardware Fault - Reading a Setup Parameter from the EEPROM was not successful.
1082	Hardware Fault - Storing a Setup Parameter to EEPROM was not successful.
1101	Analog Level Meter ALM1 - Below Normal Range (Below 3.5mA) - Level Control has Switched to Level Meter ALM2. Note: This Fault can only be generated when the Level Input Select (Parameter P.133) is set on 3.
1102	Analog Level Meter ALM1 - Above Normal Range (Above 21mA) - Level Control has Switched to Level Meter ALM2. Note: This Fault can only be generated when the Level Input Select (Parameter P.133) is set on 3.
1103	Analog Level Meter ALM2 - Below Normal Range (Below 3.5mA) - Level Control has Switched to Level Meter ALM1. Note: This Fault can only be generated when the Level Input Select (Parameter P.133) is set on 4.
1104	Analog Level Meter ALM2 - Above Normal Range (Above 21mA) - Level Control has Switched to Level Meter ALM1. Note: This Fault can only be generated when the Level Input Select (Parameter P.133) is set on 4.
1201	Parameter Security Alert - Suspicious Activity on SCADA Ethernet Port ENET1 Detected an Unusually High Number of Entries into the Security Code Entry Parameters: SCE3 : SCE2 : SCE1

FAULT CODE TABLE

Fault Code	Description of Condition
0	Normal
	Ethernet Port - ENET1 - Communication Fault
2101	The UART detected an Overrun Error reading incoming message.
2102	The UART detected a Parity Error reading the incoming message.
2103	The UART detected a Framing Error or Parity Error reading the incoming message.
2104	Incoming message failed Checksum Test.
2105	Incoming message Length Error. Maximum Allowed: 80 Bytes
2106	Incoming message with Function Code No. 15 - Byte Count Limit Exceeded. Maximum Allowed: 13 Bytes
2107	Incoming message with Function Code No. 15 - Coil Quantity Exceeds what is Allowed by Byte Count.
2108	Incoming message with Function Code No. 16 - Byte Count Limit Exceeded. Maximum Allowed: 70 Bytes
2109	Incoming message with Function Code No. 05 - Coil Address Out of Bounds. Valid Range: 1 - 320
2110	Incoming message with Function Code No. 06 - Register Address Out of Bounds. Valid Range: 40001 - 41700 and 42001 - 42080
2111	Incoming message with Function Code No. 15 - Coil Address Out of Bounds. Valid Range: 1 - 320
2112	Incoming message with Function Code No. 16 - Register Address Out of Bounds. Valid Range: 40001 - 41700 and 42001 - 42080
	Ethernet Port - ENET2 - Communication Fault
3101	The UART detected an Overrun Error reading incoming message.
3102	The UART detected a Parity Error reading the incoming message.
3103	The UART detected a Framing Error or Parity Error reading the incoming message.
3104	Incoming message failed Checksum Test.
3105	Incoming message Length Error. Maximum Allowed: 80 Bytes
3106	Incoming message with Function Code No. 15 - Byte Count Limit Exceeded. Maximum Allowed: 13 Bytes
3107	Incoming message with Function Code No. 15 - Coil Quantity Exceeds what is Allowed by Byte Count.
3108	Incoming message with Function Code No. 16 - Byte Count Limit Exceeded. Maximum Allowed: 70 Bytes
3109	Incoming message with Function Code No. 05 - Coil Address Out of Bounds. Valid Range: 1 - 320
3110	Incoming message with Function Code No. 06 - Register Address Out of Bounds. Valid Range: 40001 - 41800 , 42001 - 42100 and 42601 - 42620
3111	Incoming message with Function Code No. 15 - Coil Address Out of Bounds. Valid Range: 1 - 320
3112	Incoming message with Function Code No. 16 - Register Address Out of Bounds. Valid Range: 40001 - 41800 , 42001 - 42100 and 42601 - 42620

FAULT CODE TABLE

Fault Code	Description of Condition
0	Normal
	RS232 Port - COM1 - Communication Fault
4101	The UART detected an Overrun Error reading incoming message.
4102	The UART detected a Parity Error reading the incoming message.
4103	The UART detected a Framing Error or Parity Error reading the incoming message.
4104	Incoming message failed Checksum Test.
4105	Incoming message Length Error. Maximum Allowed: 80 Bytes
4106	Incoming message with Function Code No. 15 - Byte Count Limit Exceeded. Maximum Allowed: 13 Bytes
4107	Incoming message with Function Code No. 15 - Coil Quantity Exceeds what is Allowed by Byte Count.
4108	Incoming message with Function Code No. 16 - Byte Count Limit Exceeded. Maximum Allowed: 70 Bytes
4109	Incoming message with Function Code No. 05 - Coil Address Out of Bounds. Valid Range: 1 - 320
4110	Incoming message with Function Code No. 06 - Register Address Out of Bounds. Valid Range: 40001 - 41800 , 42001 - 42100 and 42601 - 42620
4111	Incoming message with Function Code No. 15 - Coil Address Out of Bounds. Valid Range: 1 - 320
4112	Incoming message with Function Code No. 16 - Register Address Out of Bounds. Valid Range: 40001 - 41800 , 42001 - 42100 and 42601 - 42620
	USB Port - Communication Fault
5101	The UART detected an Overrun Error reading incoming message.
5102	The UART detected a Parity Error reading the incoming message.
5103	The UART detected a Framing Error or Parity Error reading the incoming message.
5104	Incoming message failed Checksum Test.
5105	Incoming message Length Error. Maximum Allowed: 80 Bytes
5106	Incoming message with Function Code No. 15 - Byte Count Limit Exceeded. Maximum Allowed: 13 Bytes
5107	Incoming message with Function Code No. 15 - Coil Quantity Exceeds what is Allowed by Byte Count.
5108	Incoming message with Function Code No. 16 - Byte Count Limit Exceeded. Maximum Allowed: 70 Bytes
5109	Incoming message with Function Code No. 05 - Coil Address Out of Bounds. Valid Range: 1 - 320
5110	Incoming message with Function Code No. 06 - Register Address Out of Bounds. Valid Range: 40031 - 41700 and 42601 - 42620
5111	Incoming message with Function Code No. 15 - Coil Address Out of Bounds. Valid Range: 1 - 320
5112	Incoming message with Function Code No. 16 - Register Address Out of Bounds. Valid Range: 40031 - 41700 and 42601 - 42620

SECTION G
PARAMETER SECURITY

Revision Date: 12-30-22

Description

The Parameter Security feature is used to guard the Controller's Parameters from unauthorized tampering. It requires the entry of a 48 bit Security Code in order to gain Write Access to the Parameters. Security Code entry is not required to simply view the parameters, but it is required to change their value.

Each of the three Communication Ports (ENET1, ENET2 & COM1) have their own Parameter Security.

Entering the Security Code through one of the communication ports, unlocks the Write Access of the Parameters but only through the communication port through which you entered the Security Code, and leaves the locked / unlocked status of the other two communication ports unchanged.

Communication Port ENET1 is designated for connection to SCADA. Write Access protection covers all the Modbus Registers (Setup Parameters), and all the Modbus Coils (Control Bits).

Communication Port ENET2 is designated for connection to a local HMI (SC5000-CTS-HMI). Write Access protection covers all Modbus Registers (Setup Parameters), but not the Modbus Coils (Control Bits).

Communication Port COM1 is designated for connection to a local HMI (SC5000-LED-HMI). Write Access protection covers all Modbus Registers (Setup Parameters), but not the Modbus Coils (Control Bits).

The Security Code Entry is divided into three parts (SCE3 : SCE2 : SCE1), where each part is a separate 16-bit parameter that has an entry range of 1 - 65,535. All three parts of the Security Code must be entered correctly to unlock the Setup Parameters.

Once unlocked, the Write Access of the Parameters and Control Bits will remain unlocked until the Write Access Relock Delay expires, or until an operator enters a "1" into the Security Code Entry SCE1 or SCE2 or SCE3.

Communication Port ENET1 also has a "Parameter Security Alert" feature that detects an Unusually High Number of Entries (100 or more), into the Security Code Entry Parameters (SCE1, SCE2 and SCE3). If the Suspicious Activity is detected, the Controller locks out any further entries into Parameters SCE1, SCE2 and SCE3 and issues Fault Code 1201, which is written to Fault Code Parameters FLC and LFC. Status of the "Parameter Security Alert" is also available from Modbus Coil 189 (Register 40012 Bit 12). To reset the ability to write to the Security Code Entry Parameters (SCE1, SCE2 and SCE3) through Communication Port ENET1, Fault Code 1201 must be reset from a Local HMI through Communication Port ENET1 or COM1.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Security Code Entry				
SCE1	11	-	42078	Security Code Entry - **SCE3 : SCE2 : SCE1** Range: 1 - 65,535 Enter Your Security Code Here to Unlock the Parameters. Manually Relock by Entering "1" into Parameter SCE1, or SCE2, or SCE3. If you forget your Security Code, have the Serial Number and consult the factory.
SCE2	12	-	42079	
SCE3	13	-	42080	
The "Parameter Security Alert" status is available from Modbus Coil 189 (Register 40012 Bit 12).				

PARAMETER SECURITY

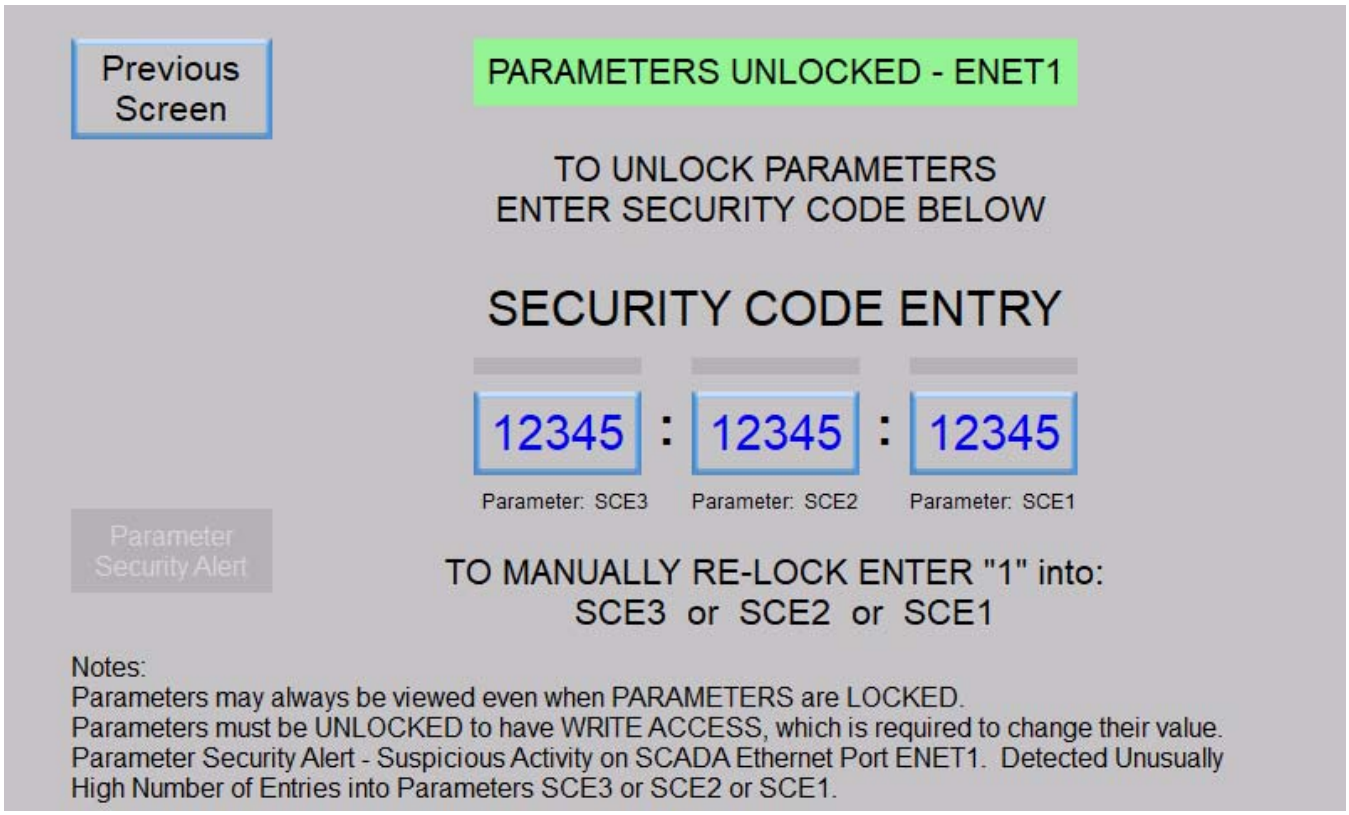
To change the Security Setup, enter the Current Security Code into Parameters **cSCE3**, **cSCE2** and **cSCE1**.

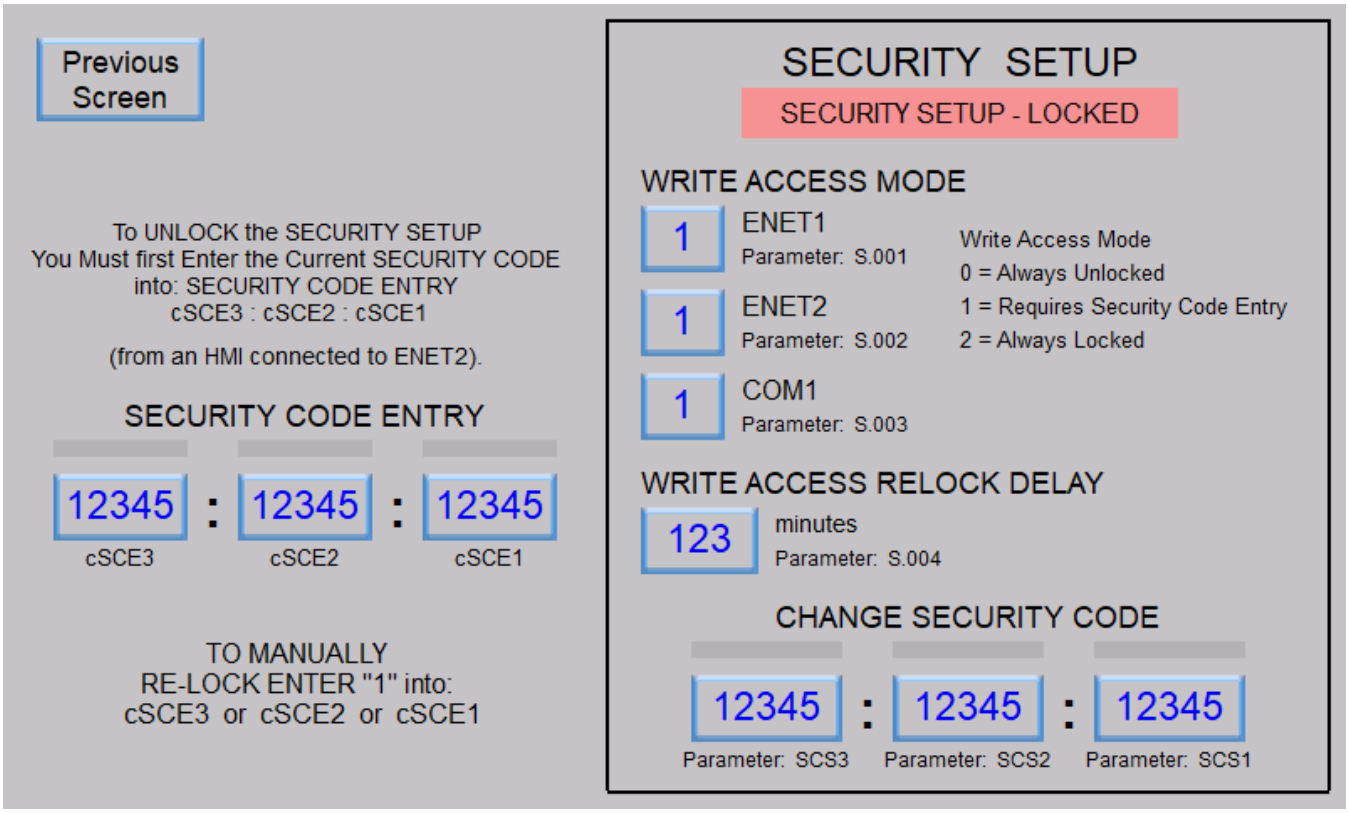
User / Operator Info.			SCADA	Description of Parameters and SCADA Notes
Parameter	Default Value	Current Value	Register Address	
Security Setup				
cSCE1	-	-	-	Security Code Entry - **cSCE3 : cSCE2 : cSCE1** Range: 1 - 255 Enter Your Security Code Here to Unlock the following Security Setup Parameters: **S.001**, **S.002**, **S.003**, **S004**, **SCS1**, **SCS2** & **SCS3**
cSCE2	-	-	-	
cSCE3	-	-	-	
S.001	0		-	**ENET1** Write Access Mode 0 = Always Unlocked 1 = Requires Security Code Entry 2 = Always Locked (This mode is only available for ENET1.)
S.002	0		-	**ENET2**
S.003	0		-	**COM1**
S.004	60 min.		-	Write Access Relock Delay Range: 10 - 480 minutes
SCS1	11	-	-	Change Security Code - **SCS3 : SCS2 : SCS1** Range: 2 - 255 Establishes the Numerical Values that will be Accepted as the Security Code.
SCS2	12	-	-	
SCS3	13	-	-	

Parameter Security Notes:

1. Write Access Mode “0” (Always Unlocked), provides Write Access for all Parameters and Control Bits through the respective Communication Port.
2. Write Access Mode “1” (Requires Security Code Entry), provides Write Access through the Communication Port through which the Security Code was entered, leaving the “Write Access” of the other Communication Ports unchanged.
3. Write Access Mode “2” (Always Locked), provides additional protection from tampering. In this mode, no Parameters or Control Bits may be written to, even with Security Code entered. This feature is only available on Communication Port ENET1, which is intended to be connected to SCADA.
4. Changing any of the above Security Setup parameters can only be done from the local HMI connected to Communication Ports ENET2 or COM1, and only after the entry of the current Security Code into Parameters cSCE3, cSCE2 and cSCE1. The Security Setup parameters will automatically relock after ten minutes, or you may manually relock them by entering a “1” into cSCE3 or cSCE2 or cSCE1.
5. Attempts to remotely read the Security Code Entry or Change Security Code registers will always return a zero.
6. Reset of a Fault Code Modbus Coil 305 (Register 40020 Bit 0) is always allowed without a Security Code Entry.

PARAMETER SECURITY - Touchscreen HMI SCREENS





SECTION H

Revision Date: 12-30-22

BACKUP or RESTORE SETUP PARAMETERS using a USB FLASH DRIVE

General Description

The USB Host Port on the SC5000 allows an operator to copy (Backup) all of the Setup Parameters from the SC5000 onto a USB Flash Drive, and then later copy (Restore) the Setup Parameters back to the same SC5000, or copy the Setup Parameter values to another SC5000.

A screen on the Touch Screen HMI, connected to the Controller, provides the operator with control and status of the Backup and Restore functions.

The Parameter values are stored on the USB Flash Drive as a text file with file name: scbackup.txt.

The backup file on the USB Flash Drive may be copied to a computer and viewed using a text editor such as Notepad.

When viewing the contents of scbackup.txt the parameter's Modbus Address will be shown on the left of the equal sign and the parameter's value will be shown to the right of the equal sign, as shown below:

```
40091 = XXXXX
40092 = XXXXX
||||||||||||||
41700 = XXXXX
```

The USB Host Port supports FAT32. When purchased USB Flash Drives are typically already formatted for FAT32, but if not you will need to use a computer to format the Flash Drive for FAT32 before inserting it into the SC5000 USB Host Port.

Please note that the USB Flash Drive used for the Backup or Restore of Setup Parameters should have no other files on it, except for scbackup.txt. While performing the Parameter Backup function, if the USB Flash Drive contains a previous copy of scbackup.txt, that file will be overwritten during the Parameter Backup process with an updated copy of scbackup.txt.

Parameter Backup

Parameter Backup performs the function of copying the SC5000 Setup Parameters to a USB Flash Drive.

To copy the Setup Parameter values from the SC5000 to a USB Flash Drive perform the following steps:

On the **SC5000-CTS-HMI** (Color Touchscreen HMI):

1. Insert the USB Flash Drive into the USB Host Port on the front of the SC5000. (The USB Flash Drive must already be formatted for FAT32 and have no files on it, except it may have an earlier copy of scbackup.txt.)
2. Go to HMI screen "Backup or Restore Parameters USB Drive".
3. Enter the Security Code into Parameters: uSCE3 : uSCE2 : uSCE1.
4. Press the "Start Backup" Button.
5. When the "Backup Complete" indicator is turned on the Backup function has been completed and it is ok to remove the USB Flash Drive.

Caution - While the Red LED near the USB Flash Drive is on Do Not Remove the USB Flash Drive.

On the **SC5000-LED-HMI**:

1. Insert the USB Flash Drive into the USB Host Port on the front of the SC5000. (The USB Flash Drive must already be formatted for FAT32 and have no files on it, except it may have an earlier copy of scbackup.txt.)
3. Enter the Security Code into Parameters: uSCE3 : uSCE2 : uSCE1.
4. While viewing Parameter PbAuP hold down the Up pushbutton for 10 seconds. After the 10 seconds, Parameter PbAup will show the Backup function's steps, starting with step 2 and ending at 5.
5. When the Parameter Backup Step parameter (PbAuP) gets to step 5 the Backup function has been completed and it is OK to remove the USB Flash Drive. Parameter PbAuP will be reset back to zero after 10 seconds.

Caution - While the Red LED near the USB Flash Drive is on Do Not Remove the USB Flash Drive.

Parameter Restore

Parameter Restore performs the function of copying the contents of the scbackup.txt file stored on a USB Flash Drive to the internal memory of the SC5000.

The Setup Parameter values are first copied to the SC5000 internal RAM (Random Access Memory) memory, and from there they are automatically copied to the SC5000 internal EEPROM (Electrically Erasable Programmable Read-Only Memory) where the Setup Parameter values are preserved during power outages.

To copy the Setup Parameter values from a USB Flash Drive to the SC5000 perform the following steps:

On the **SC5000-CTS-HMI** (Color Touch Screen HMI):

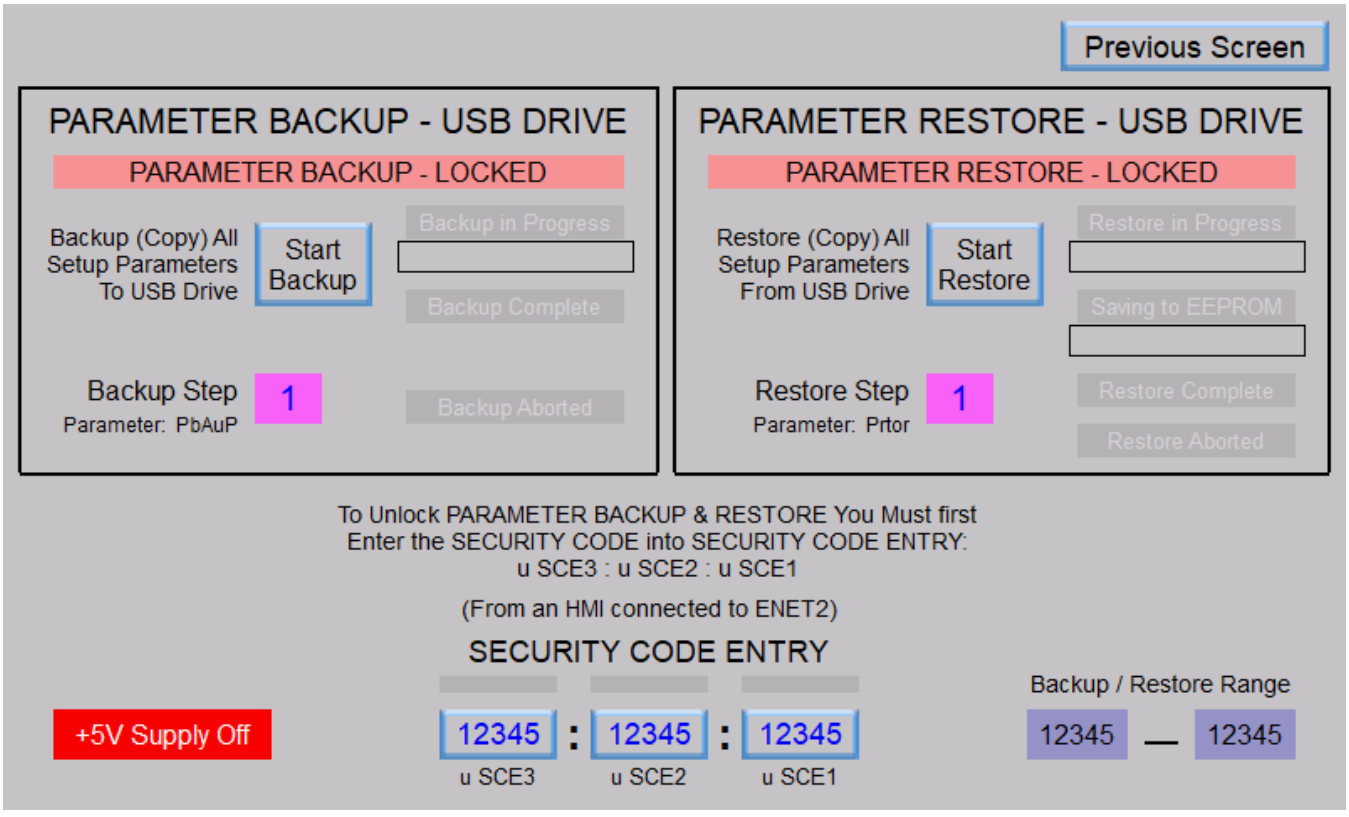
1. Insert the USB Flash Drive (containing only a copy of the file: scbackup.txt) into the USB Host Port on the front of the SC5000.
2. Go to HMI screen “Backup or Restore Parameters USB Drive”.
3. Enter the Security Code into Parameters: u SCE3 : u SCE2 : u SCE1.
4. Press the “Start Restore” Button.
5. When the “Restore Complete” indicator is turned on the Restore function has been completed and it is ok to remove the USB Flash Drive.

Caution - While the Red LED near the USB Flash Drive is on Do Not Remove the USB Flash Drive.

On the **SC5000-LED-HMI**:

1. Insert the USB Flash Drive (containing only a copy of the file: scbackup.txt) into the USB Host Port on the front of the SC5000.
3. Enter the Security Code into Parameters: u SCE3 : u SCE2 : u SCE1.
4. While viewing Parameter Prtor press & hold the Up pushbutton for 10 seconds. After the 10 seconds, Parameter Prtor will show the Restore function’s steps, starting with step 2 and ending at 6.
5. When the Parameter Restore Step parameter (Prtor) gets to step 6 the Restore function has been completed and it is OK to remove the USB Flash Drive. Parameter Prtor will be reset back to zero after 10 seconds.

Caution - While the Red LED near the USB Flash Drive is on Do Not Remove the USB Flash Drive.



SECTION I

Revision Date: 12-30-22

RESTORE SETUP PARAMETERS to FACTORY DEFAULTS

General Description

The SC5000 allows an operator to Restore the Setup Parameters back to their original Factory Default values as when the unit was new.

A screen on the Touch Screen HMI, connected to the Controller, provides the operator with control and status of the Restore function.

The follow Parameters will not be affected by the Restore function:

Calibration Parameters - Analog Inputs: C.301 - C.320
- Analog Outputs: C.401 - C.414

Security Setup Parameters - Security Code Setup: SCS1 - SCS3
- Parameter Write Access Mode: S.001 - S.003
- Parameter Write Access Relock Delay: S.004

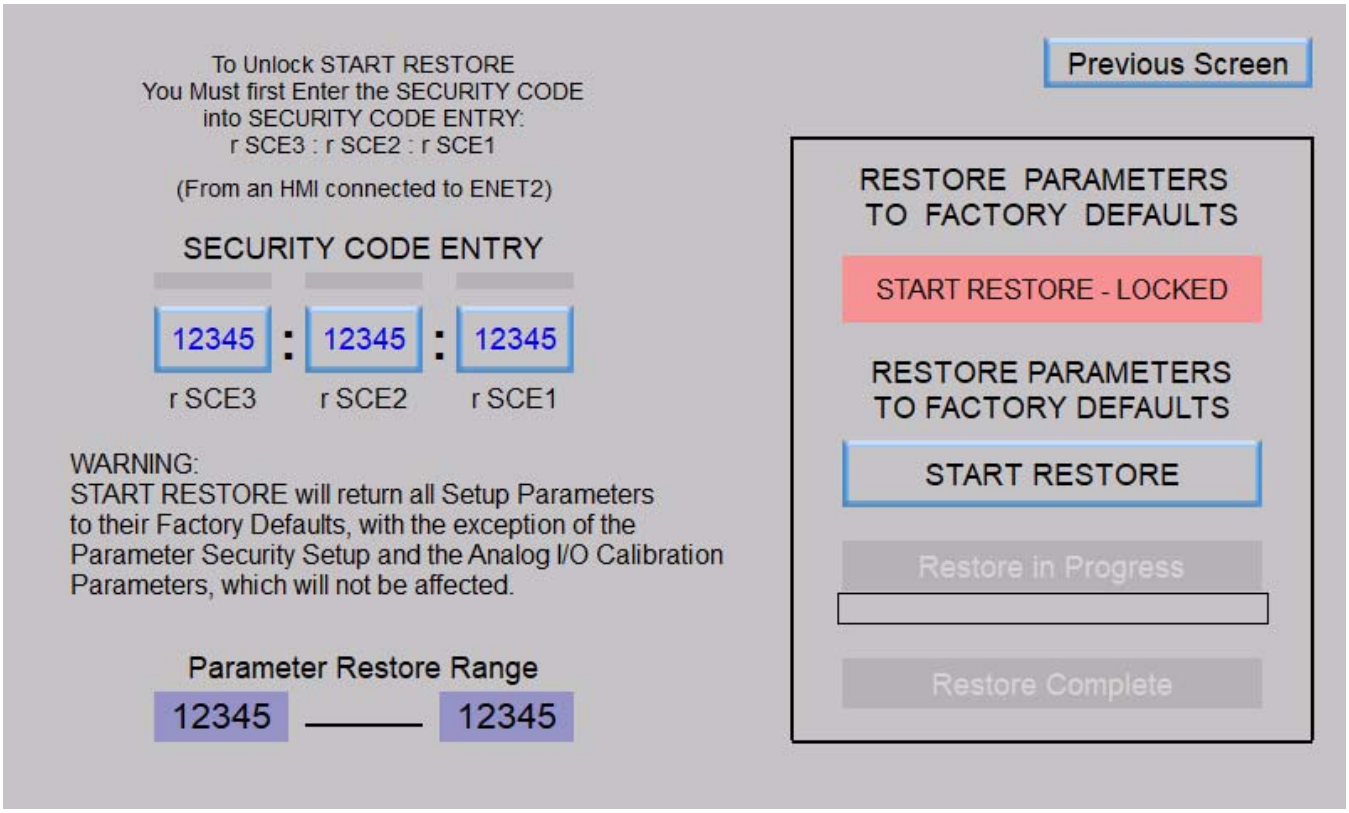
Restore Parameters

On the **SC5000-CTS-HMI** (Color Touch Screen HMI):

1. Go to HMI screen “Restore Parameters To Factory Defaults”.
2. Enter the Security Code into Parameters: r SCE3 : r SCE2 : r SCE1.
3. Press the “Start Restore” Button.
4. When the “Restore Complete” indicator is turned on the Restore function has been completed.

On the **SC5000-LED-HMI**:

1. Enter the Security Code into Parameters: r SCE3 : r SCE2 : r SCE1.
2. While viewing Parameter Fdtor press & hold the Up pushbutton for 10 seconds. After the 10 seconds, Parameter Fdtor will begin to show the Restore function’s progress as a percentage of completion.
3. When the Parameter Restore parameter (Fdtor) gets to 100% the Restore function has been completed. Parameter Fdtor will be reset back to zero after 10 seconds.



SECTION J
PULSE FLOW METERS

Revision Date: 12-30-22

PULSE FLOW METER - PFM1

The Pulse Flow Meter PFM1 provides all the necessary logic and parameters to take the incoming pulses from a Flow Meter and process them for display of the Flow Rate in gallons / minute and the Flow Totalizer in gallons.

The Pulse Flow Meter PFM1 monitors the Discrete Pulse Capture Input DPC1 for incoming pulses from the field device that measures the Flow Rate (Flow Meter).

The Discrete Pulse Capture Input DPC1 is a module designed specifically to capture and report each incoming pulse from the Flow Meter. The DPC1 module is required for the PFM1 and must be ordered with the SC5000.

The Input Pulse Sample Window (Parameter P.534) sets the period of time required for the displayed Flow Rate (Parameter Fd.61) to fully reflect a change in the incoming pulse rate.

The logic in the Pulse Flow Meter PFM1 counts the number of incoming pulses during the time set on the Input Pulse Sample Window (Parameter P.534). It then takes the number of pulses that came in during the sample window and calculates the number of pulses per minute. Next it takes the number of pulses per minute and multiplies it by the Multiply By Conversion Factor (Parameter P.532). Then the value is divided by the Divide By Conversion Factor (Parameter P.533). The Flow Rate, scaled into gallons / minute is then made available to be viewed from Parameter Fd.61.

The Pulse Flow Meter PFM1 also keeps a running total of the flow and displays it on the Flow Totalizer. The flow total is stored in an EEPROM, so that no data is lost during a power outage. The Flow Totalizer value should be read and recorded at some consistent interval (daily, weekly, monthly) and then reset back to zero. The Flow Totalizer value is in gallons and may be viewed from Parameter Fd.63.

Please see page J-4 for instructions on how to determine the Multiply and Divide By Conversion Factors.

For Pulse Flow Meter - PFM1 to function, the SC5000 must be ordered with Discrete Pulse Capture Input DPC1.

User / Operator Info.			SCADA		
Parameter	Default Value	Current Value	Register Address		Description of Parameters and SCADA Notes
Pulse Flow Meter PFM1 - Setup					
P.531	0		40531		Pulse Flow Meter PFM1 - Flow Meter Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.532	1		40532		Pulse Flow Meter PFM1 - Multiply By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be multiplied by this number.
P.533	1		40533		Pulse Flow Meter PFM1 - Divide By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be divided by this number.
P.534	0.40 minutes		40534		Pulse Flow Meter PFM1 - Input Pulse Sample Window Range: 0.10 - 1.00 min.
The Pulse Input used for PFM1 is fixed as the Pulse Capture Input DPC1.					
Pulse Flow Meter PFM1 - Data					
Fd.61	-	-	42161	Least Significant of 32-Bit Number	Pulse Flow Meter PFM1 - Flow Rate - gallons / minute
			42162	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.63	-	-	42163	Least Significant of 32-Bit Number	Pulse Flow Meter PFM1 - Flow Totalizer - gallons
			42164	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
To reset PFM1 Flow Total to zero momentarily set Modbus Coil 219 (Register 40014 Bit 10).					

PULSE FLOW METER - PFM2

The Pulse Flow Meter PFM2 provides all the necessary logic and parameters to take the incoming pulses from a Flow Meter and process them for display of the Flow Rate in gallons / minute and the Flow Totalizer in gallons.

The Pulse Flow Meter PFM2 monitors the Discrete Pulse Capture Input DPC2 for incoming pulses from the field device that measures the Flow Rate (Flow Meter).

The Discrete Pulse Capture Input DPC2 is a module designed specifically to capture and report each incoming pulse from the Flow Meter. The DPC2 module is required for the PFM2 and must be ordered with the SC5000.

The Input Pulse Sample Window (Parameter P.539) sets the period of time required for the displayed Flow Rate (Parameter Fd.71) to fully reflect a change in the incoming pulse rate.

The logic in the Pulse Flow Meter PFM2 counts the number of incoming pulses during the time set on the Input Pulse Sample Window (Parameter P.539). It then takes the number of pulses that came in during the sample window and calculates the number of pulses per minute. Next it takes the number of pulses per minute and multiplies it by the Multiply By Conversion Factor (Parameter P.537). Then the value is divided by the Divide By Conversion Factor (Parameter P.538). The Flow Rate, scaled into gallons / minute is then made available to be viewed from Parameter Fd.71.

The Pulse Flow Meter PFM2 also keeps a running total of the flow and displays it on the Flow Totalizer. The flow total is stored in an EEPROM, so that no data is lost during a power outage. The Flow Totalizer value should be read and recorded at some consistent interval (daily, weekly, monthly) and then reset back to zero. The Flow Totalizer value is in gallons and may be viewed from Parameter Fd.73.

Please see page J-4 for instructions on how to determine the Multiply and Divide By Conversion Factors.

For Pulse Flow Meter - PFM2 to function, the SC5000 must be ordered with Discrete Pulse Capture Input DPC2.

User / Operator Info.			SCADA		
Parameter	Default Value	Current Value	Register Address		Description of Parameters and SCADA Notes
Pulse Flow Meter PFM2 - Setup					
P.536	0		40536		Pulse Flow Meter PFM2 - Flow Meter Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.537	1		40537		Pulse Flow Meter PFM2 - Multiply By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be multiplied by this number.
P.538	1		40538		Pulse Flow Meter PFM2 - Divide By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be divided by this number.
P.539	0.40 minutes		40539		Pulse Flow Meter PFM2 - Input Pulse Sample Window Range: 0.10 - 1.00 minutes
The Pulse Input used for PFM2 is fixed as the Pulse Capture Input DPC2.					
Pulse Flow Meter PFM2 - Data					
Fd.71	-	-	42171	Least Significant of 32-Bit Number	Pulse Flow Meter PFM2 - Flow Rate - gallons / minute
			42172	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.73	-	-	42173	Least Significant of 32-Bit Number	Pulse Flow Meter PFM2 - Flow Totalizer - gallons
			42174	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
To reset PFM2 Flow Total to zero momentarily set Modbus Coil 220 (Register 40014 Bit 11).					

PULSE FLOW METER - PFM3

The Pulse Flow Meter PFM3 provides all the necessary logic and parameters to take the incoming pulses from a Flow Meter and process them for display of the Flow Rate in gallons / minute and the Flow Totalizer in gallons.

The Pulse Flow Meter PFM3 monitors the Discrete Pulse Capture Input DPC3 for incoming pulses from the field device that measures the Flow Rate (Flow Meter).

The Discrete Pulse Capture Input DPC3 is a module designed specifically to capture and report each incoming pulse from the Flow Meter. The DPC3 module is required for the PFM3 and must be ordered with the SC5000.

The Input Pulse Sample Window (Parameter P.544) sets the period of time required for the displayed Flow Rate (Parameter Fd.81) to fully reflect a change in the incoming pulse rate.

The logic in the Pulse Flow Meter PFM3 counts the number of incoming pulses during the time set on the Input Pulse Sample Window (Parameter P.544). It then takes the number of pulses that came in during the sample window and calculates the number of pulses per minute. Next it takes the number of pulses per minute and multiplies it by the Multiply By Conversion Factor (Parameter P.542). Then the value is divided by the Divide By Conversion Factor (Parameter P.543). The Flow Rate, scaled into gallons / minute is then made available to be viewed from Parameter Fd.81.

The Pulse Flow Meter PFM3 also keeps a running total of the flow and displays it on the Flow Totalizer. The flow total is stored in an EEPROM, so that no data is lost during a power outage. The Flow Totalizer value should be read and recorded at some consistent interval (daily, weekly, monthly) and then reset back to zero. The Flow Totalizer value is in gallons and may be viewed from Parameter Fd.83.

Please see page J-4 for instructions on how to determine the Multiply and Divide By Conversion Factors.

For Pulse Flow Meter - PFM3 to function, the SC5000 must be ordered with Discrete Pulse Capture Input DPC3.

User / Operator Info.			SCADA		
Parameter	Default Value	Current Value	Register Address		Description of Parameters and SCADA Notes
Pulse Flow Meter PFM3 - Setup					
P.541	0		40541		Pulse Flow Meter PFM3 - Flow Meter Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.542	1		40542		Pulse Flow Meter PFM3 - Multiply By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be multiplied by this number.
P.543	1		40543		Pulse Flow Meter PFM3 - Divide By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be divided by this number.
P.544	0.40 minutes		40544		Pulse Flow Meter PFM3 - Input Pulse Sample Window Range: 0.10 - 1.00 minutes
The Pulse Input used for PFM3 is fixed as the Pulse Capture Input DPC3.					
Pulse Flow Meter PFM3 - Data					
Fd.81	-	-	42181	Least Significant of 32-Bit Number	Pulse Flow Meter PFM3 - Flow Rate - gallons / minute
			42182	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.83	-	-	42183	Least Significant of 32-Bit Number	Pulse Flow Meter PFM3 - Flow Totalizer - gallons
			42184	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
To reset PFM3 Flow Total to zero momentarily set Modbus Coil 221 (Register 40014 Bit 12).					

PULSE FLOW METERS - PFM1, PFM2 & PFM3

The Controller determines the Flow Rate scaled into gallons / minute by the following procedure:

Step 1: First the number of incoming Pulses per minute is determined and recorded.

Step 2: Next the number of pulses per minute is multiplied by the Multiply By Conversion Factor.

Step 3: The last step is to divide by value determined in step 2 by the Divide By Conversion Factor.

Flow Rate Equation:

$$\text{Flow Rate (gallons / minute)} = \text{(Pulses per minute)} \times \frac{\text{Multiply By Conversion Factor}}{\text{Divide By Conversion Factor}}$$

The Multiply By and Divide By Conversion Factors are defined in the Flow Meter's Manual and come from the Pulse per Gallon setting that the operator has programmed into the Flow Meter.

Determining the Multiply By and Divide By Conversion Factors

Example 1

The pulse output of the Flow Meter connected to Pulse Flow Meter PFM1 is setup for:

1 pulse = 5 gallons or 5 gallons / pulse

What should the Multiply and Divide By Conversion Factor be set on?

Flow Rate Equation:

$$\text{Flow Rate (gallons / minute)} = \text{(Pulses per minute)} \times \frac{5 \text{ gallons}}{1 \text{ pulse}}$$

Multiply By Conversion Factor = 5

Divide By Conversion Factor = 1

Example 2

The pulse output of the Flow Meter connected to Pulse Flow Meter PFM1 is setup for:

1 pulse = 0.005 gallons

What should the Multiply and Divide By Conversion Factor be set on?

Flow Rate Equation:

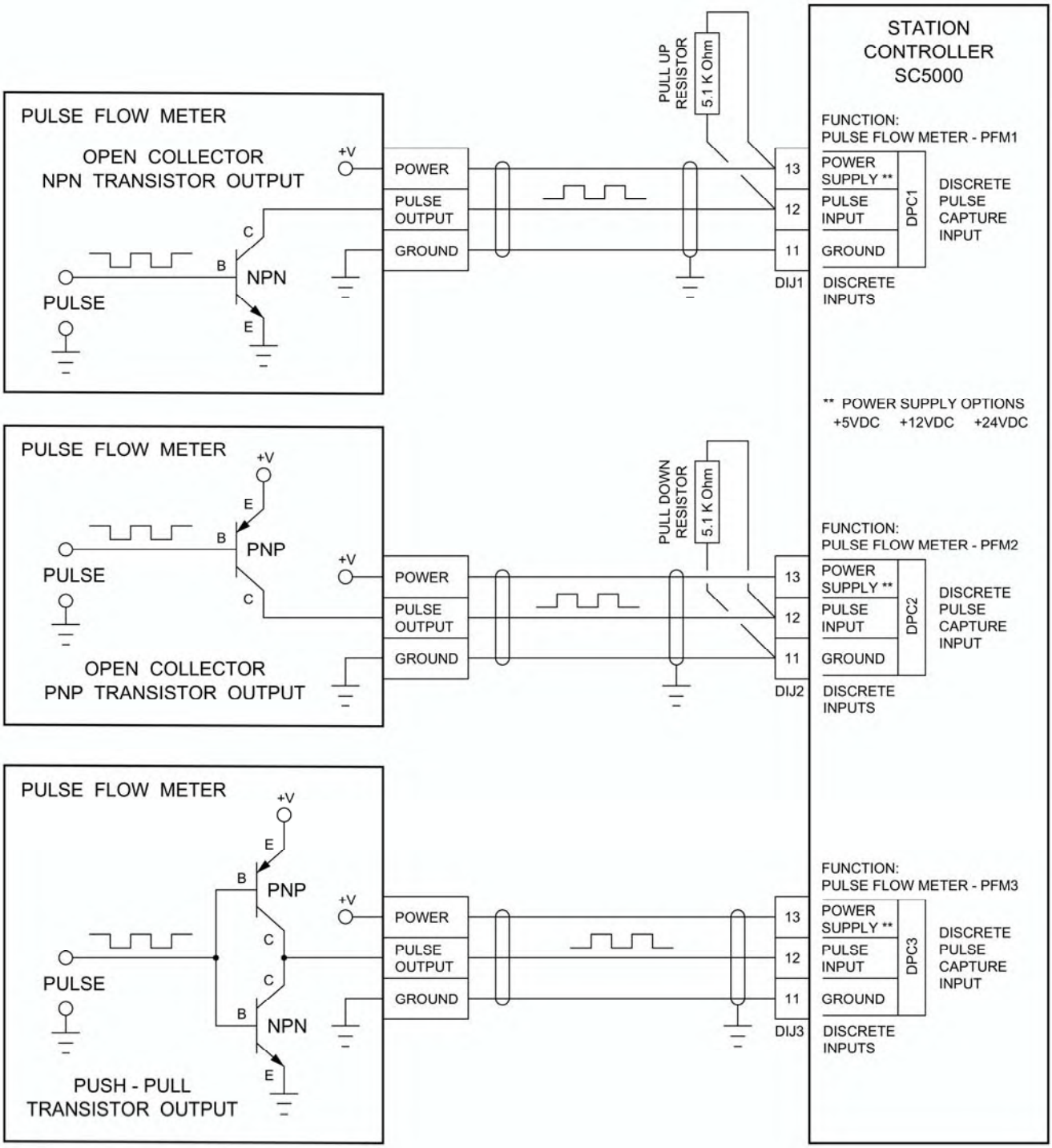
$$\text{Flow Rate (gallons / minute)} = \text{(Pulses per minute)} \times \frac{0.005 \text{ gallons}}{1 \text{ pulse}}$$

The number 0.005 can not be entered into a parameter, because it is a decimal number. Therefore, both Conversion Factors must be divided by 0.005, giving the following values:

Revised Flow Rate Equation:

$$\text{Flow Rate (gallons / minute)} = \text{(Pulses per minute)} \times \frac{1 \text{ gallon}}{200 \text{ pulses}}$$

PULSE FLOW METER EXAMPLES



Pulse Counter Inputs Specifications

Isolated, Transient Protected

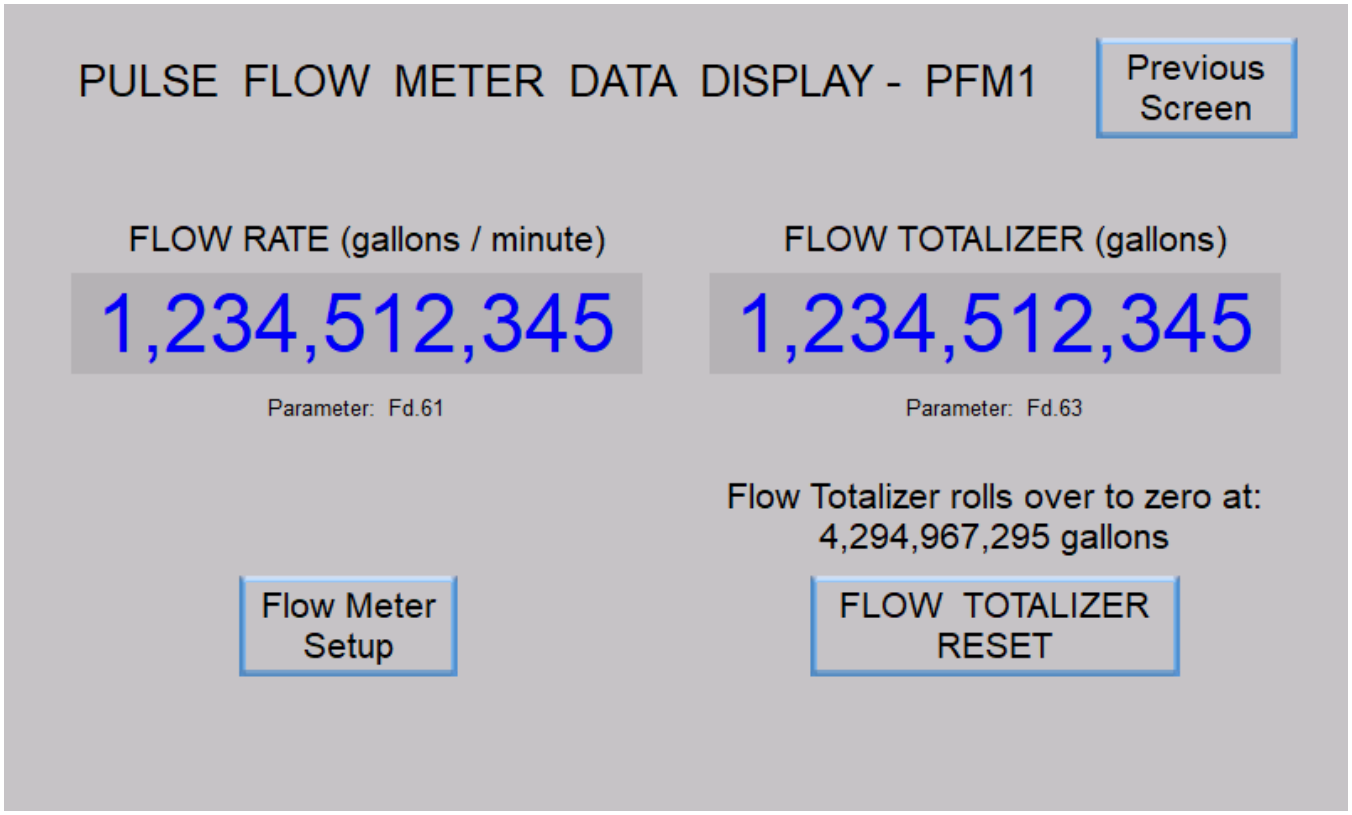
Maximum Pulse Frequency: 60 kHz (with Duty Cycle Between 40% - 60%)

Power Supply Output Voltage Options (See “Ordering Information”): +5 VDC, +12 VDC or +24 VDC

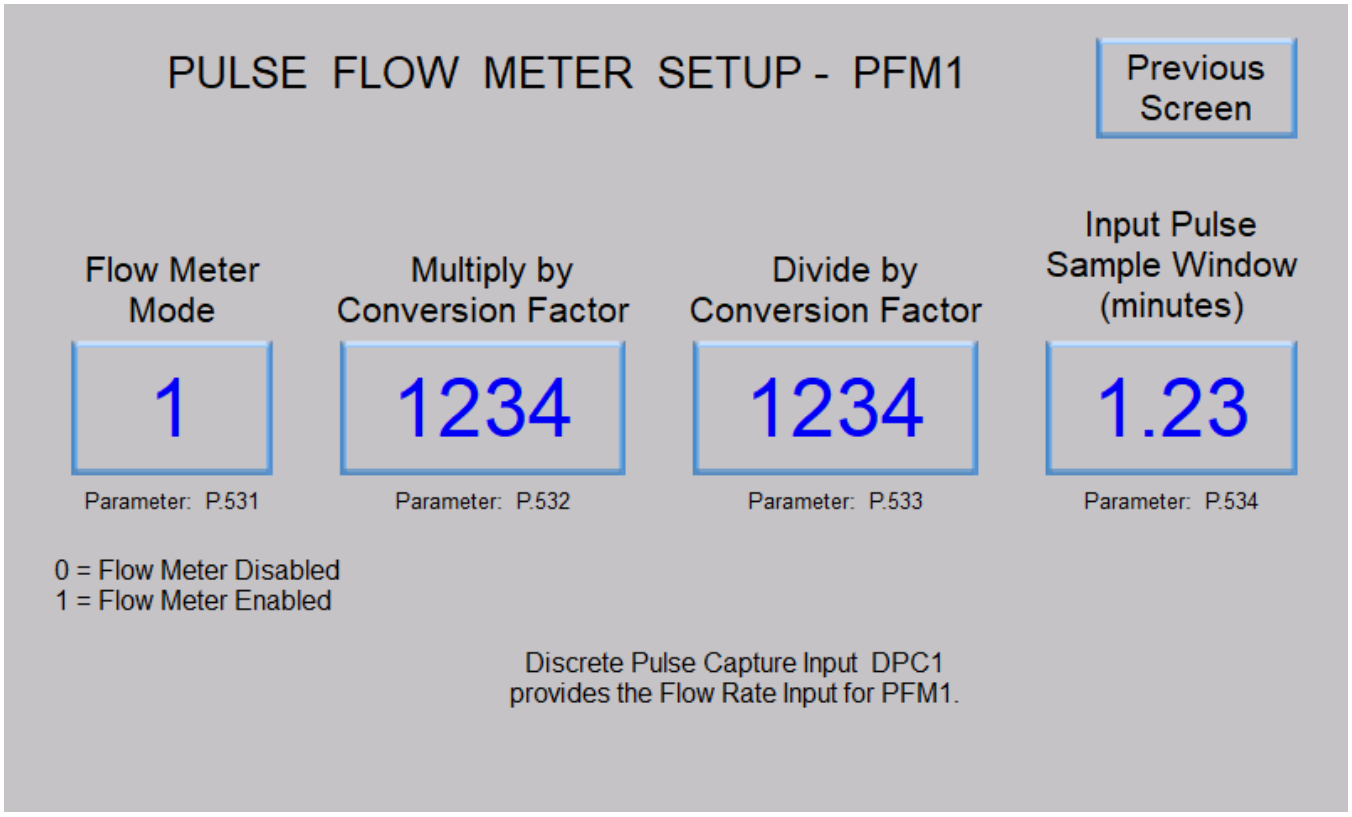
Pull Up or Pull Down Resistor Supplied with Controller: 5.1 KΩ

PULSE FLOW METER - Touchscreen HMI SCREENS

Pulse Flow Meter Data Display - Typical of Pulse Flow Meter PFM1 - PFM3



Pulse Flow Meter Setup - Typical of Pulse Flow Meter PFM1 - PFM3



SECTION K
ANALOG FLOW METERS

Revision Date: 5-9-23

ANALOG FLOW METER - AFM1

The Analog Flow Meter AFM1 provides all the necessary logic and parameters to take the selected Analog Input's data and process it for the display of the Flow Rate in gallons / minute and the Flow Totalizer in gallons.

The Analog Flow Meter AFM1 receives a 4-20mA signal from a field device that measures the Flow Rate (Flow Meter). The 4-20mA signal from Flow Meter must be connected to one of the Analog Inputs on the Controller. The Analog Input must be setup so that its data is sent to Analog Flow Meter AFM1. To do this, the Analog Input selected for this task must have its Analog Input Setup parameter set for Function 3. See Parameters F.299 - F.308 in Section C. The value of the selected Analog Input in its unscaled form is displayed as the Analog Flow Rate Input (Parameter Fd.91), which has a range of 819 - 4095.

The logic in the Analog Flow Meter first takes the Analog Flow Rate Input (Parameter Fd.91) and subtracts 819 giving it a new range of 0 - 3276. Next the value is multiplied by the Multiply By Conversion Factor (Parameter P.552). Then it is divided by the Divide By Conversion Factor (Parameter P.553). The Flow Rate, scaled into gallons / minute is then made available to be viewed from Parameter Fd.92.

The Analog Flow Meter also keeps a running total of the flow and displays it on the Flow Totalizer. The flow total is stored in an EEPROM, so that no data is lost during a power outage. The Flow Totalizer value should be read and recorded at some consistent interval (daily, weekly, monthly) and then reset back to zero. The Flow Totalizer value is in gallons and may be viewed from Parameter Fd.93.

Please see page K-4 for instructions on how to determine the Multiply and Divide By Conversion Factors.

User / Operator Info.			SCADA		
Parameter	Default Value	Current Value	Register Address		Description of Parameters and SCADA Notes
Analog Flow Meter AFM1 - Setup					
P.551	1		40551		Analog Flow Meter AFM1 - Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.552	1000		40552		Analog Flow Meter AFM1 - Multiply By Conversion Factor Range: 1 - 65,535 Note: The Analog Flow Rate Input is first conditioned to have a range of 0 - 3,276 and is then multiplied by the value set on this parameter.
P.553	3276		40553		Analog Flow Meter AFM1 - Divide By Conversion Factor Range: 1 - 65,535 Note: After the Analog Flow Rate Input is multiplied by Parameter P.552, it is then divided by the value set on this parameter.
P.554	240		40554		Analog Flow Meter AFM1 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast
Analog Flow Meter AFM1 - Data					
Fd.91	-	-	42190		Analog Flow Meter AFM1 - Analog Flow Rate Input Notes: 1. Parameter Fd.91 shows the unscaled value from the Analog Input selected as the Analog Flow Rate Input for AFM1. It has a range of: 819 @ 4.0mA & 4,095 @ 20mA. 2. The selected Analog Input must have its Analog Input Setup set for Function 3.
Fd.92	-	-	42191	Least Significant of 32-Bit Number	Analog Flow Meter AFM1 - Flow Rate - gallons / minute
			42192	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.93	-	-	42193	Least Significant of 32-Bit Number	Analog Flow Meter AFM1 - Flow Totalizer - gallons
			42194	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
To reset AFM1 Flow Total to zero momentarily set Modbus Coil 222 (Register 40014 Bit 13).					

ANALOG FLOW METER - AFM2

The Analog Flow Meter AFM2 provides all the necessary logic and parameters to take the selected Analog Input's data and process it for the display of the Flow Rate in gallons / minute and the Flow Totalizer in gallons.

The Analog Flow Meter AFM2 receives a 4-20mA signal from a field device that measures the Flow Rate (Flow Meter). The 4-20mA signal from Flow Meter must be connected to one of the Analog Inputs on the Controller. The Analog Input must be setup so that its data is sent to Analog Flow Meter AFM2. To do this, the Analog Input selected for this task must have its Analog Input Setup parameter set for Function 4. See Parameters F.299 - F.308 in Section C. The value of the selected Analog Input in its unscaled form is displayed as the Analog Flow Rate Input (Parameter Fd.94), which has a range of 819 - 4095.

The logic in the Analog Flow Meter first takes the Analog Flow Rate Input (Parameter Fd.94) and subtracts 819 giving it a new range of 0 - 3276. Next the value is multiplied by the Multiply By Conversion Factor (Parameter P.557). Then it is divided by the Divide By Conversion Factor (Parameter P.558). The Flow Rate, scaled into gallons / minute is then made available to be viewed from Parameter Fd.95.

The Analog Flow Meter also keeps a running total of the flow and displays it on the Flow Totalizer. The flow total is stored in an EEPROM, so that no data is lost during a power outage. The Flow Totalizer value should be read and recorded at some consistent interval (daily, weekly, monthly) and then reset back to zero. The Flow Totalizer value is in gallons and may be viewed from Parameter Fd.96.

Please see page K-4 for instructions on how to determine the Multiply and Divide By Conversion Factors.

User / Operator Info.			SCADA		
Parameter	Default Value	Current Value	Register Address		Description of Parameters and SCADA Notes
Analog Flow Meter AFM2 - Setup					
P.556	0		40556		Analog Flow Meter AFM2 - Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.557	1000		40557		Analog Flow Meter AFM2 - Multiply By Conversion Factor Range: 1 - 65,535 Note: The Analog Flow Rate Input is first conditioned to have a range of 0 - 3,276 and is then multiplied by the value set on this parameter.
P.558	3276		40558		Analog Flow Meter AFM2 - Divide By Conversion Factor Range: 1 - 65,535 Note: After the Analog Flow Rate Input is multiplied by Parameter P.557, it is then divided by the value set on this parameter.
P.559	240		40559		Analog Flow Meter AFM2 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast
Analog Flow Meter AFM2 - Data					
Fd.94	-	-	42200		Analog Flow Meter AFM2 - Analog Flow Rate Input Notes: 1. Parameter Fd.94 shows the unscaled value from the Analog Input selected as the Analog Flow Rate Input for AFM2. It has a range of: 819 @ 4.0mA & 4,095 @ 20mA. 2. The selected Analog Input must have its Analog Input Setup set for Function 4.
Fd.95	-	-	42201	Least Significant of 32-Bit Number	Analog Flow Meter AFM2 - Flow Rate - gallons / minute
			42202	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.96	-	-	42203	Least Significant of 32-Bit Number	Analog Flow Meter AFM2 - Flow Totalizer - gallons
			42204	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
To reset AFM2 Flow Total to zero momentarily set Modbus Coil 223 (Register 40014 Bit 14).					

ANALOG FLOW METER - AFM3

The Analog Flow Meter AFM3 provides all the necessary logic and parameters to take the selected Analog Input's data and process it for the display of the Flow Rate in gallons / minute and the Flow Totalizer in gallons.

The Analog Flow Meter AFM3 receives a 4-20mA signal from a field device that measures the Flow Rate (Flow Meter). The 4-20mA signal from Flow Meter must be connected to one of the Analog Inputs on the Controller. The Analog Input must be setup so that its data is sent to Analog Flow Meter AFM3. To do this, the Analog Input selected for this task must have its Analog Input Setup parameter set for Function 5. See Parameters F.299 - F.308 in Section C. The value of the selected Analog Input in its unscaled form is displayed as the Analog Flow Rate Input (Parameter Fd.97), which has a range of 819 - 4095.

The logic in the Analog Flow Meter first takes the Analog Flow Rate Input (Parameter Fd.97) and subtracts 819 giving it a new range of 0 - 3276. Next the value is multiplied by the Multiply By Conversion Factor (Parameter P.562). Then it is divided by the Divide By Conversion Factor (Parameter P.563). The Flow Rate, scaled into gallons / minute is then made available to be viewed from Parameter Fd.98.

The Analog Flow Meter also keeps a running total of the flow and displays it on the Flow Totalizer. The flow total is stored in an EEPROM, so that no data is lost during a power outage. The Flow Totalizer value should be read and recorded at some consistent interval (daily, weekly, monthly) and then reset back to zero. The Flow Totalizer value is in gallons and may be viewed from Parameter Fd.99.

Please see page K-4 for instructions on how to determine the Multiply and Divide By Conversion Factors.

User / Operator Info.			SCADA		
Parameter	Default Value	Current Value	Register Address		Description of Parameters and SCADA Notes
Analog Flow Meter AFM3 - Setup					
P.561	0		40561		Analog Flow Meter AFM3 - Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.562	1000		40562		Analog Flow Meter AFM3 - Multiply By Conversion Factor Range: 1 - 65,535 Note: The Analog Flow Rate Input is first conditioned to have a range of 0 - 3,276 and is then multiplied by the value set on this parameter.
P.563	3276		40563		Analog Flow Meter AFM3 - Divide By Conversion Factor Range: 1 - 65,535 Note: After the Analog Flow Rate Input is multiplied by Parameter P.562, it is then divided by the value set on this parameter.
P.564	240		40564		Analog Flow Meter AFM3 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast
Analog Flow Meter AFM3 - Data					
Fd.97	-	-	42210		Analog Flow Meter AFM3 - Analog Flow Rate Input Notes: 1. Parameter Fd.97 shows the unscaled value from the Analog Input selected as the Analog Flow Rate Input for AFM3. It has a range of: 819 @ 4.0mA & 4,095 @ 20mA. 2. The selected Analog Input must have its Analog Input Setup set for Function 5.
Fd.98	-	-	42211	Least Significant of 32-Bit Number	Analog Flow Meter AFM3 - Flow Rate - gallons / minute
			42212	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.99	-	-	42213	Least Significant of 32-Bit Number	Analog Flow Meter AFM3 - Flow Totalizer - gallons
			42214	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
To reset AFM3 Flow Total to zero momentarily set Modbus Coil 224 (Register 40014 Bit 15).					

ANALOG FLOW METERS - AFM1, AFM2 & AFM3

The Controller determines the Flow Rate scaled into gallons / minute by the following procedure:

Step 1: The Controller takes the Analog Flow Rate Input, with a range of 819 - 4095, and subtracts 819 from it giving it a new range of 0 - 3276.

Step 2: Next the Controller takes the Analog Flow Rate Input (with its new range of 0 - 3276) and multiplied it by the Multiply By Conversion Factor.

Step 3: The last step is for the Controller to divide by the Divide By Conversion Factor.

Flow Rate Equation:

$$\text{Flow Rate (gallons / minute)} = (\text{Analog Flow Rate Input}) \times \frac{\text{Multiply By Conversion Factor}}{\text{Divide By Conversion Factor}}$$

The Multiply By and Divide By Conversion Factors are determined based on the Calibration of the Flow Meter's Analog Output, which will be in gallons / minute @ 20mA.

Determining the Multiply By and Divide By Conversion Factors

Example 1

The SC5000's Analog Flow Meter AFM1 receives a 4-20mA signal from a remote pipe mounted Flow Meter which has its Analog Output calibrated for: 1000 gallons / minute @ 20mA.

For the SC5000's Analog Flow Meter AFM1 to read correctly, what should its Multiply and Divide By Conversion Factor be set on?

Flow Rate Equation:

$$\text{Flow Rate (gallons / minute)} = (\text{Analog Flow Rate Input}) \times \frac{1000 \text{ gallons / minute}}{3276}$$

Multiply By Conversion Factor = 1000

Divide By Conversion Factor = 3276

Example 2

The SC5000's Analog Flow Meter AFM1 receives a 4-20mA signal from a remote pipe mounted Flow Meter which has its Analog Output calibrated for: 90.5 gallons / minute @ 20mA.

For the SC5000's Analog Flow Meter AFM1 to read correctly, what should its Multiply and Divide By Conversion Factor be set on?

Flow Rate Equation:

$$\text{Flow Rate (gallons / minute)} = (\text{Analog Flow Rate Input}) \times \frac{90.5 \text{ gallons / minute}}{3276}$$

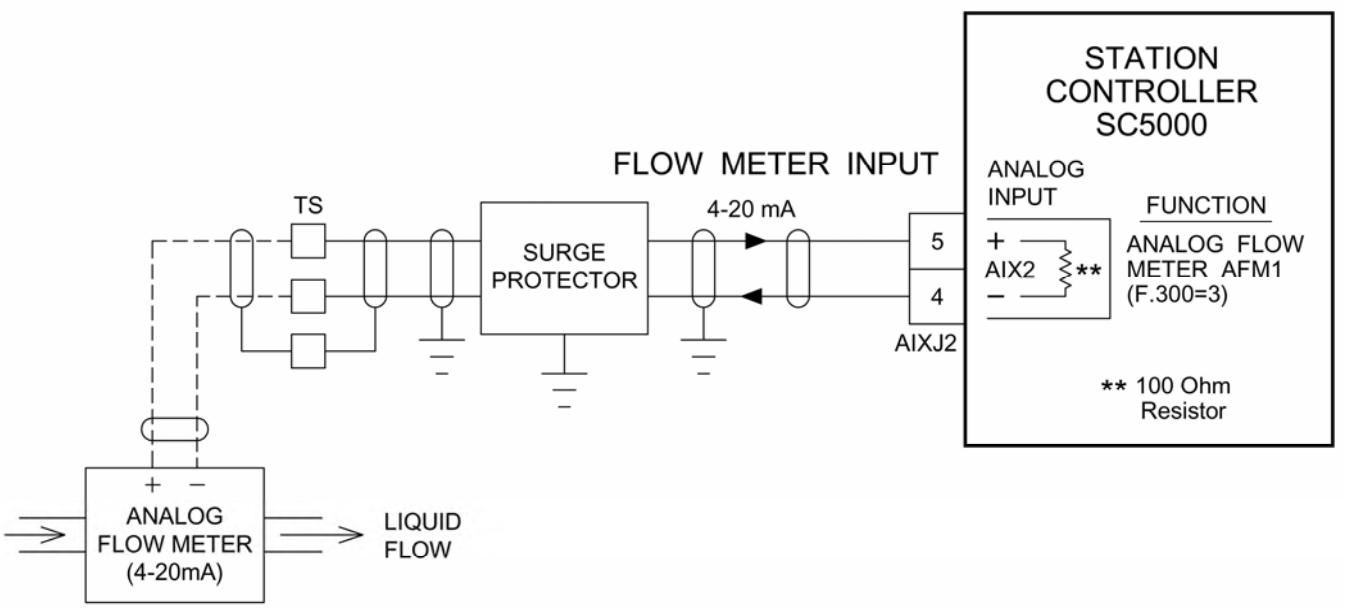
The number 90.5 can not be entered into a parameter, because it is a decimal number. Therefore, both Conversion Factors must be multiplied by 10, giving the following values:

Revised Flow Rate Equation:

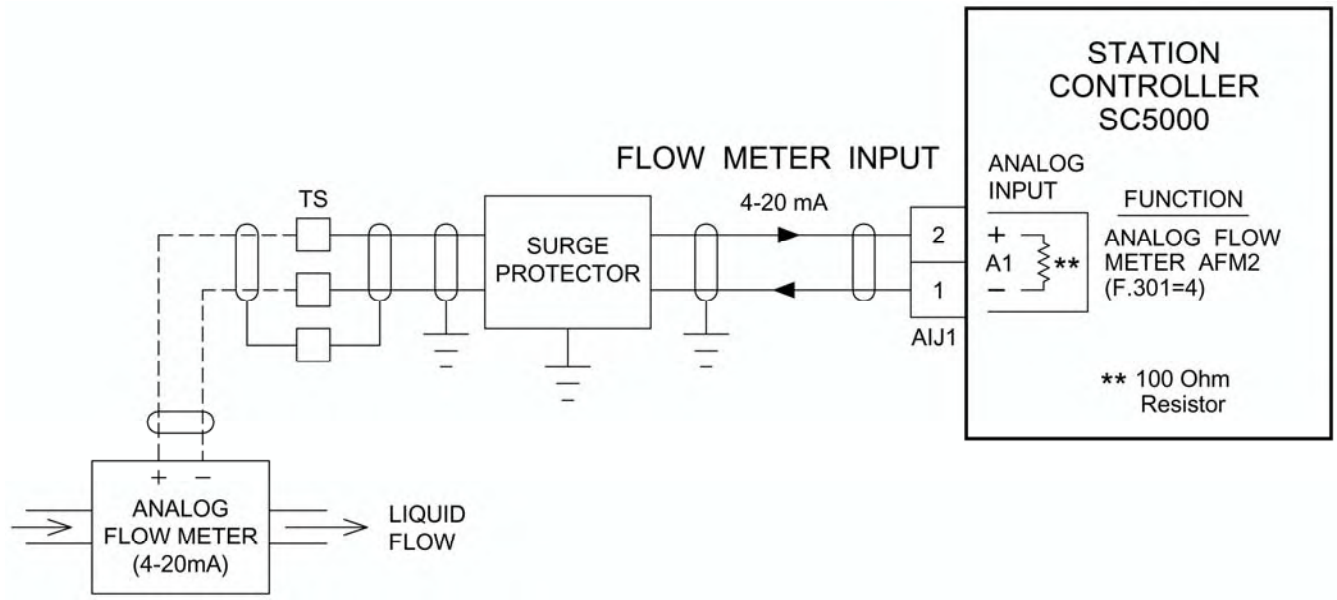
$$\text{Flow Rate (gallons / minute)} = (\text{Analog Flow Rate Input}) \times \frac{905 \text{ gallons / minute}}{32760}$$

ANALOG FLOW METER INPUT EXAMPLES

Using Analog Input AIX2 where the Analog Flow Meter provides a Powered Output



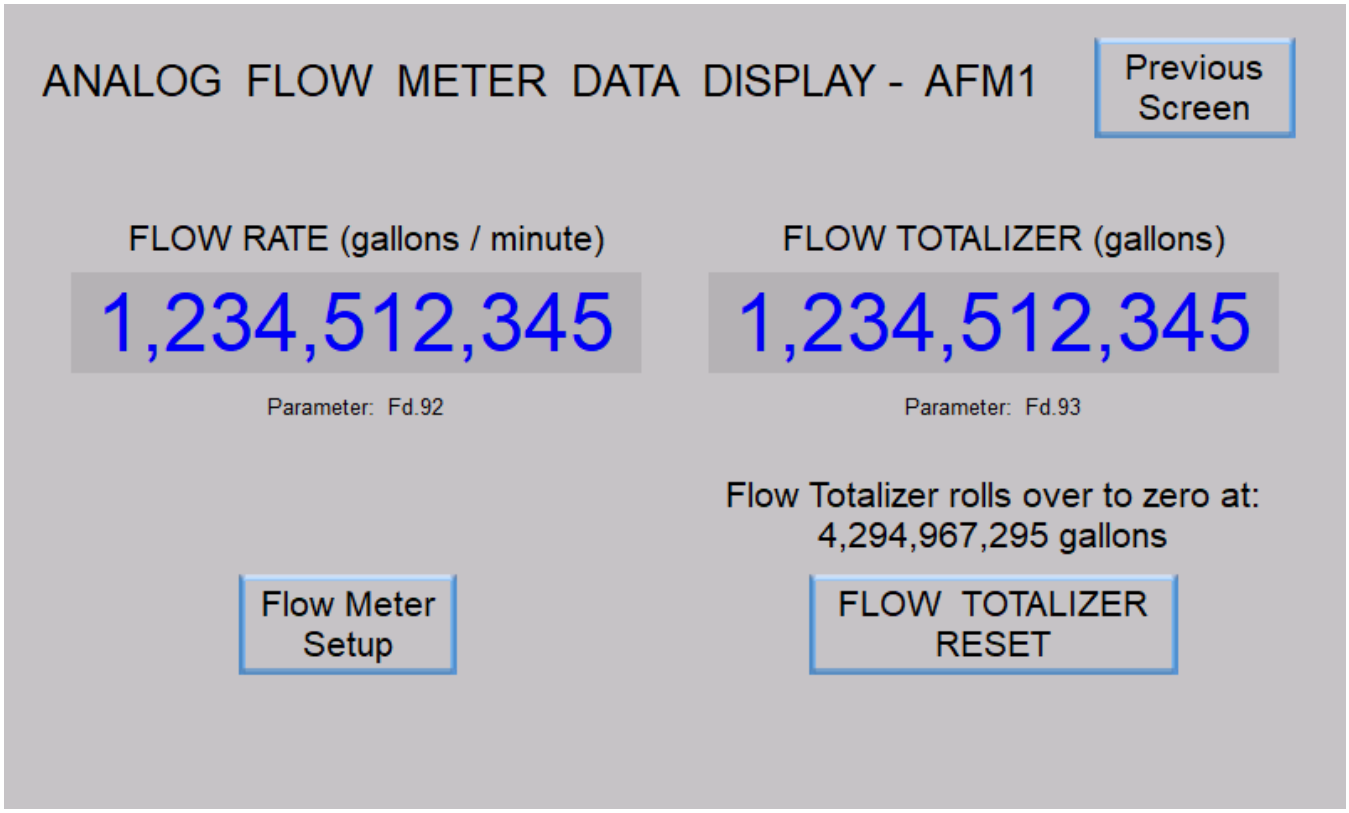
Using Analog Input A1 where the Analog Flow Meter provides a Powered Output



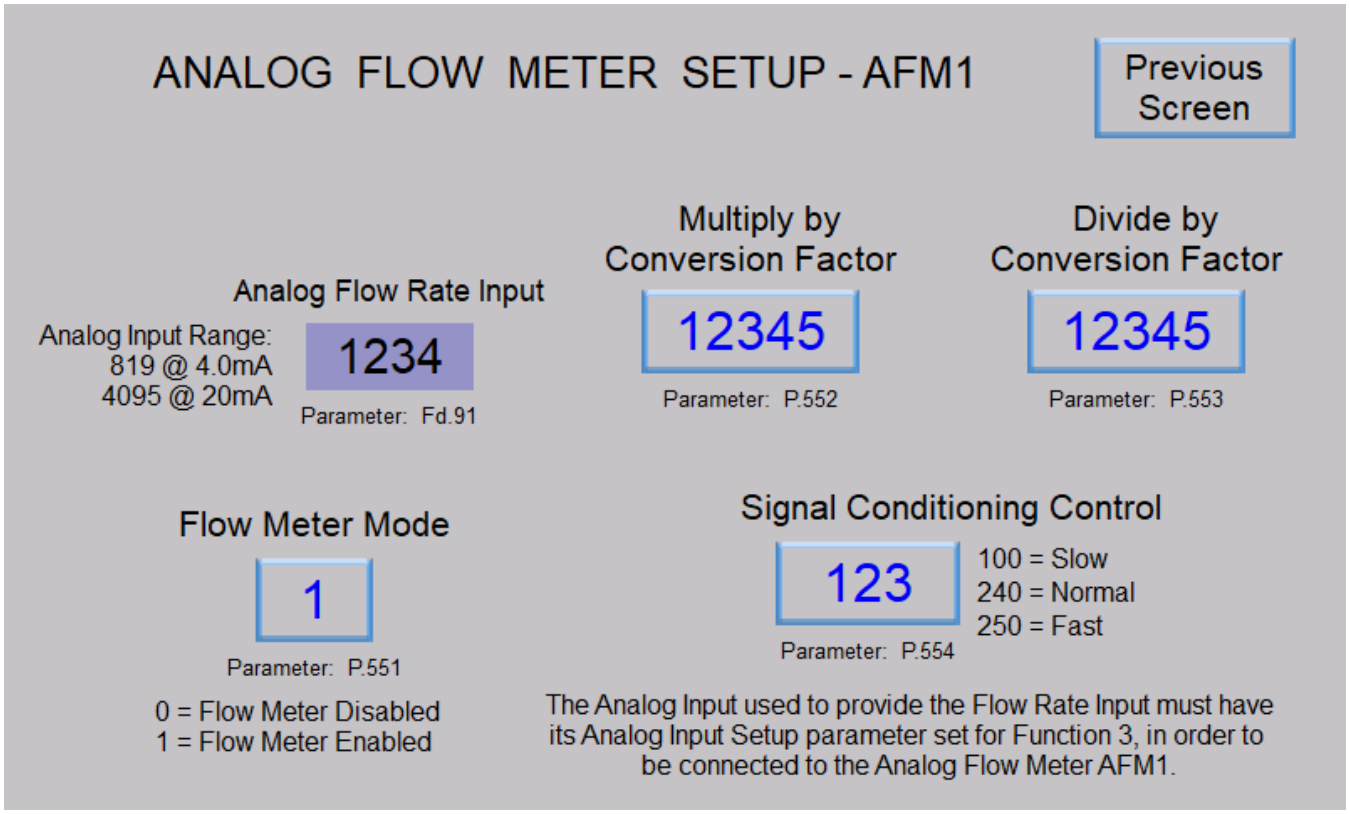
Note:
All the Analog Inputs on the SC5000 are isolated from Power Supply ground and may be connected to remote devices that are at a different ground potential.

ANALOG FLOW METER - Touchscreen HMI SCREENS

Analog Flow Meter Data Display - Typical of Analog Flow Meter AFM1 - AFM3



Analog Flow Meter Setup - Typical of Analog Flow Meter AFM1 - AFM3



SECTION L
LEVEL PROBE METER

Revision Date: 12-30-22

LEVEL PROBE METER - LPM1

Description

The Level Probe Meter LPM1 provides all the necessary logic and parameters to take the selected Discrete Input's data and process it into a value for the wet well level that is scaled into feet and tenths of feet.

The logic in the Level Probe Meter counts the number of the Electrodes on the Level Probe that are covered by liquid and using the Electrode Spacing (Parameter P.520) determines the wet well level in feet and tenths of feet. For the calculated level at each of the Level Probe's Electrodes see page L-2 .

The Level Probe Meter requires connection to a Level Probe (having 10 Electrodes) using 10 Discrete Inputs. The Discrete Input Setup parameters of the inputs used must be set for Functions 1 - 10. See pages A-7 & L-3.

The Level Probe Meter must also be enabled. See Parameter P.519 below.

To be used by the Controller to perform Level Control, the "Level Probe Meter LPM1" must be selected as the Level Input, by setting the "Level Input Select" parameter to "Level Probe Meter - LPM1" (Parameter P.133 = 5).

Status

The value of the wet well level, scaled into feet and tenths of feet, is made available to be viewed from Parameter LPd.1.

When a Level Probe Electrode is not covered by the liquid (out of the liquid), then the Discrete Input's Test Signal has no path to Control Panel Ground, and the Discrete Input is considered Open.

When a Level Probe Electrode is covered by the liquid, then the Discrete Input's Test Signal does have a path to Control Panel Ground, and the Discrete Input is considered Closed.

The liquid being measured, must be grounded to the Control Panel Ground.

The Status of the Test Signals for each of the Discrete Input (as an analog value) may be viewed from Parameters A.101 - A.130. See page A-9.

The status of the Discrete Inputs as a discrete value may also be read from Modbus Coils 1 - 30 (Register 40001 Bits 0 - 15, & Register 40002 Bits 0 - 13). See page A-10.

Please note that the Controller's Discrete Inputs are designed to read sewage very effectively but will not reliably read storm water or well water.

Sensitivity

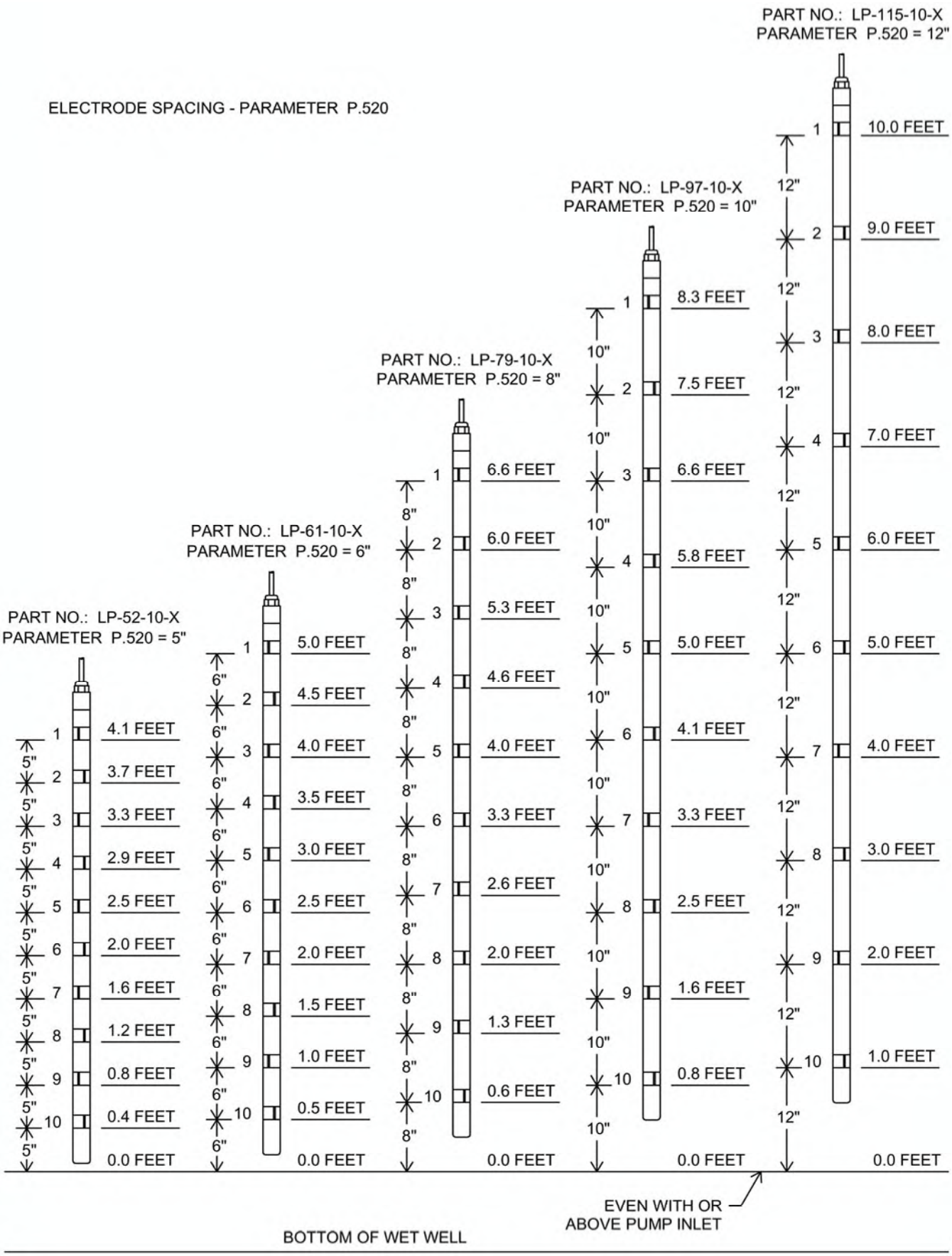
The Sensitivity of the Discrete Inputs can be changed by the operator in groups of 10 inputs as shown:

Input Sensitivity: D1 - D10 Parameter F.141 D11 - D20 Parameter F.142 D21 - D30 Parameter F.143

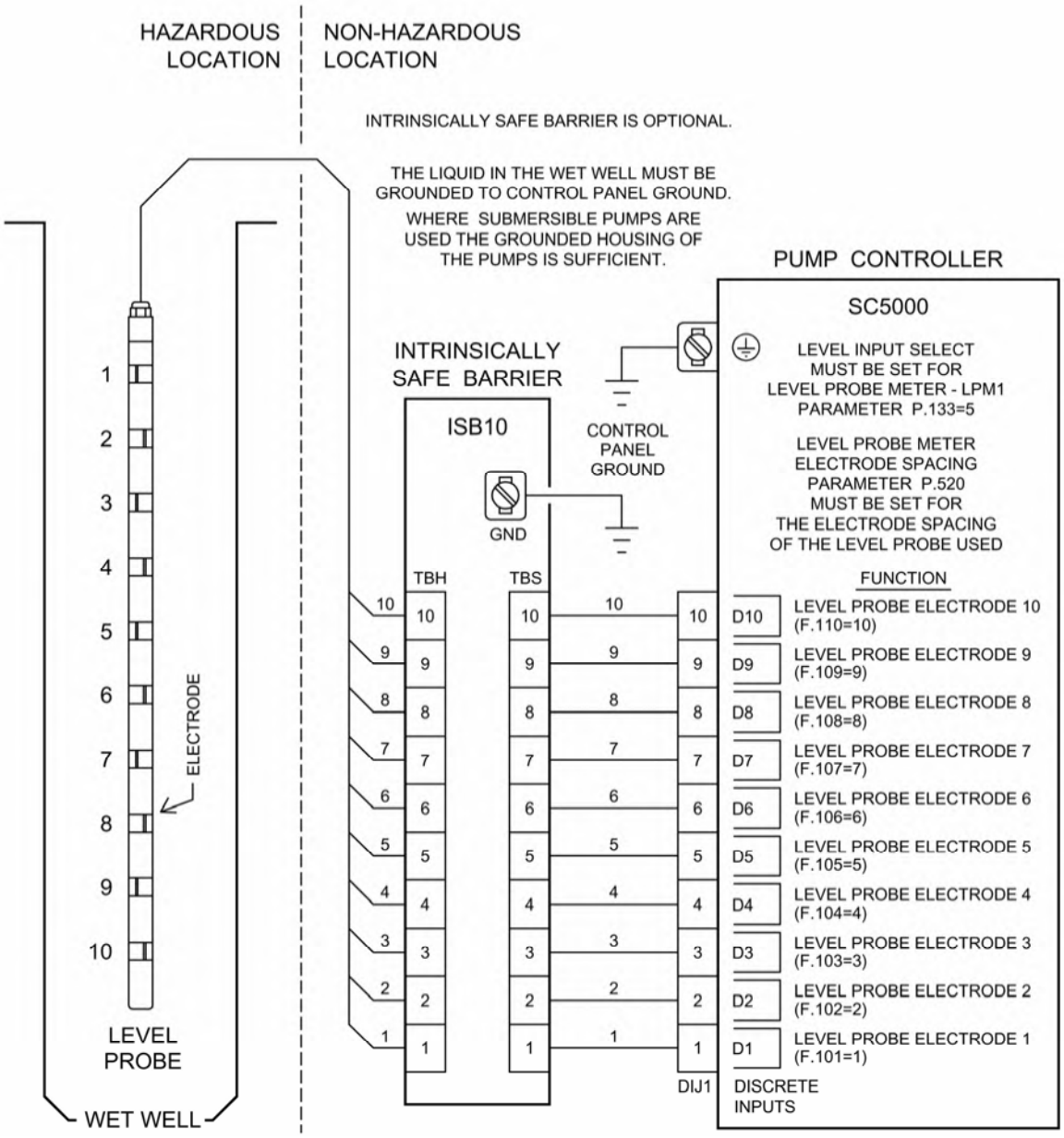
The Standard Sensitivity (the default) setting is 100 which is the best setting for reading typical sewage. For extra sensitivity while reading light sewage, the Sensitivity Parameter of the Discrete Inputs connected to the Level Probe, can be changed to 150 or higher. See page A-8.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Level Probe Meter LPM1 - Setup Parameters				
P.519	1		40519	Level Probe Meter LPM1 - Mode 0 = Level Probe Meter Disabled 1 = Level Probe Meter Enabled
P.520	12 in.		40520	Level Probe Meter Electrode Spacing 5, 6, 8, 10 or 12 inches
Level Probe Meter LPM1 - Data				
LPd.1	-	-	42138	Level Probe Meter LPM1 - Scaled into feet and 1/10 feet Note: For Parameter LPd.1 to read correctly the Level Probe Meter Electrode Spacing (Parameter P.520) must be set for the Electrode spacing of the Level Probe, in inches.

LEVEL PROBE - ELECTRODE SPACING



LEVEL PROBE CONNECTION EXAMPLE



Notes:

The Discrete Input Setup parameters of the inputs used above must be set for Functions 1 - 10.

Each of the Discrete Inputs used to monitor the Level Probe Electrodes send out a low voltage (+/- 6 V), low current (0.6 mA), AC (60 Hz) square wave as a Test Signal to determine the status of the input, either covered by liquid (Closed) or not covered by liquid (Open).

For the example above, that uses Discrete Inputs D1 - D10, the Controller compares each of the Test Signal analog values with the Discrete Input Sensitivity set on Parameters F.141. See page A-8.

The status of the Test Signals for each of the Discrete Inputs used in the example above (as an analog value) may be viewed from Parameters A.101 - A.110. See page A-9 or X-21.

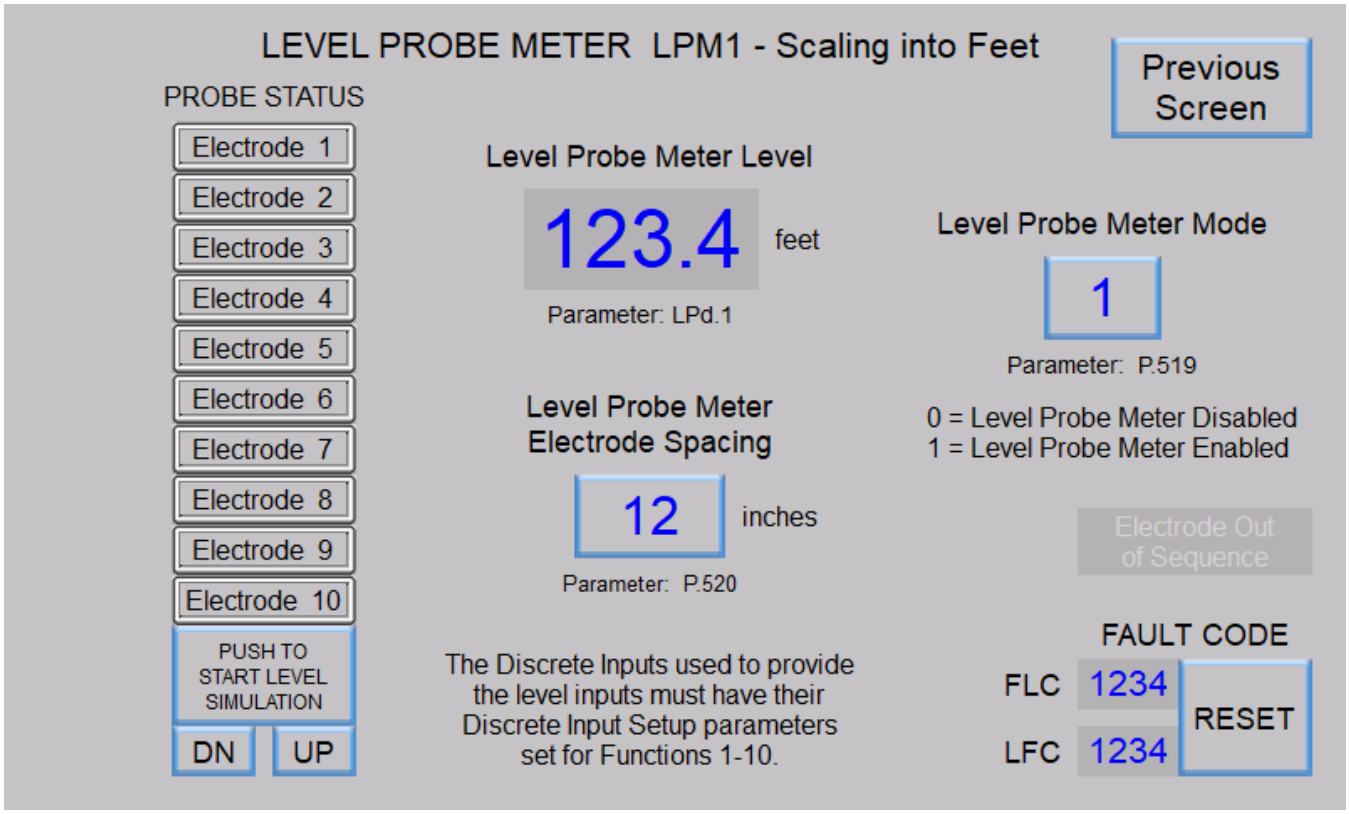
The status of the Discrete Inputs used in the example above (as a discrete value may) also be read from Modbus Coils 1 - 10 (Register 40001 Bits 0 - 9). See page A-10 or X-19.

The **SC5000-CTS-HMI** shows the Discrete Input Status on screens on the HMI. See pages L-4 & A-14.

The **SC5000-LED-HMI** shows the Discrete Input Status on Parameters n.01 - n.10 & A.101 - A.110 in the Menu. See pages X-19 & X-21.

To aid in troubleshooting, Fault Codes 1001 - 1009 are provided to show when an “Electrodes Covered Out of Sequence” fault has occurred. See page F-1 for more information.

LEVEL PROBE METER - Touchscreen HMI SCREEN



SECTION M
ANALOG LEVEL METERS

Revision Date: 12-30-22

ANALOG LEVEL METER - ALM1

Analog Level Meter ALM1 provides all the necessary logic and parameters to take the selected Analog Input's data and process it into a conditioned value scaled into feet and tenths of feet.

The 4-20mA signal from the Level Input device (typically a Pressure Transducer) must be connected to one of the Analog Inputs on the Controller. The Analog Input must be setup so that its data is sent to Analog Level Meter ALM1. To do this, the Analog Input selected for this task must have its Analog Input Setup parameter set for Function 1. See Parameters F.299 - F.308 in Section C. The value of the selected Analog Input in its unscaled form is displayed on Parameter Ld.11.

The logic in the Level Meter takes the value from Parameter Ld.11 and scales it to the Level Input Span (Parameter P.522). The finished value, scaled into feet and tenths of feet, is then made available to be viewed from Parameter Ld.12.

The **Level Input Span** (Parameter P.522) must be set to the calibrated span of the device providing the Level Input. This is the liquid level in feet that corresponds to a 20mA output from the Level Input device.

The **Level Input Zero** (Parameter P.523) is set at the factory so that with a 4.0mA Level Input the Level Meter displays 0.0 feet, with no negative sign. However, since Pressure Transducers and other Level Input devices are often not perfectly zeroed, the HMI provides UP and Down pushbuttons that allow an operator to make minor adjustments in the field to zero the Level Meter display. Before attempting to adjust the Level Input Zero, first pull the Submersible Pressure Transducer out of the liquid, or apply a 4.0mA signal to the Level Input, and then Set the Zero. When properly zeroed the Level Meter display should read 0.0 feet, with no negative sign.

The Signal Conditioning Control parameter (Parameter P.524) determines the speed at which the value displayed on Level Meter ALM1 may change in response to a change in the analog input signal. This is used to filter out sudden changes in the analog level input.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Analog Level Meter ALM1 - Setup Parameters				
P.522	23.10 feet		40522	Analog Level Meter ALM1 - Level Input Span Range: 1.00 - 231.00 feet Note: Parameter P.522 must be set to the calibrated span of the device providing the Level.
P.523	-		40523	Analog Level Meter ALM1 - Level Input Zero Note: The HMI provides UP and Down pushbuttons that allow an operator to make minor adjustments in the field to Parameter P.523 while observing the Level from Parameter Ld.12.
P.524	240		40524	Analog Level Meter ALM1 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast Note: This parameter controls the signal conditioning of Analog Level Meter ALM1
Analog Level Meter ALM1 - Data				
Ld.11	-	-	42139	Analog Level Meter ALM1 - Analog Level Input Notes: 1. Parameter Ld.11 shows the unscaled value from the Analog Input selected as the Analog Level Input for ALM1. It has a range of: 819 @ 4.0mA & 4,095 @ 20mA. 2. The selected Analog Input must have its Analog Input Function set for Function 1.
Ld.12	-	-	42140	Analog Level Meter ALM1 - Scaled into feet.

ANALOG LEVEL METER - ALM2

Analog Level Meter ALM2 provides all the necessary logic and parameters to take the selected Analog Input's data and process it into a conditioned value scaled into feet and tenths of feet.

The 4-20mA signal from the Level Input device (typically a Pressure Transducer) must be connected to one of the Analog Inputs on the Controller. The Analog Input must be setup so that its data is sent to Analog Level Meter ALM2. To do this, the Analog Input selected for this task must have its Analog Input Setup parameter set for Function 2. See Parameters F.299 - F.308 in Section C. The value of the selected Analog Input in its unscaled form is displayed on Parameter Ld.21.

The logic in the Level Meter takes the value from Parameter Ld.21 and scales it to the Level Input Span (Parameter P.527). The finished value, scaled into feet and tenths of feet, is then made available to be viewed from Parameter Ld.22.

The **Level Input Span** (Parameter P.527) must be set to the calibrated span of the device providing the Level Input. This is the liquid level in feet that corresponds to a 20mA output from the Level Input device.

The **Level Input Zero** (Parameter P.528) is set at the factory so that with a 4.0mA Level Input the Level Meter displays 0.0 feet, with no negative sign. However, since Pressure Transducers and other Level Input devices are often not perfectly zeroed, the HMI provides UP and Down pushbuttons that allow an operator to make minor adjustments in the field to zero the Level Meter display. Before attempting to adjust the Level Input Zero, first pull the Submersible Pressure Transducer out of the liquid, or apply a 4.0mA signal to the Level Input, and then Set the Zero. When properly zeroed the Level Meter display should read 0.0 feet, with no negative sign.

The Signal Conditioning Control parameter (Parameter P.529) determines the speed at which the value displayed on Level Meter ALM2 may change in response to a change in the analog input signal. This is used to filter out sudden changes in the analog level input.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Analog Level Meter ALM2 - Setup Parameters				
P.527	23.10 feet		40527	Analog Level Meter ALM2 - Level Input Span Range: 1.00 - 231.00 feet Note: Parameter P.527 must be set to the calibrated span of the device providing the Level.
P.528	-		40528	Analog Level Meter ALM2 - Level Input Zero Note: The HMI provides UP and Down pushbuttons that allow an operator to make minor adjustments in the field to Parameter P.528 while observing the Level from Parameter Ld.22.
P.529	240		40529	Analog Level Meter ALM2 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast Note: This parameter controls the signal conditioning of Analog Level Meter ALM2
Analog Level Meter ALM2 - Data				
Ld.21	-	-	42141	Analog Level Meter ALM2 - Analog Level Input Notes: 1. Parameter Ld.21 shows the unscaled value from the Analog Input selected as the Analog Level Input for ALM2. It has a range of: 819 @ 4.0mA & 4,095 @ 20mA. 2. The selected Analog Input must have its Analog Input Function set for Function 2.
Ld.22	-	-	42142	Analog Level Meter ALM2 - Scaled into feet.

LEVEL DISPLAY SPAN VERSUS PRESSURE TRANSDUCER CALIBRATION

	Transducer Calibration					
	5.0psi @ 20mA	10psi @ 20mA	15psi @ 20mA	30psi @ 20mA	60psi @ 20mA	100psi @ 20mA
Level Input Span	11.5 feet	23.1 feet	34.6 feet	69.3 feet	138.5 feet	230.9 feet

Notes:

1. Level Input Span is what is displayed with a 20 mA Level Input.
2. To find the Level Input Span Setting for other transducers use the following equation:

Pressure (psi) x 2.309 = Level (feet of water)

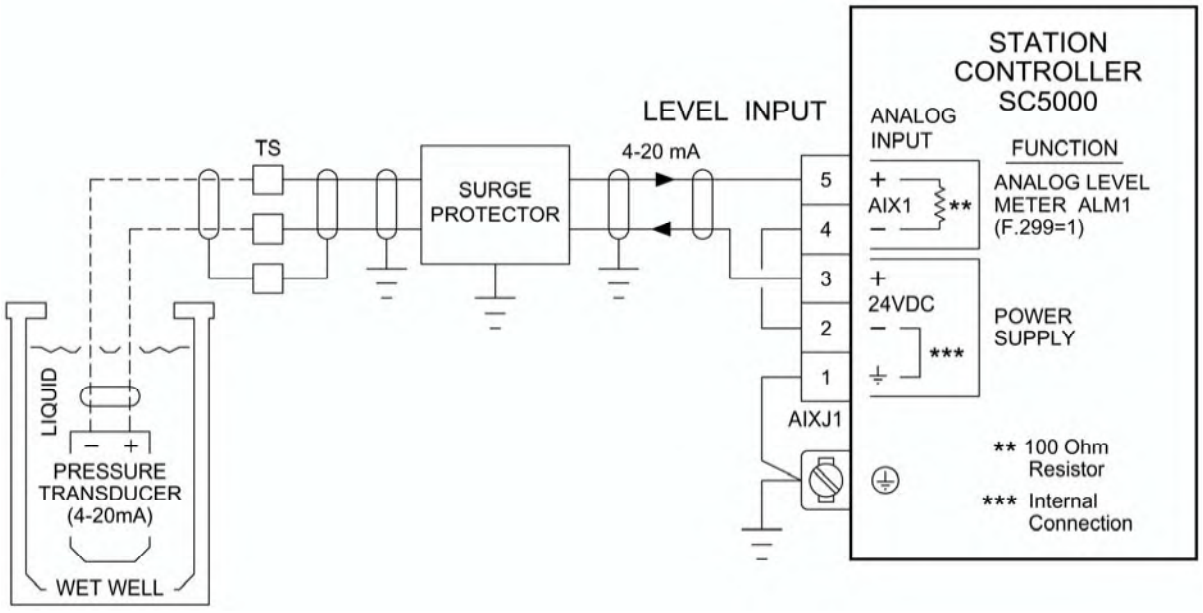
ANALOG LEVEL INPUT EXAMPLES - SINGLE TRANSDUCER

The Level Input Select (Parameter P.133) is used to select either Single or Dual Pressure Transducers as the Level Input. For more information about Parameter P.133 see pages 1-8, 2-9, 3-9 and X-5.

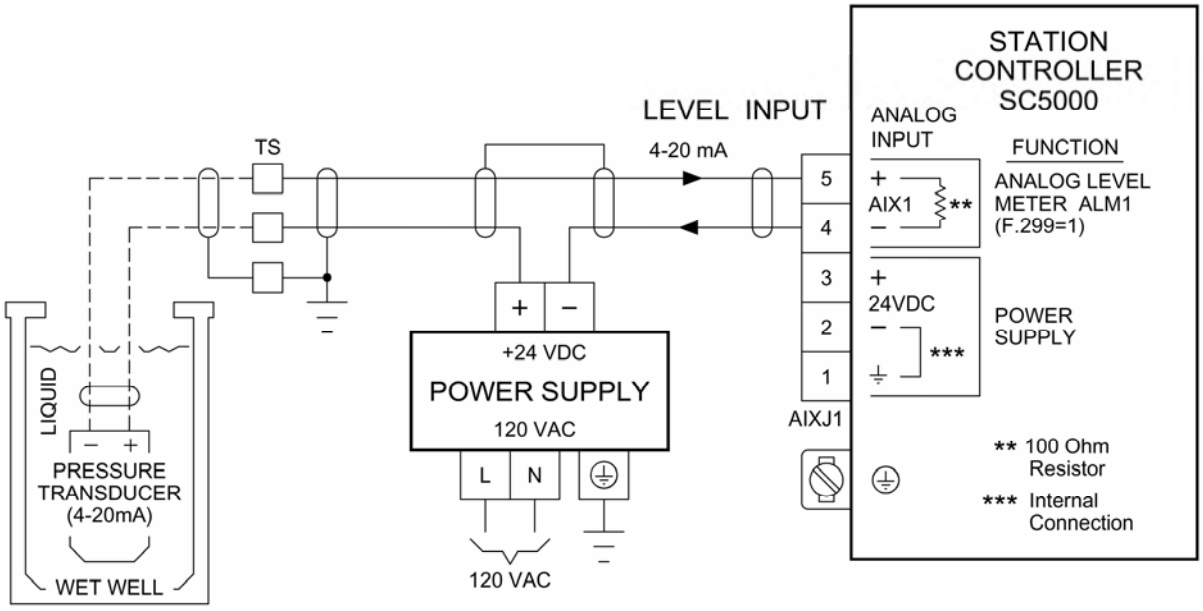
For information on using Dual Pressure Transducers see page M-5.

The examples below show the using of a Single Pressure Transducer, either Non-Isolated or Isolated.

Non-Isolated - Using the 24 VDC Power Supply on the SC5000



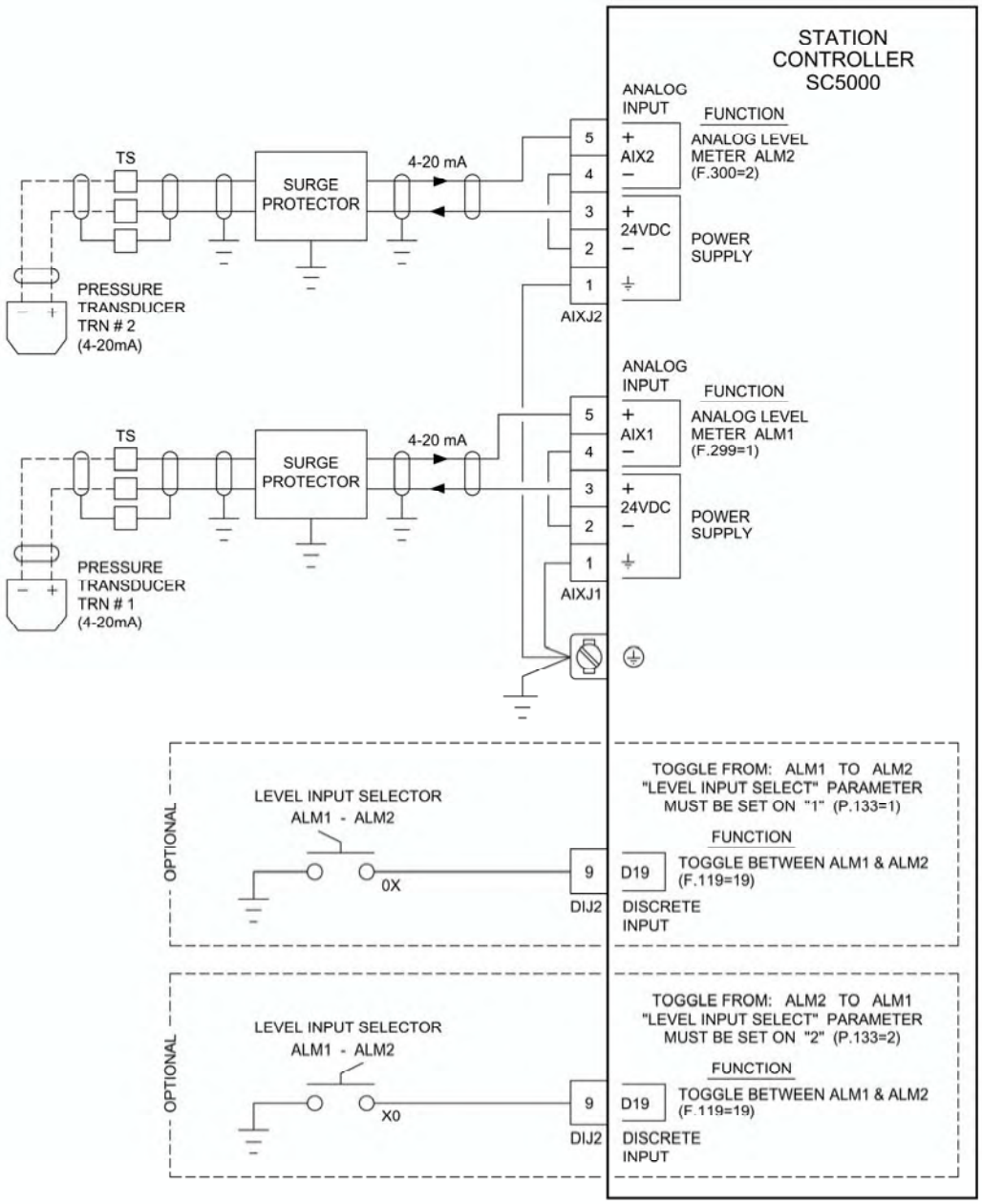
Isolated - Using an External 24 VDC Power Supply



Notes:

1. All the Analog Inputs on the SC5000 are isolated from the SC5000's Power Supply ground and may be connected to remote devices that are at different ground potentials. However, if Isolation must be maintained an external Power Supply must be used.
2. The SC5000's 24 VDC Power Supply Commons (-), on AIXJ1 pin 2 and AIXJ2 pin 2, are internally connected to ground (not isolated from ground) and should not be used in cases where isolation of the 4-20mA signal must be maintained.

ANALOG LEVEL INPUT EXAMPLE - DUAL TRANSDUCERS



Dual Transducers for the Level Input

The Controller has available two Analog Level Meters ALM1 and ALM2 that may be setup and used to provide a Level Input to the Controller's Control Logic. Each of the two Level Meters must have their own Analog Level Input, typically from two Pressure Transducers. However, the Control Logic can only use one Level Input at a time.

Manually Toggle Between ALM1 & ALM2

A Discrete Input assigned the Function of "Toggle Between ALM1 & ALM2 for Level Input" (Function 19) may be used to manually toggle from ALM1 to ALM2 or from ALM2 to ALM1.

The setting on the "Level Input Select" (Parameter P.133) will determine the following operation:

Level Input Select = 1 - Manually toggles from ALM1 to ALM2 when the Discrete Input closes.

Level Input Select = 2 - Manually toggles from ALM2 to ALM1 when the Discrete Input closes.

Automatically Toggle Between ALM1 & ALM2

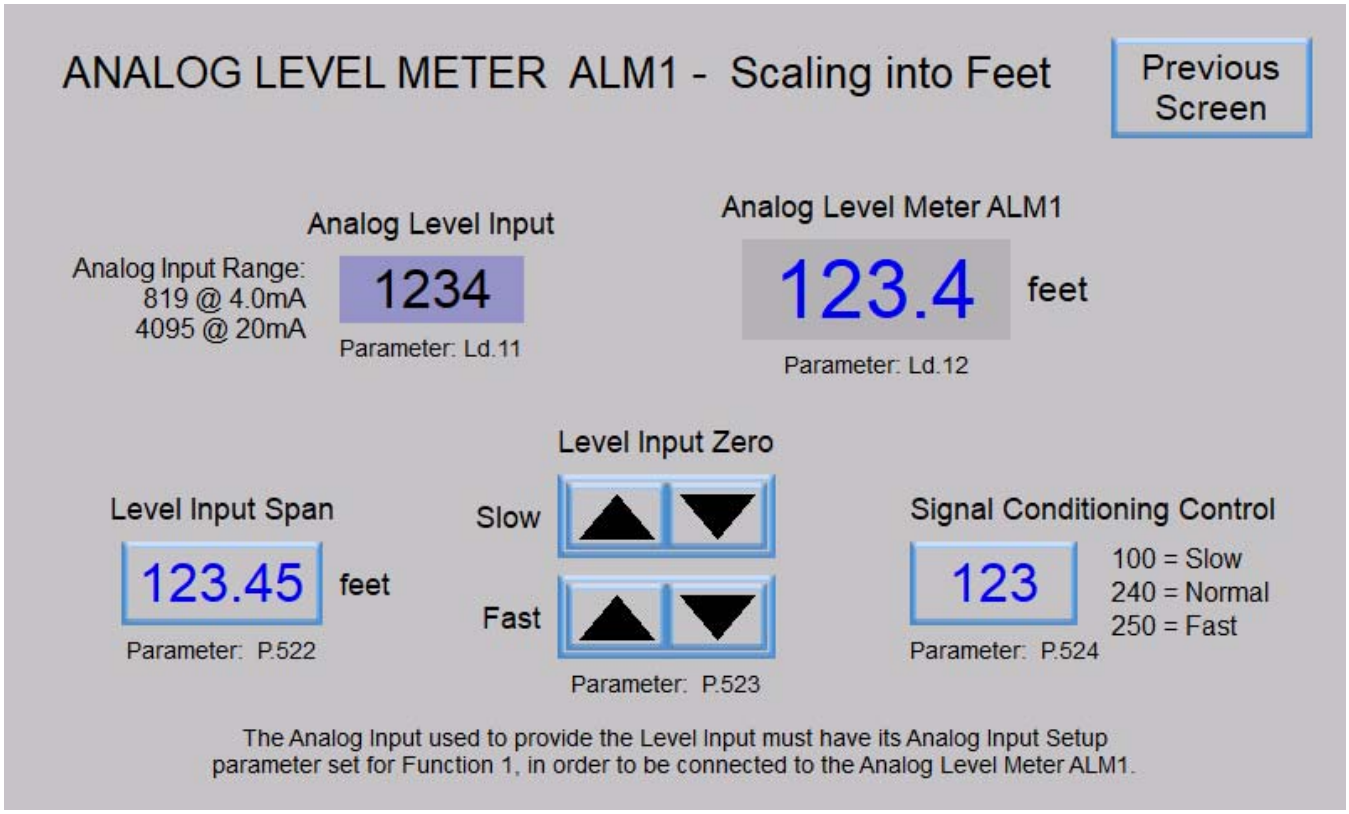
The Controller may be setup to automatically toggle between the two Analog Level Meters ALM1 and ALM2 upon a failure. Where the Failure of ALM1 or ALM2 is defined as the analog input being below 3.5 mA or above 21 mA. For a description of the Fault Codes generated by a failure of ALM1 or ALM2 see page F-2.

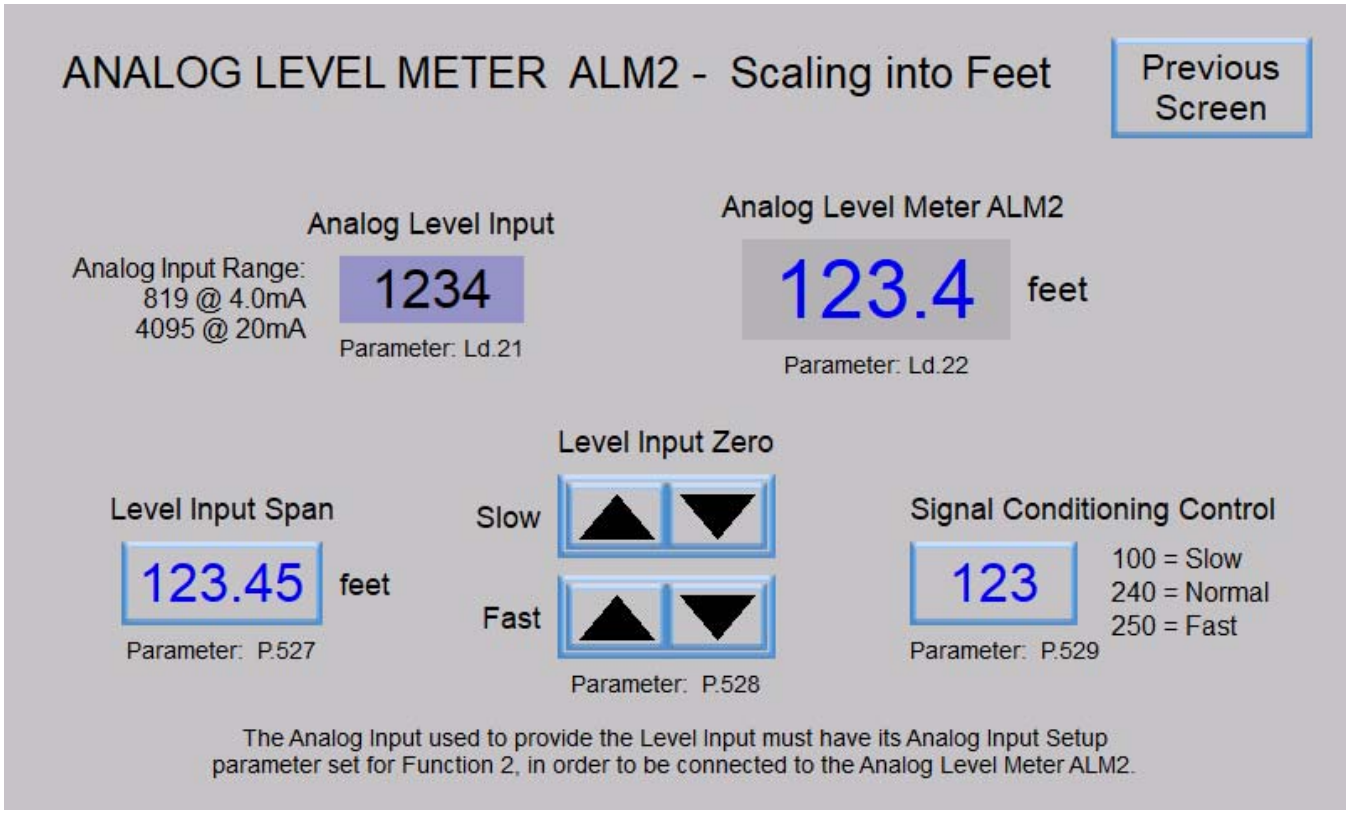
The setting on the "Level Input Select" (Parameter P.133) will determine the following operation:

Level Input Select = 3 - Automatically toggles from ALM1 to ALM2 upon failure of ALM1.

Level Input Select = 4 - Automatically toggles from ALM2 to ALM1 upon failure of ALM2.

ANALOG LEVEL METERS - Touchscreen HMI SCREENS





SECTION N
ANALOG PRESSURE METERS

ANALOG PRESSURE METER - APM1

Analog Pressure Meter APM1 provides all the necessary logic and parameters to take the selected Analog Input's data and process it into a conditioned value scaled into psi and tenths of psi.

The 4-20mA signal from the Pressure Input (typically a Pressure Transducer) must be connected to one of the Analog Inputs on the Controller. The Analog Input must be setup so that its data is sent to Analog Pressure Meter APM1. To do this, the Analog Input selected for this task must have its Analog Input Setup parameter set for Function 6. See Parameters F.299 - F.308 in Section C. The value of the selected Analog Input in its unscaled form is displayed on Parameter Pd.11.

The logic in the Pressure Meter takes the value from Parameter Pd.11 and scales it to the Pressure Input Span (Parameter P.572). The finished value, scaled into psi and tenths of psi, is then made available to be viewed from Parameter Pd.12.

The Pressure Input Span (Parameter P.572) must be set to the Pressure Transducer's calibrated Span, which is the measured pressure in psi that corresponds to a 20mA output from the Pressure Transducer.

The Signal Conditioning Control (Parameter P.573) determines the speed at which the values displayed on Pressure Meter APM1 may change in response to a change in the analog input signal. This is used to filter out sudden changes in the analog pressure input.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Analog Pressure Meter APM1 - Setup				
P.571	1		40571	Analog Pressure Meter APM1 - Pressure Meter Mode 0 = Pressure Meter Disabled 1 = Pressure Meter Enabled
P.572	100.0 psi		40572	Analog Pressure Meter APM1 - Pressure Input Span Range: 1.0 - 6,000.0 psi Note: This must be set for the Span (in psi) that the Pressure Transducer is calibrated for. This sets the displayed value with a 20mA input from the Pressure Transducer
P.573	240		40573	Analog Pressure Meter APM1 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast Note: This parameter controls the signal conditioning of Analog Pressure Meter APM1
Analog Pressure Meter APM1 - Data				
Pd.11	-	-	42221	Analog Pressure Meter APM1 - Analog Pressure Input Notes: 1. Parameter Pd.11 shows the unscaled value from the Analog Input selected as the Analog Pressure Input for APM1. It has a range of: 819 @ 4.0mA & 4,095 @ 20mA. 2. The selected Analog Input must have its Analog Input Function parameter set for Function 6.
Pd.12	-	-	42222	Analog Pressure Meter APM1 - Scaled into psi and 1/10 psi.

ANALOG PRESSURE METER - APM2

Analog Pressure Meter APM2 provides all the necessary logic and parameters to take the selected Analog Input's data and process it into a conditioned value scaled into psi and tenths of psi.

The 4-20mA signal from the Pressure Input (typically a Pressure Transducer) must be connected to one of the Analog Inputs on the Controller. The Analog Input must be setup so that its data is sent to Analog Pressure Meter APM2. To do this, the Analog Input selected for this task must have its Analog Input Setup parameter set for Function 7. See Parameters F.299 - F.308 in Section C. The value of the selected Analog Input in its unscaled form is displayed on Parameter Pd.21.

The logic in the Pressure Meter takes the value from Parameter Pd.21 and scales it to the Pressure Input Span (Parameter P.576). The finished value, scaled into psi and tenths of psi, is then made available to be viewed from Parameter Pd.22.

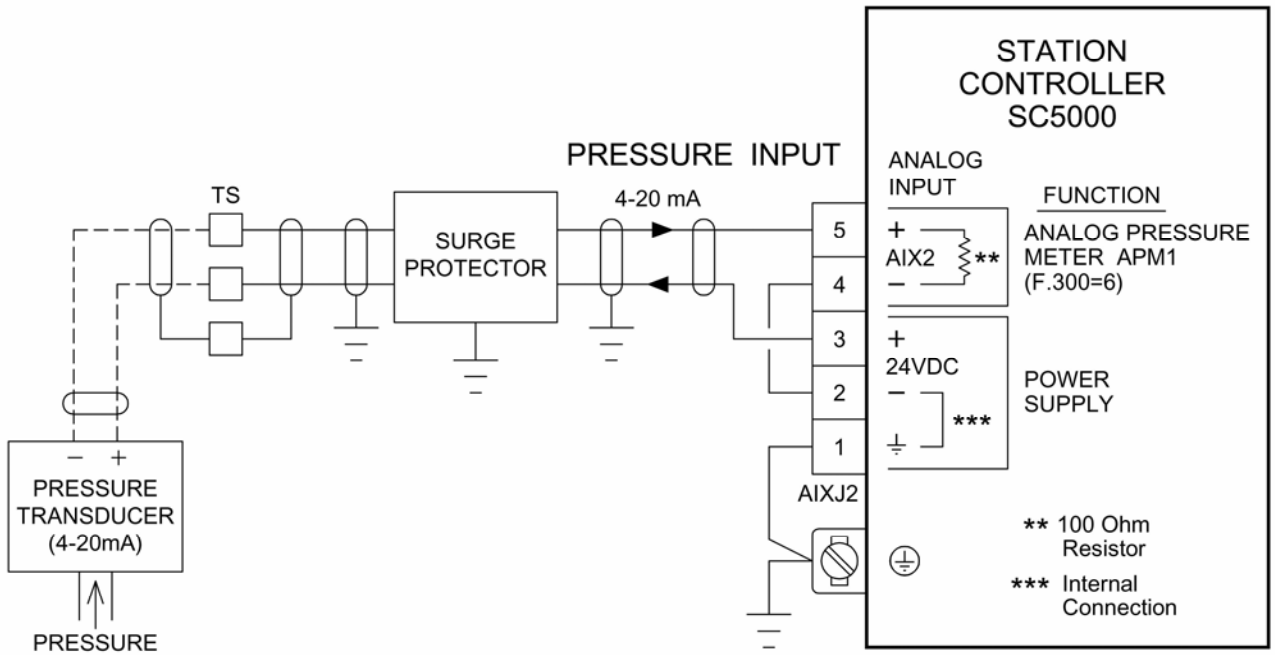
The Pressure Input Span (Parameter P.576) must be set to the Pressure Transducer's calibrated Span, which is the measured pressure in psi that corresponds to a 20mA output from the Pressure Transducer.

The Signal Conditioning Control (Parameter P.577) determines the speed at which the values displayed on Pressure Meter APM2 may change in response to a change in the analog input signal. This is used to filter out sudden changes in the analog pressure input.

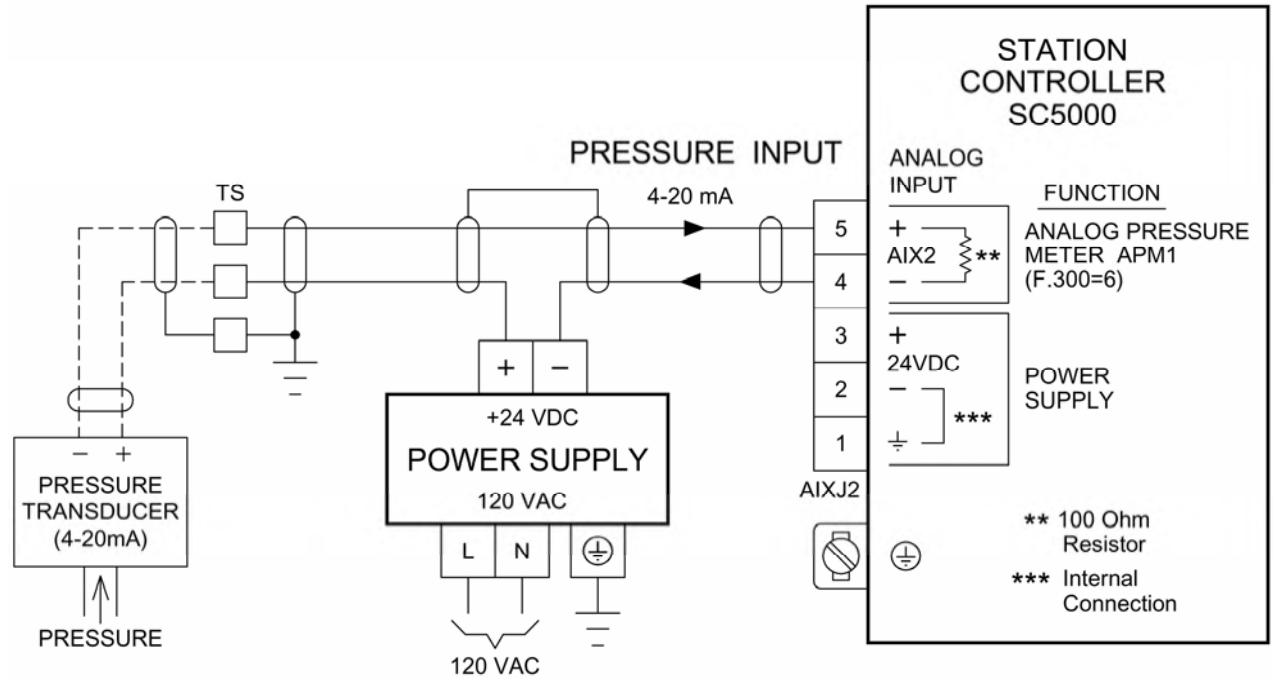
User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Analog Pressure Meter APM2 - Setup				
P.575	1		40575	Analog Pressure Meter APM2 - Pressure Meter Mode 0 = Pressure Meter Disabled 1 = Pressure Meter Enabled
P.576	100.0 psi		40576	Analog Pressure Meter APM2 - Pressure Input Span Range: 1.0 - 6,000.0 psi Note: This must be set for the Span (in psi) that the Pressure Transducer is calibrated for. This sets the displayed value with a 20mA input from the Pressure Transducer
P.577	240		40577	Analog Pressure Meter APM2 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast Note: This parameter controls the signal conditioning of Analog Pressure Meter APM2
Analog Pressure Meter APM2 - Data				
Pd.21	-	-	42223	Analog Pressure Meter APM2 - Analog Pressure Input Notes: 1. Parameter Pd.21 shows the unscaled value from the Analog Input selected as the Analog Pressure Input for APM2. It has a range of: 819 @ 4.0mA & 4,095 @ 20mA. 2. The selected Analog Input must have its Analog Input Function parameter set for Function 7.
Pd.22	-	-	42224	Analog Pressure Meter APM2 - Scaled into psi and 1/10 psi.

ANALOG PRESSURE INPUT EXAMPLES

Non-Isolated - Using the 24 VDC Power Supply on the SC5000



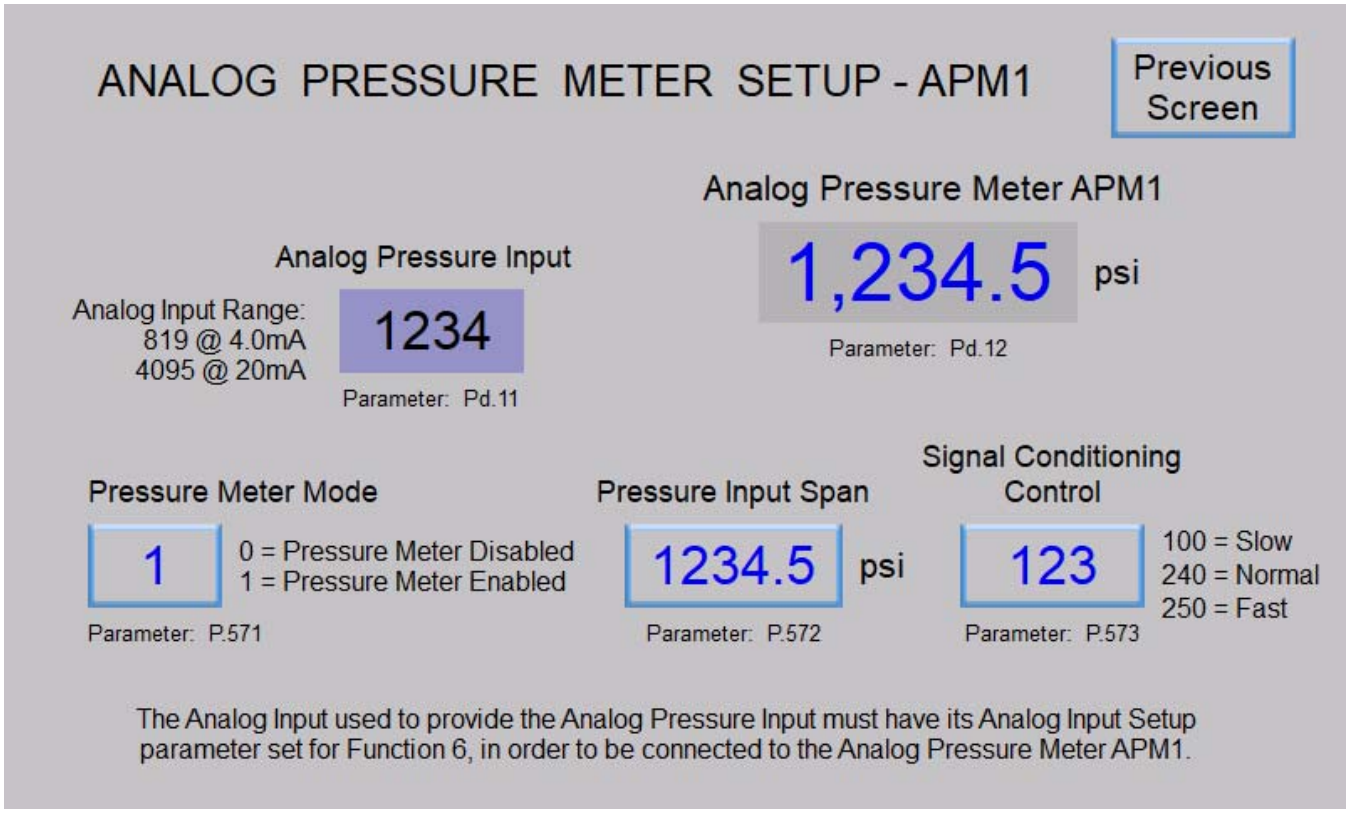
Isolated - Using an External 24VDC Power Supply

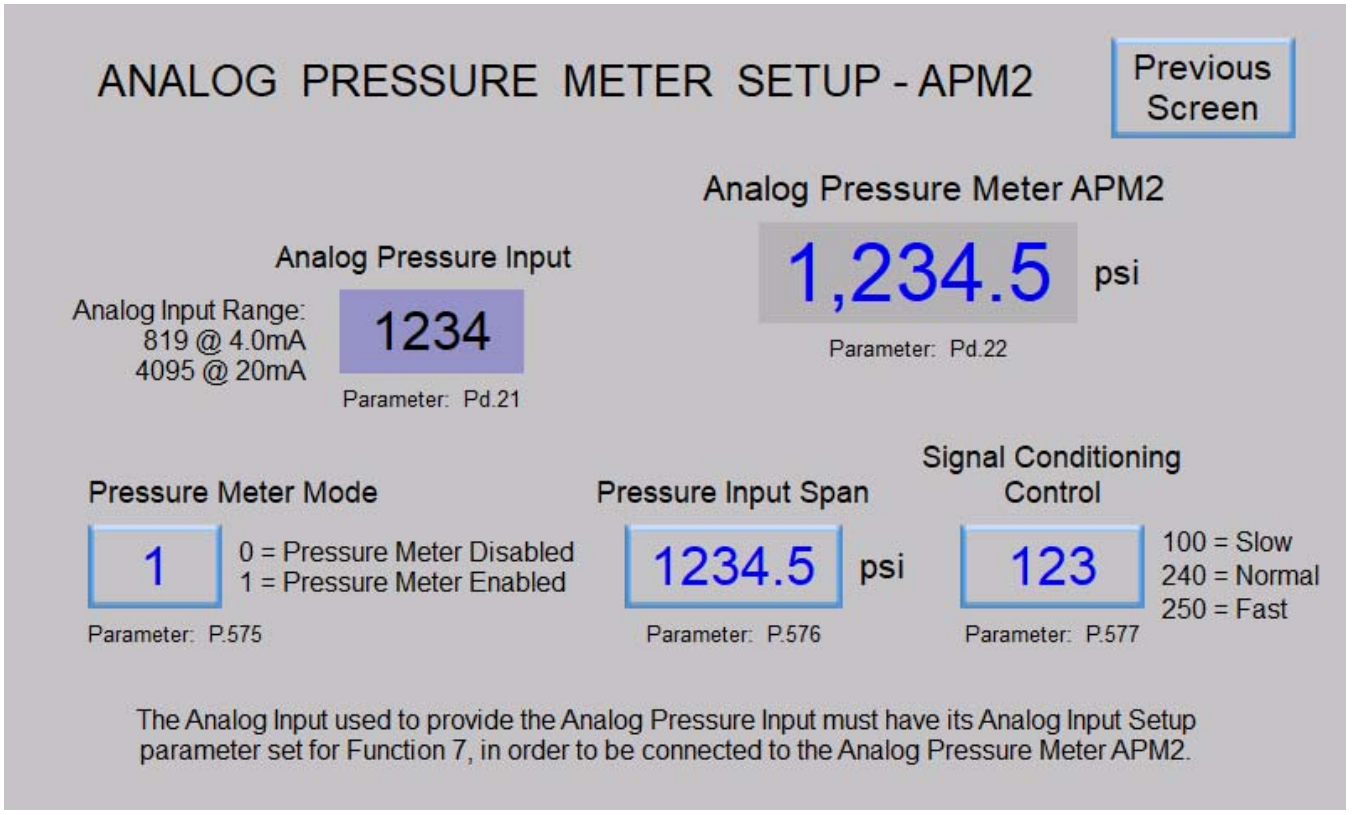


Notes:

1. All the Analog Inputs on the SC5000 are isolated from the SC5000's Power Supply ground and may be connected to remote devices that are at different ground potentials. However, if Isolation must be maintained an external Power Supply must be used.
2. The SC5000's 24 VDC Power Supply Commons (-), on AIXJ1 pin 2 and AIXJ2 pin 2, are internally connected to ground (not isolated from ground) and should not be used in cases where isolation of the 4-20mA signal must be maintained.

ANALOG PRESSURE METERS - Touchscreen HMI SCREENS





SECTION O
ANALOG CURRENT METERS

Revision Date: 12-30-22

ANALOG CURRENT METERS ACMA, ACMB & ACMC

Three Analog Current Meters ACMA, ACMB and ACMC are provided to record and display the three phases of the electrical current that flows to the pumps. The purpose for this feature is to make the motor current data of each pump available to an operator so that an issue with one of the pumps may be easily identified.

The Main Analog Current Meter is comprised of three individual meters (ACMA, ACMB and ACMC), one for each of the three phases, A, B and C. The Main Current Meter monitors and displays the electrical current that feeds to all of the pumps. This feature requires that the current in each of the three phases be monitored using AC Current Transducers (one for each phase). (An AC Current Transducer is a device that uses a Current Transformer (CT) to measure the current and then provides a 4-20mA analog output proportional to the measured current.) It is required that the Current Transducers be placed in the control panel's power circuit so that all the power leaving the Main Circuit Breaker on its way to the pumps first go through the three Current Transducers before it branches off to go to each individual Pump Circuit Breaker. The power for the controls must be taken from the Main Circuit Breaker ahead of the Current Transducers, and not routed through them, as shown in the example on page O-4.

The Main Current Meter displays the total current going to all of the pumps. In addition to this, all three phases of the electrical current going to each of the pumps is also recorded and displayed. This is accomplished by having logic that waits until each of the pumps run alone and then the three phases of motor current are recorded and displayed separately for each pump. The pump current data is stored in an EEPROM so that power interruptions do not result in a loss of the data. The pump current data values may be reset back to zero by pressing the "Pump Data Reset" pushbutton on the HMI.

The 4-20mA signals from the three Current Transducers used to measure the current must be connected to three Analog Inputs on the Controller. The three Analog Inputs must be setup so that their data is sent to the three Analog Current Meters ACMA, ACMB and ACMC. To do this, the Analog Inputs selected for this task must have their Analog Input Setup parameters set for Functions 8, 9 and 10 respectively. See Parameters F.299 - F.308 in Section C.

The logic in Current Meters ACMA, ACMB and ACMC takes the selected Analog Inputs in their unscaled form and displays them on Parameters Cd.01, Cd.02 and Cd.03.

The logic in the Current Meters take the values from Parameters Cd.01, Cd.02 and Cd.03 and scales them to the Current Transducer Span (Parameter P.584). The finished value, scaled into Amps, is then made available to be viewed from Parameters Cd.04, Cd.05 and Cd.06.

The setting for the Current Transducer Span (Parameter P.584) must be set to the Current Transducer's calibrated Span or Range, which is the measured current in Amps that corresponds to a 20mA output from the Current Transducers.

Signal conditioning logic is also provided to filter out any sudden changes in the measured current. The Signal Conditioning Control Parameter (P.585) is provided to set the speed at which the values displayed on Current Meters ACMA, ACMB and ACMC may change in response to a change in the measured current.

Notes:

1. The Current Transducers must be sized for the total current required to operate all the pumps at the same time.
2. Care must be taken not to oversize the CTs too much as this will reduce the measurement resolution.
3. Using this feature is not recommended when Variable Frequency Drives or Soft Start Starters are used. Current Transducers are typically designed to measure 50-60Hz sinusoidal waveforms and they generally do not work well in the presence of the harmonics typically generated by Variable Frequency Drives and Soft Start Starters.

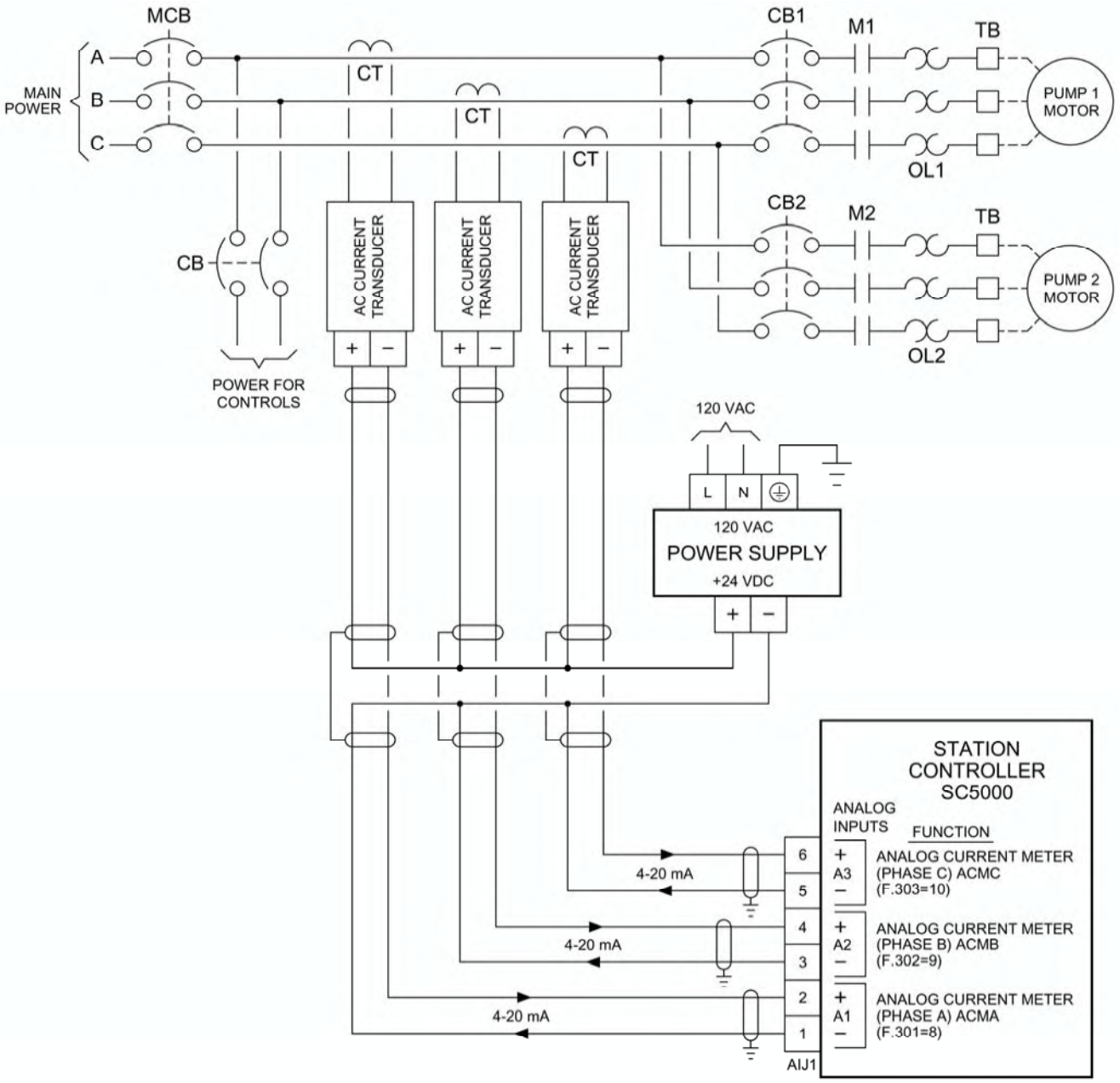
ANALOG CURRENT METERS ACMA, ACMB & ACMC

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Analog Current Meters ACMA, ACMB & ACMC - Setup				
P.583	0		40583	Analog Current Meters ACMA, ACMB & ACMC - Current Meters Mode 0 = Current Meters Disabled 1 = Current Meters Enabled
P.584	100 Amps		40584	Analog Current Meters ACMA, ACMB & ACMC - Current Transducer Span Range: 1 - 65,535 Note: This must be set for the Span or Range (in Amps) that the Current Transducer is calibrated for. This sets the displayed value with a 20mA input from the Current Transducer.
P.585	5		40585	Analog Current Meters ACMA, ACMB & ACMC - Signal Conditioning Control 1 = Slow 5 = Normal 10 = Fast Range: 1 - 10 Note: This parameter controls the analog input signal conditioning for the three Current Meters.
Analog Current Meters ACMA, ACMB & ACMC - Analog Input Data				
Cd.01	-	-	42239	Analog Current Meter ACMA - Analog Input Data - Main Phase A
Cd.02	-	-	42240	Analog Current Meter ACMB - Analog Input Data - Main Phase B
Cd.03	-	-	42241	Analog Current Meter ACMC - Analog Input Data - Main Phase C
Notes: 1. Parameters Cd.01 - Cd.03 show the unscaled values from the three Analog Inputs selected as the analog current input for ACMA, ACMB & ACMC. They have a range of: 819 @ 4.0mA & 4,095 @ 20mA. 2. The Analog Inputs selected for ACMA, ACMB & ACMC must have their Analog Input Setup parameters set for Functions 8, 9 &10 respectively.				
Pump Current Data Reset				
To reset the Pump Motor Current Data to zero momentarily set Modbus Coil 279 (Register 40018 Bit 6).				

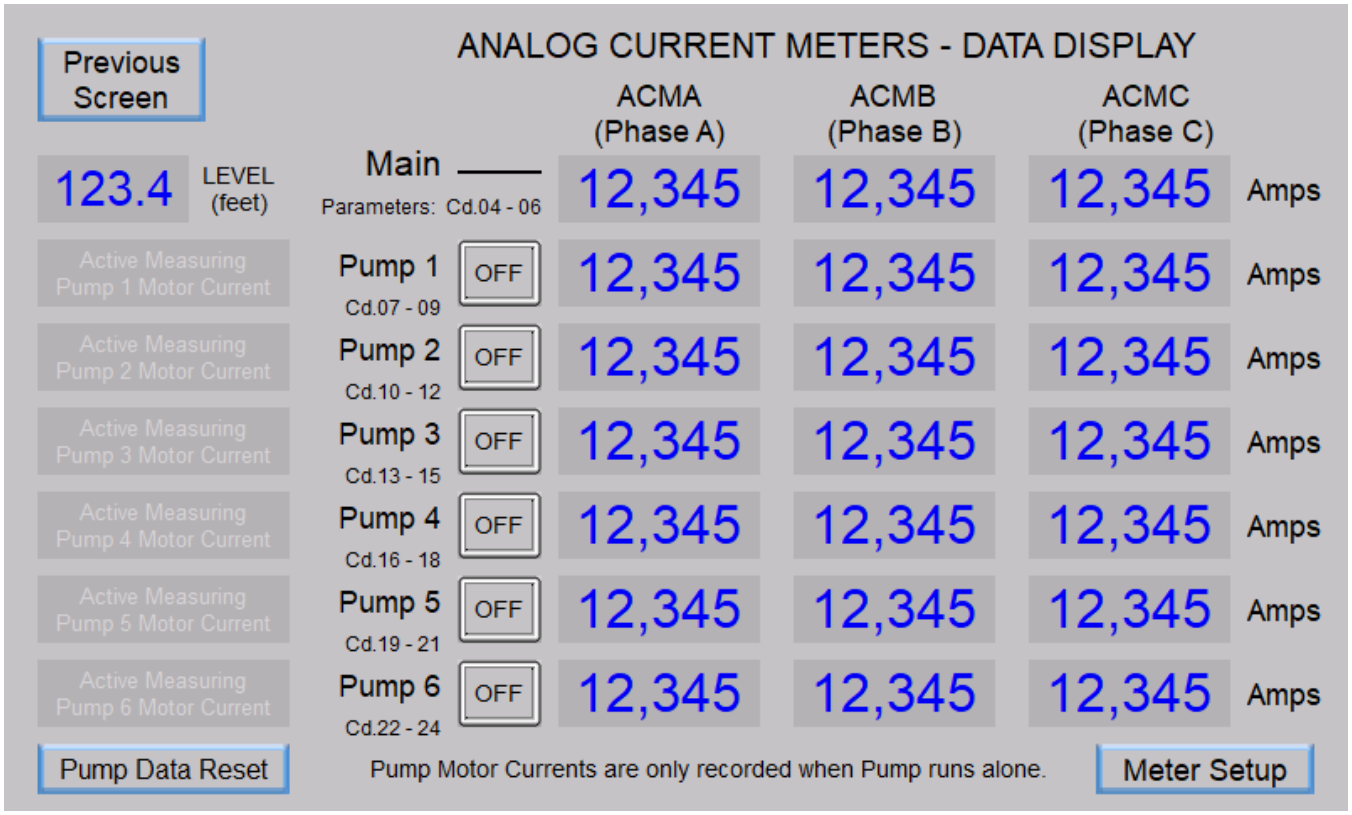
ANALOG CURRENT METERS ACMA, ACMB & ACMC

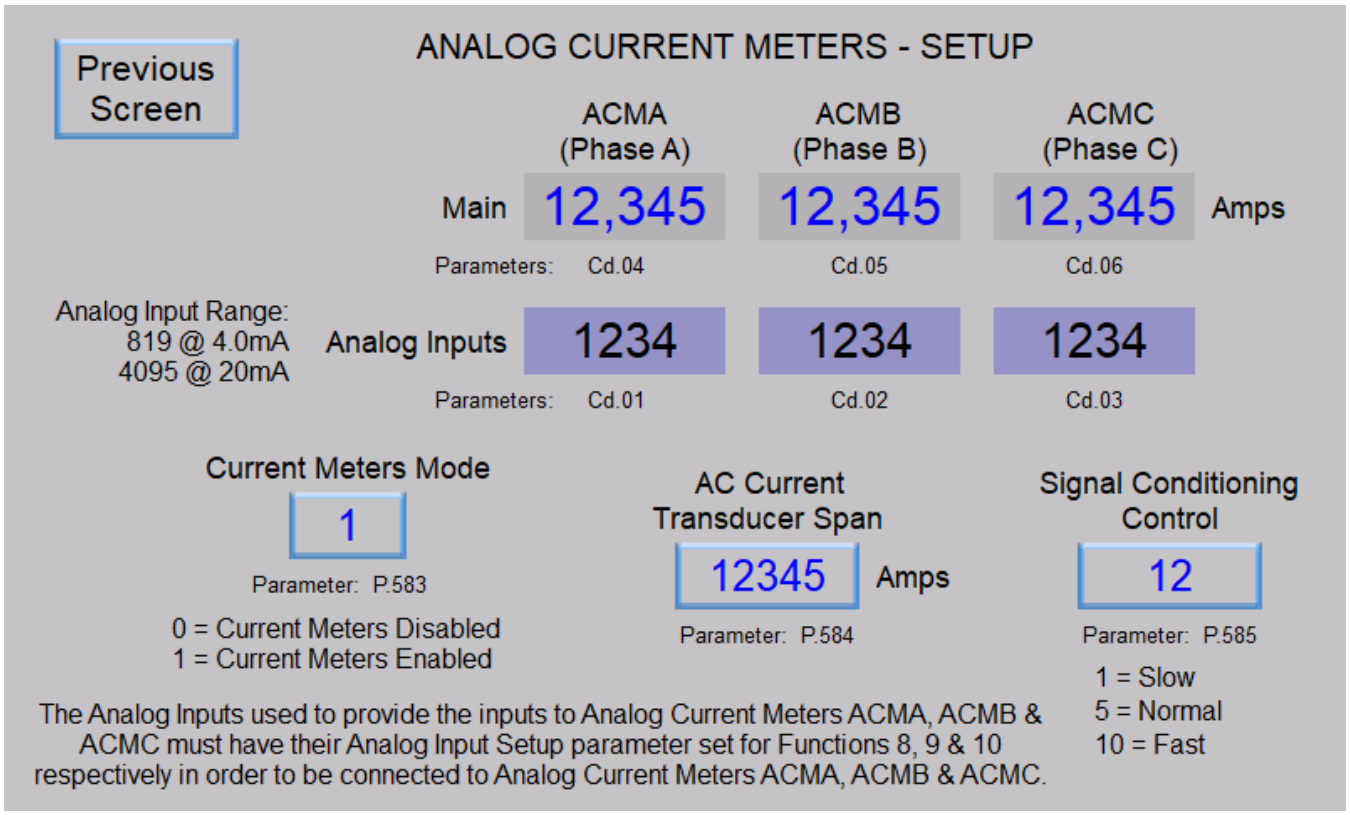
User / Operator Info.	SCADA	
Parameter	Register Address	Description of Parameters
Analog Current Meter - Main - Data Scaled into Amps		
Cd.04	42242	Analog Current Meter ACMA - Main - Phase A - Data Scaled into Amps
Cd.05	42243	Analog Current Meter ACMB - Main - Phase B - Data Scaled into Amps
Cd.06	42244	Analog Current Meter ACMC - Main - Phase C - Data Scaled into Amps
Analog Current Meter - Pump 1 - Data Scaled into Amps		
Cd.07	42245	Analog Current Meter ACMA - Pump 1 - Phase A - Data Scaled into Amps
Cd.08	42246	Analog Current Meter ACMB - Pump 1 - Phase B - Data Scaled into Amps
Cd.09	42247	Analog Current Meter ACMC - Pump 1 - Phase C - Data Scaled into Amps
Analog Current Meter - Pump 2 - Data Scaled into Amps		
Cd.10	42248	Analog Current Meter ACMA - Pump 2 - Phase A - Data Scaled into Amps
Cd.11	42249	Analog Current Meter ACMB - Pump 2 - Phase B - Data Scaled into Amps
Cd.12	42250	Analog Current Meter ACMC - Pump 2 - Phase C - Data Scaled into Amps
Analog Current Meter - Pump 3 - Data Scaled into Amps		
Cd.13	42251	Analog Current Meter ACMA - Pump 3 - Phase A - Data Scaled into Amps
Cd.14	42252	Analog Current Meter ACMB - Pump 3 - Phase B - Data Scaled into Amps
Cd.15	42253	Analog Current Meter ACMC - Pump 3 - Phase C - Data Scaled into Amps
Analog Current Meter - Pump 4 - Data Scaled into Amps		
Cd.16	42254	Analog Current Meter ACMA - Pump 4 - Phase A - Data Scaled into Amps
Cd.17	42255	Analog Current Meter ACMB - Pump 4 - Phase B - Data Scaled into Amps
Cd.18	42256	Analog Current Meter ACMC - Pump 4 - Phase C - Data Scaled into Amps
Analog Current Meter - Pump 5 - Data Scaled into Amps		
Cd.19	42257	Analog Current Meter ACMA - Pump 5 - Phase A - Data Scaled into Amps
Cd.20	42258	Analog Current Meter ACMB - Pump 5 - Phase B - Data Scaled into Amps
Cd.21	42259	Analog Current Meter ACMC - Pump 5 - Phase C - Data Scaled into Amps
Analog Current Meter - Pump 6 - Data Scaled into Amps		
Cd.22	42260	Analog Current Meter ACMA - Pump 6 - Phase A - Data Scaled into Amps
Cd.23	42261	Analog Current Meter ACMB - Pump 6 - Phase B - Data Scaled into Amps
Cd.24	42262	Analog Current Meter ACMC - Pump 6 - Phase C - Data Scaled into Amps

ANALOG CURRENT METER EXAMPLE



ANALOG CURRENT METERS - Touchscreen HMI SCREENS





SECTION T
CONTROL & STATUS BITs

Revision Date: 12-30-22

SCADA Register Address	Description of Register Contents (Where a Modbus Coil is represented by a Bit in a Register)																
40001	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Coil
	D16 - Discrete Input Status	D15 - Discrete Input Status	D14 - Discrete Input Status	D13 - Discrete Input Status	D12 - Discrete Input Status	D11 - Discrete Input Status	D10 - Discrete Input Status	D9 - Discrete Input Status	D8 - Discrete Input Status	D7 - Discrete Input Status	D6 - Discrete Input Status	D5 - Discrete Input Status	D4 - Discrete Input Status	D3 - Discrete Input Status	D2 - Discrete Input Status	D1 - Discrete Input Status	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40002	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	Coil
	Spare	Spare	D30 - Discrete Input Status	D29 - Discrete Input Status	D28 - Discrete Input Status	D27 - Discrete Input Status	D26 - Discrete Input Status	D25 - Discrete Input Status	D24 - Discrete Input Status	D23 - Discrete Input Status	D22 - Discrete Input Status	D21 - Discrete Input Status	D20 - Discrete Input Status	D19 - Discrete Input Status	D18 - Discrete Input Status	D17 - Discrete Input Status	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40003	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	Coil
	High Level Alarm Status (From All Sources)	Low Level Alarm Status (From All Sources)	Pump 6 - Call to Run Status	Pump 5 - Call to Run Status	Pump 4 - Call to Run Status	Pump 3 - Call to Run Status	Pump 2 - Call to Run Status	Pump 1 - Call to Run Status	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40004	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	Coil
	Spare	Spare	Spare	Spare	ROX 12 Relay Status	ROX 11 Relay Status	ROX 10 Relay Status	ROX 9 Relay Status	ROX 8 Relay Status	ROX 7 Relay Status	ROX 6 Relay Status	ROX 5 Relay Status	ROX 4 Relay Status	ROX 3 Relay Status	ROX 2 Relay Status	ROX 1 Relay Status	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit

CONTROL & STATUS BITs

SCADA Register Address	Description of Register Contents (Where a Modbus Coil is represented by a Bit in a Register)																
40005	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	Coil
	Spare	Spare	Spare	Spare	ROX 12 Relay - Remote Control	ROX 11 Relay - Remote Control	ROX 10 Relay - Remote Control	ROX 9 Relay - Remote Control	ROX 8 Relay - Remote Control	ROX 7 Relay - Remote Control	ROX 6 Relay - Remote Control	ROX 5 Relay - Remote Control	ROX 4 Relay - Remote Control	ROX 3 Relay - Remote Control	ROX 2 Relay - Remote Control	ROX 1 Relay - Remote Control	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40006	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	Coil
	Forced Alternation Group 2	Forced Alternation Group 1	Flush Cycle Active Status Calling All Pumps to Run	Flush Cycle Active Status Waiting For Well to Fill Up	Flush Cycle Active Status	Stop Flush Cycle	Start Flush Cycle	Spare	Spare	Spare	Pump 6 - Force On	Pump 5 - Force On	Pump 4 - Force On	Pump 3 - Force On	Pump 2 - Force On	Pump 1 - Force On	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40007	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	Coil
	Spare	Spare	Spare	Spare	Spare	Spare	Level Simulation - Probe Up Control	Level Simulation - Probe Down Control	Level Simulation - Probe On / Off Control	Level Simulation - Analog On / Off Control	Pump 6 - Disable	Pump 5 - Disable	Pump 4 - Disable	Pump 3 - Disable	Pump 2 - Disable	Pump 1 - Disable	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40008	128	127	126	125	124	123	122	121	120	119	118	117	116	115	114	113	Coil
	Spare	Spare	24VDC Supply Power Low Voltage Alarm Status	Spare	Spare	Spare	Spare	Spare	Spare	Spare	ETM 6 - Reset	ETM 5 - Reset	ETM 4 - Reset	ETM 3 - Reset	ETM 2 - Reset	ETM 1 - Reset	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit

CONTROL & STATUS BITs

SCADA Register Address	Description of Register Contents (Where a Modbus Coil is represented by a Bit in a Register)																
40009	144	143	142	141	140	139	138	137	136	135	134	133	132	131	130	129	Coil
	Spare	Float - High Level Status Discrete Input Function 60, 62, 70	Float Control - 6th On Level Discrete Input Function 69	Float Control - 5th On Level Discrete Input Function 68	Float Control - 4th On Level Discrete Input Function 67	Float Control - 3rd On Level Discrete Input Function 66	Float Control - 2nd On Level Discrete Input Function 65	Float Control -1st On Level Discrete Input Function 64	Float Control - Off Level Discrete Input Function 63	Float - Low Level Status Discrete Input Function 59, 61	Float Control Fault Status Float Out of Sequence	Float Control Active Status Calling Pump(s) to Run	Pump Cutoff High-High Level Active Disabling Pump Operation	Pump Cutoff Low-Low Level Active Disabling Pump Operation	On Generator Status Discrete Input Function 18	All Pump Disable Status Discrete Input Function 17	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40010	160	159	158	157	156	155	154	153	152	151	150	149	148	147	146	145	Coil
	Spare	Spare	Spare	Spare	Spare	Level Probe - Electrode 10 Discrete Input Function 10	Level Probe - Electrode 9 Discrete Input Function 9	Level Probe - Electrode 8 Discrete Input Function 8	Level Probe - Electrode 7 Discrete Input Function 7	Level Probe - Electrode 6 Discrete Input Function 6	Level Probe - Electrode 5 Discrete Input Function 5	Level Probe - Electrode 4 Discrete Input Function 4	Level Probe - Electrode 3 Discrete Input Function 3	Level Probe - Electrode 2 Discrete Input Function 2	Level Probe - Electrode 1 Discrete Input Function 1	Level Probe Fault Status Electrode Out of Sequence	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40011	176	175	174	173	172	171	170	169	168	167	166	165	164	163	162	161	Coil
	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40012	192	191	190	189	188	187	186	185	184	183	182	181	180	179	178	177	Coil
	Fault Code Register (FLC) Has Non-zero Fault Code	Spare	Spare	Parameter Security Alert	Spare	Spare	Spare	Spare	Spare	Spare	Pump 6 - Available For Service Status	Pump 5 - Available For Service Status	Pump 4 - Available For Service Status	Pump 3 - Available For Service Status	Pump 2 - Available For Service Status	Pump 1 - Available For Service Status	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit

CONTROL & STATUS BITs

SCADA Register Address	Description of Register Contents (Where a Modbus Coil is represented by a Bit in a Register)																
40013	208	207	206	205	204	203	202	201	200	199	198	197	196	195	194	193	Coil
	Spare	Spare	Spare	Spare	USB Port - Control Restore from USB Drive	USB Port - Control Backup to USB Drive	Spare	USB Port - Status Restore Complete	USB Port - Status Saving to EEPROM	USB Port - Status Restore Aborted	USB Port - Status Restore In Progress	USB Port - Status Backup Complete	USB Port - Status Backup Aborted	USB Port - Status Backup in Progress	USB Port - Status Parameter Security	USB Port - Status +5V Supply On	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40014	224	223	222	221	220	219	218	217	216	215	214	213	212	211	210	209	Coil
	Flow Meter - AFM3 Flow Total Reset	Flow Meter - AFM2 Flow Total Reset	Flow Meter - AFM1 Flow Total Reset	Flow Meter - PFM3 Flow Total Reset	Flow Meter - PFM2 Flow Total Reset	Flow Meter - PFM1 Flow Total Reset	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40015	240	239	238	237	236	235	234	233	232	231	230	229	228	227	226	225	Coil
	Analog Level Meter ALM2 Negative Sign Display	Analog Level Meter ALM1 Negative Sign Display	Analog Output (AO6) Cal. Force 20mA Output	Analog Output (AO6) Cal. Force 4.0mA Output	Analog Output (AO5) Cal. Force 20mA Output	Analog Output (AO5) Cal. Force 4.0mA Output	Analog Output (AO4) Cal. Force 20mA Output	Analog Output (AO4) Cal. Force 4.0mA Output	Analog Output (AO3) Cal. Force 20mA Output	Analog Output (AO3) Cal. Force 4.0mA Output	Analog Output (AO2) Cal. Force 20mA Output	Analog Output (AO2) Cal. Force 4.0mA Output	Analog Output (AO1) Cal. Force 20mA Output	Analog Output (AO1) Cal. Force 4.0mA Output	Analog Output (AOX1) Cal. Force 20mA Output	Analog Output (AOX1) Cal. Force 4.0mA Output	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40016	256	255	254	253	252	251	250	249	248	247	246	245	244	243	242	241	Coil
	Spare	Spare	Spare	Spare	Flow Calculator - Active Determining Pump 6 Outflow Rate Status	Flow Calculator - Active Determining Pump 5 Outflow Rate Status	Flow Calculator - Active Determining Pump 4 Outflow Rate Status	Flow Calculator - Active Determining Pump 3 Outflow Rate Status	Flow Calculator - Active Determining Pump 2 Outflow Rate Status	Flow Calculator - Active Determining Pump 1 Outflow Rate Status	Flow Calculator - Active Determining Latest Inflow Rate Status	Flow Calculator - Active Forcing On Another Pump(s) Status	Flow Calculator Level Rising Too Fast Status	Flow Calculator Pump Outflow Rate & Run Time Reset	Flow Calculator Inflow Totalizer Reset	Flow Calculator Start New Day	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit

CONTROL & STATUS BITs

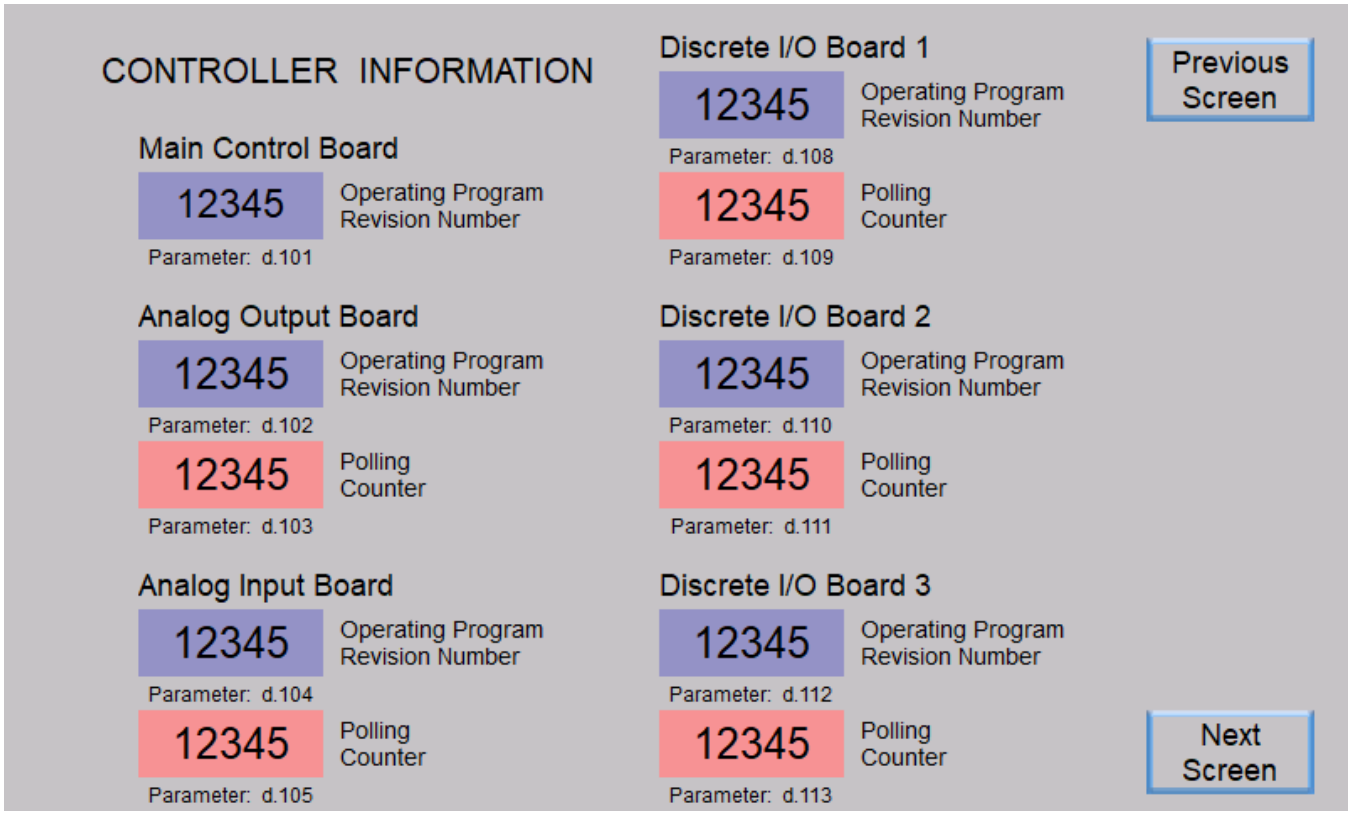
SCADA Register Address	Description of Register Contents (Where a Modbus Coil is represented by a Bit in a Register)															
40017	272	271	270	269	268	267	266	265	264	263	262	261	260	259	258	257	Coil
	Spare	Spare	High Flow Rate Alarm Status	Low Flow Rate Alarm Status	High Discharge Pressure Alarm Status	Low Discharge Pressure Alarm Status	High Supply Pressure Alarm Status	Low Supply Pressure Alarm Status	Spare	Spare	Spare	Spare	Spare	Supply Pressure Too Low for Pump Operation Status	Supply Level Too Low for Pump Operation Status	PID Controller Setpoint Override Active Status	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40018	288	287	286	285	284	283	282	281	280	279	278	277	276	275	274	273	Coil
	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Motor Current Data - Reset	Active Measuring Pump 6 Motor Current Status	Active Measuring Pump 5 Motor Current Status	Active Measuring Pump 4 Motor Current Status	Active Measuring Pump 3 Motor Current Status	Active Measuring Pump 2 Motor Current Status	Active Measuring Pump 1 Motor Current Status	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40019	304	303	302	301	300	299	298	297	296	295	294	293	292	291	290	289	Coil
	Restore Parameters To Defaults - Restore Complete	Restore Parameters To Defaults - Restore in Progress	Restore Parameters To Defaults - Unlock Status	Restore Parameters To Defaults - Start Restore	Spare	Spare	Parameter Security Setup Unlock Status	Security Code Setup Value Entered Status - SCS3	Security Code Setup Value Entered Status - SCS2	Security Code Setup Value Entered Status - SCS1	Security Code Entry Value Entered Status - SCE3	Security Code Entry Value Entered Status - SCE2	Security Code Entry Value Entered Status - SCE1	Parameter Write Access Unlock Status - COM1	Parameter Write Access Unlock Status - ENET2	Parameter Write Access Unlock Status - ENET1	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit
40020	320	319	318	317	316	315	314	313	312	311	310	309	308	307	306	305	Coil
	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	Spare	FLC & LFC - Reset	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit

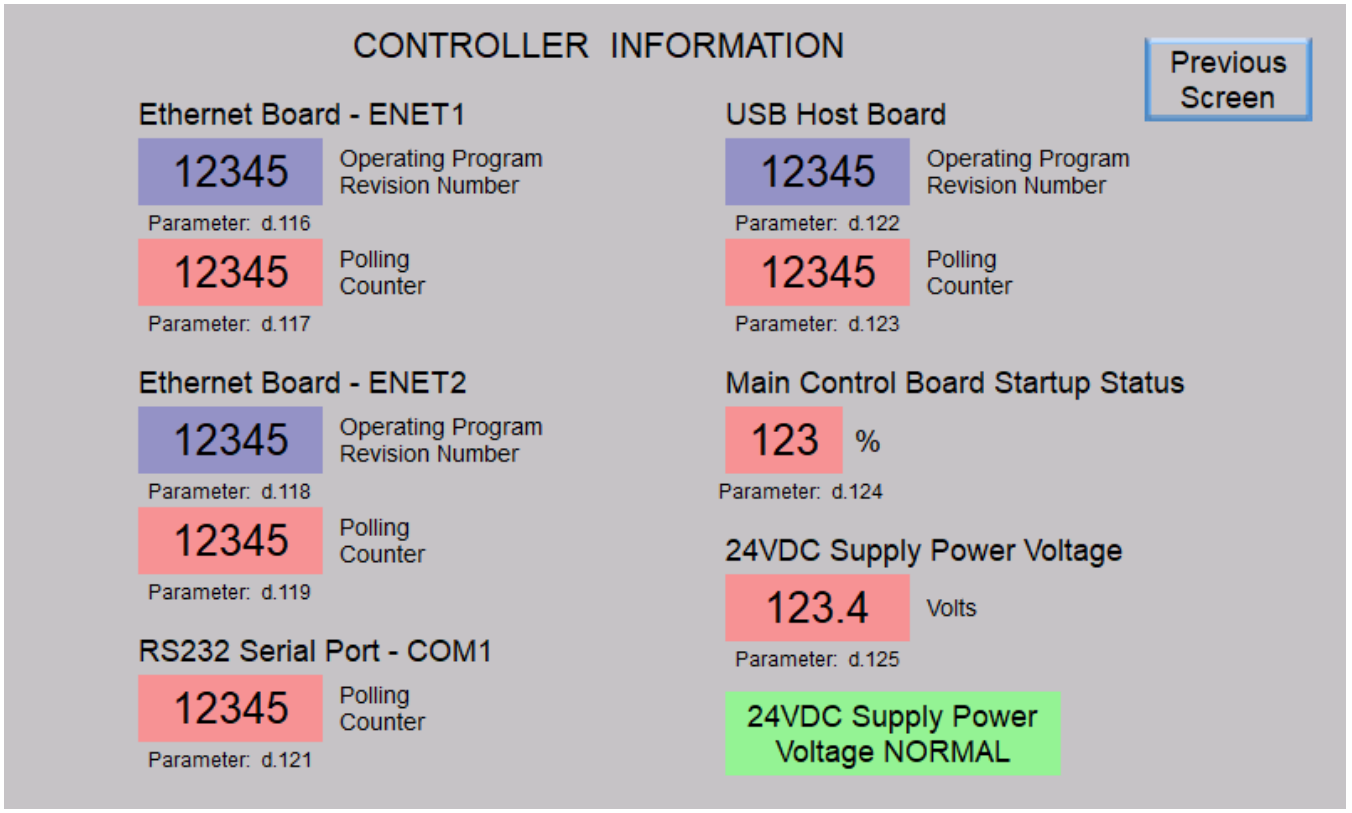
SECTION U
CONTROLLER DATA

Revision Date: 12-30-22

User / Operator Info. Parameter	SCADA Register Address	Data Description
d.101	42501	Main Control Board - Operating Program Revision Number
d.102	42502	Analog Output Board - Operating Program Revision Number
d.103	42503	Analog Output Board - Polling Counter
d.104	42504	Analog Input Board - Operating Program Revision Number
d.105	42505	Analog Input Board - Polling Counter
d.108	42508	Discrete I/O Board 1 - Operating Program Revision Number
d.109	42509	Discrete I/O Board 1 - Polling Counter
d.110	42510	Discrete I/O Board 2 - Operating Program Revision Number
d.111	42511	Discrete I/O Board 2 - Polling Counter
d.112	42512	Discrete I/O Board 3 - Operating Program Revision Number
d.113	42513	Discrete I/O Board 3 - Polling Counter
d.116	42516	Ethernet Port Board - ENET1 - Operating Program Revision Number
d.117	42517	Ethernet Port Board - ENET1 - Polling Counter
d.118	42518	Ethernet Port Board - ENET2 - Operating Program Revision Number
d.119	42519	Ethernet Port Board - ENET2 - Polling Counter
d.121	42521	RS232 Port - COM1 - Polling Counter
d.122	42522	USB Host Board - Operating Program Revision Number
d.123	42523	USB Host Board - Polling Counter
d.124	42524	Main Control Board - Startup Status (% Completion)
d.125	42525	Voltage of +24 Volt Power Supply (Volts)

CONTROLLER DATA - Touchscreen HMI SCREENS



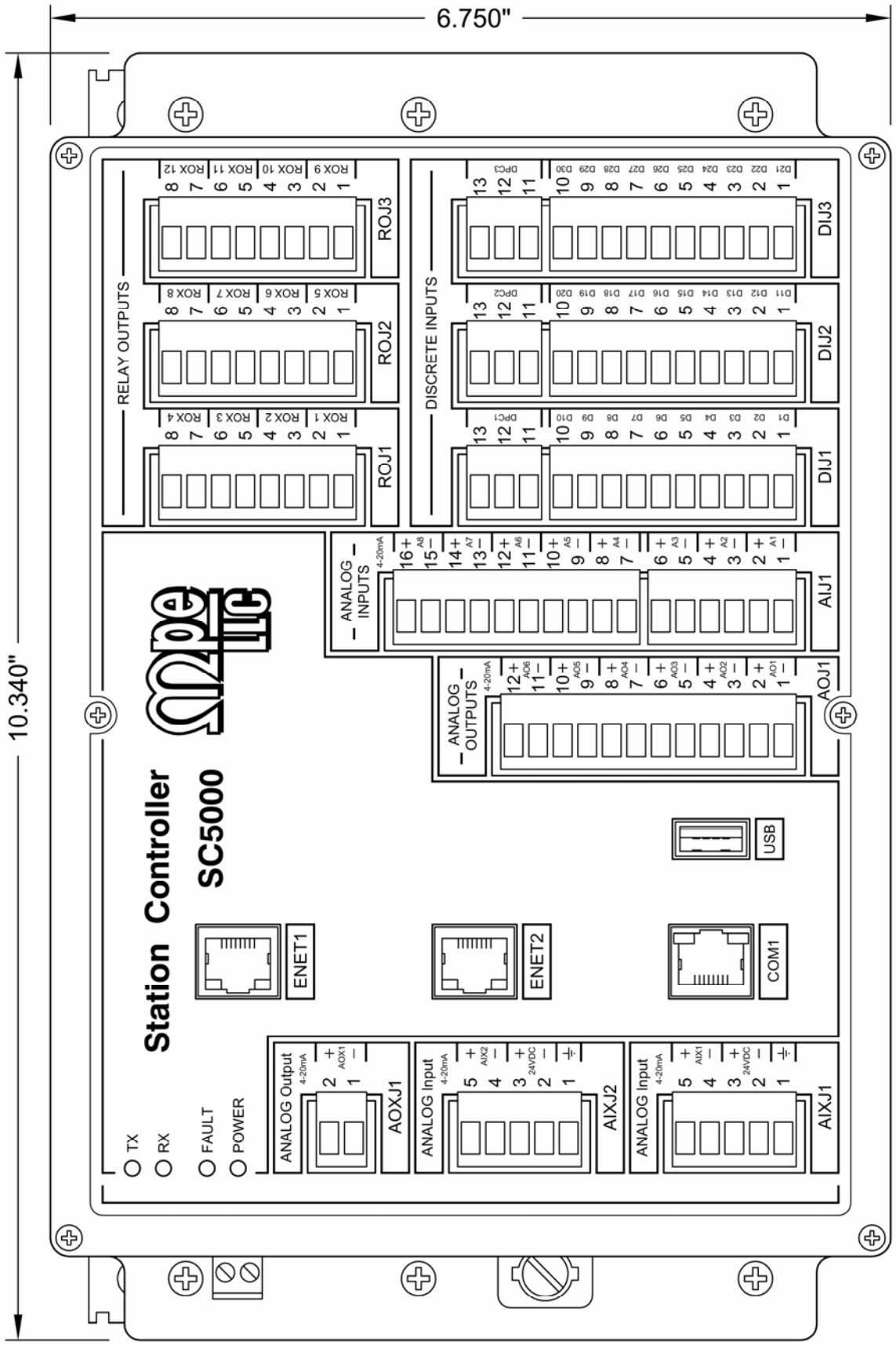


SECTION V

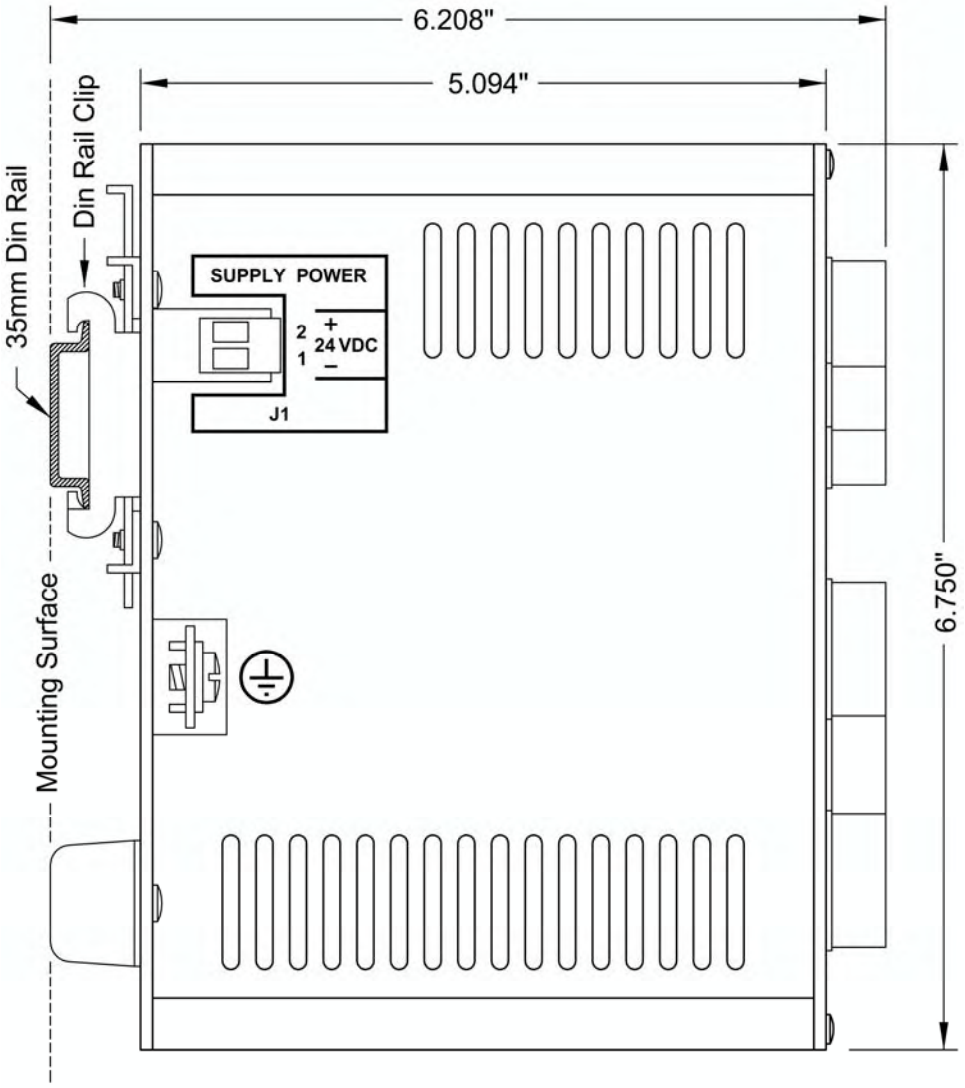
Revision Date: 12-30-22

ENCLOSURE MECHANICAL DRAWINGS

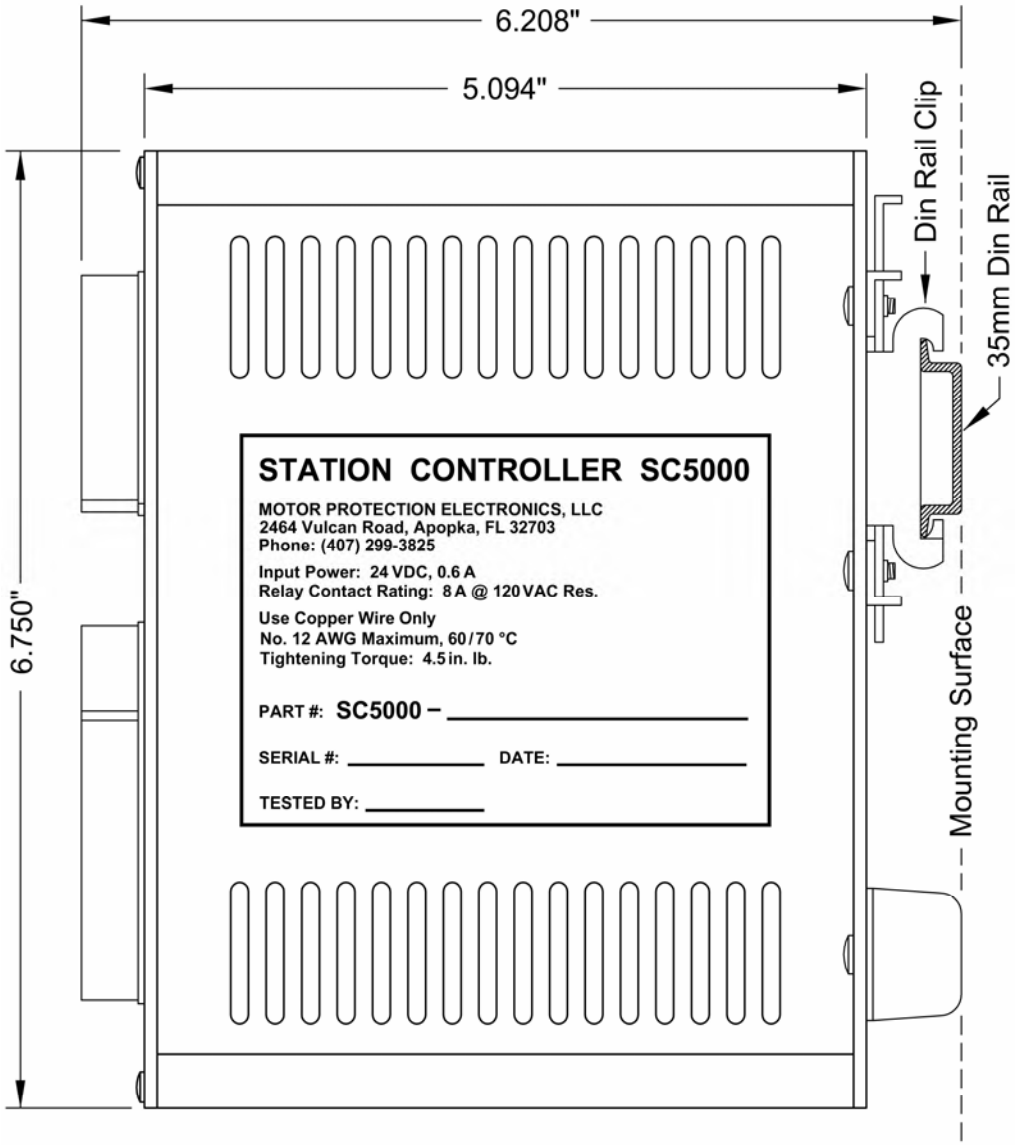
ENCLOSURE FRONT



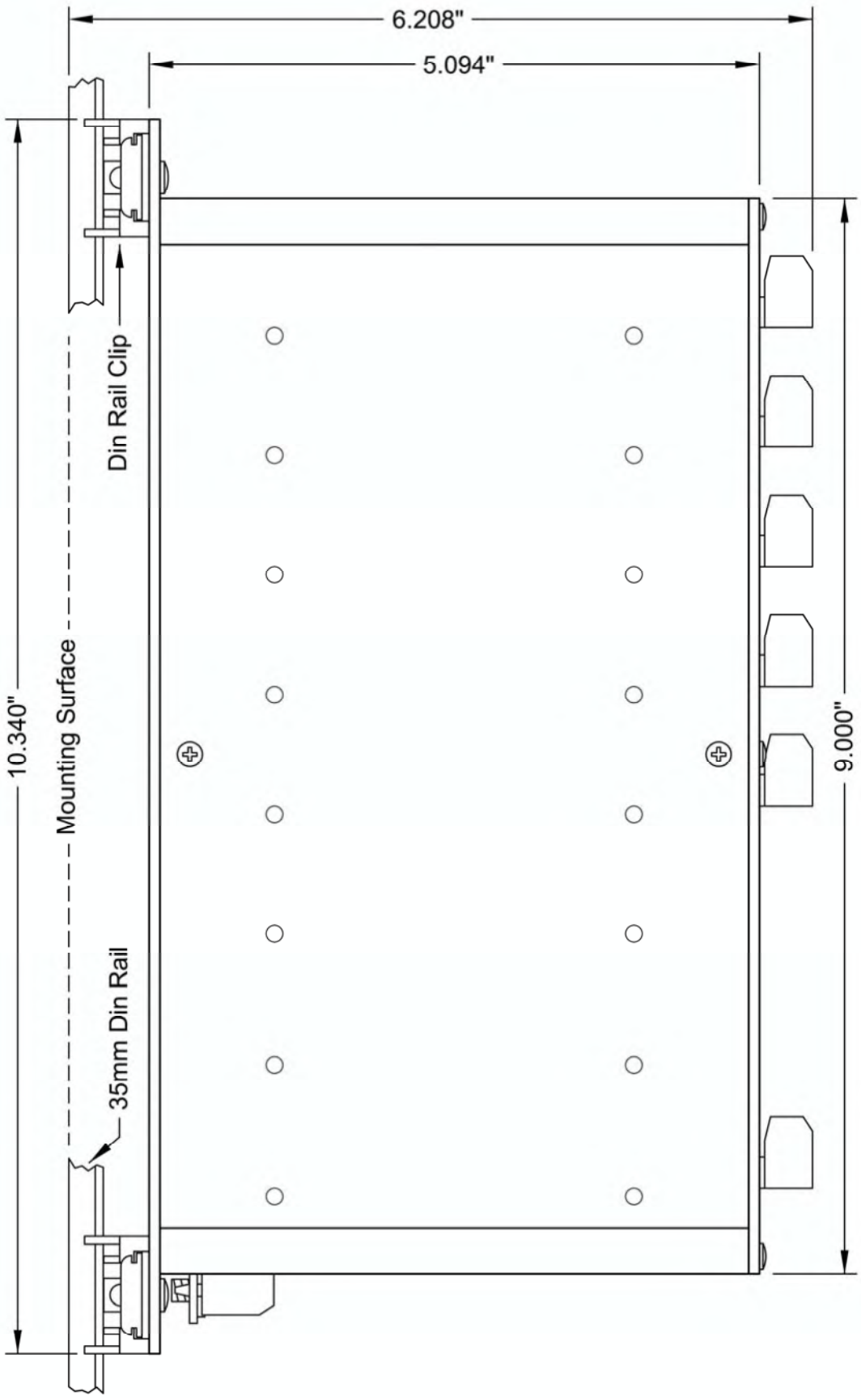
ENCLOSURE LEFT SIDE



ENCLOSURE RIGHT SIDE



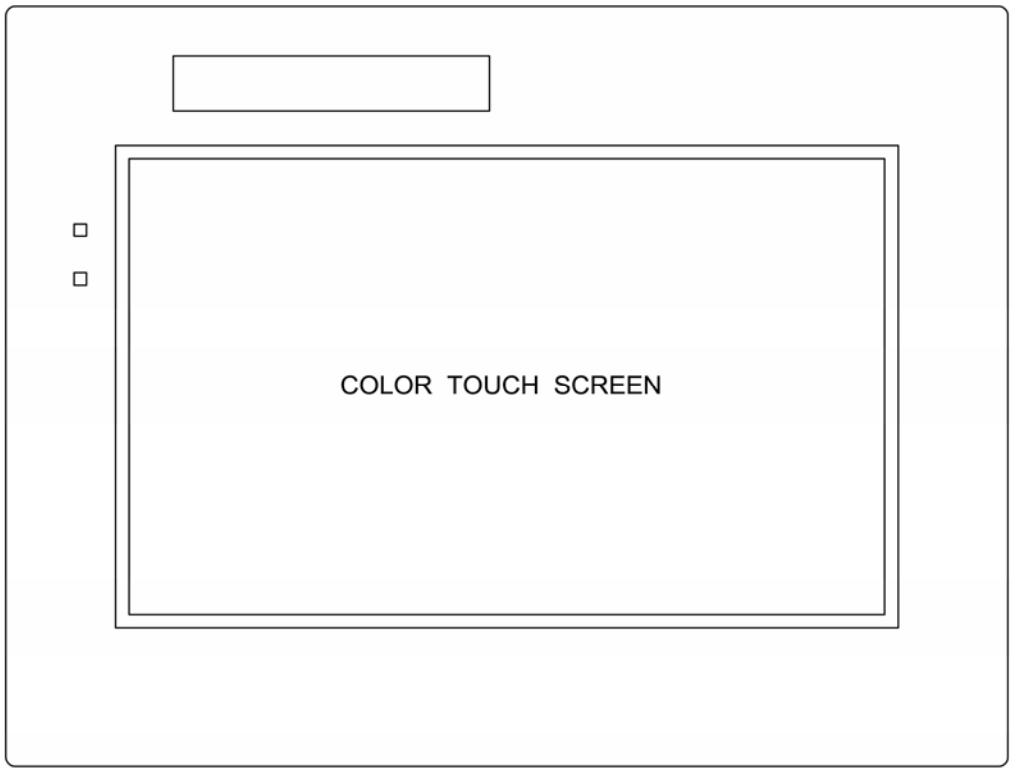
ENCLOSURE TOP



SECTION W

Revision Date: 12-30-22

SC5000-CTS-HMI



General Description and Purpose

The **SC5000-CTS-HMI** is a **C**olor **T**ouch **S**creen HMI and is recommended for LEVEL CONTROL, FLOW CONTROL, PRESSURE CONTROL or BOOSTER CONTROL applications that have control over the enclosure internal temperature.

The SC500-CTS-HMI is programmed with display screens that shows the Pump Call to Run status, Alarm status, Parameter Security Write Access status, and Fault Codes. All Setup Parameters for LEVEL CONTROL, FLOW CONTROL, PRESSURE CONTROL or BOOSTER CONTROL applications, and I/O Setup are made available on its display screens for the operator to view or change.

The SC500-CTS-HMI is a C-more (Automation Direct), 7 inch color TFT LCD, EA9 series Touchscreen HMI, programmed to provide all necessary HMI screens to interface with the SC5000.

The SC500-CTS-HMI operates as a Modbus Master using the Modbus TCP protocol.

Operating Temperature Range: –0 to 50 °C (32 to 122 °F)

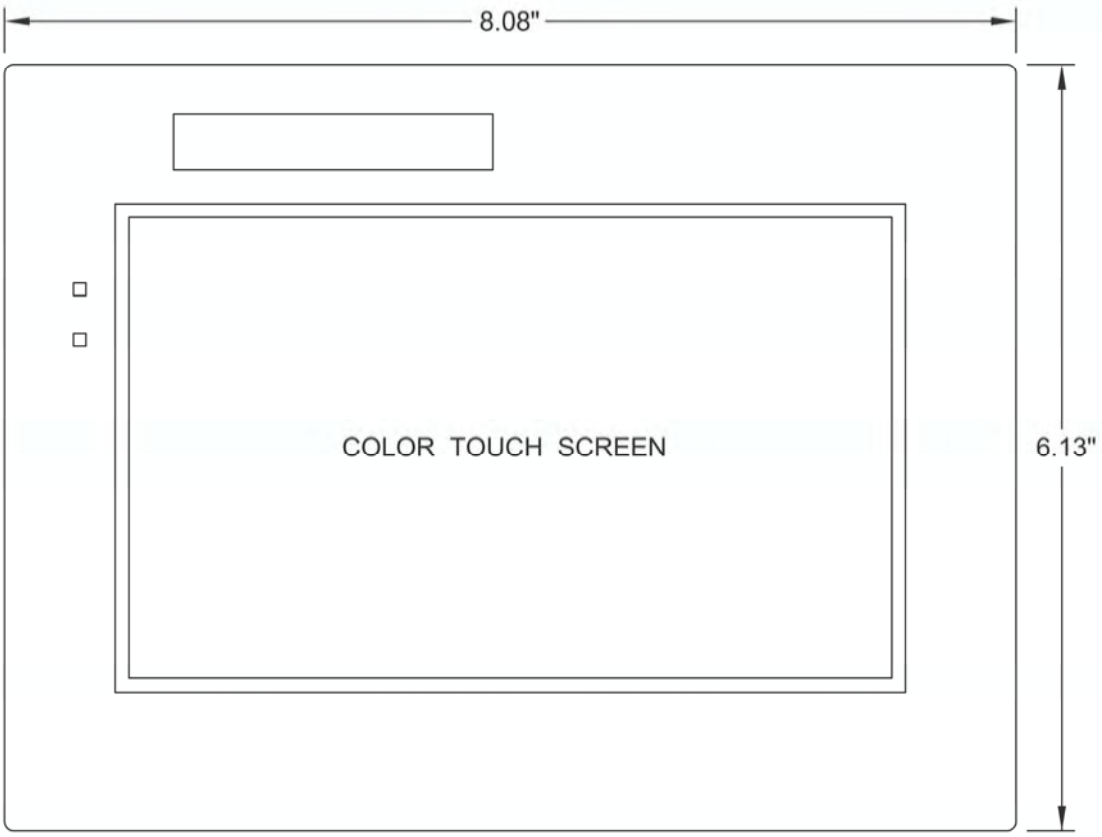
The **SC5000-CTS-HMI** is only recommended for applications that have temperature controls that keeps the enclosure internal temperature within: –0 to 50 °C (32 to 122 °F).

The SC500-CTS-HMI should be connected to the Ethernet Port ENET2 using a Cat 5 Ethernet Patch Cable.

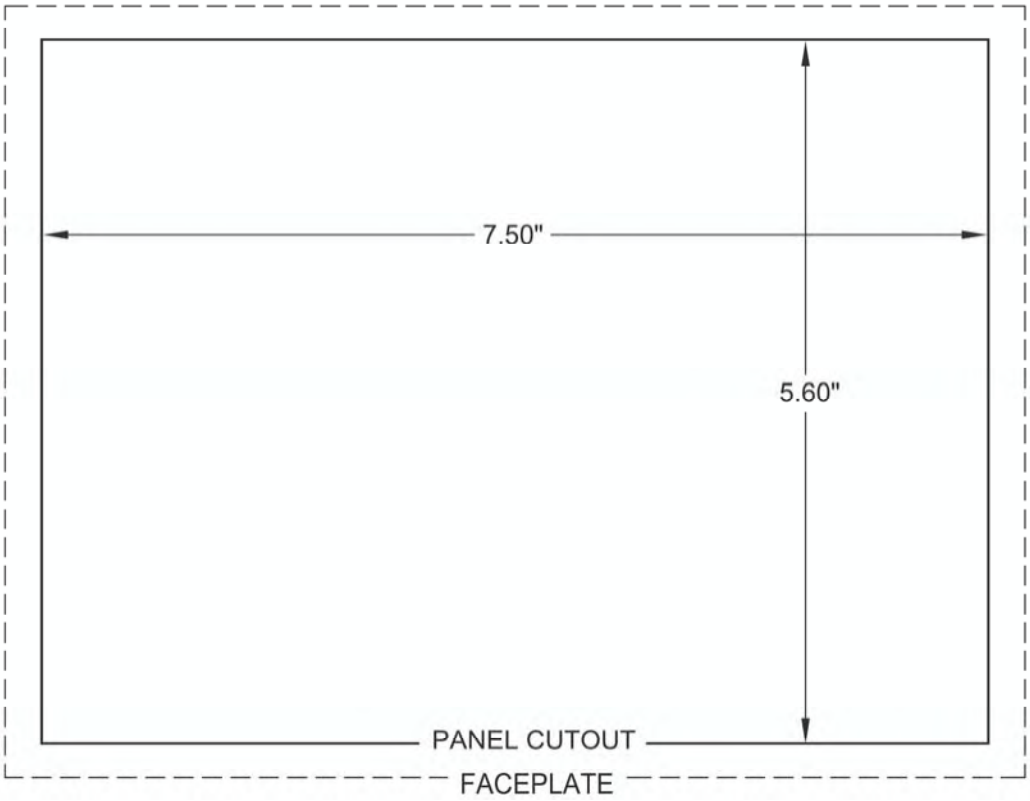
The SC500-CTS-HMI may be connected to Ethernet Port ENET1 but it is not recommended because ENET1 has a higher level of Parameter Security that hampers or prevents a number of HMI features from working. Ethernet Port ENET1 will not allow Write Access to Modbus Coils (Register Bits), which many of the HMI features require to operate (unless Parameter Security is first Unlocked). Also, the following features are blocked from functioning through ENET1: Parameter Security Setup, Parameter Restore to Factory Defaults, and Parameter Backup and Restore using a USB Flash drive.

For connection diagrams see pages 1-24, 2-17, 3-19 or 4-17.

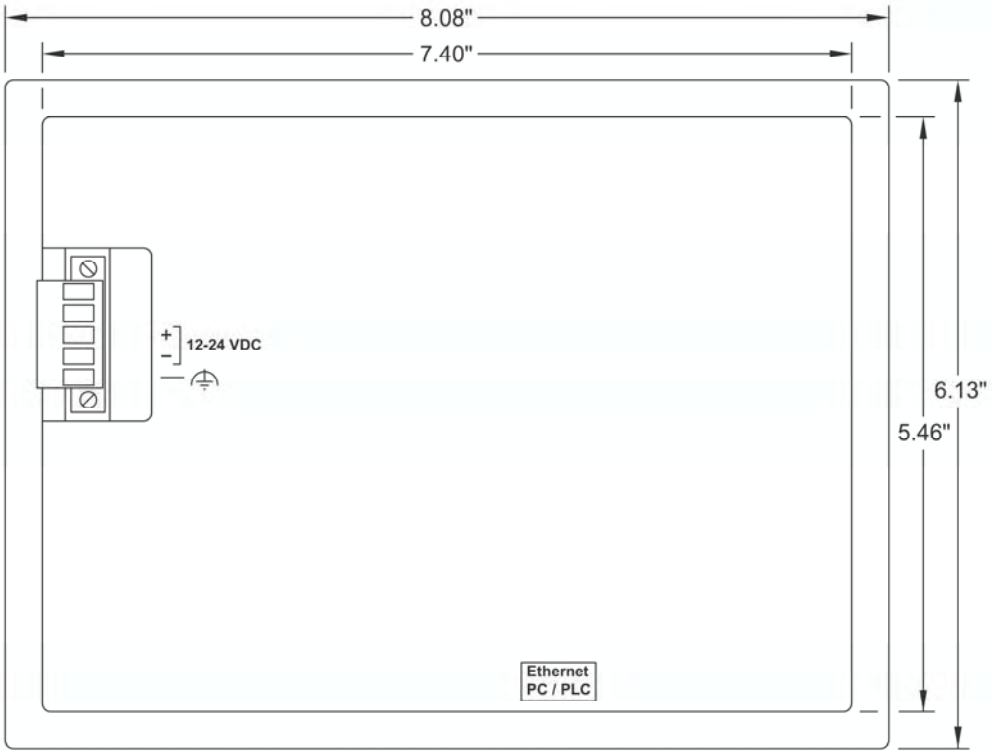
ENCLOSURE FRONT



PANEL CUTOUT



ENCLOSURE REAR



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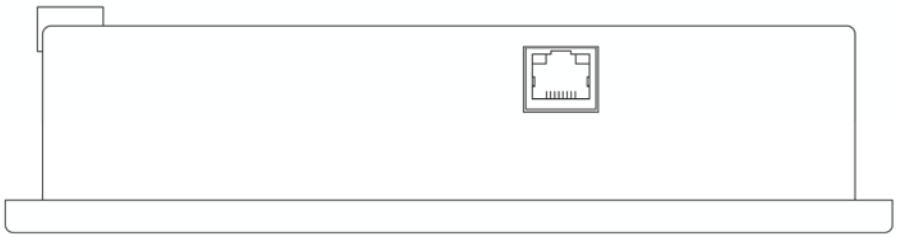
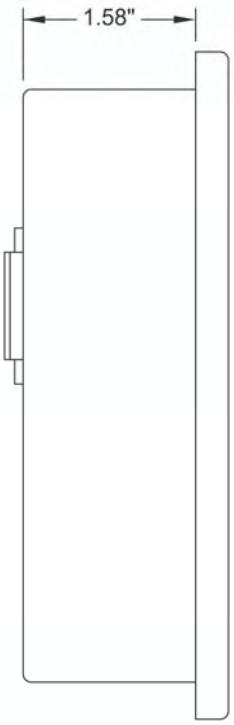
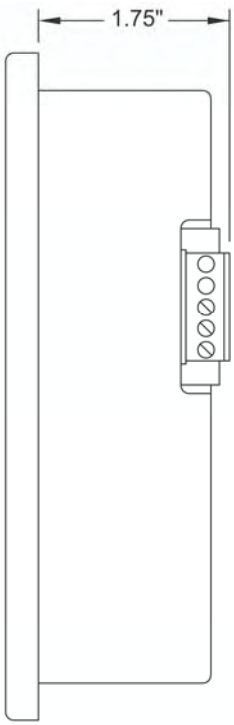


ENCLOSURE LEFT SIDE

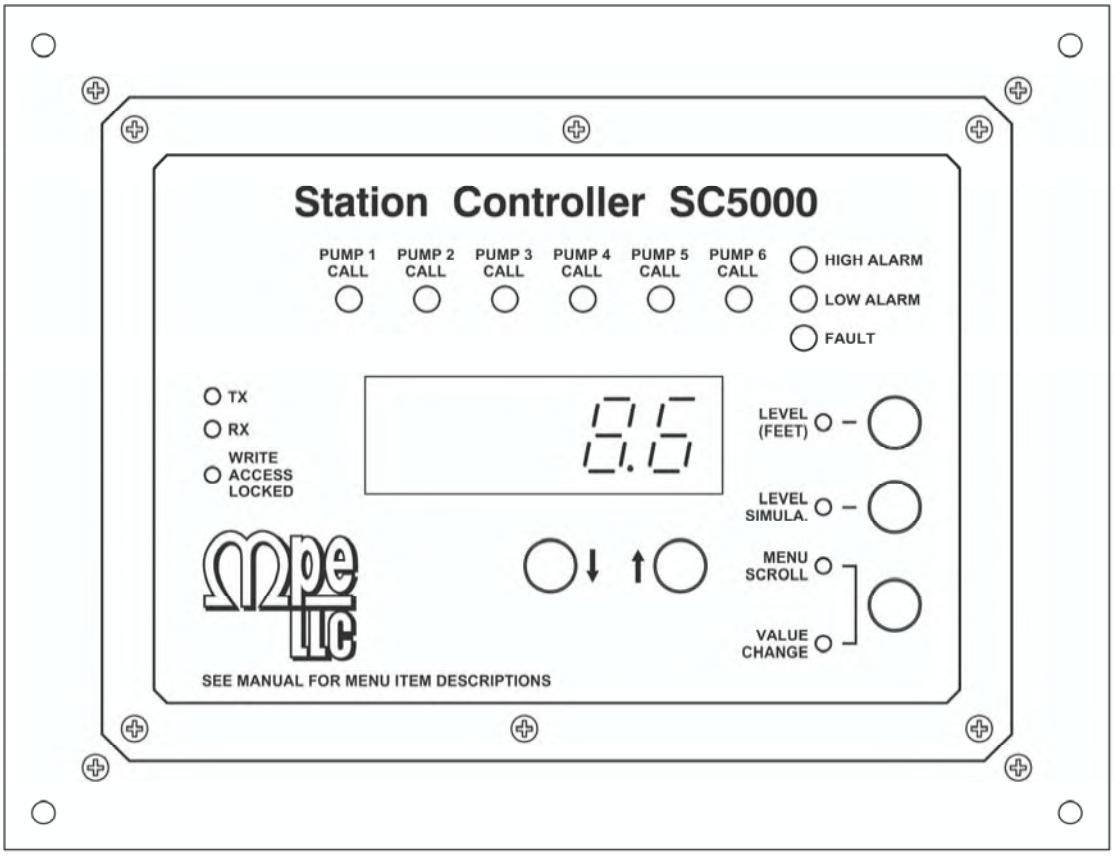


ENCLOSURE RIGHT SIDE



SECTION X
SC5000-LED-HMI

Revision Date: 5-10-23



Description

The **SC5000-LED-HMI** is a 5 digit numerical LED HMI that shows the Wet Well Level, the Pump Call to Run status, the High Level and Low Level alarm status, Parameter Security Write Access status, Fault indicator that shows when a Fault Code is present, and TX and RX communication activity status. An operator may also perform Level Simulation and reset of any Fault Codes. All Setup Parameters for LEVEL CONTROL and I/O Setup are made available in its menu for the operator to view or change.

The SC500-LED-HMI is designed and programed for use in LEVEL CONTROL applications only and is not suitable for FLOW CONTROL, PRESSURE CONTROL or BOOSTER CONTROL applications.

The SC500-LED-HMI should be connected to the Serial Port (COM1) on the SC5000 Controller using a shielded Cat 5 or Cat 6 Ethernet Patch Cable.

For connection diagram see page X-26.

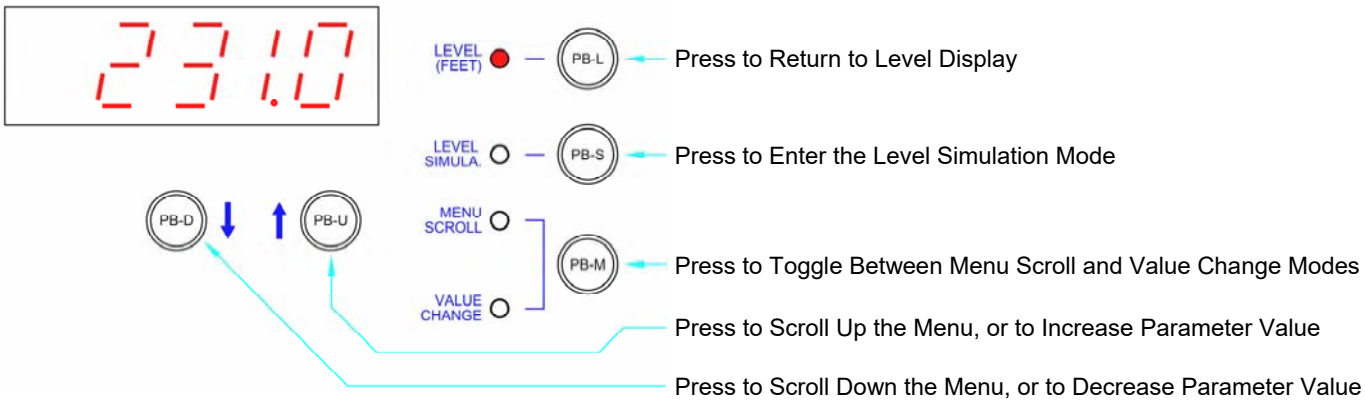
The **SC5000-LED-HMI** is recommended for LEVEL CONTROL applications that have little or no control over the enclosure internal temperature, where the **SC5000-LCD-HMI** Touchscreen would overheat and be damaged.

Specifications

- Input Power: 24 VDC ±10%, 30mA max
- Dimensions (Width x Height x Depth): 8.50” x 6.50” x 2.20”
- Ambient Operating Temperature: -20°C to +65°C (-4°F to +149°F)
- Color: White with Blue Graphics
- RS232 Communication Port (COM1): Modbus Master with Modbus RTU Protocol

SC5000-LED-HMI

OPERATOR INTERFACE FUNCTIONS



Note: To Prevent the Accidental Changing of a Parameter Value, there is a 4 second Delay Before a Parameter Value will Change.

(The PB-D or PB-U Push-Button must be Held Down for the Entire 4 second Delay.)

How to View a Setup Parameter Value

1. Press push-button PB-M until the Menu Scroll Mode indicator comes on.
2. Press push-button PB-D or PB-U as needed to arrive at the Parameter you wish to view.
3. Press push-button PB-M until the Value Change Mode indicator comes on.
4. The current value of the Parameter may then be viewed on the display.

How to Change a Setup Parameter Value

1. Press push-button PB-M until the Menu Scroll Mode indicator comes on.
2. Press push-button PB-D or PB-U as needed to arrive at the Parameter you wish to change.
3. Press push-button PB-M until the Value Change Mode indicator comes on.
4. The current value of the Parameter may then be viewed on the display.
5. Press and hold for 4 seconds, either push-button PB-D or PB-U, to change the Parameter to the desired new value.
6. Press push-button PB-M or PB-L to exit the Value Change Mode.

How to Simulate Levels

1. Press push-button PB-S.
   Note: The Simulation starts from the actual level displayed prior to entering the Level Simulation mode.
2. Press push-button PB-D or PB-U as needed to change the simulated level.
3. To end the level simulation press push-button PB-L.
   Note: If you do not exit the Level Simulation mode, normal operation will resume automatically 60 seconds after the last time the PB-U, PB-D, or PB-S push-buttons were pressed.

SC5000-LED-HMI MENU

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Level Alarms				
LoAL	2.0 feet		40101	Low Level Alarm See notes on page 1-6. Range: 0.1 - 231.0 feet
HIAL	10.0 feet		40102	High Level Alarm See notes on page 1-6. Range: 0.5 - 231.0 feet
Pump On / Off Levels				
1PoFF	3.0 feet		40103	1st Pump Off Level Range: 0.2 - 231.0 feet
1Pon	6.0 feet		40104	1st Pump On Level Range: 0.2 - 231.0 feet
2PoFF	3.5 feet		40105	2nd Pump Off Level Range: 0.2 - 231.0 feet
2Pon	6.5 feet		40106	2nd Pump On Level Range: 0.2 - 231.0 feet
3PoFF	4.0 feet		40107	3rd Pump Off Level Range: 0.2 - 231.0 feet
3Pon	7.0 feet		40108	3rd Pump On Level Range: 0.2 - 231.0 feet
4PoFF	4.5 feet		40109	4th Pump Off Level Range: 0.2 - 231.0 feet
4Pon	7.5 feet		40110	4th Pump On Level Range: 0.2 - 231.0 feet
5PoFF	5.0 feet		40111	5th Pump Off Level Range: 0.2 - 231.0 feet
5Pon	8.0 feet		40112	5th Pump On Level Range: 0.2 - 231.0 feet
6PoFF	5.5 feet		40113	6th Pump Off Level Range: 0.2 - 231.0 feet
6Pon	8.5 feet		40114	6th Pump On Level Range: 0.2 - 231.0 feet
Security Code Entry				
SCE1	-	-	42078	Security Code Entry - **SCE3 : SCE2 : SCE1** Range: 1 - 255 Enter Your Security Code Here to Unlock the Parameters. (Parameters must be UNLOCKED to have WRITE ACCESS, which allows their value to be changed.) Manually Relock by Entering "1" into Parameter SCE1, or SCE2, or SCE3.
SCE2	-	-	42079	
SCE3	-	-	42080	
Fault Code				
FLC	-	-	42499	Fault Code See Section F for Fault Code Table.
LFC	-	-	42500	Last Fault Code See Section F for Fault Code Table.
Remote Level Control Input				
rc.02	0	-	42002	Remote Level Control Input See notes on page 1-12. Range: 0 - 231.0 feet

SC5000-LED-HMI MENU

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Pump Setup				
P.091	1		40091	Master Control Mode 1 = Level Control Must be set on "1".
P.092	6		40092	Number of Pumps Present 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps
P.093	6		40093	Maximum Number of Pumps Allowed to Run at the Same Time 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps
P.094	6		40094	Maximum Number of Pumps Allowed to Run While On Generator 1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps 5 = 5 Pumps 6 = 6 Pumps Note: Must Connect Transfer Switch Contact to Discrete Input assigned to Function 18.
Pump Alternation Setup				
P.122	1		40122	Alternation Sequence Mode 1 = Standard Alternation: Group 1: Pumps 1 - 6 See page 1-12. 2 = Pump 1 Always Lead: Group 1: Pump 1 Group 2: Pumps 2 - 6 See page 1-12. 3 = Split Alternation - 2&4: Group 1: Pumps 1 - 2 Group 2: Pumps 3 - 6 See page 1-13. 4 = Split Alternation - 3&3: Group 1: Pumps 1 - 3 Group 2: Pumps 4 - 6 See page 1-13. 5 = Split Alternation - 4&2: Group 1: Pumps 1 - 4 Group 2: Pumps 5 - 6 See page 1-14. Also see: Alternation Sequence Modifier A (Parameter P.124) below.
P.124	0		40124	Alternation Sequence Modifier A 0 = Group 1 Pump(s) Are Allowed To Run With Pumps From Group 2 1 = Group 1 Pump(s) Not Allowed To Run With Pumps From Group 2 (Pump(s) in Group 1 are turned off before starting Pumps in Group 2) Note: This applies when Parameter P.122 = 2, 3, 4, or 5
P.129	0		40129	Forced Lead Pump Position - Group 1 0 = Normal Alternation X = Pump X as Lead Note: This applies to Group 1 when Parameter P.122 = 1, 3, 4, or 5
P.130	0		40130	Forced Lead Pump Position - Group 2 0 = Normal Alternation X = Pump X as Lead Note: This applies to Group 2 when Parameter P.122 = 2, 3, 4, or 5
P.131	0		40131	Time Based Alternation - Group 1 Range: 0 - 65535 minutes 0 = Disabled 60 = 1 hour 480 = 8 hours 1440 = 24 hours See notes on page 1-7.
P.132	0		40132	Time Based Alternation - Group 2 Range: 0 - 65535 minutes 0 = Disabled 60 = 1 hour 480 = 8 hours 1440 = 24 hours See notes on page 1-7.

SC5000-LED-HMI MENU

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Level Input Setup				
P.133	1		40133	Level Input Select 1 = Analog Level Meter - ALM1 - Single Transducer 2 = Analog Level Meter - ALM2 - Single Transducer 3 = Analog Level Meter - ALM1 & ALM2 - Dual Transducers - Manual Switching 4 = Analog Level Meter - ALM1 & ALM2 - Dual Transducers - Automatic Switching 5 = Level Probe Meter - LPM1 - Level Probe 6 = Float Switch Inputs 7 = Remote Level Control Input Selection 1 - Level Input is from ALM1. See Section M. Selection 2 - Level Input is from ALM2. See Section M. Selection 3 - Level Input is Manually switched from ALM1 to ALM2. See Section M. Selection 4 - Level Input is Automatically switched from ALM1 to ALM2. See Section M. Selection 5 - Level Probe with 10 Electrodes Connected to 10 Discrete Inputs. See Section L. Selection 6 - Float Switches as the primary (and only) Level Input. See pages 1-27 and 1-28. Selection 7 - Remote Level Control Input written through SCADA to Parameter rc.02. See page 1-12.
Station Control Setup				
P.137	1		40137	Numerical Display Decimal Point Position 0 = No Decimal Point 1 = XXXX.X 2 = XXX.XX 3 = XX.XXX 4 = X.XXXX
P.138	10 min.		40138	Numerical Display Blanking Delay Range: 10 - 254 minutes Note: To disable the Numerical Display Blanking feature: Set Parameter P.138 = 255.
P.149	1		40149	Pump Up or Down Mode 1 = Pump Down - Empty a Tank 2 = Pump Up - Fill a Tank Note: When parameter P.149 is changed new default level parameter values will be loaded.
P.150	5 sec.		40150	Lag Pump Delay Range: 1 - 100 seconds Note: This is the minimum time period between the calling of pumps to run. It is also used to delay the turning on of the replacement pump when an operating pump is suddenly disabled, or when a time based alternation of the pumps is performed.
P.151	1		40151	Low Level Alarm Disable 0 = Disable Alarm 1 = Enable Alarm See notes on page 1-9.
P.153	10 sec.		40153	Pump Re-enable Delay - Pump Cutoff Low-Low Level Range: 1 - 600 sec. See notes on page 1-9.
P.154	10 sec.		40154	Pump Re-enable Delay - Pump Cutoff High-High Level Range: 1 - 600 sec. See notes on page 1-9.

SC5000-LED-HMI MENU

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Level Probe Meter LPM1 - Setup				
P.519	1		40519	Level Probe Meter LPM1 - Mode 0 = Level Probe Meter Disabled 1 = Level Probe Meter Enabled
P.520	12 in.		40520	Level Probe Meter Electrode Spacing 5, 6, 8, 10 or 12 inches
See Section L.				
Analog Level Meter ALM1 - Setup				
P.522	23.10 feet		40522	Analog Level Meter ALM1 - Level Input Span Range: 1.00 - 231.00 feet Notes: 1. Parameter P.522 allows the entry of the Transducer's Calibrated Span in feet. 2. A 20mA signal **does not** need to be applied to the Process Input while Setting the Span. 3. The Decimal Point Position is set by Parameter P.137.
P.523	-		40523	Analog Level Meter ALM1 - Level Input Zero Notes: 1. While viewing Parameter P.523, the UP and Down pushbuttons may be used to make minor adjustments, to the Zero Calibration of Analog Level Meter ALM1. 2. Before attempting to adjust the Level Input Zero, first pull the Submersible Pressure Transducer out of the liquid, or apply a 4.0mA signal to the Level Input, and then Set the Zero. 3. The actual value of Parameter P.523 is not shown here, rather what is shown is the level from Analog Level Meter ALM1 (Parameter Ld.12). 4. The Decimal Point Position is set by Parameter P.137.
P.524	240		40524	Analog Level Meter ALM1 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast Note: This parameter controls the signal conditioning of Analog Level Meter ALM1
See Section M.				
Analog Level Meter ALM2 - Setup				
P.527	23.10 feet		40527	Analog Level Meter ALM2 - Level Input Span Range: 1.00 - 231.00 feet Notes: 1. Parameter P.527 allows the entry of the Transducer's Calibrated Span in feet. 2. A 20mA signal **does not** need to be applied to the Process Input while Setting the Span. 3. The Decimal Point Position is set by Parameter P.137.
P.528	-		40528	Analog Level Meter ALM2 - Level Input Zero Notes: 1. While viewing Parameter P.528, the UP and Down pushbuttons may be used to make minor adjustments, to the Zero Calibration of Analog Level Meter ALM2. 2. Before attempting to adjust the Level Input Zero, first pull the Submersible Pressure Transducer out of the liquid, or apply a 4.0mA signal to the Level Input, and then Set the Zero. 3. The actual value of Parameter P.528 is not shown here, rather what is shown is the level from Analog Level Meter ALM2 (Parameter Ld.22). 4. The Decimal Point Position is set by Parameter P.137.
P.529	240		40529	Analog Level Meter ALM2 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast Note: This parameter controls the signal conditioning of Analog Level Meter ALM2
See Section M.				

SC5000-LED-HMI MENU

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
VFD Speed Reference Setup				
P.161	50%		40161	VFD - Minimum Speed (Percent of Full Speed) Range: 0% - 95%
P.162	3.5 feet		40162	VFD - Level at Minimum Speed Range: 0.1 - 231.0 feet
P.163	6.0 feet		40163	VFD - Level at 100% Speed Range: 0.1 - 231.0 feet
P.164	0 sec.		40164	Pump Start Speed Boost Time Range: 0 - 60 seconds Note: Set for 0 seconds to Disable Feature.
P.165	100%		40165	VFD - Speed of Pump Under Remote Control Range: 0% - 100%
See notes on page 1-16.				
Flush Cycle Setup				
P.171	0		40171	Flush Cycle Mode 0 = Flush Cycle Disabled 1 = Flush Cycle Enabled
P.172	1440 min		40172	Delay Between Flush Cycles Range: 1 - 65,535 minutes
P.173	9.5 feet		40173	Flush Cycle Start Level Range: 0.2 - 231.0 feet
P.174	2.5 feet		40174	Flush Cycle Stop Level Range: 0.2 - 231.0 feet
See notes on page 1-17.				

SC5000-LED-HMI MENU

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Flow Calculator Setup				
P.175	0		40175	Flow Calculator Mode 0 = Flow Calculator Disabled - All Flow Data is Reset to Zero 1 = Flow Calculator Enabled - Internal Time Clock 2 = Flow Calculator Enabled - External Time Clock
P.176	79.0 Square Feet		40176	Surface Area of Wet Well Range: 2.0 - 2,000.0 Square Feet
P.177	20 Minutes		40177	Delay Before Forcing On Additional Pump(s) Range: 4 - 60 Minutes
P.178	20 Minutes		40178	Latest Inflow Rate Reset Delay Range: 1 - 100 Minutes
See notes on page 1-19.				

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Pulse Flow Meter PFM1 - Setup				
P.531	0		40531	Pulse Flow Meter PFM1 - Flow Meter Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.532	1		40532	Pulse Flow Meter PFM1 - Multiply By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be multiplied by this number.
P.533	1		40533	Pulse Flow Meter PFM1 - Divide By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be divided by this number.
P.534	0.40 minutes		40534	Pulse Flow Meter PFM1 - Input Pulse Sample Window Range: 0.10 - 1.00 min.
The Pulse Input used for PFM1 is fixed as the Pulse Capture Input DPC1.				
See Section J.				
Pulse Flow Meter PFM2 - Setup				
P.536	0		40536	Pulse Flow Meter PFM2 - Flow Meter Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.537	1		40537	Pulse Flow Meter PFM2 - Multiply By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be multiplied by this number.
P.538	1		40538	Pulse Flow Meter PFM2 - Divide By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be divided by this number.
P.539	0.40 minutes		40539	Pulse Flow Meter PFM2 - Input Pulse Sample Window Range: 0.10 - 1.00 min.
The Pulse Input used for PFM2 is fixed as the Pulse Capture Input DPC2.				
See Section J.				
Pulse Flow Meter PFM3 - Setup				
P.541	0		40541	Pulse Flow Meter PFM3 - Flow Meter Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.542	1		40542	Pulse Flow Meter PFM3 - Multiply By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be multiplied by this number.
P.543	1		40543	Pulse Flow Meter PFM3 - Divide By Conversion Factor Range: 1 - 1,000 Note: Input Pulse Number will be divided by this number.
P.544	0.40 minutes		40544	Pulse Flow Meter PFM3 - Input Pulse Sample Window Range: 0.10 - 1.00 min.
The Pulse Input used for PFM3 is fixed as the Pulse Capture Input DPC3.				
See Section J.				

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Analog Flow Meter AFM1 - Setup				
P.551	1		40551	Analog Flow Meter AFM1 - Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.552	1000		40552	Analog Flow Meter AFM1 - Multiply By Conversion Factor Range: 1 - 65,535 Note: The Analog Flow Rate Input is first conditioned to have a range of 0 - 3,276 and is then multiplied by the value set on this parameter.
P.553	3276		40553	Analog Flow Meter AFM1 - Divide By Conversion Factor Range: 1 - 65,535 Note: After the Analog Flow Rate Input is multiplied by Parameter P.552, it is then divided by the value set on this parameter.
P.554	240		40554	Analog Flow Meter AFM1 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast
See Section K.				
Analog Flow Meter AFM2 - Setup				
P.556	0		40556	Analog Flow Meter AFM2 - Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.557	1000		40557	Analog Flow Meter AFM2 - Multiply By Conversion Factor Range: 1 - 65,535 Note: The Analog Flow Rate Input is first conditioned to have a range of 0 - 3,276 and is then multiplied by the value set on this parameter.
P.558	3276		40558	Analog Flow Meter AFM2 - Divide By Conversion Factor Range: 1 - 65,535 Note: After the Analog Flow Rate Input is multiplied by Parameter P.557, it is then divided by the value set on this parameter.
P.559	240		40559	Analog Flow Meter AFM2 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast
See Section K.				
Analog Flow Meter AFM3 - Setup				
P.561	0		40561	Analog Flow Meter AFM3 - Mode 0 = Flow Meter Disabled 1 = Flow Meter Enabled
P.562	1000		40562	Analog Flow Meter AFM3 - Multiply By Conversion Factor Range: 1 - 65,535 Note: The Analog Flow Rate Input is first conditioned to have a range of 0 - 3,276 and is then multiplied by the value set on this parameter.
P.563	3276		40563	Analog Flow Meter AFM3 - Divide By Conversion Factor Range: 1 - 65,535 Note: After the Analog Flow Rate Input is multiplied by Parameter P.562, it is then divided by the value set on this parameter.
P.564	240		40564	Analog Flow Meter AFM3 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast
See Section K.				

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Analog Pressure Meter APM1 - Setup				
P.571	1		40571	Analog Pressure Meter APM1 - Pressure Meter Mode 0 = Pressure Meter Disabled 1 = Pressure Meter Enabled
P.572	100.0 psi		40572	Analog Pressure Meter APM1 - Pressure Input Span Range: 1.0 - 6,000.0 psi Note: This must be set for the Span (in psi) that the Pressure Transducer is calibrated for. This sets the displayed value with a 20mA input from the Pressure Transducer
P.573	240		40573	Analog Pressure Meter APM1 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast Note: This parameter controls the signal conditioning of Analog Pressure Meter APM1
See Section N.				
Analog Pressure Meter APM2 - Setup				
P.575	1		40575	Analog Pressure Meter APM2 - Pressure Meter Mode 0 = Pressure Meter Disabled 1 = Pressure Meter Enabled
P.576	100.0 psi		40576	Analog Pressure Meter APM2 - Pressure Input Span Range: 1.0 - 6,000.0 psi Note: This must be set for the Span (in psi) that the Pressure Transducer is calibrated for. This sets the displayed value with a 20mA input from the Pressure Transducer
P.577	240		40577	Analog Pressure Meter APM2 - Signal Conditioning Control Range: 1 - 254 100 = Slow 240 = Normal 250 = Fast Note: This parameter controls the signal conditioning of Analog Pressure Meter APM2
See Section N.				
Analog Current Meters ACMA, ACMB & ACMC - Setup				
P.583	0		40583	Analog Current Meters ACMA, ACMB & ACMC - Current Meters Mode 0 = Current Meters Disabled 1 = Current Meters Enabled
P.584	100 Amps		40584	Analog Current Meters ACMA, ACMB & ACMC - Current Transducer Span Range: 1 - 65,535 Note: This must be set for the Span or Range (in Amps) that the Current Transducer is calibrated for. This sets the displayed value with a 20mA input from the Current Transducer.
P.585	5		40585	Analog Current Meters ACMA, ACMB & ACMC - Signal Conditioning Control 1 = Slow 5 = Normal 10 = Fast Range: 1 - 10 Note: This parameter controls the analog input signal conditioning for the three Current Meters.
See Section O.				

SC5000-LED-HMI MENU

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes

Discrete Input Setup

Discrete Input Function			Discrete Input	
F.101	1		40601	Discrete Input - D1
F.102	2		40602	Discrete Input - D2
F.103	3		40603	Discrete Input - D3
F.104	4		40604	Discrete Input - D4
F.105	5		40605	Discrete Input - D5
F.106	6		40606	Discrete Input - D6
F.107	7		40607	Discrete Input - D7
F.108	8		40608	Discrete Input - D8
F.109	9		40609	Discrete Input - D9
F.110	10		40610	Discrete Input - D10
F.111	11		40611	Discrete Input - D11
F.112	12		40612	Discrete Input - D12
F.113	13		40613	Discrete Input - D13
F.114	14		40614	Discrete Input - D14
F.115	15		40615	Discrete Input - D15
F.116	16		40616	Discrete Input - D16
F.117	17		40617	Discrete Input - D17
F.118	18		40618	Discrete Input - D18
F.119	19		40619	Discrete Input - D19
F.120	20		40620	Discrete Input - D20
F.121	61		40621	Discrete Input - D21
F.122	62		40622	Discrete Input - D22
F.123	63		40623	Discrete Input - D23
F.124	64		40624	Discrete Input - D24
F.125	65		40625	Discrete Input - D25
F.126	66		40626	Discrete Input - D26
F.127	67		40627	Discrete Input - D27
F.128	68		40628	Discrete Input - D28
F.129	69		40629	Discrete Input - D29
F.130	70		40630	Discrete Input - D30

Function of Input: **Connect To:**

0 = Collect Discrete Data for SCADA ..... Telemetry Contact

1 = Level Probe Electrode 1 ..... Level Probe
2 = Level Probe Electrode 2 ..... Level Probe
3 = Level Probe Electrode 3 ..... Level Probe
4 = Level Probe Electrode 4 ..... Level Probe
5 = Level Probe Electrode 5 ..... Level Probe
6 = Level Probe Electrode 6 ..... Level Probe
7 = Level Probe Electrode 7 ..... Level Probe
8 = Level Probe Electrode 8 ..... Level Probe
9 = Level Probe Electrode 9 ..... Level Probe
10 = Level Probe Electrode 10 ..... Level Probe

11 = Pump 1 Disable ..... HOA and Fault Logic
12 = Pump 2 Disable ..... HOA and Fault Logic
13 = Pump 3 Disable ..... HOA and Fault Logic
14 = Pump 4 Disable ..... HOA and Fault Logic
15 = Pump 5 Disable ..... HOA and Fault Logic
16 = Pump 6 Disable ..... HOA and Fault Logic

17 = All Pump Disable ..... Phase Monitor
18 = On Generator ..... Automatic Transfer Switch
19 = Switch Between ALM1 & ALM2 for Level Input .... Select Switch
20 = Start Flush Cycle ..... External Time Clock

21 = External Alternation - Group 1 ..... External Time Clock
22 = External Alternation - Group 2 ..... External Time Clock

31 = Sequence Input 1 ..... Lead Select Switch - 1 as Lead
32 = Sequence Input 2 ..... Lead Select Switch - 2 as Lead
33 = Sequence Input 3 ..... Lead Select Switch - 3 as Lead
34 = Sequence Input 4 ..... Lead Select Switch - 4 as Lead
35 = Sequence Input 5 ..... Lead Select Switch - 5 as Lead
36 = Sequence Input 6 ..... Lead Select Switch - 6 as Lead

41 = Call Pump 1 Last ..... Logic Contact
42 = Call Pump 2 Last ..... Logic Contact
43 = Call Pump 3 Last ..... Logic Contact
44 = Call Pump 4 Last ..... Logic Contact
45 = Call Pump 5 Last ..... Logic Contact
46 = Call Pump 6 Last ..... Logic Contact

47 = Flow Calculator - Start New Day ..... External Time Clock

Pump Cutoff & Alarm

59 = Pump Cutoff - Low-Low Level (Pump Down Mode).... Float Switch
60 = Pump Cutoff - High-High Level (Pump Up Mode) ..... Float Switch

Alarm Only

61 = Low Level Alarm Only ..... Float Switch
62 = High Level Alarm Only ..... Float Switch

Pump Control & Alarm

63 = Float Control – Off Level ..... Float Switch
64 = Float Control – 1ST On Level ..... Float Switch
65 = Float Control – 2ND On Level ..... Float Switch
66 = Float Control – 3RD On Level ..... Float Switch
67 = Float Control – 4TH On Level ..... Float Switch
68 = Float Control – 5TH On Level ..... Float Switch
69 = Float Control – 6TH On Level ..... Float Switch
70 = Float Control – High Level (Pump Down Mode).....Float Switch

Notes:

1. Any Discrete Input may be set for Function “0” when the input is used only to collect data for SCADA and no other Function is desired.
2. The status of the Discrete Inputs may be read as a “0” or “1” from Modbus Coils 1 - 30 (Register 40001 Bits 0 - 15 and Register 40002 Bits 0 - 13). See page A-10.
3. For a description of the Functions see pages A-2 - A-6.
4. Pump 1(2,3,4,5,6) Disable logic may be inverted using Parameter F.145. See page A-8.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Address	Description of Parameters and SCADA Notes
Discrete Input Setup				
F.141	100		40641	Discrete Input Sensitivity - D1 - D10 Range: 90 - 210 100 = Standard Sensitivity 150 = Extra Sensitive
F.142	100		40642	Discrete Input Sensitivity - D11 - D20 Range: 90 - 210 100 = Standard Sensitivity 150 = Extra Sensitive
F.143	100		40643	Discrete Input Sensitivity - D21 - D30 Range: 90 - 210 100 = Standard Sensitivity 150 = Extra Sensitive
F.145	0		40645	Discrete Input Pump Disable Mode 0 = Disable Pump with Closed Discrete Input 1 = Disable Pump with Open Discrete Input Note: This parameter only applies to Discrete Inputs that are assigned to be Pump Disable Inputs (Function 11 - 16).
See Section A.				
Relay Output Setup				
Relay Output Function			**Relay Output**	
F.201	1		40651	Relay Output - ROX1
F.202	2		40652	Relay Output - ROX2
F.203	3		40653	Relay Output - ROX3
F.204	4		40654	Relay Output - ROX4
F.205	5		40655	Relay Output - ROX5
F.206	6		40656	Relay Output - ROX6
F.207	7		40657	Relay Output - ROX7
F.208	8		40658	Relay Output - ROX8
F.209	0		40659	Relay Output - ROX9
F.210	0		40660	Relay Output - ROX10
F.211	0		40661	Relay Output - ROX11
F.212	0		40662	Relay Output - ROX12
See Section B.				

Function of Relay Output:

0 = Remote Control

1 = Pump 1 Control
2 = Pump 2 Control
3 = Pump 3 Control
4 = Pump 4 Control
5 = Pump 5 Control
6 = Pump 6 Control

7 = Low Level Alarm
8 = High Level Alarm

Notes:

1. Output Relays set for Function 0 may be Remotely Controlled by writing to Modbus Coils 65 - 76 (Register 40005 Bits 0 - 11).
2. Output Relay's status may be viewed from Parameters ro.01 - ro.12.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes

Analog Input Setup

Analog Input Function				Analog Input
F.299	1		40669	Analog Input - AIX1
F.300	2		40670	Analog Input - AIX2
F.301	0		40671	Analog Input - A1
F.302	0		40672	Analog Input - A2
F.303	0		40673	Analog Input - A3
F.304	0		40674	Analog Input - A4
F.305	0		40675	Analog Input - A5
F.306	0		40676	Analog Input - A6
F.307	0		40677	Analog Input - A7
F.308	0		40678	Analog Input - A8

Function of Input:

0 = Collect Analog Data for SCADA

1 = Analog Level Meter ALM1
2 = Analog Level Meter ALM2
3 = Analog Flow Meter AFM1
4 = Analog Flow Meter AFM2
5 = Analog Flow Meter AFM3
6 = Analog Pressure Meter APM1
7 = Analog Pressure Meter APM2
8 = Analog Current Meter (Phase A) ACMA
9 = Analog Current Meter (Phase B) ACMB
10 = Analog Current Meter (Phase C) ACMC

Notes:

1. Any or all of the Analog Inputs may be assigned Function “0”, when the intended use is to only collect analog data for SCADA and no other Function is desired.
2. In addition to collecting data for SCAD, Functions 1 - 10 also send the analog data to one of the Analog Meters on the Controller.

See Section C.

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes

Analog Output Setup

Analog Output Function			Analog Output	
F.400	8		40690	Analog Output - AOX1
F.401	1		40691	Analog Output - AO1
F.402	2		40692	Analog Output - AO2
F.403	3		40693	Analog Output - AO3
F.404	4		40694	Analog Output - AO4
F.405	5		40695	Analog Output - AO5
F.406	6		40696	Analog Output - AO6

Function of Analog Output:

0 = No Function

1 = Pump 1 Speed Reference
2 = Pump 2 Speed Reference
3 = Pump 3 Speed Reference
4 = Pump 4 Speed Reference
5 = Pump 5 Speed Reference
6 = Pump 6 Speed Reference

7 = Pump X Speed Reference

8 = Local Analog Level Display

Notes:

1. The “No Function” (Function 0) turns off the Analog Output.
2. The “Pump 1 - 6 Speed Reference” (Functions 1 - 6) are active only when the respective pump is called to run.
3. The “Pump X Speed Reference” (Function 7) is always active.
4. The “Local Analog Level Display” (Function 8) is a copy of the “Level Input Data” (Parameter Ld.01, see page 1-8) that may be sent to a Local Analog Level Display or Telemetry Device.

   The “Local Analog Level Display - Span” (Parameter F.407) must be set so that it matches the Span set on the external Local Analog Level Display or Telemetry Device. See below.

F.407	23.1 feet		40697	Local Analog Level Display - Span Range: 0.2 - 231.0 feet Note: One of the Controller’s Analog Outputs may be assigned to perform the Function of “Local Analog Level Display” (Function 8) which sends the Level Input Data from Parameter Ld.01 to an external 4-20mA device (Local Analog Level Display or Telemetry Device). Parameter F.407 is used to scale the 4-20mA output signal so that the Local Analog Level Display will correctly display the level in feet and 1/10 of feet. The Span of the Analog Output assigned to perform Function 8 must match the Span of the external Local Analog Level Display or Telemetry Device. To make them match set Parameter F.407 so that it matches the Span set on the external Local Analog Level Display or Telemetry Device.

See Section D.

SC5000-LED-HMI MENU

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Remote Control Setup				
E.011	60 sec.		40181	Remote Control Command Canceling Delay - Ethernet Port - ENET1 Delay Range: 1 - 65535 seconds Set to "0" to disable the Remote Control Command Canceling feature.
E.012	60 sec.		40182	Remote Control Command Canceling Delay - Ethernet Port - ENET2 Delay Range: 1 - 65535 seconds Set to "0" to disable the Remote Control Command Canceling feature.
E.013	60 sec.		40183	Remote Control Command Canceling Delay - RS232 Port - COM1 Delay Range: 1 - 65535 seconds Set to "0" to disable the Remote Control Command Canceling feature.
E.015	0.0 feet		40185	Default Remote Level Range: 0.0 - 231.0 feet
See Section E.				

User / Operator Info.		Scada	
Parameter	**Default Value**	**Register Address**	**Parameter Definitions**
Ethernet Port ENET1 Setup			
E.101	2	40200	Protocol 2 = Modbus TCP
E.114 - E.111	192 . 168 . 80 . 12 (E.114 . E.113 . E.112 . E.111)	40204-40201	IP Address Range: 0 - 255
E.144 - E.141	255 . 255 . 255 . 0 (E.144 . E.143 . E.142 . E.141)	40226-40223	Subnet Mask Range: 0 - 255
E.154 - E.151	192 . 168 . 80 . 1 (E.154 . E.153 . E.152 . E.151)	40230-40227	Default Gateway Range: 0 - 255
E.161	502	40232	Port Number Range: 1 - 65,535
E.176 - E.171	0 : 80 : 194 : 219 : XXX : XXX (E.176 : E.175 : E.174 : E.173 : E.172 : E.171)	40222-40217	MAC Address
See Section E.			

Note:
The Ethernet Port reads the setup values upon power up; any changes to the above settings require that the power to be cycled before the new values are used.

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User / Operator Info.		Scada	
Parameter	**Default Value**	**Register Address**	**Parameter Definitions**
Ethernet Port ENET2 Setup			
E.201	2	40250	Protocol 2 = Modbus TCP
E.214 - E.211	192 . 168 . 80 . 12 (E.214 . E.213 . E.212 . E.211)	40254-40251	IP Address Range: 0 - 255
E.244 - E.241	255 . 255 . 255 . 0 (E.244 . E.243 . E.242 . E.241)	40276-40273	Subnet Mask Range: 0 - 255
E.254 - E.251	192 . 168 . 80 . 1 (E.254 . E.253 . E.252 . E.251)	40280-40277	Default Gateway Range: 0 - 255
E.261	502	40282	Port Number Range: 1 - 65,535
E.276 - E.271	0 : 80 : 194 : 219 : XXX : XXX (E.276 : E.275 : E.274 : E.273 : E.272 : E.271)	40272-40267	MAC Address
See Section E.			

Note:
The Ethernet Port reads the setup values upon power up; any changes to the above settings require that the power to be cycled before the new values are used.

RS232 PORT - COM1 - For Connection to the SC5000-LED-HMI

Description

The RS232 Port COM1 has the following features:

- Protocol Supported: Modbus RTU
- Connector: RJ45 for use with a Shielded CAT5 Patch Cable.
- Setup Parameters: SC5000 Controller Factory set to match the SC5000-LED-HMI.

Settings:

Baud Rate: 9600 bps
Parity Mode: No Parity
Stop Bits: 1

User / Operator Info.			SCADA	
Parameter	**Default Value**	**Current Value**	**Register Address**	**Description of Parameters and SCADA Notes**
RS232 Port COM1 Slave Address Setup				
E.347	1		40347	Slave Address - COM1 Range: 1 - 247 Note: COM1 will always respond to what is set on Parameter E.347. COM1 will also always respond to Modbus request using the Slave Address "1". (The SC5000-LED-HMI uses Slave Address "1" to communicate with the SC5000.)

SC5000-LED-HMI MENU

User / Operator Info.			SCADA	
Parameter	Default Value	Current Value	Register Address	Description of Parameters and SCADA Notes
Parameter Security Setup				
cSCE1	-	-	-	Security Code Entry - **cSCE3 : cSCE2 : cSCE1** Range: 1 - 255 Enter Your Security Code Here to Unlock the following Parameter Security Setup Parameters: **S.001**, **S.002**, **S.003**, **S004**, **SCS1**, **SCS2** & **SCS3**
cSCE2	-	-	-	
cSCE3	-	-	-	
S.001	0		-	**ENET1** Parameter Write Access Mode 0 = Always Unlocked 1 = Requires Security Code Entry 2 = Always Locked (This mode is only available for ENET1.)
S.002	0		-	**ENET2**
S.003	0		-	**COM1**
S.004	60 min.		-	Parameter Write Access Relock Delay Range: 10 - 480 minutes
SCS1	11	-	-	Security Code Setup - **SCS3 : SCS2 : SCS1** Range: 2 - 255 Establishes the Numerical Values that will be Accepted as the Security Code.
SCS2	12	-	-	
SCS3	13	-	-	
See Section G.				
Backup or Restore Setup Parameters using USB FLASH DRIVE				
uSEC1	-	-	-	Security Code Entry - **uSCS3 : uSCS2 : uSCS1** Range: 1 - 255 Enter Your Security Code Here to Unlock the Backup and Restore of Set-up Parameters using a USB FLASH DRIVE.
uSEC2	-	-	-	
uSEC3	-	-	-	
PbAuP	-	-	-	Parameter Backup Step
Prtor	-	-	-	Parameter Restore Step
See Section H for Backup and Restore Procedures.				
Restore Setup Parameters to Factory Defaults				
rSEC1	-	-	-	Security Code Entry - **rSCS3 : rSCS2 : rSCS1** Range: 1 - 255 Enter Your Security Code Here to Unlock the Restore of Setup Parameters to Factory Defaults.
rSEC2	-	-	-	
rSEC3	-	-	-	
Fdtor	-	-	-	Parameter Restore Percent of Completion
See Section I for Restore Procedure.				

User / Operator Info. Parameter	SCADA Coil Address	Description of Parameters and SCADA Notes
Discrete Input Discrete Status		
n.01	Coil 1	Discrete Input - D1
n.02	Coil 2	Discrete Input - D2
n.03	Coil 3	Discrete Input - D3
n.04	Coil 4	Discrete Input - D4
n.05	Coil 5	Discrete Input - D5
n.06	Coil 6	Discrete Input - D6
n.07	Coil 7	Discrete Input - D7
n.08	Coil 8	Discrete Input - D8
n.09	Coil 9	Discrete Input - D9
n.10	Coil 10	Discrete Input - D10
n.11	Coil 11	Discrete Input - D11
n.12	Coil 12	Discrete Input - D12
n.13	Coil 13	Discrete Input - D13
n.14	Coil 14	Discrete Input - D14
n.15	Coil 15	Discrete Input - D15
n.16	Coil 16	Discrete Input - D16
n.17	Coil 17	Discrete Input - D17
n.18	Coil 18	Discrete Input - D18
n.19	Coil 19	Discrete Input - D19
n.20	Coil 20	Discrete Input - D20
n.21	Coil 21	Discrete Input - D21
n.22	Coil 22	Discrete Input - D22
n.23	Coil 23	Discrete Input - D23
n.24	Coil 24	Discrete Input - D24
n.25	Coil 25	Discrete Input - D25
n.26	Coil 26	Discrete Input - D26
n.27	Coil 27	Discrete Input - D27
n.28	Coil 28	Discrete Input - D28
n.29	Coil 29	Discrete Input - D29
n.30	Coil 30	Discrete Input - D30

Each Discrete Input sends out its own 60 Hz square wave Test Signals to determine the status of the Discrete Input. The Controller compares each of the Test Signal analog values with the Discrete Input Sensitivity set on Parameters F.141 - F.143. The Discrete Input is considered to be:

0 = Input Open - When the Test Signal is above the Sensitivity setting.

1 = Input Closed - When the Test Signal is below the Sensitivity setting.

See Section A.

SC5000-LED-HMI MENU

User / Operator Info.	SCADA		
Parameter	**Coil Address**	**Description of Parameters and SCADA Notes**	
Relay Output Status			
ro.01	Coil 49	Relay Output - ROX1	Relay Status: 0 = Relay Not Energized 1 = Relay Is Energized
ro.02	Coil 50	Relay Output - ROX2	
ro.03	Coil 51	Relay Output - ROX3	
ro.04	Coil 52	Relay Output - ROX4	
ro.05	Coil 53	Relay Output - ROX5	
ro.06	Coil 54	Relay Output - ROX6	
ro.07	Coil 55	Relay Output - ROX7	
ro.08	Coil 56	Relay Output - ROX8	
ro.09	Coil 57	Relay Output - ROX9	
ro.10	Coil 58	Relay Output - ROX10	
ro.11	Coil 59	Relay Output - ROX11	
ro.12	Coil 60	Relay Output - ROX12	
See Section B.			

User / Operator Info. Parameter	SCADA Register Address	Description of Parameters and SCADA Notes
Discrete Input Analog Test Signal Status		
A.101	41801	Discrete Input - D1
A.102	41802	Discrete Input - D2
A.103	41803	Discrete Input - D3
A.104	41804	Discrete Input - D4
A.105	41805	Discrete Input - D5
A.106	41806	Discrete Input - D6
A.107	41807	Discrete Input - D7
A.108	41808	Discrete Input - D8
A.109	41809	Discrete Input - D9
A.110	41810	Discrete Input - D10
A.111	41811	Discrete Input - D11
A.112	41812	Discrete Input - D12
A.113	41813	Discrete Input - D13
A.114	41814	Discrete Input - D14
A.115	41815	Discrete Input - D15
A.116	41816	Discrete Input - D16
A.117	41817	Discrete Input - D17
A.118	41818	Discrete Input - D18
A.119	41819	Discrete Input - D19
A.120	41820	Discrete Input - D20
A.121	41821	Discrete Input - D21
A.122	41822	Discrete Input - D22
A.123	41823	Discrete Input - D23
A.124	41824	Discrete Input - D24
A.125	41825	Discrete Input - D25
A.126	41826	Discrete Input - D26
A.127	41827	Discrete Input - D27
A.128	41828	Discrete Input - D28
A.129	41829	Discrete Input - D29
A.130	41830	Discrete Input - D30

Notes:

1. Each of the Discrete Inputs send out a low voltage (+/- 6 V), low current (0.6 mA), AC (60 Hz) square wave as a Test Signal to determine the status of the input, either Open or Closed. The Status of the Test Signals for each of the Discrete Input (as an analog value) may be viewed from Parameters A.101 - A.130.
2. The Controller compares each of the Test Signal analog values with the Discrete Input Sensitivity set on Parameters F.141 - F.143. Each Discrete I/O Board, having 10 Discrete Inputs each, has its own Discrete Input Sensitivity setting (Parameters F.141 - F.143). See page X-13.

   The Discrete Input is considered to be:

   Open - When the Test Signal is above the Sensitivity setting.

   Closed - When the Test Signal is below the Sensitivity setting.
3. Each Discrete I/O Board generates its own 60 Hz square wave Clock Signal that is used to generate the Discrete Input Test Signals for its 10 inputs. The analog values of these Clocks are available to be viewed from Parameters A.141 - A.143. See below.
4. The status of all the Discrete Inputs as a discrete value may also be read from Modbus Coils 1 - 30 (Register 40001 Bits 0 - 16, & Register 40002 Bits 0 - 13). See page A-10.

Parameter	Register Address	Data Description
A.141	41841	Clock Signal for Discrete Inputs: D1 - D10
A.142	41842	Clock Signal for Discrete Inputs: D11 - D20
A.143	41843	Clock Signal for Discrete Inputs: D21 - D30

See Section A.

SC5000-LED-HMI MENU

User / Operator Info. Parameter	SCADA Register Address	Description of Parameters and SCADA Notes
Analog Input Status		
A.299	41849	Analog Input - AIX1
A.300	41850	Analog Input - AIX2
A.301	41851	Analog Input - A1
A.302	41852	Analog Input - A2
A.303	41853	Analog Input - A3
A.304	41854	Analog Input - A4
A.305	41855	Analog Input - A5
A.306	41856	Analog Input - A6
A.307	41857	Analog Input - A7
A.308	41858	Analog Input - A8
		Note: Parameters A.299 - A.308 are 12-bit Analog to Digital Converter input values that are conditioned and factory calibrated to the following values: 819 @ 4.0 mA 4095 @ 20 mA
		See Section C.
Analog Output Status		
A.400	41870	Analog Output - AOX1
A.401	41871	Analog Output - AO1
A.402	41872	Analog Output - AO2
A.403	41873	Analog Output - AO3
A.404	41874	Analog Output - AO4
A.405	41875	Analog Output - AO5
A.406	41876	Analog Output - AO6
		Note: Parameters A.400 - A.406 are 12-bit Digital to Analog Converter output control values that are factory calibrated to the following: 819 @ 4.0 mA 4095 @ 20 mA
		See Section D.

SC5000-LED-HMI MENU

User / Operator Info. Parameter	SCADA Register Address	Data Description
Controller Data		
d.101	42501	Main Control Board - Operating Program Revision Number
d.102	42502	Analog Output Board - Operating Program Revision Number
d.103	42503	Analog Output Board - Polling Counter
d.104	42504	Analog Input Board - Operating Program Revision Number
d.105	42505	Analog Input Board - Polling Counter
d.108	42508	Discrete I/O Board 1 - Operating Program Revision Number
d.109	42509	Discrete I/O Board 1 - Polling Counter
d.110	42510	Discrete I/O Board 2 - Operating Program Revision Number
d.111	42511	Discrete I/O Board 2 - Polling Counter
d.112	42512	Discrete I/O Board 3 - Operating Program Revision Number
d.113	42513	Discrete I/O Board 3 - Polling Counter
d.116	42516	Ethernet Port Board - ENET1 - Operating Program Revision Number
d.117	42517	Ethernet Port Board - ENET1 - Polling Counter
d.118	42518	Ethernet Port Board - ENET2 - Operating Program Revision Number
d.119	42519	Ethernet Port Board - ENET2 - Polling Counter
d.121	42521	RS232 Port - COM1 - Polling Counter
d.122	42522	USB Host Board - Operating Program Revision Number
d.123	42523	USB Host Board - Polling Counter
d.124	42524	Main Control Board - Startup Status (% Completion)
d.125	42525	Voltage of +24 Volt Power Supply (Volts)
d.126	42526	SC5000-LED-HMI - Operating Program Revision Number

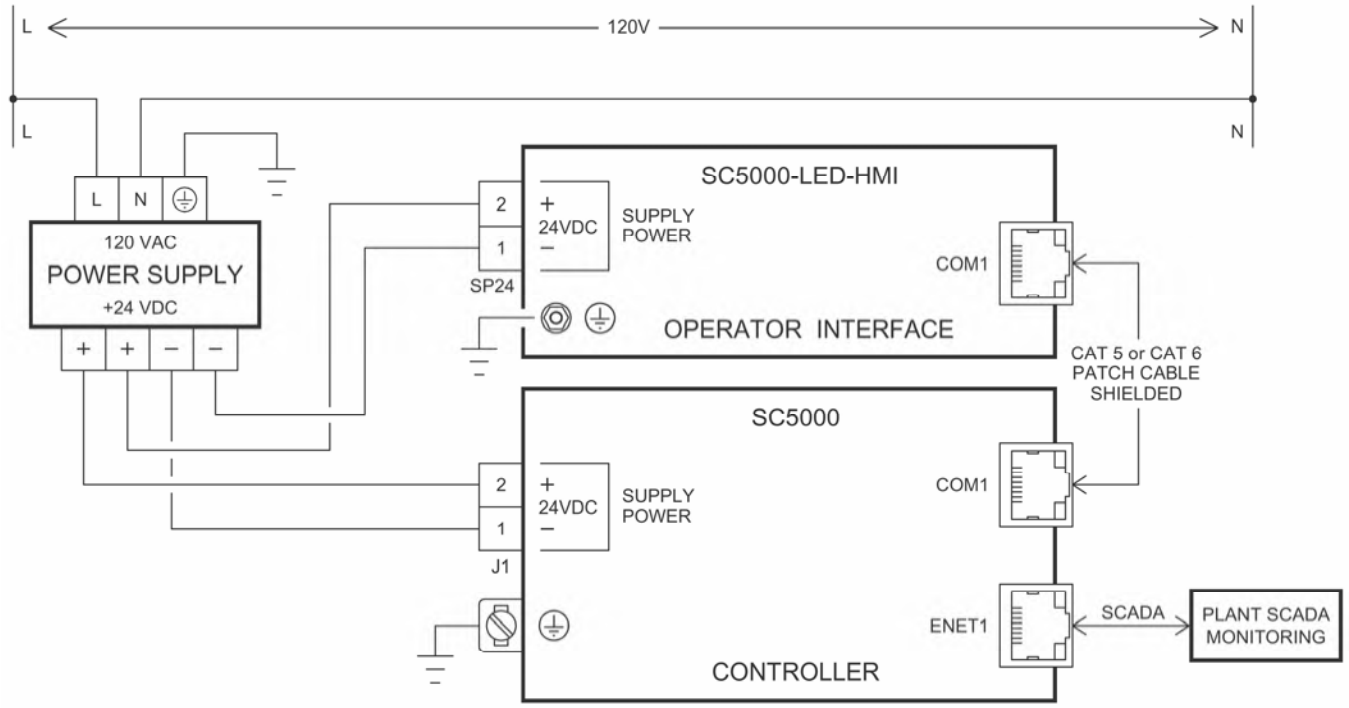
SC5000-LED-HMI MENU

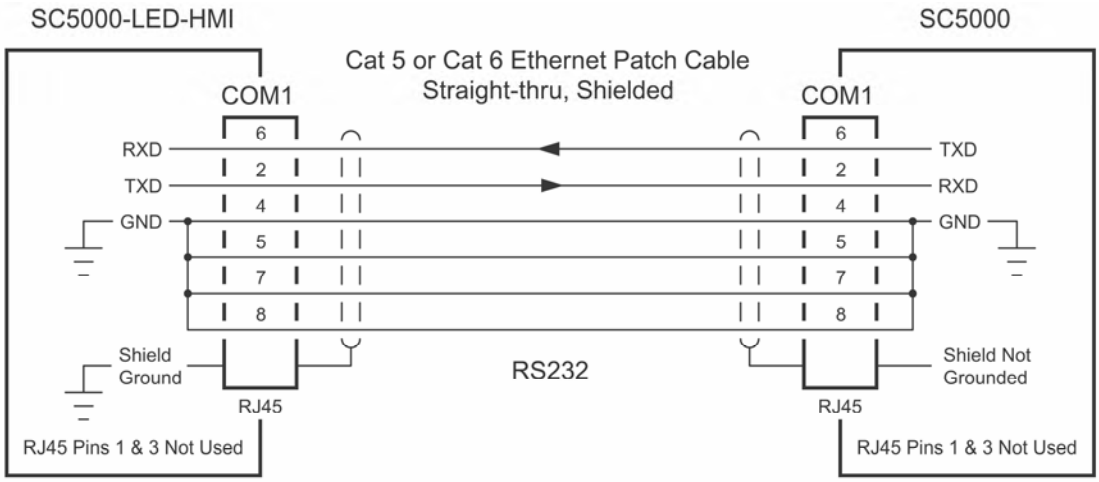
User / Operator Info. Parameter	SCADA Register Address	Description of Register Contents		
Analog Input Calibration				
C.301	**40031**	Analog Input (AIX1)	Zero Calibration	Analog Input (AIX1) Status Parameter A.299 Is Displayed While Viewing or Changing Parameter C.301 or C.302.
C.302	**40032**		Span Calibration	
C.303	**40033**	Analog Input (AIX2)	Zero Calibration	Analog Input (AIX2) Status Parameter A.300 Is Displayed While Viewing or Changing Parameter C.303 or C.304.
C.304	**40034**		Span Calibration	
C.305	**40035**	Analog Input (A1)	Zero Calibration	Analog Input (A1) Status Parameter A.301 Is Displayed While Viewing or Changing Parameter C.305 or C.306.
C.306	**40036**		Span Calibration	
C.307	**40037**	Analog Input (A2)	Zero Calibration	Analog Input (A2) Status Parameter A.302 Is Displayed While Viewing or Changing Parameter C.307 or C.308.
C.308	**40038**		Span Calibration	
C.309	**40039**	Analog Input (A3)	Zero Calibration	Analog Input (A3) Status Parameter A.303 Is Displayed While Viewing or Changing Parameter C.309 or C.310.
C.310	**40040**		Span Calibration	
C.311	**40041**	Analog Input (A4)	Zero Calibration	Analog Input (A4) Status Parameter A.304 Is Displayed While Viewing or Changing Parameter C.311 or C.312.
C.312	**40042**		Span Calibration	
C.313	**40043**	Analog Input (A5)	Zero Calibration	Analog Input (A5) Status Parameter A.305 Is Displayed While Viewing or Changing Parameter C.313 or C.314.
C.314	**40044**		Span Calibration	
C.315	**40045**	Analog Input (A6)	Zero Calibration	Analog Input (A6) Status Parameter A.306 Is Displayed While Viewing or Changing Parameter C.315 or C.316.
C.316	**40046**		Span Calibration	
C.317	**40047**	Analog Input (A7)	Zero Calibration	Analog Input (A7) Status Parameter A.307 Is Displayed While Viewing or Changing Parameter C.317 or C.318.
C.318	**40048**		Span Calibration	
C.319	**40049**	Analog Input (A8)	Zero Calibration	Analog Input (A8) Status Parameter A.308 Is Displayed While Viewing or Changing Parameter C.319 or C.320.
C.320	**40050**		Span Calibration	
See Section C.				

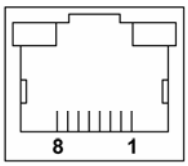
SC5000-LED-HMI MENU

User / Operator Info. Parameter	SCADA Register Address	Description of Register Contents		
Analog Output Calibration				
C.401	**40071**	Analog Output (AOX1)	Zero Calibration	Output Forced to 819 while viewing C.401
C.402	**40072**		Span Calibration	Output Forced to 4095 while viewing C.402
C.403	**40073**	Analog Output (AO1)	Zero Calibration	Output Forced to 819 while viewing C.403
C.404	**40074**		Span Calibration	Output Forced to 4095 while viewing C.404
C.405	**40075**	Analog Output (AO2)	Zero Calibration	Output Forced to 819 while viewing C.405
C.406	**40076**		Span Calibration	Output Forced to 4095 while viewing C.406
C.407	**40077**	Analog Output (AO3)	Zero Calibration	Output Forced to 819 while viewing C.407
C.408	**40078**		Span Calibration	Output Forced to 4095 while viewing C.408
C.409	**40079**	Analog Output (AO4)	Zero Calibration	Output Forced to 819 while viewing C.409
C.410	**40080**		Span Calibration	Output Forced to 4095 while viewing C.410
C.411	**40081**	Analog Output (AO5)	Zero Calibration	Output Forced to 819 while viewing C.411
C.412	**40082**		Span Calibration	Output Forced to 4095 while viewing C.412
C.413	**40083**	Analog Output (AO6)	Zero Calibration	Output Forced to 819 while viewing C.413
C.414	**40084**		Span Calibration	Output Forced to 4095 while viewing C.414
See Section D.				

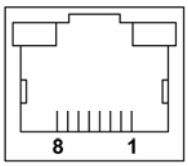
CONNECTION DIAGRAM





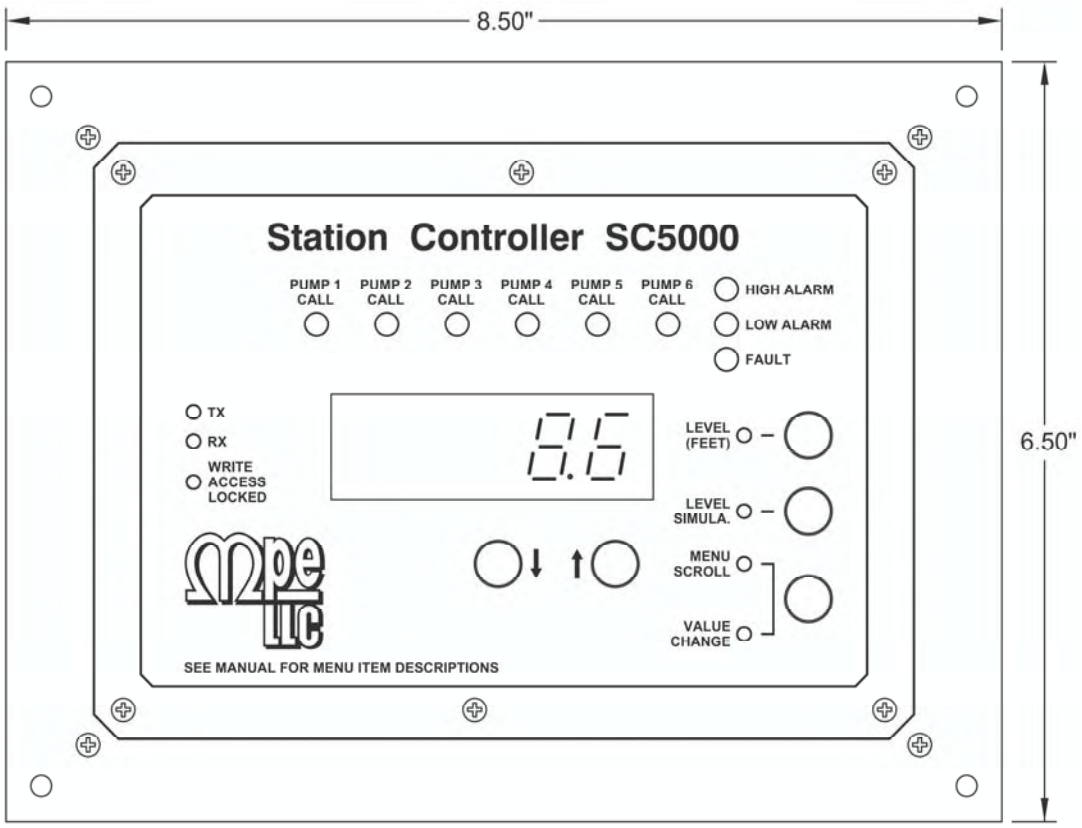


RJ45 Connector

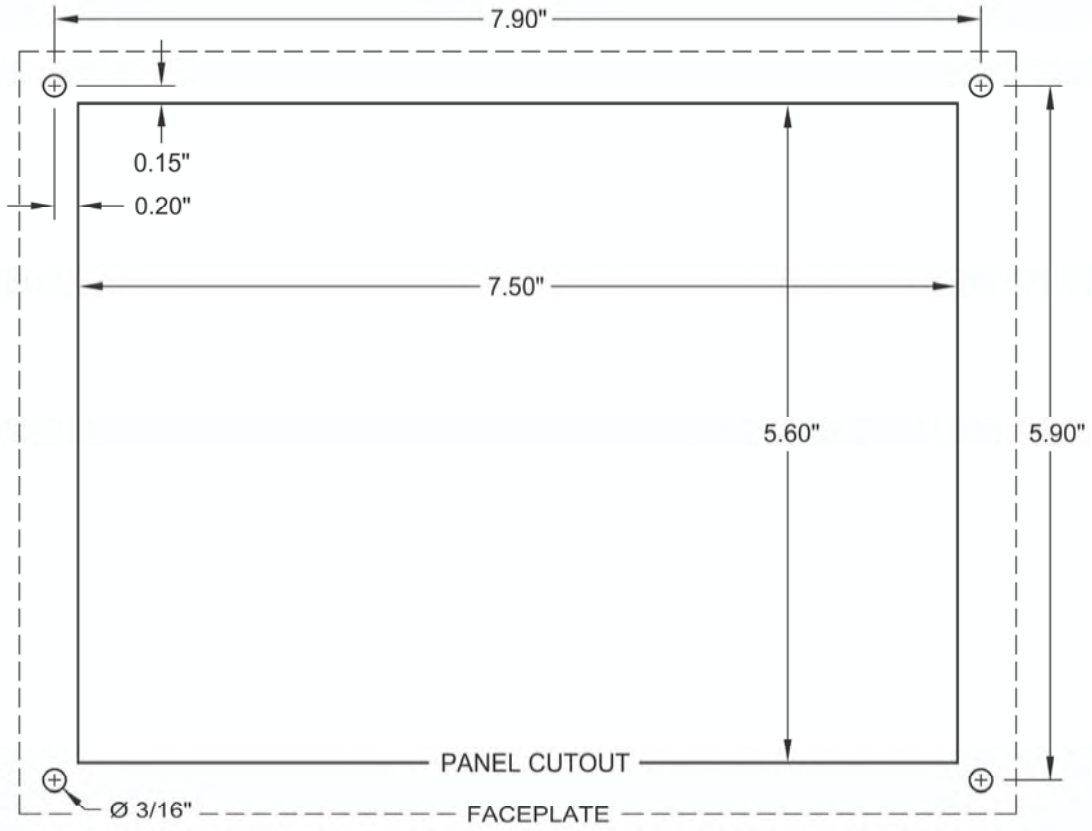


RJ45 Connector

ENCLOSURE FRONT



PANEL CUTOUT



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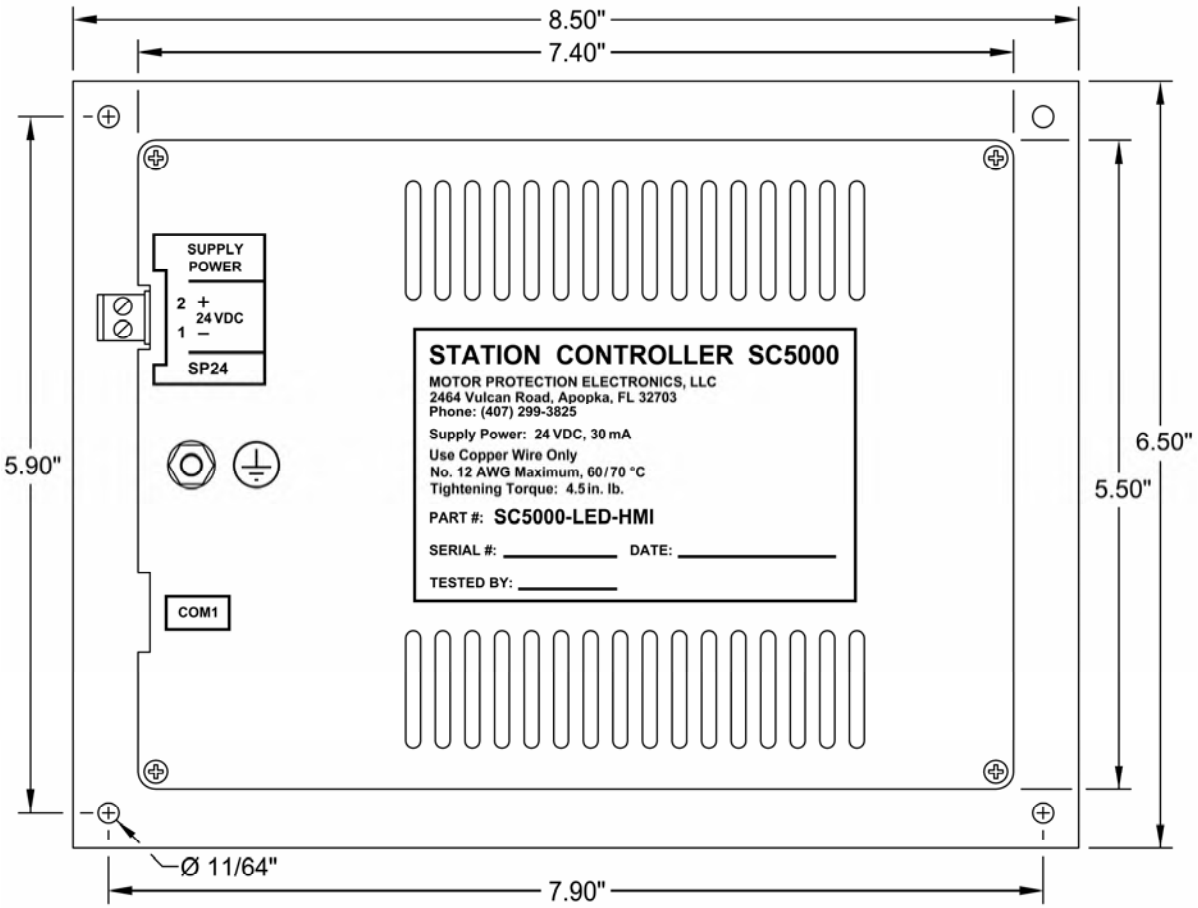
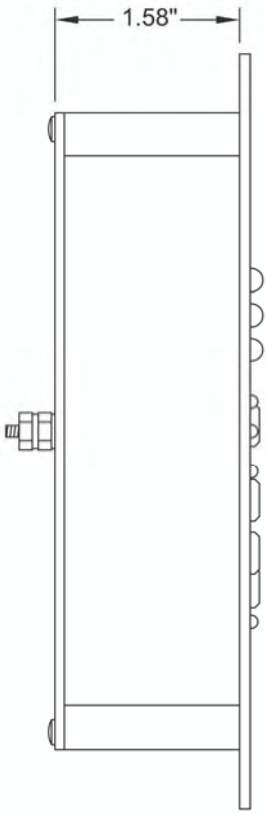


ENCLOSURE LEFT SIDE



ENCLOSURE RIGHT SIDE