# SC2000

# INSTRUCTION MANUAL


## MOTOR PROTECTION ELECTRONICS


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Operating Program Revision: 16

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# STATION CONTROLLER SC2000

## APPLICATIONS

- Simplex, Duplex, Triplex, or Quadraplex Liquid Level Control
- Pump Down (Empty a Tank) or Pump Up (Fill a Tank)
- Fixed or Variable Speed Control
- Where Connection to a SCADA System is Required

## STANDARD FEATURES

- All Setup Parameters Values may be viewed or changed from the front of the unit
- Level Input Source - Menu Selectable:
  - Analog Level Input [4-20mA from Pressure Transducer]
  - Level Probe [Conductance Probe with 10 Electrodes]
- Regulated +20VDC power for Analog Level Input
- RS-232 Serial Port with Modbus RTU Protocol
- High and Low Level Alarm Relays and Alarm Indication
- Adjustable Lag Pump(s) Delay
- Alternation Schemes - Menu Selectable:
  - Standard Alternation
  - Pump 1 Always Lead - Stays On with other Pumps
  - Pump 1 Always Lead - Turns Off with other Pumps On
  - Split Alternation - Pumps 1&2, and Pumps 3&4
  - Fixed Sequence - Pump 1 Always Lead
  - Stepped On/Off - Only One Pump Runs at a Time

  Alternator Logic Skips Disabled Pumps
  First On - **First** Off or First On - **Last** Off Alternation
- Level Simulation (Automatically ends after 1 minute)
- Security Code Protected Parameter Setup
- 18 Discrete Inputs programmable for the following functions:
  - Pump disable with HOA in OFF, or pump fault
  - External Lead Pump Selector Switch
  - All pump disable - for connection to Phase Monitor
  - Limit number of pumps called while on emergency power
  - Alternation by External Time Clock
  - Freeze wet well level during a bubbler tube purge
  - Call pump last
  - Float switch backup
  - Low Level Pump Cutoff
  - Start Flush Cycle
  - A variety of SCADA functions

  Status of Discrete Inputs may be viewed from front of Controller
- Backup Control, and High & Low Alarms using a Level Probe
- Output Relays may be programmed for control through SCADA
- Automatic Flush Cycle to reduce sludge build up
- Flow Calculator that provides the following Flow Data:
  - Latest Inflow Rate
  - Average Daily Inflow Total (Average of Last 7 Days)
- - Pump Outflow Rate (Latest for Each Pump)
- Pump 1-4 Last Run Cycle Time Meters
- Pump 1-4 Start Counters

## OPTIONAL FEATURES

- Up to four Isolated 4-20mA Analog Outputs that may be used for VFD speed control or for sending out a copy of the Level Input.
- Up to four Isolated 4-20mA Auxiliary Analog Inputs that may be used to collect analog data for SCADA.
- 4-20mA Analog Level Input may be ordered as an Isolated Input.
- The Ethernet Port Option (Option "E") is required when using Modbus TCP or DNP3 protocols.

## SPECIFICATIONS

- Input Power: 120 VAC ±10%, 13 VA max
- External Dimensions: 6.9" x 8.5" x 4.9"
- Agency Approvals: UL 508, CAN/CSA
- Ambient Operating Temperature:
  Without Analog Outputs:
  -20°C to +65°C (-4°F to +149°F)
  With Analog Outputs:
  -20°C to +50°C (-4°F to +122°F)
- Level Display: 3 Digit, 7 Segment LED
- Level Display Range: 0 - 999 feet
  (Decimal Point Position is Selectable)
- Indicators: LED
- Color: White with Blue Lettering
- Relays: 6A @ 250VAC
- Analog Level Input: 4-20mA, 250Ω Load, Transient Protected
- Level Probe Inputs: ±8V, 60Hz Square Wave ±0.8mA max, Transient Protected
- Discrete Inputs: 24VDC, Transient Protected
- Power for Discrete Inputs: Unregulated +24VDC, Transient Protected
- Power for Analog Level Input: Regulated +20VDC ±1V, Transient Protected
- Analog Outputs: Isolated 4-20mA
  Maximum Load Resistance: 600Ω
- Auxiliary Analog Inputs: Isolated 4-20mA, 250Ω Load, Transient Protected

## ORDERING INFORMATION

**Part Number:** SC2000 - X X X X

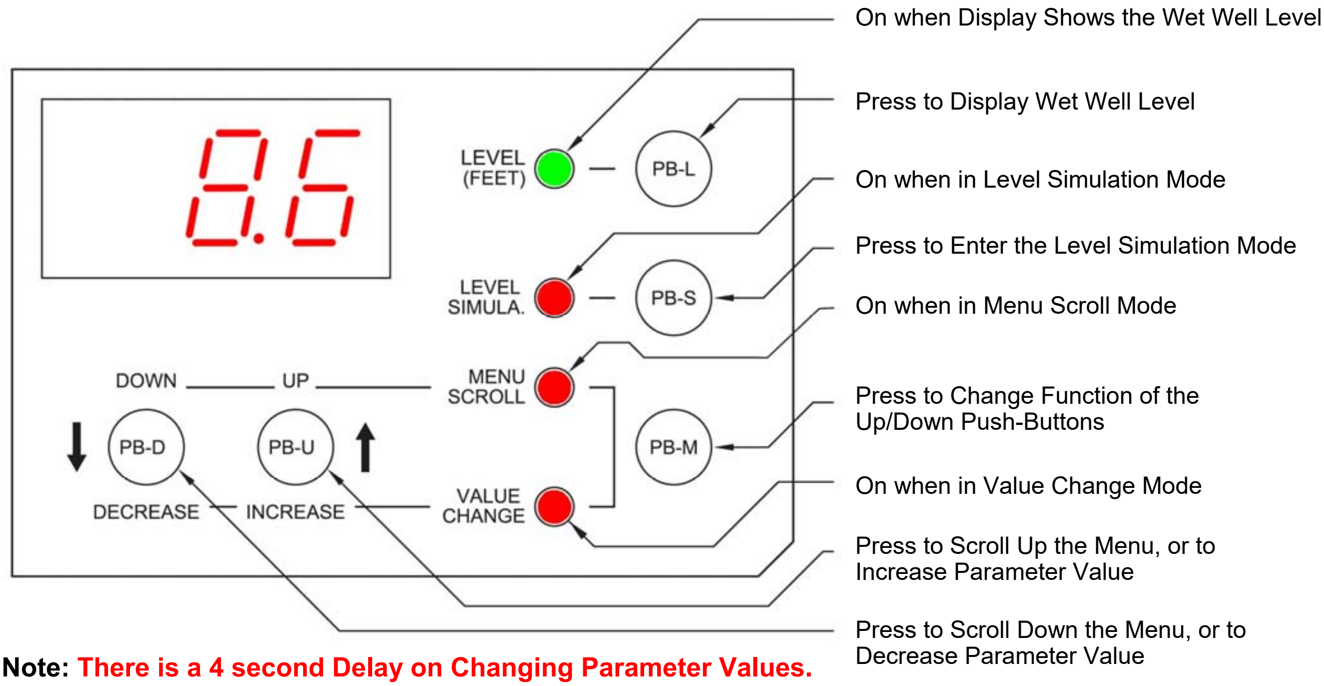
Number of Optional Analog Outputs:
0 = Zero Analog Outputs
1 = One Analog Output
2 = Two Analog Outputs
3 = Three Analog Outputs
4 = Four Analog Outputs

Number of Optional Auxiliary Analog Inputs:
0 = Zero Auxiliary Analog Inputs
1 = One Auxiliary Analog Input
2 = Two Auxiliary Analog Inputs
3 = Three Auxiliary Analog Inputs
4 = Four Auxiliary Analog Inputs

Blank = RS232 Port
E = Ethernet Port & RS232 Port

Blank = Non-Isolated Analog Level Input
S = Isolated Analog Level Input

# OPERATOR INTERFACE FUNCTIONS




**Note: There is a 4 second Delay on Changing Parameter Values.**

## How to <u>View</u> a Setup Parameter Value

1. Press push-button PB-M until the Menu Scroll Mode indicator comes on.
2. Press push-button PB-D and PB-U as needed to arrive at the Parameter you wish to view.
3. <u>Parameters Shown on Front of Controller:</u> The value of the Parameter is displayed whenever the indicator next to the Parameter label is on.

   <u>Parameters in the System Setup Sub-Menu:</u> The value of a Parameter in the System Setup Sub-Menu may be viewed by using the push-button PB-M to toggle from the Parameter number (P.13, for example) to the Parameter value.

## How to <u>Change</u> a Setup Parameter Value

1. Press push-button PB-M until the Menu Scroll mode indicator comes on.
2. Press push-button PB-D and PB-U as needed to arrive at the Parameter you wish to change.
3. <u>Parameters Shown on Front of Controller:</u> Press push-button PB-M until the Value Change indicator comes on.

   <u>Parameters in the System Setup Sub-Menu:</u> Press push-button PB-M until the Value Change indicator comes on. The current value of the Parameter will then be displayed.
4. Press and hold for 4 seconds, either push-button PB-D or PB-U, to change the Parameter to the desired new value. (If the Parameter values will not change, they may be locked. See directions below to un-lock Parameters.)
5. 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.

## How to Enter the Security Code

1. Press the push-button PB-M until the Menu Scroll mode indicator comes on.
2. Press push-button PB-U until the display reads SEC.
3. Press push-button PB-M to change to the Value Change mode.
4. Press and hold for 4 seconds, either push-button PB-D or PB-U, to change the value displayed, to that of the correct security code.

## MENU - SYSTEM SETUP

All Level Settings Have the Decimal Point Artificially Inserted Based on Parameter P.36.

| Parameter | Default Value | Current Value | Setting Definitions |
|---|---|---|---|
| - | 2.0 feet | | Low Level Alarm Range: 0.1 - 99.9 feet<br>Note: To Disable Alarm see Parameter P.50. |
| - | 3.0 feet | | 1st Pump Off Level Range: 0.2 - 99.9 feet |
| - | 6.0 feet | | 1st Pump On Level Range: 0.2 - 99.9 feet |
| - | 4.0 feet | | 2nd Pump Off Level Range: 0.2 - 99.9 feet |
| - | 7.0 feet | | 2nd Pump On Level Range: 0.2 - 99.9 feet |
| - | 4.5 feet | | 3rd Pump Off Level Range: 0.2 - 99.9 feet |
| - | 8.0 feet | | 3rd Pump On Level Range: 0.2 - 99.9 feet |
| - | 5.0 feet | | 4th Pump Off Level Range: 0.2 - 99.9 feet |
| - | 9.0 feet | | 4th Pump On Level Range: 0.2 - 99.9 feet |
| - | 10.0 feet | | High Level Alarm Range: 0.5 - 99.9 feet |
| - | 5 sec. | | Lag Pump(s) Delay Range: 1 - 100 seconds |
| **SEC** | 0 | | Security Code - Enter Your Security Code Here to Allow Parameters to be Changed. Change to other Number to Re-lock All Parameters.<br>Note: The Security Code may be Customized using Parameter P.26. See Page 2. |
| **P.13** | 4 | | Number of Pumps Present See Page 9.<br>1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps |
| **P.14** | 4 | | Number of Pumps Allowed to Run at the Same Time See Page 9.<br>1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps |
| **P.15** | 4 | | Number of Pumps Allowed to Run On Generator See Page 9.<br>1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps<br>Note: Must Connect Transfer Switch Contacts to Discrete Input Programmed for Function 7. |
| **P.16** | 1 | | Alternator Sequence Mode<br>1 = Standard Alternation See Page 11.<br>2 = Pump 1 Always Lead - Stays On With Other Pumps See Page 11.<br>3 = Pump 1 Always Lead - Turns Off With Other Pumps See Page 12.<br>4 = Split Alternation - Pumps 1&2, and Pumps 3&4 See Page 12.<br>5 = Fixed Sequence - Pump 1 Always Lead See Page 13.<br>6 = Stepped On/Off - Only One Pump Runs at a Time See Page 13. |
| **P.17** | 2 | | Pump Stop Mode See Page 10.<br>1 = First On Last Off 2 = First On First Off |
| **P.18** | 1 | | Automatic Alternation See Page 10.<br>1 = Enabled 2 = Disabled |
| **P.19** | 1 | | Pump Up or Down Mode<br>1 = Pump Down - Empty a Tank 2 = Pump Up - Fill a Tank<br>Note: When Parameter P.19 is Changed New Default Level Parameter Values will be loaded. |
| **P.20 - P.23** | - | | VFD Speed Control Setup See Page 21. |

## MENU - SYSTEM SETUP

| Parameter | Default Value | Current Value | Setting Definitions |
|---|---|---|---|
| **P.24** | 23.1 feet<br>With<br>20mA<br>Applied<br>To Input | | Level Input Calibration - Span Range: 0.9 - 99.9 feet See Page 20.<br>Notes:<br>1. 20mA is Typically Applied to the Analog Input while Setting the Span.<br>2. Parameter P.24 Shows the Wet Well Level, while allowing the Up & Down Push-buttons to Change the Internal Number used to Calculate the Displayed Level.<br>3. When Controller is set to Operate using a Level Probe, Parameter P.24 shows "77.7". |
| **P.25** | 0.0 feet<br>With<br>4.0mA<br>Applied<br>To Input | | Level Input Calibration - Zero See Page 20.<br>Notes:<br>1. 4.0mA is Typically Applied to the Analog Input while Setting the Zero.<br>2. Parameter P.25 Shows the Wet Well Level, while allowing the Up & Down Push-buttons to Change the Internal Number used to Zero the Displayed Level.<br>3. When Controller is set to Operate using a Level Probe, Parameter P.25 shows "77.7". |
| **P.26** | 0 | | Security Code Setup Parameter - Establishes What Value Will Be Accepted as the Security Code at Parameter SEC. Range: 0 - 255<br>Notes:<br>1. To Change Parameter P.26, the Current Security Code Must First be Entered into SEC.<br>2. When You Change Parameter P.26 and Exit the Value Change Mode Parameter, P.26 Will No Longer Be Viewable, Until You Enter the New Security Code into Parameter SEC.<br>3. If You Forget Your Security Code, Consult the Factory for the Master Security Code. |
| **P.27** | 0 | | High Level Alarm - Float Switch - Discrete Input Mode (Function 18)<br>0 = Normal 1 = Logic Inverted |
| **P.28 - P.33** | - | | SCADA Setup See Pages 26 - 28. |
| **P.35** | 1 sec. | | Stop Pump Delay Range: 1 - 100 seconds<br>Note: This is the Time Period that the Wet Well Level Must Remain At or Below (At or Above for Pump Up P.19 = 2) the Respective OFF Level Setting in order to Turn Off a Pump. |
| **P.36** | 1 | | Display Decimal Point Position 0 = No Decimal Point 1 = XX.X 2 = X.XX |
| **P.37** | 1 min. | | Pump Re-enable Delay after Float Backup Low Level (High Level)<br>Notes: Range: 1 - 255 minutes<br>1. Pump Down (Parameter P.19 = 1) - Delay Starts when the Low Level Float Input Opens.<br>2. Pump Up (Parameter P.19 = 2) - Delay Starts when the High Level Float Input Opens. |
| **P.38** | 1 min. | | Delay Canceling Remote Control Commands<br>Notes: Range: 0 - 254 minutes<br>1. For Modbus Protocol - Delay is Reset and Started again after each polling by the Master.<br>2. For DNP3 Protocol - Delay is Started when the Link with the DNP3 Master is lost.<br>3. To Allow all Remote Commands to Remain in Effect (Until Power Loss) Set P.38 = 255. |
| **P.39** | 0 | | Force Lead Pump Position See Page 10.<br>0 = Alternate 1 = Pump 1 Lead 2 = Pump 2 Lead 3 = Pump 3 Lead 4 = Pump 4 Lead |
| **P.40 - P.43** | - | | Flush Cycle Setup See Page 22. |
| **P.44 - P.48** | - | | Flow Calculator Setup See Pages 23 - 25. |
| **P.49** | 240 | | Analog Level Input - Signal Conditioning Control Range: 1 - 254<br>10 = Very Slow 100 = Slow 240 = Normal 250 = Fast |
| **P.50** | 1 | | Low Level Alarm Mode 0 = Disabled 1 = Enabled See Page 17.<br>Note: Setting "0" Disables Low Level Alarms from the Analog Level Input or Level Probe Inputs. |
| **P.51** | 0 | | Time Based Alternation Range: 1 - 255 1/6 hour See Page 10.<br>0 = Disabled 1 = 1/6 hour 6 = 1 hour 48 = 8 hours 144 = 24 hours |
| **P.52** | 0 | | Pump 1 (2, 3, 4) Disable - Discrete Input Mode 0 = Normal 1 = Logic Inverted |
| **P.53** | 100% | | Speed of Pumps Forced On (Remotely) Range: 0% - 100% See Page 21. |
| **FLC** | - | | Fault Code See Fault Code Table on Pages 18 - 19.<br>Note: This Automatically Returns to Zero when the Fault Clears (Except for Faults 20-29). |
| **LFC** | - | | Last Fault Code See Fault Code Table on Pages 18 - 19.<br>Note: This is a Copy of the Last Non-Zero Fault Code that was shown on Parameter FLC. |
| **oPr** | - | | Operating Program Revision Number - Control Board |
| **EPr** | - | | Operating Program Revision Number - Ethernet Board |

## MENU - SYSTEM SETUP

| Parameter | Default Value | Current Value | Setting Definitions |
|---|---|---|---|
| **F.01** | 1 | | Discrete Input 1 Function |
| **F.02** | 2 | | Discrete Input 2 Function |
| **F.03** | 3 | | Discrete Input 3 Function |
| **F.04** | 4 | | Discrete Input 4 Function |
| **F.05** | 5 | | Discrete Input 5 Function |
| **F.06** | 6 | | Discrete Input 6 Function |
| **F.07** | 7 | | Discrete Input 7 Function |
| **F.08** | 8 | | Discrete Input 8 Function |
| **F.09** | 9 | | Discrete Input 9 Function |
| **F.10** | 10 | | Discrete Input 10 Function |
| **F.11** | 11 | | Discrete Input 11 Function |
| **F.12** | 12 | | Discrete Input 12 Function |
| **F.13** | 13 | | Discrete Input 13 Function |
| **F.14** | 14 | | Discrete Input 14 Function |
| **F.15** | 15 | | Discrete Input 15 Function |
| **F.16** | 16 | | Discrete Input 16 Function |
| **F.17** | 17 | | Discrete Input 17 Function |
| **F.18** | 18 | | Discrete Input 18 Function |

| Function of Input: | Connect To: |
|---|---|
| 0 = No Function | |
| 1 = Pump 1 Disable | HOA and Fault Logic |
| 2 = Pump 2 Disable | HOA and Fault Logic |
| 3 = Pump 3 Disable | HOA and Fault Logic |
| 4 = Pump 4 Disable | HOA and Fault Logic |
| 5 = Level Freeze | Bubbler Tube Purge Logic |
| 6 = External Alternation | External Time Clock |
| 7 = On Generator | Automatic Transfer Switch |
| 8 = All Pump Disable | Phase Monitor |
| 9 = Sequence Input 1 | Lead Select Switch - 1 as Lead |
| 10 = Sequence Input 2 | Lead Select Switch - 2 as Lead |
| 11 = Sequence Input 3 | Lead Select Switch - 3 as Lead |
| 12 = Sequence Input 4 | Lead Select Switch - 4 as Lead |
| 13 = Call Pump 1 Last | Logic Contact |
| 14 = Call Pump 2 Last | Logic Contact |
| 15 = Call Pump 3 Last | Logic Contact |
| 16 = Call Pump 4 Last | Logic Contact |
| 17 = Low Level Alarm | Low Level Float Switch |
| 18 = High Level Alarm | High Level Float Switch |
| 19 = Telemetry E | Telemetry Contact |
| 20 = Telemetry F | Telemetry Contact |
| 21 = Telemetry G | Telemetry Contact |
| 22 = Telemetry H | Telemetry Contact |
| 23 = Telemetry J | Telemetry Contact |
| 24 = Telemetry K | Telemetry Contact |
| 25 = Telemetry L | Telemetry Contact |
| 26 = Telemetry M | Telemetry Contact |
| 27 = Telemetry A | Telemetry Contact |
| 28 = Telemetry B | Telemetry Contact |
| 29 = Telemetry C | Telemetry Contact |
| 30 = Telemetry D | Telemetry Contact |
| 31 = Normal Pump Operation Disable | Fault Contact |
| 32 = Float Backup – Low Level | Low Level Float Switch |
| 33 = Float Backup – Off Level | Off Level Float Switch |
| 34 = Float Backup – 1ST On Level | 1ST On Level Float Switch |
| 35 = Float Backup – 2ND On Level | 2ND On Level Float Switch |
| 36 = Float Backup – 3RD On Level | 3RD On Level Float Switch |
| 37 = Float Backup – 4TH On Level | 4TH On Level Float Switch |
| 38 = Float Backup – High Level | High Level Float Switch |
| 39 = Start Flush Cycle | External Time Clock |

Notes:
1. Function of Discrete Inputs may be set to “0” when Input is used only to collect data for Scada and no other Function is desired.
2. See Pages 14 - 16 for description of each of the above Functions.
3. Pump 1(2,3,4) Disable logic may be inverted. See Parameter P.52.
4. High Level Alarm (Function 18) may be inverted. See Parameter P.27.

| Parameter | Default Value | Current Value | Setting Definitions |
|---|---|---|---|
| **F.19** | 1 | | Level Input Source<br>1 = Analog Level Input (4-20mA) on J21<br>2 = Level Probe Input on J25<br>3 = Level Probe Input on J25 (Flashes Level Probe Electrode No. of Level Settings.)<br>4 = Remote Level Input (Follows the Level written to Scada Register)<br>Note: Level Probe not suitable for applications measuring Storm Water or Well Water. |
| **F.20** | 12 in. | | Level Probe Electrode Spacing Range: 3 - 24 inches |
| **F.21** | 0.0 feet | | Level Offset Range: 0.0 - 5.0 feet<br>Note: This adds to the Level from the Analog Level Input or Level Probe Input. |
| **F.22** | 100 | | Level Probe Sensitivity Range: 90 - 210<br>100 = Typical Sewage 150 = Light Sewage<br>Check value of Parameter L.10 with Electrode 10 covered, add 40 to it, and enter value for F.22.<br>Note: Level Probe not suitable for applications measuring Storm Water or Well Water. |

# MENU - SYSTEM SETUP

| Parameter | Default Value | Current Value | Setting Definitions | |
|---|---|---|---|---|
| **F.23** | 1 | | Analog Output 1 Function | 1 = Pump 1 Speed (Active When Pump 1 is Called)<br>2 = Pump 2 Speed (Active When Pump 2 is Called)<br>3 = Pump 3 Speed (Active When Pump 3 is Called)<br>4 = Pump 4 Speed (Active When Pump 4 is Called)<br>5 = Speed Reference any Pump (Always Active)<br>6 = Copy of Wet Well Level |
| **F.24** | 2 | | Analog Output 2 Function | |
| **F.25** | 3 | | Analog Output 3 Function | |
| **F.26** | 4 | | Analog Output 4 Function | |
| **F.31** | 1 | | HI Relay Output Function See Page 33 (Page A16).<br>0 = Disabled 1 = High Level Alarm 2 = Remote Control<br>Note: High Level indicator on front of unit will operate regardless of setting. | |
| **F.32** | 1 | | LO Relay Output Function See Page 33 (Page A16).<br>0 = Disabled 1 = Low Level Alarm 2 = Remote Control<br>Note: Low Level indicator on front of unit will operate regardless of setting. | |
| **F.33** | 1 | | P1 Relay Output Function See Page 33 (Page A16).<br>0 = Disabled 1 = Pump 1 Call 2 = Remote Control<br>Note: When set on "0" or "2" Pump 1 will be skipped over in all Alternation Sequence Modes. | |
| **F.34** | 1 | | P2 Relay Output Function See Page 33 (Page A16).<br>0 = Disabled 1 = Pump 2 Call 2 = Remote Control<br>Note: When set on "0" or "2" Pump 2 will be skipped over in all Alternation Sequence Modes. | |
| **F.35** | 1 | | P3 Relay Output Function See Page 33 (Page A16).<br>0 = Disabled 1 = Pump 3 Call 2 = Remote Control<br>Note: When set on "0" or "2" Pump 3 will be skipped over in all Alternation Sequence Modes. | |
| **F.36** | 1 | | P4 Relay Output Function See Page 33 (Page A16).<br>0 = Disabled 1 = Pump 4 Call 2 = Remote Control<br>Note: When set on "0" or "2" Pump 4 will be skipped over in all Alternation Sequence Modes. | |
| **F.37** | 10 min. | | Numerical Display Blanking Delay Range: 10 - 254 minutes<br>Note: To disable the Numerical Display Blanking feature: Set Parameter F.37 = 255. | |
| | | | | |
| **E.01 - E.62** | - | | Ethernet Port Setup See Page 28 (Page A2). | |
| | | | | |
| | | | Level Probe Backup Functions | 0 = Function Not Used<br>1 = Electrode Input 1 on Connector J25-1<br>2 = Electrode Input 2 on Connector J25-2<br>3 = Electrode Input 3 on Connector J25-3<br>4 = Electrode Input 4 on Connector J25-4<br>5 = Electrode Input 5 on Connector J25-5<br>6 = Electrode Input 6 on Connector J25-6<br>7 = Electrode Input 7 on Connector J25-7<br>8 = Electrode Input 8 on Connector J25-8<br>9 = Electrode Input 9 on Connector J25-9<br>10 = Electrode Input 10 on Connector J25-10 |
| **b.01** | 0 | | Low Level Alarm | |
| **b.02** | 0 | | Pump Control – Off Level | |
| **b.03** | 0 | | Pump Control – 1ST On Level | |
| **b.04** | 0 | | Pump Control – 2ND On Level | |
| **b.05** | 0 | | Pump Control – 3RD On Level | |
| **b.06** | 0 | | Pump Control – 4TH On Level | |
| **b.07** | 0 | | High Level Alarm | |

Notes For Level Probe Backup Functions: For status of Level Probe inputs through Scada see Page 30 (Page A9).

1. When the controller is set up to follow a 10 Electrode Conductance Level Probe as the primary level input source (Parameter F.19 = 2 or 3), the backup functions described here are not needed and will not operate.
2. If a Function (such as Pump Control – 4TH On Level) is not desired set the respective parameter equal to zero.
3. An effective Backup Pump Control would involve having a 3 point Level Probe placed high in the wet well. The Level Probe would be connected to Connector J25 terminals 1, 2, and 3. The Off Level should be made to operate from the bottom Electrode by setting Parameter b.02 = 3. The 1ST On Level should be set to operate from Electrode 2 by setting Parameter b.03 = 2. The 2ND On Level should be set to operate from Electrode 1 by setting Parameter b.04 = 1. If additional pumps are present set the 3RD On and 4TH On Levels, to operated from Electrode 1 by setting Parameter b.05 = 1, and b.06 = 1.
4. If a Backup High Level Alarm is desired, set Parameter b.07 to the number of the Electrode Input that the High Level Probe is connected to. This feature is for alarm and telemetry only and will not function as a redundant pump call. See Scada notes page 34.
5. If a Backup Low Level Alarm is desired, set Parameter b.01 to the number of the Electrode Input that the Low Level Probe is connected to. This feature is for alarm and telemetry only and will not function as a redundant pump off. See Scada notes page 34.
6. Whenever the Backup Pump Control is active the Fault indicator will be on and fault code of 30 will be present in Parameter FLC. Status of the Fault is also available through SCADA. See "Pump Called on Level Probe Backup" on Page 29 (Page A8).

## MENU - DATA DISPLAY

<table>
<tr><th>Parameter</th><th colspan="2">Data Description</th></tr>
<tr><td>L.01</td><td>Electrode 1 Status Value</td><td rowspan="10">Level Probe Electrode Status Values<br>Normal Range when Un-Covered: 240 - 255<br>Normal Range when Covered by Typical Sewage: 55 - 70<br><br>Notes:<br>1. The Controller compares each of the Electrode Status Values with what is set on Parameter F.22. When the value drops below the setting on Parameter F.22, the Controller logic considers the Electrode to be covered by liquid.<br>2. Parameters L.01 - L.10 are also used to diagnose Out of Sequence Faults (Fault Codes 21 - 29).</td></tr>
<tr><td>L.02</td><td>Electrode 2 Status Value</td></tr>
<tr><td>L.03</td><td>Electrode 3 Status Value</td></tr>
<tr><td>L.04</td><td>Electrode 4 Status Value</td></tr>
<tr><td>L.05</td><td>Electrode 5 Status Value</td></tr>
<tr><td>L.06</td><td>Electrode 6 Status Value</td></tr>
<tr><td>L.07</td><td>Electrode 7 Status Value</td></tr>
<tr><td>L.08</td><td>Electrode 8 Status Value</td></tr>
<tr><td>L.09</td><td>Electrode 9 Status Value</td></tr>
<tr><td>L.10</td><td>Electrode 10 Status Value</td></tr>
<tr><td>L.11</td><td colspan="2">Level Probe Test Signal Status Normal Range: 230 - 254<br>Note: This is a Measure of the ±8V, 60Hz Square Wave Sent Out to Each Electrode to read the level. If the value is below 210, a malfunction has occurred in the circuit that provides the Square Wave used to read the level. In this case the wet well level display will show zero, the Fault indicator will be turned on, and Fault Code 20 will be generated.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>FLH</td><td colspan="2" rowspan="2">Flow Calculator - Latest Inflow Rate FLH , FLL Gallons Per Minute<br>See pages 23 - 25.</td></tr>
<tr><td>FLL</td></tr>
<tr><td>FdH</td><td colspan="2" rowspan="2">Flow Calculator - Average Daily Inflow Total FdH , FdL Units set by Parameter P.45.<br>See pages 23 - 25.</td></tr>
<tr><td>FdL</td></tr>
<tr><td>F1H</td><td colspan="2" rowspan="2">Flow Calculator - Pump 1 Outflow Rate F1H , F1L Gallons Per Minute<br>See pages 23 - 25.</td></tr>
<tr><td>F1L</td></tr>
<tr><td>F2H</td><td colspan="2" rowspan="2">Flow Calculator - Pump 2 Outflow Rate F2H , F2L Gallons Per Minute<br>See pages 23 - 25.</td></tr>
<tr><td>F2L</td></tr>
<tr><td>F3H</td><td colspan="2" rowspan="2">Flow Calculator - Pump 3 Outflow Rate F3H , F3L Gallons Per Minute<br>See pages 23 - 25.</td></tr>
<tr><td>F3L</td></tr>
<tr><td>F4H</td><td colspan="2" rowspan="2">Flow Calculator - Pump 4 Outflow Rate F4H , F4L Gallons Per Minute<br>See pages 23 - 25.</td></tr>
<tr><td>F4L</td></tr>
</table>

## MENU - DATA DISPLAY

| Parameter | Data Description | |
|---|---|---|
| **n.01** | Discrete Input 1 Status | Discrete Input Status<br>0 = Input Open<br>1 = Input Closed<br><br>Notes:<br>1. Discrete Input Status is used when troubleshooting the wiring and logic connected to the Discrete Inputs.<br>2. Discrete Input Status data may be read from Scada Registers. See Page 32 (Page A15). |
| **n.02** | Discrete Input 2 Status | |
| **n.03** | Discrete Input 3 Status | |
| **n.04** | Discrete Input 4 Status | |
| **n.05** | Discrete Input 5 Status | |
| **n.06** | Discrete Input 6 Status | |
| **n.07** | Discrete Input 7 Status | |
| **n.08** | Discrete Input 8 Status | |
| **n.09** | Discrete Input 9 Status | |
| **n.10** | Discrete Input 10 Status | |
| **n.11** | Discrete Input 11 Status | |
| **n.12** | Discrete Input 12 Status | |
| **n.13** | Discrete Input 13 Status | |
| **n.14** | Discrete Input 14 Status | |
| **n.15** | Discrete Input 15 Status | |
| **n.16** | Discrete Input 16 Status | |
| **n.17** | Discrete Input 17 Status | |
| **n.18** | Discrete Input 18 Status | |
| | | |
| **n.19** | Auxiliary Analog Input 1 Status | Auxiliary Analog Input Status Range: 0 - 255<br>Where: 0 = 0.0 mA 51 = 4.0 mA 255 = 20 mA<br><br>Note: Auxiliary Analog Input data may be read from Scada Registers. See Page 32 (Page A15). |
| **n.20** | Auxiliary Analog Input 2 Status | |
| **n.21** | Auxiliary Analog Input 3 Status | |
| **n.22** | Auxiliary Analog Input 4 Status | |
| | | |
| **d.00** | Communication Link Established with DNP3 Master – Linkage Indicator | See Page A18. |
| **d.01** | Voltage of +5 Volt Power Supply<br>Note: Voltage is measured ahead of Voltage Regulator. | Normal Range: 8.5V - 11.3V |
| **d.02** | Voltage of +24 Volt Power Supply | Normal Range: 21V - 25V |
| **d.03** | Analog Output 1 (0 - 100%) | See Page 32 (Page A15). |
| **d.04** | Analog Output 2 (0 - 100%) | See Page 32 (Page A15). |
| **d.05** | Analog Output 3 (0 - 100%) | See Page 32 (Page A15). |
| **d.06** | Analog Output 4 (0 - 100%) | See Page 32 (Page A15). |
| **d.07** | Serial Communication – Activity Indicator | See Page 35. |
| **d.08** | Serial Communication – Shows the Address of the Last Slave Polled by the Master | See Page 35. |
| **d.09** | Serial Communication – Shows the Last Modbus Function Code Received | See Page 35. |
| **d.08-d.86** | Serial Communication – Shows the Record of the Last Modbus Message Received | See Page 35. |

## PUMP CALL SEQUENCE - Setup Parameters

The following is a description of each of the Setup Parameters used to establish the Pump Call Sequence:

Note: Discrete Inputs programmed with Functions 1-4, 6-7, 9-12, and 13-16 are also available to establish or modify the Pump Call Sequence. See the description of these Discrete Input Functions on pages 14-16.

### Number of Pumps Present - Parameter P.13

This Parameter establishes how many pumps are available at the Lift Station to perform level control.
Simplex (1 pump) Duplex (2 pumps) Triplex (3 pumps) Quadraplex (4 pumps)

| Parameter | Default Value | Setting Definitions |
|---|---|---|
| **P.13** | 4 | Number of Pumps Present<br>1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps |

### Number of Pumps Allowed to Run at the Same Time - Parameter P.14

In cases where there is an inadequately sized discharge pipe, or inadequate electrical power, running all available pumps at the same time may be a problem. This Parameter is used to set an upper limit on the number of pumps called to run at the same time. If there is no need for this feature P.14 may be left on it's default value of 4.

| Parameter | Default Value | Setting Definitions |
|---|---|---|
| **P.14** | 4 | Number of Pumps Allowed to Run at the Same Time<br>1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps |

### Number of Pumps Allowed to Run On Generator - Parameter P.15

In cases where the Emergency Generator is not sized large enough to run all the available pumps, this Parameter is used to set an upper limit on the number of pumps called to run on the Generator. There must be a contact from the Transfer Switch connected to one of the Controller's Discrete Inputs and it must be programmed for Function 7. If there is no need for this feature Parameter P.15 may be left on it's default value of 4.

| Parameter | Default Value | Setting Definitions |
|---|---|---|
| **P.15** | 4 | Number of Pumps Allowed to Run On Generator<br>1 = 1 Pump 2 = 2 Pumps 3 = 3 Pumps 4 = 4 Pumps |

### Alternator Sequence Mode - Parameter P.16

This Parameter is provided to allow the Controller to accommodate a variety of special sequence requirements.

| Parameter | Default Value | Setting Definitions |
|---|---|---|
| **P.16** | 1 | Alternator Sequence Mode<br>1 = Standard Alternation — See Page 11.<br>2 = Pump 1 Always Lead - Stays On With Other Pumps — See Page 11.<br>3 = Pump 1 Always Lead - Turns Off With Other Pumps — See Page 12.<br>4 = Split Alternation - Pumps 1&2, and Pumps 3&4 — See Page 12.<br>5 = Fixed Sequence - Pump 1 Always Lead — See Page 13.<br>6 = Stepped On/Off - Only One Pump Runs at a Time — See Page 13. |

# PUMP CALL SEQUENCE - Setup Parameters

## Pump Stop Mode - Parameter P.17

This Parameter establishes which pump is the next one to be stopped, when there are two or more pumps on.

The Controller has a corresponding “Pump Off Level” setting for each of the “Pump On Level” settings. For the “Pump Stop Mode” feature to operate, the “Pump Off Level” settings must be set on different levels. If all the “Pump Off Level” settings are set on the same level it does not matter what Parameter P.17 is set on.

**First On Last Off** - In this mode, as the level reaches one of the “Pump Off Level” settings, the pump that was most recently turned on is turned off, leaving the one that was called to run first still running.

**First On First Off** - In this mode, as the level reaches one of the “Pump Off Level” settings, the pump that was most recently turned on is left on and the pump that has been on the longest is turned off. This results in a longer cool down period for each pump between starts. This mode works the best in stations where one pump is required to run for a long period of time, with an occasional need for an additional pump.

| Parameter | Default Value | Setting Definitions |
|---|---|---|
| **P.17** | 2 | Pump Stop Mode 1 = First On Last Off 2 = First On First Off |

## Automatic Alternation - Parameter P.18

This Parameter is provided so that normal automatic alternation may be disabled (turned off). Typically, normal alternation is disabled only in applications that have an external Time Clock used to alternated the pumps.
(The Time Clock would be connected to a Discrete Input programmed for “External Alternation” , Function 6.)

| Parameter | Default Value | Setting Definitions |
|---|---|---|
| **P.18** | 1 | Automatic Alternation 1 = Enabled 2 = Disabled |

## Force Lead Pump Position - Parameter P.39

This Parameter is provided so that a fixed sequence may be established with the selected pump always as lead. For example setting Parameter P.39 on 1 will cause a fixed pump call sequence of 1-2-3-4. Parameter P.39 may also be changed by writing to a Scada Register (See Page 33)(See Page A16).

| Parameter | Default Value | Setting Definitions |
|---|---|---|
| **P.39** | 0 | Force Lead Pump Position<br>0 = Alternate 1 = Pump 1 Lead 2 = Pump 2 Lead 3 = Pump 3 Lead 4 = Pump 4 Lead |

## Time Based Alternation - Parameter P.51

This feature may be used to ensure that alternation periodically occurs even in applications that tend to run one pump for a long period of time. The internal Time Clock starts and runs whenever at least one pump is called to run. When it times out, it forces the alternation of the pumps and then resets the Time Clock. The Time Clock is also reset each time a Normal Alternation Occurs.

| Parameter | Default Value | Setting Definitions |
|---|---|---|
| **P.51** | 0 | Time Based Alternation Time Clock Range: 1 - 255 1/6 hour<br>0 = Disabled 1 = 1/6 hour 6 = 1 hour 48 = 8 hours 144 = 24 hours |

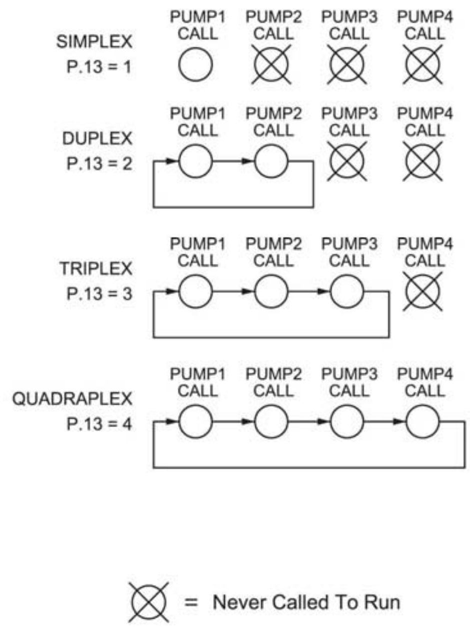
# ALTERNATION SEQUENCE MODE

## STANDARD ALTERNATION — Parameter P.16 = 1

**Notes:**

1. Unless there is some special circumstance that requires a more complicated pump call sequence, this is the sequence that should be used.
2. Parameter P.17 must be used to select either First On Last Off or First On First Off.
3. Discrete Inputs programmed as Pump 1-4 Disable inputs may be used to disable pumps.
4. Discrete Inputs programmed as Call Pump 1-4 Last inputs may be used to assign pumps to standby status.
5. Discrete Inputs programmed as Sequence Inputs 1-4 may be used to set the lead pump.
6. Parameter P.39 may be used to set the lead pump.
7. A Discrete Input programmed for External Alternation (Function 6) may be used to force alternation. When this feature is used, Automatic Alternation would normally be disabled by setting Parameter P.18 to Disabled.
8. Alternation may also be controlled remotely through a Scada System. See "Force Pump Alternation" and "Force Lead Pump Position", on Page 33 (Page A16).
9. Parameter P.51 may be used to select and setup Time Based Alternation.

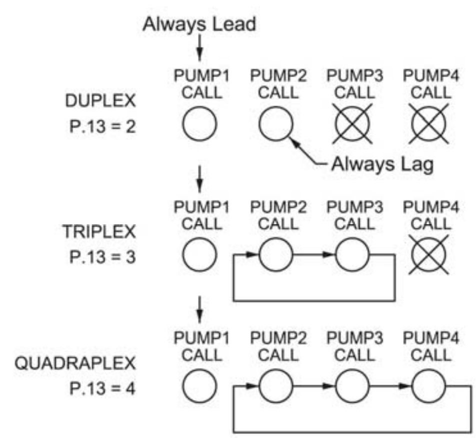
**Movement of Lead Pump Upon Alternation**




## PUMP 1 ALWAYS LEAD
## Stays On With Other Pumps — Parameter P.16 = 2

**Notes:**

1. This sequence is used when it is required that pump 1 always be lead pump. This sequence keeps pump 1 on, when the other pumps are called to run.
2. Parameter P.17 must be used to select either First On Last Off or First On First Off.
3. Discrete Inputs programmed as Pump 1-4 Disable inputs may be used to disable pumps.
4. Discrete Inputs programmed as Call Pump 1-4 Last inputs may be used to assign pumps to standby status.
5. Discrete Inputs programmed as Sequence Inputs 1-4 may be used to set the lead pump.
6. Parameter P.39 may be used to set the lead pump among pumps 2 - 4.
7. If pump 1 is disabled another pump will be called in its place.
8. A Discrete Input programmed for External Alternation (Function 6) may be used to force alternation. When this feature is used, Automatic Alternation would normally be disabled by setting Parameter P.18 to Disabled.
9. Alternation may also be controlled remotely through a Scada System. See "Force Pump Alternation" and "Force Lead Pump Position", on Page 33 (Page A16).
10. Parameter P.51 may be used to select and setup Time Based Alternation.



# ALTERNATION SEQUENCE MODE

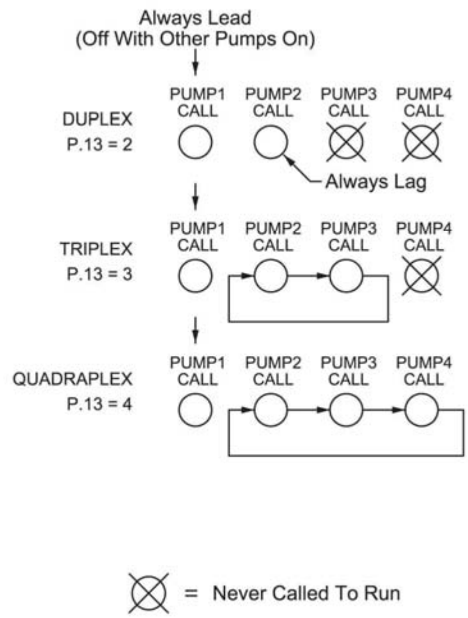
## PUMP 1 ALWAYS LEAD
## Turns Off With Other Pumps On

**Parameter P.16 = 3**

**Notes:**

1. This sequence is used when it is required that pump 1 always be lead, and when it must be turned off when another pump(s) comes on. When a pump from the second group is required, pump 1 is first turned off, then after the Lag Pump Delay, the other pump is turned on.
2. For Triplex and Quadraplex applications Parameter P.17 must be used to select either First On Last Off or First On First Off.
3. Discrete Inputs programmed as Pump 1-4 Disable inputs may be used to disable pumps.
4. For Triplex and Quadraplex applications Discrete Inputs programmed as Call Pump 2-4 Last inputs may be used to assign pumps to standby status.
5. For Triplex and Quadraplex applications Discrete Inputs programmed as Sequence Inputs 2-4 may be used to set the lead pump.
6. For Triplex and Quadraplex applications Parameter P.39 may be used to set the lead pump.
7. If pump 1 is disabled, another pump will Not be called in its place. The $1^{ST}$ Pump On/Off Level parameters are dedicated to pump 1 and will not call another pump.
8. A Discrete Input programmed for External Alternation (Function 6) may be used to force alternation. When this feature is used, Automatic Alternation would normally be disabled by setting Parameter P.18 to Disabled.
9. Alternation may also be controlled remotely through a Scada System. See “Force Pump Alternation” and “Force Lead Pump Position”, on Page 33 (Page A16).
10. Parameter P.51 may be used to select and setup Time Based Alternation.

**Movement of Lead Pump Upon Alternation**

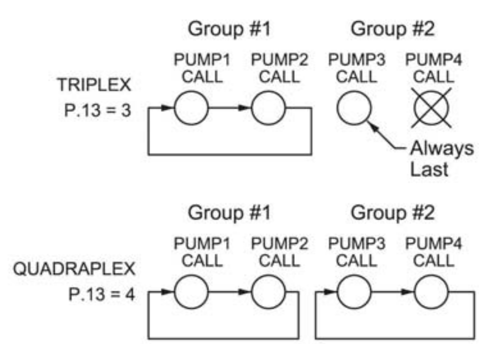



## SPLIT ALTERNATION

**Parameter P.16 = 4**

**Notes:**

1. This sequence is used when it is required that pumps be alternated in two separate groups.
2. Parameter P.17 must be used to select either First On Last Off or First On First Off.
3. Discrete Inputs programmed as Pump 1-4 Disable inputs may be used to disable pumps.
4. Discrete Inputs programmed as Call Pump 1-4 Last inputs may be used to assign pumps to standby status.
5. Discrete Inputs programmed as Sequence Inputs 1-4 may be used to set the lead pump.
6. Parameter P.39 may be used to set the lead pump of group #1.
7. If pumps from group 1 are disabled, then pumps in group #2 may be called to take their place.
8. A Discrete Input programmed for External Alternation (Function 6) may be used to force alternation of Group #1. When this feature is used, Automatic Alternation would normally be disabled by setting Parameter P.18 to Disabled.
9. Alternation may also be controlled remotely through a Scada System. See “Force Pump Alternation” and “Force Lead Pump Position”, on Page 33 (Page A16).
10. Parameter P.51 may be used to select and setup Time Based Alternation of Group #1.



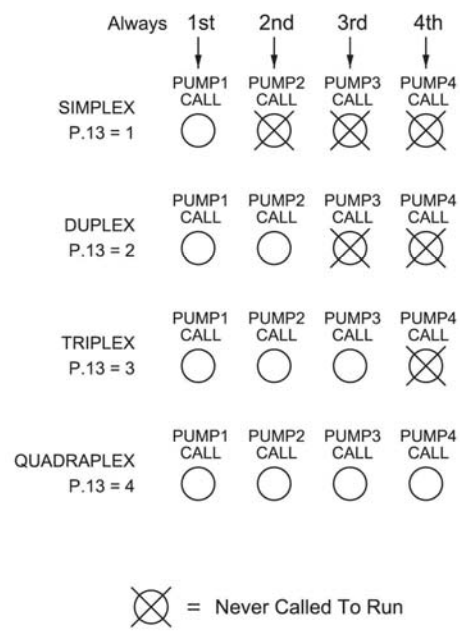
# ALTERNATION SEQUENCE MODE

## FIXED SEQUENCE

**Parameter P.16 = 5**

**Notes:**

1. This sequence is used when no alternation is required and when pump 1 should normally be lead pump. Other pumps may be made lead by setting Parameter P.39.
2. Discrete Inputs programmed as Pump 1-4 Disable inputs may be used to disable pumps.
3. Discrete Inputs programmed as Call Pump 1-4 Last inputs may be used to assign pumps to standby status.
4. Discrete Inputs programmed as Sequence Inputs 1-4 may be used to set the lead pump.
5. Parameter P.39 may be used to set the lead pump.
6. The Pump Stop Mode (Parameter P.17) has no effect on this sequence.
7. Automatic Alternation Enable/Disable (Parameter P.18) has no effect on this sequence.
8. The External Alternation feature will not function when using this sequence.
9. Sequence may also be controlled remotely through a Scada System. See "Force Lead Pump Position", on Page 33 (Page A16).
10. Time Based Alternation using Parameter P.51 will not function when using this sequence.




## STEPPED ON/OFF SEQUENCE
## Only One Pump Runs at a Time

**Parameter P.16 = 6**

**Notes:**

1. This sequence is used in stations where there is a significant difference in the size of the pumps, and when only one pump is to be allowed to run at a time. When there is a need for more pumping, the smaller pump is turned off and the next larger pump is called to run. As the need for pumping decreases, the larger pump is turned off and a smaller pump is called to run in its place (provided the Off Levels are staggered).
2. The Lag Pump Delay operates to give the check valve of the pump being turned off time to close before another pump is called to run.
3. Discrete Inputs programmed as Pump 1-4 Disable inputs should be used to disable pumps that are not able to run. It is critical that the largest pump in the group, have some type of pump fault logic connected to the respective Pump Disable discrete input.
4. Discrete Inputs programmed as Call Pump 1-4 Last will not function when using this sequence.
5. Discrete Inputs programmed as Sequence Inputs 1-4 will not function when using this sequence.
6. Parameter P.39 has no effect on this sequence.
7. The Pump Stop Mode (Parameter P.17) has no effect on this sequence.
8. Automatic Alternation Enable/Disable (Parameter P.18) has no effect on this sequence.
9. The External Alternation feature will not function when using this sequence.
10. The On Generator (Parameter P.15) has no effect on this sequence.
11. Time Based Alternation using Parameter P.51 will not function when using this sequence.

# DISCRETE INPUT FUNCTIONS

The following is a description of the Functions that may be assigned to the Discrete Inputs using Parameters F.01 - F.18:

Notes:
1. All Discrete Inputs are originally programmed with default Functions, but they may be changed at any time using Parameters F.01 - F.18.
2. Each of the Functions may only be assigned to one Discrete Input. If assigned to more than one input, the Fault indicator will come on and Fault Code 8 will be generated.

## Pump 1 (2, 3, 4) Disable - Functions 1 - 4

With Parameter P.52 = 0 (Normal Mode)

When a Discrete Input programmed as a "Pump 1 (2, 3, 4) Disable" is **closed**, the respective pump will be disabled (not allowed to run) and skipped over in the pump call sequence.

With Parameter P.52 = 1 (Logic Inverted Mode)

When a Discrete Input programmed as a "Pump 1 (2, 3, 4) Disable" is **open**, the respective pump will be disabled (not allowed to run) and skipped over in the pump call sequence.

Whenever a pump is disabled the next available pump is called in its place when needed. The one exception to this, is the Alternation Sequence - Pump 1 Always Lead (Parameter P.16 = 3), where disabling pump 1 will not result in another pump taking it's place.

## Level Freeze - Function 5

When a Discrete Input programmed for "Level Freeze" is first closed, the Wet Well Level is held steady or frozen so that a bubbler system's bubbler tube may be purged without causing the Level to jump up or down. The external logic that performs the bubbler tube purge must provide the Discrete Input closure prior to a significant change in the 4-20mA analog Level input. The Level Freeze logic keeps the Level frozen for 10 seconds and then releases it, regardless of whether the Discrete Input had re-opened or not. It does not matter how long the input remains closed, but it must be opened to reset the logic.

## External Alternation - Function 6

Each time the Discrete Input programmed for "External Alternation" transitions from open to closed, alternation of the pumps will occur. It does not matter how long the input remains closed, but it must be opened to reset the logic. If no pumps were running when the Discrete Input is closed, the alternation of the designated lead pump will still occur. Typically this input is connected to contacts from an external Time Clock.

## On Generator - Function 7

In cases where the Emergency Generator is not sized large enough to run all the available pumps, closing a Discrete Input programmed for "On Generator" will limit the number of pumps called to run to the number preset using Parameter P.15. Typically contacts from the Transfer Switch are connected to this input.

## All Pump Disable - Function 8

When a Discrete Input programmed for "All Pump Disable" is closed, all the pumps are disabled (not allowed to run), the Fault indicator will come on, the Power indicator will flash, and Fault Code 18 will be generated. This Function also disables pump operation from Float Backup using Functions 32 - 38, or Level Probe Backup using Parameters b.01 - b.07. The Discrete Input is typically connect to Phase Monitor contacts.

When the Discrete Input opens, the Lag Pump Delay must expire before the first pump is allowed to run. If any additional pumps are required, the Lag Pump Delay must expire between each one called to run.

## Sequence Input 1 (2, 3, 4) - Functions 9 - 12

When a Discrete Input programmed as a "Sequence Input 1 (2, 3, 4) " is closed, it disables normal alternation and forces one of the pumps to always be lead pump. For example, closing "Sequence Input 1" forces pump 1 to be lead and sets the sequence of 1 - 2 - 3 - 4 (assuming Parameter P.16 = 1). See page 37 for connection diagrams.

# DISCRETE INPUT FUNCTIONS

## Call Pump 1 (2, 3, 4) Last - Functions

When a Discrete Input programmed for "Call Pump 1 (2, 3, 4) Last" is closed, it assigns the respective pump to standby status, where it will always be called to run last.

If more than one but not all of the pumps are assigned to standby status, they will all be available to run if needed, but in a fixed order, and always after the pumps not assigned standby status.

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

## Low Level Alarm - Function 17

When a Discrete Input programmed for "Low Level Alarm" is closed, the Low Level indicator will come on and the Low Level Alarm relay contacts will close. This Function is for alarm and indication only and will not disable pump operation. Also see Function 32.

## High Level Alarm - Function 18

When a Discrete Input programmed for "High Level Alarm" is closed, the High Level indicator will come on and the High Level Alarm relay contacts will close. This Function is for alarm and indication only and will not affect pump operation. Also see Function 38.

## Telemetry E - D - Functions 19 - 30

When the Discrete Input(s) programmed for "Telemetry E-D" are closed, no control Function in the Controller is performed, only the status of the Discrete Inputs is placed in Scada Registers. See Page 32 (Page A15).

## Normal Pump Operation Disable - Function 31

When a Discrete Input programmed for "Normal Pump Operation Disable" is closed, all the pumps are disabled (not allowed to run), the Fault indicator will come on, and Fault Code 15 will be generated. However, this Function does allow pump operation from Float Backup using Functions 32 - 38, or Level Probe Backup using Parameters b.01 - b.07.

This Function is used when it is required that a backup system have complete control of the pumps. The Discrete Input must be connected to contacts that closes when external logic determines that switching control of the pumps to the backup system is necessary.

## Float Backup - Low Level - Function 32

When a Discrete Input programmed for "Float Backup - Low Level" is closed, the Low Level indicator will come on and the Low Level Alarm relay contacts will close. Also see Function 17.

Pump Down Mode (Parameter P.19 = 1)

All pump operation will be disabled when the "Float Backup - Low Level" input closes.

When the "Float Backup - Low Level" input opens the "Pump Re-enable Delay" (set using Parameter P.37), must expire before pump operation is allowed.

Pump Up Mode (Parameter P.19 = 2)

All available pumps will be called to run when the "Float Backup - Low Level" input closes, assuming that the "Float Backup - Off Level" input is closed.

See Page 43.

# DISCRETE INPUT FUNCTIONS

## Float Backup - Off Level - Function 33

When a Discrete Input programmed for "Float Backup - Off Level" closes, the Float Backup logic will be armed and made ready to latch in one pump call for each of the "Float Backup - 1st , 2nd, 3rd, 4th On Level" inputs that close.

As the "Float Backup - 1st , 2nd, 3rd, 4th 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.

Note: For a two float backup system, the "Float Backup - 1st , 2nd, 3rd, 4th On Level" inputs may be replaced with the High Level input for the Pump Down mode, or the Low Level input for the Pump Up mode.

See Page 43.

## Float Backup - 1st On Level - Function 34

When a Discrete Input programmed for "Float Backup - 1st On Level" closes, the Float Backup logic will issue one pump call assuming that the "Float Backup - Off Level" is closed. See Page 43.

## Float Backup - 2st On Level - Function 35

When a Discrete Input programmed for "Float Backup - 2nd On Level" closes, the Float Backup logic will issue one pump call assuming that the "Float Backup - Off Level" is closed. See Page 43.

## Float Backup - 3rd On Level - Function 36

When a Discrete Input programmed for "Float Backup - 3rd On Level" closes, the Float Backup logic will issue one pump call assuming that the "Float Backup - Off Level" is closed. See Page 43.

## Float Backup - 4th On Level - Function 37

When a Discrete Input programmed for "Float Backup - 4th On Level" closes, the Float Backup logic will issue one pump call assuming that the "Float Backup - Off Level" is closed. See Page 43.

## Float Backup - High Level - Function 38

When a Discrete Input programmed for "Float Backup - High Level" is closed, the High Level indicator will come on and the High Level Alarm relay contacts will close. Also see Function 18.

Pump Down Mode (Parameter P.19 = 1)

All available pumps will be called to run when the "Float Backup - High Level" input closes, assuming that the "Float Backup - Off Level" input is closed.

Pump Up Mode (Parameter P.19 = 2)

All pump operation will be disabled when the "Float Backup - High Level" input closes.

When the "Float Backup - High Level" input opens the "Pump Re-enable Delay" (set using Parameter P.37), must expire before pump operation is allowed.

See Page 43.

## Start Flush Cycle - Function 39

When a Discrete Input programmed for "Start Flush Cycle" closes, the Flush Cycle will start (assuming that the Flush Cycle Mode Parameter P.40 = 2). It does not matter how long the input remains closed, but it must be opened to reset the logic. Typically this input is connected to contacts from an external Time Clock. See Page 22.

# SYSTEM STATUS

## High Level Alarm

- Upon a High Level Alarm, the indicator will come on and the relay contacts will close.
- A High Level Alarm is delayed for ten seconds after power is applied.
- The High Level Alarm relay contacts will be closed when there is no power on the controller.
- The moment electrical power is applied to the controller, the High Level Alarm relay contacts open.
- The High Level Alarm relay contacts will close if there is a complete failure of the controller.
- The High Level Alarm will be activated as the level rises to or above the High Level Alarm level setting.
- A High Level float will activate the alarm. The Discrete Input used must be assigned Function 18 or 38.
- A High Level from a Level Probe Backup input will activate the alarm. See Parameter b.07.
- With the Level Input Source set for the Level Probe (Parameter F.19 = 2 or 3), if not already on, the High Level Alarm will be activated when Electrode 1 is covered with liquid.
- Status of the High Level Alarm is also available through SCADA. See Page 34 (Page A17).

## Low Level Alarm

- Upon a Low Level Alarm, the indicator will come on and the relay contacts will close.
- A Low Level Alarm is delayed for 90 seconds after power is applied.
- The Low Level Alarm relay contacts will be open when there is no power on the controller.
- The Low Level Alarm will be activated when the level is at or below the Low Level Alarm level setting.
- A Low Level float will activate the alarm. The Discrete Input used must be assigned Function 17 or 32.
- A Low Level from a Level Probe Backup input will activate the alarm. See Parameter b.01.
- The Low Level Alarm will not function as a redundant pump off, except for the Low Level Alarm from Float Backup using a Discrete Input programmed for Function 32, which will turn off the pumps.
- With the Level Input Source set for the Level Probe (Parameter F.19 = 2 or 3), if not already on, the Low Level Alarm will be activated when Electrode 10 is uncovered, unless it is disabled using Parameter P.50.
- Low Level Alarm operation may be disabled by setting Parameter P.50 = 0. This disables Low Level Alarm operation from either the Analog Level Input (Parameter F.19 = 1) or from a Level Probe (Parameter F.19 = 2 or 3). However, it will not disable alarm operation from a Low Level float input using a Discrete Input (Function 17 or 32), or from the Backup Low Level Probe input (See Parameter b.01).
- Status of the Low Level Alarm is also available through SCADA. See Page 34 (Page A17).

## Power Indication

The Power indicator is normally on, but it will alternately flash with the Fault indicator, when the All Pump Disable Discrete Input (Function 8) is closed. Fault Code Parameter FLC will also show Fault Code 18.

## Fault Indication

The Fault indicator 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 on Pages 18 - 19.

## Fault Code - Parameter FLC

The current Fault Code may be viewed at Parameter FLC. Fault Codes 20 - 29 latch into memory but are reset when the power is cycled, or may be reset by pressing the down push-button while viewing the Fault Code. Parameter FLC may also be read and reset through SCADA. See Page 34 (Page A17).

## Last Fault Code - Parameter LFC

The Last Fault Code (Parameter LFC) is a copy of the last non-zero Fault Code that was present in Parameter FLC. Parameter LFC is reset when power is cycled, or may be reset by pressing the down push-button while viewing the Last Fault Code. Parameter LFC may also be read and reset through SCADA. See Page 34 (Page A17).

## FAULT CODE TABLE

<table>
<tr><th>Fault Code</th><th colspan="2">Description of Condition</th></tr>
<tr><td>0</td><td colspan="2">Normal</td></tr>
<tr><td>1</td><td colspan="2">Communication Fault - Overrun Error reading incoming message.</td></tr>
<tr><td>2</td><td colspan="2">Communication Fault - Time out error reading incoming message.</td></tr>
<tr><td>3</td><td colspan="2">Communication Fault - Time out error responding to message.</td></tr>
<tr><td>4</td><td colspan="2">Communication Fault - Incoming message failed Checksum Test.</td></tr>
<tr><td>5</td><td colspan="2">Communication Fault - Invalid Modbus Function Code.</td></tr>
<tr><td>6</td><td colspan="2">Communication Fault - Trying to preset more than 35 registers using Function Code No. 16.</td></tr>
<tr><td>7</td><td colspan="2">Communication Fault - Trying to force to more than 100 Coils using Function Code No. 15.</td></tr>
<tr><td>8</td><td colspan="2">Parameter Setup Fault - More than one Discrete Input is assigned to the same Function.</td></tr>
<tr><td>9</td><td colspan="2">Parameter Setup Fault - Pump On & Pump Off parameters are set too close together. (They must be at least 0.2 feet apart with P.36 = 1, or 2 feet apart with P.36 = 0, or 0.02 feet apart with P.36 = 2.)</td></tr>
<tr><td>10</td><td colspan="2">Parameter Setup Fault - Pump On & Pump Off parameters are upside down. (Pump Off Level must be lower than the Pump On Level, for a pump down application.)</td></tr>
<tr><td>11</td><td colspan="2">VFD Speed Reference Setup Fault - Level at Minimum Speed is set too close to Level at 100% speed. (They must be at least 0.5 feet apart with P.36 = 1, or 5 feet with P.36 = 0, or 0.05 feet with P.36 = 2.)</td></tr>
<tr><td>12</td><td colspan="2">VFD Speed Reference Setup Fault - Level at Minimum Speed and Level at 100% speed are backwards.</td></tr>
<tr><td>13</td><td colspan="2">Communication Fault - The UART detected a Framing Error reading the incoming message. It did not find Stop Bit where expected.</td></tr>
<tr><td>14</td><td colspan="2">Communication Fault - Noise Detected on incoming message.</td></tr>
<tr><td>15</td><td colspan="2">Normal Pump Operation Disabled - Discrete Input programmed for Function 31 is closed. Pump Operation will only be allowed from Float Backup or Level Probe Backup.</td></tr>
<tr><td>16</td><td colspan="2">Pump Operation on Float Backup.</td></tr>
<tr><td>17</td><td colspan="2">Backup Float Switch Out of Sequence.<br>Note: Fault will clear when normal operation is verified.</td></tr>
<tr><td>18</td><td colspan="2">All Pump Disable - Discrete Input programmed for Function 8 is closed (Typically connected to Phase Monitor).</td></tr>
<tr><td>19</td><td colspan="2">One of the Pump On or Pump Off level control Parameters (or Parameters P.21, P.22, P.42, or P43) is set too low. One of them is set in the part of the display range that is artificially created by the Level Offset Parameter F.21. See page 5 for a description of Parameter F.21. All level control Parameters must be set higher than what is set on Parameter F.21.</td></tr>
<tr><td>20</td><td colspan="2">Level Probe Fault - Test Signal Status Below Normal Range. See Parameter L.11 on page 7.</td></tr>
<tr><td colspan="2">Fault Codes 21 - 29 Level Probe Fault<br>Electrodes Covered Out of Sequence</td><td rowspan="10">Notes:<br>1. Level Probe Fault Codes 21-29 must be present for at least 60 seconds for the fault to be latched into memory.<br>2. To reset the fault, scroll to and view Parameter FLC. Record the Fault Code, then press the Down push-button while viewing the Fault Code. Cycling power to the controller will also reset the Fault Code.<br>3. The analog value associated with each of the Level Probe Electrodes may be viewed from Parameters L.01 - L.10. See page 7.</td></tr>
<tr><td>21</td><td>Electrode 1 Covered before Electrode 2</td></tr>
<tr><td>22</td><td>Electrode 2 Covered before Electrode 3</td></tr>
<tr><td>23</td><td>Electrode 3 Covered before Electrode 4</td></tr>
<tr><td>24</td><td>Electrode 4 Covered before Electrode 5</td></tr>
<tr><td>25</td><td>Electrode 5 Covered before Electrode 6</td></tr>
<tr><td>26</td><td>Electrode 6 Covered before Electrode 7</td></tr>
<tr><td>27</td><td>Electrode 7 Covered before Electrode 8</td></tr>
<tr><td>28</td><td>Electrode 8 Covered before Electrode 9</td></tr>
<tr><td>29</td><td>Electrode 9 Covered before Electrode 10</td></tr>
<tr><td>30</td><td colspan="2">Pump(s) are Called to Operate by the Level Probe Backup Pump Control.</td></tr>
</table>

## FAULT CODE TABLE

| Fault Code | Description of Condition |
|---|---|
| 35 | Communication Fault - Write Attempt made with Register Access Mode Parameter set for Read Only. |
| 36 | Flow Calculator Setup Fault - Average Daily Inflow Total is too Large to Display. Set Parameter P.45 = 2. |
| 37 | Communication Lost - While Setup for Remote Level Input from SCADA (Parameter F.19 = 4). |

## ANALOG LEVEL INPUT (4-20mA Input) – CALIBRATION PROCEDURE

The following calibration is for the 4-20mA Analog Level Input (Parameter F.19 = 1) and does not apply when a 10 Electrode Level Probe is used (Parameter F.19 = 2 or 3).

Parameters P.24 and P.25 show the Wet Well Level, while allowing the Up & Down push-buttons to be used to change the internal numbers involved in calculating the displayed level. Therefore, the appropriate 4-20mA signal must be applied to the Level Input during each step of the calibration procedure.

If Parameters P.24 and P.25 show 77.7 feet in the display, then Parameter F.19 is setup to follow the Level Probe input. To calibrate the level display when using the Level Probe, the distance between the electrodes must be set on Parameter F.20, and Parameters P.24 and P.25 are not used.

The 4-20mA Analog Level Input signal conditioning may be slowed down or speeded up using Parameter P.49.

### LEVEL INPUT ZERO - Parameter P.25

This parameter is used to make the display read zero feet of water with a Wet Well Level input of 4.0mA.

**Calibration Procedure:**

1. Apply a 4.0mA signal to the Wet Well Level Analog Input.
   (Alternate Procedure - Pull the pressure transducer or bubbler tube out of the water.)
2. Scroll to the place in the System Setup Sub-Menu where Parameter P.25 is displayed.
3. Press the Scroll / Change mode push-button. (The Wet Well Level will be displayed.)
4. Use the Up / Down push-buttons to make the display read zero feet. Note: It is slow to change at first.
5. Perform the procedure below to calibrate the "LEVEL INPUT SPAN" Parameter.

### LEVEL INPUT SPAN - Parameter P.24

This parameter is used to establish the Wet Well Level (in feet) that corresponds to an analog input of 20mA.

**Calibration Procedure:**

1. Apply a 20mA signal to the Wet Well Level Analog Input.
   (Alternate Procedure – Subject the pressure transducer or bubbler tube to a known depth of water.)
2. Scroll to the place in the System Setup Sub-Menu where Parameter P.24 is displayed.
3. Press the Scroll / Change mode push-button. (The Wet Well Level will be displayed.)
4. Use the Up / Down push-buttons to make the display read the level (in feet of water) that your 20mA signal represents. Note: It is slow to change at first.
   (Alternate Procedure – Use the Up / Down push-buttons to make the display read the number of feet of water that the pressure transducer or the end of the bubbler tube is submerged under.)
5. Repeat the procedure above for the "LEVEL INPUT ZERO" Parameter.

### LEVEL DISPLAY SPAN VERSUS TRANSDUCER CALIBRATION

| | Transducer Calibration | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4.33psi @ 20mA | 5.0psi @ 20mA | 10psi @ 20mA | 15psi @ 20mA | 30psi @ 20mA | 60psi @ 20mA | 100psi @ 20mA | |
| **Level Display Span** | - | - | - | - | - | 139 feet | 231 feet | **P.36 = 0** |
| **Level Display Span** | - | 11.5 feet | 23.1 feet | 34.6 feet | 69.3 feet | - | - | **P.36 = 1** |
| **Level Display Span** | 9.99 feet | - | - | - | - | - | - | **P.36 = 2** |

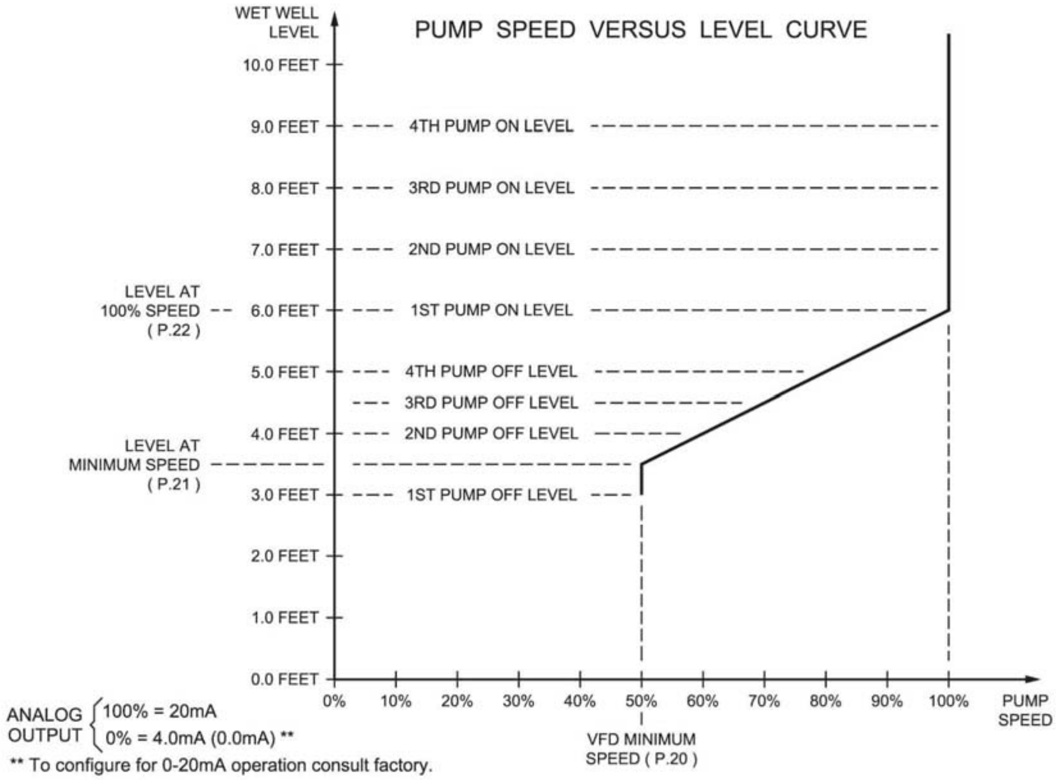
**Notes:**

1. Level Display Span is what is displayed with a 20mA Level Input.
2. Parameter P.36 is used to set the decimal point position.
3. To find the Level Input Span Setting for other transducers use the following equation:

Pressure (psi) x 2.309 = Level (feet of water)

# VARIABLE FREQUENCY DRIVE SPEED CONTROL OPTION SETUP

## Pump Down Application - Example




## VFD SPEED CONTROL - Setup Parameters

| Parameter | Default Value | Current Value | Setting Definitions |
|---|---|---|---|
| **P.20** | 50% | | Minimum Speed (Percent of Full Speed) Range: 0% - 95% |
| **P.21** | 3.5 feet | | Level at Minimum Speed Range: 0.1 - 99.9 feet |
| **P.22** | 6.0 feet | | Level at 100% Speed Range: 0.1 - 99.9 feet |
| **P.23** | 0 sec. | | Pump Start Speed Boost Time Range: 0 - 60 seconds<br>Note: Set for 0 seconds to Disable Feature. See Note 6 below. |
| **P.53** | 100% | | Speed of Pumps Forced On (Remotely) Range: 0% - 100%<br>See Page 33 (Page A16). |

**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 Speed Versus Level Curve.
2. For each application there is usually a Minimum Speed, below which pump operation is undesirable.
3. The VFD Minimum Speed may be set on either the Pump Controller using Parameter P.20 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 is 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 Codes 11 and 12 on the Fault Code Table.
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.23. 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 feature is provided to periodically maximize the lift station's discharge flow rate, to flush the sludge build up from the bottom of the wet well and from the discharge pipe.

### Flush Cycle Steps:

1. The "LEVEL" indicator begins to flash to indicate that the Flush Cycle has started.
2. Normal pump operation is suspended. Any pumps currently running are turned off.
3. Waits for the level to rise to the "Flush Cycle Start Level" set on Parameter P.43.
4. Turns on all available pumps with the Lag Pump Delay between each additional pump call.
5. Pumps the level down to the "Flush Cycle Stop Level" set on Parameter P.42.
6. Turns off all pumps.
7. The "LEVEL" indicator returns to normal to indicate that the Flush Cycle has ended.

### Automatically Starting Flush Cycle:

A. Internal Time Delay - Expiration of "Delay Between Flush Cycles" set on Parameter P.41.
B. External Time Clock - Closure of a Discrete Input that is programmed to perform Function 39.
C. Programming the SCADA system to momentarily set bit in Scada Register.

### Manually Starting / Stopping Flush Cycle:

Start - Press and hold the LEVEL Push-Button until the "LEVEL" indicator begins to flash.
(Momentarily set bit in Scada Register.)

Stop - Press and hold the LEVEL Push-Button until the "LEVEL" indicator returns to normal.
(Momentarily set bit in Scada Register.)
(Ends Flush Cycle even if it was started by the Time Delay or External Time Clock.)

**Notes:**

1. The Flush Cycle Feature only works in the "Pump Down" mode, (P.19 = 1). If Parameter P.19 is changed to "Pump Up" mode (P.19 = 2), then Parameter P.40 will be set to "0".
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%.
4. The number of pumps called to run by the Flush Cycle logic is always limited by the following:
   A. Parameter P.14 - Number of Pumps Allowed to Run At the Same Time.
   B. Closed Discrete Inputs that are Programmed for Pump 1 (2, 3, 4) Disable, or All Pump Disable.
5. All backup systems must be setup so that they do not activate within the Flush Cycle operating range set on Parameters P.42 and P.43.
6. The Low Level Float Backup (Discrete Input programmed for Function 32) will turn off all pumps upon low level. Therefore, the Flush Cycle Stop Level must be set higher than the Low Level Float.
7. The Flush Cycle Status (Active or Inactive) may be read from Scada Register.
8. For Remote Control through Scada see Page 33 (Page A16).

## FLUSH CYCLE - Setup Parameters

| Parameter | Default Value | Current Value | Setting Definitions |
|---|---|---|---|
| **P.40** | 0 | | Flush Cycle Mode<br>0 = Flush Cycle Disabled<br>1 = Activated by Internal Time Delay as set on Parameter P.41<br>2 = Activated by External Time Clock by the Closure of a Discrete Input programmed to perform Function 39. Note: Time Clock Contacts may stay closed indefinitely, but must re-open in order to reset logic for next Flush Cycle. |
| **P.41** | 24 hours | | Delay Between Flush Cycles Range: 1 - 255 hours |
| **P.42** | 2.5 feet | | Flush Cycle Stop Level Range: 0.2 - 99.9 feet |
| **P.43** | 9.0 feet | | Flush Cycle Start Level Range: 0.2 - 99.9 feet |

## FLOW CALCULATOR - Display Parameters

All Flow Calculator values may be read from SCADA Registers. See Page 34 (Page A17).

**Latest Inflow Rate**

| FLH | , | FLL | |
|---|---|---|---|
| Thousand Gallons | , | Gallons | Per Minute |

**Average Daily Inflow Total**

(Flow Totals from the Last 7 days Averaged Together)

With: **P.45 = 1**

| FdH | , | FdL | |
|---|---|---|---|
| Thousand Gallons | , | Gallons | Per Day |

With: **P.45 = 2**

| FdH | , | FdL | |
|---|---|---|---|
| Million Gallons | , | Thousand Gallons | Per Day |

Note: If Fault Code 36 Appears, Average Daily Inflow Total is too Large to Display. Set Parameter P.45 = 2

**Pump 1 Outflow Rate**

| F1H | , | F1L | |
|---|---|---|---|
| Thousand Gallons | , | Gallons | Per Minute |

**Pump 2 Outflow Rate**

| F2H | , | F2L | |
|---|---|---|---|
| Thousand Gallons | , | Gallons | Per Minute |

**Pump 3 Outflow Rate**

| F3H | , | F3L | |
|---|---|---|---|
| Thousand Gallons | , | Gallons | Per Minute |

**Pump 4 Outflow Rate**

| F4H | , | F4L | |
|---|---|---|---|
| Thousand Gallons | , | Gallons | Per Minute |

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

**Daily Inflow Totals** Gallons Per Day or Thousand Gallons Per Day (As set on Set Parameter P.45)

| Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|---|---|---|
| Newest Data | | | | | | Oldest Data |

The Daily Inflow Totals may be read from SCADA Registers.
See Page 34 (Page A17).

# FLOW CALCULATOR

**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.46), 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 a Pressure Transducer is used (F.19 = 1), or the distance between electrodes (Parameter F.20) when using a Level Probe (F.19 = 2or 3). The "Latest Inflow Rate", in Gallons Per Minute, may be viewed from Parameters FLH & FLL, and is also available in a Scada Register.

**Average Daily Inflow Total** - The Flow 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. This value is displayed as either "Gallons Per Day" or "Thousand Gallons Per Day" (See Parameter P.45). The "Average Daily Inflow Total" may be viewed from Parameters FdH & FdL, and is also available in a Scada Register.

**Pump 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 "1st On Level" and the "1st Off Level", and adding to it what flows in while the pump is running ( "Latest Inflow Rate" multiplied by the "Pump Run Time" ). This total volume of liquid is divided by the "Pump Run Time" to arrive at the "Pump Outflow Rate". The most recent "Pump Outflow Rate" of each pump in Gallons Per Minute, may be viewed from Parameters F1H & F1L, F2H & F2L, F3H & F3L, F4H & F4L, and is also available in Scada Registers.

**Notes:**

1. The Flow Calculator operates for "Pump Down - Empty a Tank" applications only, (Parameter P.19 = 1).
2. The "Average Daily Flow Total" is not valid until after 7 days of operation with Parameter P.44 = 1.
3. All flow data is erased when Parameter P.44 is set to "0".
4. While attempting to update the value of the "Latest Inflow Rate", if the level rises too fast (faster than 1 foot in 15 seconds, with Parameter F.19 = 1, or faster than one Level Probe Electrode spacing in 15 seconds, with Parameter F.19 = 2 or 3, the logic aborts the measurement, and keeps the previously determined value.
5. For remote monitoring of all flow data, from Scada Registers, see Page 34 (Page A17).

## FLOW CALCULATOR - Setup Parameters

| Parameter | Default Value | Current Value | Setting Definitions |
|---|---|---|---|
| **P.44** | 0 | | 0 = Flow Calculator Disabled 1 = Flow Calculator Enabled<br>Note: All Registers that store Flow Data will be Reset to Zero if P.44 is set on 0. |
| **P.45** | 2 | | Average Daily Inflow Total - Display Range<br>1 = 0 - 65,535 Gallons per Day<br>2 = 0 - 65,535 Thousand Gallons per Day<br>Note: Parameter P.45 also sets the Display Range of the Daily Inflow Total (Day 1 - 7) read from Scada Registers. |
| **P.46** | 79 Square Feet | | Surface Area of Wet Well Range: 3 - 999 Square Feet<br>Note: See "Surface Area Calculation" below. |
| **P.47** | 30 Minutes | | Delay Before Forcing On Another Pump (s) Range: 10 - 60 Minutes<br>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.47 is provided to set the "Delay Before Forcing On Another 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.48** | 20 Minutes | | Delay Before the "Latest Inflow Rate" Expires and is reset to zero<br>Range: 1 - 100 Minutes<br>Note: The "Latest Inflow Rate" can only be updated while the level is rising, so in cases where the flow into the station may suddenly drop to near zero, and stays near zero for an extended period of time, the Flow Calculator would 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 after a preset delay. Parameter P.48 is provided to set that delay.<br>Parameter P.48 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. |

## FLOW CALCULATOR - Calculation of: "Surface Area of Wet Well" (Parameter P.46)

### 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    $\pi = 3.14159$

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

1 cubic Feet of Liquid = 7.48052 gallons

## COMMUNICATION with a SCADA SYSTEM using the MODBUS PROTOCOL

A SCADA system, using the Modbus protocol, may communicate with the controller through either the RS232 Serial Port or through the Optional Ethernet Port. The controller operates as a Modbus Slave, where all communication is initiated by the Modbus Master.

For Communication Setup using the DNP3 Protocol see: APPENDIX A

### 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 100 Coils |
| 16 | Preset Multiple Registers | Limited to 35 Registers |

### Setup for Connection to a SCADA System using the Modbus Protocol

| Parameter | Default Value | Current Value | Setting Definitions |
|---|---|---|---|
| **P.28** | 1 | | Slave Address (See note 1 below.) Range: 0 - 247<br>Note: When using the DNP3 protocol Parameter H.32 & H.31 are used for the Slave Address rather than Parameter P.28. |
| **P.33** | 1 | | Register Access Mode (See note 2 below.)<br>1 = Read & Write 2 = Read Only |

**Notes:**

1. Each controller in a SCADA system using the Modbus protocol is assigned a unique Slave Address so that it can be polled by the SCADA system Master using that unique Slave Address. However, if communication is through the optional Ethernet Port, each Controller will also have a unique IP Address. Even when communicating through the Ethernet Port, the Controller will reject incoming messages that do not have a matching Slave Address. However, if the Slave Address Parameter P.28 is set on zero, the controller will not reject messages based on the Slave Address, and it will copy the incoming Save Address for use in the Response.
2. The Register Access Mode Parameter (P.33) is provided to prevent (when set on Read Only) malicious attempts to remotely control the pumps, or change setup parameter values. Unless greatly needed, the Register Access Mode should be left on Read & Write. This Parameter only applies when using Modbus, and does not apply when using DNP3.

## RS232 SERIAL PORT

The RS232 serial port allows a SCADA system to communicate with the Controller using the Modbus RTU protocol.

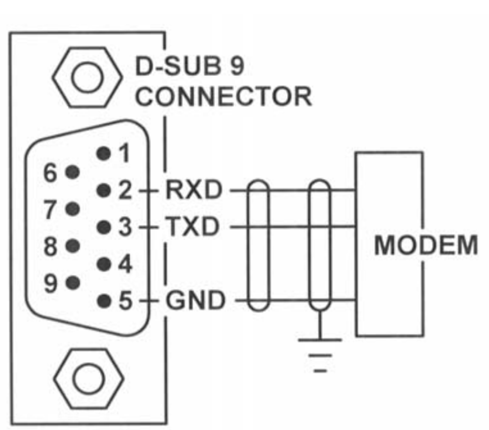
### Setup of RS232 Serial Port

The controller's RS232 serial port must be setup to communicate with the device it is connected to. The Baud Rate, Parity Mode and Stop Bits Parameter values of the two devices must be set to match.

The Delay Before Response Parameter (P.32) is provided for cases where the modem needs additional time to prepare itself before receiving a response back from the controller.

| Parameter | Default Value | Current Value | Setting Definitions |
|---|---|---|---|
| **P.29** | 4 | | Baud Rate<br>1 = 1200 bps 2 = 2400 bps 3 = 4800 bps 4 = 9600 bps<br>5 = 19200 bps |
| **P.30** | 0 | | Parity Mode<br>0 = No Parity 1 = Odd Parity 2 = Even Parity |
| **P.31** | 2 | | Stop Bits<br>1 = 1 Stop Bit 2 = 2 Stop Bits<br>(The 2nd Stop Bit is available only when No Parity is selected) |
| **P.32** | 1 ms | | Delay Before Response Range: 1 – 100 ms |

**Serial Port**



## ETHERNET PORT - Option

For DNP3 SCADA Communication Setup Also See: APPENDIX A

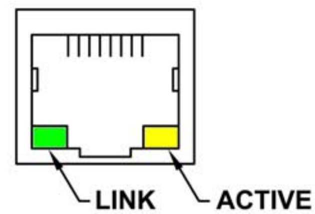
### Features

The Ethernet Port has the following features:

- Protocols Supported: Modbus TCP or DNP3
- 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




### Setup of Ethernet Port

| Parameter | Parameter / Default Value | Current Value | Parameter Definitions |
|---|---|---|---|
| **E.01** | **E.01**<br>2 | | Protocol 2 = Modbus TCP<br>3 = DNP3<br>(For DNP3 setup see: APPENDIX A) |
| **E.14 - E.11** | **E.14 . E.13 . E.12 . E.11**<br>192 . 168 . 80 . 12 | | IP Address Range: 0 - 255<br>Identifier for the device on an IP network. |
| **E.44 - E.41** | **E.44 . E.43 . E.42 . E.41**<br>255 . 255 . 255 . 0 | | Subnet Mask Range: 0 - 255<br>Range of IP addresses that can be Directly connected in the network. |
| **E.54 - E.51** | **E.54 . E.53 . E.52 . E.51**<br>192 . 168 . 80 . 1 | | Default Gateway Range: 0 - 255<br>A node on the network that serves as an entrance to another network when no direct connection exists. |
| **E.62 & E.61** | **E.62 , E.61**<br>0 , 502 | | Port Number Range: 1 - 65,535 |

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

| Parameter | Parameter / Fixed Value | Parameter Definition |
|---|---|---|
| **E.36 - E.31** | **E.36 : E.35 : E.34 : E.33 : E.32 : E.31**<br>0 : 80 : 194 : 219 : XXX : XXX | MAC Address<br>Unique number that identifies each field device.<br>It is set at the factory, and can not be changed. |

## SCADA - MODBUS REGISTERS

**Description of Register Contents**
(Where a Coil is represented by a Bit in a Register)

| Register Address | Read | Write | Coil | Bit | Description of Register Contents |
|---|---|---|---|---|---|
| 40001 | √ | | 1 | 0 | High Level Alarm From Any Source |
| | | | 2 | 1 | Low Level Alarm From Any Source |
| | | | 3 | 2 | Telemetry J Discrete Input Function 23 |
| | | | 4 | 3 | Telemetry K Discrete Input Function 24 |
| | | | 5 | 4 | Telemetry L Discrete Input Function 25 |
| | | | 6 | 5 | Telemetry M Discrete Input Function 26 |
| | | | 7 | 6 | Disabled Pump Operation Discrete Input Function 31 |
| | | | 8 | 7 | Telemetry A Discrete Input Function 27 |
| | | | 9 | 8 | Pump Called On Float Backup |
| | | | 10 | 9 | Telemetry B Discrete Input Function 28 |
| | | | 11 | 10 | Telemetry C Discrete Input Function 29 |
| | | | 12 | 11 | All Pump Disable Discrete Input Function 8 |
| | | | 13 | 12 | On Generator Discrete Input Function 7 |
| | | | 14 | 13 | Telemetry D Discrete Input Function 30 |
| | | | 15 | 14 | Pump Called On Level Probe Backup |
| | | | 16 | 15 | |
| 40002 | √ | √ | 17 | 0 | Pump 1 Remote Control Force Pump On |
| | | | 18 | 1 | Pump 2 Remote Control Force Pump On |
| | | | 19 | 2 | Pump 3 Remote Control Force Pump On |
| | | | 20 | 3 | Pump 4 Remote Control Force Pump On |
| | | | 21 | 4 | ETM 1 - Reset |
| | | | 22 | 5 | ETM 2 - Reset |
| | | | 23 | 6 | ETM 3 - Reset |
| | | | 24 | 7 | ETM 4 - Reset |
| | | | 25 | 8 | HI Relay Remote Control With Parameter F.31 = 2 |
| | | | 26 | 9 | LO Relay Remote Control With Parameter F.32 = 2 |
| | | | 27 | 10 | P1 Relay Remote Control With Parameter F.33 = 2 |
| | | | 28 | 11 | P2 Relay Remote Control With Parameter F.34 = 2 |
| | | | 29 | 12 | P3 Relay Remote Control With Parameter F.35 = 2 |
| | | | 30 | 13 | P4 Relay Remote Control With Parameter F.36 = 2 |
| | | | 31 | 14 | FLC & LFC - Reset |
| | | | 32 | 15 | |
| 40008 | √ | | 113 | 0 | Telemetry E Discrete Input Function 19 |
| | | | 114 | 1 | Telemetry F Discrete Input Function 20 |
| | | | 115 | 2 | Telemetry G Discrete Input Function 21 |
| | | | 116 | 3 | Telemetry H Discrete Input Function 22 |
| | | | 117 | 4 | All Pump Disable Discrete Input Function 8 |
| | | | 118 | 5 | On Generator Discrete Input Function 7 |
| | | | 119 | 6 | Off Level Float Discrete Input Function 33 |
| | | | 120 | 7 | High Level Alarm Float Discrete Input Functions 18, 38 |
| | | | 121 | 8 | Low Level Alarm From Level Probe Backup |
| | | | 122 | 9 | High Level Alarm From Level Probe Backup |
| | | | 123 | 10 | |
| | | | 124 | 11 | 4th Pump On Level Float Discrete Input Function 37 |
| | | | 125 | 12 | 3rd Pump On Level Float Discrete Input Function 36 |
| | | | 126 | 13 | 2nd Pump On Level Float Discrete Input Function 35 |
| | | | 127 | 14 | 1st Pump On Level Float Discrete Input Function 34 |
| | | | 128 | 15 | Low Level Alarm Float Discrete Input Functions 17, 32 |
| 40009 | √ | √ | 129 | 0 | High Level Alarm From Level Input |
| | | | 130 | 1 | Low Level Alarm From Level Input |
| | | | 131 | 2 | |
| | | | 132 | 3 | |
| | | | 133 | 4 | |
| | | | 134 | 5 | |
| | | | 135 | 6 | |
| | | | 136 | 7 | Force Pump Alternation |
| | | | 137 | 8 | |
| | | | 138 | 9 | |
| | | | 139 | 10 | Start Flush Cycle |
| | | | 140 | 11 | Stop Flush Cycle |
| | | | 141 | 12 | Flush Cycle Active |
| | | | 142 | 13 | |
| | | | 143 | 14 | |
| | | | 144 | 15 | |

| | | | | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40010 | √ | √ | Coil | 160 | 159 | 158 | 157 | 156 | 155 | 154 | 153 | 152 | 151 | 150 | 149 | 148 | 147 | 146 | 145 |
| | | | | | | | | | | | | Pump 4 Remote Control Disable Pump Operation | Pump 3 Remote Control Disable Pump Operation | Pump 2 Remote Control Disable Pump Operation | Pump 1 Remote Control Disable Pump Operation | Pump 4 Called to Run | Pump 3 Called to Run | Pump 2 Called to Run | Pump 1 Called to Run |
| | | | Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 40035 | √ | | Coil | 560 | 559 | 558 | 557 | 556 | 555 | 554 | 553 | 552 | 551 | 550 | 549 | 548 | 547 | 546 | 545 |
| | | | | | | | | | | | | Discrete Input 8 | Discrete Input 7 | Discrete Input 6 | Discrete Input 5 | Discrete Input 4 | Discrete Input 3 | Discrete Input 2 | Discrete Input 1 |
| | | | Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 40036 | √ | | Coil | 576 | 575 | 574 | 573 | 572 | 571 | 570 | 569 | 568 | 567 | 566 | 565 | 564 | 563 | 562 | 561 |
| | | | | | | | | | | | | Discrete Input 16 | Discrete Input 15 | Discrete Input 14 | Discrete Input 13 | Discrete Input 12 | Discrete Input 11 | Discrete Input 10 | Discrete Input 9 |
| | | | Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 40037 | √ | | Coil | 592 | 591 | 590 | 589 | 588 | 587 | 586 | 585 | 584 | 583 | 582 | 581 | 580 | 579 | 578 | 577 |
| | | | | Level Probe Electrode 10 | Level Probe Electrode 9 | Level Probe Electrode 8 | Level Probe Electrode 7 | Level Probe Electrode 6 | Level Probe Electrode 5 | Level Probe Electrode 4 | Level Probe Electrode 3 | Level Probe Electrode 2 | Level Probe Electrode 1 | | | | | Discrete Input 18 | Discrete Input 17 |
| | | | Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 40038 | √ | √ | Coil | 608 | 607 | 606 | 605 | 604 | 603 | 602 | 601 | 600 | 599 | 598 | 597 | 596 | 595 | 594 | 593 |
| | | | | | | | | | | | | Pump 4 Start Counter Reset | Pump 3 Start Counter Reset | Pump 2 Start Counter Reset | Pump 1 Start Counter Reset | Pump 4 Last Run Cycle Time Reset | Pump 3 Last Run Cycle Time Reset | Pump 2 Last Run Cycle Time Reset | Pump 1 Last Run Cycle Time Reset |
| | | | Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

| | | | |
|---|---|---|---|
| 40003 | √ | | Pump 1 Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours |
| 40004 | √ | | Pump 2 Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours |
| 40005 | √ | | Pump 3 Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours |
| 40006 | √ | | Pump 4 Elapsed Time Meter (hours and 1/10 hours) Range: 0.0 - 6553.5 hours |
| | | | |
| 40011 | √ | | Wet Well Level (As shown on display with no decimal point) |
| | | | |
| 40012 | √ | √ | Setup Parameter - 1st Pump On Level |
| 40013 | √ | √ | Setup Parameter - 1st Pump Off Level |
| 40014 | √ | √ | Setup Parameter - 2nd Pump On Level |
| 40015 | √ | √ | Setup Parameter - 2nd Pump Off Level |
| 40016 | √ | √ | Setup Parameter - 3rd Pump On Level |
| 40017 | √ | √ | Setup Parameter - 3rd Pump Off Level |
| 40018 | √ | √ | Setup Parameter - 4th Pump On Level |
| 40019 | √ | √ | Setup Parameter - 4th Pump Off Level |
| 40020 | √ | √ | Setup Parameter - High Level Alarm |
| 40021 | √ | √ | Setup Parameter - Low Level Alarm |
| | | | |
| 40022 | √ | √ | Force Lead Pump Position (Same as Parameter P.39)<br>0 = Alternate 1 = Pump 1 Lead 2 = Pump 2 Lead 3 = Pump 3 Lead 4 = Pump 4 Lead |
| 40023 | √ | | Current Lead Pump Position |
| 40024 | √ | | Calculated VFD Speed Reference (Percent of Full Speed, 0-100%) |
| 40025 | √ | √ | Remote Level Input (Must set Parameter F.19 = 4.) |
| 40046 | √ | √ | Speed of Pumps Forced On (Percent of Full Speed, 0-100%) (Same as Parameter P.53)<br>This Only Applies to Pumps that are Remotely Forced On by Setting Coils 17-20. |
| 40047 | √ | | Fault Code (Same as Parameter FLC) |
| 40048 | √ | | Last Fault Code (Same as Parameter LFC) |
| 40049 | √ | | Voltage of +5 Volt Power Supply (Same as Parameter d.01) |
| 40050 | √ | | Voltage of +24 Volt Power Supply (Same as Parameter d.02) |
| 40063 | √ | | Operating Program Revision Number - Control Board (Same as Parameter oPr) |
| 40231 | √ | | Operating Program Revision Number - Ethernet Board (Same as Parameter EPr) |
| | | | |
| 40071 | √ | | Auxiliary Analog Input 1 (10-Bit 205 - 1023) 205 with 4.0mA Input and 1023 with 20mA Input |
| 40072 | √ | | Auxiliary Analog Input 2 (10-Bit 205 - 1023) 205 with 4.0mA Input and 1023 with 20mA Input |
| 40073 | √ | | Auxiliary Analog Input 3 (10-Bit 205 - 1023) 205 with 4.0mA Input and 1023 with 20mA Input |
| 40074 | √ | | Auxiliary Analog Input 4 (10-Bit 205 - 1023) 205 with 4.0mA Input and 1023 with 20mA Input |
| | | | |
| 40075 | √ | | Analog Output 1 (12-Bit 0 - 4095) 0 with 4.0mA Output and 4095 with 20mA Output |
| 40076 | √ | | Analog Output 2 (12-Bit 0 - 4095) 0 with 4.0mA Output and 4095 with 20mA Output |
| 40077 | √ | | Analog Output 3 (12-Bit 0 - 4095) 0 with 4.0mA Output and 4095 with 20mA Output |
| 40078 | √ | | Analog Output 4 (12-Bit 0 - 4095) 0 with 4.0mA Output and 4095 with 20mA Output |

| | | | |
|---|---|---|---|
| 40080 | √ | | Flow Calculator - Latest Inflow Rate (Gallons Per Minute) (Same as Param. FLH,FLL) |
| 40081 | √ | | Flow Calculator - Average Daily Inflow Total (Gallons or Thousand Gallons Per Day) (Same as Param. FdH,FdL) |
| 40082 | √ | | Flow Calculator - Pump 1 Outflow Rate (Gallons Per Minute) (Same as Param. F1H,F1L) |
| 40083 | √ | | Flow Calculator - Pump 2 Outflow Rate (Gallons Per Minute) (Same as Param. F2H,F2L) |
| 40084 | √ | | Flow Calculator - Pump 3 Outflow Rate (Gallons Per Minute) (Same as Param. F3H,F3L) |
| 40085 | √ | | Flow Calculator - Pump 4 Outflow Rate (Gallons Per Minute) (Same as Param. F4H,F4L) |
| 40086 | √ | | Flow Calculator - Daily Inflow Total - Day 1 (Gallons or Thousand Gallons Per Day) |
| 40087 | √ | | Flow Calculator - Daily Inflow Total - Day 2 (Gallons or Thousand Gallons Per Day) |
| 40088 | √ | | Flow Calculator - Daily Inflow Total - Day 3 (Gallons or Thousand Gallons Per Day) |
| 40089 | √ | | Flow Calculator - Daily Inflow Total - Day 4 (Gallons or Thousand Gallons Per Day) |
| 40090 | √ | | Flow Calculator - Daily Inflow Total - Day 5 (Gallons or Thousand Gallons Per Day) |
| 40091 | √ | | Flow Calculator - Daily Inflow Total - Day 6 (Gallons or Thousand Gallons Per Day) |
| 40092 | √ | | Flow Calculator - Daily Inflow Total - Day 7 (Gallons or Thousand Gallons Per Day) |
| 40093 | √ | √ | Flow Calculator - 24 Hour Clock Advance See Page 35. |
| | | | |
| 40100 | √ | | Pump 1 Last Run Cycle Time (minutes and 1/10 minutes) Range: 0.0 - 6553.5 minutes |
| 40101 | √ | | Pump 2 Last Run Cycle Time (minutes and 1/10 minutes) Range: 0.0 - 6553.5 minutes |
| 40102 | √ | | Pump 3 Last Run Cycle Time (minutes and 1/10 minutes) Range: 0.0 - 6553.5 minutes |
| 40103 | √ | | Pump 4 Last Run Cycle Time (minutes and 1/10 minutes) Range: 0.0 - 6553.5 minutes |
| | | | |
| 40104 | √ | | Pump 1 Start Counter (Number of Pump Starts) Range: 0 - 65535 Starts |
| 40105 | √ | | Pump 2 Start Counter (Number of Pump Starts) Range: 0 - 65535 Starts |
| 40106 | √ | | Pump 3 Start Counter (Number of Pump Starts) Range: 0 - 65535 Starts |
| 40107 | √ | | Pump 4 Start Counter (Number of Pump Starts) Range: 0 - 65535 Starts |

# SCADA FEATURES

The following pages about the SC2000's SCADA features make reference to the Modbus Registers, shown on pages 29 - 31, that are used when the SCADA system operates using the Modbus Protocol. When the DNP3 Protocol is used, please refer to the DNP3 Object Library in Appendix A of this manual.

## Level

### Level Monitoring

The Level may be monitored by reading Modbus Register 40011. The value will be the same as what is displayed on the front of the controller but with no decimal point. If an operator has the Controller in the Level Simulation Mode, it will show the simulated level.

### Remote Level Input

In cases where the pumps empty or fill a remote tank, the SCADA system Master may be programmed to collect the level data from the remote tank and write the level to Modbus Register 40025 in the Controller. For the Controller to follow the value in Register 40025, Parameter F.19 must be set on 4. Also, the value written to Register 40025 must already be scaled into feet as it would be displayed on the front of the Controller, but with no decimal point. The decimal point is artificially inserted by the Controller based on Parameter P.36. For example, a level of 8.6 feet would be written as 86 (assuming that Parameter P.36 = 1).

If SCADA communication is lost, Register 40025 will no longer receive current level data. With the loss of communication the Controller will turn off all pumps and turn on the Fault indicator and place Fault Code 37 in Parameter FLC. The Level Display will also flash and show the last value written to Modbus Register 40025. Loss of communication is established when the delay set on Parameter P.38 expires. The time delay setting on Parameter P.38 must be set long enough so that it will not time out during the interval between normal communication events.

## Discrete Inputs

The status of all the Discrete Inputs may always be read from Coils 545 - 552 in Register 40035, Coils 561 - 568 in Register 40036, and Coils 577 - 578 in Register 40037, regardless of what function may be assigned to the inputs.

The status of the Discrete Inputs assigned Functions 19 - 30 (Telemetry A - M) do not perform any control functions inside the Controller, but their status may be read from Coils in Registers 40001, and 40008.

Discrete Inputs assigned with Functions 7 - 8, 17 - 18 and 31 - 38 perform their respective function inside the Controller but also have their status available to be read from Coils in Registers 40001, and 40008.

## Auxiliary Analog Input Data

The optional Auxiliary Analog Inputs may be used to monitor such things as flow, pump speed, motor current, or whatever is connected to them. The inputs perform no control function inside the Controller.

The Data may be read in a 10-bit format (205 - 1023), from Modbus Registers 40071 - 40074.

The Registers shows a value of 205 with a 4.0mA input, and 1023 with a 20mA input.

Also, an 8-bit version of the data may be viewed on the front of the Controller under Parameters n.19 - n.22.

## Analog Outputs

The internal numbers used to control the Analog Outputs are available to be read through SCADA.

The values are in a 12-bit format (0 - 4095), and may be read from Modbus Registers 40075 - 40078.

The Registers shows a value of 0 with a 4.0mA output, and 4095 with a 20mA Output.

Also, a 0-100% version of the control numbers may be viewed on the front of the Controller under Parameters d.03 - d.06.

## Pump On / Off and Alarm Levels

The Pump On, Pump Off, High Alarm, and Low Alarm levels may be viewed and changed at Modbus Registers 40012 - 40021.

# SCADA FEATURES

## Disable Pump Operation

To Disable a Pump set Coil 149, 150, 151, or 152 in Modbus Register 40010. To return a pump to normal operation, clear the respective Coil.

If SCADA communication is lost, the Pump Disable Logic will be automatically reset, and any pump that had been remotely disabled will be re-enabled after the delay set on Parameter P.38. For this feature to work properly, the Master must poll the Controller at intervals shorter than the time set on Parameter P.38. However, if Parameter P.38 is set on 255 the pumps will remain disabled until power is lost.

## Force Pump On

To Force a Pump On set Coil 17, 18, 19, or 20 in Modbus Register 40002. To return the pump to normal operation, clear the respective Coil.

If SCADA communication is lost, the Force Pump On Logic will be automatically reset, and any pump that had been remotely forced on will be turned off after the delay set on Parameter P.38. For this feature to work properly, the Master must poll the Controller at intervals shorter than the time set on Parameter P.38. However, if Parameter P.38 is set on 255 the pumps will remain on until power is lost.

## Speed of Pumps Forced On

To control the Speed of Pumps that are Forced On, write the desired speed in percent to Modbus Register 40046. The new value will be stored in non-volatile EEPROM memory. The default speed is 100%. The setting may also be viewed or changed at Parameter P.53.

## Force Pump Alternation

To force Pump Alternation, momentarily set Coil 136 in Modbus Register 40009.

## Force Lead Pump Position

The Forcing of the Lead Pump Position may be accomplished by writing a 1,2,3 or 4 to Modbus Register 40022. To return to normal alternation, write a zero to the register. Setting Register 40022 does not guarantee that the pump selected will be lead. If the pump selected as lead is disabled (by a pump disable discrete input), then the next available pump will be made lead. A lead pump selector switch connected to discrete inputs, programmed as sequence inputs, will also override what is written to Register 40022. The setting may also be changed at Parameter P.39. The content of Register 40022 is saved in non-volatile memory. The Current Lead Pump Position may be read from Register 40023.

## Relay Remote Control

Relays that are not needed for pump control or alarm outputs, may be controlled remotely by setting their Output Function (Parameters F.31 - 36) to 2.

Remote control is accomplished by setting or clearing Coils 25 - 30 in Modbus Register 40002.

Upon a loss of SCADA communication, the control commands will be automatically cleared after the delay set on Parameter P.38. For this feature to work properly, the Master must poll the Controller at intervals shorter than the time set on Parameter P.38. However, if Parameter P.38 is set on 255 the relays will remain as commanded, until power is lost..

The HI Relay operates differently from the others. It has a normally closed contact, so the logic is inverted. Also, when the power is lost to the Controller the HI Relay contact will close.

## Flush Cycle

To Start Flush Cycle, momentarily set Coil 139 in Modbus Register 40009.

To Stop Flush Cycle, momentarily set Coil 140 in Modbus Register 40009.

Flush Cycle Active / Inactive status may be read from Coil 141 in Modbus Register 40009. Where 1 is active, and 0 is inactive.

# SCADA FEATURES

## Flow Calculator

The **Latest Inflow Rate** may be read from Modbus Register 40080.

The **Average Daily Inflow Total** may be read from Modbus Register 40081.

The **Pump 1-4 Outflow Rate** may be read from Modbus Registers 40082 - 40085.

The **Daily Inflow Total (Day 1-7)** may be read from Modbus Registers 40086 - 40092.

The **24 Hour Clock Advance** feature provides the means to advance the internal 24 hour Time Clock to sometime in the last minute just before the latest 24 hour period ends. The Flow Calculator collects and keeps a running total of the liquid flowing into the lift station, and at the end of each 24 hour period the new flow data is moved to Day 1. The new flow data is then included in the calculation of the Average Daily Inflow Total. This feature is provided to speed up this process for testing and demonstration purposes. To advance to the end of the latest 24 hour period set Modbus Register 40093 to “1”. When the advancement occurs, the value in Register 40093 will be returned to “0”.

## High Level Alarm

The **High Level Alarm - From Level Input** is generated from a comparison of the displayed Level Input with the High Level alarm setting. This alarm works when Parameter F.19 is set on either 1, 2 or 3. The status of this alarm may be read from Coil 129 in Modbus Register 40009.

The **High Level Alarm - From Float Switch** is generated by the closure a float switch connected to a Discrete Input programmed for either Function 18 or 38. The status of this alarm may be read from Coil 120 in Modbus Register 40008.

The **High Level Alarm - From Level Probe Backup** is generated when liquid covers the High Level Electrode of a Level Probe Input. Parameter b.07 must be setup with the number of the Level Probe Input used to read the High Level. The status of this alarm may be read from Coil 122 in Modbus Register 40008.

The **High Level Alarm - From Any Source** is generated by any of the above three sources of High Level Alarm. The status of this alarm may be read from Coil 1 in Modbus Register 40001.

## Low Level Alarm

The **Low Level Alarm - From Level Input** is generated from a comparison of the displayed Level Input with the Low Level alarm setting. This alarm works when Parameter F.19 is set on either 1, 2 or 3. The status of this alarm may be read from Coil 130 in Modbus Register 40009.

The **Low Level Alarm - From Float Switch** is generated by the closure a float switch connected to a Discrete Input programmed for either Function 17 or 32. The status of this alarm may be read from Coil 128 in Modbus Register 40008.

The **Low Level Alarm - From Level Probe Backup** is generated when liquid uncovers the Low Level Electrode of a Level Probe Input. Parameter b.01 must be setup with the number of the Level Probe Input used to read the Low Level. The status of this alarm may be read from Coil 121 in Modbus Register 40008.

The **Low Level Alarm - From Any Source** is generated by any of the above three sources of Low Level Alarm. The status of this alarm may be read from Coil 2 in Modbus Register 40001.

## Fault Codes

The **Fault Code** (Parameter FLC) may be read from Modbus Register 40047.

The **Last Fault Code** (Parameter LFC) may be read from Modbus Register 40048.

The **Fault Code** and the **Last Fault Code** may be reset by setting Coil 31 in Modbus Register 40002.

## Elapsed Time Meters

**Pump 1-4 Elapsed Time Meters** may be read from Modbus Registers 40003 - 40006. The Elapsed Time Meters keep track of how many hours the pumps have run since the last time the meters were reset. The values read from these registers are intended for use in comparing the pump run time of one pump with the run time of the other pumps at the station, for the purpose of checking for uneven run times. (Uneven run times is an indication of a maintenance problem with one of the pumps.) Periodically the comparison of run times should be made and the registers should reset to zero. The ETM data is stored in non-volatile memory so that the data is not lost during a power outage. To reset the ETMs to zero, momentarily set the respective Coil (21 - 24) in Modbus Register 40002.

# SCADA FEATURES

## Pump 1-4 Last Run Cycle Time Meters

**Pump 1-4 Last Run Cycle Time Meters** may be read from Modbus Registers 40100 - 40103. The Last Run Cycle Time Meters keep track of how long a pump ran during its last run cycle. The data is stored in non-volatile memory so that the data is not lost during a power outage. To reset the meters to zero, momentarily set the respective Coil (593 - 596) in Modbus Register 40038.

## Pump 1-4 Start Counters

**Pump 1-4 Start Counters** may be read from Modbus Registers 40104 - 40107. The Pump Start Counters keep track of how many pump starts have occurred since the last time the counters were reset. The data is stored in non-volatile memory so that it is not lost during a power outage. To reset the counters to zero, momentarily set the respective Coil (597 - 600) in Modbus Register 40038.

# SCADA TROUBLESHOOTING

## Communication Activity Indicator

The Communication Activity Indicator (Parameter d.07) may be used to help troubleshoot communication issues.

It typically pulses from “0” to “1” momentarily to indicate that the master is sending a message. It may stay “1” if there is very little time between messages.

It does not indicate that a valid communication has occurred, only that there is activity on either the RS232 port or the Ethernet port.

When using the Ethernet Port, the Ethernet Board logic will block messages with the wrong IP Address, or when there are setup issues with the Ethernet Port. For the Activity Indicator to be pulsed, the message must be accepted and passed through the Ethernet Board to the Main Controller Board.

## Address of Last Slave Polled by Master

The Address of Last Slave Polled by Master (Parameter d.08) may be used to help troubleshoot communication issues.

When using the RS232 port, it shows the address of the last slave that was polled by the master.

When using the Ethernet Port, the Ethernet Board logic will block messages with the wrong IP Address, or when there are setup issues with the Ethernet Port. For Parameter d.08 to show the slave address, the message must be accepted and passed through the Ethernet Board to the Main Controller Board.

## Record of Last Modbus Message

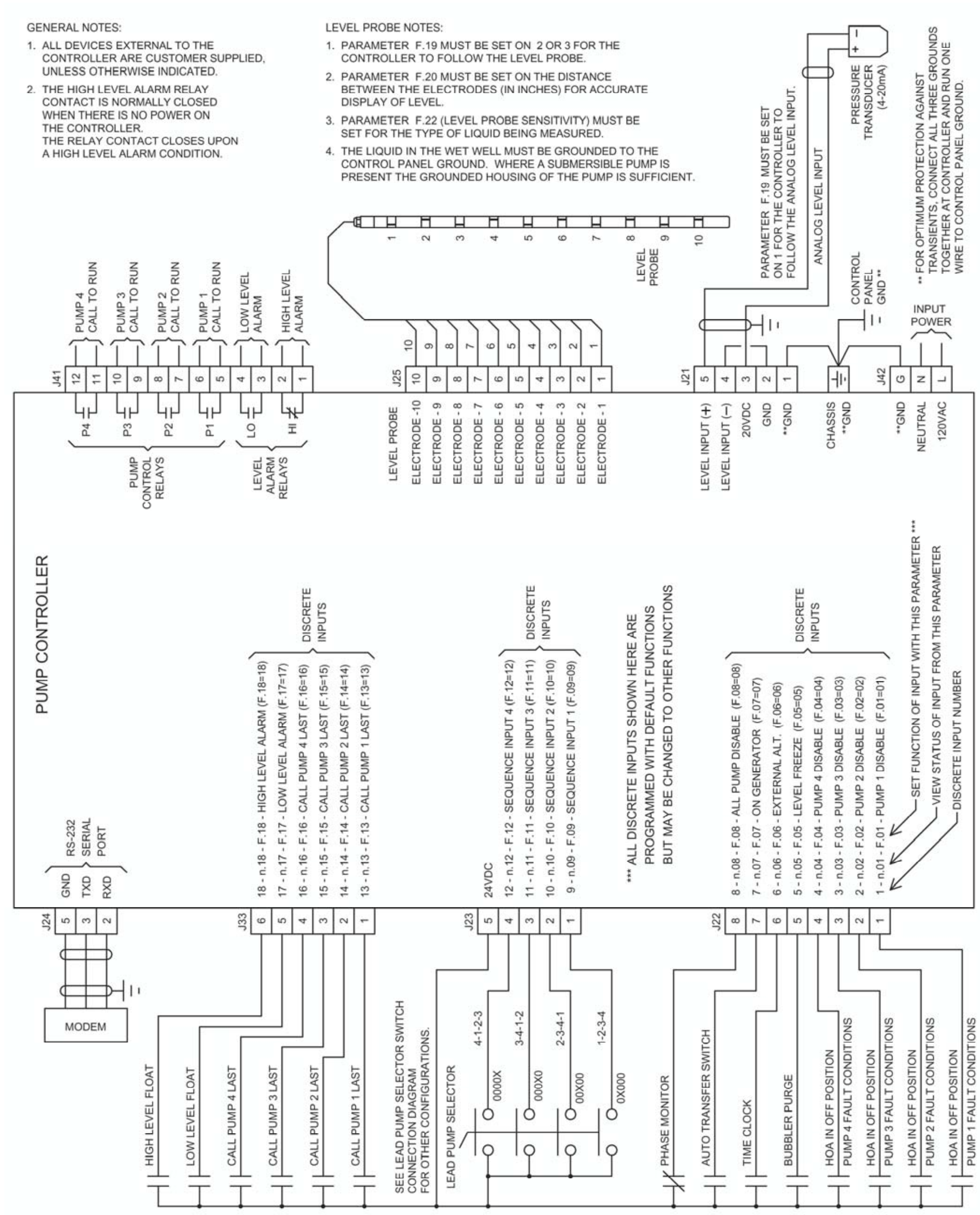
If the Slave Address is acceptable and the message does not have an Overrun Error (FLC = 1), Time Out Error (FLC = 2), Framing Error (FLC = 13), or Noise Error (FLC = 14) then the entire Modbus message will be present in data Parameters d.08 - d.86. If the Slave Address is not acceptable or if any of these errors are encountered, the rest of the message is rejected and does not show up in Parameters d.08 - d.86. If the entire message is received (present at Parameters d.08 - d.86), it may fail the Checksum Test (FLC = 4), have an Invalid Modbus Function Code (FLC = 5), or have one of 7 other faults (FLC = 6, 7, or 35). Failing any of these tests will cause the logic to not perform the Function and not send out a Response.

## Communication Fault Codes

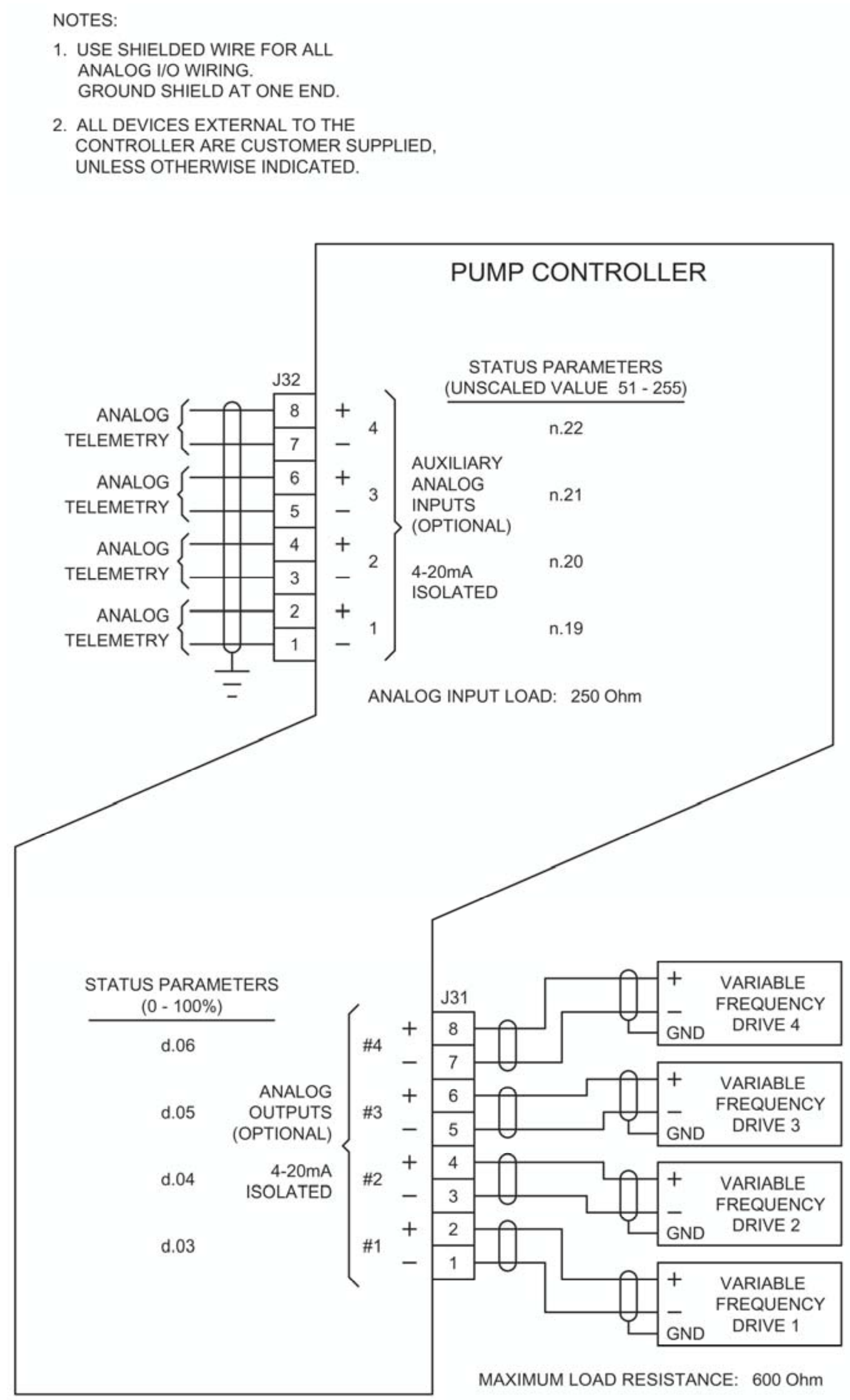
Communication Faults will often generate a Fault Code (Parameters FLC and LFC) that may be used to help determine the cause of a communication problem. When this occurs the Fault Indicator will come on.

A valid communication after a Fault will zero Parameter FLC, and will make the Fault Indicator turn off, but the Fault Code will still be available at Parameter LFC. See the Fault Code Table for the description of the communication Fault Codes 1 - 7, 13 - 14, 35, and 37.

# CONNECTION DIAGRAM - STANDARD FEATURES



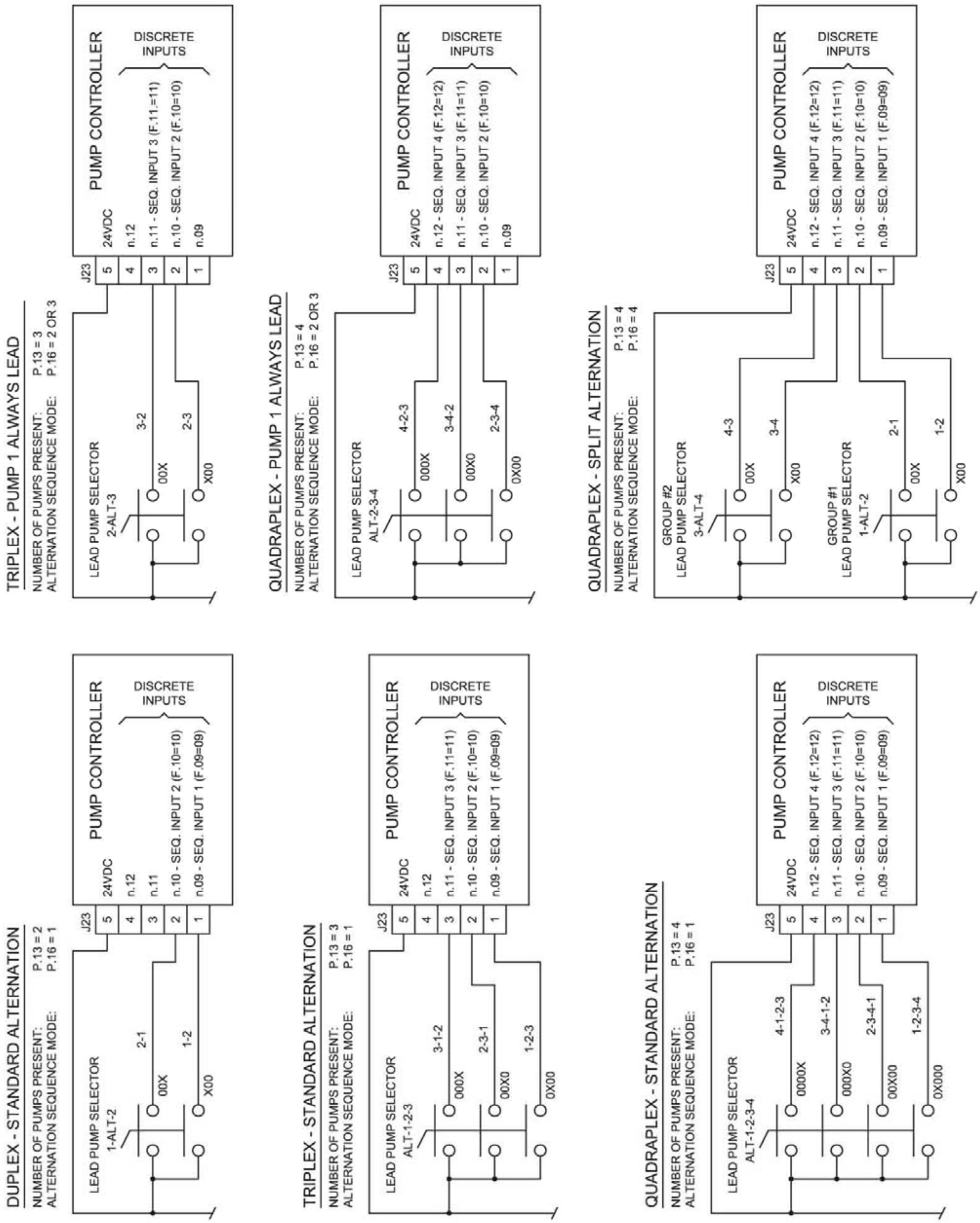
# CONNECTION DIAGRAM - OPTIONAL ANALOG I/O



# CONNECTION DIAGRAM - LEAD PUMP SELECTOR SWITCH

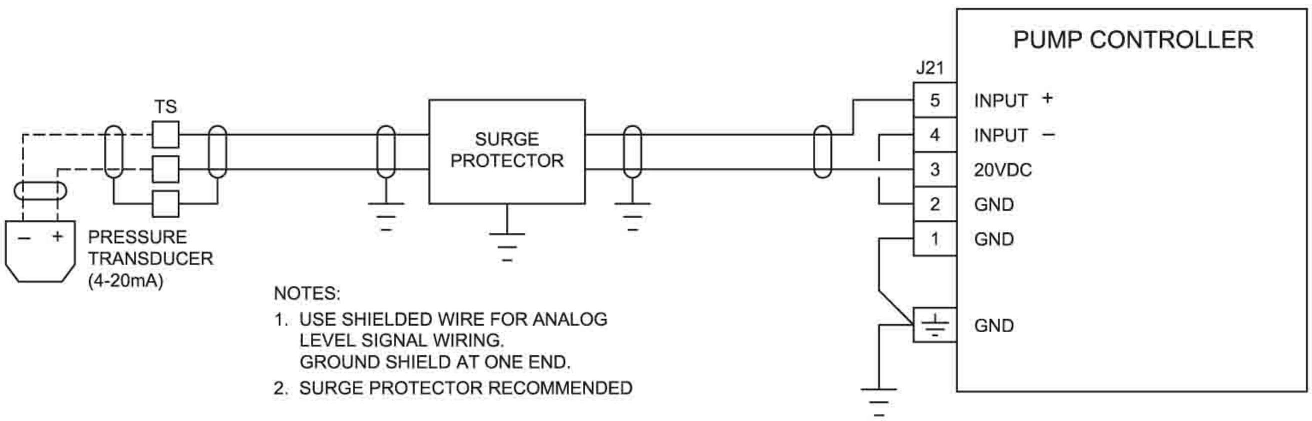
NOTES:

1. THE ALTERNATION SEQUENCE MODE PARAMETER MUST BE SET TO CORRESPOND TO THE CONNECTION DIAGRAM.
2. ALL DISCRETE INPUTS ARE PROGRAMMABLE. THE FUNCTION OF EACH INPUT MUST BE SET TO CORRESPOND TO THE CONNECTION DIAGRAM.
3. THE LEAD PUMP SELECTOR SWITCHES SHOWN HERE ARE NOT SUPPLIED WITH THE CONTROLLER.

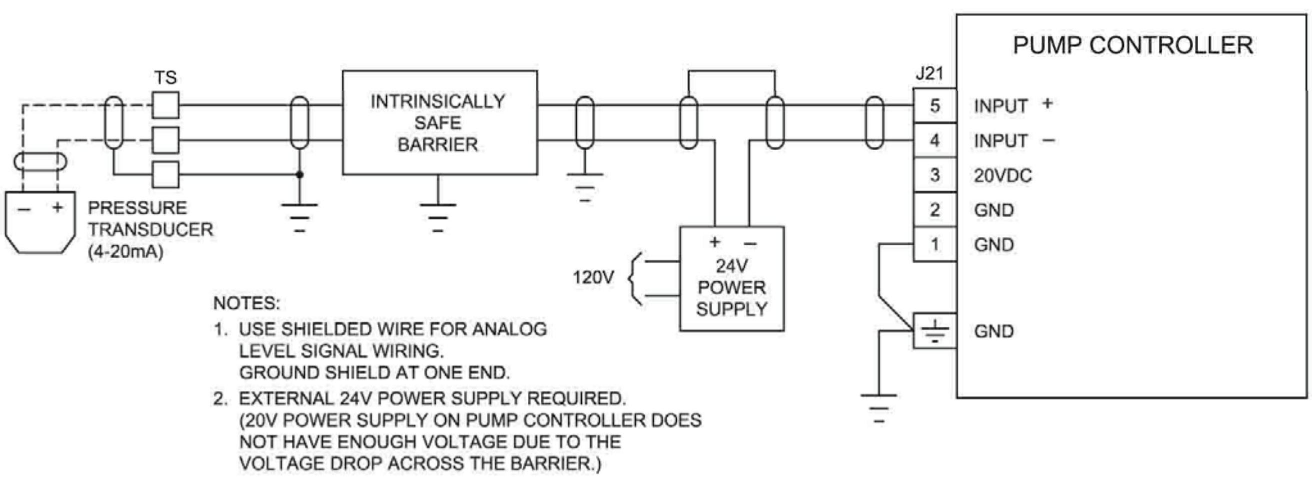


## CONNECTION DIAGRAM - ANALOG LEVEL INPUT (4-20mA Input)

SUBMERSIBLE PRESSURE TRANSDUCER CONNECTION



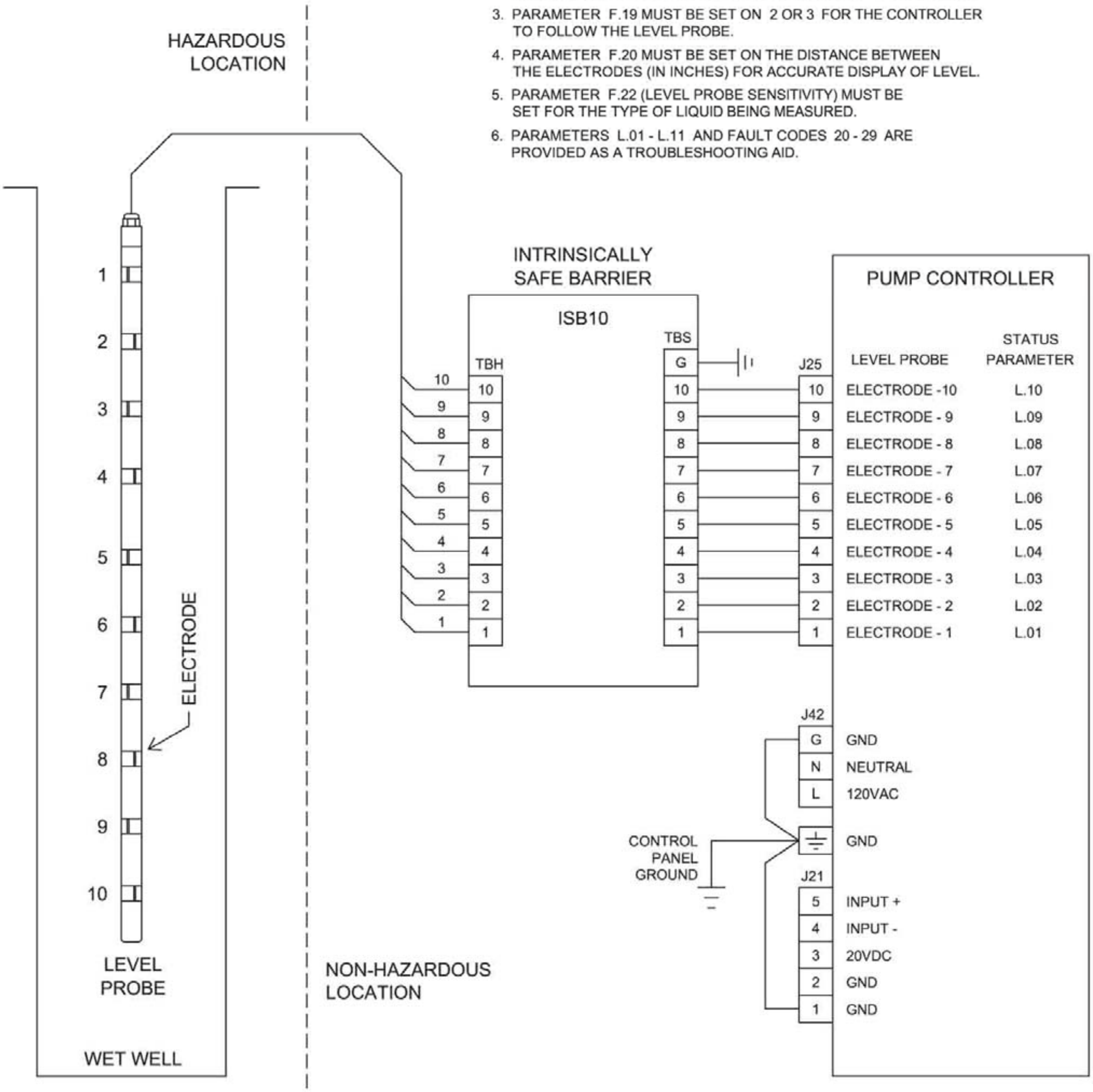

SUBMERSIBLE PRESSURE TRANSDUCER CONNECTION
WITH INTRINSICALLY SAFE BARRIER



# CONNECTION DIAGRAM - LEVEL PROBE

NOTES:

1. INTRINSICALLY SAFE BARRIER IS OPTIONAL.
2. THE LIQUID IN THE WET WELL MUST BE GROUNDED TO THE CONTROL PANEL GROUND. WHERE A SUBMERSIBLE PUMP IS PRESENT THE GROUNDED HOUSING OF THE PUMP IS SUFFICIENT.
3. PARAMETER F.19 MUST BE SET ON 2 OR 3 FOR THE CONTROLLER TO FOLLOW THE LEVEL PROBE.
4. PARAMETER F.20 MUST BE SET ON THE DISTANCE BETWEEN THE ELECTRODES (IN INCHES) FOR ACCURATE DISPLAY OF LEVEL.
5. PARAMETER F.22 (LEVEL PROBE SENSITIVITY) MUST BE SET FOR THE TYPE OF LIQUID BEING MEASURED.
6. PARAMETERS L.01 - L.11 AND FAULT CODES 20 - 29 ARE PROVIDED AS A TROUBLESHOOTING AID.

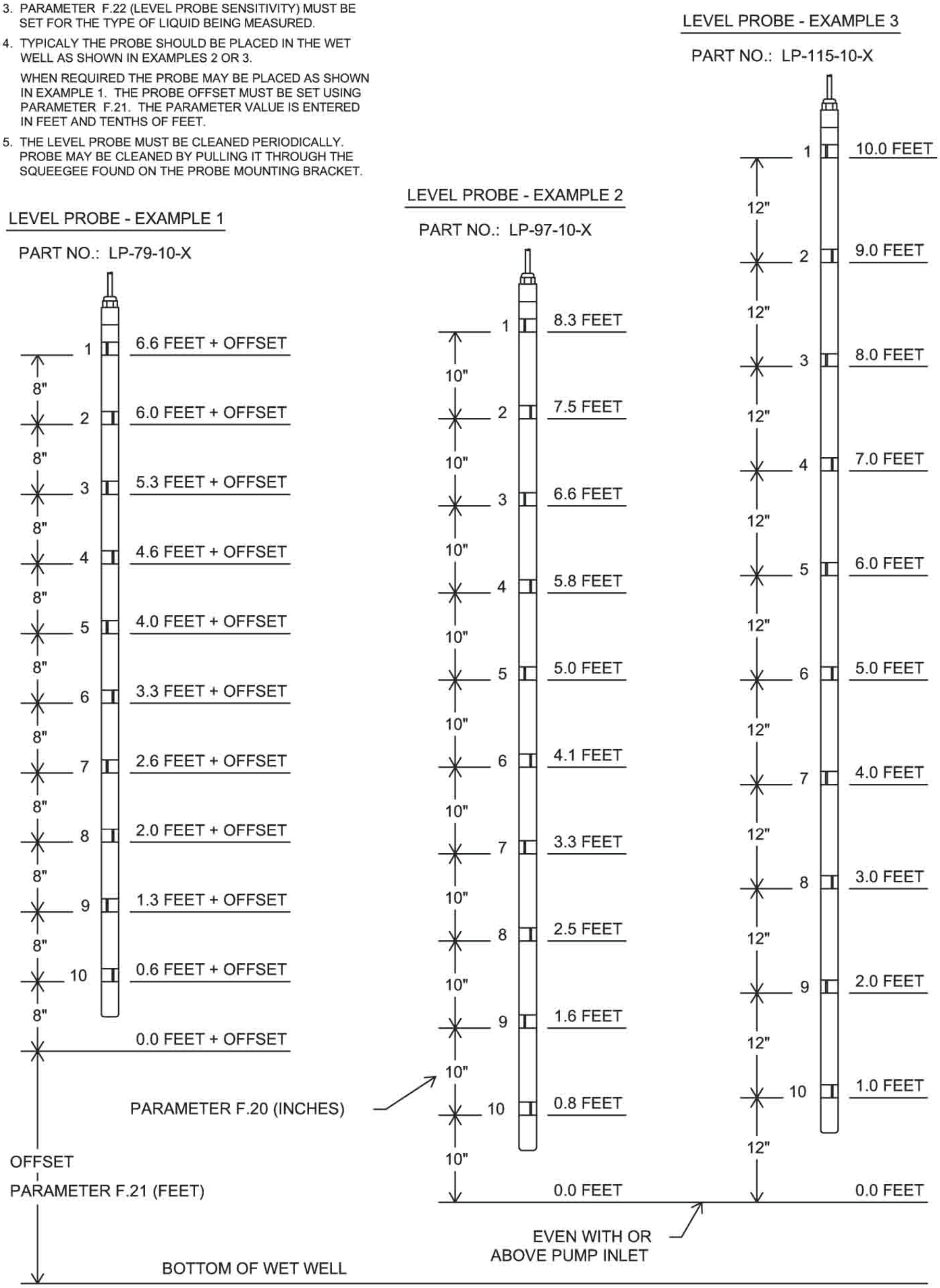


# LEVEL PROBE - PLACEMENT and SETUP

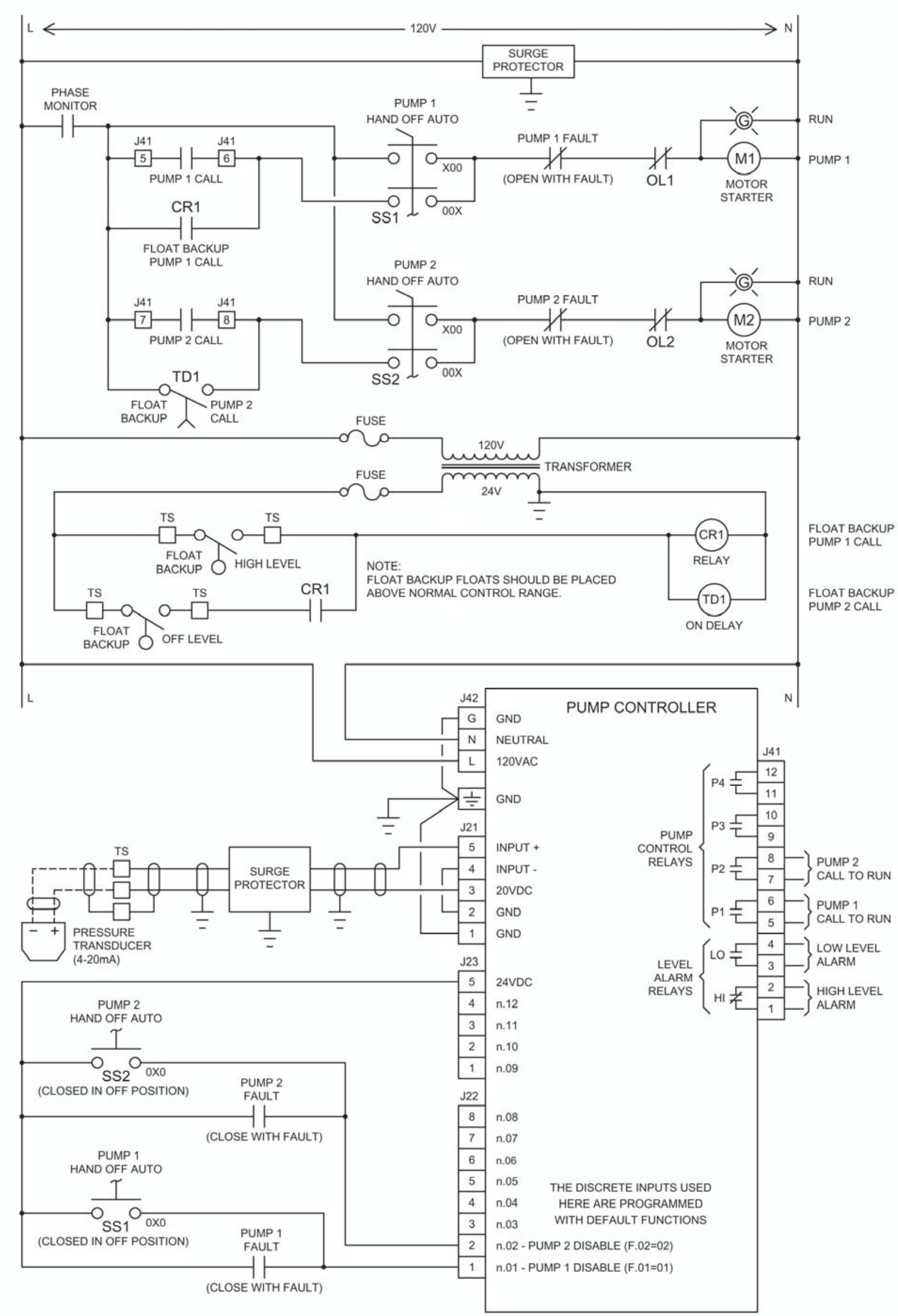
LEVEL PROBE NOTES:

1. PARAMETER F.19 MUST BE SET ON 2 OR 3 FOR THE CONTROLLER TO FOLLOW THE LEVEL PROBE.
2. PARAMETER F.20 MUST BE SET ON THE DISTANCE BETWEEN THE ELECTRODES, IN INCHES, FOR ACCURATE DISPLAY OF LEVEL.
3. PARAMETER F.22 (LEVEL PROBE SENSITIVITY) MUST BE SET FOR THE TYPE OF LIQUID BEING MEASURED.
4. TYPICALY THE PROBE SHOULD BE PLACED IN THE WET WELL AS SHOWN IN EXAMPLES 2 OR 3.

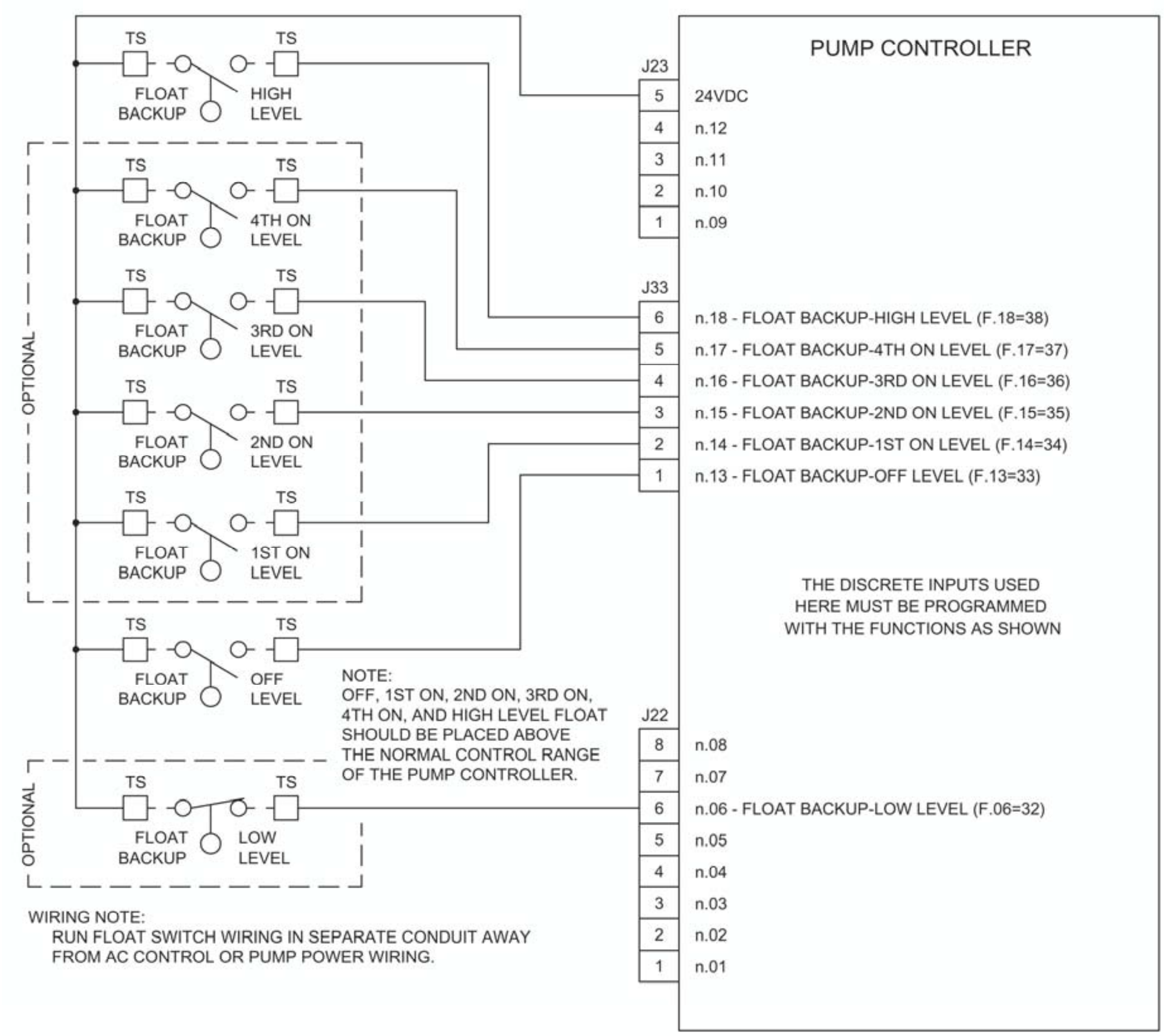
   WHEN REQUIRED THE PROBE MAY BE PLACED AS SHOWN IN EXAMPLE 1. THE PROBE OFFSET MUST BE SET USING PARAMETER F.21. THE PARAMETER VALUE IS ENTERED IN FEET AND TENTHS OF FEET.
5. THE LEVEL PROBE MUST BE CLEANED PERIODICALLY. PROBE MAY BE CLEANED BY PULLING IT THROUGH THE SQUEEGEE FOUND ON THE PROBE MOUNTING BRACKET.



## CONTROL SCHEMATIC EXAMPLE - Duplex with 24V Float Backup



## FLOAT BACKUP EXAMPLE - Pump Down




**Notes:**

1. Pump Down Applications (Parameter P.19 = 1)

   Two Float Backup - A simple two float backup system can be made using an Off float and a High float.

   High Level Input - Closure of the Float Backup High Level input will cause all pumps to be called to run, provided the Off float input is closed. The Discrete Input used for the High Level must be set on Function 38.

   Low Level input - Closure of the Low Level input will disable all pump operation. When the Low Float input opens, a delay prevents the immediate calling of the pumps. This delay is set on Parameter P.37. The Discrete Input used for the Low Level must be set on Function 32.

   Float Type - For Pump Down applications the Off, 1$^{st}$ , 2$^{nd}$ , 3$^{rd}$ , 4$^{th}$ On, and High floats must be normally open float switches that close as the level rises above the float. The Low Level float must close as the level drops below the float.

2. Pump Up Applications (Parameter P.19 = 2)

   Two Float Backup - A simple two float backup system can be made using an Off float and a Low float.

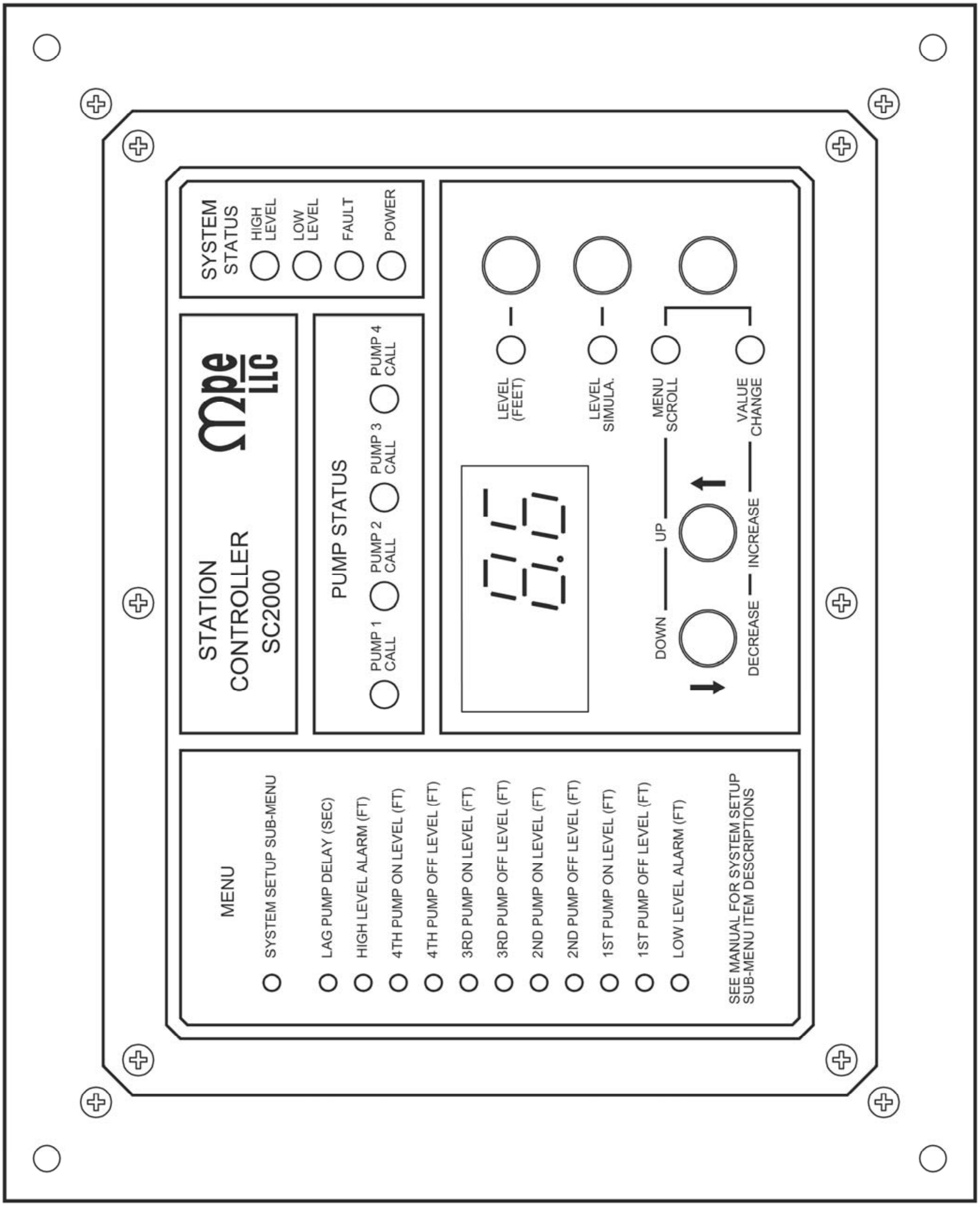
   Low Level Input - Closure of the Float Backup Low Level input will cause all pumps to be called to run, provided the Off float input is closed. The Discrete Input used for the Low Level must be set on Function 32.

   High Level Input - Closure of the High Level Float Switch will disable all pump operation. When the High Float input opens, a delay prevents the immediate calling of the pumps. This delay is set on Parameter P.37. The Discrete Input used for the High Level must be set on Function 38.

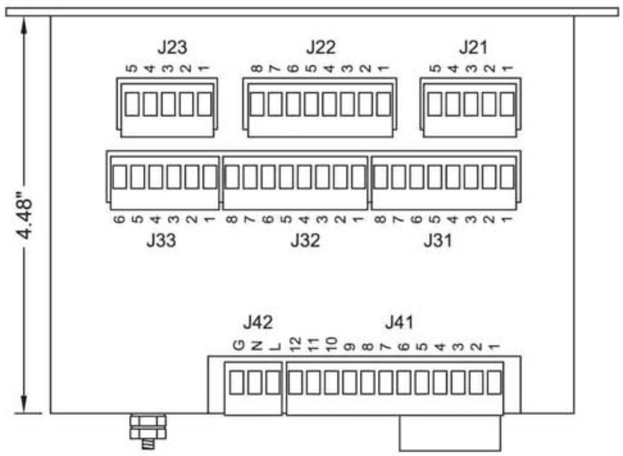
   Float Type - For Pump Up applications the Low, Off, 1$^{st}$ , 2$^{nd}$ , 3$^{rd}$ and 4$^{th}$ On floats must be normally closed float switches that close as the level drops below the float. The High Level float must close as the level rises above the float.

3. The FAULT light comes on and Fault Code 16 is generated, when a pump is called to run by the Float Backup system.

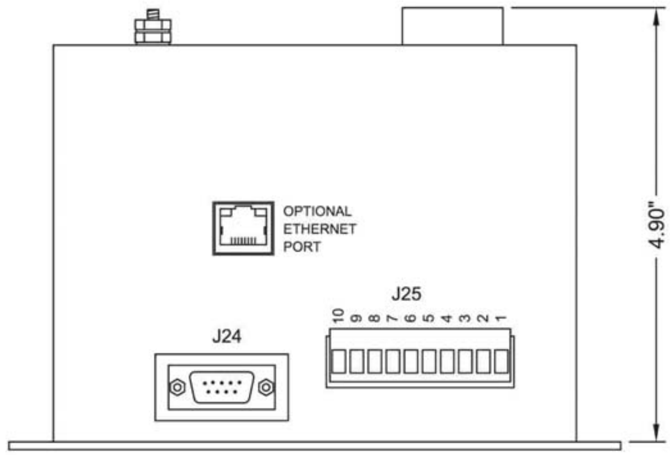
# OPERATOR INTERFACE



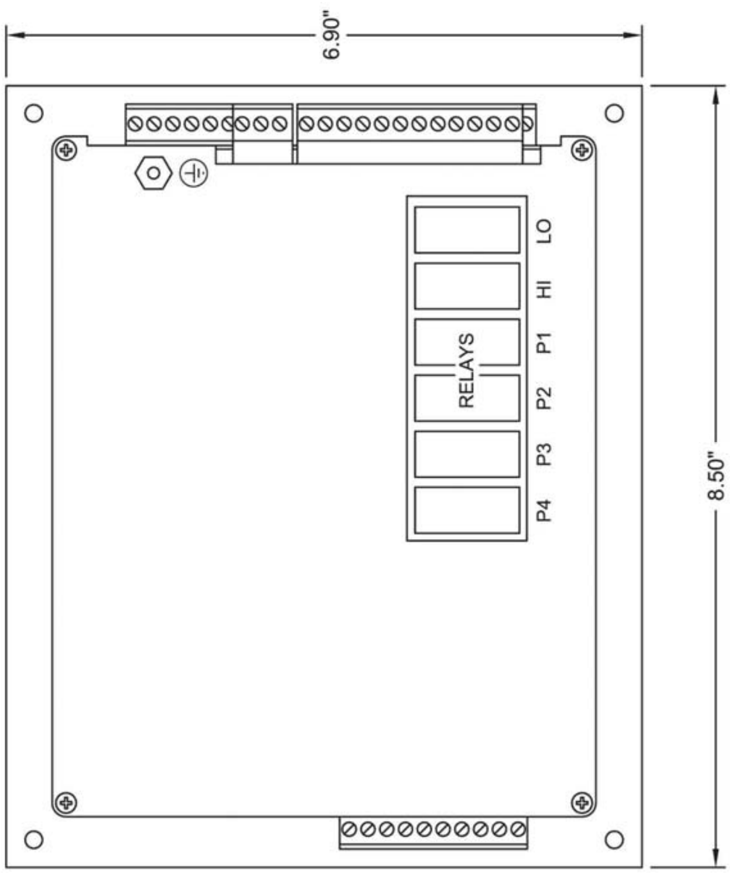
## ENCLOSURE MECHANICAL LAYOUT



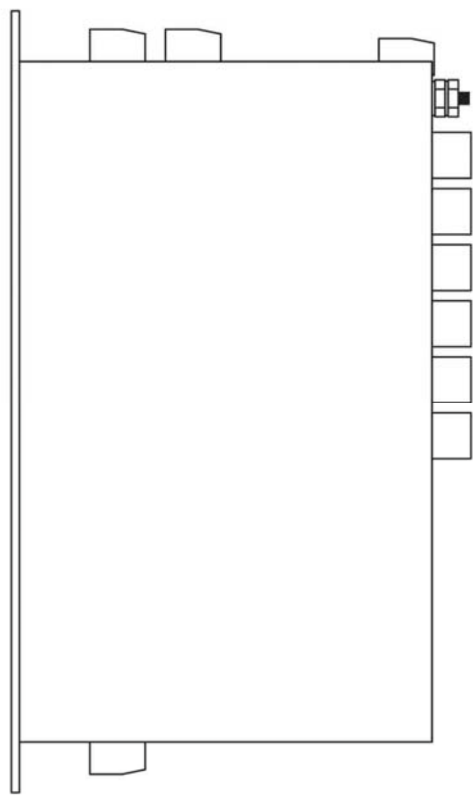

**Left Side**




**Right Side**

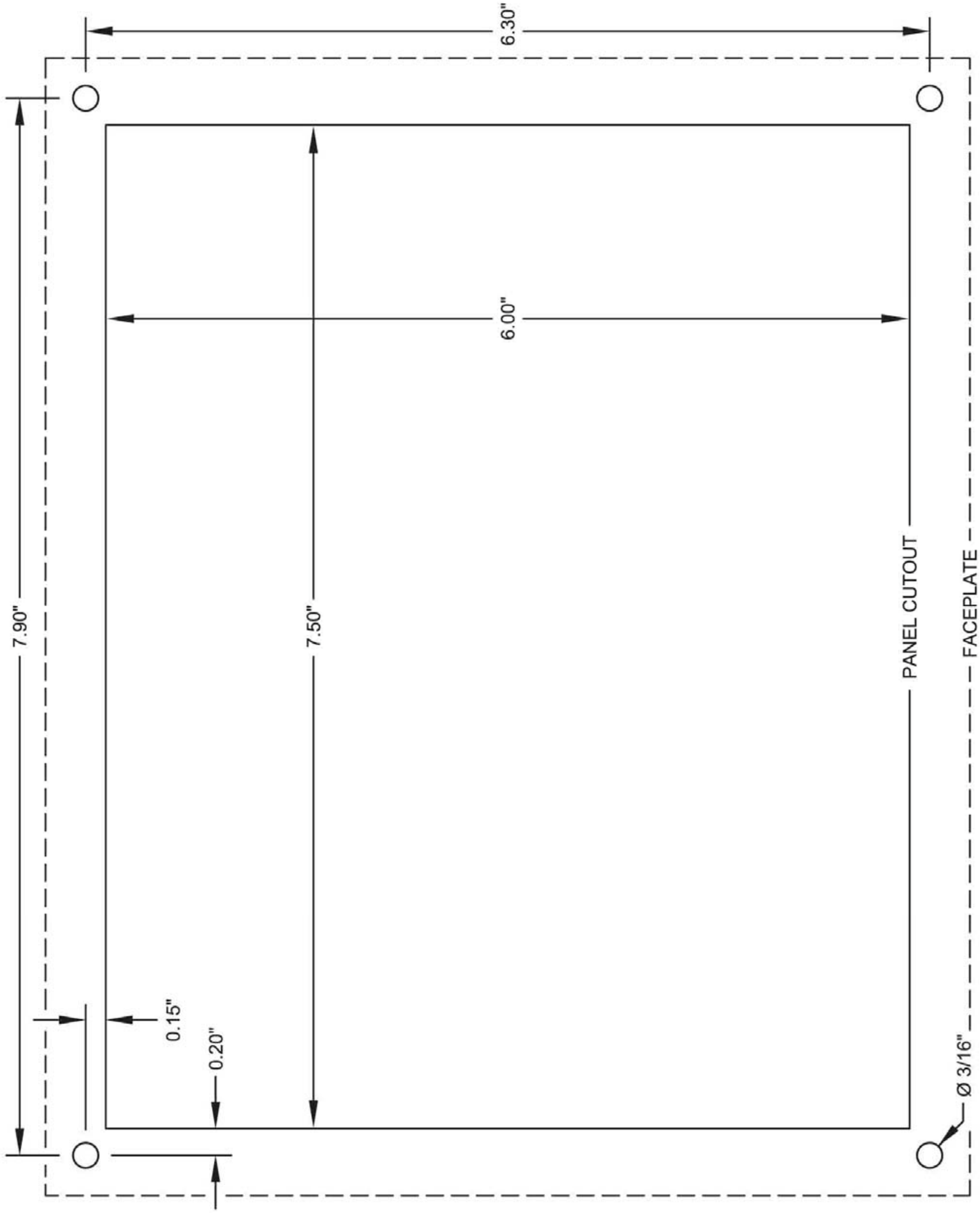



**Rear View**



**Top View**

## PANEL CUTOUT




**Not Printed to Scale. Do Not Use as a Template.**

# APPENDIX A

## DNP3 SCADA Communication Setup

**The Following Pages Only Apply to SC2000-XX E that have an Optional Ethernet Port (Option “E”), that must be Connected to a SCADA System Utilizing the DNP3 Protocol.**

## Communication Setup

| Parameter | Parameter / Default Value | Current Value | Parameter Definitions |
|---|---|---|---|
| **E.01** | **E.01**<br>2 | | Protocol 2 = Modbus TCP<br>3 = DNP3 |
| **Communication Setup Required for: Modbus TCP or DNP3** | | | |
| **E.14 - E.11** | **E.14 . E.13 . E.12 . E.11**<br>192 . 168 . 80 . 12 | | Slave IP Address Range: 0 - 255 |
| **E.44 - E.41** | **E.44 . E.43 . E.42 . E.41**<br>255 . 255 . 255 . 0 | | Slave Subnet Mask Range: 0 - 255 |
| **E.54 - E.51** | **E.54 . E.53 . E.52 . E.51**<br>192 . 168 . 80 . 1 | | Slave Default Gateway Range: 0 - 255 |
| **E.62 & E.61** | **E.62 , E.61**<br>0 , 502 | | Slave Port Number Range: 1 - 65,535 |
| **E.36 - E.31** | **E.36 : E.35 : E.34 : E.33 : E.32 : E.31**<br>0 : 80 : 194 : 219 : XXX : XXX | | MAC Address<br>Unique number that identifies each field device. It is set at the factory, and can not be changed. |
| **Additional Communication Setup Required for: DNP3** | | | |
| **H.32 & H.31** | **H.32 , H.31**<br>0 , 1 | | DNP3 Slave Address<br>Range: 0 - 65,519 |
| **H.42 & H.41** | **H.42 , H.41**<br>0 , 100 | | DNP3 Master Address<br>Range: 0 - 65,519 |
| **H.52 & H.51** | **H.52 , H.51**<br>20 , 000 | | DNP3 Master Port Number<br>Range: 1 - 65,535 |

**Note:** Above Setup Parameter values are read upon power up; any changes require the power to be cycled before the new values are used.

## DNP3 Event Object Creation Mode Setup

| Parameter | Default Value | Parameter Definitions |
|---|---|---|
| **H.01** | See Note | Globally Change the Class of All Binary Input Objects<br>0 = Class 0   1 = Class 1   2 = Class 2   3 = Class 3<br><br>Note: Parameter H.01 is used to change all the “u” Parameters to the new setting at the same time. After all the “u” Parameter values are change to the new value, the value of Parameter H.01 will be automatically return to “4”, its inactive state, after a short delay. |
| **H.02** | See Note | Globally Change the Class of All Analog Input Objects<br>0 = Class 0   1 = Class 1   2 = Class 2   3 = Class 3<br><br>Note: Parameter H.02 is used to change all the “r” Parameters to the new setting at the same time. After all the “r” Parameter values are change to the new value, the value of Parameter H.02 will be automatically return to “4”, its inactive state, after a short delay. |
| **H.03** | 0 | Event Object Storage Mode<br>0 = Store Un-Sent Event Objects in RAM Memory until Full then Begin Replacing the Oldest Event Objects with the Newer Event Objects.<br>1 = Store Un-Sent Event Objects in RAM Memory until Full and then Keep the Oldest Event Objects and Discard new Event Objects.<br><br>Note: Event Objects are Un-Sent Due to Loss of Communication or Excessively Long Polling Period. |
| **u.00 - u.79** | 2 | Binary Input Object Class<br>0 = Class 0 - No Event Object is Created   1 = Class 1 - Event Objects Created<br>2 = Class 2 - Event Objects Created   3 = Class 3 - Event Objects Created<br><br>Note: If the Master has Enabled Unsolicited Reporting (Report by Exception) for a Class, then Event Objects in that Class are sent to the Master immediately upon creation.<br><br>See Pages A7 - A10 for details. |
| **r.00 - r.32** | 2 | Analog Input Object Class<br>0 = Class 0 - No Event Object is Created   1 = Class 1 - Event Objects Created<br>2 = Class 2 - Event Objects Created   3 = Class 3 - Event Objects Created<br><br>Note: If the Master has Enabled Unsolicited Reporting (Report by Exception) for a Class, then Event Objects in that Class are sent to the Master immediately upon creation.<br><br>See Pages A12 - A13 for details. |
| **t.00 - t.32** | - | Analog Input Event Object Deadband<br>See Pages A12 - A13 for details. |

# DNP3 SCADA Description for the SC2000

## Object - [ Group number, Index number, Variation number, Data ]

With the DNP3 protocol, whenever an **Object** carrying **Data** is sent from one point to another in a SCADA system, the **Group Number**, the **Index Number**, and the **Variation Number** always go along with the Data as part of the Object. The three numbers serve to help the recipient of the Object with the task of placing the Data in the correct location in the recipient's data base, and with identifying the format of the Data.

**Group Number** - The Group Number is a number that identifies a group of a specific type of Data.

**Index Number** - The Index Number is a number that identifies a particular Object in a Group.

**Variation Number** - The Variation Number (Var) is a number which identifies the format of the Data.

**Data** - The Data is the information (the payload) that is transported by the Object.

## Object Types

**Static Objects** - A Static Type Object contains the identity, format, and current state or value of input data.

**Event Objects** - An Event Type Object contains the identity, format, and state or value of the data at the time it last changed. It will also have a time stamp to mark the Absolute Time the Object was created. Upon successfully sending the Event Objects to the Master the Event Objects will be deleted from the buffer they reside in. For Binary Input Objects, a change of state of the data must have occurred from "0" to "1" or from "1" to "0". For Analog Input Objects, the value of the analog data must have changed by more than the **Deadband limit** set on its **t.XX** parameter.

**Status Objects** - A Status Type Object contains the identity, format, and current status or value of output data.

**Command Objects** - A Command Type Object contains the identity, the format, and a request to change state or value of an output to a new specified state or value.

## Object Tables

The Object Tables in this manual document the details of the following Objects unique to the **SC2000** Controller:

| | | | |
|---|---|---|---|
| **Binary Input Object Table** | **-** | **Static Objects (Group 01)** | **Event Objects (Group 02)** |
| **Binary Output Object Table** | **-** | **Status Objects (Group 10)** | **Command Objects (Group 12)** |
| **Analog Input Object Table** | **-** | **Static Objects (Group 30)** | **Event Objects (Group 32)** |
| **Analog Output Object Table** | **-** | **Status Objects (Group 40)** | **Command Objects (Group 41)** |

## Class

The Controller is designed so that its Objects of data can be retrieved by polling based on Class, rather than by having the Master Station request each Object of data from the Slave based on its Group and Index number.

A simple way to retrieve all of the Objects of data from the Controller is for the Master to repeatedly perform a Class 0 poll. (A Class 0 poll is also known as an Integrity poll.) All Static and Event Objects would be sent to the Master, but this approach is not very efficient.

It is considerably more efficient to only perform a Class 0 poll periodically (once every ten minutes, or so), and then perform a Class 1, 2, and 3 poll at regular intervals (every minute, or so). This approach requires that each Object be assigned a Class of either 1, 2, or 3. The Master must then be setup to request the Objects by their Class. (Note: If a Binary or Analog Output value is changed in the Controller, the new value will be sent to the Master during the next Class 0 poll.)

In the Controller, to select the desired Class, each **Binary Input Object** has its own **u.XX** parameter, and each **Analog Input Object** has its own **r.XX** parameter.

**Class 0 -** With Class 0 selected, during a Class 0 poll, a Static Object carrying the current state or value of the data will be sent to the Master. An Event Object for this piece of data will not be created or sent.

**Class 1 -** With Class 1 selected, during a Class 1 poll, any Event Object that had been created (due to a change in the state or value of the data) will be sent to the Master.

**Class 2 -** With Class 2 selected, during a Class 2 poll, any Event Object that had been created (due to a change in the state or value of the data) will be sent to the Master.

**Class 3 -** With Class 3 selected, during a Class 3 poll, any Event Object that had been created (due to a change in the state or value of the data) will be sent to the Master.

## Unsolicited Reporting  (Report By Exception)

The Controller supports Unsolicited Reporting (Report By Exception) of Class 1-3 Event Objects if the Master has enabled the Unsolicited Reporting for the Class.

Any Event Object in a Class that is enabled for Unsolicited Reporting will be sent to the Master immediately upon the creation of the Event Object, and not wait to be retrieved during the normal poll of that Class.

To prevent communication log jams, only a small number of time critical alarms should ever be set to a Class that is enabled for Unsolicited Reporting.

## Binary Input Objects  -  See Pages A7- A10

The Controller provides two types of Binary Input Objects, Static and Event:

### Static  -  **Group 01,  Var 01**

**Group 01**  -  Object belongs to a group of **Binary Input Static Objects**.
**Var 01**  -  Object data is formatted as:  Binary (single bit) and is in a Packed format.

There is no **Time Stamp** associated with the Static Data.

A request for **Class 0** data will return all available Binary Input Static Objects.

### Event  -  **Group 02,  Var 02**

**Group 02**  -  Object belongs to a group of **Binary Input Event Objects**.
**Var 02**  -  Object data is formatted as:  Binary (single bit) and includes a **Time Stamp** that marks **Absolute Time** that the Object was created.

Upon its creation a Binary Input Event Object is placed in a queue until it is successfully sent to the Master, then it is deleted from the queue.

The Controller provides a Setup Parameter to set the Class (u.XX) for each Binary Input Event Object.

## Binary Output Objects  -  See Page A11

The Controller provides two types of Binary Output Objects, Status and Command:

### Status  -  **Group 10,  Var 02**

**Group 10**  -  Object belongs to a group of **Binary Output Status Objects**.
**Var 02**  - Object data is formatted as:  Binary (single bit).

Object provides a read of the current status (1 or 0) of the output.

A request for **Class 0** data will return all available Binary Output Status Objects.

### Command  -  **Group 12,  Var 01**

**Group 12**  -  Object belongs to a group of **Binary Output Command Objects**.
**Var 01**  -  Object data is formatted as:  Control Relay Output Block (CROB).

The Object request a change to the current state (1 or 0) of the output.

## Analog Input Objects - See Pages A12- A13

The Controller provides two types of Analog Input Objects, Static and Event:

### Static - Group 30, Var 04

**Group 30** - Object belongs to a group of **Analog Input Static Objects**.
**Var 04** - Object data is formatted as: 16-Bit.

There is no **Time Stamp** associated with the Static Data.

A request for **Class 0** data will return all available Analog Input Static Objects.

### Event - Group 32, Var 04

**Group 32** - Object belongs to a group of **Analog Input Event Objects**.
**Var 04** - Object data is formatted as: 16-Bit and includes a **Time Stamp** that marks **Absolute Time** that the Object was created.

Upon creation of the Object it is placed in a queue until it is successfully sent to the Master, then it is deleted from the queue.

The Controller provides a Setup Parameter to set the Class (r.XX) for each Analog Input Event Object.

The Controller also provides a Setup Parameter for the Deadband (t.XX). The Object is only created when the Analog Input value changes by more than its configured Deadband Setup Parameter.

## Analog Output Objects - See Page A14

The Controller provides two types of Analog Output Objects, Status and Command:

### Status - Group 40, Var 02

**Group 40** - Object belongs to a group of **Analog Output Status Objects**.
**Var 02** - Object data is formatted as 16-Bit.

Object belongs to a group that provides a read of the current value of an Analog Output.

A request for **Class 0** data will return all available Analog Output Status Objects.

### Command - Group 41, Var 02

**Group 41** - Object belongs to a group of **Analog Output Command Objects.**
**Var 02** - Object data is formatted as 16-Bit.

The Object request a change to the current value of an Analog Output.

## Time Objects

### Absolute Time - Group 50, Var 01

The Controller has an internal clock that is used to Time Stamp all Event Objects with the **Absolute Time**. It is a 48-bit number that represents the time in milliseconds since 00:00 hours on January 1st, 1970. The Controller keeps the internal clock current by regularly requesting the latest time from the Master.

# SC2000 DNP3 Object Library

## Binary Input Object Table

**Setup Definitions for u.XX Parameters**

0 = Class 0 - No Event Object is Created
1 = Class 1 - Event Objects Created
2 = Class 2 - Event Objects Created
3 = Class 3 - Event Objects Created

Note: If the Master has Enabled Unsolicited Reporting (Report by Exception) for a Class, then Event Objects in that Class are sent to the Master immediately upon creation.

| | Static | | Event | | | | | |
|---|---|---|---|---|---|---|---|---|
| Index | Group | Var | Group | Var | Description | Setup Parameter | Default Value | Current Value |
| 00 | 01 | 01 | 02 | 02 | Pump 1 Called to Run | u.00 | 2 | |
| 01 | 01 | 01 | 02 | 02 | Pump 2 Called to Run | u.01 | 2 | |
| 02 | 01 | 01 | 02 | 02 | Pump 3 Called to Run | u.02 | 2 | |
| 03 | 01 | 01 | 02 | 02 | Pump 4 Called to Run | u.03 | 2 | |
| 04 | 01 | 01 | 02 | 02 | Pump 1 Disable - From Discrete Input (Function 1) | u.04 | 2 | |
| 05 | 01 | 01 | 02 | 02 | Pump 2 Disable - From Discrete Input (Function 2) | u.05 | 2 | |
| 06 | 01 | 01 | 02 | 02 | Pump 3 Disable - From Discrete Input (Function 3) | u.06 | 2 | |
| 07 | 01 | 01 | 02 | 02 | Pump 4 Disable - From Discrete Input (Function 4) | u.07 | 2 | |
| 08 | 01 | 01 | 02 | 02 | All Pump Disable - From Discrete Input (Function 8) | u.08 | 2 | |
| 09 | 01 | 01 | 02 | 02 | Normal Pump Operation Disable - From Discrete Input (Function 31) | u.09 | 2 | |
| 10 | 01 | 01 | 02 | 02 | High Level Alarm - From Level Input | u.10 | 2 | |
| 11 | 01 | 01 | 02 | 02 | High Level Alarm - From Float Switch (Discrete Input Functions 18 or 38) | u.11 | 2 | |
| 12 | 01 | 01 | 02 | 02 | High Level Alarm - From Level Probe Backup | u.12 | 2 | |
| 13 | 01 | 01 | 02 | 02 | High Level Alarm - From Any Source | u.13 | 2 | |
| 14 | 01 | 01 | 02 | 02 | Low Level Alarm - From Level Input | u.14 | 2 | |
| 15 | 01 | 01 | 02 | 02 | Low Level Alarm - From Float Switch (Discrete Input Functions 17 or 32) | u.15 | 2 | |
| 16 | 01 | 01 | 02 | 02 | Low Level Alarm - From Level Probe Backup | u.16 | 2 | |
| 17 | 01 | 01 | 02 | 02 | Low Level Alarm - From Any Source | u.17 | 2 | |
| 18 | 01 | 01 | 02 | 02 | On Generator - From Discrete Input (Function 7) | u.18 | 2 | |
| 19 | 01 | 01 | 02 | 02 | Flush Cycle Active | u.19 | 2 | |

# SC2000 DNP3 Object Library

## Binary Input Object Table

**Setup Definitions for u.XX Parameters**

0 = Class 0 - No Event Object is Created
1 = Class 1 - Event Objects Created
2 = Class 2 - Event Objects Created
3 = Class 3 - Event Objects Created

Note: If the Master has Enabled Unsolicited Reporting (Report by Exception) for a Class, then Event Objects in that Class are sent to the Master immediately upon creation.

| | Static | | Event | | | | | |
|---|---|---|---|---|---|---|---|---|
| Index | Group | Var | Group | Var | Description | Setup Parameter | Default Value | Current Value |
| 20 | 01 | 01 | 02 | 02 | Float Backup - Off Level - From Discrete Input (Function 33) | u.20 | 2 | |
| 21 | 01 | 01 | 02 | 02 | Float Backup - 1st On Level - From Discrete Input (Function 34) | u.21 | 2 | |
| 22 | 01 | 01 | 02 | 02 | Float Backup - 2nd On Level - From Discrete Input (Function 35) | u.22 | 2 | |
| 23 | 01 | 01 | 02 | 02 | Float Backup - 3rd On Level - From Discrete Input (Function 36) | u.23 | 2 | |
| 24 | 01 | 01 | 02 | 02 | Float Backup - 4th On Level - From Discrete Input (Function 37) | u.24 | 2 | |
| 25 | 01 | 01 | 02 | 02 | Pump Called on Float Backup | u.25 | 2 | |
| 26 | 01 | 01 | 02 | 02 | Pump Called on Level Probe Backup | u.26 | 2 | |
| 27-39 | 01 | 01 | 02 | 02 | Spare | u.27 - u.39 | 2 | |
| 40 | 01 | 01 | 02 | 02 | Telemetry A - From Discrete Input (Function 27) | u.40 | 2 | |
| 41 | 01 | 01 | 02 | 02 | Telemetry B - From Discrete Input (Function 28) | u.41 | 2 | |
| 42 | 01 | 01 | 02 | 02 | Telemetry C - From Discrete Input (Function 29) | u.42 | 2 | |
| 43 | 01 | 01 | 02 | 02 | Telemetry D - From Discrete Input (Function 30) | u.43 | 2 | |
| 44 | 01 | 01 | 02 | 02 | Telemetry E - From Discrete Input (Function 19) | u.44 | 2 | |
| 45 | 01 | 01 | 02 | 02 | Telemetry F - From Discrete Input (Function 20) | u.45 | 2 | |
| 46 | 01 | 01 | 02 | 02 | Telemetry G - From Discrete Input (Function 21) | u.46 | 2 | |
| 47 | 01 | 01 | 02 | 02 | Telemetry H - From Discrete Input (Function 22) | u.47 | 2 | |
| 48 | 01 | 01 | 02 | 02 | Telemetry J - From Discrete Input (Function 23) | u.48 | 2 | |
| 49 | 01 | 01 | 02 | 02 | Telemetry K - From Discrete Input (Function 24) | u.49 | 2 | |
| 50 | 01 | 01 | 02 | 02 | Telemetry L - From Discrete Input (Function 25) | u.50 | 2 | |
| 51 | 01 | 01 | 02 | 02 | Telemetry M - From Discrete Input (Function 26) | u.51 | 2 | |

## Binary Input Object Table

### Setup Definitions for u.XX Parameters

0 = Class 0 - No Event Object is Created
1 = Class 1 - Event Objects Created
2 = Class 2 - Event Objects Created
3 = Class 3 - Event Objects Created

Note: If the Master has Enabled Unsolicited Reporting (Report by Exception) for a Class, then Event Objects in that Class are sent to the Master immediately upon creation.

| | Static | | Event | | | | | |
|---|---|---|---|---|---|---|---|---|
| Index | Group | Var | Group | Var | Description | Setup Parameter | Default Value | Current Value |
| 52 | 01 | 01 | 02 | 02 | Level Probe Electrode Input 1 | u.52 | 2 | |
| 53 | 01 | 01 | 02 | 02 | Level Probe Electrode Input 2 | u.53 | 2 | |
| 54 | 01 | 01 | 02 | 02 | Level Probe Electrode Input 3 | u.54 | 2 | |
| 55 | 01 | 01 | 02 | 02 | Level Probe Electrode Input 4 | u.55 | 2 | |
| 56 | 01 | 01 | 02 | 02 | Level Probe Electrode Input 5 | u.56 | 2 | |
| 57 | 01 | 01 | 02 | 02 | Level Probe Electrode Input 6 | u.57 | 2 | |
| 58 | 01 | 01 | 02 | 02 | Level Probe Electrode Input 7 | u.58 | 2 | |
| 59 | 01 | 01 | 02 | 02 | Level Probe Electrode Input 8 | u.59 | 2 | |
| 60 | 01 | 01 | 02 | 02 | Level Probe Electrode Input 9 | u.60 | 2 | |
| 61 | 01 | 01 | 02 | 02 | Level Probe Electrode Input 10 | u.61 | 2 | |
| 62 | 01 | 01 | 02 | 02 | Discrete Input 1 | u.62 | 2 | |
| 63 | 01 | 01 | 02 | 02 | Discrete Input 2 | u.63 | 2 | |
| 64 | 01 | 01 | 02 | 02 | Discrete Input 3 | u.64 | 2 | |
| 65 | 01 | 01 | 02 | 02 | Discrete Input 4 | u.65 | 2 | |
| 66 | 01 | 01 | 02 | 02 | Discrete Input 5 | u.66 | 2 | |
| 67 | 01 | 01 | 02 | 02 | Discrete Input 6 | u.67 | 2 | |
| 68 | 01 | 01 | 02 | 02 | Discrete Input 7 | u.68 | 2 | |
| 69 | 01 | 01 | 02 | 02 | Discrete Input 8 | u.69 | 2 | |
| 70 | 01 | 01 | 02 | 02 | Discrete Input 9 | u.70 | 2 | |
| 71 | 01 | 01 | 02 | 02 | Discrete Input 10 | u.71 | 2 | |

## SC2000 DNP3 Object Library

### Setup Definitions for u.XX Parameters

0 = Class 0 - No Event Object is Created
1 = Class 1 - Event Objects Created
2 = Class 2 - Event Objects Created
3 = Class 3 - Event Objects Created

Note: If the Master has Enabled Unsolicited Reporting (Report by Exception) for a Class, then Event Objects in that Class are sent to the Master immediately upon creation.

## Binary Input Object Table

| | Static | | Event | | | | | |
|---|---|---|---|---|---|---|---|---|
| Index | Group | Var | Group | Var | Description | Setup Parameter | Default Value | Current Value |
| 72 | 01 | 01 | 02 | 02 | Discrete Input 11 | u.72 | 2 | |
| 73 | 01 | 01 | 02 | 02 | Discrete Input 12 | u.73 | 2 | |
| 74 | 01 | 01 | 02 | 02 | Discrete Input 13 | u.74 | 2 | |
| 75 | 01 | 01 | 02 | 02 | Discrete Input 14 | u.75 | 2 | |
| 76 | 01 | 01 | 02 | 02 | Discrete Input 15 | u.76 | 2 | |
| 77 | 01 | 01 | 02 | 02 | Discrete Input 16 | u.77 | 2 | |
| 78 | 01 | 01 | 02 | 02 | Discrete Input 17 | u.78 | 2 | |
| 79 | 01 | 01 | 02 | 02 | Discrete Input 18 | u.79 | 2 | |
| | | | | | | | | |

# SC2000 DNP3 Object Library

## Binary Output Object Table

| | Status | | Command | | |
|---|---|---|---|---|---|
| Index | Group | Var | Group | Var | Description |
| 00 | 10 | 02 | 12 | 01 | Pump 1 Remote Control - Force Pump On |
| 01 | 10 | 02 | 12 | 01 | Pump 2 Remote Control - Force Pump On |
| 02 | 10 | 02 | 12 | 01 | Pump 3 Remote Control - Force Pump On |
| 03 | 10 | 02 | 12 | 01 | Pump 4 Remote Control - Force Pump On |
| 04 | 10 | 02 | 12 | 01 | Pump 1 Elapsed Time Meter Reset |
| 05 | 10 | 02 | 12 | 01 | Pump 2 Elapsed Time Meter Reset |
| 06 | 10 | 02 | 12 | 01 | Pump 3 Elapsed Time Meter Reset |
| 07 | 10 | 02 | 12 | 01 | Pump 4 Elapsed Time Meter Reset |
| 08 | 10 | 02 | 12 | 01 | Relay Remote Control - HI - With Parameter F.31 = 2 |
| 09 | 10 | 02 | 12 | 01 | Relay Remote Control - LO - With Parameter F.32 = 2 |
| 10 | 10 | 02 | 12 | 01 | Relay Remote Control - P1 - With Parameter F.33 = 2 |
| 11 | 10 | 02 | 12 | 01 | Relay Remote Control - P2 - With Parameter F.34 = 2 |
| 12 | 10 | 02 | 12 | 01 | Relay Remote Control - P3 - With Parameter F.35 = 2 |
| 13 | 10 | 02 | 12 | 01 | Relay Remote Control - P4 - With Parameter F.36 = 2 |
| 14 | 10 | 02 | 12 | 01 | Fault Code (FLC) & Last Fault Code (LFC) - Reset |
| 15 | 10 | 02 | 12 | 01 | Spare |
| 16 | 10 | 02 | 12 | 01 | Pump 1 Remote Control - Disable Pump Operation |
| 17 | 10 | 02 | 12 | 01 | Pump 2 Remote Control - Disable Pump Operation |
| 18 | 10 | 02 | 12 | 01 | Pump 3 Remote Control - Disable Pump Operation |
| 19 | 10 | 02 | 12 | 01 | Pump 4 Remote Control - Disable Pump Operation |
| 20 | 10 | 02 | 12 | 01 | Force Pump Alternation |
| 21 | 10 | 02 | 12 | 01 | Flush Cycle - Start Flush Cycle |
| 22 | 10 | 02 | 12 | 01 | Flush Cycle - Stop Flush Cycle |

**Setup Definitions for r.XX Parameters**

0 = Class 0 - No Event Object is Created
1 = Class 1 - Event Objects Created
2 = Class 2 - Event Objects Created
3 = Class 3 - Event Objects Created

Note: If the Master has Enabled Unsolicited Reporting (Report by Exception) for a Class, then Event Objects in that Class are sent to the Master immediately upon creation.

## Analog Input Object Table

| | Static | | Event | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Index | Group | Var | Group | Var | Description | Setup Param. | Default Value | Current Value | Dead-band Param. | Default Value | Current Value |
| 00 | 30 | 04 | 32 | 04 | Wet Well Level (As shown on display with no decimal point) | r.00 | 2 | | t.00 | 10 | |
| 01 | 30 | 04 | 32 | 04 | Pump 1 Elapsed Time Meter (hr & 1/10 hr) (0.0 - 6553.5) | r.01 | 2 | | t.01 | 10 | |
| 02 | 30 | 04 | 32 | 04 | Pump 2 Elapsed Time Meter (hr & 1/10 hr) (0.0 - 6553.5) | r.02 | 2 | | t.02 | 10 | |
| 03 | 30 | 04 | 32 | 04 | Pump 3 Elapsed Time Meter (hr & 1/10 hr) (0.0 - 6553.5) | r.03 | 2 | | t.03 | 10 | |
| 04 | 30 | 04 | 32 | 04 | Pump 4 Elapsed Time Meter (hr & 1/10 hr) (0.0 - 6553.5) | r.04 | 2 | | t.04 | 10 | |
| 05 | 30 | 04 | 32 | 04 | Auxiliary Analog Input 1 (10-Bit 205 - 1023) | r.05 | 2 | | t.05 | 10 | |
| 06 | 30 | 04 | 32 | 04 | Auxiliary Analog Input 2 (10-Bit 205 - 1023) | r.06 | 2 | | t.06 | 10 | |
| 07 | 30 | 04 | 32 | 04 | Auxiliary Analog Input 3 (10-Bit 205 - 1023) | r.07 | 2 | | t.07 | 10 | |
| 08 | 30 | 04 | 32 | 04 | Auxiliary Analog Input 4 (10-Bit 205 - 1023) | r.08 | 2 | | t.08 | 10 | |
| 09 | 30 | 04 | 32 | 04 | Analog Output 1 (12-Bit 0 - 4095) | r.09 | 2 | | t.09 | 10 | |
| 10 | 30 | 04 | 32 | 04 | Analog Output 2 (12-Bit 0 - 4095) | r.10 | 2 | | t.10 | 10 | |
| 11 | 30 | 04 | 32 | 04 | Analog Output 3 (12-Bit 0 - 4095) | r.11 | 2 | | t.11 | 10 | |
| 12 | 30 | 04 | 32 | 04 | Analog Output 4 (12-Bit 0 - 4095) | r.12 | 2 | | t.12 | 10 | |
| 13 | 30 | 04 | 32 | 04 | Voltage of +5 Volt Power Supply (Same as Parameter d.01) | r.13 | 2 | | t.13 | 10 | |
| 14 | 30 | 04 | 32 | 04 | Voltage of +24 Volt Power Supply (Same as Parameter d.02) | r.14 | 2 | | t.14 | 10 | |
| 15 | 30 | 04 | 32 | 04 | Operating Program Revision Number - Control Board (oPr) | r.15 | 2 | | t.15 | 1 | |
| 16 | 30 | 04 | 32 | 04 | Operating Program Revision Number - Ethernet Board (EPr) | r.16 | 2 | | t.16 | 1 | |
| 17 | 30 | 04 | 32 | 04 | Current Lead Pump Position | r.17 | 2 | | t.17 | 1 | |
| 18 | 30 | 04 | 32 | 04 | Fault Code (Same as Parameter FLC) | r.18 | 2 | | t.18 | 1 | |
| 19 | 30 | 04 | 32 | 04 | Last Fault Code (Same as Parameter LFC) | r.19 | 2 | | t.19 | 1 | |

## Analog Input Object Table

**Setup Definitions for r.XX Parameters**

0 = Class 0 - No Event Object is Created
1 = Class 1 - Event Objects Created
2 = Class 2 - Event Objects Created
3 = Class 3 - Event Objects Created

Note: If the Master has Enabled Unsolicited Reporting (Report by Exception) for a Class, then Event Objects in that Class are sent to the Master immediately upon creation.

| | Static | | Event | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Index | Group | Var | Group | Var | Description | Setup Param. | Default Value | Current Value | Dead-band Param. | Default Value | Current Value |
| 20 | 30 | 04 | 32 | 04 | Flow Calculator - Latest Inflow Rate (Gallons Per Minute) (Same as Param. FLH,FLL) | r.20 | 2 | | t.20 | 10 | |
| 21 | 30 | 04 | 32 | 04 | Flow Calculator - Average Daily Inflow Total (Gallons or Thousand Gallons Per Day) (Same as Param. FdH,FdL) | r.21 | 2 | | t.21 | 10 | |
| 22 | 30 | 04 | 32 | 04 | Flow Calculator - Pump 1 Outflow Rate (Gallons Per Minute) (Same as Param. F1H,F1L) | r.22 | 2 | | t.22 | 10 | |
| 23 | 30 | 04 | 32 | 04 | Flow Calculator - Pump 2 Outflow Rate (Gallons Per Minute) (Same as Param. F2H,F2L) | r.23 | 2 | | t.23 | 10 | |
| 24 | 30 | 04 | 32 | 04 | Flow Calculator - Pump 3 Outflow Rate (Gallons Per Minute) (Same as Param. F3H,F3L) | r.24 | 2 | | t.24 | 10 | |
| 25 | 30 | 04 | 32 | 04 | Flow Calculator - Pump 4 Outflow Rate (Gallons Per Minute) (Same as Param. F4H,F4L) | r.25 | 2 | | t.25 | 10 | |
| 26 | 30 | 04 | 32 | 04 | Flow Calculator - Daily Inflow Total - Day 1 (Gallons or Thousand Gallons Per Day) | r.26 | 2 | | t.26 | 10 | |
| 27 | 30 | 04 | 32 | 04 | Flow Calculator - Daily Inflow Total - Day 2 (Gallons or Thousand Gallons Per Day) | r.27 | 2 | | t.27 | 10 | |
| 28 | 30 | 04 | 32 | 04 | Flow Calculator - Daily Inflow Total - Day 3 (Gallons or Thousand Gallons Per Day) | r.28 | 2 | | t.28 | 10 | |
| 29 | 30 | 04 | 32 | 04 | Flow Calculator - Daily Inflow Total - Day 4 (Gallons or Thousand Gallons Per Day) | r.29 | 2 | | t.29 | 10 | |
| 30 | 30 | 04 | 32 | 04 | Flow Calculator - Daily Inflow Total - Day 5 (Gallons or Thousand Gallons Per Day) | r.30 | 2 | | t.30 | 10 | |
| 31 | 30 | 04 | 32 | 04 | Flow Calculator - Daily Inflow Total - Day 6 (Gallons or Thousand Gallons Per Day) | r.31 | 2 | | t.31 | 10 | |
| 32 | 30 | 04 | 32 | 04 | Flow Calculator - Daily Inflow Total - Day 7 (Gallons or Thousand Gallons Per Day) | r.32 | 2 | | t.32 | 10 | |

## Analog Output Object Table

| | Status | | Command | | |
|---|---|---|---|---|---|
| Index | Group | Var | Group | Var | Description |
| 00 | 40 | 02 | 41 | 02 | Setup Parameter - 1st Pump On Level |
| 01 | 40 | 02 | 41 | 02 | Setup Parameter - 1st Pump Off Level |
| 02 | 40 | 02 | 41 | 02 | Setup Parameter - 2nd Pump On Level |
| 03 | 40 | 02 | 41 | 02 | Setup Parameter - 2nd Pump Off Level |
| 04 | 40 | 02 | 41 | 02 | Setup Parameter - 3rd Pump On Level |
| 05 | 40 | 02 | 41 | 02 | Setup Parameter - 3rd Pump Off Level |
| 06 | 40 | 02 | 41 | 02 | Setup Parameter - 4th Pump On Level |
| 07 | 40 | 02 | 41 | 02 | Setup Parameter - 4th Pump Off Level |
| 08 | 40 | 02 | 41 | 02 | Setup Parameter - High Level Alarm |
| 09 | 40 | 02 | 41 | 02 | Setup Parameter - Low Level Alarm |
| 10 | 40 | 02 | 41 | 02 | Force Lead Pump Position (Same as Parameter P.39)<br>0 = Alternate 1 = Pump 1 Lead 2 = Pump 2 Lead 3 = Pump 3 Lead 4 = Pump 4 Lead |
| 11 | 40 | 02 | 41 | 02 | Remote Level Input (Must set Parameter F.19 = 4.) |
| 12 | 40 | 02 | 41 | 02 | Speed of Pumps Forced On (Percent of Full Speed, 0-100%) (Same as Parameter P.53)<br>This Only Applies to Pumps that are Remotely Forced On |
| 13 | 40 | 02 | 41 | 02 | Flow Calculator - 24 Hour Clock Advance<br>Set to “1” to force the Internal Time Clock to advance to the end of the current 24 hour period. |

# SCADA FEATURES

The following pages make reference to the SC2000 DNP3 Object Library, in Appendix A on pages A7 - A14.

Convention used to reference the DNP3 Objects: Group Number / Variation Number / Index Number

## Level

### Level Monitoring

The Level may be monitored by reading Analog Input Object: 32/04/00. The value will be the same as what is displayed on the front of the controller but with no decimal point. If an operator has the Controller in the Level Simulation Mode, it will show the simulated level.

### Remote Level Input

In cases where the pumps empty or fill a remote tank, the SCADA system Master may be programmed to collect the level data from the remote tank and write the level to Analog Output Object: 41/02/11 in the Controller. The status may be read from Analog Output Object: 40/02/11. For the Controller to follow this value, Parameter F.19 must be set on 4. Also, the value written to Controller must already be scaled into feet as it would be displayed on the front of the Controller, but with no decimal point. The decimal point is artificially inserted by the Controller based on Parameter P.36. For example, a level of 8.6 feet would be written as 86 (assuming that Parameter P.36 = 1).

If the SCADA Communication Link with the Master is lost, the Controller will no longer receive current level data, and it must not continue to run the pumps. If the loss of the Communication Link with the Master is established, the time delay set on Parameter P.38 will start. When the time delay expires, the Controller will turn off all pumps and turn on the Fault indicator and place Fault Code 37 in Parameter FLC. The Level Display will also flash and show the last value written to the Controller. The status of the Communication Link with the DNP3 Master may be viewed from Parameter d.00. See Page A18.

## Discrete Inputs

The status of all the Discrete Inputs may always be read from Binary Input Objects: 02/02/62-79, regardless of what function may be assigned to the inputs.

The status of the Discrete Inputs assigned Functions 19 - 30 (Telemetry A - M) do not perform any control functions inside the Controller, but their status may be read from Binary Input Objects: 02/02/40-51.

Discrete Inputs assigned with Functions 7 - 8, 17 - 18 and 31 - 38 perform their respective function inside the Controller but also have their status available to be read, as shown in the “Binary Input Object Table”.

## Auxiliary Analog Input Data

The optional Auxiliary Analog Inputs may be used to monitor such things as flow, pump speed, motor current, or whatever is connected to them. The inputs perform no control function inside the Controller.

The Data may be read in a 10-bit format (205 - 1023), from Analog Input Objects: 32/04/05-08.

The Object Data shows a value of 205 with a 4.0mA input, and 1023 with a 20mA input.

Also, an 8-bit version of the data may be viewed on the front of the Controller under Parameters n.19 - n.22.

## Analog Outputs

The internal numbers used to control the Analog Outputs are available to be read through SCADA.

The values are in a 12-bit format (0 - 4095), and may be read from Analog Input Objects: 32/04/09-12.

The Object Data shows a value of 0 with a 4.0mA output, and 4095 with a 20mA Output.

Also, a 0-100% version of the control numbers may be viewed on the front of the Controller under Parameters d.03 - d.06.

## Pump On / Off and Alarm Levels

The Pump On, Pump Off, High Alarm, and Low Alarm levels may be changed from Analog Output Objects: 41/02/00-09, and they may be viewed from Analog Output Objects: 40/02/00-09.

# SCADA FEATURES

## Disable Pump Operation

To Disable Pumps write 1 to Binary Output Objects: 12/01/16-19. To return pumps to normal operation, write 0. Status of pump disable may be read from Binary Output Objects: 10/02/16-19.

If the SCADA Communication Link with the Master is lost, the Pump Disable Logic will be automatically reset, and any pump that had been remotely disabled will be re-enabled. If the loss of the Communication Link with the Master is established, the time delay set on Parameter P.38 will start. When the time delay expires, the Pump Disable Logic will be reset. The status of the Communication Link with the DNP3 Master may be viewed from Parameter d.00. See Page A18.

## Force Pump On

To Force Pump On write 1 to Binary Output Objects: 12/01/00-03. To return pumps to normal operation, write 0. The status may be read from Binary Output Objects: 10/02/00-03.

If the SCADA Communication Link with the Master is lost, the Force Pump On Logic will be automatically reset, and any pump that had been remotely forced on will be turned off. If the loss of the Communication Link with the Master is established, the time delay set on Parameter P.38 will start. When the time delay expires, the Force Pump On Logic will be reset. The status of the Communication Link with the DNP3 Master may be viewed from Parameter d.00. See Page A18.

## Speed of Pumps Forced On

To control the Speed of Pumps that are Forced On, write the desired speed in percent to Analog Output Object: 41/02/12. The status may be read from Analog Output Object: 40/02/12. The new value will be stored in non-volatile EEPROM memory. The default speed is 100%. The setting may also be viewed or changed from Parameter P.53.

## Force Pump Alternation

To force Pump Alternation, write 1 to Binary Output Object: 12/01/20.

## Force Lead Pump Position

The Forcing of the Lead Pump Position may be accomplished by writing a 1,2,3 or 4 to Analog Output Object: 41/02/10. The status may be read from Analog Output Object: 40/02/10. To return to normal alternation, write a zero. Setting a pump to lead does not guarantee that the pump selected will be lead. If the pump selected as lead is disabled (by a pump disable discrete input), then the next available pump will be made lead. A lead pump selector switch connected to discrete inputs, programmed as sequence inputs, will also override the setting. The setting may also be changed at Parameter P.39. The value of the setting is saved in non-volatile memory. The Current Lead Pump Position may be read from Analog Input Object: 32/04/17.

## Relay Remote Control

Relays that are not needed for pump control or alarm outputs, may be controlled remotely by setting their Output Function (Parameters F.31 - 36) to 2.

Remote control is accomplished by write 1 or 0 to Binary Output Objects: 12/01/08-13. The status may be read from Binary Output Objects: 10/02/08-13.

The HI Relay operates differently from the others. It has a normally closed contact, so the logic is inverted. Also, when the power is lost to the Controller the HI Relay contact will close.

If the SCADA Communication Link with the Master is lost, the relay control commands will be automatically cleared. If the loss of the Communication Link with the Master is established, the time delay set on Parameter P.38 will start. When the time delay expires, the relay control commands will be cleared. The status of the Communication Link with the DNP3 Master may be viewed from Parameter d.00. See Page A18.

## Flush Cycle

To Start Flush Cycle, write 1 to Binary Output Object: 12/01/21.

To Stop Flush Cycle, write 1 to Binary Output Object: 12/01/22.

Flush Cycle Active / Inactive status may be read from Binary Input Object: 02/02/19. Where 1 is active, and 0 is inactive.

# SCADA FEATURES

## Flow Calculator

The **Latest Inflow Rate** may be read from Analog Input Object: 32/04/20.

The **Average Daily Inflow Total** may be read from Analog Input Object: 32/04/21.

The **Pump 1-4 Outflow Rate** may be read from Analog Input Objects: 32/04/22-25.

The **Daily Inflow Total (Day 1-7)** may be read from Analog Input Objects: 32/04/26-32.

The **24 Hour Clock Advance** feature provides the means to advance the internal 24 hour Time Clock to sometime in the last minute just before the latest 24 hour period ends. The Flow Calculator collects and keeps a running total of the liquid flowing into the lift station, and at the end of each 24 hour period the new flow data is moved to Day 1. The new flow data is then included in the calculation of the Average Daily Inflow Total. This feature is provided to speed up this process for testing and demonstration purposes. To advance to the end of the latest 24 hour period write 1 to Analog Output Object: 41/02/13. When the advancement occurs, the value will be returned to “0”. The status may be read from Analog Output Object: 40/02/13.

## High Level Alarm

The **High Level Alarm - From Level Input** is generated from a comparison of the displayed Level Input with the High Level alarm setting. This alarm works when Parameter F.19 is set on either 1, 2 or 3. The status of this alarm may be read from Binary Input Object: 02/02/10.

The **High Level Alarm - From Float Switch** is generated by the closure a float switch connected to a Discrete Input programmed for either Function 18 or 38. The status of this alarm may be read from Binary Input Object: 02/02/11.

The **High Level Alarm - From Level Probe Backup** is generated when liquid covers the High Level Electrode of a Level Probe Input. Parameter b.07 must be setup with the number of the Level Probe Input used to read the High Level. The status of this alarm may be read from Binary Input Object: 02/02/12.

The **High Level Alarm - From Any Source** is generated by any of the above three sources of High Level Alarm. The status of this alarm may be read from Binary Input Object: 02/02/13.

## Low Level Alarm

The **Low Level Alarm - From Level Input** is generated from a comparison of the displayed Level Input with the Low Level alarm setting. This alarm works when Parameter F.19 is set on either 1, 2 or 3. The status of this alarm may be read from Binary Input Object: 02/02/14.

The **Low Level Alarm - From Float Switch** is generated by the closure a float switch connected to a Discrete Input programmed for either Function 17 or 32. The status of this alarm may be read from Binary Input Object: 02/02/15.

The **Low Level Alarm - From Level Probe Backup** is generated when liquid uncovers the Low Level Electrode of a Level Probe Input. Parameter b.01 must be setup with the number of the Level Probe Input used to read the Low Level. The status of this alarm may be read from Binary Input Object: 02/02/16.

The **Low Level Alarm - From Any Source** is generated by any of the above three sources of Low Level Alarm. The status of this alarm may be read from Binary Input Object: 02/02/17.

## Fault Codes

The **Fault Code** (Parameter FLC) may be read from Analog Input Object: 32/04/18.

The **Last Fault Code** (Parameter LFC) may be read from Analog Input Object: 32/04/19.

The **Fault Code** and the **Last Fault Code** may be reset by write 1 to Binary Output Object: 12/01/14.

## Elapsed Time Meters

**Pump 1-4 Elapsed Time Meters** may be read from Analog Input Objects: 32/04/01-04. The values read from these registers are intended for use in comparing the pump run time of one pump with the run time of the other pumps at the station, for the purpose of checking for uneven run times. (Uneven run times is an indication of a maintenance problem with one of the pumps.) Periodically the comparison of run times should be made and the registers should reset to zero. The ETM data is stored in non-volatile memory just prior to a total loss of internal 5V power, so the data is not lost during a power outage. To reset the ETMs to zero, write 1 to Binary Output Objects: 12/01/04-07.

# SCADA TROUBLESHOOTING

## Communication Link Established with DNP3 Master

The status of the "Communication Link Established with DNP3 Master" may be viewed from Parameter d.00 and may be used to help troubleshoot communication issues.

Parameter d.00 pulses from "0" to "1" momentarily to indicate that the Controller is Linked to the DNP3 Master.

If the Link with the DNP3 Master is lost or not established, then Parameter d.00 will show a "0".

The pulsing from "0" to "1" does not indicate that the Controller is being polled, only that it is Linked to the DNP3 Master.