Section 14

Digi-Gage Control Systems

This section provides information on all control products offered by EG Controls including the following:

- Digi-Gage Control Systems
- Digi-Gage Control Systems to interface with SCADA Systems
- Digi-Gage Controller Only
- Digi-Gage Retrofit Control System

In this section, you will find:

- A listing of all the Digi-Gage “standards” that can be priced and purchased via our online Representative Pricing System (15 HP and below only – please call for a quotation on systems with higher HP)
- Digi-Gage Brochure (available online)
- Digi-Gage Operations Manual (available online)
- Digi-Gage Technical Data Sheets for 2300, 2400 and 2600 (available online)
- Digi-Gage Control System Standard Specification (available online)
- Digi-Gage Customer Configuration Worksheet, Duplex (available online)
  A triplex version is also available online but is not included in this book.

For further assistance…

Please call 904-292-0110 or sales@egcontrols.com
Standard systems available for Online Pricing include the following:

Choose from two different type base system configurations:

Type 1  E Frame Pump Breakers, NEMA Rated Motor Starters, Overload Reset Pushbutton Mounted through Inner Door

Type 2  G Frame Pump Breakers (for 480V Systems), Q Frame Pump Breakers (for 208-240V Systems), IEC Rated Motor Starters

**Digi-Gage Series, Duplex or Triplex Pump Control Panel**
200-208V; 230-240V; or 460-480V, 3 phase for up to 15 HP

**Digi-Gage Series, Controller Only**
200-208V; 230-240V; or 460-480V, 3 phase for up to 15 HP

The base system is UL listed and includes the following:

*Note: Those items in bold are included in a Controller Only unit.*

- Digi-Gage 2300 Controller
- Lexan Control Plate with programming instructions
- Pump Circuit Breakers
- Full Voltage Non-Reversing Motor Starters
- **Anti-Condensation Heater for the Enclosure**
- Plug in Relays with 10A DPDT contacts and LED indicators for Pump and Alarm outputs
- Output Status Indicator LEDs (daylight visible) mounted on deadfront inner door for HIGH/LOW Level Alarms and up to three pumps
- Ground Lugs for Pump and Service Connections
- **Serialized UL 508 Label**
- Control Power Circuit Breaker Operable Through Inner Door
- **24VAC Control Power Transformer with Circuit Breaker for Digi-Gage and Relay Power**
- Hand-Off-Automatic Switches
- Run Pilot Lights
- **As Built Drawings (2)**
- **Standard Digi-Gage Operations Manual**

Continue to next page for additional option information…
For all Digi-Gage control panels, possible options include the following:
Note: All of the following options are available at additional cost. Cost varies by option requirements - see system for actual pricing.

1. Main Breaker Through the Door Operators (for Pump, Main or Both) n/a for Controller Only
2. Circuit Breakers for Auxiliary Power
3. Lightning Arrestor n/a for Controller Only
4. Surge Arrestor n/a for Controller Only
5. Line Monitor/Protection Relay (undervoltage for 1 ph, phase monitor for 3 ph) n/a for Controller Only
6. Duplex Receptacle
7. Pump Start Time Delay
8. Elapse Time Meter
9. Cycle Counter (resettable, mounted on inner door – consult factory if non-resettable is required)

Options 10 – 14 are back up float control circuits not applicable for Digi-Gage panels.
10. Float Status Pilot Lights
11. Float Simulation Test Switches
12. Level Float Circuits (High and/or Low Available)
13. 24 VAC Float Switch Control Circuit (replaces standard 120V circuit, customer must supply float switches)
14. Intrinsic Safe Float Control Circuit (replaces standard 120V circuit, customer must supply float switches)
15. 120 VAC Float Back Up Control Circuit
16. 24 VAC Float Back Up Control Circuit
17. Intrinsic Safe Float Back Up Control Circuit
18. Motor Overtemperature Alarms
19. Seal Fail Alarms
20. Station Alarms (Audible)
21. Station Alarms (Visual)
22. Remote Alarm Enclosure
23. Phone Dialer (customer must supply dialer, can choose factory or field installation)
24. Isolated Dry Contacts (wired to terminals)
25. Single Phase Start Kit (for 1 phase panels only, customer can choose factory or field installation)
26. Bubbler Air Supply Source
27. Submersible Level Transmitter and associated components
28. Vertical Bargraph
29. UL Power Supply (required if any non-UL components are used)
30. OFF/ON Heater Switch
31. Control Power Transformer
32.
Product Overview

The Digi-Gage 2300 is a level monitoring system capable of controlling up to three pumps or measuring wet wells and tank levels. This exceptional versatility has been proven in a broad spectrum of applications ranging from critical control of tank levels to monitoring effluent flow in pumping stations.

The Digi-Gage delivers the control efficiency and productivity needed to meet today’s exacting standards. The system uses an internal pressure transducer (15 psi max) or a remote mounted submersible pressure transducer to monitor water and wastewater.

Other models are available to handle a variety of liquid level control requirements:

- Digi-Gage 2400 for up to 4 pumps in a triplex or quadruplex configuration (constant speed).
- Digi-Gage 2600 for up to 6 pumps in a fiveplex or sixplex configuration (constant speed).
- Vari-Gage 3300 for up to 3 pumps in a duplex or triplex configuration (constant or variable speed).

Product Features

- Easy to configure for simplex, duplex or triplex applications
- Program with only three simple steps!
- Level simulation by using UP and DOWN arrow keys
- Performs self-diagnostics upon power up to maintain optimum status
- Pneumatic connector accepts standard ¼" OD flex tubing
- Draw-out chassis construction
- No wires or pneumatic connections to disconnect
- Three field selectable inputs: 4-20mA; 0-10V, 0-15 psi
- NEMA 1 housing
- Easy to read ½" high 7 segment LED
- Differential level control
- Level indication (0 – 999)
- 15 discrete LED’s for Mode/Status indication
- EEPROM (electrically erasable programmable read only memory) lasts for 100 years – no battery back-up required
- Pump up or pump down capability
- Manual or automatic alternation
- MODBUS communications capability
- Lag pump start delay of ten seconds
- 100% digital technology -- virtually eliminating all sources of drift or error.
- Works with Scada Express for implementation of remote station monitoring and control.

Manufacturer Information

The Digi-Gage is exclusively available from:

EG Controls
JACKSONVILLE, FLORIDA
11790 Philips Highway
Jacksonville, Florida 32256
Telephone: 904-292-0110    Fax: 904-292-0119
Email: sales@egcontrols.com
Visit out website at www.egcontrols.com
**Technical Specifications**

- **Input Power:**
  24VAC, 8.5 VA, 350mA
- **Environment:**
  Ambient Temperature (-10°C to 70°C)
- **Display Range:**
  Keypad selectable, 0-999, 0-99.9, 0-9.99, 0-.999
- **Resolution:**
  0.006%, 14 bit A/D
- **Input Options:**
  4-20mA (50 Ω impedance)
  0-10 VDC (>150K Ω impedance)
  0-15 psi (clean, dry air only)
- **Memory:**
  NOVRAM EEPROM 100 Year Memory. No batteries needed
- **Programming:**
  Via front panel function keys
- **Display:**
  .5" high 7 segment red LED, 3 digit
- **Housing:**
  Type 1, NEMA 1
- **Discrete Outputs:**
  7 contacts, SPST, 1A@120VAC
  3 pumps, 2 alarms (high and low)
  2 bubbler controls (isolate and purge)
- **Analog Output:**
  4-20mA (600 Ω load max)
- **Linearity:**
  +/- .005% analog output; +/- 0.1% pneumatic input

**Dimensions**

- **Dimensions:** 3.78" x 3.78" x 7.32"
- **Depth behind panel:** 6.4" max
- **Panel Cutout:** 3.6" x 3.6"
Product Overview

The Digi-Gage 2400 is a level monitoring system capable of controlling up to four pumps or measuring wet wells and tank levels. This exceptional versatility has been proven in a broad spectrum of applications ranging from critical control of tank levels to monitoring effluent flow in pumping stations.

The Digi-Gage delivers the control efficiency and productivity needed to meet today's exacting standards. The system uses an internal pressure transducer (15 psi max) or a remote mounted submersible pressure transducer to monitor water and wastewater.

Other models are available to handle a variety of liquid level control requirements:
- Digi-Gage 2300 for up to 3 pumps in a duplex or triplex configuration (constant speed).
- Digi-Gage 2600 for up to 6 pumps in a five-plex or six-plex configuration (constant speed).
- Vari-Gage 3300 for up to 3 pumps in a duplex or triplex configuration (constant or variable speed).

Product Features

- Easy to configure for simplex, duplex or triplex applications
- Program with only three simple steps!
- No wires or pneumatic connections to disconnect
- Three field selectable inputs: 4-20mA; 0-10V, 0-15 psi
- NEMA 1 housing
- Easy to read ½” high 7 segment LED
- Differential level control
- Level indication (0 - 999 max)
- 15 discrete LED’s for Mode/Status indication
- EEPROM (electrically erasable programmable read only memory) lasts for 100 years – no battery back-up required
- Draw-out chassis construction
- Pneumatic connector accepts standard 1/4” OD flex tubing
- Pump up or pump down capability
- Manual or automatic alternation
- Performs self-diagnostics upon power up to maintain optimum status
- MODBUS communications capability
- Lag pump start delay of ten seconds
- 100% digital technology -- virtually eliminating all sources of drift or error.
- Level simulation by using UP and DOWN arrow keys
- Works with Scada Express for implementation of remote station monitoring and control.

Manufacturer Information

The Digi-Gage is exclusively available from:

EG Controls
JACKSONVILLE, FLORIDA
11790 Philips Highway
Jacksonville, Florida 32256
Telephone: 904-292-0110 Fax: 904-292-0119
Email: sales@egcontrols.com
Visit our website at www.egcontrols.com
**Technical Specifications**

**Input Power:**
24VAC, 8.5 VA, 350mA

**Environment:**
Ambient Temperature (-10°C to 70°C)

**Display Range:**
Keypad selectable, 0-999, 0-99.9, 0-9.99, 0-99

**Resolution:**
0.006%, 14 bit A/D

**Input Options:**
4-20mA (50 Ω impedance)
0-10 VDC (>150Ω impedance)
0-15 psi (clean, dry air only)

**Memory:**
NOVRAM EEPROM 100 Year Memory. No batteries needed

**Programming:**
Via front panel function keys

**Display:**
.5” high 7 segment red LED, 3 digit

**Housing:**
Type 1, NEMA 1

**Discrete Outputs:**
8 contacts, SPST, 1A@120VAC
4 pumps, 2 alarms (high and low)
2 bubbler controls (isolate and purge)

**Analog Output:**
4-20mA (600 Ω load max)

**Linearity:**
+/- .005% analog output; +/- 0.1% pneumatic input

---

**Dimensions**

**Dimensions:**
3.78” x 3.78” x 7.32”

**Depth behind panel:**
6.4” max

**Panel Cutout:**
3.6” x 3.6”

---

**EG Controls**

Jacksonville, Florida 32256

Telephone: 904-292-0110  Fax: 904-292-0119
**Product Overview**

The Digi-Gage 2600 is a level monitoring system capable of controlling up to six pumps or measuring wet wells and tank levels. This exceptional versatility has been proven in a broad spectrum of applications ranging from critical control of tank levels to monitoring effluent flow in pumping stations.

The Digi-Gage delivers the control efficiency and productivity needed to meet today’s exacting standards. The system uses an internal pressure transducer (15 psi max) or a remote mounted submersible pressure transducer to monitor water and wastewater.

**Product Features**

- Easy to configure for quadruplex, fiveplex or sixplex applications
- Program with only three simple steps!
- No wires or pneumatic connections to disconnect
- Three field selectable inputs: 4-20mA; 0-10V, 0-15 psi
- NEMA 1 housing
- Easy to read ½” high 7 segment LED
- Differential level control
- Level indication (0 – 999 max)
- 15 discrete LED’s for Mode/Status indication
- EEPROM (electrically erasable programmable read only memory) lasts for 100 years – no battery back-up required
- Draw-out chassis construction
- Pump up or pump down capability
- Manual or automatic alternation
- Performs self-diagnostics upon power up to maintain optimum status
- Pneumatic connector accepts standard 1/4” OD flex tubing

**MODBUS communications capability**
- Lag pump start delay of ten seconds
- 100% digital technology -- virtually eliminating all sources of drift or error.
- Level simulation by using UP and DOWN arrow keys
- Works with Scada Express for implementation of remote station monitoring and control.

**Manufacturer Information**

The Digi-Gage is exclusively available from:

EG Controls
11790 Philips Highway
Jacksonville, Florida 32256
Telephone: 904-292-0110  Fax: 904-292-0119
Email: sales@egcontrols.com
Visit our website at www.egcontrols.com
### Technical Specifications

**Input Power:**
24VAC, 8.5 VA, 350mA

**Environment:**
Ambient Temperature (-10°C to 70°C)

**Display Range:**
Keypad selectable, 0-999, 0-99.9, 0-9.99, 0-.999

**Resolution:**
0.006%, 14 bit A/D

**Input Options:**
4-20mA (50 Ω impedance)
0-10 VDC (>150k Ω impedance)
0-15 psi (clean, dry air only)

**Memory:**
NOVRAM EEPROM 100 Year Memory. No batteries needed

**Programming:**
Via front panel function keys

**Display:**
.5” high 7 segment red LED, 3 digit

**Housing:**
Type 1, NEMA 1

**Discrete Outputs:**
8 contacts, 6 pumps, 2 alarms (high and low)

**Analog Output:**
4-20mA (600 Ω load max)

**Linearity:**
+/- .005% analog input; +/- 0.1% pneumatic input

---

### Dimensions

**Dimensions:**
3.78” x 3.78” x 7.32”

**Depth behind panel:**
6.4” max

**Panel Cutout:**
3.6” x 3.6”
TABLE OF CONTENTS

CHAPTER 1  INTRODUCTION ................................................................................................................................. 5
  1.1  Equipment Application Notice .......................................................................................................................... 5
  1.2  Transducer Resolution ......................................................................................................................................... 5

CHAPTER 2  OPERATION ............................................................................................................................................... 7
  2.1  General ................................................................................................................................................................. 7
  2.2  Applying Power to the Digi-Gage .......................................................................................................................... 9
  2.3  Auto Mode ............................................................................................................................................................ 9
  2.4  Operational Overview .......................................................................................................................................... 9
  2.5  Level Alarms ....................................................................................................................................................... 10
  2.6  Purge .................................................................................................................................................................... 10
  2.7  Lamp Test ............................................................................................................................................................ 10
  2.8  Simulate (Manual Operation) .............................................................................................................................. 11
  2.9  Memory ............................................................................................................................................................... 11

CHAPTER 3  CONFIGURATION .................................................................................................................................. 13
  3.1  Input Configuration .............................................................................................................................................. 13
  3.2  Option Configuration .......................................................................................................................................... 14

CHAPTER 4  CALIBRATION ......................................................................................................................................... 17
  4.1  Calibration Mode Overview ................................................................................................................................ 17
  4.2  Calibration Procedure .......................................................................................................................................... 18

CHAPTER 5  PROGRAMMING ................................................................................................................................ 21
  5.1  Programming Function Overview ...................................................................................................................... 21
  5.2  Programming the Digi-Gage ................................................................................................................................ 22
  5.3  Exiting the Program Mode .................................................................................................................................. 24

CHAPTER 6  INSTALLATION .................................................................................................................................... 25
  6.1  Mounting ............................................................................................................................................................ 25
  6.2  Analog Inputs ....................................................................................................................................................... 26
  6.3  Communications .................................................................................................................................................. 28
  6.4  Pneumatic Connection ...................................................................................................................................... 30
  6.5  Optional Bargraph ............................................................................................................................................... 30

CHAPTER 7  TROUBLESHOOTING .................................................................................................................................. 31
  7.1  Error Codes ....................................................................................................................................................... 31

CHAPTER 8  MODEL COMPARISON ................................................................................................................................ 32

CHAPTER 9  STATEMENT OF WARRANTY .................................................................................................................. 33

Appendix ................................................................................................................................................................. 33
  Implementation of a Third Party SCADA System .................................................................................................... 34
  Internal Register Format .......................................................................................................................................... 35
  Calibration Theory .................................................................................................................................................. 39
  Calibration Math .................................................................................................................................................... 40
  Index ......................................................................................................................................................................... 41
Chapter 1  Introduction

IMPORTANT: PLEASE READ INSTRUCTIONS BEFORE USING THE DIGI-GAGE!

Congratulations on purchasing an EG Controls Digi-Gage Controller. Please be sure to carefully read and understand these instructions before operating. This manual should be kept in a convenient location for reference. If you have any questions, please do not hesitate to call your local representative or EG Controls directly for technical assistance.

1.1 Equipment Application Notice

Any failure of this instrument or system, for whatever reason, may leave an operating process without protection. Depending upon the application, this could result in possible damage to property or injury to persons. Please consider the need for additional backup equipment or alternate means of protection such as standby float controls, alarms, output limiters, failsafe valves, relief valves, emergency shutoffs, emergency switches, etc. If additional information is required, please contact your local representative or EG Controls, Inc.

To contact EG Controls:

EG Controls
11790 Philips Highway
Jacksonville, Florida 32256
Telephone: 904/292-0110
Fax: 904/292-0119
Website: www.egcontrols.com
Email: sales@egcontrols.com
Visit our website at www.egcontrols.com

1.2 Transducer Resolution

The standard operating range of the bubbler pressure transducer supplied within all Digi-Gage models is 0-35 feet. Should your application require a lower control range, 0 - 2 feet for example, you can recalibrate the Digi-Gage to achieve increased resolution without changing the sensor. Due to the high resolution capability of the 14 bit processor in the Digi-Gage, resolution of hundredths of a foot can be achieved with a simple decimal point change in the calibration procedure. The sensor will perform as well in the 0.00 - 2.00 foot control range as it does in a 0 - 35 foot range. The only requirement is that the control range be within the limits of 0 - 35 feet. For more information, please refer to Section 4.2 on Calibration Procedure on page 18 of this Manual.
Chapter 2  Operation

2.1  General

A typical Digi-Gage Model 2300 is shown below:

The Digi-Gage controller draw-out module can be easily removed from the outer housing. Grasp the lower portion of the frame and use a small screwdriver to press down the internal clip that shows through the rectangular opening at the base of the housing. When you feel the clip release, the handle will swing out and allow you to easily remove the draw-out module. You will need to remove the draw-out module to locate internal DIP switches and select the placement of the input jumper to configure the Digi-Gage to the type of sensory input required. See section 3.1 on page 13 for more information.

The full Digi-Gage control system, as pictured on the following page (Figure 2-B, page 8), includes the Digi-Gage microprocessor unit and several other operational features offered by EG Controls. Some of these features are:

- Bright Led Output Status Indicator Lights
- Printed Programming Instructions
- (Optional) User Adjustable Bargraph for Front Panel Level Indication
Figure 2-B  Sample Digi-Gage Control Plate for Duplex Operation

*Please note that Figure 2-B includes the optional bargraph and depicts Model 2300 only.*

Models 2400 and 2600 would be similar.
2.2 Applying Power to the Digi-Gage

When power is first applied to the Digi-Gage, you will see a LAMP TEST. During this test, the Digi-Gage begins sensing the process input and checking the memory (RAM, EPROM and EEPROM) for data integrity. When the test is complete, and the level averaging system has established valid data, the current level will be shown in the digital display.

If pumps are being called to operate, their activation will be staggered in 10 second intervals to prevent simultaneous starting. If a PURGE interval was programmed (Digi-Gage models 2300 and 2400 only), the PURGE cycle will automatically start and initialize the Purge Cycle interval timer (user selectable from 1 - 24 hours). To disable the PURGE function, set the value to zero (0).

2.3 Auto Mode

In the Auto mode, the controller will respond automatically to the system configuration and to the programmed setpoints in the controller.

2.4 Operational Overview

During the LAMP TEST that begins when the Digi-Gage is switched on, every LED on the panel is illuminated. The Lamp Test can be repeated later in AUTO mode (the normal operating mode) by pressing the UP arrow. In AUTO mode, the display shows the calibrated level as read from the input. The display is updated continuously except immediately after power-up, during a purge, or in case of an error. In Simulate (SIM) mode, the display behaves identically to the AUTO mode, except that the value is adjusted manually using the UP and DOWN arrows.

In case of an error, an error code will be displayed—see Error Section 7.1 on page 31 for specific codes and code definitions. For example, if an attempt was made to calibrate two different level readings at the same point, or to calibrate the unit backwards (high reading at low level), the unit would show “E06”. The error message is designed only to tell the operator that the data entered cannot be used and to try again. The system has not been changed or affected at all. A more serious error code would be “E03”, meaning the A/D converter chip failed, the unit couldn’t measure the input and all outputs have been turned off.
2.5 **Level Alarms**

The High and Low alarm setpoints may be set anywhere within the control range, but the High alarm must always be greater than the Low alarm. These alarm settings may be defeated by setting them to zero. If desired, either or both alarms may be set to redundantly stop the pumps (see Section 3.2 on Option Configuration on page 14 for a discussion of the internal DIP switches regarding high level and low level inhibit). There is a five (5) second delay on all alarm outputs.

2.6 **Purge**

*(Available only on the Digi-Gage 2300 and 2400.)*

When the unit first starts, a purge cycle is initiated. Whenever the programmed purge time (between 1 and 24 hours) expires, the following sequence occurs:

1) PURGE LED lights: Analog input is frozen, the solenoid relay closes and isolates the pneumatic input to the Digi-Gage.
2) After a one (1) second delay, the compressor relay closes and activates the solenoid valve which applies high pressure to the bubbler tube.
3) After ten (10) seconds, the compressor relay opens.
4) After six (6) seconds, the isolation solenoid relay opens.
5) After five (5) seconds, the PURGE LED goes out and the Analog input updates.

A manual purge cycle may be forced by pressing the DOWN arrow while in the AUTO mode. The blowdown phase may be extended by holding the DOWN arrow as long as desired. NOTE: If the Purge interval is set to ZERO(0), all purge functions are disabled. There will be no manual purge, no automatic purge, and no purge at start-up. See the PROGRAMMING Section 5.1 on page 21.

2.7 **Lamp Test**

When power is first applied to the Digi-Gage, the Lamp Test is activated while the Analog Input is being stabilized. At any time thereafter, the lamps may be tested by pressing the UP arrow while in AUTO mode.

During the Lamp Test, all fifteen (15) LEDs should light steadily, and the three-digit display should show “8.8.8.” representing all segments of all digits and the three decimal points.

The Lamp Test has no effect on the normal operation of the unit.
2.8 SIMulate (Manual Operation)

When in the SIMulate mode, the controller will function as in the AUTO mode, but the UP and DOWN arrows will be used to vary the numeric display.

The following steps occur during a SIMulate test:

1) The transducer or Analog Input is taken out of the circuit.
2) The pumps turn on and off based on the simulated level.
3) The Analog Output (AO) varies based on the simulated level.
4) The Alarms turn on and off based on the simulated level.

Placing the system in the SIM mode bypasses the actual system sensor. A three minute “deadman” timer automatically returns the controller to the automatic mode if no Key button is pressed for three minutes.

2.9 Memory

All models store calibration and setpoint data in Electrically Erasable Programmable Read-Only Memory (EEPROM). When calibration or programming is complete and the AUTO Key is pressed, all changes in setpoints and calibration are stored in EEPROM. This ensures that the program, setpoints, and calibration will remain intact in the event of power failure. Data is saved for up to 100 years without power. When power is reestablished, the program and calibration are recalled and transferred to the working memory of the microprocessor. An error detection algorithm is used to detect any possible storage errors. If an error is ever detected on power-up, all outputs are disabled and the Digi-Gage will automatically go into PROGram mode. At that time, the operator may examine and re-enter the program and/or calibration mode.
Chapter 3  Configuration

3.1  Input Configuration

A choice of three process inputs is offered in the standard Digi-Gage unit: 4 - 20mA, 0 - 10VDC and 0 - 35 feet of water with the internal pressure transducer. There are three jumper pins on the rear PC board of the unit that are used to select the desired input. First, remove the draw-out module from the housing. Next, turn the unit around to find three input pins labeled W1, W2 and W3 on the rear P.C. Board (see Figure 3-A). Use the chart below to determine the jumper location and move the jumper to the desired input pin location. Caution: Only one jumper should be installed on this board.

<table>
<thead>
<tr>
<th>Jumper Location</th>
<th>Type of Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>4 - 20mA</td>
</tr>
<tr>
<td>W2</td>
<td>0 - 35 feet of water (15 PSI)</td>
</tr>
<tr>
<td>W3</td>
<td>0 - 10VDC</td>
</tr>
</tbody>
</table>

Important! The unit is shipped from the factory pre-calibrated for either pressure, voltage or current input based on panel requirements. Please do not move jumpers or re-calibrate without fully understanding the calibration settings. See Calibration Procedure Section 4.2 on page 18. Damage to the Digi-Gage may result if jumpers are moved without properly re-calibrating the unit.
3.2 Option Configuration

Various options may be selected by simply altering the DIP switch settings on the CPU board. To locate the DIP switches, remove the draw-out module from the housing (see page 7). With the face plate directly in front of you, look for the burnt orange rectangle on the right hand vertical board. It is located beyond the blue rectangle and before the midpoint of the board. This burnt orange rectangle is the set of DIP switches represented in Figure 3-B. \textit{Note: Switch 7 is not used for Digi-Gage models 2300, 2400 and 2600.}

![Option Configuration DIP Switch](image)

3-B Option Configuration DIP Switch

<table>
<thead>
<tr>
<th># of Pumps to Alternate</th>
<th>Digi-Gage 2300</th>
<th>Digi-Gage 2400</th>
<th>Digi-Gage 2600</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1,2,3 off</td>
<td>1,2,3 off</td>
<td>1,2,3 off</td>
</tr>
<tr>
<td>3</td>
<td>(1,2, off) (3 on)</td>
<td>(1,2, off) (3 on)</td>
<td>(1,2, off) (3 on)</td>
</tr>
<tr>
<td>4</td>
<td>n/a</td>
<td>(1,3 off) (2 on)</td>
<td>(1,3 off) (2 on)</td>
</tr>
<tr>
<td>5</td>
<td>n/a</td>
<td>n/a</td>
<td>(1 off) (2,3 on)</td>
</tr>
<tr>
<td>6</td>
<td>n/a</td>
<td>n/a</td>
<td>(2,3 off) (1 on)</td>
</tr>
</tbody>
</table>
Number of Pumps to Alternate:

The first three (3) switches are used to set up the number of pumps to be included in the alternation scheme, whether the controller is in automatic or manual. Pumps not included in the alternation scheme can be used to start or stop anywhere throughout the control range. To disable a pump not used in the alternation scheme, set the start and stop setpoints outside the control range.

![Diagram of Number of Pumps to Alternate]

High Level Inhibit:

If switch is OFF, outputs will function normally. If switch 4 is ON, all pump outputs will be turned OFF on high level alarm.

![Diagram of High Level Inhibit]

Low Level Inhibit:

If switch is OFF, outputs will function normally. If switch 5 is ON, all pump outputs will be turned OFF on low level alarm.

![Diagram of Low Level Inhibit]
Analog Input Response:

If switch 6 is OFF, the Fast Response function will be active and will immediately display the value of the analog input.

If switch 6 is ON, the Slow Response function will be active and the analog input will be averaged over a larger number of samples. When power is first applied, the LED will display “SLO” at the beginning of the process to collect the required input samples. After this process is complete, it will show the average value of the input samples. This level averaging is useful in smoothing out wave action, pressure blips, water hammer or other noise.

Note: Switch 7 is not used in Digi-Gage models 2300, 2400 and 2600.

Pump Mode:

If switch 8 is OFF, pumps will be energized on a falling level. If switch 8 is ON, pumps will be energized on a rising level.
Chapter 4  Calibration

4.1  Calibration Mode Overview

All Digi-Gage units are shipped from the factory pre-calibrated for either pressure, voltage or current input based on panel requirements. Please do not move jumpers or re-calibrate without reading and fully understanding the calibration settings. This section will review the steps to recalibrate the unit for any other input.

These settings are the ONLY settings that can be changed while in the Calibrate Mode:

1. Decimal Point Location can be either 000., 00.0, 0.00 or 000
2. High digital value of high analog input signal
3. Low digital value of low analog input signal
4. Minimum output value of 4 - 20mA analog output 0 - 100%
5. Maximum output value of 4 - 20mA analog output 0 - 100%

Calibration Function Keys:

- **AUTO** Key is pressed to enter new calibration values once selected.
- **PROG** Key takes a "Snapshot" of the internal 14 bit (0 To 16,383) raw value of the analog signal applied to the Digi-Gage during calibration of high and low setpoints.
- **SIM** Key is used when changes have been made in error and should be discarded. Press SIM then AUTO to discard changes and revert to previous stored data.
- **STEP** Key is pressed to select high and low calibration Points and to select Min And Max Analog Output values.
- Arrow keys set values for the digital readout for high and low analog input calibration signal, the Min and Max value of the analog output and the decimal point position.
“Taking a snapshot” occurs when the PROG Key is pressed. This means that the raw data 14-bit number between 0 and 16,383 has been temporarily memorized by the unit. This setting is not fully implemented and used by the Digi-Gage until the calibration procedure is complete and the AUTO Key is pressed.

4.2 Calibration Procedure

Input Calibration is the same for all models.

The unit is shipped from the factory fully pre-calibrated for either pressure, voltage or current input based on panel requirements. If the type of input needed has not changed, no further calibration is necessary.

CAUTION: When the unit is in Calibrate mode, no pumps will be started to minimize any adverse effect of line or pressure noise. There is a 5-minute “deadman” timer that will exit to the AUTO mode if no keys are pressed.

Once you have determined the type of input to be used with your Digi-Gage (i.e. 0-35 feet of water pressure; 0 - 10 VDC or 4 - 20mA), remove the draw-out module from the housing (See page 7). Turn the unit around to find the three input pin locations labeled W1, W2 and W3 on the rear PC board (see Figure 3-A on page 13). Place the blue jumper over the jumper pins corresponding to the type of input you have selected for your system. If you are not using a bubbler input, you will require an external input signal from a signal generator for (W1) 4 - 20mA input OR (W3) 0 - 10VDC input. It is essential that you have a reference input signal to be able to calibrate your controller. The external input signals (either 4 - 20mA or 0 - 10VDC) are wired to the F(+) and F(-) input terminals on the rear of the Digi-Gage housing. It is important that you maintain the proper polarities when wiring to the input terminals.

![Calibration Set-up for use with 4-20mA Signal Generator](image)

Figure 4-A Calibration Set-up for use with 4-20mA Signal Generator

Please read the following for important instructions for calibrating the Digi-Gage unit

Tools required: Standard screwdriver; 20mA DC Signal Generator or Loop Calibrator with AC Adapter (Altek model 234 or 334A)
CAUTION: DO NOT ATTEMPT TO CALIBRATE THIS UNIT WITHOUT THE PROPER TOOLS. IT COULD RESULT IN DAMAGE TO THE DIGI-GAGE UNIT.

Please follow these steps to prepare for calibrating your Digi-Gage unit:

1) Make sure the internal blue jumper is properly set for the input signal (See Input Configuration, section 3.1 on page 13)
2) Set the internal dip switch for the number of pumps to control and alternate (see Option Configuration, paragraph 3.2 on page 14).
3) Disconnect submersible pressure transducer wires from the back of the Digi-Gage input terminals F (+) and F (-). CAUTION: DO NOT PROCEED FURTHER UNTIL THESE WIRES HAVE BEEN DISCONNECTED.
4) Connect a 20mA DC Signal Generator or Loop Calibrator to input terminals F(+) and F(-) on the Digi-Gage as shown in figure 4-A on page 18.
5) Use the following table to determine how the submersible pressure transducer has been calibrated.

<table>
<thead>
<tr>
<th>PSI (A.O. = 4mA)</th>
<th>PSI (A.O. = 20mA)</th>
<th>FEET OF WATER</th>
<th>FEET OF WATER</th>
<th>DG DISPLAY DEC. POINT LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN</td>
<td>MAX</td>
<td>MIN</td>
<td>MAX</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>2.5</td>
<td>0</td>
<td>5.77</td>
<td>5.77</td>
</tr>
<tr>
<td>0</td>
<td>5</td>
<td>0</td>
<td>11.53</td>
<td>11.50</td>
</tr>
<tr>
<td>0</td>
<td>10</td>
<td>0</td>
<td>23.07</td>
<td>23.10</td>
</tr>
<tr>
<td>0</td>
<td>15</td>
<td>0</td>
<td>34.60</td>
<td>34.60</td>
</tr>
<tr>
<td>0</td>
<td>30</td>
<td>0</td>
<td>69.20</td>
<td>69.20</td>
</tr>
<tr>
<td>0</td>
<td>.25</td>
<td>0</td>
<td>.577</td>
<td>.577</td>
</tr>
</tbody>
</table>

Figure 1

Please note: (PSI) X 2.3067 = (Feet of Water)

Now you are ready to calibrate the Digi-Gage.

To access the calibrate mode:

1) Press and hold the PROG key
2) Press the STEP key
3) The 3 LED’s above the AUTO, PROG and SIM keys will begin to flash
4) The digital display will read CAL.
5) You are now in the calibrate mode.
6) Press the STEP key and the display decimal point will begin to flash, indicating that the decimal point can be moved.
7) Use the arrow keys to move the position of the decimal point to the desired position, left or right. The decimal point position should allow the digital display to read the maximum calibration of the input signal generated by a 20mA DC output from the submersible pressure transducer.
8) When the decimal point is in the appropriate position, press the STEP key to advance to the next calibration step.
9) The high alarm LED comes on steady. This setpoint will determine the high limit or maximum calibrated level available from the submersible pressure transducer. See Figure 1 above. Use the arrow keys to adjust the digital display numbers to the maximum signal available from the submersible pressure transducer (in feet of water).
10) Adjust the 20mA DC Signal Analyzer or Loop Calibrator to 20mA DC while the digital display shows the number that corresponds to the factory calibration (20mA DC equals ____ feet of water). Press the PROG key to record (take a snapshot of) the submersible pressure transducer high limit or maximum output. You will not be acknowledged that a snapshot has been taken.
11) Press the STEP key to advance to the next calibration step.
12) The low alarm LED comes on steady. This setpoint determines the low limit or minimum calibrated level available from the submersible pressure transducer. Use the arrow keys to adjust the digital display numbers to the minimum signal available from the submersible pressure transducer (in feet of water).

13) Adjust the 20mA DC Signal Analyzer or Loop Calibrator to 4mA DC while the digital display shows the number that corresponds to the factory calibration (4mA DC equals 0 feet of water). Press the PROG key to record (take a snapshot of) the submersible pressure transducer low limit or minimum output. You will not be acknowledged that a snapshot has been taken.

14) Press the AUTO key to enter the input calibration data into memory (EEPROM).

15) This concludes the calibration procedure.

Once calibration is complete, you should do the following:

1) Disconnect the 20ma DC Signal Generator or Loop Calibrator from the back of the Digi-Gage input terminals F (+) and F (-).
2) Re-connect the submersible pressure transducer wires to input terminals F (+) and F (-) of the Digi-Gage as shown on the as-built drawing.

Now, you are ready to program the Digi-Gage. See section 5.2 on page 21 for programming instructions, including programming of the analog output from the Digi-Gage, which is used for the bargraph option.

NOTE: If the Display reads E06 after this operation, the input was not changed between calibration points (step 7), or an attempt was made to reverse the two points (High point sump level less than Low point sump level). If this error is displayed, all changes just made have been automatically discarded and you will need to start your full input calibration procedure from the beginning.
Chapter 5  Programming

5.1  Programming Function Overview

Basic function keys used to program the Digi-Gage:

- **AUTO** Key is pressed to return to normal operating mode (AUTO) after making programming changes or testing in SIM Mode. The unit is in AUTO mode when the LED is lit.
- **PROG** Key is pressed to program new level settings, to select ALTERNATE Mode for Manual or Automatic alternation, to enable/disable/set the Purge function and to set minimum and maximum Analog Output (A.O.) level settings. The unit is in PROG mode when the LED is lit.
- **SIM** Key is pressed to perform system testing. The Arrow keys are used to simulate rising and falling values and the Digi-Gage outputs (alarms, pumps and AO) will respond to any changes. The unit is in SIM mode when the LED is lit.
- **STEP** Key is pressed to view the current setpoints and make changes, as required. Step through all 12 LED’s to view different setpoints and make changes, as desired. Changes can only be made while in PROG mode. The current value of each setpoint is displayed in the Digital Display.
- **Arrow Keys** are used to change digital setpoint values in PROG mode and to simulate increasing and decreasing digital values.
5.2 Programming the Digi-Gage

For the Digi-Gage 2300:

1) Press the PROG Key. The LED above the Key will illuminate.
2) Press the STEP Key to illuminate the HIGH LEVEL LED and the current value stored for the high alarm.
3) Use the UP or DOWN arrows to change the value.
4) Once the set point is correct, press the STEP Key to proceed to the next set point.
5) The LOW LEVEL LED will now be illuminated and the current value for low level alarm will be displayed.
6) Use the UP or DOWN arrows to alter the setpoint if desired. This should be repeated for each setpoint. When a large change is being programmed, holding the STEP Key and either the UP or DOWN arrow simultaneously will change the displayed values more rapidly.

LEAD, LAG 1 and LAG 2 each have separate start and stop setpoints. The unit checks the set point values during programming to prevent functionally reversing START/STOP SET POINTS. The START setpoint must be below the Stop set point in pump UP applications. For pump DOWN applications, the START set point must be above the STOP set point. The digital display will not allow you to set a number below the STOP setpoint.

When PUMP ALT is selected, either an “ALO”, “AFO”, “P - 1”, “P - 2” or “P - 3” will be displayed. Use the UP and DOWN Arrow Keys to select the setting you desire.

Automatic Alternation Choices: Manual Alternation Choices:
“ALO”: Last on, First off P-1: Pump Sequence is 1-2-3
“AFO”: First on, First off P-2: Pump Sequence is 2-3-1

P-3: Pump Sequence is 3-1-2

Note: If only 2 pumps are allowed to alternate (see Option Configuration Section 3.2 on page 14 on the number of pumps to alternate,), then only “ALO”, “AFO” or “P - 1” or “P - 2” will be displayed. In this case, the third ("Lag 2") pump can still be programmed and will operate independently of the alternation sequence. The Lag 2 output can also be disabled by setting the Start/Stop levels to 0. When the selected alternation scheme calls for a new Lead pump during normal operation in the AUTO mode, the “Alternate” LED flashes briefly to confirm the action.

The PURGE step is used to select automatic purging and how many hours between purges. If 0 is selected, PURGE is deactivated. If any interval between 1 and 24 hours is selected then the PURGE cycle will be activated and the system will automatically purge based on the hours selected.

The 4-20 mA Analog Output (A.O) is a linear function between Analog Output (AO) MIN Level and Analog Output (AO) MAX Level setpoints, which are programmed from the keyboard. These setpoints can be reversed on the Digi-Gage if an inverse function is desired.

When programming is complete, press the AUTO Key to permanently store the operating program in EEPROM memory. Programming changes may be discarded by pressing the SIM Key first, then the AUTO Key.

For the Digi-Gage 2400:

1) Press the PROG Key. The LED above the Key will illuminate.
2) Press the STEP Key to illuminate the HIGH LEVEL LED and the current value stored for the high alarm.
3) Use the UP or DOWN arrows to change the value.
4) Once the set point is correct, press the STEP Key to proceed to the next set point.
5) The LOW LEVEL LED will now be illuminated and the current value for low level alarm will be displayed.
6) Use the UP or DOWN arrows to alter the setpoint if desired. This should be repeated for each setpoint. When a large change is being programmed, holding the STEP Key and either the UP or DOWN arrow simultaneously will change the displayed values more rapidly.

Pump Start and Stop setpoints are entered by observing the status of two LED’s. The LED’s located just below the High and Low Alarm LED’s will light to show which pump is currently being programmed. START or STOP LED’s located below the Pump LED’s will indicate which function is being set.

Example: The START setpoint must be below the Stop set point in pump UP applications. For pump DOWN operation, the START set point must be above the STOP set point. The digits will not move above this value.

When PUMP ALT is selected, either an “ALO”, “AFO”, “P - 1”, “P - 2”, “P - 3” or “P - 4” will be displayed. Use the Arrow Keys to select the setting you desire.

**Automatic Alternation Choices:**

<table>
<thead>
<tr>
<th>Alternation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALO</td>
<td>Last on, First off</td>
</tr>
<tr>
<td>AFO</td>
<td>First on, First off</td>
</tr>
</tbody>
</table>

**Manual Alternation Choices:**

<table>
<thead>
<tr>
<th>Alternation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-1</td>
<td>Pump Sequence is 1-2-3-4</td>
</tr>
<tr>
<td>P-2</td>
<td>Pump Sequence is 2-3-4-1</td>
</tr>
<tr>
<td>P-3</td>
<td>Pump Sequence is 3-4-1-2</td>
</tr>
<tr>
<td>P-4</td>
<td>Pump Sequence is 4-1-2-3</td>
</tr>
</tbody>
</table>

Note: The number of pumps selected to alternate (see Option Configuration Section 3.2 on page 14 on the number of pumps to alternate.) will be displayed in the program alternation mode display. You will always see ALO and AFO and the number of pumps selected to alternate. For example, if you choose three pumps to alternate, you would see ALO, AFO and P - 1, P - 2, P - 3. In this case, the fourth pump can still be programmed and will operate independently of the alternation scheme. The Lag 3 pump can also be disabled by setting Start and Stop levels to “0”. When the selected alternation scheme calls for a new Lead pump during normal operation in the AUTO mode, the “Alternate” LED flashes briefly to confirm the action.

The PURGE step is used to select automatic purging and how many hours between purges. Select 0 to deactivate the PURGE function. If any interval between 1 and 24 hours is selected then the PURGE cycle will be activated and the system will automatically purge based on the hours selected.

The 4-20 mA Analog Output (A.O) is a linear function between Analog Output (AO) MIN Level and Analog Output (AO) MAX Level setpoints, which are programmed from the keyboard. These setpoints can be reversed on the Digi-Gage if an inverse function is desired.

When programming is complete, press the AUTO Key to permanently store the operating program in EEPROM memory. Programming changes may be discarded by pressing the SIM Key first, then the AUTO Key.

For the Digi-Gage 2600:

1) Press the PROgram Key. The LED above the Key will illuminate.
2) Press the STEP Key to illuminate the HIGH LEVEL LED and the current value stored for the high alarm.
3) Use the UP or DOWN arrows to change the value.
4) Once the setpoint is correct, press the STEP Key to proceed to the next setpoint.
5) The LOW LEVEL LED will now be illuminated and the current value for low level alarm will be displayed.
6) Use the UP or DOWN arrows to alter the setpoint if desired. This should be repeated for each setpoint. When a large change is being programmed, holding the STEP Key and either the UP or DOWN arrow simultaneously will change the displayed values more rapidly.

PUMP START and PUMP STOP setpoints are entered by observing the status of two LEDs. The LED’s located just below the High and Low Alarm LED’s will light to show which pump is currently being programmed. START or
STOP LED’s located below the Pump LED’s will indicate which function is being set. The unit checks the set point settings during programming to prevent functionally reversing START/STOP SET POINTS.

Example: The START setpoint will be below the Stop set point in pump up applications. For pump down operation, the START set point will be above the STOP set point. The digits will not move above this value.

When PUMP ALT is selected, either an “ALO”, “AFO”, “P - 1”, “P - 2”, “P - 3”, “P - 4”, “P - 5” or “P - 6” will be displayed:

**Automatic Alternation Choices:**

- “ALO” : Last on, First off
- “AFO” : First on, First off

**Manual Alternation Choices:**

- P-1: Pump Sequence is 1-2-3-4-5-6
- P-2: Pump Sequence is 2-3-4-5-6-1
- P-3: Pump Sequence is 3-4-5-6-1-2
- P-4: Pump Sequence is 4-5-6-1-2-3
- P-5: Pump Sequence is 5-6-1-2-3-4
- P-6: Pump Sequence is 6-1-2-3-4-5

Note: The number of pumps selected to alternate (see Option Configuration Section 3.2 on page 14 on the number of pumps to alternate) will be displayed in the program alternation mode display. You will always see ALO and AFO and the number of pumps selected to alternate. For example, if you choose five pumps to alternate, you would see ALO, AFO and P - 1, P - 2, P - 3, P - 4 or P - 5. In this case, the sixth pump can still be programmed and will operate independently of the alternation scheme. The Lag 5 pump may be disabled by setting Start and Stop levels to “0”. When the selected alternation scheme calls for a new Lead pump during normal operation in the AUTO mode, the “Alternate” LED flashes briefly to confirm the action.

The 4-20 mA Analog Output (A.O) is a linear function between Analog Output (AO) MIN Level and Analog Output (AO) MAX Level setpoints, which are programmed from the keyboard. These setpoints can be reversed on the Digi-Gage if an inverse function is desired.

When programming is complete, press the AUTO Key to permanently store the operating program in EEPROM memory. Programming changes may be discarded by pressing the SIM Key first, then the AUTO Key.

### 5.3 Exiting the PROGRAM mode

After all the setpoints have been programmed, exit the PROGرام mode by pressing the AUTO Key. The LED above the Key will illuminate, and the LEVEL display will show the process variable. To test your program, enter the SIMulate mode by pressing the SIM key and use the UP and DOWN Arrow Keys to simulate a rising and falling level.
Chapter 6  Installation

6.1  Mounting

The Digi-Gage is enclosed in a NEMA1 case which mounts through a panel cutout and is clamped in place by upper and lower mounting brackets.

![Physical Dimensions for the Digi-Gage 2300 (similar to 2400 and 2600)](image)

**Figure 6-A  Physical Dimensions for the Digi-Gage 2300 (similar to 2400 and 2600)**

The molded terminals at the rear of the Controller accept #6 spade or ring terminals. For electrical connections; refer to the terminal block layouts in Figure 6-C on page 27 for the specific unit purchased.

Your Controller is provided with relay contact outputs rated for 1.0 Amperes @ 120 VAC. For terminal connections, see diagram on the back of the housing for each specific Digi-Gage model.

The Analog Output is able to source 4-20 mA into 600 ohms maximum. For terminal connections, see Figure 6-B on page 26 for a full wiring diagram for a typical Model 2300. Wiring diagrams for the back of the housing for all three models are shown in Figure 6-C on page 27.
6.2 Analog Inputs

The Analog Input terminals accept either 4 - 20mA or 0 - 10V inputs from external sources or 0 - 35 feet of level from the internal pressure port on the back of the Digi-Gage. The operator must select the input to be used by setting a jumper on the rear PC board inside the case. Please review Input Configuration Section 3.1 on page 13 for additional information. Be sure to observe the proper polarity when connecting to the F(+) and F(-) analog input terminals.

Note: Make sure that you follow the proper calibration procedure for the input you have selected. Please review Calibration Procedure Section 4.2, page 18 for additional calibration information.

The auxiliary input on Terminals D and E is designed to accept a dry contact closure. The unit is shipped with a jumper in place on these terminals. The removal of this jumper will deny access into the PROGram or calibrate modes.

Figure 6-B  Recommended Wiring for Digi-Gage 2300 (similar for 2400 and 2600)

Specifications:
Input Power: 24 VAC, 8.5 VA, 350mA
Environment: Ambient temperature (-10°C to 70°C)
Display Range:
Keypad selectable, 0-999, 0-99.9, 0-9.99, 0-.999)
Resolution: 0.006%, 14 bit A/D
Input Options:
4-20mA (50 ohms impedance)
0-10VDC (>150K ohms impedance)
0-15 PSI (clean, dry air only)

Memory:
NOVRAM EEPROM 100 Year Memory, no batteries needed
Display: .5” high, 7 segment red LED, 3 digit
Discrete Outputs:
7 contacts, SPST, 1A@120VAC; 3 pumps, 2 alarms (high and low); 2 bubbler controls (isolate and purge)
Analog Output: 4-20mA (600 ohms load max)
Linearity: +/- .005% analog output; +/-0.1% pneumatic input
Figure 6-C   Outer Housing Diagrams for Digi-Gage Models 2300, 2400 & 2600
6.3 Communications

All Digi-Gage models have a standard communications port for accepting MODBUS communications.

MODBUS protocol settings must be created before the Digi-Gage can send or receive data. The Digi-Gage will be preset at the factory with the communications option turned off. The following instructions are only needed if you should need to make changes in the RTU configuration.

The RTU setup mode is entered by pressing the PROG and Down-arrow keys simultaneously. After you have entered the RTU setup mode, you should be aware that the LED’s serve a different purpose while in the RTU configuration mode. The following chart shows how the LED’s are redefined:

<table>
<thead>
<tr>
<th>HIGH</th>
<th>LOW</th>
<th>STAR</th>
<th>STOP</th>
<th>STAR</th>
<th>STOP</th>
<th>STAR</th>
<th>STOP</th>
<th>ALTERNATE</th>
<th>PURGE</th>
<th>A.O. (MIN)</th>
<th>A.O. (MAX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>KILOBAUD</td>
<td>BASE REGISTER</td>
<td>PARITY</td>
<td>CTS DELAY</td>
<td>MASTER (1) SLAVE (0)</td>
<td>REPLY TIME</td>
<td>MONITOR</td>
<td>NAK (NO ACKNOWLEDGMENT)</td>
<td>XMT (TRANSMIT)</td>
<td>RCV (RECEIVE)</td>
<td></td>
</tr>
</tbody>
</table>

The functions are, from top to bottom, **RTU address**, **kilobaud**, **Base Register**, **Stop/Parity** (1e, 1o, 1n, 2n), **CTS delay**, **Master/slave**, and **Reply Timeout**. Below these functions, a **Monitor** LED indicates a communications parameter is being monitored, and **NAK**, **XMT**, and **RCV** LEDs indicate those events in real time. Press the STEP key to move throughout these functions.

To disable the RTU operation, select an address of zero (0), the display will show OFF and no other configuration steps will be available.

The three lowest LED’s continuously display transmit and receive status, with the NAK(no acknowledgment) LED blinking whenever a NAK is sent or received.

**NOTE:** Change to Address, Kilobaud, Base Register, Parity, and Master/slave mode do not take effect until the AUTO key is pressed and those changes are saved and the serial port is reinitialized.
To implement MODBUS protocol settings:
The unit is programmable from the front panel. These set serial channel parameters (baud rate, parity), unit address, and register block base address.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Fixed or Selectable</th>
<th>Displays the following</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>Fixed</td>
<td>MODBUS RTU</td>
</tr>
<tr>
<td>Mode</td>
<td>Selectable</td>
<td>Master (1) or Slave (0)</td>
</tr>
<tr>
<td>Bit Rate</td>
<td>Selectable</td>
<td>.3, 1.2, 2.4, 4.8, 9.6 or 19.2 Baud Rate</td>
</tr>
<tr>
<td>Parity</td>
<td>Selectable</td>
<td>Even, Odd or None</td>
</tr>
<tr>
<td>Word Structure</td>
<td>Fixed</td>
<td>8 databits, 1 or 2 stop bits, parity</td>
</tr>
<tr>
<td>Unit Address</td>
<td>Selectable</td>
<td>1 - 255, disable</td>
</tr>
<tr>
<td>Base Register</td>
<td>Selectable</td>
<td>400001 - 465401 in 100 register steps</td>
</tr>
</tbody>
</table>

**Unit Address:** This refers to the Digi-Gage’s own Slave address or the address of the attached Slave.

**Base Register:** The first register number in a block of ninety-nine (99) register numbers reserved to store data being written to and/or read from the Digi-Gage. For example, selecting 3 as the Base Register uses the registers 40301-40399 (40031-400399). The Digi-Gage supports both five and six digit register addresses.

The register assignments within the block are fixed and contain raw and scaled analog values, setpoints and packed bitmaps of I/O status.

**Mode:** The unit can operate as a MODBUS Slave or a Master. In the Master mode, it emulates the operation of a slave. See page 30 for more information.

*Important! In either mode, lack of received data on the serial port for four minutes results in re-initializing the serial port, in case the port was somehow disabled. An error message of E09 is a communications error. See section 7.1 on page 31 for more information.*
### MODBUS Master or Slave Operation

<table>
<thead>
<tr>
<th>Master</th>
<th>Slave</th>
</tr>
</thead>
</table>
| When operating as a Master, the slave’s setpoint registers in the selected block are read continuously, while the process data are written continuously. Master-mode setpoint changes are made either from the Digi-Gage panel and are written to the slave or from the values read from the slave. | When operating as a slave, all valid read and write requests are honored. A request is considered to be invalid if:  
- It falls outside the selected register block for the unit (a NAK will be generated)  
- It is requesting to write to a read only register (the write will be ignored)  
- It is not a message of type 3 (read HR), 4 (read IR), 6 (write one HR), or 16 (write multiple HR). In this case, a NAK will be generated. |
| At startup, the Master writes its entire block of registers to the slave. This ensures that the setpoint data in both units are synchronized. After a successful first write, the unit starts alternately writing the Read-only registers and reading the Read-write registers. | Read requests to 3xxxxx registers (message type 4) are aliased to the corresponding 4xxxxx registers (message type 3). |
| When the Master is in PROGram mode, all registers are written continuously, locking out and possibly overwriting any setpoint changes made in the slave. This protects the operator’s direct setpoint entries until the unit is returned to AUTO mode. | Before a setpoint change is accepted, it is checked for absolute range, then compared to whatever other setpoints it is related to (i.e., lead start level vs. lead stop level, taking the pump-in/pump-out selection into account). Setpoint changes that might result in erratic unit operation are discarded. Acceptable changes within the same message are kept. If a correction was made, all registers are written back to the slave. |
| Before a setpoint change is accepted, it is checked for absolute range, then compared to whatever other setpoints it is related to (i.e., lead start level vs. lead stop level, taking the pump-in/pump-out selection into account). Setpoint changes that might result in erratic unit operation are discarded, but acceptable changes within the same message are kept. If a correction was made, all registers are written back to the slave. | |
| Master Mode uses message types 3 (read HR), 6(write one HR), and 16 (write mult HR). | |

### Extended Monitoring Module

If your Digi-Gage system is equipped with SCADA Express and an Extended Monitoring Module, there is a PLC which is polled by the Digi-Gage on one port, and the SCADA system on another. When the SCADA system wishes to write a setpoint, the new value is simply written to the PLC and the Digi-Gage detects the change.

### 6.4 Pneumatic Connection

Your controller is equipped with an integral pressure transducer and a 1/4” pneumatic fitting at the rear of the unit. The fitting is supplied with a ferruleless sleeve which can be used with 1/4” O.D. Flex Tubing. Only clean dry air should be applied to this connection. Maximum working pressure should not exceed 15.12 PSI or 35 feet of water pressure. Proof pressure is 30 PSI.

### 6.5 Optional Bargraph

The Digi-Gage can be equipped with a digital bargraph for a visual display of the levels being monitored. The bargraph unit is an analog input solid state bargraph that is mounted directly on the front panel of the Digi-Gage. The model used within the Digi-Gage features a 5” scale with 51 segments. The bargraph displays the same settings indicated on the digital readout and requires no separate set up procedures or adjustment.
## Chapter 7  Troubleshooting

### 7.1  Error Codes

The Digi-Gage is able to perform self-diagnostic tests and report the results on its display in the form of error codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>E01</td>
<td>There has been a checksum error reading the EEPROM, where the setpoints and calibration are stored. A setpoint or the calibration may be incorrect. Unit is placed directly into PROGram mode so that user may check, correct if necessary, and save (by pressing the AUTO Key). This error inhibits all pump operation. Pressing the AUTO Key clears this error condition.</td>
</tr>
<tr>
<td>E02</td>
<td>The unit’s RAM has failed its power-up test. Return unit to the factory for repair. This error inhibits all pump operation.</td>
</tr>
<tr>
<td>E03</td>
<td>The Analog to Digital converter has failed. Return unit to the factory for repair. This error inhibits all pump operation.</td>
</tr>
<tr>
<td>E04</td>
<td>The EPROM failed its power-up checksum test. Return unit to the factory for repair. This error inhibits all pump operation.</td>
</tr>
<tr>
<td>E06</td>
<td>Calibration error: the high point is not greater than the low point or the input wasn’t changed before calibrating the second point. All changes have been discarded, so try again. This code appears on units when they are first manufactured, before initialization.</td>
</tr>
<tr>
<td>E07</td>
<td>DIP switches 1-3 are set incorrectly, to alternate more pumps than this unit can control. Maximum number of pumps for this model has already been reached. This cannot occur on the Digi-Gage 2300 because the extra DIP switches are ignored.</td>
</tr>
<tr>
<td>E09</td>
<td>Trouble with communications. This interpretation varies slightly depending on whether Master or Slave operation is in use. If the unit is a Master, either eight consecutive polls have failed or a NAK response has been received from the slave. If the unit is a Slave, either a NAK response was sent to the Master or port inactivity timeout has expired (the Master has failed).</td>
</tr>
</tbody>
</table>
Chapter 8  **Model Comparison**

This chapter will review the differences between the Digi-Gage 2300, 2400 and 2600.

All models include:
Alternate or Manual Pump Alternation
High Alarm (Optional Pump Inhibit)
Low Alarm (Optional Pump Inhibit)
Fast/Slow Analog Input Response
Pump In or Out Selection
Analog Output MIN/MAX Value Settings
Analog Output MIN/MAX Level Settings
Communications Port

Model Differences include:

<table>
<thead>
<tr>
<th>Model #</th>
<th># of Pumps</th>
<th>Analog Outs</th>
<th>Purge Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digi-Gage 2300</td>
<td>3</td>
<td>1</td>
<td>1 - 24</td>
</tr>
<tr>
<td>Digi-Gage 2400</td>
<td>4</td>
<td>1</td>
<td>1 - 24</td>
</tr>
<tr>
<td>Digi-Gage 2600</td>
<td>6</td>
<td>1</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Chapter 9  Statement of Warranty

EG Controls, Inc. warrants its equipment and all parts thereof (in the aggregate “equipment”) to be free from defects in material and workmanship under normal use and service when properly applied, installed and maintained. EG Controls’ obligation under this warranty is limited to repair or replacement of defective components, as EG Controls deems appropriate, FOB Factory, Jacksonville, Florida. All other warranties, express or implied, are disclaimed and denied.

EG Controls’ maximum liability under this warranty shall never exceed the cost of the subject product and EG Controls reserves the right, at its sole discretion, to refund the purchase price in lieu of repair or replacement. EG Controls shall in no case be liable under this warranty for consequential damages of any kind including but not limited to loss of time, inconvenience, lost profit, labor charges, or other incidental or consequential damages with respect to persons, business, or property.

This warranty applies with respect to commercial classes of equipment. We warrant this equipment for a period of time, such warranty commencing from the date of shipment as described below:

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>WARRANTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digi-Gage Control Systems</td>
<td>1 year</td>
</tr>
<tr>
<td>Parts Ordered as Separate Components</td>
<td>3 months</td>
</tr>
</tbody>
</table>

This warranty does not apply if the product has been subjected to improper storage, misuse, neglect, unauthorized alteration, improper installation, accidental damages (including “acts of God” such as lightning or other natural disasters), faulty repair efforts, or transit damage. Similarly, this warranty does not apply to products or parts in instances where adjustments thereof will correct the alleged defect and does not cover expendable items such as light bulbs and fuses.

EG Controls will not assume responsibility or accept invoices for unauthorized repairs to its control equipment. Nor will it be responsible for damage to its control equipment through attempts to operate the equipment beyond its rated capacity, intentional or otherwise.

EG Controls expressly disclaims any warranty of merchantability or fitness for a particular use or purpose with respect to the goods sold.

EG Controls neither assumes nor authorizes any other person, company, or other entity to assume on its behalf any other warranties or liabilities in connection with EG Controls’ systems.

This warranty can be modified only by an officer of EG Controls and then only by a signed, written statement specifically describing and setting out any modifications.

Effective 15 May 1998
Appendix

Implementation of a Third Party SCADA System

If you purchase a Digi-Gage with a SCADA Express control system, no additional set up will be required. If you purchase a Digi-Gage and wish to connect the system to a third party SCADA system, the following information will be important.

IMPORTANT!! Please note that detailed knowledge of MODBUS protocol is required.

Pump Elapsed-Time-Meter and Start-Count registers have been added. The ETMs can be scaled to resolutions of 0.1, 0.2, 0.5, and 1 hour per count, allowing ranges of 6553.5, 13107, 32765.5, and 65535 hours, respectively. The Start Counter range is fixed at 0-65535 starts. All ETMs and Start Counters overflow by rolling back over to zero.

Pump statistics can be reset by setting the Command Enable bit (0x8000) in the Command Word (4xxx56) and toggling the appropriate bit for that pump’s data (0x0004-0x0080 for pumps 1-6).

The new register assignments are

<table>
<thead>
<tr>
<th>Register Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4xxx57-4xxx58</td>
<td>(2 reserved)</td>
</tr>
<tr>
<td>4xxx59-4xxx64</td>
<td>Pump (1-6) Start Count</td>
</tr>
<tr>
<td>4xxx73-4xxx78</td>
<td>Pump (1-6) ETM (0.1, 0.2, 0.5 or 1.0 hours/count)</td>
</tr>
<tr>
<td>4xxx79-4xxx80</td>
<td>(2 reserved)</td>
</tr>
<tr>
<td>4xxx98</td>
<td>Seconds since key hit (0-65535, for SCADA watchdog), moved from</td>
</tr>
<tr>
<td>4xxx64</td>
<td></td>
</tr>
</tbody>
</table>

The AO1-AO4 Min and Max (4xxx73-4xxx80) register functions have been deleted, and the register addresses reassigned as noted above.

Unit Factory Initialization is now accomplished by holding the four corner keys (AUTO+SIM+STEP+DOWN) and applying power (sliding the unit into its case, for example).

To select the upper half of the options set in the Factory DIP-switch initialization, turn S8 ON. This shifts the other seven switches to a new set of functions. Setting the ETM scale is accomplished by setting the switches according to the table below, then applying the power to the unit while holding the AUTO+SIM+UP keys:

<table>
<thead>
<tr>
<th>SCALE</th>
<th>SWITCH COMBINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 HR</td>
<td>S8 on</td>
</tr>
<tr>
<td>0.2</td>
<td>S1+S8 on</td>
</tr>
<tr>
<td>0.5</td>
<td>S2+S8 on</td>
</tr>
<tr>
<td>1.0</td>
<td>S1+S2+S8 on</td>
</tr>
</tbody>
</table>

The TTY-mode has been updated to set ETM scaling. The new selections are *H ETMs-1 hr, *I ETMs-.2hr, *J ETMs .5hr, *K ETMs 1 hr

Upon updating an existing unit, the Display will show E.01. This is normal, as the NVRAM contents have been changed to make room for stored pump statistics. If you see this error message, however, please be aware that the the Lead-Lag Max VFD speeds (PROG-mode with LED’s blinking) will have been changed to 0 and will need to be reset to 100% or their previous settings. All other setpoint and calibration data will still be intact. Failure to take the reset step will result in all drives running at minimum speed.
### Internal Register Format

<table>
<thead>
<tr>
<th>Register</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4xxx01</td>
<td>Process Variable Display</td>
</tr>
<tr>
<td>4xxx02</td>
<td>Decimal Point position (0.3, 0=blanked, 1=xxx, 2=xx.x, 3=x.xx)</td>
</tr>
<tr>
<td>4xxx03</td>
<td>Raw A/D Input Word (0-16383)</td>
</tr>
<tr>
<td>4xxx04</td>
<td>Relay Output and Limit Alarms bitmaps</td>
</tr>
<tr>
<td>4xxx05</td>
<td>Current Lead Pump Number (1 to n)</td>
</tr>
<tr>
<td>4xxx06</td>
<td>Logical / physical pump required bitmap</td>
</tr>
<tr>
<td>4xxx07</td>
<td>Last Error Number (0-9)</td>
</tr>
<tr>
<td>4xxx08</td>
<td>Operating Mode</td>
</tr>
<tr>
<td>4xxx09-4xxx16</td>
<td>Lead Lag (1-8) Pump Start Setpoint (0-999)</td>
</tr>
<tr>
<td>4xxx17-4xxx24</td>
<td>Lead Lag (1-8) Pump Stop Setpoint (0-999)</td>
</tr>
<tr>
<td>4xxx25</td>
<td>High Alarm Setpoint (0-999)</td>
</tr>
<tr>
<td>4xxx26</td>
<td>Low Alarm Setpoint (0-999)</td>
</tr>
<tr>
<td>4xxx27-4xxx30</td>
<td>Lead Lag (1-4) VFD Max. Speed Level (0-999)</td>
</tr>
<tr>
<td>4xxx31-4xxx34</td>
<td>Lead Lag (1-4) VFD Min. Speed Level (0-999)</td>
</tr>
<tr>
<td>4xxx35</td>
<td>VFD Ramp Rate Damping (1=fast, 20=slow)</td>
</tr>
<tr>
<td>4xxx36</td>
<td>Alternation Mode (0=AEO, 1n=manual, 255=AFO)</td>
</tr>
<tr>
<td>4xxx37</td>
<td>Purge Interval (1-24 hours; 0=inhibit)</td>
</tr>
<tr>
<td>4xxx38</td>
<td>Alternation Interval (1-168 hours, 0=inhibit)</td>
</tr>
<tr>
<td>4xxx39-4xxx46</td>
<td>Lead Lag (1-8) VFD Max. Speed Output (0-255)</td>
</tr>
<tr>
<td>4xxx47-4xxx54</td>
<td>Lead Lag (1-8) VFD Min. Speed Output (0-255)</td>
</tr>
<tr>
<td>4xxx55</td>
<td>SIM mode Simulated Process Variable (0-999)</td>
</tr>
<tr>
<td>4xxx56</td>
<td>Command word</td>
</tr>
<tr>
<td>4xxx57-4xxx58</td>
<td>(2 reserved)</td>
</tr>
<tr>
<td>4xxx59-4xxx64</td>
<td>Pump (1-6) Start Count</td>
</tr>
<tr>
<td>4xxx65</td>
<td>Raw D/A 1 Output Word (0-255)</td>
</tr>
<tr>
<td>4xxx66</td>
<td>Raw D/A 2 Output Word (0-255)</td>
</tr>
<tr>
<td>4xxx67</td>
<td>Raw D/A 3 Output Word (0-255)</td>
</tr>
<tr>
<td>4xxx68</td>
<td>Raw D/A 4 Output Word (0-255); reserved</td>
</tr>
<tr>
<td>4xxx69</td>
<td>AI Max. reading calibration constant (Min+1 to 999)</td>
</tr>
<tr>
<td>4xxx70</td>
<td>AI Min. reading calibration constant (0 to Max-1)</td>
</tr>
<tr>
<td>4xxx71</td>
<td>AI Max. input calibration constant (Min+1 to 16383)</td>
</tr>
<tr>
<td>4xxx72</td>
<td>AI Min. input calibration constant (0 to Max-1)</td>
</tr>
<tr>
<td>4xxx73-4xxx78</td>
<td>Pump (1-6) ETM (0.1, 0.2, 0.5 or 1.0 hours/count)</td>
</tr>
<tr>
<td>4xxx79-4xxx80</td>
<td>(2 reserved)</td>
</tr>
<tr>
<td>4xxx81</td>
<td>Options Word (bitmap)</td>
</tr>
<tr>
<td>4xxx82</td>
<td>Purge Interval Timer</td>
</tr>
<tr>
<td>4xxx83</td>
<td>Alternation Interval Timer</td>
</tr>
<tr>
<td>4xxx84</td>
<td>Units 7-segment LED Display bitmap</td>
</tr>
<tr>
<td>4xxx86</td>
<td>Hundreds 7-segment LED Display bitmap</td>
</tr>
<tr>
<td>4xxx87</td>
<td>Discrete LED Display diatmap</td>
</tr>
<tr>
<td>4xxx88</td>
<td>Discrete LED Flash Attribute Bitmap</td>
</tr>
<tr>
<td>4xxx89</td>
<td>Switch Input/Status bitmap</td>
</tr>
<tr>
<td>4xxx90</td>
<td>NVRAM Checksum (0-65535)</td>
</tr>
<tr>
<td>4xxx91</td>
<td>Start Count (0-65535)</td>
</tr>
<tr>
<td>4xxx92</td>
<td>Scan period (x100 uSec)</td>
</tr>
<tr>
<td>4xxx93</td>
<td>Keypad Image (bitmap)</td>
</tr>
<tr>
<td>4xxx94</td>
<td>Number of pumps in alternation (1 to n)</td>
</tr>
<tr>
<td>4xxx95</td>
<td>Bad Received Message Count (0-65535)</td>
</tr>
<tr>
<td>4xxx96</td>
<td>Firmware revision level (x100; eg., 300=300)</td>
</tr>
<tr>
<td>4xxx97</td>
<td>Unit Model number (2300, 2400, 2600, 3300)</td>
</tr>
<tr>
<td>4xxx98</td>
<td>Seconds since key hit (0-65535, for SCADA watchdog)</td>
</tr>
<tr>
<td>4xxx99</td>
<td>(1 reserved)</td>
</tr>
</tbody>
</table>
Relay Output Bitmap/ Limit Alarm Bitmap (4xxx06, r/o)

<table>
<thead>
<tr>
<th>Bit Address</th>
<th>DG2300</th>
<th>DG2400</th>
<th>DG2600</th>
<th>VG3300</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0001</td>
<td>P-1</td>
<td>P-1</td>
<td>P-1</td>
<td>P-1</td>
</tr>
<tr>
<td>0x0002</td>
<td>P-2</td>
<td>P-2</td>
<td>P-2</td>
<td>P-2</td>
</tr>
<tr>
<td>0x0004</td>
<td>P-3</td>
<td>P-3</td>
<td>P-3</td>
<td>P-3</td>
</tr>
<tr>
<td>0x0008</td>
<td>Compressor</td>
<td>P-4</td>
<td>P-4</td>
<td>High Alarm</td>
</tr>
<tr>
<td>0x0010</td>
<td>Solenoid</td>
<td>Compressor</td>
<td>P-5</td>
<td>Low Alarm</td>
</tr>
<tr>
<td>0x0020</td>
<td>High Alarm</td>
<td>Solenoid</td>
<td>P-6</td>
<td>N/C</td>
</tr>
<tr>
<td>0x0040</td>
<td>Low Alarm</td>
<td>High Alarm</td>
<td>High Alarm</td>
<td>N/C</td>
</tr>
<tr>
<td>0x0080</td>
<td>N/C</td>
<td>Low Alarm</td>
<td>Low Alarm</td>
<td>N?C</td>
</tr>
</tbody>
</table>

0x2000 Input signal no present Alarm (input<1.5 mA or <0.35V>
0x4000 Low level Alarm
0x8000 High level Alarm

Logical/ Physical Pump Required (4xxx06, r/o)

<table>
<thead>
<tr>
<th>Bit Address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0001</td>
<td>Pump 1 required</td>
</tr>
<tr>
<td>0x0002</td>
<td>Pump 2 required</td>
</tr>
<tr>
<td>0x0004</td>
<td>Pump 3 required</td>
</tr>
<tr>
<td>0x0008</td>
<td>Pump 4 required</td>
</tr>
<tr>
<td>0x0010</td>
<td>Pump 5 required</td>
</tr>
<tr>
<td>0x0020</td>
<td>Pump 6 required</td>
</tr>
<tr>
<td>0x0100</td>
<td>Lead Pump required</td>
</tr>
<tr>
<td>0x0200</td>
<td>Lag1 Pump required</td>
</tr>
<tr>
<td>0x0400</td>
<td>Lag 2 Pump required</td>
</tr>
<tr>
<td>0x0800</td>
<td>Lag 3 Pump required</td>
</tr>
<tr>
<td>0x1000</td>
<td>Lag 4 Pump required</td>
</tr>
<tr>
<td>0x2000</td>
<td>Lag 5 Pump required</td>
</tr>
</tbody>
</table>

Operating Mode (4xxx06, r/o)

<table>
<thead>
<tr>
<th>Bit Address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0000</td>
<td>AUTOmatic</td>
</tr>
<tr>
<td>0x0001</td>
<td>SIMulate</td>
</tr>
<tr>
<td>0x0002</td>
<td>PROGram</td>
</tr>
<tr>
<td>0x0004</td>
<td>CALibrate</td>
</tr>
<tr>
<td>0x0008</td>
<td>RTU configuration</td>
</tr>
</tbody>
</table>

Command Word (4xxx56, r/w, volatile)

<table>
<thead>
<tr>
<th>Bit Address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0001</td>
<td>Initiate Purge (toggle while Enable bit is set)</td>
</tr>
<tr>
<td>0x0002</td>
<td>Force Alternation (toggle while Enable bit is set)</td>
</tr>
<tr>
<td>0x0004</td>
<td>Reset P1 ETM and Start Count (toggle while Enable bit is set)</td>
</tr>
<tr>
<td>0x0008</td>
<td>Reset P2 ETM and Start Count (toggle while Enable bit is set)</td>
</tr>
<tr>
<td>0x0010</td>
<td>Reset P3 ETM and Start Count (toggle while Enable bit is set)</td>
</tr>
<tr>
<td>0x0020</td>
<td>Reset P4 ETM and Start Count (toggle while Enable bit is set)</td>
</tr>
<tr>
<td>0x0040</td>
<td>Reset P5 ETM and Start Count (toggle while Enable bit is set)</td>
</tr>
<tr>
<td>0x0080</td>
<td>Reset P6 ETM and Start Count (toggle while Enable bit is set)</td>
</tr>
<tr>
<td>0x8000</td>
<td>Enable Commands</td>
</tr>
</tbody>
</table>
Options Word (4xxx84-4xxx86, r/o)

0x0001  Live Zero
0x0002  Pump stagger-start on Boot only
0x0004  Disable SIM-mode deadman timer
0x0008  Disable PROG-mode deadman timer
0x0010  Disable RTU functions
0x0020  Disable entry into PROG, CAL, and RTU Config. modes
0x0300  Pump ETM scale selection (0-3):
         0x0000  Pump ETM 0.1 hour/count scale
         0x0100  Pump ETM 0.2 hour/count scale
         0x0200  Pump ETM 0.5 hour/count scale
         0x0300  Pump ETM 1.0 hour /count scale

7-Segment LED Display (4xxx84-4xxx86, r/o)

0x0001  Segment A (top)
0x0002  Segment B (upper right)
0x0004  Segment C (lower right)
0x0008  Segment D (bottom)
0x0010  Segment E (lower left)
0x0020  Segment F (upper left)
0x0040  Segment G (center)
0x0080  Segment H (decimal point)

Discrete LED Display (4xxx87), Discrete LED Flash Attribute (4xxx88, r/o)

<table>
<thead>
<tr>
<th>0x0001</th>
<th>DG2300</th>
<th>DG2400</th>
<th>DG2600</th>
<th>VG3300</th>
<th>RTU Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0001</td>
<td>Hi Alarm</td>
<td>Hi Alarm</td>
<td>Hi Alarm</td>
<td>Hi Alarm</td>
<td>RTU Address</td>
</tr>
<tr>
<td>0x0002</td>
<td>Lo Alarm</td>
<td>Lo Alarm</td>
<td>Lo Alarm</td>
<td>Lo Alarm</td>
<td>Kilobaud</td>
</tr>
<tr>
<td>0x0004</td>
<td>Lead Start</td>
<td>Lead</td>
<td>Lead</td>
<td>Lead</td>
<td>Base Register</td>
</tr>
<tr>
<td>0x0008</td>
<td>Lead Stop</td>
<td>Lag No. 1</td>
<td>Lag</td>
<td>Lag</td>
<td>Parity</td>
</tr>
<tr>
<td>0x0010</td>
<td>Lag Start</td>
<td>Lag No. 2</td>
<td>Lag No. 2</td>
<td>Standby</td>
<td>CTS Delay</td>
</tr>
<tr>
<td>0x0020</td>
<td>Lag Stop</td>
<td>Lag No. 3</td>
<td>Lag No. 3</td>
<td>Start</td>
<td>Master/Slave</td>
</tr>
<tr>
<td>0x0040</td>
<td>Standby Start</td>
<td>Start</td>
<td>Lag No. 4</td>
<td>Stop</td>
<td>Reply Timeout</td>
</tr>
<tr>
<td>0x0080</td>
<td>Standby Stop</td>
<td>Stop</td>
<td>Lag No. 5</td>
<td>Min Speed</td>
<td></td>
</tr>
<tr>
<td>0x0100</td>
<td>Pump Alternate</td>
<td>Pump Alternate</td>
<td>Analog Out</td>
<td>Max Speed</td>
<td>Monitor</td>
</tr>
<tr>
<td>0x0200</td>
<td>Purge</td>
<td>Purge</td>
<td>Start/Max</td>
<td>Pump Alternate</td>
<td>NAK</td>
</tr>
<tr>
<td>0x0400</td>
<td>A.O. Min</td>
<td>A.O. Min</td>
<td>Stop/Min</td>
<td>Configure</td>
<td>XMT</td>
</tr>
<tr>
<td>0x0800</td>
<td>A. O. Max</td>
<td>A. O. Max</td>
<td>Alternate</td>
<td>Ramp Speed</td>
<td>RCV</td>
</tr>
<tr>
<td>0x1000</td>
<td>AUTO</td>
<td>AUTO</td>
<td>AUTO</td>
<td>AUTO</td>
<td>AUTO</td>
</tr>
<tr>
<td>0x2000</td>
<td>PROG</td>
<td>PROG</td>
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<tr>
<td>0x4000</td>
<td>SIM</td>
<td>SIM</td>
<td>SIM</td>
<td>SIM</td>
<td>SIM</td>
</tr>
</tbody>
</table>
Switch Input/Status (4xxx89,r/o)

0x0001    SW1 DIP Switch 1 is ON (Pumps in Alternation +4)
0x0002    SW1 DIP Switch 2 is ON (Pumps in Alternation +2)
0x0004    SW1 DIP Switch 3 is ON (Pumps in Alternation +1)
0x0008    SW1 DIP Switch 4 is ON (Hi alrm inhibit)
0x0010    SW1 DIP Switch 5 is ON (Lo alarm inhibit)
0x0020    SW1 DIP Switch 6 is ON (Slow AI response)
0x0040    SW1 DIP Switch 7 is ON (VFD Load-sharing)
0x0080    SW1 DIP Switch 8 is ON (Pump-out operation)
0x0100    PV is Negative
0x0200    In Purge Cycle
0x0400    A/D Converter Failed
0x0800    AUX IN Closed
0x1000    Lamp Test in progress
0x2000    Error indication is displayed

Keypad Image (4xxx93,r/o)

0x0001    AUTO
0x0002    PROG
0x0004    SIM
0x0008    STEP
0x0010    Up-arrow
0x0020    Down-arrow
**Calibration Theory**

There are two points calibrated on a graph, set by the operator. The Digi-Gage calculates the level based on drawing a line through these points, interpolating between them or extrapolating outside them. The endpoint values (Y-axis) are set with the UP and DOWN arrows, and the input readings (X-axis) are captured with the PROG Key.

**Figure A:** Calibration Theory

**Figure B:** The Calibration Function Graph
**Calibration Math**

Formula: \[ y = mx + b \text{ where } m = \frac{(y_2 - y_1)}{(x_2-x_1)} \text{ divided by } (x_2-x_1) ; \quad b = y_1 - (mx_1) \]

\[ x_1 = \text{Low Endpoint } \quad \quad y_1 = \text{Low input} \]
\[ x_2 = \text{High Endpoint } \quad \quad y_2 = \text{High input} \]

EXAMPLE: If the operator wanted to determine the proper scaling of the 4-20mA signal to a 1.0 to 10.0 foot level, the formula would be applied, as follows:

\[ y = mx + b \]

where \( y \) is the desired level in feet.

\( m \), or the ratio between the two values, is calculated by taking the minimum level (1 foot) and subtracting it from the maximum level (10 feet). This result is divided by the high milliampere reading (20mA) minus the low milliampere reading (4mA).

\[ m = \frac{(y_2-y_1)}{(x_2-x_1)} = \frac{(10.0-1.0)}{(20-4)} = 0.5625 \]

\( b \), or the offset, is calculated by multiplying the minimum milliampere signal by the ratio, \( m \), and subtracting this from the minimum level.

\[ b = y_1 - mx_1 = 1 - 0.5625(4) = -1.25 \]

The final equation will be:

\[ y = \text{the desired level} \]
\[ x = \text{the milliampere signal.} \]
\[ y = 0.5625x - 1.25 \]

If, for example, the level at 7.25mA was required, \( x \) replaces 7.25 in the final equation:

\[ y = 0.5625(7.25) - 1.25 = 2.828125 \text{ft} \]
Index

Alarm(S), 23, 32
Alternate, 5, 22, 23, 24, 31
**Alternation**, 22, 23, 24, 32
Analog Input, 11, 15, 26, 32
Analog Output, 11, 22, 23, 24, 25, 32
AO, 11, 22, 23, 24
Auto, 9
Automatic, 22, 23, 24
bargraph, 7
Calibration, 5, 11, 18, 20, 26, 31
Code(s), 31
Configuration, 9, 10, 13, 14, 22, 23, 24, 26
damage, 5
Damage, 5
Display, 9, 20
EEPROM, 9, 11, 22, 23, 24, 31
Electrical, 25
**Endpoint**, 40
Error, 9, 31
Error Code, 9, 11, 20, 31
Formula, 40
High Alarm, 32
**High Level**, 15
Input, 7, 9, 10, 11, 13, 15, 16, 17, 18, 20, 26, 31, 32, 39, 40
Installation, 25
**Jumper(S)**, 13
**Lead**, 22, 23, 24
Lamp, 9, 10
**Lead**, 22, 23, 24

LED, 7, 9, 10, 22, 23, 24
Low Alarm, 23, 32
**Low Level**, 15
Manual, 5, 11, 22, 23, 24, 32
Memory, 9, 11, 22, 23, 24
Mode, 9, 10, 11, 16, 17, 18, 22, 23, 24, 31
Mounting, 25
Output, 5, 7, 11, 17, 22, 23, 24, 25, 32
Pneumatic, 10, 30
Process, 5, 9, 13, 16, 24
Programming, 21, 22, 23, 24
Pump Alt, 32
Pumps, 9, 10, 11, 15, 16, 18, 22, 23, 24, 31
Purge, 9, 10
Ram, 9, 31
RAM, 9, 31
Resolution, 5
Sensor, 5, 11
Setpoint, 11, 22, 23, 24, 31
SIM Mode, 9, 11, 22, 23, 24
Simulate, 9
**Snapshot**, 18
Standy, 22
Theory, 39
Transducer, 5, 11, 13, 30
Troubleshooting, 9, 11, 20, 31
Warranty, 33
Wiring, 18, 25
Digi-Gage 2300 Series
DUPLEX PUMP CONTROL PANEL
SPECIFICATION
for

CITY OF

Note: This specification represents a typical duplex system and can easily be adapted for Triplex Pump Control Panels. Specifications for control systems utilizing the Digi-Gage 2400 or 2600 may be obtaining by contacting your representative or the factory.

DATE: 9/17/07
Table of Contents

1. GENERAL ........................................................................................................................................................................ 3
   1.1 SCOPE OF WORK ......................................................................................................................................................... 3

2. PRODUCTS ..................................................................................................................................................................... 4
   2.1 GENERAL ...................................................................................................................................................................... 4
   2.2 CONSTRUCTION .......................................................................................................................................................... 4

3. EQUIPMENT DESCRIPTION .................................................................................................................................................. 5
   3.1 PUMP CONTROLLER ................................................................................................................................................... 5
   3.2 LED INDICATORS ....................................................................................................................................................... 6
   3.3 OPERATOR INTERFACE ............................................................................................................................................... 6
   3.4 COMMUNICATIONS PORT ........................................................................................................................................ 7
   3.5 CONTROLLER HOUSING .......................................................................................................................................... 8
   3.6 PNEUMATIC CONNECTIONS (FOR BUBBLER SYSTEMS ONLY) .................................................................................. 8
   3.7 INNER DOOR DEVICES ........................................................................................................................................... 8
   3.8 CIRCUIT BREAKERS ................................................................................................................................................. 8
   3.9 MOTOR STARTERS .................................................................................................................................................... 9
   3.10 RELAYS ............................................................................................................................................................... 9
   3.11 PRESSURE TRANSDUCER ..................................................................................................................................... 9
   3.12 PILOT LIGHT INDICATORS .................................................................................................................................. 9
   3.13 PHASE MONITOR RELAY ................................................................................................................................... 9
   3.14 RUNNING TIME METER ......................................................................................................................................... 10
   3.15 LIGHTING ARRESTER/SURGE ARRESTER .............................................................................................................. 10
   3.16 TRANSFORMER .................................................................................................................................................... 10
   3.17 CONVENIENCE RECEPTACLE ................................................................................................................................. 10
   3.18 BARGRAPH ........................................................................................................................................................... 10
   3.19 ALARMS ............................................................................................................................................................ 11
   3.20 HAND-OFF-AUTOMATIC SWITCH ........................................................................................................................... 11
   3.21 MANUAL TRANSFER ASSEMBLY ........................................................................................................................... 11
   3.22 MONITORS .......................................................................................................................................................... 11

4. QUALITY ASSURANCE ....................................................................................................................................................... 12
   4.1 MANUFACTURER EXPERIENCE ............................................................................................................................. 12
   4.2 MANUFACTURER QUALITY CONTROL .................................................................................................................... 12
   4.3 MANUFACTURER APPROVAL ................................................................................................................................ 12

5. SUBMITTAL REQUIREMENTS ........................................................................................................................................ 13
   5.1 BASE BID ............................................................................................................................................................. 13
   5.2 SUBSTITUTIONS .................................................................................................................................................... 13
   5.3 SHOPDRAWING SUBMITTALS .................................................................................................................................. 13
   5.4 RECORD DOCUMENTS AND TESTING .................................................................................................................. 13

6. WARRANTIES ..................................................................................................................................................................... 14

7. EQUIPMENT IDENTIFICATION ..................................................................................................................................... 14

8. EXECUTION ..................................................................................................................................................................... 15
1. General

1.1 Scope of Work

The contractor shall furnish, install and place into operation a pump control system designed to operate sewage pumps in a sewage lift station as described herein. The control system shall be designed utilizing the latest proven technology in control design for sewage lift stations. The control system shall be operator and maintenance friendly to ensure ease of system set up and to limit system down time.

The pump control system shall be capable of operating 2 pumps at ___HP, ___ Voltage, ___ full load amps (FLA), ___ phase in a constant speed mode in order to convey sewage to the next pump station without causing a sewage over-flow wherever possible regardless of system demands.

The control system shall be comprised of a standard off the shelf microprocessor (programmable logic controllers with custom software shall not be acceptable). The controller shall have a digital readout and a keypad consisting of 6 keys for entering operational settings. The controller shall be capable of accepting a pressure input of 0-35 feet, a current input of 4-20mA DC or a voltage input (field selectable) of 0-10 VDC. The controller shall be 100% digital. Control adjustments shall be accomplished by direct digital inputs (potentiometers or other analog adjustments shall not be acceptable). The controller shall allow for programming changes and complete level simulation from the front of the control plate. LED indicators shall be lighted and identify the function to be changed as the operator steps through the programming mode. All of the above shall be accomplished from the face of the control plate without codes and keypad sequences. The controller shall have a scaleable 4-20mA DC analog output. All digital outputs from the controller shall be normally open relay contacts rated for 120VAC. The unit shall have an RTU port capable of operating with standard MODBUS Protocols. The unit shall meet all the requirements described in section 3.1 of this specification labeled “ Components “- Pump Controller.
2. Products

2.1 General

2.1.1 Codes
Electrical equipment, materials and workmanship shall comply with all applicable codes, safety and fire law regulations at the location of the work and shall conform to applicable codes and standards of the organizations listed below:

(1) Institute of Electrical and Electronic Engineers. (IEEE)
(2) National Electric Code. (NEC)
(3) National Electrical Manufacturers Association (NEMA)
(4) American National Standards Institute. (ANSI)
(5) Underwriters Laboratories. (UL-508 or 913 for intrinsically safe)

2.1.2 Component Standards
All equipment and materials shall be new and shall bear the manufacturers name and trade name. In cases where the standard has been established for the particular material, the material shall be so labeled. The equipment to be furnished shall essentially be the standard product of a manufacturer regularly engaged in the production of the required type of equipment for this type of work and shall be the manufacturers latest approved design. Equipment and material shall be suitably delivered and stored and shall be readily accessible for inspection. All items subject to moisture damage shall be stored in dry spaces. All material and equipment shall be protected against dirt, dust, water and chemical or mechanical injury, vandalism and theft.

2.2 Construction

2.2.1 Enclosure
The described equipment shall be housed in a single NEMA 3R enclosure fabricated from Type 304 stainless steel. The enclosure size shall be approximately ___ high, ___ wide, ___ deep. Pilot and indicator devices shall be mounted on the hinged inner door.

2.2.2 Hinged Inner Door
The hinged inner door shall be provided fabricated from 5052-H32.080 marine alloy brushed aluminum. It shall be completely removable for ease of service and shall be held closed by at least (2) hand operated 1/4 turn fasteners.

2.2.3 Control Circuit Wiring
Control circuit wiring inside the panel shall be (16) gauge minimum, type MTW or THW, rated for 300 volts. All power wiring shall be rated for 600 volts. Conductors shall be color coded in the same colors throughout the entire panel. Components having numerical or alphabetical references shall have all wiring similarly coded using a standard decal, which shall be placed on the insulation materials within the confines of the enclosure. The decals shall be placed at all wiring terminations for ease of wire identification.
3. Equipment Description

3.1 Pump Controller

The pump controller shall utilize a microprocessor with a digital display to program and alternate up to three (3) pumps with high and low level alarms. The controller shall utilize at a minimum a 14 Bit analog input. The controller shall supply a 4-20 mA DC output signal. The 4-20mA DC output signal shall be programmable from the front of the panel.

3.1.A For bubbler sensory input:
Accurate measurement of the liquid level in the sump shall be made by a bubbler type system in which variations by air pressure shall be applied to a solid-state strain gauge type pressure transducer mounted within the controller. Linearity shall be plus or minus 0.1%, repeatability and hysteresis plus or minus 0.15% of full-scale input. Temperature operating range shall be -10º to 70ºC. The pressure transducer shall convert the reflected pressure into a digital LED display indicating level in feet and tenths of feet. A key pad and on board circuitry shall control the air compressor and purge solenoid to automatically blow down the bubbler tube at preset intervals of 1-24 hours. An automatic purge shall occur after a power outage. The automatic purge shall be capable of being disabled through a keypad on the front of the panel. The following sequence shall occur during the purge cycle:
(1) Purge LED lights, analog input is frozen. Solenoid output relay closes.
(2) After a one (1) second delay, the compressor and the high pressure solenoid valve are activated.
(3) After ten (10) seconds the compressor is deactivated.
(4) After six (6) seconds the isolation solenoid valve is deactivated.
(5) After five (5) seconds, the purge LED goes out and the Analog input updates.

3.1.B For submersible level transducer sensory input:
The submersible level transducer shall be specifically designed to meet rigorous environments encountered in level measurement applications. It shall provide repeatable precision depth measurements under the most adverse conditions. This level transducer shall incorporate an isolated diaphragm sensor, which is specifically designed for use with hostile fluids and gases. The sensor will utilize a silicon pressure cell that has been fitted into a stainless steel housing with an integral, compliant stainless steel barrier diaphragm. The sensor assembly shall be housed in a rugged 316SS case. The level transducer shall have a static accuracy of +/-1% FSO BFS(Full Scale Output, Best Fit Straight Line) and shall be certified intrinsically safe for hazardous locations. Construction shall be of welded 316SS construction.

3.1.C For ultrasonic level transducer sensory input:
The ultrasonic level transducer shall be a corrosion resistant PVC assembly and consist of two part construction. One part shall be the probe itself and the other, housing for the transmitter electronics. The level transducer shall be an ultrasonic design for hostile fluids and gases. The sensor shall operate at 50kHz, shall be mounted a minimum of 18” above the maximum head height and shall be resistant to condensation on operating surfaces. The sensor shall automatically compensate for temperature over the range of -40º to +60ºC. The level transducer shall provide a 4-20mA DC output for the microprocessor controller. The level transducer shall control sensor output power to adjust for optimum echo conditions on commands sent from its monitor and provide excellent noise immunity. The level transducer shall have a minimum accuracy of +/-1.5% of full scale and a zero dead band area for fast and reliable response.
3.1.2 Pump Controller Operations

Pump-up or pump-down operation and pump inhibit on low level or high level shall be switch selectable within the controller. The controller shall automatically alternate up to three (3) pumps in automatic operation. Alternation schemes shall include “First On First Off” (FOFO), “Last On First Off” (LOFO) and manual operation 1-2-3, 2-3-1 or 3-1-2 and shall be selectable from the front panel of the controller. In duplex operation the third pump shall not alternate but shall be capable of starting or stopping anywhere throughout the control range. The controller shall allow the placement of the third pump to be user-selectable.

3.1.3 Pump Controller Configuration

The duplex controller shall be expandable to three (3) pump operation by selecting three (3) pump operation within the controller. The controller shall be capable of being configured in the following manner:
(1) duplex with standby pump
(2) duplex with jockey pump
(3) full triplex operation

3.2 LED Indicators

The front of the controller shall have six (6) push-buttons for the following functions:
(1) Automatic button with LED indication
(2) Program button with LED indication
(3) Simulate button with LED indication
(4) Step button
(5) Up arrow button for setting values and selecting functions.
(6) Down arrow button for setting values and selecting functions.

3.3 Operator Interface

3.3.1 Front Panel
The front panel of the digital controller shall provide a convenient operator interface for observation of status and programming. The front of the controller shall have twelve (12) LED’S for function identification and three (3) LED’S for mode identification. The LED identification shall be as follows:

<table>
<thead>
<tr>
<th>FUNCTION IDENTIFICATION</th>
<th>MODE IDENTIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) HIGH ALARM</td>
<td>(1) AUTO</td>
</tr>
<tr>
<td>(2) LOW ALARM</td>
<td>(2) PROG</td>
</tr>
<tr>
<td>(3) START LEAD</td>
<td>(3) SIM</td>
</tr>
<tr>
<td>(4) STOP LEAD</td>
<td></td>
</tr>
<tr>
<td>(5) START LAG 1</td>
<td></td>
</tr>
<tr>
<td>(6) STOP LAG 1</td>
<td></td>
</tr>
<tr>
<td>(7) START LAG 2</td>
<td></td>
</tr>
<tr>
<td>(8) STOP LAG 2</td>
<td></td>
</tr>
<tr>
<td>(9) ALTERNATE</td>
<td></td>
</tr>
<tr>
<td>(10) PURGE</td>
<td></td>
</tr>
<tr>
<td>(11) A. O. MIN</td>
<td></td>
</tr>
<tr>
<td>(12) A. O. MAX</td>
<td></td>
</tr>
</tbody>
</table>

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3.3.2 LED Display
A 1/2” high 3-digit digital LED display shall be used for both level display information, programming and calibration.

3.3.2A During normal operations, the LED display will show wet well level.

3.3.2B During programming or calibration, the LED display will show operational parameters and programmed data. The other twelve LED indicators on the front of the microprocessor controller shall also light during programming or calibration to show the setpoints being created. Depressing the Program Key and then depressing the Step Key should allow the operator to sequentially view the alarm and operational settings for the system. Changes to these settings shall be accomplished by depressing the up or down arrow keys to increase or decrease the level settings and to adjust other operational settings. The program shall be stored in EEPROM memory, a non-volatile memory, which shall retain the program when the unit is un-powered without the use of batteries.

3.3.3 Diagnostic Test
The controller shall, when power is applied, go through a diagnostic test of the processor and memory and shall light all digital display digits and all LED indicators as part of a diagnostic test and then automatically return to the automatic mode of operation.

3.3.4 Simulation Capabilities
The controller shall provide a simulate key on the front of the controller to simulate the rising and falling of levels to verify the pump and alarm operating points. The simulation shall be accomplished by depressing the simulate key. Arrow UP and DOWN keys shall be provided to simulate the rising or falling level. Holding the arrow key down for a longer time shall cause the levels on the display to change at a faster rate. A “deadman” timer shall automatically return the controller to the automatic mode if no Key button is pressed for three (3) minutes.

3.3.5 Input Power
The input power to the controller shall be 24 volts AC.

3.3.6 Pump Start-up after Power Loss
Upon power up or return from low level or high level lockout, the controller shall stagger the pumps on utilizing cascading ten (10) second intervals to avoid current or hydraulic surges. Pump Start LED’S shall flash during the interval timing and go to a steady state when the pump run contact closes.

3.3.7 Alarm Tripping
The controller shall employ a (5) second delay on both high level and low level alarm conditions to avoid instantaneous nuisance alarm tripping. The high and low level alarm LED’S shall flash when the alarm is activated after the five-second delay.

3.4 Communications Port
An independent serial port shall be available for communicating with host computers, other RTU’S, telephone modems, spread spectrum radios, set frequency radios, leased line modems and cellular telephone modems. The controller shall be capable of communicating via MODBUS standard non-proprietary protocol.
3.5 Controller Housing

The entire controller and pressure transmitter shall be totally self-contained in a housing. The complete controller and pressure transducer shall be easily removable by unlatching the handle and drawing out the controller and the pressure transducer from the housing. The removing of the controller and the pressure transducer from the housing shall be accomplished without the need for the disconnection of any wires from the housing or tubing from the system transducer. The electrical connections between the control module and the housing shall be made by self-cleaning heavy-duty spring loaded contacts. The controller case shall be 4” high x 4” wide x 6” deep.

3.6 Pneumatic Connections (for Bubbler Systems only)

The pneumatic connection to the pressure transducer shall be made by a pneumatic quick connect fitting. When the controller is drawn out of the housing and the pressure transducer disconnects, the level sensing pressure tube shall close forming an air tight seal to prevent loss of level pressure.

3.7 Inner Door Devices

The following devices shall be operable or viewed through the inner door to prevent operator exposure to live electrical current:

(1) Hand-Off-Auto selector switches to override automatic mode control.
(2) Neon indicator run lights.
(3) Ground fault protected, 115V convenience receptacles.
(4) Running time meters for each pump.
(5) Pump circuit breakers for each pump.
(6) Main circuit breaker, if required.
(7) Manual Transfer with sliding bar mechanical interlock (includes main circuit breaker)
(8) Moisture sensing pilot lights.
(9) Motor over temperature pilot lights.

3.8 Circuit Breakers

All electrical circuits shall be protected by molded case circuit breakers. Each pole of the breaker shall provide inverse time delay overload protection and instantaneous short circuit protection by means of a thermal magnetic element.

The breaker shall be operated by a toggle-type handle and shall have a quick make, quick break switching mechanism that is mechanically trip free from the handle. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual “on” and “off” position. Breakers shall be completely enclosed in a molded case and shall bear the UL label.
Short circuit interrupting duty (14 KAIC minimum) rating for all motor protection circuit breakers shall be applicable for operating conditions. Substitution of fuses to replace circuit breakers is not acceptable.

Circuit breakers shall be operable through the inner door to prevent exposing the operator to live power.

3.9 Motor Starters

All starters shall be full-voltage non-reversing NEMA rated (Size 1 minimum) and bear a UL label. The coil operating voltage shall be 120 volts AC 60 Hz. IEC horsepower rated starters will not be accepted due to a reduced life expectancy. All starters shall be complete with ambient compensated overload relays of the bi-metallic type. The overload relays shall be equipped with an electrical isolated normally open contact to annunciate a motor overload condition.

3.10 Relays

3.10.1 Relay Type
Relays shall be of the square base plug in type with integral LED indicator lights. All relays shall have a transparent polycarbonate dust cover to protect the contact surfaces from airborne dust and other contaminants. All relays shall have DPDT or 4PDT contacts, as required. Relays shall be rated for continuous duty operation.

3.10.2 Relay Contacts
Relay contacts shall be of the plug-in type with LED indicators and rated for 10 amps at 300VAC. Relay sockets shall have screw terminals with self-lifting clamps and terminal identification numbers located at each connection on the relay socket.

3.11 Pressure Transducer

The pressure transducer with the controller unit shall be of the solid state strain gauge type and shall be mounted within the controller. Linearity shall be +/-1%. Repeatability and hysteresis shall be +/-15% of full scale output. Temperature operating range shall be -10 °C to +70°C.

3.12 Pilot Light Indicators

The controller output indicator lights shall be of the long life, solid-state type with a built in ballast resistor and blocking diode for use with 24 VAC or VDC voltages. Pilot lights shall be equipped with 3/16” quick connect terminals for ease of field replacement. Soldered terminals shall not be acceptable. Other panel lights shall be neon rated for 125 VAC and shall be high brightness lamps with appropriate built-in resistors to assure long life and desired brightness. The lamps shall be self-insulated and capable of operating for a minimum of 25,000 life hours.

3.13 Phase Monitor Relay
The three-phase monitor relay shall be connected to the incoming side of the power input terminals. The unit shall have six LED indicators that annunciate the status of incoming power and monitor loss of phase, phase reversal, under voltage, high voltage and phase imbalance. It shall also include a memory that remembers the last 10 types of faults and the order in which they occurred. A special user-friendly adjustment panel allows the operator to make adjustments to phase imbalance, low and high voltage trip points, individually adjustable trip and restart delays and offers a selectable restart setting.

3.14 Running Time Meter

A running time meter measuring hours and hundreds of an hour of operation up to 99999.9 shall be provided for each pump. The time meter shall operate from the control voltage of the motor starter. The meter shall incorporate quartz crystal electronics to ensure accurate time recording. The hours shall be displayed with a reliable electro-mechanical wheel indicator to ensure a permanent record of total running time.

3.15 Lighting Arrestor/ Surge Arrestor

A lighting/surge arrestor shall be provided at the service entrance to the control panel. The unit shall be of the solid-state type and be able to clamp in five (5) nanoseconds and absorb up to 25KA peak surge current during an occurrence. The unit shall have a surge life expectancy of 10,000 occurrences at 200 amps.

3.16 Transformer

Transformers shall be rated. Transformers shall be multi-tap, 208/240/480 Volt AC primary, 120/24 Volt AC secondary, dry type control power transformers and shall be designed and tested in accordance with the latest applicable standards of ANSI, IEEE and NEMA, and shall be UL listed.

3.17 Convenience Receptacle

A GFI receptacle shall be provided to protect against ground fault leakage and shock. The unit shall have retractable ground pin and polarized blades for two (2) or three (3) wire receptacles. The unit shall require a reset after any ground fault interruption.

3.18 Bargraph

A solid-state microprocessor design based bargraph shall be provided for vertically monitoring the wet well. The Bargraph range shall be user scaleable from 0 to 3 feet at a minimum to 0 to 35 feet maximum from the front plate of the controller. The bargraph shall be of a solid-state microprocessor based design and have at a minimum, 51 segments and a resolution of 2.0%. The bargraph shall utilize a high visibility illuminated LED display with a minimum response time of 55 milliseconds. The bargraph shall be capable of operating in temperatures ranging from 0º to 60º C.
3.19 Alarms

High and Low Level alarms shall be available with a silence push button. On decreasing levels, the alarm condition will automatically reset when the level falls below the high level alarm setpoint. On increasing level, the low level alarm shall automatically reset when the level rises above the low level alarm setpoint.

3.20 Hand - Off - Automatic Switch

Standard HOA switches shall be supplied on the inner door for each pump. The switches shall have a minimum dielectric strength of 1000 volts and a minimum insulation resistance of 100 megaohms. The switches shall be AC rated.

3.21 Manual Transfer Assembly

A manual transfer assembly shall be provided that includes the following:

1. Normal Main and Emergency main circuit breakers sized per NEC requirements. Main breakers shall be UL service entrance rated, 14 KAIC minimum.
2. A sliding bar interlock shall provide mechanical interlocking between two (2) adjacent circuit breakers. When moving the sliding bar interlock handle from one side to another, the bar shall extend a sufficient distance to alternately block movement of the blocked circuit breaker handle. This will ensure that both circuit breaker handles cannot be turned “ON” at the same time.
3. Generator receptacle shall be compatible with the municipality’s existing generator. The generator receptacle shall be model ___ as manufactured by ______. No equal.

3.22 Monitors

3.22.1 Seal Failure Relays
Seals Failure relays providing adjustable resistance sensing circuitry from 0 to 250,000 ohms for each pump shall be supplied. Upon activation, the seal failure relay shall not shut down the pump but shall illuminate a red pilot light located on the inner door that shall correspond to the appropriate pump. The moisture sensing probes shall be supplied and installed in the pumps by the pump manufacturer.

3.22.2 Over Temperature Sensing Relays
Pump over temperature (manual reset) sensors located in the pump motor shall be supplied for each pump. A red pilot light and reset push button for each pump motor shall be supplied and located on the inner door. When activated, the appropriate pilot light shall illuminate and the associated pump shall not be allowed to run, even if the motor cools sufficiently, until the appropriate reset push-button has been reset.
4. Quality Assurance

4.1 Manufacturer Experience

4.1.1 UL Certification
The manufacturer of the control system shall be certified by Underwriters Laboratories (UL) as being a UL 508 listed manufacturing facility and certified to install a serialized label for quality control and insurance liability considerations.

4.1.2 Liability Insurance
The manufacturer of the control system must carry blanket liability insurance of at least ten (10) million dollars.

4.1.3 Experience
The manufacturer of the control system must be able to document ten years of experience in successfully designing and manufacturing similar control systems for wastewater pumping applications.

4.2 Manufacturer Quality Control

The complete control system shall be functionally tested at the manufacturing facility and certified as a complete system to assure proper operation per specification. All components must be mounted with stainless steel hardware.

4.3 Manufacturer Approval

Manufacturers listed in this specification do not constitute approval. All controls must have the capabilities and functions as outlined in the specifications.
5. Submittal Requirements

5.1 Base Bid

The base bid control system shall be the Digi-Gage 2300 system as manufactured by EG Controls Inc. of Jacksonville Florida and represented by: _______________________. All bidding contractors shall base their bid on the Digi-Gage 2300 control system. Contract shall be awarded on the base bid control system. Alternative deductive systems will be considered only after contract award and must be specified with any applicable deducts at bid time in order to receive consideration. Bidders submitting alternate quotations shall submit appropriate cut sheets, circuit drawings and a detailed bill of materials with their alternate bid packages. Approval of an alternative system shall be at the sole discretion of the engineer. All equipment and materials shall be new and shall be specifically designed for the function herein.

5.2 Substitutions

The Engineer will consider proposals for substitution of materials, equipment, methods and services only when proposals are accompanied by full and technical data and all other information required by the Engineer for the proposed substitution. Substitution of materials, equipment, methods and/or services is not allowed unless such substitution has been specifically approved by the Engineer.

5.3 Shop Drawing Submittals

5.3.1 Drawing Requirements
All drawings are to be of the computer generated class.

5.3.2 Engineering Approval
The Engineer reserves the right to approve or disapprove any and all equipment based upon his evaluation. Approval for fabrication and installation will be made only after submittal and review of all shop contract documents. The information required for approval shall include the following items and be provided in (8) sets as a minimum:
1) Appropriate cut sheets
2) Complete electrical schematics detailing the system
3) A complete bill of material
4) Detailed drawings of the enclosure
5) Exploded detail of every control faceplate, light, switch or meter mounted on the exterior of the enclosure.

5.4 Record Documents And Testing

5.4.1 Record Documents

1) Eight (8) sets of as built drawings as per Section 5.3.2, items 1 through 5 of this specification are to be supplied depicting “as built” conditions. This submittal is to include any field modifications made by the authorized start-up personnel during installation, start-up or testing.
2) Original copy of the final Quality Control report.
3) A complete detailed O & M manual specifically prepared for this system. A typical general O & M manual will not be acceptable.

5.4.2 Testing
The control panel shall be thoroughly tested at the factory prior to shipment.

6. Warranties
All guarantees implied or stated by the control system manufacturer shall be passed in full force to the owner.

All components in the specified control system shall carry, at a minimum, a comprehensive, parts only, twelve (12) months guarantee against defects in workmanship and material from the date of final inspection and acceptance not to exceed eighteen (18) months from the date of shipment from the manufacturer’s facility.

The manufacturer of the control system shall warrant all components in the system for unit responsibility purposes.

7. Equipment Identification
All electrical equipment shall be identified in accordance with these specifications. All identification labels, both within the enclosure and external, shall be laser-screened, laminated mylar. All control wiring shall be numbered on each termination.

Screw-in type, engraved nameplates or laser-screened laminated mylar shall be provided to identify all individually mounted push-buttons, rocker switches, lights, meters, disconnect switches, circuit breakers, motor starters, transformers, relays, fuses, phase monitors, surge arrestors and any other equipment for which identification is required for eventual service or replacement. This includes the appropriate equipment within the cabinet. Embossed tape is not acceptable.

A factory ID label shall be installed inside the outer door including the following information:
- Factory Order Number
- Factory Ship Date
- Supply Voltage, Phase and Frequency
- Control Voltage
- Electrical Wiring Diagram Number
- Wire (number of incoming wires)
- Motor HP and Full Load Current

A warning label stating “DANGER - Disconnect all sources of power before opening door” shall be installed on the inner door.

Control switches, indicators and all backpanel-mounted components shall be clearly labeled in accordance with the schematic ladder diagram.
8. Execution

8.1 Field Wiring
Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported such that circuit termination points are not stressed.

8.2 Panel Protection
The pump control panel shall be maintained in an upright position at all times. Lifting shall be only at the floor sills or the top mounting lifting angles.

The pump control panel shall be protected at all times. Any damage to the paint shall be carefully repaired using touch up paint that can be identified by the pump control manufacturer.
Customer Configuration Worksheet

Product Type: Digi-Gage

Customer Name: ___________________________________ REP: ________________

Project Name: ___________________ Delivery Date Requested: ________________

Size of Panel: duplex or triplex     Type of Panel: Control Panel or Controller Only

Service Information: Voltage: _____ Wire: _____ Phase: 1 or 3     Motor FLA: _________

___ Type 1 (E Frame Breaker with NEMA Rated Starters)
___ Type 2 (Q Frame Breaker with IEC Rated Starters)

The **Base Configuration** includes the following: ** Items in **BOLD** are included in a Controller Only unit.

*Note: Optional Features can be found on the next page.*

- Digi-Gage 2300 Controller
- Lexan Control Plate with Programming Instructions
- Pump Circuit Breakers
- Full Voltage Non-Reversing Motor Starters
- Anti-Condensation Heater for the Enclosure
- Plug In Relays with 10 Amp DPDT Contacts and LED Indicators for Pump and Alarm Outputs
- Output Status Indicator LED’s (daylight visible) Mounted on Deadfront Inner Door for HIGH/LOW Level Alarm for up to Three Pumps
- Ground Lugs for Pump and Service Connections
- Serialized UL 508 Label
- Control Power Circuit Breaker Operable through Inner Door
- 24 VAC Control Power Transformer with Circuit Breaker for Digi-Gage and Relay Power
- Hand-Off-Automatic Switches
- Run Pilot Lights
- As Built Drawings (2)
- Standard Digi-Gage Operations Manual
Circle those options that you would like to request:

<table>
<thead>
<tr>
<th>Option #</th>
<th>Option</th>
<th>Sub-Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Main Breaker Through the Door Operators</td>
<td>A. NEMA 12 for Pump or Main</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. NEMA 12 for BOTH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. NEMA 4X for Pump or Main</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. NEMA 4X for BOTH</td>
</tr>
<tr>
<td>2</td>
<td>Circuit Breaker for Auxiliary Power</td>
<td>A. 150 Amp; 10 KAIC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. 20 Amp, 10 KAIC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. 30 Amp, 10 KAIC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. <strong>Quantity Needed:</strong> __________________________</td>
</tr>
<tr>
<td>3</td>
<td>Lightning Arrestor</td>
<td>A. Single Phase, 120/240 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. Three Phase, 600 V</td>
</tr>
<tr>
<td>4</td>
<td>Surge Arrestor</td>
<td>A. Single Phase, 120/240 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. Three Phase, 600 V</td>
</tr>
<tr>
<td>5</td>
<td>Line Monitor/Protection Relay</td>
<td>A. Undervoltage Relay, Plug In, SPDT, 208/240V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1 ph)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. Phase Monitor Relay, Plug In, 208/240 V (3 ph)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Phase Monitor Relay, Surface Mount, 460/480 V (3 ph)</td>
</tr>
<tr>
<td>6</td>
<td>Duplex Receptacle</td>
<td>A. Mounted on Backpanel</td>
</tr>
<tr>
<td></td>
<td>GFCI Type, 120V</td>
<td>B. Mounted on Inner Door</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. <strong>Load Requirement:</strong> __________________________</td>
</tr>
<tr>
<td>7</td>
<td>Pump Start Time Delay, 120V</td>
<td>Yes or No</td>
</tr>
<tr>
<td>8</td>
<td>Elapse Time Meter</td>
<td>A. Standard, Mounted on Inner Door</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. NEMA 4X, Mounted on Inner Door</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. NEMA 4X, Mounted on Outer Door</td>
</tr>
<tr>
<td>9</td>
<td>Cycle Counter (Resettable)</td>
<td>Yes or No</td>
</tr>
<tr>
<td></td>
<td><strong>Contact Factory if Non-Resettable is required.</strong></td>
<td>Will be mounted on Inner Door</td>
</tr>
<tr>
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<tr>
<td></td>
<td><strong>Options 10 – 14 are in gray and applicable for Float Control Panels Only</strong></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Float Status Pilot Lights for 24 VAC and 12 VAC Float Switches only</td>
<td>Yes or No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Will be mounted on Inner Door</td>
</tr>
<tr>
<td>11</td>
<td>Float Simulation Test Switches</td>
<td>A. For 24 VAC &amp; 120 VAC Float Switches Mounted on Inner Door</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. For Intrinsic Safe (IS) Float Switches Mounted on Backpanel</td>
</tr>
<tr>
<td>12</td>
<td>Level Float Circuits</td>
<td>Low Level Float Circuit</td>
</tr>
<tr>
<td></td>
<td>Both High and Low are available. Select only 1 High and 1 Low Circuit for a maximum of two circuits.</td>
<td>A. Shutdown Required? Y N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. Without Pilot Light, NO input, 120V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. With Pilot Light (NO input, 120V)</td>
</tr>
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<td></td>
<td></td>
<td>D. Pilot Light &amp; Reset Pushbutton</td>
</tr>
<tr>
<td></td>
<td>High Level Float Circuit</td>
<td>A. Without Pilot Light, NO input, 120V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. With Pilot Light (NO input, 120V)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Pilot Light &amp; Reset Pushbutton</td>
</tr>
<tr>
<td>13</td>
<td>24 VAC Float Switch Control Circuit (replacing 120V) Floats NOT included.</td>
<td>A. 4 FS control (4 NO inputs)</td>
</tr>
<tr>
<td></td>
<td>Choose A and either B or C (but not both) to reach the appropriate number of control inputs.</td>
<td>B. Add 1 (NO) input for 5 FS Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Add 2 (NO) inputs for 6 FS Control</td>
</tr>
<tr>
<td>14</td>
<td>Intrinsic Safe (IS) Float Control Circuit (replacing 120V) Floats NOT included.</td>
<td>A. 4 FS control (4 NO inputs)</td>
</tr>
<tr>
<td></td>
<td>Choose A and either B or C (but not both) to reach the appropriate number of control inputs.</td>
<td>B. Add 1 (NO) input for 5 FS Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Add 2 (NO) inputs for 6 FS Control</td>
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<tr>
<td><strong>Options 15 – 17 are shaded and applicable for EG, MicroView or Digi-Gage Panels ONLY.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 15 | 120 VAC Float Back Up Control Circuit (floats not included) | A. 1 Float with High Alarm  
B. 2 Floats with Stop/Start/High Alarm  
C. 3 Floats with Stop/Start/High Alarm |
| 16 | 24 VAC Float Back Up Control Circuit (floats not included) | A. 1 Float with High Alarm  
B. 2 Floats with Stop/Start/High Alarm  
C. 3 Floats with Stop/Start/High Alarm |
| 17 | Intrinsic Safe Float Back Up Control Circuit (floats not included) | A. 1 Float with High Alarm  
B. 2 Floats with Stop/Start/High Alarm  
C. 3 Floats with Stop/Start/High Alarm |
| 18 | Motor Overtemperature Alarms | A. Auto Reset with Pilot Light (NC input)  
B. PB reset with Pilot Light (NC input) |
| 19 | Standard Seal Failure Alarms NO Input  
Alarms may also be provided by customer supplied Mini-CAS II or ABS Sealminder. | Pump Shutdown required? Y N  
A. Relay with Pilot Light  
B. Relay with Pilot Light & Reset Pushbutton  
C. Min-CAS II with Reset PB, 1 PL & 1 Relay  
D. Mini-CAS II with Reset PB, 2 PL & 1 Relay  
E. ABS with Pilot Light  
F. ABS with PL & Reset PB |
| 20 | Station Alarms (Audible) | A. Alarm Buzzer, 90db@2 feet  
B. Alarm Horn, 4 Inch, 95db@10 feet  
C. Alarm Bell, 6 Inch, 90db@2 feet |
| 21 | Station Alarms (Visual) | A. Beacon, 25W@120V  
B. Beacon, 60W@120V  
C. Flasher  
D. 12VDC Strobe Light Buzzer |
| 22 | Remote Alarm Enclosure | A. NEMA 3R, Painted Galvanized Steel  
B. NEMA 3 R, Stainless Steel |
| 23 | Phone Dialer  
12"H x 10"W x 6" D  
Must be customer supplied & UL approved. Can be installed by EG or in the field | A. 4 Channel Dialer (w/o surge protector)  
B. 8 Channel Dialer (w/o surge protector)  
C. GFCI Duplex Receptacle |
| 24 | Isolated Dry Contacts (wired to terminals) | A. Pump ON, NO (side mounted)  
B. Pump OFF, NC (side mounted)  
C. Motor O/L Trip NO  
D. High Level Alarm, NC or NO  
E. Low Level Alarm, NC or NO  
F. Control Power Fail, NC or NO  
G. Seal Failure (NC or NO)  
H. Overtemperature (NC or NO)  
I. Bubbler Air Fail  
J. Common Mini-CAS Alarm |
| 25 | Single Phase Start Kits | Installed by EG or in the field  
Specify HP: ______________ |
| 26 | Bubbler Air Supply Source  
Required for EG panels or for Digi-Gage panels operating on bubbler input. A power supply may also be needed. | A. Primary Air Compressor (0 – 10 feet)  
B. Secondary Air Compressor (0-10 feet)  
C. Loss of Air Flow Alarm Only  
D. BAMS-20B (only for two air compressors) |
| 27 | Submersible Level Transmitter | Supplied by EG or Customer  
A. Transmitter for 0 – 35 Feet with 55 Foot Cable  
B. Add Lightning Protection Kit  
C. Add Intrinsic Safe Barrier |
|---|---|---|
| 28 | Vertical Bargraph  
51 segment, red – Used only for Digi-Gage panels | Yes or No |
| 29 | UL Power Supply  
*Needed if any customer supplied non-UL components are being used* | A. Transformer and GFCI Receptacle  
B. GFCI Receptacle Only |
| 30 | OFF/ON Heater Switch | Yes or No |
| 31 | Control Power Transformer  
*Required for 1 phase, 2 wire systems or 3 phase, 3 wire, 480 V systems*  
**Amps @ 120 Volt** | A. 150 Volt; 1.3 Amps  
B. 200 Volt; 1.7 Amps  
C. 250 Volt; 2.1 Amps  
D. 300 Volt; 2.5 Amps  
E. 350 Volt; 2.9 Amps  
F. 500 Volt; 4.2 Amps  
G. 750 Volt; 6.3 Amps  
H. 1 KVA; 8.3 Amps  
I. 1.5 KVA; 12.5 Amps  
J. 2 KVA; 16.7 Amps |