Digi-Gage Operations Manual

12/13/2016

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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.

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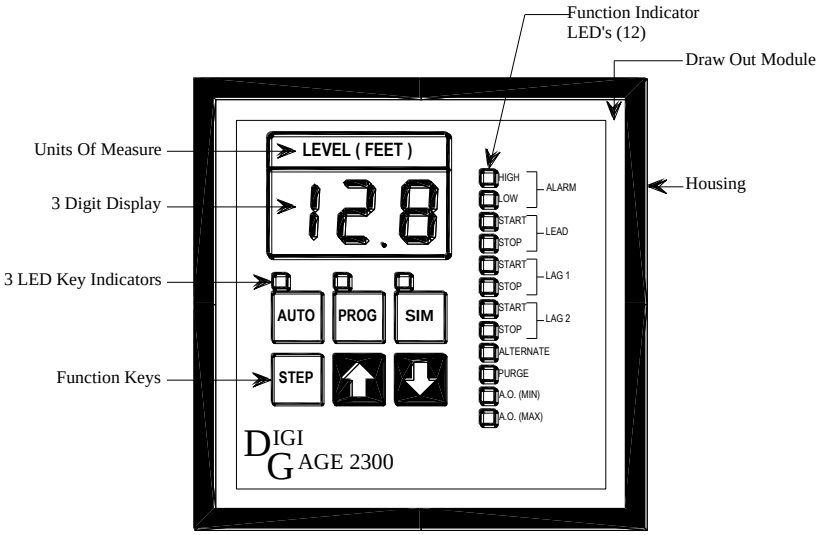
1.2 Transducer Resolution

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

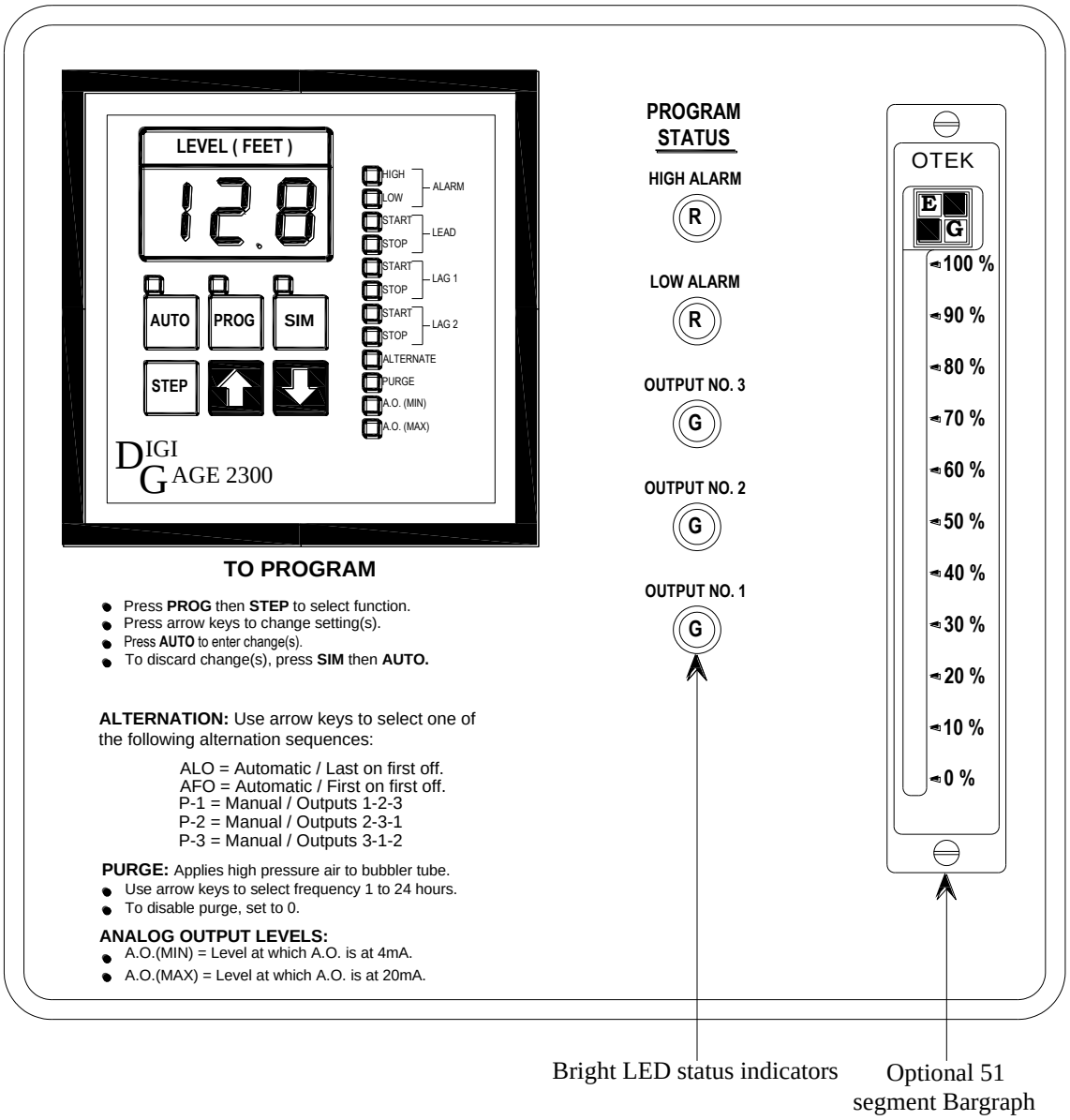


Figure 2-B Sample Digi-Gage Control Plate for Duplex Operation

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.

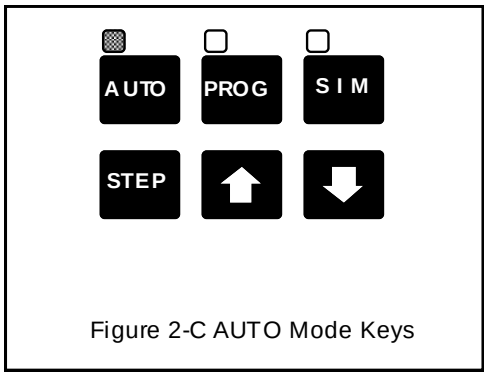


Figure 2-C AUTO Mode Keys

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.

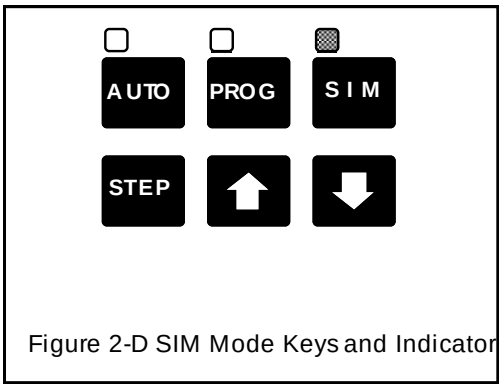


Figure 2-D SIM Mode Keys and Indicator

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.**

Jumper Location	**Type of Input**
W1	4 - 20mA
W2	0 - 35 feet of water (15 PSI)
W3	0 - 10VDC

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.

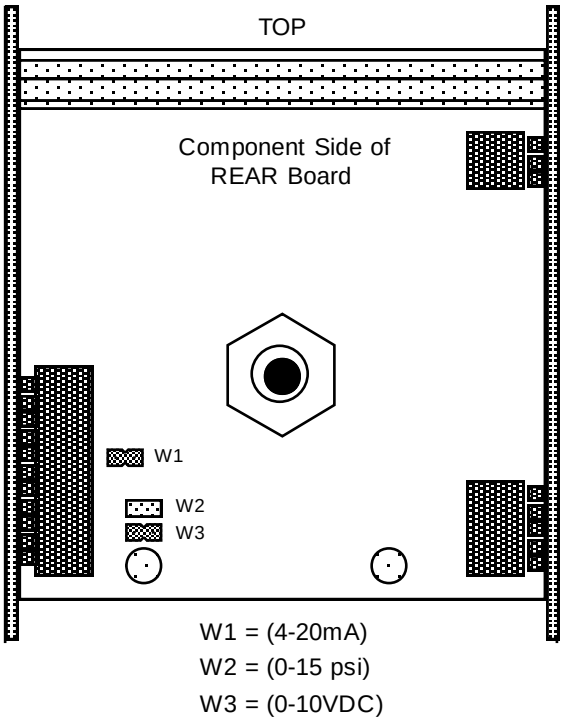
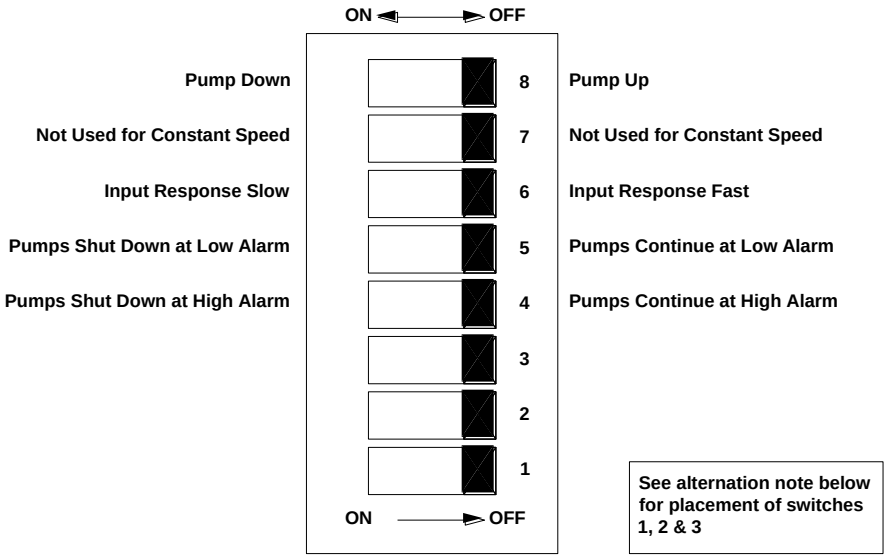


Figure 3-A Location of Input Jumpers

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

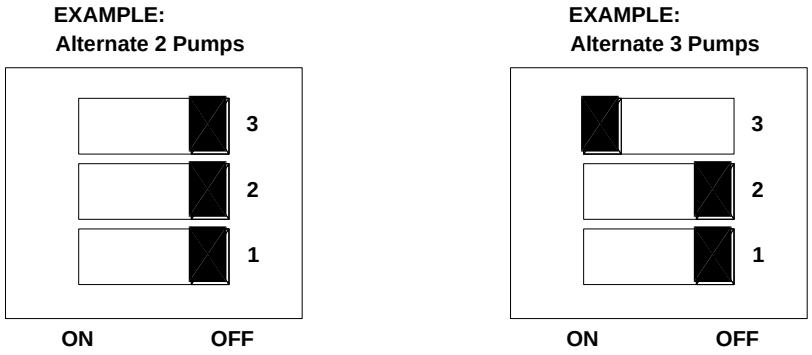


3-B Option Configuration DIP Switch

# of Pumps to Alternate	Digi-Gage 2300	Digi-Gage 2400	Digi-Gage 2600
2	1,2,3 off	1,2,3 off	1,2,3 off
3	(1,2, off) (3 on)	(1,2, off) (3 on)	(1,2, off) (3 on) (see Pumps to Alternate)
4	n/a	(1,3 off) (2 on) (see Pumps to Alternate)	(1,3 off) (2 on)
5	n/a	n/a	(1 off) (2,3 on)
6	n/a	n/a	(2,3 off) (1 on)

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.



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.

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.

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.

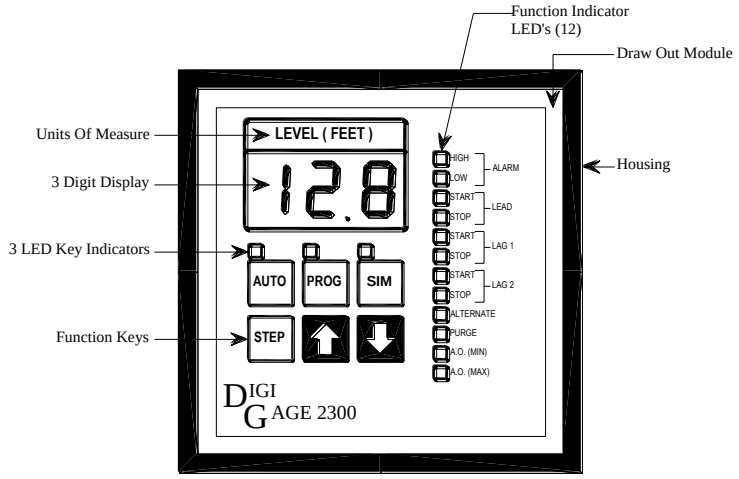
Pump Mode:

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 PROGram 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.

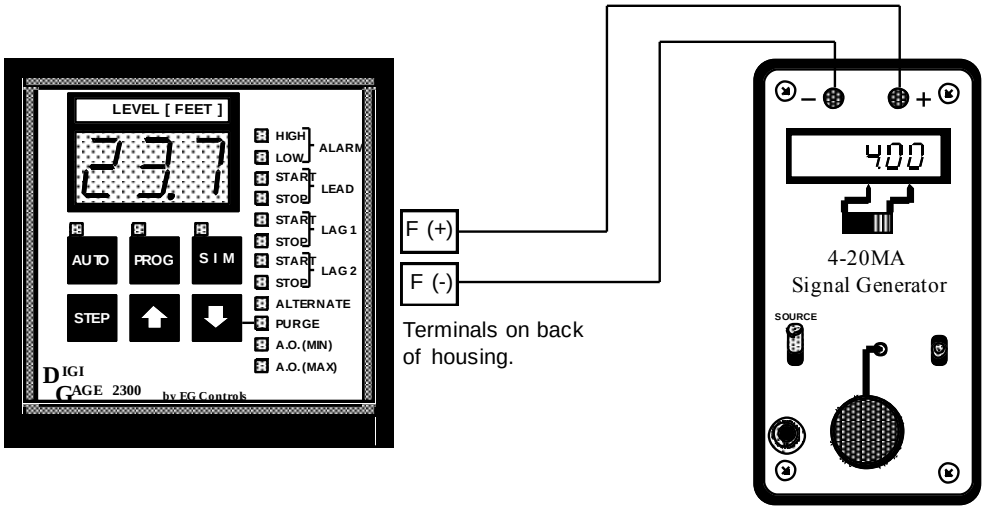


Figure 4-A Calibration Set-up for use with 4-20mA Signal Generator

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.

PSI (A.O. = 4mA)	PSI (A.O. = 20mA)	FEET OF WATER	FEET OF WATER	DG DISPLAY DEC. POINT LOCATION
MIN	MAX	MIN	MAX	
0	2.5	0	5.77	5.77
0	5	0	11.53	11.50
0	10	0	23.07	23.10
0	15	0	34.60	34.60
0	30	0	69.20	69.20
0	60	0	138.40	138.00
0	.25	0	.577	.577

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.

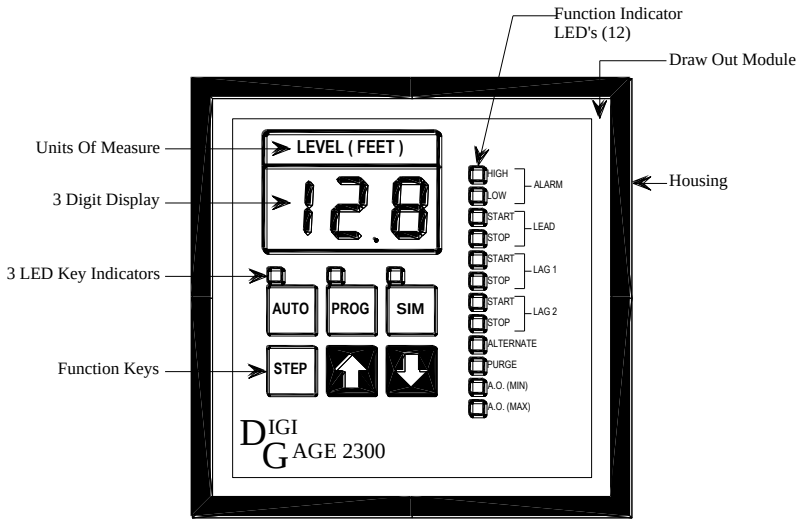
Now, you are ready to program the Digi-Gage. See section 5.2 on page 21 for programming instructions, including programming of the analog output from the Digi-Gage, which is used for the bargraph option.

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:



Programming Function Keys:

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 similate 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 PROGram mode. The current value of each setpoint is displayed in the Digital Display.

Arrow Keys are used to change digital setpoint values in PROGram Mode and to simulate increasing and decreasing digital values.

5.2 Programming the Digi-Gage

For the Digi-Gage 2300:

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 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 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 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:
"ALO" : Last on, First off
"AFO" : First on, First off

Manual Alternation Choices:
P-1: Pump Sequence is 1-2-3-4
P-2: Pump Sequence is 2-3-4-1
P-3: Pump Sequence is 3-4-1-2
P-4: Pump Sequence is 4-1-2-3

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 .

<u>For the Digi-Gage 2600:</u>

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 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 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 PROGram 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.

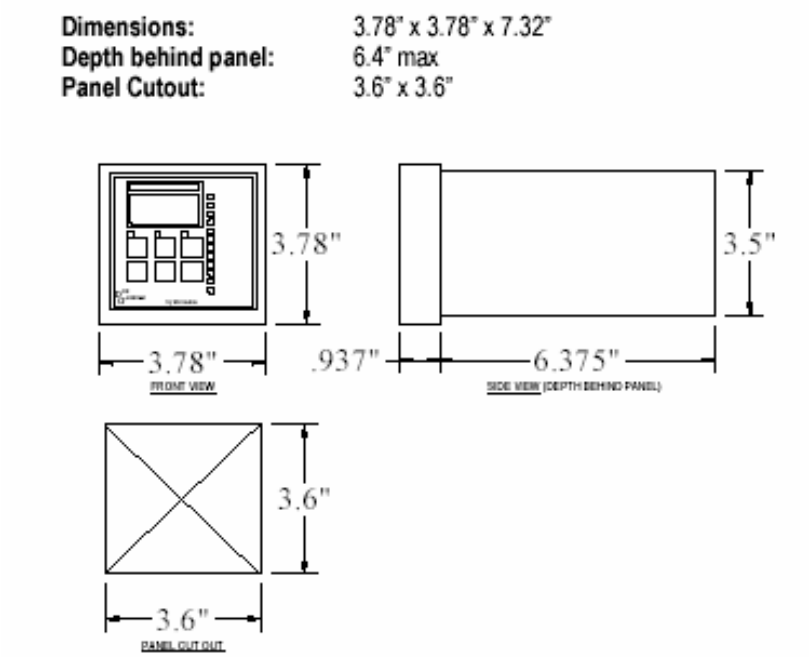


Figure 6-A Physical Dimensions for the Digi-Gage 2300 (similar to 2400 and 2600)

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.

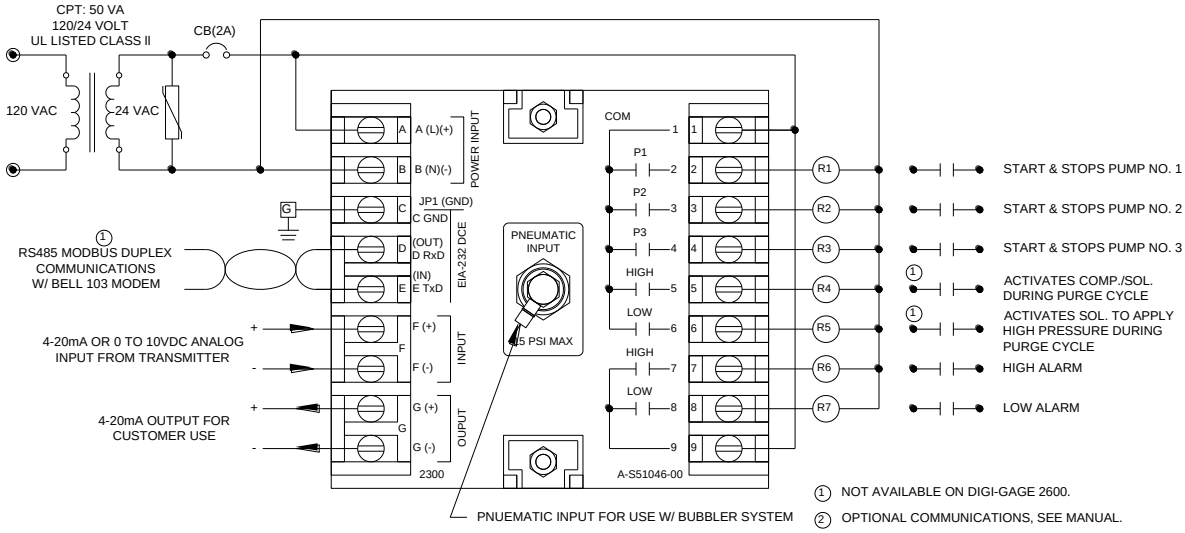


Figure 6-B Recommended Wiring for Digi-Gage 2300 (similar for 2400 and 2600)

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

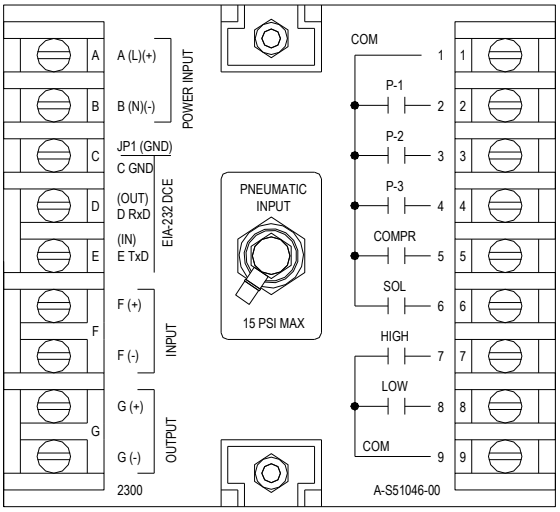
Display: .5" high, 7 segment red LED, 3 digit

Discrete Outputs:

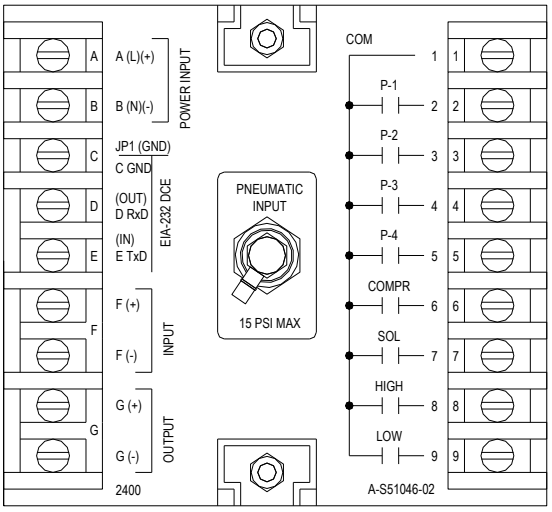
7 contacts, SPST, 1A@120VAC; 3 pumps, 2 alarms (high and low); 2 bubbler controls (isolate and purge)

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

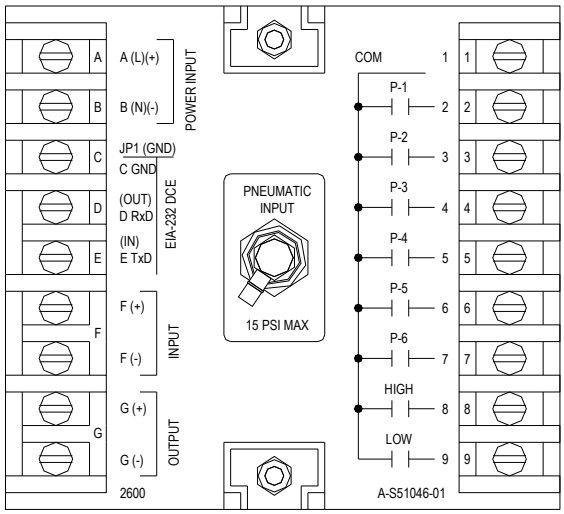
Linearty: +/- .005% analog output; +/-0.1% pneumatic input



Digi-Gage Model 2300



Digi-Gage Model 2400



Digi-Gage Model 2600

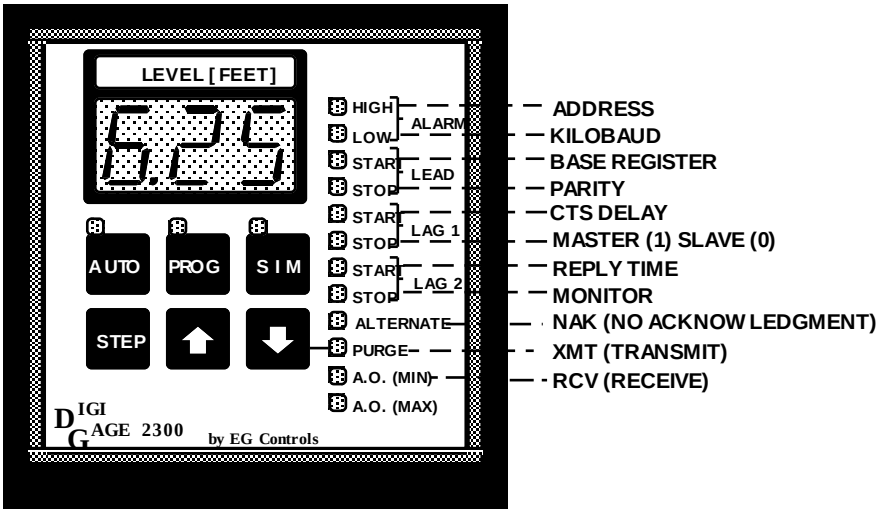
Figure 6-C Outer Housing Diagrams for Digi-Gage Models 2300, 2400 & 2600

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:



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.

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

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

Master	Slave
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. 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. 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, 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).	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. Read requests to 3xxxxx registers (message type 4) are aliased to the corresponding 4xxxxx registers (message type 3). Before a setpoint change is accepted, it is checked for absolute range, then compared to whatever other setpoints it is related to (ie, lead start level vs. lead stop level, taking the pump-in /pump -out selection into account). Setpoints changes that might result in erratic unit operation are discarded.

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 ferruless 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.

Code	Meaning
E01	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.
E02	The unit's RAM has failed its power-up test. Return unit to the factory for repair. This error inhibits all pump operation.
E03	The Analog to Digital converter has failed. Return unit to the factory for repair. This error inhibits all pump operation.
E04	The EPROM failed its power-up checksum test. Return unit to the factory for repair. This error inhibits all pump operation.
E06	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.
E07	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.
E09	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).

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:

Model #	# of Pumps	Analog Outs	Purge Cycle
Digi-Gage 2300	3	1	1 - 24
Digi-Gage 2400	4	1	1 - 24
Digi-Gage 2600	6	1	N/A

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:

PRODUCT	WARRANTY
Digi-Gage Control Systems	1 year
Parts Ordered as Separate Components	3 months

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

4xxx57-4xxx58	(2 reserved)
4xxx59-4xxx64	Pump (1-6) Start Count
4xxx73-4xxx78	Pump (1-6) ETM (0.1, 0.2, 0.5 or 1.0 hours/count)
4xxx79-4xxx80	(2 reserved)
4xxx98	Seconds since key hit (0-65535, for SCADA watchdog), moved from 4xxx64.

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

SCALE	SWITCH COMBINATION
0.1 HR	S8 on
0.2	S1+S8 on
0.5	S2+S8 on
1.0	S1+S2+S8 on

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

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

Relay Output Bitmap/ Limit Alarm Bitmap (4xxx06,r/o)

	DG2300	DG2400	DG2600	VG3300
0x0001	P-1	P-1	P-1	P-1
0x0002	P-2	P-2	P-2	P-2
0x0004	P-3	P-3	P-3	P-3
0x0008	Compressor	P-4	P-4	High Alarm
0x0010	Solenoid	Compressor	P-5	Low Alarm
0x0020	High Alarm	Solenoid	P-6	N/C
0x0040	Low Alarm	High Alarm	High Alarm	N/C
0x0080	N/C	Low Alarm	Low Alarm	N?C

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)

0x0001	Pump 1 required
0x0002	Pump 2 required
0x0004	Pump 3 required
0x0008	Pump 4 required
0x0010	Pump 5 required
0x0020	Pump 6 required
0x0100	Lead Pump required
0x0200	Lag1 Pump required
0x0400	Lag 2 Pump required
0x0800	Lag 3 Pump required
0x1000	Lag 4 Pump required
0x2000	Lag 5 Pump required

Operating Mode (4xxx06,r/o)

0x0000	AUTOmatic
0x0001	SIMulate
0x0002	PROGram
0x0004	CALibrate
0x0008	RTU configuration

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

0x0001	Initiate Purge (toggle while Enable bit is set)
0x0002	Force Alternation (toggle while Enable bit is set)
0x0004	Reset P1 ETM and Start Count (toggle while Enable bit is set)
0x0008	Reset P2 ETM and Start Count (toggle while Enable bit is set)
0x0010	Reset P3 ETM and Start Count (toggle while Enable bit is set)
0x0020	Reset P4 ETM and Start Count (toggle while Enable bit is set)
0x0040	Reset P5 ETM and Start Count (toggle while Enable bit is set)
0x0080	Reset P6 ETM and Start Count (toggle while Enable bit is set)
0x8000	Enable Commands

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)

	DG2300	**DG2400**	**DG2600**	**VG3300**	**RTU Config**
0x0001	Hi Alarm	Hi Alarm	Hi Alarm	Hi Alarm	RTU Address
0x0002	Lo Alarm	Lo Alarm	Lo Alarm	Lo Alarm	Kilobaud
0x0004	Lead Start	Lead	Lead	Lead	Base Register
0x0008	Lead Stop	Lag No. 1	Lag No. 1	Lag	Parity
0x0010	Lag Start	Lag No. 2	Lag No. 2	Standby	CTS Delay
0x0020	Lag Stop	Lag No. 3	Lag No. 3	Start	Master/Slave
0x0040	Standby Start	Start	Lag No. 4	Stop	Reply Timeout
0x0080	Standby Stop	Stop	Lag No. 5	Min Speed	
0x0100	Pump Alternate	Pump Alternate	Analog Out	Max Speed	Monitor
0x0200	Purge	Purge	Start/Max	Pump Alternte	NAK
0x0400	A.O. Min	A.O. Min	Stop/Min	Configure	XMT
0x0800	A. O. Max	A. O. Max	Alternate	Ramp Speed	RCV
0x1000	AUTO	AUTO	AUTO	AUTO	AUTO
0x2000	PROG	PROG	PROG	PROG	PROG
0x4000	SIM	SIM	SIM	SIM	SIM

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

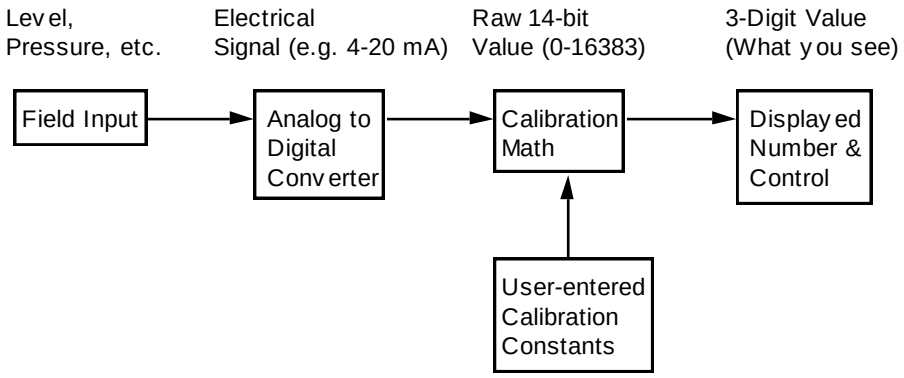


Figure A: Calibration Theory

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.

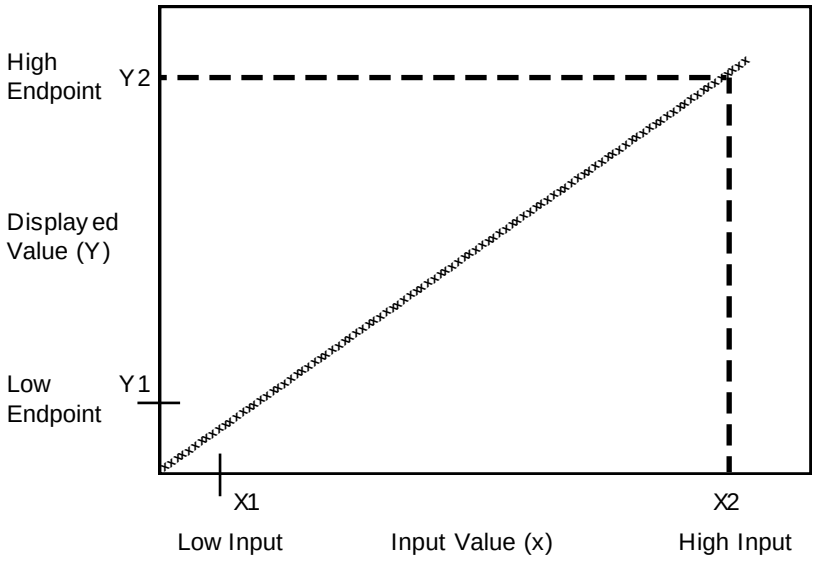


Figure B: The Calibration Function Graph

Calibration Math

Formula: $y = mx + b$ **where** $m = (y_2 - y_1)$ **divided by** (x_2-x_1); $b = y_1 - (mx_1)$

x_1 = **Low Endpoint** y_1 = **Low input**

x_2 = **High Endpoint** y_2 = **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).

In equation format:

y_2= maximum level =10.0ft

y_1= minimum level=1.0ft

x_2= high miliampere reading=20mA

x_1= low miliampere reading=4mA

$m= (y_2-y_1)/(x_2-x_1)$=(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.

In equation format:

$b=y_1-mx_1$=1-.5625(4)=-1.25

The final equation will be:

y= the desired level

x= 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=2.828125ft

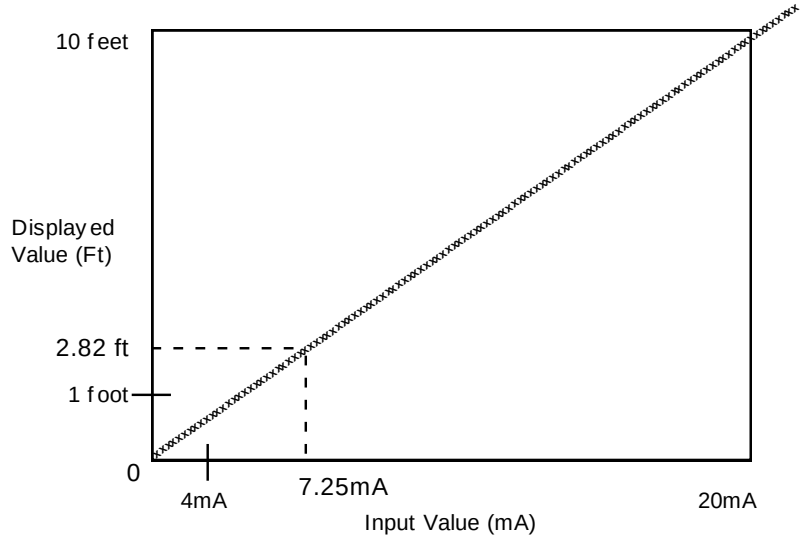


Figure C: Calibration Formula Example

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