

LEVEL.Com™ 100 LIQUID LEVEL
COMPUTER

CALIBRATION KIT INSTRUCTION MANUAL

Version 1.02

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Table of Contents

TABLE OF FIGURES	5
INTRODUCTION.....	7
GENERAL INFORMATION	8
SETUP FOR USE	9
CALIBRATION FOR V2.81 AND EARLIER	11
CALIBRATION FOR V2.82 TO 2.85	13
CALIBRATION FOR 2.85 AND LATER.....	15
CAN'T ZERO SENSOR FAULT	17
ZERO OFFSET FOR 16 BIT SENSORS.....	18
ANALOG OUTPUT CALIBRATION.....	20

Table of Figures

Figure 1 LC-100 Controller Circuit Board	7
Figure 2 Calibration Kit Case	8
Figure 3 Calibration Kit Contents	8
Figure 4 General Setup View	9
Figure 5 Bottom View of LevelCom 100	9
Figure 6 Connection Fitting View.....	9
Figure 7 LevelCom 100 Interior.....	10
Figure 8 LC100-AO-1 Calibration Potentiometers.....	20

Introduction

This manual assumes familiarity with the LevelCom 100 operation. A manual for the LevelCom 100 is included in this kit for reference. Make sure you understand the operation of the LevelCom 100 before you begin this calibration procedure. If you are calibrating to troubleshoot a problem make sure you have studied the troubleshooting information in the LC-100 manual. Other system problems like rust damage to the bubbler down tube, sense line leaks, or incorrect specific gravity values can cause offsets that look like calibration issues.

Calibration procedures are given for machines with a firmware level of v2.81 or earlier, and for v2.82 to v2.85. These are included because it is possible to encounter these earlier firmware versions in the field. You should check the version of the firmware in the LevelCom 100 before calibrating to know which procedure to use.

Figure 1 shows the main controller circuit board. To identify the version number read the label on the program EPROM in the socket near the large blue power transformer. If the RS-422/485 communication interface is installed you will have to remove the interface circuit board to see the EPROM.

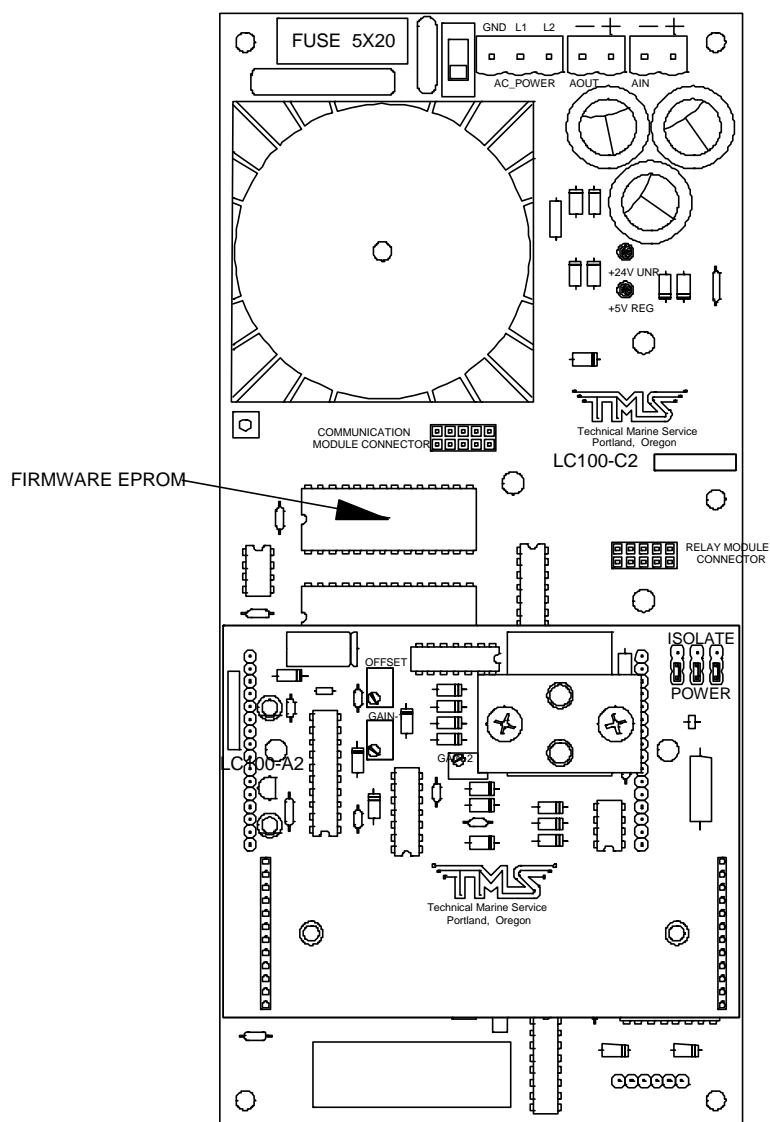


Figure 1 LC-100 Controller Circuit Board

General Information

This kit contains everything needed for calibrating LevelCom 100 Liquid Level Computers.

Open the case and familiarize yourself with the contents. **Figure 2** shows the opened case with the calibration equipment in place. **Figure 3** shows the equipment contained in the calibration kit.

The Hand Pump is a Ralston Instruments model APGV-0000. This pump has a fine adjustment displacer, a bleed valve to relieve pressure, and a hose for connection to equipment.

The Pressure gauge is a Fluke 717, 100G Pressure Calibrator. This device can measure 4-20 mA signals and provide 24V loop power for sensors. Test leads are included for this instrument but will not be needed for LC100 pneumatic calibration.

The connection fitting is used to connect the hand pump and the pressure gauge to the LC-100 for calibration. The Parker Parflex 1/8" tubing, is used to connect the pressure gauge to the calibration fitting. There are Parker Pushlock fittings on the pressure gauge and calibration fitting for this tubing.

A small screwdriver is included for adjusting the calibration potentiometers in the LC100.



Figure 2 Calibration Kit Case



Figure 3 Calibration Kit Contents

Setup for use

Before beginning the calibration procedure the service air should shut off and be detached from the LevelCom 100. Usually there is a valve available in the supply air line for this purpose. LevelCom 100s are often mounted on plates with a local pressure regulator.

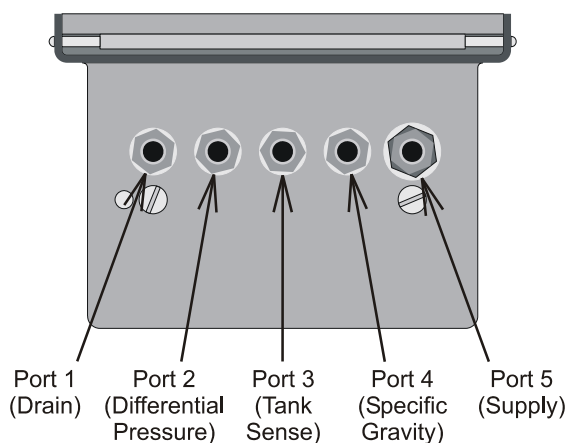


Figure 5 Bottom View of LevelCom 100

Figure 4 shows a valve visible on the supply air line between the pressure regulator and the LevelCom 100.

Figure 5 shows a bottom view of the LevelCom 100 box identifying the valve ports. The Calibration fitting will be attached to the Drain port on the LevelCom 100.

Figure 6 shows a close-up of the connection fitting. The connections to the gauge and hand pump are also visible. The hand pump hose fittings can be finger tight. These connections are sealed by o-rings inside of the fittings and do not need to be screwed down tightly.

Make sure the ends of this tubing are clean before inserting them into the Pushlock fittings. If the tubing is dirty, or scratched the



Figure 4 General Setup View

Pushlock fittings may not seal correctly causing leaks. Leaks in the calibration system make accurate calibration difficult, if not impossible. These tubing connections are the most likely source of leaks.



Figure 6 Connection Fitting View

The Fluke gauge is connected to the connection fitting using the nylon tubing. This tubing plugs into the Parker Pushlock fittings on the gauge and the connection fitting.

Figure 7 shows the circuit boards inside the LevelCom 100. The sensor type is written in the white silkscreened rectangle on the sensor board as shown. You must identify the type of sensor installed before beginning the calibration procedure.

The calibration potentiometers are also identified in this drawing.

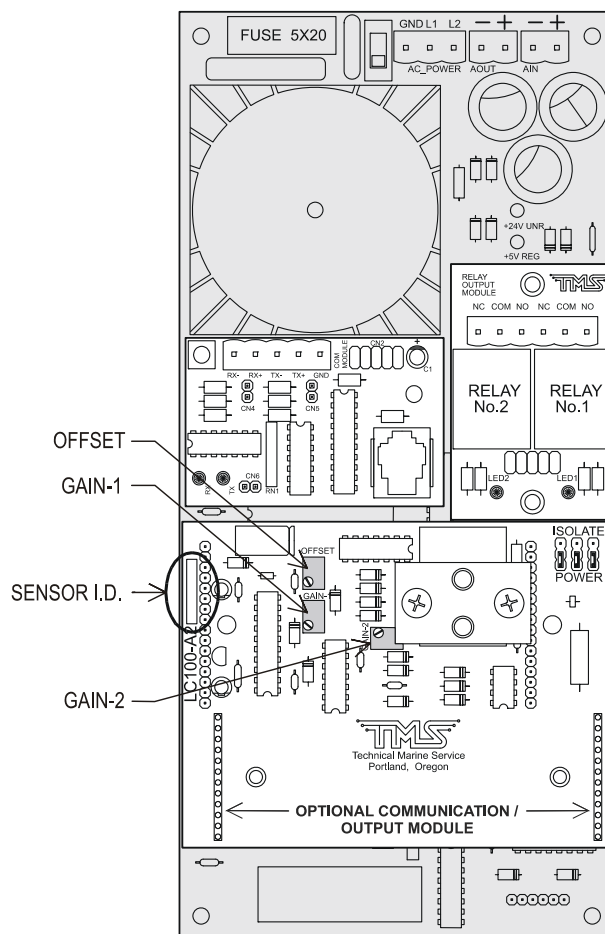


Figure 7 LevelCom 100 Interior

Calibration for v2.81 and Earlier

Calibration Procedure

NOTE: This procedure assumes familiarity with the LevelCom 100 program. If you require assistance in entering the program please refer to the programming sections of the LevelCom 100 manual and the Configuration Flow Chart. The CALIBRATE menu is an item in the UTILITIES menu.

1. Connect the calibration fitting to **PORT 1 DRAIN** on the LevelCom 100 (Refer to Figure 5 for the location). The bleed valve on the hand pump must be open.
2. Enter the LevelCom 100 program. Access the CALIBRATE menu and select "CHAN 0". Press **ENTER**. The output from the pressure sensor will be displayed.
3. At this point the LevelCom 100 will display the output from the pressure sensor. This is a number directly from the hardware. It is not scaled into any engineering units. The following table shows the value you should see:

15 PSI	50
30 PSI	50
100 PSI	80

4. If the number displayed is different from the numbers in the table adjust the **OFFSET** potentiometer on the pressure sensor circuit board until the display reads correctly. This number will be referred to below as the "zero offset" (Refer to Figure 7 for the location of the OFFSET potentiometer). Remember the zero offset number; you will use it in the next steps.

5. Close the bleed valve on the hand pump and apply the pressure shown in the following table to the LevelCom 100 based on the pressure sensor type installed:

15 PSI	400.0" H ₂ O	(14.45 psi)
30 PSI	800.0" H ₂ O	(28.90 psi)
100 PSI	1200.0" H ₂ O	(43.35 psi)

The instrument should now read 4000 plus the zero offset number measured or adjusted earlier in step 4. That is, if the zero offset was 48, the machine should display 4000+48 or 4048. If the reading is different from this value adjust the **GAIN-1** potentiometer until the correct reading shows on the display. (Refer to Figure 7 for the location of the GAIN-1 potentiometer)

NOTE: It is very important here that the hand pump and calibration gauge setup does not leak. It is very difficult to do this adjustment correctly if there are even small leaks in the calibration equipment.

6. Open the bleed valve on the hand pump and recheck the zero offset value. If the zero offset value is different than it was when measured before, repeat steps 4 and 5 until both measurements are correct.
7. Select "CHAN-1" from the CALIBRATE menu.

8. Close the bleed valve on the hand pump and apply the pressure shown in the following table to the LevelCom 100 based on the pressure sensor type installed:

15 PSI	400.0" H ₂ O	(14.45 psi)
30 PSI	800.0" H ₂ O	(28.90 psi)
100 PSI	1200.0" H ₂ O	(43.35 psi)

9. The display should show a number near 3200. Adjust the **GAIN-2** potenti-

ometer until the correct reading of 3200 is on the display. (Refer to Figure 7 for the location of the GAIN-2 potentiometer)

10. The calibration is complete. Remove any fittings that were attached for calibration, and return the machine to normal operation. Verify that the machine is reading the correct depth for the liquid in the tank.

Calibration for v2.82 to 2.85

Field Calibration Procedure

Note: This procedure assumes familiarity with the LevelCom 100 program. If you require assistance in entering the program please refer to the programming sections of the LevelCom 100 manual and the Configuration Flow Chart. The CALIBRATE menu is an item in the UTILITIES menu.

1. Determine the type of pressure sensor installed in the LevelCom 100 by inspecting the white silk-screened area of the Pressure Sensor Circuit Board (Refer to Figure 7 for the location).
2. Connect the calibration fitting to **PORT 1 DRAIN** on the LevelCom 100 (Refer to Figure 5 for the location). The bleed valve on the hand pump must be open.
3. Enter the LevelCom 100 configuration interface. Access the CALIBRATE menu and select "FIELD CAL". Press **ENTER**. The output from the pressure sensor will be displayed. This is a number directly from the hardware. It is not scaled into any engineering units. The following table shows the value you should see:

15 PSI	50
30 PSI	50
100 PSI	80
100 PSI 16 bit	See note for 16 bit sensor

4. Adjust the **OFFSET** potentiometer on the pressure sensor circuit board until the display reads as shown in the table (Refer to Figure 7 for the location of the OFFSET potentiometer). Press **ACK**

when this step is done and proceed to step 5.

5. Close the bleed valve on the hand pump and apply the following pressure to the LevelCom 100 based on the pressure sensor type installed:

15 PSI	400.0" H ₂ O	(14.45 psi)
30 PSI	800.0" H ₂ O	(28.90 psi)
100 PSI	1200.0" H ₂ O	(43.35 psi)
100 PSI 16 bit	2400.0" H ₂ O	(86.70 psi)

The instrument will now read the applied pressure in inches of water to an accuracy of 0.1". If the reading is different from this value adjust the **GAIN-1** potentiometer until the correct reading shows on the display, agreeing with the reading on the calibration gauge. (Refer to Figure 7 for the location of the GAIN-1 potentiometer)

Note: It is very important here that the hand pump and calibration gauge setup does not leak. It is very difficult to do this adjustment correctly if there are even small leaks in the calibration equipment.

6. Open the bleed valve on the hand pump and press **ACK** to recheck the zero offset value. If the zero offset value is different than it was when measured before, repeat steps 4 through 6 until both measurements are correct.
7. Select "CHAN-1" from the CALIBRATE menu.

8. Close the bleed valve on the hand pump apply the following pressure to the LevelCom 100 based on the pressure sensor type installed:

15 PSI	400.0" H ₂ O	(14.45 psi)
30 PSI	800.0" H ₂ O	(28.90 psi)
100 PSI	1200.0" H ₂ O	(43.35 psi)
100 PSI 16 bit	2400.0" H ₂ O	(86.70 psi)

9. The LevelCom 100 display should show a number near 3200. Adjust the **GAIN-2** potentiometer until the correct reading of 3200 is on the display. (Refer to Figure 7 for the location of the GAIN-2 potentiometer)

10. The calibration is complete. Remove the fittings that were attached for calibration, and return the LevelCom 100 to normal operation. Verify that it is reading the correct depth for the liquid in the tank.

Note: Remember that the LevelCom 100 reads out differently in different parts of the

above procedure. When you are setting the zero level the LevelCom 100 is reading out unscaled numbers from the Analog to Digital converter on the sensor board. At this point there will be no decimal point shown. When you are setting the span value the LevelCom 100 will display pressure in inches of water. Since the LevelCom 100 displays with a resolution of 0.1 inches you will see a decimal point on the display. The **ACK** button toggles between these two states. It is very important that there is no pressure on the system when you toggle to the state for setting the span. The zero reading you set is read and used to process the span reading and the zero is recorded when the **ACK** button is pressed.

The readings on the display are filtered to reduce noise for readability. To reduce waiting time press the **MODE** button to bypass the filter algorithm. When the **MODE** button is released the filter functions as usual.

Calibration for 2.85 and later

Field Calibration Procedure

Note: This procedure assumes familiarity with the LevelCom 100 program. If you require assistance in entering the program please refer to the programming sections of the LevelCom 100 manual and the Configuration Flow Chart. The CALIBRATE menu is an item in the UTILITIES menu.

1. Determine the type of pressure sensor installed in the LevelCom 100 by inspecting the white silk-screened area of the Pressure Sensor Circuit Board (Refer to Figure 7 for the location).
2. Connect the calibration fitting to **PORT 1 DRAIN** on the LevelCom 100 (Refer to Figure 5 for the location). The bleed valve on the hand pump must be open.
3. Enter the LevelCom 100 configuration interface. Access the CALIBRATE menu and select "FIELD CAL". Press **ENTER**. The output from the pressure sensor will be displayed. This is a number directly from the hardware. It is not scaled into any engineering units. The following table shows the value you should see:

15 PSI	0
30 PSI	0
100 PSI	0
100 PSI 16 bit	See note for 16 bit sensor

4. Adjust the **OFFSET** potentiometer on the pressure sensor circuit board until the display reads as shown in the table (Refer to Figure 7 for the location of the OFFSET potentiometer). Press **ACK**

when this step is done and proceed to step 5.

5. Close the bleed valve on the hand pump and apply the following pressure to the LevelCom 100 based on the pressure sensor type installed:

15 PSI	400.0" H ₂ O	(14.45 psi)
30 PSI	800.0" H ₂ O	(28.90 psi)
100 PSI	1200.0" H ₂ O	(43.35 psi)
100 PSI 16 bit	2400.0" H ₂ O	(86.70 psi)

The instrument will now read the applied pressure in inches of water to an accuracy of 0.1". If the reading is different from this value adjust the **GAIN-1** potentiometer until the correct reading shows on the display, agreeing with the reading on the calibration gauge. (Refer to Figure 7 for the location of the GAIN-1 potentiometer)

Note: It is very important here that the hand pump and calibration gauge setup does not leak. It is very difficult to do this adjustment correctly if there are even small leaks in the calibration equipment.

6. Open the bleed valve on the hand pump and press **ACK** to recheck the zero offset value. If the zero offset value is different than it was when measured before, repeat steps 4 through 6 until both measurements are correct.
7. Select "CHAN-1" from the CALIBRATE menu.

8. Close the bleed valve on the hand pump apply the following pressure to the LevelCom 100 based on the pressure sensor type installed:

15 PSI	400.0" H ₂ O	(14.45 psi)
30 PSI	800.0" H ₂ O	(28.90 psi)
100 PSI	1200.0" H ₂ O	(43.35 psi)
100 PSI 16 bit	2400.0" H ₂ O	(86.70 psi)

9. The LevelCom 100 display should show a number near 3200. Adjust the **GAIN-2** potentiometer until the correct reading of 3200 is on the display. (Refer to Figure 7 for the location of the GAIN-2 potentiometer)

10. The calibration is complete. Remove the fittings that were attached for calibration, and return the LevelCom 100 to normal operation. Verify that it is reading the correct depth for the liquid in the tank.

Note: Remember that the LevelCom 100 reads out differently in different parts of the

above procedure. When you are setting the zero level the LevelCom 100 is reading out unscaled numbers from the Analog to Digital converter on the sensor board. At this point there will be no decimal point shown. When you are setting the span value the LevelCom 100 will display pressure in inches of water. Since the LevelCom 100 displays with a resolution of 0.1 inches you will see a decimal point on the display. The **ACK** button toggles between these two states. It is very important that there is no pressure on the system when you toggle to the state for setting the span. The zero reading you set is read and used to process the span reading and the zero is recorded when the **ACK** button is pressed.

The readings on the display are filtered to reduce noise for readability. To reduce waiting time press the **MODE** button to bypass the filter algorithm. When the **MODE** button is released the filter functions as usual.

Can't Zero Sensor Fault

When you encounter the Can't Zero Sensor fault on the LevelCom 100 you may not have to do a complete calibration. This error message comes up when the zero point of the sensor drifts out of an allowable range. You might try the following procedure to verify that the sensor has not failed before trying a complete calibration procedure. This issue comes up more frequently with 100 PSI 16 bit sensors but can occur with any sensor type.

1. Enter the LevelCom 100 program. Access the CALIBRATE menu and select "CHAN 0". Press **ENTER**. The output from the pressure sensor will be displayed.
2. At this point the LevelCom 100 will display the output from the pressure sensor. This is a number directly from the hardware. It is not scaled into any engineering units. The following table shows the value you should see:

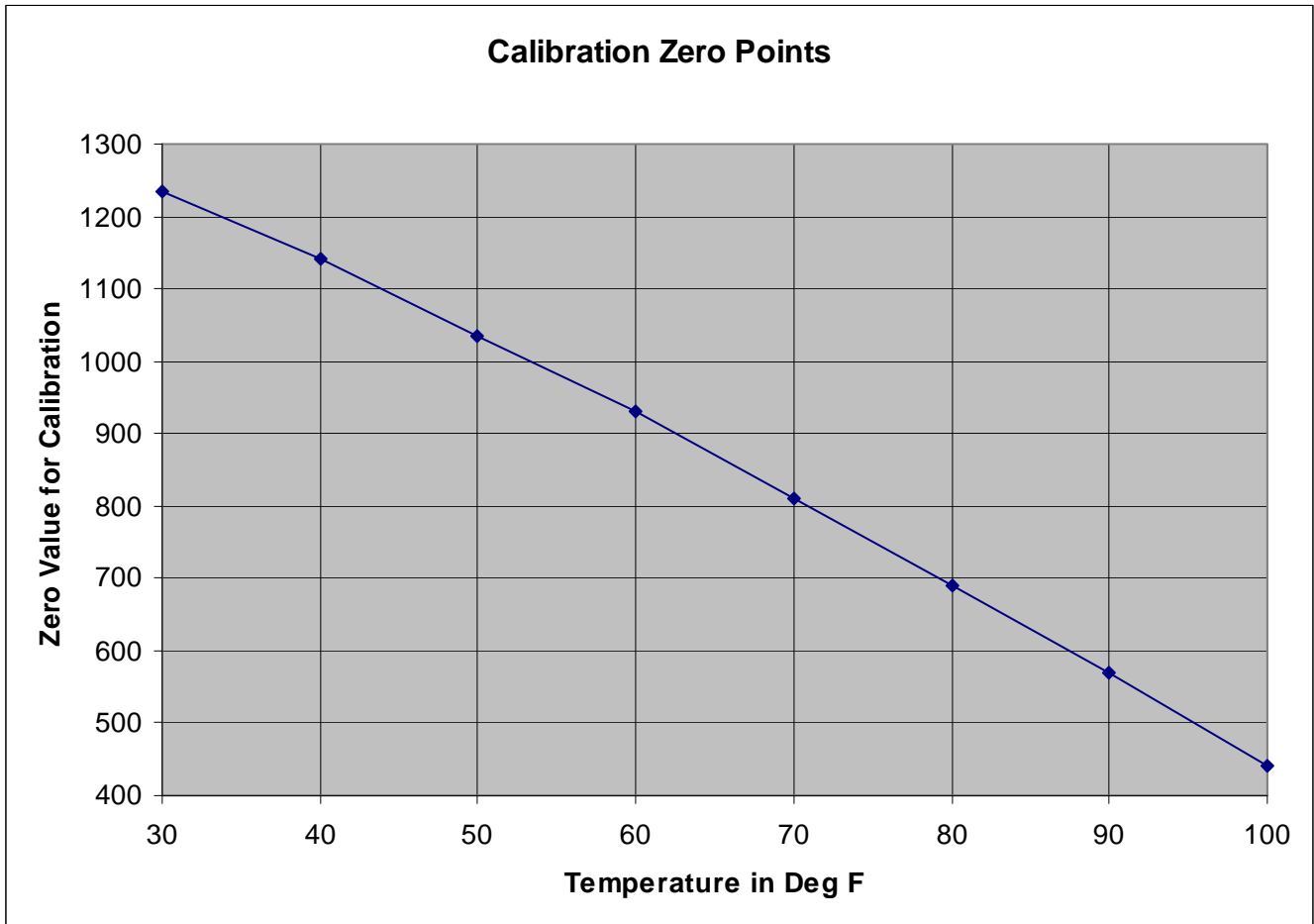
15 PSI	50
30 PSI	50
100 PSI	80
100 PSI 16 bit	See note for 16 bit sensor

3. If the number displayed is different from the numbers in the table adjust the **OFFSET** potentiometer on the pressure sensor circuit board until the display reads correctly. This number will be referred to below as the "zero offset" (Refer to Figure 7 for the location of the OFFSET potentiometer).

When the zero is set cycle the power and verify that the machine comes into normal operation. At this point you should verify that the machine is reading correctly, if so you don't need to do the complete calibration procedure.

The 100 PSI 16 bit sensor boards are more sensitive to temperature changes. Because of this you can't just set the zero to a single value, you have to know the ambient temperature, and you will have to look up the value required. See the next section to find the required value.

Zero Offset for 16 bit Sensors



100 PSI 16 bit sensors are more sensitive to changes in temperature. The zero point will drift noticeably with changes in ambient temperature. Because of this sensitivity you cannot set a fixed value for the zero when calibrating these sensors. Before you set the zero point for 16 bit sensor boards you will need to take an ambient temperature measurement.

The above graph and the tables to the right give the zero point needed based on the ambient temperature reading of the Level-Com 100.

Deg F	Zero
30	1235
40	1140
50	1035
60	930
70	810
80	690
90	570
100	440

Deg C	Zero
0	1217
5	1128
10	1035
15	937
20	836
25	729
30	619
35	505
40	386

Use these tables for all versions if you are using the **v2.82 to 2.85** calibration procedure or if you are correcting the **Can't Zero Sensor** fault condition.

You will need to use the following tables if you are using the calibration procedure for **v2.86** or higher. In these machines a value of 1180 is subtracted from the raw zero value before display. Because of this it is possible for the displayed number to be negative. Use the tables to the right to find the value needed.

Deg F	Zero
30	55
40	-40
50	-145
60	-250
70	-370
80	-490
90	-610
100	-740

Deg C	Zero
0	37
5	-52
10	-145
15	-243
20	-344
25	-451
30	-561
35	-675
40	-794

Analog Output Calibration

Note: If the analog output is being used as a control output be sure to secure the controlled process before you begin because you may be disconnecting the LevelCom 100 from the controlled process, or you may be generating meaningless control signals while performing the calibration procedure.

This procedure will use the Fluke pressure gauge to measure the output current from the analog output. You will use the test leads included in this kit with the pressure gauge for this operation.

Calibration Procedure

1. Connect the meter to the Analog output connector. If the LevelCom 100 is set up to power the analog output you can connect directly to the terminals, however if the output is set up to be externally powered you will need to connect the meter into the complete circuit.
2. Enter the LevelCom 100 program. Access the CALIBRATE menu and select "AN OUT". Press **ENTER**. "ZERO" will be displayed. Press **ENTER**. The meter should read 4 mA. If it doesn't, adjust the **ZERO** potentiometer on the analog output board until the meter reads 4 mA. (Refer to Figure 8 for the location of the ZERO potentiometer)
3. Press the **UP** or **DOWN** keys to scroll to "SPAN" and press **ENTER**. The meter should read 20mA. If it doesn't, adjust the **SPAN** potentiometer until the meter reads 20 mA. (Refer to Figure 8 for the location of the SPAN potentiometer)

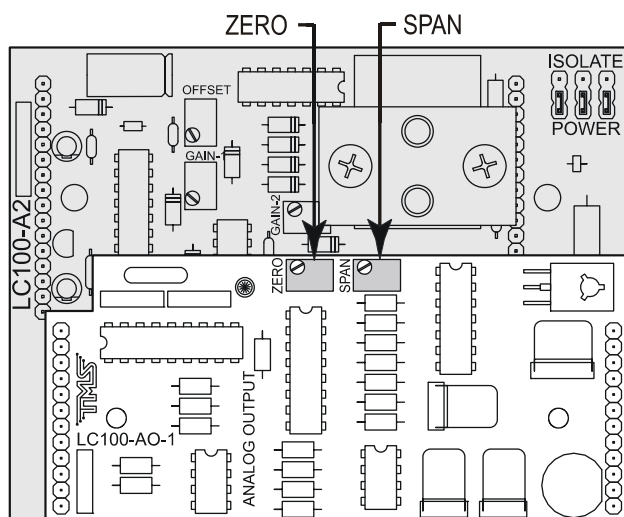


Figure 8 LC100-AO-1 Calibration Potentiometers

4. Press the **UP** or **DOWN** keys to scroll to "ZERO" and press **ENTER**.
5. The meter should read 4 mA. If it does the calibration is complete, if not repeat steps 2 – 4 until the meter reads 4 mA when you enter ZERO, and 20 mA when you enter SPAN.
6. Now you can check the linearity of the output with the other items in this menu. When the span and zero calibration is done entering the following menu items should give the following meter readings:

25% - 8 mA
50% - 12 mA
75% - 16 mA

This completes the test and calibration of the analog output circuit.