# PCL4000 SERIES
# PRESSURE CALIBRATOR

## Operator's Manual

OMEGA ENGINEERING, INC.
An OMEGA Technologies Company

http://www.omega.com
e-mail: info@omega.com

# TABLE OF CONTENTS
# PCL4000 SERIES
# PRECISION PRESSURE CALIBRATOR

## SECTION 1 INTRODUCTION

The OMEGA® PCL4000 is a precision pressure calibrator for field and laboratory use that has mA, mV and V ranges. An option available is an RS-232-C interface (part number PCL4000-RS3 or PCL4000RS5). Refer to Section 9 for additional accesssories.

The following models are available from OMEGA:

| MODEL | MEASURING RANGE |
|---|---|
| PCL4000E | P1: 0 - 200 kPa |
| PCL4000F | P2: 0 - 2000 kPa |
| PCL4000G | P1: 0 - 200 kPa<br>P2: 0 - 2000 kPa |

## SECTION 2 UNPACKING

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, please call the OMEGA Customer Service at 1-800-622-2378 or (203) 359-1660.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

**NOTE**

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

Make sure the following is packed in the box:

- 1 Carrying case (for field use)
- 1 AC Adaptor
- 2 Test leads
- 1 Set of pressure connectors and hose set
- 1 Operator's manual

## SECTION 3 PARTS OF THE CALIBRATOR

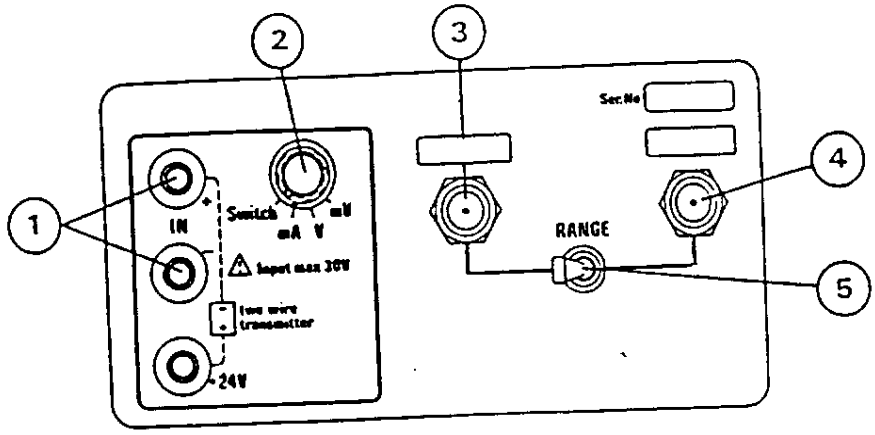


Figure 3-3. Top View

### 3.1 PRESSURE INPUTS

The pressure transducers have separate pressure inputs (3, 4) in case of dual range model. The 1/8" pressure connectors enable tight connection with hand tightening. Use of a wrench may damage the connector.

The pressure input selector switch (5) in the input panel is used for transducer selection in case of dual range model.

To zero the transducer make sure that the selected pressure input is open to ambient. Then press the zero key in the front keyboard panel.

The word 'Zero' appears on the display one second after the key is pressed.

Only non-corrosive gases are recommended to be used as pressure media.

### 3.2 ELECTRICAL INPUT

Measurement of ±60mA is achieved by turning the input panel selector (2) to the position 'mA' and connecting the current to the input terminals (1).

Voltage can be measured by using two ranges. In the selector position 'mV' voltages up to ±150mV can be measured. With higher voltages up to ±15V use the selector position 'V'.

In the selector position 'SWITCH' PCL4000 detects the state (open/closed) of a pressure switch contact connected to the input terminals indicated by the letter 'O' or 'C' on the display.

## SECTION 4 POWER ON/OFF, BATTERIES

The PCL4000 is switched on by pressing the ON button in the front panel. The operation starts with an internal test sequence. If the pressure reading is not near enough to zero, zeroing of the pressure transducer is requested. If you do not want to zero the transducer, press any key on the keypad to continue.

To switch off the device press the OFF button in the front panel.

The PCL4000 is supplied with rechargeable nickel-cadmium batteries and a battery charger. The remaining battery operation time can be read by pressing the Batt key (3). Eg. the display 'Batt 40' means that approximately 40% of battery operation time is left. When the batteries are nearly empty, the battery display flashes at approximately four times a minute. After charging the batteries wait at least 15 minutes before checking the battery condition. This allows the NiCad batteries to cool down after recharging.

The PCL4000 will operate more than 50 hr after 16 hr of recharging. The operating time is 15 hr if 24V output is loaded with an average of 12mA. The PCL4000 can be used while being recharged.

# SECTION 5 SCALING OF THE DISPLAY READINGS

## 5.1 INITIAL DISPLAY MODE AND PRESSURE UNITS

After the calibrator is switched on it will display the selected input pressure in engineering units on the upper display and the electrical signal in selected units on the lower display.

The pressure units are selected by pressing the UNIT key (numeric key 9), which moves the cursor in the display to the desired pressure unit.

The PCL4000 has a certain measurement range in each pressure unit for each transducer. The underrange or overrange state is indicated by flashing the limit value.

## 5.2 SELECTING DISPLAY MODES

### 5.2.1 Pressure Display

The pressure can be measured in engineering units or in % of a preset pressure range.

To change the pressure display from engineering units to percentage mode or vice versa press the p/% (4) key. A flashing arrow at the lower left corner of the display indicates that the percentage mode is selected.

### 5.2.2 Electrical Display

The electrical display can indicate values in three modes:
- normal mode (mA, mV, V)
- % mode
- error % mode

Mode can easily be changed by pressing the MODE key (numeric key 1).

- In **normal mode** the measured electrical quantity is displayed in engineering units.

- In **% mode** the display is in percentage of the preset electrical range. The %-arrow at the lower left corner is flashing.

- The **error % mode** is the most convenient mode in transmitter calibration. It displays the transmitter output signal error directly in percentage of the span. The error % -arrow at the upper left corner is flashing. See Section 5.3.

### 5.2.3 Calibrating Square Rooting Transmitters

If the transmitter under test is of square rooting type, a different error calculation is needed. The square rooting calculation function is selected by pressing the √/lin key (numeric key 2). The square rooting calculation function is indicated by a flashing arrow pointing to the sign √ on the lower display. Change back by pressing again the √/lin key.

## 5.3 ENTERING END POINT VALUES OF THE RANGES

If the PCL4000 is used for transmitter calibration, it is most convenient to use % scales. Before using the % scales check the zero and full scale points of the pressure and the selected electrical signal.

To ease in the set-up, the following ranges are automatically set when the calibrator is switched on:

```
mA range          =  4 mA to 20 mA
mV range          =  0 mV to 100 mV
V range           =  0 V to 10 V
pressure range    =  0 bar to 1 bar
```

Often the electrical signal is 4 to 20 mA and the pressure range starts at zero. Then the only value that needs to be changed is the pressure full scale value.

Select the measurement units for pressure and electrical measurement before checking the end points of the ranges. Use the upper 0% and 100% keys (numeric keys 7, 8) for pressure and lower 0% and 100% keys (numeric keys 0, .) for the selected electrical unit. Press the corresponding key, and the valid end point value is shown on the display.

If the value is OK, you can check another one or press the ENT key to free the display. If the end point needs to be changed press the same key again and enter a new value.

Example: Change the original pressure full scale value to 1.5 bar:

- Press the pressure full scale key (8).

  The old 100% value (1 bar) is now displayed on the upper display in the selected pressure units.

- Press the pressure range end point key (8) again.

- The display 'FS ?' requests the full scale pressure value and you can enter the new value by pressing

**1.5 ENT**

If the % value is outside the limits ±200%, the limit value will flash. The % values will also flash if the measurement in engineering units is out of measuring range.

## SECTION 6 HOW TO SET UP CALIBRATOR FOR FIELD USE

In laboratories and maintenance shops the PCL4000 is easiest to use without its carrying case. In order to remove the carrying case, remove the power cord, then open both carrying case flaps and the strap around the instrument. Lift the rear of the instrument about an inch, lift the front of the instrument, and pull it out of the case. The carrying handle may then be turned downwards in front to act as a table prop for easier viewing. The unit is installed back into its case in the reverse order.

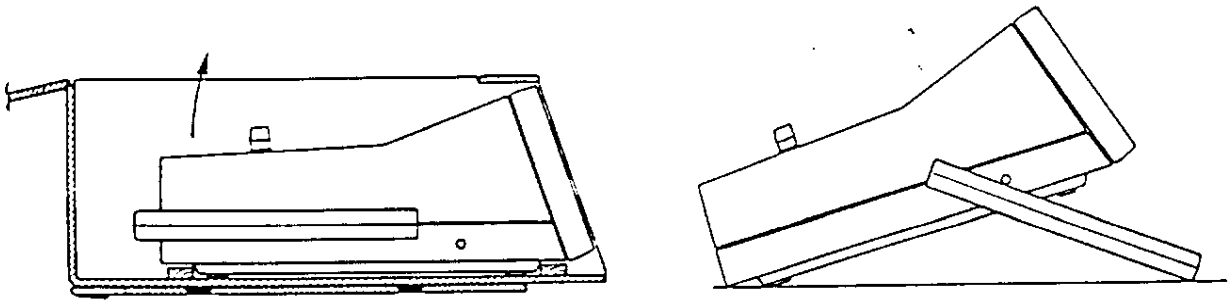

Figure 6-1. Use of Handle

## SECTION 7 CALIBRATING A TRANSMITTER

Use a PCL4000HP calibration pressure pump or equivalent as a pressure source and connect it to the transmitter and to the PCL4000 pressure input.

Check that the PCL4000 electrical input selector is in position 'mA'. Connect the transmitter to the loop and feed the current through the PCL4000 input.

The low input impedance of the PCL4000 input enables also connection parallel with the current measurement diode of the transmitter. If there is no external power supply in the loop, the 24V supply option is needed. If the percentage scales are used in the current measurement, the current must flow in positive direction.

Check that the percentage scale end points of pressure and electrical measurement correspond to the transmitter pressure range and output signal range. Select the Error % mode for current measurement.

Generate any pressure within the transmitter pressure range and read the percentage output error in the lower display.

Correct the transmitter calibration if needed.

To adjust the calibration of the transmitter no precise pressure adjustments at 0% and 100% are needed.

Just generate a pressure near 0% and adjust the transmitter zero for minimum output error reading, then adjust the transmitter span respectively near 100%.

With the PCL4000 it is easy to check the transmitter output error at any point and optimize the calibration at the most often used part of the range.

If a test protocol is needed, calibration results can be stored in memory and can be recalled after the entire calibration sequence is completed. There are 21 memories (0 ... 9, '+/-' and '.0' ... '.9') available. Eg. storing both displays to the memory 3 is made by pressing

**STO 3**

To recall the readings stored in the memory '.5' press

**RCL .5**

If you want to clear all memory registers, hold the CL key pressed when the PCL4000 is switched on.

# SECTION 8 MAINTENANCE

## 8.1 INTRODUCTION

This section of the manual contains the information required in checking the accuracy and in recalibrating the PCL4000. The recommended calibration interval is 6 months. No other periodical maintenance is required for normal operation.

## 8.2 DISASSEMBLY INSTRUCTIONS

It is necessary to open the PCL4000 case to access the calibration potentiometers. Remove the 4 screws located at the bottom of the instrument and remove the top cover. The calibration potentiometers are located at both sides of the input panel assembly (see Figure 8-1.). Adjustment of electrical ranges is accessible through the holes in the 24V converter board.

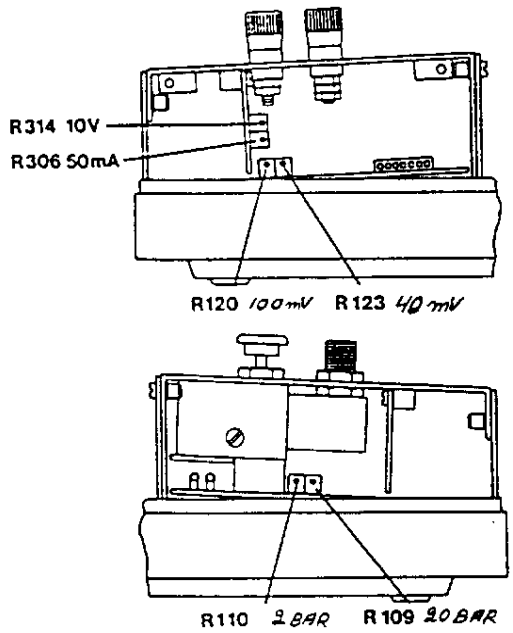


Figure 8-1. Location of Potentiometers

## 8.3 EQUIPMENT REQUIRED

For checking and recalibration of pressure ranges a dead weight tester is preferable. The accuracy of the tester must be 0.025 % or better near the full scale of the PCL4000. For electrical ranges a DC calibrator with 0.01 % or better accuracy near the full scale points of the PCL4000 measuring ranges is required.

## 8.4 CALIBRATION PROCEDURE

If the PCL4000 has been in normal room temperature, it can be recalibrated after being on for half an hour. If the PCL4000 has been in extreme ambient conditions, one or two additional hours are recommended for the instrument to stabilize before calibration is started. The calibration points are given in the table below. Note that mV calibration affects all ranges ie. if mV calibration is changed, all other ranges including pressure ranges must be calibrated. Pressure ranges, 15V and mA ranges can be calibrated in any order without affecting the calibration of other ranges.

Before beginning the calibration of pressure ranges make sure that there are no leaks in the tubing or connector, by closing the tube from the dead weight tester and checking in the pressure display that the pressure is not falling. (The reading may decrease slowly at the beginning due to temperature changes.)

| Range | Calibration point * | Adjustment |
|---|---|---|
| mV | 40 mV ( 25...45 mV) | R123 |
| mV | 100 mV ( 80...150 mV) | R120 |
| V | 15 V ( 8...15 V) | R314 |
| mA | 50 mA ( 20...60 mA) | R306 |
| P1 | 2 bar (1.6...2.0 mbar) | R110 |
| P2 | 20 bar ( 18...20 bar) | R109 |

* Any point within '( )' can be used if the full scale reference is not available.

# SECTION 9 ACCESSORIES

| PART NUMBER | DESCRIPTION |
|---|---|
| PCL-4000HP | Pneumatic hand pump (max. 300 PSI) |
| PCL-4000MA | Current simulator module |
| PCL-4000PS | Pressure switch testing and checking |

# SECTION 10 SPECIFICATIONS

## 10.1 PCL4000E

### GENERAL

| | |
|---|---|
| **Display:** | 2 x 6 digit 0.413" (10.5 mm) Liquid Crystal Display |
| **Overrange indication:** | display blinks max reading of the selected range |
| **Reading rate:** | 1.25 readings/sec. |
| **Warm-up time:** | less than 1 min. |

### OPERATING CONDITIONS

| | |
|---|---|
| **Storage temperature:** | -4 to 140°F (-20 to +60°C) |
| **Operating temperature:** | 32 to 104°F (0 to 40°C) |
| **Humidity:** | <80% R.H. non-condensing |

**BATTERY OPERATION**

50 hr operation with one recharge (after 16 hours)

Using 24V loop supply the battery lasts 15 hours with average 12mA output current

### PRESSURE MEASUREMENT

| | |
|---|---|
| **Measuring ranges:** | P1: 0 to 200 kPa (2000 mbar, 30 PSI)<br>- accuracy: 0.04 kPa ±0.05% of reading at 68 to 79°F (20 to 26°C)<br>- max overpressure 600 kPa (90 PSI) with negligible effect on calibration. |
| **Temperature coefficient:** | ±0.0028% RDG/°F (±0.005%RDG/°C) |
| **Pressure connector:** | 1/8" BSP 60° internal cone |
| **Calibration media:** | non-corrosive gases compatible with nickel, brass, quartz and urethane |

**DIMENSIONS (with carrying case)**

12.4"(d) x 8.2"(w) x 5.2"(h)
310(d) x 205(w) x 130(h) mm

**WEIGHT**

7 lbs (3 kg)

NOTE: For Electrical Measurement, refer to Specifications Section 10.4.

## SPECIFICATIONS (Cont'd)

10.2 PCL4000F

### GENERAL

| | |
|---|---|
| Display: | 2 x 6 digit 0.413" (10.5 mm) Liquid Crystal Display |
| Overrange indication: | display blinks max reading of the selected range |
| Reading rate: | 1.25 readings/sec. |
| Warm-up time: | less than 1 min. |

### OPERATING CONDITIONS

| | |
|---|---|
| Storage temperature: | -4 to 140°F (-20 to +60°C) |
| Operating temperature: | 32 to 104°F (0 to 40°C) |
| Humidity: | <80% R.H. non-condensing |

| | |
|---|---|
| BATTERY OPERATION | 50 hr operation with one recharge (after 16 hours)<br>Using 24V loop supply the battery lasts 15 hours with average 12mA output current |

### PRESSURE MEASUREMENT

| | |
|---|---|
| Measuring ranges: | P2: 0 to 2000 kPa (20 bar, 300 PSI)<br>- accuracy 0.4 kPa ±0.05 % of reading<br>- max overpressure 2800 kPa (420 PSI) with negligible effect on calibration |
| Temperature coefficient: | ±0.0028% RDG/°F (±0.005%RDG/°C) |
| Pressure connector. | 1/8" BSP 60° internal cone |
| Calibration media: | non-corrosive gases compatible with nickel, brass, quartz and urethane |

| | |
|---|---|
| DIMENSIONS (with carrying case) | 12.4"(d) x 8.2"(w) x 5.2"(h)<br>310(d) x 205(w) x 130(h) mm |
| WEIGHT | 7 lbs (3 kg) |

NOTE: For Electrical Measurement, refer to Specifications Section 10.4.

## 10.3 PCL4000G

### GENERAL

| | |
|---|---|
| **Display:** | 2 x 6 digit 0.413" (10.5 mm) Liquid Crystal Display |
| **Overrange Indication:** | display blinks max reading of the selected range |
| **Reading rate:** | 1.25 readings/sec. |
| **Warm-up time:** | less than 1 min. |

### OPERATING CONDITIONS

| | |
|---|---|
| **Storage temperature:** | -4 to 140°F (-20 to +60°C) |
| **Operating temperature:** | 32 to 104°F (0 to 40°C) |
| **Humidity:** | <80% R.H. non-condensing |

**BATTERY OPERATION**

50 hr operation with one recharge (after 16 hours)

Using 24V loop supply the battery lasts 15 hours with average 12mA output current

### PRESSURE MEASUREMENT

**Measuring ranges:**

P1: 0 to 200 kPa (2000 mbar, 30 PSI)
- accuracy 0.04 kPa ±0.05 % of reading at 68 to 79°F (20 to 26°C)
- max overpressure 600 kPa (90 PSI) with negligible effect on calibration

P2: 0 to 2000 kPa (20 bar, 300 PSI)
- accuracy 0.4 kPa ±0.05 % of reading
- max overpressure 2800 kPa (420 PSI) with negligible effect on calibration

| | |
|---|---|
| **Temperature coefficient:** | ±0.0028% RDG/°F (±0.005%RDG/°C) |
| **Pressure connector:** | 1/8" BSP 60° internal cone |
| **Calibration media:** | non-corrosive gases compatible with nickel, brass, quartz and urethane |

| | |
|---|---|
| **DIMENSIONS (with carrying case)** | 12.4"(d) x 8.2"(w) x 5.2"(h)<br>310(d) x 205(w) x 130(h) mm |
| **WEIGHT** | 7 lbs (3 kg) |

**NOTE:** For Electrical Measurement, refer to Specifications Section 10.4.

## 10.4 ELECTRICAL MEASUREMENT

| | |
|---|---|
| Measuring ranges: | -150 to 0 to +150 mV<br>- accuracy: 0.01 mV ±0.03 % of reading<br>-15 to 0 to +15 V<br>- accuracy: 2 mV ±0.03 % of reading<br>-24 to 0 to +24 mA<br>- accuracy: 0.002 mA ±0.03 % of reading<br>-60 to 0 to +60 mA<br>- accuracy: 0.004 mA ±0.03 % of reading |
| Noise rejection: | NMR more than 60dB at 50 or 60Hz |
| Input impedance: | mV more than 100 Mohm<br>V more than 1 Mohm<br>mA less than 5 ohm |
| Temperature coefficient: | ±0.0011% RDG/°F (± 0.002% RDG/°C). |