

# MultiCal Instruction Sheet

## kPa/PSI Pressure Module

### Introduction

MultiCal pressure modules are used to measure pneumatic or hydraulic pressures. They can also be used to measure vacuum.

MultiCal modules don't display pressure, since they only have an electrical output. Instead, the modules convert pressure to millivolts. Modules are used with devices capable of measuring DC millivolts, such as a digital multimeters or oscilloscopes.

MultiCals are calibrated to convert pressure units (for this model, inches kPa or PSI) to 1 millivolt per pressure unit. Vacuum readings will of course be negative.

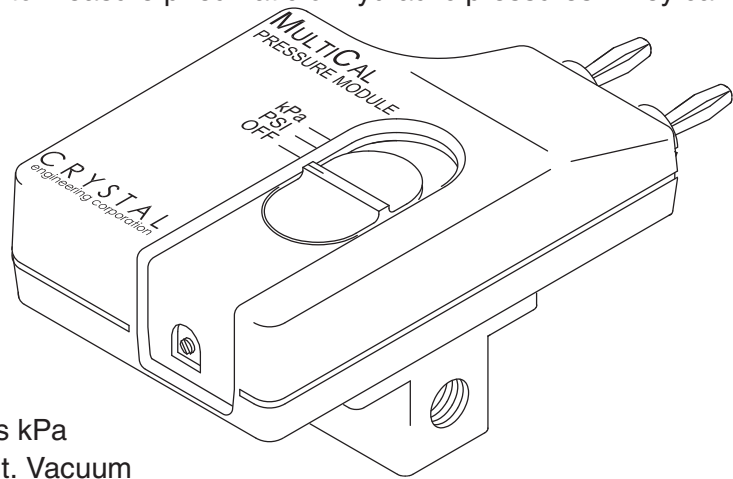
Pressure is measured by connecting an appropriate fitting to one of the two  $\frac{1}{8}$ " female NPT ports (plug any unused port). Any gas or liquid compatible with 316 stainless steel, PTFE (polytetrafluoroethylene) impregnated hard anodized aluminum, and buna-n rubber, can be applied to the module as the pressure source.

The three-position switch acts as a power switch as well as selecting kPa or PSI scaling for the output. The OFF position is used to measure the internal battery condition via an external multimeter.

MultiCal modules perform best when used with high accuracy multimeters. We recommend meters manufactured by the Fluke Corporation, but MultiCals can be used with any meter that has  $10M\Omega$  or greater input impedance, and (preferably) 4mm banana jacks on 19mm ( $\frac{3}{4}$ " ) centers.

**When used with a high performance multimeter, the pressure adapter becomes more than just a "digital pressure gauge".** By using the features built-in to the Fluke 87 for example, the system becomes a datalogger capable of measuring and recording peak high, peak low and average pressures.

This manual includes instructions for calibrating the module itself, but we also offer repair, calibration/certification services. MultiCals are manufactured (and serviced) by a company that only makes pressure measuring instruments. It's the only thing we do and that's why we say: **Pressure is Our Business!**



## Operating Instructions

To ensure safe and accurate operation, please be familiar with the following operations and functions.

### WARNING:

**Severe injury or damage can occur through improper use of pressure instruments!**

Do not exceed recommended pressure limits of tubing and fittings. Be certain all pressure connections are secured. Never disconnect pressure instrumentation without first relieving system pressure.

### CAUTION:

**Never insert any object** (other than a 1/8" NPT fitting) **into the inlet ports.** The sensor diaphragm is very thin and can be damaged or destroyed by solid or sharp objects. Clean the sensor with appropriate solvents, only.

The internal pressure sensor measures the difference between atmospheric (barometric) pressure, and the pressure (or vacuum) applied to the pressure port. The pressure being measured can be either liquid or gaseous, providing it is compatible with the materials listed in the specification section.

PTFE tape should be used with any fittings installed into either of the 1/8" female NPT ports. Two ports are provided so that additional tees should not be required. Plug any unused ports.

MultiCals have been calibrated for use with meters that have 10M $\Omega$  input impedance, as do most handheld meters, and some benchtop multimeters. If your meter has higher or lower input impedance, add 0.1% to the specification of the MultiCal, or refer to the Calibration section of this manual for other methods of eliminating the error introduced by an impedance mismatch.

### Pressure Measurement

Follow this procedure to correctly use the MultiCal pressure module.

1. Plug the MultiCal directly into the voltage input terminals of the multimeter or with the patch cord set. The patch cord set consists of a 48" cord with double banana plugs on each end and a double banana jack splice. Plug the splice into the MultiCal and the patch cord into the splice. Plug the other end of the patch cord into the multimeter. Polarity is marked on the MultiCal and on the patch cord and splice.
2. Set the multimeter to the millivolt (DC) range.
3. **Check the battery condition: With the MultiCal still in the OFF position, the multimeter must indicate a minimum reading of 100 mV.** Readings less than 100 mV indicate the battery must be replaced. To be sure that your pressure measurements are accurate, always check the battery condition first, and replace the battery if necessary.
4. Turn on the MultiCal by sliding the switch to the range you intend to use.

5. “Zero” the MultiCal. Without any pressure or vacuum applied to the module turn the knob opposite the banana plugs until your meter reads precisely zero. ***Prior to taking measurements, and recommended when changing scales, the module should be “zeroed” at barometric pressure.***

Most multimeters “forget” the “relative” setting when changing from mV to any other scale, even just to Volts. Some meters autorange from mV to Volts and then lose the “relative” value. In these cases the zero knob may be more convenient than the “relative” button on the multi-meter.

***The zero reading may also shift when the MultiCal is shifted from a vertical to a horizontal orientation.*** This is due to the oil filling that transmits the pressure signal from the stainless steel diaphragm to the silicon pressure sensor. The magnitude of the shift is typically 0.07 kPa or less.

6. Apply pressure to the MultiCal. If the meter reads overrange, change the multimeter range to DC volts (instead of mV). Note: The decimal place will be for volts. Multiply the reading by 1000. For example, 0.200 V would be 200 kPa.

### Battery Replacement

1. Set the power switch to the OFF position.
2. Disconnect the MultiCal from the multimeter and any pressure connections.
3. Turn the MultiCal so the power switch is facing down. Remove the single screw located between the banana plugs.
4. Grasp the one case half in each hand. Pull the two halves apart, beginning at the end with the banana plugs.
5. Remove and replace the battery.
6. Reassemble the MultiCal. To reassemble, mate the two case halves at the end opposite the banana plugs, then “snap” the two halves together.

## MultiCal Calibration

A calibration cycle of 1 year is recommended to maintain the MultiCal within specifications.

**Table 1: Recommended Equipment**

Instrument	Minimum Specification	Recommended Model
Pressure Standard	$\pm 0.025\%$ of Reading	DH Instruments PPC2+
Digital Voltmeter	$\pm 0.025\%$ of Reading 10M $\Omega$ input impedance	Fluke 45

You do not need to use a reference multimeter, if the MultiCal will be used with only one multimeter. In those cases, your overall accuracy may be better if it is calibrated as a set with the matching multimeter.

The recommended Digital Voltmeter listed in Table 1 has 10M $\Omega$  input impedance - as do many handheld multimeters. Your reference multimeter should have the same input impedance as the multimeter(s) the module will be used with. In some cases this may mean that the reference multimeter will need to have its input impedance lowered.

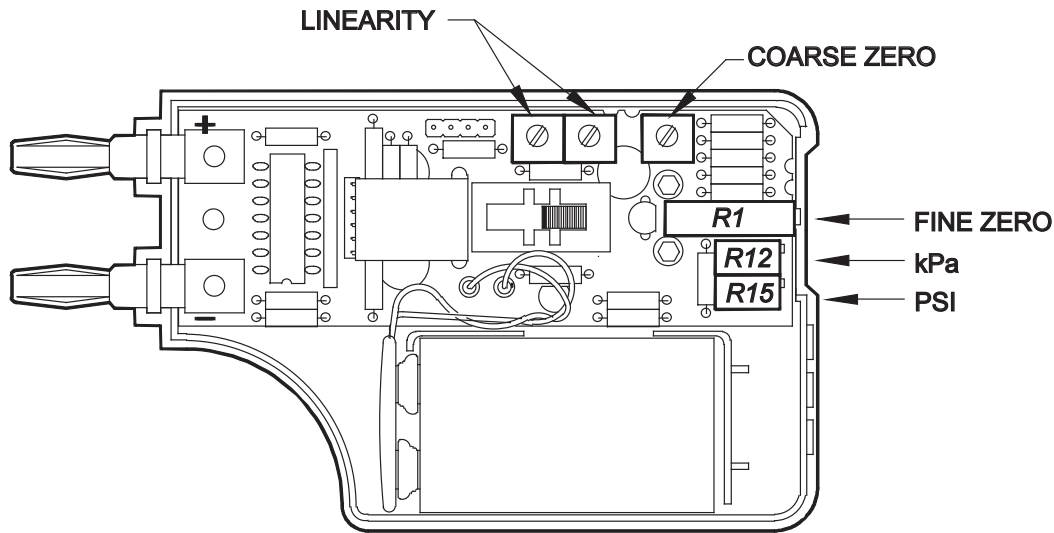
For example, a Fluke 8840A is an excellent benchtop meter, but it has an input impedance of  $\geq 10,000M\Omega$ . If the module will be normally used with a lower impedance meter, like a Fluke 87, which has an input impedance of 10M $\Omega$ , simply connect a 10M $\Omega$  resistor in parallel with the input to the 8840A.

### Procedure

1. Connect the MultiCal to the pressure calibration system and to the multimeter. Be sure that the pressure calibration system and the connection to the MultiCal is leak free.
2. Allow the MultiCal to stabilize at room temperature, away from drafts, for at least 30 minutes before proceeding with calibration. Turn on the multimeter and allow it to warm up per the multimeter operating instruction. Set the multimeter to the appropriate DC volt or millivolt scale.
3. Verify the condition of the battery and replace the battery if necessary. Follow the Battery Replacement procedure to disassemble the MultiCal, but do not remove the battery or reassemble the MultiCal.
4. Set the switch on the MultiCal to the kPa position (switch in position closest to the banana plugs). Allow the MultiCal to warm up for two minutes.
5. The Fine Zero potentiometer (R1) should be set to the center of its rotational range. To center the Fine Zero, rotate the Fine Zero potentiometer fully clockwise until a "click" is heard. Then rotate the FINE ZERO potentiometer counter-clockwise 7½ turns. Adjust the COARSE ZERO pot until the output is as close to zero as possible. Trim in the final reading to 0 mV  $\pm 0.01$  mV with the FINE ZERO potentiometer.

6. Check the kPa pressure points shown on Table 2. Adjust R12 if necessary to bring the readings to within the tolerances shown on Table 2.
7. Set the switch on the MultiCal to the PSI position.
8. Test the MultiCal at the 30 PSI point. The reading should be within the tolerance shown in Table 2. If not, adjust R15 until both points are within specification.
9. In the unlikely event that you are unable to adjust the MultiCal so that all of the points meet the tolerances of Table 2, contact Customer Service for assistance. Do not readjust linearity. The linearity adjustment is factory set and should never require readjustment, unless the sensor is replaced.

**Figure 1: Potentiometer Locations**



**Table 2: Readings in mV @ 23°C ±5°C**

True Pressure	Acceptable Output (mV)
100 kPa	99.92 to 100.07
200 kPa	199.87 to 200.12
30 PSI	29.98 to 30.03

## Specifications

The following specifications apply at 23°C, ±5°C for 1 year after calibration, and when used with measuring devices having 10MΩ input impedance, or shunted so that their input impedance is 10MΩ. Also, the module must be "zeroed" prior to taking measurements to achieve the pressure specifications.

## Pressure

Range	Accuracy
0 to 200 kPa	$\pm(0.05\% \text{ of Reading} + 0.1''\text{H}_2\text{O})$
0 to 30 PSI	$\pm(0.05\% \text{ of Reading} + 0.01\text{PSI})$
30 to 50 PSI	$\pm(0.25\% \text{ of Reading})$
0 to -100kPa	$\pm(0.5\% \text{ of Reading} + 0.14 \text{ kPa})$
0 to -14.7 PSI	$\pm(0.25\% \text{ of Reading}), \text{ typical}$

Maximum Working Pressure: 100 PSI

Burst Pressure: 500 PSI

Wetted Materials: 316 Stainless Steel, PTFE impregnated hard anodized aluminum, and buna-n rubber.

Unless otherwise specified at time of purchase: 1 PSI = 27.6806''H<sub>2</sub>O (water at 4°C)

## Operating Environment

Temperature Range	Humidity
-10 to 10°C	Uncontrolled Humidity
10 to 30°C	0 to 95% Relative Humidity
30 to 40°C	0 to 75% Relative Humidity
40 to 50°C	0 to 45% Relative Humidity
50 to 55°C	0 to 35% Relative Humidity

## Temperature Derating

Add to Basic Accuracy Specification. °C = ambient temperature.

Temperature Range	Derating
28 to 55°C	$(0.016\%/^{\circ}\text{C}) \times (^{\circ}\text{C} - 28^{\circ}\text{C})$
18 to 28°C	No Derating
0 to 18°C	$(0.048\%/^{\circ}\text{C}) \times (18^{\circ} - ^{\circ}\text{C})$
-10 to 0°C	$(0.264\%/^{\circ}\text{C}) \times (9^{\circ} - ^{\circ}\text{C})$

## General Specifications

Weight	164 grams (5.8 oz.) w/battery
Overall length	118mm (4 <sup>5</sup> / <sub>8</sub> '')
Battery	NEDA#1604, 6F22, 006P
Battery Life	400 Hours typ. w/alkaline battery
Output	1mV/unit into 10MΩ load
Storage	-51°C to 71°C

## EC Declaration of Conformity



I/We

**Crystal Engineering Corporation**

of

720 Aerovista Place, Suite B  
San Luis Obispo, CA, 93401  
USA

declare that

**Pressure Module  
MultiCal Series (All Versions)**

In accordance with the following directives

**89/336/EEC**

**The Electromagnetic Compatibility Directive  
and its amending directives**

has been designed and manufactured to the following specifications

EN 61326-1:2002	Conducted Emissions	Class A	N/A
EN 61326-1:2002	Radiated Emissions	Class A	Pass
EN 61000-3-2:1995	Current Harmonic Emissions	Class A	N/A
EN 61000-3-3:1995	Voltage Variations & Flicker	N/A	N/A
EN 61000-4-2:2002	Electrostatic Discharge		Pass
EN 61000-4-3:2002	Radiated EM Field		Pass
EN 61000-4-4:2002	Electrical Fast Transient/Burst		N/A
EN 61000-4-5:2002	Surge Immunity		N/A
EN 61000-4-6:1994	RF Conducted Disturbances		N/A
EN 61000-4-8:1994	Power Magnetic Field		N/A
EN 61000-4-11:1994	Voltage Dips and Interruptions		N/A

Note: Product is battery operated.

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all essential requirements of the Directives

David K. Porter, P.E.  
(NAME OF AUTHORIZED PERSON)

Director of Engineering  
(TITLE OF AUTHORIZED PERSON)

  
(SIGNATURE OF THE AUTHORIZED PERSON)

16 July 2003  
(DATE OF ISSUE)

## Warranty

Crystal Engineering Corporation warrants MultiCals to be free from defects in material and workmanship under normal use and service for one (1) year from date of purchase to the original purchaser. It does not apply to batteries or when the product has been misused, altered or damaged by accident or abnormal conditions of operation.

Crystal Engineering will, at our option, repair or replace the defective device free of charge and the device will be returned, transportation prepaid. However, if we determine the failure was caused by misuse, alteration, accident or abnormal condition of operation, you will be billed for the repair.

**CRYSTAL ENGINEERING CORPORATION MAKES NO WARRANTY OTHER THAN THE LIMITED WARRANTY STATED ABOVE. ALL WARRANTIES, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, ARE LIMITED TO A PERIOD OF ONE (1) YEAR FROM THE DATE OF PURCHASE. CRYSTAL ENGINEERING SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.**

Note (USA only): Some states do not allow limitations of implied warranties or the exclusion of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may have other rights which vary from state to state.

### How to Contact Us:

Phone . . . . . (805) 595-5477

**Toll-Free . . . . . (800) 444-1850**

Fax . . . . . (805) 595-5466

Email . . . . . [service@crystalengineering.net](mailto:service@crystalengineering.net)

**Web . . . . . [www.crystalengineering.net](http://www.crystalengineering.net)**

If calling, have ready the model number, serial number, date of purchase and reason for return. You will receive instructions for returning the device to Crystal Engineering.

Send your comments to: [feedback@crystalengineering.net](mailto:feedback@crystalengineering.net)

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720 Aerovista Place, Suite B

San Luis Obispo, CA 93401-8701