

MultiCal Operation Manual

for MultiCal Hg/PSI Pressure Module





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Overview

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.

This MultiCal is calibrated to convert pressure units (inches Hg or psi) to 1 millivolt per pressure unit. Vacuum readings will be negative.

Pressure is measured by connecting an appropriate fitting to one of the two 1/8" female NPT ports, while plugging 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 is used to power on the unit and to select inches Hg 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. The MultiCal can be used with any meter that has 10MΩ or greater input impedance, and (preferably) 4mm banana jacks on 19mm (3/4") centers.

Crystal Engineering is the company that designs, manufactures, markets, and services the MultiCal, nVision, XP2i, 30 Series, M1, and a variety of industry specific pressure measuring equipment. Crystal Engineering pioneered features like full temperature compensation and "of reading" rated gauges and calibrators. Pressure measuring equipment is the only thing we do and that's why we say:

Pressure Is our Business

Operation

FUNCTIONS

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 10MΩ 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 auto-range 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 Multi-Cal 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 0.1 inHg or less.
- 6 Apply pressure to the MultiCal. If the meter reads over-range, 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, 0.500 V would be 500 psi.

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.

Calibration

RECOMMENDED EQUIPMENT

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

Instrument	Minimum Specification
Pressure Standard	± 0.025% of Reading
Digital Voltmeter	$\pm0.025\%$ of Reading with a 10M Ω input impedance

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.

Many digital voltmeters have a 10 M Ω input resistance. 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, if your reference multimeter has an input impedance of \geq 10,000M Ω , and the MultiCal will normally be used with a 10M Ω impedance meter, simply connect a 10M Ω resistor in parallel with the input to the reference.

CALIBRATION 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 steps 1–4 of the <u>Battery Replacement</u> procedure to disassemble the Multi-Cal (do not remove the battery or reassemble the MultiCal).
- 4 Set the switch on the MultiCal to the INCHES Hg 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 Course Zero pot until the output is as close to zero as possible. Trim in the final reading to 0 mV ±0.01 mV with the Fine Zero potentiometer.



Potentiometer locations.

6 Check the inches of mercury pressure points shown in the following table. Adjust R12 if necessary to bring the readings to within the tolerances shown in

the table.

Readings in mV @ 23°C ±5°C			
True Pressure	Acceptable Output (mV)		
15 inHg	14.975 to 15.025		
30 inHg	29.960 to 30.040		
250 psi	249.73 to 250.27		
500 psi	499.48 to 500.52		

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 the table above. 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 the table above, 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.

Specifications

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

PRESSURE

Pressure	Range Accuracy
0 to 30 inHg	±(0.1% of Reading + 0.01 inHg)
0 to 500 psi	±(0.1% of Reading + 0.02 psi)
0 to -30 inHg	±(0.1% of Reading+ 0.01 inHg)
0 to -14.7 psi	±(0.25% of Reading), typical
Maximum Working Pr	essure: 500 psi
Burst Pressure:	1000 psi
Wetted Materials:	
Note: Unless otherwi	se specified at time of purchase: 1 psi = 2.03602

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%/°C) x (°C–28°C)
18 to 28°C	.No Derating
0 to 18°C	. (0.048%/°C) x (18°–°C)
-10 to 0°C	. (0.264%/°C) x (9°–°C)

GENERAL SPECIFICATIONS

Weight
Overall Length118mm (4 5/8")
BatteryNEDA # 1604, 6F22, 006P

- $Output \dots \dots 1 mV/unit into 10 M\Omega \ load$
- Storage.....-51 to 71°C

EC DECLARATION OF CONFORMITY

C	DECLARATION OF CO According to ISO/IEC 1705	NFORMITY 0-1:2010		
lanufacturer's Name:	Crystal Engineering Corporatio An AMETEK Inc. company	n		
lanufacturer's Address:	708 Fiero Lane, Suite 9 San Luis Obispo, CA 93401 USA			
Declares under sole responsibility that	the product as originally delivered			
Product Name: fodel Number:	Pressure Module MultiCal Series			
complies with the essential requireme ccordingly:	nts of the following applicable Europ	ean Directives, and c	arries the CE mai	rking
MC Directive 2004/108/EC				
<i>Itandard</i> ISPR 11:2003 N 61326: 2006	EHSR CISPR 11:2009/A1:2010 harmonized standard has been compared to the standard used for certification purposes and no changes in the 'state of the art' apply to the equipment. (1) Harmonized			
and conforms with the following produ	uct standards:			
Standard CISPR 11:2003 EN 61326-1:2006 (EN 61000-4-2) EN 61326-1:2006 (EN 61000-4-3) EN 61326-1:2006 (EN 61000-4-8)	Description Radiated Emissions Electrostatic Discharge Radiated Immunity Magnetic Field Immunity	Class Class A Criteria A Criteria A Criteria A	Status Pass Pass Pass Pass	EHSR See (1) Harmonized Harmonized Harmonized

USA Signatory:

Division Vice President & Crystal Business Manager David K Porter, P.E.

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FACTORY SERVICE

Please complete the Return Material Authorization (RMA) form on our website. This will generate an authorization number and provide return instructions.

TRADEMARKS

"Pressure is Our Business" is a registered trademark of Crystal Engineering Corp.

WARRANTY

Crystal Engineering Corporation warrants the MultiCal Pressure Module 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.

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