

# APMi Series Operation Manual

for Intrinsically Safe Advanced Pressure Module



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# Overview

## INTRODUCTION

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The Crystal APMi series of intrinsically safe pressure modules allow you to add additional pressure measurement capability to your HPC50 pressure calibrator. The APMi uses the same reliable, high accuracy, digital temperature compensated technology found in Crystal products, housed in a rugged enclosure with a selectable-length cable to connect to your HPC50 calibrator. Two APMi modules can be connected to a single HPC50 calibrator.

**Note:** Currently, the HPC50 is the only Crystal calibrator supported by the APMi pressure module.

**Note:** This manual includes information on the APMi modules only. For details on the operation of the HPC50 Series, please refer to the [User Manual](#).

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### What's Included

Each unit includes an APMi pressure module, an interface cable of your choice (1, 3, or 10 meter), a fitting of your choice (1/4 NPT Male, 1/4 BSP Male, or M20 x 1.5 Male), an ISO 17025 Accredited Calibration Certificate (NIST traceable), and AMETEK product CD. Crystal Engineering calibration facilities are A2LA accredited, (#2601.01) which is internationally recognized by ILAC.

# Operation

## ADVANCED PRESSURE MODULE (APMi) INSTRUCTIONS

### Pressure Connection

Crystal CPF ♦ System: Medium Pressure Female (MPF) (1/4" medium pressure tube system with 7/16-20 threads). See our [CPF Brochure](#) for further information.

♦ U.S. Patent No. 8,794,677

CPF o-ring size and material: AS568A-012, Viton 80 durometer (P/N 3981).

For most applications CPF Fittings can be hand tightened for use up to 10 000 psi / 700 bar / 70 MPa (no tools required). Wrench tightening is recommended (to achieve a metal to metal cone seal) for applications where chemical compatibility of the process fluid and the o-ring are a concern, or for pressures above 10 000 psi / 700 bar / 70 MPa. We recommend a tightening torque of 120 in-lbs ± 20 in-lbs. Please note this is only a fraction of the typical torque required to seal a 1/4" NPT fitting. If a torque wrench isn't practical to use, the fittings can be assembled as follows: Hand tighten fitting fully until the cone has bottomed out. Tighten an additional 20° using a wrench. Apply a small amount of media-compatible lubricant to the gland threads and male cone to increase fitting life, reduce the likelihood of galling, and promote sealing.

**! CAUTION:** To achieve CPF maximum allowable working pressures no o-ring substitutions are allowed. See our CPF brochure and CES-003 CPF Safety Guide available from the website at [ametekcalibration.com](http://ametekcalibration.com) for further detail.

**! WARNING:** Pressurized hoses and associated equipment are potentially dangerous. Slowly bleed off pressure from the system being pressurized prior to connecting or disconnecting the Crystal APMi.

### Measuring Vacuum

All ranges of the APMi can be used to measure moderate vacuum. Ranges 300 psi / 30 bar / 3 MPa and below are calibrated for vacuum use.

When measuring pressure less than ambient barometric conditions, a minus sign (-) will appear.

**! CAUTION:** The APMi is not recommended for continuous use at high vacuum.

### Overpressure Conditions

The APMi will read pressure up to approximately 110% of the rated pressure range. The HPC50 Calibrator will display an overpressure warning. For example, above 110% of the range, "OL" will display on the HPC50, indicating an Overload Alarm. The zero function does not affect when the "OL" is displayed to indicate overpressure. So depending on the zero value, it is possible that the display will indicate "OL" without the maximum pressure being displayed.

For instance, if a 100 psi APMi is zeroed when 30 psi is being applied, it will indicate that the overpressure condition has been reached at 80 psi. (i.e., 110% x 100 psi – 30 psi = 80 psi).

Overpressure can affect accuracy, but the effect is only temporary unless the sensor has been damaged. See [Specifications](#) for maximum allowable overpressure ratings.

# Specifications

## ACCURACY

### psi (Gauge Pressure)

#### ► 18 to 28° C

0 to 30% of Range: ..... ±(0.01% of Full Scale)

30 to 110% of Range: ..... ±(0.035% of Reading)

Vacuum\*: ..... ±(0.05% of Full Scale\*\*)

#### ► -20 to 50° C

0 to 30% of Range: ..... ±(0.015% of Full Scale)

30 to 110% of Range: ..... ±(0.050% of Reading)

Vacuum\*: ..... ±(0.05% of Full Scale\*\*)

\* Applies to 300 psi / 30 bar / 3 MPa and lower ranges only.  
Vacuum Range = -14.5 psi / -1.0 bar / -1MPa.

\*\* Full Scale is the numerical value of the positive pressure range.

### psiA (Absolute Pressure with BARO Option)

All absolute accuracies are equivalent to the gauge pressure accuracies, except as noted below.

15 psi / 1 bar / 100 kPa Range: ..... Gauge Accuracy +0.005 psiA

30 psi / 3 bar / 300 kPa Range: ..... Gauge Accuracy +0.005 psiA

100 psi / 10 bar / 1MPa Range: ..... Gauge Accuracy +0.002 psiA

Includes all effects of linearity, hysteresis, repeatability, temperature, and stability for one year.

Exposure to environmental extremes of temperature, shock, and/or vibration may warrant a more frequent recertification period.

APMi modules must be exercised and re-zeroed whenever exposed to significant changes in environmental conditions to achieve these specifications. To exercise a module, cycle the module between zero (ambient barometric pressure) and the pressure of interest. A properly exercised module will return to a zero reading (or return to the same ambient barometric reading).

## ACCURACY CONTINUED

All models indicate vacuum, but vacuum specification applies only where specified.

Not recommended for continuous use at high vacuum. Refer to [XP2i-DP data sheet](#) for gauges that are intended for continuous high vacuum use.

The BARO option for the HPC50 Series allows you to toggle between gauge and absolute pressure using the same APMi module.

## SENSOR

Wetted Materials: ..... (wrench tight) 316 stainless steel  
 (finger tight) 316 stainless steel  
 and Viton® with internal o-ring  
 (15 psi / 1 bar / 100 kPa) 316 stainless steel and Viton®

Diaphragm Seal Fluid ..... Silicone Oil

Connection ..... Crystal CPF Female

All welded, with a permanently filled diaphragm seal.

Metal to metal cone seal; O-ring can be removed if necessary.

1/4" male NPT adapter is included unless BSP or M20.

1/4" medium pressure tube system is compatible with HIP LM4 and LF4 Series, Autoclave Engr SF250CX Male and Female Series.

## OUTPUT

Pressure Resolution ..... up to 6 digits

Display Update ..... up to 10 per second

Pressure resolution and display update are the maximum values available. The resolution of your Crystal device may be different.

## PRESSURE OVERLOAD

Overload Alarm ..... "+OL" in display at 110% F.S.

## OPERATING TEMPERATURE

Temperature Range ..... -20 to 50° C (-4 to 122° F)

< 95% RH, non-condensing. No change in accuracy over operating temperature range, except as noted in the accuracy specifications. APMi must be zeroed to achieve rated specification.

Applies to all modules.

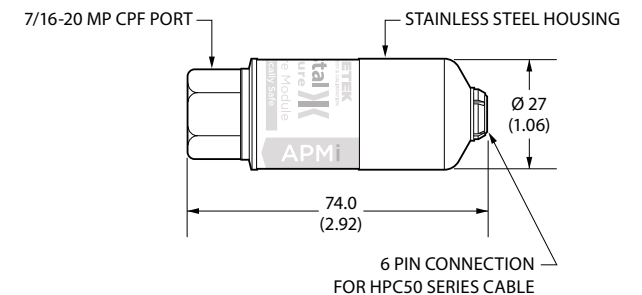
## STORAGE TEMPERATURE

Temperature Range ..... -40 to 75° C (-40 to 167° F)

## ENCLOSURE

Dimensions ..... 2.9 x 1.1 in (74.0 x 27.0 mm)

Weight ..... 0.39 lbs (176.0 g)



## ACCURACIES, RANGES, AND RESOLUTIONS

psi	bar	kPa/MPa	Overpressure	psi	kg/cm2	inHg	inH2O	mmHg	mmH2O	kPa	bar	mbar	MPa
15PSI	1BAR		3.0 x	0.0001	0.00001	0.001	0.01	0.01	0.1	0.001	0.00001	0.01	
			3.0 x	0.0001	0.00001	0.001	0.01	0.01	0.1	0.001	0.00001	0.01	
		100KPA	3.0 x							0.001	0.00001	0.01	
30PSI	3BAR		3.0 x	0.001	0.0001	0.001	0.01	0.01	1	0.01	0.0001	0.1	0.00001
			3.0 x	0.001	0.0001	0.001	0.01	0.01	1	0.01	0.0001	0.1	0.00001
		300KPA	3.0 x							0.01	0.0001	0.1	0.00001
100PSI	10BAR		2.0 x	0.001	0.0001	0.01	0.1	0.1	1	0.01	0.0001	0.1	0.00001
			2.0 x	0.001	0.0001	0.01	0.1	0.1	1	0.01	0.0001	0.1	0.00001
		1MPA	2.0 x							0.01	0.0001	0.1	0.00001
300PSI	30BAR		2.0 x	0.01	0.001	0.01	0.1	0.1		0.1	0.001	1	0.0001
			2.0 x	0.01	0.001	0.01	0.1	0.1		0.1	0.001	1	0.0001
		3MPA	2.0 x							0.1	0.001	1	0.0001
1KPSI	100BAR		2.0 x	0.01	0.001	0.1				0.1	0.001		0.0001
			2.0 x	0.1	0.001	0.1				0.1	0.001		0.0001
		10MPA	2.0 x							0.1	0.001		0.0001
3KPSI	300BAR		1.5 x	0.1	0.01	0.1				1	0.01		0.001
			1.5 x	0.1	0.01	0.1				1	0.01		0.001
		30MPA	1.5 x							1	0.01		0.001
10KPSI	700BAR		1.5 x	0.1	0.01					1	0.01		0.001
			1.5 x	0.1	0.01					1	0.01		0.001
		70MPA	1.5 x							1	0.01		0.001

Resolutions shown are the maximum resolutions available. The resolution of your Crystal device may be different.

\* CPF adaptor fitting is not included. 1/4" medium pressure tube system is compatible with HIP LM4 and LF4 Series, Autoclave Engr SF250CX Male and Female Series. [See our CPF data sheet](#) for additional adapter fittings.

## Ordering Information

Model	P/N	Fitting	Interface Cable Length
APMi	_____	_____	_____
		NPT.....omit	1 m / 3.3 ft ..... (omit)
		G 1/4 B.....-BSP	3 m / 10 ft.....3M
		M20x1.5 ... -M20	10 m / 33 ft.....10M

### SAMPLE PART NUMBERS

APMi30PSI ..... 30 psi APMi with a 1/4" NPT male pressure fitting and 1 meter cable.

APMi700BAR-BSP-3M ... 700 bar APMi with a 1/4" BSP male pressure fitting and 3 meter cable.

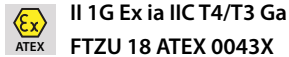
APMi10MPA-M20-10M... 10 MPa APMi with an M20x1.5 male pressure fitting and 10 meter cable.

## Pressure Conversions

1 PSI = 27.6806 inches of water column (water at 4°C [39.2°F])  
 703.087 millimeters of water column (water at 4°C [39.2°F])  
 70.3087 centimeters of water column (water at 4°C [39.2°F])  
 2.03602 inches of mercury (mercury at 0°C [32°F])  
 51.7149 millimeters of mercury (mercury at 0°C [32°F])  
 6.8948 kilopascals  
 0.070307 kilograms per square centimeter  
 0.068948 bar  
 68.948 millibar  
 0.0068948 megapascals

## HAZARDOUS LOCATIONS

The HPC50 Series calibrator with an APMi module has a rating of:



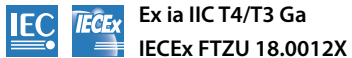
Exia Intrinsically Safe and Non-Incendive for Hazardous Locations:

Class I, Division 1, Groups A, B, C, and D; Temperature Code T4/T3. Class I, Zone 0, AEx ia IIC T4/T3 Ga.

The APMi can be connected and disconnected in Hazardous Areas.

Sécurité intrinsèque et non incendiaire pour dangereux Lieux:


Classe I, Division 1, Groupes A, B, C, and D; Code de température T4/T3. Classe I, Zone 0, AEx ia IIC T4/T3 Ga.



## Entity Parameters

$U_i = 5.0\text{ V}$   
 $I_i = 740\text{ mA}$   
 $P_i = 880\text{ mW}$   
 $C_i = 9.2\text{ }\mu\text{F}$   
 $L_i = 12\text{ }\mu\text{H}$

## Certifications

 We declare that the APMi is in accordance with the ATEX Directive, Electromagnetic Compatibility Directive, the Pressure Equipment Directive, and RoHS Directive per our declaration(s).



This HPC50 is approved for use as a portable test instrument for Marine use and complies with DNV GL Rules for Classification of Ships, High Speed & Light Craft, and Offshore Units.

# Support

## CALIBRATION

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If adjustment is required, we recommend returning the APMi to the factory. Factory service offers benefits you won't find anywhere else. Factory calibration tests your APMi utilizing NIST traceable standards, resulting in calibration certificates that provide performance data and uncertainties. Our calibration facilities are A2LA accredited (cert #2601.01) to ISO 17025:2005 & ANSI/NCSL Z540-1-1994. A2LA is internationally recognized as an accreditation body by the International Laboratory Accreditation Cooperation, ILAC. Furthermore, upgrades may be available to add or enhance operating features. We designed the product to last, and we support it so that you can get the most from your investment.

Under normal operating conditions, we recommend the APMi be calibrated on an annual basis. Your quality system may require more or less frequent calibration, or your experience with the gauge, or operating environment may suggest longer or shorter intervals.

**CRYSTALCONTROL** There are no internal potentiometers. The APMi has a "span factor" (userspan), set to approximately 1 (as shipped from the factory). As components age this may need to be changed to a value slightly higher or lower, to slightly increase or decrease all readings. This adjustment can be made with a computer through our free CrystalControl software.

"Zero" the APMi, then record the displayed pressure for two or more pressure points. Determine if the APMi would benefit from an overall increase or decrease of the indicated pressures. Adjust the userspan value accordingly and validate the results.

## ACCESSORIES AND REPLACEMENT PARTS

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### **MPM-1/4MPT** CPF Male to 1/4" Male NPT Fitting

Included as standard

### **MPM-1/4BSPM** CPF Male to 1/4" Male BSP Fitting

Included with -BSP

### **MPM-M20x1.5M** CPF Male to M20 Male Adapter

Included with -M20



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\*ISO 17025 accredited calibration lab, (A2LA #2601.01).

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 us.

## WARRANTY

Crystal Engineering Corporation warrants the APMi (Advanced 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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