

**40M Series Recorders, Indicators, and Controllers**



*These instruments are used wherever accurate chart records, precise indications, or control of the measured variable are required for efficient process management. The 40M Series Recorders and Indicators continuously record or indicate measurement of one or more process variables. They provide high accuracy, local reading, and fast response to the measured signal change and can accommodate up to four pens, or one or two pointers. The 40M Series Controllers receives mechanical, pneumatic, or electrical inputs from an integrally-mounted measuring or receiving element; compare it to a set point; and as a function of the control mode, produce a standard pneumatic output signal to modulate a remote final operator that may be as far as 100 m (300 ft) distant. They control one or two measurements, and either record or indicate the variable.*

**MANY CONFIGURATIONS – NUMEROUS RANGES**

One standard enclosure can be readily configured to accommodate recorders, indicators, or controllers having a large and varied selection of features and options. Numerous temperature, head, relative humidity, pressure, differential pressure, and electronic servo elements are available to operate at a wide variety of standard ranges.

**WIDE SELECTION OF CONTROL MODES**

Controllers are available with on-off, proportional, proportional plus derivative, proportional plus integral (reset), proportional plus integral plus derivative, or narrow band proportional actions. The standard derivative or integral has the complete range from 0.01 to 50 minutes for both derivative and integral actions.

## HIGH-QUALITY ENCLOSURE CONSTRUCTION

Durable die-cast aluminum case and door with corrosion-resistant vinyl finish. Gasketed door with glass window and cam-latch protects the interior from an excess of fumes, dust, and moisture. A shatterproof glass window is optionally available for more demanding applications.

## VERSATILE MOUNTING

These instruments may be mounted in a panel, on a surface, or attached to a yoke.

## PERFORMANCE SPECIFICATIONS

### Dead Band

#### RECORDERS AND INDICATORS

0.2% of span

#### CONTROLLERS

0.1% of span

### Accuracy

Depends upon measuring element used.

### Repeatability

Depends upon measuring element used.

### Hysteresis

Depends upon measuring element used.

### Supply Pressure Effect

A variation within supply pressure limits causes the output of the controller to change by less than 1.2% of span.

### Measuring Element

Refer to specifications relating to the particular element used.

## FUNCTIONAL SPECIFICATIONS

### Ambient Temperature Operative Limits

-30 and +60° C (-20 and +140° F) unless limited by measuring element.

### Supply Voltage and Frequency

120, 220, or 240 V ac, +10, -15%, at 50 or 60 Hz,  $\pm 3$  Hz, as specified.

### Controllers Only

#### CONTROLLER ACTION

The output signal either increases or decreases with increasing measurement. The action is reversible in the field.

#### SUPPLY PRESSURE LIMITS

115 and 155 kPa, 17 and 22 psi, or 1.15 and 1.55 bar or kg/cm<sup>2</sup>.

#### OUTPUT SIGNAL

20 to 100 kPa, 3 to 15 psi, or 0.2 to 1.0 bar or kg/cm<sup>2</sup>, as specified.

#### AIR CONSUMPTION (UNDER NORMAL OPERATION)

0.5 scmh (0.3 scfm).

### Indicator Scale

Black markings on white background. Refer to Chart and Dial Catalog 600 for available ranges.

#### SECTOR

The effective length is 175 mm (6.8 in).

#### CONCENTRIC

The effective length is 595 mm (23.4 in).

### Indicator Pointer

Concentric scale indicators have a black pointer and single sector scale indicators have an orange pointer. Dual sector scale indicators have one orange and one black pointer.

## FUNCTIONAL SPECIFICATIONS (CONT.)

### Recorder Chart Drive

#### ELECTRICAL

The standard speed is one revolution per 24 hours for nominal 120 or 240 V, 50 or 60 Hz, as specified.

#### MECHANICAL

The standard speed is one revolution per 24 hours with a 24-hour movement.

### Recorder Pens

#### BOX-TYPE

For 1-, 2-, 3-, or 4-pen instruments.

#### FIBER TIP-TYPE

For 1-, 2-, 3-, or 4-pen instruments. Disposable ink cartridge with integral fiber-tip pen. Minimum of 50 m (500 ft) ink line at a nominal 25 mm/s (1 in/s) pen speed.

### Recorder Expendable Accessories

100 HUMITEX™ nominal 300 mm (12 in) circular charts with a nominal 100 mm (4 in) calibrated width, and the specified inking systems are provided with

each instrument.

### Dual Indicating Gauge (Controllers)

Visible through a window near the top of the door. The output signal is indicated on the upper scale and the supply pressure on the lower scale on single action controllers. On dual or duplex action controllers, both pointers indicate the output signals. Both are expressed in kPa, psi, bar, or kg/cm<sup>2</sup>, as specified.

### Index pointer

The setting index in sector scale indicating controllers has a bright orange tip. The setting index in recording controllers has a silver color tip.

### Cardboard Nameplate

A cardboard nameplate is supplied for displaying the chart factor.

Table 1.

Required Selection for Standard Instruments (Selectable Using Instrument Model Code)	Recorders and Indicators				Electric Controllers				Pneumatic Recording and Sector Indicating Controllers						
	Circ ular Chart Recorder 40M R-R	Sec tor Scale Ind. 40M N-N	Con c. Scale Ind. 40M K-K	O	Circ ular Chart Recorder 40M R-E	Sec tor Scale Ind. 40M N-E	Con . Scale Ind. 40M K-E	Single Action		Duplex Action		Dual Action		Auto-Selector Action Ind. 40M R-H N-H	
								Rec R-A	Ind. 40M N-A	Rec R-B	Ind. 40M N-B	Rec R-C	Ind. 40M N-C		
1st Control Unit Type(b), Select one	No	No	No	O	O	O	O	O, P, NB, PI, PD, PID							
2nd Control Unit Type(b), Select one	No	No	No	O	O	O	O	No							
A/M Internal Transfer Switching (1st Control Unit)	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
A/M Internal Transfer Switching (2nd Control Unit)	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	
Controller Output Signal and Gauge	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Electrical Chart Drive	Yes	No	No	Yes	No	No	No	Yes	No	Yes	No	Yes	No	Yes	
Mechanical Chart Drive	Yes	No	No	Yes	No	No	No	Yes	No	Yes	No	Yes	No	Yes	
Sector Scale	No	Yes	No	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
Concentric Scale	No	No	Yes	No	No	Yes	No	No	No	No	No	No	No	No	
Pen Quantity	1 to 4	No	No	1 to 3	1 to 3	No	No	1 to 3	No	1	No	2	No	2	
Pointer Quantity	No	1 or 2	1	No	1 or 2	1	No	1 or 2	No	1	No	2	No	2	
Single Range Scale	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No	
Dual Rang Scale	No	Yes	No	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes	
<b>Measuring Element Selection(c)</b>															
<b>Elem. Code</b>	<b>Element Description(d)</b>														
DE-A, B	Diff. Pressure, Type 37 Diaphragm														
EOOOO	RTD, TC, dc, mV, dc mA, Elec. Servo														
MA-J	Rel. Hum., Hair (Rear Conn./0.6in)														
MA-K	Rel. Hum., Hair Element (Top Conn.)														
MC-A, B	Head Measurement, Float and Cable														
PA-CA, CC	Absolute Pressure, Bellows														
PA-MA	Absolute Pressure, Double Spiral														
PB-AA, AM	Pressure, Helical Element														
PB-BA, BM	Pressure, Spiral Element														
PB-CA	Pressure, Bellows Element														
PB-CC	Pressure, Bellows Element														
PB-DF	Pressure, 2-in Diaphragm Element														
PB-PF	Pressure, 3-in Diaphragm Element														
PB-GA	Pressure, Heavy Duty Helical														
PB-MC	Pressure, Double Spiral Element														
PC	Pressure, Pneumatic Receiver														
TA-1H, TA-1J	Temperature, Filled Thermal System														
TA-1A	Temperature, Filled Thermal System														
TA-2A, 2B	Temperature, Filled Thermal System														
TA-3B	Temperature, Filled Thermal System														

(a)Exact instrument configurations are governed by the space available in the case and by the available torque from the measuring element. Consult inventors for specific requirements.

(b)Six control modes are available as indicated on Page 2. O = on-off, P = Proportional, NB = Narrow Band, PI = Proportional+Integral, PD = Proportional+Derivative, and PID = Proportional+Integral+Derivative.

(c)Quantities listed are maximum permitted. Consult Foxboro for combining element types.

(d)Also refer to element tables for range and span limits.

## ELEMENT SPECIFICATIONS

Table 2. Differential Pressure Elements

Element Code	Element Type	Spans Available Between(a)			Maximum Operating Pressure		
		kPa ΔP	inH <sub>2</sub> O ΔP	mbar ΔP	MPa	psi	bar or kg/cm <sup>2</sup>
DE-A,B(b)	Type 37, Diaphragm	5 and 50	20 and 200	50 and 500	14	2000	140

(a) This is a zero-based element. The lower range value is zero, and the upper range value is between the spans listed.

(b) Body and cover material for DE-A is carbon steel; material for DE-B is 316 ss.

Table 3. Electronic Servo Element (For Electronic Inputs)

Element Code	Sensor or Input Signal	Measurement	Range Limits	Span Limits
E□□□□□	Platinum RTD	Temperature	-200 and +650°C (-325 and + 1200°F)	20 and 550°C (40 and 1000°F)
E□X□□□	Platinum RTD	Temperature Difference	-200 and +650°C (-325 and + 1200°F)	15 and 165°C (25 and 300°F)
E□□□□□□	Thermocouple	Temperature or Temperature Difference	-15 and +100 mV(a)	5 and 100 mV(a)
E□M□□□	Millivolt Input	Temperature or Temperature Difference	-15 and +100 mV	5 and 100 mV
E□A□□□	Milliampere Input	Temperature or Temperature Difference	40 and 20 mA or 10 and 50 mA	16 or 40 mA

(a) Range and span limits for thermocouples are shown in millivolts only, rather than °C and °F. This simplifier listing thermocouple range and span limits which vary with wire size, thermocouple type, and thermocouple construction.

Table 4. Relative Humidity Element (Used with Recorder or Sector Scale Indicator Only)

Element Code	Element Type	Relative Humidity Range Limits
MA-J(a)	Hair Element, Rear Connected, 15 mm (0.6 in) extension	0 and 100 %
MA-k(b)	Hair Element, Top Connected	0 and 100%

(a) Human hair element in perforated protective cage. Use temperature element TA-1H if a combination relative humidity and temperature recorder or sector scale indicator is required.

(b) Same as Note (a) except that the temperature element is TA-1J.

Table 5. Head Measurement Element

Element Code	Element Type	Float Travel Range Limits	
		m	ft
MC-A	Float and Cable, 270° Turn	0 and 0.125 to 0 and 0.9 m	0 and 0.417 to 0 and 3 ft
MC-B	Float and Cable, Multi-Turn	0 and 0.9 to 0 and 15 m	0 and 3 to 0 and 50 ft

**Table 6. Temperature Elements – Filled Thermal Systems**

Element Code	System Class	Range Limits		Spans Available Between	
		°C	°F	°C	°F
TA-1H(a)	I	-130 and +330	-200 and +600	25 and 330	40 and 600
TA-1J(b)	I	-130 and +330	-200 and +600	25 and 330	40 and 600
TA-1A	IA	-130 and +330	-200 and +600	25 and 330	40 and 600
TA-2A and 2B	IIA and IIB	-45 and +330	-50 and +600	Varies with Operating Temperature(c)	
TA-3B	IIIB	-195 and +760	-320 and +1400	70 and 550	120 and 1000

- (a)Use with MA-J relative humidity element when a combination temperature and relative humidity recorder, indicator or controller is required. Element is top-connected to case.
- (b)Same as Note (a) except that the relative humidity element is MA-K.
- (c)Does not include temperature over-range values. Narrow spans are at the low end of the range. The maximum span is 215° C (400° F).

**Table 7. Pneumatic Pressure and Receiver Elements(a)**

Element Code	Element Type	Element Material	Spans Available Between(a)	
			kPa or MPa(b)	psi(c)
PA-CA	Absolute Bellows	316 ss	17 and 240 kPa abs	2.5 and 35 psia
PA-CC		Bronze	13 and 270 kPa abs	1.9 and 39 psia
PA-MA	Absolute Double Spiral	316 ss	140 and 700 kPa abs	20 and 100 psia
PB-AA	Helical	316ss	1.4 and 40 MPa	200 and 6000 psi
PB-AM(d)		K-Monel	1.7 and 14 MPa	250 and 2000 psi
PB-BA	Spiral	316 ss	82 and 1400 kPa 82 and 100 kPa vacuum	12 and 200 psi 12 and 15 psi vacuum
PB-BM(d)		K-Monel	140 and 1400 kPa	20 and 200 psi
PB-CA	Bellows	316 ss	35 and 200 kPa	4.5 and 29 psi
PB-CC		Brass	30 and 180 kPa 34 and 100 kPa vacuum	4 and 26 psi 4.9 and 15 psi vacuum
PB-DF	Diaphragm 50 mm (2 in)	Cu-Ni-Sn Alloy	6 and 70 kPa 6 and 35 kPa vacuum	0.9 and 10 psi 0.9 and 5 psi vacuum
PB-PF	Diaphragm 75 mm (3 in)	Cu-Ni-Sn Alloy	2 and 10 kPa 2 and 6 kPa vacuum	0.3 and 1.5 psi 0.3 and 0.9 psi vacuum
PB-GA	Heavy Duty Helical	316 ss	0.5 and 200 MPa	75 and 30000 psi
PB-MC	Double Spiral	Bronze	280 and 420 kPa 70 and 100 kPa vacuum	40 and 60 psi 10 and 15 psi vacuum
PC 3 to 15	Receiver (Bellows)	Brass	80 kPa	12 psi
PC 3 to 18			100 kPa	15 psi
PC 3 to 27			–	24 psi

- (a)All elements except Codes PC have zero-based ranges. Therefore, the lower range value is zero, and the minimum and maximum upper range values are as listed. Also, the above values are not applicable to concentric scale indicators. Contact Invensys for element span and range values for concentric scale indicator applications.
- (b)To convert kPa to bar or kg/cm<sup>2</sup>, multiply kPa value by 0.01; to convert MPa to bar or kg/cm<sup>2</sup>, multiply MPa value by 10.
- (c)To convert psi to inH<sub>2</sub>O, multiply psi value by 2.7.73. To convert psi to inHg, multiply psi value by 2.036.
- (d)Elements comply with National Association of Corrosion Engineers (NACE) Standard MR-01-75.

## PHYSICAL SPECIFICATIONS

### Enclosure

Die cast aluminum case and door. The door has a glass window.

### Finish

Textured grey vinyl paint.

### Connections

All connections are located in the bottom of the case.

#### ELECTRICAL

A 22 mm (0.9 in) diameter hole is provided for a nominal 20 mm (CEE 23), PG16, or 1/2 in conduit fitting.

#### PNEUMATIC

The supply and output connections for the controllers are tapped for 1/4 NPT.

#### SENSOR

Connections are provided consistent with the particular sensor used.

### Approximate Mass

#### RECORDERS AND INDICATORS

11 kg (25 lb)

#### CONTROLLERS

13 kg (29 lb)

### Mounting

The instrument can be either flush, surface, or yoke mounted. Instruments containing a heavy duty helical element or Type 37 element cannot be surface mounted. Yoke mounting is required for instruments containing a Type 37 element. The relative humidity element is top-mounted to the case, and the instrument can only be surface mounted.

### Blow-out Plug

Located in the bottom of the case.

### Data Label

Aluminum data label attached to instrument with pressure sensitive adhesive. Includes space for customer tag data from 88 to 330 characters and spaces, depending on the type of measurement (pressure, temperature, flow, etc.). For additional space, see Optional Customer Tag.

## PRODUCT SAFETY SPECIFICATIONS

These instruments have been designed to meet the consensus requirements of the Occupational Safety and Health Administration (OSHA). When properly installed they can be used in Ordinary Locations

(General Purpose) and are suitable (without internal illumination or Type 70 contact options) for Class I, Groups B, C, and D, Division 2, hazardous locations.

## OPTIONAL FEATURES

Table 8. Optional Feature

Optional Feature	Description	AS Reference
Shatterproof Glass Door	Used in applications where standard door is vulnerable to breakage. Not available with flush panel mounting.	SPG
Flush Door Lock	With 2-keys	FDL
Inlet Purge Restrictor	Connection tapped for 1/4 NPT fittings.	IPR
Nameplate	Laminated plastic nameplates 38 x 76 mm (1.5 x 3 in) with white characters on a black background. Maximum of 5 lines with 28 characters or spaces 3 mm (0.13 in) high, or 24 characters or spaces 4 mm (0.16 in) high per line.	N/P

Table 8. Optional Feature (Continued)

Optional Feature	Description	AS Reference
Internal Illumination	An incandescent lamp is available for operation from a nominal 120 or 240 V ac power source, as specified. Ordinary Locations (General Purpose) electrical classification only.	II-I
Type 70 Electrical Contacts(a)	A variety of contact systems is available to provide a wide range of switching functions to actuate external control or alarm circuits. Ordinary Locations (General Purpose) electric classification only.	Contact Invensys
Recorder Chart Drives	Pneumatic, Single Speed – One revolution in 24 hours (Code PE24H). Pneumatic, Two Speed – One revolution in 24 hours or 7 days (Code PE7D + 24H). Electrical, Single Speed – One revolution in 30 seconds; 1, 2, 4, 6, 7.5, 12, 15, 24, 30, or 96 minutes; 1, 2, 3, 4, 6, 8, or 12 hours; or 2, 3, 4, or 7 days. Electrical, Two Speed – Any combination of two of the following speeds: One revolution in 30 seconds; 1, 4, 5, 6, 12, 24, or 30 minutes; 1, 2, 4, 8, 12, or 24 hours; 2, 3, or 7 days. Mechanical, Single Speed – One revolution in 8 or 12 hours with 24 hour movement; 24 or 48 hours with 7-day movement; or 8 days with 8-day movement. Mechanical, Two Speed – One revolution in 7 days/24 hours with 7-day movement; or 8 days/24 hours with 8-day movement.	–
External Manual Set Knob(a)	A knob which engages with the set point adjustment mechanism is fitted on the door.	OCS
External Connection to Integral (Reset) Bellows(a)	Used when an external feedback signal must be applied to prevent integral circuit saturation.	FSM
“Batch” Function Attachment(a)	For process involving discontinuous control, the integral function is modified to prevent overshoot and to initiate immediate corrective action when control is resumed. Available with single and duplex action controllers.	Suffix S
Ratio Attachment (a,b)	Provides manual means for setting the ration between an uncontrolled variable (primary) and a controlled variable (secondary). The ratio is adjustable between 0.5:1 and 1.7:1 for square-root scales, or between 0.3:1 and 3:1 for uniform scales. Available with single action controllers.	Suffix Q for Manual Set Ratio Suffix R for Pneumatic Set Ratio
Pneumaticset Attachement(a,b)	Enables the set point to be positioned pneumatically. Available over the full span or part of the span. Available with single action controllers. Full Span: Adjustable Span: Adjustable Span with Index Pointer to show start point:	Suffix N Suffix P Suffix P and SIP
Relation Attachement(a)	Maintains a fixed manually adjustable difference between an uncontrolled variable (primary) and a controlled variable (secondary). The relation is adjustable between 0 and $\pm 50\%$ of span.	RELATION
Pulse Counter	A 6-digit electromechanical counter, with a manual push-button reset, is available. In the recorder, it is visible through the top central window in the door. In the controller, it is located in the upper right corner and can be seen after opening the door. The counter is intended for use with the optional low pulse frequency output feature of the E96 Magnetic Flow Transmitter.	KP for 6-digit KR for 8-digit
Customer Tag	Stainless steel tag wired to instrument for customer tag data that doesn't fit on data plate. There can be a maximum of 10 lines of data with 40 characters and spaces per line.	MTS

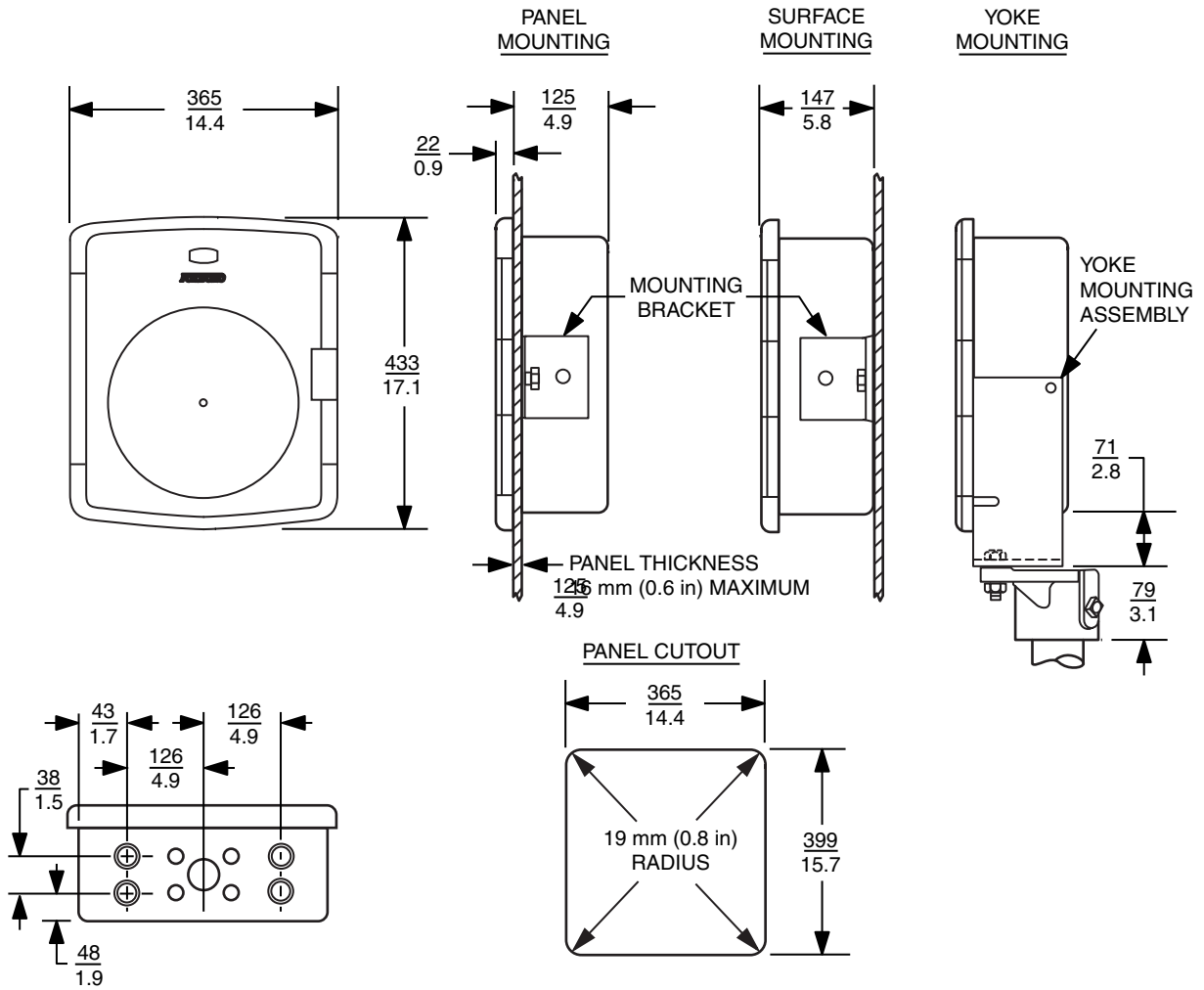
(a)Controller Options only.

(b)Not available with RTD, Thermocouple, or mV input signal.



DIMENSIONS - NOMINAL

mm  
in



## **ORDERING INSTRUCTIONS**

1. Instrument Model Code(a)
2. Element Code(a)
3. Supply Voltage and Frequency
4. Optional Signal
5. Recorder Chart Drive
6. Type of Pen(s)
7. Optional Features
8. Tag and Application

(a) Refer to Tables 1 through 7 for instrument and element codes.

## **OTHER M&I PRODUCTS**

Invensys provides a broad range of measurement and instrument products, including solutions for pressure, flow, analytical, positioners, temperature, controlling and recording. For a listing of these offerings, visit the Invensys Operations Management web site at:

[www.iom.invensys.com](http://www.iom.invensys.com)



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your local Invensys representative.  
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