

**40P Series Pressure Recorders, Indicators,
and Recording or Indicating Controllers**



**RECORDING
CONTROLLER**



**SECTOR SCALE
INDICATOR**



**CIRCULAR CHART
RECORDER**

These instruments are used wherever precise chart records, indication, or control of pressure measurement is required. They record on a circular chart, or indicate on a sector scale or concentric scale. The recorders and sector scale indicators are available with up to four pens and two pointers, respectively. The concentric scale indicator is available with one pointer. The controllers control one or two measurements while the control elements transmit a standard pneumatic signal to a final operator that may be as far as one hundred metres (three hundred feet) distant.

WIDE VARIETY OF RANGES

Metal diaphragm bellows or spiral or helical bourdon tube measuring elements are available for operation from full vacuum up to 200 MPa (30 000 psi, or 2000 bar or kg/cm²). Spans may be as narrow as 2 kPa (0.3 psi, or 0.02 bar or kg/cm²). Elevated-zero (compound) or suppressed-zero ranges are also available. These elements can be selected from a variety of materials to suit many process requirements.

VERSATILE MOUNTING

These instruments may be mounted in a panel, on a surface, or on a vertical pipe.

WIDE SELECTION OF CONTROL MODES

The controllers are available with On-Off, Proportional, Proportional plus Derivative, Proportional plus Integral (Reset) (STABILOG™), and Proportional plus Integral plus Derivative (HYPER-RESET™) control functions.

WEATHERPROOF CONSTRUCTION

A glass fiber reinforced case and gasketed door with a shatterproof glass window meet IEC IP53 and provide the environmental protection of NEMA™ Type 3.

PERFORMANCE SPECIFICATIONS

(Under Reference Operating Conditions)

Accuracy
See Measuring Element Specifications

Repeatability
0.25% of span

Dead Band (Recorders and Indicators)
0.20% of span

Dead Band (Controllers)
0.1% of span

PHYSICAL SPECIFICATIONS

Enclosure
The case and door are glass fiber reinforced polyester moldings, compounded for superior corrosion resistance. The door has a shatterproof glass window. The overall construction meets IEC IP53 and provides the environmental protection of NEMA Type 3.

Data Label
Aluminum data label fastened to chart plate with pressure sensitive adhesive. Includes space for customer tag data up to a maximum of 220 characters and spaces. For additional space, see Optional Customer Tag.

Flammability Rating
The case and door meet Type V-0 of UL 94. (Underwriters Laboratory Incorporated Standard for Test Flammability of Plastic Materials, UL 94.)

Element Materials
Refer to Measuring Element Specifications table.

Finish
Case is grey polyester, and door is blue textured (either epoxy powder coating or baked vinyl).

Approximate Mass (Excluding Element)
RECORDERS AND INDICATORS
11 kg (24 lb)
CONTROLLERS
13 kg (28 lb)

FUNCTIONAL SPECIFICATIONS

Elements

Refer to Measuring Element Specifications for types, materials, and ranges.

Connections

All connections are located in the bottom of the case.

ELEMENTS

For upper range values up to 14 MPa (2000 psi, or 140 bar or kg/cm²) the connections are tapped for R1/4 or 1/4 NPT, as specified. For upper range values from 14 MPa (2000 psi, or 140 bar or kg/cm²) up to 70 MPa (10 000 psi, or 700 bar or kg/cm²), the connections are threaded for R1/2 or 1/2 NPT, as specified. For upper range values above 70 MPa (10 000 psi, or 700 bar or kg/cm²) a 9/16-18 internally threaded AmincoTM fitting with compression nut and sleeve is used.

ELECTRICAL

A nominal 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.

Mounting

Standard mounting is flush in a panel up to 16 mm (0.6 in) thick or on a surface. (Surface mounting is not available for units fitted with heavy duty helical elements.) A kit of parts for vertical mounting on a DN 50 or 2 in pipe is available as an option.

Blow-out Plug

Located in the bottom of the case.

Cardboard Nameplate

A cardboard nameplate is supplied for displaying the chart factor.

Controllers Only

CONTROLLER ACTION

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

SUPPLY PRESSURE

140 kPa (20 psi, or 1.4 bar or kg/cm²).

OUTPUT SIGNAL

20 to 100 kPa, 3 to 15 psi, or 0.2 to 1.0 bar or kg/cm², as specified.

AIR CONSUMPTION (UNDER NORMAL OPERATION)

0.5 m³/h (0.3 cfm) at standard conditions.

Ambient Temperature Limits

-30 and +60 °C (-20 and +140 °F).

Recorder Chart Drives

ELECTRICAL

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

MECHANICAL

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

FUNCTIONAL SPECIFICATIONS (CONT.)

Recorder Pens

For Recorder and Single Action Recording Controllers, specify using Model Code. For Dual, Duplex, and Auto-Selector Controllers, see applicable Model Code and Optional Features section.

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 365 m (1200 ft) ink line at a nominal 25 mm/s (1 in/sec) per 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.

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.

Indicator Scales

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

SECTOR

The effective length is 171 mm (6.75 in).

CONCENTRIC

The effective length is 594 mm (23.4 in).

Dual Indicating Gauge

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. Both are expressed in kPa, psi, bar, or kg/cm², as specified.

Index Pointer

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

MEASURING ELEMENT SPECIFICATIONS

Table 1. Element Spans, Ranges, and Accuracy (For a Torque Factor Rating of 30

Element Code	Element Type	Element Material	Spans Available Between(a)		Accuracy (% of Span)
			kPa or MPa(b)	psi(c)	
PA-CA	Absolute Bellows	316 ss(d)	17 and 240 kPa abs	2.5 and 35 psia	±0.5
PA-MA	Absolute Double Spiral	316 ss	140 and 700 kPa abs	20 and 100 psia	±0.5
PB-AA	Helical	316 ss	1.4 and 40 MPa	200 and 6000 psi	±0.5(e)
PB-AM		K-Monel™	1700 and 14 000 kPa	250 and 2000 psi	±0.5
PB-BA	Spiral	316 ss	82 and 1400 kPa 82 and 100 kPa vac	12 and 200 psi 12 and 15 psi vac	±0.5
PB-BM		K-Monel	140 and 1400 kPa	20 and 200 psi	
PB-CA	Bellows	316 ss	35 and 200 kPa	4.5 and 2.9 psi	±0.75
PB-CC		Brass	30 and 180 kPa 34 and 100 kPa vac	4 and 26 psi 4.9 and 15 psi vac	
PB-DF	Diaphragm 50 mm (2 in)	Cu-Ni-Sn Alloy	6 and 70 kPa 6 and 35 kPa vac	0.9 and 10 psi 0.9 and 5 psi vac	±0.5
PB-PF	Diaphragm 75 mm (3 in)	Cu-Ni-Sn Alloy	2 and 10 kPa 2 and 6 kPa vac	0.3 and 1.5 psi 0.3 and 0.9 psi vac	±0.75
PB-GA	Heavy Duty Helical	316 ss	0.5 and 200 MPa	75 and 30 000 psi	±0.5(f)
PB-MC	Double Spiral	Bronze	280 and 420 kPa 70 and 100 kPa vac	40 and 60 psi 10 and 15 psi vac	±0.25
PC 3 to 15	Receiver (Bellows)	Brass	80 kPa	12 psi	±0.5
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/cm², multiply kPa value by 0.01; to convert MPa to bar or kg/cm², multiply MPa value by 10.

(c)To convert psi to inH₂O, multiply psi value by 2.773. To convert psi to inHg, multiply psi value by 2.036.

(d)AISI Type 316 stainless steel.

(e)Accuracy value given is at spans to 20 MPa (3000 psi); accuracy value gradually increases to ±0.75% of span above 20 MPa (3000 psi).

(f)Accuracy value given is at spans to 20 MPa (3000 psi); accuracy value gradually increases to ±1.0% of span above 20 MPa (3000 psi).

OPTIONAL FEATURES

Flush Door Lock
with 2 keys

Inlet Purge Restrictor

Connection tapped for 1/4 NPT fittings.

Nameplate

Laminated plastic nameplates 38 x 76 mm (1.5 x 3 in) with white characters on a black back-ground. 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.

Internal Illumination

An incandescent lamp is available for operation from a nominal 120 or 240 V ac power source, as specified.

Pipe Mounting

A bracket is available for mounting on a DN 50 or 2 in vertical pipe.

Type 70 Electric Contacts

A variety of contact systems is available to provide a wide range of switching functions to actuate external control or alarm circuits. Refer to TI 33-10a.

Fiber Tip Pen

For Dual, Duplex, and Auto-Selector Controllers only. (Note that this pen is a standard selection using Model Code for a Recorder or Single Action Recording Controller.) Standard box-type pen can be replaced with a fiber-tip pen with disposable ink cartridge. Minimum of 365 m (1200 ft) ink line at a nominal 25 mm/s (1 in/s) chart speed. Specify Auxiliary Specification Code (AS Code) PN-FT.

Customer Tag

Stainless steel tag attached 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. Specify AS Code MTS.

Recorder Chart Drives

ELECTRICAL, SINGLE SPEED

One revolution in 1, 2, 4, 6, 7.5, 12, 15, 24, or 30 minutes; 1, 2, 3, 4, 6, 8, or 12 hours; or 2, 3, 4, 7, or 31 days.

ELECTRICAL, TWO SPEED

Any combination of two of the following speeds: One revolution in 30 seconds; 1, 5, 6, 12, 24, or 30 minutes; 1, 4, 8, 12, or 24 hours; or 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; 8 days with 8-day movement; 7 days with 7-day movement; 31 days with 31-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.

Overrange Protection

Overrange protection against damage to the instrument linkage, pens, or pointers is a standard feature for diaphragm bellows and absolute bellows, but is available as an optional feature for spiral, double-spiral, helical, and heavy duty helical elements.

Preparation for Special Service

The elements are cleaned, assembled, calibrated, and packaged in a Class 10 000 Clean Room which meets both mandatory and non-mandatory requirements established by U.S. Federal Standard 209a, or using acceptable alternative facilities following procedures established to meet strict user requirements for each specific type of service. For oxygen service, this preparation is available for 316 ss spiral and helical elements only. Copper bearing alloys, used to braze the cleanout tube to the tip of stainless steel spirals, are in contact with the process.

For nuclear service, only stainless steel helical elements are used.

Pressure Seals

A range of pressure seals in a variety of materials of construction is available for use with 316 ss spiral and helical elements.

Sanitary Pressure Seals

This option provides 3A authorization under 37-00 for pressure sensing devices by means of Ametec-Mansfield and Green (M and G) fittings for sanitary applications. Specify AS Code 3A.

40P Series Controllers Only

TRANSFER SWITCH AND SUPPLY REGULATOR ARRANGEMENTS

Four basic arrangements are available: internal supply regulator only; two-position nozzle seal switch only; internal supply regulator with two-position nozzle seal switch; and internal sub-panel with an output regulator and a balance indicator and two position A/M switch.

EXTERNAL MANUAL SET KNOB

A knob which engages with the set-point adjustment mechanism is fitted on the door.

EXTERNAL CONNECTION TO INTEGRAL (RESET) BELLOWS

Used when an external feedback signal must be applied to prevent integral windup.

40P Series Controllers Only (Cont.)

BATCH FUNCTION ATTACHMENT

For processes involving discontinuous control, the integral function is modified to prevent overshoot and to initiate immediate corrective action when control is resumed.

PNEUMATICSET ATTACHMENT

Enables the set point to be positioned pneumatically. Available over the full span or part of the span.

RATIO ATTACHMENT

Provides manual means for setting the ratio 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.

RELATION ATTACHMENT

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.

MODEL CODE (RECORDERS AND INDICATORS)

<u>Description</u>	<u>Model</u>
Recorders and Indicators - Rectangular Polyester Case	40P
<u>Function</u>	
Circular Chart Recorder	R
Sector Scale Indicator	N
Concentric Scale Indicator	K
<u>Internal Mechanism</u>	
Standard Recorder (40PR)	-R
Standard Sector Scale Indicator (40PN)	-N
Standard Concentric Scale Indicator (40PK)	-K
Recorder or Indicator with Type 70 Contacts	-E
<u>Mounting</u>	
Flush	F
Pipe	P
Surface	S
<u>Chart Drive or Scale</u>	
Mechanical Chart Drive, 24-hour rotation and wind (40PR)	M
Electric Chart Drive, 24-hour rotation, 120 V ac, 60 Hz (40PR)	E
Sector Scale (40PN)	N
Concentric Scale (40PK)	K
Optional Chart Drives, refer to "Optional Features" section (40PR)	X
<u>Pens or Pointers</u>	
One pen (40PR) or one pointer (40PN or 40PK)	1
Two pens (40PR) or two pointers (40PN only)	2
Three pens (40PR)	3
Four pens (40PR)	4
<u>Pen Type or Scale Type</u>	
Box-Type Pen (40PR)	B
Fiber Tip Disposable Pen (40PR)	F
Single Range Scale (40PN or 40PK)	S
Double Range Scale (40PN)	D
<u>Measurement Element</u>	
Absolute pressure, bellows	/PA-CA
Receiver, bellows	/PC
Absolute pressure, double spiral	/PA-MA
Pressure, double spiral	/PB-MC
Pressure, helical	/PB-AA
Pressure, spiral	/PB-BA
Pressure, bellows	/PB-CA,CC
Pressure, diaphragm	/PB-DF,PF
Pressure, heavy duty helical	/PB-GA
Examples: 40PR-RFE2F/PB-AA, 40PN-NSN2S/PB-BA	

MODEL CODE (SINGLE ACTION CONTROLLER)

Description	Model
Single Action Controller - Rectangular Polyester Case	40P
<u>Function</u>	
Recording	R
Indicating with sector scale	N
<u>Action</u>	
Single (Control unit actuated by the first listed element)	-A
<u>Control</u>	
On-Off	1
Full Proportional, 0.5 to 200%	2
Full Proportional plus Derivative, 0.01 to 50 minutes	3
Full Proportional plus Integral (Reset), 0.01 to 50 minutes per repeat	4
Full Proportional plus Integral plus Derivative	5
Narrow Band Proportional, 0.5 to 25% or 1.0 to 50%	6
<u>Automatic/Manual Internal Transfer Switching</u>	
W/o internal regulator, w/o transfer switch (A1 only)	J
Two-position nozzle seal switch (A2, A3, A4, A5, and A6 only)	L
Balanceable automatic/manual unit--right (A2, A3, A4, A5, and A6 only)	N
Balanceable automatic/manual unit--left (A2, A3, A4, A5, and A6 only)	P
<u>Output Signal and Gauge</u>	
3 to 15 psi signal, 22 psi gauge	2
0.2 to 1.0 kg/cm ² signal, 1.5 kg/cm ² gauge	4
20 to 100 kPa signal, 150 kPa gauge	5
0.2 to 1.0 bar signal, 1.5 bar gauge	6
<u>Mounting</u>	
Flush	-F
Pipe	-P
Surface	-S
<u>Chart Drive or Scale</u>	
Mechanical Chart Drive, 24 hour rotation and wind (40PR)(a)	M
Electrical Chart Drive, 24 hour rotation, 120 V ac, 60 Hz (40PR)(b)	E
Not Chart Drive	X
Sector Scale (40PN)	N
<u>Pens or Pointers</u>	
One pen (40PR) or one pointer (40PN)	1
Two pens (40PR) or two pointers (40PN)	2
Three pens (40PR)	3
<u>Pen Type or Scale Type</u>	
Box-Type Pen (40PR)	B
Fiber Tip Disposable Pen (40PR)	F
Single Scale (40PN)	S
Double Scale (40PN)	D
<u>Measurement Element</u>	
Absolute pressure, bellows	/PA-CA
Receiver, bellows	/PC
Absolute pressure, double spiral	/PA-MA
Pressure, double spiral	/PB-MC
Pressure, helical	/PB-AA
Pressure, spiral	/PB-BA
Pressure, bellows	/PB-CA,CC
Pressure, diaphragm	/PB-DF,PF
Pressure, heavy duty helical (maximum of one per instrument)	/PB-GA

(a)For optional rotations and winds, specify "M" and refer to "Optional Features" section.

(b)For optional rotations, voltages, and frequencies, specify "e" and refer to "Optional Features" section.

MODEL CODE (DUPLEX, DUAL, AND AUTO-SELECTOR CONTROLLER)

Description	Model
Duplex, Dual, and Auto-Selector Controller - Rectangular Polyester Case	40P
<u>Function</u>	
Recording(a)	R
Indicating with sector scale	N
<u>Action</u>	
Duplex (one element actuates one measurement pen or pointer and two control units)	-B
Dual (two elements, each actuate one pen or pointer and one control unit)	-C
Auto-Selector	-H
<u>First Control (Right Hand)</u>	
On-Off	1
Full Proportional	2
Full Proportional plus Derivative (-C, -H only)	3
Full Proportional plus Integral (Reset) (-C, -H only)	4
Full Proportional plus Integral plus Derivative (-C, -H only)	5
Narrow Band Proportional	6
<u>Second Control (Left Hand)</u>	
On-Off	1
Full Proportional	2
Full Proportional plus Derivative (-C, -H only)	3
Full Proportional plus Integral (-C, -H only)	4
Full Proportional plus Integral plus Derivative (-C, -H only)	5
Narrow Band Proportional	6
<u>Automatic/Manual Internal Transfer Switching (First Control -- Right Hand)</u>	
With Out internal regulator, w/o transfer switch (1 only)	J
Two-position nozzle seal switch (-B2, -B6, -C2 to -C6, -H2 to -H6 only)	L
Balanceable automatic/manual unit (-B2, -B6, -C2 to -C6, -H2 to -H6 only)	N
<u>Automatic/Manual Internal Transfer Switching (Second Control -- Left Hand)</u>	
With Out internal regulator, w/o transfer switch (-B, -C) (1 only)	J
Two-position nozzle seal switch (-B2, -B6, -C2 to -C6 only)	L
Balanceable automatic/manual unit (-B2, -B6, -C2 to -C6 only)	P
Auto-Selector (-H only)	T
<u>Output Signal and Gauge</u>	
3 to 15 psi signal, 22 psi gauge	2
0.2 to 1.0 kg/cm ² signal, 1.5 kg/cm ² gauge	4
20 to 100 kPa signal, 150 kPa gauge	5
0.2 to 1.0 bar signal, 1.5 bar gauge	6
<u>Mounting</u>	
Flush	-F
Pipe	-P
Surface	-S
<u>Chart Drive or Scale</u>	
Mechanical Chart Drive, 24 hour rotation and wind (40PR)(b)	M
Electrical Chart Drive, 24 hour rotation, 120 V ac, 60 Hz (40PR)(c)	E
Not Chart Drive	X
Single Scale (40PN)	S
Double Scale (40PN)	D
<u>Measurement Element</u>	
Receiver, bellows	/PC
Absolute pressure, double spiral	/PA-MA
Pressure, double spiral	/PB-MC
Pressure, helical	/PB-AA
Pressure, spiral	/PB-BA

MODEL CODE (DUPLEX, DUAL, AND AUTO-SELECTOR CONTROLLER)

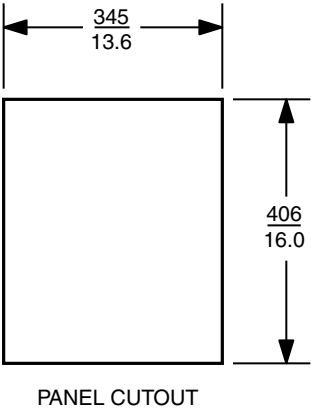
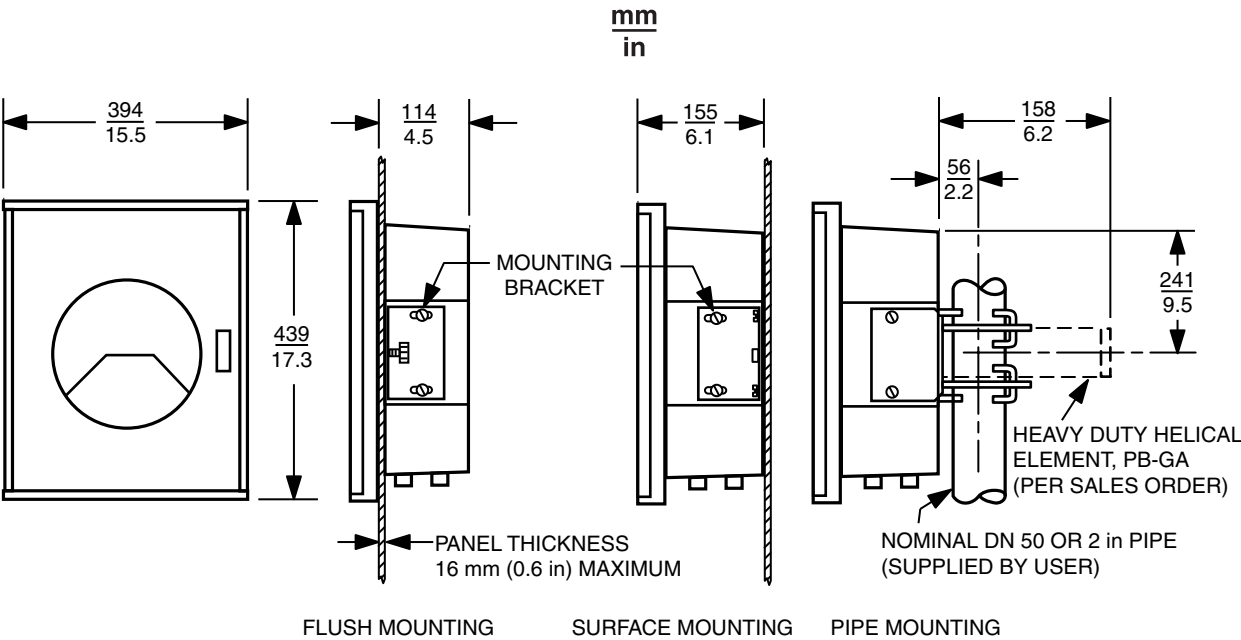
Description	Model
Duplex, Dual, and Auto-Selector Controller - Rectangular Polyester Case	40P
Pressure, bellows	/PB-CC
Pressure, diaphragm	/PV-DF

(a) Box-type pen is standard. For optional Fibre Tip Pen, specify AS Code PN-FI. see "Optional Features" section.

(b) For optional rotations and winds, specify "M" and refer to "Optional Features" section.

(c) For optional rotations, voltages, and frequencies, specify "E" and refer to "Optional Features" section.

DIMENSIONS - NOMINAL



NOTE:
FOR HORIZONTAL MULTIPLE PANEL MOUNTING,
A MINIMUM DISTANCE OF 445 mm (17.5 in) FROM
CENTER LINE TO CENTER LINE IS REQUIRED.

ORDERING INSTRUCTIONS

1. Model Code
2. Mounting
3. Element Type, Material, and Range
4. Measurement Range
5. Measurement Correction
6. Chart or Scale Range
7. For Recorder: Chart Drive and Pen Type
8. For Indicator: Select Sector or Concentric Scale
9. For Controller: Controller Action
10. For Controller: Supply Pressure and Output Signal
11. Optional Features
12. Tag and Applications

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/

