

743C Series**FIELD STATION MICRO™ Controller**

The 743C is a self-contained, field-mounted, stand-alone, microprocessor-based controller with an integral power supply. It performs the standard proportional, integral, and derivative (PID) control functions of analog instruments. Additionally, it provides enhanced functions such as Foxboro's patented EXACT® tuning algorithm, user-configurable control functions, a comprehensive calculation capability, and signal conditioning. Standard controller signals include: four analog inputs, two frequency inputs, two contact inputs, an optional platinum RTD direct input, two analog outputs, and two contact outputs. Optionally, one of the 4 to 20 mA analog outputs may be isolated.

A fluorescent display is used to show the control variables in bargraph format, and to provide precision digital readout. It also displays an electronic loop tag, controller status, and alarm indication. A keypad, located on the front of the controller, is used for operator interface and configuration.

The controller is housed in a field-mounted enclosure that meets IEC IP65 and that also provides the environmental and corrosion resistant protection of NEMA Type 4X. The enclosure can be mounted to a surface or panel, or mounted to a nominal DN50 or 2 in pipe.

FEATURES

- Dynamic Compensation with Lead/Lag, Impulse, and Dead Time Functions
- Assignable Alarms
- Algebraic Computation
- Flexible Configuration Blocks with Internal Signal Routing
- RS-485 Serial Communications
- Pulse Driven Input
- Boolean Logic Capability
- Configuration and Display of an Independent Variable
- Ratio Control
- Simple Batch Control
- Single Station Cascade Control
- NEMA 4X Enclosure
- EXACT Control (Foxboro U.S. Patent RE 33267)
- Fully Interactive Display
- Standard Computer Interface for Operation and Configuration
- Nonvolatile Memory
- Transportable Configuration
- Power Failure Recovery Logic
- Front Panel Keypad for Both Configuration and Operator Interface
- Internal Signal Sources for Calibration
- Passcode Security
- Integral Field Power Supply



EXACT CONTROL

EXACT control uses microprocessor technology to make ongoing controller adjustments based on the actual, real time process dynamics. This is in direct contrast to other "self-tuning" controllers that establish the values of tuning parameters based on an arbitrary process model.

While continuously scanning the process variables, EXACT control initiates corrective action upon sensing a process upset. The user selects the desired response by specifying the desired damping and overshoot-to-load change, such as quarter amplitude damping.

Values of EXACT can be read by the user.

EXACT control functions as if your best operator is on the job 24 hours a day. It can be turned on or off at the keypad or by configuring logic functions, allowing these controllers to function as advanced PID controllers.

PULSE DRIVEN INPUT

There is provision for two pulse inputs, forming a pulse up/pulse down pair that can be assigned to any scaled signal such as remote set point. This function is compatible with the signals used for older stepping motor type devices.

ASSIGNABLE ALARMS

Four dual-level alarms, each with a dead band and one Boolean output, are assignable to a wide variety of signals, including non-control signals. High/High, High/Low, and Low/Low types; Latching, Nonlatching, and Permissive action; and Absolute, Deviation, and Rate-of-Change form are supported. Thus, virtually any alarm application is accommodated.

RS-485 SERIAL COMMUNICATIONS INTERFACE

This controller is equipped with an RS-485 serial port for communication with most host computers, either directly or via an RS-232/RS-485 converter or equivalent accessory. Protocol conforms to ANSI Specification X3.28-1976, Subcategory E3. Using the Foxboro Model F6501A converter, up to 30 controllers can be accommodated with a single host communication port.

Serial communications capability includes uploading/downloading of configuration, setting of Auto/Manual (A/M) or Remote/Local (R/L) status and manual output and local setpoint values, polling of all inputs and the auxiliary output, and writing as well as reading of all configurable parameters. Both loops of the single station cascade controller are accommodated. The user can also select parity, stop bits, and panel or workstation (host) priority.

COMPUTATIONAL CAPABILITY

This controller performs up to three independent calculations. The variables may include the results of other calculation blocks, scaled and conditioned inputs, and other internal control signals.

An equation is entered from the keypad one character at a time following the usual rules of algebra and a few easy-to-learn rules. The result of this flexibility is exceptional computational capability in a single station controller.

SIMPLIFIED CONFIGURATION AND OPERATION

Because of its flexibility, this controller is easily configured to meet the most exacting process requirements. All operating functions are examined and/or changed by keystrokes. Interactive prompting simplifies setting the adjustable parameters.

COMPLETE SECURITY

The operator has keypad access to read the values of inputs, alarm and limit settings, and the operating configuration. However, the operator can adjust only those settings which were specified as operator-adjustable when the controller was configured. A passcode must be entered from the keypad to enable adjustment of the remaining parameters. In addition, a keypad disable jumper, accessible from inside the tamper resistant enclosure, is provided.

This passcode is determined by an authorized person at the time the controller is configured. Thus, only those who have been given this passcode can change any of the protected parameters.

BOOLEAN LOGIC CAPABILITY

There are five single gates and five dual gates. Each gate is configured by selecting the logic and then selecting the source of each input. Gates 0 through 4 are the single input gates and are configured DIRECT or NOT by the user. Gates 5 through 9 are the dual input gates and the user selects one of the following logic types for each one: OR, NOR, AND, NAND, XOR, or NXOR.

DYNAMIC COMPENSATION

The result of a dedicated calculation block can be passed through a dynamic compensator, prior to distribution. The dynamic compensator provides lead/lag, impulse, and dead time functions, each with its individual follow switch. Functionally, dead time precedes lead/lag and is the input to the lead/lag function.

Utilizing the dynamic compensator and the follow switches, feedforward and other complex control applications are easily and efficiently handled.

FRONT PANEL

The controller can be configured and operated entirely from the front panel without need for any external equipment. The panel consists of an alphanumeric display, a graphics display, status indicators, an alarm (horn) symbol, and a keypad. Refer to Figure 1.

The alphanumeric display at top of front panel has two lines of nine characters each. The characters are 5 mm (0.196 in) high, and colored Blue-Green.

The graphics display consists of three bargraphs, each having 50 segments plus a pointer on top and bottom. The bars are 55.4 mm (2.18 in) long. The left and center bargraphs are 5 mm (0.196 in) wide, and the right bar graph is narrower at 2.5 mm (0.098 in). The bargraphs are colored Blue-Green.

The status characters (W/P, R/L, A/M) are 4 mm (0.157 in) high and the alarm symbol (horn) is 5 mm (0.196 in) high. The status characters are colored Blue-Green, and the alarm symbol is Red.

The keypad has eight keys as shown in Figure 1 and identified in Table 1. The key switches are single pole, normally open contacts, all closing to a common lead. For actuation, keys must be depressed for a minimum of 200 ms (0.2 s).

Table 1. Keypad Description

Key Name	Usage of Key
	Depression at any time will cause Controller to exit FACEPLATE mode and enter the User Interface, provided the Controller is in PANEL (P). If Controller is in WORKSTATION (W), the TAG key will be ignored.
	If an alarm has not been acknowledged, depression of ACK key will remove the alarm from the Alarm indicator flashing queue and put alarm into the Alarm indicator steady queue. ACK is activated whether in W or P.
	Short Depression (0.1 to < 0.3 s): Moves through variables being displayed bargraphs, displaying each, in turn, on lower alphanumeric display. Long Depression (≥ 0.3 s): Toggles between faceplates of Primary and Secondary Controller provided the Cascade Controller is configured and active. Otherwise same action as if it were a Short Depression. The SEL key is independent of whether Controller in W or P.
	Controller Status Switch; toggles between Workstation (W) and Panel (P) operation. This key will be ignored if Controller is in "W" and configured to "W" priority, or if not configured to NONE.
	Controller Status Switch; toggles between Auto (A) and Manual (M) operation. This key will be ignored if Controller is in "W", or if in "P" when A/M not configured to NONE. The bargraph pointer indicator will automatically preselect the Output Bargraph when transferring to "M", and the Measurement Bargraph when transferring to "A".
	Controller Status Switch; toggles between Remote (R) and Local (L) setpoint operation. This key will be ignored if Controller is in "W", or if in "P" when R/L is not configured to NONE. On secondary Faceplate, toggles between CASCADE and bypass control for a CASCADE function switch selection of NONE.
	Up and Down arrows are bidirectional movement requestors. Select menu items, functions, and reconfigure parameters.

COPY MEMORY FEATURE

This optional copy memory feature permits the configuration of one controller to be duplicated for use in another controller. This is accomplished using two NOVRAMS (nonvolatile, random access memory modules) and a configuration copy accessory. Briefly, after turning off the power, the procedure is as follows: remove the configured NOVRAM from the controller; install the copy accessory; plug the

configured NOVRAM and a second NOVRAM (to be configured) into the copy accessory; then turn on the power and the second NOVRAM is copied for use in another controller. With minimum effort, any number of controllers can thus be configured with the same parameter values as the original controller. Then individual parameters in each controller are easily changed to fit the particular loop.

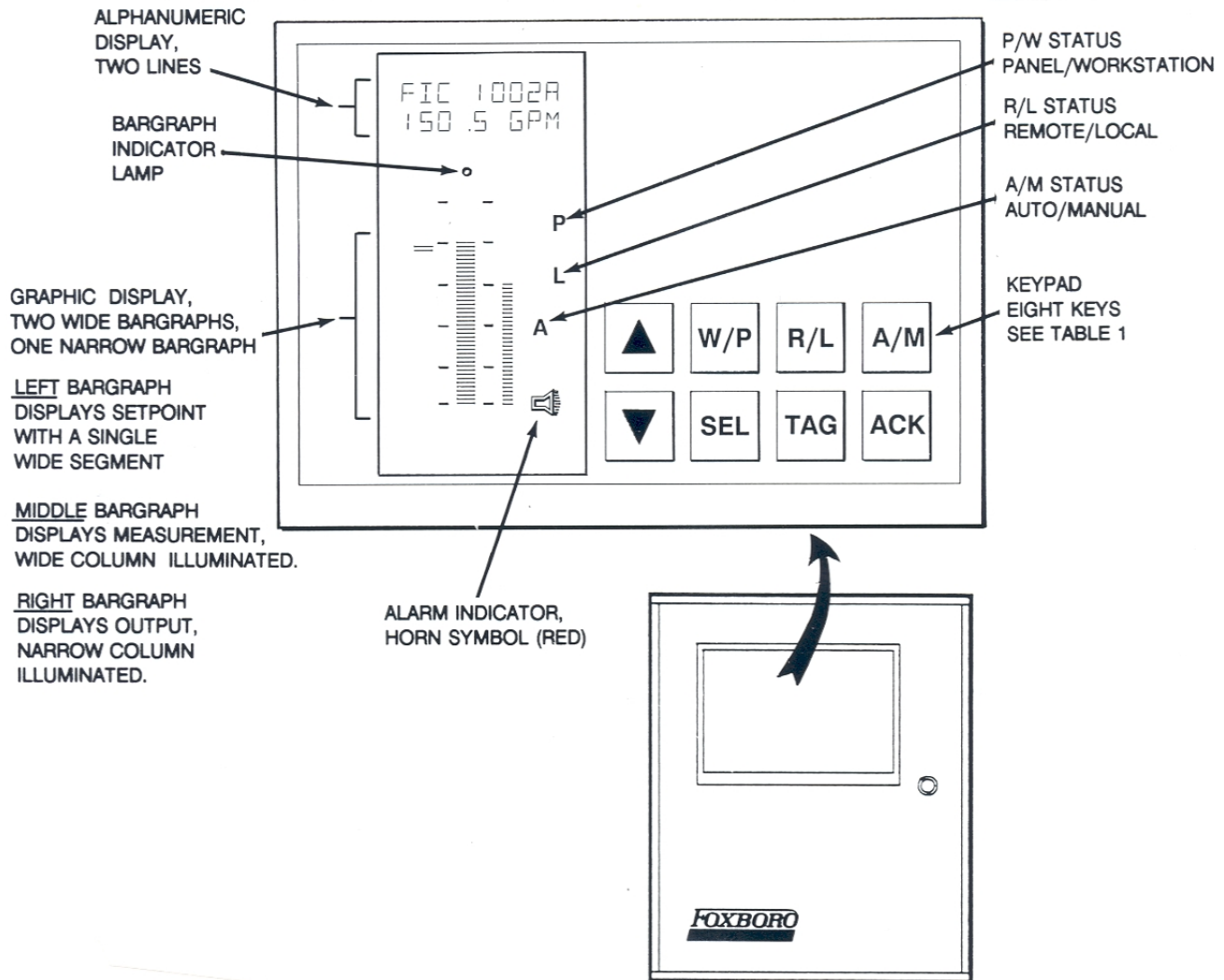


Figure 1. Controller Front Panel

OPERATING AND STORAGE CONDITIONS

Influence	Reference Operating Conditions	Normal Operating Condition Limits	Operative Limits	Transportation and Storage Limits
Ambient Temperature	23 ±2°C (73 ±3°F)	–10 and +60°C (14 and 140°F)	–10 and +60°C(a) (14 and 140°F)(a)	–40 and +70°C (–40 and +158°F)
Relative Humidity	50 ±10%	5 and 95%	5 and 95%	0 and 100%
Supply Voltage	24, 120, 220 and 240 V ac, ±1% 24 V dc, ±1%	V ac, +10, –15% V dc, +10, –15%	V ac, +15, –20% V dc, +10, –15%	– –
Supply Frequency	50/60 Hz, ±0.1 Hz	50/60 Hz, ±3 Hz	40 and 65 Hz	–
Vibration	Negligible	5 and 500 Hz at an acceleration of 10 m/s ² (1 “g”)	–	10 m/s ² (1 “g”) for 1 hour
Mechanical Shock	Negligible	–	–	A 42 inch drop when in shipping container.

(a) Lower operative limit extends to –20°C (–4°F) with enclosure heater option.

PERFORMANCE SPECIFICATIONS

Accuracy at Numeric Display

Numeric Display Accuracy Table

Parameter	Accuracy
Set Point	
Operator	±0.1% of span
External	±0.1% of span
Ratio	±0.1% of span
Input	
Analog	±0.1% of span
Frequency	±0.1% of span
RTD (Direct Meas.)	±0.5°C
Output	
Valve	±0.5% of span
Retransmit (linear)	±0.25% of span
Linearization	
RTD	±0.5°C, reading only
Thermocouple	±0.5°C, reading only
Control Modes	
Prop. Band	±5% of indicated value
Integral & Deriv.	±5% of indicated value (setting ≥0.1 min) ±0.5 s (setting <0.1 min)
Alarm Settings	
Absolute	±0.1% of span
Deviation	±0.1% of span
Rate-of-Change	±0.1% of span
Calculations	±0.1% of span

Resolution

DISPLAY

±0.1% of upper range value

BARGRAPH

±2% of upper range value

Ambient Temperature Effect

Maximum error in percent of span, except as noted, for a 30°C (55°F) change in temperature within normal operating limits. See table below.

Parameter	Maximum Error
Set Point	
Local	less than 0.1%
Remote	less than 0.5%
Input	
Analog	less than 0.5%
Frequency	less than 0.25%
RTD	less than 0.5°C
Output	
Valve	less than 0.5%
Retransmit	less than 0.5%

Humidity Effect

Maximum error in any conversion, calculation, or setting is ±0.1% of span for a change from reference conditions to 95% R.H. at 30°C (85°F) wet bulb.

Frequency Response

Analog input to output conversion is flat to 3 Hz.

Output Noise

0.25% maximum, peak-to-peak.

Supply Voltage Effect

±0.1% of span (maximum) for a +10% or –15% change in ac or dc voltage within normal operating conditions.

FUNCTIONAL SPECIFICATIONS**Proportional Input Signals**

Any combination of the following proportional inputs. All input signals are converted ten times per second and can be characterized or combined in a variety of calculations. See table below.

Proportional Type Input Signal	Maximum Number	Details
4 to 20 mA dc Current Input	4	4 to 20 mA dc input is standard. Inputs are across 250 resistors located on terminal block at lower left, inside of enclosure.
1 to 5 V dc Voltage Input	4	Controllers will accept 1 to 5 V dc by removing the input resistor(s) used with the current input.
Thermocouple Input (requires 893 Temperature Transmitter, or equivalent)	1	Linearization of displayed value is provided, as follows: Thermocouple Temperature Range Type J –20 to +760°C (–4 to +1400°F) Type K –20 to +1380°C (–4 to +2500°F) Type E –130 to +540°C (–200 to +1000°F)
1 to 9999 Hz Frequency Input	2	Input pulse rates, voltage levels, and field power are compatible with Foxboro E83 Series Vortex Flowmeter, and with Foxboro 81 and 82 Series Turbine Flowmeter having a preamplifier input. Input impedance is 250Ω.
1 to 9999 Hz Pulse Up/ Pulse Down Inputs	1 Pair	1 to 9999 Hz pulse up/pulse down pair of inputs driven by external contact closure or voltage pulse. Contact closure/open times and pulse voltage level are compatible with older stepping motor devices.
Resistance Temperature Detector (RTD) Input, Direct or Temperature Difference Measurement. See Model Code section to select this optional RTD input.	1	Platinum, per IEC 100 or SAMA* 100 (RC 21-4) temperature curves. Linearization of displayed value is provided, as follows: IEC 100 SAMA 100 Range –200 to +850°C –200 to +600°C (–330 to +1560°F) (–330 to +1100°F) Span 110 to 1000°C 110 to 800°C (198 to 1800°F) (198 to 1440°F)

*Scientific Apparatus Makers Association

Two Discrete Inputs

Two nonisolated contact or transistor switch inputs, 5 V dc nominal open circuit voltage, 1 mA maximum current. For remote status changes such as A/M, R/L, W/P, EXT ACK, and tracking functions.

Output Signals

TWO NONISOLATED ANALOG OUTPUTS

- Control Output Signal: 4 to 20 mA nominal into 500 Ω maximum; isolation provided as an option.
- Auxiliary: 1 to 5 V dc nominal into 2 k Ω minimum, or 4 to 20 mA nominal into 500 Ω maximum, jumper selectable. Can be assigned by user for measurement, set point, control, or conditioned input signals.

TWO DISCRETE OUTPUTS

Two nonisolated open collector transistor (NPN) switch outputs, diode clamped at 62 V $\pm$ 5%. For status indication of A/M, R/L, W/P, and alarms, or can be configured as the destination for any two of the Boolean Gate Inputs. Contact ratings are 50 V dc maximum, 250 mA maximum. Leakage current is 100 μ A maximum.

Control Functions

Within this controller are two interconnected controllers with individual built-in options that can be configured. Thus, the 743CA is an advanced single station cascade controller. The Secondary controller can be disabled to provide a single controller having the functions of the Primary.

PRIMARY CONTROLLER

Standard algorithms are P, I, PD, PI, PID, and EXACT control. The following options may be configured: nonlinear extender, ratio, measurement and set point tracking, output tracking, remote/local set point, output multiplication or summing, external reset, external limits for output, and simple batch control.

SECONDARY CONTROLLER

This controller is enabled by configuring CASCADE in the user interface menu. The standard algorithms are P and PI. Ratio and external limits for output are configurable options.

Other Control Functions

- Input bias, gain, and output bias available for every input.
- Characterizers (two available, 10 and 15 segments, assignable).
- Boolean Gate Logic {DIRECT and NOT (single input); OR, NOR, AND, NAND, XOR, and NXOR (dual input); 18 function switches. Inputs selectable from contact inputs, alarm output states, status indicator outputs, EXACT state, gate outputs, and three fixed states.}
- Signal Conditioning (square, square root, characterizer).

Toggle Mode

Configuring the TOGGLE mode allows a user to toggle (switch) between a menu level and the normal front panel display and back to the same menu level utilizing the TAG key.

Alarms

Four dual-level alarms, each with a dead band and one Boolean output are available. Each alarm is configurable for Absolute, Deviation, Rate-of-Change, High/Low, High/High, Low/Low, Latching, Nonlatching, or Permissive. Each alarm can be configured to act on any one of a number of user-selected points.

- The alarm status is indicated by a combination of alphanumeric display, the bar graphs, an alarm symbol, and the contact outputs.
- The alarm dead band is adjustable between 0 and 100% of span.

Calculations

There are three calculation functions, designated CALC 1, CALC 2, and CALC 3. The variables in each calculation can be any combination of direct inputs to the controller, configured constants, and results of other calculation blocks. The available operators are +, -, /, *, >, <, and ten Boolean gates. Open and close brackets are also available for grouping variables.

Transmitter Power Supply

Nominal 27 V dc minimum, 30 V dc maximum power supply with a 250 Ω limiting resistor at each transmitter connection. Provides field power for two 4 to 20 mA transmitters with a maximum series resistance of 350 Ω in each current loop, including the 250 Ω input resistor.

Dynamic Compensation

The result of CALC 3 may be passed through the dynamic compensator function prior to distribution. This block provides lead/lag, impulse, and dead time functions, each with its individual follow switch.

Functionally, dead time precedes lead/lag and is the input to the lead/lag function.

Dead time allows the input to be delayed by a configured time before making it available at the output. The lead/lag function allows the output to dynamically lead or lag the input by a configured time. Both functions can be enabled or by-passed selectively utilizing the follow switches.

The impulse can be positive, negative, or bi-polar and is part of the lead/lag function.

Dynamic Compensation Adjustment Limits**DEAD TIME**

0 and 200 minutes

LEAD/LAG TIME

0 and 200 minutes

Execution Rate

Ten times per second. May be five times per second for some complex configurations.

Memory

All configuration and operating parameters (not status data) are stored in a nonvolatile RAM device having a ten year data retention capability. Should a power failure occur, essential control settings and last operating conditions are saved indefinitely. No batteries are used.

Input Filter

Second order Butterworth filter. Adjustment time: 0 to 10 minutes.

Signal Distribution

Twenty-five signals are available for internal routing. These are the conditioned and scaled inputs, unconditioned inputs, control inputs and outputs, and calculation results.

Power On/Off Switch

A rocker type ON/OFF power switch is provided within the enclosure.

PHYSICAL SPECIFICATIONS**Enclosure**

The case is a glass fiber reinforced polyester molding, compounded for superior corrosion resistance. The door is glass fiber reinforced, modified polyphenylene oxide. The overall construction meets IEC IP65, and provides the environmental and corrosion resistant protection of NEMA Type 4X.

Electrical Connections

Electrical conduit holes, located on bottom of enclosure, accommodate 1/2-in conduit (see "Dimensions—Nominal" section). User signal wires, with a maximum size of #14 AWG (2.50mm²), are terminated at a 32-terminal block at the lower rear surface of the case. Power wires, ranging in size from #22 to #12 AWG (0.5 to 4 mm²), terminate at a 3-terminal block (having a protective cover) at the bottom of the case.

Keypad

The contacts are stainless steel snap domes trapped between an upper and lower silver contact. Overlay colors are Red for ACK; Blue for I, Ø, and SEL; Light Gray for W/P, R/L, and A/M; Gray for TAG; and

Black for background.

Display

Vacuum fluorescent lamps in glass enclosure having a glass frit seal and tin plated copper pin outs. Horn symbol (for alarms) is Red, and bargraphs and alphanumeric characters are Blue/Green.

Electronic Packaging

The electronic circuitry is mounted on two 1.6 mm (0.062 in) thick, glass-based epoxy, wiring boards. These electronic printed wiring assemblies (PWA's) are interconnected using 20-pin connectors.

Mounting

Enclosure can be mounted to a panel, to a flat surface, or to a DN50 or 2 in pipe. For enclosure and mounting dimensions, see "Dimensions-Nominal" section.

Approximate Mass

6.4 kg (14 lb)

MODEL CODE

Description	Model
FIELD STATION MICRO Controller	743CA
<u>Nominal Supply Voltage and Frequency</u>	
120 V ac, 50/60 Hz	–A
220 V ac, 50/60 Hz	–B
240 V ac, 50/60 Hz	–C
24 V dc	–D
24 V ac, 50/60 Hz	–E
100 V ac, 50/60 Hz	–J
<u>Mounting</u>	
Pipe Mounting	F
Panel or Surface Mounting	P
<u>Optional Selections</u>	
Output Isolation, 4 to 20 mA	–1
Platinum RTD Input(a)	–2
Enclosure Heater (Not Available with 743CA–D, 24 V dc Supply) Required for Operating Temperature below –10°C (+14°F) down to a lower limit of –20°C (–4°F)	–3
Examples: 743CA–AP, 743CA–BF–2, 743CA–AF–123	

(a) Minimum span with platinum RTD is 111°C (200°F)

PRODUCT SAFETY SPECIFICATIONS**Electrical Classification**

Testing Laboratory, Types of Protection, and Area Classification	Conditions of Certification	Electrical Certification Specification
CSA: Certified for use in ordinary (non-hazardous) locations.	–	CS–E/CGZ
CSA: Suitable for Class I, Groups A, B, C, and D, Division 2 hazardous locations.	Without Enclosure Heater: Temperature Code T4. With Enclosure Heater, Optional Code “–3”: Temperature Code T3.	CS–E/CNZ
FM: Nonincendive for Class I, Groups A, B, C, and D, Division 2 hazardous locations.	Not available with enclosure heater, Optional Code “–3”. Temperature Code T4.	CS–E/FNZ

OPTIONAL FEATURES AND ACCESSORIES**Output Isolation**

This option replaces the nonisolated control output signal by an isolated 4 to 20 mA nominal signal (500 Ω load maximum). Select Model Code Optional Suffix “-1”.

Platinum RTD Input

This option provides for accepting a platinum RTD calibrated per IEC 100 or SAMA 100 temperature curves. Each curve is linearized for digital readout over the ranges and spans listed below:

IEC 100 (Direct or Δ T Measurement)

Range: -200 to +805°C (-330 to +1560°F)

Span: 110 to 1000°C (198 to 1800°F)

SAMA 100 (Direct or Δ T Measurement)

Range: -200 to +600°C (-330 to +1100°F)

Span: 110 to 800°C (198 to 1440°F)

Specify by selecting Model Code Optional Suffix “-2”.

Enclosure Heater

A thermostatically controlled enclosure heater option is required when operating at ambient temperatures below -10°C (+14°F). By using the heater, operation of the controller is extended down to -20°C (-4°F). This heater is not available with the 24 V dc supply (743CA-D). Specify by selecting Model Code Optional Suffix “-3”.

Surge Suppressor

A surge suppressor is optionally available for use with serial communication input when external wiring is located near transient producing sources such as meters, solenoids, high voltages, etc. Specify AS Code SURSUP.

Configuration Copy Accessory

All of the operating configuration is stored in a NOVRAM. The copy accessory permits the entire contents of the memory module to be quickly copied to another NOVRAM, either a spare or one from another controller. Specify Part Number K0143DV for the copy accessory, and Part Number K0141LA for a spare NOVRAM.

Computer Based Training Package

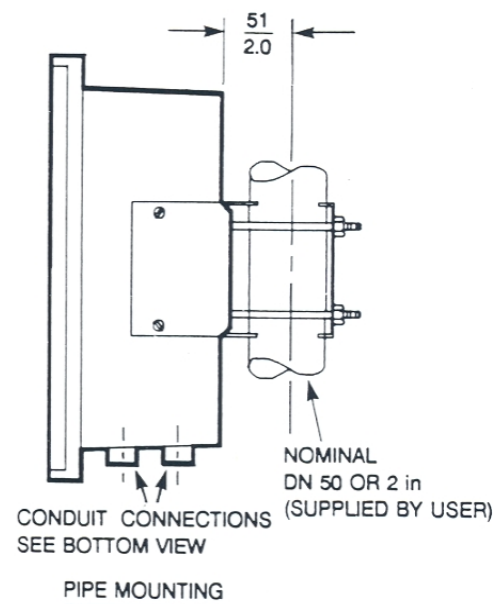
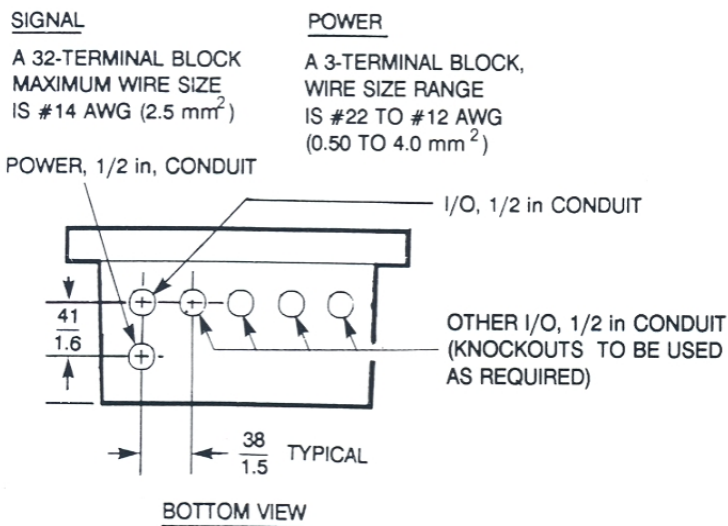
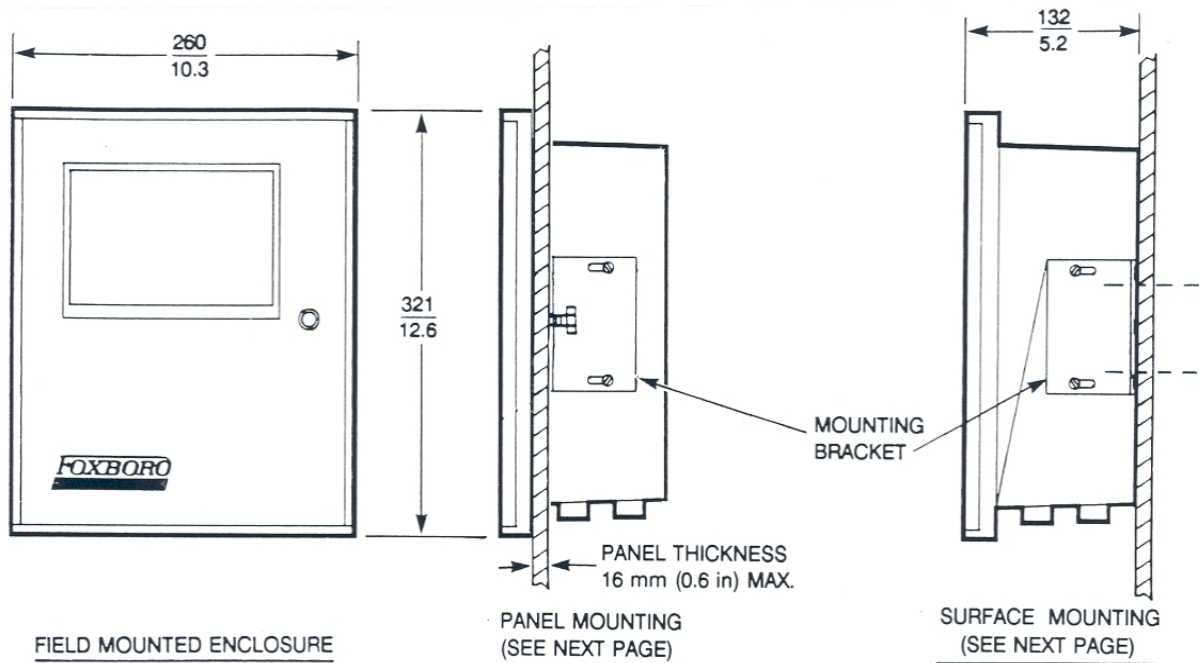
Consists of a software program that operates on any IBM-compatible personal computer that has a 256K RAM (minimum) and MS-DOS 2.0 release. The package includes a keyboard overlay so that designated keys on the computer clone the function of the controller front panel keyboard. Specify Part Number L0121AA for 5 1/4-inch diskette, or Part Number L0121AB for 3 1/2-inch diskette.

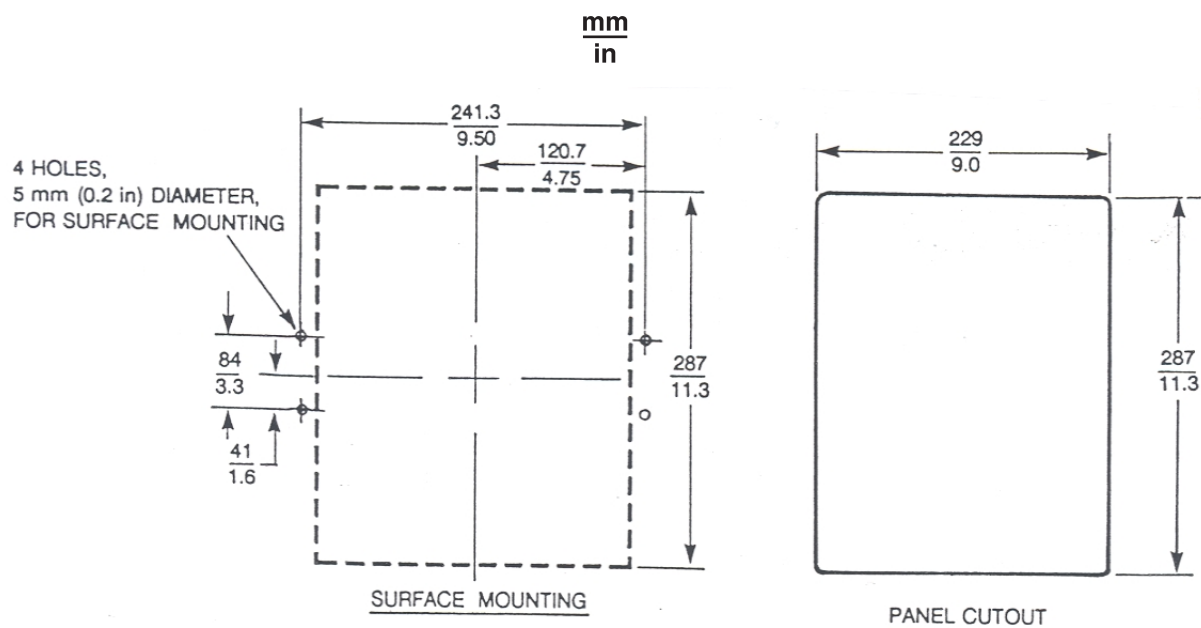
ORDERING INSTRUCTIONS

1. Model Number
2. Optional Features
3. Accessories
4. User Tag Data

DIMENSIONS – NOMINAL

mm
in



DIMENSIONS – NOMINAL (Cont.)**NOTES:**

1. FOR HORIZONTAL MULTIPLE PANEL MOUNTING, A MINIMUM DISTANCE OF 267 mm (10.5 in) FROM CENTER LINE TO CENTER LINE IS REQUIRED.
2. FOR VERTICAL MULTIPLE PANEL MOUNTING, A MINIMUM DISTANCE OF 376 mm (14.8 in) FROM CENTER LINE TO CENTER LINE IS REQUIRED.

PATENT NOTICE

This product and its components are protected by one or more of the following U.S. Patents, and other patents pending:
4, 616, 332; 4, 658, 348; 4, 704, 676; RE 33267; and
corresponding foreign patents.

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