Instruction **MI 018-885**

February 1998

762CNA
SINGLE STATION MICRO®
Controller

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Preface

Safety Considerations

Foxboro products are designed and manufactured to minimize the risk of damage and injury to property and personnel. They meet or exceed applicable governmental and industry safety design standards. However, their safe use depends on proper installation, operation, and maintenance by you, the user. This manual provides you with the information needed for this. Please pay close attention to the portions of this manual that relate to safety.

Organization

This manual is designed to present in a single document all information about the 762C Controller needed by installers, process engineers, operators, and maintenance personnel. A parts list is included in Appendix D and a dimensional print is included in Appendix E. The only additional document that may be needed for some installations is *MI 018-888, Serial Communications Guide for 762C and 743CB Controllers*, a reference intended primarily for programmers and software engineers.

Intended Audience

This manual is intended for the following types of readers:

- Process Operators
- Process Engineers
- Process Supervisors
- Maintenance Personnel
- Equipment Installers
- Programmers/Software Engineers

How to Use This Manual

Process Operators

If you are interested in operating information, first read Chapter 2 – Product Overview, and then read Chapter 5 – Operation. If you need more information, read the Appendix references given in Chapter 5.

Process Engineers

If you are interested in configuration details, first read Chapter 2 – Product Overview for general information about the product. You may also want to look at Appendix A for detailed specification and agency certification data.

To learn how to configure the unit, read Chapter 4 – Configuration. To make use of the information in Chapter 4, you should also become familiar with the configuration worksheets in Appendix B and the structure diagrams in Appendix C. You will find the structure diagrams to be the most important tool in configuring your controller.

For detailed information on the EXACT control feature, read Chapter 6 – EXACT Tuning.

For operating information, read Chapter 5 – Operation.

For detailed instructions on programming serial communication functions in a host, refer to *MI 018-888, Serial Communications Guide for 762C and 743CB Controllers*.

Process Supervisors

Use the same guidelines as those given for process engineers.

Maintenance Personnel

For calibration, troubleshooting, and maintenance information, read Chapter 7. For background purposes, it may also be advisable to read Chapter 2 –Product Overview and Appendix A –Specifications.

Equipment Installers

For quick check information, read Chapter 1 – Quick Check.

For more detailed installation instructions, first read Chapter 2 – Product Overview, and then read Chapter 3 – Installation. You may also need to refer to the dimensional print in Appendix E and the parts list in Appendix D.

For information on Electrical Classification, Agency Certifications, and Product Safety Specifications, refer to Table A-4 on page 187.

If you need additional information that cannot be found in the manual, call Foxboro Field Service or Foxboro Technical Support at 1-800-441-6014 in the U.S.A. or your local Foxboro representative.

Programmers/Software Engineers

Review Chapter 2 – Product Overview and the sections of Chapter 3 – Installation and Chapter 4 – Configuration that pertain to wiring and communications functions. Refer to *MI 018-888, Serial Communications Guide for 762C and 743CB Controllers*, for detailed descriptions of the controller protocol and communications functionality.

User Feedback

After you have had an opportunity to use this manual to install, configure, and operate the equipment, please fill out the user feedback form on the following page and return it to us.

762C/743CB Serial Communications Guide User Feedback Form	Company Name ______________________________ Your Name (optional) ___________________________ Your Position or Dept. ___________________________

Instructions: Foxboro seeks your constructive suggestions for improving this manual. Please *print* information requested above, then circle rating scale for each section of the manual in the column provided. If you find errors, please be specific about page number and subject in the Comments column. Use space on the back of this form for additional comments. You may FAX *both sides* of the completed form with additional pages, if necessary, to The Foxboro Company, Technical Communications at 508-549-4380 or follow the instructions on the back for mailing this form. Thank you for your assistance and suggestions.

A rating of 0 is poor; 4 is excellent; NA is not applicable.

Chapter of Manual	**Accuracy**	**Completeness**	**Ease of Access**	**Relevance**	**Comments *Please Print***
TOC, Figures, Tables	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
Preface	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
1. Overview	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
2. Hardware	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
3. Message Requirements	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
4. Function 1 POLL	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
5. Function 1 SET	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
6. UPLOAD Message	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
7. DOWNLOAD Message	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
8. Extended POLL Message	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
9. READ Message Details	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
10. WRITE Message Details	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
11. Function 2 POLL Message	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
12. Function 2 SET Message	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	‘
13. Error Detection	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
Appendix A	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
Appendix B	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
Appendix C	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	
Index	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	0 1 2 3 4 NA	

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Quick Check

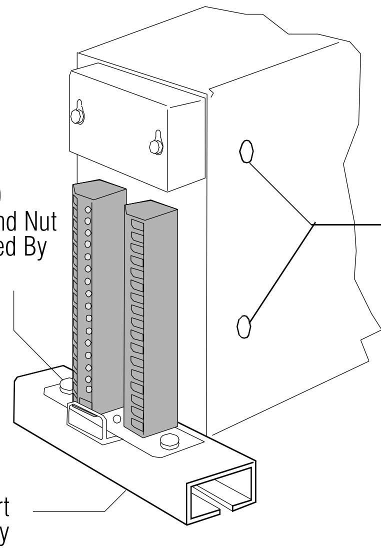
1

The purpose of this chapter is to:

- Verify that your controller is operating to factory specifications.
- Introduce you to the basic controller functions.
- Direct you to more detailed instructions.

The chapter is divided into the following major sections:

Figure 1-1. Rear Support for Controller



1 Secure rear of housing to a support as shown in Figure 1-1.

2 Slide controller into housing until latch engages.

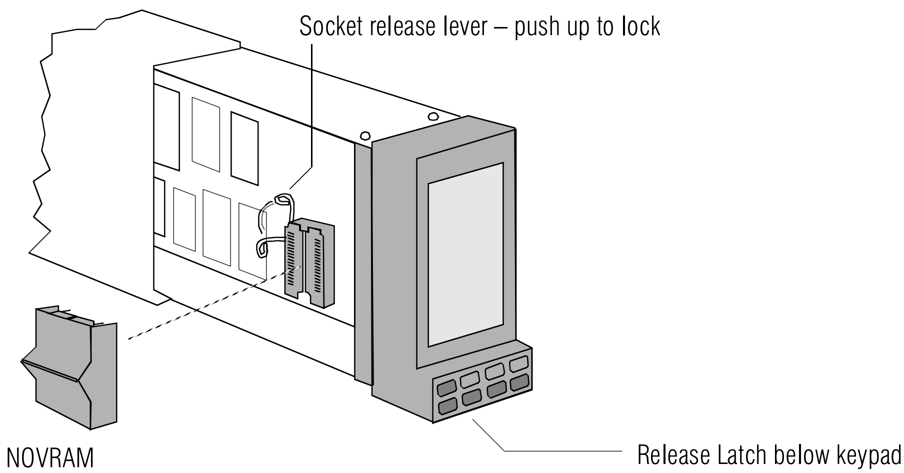
3 Secure latch release cover in place to prevent inadvertent removal of controller.

CAUTION Once the controller has been placed in operation, do not withdraw it from the housing except for service. When the controller is partly withdrawn, it is disconnected from the back panel and the power source and the process is not controlled.

Seating the NOVRAM

CAUTION The NOVRAM memory chip may be dislodged during shipping. Before connecting power, verify that the NOVRAM is fully seated in the socket. If the NOVRAM is not properly seated prior to power-up, the factory-set parameters may be corrupted when power is applied to the controller.

Figure 1-2. Seating the NOVRAM



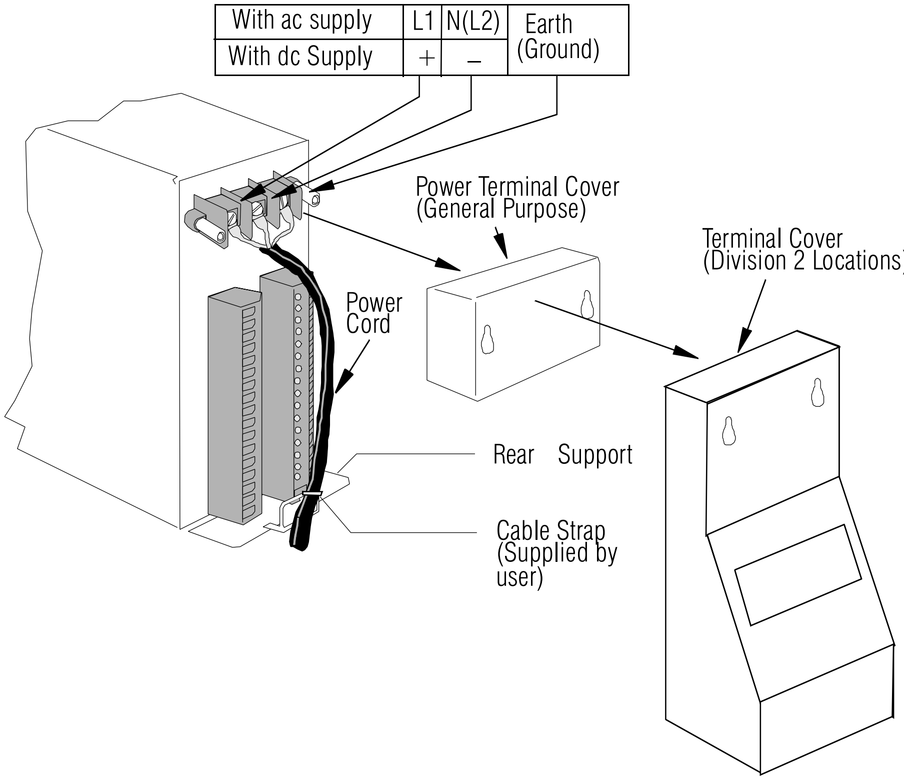
After verifying that the NOVRAM is seated, continue to next item.

Connecting to Power Source

The 762C controller can be ordered with an operating voltage of 24, 100, 120, 220, 240 V ac or 24 V dc. Verify that your power input is the same as indicated on the data label.

CAUTION Observe polarity on 24 V dc units.

Figure 1-3. Connecting to Power Source

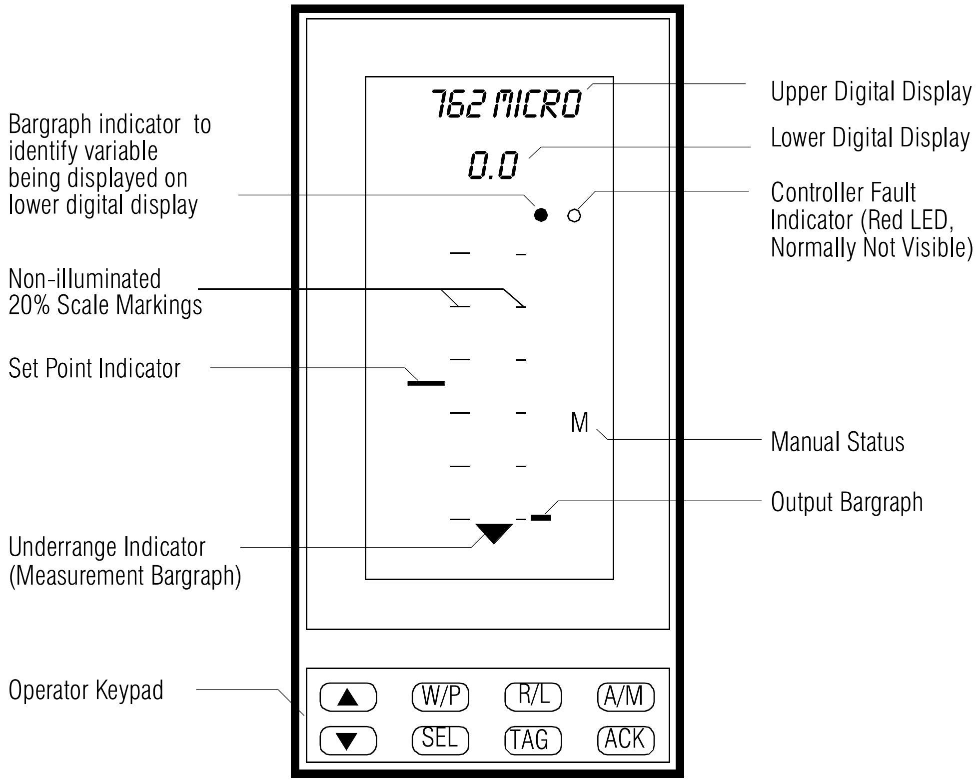


WARNING Protection against shock hazards requires power grounding. Failure to properly earth (ground) this equipment could result in lethal voltages on exposed metal surfaces in the event of equipment malfunction.

Controller Display

Unless you ordered an alternate configuration, the controller will display something similar to that shown in Figure 1-4.

Figure 1-4. Controller Display



NOTE The Controller Fault Indicator (red LED) is on only if the controller malfunctions.

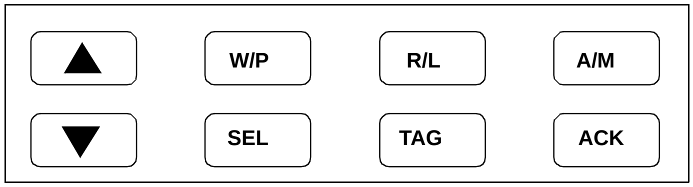
Notice that:

- The Upper Digital Display reads the Foxboro configured Loop Tag (762 MICRO).
- The Lower Digital Display reads the same value as the Output Bargraph (0.0%).
- The bargraph indicator is above the Output Bargraph. The value of the output is shown on the Lower Digital Display.
- The Auto/Manual Status Indicator displays M, which indicates that the unit is in Manual mode.
- The Output Bargraph reads 0% of span.
- The Measurement Bargraph indicates that the measurement input is underrange.
- The Set Point Indicator reads 50% of span (default value).

Changing the Display

To check out the panel display and to become familiar with the functions of the keypad (see Figure 1-5), exercise the keys as described below.

Figure 1-5. Operator Keypad



The W/P and R/L keys are configured in the OFF position and are not functional at this time. When configured, a W or P and an R or L appear on the display.

Using the A/M Key

The A/M key will transfer the controller between AUTO (A) and MANUAL (M). Try pressing the A/M key. Return to MANUAL before proceeding. Notice that the bargraph indicator always moves over the Output Bargraph when you transfer the controller to Manual and that it moves over the Measurement Bargraph when you transfer to Auto.

Using the SEL Key

Try pressing the SEL key. Note that this causes the Digital Display to show the value for the Set Point Indicator, or the Measurement Bargraph, or the Output Bargraph, depending on the location of the bargraph indicator.

Manual Output

Press the SEL key to move the bargraph indicator to the Output Bargraph. You are now prepared to adjust the controller output and to read the values on the Output Bargraph and the Lower Digital Display.

Increase the output by pressing the Δ key. The Output Bargraph and the Lower Digital Display will read the value you select.

To decrease the output, press the ∇ key.

If you press/hold either the Δ or the ∇ key while adjusting the manual output, the value changes at an accelerated rate that depends on the duration of the hold.

It is not necessary to return the controller to the original values before proceeding to the next step.

Adjusting the Set Point

Press the SEL to move the bargraph indicator over the set point. The Measurement and Set Point Indicator engineering unit labels are the same (PCT is factory default). Press the Δ or ∇ keys to adjust the set point. Note the set point value (shown on the lower display) and its corresponding indicator change (each segment represents a 2% change in the value). Holding the key causes the value to change at a faster rate.

Reading Additional Information

Use the following keys to read the controller information.

Table 1-1. Keypad Functions

Key	Function
TAG	To enter the READ mode or to return to the operating mode.
▲	To display the previous option
▼	To display the next option
SEL	To back up through the menu.
ACK	To answer YES to a displayed question and to display the next parameter.

To READ controller information, use the procedure on the following page. Note that READ mode does not affect operation of the controller.

Display	Description
762 MICRO 0.0	This is the digital display in normal position.
Press TAG	
MENU READ ?	Do you want to read available information? Press ACK to read.
Press ACK	
READ VALUES ?	Do you want to read various values? If NO, press ▼ key. If YES, press ACK.
Press ▼	
READ CONFIG ?	Do you want read the configuration? See note below.
Press ACK twice	
STRATEGY ONE FUNC ?	Configuration Strategy? Configured for one function.
Press ACK	
CONFIG FUNC 1 ?	Function 1 configuration?
Press ACK	
FUNC 1 PI, PID ?	Function configured for either PI or PID (default configuration).
Press ACK	
PI, PID DISPLAY ?	Review controller display configuration?

NOTE RD CONFIG and following items above are only available if SHOWOP RD CFG was configured YES.

Reading Additional Information (cont.)

You can continue to read by pressing the ACK key. If you want to back up to a previous option, press the SEL key. Pressing the ∇ key repeatedly selects further options.

Return to NORMAL

To return to normal operation at any time, press the TAG key. Note that no changes can be made in the READ mode.

This completes the checkout procedure to verify that you have a functional unit as shipped from our factory.

Looking for More Information?

For more detailed information, refer to the following sections of this manual:

For general installation information, refer to Chapter 3. For dimensional details, refer to Appendix E.

For configuration instructions, refer to Chapter 4 and to Appendices B and C.

For operating instructions, refer to Chapter 5.

For calibration, troubleshooting and maintenance information, refer to Chapter 7. For replacement parts and accessories, refer to the parts list in Appendix D.

For information on serial communications programming, refer to *MI 018-888, Serial Communication Guide for 762C and 743CB Controllers*.

For information about specifications and agency certifications, refer to Appendix A.

If you need additional help, please call the Foxboro Customer Service Center at 1-800-441-6014 in the U.S.A. or your local Foxboro representative.

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Product Overview

2

This chapter is a summary of the general characteristics of the product. Detailed specifications can be found in Appendix .

The chapter is divided into the following parts:

Description

The 762CNA is a microprocessor-based controller that can perform proportional, integral, and derivative (PID) control functions for two independent loops. The two loops can also be configured to form a single-station cascade or auto-selector controller. In addition, the 762CNA offers many enhanced control functions, such as EXACT tuning, totalizing, and comprehensive calculation and logic capabilities.

As an alternative, you can configure the 762CNA as a single or dual auto/manual transfer station or a single or dual 3-variable indicator. Control capability can be intermixed with either auxiliary station type.

A fluorescent front panel display shows current values of control variables in bargraph format and selected values in numeric form. It also displays an electronic loop tag, controller status, and alarm status. A keypad, located on the front of the unit, is used for operator input and configuration functions.

The front panel shows the status of Controller 1 (or Auxiliary Station) as Faceplate 1 and the status of Controller 2 (or Auxiliary Station) as Faceplate 2. To change from one faceplate to the other, press/hold the SEL key on the keypad.

The 762CNA mounts in a compact DIN housing designed for semi-flush panel mounting. Terminations are located at the rear of the unit.

RS-485 serial communication enables complete supervisory capability from a host computer.

Figure 2-1. Model 762CNA Controller

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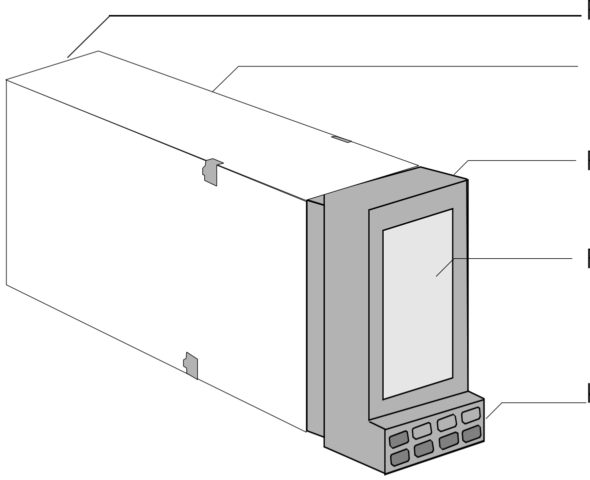
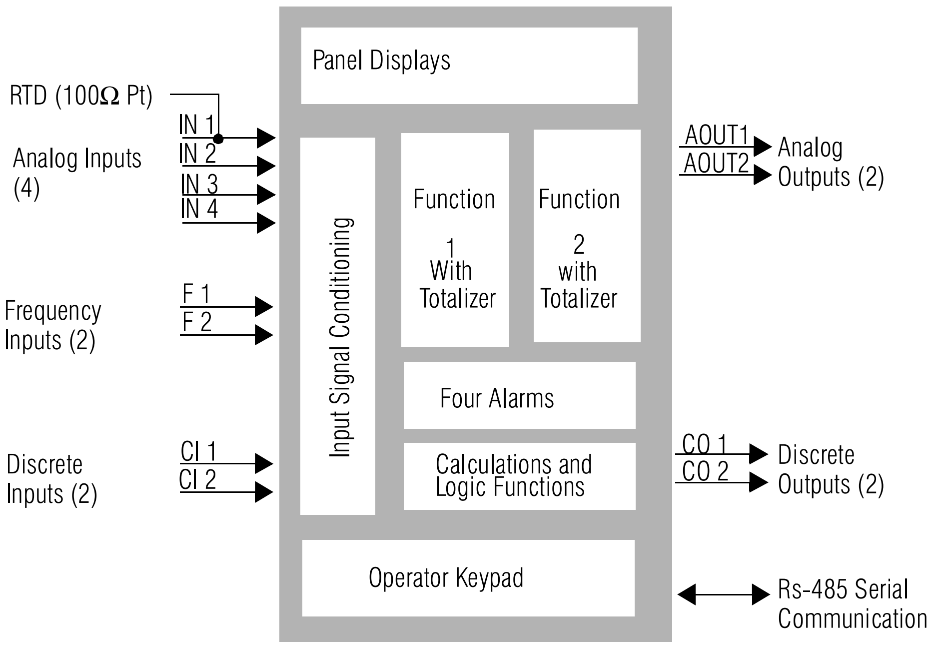


Functional Block Diagram

Figure 2-2 illustrates the inputs, outputs, and functions of a 762CNA Series station. Explanations follow the block diagram. For more detailed information, refer to Appendix A – Specifications on page 183 and Appendix F –Controller Functional Diagram on page 261.

Figure 2-2. Block Diagram of a 762CNA Control Station



Inputs

Type	Qty.	Description
Analog	4	4-20 mA dc (May be changed to 1 - 5 V dc by removing input resistors.) Assignable to any controller or function. A 100Ω Platinum RTD input can be substituted for Analog Input 1 by adding a hardware option.
Frequency	2	1 to 9999 Hz, assignable to any function. May be combined into one up/down pulse signal.
Discrete	2	5 V dc, 1 mA max, non-isolated contact or transistor switch inputs, assignable to any function. Used for remote status changes such as A/M, R/L, W/P, EXT ACK, tracking functions, and totalizer logic.

Outputs

Type	Qty.	Description
Analog	2	4-20 mA non-isolated, assignable to any function. Isolation option is available for Output 1. Output 2 may be converted to 1 - 5 V dc by jumper selection.
Discrete	2	Non-isolated, open collector transistor switch outputs, assignable to alarm, status, or Boolean logic functions. 50 V dc, 250 mA max.

Input Signal Conditioning

Type	Description
Linear	The conditioned signal is directly proportional to the input signal.
Square Root	The conditioned signal is proportional to the square root of the input signal.
Squared	The conditioned signal is proportional to the square of the input signal.
Characterizer 1	Signal conditioning modifies the input signal to match the characteristics of a custom curve entered by the user (8 segments).
Characterizer 2	Signal conditioning modifies the input signal to match the characteristics of a second custom curve entered by the user (8 segments).
Thermocouple (Transmitter)	Signal conditioning linearizes the display to match the characteristics of a standard thermocouple type (E, J, or K). For display purposes only.
RTD	Signal conditioning linearizes the display to match the characteristics of a standard RTD type (IEC 100 or SAMA 100). For display purposes only.
Input Filter	A second-order Butterworth filter may be assigned to any input.

Alarms

Item	Description
Quantity	Four, assignable to any input or output signal or internal variable.
Type	2-level (high/high, low/low, or high/low) with adjustable deadband.
Form	Can be configured to activate on Absolute Value, Deviation from a reference value, or Rate-of Change of a variable.
Action	Latching, nonlatching, or permissive. (Latching alarms require operator acknowledgment. Nonlatching alarms may be acknowledged but are self clearing when the alarm condition no longer exists. Permissive alarms do not require acknowledgment.)

Calculations/Logic Functions

Calculation	Description
Boolean Logic	Five single and five dual gates are available for logic computation. Each gate is configured by first selecting the logic and then selecting the source of each input. Inputs may be contact inputs, alarm output states, status indicator outputs, EXACT state, gate outputs, or three fixed states. (Refer to Table 4-3, Gate Input List, on page 53.) Gates 0 through 4 are single input gates user-configured as DIRECT or NOT (inverse logic). Gates 5 through 9 are dual input gates, each of which can be defined as: OR, NOR, AND, NAND, XOR, or XNOR.
Dynamic Compensation	Lead/lag, impulse, and deadtime calculations with user-adjustable Gain, Input Bias, Out Bias, and Deadtime. The result of a dedicated calculation function can be passed through a dynamic compensator, prior to signal distribution. The dynamic compensator provides lead/lag with an impulse option, and dead time functions, each with its individual follow switch. Functionally, dead time precedes lead/lag. Using the dynamic compensator and the follow switches, you can implement feedforward and other complex control applications easily and efficiently.

Calculation	Description
Algebraic	The 762CNA can perform up to three independent algebraic calculations. Each may contain up to nine characters. The variables may include results of other calculation blocks, scaled and conditioned inputs, and other internal control signals. To configure an equation, enter one character at a time from the keypad, following the usual rules of algebra, and a few easy-to-learn rules.

Controller Selections (Functions 1 and 2)

Type	Description
PID	Proportional (P), Integral (I), and Derivative (D) algorithm is standard for both controllers. May be configured as P, I, PD, PI, or PID.
EXACT	EXACT control, the Foxboro patented adaptive tuning system, is available on both control loops, subject to totalizer configuration constraints.
Cascade	With this configuration, the output of Controller 1 is the set point of Controller 2. Allows bumpless transfer between auto/manual and between remote/local set point modes.
Batch	Either or both controllers can be configured for batch control, which prevents controller windup when the controlled process is shut down.
Auto Selector	The two controllers can be combined to provide a single auto-selected output that can be used for constraint or dual mode control. The choice of lower, higher, or logic-selected output is available. Feedback signals prevent controller windup. You can configure one common or two independent auto/manual functions.
Split Range	The two 4-20 mA outputs can be driven from a single controller. This allows one measured variable to be controlled by two manipulated variables. A typical application is a temperature control system in which both the heating medium and the cooling medium are manipulated.
Remote or Local Setpoints	The set points of both controllers may be adjusted manually from the front panel keypad or automatically from a remote device. Each remote set point can be sourced to any signal in the Signal Distribution List (see Table 4-2). The R/L key toggles between remote and local set point modes.
Panel or Workstation	Supervision of the controller can be local (Panel) or remote (Workstation).
Other	Nonlinear extender, measurement and set point tracking, output tracking, output multiplication or summing, external feedback, external output limits. Dynamic compensation (lead/lag, impulse, deadtime) provides a capability for implementing feedforward and other advanced control algorithms. Bypass of the control algorithm by enabling the set point to manipulate the output directly.

Totalizers (Functions 1 and 2)

Quantity	Description
2	Two 7-digit totalizers can be assigned to any internal or external signal. The totalizers can be set to integrate *up to* a preset value or *down from* a preset value, and to produce a logic output when the count equals the target value. Totalization and EXACT tuning are mutually exclusive. (If Function 1 or Function 2 is configured for EXACT tuning, an associated totalizer is not available.) Each totalizer has its own tag and engineering units label.

Station Configurations (Functions 1 and 2)

Configuration	Functions
Single Function Station	As a single-function station, Function 2 is not operative. Function 1 may be any *one* of: PID, PID with EXACT, I ONLY, P/PD, 3-variable indicator, or auto/manual station. If Function 1 is anything other than PID with EXACT, *two* totalizers, TOTAL1 and TOTAL2, are available. If Function 1 is PID with EXACT, TOTAL2 only is available.
Dual Function Station	As a dual-function station, both functions are operative. Both may be PID, PID with EXACT, P/PD, I ONLY, 3-variable indicators, or auto/manual stations. TOTAL1 is available if Function 1 is anything other than EXACT. TOTAL2 is available if Function 2 is anything other than EXACT.
Single Station Cascade	As a cascade control station, Function 1 is the primary controller and Function 2 is the secondary controller. Both may be PID with or without EXACT, P/PD, OR I ONLY. TOTAL1 is available if Function 1 is anything other than EXACT. TOTAL2 is available if Function 2 is anything other than EXACT.
Auto-Selector Controller	As an auto-selector, both controllers may be PID, PID with EXACT, P/PD, OR I ONLY.
Auto/Manual Switching Station	An Auto/Manual Station provides all of the features of a controller without the control algorithm. Up to two auto/manual stations may be configured.
3-variable Indicator Station	Up to two 3-variable indicator faceplates are available. Each selected variable has its own bargraph, digital display of engineering units, and loop tag display. The 3-variable faceplates are mutually exclusive with controllers and auto/manual stations. If only one controller or manual station is configured, you may configure one 3-variable faceplate.

Other Features

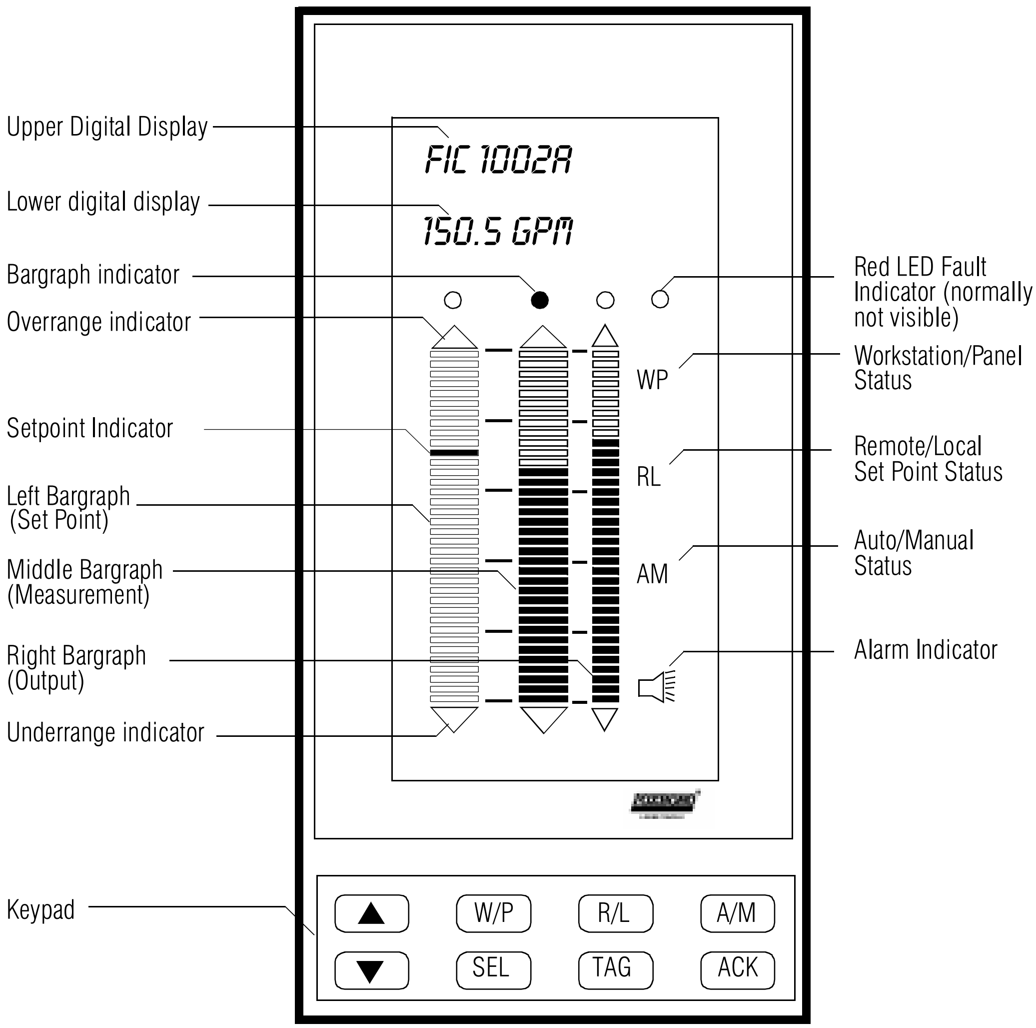
Feature	Description
“Copy Configuration” Accessory	This optional accessory permits you to copy the configuration of one controller for use in another controller. This is accomplished using two NOVRAMs (nonvolatile, random access memory modules) and a configuration copy accessory device. To use this feature, simply turn off power, 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, and turn on power. The first NOVRAM is then copied into the second 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. Individual parameters in each controller can then be easily changed to fit a particular loop.
Actual Output Indication	The output bargraph and digital indicator can be configured to display the actual 4-20 mA output value by connecting the 4-20 mA output to an unused input and assigning the output bargraph to that input.
Output Reverse	The output, AOUT 1 or AOUT 2, can be configured to be a value equal to 100% minus the actual output.
RS-485 Serial Communications Interface	The 762CNA controller is equipped with an RS-485 serial port for communication with most host computers, either directly or through an RS-232/RS-485 converter or equivalent accessory. The protocol conforms to ANSI Specification X3.28-1976, Subcategory E3. Using the Foxboro Model F6501A converter, up to 90 controllers can be accommodated by a single host communication port. Serial communications capability includes uploading/downloading of configuration, remote setting of Auto/Manual (A/M), Remote/Local (R/L) status, manual output value, local set point values, polling of all inputs and outputs, and writing as well as reading of all configurable parameters. Both control loops are accommodated by the single port. You can also select baud rate, parity, and panel or workstation (host) priority.
Passcode Security	Using the keypad, you can read the values of inputs, alarm and limit settings, and the current operating configuration. However, you can adjust only those settings that were specified as operator-adjustable when the controller was configured. To adjust the remaining parameters, you must enter a passcode from the keypad. The 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. The passcode can be changed at any time by the authorized person.
pH Display	The display of the measurement, local set point, or remote set point may be displayed before or after the signal is characterized. If pH Display is activated, the displays are before characterization. This feature is often used on pH applications when it is important to read pH, but control be performed on concentration.

Front Panel

The 762CNA controller can be configured and operated entirely from the front panel with no external equipment. The panel consists of an alphanumeric display, a graphics display, status indicators, an alarm indicator (horn symbol), and a keypad. Refer to Figure 2-3. A controller faceplate is shown for illustrative purposes.

Display Functions

Figure 2-3. Panel Display (Faceplate 1 or 2)



The alphanumeric display at the top of the front panel has two lines of nine characters each, 5 mm (0.196 in) high, colored blue-green.

Display Functions (cont.)

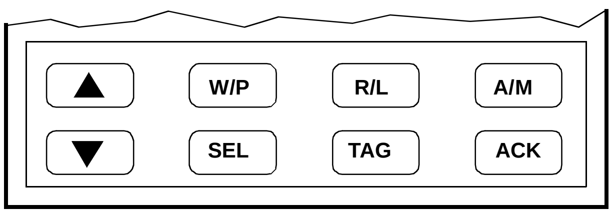
The graphics display consists of three bargraphs, each having 50 segments (each 2% of full scale) plus a triangular pointer on top and bottom to indicate when the variable is either above or below the range of the display. The bars are 55.4 mm (2.18 in) long. The left and center bargraphs are 5 mm (0.196 in) wide, and the right bar graph is 2.5 mm (0.098 in). All are colored blue-green.

The status characters (W/P, R/L, A/M) are 4 mm (0.157 in) high; the alarm symbol is 5 mm (0.196 in) high. The status characters are colored blue-green; the alarm symbol is red. The position of the bargraph indicator or "dot" identifies which variable is currently displayed on the Lower Digital Display. To move the indicator to the next position, press (short press) the SEL button.

Keypad Functions

The keypad has eight keys as shown in Figure 2-4 and identified in the table below. The key switches are single pole, normally open contacts, all closing to a common lead. For actuation, keys must be pressed for a minimum of 200 ms (0.2 s).

Figure 2-4. Keypad



Key	Function
▲ ▼	Pressing these keys moves you forward and backward through menu items and functions, and permits you to adjust parameter values. Also use these keys to increase and decrease set point and manual output values.
W/P	When W/P is configured, pressing this key toggles between Workstation and Panel mode. In Workstation mode, the controller is supervised from a remote workstation via the serial communication port. In the Panel mode, the controller is locally supervised. This key is disabled when the unit is configured for workstation priority and when W/P is routed to any selection from the Gate Input List.
R/L	When R/L is configured, pressing this switch toggles between Remote (R) and Local (L) set point operation. This key is disabled when the controller is in the W mode and when R/L is routed to any selection from the Gate Input List.

Key	Function
A/M	Pressing this key toggles between Auto (A) and Manual (M) operation. When transferring from A to M, the bargraph indicator light automatically selects the Output Bargraph for alphanumeric display. When transferring from M to A, it selects the Measurement Bargraph. This key is disabled when the controller is in the W mode and when A/M is routed to any selection from the Gate Input List.
SEL (Short press)	A short press (200 to 300 ms) selects the next variable for display on the Lower Digital Display (alphanumeric). Also provides access to remote set point, ratio, and totalized count, when so configured.
SEL (Long Press)	A long press (≥300 ms) toggles between Faceplates 1 and 2, provided they are configured and active. If only one faceplate is configured, the key performs the same functions as a short press.
TAG	Pressing this key causes the controller to exit from the faceplate display and enter the User Interface. If the controller is in W mode, this key is disabled.
ACK	In NORMAL mode, pressing this key acknowledges an alarm condition, causing the indicator to change from flashing to steady. This key is functional in both W and P modes.

A keypad disable link is provided to prevent unauthorized tampering in remote unmanned locations. See page 26 for information about this link.

762C SINGLE STATION MICRO Controller

February 1998

FOXBORO®

A SIEBE COMPANY

The Intelligent Automation People

Installation 3

This chapter provides all information necessary for installing the controller. It is divided into the following major sections:

Important Safety Precautions

Shock Hazards

This product operates from hazardous voltage power sources. Hazardous voltage points are labeled and/or covered within the enclosure. For your own safety, please observe these warnings and replace all protective covers after servicing.

Explosion Hazards

Certain versions of this product are designed for use in Class I, Division 2 hazardous locations. If you have one of these versions, never connect or disconnect power wiring or field wiring unless the area is known to be nonhazardous. Doing this in the presence of an explosive gas-air mixture could result in an explosion.

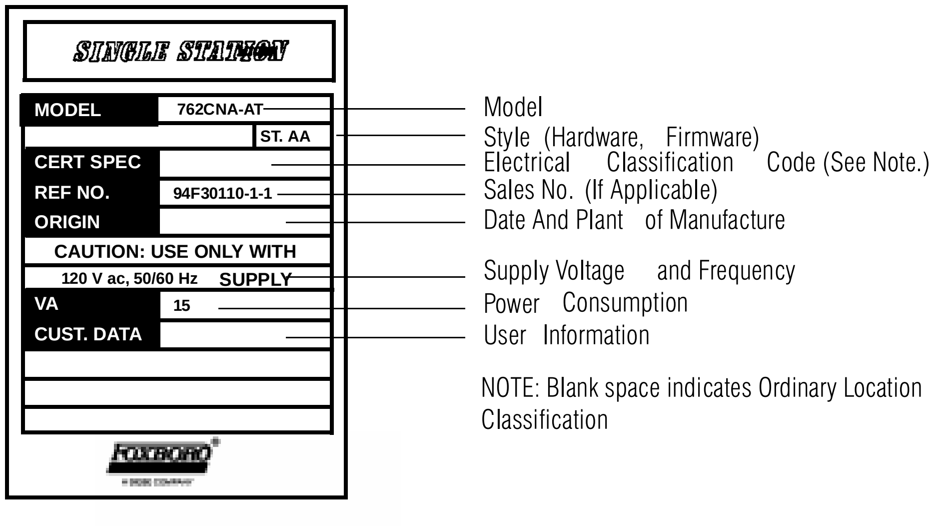
Unpacking

1. Remove the controller from its shipping container and check for visible damage.
2. Remove the mounting brackets.
3. Save the container until you determine that no shipping damage has occurred.
4. If no damage is observed, proceed with installation.
5. If the controller has been damaged, notify the carrier immediately and request an inspection report. Obtain a signed copy of the report from the carrier and contact Foxboro in the U.S.A. (Dept. 880 at 1-800-441-6014) or your local Foxboro representative.

Controller Identification

The data plate, located on top of the chassis, contains information specific to your controller. A typical data plate is shown in Figure 3-1.

Figure 3-1. Typical Data Plate



Positioning Links

The controller 2 output (AOUT 2) and keyboard enable/disable functions are link-selectable as shown in Table 3-1. The links have been positioned in the factory in the 4-20 mA output and keypad enable positions. The links are located on the main printed wiring assembly (PWA) as shown in Figure 3-2.

CAUTION Turn off controller power before positioning links. Repositioning links with power on can damage components.

Figure 3-2. Link Locations

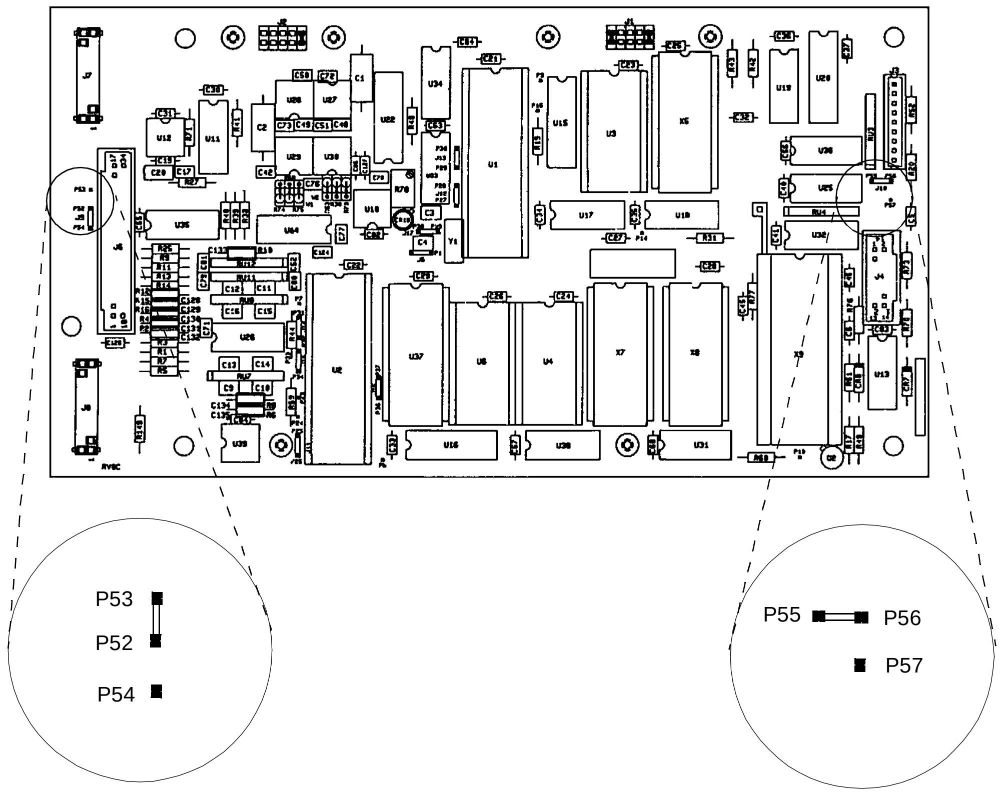


Table 3-1. Link Locations

Function	Setting	Link Position
Keypad Enable/Disable	Enabled	P55 - P56
	Disabled	P56 - P57
AOUT 2 Output	1 - 5 V dc	P52 - P54
	4 to 20 mA	P52 - P53

Installation Procedure

The controller is shipped in its housing, which mounts in a DIN panel cutout. For exact cutout dimensions, refer to the Dimensional Print in Appendix E.

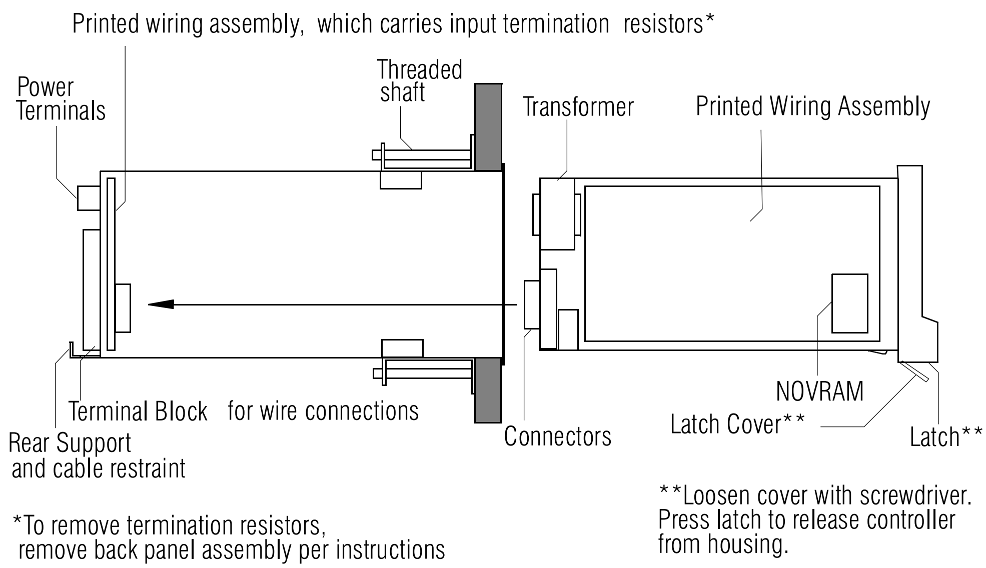
NOTE If you plan to use 1-5 V dc instead of 4-20 mA on some inputs, you will have to remove the 250Ω resistors across the selected input terminals. Although it is usually more convenient to do this before installing the housing in the panel, you may also do it after installation. Refer to "Removing Input Range Resistors" on page 29 for instructions.

CAUTION Be sure that installation complies with all applicable codes, safety regulations, and certification requirements. For product safety specifications, refer to Table A-4 on page 187.

The installation procedure is as follows:

1 Remove the controller from its housing and set it aside. To do so, loosen the latch release screw and swing cover down, press the latch (below the keypad) and slide the controller out of the housing, as shown in Figure 3-3.

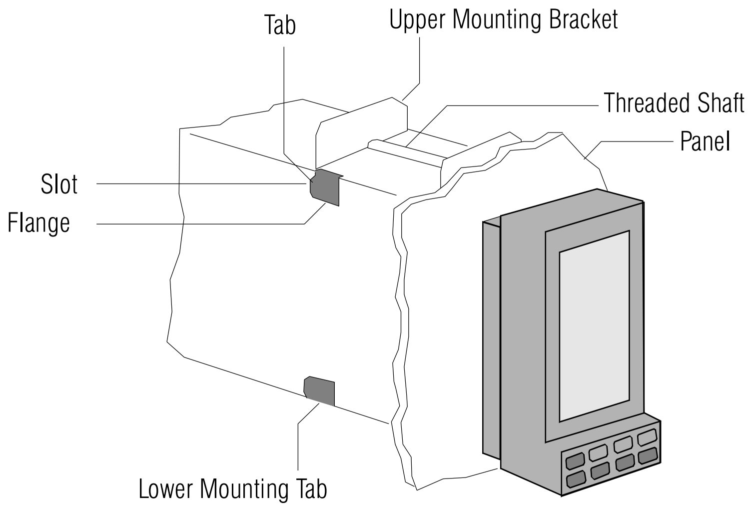
Figure 3-3. Removing Controller from Housing



2 Mount the housing in the panel cutout.

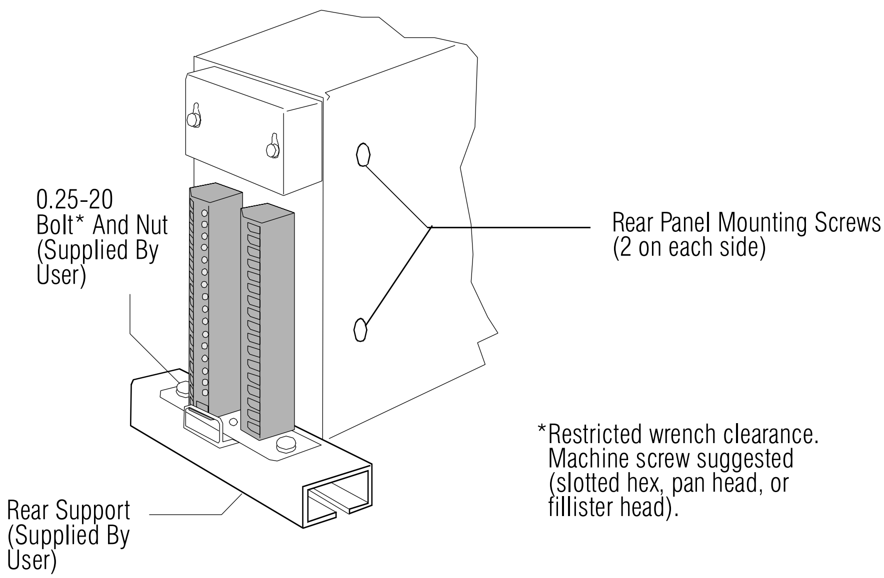
Attach upper and lower mounting brackets to housing by inserting tabs on brackets into slots in housing, as shown in Figure 3-4. (Note that upper bracket can be mounted *only* on top of housing; and lower bracket can be mounted *only* on bottom of housing.) Tighten threaded shaft in each mounting.

Figure 3-4. Mounting of Controller



3 Secure rear of housing to a support as shown in Figure 3-5.

Figure 3-5. Rear Support for Controller



4 Slide controller into housing until latch engages.

5 Secure latch release cover in place to prevent inadvertent removal of controller.

CAUTION Once the controller has been placed in operation, do not withdraw it from the housing except for service. When the controller is partly withdrawn, it is disconnected from the back panel and the power source and the process is not controlled.

Removing Input Range Resistors

To modify an analog input to accept a 1-5 V dc signal, you must remove the 250Ω input range resistor connected across the terminals of that input. Removing a resistor requires that you remove the rear panel assembly from the rear of the controller housing in order to gain access to the resistors.

To remove input range resistors for selected inputs, execute the following procedure:

1 Disconnect power from the housing.

2 Remove the controller from the housing.

3 Unbolt the rear support for the housing.

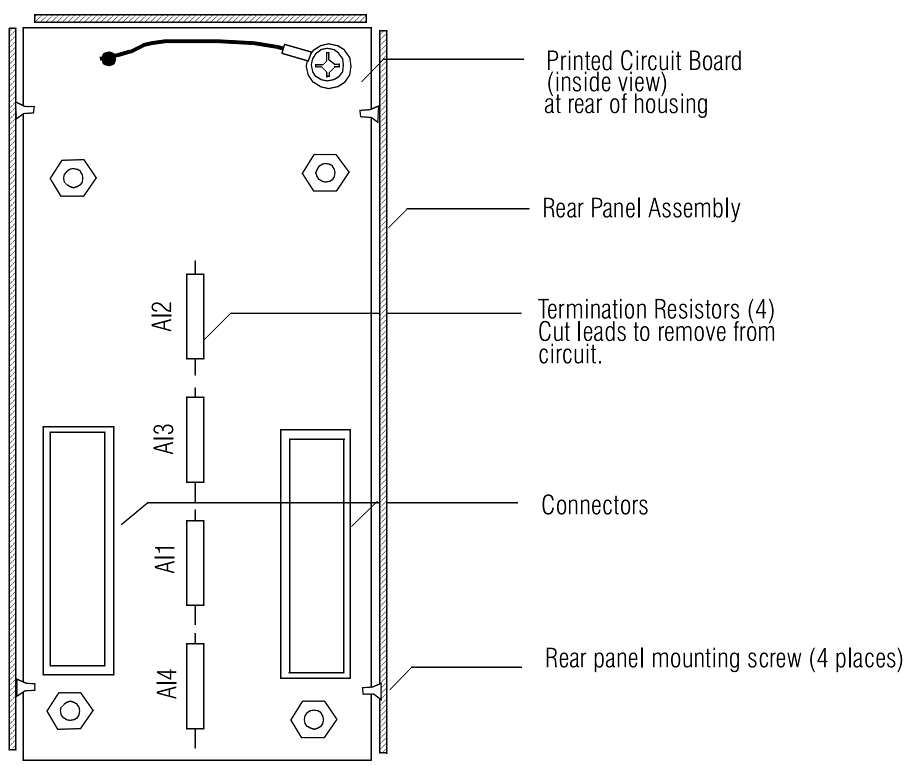
4 Remove the four mounting screws at the rear of the housing that secures the back panel assembly to the housing.

5 Gently pull the rear panel assembly away from the rear of the housing until you have access to the input range resistors.

   Note that the resistors are identified by markings on the board as AI1, AI2, AI3, and AI4, which mean Analog Input 1, Analog Input 2, etc. Using wire cutters, snip the desired resistor(s) from the circuit.

6 After verifying that the board is clean, reinstall the back panel assembly into the housing, using the four mounting screws.

Figure 3-6. Removing Input Range Resistors



Removing Input Range Resistors (cont.)

7 Bolt the housing to the rear mounting support.

8 Slide the controller back into the housing, secure the latch release cover, and re-connect power.

Signal Wiring Guidelines

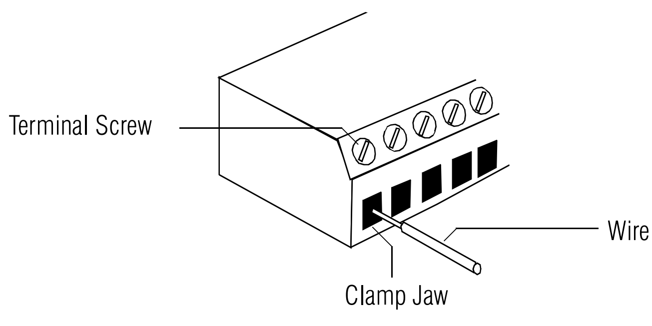
CAUTION Except for the 4 to 20 mA isolated output module, all inputs, outputs, and the transmitter power supply share a **non-isolated, common, ungrounded** reference line. This line will be normally connected to plant ground (or some other reference point) by external wiring schemes adopted by plant practices. In doing this, care must be exercised that such grounding shall only occur at a **single point**, and by **single** connection of "common" to the designated reference point (plant ground).

CAUTION Multiple connections of "common" lines to various grounding locations will result in ground loops and give rise to faulty unit operation. Similar problems will occur if multiple grounding is made both at the 762CNA and at the receiver/transmitter locations.

Connecting Wires to Terminals

762C controllers have compression type terminals as shown in Figure 3-7.

Figure 3-7. Connecting Wires to Terminals



To connect a wire to one of these terminals:

1 The controllers are shipped from the factory with the terminal clamp jaws fully open. If, however, the jaw is closed, turn the terminal screw counterclockwise until the clamp jaw is fully open.

2 Insert stripped wire into clamp jaw as shown. Recommended wire strip length is 1.4 cm (0.5 inches).

Connecting Wires to Terminals (cont.)

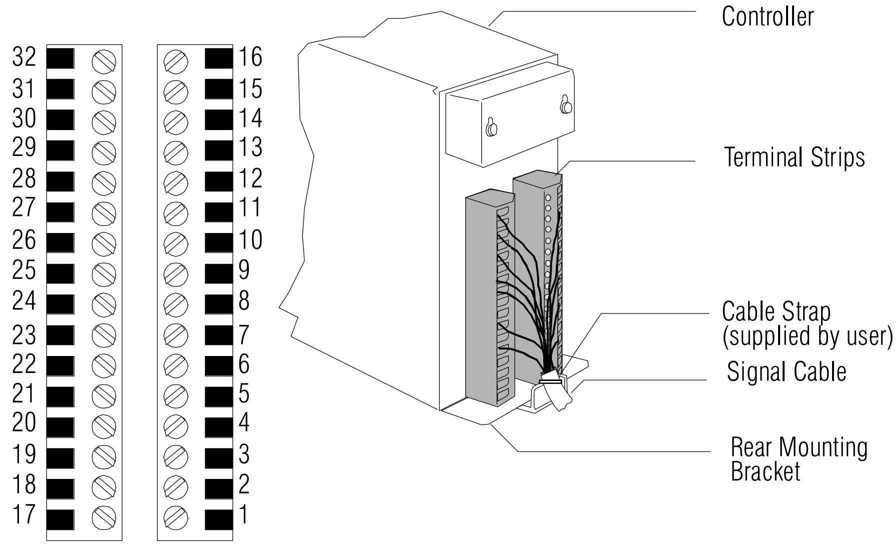
3 Turn terminal screw clockwise to tighten clamp.

4 Verify that clamp grips only the metal wire and not the insulation. Also verify that the wire is secured in place after tightening clamp. Recommended installation torque is 3.39 to 5.42 N-m (2.5 to 4.0 lb-in).

Wiring to Controller

Terminal locations are shown in Figure 3-8. Wiring connections for the 32 terminals are shown in Table 3-2 through Table 3-4. Examples of typical wiring configurations are shown in Figure 3-10 through Figure 3-16. After connecting the signal wires, secure them with a cable strap to the rear of the controller as shown in Figure 3-8.

Figure 3-8. Terminal Identification



Input Signal Wiring

This section describes installation of input signal wiring for all types of inputs.

Input Signal Terminal/Wire Designations

Table 3-2 designates input signal terminals by terminal number. For examples of typical input signal wiring circuits, refer to the applicable section following Table 3-2.

Table 3-2. Terminal and Wire designations for Input signal Wiring

Function	Terminal Number
Internal dc Power for 4-20 mA Transmitter[a] (+):	1
Internal dc Power for 4-20 mA Transmitter[a] (+):	17
Common for Internal dc Power:	3, 6 and 19
Analog[b] Input 1(+):	2
Analog[b] Input 1 (–):	4
Analog[b] Input 2 (+):	5
Analog[b] Input 2 (–):	7
Analog[b] Input 3 (+):	21
Analog[b] Input 3 (–):	23
Analog[b] Input 4(+):	18
Analog[b] Input 4(–):	20
Frequency Input 1 from Flowmeter; or Pulse-Up Input from Computer for Set Point	15
Frequency Input 2 from Flowmeter; or Pulse-Down Input from Computer for Set Point	13
Common for Frequency or Pulse Inputs:	14
Frequency Input 1 (+) for Controller-Powered Flowmeter:	16
Frequency Input 2 (+) for Controller-Powered Flowmeter:	12
RTD;Temperature Measurement	
Blk Wire:	9
Grn Wire:	10
Wht Wire:	11
RTD; Temperature Difference Measurement	
Wht Wire (Reference Sensor):	9
Grn and Blk Wires (Act. & Ref. Sensors):	10
Wht Wire (Active Sensor):	11
Contact Input 1:	29(+)
Contact Input 2:	28(+)
Contact Input Common:	30

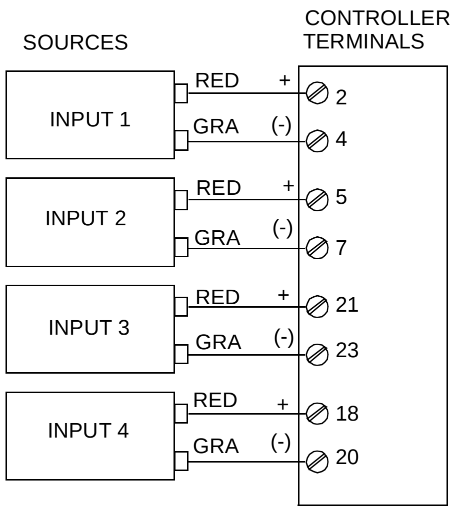
a. Unit can supply power for up to two 4 to 20 mA transmitters.
b. 4-20 mA, field convertible to 1-5 V dc.

Analog Input Signal Wiring

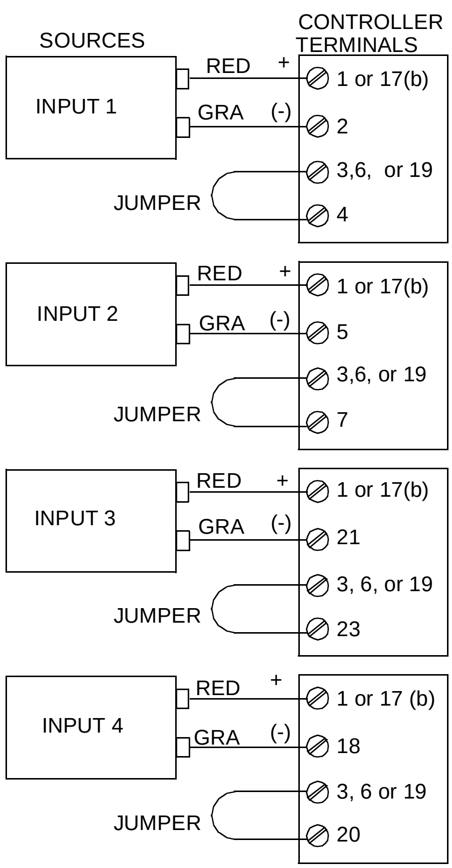
Examples of analog input signal wiring for the 32-position terminal block are shown in Figure 3-9.

Figure 3-9. Examples of Analog Input Signal Wiring

Self-Powered Signal Sources



Controller-Powered 4-20 mA Transmitters



NOTES:

a. Standard controllers can supply power to two 4-20 mA transmitters.

b. If controller power is used for two transmitters, connect (+) wire of one trans-mitter to Terminal 1; connect (+) wire of other transmitter to Terminal 17.

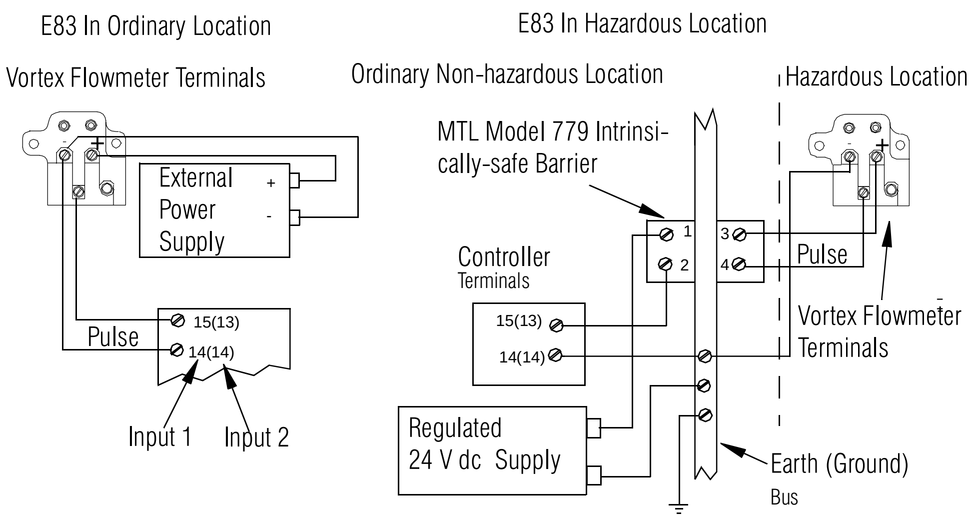
c. Make a note of which signal is connected to each input. The information will be required during configuration.

Frequency Input Signal Wiring

Examples of frequency input signal wiring of controller are shown in Figure 3-10 through Figure 3-13.

Figure 3-10. Examples of Frequency Input Signal Wiring for E83 Vortex Flowmeter

EXTERNALLY POWERED VORTEX FLOWMETER:



Controller-powered Vortex Flowmeter:

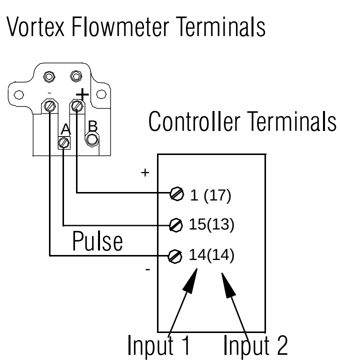


Figure 3-11. Examples of Frequency Input Signals from 81 or 82 Turbine Flowmeter with PA108, PA109, or A2020LA Preamplifier

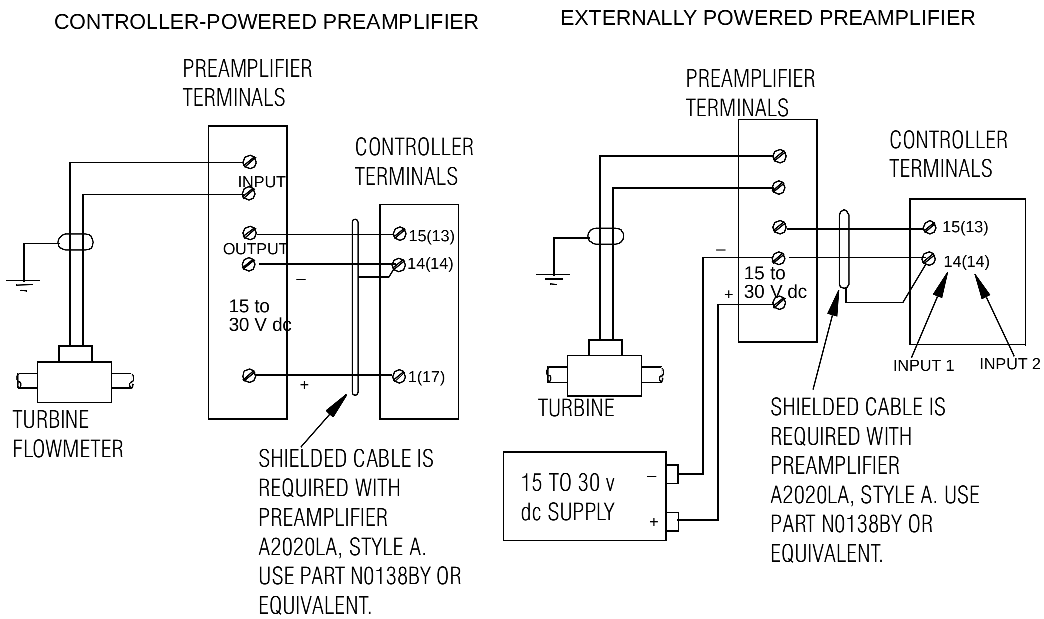


Figure 3-12. Examples of Frequency Input Signals from 81 or 82 Turbine Flowmeter with PA-106A Preamplifier

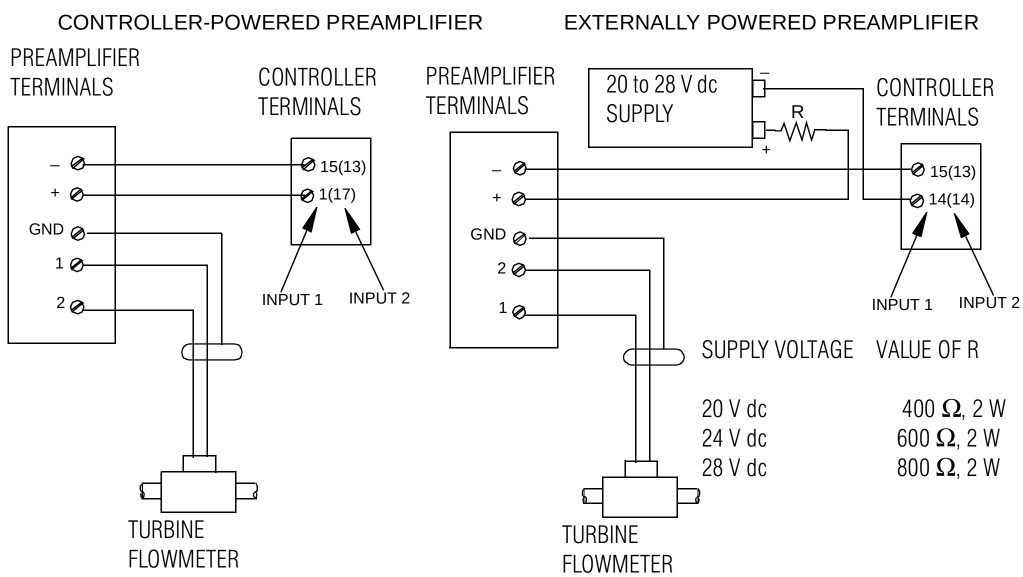
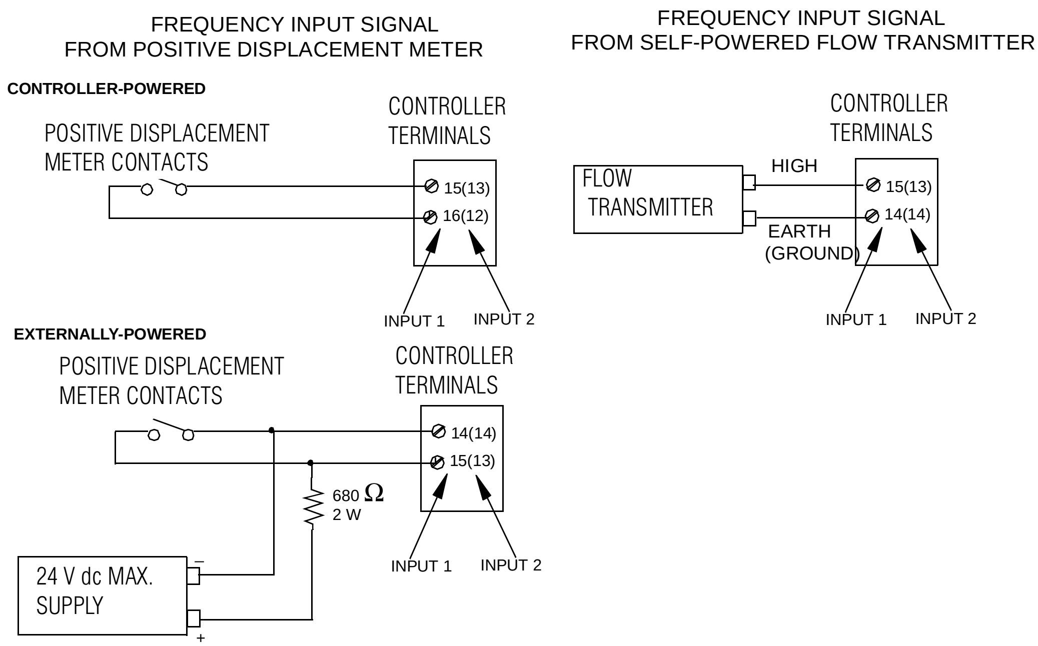


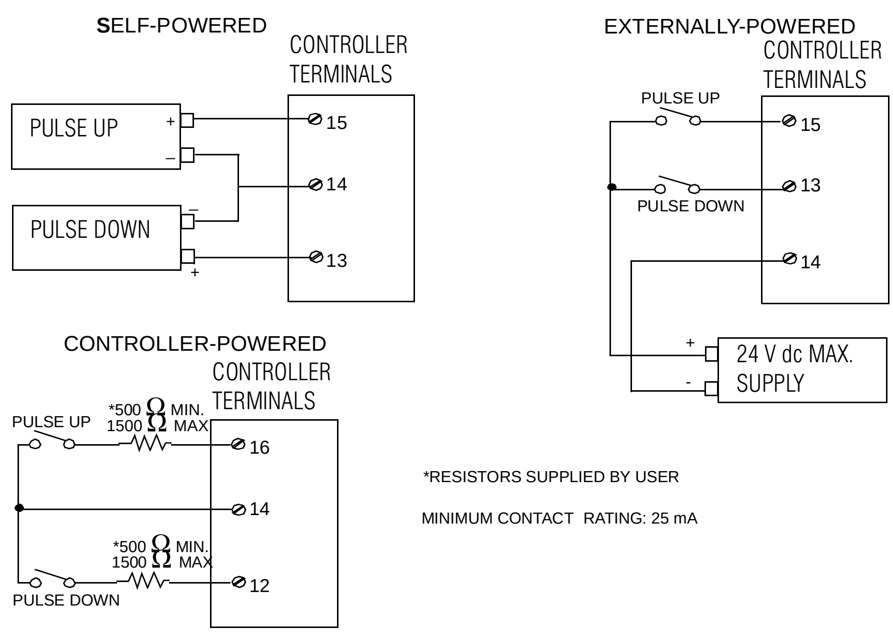
Figure 3-13. Examples of Frequency Input Signals from Self-Powered Flow Transmitter and Positive Displacement Meters



Pulse Input Wiring

762C Series Controllers can have pulse input signal for remote supervisory control of set point or for certain remote, direct digital control (DDC) backup of output. Examples of pulse input signal wiring are shown in Figure 3-14.

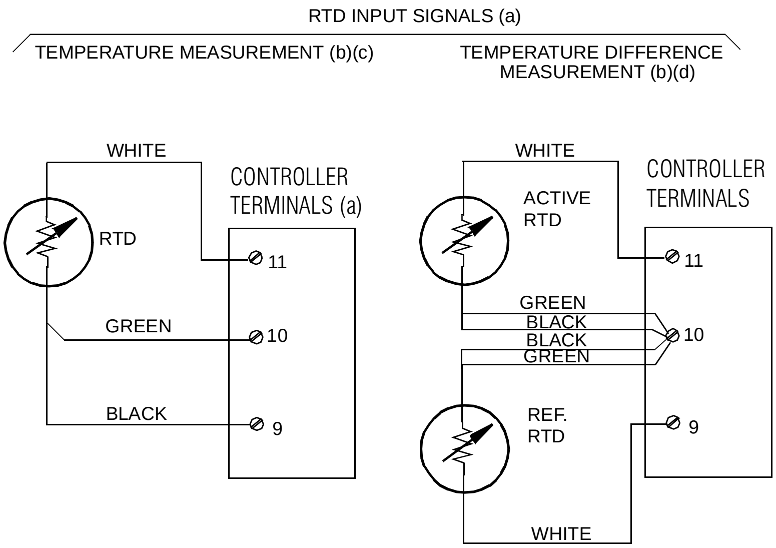
Figure 3-14. Examples of Pulse Input Wiring for Remote Set Points



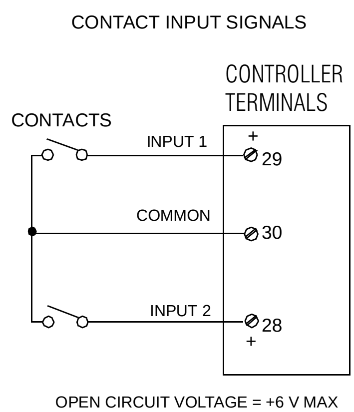
RTD and Contact Input Wiring

Examples of RTD and contact input signal wiring of controller are shown in Figure 3-15. To use an RTD, the RTD Input Option must be installed and Analog Input 1 Terminals 2 and 4 must be disconnected.

Figure 3-15. Examples of RTD and Contact Input Signal Wiring



a. RTD Input Option is dedicated to Input 1.
b. Diagrams show wire colors for Foxboro RTDs.
c. To maintain specified accuracy, RTD extension wires must all be the same length and gauge.
d. With temperature difference measurement, the reference RTD is used for the lower temperature.



Output Signal Wiring

Output Signal Terminal/Wire Designations

Table 3-3 designates output signal terminals by terminal number. For examples of output signal wiring, refer to Figure 3-16.

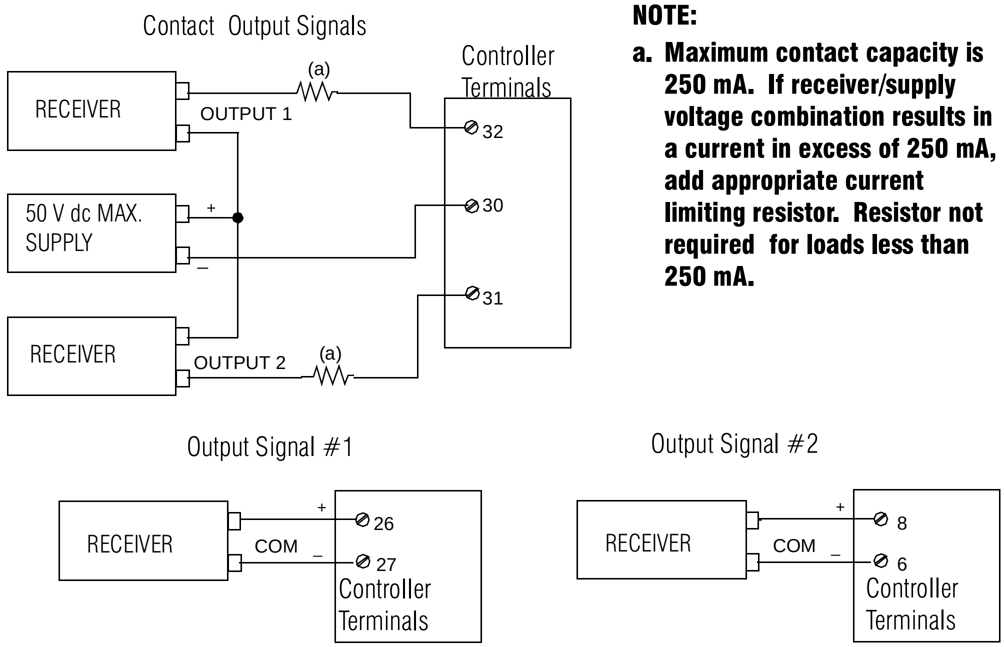
Table 3-3. Output Signal Terminal and Wire Designations

Function	Terminal Number
Control Output Signal #1; 4-20 mA (+):	26
Control Output Signal #1; 4-20 mA (–):	27
Control Output Signal #2; 4-20 mA(+) or 1-5 V dc (+):	8
Control Output Signal #2; 4-20 mA(-) or 1-5 V dc (-):	6
Contact Outputs: Open collector switch (NPN) output. Contact Outputs 1 and 2 can be configured by user for the following: Remote Status Indication of A/M, R/L, W/P, Alarms, EXACT Algorithm, Contact Inputs, Gate Outputs, Auto Selector Status, Totalizer Status.	
Contact Output 1:	32 (+)
Contact Output 2:	31 (+)
Common for Contact Outputs:	30 (–)

Output Signal Wiring Examples

Examples of output signal wiring are shown in Figure 3-16.

Figure 3-16. Examples of Output Signal Wiring of Controller



NOTE:

a. Maximum contact capacity is 250 mA. If receiver/supply voltage combination results in a current in excess of 250 mA, add appropriate current limiting resistor. Resistor not required for loads less than 250 mA.

Serial Communication Wiring

This section describes installation of wiring for serial communication functions. Refer to “Serial Communications” on page 101 for important configuration details. For detailed programming information, refer to *MI 018-888, Serial Communication Guide for 762C and 743CB Controllers.*

Terminal/Wire Designations

Table 3-4 designates terminals for serial communications wiring by terminal number for a controller. For examples of serial communications wiring, refer to the next section. If controller has optional surge protection, see “Accessory Equipment” on page 41 for wiring details.

Table 3-4. Serial Communications Terminal/Wire Designations

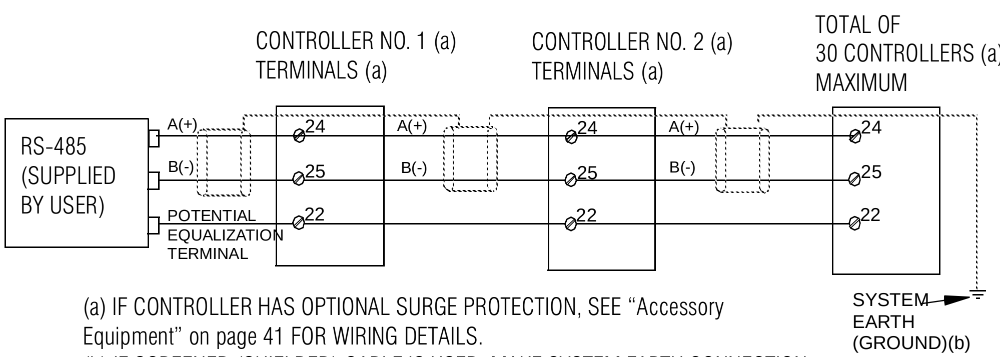
Function	Terminal No.
RS-485-A Serial Connection:	24 (+)
RS-485-B Serial Connection:	25 (–)
Potential Equalization Terminal:	22

RS-485 is used for serial communication of measurement, set point, output, alarm, and status signals. Maximum number of controllers that can be connected in a single loop is 30. Maximum accumulated cable length is 1.5 km (5000 ft).

Wiring to an RS-485 Interface

Figure 3-17 shows an example of 762C controller terminal serial communications wiring to an RS-485 Interface. If a Foxboro Model F6501A RS-232 to RS-485 Converter is used, refer to “RS-232/RS-485 Converter” on page 42 for additional details. Use twisted-wire pair for serial communications wires A and B. If screened (shielded) cable is used, connect screens to system earth (ground).

Figure 3-17. Serial Communications Wiring of Controller



(a) IF CONTROLLER HAS OPTIONAL SURGE PROTECTION, SEE “Accessory Equipment” on page 41 FOR WIRING DETAILS.
(b) IF SCREENED (SHIELDED) CABLE IS USED, MAKE SYSTEM EARTH CONNECTION AT ANY SINGLE POINT ALONG THE SHIELD RUN.

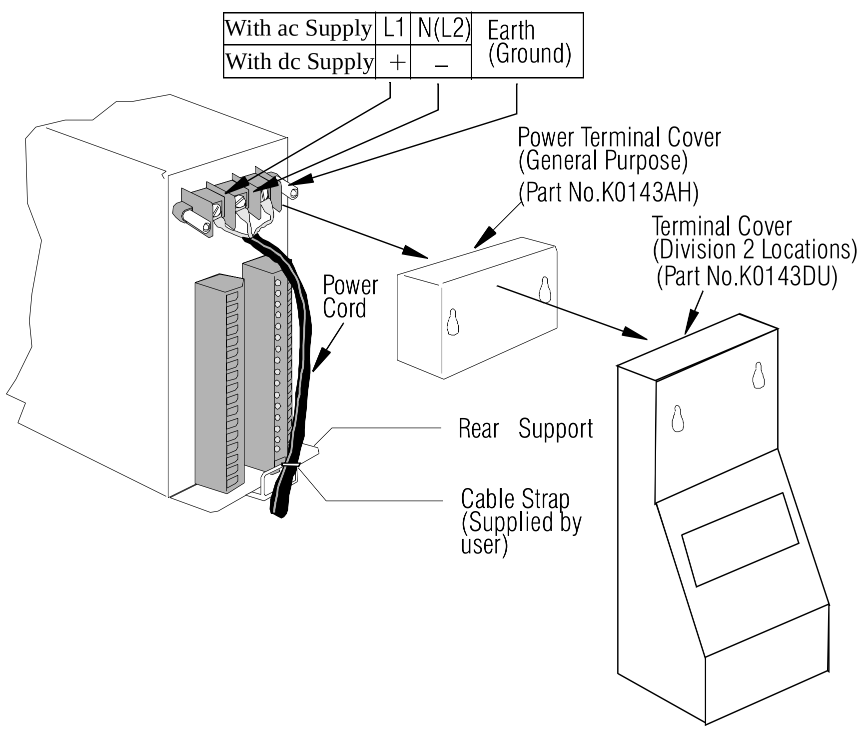
Power Wiring

To connect power wires to the controller, complete the following procedure.

1. Remove protective cover from terminals on rear of controller as shown in Figure 3-18.
2. Connect wires to applicable terminals as shown.
3. Secure cable to rear of controller with a cable strap as shown.
4. Reinstall protective cover over terminals.

WARNING For protection against fire and electrical shock hazards:
- Protective cover must be installed over power terminals.
- All wiring must conform to local electrical code requirements.
- The power earth (ground) terminal must be connected to the ground point serving the branch circuit powering the unit.
- Power wiring must be kept separate from low voltage field circuit wiring.

Figure 3-18. Power Wiring to Controller



Accessory Equipment

This section describes the installation of common accessory devices, such as a surge suppressor, an RS-232/RS-485 converter, and an Opto-22 converter.

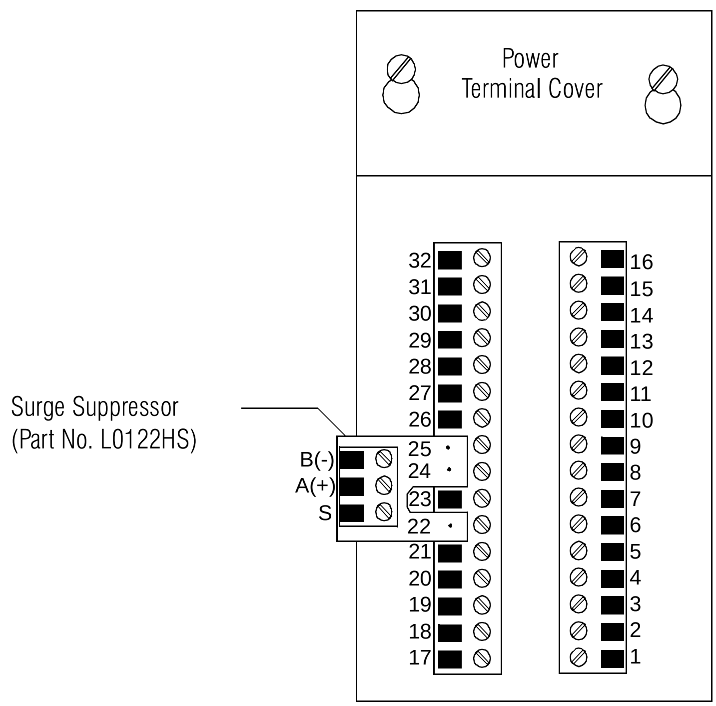
Optional Surge Suppressor

Surge protection is sometimes required with serial communications (RS-485) wiring. If input wiring is located near transient-producing sources, such as motors, solenoids, or high voltages, surge protection may be required.

To install a surge suppressor, execute the following procedure:

1. Disconnect power source from controller (or disconnect power by pulling controller from housing).
2. Remove protective cover if there is one (used only for Division 2 locations) from terminal blocks located on rear of controller.
3. Install surge suppressor assembly in terminal blocks as shown in Figure 3-19.

Figure 3-19. Installation of Optional Surge Suppressor



Optional Surge Suppressor (cont.)

4 Connect wires referenced in Figure 3-17 to the corresponding terminals on the suppressor assembly. For input wiring to the surge suppressor, use twisted-wire pair.

Input Wiring to Surge Suppressor

1 Connect wires from RS-485 to terminals of surge suppressor as shown in Figure 3-19. Use twisted-wire pair.

2 If screened (shielded) cable is used, connect screen to system earth (ground).

RS-232/RS-485 Converter

The Foxboro RS-232 to RS-485 Converter provides the interface between the RS-485 field-wiring (twisted-wire pairs) and the RS-232 communications for the host computer, as shown in Table 3-5.

Table 3-5. RS-232/RS-485 Converter Specifications

Item	Specification
Supply Voltage Limits	120, 220, or 240 V ac +10% and -15%. Supply voltage as specified in sales order.
Supply Frequency Limits	50 or 60 Hz; ±3 Hz.
Inputs	Accepts up to three independent RS-485 twisted-wire pairs. Each pair can have up to thirty controllers connected to it. The other input is the RS-232 connection to the host computer.
Connections	Terminal block for RS-485 twisted-wire pair terminations and 25-pin D-type connector for RS-232 cable.

Wiring

This section gives wiring details of the F6501A RS-232 to RS-485 Converter used for serial communications with the controller.

Wiring to Controllers

Controller connections are made to the rear of the converter at the RS-485 interface shown in Figure 3-20 on page 44. Table 3-6 shows the function of each terminal of the RS-485 interface. Note that terminals are arranged in redundant pairs (links). For example, terminals 1 and 3 are electrically the same; terminals 2 and 4 are electrically the same. Each redundant pair will support up to 30 controllers. The maximum number of controllers that can be connected to the converter using all three links is 90.

Table 3-6. RS-485 Terminal Connections on RS-232/485 Converter

Converter Terminal Numbers	Function	Sample Device Addresses*
1 and 3 (+) 2 and 4 (–)	Interface for up to 30 Devices	1 through 30
5 and 7 (+) 6 and 8 (–)	Interface for up to 30 Devices	31 through 60
9 and 11 (+) 10 and 12 (–)	Interface for up to 30 Devices	61 through 90
13	RTS Signal	---
14	Case Earth (ac Ground)	---

* Addresses shown are for illustration only. Actual addresses are assigned by the user. Any address may be connected to any terminal pair.

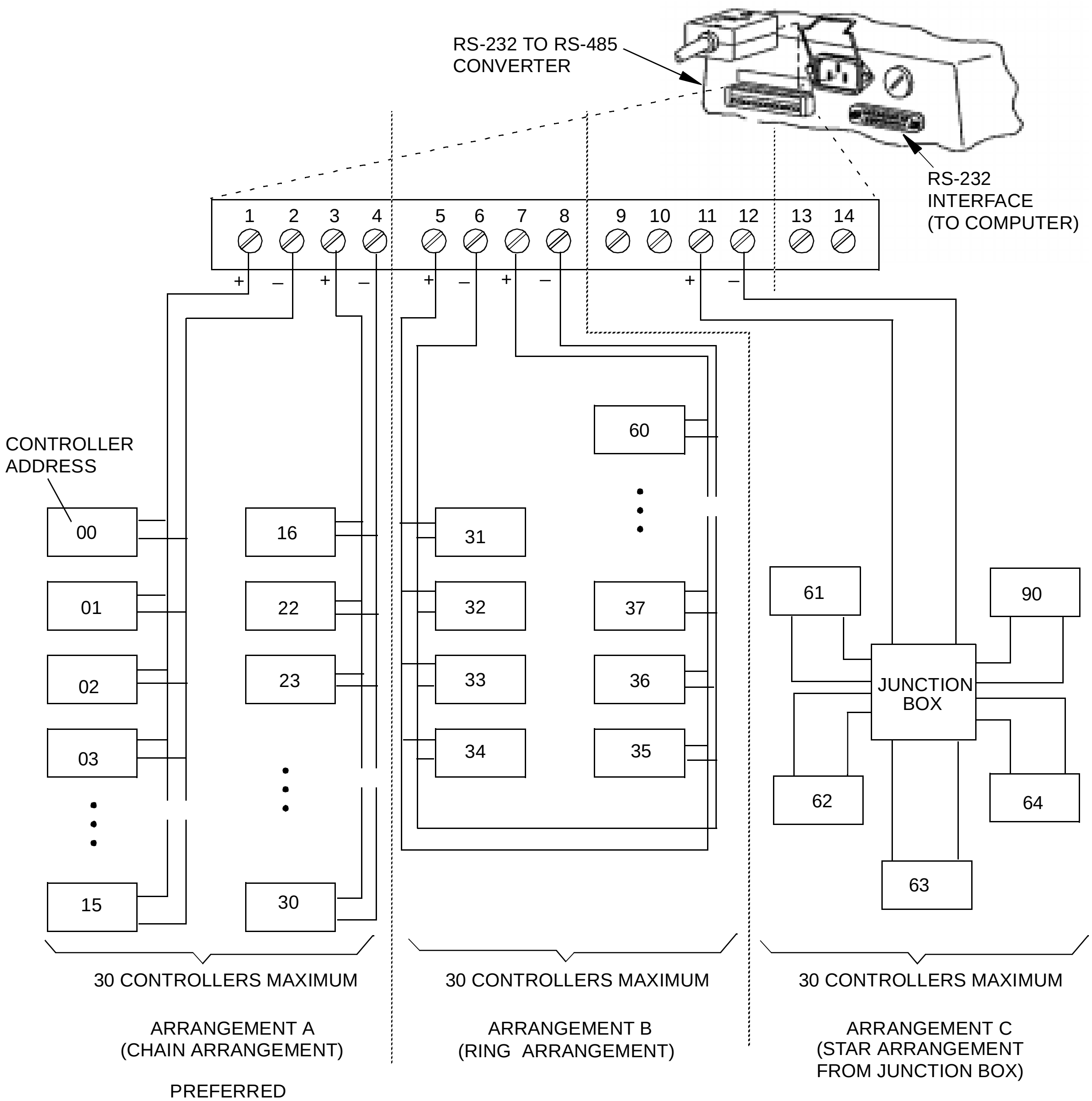
NOTE For each link, 30 controllers can be either connected to a single terminal pair or split between terminal pairs in any combination totaling 30 (Arrangement A in Figure 3-20).

The preferred field wiring arrangement (chain arrangement) is shown as Arrangement A in Figure 3-20 on page 44. Note that, with Arrangement A, a break in either the (+) or (-) wire run disconnects all instruments on the remote side of the break.

As an option, any of the following field wiring arrangements can be used.

- A “ring” arrangement can be connected to any of the three terminal groups by using plus-to-plus and minus-to-minus wiring.
- A “star” arrangement can be connected to any of the three terminal groups by using a junction box.

Figure 3-20. F6501A RS-232 to RS-485 Converter Signal Wiring



Interface Requirements

The following details are included for information only, to assist users in interfacing their OPTO22 cards to Foxboro controllers. The information presented is applicable to the current OPTO22 AC24 family requirements and may or may not be applicable to future design introductions. Requirements may also vary, depending on configuration and/or other devices connected to the network. For this reason, Foxboro emphasizes that the data presented is for guidance only; no warranty or guarantee of any kind is implied.

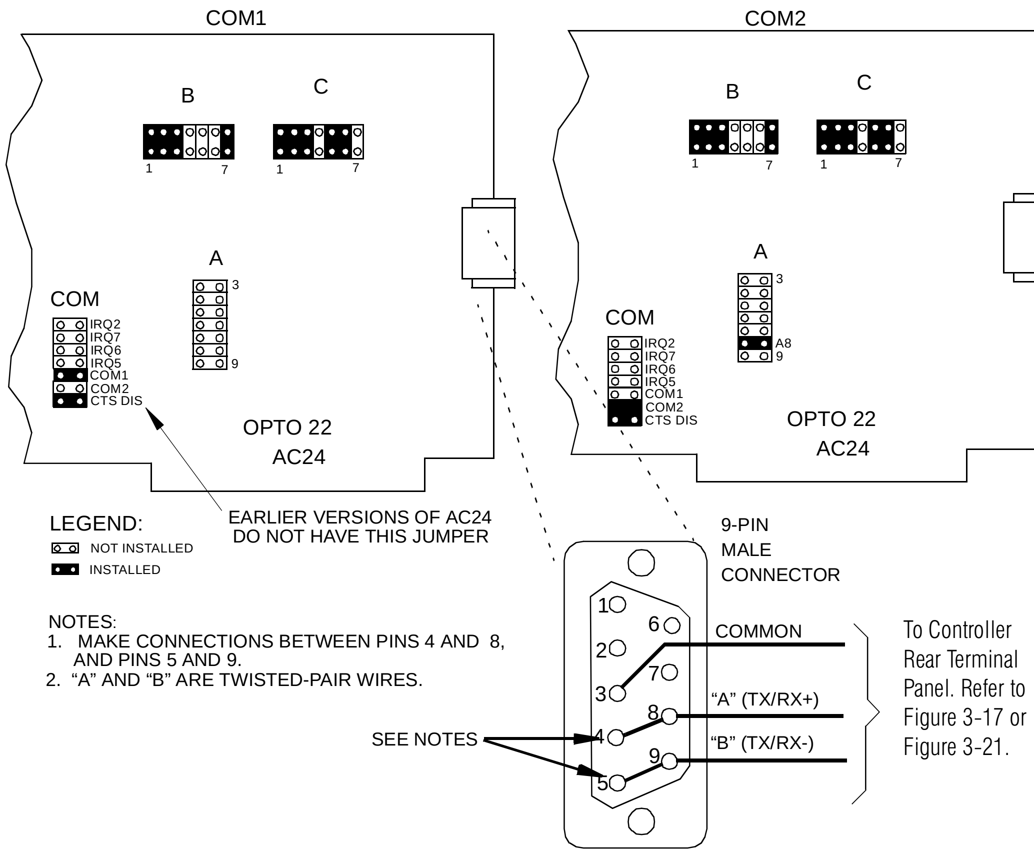
For complete details of the AC24 converter card, address, interrupt, and communications jumpers, consult the manufacturer's specifications. For controller connections, refer to Figure 3-17.

Configuration

Before installing your AC24, configure your board by selecting the appropriate address, interrupt, and communications jumpers, as shown in Figure 3-21.

The host PC is set up to use one asynchronous communications port, COM1 or COM2.

Figure 3-21. Cable Connections to 9-Pin Male RS-485 Connector



762C SINGLE STATION MICRO Controller

February 1998

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A SIEBE COMPANY

The Intelligent Automation People

Configuration 4

This chapter describes all configuration options and defines procedures for implementing them. If you have not yet read Chapter 2 - Product Overview, we suggest that you do so before proceeding.

The chapter is divided into the following major sections:

Introduction

Configuration is the process of enabling functional capability in the controller firmware for a specific application. This section will enable you to systematically determine, record, and configure the value or status of each parameter required for your application. Whether you have a controller with standard default values or one with factory pre-configured default values, you can reconfigure your controller to meet your specific requirements. Most applications require only simple variations to the default values and statuses already entered.

The following material will help you to configure your controller:

- Appendix B - Configuration Plan Worksheets
- Appendix C - Structure Diagrams
- Appendix F - Functional Diagrams
- Glossary

Planning Your Configuration

There are two common approaches to configuring your controller. One is to first identify and record all the changes you need to make to the default configuration and then to implement them. This approach is preferred because there is less need to move around in the product structure. However, you may prefer to implement each change as you identify it.

Appendix B will be especially important in planning your configuration. It is primarily a worksheet whose content is described below:

Table 4-1. Content of Configuration Worksheet

Structure Diagram Location	Prompt/ Parameter	Parameter Limits	Standard Factory Configuration	User Configuration	Remarks and Notes
Direction to parameter on specific sheet of Appendix C and to horizontal and vertical coordinates on that sheet.	Prompts to parameters in the order they are displayed when menu structure is sequenced step by step.	Limits of each parameter with units as applicable.	Standard factory configuration as shipped from Foxboro.	Column for you to record your configuration.	Additional information and space for your notations.

As you determine changes that must be made to the standard factory configuration (default) values for your application, record them in the User Configuration column of this worksheet.

Planning Your Configuration (cont.)

Throughout the Configuration section of this instruction, you will find location designators (e.g., 2 - A3). These direct you to the parameter you are looking for in the structure diagram in Appendix C. In the example given, the 2 refers to the diagram beginning with Balloon 2 in the upper left corner. The designation A3 refers to map coordinates on that diagram.

NOTE Diagrams in Locations 2, 3, 6, and 7 are so simple that map coordinates are not used.

More detailed information on using the structure diagrams is located in the beginning of Appendix C.

During configuration, you will need to access various signals such as inputs, outputs, measurements, set points, and calculated values. These are located in a Signal Distribution List which is in Location 6 in the structure and explained in Table 4-2 on page 52.

You will also need to access alarms, gates, contact inputs, and other logic functions to initiate actions. These are located in the Gate Input List in Location 7 in the structure and explained in Table 4-3 on page 53.

Appendix F provides a functional overview of the controller. It can be used with Appendix B, Configuration Worksheets, and Appendix C, Structure Diagrams, to select the product capability needed to match your application.

Table 4-2. Signal Distribution List

Name	Signal
A	Conditioned Analog Input IN1
B	Conditioned Analog Input IN2
C	Conditioned Analog Input IN3
D	Conditioned Analog Input IN4
E	Conditioned Frequency Input F1
F	Conditioned Frequency Input F2
G	Constant, adjustable
H	Constant, adjustable
I	Constant, adjustable
J	Constant, adjustable
C1 MEAS	Controller 1 Measurement
C1 LOCSP	Controller 1 Local Set Point
C1 REMSP	Controller 1 Remote Set Point
C1 SETP	Controller 1 Active Set Point
C1 OUT	Controller 1 Output
C2 MEAS	Controller 2 Measurement
C2 LOCSP	Controller 2 Local Set Point
C2 REMSP	Controller 2 Remote Set Point
C2 SETP	Controller 2 Active Set Point
C2 OUT	Controller 2 Output
ASEL OUT	Selected Output of Auto Selector
AOUT 1	Analog Output 1
AOUT 2	Analog Output 2
CALC 1	Result of Calculation 1
CALC 2	Result of Calculation 2
CALC 3	Result of Calculation 3
IN1	Analog Input 1
IN2	Analog Input 2
IN3	Analog Input 3
IN4	Analog Input 4
F1	Frequency Input 1
F2	Frequency Input 2
TOTAL 1	Totalizer 1 Accumulated Value*
TOTAL 2	Totalizer 2 Accumulated Value*
100 PCT	Constant, fixed at 100 percent
0 PCT	Constant, fixed at 0 percent
NONE	No Source

*Lower two bytes of 3-byte number

Table 4-3. Gate Input List

Name	Source	True State
CI 1	Contact Input 1	Closed
CI 2	Contact Input 2	Closed
ALARM 1	State of Alarm 1	In Alarm
ALARM 2	State of Alarm 2	In Alarm
ALARM 3	State of Alarm 3	In Alarm
ALARM 4	State of Alarm 4	In Alarm
C1 A/M	State of Automatic or Manual, Controller 1	Automatic
C1 R/L	State of Remote or Local, Controller 1	Remote
C2 A/M	State of Automatic or Manual, Controller 2	Automatic
C2 R/L	State of Remote or Local, Controller 2	Remote
W/P	State of Workstation or Panel	Workstation
COMMFAIL	Communications Timeout	Timed Out
C1 EXACT	State of EXACT, Controller 1	Enabled
C2 EXACT	State of EXACT, Controller 2	Enabled
TOTAL 1	State of Totalizer 1	Totalizer reached preset value or counted down to zero
TOTAL 2	State of Totalizer 2	Totalizer reached preset value or counted down to zero
AUTOSEL	Auto Select Output State	False = C2 output; True = C1
GATE 0	Output of Gate 0	True
GATE 1	Output of Gate 1	True
GATE 2	Output of Gate 2	True
GATE 3	Output of Gate 3	True
GATE 4	Output of Gate 4	True
GATE 5	Output of Gate 5	True
GATE 6	Output of Gate 6	True
GATE 7	Output of Gate 7	True
GATE 8	Output of Gate 8	True
GATE 9	Output of Gate 9	True
ON	Fixed State Input	Always
OFF	Fixed State Input	Never
NONE	Function Switch Not Used	N/A

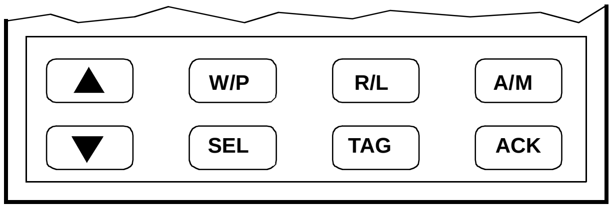
NOTE:

A switch assignment other than NONE has priority over the W/P, A/M, and R/L keys and the communication link. For example, if C1 A/M is assigned through Gate 1, the A/M key or a supervisory host command to change A/M status is ignored.

Implementing Your Configuration

When you have determined the necessary changes for your application, use the keypad on the front panel to implement the changes.

Figure 4-1. Keypad



CAUTION Entering the CONFIGuration mode freezes both outputs, ceases all algorithm execution, and blanks the graphics display. Also, when you return from CONFIG to Normal Operation, the controller is placed in manual control, local set point (if R/L is configured), and panel (if W/P is configured). The display will be that of Controller 1 (or FUNCtion 1) with the bargraph identifier positioned over the output (right) bargraph.

Five of the eight keys are used during configuration.

Table 4-4. Keypad

Key	Description
TAG	Used to go from Normal Operation to READ mode and to return from any point in READ or SET to Normal Operation.
▼ ▲	Used to sequence up and down in the program structure and to change menu entries (i.e., mode, alarm, status, and limit settings).
ACK	Used to step sequentially through all remaining items in the structure and to "enter" a changed value or status.
SEL	Used to return display in minor increments back through the program structure.

Implementing Your Configuration (cont.)

To go from Normal Operation to CONFIGuration, use the following procedure. This procedure assumes that the factory default passcode is configured.

```
762 MICRO
0.0
```
Press TAG

```
MENU
READ      ?
```
Press ▼

```
MENU
SET        ?
```
Press ACK

```
SET
OPTUNE  ?
```
Press ▼

```
SET
SECURE   ?
```
Press ACK

```
PASSCODE
=
```
Press ACK
(3 TIMES) *

```
SECURE
ALLTUNE ?
```
Press ▼
(2 TIMES)

```
SECURE
CONFIG  ?
```
Press ACK

*For default passcode: (blank)(blank)(blank)

CAUTION Entering the CONFIGuration mode freezes both outputs, ceases all algorithm execution, and blanks the graphics display. Also, when you return from CONFIG to Normal Operation, the controller is placed in manual control, local set point (if R/L is configured), and panel (if W/P is configured). The display will be that of the Controller 1 (or FUNCtion 1) with the bargraph identifier positioned over the output (right) bargraph.

Implementing Your Configuration (cont.)

Continue using the ∆, ∇, ACK, and SEL keys, and go to the category and subdivision of each parameter to be changed. The Location column of the Configuration Worksheets in Appendix B and the Structure Diagrams in Appendix C help you get there.

As Figure 4-2 shows, you move sequentially through the structure with the ACK key and up and down with the ∆ and ∇ keys. The SEL key enables you to return the display back through the structure in minor increments. Lastly, you can return to Normal Operation at any time with the TAG key.

The category is on the upper line of the display and the subdivision on the lower line.

CONFIG
GATES

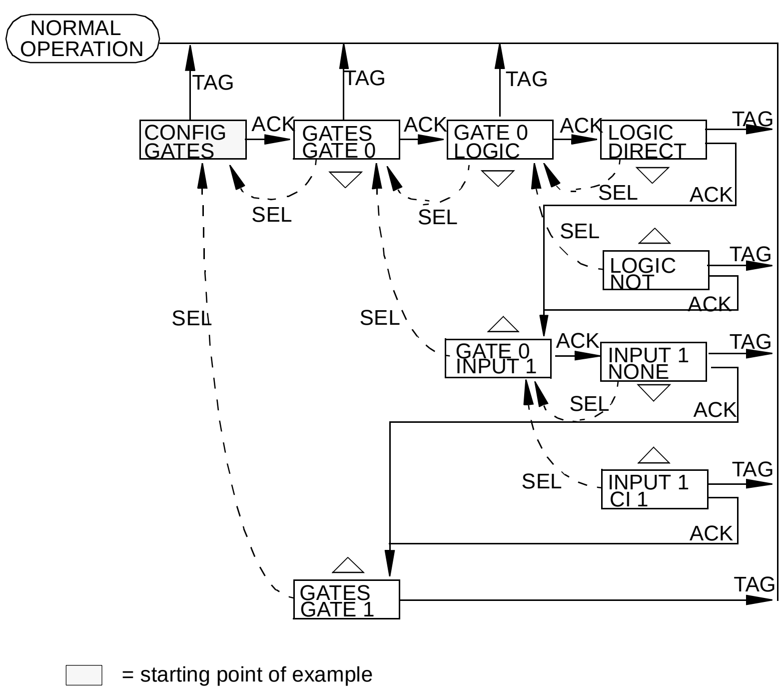
Pressing the ACK key causes the subdivision to move to the upper line and its value or status to appear on the lower line.

GATES
GATE 0

Use the ∆ and ∇ keys to change the selection, value or status.

After the change is completed, press the ACK key to “enter” the new selection, value or status. The display then advances to the next item in the structure.

Figure 4-2. Example Showing Use of Configuration Keys



CAUTION A selection, value, or status is not entered into the data base until the ACK key is pressed.

In the READ or SET mode, holding down the ∆, ∇, ACK, and SEL key causes the displays to sequence automatically.

Values of some parameters are entered or changed one character at a time. The first character will flash; it may be changed by pressing the ∆ or ∇ key. The available characters are listed in Table 4-5. Not all parameters use the entire list.

Table 4-5. List of Characters

Character	Character
9 through 0	<
.(decimal)	/
-(minus)	,(comma)
(blank)	+
A through Z	*
_(underline)	)
\	(
@	’(apostrophe)
?	(test)
>	√(sq root)
=	°(degree)

Note: Test = All character segments lighted

After changing the first character, enter it by pressing the ACK key. The next character then flashes. Repeat this process for each character in succession. Use the SEL key to backspace and correct an error. When the final character is entered, the display changes to the next item in the structure.

NOTE Parameters in the CONFIG section of the structure *must* be configured before those in the ALLTUNE (or OPTUNE) section.

When the configuration is completed, use the TAG key to return to Normal Operation.

CAUTION At various points in the Configuration section of this instruction, examples are given. If you implement an example on your instrument, the results are stored in your configuration module. Thus, the next user may encounter different entries than are shown in the *Standard Factory Configuration* column of Appendix B.

Common Configuration Functions

This section contains the following subjects:

Security

A PASSCODE enables you to prevent unauthorized personnel from changing the configuration and those categories of values you choose to protect.

The 762CNA Controller is shipped from the factory with a PASSCODE of three blanks. The passcode may be changed to three other characters. Any characters from Table 4-5 can be used. The configuration parameter to do this is NEWPASS. It is found in Location 5-C2 in the structure diagrams.

After you enter the characters and press the ACK key, you are asked to enter them a second time as a verification (VERIFY). If the two entries match, the new passcode replaces the previous passcode.

Under the configuration parameter SHOWOP (Location 2 in the structure diagrams), you can allow or prevent unauthorized personnel from changing the values of those parameters (TUNE C1, C1 LIMITS, TUNE C2, C2 LIMITS, ALARMS, CONSTS, TOTALS, RD CFG) that may be adjusted without the use of a PASSCODE (in OPTUNE). ACKnowledge YES for each parameter group that authorized personnel may adjust in OPTUNE. Note that SHOWOP categories displayed depend on whether the function is configured. For example, if neither totalizer is enabled, TOTALS does not appear under SHOWOP.

Control Type and Tuning

For each controller, the standard algorithms are PI/PID, I, P/PD, and EXACT control. The factory default is PI/PID. If you select a different algorithm, you will need to configure a change. You can configure each of the two control FUNCtions at Location 5-A1 in the structure diagrams.

Next determine your values for the algorithm selected. The parameter limits and the default configuration for Proportional (PF), integral (IF), and derivative (DF) control are as follows:

Table 4-6. Control Parameter Limits

Parameter	Limits	Default
PF	1 and 8000%	200
IF	0.01 and 200 minutes/repeat	2.0
DF	0 and 100 minutes	0.0

Control Type and Tuning (cont.)

Note that the PI and PID algorithms are grouped together as are the P and PD algorithms. To get PI or P, set DF to zero. To get PID or PD, set DF to a value.

Set Point Lag (SP LAG), the ratio of lead to lag, can be configured between 0 and 1. Zero (0) means that no proportional gain is applied to the set point; all proportional gain is applied to the measurement. One (1) is used for a dominant deadtime process (delay). Typically, 0.2 is used for a dominant lag process.

Details of EXACT parameters are discussed in Chapter 6 of this instruction manual.

BYPASS causes the set point to go directly to output. Make a ON entry to enable bypass for Controller 1 at TUNE C1 and for Controller 2 at TUNE C2. The factory default is OFF. Both are at Location 4-A1 in the structure diagrams.

Input Signals

Analog Inputs

The 762CNA has four analog inputs (IN1, IN2, IN3, IN4). These inputs are 4-20 mA dc (through 250-ohm resistors). They can be changed to 1-5 V dc by removing the 250-ohm input termination resistors. One can be an RTD input. If you use an RTD input, you must configure it as IN1 and also have the RTD hardware option. IN1 through IN4 can be specified from the Signal Distribution List (Location 6 in the structure diagrams).

Frequency Inputs

The frequency/pulse inputs can be two 1 to 9999 Hz inputs or a pair of Pulse Up/Pulse Down inputs. Frequency rates below 1 Hz are cut off and ignored, producing the same results as inputs of 0 Hz. When configured as pulse inputs, F1 is the pulse up input and F2 is the pulse down input. The instantaneous difference between the pulse up and pulse down input is F2; the integrated difference is F1. F1 and F2 can be specified from the Signal Distribution List.

In a pulse set point application (which emulates Foxboro 62HM controllers), the following configuration entries must be made:

1. Select PULSED at FREQ I/P (Location 5-B2 in the structure diagrams).
2. Configure the SET PT TYPE as R/L (Location 5-G1).
3. Configure LOCTRK as ON (Location 5-H1).
4. Configure SOURCE as CALC n (Location 5-H1).
5. Configure CALC n as L+F (Location 5-C1). Signal F is the scaled and conditioned version of F2.

Input Signals (cont.)

All analog or frequency input signals can be conditioned and scaled, characterized, or combined in a variety of calculations. These operations are discussed later in this chapter.

Discrete Inputs

The controller also has two discrete (non-isolated contact or transistor switch) inputs, CI1 and CI2. You can use them, for example, to actuate remote status changes of auto/manual (A/M), remote/local (R/L), workstation/panel (W/P), EXTernal ACKnowledge, tracking functions (MEAS-TRK and OUTTRK), and totalizer functions (HOLD and RESET). CI1 and CI2 are specified from the Gate Input List.

Input Signal Conditioning and Scaling

Each of the analog and frequency inputs discussed above can be passed through a Butterworth FILTER adjusted for 0 to 10 minutes, then FORMATted as LINEAR, SQUARED, SQuare ROOTed, or CHARacterized over one of two selectable series of points. Lastly, an INBIAS may be applied before a GAIN and an OUTBIAS after the GAIN. The equation is:

$$[\text{FORMATted Input} + \text{INBIAS}\,] \times \text{GAIN}\,) + \text{OUTBIAS} \;=\; \text{Conditioned Input}$$

See Figure 4-3 for a diagram representing the signal conditioning and scaling process.

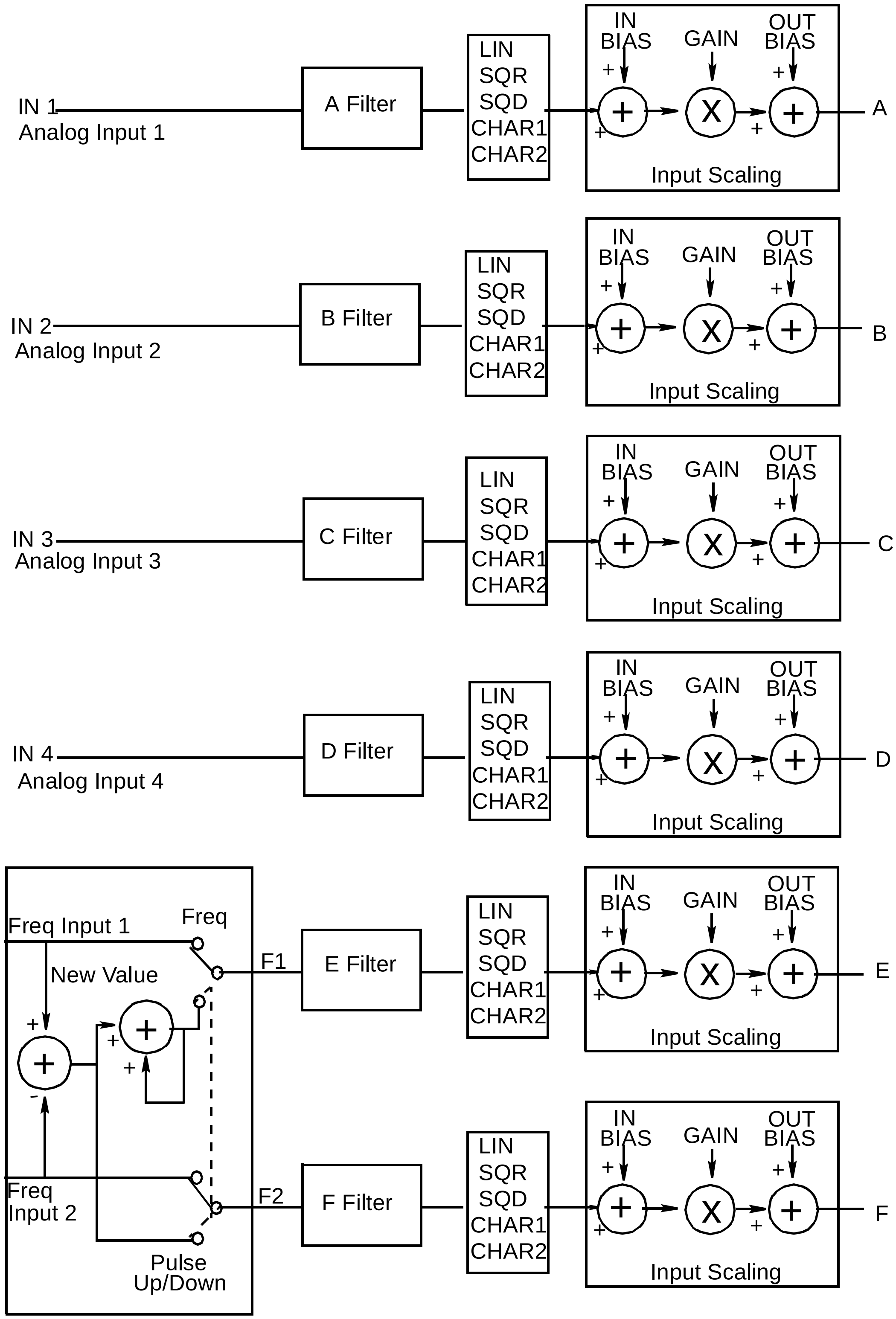
The order of these functions is reversed during configuration (i.e., OUTBIAS, GAIN, INBIAS, FORMAT, and FILTER) at Location 5-B2 of the structure diagrams.

Analog inputs IN1, IN2, IN3, and IN4 become signals A, B, C, and D after signal conditioning and scaling. Likewise, frequency inputs F1 and F2 become E and F.

Four constants may be used, identified as G, H, I, and J. These may be adjusted through OPTUNE (if allowed) and ALLTUNE at Location 4-B2 of the structure diagrams.

All conditioned inputs (A - F) and the constants (G - J) are available in the Signal Distribution List (Location 6).

Figure 4-3. Input Signal Conditioning and Scaling



Output Signals

The 762CNA has two analog output signals. AOUT1 is a 4 to 20 mA signal into 500 ohms maximum. AOUT2 can be a 4 to 20 mA or 1 to 5 V dc, jumper selectable signal. You can configure either at Location 5-C2 in the structure diagrams to output a signal from the Signal Distribution List. Note, however, that certain configurations automatically assign the source of AOUT 1 and AOUT 2.

The controller also has two discrete (non-isolated open collector transistor switch) outputs, CO1 and CO2. You can use them for status indication of A/M, R/L, W/P, and alarms. You can also configure them as the destination for any two of the Boolean gate outputs. Configuration is done at Location 5-C2 in the structure diagrams to output a signal from the Gate Input List.

Display Features

TAG

The top line of the alphanumeric display can read a looptag of your choosing during normal operation mode. You can configure the TAGs for both the first and second controller to be up to a nine character ASCII text string. Enter the configuration at TAG in Location 5-E1 of the structure diagrams. Enter the TAG one character at a time as explained in "Implementing Your Configuration" on page 54.

Display Variable (in place of Looptag)

If an engineering variable is desired in place of a looptag, it may be configured at TOP LINE VARIABLE at Location 5-E1 in the structure diagrams. Enter its TYPE (LINEAR or TEMP), ENG UNiTS, range (URV and LRV), and SOURCE (from the Signal Distribution List). Thus, this function provides a simple indication of any assigned SOURCE variable.

Measurement, Set Point Display (MEAS, SP)

In normal operation mode, the engineering scaled value of the measurement or set point, as identified by the Bargraph Identifier, is located on the second line of the alphanumeric display. Configure this display at MEAS, SP in Location 5-E2 by specifying its TYPE (LINEAR or TEMPerature), ENG UNiTS, and range (URV or LRV). If you select TEMPerature, specify the SCALE as IEC 100 or SAMA 100 for an RTD input or T/C J, T/C K, or T/C E for a thermocouple input from a temperature transmitter. Also, specify the ENG UNiTS as DEG F or DEG C.

Auto/Manual Control (A/M)

The controller can be placed in either an automatic (A) or manual (M) mode. This can be changed by the A/M key on the front of the controller if the controller is in panel mode (P) and if the function switch (A/M) is configured to NONE. A switch assignment other than NONE has priority over the A/M key. Auto or Manual control may be specified at Location 5-G2 under the following conditions:

STARTUP:	A/M state upon application of power or restart after a power failure.
FLUNK:	A/M state upon loss of serial communications (when in Workstation mode) between controller and host computer. Besides a choice of Auto or Manual, the configurator may also select the last status (LAST A/M) of control before serial communications was lost.
SWITCH:	An entry from the Gate Input List here drives the specified SWITCH to change the controller operation from Auto to Manual or vice versa. A configuration of ON or to an entry from the Gate Input List whose logic is in the True state sets the control to the AUTO mode. Conversely, OFF or (False) sets the control to the MANUAL mode. A switch assignment other than NONE has priority over the A/M key or the communication link; e.g., if A/M were assigned through Gate 1, then the A/M key or a supervisory host command to change A/M status would be ignored.

Alarms

Critical process signals are often monitored by process alarms that alert operating personnel to out-of-range or abnormal conditions. Occasionally, these alarms are used in a non-alert mode for interlocking logic.

This section describes the kinds of alarms available in the controller, how they operate, and how to enable them. Examples illustrate various situations in which alarms are used.

This section contains the following subjects:

General Information

The Controller has four alarms. Each alarm can activate on any one of the signals from the Signal Distribution List. Each alarm has two alarm levels and a deadband whose values can be set. Each also has one Boolean output. You can also configure each alarm to have a specific Form, Type, and Action as follows:

Table 4-7. Alarm Configurations

Form:	Absolute, Deviation, or Rate of Change
Type:	High/Low, High/High, or Low/Low
Action:	Latching, Nonlatching, or Permissive

For deviation alarms, both the reference and alarmed variables are selected from the Signal Distribution List.

Measurement and output alarm conditions of Controller 1 and/or Controller 2 can be viewed on the alphanumeric and bargraph displays on the faceplate of the controller. The Output and Measurement bargraphs can each display one of the four alarms. The alarm must, however, be an absolute or deviation alarm, not a permissive alarm. Alarms can also be displayed on a 3-bar indicator display. The alarm is only displayed on the bargraph display of an alarmed variable.

Lastly, in addition to acknowledging alarms with the ACK key, you can configure alarms to be EXTernally ACKnowledged by one of parameters from the Gate Input List. The ACK key is active even if EXT ACK is used.

The basic configuration of alarms is done in the CONFIGuration section (Location 2-A2) in the structure diagrams as just described. However, the alarm level and deadband values are adjusted in the ALLTUNE (OPTUNE) section (Location 4-A2); the display selections are added in the DISPLAY section (Location 5-E2, 8-A2, or 9-A2).

Forms of Alarms

There are three forms of alarms:

- Absolute (ABS)
- Deviation (DEV)
- Rate of Change (ROC)

Absolute Alarms

An ABSolute alarm measures a variable relative to the zero process condition; e.g., temperature measurement or level in a vessel. An ABSolute alarm has one input variable. This input is the monitored value that is compared with the configured alarm levels. When the attached monitored value exceeds the alarm level, an alarm condition occurs and the Boolean output associated with that alarm is set to True. In the case of Hi/Hi and Lo/Lo alarms (see "Types of Alarms" on page 66), the second alarm level (Level 1 for Hi/Hi, Level 2 for Lo/Lo) trips the Boolean output.

Assign the input variable from the Signal Distribution List using the parameter ATTACH at Location 5-B2 in the structure diagrams.

Deviation Alarms

A DEViation alarm monitors a process variable in relation to a reference variable. For example, you can use this form to determine how the measurement is performing in relation to the set point, or how "Flow 1" is performing in relation to "Flow 2". A DEViation alarm has one input that is the monitored variable and one that is the reference variable. When the difference between the two variables exceeds the configured alarm level, an alarm condition occurs and the Boolean output associated with that alarm is set to True.

Select both monitored and reference variables from the Signal Distribution List. Assign the monitored variable using the parameter ATTACH and the reference variable using the parameter REF at Location 5-B2 in the structure diagrams.

Rate of Change Alarm

Use a Rate-of-Change alarm when the change of a variable in an increment of time is important; i.e., the change in temperature per change in unit time in a reactor. Because of its infrequent use and greater complexity, the rate of change alarm is discussed in detail later in the "Additional Configuration Functions" section.

Types of Alarms

There are three types of alarms:

- High/Low (HI/LO)
- Low/Low (LO/LO)
- High/High (HI/HI)

Each alarm type uses a deadband (DB), a user adjustable parameter that prevents intermittent alarming when the monitored value hovers around the alarm levels.

Examples of all alarm types are given on the following pages.

High/LOw Alarms

Figure 4-4 and Figure 4-5 show High/Low alarms when used with Absolute and Deviation forms of alarm respectively.

Table 4-8. High/Low alarms

Alarm State	When Monitored Signal Is
Enters High Alarm	Greater than the HI alarm level
Exits High Alarm	Less than the HI alarm level minus the deadband
Enters Low Alarm	Less than the LO alarm level
Exits Low Alarm	Greater than the LO alarm level plus the deadband

Figure 4-4. High/Low Absolute Alarm

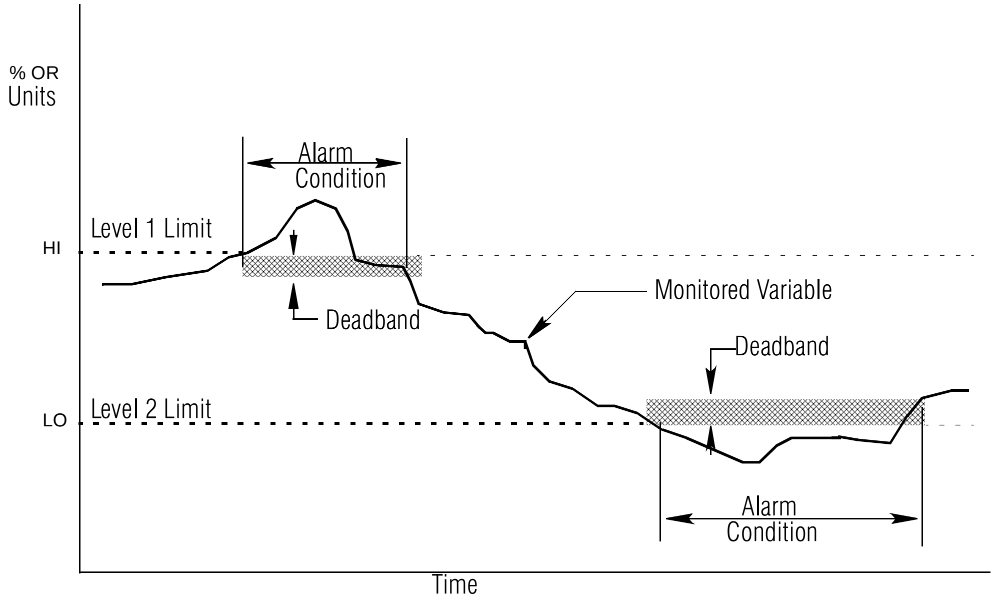
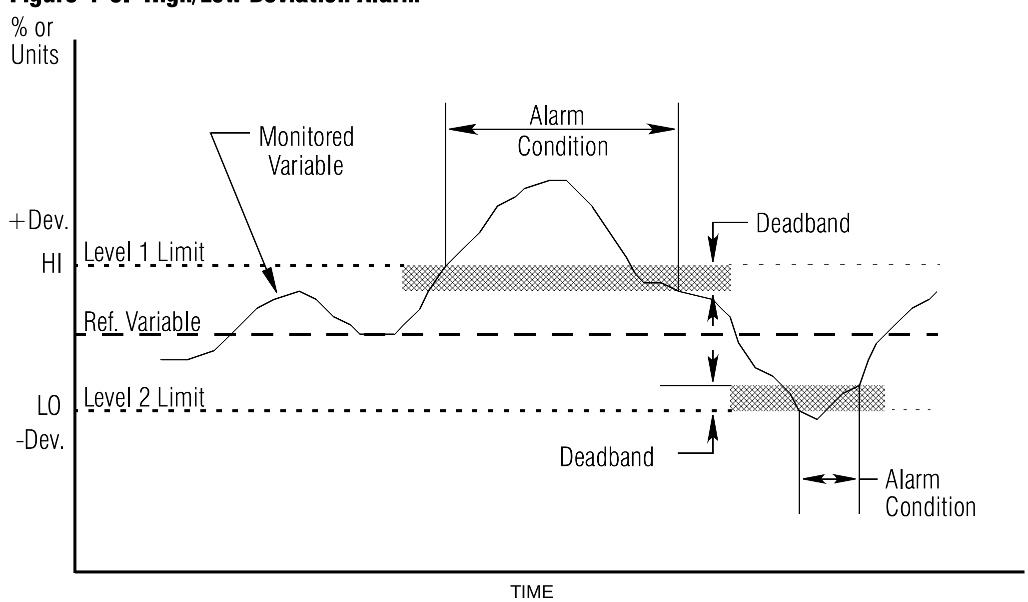


Figure 4-5. High/Low Deviation Alarm



High/High Alarms

Table 4-9. High/High Alarms

Alarm State	When Monitored Signal Is
Enters Warning	Greater than the Lower alarm level
Exits Warning	Less than the Lower alarm level minus the deadband
Enters High Alarm	Greater than the Higher alarm level
Exits High Alarm	Less than the Higher alarm level minus the deadband

Figure 4-6 and Figure 4-7 show High/High alarms when used with Absolute and Deviation forms of alarm respectively. Note that in the warning state, the alarm activates the alarm indicator on the front panel but not the Boolean alarm output. The alarm condition activates this output.

Figure 4-6. High/High Absolute Alarm

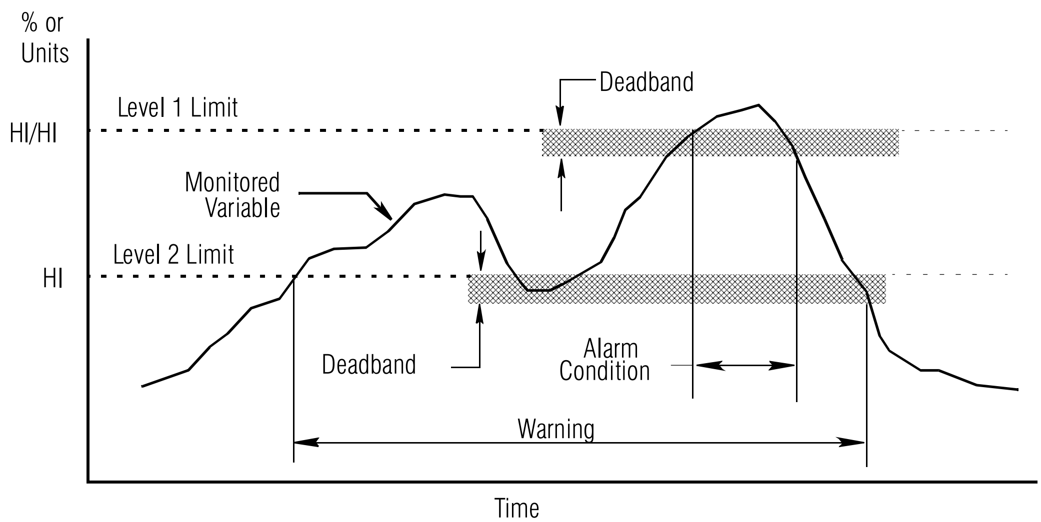
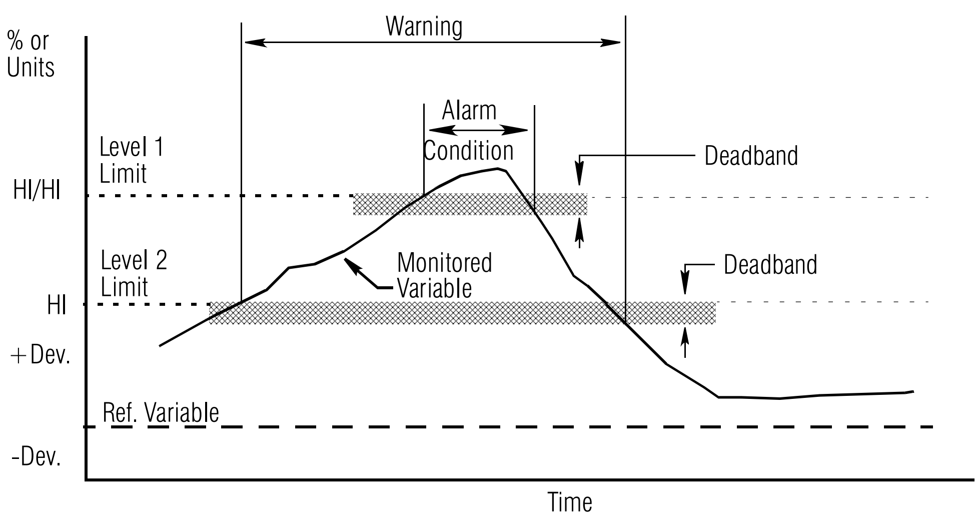


Figure 4-7. High/High Deviation Alarm



LOw/LOw Alarms

Table 4-10. Low/Low Alarms

Alarm State	When Monitored Signal Is
Enters Warning	Less than the Higher alarm level
Exits Warning	Greater than the Higher alarm level plus the deadband
Enters Low Alarm	Less than the Lower alarm level
Exits Low Alarm	Greater than the Lower alarm level plus the deadband

Figure 4-8 and Figure 4-9 show Low/Low alarms when used with Absolute and Deviation forms of alarm respectively. Note that similar warning and alarm condition states occur as in the High/High alarm type.

Figure 4-8. Low/Low Absolute Alarm

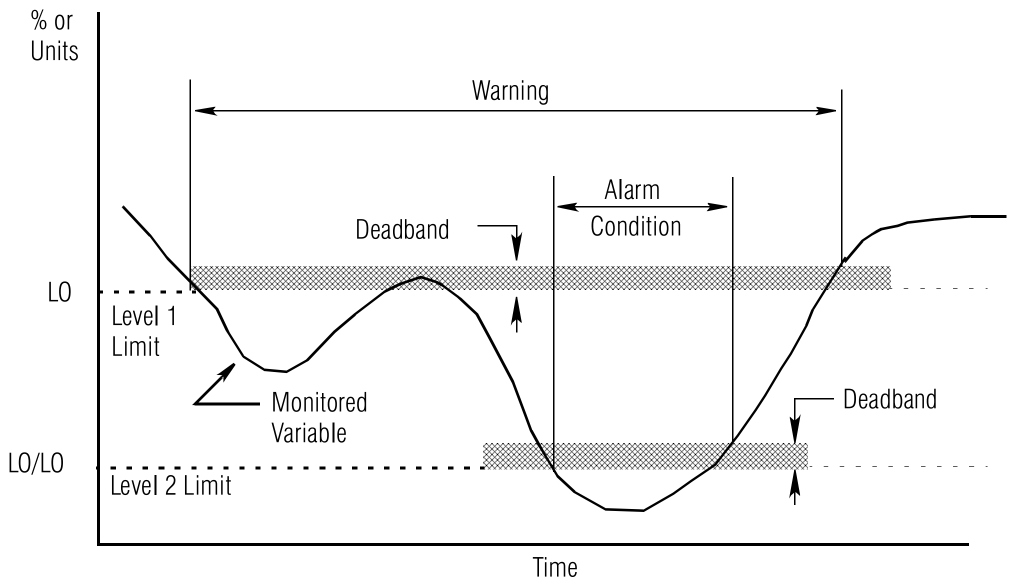
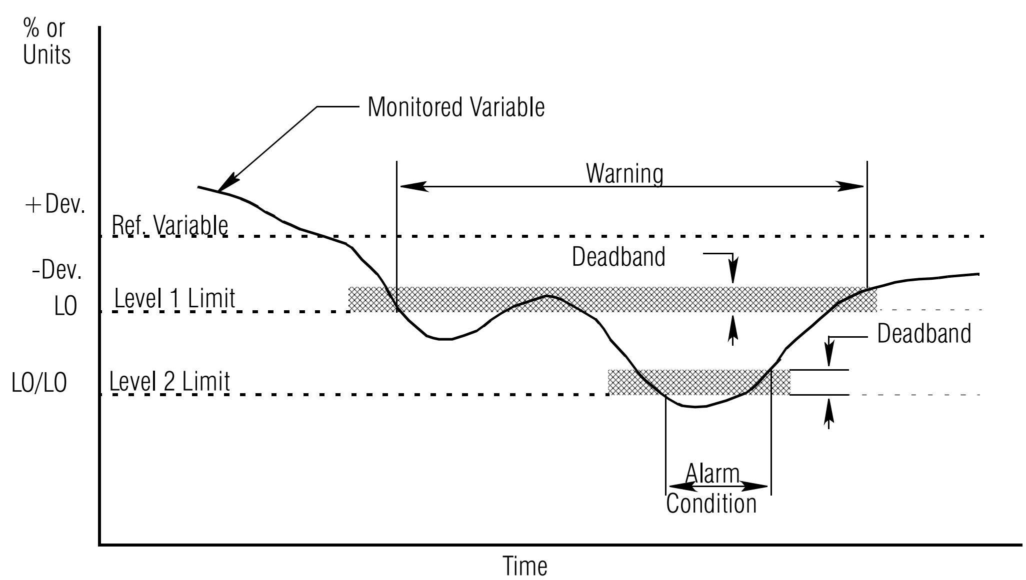


Figure 4-9. Low/Low Deviation Alarm



Alarm Action

There are three kinds of alarm action:

- Latching (LAT)
- Nonlatching (NON LAT)
- Permissive (PERMISVE)

A LATching action requires that the user always acknowledge an alarm state either during or after the time that the alarm condition exists.

A NONLATching action provides notification during transient alarm conditions, but is self clearing once these conditions no longer exist.

A PERMISsiVE action is used to monitor signals to generate logic-only action. This action requires no operator interaction.

A summary of alarm action characteristics is given in Table 4-11.

Table 4-11. Alarm Actions

Alarm Action Characteristics	Latching	Nonlatching	Permissive
Both warning and alarm state require acknowledgment	Yes	Allowed, not required	No; Cannot be acknowledged
Exiting warning or alarm state cancels requirement to acknowledge alarm	No	Yes	N/A
Alarm indicator flashes when acknowledgment required	Yes	Yes	Never; no display
Alarm indicator ON continuous in warning or alarm state following acknowledgment	Yes	Yes	Never; no display
Boolean output is TRUE in alarm state	Yes	Yes, only until the alarm state is ACKed	Yes
Boolean output is TRUE in warning state	No	No	No

Configuring, Tuning, and Displaying Alarms

Configuring the form, type, and action of each of your alarms as well as attaching the selected input variable and reference variable (in the case of a Deviation alarm) is done in CONFIG at Location 5-A2 in the structure diagrams.

Tuning the alarm levels and the deadband values is done in ALLTUNE (or OPTUNE) at Location 4-A2 in the structure diagrams. Level 1 is assumed to be the higher of the two alarm levels; i.e., Level 1 is HI in a HIgh/LOw alarm, HI/HI in a HIgh/HIgh alarm, and LO in a LOw/LOw alarm. Level 2 is LO in a HIgh/LOw alarm, HI in a HIgh/HIgh alarm, and LO/LO in a LOw/LOw alarm.

Configuring measurement or output alarm conditions to display on the faceplate is done in DISPLAY at Location 5-E2 or 9-A2 in the structure diagrams.

Configuring, Tuning, and Displaying Alarms (cont.)

NOTE If more than one alarm is configured for measurement or for output, only the first (lowest numbered) alarm will be displayed. Rate of change alarms cannot be displayed.

Configuring alarms to display on a 3 bar indicator is done at Location 8-B2 in the structure diagrams. An alarm is only displayed on the bargraph display of an alarmed variable. For an alarm to be displayed on the bargraph of a 3-bar indicator, the bar must be sourced to the same parameter that the alarm is attached and the alarm display must be turned on.

Alarm Configuration Examples

Example 1 An application requires a High/Low absolute alarm on the measurement to Controller 1. The alarm levels are to be 10 and 90% and have a dead band of 2%. The alarm output, when active, should close a contact output for as long as the alarm condition persists or until the alarm is acknowledged (nonlatching action). Finally, the alarm levels must be indicated on the measurement bargraph display.

NOTE The parameters in CONFIG must be configured before those in ALLTUNE.

1. Access CONFIG ALARMS (Location 5-A2) and go to ALARM 1.
2. Select HI/LO from the menu for TYPE.
3. Select NON LAT from the menu for ACTION.
4. Select ABS from the menu for FORM.
5. Connect this alarm to the Controller 1 Measurement by selecting C1 MEAS from the menu for ATTACH.
6. Go to EXT ACK (Location 5-B2) and select NONE from the menu.
7. Access CONFIG OUTPUTS (Location 5-C2) and select ALARM 1 from the menu for CO 1. This connects the alarm to a contact output.
8. Access FUNC 1 DISPLAY (Location 5-E1) and go to DISPLAY ALARMS (Location 5-E2).
9. Select MEAS ALM from the menu and then select YES.

NOTE To assign the alarm levels you must now exit the CONFIGuration Mode and enter the ALLTUNE mode.

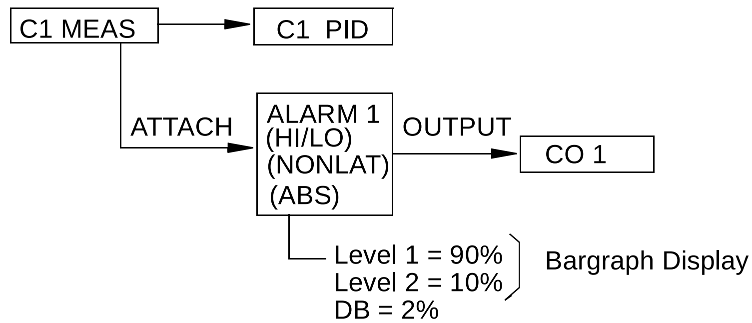
10. Access ALLTUNE ALARMS (Location 4-A2) and go to ALARM 1.
11. Select a value of 90 for LEVEL 1. (For any alarm TYPE, LEVEL 1 is always the numerically greater value.)

Example 1 (cont.)

12 Select a value of 10 for LEVEL 2.

13 Select a value of 2 for DB (dead band). The configuration of this example is now complete.

This may be shown pictorially as:



Example 2

A High/Low, nonlatching, deviation alarm is required on the measurement of a remote/local set point controller. The alarm is to be activated when the measurement deviates from the remote set point by some level (C1 MEAS - C1 REMSP).

[The intent of this example is to demonstrate the configuration of a deviation alarm. The other attributes of this alarm (Output, Display requirements, Levels, and Dead Band), if given, would be configured as in Example 1, Steps 7 - 13.]

1 Access CONFIG ALARMS (Location 5-A2) and go to ALARM 1.

2 Select HI/LO from the menu for TYPE.

3 Select NON LAT from the menu for ACTION.

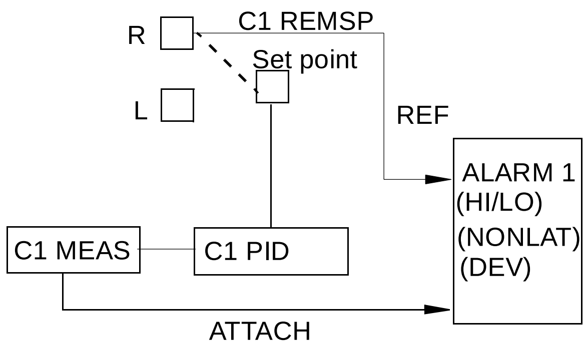
4 Select DEV from the menu for FORM.

A Deviation alarm has two inputs: the alarmed variable (the measurement in this example) and a REFerence variable.

5 Select C1 REMSP from the menu for REF.

6 Select C1 MEAS from the menu for ATTACH.

7 Configure Output, Display, Levels, and Dead Band requirements to complete this example.



Example 3 The output state of a deviation alarm determines whether the EXACT state is ON or OFF and whether Contact Output 2 is open or closed.

NOTE For this example assume that ALARM 1 is the alarm in question and that its configuration has been completed. Further assume that Controller 1 has been configured to the point of selecting the TYPE of control.

1. Access CONFIG FUNC 1 (Location 5-A1) and select EXACT.
2. At EXACT SW in Location 5-G3, select ALARM 1 from the menu. This selection means that EXACT is activated (turned ON) when ALARM 1 is in the alarm state.
3. Access CONFIG OUTPUTS (Location 5-C2) and select CO 2.
4. Select ALARM 1 from the menu for CO 2. This selection means that Contact Output 2 is closed when ALARM 1 is in the alarm state. The configuration of this example is now complete.

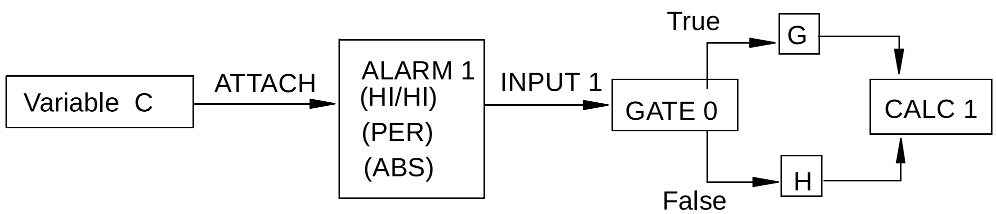
Example 4 A permissive alarm, connected to scaled variable C, is used to activate a logic gate whose output is used as a Boolean operator in a calculation. The use of such an operator as a switch is discussed in “Example 3: Signal Switching” on page 84.

1. Access CONFIG ALARMS (Location 5-A2) and go to ALARM 1.
2. Select HI/HI for Type, PERMISIVE for Action, and ABS for Form.
3. Select C from the menu for ATTACH.
4. Access CONFIG GATES (Location 5-A3), go to GATE 0 (GATE 0 is DIRECT), and select ALARM 1 from the menu for INPUT 1.
5. Access ALLTUNE ALARMS (Location 4-A2) and assign values for LEVEL 1, LEVEL 2, and DB for ALARM 1.

NOTE Since the Warning state of a permissive alarm does not trigger alarm logic, the two levels are usually set to the same value.

6. Access CONFIG CALC and go to CALC 1. If G is to be a constant used if Gate 0 is in the true state and H if in the False state, configure CALC 1 = G0H.

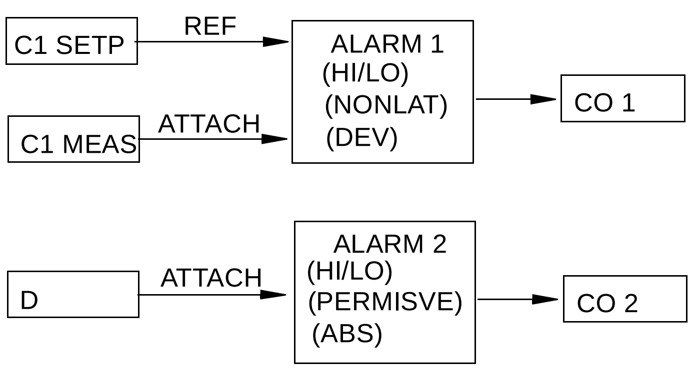
This may be shown pictorially as:



Example 5 A Deviation alarm is required to monitor the difference between the measurement and the set point of a process. This alarm is to be displayed on the controller. A second alarm is also required for monitoring the level of a tank.

1. Access CONFIG ALARMS (Location 5-A2) and go to ALARM 1.
2. Select HI/LO for TYPE, NONLAT for ACTION, and DEV for FORM.
3. Connect this alarm to Controller 1 Measurement by selecting C1 MEAS from the menu for ATTACH. Select C1 SETP for REF.
4. Go to ALARM 2 and select HI/LO for TYPE, PERMISIVE for ACTION, and ABS for FORM.
5. ATTACH this alarm to IN 4 scaled and conditioned variable D to which the level transmitter is connected.
6. Access CONFIG OUTPUTS (Location 5-C2) and select ALARM 1 from the menu for CO 1 and ALARM 2 for CO 2.
7. Access FUNC 1 DISPLAY (Location 5-E1) and go to DISPLAY ALARMS (Location 5-E2. Select MEAS ALARMS from the menu and then select YES.
8. Access ALLTUNE ALARMS (Location 4-A2) and go to ALARM 1. Select the desired values for LEVEL 1, LEVEL 2 and DB.
9. Go to ALARM 2 and select the desired values of LEVEL 1, LEVEL 2 and DB for ALARM 2.

This may be shown pictorially as:



Alternate Station Configurations

This section contains the following subjects:

Dual Controller

You can use the 762CNA as two controllers with independent control strategies. All control functions (P, I, PI, PD, PID, and EXACT) are available to each loop. Specify the STRATEGY as TWO FUNC at Location 5-B1 in the structure diagrams. Then configure the first loop in CONFIG FUNC 1 and the second loop at CONFIG FUNC 2, both at Location 5-A1 in the structure diagrams.

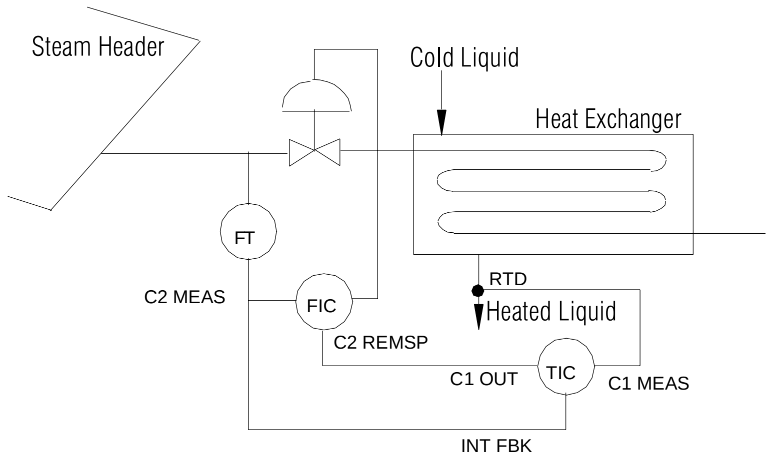
Cascade Controller

You can also configure the 762CNA to operate as a cascade controller. As such, the output of Controller 1 (primary controller) is used as the set point or ratio input of Controller 2 (secondary controller). The configuration allows bumpless transfers between auto/manual modes and between remote/local set point modes. To configure the 762CNA as a cascade controller, specify the STRATEGY as CASCADE at Location 5-B1 in the structure diagrams. Then configure the primary controller at FUNC 1 and the secondary controller at FUNC 2, both at Location 5-A1 in the structure diagrams.

Example A single station cascade controller is required as shown in Figure 4-10. As steam is drawn from the header, the pressure drops, reducing the flow to the heat exchanger and causing fluctuations in heated liquid temperature. By measuring the steam flow, the secondary controller can quickly adjust the steam flow to compensate for pressure fluctuations, thus minimizing the temperature variation seen in the heated fluid.

Example (cont.)

Figure 4-10. Single Cascade Controller Example



The primary is a temperature controller (RTD Option is used) and the secondary is a flow controller. The integral feedback (INT FBK) to the primary is the measurement of the secondary.

For this example, start with configuration of STRATEGY to CASCADE. Next, configure the primary, then the secondary, and finally the inputs.

1 Access CONFIG STRATEGY (Location 5-A1) and select CASCADE from the menu.

2 Access CONFIG FUNC 1 and go to DISPLAY (Location 5-E1).

3 At this point you would configure MEAS, SP TYPE as TEMP, and then the SCALE, ENG UNiTS, and range (URV and LRV), if given, in the example at Location 5-E2 and 5-E3.

4 Access CONFIG FUNC 1 and go to MEAS (Location 5-G2). Select LINEAR from the menu for FORMAT.

5 Select A from the menu for SOURCE. INPUT 1 must be used for an RTD and A is INPUT 1 after signal conditioning.

6 Access CONFIG FUNC 2 and go to DISPLAY (Location 5-E1).

7 At MEAS, SP (Location 5-E2), go to TYPE and select LINEAR.

8 Access CONFIG FUNC 2 and go to MEAS (Location 5-G2). Select B from the menu for SOURCE. (Flow Measurement)

9 Access CONFIG INPUTS and go to INPUTS A (Location 5-B2).

10 Go to FORMAT and select LINEAR from the menu.

11 Go to INPUTS B and repeat Step 10.

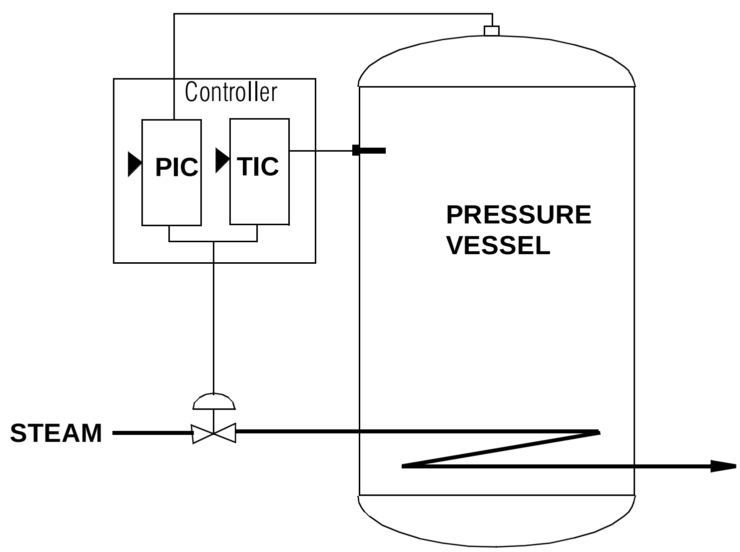
This completes the configuration of the requirements given for this example.

Auto Selector Controller

You can also configure your instrument to operate as a two-controller auto selector station, as shown in Figure 4-11. In auto selector mode, a single valve is controlled by more than one controller. Typical applications are processes such as shown in the diagram in which a vessel is normally controlled to maintain a certain temperature, but at other times must be controlled to maintain pressure.

As long as pressure is within an acceptable range, temperature is controlled. If pressure rises above a specified value, steam flow must be decreased to keep the pressure within range. As pressure rises and falls, control is required to transfer smoothly from temperature to pressure and vice versa. Because the outputs of two controllers are tied together and control shifts from one to the other, feedback is provided to prevent wind-up in the controller that is not currently active. If this were not provided, control might overshoot wildly whenever control is transferred from one controller to the other.

Figure 4-11. Typical Auto Selector Control Application



To configure the 762CNA as an auto selector controller, specify the STRATEGY as AUTO SEL at Location 5-B1 in the structure diagrams. Next, specify TYPE to be HI SELECT, LO SELECT, or GATE 4. For HI SELECT, the higher output (C1 OUT or C2 OUT) is selected; for LO SELECT, the lower output is selected. When GATE 4 is TRUE, C1 OUT is selected; when FALSE, C2 OUT is selected. If configured as HI SELECT or LO SELECT, specify if the TRK MAN feature is to be used. TRK MAN connects the OUT TRK switches and signals so that placing one controller in MANUAL, puts the other controller into track. Then configure the first controller as FUNC 1 and the second controller as FUNC 2, both at Location 5-A1 in the structure diagrams.

Auto/Manual Station

You may also configure the 762CNA as one or two auto/manual transfer stations. If a controller or indicator is configured, only one auto/manual station is available. Configuring your instrument as an auto/manual station will enable you to manually select either an incoming signal or a manually-adjusted signal and send the results to a valve or other receiver. This allows you to interrupt a signal that is sourced from another device and manually take control of it. In addition, all of the supporting functions available in the controller (e.g., calculation blocks) are available in the auto/manual station.

To configure the 762CNA as an auto/ manual station, specify the STRATEGY as ONE FUNC or TWO FUNC at Location 5-A1 in the structure diagrams. Then configure FUNC 1, FUNC 2, or both as A/M STN at Location 5-B1 in the structure diagrams. From there go to Location 9 to configure the details of your auto/manual station. Configure the set point display type to NONE to eliminate the normal controller set point function and bargraph.

NOTE Check the BIAS under OPTUNE or ALLTUNE, as it affects the output when in AUTO mode. For proper operation as an A/M Station, the BIAS should be set to zero.

Indicator Station

You can also use the 762CNA as one or two 3-variable indicators. Each variable has its own bargraph, digital engineering units, and loop tag. If a controller or auto manual station is configured, only one 3-variable indicator is available. To configure the 762CNA as a 3-variable indicator:

1. Specify the STRATEGY as ONE FUNC or TWO FUNC at Location 5-B1 in the structure diagrams.
2. Configure FUNC 1, FUNC 2, or both as 3 BAR IND at Location 5-B1 in the structure diagrams.
3. Go to Location 8 to configure the details of each of the bargraphs of your 3-variable indicator.
4. Specify a 9-character loopTAG. If a blank TAG line is desired, then blank entries must be made.
5. Specify the TYPE of indication (LINEAR or TEMP), ENG UNiTS and range (URV and LRV). If you select TEMPerature, specify the SCALE as IEC 100 or SAMA 100 for an RTD input or T/C J, T/C K, or T/C E for a temperature transmitter thermocouple input. Specify the ENG UNiTS as DEG F or DEG C.
6. Specify the SOURCE of the variable indicated from the Signal Distribution List. A SOURCE selection of NONE blanks the respective bargraph and its digital display.
7. Specify for each variable, whether or not alarms should be displayed at Location 8-B2. For an alarm to appear on a given bargraph, there must be an alarm ATTACHED to the SOURCE of that bargraph. Alarms are configured at Location 5-A2.

Additional Configuration Functions

This section contains the following subjects:

Logic Gates

There are five single input gates and five dual input gates. See Table 4-12. Each gate is configured by selecting the LOGIC and then selecting the source of the INPUT from the Gate Input List. Gates 0 through 4 are the single input gates and each one is configured DIRECT or NOT. Gates 5 through 9 are the dual input gates and each one is configured OR, NOR, AND, NAND, XOR, or XNOR. The configuration is done at Location 5-A3 in the structure diagrams.

Table 4-12. Configuring Logic Gates

Gate	Logic	Input 1	Input 2	Output
0 - 4	DIRECT	True False	N/A	True False
0 - 4	NOT	True False	N/A	False True
5 - 9	OR	True True False False	True False True False	True True True False
5 - 9	NOR	True True False False	True False True False	False False False True
5 - 9	AND	True True False False	True False True False	True False False False
5 - 9	NAND	True True False False	True False True False	False True True True
5 - 9	XOR	True True False False	True False True False	False True True False
5 - 9	XNOR	True True False False	True False True False	True False False True

When gate states are read on the display (Location 1-C3), True status is represented by the term "closed" and false status by the term "open".

Gates are cascadeable. They are evaluated in ascending order once each 100 milliseconds. They are intended primarily for combinational rather than sequential logic. See Example 3 on page 84 and Example 4 on page 85 in the Calculation Examples section.

Calculations

The output of the CALCulation blocks can be derived from a calculation involving a number of inputs. These inputs may be direct inputs to the controller, conditioned and scaled inputs, constants, or the output of another CALCulation block.

The characters available for use in the equations are listed in Table 4-13.

Table 4-13. Characters for Use in Calculations

Character	Description	Character	Description
A	Analog Input A	X	Output of Calculation CALC 1
B	Analog Input B	Y	Output of Calculation CALC 2
C	Analog Input C	Z	Output of Calculation CALC 3
D	Analog Input D	@	AOUT 1 Output
E	Frequency Input E	(	Open Bracket
F	Frequency Input F	√	Square Root Brackets
G	Constant G	)	Closed Bracket
H	Constant H	*	Multiplication Operator
I	Constant I	/	Division Operator
J	Constant J	-	Subtraction Operator
K	C2 Local Set Point	+	Addition Operator
L	C1 Local Set Point	>	Greater than (high select)
M	C1 Measurement	<	Less than (low select)
N	C2 Measurement	0	Output of Gate 0
O	C1 Output	1	Output of Gate 1
P	C2 Output	2	Output of Gate 2
Q	C2 Remote Set Point	3	Output of Gate 3
R	C1 Remote Set point	4	Output of Gate 4
S	C1 Active Set point	5	Output of Gate 5
T	C2 Active Set point	6	Output of Gate 6
U	AOUT 2 Output	7	Output of Gate 7
V	TOTAL 1*	8	Output of Gate 8
W	TOTAL 2*	9	Output of Gate 9
		(blank)	Terminates the Equation

*Lower two bytes of 3-byte number

Each equation may have as many as nine characters. Each character is selected using the up and down arrow keys. In each position in the equation, only those characters that may be entered are available in the selection list. For example, a variable can not follow a variable and is not offered for selection at that point. The selected character is entered using the ACK key. The cursor then moves one position to the right.

The usual rules of mathematics apply. However, there are a few additional rules.

Calculations (cont.)

1 To save space, if there is an open bracket with no associated closed bracket, there is an implied closed bracket to the right of the rightmost character. Similarly, if there is a closed bracket with no associated open bracket, there is an implied open bracket to the left of the leftmost character. For example, (A/B)*(D+H) has 11 characters and thus exceeds the limit of nine. This can be made acceptable by rewriting the equation as A/B)*(D+H.

2 A square root is treated like an open bracket during evaluation except that the square root is taken after evaluating the contents of the bracket. For example, in the expression A * √ (B + C), B is added to C, then the square root of the sum is taken and multiplied times A.

3 The left argument of a gate is selected in the True state and the right argument in the False state. For example, in the equation CALC 1 = A0B, CALC 1 = A if the output of Gate 0 is True but CALC 1 = B if the output of Gate 0 is False. Thus gates can perform switch functions.

4 The order of evaluation is:

Contents of a bracket pair

All gates (switches) left to right

All selectors left to right

All multiplications and divisions left to right

All additions and subtractions left to right

The SEL key will move the cursor one position to the left. If the SEL key is pressed when the cursor is in the leftmost position, the equation entry is aborted. If in going back to make a change, the up or down arrow key is used to select a different category from the current selected character, the characters to the right of the cursor position are blanked.

Several examples are given below to help you understand how to configure this powerful function.

Example 1: Simple Math

A controller is used for pressure-temperature compensated head flow. The equation measurement = √hP/T applies. The head is INput 1; the pressure, INput 2; and the temperature, INput 3. Because the inputs and output are expressed in percent of range, a scaling factor, G, is required. Its value is set in ALLTUNE.

To enter this, choose CALC 1 (or CALC 2 or CALC 3) to be the calculation. The scaled INputs 1, 2, and 3 are A, B, and C respectively.

Example 1: Simple Math (cont.)

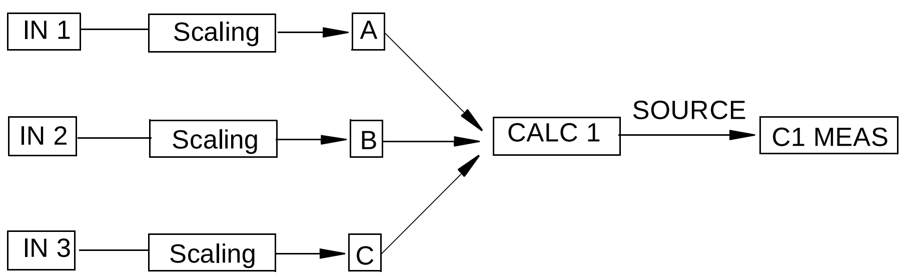
Nine characters can be entered to form an equation. Since the √ is treated like an open bracket, all terms to the right (up to a closed bracket if there is one) are evaluated and then the result is square rooted. Therefore, the equation is CALC 1 = √A*B*G/C and the calculation entry is √A*B*G/C at Location 5-C1 in the structure diagrams. Only eight of the available nine character spaces were required.

Later in the configuration, CALC 1 is assigned as the SOURCE of the Controller 1 measurement (FUNC 1 MEAS) at location 5-G2 in the structure diagrams.

Example 2: Signal Selecting

An application requires selection of the measurement based on the highest of three temperature transmitter inputs. INputs 1, 2, and 3 are utilized.

The scaled INputs 1, 2, and 3 are A, B, and C respectively. CALC 1 is chosen to be the calculation variable. The equation is CALC 1 = A>B>C and the calculation entry is A>B>C at Location 5-C1 in the structure diagrams. The result of CALC 1 will be the highest value of A or B or C. Later in the configuration, CALC 1 is assigned as the SOURCE of the Controller 1 measurement (FUNC 1 MEAS) at location 5-G2 in the structure diagrams. This completes the application requirement. It is shown pictorially as:



Example 3: Signal Switching

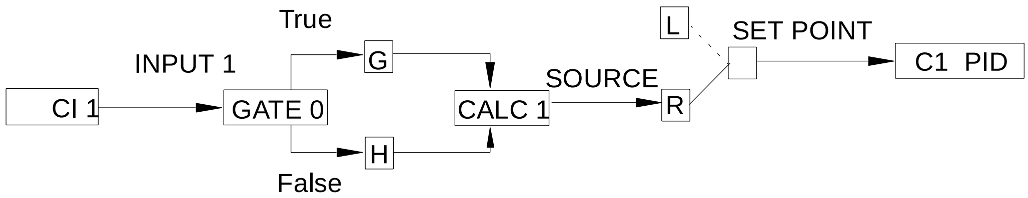
Depending on the state of an external contact, either one of two set points are required by the controller.

Gates 0 through 9 behave like switches when used as operators in a calculation. If the gate output is true, the variable or expression to the left of the gate is used. If the gate output is false, the variable or expression to the right is used.

CALC 1 is chosen to be the calculation variable. Constants G and H are used to store the two set points. The equation is CALC 1 = G0H and the calculation entry is G0H, where 0 is the output of Gate 0. The calculation entry is made at Location 5-C1 in the structure diagrams.

Example 3: Signal Switching (cont.)

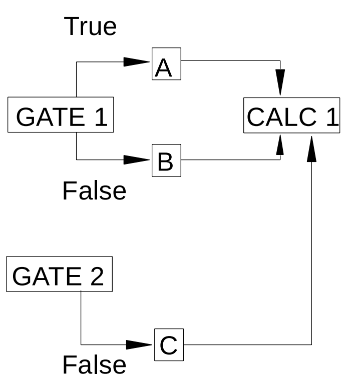
The input of Gate 0 is assigned to a contact input to cause its state to change. If the controller is configured for remote/local (R/L) set point operation and CALC 1 is assigned as the source of the remote set point, either the value of G or H will become the set point depending on the state of Gate 0. This is shown pictorially below:



NOTE See Alarm Configuration "Example 4" on page 74 to see how a Permissive alarm can trigger a switch.

Example 4: Using Gates Together

Following up on the previous example, two or more gates may be used together. If we want the result of CALC 1 to be A if Gate 1 is in the true state and B if Gate 1 is in the false state, the equation is CALC 1 = A1B. If we want the results of that equation to be further modified to be C if Gate 2 is in the false state, the equation becomes CALC 1 = (A1B)2C and the calculation entry is (A1B)2C. This expression could be simplified as A1B)2C with the same results. This is shown pictorially as:



It may also be expressed as:

GATE 1	GATE 2	CALC 1
True	True	A
False	True	B
True	False	C
False	False	C

Example 5: Ramping Set Point

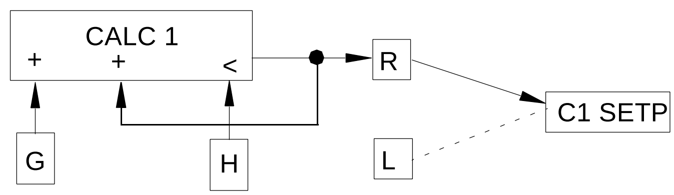
A ramp can be generated by taking advantage of the calculation function's capability to reuse a calculation within the same expression.

CALC1 = CALC1 + G will create a ramp since the value of CALC1 is incremented by the constant G in each computation cycle.

Furthermore, if the calculation is expanded to be CALC1 = (CALC1 + G) < H, the ramp will continue as long as its value is less than the constant value H and will stop ramping when its value reaches H.

Symbolically, this appears as X + G) < (H in the calculation entry.

If the controller is configured for Remote/ Local (R/L) set point operation and CALC1 is assigned as the source of the remote set point, then the set point will be the ramping value up to a maximum value of constant H. This is shown pictorially as:



Dynamic Compensation

Dynamic Compensation is used often in feedforward control strategies to help optimize the model response.

The result of CALC 3 can be passed through a dynamic compensator prior to signal distribution. The dynamic compensator is composed of DEAD-TIME and LEADLAG functions, each with its own FOLLOW switch. The DEADTIME precedes the LEADLAG and is the input of the LEADLAG function. The ratio of lead to lag is controlled by a user specified GAIN factor. The result may also be subjected to a specified bias. The lag is controlled by specifying lag time (T). See Figure 4-12 and Figure 4-13.

The user can also configure an impulse option. If this option is configured, the GAIN is applied as usual but the steady state settles out to a zero level (plus BIAS) rather than at the new input value. If either POSITIVE or NEGATIVE impulse modes are configured, only a positive or negative shift in the input value is detected and the corresponding output pulse is positive or negative (again returning to the bias baseline at the lag time rate). The configuration for both a POSITIVE and NEGATIVE impulse option is BIPOLAR. See Figure 4-12 and Figure 4-14.

Dynamic Compensation (cont.)

When a process variable (CALC 3) connected to the function varies by some amount (delta), the block output value will lag, track, or lead the CALC 3 change, depending on whether a gain of 0 (lag), 1 (track), or n>1 is specified.

Figure 4-12. Dynamic Compensation

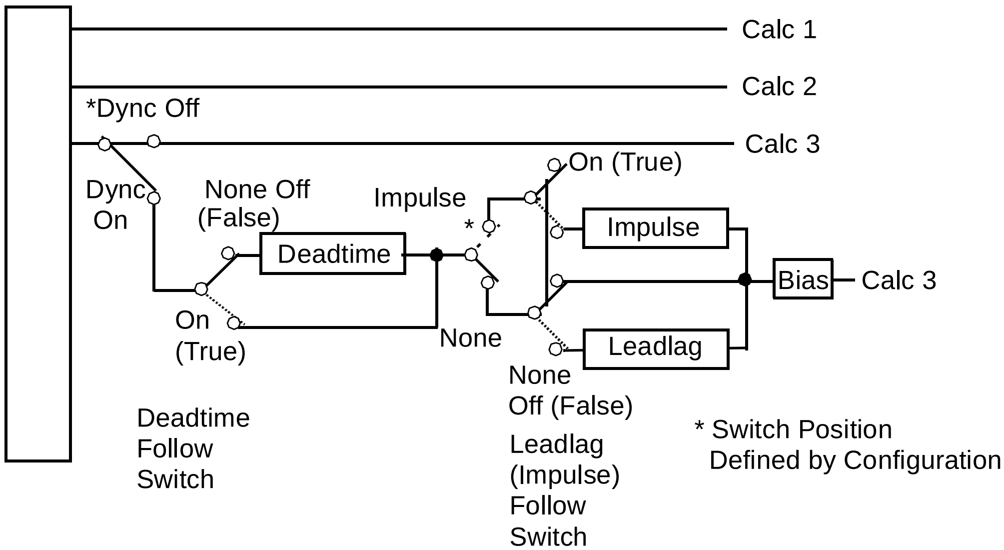


Figure 4-13. Nonimpulse Mode

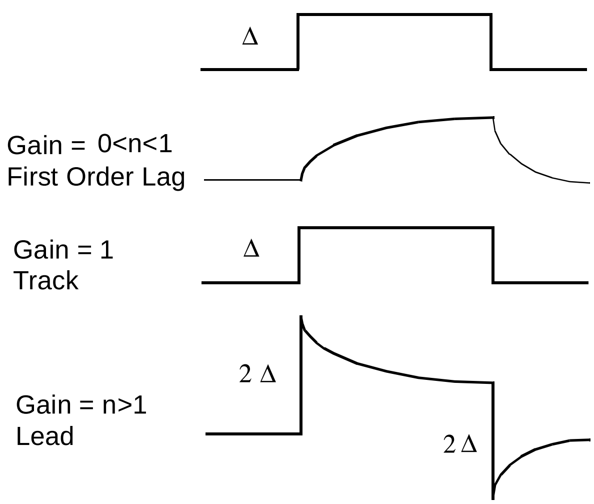
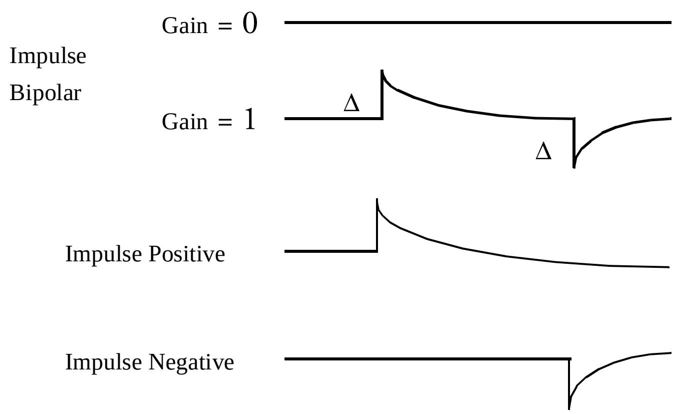


Figure 4-14. Impulse Mode

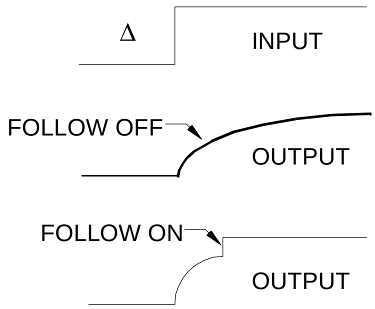


As shown in Figure 4-13, lead action is applied in the form of an instantaneous amplification of the change in CALC 3 value (delta). The increase in the block output value lags, or decays, to a steady state representing the new level of CALC 3 (plus any user specified BIAS applied to the output of the function. The time constant required to settle out is configured as LEADLAG TIME by the user. Lag action is applied by specifying a GAIN of 0, in which case the output change in value simply lags the CALC 3 step change by the specified LEADLAG TIME. With a GAIN of 1, the output value follows (tracks) the input (CALC 3) value.

If the optional IMPULSE mode is configured, the GAIN is applied as in the nonIMPULSE mode, but the steady state settles out to a zero level (plus BIAS) rather than at the new input (CALC 3) value. If either POSITIVE or NEGATIVE IMPULSE modes are configured, only a positive or negative shift in the input value will be detected, and the corresponding output pulse will be positive and negative respectively (again returning to the bias baseline with the LEADLAG TIME exponential decay). See Figure 4-14.

The DEADTIME and LEADLAG functions each have their own FOLLOW switches which can be used to bypass either or both functions when the state of these switches is TRUE. When one of these functions are employed, and its follow switch is activated, the output jumps to the input. See Figure 4-15. Any entry from the Gate Input List can be used to drive the Deadtime and Leadlag Follow switches.

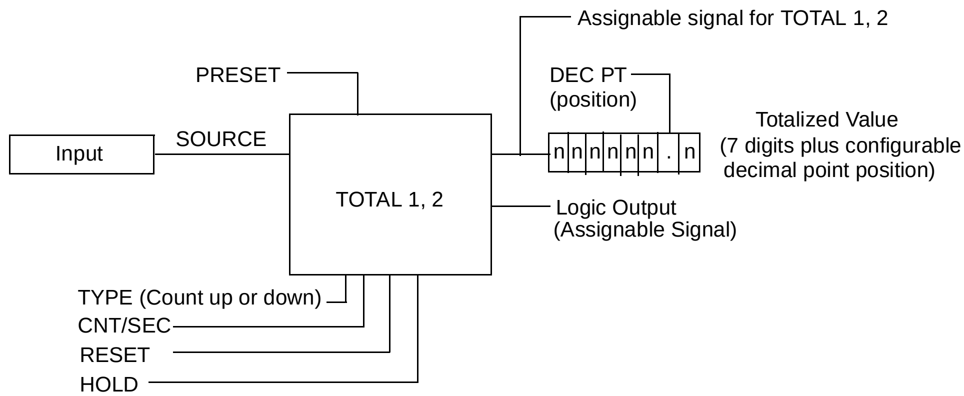
Figure 4-15. Follow Switches



Totalizers

Up to two 7-digit totalizers are available. The totalizers can be configured to integrate up to a preset value or down from a preset value to zero and produce a logic event output. Any internal or external signal can be totalized.

Figure 4-16. Totalizer



Totalization and EXACT tuning are mutually exclusive. For example, if one controller is configured for EXACT tuning, only the other faceplate can be configured for totalization; if both controllers are configured for EXACT tuning, no totalizers will be available. However, if FUNCtion 1 is configured for EXACT, a signal associated with FUNCtion 1 can be totalized with the totalizer in FUNCtion 2.

1. Begin CONFIGuration of a Totalizer at Location 5-A1 in the structure diagrams.
2. At the prompt TOTAL n, select YES and ACKnowledge if you wish to configure the totalizer.
3. Specify its TAG, the SOURCE of what is being totalized from the Signal Distribution List, the CouNT/SECond (at 100% signal level), the DECimal PoinT position in the totalizer display, the events from the Gate Input List that you wish to HOLD (deactivate) and RESET the totalizer, and the TYPE of totalizer (COUNT UP or COUNT DOWN).

Totalizers (cont.)

4 Tune the totalizer at Location 5-A3 in the structure diagrams by specifying TOTAL (the starting point if not zero or the preset value), PRESET (the value it is to count up to or down from), and STATE (whether the totalizer is to be enabled [COUNT] or disabled [HOLD] or RESET). The STATE is only available in the menu at this location when the HOLD and/or RESET switches in the totalizer configuration menu (Location 5-B1) have been sourced to NONE.

Example 1: Inventory Control

A process flow requires continuous totalization. The totalizer source is conditioned signal A from analog input 1. The totalizer is to count up. Since totalization is continuous, the HOLD and RESET logic inputs are not required. The scale factor is set to produce 3600 counts/minute (60 counts/second) when the flow rate is at 100%.

1 Begin configuration at TOTAL 1 at Location 5-A1 in the structure diagrams.

2 If TOTAL 1 reads NO, change to YES.

3 Specify desired TAG.

4 Specify SOURCE as signal A.

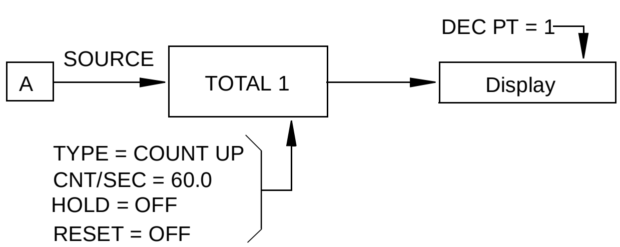
5 Specify CNT/SEC as 60.0 counts/second.

6 Specify DEC PT as 1 (meaning one place from the right).

7 Specify HOLD and RESET as OFF. This prevents the totalizer from being interrupted (HOLD) or cleared (RESET) unless reconfigured.

8 Specify TYPE as COUNT UP.

This is shown pictorially as:

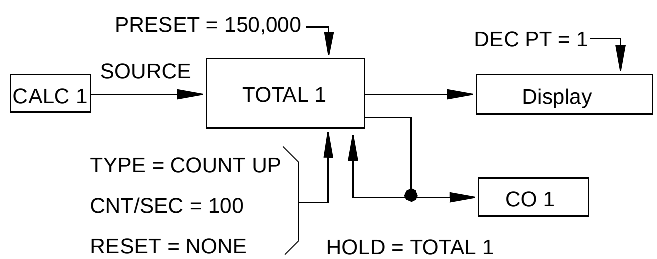


Example 2: Batching

A totalizer is used to batch 150,000 pounds of a product. The product rate is computed in a calculation. The totalizer is reset manually by the operator. A logic signal trips a solenoid when the batch ends. The scale factor is set to produce 100 counts/second when the product rate is 100%.

1. Begin configuration at TOTAL 1 in Location 5-A1 in the structure diagrams.
2. If TOTAL 1 reads NO, change to YES.
3. Specify desired TAG.
4. Specify SOURCE as CALC 1.
5. Specify CNT/SEC as 100.
6. Specify DEC PT as 1 (meaning one place from the right).
7. Specify HOLD as TOTAL 1 from the Gate Input List. This ensures that the totalizer will stop when the PRESET value is reached.
8. Specify RESET as NONE. This allows the TOTAL to be RESET (cleared to zero) in OPTUNE or ALLTUNE at Location 4-B3 in the structure diagrams.
9. Specify TYPE as COUNT UP.
10. Go to Location 4- B3 in the structure and specify PRESET 1 as 150,000.
11. Go to CO 1 at Location 5-C2 in the structure and select TOTAL 1 from the menu to actuate CO 1 for the solenoid.

This is shown pictorially as:



Set Point

The set point may be configured as LOCAL, REMOTE/LOCAL (R/L), or RATIO. Whatever your selection, you may configure the controller to have the local set point track the measurement by specifying a parameter from the Gate Input List to activate the measurement tracking switch. This is done at MEASTRK in Location 5-G1 in the structure diagrams.

If you configure the controller R/L, you may also configure the following features:

Set Point (cont.)

- Specify that the local set point track the remote set point (LOCTRK) when in REMOTE and when one of the parameters from the Gate Input List activates the set point local tracking switch.
- Specify that a parameter from the Gate Input List SWITCH remote to local control and vice versa. A configuration of ON or to an entry from the Gate Input List whose logic is in the True state fixes the control in the REMOTE mode. Conversely, OFF or (False) fixes the control in the LOCAL mode.

NOTE A switch assignment other than NONE has priority over the R/L key or the communication link. For example, if R/L is assigned through Gate 1, the R/L key or a supervisory host command to change R/L status is ignored.

- Specify (in STARTUP) whether the controller is to be in REMOTE or LOCAL upon restart after a power failure.
- Specify INBIAS applied to the remote signal.
- Specify the SOURCE of the remote set point to be any signal from the Signal Distribution List.

To configure your instrument as a ratio controller, see See “Ratio Control” on page 93.

Configuration of these features are done at Location 5-G1 in the structure diagrams.

Lastly, the set point may be FORMATted to be linear, squared, square rooted, or characterized over one of two selectable series of points.

When configured as REMOTE/LOCAL, the R/L key on the front of the controller can change the set point operation from REMOTE to LOCAL and vice versa. The function switch R/L must be configured to NONE. If the W/P feature is configured ON, the controller must be in the panel mode (P).

Set Point Configuration Example 1

A Remote/Local set point controller is required. The local set point must track the remote value when the controller is in Remote.

1. Access CONFIG FUNC 1 (Location 5-A1) and go to SET PT (Location 5-G1).
2. Select R/L for TYPE.
3. Go to LOCTRK (Location 5-H1) and select ON from the menu. The configuration of this example is now complete.

Set Point Configur-ation Example 2

The R/L status should always be in Remote during normal operation.

1. Access CONFIG FUNC 1 (Location 5-A1) and go to SET PT (Location 5-G1).
2. Select R/L for TYPE.
3. Go to SWITCH (Location 5-H1) and select ON from the menu. The configuration of this example is now complete.

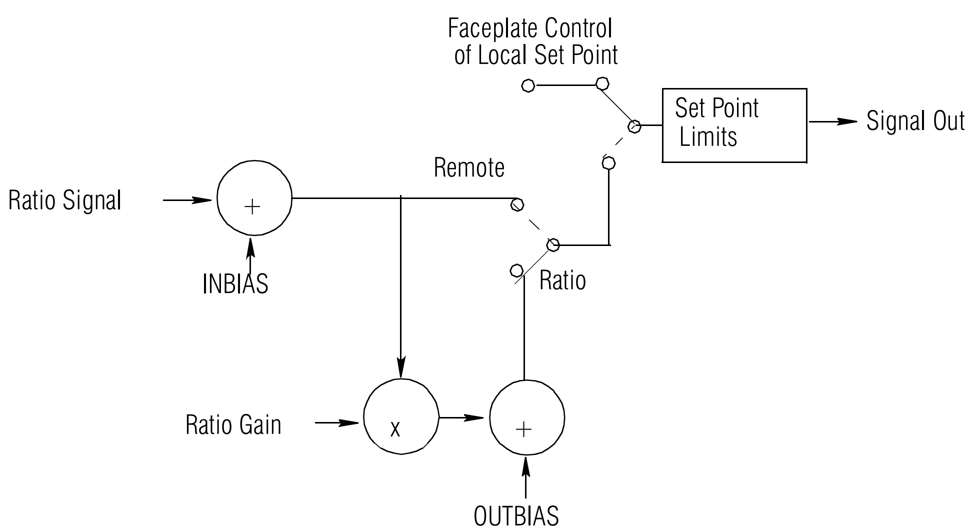
Set Point Limits

Set point limits apply to both local and remote set points. Specify them in ALLTUNE at Location 4-B1 of the structure diagrams.

Ratio Control

When using the 762CNA as a ratio controller, access SET PT at Location 5-G1 in the structure diagrams and select RATIO as the TYPE. Specify the RL LOGIC (LOC TRK, SWITCH, and STARTUP) as described in “Set Point” on page 91. Then select the SOURCE of the ratio SIGNAL and set an INBIAS if required. The biased signal can be multiplied by a RANGE factor of from 0 to 1 to 0 to 5. It then can have an OUTBIAS added. See Figure 4-17. The ratio SOURCE can be entered from the controller face-plate (or workstation) or can be any signal ROUTED from the Signal Distribution List as configured.

Figure 4-17. Ratio



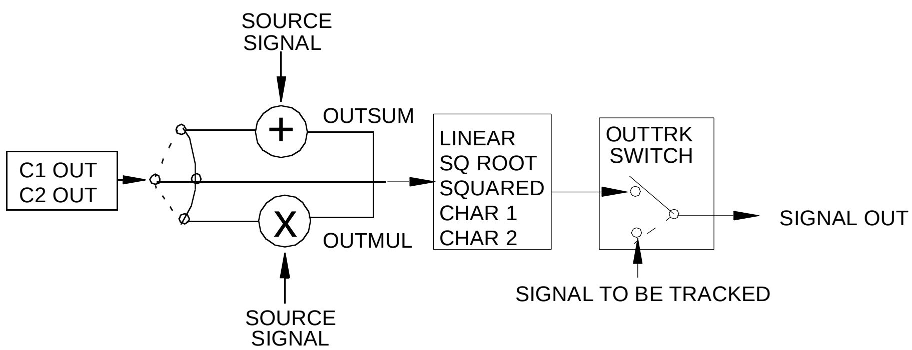
Output Summing and Multiplying

The OUTPUT can be modified by adding to it (OUTSUM), or multiplying it by (OUTMUL) a parameter from the Signal Input List in percent (divided by 100). This is done in OUTPUT MODIFIER at Location 5-G2 in the structure diagrams. The result then can then be FORMATted as linear, squared, square rooted, or characterized over one of two selectable series of points. See Figure 4-18.

Output Tracking

The OUTPUT can also be configured so that the OUTTRK SWITCH entry made from the Gate Input List causes the output to track (OUTTRK) a SOURCE that is specified from the Signal Input List. This is done at Location 5-G2 in the structure diagrams. See Figure 4-18. The output is not bumped on a transfer from track to run.

Figure 4-18. Output Modification and Tracking

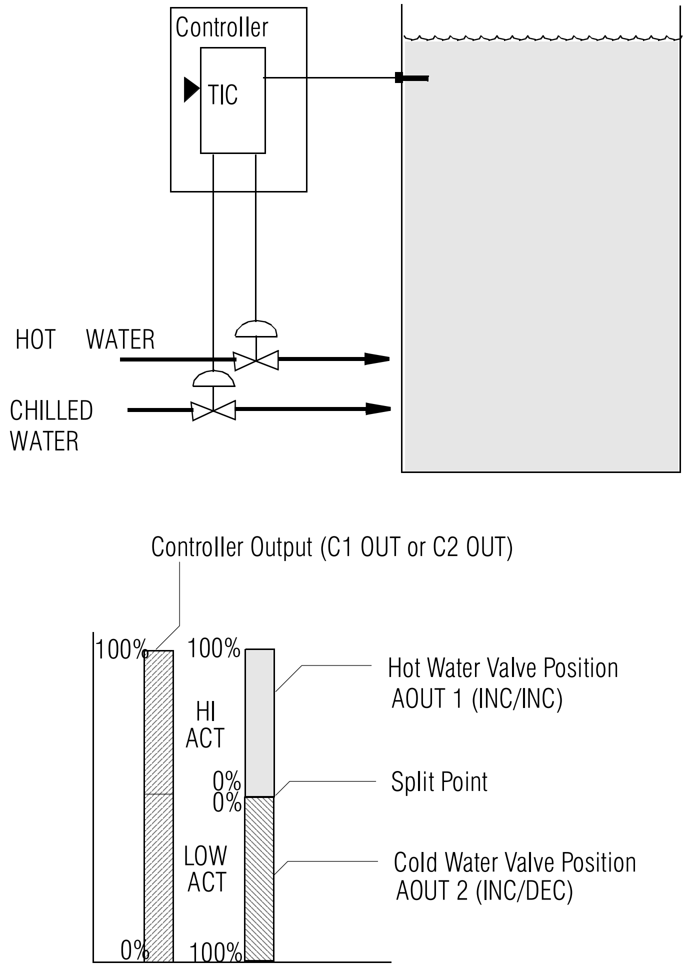


Split Range Output

You can configure the two analog outputs of the 762CNA for split range control of two valves by a single controller. This feature is available on Controller 1 and in Cascade and Auto Selector configurations. A typical application is illustrated in Figure 4-19. In this application, temperature is controlled by alternately controlling the flow of hot water and chilled water to a vessel.

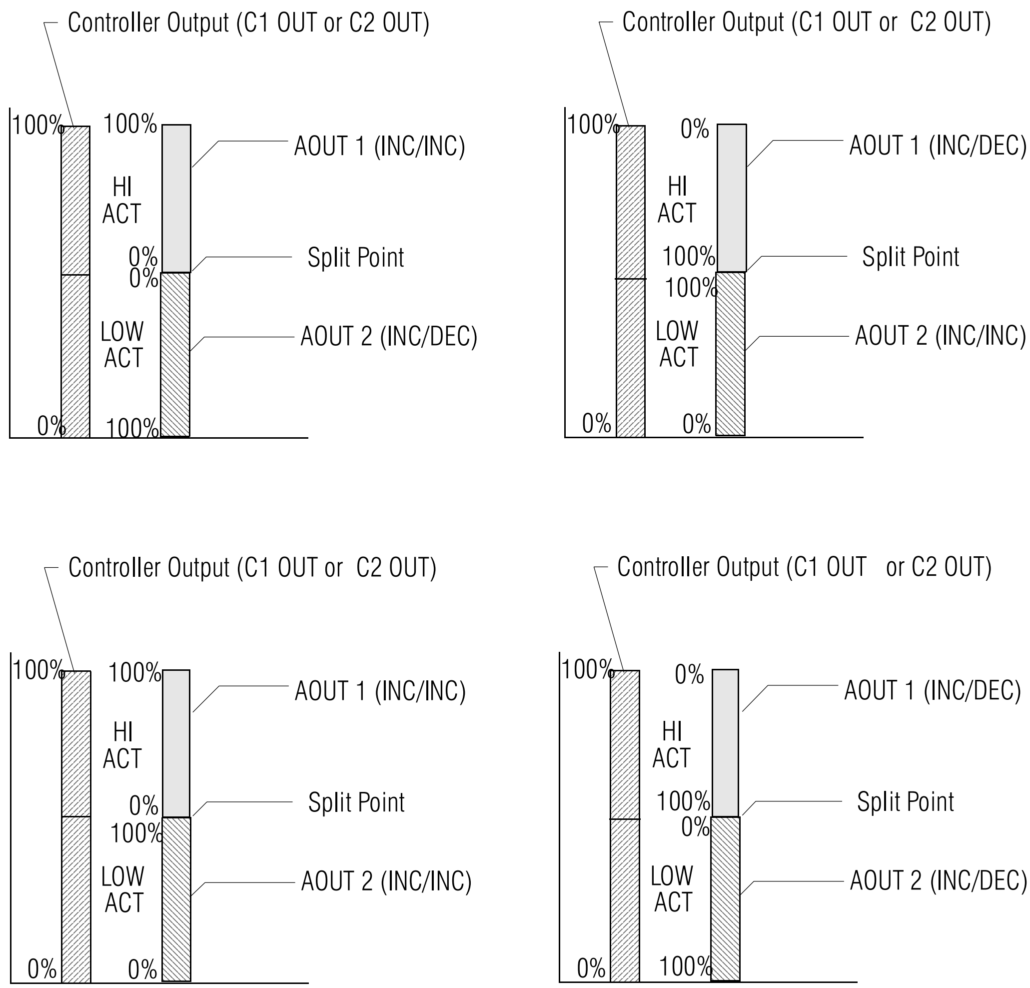
As shown in the diagram, when the controller output is in the upper part of its range, the chilled water valve is closed and the hot water valve is throttling. Conversely, when the controller output is in the lower part of its range, the hot water valve is closed and the chilled water valve is throttling. The split point and its associated dead band determine how this transition occurs.

Figure 4-19. Split Range Application



To configure Split Range Output, go to CONFIG OUTPUTS at Location 5-C2 in the structure diagrams and specify SPLT RNG YES. Specify the SPLIT PT in percent of controller output. Next, set the DEADBAND. Then specify the controller action in the low (LOW ACT) and high (HI ACT) portions of the range. In each portion of the range, you may configure the analog output (AOUT n) to increase with decreasing controller output (Cn OUT) (INC/DEC) or increase with increasing controller output (INC/INC). See Figure 4-20. Lastly, specify the deadband which creates a symmetrical zone on either side of the split point during which no output change occurs.

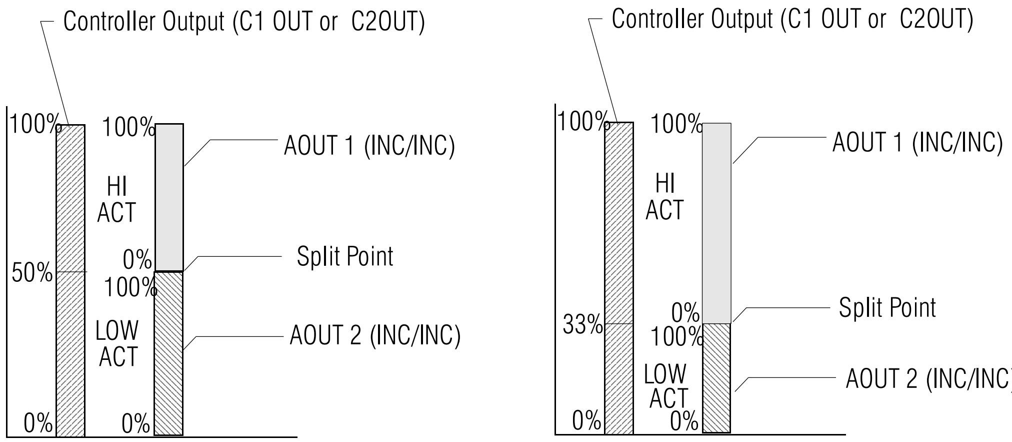
Figure 4-20. Split Range Diagrams



Split Range Output (cont.)

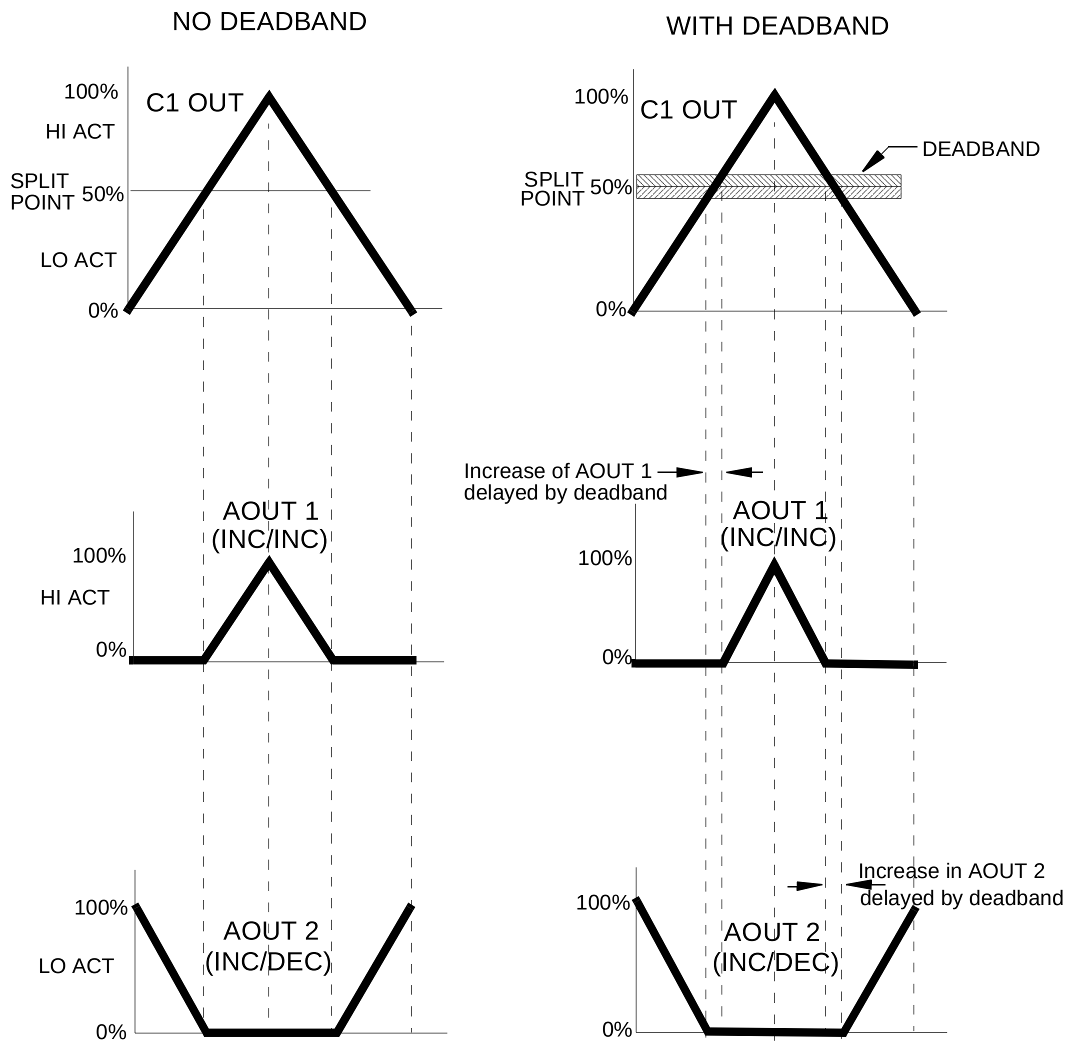
In Figure 4-21, note that moving the split point effectively changes the gain between AOUT 1 and AOUT 2. In the left diagram, the gain of AOUT 1 to C1 OUT and AOUT 2 to C1 OUT are equal since a 50% change in C1 OUT results in a 100% change in both AOUT 1 and AOUT 2. In the right diagram, the gain of AOUT 2 to C1 OUT is higher than AOUT 1 to C1 OUT since only a 33% change in C1 OUT causes a 100% change in AOUT 2 while a 67% change in C1 OUT is required to cause a 100% change in AOUT 1. This relationship is convenient for loop tuning.

Figure 4-21. Effect of Shifting Split Point



In Figure 4-22, note that a deadband of 0% results in no delay between AOUT 1 and AOUT 2 at the split point; e.g., one valve opens when the other closes. Adding a deadband introduces a delay between AOUT 1 and AOUT 2 at the split point; e.g., both valves are closed. The larger the deadband, the longer both valves are closed.

Figure 4-22. Effect of Deadband



Output Limits

High and low external limits (EXTLIM) can be configured to be any SOURCE selected from the Signal Distribution List. Each limit can be transferred between its internal and external value by a SWITCH from the Gate Input List. ON (True) sets the limits to external; OFF (False) and NONE to internal. Configuration of EXTLIM is done at Location 5-G3 in the structure diagrams. Internal limits can be tuned in ALLTUNE (OPTUNE) at Location 4-B1. The internal limits are independent of the external limits. Output limits are applied prior to split ranging.

If batch action is used, OUT HLIM represents Hi Batch Trip and OUT LLIM represents Lo Batch Trip.

Output Action

You may configure the controller algorithm output (C1 OUT or C2 OUT) to increase with decreasing measurement (INC/DEC) or increasing measurement (INC/INC). This is done at ACTION in Location 5-G2 in the structure diagrams.

Output Upon Restart (STARTUP)

The value of output upon restart (STARTUP) after a power loss can be configured to any value from 0% to 100% or the last value before the power loss occurred. This is done at OUTPUT STARTUP in Location 5-G3 in the structure diagrams.

Output Reverse

The output bargraph on the controller display is normally a direct indication of the output signal and the manipulated variable. Increasing the controller output raises the bargraph (and the corresponding digitally displayed value), increases the manipulated variable and usually, but not always, increases the process or measured variable.

In some applications, a valve operator or positioner is selected for fail-safe or other reasons, where an increase in controller output actually decreases the manipulated variable. If not addressed, this can result in confusion when viewing the display, as well as improper implementation of high-low alarms and high-low limits.

This can be easily compensated for, by first completely configuring the controller just as if the manipulated variable changed *directly* with the output, and then, as the last step, simply selecting YES for REVERSE in the OUTPUTS, AOUT1/AOUT2 menu (Location 5-D2 in the structure diagrams). When configured in this manner, the output bagraph will rise and the manipulated variable will increase when the analog output decreases, thus providing the proper response with a reverse acting valve operator.

Output Bargraph

The Output Bargraph causes any item from the Signal Distribution List (Location 6) to be displayed on the output (right) bargraph. This allows you to indicate a true (live) output. For example, the output from a valve position transmitter could be connected to an unused input which then could be displayed on the output bargraph. This feature is configured at OUTBAR in Location 5-E2 in the structure diagrams.

Characterizers

Characterization consists of one or two curves of 8 segments (9 points). Each curve may be assigned to any of the following signals:

- Analog Input A, B, C, or D (Location 5-B2)
- Frequency Input E or F (Location 5-B2)
- Measurement of a Controller, MEAS (Location 5-G2)
- Set point of a Controller, SET PT (Location 5-G1)
- Nonlinear Controller, NONLIN (Location 5-G2)
- Output of a Controller, OUTPUT (Location 5-G2)
- Calculation, CALC (Location 5-C1)

NOTE Vertical slope of a curve is not allowed (for any one value of X there can be only one value of Y).

Entries may be expressed in whole numbers or to tenths of a whole number.

The specification of the sequence of X, Y pairs is done at Location 5-D1.

Nonlinear Control

The controller error (difference between measurement and set point) may be characterized over one of two selectable series of points at Location 5-G2 in the structure diagrams. This type of control is often used for difficult pH applications when the set point is not changed and when set as a deadzone for nonlinear filtering of error noise. See section immediately above for more information on Characterization.

pH Display

The display of the measurement, local set point, or remote set point may be displayed before or after the signal is characterized. If pH DISP is activated (ON) the displays are before characterization. This feature is often used on a pH application when it is important for the operator to read pH, but control be performed on concentration. Specify this feature at Location 5-E2 in the structure diagrams.

Serial Communications

The controller can be operated from either a computer workstation (W) or from its panel (P). This can be changed by the W/P key on the front of the controller if W/P is configured ON (Location 5-C2), workstation PRIORITY is configured P or BOTH (Location 5-D3), and the W/P function SWITCH is configured to NONE (Location 5-D3). If the controller is to be operated via a computer, W/P must be configured ON and several other parameters must be configured as described in Table 4-14.

Table 4-14. Configuration of Serial Communication Parameters

Parameter	Configuration Method
ADDRESS:	Enter the device number (0 to 99) on the serial communication port.
BAUD:	Enter the data transfer speed (2400,4800, 9600, or 19200 bits/second) between the host and the controller.
PARITY:	Enter odd, even, or none.
TIMEOUT:	Enter the length of time that communication is interrupted before FLUNK action is implemented. However, a TIMEOUT of 0 equals no FLUNK feature.
FLUNK:	Enter state of W/P desired if serial communication is lost. Choices are W, P, and LAST W/P status before loss occurred. To assure continuous operator control, set FLUNK to P if PRIORITY is set to W. When FLUNK is set to W or to LAST W/P, the W flashes after TIMEOUT expires.
PRIORITY:	Specify W or P to select whether the workstation or panel can switch controller operation from W to P and vice versa. Specify BOTH if switching can be done by both the workstation and the panel.
STARTUP:	Enter state of W/P desired upon restart after a power failure.
SWITCH:	An entry from the Gate Input List here enables an activation of the specified switch to change the controller operation from W to P or vice versa. A configuration of ON or to an entry from the Gate Input List whose logic is in the True state fixes the control in the WORKSTATION mode. Conversely, OFF or (False) fixes the control in the PANEL mode.

NOTE A switch assignment other than NONE has priority over the W/P key or the communication link. For example, if W/P is assigned through Gate 1, the W/P key or a supervisory host command to change W/P status is ignored.

Communications Example

Serial communications will be used to supervise the controller at 2400 baud and with address number 6. The controller should FLUNK to manual and panel after a TIMEOUT of 10 minutes; that is, when the host has had no communication with the controller for over 10 minutes.

1 Access CONFIG FUNC 1 and go to A/M (Location 5-G2).
2 Go to FLUNK and select M from the menu.
3 Access CONFIG W/P at Location 5-C2 and select ON.
4 Enter 06 in the ADDRESS block.
5 Select 2400 from the menu for BAUD.
6 Select EVEN, ODD, or NONE for PARITY as desired.
7 Go to TIMEOUT and confirm that the factory-configured value of 10.00 minutes is still in place. Change value if necessary.
8 Select P from the menu for FLUNK. The configuration of this example is now complete.

Toggle

If TOGGLE is configured ON, the user may go from one of the User Interface modes (READ or SET) to the Normal Operation mode and return to the function from which the User Interface was exited using the TAG key. TOGGLE functions above and below the PASSCODE barrier. However, this feature is particularly useful if the function is after the PASSCODE.

TOGGLE only applies if the controller is in PANEL (P) mode. Also, TOGGLE defaults to OFF in a power failure.

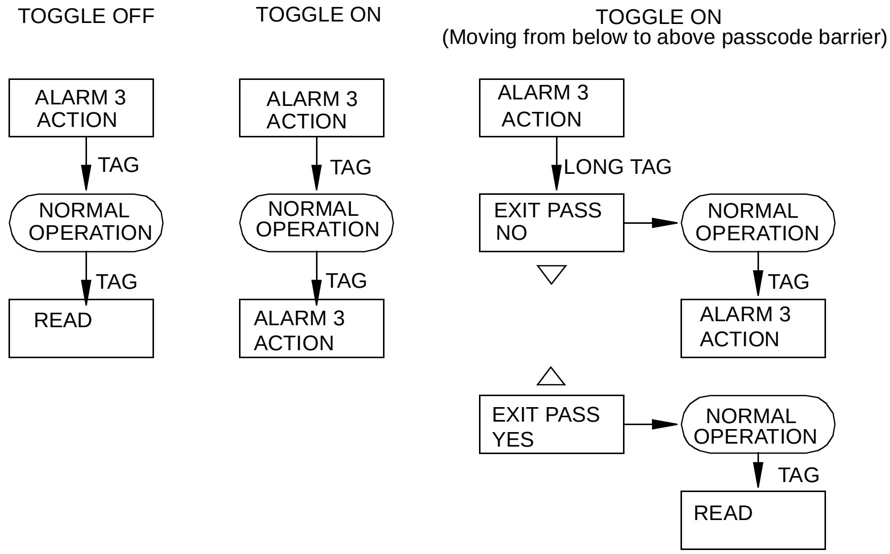
Lastly, if TOGGLE is configured and the user is in the firmware structure below the PASSCODE but wants to go to a section of the structure above the PASSCODE, he must do the following:

1 Press a long TAG (more than 0.3 second). Display will read EXIT PASS NO.
2 Using an arrow key, change the NO to YES. Press ACK key. Display will show Normal Operation.
3 Pressing the TAG key again will bring you to READ in the firmware structure and not to the function from which the user interface was previously exited.

NOTE If NO is ACKnowledged in Step 2, the display will show Normal Operation. However, the next use of the TAG key will return you to the function from which the User Interface was exited.

Figure 4-23 expresses the Toggle feature pictorially. The configuration parameter ALARM 3 ACTION was selected arbitrarily for the example in this figure.

Figure 4-23. TOGGLE Feature



Batch Control

You can configure the 762CNA to operate in discontinuous batch mode. If so configured, the process starts and stops without causing controller windup and subsequent overshoot if PRELOAD is correctly set as the measured variable re-enters the control range. Configure this feature ON or OFF at Location 5-G3 in the structure diagrams. The PRELOAD adjustment is made in ALLTUNE/OPTUNE at Location 4-B1. Refer also to the Output Limits section on page 98.

Integral Feedback

Integral feedback is used to prevent controller windup when the control algorithm output cannot manipulate the valve. Refer to the Cascade Controller example on page 76 for a practical application of this function.

The SOURCE of the INTegral FeedBacK can be configured to be a signal from the Signal Distribution List. In a typical control loop, the integral feedback is sourced to the controller output (Cn OUT). This is done in INT FBK at Location 5-G3 in the structure diagrams. The correct connection is made automatically for cascade and auto select configurations.

Rate of Change Alarms

A Rate of Change alarm is used when the change of a variable in an increment of time is important; i.e., the change in temperature per change in unit time in a reactor. A Rate of Change alarm has one input variable. The alarm levels are entered in percent and referenced to time. The units are percent per minute. When the attached monitored variable exceeds the alarm level, an alarm condition occurs and the Boolean output associated with that alarm is set to True. The time interval for trip points is fixed at one minute; e.g., a level of 50% equals 50%/minute. The time between the alarm condition and activation of the alarm is typically 5 to 10 seconds. It takes less time if the rate is way over the limit but longer if the rate is only slightly over the limit.

The input variable is assigned from the Signal Distribution List using the parameter ATTACH at Location 5-B2 in the structure diagrams.

Alarm levels and deadband have a different meaning for ROC alarms. For an ROC alarm, alarm levels and deadband are interpreted as percent change per minute. This may be thought of as an absolute alarm applied to dm/dt instead of to m, where dm/dt is the rate of change in percent per minute. The filter time is 6 seconds and dm/dt values are approximately 1% precise. A minimum of 5%/minute deadband should be used on ROC alarms. Lastly, Rate of Change alarms can not be configured for display.

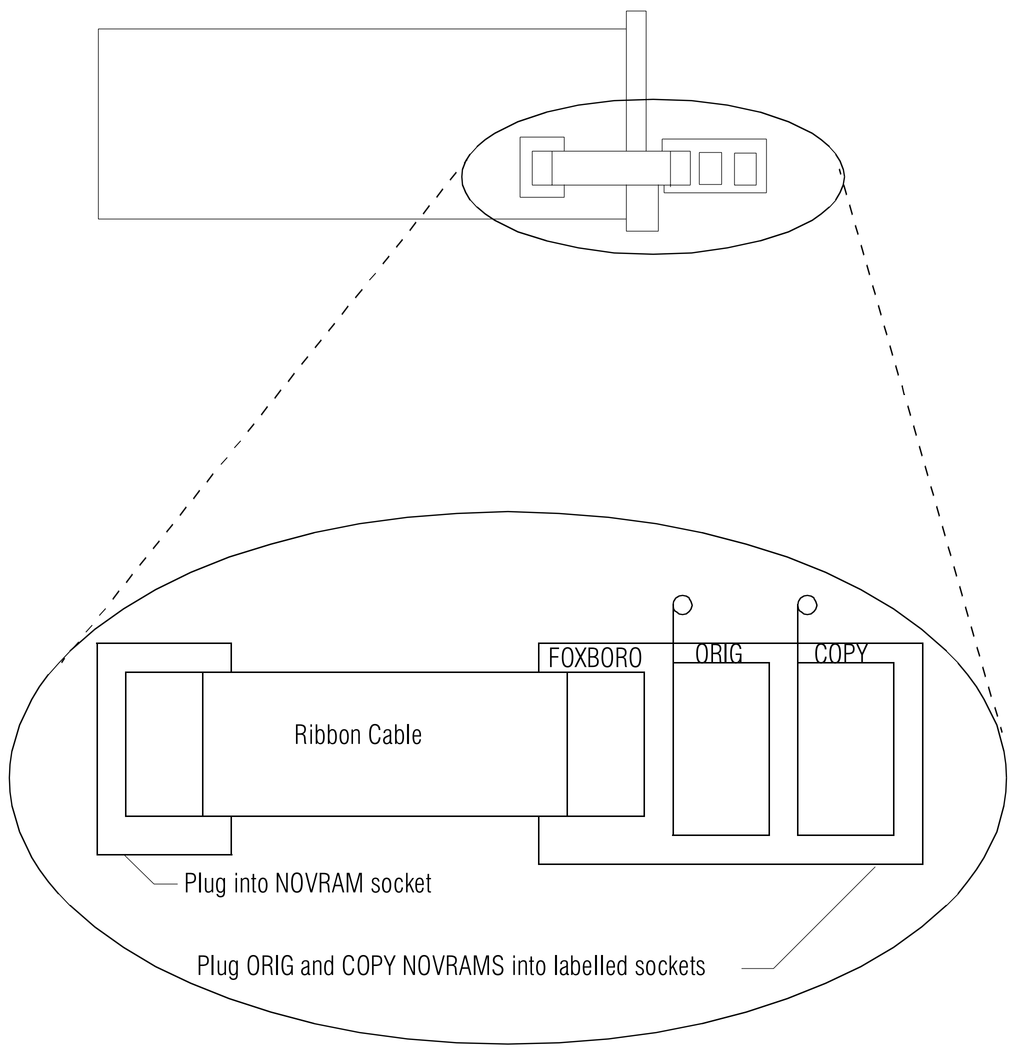
Configuration Copy Accessory

A configuration copy accessory (Part L0122TU) is available from Foxboro. With this accessory, additional controllers can be configured to match an existing one without the need to go through the step-by-step configuration procedure previously described.

Even if an exact duplicate configuration is not desired, the configuration copy accessory can still be used. If the configuration of the second controller is to be similar to the first, the first one can be copied and the copy then changed using the step-by-step procedures described in this Chapter. The procedure used to copy a configuration is as follows:

1. Depress latch under front panel to withdraw controller. Withdraw controller several inches from housing (power is removed from unit).
2. Release the locking latch on the socket of the memory module (NOVRAM) and lift the module out of its socket. Identify this module so that it cannot be confused with the module to be configured.
3. Insert configuration copy accessory (See Figure 4-24) into this socket with ribbon cable toward front of controller and lock latch of socket.
4. Release both latches on copy accessory. Position configured memory module so that the key is on bottom and insert module into left side of accessory (labeled “ORIG”). Lock left accessory latch.
5. Insert unconfigured memory module similarly into right side of accessory (labeled “COPY”). Lock right accessory latch.
6. Reconnect power by sliding controller back into housing with ribbon cable extending out the front of the housing. When lower display shows value of engineering units, new memory module is configured. This takes only a few seconds.
7. Withdraw controller from housing. Release all three latches and remove the two modules and copy accessory.
8. Plug original and newly configured memory modules back into their controllers. Lock latches. Reinstall controllers into their housings.
9. Calibrate controller with newly configured memory module. See Chapter 7 of this instruction.

Figure 4-24. Configuration Copy Accessory



762C SINGLE STATION MICRO Controller

February 1998

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Operation 5

The purpose of this section is to describe all features of the 762CNA Controller that are of interest to the process operator — how to read the displays, how to operate the keys, and how to perform various operator functions.

The chapter is divided into the following major sections:

Functions

The 762CNA provides two functions (with totalizers) that can operate as:

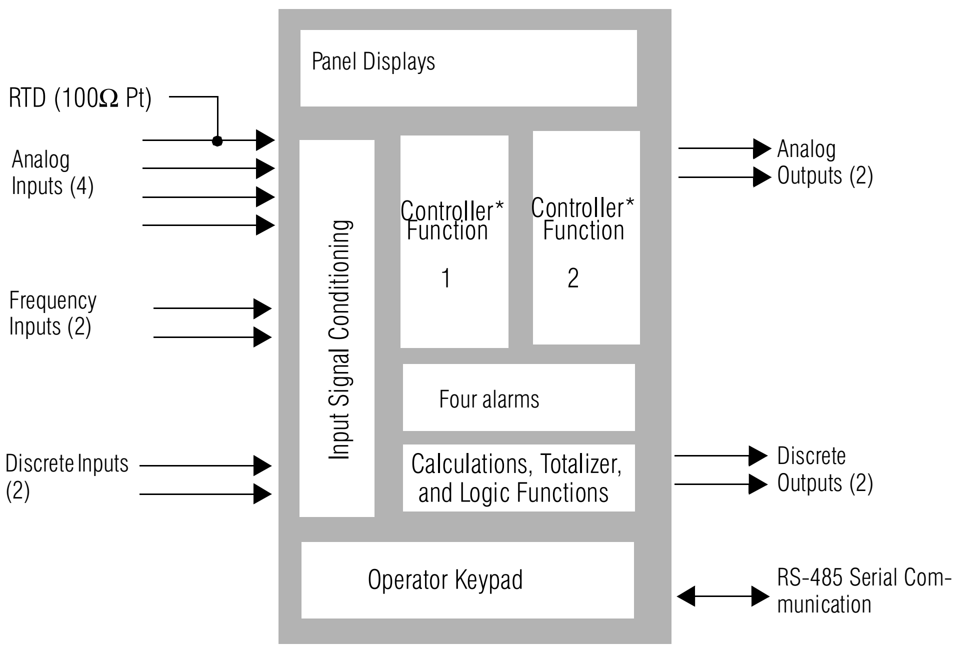
- Two independent controllers
- Single-station cascade controller
- Auto selector controller
- Single or dual auto/manual control station
- Single or dual 3-variable indicating station

The various functions can be intermixed, subject to some configuration constraints.

Block Diagram

Figure 5-1 is a simplified block diagram that shows the inputs, outputs, and functions available in a 762CNA instrument. Explanations of each item follow the diagram. For detailed specifications, refer to Appendix A – Specifications.

Figure 5-1. Block Diagram of a 762CNA Control Station



* Auto/manual station or 3-bar Indicator functions are available as alternates to the controller functions.

Alarms

Four alarms, assignable to any input or output signal, are provided. All alarms are 2-level (high/high, high/low, low/low) and may be configured to trigger on the present value of a signal, a difference between two signals, or on the rate-of-change of a signal. They may also be set up as latching, non-latching, or permissive alarms. Permissive alarms do not require operator acknowledgment.

Signal Conditioning

Input signals can be configured with any of a wide range of input signal conditioning functions to match any measurement or display requirement. Scaling gains and biases, square, square root, and characterized profiles, as well as filtering, are also supported.

Calculation Functions

If so configured, the variables used for indication and control can be computed values – the results of algebraic or Boolean calculations. Three multi-term calculation functions are provided.

Totalizers

Two 7-digit totalizer functions are available (except in any function block in which EXACT is configured). The totalizers may be assigned to any internal or external signal and may be set to count up to or down from a preset value. When a totalizer reaches the target value, a logic event output is generated, which may be used as an input to a number of other functions. Reset and hold logic is provided for each totalizer.

Inputs

Type	No.	Description
Analog	4	4-20 mA non-isolated or 1-5 V dc (any combination). Using a hardware option, you may connect a 100 Ω platinum RTD to Analog Input 1. Analog inputs can be assigned to any analog function.
Frequency	2	1 to 9999 Hz. May be assigned to any analog function. May also be combined into one up/down pulse input signal.
Discrete	2	Non-isolated contact or transistor switch inputs. May be assigned to any binary function.

Outputs

Type	No.	Description
Analog	2	4-20 mA non-isolated. Analog Output 2 can be changed to 1-5 V dc by moving a jumper. Analog outputs can be assigned to any function (subject to configuration constraints). Isolation is available as an option on Analog Output 1.
Discrete	2	Non-isolated open collector NPN transistor switch outputs. May be assigned to any binary function.

Data Communication

Two-way data communication with remote computers is provided through an RS-485 serial port. Using this feature, you can exercise supervisory control of the controller from a remote host computer, including upload/download of measurement, configuration, and control status information. A single host can supervise up to 30 control stations on a single loop. Addresses are available for 100 stations. An F6501A converter connects to 90 stations; an OPTO-22 isolator board to 30; and an I/A Series Instrument Gateway to 60 units in Version 4.0 or to 48 in Versions 2 and 3. The major determining factor in defining the maximum number of stations is speed of response between host and units.

EXACT Control

The Foxboro-patented EXACT control function provides automatic adaptive tuning for either or both control loops, subject to totalizer configuration constraints. If the controller is configured with EXACT, the function can be enabled or disabled through the keypad or any other switch signal such as a contact input or the state of a gate or alarm.

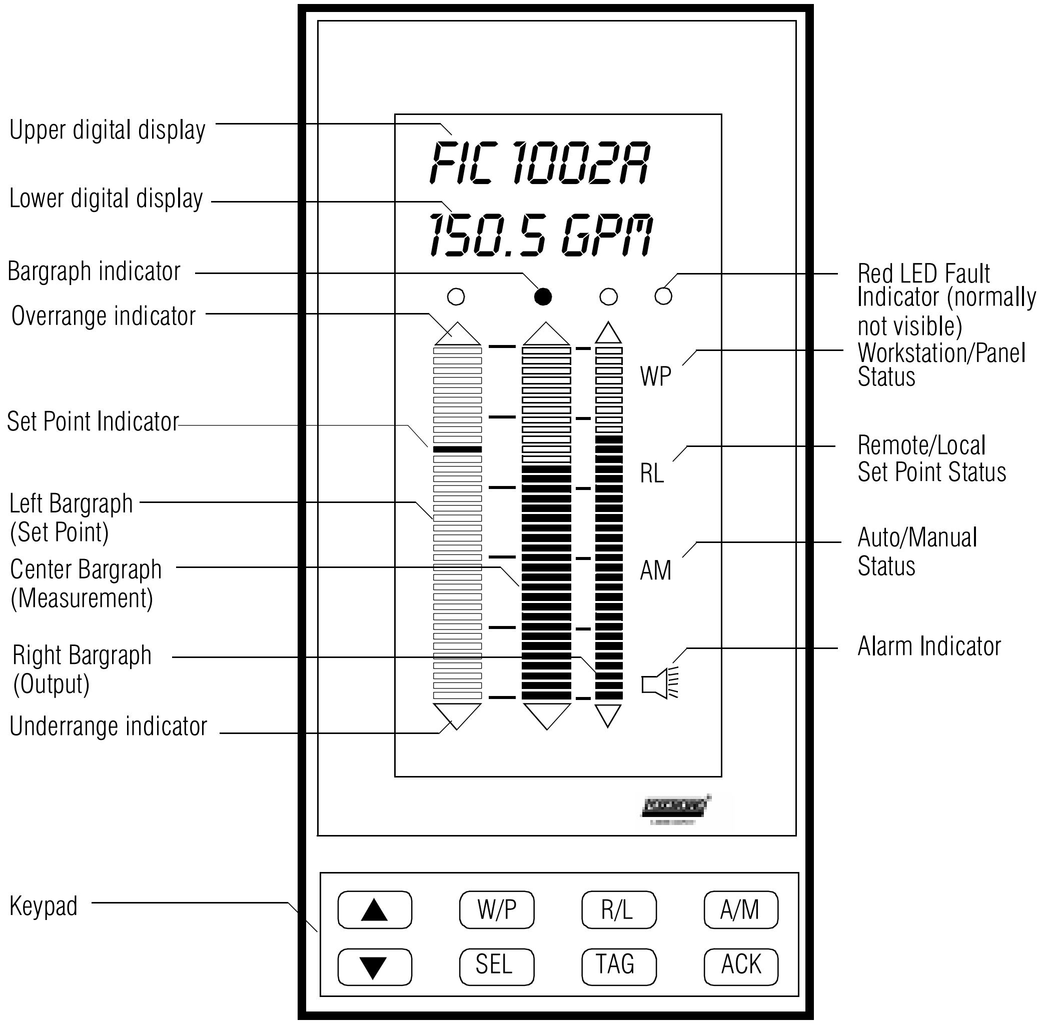
Security

The unit may be configured to require you to enter a passcode before performing certain TUNE operations such as changing parameter values.

Controls and Indicators

Operator controls and indicators are located on the front panel. Figure 5-2 shows the panel arrangement and identifies the function of each element. Figure 5-3 on page 115 shows the arrangement and functions of the keypad.

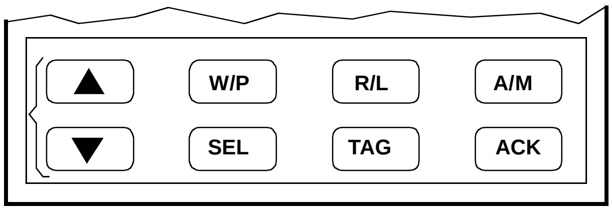
Figure 5-2. Panel Display (Faceplate 1 or 2)



Upper Digital Display	In NORMAL, shows loop tag or scaled value of variable with engineering units label. In READ and SET modes, shows a category of parameter or a message.
Lower Digital Display	In NORMAL, shows present value of variable identified by bargraph indicator. When an alarm exists, displays ID of variable. In READ and SET, shows parameter or message detail.
Bargraph Indicator	Identifies variable being displayed on Lower Digital Display. There are also “no indicator” positions. See “Bargraph Indicator Positions” on page 118.
Overrange Indicator	On steady when variable is between 100% and 102%. Flashes when variable is above 102%.
Left Bargraph	Shows present value of Variable #1 (usually set point).
Center Bargraph	Shows present value of Variable #2 (usually measurement).
Right Bargraph	Shows present value of Variable #3 (usually controller output).
Underrange Indicator	On steady when variable is between 0% and -2%. Flashes when below -2%.
Keypad	Operator entry keypad. (For details, refer to Figure 5-3.)
Red LED Fault Indicator	When ON, shows hardware error, such as watchdog timer timeout, low ac voltage or primary power.
WP	Status indicator for Workstation (W) or Panel (P) control. W flashes if communication fails when in W mode and flunk is set to W. Neither W or P are lighted when W/P is configured OFF.
RL	Status indicator for Local (L) or Remote (R) set point and for Ratio (R) or Local (L) set point. Neither R or L are lighted when set point TYPE is configured as LOCAL.
AM	Status indicator for Automatic (A) or Manual (M) control. Both are on when OUTTRK is active. Flashes A, M, or AM when open loop condition exists. An open loop occurs: • When the inactive controller is selected in an auto-selector configuration. • In a cascade primary loop, when the secondary is in Manual, Local, or OUTTRK. • When limits prevent the output from moving in either direction, as when limits are crossed or opposing.
Alarm Indicator	Flashes when active, steady when acknowledged. Off when returned to normal after being acknowledged.

Keypad

Figure 5-3. Keypad



▲ ▼	In NORMAL mode, press these buttons to increase or decrease value of set point, ratio gain, or output by one increment. Press and hold to increase the rate of change in value.
W/P	Press to transfer control between computer Workstation and controller front Panel when W/P switch priority is Panel and communications are enabled (W/P = ON).
R/L	Press to transfer between Remote and Local (or Ratio and Local) set point when set point TYPE is configured as R/L (or RATIO) and R/L SWITCH is set to NONE.
A/M	Press to transfer between Auto and Manual control when A/M SWITCH is set to NONE.
SEL (Short press)	A short press (200 to 300 ms) selects the next variable for display on the Lower Digital Display (alphanumeric). Also provides access to remote set point, ratio, and totalized count, when so configured.
SEL (Long Press)	A long press (≥300 ms) toggles between Faceplates 1 and 2, provided they are configured and active. If only one faceplate is configured, the key performs the same functions as a short press.
TAG	In NORMAL mode, press to go to READ mode. If TOGGLE feature is configured, press to go to last function from which READ or SET was exited. In READ or SET mode, press to go to NORMAL mode.
ACK	In NORMAL mode, press to acknowledge an alarm. In READ or SET, press to move one step through structure, or to accept a new parameter entry.

If none of the keys are operational, the keyboard enable/disable link is in the disable position. See page 26.

Structure Diagrams

The 762CNA is a powerful instrument with many user-adjustable parameters, displays, and possible configurations. It is beneficial to navigate through the various displays and parameter settings called the *product structure* using a map that tells you where you are in the structure, where you want to go, and how to get there. The map is called a *structure diagram*. A series of structure diagrams for the controller is included in Appendix C. Please use these diagrams as an aid to understanding the operating procedures discussed in this chapter.

Modes of Operation

The 762CNA operates in one of three modes:

Mode	Description
NORMAL	In this mode, you can perform the usual configured functions such as reading values of variables, changing set points or output values, switching between auto and manual or remote and local, acknowledging alarms, transferring between faceplates, etc.
READ	In this mode, you can read the value and status of parameters, variables, and if permitted, the current configuration.
SET	In this mode, you can change values of parameters that have been configured as operator-adjustable and, when past the passcode, values of non-operator-adjustable parameters and the configuration.

This section of the manual describes NORMAL and READ modes of operation. Refer to Section 4 – Configuration for detailed information on operating in the SET mode.

SET OPTUNE

The operator can set parameters in ALLTUNE by first entering a passcode. He may also be permitted to adjust certain parameters in OPTUNE without entering a passcode. The parameter groups he can adjust are determined by the configuration of SHOWOP, which is described in Chapter 4 – Configuration. The various parameter groups that can be selected by SHOWOP are:

- TUNE C1
- C1 LIMIT
- TUNE C2
- C2 LIMIT
- CONSTS
- ALARMS
- TOTALS
- RD CFG

The steps necessary to perform the permitted SET OPTUNE functions can be determined by referring to Structure Diagram 4 on page 241.

NORMAL Mode Operation

When operating in NORMAL mode, you can:

- Read values of the three variables displayed on the bargraphs and, if the unit is so configured, read the values of remote and local set points and the present values of totalizers.
- Change control status (transfer between Workstation/Panel, Remote/ Local, Ratio/Local, and Auto/Manual).
- Change set point or ratio in Auto and Manual, or change output in Manual, if the unit is configured to permit such changes.
- Display/acknowledge alarms.
- Enable/disable EXACT tuning, subject to configuration constraints.
- Switch from one faceplate display to the other.
- Switch from NORMAL mode to READ and SET modes and return.
- Initiate, hold, or reset totalizers, if so configured.

Entering a Passcode

The unit will prompt you to enter an alphanumeric passcode before permitting you to perform certain restricted functions. The factory default is (blank)(blank)(blank), which can be entered by pressing ACK three times. (Refer to the structure diagrams in Appendix C for assistance in understanding the procedure described below.)

To enter a passcode (starting in NORMAL mode):

1. Press TAG. This places you in READ mode.
2. Press ∆ to go to SET.
3. Press ACK to go to OPTUNE.
4. Press ∆ to go to SECURE.
5. Press ACK to go to PASSCODE =. (With cursor under first digit location, the digit flashes.)
6. Press ∆ repeatedly (or press/hold) until first digit of your passcode is displayed.
7. Press ACK to accept first digit and move to next digit.
8. Press ∆ repeatedly (or press/hold) until second digit of your passcode is displayed.
9. Press ACK to accept second digit and move to next digit.
10. Repeat entry steps for next digit.

When all digits have been entered correctly, the display shows ALLTUNE. You may now proceed with your SET operation.

If the passcode is not accepted, the display shows the message, WRONG PASSCODE. Press TAG to return to normal operation and start over.

Reading Values of Variables

The three bargraphs display the current values of the 3 variables – usually assigned to set point, measurement, and output. The bargraphs indicate 0 to 100% of full scale, with each display segment equal to 2% of full scale.

To display the numerical value and measurement units of any one of the three variables on the lower line of the digital display, press the SEL key as many times as necessary to advance the bargraph indicator to the desired variable.

Bargraph Indicator Positions

You can identify which variable is being displayed by observing the position of the bargraph indicator. If the indicator is over a bargraph, that variable is currently displayed on the Lower Digital Display.

Three indicator positions are always available for the bargraphs. In some situations, however, four positions – three variables and one *no-indicator* – are available. In other situations, five positions – three variables and *two* no indicators – are available.

Position 4

Position 4, a *no-indicator* position, is used when the unit is configured for remote set point or ratio operation. In remote set point operation, when you use the SEL key to move the bargraph indicator to Position 4 (no indicator visible), the Lower Digital Display shows the value of the set point *not* currently in use. This means that if the controller is in *local* mode, the Lower Digital Display shows the value of the *remote* set point, the one *not* currently being used. Similarly, if the unit is in *remote* mode, the Lower Digital Display shows the value of the *local* set point, which can be adjusted by the Δ and ∇ keys. In both cases, the left bargraph shows the value of the set point currently in use. Note that the top line of the display is not affected.

For situations in which you configure a local (no remote) set point plus a totalizer, the Lower Digital Display shows the current value of the totalizer when you move the bargraph indicator to Position 4 (no indicator visible).

Position 5

For situations in which you configure both a remote set point (or ratio) and a totalizer, a *second* no indicator position, Position 5, becomes available. Position 4 is then used for displaying the inactive set point value and Position 5 is used for displaying the totalizer value.

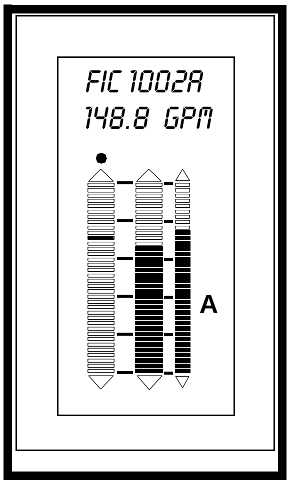
To determine which set point is currently being used, note which symbol (R or L) is illuminated at the right of the panel. If the unit is configured for local set point only, the R/L indicators are not visible.

For information on operation as a ratio controller, refer to Table 5-3 on page 123.

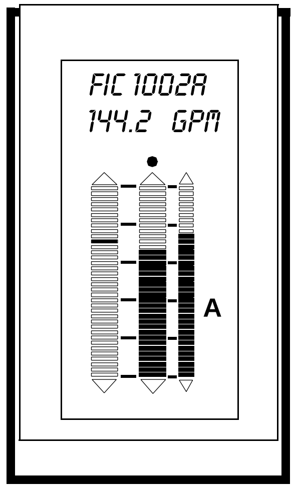
Figure 5-4 on page 119 and Figure 5-5 on page 120 show faceplate displays as they appear under the various operating situations described above.

The top line of the display for Position 5 is the totalizer tag which was configured in Location 5-B1 of the structure diagrams.

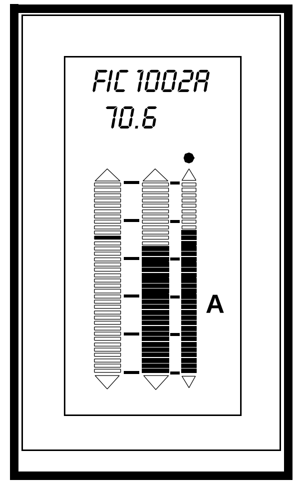
Figure 5-4. Faceplate Displays When Configured for Local Set Point and Totalizer



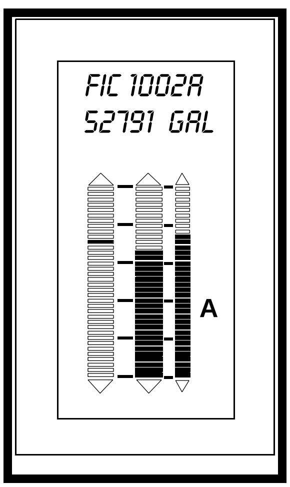
Bargraph indicator over Left Bargraph. Display shows local set point value. No R, L, W, or P visible. (Set point type local only.) Auto mode.



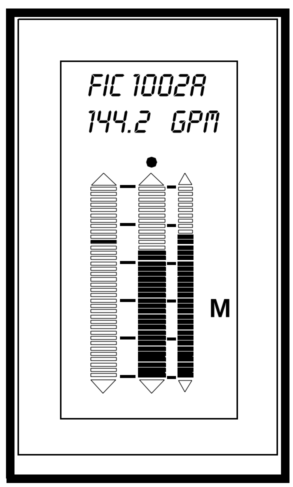
Bargraph indicator over Mid Bargraph. Display shows measurement value. No R, L, W, or P visible. (Set point type local only.) Auto mode.



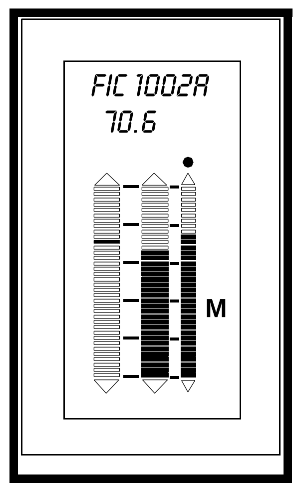
Bargraph indicator over Right Bargraph. Display shows output value in percent. No R, L, W, or P visible. (Set point type local only.) Auto mode.



Bargraph indicator in Position 4 (no indicator). Display shows totalizer value. No R, L, W, or P visible. (Set point type local only.) Auto mode.

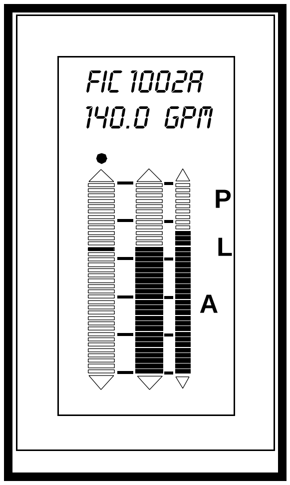


Bargraph indicator over Mid Bargraph. Display shows measurement value. No R, L, W, or P visible. (Set point type local only.) Manual mode.

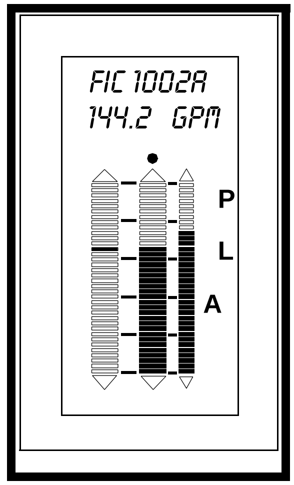


Bargraph indicator over Right Bargraph. Display shows output value in percent. No R, L, W, or P visible. (Set point type local only.) Manual mode.

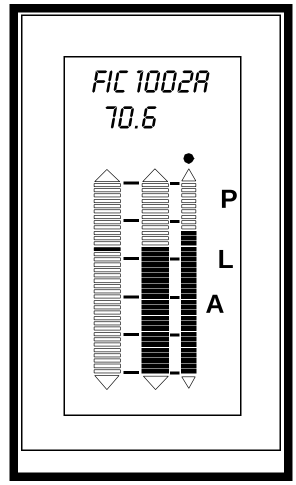
Figure 5-5. Faceplate Displays When Configured for Workstation/Panel and Local/Remote Set Point and Totalizer



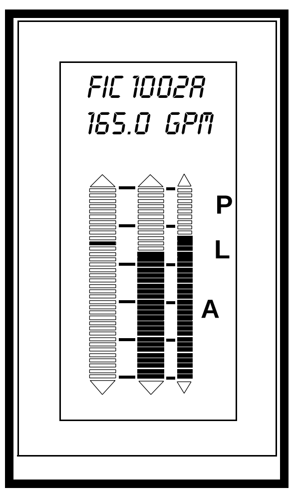
Local set point and panel mode. Indicator over left bargraph. Display and left bargraph show local set point value. Auto mode. When in remote mode, faceplate is the same except that R replaces L and display and left bargraph shows remote set point value.



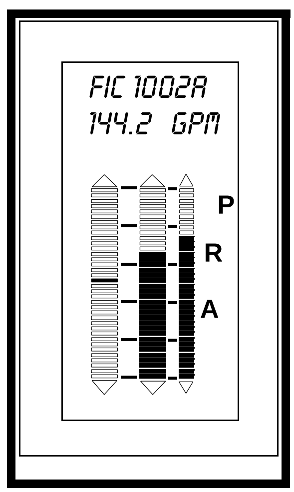
Local set point and panel mode. Indicator over mid bargraph. Display shows measurement value. Auto mode. When in remote mode, faceplate is the same except that R replaces L and display and left bargraph shows remote set point value.



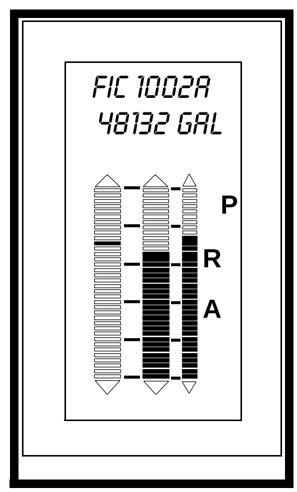
Local set point and panel mode. Indicator over right bargraph. Display shows output value in percent. Auto mode. When in remote mode, faceplate is the same except that R replaces L and display and left bargraph shows remote set point value.



Local set point and panel mode. Indicator in Position 4 (no indicator). Left bargraph shows local set point. Display shows remote set point value. Auto mode.



Remote set point and panel mode. Indicator in Position 4 (no indicator). Left bargraph shows remote set point. Display shows local set point value. Auto mode.



Remote set point and panel mode. Indicator in Position 5 (no indicator). Display shows totalizer value. Auto mode.

Changing the Control Status

To switch between Auto and Manual modes, press the A/M key. To switch between Remote and Local set points or between Ratio and Local modes, press the R/L key. For these keys to be active, their respective switches must be configured to NONE. Also, if serial communications are enabled, W/P must be configured to P.

To switch between Workstation and Panel operation, press the W/P key. For this key to be active, W/P must be configured ON and W/P PRIORITY must be set to P or BOTH.

All transfers except R/L are bumpless. R/L transfer is bumpless if LOCTRK is set. A/M, R/L, and W/P can be switched remotely via respective switches.

NOTE When the controller is placed in Manual, the bargraph indicator moves over the right bargraph (output). When placed in Auto, it moves over the middle bargraph (measurement).

Changing Set Point, Output, and Variables

To increase or decrease local set point:

1. With controller in local mode, press SEL to select the bargraph display. If the indicator is not over the Left Bargraph, press SEL repeatedly until it is positioned over the Left Bargraph.
2. Press the Δ/∇ keys to change the value. To increase the rate of change in the value, press/hold the key.

Table 5-1 describes how the arrow keys affect controller variables with different positions of the bargraph indicator in both automatic and manual modes, when R/L is not configured.

Table 5-2 on page 122 defines similar functions when R/L and a totalizer are configured.

Table 5-3 on page 123 defines operation in ratio mode.

Table 5-1. Effect of Δ/∇ Keys with R/L Not Configured

Auto/Manual Status	Indicator Above Bargraph	Variable Adjusted by Δ/∇ Keys	Comments
Auto	Any Bargraph	Set Point	
Manual	Set Point	Set Point	Output will not change.
	Measurement	Output	Set point will not change
	Output	Output	Set point will not change

Changing Set Point, Output, and Variables (cont.)

When the unit is configured for the Remote/Local set point function and you have selected *remote* set point operation, you can use the ∆/∇ keys to adjust the local set point and the output, subject to certain restrictions. The restrictions are described in Table 5-2.

Table 5-2. Operation of Remote/Local Controller with Totalizer

Status Setting A/M	Status Setting R/L	Identifier Above	Contents of Lower Digital Display	Variable Adjusted by ∆/∇ Keys
A	R	Set Point[1]	Remote Set Point	No Adjustment
		Measurement	Measurement	“
		Output	Output	“
		No Indicator[1]	Local Set Point	Local Set Point
		No Indicator[1, 3]	Totalizer	No Adjustment
	L	Set Point[2]	Local Set Point	Local Set Point
		Measurement	Measurement	Local Set Point
		Output	Output	Local Set Point
		No Indicator[2]	Remote Set Point	No Adjustment
		No Indicator[2, 3]	Totalizer	“
M	R	Set Point[1]	Remote Set Point	No Adjustment
		Measurement	Measurement	Output
		Output	Output	Output
		No Indicator[1]	Local Set Point	Local Set Point
		No Indicator[1, 3]	Totalizer	No Adjustment
	L	Set Point[2]	Local Set Point	Local Set Point
		Measurement	Measurement	Output
		Output	Output	Output
		No Indicator[2]	Remote Set Point	No Adjustment
		No Indicator[2, 3]	Totalizer	“

1. Set point indicator shows remote set point.
2. Set point indicator shows local set point.
3. This position is present only if a totalizer is configured.

Changing Set Point, Output, and Variables (cont.)

When the unit is configured for the Ratio/Local function and you have selected *ratio* operation, you can use the Δ/∇ arrow keys to adjust the local set point, output, and ratio gain, subject to certain restrictions. The restrictions are described in Table 5-3.

Table 5-3. Operation of Ratio Controller with Totalizer

Status Setting A/M	Status Setting R/L	Bargraph Identifier Position	Contents of Lower Digital Display	Variable Adjusted by Δ/∇ Keys
A	R (Ratio)	Set Point[2]	Ratioed Variable[1]	Ratio Gain[5]
		Measurement	Measurement	Ratio Gain[5]
		Output	Output	Ratio Gain[5]
		No Indicator[2]	Ratio Gain	Ratio Gain[5]
		No Indicator[4]	Totalizer	No Adjustment
	L (Local)	Set Point[3]	Local Set Point	Local Set Point
		Measurement	Measurement	Local Set Point
		Output	Output	Local Set Point
		No Indicator[3]	Ratioed Variable[1]	Ratio Gain
		No Indicator[4]	Totalizer	No Adjustment
M	R (Ratio)	Set Point[2]	Ratioed Variable[1]	Ratio Gain[5]
		Measurement	Measurement	Output
		Output	Output	Output
		No Indicator[2]	Ratio Gain	Ratio Gain[5]
		No Indicator[4]	Totalizer	No Adjustment
	L (Local)	Set Point[3]	Local Set Point	Local Set Point
		Measurement	Measurement	Output
		Output	Output	Output
		No Indicator[3]	Ratioed Variable[1]	Ratio Gain[5]
		No Indicator[4]	Totalizer	No Adjustment

1. Ratioed Variable is product of the ratio signal, ratio gain, and range.
2. Set point bargraph shows ratioed variable.
3. Set point bargraph shows local set point.
4. This position is present only if a totalizer is configured.
5. If ratio is sourced to faceplate and ratio gain is not cascaded from controller output.

Displaying/Acknowledging Alarms

Alarm information (horn symbol alarm indicator) is displayed regardless of which faceplate is in use. If the unit is so configured, alarm points can be displayed in the bargraphs. Typical displays for an absolute measurement high/low alarm with alarm levels indicated are shown in Figure 5-6.

High/High and Low/ Low Alarms

Displays for high/high and low/low types of alarms are similar to those illustrated for a high/low alarm except for different placement of the alarm points. With rate-of-change alarms, however, no indication appears on the bargraphs. When a rate-of-change alarm is active, only the alarm indicator on the faceplate flashes. When you press the ACK key to acknowledge the alarm, the Lower Digital Display shows the status of the latest active alarm. By pressing ACK repeatedly, you can cycle through the status of all alarms and the current value of the selected variable.

Latching Alarms

If a *latching* alarm condition occurs, the alarm indicator flashes until you press the ACK key. At this point, the alarm indicator goes out if the alarm condition has ended. If the condition persists, it changes from flashing to steady. The steady alarm indication continues as long as the alarm condition exists.

Non-latching Alarms

If a *nonlatching* alarm condition occurs, the alarm indicator flashes until you press the ACK key *or* the alarm condition ends. When the alarm is acknowledged, the alarm indicator stops flashing and becomes steady. When the alarm condition ends, the alarm indicator goes out.

Acknow-ledging Alarms

After you acknowledge an alarm, the condition causing the alarm is identified by a flashing message in the lower line of the alphanumeric display. The message continues to flash as long as the alarm condition exists, or until you press the ACK key again. When you press the ACK key a second time, the message disappears and the value of the previously selected bargraph is again displayed.

Multiple Alarms

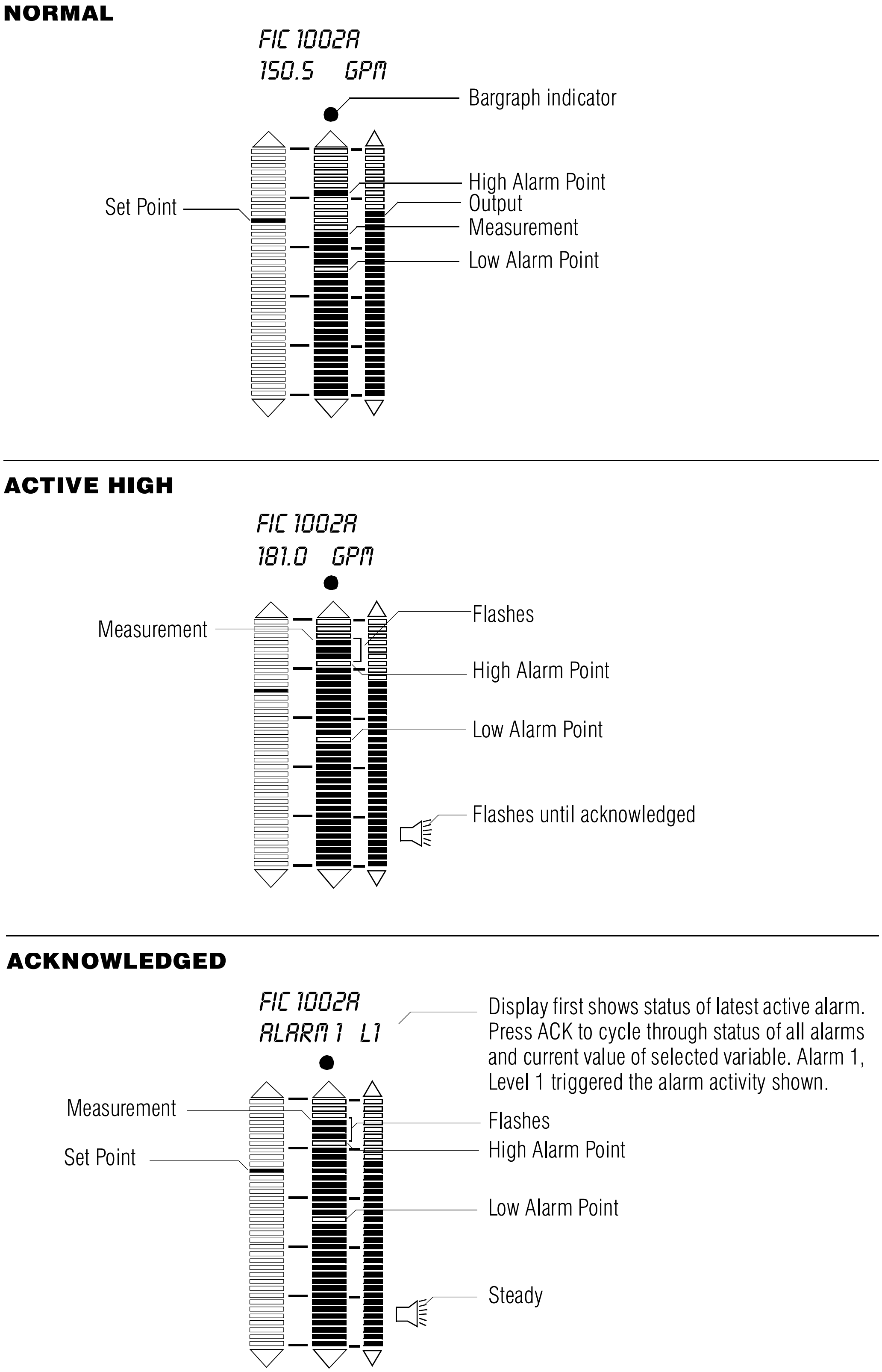
If more than one alarm condition exists, you can identify each condition in turn by pressing the ACK key repeatedly. After all active alarm conditions have been identified, the previously selected bargraph value is displayed. The alarm indicator, however, continues to be illuminated. You can again display the identifications of the alarm conditions by repeatedly pressing the ACK key. If an alarm condition no longer exists, it is removed from the alarm queue.

Audible Warning

Alarms may be assigned to one or two contact outputs to drive a horn bus. With a *latching* alarm, the alarm contact output resets when the alarm condition is ACKnowledged and the alarm condition returns to normal. With a *nonlatching* alarm, the alarm contact resets when the alarm condition is ACKnowledged *or* the alarm condition returns to normal, whichever is first. With a *permissive* alarm, no visual indication is provided. However, the alarm contact is active.

In addition to connecting to a contact output, the boolean output of the alarm, can be used anywhere any other signal in the Gate Input List can be used.

Figure 5-6. Alarm Displays, High Alarm on Absolute Measurement (Level 1, Latched)



Changing Alarm Settings

If you are authorized to do so, you can increase and decrease alarm settings from OPTUNE (Refer to the Structure Diagram on page 241). You can also do this from ALLTUNE if you have entered the passcode.

To change the alarm setting for Alarm 1 Level 2, refer to Structure Diagram shown on page 241 and execute the following procedure:

1. Starting in NORMAL mode, press TAG to go to READ, then ▿ to go to SET mode.
2. If not configured for alarms to be present in OPTUNE, press ▿ to go to SECURE. Then press ACK to display PASSCODE =?. Enter passcode and press ACK to move to ALLTUNE. Go to Step 4.
3. Press ACK to go to OPTUNE, if configured for alarms to be present in OPTUNE.
4. Press ACK to go to TUNE C1.
5. Press ▿ repeatedly until display shows ALARMS.
6. Press ACK to go to ALARM 1.
7. Press ACK to go to LEVEL 1 =?.
8. Press ▵/▿ keys to adjust LEVEL 1. Press ACK to enter setting.
9. Press ACK to go to ALARM 1 LEVEL 2. The lower display will show the current setting for ALARM 1 LEVEL 2.
10. Press ▵/▿ keys to increase or decrease the LEVEL 2 setting. When desired value is displayed, press ACK to accept the setting.
11. Press ACK to go to ALARM DEADBAND.
12. Press ▵/▿ keys to increase or decrease deadband. Press ACK to enter setting.
13. Press TAG to return to NORMAL operation.

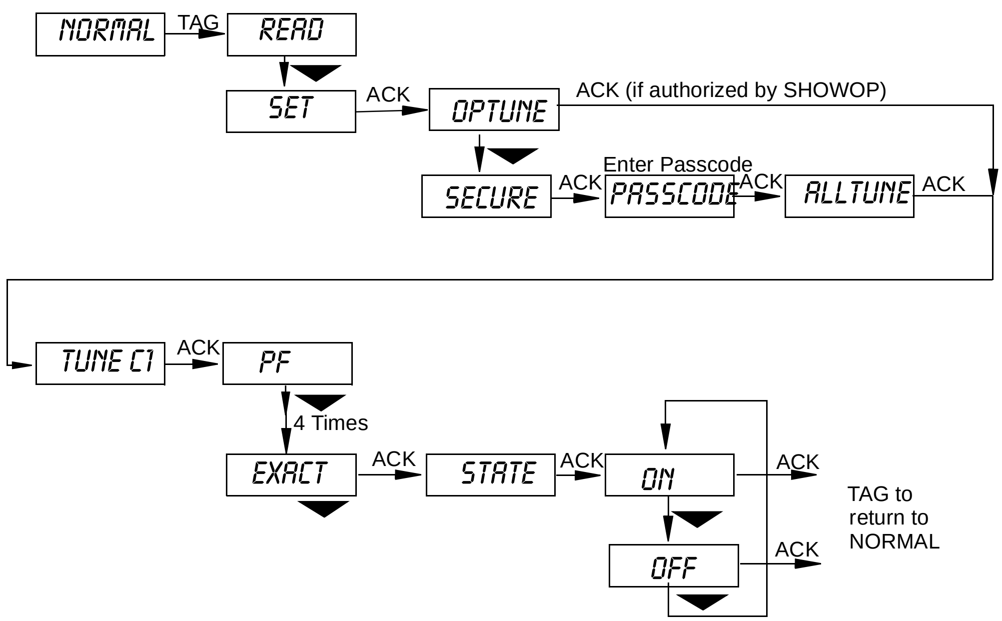
Enabling/Disabling EXACT Tuning

EXACT adaptive tuning is described in detail in Chapter 6. If the unit is so configured, you can enable or disable the function.

To enable or disable EXACT self-tune mode, execute the procedure illustrated in the flow diagram of Figure 5-7. The EXACT switch must be configured NONE in order to gain access in ALLTUNE.

The default configuration for the EXACT SWITCH parameter is "None" as shown in Appendix B, page 197. With this configuration, EXACT is automatically turned off during power-up, during a power interruption, and when exiting from the CONFIGURATION mode. To make EXACT active at all times, set the EXACT SWITCH parameter to "On." To control EXACT from an external source, assign the EXACT SWITCH parameter to an external contact.

Figure 5-7. Flow Diagram for Enabling/Disabling EXACT Tuning



Switching Faceplate Displays

If Controller Function 2 is configured, press/hold the SEL key to switch the display to Faceplate #2. To switch back to Faceplate #1, press/hold SEL again.

Switching Modes

From the keypad, you can switch from NORMAL mode to READ mode by pressing TAG.

To switch from READ mode to SET mode, press the ∇ key.

To return to NORMAL mode at any time, press TAG.

Operation as an Auto/Manual Station

Either or both functions of the 762CNA can be configured as Auto/Manual Stations. When an A/M Station is configured, operation is essentially the same as when a controller is configured, except that no control algorithm is computed. This means that all features and configuration options other than a control algorithm are available for use.

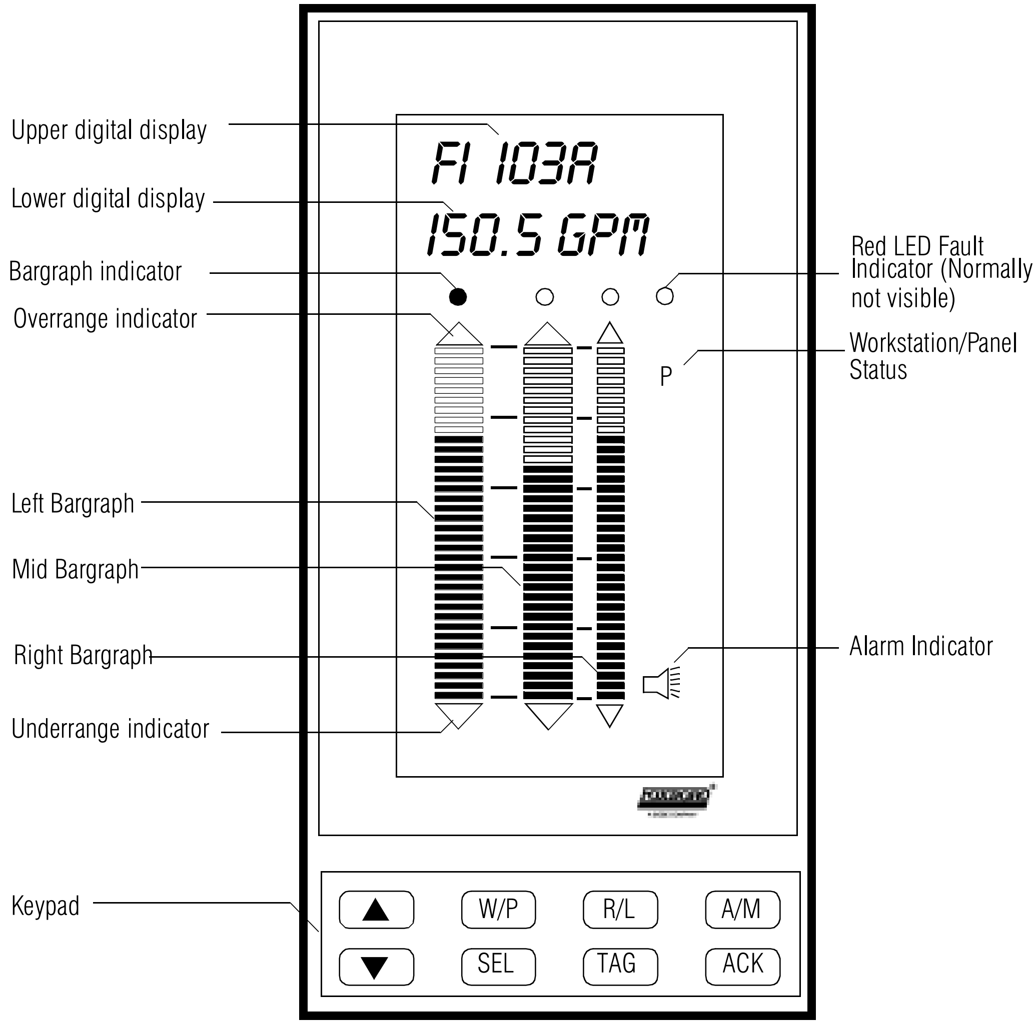
When in Auto mode, the output is equal to its configured source value. The measurement input is then displayed on the middle bargraph and the output on the right bargraph. The left bargraph displays an assigned value, if configured. Use the SEL key to view the value on the lower digital display. The factory default is a blanked bargraph.

In Manual mode, the output is determined by use of the ∆/∇ keys as in a controller. If dual functions are configured, use the “Switching Faceplate Displays” procedure described on the previous page.

Operation as a 3-Variable Indicator Station

Either or both functions of the 762CNA can be configured as 3-variable indicators. When a 3-variable indicator, sometimes called a 3-bar indicator, is configured, the faceplate display is as shown in Figure 5-8.

Figure 5-8. 3-Variable Indicator Station (Faceplate 1 or 2)



In a 3-variable indicator, the Upper Digital Display shows the loop tag identification of the variable being displayed in the Lower Digital Display and the selected bargraph. As you move the bargraph indicator to the next bargraph by pressing the SEL key, the loop tag and displayed value change accordingly.

Since A/M and R/L functions are not applicable, the symbols do not appear on the faceplate and the associated keys are not operative. The WP symbols and the W/P key are operative only if configured. Depending on the setting, either W or P appears on the faceplate.

Since the bargraphs display the present values of their associated variables, the values cannot be adjusted with the Δ/∇ keys. Operating procedures for alarms are the same as when a controller is configured.

Operation as an Auto-Selector Station

When the unit is configured as a single-station auto-selector, two controllers alternately control a single output. Control shifts smoothly from one to the other depending on how the loops are configured and operated. Selection can be high select, low select, or event-driven (via GATE 4). Feedback from the output is provided to prevent windup in the controller that is currently not selected for control.

When viewing the faceplate of the *unselected* controller, the operator sees a flashing AM indicator.

Operation as a Cascade Control Station

When the unit is configured as a single-station cascade control station, Controller 1 is configured as the primary controller and Controller 2 is the secondary or slave controller. The output of Controller 1, therefore, is used as the remote set point or ratio gain for Controller 2. The output of Controller 2 controls the valve or other actuator.

The AM status indicator flashes to indicate an open loop condition in a cascade primary loop when the secondary is in Manual, Local, or OUTTRK.

Totalizer Operation

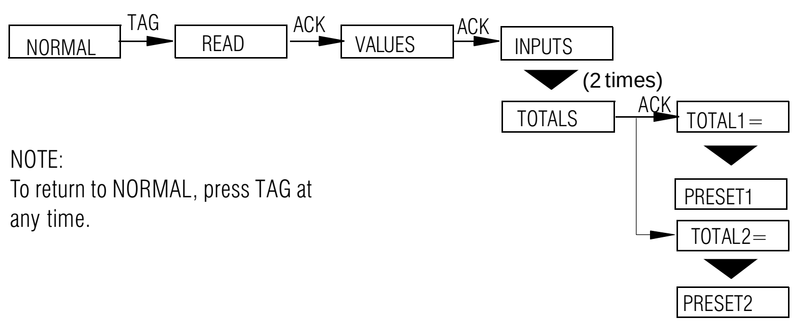
As described earlier in this chapter, you can observe the present value of a totalizer by pressing SEL to move the bargraph indicator to a position in which the value is displayed on the Lower Digital Display. (This is the fourth or fifth press of the SEL key, depending on whether or not the fourth position is used to display an inactive set point.)

To observe the preset value or current value of the totalizer, enter the READ mode by pressing TAG. Then use the Structure Diagrams and the keypad to move to PRESETn, where you can read the preset value or to TOTALn, where you can read the current value. The sequence is illustrated in Figure 5-9.

If you want to change the state of a totalizer (RESET, HOLD, COUNT), adjust the totalizer value or preset value, and you are authorized to do so, use the OPTUNE or ALLTUNE mode.

Procedures for moving around in the product structure using the keypad and Structure Diagrams are described in Chapter 4 – Configuration.

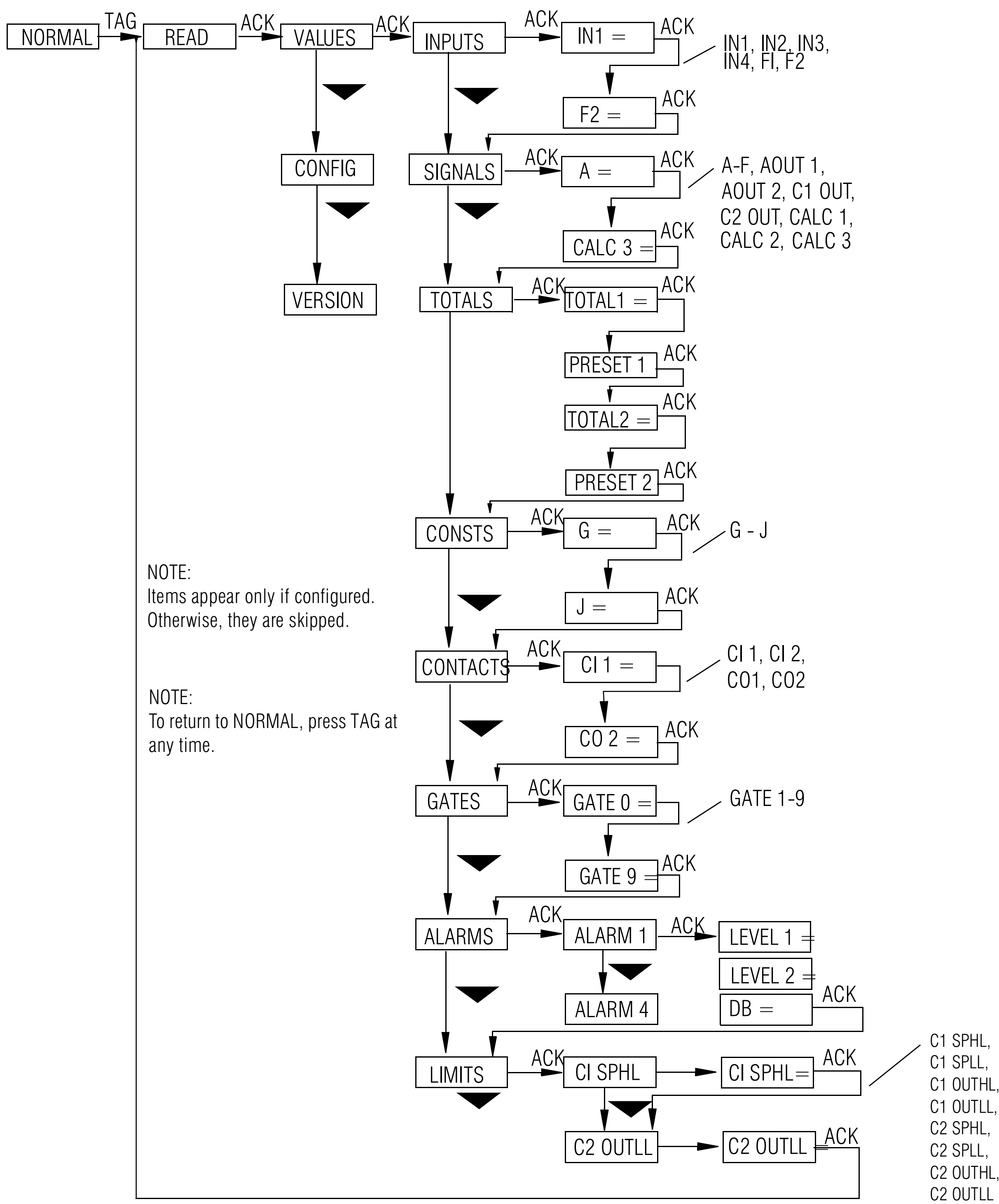
Figure 5-9. Reading the Value of Totalizer Preset



READ Mode Operation

In the READ mode, you can display process parameters, and if access is allowed via SHOWOP RD CFG, the configuration. Figure 5-10 is a flow diagram that shows how to read the various parameters and values.

Figure 5-10. Structure Diagram for READ Mode Functions



762C SINGLE STATION MICRO Controller

February 1998

FOXBORO®
A SIEBE COMPANY

The Intelligent Automation People

EXACT Tuning

6

This chapter describes the Foxboro patented EXACT adaptive tuning system, a feature of the 762CNA controller.

The chapter is divided into the following major sections:

Technical Description

EXACT (**EX**pert **A**daptive **C**ontroller **T**uning) is a patented mechanism for automatically adjusting controller parameters to maintain optimal control of your process at all times. EXACT is more efficient than manual tuning and provides a means of managing processes that are otherwise difficult to control. In addition, a “pretune” feature permits you to achieve optimal settings of six key parameters quickly even when initial values vary widely from the target.

Benefits of EXACT Tuning

Benefits of using EXACT tuning are:

- Accelerates process startup
- Optimizes controller tuning in the presence of noise, variable dynamics, process nonlinearities, deadtime, set-point changes, and load variations
- Matches tuning to current operating conditions
- Frees skilled personnel to do other tasks
- Reduces operating expenses through more efficient process control.
- Does not require a mathematical model of your process

The EXACT algorithm determines the response of your particular process to an upset — a change in load or set point — and calculates new tuning parameters automatically. This technique closely emulates the actions an expert control engineer takes in tuning a controller. EXACT tuning, however, checks the process five times every second, 24 hours a day, to determine whether a parameter change should be made.

EXACT Steps

The basic steps performed by an EXACT controller are:

1. Wait for a significant process upset (magnitude greater than twice the noise level).
2. Determine the actual response of the process to the upset.
3. Calculate optimal values of P, I, and D, using the STUN self-tune algorithm.
4. Return to normal operation, using the new values.

The EXACT algorithm has 18 numeric parameters, of which eight can be set by the user. The remaining ten are determined by the process itself and are, therefore, continually updated. Initially, the eight user-adjustable parameters are set at factory defaults, which represent safe, general purpose values.

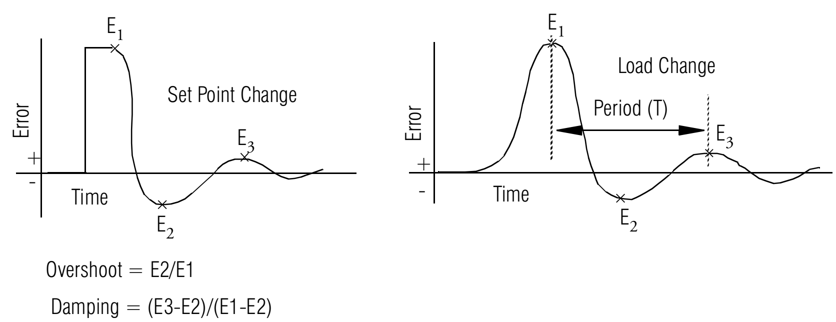
EXACT Steps (cont.)

Even if the values of key parameters are unknown or the default values are wrong for your process, you can calculate new values automatically, using the EXACT *pretune* feature. The pretune procedure, using the PTUN algorithm, starts with the factory-set defaults and calculates optimum values of the six parameters by determining the response of the process to an intentionally introduced process upset, called a "bump." The magnitude of the bump is user-adjustable.

Determining Process Response (Pattern Recognition)

The pattern to be recognized by the EXACT algorithm is the variation of error versus time, where error is defined as the difference between measurement and set point. The general goal, which is to minimize error, may be defined in various ways. For some processes, the goal is to minimize the peak magnitude of error (overshoot). For others, it is to achieve maximum reduction of successive error peaks (damping). For others, it is to reduce steady-state error to zero in the shortest possible time. The various goals are defined by the terms *overshoot*, *damping*, and *period*.

Figure 6-1. Pattern Recognition Characteristics



The EXACT pattern recognition approach is unique — its algorithm does not require a mathematical model of the process.[1,2,3] Instead, it uses direct feedback of actual process performance to determine the action required.

The self-tuning PID algorithm monitors the closed-loop recovery of the process following a disturbance to set point or load. It then automatically calculates P, I, and D to minimize process recovery time, subject to user-specified damping and overshoot limits.

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1. Rohrs, C. E., Valavani, L., Athans, M., and Stein, G., "Robustness of Adaptive Control Algorithms in the Presence of Unmodeled Dynamics," MIT Industrial Liaison Program, Publication No. 01-016, 1983.
2. Fjeld, M. and Wilhelm, R. G., Jr., "Self-Tuning Regulators - The Software Way," Control Engineering, November 1981, P. 99.
3. Clarke, D. W., "The Application of Self-Tuning Control," Trans Inst MC Vol. 5. No. 2, April-June 1983, P. 59.

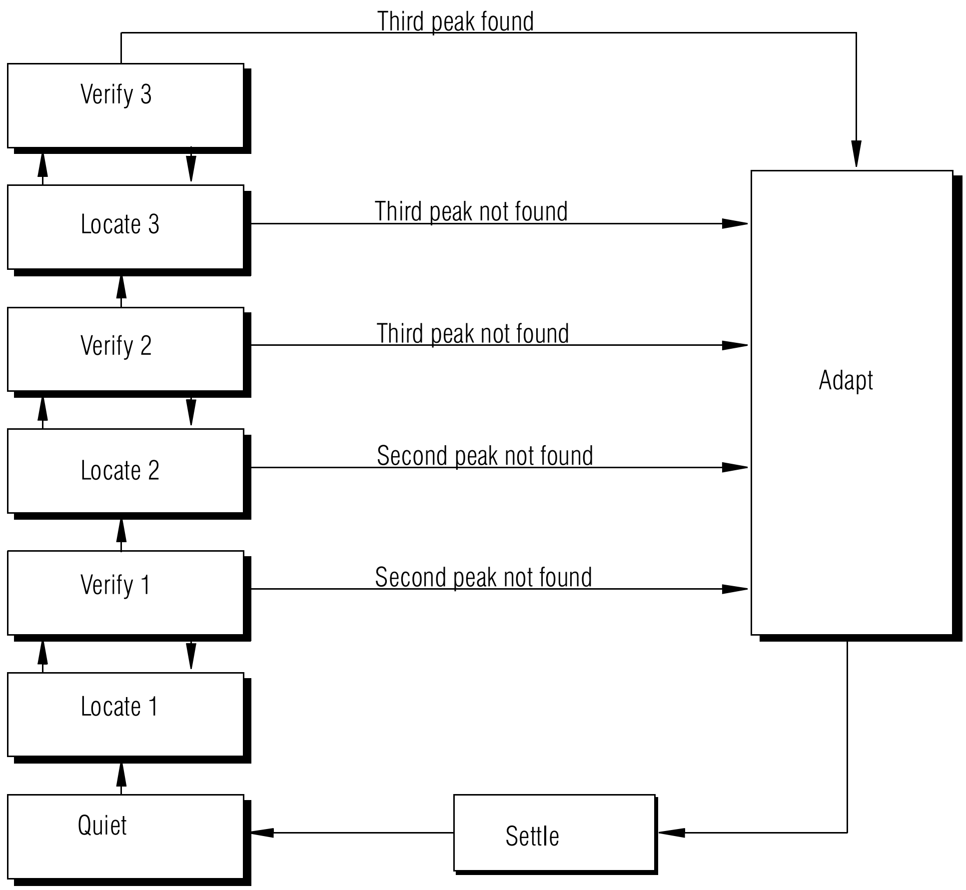
Determining Process Response (cont.)

For most processes, however, damping and overshoot are not independent; the period of oscillation must be included to define the shape of the pattern. The period can be nondimensionalized by using the controller I and D values to produce ratios similar to those proposed by Ziegler-Nichols[1] and Shinskey[2]. The ratios *I/period* and *D/period* define the lead and lag phase angles of the controller response. P, I, and D computations are therefore based upon the period of oscillation and are constrained by the user-set damping and overshoot parameters (see Figure 6-1).

Calculating PID Values (STUN Algorithm)

Figure 6-2 is a state diagram of the EXACT self-tune algorithm, called STUN. The current status of the control process is shown on the two-line display on the face of the 762CNA controller. If corrective action is currently being taken, you can display either the reason the current step is being implemented, or the name of the last corrective step completed.

Figure 6-2. STUN Algorithm State Diagram



1. Ziegler, J. G. and Nichols, N. B., "Optimum Settings for Automatic Controllers", Trans ASME, November 1942.
2. Shinskey, F. G., Process Control Systems, McGraw-Hill, New York, NY, 2nd Edition, 1979, pp. 96-99.

Locating Peak 1

In normal operation, set point and measurement are close to each other and the algorithm is in the QUIET state (error is too small to activate the self-tune algorithm). However, when a disturbance appears in the process that causes the error to exceed twice the noise band, the algorithm “wakes up” and begins to “watch” the error in anticipation of a peak. While waiting for the first peak, the state is defined as LOCATE 1. Once a peak occurs, the algorithm stores the magnitude of the peak and starts a timer to record the elapsed time to the next peak, which is defined as the period of oscillation.

Ziegler-Nichols Method

Ziegler-Nichols developed a tuning procedure that involved adjusting I and D until I/period equals 0.5 and D/period equals 0.12. However, it has since been found that much better tuning and quicker convergence result when the ratios of I/period and D/period are changed by the algorithm. A process with a dominant deadtime requires smaller ratio values than one with a dominant lag. If the response is overdamped and distinct peaks are not found, I and D are adjusted by applying expert rules.

Verifying Peak 1

Before searching for Peak 2, the algorithm verifies that the first is a true peak (during the VERIFY 1 state). If a new extreme value occurs during this verification state, it then becomes the first peak and the timer is restarted.

Locating Peaks 2 and 3

After Peak 1 occurs and is verified, the algorithm uses the same method to locate and verify Peaks 2 and 3.

Damping, Overshoot, and Period

The peak information is then expressed in the previously-defined terms of “overshoot”, “damping”, “I/period”, and “D/period.” Validity is determined for this information based upon the height of the peaks relative to the nominal noise band and the time between peaks relative to the period of a nominal damped sinusoid.

When the loop is properly tuned, the values of P, I, and D remain essentially unchanged from disturbance to disturbance. However, if the disturbance changes shape or if the process changes, EXACT will automatically determine new values.

Calculating P, I, D

Up to this point, the controller is operating as a fixed parameter PID controller. However, it has observed the loop response to a disturbance. The algorithm then uses the response information to calculate new values of P, I, and D (during the ADAPT state). The first step in calculating new P, I, and D values uses the period information to set I and D directly and damping or overshoot error to adjust **P**. The interaction between P, I, and D, however, requires this algorithm to be slightly more sophisticated — P must be further adjusted to compensate for the changes in I and D values.

Settling State

The self-tuning cycle is complete when the newly calculated P, I, and D values are set into the controller. The algorithm then goes through a *settling* state that allows a smooth transition into locating a new first peak, if necessary. The SETTLE state is only used to assure that the next peak found is a true peak. Switching the controller from MANUAL to AUTO or initially activating the self-tuning feature forces the algorithm into the SETTLE state.

Calculating Initial Parameters (PTUN Algorithm)

If the control characteristics of the process are not known, optimum values for six key parameters (PF, IF, DF, NB, WMAX, and DFCT) can be calculated by the pretune (PTUN) algorithm. Before enabling this feature, however, the controller must be in MANUAL, with the measurement steady and near the set point.

Introducing Process Upset

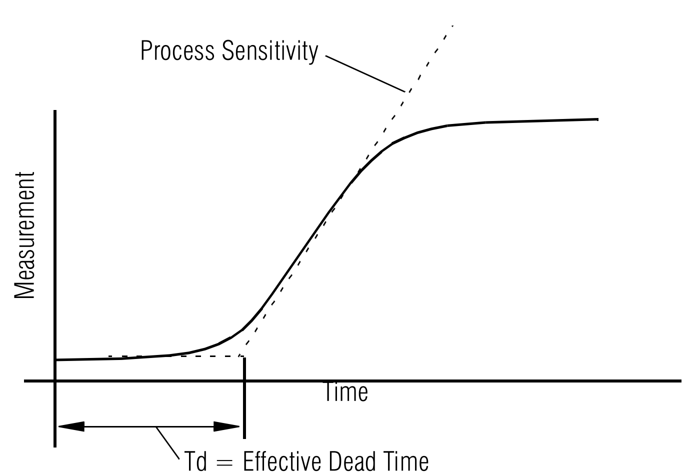
PTUN uses the factory-set (or user-adjusted) values of these six parameters as the starting values. The mechanism of the pretune function is to introduce a small process upset (output change) and determine the response of the process to this upset. The resultant process reaction curve provides data for the PTUN algorithm to calculate optimum values of the six parameters. The size of the process upset is provided by a parameter called BUMP.

After the procedure is finished, these optimum values are entered into the memory of the controller. In this way, the self-tune algorithm then starts with more correct values of P, I, and D, and thus, the measurement is stabilized faster. (PTUN-calculated values of PF, IF, and DF are the initial values of P, I, and D for the STUN algorithm.)

Computing IF, DF, WMAX

A typical process reaction curve (see Figure 6-3) identifies the effective process dead time and process sensitivity. The estimate of dead time is used to determine integral time (IF), derivative time (DF), and the maximum wait time (WMAX).

Figure 6-3. Typical Process Response to Step Change in Controller Output



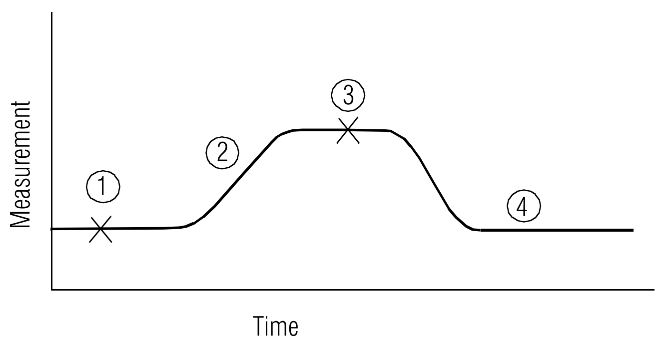
Computing PF, NB, DFCT

The proportional band (PF), integral time (IF), derivative time (DF), and wait time (WMAX) are calculated from both the sensitivity of the process reaction curve and the dead time. The nominal noise band (NB) is determined by observing the measurement and estimating the peak-to-peak amplitude that is of higher frequency content than the closed loop can remove. If the noise content is high, the derivative factor (DFCT) is reduced, since derivative action is not effective in a high noise environment. Usually DFCT is set to 1.

4 Pretune Phases

The four main phases of pretune are shown in Figure 6-4. As they occur, they are shown on the display of the controller. The process upset occurs with a step change in controller output at point 1. The algorithm waits for steady state during 2 (the messages PTUN = SMALL 1 and PTUN = WAIT 2 will be displayed), calculates the control parameters, and returns the controller output to its starting value at point 3 (PTUN = PID 3). If the process is an integrating type or if it has high gain, point 3 is reached when the measurement changes by 10% of its span or the bump size, whichever is larger. Finally, the noise band and derivative factor are calculated during 4 (PTUN = NB 4). When the process is completed, the message PTUN = FINISH will appear.

Figure 6-4. Pretune States



User-adjustable Parameters

In configuring a 762CNA controller, you can leave any of the user-adjustable parameters at the factory-set values, change them to new values, or use the pretune function (PTUN) to calculate optimum settings of six key user-set parameters (PF, IF, DF, NB, WMAX, and DFCT). Factory-set default values and acceptable maximum and minimum values for each parameter are listed in Table 6-6, "EXACT Parameter Limits and Values," on page 156.

Initial Values of P, I, and D (PF, IF, and DF)

The PF, IF, and DF parameters are the PID values used by the controller when EXACT tuning is either not configured or not enabled. They also are the starting values for P, I, and D used by the self-tune algorithm, STUN.

If you have little or no knowledge of the PID values required for your process and choose not to run PRETUNE, you can start with the factory-set values. EXACT eventually corrects any unreasonable initial values.

Noise Band (NB)

Virtually every process measurement has the potential of being "noisy." The term, noise, is used because the measurement data contains no information useful for loop tuning. To avoid an attempt to extract tuning information when none is present, the self-tune algorithm must know the peak-to-peak magnitude of this noise. Self-tuning begins whenever the error exceeds twice the noise band. The magnitude of the noise band is also used by the self-tune algorithm to determine whether or not an observed peak is noise.

Derivative Factor (DFCT)

In some processes, such as those with large dead time or high measurement noise, derivative action is not beneficial. In others, it is very helpful.

The DFCT Derivative Factor provides a mechanism for you to attenuate or amplify the influence of derivative to period ratio. By varying this factor, you can change the value of the adapted derivative term. Setting this factor to 0.0 transforms the controller into a PI controller; setting it to 1.0 produces normal derivative action. For processes that require a large amount of derivative action (such as a double integral process), DFCT can be increased to as much as 4.0.

Maximum Wait Time (WMAX)

The self-tune algorithm requires an estimate of the time scale of the process. This parameter defines the maximum time that the algorithm waits for the second peak before deciding the response is non-oscillatory (see Figure 6-5). WMAX should be set greater than half the maximum period of oscillation T (refer to Figure 6-6) and less than eight times the minimum period of oscillation T, or *T/2 <WMAX< 8T.*

Figure 6-5. Maximum Wait Time (WMAX)

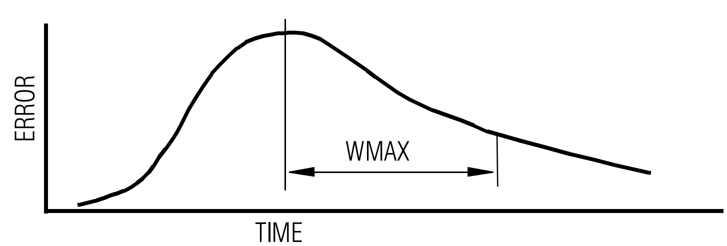
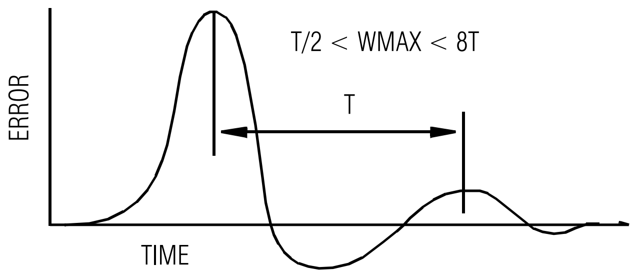


Figure 6-6. Period of Oscillation (T)



Change Limit (CLM)

You may want to limit the maximum and minimum values of P and I calculated by EXACT. The CLM parameter is the factor by which PF and IF are multiplied and divided to set these limits. Division is used to set the lower limit; multiplication for the upper limit. For example, if PF equals 100 and CLM equals 4, P calculated by EXACT will be limited to values between 25 and 400%.

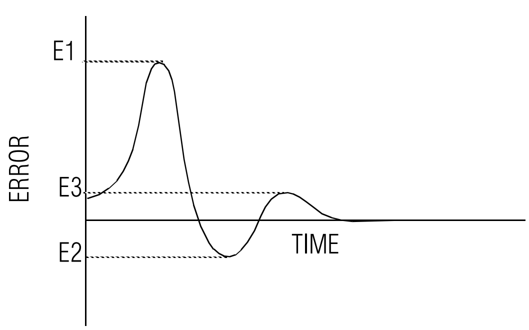
Output Cycling Limit (LIM)

EXACT monitors the controller output when it is oscillating at a frequency higher than that to which the loop can respond. If the average peak-to-peak amplitude exceeds LIM for over three minutes, the controller is automatically detuned by increasing P and reducing D. This feature is useful for processes that have very little dead time and that require a high controller gain. For this type of process, the value of LIM should be reduced.

Target Damping (DMP) and Overshoot (OVR)

Since neither damping nor overshoot can generally be set independently, the algorithm uses the larger deviation from target. Generally, damping minus its target is the greater since the overshoot target is usually chosen as 50%, while the damping target is usually 10% to 20%. See Figure 6-7.

Figure 6-7. Damping and Overshoot



$$OVR = -\frac{E2}{E1}$$

$$DMP = \frac{E3-E2}{E1-E2}$$

BUMP Parameter

The PTUN function uses the BUMP parameter to introduce a small process upset for generating data for input to STUN. The value entered determines the magnitude and direction of the upset. The BUMP value, however, should not be so large that it drives the output off scale. For example, if the output is at 6% of scale, with the measurement steady and near the set point, a BUMP value of -8% would drive the output off scale (to -2%). Therefore, its value is automatically decreased to -6%. If the BUMP value is too small to activate the pretune algorithm, the error message PTUN = SMALL 1 will not disappear. In this case, the BUMP should be increased and PTUN rerun.

Using EXACT Tuning with 762C Controllers

Table 6-5, "EXACT Parameters," on page 155 defines the parameters used by EXACT. Table 6-6, "EXACT Parameter Limits and Values," on page 156 defines limits and default values for each. In both tables, the parameters are listed in the same sequence in which they appear in the display.

Use of Structure Diagrams

Structure diagrams illustrate graphically the sequence in which displays appear on the face of the 762CNA controller as you press various keys. A structure diagram is a map of the product structure that enables you to move easily from one parameter or display to another.

To enter the structure from normal operating mode, press TAG. You can then move around within the structure by using ACK, SEL, and the ∆/∇ keys. To leave the structure and return to normal operation, press TAG at any time.

While you are in the structure (after pressing TAG), use ACK to accept a displayed value or to move to the right or to the next item in the diagram. Use SEL to step to the left or backward in minor increments. Use the ∆/∇ keys to display a different value in a sequence or to move directly up or down to a different location in the structure. Key functions are described in more detail in Table 6-1.

Figure 6-8, which is an excerpt from Structure Diagram 4 (see page 241), shows the part of the 762CNA configuration sequence that pertains to EXACT.

Keys Used with EXACT

Table 6-1. Keys Used with EXACT

Key	Function
TAG	Press to move from normal operation to the product structure. When in the product structure, press TAG to return to normal operation.
ACK	Press to accept a displayed value or to move the next item in the structure (to the right or down in the structure).
∆	Press to increase the value displayed by one increment, to display the next item in a series of items, or to move upward in the structure to the next item. Press/hold to increase the rate of change of a value.
∇	Press to decrease the value displayed by one increment, to display the next item in a series of items, or to move down in the structure to the next item. Press/hold to increase the rate of change of a value.
SEL	Press to move backward in the structure in minor increments.

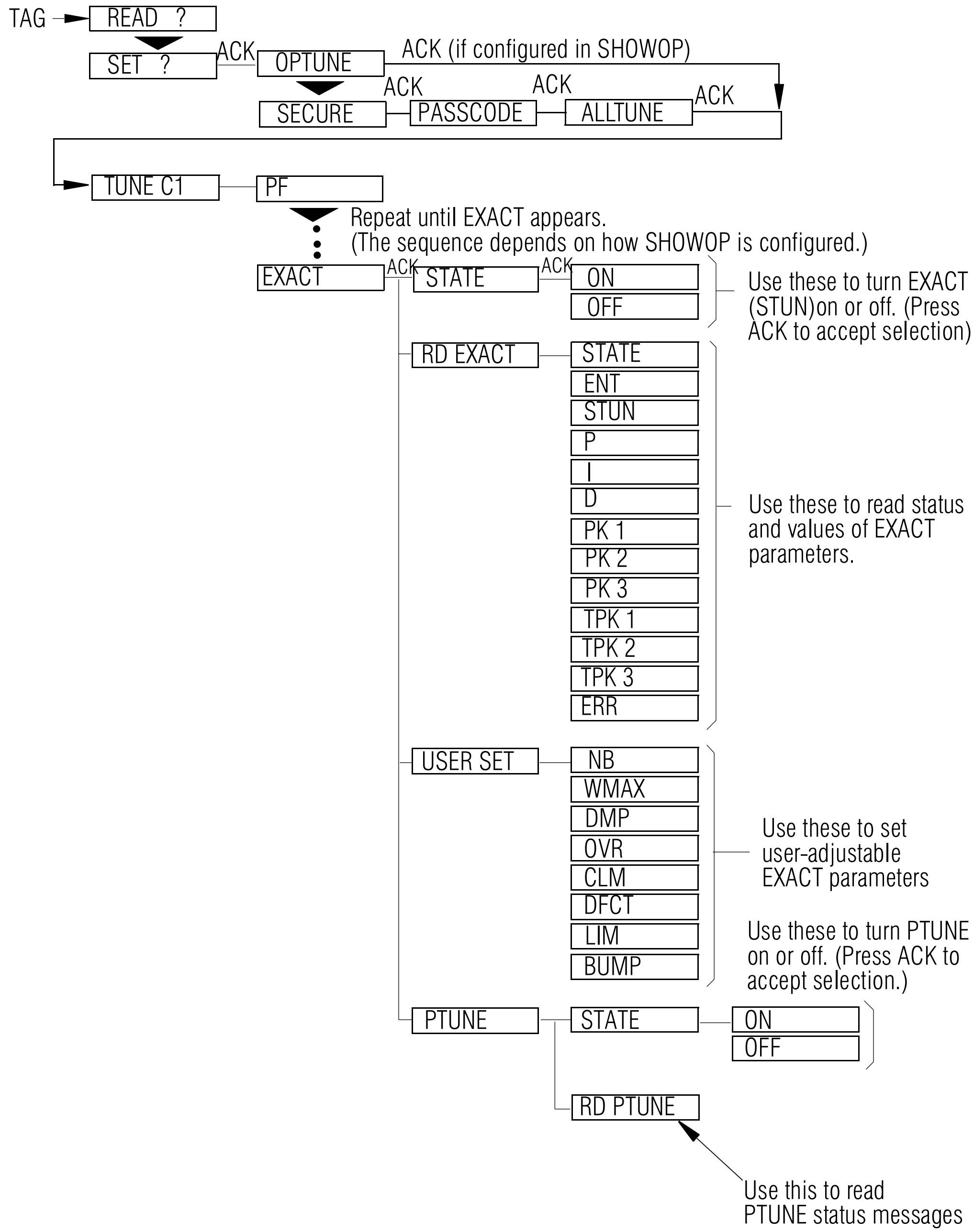
Responding to a ? Prompt

If a question mark appears in the alphanumeric display (on the right side of the lower line), it means that an additional user action or data entry is required.

When a question mark appears, you should perform one of the following:

- Press the ACK key to acknowledge that the parameter shown is the desired one.
- Press the ∆ or ∇ key to display a different parameter. Press again and again until desired parameter is displayed. Then press ACK to accept the parameter.
- Press the ∆ or ∇ key to change the value. Press ACK to accept the value.

Figure 6-8. Structure Diagram for EXACT



Configuring EXACT

You enter all EXACT parameters into controller memory by stepping the display through the structure diagram to USER SET and then selecting/entering the values. To step the display to a desired location in the structure diagram, repeatedly press either the ACK or Δ/∇ keys until the desired message appears on the display, using the Structure Diagram as a map.

EXACT configuration consists of entering three Yes/No decisions and 8 numerical parameter entries. The process itself determines 10 additional parameters.

In configuring EXACT, you must make the following decisions:

1. Should EXACT be configured into controller?
2. Should the operator be allowed to read values and status of parameters and change those that are adjustable — without using security passcode?
3. Do you intend to use the PTUNE pre-tuning function to calculate initial parameter values?

You must also enter values (or use the factory-set default values) for the following parameters:

NB*	Noise Band
WMAX*	Maximum waiting time for peaks
DMP	Damping
OVR	Overshoot
CLM	Clamp (sets limits for P and I influences)
DFCT*	Derivative factor
LIM	Cycling limit
BUMP	Magnitude and sign of PTUN upset

*These values can be automatically determined by using PTUN.

For a detailed description of the procedure for making these entries, refer to the Tutorial Example that follows on page 150. For a description of the complete configuration process, refer to “” on page 49.

Note that you can change any of the Yes/No decisions or the values of the 8 adjustable parameters at any time.

Status Messages

When EXACT is configured and enabled, self-tuning occurs automatically whenever the measurement deviates from the set point by an amount greater than twice the value of the noise band (NB) parameter.

If you step the display to RD EXACT ENT during the STUN correction process, a status message appears. The message shows the reason why a specific corrective action was taken. See Table 6-4, “Messages – RD EXACT ENT,” on page 149 for a list of these messages.

Status Messages (cont.)

If you step the display to RD EXACT STUN during the correction process, a different sequence of messages will appear. Each message displays the status of the specific correction action currently taking place. See Table 6-3 for a list of these messages.

Messages — Read EXACT Pretune

Table 6-2. RD EXACT PTUNE

Display	Meaning
RD PTUNE	Specific step in operation of pretune function.
RD PTUNE = OFF	Pretune function has not been switched on.
RD PTUNE = IN AUTO?	Pretune function is ready. Put controller in AUTO.
RD PTUNE = SMALL 1	Phase 1. Small (<2.5%) change in measurement. (If message lasts longer than twice process dead time, value of BUMP is too small.)
RD PTUNE = WAIT 2	Phase 2. Waiting for steady state.
RD PTUNE = PID 3	Phase 3. New values of P, I, and D calculated. Output is returned to initial value.
RD PTUNE = NB 4	Phase 4. Measured noise band.
RD PTUNE = FINISH	Pretune function finished. Values of the 6 key EXACT parameters have been calculated and put into memory.
RD PTUNE = INC WRONG	Pretuning not completed because controller output action (INC/INC or INC/DEC) is configured wrong.
RD PTUNE = NOISE	Pretuning not completed because value of noise band (NB) is too small.

Messages — Read EXACT Self-tune

Table 6-3. RD EXACT STUN

Display	Meaning
RD EXACT STUN	Status of specific corrective action taking place.
STUN = QUIET	No corrective action is taking place (error is <2NB).
STUN = LOCATE 1, 2, or 3	A peak (1, 2, or 3) has been located.
STUN = VERIFY 1, 2, or 3	The located peak (1, 2, or 3) has been verified.
STUN = ADAPT	P, I, and/or D has been adjusted.
STUN = SETTLE	Waiting for next peak.
STUN = MANUAL	Self-tuning is operational, but controller is in MAN.
STUN = INACTIVE	EXACT is temporarily disabled due to a configured condition that affects the closed-loop control.

Messages — Read EXACT Entries

Table 6-4. Messages – RD EXACT ENT

Display	Meaning
RD EXACT ENT	Reason why specific corrective action was taken. (This parameter is updated every time P, I, and/or D is adjusted.)
ENT = 1 PEAK	Only one significant (with respect to noise band) peak was found. Measurement is approximately critically damped.
ENT = 2 PEAKS	2 peaks found.
ENT = 3 PEAKS	3 peaks found. If peaks are significant, response period is used to adjust proportional and derivative actions.
ENT = DAMPED	Error signal (measurement deviation from set point) was overdamped. Response may *appear* overdamped if WMAX is set too low. If so, algorithm will tighten control settings (decrease P and I, and increase D). This can lead to instability.
ENT = SUSPECT	Error signal has suspicious shape that may be caused by multiple disturbances. P, I, and/or D were slightly adjusted based on this suspicious shape.
ENT = FAST	Error signal response occurred faster than expected, based on WMAX time. No corrective action was taken. (If response was correct, WMAX should be reduced to allow EXACT algorithm to operate; WMAX should be smaller than 8 times minimum period of oscillation.)
ENT = SP CHANGE	A large set point change occurred after algorithm had located or verified a peak. Additional corrective action did not occur because algorithm went immediately into SETTLE (waiting for the next peak) state. ("Large" set point change means value larger than peak being observed.)
ENT = OOR	Error signal was observed but P, I, and/or D were not changed because process was out of control range. (For example, measurement is low, but output is already at high limit.)
ENT = CLAMPED	Algorithm attempted to change P and I to values larger than settings of PF and IF modified by CLM. These values are set at CLM limits. (If required, settings of PF, IF, or CLM can be changed.)
ENT = INIT	EXACT algorithm has been initialized. (This can occur when power is turned on, or when first switching from MAN to AUTO.)

Tutorial Example

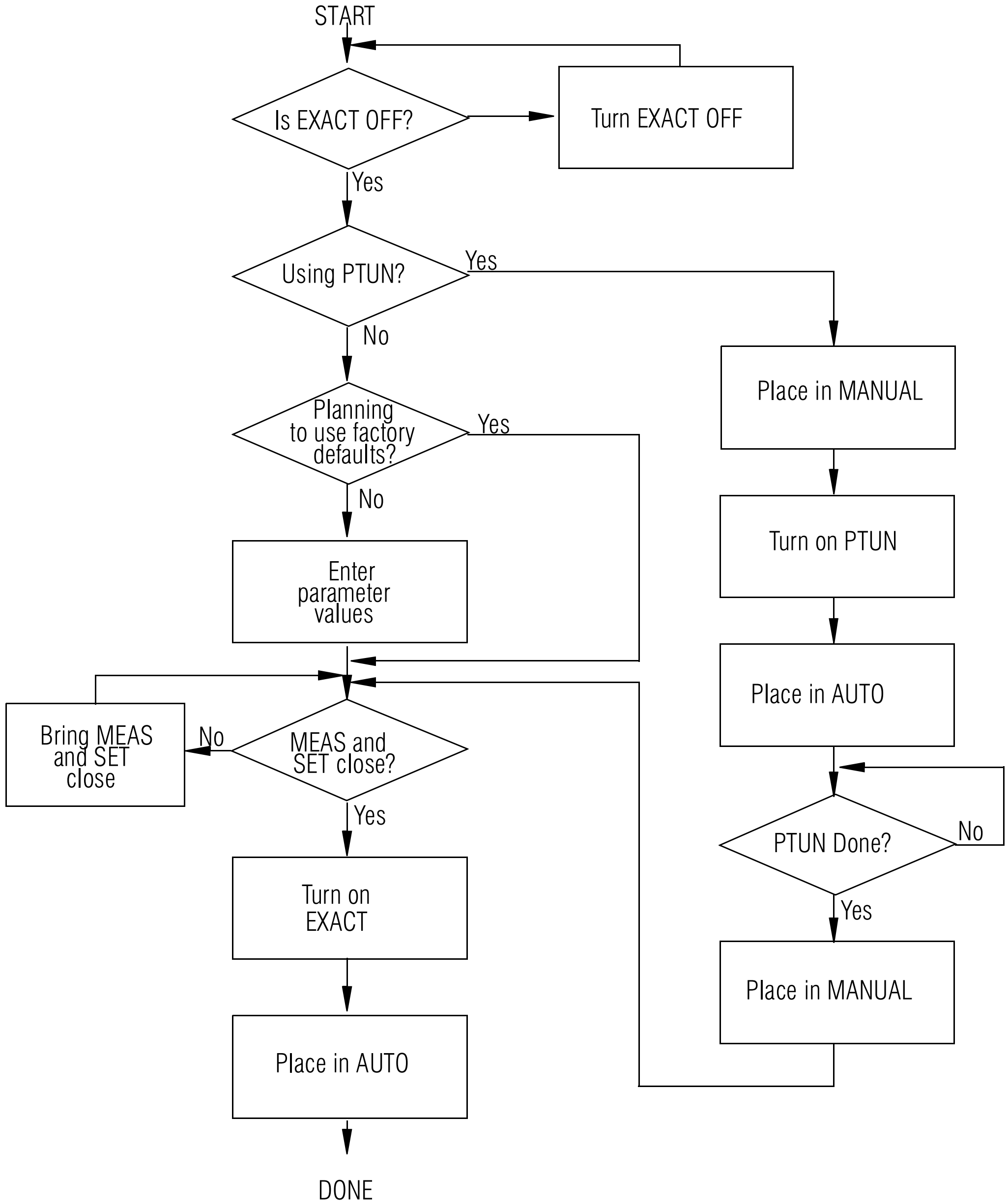
The following example describes the procedure for setting up and using EXACT tuning for achieving optimal control of a process loop. Before starting, you should decide the following:

1 Do you want to use PTUN to generate initial parameter values?

2 If not, do you want to use factory default values for all parameters or do you want to enter your own values? If you want to enter your own values, please have them ready to enter when requested.

A flow chart of the functional steps in the procedure is illustrated in Figure 6-9. The detailed steps of the procedure follow the general flow diagram.

Figure 6-9. General Flow Diagram for Configuring EXACT



Tutorial Example (cont.)

NOTE The following is intended only as an example of the use of EXACT and does not include such items as configuring passcodes. For such information, refer to the general procedures described in “” on page 49. Also, the example assumes that FUNC 1 is configured as an EXACT controller, TUNE C1 is present in the OPTUNE menu, and Totalizer 2, although available, is disabled.

To configure EXACT for a typical control loop, execute the following procedure:

1 Is EXACT off? If yes, go to Step 2. If not, do the following:

- **a** From normal operation, press TAG to go to READ.
- **b** Press ∇ to go to SET.
- **c** Press ACK three times to go to PF.
- **d** Press ∇ three times to go to EXACT.
- **e** Press ACK to go to STATE.
- **f** Press ACK.
- **g** If OFF appears, press ACK to accept. If not, press ∇ to display OFF. Then press ACK to accept.
- **h** The display will show RD EXACT.
- **i** Go to Step 2.

2 Are you planning to use PTUN? If not, go to Step 3. If yes, do the following:

- **a** Press ∇ repeatedly until the display shows PTUNE.
- **b** Press ACK to step to STATE ?
- **c** Press ACK again to step to STATE = ?
- **d** Press ACK. The current status is then displayed.
- **e** If ON, press ACK to accept the value. If OFF, press ∇ until PTUNE = ON appears.
- **f** Press ACK to step to PTUN READ ?
- **g** Press ACK again to display RD PTUNE = ?
- **h** Press ACK repeatedly until IN AUTO appears.
- **i** Press A/M to accept. This places the controller in AUTO.
- **j** The display will then show a sequence of status messages. When the message PTUN = FINISH appears, press TAG to place the controller into MAN.
- **k** Go to Step 5.

Tutorial Example (cont.)

3 Since you are not planning to use PTUN, you either have to enter new parameter values or use the factory-set defaults. If you plan to use defaults, go to Step 5. If you want to enter new values, go to Step 4.

4 To enter new parameter values, do the following:

   a Press TAG to step to READ.

   b Press ∇ to move to SET.

   c Press ACK three times to move to PF.

   d Press ∇ four times to move to EXACT.

   e Press ACK to move to STATE.

   f Press ∇ twice to move to USER SET.

   g Press ACK to step to NB?

   h Use the SEL key to select the digit to be changed. Use the ∆/∇ keys to change the value of the digit.

   i Press ACK to accept value and move to the next digit.

   j When you have entered all digits correctly, press ACK to accept the value.

   k Press ACK to step to the next parameter. Execute the data entry steps for this parameter and press ACK to move to the next.

   l When you have entered all parameters, press TAG. Proceed to Step 5.

5 Verify that measurement and set point are close to each other and that the process is stable. If not OK, wait before proceeding further. If the process is OK, turn EXACT ON. To do this execute the following:

   a Step the display to EXACT STATE ?.

   b Press ACK to display STATE = _____.

   c If display shows STATE = ON, press ACK to accept. If display shows STATE = OFF, press ∇ until display shows STATE = ON.

   d Press ACK to accept.

   e Press TAG to place the controller in AUTO.

The controller is now in AUTO with EXACT enabled and operating in the STUN mode. To observe the status of the STUN process, execute the following procedure:

1 Press TAG to move to READ.

2 Press ∇ to move to SET.

3 Press ACK three times to move to PF.

Tutorial Example (cont.)

4 Press ∇ four times to move to EXACT.

5 Press ACK to move to STATE.

6 Press ∇ to move to RD EXACT.

7 press ACK to move to STATE.

8 Press ∇ twice to move to STUN.

9 Press ACK to display the current step (one of the messages shown in Table 6-3).

When the calculation process is complete, press TAG to return.

EXACT Parameter Tables

Table 6-5. EXACT Parameters

Parameter	Meaning
PF, IF, DF	Values of proportional, integral, and derivative actions that the controller uses when EXACT tuning is not configured (or not enabled). These are also used as initial values for P, I, and D, below.
EXACT STATE	Should EXACT tuning be enabled (ON or OFF)?
EXACT	The 18 parameters (below) that comprise EXACT algorithm.
P, I, D	Latest updated values of proportional, integral, and derivative actions that the controller is using. (Original starting values came from MODES PF, IF, and DF, above.)
PK1, PK2, PK3	Actual magnitudes of most recent series of error peaks. Error expressed as amount of deviation of measurement from set point.
TPK1, TPK2, TPK3	Actual time intervals between most recent series of error peaks (from upset to Peak 1, Peak 1 to Peak 2, Peak 2 to Peak 3).
ERR	Error. Deviation of measurement from set point.
NB	Noise Band. Error band (±) within which process will be controlled by last values of P, I, and D. When error exceeds 2xNB, corrective action will start (EXACT starts to look for peaks).
WMAX	Maximum waiting time between Peak 1 and Peak 2.
DMP	Damping. Desired amount of damping of measurement signal.
OVR	Overshooting. Desired amount of measurement overshooting.
CLM	Clamp. Factor by which PF or IF values are either multiplied or divided by to establish maximum and minimum EXACT values of P and I.
DFCT	Derivative Factor. Factor by which D is multiplied.
LIM	Limit. If output cycles for more than three minutes, controller is detuned by increasing P and decreasing D.
BUMP	Bump (upset) value for pretuning (PTUN) function, expressed as ±% of output.
RD EXACT	The status of the various affected parameters during corrective action.
RD EXACT ENT	Reason why specific action was taken. Ten messages are available; see Table 6-3, "RD EXACT STUN," on page 148.
RD EXACT STUN	Self-tuning. Specific step just completed during corrective action. Eight messages are available for 762CNA controller. See Table 6-3, "RD EXACT STUN," on page 148 for a detailed list.
EXACT PTUNE	Pretuning function. Method of obtaining initial values of six key EXACT parameters, if details are not known about process.
PTUNE STATE	Should pretune function be enabled (ON or OFF)?
PTUNE RD PTUNE	Specific pretuning step just completed. Nine messages are available; see Table 6-2, "RD EXACT PTUNE," on page 148.

Parameter Limits and Values

Table 6-6. EXACT Parameter Limits and Values

	Parameter Limits			
Parameter*	**Min**	**Max**	**Default Value**	**User Configuration**
PF	1%	8000%	200%	
IF	0.01 min/rep	200 min/rep	2.00 min/rep	
DF	0 min	100 min	0.0 min	
EXACT				
EXACT STATE	ON	OFF	OFF	
EXACT				
P	1%	8000%	**	
I	0.01	200 min	**	
D	0	100 min	**	
PK1	–102%	+102%		Values are
PK2	–102%	+102%		determined
PK3	–102%	+102%		by process
TPK1		<WMAX		
TPK2		WMAX		
TPK3		>WMAX		
ERR	–102%	+102%		
NB	0.5%	30%		
WMAX	0.5 min	200 min	5 minutes	
DMP	0.1	1	0.2	
OVR	0	1	0.5	
CLM	1.25	100	10	
DFCT	0	4	1	
LIM	2%	80%	80%	
BUMP	-50%	+50%	8%	
RD EXACT				
RD EXACT ENT	(10 messages)		INIT	(No Entry)
RD EXACT STUN	(11 messages)		MANUAL	(No Entry)
EXACT PTUNE				
PTUNE STATE	ON or OFF		OFF	OFF***
PTUNE RD PTUNE	(9 Messages)		OFF	(No Entry)

* After EXACT is configured, specify the parameters listed above. These parameters can also be specified in OPTUNE if the controller is so configured.

** Starting values of P, I, and D are same as PF, IF, and DF (at top of table). EXACT will then continually update these values.

*** PTUN STATE is normally OFF. When you start to use pretune function, you are prompted to turn it ON. After function is completed, it automatically resets to OFF.

762C SINGLE STATION MICRO Controller

February 1998

FOXBORO®
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7 Calibration, Troubleshooting, Maintenance

This chapter is divided into the following major sections:

Calibration

Frequency of Calibration

The inputs and outputs have been calibrated in the factory to an accuracy of ±0.1%. Normally these functions do not require recalibration unless:

- Components have been changed.
- RTD or frequency (if present) measurement range has been changed.
- Controller configuration (in NOVRAM) was copied from another controller.

Calibration Equipment Accuracy

All calibration equipment (milliammeter, voltmeter, etc.) should have an accuracy of better than ±0.1%. If you use the measurement transmitter as the calibrating milliampere input signal source, the transmitter must be in calibration.

Calibration Connections

The calibrating signal for current and voltage inputs (IN 1, IN 2, IN 3, IN 4) can be generated internally in the controller or connected externally at the 32-pin terminal board at the rear of the housing. RTD input and measurement of outputs (OUT 1 and OUT 2) are done at the 32-pin terminal board.

Calibration Procedures

NOTE Calibration and a Display Test, contained within the product structure, are conducted via the keypad on the front panel. To leave the Normal Operating mode to do these functions and return to Normal Operation, press the TAG key. Use the ∆ and ∇ keys to move the display up or down and the ACK key to move the display forward horizontally in the product structure. Use the SEL key to move the display in minor increments back through the product structure.

The ∆ and ∇ keys are also used to adjust values that are shown on the lower alphanumeric display line. The digits are entered from right to left. If a ∆ or ∇ key is continuously pressed, numbers in the next highest significant digit will change. Releasing and then pressing the key repeatedly causes the numbers to change by one unit (in normal counting sequence) with each depression.

Preliminary Procedures

Access the CONFIGuration or TEST parameter in the product structure using the TAG, ∇, and ACK keys on the front panel following Figure 7-1.

Use the ∆ and ∇ and ACK keys and Figure 7-2 as you conduct calibration or display tests as described in this section of your instruction.

Figure 7-1. Structure Diagram 1

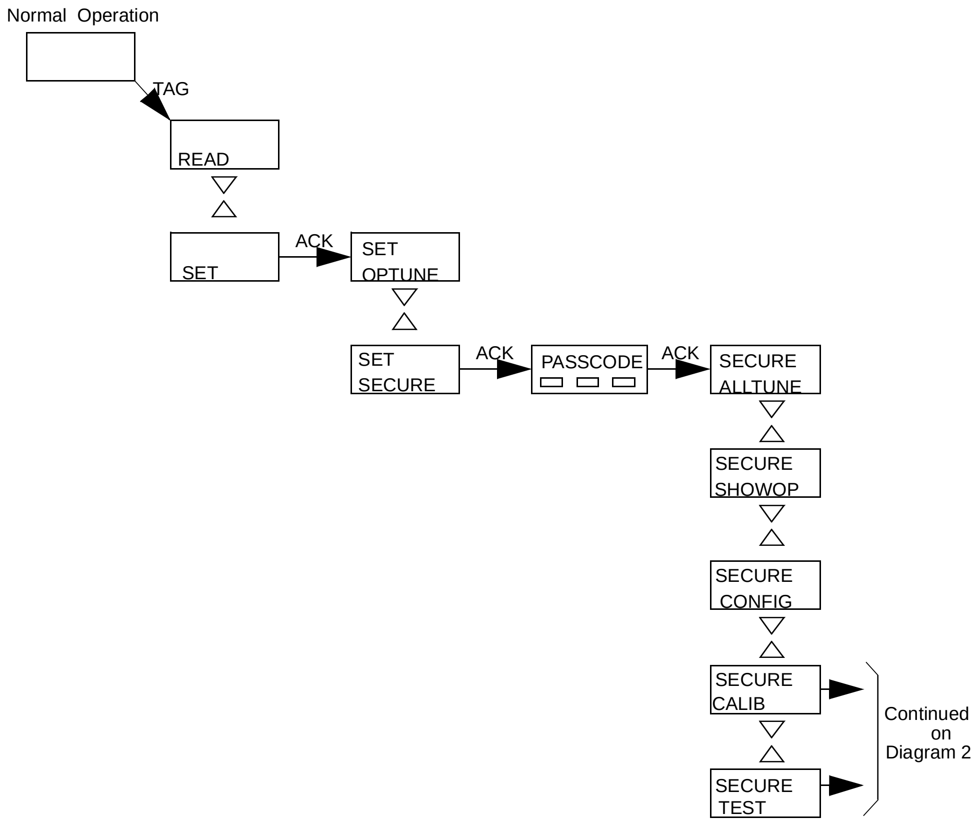
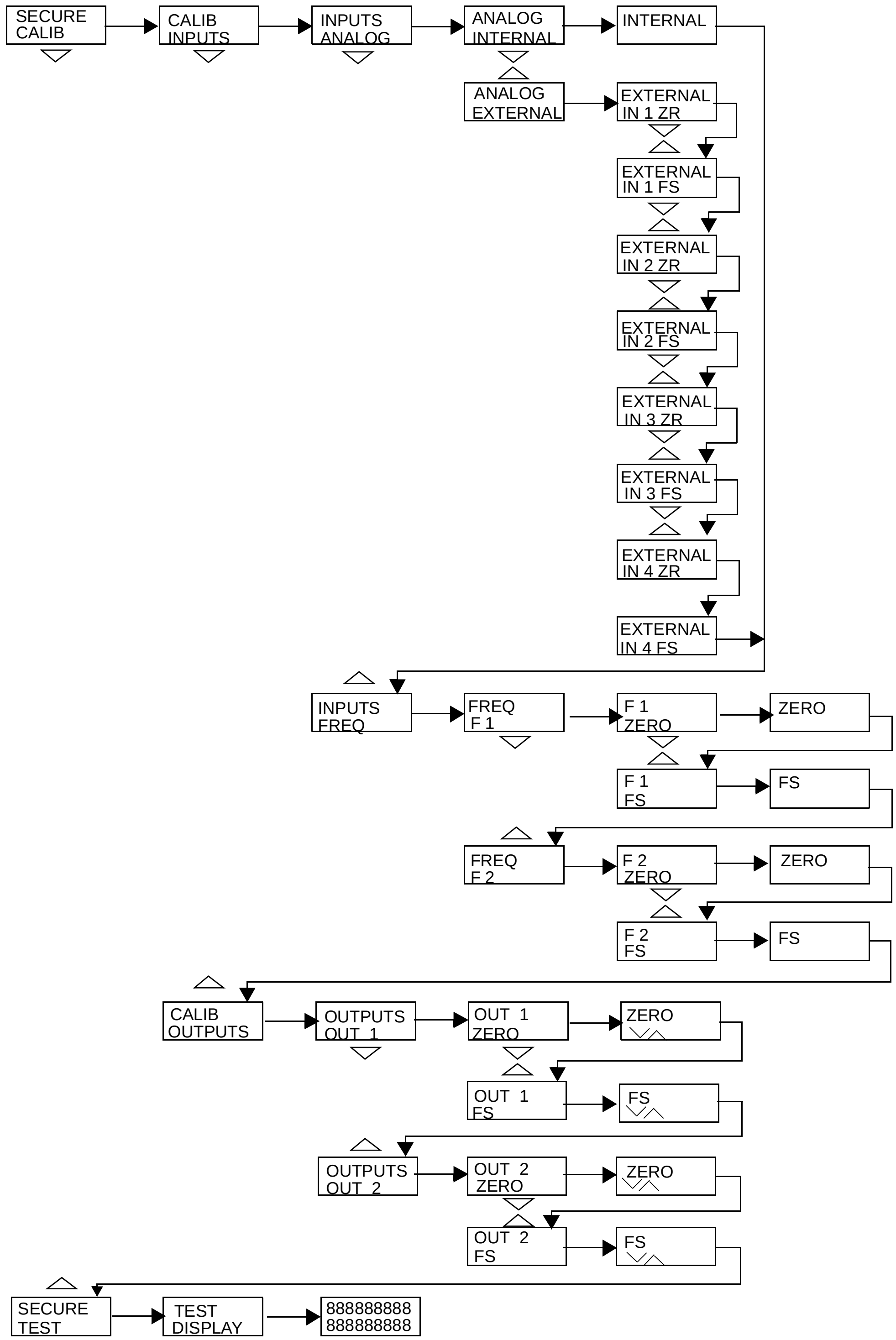


Figure 7-2. Structure Diagram 2



Current or Voltage Inputs (IN 1, IN 2, IN 3, and IN 4)

The source of the calibrating signal (from either an internal or external source) determines if the EXTERNAL or INTERNAL calibration is used.

INTERNAL Calibration

To perform an internal calibration, do the following:

1. Using the ACK key, move to INPUTS ANALOG and then to ANALOG INTERNAL in the product structure. Calibration input signals (corresponding to 4 and 20 mA or 1 and 5 V) are generated internally. When the ACK key is pressed, calibration is completed during an 8-second countdown for all four inputs (whether used or not). Accuracy of the internal input signal is ±0.25% of span.

EXTERNAL Calibration

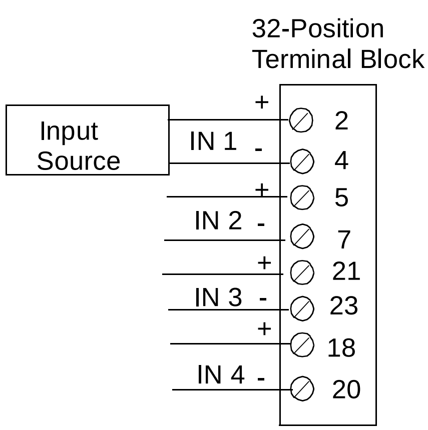
To perform an external calibration, do the following:

1. Connect an adjustable input source (4 to 20 mA or 1 to 5 V, as applicable) to terminals of input being calibrated (Input 1, 2, 3, or 4) as shown in Figure 7-3.

NOTE If the external calibrating signal is in error, the controller will still use this value as 0 or 100% input. However, if the signal error exceeds ±4.5%, an error message (TOO HIGH or TOO LOW) will flash and the opportunity to recalibrate will be displayed again.

2. Turn on controller power. Adjust input source to 4.000 mA or 1.000 V, as applicable for 0% input signal.

Figure 7-3. Terminal Connections for External Current or Voltage Inputs



3. Using the ACK key, move to INPUTS ANALOG and then to ANALOG INTERNAL. Using the ∇ key, go to ANALOG EXTERNAL.
4. Using the ACK key to move to EXTERNAL IN 1 ZR.

EXTERNAL Calibration (cont.)

5 Press ACK key to implement 0% input signal. A 8-second countdown will elapse to allow controller to average input. IN 1 FS will now appear on lower line.

6 Adjust input source to 20.000 mA or 5.000 V, as applicable for 100% input signal.

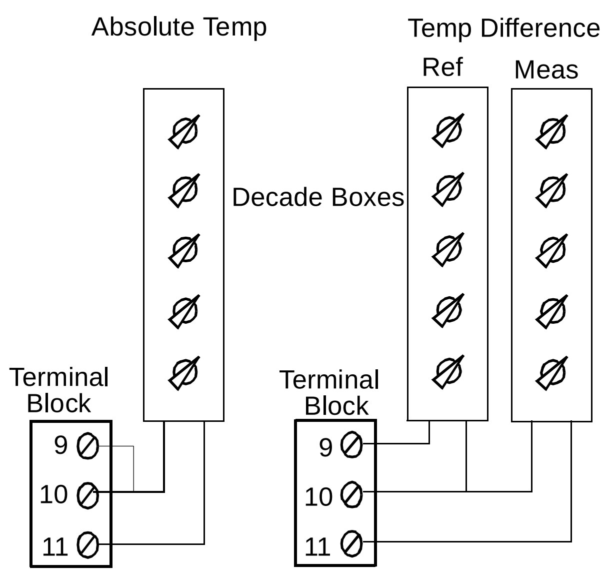
7 Press ACK key to implement 100% input signal. A 8-second countdown will elapse to allow controller to average input.

8 Prompting on display for Input 2 (and then Inputs 3, and 4) is same as that for Input 1. Complete this procedure for all four inputs.

RTD Input

This calibration procedure is similar to the EXTERNAL calibration in the preceding section, except that the calibrating signals are resistances from a decade box and only applies to INPUT 1. These resistances are applied to the terminals for absolute-temperature or for temperature-difference calibration as shown in Figure 7-4.

Figure 7-4. Terminal Connections for RTD Input Calibration



With *absolute-temperature* measurement, the resistances corresponding to 0 and 100% inputs can be determined from the IEC 100 or SAMA 100 curve, whichever is applicable. With *temperature-difference* measurement, the 0 and 100% resistances listed in the applicable curve must be modified for use in the calibration procedure. This modification is required to minimize errors due to the noncompensation of the measurement. See "Controller Range Conversion" on page 166 for this modification.

If the temperature range is being changed, the jumpers and potentiometers on the RTD printed wiring assembly (inside the controller) must be adjusted for the new range before calibrating the input. See "Controller Range Conversion" on page 166.

Frequency Inputs (F1 and F2)

This calibration requires no external connections. The calibration is accomplished entirely from the front panel keyboard.

1 Using the ACK and ∇ keys, move to INPUTS FREQ in the product structure.

2 Using the ACK key, proceed to FREQ F 1 (for F 1 calibration) or the ACK and ∇ keys to proceed to FREQ F 2 (for F 2 calibration). Follow the prompting which is summarized below.

3 Press ACK key. The lower display line shows ZERO ?. Press ACK key again and ZERO will move to top line.

4 Note that the default value for F1and F2 ZERO is 0. Use ∆ and ∇ keys to enter on lower display line frequency corresponding to 0% input. Press ACK key to implement 0% calibration.

5 The lower display line now shows FS (full scale). Press ACK key (FS will move to top line). Note that the default value for F1 full scale is 2000 and for F2 full scale is 1000. Use ∆ and ∇ keys to enter on lower display line frequency corresponding to 100% (full scale) input. The maximum full-scale input is 9999 Hz. Press ACK key to implement 100% calibration.

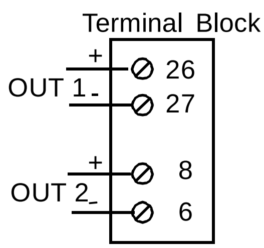
6 If F 1 was just calibrated, F 2 will now appear on lower line. If F 2 is to be calibrated, repeat procedure beginning with Step 3.

OUT 1 and OUT 2

1 If OUT 1 is being calibrated, connect a 0 to 20 mA milliammeter to terminals 26 and 27 on the 32-pin terminal block. If OUT 2 is being calibrated, connect a 0 to 20 mA milliammeter or a 0 to 5 V dc voltmeter (as applicable) to terminals 8 and 6. See Figure 7-5.

NOTE If output does not calibrate, check jumper positions for 1-5 V dc or 4-20 mA. Refer to“Positioning Links” on page 26.

Figure 7-5. Terminal Connections for Output Calibration



2 Using the ACK and ∇ keys, move to CALIB OUTPUTS in the product structure. If OUT 1 is being calibrated, proceed to OUTPUTS OUT 1 by pressing the ACK key. If OUT 2 is being calibrated, proceed to OUTPUTS OUT 2 with the ACK and ∇ keys. Follow display prompts as summarized below.

OUT 1 and OUT 2 (cont.)

3 Press ACK key. The lower display line shows ZERO. Press ACK key again and ZERO will move to upper display line. Use ∆ and ∇ keys to adjust meter reading to 0% controller output. For OUT 1, reading should be 4.000 mA. For OUT 2, reading should be 4.000 mA (4 to 20 mA output) or 1.000 V (1 to 5 V output). Press ACK key to implement this value. FS (full scale) will appear on lower display line.

4 Use ∆ and ∇ keys to adjust meter reading to 100% controller output. For OUT 1, reading should be 20.000 mA. For OUT 2, reading should be 20.000 mA (4 to 20 mA output) or 5.000 V (1 to 5 V output). Press ACK key to implement this value.

Controller Range Conversion

Use the applicable procedures described below to change the input range of the controller.

Conversion from 4 to 20 mA to 1 to 5 V Range

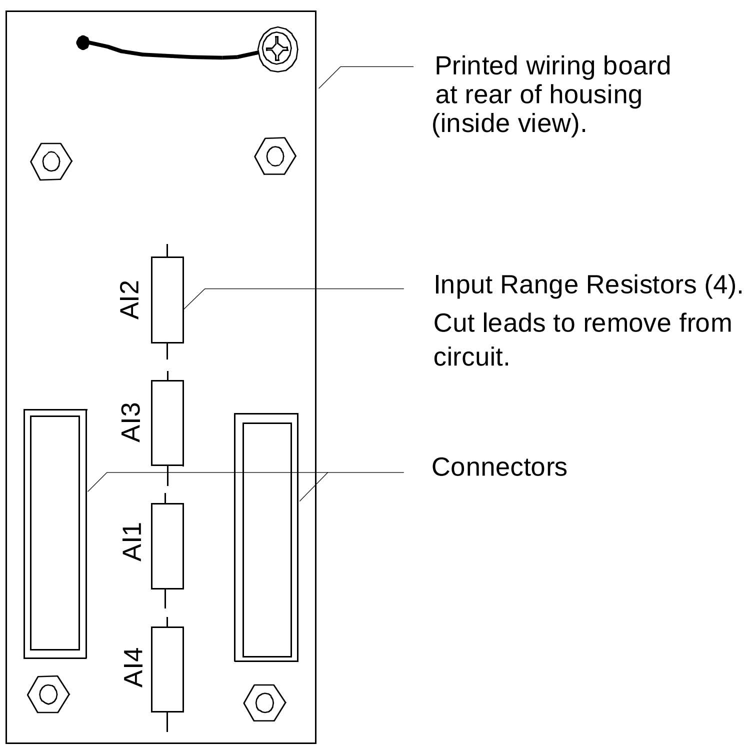
1 Remove power from controller.

2 Remove rear housing assembly (containing 32-pin terminal block) by removing four screws.

3 Snip out the resistor associated with the input range being changed. See Figure 7-6 for identification of resistors.

4 Replace rear housing assembly and restore power.

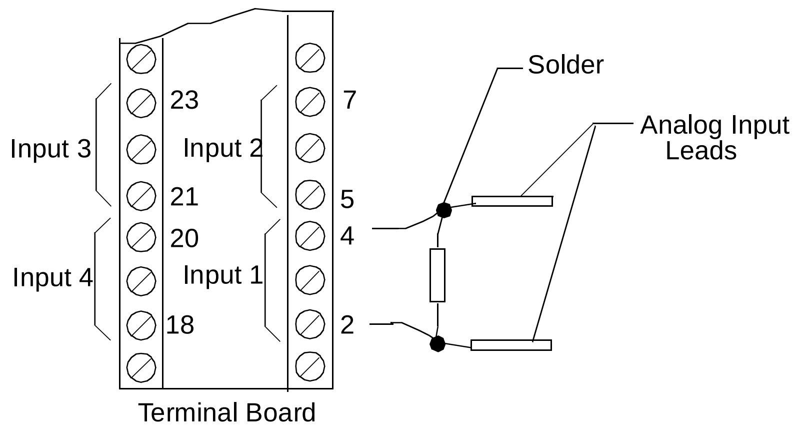
Figure 7-6. Location of Input Range Resistors



Conversion from 1 to 5 V to 4 to 20 mA Range

1. If power source is connected to controller, disconnect it.
2. Solder new input resistor, part number NO986FK (wire wound 250 ohm ±0.1%, 2 W) externally at the 32-pin terminal block between the "+" and "-" input signal leads of the input range being changed. See Figure 7-7.
3. Restore power.

Figure 7-7. Addition of Input Range Resistors



Conversion of RTD Input Range

Use IEC 100 or SAMA 100 curves (refer to Foxboro TI 005-028 or TI 005-274), whichever is applicable, to determine resistances corresponding to the desired temperature range limits.

Preliminary Steps

To make the conversion, first perform the following steps:

1. Remove controller from housing and place in special housing, part number L0122TZ (available from Foxboro), designed to facilitate calibration while the unit is powered.
2. Connect one decade box (for absolute-temperature measurement) or two decade boxes (for temperature-difference measurement) to the 32-pin terminal block as shown in Figure 7-4.
3. On RTD printed wiring assembly, connect 0 to 12 V voltmeter to pins 9 (+) and 1 (-). Use miniature hook clips or internal pin connectors to make connections. See Figure 7-8.
4. On PWA, connect Jumpers J1, J3, and J4 as specified in Figure 7-8 and Table 7-1 through Table 7-3. (Jumper J4 is used only with temperature-difference measurement.)

Figure 7-8. RTD Printed Wiring Assembly

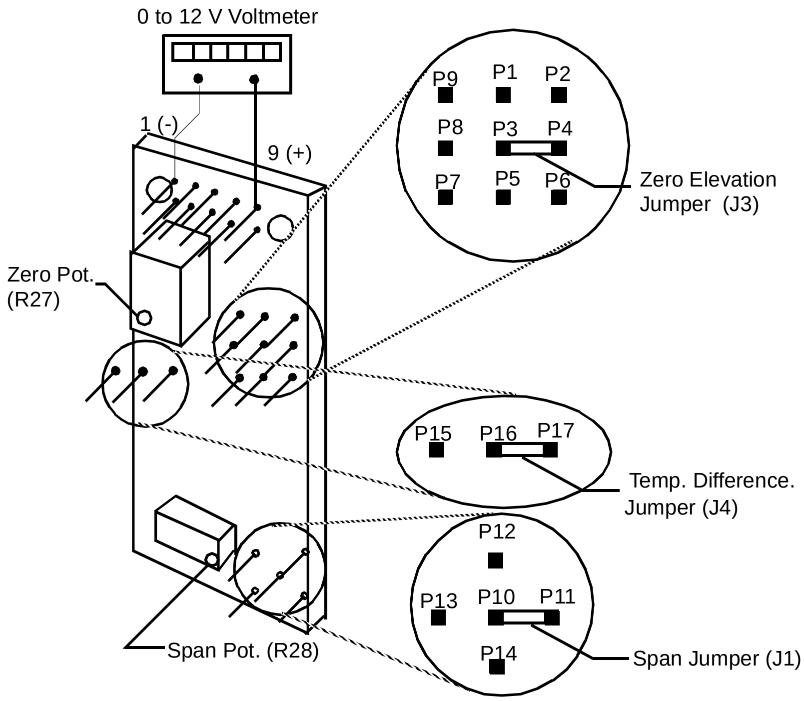


Table 7-1. RTD Span Jumper Positions

Temperature Span Limits		Jumper Position
°F	°C	(J1)
200 and 300	111 and 167	P10 - P11
300 and 500	167 and 278	P10 - P12
500 and 900	278 and 500	P10 - P13
900 and 1800	500 and 1000	P10 - P14

Table 7-2. RTD Zero Elevation Jumper Positions

Lower Range Value Temperature		Jumper Position
°F	°C	(J3)
Above 1170	Above 630	P1 - P2
800 to 1170	425 to 630	P3 - P4
450 to 800	230 to 425	P5 - P6
125 to 450	55 to 230	P5 - P7
-180 to +125	-120 to +55	P3 - P8
-325 to -150	-200 to -100	P1 - P9*

*With temperature-difference measurement, put jumper in P1 - P9 position.

Table 7-3. RTD Temperature Difference Jumper Positions

Reference Temperature	Jumper Position (J4)
Greater than Lower Range Value	P15 - P16
Less than Lower Range Value	P16 - P17

5 On PWA, turn ZERO and SPAN Potentiometers (R27 and R28) to middle of their adjustments (about 15 turns in from either end of adjustment).

6 Restore power to controller. Continue with applicable procedure (absolute temperature or temperature difference) that follows.

Absolute Temperature Measurement

To perform an absolute temperature measurement, do the following:

1 Complete the Preliminary Steps described above.

NOTE Note In Steps 2 and 3 below, E1 and E2 must be between -4 and +12 V. If either is outside of these limits, adjust ZERO Potentiometer (R27) so that the value is between these limits.

---

2 Set decade box to resistance corresponding to URV (upper-range value). Record reading of voltmeter; this is E2 in equation in Step 4.

3 Set decade box to resistance corresponding to LRV (lower range value). Record reading of voltmeter; this is E1 in equation in Step 4.

4 Calculate E3 in equation

$$E3 = \frac{4 \times E2}{E2 - E1}$$

5 Set decade box at URV, and adjust SPAN Potentiometer (R28) so that voltmeter reads E3.

6 Set decade box at LRV, and adjust ZERO Potentiometer (R27) so that voltmeter reads 1.000 ±0.004 V.

7 Set decade box at URV. If voltmeter does not read 5±0.01 V, adjust SPAN Potentiometer (R28) to get correct reading. Repeat Steps 6 and 7 until both readings are satisfactory.

8 Remove power, disconnect voltmeter and decade box, remove controller from special housing and replace in original housing, reconnect decade box, restore power.

9 Calibrate Input IN 1 (see “RTD Input” on page 164).

Temperature Difference Measurement

To perform a temperature difference measurement, do the following:

1. Ascertain that new range meets following limitations:
   - **a** Reference temperature (TREF) cannot be higher than midpoint between LRV and URV.
   - **b** Temperature difference (ΔT) cannot be less than 200 °F(111 °C).
2. Complete “Preliminary Steps” (above).

NOTE In Steps 4 and 5 below, E1 and E2 must be between -4 and +12 V. If either is outside of these limits, adjust ZERO Potentiometer (R27) so that value is between these limits.

---

3. Set *reference* decade box to resistance corresponding to *lower-range* value (RLRV). Set *measurement* decade box to resistance corresponding to *upper-range* value (RURV).
4. Record voltmeter reading; this is E2 in equation in Step 6.
5. Set both decade boxes at RLRV. Record voltmeter reading; this is E1 in equation in Step 6.
6. Solve for E3 in equation

$$E3 = \frac{4 \times E2}{E2 - E1}$$

7. Set each decade box to value specified in Step 3. Adjust SPAN Potentiometer (R28) so that voltmeter reads E3.
8. Set both decade boxes to RREF. Adjust ZERO Potentiometer (R27) so that voltmeter reads Y, where

$$Y = 1 + \frac{TREF - TLRV}{TURV - TLRV}$$

Example: TLRV = -50 °F, TURV = 150 °F, and TREF = 50 °F

[Note that TREF is at middle (50%) of span]

$$Y = 1 + \frac{50 - (-50)}{150 - (-50)} \times 4 = 3V$$

9 Remove power, disconnect voltmeter and decade boxes, unplug controller from rear housing assembly, reinstall rear housing assembly in housing, replace controller in housing, reconnect decade boxes, restore power.

10 Calibrate Input IN 1 (See "RTD Input" on page 164). Use R0% and R100% calculated in the equations below as the calibrating resistances for zero and full-scale, respectively.

Calculating Calibrating Resistances for Temp. Difference Measurement

Temperature-difference is an uncompensated, nonlinear measurement. When calibrating the RTD input, modify the RURV and RLRV values used in the procedure above to minimize the error due to this nonlinearity, as shown in the equations:

$$\text{R0\%} = \text{RREF} - (\text{RURV} - \text{RLRV}) \times \frac{(\text{TREF} - \text{TLRV})}{(\text{TURV} - \text{TLRV})}$$

$$\text{R100\%} = \text{RREF} - (\text{RURV} - \text{RLRV}) \times \frac{(\text{TREF} - \text{TLRV})}{(\text{TURV} - \text{TLRV})}$$

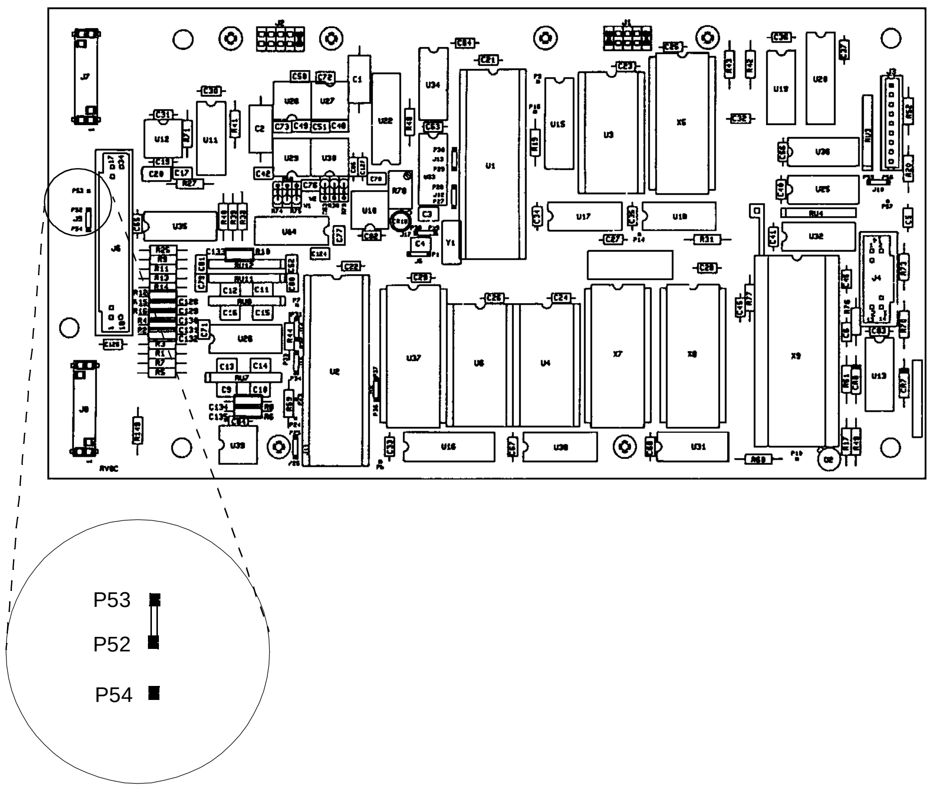
Output 2 Selection

Output 2 is jumper selectable as 1 to 5 V dc nominal into 2 kΩ minimum or 4 to 20 mA nominal into 500 Ω maximum. See Table 7-4 for jumper position and Figure 7-9 for jumper location.

Table 7-4. Output 2 Jumper Positions

Output	Jumper Position
4 to 20 mA	P52 - P53
1 to 5 V	P52 - P54

Figure 7-9. Output 2 Jumper Location



Troubleshooting

Test Display

This TEST checks that all portions of the display can be illuminated. It is accessed by going to SECURE CALIB in the menu structure (See Figure 7-1) and pressing the ∇ key. The display will show SECURE TEST. Press the ACK key. The display will change to TEST DISPLAY. Press the ACK key again. If any segment of the display (except the controller fault indicator) is not illuminated, that segment is malfunctioning. Press ACK to return to Normal mode after the test.

Error Messages

Certain problems will generate error messages on the display. These messages are described below:

NOVRAM COPY FAIL: Copy function was not successfully executed. Make sure NOVRAMS and copy accessory are properly seated and try again.

NOVRAM ALL FAIL*: Memory module failures. Both original (master) and copy failed.

NOVRAM MSTR FAIL*: Memory module failure.

WRONG NOVRAM*: Memory module is for a 760, 761, or other controller or contains corrupt data.

*Replace NOVRAM if these errors occur.

Display Problems

Symptom: Display becomes unstable and flashes on and off.

Possible Cause: Input voltage may have dropped below minimum level.

Symptom: Display goes blank.

Possible Cause: Input voltage may have dropped below minimum level.

Symptom: Display blank and controller fault indicator flashes.

Possible Cause: NOVRAM may not be properly seated or is damaged.

Configuration Problems

Compare the actual configuration of the parameter in question against the desired configuration as recorded on the Configuration Worksheet. If the worksheet is not available, place the NOVRAM in another controller. If the problem is present in the second controller, it is most likely a configuration problem. The copy accessory can often be used to save a corrupted NOVRAM. Copy a good NOVRAM onto the corrupted NOVRAM.

If the controller oscillates when in automatic, and if the output and measurement stop oscillating when placed in manual, the controller may not be tuned properly.

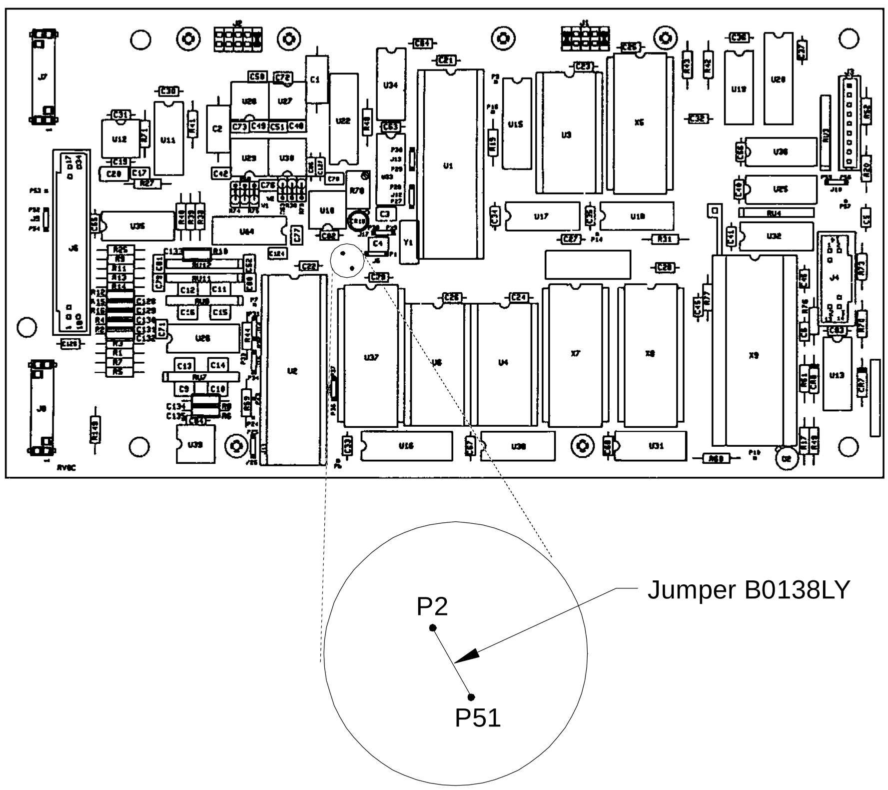
If the controller tuning parameters wind up when EXACT is configured and left on, switch EXACT off or the controller to manual and the output to a safe state.

Diagnostic Checks

You can check Analog Output 1 and 2, 1 and 5 V voltage references, and the four analog inputs in the diagnostic mode. You can also check the Contact Inputs and Outputs. To enter this mode, remove the controller from its housing and insert jumper, part number B0138LY (available from Foxboro) on pins P2 and P51. See Figure 7-10. Place controller in housing on bench and supply power. The display will briefly flash the message "EXACT CONTROL" and then go dark. Pressing various keys will cause different patterns to appear on the digital and bargraph displays, including all segments ON and all segments OFF.

CAUTION Never perform diagnostic checks while controller is connected to a process. The checks may change output values.

Figure 7-10. Location of Diagnostic Jumper



Diagnostic Checks (cont.)

Now that you are in the diagnostics mode, you can run eight diagnostic checks (one with each of the keys on the front panel). See Table 7-5. Read the current at Output 1 on a milliammeter connected at terminals 26(+) and 27(-) and the current or voltage (depending on the position of the output jumper) at Output 2 at terminals 8(+) and 6(-). If the current or voltage reading does not match the expected value for the parameter being tested, there is a problem. The last four checks require an input. Connect inputs at terminals shown in Figure 7-3.

Table 7-5. Diagnostics

Key	Tested Parameter
Δ	Full Scale (approx. 23 mA or 5.75 V)
∇	Zero (0 mA or 0 V)
W/P	5 V Reference (20 mA or 5 V)
SEL	1 V Reference (4 mA or 0 V)
R/L	Analog Input 4
TAG	Analog Input 3
A/M	Analog Input 1
ACK	Analog Input 2

In the Diagnostic Mode, Contact Inputs are repeated to the Contact Outputs. Contact Inputs and Outputs are connected at the terminals shown in Table 7-6.

Table 7-6. Contact Input and Output Terminals

Signal	Terminal
CI 1	29
Common	30
CI 2	28
CO 1	32
Common	30
CO 2	31

Return to Normal Operating Mode by removing power from your bench housing, removing the diagnostic jumper, and replacing controller into its original housing.

Maintenance

General Information

The maintenance of the 762CNA Controller is limited to miscellaneous tests and checks, and replacement of the parts listed below. For part numbers, see Appendix D.

- Front panel assembly
- NOVRAM and associated three memory chips (ROMs)
- Transformer assembly
- Rear panel assembly
- Display Cable
- RTD temperature measurement and output Isolation Boards
- Surge Suppressor
- Miscellaneous mechanical parts

WARNING This product has many components that have critical safety characteristics. Component substitution may impair the electrical safety of this equipment and its suitability for use in Class I, Division 2 hazardous locations. DO NOT substitute components. Replace components only with identical factory supplied components.

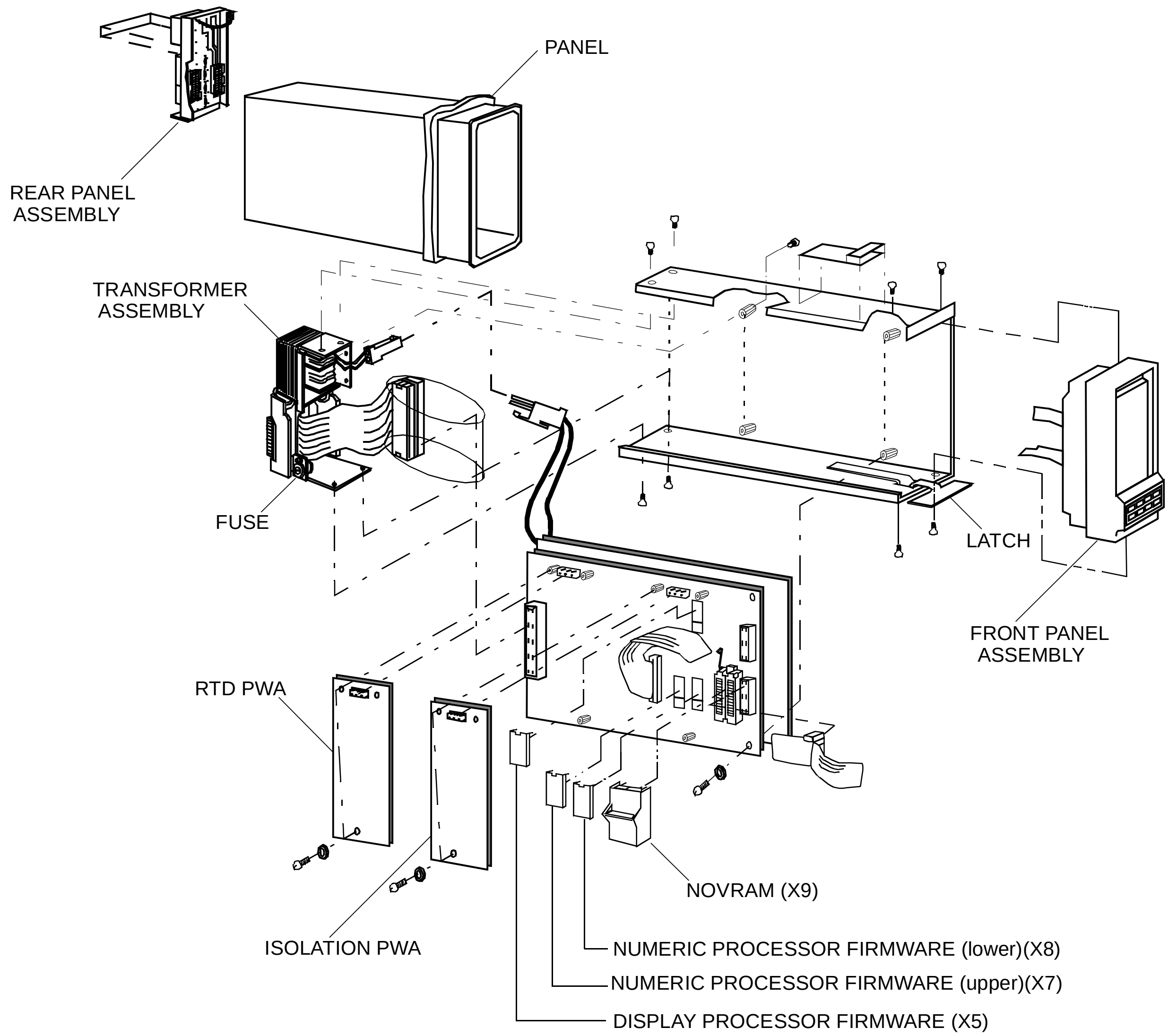
Attempts by the user to repair the printed wiring assemblies could result in damage and voiding of the warranty. The recommended repair procedure is replacement of the printed wiring assembly (PWA) or return of the PWA to the factory for repair.

It is recommended that the controller be removed from its housing to a service bench for replacement of parts.

Removal and Replacement of Parts

Figure 7-11 is essentially self-explanatory in showing how parts are removed and reinstalled. Refer to the applicable sections immediately following for additional details.

Figure 7-11. Controller Assembly Diagram



Replacement of Fuse

If the controller faceplate has no illumination (including the fault indicator), it may indicate that either the power supply external to the controller has been interrupted or the fuse inside the controller has opened.

If the external power supply is intact, check the fuse and, if necessary, replace it with the applicable slow-blow fuse in Table 7-7. To expose the fuse, withdraw the controller from its housing. The fuse is located on the side at the rear of the chassis.

Table 7-7. Fuses

Supply Voltage	Current	Fuse Part No.
24 V ac or V dc	2 A	C3510KX
120 V ac	0.5 A	C3510KP
220, 240 V ac	0.3 A	P0156BM

Front Panel Assembly Replacement

Before removing the front panel, note the routing of the two cables (display and keypad) and how they plug into their sockets on the printed wiring assembly.

When removing the front panel, first lower the latch cover under the keypad. Then remove the four screws holding the panel to the housing. Ease the top of the panel out of the housing and tilt the panel forward to about 45°, and then ease the bottom out of the housing and out of the latch lever.

Precautions When Replacing ROMs

The ROMs, which are MOS devices, are very susceptible to damage from electrostatic discharge, and precautions *must* be taken to protect them from potentials greater than 100 V. Procedures have been established for the storage and handling of these products to prevent electrostatic buildup, and the user should follow recommended practices.

The ROMs (and the NOVRAM) are packed in a special conductive bag. They should be stored in this bag until they are to be installed. Because the NOVRAM is subject to more handling than the ROMs, it is supplied in a conductive holder for additional protection.

Transformer Assembly Replacement

The transformer assembly can be replaced by using the following procedure:

1. Remove the signal cable.
2. Remove the four transformer assembly mounting screws and slide the assembly out of the rear of the chassis.
3. Remove the power cable.
4. Reverse the procedure to install the new transformer assembly.

RTD Input or Isolated Output PWA Replacement

These optional PWAs are installed side-by-side on the main component PWA (See Figure 7-11).

Observe the following details when either option is a field installation:

1. Remove jumper(s) from socket(s) of PWA being installed. Save jumper(s) so it can be reinstalled later if option is to be removed.
2. Plug PWA into its socket and insert mounting screws. Secure PWA in place.

Replacement of Other Parts

The procedures to remove and reinstall other replaceable parts will be obvious from Figure 7-11. Before removing a plug-in cable note its routing for correct reinstallation.

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Specifications A

Functional Specifications

Table A-1. Functional Specifications — Standard Product

Item	No.	Specification
Analog Input Signals (proportional):		
Analog Inputs	4 total	Any combination of the input types listed below. All input signals are converted ten times per second and can be characterized and/or combined in a variety of calculations.
4 to 20 mA dc Current Input		4 to 20 mA dc input (through 250Ω input resistor across terminals) is standard.
1 to 5 V dc Voltage Input		Can accept 1 to 5 V dc by removing the input resistors from the input terminals.
Thermocouple Input (requires 893 or ITT-10 Temperature Transmitter or equivalent)	1	May be substituted for any Analog Input. Linearization of displayed value is provided, as follows: **T/C Type — 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)
Resistance Temperature Detector (RTD) Input, Direct or Temperature Difference Measurement. (Can use up to 4 RTDs on any input by using 894 transmitters for each.)	1	May be substituted for Analog Input 1 by using a hardware option. 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 (–330 to +1560 °F) / 200 to +600 °C (–330 to +1100 °F) Span: 110 to 1000 °C (198 to 1800 °F) / 110 to 800 °C (198 to 1440 °F)
Frequency Inputs(proportional):		
1 to 9999 Hz Frequency Input	2 total	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 250 Ω.

*Scientific Apparatus Manufacturers Association

Table A-1. Functional Specifications — Standard Product (Continued)

Item	No.	Specification
1 to 9999 Hz Pulse Up/ Pulse Down Inputs	1 Pair	The two frequency inputs may combined into one 1-9999 Hz pulse-up/pulse-down pair of inputs driven by an external contact closure or voltage pulse. Contact close/open times and pulse voltage level are compatible with older stepping motor devices.
Contact Inputs:		
Two Discrete Inputs		Two non-isolated contact or transistor switch inputs, 5 V dc nominal open circuit voltage, 1 mA maximum current. Used for remote status changes such as A/M, R/L, W/P, EXT ACK, and tracking functions.
Control Functions:		
Standard Algorithms		For each controller, the standard algorithms are P, I, PD, PI, PID, and EXACT control. They may also be configured for: nonlinear extender, ratio set point, measurement and set point tracking, output tracking, remote/local set point, output multiplication or summing, integral feedback, external limits for output, simple batch control, and cascade operation.
Other Control Functions		Input bias, adjustable gain, and output bias available for every input. Characterizers (two available, 8 segments each, assignable). 10 Boolean Gates, Logic {DIRECT and NOT (single input); OR, NOR, AND, NAND, XOR, and XNOR (dual input). 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). Split range outputs (configurable for both 4-20 mA outputs)
Auto Selector		Two controllers with a single selected output. The choice of lower, higher, or logic-selected output is available. One common or two independent auto/manual functions are possible.
Totalizer		Up to two 7-digit totalizers are available. Totalizers can be set to integrate up to or down from a preset value and produce a logic event output. Any internal or external signal can be totalized.
Output Signals:		
Two Non-isolated Analog Outputs		Output 1: 4-20 mA nominal into 500 Ω maximum; isolation provided as an option. Output 2: 4-20 mA nominal into 500 Ω maximum, or 1-5 V dc nominal into 2 kΩ minimum, jumper selectable. Can be assigned by user for measurement, set point, control, or conditioned input signals.

Table A-1. Functional Specifications — Standard Product (Continued)

Item	No.	Specification
Two Discrete Outputs		Two non-isolated open collector transistor (NPN) switch outputs. For status indication of A/M, R/L, W/P, and alarms. Can also be configured as the destination for any two of the Boolean Gate Outputs. Contact ratings are 50 V dc maximum, 250 mA maximum. Leakage current is 100 µA maximum.
Alarms		Four dual-level alarms are available, each with adjustable dead band and one Boolean output. 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. Can be configured to indicate alarm status by a combination of alphanumeric display, the bar graphs, an alarm symbol, and the contact outputs. The alarm deadband 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 28 V dc power supply with a 250Ω limiting resistor at each transmitter connection. Provides field power for two 4-20 mA transmitters with a maximum series resistance of 350Ω in each current loop, including the 250Ω input resistor.
Execution Rate		Ten times per second.
Toggle Mode		If configured, the TOGGLE mode allows a user to toggle (switch) between a menu level and the normal front panel display with a single keystroke.
Dynamic Compensation		The result of CALC 3 may be passed through the dynamic compensator function prior to distribution. This block provides lead/lag and dead time functions, each with its individual follow switch. Functionally, dead time precedes lead/lag. Dead time allows the input to be delayed by a configured time before making it available at the output, thus allowing the output to lead or lag the input by the configured time. Both functions can be enabled or by-passed selectively by using the follow switches. The impulse can be positive, negative, or bipolar and is part of the lead/lag function.

Table A-1. Functional Specifications — Standard Product (Continued)

Item	No.	Specification
Dynamic Compensation Adjustment Limits		Dead Time: 0 and 200 minutes Lead/lag Time: 0 and 200 minutes
Memory		All configuration and operating parameters (not status data) are stored in a nonvolatile RAM 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 filters. Adjustable from 0 to 10 minutes in 0.01 minute intervals. May be used with any input proportional signal.
Signal Distribution		Thirty-six signals are available for internal routing. They are the conditioned and scaled inputs, unconditioned inputs, control inputs, control outputs, and calculation results.
Power Consumption		12 VA maximum with 4 to 20 mA outputs.

Physical Specifications

Table A-2. Physical Specifications – Standard Product

Item	Specification
Display	Vacuum fluorescent lamps in a glass enclosure having a glass frit seal and tin plated copper pinouts. Horn symbol for alarms is red; bargraphs and alphanumeric characters are blue/green.
Signal Connections (on rear panel)	Two 16-position terminal blocks with compression terminals for wire sizes up to 3.3 mm^2 (12 AWG).
Power Connections (on rear panel)	3-position terminal strip with 8-32 screw connections.
Mounting	Controller mounts through a panel. Refer to Appendix E for cutout dimensions.
Approximate Mass	2.8 kg (6.2 lb)

Operating and Storage Conditions

Table A-3. Operating and Storage Conditions

Influence	Reference Operating Conditions	Normal Operating Condition Limits	Operative Limits	Transportation and Storage Limits
Ambient Tempera-ture	23±2°C (73±3°F)	-10 and +60°C(15 and 140°F)	-10 and +60°C * (15 and 140°F)	-40 and +70°C (-40 and +160°F)
Relative Humidity	50±10%	5 and 95% noncondensing	5 and 95% noncondensing	0 and 100% noncondensing
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%	NA
Supply Frequency	50/60 Hz, ±0.1 Hz	50/60 Hz, ±3 Hz	47 and 63 Hz	NA
Vibration	Negligible	5 and 200 Hz at an acceleration of 2.5 m/s/s	--	10 m/s/s (1g) for 1 hour when in shipping con-tainer
Mechanical Shock	Negligible	--	--	A 42-inch drop when in shipping container

*Lower operative limit extends to -20°C (-5°F) with Enclosure Heater option.

Electrical Safety Specifications

Table A-4. Electrical Classification

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
CSA for use in Ordinary Locations.	Controllers without a hous-ing are not approved.	CS-E/CG-A
CSA for Class I, Division 2, Groups A, B, C, and D.	Controllers without a hous-ing are not approved. Tem-perature Code T5.	CS-E/CN-A
FM for Class I, Division 2, Groups A, B, C, and D.	Temperature Code T5. Controllers without a hous-ing are not approved.	CS-E/FN-A

NOTE These controllers have been designed to meet the electrical safety descriptions listed in the table above. For detailed information or status of testing laboratory approvals/certifications, contact Foxboro.

Performance Specifications

Accuracy at Numeric Display

Parameter	Accuracy
Set Point	±0.1% of span
Input	
Analog	±0.1% of span
RTD (Direct Measurement)	±0.5% °C
Output	±0.5% of span
Linearization	
RTD	±0.5 °C, reading only
Thermocouple	±0.5 °C, reading only

Resolution

Display: ±0.1% of span

Bargraph: ±2% of span

Frequency Response

Analog input to output conversion is flat to 3 Hz.

Supply Voltage Effect

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

Output Noise

0.25% maximum, peak-to-peak.

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 is:

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	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.

Optional Features and Accessories

Table A-5. Optional Features and Accessories

Feature	Specification
Output Isolation	This option provides an isolated 4-20 mA nominal signal (500 Ω load maximum) on Output No. 1. Specify by selecting Option suffix “-1”.
Platinum RTD Input	This option provides for accepting a platinum RTD on input number 1. 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 ΔT Measurement) Range: –200 to +805 °C (–330 to +1560 °F) Span: 110 to 1000 °C (198 to 1800 °F) SAMA 100 (Direct or ΔT 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”.
Configuration Copy Accessory	All of the operating configuration data is stored in a NOVRAM. The copy accessory permits the entire contents of the NOVRAM module to be quickly copied to another NOVRAM, either a spare, or one from another controller. Specify Part Number L0122TU for the copy accessory, and Part Number K0141LN for a spare NOVRAM.
Surge Suppressor	A surge suppressor is available as an option for use with serial communication input when external wiring is located near transient producing sources such as meters, solenoids, high voltages, etc. Specify Auxiliary Specification (AS) SURSUP.
Diagnostic Jumper	A diagnostic jumper, part number B0138LY, is available for use in controller troubleshooting. Installing the jumper on the main PWA enables checking the two analog outputs, four analog inputs, 1 and 5 V voltage references, and the discrete inputs and outputs.
Factory Preconfiguration	Unless otherwise specified, the unit is shipped with a Factory Default configuration consisting of a single measurement input, a local set point, PID control, and scale ranges of 0 to 100 percent. Many optional factory preconfigurations are available. Select the preconfiguration that most closely meets your needs and then make changes in the field as needed to meet your specific needs. It usually is necessary to change, at minimum, the loop tag, the scale ranges, and the PID controller tuning parameters to suit process requirements. Optional factory preconfiguration is offered without additional charge. To order, refer to the Model Code and specify the AS for the configuration that most nearly meets your needs. The AS is shown in the loop tag display to assist in initial field identification.

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Configuration Worksheets

B

This appendix contains information that will help you configure your controller.

Table B-5 contains the actual configuration worksheets. Figure B-1 defines the content of the worksheets. Tables B-1, B-2, B-3, and B-4 contain reference data needed for making configuration entries.

This appendix also contains diagrams of optional factory preconfiguration options that may have been specified. The Auxiliary Specification (AS) reference code used to specify a preconfiguration option is initially displayed in the looptag position on the controller faceplate to assist you in initial field identification.

Figure B-1. Definition of Worksheet Contents

"Map-locator" that identifies the specific structure diagram sheet in Appendix C that contains the parameter and also the XY coordinates of the location of the parameter on that sheet. The first digit is the sheet number; the second is the XY location.

Prompts to parameters in the order in which they are displayed when you step through the menu structure.

Limits of each parameter.

Standard factory configuration as shipped from Foxboro. Factory Preconfiguration Options will differ.

Space for you to record your specific configuration.

Additional information and space for your notations.

Structure diagram Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration	Remarks and Notes
CONFIG SETPT					
5-G1	SETPT	- - - -			
	TYPE	LOCAL, R/L, RATIO	LOCAL		If LOCAL, ACK key takes you to MEAS TRK.
	(R/L)	- - - -			
5-H1	RL LOGIC	- - - -			
	LOCTRK	See Table B-2.	NONE		
	SWITCH	See Table B-2.	NONE		
	STARTUP	R, L	L		
	INBIAS	-99.9 and +102%	0.0		
	SOURCE	See Table B-1.	D		
5-G1	(RATIO)	- - - -			
5-H1	RL LOGIC	- - - -			
	LOCTRK	See Table B-2.	NONE		
	SWITCH	See Table B-2.	NONE		
	STARTUP	R, L	L		
	OUTBIAS	-99.9 AND +102%	0.0		
	SIGNAL	- - - -			
	INBIAS	-99.9 AND +102%	0.0		
	SOURCE	See Table B-1			
	RANGE	0-1.0 and 0-5.0	0-1.0		
	SOURCE	FCEPLATE, ROUTED	FCEPLATE		
	(ROUTED)	See Table B-1.	IN2		
5-G1	MEAS TRK	See Table B-2.	NONE		
	FORMAT	LINEAR, SQ ROOT, SQUARED, CHAR 1, CHAR 2			

Table B-1. Signal Distribution List

Name	Signal	Name	Signal
A	Conditioned Analog Input IN1	C2 OUT	Controller 2 Output
B	Conditioned Analog Input IN2	ASELOUT	Selected Output of Auto Selector
C	Conditioned Analog Input IN3	AOUT 1	Analog Output 1
D	Conditioned Analog Input IN4	AOUT 2	Analog Output 2
E	Conditioned Input F1	CALC 1	Output of Calculation 1
F	Conditioned Input F2	CALC 2	Output of Calculation 2
G	Constant	CALC 3	Output of Calculation 3
H	Constant	IN1	Analog Input 1
I	Constant	IN2	Analog Input 2
J	Constant	IN3	Analog Input 3
C1 MEAS	Controller 1 Measurement	IN4	Analog Input 4
C1 LOCSP	Controller 1 Local Set Point	F1	Frequency Input 1
C1 REMSP	Controller 1 Remote Set Point	F2	Frequency Input 2
C1 SETP	Controller 1 Set Point	TOTAL 1	Totalizer 1 (Lower 2 bytes of 3-byte number)
C1 OUT	Controller 1 Output	TOTAL 2	Totalizer 2 (Lower 2 bytes of 3-byte number)
C2 MEAS	Controller 2 Measurement	100 PCT	Constant with value of 100%
C2 LOCSP	Controller 2 Local Set Point	0 PCT	Constant with value of 0 %
C2 REMSP	Controller 2 Remote Set Point	None	No Source
C2 SETP	Controller 2 Set Point		

Table B-2. Gate Input List

Name	Source	True State	Name	Source	True State
CI1	Contact Input 1	Closed			
CI2	Contact Input 2	Closed	AUTOSEL	Auto Select Output State	False = C2 OUT True = C1 OUT
ALARM 1	State of Alarm 1	In Alarm	GATE 0	Output of Gate 0	True
ALARM 2	State of Alarm 2	In Alarm	GATE 1	Output of Gate 1	True
ALARM 3	State of Alarm 3	In Alarm	GATE 2	Output of Gate 2	True
ALARM 4	State of Alarm 4	In Alarm	GATE 3	Output of Gate 3	True
C1 A/M	State of Controller 1 Automatic or Manual	Automatic	GATE 4	Output of Gate 4	True
C1 R/L	State of Controller 1 Remote or Local	Remote	GATE 5	Output of Gate 5	True
C2 A/M	State of Controller 2 Automatic or Manual	Automatic	GATE 6	Output of Gate 6	True
C2 R/L	State of Controller 2 Remote or Local	Remote	GATE 7	Output of Gate 7	True
W/P	State of Workstation or Panel	Workstation	GATE 8	Output of Gate 8	True
COMMFAIL	Communications Timeout	Timed Out	GATE 9	Output of Gate 9	True
C1 EXACT	State of EXACT, Controller 1	Enabled	ON	Fixed State Input	Always
C2 EXACT	State of EXACT, Controller 2	Enabled	OFF	Fixed State Input	Never
TOTAL 1	State of Totalizer 1	Totalizer reached preset value	NONE	Function Switch not used	N/A
TOTAL 2	State of Totalizer 2	Totalizer reached preset value			

Table B-3. List of Characters

Character
9 through 0
.(decimal)
-(minus)
blank
A through Z
_(underline)
\
@
?
>
=
<
/
,(comma)
+
*
)
(
’(apostrophe)
(test)*
√(sq root)
°(degree)

*All character segments lighted

Table B-4. Characterization Curve Planning Table

CHAR 1		CHAR 2	
X01 = ______	Y01 = ______	X01 = ______	Y01 = ______
X02 = ______	Y02 = ______	X02 = ______	Y02 = ______
X03 = ______	Y03 = ______	X03 = ______	Y03 = ______
X04 = ______	Y04 = ______	X04 = ______	Y04 = ______
X05 = ______	Y05 = ______	X05 = ______	Y05 = ______
X06 = ______	Y06 = ______	X06 = ______	Y06 = ______
X07 = ______	Y07 = ______	X07 = ______	Y07 = ______
X08 = ______	Y08 = ______	X08 = ______	Y08 = ______
X09 = ______	Y09 = ______	Y09 = ______	Y09 = ______

Table B-5. Configuration Worksheets

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration	Remarks/Notes
TUNE C1					
4-A1	SECURE ALLTUNE	- - - -			
	ALLTUNE TUNE C1	- - - -			
4-B1	PF	1 and 8000%	200		
	IF	0.01 and 200 min/repeat	2.0		If configured I ONLY at Loc. 5-B1, ACK key takes you to C1 LIMIT
	DF	0 and 100 minutes	0.0		
	SPLAG	0.00 and 1.00	1.00		
	EXACT	- - - -			
4-C1	STATE	ON, OFF	OFF		ON/OFF choice is available only if EXACT NONE is configured at Location 5-G3
	RD EXACT	- - - -			
	STATE	message (ON,OFF)	OFF	(no entry)	
	ENT	message	INIT	(no entry)	
	STUN	message	OFF	(no entry)	
	P	1 and 8000%	From TUNEC1 PF		READ only
	I	0.01 and 200 repeats/min.	From TUNEC1 IF		
	D	0 and 100 min.	From TUNEC1 DF		
	PK 1	-102 and +102%	- - - -		
	PK 2	-102 and +102%	- - - -		
	PK 3	-102 and +102%	- - - -		
	TPK 1	<WMAX	- - - -		
	TPK 2	WMAX	- - - -		
	TPK 3	>WMAX	- - - -		
	ERR	-102 and +102%	- - - -		
4-C2	USER SET	- - - -			
	NB	0.1 and 30%	2.0		
	WMAX	0.1 and 200 minutes	5.00		
	DMP	0.1 and 1	0.2		
	OVR	0 and 1	0.50		
	CLM	1.25 and 100	10.00		
	DFCT	0 and 4	1.00		
	LIM	2 and 80%	80.0		
	BUMP	-50 and +50%	8.0		
	PTUNE	- - - -			
	STATE	ON, OFF	OFF		
	RD PTUNE	message (ON, OFF)	OFF	(no entry)	
4-B1	BIAS	-99.9 and +102%	50.0		Only if configured P/PD
	BALANCE	0.00 and 200 minutes	2.0		Only if configured P/PD (1st order lag)
	PRELOAD	-99.9 and 102%	0.0		Only if BATCH is configured ON
	BYPASS	ON, OFF	OFF		

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration	Remarks/Notes
TUNE C1 LIMIT					
4-A1	C1 LIMIT	- - - -			
4-B1	SP HILIM	-2 and +102%	102.0		
	SP LOLIM	-2 and +102%	-2.0		
4-B1	OUT HLIM	-2 and +102%	102.0		Batch limits if BATCH is configured ON at Location 5-G3
	OUT LLIM	-2 and +102%	-2.0		
TUNE C2					
4-A1	SECURE ALLTUNE	- - - -			
	ALLTUNE TUNE C2				
4-B1	PF	1 and 8000%	200		
	IF	0.01 and 200 min./repeat	2.0		If configured I ONLY at Location 5-B1, ACK key takes you to C1 LIMIT
	DF	0 and 100 minutes	0.0		
	SPLAG	0.00 and 1.00	1.00		
4-C1	EXACT	- - - -			
	STATE	ON, OFF	OFF		ON/OFF choice is available only if EXACT NONE is configured at Location 5-G3
	RD EXACT	- - - -			
	STATE	message (ON,OFF)	OFF	(no entry)	
	ENT	message	INIT	(no entry)	
	STUN	message	OFF	(no entry)	
	P	I and 8000%	From TUNEC2 PF		READ only
	I	0.01 and 200 min/repeat	From TUNEC2 IF		
	D	0 and 100 minutes	From TUNEC2 DF		
	PK 1	-102 and +102%	- - - -		
	PK 2	-102 and +102%	- - - -		
	PK 3	-102 and +102%	- - - -		
	TPK 1	<WMAX	- - - -		
	TPK 2	WMAX	- - - -		
	TPK 3	>WMAX	- - - -		
	ERR	-102 and +102%	- - - -		
4-C2	USER SET	- - - -			
	NB	0.1 and 30%	2.0		
	WMAX	0.1 and 200 minutes	5.00		
	DMP	0.1 and 1	0.2		
	OVR	0 and 1	0.50		
	CLM	1.25 and 100	10.00		
	DFCT	0 and 4	1.00		
	LIM	2 and 80%	80.0		
	BUMP	-50 and +50%	8.0		
	PTUNE	- - -			
	STATE	ON, OFF	OFF		
	RD PTUNE	message (ON, OFF)	OFF	(no entry)	

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration	Remarks/Notes
4-B1	BIAS	-99.9 and +102%	50.0		Only if configured P/PD
	BALANCE	0.00 and 200 minutes	2.0		Only if configured P/PD (1st order lag)
	PRELOAD	-99.9 and 102	0.0		Only if BATCH is config-ured ON
	BYPASS	ON, OFF	OFF		
TUNE C2 LIMIT					
4-A1	C2 LIMIT	- - - -			
4-B1	SP HILIM	-2 and +102%	102.0		
	SP LOLIM	-2 and +102%	-2.0		
	OUT HLIM	-2 and +102%	102.0		Batch limits if BATCH is configured ON at Loc. 5-G3
	OUT LLIM	-2 and +102%	-2.0		
TUNE CONSTS					
4-A2	ALLTUNE CONSTS	- - - -			
	G	-99.9 and +102%	50.0		
	H	-99.9 and +102%	50.0		
	I	-99.9 and +102%	50.0		
	J	-99.9 and +102%	50.0		
TUNE ALARMS					
4-A2	ALLTUNE ALARMS	- - - -			
4-B2	ALARM 1				
	LEVEL 1 =	-99.9 and +102%	102.0		
	LEVEL 2 =	-99.9 and +102%	-2.0		
	DB =	0 and 100	2.0		
	ALARM 2				
	LEVEL 1 =	-99.9 and +102%	102.0		
	LEVEL 2 =	-99.9 and +102%	-2.0		
	DB =	0 and 100	2.0		
	ALARM 3				
	LEVEL 1 =	-99.9 and +102%	102.0		
	LEVEL 2 =	-99.9 and +102%	-2.0		
	DB =	0 and 100	2.0		
	ALARM 4				
	LEVEL 1 =	-99.9 and +102%	102.0		
	LEVEL 1 =	-99.9 and +102%	-2.0		
	DB =	0 and 100	2.0		
TUNE TOTALS					
4-A3	ALLTUNE TOTALS	- - - -			
4-B3	TOTAL 1 =	0 and 9999999	0		
	PRESET 1 =	0 and 9999999	0		
	T1 STATE	RESET, HOLD, COUNT	COUNT		
	TOTAL 2 =	0 and 9999999	0		
	PRESET 2 =	0 and 9999999	0		
	T2 STATE	RESET, HOLD, COUNT	COUNT		
SHOWOP					
2	SHOWOP	- - - -			
	TUNE C1	YES, NO	YES		
	C1 LIMITS	YES, NO	YES		
	TUNE C2	YES, NO	YES		
	C2 LIMITS	YES, NO	YES		

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration	Remarks/Notes
	ALARMS	YES, NO	YES		
	CONSTS	YES, NO	YES		
	TOTALS	YES, NO	YES		
	RD CFG	YES, NO	YES		
CONFIG STRATEGY					
5-A1	CONFIG STRATEGY	- - - -	ONE FUNC		
5-B1	ONE FUNC	- - - -			
	CASCADE	- - - -			
	AUTO SEL	- - - -			
	TYPE	LO SELECT, HI SELECT, GATE 4	LO SELECT		
	TRK MAN	YES, NO	NO		For LO SELECT or HI SELECT only
	TWO FUNC	- - - -			
CONFIG FUNC1					
5-A1	CONFIG FUNC1	- - - -	PI, PID		
5-B1	PI, PID				See CONFIG DISPLAY
	EXACT				See CONFIG DISPLAY
	A/M STN				See CONFIG A/M STN DISPLAY
	3 BAR IND				See CONFIG 3 BAR IND
	I ONLY				See CONFIG DISPLAY
	P, PD				See CONFIG DISPLAY
CONFIG FUNC2					
5-A1	CONFIG FUNC2	- - - -	PI, PID		
5-B1	PI, PID				See CONFIG DISPLAY
	EXACT				See CONFIG DISPLAY
	A/M STN				See CONFIG A/M STN DISPLAY
	3 BAR IND				See CONFIG 3 BAR IND
	I ONLY				See CONFIG DISPLAY
	P, PD				See CONFIG DISPLAY
CONFIG TOTAL 1					
5-A1	CONFIG TOTAL 1	YES, NO	NO		If EXACT is configured, jumps to TOTAL 2
5-B1	(YES)	- - - -			
	TAG	See Table B-3	TOTAL		Enter up to 9 characters
	SOURCE	See Table B-1	A		
	CNT/SEC	0.1 and 2000	1.0		
	DEC PT	0 and 7	0		
	HOLD	See Table B-2	NONE		
	RESET	See Table B-2	NONE		
	TYPE	COUNT UP, COUNT DN	COUNT UP		
CONFIG TOTAL 2					
5-A1	CONFIG TOTAL 2	YES, NO	NO		If EXACT is configured, jumps to CONFIG INPUTS
5-B1	(YES)	- - - -			
	TAG	See Table B-3	TOTAL		Enter up to 9 characters
	SOURCE	See Table B-1	A		
	CNT/SEC	0.1 and 2000	1.0		
	DEC PT	0 and 7	0		

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration	Remarks/Notes
	HOLD	See Table B-2	NONE		
	RESET	See Table B-2	NONE		
	TYPE	COUNT UP, COUNT DN	COUNT UP		
CONFIG INPUTS					
5-A2	CONFIG INPUTS	- - - -			
5-B2	A	- - - -			
	OUTBIAS =	-99.9 and +102%	0.0		
	GAIN =	-9.999 and +9.999	1.000		
	INBIAS =	-99.9 and +102%	0.0		
	FORMAT =	LINEAR, SQ ROOT, SQUARED, CHAR 1, CHAR 2	LINEAR		
	FILTER =	0 and 10 minutes	0.00		0.00 minute is no filter
	B	- - - -			
	OUTBIAS =	-99.9 and +102%	0.0		
	GAIN =	-9.999 and +9.999	1.000		
	INBIAS =	-99.9 and +102%	0.0		
	FORMAT =	LINEAR, SQ ROOT, SQUARED, CHAR 1, CHAR 2	LINEAR		
	FILTER =	0 and 10 minutes	0.00		0.00 minute is no filter
	C	- - - -			
	OUTBIAS =	-99.9 and +102%	0.0		
	GAIN =	-9.999 and +9.999	1.000		
	INBIAS =	-99.9 and +102%	0.0		
	FORMAT =	LINEAR, SQ ROOT, SQUARED, CHAR 1, CHAR 2	LINEAR		
	FILTER =	0 and 10 minutes	0.00		0.00 minute is no filter
	D	- - - -			
	OUTBIAS =	-99.9 and +102%	0.0		
	GAIN =	-9.999 and +9.999	1.000		
	INBIAS =	-99.9 and +102%	0.0		
	FORMAT =	LINEAR, SQ ROOT, SQUARED, CHAR 1, CHAR 2	LINEAR		
	FILTER =	0 and 10 minutes	0.00		0.00 minute is no filter
	FREQ I/P	FREQ, PULSED	FREQ		
	E	- - - -			
	OUTBIAS =	-99.9 and +102%	0.0		
	GAIN =	-9.999 and +9.999	1.000		
	INBIAS =	-99.9 and +102%	0.0		
	FORMAT =	LINEAR, SQ ROOT, SQUARED, CHAR 1, CHAR 2	LINEAR		
	FILTER =	0 and 10 minutes	0.00		0.00 minute is no filter
	F	- - - -			
	OUTBIAS =	-99.9 and +102%	0.0		
	GAIN =	-9.999 and +9.999	1.000		
	INBIAS =	-99.9 and +102%	0.0		
	FORMAT =	LINEAR, SQ ROOT, SQUARED, CHAR 1, CHAR 2	LINEAR		
	FILTER =	0 and 10 minutes	0.00		0.00 minute is no filter

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration	Remarks/Notes
CONFIG ALARMS					
5-A2	CONFIG ALARMS	- - - -			Configure TYPE, ACTION, FORM and then ATTACH input
5-B2	ALARM 1	- - - -			
	TYPE	HI/HI, HI/LO, LO/LO, OFF	OFF		
	ACTION	LATCHING, NON LAT, PER-MISVE	NON LAT		
	FORM	ABS, DEV, ROC	ABS		
	(DEV REF)	See Table B-1	NONE		
	ATTACH	See Table B-1	NONE		
	ALARM 2	- - - -			
	TYPE	HI/HI, HI/LO, LO/LO, OFF	OFF		
	ACTION	LATCHING, NON LAT, PER-MISVE	NON LAT		
	FORM	ABS, DEV, ROC	ABS		
	(DEV REF)	See Table B-1	NONE		
	ATTACH	See Table B-1	NONE		
	ALARM 3	- - - -			
	TYPE	HI/HI, HI/LO, LO/LO, OFF	OFF		
	ACTION	LATCHING, NON LAT, PER-MISVE	NON LAT		
	FORM	ABS, DEV, ROC	ABS		
	(DEV REF)	See Table B-1	NONE		
	ATTACH	See Table B-1	NONE		
	ALARM 4	- - - -			
	TYPE	HI/HI, HI/LO, LO/LO, OFF	OFF		
	ACTION	LATCHING, NON LAT, PER-MISVE	NON LAT		
	FORM	ABS, DEV, ROC	ABS		
	(DEV REF)	See Table B-1	NONE		
	ATTACH	See Table B-1	NONE		
	EXT ACK	See Table B-2	NONE		

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration	Remarks/Notes
CONFIG GATES					
5-A3	CONFIG GATES	- - - -			
5-B3	GATE 0	- - - -			
	LOGIC	DIRECT, NOT	DIRECT		
	INPUT 1	See Table B-2	NONE		
	GATE 1	- - - -			
	LOGIC	DIRECT, NOT	DIRECT		
	INPUT 1	SeeTable B-2	NONE		
	GATE 2	- - - -			
	LOGIC	DIRECT, NOT	DIRECT		
	INPUT 1	See Table B-2	NONE		
	GATE 3	- - - -			
	LOGIC	DIRECT, NOT	DIRECT		
	INPUT 1	See Table B-2	NONE		
	GATE 4	- - - -			
	LOGIC	DIRECT, NOT	DIRECT		
	INPUT 1	See Table B-2	NONE		
	GATE 5	- - - -			
	LOGIC	OR, NOR, AND, NAND, XOR, XNOR	AND		
	INPUT 1	See Table B-2	NONE		
	INPUT 2	See Table B-2	NONE		
	GATE 6	- - - -			
	LOGIC	OR, NOR, AND, NAND, XOR, XNOR	AND		
	INPUT 1	See Table B-2	NONE		
	INPUT 2	See Table B-2	NONE		
	GATE 7	- - - -			
	LOGIC	OR, NOR, AND, NAND, XOR, XNOR	AND		
	INPUT 1	See Table B-2	NONE		
	INPUT 2	See Table B-2	NONE		
	GATE 8	- - - -			
	LOGIC	OR, NOR, AND, NAND, XOR, XNOR	AND		
	INPUT 1	See Table B-2	NONE		
	INPUT 2	See Table B-2	NONE		
	GATE 9	- - - -			
	LOGIC	OR, NOR, AND, NAND, XOR, XNOR	AND		
	INPUT 1	See Table B-2	NONE		
	INPUT 2	See Table B-2	NONE		

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration	Remarks/Notes
CONFIG CALC					
5-C1	CONFIG CALC	- - - -			
	CALC 1 =	- - - -	A		Select up to 9 characters from Table 4-13
	CALC 2 =	- - - -	A		
	CALC 3 =	- - - -	A		
	DYNC	0N, 0FF	0FF		If OFF, ACK key takes you to CHAR 1
5-D1	(0N)				If ON, CALC 3 is dynamically compensated
	DEADTIME	- - - -			
	TIME	0 and 200 minutes	0.00		
	FOLLOW	See Table B-2.	OFF		
	LEADLAG	- - - -			
	GAIN =	0 and 9.999 minutes	1.000		
	BIAS =	-99.9 and +102%	0.0		
	TIME =	0 and 200 minutes	0.00		
	IMPULSE	NONE, BIPOLAR, POSITIVE, NEGATIVE	NONE		
5-D2	FOLLOW	See Table B-2	OFF		
5-C1	CHAR 1	- - - -			
5-D1	POINTS	1 and 9	2		
	X1, X2, etc.	-99.9 and +102%	0.0, 100.0	See Table B-4	Display will alternate between CHAR 1 Xn and CHAR 1 Yn
	Y1, Y2, etc.	-99.9 and +102%	0.0, 100.0	See Table B-4	Display will alternate between CHAR 1 Xn and CHAR 1 Yn
5-C1	CHAR 2	- - - -			
5-D1	POINTS	1 and 9	2		
	X1, X2, etc.	-99.9 and +102%	0.0, 100.0	See Table B-4	Display will alternate between CHAR 2 Xn and CHAR 2 Yn
	Y1, Y2, etc.	-99.9 and +102%	0.0, 100.0	See Table B-4	Display will alternate between CHAR 2 Xn and CHAR 2 Yn
CONFIG OUTPUTS					
5-C2	CONFIG OUTPUTS	- - - -			
	CO 1	See Table B-2	NONE		
	CO 2	See Table B-2	NONE		
	SPLT RNG	YES, NO	NO		
5-D2	(YES)				
	SPLIT PT	0 and 100%	50		
	DEADBAND	0 AND 10	5		
	LOW ACT	INC/INC, INC/DEC	INC/DEC		
	HI ACT	INC/INC, INC/DEC	INC/INC		
5-C2	AOUT 1	- - - -			
5-D2	REVERSE	YES, NO	NO		
	SOURCE	See Table B-1	NONE		Only if output is assignable
5-C2	AOUT 2	- - - -			
5-D2	REVERSE	YES, NO	NO		
	SOURCE	See Table B-1	NONE		Only if output is assignable

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration	Remarks/Notes
CONFIG W/P					
5-C2	CONFIG W/P	- - -	OFF		
	(ON)				
5-D2	ADDRESS	0 and 99	0		
	BAUD	2400, 4800, 9600,19200	4800		
	PARITY	ODD, EVEN. NONE	NONE		
	TIMEOUT	0 and 200 minutes	10.0		If 0.00, function never times out
	FLUNK	W, P, LAST W/P	P		
5-D3	PRIORITY	W, P, BOTH	P		
	STARTUP	W, P	P		Never set to W when PRIORITY is set to W
	SWITCH	See Table B-2	NONE		
CONFIG PASSCODE, TOGGLE					
5-C2	CONFIG NEW PASS =	3 characters	Three blanks		Select characters from Table B-3
	VERIFY =				
	CONFIG TOGGLE	ON, OFF	OFF		

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration		Remarks/Notes
CONFIG DISPLAY						
				CNTL 1	**CNTL 2**	
5-E1	CONFIG DISPLAY	- - - -				
	TOP LINE	TAG, VARIABLE	TAG			
	(TAG)	See Table B-3	762 MICRO			Enter up to 9 characters
	(VARIABLE)					
	TYPE	LINEAR, TEMP	LINEAR			
5-F1	LINEAR	- - - -				
	ENG UNTS	See Table B-3				Enter up to 4 characters
	URV	-999 and +9999				
	LRV	-999 and +9999				
	TEMP	- - - -				
	SCALE	IEC 100, SAMA 100, T/C J, T/C K, T/C E	IEC 100			
	ENG UNTS	DEG F, DEG C	DEG C			
	URV	Depends on SCALE				
	LRV	Depends on SCALE				
5-E1	SOURCE	See Table B-1	NONE			
5-E2	MEAS, SP					
	TYPE	LINEAR, TEMP	LINEAR			
	LINEAR	- - - -				
5-F2	ENG UNTS	See Table B-3	PCT			Enter up to 4 characters
	URV	-999 and +9999	100.0			
	LRV	-999 and +9999	0.0			
5-E2	TEMP	- - - -				
5-F2	SCALE	IEC 100, SAMA 100, T/C J, T/C K, T/C E	IEC 100			
	ENG UNTS	DEG F, DEG C	DEG C			
	URV	Depends on SCALE	100.0			
	LRV	Depends on SCALE	0.0			
5-E2	OUTBAR	- - - -				
	SOURCE	See Table B-1	See Remarks			C1 OUT for Controller 1 C2 OUT for Controller 2
	RATIO	- - - -				
	ENG UNTS	See Table B-3	PCT			
	URV	-999 and +9999	100.0			
	LRV	-999 and +9999	0.0			
5-E2	ALARMS	- - - -	- - - -			
	MEAS ALM	YES, NO	NO			
	OUT ALM	YES, NO	NO			
	PH DISP	ON, OFF	OFF			
CONFIG SETPT						
5-G1	SETPT	- - - -				
	TYPE	LOCAL, R/L, RATIO	LOCAL			If LOCAL, ACK key takes you to MEAS TRK
	(R/L)	- - - -				
5-H1	RL LOGIC	- - - -				
	LOCTRK	See Table B-2	OFF			
	SWITCH	See Table B-2	NONE			
	STARTUP	R, L	L			
	INBIAS	-99.9 and +102%	0.0			
	SOURCE	See Table B-1	B			

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration		Remarks/Notes
5-G1	(RATIO)	- - - -				
5-H1	RL LOGIC	- - - -				
	LOCTRK	See Table B-2	OFF			
	SWITCH	See Table B-2	NONE			
				CNTL 1	**CNTL 2**	
	STARTUP	R, L	L			
	OUTBIAS	-99.9 AND +102%	0.0			
	SIGNAL	- - - -				
	INBIAS	-99.9 AND +102%	0.0			
	SOURCE	See Table B-1				
	RANGE	0-1.0 and 0-5.0	0-1.0			
	SOURCE	FCEPLATE, ROUTED	FCEPLATE			
	(ROUTED)	See Table B-1	IN2			
5-G1	MEAS TRK	See Table B-2	OFF			
	FORMAT	LINEAR, SQ ROOT, SQUARED, CHAR 1, CHAR 2	LINEAR			
CONFIG MEAS						
5-G2	MEAS	- - - -				
	FORMAT	LINEAR, SQ ROOT, SQUARED, CHAR 1, CHAR 2	LINEAR			
	SOURCE	See Table B-1	A			
CONFIG A/M						
5-G2	A/M					
	STARTUP	A, M	M			
	FLUNK	A, M, LAST A/M	M			
	SWITCH	See Table B-1	NONE			
CONFIG NONLIN, ACTION						
5-G2	NONLIN	CHAR 1, CHAR 2, NO	NO			
	ACTION	INC/DEC, INC/INC	INC/DEC			
CONFIG OUTPUT						
5-G3	OUTPUT	- - - -				
	FORMAT	LINEAR, SQ ROOT, SQUARED, CHAR 1, CHAR 2	LINEAR			
	MODIFIER	OUTMUL, OUTSUM, NO	NO			Do not use OUTMUL if BATCH is ON
	OUTMUL	See Table B-1	B			
	OUTSUM	See Table B-1	B			
	OUTTRK	- - - -				
	SWITCH	See Table B-2	OFF			
	SOURCE	See Table B-1	IN 2			
5-G3	EXTLIM	- - - -				
	HIGH	- - - -				
	SWITCH	See Table B-2	OFF			
	SOURCE	See Table B-1	IN 2			
	LOW	- - - -				
	SWITCH	See Table B-2	OFF			
	SOURCE	See Table B-1	IN 2			
	STARTUP	VALUE, LAST VAL	LAST VAL			
	(VALUE)	-2 and +102%	0.0			

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration		Remarks/Notes
CONFIG EXACT, BATCH, INT FBK						
5-G3	EXACT SW	SeeTable B-2	NONE			
	BATCH	ON, OFF	OFF			
	INT FBK	See Table B-1	C1 OUT			
CONFIG 3BARIND						
				Ind. 1	Ind. 2	
8-A1	LFT BAR	- - - -				
8-B1	TAG	SeeTable B-3	BAR 1			Enter up to 9 characters
	TYPE	LINEAR, TEMP	LINEAR			
	LINEAR	- - - -				
8-C1	ENG UNTS	See Table B-3				Enter up to 4 characters
	URV	-999 and +9999				
	LRV	-999 and +9999				
8-B1	TEMP	- - - -				
8-C1	SCALE	IEC 100, SAMA 100, T/C J, T/C K, T/C E	IEC 100			
	ENG UNTS	DEG F, DEG C	DEG C			
	URV	Depends on SCALE				
	LRV	Depends on SCALE				
8-B1	SOURCE	See Table B-1				
8-A1	MID BAR	- - - -				
8-B1	TAG	See Table B-3	BAR 2			Enter up to 9 characters
	TYPE	LINEAR, TEMP	LINEAR			
	LINEAR	- - - -				
8-C1	ENG UNTS	See Table B-3	PCT			Enter up to 4 characters
	URV	-999 and +9999	100.0			
	LRV	-999 and +9999	0.0			
8-B1	TEMP	- - - -				
8-C1	SCALE	IEC 100, SAMA 100, T/C J, T/C K, T/C E	IEC 100			
	ENG UNTS	DEG F, DEG C	DEG C			
	URV	Depends on SCALE	100.0			
	LRV	Depends on SCALE	0.0			
8-B1	SOURCE	See Table B-1				
8-A1	RT BAR	- - - -				
8-B1	TAG	See Table B-3	BAR 3			Enter up to 9 characters
	TYPE	LINEAR, TEMP	LINEAR			
	LINEAR	- - - -				
8-C1	ENG UNTS	See Table B-3	PCT			Enter up to 4 characters
	URV	-999 and +9999	100.0			
	LRV	-999 and +9999	0.0			
8-B1	TEMP	- - - -				
8-C1	SCALE	IEC 100, SAMA 100, T/C J, T/C K, T/C E	IEC 100			
	ENG UNTS	DEG F, DEG C	DEG C			
	URV	Depends on SCALE	100.0			
	LRV	Depends on SCALE	0.0			
8-B1	SOURCE	See Table B-1				
8-A2	ALARMS	- - - -				
8-B2	LBAR ALM	YES, NO	NO			
	MBAR ALM	YES, NO	NO			
	RBAR ALM	YES, NO	NO			

Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration		Remarks/Notes
CONFIG A/M STN DISPLAY						
				Station 1	**Station 2**	
9-A1	DISPLAY	- - - -				
	TOP LINE	TAG, VARIABLE	TAG			
	(TAG)	See Table B-3	762 MICRO			
	(VARIABLE)	- - - -				Enter up to 9 characters
9-B1	TYPE	LINEAR, TEMP	LINEAR			
	LINEAR	- - - -				
9-C1	ENG UNTS	See Table B-3				Enter up to 4 characters
	URV	-999 and +9999				
	LRV	-999 and +9999				
9-B1	TEMP	- - - -				
9-C1	SCALE	IEC 100, SAMA 100, T/C J, T/C K, T/C E	IEC 100			
	ENG UNTS	DEG F, DEG C	DEG C			
	URV	Depends on SCALE				
	LRV	Depends on SCALE				
9-B1	SOURCE	See Table B-1	NONE			
9-A1	SETP	- - - -				
9-B1	TYPE	LINEAR, TEMP, NONE	LINEAR			
	(LINEAR)	- - - -				
9-C1	ENG UNTS	See Table B-3	PCT			Enter up to 4 characters
	URV	-999 and +9999	100.0			
	LRV	-999 and +9999	0.0			
9-B1	(TEMP)	- - -				
9-C1	SCALE	IEC 100, SAMA 100, T/C J, T/C K, T/C E	IEC 100			
	ENG UNTS	DEG F, DEG C	DEG C			
	URV	Depends on SCALE	100.0			
	LRV	Depends on SCALE	0.0			
9-A1	MEAS	- - - -				
9-B1	TYPE	LINEAR, TEMP	LINEAR			
	LINEAR	- - - -				
9-C1	ENG UNTS	See Table B-3	PCT			Enter up to 4 characters
	URV	-999 and +9999	100.0			
	LRV	-999 and +9999	0.0			
9-B1	TEMP	- - - -				
9-C1	SCALE	IEC 100, SAMA 100, T/C J, T/C K, T/C E	IEC 100			
	ENG UNTS	DEG F, DEG C	DEG C			
	URV	Depends on SCALE	100.0			
	LRV	Depends on SCALE	0.0			
9-A2	OUTBAR	- - - -				
	SOURCE	See Table B-1	C1 OUT			
9-A2	ALARMS	- - - -				
	MEAS	YES, NO	NO			
	OUT	YES, NO	NO			
CONFIG A/M STN SETPT						
9-A3	SET PT	- - - -				
	TYPE	LOCAL, R/L	LOCAL			
	(R/L)	- - - -				
9-B3	RL LOGIC	- - - -				

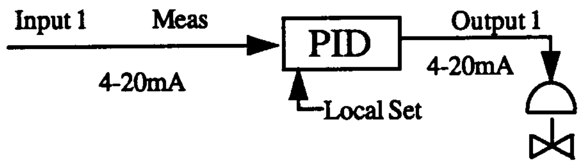
Table B-5. Configuration Worksheets (Continued)

Location	Prompt/Parameter	Parameter Limits	Standard Factory Configuration	User Configuration		Remarks/Notes
	LOCTRK	See Table B-2	OFF			
	SWITCH	See Table B-2	NONE			
	STARTUP	R, L	L			
	INBIAS	-99.9 and +102%	0.0			
	SOURCE	See Table B-1	B			
9-A3	MEAS TRK	See Table B-2	NONE			
	FORMAT	LINEAR, SQ ROOT, SQUARED CHAR 1, CHAR 2	LINEAR			
CONFIG A/M STN MEAS, A/M						
9-D1	MEAS	- - - -				
	FORMAT	LINEAR, SQ ROOT, SQUARED CHAR 1, CHAR 2	LINEAR			
	SOURCE	See Table B-1	A			
	A/M	- - -				
	STARTUP	A, M	M			
	FLUNK	A, M, LAST A/M	M			
	SWITCH	See Table B-2	NONE			
CONFIG A/M STN OUTPUT						
9-D2	OUTPUT	- - -				
	SOURCE	See Table B-1				
	FORMAT	LINEAR, SQ ROOT, SQUARED, CHAR 1, CHAR 2	LINEAR			
	MODIFIER	OUTMUL, OUTSUM, NO	NO			
9-E2	OUTMUL	See Table B-1	B			
	OUTSUM	See Table B-1	B			
9-D3	OUTTRK	- - -				
9-E3	SWITCH	See Table B-2	OFF			
	SOURCE	See Table B-1	IN 2			
9-D3	EXTLIM	- - -				
9-E3	HIGH	- - -				
	SWITCH	See Table B-2	OFF			
	SOURCE	See Table B-1	IN 2			
	LOW	- - -				
	SWITCH	See Table B-2	OFF			
	SOURCE	See Table B-1	IN 3			
9-D3	STARTUP	VALUE, LAST VAL	LAST VAL			
9-E3	(VALUE)	-2 and +102%	0.0			

Factory Preconfiguration Diagrams

Auxiliary Specification Reference

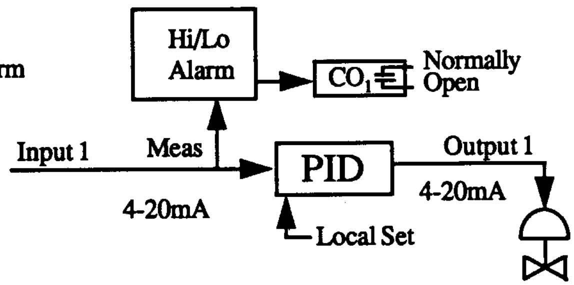
SINGLE LOOP CONTROLLER



SINGLE C

SINGLE LOOP CONTROLLER

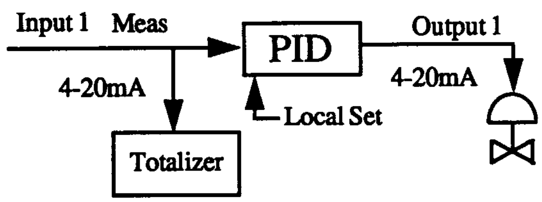
With Hi/Lo Measurement Alarm



SINGLE C1

SINGLE LOOP CONTROLLER

With One Totalizer

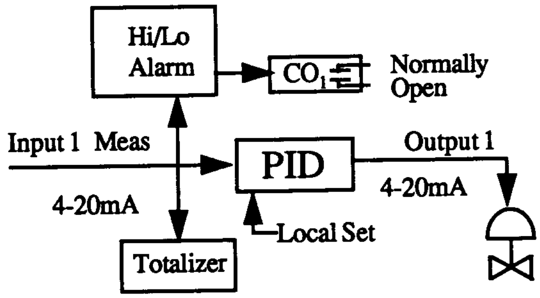


SINGLE C2

SINGLE LOOP CONTROLLER

Auxiliary
Specification
Reference

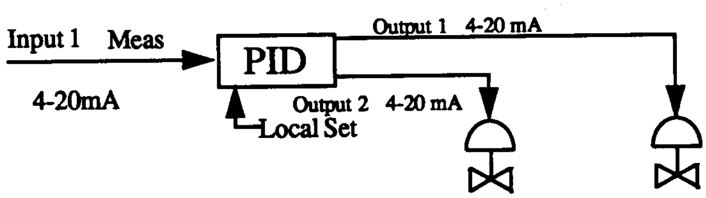
With Hi/Lo Alarm
and Totalizer



SINGLE C3

SINGLE LOOP CONTROLLER

With Split Range Outputs

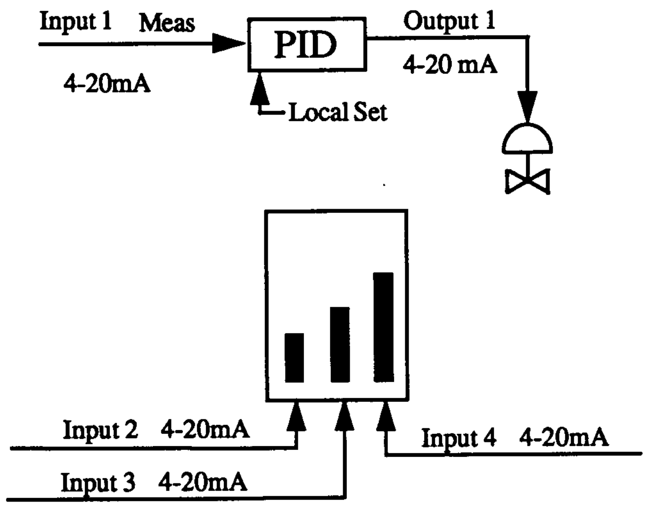


SINGLE C4

SINGLE LOOP CONTROLLER

Auxiliary Specification Reference

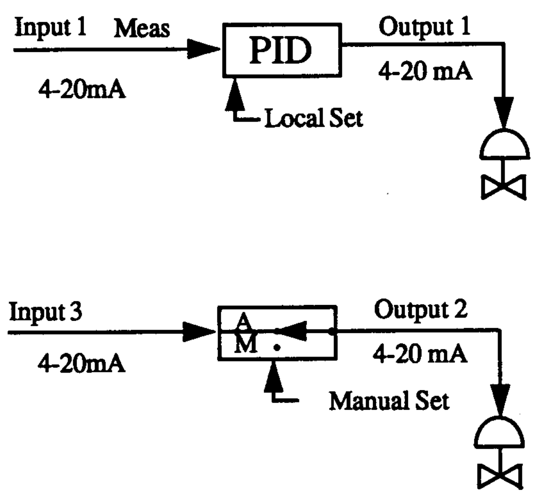
With 3-Variable Indicator Station



SINGLE C5

SINGLE LOOP CONTROLLER

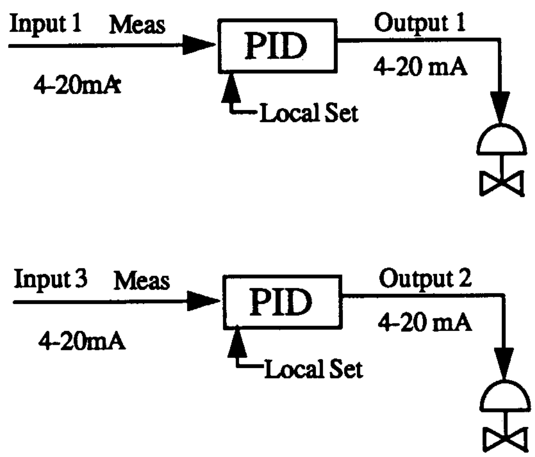
With Auto-Manual Transfer Station



SINGLE C6

DUAL LOOP CONTROLLER

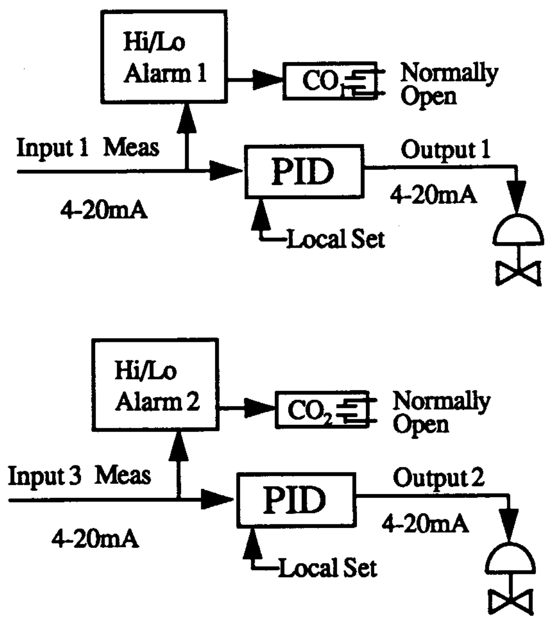
Auxiliary Specification Reference



DUAL C

DUAL LOOP CONTROLLER

With Hi/Low Measurement Alarm

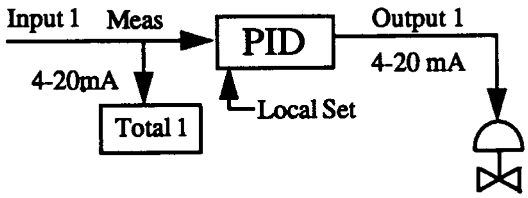


DUAL C1

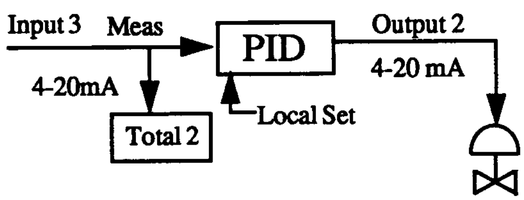
Auxiliary
Specification
Reference

DUAL LOOP CONTROLLER

With Two
Totalizers

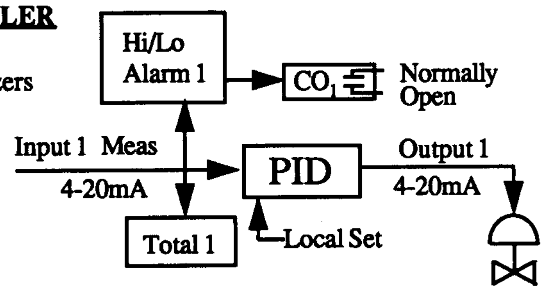


DUAL C2

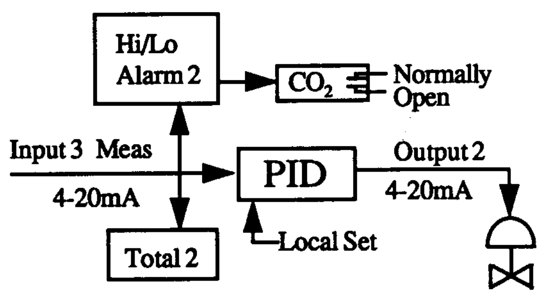


DUAL LOOP CONTROLLER

With Alarms and Totalizers

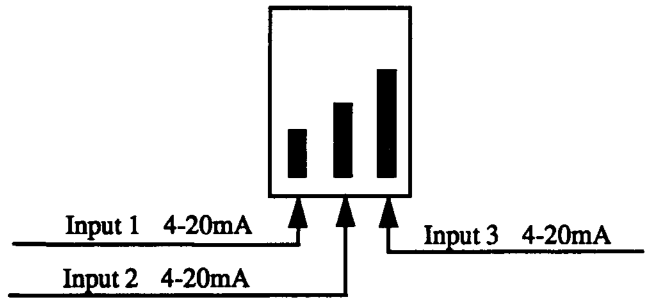


DUAL C3



3-VARIABLE INDICATOR STATION

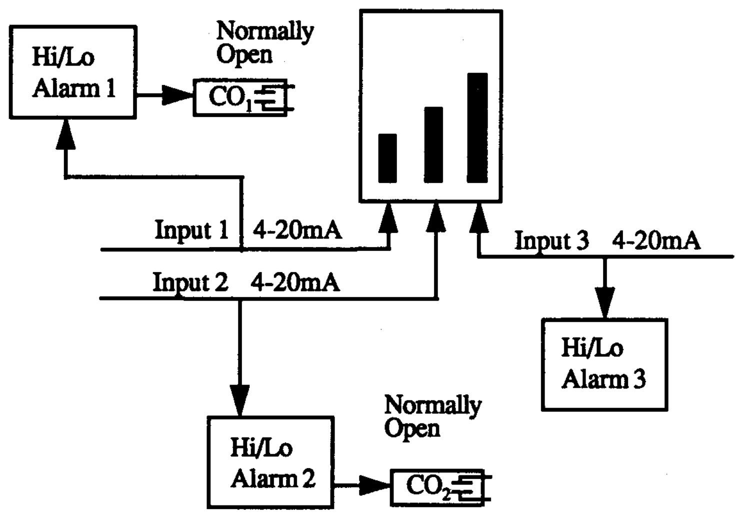
Auxiliary Specification Reference



IND S

3-VARIABLE INDICATOR STATION

With Three Hi/Low Alarms

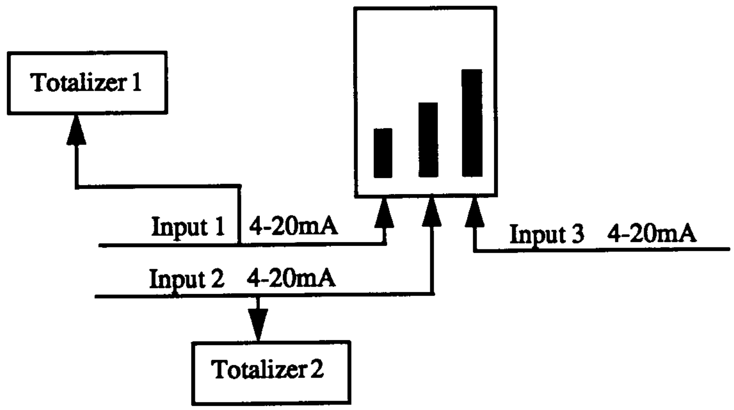


IND S1

Auxiliary
Specification
Reference

3-VARIABLE INDICATOR STATION

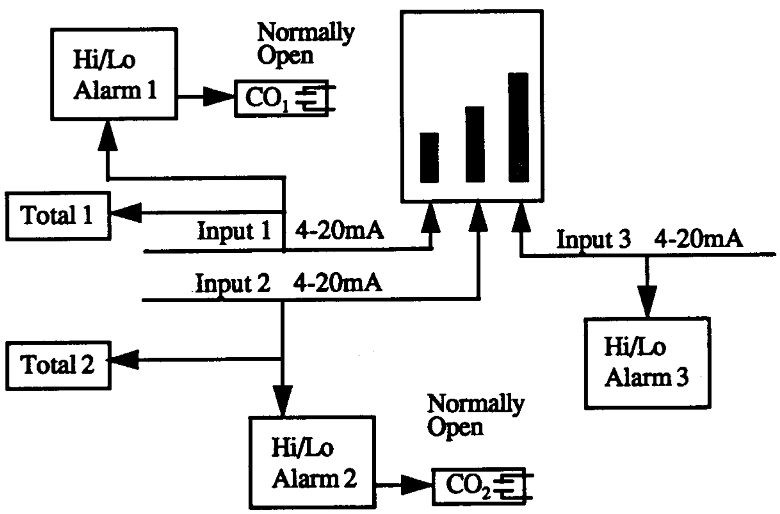
With Two Totalizers



IND S2

3-VARIABLE INDICATOR STATION

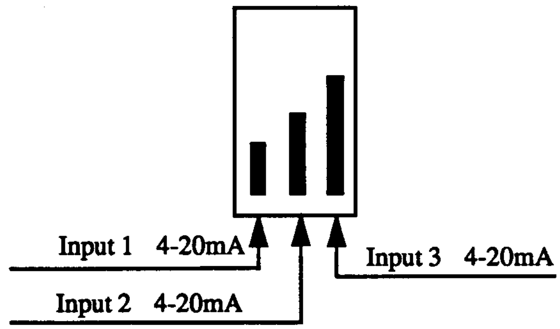
With Alarms and Totalizers



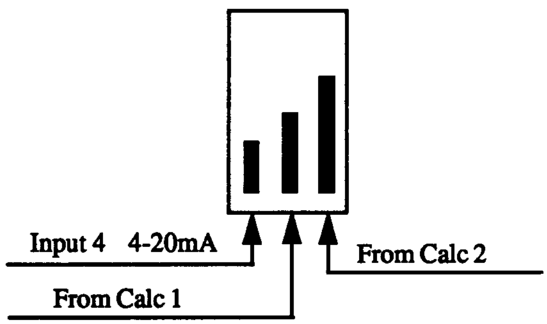
IND S3

TWO 3-VARIABLE INDICATOR STATIONS

Auxiliary Specification Reference



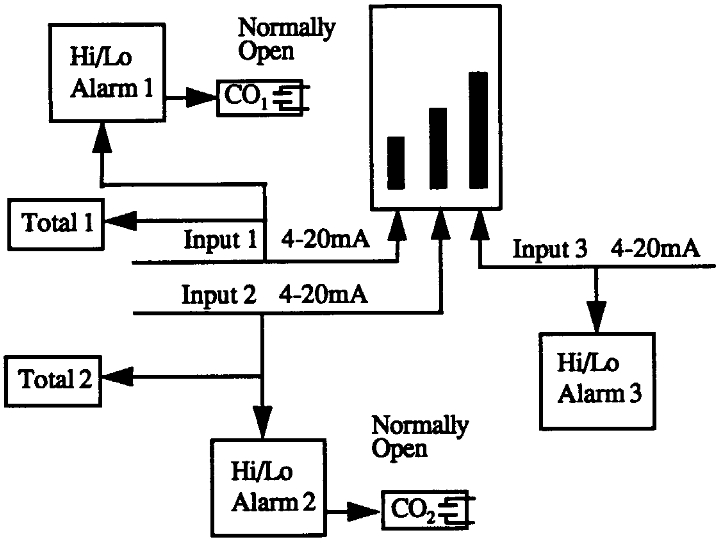
IND S4



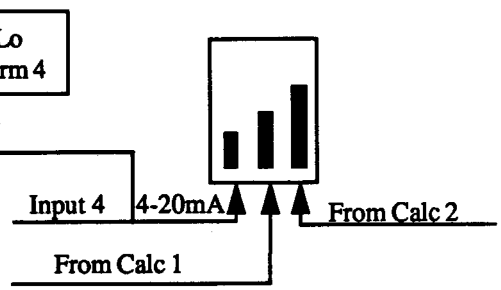
TWO 3-VARIABLE INDICATOR STATIONS

Auxiliary Specification Reference

With Alarms and Totalizers



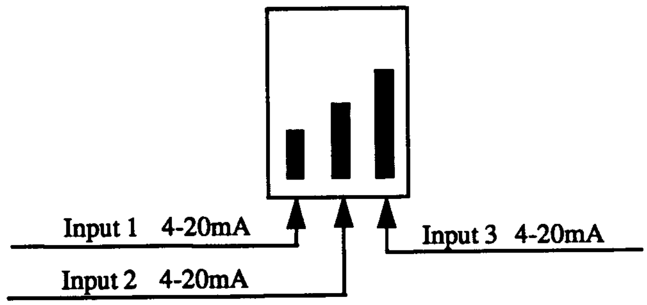
IND S5



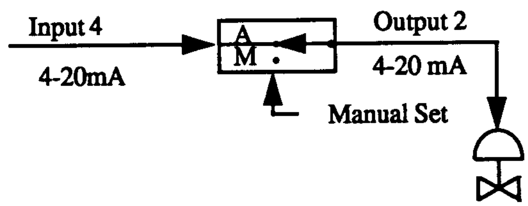
3-VARIABLE INDICATOR STATION

Auxiliary Specification Reference

With Auto-Manual
Transfer Station

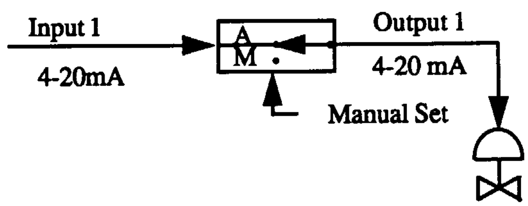


IND S6



AUTO/MANUAL TRANSFER STATION

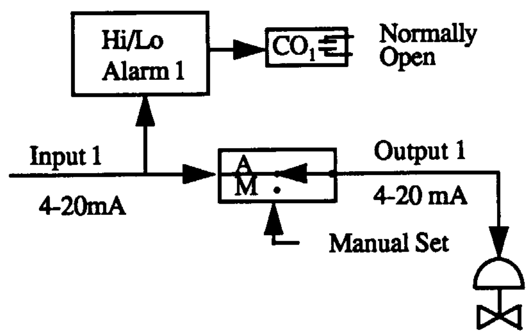
Auxiliary Specification Reference



A/M S

AUTO/MANUAL TRANSFER STATION

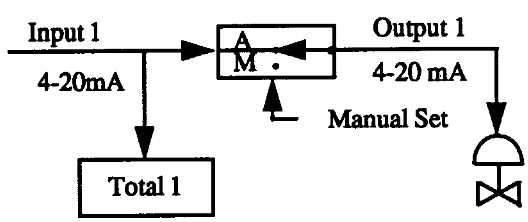
With Hi/Low Alarm



A/M S1

AUTO/MANUAL TRANSFER STATION

With Totalizer

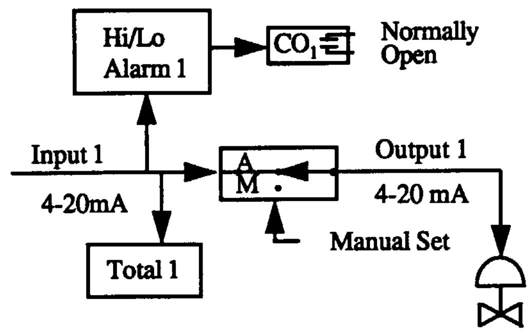


A/M S 2

AUTO/MANUAL TRANSFER STATION

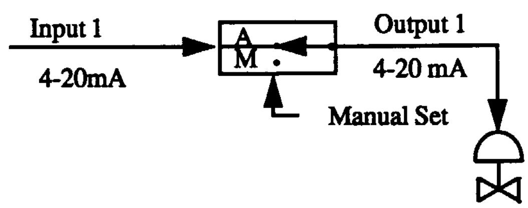
Auxiliary Specification Reference

With Hi/Low Alarm and Totalizer

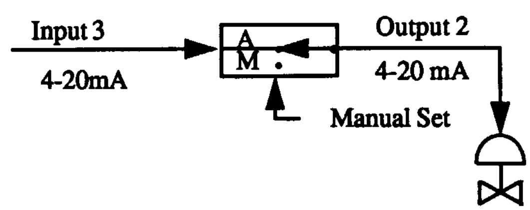


A/M S3

TWO AUTO/MANUAL TRANSFER STATIONS



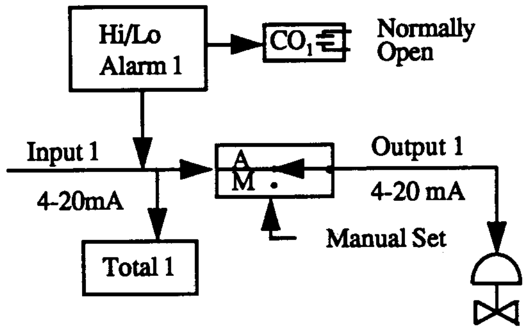
A/M S4



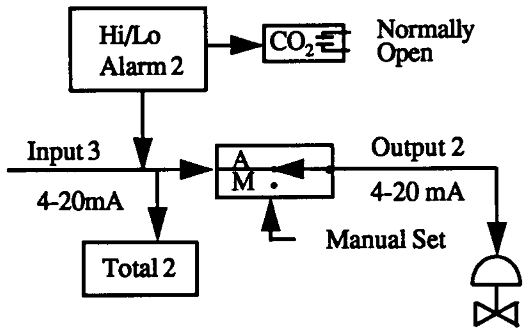
TWO AUTO/MANUAL TRANSFER STATIONS

Auxiliary Specification Reference

With Hi/Low Alarms and Totalizers

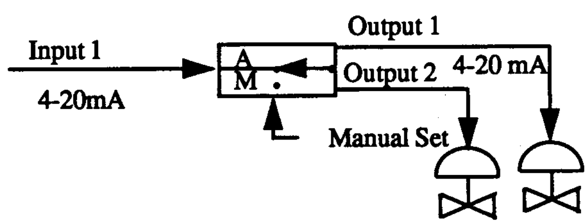


A/M S5



AUTO/MANUAL TRANSFER STATION

With Split Range Outputs



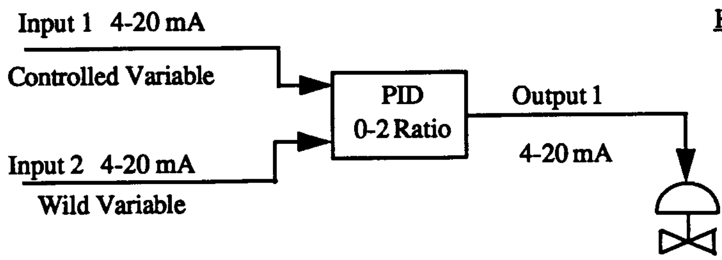
A/M S6

Auxiliary Specification Reference

SINGLE LOOP RATIO CONTROLLER

With Square Root Inputs

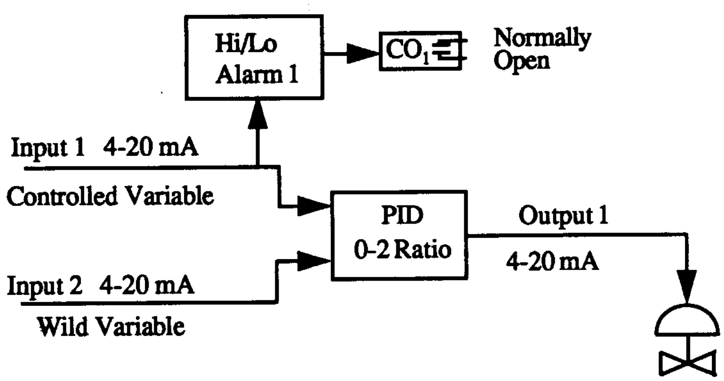
RATIO C



SINGLE LOOP RATIO CONTROLLER

With Hi/Lo Alarm, Square Root Inputs

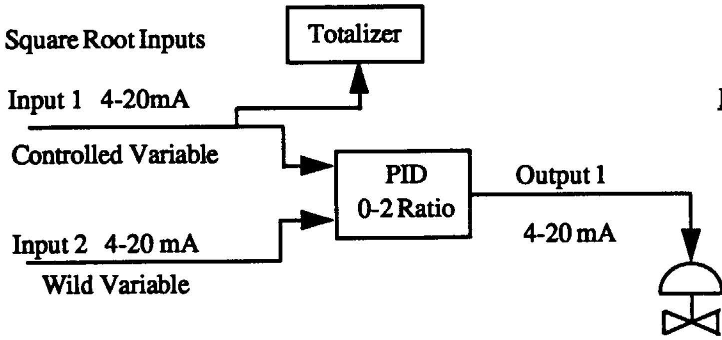
RATIO C1



Auxiliary Specification Reference

SINGLE LOOP RATIO CONTROLLER

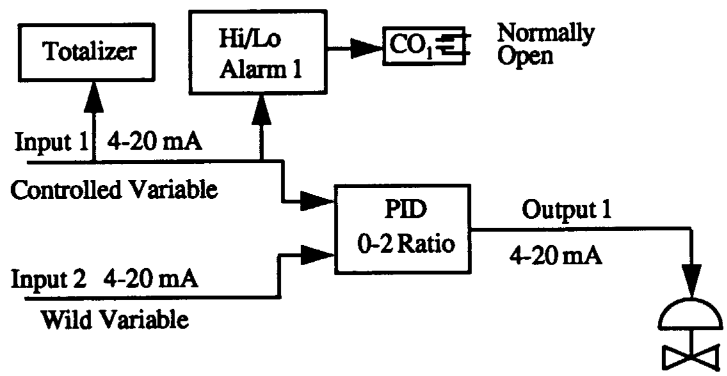
With Totalizer, Square Root Inputs



RATIO C2

SINGLE LOOP RATIO CONTROLLER

With Hi/Lo Alarm, Totalizer, Square Root Inputs



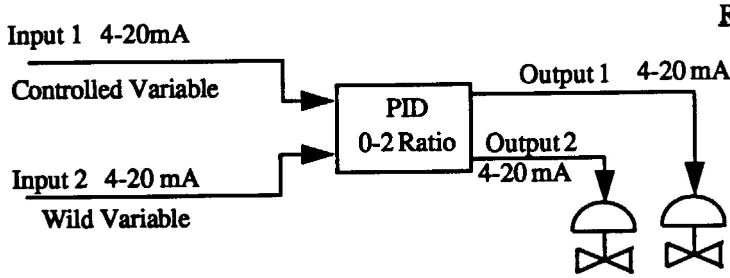
RATIO C3

SINGLE LOOP RATIO CONTROLLER

Auxiliary Specification Reference

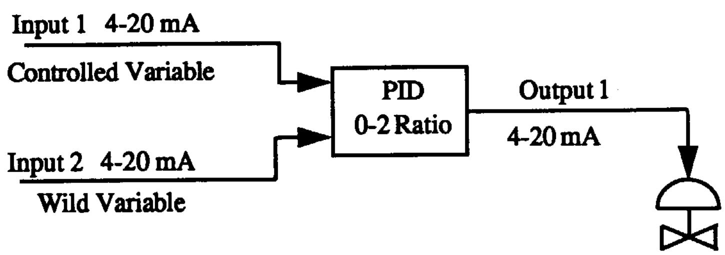
With Split Range Outputs, Square Root Inputs

RATIO C4

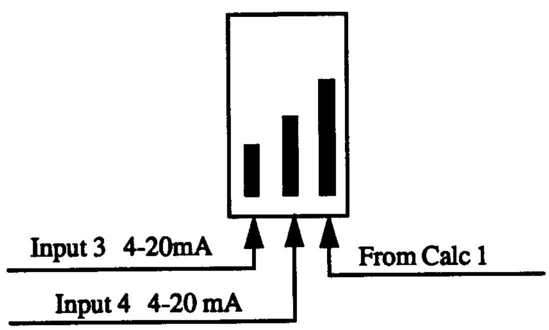


SINGLE LOOP RATIO CONTROLER

With 3-Variable Indicator, Square Root Inputs



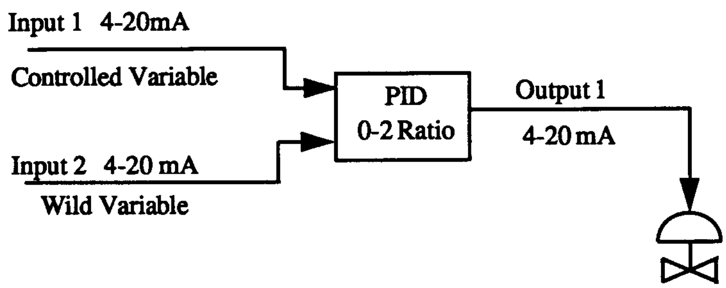
RATIO C5



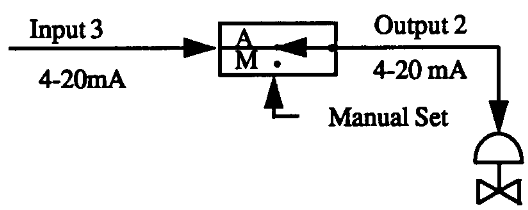
SINGLE LOOP RATIO CONTROLLER

Auxiliary
Specification
Reference

With Auto/Manual Transfer Station, Square Root Inputs



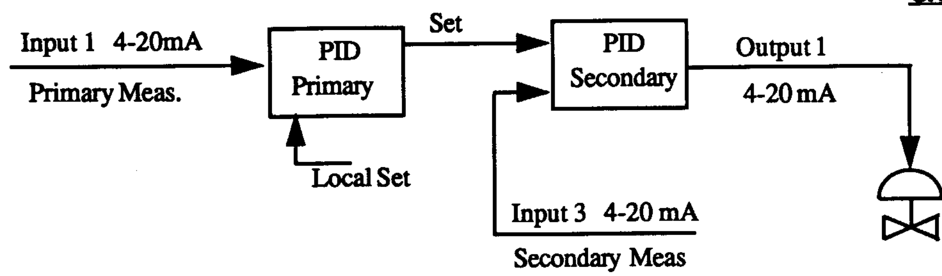
Ratio C6



CASCADE CONTROLLER

Auxiliary Specification Reference

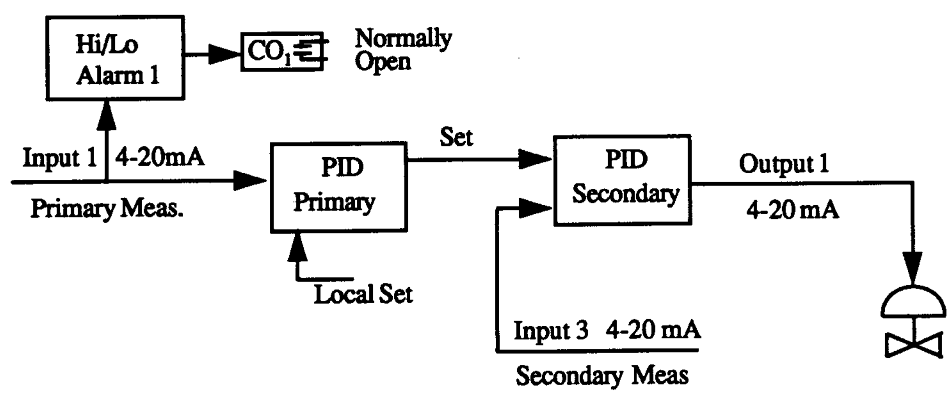
CASCDE C



CASCADE CONTROLLER

With Hi/Low Primary Alarm

CASCDE C1

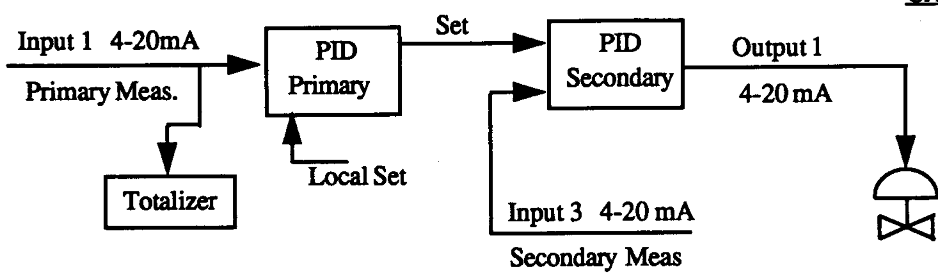


Auxiliary
Specification
Reference

CASCADE CONTROLLER

With Totalizer

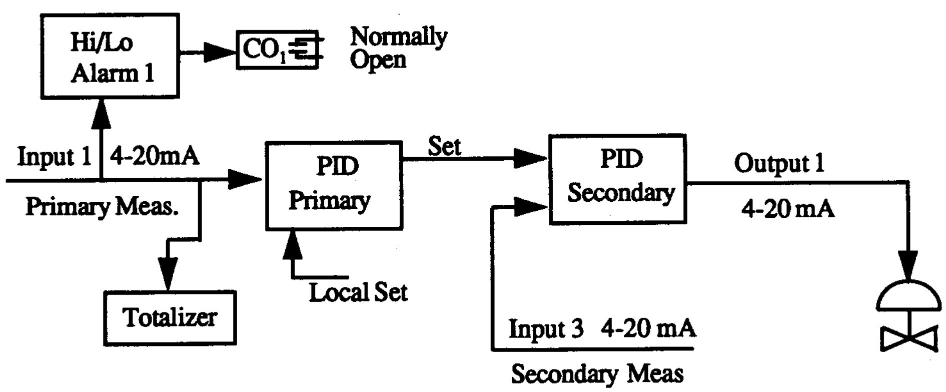
CASCDE C2



CASCADE CONTROLLER

With Hi/Low Primary Alarm and Totalizer

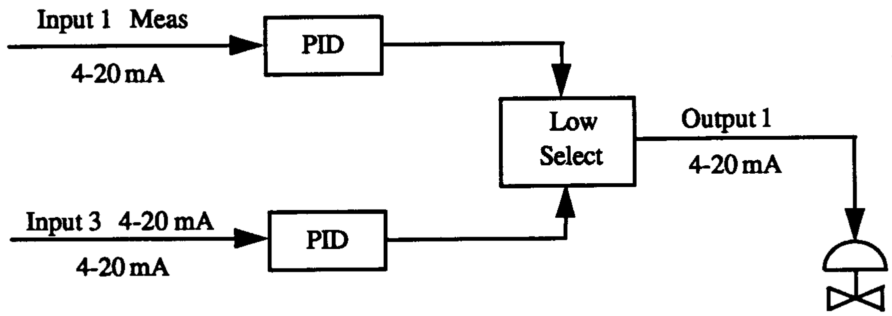
CASCDE C3



AUTO SELECTOR CONTROLLER, LOW SELECT

Auxiliary Specification Reference

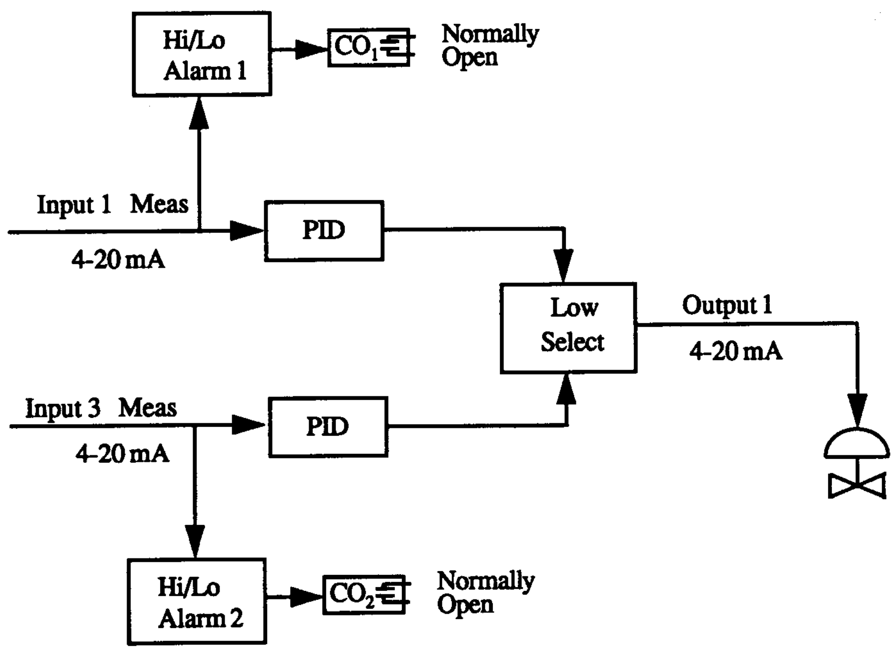
A SEL C



AUTO SELECTOR CONTROLLER, LOW SELECT

With Hi/Lo Measurement Alarms

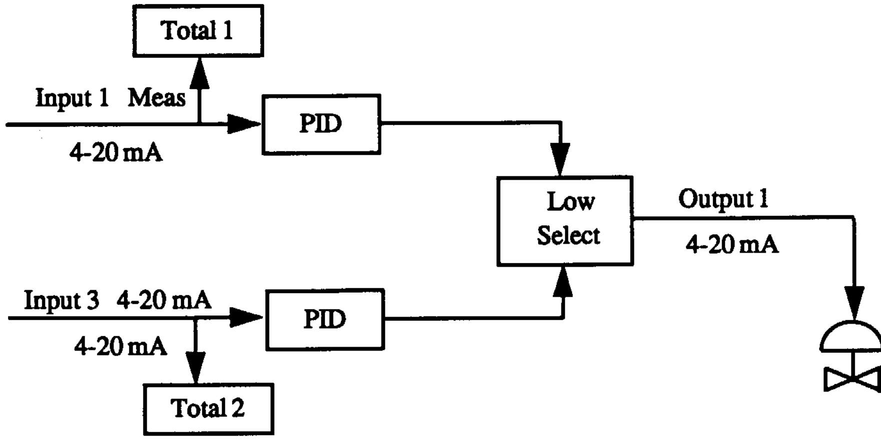
A SEL C1



AUTO SELECTOR CONTROLLER, LOW SELECT

With Totalizers

Auxiliary Specification Reference

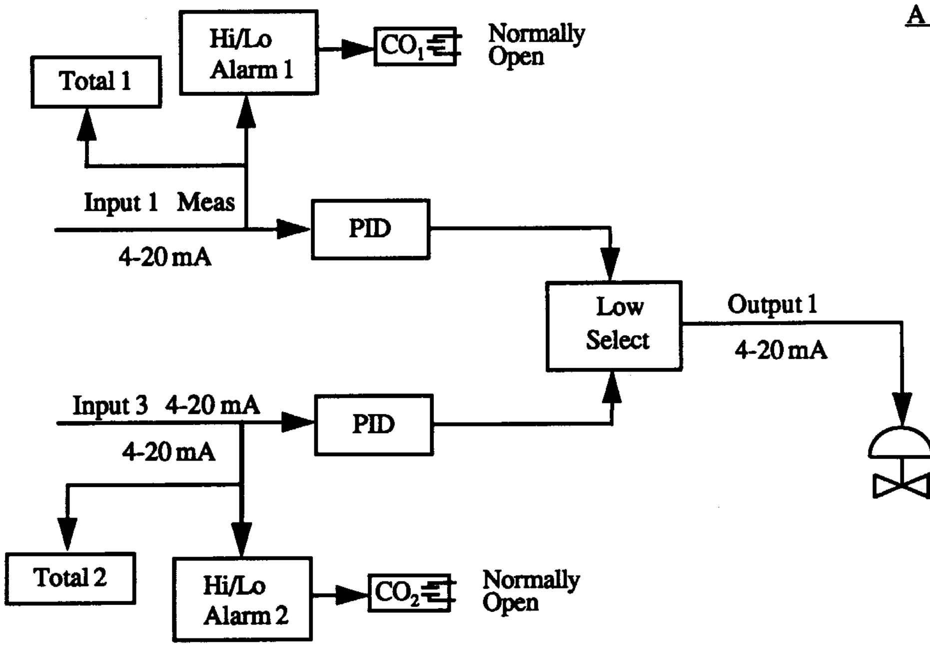


A SEL C2

AUTO SELECTOR CONTROLLER, LOW SELECT

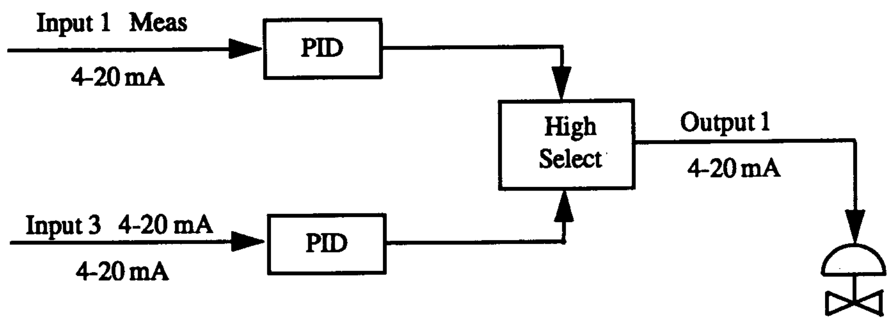
With Hi/Lo
Measurement Alarms and Totalizers

A SEL C3



AUTO SELECTOR CONTROLLER, HIGH SELECT

Auxiliary Specification Reference

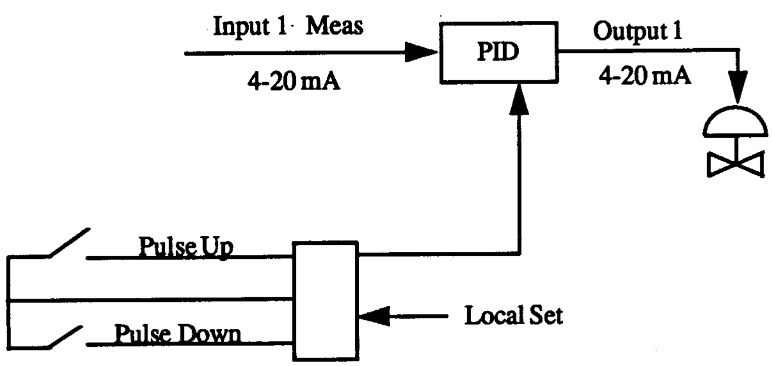


A SEL C4

SINGLE LOOP CONTROLLER

With Pulse or Contact Driven Setpoint

PULSE SP

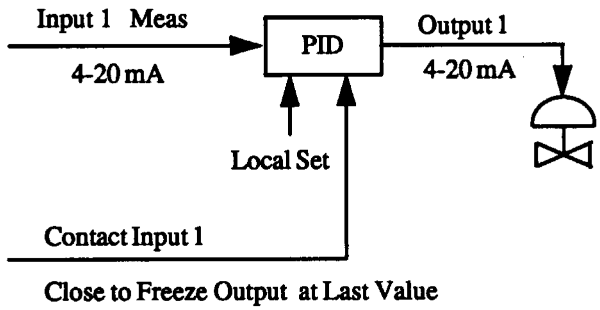


SINGLE LOOP CONTROLLER

With Output Freeze from Contact Input 1

Auxiliary Specification Reference

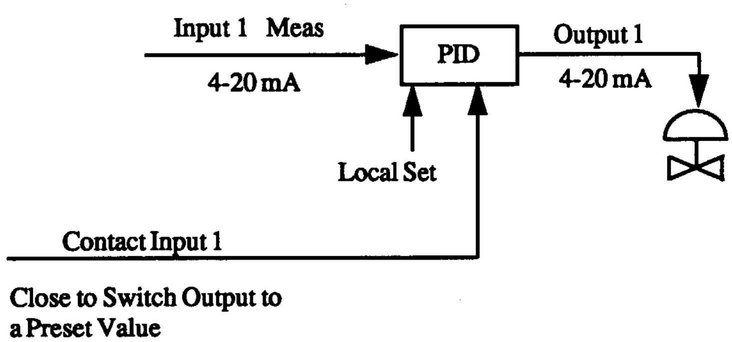
FREEZE



SINGLE LOOP CONTROLLER

With Output Switching to a Preset Value from Contact Input 1

PRESET



762C SINGLE STATION MICRO Controller

February 1998

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A SIEBE COMPANY

The Intelligent Automation People

Structure Diagrams

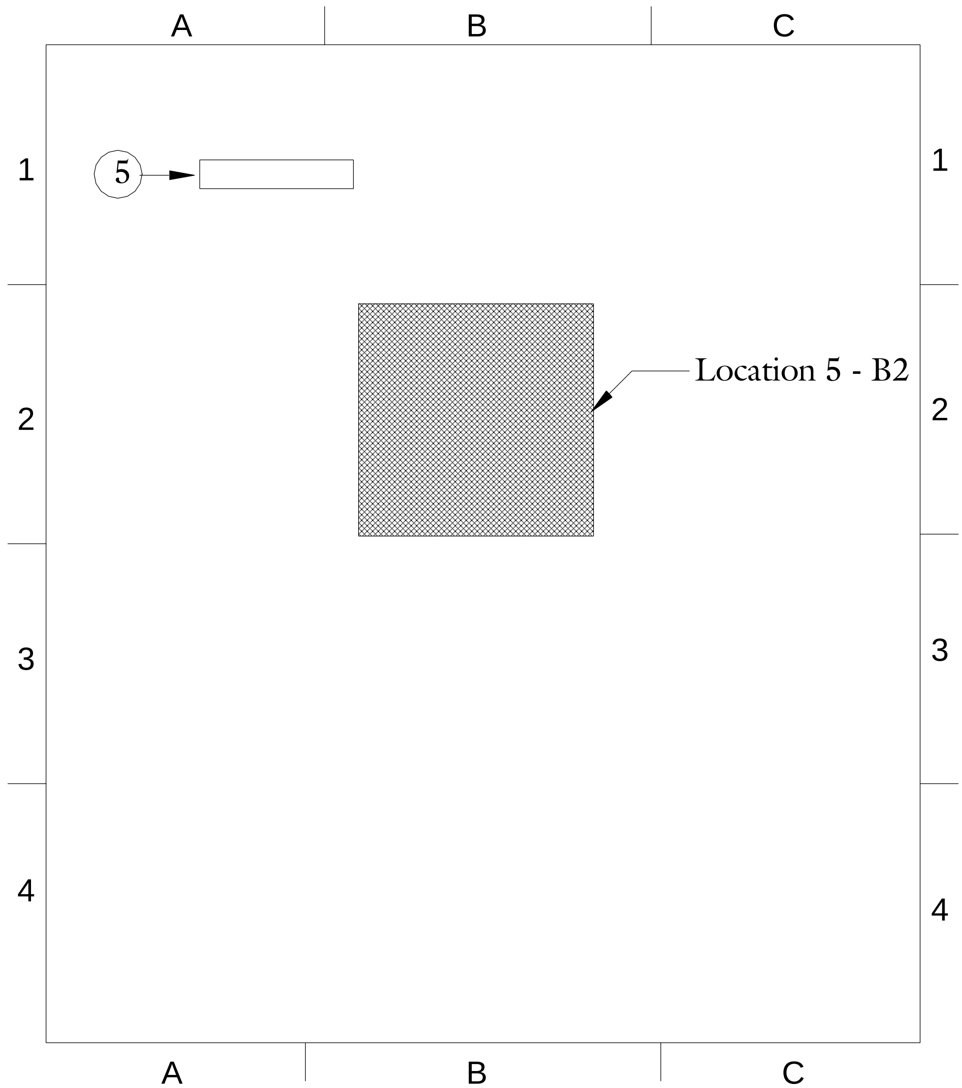
C

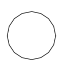
This appendix contains the structure diagrams for the 762C Controller. By following this appendix, you can locate the parameter you wish to read or change.

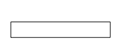
- Access to the structure from Normal Operation is achieved by pressing the TAG key. This brings you to the first item in the structure, READ.
- The ∆ and ∇ keys move you vertically within a connected group of parameters in the diagram.
- The ACK key moves you horizontally through a group of parameters and then on to the next group.
- The SEL key moves you back through the diagram in minor increments.

At various points in the diagrams you will find arrows and numbered balloons. These direct you to subsequent pages in the diagram. Also, some sections are marked with an asterisk (*) with a note to repeat for a similar entry. This is done to keep the diagrams as brief as possible.

Throughout the text of Chapter 4, Configuration and in Appendix B, Configuration Worksheets, you will find location designators (e.g., 5-B2). These direct you to the parameter you are looking for in the diagram. In the example given, the 5 refers to the diagram beginning with Balloon number 5 in the upper left hand corner (Structure Diagram 5). The designation B2 refers to map coordinates on that page. Therefore, a reference to configure ALARM 1 is 5-B2.



 = Diagram number

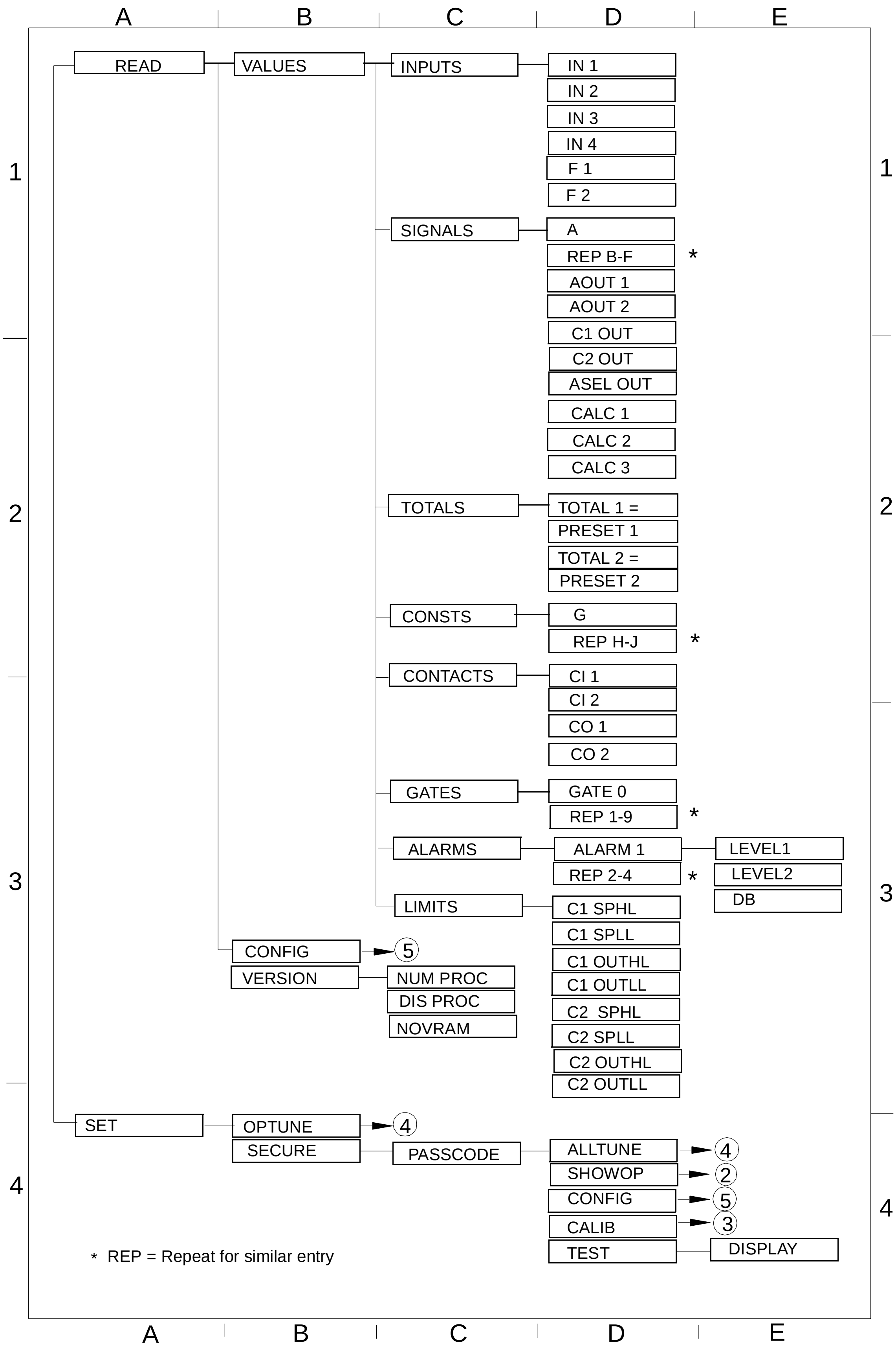
 = Category or subdivision which appears in the upper or lower digital (alphanumeric) display

A - C = Horizontal axis diagram coordinate

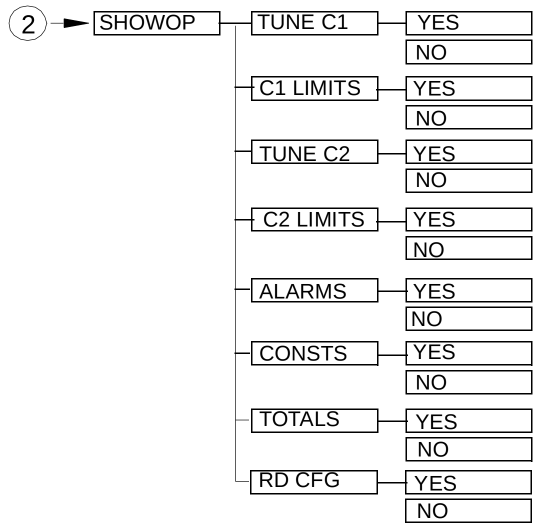
1 - 4 = Vertical axis diagram coordinate

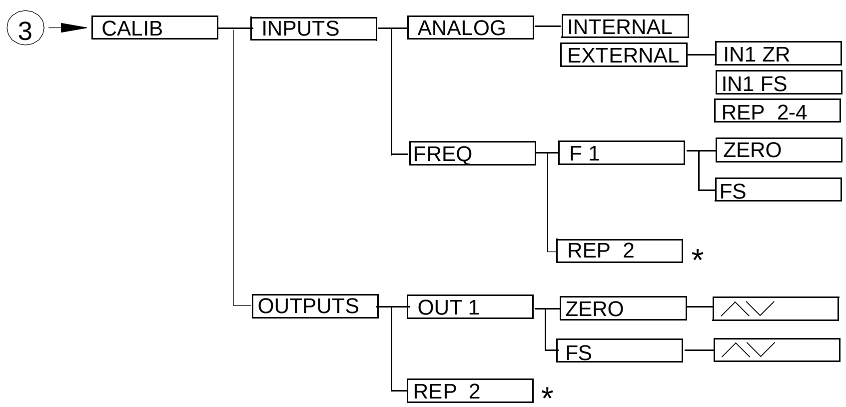
Example: Location 5-B2 refers to diagram with balloon 5 in the upper left corner of the diagram and coordinates B (horizontal) and 2 (vertical) within that diagram.

Structure Diagram 1 – READ

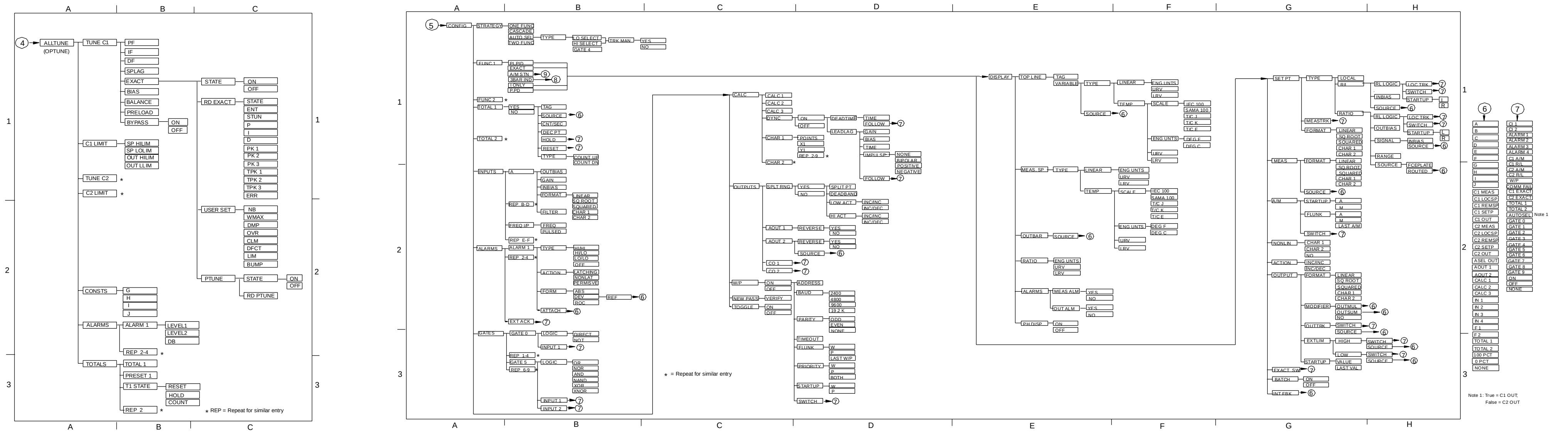


Structure Diagrams 2 and 3

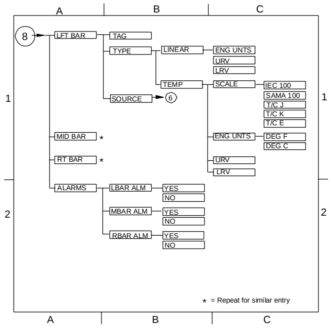


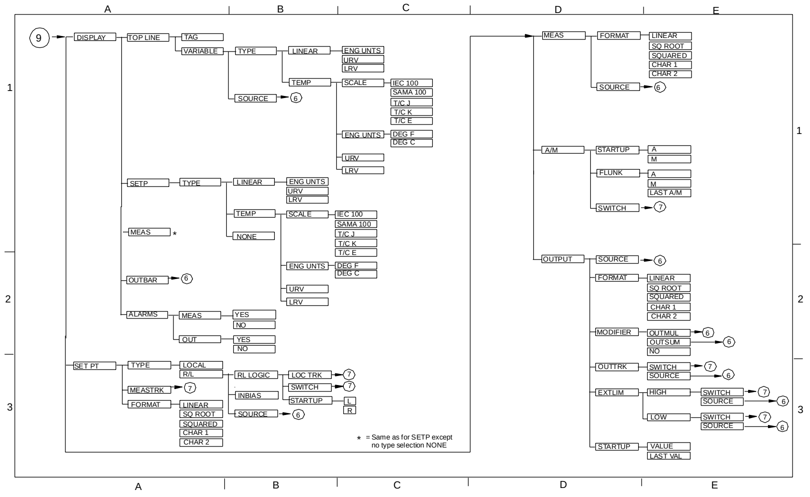


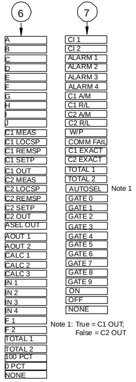
* REP = Repeat for similar entry


ALLTUNE (OPTUNE)
TUNE C1
C1 LIMIT
TUNE C2
C2 LIMIT
CONSTS
ALARMS
TOTALS
REP = Repeat for similar entry
CONFIG
STRATEGY
FUNC 1
FUNC 2
TOTAL 1
TOTAL 2
INPUTS
ALARMS
GATES
CALC
OUTPUTS
W/P
NEW PASS
TOGGLE
DISPLAY
SET PT
MEAS
A/M
NONLIN
ACTION
OUTPUT
EXACT SW
BATCH
INT FRK
= Repeat for similar entry
Note 1: True = C1 OUT; False = C2 OUT

Structure Diagram 8 – 3-Bar Indicator, 9 – A/M Station, 6 – Signal Distribution List, and 7 – Gate Input List







762C SINGLE STATION MICRO Controller

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Parts List

D

NOTE Information in this Parts List is based on PL 009-136 dated 12/94.

762CNA SINGLE STATION MICRO Controller with Integral Power Supply Style AA*, DIN Panel Mounted

Model Code

762CNA = SINGLE STATION MICRO Controller, DIN Panel-Mounted with Integral Power Supply

Voltage
–A = 120 V ac, 50/60 Hz
–B = 220 V ac, 50/60 Hz
–C = 240 V ac, 50/60 Hz
–D = 24 V dc
–E = 24 V ac, 50/60 Hz
–J = 100 V ac, 50/60 Hz

Housing
T = Terminal Block on Rear of Housing
W = Controller Chassis Without Housing

Optional
–1 = Output Isolation
–2 = RTD Input

NOTE To order parts, call Foxboro at 800-343-1198. (In Massachusetts, call 800-322-2322.)

* The second letter in the style is the firmware style.

Figure D-1. DIN Panel-Mounted Controller Assembly

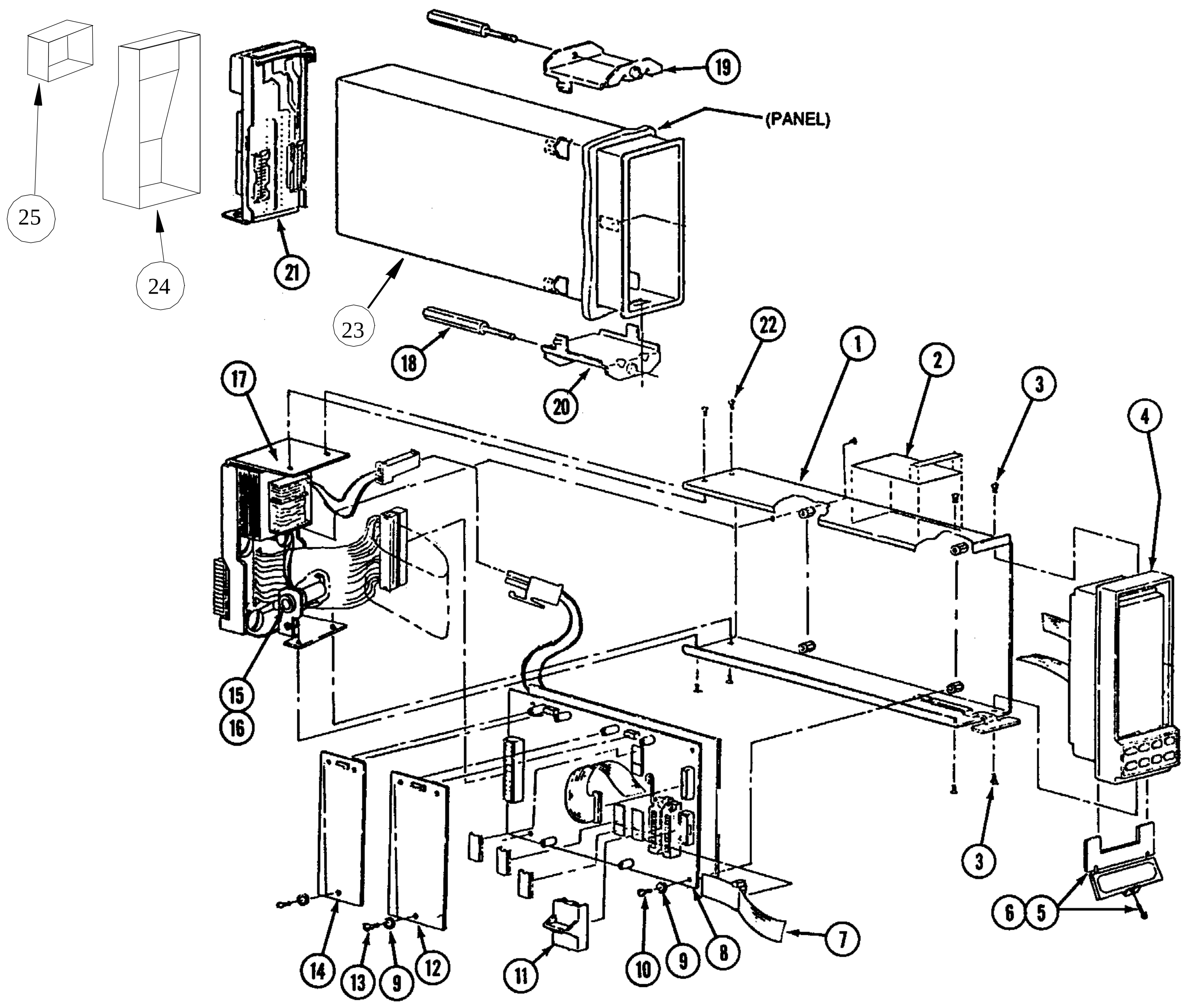

Table D-1. DIN Panel Mounted Controller Assembly (Figure D-1)

Item	Part No	Qty	Part Name
1	L0122HX	1	Chassis Assembly
2	B0171PC	1	Data Label
3	X0167VT	4	Tap Screw, 0.143-19 x 0.500, fh
4	L0117AV	1	Base Assembly (see Figure D-2)
5	K0143EJ	1	Cover Assembly
6	B0130JX	AR	Adhesive
7	K0143DE	1	Cable Assembly, Display
8	Below	1	Electronic Module (see Figure D-3)
	L0122JR		For All Model Code Suffixes Except –D
	L0122JS		For Model Code Suffix –D
9	X0173NY	7	Washer, Wave
10	A2004EK	4	Screw, 0.138-32 x 0.75, pnh
11	--	1	Memory Module (see Figure D-3)
12	K0143BW	1	PWA, Optional (For Model Code Suffix –1)
13	X0169KY	3	Screw, 0.138-32 x 0.25, pnh
14	K0143CB	1	PWA, Optional (For Model Code Suffix –2)
*15	Below	1	Fuse (part of item 17)
	C3510KP		1/2 A, 120 V (for Voltage –A and –J)
	P0156BM		300 mA, 220/240 V (for Voltage -B and -C)
	C3510KX		2 A, 24 V (for Voltage –D and –E)
16	E0118BA	1	Fuseholder (part of item 17)
17	Below	1	Bracket Assembly
	L0122HZ		For Model Code Suffix –A
	L0122JA		For Model Code Suffix –B
	L0122JB		For Model Code Suffix –C
	L0122JE		For Model Code Suffix –D
	L0122JC		For Model Code Suffix –E
	L0122JD		For Model Code Suffix –J
18	G0114AK	2	Clamp, Screw
19	G0114BY	1	Clamp, Upper
20	G0114AJ	1	Clamp, Lower
21	L0122HY	1	Back Panel Assembly
22	X0169YG	4	Tap Screw, 0.112-40 x 0.25, fh
23	L0122HM	1	Housing
24	K0143DU		Terminal Cover (Division 2 only)
25	K0143AH		Terminal Cover (General Purpose only)

*Parts Preceded by an Asterisk are Recommended Spare Parts.
Give Instrument Model Number and Style when Ordering.
See Recommended Spare Parts Summary Section for Quantities.

Figure D-2. Base Assembly

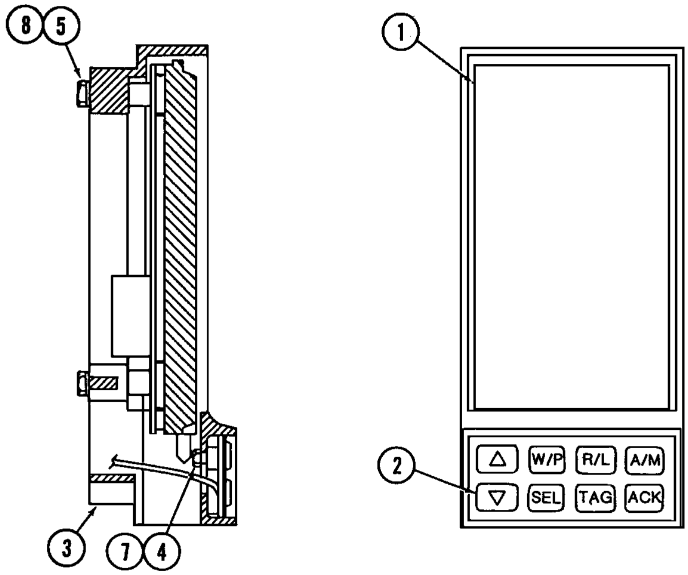

Table D-2. Base Assembly (Figure D-1)

Item	Part No	Qty	Part Name
1	L0117AN	1	Display Assembly
* 2	L0117BS	1	Membrane Switch Assembly
3	L0117AW	1	Base Molding
4	X0120ML	2	Screw, pnh, 0.112-40 x 0.25
5	X0172TE	4	Screw, pnh, 138-32 x 0.75
6	X0167VT	4	Screw, flh, 0.143-19 x 0.500 (not shown)
7	X0143AD	2	Washer, flat, 0.112
8	X0143AE	4	Washer, flat, 0.138

Figure D-3. Electronics Module Assembly - Digital PWA

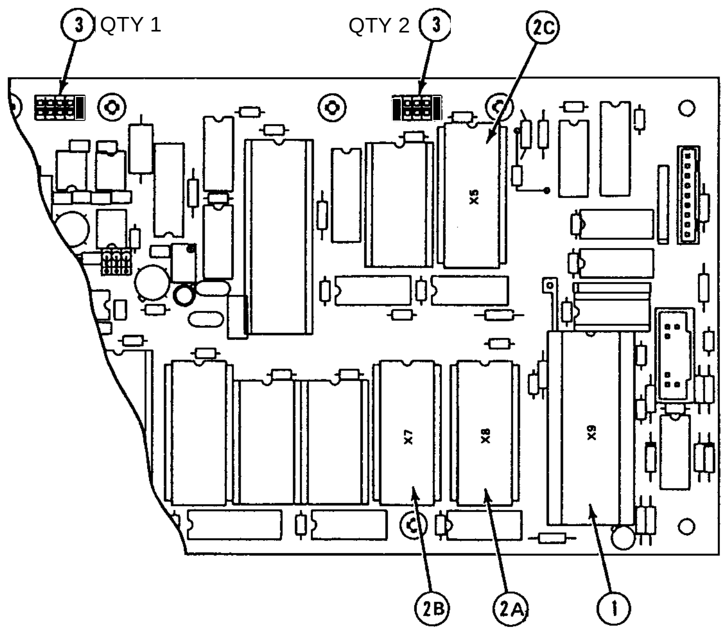

Table D-3. Digital PWA Portion of Electronics Module Assembly (Figure D-3)

Item	Part No	Qty	Part Name
*1	K0141LN	1	Memory Module (location X9)
2	L0122RL	1	Set of items 2A, 2B, and 2C
2A		ref	Numeric Processor Firmware, Lower (location X8)
2B		ref	Numeric Processor Firmware, Upper (location X7)
2C		ref	Display Processor Firmware (location X5)
3	K0143FA	3	Jumper
4	K0141FN	1	Set of items 1, 2A, 2B, and 2C

Table D-4. Recommended Spare Parts Summary

Figure Number	Item Number	Part Number	Number of Parts Recommended for 1 Inst.	5 Inst.	20 Inst.	Part Name
D-1	15	Below C3510KP P0156BM C3510KX	2	2	2	Fuse 1/2 A, for 120 V use 300 mA, for 220/240 V use 2 A, for 24 V use
D-2	2	L0117BS	0	1	1	Membrane Switch Assembly
D-3	1	K0141LN	0	1	1	Memory Module

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Dimensional Print

E

NOTE Information in this appendix is based on DP 018-836 dated 10/94.

Figure E-1. 762CNA SINGLE STATION MICRO Controller

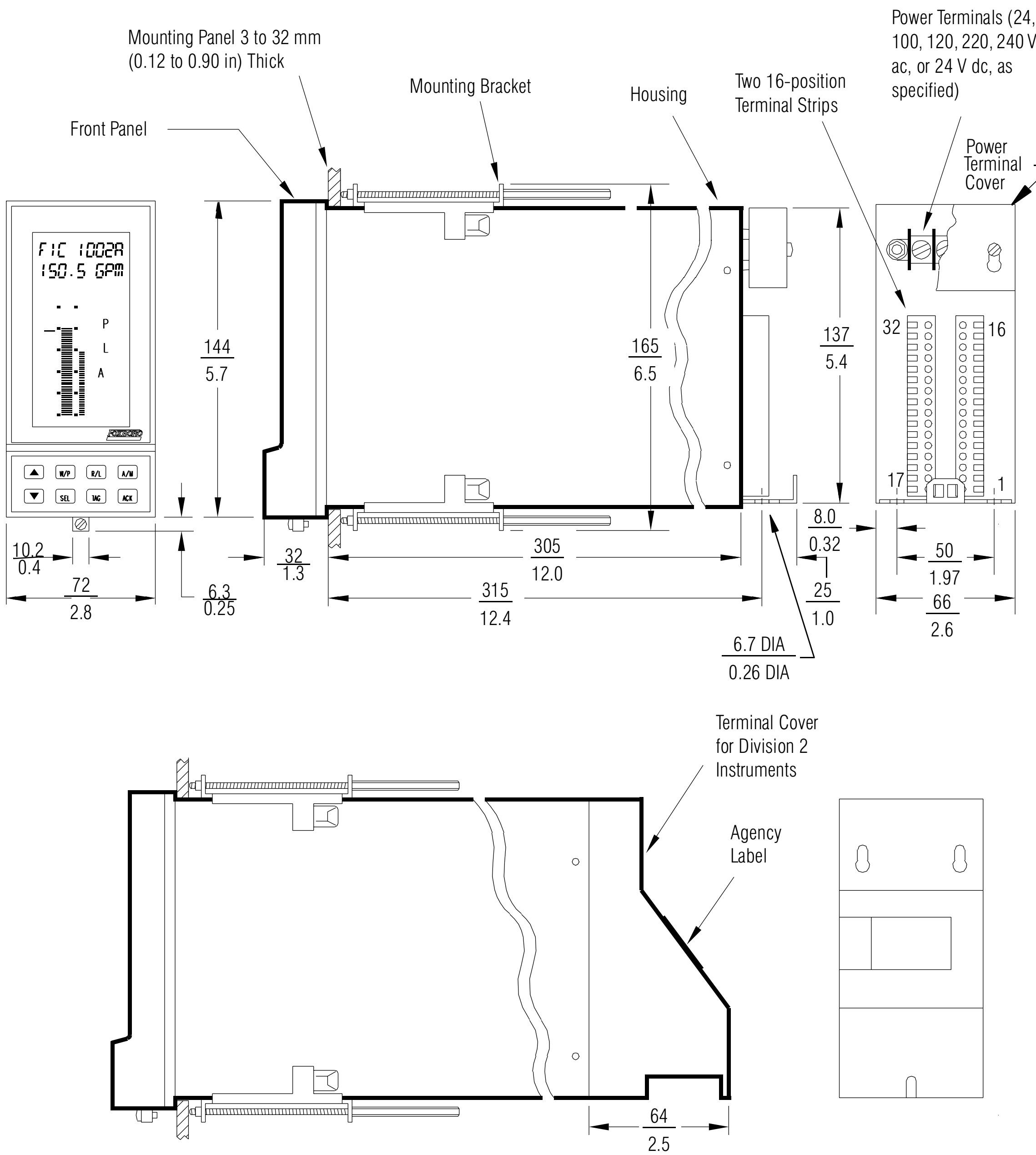
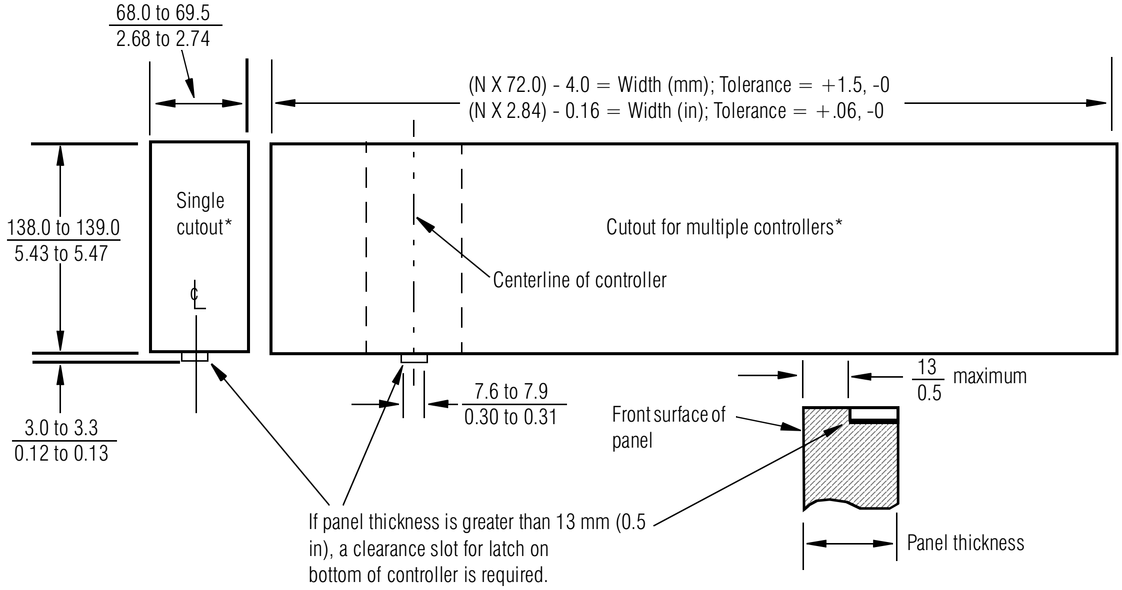
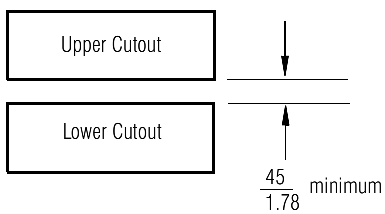


Figure E-2. Panel Cutout Dimensions



*If panel has more than one cutout, allow 45 mm (1.78 in) vertical distance between cutouts as shown below. This provides 36 mm (1.4 in) spacing between controllers.



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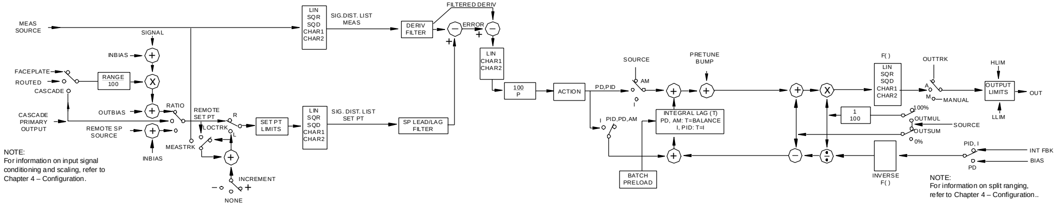
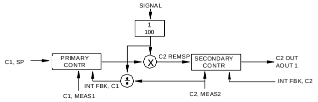
Functional Diagram

F

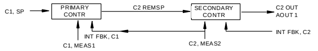
FUNCTIONAL DIAGRAM OF 762C/743CB CONTROLLER



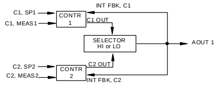
CASCADE (RATIO)



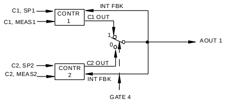
CASCADE (SIMPLE)



AUTO SELECT (HI or LO)



AUTO SELECT (GATE 4)



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Glossary

G

This Glossary contains words that may appear on your display. Most are configuration parameters. However, messages related to EXACT control and those that indicate a problem with your controller are also included.

A

A
IN 1 after signal conditioning, gain, and biases have been applied.

ABS
ABSolute alarm.

ACTION
OUTPUT INCreases with INCreasing measurement; OUTPUT INCreases with DECreasing measurement.

ACTION
LATCHING, NON LATching, or PERMISVE alarms.

ADDRESS
Device number (0 to 99) on serial communication port. A total of 30 can be used.

ALARM n
Alarm number 1 through 4.

ALARMS
CONFIGuration, tuning values (ALLTUNE), and DISPLAYing values of up to four alarms.

ALLTUNE
Sets values of TUNE, LIMITS, CONSTS, ALARMS, and TOTALS.

A/M
Auto/Manual.

A/M STN
Specifies Auto/Manual Station function in CONFIGuration.

Analog
Specifies an ANALOG CALIBration INPUT.

AND
AND gate.

AOUT 1, AOUT 2
Analog Output 1 or 2.

AUTOSEL
Logic output of Auto Selector; True = C1 OUT, False = C2 OUT.

ATTACH
Specifies signals from Signal Distribution List that will activate alarms.

AUTO SEL
Specifies the STRATEGY of using the controller as an AUTO SELector.

B

B
IN 2 after signal conditioning, gain, and biases have been applied.

BALANCE
Time function used in P/PD controller.

BATCH
BATCH action function.

BAUD
Data transfer speed between host and controller.

BIAS
Output BIAS for P/PD controller.

BIPOLAR
In dynamic compensation (DYNC), a lead/lag (LLAG) IMPULSE that is both POSITIVE and NEGATIVE.

BOTH
Allows either the workstation or the panel to switch controller operation from W to P or vice versa.

BUMP
Parameter in EXACT configuration.

BYPASS
Routes the set point directly to the output, thus bypassing the control algorithm.

C

C
IN 3 after signal conditioning, gain, and biases been applied.

Cn A/M
Auto/Manual function of Controller 1 or 2.

Cn EXACT
EXACT function of Controller 1 or 2.

Cn LIMITS
Protects access to set point and output LIMITS in SHOWOP.

Cn LOCSP
Local Set point of Controller 1 or 2.

Cn MEAS
Measurement signal of Controller 1 or 2.

Cn OUT
Output signal of Controller 1 or 2.

Cn OUTHL
Parameter to READ VALUE of High Output Limit of Controller 1 or 2.

Cn OUTLL
Parameter to READ VALUE of Low Output Limit of Controller 1 or 2.

Cn R/L
Remote/Local function of Controller 1 or 2.

Cn REMSP
Remote Set point of Controller 1 or 2.

Cn SETP
Active Set point of Controller 1 or 2.

Cn SPHL
Parameter to READ VALUE of High Set Point Limit of Controller 1 or 2.

Cn SPLL
Parameter to READ VALUE of Low Set Point Limit of Controller 1 or 2.

CALC, CALC n
Up to three CALCulations on a number of inputs to the controller.

CALIB
Allows CALIBration of controller.

CASCADE
Specifies the STRATEGY of using the controller as a CASCADE controller.

CHAR n
Up to 9-point (8-segment) CHARacterization of signal.

CI 1, CI 2
Contact Input 1 and 2.

CLM
Change Limit in EXACT configuration.

CNT/SEC
In totalizer, counts per second at 100% totalizing rate.

CO 1, CO 2
Contact Output 1 and 2.

COMM FAIL
Logic signal in Gate Input List generated by serial communication failure.

CONFIG
Allows entering of controller CONFIGuration.

CONSTS
Constants G through J.

CONTACTS
Parameter to READ VALUE of contact inputs and outputs.

COUNT
Specifies STATE of Totalizer as Counting.

COUNT UP, DN
Specifies TYPE of Totalizer action, counting up or down from preset value.

D

D
Derivative in EXACT configuration.

D
IN 4 after signal conditioning, gain, and biases have been applied.

DB
Deadband of alarms and split range.

DEADBAND
Deadband of split range.

DEADTIME
DEADTIME in Dynamic Compensation (DYNC).

DEC PT
Specifies DECimal PoinT position in the Totalizer display.

DEG C
Temperature in Celsius degrees.

DEG F
Temperature in Fahrenheit degrees.

DEV
DEViation alarm.

DF
Faceplate derivative value in ALLTUNE configuration.

DFCT
Derivative Factor in EXACT configuration.

DIRECT
Gate output is same as input.

DIS PROC
Identifies VERSION of the DISplay PROCessor firmware.

DISPLAY
Allows configuration of information that is to be presented on controller faceplate.

DMP
Maximum allowed damping in EXACT configuration.

DYNC
Dynamic Compensation consisting of DEADTIME, LEADLAG, and IMPULSE.

E

E
F 1 after signal conditioning, gain, and biases have been applied.

ENG UNTS
Engineering Units.

ENT
Reason for particular action taken in EXACT tuning.

ENT - 1 PEAK
Message - only one significant (with respect to noise band) peak was found. Measurement is approximately critically damped.

ENT = 2 PEAKS
Message - two peaks found. If peaks are significant, response period is used to adjust proportional and derivative actions.

ENT = 3 PEAKS
Message - 3 peaks found. If peaks are significant, response period is used to adjust proportional and derivative actions.

ENT = DAMPED
Message - error signal (measurement deviation from set point) was overdamped. Response may *appear* overdamped if WMAX is set too low. If so, algorithm will tighten control settings. This can lead to instability.

ENT = SUSPECT
Message - error signal has suspicious shape that may be caused by multiple disturbances. P, I, and/or D were slightly adjusted based on this suspicious shape.

ENT = FAST
Message - error signal response occurred faster than expected, based on WMAX time. No corrective action was taken.

ENT = SP CHANGE
Message - a large set point change occurred after algorithm had located or verified a peak. Additional corrective action did not occur because algorithm went immediately into SETTLE (waiting for next peak) state.

ENT = OOR
Message - error signal was observed but P, I, and/or D were not changed because process was out of control range.

ENT = CLAMPED
Message - algorithm attempted to change P and I to values larger than setting of PF and IF modified by CLM.

ENT = INIT
EXACT algorithm has been initialized.

ERR
Error parameter in EXACT configuration.

EVEN
EVEN PARITY.

EXACT
EXpert Adaptive Controller Tuning.

EXACT SW
Specifies an event from the Gate Input List to activate EXACT tuning.

EXIT PASS
Enables passage from below to above the PASSCODE when TOGGLE feature is configured.

EXT ACK
Allows specification from Gate Input List of a parameter to EXTernally ACKnowledge an alarm.

EXTERNAL
Specifies EXTERNAL ANALOG INPUT in CALIBration.

EXTLIM
EXTernal LIMits of OUTPUT.

F

F
F2 after signal conditioning, gain, and biases have been applied.

F1, F2
Frequency (pulse) inputs 1 and 2.

FCEPLATE
Panel faceplate as applied to mechanism to select source of ratio.

FILTER
FILTER time that can be applied to each input.

FLUNK
Loss of serial communication between controller and host to produce a specified action (in W of W/P mode).

FOLLOW
Switch used in Dynamic Compensation to bypass Deadtime and Leadlag functions.

FORM
ABSolute, DEViation, or Rate Of Change alarms.

FORMAT
Signal conditioning (LINEAR, SQUARED, SQ ROOT, CHAR).

FREQ
Specifies FREQuency for Calibration.

FREQ
FREQuency inputs as opposed to a pair of pulse up/pulse down inputs.

FREQ I/P
Two FREQuency or one pulse up/pulse down pair of inputs.

FS
Implements Full Scale CALIBration when FREQuency INPUT is used.

FUNC n
In CONFIGuration, specifies FUNCtion 1 or 2 of the instrument. Available functions include various controller types, A/M Station, and 3-Bar Indicator.

G

G
One of four constants.

GAIN
Gain as applied to inputs and lead/lag function of dynamic compensation.

GATES, GATE n
Boolean GATE 0 through 9.

H

H
One of four constants.

HI ACT
In HIgh (above split point) end of SPLIT RaNGe, specifies whether output increases with increasing or decreasing measurement.

HI SELECT
SELECTion of the HIgher output when using auto selector control.

HI/HI
High-High alarm.

HI/LO
High-Low alarm.

HOLD
Specifies an event from the Gate Input List to HOLD (disable) the Totalizer.

I

I
Integral in EXACT configuration.

I
One of four constants.

I ONLY
Integral only controller.

IEC 100
RTD using IEC 100 curve.

IF
Faceplate integral value in ALLTUNE configuration.

IMPULSE
A function of LEADLAG in Dynamic Compensation.

IN n
Analog INput 1 through INput 4.

IN BIAS
Bias functionally applied before GAIN on inputs. (Configured after GAIN). Also, bias applied to set point.

INC/DEC
Output INCreases with DECreasing measurement.

INC/INC
Output INCreases with INCreasing measurement.

INPUTS
Four analog and two frequency inputs.

INPUT n
Input to Boolean gate.

INTERNAL
Specifies INTERNAL ANALOG INPUT in CALIBration.

INT FBK
INTegral FeedBacK.

J

J
One of four constants.

L

L
Specifies Local control upon STARTUP after a power failure.

LAST A/M
Last status of A/M before serial communication was lost.

LAST W/P
Last status of W/P before serial communication was lost.

LAST VAL
The LAST VALue of the output before a power loss.

LATCHING
LATCHING alarm action.

LBAR ALM
Specifies display of Left BAR ALarM limits on a 3-Bar Indicator for SOURCE signal alarmed.

LEADLAG
Lead/lag in Dynamic Compensation (DYNC).

LEVEL 1
LEVEL 1 alarm value in ALLTUNE (or OPTUNE).

LEVEL 2
LEVEL 2 alarm value in ALLTUNE (or OPTUNE).

LFT BAR
LeFT BARgraph in a 3-Bar Indicator.

LIM
Output Cycling LIMit in EXACT configuration.

LIMITS
Parameter to READ set point and output LIMITS.

LINEAR
Linear variable in TOP LINE, MEAS SP, or 3 Bar Indicator display.

LINEAR
LINEAR conditioning; repeats input.

LO SELECT
SELECTion of the LOwer output when using auto selector control.

LOCAL
Provides configuration of LOCAL Set Point.

LOC TRK
Causes local set point to track remote set point.

LOGIC
Defines logic gate Boolean type.

LO/LO
Low-low alarm.

LOW
LOW EXTernal output LIMits.

LOW ACT
In Low end (below split point) of SPLIT RaNGe, specifies whether output increases with increasing or decreasing measurement.

LRV
Lower Range Value.

M

MBAR ALM
Specifies display of Middle BAR ALarM limits on a 3-Bar Indicator for SOURCE signal alarmed.

MEAS
Provides access to signal conditioning and SOURCE of controller MEASurement.

MEAS
DiSPlay of the MEASurement in Auto/Manual Station.

MEAS ALM
Specifies display of the MEASurement ALarM.

MEAS, SP
The engineering scaled value of the variable identified by the Bargraph Identifier. It is located on the second line of the alphanumeric display.

MEAS TRK
MEASurement Tracking. Local set point tracks measurement.

MID BAR
MIDdle BARgraph in a 3-Bar Indicator.

MODIFIER
Modification of OUTPUT by adding it to (OUTSUM) or multiplying it by (OUTMUL) a parameter from the Signal Input List.

N

NAND
NAND gate.

NB
Noise Band in EXACT tuning.

NEGATIVE
In dynamic compensation (DYNC), IMPULSE that is only NEGATIVE.

NEW PASS
Set NEW PASScode.

NO
No assignment; not used.

NONE
No signal in Signal Distribution List; Function switch not used in Gate Input List. Refer to various sections in this document for further description.

NON LAT
NONLATching alarm action.

NONLIN
NONLINear curve, consisting of a number of x-y coordinate pairs, which is applied to controller error (Set Point - Measurement).

NOR
NOR gate.

NOT
Logic signal reversal.

NOVRAM
Identifies version of the NOVRAM configurator module.

NOVRAM ALL FAIL
Copy function failed; problem in both ORIG and COPY memory modules.

NOVRAM COPY FAIL
Copy function failed; problem in (COPY) memory module.

NOVRAM MSTR FAIL
Copy function failed; problem in master (ORIG) memory module.

NUM PROC
Identifies VERSION of the NUMeric PROCessor firmware.

O

ODD
ODD PARITY for serial communications.

OFF
Definition varies — Refer to various sections in this document.

ON
Definition varies — Refer to various sections in this document.

ONE FUNC
Specifies the STRATEGY of using the instrument as a single controller, auto/manual station, or 3-bar indicator.

OPTUNE
Allows OPerator TUNing of specified parameters as specified in SHOWOP.

OR
OR gate.

OUT n
Specifies OUTPUT during CALIBration.

OUT ALM
Specifies display of the OUTput ALarM.

OUT HLIM
Allows setting High LIMit of OUTput in ALLTUNE (or OPTUNE).

OUT LLIM
Allows setting Low LIMit of OUTput in ALLTUNE (or OPTUNE).

OUTBAR
Specifies signal to be displayed on the right bargraph (usually C1 OUT or C2 OUT).

OUTBIAS
Bias functionally applied after GAIN for inputs. (Configured before GAIN). Also, BIAS added to RATIO after GAIN has been applied.

OUTMUL
Provides OUTput MULtiplication; modified analog input is multiplied by controller output.

OUTPUT REVERSE

Reverses controller output to accommodate reverse acting valve operator.

OUTPUTS
Allows configuration of parameters relating to control output.

OUTSUM
Provides OUTput SUMming; modified analog input is added to controller output.

OUTTRK
Specifies that OUTput TRacK as source specified from the Signal Input List.

OVR
Overshoot in EXACT configuration.

P

P
Proportional band in EXACT configuration.

P
Panel control.

PARITY
Error detection feature in serial communications.

PASSCODE
User-defined security access code. To configure a new passcode, see NEW PASS.

PD
Proportional plus Derivative controller.

PERMISVE
Permissive alarm action; No alarm display but Boolean logic is active.

PF
Faceplate proportional band value in ALLTUNE configuration.

PH DISP
Allows the local or remote set point to be displayed before or after the signal is characterized.

PI
Proportional plus Integral controller.

PID
Proportional plus Integral plus Derivative controller.

PK1, 2, 3
Peak Height in EXACT configuration.

POINTS
Total number of POINTS to be used with CHAR 1 or CHAR 2.

POSITIVE
In dynamic compensation (DYNC), IMPULSE that is only POSITIVE.

PRELOAD
In ALLTUNE, the PRELOAD of the BATCH feature.

PRESET1, 2
Specifies the number that Totalizer 1 or 2 is to count up to or down from.

PRIORITY
Allows selection of whether the workstation or panel can switch controller operation from W to P and vice versa.

PTUNE
Pretune state monitoring in EXACT configuration.

PULSE
One pair of pulse up/pulse down inputs as opposed to two frequency inputs.

R

R
Specifies Remote control upon STARTUP after a power failure.

RANGE
Gain as applied to RATIO function.

RATIO
RATIO control.

RATIO
Specifies the details of the RATIO DISPLAY.

RBAR ALM
Specifies display of Right BAR ALarM limits on a 3-Bar Indicator for SOURCE signal alarmed.

RD EXACT
READ parameters in EXACT algorithm.

RD PTUNE
READ message relating to Pretune (PTUNE) function.

RD PTUNE = OFF
Message that Pretune function has not been switched on.

RD PTUNE = IN AUTO?
Message that Pretune function is ready. Put controller in AUTO.

RD PTUNE = SMALL 1
Message - small (2.5%) change in measurement. Phase 1. If message lasts longer than twice process dead time, value of BUMP is too small.

RD PTUNE = WAIT 2
Message - waiting for steady state. Phase 2.

RD PTUNE = PID 3
Message - new values of P, I, and D calculated. Output is returned to initial value. Phase 3.

RD PTUNE = NB 4
Message - measured noise band. Phase 4.

RD PTUNE = FINISH
Message - Pretune function finished. Values of the 6 key EXACT parameters have been calculated and put into memory.

RD PTUNE = INC WRONG
Message - Pretuning not completed because controller action is configured wrong.

RD PTUNE = NOISE
Message - Pretuning not completed because value of noise band (NG) is too small.

READ
Allows operator to READ controller CONFIGuration and VALUES.

REF
REFerence variable in DEViation alarms.

RESET
Specifies an event from the Gate Input List to RESET the Totalizer.

R/L
Permits configuration of Remote Set Point.

RL LOGIC
Specifies the LOC TRK, SWITCHing, and STARTUP in Remote/Local set point and Ratio control.

ROC
Rate of Change alarm FORM.

ROUTED
The parameter used to route any signal from the Signal Distribution List to be the SOURCE of the RATIO function.

RT BAR
Right BAR in a 3-Bar Indicator.

S

SAMA 100
RTD using SAMA 100 curve.

SCALE
RTD or Thermocouple curve (SCALE).

SECURE
Passcode protected category in SET mode.

SET
Allows user to enter CONFIGure and TUNE modes.

SET PT
Allows configuration of LOCAL set point, REMOTE set point, and RATIO.

SHOWOP
Allows selection of those parameters (TUNE, LIMITS, ALARMS, CONSTS, TOTALS) that may be adjusted (OPTUNE) without use of a PASSCODE. YES enables adjustment.

SIGNAL
Specifies INBIAS and SOURCE as applies to RATIO function.

SIGNALS
Parameter to READ VALUE of conditioned input, analog output, and CALCulation SIGNALS.

SOURCE
The SOURCE of EXTernal LIMits, output tracking (OUTTRK), MEA-Surement, and RATIO from the Signal Distribution List.

SP HILIM
Allows setting HIgh LIMit of Set Point in ALLTUNE (or OPTUNE).

SP LAG
Specifies Set Point LAG (ratio of lead to lag) in ALLTUNE (or OPTUNE).

SP LOLIM
Allows setting LOw LIMit of Set Point in ALLTUNE (or OPTUNE).

SPLIT PT
Specifies point of split (in percent) in SPLIT RNG.

SPLT RNG
One control algorithm is divided into two analog output ranges when YES is selected.

SET P
Display of the Set Point in an Auto/Manual Station.

SQUARED
Input SQUARED.

SQ ROOT
SQuare ROOT of input.

STARTUP
Allows status selection for A/M, R/L, and W/P upon restart after a power failure. Also allows selection of OUTPUT value to be a value from 0% to 100% or the LAST VALue of output before power loss.

STATE
EXACT (STUN) function is ON or OFF.

STATUS ENT
EXACT Message - reason why specific corrective action was taken. This parameter is updated every time P, I, and/or D is adjusted.

STATUS STUN
EXACT Message - status of specific corrective action taking place.

STRATEGY
Specifies whether the instrument is to be used as a ONE FUNCTION instrument, TWO FUNCTION instrument, CASCADE controller, or AUTO SELECTOR controller.

STUN = QUIET
EXACT Message - no corrective action is taking place (error is <2NB).

STUN = LOCATE 1, 2, OR 3
EXACT Message - a peak (1, 2, or 3) has been located.

STUN = VERIFY 1, 2, OR 3
EXACT Message - the located peak (1, 2, or 3) has been verified.

STUN = ADAPT
EXACT Message - P, I, and/or D has been adjusted.

STUN = SETTLE
EXACT Message - waiting for next peak.

STUN = MANUAL
EXACT Message - self-tuning is operational, but controller is in MANual.

STUN = INACTIVE
EXACT Message - EXACT is temporarily disabled due to a configured condition that affects the closed-loop control.

STUN
Step being executed in EXACT tuning.

SWITCH
Configuration of one of the entries in the Gate Input List to act as a SWITCH.

T

TAG
A TOP LINE display of up to a nine characters.

Tn STATE
Specifies the STATE (COUNT, RESET, or HOLD) of Totalizer 1 or 2.

T/C E, T/C J, T/C K
Thermocouple using type E, J, or K curve.

TEMP
TEMPerature display (RTD or Thermocouple).

TIME
Time in dynamic compensation (in minutes).

TIME OUT
Length of time in minutes that communication is interrupted before FLUNK action is implemented.

TOGGLE
Enables user to go from one of the User Interface modes (READ or SET) to the Normal Operation mode and return to the function from which the User Interface was exited using the TAG key.

TOP LINE
A nine character ASCII string or an engineering scaled variable with a units label.

TOTAL 1,2
In READ, displays the value of Totalizer 1 or 2.

TOTAL 1, 2
Specifies the CONFIGuration of TOTALizer 1 or 2.

TOTAL 1, 2
Totalizer status in Gate Input List and lower two bytes of totalizer value in Signal Distribution List.

TOTALS
Allows setting values for the Totalizers in ALLTUNE (or OPTUNE).

TPK1, 2, 3
Time to peak parameter in EXACT configuration.

TRK MAN
Specifies whether output tracking switches and signals of the two controllers are common in an Auto Selector.

TUNE C1, 2
Allows TUNing the control mode of Controller 1 or 2.

TWO FUNC
Specifies the STRATEGY of using the instrument for TWO FUNCtions other than CASCADE and AUTO SELect

TYPE
Attributes that determine kind of controller.

TYPE
Type of alarms; High-high, High-low, or Low-low.

TYPE
Type of TOP LINE VARIABLE display, MEAS, SP display, 3-Bar Indicator display, and A/M Station display.

U

URV
Upper Range Value.

USER SET
USER SET values in EXACT control.

V

VALUE
The VALUE (0 to 100%) of output upon restart (STARTUP) after a power loss.

VALUES
Allows operator to READ VALUES of various parameters.

VARIABLE
Variable input to the TAG DISPlay in place of an ASCII looptag.

VERIFY
VERIFY NEW PASScode.

W

W
Workstation control.

WMAX
Maximum Wait Time in EXACT configuration.

W/P
Workstation/Panel.

WRONG NOVRAM
Memory module is for another model controller.

X

X nn, Y nn
Values of x-y pair, in characterizer function.

XNOR
Exclusive-NOR gate.

XOR
Exclusive-OR gate.

Y

YES
Feature used.

Z

ZERO
Implements CALIBration of ZERO when FREQuency INPUT is used.

762C SINGLE STATION MICRO Controller

February 1998

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The Intelligent Automation People

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