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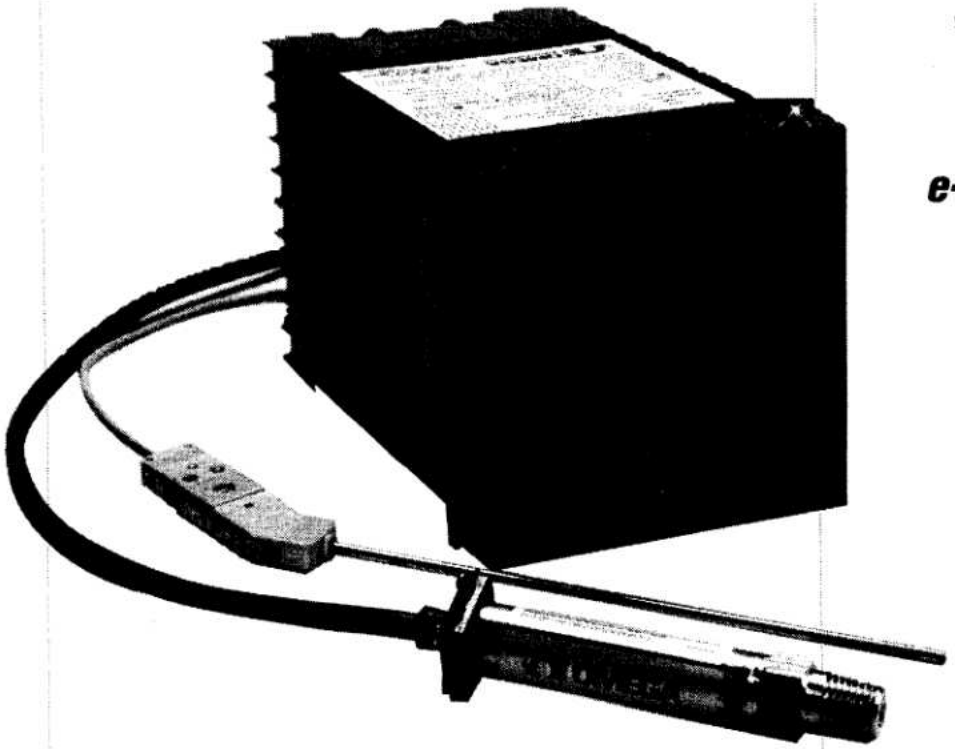
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User's Guide



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CN3000 Series
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Programmable Controllers

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SECTION 1 - DESCRIPTION & INSTALLATION

INTRODUCTION

The OMEGA CN3000 microprocessor-based, panel mounted ¼ DIN size controller has flexibility in advanced control and is easy to use. The CN3000 has new features and more application flexibility. This manual is written to take you step by step through the installation, set-up, tuning and operation of this new controller. Attention to this manual will help ensure a successful application.

The controller contains a unique blue vacuum fluorescent dot-matrix display that can display numbers, key words and graphs to give the operator the PV, SP controller status and other important information at a glance. With the five blue keys, the operator can change the setpoint, start or stop the controller or go into manual or automatic control. The operator does not need to know any of the programming or numeric key routine to operate the controller. The remaining 10 gray keys are used in programming and provide the first ¼ DIN controller with direct numeric entry and may also be used as soft keys for macros.

The instrument is a 3-Mode PID controller with ON/OFF, time-proportional or analog output(s). The CN3000 may be configured as a single or dual loop controller with custom configurations for difficult applications. It has universal input and accepts up to two TC, RTD or voltage and current inputs with selection by internal jumper. The control output(s) can be solid state relay, electromechanical relay, DC trigger, open collector, 4/20 mADC or 0-5 VDC analog output. Up to 4 outputs may be supplied.

Many previously optional functions such as self-tune, profiles, event monitors and control limiters are available in set-up programming. In addition, many new features like multiple PID sets, macros, data logger, powerful user math functions and history file are available through programming. A new menu-driven system has been provided to simplify configuration procedure and easy set-up programming.

The controller is also available with optional parallel printer, digital communications and/or digital I/O cards.

CAUTION

THIS CONTROLLER IS FIELD CONFIGURABLE. CHECK THE HARDWARE CONFIGURATION BEFORE APPLYING POWER.

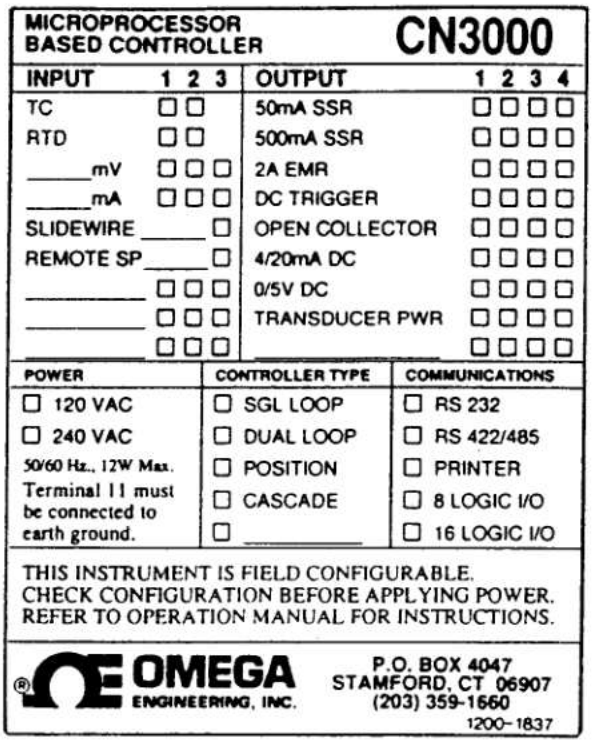
WARNING

IN ANY CRITICAL APPLICATION WHERE FAILURE COULD CAUSE PRODUCT LOSS OR ENDANGER PERSONNEL, A SECOND REDUNDANT LIMIT CONTROLLER IS RECOMMENDED.

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IDENTIFICATION

Refer to the case mounted top label on each unit for proper identification of supply voltage, input(s), alarm/timer and sensor type before proceeding.



MODELS AND ACCESSORIES

MODEL	DESCRIPTION
CN3001	Single output, Mechanical relay
CN3002	Single output, AC SSR
CN3003	Single output, 4-20mA, 0-5VDC
CN3004	Single Output, DC pulse/Open Collector

PLUG-IN OUTPUT MODULES	
SUFFIX	DESCRIPTION
-R3	2A Mechanical Relay
-T3	50 mA SSR
-F3	4-20 mA/0-5 VDC
-D3	DC Pulse/Open Collector

(NOTE: Each CN3000 controller can have up to 4 output modules (three optional modules plus the original standard output module).)

ADDITIONAL OPTIONS	
SUFFIX	DESCRIPTION
-MATH	Math and Linearizer Functions

TRANSDUCER POWER SUPPLY	
SUFFIX	DESCRIPTION
-X3	Transducer Power, 12/24 VDC, 25 mA

COMMUNICATIONS OPTIONS		OPTION CARD
SUFFIX	DESCRIPTION	SLOT USED
-RS3	RS-232 Isolated	1
-RS4	RS-422/485 Isolated	1
-PR3	Parallel Printer Port	1
-CC3*	Calendar/Clock	0
-L31	8 Logic Input/Output	1
-L32	16 Logic Input/Output	2

(NOTE: A maximum of 2 card slots are available.)
(* = NOT FIELD INSTALLABLE)

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INPUT RANGES

INPUT RANGES (For input 1 and input 2)

Type	RANGE
J TC	-350 to 2100°F / -212 to 1148°C
K TC	-350 to 2500°F / -212 to 1371°C
T TC	-400 to 750°F /-240 to 398°C
E TC	-350 to 1800°F / -212 to 982°C
R TC	-50 to 3200°F / -45 to 1760°C
S TC	-50 to 3200°F / -45 to 1760°C
B TC	+70 to 3300°F / +21 to 1815°C
N TC	-200 to 2300°F / -128 to 1260°C
Platinel II TC	-100 to 2500°F / -73 to 1371°C
W5%Re/W26%Re TC	+32 to 4200°F / 0 to 2315°C
W3%Re/W25%Re TC	+32 to 4300°F / 0 to 2371°C
W/W26%Re TC	+32 to 4200°F / 0 to 2315°C
Ni/Ni18%Mo TC	0 to 2390°F / -15 to 1310°C
Pt RTD*, 100Ω, α = 0.00385	-225 to 1560°F / -142 to 848°C
Pt RTD*, 100Ω, α = 0.00392	-225 to 1160°F / -142 to 628°C
Thermistor, 2252Ω @ 25°C	-58 to 300°F / -50 to 150°C
Current†	0-20 mADC / 4-20 mADC
Voltage†	0-100 mVDC††

* Contact OMEGA for other RTD inputs.
† Voltage and Current inputs are fully scalable for zero and span. Maximum display is ± 19,999 counts.
†† Input 3 accepts 0-5VDC, 0-20 mADC, 0-500 mVDC.

UNPACKING

Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, please call the OMEGA Customer Service Department at 1-800-622-2378 or (203) 359-1660.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

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MOUNTING

HAZARD: INSURE THAT ALL POWER AND MEASURING CIRCUITS ARE DISCONNECTED BEFORE INSTALLATION IS ATTEMPTED.

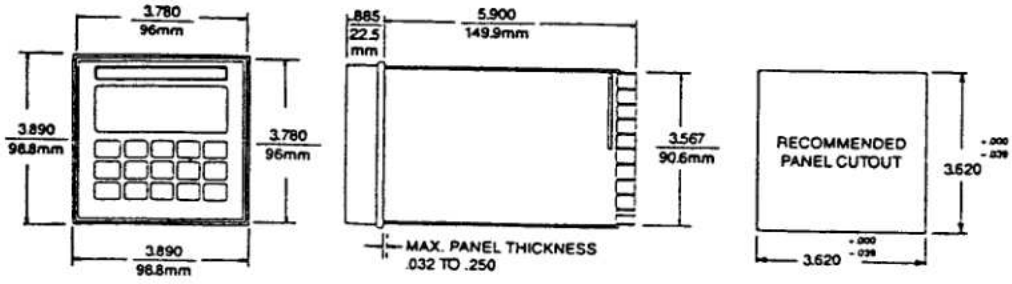
In the normal course of installation and operation, there is no reason to remove the electronic assembly from the case. If the electronic assembly is removed, SPECIAL PRECAUTIONS MUST BE TAKEN TO PREVENT STATIC DISCHARGES FROM DAMAGING C-MOS INTEGRATED CIRCUITS AND CAUSING DEVICE FAILURE.

The entire electronic assembly can be removed from the case for servicing without disturbing the rear terminal wiring. Remove the rear tension bolt (if installed), grasp the front bezel and carefully pull the assembly out of the case. When parallel printer, serial communications or digital I/O option cards are included, these connections are made through edge card connectors that may be bolted to the rear of the enclosure and will disconnect automatically when the electronic assembly is removed. When reinstalling the electronic assembly, make sure that the unit is inserted right side up and that all boards are firmly in their connectors.

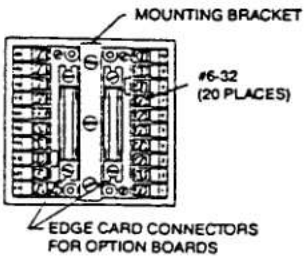
The controller is designed for mounting in a control cabinet or rack where access to the rear terminals is enclosed and where supply and load wiring can be properly terminated. Prepare a standard ¼DIN panel cutout of 3.620 inches by 3.620 inches (92 X 92 mm) and insert the controller into the panel cutout. The U-shaped mounting bracket, supplied with each unit, is installed from the rear of the controller and held in place by two machine screws threaded into the housing. Tighten the bracket with the hardware supplied to ensure a snug fit.

The CN3000 controller has been designed to resist moisture leakage under hose tests when mounted to a panel with the bezel gasket. If sealed mounting is desired, install the single screw (tension bolt) supplied in the hole in the center of the rear barrier and tighten snugly. (NOTE: It is necessary to remove this screw before removing the electronic assembly from the case for servicing.)

DIMENSIONS



TERMINALS



PANEL CUTOUT 3.620 X 3.620 +.000/-.039 (92 X 92 mm)

NOTE: For panel mounting of two or more units, use a minimum horizontal spacing of 4.5 inches on center.

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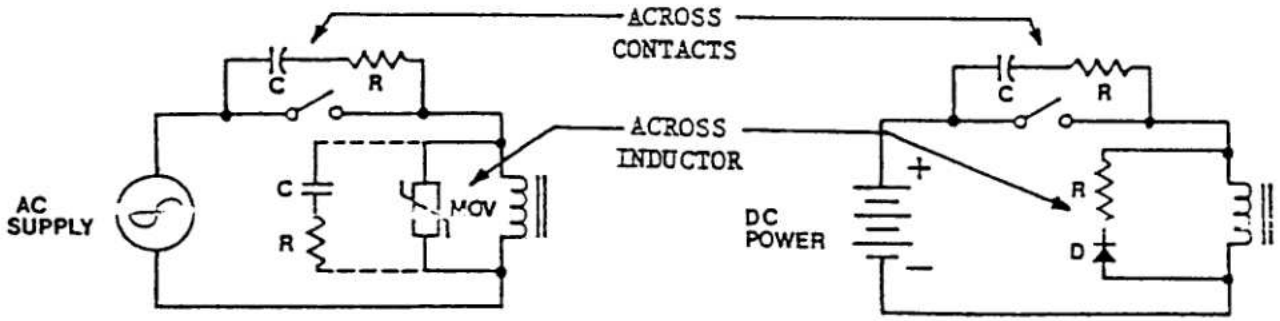
WIRING

Successful operation begins with proper installation. Good installation requires not only that good wiring practices be followed but also that reasonable protection be provided against external electrical influences that could interfere with controller operation. In addition, all wiring must conform to applicable local and national codes. The controller should be wired with an external power disconnect and fuse.

NOISE SUPPRESSION

The primary sources of electrical interference (noise) that can impact any digital device are inductors most commonly found as coils and windings in solenoids, relays and transformers. It is important to suppress any potential for electrical noise at its source to ensure reliable controller operation. Specifically, this means putting noise suppression devices across the terminals of all inductors in your system.

AC NOISE SUPPRESSOR DC NOISE SUPPRESSOR



If you do not have the necessary components available, they may be purchased locally or in kit form from the factory.

OMEGA PART NUMBER	DESCRIPTION
1821-101	Noise suppression kit includes one 0.1 uF capacitor, one 220Ω resistor, one 47Ω resistor (RC snubber) and one MOV rated for up to 130 VAC at 35 Joules.

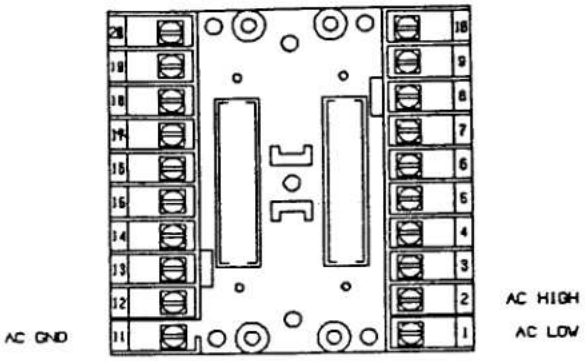
When wiring to the controller, twisted pair with insulated shield is recommended for all signal leads. Make sure that the shield is grounded ONLY at the controller - use AC power ground terminal 11. Be sure to protect against ground loops in signal leads, shields and all other input and output wiring.

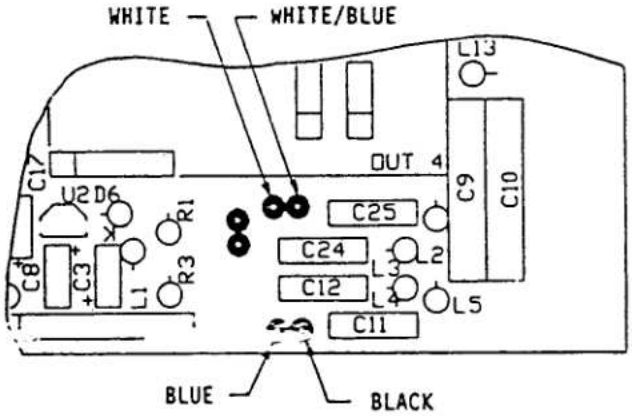
Low level signal leads and high level power cables must not be run in the same conduit, bundle or cable tray. Care when wiring means better system reliability.

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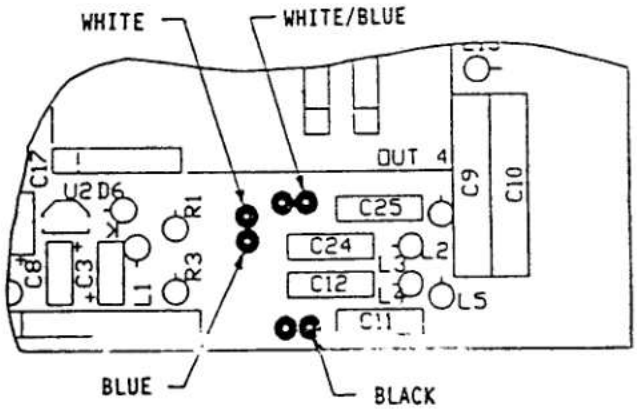
AC SUPPLY WIRING

Connect the AC line power to the rear terminals as shown at the right. The unit is normally connected for 120 VAC operation. Recheck the case label for the proper supply voltage rating. It is also possible to field reconnect the controller for use on 220 or 240 VAC. If a change is required, reconnect the transformer primary color coded leads to the pins as shown below. These pins are located on the right bottom side of the controller (from the rear) on the output board just below output #4.





120 VAC CONNECTIONS



220 or 240 VAC CONNECTIONS

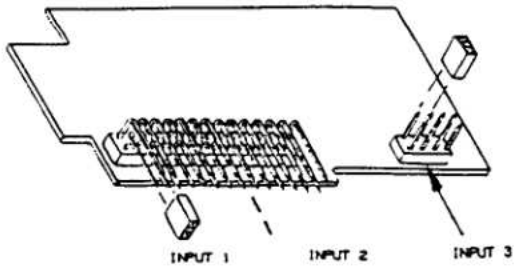
INPUT HARDWARE CONFIGURATION

Every controller contains all of the hardware circuitry necessary to implement up to two inputs in any combination of the following types: Thermocouple, RTD, thermistor (with special kit), voltage or current analog inputs. A third current or voltage input is available for inputs such as remote setpoint. If the controller has been preconfigured for the application, then no hardware configuration is needed. If the controller has not been input configured or if a change in input is required, it is necessary to perform this change before wiring the input terminals. All input hardware configuration is performed by moving shunt jumper blocks on the smaller input adder board located on the CPU board near the rear of the controller. (See figures on the following page.) Changing from one input type to another does require recalibration for best accuracy. Refer to Section 12 for software input configuration and recalibration information.

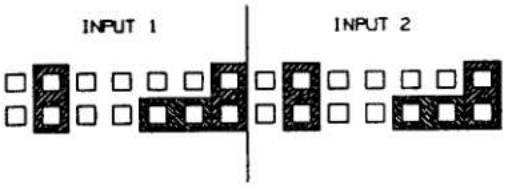
For single loop controllers, it is recommended that input 2 and input 3 (if unused) be hardware configured for 20mA input ranges to prevent unwanted stray influences.

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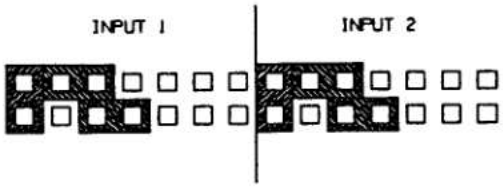
JUMPER BLOCK CONFIGURATION



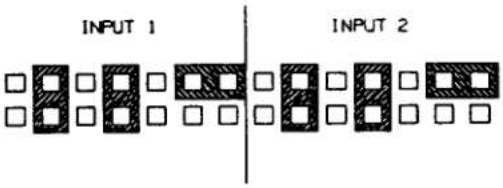
Inputs 1 and 2 need not have the same configuration



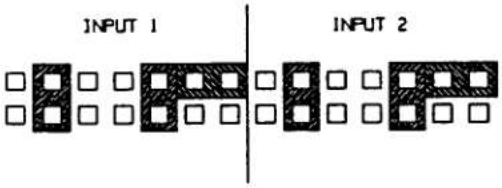
THERMOCOUPLE INPUTS



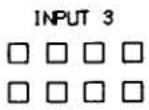
RTD INPUTS & OHMS INPUTS



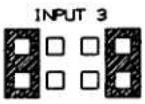
20 mA ANALOG INPUTS



100 mV ANALOG INPUTS



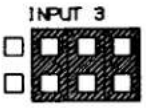
0/5V INPUT
(WITH NO JUMPERS)



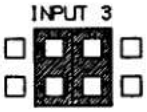
20 mA INPUT



500 mV
INPUT



SLIDEWIRE
< 200 Ω

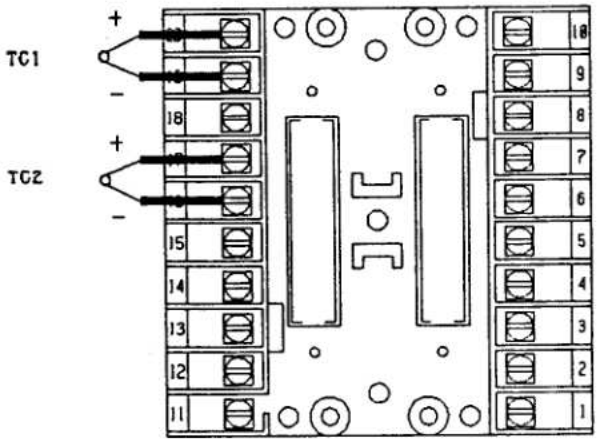


SLIDEWIRE
OVER 200 Ω

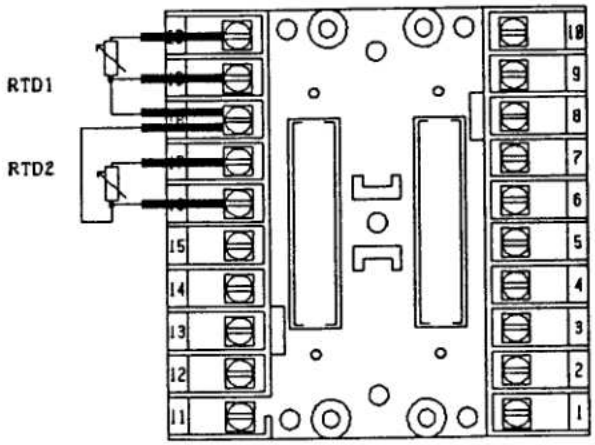
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INPUT WIRING

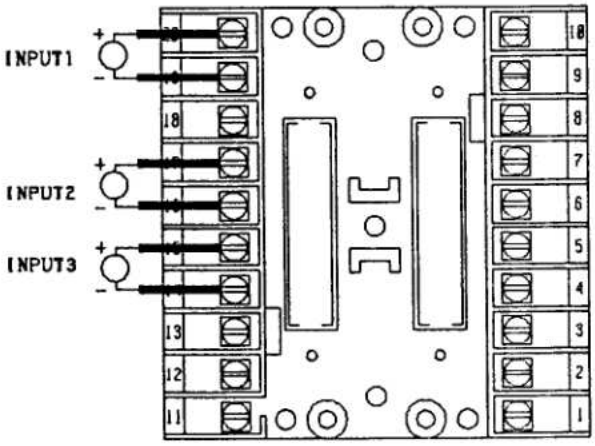
Once the jumper block programming has been performed to match the application, the input wiring can be made to the corresponding rear barrier terminals. The appropriate wiring must conform to the input type selected in the jumper block programming. Remote setpoint input is usually programmed for analog input 3.



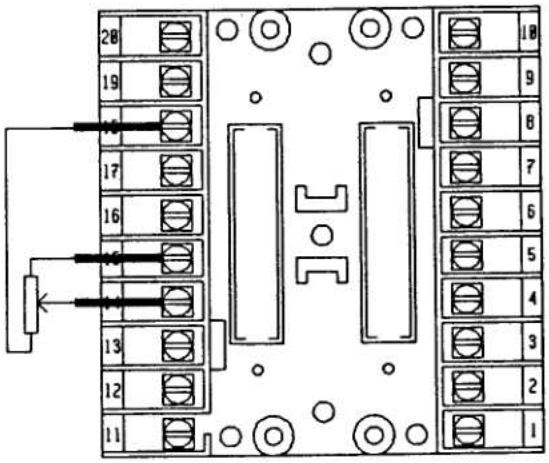
THERMOCOUPLE INPUTS



RTD INPUTS



ANALOG INPUTS

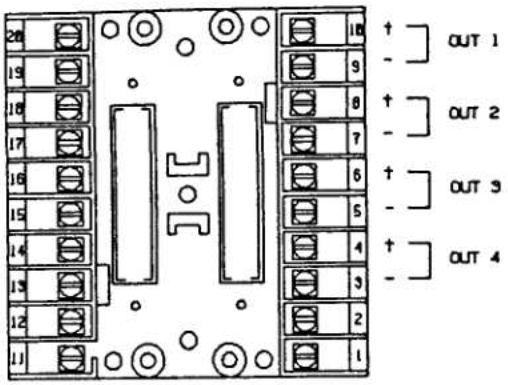


SLIDEWIRE CONNECTIONS

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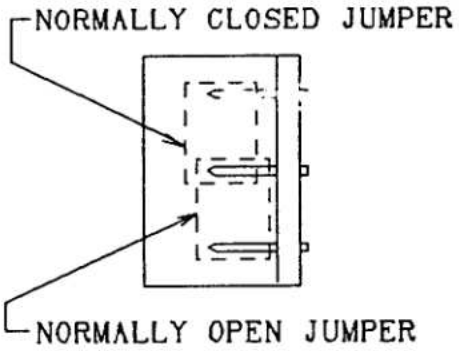
OUTPUT WIRING

The controller may have 4 independent outputs. Each output requires a separate plug-in module on the output module (right board from the rear). Output types include electromechanical relay, solid state relay, DC trigger output, open collector output, analog voltage output, analog current output and transducer power supply. The output module may be installed in any of the output positions. Check the case label for identification and location of the outputs supplied. **Make sure that the wiring to each output is correct. An output card may be damaged by incorrect connections.**



ELECTROMECHANICAL RELAY OUTPUT

The electromechanical relay (EMR) is rated 2 amperes max at 240 VAC non-inductive load. While the relay is a single pole, double throw, only one side of the relay is available. Select normally open (NO) or normally closed (NC) by moving a jumper block on the relay output board.



RELAY OUTPUT JUMPER LOCATION

The designations normally open (NO) and normally closed (NC) refer to the de-energized relay state, i.e., no power to the relays. To provide reliable alarm and control action under power failure, the relays are usually configured to energize during normal operation. When configured for a control output, the relays are configured to be de-energized with the output turned off and energized when the controlled output is turned on. When wiring to these relays, be sure to keep this in mind.

Special care should be taken when wiring these relays to inductive devices such as coils and transformers. Noise suppressors shown on the diagrams in "Noise Suppression" in Section 1 are important to reduce electrical noise.

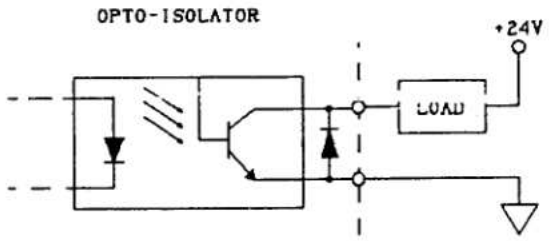
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SOLID STATE RELAY OUTPUT

The opto-isolated solid state relay is rated at 50 mA max at 240 VAC. Refer to the case label for the type installed in the controller. Current limiting semiconductor fuses such as OMEGA KAX or KBH series are recommended to protect the Solid State Relay.

OPEN COLLECTOR/DC TRIGGER OUTPUT

The controller may be supplied with open collector or DC trigger outputs. For the open collector output, the emitter and collector of the NPN output transistor of the photo-coupler module are brought out for user connection. The collector is brought out on the (+) output terminal and the emitter is brought out on the (-) output terminal as shown in the output terminal drawing in Section 1. The maximum supply that may be switched by this output circuit is 50 milliamperes at 24 VDC. A typical load circuit is shown at the right.

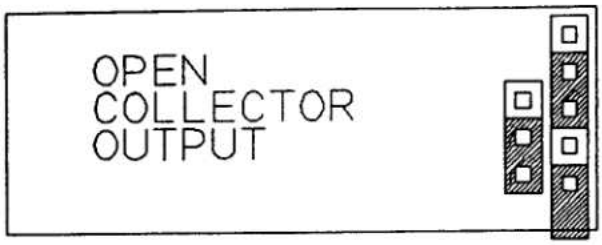


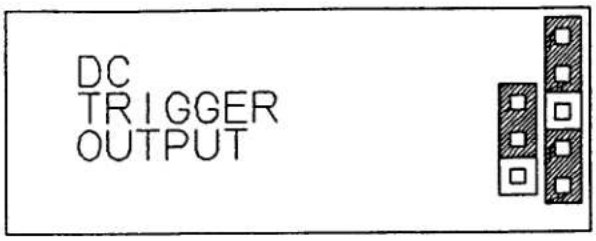
TYPICAL OC CIRCUIT

The controller may also have a DC trigger output for use in firing external solid state relays. This output is designed to fire most standard solid state relays with an input circuit for a 3-32 VDC trigger. Refer to the case output terminal drawing in the section "Output Wiring" within Section 1 for output polarity.

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The same output module is used for both the open collector and the DC trigger outputs. Depending on the application, the appropriate jumper blocks are moved to select the desired output type. The jumper locations for both options are shown below.

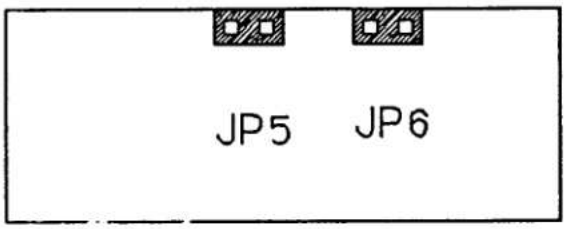




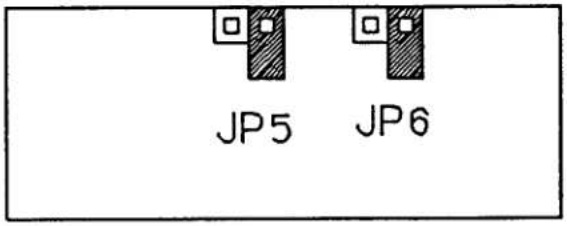
JUMPER PROGRAMMING

ANALOG VOLTAGE OR CURRENT OUTPUT

An analog voltage or current output module may be supplied for either proportional control outputs or for retransmitting outputs. Standard analog outputs are 20 mADC into a maximum load resistance of 600Ω and 5 VDC into a minimum load resistance of 1kΩ. Analog output modules are capable of current ranges up to 20 mA and voltage ranges up to 12V but the actual ranging is performed in software configuration. A special output module is provided when voltage outputs must reach values less than 500 mV. Voltage or current output is selectable by jumper programming. Jumpers JP5 and JP6 are shorted for current output and open circuited for voltage output. Refer to the case terminal drawing in the section "Output Wiring" within Section 1 for output polarity.



FOR CURRENT OUTPUT



FOR VOLTAGE OUTPUT

Other output voltage and current values may be supplied on special order from the factory.

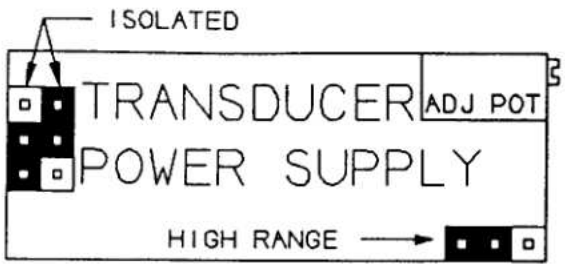
TRANSDUCER POWER SUPPLY

A transducer power supply module may be installed in any of the output module positions (OUT1 thru OUT4). The power supply may be wired for powering either 4-wire or 2-wire transducers depending on the specific transmitter used. Refer to the case output terminal drawing in the section "Output Wiring" in Section 1 for output polarity. The user must wire the power supply to the transducer.

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Each power supply module is limited to a maximum of 30 milliamperes of load current. The output voltage may be either isolated (5 to 15 volts) or non-isolated (5 to 24 volts) which are programmed by jumper selection and a potentiometer adjustment on the module. Jumper locations are indicated below:

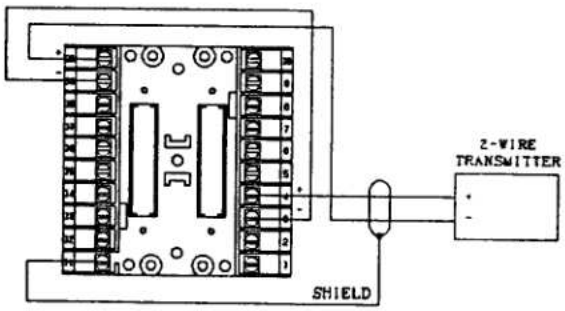


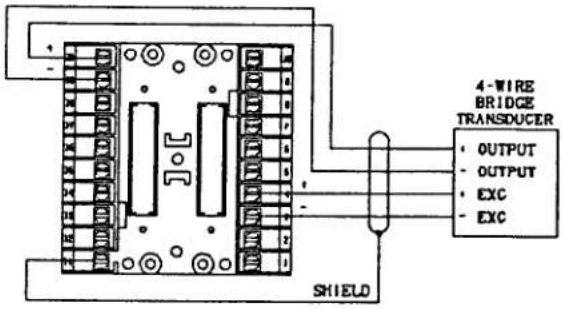


Applications for bridge transducers (i.e., pressure) should use the 5 through 10 volts DC non-isolated supply. Loop powered transmitters may use non-isolated supplies up to 24 volts DC. The isolated supply should only be used when no option card is installed and the isolated supply is required for proper operation of the transducer since the power supply module uses the same isolated supply. All transducer power supply outputs are regulated. The output voltage is set by jumper and multiturn potentiometer. Approximate ranges at each end of the potentiometer adjustment are listed below:

	ISOLATED		NON-ISOLATED	
	CCW	CW	CCW	CW
HIGH RANGE	9V	15V	9V	26V
LOW RANGE	5V	13V	5V	13V

Two examples of wiring a transducer/transmitter to the controller are shown below. Both of these drawings assume that INPUT 1 is the input to be used and that the power supply is installed in OUTPUT 4. Note that the signal connections must be in the negative supply lead for 2-wire transmitters. Change the wiring appropriately for other configurations.



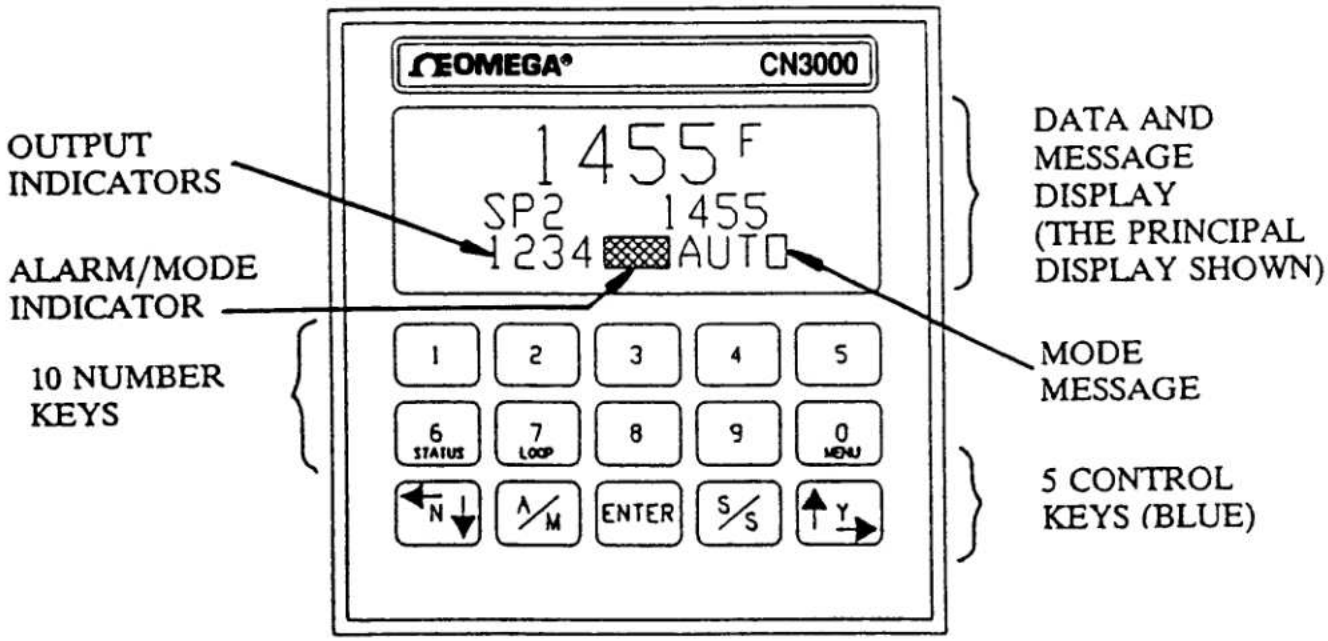


OPTIONS CARD WIRING

Up to two center option cards - RS232 or RS422/485 communications, parallel printer and 8 or 16 logic I/O - may be installed in a controller. Wiring is performed through mass-terminated card edge connectors mounted on each side of the center barrier. For wiring and operating details on these option cards, refer to Section 14 of this manual.

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SECTION 2 - DISPLAY AND KEYPAD



DISPLAY

The blue vacuum fluorescent dot matrix display has four lines of 10 characters per line and provides all controller communications to the operator. Some displays use double height numerals to emphasize important values such as the process variable (PV). The display is also dot addressable for the graph function and other graphic displays.

The **top line** of the principal display shows the process variable (PV) for the current loop in double high numerals with the legend at the right. The **middle line** displays SP (for single loop controllers), RSP (for single loop controllers with remote setpoint enabled) or MS (for single loop controllers using a setpoint generated with MATH routines) followed by the setpoint value (SP). The **middle line** for two loop controllers displays the loop identification SP1 or SP2, RS1 or RS2 (for controllers with remote setpoint enabled) or MS1 or MS2 (for controllers with setpoint generated by a MATH routine) followed by the respective setpoint value (SP). Overrange or any number that is too large to display will appear as a row of asterisks or dashes. The bottom line displays status information. The **four numerals** at the **bottom left** represent the four outputs. The **center cross-hatched area**, the alarm/mode indicator, will light continuously after an alarm has been tripped until the alarm is cleared. The area at the **right end** of the **bottom line** (mode message) will display various annunciator messages such as AUTO, STOP, MANx, PAUS, etc. For two loop controllers, there are two principal displays.

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SIGN-ON DISPLAYS

On power up, there are five sign-on displays that appear sequentially before the Principal Display.

DISPLAY 1 OMEGA name.

DISPLAY 2 OMEGA logo.

DISPLAY 3 The first line lists the internal program number and revision as well as a date code for the controller. The next line lists the amount of RAM installed. The third line displays whether the battery backed real time clock option has been installed (either NO BATTRTC or DAY/HR:MIN) and the last line displays the measured voltage of the memory battery. If the battery is ok, an UP ARROW is displayed after the voltage reading. If the battery should be replaced, an × is displayed.

DISPLAY 4 The next display lists the types of output installed for OUT1...OUT4.

DISPLAY 5 This display lists the installed option cards. If communications, printer or logic I/O cards are installed, they are listed here.

If the displays pass by too quickly to read, press either ARROW key to hold a display. Releasing the ARROW key will allow the displays to continue scrolling. After the last sign-on display has been presented, the principal display appears.

OPERATING KEYS

The controller has a 15-key keypad for programming and operation. Only the bottom row of blue keys is required for normal operation. With these 5 keys, the operator can change the setpoint, start or stop the controller or go into manual or automatic control. The function of each of the blue keys is described as follows:

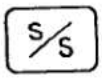


The UP or RIGHT ARROW key is used to increment the displayed value, backup to the previous display or answer "YES" to a displayed question.



The **A/M** key switches the controller function between AUTOMATIC and MANUAL control. A mode indicator (MAN, AUTO or P ON) is displayed during MANUAL, AUTOMATIC or PROFILE control. This key is also used for AUTO-MEASURE for inputs such as linearizer, tare and calibration and as a jump key in selected programs. If the controller is in the STOP mode, the **A/M** key does not have any effect since all control outputs remain OFF.

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The **S/S** key switches the controller function between START and STOP. This key is also used to enter a negative SIGN during a numeric data entry and as a SHIFT key to allow easy movement within the menu system.

The START/STOP (S/S) key is used to enable or disable the control outputs while at the Principal Display. This is **not** a power switch. The controller electronic circuitry remains powered when the control outputs are turned off by this key. When the controller is in the STOP mode, the annunciator block at the right of the bottom row of the screen will display the word STOP. For two loop controllers, the START/STOP key may be configured to have a different affect on each of the two loops. Refer to menu item **S/S CFG** (77) in the OPERATN menu for the current setting. The **S/S CFG** menu item allows a selection for the **S/S** key to operate only on the currently displayed loop or on both loops when pressed.

The START/STOP key also halts execution of a profile at any time. Control outputs are turned OFF.

NOTE: If a profile ends with control outputs enabled, the annunciator block will display AUTO. Pressing the **S/S** key will restart the profile. A second press is required to turn OFF the outputs.

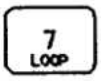


The LEFT or DOWN ARROW key is used to decrement the displayed value, advance to the next display or answer "NO" to a displayed question.

The 10 gray numeric keys also have multiple functions. In addition to being used for direct digital data entry, keys 1-2-3-4-5-8 are available for soft-key macros and keys 6-7-9-0 have specific functions as described below:



The **"6"** key (STATUS) is used to access a series of displays that show the current status of the controller. Use the STATUS key while at the Principal Display. The profile status is displayed with the first press of the STATUS key. The profile display shows the process variable, target setpoint, profile number with step and the time remaining in the step for the current selected loop. If no profile is running, the profile number and step will be "0". The next display shows the monitors (alarms, limits) that are in tripped condition. Up to six three-digit numbers appear in a list to indicate the monitor numbers that are tripped. Press the STATUS key again to show additional monitor displays. Another press of the STATUS key displays all four outputs with the current value of the output in percentage. If the controller is configured for two loops, the next display will show the values for the process variable and setpoint for both loops. A final press of the STATUS key returns to the Principal Display.



The **"7"** key (LOOP) switches between the loop 1 and loop 2 Principal Displays. The **"7"** key may only be used while at one of the Principal Displays or while in manual control and permits switching between loops to access outputs in both loops.

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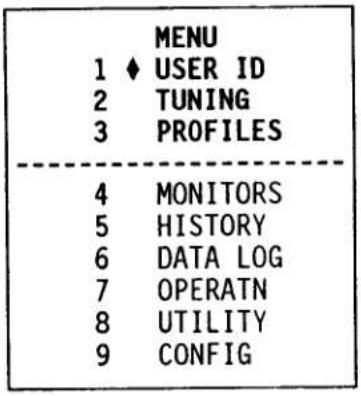
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SECTION 3 - THE MENU SYSTEM

User access to all controller programming is based on a menu system that separates user addressable functions into a logical arrangement. Parameter selection and value setting follow consistent rules that make this controller easy to configure and operate.

THE MENUS

The menu system is accessed from the principal display by pressing the MENU key. The display changes to show the main menu.



The main menu display shows three menu items at a time. The cursor is the filled diamond (♦). The cursor is positioned by the ARROW keys with the display scrolling to show all menu items (9 maximum).

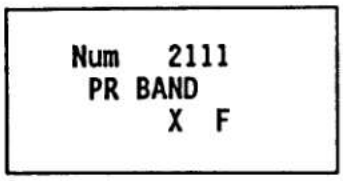
To select a menu item, either position the cursor next to it and press ENTER, or press the corresponding number key (1 to 9). The item need not be currently displayed to be selected by its number. In this manual, the numbers in parentheses ( ) preceding the menu item titles are the sequential direct entry numbers. (Refer to the end of Section 13 - MENU MAPS for a list of frequently used direct entry numbers.) To back up to the previous menu or to the principal display from the main menu, press the MENU key.

Items that cannot be selected have a mark in the cursor column next to the item number. An open diamond (◊) identifies an item which has been locked out by the master operator. An item which is locked out by the controller as inappropriate for the configuration displays the * symbol. The cursor changes to an × when the cursor is positioned next to these items indicating that they cannot be selected. (Pressing the item's number key causes the display to show the item with the × cursor next to it.)

For items that have been restricted by the security system, the item name may be chosen to be left visible or blanked; refer to Section 12 - SECURITY for more information. Menu maps are shown in Section 13.

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NUMERIC ENTRY



Items requiring a numeric entry use this type of display. The top line is labeled Num XXXX where the number identifies the menu choices to reach this display. For example, pressing 2-1-1-1 while at the main menu will produce this display.

The middle line of the display identifies the item to be entered or changed. The third line of the display shows the current value for the parameter.

Use the ARROW keys to increment or decrement the value or press the ENTER key followed by the new parameter value using the numeric keys. Use the LEFT ARROW key to delete a digit already entered. Deleting all of the digits and pressing ENTER restores the old value. To enter a negative number, press the S/S (sign) key anytime during the entry of the value. (In the event the field is filled with numbers before pressing the S/S key, LEFT ARROW to allow at least 1 space in the field to enter the sign.) Press the ENTER key to load the number displayed.

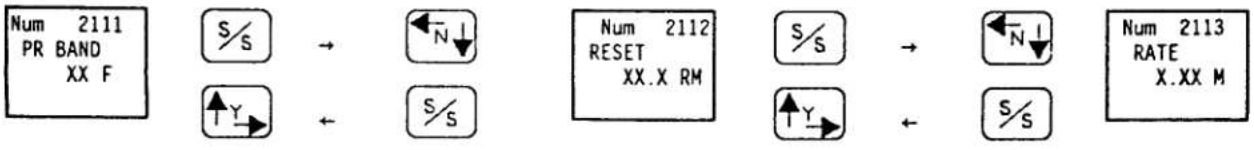
To return to the principal display, press the S/S (shift) key (an UP ARROW will be displayed in the top line) followed by the MENU key.

LAST ENTRY

The menu system also has provisions for easily switching between the principal display and any numeric entry display by using the "9" key. For example: in setting manual tuning parameters, it may be desirable to change the primary PR BAND setting in loop 1, watch the PV as the controller stabilizes and then return to change the PR BAND again. From the principal display, press the MENU key to access the menu system, enter the number 2-1-1-1 in sequence to display the PR BAND entry screen for the loop 1 primary output, change the PR BAND as required and then press the S/S (shift) and MENU keys to return to the principal display. After viewing the PV to determine the effect of the last change, return to the PR BAND display by pressing the "9" (last data entry display). When at the principal display, the "9" key always calls the last data entry display used.

PREVIOUS/NEXT ITEM

The menu system also allows quick access to the previous or next value display within the same sub-menu by using the shift (S/S) key followed by either the down (↓) or up (↑) arrow keys. This is useful, for example, in shifting directly from the PR BAND to RESET to RATE value displays in the TUNING menu. Shift DOWN moves deeper into the menu. Conversely, shift UP moves up in the menu system.



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SWITCH ENTRY

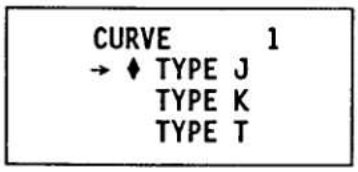
In many of the menus, there are displays which require a decision, i.e., ON/OFF, YES/NO or ENABLE/DISABLE, in response to a question. For these entries, position the cursor adjacent to the desired response and press **ENTER**. The current selection is indicated by an arrow symbol (→).



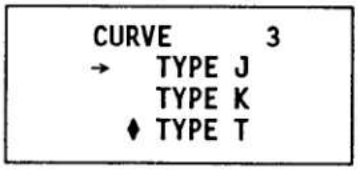
LIST SELECTION

Some displays offer a list of choices. For these entries, position the cursor (♦) adjacent to the desired selection and press **ENTER**. The current selection is indicated by a right arrow symbol (→) and the list selection number representing the cursor position is shown in the upper right corner. To move to a new selection, use the up/down arrow keys or press the number of the list selection. The cursor diamond (♦) will move to the new location. Press ENTER to confirm the selection.

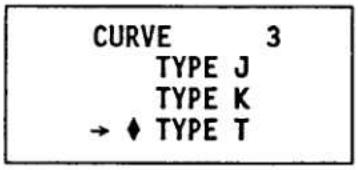
Pressing the **MENU** key exits the list display. However, this display cannot be exited unless the cursor (♦) and the current selection arrow (→) are aligned. If the two are not aligned, first press the **MENU** key to align the cursor with the selection arrow and then press the **MENU** key a second time to exit the display.



Initial Selection



cursor to
new selection



Press ENTER
to confirm

Press MENU to exit

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SECTION 4 - USER IDENTIFICATION

The controller has been provided with a security system to prevent unauthorized operators from changing parameters. User identification is not required to operate the controller but any or all of the first level set-up displays may be locked out to prevent unauthorized access. Information on restricting displays is contained in Section 12 (CONFIGURATION).

To access any set-up displays that have been locked out by the security system, identify yourself as an authorized user by the entry of your USER ID. The user ID is entered from the main menu under the topic "USER ID". When this item has been selected, a numeric entry display is provided to enable you to enter your ID number.

Once a valid user number has been entered, any display for which the user number is privileged may now be accessed. The operating keys described in Section 2 (DISPLAY AND KEYPAD), macros and digital communications commands all bypass the security system and may be accessed by any operator.

The USER ID is reset to zero every time the controller is powered up. Therefore, if the security system is enabled and the controller is powered down, the relevant USER ID must be reentered when the controller is reenergized in order to access restricted displays.

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SECTION 5 -TUNING

THIS CONTROLLER MUST BE TUNED BEFORE USE

CONTROLLER TUNING

Controller tuning is required to ensure that the controller action (output) will be appropriate for the process being controlled.

The simplest control action is ON/OFF control where the only tuning required is the selection of a differential band to minimize output chatter at the control point. This controller can provide ON/OFF control. (See ON/OFF in CONFIG Section 12.)

Most controller applications will use PID control action. These three elements, Proportional, Integral and Derivative allow the controller to successfully control a process. However, the user must select PID tuning values that match the controller performance to the characteristics of the process. Although the three terms interact, the following descriptions are intended to provide simplified operation of these important parameters. Contact the factory for a more detailed discussion on the PID parameters.

The "P" (PROPORTIONAL) term establishes the controller response to a change in the process. The proportional (PROPORTIONAL BAND) term is specified in PV units and is the reciprocal of the controller gain which governs the response of the controller to a change in the PV input. Too much gain (lower PR Band) will cause system to be unstable and oscillate while too low a gain (higher PR Band) will cause the controller to be sluggish and take too long to reach the setpoint value.

The "I" control action (commonly called RESET) automatically adjusts the output for the deviation between the PV and the setpoint (SP) value. RESET is entered in repeats per minute and tuning reset involves selecting the optimum repeats per minute that will effectively offset the PV back to the SP value. Too much reset will cause overshoot. Too little reset will delay recovery. All processes can benefit from Reset action.

The "D" control action (commonly called RATE) provides for a temporary change in controller gain in response to a system disturbance which decays to the original gain value after a programmed period of time. Rate is specified in minutes. Too long a rate time may cause overshoot and too little rate will delay recovery. Selection of an appropriate Rate is somewhat difficult to implement. Therefore, Rate should be used with caution.

This controller offers full PID control for all outputs. A SELF-TUNE selection allows the controller to automatically calculate the optimum PID values for most systems.

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To take advantage of the more cost effective ON/OFF control devices and still take advantage of PID control action, Time Proportional (TPR) control is available. In addition to the PID parameters, an additional parameter, CYCLE TIME, must be selected. The cycle time should be short enough for good control but slow enough for long control device life. See CYC TIME in OUTPUT CONFIGURATION.

Each control loop is tuned separately. This controller can be configured for one control output either reverse acting (HEAT) or direct acting (COOL). There can be two control outputs with one reverse and one direct acting output driving the same process. There can also be two direct or two reverse acting outputs driving the same process. What ever the application, each output has its own user selectable tuning parameters defined in this section.

THE TUNING CHOICE

This controller offers two methods for tuning, SELF-TUNE which automatically determines the PID tuning constants, and MANUAL tuning. Because changing loads may require different PID values for optimum control at each load, this controller can also store 8 PID sets which may be individually called as needed. The following pages list all tuning parameters in the numbered order that they are called. To address a tuning parameter, start with the TUNING menu, Item 2 in the Main Menu. The numbers shown under MANUAL TUNING are the display number address from the Main Menu.

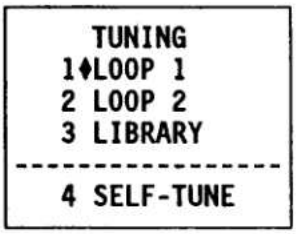
For Self-Tuning, proceed to tuning display number 24. For Manual tuning, the tuning selections start with tuning display number 21. If a tuning display does not appear when addressed, access may have been restricted by the controller security. See USER ID Section 4.

THE TUNING MENUS

From the Main Menu select Item 2 "TUNING" to access the tuning menus. (It may be useful to refer to the TUNING MENU MAPS in Section 13 to review the menu items available.)

Each control loop is tuned independently. Within the TUNE menu there is a dedicated display for every settable parameter. The parameter of interest is located by stepping through a series of menus or by directly addressing each parameter from the Main Menu by its display number. With Self-Tune, the controller automatically updates all relevant tuning displays. The self-tune values may then be manually adjusted if desired.

THE TUNING MENU DISPLAY
MAIN MENU ITEM #2



The tuning menu begins with the selection of the loop to be tuned, library to be accessed or self-tuning to be worked. Select the desired menu item by moving the cursor (use the ARROW keys) to the item and press ENTER or just press the item number.

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THE DISPLAY FOR ITEM 1 ABOVE
THIS DISPLAY IS NUMBER 21

```
LOOP 1
1♦PRIMARY
2 SECONDARY
3 COPY
```

This is the LOOP 1 sub-menu that will appear when Item 1 above is selected. A similar sub-menu exists for LOOP 2 if operational. Select the desired sub-menu item in the same manner as above.

THIS DISPLAY FOR ITEM 1 ABOVE
THIS DISPLAY IS NUMBER 211

```
PRIMARY
1♦PR BAND
2 RESET
3 RATE
```

This is the primary (PRI) output tuning sub-menu that will appear when Item 1 above is selected. A similar sub-menu exists for the secondary (SEC) output if operational. COPY, if selected, has its own menus.

THE DISPLAY FOR ITEM 1 ABOVE
THIS DISPLAY IS NUMBER 2111

```
NUM   2111
PR BAND
     5F
```

This is a typical tune setting display, i.e., the primary proportional band (menu item 1 above, display 211). Use the ARROW keys or the direct digital data entry routine to set in the desired value. Similar data entry displays exist for all tuning parameters.

WHAT TO TUNE

The tuning parameters are presented in logical sets. Each loop has its own tuning values with individual sets displayed for primary and secondary parameters. The library sets also have primary and secondary tuning values. Ignore any unneeded displays. The numbers shown are the individual display addresses that can be called directly by number from the Main Menu. Each output must be tuned. The tuning parameters are:

	ACTIVE LOOP		EACH LIBRARY SET	
PARAMETER	PRI OUTPUT	SEC OUTPUT	PRI OUTPUT	SEC OUTPUT
AUX SP	- - - -	2X21	- - - -	2331
PR BAND (P)	2X11	2X22	2321	2332
RESET (I)	2X12	2X23	2322	2333
RATE (D)	2X13	2X24	2323	2334
CYC TIME	CONFIG	CONFIG	- - - -	- - - -
DIFF'L	2X14	2X25	2324	2335
SP BIAS	2X15	- - - -	2325	- - - -

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MANUAL TUNING

Manual tuning is started by selecting the Loop to be tuned. Please note that setting a tuning parameter to zero turns that parameter OFF.

21 LOOP1 The 21XX set of displays allow assigning manual PID values to both primary and secondary outputs in Loop 1 as follows:

211 PRIMARY The primary output PID values are found in the 211X set of displays.

2111 PR BAND Set the proportional band from 5 to 4000 in PV units.

2112 RESET Set the reset from 0.00 to 20.00 repeats per minute. Entering "0" turns reset OFF.

2113 RATE Set the rate from 0.00 to 20.00 minutes. Entering "0" turns rate OFF.

2114 ± DIFF'L Used with ON/OFF control outputs. The output will turn ON at the primary setpoint value plus the differential value and turn OFF at the setpoint value minus the differential value. Enter the DIFF'L in PV units from 0 to 200.

2115 SP BIAS The value entered for SETPOINT BIAS is added to the primary setpoint and provides an offset from the primary setpoint shown in the principal display. For example, if the setpoint shown in the primary display is 500 and the SP BIAS is -25, the actual setpoint used by the controller will be 475 (500 - 25). The default setting of "0" provides that the primary setpoint and the setpoint used by the controller will be the same value. The SP BIAS value may be from -32,000 to + 32,000 PV units.

212 SECONDARY The secondary output PID values are found in the 212X set.

2121 AUX SP The secondary output may be set to control with an offset (AUX SP) from the primary setpoint. For example, if the primary setpoint is 100 and the AUX SP is -10, the secondary output will use 90 (100 - 10) as its setpoint value. The default setting of "0" causes both primary and secondary setpoints to have the same primary setpoint value. The AUX SP value may be from -32,000 to +32,000 PV units. NOTE: PRIMARY SP BIAS affects both the primary and secondary setpoints.

2122 PR BAND Set the Proportional Band from 5 to 4000 PV units.

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2123 RESET Set Reset from 0.00 to 20.00 repeats per minute. Entering "0" turns Reset OFF.

2124 RATE Set Rate from 0.00 to 20.00 minutes. Entering "0" turns Rate OFF.

2125 ± DIFF'L Used with ON/OFF control outputs. The output will turn ON at the secondary setpoint value minus the differential value and turn OFF at the setpoint value plus the differential value. Enter the DIFF'L in PV units from 0 to 200.

213 COPY To copy the active PID set to another control loop or to any of the 8 library tune sets, select the destination for the copy, i.e., COPY TO and press ENTER. Any values previously stored in the selected destination will be lost. The PID values in the active loop remain unchanged by the COPY command.

22 LOOP2 The 22XX set of displays allow assigning manual PID values to both primary and secondary outputs in Loop 2. All Loop 2 entries are identical to the Loop 1 menu items above except for the change in display number address to X2XX.

23 LIBRARY To address the 8 library PID sets, use the following displays.

231 TUNE SET Select the PID set number from 1 through 8 for editing or creation.

232 PRIMARY To enter PRIMARY output PID values for the selected set as follows:

2321 PR BAND Set the proportional band from 5 to 4000 in PV units.

2322 RESET Set reset from 0.00 to 20.00 repeats per minute. Entering "0" turns Reset OFF.

2323 RATE Set rate from 0.00 to 20.00 minutes. Entering "0" turns Rate OFF.

2324 ± DIFF'L Used with ON/OFF control outputs. The output will turn ON at the primary setpoint value plus the differential value and turn OFF at the setpoint value minus the differential value. Enter the DIFF'L in PV units from 0 to 200.

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2325 SP BIAS The value entered for SETPOINT BIAS is added to the primary setpoint and provides an offset from the primary setpoint shown in the principal display. For example, if the setpoint shown in the primary display is 500 and the SP BIAS is -25, the actual setpoint used by the controller will be 475 (500 - 25). The default setting of "0" provides that the primary setpoint and the setpoint used by the controller will be the same value. The SP BIAS value may be from -32,000 to + 32,000 PV units.

233 SECONDARY To enter SECONDARY output PID values for the selected set as follows:

2331 AUX SP The secondary output may be set to control with an offset (AUX SP) from the primary setpoint. For example, if the primary setpoint is 100 and the AUX SP is -10, the secondary output will use 90 (100 - 10) as its setpoint value. The default setting of "0" causes both primary and secondary setpoints to have the same primary setpoint value. The AUX SP value may be from -32,000 to +32,000 PV units. NOTE: PRIMARY SP BIAS affects both the primary and secondary setpoints.

2332 PR BAND Set the proportional band from 5 to 4000 in PV units.

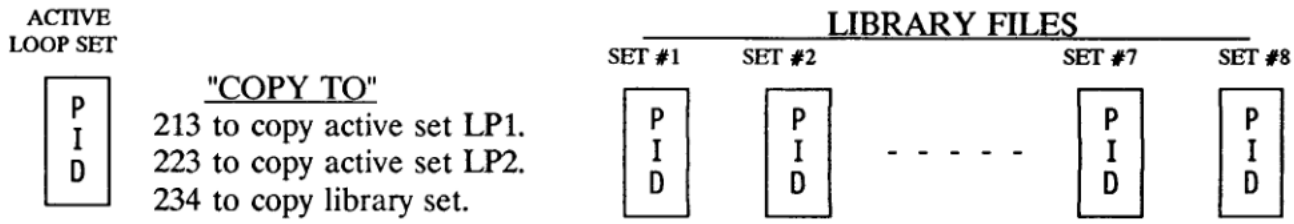
2333 RESET Set reset from 0.00 to 20.00 repeats per minute. Entering "0" turns Reset OFF.

2334 RATE Set rate from 0.00 to 20.00 minutes. Entering "0" turns Rate OFF.

2335 ± DIFF'L Used with ON/OFF control outputs. The output will turn ON at the secondary setpoint value minus the differential value and turn OFF at the setpoint value plus the differential value. Enter the DIFF'L in PV units from 0 to 200.

234 COPY To copy a stored PID set to either control loop or to one of the other 7 PID sets, select the destination for the COPY command and press ENTER. Note that any values previously stored in the selected destination will be lost. The PID values in the current stored set remain unchanged by the COPY command. NOTE: When copying PID sets created with 1° resolution to a loop with 0.1° RTD resolution, the decimal point position is ignored. Therefore the values for PR BAND, ± DIFF'L and SP BIAS are not automatically converted for the proper resolution.

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24 SELFTUNE The self-tune program automatically measures the process response to a change in controller output. The 24X series of displays allow selection of Self-Tune and the necessary self-tune directions.

When the self-tune program is initiated, the controller turns the selected output 100% ON. When the PV reaches 50% of the difference between the starting PV and the TUNE SP value, the output is turned OFF. The self-tune program computes the optimum PID values based on the measured system response. As soon as the controller gets the calculated PID values, they are stored in the selected destination. The controller will then control using the active loop set parameters at the completion of a self-tune cycle.

241 OUTPUT Select the output to be self-tuned from the list of outputs.

242 RESULTS The computed PID constants must be stored in either one of the control loops or in one of the 8 library locations. Select the destination from the list displayed. Note that any values previously stored in the selected destination set will be lost.

243 PV @REST Enter the PV value before control begins. For reverse acting outputs this value would normally be the ambient conditions.

244 TUNE SP Enter the tune setpoint value where the load response is to be evaluated. For the self-tune program to work properly, the difference between the PV @REST and the TUNE SP must be at least 30 PV units. TUNE SP will often be the operating setpoint.

245 RESPONSE Two operating response selections are provided. Select FAST RESPONSE to reach setpoint quickly with some overshoot possible or SLOW RESPONSE where the time to reach setpoint is longer but the chance for overshoot is minimized.

246 START After all of the self-tune selections have been made, Press START to begin Self-Tune. The principal display will show "TUNE" in the message block. When self-tune program is completed, the new constants are stored in the selected destination, the TUNE message changes to "AUTO" or "P ON" and the controller operates using the active loop PID constants.

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The self-tune program can be initiated in any mode other than STOP. However, it is best utilized while the loop to be tuned is in AUTO. Careful consideration should be given to other control outputs that are assigned to the loops. These other outputs continue to control in relation to the instantaneous profile setpoint while in PROFILE mode or the displayed setpoint in the AUTO mode. In the AUTO mode, undesirable interaction may be prevented by adjusting the displayed setpoint. In PROFILE mode, the setpoints at the end of the active segment may be changed, but the instantaneous setpoint is not displayed. A control output should not be tuned during a profile ramp if other control output(s) are also assigned to the loop. The tune setpoint should always equal the displayed setpoint when more than one output is assigned to the loop being tuned.

The MANUAL mode (MAN# or P M#) freezes the output percentage of **ALL** outputs in a loop. This characteristic prevents the self-tune program from executing properly.

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SECTION 6 - PROFILE CONTROL

IF A PROFILE HAS BEEN ASSIGNED TO EITHER LOOP 1 or LOOP 2, THE CONTROLLER MUST BE IN STOP MODE FOR PROFILE PROGRAMMING.

The controller profile menu allows the user to create and store up to 99 profiles with 99 steps each and also provides for the assignment of a stored profile to a control loop. To work with profiles, select item 3 or press ENTER at PROFILES in the main menu.

PROFILE MENU

```
   PROFILES
 1♦PROGRAM
 2 ASSGN L1
 3 ASSGN L2
-----------------
 4 DEL PROF
```

The first profile menu includes selections to program a profile, assign a profile to a loop and to delete a profile.

THE PROFILE COMMAND LIST

There are 14 different profile control commands to choose from in creating each step of a profile. Each control command has a dedicated display for entering the specific values or decisions for that command. It is important to distinguish between a SEGMENT in a profile and a STEP. A segment is normally considered to be a time interval during which the SP may be held constant (SOAK) or changed to a new value (RAMP) during the time interval. A profile program may have many steps within a single segment. For example, at the start of a segment, individual step commands might be used to trigger an alarm, turn an output OFF, display a special message, etc. It is important not to confuse steps (individual commands) with segments (time intervals between setpoints).

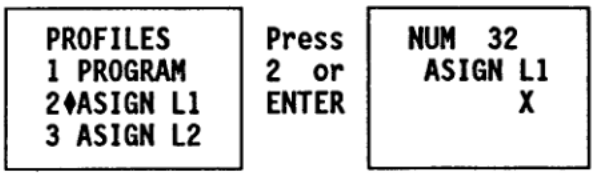
NUMBER	COMMAND	NUMBER	COMMAND	NUMBER	COMMAND
1	DELETE	7	CONTROLS	13	LOOP
2	INSERT	8	END	14	LINK
3	TIME SEG	9	TUNSET	15	CALL
6	ASURD SOAK	10	FLAG	16	RETURN
		11	DELAY		
		12	LABEL		

These commands are explained later in this section. A profile is created by assigning a 1 or 2 digit number to identify the profile and then selecting the desired profile control commands one at a time from the list of 14 in a logical order and assigning values or decisions for each command. INSERT and DELETE commands allow corrections and changes at any time.

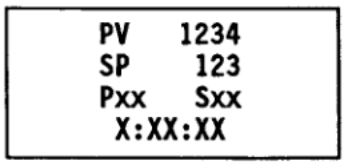
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TO RUN A PROFILE

To run one of the stored profiles, select ASIGN item at the PROFILES menu and ENTER the profile number. Press MENU to return to the principal display and press START. "P ON" will show in the message block indicating that the profile is running.



The profile will start at the first step of the selected profile and the Principal Display will show "P ON" in the message box. The current target setpoint is displayed while a profile is running. The operator may temporarily change the target setpoint using the UP/DOWN arrow keys to replace the programmed setpoint but the change will not affect the profile data in memory. A profile status display is available by pressing STATUS until this display appears.

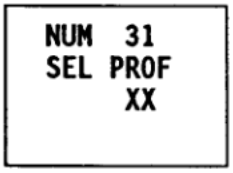


The top line displays the process variable (PV), the second line displays the current target setpoint (SP), the third line displays the profile number (Pxx) and step number (Sxx) and the fourth line displays the time remaining in the step. If an error is encountered during the execution of a profile, the profile program will stop execution at the step producing the error and the top two lines will be replaced by an error message to help the operator in correcting the error. Pressing the STOP key when at the operator display will halt execution of the profile.

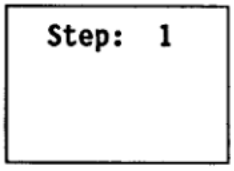
To return to non-profile control, ENTER profile "0" at the ASIGN Lx menu which de-selects profile control.

TO CREATE OR REWORK A PROFILE

From the principal display (with the controller stopped), press Menu-3-1.



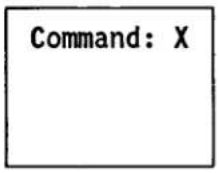
ENTER the desired profile number (between 1 and 99) using the ARROW keys or the numeric data entry system. Since ENTER is used for data entry, press MENU to advance to the next display.



Each step in the profile has a dedicated display. If an existing profile is called, a defined step will be displayed. If a new profile is being created, the display will be blank.

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SELECTING A PROFILE CONTROL COMMAND



After any step in an existing or new profile is called, press ENTER and a profile control command will be displayed.

Use the ARROW keys or numeric data entry to call the desired profile control COMMAND to the display. Press ENTER and key in the value or decision desired. When multiple data is called for on the same display, use ENTER to advance the cursor. Multiple ENTER presses may be required.

Press ENTER to move to the next step and ENTER again to address the next profile control COMMAND. Create the profile as a continuous series of steps providing all of the desired instructions.

PROFILE COMMANDS

1 Delete current step To delete a step previously entered in the program. Bring the step number to be deleted to the display and press the ENTER key. Now bring the Delete command to the display and press the ENTER key. The display will respond DELETE? which requires either a YES or NO answer. If the answer is YES, move the cursor to YES and press ENTER, then MENU. For NO, press MENU and the DELETE command will be canceled.

2 Insert new step To insert a step between two steps in an existing program. Bring the second step to the display and press ENTER. Then bring the Insert command to the display and press the ENTER key. Now write the new step with its values or decisions and press the ENTER key. The new step will now be inserted in the profile and all further existing steps will be incremented one step number.

3 TIME SEG When the arrow cursor is next to 0:00:00, enter time segment data as HR:MIN:SEC using the number or arrow keys. Press ENTER. The target setpoint value (SP) is set the same way. If the target SP is the same as the previous segment, the temperature will be held constant (SOAK). If the target SP value is different from the previous segment, the SP will be linearly ramped to the new setpoint. NOTE: The target setpoint value to be entered is without decimal point. The user must interpret the decimal location, if any, relative to the loop to which the profile is assigned.

6 ASURD SOAK Assured soak has three selections - OFF, DISCRETE and CONTINUE. OFF may be used at the beginning of a program as a reminder that the assured soak is OFF or it may be used to turn assured soak OFF at any step in a program if ASURD SOAK has previously been turned ON. Assured soak DISCRETE is used to hold the clock until the PV is within the soak tolerance at the end of the segment time. Assured soak CONTINUE is used to ensure that the process is soaked within the specified tolerance for the entire segment time. Under assured soak DISCRETE and CONTINUE, the clock is held until the PV is contained within the soak tolerance during the segment time. The total segment time may therefore be longer than the pro-grammed time entered. For both DISCRETE and CONTINUE, the bottom line provides for entry of the soak tolerance in PV units (the soak tolerance is assumed to be both plus and minus).

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7 CONTROLS To set the status of the control outputs, select ACTIVE to enable or OFF to disable the control outputs assigned to the loop while permitting the profile program to continue running.

8 END End of the profile program. The controlled outputs will be left in the state as they were at the end of the step just previous to the END step. ***If control outputs are not turned OFF prior to an END command, the controller will maintain the last setpoint in the profile.***

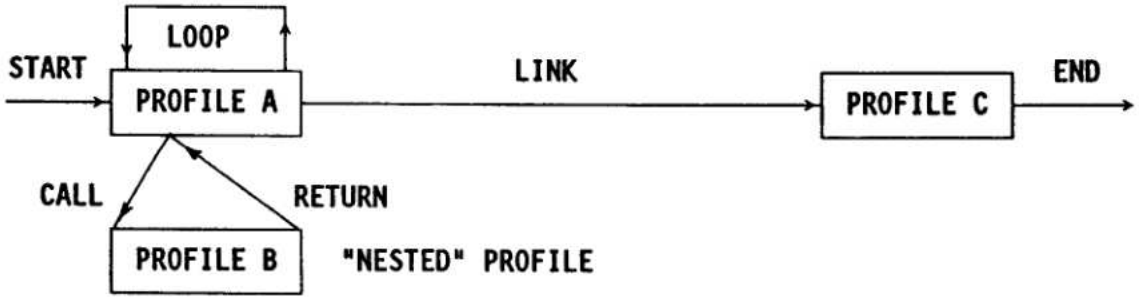
9 TUNSET Up to eight different sets of PID constants (1 through 8) may be used. This command permits the user to assign or change to a new PID set at any step in the profile program. ENTER the TUNE SET number.

10 FLAG To set a flag ON, OFF or WAIT. ENTER the flag number and also any delay time until the flag is to be triggered ON and OFF. A zero delay time will cause the flag to be triggered immediately. For a WAIT FLAG, the profile is halted at this step until the entered flag number has been tripped. (Flags are defined in the MONITORS menu. Also see the EVENT RELAY example in MONITORS.)

11 DELAY Enter a delay in the program in HR:MIN:SEC.

12 LABEL To place a label in the program as a target for the LOOP, LINK or CALL commands. Enter a label number from 1 to 255.

The following commands 13-14-15-16 allow the user to repeat a profile (LOOP), connect profiles together (LINK) and to nest one profile within another (CALL/RETURN).



13 LOOP To loop (repeat) to a label within the same profile, set the target label number and the number of times for the profile to loop or repeat (COUNT). NOTE: Since the loop command follows the actual loop itself, set the count to **1 less** than the total number of loop executions desired.

14 LINK A LINK command causes the profile to link with another profile. This command can be used where profiles with more than 99 steps are required. **Enter the target profile number and the target label number within that profile.**

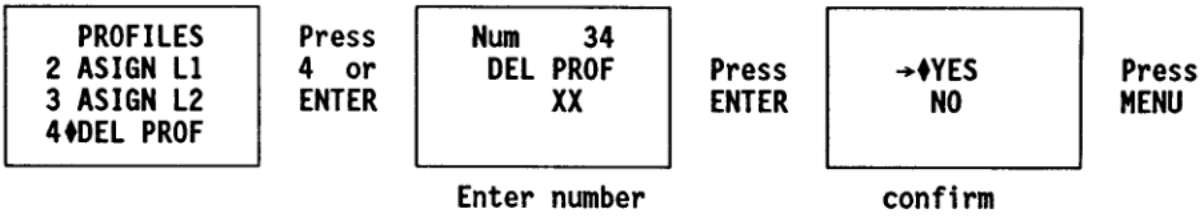
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15 CALL The CALL command causes the program to jump to a label within the same profile or inside another profile with return to the calling program at the end of the called subroutine. This is useful when a routine is used in several different profiles and it is easier to share a common subroutine than to duplicate the program steps in each profile. **Enter the target profile number and the target label number within that profile.** When the sub-routine has been completed, a RETURN command in the sub-routine will return program control to the step following CALL.

16 RETURN RETURN at the end of a subroutine transfers profile control to the line following the CALL command that initiated the move to the subroutine. To test a subroutine by itself without a calling profile, run the subroutine as written. Since the RETURN command functions the same as the END command, there is no need to alter the RETURN command to END.

TO DELETE A PROFILE

34 DEL PROF Use this command to erase a previously stored profile from memory. Subsequent displays provide for entry of the profile number to be erased and then require confirmation to delete the profile.

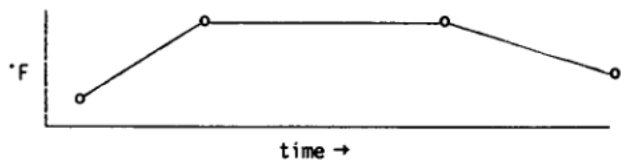


NOTE ON KEY USAGE: The most used key in programming a profile is ENTER. Pressing ENTER tells the controller logic that data will be keyed next or previously keyed data will be loaded into memory. ENTER is also used in profile programming to advance to the next data input. When ENTER is needed for data entry, the MENU key provides an alternative means of advancing the display.

Consider a simple three segment profile to be called profile #10.

EXAMPLE OF WRITING A SIMPLE PROFILE - EXAMPLE 1

Step 1. Ramp to 300°F in 5 seconds.
Step 2. Soak at 300°F for 10 seconds.
Step 3. Ramp to 100°F in 7 seconds.
Step 4. End the profile.



Start from the principal display by pressing MENU-3-1 in sequence. The display will sequence to the SEL PROF display. Use the ARROW keys to select profile number 10 and then press MENU to begin Profile 10 at Step #1.

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STEP 1
a) Press ENTER and a COMMAND will be displayed.
b) Use the ARROW keys to scroll through the commands until TIME SEG (command #3) is displayed. Press ENTER to select this command.
c) Key in a time of 5 seconds for the first segment and press ENTER to load it.
d) Press ENTER to move the cursor to the SP value and key in 300 as the ramp to setpoint. Press ENTER to load the SP value into memory.

STEP 2
a) Press ENTER to proceed to Step 2 in example 1.
b) Press ENTER again. COMMAND will display. Since the last command was TIME SEG, no search is necessary. Press ENTER to use the TIME SEG command again.
c) Key in a time of 10 seconds for the second segment and press ENTER.
d) Press ENTER to move to the SP value and key in 300 as the soak setpoint and press ENTER.

STEP 3
a) Press ENTER to go to Step 3 in example 1.
b) Press ENTER again and COMMAND will display. Press ENTER to use TIME SEG again.
c) Key in a time of 7 seconds for the third segment time and press ENTER.
d) Press ENTER to key in 100 as the ramp to setpoint value and press ENTER to load the value.

STEP 4
a) Press ENTER to go to Step 4 in example 1.
b) Press ENTER again to scroll to COMMAND #8 "END" and press ENTER.

The profile is now programmed. Press MENU 3 times to return to the principal display. To run the profile, start by pressing MENU-3-2 and keying in number 10 as the selection. Press MENU three times to return to the principal display. Press the S/S key to start the profile. Observe the setpoint change as the profile runs. Also notice that "P ON" is displayed in the message block.

To short cut the need for all of the key presses, once a profile is established, it can be assigned to a soft key macro so that one key stroke calls and starts the selected profile. See Section 11 - UTILITY for more information on Macros.

NOTE

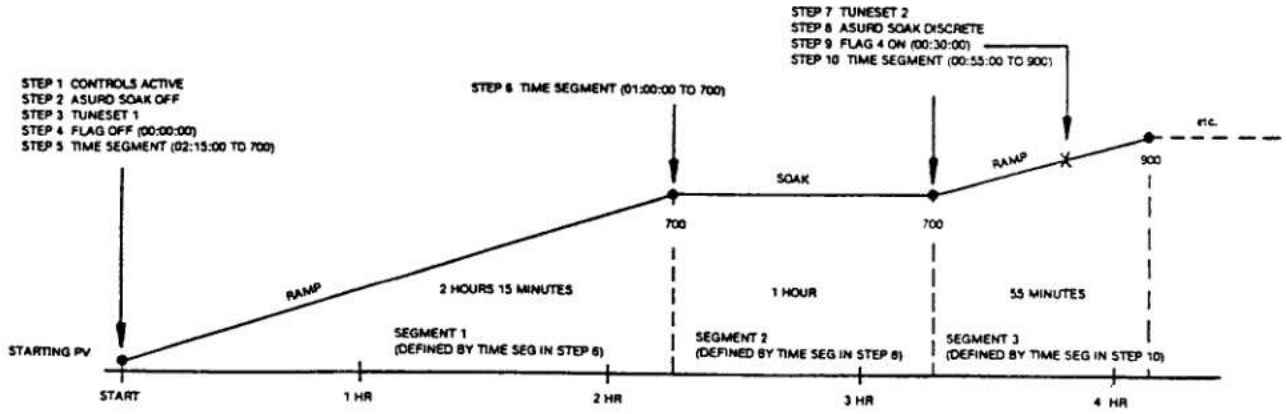
This profile will not initiate control unless CONTROLS are still ACTIVE.

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EXAMPLE OF WRITING AN ADVANCED PROFILE - EXAMPLE 2

While the writing of a profile program is straight forward, the following example shows how the commands are used and should help in writing profiles. In this example, the requirements are first discussed followed by the line that will appear on the PROFILE DISPLAY screen. The example that follows creates a profile to control the process described below:

1. Use Tune Set #1 for the first part of this profile.
2. Set CONTROLS active.
3. Ramp to 700° in 2 hours 15 minutes.
4. Soak at 700° for 1 hour.
5. Change to Tune Set #2 for the balance of the profile.
6. From this step on, confirm that the target temperature has been reached before continuing.
7. Turn ON an event output (output #4).
8. Ramp to 900° in 55 minutes.
9. Loop through the next two steps a total of 10 times.
10. Ramp up to 1000° in 10 minutes. (part of repeated cycle)
11. Ramp down to 900° in 10 minutes. (part of repeated cycle)
12. Turn OFF the event output (output #4).
13. Turn OFF assured soak.
14. Cool down to 300° in 1 hour.
15. Turn OFF all controlled outputs and stop the profile.



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EXAMPLE

It is good practice to set the initial conditions at the beginning of the profile. The first three steps define the starting conditions for our example.

(SET CONDITIONS FOR SEGMENT 1)

```
Step:  1
CONTROLS
 ACTIVE
```

```
Step:  2
ASURD SOAK
   OFF
```

```
Step:  3

TUNSET  1
```

In this example, we want to turn OFF event output 4 (configured in MONITORS as flag 4) at the beginning of the profile program. Notice that we must set the delay time to zero to initiate this output at the beginning of the segment.

```
Step:  4
FLAG    4
   OFF
 0:00:00
```

The first segment is to be 2 hours and 15 minutes with the PV ramping to 700°.

(START OF SEGMENT 1)

```
 Step:  5
TIME SEG
  2:15:00
SP   700
```

The next segment is to be 1 hour to soak at the same PV value as the previous segment.

(START OF SEGMENT 2)

```
 Step:  6
TIME SEG
  1:00:00
SP   700
```

We then desire to use previously determined TUNESET #2 starting with segment 3.

(SET CONDITIONS FOR SEGMENT 3)

```
Step:  7

TUNSET  2
```

At this point we desire to make sure that the PV value actually reaches within 20 PV units (soak tolerance) of the segment SETPOINT value at the end of the segment before moving to the next segment. This will affect all steps after this command. We therefore use the command ASURD SOAK DISCRETE.

```
Step:  8
ASURD SOAK
DISCRETE
      20
```


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We then want to turn ON event output #4 after a timed interval of 30 minutes has elapsed after the start of segment 3 so we use the command FLAG. This timing is concurrent with the elapsed segment time for SEGMENT 3.

```
Step:  9
FLAG    4
  ON
 0:30:00
```

(START OF SEGMENT 3)

The next segment is to call for ramping to a PV of 900° in a timed interval of 55 minutes.

```
Step: 10
TIME SEG
  0:55:00
SP   900
```

(SET CONDITIONS)

Our process requires that we repeat the next section of steps so we need to enter a label as the target for a loop command. We arbitrarily assign label #1 to this step.

(START NEXT SEGMENT)

```
Step: 11

LABEL   1
```

The first step of the repeated group of segments requires a ramp to a PV of 1000° over a 10 minute period.

```
Step: 12
TIME SEG
  0:10:00
SP  1000
```

Our next segment ramps back to a PV of 900° over a 10 minute period.

```
Step: 13
TIME SEG
  0:10:00
SP   900
```

Since the above steps are to be repeated 10 times, we use the LOOP command next to reference the previously inserted LABEL #1.

```
Step: 14
LOOP
COUNT   9
LABEL   1
```

(SET CONDITIONS)

We must now turn OFF event output #4 immediately so we use the FLAG command with zero time delay.

```
Step: 15
FLAG    4
  OFF
 0:00:00
```

We now desire to turn OFF assured soak so we use the ASSURED SOAK OFF command.

```
Step: 16
ASURD SOAK
   OFF
```

(START SEGMENT)

The last segment calls for us to reduce the PV to 300° over a 1 hour time period.

```
Step: 17
TIME SEG
  1:00:00
SP   300
```


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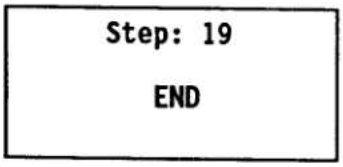
(SET CONDITIONS)

Once we have completed the cool down phase, we desire to turn off the outputs.



Since we are now at the end of our profile program, we use the END command to indicate that there are no more steps.

(END)



This ends our program example.

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SECTION 7 - MONITORS

Monitors refer to a class of functions that include alarms, triggers, limits and events that may be used to actuate one of the four plug-in output modules or initiate a specific action within the controller such as log an event, initiate a controlled shutdown, print data or other similar action. While monitors can perform the same function as alarms in a standard controller, the controller monitors do not have the limitations of dedicated alarms. This provides a great increase in both the number of monitors and the flexibility of their actions.

MONITOR

A monitor compares two values, an input and a setpoint. In most cases, the input will be the process variable (PV). The setpoint represents a value related to the input at which the monitor will trip and cause the desired action, i.e., sound an alarm or stop control. Both the monitor input and the monitor setpoint are selectable (PV or SP). The action of each monitor, turn ON or OFF, is also individually defined. Anytime a monitor (except those affected by the QUIET command) is tripped or cleared, the event is logged in the history file.

ALARMS AND TRIGGERS

The most common use of a monitor is as an alarm. The input is the PV and the setpoint is the limit value. A HIgh alarm trips when the PV equals or exceeds the SP. A LOw alarm trips when the PV is equal to or below the SP. A deviation alarm is slaved to the controlling setpoint and shifts when that setpoint is changed. A HIgh or LOw deviation alarm trips when the PV reaches the deviation setpoint value from the primary setpoint. Deviation band alarms trip when the PV is outside the deviation band.

When an alarm is to drive an output relay, it is recommended that an output relay be de-energized when tripped to provide "failsafe" type operation. This is the same action that will occur if power to the controller is lost. See the FORCEOUT (417 or 427) feature to program this action.

Triggers are similar to alarms since additional alarms may be configured under the trigger menu. Triggers may also be configured with new characteristics not available under the alarms submenu with a selection of input sources using a full list of logic functions to define the operation of the trigger.

HYSTERESIS

To avoid nuisance tripping of a monitor as the input makes small changes around the setpoint, a Hysteresis is included. After a monitor has tripped, the input must return to setpoint and backup at least the hysteresis value before the monitor will clear. A monitor always trips at setpoint and clears only after the input has returned to the setpoint and backed up the hysteresis value.

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OUTPUT ACTION

A monitor can be programmed to drive any one or all of the four outputs and will override the normal control output action.

FLAGS

Flags are general purpose internal ON/OFF switches that provide a universal internal communications system that eliminates the need for many individual user commands while providing maximum capability and flexibility of control functions.

Flags can be set (ON) or cleared (OFF) from a multitude of internal or external sources and a flag state, ON or OFF, can be read by a multitude of control functions. The result is a very flexible system which allows the user to customize the controller for a specific application.

Typical flag functions include triggering alarms and control outputs. The controller itself uses hidden flags for many of its command actions. Flags are particularly useful in profile control where they provide the trigger for action when programmed events occur such as an output based on time, PV or segment. The example at the end of Section 6 illustrates the use of a flag to provide an event output when a specified step has been reached in the profile.

In this controller a flag is selected by number, programmed when to be ON and OFF and where it is to be used to communicate. Flags are selectable in profile programming and in monitors.

SPECIAL FUNCTIONS

Several alternative modes of alarm monitor operation are available.

A DEVIATION (4153) alarm or (4253) trigger tracks the controller setpoint. This selection eliminates the need to manually change the alarm or trigger setpoint each time the controller setpoint is changed and is especially useful in profile control. The deviation can be set above or below the controller setpoint.

A DEVIATION BAND (4153) alarm or (4253) trigger monitor also tracks the controller setpoint but this alarm will trip when the PV exceeds the deviation band setpoint on either side of the controller setpoint.

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More selections are provided under OPTIONS (418 and 428):

1. INHIBIT (4181 and 4281) used during startup inhibits the monitor until the PV gets within an acceptable operating value.
2. LATCH (4184 and 4284) for a maintained output until unlatched.
3. ONE SHOT (4185 and 4285) for a one-time pulse output.

NOTE

SOME CONFIGURATION MAY BE REQUIRED FOR APPROPRIATE OUTPUT ACTION IN THE EVENT OF A SENSOR BREAK OR INPUT MALFUNCTION.

This controller has built-in sensor break protection that can be enhanced for a specific application through the use of the MONITORS feature. **Since the controller can be field configured for a number of input types and output functions, each controller application should be carefully reviewed with regard to the preferred action of the outputs with a malfunction of the input signal (i.e., RTD, thermocouple, analog).** In most cases, a MONITOR can be configured to provide the necessary protection.

Should the sensor circuit open (thermocouple input), the PV display on the affected loop will read "----". The response of the controller outputs to a sensor break depends on the configuration and the use of the controller. In its DEFAULT configuration, the outputs will simulate the action which results from the presence of a very high (out-of-range) PV input (i.e., up-scale thermocouple break protection). With the default configuration, a reverse acting (HEATING) output will turn OFF and a direct acting output (COOLING) will turn ON.

In some applications, this action may not be desirable. In those cases, a MONITOR should be configured to provide the appropriate protection by overriding the output. To force the direct acting output (COOLING) to turn OFF with a sensor break, a monitor should be configured as shown in example 2 at the end of this section.

4 MONITORS

Creating a monitor involves several selections and decisions all found in the 4XXX menus. Start by selecting the monitor function - ALARMS (41) or TRIGGERS (42), an alarm or trigger number (411 or 421). Then go to the SETUP menu (415 or 425) and program the INPUTs (4151, 4251 or 4252), the TYPE of monitor (4153 or 4253), ASSIGN the OUTPUT (416 or 426) and any special actions (4181 through 4188 or 4281 through 4288). Then return to the monitor operational displays for RSET/INH (412 or 422), setpoint (413 or 423) and HYSTRSIS (4154 and 4254) selections. At any time ENABLE (414 or 424) can be deselected to ignore the monitor while saving it for future use.

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41 ALARMS This menu item provides entries to configure and use a monitor as an alarm.

411 ALARM # Identify the number of the monitor to be created, modified or reviewed. Monitor numbers may be from #1 to #9. Alarm numbers do not have to be consecutive. The alarm number selected here is active for all of the following alarm displays.

412 RESET/INH Reset/Inhibit operates when the LATCH and/or INHIBIT modes have been enabled in the OPTIONS menu (418). When selected, it acts to RESET or INHIBIT (clear) a tripped monitor.

With LATCH (4184) enabled, RSET/INH will RESET the Alarm Monitor but only if the input has returned to within an acceptable range.

When INHIBIT (4181) is enabled, RSET/INH will override the LATCH feature and immediately disable the Alarm Monitor until the input returns to within the acceptable range.

413 SETPOINT Used to enter a setpoint value for the selected alarm number in PV units. SETPOINT values may be from -32,000 to +32,000. For deviation setpoint alarms, the value is entered in deviation PV units. Setpoint values are not checked against the actual span of the controller so that the user must make sure the values entered are correct. NOTE: Decimal points are not displayed for setpoint value. Remember that 0.1° RTD has an implied decimal point.

414 ENABLE? Enable or disable the selected alarm number. This feature can be used to temporarily turn off an alarm without removing or changing its configuration parameters.

415 SETUP The SETUP menu items permit configuration of an alarm monitor to an application requirement.

4151 INPUT Chose either loop 1 or loop 2 process variable (PV) as the input for the alarm monitor.

4153 TYPE Select the type of alarm monitor required.

1 PROC HI A high process alarm. The alarm trips when the PV increases to the alarm SETPOINT.

2 PROC LO A low process alarm. The alarms trips when the PV decreases to the alarm SETPOINT.

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3 DEV HI A high deviation alarm. The alarm trips when the PV increases to the alarm SETPOINT deviation value from the controller primary setpoint. The alarm setpoint value may be either positive or negative but is usually positive.

4 DEV LO A low deviation alarm. The alarm trips when the PV decreases to the alarm SETPOINT deviation value from the controller primary setpoint. The alarm setpoint may be either positive or negative but is usually negative.

5 DEV BND A deviation band alarm. The alarm trips when the PV is outside the deviation band.

4154 HYSTRSIS Hysteresis is the difference in PV units between the alarm turn OFF and the alarm turn ON values and reduces excessive alarm switching with small input changes. The hysteresis is positioned so that the alarm actuates at the setpoint value but the PV must pass the setpoint by the hysteresis value to deactivate. Set the hysteresis in PV units. NOTE: Decimal points are not displayed for hysteresis values. Remember that 0.1° RTD has an implied decimal point.

4155 SET FLAG Each alarm can turn a flag ON when tripped. The flag is cleared (OFF) when the alarm is cleared. Refer to Table 7-1 for flag numbers.

4156 CLEAR FLAG Each alarm monitor can turn a flag OFF when tripped. The flag is set ON when the alarm is cleared. Refer to Table 7-1 for flag numbers.

416 ASSGN TO Assign the alarm to an output. The selection lists the four standard outputs. More than one monitor can be assigned to the same output, a single monitor may be assigned to more than one output or a monitor may be used to override a control output. Check all outputs to assure proper assignment.

417 FORCEOUT Select the action of the alarm output when tripped. Since a single monitor may be assigned to several outputs, it is necessary to configure the effect of the monitor on each output to which it has been assigned. If FORCEOUT is assigned ON, the output is turned ON when the alarm is tripped. If FORCEOUT is OFF, the output is turned off when the alarm is tripped. If multiple monitors affect the same output and force it to conflicting states, the OFF state predominates.

If **OUTPUTS/FUNCTION/ASSIGNMENT 9221** is set to **NONE/ALM**, FORCEOUT must be coordinated with output parameter **925 DEFAULT**. When **FORCEOUT** is ON, the **DEFAULT** must be OFF and vice versa.

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418 OPTIONS Used to customize the selected alarm with special functions.

4181 INHIBIT Select either YES or NO (default). When YES is selected, RSET/INH provides the operator with the means to disarm (silence/acknowledge) a tripped alarm. The alarm will not be re-armed until the input returns to within an acceptable range. See RSET/INH (412) for more on INHIBIT.

4182 AUTO IN1 This menu selection is similar to the INHIBIT command above. If YES is selected, the AUTO INHIBIT function operates in the same fashion except that the alarm is automatically reset every time the loop 1 process is restarted. This feature is activated on power-up, when the START key is used to begin a process or a Ramp & Soak Profile is repeated.

4183 AUTO IN2 This menu selection is similar to the INHIBIT command above. If YES is selected, the AUTO INHIBIT function operates in the same fashion except that the alarm is automatically reset every time the loop 2 process is restarted. This feature is activated on power-up, when the START key is used to begin a process or a Ramp & Soak Profile is repeated.

4184 LATCH Select either YES or NO (default). When LATCH is ENABLED, RSET/INH provides the operator with the means to RESET a LATCHed alarm. However, it will only unLATCH if the input mode has returned to within an acceptable range. See RSET/INH (412) for more on LATCH mode.

4185 ONE SHOT A one-shot provides a single output pulse when the alarm is tripped.

4186 DIS.W/L1 Answering YES causes the selected alarm to be disabled when loop 1 is in the STOP mode. Alarms are not affected by STOP mode when "NO" is selected.

4187 DIS.W/L2 Answering YES causes the selected alarm to be disabled when loop 2 is in the STOP mode. Alarms are not affected by STOP mode when "NO" is selected.

4188 QUIET? This option affects the display of a tripped alarm and history logging of an alarm. If NO is selected, tripping the selected alarm will cause the center annunciator block in the bottom row of the principal display to illuminate until cleared. Tripping and clearing of the alarm will log into the history file. Selecting YES does not affect the operation of the alarm but the annunciator display and logging to the history file will not occur. The default selection for alarms 1 to 9 is "NO".

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42 TRIGGERS This menu item provides entries to configure and use a monitor as a trigger.

421 TRIGGER# Identify the number of the trigger to be created, modified or reviewed. Trigger numbers may be from #10 to #64. Trigger numbers do not have to be consecutive. The trigger number selected here is active for all of the following trigger displays.

422 RESET/INH Reset/Inhibit operates when the LATCH and/or INHIBIT modes have been enabled in the OPTIONS menu (426). When selected, it acts to RESET or INHIBIT (clear) a tripped monitor.

With LATCH (4284) enabled, RSET/INH will RESET the Trigger Monitor but only after the input has returned to within an acceptable range.

When INHIBIT (4281) is enabled, RSET/INH will override the LATCH feature and immediately disable the Trigger Monitor until the input returns to within the acceptable range.

423 SETPOINT Used to enter a setpoint value for the selected trigger number in PV units. SETPOINT values may be from -32,000 to +32,000. For deviation setpoint alarms, the value is entered in deviation PV units. Setpoint values are not checked against the actual range of the controller so that the user must make sure the values entered are correct. When the input for a trigger monitor is a flag, the SETPOINT should be set to "1" for PROC HI, PROC LO, DEV HI, DEV LO and DEV BND types. Flag trigger setpoints for logic types such as A > B, A < B, etc may be set to either "Ø" or "1" as appropriate. NOTE: Decimal points are not displayed for setpoint value. Remember that 0.1° RTD has an implied decimal point.

424 ENABLE? Enable or disable the selected trigger number. This feature can be used to temporarily turn off an trigger without removing or changing its configuration parameters.

425 SETUP The SETUP menu items permit configuration of a trigger monitor to an application requirement.

4251 INPUT A Choose the "A" input for the selected trigger. Selections include LOOP1 and LOOP2 PV or SP, OUT1...4%, FLAG and SPECIAL. For flag inputs, enter the appropriate flag number from Table 7-1. Use flag "#0" to de-select the flag. Outputs 1 to 4 are 0 to 100% with 0.1% resolution but no decimal point is displayed. Consult the factory for the use of SPECIAL.

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FLAG #	DESCRIPTION
#1 to #15	USER ASSIGNABLE FLAGS
#16 to #23	BANK "A" LOGIC I/O LINES 1 THRU 8
#24 to #31	BANK "B" LOGIC I/O LINES 1 THRU 8
#32 to #34	NON-ISOL LOGIC INPUT LINES 1 THRU 3
#35 to #127	RESERVED FLAGS
#128 to #135	USER FLAGS ASSIGNED TO MACROS
#136	TRUE IF LOOP 1 STOPPED (read only)
#137	TRUE IF LOOP 1 IN MANUAL CONTROL (read only)
#138	TRUE IF LOOP 1 PROFILE IS ACTIVE (read only)
#139	TRUE IF LOOP 1 IS PAUSED (read only)
#140	TRUE IF LOOP 1 REMOTE SP IS ACTIVE (read only)
#141 to #143	RESERVED FLAGS
#144	TRUE IF LOOP 2 STOPPED (read only)
#145	TRUE IF LOOP 2 IN MANUAL CONTROL (read only)
#146	TRUE IF LOOP 2 PROFILE IS ACTIVE (read only)
#147	TRUE IF LOOP 2 IS PAUSED (read only)
#148	TRUE IF LOOP 2 REMOTE SP IS ACTIVE (read only)
#149 to #152	RESERVED FLAGS
#153	DATA LOGGING FILE TO PRINTER
#154	DATALOG STATISTICS TO PRINTER
#160	DATA LOGGER ON/OFF
#161 to #247	INTERNAL FLAGS - CONSULT FACTORY

Table 7-1

4252 INPUT B Choose the "B" input for the selected trigger. Selections include TRIG SP, FLAG, LOOP1 and LOOP2 PV or SP, OUT1...4% and SPECIAL. TRIG SP allows a SETPOINT (423) to be used as input B. For flag inputs, enter the appropriate flag number from Table 7-1. Use flag "#0" to de-select the flag. Outputs 1 to 4 are from 0 to 100% with 0.1% resolution but no decimal point is displayed. Consult the factory for the use of SPECIAL.

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4253 TYPE Select the type of trigger logic function to be used relative to inputs "A" and "B".

1 PROC HI A high process trigger. The trigger trips when the PV (Input A) increases to the trigger SETPOINT (Input B).

2 PROC LO A low process trigger. The trigger trips when the PV (Input A) decreases to the trigger SETPOINT (Input B).

3 DEV HI A high deviation trigger. The trigger trips when the PV (Input A) increases to the trigger SETPOINT deviation value (Input B) from the controller primary setpoint. The trigger setpoint value may be either positive or negative but is usually positive. This function is normally usable only when Input A is either Loop1 PV or Loop2 PV.

4 DEV LO A low deviation trigger. The trigger trips when the PV (Input A) decreases to the trigger SETPOINT deviation value (Input B) from the controller primary setpoint. The trigger setpoint may be either positive or negative but is usually negative. This function is normally usable only when Input A is either Loop1 PV or Loop2 PV.

5 DEV BND A deviation band alarm. The alarm trips when the PV (Input A) is outside the deviation band (Input B). This function is normally usable only when Input A is either Loop1 PV or Loop2 PV.

6 A > B This selection trips the trigger when input "A" is greater than input "B".

7 A < B This selection trips the trigger when input "A" is less than input "B".

8 A = B This selection trips the trigger when input "A" is equal to input "B".

9 AND This selection trips the trigger (TRUE) when the "A" and "B" flag inputs are both TRUE and clears the trigger (FALSE) for any other condition of inputs "A" and "B".

10 OR This selection trips the trigger (TRUE) when either the "A" or "B" flag inputs are TRUE and clears the trigger (FALSE) when inputs "A" and "B" are both FALSE.

11 XOR This selection trips the trigger (TRUE) when either the "A" or "B" flag input is TRUE but not when Inputs "A" and "B" are both TRUE or both FALSE.

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12 NAND This selection clears the trigger (FALSE) when the "A" and "B" flag input are both TRUE and trips the trigger (TRUE) for any other condition of inputs "A" and "B".

13 NOR This selection clears the trigger (FALSE) when either the "A" or "B" flag inputs are TRUE and trips the trigger when the trigger (TRUE) when inputs "A" and "B" are both FALSE.

14 XNOR This selection clears the trigger (FALSE) when either the "A" or "B" flag input is TRUE and trips the trigger (TRUE) when inputs "A" and "B" are both TRUE or both FALSE.

4254 HYSTRSIS Hysteresis is the difference in PV units between the trigger turn OFF and the alarm turn ON values and reduces excessive trigger switching with small input changes. The hysteresis is positioned so that the trigger actuates at the setpoint value but the PV must pass the setpoint by the hysteresis value to deactivate. Set the hysteresis in PV units. NOTE: Decimal points are not displayed for hysteresis values. Remember that 0.1° RTD has an implied decimal point. Hysteresis is ignored for all trigger types utilizing logic functions (ie, A > B, XOR, etc.).

4255 SET FLAG Each trigger can turn a flag ON when tripped. The flag is cleared (OFF) when the trigger is cleared. Refer to Table 7-1 for flag numbers.

4256 CLEAR FLAG Each trigger monitor can turn a flag OFF when tripped. The flag is set ON when the trigger is cleared. Refer to Table 7-1 for flag numbers.

426 ASSGN TO Assign the trigger to an output. The selection lists the four standard outputs. More than one monitor can be assigned to the same output, a single monitor may be assigned to more than one output or a monitor may be used to override a control output. Check all outputs to assure proper assignment.

427 FORCEOUT Select the action of the trigger output when tripped. Since a single monitor may be assigned to several outputs, it is necessary to configure the effect of the monitor on each output to which it has been assigned. If FORCEOUT is assigned ON, the output is turned ON when the monitor is tripped. If FORCEOUT is OFF, the output is turned off when the monitor is tripped. If multiple monitors affect the same output and force it to conflicting states, the OFF state predominates.

If OUTPUTS/FUNCTION/ASSIGNMENT **9221** is set to **NONE/ALM**, FORCEOUT should be coordinated with output parameter **925 DEFAULT**. When **FORCEOUT** is ON, the **DEFAULT** should be OFF and vice versa.

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428 OPTIONS Used to customize the selected trigger monitor with special functions.

4281 INHIBIT Select either YES or NO (default). When YES is selected, RSET/INH provides the operator with the means to disarm (silence/-acknowledge) a tripped trigger. The trigger will not be re-armed until the input returns to within an acceptable range. See RSET/INH (422) for more on INHIBIT.

4282 AUTO IN1 This menu selection is similar to the INHIBIT command above. If YES is selected, the AUTO INHIBIT function operates in the same fashion except that the trigger is automatically reset every time the loop 1 process is restarted. This feature is activated on power-up, when the START key is used to begin a process or a Ramp & Soak Profile is repeated.

4283 AUTO IN2 This menu selection is similar to the INHIBIT command above. If YES is selected, the AUTO INHIBIT function operates in the same fashion except that the trigger is automatically reset every time the loop 2 process is restarted. This feature is activated on power-up, when the START key is used to begin a process or a Ramp & Soak Profile is repeated.

4284 LATCH? Select either YES or NO (default). When LATCH is ENABLED, RSET/INH provides the operator with the means to RESET a LATCHed trigger. However, it will only unLATCH if the input mode has returned to within an acceptable range. See RSET/INH (42) for more on LATCH mode.

4285 ONE SHOT A one-shot provides a single output pulse when the trigger is tripped.

4286 DIS.W/L1 Answering YES causes the selected trigger to be disabled when loop 1 is in the STOP mode. Alarms are not affected by STOP mode when "NO" is selected.

4287 DIS.W/L2 Answering YES causes the selected trigger to be disabled when loop 2 is in the STOP mode. Alarms are not affected by STOP mode when "NO" is selected.

4288 QUIET? This option affects the display of a tripped trigger and history logging of a trigger. If NO is selected, tripping the selected trigger will cause the center annunciator block in the bottom row of the principal display to illuminate until cleared and the tripping and clearing of the trigger will log into the history file. Selecting YES does not affect the operation of the trigger but the annunciator display and logging to the history file will not occur. The default selection for triggers 10 through 64 is "YES".

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EXAMPLE 1 - CREATING AN EVENT OUTPUT MONITOR

To create Monitor #10 using input flag #4 driving an event relay operating on Output 4 proceed as described below. With this configuration, Output #4 will remain "ON" until the event flag is tripped "OFF".

1) Select a TRIGGER MONITOR# (421) - 10.
2) Enter a SETPOINT (423) value of "1" (flag monitor)
3) ENABLE (424) monitor #10.
4) Input A FLAG (4251) #4 under SETUP/INPUT A/FLAG.
5) Input B select TRIG SP (4252) to enable the setpoint selected in step 2.
6) Select A = B under TYPE (4253) to trigger on when both inputs are true.
7) ASSIGN (4264) the monitor to OUTPUT 4.
8) Select "ON" under FORCE (4274) for output 4.

EXAMPLE 2 - CREATING A MONITOR TO OVERRIDE A DIRECT ACTING OUTPUT

To create a monitor to override and shut OFF a direct acting control output when a thermocouple sensor fails open, follow the procedure outlined below:

1. Select ALARMS (41) at the MONITORS menu.
2. Select an appropriate ALARM# (411) to be used.
3. Enter a SETPOINT (413) value: Enter a value equal to the MAX SENSOR PV for an upper limit setpoint.
4. Select ENABLE (414) - "YES"
5. Select SETUP (415) in the menu.
6. Under INPUT (4151), select PV for the appropriate loop.
7. Under TYPE (4153), select PROC HI.
8. Under ASSIGN (416), select the output number for the direct acting output to be affected by this monitor.
9. Select OFF under FORCE (417) for the same output number.

This monitor will sense the presence of the high PV caused by a sensor break condition (thermocouple only) and FORCE the direct acting output to its OFF state.

Many combinations of protection can be achieved through the use of a MONITOR. The MONITOR(S) give the added benefit of alarm annunciation in the event of open sensor input. Other Monitors are created in a similar fashion.

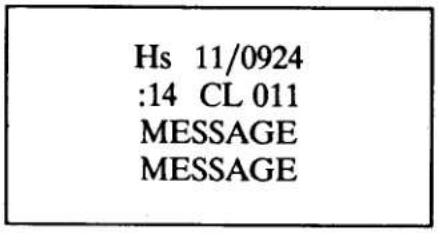
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SECTION 8 - HISTORY

The controller maintains a history file. Each monitor logs into HISTORY the monitor number and date/time when it trips or clears so that the duration of the event can be determined. If the monitor is a latching type, the clear log to HISTORY is delayed until the latch is cleared. For a monitor that is inhibited, the monitor will not log into HISTORY until the inhibit flag is manually or automatically reset (see RESET/INH (412 or 422)). Monitors that have been set QUIET will also not log into the history file (see QUIET? (4188 and 4288)).

It is suggested that if you do not have the real-time clock option installed, the controller clock be reset to the current date and time before using the history feature. Doing so will provide a more meaningful time record in the history file.

51 REVIEW REVIEW permits an examination of the HISTORY data file. The last event to be recorded is displayed first. Scroll forward and backward in the file by using the UP and DOWN ARROW keys. A typical HISTORY data display is shown below:



The first line of the HISTORY data display begins with the letters **Hs** to identify the display as the history file. The balance of the first line displays the **DAY/HOURS-MINUTES** (24 hour clock). The second line begins **:SECONDS**. The Balance of the line describes the event. In this case, monitor #11 was cleared at the time recorded. If the monitor had been tripped, the event would have been described **"TR 011"**. If a message has been installed (special programming) with a reference number matching the monitor number, then that message will be displayed on the bottom lines of the display when the monitor trips.

53 CLEAR This command will clear all previously recorded history data leaving the file clear for the next monitor data to be entered.

54 TEST EXC Selecting this menu item will enter a record into the HISTORY log at the time of its execution. The record will be numbered with the reference number entered in the H TEST# menu display.

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55 H TEST # The History Test Number allows entry of a reference number (from 0 to 255) that will appear in the history log.

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SECTION 9 - DATA LOG

The controller includes a data logger. The data logger will store a maximum of 600 data points of a selected parameter based on time in one or two files. The stored data can be displayed as a graph with time and value shown. The data logging menu provides for reviewing a block of existing data using the statistical tools in the GRAPH menu or by marking a starting point for new data to be collected and then evaluating this new data using similar statistical tools in the STATISTICS menu.

Before using the data logger, first configure it in the SETUP menu. It is also suggested that if the real-time clock option has not been included in the controller, the controller clock be set to the current date and time before using the data logging feature. Doing so will provide a more meaningful time record in the data file.

NOTE: The values for PV, SP, etc are written to the data logging file without any decimal points. The user must interpet the file data knowing the actual decimal point location.

61 START Selecting START initiates the data logging process. Data is written to the file beginning at the moment when this command is selected even if the controller is in STOP mode. This command starts all allocated files simultaneously.

62 STOP Selecting STOP halts the data logging process. Writing data to the file ceases when this command is selected. Data log "STOP" has no effect on the controller outputs. This command stops all allocated files simultaneously.

The data logger has both on-line and off-line capability. While data is being logged, MARKERS can be inserted and some statistical calculations made. After data is collected, the GRAPH program allows very detailed data analysis.

63 GRAPH Selecting GRAPH will display a graph of the selected variable versus time. The time and magnitude of the variable at the long vertical cursor line are also displayed digitally along the bottom of the graph. Upon first entry into the graph menu, the screen shows the whole log in the scale selected in the data log SETUP menu. The cursor can be moved by using the LEFT and RIGHT ARROW keys and the data along the bottom of the graph will change based on the position of the cursor. Pressing the ENTER key toggles between the logged data at the current cursor position (same format as VIEW LOG) and the GRAPH display. Block commands 3 and 4 must be used to obtain valid statistical analysis.

Note that unless STOP has been selected or the data logger has been setup for AUTOSTOP, the file can be overwritten while in GRAPH. This may result in needed data being lost. The graph displayed is the record as of the initial selection of GRAPH and is not updated as new data is recorded. To read the latest data, press MENU, then press ENTER.

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When in GRAPH, the number keys 1 through 9 are assigned to various special functions which are active only in GRAPH. These keys function are described below. Note: The "ENTER" key is not required after selecting the key number. Press MENU at any time to exit GRAPH.

1 **ZOOM IN** - Pressing the "1" key zooms in by a factor of 2 until there is one data point per pixel displayed on the screen. Repeated pressing of the "1" key may be necessary to achieve the greatest resolution.

2 **ZOOM OUT** - Pressing the "2" key zooms out by a factor of 2 each time the key is pressed. The ZOOM OUT key may be used as many times as necessary. The minimum resolution is 128 data points per pixel.

3 **BLOCK START** - Pressing the "3" key places a short vertical line at the cursor to identify the beginning of a block of data to be evaluated with one of the statistical analysis tools. Pressing the "3" key at several positions along the time axis moves the marker to the last key press although the old BLOCK START marker is still displayed until the screen is redrawn. To select a new BLOCK START, first select a new BLOCK END in order for the new block to be used in the statistics tools. The BLOCK START marker is erased when GRAPH is exited.

4 **BLOCK END** - Pressing the "4" key places an intermediate length vertical line to mark the end of a block of data to be evaluated with one of the following statistical analysis tools. Pressing the "4" key at several positions along the time axis moves the marker to the last key press although the old BLOCK END marker is still displayed until the screen is redrawn. The BLOCK END marker is erased when GRAPH is exited.

5 **MAX** - Pressing the "5" key displays the maximum value of the selected variable within the block. The result is displayed on the bottom line of the display.

6 **MIN** - Pressing the "6" key displays the minimum value of the selected variable within the block. The result is displayed on the bottom line of the display.

7 **MEAN** - Pressing the "7" key displays the mean value of the selected variable within the block. The result is displayed on the bottom line of the display.

8 **SAMPLE COUNT** - Pressing the "8" key displays the number of samples in the block. The result is displayed on the bottom line of the display.

9 **DELTA TIME** - Pressing the "9" key displays the time interval within the block. The result is displayed on the bottom line of the display. Data logged under the INTERMITTENT INTERVAL mode will display zero time under this function.

64 VIEW LOG Used to review the actual numerical data for the selected variable. Each display shows the date of the data record and the value of the variable at the logged time. Use the UP and DOWN ARROW keys to scroll through the data records point by point. Upon entry into VIEW LOG, the first display starts at the first data record.

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65 FILE # Two files are available for logging data. Each of these files can be set to log a different variable. Before using any other items in the DATA LOG menu, it is necessary to select the file number using this menu entry.

66 MARK BEG "Mark beginning" is used during the data logging process. Data logged between MARK BEGINNING and MARK END may be analyzed using the STATISTICS (selection 68). This command can be repeated with MARK END anytime **while** data logging and does not affect normal data logging functions.

67 MARK END "Mark" end is used during the data logging process. Data logged between MARK BEGINNING and MARK END may be analyzed using the STATISTICS function. This process can be repeated in conjunction with MARK BEGINNING anytime **while** data logging and does not affect normal data logging functions.

68 STATISTICS Displays four statistical values computed from the data in the block between MARK BEG and MARK END. The controller can continue operation during statistics. **NOTE: Statistics only function properly if the mark commands 66 and 67 have been used.**

MAXIMUM - The maximum value logged within the marked block.

MINIMUM - The minimum value logged within the marked block.

MEAN - The mean value of the data in the block.

TIME INTERVAL - ▲T displays the time interval between the beginning and the end mark of the block. Data logged under the INTERMITTENT INTERVAL mode will display zero for this function.

69 SETUP Used to establish the rules for logging data. These rules, including scaling, apply to all files. Only one scale may be active at a time.

691 CLEAR The CLEAR command clears the data logging file and leaves it empty for new data to be logged.

692 INTERVAL The time interval between logged values. Time is entered in MINUTES:SECONDS. Setting the interval to "000:00" alters the interval to an INTERMITTENT record cycle that saves one sample every time that START (DATA LOGGING menu) is selected.

693 AUTO STOP If AUTO STOP is enabled, the data logger will stop entering data when the file is filled. If not enabled, the data logger will overwrite the existing data in the file after it reaches the end of the file capacity.

694 GR SCALE The GRAPH (63) selection requires display boundaries that can be automatically determined by the controller or manually selected by the user. The Graph Scale 694X set of displays allows the user to set these boundaries.

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6941 MANUAL? Used to enable manual graph scaling by entering values for the MINIMUM, MAXIMUM and HOR AXIS. Responding NO causes the controller to auto scale the data and positions the extremes of the data at the limits of the display area.

6942 MINIMUM Sets the minimum input value for the vertical axis when MANUAL scaling is selected.

6943 MAXIMUM Sets the maximum input value for the vertical axis when MANUAL scaling is selected.

6944 HOR AXIS Sets the input value for the horizontal axis (time) when MANUAL scaling is selected.

695 INPUTS Select the variable to be logged from this list.

PV1	OUTPUT 1
PV2	OUTPUT 2
PV3	OUTPUT 3
SP LOOP1	OUTPUT 4
SP LOOP2	

697 ALLOCATE It is necessary to allocate and size the files for use in data logging. When allocating or resizing the files, any data previously stored in a preexisting file will be lost.

6971 #SAMPLES This parameter establishes the number of sample records that may be contained in a file. ***When you change the number of samples, the number of files is automatically reset to zero and you must also reallocate the number of files in the following menu item.*** Since memory is limited, the number of samples may also be limited depending on the number and length of profile programs and the number of data logging files that are active. You may enter file lengths up to a maximum of 600 samples. The default number of samples is 600 samples. All allocated files have the same length.

6972 # FILES You may allocate up to 2 files for recording different variables. Do not allocate files that you do not expect to use since unnecessary allocation may limit the memory available for profile programs and other files stored in memory. If there is insufficient memory for the number of samples times the number of files allocated, the controller will display an error message. In this case, reduce the number of samples per file and/or the number of files to be allocated.

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