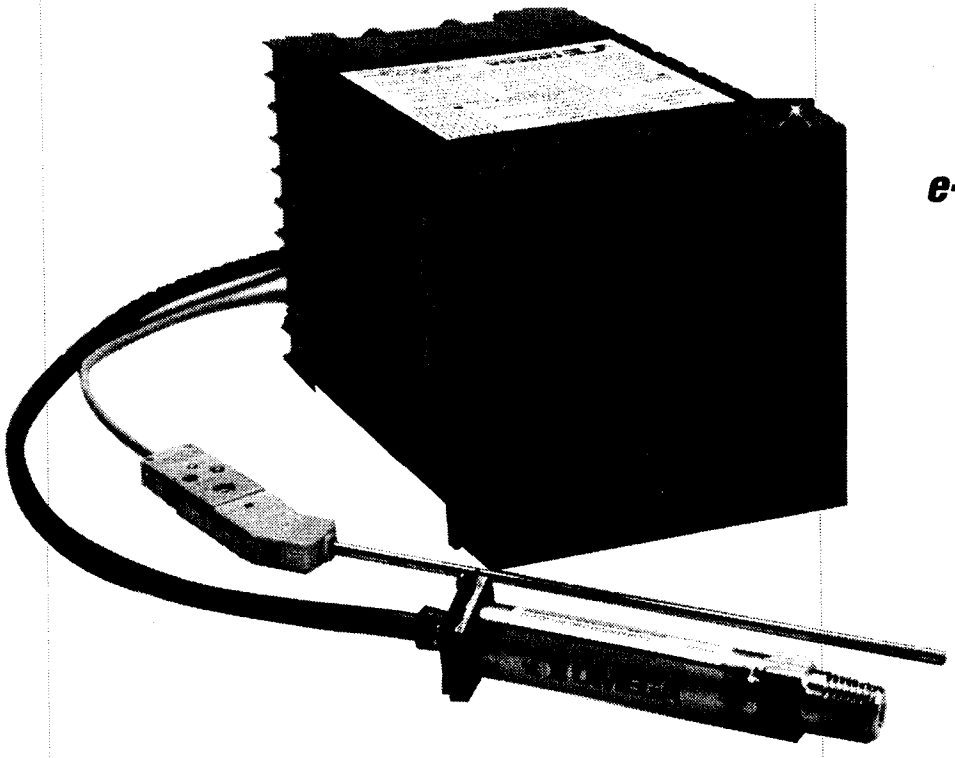
User's Guide



OMEGA®
An OMEGA Technologies Company

http://www.omega.com
e-mail: info@omega.com

CN3000 Series
Dual Input
Programmable Controllers

omega.com™
OMEGA®

OMEGAnet℠ On-Line Service http://www.omega.com	Internet e-mail info@omega.com

Servicing North America:

USA:
ISO 9001 Certified
One Omega Drive, Box 4047
Stamford, CT 06907-0047
Tel: (203) 359-1660 FAX: (203) 359-7700
e-mail: info@omega.com

Canada:
976 Bergar
Laval (Quebec) H7L 5A1
Tel: (514) 856-6928 FAX: (514) 856-6886
e-mail: canada@omega.com

For immediate technical or application assistance:

USA and Canada: Sales Service: 1-800-826-6342 / 1-800-TC-OMEGA℠
Customer Service: 1-800-622-2378 / 1-800-622-BEST℠
Engineering Service: 1-800-872-9436 / 1-800-USA-WHEN℠
TELEX: 996404 EASYLINK: 62968934 CABLE: OMEGA

Mexico and Latin America: Tel: (95) 800-TC-OMEGA℠ FAX: (95) 203-359-7807
En Español: (203) 359-1660 ext: 2203 e-mail: espanol@omega.com

Servicing Europe:

Benelux:
Postbus 8034, 1180 LA Amstelveen, The Netherlands
Tel: (31) 20 6418405 FAX: (31) 20 6434643
Toll Free in Benelux: 06 0993344
e-mail: nl@omega.com

Czech Republic:
Ostravska 767, 733 01 Karvina
Tel: 42 (69) 6311899 FAX: 42 (69) 6311114
e-mail: czech@omega.com

France:
9, rue Denis Papin, 78190 Trappes
Tel: (33) 130-621-400 FAX: (33) 130-699-120
Toll Free in France: 0800-4-06342
e-mail: france@omega.com

Germany/Austria: Daimlerstrasse 26, D-75392 Deckenpfronn, Germany
Tel: 49 (07056) 3017 FAX: 49 (07056) 8540
Toll Free in Germany: 0130 11 21 66
e-mail: germany@omega.com

United Kingdom:
ISO 9002 Certified

25 Swannington Road,	P.O. Box 7, Omega Drive,
Broughton Astley, Leicestershire,	Irlam, Manchester,
LE9 6TU, England	M44 5EX, England
Tel: 44 (1455) 285520	Tel: 44 (161) 777-6611
FAX: 44 (1455) 283912	FAX: 44 (161) 777-6622

Toll Free in England: 0800-488-488
e-mail: uk@omega.com

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

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.

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.

MICROPROCESSOR BASED CONTROLLER **CN3000**

INPUT	1 2 3	OUTPUT	1 2 3 4
TC	☐☐	50mA SSR	☐☐☐☐
RTD	☐☐	500mA SSR	☐☐☐☐
_____mV	☐☐☐	2A EMR	☐☐☐☐
_____mA	☐☐☐	DC TRIGGER	☐☐☐☐
SLIDEWIRE _____	☐	OPEN COLLECTOR	☐☐☐☐
REMOTE SP_____	☐	4/20mA DC	☐☐☐☐
_____	☐☐☐	0/5V DC	☐☐☐☐
_____	☐☐☐	TRANSDUCER PWR	☐☐☐☐
_____	☐☐☐	_____	☐☐☐☐

POWER	CONTROLLER TYPE	COMMUNICATIONS
☐ 120 VAC	☐ SGL LOOP	☐ RS 232
☐ 240 VAC	☐ DUAL LOOP	☐ RS 422/485
50/60 Hz., 12W Max.	☐ POSITION	☐ PRINTER
Terminal 11 must be connected to earth ground.	☐ CASCADE	☐ 8 LOGIC I/O
	☐ _____	☐ 16 LOGIC I/O

THIS INSTRUMENT IS FIELD CONFIGURABLE.
CHECK CONFIGURATION BEFORE APPLYING POWER.
REFER TO OPERATION MANUAL FOR INSTRUCTIONS.

OMEGA ENGINEERING, INC.
P.O. BOX 4047
STAMFORD, CT 06907
(203) 359-1660
1200-1837

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)

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.

MOUNTING

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

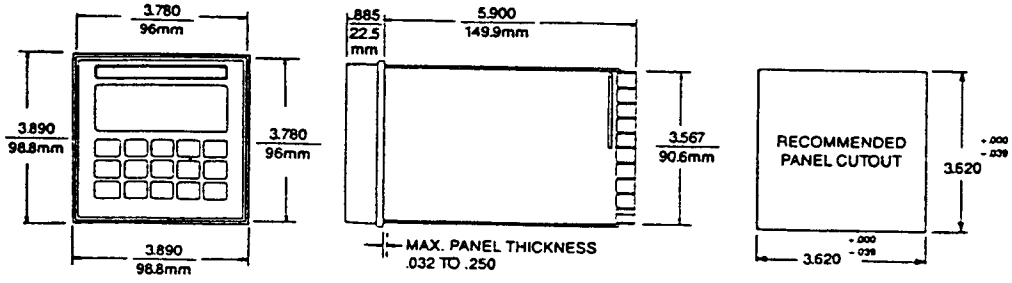
In the normal course of installation and operation, there is no reason to remove the electronic assembly from the case. If the electronic assembly is removed, SPECIAL PRECAUTIONS MUST BE TAKEN TO PREVENT STATIC DISCHARGES FROM DAMAGING C-MOS INTEGRATED CIRCUITS AND CAUSING DEVICE FAILURE.

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.

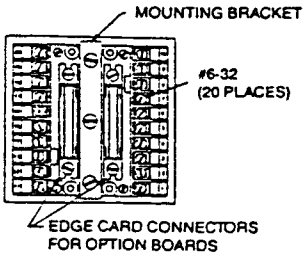
The controller is designed for mounting in a control cabinet or rack where access to the rear terminals is enclosed and where supply and load wiring can be properly terminated. Prepare a standard ¼DIN panel cutout of 3.620 inches by 3.620 inches (92 X 92 mm) and insert the controller into the panel cutout. 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.

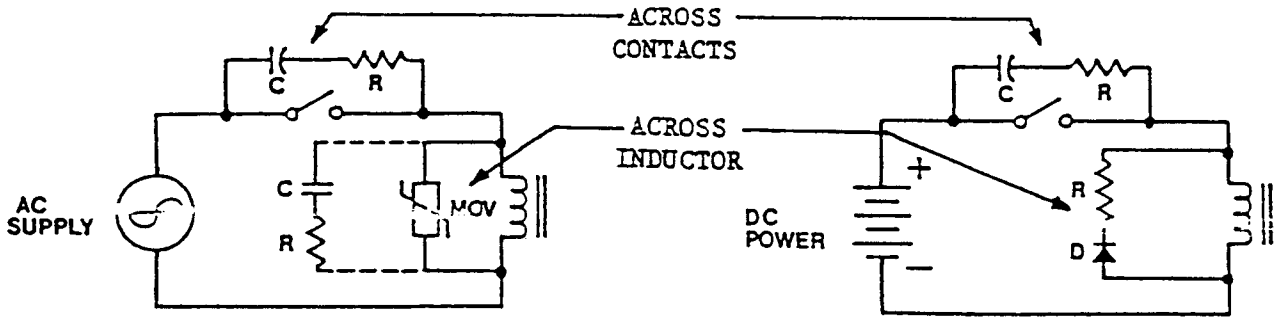
WIRING

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.

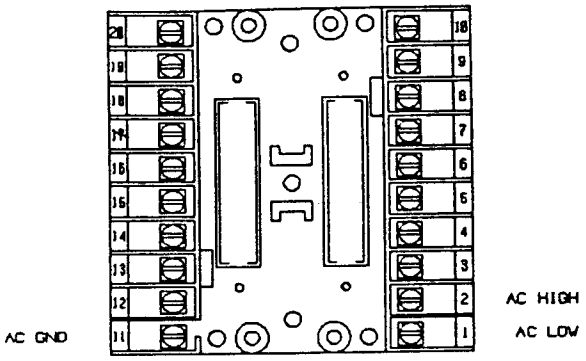
OMEGA PART NUMBER	DESCRIPTION
1821-101	Noise suppression kit includes one 0.1 uF capacitor, one 220Ω resistor, one 47Ω resistor (RC snubber) and one MOV rated for up to 130 VAC at 35 Joules.

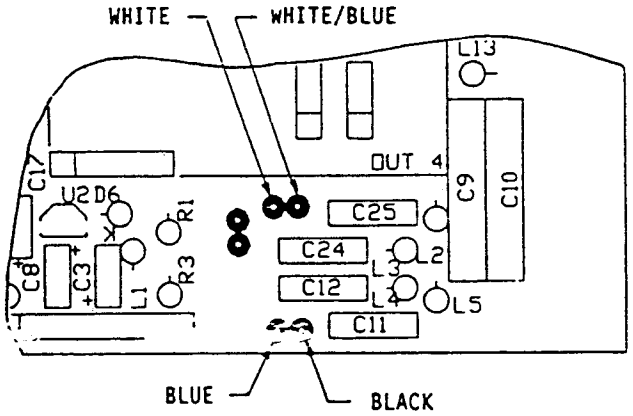
When wiring to the controller, twisted pair with insulated shield is recommended for all signal leads. Make sure that the shield is grounded ONLY at the controller - use AC power ground terminal 11. Be sure to protect against ground loops in signal leads, shields and all other input and output wiring.

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.

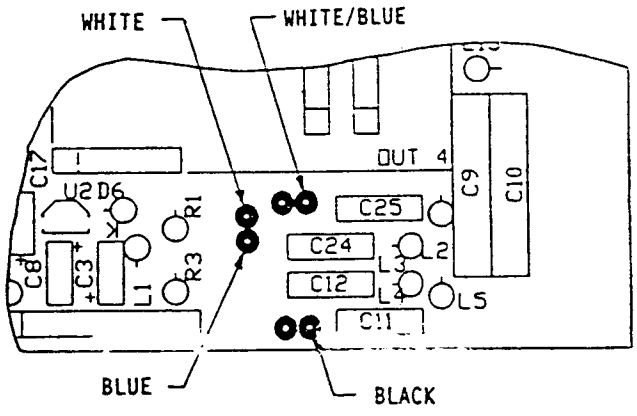
AC SUPPLY WIRING

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



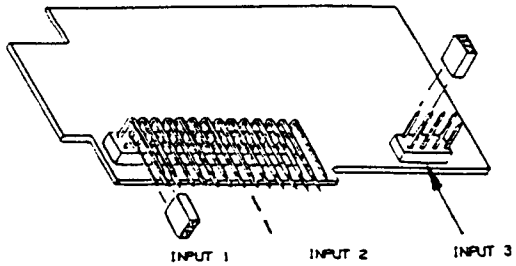
220 or 240 VAC CONNECTIONS

INPUT HARDWARE CONFIGURATION

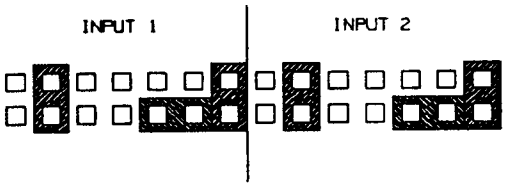
Every controller contains all of the hardware circuitry necessary to implement up to two inputs in any combination of the following types: Thermocouple, RTD, thermistor (with special kit), voltage or current analog inputs. A third current or voltage input is available for inputs such as remote setpoint. 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.

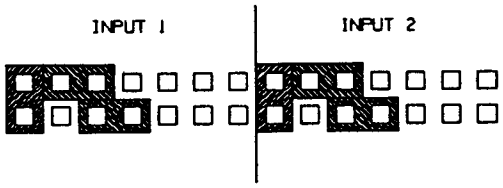
JUMPER BLOCK CONFIGURATION



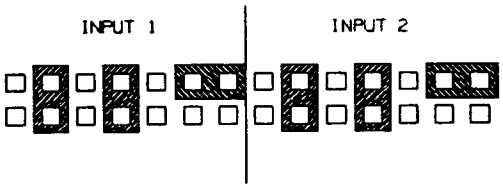
Inputs 1 and 2 need not have the same configuration



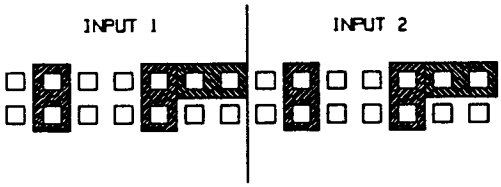
THERMOCOUPLE INPUTS



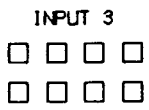
RTD INPUTS & OHMS INPUTS



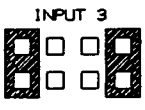
20 mA ANALOG INPUTS



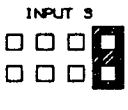
100 mV ANALOG INPUTS



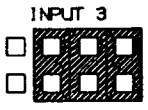
0/5V INPUT
(WITH NO JUMPERS)



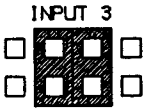
20 mA INPUT



500 mV
INPUT



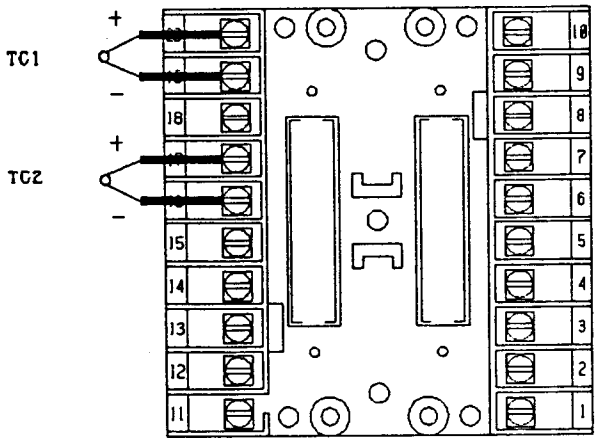
SLIDEWIRE
< 200 Ω



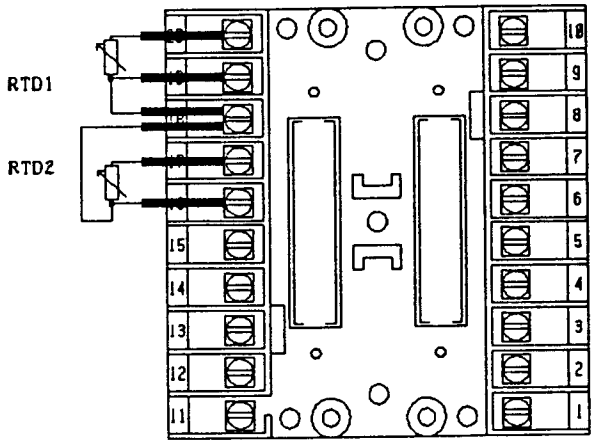
SLIDEWIRE
OVER 200 Ω

INPUT WIRING

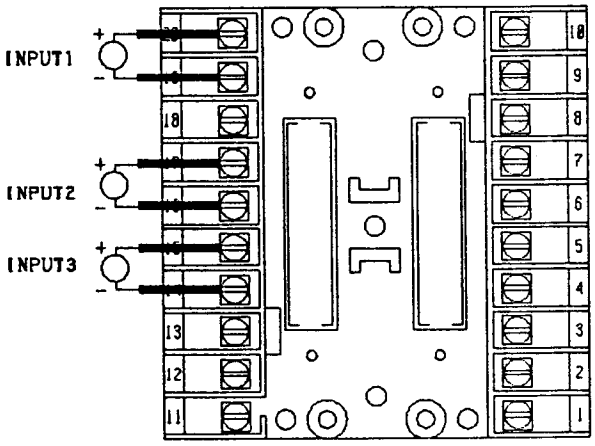
Once the jumper block programming has been performed to match the application, the input wiring can be made to the corresponding rear barrier terminals. The appropriate wiring must conform to the input type selected in the jumper block programming. Remote setpoint input is usually programmed for analog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



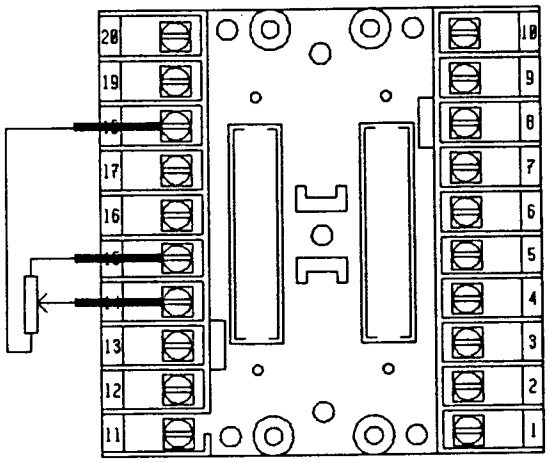
THERMOCOUPLE INPUTS



RTD INPUTS



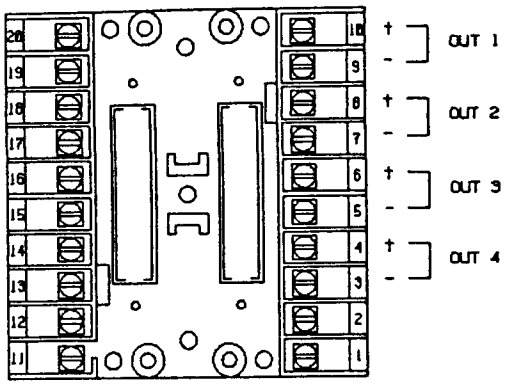
ANALOG INPUTS



SLIDEWIRE CONNECTIONS

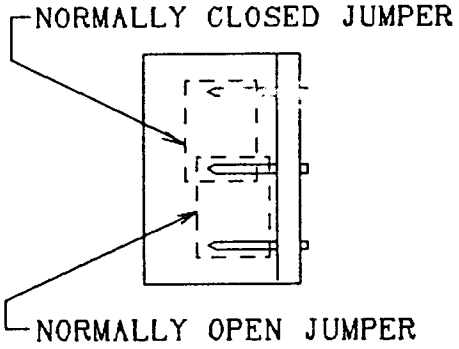
OUTPUT WIRING

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.

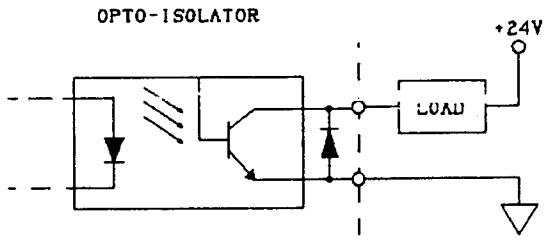
Special care should be taken when wiring these relays to inductive devices such as coils and transformers. Noise suppressors shown on the diagrams in "Noise Suppression" in Section 1 are important to reduce electrical noise.

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

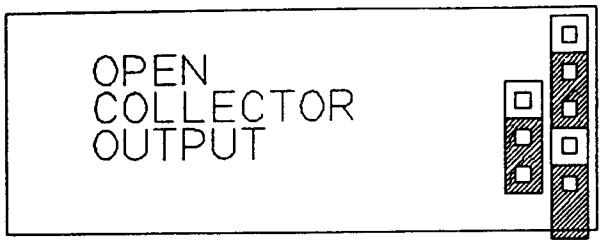
The controller may be supplied with open collector or DC trigger outputs. For the open collector output, the emitter and collector of the NPN output transistor of the photo-coupler module are brought out for user connection. The collector is brought out on the (+) output terminal and the emitter is brought 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.

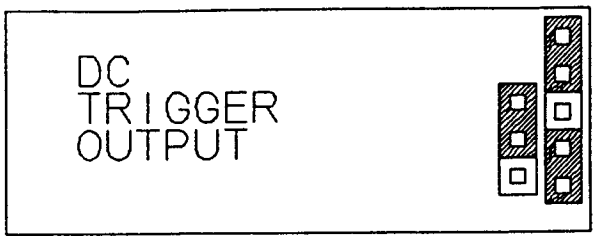


TYPICAL OC CIRCUIT

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.

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.

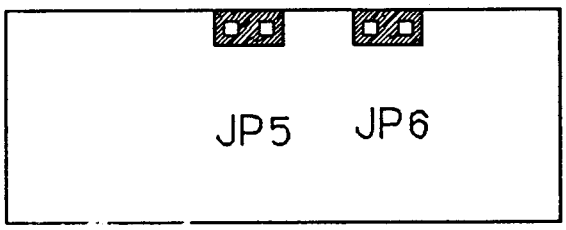




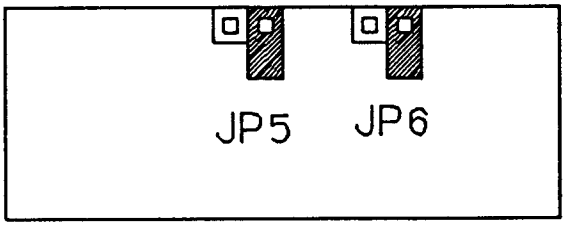
JUMPER PROGRAMMING

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



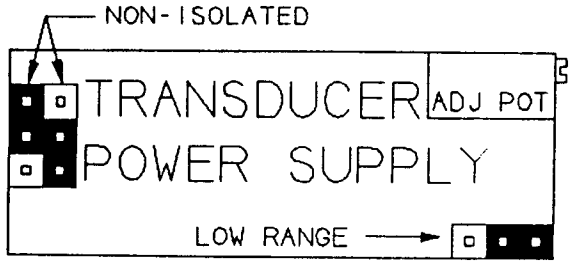
FOR VOLTAGE OUTPUT

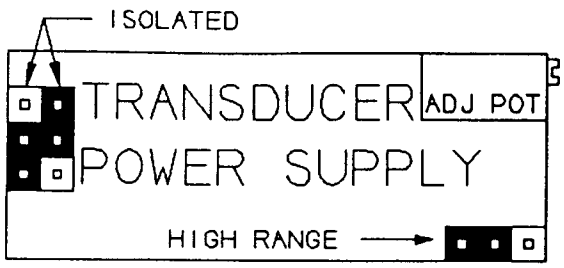
Other output voltage and current values may be supplied on special order from the factory.

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.

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:

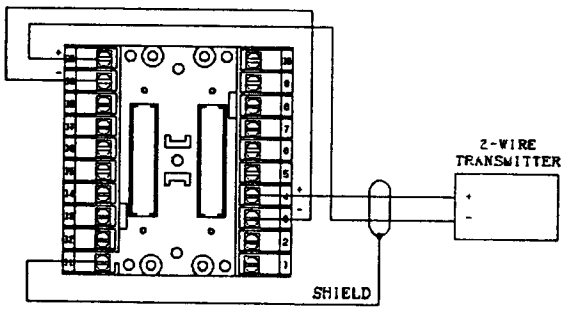


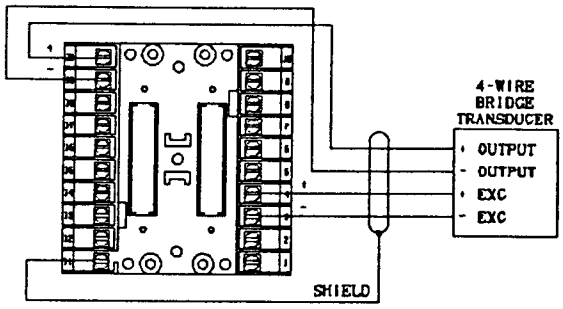


Applications for bridge transducers (i.e., pressure) should use the 5 through 10 volts DC non-isolated supply. Loop powered transmitters may use non-isolated supplies up to 24 volts DC. The isolated supply should only be used when no option card is installed and the isolated supply is required for proper 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.

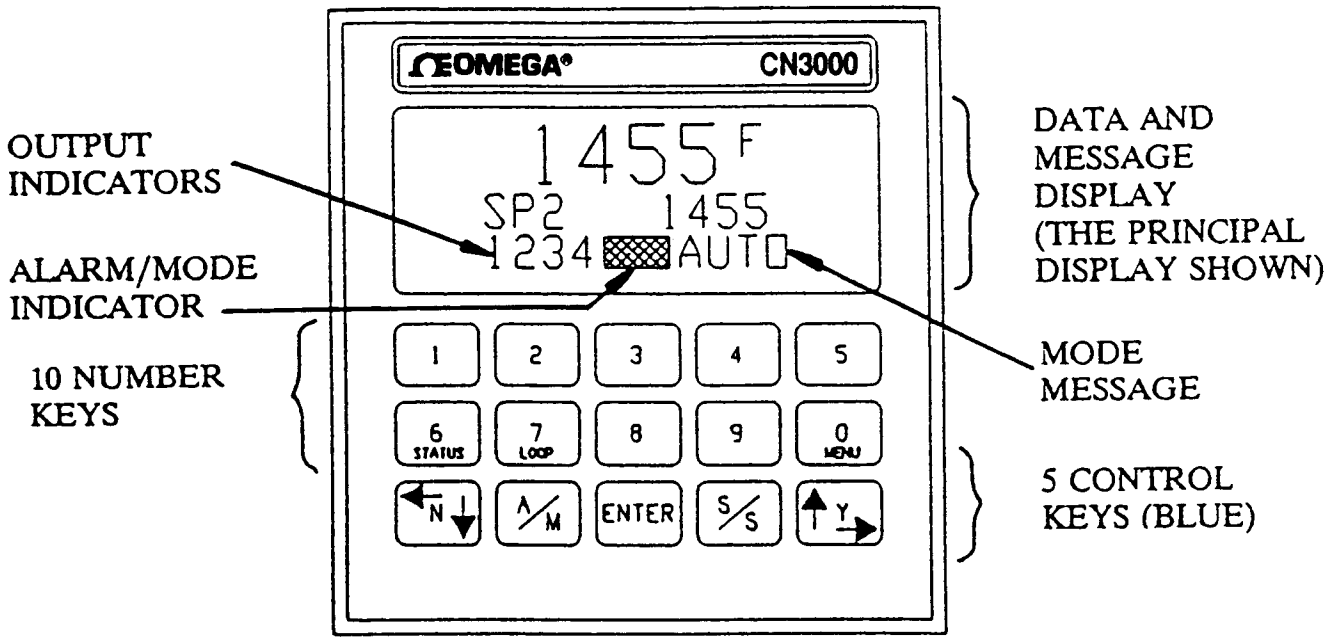




OPTIONS CARD WIRING

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.

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.

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.

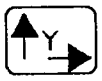
DISPLAY 4 The next display lists the types of output installed for OUT1...OUT4.

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.

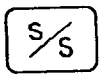
OPERATING KEYS

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.

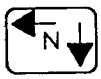


The S/S key switches the controller function between START and STOP. This key is also used to enter a negative SIGN during a numeric data entry and as a SHIFT key to allow easy movement within the menu system.

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.

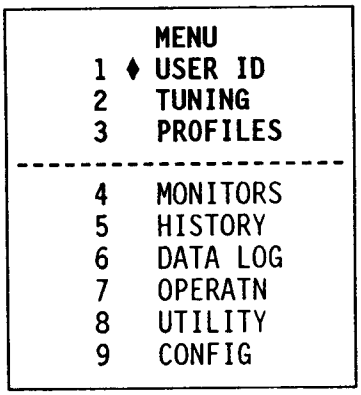
The "7" key (LOOP) switches between the loop 1 and loop 2 Principal Displays. The "7" key may only be used while at one of the Principal Displays or while in manual control and permits switching between loops to access outputs in both loops.

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.



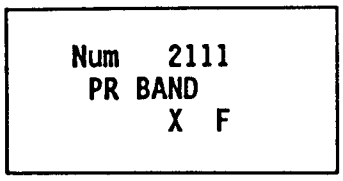
The main menu display shows three menu items at a time. The cursor is the filled diamond (♦). The cursor is positioned by the ARROW keys with the display scrolling to show all menu items (9 maximum).

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.

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.

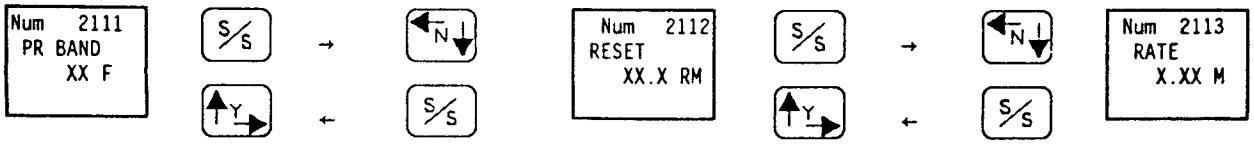
To return to the principal display, press the S/S (shift) key (an UP ARROW will be displayed in the top line) followed by the MENU key.

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.



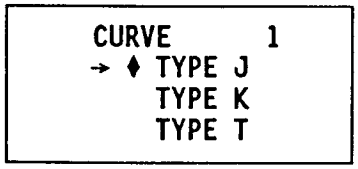
SWITCH ENTRY

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 (→).

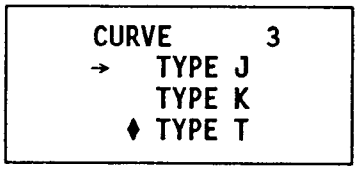
LIST SELECTION

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.

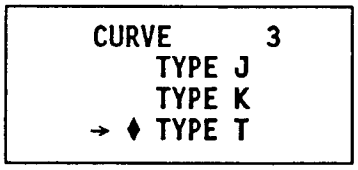
Pressing the **MENU** key exits the list display. However, this display cannot be exited unless the cursor (♦) and the current selection arrow (→) are aligned. If the two are not aligned, first press the **MENU** key to align the cursor with the selection arrow and then press the **MENU** key a second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



Initial Selection



cursor to
new selection



Press ENTER
to confirm

Press MENU to exit

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.

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.

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.

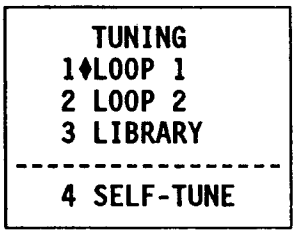
For Self-Tuning, proceed to tuning display number 24. For Manual tuning, the tuning selections start with tuning display number 21. If a tuning display does not appear when addressed, access may have been restricted by the controller security. See USER ID Section 4.

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.

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	- - - -

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.

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.

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.

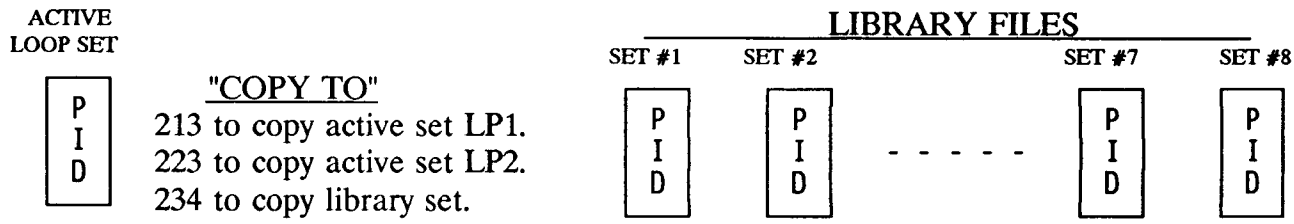
2332 PR BAND Set the proportional band from 5 to 4000 in PV units.

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.



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.

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.

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

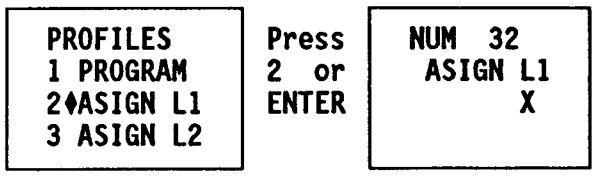
There are 14 different profile control commands to choose from in creating each step of a profile. Each control command has a dedicated display for entering the specific values or decisions for that command. It is important to distinguish between a SEGMENT in a profile and a STEP. A segment is normally 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		

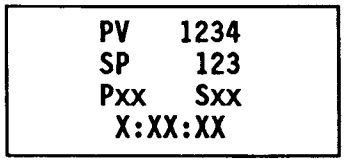
These commands are explained later in this section. A profile is created by assigning a 1 or 2 digit number to identify the profile and then selecting the desired profile control commands one at a time from the list of 14 in a logical order and assigning values or decisions for each command. INSERT and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

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.

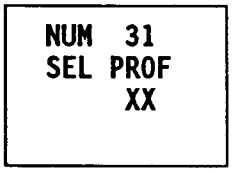


The top line displays the process variable (PV), the second line displays the current target setpoint (SP), the third line displays the profile number (Pxx) and step number (Sxx) and the fourth line displays the time remaining in the step. If an error is encountered during the execution of a profile, 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.

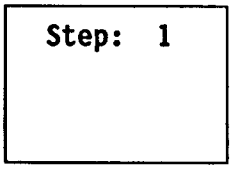
To return to non-profile control, ENTER profile "0" at the ASIGN Lx menu which de-selects profile control.

TO CREATE OR REWORK A PROFILE

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

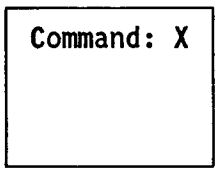


ENTER the desired profile number (between 1 and 99) using the ARROW keys or the numeric data entry system. Since ENTER is used for data entry, press MENU to advance to the next display.



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.

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).

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.***

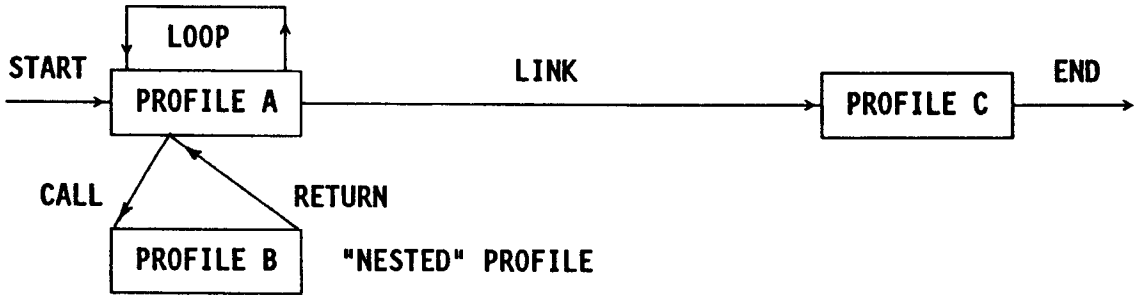
9 TUNSET Up to eight different sets of PID constants (1 through 8) may be used. This command permits the user to assign or change to a new PID set at any step in the profile program. ENTER the TUNE SET number.

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.

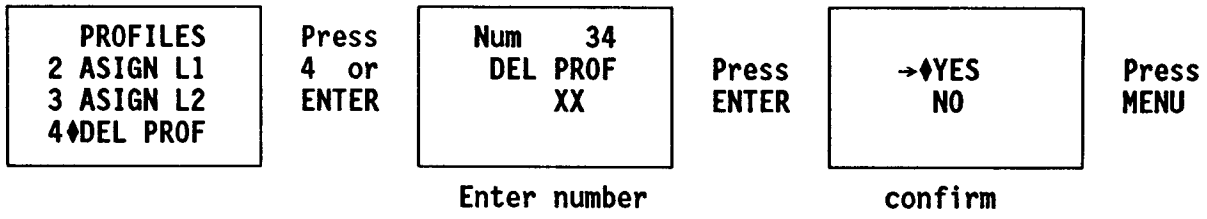
14 LINK A LINK command causes the profile to link with another profile. This command can be used where profiles with more than 99 steps are required. **Enter the target profile number and the target label number within that profile.**

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.

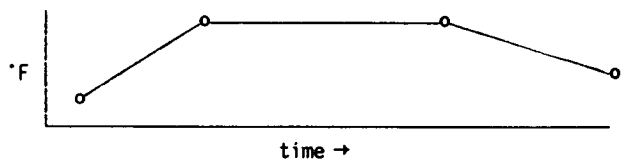


NOTE ON KEY USAGE: The most used key in programming a profile is ENTER. Pressing ENTER tells the controller logic that data will be keyed next or previously keyed data will be loaded into memory. ENTER is also used in profile programming to advance to the next data input. When ENTER is needed for data 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.

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.

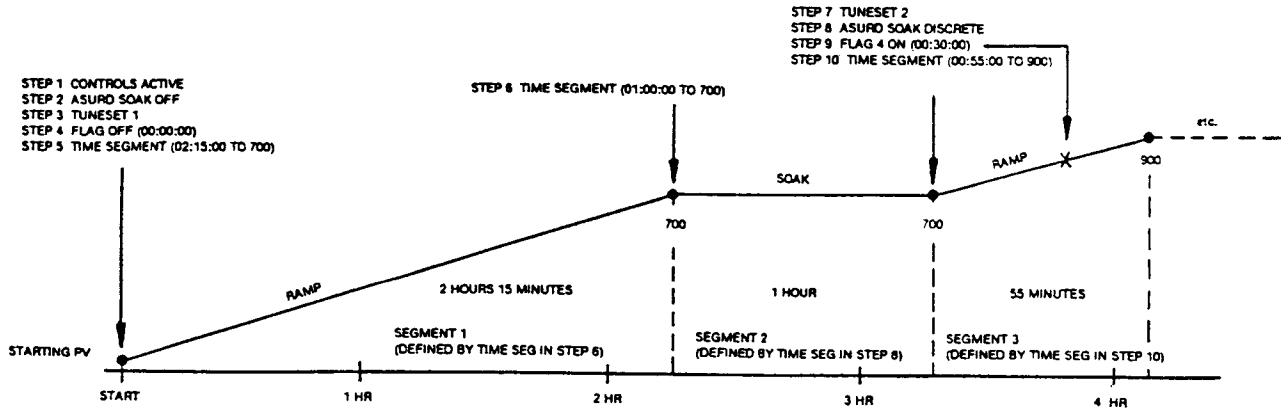
NOTE

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

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.



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
```

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
```

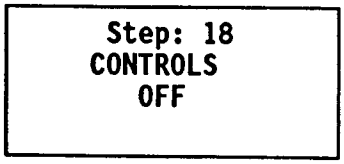
(START SEGMENT)

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
```

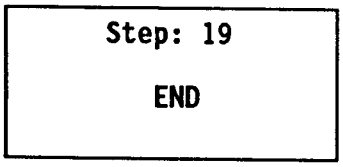
(SET CONDITIONS)

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.

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.

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.

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.

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.

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.

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".

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.

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.

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.

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.

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".

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.

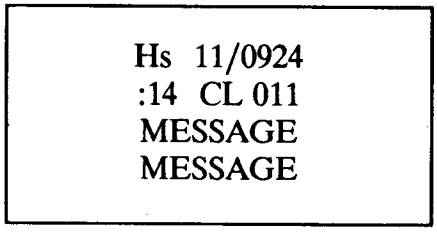
Many combinations of protection can be achieved through the use of a MONITOR. The MONITOR(S) give the added benefit of alarm annunciation in the event of open sensor input. Other Monitors are created in a similar fashion.

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.

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

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.

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.

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.

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.

EXAMPLE OF SETTING UP A DATA LOGGING FILE

To use data logging to view the process variable (PV) during the tuning process, proceed as described below. (Refer to the DATA LOG MENU MAP in Section 12.)

1) From the principal menu press MENU-6-9 to step through to SETUP.
2) The process to be controlled is a typical heating application. Estimate a time between data samples that would yield a usable set of data. For this example, set INTERVAL to 003:00 minutes.
3) Since the default file will log 600 data points, we need not change the allocation of 600 samples for file #1. A sample every 3 minutes will permit a data record of up to 30 hours so enabling AUTOSTOP is not needed. By not enabling AUTOSTOP, the file will be overwritten after the initial 30 hour record so that a continuous record of the last thirty hours of operation is always available.
4) In this application, log the process variable. In the INPUTS sub-menu, select FILE1 IN and pick INPUT 1.
5) For this application, let the controller set the scale based on the range of data recorded. Therefore select "NO" under GR SCALE/MANUAL? to enable auto scaling.
6) It is good practice to start off with a clean record file. Therefore, select CLEAR to erase all data that may be remaining in the file from a previous application.

The data logger has now been setup and is ready to go. Select file #1 in menu item 65 to enable a review of file #1 once data has been recorded. Enable the data logger using the START command. STOP disables the data logger and prevents recorded data from being overwritten. Use the MARK BEG and MARK END to evaluate data using the STATISTICS sub-menu during controller operation or view and analyze the data in GRAPH.

SECTION 10 - OPERATN

The OPERATN menu provides selections for accessing functions relating to the controller's operation. Many of these menu selections duplicate operating key functions that are available directly using the front keypad. These functions are also provided here in order to facilitate their inclusion in macros.

71 START L1 This item will START Loop 1 when selected.

72 START L2 This menu item will START Loop 2 when selected.

73 STOP L1 This menu item will STOP Loop 1 when selected.

74 STOP L2 This menu item will STOP Loop 2 when selected.

75 PAUSE This menu item will PAUSE both Loop 1 and Loop 2 if a profile is running in either or both loops. No action will occur in loops which are not running a profile.

76 RESUME This menu item will cause a profile running in either Loop 1 or Loop 2 that has been previously PAUSED to RESUME when selected. If no profile is running, selecting this parameter has no effect.

77 S/S CFG This menu item permits configuration of the way the front panel **START/STOP** key works for two loop controllers. Selecting **CURR LP** (CURRENT LOOP) restricts the **START/STOP** key to operate only the current loop. If the second loop is to be affected, then a press of the "7" (LOOP) key while at the Principal Display will allow use of the **START/STOP** key in the other loop.

Selecting **BOTH LPs** (BOTH LOOPS) enables the **START/STOP** key to affect both loops simultaneously.

For single loop controllers, this menu item has no effect. This selection is ignored when the controller is started or stopped through the OPERATN menu commands.

78 REM SP This menu item enables or disables the remote setpoint feature. DISABLE turns OFF the remote setpoint selection previously made. Selections of L1 RSP, L2 RSP and L1&2 RSP enable the remote setpoint for Loop 1, Loop 2 or Loop 1 and Loop 2 respectively. When enabled, remote setpoint preempts the front panel setpoint, a setpoint generated by a MATH routine or a profile setpoint.

79 COMM The selections in this sub-menu allow operating parameters for the serial communication option to be entered. If a serial communications option card has not been installed, these parameters are ignored.

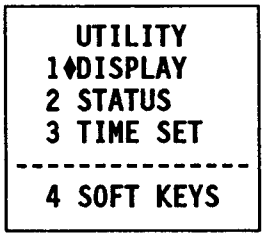
791 UNIT Enter the unit number from 0 to 63. Both the EIA-232 (RS-232) and RS-422/485 communications option cards require the use of the unit number in the communications protocol. Remember that no two units on the same communications link can have the same unit number. The default unit number is unit #1.

792 BAUD Select the baud rate to be used in serial communications. The list includes baud rates of 9600, 4800, 2400 and 1200 baud. The default baud rate is 9600 baud.

SECTION 11 - UTILITY

Utility menu items provide a means to change some display characteristics, review the controller status, set the internal calendar/clock and write macros. (Refer to the UTILITY MENU MAP in Section 13.)

8 UTILITY From the Main Menu, select Item 8 "UTILITY".



81 DISPLAY Used to customize some of the parameters relating to the display.

813 DP - LP1 The decimal point position applies to both the process variable (PV1) and setpoint (SP1) in Loop 1. The decimal point location will only be saved on power down for loops with process inputs. The decimal point position is a display function only and does not change any data value previously entered. The decimal position affects all data entry displays such as proportional band where PV units are used. The decimal position is counted from the right and can be from 0 to 4 places.

814 DP - LP2 The decimal point position applies to both the process variable (PV2) and setpoint (SP2) in Loop 2. The decimal point location will only be saved on power down for loops with process inputs. The decimal point position is a display function only and does not change any data value previously entered. The decimal position affects all data entry displays such as proportional band where PV units are used. The decimal position is counted from the right and can be from 0 to 4 places.

82 STATUS Accesses the controller status screens.

821 ALARM Displays the number of any MONITOR (including ALARMS) that is tripped.

823 OUTPUT Displays the output percentage from 0 to 100.0% for each of the outputs (1 to 4).

824 PROFILE Displays the process variable (PV), target setpoint and profile number and step when profile control is active. For two loop controllers, the **"7"** key may be used to switch the display between the two loops.

825 LOGIC IO This status display provides information on the 16 optional I/O channels. The bank "A" or "B" designation is assigned in the CONFIGURATION menu (972 or 973). The diamond symbol (◊) represents a logic input. The symbol changes to a filled diamond (♦) when the channel is active (TRUE). The round symbol (O) represents a logic output (the symbol looks like an "O"). The symbol changes to a filled circle (●) when the channel is active (TRUE).

The right arrow symbol (→) selects bank "A" or bank "B" and is switched by either the UP or DOWN ARROW keys. Pressing any of the number keys from 1 through 8 toggles that numbered channel in the selected bank. If the input channel is assigned to a logic card or if the output channel is driven by a monitor, toggling the channel will cause the channel indication to be overwritten with the current status and may not indicate the toggle state. If the I/O option card is not installed or if the I/O position has been de-selected (see 97 in Section 12), the bank may be used as switches for use in any place that a flag may be used such as in profiles or monitors. De-selecting a bank will also allow use of the status screen to manually simulate the logic I/O channel operation for checking the controller operation.

83 TIME SET Sets the internal calendar and clock. If the clock saver option (RTC) has been installed, then the controller calendar and clock will continue to run even though the unit has been powered down. If the RTC has not been installed, the clock stops on power down and restarts where it stopped on power up. If functions that use the clock such as the timer, printer, data logging or history functions must indicate the correct time, then the calendar and clock must be reset on power up for controllers without the RTC option. The presence of the RTC option is displayed in the third sign-on display.

831 HRS:MIN Enter the time in hours and minutes (left to right) based on a 24-hour clock. Set the time to some close future time since the START command is used to reset the clock after all of the values have been entered.

832 DATE Enter the day of the month from 1 to 31.

833 MONTH Enter the number corresponding to the month from 1 to 12.

834 YEAR Enter the 4-digit year.

835 START After all of the calendar and clock values have been keyed in, select START to reset the controller clock to the new values.

836 SHOW CLK Show clock displays the present calendar and clock information. The first line shows the month and year while the second line shows the "day-of-the-month/hours-minutes:seconds" based on a 24-hour clock.

837 SET BRTC This command is used to update the backup real-time clock/calendar option to the currently stored date and time. It has no affect for controllers which do not have the clock/calendar option.

84 MACROS Macros allow a preprogrammed set of keystrokes to be invoked through a single keystroke, by a logic input or by a flag. Six keys (1, 2, 3, 4, 5 and 8) are available for assignment as macro keys. Flags 128 through 135, I/O channel flags 16 through 31 and logic input flags 32 through 34 may also be used to trigger a macro.

Keypad macros are usable only while at the Principal Display. To utilize a pre-recorded macro key, press the desired number key and the preprogrammed sequence of keystrokes will execute. If there is no macro recorded for the key pressed or if the macro has been locked, the key press is ignored.

Flag macros will only execute while the controller is at the Principle Display. If a macro flag is tripped while another top level display such as one of the status displays is being viewed, the controller automatically scrolls to the operator display for the running of the macro. If the user wishes the unit to return to a top level display other than the main operator display after completion of the macro, the key strokes needed to reach the desired display must be included at the end of the programmed macro.

Flag macros will not execute while the user is in the menu structure or while another macro is executing. Macros that have been tripped go into a queue and will be run after the user returns to the Principal Display and/or after the currently running macro has been completed.

Macros assigned to flags 128 through 135 are activated when the individual flag is set in either MONITORS or PROFILES. Macros may also be tripped from logic I/O channels (Flags 16 through 31) or logic input channels 1, 2 or 3 (Flags 32 through 34).

If no logic I/O option board is installed, macros tied to either bank's logic I/O channels may be toggled through the UTILITY/STATUS/LOGIC IO display (825). Toggling from its inactive to active state (the indicator changes from ○ to ● for an output or from ◊ to ♦ for an input) and returning to the Principal Display will allow a macro assigned to that Logic I/O channel to initiate. The flag must be toggled from OFF to ON and must be ON when the user leaves the LOGIC (825) display for the macro to run.

If a Logic I/O option board is installed, the I/O status display will indicate the state of the assigned logic inputs but cannot be toggled as described for controllers with no logic I/O option board installed. Attempting to toggle an I/O line will cause the display to flicker but the indicated state will not change. The flicker, however, is recognized as a tripping of the flag and the macro will run when the user returns to the Principal Display. Normally, an optional I/O channel is tripped by an external logic level signal change which will also initiate the assigned macro.

A single Logic I/O channel may be used to run two macros (to start and stop the controller for example) by using two of the user assignable macro flags (128 through 135) to trip off two separate MONITORS. The two macro flags will be set by two different triggers defined in MONITORS. One trigger will be defined to set a macro flag when the Logic I/O flag is active (= 1) and the second trigger will be defined to set another macro flag when the same Logic I/O flag is inactive (= 0). In this way, a single logic input can be used to start and stop the controller.

Macros bypass keypad security. When recording a macro, keep in mind that macros should be set up only for functions that *any operator* is authorized to use. Do not end a macro within the menu system unless the purpose of the macro is to provide quick access to a particular display.

When a macro is run, the (9) key (LAST ENTRY) is automatically reset to display the USER ID screen. This is done to ensure that the operator cannot access an unauthorized path within the menu system since the "9" key ordinarily allows access to the last menu displayed which may not be privileged to the operator.

NOTE: Although using the ARROW keys while recording macros is valid, there is a potential for error. DO NOT use the ARROW keys to change a numeric value inside a macro since the base or starting number may be different at execution time than at recording time. For creating numeric values inside a macro, the user is advised to use direct digital entry.

CAUTION: Keys selected while recording a macro are ACTIVE and may alter preselected values or settings. After recording a macro, review the values and/or settings in those menu items that were accessed during macro recording.

841 MACRO # The macro number menu allows the user to select a front panel number key (1, 2, 3, 4, 5 or 8), macro flags #128 through #135, I/O channels A 1 through I/O A 8, I/O channels B 1 through I/O B 8 or LOGC IN1 through LOGC IN3 for use as a macro trigger. The macro assignment to that key, flag or logic channel may then be recorded, played back in slow motion or locked.

842 RECORD To program a new macro or overwrite an existing macro for the selected key, logic input or flag. Selecting RECORD changes the display to the Principal Display. REC is displayed in the message block. Subsequent keystrokes are recorded as the macro. At the Principal Display, keys 1 through 9 cannot be recorded and an error message will display. The keystrokes will not be recorded. Press any key to clear the message. Also note that the A/M key may be used in the creation of a macro (RECORD sub-menu) but can never be recorded in a step. Any of the number keys may be recorded when not at the Principal Display. A single macro may not have more than 250 keystrokes. If RECORD is selected while already in the process of recording a macro, the recording is restarted and the previous keystrokes are lost.

During the macro definition, pressing the **A/M** key will display the following RECORD sub-menu.

8421 END MAC Used to end the recording of a macro definition.

8422 WAIT VAL This command allows a pause to be inserted in the macro. WAIT VAL may only be selected when in a numeric entry, switch entry or list entry display. The keystrokes used after selecting WAIT VAL are not recorded until the keystroke used to leave the data entry screen is pressed. When a WAIT VAL is encountered during the execution of a macro, the macro execution is suspended while the user enters a new value or selection. When the user exits the data entry display using any valid keystroke that will exit a display, the macro execution is resumed.

8423 IGNORE Used to return to the macro definition without entering additional keystrokes.

There are a number of error messages that may be displayed while recording a macro. If such a message does occur, note the message and press any key to clear the message.

EXAMPLE OF WRITING A MACRO - The following is an example of assigning key 5 as a macro so that a new PID set can be selected when the "5" key is pressed.

Starting from the Principal Display,
Press the MENU key to access the menu system,
Press "8-4-1" in sequence to reach the MACRO # display,
Scroll to "KEY 5", press "ENTER" and "ENTER" again to select KEY 5,
Press S/S followed by the Down Arrow (next list item) key to turn on the record function,

The Principal Display appears with REC in lower right corner,
Press "0-2-3-1" in sequence to access the display for PID set number entry,
Press the A/M key to access the RECORD sub-menu screen,
Press "2" to select WAIT VAL so that the user may select the required PID set,
Press "0-4" in sequence to enter the copy display,
Press "1", "ENTER" and "ENTER" again to copy the selected PID set to LOOP 1,
Press S/S followed by MENU to return to the Principal Display,
Press the A/M key to access the RECORD sub-menu,
Press "1" to end the macro,
The Principal Display will show and the MACRO definition is completed.

From the Principal Display, when the "5" key is pressed, the PID set display is immediately shown allowing the new set number to be entered. Pressing MENU causes the macro to resume, changing the PID set and returning to the Principal Display.

843 SLO PLAY Used to execute, in slow motion, the macro selected by MACRO #. Each display in the macro is displayed briefly and a user key press is required at any WAIT VAL data entry display. If no macro is recorded for the macro number selected, an error message informs the user and pressing any key will clear the error message.

844 LOCKMAC? Used to lock or unlock the selected macro. A locked macro remains in memory but does not execute. If no macro is recorded for the selected key or flag, an error message informs the user and pressing any key will clear the error message.

86 PRINTER This sub-menu item includes setup parameters for the parallel printer option if installed and allows a selection for transmitting data generated within the controller to the printer. A printer output may also be initiated by using a monitor which sets an appropriate flag (see Section 7).

861 PRINTTST If a parallel printer option card is installed in the controller and connected to an external printer, selecting this menu item causes the controller to output a continuous string of test characters to the printer for use in testing the printer operation. The printer test output is discontinued by pressing any key on the controller keyboard.

862 TEXT LEN This selection allows you to select the number of lines to be printed on the printer page before a form feed. If set to zero, no form feed is transmitted and the controller assumes a continuous paper roll. The default selection is "0".

863 USE LF? Some printers require a line feed character to be sent after a carriage return in order to advance the paper to the next line. Answer YES if your printer requires a line feed character or NO if the line feed is not required. Refer to your printer manual for information on your printer specifications.

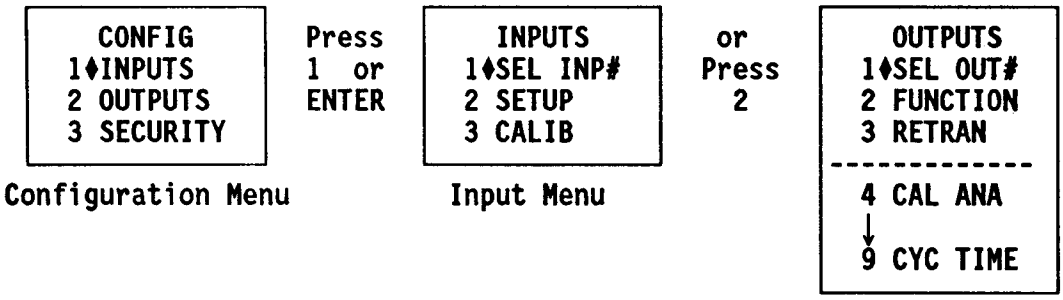
864 PRN DLOG If you respond YES at this menu item, the DATA LOGGING file will be sent to the printer after you have exited the menu item. If more than one file has been allocated in DATA LOGGING, all files will be printed. The default selection is NO.

865 PRN STAT If you respond YES at this menu item, the statistics generated between MARK BEG and MARK END in menu STATISTICS (68) will be sent to the printer after you have exited the menu item. The default selection is NO.

SECTION 12
CONFIGURATION PROGRAMMING

Configuration programming matches the controller to the application, i.e., select inputs and outputs, establish the security parameters and provide controller calibration. A controller configured prior to delivery may not need configuration. However, it may be desirable to review the selections. (Refer to the CONFIGURATION MENU MAP in Section 13.)

9 CONFIG From the Main Menu select Item 9 "CONFIG".



INPUT CONFIGURATION

91 INPUTS A large selection of thermocouple, RTD and current/voltage input programs are stored in the controller and may be selected from the Input configuration menus. There are three possible inputs (INPUT 1, INPUT 2 and INPUT 3). The selected input program must agree with the input hardware configuration (see Section 1 - INPUT HARDWARE CONFIGURATION). Each input may be a different type. If the controller has been preconfigured, these selections have already been performed and access to these displays will only be needed to change the selections. Each of the INPUTS is configured using the following displays.

Input configuration check list:

1. Select the input by number (911), i.e, 1, 2 or 3.
2. In SETUP (912): Select the type of input (9122)
   Select the proper calibration curve (9123)
   Select input averaging (9124)
   Select unit C or F (9125)
   Define CJC (9126 - 9127)
   Define RTD if used (9128 - 9129)
3. Input calibration (913) should not be necessary.
4. Check configuration of jumper on the input board (see Section 1).

911 SEL INP# Select the input number to define or change from 1 to 3. Selecting this number will load the previously stored data for the selected input into each of the data displays for review or change.

912 SETUP To configure the input to match the application, use the following menu items.

9122 TYPE Used to select the input type from a list (T/C, RTD, CURRENT and VOLTAGE). The thermistor sensor is a special case and uses the slidewire selection on input 3. (Note that the thermistor input also requires a hardware kit which is not detailed in this manual.)

9123 CURVE Used to select the input linearization. Any of the thermocouple, RTD or thermistor linearizations may also be used with a non-linearized analog transmitter input. The thermocouple selection may be changed from one type to another on a unit calibrated for thermocouple input or an RTD selection may be changed on a unit calibrated for RTD input without needing to recalibrate the controller.

CURVE ID	CURVE DESCRIPTION	SPAN LIMITS	
TYPE J	I/C - Thermocouple	-350/+2100° F	-212/+1148° C
TYPE K	C/A - Thermocouple	-350/+2500° F	-212/+1371° C
TYPE T	Cu/C - Thermocouple	-400/+750° F	-240/+398° C
TYPE E	Cr/C - Thermocouple	-350/++1800° F	-212/+982° C
TYPE R	Pt/Pt13%Rh - Thermocouple	-50/+3200° F	-45/+1760° C
TYPE S	Pt/Pt10%Rh - Thermocouple	-50/+3200° F	-45/+1760° C
TYPE B	Pt6%Rh/Pt30%Rh - Thermocouple	+70/+3300° F	+21/+1815° C
TYPE N	NiCrSi/NiSiMn - Thermocouple	-200/+2300° F	-128/+1260° C
PLAT II	Platinel II - Thermocouple	-100/+2500° F	-73/+1371° C
W5/W26Re	W5%Re/W26%Re - Thermocouple	+32/+4200° F	0/+2315° C
W3/W25Re	W3%Re/W25%Re - Thermocouple	+32/+4300° F	0/+2315° C
W/W26Re	W/W26%Re - Thermocouple	+32/+4200° F	0/+2315° C
Ni/N18Mo	Ni/Ni18%Mo - Thermocouple	0/+2390° F	-15/+1310° C
98./3920	98.129Ω Pt @ 0° C - 3920 ppm RTD	-225/+1110° F	-142/+598° C
100/3850	100Ω Pt @ 0° C - 3850 ppm RTD	-225/+1560° F	-142/+848° C
100/3890	100Ω Pt @ 0° C - 3890 ppm RTD	-225/+1160° F	-142/+626° C
100/3911	100Ω Pt @ 0° C - 3911 ppm RTD	-225/+1160° F	-142/+626° C
100/3926	100Ω Pt @ 0° C - 3926 ppm RTD	-142/+1160° F	-142/+626° C
100/4270	100Ω Cu @ 0° C - 4270 ppm RTD	-148/+500° F	-100/+260° C
100/6180	100Ω Ni @ 0° C - 6180 ppm RTD	-75/+350° F	-59/+176° C
120/6720	120Ω Ni @ 0° C - 6720 ppm RTD	-110/+500° F	-78/+260° C
150/6704	150Ω Ni @ 25° C - 6704 ppm RTD	-58/+560° F	-50/+293° C
200/3850	200Ω Pt @ 0° C - 3850 ppm RTD	-300/+660° F	-184/+348° C
200/3900	200Ω Pt @ 0° C - 3900 ppm RTD	-32/+608° F	0/+320° C
200/3926	200Ω Pt @ 0° C - 3926 ppm RTD	-300/+660° F	-184/+348° C
OHMS	Ohmmeter Range	45 to 460Ω	
PROCESS0	Zero Based Process Input		
PROCESS4	Live Zero Process Input (20% od span)		
Thm 2252	2252Ω Thermistor (spcl hardware req'd)	-58/+300° F	-50/+150° C

Other input ranges and types may be supplied on special order from the factory.

9124 INPUT AVG Most applications require some input signal averaging to prevent random noise and other transients from affecting the controller. Select from 1 to 64 samples to be averaged to alter the response to input changes. The default value is 5 samples.

9125 TO DEGREE C? Select YES to display in degrees C. Select NO to display in degrees F for all Thermocouple, RTD and Thermistor inputs.

> CAUTION
>
> Responding YES to this menu item does not automatically convert any parameter value previously entered in PV units such as proportional band, auxiliary setpoint, etc. All such items must be reentered in the converted values in their respective entry displays.

9126 EXT CJC? Select YES to allow the input to ignore the built-in internal thermocouple cold junction reference for thermocouple inputs. When the internal cold junction compensation is disabled, enter the external cold junction reference value in the next menu item.

9127 EXT CJC= When the internal cold junction compensation is turned off ("YES" in the above menu item), thermocouple inputs require another value to be used in the calculations. This value may be the reference value for an external thermocouple reference. Enter the value in millivolts referenced to ice.

9128 RTD 0.1? Select YES for 0.1° resolution RTD inputs. Select NO for 1° normal resolution. For 0.1° RTD, any parameters entered in PV units such as the proportioning band, setpoint, etc. must be reentered in the proper units in their respective entry displays.

9129 RTD LEAD The controller will compensate for 3-wire sensor lead resistance to indicate within its rated accuracy. For applications with high resistance leads, the accuracy will be improved if the lead resistance is entered at this display.

Enter the resistance in ohms measured between the ground lead (terminal 18) and the negative lead (terminal 16 or 19). (The leads must be disconnected from the controller when the measurement is made.) Lead resistance up to 5 ohms produces an error less than 0.1% of span when 0 (the default) is entered.

913 CALIBRATE Used to recalibrate the controller. This procedure is rarely required and should only be performed by persons having the proper equipment. Field recalibration will replace the factory calibration. Do not recalibrate the controller unless a test of the instrument's indication shows that it must be recalibrated or a change in the input configuration is required.

9131 CALIB ZERO This display is used to calibrate each input to its low calibration reference.

For thermocouple and voltage inputs, the message "CALIB ZERO - APPLY 0.000mV" appears. For current inputs, the message CALIB - ZERO - APPLY 0.000mA" appears. For any of these inputs, shorting the input terminals will produce a suitable signal.

For RTD inputs, the message "CALIB ZERO - APPLY 249 Ohms" appears. Using copper wire, connect a precision decade box to the appropriate terminals in the 3-wire RTD configuration (refer to INPUT WIRING in Section 1). For RTD inputs, set the decade box for 249Ω±0.01Ω.

With the proper input signal applied, wait two minutes at this display, then press the A/M key to remeasure the input and replace the previous calibration data. Pressing any other key will leave the previous calibration data intact and the display will revert to the CALIBRATE menu.

9132 CALIB SPAN When INPUT 1 and 2 are configured as thermocouple or voltage inputs, the message "CALIB SPAN - APPLY 100.00mV" appears. For current inputs the message "CALIB SPAN - APPLY 20.000mA" appears. When INPUT 3 is configured for voltage, the message "CALIB SPAN - APPLY HI SIGNAL" appears.

For thermocouple inputs, apply 100 mVDC from a precision calibration source. For voltage and current inputs, apply the appropriate input signal from a precision calibration source. This may be 100mV, 500mV, 5V or 20mA as selected by the input configuration jumpers (refer to JUMPER BLOCK CONFIGURATION in Section 1). In some cases, other values may be used for special applications. Consult the factory.

For RTD inputs, the message "CALIB SPAN - APPLY 450 Ohms" appears. For RTD inputs, set the decade box for 450Ω±0.01Ω.

With the proper input signal applied, wait two minutes at this display and then press the A/M key to remeasure the input and replace the previous calibration data. Pressing any other key will leave the previous calibration data intact and return to the CALIBRATE menu.

9133 CALIB CJC Calibrate CJC provides for calibration of the cold junction compensator used with thermocouple inputs. This step is not required for RTD, current, voltage or thermistor inputs. Connect a Type J thermocouple with the tip in stirred ice water to the input terminals. Press the A/M key to direct the controller to measure and store the input. Pressing any other key will direct the controller to ignore the command. After measuring the input, the previous menu is displayed.

9134 LOW DISP Used to scale the display for an analog input. The value entered here will be the displayed value in PV units at the LOW INPUT value (9136). The default value is zero. This menu item must be zero for thermocouple, RTD and thermistor inputs.

9135 HI DISP Used to scale the display for an analog input. The value entered here will be the displayed value in PV units at the HI INPUT value (9137). The maximum value that can be displayed is 20,000 counts. For thermocouple, RTD and thermistor inputs, this menu item should normally be zero.

9136 LOW INPT Used in scaling the display to enter the analog input value in normalized units that corresponds to the LOW DISP value (9134). When the controller is calibrated, values are stored that correspond to 0 and full input. These two calibration points set constants at 0 and +31,565 internal counts. The plus counts are mirrored at -31,565 counts to provide a full bipolar input. Thus, the LOW INPT value is entered in normalized units of the calibration range of -31,656 to 31,565 counts. For example, if the input range is 0 to 20 mA and the low display value is to begin at 4 mA, then the LOW INPT value should be (4/20 × 31,565) or you should enter 6313. For a 0 to 10V input calibration, if LOW DISP is to be at 1V, then LOW INPT should be (1/10 × 31,565) or 3156. The default value for LOW INPT is zero. This menu item should be zero for thermocouple, RTD and thermistor inputs which disables this function.

9137 HI INPT Used in scaling the display to enter the analog input value in normalized units that corresponds to the HI DISP value (9135). Like the LOW INPT, it is entered in normalized units of the calibration range of -31.656 to 31,565 counts. For example, if the input range is 0 to 20 mA and the high display value is to be equal to 20 mA, then the HI INPT value should be (20/20 × 31,565) or you should enter 31,565 counts. For a 0 to 10V input calibration with the HI DISP at 9V, then HI INPT should be (9/10 × 31,565) or 24,409. For thermocouple, RTD and thermistor inputs, this menu item should normally be zero.

OUTPUT CONFIGURATION

92 OUTPUTS Each of the 4 outputs may be assigned to one of two control loops and may perform different applications. This configuration is accomplished as described below:

Output configuration check list:

1. Select the output by number (921), i.e, 1, 2, 3 or 4.
2. In FUNCTION (922): Assign the output to a loop (9221)
   Select the type of output (9222)
   Select output limits (9223 - 9226)
   For retransmission set parameters (923X)
3. Output calibration (924) should not be necessary.
4. Make sure output modules on output board agree with the output programming.

921 SEL OUT# Used to select the output number from 1 through 4 (the plug-in output module must be compatable with the configuration parameters selected below). Selecting an output number will load the previously stored data for the selected output into each of the data displays for review or change. An output must be selected before it can be configured.

922 FUNCTION Used to configure an output to the application.

9221 ASSIGNMENT Select the controller loop and output application for the list below.

NONE/ALM Use this item if no output is installed or if the output is not used. This selection is also used if the output is used for a monitor function (i.e., alarm).

L1 PRI R A primary reverse acting output in control loop 1. (Typically used to control a heater.)

L1 PRI D A primary direct acting output in control loop 1. (Typically used for cooling control.)

L1 PRI S Split output action may only be used with an analog output and splits the analog output so that it functions as a heating (reverse) output above 50% output and as a cooling (direct) output below 50% output. Primary tuning constants will be used for the reverse action and the secondary tuning constants will be used for the direct action. This selection often called "split range output" assigns the output to loop 1.

L1 SEC R A secondary reverse acting output in control loop 1. (Typically used to control a heater.)

L1 SEC D A secondary direct acting output in control loop 1. (Typically used for cooling control.)

L1 SEC S Split output action may only be used with an analog output and splits the analog output so that it functions as a heating (reverse) output below 50% output and as a cooling (direct) output above 50% output. Primary tuning constants will be used for the reverse action and secondary tuning constants will be used for the direct action. This selection often called "split range output" assigns the output to loop 1.

L2 PRI R A primary reverse acting output in control loop 2. (Typically used to control a heater.)

L2 PRI D A primary direct acting output in control loop 2. (Typically used for cooling control.)

L2 PRI S Split output action may only be used with an analog output and splits the analog output so that it functions as a heating (reverse) output above 50% output and as a cooling (direct) output below 50% output. Primary tuning constants will be used for the reverse action and the secondary tuning constants will be used for the direct action. This selection often called "split range output" assigns the output to loop 2.

L2 SEC R A secondary reverse acting output in control loop 2. (Typically used to control a heater.)

L2 SEC D A secondary direct acting output in control loop 2. (Typically used for cooling control.)

L2 SEC S Split output action may only be used with an analog output and splits the analog output so that it functions as a heating (reverse) output below 50% output and as a cooling (direct) output above 50% output. Primary tuning constants will be used for the reverse action and secondary tuning constants will be used for the direct action. This selection often called "split range output" assigns the output to loop 2.

RETRANS This code assigns an analog output to serve as a retransmitting type output. The variable to be retransmitted is assigned in menu item RTRN SEL in this same OUTPUTS configuration menu.

9222 TYPE Following the assignment of an output to a control loop and selecting its application use, the next display requires the output type to be selected from a list for that output.

NONE/ALM Only used when the output is not used or if the output is used for an alarm (MONITOR) function.

TIME PR Select Time Proportional control EMR, SSR, open collector and DC trigger outputs only.

FRQ PULS For pulse output using EMR, SSR, open collector and DC trigger outputs to operate displacement pumps. Pulse frequency varies from a minimum of 1 pulse every 8 minutes to the maximum pulse frequency selected in MAX PULS (9226). The pulse duration is 250 ms for low pulse rates and switches over to a 50% duty cycle when the pulse rate exceeds 2 pulses per second.

ANALOG For analog proportional outputs only.

ANAPHLIN This analog output drives a non-linearized phase-fired power controller so that a nearly linear control results.

ON/OFF Select ON/OFF control output for EMR, SSR, open collector and DC trigger outputs only. For a reverse output, the output will stay ON until the PV is the ± DIFF'L value (see TUNING) beyond the setpoint value and turns ON the ± DIFF'L value below the setpoint. For a direct output, this action reverses. ON/OFF outputs are not affected by slew rate or maximum or minimum output limits.

9223 MAX PWR Used to limit the output power. Enter the maximum power limit in percent. This setting may be overridden by a monitor if so configured. The default setting is 100%.

9224 MIN PWR Used to maintain a minimum level of output power to the load. Enter the minimum power level in percent. This setting may be overridden by a monitor if so configured. The default setting is 0%.

9225 MAX SLEW Used to set the maximum rate-of-change for an output in percent per minute. This setting may be overridden by a monitor if so configured. Monitors are unaffected by slew rate settings. Control outputs are constrained by slew rate limitations at all times including during START/STOP operation. The slew rate limit is 32,000 percent per minute.

9226 MAX PULS When the output is configured under OUTPUT TYPE as a FREQUENCY PULSE output, this menu item sets the pulse rate from 1 to 511 pulses per minute.

923 RETRAN Used to configure an analog output for retransmission of one of the controller variables.

9231 RTRN SEL Used to select the variable to be retransmitted.

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

9232 0% AT Used to set the value of the retransmitted variable at 0% output.

9233 100% AT Used to set the value of the retransmitted variable at 100% output.

924 CAL ANA The CAL 0% and CAL 100% entries allow you to adjust the actual voltage or current delivered by an analog output module at 0% output and 100% output. This procedure is rarely needed and should only be performed if the proper equipment is on hand to enable a proper calibration. Do not recalibrate an output unless a test of the output shows that it must be recalibrated or if the type of output is changed.

As a part of the procedure to calibrate an analog output, it is necessary to first set either 0% or 100% output under manual control for the output to be calibrated.

The actual number displayed (or entered) here represents internal controller values used in generating analog output signals. A larger number generates a larger analog output signal. Beyond this, the scale for these values is not standardized but most analog output cards will deliver the same output values within a few percent when given the same numbers here. Some nominal entries for analog outputs are listed below:

CURRENT OUTPUTS:			VOLTAGE OUTPUTS:		
0mA	≈	4360	0V	≈	958
4mA	≈	9600	1V	≈	2560
20mA	≈	31104	5V	≈	8968
			10V	≈	16976

Note that the output from normal Analog Output Modules in the voltage mode will not swing all the way to 0 volts; typically they swing below 500 mV depending on the load. The addition of an external load resistor (1K, ½W across the + and - output terminals) generally allows the output to fall below 50 mV (0.5% of a 10V span) if the application does not require the output to sink significant current. A hardware modification is available to allow these modules to swing to 0V without load. Modules with the hardware modification cannot be used in the current mode.

9241 CAL 0% This item provides a method of calibrating an analog output at 0% output. Connect an appropriate instrument (either a voltmeter or milliammeter) to measure the output being calibrated. Use direct numerical entry or the UP or DOWN ARROW keys to change the displayed number to a new value. You ***MUST*** exit this display to the OUTPUTS display using the MENU key to enter the change on the output. Repeat this step until the output measures correctly.

9242 CAL 100% This item provides a method of calibrating an analog output at 100% output. Connect an appropriate instrument (either a voltmeter or milliammeter) to measure the output being calibrated. Use direct numerical entry or the UP and DOWN ARROW keys to change the displayed number to a new value. You ***MUST*** exit this display to the OUTPUTS display using the MENU key to enter the output change. Repeat this step until the output measures correctly.

925 DEFAULT This item is used only for unassigned outputs that have NONE/ALM selected for OUTPUT/FUNCTION/ASSIGNMENT. The default status of an output may either be ON or OFF. The DEFAULT setting determines the status of an output when de-energized. The default selection may be toggled to test a particular output, e.g, an alarm.

This menu item must be coordinated with MONITOR/FORCEOUT (417 and 427). When DEFAULT is OFF, then FORCEOUT must be ON and vice versa.

926 CYC TIME Used for time proportioning outputs only. The cycle time is the total of the ON plus the OFF time for a SSR, OC, DC TRIGGER or EMR output and should generally be set as long as practical without causing load cycling. Enter the CYCLE TIME from 1 to 511 seconds for the output being configured.

927 ANNUNS This selection provides a means for configuring the output annunciator display on the bottom row of the principal display. Each output (#1 to #4) may have the display logic inverted. Answering NO causes the output annunciator to be lit when the output is turned on by the controller. Selecting YES causes the annunciator to be lit when the output is off.

93 SECURITY The keypad security system utilized by the controller permits all of the first level menu items to be locked out to prevent unauthorized access and change of the parameters. The various aspects of the security system are described below:

931 SECURITY The security item is used to enable or disable the keyboard security system. Select YES or NO on the appropriate display. The use of digital communications and macros are not affected by the keypad security system.

932 SEC VISI Use security visibility to set menu item blanking according to user privilege. Answering YES allows all menu texts to display even through the security system will prevent access to the same item. Answering NO will blank out all menu item text lines where security will not allow access. The MASTER user will automatically see all menu text lines.

933 SEC IDS Use security identification codes to assign up to 7 user security codes, all with different privileges, plus the security code for the MASTER user. Selecting any of the eight users presents a display allowing the entry of a 5-digit numeric code (either positive or negative) to identify users.

Please note that when supplied from the factory, the MASTER user ID is default "0". Since the USER ID number is automatically reset to zero after a power down, it is necessary to set the MASTER user to some number other than 0 to permit enabling of the security system. Take advantage of the user number reset on power down by retaining one of the user ID's set to zero. By doing this, you can program those screens available to an unprivileged user for USER ID "0" and only those screens will be available on power up.

Remember that once the security system has been enabled, you must remember the numbers assigned since there is no method of accessing menu items under control of the security system other than by entering the proper USER ID.

934 PRIVILG Use the security privilege assignment menu to set the menu item accessibility according to the user number. The MASTER user automatically has access to all menu items. Privilege levels are assigned by entering a numeric value from 0 to 127 which is the sum of the numbers assigned to each of the following menu topics:

TUNING	1
PROFILES	2
MONITORS	4
HISTORY/DATALOG	8
OPERATION	16
UTILITY	32
CONFIG	64
	127

To prevent a user from accessing one or more of the above topics, eliminate the number(s) representing that topic from the entered sum value and the controller will block that user from entering the menu topics so deleted.

When the USER ID is entered on power up or when ever the USER ID is changed, the corresponding security privilege assigned to the user number is enabled and only the screens allowed to that user may be accessed.

94 MATH (OPTIONAL) This selection of menu entries can be used to configure relationships between inputs, outputs, setpoints and the process variable. PV bias as well as feed-forward, cascade, ratio control and linearization of an input can be accomplished with sixteen equations (EQ01-EQ16), 16 integer constants (K01-K16), 16 memory locations (M01-M16) and three 31-segment linearizations.

Each equation consists of two operands, an operator and a destination for the result. In the equation A + B = C, A and B are operands, + is the operator and C is the destination.

Equations can be chained for complex calculations (as shown in example #2 in this section). The equations are evaluated in sequential order from equation #01 through #16. Attention to parenthesis and the order of operations is important. To achieve a correct mathematical result, calculations may need to be entered in the equation list in a particular order.

NOTE: Using the MATH feature reduces the update rate for the display and outputs. MATH routines should be kept as short and simple as possible.

WARNING: To guard against hazard to personnel and property, the MATH feature should be programmed only by qualified technicians. Errors in logic, equation sequence or equation definition can result in unexpected control responses.

MATH menu selections are described in the following text.

941 CONSTNTS This menu entry enables the user to enter 16 integer constants (±32,000 counts per integer constant) for use in equations (described under 942). Constants K01 through K16 may be selected by using the UP and DOWN ARROW keys to scroll through the 16 constants. To set the value of a constant, press the ENTER key and use direct numeric entry of the value. Pressing the ENTER key again will accept the value and complete the entry procedure.

Select another constant using the UP/DOWN ARROW keys or return to the previous menu by pressing the MENU key.

For NON-INTEGER constants such as 1.25, set a constant (K01, for example) to 125 and a second constant (K02) to 100. The equation **K01 / K02 --> M01** divides the first constant by the second constant and puts the result in memory location (M01). (Memory locations are described under menu 942.) Memory locations can store real numbers. Memory location (M01) is now 1.25 which may be used in a subsequent equation.

942 EQUATION A list of 16 sequentially numbered equations are provided in this menu. The sample display illustrates how the non-integer constant equation from the example shown in 941 above would appear in EQ #01.

MXX M 1 through M16 are memory locations. Memory locations used as an operand are read by the equation. When memory locations are used as a destination, they are written to and can be read in a subsequent equation. After a power down, the memory locations will be reset to zero and recalculated.

KXX K01 through K16 are integer constants which have been entered in menu item 941. Constants are saved in non-volatile memory and are restored after the controller has been powered down.

OUTX OUT1 through OUT4 are the final output values in counts (0 to +32,000). These variables are conditioned and are limited by such parameters as MAX PWR (9223) and MIN PWR (9224).

OTX% OT1% through OT4% are the final output values in percent (0.0 to 100.0 in 0.1% resolution). These variables are conditioned and are limited by such parameters as MAX PWR (9223) and MIN PWR (9224). These variables are the same as OUT1 through OUT4 except that they are in percent.

OTXR OT1R through OT4R are the output power levels requested by the control algorithm before they are conditioned by limiting parameters. These variables range in value from 0 to +32,000.

OPERATOR LIST The operators described below define the functions to be applied to the operands in an equation.

END The end operator is the default operator for an unprogrammed equation. END disables any equation in which it is selected. The controller begins with equation 01 and sequentially steps through the equations until it encounters an equation with an END operator. **Any equations beyond the first one with an END operator are ignored.**

STOR This operand is used to move operand 1 to the destination without performing any operation on it.

+ The addition operator is used to sum the first and second operand.

- The subtraction operator is used to obtain the difference between the first operand and the second operand.

× The multiplication operator is used to obtain the product of the first and second operands.

/ The division operator is used to divide the first operand by the second operand.

SQRT The square root operator is used to extract the square root of the first operand. The second operand should be blank spaces for this equation.

LINX The linearizer operators (LINA, LINB and LINC) are used to process the value of an operand through one of three linearizations programmed by the user under LINEAR X (943/944/945). When the LINX operator is used, the second operand should be blank spaces.

NLOG The logarithm operator takes the natural logarithm of the first operand. The second operand should be blank spaces for this equation.

NOP The No Operation operator is used to temporarily turn off an equation without rewriting the equations further on in the list.

DESTINATION LIST The list of destinations includes 26 locations that may be selected for the output of an equation.

(BLANK) Blank spaces is the default destination for an equation before it has been programmed.

PVX PV1 through PV3 are the values that appear in double height on the Principal Display. They are also the process measurements used by the control algorithm.

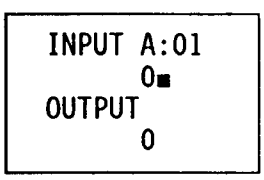
SPX SP1 and SP2 are the setpoint values for the respective loops in display units. NOTE: When setpoint is used as a destination, the display will indicate that remote setpoint is active and profile control will be prohibited.

SPBX SPB1 and SPB2 are the setpoint biases for Loop 1 and Loop 2.

ASPX ASP1 and ASP2 are the auxiliary setpoints for Loop 1 and Loop 2.

MXX M 1 through M16 are memory locations. Memory locations may be either read or written to and are used to save the output value of one equation for input to another equation. Values saved in memory are recalculated after the controller has been powered down.

943/944/945 LINEAR X These menus enables the user to define three 31-segment piece-wise linearizer curves. A linearizer is applied to an operand in a MATH equation by selecting the LINX operator. Refer to the drawing below for a typical view of the linearizer data entry display.



The letter and number at the right of the first line of the display identifies the linearizer as A, B or C and the breakpoint number from 01 through 32. The label, INPUT (on the first line), is shown above its assigned value (on the second line). The label, OUTPUT (on the third line), appears above its assigned value (on the fourth line).

To display a breakpoint, enter the appropriate linearization menu and use the UP and DOWN ARROW keys to scroll through the list until the desired breakpoint appears.

To change the values for the breakpoint, display the breakpoint data, then press the ENTER key. The input value for the breakpoint must be expressed in the same units as the operand that will appear in the equation with the LINX operator. Use direct numeric entry to set the value for INPUT. When the desired number has been entered, press the ENTER key to accept it. NOTE: Consecutive input values must increase in magnitude as the breakpoints increase from 0 to 32.

The square cursor now appears to the right of the OUTPUT value. The output value for the breakpoint must be expressed in the same units as the destination. Use direct numeric entry to set the value for OUTPUT and then press the ENTER key to accept it. The controller uses the slope between consecutive breakpoints to determine the value for the destination.

The ARROW keys can now be used to select another breakpoint or press the MENU key to return to the previous menu.

MATH EXAMPLES The MATH routines provide a very flexible programming structure that enables the controller to handle sophisticated signal conditioning. The following examples are provided to aid in the understanding of the MATH programming steps and demonstrate some of the power inherent in the MATH package.

EXAMPLE #1 - We desire to operate the controller with two thermocouple inputs operating in differential to control a single output. This example assumes that INPUT 1 and INPUT 2 have already been configured and calibrated as thermocouple inputs of an appropriate thermocouple type and that appropriate output programming has been performed.

1. Move to the equation display (942) and use the UP/DOWN ARROW keys to arrive at the EQ01 (Equation #01) display.

2. Press the ENTER key to initiate the cursor at the Operand 1 entry. Use the UP/DOWN ARROW keys to scroll the operand list until the Operand INP1 is displayed. (This operand is the scaled and conditioned signal from Input 1.) Press the ENTER key to accept the selection and advance to the next line.

3. Use the UP/DOWN ARROW keys to scroll the operator list until the subtraction (-) operator is displayed. Press ENTER again to select the operator and advance to the third line.

4. Use the UP/DOWN ARROW keys to scroll the operend list until the Operand INP2 is displayed. (This operand is the scaled and conditioned signal from Input 2.) Press the ENTER key to accept the operand and advance to the fourth line.

5. Use the UP/DOWN ARROW keys to scroll the output list until the destination PV1 is displayed. (This destination is the Loop 1 input to the control portion of the program.) Press the ENTER key to accept the selection.

6. The equation is now complete. Input 2 will be subtracted from Input 1 and the result sent to the control algorithm portion of the controller. Press the MENU Key 4 times to return to the Principal Display. The controller will now utilize Loop 1 to control the outputs that have been assigned based on the difference in the two thermocouple inputs.

EXAMPLE #2 - For this example, we chose to enter a complicated formula that will control the output based on the computation using two inputs. The two inputs are configured as a thermocouple temperature input for INPUT 1 and an input from a transducer on INPUT 2. It is assumed that proper output configuration has also been performed. The formula that we will use is shown below:

$$\text{Display} = \frac{33 * (\text{Ln}(TR/100)) + T}{1 - (7/54) * (\text{Ln}(TR/100))}$$

where:

T = the measured temperature (INPUT 1)
TR = the measured transducer input (INPUT 2)

1. The first step is to rewrite the formula to break it into a number of simple equations that can be handled by the controller MATH routines. These proposed equations are listed below.

```
(EQ01)    TR / 100  =  M01 (Memory #1)
(EQ02)    Ln(M01)   =  M02 (Memory #2)
(EQ03)    33 * M02  =  M03 (Memory #3)
(EQ04)    M03 + T   =  M04 (Memory #4)
(EQ05)    7 / 54    =  M05 (Memory #5)
(EQ06)    M05 * M02 =  M06 (Memory #6)
(EQ07)    1 - M06   =  M07 (Memory #7)
(EQ08)    M04 / M07 =  PV1
```

Equations 1 through 4 resolve the numerator and Equations 2 and 5 through 7 resolve the denominator. Equation 8 provides the final solution and displays it as PV1.

2. Move to the CONSTNTS menu (941) and enter the value 100 for K01 (Constant #1). Enter 33 for K02, 7 for K03, 54 for K04 and 1 as K05. Press the MENU key to return to the MATH menu.

3. Change to the equation display (942) and start with equation EQ01. To enter the equation INP2 / K01 = M01 for (TR/100), press the ENTER key to initiate the cursor at the operand 1 entry. Use the UP/DOWN ARROW keys to scroll the operand list until the operand INP2 (processed input 2 - transducer input) is displayed. Press the ENTER key to accept the selection and advance to the next line.

4. Use the UP/DOWN ARROW keys to scroll the operator list until the division (/) operator is displayed. Press the ENTER key to accept the selection and advance to the third line.

5. Use the UP/DOWN ARROW keys to scroll the operand list until K01 (constant #1 with a value of 100) is displayed. Press ENTER again to accept the operand and advance to the fourth line.

6. Use the UP/DOWN ARROW keys to scroll the destination list until M01 (memory #01) is displayed. Press the ENTER key to accept the selection.

7. Use the UP/DOWN ARROW keys to change EQ02. We will enter equation #2 M01 NLOG N/A = M02 for (Ln(TR/100)).

8. Enter M01 (memory #01) as the first operand, NLOG as the operator, "blank" as the second operand and M02 (memory #02) as the destination.

9. Change to equation EQ03 which will be K02 * M02 = M03 for (33 * (Ln(TR/100)). Select K02 (which is 33) for the first operand, multiplication (*) as the operator, M02 (memory #02) for the second operand and M03 (memory #03) for the destination.

10. Equation EQ04 will be M03 + INP1 = M94 for (33 * (Ln(TR/100)). Select M03 (memory #01) for the first operand, addition (+) as the operator, INP1 (processed input 1 - temperature) for the second operand and M04 (memory #04) for the destination.

11. EQ05 will be K03 / K04 - M05 to calculate (7/54). EQ06 will be M05 * M02 = M06 for 7/54 * (Ln(TR/100)). EQ07 will be K05 - K06 = M07 for (1 - (7/54 * (Ln(TR/100))).

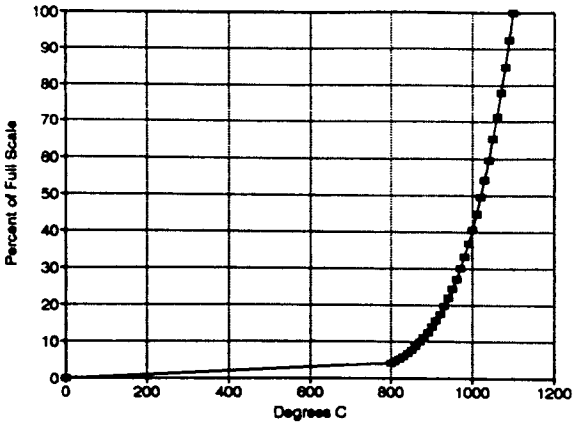
12. Equation EQ08 will be M04 / M07 = PV1 for {(33 * (Ln(TR/100)) + T)} / {1 - (7/54 * (Ln(TR/100)))}.

13. The formula entry is now complete using 5 constants, 7 memory locations and 8 equations. This math routine could have been accomplished reusing 3 constant locations but 7 were used to make the example earier to follow. Press the MENU key 4 times to return to the Principal Display. The controller will now respond to the two inputs as calculated by the MATH routines.

EXAMPLE 3 - The third example demonstrates the use of piece-wise linearization for applications where no formula is available and only non-linear data can be provided. For this example, we want to set up the controller to take a 0/100 mVDC analog signal on INPUT 1 (terminals 19 & 20) from a radiation pyrometer and display linearized temperature from 800 to 1100°C.

When doing piece-wise linearization in MATH, it is very important to know what units the signal that will be linearized are in. This means that the calibration parameters are critical. As stated, the input signal is 0 to 100 mV and these values are used for the zero and span calibration. Since we desire to use the entire calibrated span, the LOW INPT should be 0 and the HI INPT should be 31,565. It will be easier to enter the linearization break point data if we scale the input from 0 to 10,000 counts so that the LOW DISP should be 0 and the HI DISP should be 10,000. (Note: Better resolution would occur if we used the full span of 31,565 counts but using 10,000 in this example makes the entry easier to understand.)

Use the instructions in MENU 91 to setup INPUT 1 as a VOLTAGE type with PROCESS0 curve, then calibrate this input by entering the values listed in the previous paragraph for LO DISP, HI DISP, LO INPT and HI INPT. The input jumper blocks must also be configured as shown for 100 mV analog inputs on Page 1-7.



The graph at the left is typical of an infrared radiation pyrometer. The data for the graph is given below. Since the data indicates that as the temperature increases, the signal becomes more linear, we should be able to drop some data points to reduce the number of segments without materially affecting the accuracy of the display. For this reason, we will drop every other data point above 1000°C.

° C (OUTPUT)	% FS X 100 (INPUT)
0	0
800	400
810	460
820	530
830	600
840	680
850	770
860	880
870	990
880	1120
890	1260

° C (OUTPUT)	% FS X 100 (INPUT)
900	1410
910	1580
920	1770
930	1980
940	2210
950	2460
960	2720
970	3010
980	3330
990	3690
1000	4070

° C (OUTPUT)	% FS X 100 (INPUT)
1010	4490
1020	4850
1030	5430
1040	5960
1050	6530
1060	7150
1070	7800
1080	8500
1090	9240
1100	10000

Now that we have described the data and how it will be interpreted by the controller, we can enter the linearization data into the MATH programming data entry screens.

1. Move to the LINEAR A menu (943). For each breakpoint, we need to enter the INPUT in units of the scaled signal data which runs from 0 to 10,000 counts (%FS * 100) and the OUTPUT as the desired temperature display.

2. Beginning with breakpoint A:01, press the ENTER key and enter the first set of data INPUT: 400 using direct numerical entry. Press the ENTER key again to accept the input value and advance to the output entry line. Use direct numerical entry to enter OUTPUT: 800 and press the ENTER key once more to accept the value. Advance to the breakpoint A:02 by pressing the UP ARROW key and enter INPUT: 460, OUTPUT: 810. Advance through the table entering the data for each data point through 1000°.

3. Beginning with 1020° up to 1100°, enter the data for each breakpoint in 20° increments. Once you have entered the data for 1100°, leave all remaining breakpoint entries at the default INPUT: 0, OUTPUT: 0.

4. Press the MENU key once to return to the MATH menu and select EQUATION to access the EQ01 equation entry display. In this example, we wish to process the scaled input signal from INPUT 1 through LINEARIZATION A. To accomplish this, press the ENTER key to initiate the cursor at the operand 1 entry. Use the UP/DOWN ARROW keys to scroll the operand list until the operand INP1 (processed input 1) is displayed. Press the ENTER key to accept the selection and advance to the next line.

5. Use the UP/DOWN ARROW keys to scroll the operator list until the LINA operator appears. (The linearizer data was entered in LINEAR A.) Press the ENTER key to accept the selection and advance to the third line.

6. The linearizer function is a single operand operation so that operand 2 should be left at blank spaces. Press the ENTER key to advance to the fourth line.

7. Use the UP/DOWN ARROW keys to scroll the destination list until PV1 (Loop 1 input to the control algorithm) is displayed. Press the ENTER key to accept the selection. This single equation is all that is required to run the linearization routine so press the MENU key four times to return to the Principal Display.

8. This ends the linearizer example. The controller should now be displaying linearized temperature based on the breakpoints entered.

96 FUNCTION These standard controller types have been provided. Select the desired type from the list.

1. LOOP 1 - This is the standard single loop controller type needed for most applications.

2. LOOP 1&2 - This configuration provides two completely separate single loop controllers with separate parameters, setpoints, etc. and is referred to as a dual loop controller.

97 OPT CARD This menu accesses displays to specify the option card position(s) in the controller and to configure the logic I/O channel(s) if installed. NOTE: The installed position of the option card is displayed in the sign-on displays for reference.

971 PRN POS Enter the position number for the optional parallel printer option card. Position "1" is the option card connected directly to the CPU board while position "2" is the card connected to option card 1. Position "0" de-selects this option even if the card is installed.

972 IO A POS Enter the position number for the logic I/O option card to be identified as logic bank "A". Position "1" is the option card connected directly to the CPU board while position "2" is the card connected to option card 1. Position "0" de-selects this option even if the card is installed.

973 IO B POS Enter the position number for the logic I/O option card to be identified as logic bank "B". Position "1" is the option card connected directly to the CPU board while position "2" is the card connected to option card 1. Position "0" de-selects this option even if the card is installed.

974 IO A CFG Use this menu item to configure the logic I/O channels on optional logic card bank "A".

9741...8 IO A #X There are 8 channels on each logic I/O option card. This selection permits configuring each of the bank "A" channels individually as an input channel or as an output channel.

975 IO B CFG Use this menu item to configure the logic I/O channels on optional logic card bank "B".

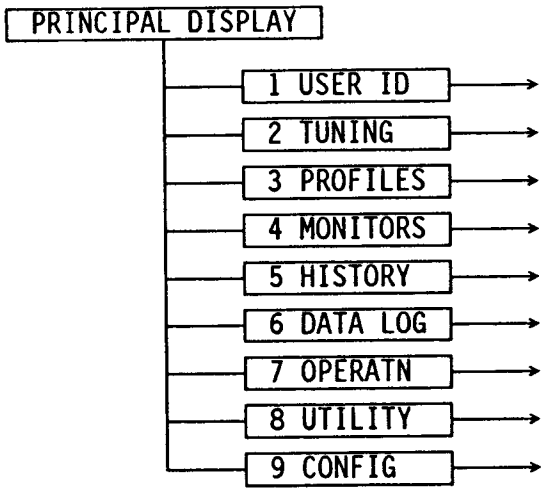
9751...8 IO B #X There are 8 channels on each logic I/O option card. This selection permits configuring each of the bank "B" channels individually as an input channel or as an output channel.

98 MEMORY CLEAR Selecting this menu item will erase all configuration and data programming except for the input configuration. Refer to MEMORY CLEAR PROCEDURE in Section 15 for a further explaination of the use of this process.

SECTION 13 - MENU MAPS

This section illustrates the standard menu tree divided according to the main menu titles as shown below. All item subject titles are shown although the secondary data entry screens have been deleted to simplify the illustration and make the menu system easier to understand. These menu maps are useful in quickly determining the menu path to reach a given title.

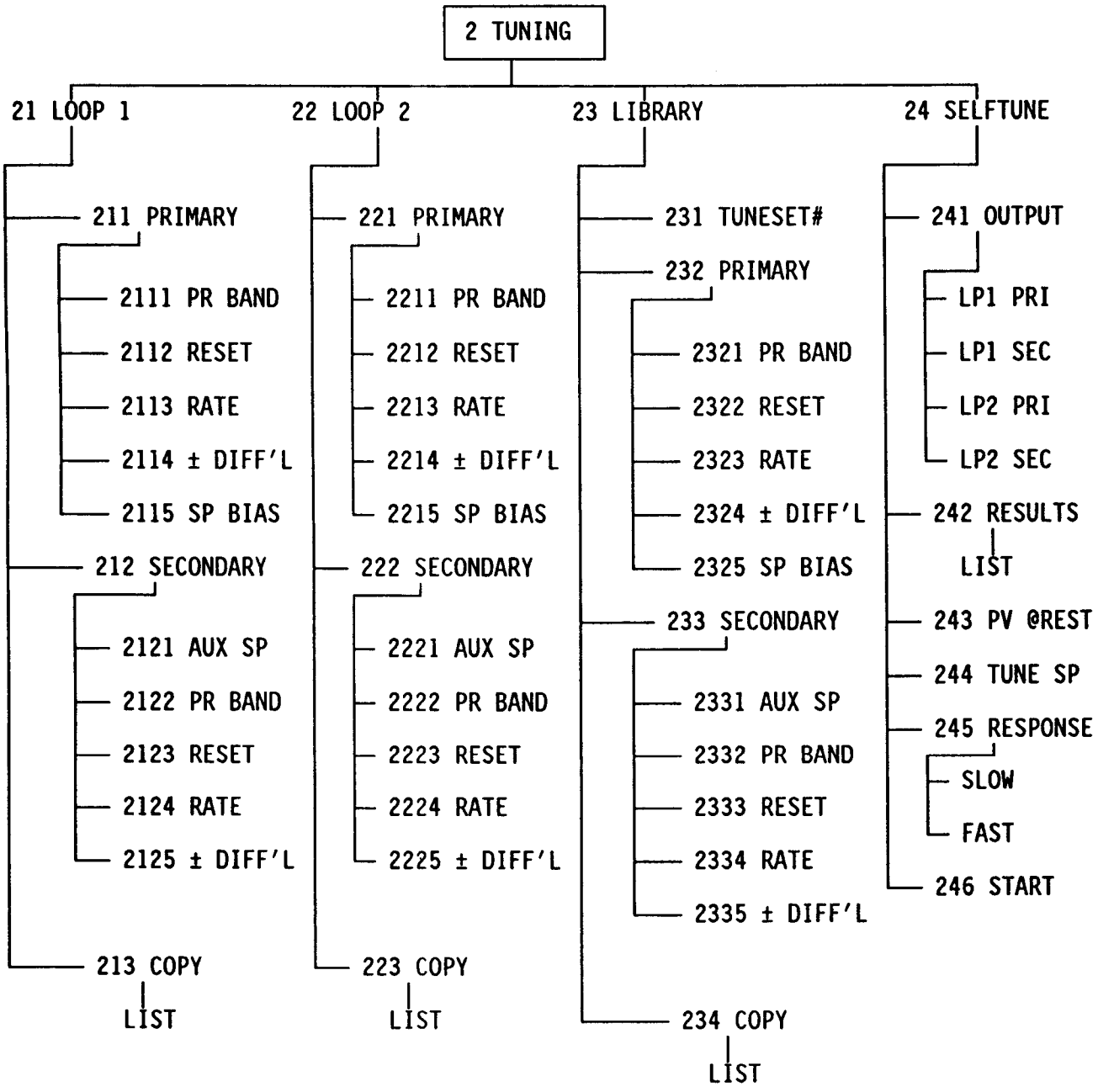
At the end of this section is a directory of frequently used displays. This directory will be useful for quickly accessing commonly used displays.



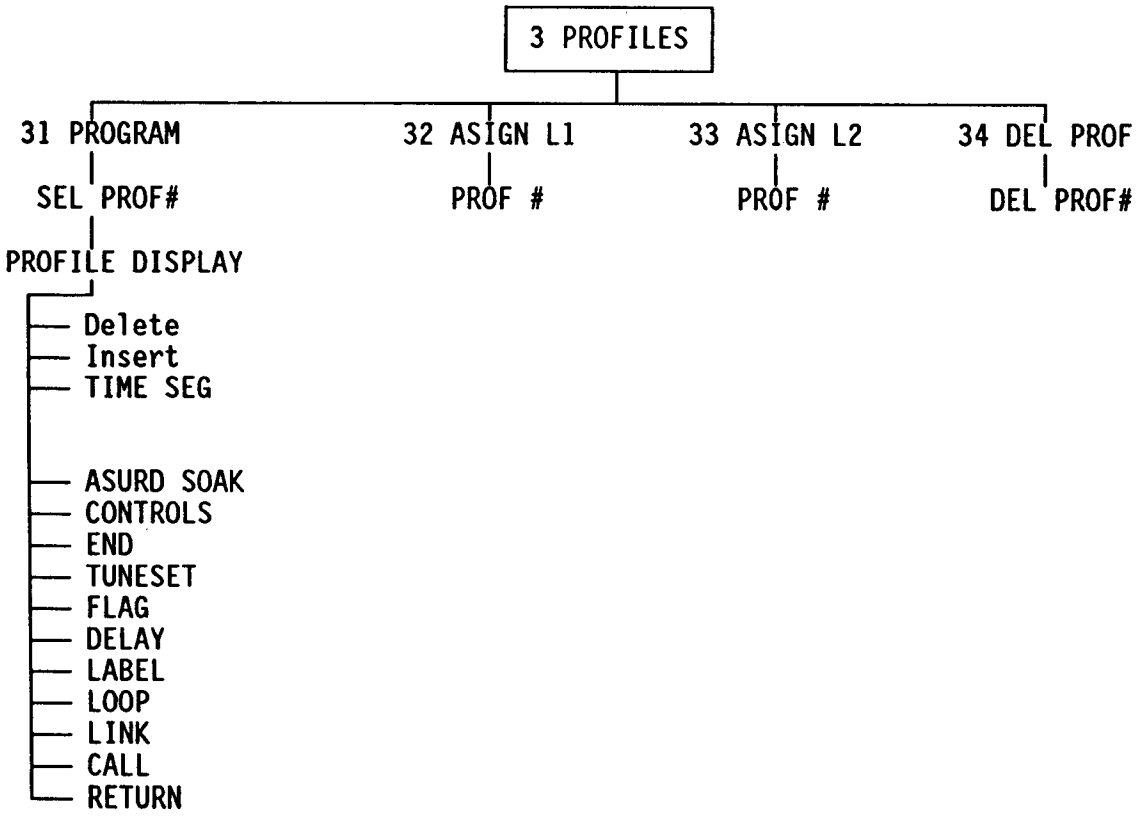
(See Section 4 for details)

1 USER ID

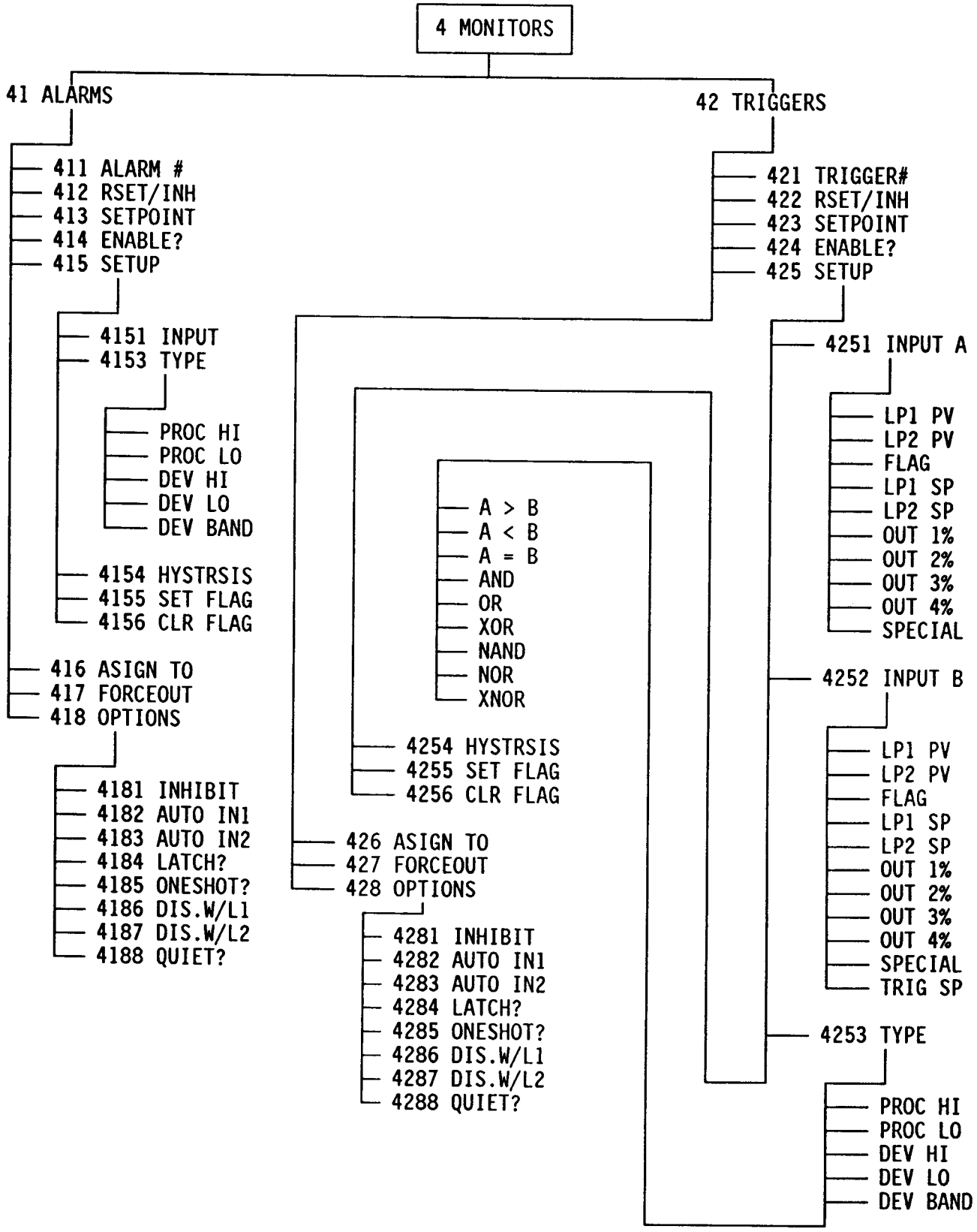
(See Section 5 for details)



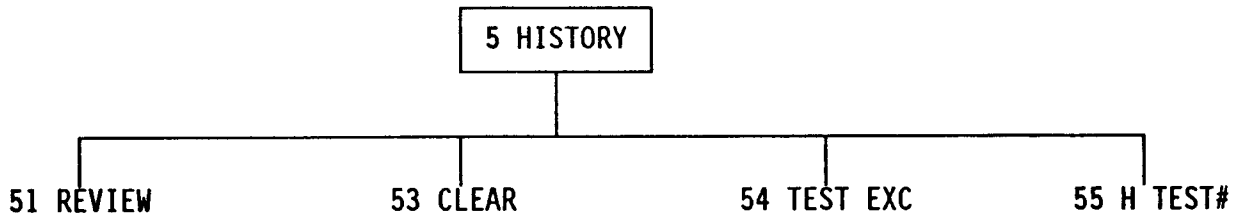
(See Section 6 for details)



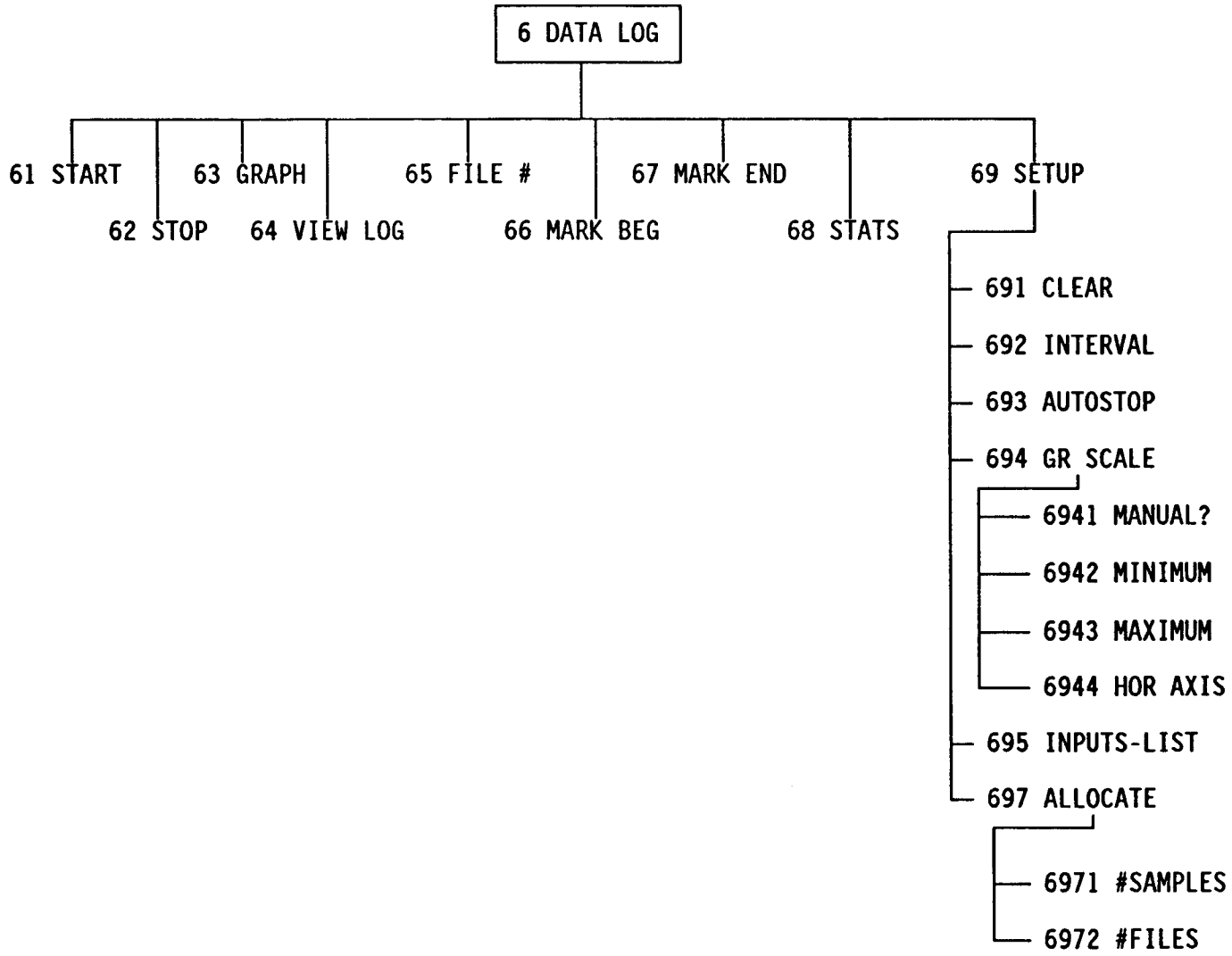
(See Section 7 for details)



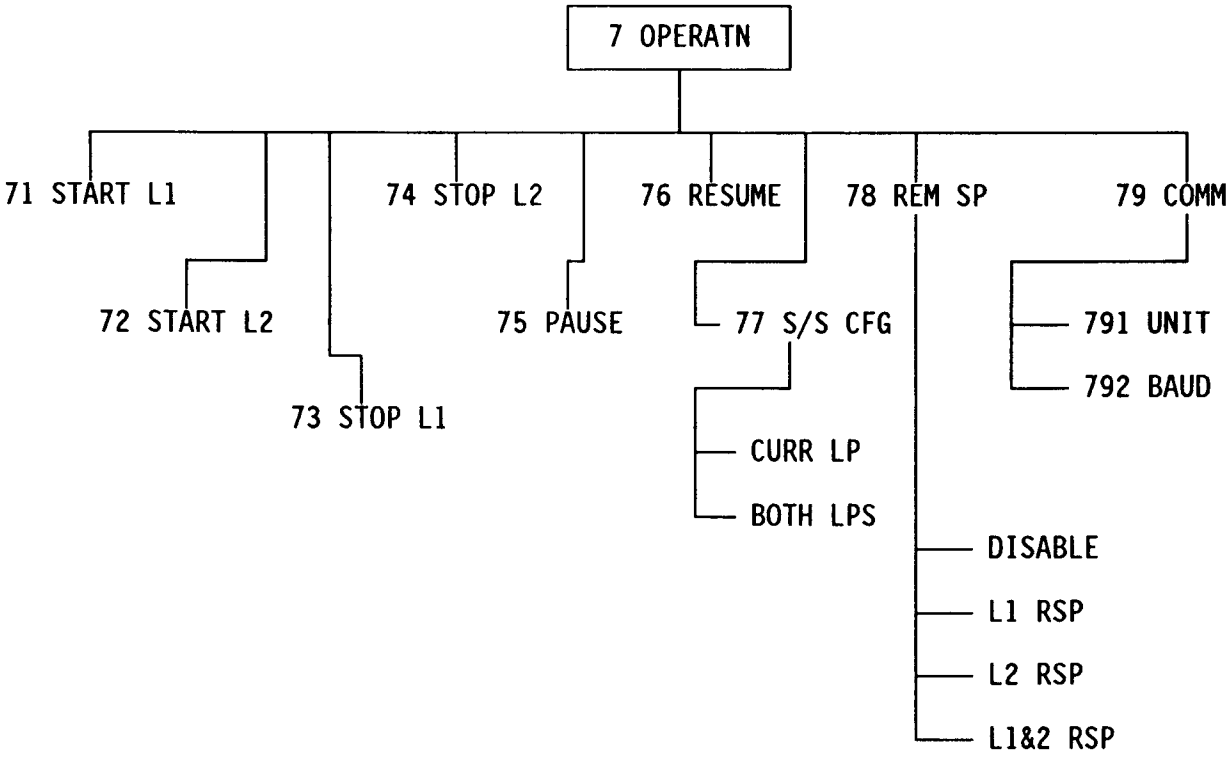
(See Section 8 for details)



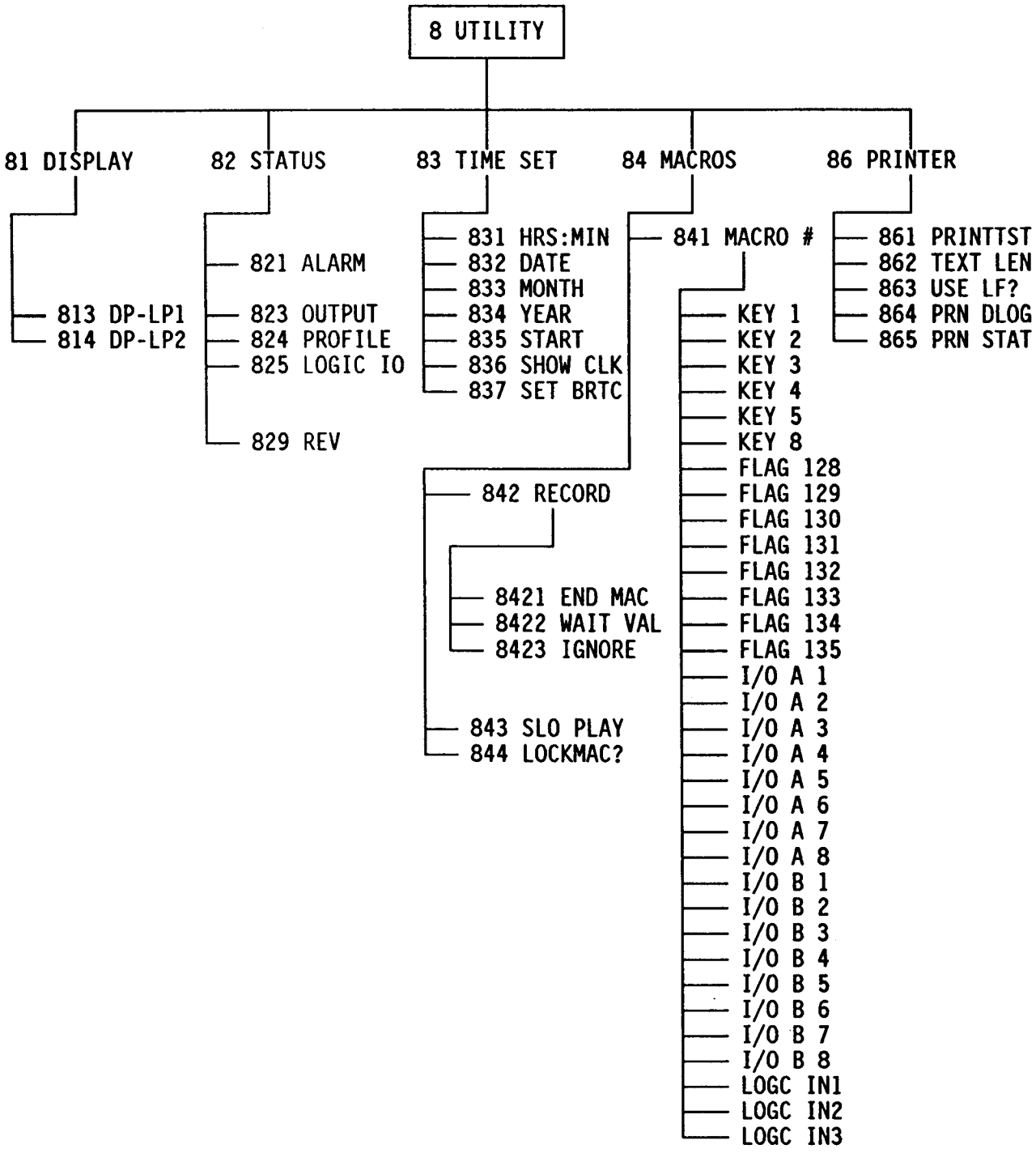
(See Section 9 for details)



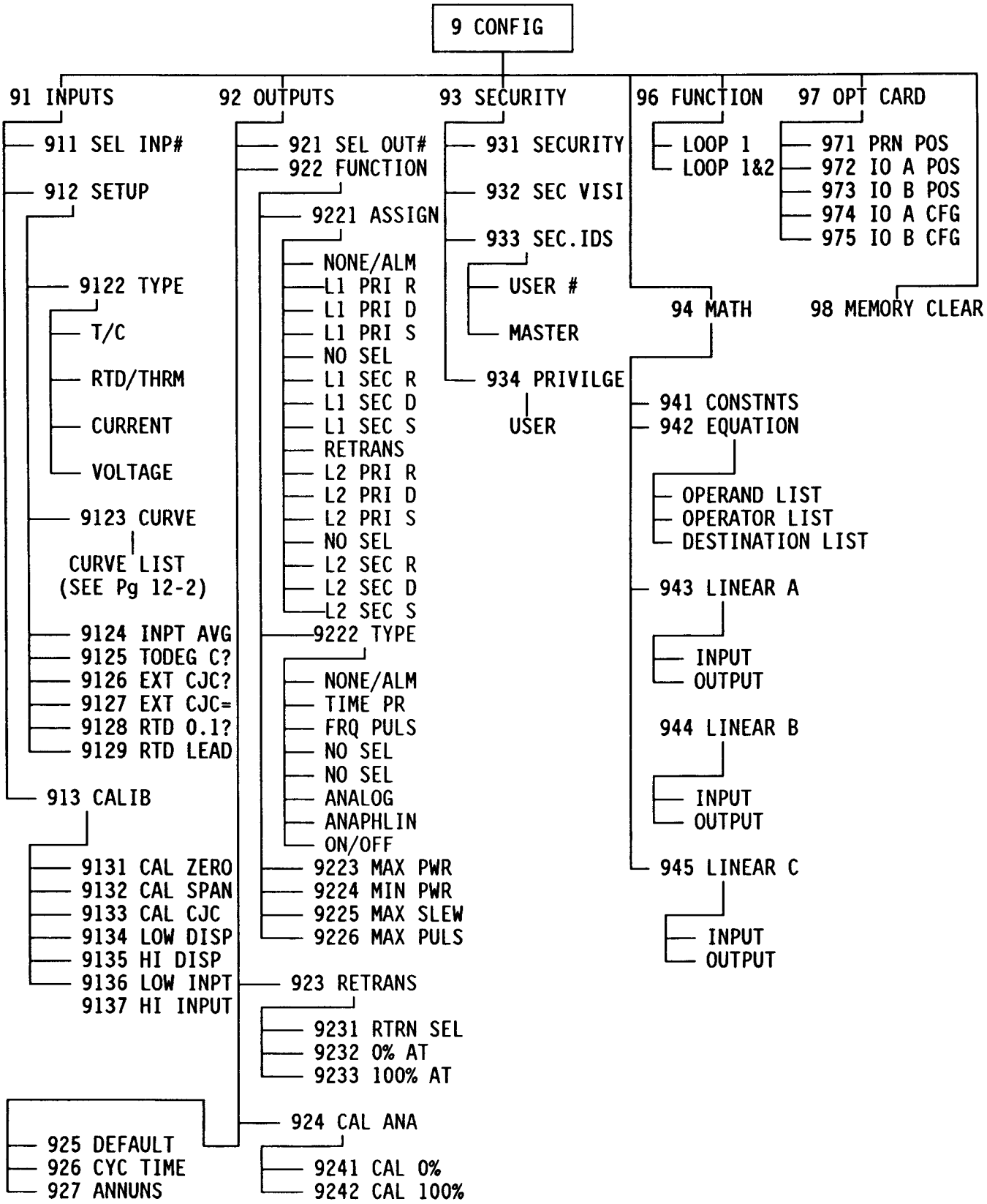
(See Section 10 for details)



(See Section 11 for details)



(See Section 12 for details)



DIRECTORY OF FREQUENTLY USED DISPLAYS

The menu system allow quick access to needed displays. To use this directory, locate the display title of interest in the directory and press the key sequence as indicated. All key sequences start from the principal display.

1 USER ID
- USER ID = 01

2 TUNING
- LP1 PRI P = 02111
- I = 02112
- D = 02113
- LP1 SEC P = 02122
- I = 02123
- D = 02124
- AUX SP = 02121
- LP2 PRI P = 02211
- I = 02212
- D = 02213
- LP2 SEC P = 02222
- I = 02223
- D = 02224
- AUX SP = 02221
- LIB SELECT = 0231
- LIB PRI P = 02321
- I = 02322
- D = 02323
- LIB SEC P = 02332
- I = 02333
- D = 02334
- SELF-TUNE START = 0246

3 PROFILES
- LP1 PROFILE = 032
- LP2 PROFILE = 033

6 DATA LOG
- START = 061
- STOP = 062
- VIEW PLOT = 063
- VIEW DATA = 064
- MARK BEG = 066
- MARK END = 067
- VIEW STATS = 068

While Viewing Plot (063)

Press
- 1 = ZOOM IN
- 2 = ZOOM OUT
- 3 = BLOCK START
- 4 = BLOCK END
- 5 = MAX VALUE
- 6 = MIN VALUE
- 7 = MEAN VALUE (Mark window)
- 8 = NUMBER OF SAMPLES
- 9 = TIME INTERVAL

7 OPERATN
- PAUSE L1 & L2 = 0733
- RESUME L1 & L2 = 0736

8 UTILITY
- VIEW CLOCK = 0836

SECTION 14 - OPTIONS BOARDS

The OMEGA CN3000 is available with a number of optional boards which facilitate its use. These are listed below for reference:

OMEGA No.	DESCRIPTION
CN3000-RS3	EIA-232 (RS-232) Isolated Communication (1 Board)
CN3000-RS4	RS-422/485 Isolated Communications (1 Board)
CN3000-PR3	Parallel Printer Port (1 Board)
CN3000-L31	8 Channel Logic I/O Board (1 Board)
CN3000-L32	16 Channel Logic I/O (2 Boards)

Each of the options boards interfaces with external equipment. Carefully read the description of the option in this section to determine the requirements for the interface equipment. You will also need an accessory cable to connect the option board with the external equipment or an edge card connector to mate with the CN3000 option card for customer wiring.

Option board(s) may be installed at the factory or may be installed in the field. If your controller has the options board(s) factory installed, skip over the installation section below and proceed to the section describing the options board functions, jumper selection and wiring.

OPTIONS BOARD INSTALLATION (ALL OPTION BOARDS)

Each controller can accommodate two option boards which can be installed on the center bracket between the two outer boards. An options board may be installed in either position. Installation of the option board(s) is described in the following procedure.

1. Loosen the bracket by removing the two long screws holding the bracket to the bezel and gently remove the bracket. (Refer to Figure #1.)

2. Remove the option board from its protective antistatic envelope taking care to hold the board by its edges and protecting the board from static damage. Mount the board on either side of the bracket with the card edge fingers to the rear and the component side of the board facing the CPU board (the board with a battery) using the screws provided. It is recommended that if a single option board is to be installed, it should be installed in option position #2 for ease of installation. Refer to Figures 1 and 2.

3. If two boards are being installed, the two boards must first be connected together prior to assembly into the controller. Connect the white/red lead from the board in position 1 on to the pin marked with a plus sign (+) on the board in position 2. Plug the white/black lead to the minus (-) pin in the same fashion. Now connect the flat cable from the option board in position 2 to the connector on the option board in position 1.

4. Plug the two (2) loose wires from the option board onto power board pins +20V (white/red) and -20V (white/black).

5. Direct the white/red and white/black wires so that they do not interfere with assembly. If a board is installed in position 1, preform the flat cables in a "V" shape to provide the proper lead forming as shown in Figure 2. Re-insert the bracket into the controller from the top side of the controller. Make sure that the component side(s) of the options board(s) are inserted as shown in the drawing with the jumper pins at the bottom edge of the controller. Take care not to unduly stress the option boards or the controller boards during insertion to prevent damage to the components or copper foil.

6. When the bracket is firmly seated, reinstall the two long bracket retaining screws.

7. Now connect the remaining flat cable from the option board into the connector at the edge of the CPU board. Make sure that the flat cable was pre-folded as shown in Figure 2 before installation for cables coming from option position #1.

8. Punch out the corresponding knock-out at the rear of the case, insert the options cable with connector pin 1 down (watch that the key position between pins 3 and 5 is matched in the cable connector) and screw the connector to the rear case.

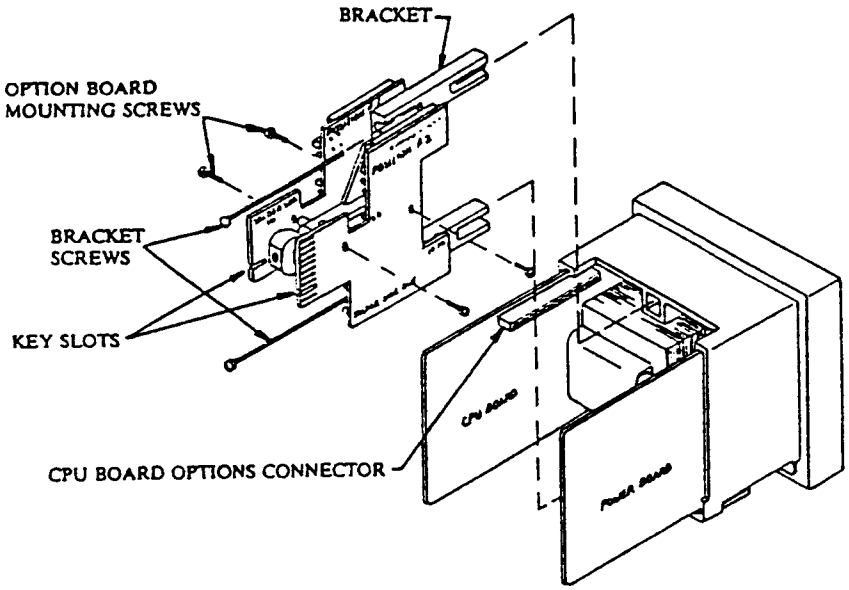


Figure 1

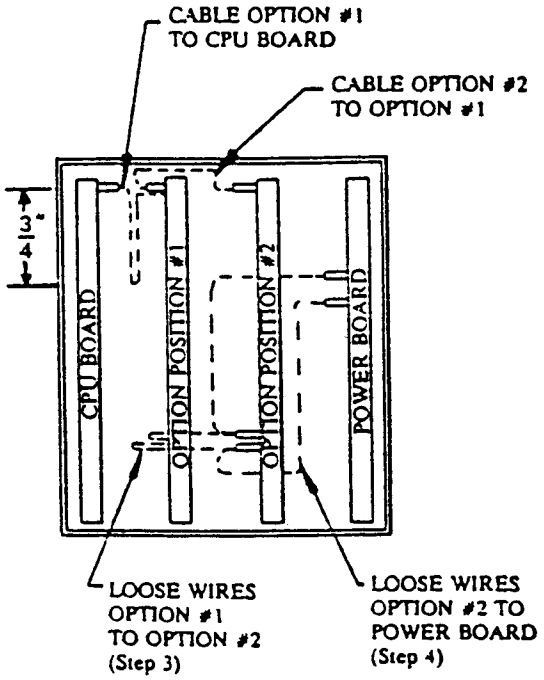


Figure 2 (REAR VIEW)

SERIAL COMMUNICATIONS OPTION (EIA-232, EIA-422/EIA-485)

The CN3000 controller serial communications option conforms to EIA-232 (RS-232), EIA-422 (RS-422) or EIA-485 (RS-485) for communications with a remote MS-DOS based host computer. The EIA-232 interface may be the easier interface to implement since most MS-DOS host computers have a built-in EIA-232 port. Use of the EIA-422 or EIA-485 interface normally requires an additional interface card to be installed in the host in order to facilitate EIA-422/485 communications. EIA-232 communications is intended for communications between the host and a single CN3000 controller (refer to the discussion on multi-drop EIA-232 communications later in this section) while EIA-422 is specified for use in communication systems of up to 10 controllers and EIA-485 is designed for use with communication systems with up to 32 controllers.

Full duplex (separate transmit and receive lines) EIA-232 transmission can be accomplished with three leads in its simplest form while EIA-422/485 transmission requires 5 leads. Transmission distances between the controllers and the host will vary with the EIA-232 usable over the shortest distance. The EIA-422/485 balanced interface will permit the longest transmission distances. However, all digital communication interfaces are distance limited by the baud rate, the resistance of the cable leads and the capacitance between leads of the interconnecting cable.

THE EIA-232 (RS-232) COMMUNICATIONS OPTION

The EIA-232 communications board enables full duplex serial communications with a remote MS-DOS based host computer. In the simplest form, only the TXD (transmitted data), RXD (received data) and GND (common signal return) are needed for full duplex transmission. If only a 3-wire cable is used between the controller and the host, then the CTS (clear to send), DSR (data set ready) and DCD (data carrier detect) lines may need to be tied to the DTR (data terminal ready) at the host computer to disable handshaking. If an OMEGA supplied transition cable assembly is used with a standard communications cable which connects these lines between the controller and the host, disabling of handshaking is taken care of in the wiring and does not need to be done by the user.

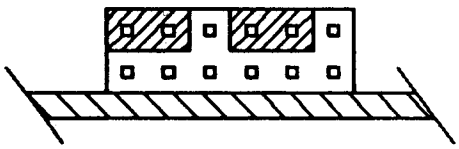
A number of hardware options are configurable using four jumper blocks. Although the board does not support handshaking, the CTS (clear-to-send) line may be set up so that the host can see when the controller is transmitting (the CTS line will be set to "OFF" or negative when transmitting). (NOTE: This "CTS" feature is different from the normal use of the CTS line which ordinarily responds to an RTS "ON" state by the host.) When the "CTS" feature is disabled, it is tied high. All other handshaking lines are internally tied high.

The EIA-232 option board is isolated but may be configured to operate from either the internal isolated controller supply or from a single +12VDC to +24V @ 50 mA external supply.

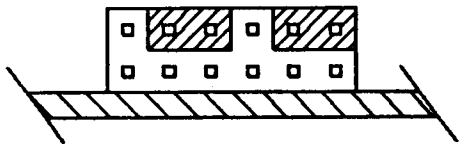
Although EIA-232 communications is intended for communications between a single controller and a host, the CN3000 communications board may be jumper configured for tri-state operation so that multi-drop communications may be utilized.

JUMPER SELECTION - EIA-232

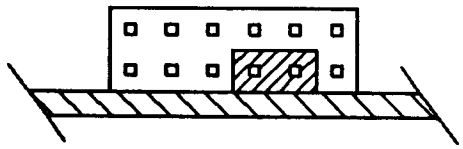
The jumper selection positions are located at the edge of the communications board and are accessible on the bottom side of the controller. Because the CN3000 may be supplied with two option boards, make sure that you properly identify the EIA-232 board before changing configuration jumpers. The jumper positions are shown below:



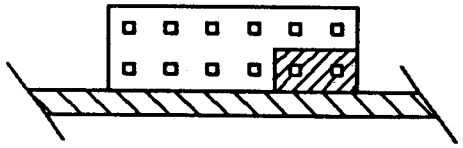
INTERNAL SUPPLY
(Factory Default)



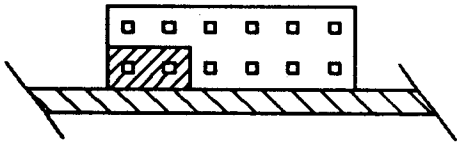
EXTERNAL SUPPLY



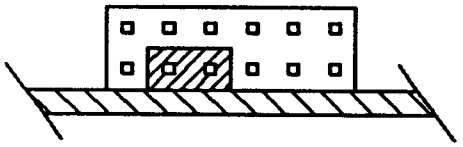
"CTS" DISABLED
(Factory Default)



"CTS" ENABLED



TRI-STATE DISABLED
(Factory Default)



TRI-STATE ENABLED

THE EIA-422/EIA-485 COMMUNICATIONS OPTION

The EIA-422/EIA-485 communications option allows either full or half duplex serial communications with a remote MS-DOS based host computer. For full duplex (separate transmit and receive lines) communications, the TXD-A (transmit data), TXD-B (transmit data complement), RXD-A (receive data), RXD-B (receive data complement) and GND lines are needed. For half-duplex (only a single pair of wires for transmit/receive plus GND), the TXD-A and TXD-B wires are used for both transmit and receive connections. The "A" terminal is negative with respect to the "B" terminal fpr a binary 1 (MARK or OFF) state. The "A" terminal is positive with respect with the "B" terminal for a binary 0 (SPACE or ON) state.

The CTS-A (clear to send), DSR-A (data set ready) and DCD-A (data carrier detect) lines, if present on the host EIA-422/485 interface card, may need to be tied to the DTR-A (data terminal ready) at the host and the CTS-B (clear to send complement), DSR-B (data set ready complement) and DCD-B (data carrier detect complement) lines may need to be tied to the DTR-B (data terminal ready complement) at the host to disable handshaking. If an OMEGA supplied transition cable with standard communications cable is used between the controller and the host, disabling of handshaking is taken care of in the wiring and does not need to be done by the user.

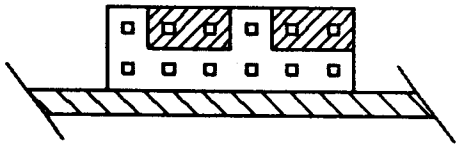
Several hardware options are configurable using four shunt jumper blocks. This board does not support handshaking and all handshake lines are tied high.

The EIA-422/EIA-485 option board is isolated and may be configured to operate from either the internal controller isolated supply or a single +7 to +13VDC external power supply capable of supplying 150 mA continuously under normal operating conditions and 250 mA under fault (shorted line) conditions. The EIA-422/EIA-485 interface is solely intended for multiple unit operation from a single host computer. This board will operate in systems of up to 32 units on the same data interface.

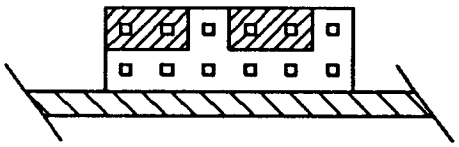
Most EIA-422 and EIA-485 applications involve operation at fairly high baud rates over lengthy cable networks and must be terminated with a pair of 120Ω terminating resistors (100Ω terminating resistor for EIA-422) to prevent ringing on the cable. **For these applications, it is mandatory that an external power supply be used since the CN3000 internal supply cannot supply the load required.** For low baud rates and short cables where the terminating resistors are not needed to prevent ringing, it may be possible to use the internal CN3000 power supply for communications.

JUMPER SELECTION - EIA-422/EIA-485

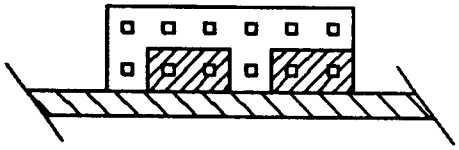
The jumper selection positions are located at the edge of the communications board and are accessible on the bottom side of the controller. Because the CN3000 may be supplied with two option boards, make sure that you properly identify the EIA-422/EIA-485 board position before changing configuration jumpers. The jumper positions are shown below:



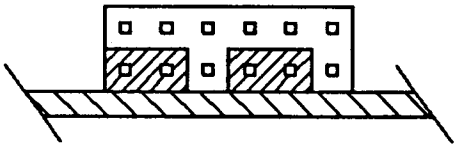
EXTERNAL SUPPLY
(Factory Default)



INTERNAL SUPPLY



FULL DUPLEX
(Factory Default)



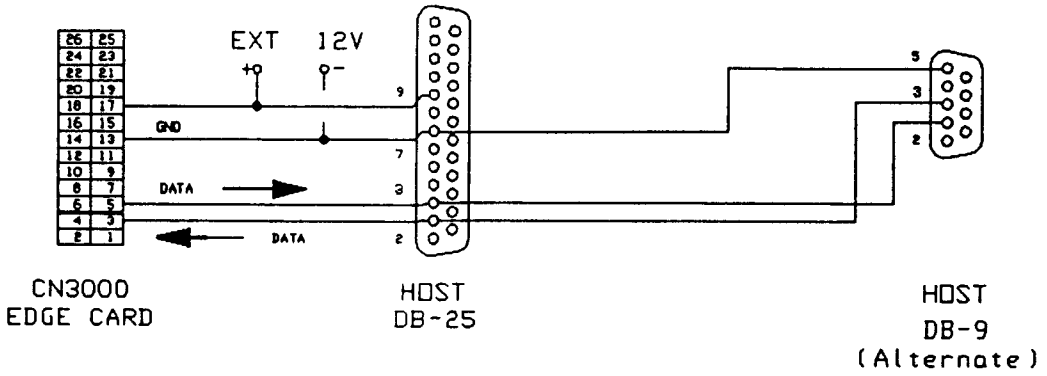
HALF DUPLEX

WIRING - EIA-232 AND EIA-422/EIA-485

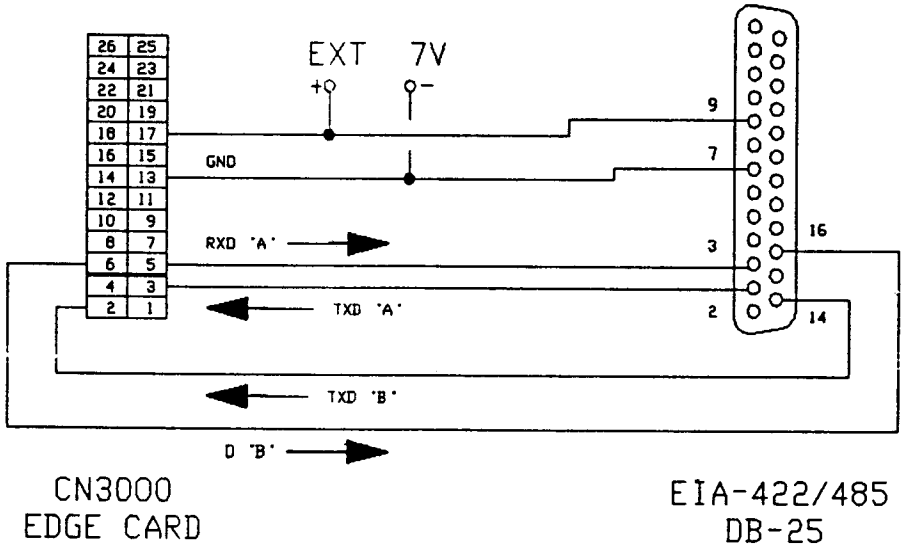
All connections to the communications board are made through a 26-pin edge card connector (OMEGA P/N CN3000-CONNECTOR supplied separately) which mounts to the plastic housing using two screws. Provisions have been made for an edge card connector key between edge card pins 3 and 5 to prevent backward mounting of the connector. The pin layout on the edge card has been set up so that mass terminated flat communication cables will match the standard EIA-232D DB-25 pin out for DCE (data circuit-terminating equipment) when pin 1 on the option board is connected with pin 1 on the DB-25 connector. For EIA-422/EIA-485, the pin layout for the corresponding DB-25 connector conforms with EIA-530 when pin 1 on the option board is connected with pin 1 on the DB-25 connector. The table below shows the pin arrangement for both the edge card and DB-25 connections. OMEGA offers edge card connectors and a 5" pre-assembled edge card to 25-pin D transition cable as accessory items. Consult the factory for more information.

		DESCRIPTION	
EDGE CARD	DB-25 PINS	EIA-232	EIA-422/EIA-485
1	1	NONE	NONE
3	2	TXD	TXD-A
5	3	RXD	RXD-A
7	4	NONE	NONE
9	5	CTS	CTS-A
11	6	DSR	DSR-A
13	7	GND	GND
15	8	DCD	DCD-A
17	9	EXT +12V	EXT +7V
19	10	NONE	DCD-B
21	11	NONE	NONE
23	12	NONE	NONE
25	13	NONE	CTS-B
2	14	NONE	TXD-B
4	15	NONE	NONE
6	16	NONE	RXD-B
8	17	NONE	NONE
10	18	NONE	NONE
12	19	NONE	NONE
14	20	NONE	NONE
16	21	NONE	NONE
18	22	NONE	DSR-B
20	23	NONE	NONE
22	24	NONE	NONE
24	25	NONE	NONE
26	N/C	NONE	NONE

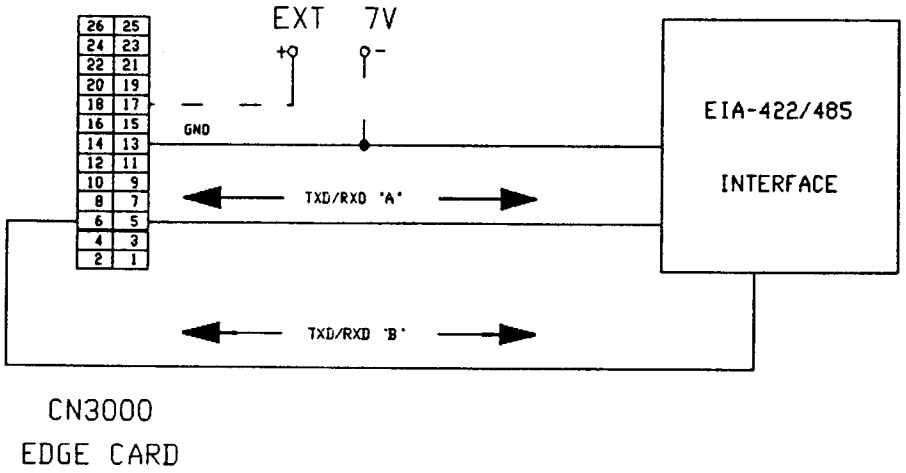
For short cable lengths in areas that are not noisy, unshielded cable may suffice. In noisy environments, it may be necessary to use shielded twisted pair cables to avoid noise pick up. If a shield is used, connect the shield to pin 1 of the DB-25 connector at the host. Do not intermingle cables for data and power lines. Make sure that data cables are not run in the same conduit or cable tray with supply power wiring.



TYPICAL EIA-232 CONNECTIONS



TYPICAL FULL DUPLEX EIA-422/485 CONNECTIONS (per EIA-530)



TYPICAL HALF DUPLEX EIA-422/485 CONNECTIONS

OPERATION - COMMUNICATIONS (EIA-232, EIA-422/EIA-485)

Before the communication link may be used, each CN3000 controller must be software configured to set the baud rate, parity, unit address and other communications parameters. Refer to Menu 79 in Section 10 for details on this configuration.

In order to communicate to a controller through the serial communication interface, you must have the OMEGA operating software package which is to be installed in an MS-DOS based host computer. This software package enables the host computer to read and write the operating parameters to each unit controller. Consult the factory for more information on this package.

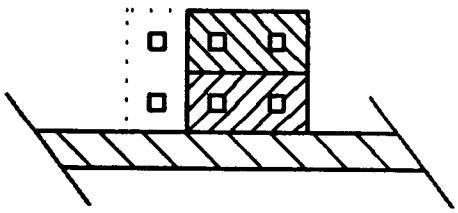
THE PARALLEL PRINTER OPTION

The parallel printer output enables the controller to send data to a remote printer using the IBM-PC parallel printer interface. Although there is space for two option boards, only one parallel printer board may be used in each controller.

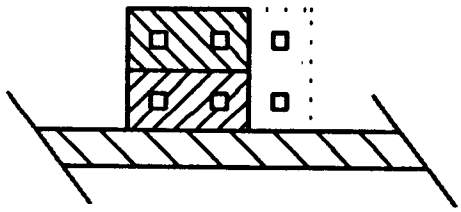
The CN3000 parallel printer output will interface with almost all printers that are designed for use on an IBM-PC parallel printer port. In addition to the printer option board, you will need to prepare an interconnecting printer cable between the controller and the printer or may purchase a 5" transition cable assembly as an accessory from the factory which mounts to the controller edge card and terminates in a 25-pin D connector and mates with a customer supplied PC printer cable.

JUMPER SELECTION - PRINTER OPTION

The printer board is isolated but may be configured to operate from either the internal isolated controller supply or from an external single +7 to +12VDC @ 50 mA supply using two shunt jumper blocks (supplied on the option board). The jumper positions are shown below:



INTERNAL SUPPLY
(Factory Default)



EXTERNAL SUPPLY

NOTE

SINCE THE TRANSITION CABLE USES A DB-25 CONNECTOR AND THE +SUPPLY VOLTAGE IS ON PIN 26, THE TRANSITION CABLE CANNOT BE USED WHEN AN EXTERNAL SUPPLY IS SELECTED.

WIRING - PRINTER OPTION

All connections to the parallel printer board are made through a 26-pin edge card connector (OMEGA P/N CN3000-CONNECTOR supplied separately) which mounts to the plastic housing using two screws. Provisions have been made for a card edge connector key between edge card pins 3 and 5 to prevent backward mounting of the connector. The pin layout on the card edge has been set up so that mass terminated flat cables will match the standard DB-25 IBM-PC parallel printer connections when pin 1 on the option board is connected with pin 1 on the DB-25 connector. The table below shows the pin arrangement for both the edge card and the DB-25 connections. OMEGA offers card edge connectors and a pre-assembled transition cable as an accessory item. Consult the factory for more information.

EDGE CARD	DB-25 PINS	DESCRIPTION
1	1	STROBE
3	2	DATA 1
5	3	DATA 2
7	4	DATA 3
9	5	DATA 4
11	6	DATA 5
13	7	DATA 6
15	8	DATA 7
17	9	DATA 8
19	10	N/C
21	11	BUSY
23	12	N/C
25	13	N/C
2	14	PULLED UP TO +5V
4	15	N/C
6	16	PULLED UP TO +5V
8	17	GROUND
10	18	GROUND
12	19	GROUND
14	20	GROUND
16	21	GROUND
18	22	GROUND
20	23	GROUND
22	24	GROUND
24	25	GROUND
26	N/C	EXTERNAL +7 TO +12V

For short cable lengths in areas that are not noisy, unshielded cable may suffice. In noisy environments, it may be necessary to use shielded cables to avoid noise pick up. All installations are distance limited by the resistance of the cable leads and the capacity between leads of the interconnecting cable. DO NOT intermingle cables for data with power lines. Make sure that data cables are not run in the same conduit or cable tray with supply power wiring.

OPERATION - PRINTER OPTION

Before the parallel printer output may be used, the CN3000 controller must be software configured to identify the card position in the controller and select the information to be supplied to the printer. Refer to Menu 971 in Section 12 and Menu 86 in Section 11 for details on this configuration. You may also use flag trigger monitors (Menu 42 in Section 7) to initiate printer output.

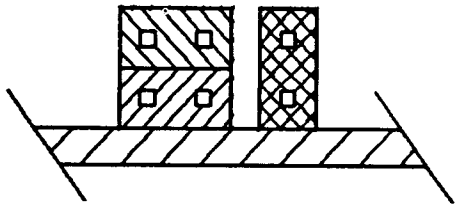
THE LOGIC I/O OPTION

The logic I/O option enables a CN3000 controller to send or receive digital signals to or from remote digital I/O logic modules. You may have either 8 I/O channels (1 board) or 16 logic I/O channels (2 boards). The logic board is designed to work with external modules operating with negative true logic (active low) operating at 5VDC. Each channel may be set up as an input or an output channel in the controller software programming but not both. This option will work with a number of manufacturers' standard input/output mounting boards with appropriate 5V I/O modules. Contact OMEGA for suggestions on a suitable mounting board and logic modules.

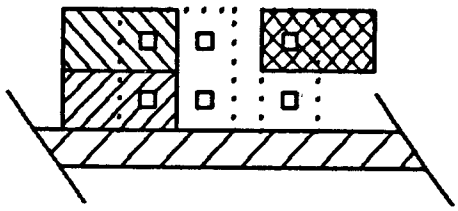
All I/O channels are pulled up on the option board through a 22K resistor to the +5V supply. The saturation voltage is approximately 1.1V at 12 mA.

JUMPER SELECTION - LOGIC I/O

The Logic I/O option board is isolated but may be configured to operate from either the internal isolated controller supply or from an external single +5VDC @ 50 mA supply using three shunt jumper blocks (supplied on the option board). The jumper positions are shown below:



INTERNAL SUPPLY
(Factory Default)



EXTERNAL SUPPLY
(No jumper connections)

CAUTION: When the internal supply is selected, it also connects to pins 1 and 25 of the edge connector. The controller internal power supply must not be used to operate the remote logic I/O mounting board and its modules. Make sure that pins 1 and 25 are NOT connected to the remote module's power supply. (There usually are jumpers on the remote rack for this purpose.) Connector pins 1 and 25 are to be used only when the external supply is used to power the CN3000 logic I/O option board.

WIRING - LOGIC I/O

All connections to the logic I/O board are made through a 26-pin edge card connector (OMEGA P/N CN3000-CONNECTOR supplied separately) which mounts to the plastic housing using two screws. Provisions have been made for an edge card connector key between card edge pins 3 and 5 to prevent backward mounting of the connector. The pin layout on the card edge has been set up so that mass terminated flat cables will match the standard 26-pin edge card connector on a remote logic I/O mounting board when pin 1 on the option board is connected with pin 1 on the 26-pin mounting board connector. The table below shows the pin arrangement for the 26-pin edge card connector. OMEGA offers a pre-assembled unshielded 3' logic I/O cable (OMEGA P/N CN3000-I/O CABLE) as an accessory item. Consult the factory for more information.

EDGE CARD	DESCRIPTION
1	Vcc = +5VDC
3	N/C
5	N/C
7	N/C
9	Logic I/O #8
11	Logic I/O #7
13	Logic I/O #6
15	Logic I/O #5
17	Logic I/O #4
19	Logic I/O #3
21	Logic I/O #2
23	Logic I/O #1
25	Vcc = +5VDC

EDGE CARD	DESCRIPTION
2	Logic Ground
4	Logic Ground
6	Logic Ground
8	Logic Ground
10	Logic Ground
12	Logic Ground
14	Logic Ground
16	Logic Ground
18	Logic Ground
20	Logic Ground
22	Logic Ground
24	Logic Ground
26	Logic Ground

The remote digital I/O logic mounting board(s) and modules should be as close to the controller as possible. For short cable lengths in areas that are not noisy, unshielded cable may suffice. In noisy environments, it may be necessary to use shielded cables to avoid noise pick up. All installations are distance limited by the resistance of the cable leads and the capacitance between leads of the interconnecting cable. DO NOT intermingle logic cables with power lines. Make sure that logic cables are not run in the same conduit or cable tray with supply power wiring.

OPERATION - LOGIC I/O

Before the logic I/O option may be used, the CN3000 controller must be software configured to identify the board position in the controller and configure each channel for use within the controller. Refer to Menu 97 in Section 12 for logic I/O configuration and Section 7 to configure a trigger monitor for use with the logic channel. Refer to Menu 825 in Section 11 for special logic status displays.

SECTION 15 - SERVICE

If difficulty is experienced with a controller, first recheck all wiring. Also pull the electronic assembly forward out of the case to check that all plug-in components including cables are snugly in their connectors.

Check that the correct key sequence has been used and that the setpoints and tuning values set into the controller are appropriate for the application.

DIAGNOSTIC DISPLAYS

On start-up and throughout normal operation, the controller monitors internal operations and power levels. Upon detection of an out-of-tolerance condition, the controller will shut off the control output(s), activate alarm(s) and display an appropriate message. Some simple messages such as "OPEN SENSOR" are obvious and can be easily by corrected. Other messages may indicate that service is required. A listing of error messages along with some suggestions for dealing with the problem follows:

Cannot delete the end of profile
You cannot delete the step following the last programmed step of a profile.

Cannot insert twice
The "insert new step" command in profiles must be followed by a command other than INSERT. Two blank steps may not be inserted consecutively.

Can't delete while a profile is running
You must de-select or STOP a profile before you can delete.

Can't program while a profile is running
Profiles may be programmed or edited only when no other profile is running.

CJ CAL BAD
The measured cold junction calibration (9-1-3-3) value was not within a reasonable range. Wait a few minutes and repeat the step. If this message is still displayed, consult the factory.

CONFIG DATA LOST PRESS ENTER
An error has been detected in the configuration data. Reprogram the configuration data (Section 12) to restore the data. NOTE: All installed outputs should be initialized as described in MEMORY CLEAR PROCEDURE (step E) in this section.

Key storage full. Ending recording.

This message appears when the memory allocated for macros has been filled.

Label not found

A label number that does not exist has been used in a profile LOOP command.

LOCKMAC cannot be selected.

This message appears if an attempt is made to include LOCKMAC while recording a macro. You cannot lock or unlock a macro using a macro key.

MACRO # cannot be changed

This message appears if you attempt to select another macro key while recording a macro. Chaining macros is not allowed.

MACRO DATA LOST PRESS ENTER

The data for a macro has been damaged or erased and cannot be run. Press ENTER. Reenter the macro if it is still needed.

No recording found for this macro

An unused macro number has been selected under SLO PLAY or LOCKMAC?.

No room left for another profile.

The memory allocated for profiles has been filled.

No room left for recording.

The memory allocated for macros has been filled.

No room left for this command.

The memory allocated for profiles has been filled.

PBID ERR

The P-BUS ID routine has not identified an output or option board correctly. Make sure that all output and option cards are securely in their connectors. Try a power-down reset to see if the error may be cleared.

PROFILE DATA LOST PRESS ENTER

An error has been detected in the profile data. Reprogram the profiles to restore the data.

Profile does not exist.

A profile number that has not been programmed has been selected in a profile DELETE command.

Profile not found
A label number that does not exist has been used in a profile LINK or CALL command.

RECORDING: Last key pressed is illegal.
An illegal key has been pressed while recording a macro.

SLO PLAY cannot be selected.
SLO PLAY has been selected while recording a macro.

THERE CANNOT BE MORE THAN 99 STEPS
The profile being programmed already has 99 steps. Break the profile into two or more profiles and use the LINK command to chain them together.

Too Many Calls
A profile has been programmed with more CALL commands than allowed.

Too Many Flags
A profile has been programmed with more FLAG commands than allowed.

Too Many Loops
A profile has been programmed with more LOOP commands than allowed.

MEMORY CLEAR PROCEDURE

NOTE

This process should only be performed as a last resort. Use of this procedure will cause configuration parameters to be lost requiring reprogramming and reconfiguring of the controller.

The following procedure should be used to clear the memory:

A. Key in MENU-9-8 to reach a display that says "HAVE YOU LOST DATA & NEED TO START NEW?".

B. If the answer is yes, press the "YES" key which results in a display that says "YOU MUST RE-CONFIG OK?". Pressing the "NO" key returns you to the CONFIG menu.

C. If you respond "YES", you will be requested to enter the numbers "7-3-2-8-ENTER" in sequence to confirm that you wish to proceed. If you do not wish to reconfigure the unit, respond "NO".

D. The controller program will clear the memory. Input configuration and calibration will be retained.

E. It is recommended that you enter the following key sequence:

Menu-9-2-1
0-1-UP
0-1-UP
0-1-UP
0-0-0-0

The purpose of this sequence is to initialize any installed outputs. Failure to do so may result in a loss of configuration data message following a power down.

F. The controller must now be reconfigured for the application.

BATTERY REPLACEMENT

The controller contains a field replaceable lithium battery used to power the internal memory. The battery voltage is measured and the result is shown in the third sign-on display (see Section 2). If the battery needs to be replaced, remove the controller from its housing and replace the battery located on the left printed wiring board from the rear using a Ray-O-Vac BR2330, CR2330 or equivalent. When replacing the battery, take care not to distort the battery retaining clip.

Before replacing a battery, make a record of the controller configuration and saved profiles since removing the controller from its case and replacing the battery will cause this data to be lost.

INDEX

Q

R

S

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. P.O. number to cover the COST of the repair,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

TEMPERATURE

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE, STRAIN AND FORCE

- Transducers & Strain Gauges
- Load Cells & Pressure Gauges
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition & Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments