

MODEL PC100-2 TEMPERATURE CONTROLLER USER MANUAL

Covers Model PC100-2.

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SECTION 1. GENERAL INFORMATION

INTRODUCTION

Congratulations on your purchase of the PC100-2 Temperature Controller!! Your new controller was manufactured under stringent quality control procedures to insure trouble free operation for many years of service. If you should encounter difficulties with the use or operation of your controller, contact Sun Systems' "Customer Service Department" between the hours of 9:00 and 5:00 EST.

As with all Sun Systems products, we would appreciate any comments, suggestions or criticisms that you may have or develop regarding your evaluation of this equipment. Please address your comments to:

Product Service Manager
Sun Electronic Systems, Inc.
1845 Shepard Drive
Titusville, FL 32780
Tel: (321) 383-9400
Fax: (321) 383-9412
Website: www.sunelectronics.com
Email: sales@sunelectronics.com

LIMITED WARRANTY INFORMATION

PC100-2 Temperature Controller

SUN ELECTRONIC SYSTEMS, INC. WARRANTS THIS PRODUCT TO THE ORIGINAL PURCHASER TO BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP AND TO OPERATE WITHIN APPLICABLE SPECIFICATIONS FOR A PERIOD OF TWO (2) YEARS FROM THE DATE OF SHIPMENT, PROVIDED IT IS USED UNDER NORMAL OPERATING CONDITIONS. THIS WARRANTY DOES NOT APPLY TO SEALED ASSEMBLIES WHICH HAVE BEEN OPENED, OR TO ANY ITEM WHICH HAS BEEN REPAIRED OR ALTERED WITHOUT SUN SYSTEMS AUTHORIZATION.

RISK OF LOSS OR DAMAGE TO THE PRODUCT SHALL PASS TO THE CUSTOMER UPON DELIVERY, BY SUN SYSTEMS, TO THE CARRIER AT SUN SYSTEMS PREMISES.

WE WILL REPAIR OR, AT OUR OPTION, REPLACE AT NO CHARGE ANY OF OUR PRODUCTS WHICH IN SUN SYSTEMS JUDGMENT, ARE FOUND TO BE DEFECTIVE UNDER THE TERMS OF THIS WARRANTY. EXCEPT FOR SUCH REPAIR OR REPLACEMENT, SUN SYSTEMS WILL NOT BE LIABLE FOR ANY LOSS OR DAMAGE TO PERSONS OR PROPERTY CAUSED EITHER DIRECTLY OR INDIRECTLY BY USE OF THIS PRODUCT OR FOR ANY INCIDENTAL DAMAGES OR FOR ANY CONSEQUENTIAL DAMAGES, AS THOSE TERMS ARE DEFINED IN SECTION 2-715 OF THE UNIFORM COMMERCIAL CODE. BEFORE USING, PURCHASER SHALL DETERMINE THE SUITABILITY OF THIS PRODUCT VIA THIS DOCUMENT FOR HIS INTENDED USE AND PURCHASER ASSUMES ALL RISK AND LIABILITY WHATSOEVER IN CONNECTION THEREWITH. NO STATEMENT OR RECOMMENDATION NOT CONTAINED HEREIN SHALL HAVE ANY FORCE OR EFFECT UNLESS IN AGREEMENT SIGNED BY AN OFFICER OF SUN ELECTRONIC SYSTEMS, INC.

INITIAL INSPECTION AND UNPACKING

Inspect the shipping container for obvious damage. If the shipping container is damaged, then a written note on the bill of lading describing the damage should be made while the delivery person is still on the premises. Unpack the PC100-2 and save all carton and cushioning material in case the unit needs to be returned. Verify the contents of the carton matches that of the items listed on the packing slip.

LOST OR DAMAGED EQUIPMENT

If you determine that the goods described on the packing slip are lost or damaged, first notify the transportation company to obtain the correct procedure for returning merchandise for repair or replacement. Then call Sun Systems for a return material authorization (RMA) number, so that we may best handle the merchandise when it is returned.

PC100-2 GENERAL DESCRIPTION

The Model PC100-2 is a 1/4 DIN size, digitally controlled, electrically isolated dual sensor input, single-channel ramping temperature controller with advanced control routines, Fuzzy Logic auto tuning of PID coefficients, and standard GPIB (IEEE-488) and RS232/422 remote control capabilities.

The PC100-2 consists of four components: the main controller section, the remote interface board and cable, the process I/O board and cable, and your temperature sensors. The controller section contains the keypad, display, and most of the electronics. The remote interface section is a small rectangular metal plate with a DB9 connector and a GPIB connector. A 2 foot 26 conductor flat cable, that connects the remote connectors to the PC100-2, is also supplied with the remote interface. The process I/O section consists of a PC board with a line transformer, and barrier strips for input and output to the process you will be controlling. The process I/O board is equipped with a 2 foot long 20 conductor flat cable to be plugged into the PC100-2. The last item that makes up the PC100-2 package are the sensors if sensors were ordered and the connector. The PC100-2 was calibrated at the factory using the probes supplied with the controller, if probes were ordered.

Inspect all shipping material and containers for the items described above. If you have not received all of the items listed, call Sun Electronic Systems for assistance.

Note: The PC100-2 does not include temperature probes unless they were ordered as an option. See Page 14 for sensor hookup information.

MOUNTING AND CONNECTING CONTROLLER

First make sure that line power is disconnected from the equipment before work is started.

Connection of the PC100-2 to your equipment involves the following steps. Mounting the main controller, mounting the remote connector plate, mounting the process I/O board and wiring it to your equipment, and finally mounting the temperature sensor.

The PC100-2 controller mounts in a standard 1/4 DIN panel opening. See figure 1 for mechanical details. Simply slide the controller into the cutout then tighten the 2 screws on the front panel (clockwise) while holding the unit in place. Do not over tighten the panel hold screws. As the panel hold screws are tightened, small levers will swing out and capture the rear side of the panel thus holding the controller in place. To remove the controller, turn the two panel hold screws counter clockwise until the hold levers swing back out of the way.

The remote control connector plate is mounted at any convenient place on your equipment. Pick a location that is accessible for remote cable hookup. Figure 2 provides recommended cutout information.

Figure 1. Standard 1/4 DIN Panel Opening

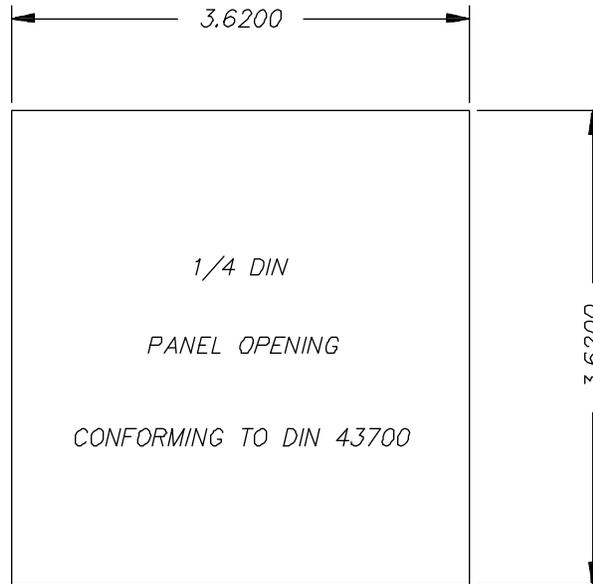
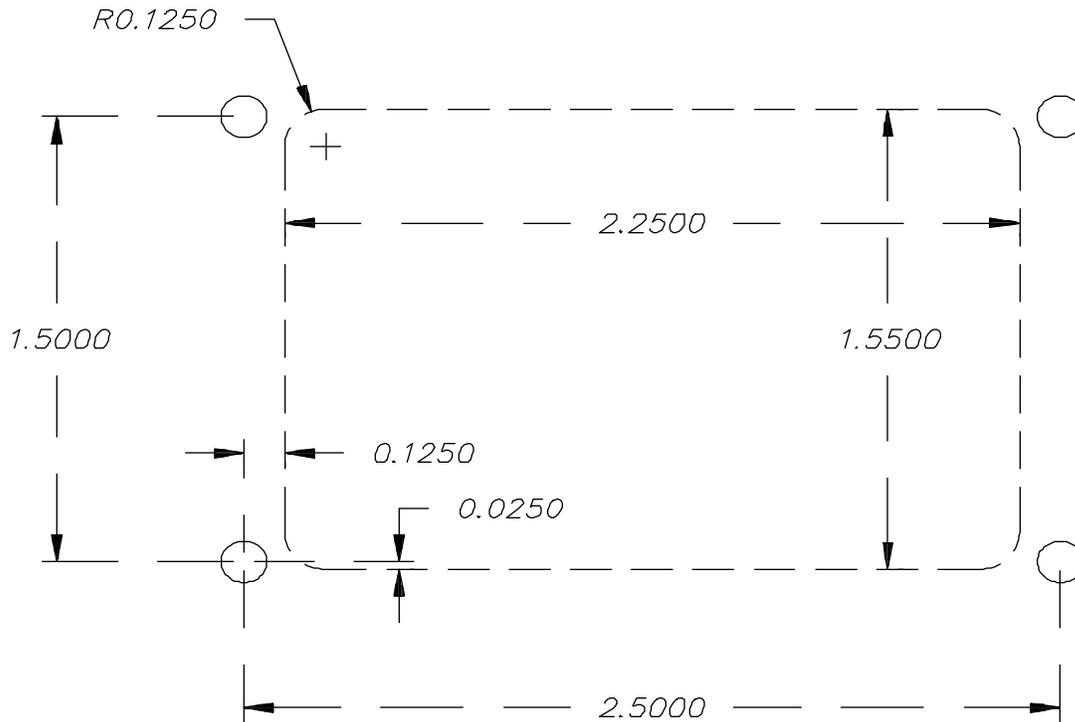


Figure 2. Fixing Details For Remote Control Board



The process I/O board provides all of the wiring connections to your equipment. It should be mounted on a panel inside of your equipment enclosure in close proximity to the high power loads. The board connects to your AC line and provides low level control signals to control your power control relays. Figure 3 provides mounting hole information. AC line voltage is brought into the board (See Figure 4) on the 2 position screw terminal block, labelled P5, located next to the fuse. A switch is provided on the board for line voltage selection. Push the slide switch to the right for 110 VAC operation, to the left for 220 VAC. Connect the HOT line wire to the top terminal and NEUTRAL to the lower terminal when using 110VAC. Along the top edge of the board is provided wire screw headers for the 8 process control outputs. Figure 4 provides the schematic of the process I/O board. As can be seen the outputs start with bit 0 on the top left and run to bit 7 at the top right. Each output consists of two terminal positions, a 12 volt supply at left and the open collector output. Note that the process outputs can not drive line powered loads directly. It is mandatory to use a relay between the I/O board and your heater, cool valve, etc. The most commonly used power driver for powering heaters or valves, etc, is a solid state relay module. They are available in a multitude of voltage and current capacities that are easy to use and very reliable. They are controlled by a 3 to 32 volt control signal (provided by I/O board) and typically control a 110/240 VAC load. The line side is isolated from the control side via its internal optical isolator, and the line side turns on at line zero voltage crossings to minimize electrical noise. To connect a process control output bit to a solid state relay (SSR) simply connect the +12 volt output to the relay positive input and connect the open collector bit output to the SSR minus terminal. The SSR should be mounted to a metal panel in your equipment for heat sinking. If you require an analog voltage for control of your process load, such as a phase

controller, then analog output D/A-B can be configured for PID output in the PC100-2 MENU (see MENU section). An example hookup of the process I/O board to a temperature chamber is shown in figure 5.

Figure 3. Fixing Details For The Process I/O Board

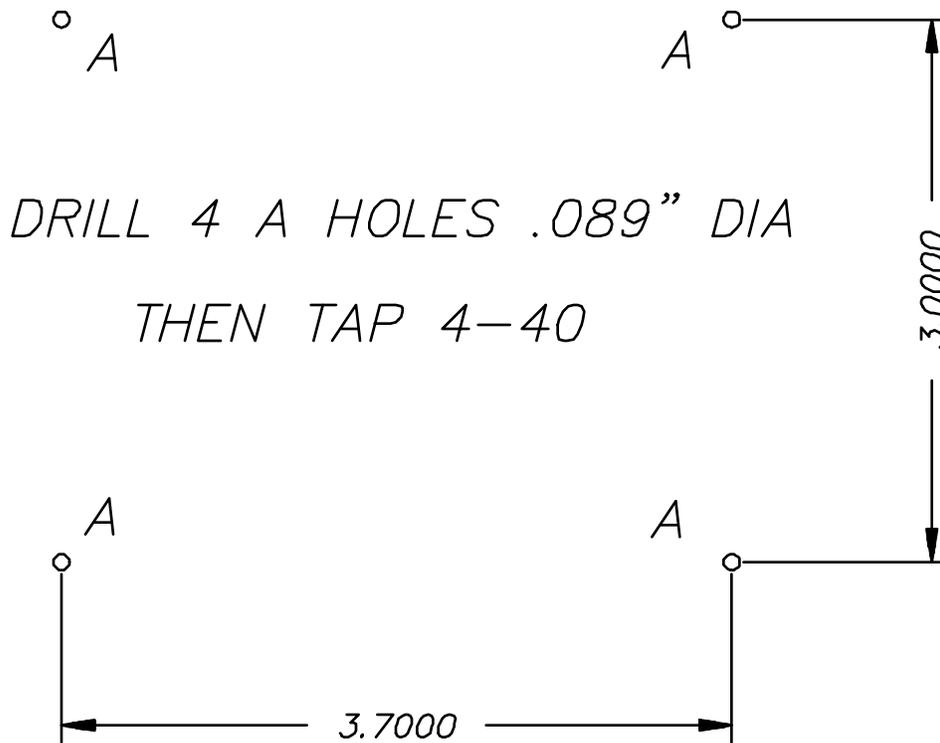
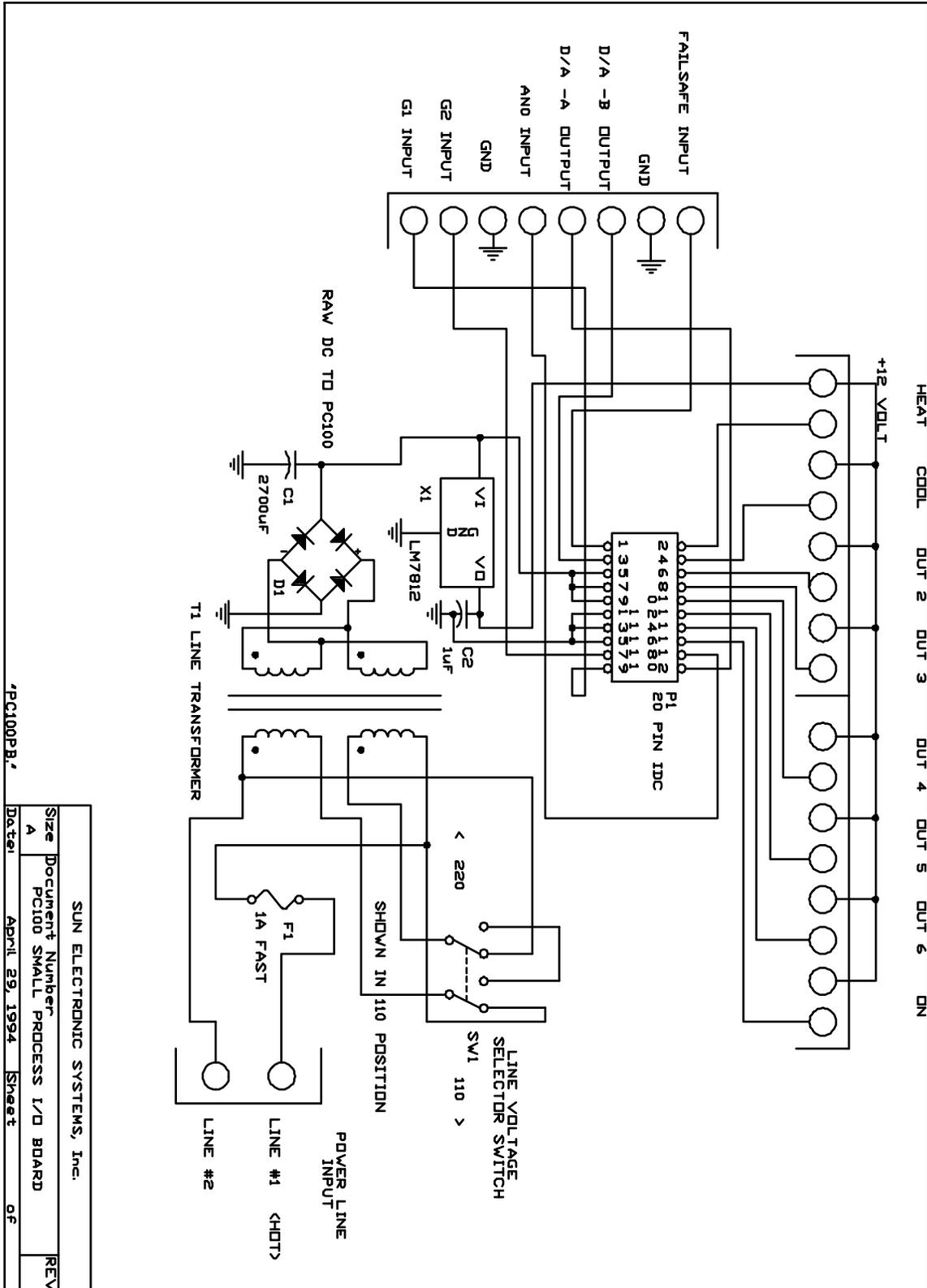
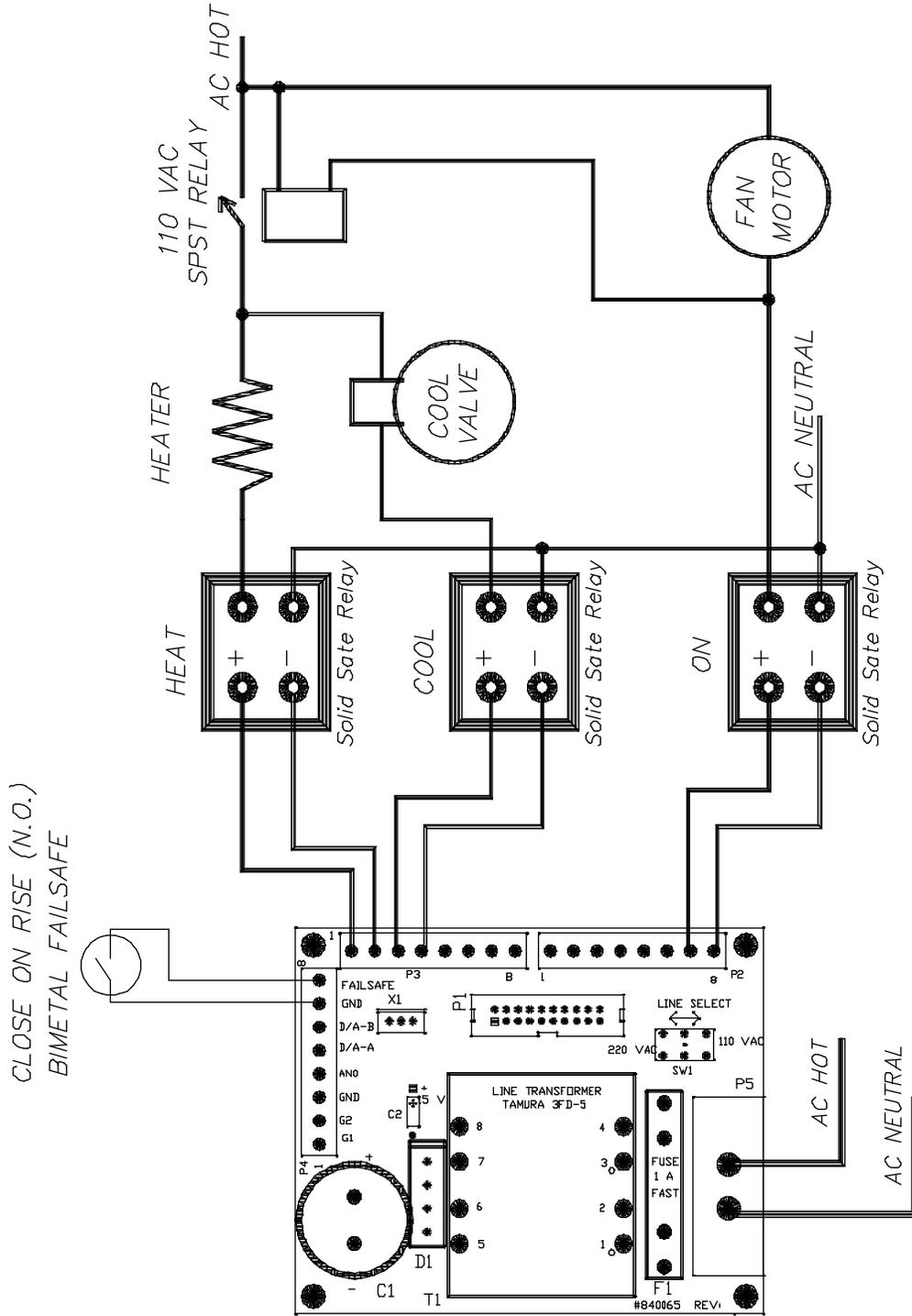


Figure 4. Process I/O Board Schematic



SUN ELECTRONIC SYSTEMS, Inc.	
Size	Document Number
A	PC100 SMALL PROCESS I/O BOARD
Date:	April 29, 1994
Sheet	of
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Figure 5. Example Hookup of Process I/O Board to Chamber



Also available on the I/O board (see figure 4) is another 8 position connector on the left side of the board. This connector provides for 2 TTL level digital inputs (G1 & G2), one analog 0 to 5 volt input (AN0), two analog 0 to 5 volt outputs, a fail-safe contact closure input, and 2 controller ground connections. Contact closure between the fail-safe input and ground will light the PC100-2 fail-safe LED and turn off all of the process control outputs. For safety purpose, a bimetal over temperature fail-safe sensor and a relay should be incorporated in the heating circuit to prevent over heating should the heater solid state relay fail in the on condition. See figure 5.

The last step is to mount the temperature sensors. Your PC100-2 has been set up for the type of probes requested when ordering the controller. The unit is set for degree C temperature scale by default when shipped. Figure 6 shows the connection diagram for all of the probe types accepted by the PC100-2. Probe type changing, temperature scale changing, and calibration are covered later in this manual. When locating the temperature probe try to select a location that will minimize the thermal time delay between process temperature variations and the probe's sensed temperature.

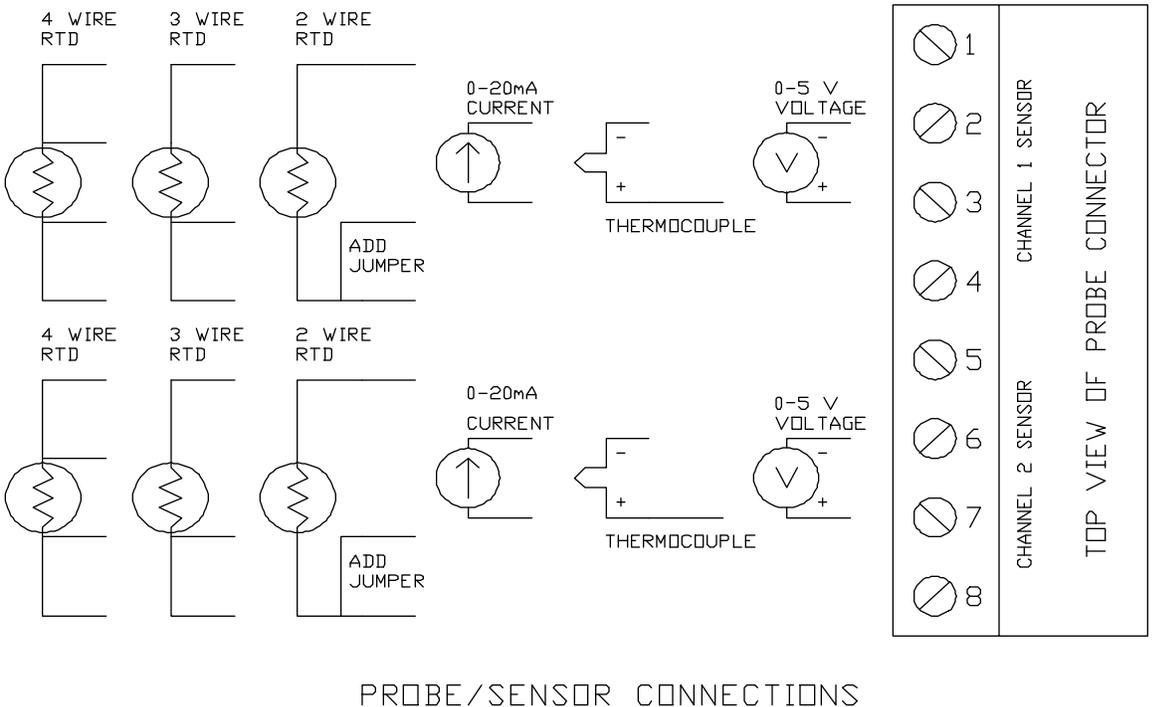


Figure 6. Connection Diagram for Probe / Sensor Connector located on back of controller

At this point make sure that all the cables are plugged into the rear of the PC100-2 and then close up your equipment chassis. Apply power to the controller and press the front panel ON button. The unit will power up with its self test message and then begin displaying the channel 1 temperature on the LCD top line and channel 2 temperature on LCD bottom line. Until a temperature is set, the controller will not turn on your heat or cool loads so the temperature should not change much if the wiring is ok. At this point you should check that the controller can turn on and off your process heating and cooling loads.

To check the heater, enable the heat enable by pressing the front panel heat enable key (LED on). Next press the SET SEG key then the ENTER key. The PC100-2 will prompt you for the RATE. Just press enter to leave it unchanged. Next it prompts for WAIT, again press enter. Then it prompts for SET. Type in 50 and press enter to set the target temperature for 50 deg. You may use any other temperature above the probe temperature. You will now see the HEAT LED turn on signifying that the heat process output (Bit 0) is on. If the heater is wired correctly the temperature should move higher. To check the cooling side, if your equipment cools, press the cool enable and set a low temperature using the SET SEG key as above. If you are using automatic compressor control and/or cool boost these features must be enabled in the PC100-2 MENU, (See Section 3). To enable them press the SHIFT key then red MENU key and then ENTER. Answer shift YES to enter menu then just press the enter key after each menu question until you reach the parameter you wish to change, then press enter after each prompt until the menu terminates. Now we can run through the major controller features in a simple example format. First we will run the unit in its simple single temperature mode and then we will create a simple local program from the front panel and run it. Finally we will connect an IBM compatible PC to the RS232 port and run SUN's data logging software, that has been supplied with your PC100-2, to show remote control features.

SINGLE TEMPERATURE MODE EXAMPLE:

The single temperature mode is the most commonly used mode. You simply set a RATE of change in Deg per Minute, set a WAIT at temperature time, then SET the target temperature that you want the controller to go to. All three of these parameters are prompted for when the SET SEG key is pressed, followed by pressing the ENTER key. First the current RATE setting is displayed on the LCD top line and the bottom line prompts for the new setting. If you wish to keep the setting then just press ENTER key otherwise type in the new value you want and press ENTER. Then the current WAIT time is displayed on the top LCD line and the PC100-2 prompts for your new setting. Note that forever means that the time at temperature counting will not take place. The PC100-2 will not beep and turn on the time out LED. Type in the new WAIT time, (just the number of minutes or hour:minutes:seconds) and press ENTER or just ENTER for no change. The final prompt is for the SET temperature that you wish the PC100-2 to ramp to and control to. Once the above three parameters have been set, and the HEAT and COOL ENABLES are on, the controller will ramp to the SET temperature. During the ramping the PC100-2 will display the current set temperature that it is calculating "CSET=" until it reaches the SET you typed in. As soon as the channel 1 probe temperature (in normal PID mode) is within +/- 1.0 deg C (by default) of the SET temperature the PC100-2 starts to count down the WAIT time. When the wait time reaches zero the TIME OUT LED is turned on and the buzzer beeps. The PC100-2 continues to hold the SET temperature until you set a new value via the SET SEG key. You can at any time turn off the controlling function by pressing the STOP key then ENTER key or by just disabling the heat and or the cool enables. That is about all there is to the single temp mode.

LOCAL PROGRAM MODE EXAMPLE:

The local program mode allows the PC100-2 to cycle through a number of RATE, WAIT, and SET segments automatically. The PC100-2 provides for 10 separate local programs that are stored in the unit's battery backed memory. FOR-NEXT loop commands are provided so that whole programs or sections of a program may be repeated as specified by the user. The GOSUB command even allows other local programs to be called as subroutines. To create a local program from the front panel you will do the following;

<p><shift> EDIT 2 ENTER END</p>	<p>start edit mode prog #2 end is displayed signifying that prog #2 is empty. If it was not empty you would press STOP ENTER to exit the edit mode and then pick another prog number or DEL the program to clear it.</p>
<p><shift> FOR I0 ,0 ,10 ENTER SET SEG ENTER</p>	<p>We will loop 10 times The PC100-2 will prompt for RATE, WAIT, and SET values</p>
<p>20 ENTER 3 ENTER 12.5 ENTER SET SEG ENTER</p>	<p>you enter 20 for rate you enter 3 minutes for wait you enter 12.5 deg for setpoint you want to enter the next temp segment. The PC100-2 will prompt for RATE, WAIT, and SET.</p>
<p>ENTER 0:4:30 ENTER 55.2 ENTER <shift> NEXT I0 ENTER <shift> UP or DOWN</p>	<p>you just press ENTER to use the same rate you set the wait to 4 minute and 30 seconds SET temp will be 55.2 deg The matching NEXT to the FOR You can use the red UP and DOWN arrows to move around in the local pro gram. Let us assume that we wish to loop 5 times through the program rather than ten. Use the UP arrow until the first line FOR command is displayed.</p>
<p>FORI0,0,10</p>	<p>Now use the backspace key to erase the 10 and type in 5.</p>
<p>FORI0,0,5</p>	<p>Then press ENTER and the modified line is stored.</p>
<p>STOP ENTER <shift> RUN 2 ENTER</p>	<p>Use stop enter to exit edit mode. Use RUN to run the program.</p>

The program will begin running. The heat and cool enables will turn on and the LOCAL PROGLED will light up. Starting with the current probe temperature, the controller will ramp the temperature to 12.5 deg at a rate of 20 deg per minute. Once the channel 1 probe temperature is within 1.0 deg of the set temperature the unit will begin counting down the 3 minute wait time. When the wait time reaches zero the time out LED will blink and the buzzer will beep. The PC100-2 will then begin its ramp to 55.2 deg. After the 4 and one half minute wait at 55.2 deg the program will loop back to the beginning and repeat the process described above. The program will loop 5 times as directed by the FOR-NEXT commands. At any time while the program is running, you may suspend program execution by pressing the HOLD key ENTER key and then resume from the hold by just pressing the HOLD key ENTER key. Again the program may also be stopped by pressing the STOP and ENTER key.

So now we have our local program but let us assume that we now want to do a few more things. First we want the process to be at 30 deg for 1 minute before we start the cycling. Secondly, we want the process temperature to stay at 30 deg after the cycling until we manually stop it. Let us edit the program as follows;

<shift> EDIT 2 ENTER	Edit program #2
FORIO,0,5	the first line of the prog is displayed
SET SEG ENTER	we will store a new segment before the first line. Answer the prompts
30 ENTER	ramp at 30 deg per minute
1 ENTER	wait for 1 minute
30 ENTER	set for 30 deg

Now use the red DOWN arrow to move to the last line of the program the END line.

END	the END is displayed
SET SEG ENTER	we will store another segment before the END command. Answer the prompts
30 ENTER	rate equals 30 deg per minute
99:59:59 ENTER	wait for about 100 hours
30 ENTER	set for 30 deg
STOP ENTER	end edit

Now when the program runs, the process will go to 30 deg for 1 minute. Then the 5 cycles will be done and then it will go to 30 deg and stay there for 100 hours. You will use the STOP key to manually terminate the 100 hour 30 deg soak whenever you wish. At this point you may wish to experiment with some of the other local program commands such as the GOSUB, FOR-NEXT loops within FOR-NEXT loops, BKPNT commands, IN commands that read process bit on/off inputs into I variables, etc.

GPIB (IEEE-488) REMOTE CONTROL

SUN SYSTEMS has been producing GPIB remote controllable process controllers since 1978. Over the years, hundreds of instruments, from power supplies to network analyzers have come on the market that provide a GPIB remote port. Due to its enhanced capabilities, over RS232/422, and wide spread acceptance, GPIB remote control is the preferred interface for ATE systems.

The PC100-2 GPIB interface supports TALK and LISTEN as well as SERIAL and PARALLEL POLLING. The PC100-2's GPIB device address is set up from the front panel MENU. To send a command to the PC100-2 you will send the ASCII string for the command, as given in this manual, with a line feed and/or EOI terminator, a carriage return if sent will be ignored. Data sent by the PC100-2 to the bus controller will be ASCII characters terminated with carriage return then line feed with EOI set. If any interrupts are enabled and the GPIB remote is active and an interrupt occurs the SRQ line will be asserted on the bus. The system controller can then perform a serial poll, or parallel poll if enabled in the PC100-2 MENU, to service the interrupt. If you chose not to service the PC100-2 interrupts, the PC100-2 will display a SRQ OVERFLOW message. The message is just to inform you that an interrupt has not been serviced and can be ignored without causing any problem. Since the PC100-2 has built in deviation limit, upper and lower limit checking, and wait at temperature timing, it is suggested that the system programmer use these features rather than constantly reading the probe temperature and duplicating those functions in the bus controller software. Some example GPIB programs are supplied on the floppy disk (see PC1_GPIB). Since there are so many different manufactures of GPIB computers or interface cards, each with its own software particulars, we are not able to provide examples for all possible platforms but the examples provided should be instructive.

SECTION 2. FRONT PANEL DESCRIPTION

LCD DISPLAY

The LCD display on the PC100-2 is a two-line 32 character display. When not in the MENU, line one displays the sensor # 1 temperature reading or any error message regarding channel 1, and line two displays sensor # 2 temperature reading, any error message regarding channel 2, or alternatively displays CSET/SET/WAIT values when controlling a process. Line two also displays various responses from the controller as well as any data entry by the user from the front panel.

LED INDICATORS

The front panel on the PC100-2 contains nine LED indicators. The FAIL-SAFE indicator lights whenever a fail-safe condition occurs. The HEAT and the COOL LEDs light when the controller turns on the heat and cool outputs. These LEDs will not light unless the HEAT ENABLE and/or COOL ENABLE are activated. The REM CTL LED lights when either GPIB, RS232 or RS422 remote control is active. The LOCAL PROG LED lights when in local program edit mode or when a local program is running and blinks when the local program has been set to run at a time of day. The TIME OUT LED lights when the wait time for a set point has timed out. The LED next to the red SHIFT key is used to indicate that the SHIFT is active. Using the SHIFT key allows entry of the commands printed in red on the controller front panel. The remaining two LEDs indicate that the heat and/or cool enables are active.

KEYPAD

The keypad on the PC100-2 is labelled with white and red commands on and above the keys. To access the commands labelled in white, the key is simply pressed and the function will appear on line two of the display. To access the commands labelled in red, the red SHIFT key must first be pressed followed by the desired key. The ENTER key must be pressed after all commands for the controller to accept the command. Each key's unshifted and shifted function is explained below. The white back arrow is used to back space.

0-9	Numeric data entry
-	Negative sign
.	Decimal point
Left Arrow	Backspace key during command entry
STOP	The STOP function, when used in the MENU, will cause the menu to exit. Any changes made in the menu before the STOP key was pressed are saved by the controller. If STOP is pressed when a local program is running, the local program will terminate. If STOP is pressed when in local program edit, the program is saved and the local program edit mode is exited. If STOP is pressed when a valid set temperature is present, the controller will stop controlling to that temperature and set SET=NONE and WAIT = FOREVER.

ENTER	Enters commands into the PC100-2. All commands must be followed by the ENTER key for the PC100-2 to accept the command. When in local program edit mode, the ENTER key is used to insert the present line into the local program.
SET SEG	Allow for easy entry of the RATE, WAIT, and SET values. When the command is entered the controller will display the current setting and prompt for the new values. The user must then only enter the value desired using the numeric entry keys or just enter for no change.
HEAT ENABLE COOL ENABLE	Used to enable/disable the heat and cool outputs. If the LED is on, the function is enabled. If the LED is off, the function is disabled. The switches operate in a push-on/push-off or alternate action fashion. When in local program edit, depressing these switches enters HON or HOFF when HEAT ENABLE is pressed and CON or COFF when COOL ENABLE is pressed. If the opposite action is desired, backspace over the entry and re-enter to get the correct action.
ON/OFF	Turns the unit on and off.
<SHIFT> RUN n	Causes local program “n” in the PC100-2’s memory to begin running. Program number “n”, where n = 0 to 9.
<SHIFT> UP <SHIFT> DOWN	Only valid in local program edit. Allows for scrolling ARROW up and down through the local program.
<SHIFT> MENU	Causes entry into the PC100-2 configuration menu. This menu is fully explained in Section 3.
<SHIFT> EDIT n	Enables the local program edit mode. To exit local program edit, the STOP command must be issued.
<SHIFT> DEL	Performs two functions: (1) delete current program line during local program edit or (2) delete a local program when not in local program edit mode. If deleting a local program, the controller will ask “YOU SURE (Y/N)?” before deleting the program
<SHIFT> BKPNT	Used in local programming. Either a number or an I variable I0-I9 must follow the BKPNT statement. The BKPNT statement is fully explained in the Local Programming Section (Section 4) and the Detailed Command Description Section (Section 10).

<SHIFT> IN/YES	Performs two functions. When in the MENU, this key functions as YES. When not in the MENU, the key functions as the IN command. The IN statement is fully explained in the Local Programming Section (Section 4) and the Detailed Command Description Section (Section 10).
<SHIFT> FOR <SHIFT> NEXT	Used in local programming. Marks the beginning and the end of a FOR/NEXT loop. The FOR and NEXT statements are fully explained in the Local Programming Section (Section 4) and the Detailed Command Description Section (Section 10).
<SHIFT> OUT/NO	Performs two functions. When in the MENU, this key functions as NO. When not in the MENU, the key functions as the OUT command. The OUT statement is fully explained in the Local Programming Section (Section 4) and the Detailed Command Description Section (Section 10).
<SHIFT> GOSUB	Used in local programs to call another program as a subroutine. Explained in Local Programming Section.
<SHIFT> HOLD	Suspends WAIT timing when in single temp mode. Suspends local program when in RUN mode.
<SHIFT> :	
<SHIFT> ,	Numeric delimits.
<SHIFT> I	I variable.

SECTION 3. MENU

The PC100-2 contains one menu for configuration. Listed below are the functions contained in the menu. Many of these functions can also be accessed remotely. The menu items are listed in the order of their appearance in the menu.

CAL TO STAND (CALIBRATE TO A STANDARD)

The PC100-2 can be calibrated in two ways: (a) calibrate to a standard and (b) calibrate at 0 and 100 deg C. Calibrating at 0 and 100 deg C is used when the probe type has to be changed and is explained in Section 7. The calibrate to a standard is explained below and is accessed from the menu.

Answering YES to this menu item will invoke a group of commands to calibrate the probe to your in-house standard at your facility. The basics of calibrating to a standard will be explained and then the menu prompts will be explained.

Before leaving the factory, each unit is calibrated for the probe type specified when the PC100-2 was ordered. However, there is the ability to re-calibrate the unit at your facility using an in-house standard if so desired. Calibrating the PC100-2 to a standard requires placing the probe at two temperatures and entering the values at these two temperatures into the unit. The temperatures can be any two temperatures that you choose. These readings would be obtained from the in-house measurement device. The menu is set up such that each temperature is entered separately. Only one temperature can be entered for the two probes each time through the menu. After the first temperature is entered for both the probes, the menu must be exited and then re-entered to enter the second temperature. To obtain the best results, the two temperatures should be reasonably far apart.

The first prompt displayed after answering yes to CAL TO STAND? is ENTER CAL ACCESS CODE?. The cal access code is 9 for the PC100-2 and this cannot be changed. Having a cal access code should prevent unauthorized personnel from inadvertently calibrating the unit. Once the correct cal access code has been entered, the CLR STD CAL CH_1 prompt is displayed. Answering yes to this prompt will clear any previous calibration to a standard information for channel 1. If this is the first time through the menu to enter temperature 1, you should answer YES to CLR STD CAL CH_1. However, if temperature 1 has already been entered (i.e. this is the second time through the menu), then you must answer NO to CLR STD CAL CH_1 to prevent erasing the information already obtained for temperature 1. The next prompt is CAL TO STD CH_1 ?. Say YES to this if you are calibrating channel 1, or say no to proceed to channel 2. If calibrate channel 1 was selected, then the next prompt will be TEMPERATURE 1?. If you want to enter the first temperature, answer YES. If you answered YES, the next prompt is ENTER TEMP 1?. At this time the standard reading numeric value should be entered. A similar set of prompts are displayed for channel 2 immediately following channel 1. You can then either exit the menu, by pressing STOP, or continue with the other items in the menu. You must eventually exit the menu, however, to enter temperature 2.

If you answered NO to the TEMPERATURE 1 prompt, the next prompt will be TEMPERATURE 2?. Answering YES to this prompt causes ENTER TEMP 2 to be displayed. At this time the second standard reading numeric value should be entered. A similar set of prompts are provided for calibrating channel 2 immediately following channel 1. You can then either exit the menu or continue with the rest of the menu. Shown below is a typical dialogue to calibrate the probes to a standard using the standard readings of -20 and 120 deg C. The probes and standard must first be placed in a substance or area that is -20 deg C and let stabilize. If the PC100-2 is being used to control a temperature chamber, the chamber itself should be used as the area that is at -20 deg C. With the standard probe and the PC100-2 probes very close together, enter SET= -20 and WAIT= 00:15:00 into the unit. After the wait time

times out, perform the procedure listed below. (The controller will still control to the set temperature while in the MENU as described below.)

Controller	User Input
	<SHIFT> MENU
Enter Menu ?	yes
Cal to Stand ?	yes
Enter Cal Access Code ?	9
Clr Std Cal Ch_1 ?	yes
Cal to Std Ch_1 ?	yes
Temperature 1 ?	yes
Enter Temp 1?	enter reading from your standard
Clr Std Cal Ch_2 ?	yes
Cal to Std Ch_2 ?	yes
Temperature 1 ?	yes
Enter Temp 1 ?	enter reading from your standard
Modify Scale Ch_1 ?	no
Modify Scale Ch_2 ?	no
Exit Menu ?	yes

Now place the probes and standard in a substance or area that is 120 deg C and let stabilize. If the PC100-2 is controlling a temperature chamber, enter SET=120 and WAIT=00:15:00 into the unit and wait for the time-out to occur before proceeding.

	<SHIFT> MENU
Enter Menu ?	yes
Cal to Stand ?	yes
Enter Cal Access Code ?	9
Clr Std Cal Ch_1?	no
Cal to Std Ch_1	yes
Temperature 1 ?	no
Temperature 2 ?	yes
Enter Temp 2 ?	enter reading from standard
Clr Std Cal Ch_2 ?	no
Cal to Std Ch_2 ?	yes
Temperature 1 ?	no
Temperature 2 ?	yes
Enter Temp 2 ?	enter reading from standard
Modify Scale Ch_1	no
Modify Scale Ch_2	no
Exit Menu?	yes

MODIFY SCALE CH_1 ?

Allows changing of channel 1 temperature scale to deg C, F, or K.

MODIFY SCALE CH_2 ?

Allows changing of channel 2 temperature scale to deg C, F, or K.

CHART CH_1 TEMP? (CHART CH_2 TEMP?, & OUTPUT PID)

Answering YES to this prompt will enable the 0-5V chart output of the channel 1 probe readings. The next two prompts define the upper and lower chart values. The prompt LOW CHART VALUE also displays the present setting of the low chart value. To change the value, simply enter the number. The same is done for the next prompt HIGH CHART VALUE. A similar set of prompts are provided to enable the chart output on the analog port D/A-B for channel 2 immediately following channel 1. For a complete description on connecting a chart recorder, see Section 6.

Answering NO to the CHART CH_1 TEMP? prompt will cause the OUTPUT PID prompt to be displayed. This would be enabled when analog control is desired. This will cause the PID loop control to be output in one of four different modes. (Both of these items, the chart output channel 1 and the PID output utilize the same analog port (D/A-A). Therefore, only one of these can be enabled at a time.) If you answer YES to the OUTPUT PID, you will be prompted with WHICH MODE (0-3)? The four modes are described below:

- Mode 0: 0V = full cool, 2.5V = off, 5V = full heat
- Mode 1: 0V = heat off, 5V = full heat
- Mode 2: 0V = cool off, 5V = full cool
- Mode 3: 0V = off, 5V = full heat/cool

If the process should be heating, the D/A output is for heat control and Bit I/O bit 4 will be high. If the process should be cooling, the D/A output is for cool control and Bit I/O bit 4 will be low. Bit I/O and the D/A output are fully discussed in Section 8.

ADVANCED PID?

Answering YES to this menu will allow the PC100-2 to be used in advanced PID control modes. The user can select one of the following modes :

- Mode 0 ; Normal PID control
- Mode 1 ; Average of Ch_1 and Ch_2 temperatures
- Mode 2 ; Slowly force Ch_2 to set temperature
- Mode 3 ; Control to Ch_2 temperature
- Mode 4 ; Control to average and force Ch_2 to set temperature

When mode 2 or 4 is selected, the PC100-2 prompts DAMPING COEFF ? and displays the default value on the bottom line. The user may enter a new value or just hit ENTER to select the default value. The larger the damping coefficient, the slower the controller will move Ch_2 temperature to the set point. The advanced PID modes also change when the PC100-2 starts to count down the WAIT time as follows

- PIDA = 0 ; when $ABS (SET - CH_1) < WAIT TRIGGER$
- PIDA = 1 ; when $ABS (SET - (CH_1 + CH_2)/2) < WAIT TRIGGER$
- PIDA = 2 ; when $ABS (SET - CH_2) < WAIT TRIGGER$
- PIDA = 3 ; when $ABS (SET - CH_2) < WAIT TRIGGER$
- PIDA = 4 ; when $ABS (SET - CH_2) < WAIT TRIGGER$

DISABLE INTS? (DISABLE INTERRUPTS)

Answering YES to this menu item will disable the following remote interrupts: single time-out, deviation, local program time-out, local program done, breakpoint, and command error. Answering NO will enable the interrupts. To selectively enable/disable the interrupts, the remote SINT command should be used.

GPIB&422 ADDRESS (0-31)

This prompt will display the current GPIB address and allow you to change it. This address number is the GPIB device address as well as the unit address used by the RS422/485 TALK and LISTEN commands.

GPIB LOCKUP TIME?

This item allows entering of the maximum lockup time in seconds for the GPIB interface. The range is 2-59 seconds. If 0 is selected, then GPIB lockup interrupts are disabled. The controller uses this value when deciding on how long to wait when trying to send a requested string out over the remote GPIB bus.

TIME-OUT PRETIME

This value is the length of time before an actual wait period time-out that the controller will generate a single time-out interrupt. The range is 0-59 seconds. This allows readings to be taken before the controller begins ramping to the next set point.

SERIAL PORT MODE

Used to select which serial port you wish to use. Enter 1 for RS232 or 2 for RS422/485.

BAUD RATE SET

This menu item allows changing and examining of the RS232 baud rate. The range is 1-6 based on the following:

- 1 = 9600 baud
- 2 = 4800 baud
- 3 = 2400 baud
- 4 = 1200 baud
- 5 = 600 baud
- 6 = 300 baud

RS CHAR ECHO ON?

Answering YES to this prompt will enable RS232 character echo. Character echo allows you to see what you have typed when communicating to the PC100-2 from a dumb terminal.

RS DTR-CTS ON?

Answering yes will enable hardware handshake for the RS232. The PC100-2 will wait for Clear To Send (CTS) before transmitting and will drop Data Terminal Ready (DTR) when it is busy. If you are in RS422 serial port mode this prompt will not be given and this function will be set to OFF.

DEVIATIONLIMIT

This item allows setting and examining of the deviation limit. The range is between .01 and 300. If the deviation limit interrupt is enabled, and the probe temperature varies by more than + or - the set limit, an interrupt will be generated. (See Section 5 D. Remote Interrupt Characters)

CHANNEL_1 LTL

The lower temperature limit for channel 1 can be changed and examined with this menu item. The temperature is entered in the current temperature scale. Temperature SET points cannot be made lower than the lower temperature limit for channel 1. In addition, an interrupt will be generated to the active remote device if the channel 1 reading goes below lower temperature limit. If the probe reading is less than the lower temperature limit, the controller will automatically suspend cooling process and if the temperature goes below the LTL by about 8 degrees, then the controller will automatically turn off the COOL ENABLE output.

CHANNEL_1 UTL

The upper temperature limit for channel 1 can be changed and examined with this menu item. The temperature is entered in the current temperature scale. Temperature SET points can not be made higher than the upper temperature limit for channel 1. In addition, an interrupt will be generated to the active remote device if the channel 1 reading exceeds upper temperature limit. If the probe reading is higher than the upper temperature limit, the controller will automatically suspend heating, and if the probe reading is higher than UTL by about 8 degrees, then the controller will turn off the HEAT ENABLE output.

CHANNEL_2 LTL

The lower temperature limit for channel 2 can be changed and examined with this menu item. The temperature is entered in the current temperature scale. An interrupt will be generated to the active remote device if the channel 2 reading goes below lower temperature limit. If the probe reading is less than the lower temperature limit, the controller will automatically suspend cooling process and if the temperature goes below the LTL by about 8 degrees, then the controller will automatically turn off the COOL ENABLE output.

CHANNEL_2 UTL

The upper temperature limit for channel 2 can be changed and examined with this menu item. The temperature is entered in the current temperature scale. An interrupt will be generated to the active remote device if the channel 2 reading exceeds upper temperature limit. If the probe reading is higher than the upper temperature limit, the controller will automatically suspend heating, and if the probe reading is higher than UTL by about 8 degrees, then the controller will turn off the HEAT ENABLE output.

PULSE WIDTH MOD

This menu item permits examination and modification of the Pulse Width Modulation Period. See PWMP command in the Detailed Command Description Section 10 for a full explanation of this feature. For most applications the 2 second default value should be used.

MODIFY TIME

The PC100-2 is equipped with a battery backed real time clock. The current time of day can be modified and examined here. To change the time simply type the new time into the controller in the format hh:mm:ss in 24 hour format (military format).

POW DOWN RESTART

The power down restart feature of the PC100-2 will cause the controller to automatically restart if power is removed from the controller. The value entered here is the number of minutes the controller will wait with the power off before disabling the automatic restart. This number can range from 0-59 minutes. Note that a valid time of day must be set before this feature will work.

LINE FREQ

This tells the controller which line frequency is being used to power the controller. The digital filtering for the probe signal is optimized for the line frequency that is being used.

+/- WAIT TRIGGER

This is the +/- tolerance at which the controller detects that the set point has been reached and the WAIT time should begin counting down thus providing guaranteed temperature soaking. The default is 1 deg C.

ENABLE BUZZER

This menu item enables/disables the buzzer.

RUN LP AT TOD

This menu item enables/disables the local program (LP) to run at a particular time of day (TOD). The "(Y)" or "(N)" on the second line of the display indicates if the local program is enabled to run at a time of day. The time displayed is the time that the program is set to run. Pressing ENTER only at this menu prompt will take you to the next item. Entering NO will disable the local program running at a time of day and take you to the next menu item. Entering YES will enable the local program to run at a time of day. The menu will then display "PROG# to RUN?". Enter the program number you wish to run. The program will then display, "ENTER TIME?". The time that the program will run can now be entered. If an error is made while entering the time and the ENTER key is pressed, the local program running at a time of day will be disabled and the menu will go to the "Run LP at TOD" prompt to allow for correct entry. The LOCAL PROG front panel LED will flash to signify that LP is set to run.

COMPRESSOR CTL

This menu item enables the automatic compressor control feature of the PC100-2. When enabled, Process output bit 2 acts as the control for the compressor. See Section 8 for complete description of the compressor control feature.

COOL BOOST

This menu item enables the automatic boost cool output control feature. When enabled, Process output bit 3 acts as the control for a boost cooling valve. Boost cooling is used on some closed cycle refrigerated temperature chambers.

AUTO TUNE PID ?

This menu enables/disables the automatic tuning of the PID coefficients. PC100-2 uses a Fuzzy Logic evaluation technique to determine the appropriate PID coefficients based on the thermal response and error tracking during the control process. However, it should be noted that enabling the auto tuning disables any advanced PID mode settings and sets it to the normal PID mode. It should also be noted that if auto tuning is disabled, the PID coefficients will automatically be set to the default settings. The menu items listed below are used for manual setting of PID coefficients and will be displayed only when auto tuning is disabled.

PH = (P COEFFICIENT FOR HEAT)

This menu item allows examination/modification of the Proportional coefficient of the PID coefficients for heating. (Factory Default=.250)

IH = (I COEFFICIENT FOR HEAT)

This menu item allows examination/modification of the Integral coefficient of the PID coefficients for heating. (Factory Default=.001)

DH = (D COEFFICIENT FOR HEAT)

This menu item allows examination/modification of the Derivative coefficient of the PID coefficients for heating. (Factory Default=.1)

PC = (P COEFFICIENT FOR COOL)

This menu item allows examination/modification of the Proportional coefficient of the PID coefficients for cooling. (Factory Default=.25)

IC = (I COEFFICIENT FOR COOL)

This menu item allows examination/modification of the Integral coefficient of the PID coefficients for cooling. (Factory Default=.001)

DC = (D COEFFICIENT FOR COOL)

This menu item allows examination/modification of the Derivative coefficient of the PID coefficients for cooling. (Factory Default=.1)

SECTION 4. LOCAL PROGRAMMING

The Model PC100-2 provides commands to control the flow of local programs which permit automatic test operation by the controller. Ten local programs may be entered into the Model PC100-2 either from the local control panel or from either the GPIB or RS-232/422 interfaces. The unit provides 10 global integer variables designated by the letter "I". The "I" variable may be used in: 1) a FORIn/NEXTIn statements for multiple pass loops, 2) IN and OUT instructions for communication with Model PC100-2 I/O interfaces and 3) arithmetic expressions containing additions and subtractions. The END instruction designates the end of the program. The STOP command is used to terminate the edit mode from the front panel.

A program is entered into the unit locally from the front panel by using the EDIT function. The program may also be downloaded from a remote interface using the STORE command. Command DEL permits deleting program lines during local program edit. DEL "n" deletes the local program "n" when not in the local program edit mode. A program is executed using the RUN "n" command or the RUN "n" TIME menu item or command and can be prematurely terminated with the STOP command.

Debug assistance and host computer synchronization is provided with the BKPNT nn or BKPNT Im commands and the breakpoint interrupts. The commands permit the operator to place breakpoints in the program to suspend program execution. The interrupts are provided to inform the host computer that a breakpoint has occurred. The program will remain suspended until the enter key is depressed on the local control panel or until a remote BKPNTC command is received. BKPNT nn displays the value nn and BKPNT Im displays the value of "Im" when encountered during local program execution. The remote BKPNT? command is provided so that the host computer may determine the breakpoint value after receiving a breakpoint interrupt.

EDIT "n"	EDIT local program "n" where n=0 to 9.
RUN "n"	RUN local program "n" where n=0 to 9.
RUN "n" TIME=hh:mm:ss	RUN program "n" at time of day
STOP	Terminate a running LP or STOP an EDIT session.
DEL [#"n"]	DELETE LINE currently being displayed if in local program edit mode. If not in local program edit mode, used to delete the local program "n".
BKPNT nnn	BREAKPOINT, suspends program operation, displays Integer Bkpnt nnn value, and generates an interrupt if enabled.
BKPNT Im	BREAKPOINT, suspends program operations displays current "Im" value, and generates an interrupt if enabled.
FORIm[m=0 thru 9],[starting integer value],[ending integer value] , [+ / -]	FOR statement marks the beginning of a loop. Note that there is a "," (comma) after the FOR Im and not an "=" as in normal for/next loop programming. This is due to the fact that there is no "=" on the PC100-2 front panel keyboard. The "Im" variable is either increased [+ , default] or decreased [-] from the starting integer to the ending integer. FOR statements may be nested 4 deep.

GOSUB “n”	Call program “n” as a subroutine. nest 4 deep.
NEXT Im	NEXTIm marks the end of the for/next loop
END	End of program statement.
LIST “n”	List program “n” to a remote interface.
STORE “n”	Store to program “n” from a remote interface. Program “n” must be empty before storing is allowed.

SECTION 5. REMOTE CONTROL - GPIB, RS232 and RS422

RS-232 SERIAL PORT PROTOCOLS

The serial port's operation depends on whether CMD ERROR INT'S are enabled or disabled via the SINT remote command. The MENU item "DISABLE INTS ?" only disables or enables all of the interrupts. For total control of the RS interrupts, the remote SINT command should be used. See the full description of the SINT command in Detailed Command Descriptions.

If command error interrupts are disabled, no indication to the host computer communicating to the serial interface is given as to whether a command was accepted or rejected. To determine last command status the "?" command may be used. If command error interrupts are enabled, the controller responds with a "?" message if the command received was rejected. If the command was accepted and the type of command does not invoke a reply, i.e., such as a SET=nnn.n command, the controller will reply with an OK message. If the accepted command invokes a reply, then the reply is sent without the OK message. The CMD ERROR INT ENABLED mode is convenient since every command sent to the controller generates a reply back to the host computer thereby providing a handshake.

The RS port operating parameters are set up in the MENU. The MENU allows setting of the BAUD RATE, ECHO on / off, and whether to use hardware handshake. The serial port sends a zero for the parity bit and does not check incoming parity. When DTR/CTS is not selected only the TRAN DATA, REC DATA and GROUND signal lines are significant to the controller.

RS232 CABLE WIRING DIAGRAM FOR PC100-2

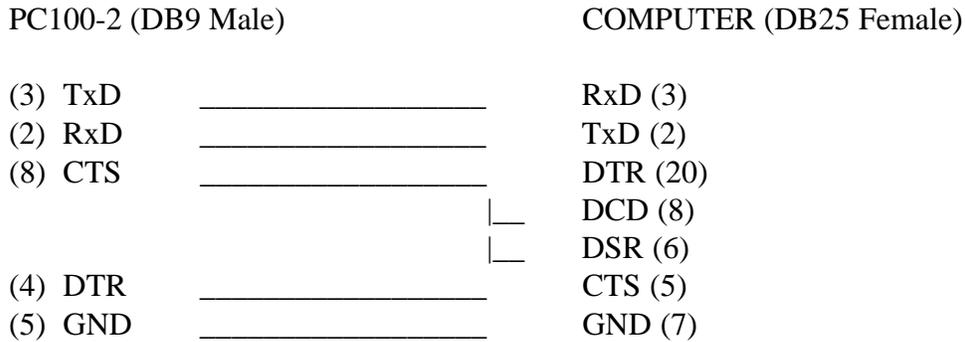
To communicate over the RS232 bus, a cable constructed with a male DB9 connector on the PC100-2 controller and a female DB9 connector on PC end and wired as follows is required:

PC100-2 CONTROLLER (DB9 Male)	COMPUTER (DB9 Female)
(pin#)	(pin#)
(3) TxD	RxD (2)
(2) RxD	TxD (3)
(5) GND	GND (5)

To communicate through Windows HyperTerminal, use the following settings:

- Connect using desired COM port
- Bits per second: 9600 (default setting in PC100-2 MENU)
- Data bits: 8
- Parity: NONE
- Stop bits: 1
- Flow Control: NONE

If your computer is using a DB25 Male connector instead of the DB9, the wiring connections are as follows. For example purposes this diagram also assumes DTR/CTS control is selected.



****NOTE:** CTS & DTR are Optional. If selected in PC100-2 MENU but not hardwired, unit will not communicate.

RS-422/485 SERIAL PORT PROTOCOLS

The RS422 serial port mode works as explained above for the RS232 except that there is no hardware handshake support. Only Txd and RxD are used. To allow for connection of multiple PC100-2's to a single RS422 cable each PC100-2 must be addressed to talk and listen. By providing unit addressing capability multiple PC100-2's can be connected to a common serial cable. Figure 7 shows the wiring diagrams for a 4 wire full duplex bus and for a 2 wire half duplex bus. To use the PC100-2 with the 2 wire half duplex setup jumper F must be cut and jumper H must be installed on the #840059 CPU board (see figure 8). Up to 31 PC100-2's can be on a cable. The end PC100-2 needs to have two 120 ohm 1/4 watt terminator resistors added to the remote connector module board in R1 and R2 places provided. The following commands are provided to control data flow over the serial bus.

- | | |
|-------------|--|
| LISTEN nn | Tell PC100-2 nn to listen to commands sent by host. |
| LISTEN ALL | Tell all PC100-2's on bus to listen. |
| LISTEN NONE | All commands other than LISTEN and TALK are ignored. |
| TALK nn | Tell PC100-2 nn to talk out over the bus to host. |
| TALK NONE | Tell all PC100-2's not to talk to host. |

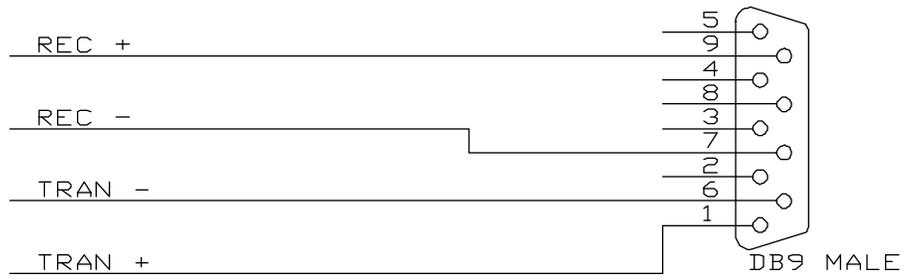
GPIB PORT PROTOCOLS

When CMD ERROR INT'S are enabled, the GPIB port sends a CMD ERROR SRQ interrupt on commands received with errors. If command error interrupts are disabled, then no response is sent to the GPIB port if command errors are detected. In all cases, the only data that is sent to the GPIB interface by the controller is that which is requested by a command received by the controller. The GPIB port does not respond with "OK" after commands that do not send back data since handshaking is an inherent feature of the GPIB.

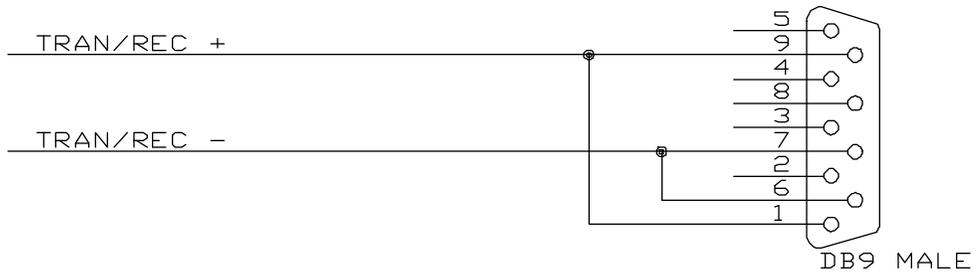
The MENU allows you to examine the GPIB address, and the GPIB LOCKUP TIME, which is the length of time that the controller will wait for the host to accept data before generating a GPIB LOCKUP interrupt. The SINT remote command also provides the ability to set up the parallel poll.

REMOTE INTERRUPT CHARACTERS

<u>Condition</u>	<u>Serial Port</u>	<u>GPIB Port (HEX)</u>
No Interrupt	(n/a)	\$00
Single T.O. INT	I	\$41
Command Error INT	?	\$42
LP Timeout INT	P	\$43
LP Done INT	E	\$45
DEVIATION INT	D	\$46
OVER Temperature INT	O	\$47
UNDER Temperature INT	U	\$4A
GPIB Lock-up INT	(n/a)	\$4F
POWER Going Down	!	(none)
POWER Up no auto cont.	Z	(none)
POWER Up auto cont.	X	(none)
BKPNT	B	\$50



RS422 FULL DUPLEX REMOTE CONNECTOR WIRING



RS422 HALF DUPLEX REMOTE CONNECTOR WIRING

Figure 7. Wiring Diagram for 4 Wire Full Duplex and 2 Wire Half Duplex Bus

Convert From Full Duplex To Half Duplex
Cut F Trace And Install H Jumper

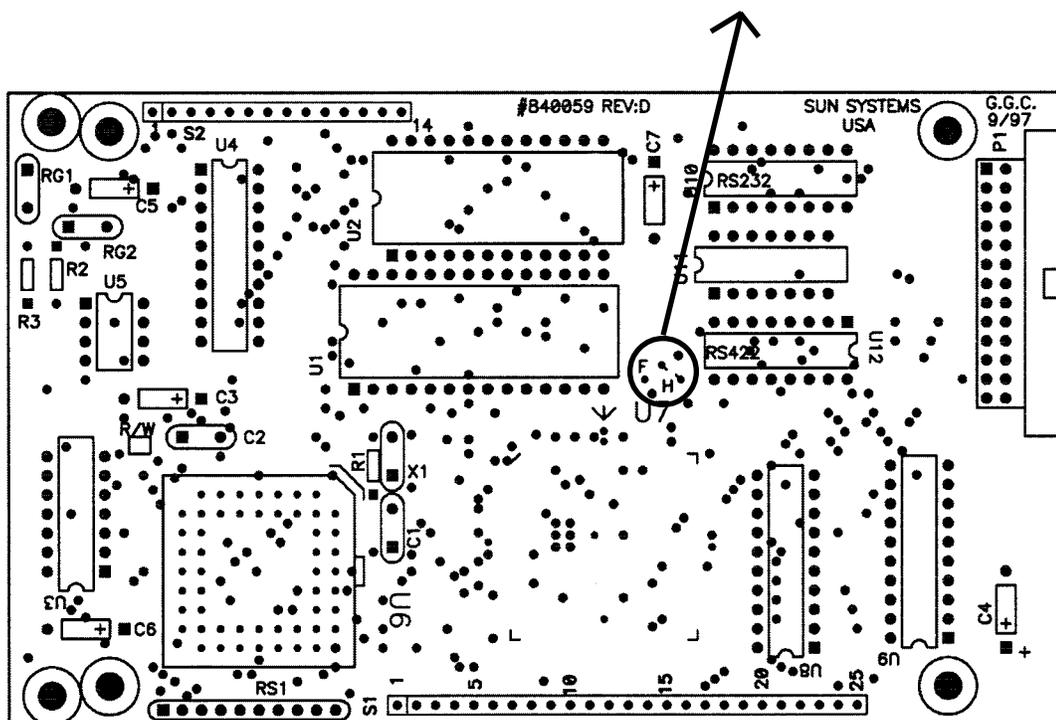
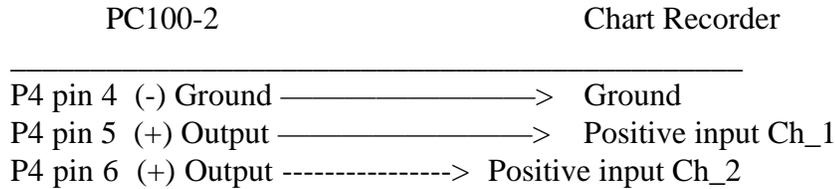


Figure 8. Jumper for 2 Wire Half Duplex Setup
FGPA PC100 CPU BOARD 6/97 REV D

SECTION 6. CONNECTING A CHART RECORDER

The PC100-2 is capable of driving a chart recorder that accepts a 0-5V input, to chart the probe readings. The 0-5V chart outputs are found on the process I/O board left side wire screw header P4. They are marked as (D/A-A) for channel 1, and (D/A-B) for channel 2.



When setting up the chart recorder, the MENU must be accessed. At the menu prompt “CHART CH_1TEMP?”, answer YES if you want to record channel 1 temperature readings. The low and high chart values must then be entered. This is the range of temperatures that you want the PC100-2 to output. For instance, if a process is running that goes from 20 deg C to 70 deg C, you may want to make the low chart value 15 and the high chart value 75. This will give the best resolution and still handle all possible temperatures in the process. The same should be done at the CHART CH_2 TEMP ? menu prompt to record channel 2 readings.

SECTION 7. CHANGING PROBE TYPES

The following procedure is required to change probe types on the PC100-2.

- Note:
- a) All commands can only be performed from the front panel.
 - b) Changing of probe type is allowed within the same category as it was setup at the factory, e.g., If channel 1 is setup for narrow thermocouple, then the user may change the probes to a narrow J, K, or T and not to an RTD or Wide thermocouple or Voltage or Current.

1. Unplug the controller.
2. Insert the desired probe into the probe connector based on the probe hookup diagram figure 5.
3. Plug the controller in and turn the controller on with the new probe in place. You may get a PROBE ERROR message. This is normal since the controller is set up for the previous probe type.
4. Type MENU-9 <ENTER>. This places the controller in the calibrate/change probe menu. The current type will display for a couple seconds. The prompts for the new probe type will be displayed.
5. Press the ENTER key until the desired probe type is on the display (if the desired probe type is the first choice, it is not necessary to press ENTER. Continue to step 6).
6. When the desired probe type is on the display, type YES <ENTER>.
7. The controller will now ask if the probe is at 0 deg C. At this point, immerse the probe tip into ice water (or use SUN's TCAL2 probe calibrator) and let stabilize for a few minutes. It is recommended that if ice water is used, that the water be stirred so that the ice water bath is the same temperature throughout. If you answer no then rough default values will be set.
8. After waiting for probe stabilization, type YES <ENTER>.
9. The controller will now ask if the probe is at 100 deg C. At this point, immerse the probe tip into boiling water (or use SUN's TCAL2 calibrator, etc.) and let stabilize for a few minutes.
10. After waiting for probe stabilization, type YES <ENTER>.
11. You must now select the desired scale, deg C, deg F, or deg K. Type 1 <ENTER> for deg C, type 2 <ENTER> for deg F, or type 3 <ENTER> for deg K.
12. To fine calibrate to a house standard, the calibrate to a standard can be performed from the MENU, optionally, if you wish. See Section 3 Menu.

SECTION 8. INPUT/OUTPUT

The PC100-2 has 8 bits of on/off output, 2 bits of on/off input, and a fail-safe input. (The 8 bits of on/off output and the two bits of on/off input will be referred to as Bit I/O). Of the 8 bits of output, 5 are available to the user through the use of the OUT0 command. The remaining three (Bit 0,1 &7) are always used by the controller for heat, cool, and power on/off respectively. Some of the 5 remaining outputs may be used if special functions, such as compressor control etc., are enabled in the MENU. The inputs are available to the user through the use of the IN0 command. The outputs are open collector 12 Volt, 100 mA and are capable of controlling solid state relays or small 12 volt DC relays. The two inputs can be used to sense TTL levels or dry relay switch closure contact to ground (a 10k ohm pull-up to +5 v is built in).

Also available on the PC100-2 are two analog outputs. These ports can be configured to drive a chart recorder, output the PID control loop values, or simply output a voltage from 0-5 Volt when written to using the OUT3 command.

The commands listed below control communication with the input/output interfaces:

BIT I/O

OUT0:n,m	where n=2-6 for the number of the output and m=1 or 0 for on/ off (1=on, 0=off). Bits 0,1, and 7 are used for heat,cool, and power on/off, respectively.
IN0:n,Im	where n = 0(for G1) or 1(for G2) for the number of the input and m = 0-9 for the I variable to store the state of the input. The I variable can then be read via the “In?” command.

COMPRESSOR CONTROL

Bit 2 of the Bit I/O can be configured to turn on/off the compressor of a compressor based temperature chamber. This feature is enabled via the menu from the front panel. If enabled, bit 2 will be on whenever cooling is required. However, it takes about 1 minute to enable bit 2 when the unit is switched on. The bit will remain on to keep the compressor on for a minimum of 4 minutes. If cooling is not required for 4 minutes, bit 2 will be turned off to turn the compressor off. If cooling is required any time, the 4 minute counter is restarted and the compressor switches on after a brief delay of about 1 minute. If bit 2 is to be used for any other purpose, Compressor Control must be disabled from the Menu from the front panel.

REVERSE LOGIC FOR HEAT, COOL, COMPRESSOR AND BOOST COOL

The PC100-2 is initially configured for standard output logic for bits 0, 1, 2, and 3 of the Bit I/O, which is heat, cool, compressor control and boost cool respectively. Standard logic means that if the action is required to be on, the output will be low, or 0 Volts thus sinking current through your solid state relay. If the action is required to be off, the output will be high. Some systems require reverse logic, however. If your system requires reverse logic, i.e.; a freon evaporator bypass valve for example, jumper runs on Front Panel Logic PC board (#840060) can be cut to enable reverse logic. Figure 9 shows the location of the runs to cut. To enable reverse logic for heat (bit 0), H1 should be cut. To enable reverse logic for cool (bit 1), C1 should be cut. To enable reverse logic for compressor control (bit 2),H2 should

be cut. The PC100-2 must be disassembled to perform these cuts. See repair section for controller disassembly procedure in Section 12.

ANALOG OUTPUT

OUT3:m,nn

where m = 0 or 1 (Channel number)

nn = 8 bit integer from 0-255, 0=0 V, 255=5 V

All Normally Active Low
 To Invert:
 FS; cut upper trace
 Heat; cut next lower
 Cool; cut next lower
 H2; cut next lower
 C2; cut next lower

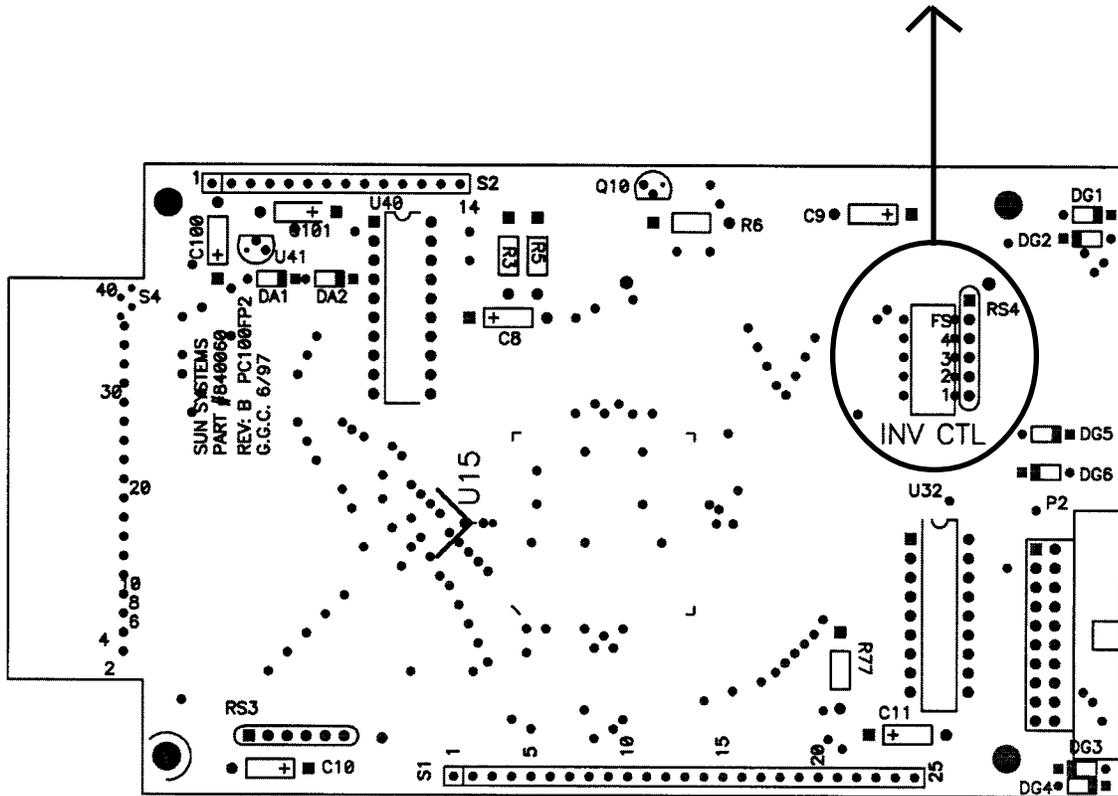


Figure 9. Jumpers for Reverse Logic
 PC100FP2 PCB 6/97 REV B

SECTION 9. DETAILED COMMAND DESCRIPTIONS

BKPNT

Function: Local program breakpoint or pause command

Syntax: **BKPNT**nnn display number nnn at breakpoint
 BKPNTI_m display I variable value at breakpoint

Description:

The breakpoint command allows for local program operation to be suspended until the ENTER key is depressed on the front panel or until the remote controller issues a BKPNTC command. The BKPNT command permits program debugging by providing convenient pauses in local program execution such that an operator may examine local program performance and is also useful when a host controller may wish to perform I/O at a point in the local program. One form of the breakpoint command displays a number on the front panel display when encountered which is useful for identifying different breakpoints within a program. The other form of the breakpoint command displays the value of one of the I variables, 0-9, which is useful for breakpoints that are placed within FOR/NEXT loops.

Restrictions:

Breakpoint values displayed on front panel display. To read over remote bus issue BKPNT? command.

See Also: **BKPNT?**, **BKPNTC**

Example: editing from the local keyboard

```
EDIT«       edit program
END         controller response
BKPNT100«   set breakpoint 100
END         controller response
FOR I2,1,10« begin FOR/NEXT loop
END         controller response
BKPNTI2«    set breakpoint for I variable #2
END         controller response
NEXTI2«     end FOR/NEXT loop
END         controller response
STOP«       terminate program entry
```

BKPNTC

Function: Remote bus command to continue from breakpoint

Syntax: **BKPNTC**

Description:

When the BKPNT interrupt is enabled by the SINT remote command or from the MENU and a local program is started via a remote RUN command, then when a BKPNT is reached during local program execution the breakpoint interrupt is sent to the appropriate remote bus. The host controller upon receiving the breakpoint interrupt may issue a BKPNT? command to read the value of the breakpoint and issue a BKPNTC to continue local program execution.

Restrictions: Remote only command

BKPNT?

Function: Remote bus command to read value of breakpoint

Syntax: **BKPNT?**

Description:

When the BKPNT interrupt is enabled by the SINT remote command or from the MENU and a local program is started via a remote RUN command, then when a BKPNT is reached during local program execution the breakpoint interrupt is sent to the appropriate remote bus. The host controller upon receiving the breakpoint interrupt may issue a BKPNT? command to read the value of the breakpoint and issue a BKPNTC to continue local program execution.

Restrictions: Remote only command

C

Function: Set or examine the current set temperature in deg C

Syntax: nnn.nC set current set temperature
 C examine current set temperature

Description:

The C command is a TC01 controller compatible command which either sets the current set temperature or examines the controller for the current set temperature. The set or response is in degrees centigrade always. The C command returns with a value of -1999 if the current set temperature is equal to none.

Restrictions: Remote command only.

See Also: **SET**

Example:

150.0C«	Set current set temperature to 150.0 deg C
C«	Send command to examine current set temp.
150.0	Controller response, temp. = 150 deg C
SET?«	Examine current set temp with SET command
150.0	Controller response

C1? & C2?

Function: Examine current Ch 1 and Ch 2 probe temperatures

Syntax: **C1?, C2?**

Description:

The C1? and C2? commands provide the means for a remote interface to read the present value of the probes. The Ch1 value is normally displayed on the first line and Ch2 value is displayed on the second line of the front panel LCD display. The units for the probe are set in the menu for deg F, C, or K.

Restrictions: Remote Interface command only.

See Also: **T**

Example:	C1?«	read probe Ch1
	25.0	controller response, 25.0 units
	C2?	read probe Ch2
	25.0	controller response, 25.0 units

CALAX

Function: CALAx command allows for the offset adjustment on the measurement reading of channel x.

Syntax: **CALAx, access code, standard reading**
where x = 1 or 2 (Ch_1 or Ch_2)
access code = 9
standard Reading = Known measurement value

Description:

The CALAx command allows user to offset the measurement value on channel x. See Calibrate to a Standard and Changing probe type sections for complete calibration procedure. The CALAx command may be used after an initial calibration sequence to fine tune the calibration of a particular channel.

Restrictions: Remote command only

See Also: CALBx, CALC

Example: Offset adjustment for channel 2
Ch_2 sensor is placed at 0°C
After stabilizing, Ch_2 sensor reads 0.5°C
The command CALA2,9,0.0 is issued
The sensor now reads 0°C

CALBX

Function: CALBx command allows for the gain adjustment on the measurement reading of channel x.

Syntax: **CALBx, access code, standard reading**

where	x	=	1 or 2 (Ch_1 or Ch_2)
	access code	=	9
	standard Reading	=	Known measurement value

Description:

The CALBx command allows user to modify the gain on channel x. See Calibrate to a Standard and Changing probe type sections for complete calibration procedure. The CALBx command may be used only after CALA has been done on the channel.

Restrictions: Remote command only

See Also: **CALAx, CALC**

Example: Gain adjustment for channel 2
Ch_2 sensor is placed at 100°C
After stabilizing, Ch_2 sensor reads 100.5°C
The command CALA2,9,100.0 is issued
The sensor now reads 100.0°C

CALC & CALCX

Function: The CALC command allows the user to clear all offset and gain adjustments for the PC100-2 sensors. The CALCx command allows the user to clear the standard offset and gain adjustments for individual channels.

Syntax: **CALC, access code**
CALCx, access code

where x = 1 or 2 (Ch_1 or Ch_2)
 access code = 9

Description:

The CALC command allows user to clear all the offset and gain adjustments for both the channels. See Calibration to a Standard and Changing probe types for complete calibration procedure.

Note: The CALC command should only be used prior to calibration of both Ch_1 and Ch_2 sensors. To clear only one channel's standard offset and gain adjustments, use the CALCx command.

Restrictions: Remote command only

See Also: **CALAx, CALBx**

Example: CALC,9 All standard offset and gain adjustments are cleared for both channels
 CALC2,9 Clear offset and gain adjustments for channel 2 only

COFF

Function: Disable cooling

Syntax: **COFF**

Description:

The COFF command permits a remote interface to disable cooling by the controller. The front panel COOL switch also disables controller cool function when depressed if cooling was enabled. When editing the local program from the front panel keyboard, depressing the COOL switch on the front panel enters either CON or COFF. If the opposite action is desired, backspace over the entry and re-enter to get the correct action. The local program defaults to CON when the local program begins running.

Restrictions: None

See Also: **CON, HOFF, HON**

Example: COFF« disable cooling

CON

Function: Enable cooling

Syntax: **CON**

Description:

The CON command permits a remote interface to enable cooling operation. The COOL switch located on the front panel can also enable cooling operation if depressed when cooling is disabled. When editing the local program from the front panel keyboard, depressing the COOL switch on the front panel enters either CON or COFF. If the opposite action is desired, backspace over the entry and re-enter to get the correct action. The local program defaults to CON when the local program begins running.

Restrictions: None

See Also: **COFF, HON, HOFF**

Example: CON« Enable cooling operation

CSET

Function: Examine the present control value.

Syntax: **CSET?**

Description:

The CSET command allows for examining the present value that the controller is attempting to control to. During ramping, this value is alternately displayed on LINE2 of the front panel LCD display.

Restrictions: Remote only

See Also: **TEMP?**

Example: assumes scale in degrees C

```
RATE=10« define temperature segment, RATE=10 deg C/m
WAIT=30« wait=30 min.
TEMP?« examine present temperature
25.0 controller response, 25.0 deg C
SET=35.0« set new final temperature, 35.0 deg C wait 30 seconds
CSET?« examine present ramp target temperature
30.0 controller response, 30.0 deg C
```


DEVL

Function: Set or examine the deviation limit

Syntax: **DEVL=nnn.n** Set deviation limit
DEVL? Examine deviation limit

Description:

The DEVL command sets the deviation limits for the probe. If the deviation limit interrupt is enabled with the SINT remote command or from the MENU and the probe temperature varies by more than the set limit, an interrupt will be generated to the active remote interface.

Restrictions:

Remote command only. MENU must be accessed to set the deviation limit from the front panel. Deviation Limit range is between 0.1 and 300.

See Also: **UTL, LTL, SINT**

Example: if SCALE=C

DEVL=2.5«	set deviation limit to 2.5 deg C
DEVL?«	examine deviation limit
2.5	controller response, 2.5 deg C
RATE=30«	define temp. segment
WAIT=03:00:00«	wait for 3 hours
SET=-55.0«	set final temp. to -55.0 deg C if after 1 hour, the temperature starts to rise, and if deviation interrupts are enabled, a deviation interrupt will be sent to the active remote interface.

EDIT

Function: Edit local program from the local keyboard.

Syntax: **EDITn** where n=0,9

Description:

The EDIT command allows for program loading and editing from the local keyboard. The PC100-2 allows up to ten local programs. The local programs may be edited by using the up and down arrows, delete line (DEL) command or by entering new commands which are placed in front of the command presently displayed on the front panel LCD display. Local program editing is terminated by entering the STOP command.

Restrictions: Local keyboard command only.

See Also: **STORE, LIST, END, STOP**

END

Function: Terminate remote local program downloading.

Syntax: **END**

Description:

The END command terminates remote program downloading when using the STORE command from a remote host computer.

Restrictions: Remote command only.

See Also: **EDIT, STORE, STOP**

FOR/NEXT

Function: Loop definition command for local programming

Syntax: **FOR** Im , <Beginning Value>,<Ending Value> or
FOR Im , <Beginning Value>,<Ending Value>, + or
FOR Im , <Beginning Value>,<Ending Value>, -
NEXT Im

Description:

The FOR/NEXT loop command provides looping capability for local program operation. Commands contained within the boundaries of the FOR statement and the NEXT statement are repeated as defined by the FOR statement. The beginning or ending value may be any integer value or an I variable value. The FOR/NEXT loop either increments the beginning value until the beginning value is equal to or greater than the ending value or decrements the beginning value, when the minus option is used, until the beginning value is equal to or less than the ending value. The number of loop executions is equal to the absolute value of the ending value minus the beginning value. Without regard to the beginning and ending values, the loop is always executed one time. FOR/NEXT loops may be nested four deep when considering the first loop as nest#1.

Restrictions: None

Example:	DEL	clear program (remote)
	STORE	load local program
	FOR I5,1,5«	FOR I variable #5, step 1,2,3,4
	FOR I2,5,I5,«	FOR I variable #2, 5, I variable #5, dec
		step 5,4,3,2 (Pass 1)
		step 5,4,3 (Pass 2)
		step 5,4 (Pass 3)
		step 5 (Pass 4)
	BKPNT I2«	set breakpoint, display I variable #2
	NEXT I2«	end FOR/NEXT nest #2
	NEXT I5«	end FOR/NEXT nest #1
	END«	end program store
	RUN	run program

When the program is run, the breakpoint value will display the step sequence for the FOR/NEXT I2 variable loop.

GOSUB

Function: Execute local program m as a subroutine

Syntax: **GOSUB** m or **GOSUB** #m

Description:

The GOSUB command allows local programs to be called by other local programs as subroutines. At the end of a local program called by a GOSUB command, execution returns to the command following the GOSUB command in the calling program. Nesting is supported for four levels considering the first calling programs nest 1. I variables are global to all local programs.

Restrictions: Local program command.

See Also: **FOR/NEXT**

Example: Listing of local program 2

For I3,0,10	set FOR/NEXT for 10 cycles
GOSUB#0	execute LP#0
GOSUB#1	execute LP#1
NEXT I3	end FOR/NEXT loop for I variable # 3
END	end of LP #2

HOFF

Function: Disable heat output.

Syntax: **HOFF**

Description:

The HOFF command permits a remote interface to disable the heat output. The front panel HEAT switch also disables controller heat function when depressed if heat was enabled. When editing the local program from the front panel keyboard, depressing the HEAT switch on the front panel enters either HON or HOFF. If the opposite action is desired, backspace over the entry and re-enter to get the correct action. The local program defaults to HON when the local program begins running.

Restrictions: None

See Also: **CON, COFF, HON**

Example: HOFF« disable heat output

HOLD

Function: Pause execution of local program.

Syntax: **HOLD**

Description:

Pressing the HOLD button while the local program is executing pauses the program execution until the HOLD is pressed again. HOLD command also pauses the WAIT time count if the local program was executing the WAIT time while the HOLD was pressed.

Restrictions: Front Panel Operation only.

HON

Function: Enable heat output

Syntax: **HON**

Description:

The HON command permits a remote interface to disable the heat output. The front panel HEAT switch also disables controller heat function when depressed if heat was enabled. When editing the local program from the front panel keyboard, depressing the HEAT switch on the front panel enters either HON or HOFF. If the opposite action is desired, backspace over the entry and re-enter to get the correct action. The local program defaults to HON when the local program begins running.

Restrictions: None

See Also: **COFF, CON, HOFF**

Example: HON« Enable heat output

IVARIABLES

Function: Set or examine I variables.

Syntax:	$I_m = \langle \text{value} \rangle$	$I_m, \langle \text{value} \rangle$	set I_m equal to value
	$I_m = I_m + \langle \text{value} \rangle$	$I_m, I_m + \langle \text{value} \rangle$	set I_m equal to sum of values
	$I_m = I_m - \langle \text{value} \rangle$	$I_m, I_m - \langle \text{value} \rangle$	set $I_m =$ to difference of values.
	$I_m ?$	$I_m ?$	examine I variable m

Description:

I variables are used in local programs for loop control and general purpose Integer arithmetic. A value may be any integer in the range of +32768/-32767 or another I variable. The controller supports 10 I variables, where "m" ranges from 0 to 9. From the front panel a comma "," is used for the equal "=" sign.

Restrictions: None. From the Front Panel a comma is used for the equal sign.

See Also: **FOR/NEXT, IN, OUT, BKPNT**

Example:	$I_0 = 52 \ll$	set I variable #0 to 52
	$I_2 = I_0 \ll$	set I variable #2 equal to I variable #0
	$I_5 = I_0 - 9 \ll$	set I var.#5 = I var.#0 - 9 = 43
	$I_6 = I_0 + I_5 \ll$	set I var.#6 = I var.#0 + I var.#5 = 95
	$I_6 ? \ll$	examine I variable #6
	95	controller response

IN

Function: Input data from the BIT I/O

Syntax: **IN**<device number>:<address>,Im

Description:

The IN command allows data read capability from the two inputs provided. The device number for the two inputs is 0. Data values read are stored in I variables.

Restrictions:

The only device number allowed is 0 and the only device addresses allowed are 0 and 1.

See Also: **OUT, I variables**

Example: IN0:0,I2« Read device 0, bit 0, store in I var.#2.

LIST

Function: List the local program from a remote interface

Syntax: **LISTn** where n=0,9

Description:

The LIST command permits a remote interface to upload the local program from the controller. This command allows a remote operator to verify the results of a STORE instruction, which downloads the program to the controller. In addition, some communication programs allow for capturing data to text files. In this manner, local programs can be maintained on a personal computer and downloaded or uploads if required.

Restrictions: Remote interface command only

See Also: **STORE**

Example: DEL1« clear local program #1
STORE1« ready controller for local program #1 download
*** send local program
END« end download
LIST1« request upload of local program #1
*** local program displayed

LISTEN

Function: Sets the PC100-2 in listen mode.

Syntax: **LISTEN nn**
LISTEN ALL
LISTEN NONE

Description:

When the RS422 serial port is used for communication between the host computer and the PC100-2 unit/s, the LISTEN nn sets the PC100-2 #nn in listen mode. The LISTEN ALL sets all the PC100-2 units on the bus in listen mode. The LISTEN NONE indicates the units on the bus to ignore all commands other than LISTEN and TALK commands.

Restrictions: Remote command only.

See Also: **TALK**

LLO

Function: RS-232 Command to lockout local keyboard

Syntax: **LLO**

Description:

The Local Lockout (LLO) command may be issued from a host processor to lockout the local keyboard. The LLO command only applies to host computers communicating over the RS-232 serial interface. Local keyboard function may be unlocked through the use of the RTL command. Local keyboard lockout operation for host processors communicating over the IEEE-488 interface is a bus interface command. The syntax varies according to the particular host computer.

Restrictions:

RS-232 remote interface command only. Each host GPIB interface uses unique syntax for local lockout commands.

See Also: **RTL**

Example: LLO« lockout local keyboard
 run sensitive testing
 RTL« unlock local keyboard

LTL1 & LTL2

Function: Set or examine the lower temperature limit

Syntax: **LTL1=nnn.n** Set LTL for channel 1, variable units
LTL1? Examine LTL channel 1, variable units
LTL2 = nnn.n Set LTL for channel 2, variable units
LTL2? Examine LTL channel 2, variable units

Description:

The LTL command allows for setting the lower temperature limit for both channels below which an interrupt will be generated and the cooling process will be suspended/disabled. The units for the LTL command are those as selected in the MENU for the probe.

Restrictions:

Remote command only. Changing the LTL1 and LTL2 from the front panel can only be done through the MENU. Temperature values for the LTL command must range between -200 deg C and the UTL setting.

See Also: **UTL1 & UTL2**

Example: If scale is set to deg C
LTL1=-100.0« set LTL Ch_1 to -100 deg C
LTL1? examine LTL Ch_1
-100.0 controller response, -100 deg C

M

Function: Set or examine the current wait at temperature time.

Syntax: nnn.n**M** Set the temperature segment wait time
 M Examine the current temperature wait time

Description:

The M command is a TC01 controller compatible command which either sets the current temperature segment wait time, sometimes referred to as ‘soak period’, or allows a remote interface to examine the current setting. When setting wait times, nnn.n represents the wait time in minutes. If wait time is equal to forever, M returns 1999.

Restrictions: Remote command only.

See Also: **WAIT**

Example: 12.1M« Set wait time for 12.1 minutes
 M« Examine wait time
 12.1 Response from controller
 WAIT?« Examine wait time with WAIT command
 00:12:06 Response from controller

OFF

Function: Turn off PC100-2

Syntax: **OFF**

Description:

The OFF command turns off the PC100-2. As long as the PC100-2 is connected to an appropriate line voltage, the controller is still powered on. The OFF command turns off the front panel display, indicators and switch functions, except for the POWER switch. In addition, commands received over the remote interfaces are ignored except for the ON command and the STATUS? command. Depressing the POWER switch when the controller is ON results in the same function as the OFF command.

Restrictions: Remote interface command only

See Also: **ON**

Example: OFF« Turn OFF PC100-2

ON

Function: Turn on PC100-2

Syntax: **ON**

Description:

The ON command enables power and function of the controller. When the controller is plugged in to an appropriate line voltage, the controller is powered on and can accept a power on command from either the front panel by depressing the power switch or from a remote interface by using the ON command.

Restrictions: Remote interface command only

See Also: **OFF**

Example: ON« Turn on PC100-2

OUT

Function: Output data to the BIT I/O port or the Analog port.

Syntax: **OUT**<device number>:<address>,<data>
Bit I/O = device 0, Analog port = device 3

Description:

The OUT command permits data to be transferred to an output device such as the Bit I/O or digital to analog convertor port (also referred to as Analog port in this manual). For a complete description on operating with an I/O device, consult the Input/Output Section 8.

Restrictions: None

See Also: **IN**

Example: OUT0:5,1« set Bit I/O bit 5
OUT3:0,255« output 255 to D/A-A port (0=0V, 255=5V)
OUT3:1,255« output 255 to D/A-B port (0=0V, 255=5V)

PIDA

Function: Set or examine the Advanced PID modes

Syntax: **PIDA**=n[,mmm.m] Set advanced mode n with optional damping mmm.m

n = 0 ; Normal PID control

n = 1 ; Average of Ch_1 & Ch_2

n = 2 ; Slowly force Ch_2 probe to set temperature

n = 3 ; Control to Ch_2 probe temperature

n = 4 ; Control to average of Ch_1 & Ch_2 and force Ch_2 to set temp.

mmm.m ; When n is 2 or 4, a damping coeff. may be entered to control loop speed. Damping range = 0 to 1000, default = 400.

PIDA? Examine current mode

Description: The PIDA command is used to select one of the advanced PID control modes. This command is not valid when automatic tuning of PID coeff. is enabled, in which case the PIDA is automatically set to n=0 i.e., normal PID control mode. When mode 2 or 4 is selected, a damping coeff. may be set. If you choose not to specify a damping coefficient, a default value of 400 is set. The larger the damping number the slower the controller will move the Ch_2 reading to set temperature. The PIDA modes also change when the PC100-2 starts to count down the WAIT time.

PIDA = 0 ; when $ABS (SET - CH_1) < WAIT \ TRIGGER$

PIDA = 1 ; when $ABS (SET - (CH_1 + CH_2)/2) < WAIT \ TRIGGER$

PIDA = 2 ; when $ABS (SET - CH_2) < WAIT \ TRIGGER$

PIDA = 3 ; when $ABS (SET - CH_2) < WAIT \ TRIGGER$

PIDA = 4 ; when $ABS (SET - CH_2) < WAIT \ TRIGGER$

where WAIT TRIGGER is the value set in the MENU.

Restrictions: PC100-2 must not be in automatic PID tuning mode.

Example: PIDA = 4,500 Set mode 4 with 500 damping.

PIDC

Function: Set or examine PID coefficients for cool control

Syntax: **PIDC=**nnn.n,nnn.n,nnn.n set cool PID coefficients
PIDC? examine cool PID coefficients

Description:

The PIDC command permits modification and examination of the proportional, integral and derivative (PID) coefficients used in the algorithm which controls the cooling process. PID coefficients may be changed to accommodate varying changes in your system. The PID Application note contains a procedure for tuning PID coefficients to a particular application (Contact Sun for this Application note). PID coefficients are stored in battery backed memory.

Restrictions:

Remote command only. To change PIDs from the front panel, the MENU must be accessed.

See Also: **PIDH, PWMP**

Example: PIDC=0.5,0.25,1e-3« set PID coefficients
PIDC?« examine PID coefficients
0.50 controller response, P
0.25 controller response, I
0.001 controller response, D

PIDH

Function: Set or examine PID coefficients for heat control

Syntax: **PIDH**=nnn.n,nnn.n,nnn.n set heat PID coefficients
PIDH?<< examine heat PID coefficients

Description:

The PIDH command permits modification and examination of the proportional, integral and derivative (PID) coefficients used in the algorithm which controls the heating process. PID coefficients may be changed to accommodate varying changes in your system. The PID Application note contains a procedure for tuning PID coefficients to a particular application (Contact Sun for this Application note). PID coefficients are stored in battery backed memory.

Restrictions:

Remote command only. To change PIDs from the front panel, the MENU must be accessed.

See Also: **PIDC, PWMP**

Example: **PIDH**=0.5,0.25,1e-3<< set PID coefficients
PIDH?<< examine PID coefficients
0.50 controller response, P
0.25 controller response, I
0.001 controller response, D

PWMP

Function: Set or examine the pulse width modulator period

Syntax: **PWMP=nnn.n** set PWM period
PWMP? examine PWM period

Description:

The PWMP command permits modification of the period allocated to the pulse width modulation algorithm. When controlling temperature, the controller uses a constant period of time of which the controller calculates the portion of time for which heat or cool should be turned on. This is based on the feedback from the probe and the PID coefficients. Shorter periods of time for pulse width modulation translate into faster tracking of changes in your system. When changes are expected to be minimal for an extended time, during long soak periods for example, it is more economical not to adjust quite so frequently. In this case, increasing the PWM period, thus reducing the modulation rate, conserves power and coolant and reduces wear on coolant supply valves.

Restrictions:

Remote only command. To change the PWM period from the front panel, the MENU must be accessed. Period range from 2 seconds to 30 seconds

See Also: **PIDH, PIDC**

Example: PWMP=2« set PWM period to 2 seconds
TEMP?« examine current temperature
25.0 controller response
RATE=10« define new temperature segment
WAIT=5« set wait for 5 min., stabilize mass
SET=35.0« set new temp to 35.0
after 1 min for ramp and
after 5 min for wait timeout
PWMP=15« set PWM period for 15 sec.
WAIT=10:00:00« set long wait period, 10 hrs.
SET=35.0« again, set temperature

RATE

Function: Set the current rate of change for ramping

Syntax: **RATE=nnn.n** Set the current ramping rate
RATE? Examine the current ramping rate

Description:

The RATE command allows for setting or examining the rate at which the controller will control the change from one set point to the next set point. Rate is based on the probe and on the units of SCALE set up for the probe in the menu. When setting or examining the rate, nnn.n represents units per minute. Units may be deg F, C, or K.

Restrictions:

Remote only, see SET SEGment in this section for front panel equivalent. Your system dynamics will limit the maximum ramping rate.

See Also: **SET, WAIT**

Example: If SCALE for the probe is in deg C

RATE=10.0«	set ramping rate for 10.0 deg C/minute
RATE?«	examine present ramping rate
10.0	controller response, 10.0 deg C/min.
TEMP?«	read present temperature
25.0	controller response, for example 25.0 deg C
SET=35.0«	set new set point, for example 35 deg C
	after waiting 30 seconds
TEMP?«	read present temperature
30.0	controller response, up 5 deg C in one half minute.

RTL

Function: RS-232 Command to unlock local keyboard

Syntax: **RTL**

Description:

The Return to Local (RTL) command may be issued from a host processor to unlock the local keyboard. The RTL command only applies to host computers communicating over the RS-232 serial interface. Local keyboard function may be locked through the use of the LLO command. Local keyboard unlock operation for host processors communicating over the IEEE-488 interface varies according to the particular host computer syntax requirements.

Restrictions:

RS-232 remote interface command only. GPIB interface host computers have unique methods for returning to local operation.

See Also: **LLO**

Example: LLO« lockout local keyboard
run sensitive testing
RTL« unlock local keyboard

RUNn

Function: Starts the execution of the local program

Syntax: **RUNn** where n=0,9

Description:

The RUN command initiates the execution of the local program. The local program is entered into the controller using the EDIT command from the local keyboard or downloaded from a remote host computer using the STORE command. Local program execution may be prematurely terminated by issuing a STOP command.

Restrictions: None

See Also: **RUN TIME, EDIT, STOP, STORE, END**

Example:

This example downloads a simple program from remote processor and then executes the program. Scale in deg C.

DEL «	delete current program
STORE«	prepare controller for entering local program
FOR I2,0,10«	set FOR loop for 10 loops
RATE=10«	define temp. segment 1, RATE=10 deg C/m
WAIT=15«	wait = 15 minutes
SET=-55.0«	set final temp to -55.0 deg C
SET=125.0«	define temp. segment 2, rate=10 deg C/m
WAIT=15«	wait=15 minutes, final temp=125.0 deg C
NEXT I2«	mark end of FOR loop, I2
END«	mark end of local prog. and end of STORE
RUN«	run local program

RUNnTIME

Function: Starts the execution of the local program at a specific time of day.

Syntax: **RUNnTIME=hh:mm:ss** where n=0,9
where hh=hours, mm=minutes,ss=seconds
in military time.

Description:

The RUNnTIME command initiates the execution of the local program at a specific time of day. The local program is entered into the controller using the EDIT command from the local keyboard or downloaded from a remote host computer using the STORE command. Local program execution may be prematurely terminated by issuing a STOP command.

Restrictions: Remote only.

See Also: **RUN, EDIT, STOP, STORE, LIST, END**

Example:

This program lists the current local program from a remote interface and then prepares for executing the program at 5:00 PM.

```
LIST1«          list local program #1
                controller response:
FOR I2,0,10     set FOR loop for 10 loops
RATE=10        define temp. segment 1, RATE=10 deg C/m
WAIT=15        wait = 15 minutes
SET=-55.0      set final temp to -55.0 deg C
SET=125.0      define temp. segment 2, rate=10 deg C/m
                wait=15 minutes, final temp=125.0 deg C
NEXT I2        mark end of FOR loop, I2
END            mark end of local prog. and end of STORE
```

```
RUN1TIME=17:00:00« run local program #1 at 5:00 PM
```

S/!

Function: Transmit and receive ASCII data from the GPIB to the RS-232 Serial Interface.

Syntax: !sss...sss transmit string sss...sss to the serial intf.
 S receive string from serial interface.

Description:

The S/! command is a TC01 compatible command which allows the GPIB interface to transmit ASCII data to the RS-232 serial interface or receive data from the serial interface. Care should be taken that a serial device does not transmit data to the controller until an S command has been issued, since, data received from a serial device without an S command pending will be interpreted as command data for the controller. An S command is required for each string of characters, terminated with a carriage return and/or line feed, to be transferred to the GPIB interface. GPIB lockup time is inhibited for the S command to allow time for a serial device to respond to a prompt message.

Restrictions: GPIB remote interface command only.

See Also: n/a

Example: These commands must originate from the GPIB interface
 S« GPIB interface sends request for reply prior to sending a prompt
 message to insure that the reply message is sent to the GPIB
 interface by the controller.

 !send status« the string "send status" is sent from the controller's serial interface
 to prompt serial interface device.

 I'm OK controller response, transfers message received from serial inter
 face to the GPIB interface.

SCALE1 & SCALE2

Function: Examine present scale for Ch_1 and Ch_2

Syntax: **SCALE1?** examine scale Ch_1
SCALE2? examine scale Ch_2

Description:

The SCALE command allows a remote interface to examine the present scale or units of measure for both the channels. The scale for the channels are set in the MENU.

Restrictions: Remote interface command only

See Also: **MENU**

Example: **SCALE?«** examine probe scale
DEG C controller response, degrees Centigrade

SDEF

Function: Set or examine some of the default parameters.

Syntax: **SDEF = xxxxx** Sets SDEF parameters where x is Y or N.
SDEF? Examines the SDEF parameters by returning a 5 character string.

where position	1;	Y=RS echo is on
	2;	Y=chart temp
	3;	Y=DTR-CTS enabled
	4;	Y=output PIDs to D/A-A
	5;	Y=buzzer on

Description:

The SDEF allows for setting or examining several of the default settings for the PC100-2 over the remote bus.

Restrictions: Remote command only.

SET

Function: Set or examine temperature segment final temperature

Syntax: **SET**=nnn.n Set segment final temperature
SET? Examine segment final temperature

Description:

The SET command allows for setting or examining the final temperature within a temperature segment. The temperature segment consists of the change of temperature, defined by the RATE command, from the present temperature to the temperature defined by the SET command, plus the time specified by the WAIT command to soak at the temperature defined by the SET command. The units accepted by the SET command are those chosen in the menu. For best results, a temperature segment should be entered as RATE, WAIT then SET.

Restrictions:

Remote only, see SET SEGment in this section for front panel equivalent. The value set by the SET command must range between the values set for the LTL and UTL commands.

See Also: **RATE, WAIT, LTL, UTL**

Example: If SCALE for the probe is in deg C
RATE=10.0« set ramping rate for 10.0 deg C/minute
WAIT=5 set wait = 5 minutes
TEMP?« read present temperature
25.0 controller response, for example 25.0 deg C
SET=35.0« set new set point, for example 35 deg C
SET? examine present set temp.
35.0 controller response after waiting 30 seconds
TEMP?« read present temperature
30.0 controller response, up 5 deg C in one half minute

SET SEGMENT

Function: Allows the user to set the RATE, WAIT, and SET values

Syntax: <SHIFT> SET SEG

Description:

Allows for easy entry of the RATE, WAIT, and SET values. When the command is entered, the controller responds on the display with the current settings and prompts for new values. The user must then only enter the value desired using the numeric keys or just enter for no change.

Restrictions: Front Panel Operation only.

See Also: SET, WAIT, RATE.

SINT

Function: Set or examine interrupt parameters.

Syntax: **SINT=xxxxxxxxn** Sets interrupt parameters where x is Y or N and n is a digit from 0-8
SINT? Examines interrupt parameters. Controller returns an 11 character string.

where position

1;	Y =	all remote interrupts off
2;	Y =	single timeout interrupt enabled
3;	Y =	deviation interrupt enabled
4;	Y =	Local program timeout interrupt enabled.
5;	Y =	Local program done interrupt enabled
6;	Y =	Buzz single timeout
7;	Y =	Buzz LP done
8;	Y =	Buzz LP timeout
9;	Y =	command error interrupt enabled
10;	Y =	BKPNT interrupt enabled
11;	0 =	no parallel pole 1 to 8 to define parallel pole bit

Description:

The SINT command allows for setting or examining the interrupt parameters over the remote bus.

Restrictions: Remote command only.

STATUS?

Function: Allows polling in lieu of interrupts for remote operation.

Syntax: **STATUS?**

Description:

This command will allow polling to take place instead of interrupts when controlling the PC100-2 via one of the remote busses.

Restrictions: Remote interface command only.

Example: **STATUS?** Returns with 18 character response
where char position:

- 1; Y=power is on
- 2; Y=command error last command
- 3; Y=time out LED is on
- 4; Y=waiting for timeout
- 5; Y=heat output is enabled
- 6; Y=cool output is enabled
- 7; Y=valid set temperature
- 8; Y=deviation limit exceeded
- 9; Y=currently ramping
- 10; Y=probe temp<lower limit
- 11; Y=probe temp>upper limit
- 12; Y=waiting at a breakpoint
- 13; Y=in LP run mode
- 14; Y=in LP remote store mode
- 15; Y=in local edit LP mode
- 16; Y=waiting to run LP at time of day
- 17; Y=GPIB bus timeout
- 18; Y=in local keyboard lockout mode

STOP

Function: Terminate local program execution, terminate local program edit, exit menu, and terminate single temperature segment execution.

Syntax: **STOP**

Description:

If in Local Program operation, the STOP command terminates local program execution in the controller. If in local program edit from the front panel, the STOP command from the front panel ends local program edit. If in the MENU, the STOP command from the front panel will exit the menu. If running in single temperature mode, then entering the STOP command terminates the temperature segment and sets SET=NONE and WAIT=FOREVER.

Restrictions: None

See Also: **RUN**

STOP-9

Function: Restores controller to factory default settings and clears all local program data.

Syntax: **STOP-9**

Description:

The STOP-9 command resets the controller to factory default settings, deletes the local program, and all limits. You may wish to write down settings and the local program before issuing this command. Calibration information is not affected. The controller will go to the power off mode after this command is executed.

Restrictions: None

Example: STOP-9<< Reset controller to factory default settings.

STOREn

Function: Stores a downloaded local program from a remote interface.

Syntax: **STOREn** where n=0,9

Description:

The STORE command allows a remote interface to download a local program to the controllers local memory. Once downloaded, the local program may be executed by issuing a RUN command. Prior to downloading a program to the controller, the local program must be cleared by using the DEL command. Local programs can be displayed or uploads to the remote interface by using the LIST command.

Restrictions: Remote interface command only.

See Also: **LIST, RUN, DEL, STOP**

Example: DEL3 « clear existing local program #3
STORE3« ready controller for accepting LP#3 commands
*** send LP commands
END« terminate store operation
LIST3« display new local program #3
*** controller displays local program
RUN3« execute local program #3

STOP« terminate local program activity

T

Function: Examine current Ch_1 probe temperature in deg C

Syntax: **T**

Description:

The T command is a TC01 controller compatible command which examines the present channel 1 probe temperature. The response is always in degrees centigrade.

Restrictions: Remote interface command only.

See Also: **TEMP?**

Example: SET=25.0« Set current set temperature to 25 deg C
After ramp period ended
T½ Examine current temperature
25.1 Actual temperature returned
TEMP?« Examine current temperature
25.1 Actual temperature returned

TALK

Function: Sets the PC100-2 in talk mode.

Syntax: **TALK nn**
TALK NONE

Description:

When the RS422 serial port is used for communication between the host computer and the PC100-2 unit/s, the TALK nn sets the PC100-2 #nn in TALK mode. The TALK NONE indicates the units on the bus not to respond to the host computer.

Restrictions: Remote command only.

See Also: **LISTEN**

TEMP

Function: Examine current channel 1 probe temperature

Syntax: **TEMP?**

Description:

The TEMP command provides the means for a remote interface to read the present value of the probe. This value is normally displayed on the first line of the front panel LCD display. The units for the probe are set in the menu for deg F, C, or K.

Restrictions: Remote Interface command only.

See Also: **T**

Example: TEMP?« read probe
25.0 controller response, 25.0 units

TIME

Function: Set or examine time of day

Syntax: **TIME**=hh:mm:ss set time of day
TIME? examine present time of day

Description:

The **TIME** command is useful for documenting report outputs and for starting local programs at a specific time of day. Time is entered and displayed in a 24 hour format, i.e., hours (hh) range from 00 to 23; minutes (mm) range from 00 to 59 and; seconds (ss) range from 00 to 59.

Restrictions:

Remote only command. To change the time from the front panel, the **MENU** must be accessed.

See Also: **RUN TIME**=hh:mm:ss

Example: **TIME**=13:30:00« set time to 1:30 PM
TIME?« examine time of day
13:30:00 controller response

UTL1 & UTL2

Function: Set or examine the upper temperature limit

Syntax: **nnn.n**UTL TC01 compatible set Ch_1 UTL in deg C
 UTL TC01 compatible examine Ch_1 UTL in deg C
 UTL1=nnn.n Set Ch_1 UTL, variable units
 UTL1? Examine Ch_1 UTL, variable units
 UTL2=nnn.n Set Ch_2 UTL, variable units
 UTL2? Examine Ch_2 UTL, variable units

Description:

The TC01 compatible commands provide for setting and examining the UTL in degrees centigrade only. If temperature units are desired to be the same as that set in the menu for the SCALEm variable, then the UTLm=nnn.n and UTLm? command formats should be used. If the temperature exceeds the UTL setting, then an over temperature interrupt will be generated to the active remote interface.

Restrictions:

TC01 compatible commands operate from the remote interface only.

See Also: **LTL1 & LTL2**

Example: If scale is set to deg F
 150.0UTL« set UTL Ch_1 to 150 deg C
 UTL« examine UTL Ch_1 in deg C
 150.0 controller response, 150.0 deg C
 UTL1?« examine UTL1 in units of SCALE1, deg F
 302.0 controller response, 302 deg F

VER?

Function: Examine the version of software in the PC100-2

Syntax: **VER?** request the version of software

Description:

This command is used to determine the version of software that is in the PC100-2

Example:

VER? request the version
SUN SYSTEMS x.xx controller response, where x.xx is the
 version number

WAIT

Function: Set or examine the temperature segment wait period

Syntax: **WAIT=hh:mm:ss** set wait in hours:minutes:seconds
WAIT=mm set wait in minutes only (mm=00 to 59)
WAIT=F(OREVER) set WAIT to forever
WAIT? examine current wait setting

Description:

The WAIT command determines the time at which the controller will maintain the set temperature after the probe temperature is within the value specified in “+/- AT SET TRIGGER” variable set in the menu. Once the wait period begins, the wait time continues regardless of changes in probe temperature. When running a local program, the next command in the program is executed after the wait period is timed out. In single temperature mode, the controller continues to maintain the set temperature after the wait period timeout. During the wait period, examination of WAIT returns the time remaining in the wait period. After the end of a wait timeout, the WAIT is reset to FOREVER. For best operation the temperature segment should be entered RATE, WAIT then SET.

Restrictions:

Remote only, See SET SEG (SET SEGment in this section for front panel control equivalent).
Range from 99:59:59 to 00:00:01

See Also: **SET, RATE, M**

Example: **RATE=10**« define temperature segment,rate=10 deg C/min
WAIT=00:10:30« wait=10 min, 30 sec
TEMP?« examine current Ch_1 temperature
25.0 controller response, 25.0 deg C
SET=35.0« set new temperature, 35 deg C
after 1 minute, set temperature is reached,
wait period begins; after 1 more minute,
WAIT?« examine wait setting
00:09:30 controller response, 9 min, 30 sec remaining

SECTION 10. MODEL TC01 COMPATIBILITY COMMANDS

The Model PC100-2 provides limited upwards compatibility with our Model TC01 temperature controller as described below. Consult your TC01 manual for a complete definition of these commands.

nnn.nC	Set Temperature (deg C)
C	Examine Temperature (deg C)
nnn.nM	Set Time at Temperature, Wait time (minutes)
M	Examine Time at Temperature (minutes)
T	Examine Temperature in deg C always
!sss...sss	Transfer String sss...sss received from GPIB to RS232/422 interface
S	Transfer next string received from RS232/422 interface to GPIB

SECTION 11. SPECIFICATIONS

Power Requirements	Power consumption: 35 W Voltage: 110/220/240 Frequency: 50/60 Hz
Mechanical Package	1/4 DIN x 6.0" Deep
Temperature Set Point Range	Full range of probe selected
Time at Temperature Range	1.0 sec to 99 hr 59 min 59 sec or continuous
Temperature Ramping Rate Control	Locally controlled from .1 deg C/min up to the heat/cool rate of change of the system
Programmable Set Temps and Times	Number of set temperatures and set times limited only by available program memory, but typically 100+ segments
Absolute Error	+/- .25 deg C (not including probe error)
Long Term Stability (per month)	+/- .2 deg C
Temperature Resolution	.02 deg C
Line Voltage Sensitivity	+/- .1 deg C for a 10 % line voltage change
Local Junction Compensation	.05 deg C/deg C (5 deg C to 45 degC)
Programmable Temperature Loop Control	1 to 65,535 FOR/NEXT loop executions for 10 loops, nesting supported
Temperature Control Technique	PID algorithm/Pulse width modulated, programmable from keyboard or remote interfaces
Local Operation	20 key keypad, 2 line 16 characters per line alphanumeric LCD display
Remote Operation	Built in IEEE-488 and RS232 interfaces
Additional I/O Capability	5 auxiliary outputs, 2 auxiliary inputs, 2 analog output channels
Safety Features	Open/short probe detection, adjustable upper and lower temperature limits. Fail-safe input

Convenience Features

Heat/cool enable/disable switches, battery backed memory for local program, configuration menu, remote interrupt operation, time of day clock.

SECTION 12. REPAIR INFORMATION

Due to the test system required, it is not recommended that the PC100-2 be repaired in the field. If a problem should arise, call Sun directly to resolve the problem over the phone, if possible, or to arrange for the unit to be sent back to Sun for repair.

When calling to return a controller, Sun Systems will issue a Return Material Authorization (RMA) number. This RMA number should be on any paperwork sent with the controller and should also be displayed on the shipping box. If a unit is returned without an RMA number, the repair could be delayed.

Should there ever be a need to replace the software in the PC100-2 (i. e., with a new version supplied by Sun Systems in an EPROM) the following procedure should be performed:

1. Write down all important settings you have entered into the PC100-2 as well as saving the local programs. The local programs can be uploaded to a host computer and saved on a floppy disk. **LOCAL PROGRAMS AND OTHER DATA MAY BE DESTROYED WHEN CHANGING SOFTWARE. SAVE ANY IMPORTANT INFORMATION BEFORE PERFORMING THE REST OF THIS PROCEDURE.**
2. Unplug the unit. Remove line power to equipment that the PC100-2 is connected to.
3. Remove the PC100-2 from the equipment panel by unscrewing (5 or 6 revolutions counter clockwise) the two panel hold screws on the units front panel. Slide PC100-2 out & remove two flat cables and probe connector to free controller from its wiring.
4. Unscrew the screw on the back of the PC100-2 until it is loose.
5. Pull off front panel.
6. Remove nut from screw that comes from back & remove screw.
7. Remove 4 screws on the bottom of the unit. then slide controller boards stack out.
8. The bottom board contains the firmware EPROM chip. Remove bottom board from 3 board stack, by removing four standoffs then unplug board.
9. Remove the EPROM carefully and replace it with the new one supplied by Sun Systems. Check for proper pin orientation when installing IC.
10. Reassemble the unit, reconnect the PC100-2 rear connectors and remount in equipment panel.
11. Turn the controller on. A new version number should be displayed on power up. Next, key in the command STOP-9 then ENTER to the controller. This will reset

the controller to factory default settings stored in the new EPROM and reboot the controller.

SECTION 13. REPLACEMENT OR OPTIONAL PARTS

190001	3 wire 100 ohm RTD .392 probe
190008	J thermocouple probe
190009	K thermocouple probe
190010	T thermocouple probe
190006	Solid state probe
980054	Assembled Process I/O board
980004	Assembled remote interface board
800011	3 amp solid state relay
800003	25 amp solid state relay

SECTION 14. ERROR CODES

SRQ OVERFLOW

This message is just to inform you that an interrupt has not been serviced and can be ignored without causing any problems. Refer to **GPIB (IEEE-488) REMOTE CONTROL** in Section 1.