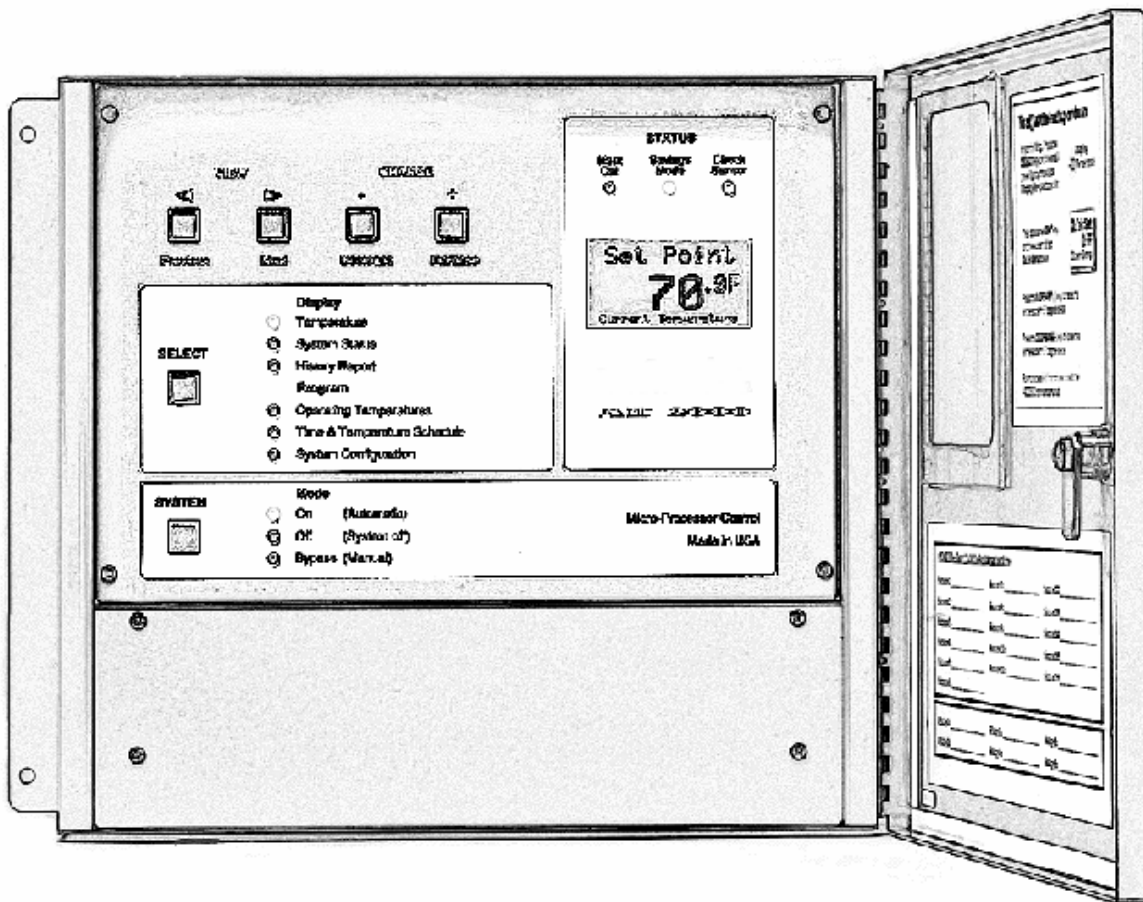


AD 2000™

Temperature Control
For Domestic Hot Water Heating Systems



Operators Manual

Rev: June 4, 2005
EPROM V 2.2

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AD 2000™ OPERATORS MANUAL

Application: Domestic Hot Water Heating System

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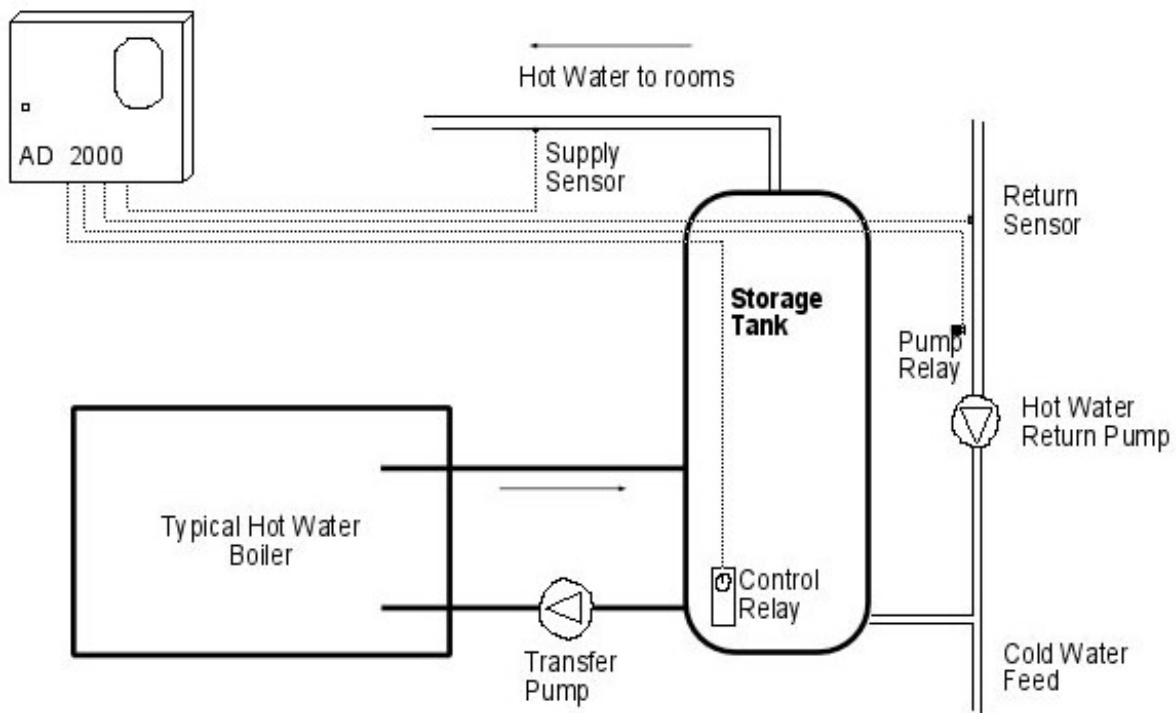
1. Domestic Hot Water Heating System: Basic Control Strategy

Domestic hot water systems using a set point aquastat as an operating control maintain a constant temperature 24 hours per day. This constant temperature (usually 125 – 140 degrees) is typically set so that no “lack of hot water” complaints are made during peak usage times of the day. Peak usage commonly occurs only 3 or 4 hours per day, the rest of the time water is heated (and reheated) to an unnecessarily high temperature. The set point aquastat doesn't respond to changing usage requirements.

The AD 2000™ Domestic Hot Water Control can utilize up to five control strategies to achieve considerable energy savings (15% - 30%) and extend your equipment life.

1. **Time based adjustment of temperature:** Raises and lowers supply temperature automatically to match usage periods throughout the day (48 unique settings per day are available).
2. **Recirculating pump control:** Can reduce stand-by heat loss in the hot water Recirculating loop by cycling the return pump.
3. **Heater sequencing:** Provide even wear on system by balancing work load and matching of firing rate to usage requirements.
4. **Seasonal adjustment:** Temperature settings are gradually altered automatically to compensate for changes in cold water temperature and outdoor weather conditions.
5. **Self-Correction Algorithm:** Periodically adjusts programmed timing schedule by adapting to changing temperature requirements.

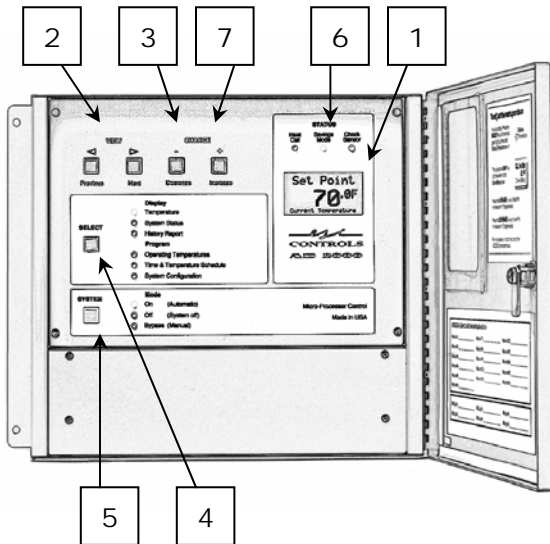
Typical single stage heater application:



2. AD 2000: Front Panel Function

1. Display Window

The AD 2000™ incorporates a 172 character 22 X 8-line backlit LCD display. All temperature, status and programming information can be viewed on the display window.



The display will automatically begin to cycle through each screen in the "Display Temperature" mode once 5 minutes has elapsed without a key press.

2. View Keys: < Previous and Next >

Pressing the Previous or Next key will manually scroll through all display and program settings. The number available is determined by settings in the System Configuration setup.

3. Change Keys: - Decrease and Increase +

Pressing the Decrease or Increase keys will raise or lower the programmed value presently shown in the display window.

4. Select Key:

Pressing the Select key cycles through the 3 display and 3 program modes.

5. System Key:

Pressing the System key will cycle through the 3 basic modes of operation:

On (Automatic): The AD 2000™ is controlling the system - Normal Operation.

Off (System Off): Turns system and AD 2000™ off - For Boiler Service.
After 5 minutes in the "OFF" mode the LCD will display "System Off".

Bypass (Manual): Reverts system back to original controls.
After 5 minutes in the "BYPASS" mode the LCD will display "System Bypassed".

6. Status LED's:

Multi-colored Status LED's provide an "at a glance" view of basic system operation. Detailed information is available from the display window in System Status mode.

Heat Call (amber): AD 2000™ has determined a need for hot water, relay(s) energized (Closed).

Savings Mode (green): Set point exceeded, relays de-energized (Open).

Check Sensor (red): A sensor, or wiring to the sensor has been damaged.

7. Program Mode Lockout

To prevent unauthorized tampering with AD 2000™ program settings, four levels of Lockout are provided. An individual Lockout is available for each of the three Programming Groups, as well as a global "All Settings Locked" Mode. To enable/disable a lockout condition go to the first screen in any of the (3) Programming Groups. Press both Decrease and Increase Keys *at the same time*. The display will read - Settings Locked -.

For the highest level of security enable the "All Settings Locked" Mode. Once "All Settings Locked Mode" is activated, the Select Key will no longer cycle through the LED's in the (3) programming groups. Set "All Settings Locked" Mode from the first screen in the "Display Temperatures" rotation.

Temperature can still be adjusted within parameters you have specified from the Quick-Set screen.

3. Program: System Configuration

Press the SELECT Key until the System Configuration LED is lit.

System configuration typically needs to be set at the time of installation. The settings entered into System Configuration tell the AD 2000™ about your buildings heating system and how it needs to control it.

When the first screen "System Configure" appears, pressing the NEXT Key is followed by:

Number of Active Heaters:

Selects the number of heaters to be wired into the control. Each heater may be individually controlled or wired to switch together.

- Adjustment Range: 1- 4 Heaters
- Default Setting: 4

Number of Active Pumps:

Selects the number of pumps to be wired into the control.

- Adjustment Range: 0 - 2 Pumps
- Default Setting: 2

Min Heater On Time:

The Minimum On Time setting is used to reduce heater short-cycling. This setting applies to multiple stages if applicable.

- Adjustment Range: 0 - 15 Minutes
- Default Setting: 3 Minutes

Min Pump On Time:

The Minimum On Time setting is used to reduce unnecessary pump cycling. This setting applies to multiple pumps if applicable.

- Adjustment Range: 0 - 15 Minutes
- Default Setting: 3 Minutes

Number of Extra Sensors:

Selects the number of additional sensors installed to monitor temperatures. For example - cold water inlet, branch return lines, or storage tanks.

- Adjustment Range: 0 - 9 Sensors
- Default Setting: 0 Sensors

Outdoor Sensor Display:

You may decide to install an outdoor sensor. This setting selects whether or not an outdoor temperature sensor is installed.

- Adjustment Range: On - Off
- Default Setting: Off

Set The Active Temperature Units:

Choose to view temperatures in Fahrenheit (U.S.A.), or Celsius units (foreign). Pressing the Increase key will change Fahrenheit to Celsius.

- Adjustment Range: Fahrenheit, Celsius
- Default Setting: Fahrenheit

- Quick Set:

With Quick Set, ALL of the temperature entries can be globally increased or decreased at once, in .5 degree increments. If set to ON, an entry screen will appear in "Display Temperatures" mode, following the Set Point screen. If set to OFF, the screen will not be displayed. By combining Quick Set with Program Mode Lock Out (see page 3, #7) the on-site janitor can be taught a "SIMPLE" way to adjust the hot water in his/her building without having to learn how to fully use the control.

- Adjustment Range: On or Off
- Default Setting: On

- Calibrate Sensor (#1 to 16):

The installer can calibrate the individual sensors in .5 degree increments. Press the decrease or increase key to change value. Press Previous or Next key to select different sensor to calibrate. Note: sensors are accurate to within .5 Deg. F. Under most circumstances calibration is not required.

- Adjustment Range: -25 to +25 Degrees
- Default Setting: 0 Degrees

- Relay Test (#1 to 6):

Relay Test enables the installer to verify that each of the relay outputs are wired correctly and controlling. Pressing and holding down the Increase key will close the relay contact and pressing and holding the Decrease key will open the relay contact.

4. Program: Operating Temperatures

Press the SELECT Key until the Operating Temperatures LED is lit.

Operating Temperatures typically needs to be set at the time of installation. The settings entered into Operating Temperatures usually will not have to be changed, but may be adjusted to "Fine-Tune" system performance.

When the first screen "Temperature Settings" appears, pressing the NEXT Key is followed by:

- Max Supply Setting:

Sets the Maximum supply temperature which can be programmed in the "Time & Temperature" schedule (supply hi-limit adjustment)

- Adjustment Range: 90 - 190 Degrees
- Default Setting: 140 Degrees

- Min Supply Setting:

Sets the Minimum supply temperature which can be programmed in the "Time & Temperature" schedule (supply lo-limit adjustment)

- Adjustment range: 90 - 190 Degrees
- Default Setting: 120 Degrees

- Heater Differential:

This adjustment sets how much the actual supply temperature may deviate from the desired set point temperature before the heat source is turned on or off. Used to reduce short cycling and maintain precise temperature control.

- Adjustment Range: .5 to 25 Degrees
- Default Setting: 1 Degree

- Pump Turn On Setting:

Selects the return temperature below which the return pump operates.

- Adjustment Range: 50 - 150 Degrees
- Default Setting: 100 Degrees

- Pump Differential:

This adjustment sets how much the actual return temperature may deviate from the desired set point temperature before the recirculation pump is turned on or off. This setting can be used to reduce pump cycling.

- Adjustment Range: .5 to 25 Degrees
- Default Setting: 1 Degree

Note: Should a sensor wire incur damage the "Check Sensors" LED will light on the front panel and an error message will be displayed when reading the value of the damaged sensor.

5. Program: Time/Temperature Schedule

Press the SELECT Key until the Time & Temperature Schedule LED is lit.

Time/Temperature Schedule is pre-set at the factory with the default settings listed on page 15. These settings should work satisfactorily for most buildings. You may also decide to change the settings as described below.

When the first screen "Heating Schedule" appears, pressing the NEXT Key is followed by:

"Make a selection using the Increase and Decrease keys" - If one of these keys is pressed, the display will cycle between the following selections:

1. Review & Adjust Days:
Review & adjust setpoint schedule in 30-minute increments. Beginning Monday 12:00 am
2. Load Default Values:
Factory programmed settings will be re-entered into system memory.
3. Set the Clock:
Allows time, date and year to be adjusted.
4. Set All Days Together:
Set all 7 days of the week on the same schedule.
5. Set MO-FR & SA-SU:
Set the same schedule during weekdays and a different schedule for the weekend.
6. Set MO-TH & FR-SU:
Set the same schedule Monday - Thursday and a different schedule Friday - Sunday.
7. Set Days Individually:
Adjust each day of the week to a different temperature.

Note: If the Time/Temperature Schedule is LOCKED (see page 3 - #7) the only option available is to view "Review & Adjust Days". No adjustments may be made if locked.

Pressing the NEXT Key at any of the above prompts will enter the selected programming option.

Example: If you wish to program *Monday - Friday & Saturday - Sunday* press the NEXT Key at that prompt. "Choose Time Increment" appears. Press the INCREASE (+) Key and three choices available are:

- 30 Minute / Step - 48 settings per day
 - 1 Hour / Step - 24 settings per day
 - 2 Hour / Step - 12 settings per day (most common)
- Choose the desired Time Increment by pressing the NEXT Key.

If Monday - Friday was selected with a 2-hour step, the display will read:

Mon - Fri 12:00am
120 Deg

Pressing the DECREASE or INCREASE Keys will increment the temperature up or down. Pressing the NEXT Key will move to the next time interval.

Mon - Fri 2:00am
121 Deg

There are up to 48 half-hour increments per day to cycle through. Selecting a group of days can be a real time saver. Depending on the application, a separate weekday and weekend program should be sufficient.

- Adjustment Range: 90-190 degrees
- Default Settings: See appendix

Program Time & Date: (Set the Clock)

Programming the current time and date needs to be set only once. The AD 2000™ will automatically adjust for daylight savings time and leap year corrections. Pressing the PREVIOUS and NEXT Keys at the "Set the Clock" prompt will reveal the seven screens below.

Example: 4:22 PM on June 4, 2007, which is a Thursday.

Display:	Minute	Hour	Date	Month	Year	Day	Daylight Savings
Enter:	22	4 PM	4	06	07	Mon	On

← → Use Previous or Next Keys To Change Screens.
↓ ↑ Use Decrease or Increase Keys To Change Values.

Note: Daylight Savings Correction automatically corrects its internal time clock to accommodate areas in the country that are affected by spring and fall time adjustments. Leap year correction is automatic.

6. Display: Temperatures

Press the SELECT Key until the Display Temperatures LED is lit.

Display Temperatures allows the user to view all current temperature readings and setpoints. The number of sensors available is determined in the System Configuration setup.

When the first screen "Display Temperatures" appears, pressing the NEXT Key is followed by:

Example:
Press Next Key Set Point Temperature

- " Current Temperature Heater One
- " Current Temperature Heater Two
- " Current Temperature Heater Three
- " Current Temperature Heater Four
- " Current Temperature Pump One
- " Current Temperature Pump Two
- " Current Temperature Extra Sensor One
- " Current Temperature Extra Sensor Two
- " Up to # Sensors installed in programming
- " Outdoor Temperature
- " Software Version
- " Vanity Screen (installation information)

Note: It is possible to temporarily override the programmed temperature schedule from the Temperature Display Mode. While the Set Point screen is displayed, pressing the Decrease or Increase keys will temporarily change the set point until the next scheduled temperature change.

The letters OVR (Override) will appear to confirm the change. The new set point will be used until the next time the temperature is scheduled to change. This feature may be used if a temporary change in temperature is required.

Important: After adjusting Set Point or Quick Set, allow up to 30 seconds for the AD 2000™ to respond to the change.

7. Display: System Status

Press the SELECT Key until the System Status LED is lit.

System Status provides the user information on all current relay status readings and setpoints. The number of viewable items available is determined in the "System Configuration" setup. Current System Status will also provide information on boiler run-time and provide savings calculations.

When the first screen "Status Displays" appears, pressing the NEXT Key is followed by:

Example: System Status page

HEATERS:	PUMPS:
#1 ON	#1 OFF
#2 OFF	#2 OFF
#3 OFF	
#4 OFF	

Example: System Status page 2

	Days hr min
Days On-Line:	0400 25 06
Days Off-Line:	0002 30 22
Power Losses	= 3 events

Example: System Status page 3

HEAT CALL EVENTS
 Last 7: 75
 Prev 7: 89
 HEATER ON TIME
 Last 7: 12h 08m
 Prev 7: 13h 23m
 HEATER # (1, 2, 3 or 4)

Note: The status pages listed above are repeated for each individual heater or lo/hi stage as well as the entire system in total.

*Savings calculation = Last 7 days (now to 7 days ago.) Vs Previous 7 days (7 to 14 days ago.)

<h2>8. Display: History Reports</h2>

Press the SELECT Key until the History Report LED is lit.

The AD 2000™ History Reports can provide valuable information about how your heating system has been operating. Each chart presents data recorded over the last 24 hours. Two types of charts are available: Heat Call and Temperature Charts. Both types of charts provide different information, but the information is displayed in the same format. The far right side of the chart represents the present time, while the left side is exactly 24 hours previous. Hash marks located at the bottom of each chart every 3 hours can help you figure out exactly what time a particular condition occurred.

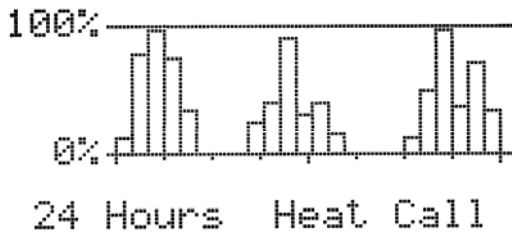
When the first screen “Chart Displays” appears, pressing the NEXT Key is followed by:

Example:

Press Next Key	24-hr graph: Heat Call Detail
"	24 hr bar graph: Heat Call Heater #2
"	24 hr bar graph: Heat Call Heater #3
"	24 hr bar graph: Heat Call Heater #4
"	24 hr line graph: Temperature Heater #1
"	24 hr line graph: Temperature Heater #2
"	24 hr line graph: Temperature Heater #3
"	24 hr line graph: Temperature Heater #4
"	24 hr line graph: Temperature Pump #1
"	24 hr line graph: Temperature Pump #2
"	24 hr line graph: Temperature Extra Sensor #1
"	Up to number of Extra Sensors installed in programming
"	24 hr line graph: Outside Temperature

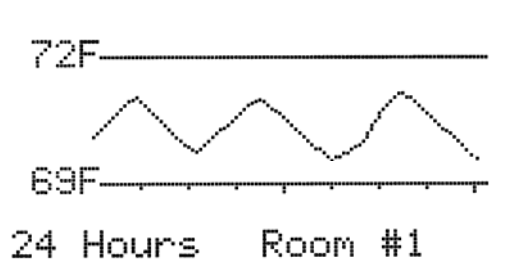
Heat Call Charts

The Heat Call chart is divided into 24 sections (bars). Each section represents an hour of time. A bar that extends to the top of the chart (100%) indicates that the AD 2000™ had called for heat the entire 1-hour period. It is possible that your boiler may have cycled on or off on pressure during this period. A bar that extends only half way (50%) indicates a heat call time of 30 minutes.

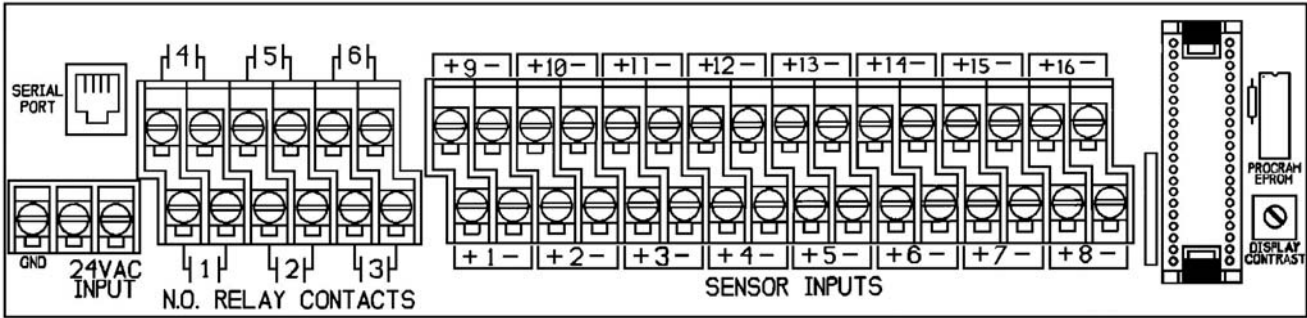


Temperature Charts

The AD 2000™ samples and records the temperature for each active sensor every 15 minutes. The weighted average of all room sensors is also recorded. The Temperature Chart is auto scaling and will always display the highest and lowest temperature value of a given sensor on the left side of the chart.



10. Terminal Block Wiring Diagram



Notes: Domestic Hot Water Heating Application – EPROM V2.2

Applying 24Vac Input and Ground

Use a dedicated Class 2 (fused) 24Vac transformer rated at 20 or 40VA to power the AD 2000. The control should also be properly grounded to a water pipe, conduit ground or other suitable connection using the provided grounding terminal.

Clearing Data Logging Memory:

To clear data logging memory and run-time counters: Remove 24Vac power from the AD 2000, press and hold down the NEXT key for a few seconds while re-applying 24Vac power.

Adjusting LCD Display Contrast:

Allow the AD 2000™ to warm up for at least 30 minutes before adjusting the LCD Display Contrast potentiometer. As the control heats up, the display will darken. Set for best viewing clarity at eye level.

Serial Port Tips:

It is important not to connect a phone line directly into the serial port. The Serial Port is used to connect to an external modem or notebook PC.

Wiring Control Relay Outputs: DO NOT EXCEED 24Vac

N.O. Relay Contacts #1 - #4	Boiler (heat stages) 1 - 4
N.O. Relay Contacts #5 and #6	Pump 1 & 2

IMPORTANT: Wire the AD 2000™ in series with existing safety and/or operating controls. Do not use the AD 2000™ to substitute any safety or limit control.

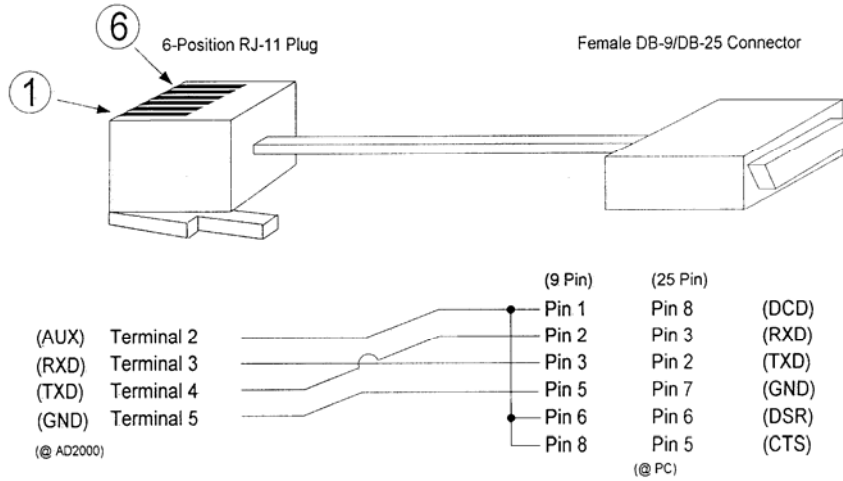
Wiring Sensor Inputs:

Sensor Input #1 through #04	Heater Supply Sensors 1 - 4	Non-Polarized inputs
Sensor Input #05 & #06	Pump Sensors	Non-Polarized inputs
Sensor Input #07 - #15	Extra Monitoring Sensor(s)	Non-Polarized input
Sensor Input #16	(optional) Outdoor Temperature	Non-Polarized input

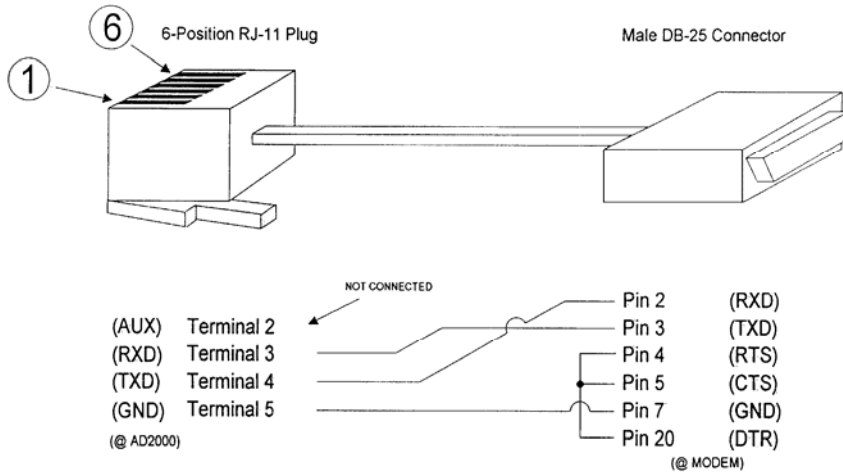
When a sensor is initially wired into the AD 2000™ it will gradually come up to temperature. This is due to RFI noise filtering designed into the control. If you want to read the temperature immediately, cycle power to the AD 2000™ or view its reading from the corresponding “Calibrate Sensor” screen in the System Configuration menu.

11. PC and Modem Interface Cable Wiring

Wiring Diagram: AD 2000™ to NoteBook PC



Wiring Diagram: AD 2000™ to External Modem



12. Default Time/Temperature Schedule

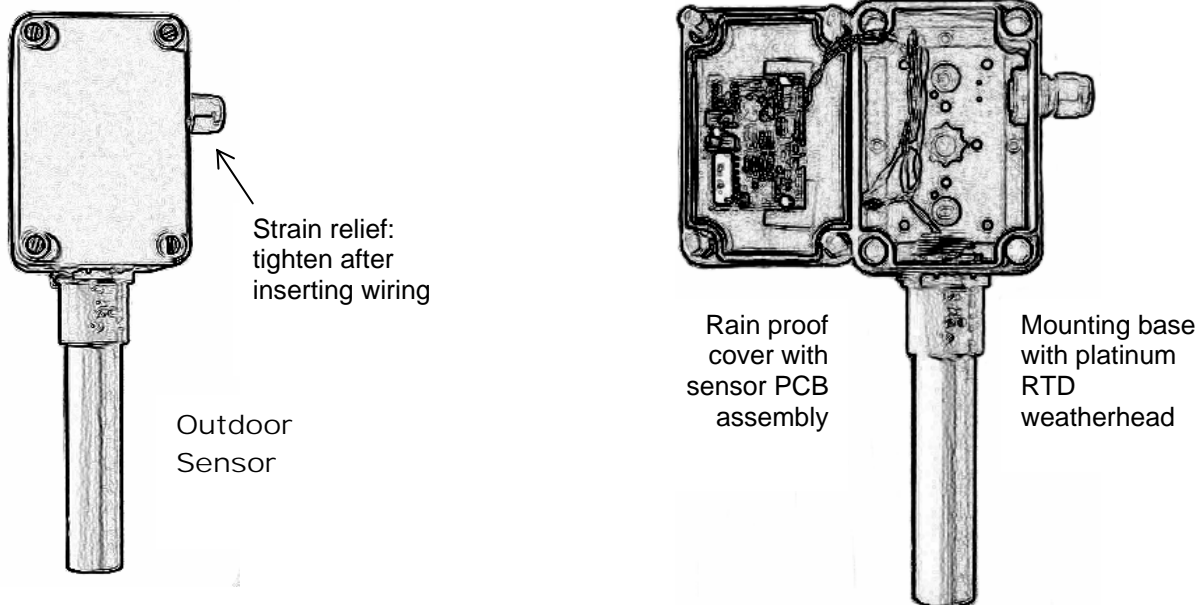
The default time/temperature schedule is pre-programmed into each AD 2000™ at the factory. You may choose to manually enter a completely new schedule or to modify the default settings using the “Quick-Set” command described on page 5. At any time you may also restore the default values listed below using the “Load Default Values” also described on page 7. The default schedule is typical for an apartment/condominium residential setting.

Helpful Tips:

Use the Quick-Set command to instantly adjust all of the settings up or down in ½ degree increments.

Use the Time/Temperature Schedule mode to make changes to specific times and/or days.

13. Sensor Installation



Outdoor Sensor (optional)

Install outdoor sensor on the North Side of the building. Keep away from external sources of heat such as drier vents and exhaust stacks. If north Side mounting is not practical be sure the sensor is shielded from the sun.

Attach the wires from the AD 2000™ unit to the outdoor sensor terminal labeled “Power”. This input is non-polarized.

14. AD 2000™ Product Specifications

Physical Enclosure

Blue Epoxy coated 16-gauge steel with key lock and viewing window

Dimensions

15 7/8" x 12 5/8" x 3" W x H x D

Weight

Approximately 20 lbs.

Analog inputs: 16

Type:	Range
Room Sensor	0 to +122 degrees F.
Outdoor Sensor	-30 to +130 degrees F.
Boiler Sensor	+40 to +240 degrees F.

Relay Outputs: 6
N.O. Dry Contact – 24Vac Maximum

Display

128 x 64 pixel backlit LCD
Resolution: .5 degrees F or C

Expansion Bus

40 pin processor direct for future expansion

Serial Port

9600+ baud communications

Power Requirements

24Vac @ 20 or 40VA

Battery backup

Lithium – 10 year