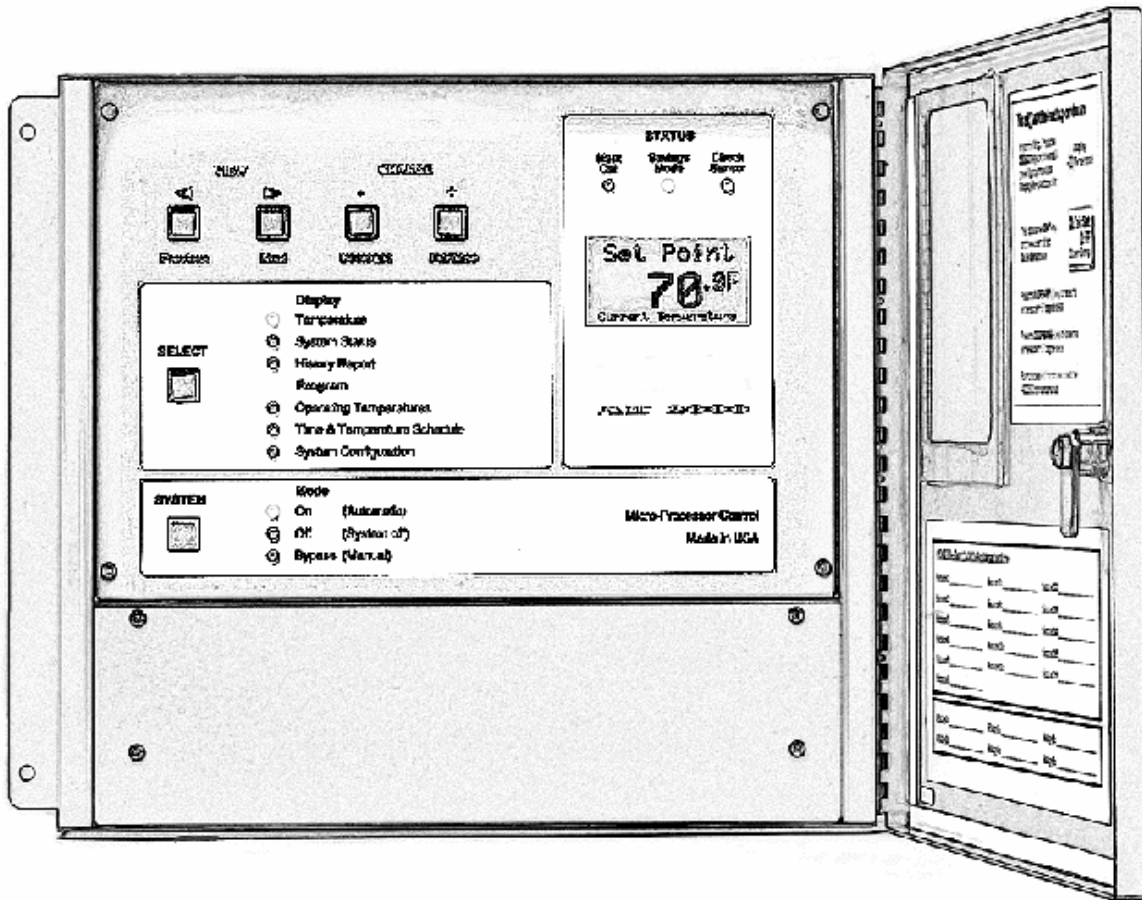


AD 2000™

Temperature Control For Hydronic Heating Systems



Operators Manual

Rev: September 15, 2004
EPROM V 2.2

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AD 2000™ OPERATORS MANUAL

Application: Hydronic Heating System

Rev: September 15, 2004
EPROM Ver: 2.2

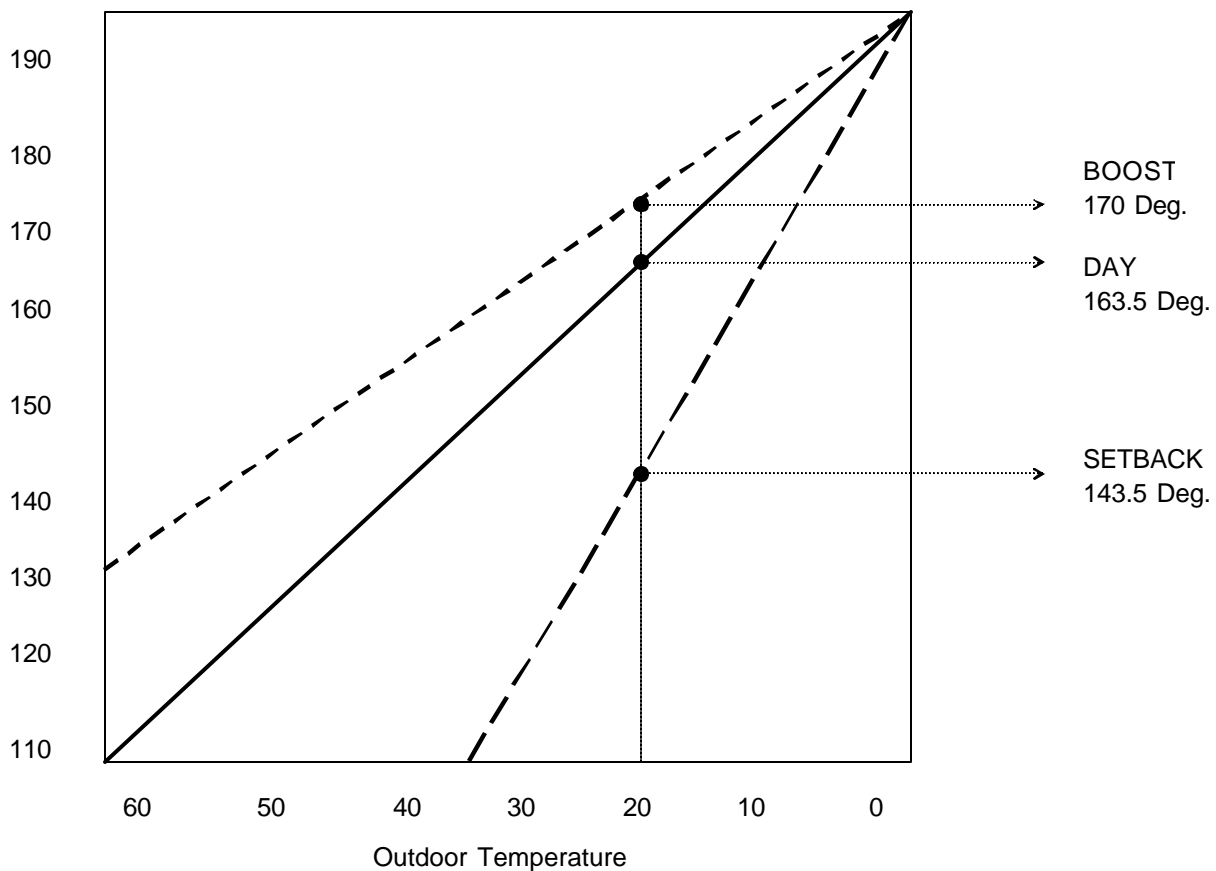
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1. Hydronic Heating System: Basic Control Strategy

Many hot water heating systems operate at a set maximum temperature regardless of outside air temperature. Since the boiler must be sized to compensate for winter's coldest days, its heating output is excessive during moderate and mild temperatures. The boiler will heat the circulating water to the hottest temperature, even though the demand for heat varies as outdoor temperature changes. This results in energy waste and inconsistent indoor temperatures.

The microprocessor-based AD 2000™ combats this situation by controlling the circulating hot water temperature based on outdoor air temperatures. Comfortable living conditions are maintained by varying the circulating water temperature in response to outdoor temperature changes. This function, called Reset, customizes the heating system to produce only enough heat to match the heat loss of the building. The reset function combined with night setback and outdoor cutoff can provide the owner with maximum energy savings and minimal adjustment.



The following program settings have been entered to create the example above:

Outdoor Cutoff Temperature	60
Design Temperature	0
Boost Amount @ Outdoor Cutoff	20
Boost Amount @ Design Temp	0
Day Temp @ Outdoor Cutoff	110
Day Temp @ Design Temp	190
Setback Amount @ Outdoor Cutoff	25
Setback Amount @ Design Temp	10
Lo-Limit Setting	110
Hi-Limit Setting	190

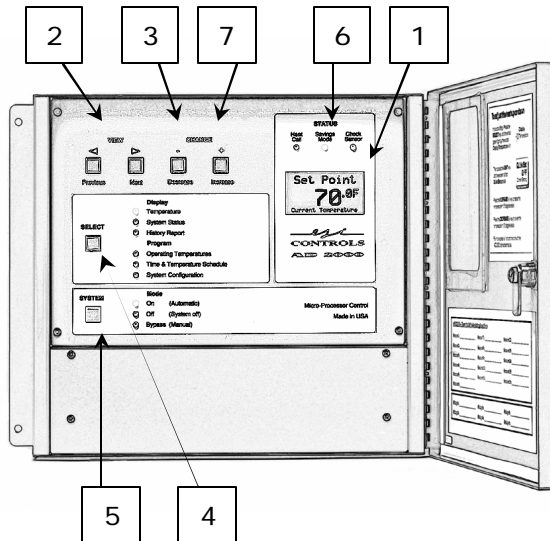
As demonstrated above, at an outdoor temperature of 20 degrees, the AD 2000™ will be calling for 170-degree temperatures during BOOST periods, 163.5 degrees during DAY periods and 148.5 degree temperatures during SETBACK periods.

Three individually programmable reset curves offer maximum flexibility and control.

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 heat, relay(s) energized (Closed).

Savings Mode (green): Set point or outdoor temperature cutoff 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:

- **Select Boiler Type:** "SINGLE STAGE" or "LO/HI FIRE"

Select the proper configuration for the system type you are working with.

- **Number of Boilers:**

Enter the number of heat stages. The AD 2000™ can control 4 single stage boilers or 2 Lo-Hi fire boilers.

- Adjustment Range Single Stage 1 - 4 Boilers
- Adjustment Range Lo/Hi Fire 1 - 2 Boilers*
- Default Setting: Single Stage 4 Boilers

***CAUTION: Lo/Hi Fire**

If Lo-Hi fire boilers are rotated, the stages need to be rotated in such a way to prevent Hi fire first and the possibility of mixing stages between boilers. Consult boiler-wiring diagram for instructions on wiring Lo-Hi fire boilers.

- **Min Boiler On Time:**

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

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

- **Boiler Rotation Mode:**

Rotation balances the workload on boilers and extends boiler life.

- Adjustment Range: OFF, 24 Hours, 48 Hours, 7 days, 30 days, Run Time Balance
- Default setting: OFF

"Run Time Balancing" fires the boiler with the least incremental run time for the previous week first.

- **Number of Extra Room Sensors:**

Selects the number of room sensors to be wired into the control. Extra room sensors are for monitoring actual space temperature to help set reset curves. Room Sensor Type = Electronic / Temperature Range = +30 to +130 Degrees F.

- Adjustment Range: 0 to 9 room sensors
- Default Setting: 0

- **Number of Extra Water Sensors:**

Selects the number of extra water sensors beyond the supply sensor to be wired into the control. Extra water sensors are for monitoring purposes to adjust reset curves. Water Sensor Type = Platinum RTD / Temperature Range = +40 to +240 Degrees F.

- Adjustment Range: 0 to 5 water sensors
- Default Setting: 0

- **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 or Celsius
- Default Setting: Fahrenheit

- Quick Set:

With Quick Set, ALL of the Reset curve (Day, Boost & Setback) 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 heat 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:

- Hi-Limit: (max temp)

Maximum supply temperature should be set to the hottest temperature necessary to provide adequate heat during the coldest periods of Winter known as design temperature (*see below). The AD 2000 will modulate the boiler supply temperature between the Lo-Limit and Hi-Limit settings automatically as the weather changes.

- Adjustment Range: 120 to 240 Degrees F.
- Default Setting: 190 Degrees F.

- Lo-Limit: (min temp)

Minimum supply temperature is established by the AD 2000 when the outside temperature drops below the outdoor cutoff temperature. The supply temperature will increase as outdoor temperature decreases, up to the Hi-Limit Temperature Setting.

- Adjustment range: 60 to 180 Degrees F.
- Default Setting: 140 Degrees F.

Typical settings for Minimum Supply Temperature:

- Copper Tube Boilers: 90 to 140 Degrees F.
- Cast Iron Sectional Boilers: 110 to 150 Degrees F.
- Steel Water Tube Boilers: 140 to 180 Degrees F.
- When in doubt about the minimum temperature setting, consult boiler manufacturer.

- **Heater Differential:**

This adjustment sets how much the actual supply water temperature may deviate above and below the desired set point temperature. Used to prevent boiler short cycling.

- Adjustment Range: 1 to 30 Degrees F.
- Default Setting: 15 Degrees F.

- **Temperature Delay for stage activation:**

Activation temperature delay used in a multiple heater installation. Whether Lo-Hi fire or single stage, this value sets the allowable drop in temperature before next stage is activated or Hi fire condition. Activation occurs AFTER temperature drops below Heater Differential setting AND Minimum Boiler on time is reached for preceding stage.

- Adjustment Range: 3 to 60 Degrees F.
- Default Setting: 10 Degrees F.

- **Design Temperature:**

Outside design temperature is the coldest outside temperature expected for a normal heating season. (Example: Chicago outside design temperature is -10 Degrees F)

- Adjustment Range: -30 to +40 Degrees F.
- Default Setting: 0 Degrees F.

- **Outdoor Cutoff Temp:**

Selects the outdoor temperature where boiler operation ceases. This feature provides considerable savings during spring and fall months when day and night temperatures fluctuate widely.

- Adjustment Range: 35 to 85 Degrees F.
- Default Setting: 60 Degrees F.

Setting DAY Reset Curve:

- **Max Temp for DAY at Design Temperature:**

Selects the maximum supply temperature at the outdoor design temperature. Maximum temperature supplied will not exceed Hi-Limit as described above.

- Adjustment Range: 60 to 240 Degrees F.
- Default Setting: 190 Degrees F.

- **Min Temp for DAY at Outdoor Cutoff Temp:**

Selects the minimum supply temperature at the outdoor cutoff temperature. Minimum temperature supplied will not fall below Lo-Limit as described above.

- Adjustment Range: 60 to 240 Degrees F.
- Default Setting: 140 Degrees F.

- **Amount of BOOST at Design Temperature:**

Selects the amount of increased supply temperature added to the Max Temp for DAY reset curve. Maximum temperature supplied will not exceed Hi-Limit as described above.

- Adjustment Range: 0 to 50 Degrees F.
- Default Setting: 0 Degrees F.

- **Amount of BOOST at Outdoor Cutoff Temp:**

Selects the amount of increased supply temperature added to the Min Temp for DAY reset curve. Minimum temperature supplied will not fall below Lo-Limit as described above.

- Adjustment Range: 0 to 50 Degrees F.
- Default Setting: 0 Degrees F.

- Amount of SETBACK at Design Temperature:

Selects the amount of decreased supply temperature subtracted from the Max Temp for DAY reset curve. Maximum temperature supplied will not exceed Hi-Limit as described above.

- Adjustment Range: 0 to 50 Degrees F.
- Default Setting: 0 Degrees F.

* Caution should be taken that the system has enough time to recover from setback during cold weather conditions.

- Amount of SETBACK at Outdoor Cutoff Temp:

Selects the amount of decreased supply temperature subtracted from the Min Temp for DAY reset curve. Minimum temperature supplied will not fall below Lo-Limit as described above.

- Adjustment Range: 0 to 50 Degrees F.
- Default Setting: 0 Degrees F.

- Outdoor Temperature to activate 2nd Pump:

Selects an outdoor temperature setting below which a second supply pump will activate.

- Adjustment Range: 35 to 85 Degrees F.
- Default Setting: 60 Degrees F.

Note: 1st pump relay is deactivated 1 degree higher than outdoor cutoff setting.

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
SETBACK

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 or Mon – Fri 2:am
DAY BOOST

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: Setback, Day, Boost
- 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 January 31, 2001 which is a Wednesday.						
Display:	Minute	Hour	Date	Month	Year	Day	Daylight Savings
Enter:	22	4 PM	31	01	01	Wed	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: Room sensors 1 to 9 (if installed)
" " "	Current Temperature: Extra water sensors 1 to 5 (if installed)
" " "	Current Temperature: Supply
" " "	Current Temperature: Outdoor
" " "	Software Version
" " "	Vanity Screen (Installation Info:)

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 1

Boilers:	Pumps:
#1 ON	#1 ON
#2 OFF	#2 OFF
#3 OFF	
#4 ON	

Example: System Status page 2

Days on Line:	0400:25:06
Days off Line:	0002:30:22
Power Losses	3

Example: System Status page 3

- Heat Call Events -	
Last 7:	85
Prev 7:	78
- Boiler on Time -	
Last 7:	5 h 11 m
Prev 7:	8 h 28 m
Boiler #1	

Example: System Status page 4

- Degree Days -	
Last 7:	252
Prev 7:	189
- Heater On Time -	
Last 7:	12 h 23 m
Prev 7:	19 h 29 m
*Savings	xx.x%

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.)

8. Display: History Reports

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.

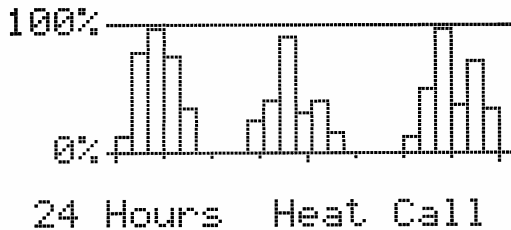
When the first screen “Chart Displays” appears, pressing the **NEXT** Key is followed by:

Example:

Press Next Key	24-hr graph:	Heat Call Detail
“ “ “	24-hr graph:	Room sensors 1-9 (if installed)
“ “ “	24-hr graph:	Extra water sensors 1-5 (if installed)
“ “ “	24-hr graph:	Supply Temperature
“ “ “	24-hr graph:	Outdoor Temperature

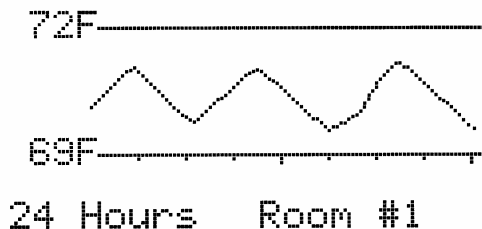
Heat Call Charts

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.

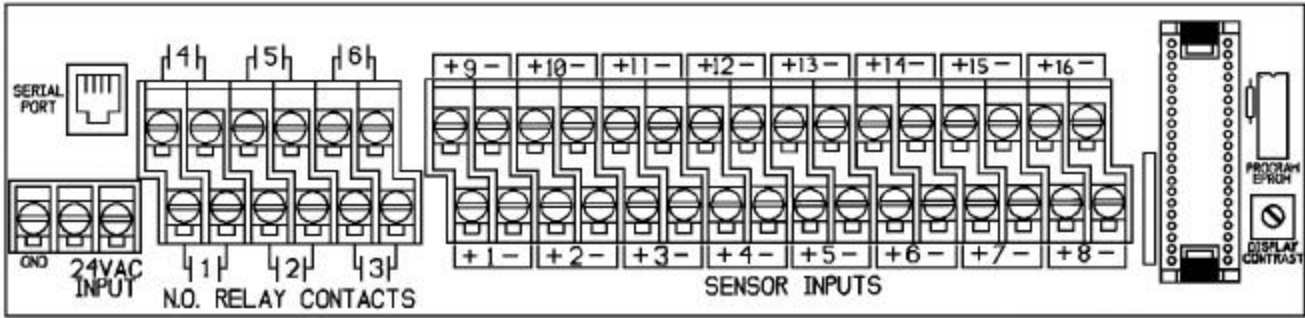


Temperature Charts

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: Hydronic 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 and #2	Boiler (heat stages) 1 & 2	or Lo/Hi Boiler #1
N.O. Relay Contacts #3 and #4	Boiler (heat stages) 3 & 4	or Lo/Hi Boiler #2
N.O. Relay Contacts #5 and #6	Pumps 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.

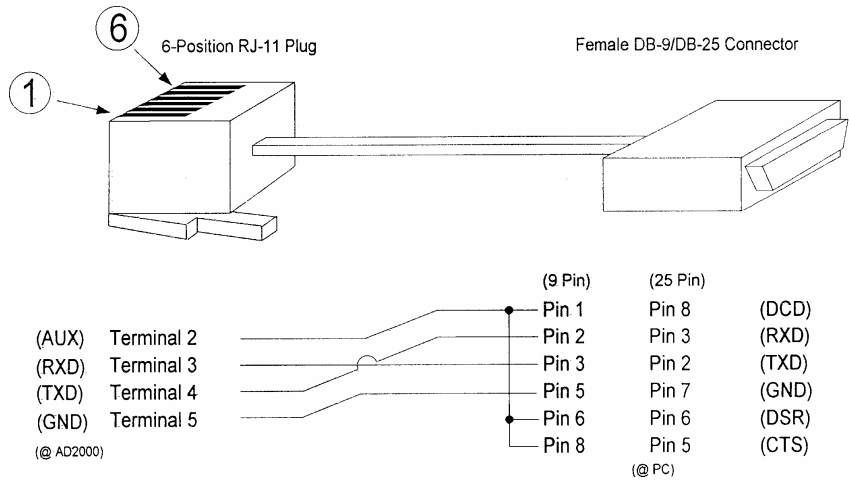
Wiring Sensor Inputs:

Sensor Input #1 through #09	Optional Room Sensors	Non-Polarized inputs
Sensor Input #10 through #14	Optional Boiler Monitoring Sensors	Non-Polarized inputs
Sensor Input #15	Supply Temperature Sensor	Non-Polarized input
Sensor Input #16	Outdoor Temperature Sensor	Non-Polarized input

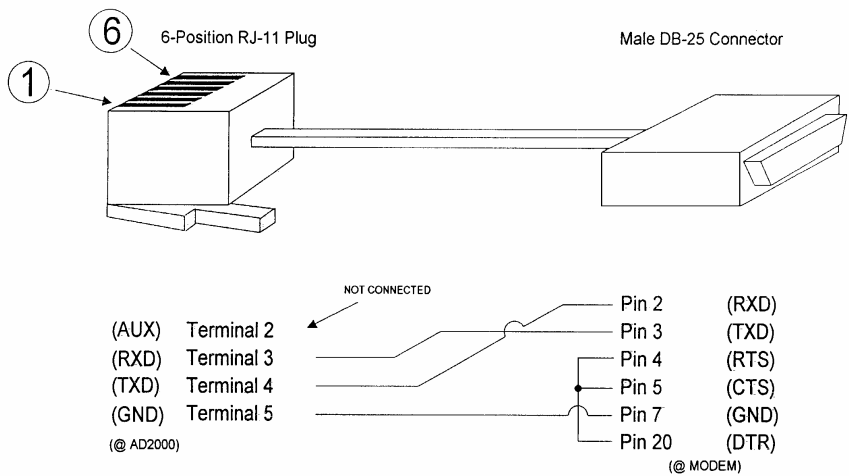
When a sensor is initially wired into the AD 2000™ it will gradually come up to temperature. This is due to RFI noise filtering designed into the control. If you want to read the temperature immediately, cycle power to the AD 2000™ or view its reading from the corresponding “Calibrate Sensor” screen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

Day	Time	Temperature
Monday -Friday	12:00am – 05:00am	SETBACK
Monday -Friday	05:00am – 06:00am	BOOST
Monday -Friday	06:00am – 10:00am	DAY
Monday -Friday	10:00am – 04:00pm	SETBACK
Monday -Friday	04:00pm – 05:00pm	BOOST
Monday -Friday	05:00pm – 12:00am	DAY

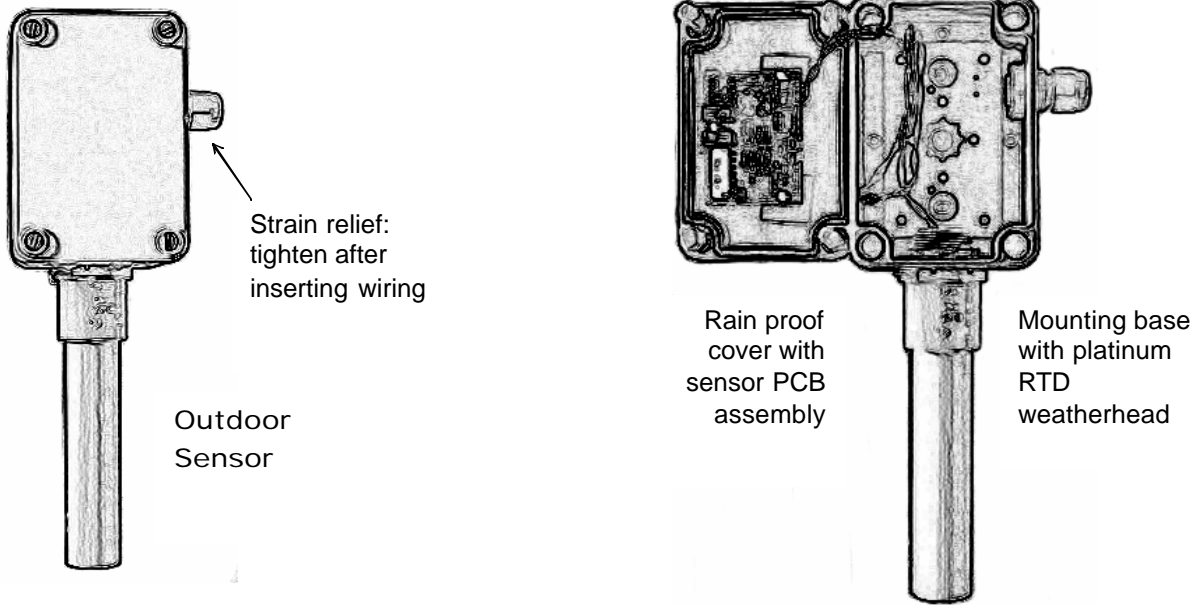
Day	Time	Temperature
Saturday – Sunday	12:00am – 01:00am	DAY
Saturday – Sunday	01:00am – 05:00am	SETBACK
Saturday – Sunday	05:00am – 06:00am	BOOST
Saturday – Sunday	06:00am – 01:00pm	DAY
Saturday – Sunday	01:00pm – 04:00pm	SETBACK
Saturday – Sunday	04:00pm – 12:00am	DAY

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.

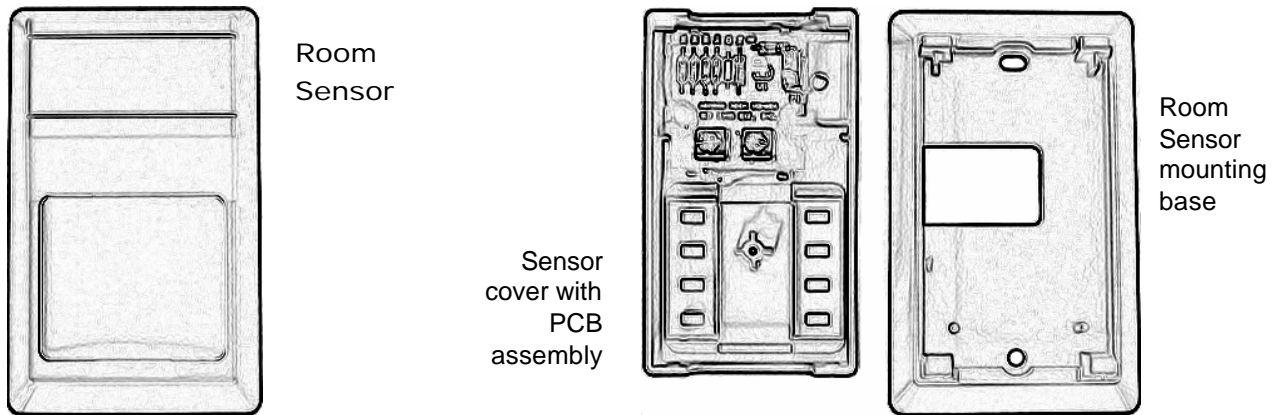
13. Sensor Installation



Outdoor Sensor

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.



Room Sensor

Locate the room sensor in an area that is not in direct exposure to sunlight, radiation or near windows. A typical location is in a hallway near the intercom system (if provided). Mount the sensor approximately 5 feet above the floor level. It may be convenient to run the wiring down the inside of the hall closets to the boiler room.

Attach the wires from the AD 2000™ unit to the room sensor terminals provided. 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