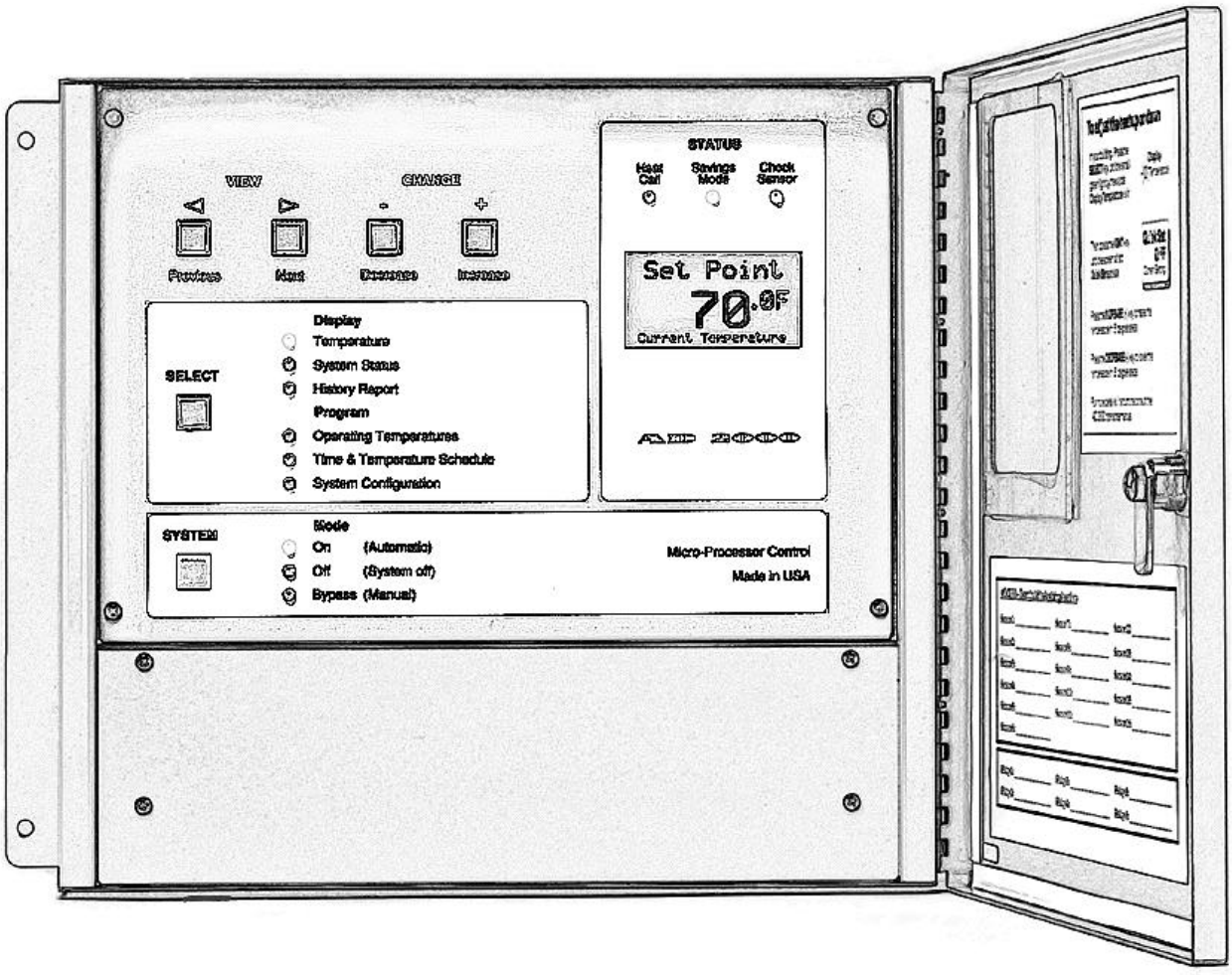
AD 2000™

Temperature Control

For Steam Heating Systems



Operators Manual

Rev: September 15, 2004 - EPROM V 2.6A

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AD 2000™ OPERATORS MANUAL

Application: Steam Heating System

Rev: September 15, 2004
EPROM Ver: 2.6A

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1. Steam Heating System: Basic Control Strategy

The AD 2000™ monitors outside temperature and the inside temperature of up to 15 room sensors. If the outdoor temperature is below set point (adjustable) and the weighted average of the room temperature is lower than set point, the heating system will be activated. On a rise in room and/or outdoor temperature the system will be de-activated.

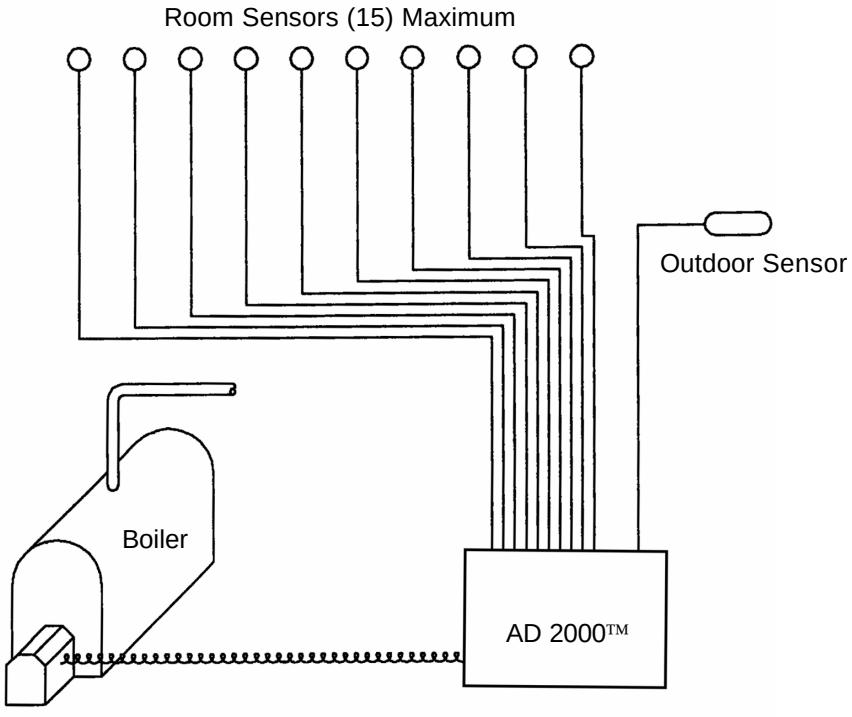
The weighted building average temperature is determined by the following conditions:

- Room sensors must read within the adjustable Hi/Lo exclude settings
- Lowest and Highest reading sensors are only given 1/2 value in determining average
- The average of the room sensors is then calculated

Example: With the Lo Exclude setting at 55 F. and the Hi Exclude setting at 85 F.

	Location	***Temp.***	***Result***	***Weighting***
Sensor 1	Apartment: #110	68 F.	Lowest Reading	50%
Sensor 2	Apartment: #212	55 F.	Lo Exclude	0%
Sensor 3	Apartment: #324	75 F.	Highest Reading	50%
Sensor 4	Apartment: #417	72 F.	OK	100%
Sensor 5	Apartment: #584	74 F.	OK	100%
Sensor 6	Apartment: #662	89 F.	Hi Exclude	0%

In the above example, the weighted average temperature for the building is 72.5 F.

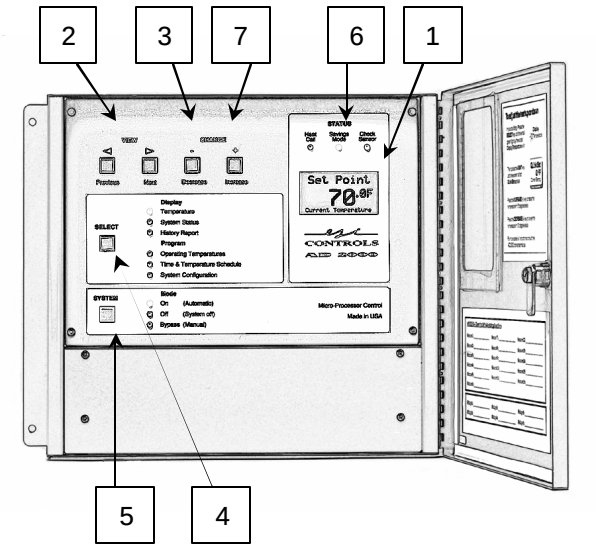


Note: Should a room sensor or wire become damaged, it will automatically be excluded from the averaging calculation. The red "Check Sensor" LED will light on the front panel and an error message will be displayed when reading the value of the damaged room sensor.

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, relays energized (Closed).

Savings Mode (green): Weighted average exceeds set point and/or outdoor cutoff exceeded, relays de-energized (Open).

Check Sensor (red): A sensor or wiring is damaged, or reads above or below exclude settings.

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 -.** Repeat to unlock settings.

For the highest level of security enable the "All Settings Locked" Mode. Once "All Settings Locked" Mode is activated, the Select Key no longer cycles 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 Room Sensors:
Selects the number of room sensors to be wired into the control. The weighted average reading of all room sensors installed will determine temperature.

- Adjustment Range: 1 to 15 room sensors
- Default Setting: 4

• Number of Boiler Stages:
Selects the number of boilers (heat stages) to be wired into the control.

- Adjustment Range: 1 or 2
- Default Setting: 1

• Min Boiler On Time: (Min Stage 1 On Time)
The Minimum On Time setting is used to reduce boiler short cycling.

- Adjustment Range: 0 to 60 Minutes
- Default Setting: 3 Minutes

• Min Stage 2 On Time: (viewable only when 2 boiler stages are selected)
The Minimum On Time setting for Stage 2 is also used to reduce boiler short-cycling.

- Adjustment Range: 0 to 60 Minutes
- Default Setting: 3 Minutes

• Stage 2 Turn On Delay: (viewable only when 2 boiler stages are selected)
The Delay for Stage 2 prevents the second heat stage (boiler) from starting for an adjustable time following Stage 1 activation.

- Adjustment Range: 0 to 60 Minutes
- Default Setting: 10 Minutes

• Pump Turn Off Delay:
Selects a period of time, in ten-minute increments, after the heat source is deactivated which allows for condensate to return to the boiler. Following this period, the pump will be shut off.

- Adjustment Range: 10 to 360 minutes
- Default Setting: 60 minutes

• 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 Time/Temperature Schedule 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. Once the initial settings have been entered they 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 Room Temperature:

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

- Adjustment Range: 40 to 90 Degrees
- Default Setting: 76 Degrees

• Min Room Temperature:

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

- Adjustment range: 40 to 90 Degrees
- Default Setting: 65 Degrees

• Room Differential:

This adjustment sets how much the actual average room temperature may deviate from the desired setpoint temperature before the heat source is turned on or off. Used to reduce short cycling and establish heat in furthest apartments.

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

• Stage 2 Differential: (viewable only when 2 boiler stages are selected)

This adjustment sets how much the average room temperature is allowed to drop below Room Differential (set above) before 2nd Heat Stage is activated.

- Adjustment Range: 0 to 10 Degrees
- Default Setting: 2 Degree

• Outdoor Cutoff: Stage 1

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: 40 to 75 Degrees
- Default Setting: 60 Degrees

• Outdoor Cutoff Stage 2: (viewable only when 2 boiler stages are selected)

Selects the outdoor temperature where Stage 2 boiler operation ceases. This feature provides considerable savings during spring and fall months when day and night temperatures fluctuate widely.

- Adjustment Range: 0 to 75 Degrees
- Default Setting: 60 Degrees

• Room Sensor Hi-Exclude:

Hi-Exclude will temporarily remove an offensive sensor from the averaging calculation if it exceeds the Hi-Exclude setting. Example: A tenant may attempt to heat their apartment with an external space heater or stove. This would send a false overheating signal to the control.

- Adjustment Range: 65 to 95 Degrees
- Default Setting: 85 Degrees

• Room Sensor Lo-Exclude:

As above, should a sensor drop below Lo-Exclude setting it will be removed from the averaging calculation. Example: A tenant may wish to open a window to "air out" their apartment.

- Adjustment Range: 50 to 70 Degrees
- Default Setting: 55 Degrees

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 13. 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. Enable/disable daylight savings time.

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
72.0 F

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
71.0 F

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: 40 to 85 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 December 31, 2004 which falls on a Frirday.

Display:	Minute	Hour	Date	Month	Year	Day	Daylight Savings
Enter:	22	4 PM	31	12	04	Fr	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	Room Average Temp
" "	Set Point Temperature
" "	Quick Set (If Included In System Configuration)
" "	Outside Temperature
" "	Current Temperature: Room One
" "	Current Temperature: Room Two
" "	Current Temperature: Room Three
" "	" " Repeat up to the number of sensors installed
" "	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 60 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
- Boiler One: ON
- Pump: ON
- Heat Call
- Outdoor Below Cutoff

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
- Degree-Days Last 7 days Vs Previous 7 days
- Heater on Last 7 days Vs Previous 7 days
- 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.

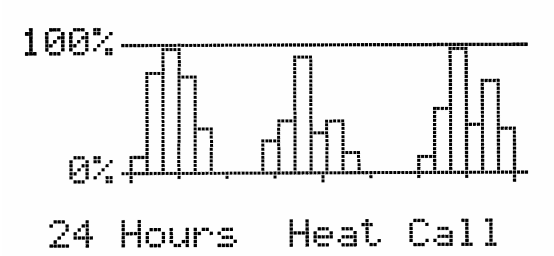
When the first screen "Chart Displays" appears, pressing the NEXT Key is followed by:

Example:

Press Next Key		24-hr graph:	Heat Call Detail
"	"	24-hr graph:	Room Average Temperature
"	"	24-hr graph:	Outside Temperature
"	"	24-hr graph:	Room One
"	"	24-hr graph:	Room Two
"	"	24-hr graph:	Room Three
"	"	24-hr graph:	Repeat up to the number of sensors installed

Heat Call Charts

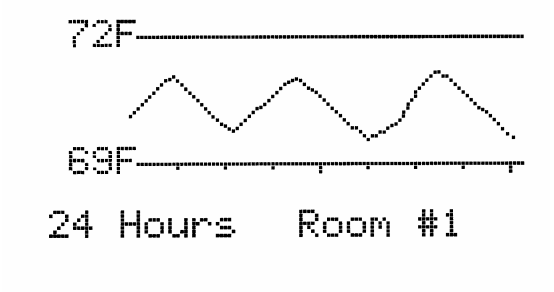
The Heat Call chart is divided into 24 sections (bars). Each section represents an hour of time. A bar that extends to the top of the chart (100%) indicates that the AD 2000™ had called for heat the entire 1-hour period. A bar that extends only half way (50%) indicates a heat call time of 30 minutes.



Note: The Heat Call bars indicate that the AD 2000™ is calling for heat - it is possible that your boiler may cycle off and back on again due to pressure, or the activation of other safety and/or limit control.

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.



9. A Few Words of Advice

Thanks for purchasing the AD 2000™ control. We designed the system with the customer in mind.

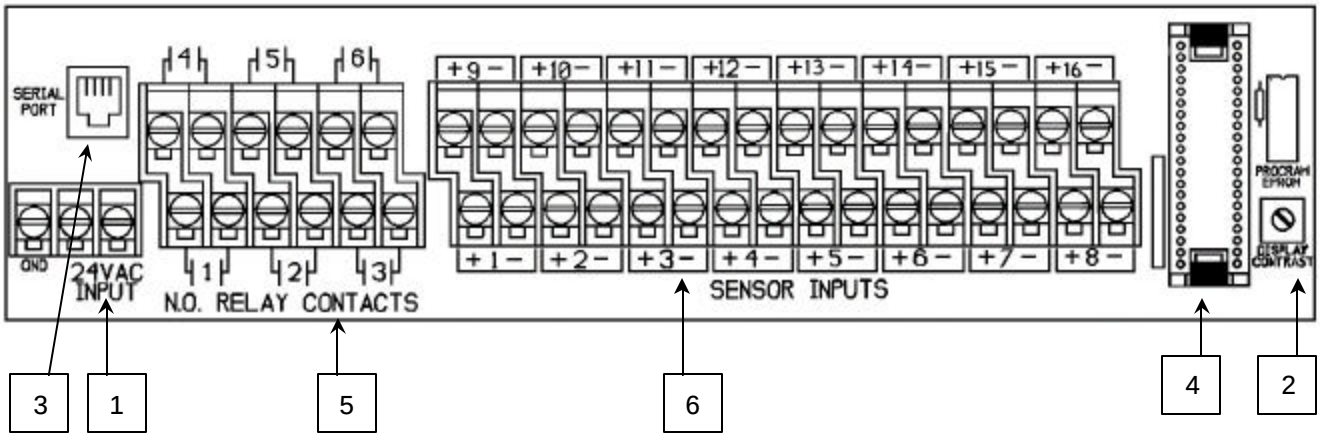
Real time temperature information from various locations within the building will assist any attempts to balance the steam system.

Be sure to balance the system carefully with correctly sized vents or traps for both maximum comfort and energy savings.

Periodic maintenance including a weekly boiler blow down should be performed.

Notes:

10. Terminal Block Wiring Diagram



Notes: Multi-Sensor Steam Application – EPROM V2.6A

1. 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.

2. 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.

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

4. Program EPROM
The Program EPROM contains the code which instructs the AD 2000™ how to run your system. This EPROM may be upgraded as improvements are made. Note the version of the EPROM in your AD 2000™ system when requesting the latest version.

5. Wiring Control Relay Outputs: DO NOT EXCEED 24Vac

N.O. Relay Contacts #1 and #2	Boiler (heat stage) 1	Relays 1 and 2 switch at the same time
N.O. Relay Contacts #3 and #4	Boiler (heat stage) 2	Relays 3 and 4 switch at the same time
N.O. Relay Contacts #5 and #6	Pump	Relays 5 and 6 switch at the same time

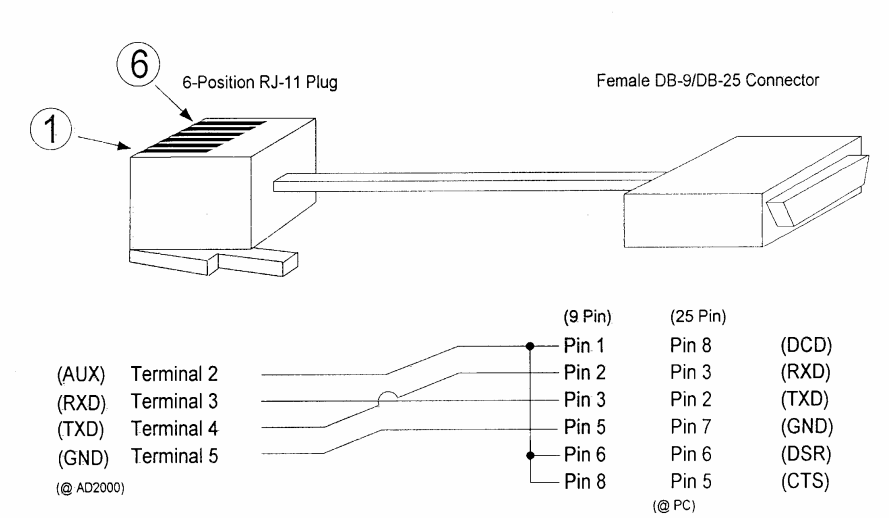
IMPORTANT: Wire the AD 2000™ in series with existing safety and/or operating controls. Do not use the AD 2000™ to substitute any safety or limit control.

6. Wiring Sensor Inputs:

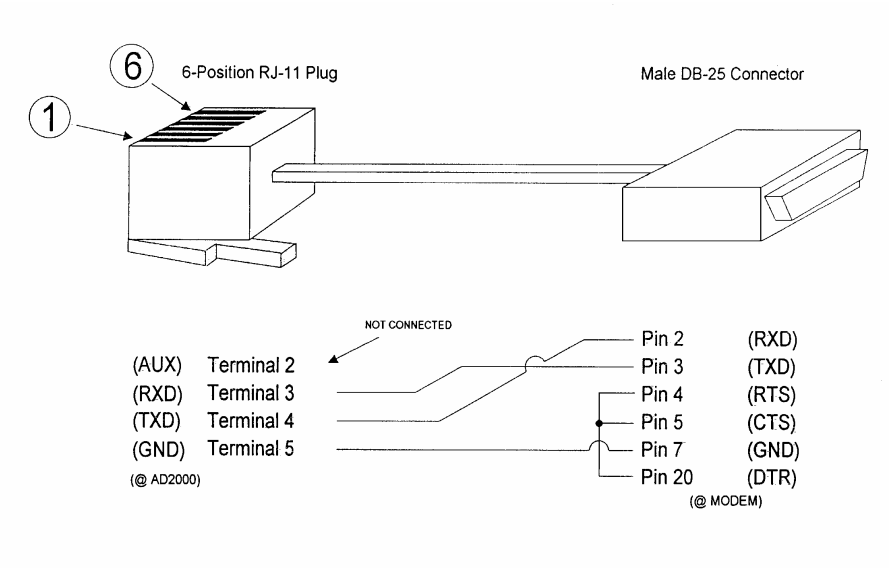
Sensor Input #1 through #15	Room Sensors #1 through #15	Non-Polarized inputs
Sensor Input #16	Outdoor Temperature Sensor	Non-Polarized input

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.

Wiring Diagram: AD 2000™ to PC Direct



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 4. At any time you may also restore the default values listed below using the "Load Default Values" also described on page 6.

Day	Time	Temperature
Monday-Friday	12:00am – 04:00am	70 degrees
Monday-Friday	04:00am – 05:00am	71 degrees
Monday-Friday	05:00am – 06:00am	72 degrees
Monday-Friday	06:00am – 10:00am	73 degrees
Monday-Friday	10:00am – 11:00am	72 degrees
Monday-Friday	11:00am – 12:00pm	71 degrees
Monday-Friday	12:00pm – 03:00pm	70 degrees
Monday-Friday	03:00pm – 04:00pm	71 degrees
Monday-Friday	04:00pm – 05:00pm	72 degrees
Monday-Friday	05:00pm – 11:00pm	73 degrees
Monday-Friday	11:00pm – 12:00am	72 degrees

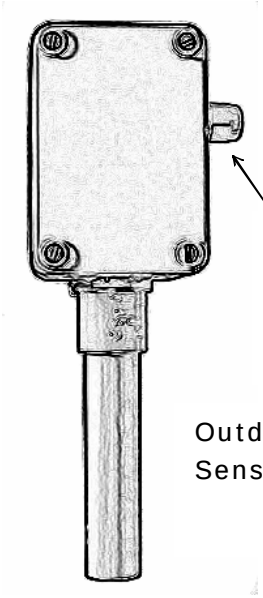
Day	Time	Temperature
Saturday – Sunday	12:00am – 01:00am	72 degrees
Saturday – Sunday	01:00am – 05:00am	71 degrees
Saturday – Sunday	05:00am – 06:00am	72 degrees
Saturday – Sunday	06:00am – 01:00pm	73 degrees
Saturday – Sunday	01:00pm – 05:00pm	72 degrees
Saturday – Sunday	05:00pm – 12:00am	73 degrees

Helpful Tips:

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

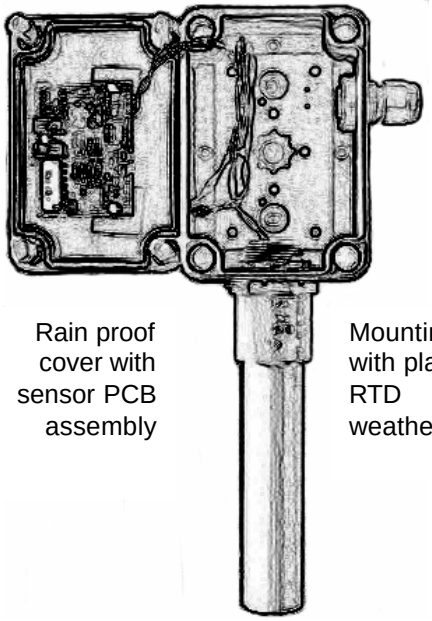
Use the Time/Temperature Schedule mode to make changes to specific times and/or days.

13. Sensor Installation



Strain relief: tighten after inserting wiring

Outdoor Sensor



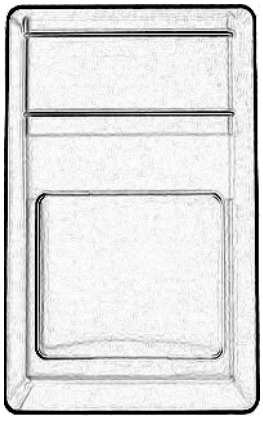
Rain proof cover with sensor PCB assembly

Mounting base with platinum RTD weatherhead

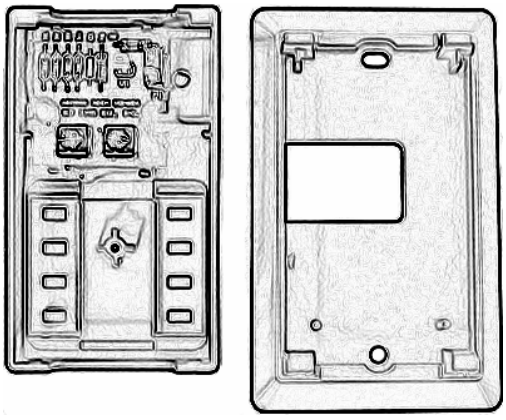
Outdoor Sensor

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



Sensor cover with PCB assembly

Room Sensor mounting base

Room Sensor

Locate the room sensor on an interior wall 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
Note: Relay contacts will close when power is removed from AD 2000™

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-N-8-1 baud communications

Power Requirements
24Vac @ 20 or 40VA

Battery backup
Lithium – 10 year