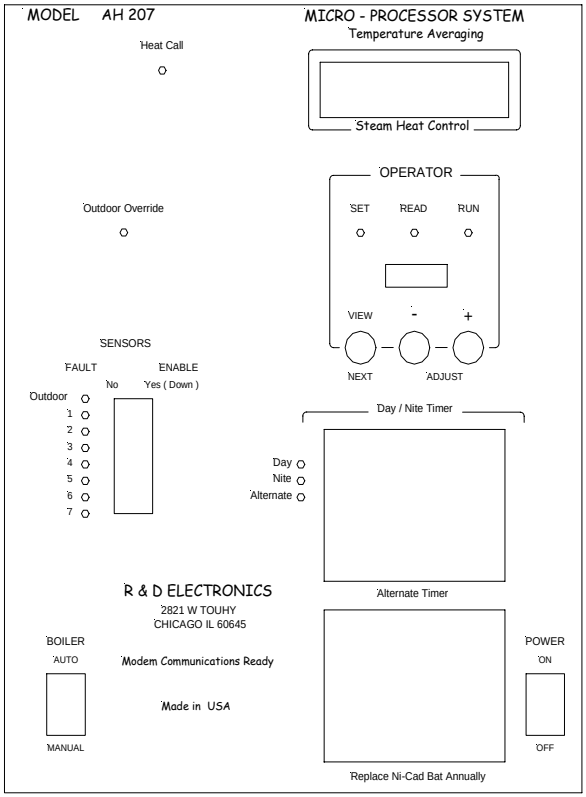



**-- OWNERS MANUAL -- Model RF207, 207M -- Temperature Averaging Steam Heating Control with wireless remote sensors.**

*The R&D Electronics model RF207 offers the latest in spread spectrum frequency hopping technology for controlling commercial and multifamily steam heated buildings. Remote room temperaturesensors are powered by lithium batteries with a life expectancy of three or more years.*

The R&D Electronics Model RF207 consists of a main panel with a 32 character LCD display, up to 7 wireless remote indoor sensors *(up to 3 sensors may be hard wired along with 4 wireless sensors)*, and an outdoor override sensor. The panel has 19 LED's which indicate the status of all the important ON/OFF conditions. The display is operated by a three position SET, READ, and RUN switch which separates the three main user menus for easy operation. Three key switches are used to read, select and modify settings. The *next* key will scroll through the menu lists. The *increase* and *decrease* keys will change setpoint values. Pressing both the increase and decrease keys together will display the hidden system configuration menu.

A built-in time clock mounted on the front panel programs the Day/Night setpoint schedule. The second or alternate time clock can be programmed either as an evening or morning boost, or a mid-day setback. When the alternate time clock is ON, the alternate clock schedule overrides the Day/Night schedule, activating a third temperature setpoint. If the average building temperature falls below the building setpoint shown in the RUN menu, two heat call circuits will close. After steam builds, and the average temperature of the building rises the amount of the SET menu temperature rise, the heat call circuit will open. The Outdoor Override setting (typically 55 F.) programs the warm weather shutdown. A hardware option ("M" version) is available to additionally control (1) two additional boilers, one of which can be a lead lag boiler, (2) a vacuum pump and (3) a combustion air damper.

The setpoint can be programmed to gradually increase (weather anticipation) as outdoor temperature decreases. At 70 F. outdoors, the building setpoint is equal to the programmed value in the SET menu. For example, a weather anticipation setting of 1.5 F., will increase the setpoint

by .75 F. at 30 deg. F. outdoors, and by 1.5 deg. F at at -10 deg. F. outdoors. Mini rocker switches can disable a sensor from being included in the building average temperature. An open or shorted sensor wire or a non-transmitting RF sensor is automatically considered out of range and excluded from the average building temperature. Individual sensor fault LED's indicate which sensors are excluded from the average.

A manual bypass switch located on the front panel will allow operation of the boiler from an external back-up device in the unlikely event of a control failure.

## OPERATOR ADJUSTMENT MENU

**SET**

*1 DAY TEMPERATURE SETPOINT: {72}*

The RF207 will set the average building temperature, although the maximum or minimum worst case room temperatures may vary greatly. Usually, the average day temperature must be set between 70 and 75 degrees to assure that all building locations will receive sufficient heat. The more closely a building is balanced, the lower you may set the average day temperature. Keep in mind that air infiltration may cause floors to be 2-4 degrees colder than temperatures measured 5 feet above the floor where the heat sensors should bed mounted.

*2 NIGHT TEMPERATURE SETPOINT: {68}*

The amount of night setback is a compromise between fuel savings, and comfort. During an 8 hour night setback period, a setback of 3 and 7 degrees will save nearly as much fuel as a 10 degree setback, and cause less discomfort.

*3 ALTERNATE TEMPERATURE SETPOINT: {70 to 74}*

The two most common schedules are a Monday thru Friday setback from 9AM to 3PM, or a 7-day boost from 4PM to 9PM.

*4 OUTDOOR CUTOFF: {55}*

50 F. to 60 F. works well in most buildings. Also known as Warm Weather Shutdown.

*5 HEATING CYCLE LENGTH: {1.0}*

A typical setting is 1.0 deg. F. To determine the most efficient T Rise setting, you will need to experiment. If your setting is too low, short cycling will result. The boiler will turn off too soon, leaving radiators at the far end of the building less than full of steam. If your setting is too high, an unnecessary temperature overshoot will result, and there will be excessive time delays between heating cycles.

*6 COLD WEATHER BOOST: {1.5}*

The cold weather boost will proportionally increase the building setpoint a small amount as outdoor temperature decreases. At 70 deg. F. outdoors, the building setpoint is equal to the day temperature setpoint. As outdoor temperature decreases and reaches 30F., the building setpoint will increase .75 deg. F., and at –10 deg. F. outdoors the setpoint will increase 1.5 deg. F.

Buildings which loose heat fast will be more comfortable with a higher Cold Weather Boost setpoint than buildings which are well insulated and more air tight.

*PANEL MINI ROCKER SWITCHES:*
Selects the room sensors that are to be included in the average building temperature calculation.

**READ**

Place the OPERATOR slide switch in READ. Press VIEW NEXT. The READ menu will display the 8 room zone sensors and the outdoor temperature.

**RUN**

**The RUN menu displays all the important operating conditions for the computer**. **(1)** the average building temperature, **(2)** the calculated building setpoint determined by the present time schedule and outdoor temperature, **(3)** Output relay "ON" status and setback timer schedule, **(4)** indicates which RF sensors are in low battery condition (see also field service section on low battery indicator), **(5-7)** boiler runtime history for the last 2 days and the 14 day average, **(8)** zone data logging for 2 hrs. in six 20 minute intervals, **(9-D)** zone data logging for 12 hrs. in six 2 hr. intervals for a total of 48 hrs. Data logs read oldest first (upper left) and most recent last (lower right) (Also see SYSTEM: Line 3), **(E)** sensor digital addresses for registered RF sensors 1 thru 4, **(F)** RF sensor digital addresses 5 thru 8, (**G)** Transmit Test Counts Zone 1-8. During a period of 2.66 days, the computer counts the number of missed signal receptions for each sensor. The eight digit is the running count. "A" is equivalent to "10" counts while "F" is equivalent to the maximum count or hexadecimal "16". At any given moment during the 2.66 day refresh period, *a weaker sensor will display a higher test count than test counts recorded for the stronger sensors.* To remove a sensor from the test count it is necessary to go through the procedure for removing the sensor from system ID registration (see setup menu item 7).

**SYSTEM SETUP**

**SYSTEM:** -- INITIAL SETUP: Set operator switch to RUN, then <u>press the + plus and - minus keys together</u>:

| | | |
|---|---|---|
| *1* | *SENSOR LIMIT + Max Span:* | *{15}* |
| *2* | *SENSOR LIMIT - Min Span:* | *{15}* |

Sensors are excluded from the average when reading above the maximum or below the minimum span limits. The active day, night or alternate setpoint is the center reference point. It is normal for sensors to switch in or out of the average at the moment in time when the day/night or alternate timer period changes. If this is a concern, than it will be necessary to increase the sensor spam limit.

Cooking stoves can be a problem in studio or small one bedroom apartments. If the day setpoint temperature were 72 deg. F. and the sensor Max Span were only 10 deg. F., an apartment reading 87 deg. F. will be removed from the average. The average temperature reading will drop

causing the boiler to run even more. A second or third apartment may be removed from the average as the building continues to overheat. To avoid this situation, do not set the sensor max span much below 15 deg. F.

If the day setpoint temperature were 72 deg. F. and the sensor Minimum Span were 10 deg. F., a sensor reading 62 deg. F. would be removed from the average. To avoid under heating the building do not set the sensor Minimum Span much below 10 deg. F.

*3 DISPLAY DATA LOGGING AND RF SENSOR ID ADDRESSES {8}*

Selects the number of data screens that will appear in the RUN menu list. Items 1 thru 8 allows viewing the 48 hours of indoor temperature data, items 9 thru 12 allows viewing of RF sensor digital addresses useful for troubleshooting RF sensor registration and sensor signal strengths.

*4 ZONE LOG APT. # ZONE 1-7 {1}*

Selects the zone which will be used for data logging. The computer records zone temperature reading every 30 seconds, and will calculate the average of 40 readings over a 20 minute period, or 240 readings over a 2 hour period. In the RUN menu. Data Screen Six shows 6 temperature readings starting from top left to bottom right . The top left reading was the temperature 2 hrs. ago., and the bottom right reading was the temperature twenty minutes ago. Data Screen Seven shows 6 temperature readings beginning 12 hrs. ago, and ending 2 hrs. ago. Data Screen Eight shows 6 temperature readings beginning 24 hrs back and ending 14 hrs back, etc.

*5 VACUUM PUMP LEAD -- applies to RF207M only {.5}*

The vacuum pump relay closes on temperature fall before the boiler relay closes. The amount of the lead differential for the vacuum pump is adjustable in deg. F.

*6 VACUUM PUMP OFF DELAY -- applies to RF207M only {:30}*

The vacuum pump remains ON after the main or lead boiler turns OFF for the above time delay, measured in minutes.

*7 BEGIN REGISTER SENSORS {NO}*

RF sensors may be permanently added or removed from the system at any time. The procedure requires this screen to be set to YES. The RF sensors are registered by setting the READ menu to the desired zone number. Select the RF sensor to be registered. Press the reset button beneath the plastic sensor cover and wait for the LED on the sensor PC board to finish flashing. The sensor reading will appear within the control display. To disable or remove a sensor from the register, in the READ menu select the zone to be cleared and press the + and - keys simultaneously.
**IMPORTANT:** ***Return to RUN menu 7 and select begin registration "NO".***

*8 UNIT / ZONE PASS CODE {321}*

First make a dial up connection through a modem. Enter "P" followed by this adjustable code number to gain access to the heating control.

9 *REFRESH RATE – HOURS* *{4.0}*

In order to conserve battery life, the wireless sensors transmit multiple signals only when there is a 2 deg. F. change in room temperature. A single supervisory transmission is made every 15 minutes to let the receiver know that a sensor is still operational, even though room temperatures have remain constant. The single supervisory signal can easily be missed by the receiver unless the refresh rate is sufficiently long. Too short a refresh rate could result in unnecessarily removing sensors from operation leading to data loss.

A STAGE 2 EARLY SHUTDOWN {50%}

Two boilers can be configured to turn on simultaneously while lag boiler turns off part way through the heating cycle temperature rise. Similarly a lo/hi/lo burner can be configured to allow the burner to return to lo fire part way through the heating cycle. See application drawings

**Restoring Factory Default Operator Settings:** To Reset the SET and SYSTEM user variables to factory default settings: (1) turn Power switch OFF, (2) hold the NEXT key while turning the Power back ON.

**Manual Bypass:** Turn POWER switch OFF. Place BOILER switch in MANUAL to activate a single boiler. To activate combustion air, vacuum pump or additional boilers, open control door and select toggles switches sw2 thru sw5 on terminal board to UP.

**Notes on 48 hr. data logging:** The six displayed numbers are the averaged readings over the measurement period. The actual room temperatures during the measurement period could be +/- 3 degrees above or below the average temperature over the measurement period. You may calibrate the time scale by resetting control power *before* collecting the data 48 hrs. later. Special data collection sheets from R&D Electronics are available.

## SETBACK TIMER

"ON" corresponds to DAY and "OFF" to night. The timer can accommodate 16 on/off periods while only *two* are suggested for (P1) Day/Night and *one* for (P2) Alternate. Only one on/off group schedule for (MO thru FR) and one for (SA, SU) are needed. A third schedule is sometimes used to extend the Friday DAY schedule. The (P2) Alternate time period will override the Day/Night schedule. NOTE: More Detailed timer programming procedure is affixed to the control enclosure.

The backup battery is fully charge in 24-48 Hrs. and will maintain the setback timer for 4 mo. without power. The battery does not charge when the power switch is left OFF. Replace 1.5V Ni-Cad or NiMeH battery after 5 years.

**FIELD SERVICING AND INSTALLATION** If the 3AG 1A fuse on the terminal board is bad, you may try replacing it. On rare occasions, there may be a fault on the terminal board. It is easiest to replace the main panel with a known good panel before attempting to determine whether the terminal board is defective. You may order field replacements for either board.

**Suggested spare parts for qualified serviceman:** 1) One receiver, one receiver to control cable and one receiver transformer. 2) One wireless sensor. 3) One Maxim 3110 UART IC to reduce troubleshooting effort. 4) One control panel with 26 pin grey connector. 5) One complete back board if you do not have a Maxim 3110 UART IC. 6) Digital volt meter. SERVICE PARTS KITS ARE AVAILABLE FROM R&D ELECTRONICS.

**RF remote sensors:** 1) The 6 Vdc CR123A lithium batteries should be replaced every 3 to 5 years. 2) RUN menu four will warn of an impending battery failure. If a low battery warring is ignored and a sensor completely stops transmitting and by chance there is a momentary interruption of control power, the low battery indication data will be lost. In other words, it still may be necessary to retrieve sensors for battery testing. 3) Inside each sensor is a micro switch which can be used to force a transmission. The micro switch is also used to register sensor ID's. 4) Breathing on a sensor to increase its reading 2 deg. F. can also initiate a transmission.

Note 1: The wireless sensors cannot be tested for calibration in the field. Sensors must be returned to the factory where a perfectly constant temperature environment for over 4 hours can be simulated. When there is little or no change in room temperature, the sensors do not transmit frequently enough to be certain that the most current update has been transmitted to the control.

Note 2: Sensor fault lights are ON whenever sensors are outside the range limits determined in the Advanced Setup menu. Sensor limits are "sliding" and will change along with the program schedule and and when the operator changes the day, night and alternate setpoints.

**RF receiver:** NEVER MOUNT THE RECEIVER DIRECTLY TO BRICK or MASONRY. Wood is recommended for better serviceability and reliability. Receiver power is supplied by a 10 Vdc. 400 ma. transformer. There are no user serviceable parts or setup requirements for the receiver.

**System Troubleshooting:** 1) After power up if the 32 character display is blank, replace panel. If the status LED's are not functioning but the display operates at power up, *or in order to save time* try temporarily removing the Maxim 3110 UART IC from the control back board. If the panel is still not functioning, it will have to be replaced. 2) Remove receiver cover. If no LED's are flashing due to normal RF noise level, check 10 Vdc transformer power across Pwr and Gnd terminals. Press receiver test micro switch or press the test switch on a spare room sensor. The valid decode LED's on the receiver PC board should flash. 3) Try replacing the complete 9 pin RS-232 to modular cable between the receiver and heat control back board, otherwise replace receiver. 4) If the receiver and interconnect cable are apparently good, try replacing the control back board *or in order to save time*, replace the 24 pin Maxim 3110 UART IC on the rear board. 5) Replace control panel.

**Outdoor Sensor:** Outdoor sensor must not be mounted in direct sunlight, usually this means it must be mouted on the north side of the building. **1**. Place 3 1/2 digit DVM (-) at **TS1** terminal 2 [outdoor sensor (-)], and DVM (+) at **TS1** terminal 3 [analog sensor S1 (+)]. Verify that dvm reads 13 Vdc, or replace front panel. **2**. Move DVM (+) to **TS1** terminal 1 [outdoor sensor (+)] and measure the outdoor sensor voltage, then look up the corresponding temperature on the chart in Table 1. Verify that the outdoor sensor is not in direct sun light. Replace the sensor if the DVM reading does not correspond with the outdoor temperature. Replace panel if outdoor temp. reading on control is not within +/- 2 F. of the measured value.

**Table 1 -- OUTDOOR SENSOR -- voltage to temperature conversion**

| | | | |
|---|---|---|---|
| -20 F = 2.44 V | 10 F = 2.61 V | 50 F = 2.83 V | 80 F = 3.00 V |
| 10 F = 2.49 | 20 F = 2.66 V | 60 F = 2.89 V | 90 F = 3.05 V |
| 0 F = 2.55 V | 30 F = 2.72 V | 70 F = 2.95 V | 100 F = 3.10 V |

**Analog Room Sensors:** Sensors 1 thru 3 may be hard wired to the wiring board, or wireless. If hard wired sensors are installed, begin registering the wireless sensors at room sensor zone 4. If a sensor warning light is on, you will need to know if the hard wired sensor is open, shorted, or whether the sensor is actually defective. The sensors are extremely reliable, and wiring defects occur 50 times more frequently than defective sensors.

1. Sometimes a **(+)** lead sensor wire will short to ground elsewhere in the building. If there is an additional system short to conduit ground, it will be necessary to trace both shorts before reconnecting the defective sensor line. Two shorts in your system can result in the "grounding" of the +13Vdc. Isolate each sensor from the terminal board one at a time to locate the second short.

2. *Test the microprocessor analog inputs:* Connect the DVM **(-)** lead to the outdoor sensor **(-)** terminal or common. Connect the DVM **(+)** lead to the zone sensor **(-)** terminal under test. The voltage at the **(-)** terminal should be directly proportional to **Table 2**, the room sensor temperature chart. The sensors should read between 2.1 and 3.1 volts ( 60 to 85 F). The display should read the correct temperature.

3. *Testing for reversed sensor polarity and shorted lines:* If in step 1 the DVM reads 12 to 13 Vdc, then the sensor wiring is either shorted, or the sensor polarity is reversed. Try disconnecting the sensor and reversing the wiring polarity.

4. *Testing for an open line:* If in step 1 the DVM reads 0, then the line is either open, or the sensor is defective. Try disconnecting the sensor and using your DVM in the Ohms position to read the resistance of the line and the sensor. For most DVM's, the resistance of a sensor will be between 1 and 10 Meg. Ohms. If you can read the resistance correctly, then the wire is probably OK, and the sensor itself is defective. Otherwise, you may have to go to the apartment and measure the voltage across the sensor. If you measure +13Vdc without the sensor connected, then the line is good. A good sensor will read approx. 13Vdc - 2.5Vdc or 10.5Vdc across the terminals.

5. If the results above indicate a shorted line, then either replace the entire line, or cut the line in half, then half again, etc. to determine where the short is located. Most often, it will caused by a staple through a wire or the wire may have been cut at floor level.

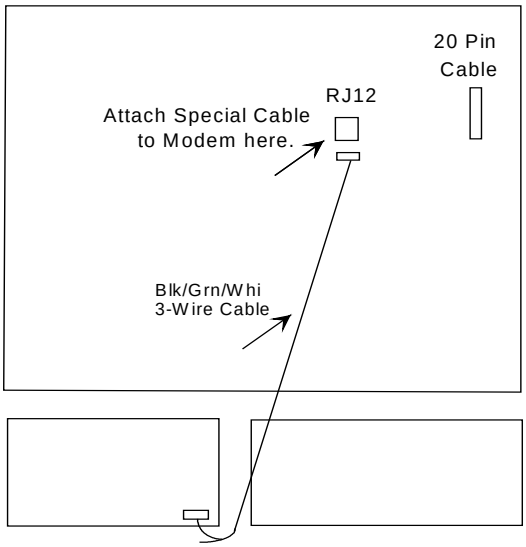
**TABLE 2 – ANALOG ROOM SENSOR VOLTAGE TO TEMPERATURE CONVERSION**

| SENSOR | | SENSOR | | SENSOR | | SENSOR | | SENSOR | |
|---|---|---|---|---|---|---|---|---|---|
| Vdc. | DEG.F. | Vdc. | DEG.F. | Vdc. | DEG. F. | Vdc. | DEG. F | Vdc. | DEG. F. |
| 2.10 | 60 | 2.34 | 66 | 2.58 | 72 | 2.82 | 78 | 3.06 | 84 |
| 2.14 | 61 | 2.38 | 67 | 2.62 | 73 | 2.86 | 79 | 3.10 | 85 |
| 2.18 | 62 | 2.42 | 68 | 2.66 | 74 | 2.90 | 80 | | |
| 2.22 | 63 | 2.46 | 69 | 2.70 | 75 | 2.94 | 81 | | |
| 2.26 | 64 | 2.50 | 70 | 2.74 | 76 | 2.98 | 82 | | |
| 2.30 | 65 | 2.54 | 71 | 2.78 | 77 | 3.02 | 83 | | |

**MODEM OPERATION**

A communications program such as Microsoft HyperTerminal is necessary. Use the special cable provided from the 25 pin RS232 modem port to the 6 pin modular jack on the RF207. (1) Setup a HyperTerminal dial-up connection. Data sent over to the 32 character LCD will also be sent to the modem. (2) Set Modem Baud Rate to 9600 N, 8, 1 . Type "P" followed by the 3 digit pass code (see setup menu) to gain access. All control functions are available through the modem except programming the timer and excluding individual sensors from the average. (3) Computer keyboard emulates the RF207 front panel switches as follows:

| | | | | | |
|---|---|---|---|---|---|
| 1 | = SET | 4 | = SYSTEM | ENTER | = NEXT |
| 2 | = READ | | | (+) | = INCREASE |
| 3 | = RUN | | | (-) | = DECREASE |




**-- MODEM CONNECTIONS –**

**-- front panel rear view --**

Note:
(1) Blk, Whi and Grn connection from processor brd. to main brd.

(2) RJ12 connection to modem on back of panel. The wireless receiver connects to the terminal board, not at the back of the front panel.

## Model RF207M – multiple boiler and vacuum pump wiring

(RY3) is used only to turn on a vacuum pump which should precede a heat call. The pump lead time is adjust by changing the pump temperature differential within the setup menu. A vacuum pump will run an adjustable time period after the boilers turn off.

(RY4) is an addition contact closure simultaneous with (RY1) and (RY2).

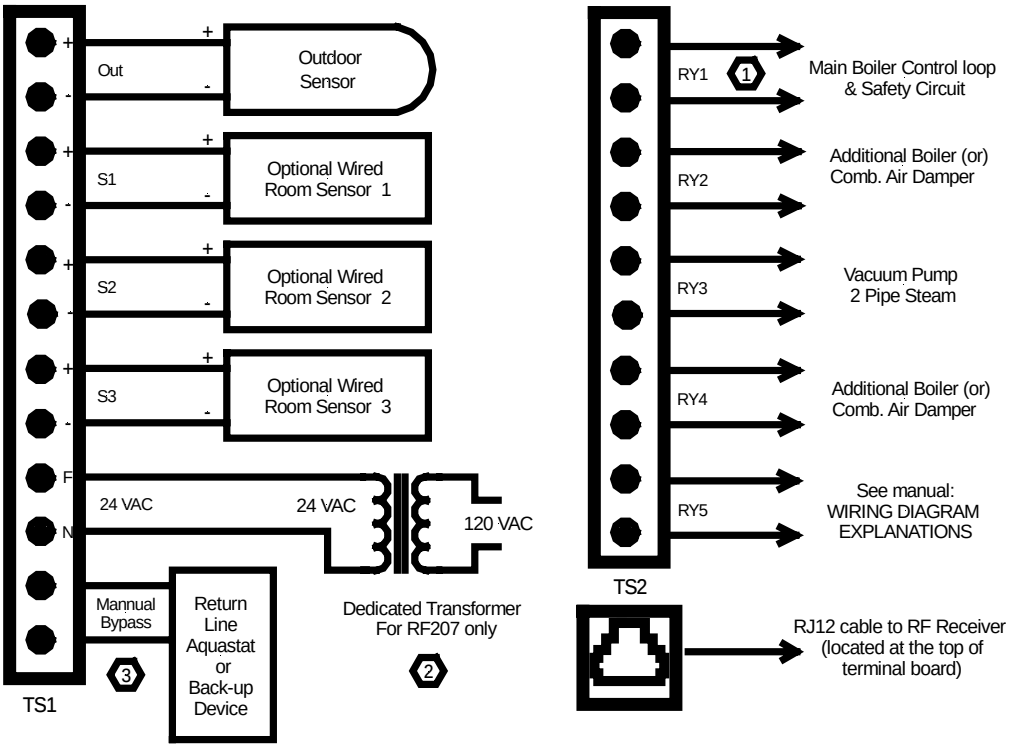
(RY5) operates a lag boiler, turning on simultaneously with (RY1,2,4) but turning OFF part way through the heating cycle temperature rise. The early shutdown percentage is adjustable from 10 to 90% within the advanced setup menu. A lower setting will provide increased fuel saving, but care should be taken to verify that steam has reached the far end of the building before the heat cycle has ended.

## Lead/lag or early shutdown for two boilers vs. a single Lo/Hi/Lo boiler

For two separate boilers and lead lag early shutdown applications, the lag boiler is attached to terminals (RY5). For single lo/hi/lo fire boilers with power burners, either (RY1,2 or 4) may be used to activate lo fire. (RY5), since it opens first is to be connected to the burner hi fire contact. To maintain a minimum boiler water temperature during summer, connect the boiler aquastat in parallel with (RY5) and the burner low fire contacts.

## RF207 WIRING DIAGRAM

ISSUE "A" 09-12-06




1. Dry Contacts, rated 24 vac. No power is supplied by the RF207 to the burner control circuit.
2. Do not power the RF207 with a RELAY TRANSFORMER WHICH ALSO POWERS A GAS VALUE OR A RELAY.
3. Remove jumper when installing a manual bypass control.

Note :

When using shielded sensor wire DO NOT BRING SHIELD INTO HEATING CONTROL, Join the shields together outside the control and connect to electrical conduit ground.