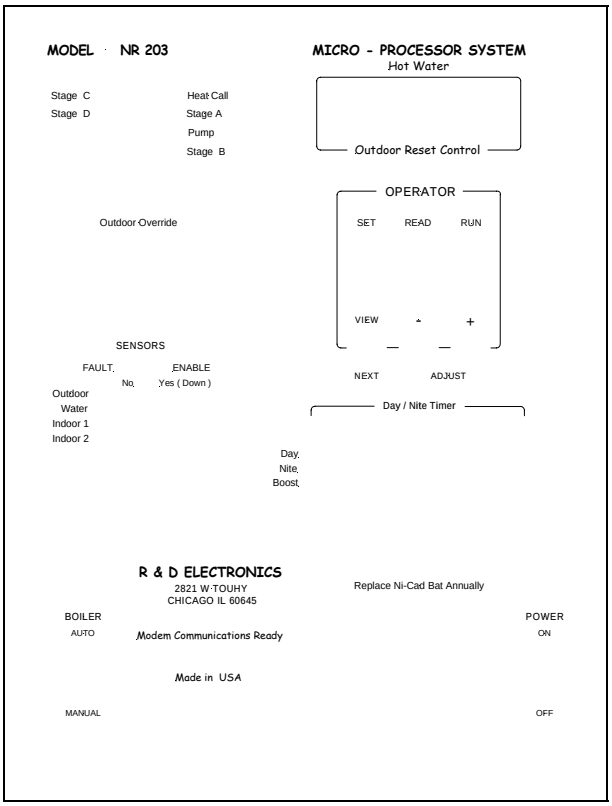
OWNERS MANUAL - NR203 -HW6 - 2 thru 4 Stage Hot Water Boiler Control Learns the Outdoor Reset Curve from Indoor Temperatures -- om_Nr203LrnHw6.doc --



The R&D Electronics Model NR203 consists of a main panel, a boiler water temp. sensor, an outdoor sensor, and up to 4 optional indoor sensors. The main panel has 17 LED's which indicate all important ON/OFF operating conditions, including heat call, pump and air damper, sensor faults, outdoor override, and the present time schedule.

The COMPUTED WATER SETPOINT varies from the operator Initial Temperature setting at +50F. to the Final Temperature at -10F. If the boiler water temperature falls below the computed setpoint by ½ the amount of the differential, ry1 - combustion air, and ry2 - boiler stage A circuits will close. If the boiler water temperature falls an additional lag differential, ry4 - boiler stage B circuit will close. The Outdoor Override setting (typically 55 F.) programs the warm weather shutdown, turning off pump relay ry3. The 4 fault indicating LED's show defective outdoor, water, or room zone sensors.

The amount of night WATER TEMPERATURE SETBACK will proportionally decrease as outdoor temperature decreases. At 50 F. outdoors, the setback is equal to the value shown in the SET menu. At 20 F. outdoors, the setback will have decreased to 1/2 the amount of the SET value. At -10 F. outdoors, the setback equals zero. This patented method of varying night setback eliminates the possibility of tenant discomfort or building freeze-up during cold weather.

At the beginning of the DAY set period (when the setback timer first changes to ON), a MORNING BOOST period begins. For 60 minutes, the water temperature will be increased the amount of the night setback. WARM WEATHER SHUTDOWN (or outdoor cutoff)

prevents the boiler and pump from operating when the outdoor temperature exceeds the programmed value.

Enabling (1) to (4) room sensor mini rocker switches activates the DAYTIME INDOOR TARGET TEMPERATURE FEATURE . The difference between the actual average indoor and the daytime target temperature is multiplied by the adjust rate (system menu #8). The resulting error (displayed in the run menu as *indoor error efffect*) is added over time to the initial and final operator setpoints. As the error decreases over time, so does the amount of each adjustment, correcting the outdoor reset curve to actual indoor temperatures.

Automatic corrections to the initial and final operator setpoints can (within reason) null out the computed indoor error effect. For best results enable learning 3 days in mild and 3 days in cold weather. When no further automatic corrections are needed, disable the room zone sensors using the front panel mini rocker switches. Alternatively, operate all season with indoor temperature compensation actived at the low default rate. Individual sensors are part of the average temperature only when they are within the limits set in the SYSTEM SETUP menu. Locate learning sensors where there are no zone thermostats controlling zone valves, or it will be necessary to override the thermostats.

Adjustments to outdoor temperature are made every 15 minutes and added to the computed setpoint. The calculated amount of the outdoor temperature and wind correction is displayed in the run menu as the WEATHER CHANGE EFFECT. The weather change effect decreases towards zero as outdoor temperature becomes stable.

DESIGN HIGHLIGHTS

* Motorola MC68HC11 operates in single chip mode. Internal ram, rom, and eeprom.
* Modem operation from any PC with standard communications software.
* Auto self adjustment of warm and cold weather outdoor reset curve.
* Water temperature setpoint will rapidly increase or decrease when weather changes.
* Operator setpoints are retained in eeprom (permanent memory).
* Patented night setback proportioned to outdoor temperature.
* Morning Boost automatically compensates for night setback regardless of the amount.
* Includes (1) one outdoor, (1) strap-on water sensor. Optional: (2) room zone sensors.
* Warm Weather Shutdown.
* Controls a combustion air damper and circulating pump.
* 32 Character backlight LCD Display.
* Monitors actual building temperatures in up to four room zones.
* Temperature data logging for 48 hrs. Select either room zone sensor.
* Auto and Manual Boiler Rotation; Daily.
* All sensor have fault protection circuits and LED indicators.
* Setback Timer weekday/weekend programmable with battery back-up.
* Minimum boiler setpoint when condensation is a problem.
* Manual bypass for all relay outputs.

* Two-second delay between firing of successive boiler stages.
* Plug-in panel for quick service without disturbing the field wiring.
* 16 Gauge steel enclosure with means for a padlock

OPERATOR ADJUSTMENT

SET

Place OPERATOR switch in SET. Press VIEW NEXT. Press + or - to change.

1 INITIAL TEMP. -- @ 50 F. Outdoors {80}

For most hot water heating systems, the INITIAL temperature will be set between 80 and 100 F. An increase in INITIAL temperature will not, contrary most other systems, increase the computed water temperature setpoint at the final temperature (-10F. outdoors). In this product, the initial temperature is not a parallel shift, the slope of the reset curve changes with the initial or final temperatures. If it is cold indoors during warm weather, increase the INITIAL temp. 2 deg. F. for every 1 deg. F. you would like to increase the indoor room temperature. Wait 24 hours after readjustments to allow the indoor temperature to stabilize at the new setpoint.

2 FINAL TEMP. -- @ -10 F. Outdoors {180}

Increasing the final temperature will increase the computed water temperature setpoint most during cold and least during warm weather. Increase the final temperature approximately 2 deg. F. for every 1 deg. F. you would like to increase the indoor room temperatures when it is cold outside.

The computed water temperature setpoint will continue increasing beyond the final temperature as the outdoor falls below -10 F, but the hi limit safety control will prevent the water temperature from exceeding 220 deg. F. in most system. Most hot water systems having finned baseboards, requiring a final temperature of 200 deg. F. A low temperature hot water system with floor or wall mounted radiators may need a final temperature of only 150 to 170 F., while systems with fan coils, cast iron radiators, or floor radiation may need a final temperature of even less. The optimum initial and final settings can best be determined by installing zone monitoring sensors and performing trials.

The higher the ***initial setback*** setting, the greater the fuel savings. Hot water systems take a long time to cool down, and boiler cycling can be reduced enormously during setback. Because setback is proportioned to outdoor temperature and recovery problems are eliminated, very large initial water temperature setbacks are practical. Chart 1 shows the computed amount of water temperature setback at various outdoor temperatures. Over a nominal setback period of 8 hours, and with outdoor temperatures in the range of 20 to 40 deg. F., and with an initial setback of 60 deg F.; indoor temperatures may only decline 3 to 5 F.

3 NIGHT WATER TEMPERATURE SETBACK {40}

The displayed value represents the setback only at 70 deg. F. outdoors, and can be thought of as the ***initial water temperature setback***. The computed water temperature setback decreases as outdoor temperature decreases. At 30 deg. F. outdoors, the water temperature setback is 1/2 the initial value. At -10 F. outdoors, the water temperature setback is zero.

4 DAYTIME INDOOR TARGET {72}

If one to four room sensors are activated, the NR203 corrects the water temperature setpoint (raising or lowering) based upon the difference between the target temperature and the average of the room sensors. The present error is displayed in the RUN menu, and the proportional effect of the indoor error can be adjusted System Setup menu #8.

5 OUTDOOR CUTOFF (Warm Weather Shutdown) {56}

Set between 55 and 65 deg. F.

6 HEATING CYCLE LENGTH (Differential) {12}

A setting of 15 F. is correct for most hydronic systems. If the heating cycle length is not in the 4 to 8 minute range, then readjust the differential. Copper tube boilers will require higher settings, while cast iron boilers will require lower. A differential setting that is too low will cause short cycling and fuel waste, and too high a setting may cause room temperatures to rise and fall excessively. If the heating cycle length is too short with an differential setting of 30 (most common with copper tube boilers), then the circulating sensor will have to be moved to the return water side of the boiler.

7 AUTO BOILER ROTATION {NO}

YES will allow the LEAD STAGE to advance each morning at the beginning of the boost period.

8 SELECT LEAD STAGE {1}

You may manually select the lead stage, or if auto rotation is ON this number will automatically advance. The display shows 1 for stage A, and 8 for stage H.

READ

Place the OPERATOR slide switch in READ. Press the VIEW NEXT. The READ menu will display the boiler water temp., the outdoor temperature, and the 4 room zone sensors readings.

RUN

The RUN menu will display (1) computed water setpoint determined by outdoor temp., schedule, operator setting, indoor error effect, and weather change effect, (2) average indoor readings, (3) indoor target error effect, (4) weather change effect, (5) indoor sensors that are active, (6) pump operation [1 in display]; combustion air or heat call [2 in display]; boiler

stages in operation [ABCDEFGH in display]; and the time period. (7) boiler runtime for the previous 24 hour period, (8) boiler runtime for the previous 24 to 48 hour period, (9) zone data logging for previous 2 hrs. period over six 20 minute intervals, (A-D) zone data logging over six 2 hour periods total of 48 hrs. Data Logs reads oldest first (upper left) and most recent measurement last (lower right). (See SYSTEM menu #2 and #3 for data logging setup).

SYSTEM SETUP

SYSTEM: (Press plus+ and minus- keys together).

1 MORNING BOOST MINUTES {1:00}

The boost period begins when the time clock switches from night to day. Use a 60 minute boost for an 8 hour setback, or a 30 minute boost for a 4 hr. setback period. To test the boost function, you may set the morning boost time to 5 minutes. If you set the displayed value to zero, you can eliminate morning boost without effecting auto rotation.

2 DATA LOGGING ITEMS {1-5}

Set for the number of data logging items desired in the RUN menu. You may set to zero if you do not want to show data logging items.

3 ZONELOG APT. # 1-2 {1}

Select room zone sensor 1 or 2 for 48 hrs. of data logging.

The following 4 items should be set by a qualified heating contractor:

4 INTER-STAGE LAG DIFFERENTIAL {2 to 6}

If the water temperature drops below the computed setpoint, minus ½ the heating cycle differential, minus the lag differential, the next boiler or stage will turn ON. This process continues until all the boilers or boiler stages are ON. The fewer the zone valves, the more stable the system, and the lower you may set the lag differential.

5 WATER ABSOLUTE MINIMUM TEMP. {50}

Flue gases may condense and cause a boiler to sweat under certain conditions. The condensate may appear on fire tubes, cast iron sections, or the burner itself, etc. Consult the boiler mfr. to determine if a particular model boiler requires a minimum temperature setting to protect it from corrosion. A minimum temperature setting of 130F will reduce boiler condensation, but may cause the building to overheat in warm weather. It may be necessary to install a piping system which includes a mixing valve to blend supply and return water.

6 NO. OF BOILER STAGES {1 to 8}

For lo/hi firing this number will be twice the number of boilers.

7 LO/HI ROTATION SEQUENCE {NO}

Set to YES if each boiler has two burner control circuits, one for low (stage1), and the second for the hi (stage2) firing.

8 INDOOR ERROR ADJUSTMENT RATE {0.5}

The difference between the indoor temperatures and the daytime target temperature is multiplied by this factor to determine the indoor error effect added to the computed water temperature setpoint. The computed water temperature is now determined by the outdoor temperature, the initial and final temperatures, and the indoor error effect.

9 WEATHER CHANGE SPEED {2.0}

The NR203 measures outdoor temperatures evey 15 minutes. The absolute amount of the outdoor temperature change when multiplied by the *weather change speed* is added to setpoint. For a *weather change speed* setting of 1.5, a -2 degree weather change results in a +3 degree increase in the computed water temperature setpoint. The setpoint compensation decrease gradually over a 1 hr. period.

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A INDOOR SENSOR +MAX SPAN {6}

An indoor sensor which is above the daytime target temperature by this value is excluded from the indoor average learning temperature. Panel LED's will indicate the fault, and Run Menu #5 will display a "-" instead of the indoor zone sensor number.

B INDOOR SENSOR -MIN SPAN {10}

Same as above, but excludes the lower reading sensors. Use with caution.

C DROP INDOOR WARMEST {NO}

Operator can allow the warmest sensor removed to be automatically removed from the average, which is usually a good idea. If the warmest sensor is also out of +MAX SPAN range, then this option will have no further effect. It is useful for removing one sensor which is still within the maximum range. 6 UNIT / ZONE PASS CODE

D UNIT / ZONE - PASS CODE {321}

After completing a dial up connection, Enter "P" followed by this access code to establish communication with the remote heating control.

Restoring Factory Default Operator and System Settings: To reset the SET and SYSTEM user variables to default settings first turn Power OFF. Hold the NEXT key while turning the Power ON. *Consult your contractor before resetting to factory defaults. This reset will change items 4-7 in the SYSTEM menu (described above) which are specific to your type of boiler and may impair its operation.*

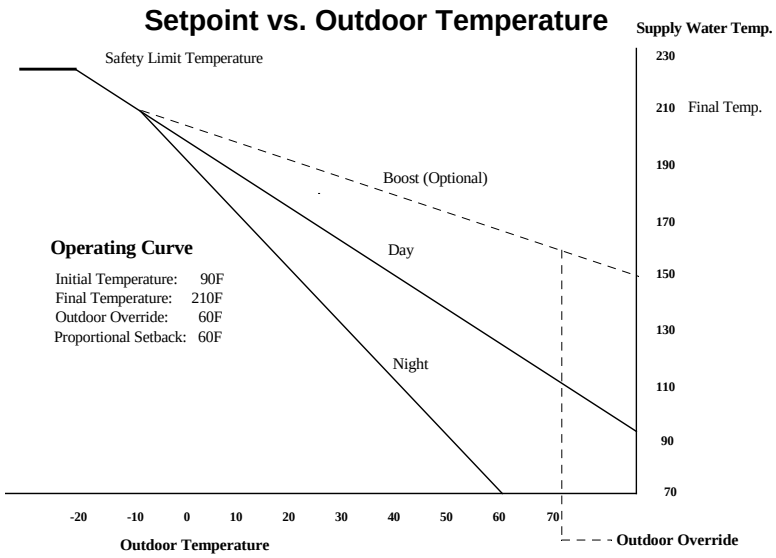
Manual Bypass: Turn POWER switch OFF. Place BOILER switch in MANUAL for combustion air damper (if installed). Manual bypass switch for each stage is behind the front panel on the terminal wiring board. Auto position is DOWN, Bypass is UP. Stage1 -- ry2, Pump -- ry3, Stage2 -- ry4, Stage3 -- ry5, Stage4 -- ry6.

Setback Timer: If the Day/Night Timer display indicates ON, control is in the DAY period, whereas OFF is Night. Timer memory allows 6 ON and 6 OFF entries. A 5-day (MO thru FR) and a 2-day (SA SU) group schedule will program the entire week in only 4 program steps. The rechargeable battery will fully charge in 24 Hrs., and maintain the timer for 4 mo. without power. The rechargeable battery receives charging current even when the front panel power switch is turned off. REPLACE THE NI-CAD BATTERY AT LEAST EVERY 3 YEARS.

Notes on 48 hr. data logging: The six displayed numbers are the average of readings every 30 seconds and update every two hours. The min. or max. room temperatures could be +/- 2 degrees above or below the recorded average temperature over time. You may choose to 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.

WATER SETBACK VS. OUTDOOR TEMP.

Initial Setback	CALCULATED SETBACK						
60 *	0	10	20	30	40	50	60
*							
40 *	0	7	13	20	26	33	40
*							
20 *	0	3	6	10	13	16	20
	-10	*0*	*10*	*20*	*30*	*40*	*50*	*60 OutdoorTemp*



FIELD SERVICING -- Testing the remote sensors.

MAIN PANEL AND TERMINAL BOARD

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.

Room Sensors: If a sensor warning light is on, you will need to know if the sensor wiring is open, shorted, or whether the sensor is actually defective. The sensors are extremely reliable, and wiring defects occur 50 times as frequently as defective sensors. If the radiators are turned off within an apartment where there is a remote sensor, the sensor warning light may turn on and falsely indicate a bad sensor, or if the sensor high limit in the SYSTEM menu is set below the current room temperature, the warning light will also turn ON.

Problem: All the sensor warning lights are ON. You must determine whether the panel is good.
1. Connect a digital volt meter DVM **(-)** lead to **TS1** terminal 2 [outdoor sensor (-)] or sensor common. Connect the DVM **(+)** lead to the **(+)** terminal of any sensor input. Verify dvm read 12.8 to 13.8 Vdc. If not true, then the main panel is defective.

2. 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.

3. *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.

4. *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.

5. *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. If the sensor is good, you will read approx. 13Vdc - 2.5Vdc or 10.5Vdc across the sensor.

6. If the results of the above steps indicate a shorted line, then you will either have to 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 be due to a staple through a wire within an apartment, or the wire got cutoff at the floor.

TABLE 1 -- ROOM SENSOR VOLTAGE TO TEMPERATURE CONVERSION

SENSOR Vdc	Deg.F	SENSOR Vdc	Deg.F	SENSOR Vdc	Deg.F
2.10	60	2.46	69	2.82	78
2.18	62	2.54	71	2.90	80
2.26	64	2.62	73	2.98	82
2.34	66	2.70	75	3.06	84
2.42	68	2.78	77		

Outdoor, and Water or Return Steam Sensors:

1. Place 3 1/2 digit volt meter or DVM (-) at **TS1** terminal 2 [outdoor sensor (-)], and DVM (+) at **TS1** terminal 3 [pipe temperature sensor (+). Verify 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 2. 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 +/- 3 F. of the measured value.

3. Move DVM (+) to **TS1** terminal 5 [water sensor (-)] and measure the water temp. voltage, then look up the corresponding temp. on the chart in Fig. 1. Replace the sensor if the DVM reading does not correspond with the pipe temperature. Replace panel if water temp. reading on control is not within +/- 4 F. of the measured value.

TABLE 2 -- VOLTAGE TO TEMP. CONVERSION (Water or Outdoor sensors)

Voltage = deg. F.	Voltage = deg. F.	Voltage = deg. F.	Voltage = deg. F.
2.43 = -22	2.79 = 42.8	3.15 = 107.6	3.49 = 168.8
2.45 = -18.4	2.81 = 46.4	3.17 = 111.2	3.51 = 172.4
2.47 = -14.8	2.83 = 50.0	3.19 = 114.8	3.53 = 176
2.49 = -11.2	2.85 = 53.6	3.21 = 118.4	3.55 = 179.6
2.51 = - 7.6	2.87 = 57.2	3.23 = 122	3.57 = 183.2
2.53 = - 4.0	2.89 = 60.8	3.25 = 125.6	3.59 = 186.8
2.55 = - .4	2.91 = 64.4	3.27 = 129.2	3.61 = 190.4
2.57 = 3.2	2.93 = 68	3.29 = 132.8	3.63 = 194
2.59 = 6.8	2.95 = 71.6	3.31 = 136.4	3.65 = 197.6
2.61 = 10.4	2.97 = 75.2	3.33 = 140	3.67 = 201.2
2.63 = 14	2.99 = 78.8	3.35 = 143.6	3.69 = 204.8
2.65 = 17.6	3.01 = 82.4	3.37 = 147.2	3.71 = 208.4
2.67 = 21.2	3.03 = 86	3.39 = 150.8	3.73 = 212
2.69 = 24.8	3.05 = 89.6	3.41 = 154.4	3.75 = 215.6
2.71 = 28.4	3.07 = 93.2	3.43 = 158	3.77 = 219.2
2.73 = 32	3.09 = 96.8	3.45 = 161.6	3.79 = 222.8
2.75 = 35.6	3.11 = 100.4	3.47 = 165.2	3.81 = 226.4

MODEM OPERATION

Any communications program such as Microsoft Hyper-Terminal or Procomm™ will work Use the special cable provided from the 25 pin RS232 port on the modem to connect to the 6 pin modular jack on the CB200 series control. (1) Choose a name and setup a new dial-up connection. Data will be sent to the PC in the same format shown on the heating control's 32 character LCD. (2) Set your PC Modem Baud Rate to 9600 N, 8, 1 . All functions are available through the modem except programming the time clock, and disabling individual zone sensors. The following numeric computer keys will emulate the one slide switch and the three key switches on the CB200 series front panel:

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

The R&D Electronics modem kit includes a Zoom ™ model 2948 or 2949 external modem custom initialized, two R&D Electronics custom cables, one connecting the microprocessor board to the RJ12 connector on the main panel board, and a second cable connecting the RJ12 connector on the main board to the Zoom™ modem. The Zoom™ modem is then connected to the telephone line using a standard RJ11 cable that comes with the modem.

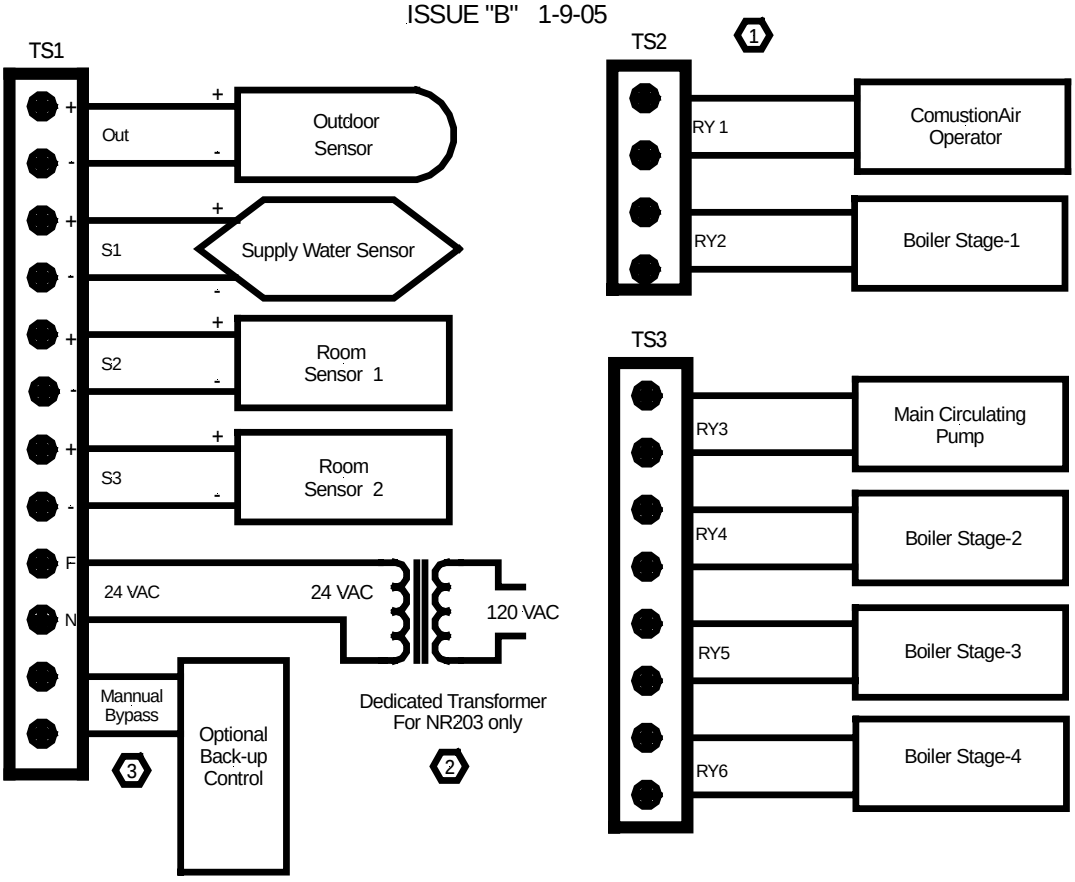
Typical installation time for the modem kit is under 15 minutes, provided that there is an existing telephone jack nearby. For help with HyperTerminal ™ consult with factory. We will guide you over the phone on how to set up your existing Windows HyperTerminal ™ communications program.

ORDERING INFORMATION

Model NR203 HW6 includes 2 stage output, pump and air damper control. Add suffix -4 to operate 4 stages. Covered by US Patent No. 4,557,417

NR203 WIRING DIAGRAM

ISSUE "B" 1-9-05



1 All dry relay contacts rated 24 Vac. No 24 Vac power is supplied by heat control.

2 Do not take power from a RELAY TRANSFORMER MODULE or a gas valve and use it to power theHeating Control.

3 Remove jumper when installing a manual bypass or emergency backup control.

Note : Connect circulating sensor shielded to the (+) terminal at the field wiring board. The shield should be left open at the water temperature sensor. Outdoor sensor does not require shielding, but is preferable for durability.