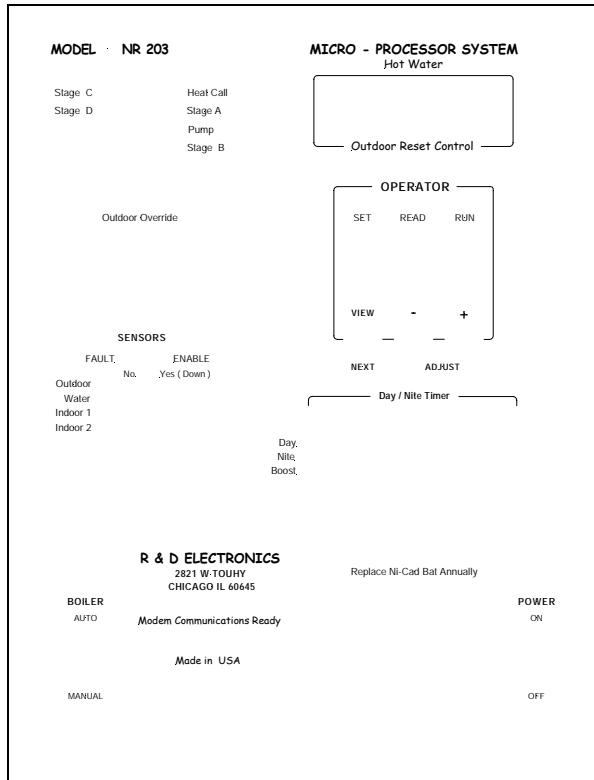


**OWNERS MANUAL- Model NR203, 203-4 - Hot Water Outdoor Reset Control --**  
om\_Nr203Hw1.doc



The R&D Electronics Model NR203 using HW1C software consists of a main panel, a boiler water temp. sensor, an outdoor sensor, and up to 2 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. A simple 3 position slide switch labeled SET, READ, and RUN controls the 32 character LCD display. SET contains a list of (5) preliminary adjustments and (2) main adjustments for the regulation of boiler water temperature

The computed water setpoint varies from the operator Initial Temperature setting at +70F. to the Final Temperature at -10F. If the boiler water temperature falls below the computed setpoint by 1/2 the amount of the differential, ry1 - combustion air, and ry3 -

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 ry2. 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 70 F. outdoors, the setback is equal to the value shown in the SET menu. At 30 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.

### DESIGN HIGHLIGHTS

- \* Motorola MC68HC11 operates in single chip mode. Internal ram, rom, and eeprom.
- \* Modem operation from any PC with standard communications software.
- \* 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 two 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 if 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. {90}

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 temperatures. Wait 24 hours after readjustments to allow the indoor temperature to stabilize at the new setpoint.

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.

2 FINAL TEMP. {200}

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 have 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 170 F., while systems with fan coils, cast iron radiators, or floor radiation may require a final temperature of only 140 F. 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.

4 OUTDOOR CUTOFF ( Warm Weather Shutdown) {56}

Set between 55 and 65 deg. F.

5 HEATING CYCLE LENGTH (Differential) {16}

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. Too low a differential setting 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.

6 AUTO BOILER ROTATION {NO}

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

7 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 present circulating water temp., the outdoor temperature, and the 2 room zone sensors readings.

RUN

The RUN menu will display (1) computed water setpoint determined by outdoor temp., schedule, and operator settings. (2) pump operation [1 in display]; combustion air or heat call [2 in display]; boiler stages in operation [ABCDEFGH in display]; and the time period. (3) zone data logging for 2 hrs. in six 20 minute measurements, (4-7) zone data logging for 12 hrs. in six 2 hr. measurements for a total of 48 hrs. Data Logs reads oldest first (upper left) and most recent measurement last (lower right). (Also see SYSTEM: Lines 3 and 4).

SYSTEM INITIAL SETUP

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

1 MORNING BOOST MINUTES {1:00}

The boost period begins at moment 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 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 all together, 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 mfg. 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 no. of boilers.

7 LO/HI ROTATION SEQUENCE { NO }

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

**Restoring Factory Default Operator and System Settings:** To Reset the SET and SYSTEM user variables to factory default settings. 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.

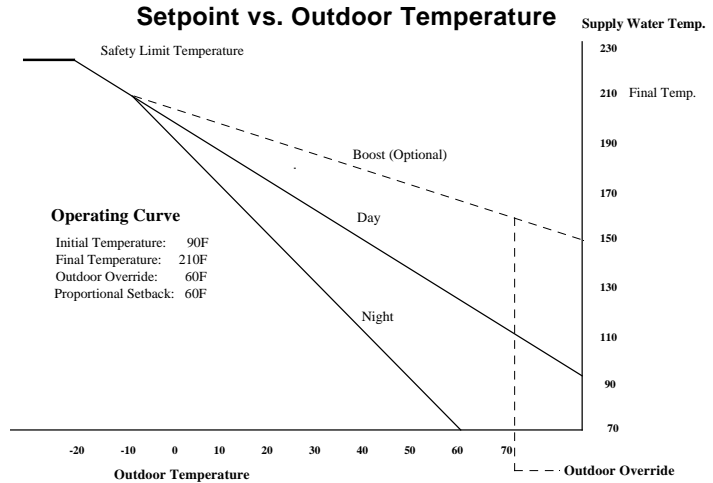
**Notes on 48 hr. data logging:** The six displayed numbers are the average of readings every 30 seconds and update every two hours. The min. or max. room temperatures could be +/- 2 degrees above or below the recorded average temperature over time. You may choose to calibrate the time scale by resetting control power *before* collecting the data 48 hrs. later. Special data collection sheets from R&D Electronics are available.

**Initial Setback**    CALCULATED SETBACK

60 *	0	7	14	22	29	36	43	51
*								
40 *	0	4	9	13	18	22	27	31
*								
20 *	0	2	5	7	10	12	15	17

-----

	-10	0	10	20	30	40	50	60	Outdoor Temp.
--	-----	---	----	----	----	----	----	----	---------------



**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	SENSOR 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**

If a modem is installed, any communications program such as Microsoft HyperTerminal, Works, or Procomm will work. Use the special cable provided from the 25 pin RS232 port on the modem to the 6 pin modular jack on the NR203. (1) Choose a name and setup a new dial-up connection. Data will be sent to the modem in the same format that it is displayed in the 32 character LCD. (2) Set your PC Modem Baud Rate to 9600 N, 8, 1 . All functions are available through the modem except for programming the time clock, and enabling the zone sensors. (3) Your computer keyboard emulates the NR203 front panel switches as follows:

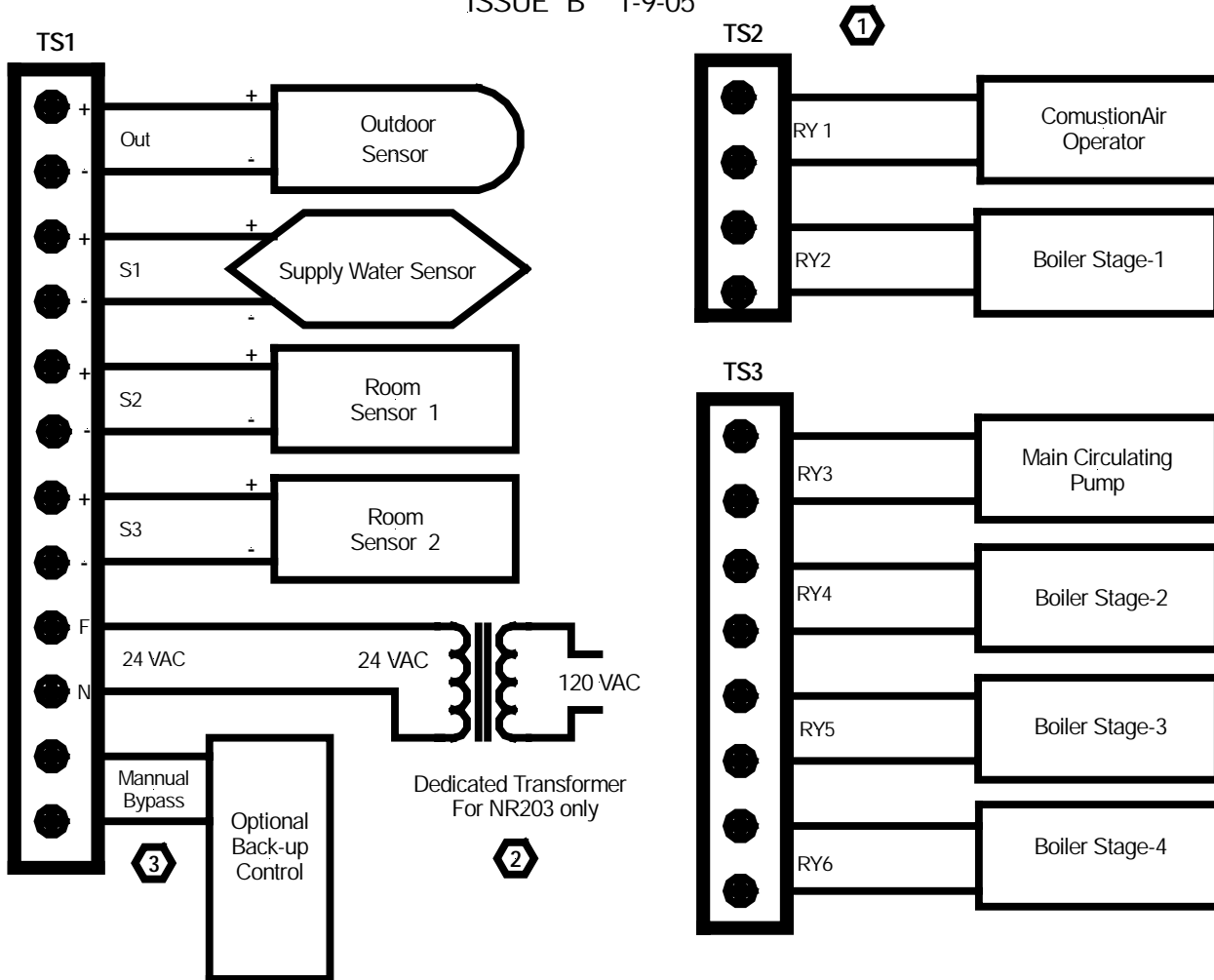
1	= SET	4	= SYSTEM	ENTER	= NEXT
2	= READ	(+)	= INCREASE		
3	= RUN	(-)	= DECREASE		

**ORDERING INFORMATION:**

NR203 operates (1) or (2) stages, NR204-4 operates up to (4) stages.

# 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 the Heating 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.