Ohmeda
Service Manual

Care Plus Incubator

6/28/88

Important

The information contained in this service manual pertains only to those models of products which are marketed by Ohmeda as of the effective date of this manual or the latest revision thereof. This service manual was prepared for exclusive use by Ohmeda service personnel in light of their training and experience as well as the availability to them of parts, proper tools and test equipment. Consequently, Ohmeda provides this service manual to its customers purely as a business convenience and for the customer's general information only without warranty of the results with respect to any applicatio of such information. Furthermore, because of the wide variety of circumstance under which maintenance and repair activities may be performed and the uniqu nature of each individual's own experience, capacity, and qualifications, the fac that customer has received such information from Ohmeda does not imply in anyway that Ohmeda deems said individual to be qualified to perform any such maintenance or repair service. Moreover, it should not be assumed that every acceptable test and safety procedure or method, precaution, tool, equipment o device is referred to within, or that abnormal or unusual circumstances, may no warrant or suggest different or additional procedures or requirements.

This manual is subject to periodic review, update and revision. Customers are cautioned to obtain and consult the latest revision before undertaking any service of the equipment. Comments and suggestions on this manual are invite from our customers. Send your comments and suggestions to the Manager of Service Education, Ohmeda, Ohmeda Drive, Madison, Wisconsin 53707.

CAUTION: Servicing of this product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision to this service manual which is clearly and thoroughly understood.

This static control precaution symbol appears throughout this manual. When this symbol appears next to a procedure in this manual, static contro precautions MUST be observed. Use the static control work station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted t ground and not through static sensitive devices.

Technical Competence

The procedures described in this service manual should be performed by trained and authorized personnel only. Maintenance should only be undertaken by competent individuals who have a general knowledge of and experience wit devices of this nature. No repairs should ever be undertaken or attempted by anyone not having such qualifications.

Genuine replacement parts manufactured or sold by Ohmeda must be used for all repairs.

Read completely through each step in every procedure before starting the procedure; any exceptions may result in a failure to properly and safely complete the attempted procedure.

Definitions

Note: A note provides additional information to clarify a point in the text.

Important: An Important statement is similar to a note, but is used for greater emphasis.

CAUTION: A CAUTION statement is used when the possibility of damage to th equipment exists.

WARNING: A WARNING statement is used when the possibility of injury to th patient or the operator exists.

Air Control Mode: Manual mode of operation. The interior incubator temperature is maintained at the air control temperature.

Desired Environmental Temperature (DET): The air temperature required to maintain the infant's temperature at the patient control temperature (patient control mode).

Incubator Temperature: The air temperature measured at a point 10 cm above the mattress.

Patient Control Mode: Servo mode of operation. The incubator changes the DET to maintain the desired patient skin temperature.

Patient Probe: The Ohio patient temperature probe, model LA003.

Temperature Rise Time: The time required for the incubator temperature to rise 10 C at ambient temperatures without water in the humidifier.

Temperature Equilibrium: The condition where the average incubator temperature does not vary by more than 0.2 C in a one hour period.

Temperature Variability: The maximum difference between the incubator temperature and the average incubator temperature at equilibrium.

Temperature Overshoot: The number of degrees by which the average incubator temperature exceeds the average incubator temperature at temperature equilibrium following a change in the air control temperature (air control mode).

Notes

Table of Contents

Table of Contents

Table of Contents

Notes

List of Illustrations

List of Illustrations

⚠ Warnings

Two people are required to lift the Care Plus Incubator. Follow safe lifting techniques to avoid injury.

If the mounting knobs that attach the incubator to the cabinet are not securely fastened, the incubator could tip off of the cabinet when the hood is opened.

After completing any portion of the calibration and adjustment procedures for the Care Plus Incubator, perform the Checkout Procedure to make sure that the unit is operating correctly. In addition a final electrical safety check and leakag current test must be performed. Record the information for future reference.

Disconnect the power to the incubator for the mechanical portion of the Checkout Procedure.

Use extreme care while performing calibration and adjustment procedures, or while working on the Care Plus Incubator with power connected. An electrica shock hazard does exist; be certain to observe all standard safety precautions.

Before any disassembly or repair, disconnect the electrical supply and any gas supply connections. Also remove any accessories. Do not perform any service or maintenance with the power applied unless specifically told to do so in the procedure.

After completing a repair of the Care Plus, the appropriate calibration procedure must be performed to make sure the Care Plus is in proper operating condition. In addition, a final electrical safety check and leakage current test must be performed. Record the information for future reference.

If a system failure alarm occurs, the unit must be removed from use until it has been serviced.

Disconnect power to the incubator and allow the heater to cool for at least 15 minutes before servicing or cleaning to avoid the danger of a burn.

Never oil or grease oxygen equipment unless a lubricant that is made and approved for this type of service is used. Oils and grease oxidize readily, and in the presence of oxygen, will burn violently. Vac Kote (R) is the oxygen service lubricant recommended (Stock No. 0220-0091-300).

Two people are required to safely replace a caster. Remove the incubator and all accessory equipment from the cabinet before replacing a caster.

(R) Vac Kote is a Registered trademark of Ball Brothers Corp.

⚠ Cautions

Servicing of this product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision of this service manual which is clearly and thoroughly understood.

This static control precaution symbol appears throughout this manual. When this symbol appears next to a procedure in this manual, static control precautions MUST be observed. Use the static control work station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

Use the Static Control Work Station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

When handling the controller, avoid bumping the fan or the heater. If these items are knocked out of alignment, the fan can grate against either the heater or the base.

Insulation on the electrical wiring can deteriorate with age. When performing the Checkout Procedure, check for brittle or deteriorated insulation on the power cord.

Inner wall fasteners are permanently attached to the inner wall and cannot be removed without damaging them.

Make sure the control board connectors are properly aligned before applying power.

If early model heaters are not installed with the nuts on the inside of the controller and the screws on the outside, water can leak in during cleaning and damage the electronics.

If gaskets are not installed properly, water can leak in during cleaning and damage the electronics.

The incubator control circuitry is located inside the removable controller. The controller interfaces with the operator through the LEDs and switches on the display board, mounted behind the control panel.

The major portion of the control logic, switch interpretation, and power supply generation occurs on the control board. Three external thermistor assemblies supply a total of five temperature signals to the control board.

The patient temperature probe attaches to the patient and plugs into the jack located on the left side of the controller. It contains one thermistor and outputs the patient temperature signal, which is used to generate the patient temperature display and to adjust heater output in the patient control mode.

The air temperature sensor mounts on the hood inside the infant compartment and attaches with the air temperature sensor connector, located on the left side of the controller. It contains two separate thermistor circuits: the air control thermistor signal is used by the control circuitry to adjust heater output and to trigger alarms; the air display thermistor signal is used by the control circuitry to generate the front panel air temperature display. The air display signal is also input to an independent air safety circuit, which shuts down the heater if the signal exceeds preset temperature safety limits.

The air flow sensor is mounted on the rear bulkhead of the controller and is used to verify that the heater fan is working. The air flow sensor contains two thermistor circuits, one of which is heated by a resistor inside the sensor assembly. Normally, the fan cools the heated thermistor to within several degrees of the unheated thermistor. If the fan fails to operate properly, the temperature difference between the unheated and the heated thermistors increases and triggers the air circulation alarm.

Note: Comparing the two thermistor readings cancels out any changes in room temperature. This means that air flow sensor operation is independent of ambient temperature within the operational range.

A separate thermal switch, mounted on the rear of the controller, shuts down the heater if the heater temperature (monitored at the thermal switch) exceeds 76.7 C (170 F).

1.1 Control Board

The control board contains the incubator logic circuitry, diagramed in Figure 1-1, page 1-3, as well as the power supply and distribution circuitry, diagramed in Figure 1-2, page 1-4.

The board centers around U19, the 8032 microcontroller. The microcontroller interfaces with its peripherals through three I/O expanders on the data bus. Analog signals are multiplexed to the Analog to Digital Converter (ADC), and the results of the conversion are read in through I/O expander U15. The microcontroller communicates with the air safety circuit, the watchdog timer, and the alarm tone generator through a second I/O expander, U17. A third I/O expander, located on the display board (U2), interfaces with the control panel touch switches and displays. As indicated in Figure 1-1, the heater control, the air safety, the watchdog timer, and the alarm circuits generate feedback signals to the microcontroller.

The program memory is stored in EPROM U16. A transparent octal latch connected to the EPROM address lines (A_0 through A_7) allows the microcontroller's bi-directional data bus port to both address the EPROM and then read out programmed data.

The power supply circuitry produces regulated low voltage dc supplies for the control circuitry and the display board. It also generates two monitoring signals used to compensate heater output for fluctuations in line voltage and to detect power failure. In the event of a power failure, a NI-CAD battery inside the controller supplies the power failure alarm and maintains the standby control memory for up to 10 minutes (with the battery fully charged).

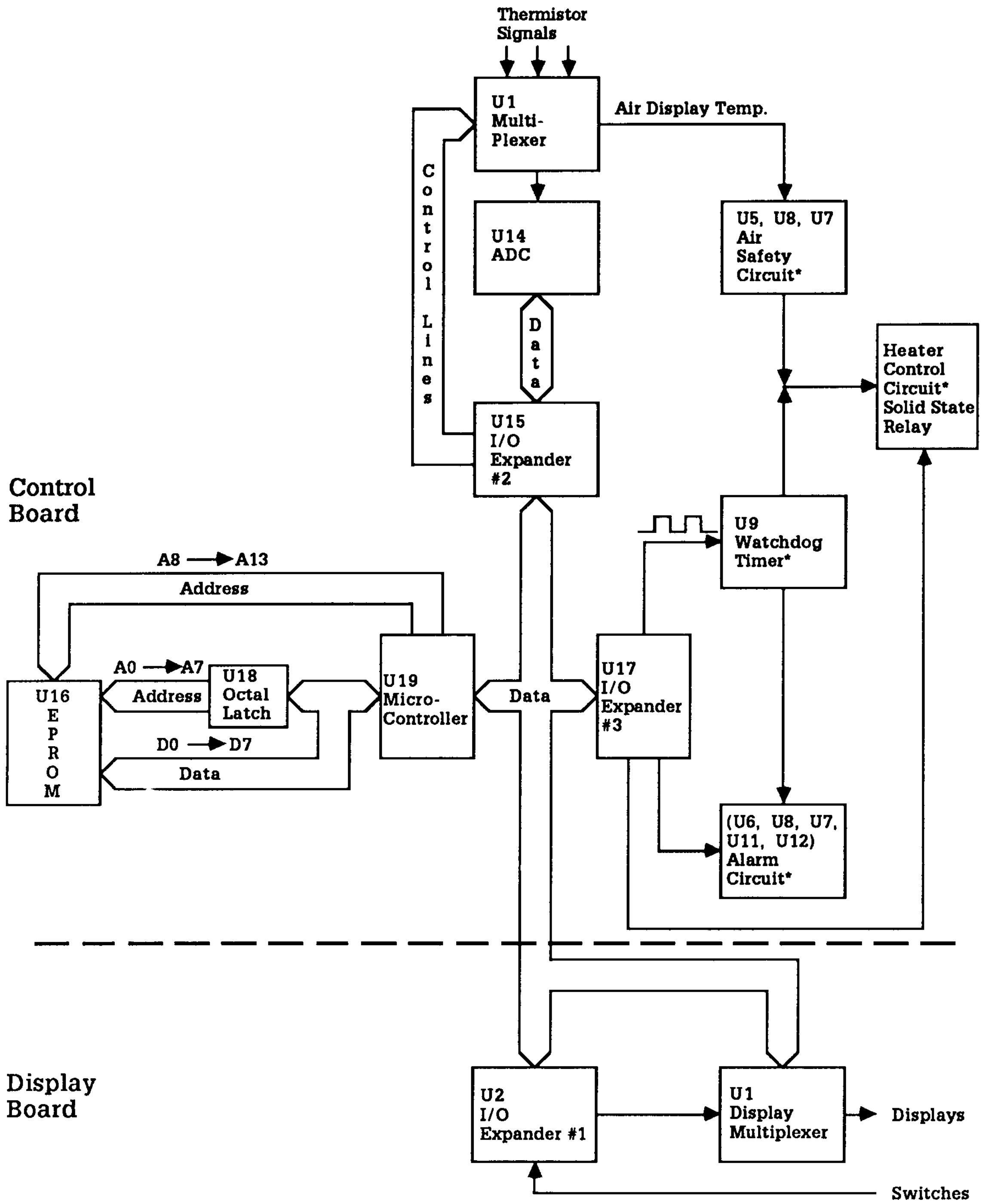


Figure 1-1 Control Circuitry Block Diagram

*** Circuit produces feedback signal to microcontroller.**

A. Power Supply Circuitry

The power supplies and power monitoring signals are generated as shown in Figure 1-2. The line frequency signal pulse that detects power failures, the +8 V unregulated supply to the heater control circuit safety relay, and the +5 V display supply to the display board are derived from the 8 Vac transformer secondaries. The line voltage signal, which adjusts the number of heater power cycles to compensate for voltage fluctuations; the 9.8 Vdc supply, used to heat the heated air flow sensor thermistor and to charge the battery; and the +5 V standby supply, used to power control board circuitry are derived from the 11 Vac transformer secondaries. Signals that can be adjusted as part of the calibration procedure are indicated in Figure 1-2.

During a power failure a NI-CAD battery supplies two voltage levels (+5 V STBY and +9 VSTBY). The +9 VSTBY supply (actual voltage approximately 7 Vdc) activates the alarms, and the 5 volt supply powers the microcontroller and the associated integrated circuits.

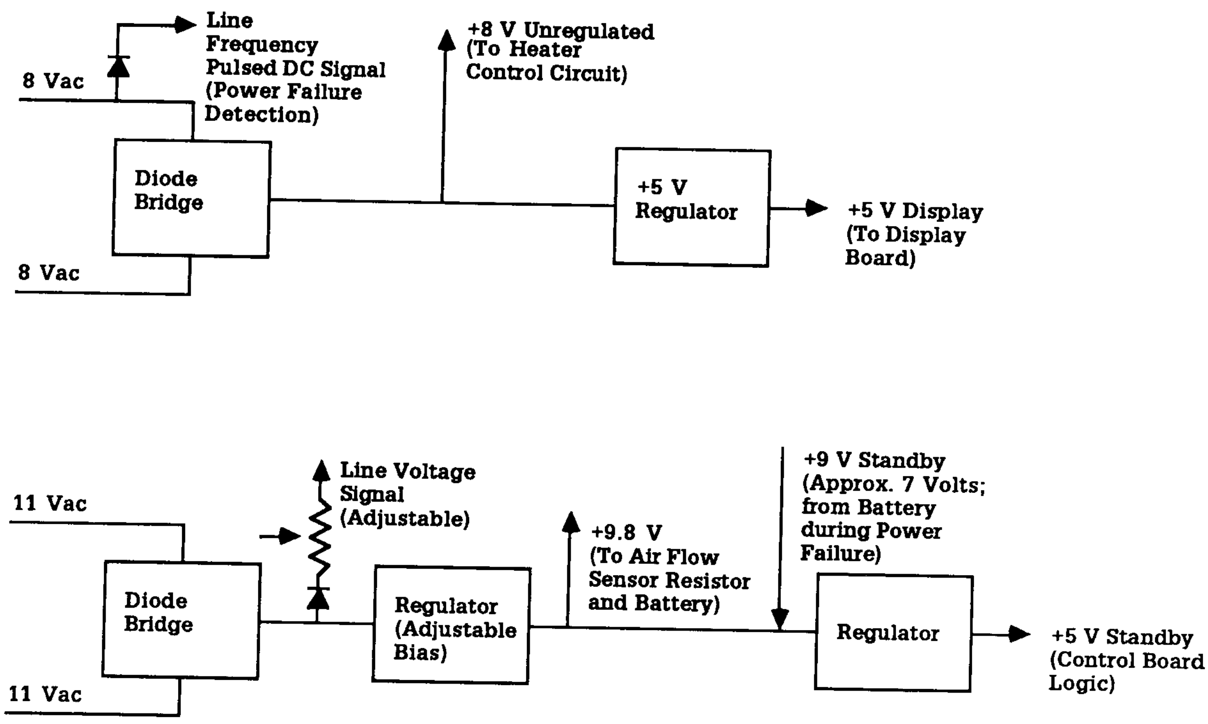


Figure 1-2 Power Supply Circuitry

1. Line Frequency, +8 Volt Unregulated and +5 Volt Display Supplies

A nominal 8 Vac from the line voltage transformer secondary is input to the power supply board at J2 pins 2 and 3.

This signal is conditioned by CR1 and R14, and fed through a 1K resistor to a Schmitt trigger NAND gate, U7B. The other gate input is tied high, so the gate acts as an inverter. The gate will not respond until the input exceeds 1.9 Vdc minimally. The resulting signal pulse, INTO, is input to the microcontroller on P3.2. Absence of this signal is interpreted as a power failure.

Bridge rectifier CR2 and capacitor C3 provide a filtered, unregulated +8 Vdc, which supplies the opto-isolator controlling the heater control circuit's safety relay, and the +5 volt regulator (VR2). The unregulated +8 volt supply can be measured at TP1-5.

Regulator VR2 outputs a nominal +5 Vdc to power the display board LEDs. This output can be measured at J3 pin 12, 13 or TP1-3. When the line voltage is within 10% of the nominal voltage, the regulator output should range between 4.8 and 5.2 Vdc with a load of 500 ma. The maximum allowable ripple voltage is 150 mV.

2. Line Voltage Signal, +9.8 Volt, and +9 Volt and +5 Volt Standby Supplies

A nominal 11 Vac from the transformer secondary is input to the control board at J2 pins 4 and 5. Bridge rectifier CR3 and capacitor C4 provide a full wave, unregulated voltage of approximately +12 Vdc.

This voltage is applied to resistor R19 to produce the line voltage monitoring signal. The line voltage signal is input to the ADC through the multiplexer (U1). The digital output is sent to the microcontroller where it adjusts heater power cycling to compensate for line voltage changes. When the incubator is operating at the rated voltage and R19 is properly adjusted, a reading of approximately 700 mV can be measured at U1 pin 15 (TP1-2).

The nominal +12 volt supply is also applied to regulator VR1 to produce the 9.8 volt supply. Regulator output can be calibrated using R20. When R20 is properly adjusted, a reading of 9.8 +/- 0.1 Vdc can be measured at TP1-1. This voltage is used for charging the NI-CAD battery through R18, and for supplying the resistor used to heat the heated air flow sensor thermistor. It also supplies +5 volt standby regulator, VR3.

When line voltage is available, current flows from the output of VR1 through CR10 to supply 9.0 volts at the input of VR3, (TP1-6). In turn, regulator VR3 outputs a voltage of 5.0 +/- 0.2 Vdc to the control circuitry (TP1-4). The maximum allowable ripple voltage is 150 mV.

When power loss occurs, the 7.2 volt NI-CAD battery maintains power to control board regulator VR3 through CR11. The output of VR3 powers the incubator logic circuits and will remain at +5.0 +/- 0.2 Vdc until the input to the regulator drops below +7.0 Vdc. When the input voltage falls below +7.0 Vdc, the regulator output (+5 Vdc supply) may not be within the allowed tolerance (+/-0.2 Vdc). The battery's + 9 standby output also supplies approximately +7 Vdc to the alarm speaker.

B. Analog to Digital Converter

The analog to digital conversion circuit shown in the Figure 1-1 block diagram, page 1-3, has three separate sections: the Analog to Digital Converter (ADC); a multiplexer used to select converter input; and a reference voltage generator.

1. Analog to Digital Converter (ADC)

The ADC, U14, operates asynchronously, continuously converting analog voltag inputs into a number of counts between 0 and 3999 (BCD format). The conversion rate is set by an internal oscillator whose frequency is determined by the external components R67 and C37. The exact oscillator frequency is not critical and may vary by +/- 15% from the nominal 400 kHz. The oscillator frequency can be measured on pin 18 of U14. With a nominal 400 kHz clock frequency, conversions within the ADC 3711 will take place at an approximate rate of three per second.

The ADC communicates with the microcontroller through I/O expander U15. The ADC data latch is permanently enabled by tying pin 19 (DLE) low. The start conversion and the conversion complete signals synchronize the data conversion, which proceeds as follows:

1. The microcontroller's start conversion pulse triggers a new conversion, prematurely ending any conversion in progress.

2. The conversion complete output goes low on the falling edge of the start conversion pulse. It returns to a high level when the ADC completes the conversion. The low to high transition prompts the microcontroller to read the ADC output.

3. The first set of data, from the prematurely terminated cycle, is discarded since there is no way to determine if it represents an entire conversion.

4. The microcontroller waits until the new conversion cycle has been completed.

5. The data is read by the microcontroller, converted to temperatures or voltage percentages, and stored in RAM.

The BCD data is output on binary data lines, (bit 1 to bit 8, pins 23, 24, 3, and 4 respectively) in accordance with the coded digit select signals applied to the ADC digit select inputs (D0 and D1, pins 20 and 21 respectively). The digit select codes are summarized below:

D0	D1	Selected Digit
L	L	Digit 0 (LSD)
L	H	Digit 1
H	L	Digit 2
H	H	Digit 3 (MSD)

2. Analog Inputs

Important: The information on voltage input levels given in this section and in the appendices is approximate. It is based on an offset voltage of 1.99 Vdc measured at TP2-4 and will vary with the actual offset voltage.

Analog voltage signals are directed to the ADC inputs through an eight channel analog multiplexer, U1. Multiplexer switch selection is software controlled by the microcontroller, which toggles the A, B, and C input lines of the multiplexe through I/O expander U15.

CONTROL INPUT A	B	C	SWITCH	PIN NO.	SIGNAL
0	0	0	X0	13	CAL LOW
0	0	1	X1	14	CAL HIGH
0	1	0	X2	15	LINE COMP
0	1	1	X3	12	AIR FLOW UNHEATED
1	0	0	X4	01	PATIENT
1	0	1	X5	05	AIR DISPLAY
1	1	0	X6	02	AIR CONTROL
1	1	1	X7	04	AIR FLOW HEATED

Note: The MUX inhibit terminal (pin 6) is connected to I/O expander #2, U15, ar is used to disable U1 in favor of a second 4051B analog switch. The second switch is not currently installed, but may be added for future applications.

The ADC has three separate input ranges. The first input range involves the lin voltage monitoring signal produced by the power circuitry and used to compensate for fluctuations in line voltage. R19 adjusts the signal level, which ranges from approximately 630 to 770 mV for line voltages between 90% and 110% of the nominal input.

≅ADC Input	≅ADC Counts	Percent of Nominal Voltage
630 mV	1600	90% (Lowest voltage that can be compensated)
700 mV	2000	100%
770 mV	2400	110% (Highest voltage that can be compensated)

≅ ADC input voltages and counts are approximate values for general reference only.

The second input range includes: the patient temperature, the air control temperature, the air display temperature, and the ADC high and low calibration test signals. All five channels have a 5.76 kOhm resistor in series between the signal and a 1 volt reference supply. On the three temperature channels, the signal source is a thermistor that produces ADC inputs of between 920 and 410 mV for temperatures between 0 and 50 C. A partial list of approximate ADC inputs follows:

Thermistor Temperature	Equivalent Resistance	≅ ADC Counts	≅ ADC Input Voltage
20 C	12,526 Ohm	2240	740 mV
25 C	10,000 Ohm	1920	690 mV
30 C	8,036 Ohm	1590	640 mV
35 C	6,500 Ohm	1260	580 mV
40 C	5,289 Ohm	930	520 mV

≅ ADC input voltages and counts are approximate values for general reference only.

The remaining two channels use precision resistors to produce ADC input signals of approximately 690 mV for cal low, and approximately 540 mV for cal high. When the ADC is properly calibrated, these readings correspond to temperatures of 25.05 C +/- 0.3 C for cal low and 37.96 +/- 0.3 C for cal high.

Signal	Resistor	≅ Voltage	≅ ADC Counts	Temperature
Cal Low	R8, 10 kOhm	690 mV	1922	25 C
Cal High	R5, 5.76 kOhm	540 mV	1059	38 C

≅ ADC input voltages and counts are approximate values for general reference only.

The third input range is used for the two air flow thermistors. A 750 Ohm resistor in series between each thermistor and the 1 volt supply produces ADC inputs between 1,040 mV and 360 mV for temperatures between 12 and 120 C. A partial list of approximate ADC inputs follows:

Thermistor Temperature	Equivalent Resistance	≅ ADC Counts	≅ ADC Input Voltage
20 C	12,526 Ohms	3892	1020 mV
50 C	3,563 Ohms	3143	890 mV
100 C	662 Ohms	868	510 mV

≅ ADC input voltages and counts are approximate values for general reference only.

3. Reference Voltage

The LM-10 combination op-amp and voltage reference circuit (U13A and B) uses its 200 mV internal reference source to supply two reference voltages. The buffer portion of the LM-10, U13B, supplies a fixed, nominal 1 volt reference to the ADC input circuits. This is amplified by the op-amp portion of the LM-10 to provide an adjustable, nominal 2 volt reference to the ADC. During ADC calibration, the level of the 2 volt reference is adjusted using R25.

The nominal 1 volt supply should give a reading of about 1.1 Vdc at TP2-3. The nominal 2 volt ADC reference should give a reading of about 2.2 Vdc at TP2-4. The exact readings may vary between units.

C. Microcontroller

The heart of the control system is the 8032 microcontroller U19. It has been configured to operate from external memory by grounding the EA line, pin 31. The clock speed is 6 MHz and can be verified by measuring a frequency of 1 MHz at the Address Latch Enable (ALE), pin 30, (ON = 0.33 usec and OFF = 0.67 usec).

1. EPROM Read

Port 0 and port 2 are used to to read instructions from EPROM U16 (27128A). Port 2 outputs the high level address bits (8 bits) directly to U16, while port 0 serves as a multiplexed lower level address (8 bits) and data bus.

At the start of the read, all address bits are output simultaneously. On the falling edge of the ALE signal, the lower eight address bits are latched into a transparent octal data latch, U18, and port 0 is set to input mode. Then, the program store enable signal (PSEN) goes low to enable data transfer from the EPROM.

2. Peripheral Interface

Port 1 goes directly to three 8243 I/O expanders. Bits 5-7 are connected to the chip select lines of display board expander U2 (bit 5), and control board expanders U15 (bit 6) and U17 (bit 7). Only one of the I/O expanders can be enabled at a time. Bits 0-3 hold the instructions to be carried out by the enabled integrated circuit when bit 4 goes from a high to a low logic level.

3. Miscellaneous Functions

Port 3 performs several miscellaneous tasks required by the control system: it provides a serial interface for manufacturing testing; monitors the presence or absence of line power; checks the status of the watchdog timer; and sends data and clock signals to the display board driver.

The serial interface consists of the microcontroller transmit line (TXD/P3.1), the receive line (RXD/P3.0), a +5 Volt Standby connection and a connection to logic ground. These lines are all connected to J6 to allow factory testing.

$\overline{\text{INT0}}$/P3.2 is the line frequency signal pulse, which is derived from the +8 Vac nominal supply (discussed in Section A, Power Supply Circuitry). Absence of the line frequency signal pulse is used to detect a power failure.

$\overline{\text{INT1}}$/P3.3 monitors the status of the watchdog timer and the two unused address bits.

T0/P3.4 sends serial data to the display driver, U1 (display board), while T1/P3.5 clocks the driver.

D. Heater Control

The heater control algorithm ensures that line voltage variations will not affect the heater output so long as the voltage remains between 90 and 110% of the nominal voltage (115 volts for 120 volt units). For voltages outside this range, the line voltage is assumed to be either 90 or 110% depending on the violated limit.

Heater output is controlled by varying the number of ac cycles delivered to the heater. Depending on the line voltage and the percentage of the maximum heater output necessary to maintain the required temperature, between 0 and 60 cycles will be delivered to the heater every second. When the line voltage is within 10% (90% to 110%) of the nominal voltage, the number of heater power cycles is calculated proportionately:

$$\text{Number of cycles} = 50 \times \frac{(\text{rated voltage})^2}{(\text{line voltage})^2} \times (\text{required \% max. heater output})$$

If the line voltage is less than or equal to 90% of the nominal voltage, the number of cycles is calculated by multiplying the percentage of the maximum heater output required by 60. For example, at 90% of the nominal voltage, the heater would be on for 60 cycles out of 60 when 100% of the maximum heater output was required. Above 110% of the rated voltage, the number of cycles is calculated by multiplying the percentage of maximum heater output by 40.

The heater control routine is independent of line frequency.

1. Heater Control Circuit

As shown in Figure 1-3, the heater control circuit consists of a safety relay, a solid state relay, and a thermal switch wired in series. The heater is normally switched ON and OFF by closing or opening the heater neutral.

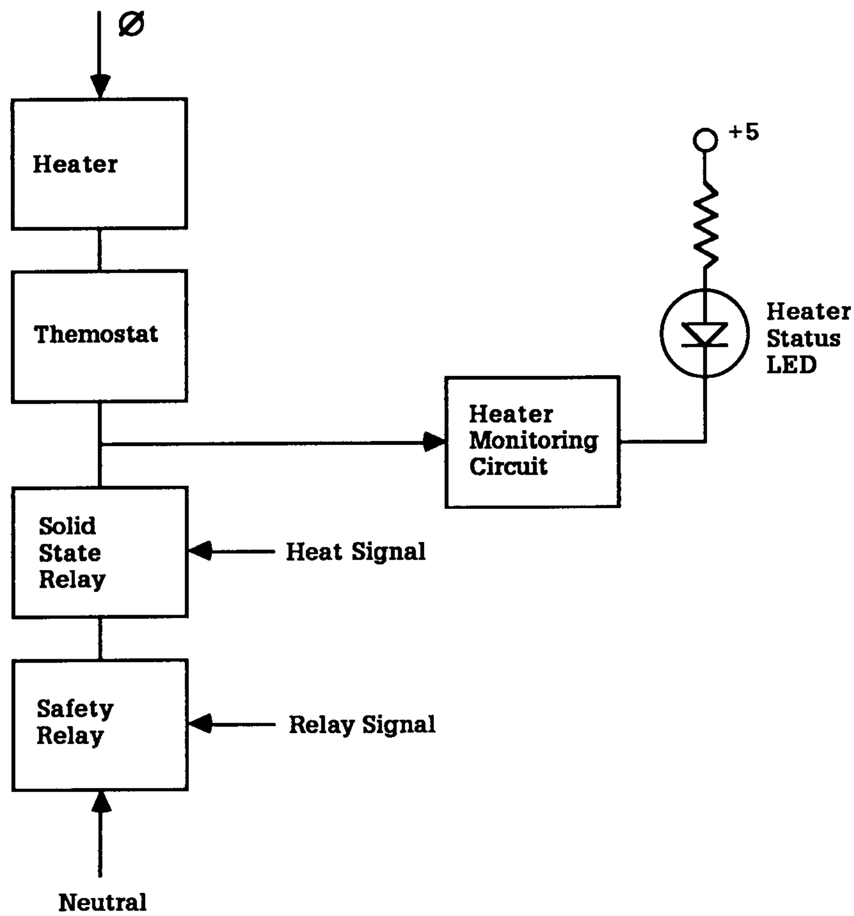


Figure 1-3 Heater Control and Monitoring Circuits

Safety Relay

The safety relay, K1, is controlled by the Relay signal, which is produced by gating the outputs of the air safety circuit and the watchdog timer circuit. The safety relay shuts down the heater if the watchdog timer fails to receive clock pulses, if the air probe shorts or opens, or if the air temperature exceeds the preset limit. An opto-isolator triac driver, U4, isolates the low voltage and the line voltage circuits.

Under normal conditions, the Relay signal is high (+2.4 Vdc minimum). This switches ON FET U12B, causing the relay coil to energize and close the contacts.

Note: This requires a minimum 7.32 Vdc from the unregulated +8 volt supply (TP1-5).

If the air safety circuit or the watchdog timer trigger an alarm, the Relay signal goes low (0.5 Vdc Maximum), switching OFF the FET and opening the safety relay contacts.

Solid State Relay

When the safety relay is closed, the solid state relay switches the heater ON and OFF under microcontroller control.

The microcontroller switches ON the heater by setting the Heat signal (U15 pin 21; P5.3) high. This switches ON U12A connecting the solid state relay neutral line to neutral and activating the zero crossing detection circuit inside the relay. Because this circuit switches ON or OFF only at zero voltage there may, in practice, be up to a half cycle switching delay.

Thermal Switch

The thermal switch is mounted on the rear of the controller, near the heating element, and is set to open if its temperature exceeds 76.7 C (170 F). The thermal switch self resets (closes) when it has cooled.

2. Heater Monitoring Circuit

Note: Heater status is monitored before the thermal switch. Hence when the thermal switch is open, the feedback from the monitoring circuit still indicates that the heater is ON.

The heater monitoring circuit outputs the heater status signal to the microcontroller through I/O expander U17. When the heater is ON, the heater status signal is low. As a diagnostic aid, a heater status LED on the control board illuminates whenever the heater is ON.

The heater status signal is derived from a portion of the heater ac signal input to CR13. When the heater is OFF, the dc output from CR13 powers opto-isolator U3 and sets the U7A NAND gate input low. The NAND gate output goes high, and the heater status LED goes out.

When the heater is ON, there is no voltage potential across CR13, and the opto-isolator is not powered. The second NAND gate input is tied high, so the gate output goes low, and the heater status LED illuminates.

Note: Every half cycle the output U3 pin 4 will show small glitches caused by the charge/discharge of capacitor C20. These glitches do not affect circuit performance unless they exceed U7's (74LS132) trigger voltage of 1.4 Vdc.

E. Watchdog Timer

A watchdog timer circuit checks that the microcontroller is working properly. After every cycle through the system software, the microcontroller sends a low pulse to the A input of U9A, a retriggerable monostable timer (74LS123). This causes the output (Q) to go high and the inverted output $(\overline{Q})$ to go low for a period of time determined by the time constant of the RC network on the RxCx and Cx pins (Tau = 0.45 x R x C = 0.23 Sec). If another pulse from the microcontroller is not received at the A input before the time constant expires, both outputs change logic levels. The output,(Q), goes low and is gated by NAND gate U7D and NOR gate U8 to produce a logic low Relay signal. This de-energizes the safety relay and shuts down the heater. The inverted output,$(\overline{Q})$, sets the Reset pin on timer U6A high, triggering the high priority audio alarm. The inverted output, $(\overline{Q})$, is also gated through NOR gate U8C to produce the logic low interrupt signal that begins the microcontroller software recovery routine $(\overline{INT1})$.

F. Alarm Tone Generator

The alarm circuit consists of an alarm tone generator and control circuitry for high or low priority alarm conditions. Frequencies for the tone generator are produced by two timer circuits, U6A and U6B. If no alarm is present, the reset pins on both timers are held low and no signal is produced.

1. High Priority Alarms

Two timers are cascaded to generate the high priority audio alarm. They can be triggered either by the microcontroller through I/O expander U17 or by the watchdog timer. NOR gate U8B checks the output of both circuits. If either signal goes high, the reset pins for both timers go high. This causes U6B to generate a 2 kHz signal. A 1 Hz signal from the second timer (U6A) pulses the control line of the first timer through R35. This alters the frequency of the first timer (U6B) to produce a warbling effect (two tone alternating alarm).

U7C gates the output of NOR gate U8B with the low priority alarm line. This ensures that the high priority alarm will override the low priority alarm when both are active.

2. Low Priority Alarms

The low priority alarm is triggered by a 1 Hz pulse from the microcontroller through I/O expander U17. Before the command is executed, NAND gate U7C checks the low priority alarm signal against the output of NOR gate U8B to make sure that a high priority alarm is not already in effect. If no high priority alarm is active, (U7C pin 5 high), the reset line on timer U6B is pulsed once a second, producing a pulsed, 2 kHz signal (TP2-1). This results in a one second on, one second off (i.e. 2 kHz) audio alarm. The 2 kHz signal is adjusted to +/-100 Hz by

R36. The volume of the audio alarm is adjusted by R37. For maximum volume, R37 should be adjusted fully counterclockwise.

G. Air Safety Circuit

The air safety circuit opens the safety relay to shut down the heater if the air temperature exceeds the preset safety limit, or if a short or open circuit is detected in the air temperature sensor. The air safety circuit is completely independent of the microcontroller and has two subcircuits: the air probe test circuit, which monitors the air display signal to detect a short or open circuit; and the high air temperature circuit, which monitors the air display signal to detect high temperatures.

1. Air Probe Test Circuit

Important: The information on voltage input levels given in this section and in the appendices is approximate. It is based on an offset voltage of 1.99 Vdc measured at TP2-4 and will vary with the actual offset voltage.

The $\overline{SO}$ signal output by this circuit goes low when the air display thermistor circuit is open or shorted. Air display signals that exceed 880 mV (approximately equivalent to 25.69 kOhm, or 5 C) are interpreted as open circuits. Signals that fall below 410 mV (approximately equivalent to 35.63 kOhm, or 50 C) are interpreted as short circuits.

The air display signal is input in parallel to two open collector comparators U5B and U5C, which feature high impedance output under normal conditions. If the air display thermistor opens, comparator U5C's output pulls $\overline{SO}$ low. If the air display thermistor shorts, comparator U5B's output pulls $\overline{SO}$ low.

The $\overline{SO}$ signal is gated by the relay circuit to produce the Relay signal. A logic low $\overline{SO}$ signal causes the Relay signal to go low, opening the safety relay to shut down the heater. The $\overline{SO}$ signal (TP2-5) is also fed back to the microcontroller through I/O expander U17, pin 1 (P5.0) for alarm generation.

2. High Air Temperature Circuit

Important: The information on voltage input levels given in this section and in the appendices is approximate. It is based on an offset voltage of 1.99 Vdc measured at TP2-4 and will vary with the actual offset voltage.

Comparator U5A compares the air display signal to a reference voltage supplied by one of five resistor networks. Each network corresponds to a different temperature limit. They are connected to the comparator through multiplexer U10. Microcontroller signals applied through I/O expander U17 select the appropriate network based on the mode of operation and the control temperature. If the air display thermistor voltage signal is less than the reference voltage, comparator output, OT (TP2-6), floats high and is gated through U8A to produce a logic low Relay signal, which opens the safety relay to shut down the heater.

The OT signal (TP2-6) is also fed back to the microcontroller through I/O expander U17, pin 23 (P5.1).

Maximum temperatures and the corresponding voltages are shown below.

Mode	Control Temperature	Alarm Temperature	Approx. Voltage	Resistance
Air Control	< 37 C	38 C	540 mV	5,731 Ohm
Air Control	> 37 C	40 C	520 mV	5,270 Ohm
Patient	All	40 C	520 mV	5,270 Ohm

Important: Control board dip switches 1 and 2 must both be set to OFF for the high air temperature circuit to function.

Note: The alarm has about 1 C hysteresis before resetting.

H. Relay Circuit

The relay circuit produces the Relay signal, which directly controls the heater safety relay. The relay circuit and all the signals used by the circuit are independent of the microcontroller.

The relay circuit consists of two gates: NAND gate U7D gates the output of th watchdog timer and the air probe test circuit signal ($\overline{\text{SO}}$); NOR gate U8A gates the NAND output with the OT signal to produce the Relay signal. The Relay signal goes low, opening the safety relay to shut down the heater if: the $\overline{\text{SO}}$ signal goes low; the OT signal goes high; or the watchdog timer output goes low.

1.2 Display Board

The display board is the interface between the operator and the control system It informs the operator about the incubator and patient status. The operator controls the system by depressing the various switches on the front display. Two integrated circuits simplify display board operation: the 8243 I/O expander, used in conjunction with the switches; and the MM5451 LED driver for the displays.

A. Switch Decoding

Signals pass between the microcontroller and the display board through I/O expander U2, at a rate of approximately 1 MHz. The I/O port is activated by a logic low on the chip select line ($\overline{\text{CS1}}$). Command words are latched into port 2 on the high to low transition of the PROG line and decoded to set a high impedance on the selected port lines. Ports 6 and 7 are connected to the front panel switches. When a switch is depressed, the corresponding line is pulled low and loaded into the I/O expander's input buffer. The data in the buffer is transferred to the microcontroller on the low to high transition of the Prog line.

B. LED Displays

The LED display driver, U1, controls the LED displays. Data is input to pin 22 synchronously with the clock signal (pin 21). The first bit activates the driver, and 35 data bits follow. After the 35th bit is loaded, data is latched to provide direct output. Because the output is inverted, a logical 1 switches ON the appropriate LED at the output.

Display brightness is factory preset, but can be adjusted using R11.

C. Multiplexing of Displays

To minimize the number of driver lines required, displays are multiplexed through U1. Displays are divided into four groups: control temperature LEDs, air temperature LEDs, patient temperature LEDs and miscellaneous LEDs (mode, alarm and heater power). Port 4 of I/O expander U2 turns on a Darlington transistor to select the active display channel. The large gain of the Darlington allows a small current to sustain the load current from the LEDs.

Bits 1-32 supply the necessary information to each section. Bit 33 is unused. Bit 34 is tied to a 221 ohm +/-1% resistor, used for calibration. After each of the four display groups have been serviced, a string of 35 zeroes is sent on the data line to reset the driver for the next string of data; the driver operates with serial input and does not have a master reset.

The basic display circuit (one LED) includes: the +5 V DISP supply from the control board routed through the 1N4001 diode, the collector emitter junction of the enabled Darlington transistor, the LED, and the MM5451 decoder.

1.3 Specifications

See Section 6, Illustrated Parts for a complete listing of incubator stock numbers.

A. Electrical Specifications

1. Power Requirements

Domestic (Designed to UL 544 and CSA 22.2 specifications)
120 Vac 60 Hz Models (115 Vac +/- 10%, 5.7 Amps)

Export (Designed to IEC 601-1 and IEC 601-2 specifications)
100 Vac 50/60 Hz Models (100 Vac +/- 10%, 6.6 Amps)
120 Vac 50/60 Hz Model (115 Vac +/- 10%, 5.7 amps)
220 Vac 50/60 Hz Models (220 Vac +/- 10%, 3.0 Amps)
240 Vac 50/60 Hz Models (240 Vac +/- 10%, 2.7 Amps)

Nominal Power Consumption 450 watts at maximum heater output

2. Line Voltage Compensation

Heat output compensated for line voltage fluctuations up to 10% of nominal lin voltage.

3. Circuit Breaker

Rated Current: 7 Amps
Trip Point: 9.45 Amps Minimum
Type: Manual Resetting
Model: Airpax Snapak

B. Performance Specifications

1. Patient Temperature Measurement

Range Displayed: 22 to 42 C (71.6 to 107.6 F)
Accuracy: +/- 0.3 C (+/- 0.5 F) within range
Resolution: +/- 0.1 C or F

Probe Model Number LA003
Probe Interchangeability +/- 0.1 C (+/- 0.2 F)

2. Air Temperature Measurement
Range Displayed: 5 to 50 C (41.0 to 122.0 F)
Resolution: +/- 0.1 C or F
Accuracy: Varies over temperature range

Temperature Range	Accuracy
5 to 22 C (41 to 71.6 F)	+/- 0.5 C (0.9 F)
22 to 42 C (71.6 to 107.6 F)	+/- 0.3 C (0.5 F)
42 to 50 C (107.6 to 122.0 F)	+/- 0.5 C (0.9 F)

3. Control Temperature Ranges

Patient Control Mode:	35.0 to 37.0 C (95.0 to 98.6 F) Up to 37.5 C (99.5 F) with internal dipswitch (Section 3.3.K)
Air Control Mode:	20.0 to 37.0 C (73.4 to 98.6 F) Up to 39.0 C (102.2 F) with control panel Override switch.

4. Thermal Performance
*Temperature Rise Time: 25 - 30 min per 10 C (18 F)
*Temperature Variability: 0.2 C (0.4 F)
*Temperature Overshoot: Less than 0.5 C (0.9 F)

***Note:** Terms are defined in the Definition Section.

5. Alarms

Indicator and Nonsilenceable Audio Alarm
Power Failure

Indicator and Silenceable Single Tone Alarm
Difference between patient temperature and patient control temperature exceeds 1.0 C (patient control mode; adjustable to 0.5 C, Section 3.3.J.)

Air temperature is 1.5 C above or 3.0 C below air control temperature (air control mode; Disabled for 30 minutes after power up and for 15 minutes after control temperature change).

Indicator, Silenceable Two Tone Alarm and Heater Shutdown
Air temperature sensor disconnected (both modes)

Patient probe disconnected or malfunctioning (patient control mode)

Air circulation system failure

Patient temperature > 42.0 C or < 30.0 C

Air temperature > 38.0 C (air control mode w/o Override); Air temperature > 40.0 C (patient control mode or control mode w/ Override)

Indicator, Nonsilenceable Two Tone Alarm, Heater Shutdown and Possible Error Code
System failure

6. Operator Prompt Tone
An intermittent audio tone sounds when the unit is first switched ON, and when the patient control mode is first selected. The tone is silenced when control temperature is entered. The heater will not operate until a control temperature has been entered.

7. Proportional Heat Control
Features zero voltage switching to minimize radiated and conducted EMI. Heater power is compensated for line voltage fluctuations up to 10% from the nominal voltage.

C. Safety Specifications

1. Isolation Voltage
2500 Vrms @ 60 Hz from the patient probe tip to the ac phase and neutral lines for one minute.

 Type B IEC Isolation

2. Leakage Current
From enclosure to ground with ground wire open and with UL, CSA, or AAMI test load attached:

a. Less than 50 microamperes measured at the metal tip of the patient probe; less than 100 microamperes measured at any exposed metal surface for equipment rated at 120 Vac, 50/60 Hz.

b. Less than 100 microamperes measured at the metal tip of the patient probe; less than 200 microamperes measured at any exposed metal surface for equipment rated at 220 Vac, 50/60 Hz or 240 Vac, 50/60 Hz.

3. Self Test
The microcontroller performs self test and software verification functions when the power is first switched ON.

D. Environmental Specifications

Operating Temperature Range:	20 to 30 C (68 to 86 F)
Storage Temperature Range:	-25 to 60 C (-13 to 140 F)
Operating Humidity Range:	0 to 95%
Air Velocity Over Mattress:	Less than 10 cm/sec (double walled units) Less than 35 cm/sec (single walled units)
Noise Level Within Unit:	Less than 60 Decibels, A weighted

Humidity Within Unit (when using built in humidifier):	50% +/- 10%, depending on operating conditions
Oxygen Concentration Within Unit:	25 to 45% with 5 L/min oxygen input 35 to 65% with 10 L/min oxygen input 45 to 70% with 15 L/min oxygen input

E. Mechanical Specifications (without accessories)

Dimensions with cabinet
Weight: 185 lbs (84.04 kg)
Height: 53.5 inches (135.9 cm)
Depth: 25.5 inches (64.8 cm)
Width: 35.0 inches (88.9 cm)

Incubator only
Height: 24.5 inches (62.2 cm)
Depth: 24.2 inches (61.5 cm)
Width: 32.7 inches (83.1 cm)

Mattress: 13.7 x 25.6 inches (34.8 x 65.0 cm)
Tilt Positions: +/- 8 degrees in 4 degree angular increments
Casters: 5 inch diameter, 2 locking, 2 non-locking

WARNING: Two people are required to lift the Care Plus Incubator. Follow safe lifting techniques to avoid injury.

2.1 Receiving

Refer to the setup instructions shipped with the Care Plus Incubator for initial unpacking and setup of the unit after shipment.

WARNING: If the mounting knobs that attach the incubator to the cabinet are not securely fastened, the incubator could tip off of the cabinet when the hood is opened.

Inspect the Care Plus Incubator and all accessory items for any signs of damage that may have occurred during shipment. File a damage claim with the shipping carrier if damage has occurred. Also confirm the presence of all accessory items as listed on the packing slip.

2.2 Checkout Procedure

WARNING: After completing any portion of the calibration and adjustment procedures for the Care Plus Incubator, perform the Checkout Procedure to make sure that the unit is operating correctly. In addition a final electrical safety check and leakage current test must be performed. Record the information for future reference.

Note: Refer to Section 3.3, Calibration, if the results of the Checkout Procedure indicate that the display brightness, the alarm volume, the alarm frequency, the air safety circuit trip point, or the ADC reference voltage need adjustment.

A. Mechanical Checks

WARNING: Disconnect the power to the incubator for the mechanical portion of the Checkout Procedure.

Important : See Figure 2-1, page 2-4, for the location of mechanical controls and other incubator components.

1. Disconnect the power cord for the Care Plus Incubator for the mechanical portion of the Checkout Procedure.

2. Examine the power cord for damage. Replace the power cord if damage is evident.

3. Examine the incubator for obvious signs of damage.

4. Lock the two front casters and check that the unit is held in place.

5. Open the cabinet and verify that the four incubator mounting knobs, which attach the incubator to the cabinet, are secured tightly in place.

6. Check the front door seals. With the door closed, check that the clear plastic seals on the upper and lower edges fit tightly.

7. Rotate both front door latches toward the center of the incubator and lower the door. Make sure that the inner wall is securely fastened to the door and that the deflector panel (Figure 2-1) is installed on the inner wall.

8. Make sure that the front door is securely fastened to the incubator. Openin the door exposes the two spring-loaded metal hinge pins that slide into holes in the base platform. If the door is not properly attached, pull both pins out towards the sides of the incubator and line them up with the hinge Release the pins and verify that they snap into position.

9. Check that the mattress and the mattress tray are properly installed. Verify that you must lift the tray slightly to slide it out of the hood. This prevents the tray from sliding out accidentally. Slide the mattress tray back into the hood.

10. Check the portholes. Open the portholes by pressing on the clear plastic latch. The cover should swing open. If arm cuffs are installed, the elastic cuff band should fit into the groove around the porthole without obstructin the cover. Close the porthole and verify that the latch holds it in place.

11. If the optional inner walls are installed, check that they are securely attached to the outer walls. To attach the inner wall, align the inner wall fasteners with the mounting posts on the outer hood and push in on the plunger portion of the fastener. Also verify that the deflector panel is attached to the rear inner wall.

12. If the upper inner wall is not used, make sure that hole plugs are inserted into the unused top mounting holes.

13. Check the hood seals. Examine the seals at the bottom of the left, right and back sides of the hood. They should seal tightly when the hood is closed.

14. Check that the tubing access covers are also installed on either side of the hood.

15. Check the hood tilt latch. To open the front door, depress the hood tilt release and rotate the hood back approximately 30 degrees, until it locks into position with an audible click. Push against the hood and make sure that it is held in place. To close the hood, support the hood and press the hood tilt release. Gently lower the hood.

Note: The hood tilt release must be depressed while raising or lowering the hood.

16. Check the operation of the tilt mechanism. Press in the locking button in the center of the tilt handle and push down on the handle. Release the locking button and verify that the mechanism locks in the four degree position. Press the locking button again and rotate the handle downwards. Release the locking button and verify that the mechanism locks in the eigh degree position. Depress the locking button and lift up on the tilt handle t return to the horizontal position. Repeat this step for the second tilt handl

17. Check that the controller is latched in position. The controller latches should be all the way down, parallel with the sides of the controller.

18. Locate the humidifier fill port, on the left side of the unit. Grasp the handle on the lower edge of the fill port and pull it out into the open position. Make sure that it does not come out all the way unless you rotate it clockwise. Rotate it counterclockwise into the drain position. Rotate the fill port back into the upright position and push it back into the lower unit.

19. Unscrew the two filter mounting knobs on the rear of the incubator, lift off the vented filter cover panel, and check the condition of the filter. If the filter is dirty, has been used with an infectious patient, or has been in use f three months it must be replaced. When you replace the filter, mark the date on the label supplied with the replacement filter. Affix the label to th exterior of the filter cover panel.

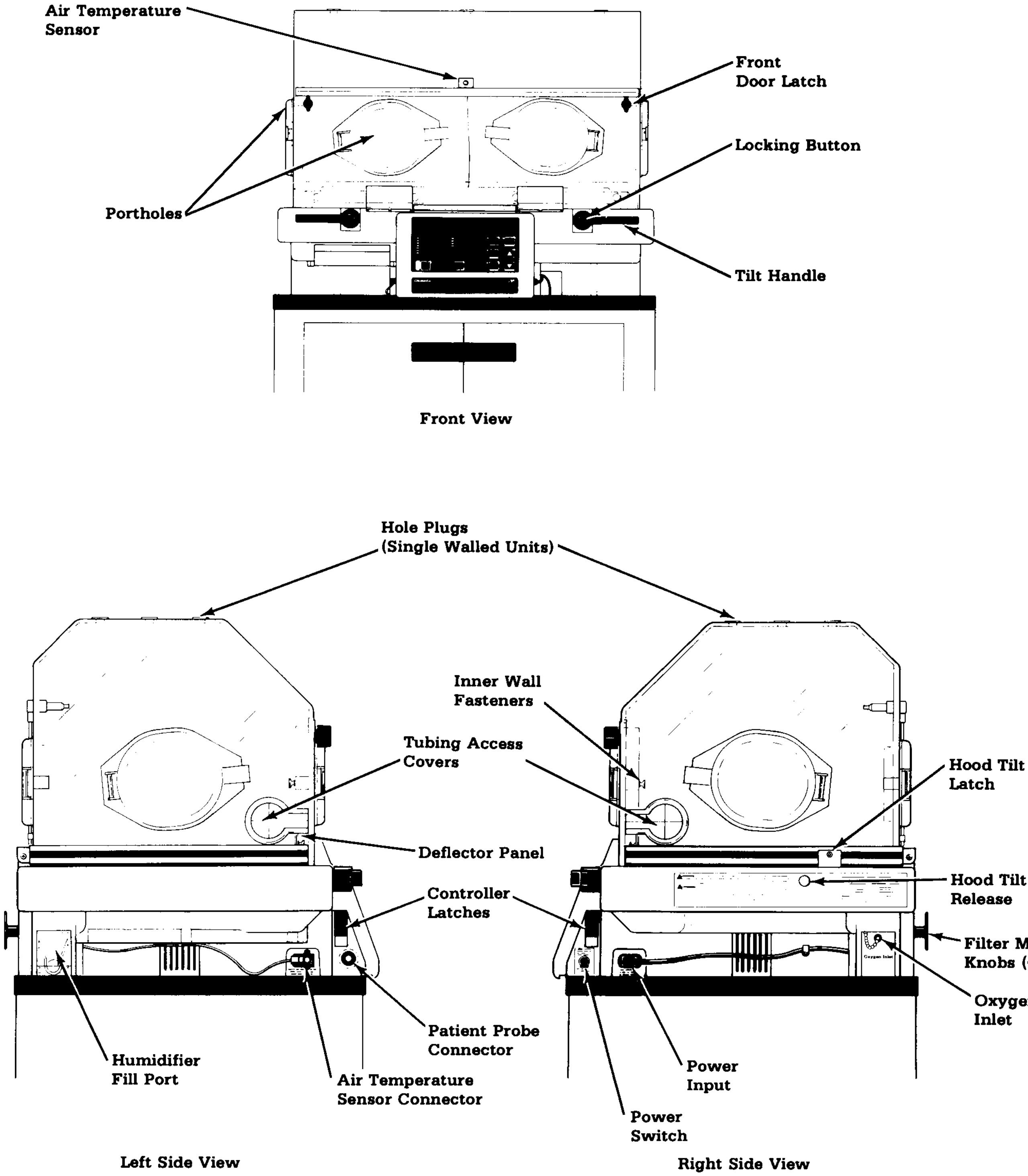


Figure 2-1 Operating Controls, Indicators and Connectors

Item (Figure 2-1)	Function
Hood tilt latch and hood tilt release	Prevents hood from opening accidently. Also secures hood in the tilted position; You must press and hold the hood tilt releas button while raising or lowering the hood.
Door hinge pins (not shown)	Spring loaded metal pins inside the front door hinges. Open doo and pull hinge pins toward the sides of the incubator to remove the door.
Tilt handles and locking buttons	Depress locking button in center of handle and rotate handle fo Trendelenburg and Fowler positioning.
Portholes	Press the clear plastic latch to open the porthole.
Tubing access covers	Route cables and tubes into or out of the unit through the tubin access covers.
Door latches	Turn door latches toward the center of the incubator to open th front door.
Humidifier and fill port	To use humidifier, pull port out, add water up to the fill line onl push port back in. Pull port out and rotate counterclockwise to drain. Pull port out and rotate clockwise to remove.
Oxygen inlet	Connect tubing between flowmeter outlet and oxygen inlet to raise hood oxygen concentration.
Patient probe connection	Push probe connector firmly into socket until it clicks. Grasp t connector and pull to disconnect.
Air temperature sensor connection	Keyed connector for air temperature sensor; to connect the air temperature sensor, align the connectors and push them together. Disconnect the sensor by pressing in the back of the connector while pulling back on the "T" handle.
Controller latches	Pull latches up (perpendicular to controller sides) to slide out t controller. Push down to secure controller.
Filter cover	Vented panel on rear of unit. Remove knobs and panel to acce filter.
Power switch and circuit breaker	Combination power switch and circuit breaker. Set the switch ON to reset circuit breaker.
Inner wall fastener	Used to secure inner walls. Line up with mating mounting post in outer hood and press in plunger to snap in place. Pull out the plunger to release.
Hole plugs	Used to plug the holes in the top of the hood on single walled units.

B. Accessory Checks

1. Check that all accessories are securely mounted.

2. Check the operation of any accessories with reference to the appropriate operation and maintenance manuals.

3. If an Ohmeda manometer will be used, verify that it reads 0 Kpa at atmospheric pressure. If it is necessary to zero the manometer, unscrew the plastic bezel over the plastic cover. Adjust the zeroing screw located on top of the manometer, above the 4 Kpa marking.

4. Set up any required suction or gas supply systems. Check them for leaks as outlined in the appropriate operation and maintenance manuals.

C. Controller Checks

Important: Figure 2-2, page 2-7, identifies the individual control panel switches.

Important: The Enable switch must be pressed to activate the temperature adjustment, the Override, or the control mode switches. These switches remain active as long as the enable indicator is illuminated (approximately 12 seconds after the last time one of these switches is pressed).

Note: When the patient probe is initially plugged in for checkout, LLLL will be displayed in place of the patient temperature, if its reading is below 22.0 C, (71.6 F).

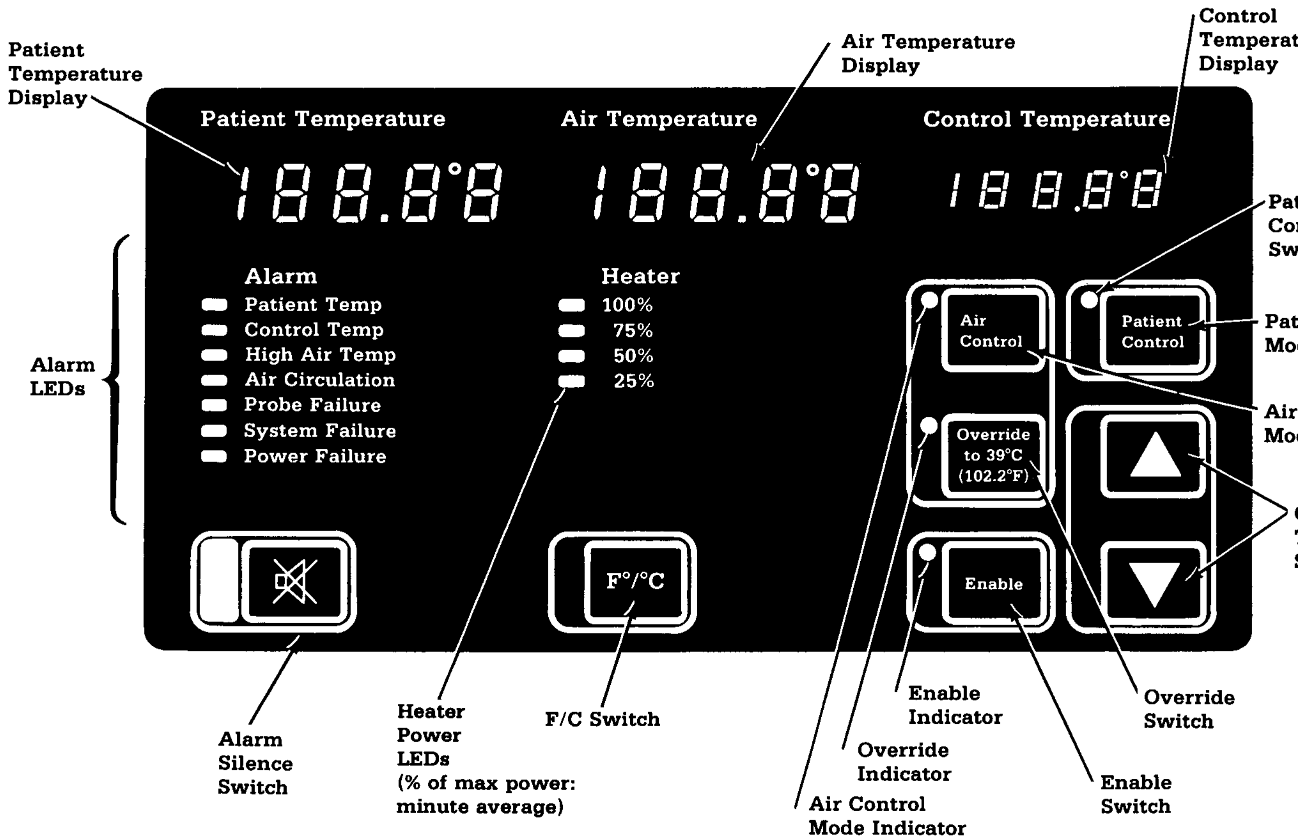


Figure 2-2 Control Panel

1. Make sure the power cord is connected to the socket on the right side of the controller.
2. Plug the patient probe into the labeled connection on the left side of the controller.
3. Line up the air temperature sensor connectors. Plug the air temperature sensor into the labeled connection on the left side of the controller.
4. Route the patient probe cord through the tubing access cover and place the patient probe inside the incubator.
5. Plug the power cord into an appropriately rated power source (see rating plate for proper voltage etc.).

6. Switch the power ON and verify the following sequence:

   a. An alternating two tone audible alarm sounds for approximately five seconds, all the indicators illuminate and 188.88 appears in the three temperature displays.

   b. All indicators are extinguished except for the air control and the enable indicators. The temperature displays change to show from left to right:

Patient Temperature	**Air Temperature**	**Control Temperature**
XX.XX (software version no. for example 01.01)	60.H (AC freq. 50 Hz for 50 Hz models)	39.0 C (max. manual control temp.)

   c. An operator prompt tone sounds, and the control temperature display flashes 33.0 C. The operator prompt tone will sound every two seconds until a control temperature is entered by pressing either the ↑ or ↓ switch.

7. Adjust the control temperature to silence the prompt tone.

8. Check display illumination and the audible alarm by depressing and holding the Alarm Silence switch until all of the indicator LEDs illuminate, and 188.8 appears in the three temperature displays (approximately five seconds). The alternating two tone alarm should sound.

9. Check the Enable switch. Press the Enable switch. The enable indicator should illuminate and go out after approximately 12 seconds. Verify that pressing the ↑ and ↓ switches has no effect when the enable indicator is extinguished.

10. Check the analog to digital calibration and the line voltage. Depress and hol the Enable switch until the following values appear in the temperature displays (approximately five seconds):

Patient Temperature	**Air Temperature**	**Control Temperature**
25.05 C (+/- 0.2 C) (low calibration point)	37.95 C (+/- 0.2 C) (high calibration point)	From 09.00 to 11.00 (Service use only)

Note: An alternating two tone alarm will sound to indicate that the actual temperatures are not displayed.

11. Check the patient probe. Warm the patient probe by placing it between your fingers. Verify that the displayed patient temperature increases. If an AAMI approved thermometer is available, place both the thermometer and the patient probe in a glass of warm water. Stir the water and wait several

minutes until the thermometer reading stabilizes. Verify that the patient temperature shown on the control panel is within 1 C of that shown on the thermometer. Replace the probe and repeat the check if the reading is outside the 1 C range.

12. Check the normal range of air control temperatures. Press the Enable switch to activate the ↑ and ↓ switches. The enable indicator will illuminate. Press and hold the ↓ switch. Verify that the lowest control temperature attainable is 20.0 C. If the enable indicator has gone out, press the Enable switch again. Depress the ↑ switch and verify that the air control temperature cannot be set above 37.0 C.

13. Check the extended range of air control temperatures. With the control temperature set to 37.0 C, sequentially press the Enable and Override switches. Both the enable and the override indicators should illuminate. Depress the ↑ switch and verify that the maximum air control temperature is now 39.0 C. The override indicator will remain illuminated as long as the control temperature setting remains at, or above, 37.0 C.

14. Check the the F/C switch. Adjust the control temperature to 36.0 C and press the F/C switch. Verify that the control temperature is now displayed as 96.8 F. Press the switch a second time to return to a Celsius display.

15. Switch to the patient control mode of operation. Press the Enable and the Patient Control switches. Then, verify the following sequence:

    a. The enable and the patient control indicators illuminate.

    b. The control temperature display flashes 36.5 C and an operator prompt tone sounds every two seconds. Adjust the control temperature to silence the prompt tone. The enable indicator will be extinguished approximately 12 seconds after the last time the ↑ or ↓ switch is pressed.

Note: A patient temperature alarm will be triggered if the patient probe temperature differs from the control temperature by more than 1.0 C. If the probe temperature is below 30.0 C or above 42.0 C the heater will not switch ON.

16. Change the range of patient control temperatures. Press the Enable switch to activate the ↑ and ↓ switches. The enable indicator will illuminate. Press and hold the ↓ switch. Verify that the lowest control temperature attainable is 35.0 C. If the enable indicator goes out, press the Enable switch again. Then depress the ↑ switch. Verify that the patient control temperature cannot be set above 37 C.

Note: The maximum patient control temperature can be raised to 37.5 C by placing control board dipswitch 3 in the ON position. (Section 3.3.K)

17. Check the patient temperature alarm. Press the Enable switch and adjust the patient control temperature until it exceeds the patient temperature by more than 1.0 C. An intermittent single tone alarm should sound, the patient

temperature should flash, and the patient temperature alarm indicator should illuminate. Press the Enable switch and adjust the patient control temperature until it is within 0.8 C of the patient temperature. The alarm should cancel.

Note: Service personnel can configure the alarm to trigger if the difference exceeds 0.5 C, and to reset when the difference is less than 0.3 C. See Section 3.3 J, Setting the Patient Temperature Alarm.

18. Check the probe failure alarm.

    a. Unplug the patient probe from the controller. Verify that an alternating two tone alarm sounds, the probe failure LED illuminates, HHHH flashes in the patient temperature display, and the heater power LEDs are extinguished. Plug the probe back in and verify that the alarm cancels.

    b. Unplug the air temperature sensor from the controller. Verify that an alternating two tone alarm sounds, 00.0 C flashes in the air temperature display, the probe failure LED illuminates, and the heater power LEDs ar extinguished. Align the connectors and plug the air temperature sensor back into the controller. Verify that the alarm cancels.

19. Check the power failure alarm and the battery backed memory. First verify that you are still in the patient control mode. Then adjust the patient control temperature to 36.0 C. Switch to the air control mode and adjust th control temperature to 35.0 C. Unplug the incubator. An intermittent, nonsilencable alarm should sound, and the power failure LED should illuminate. All other displays and indicators will be extinguished. Wait tw minutes and plug the incubator back in. Verify that the alarm cancels and that the unit returns to the air control mode of operation with a control temperature of 35.0 C. Switch to the patient control mode and verify a control temperature of 36.0 C.

Note: A fully charged battery should supply the power failure alarm for approximately 10 minutes. If the alarm is tested for the full 10 minutes, the incubator must be run for at least two hours to recharge the battery before it is used with a patient. Total recharge time is 8 to 10 hours.

20. Check the Alarm Silence switch. Unplug the air temperature sensor and press the Alarm Silence switch. Verify that the alarm is silenced for one minute. Reconnect the air temperature sensor.

D. Operational Checks

1. Make sure that the incubator is in the air control mode.

2. Verify that the front door, the portholes, and the hood are closed.

3. Set the control temperature as close to the air temperature as possible. Allow the air temperature reading to stabilize. Verify that the air temperature remains within 0.5 C of the control temperature for five minutes after stabilization.

Notes

3/Calibration and Adjustment

WARNING: Use extreme care while performing calibration and adjustment procedures, or while working on the Care Plus Incubator with power connected. An electrical shock hazard does exist; be certain to observe all standard safety precautions.

3.1 Special Tools and Equipment

The following tools (or their functional equivalents) are required to complete the recommended service procedures. If you do not already have these items, they can be ordered from Ohmeda.

Description	Stock Numb
Digital Multimeter, 3 1/2 digit	0175-2379-0(
Leakage Current Tester with AAMI Test Load	0175-2284-0(
Static Control Work Station (recommended)	0175-2311-0(
0.1% Accuracy Variable Resistance Box	
Soldering Iron	

Optional items include:

Description	Stock Numb
Oscilloscope, 15 MHz, dual trace	0175-2302-0(
Ohmeda Temperature Simulator Box (variable resistance box with switches preset to various temperatures)	0271-2788-8(
Hair dryer (1000 watts), or heat gun (glass of hot water, >45 C, can be used as substitute)	

Note: Connecting a variable resistance box to the incubator requires a special cable, which can be constructed as shown in Figure 3-1. This cable is not supplied by Ohmeda, because there is no one connector that will accommodat all types of variable resistance boxes.

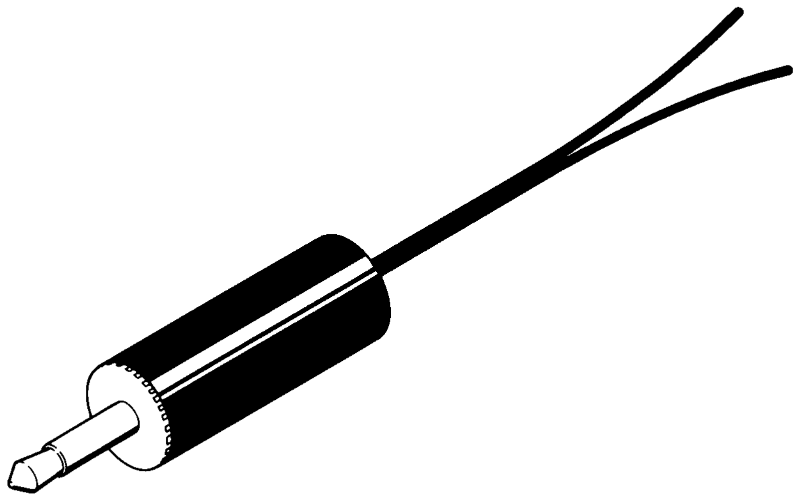


Figure 3-1 Cable for Variable Resistance Box

3.2 Calibration Loop (background information)

Note: The audible alarm sounds continuously in this loop, although the normal incubator alarms are disabled during the calibration loop.

This loop is used to adjust ADC converter calibration, the 2 kHz alarm frequency, the line voltage compensation, and display brightness. To enter the calibration loop, hold down the Enable switch during power up until a continuous alarm sounds. During the calibration loop:

1. The 2 kHz audio alarm sounds continuously. This allows frequency adjustments.

2. A four place (XX.XX C) patient probe reading appears in the patient temperature display.

Note: This display appears even if the patient temperature is outside the normal display range.

3. The percent of rated line voltage at which the unit is operating appears in the control temperature display (XX.XX = XXX.X%). When the correct percentage is displayed, the line voltage compensation is properly adjusted.

4. Output 34 on the display driver is activated. This allows the display brightness voltage to be read and adjusted.

3.3 Calibration Procedures

WARNING: After completing any portion of the calibration and adjustment procedures for the Care Plus Incubator, perform the Checkout Procedure to make sure that the unit is operating correctly. In addition a final electrical safety check and leakage current test must be performed. Record the information for future reference.

WARNING: Before any disassembly or repair, disconnect the electrical supply and any gas supply connections. Also remove any accessories. Do not perform any service or maintenance with the power applied unless specifically told to do so in the procedure.

WARNING: After completing a repair of the Care Plus, the appropriate calibration procedure must be performed to make sure the Care Plus is in proper operating condition. In addition a final electrical safety check and leakage current test must be performed. Record the information for future reference.

CAUTION: Use the Static Control Work Station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

Important: Reference Figure 3-2, page 3-4, for the location of control board potentiometers and test points.

A. Preparation

1. Set up an anti-static work station on a flat surface near the incubator. Use a conductive wrist strap to dissipate any static from yourself to the anti-static mat.

2. Remove the controller from the incubator. First unplug the patient probe, the air temperature sensor, and the power supply cord from the controller. Then lift up the controller latches and slide it forward, out of the incubator. Place the controller on the anti-static mat.

CAUTION: When handling the controller, avoid bumping the fan or the heater. If these items are knocked out of alignment, the fan can grate against either the heater or the base.

3. Remove the six screws and lock washers used to attach the controller cover.

4. Reconnect the power cord and the air temperature sensor to the controller.

5. Verify that control board switches 1, 2, 7 and 8 are in the OFF (open) position.

Note: Leave switch 4, which selects either a 0.5 C or a 1.0 C limit for the patient temperature alarm, in its original position.

Note: Leave switch 3, which selects a maximum patient control temperature (patient control mode), in its original position.

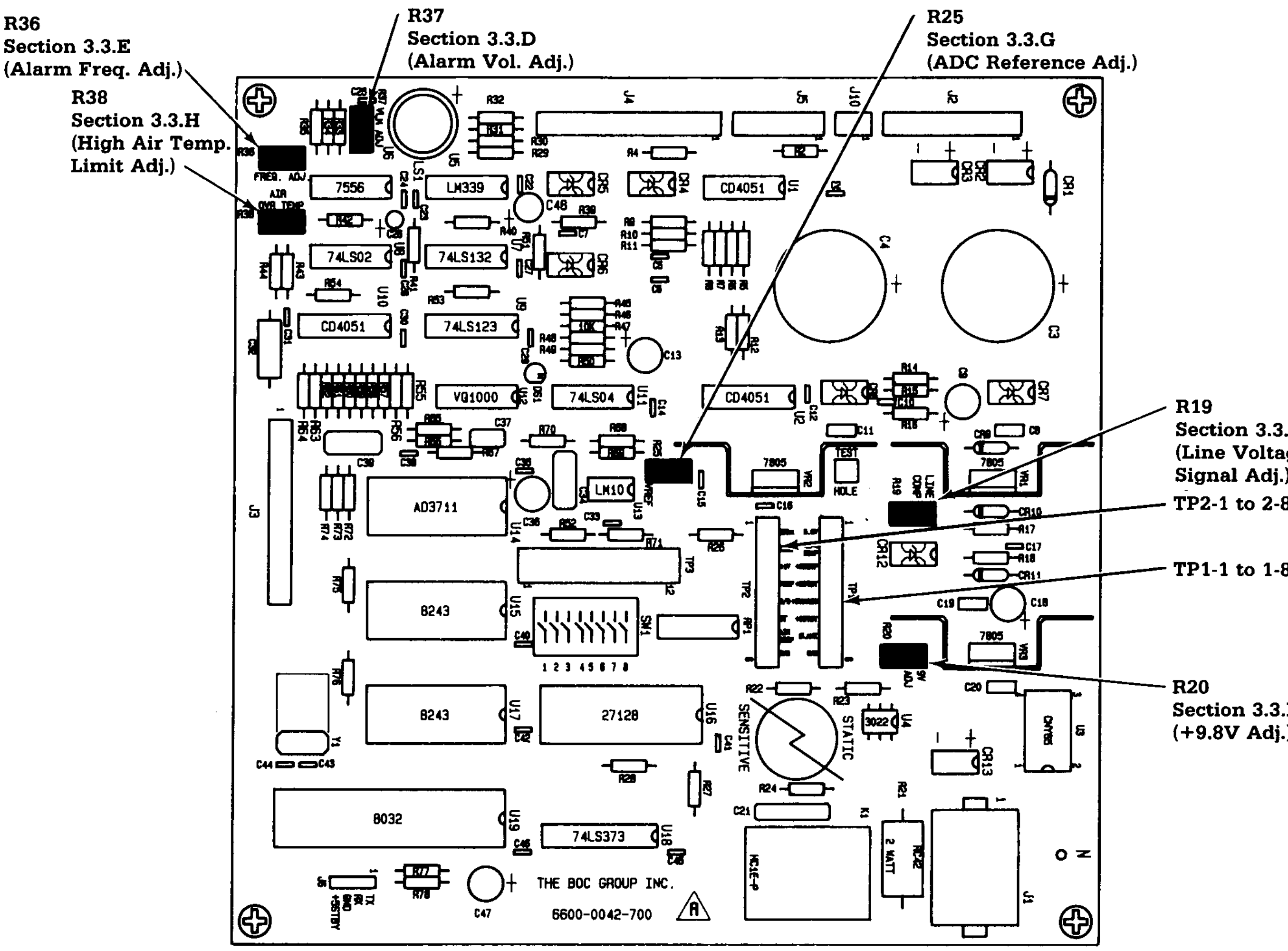


Figure 3-2 Control Board Test Points and Potentiometers

B. Check Voltage Supplies

1. Switch ON the incubator. It will proceed through the normal power up tests. Enter a control temperature to silence the prompt tone.

2. Adjust control board potentiometer R20 until TP1-1 measures 9.8 +/- 0.05 Vdc with respect to GND (TP1-8).

3. Verify the following voltages on the control board with respect to GND (TP1-8):

Test Point	Voltage
TP1-3	5.0 +/- 0.3 Vdc
TP1-4	5.0 +/- 0.3 Vdc
TP1-5	8.0 +/- 1.5 Vdc
TP1-6	9.0 +/- 0.3 Vdc

Note: These voltages cannot be adjusted. The control board must be replaced when they are not within the specified range.

C. Display Brightness

Note: Because display brightness is factory calibrated for both replacement boards and complete controllers, brightness adjustments are only required if the LEDs appear to be dim.

1. Hold down the Alarm Silence switch until all the displays illuminate (approximately five seconds). Check that all displays are illuminated and of uniform brightness. If the displays are acceptable, proceed to Section D. Otherwise, continue with this adjustment procedure.

2. Switch OFF the power and remove the front controller panel.

   a. Turn the controller upside down and remove the lower three front panel mounting screws, shown in Figure 3-3.

   b. Turn the controller right side up and remove the remaining front panel mounting screws, shown in Figure 3-3.

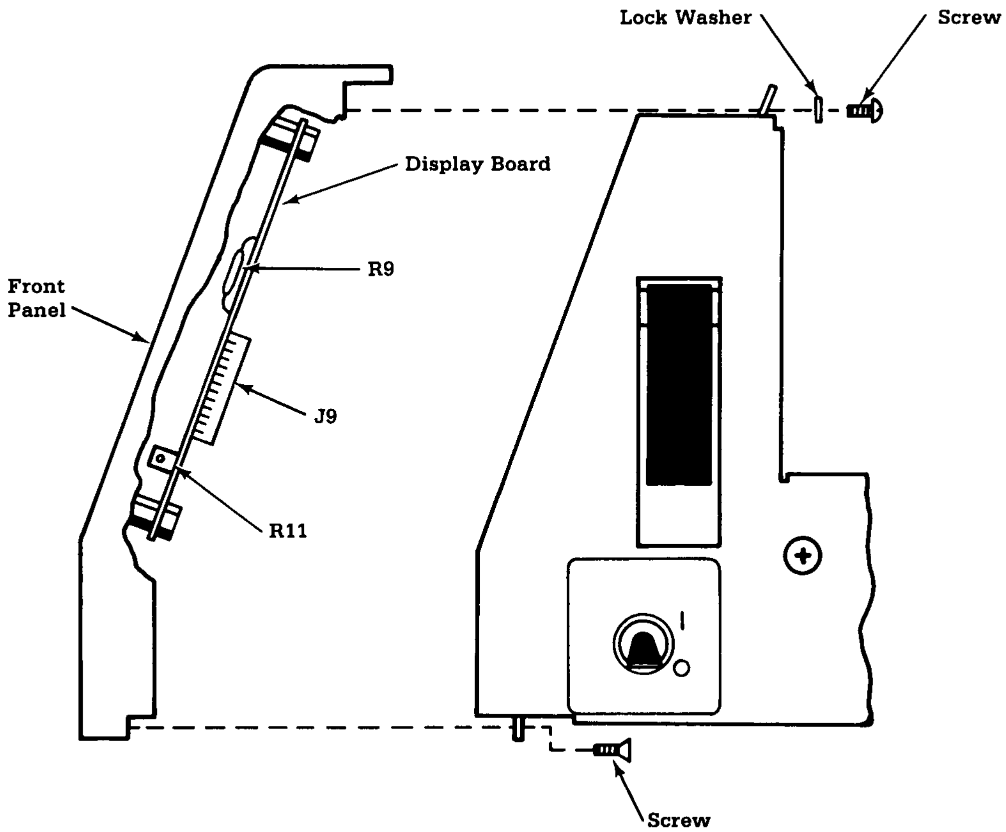


Figure 3-3 Display Brightness Adjustment

Note: Complete disassembly of the front panel is not required. Voltage measurements can be made between pins 11 and 12 of J9, the connector on the back of the display board.

---

3. Reconnect the power cord.

4. Enter the calibration loop by switching the unit ON while holding down the Enable switch. Continue to hold the Enable switch until a continuous singl tone alarm sounds, indicating that the calibration loop is active.

5. Monitor the voltage between pins 11 and 12 of J9, the connector on the rea of the display board. Adjust display board potentiometer R11 (accessible from the edge of the board) to obtain a reading of 3.30 +/- 0.2 Vdc.

Note: This voltage corresponds to the voltage drop across R9.

Important: The voltage measured across R9 will differ if the calibration loop is not used.

6. Replace the display board if an acceptable level of brightness cannot be achieved.

D. Alarm Volume

Verify that control board potentiometer R37 is adjusted fully counterclockwis for maximum volume.

E. Alarm Frequency

Note: Because the alarm frequency is precalibrated at the factory for both replacement boards and complete controllers, frequency adjustments are only required when replacing a control board component that is part of the alarm circuit.

1. Verify that the incubator is in the calibration loop.
2. Verify that the frequency output at TP2-1 is 2 kHz +/- 0.1 kHz. Adjust R36 on the control board as required.

Note: If test equipment is not available to check the frequency, adjust R36 for maximum sound level.

F. Line Voltage Compensation

1. Verify that the incubator is in the calibration loop. In this loop the control temperature display continuously shows the percent of nominal input voltage at which the unit is operating.

Note: Multiply the displayed value by ten to get the actual percentage (XX.XX = XXX.X%).

2. Determine the rated heater voltage of your unit from the serial number sticker on the back of the base platform.
3. Measure the line voltage between the appropriate transformer primaries (pins 4 and 2 on 120 volt units):

Rated Input Voltage (from serial number sticker)	Nominal Input Voltage	Measure Between Pins
240 volts	240 volts	6 and 2
220 volts	220 volts	5 and 2
120 volts	115 volts	4 and 2
100 volts	95 volts	3 and 2

4. Calculate the percent of the nominal input voltage by dividing the measure voltage by the nominal input voltage and multiplying by 100%.

$$\text{\% of line voltage} = \frac{\text{(Measured Voltage)}}{\text{(Nominal Input Voltage)}} \times 100\%$$

5. Adjust control board potentiometer R19 until the control temperature display shows the percentage calculated in the previous step +/- 2%.

Note: The control temperature reading appears in the format XX.XX, which must be multiplied by ten to give the actual percentage, XXX.X%.

G. Analog to Digital Converter (ADC)

1. Verify that the incubator is in the calibration loop.

2. Attach 0.1% accuracy resistance box to the patient probe jack. Adjust the box settings for a resistance of 5900 ohms +/- 0.1% (Ohmeda temperature simulator box setting I7).

Note: The Ohmeda temperature simulator box (Stock No. 0220-1114-800) is a variable resistance box with switch settings corresponding to predetermined temperatures.

3. Adjust control board potentiometer R25 until 37.3 +/- 0.05 C appears in the patient temperature display.

4. Switch OFF the power to exit the calibration loop.

5. Switch the incubator ON. After the normal power up sequence, enter a control temperature to silence the prompt tone.

6. Check the readings from the calibration resistors. Depress and hold the Enable switch until the proper calibration readings appear in the patient and air temperature displays (approximately five seconds):

Patient Temperature	25.05 +/- 0.2 C
Air Temperature	37.97 +/- 0.2 C

7. Adjust the resistance box settings for the following resistances. Verify that the corresponding temperature appears in the patient temperature display.

Resistance Input	Ohmeda Temp. Simulator Box Setting	Patient Temperature
7060 ohms +/- 0.1%	I3	33.0 +/- 0.1 C
6190 ohms +/- 0.1%	I11	36.2 +/- 0.1 C
5496 ohms +/- 0.1%	I2	39.0 +/- 0.1 C

8. Disconnect the resistance box from the patient probe jack.

9. Switch OFF the controller.

H. Air Safety Circuit Calibration (High Air Temperature Alarm)

This procedure requires a hot air source. Either a hair dryer (approximately 1000 watts), or a heat gun , or a glass of hot water (>45 C) can be used for this purpose.

1. Switch the controller ON.
2. In the air mode, adjust the control temperature to 36.9 C.
3. The heater should switch ON. Verify that the heater power LEDs on the display panel and the heater status LED on the control board are both illuminated. The heater status LED may flicker.
4. If you are using a glass of hot water (>45 C) as the heat source:
   a. Unscrew the two mounting screws that attach the air temperature senso to the hood. Remove the sensor mounting blocks and pull the sensor out of the hood.
   b. Place the air temperature sensor in the glass of hot water (>45 C). The rate of temperature increase should not exceed 0.05 C per second.
5. If you are using a heat gun or blow dryer, switch it on and point it at the air temperature sensor. Observe how quickly the displayed air temperature increases. If necessary, reposition the heat gun (dryer) so that the rate of increase does not exceed 0.05 C per second.
6. Monitor the air temperature display. When the high air temperature alarm illuminates, verify an air temperature display of 38.0 +/- 0.3 C. Also verify that the safety relay opens (audible click; heater status LED extinguished)
7. Press the alarm silence switch and remove the air temperature sensor from the glass of water or switch OFF the blow dryer.

Important: This alarm will not reset unless the alarm silence switch is pressed

8. Monitor the air temperature display and verify that the alarm resets.
9. If the alarm is triggered at an air temperature other than 38.0 +/- 0.3 C, adjus R38 on the control board and repeat this procedure.
10. If necessary, remount the air temperature sensor on the hood.

Important : This alarm will not reset unless the alarm silence switch is presse

I. Thermal Switch Operation

1. Hold a hot soldering iron (minimum temperature 76.7 C) against the thermal switch on the rear of the controller.

2. Listen for an audible click, indicating that the switch has opened. The click should occur within a few seconds. When the thermal switch has opened the heater indicator light on the control board should be constantly illuminated.

Note: An open thermal switch makes it appear as if the heater is continuously enabled. This may trigger error code E13. Switch the unit OFF and continue with step 3.

3. Remove the soldering iron and allow the switch to cool.

4. Listen for a second click indicating that the switch has closed. When the thermal switch closes, the heater indicator LED may flicker depending on the status of the heater.

5. If the thermal switch fails these tests, it must be replaced.

J. Setting the Patient Temperature Alarm Threshold

If desired, reset the patient temperature alarm to trigger when the difference between the patient control temperature and the monitored patient temperature exceeds 0.5 C. This is done by setting dipswitch 4 to the ON position.

K. Setting the Maximum Patient Control Temperature

If desired, the maximum patient control temperature (patient control mode) can be set at 37.5 C instead of 37.0 C. This is done by setting dipswitch 3 to the ON position.

L. Closure

1. Switch OFF the controller.

2. Verify that the power cord, the air temperature sensor, and the patient probe are disconnected from the controller.

3. Make sure that the dipswitches are configured for normal operation. Switches 1, 2, 7 and 8 must be OFF. The position of switches 3 and 4 will vary depending on the maximum patient control temperature and the tolerance selected for the patient temperature alarm.

Note: If dipswitches 1 and 2 are not OFF, error code E09 (incorrect dipswitch setting) will be triggered.

4. Replace the controller cover. Use the six screws and lock washers removed in Section A to secure the cover.

CAUTION: When handling the controller, avoid bumping the fan or the heater. If these items are knocked out of alignment, the fan can grate against either the heater or the base.

5. With the controller release latches in the release position (perpendicular to the controller sides), carefully slide the controller back into the incubator.

6. Push the controller latches down into the locked position.

7. Connect the air temperature sensor and the power cord to the controller.

8. Turn the unit ON. Verify that the fan is circulating air and that the fan is not rubbing against the base platform. Repeat steps 5 through 8, if there is rubbing.

9. Complete the leakage current test in Section 3.4.

10. Perform the Checkout Procedure in Section 2.2.

3.4 Leakage Current

Use approved equipment and techniques to test the unit's leakage current and ground continuity. Follow the directions supplied by the test equipment manufacturer to verify the following:

a. Less than 50 microamperes measured at the metal tip of the patient probe; less than 100 microamperes measured at any exposed metal surface for equipment rated at 120 Vac, 50/60 Hz.

b. Less than 100 microamperes measured at the metal tip of the patient probe; less than 200 microamperes measured at any exposed metal surface for equipment rated at 220 Vac, 50/60 Hz or 240 Vac, 50/60 Hz.

Notes

WARNING: Use extreme care while performing calibration and adjustment procedures, or while working on the Care Plus Incubator with power connected. An electrical shock hazard does exist; be certain to observe all standard safety precautions.

CAUTION: When handling the controller, avoid bumping the fan or the heater. If these items are knocked out of alignment, the fan can grate against either the heater or the base.

CAUTION: Use the Static Control Work Station (Stock No. 0175-2311-00) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

Note: Self test programs stop when a system error code is detected. Therefore a second error code will not be displayed for another failure. The same failure can trigger more than one error code. The actual code that appears is determined by the point in the test loop where the fault occurs.

The Care Plus features three levels of testing for maximum reliability and ease of troubleshooting. Self tests are performed on power up to check microcontroller, EPROM, and RAM function. They are performed continuously during operation to verify proper ADC, heater control, safety circuit, temperature sensor, alarm, RAM, and software operation.

Control panel switches activate on demand tests that can be used to assess error codes. Specifically you can compare the readings from both air flow or air temperature thermistors to verify a sensor failure; verify ADC calibration and check for drift; check the individual ADC channels; monitor the occurrence of any software upsets and check the line voltage. A separate RAM memory test loop continuously repeats the power up tests.

When required, you can operate the controller outside the incubator to directly measure control board signals. During controller testing, it is important to remember that the alarm criteria discussed in this section apply regardless of whether or not the controller is installed in the unit. Failure to connect the patient probe (or an equivalent load) in patient control mode, or the air temperature sensor in either operational mode will trigger the probe failure alarm. Air or patient temperature readings outside the alarm limits will still activate the corresponding alarms. In patient control mode the heater will not switch ON unless the patient temperature reading is within the 30 to 42 C range.

4.1 Alarms and Error Codes

There are two types of alarms on the Care Plus incubator. The first group of alarms are indicated by the alarm LEDs on the control panel. When one of these alarms is active the corresponding LED illuminates and an audible alarm sounds.

Error codes are a subset of the system failure alarm. When the system failure alarm illuminates for anything other than a gross microcontroller failure, the corresponding error code appears in the control temperature display.

A. Front Panel Alarms

1. Patient Temperature Alarm
(active in the patient mode only)

This alarm is active only in the patient control mode. It is triggered when the difference between the patient temperature and the control temperature exceeds 1 C. The alarm self resets when the patient temperature returns to within 0.8 C of the control temperature.

Note: The patient temperature alarm can be adjusted to trigger if the temperature difference exceeds 0.5 C and reset when the difference is less than 0.3 C (Refer to Section 3.3.J.).

Note: If the patient temperature is outside the 22 to 42 C range either LLLL or HHHH, respectively, will appear in the patient temperature display.

Audio Signal: Intermittent single tone if patient temperature within the 30 to 42 C range. Outside this range an alternating two tone alarm sounds.

Alarm Silence: 15 minutes if temperature difference is < 2 C
5 minutes if temperature difference is 2 C or higher.
1 minute if patient temperature < 30 C or > 42 C.

Heater Status: Heater is automatically shut off if the patient temperature is not between 30 and 42 C.

2. Control Temperature Alarm
(active in air control mode only)

The control temperature alarm is active only in the air control mode. It is suppressed for 30 minutes when power is first applied and for 15 minutes after each mode or control temperature change. The alarm is triggered when the reading from the air control thermistor exceeds the control temperature by more than 1.5 C or falls more than 3 C below the control temperature. The alarm self resets with a hysteresis of 0.2 C.

Audio Signal: Intermittent single tone

Alarm Silence: 15 minutes

Heater Status: Normal heater operation, dependent on selected control temperature and air temperature.

3. High Air Temperature Alarm

This alarm is triggered if the air display temperature exceeds the maximum control temperature (air control mode) or the maximum DET (the temperature required to maintain the infant at the selected control temperature in patient control mode) by more than 1 C. This alarm is not self resetting; you must pres the alarm silence switch before the alarm will reset.

To display the DET in patient control mode, depress and hold the Air Control switch until the DET appears in the air temperature display (approximately fiv seconds).

A transient alarm may be triggered if you change from a mode with a 40 C alarm limit to a mode that has a 38 C alarm limit.

Control Mode	Temp. Range	Alarm Limit
Patient Control	35.0 to 37.0 C (Max. DET 39.0 C)	40.0 C
	35.0 to 37.5 C (Dipswitch 3 ON; Section 3.3.K; Max. DET still 39.0 C)	40.0 C
Air Control	20.0 to 37.0 C (Normal Range)	38.0 C
	37.0 to 39.0 C (Override switch)	40.0 C

Audio Signal: Alternating two tone

Alarm Silence: 5 minutes

Heater Status: Heater is automatically shut off.

4. Air Circulation Alarm

This alarm triggers when the flow of cooling air over the air flow sensor stops. The air flow sensor contains a heated and an unheated thermistor. During norm operation, the air flow over the sensor cools the heated thermistor. If the air flow stops, the heated thermistor is no longer cooled and the temperature difference between the two thermistors increases. When the difference reache 21 C, the air circulation alarm is triggered. The alarm resets when the differenc drops below 19 C.

To display the temperature of both thermistors, depress and hold the F/C swit until the temperature of the heated thermistor appears in the air temperature display and the temperature of the unheated thermistor appears in the control temperature display (approximately five seconds). These displays do not have decimal point so the readings must be divided by ten to convert to degrees C.

The air circulation alarm is most commonly triggered by a blower motor failur or a missing fan blade.

Audio Signal: Alternating two tone

Alarm Silence: 5 minutes

Heater Status: Heater is automatically shut off

5. Probe Failure Alarm
In the air control mode, the probe failure alarm is triggered by a disconnected air temperature sensor. In the patient control mode, the probe failure alarm is triggered by either a disconnected or faulty patient temperature probe (short or open) or a disconnected air temperature sensor. The alarm self resets when the condition is remedied.

The patient temperature probe is judged to be disconnected or faulty if its signal is outside the 5 to 50 C range (approximately 880 to 410 mV). The air temperature sensor is assumed to be disconnected if both the air control and the air display signals are outside this range. This means that the probe failure alarm will be triggered instead of error codes 10 or 11 if both circuits in the air temperature sensor are open or shorted.

If neither the probe (patient control mode only) or the sensor are disconnected, one or the other is faulty. Check the patient temperature probe (patient control mode only) by observing the patient temperature display and verifying that it is consistent with the temperature of the probe. If LLLL or HHHH appear in the display, check the actual probe reading by depressing and holding the Air Control switch until a value appears in the patient temperature display (approximately five seconds). If the temperature is outside the 5 to 50 C range, replace the patient temperature probe.

Check the air temperature sensor by depressing and holding the Override switch until the air control thermistor reading appears in the patient temperature display and the air display thermistor reading appears in the air temperature display (approximately five seconds). If both readings are outside the 5 to 50 C range, replace the air temperature sensor.

Audio Signal: Alternating two tone

Alarm Silence: 1 minute

Heater Status: Heater is automatically shut off

6. System Failure Alarm
The system failure alarm is triggered if one, or more, of the system parameters monitored by the microcontroller self tests fail. This section describes the actual tests and gives a list of probable causes for each code.

If the microcontroller fails, there may be some cases where the only indication is a continuous, nonsilenceable audio alarm (i.e. no alarm indicator illuminates and no error code appears). This occurs because the microprocessor controls the display indicators. To ensue patient safety, an microprocessor independent safety relay will switch off the heater if the temperature exceeds preset safety limits.

WARNING: If a system failure alarm occurs, the unit must be removed fror use until it has been serviced.

Audio Signal: Alternating two tone

Alarm Silence: Cannot be silenced

Heater Status: Heater is automatically shut off

7. Power Failure Alarm
The power failure alarm is triggered when the line frequency signal pulse is no input to the microcontroller (U16 INT0 P3.2). During a power failure alarm the NI-CAD battery powers the control logic and RAM circuits for up to 10 minute: If power is restored within this time, the unit will return to the mode of operation and the control temperature in effect before the power loss.

The power failure alarm can be caused by a disconnected plug , faulty wiring o a faulty transformer.

Note: The power failure alarm is not triggered by an open circuit breaker.

Audio Signal: Intermittent single tone

Alarm Silence: Cannot be silenced

Heater Status: There is no power to the heater

B. Error Codes

Important: The recommended service policy is to limit repair procedures to sensor or board replacement, or in some cases the replacement of socketed integrated circuits. Additional information is provided for the purpose of identifying the faulty assembly.

Error codes are a subset of the system failure alarm. When an error code is triggered, an alternating two tone alarm sounds, the heater is automatically shu off, and normal incubator operation stops. However, the patient and air temperature displays will continue to update, and the various on demand test functions are still available.

This section individually discusses each error code, specifically covering the triggering conditions, any applicable on demand tests, and test points.

1. E01, Instruction Test Failure
A software routine executes selected instructions from the 8032 microcontroller. The results are then checked, and if any mistakes are found thi error is triggered.

There are no related test points, however the RAM memory test loop cycles repeatedly through this test. To begin the loop, switch off the unit. Then turn i back on while depressing the Override switch until a continuous alarm sounds (approximately five seconds). If the error recurs, replace the microcontroller (U19) and repeat the test. Replace the control board if the problem persists.

2. E02, ADC High Calibration Failure
The reading from the ADC calibrate high resistor (R5, 5.76 kOhm) has exceeded the limits of 37.96 +/-0.3 C for two consecutive ADC readings. This corresponds to a voltage of approximately 540 mV at the ADC input (U1 pin 14).

To see if the ADC requires calibration, depress the Enable switch until the low calibration test point (25.05 +/-0.3 C) appears in the patient temperature display, and the high calibration reading (37.96 +/-0.3 C) appears in the air temperature display (approximately five seconds). If both readings exceed or nearly exceed the limits, calibration is required. The second possibility is that resistor R5 may be out of tolerance. If the problem persists, replace the control board.

3. E03, ADC Low Calibration Failure
The reading from the ADC calibrate low resistor (R8, 10 kOhm), has exceeded the limits of 25.05 +/-0.3 C for two consecutive ADC readings. This corresponds to a voltage of approximately 690 mV at the ADC input (U1 pin 13).

To see if the ADC requires calibration, depress the Enable switch until the low calibration test point (25.05 +/-0.3 C) appears in the patient temperature display and the high calibration reading (37.96 +/-0.3 C) appears in the air temperature display (approximately five seconds). If both readings exceed or nearly exceed the limits, calibration is required. The second possibility is that resistor R8 may be out of tolerance. If the problem persists, replace the control board.

4. E04, EPROM Checksum Failure
The results of the EPROM memory checksum differ from the correct result stored at memory locations 3FFE and 3FFF on U16.

There are no related test points, however the RAM memory test loop cycles repeatedly through this test. To begin the loop, switch off the unit. Then turn it back on while depressing the Override switch until a continuous alarm sounds. If the error recurs, replace the EPROM (U16), and repeat the RAM test loop. If the error still recurs, replace the control board.

5. E05, RAM Test Failure
The data read out of a RAM memory location differs from the test pattern written to it.

There are no related test points, however the RAM memory test loop cycles repeatedly through this test. To begin the loop, switch off the unit. Then turn it back on while depressing the Override switch until a continuous alarm sounds. If the error recurs replace the control board.

6. E07, ADC Converter Failure
This alarm is triggered if the Conversion Complete Signal from the ADC does not occur within two seconds of the Start Conversion signal from I/O expander #2.

Do not attempt to monitor these signals; the Start Conversion and the Conversion Complete pulses are extremely narrow with durations of only a few nano seconds. Verify that no conversions are being completed by heating or cooling either the air temperature sensor or the patient temperature probe and observing that the temperature displays do not update.

Replace the ADC (U14) and restart the unit. If the error still recurs, replace the control board.

7. E08, S/0 Circuit Not Working
The logic level of the safety circuit $\overline{SO}$ signal does not agree with the level that would be expected based on the air display temperature. The $\overline{SO}$ signal (TP2-5) should be low only when the air display temperature is outside the 5 to 50 C range, approximately 0.884 to 410 mV at TP2-7.

If the air display temperature were actually outside this range, error code E10 would be triggered.

The most probable cause is a faulty comparator circuit (U5) in the S/O circuit. Since this is not a socketed chip, control board replacement is recommended.

8. E09, Incorrect Dip Switch Setting
The signals from dipswitches 1 and 2 are logic high (corresponds to logic low inputs at U17 for the inverted signals). The most probable cause is that dipswitches 1 and 2 are improperly configured. Set both dipswitches to the OFF (open) position.

If the dipswitches are correctly configured, either the dipswitch or an inverter (U11B or U11C) may be faulty. Board replacement is recommended, since these circuits are not socketed.

9. E10, Air Display Sensor Bad
The air display signal is outside the 5 to 50 C range (approximately 880 to 410 mV at TP2-7) for two consecutive ADC readings during which time the air control signal remains within the 5 to 50 C range.

Observe the displayed air temperature. If it is outside the 5 to 50 C range, replace the air temperature sensor. Alternatively, perform a continuity check on the sensor by measuring the resistance between pins 4 and 5 on the sensor connector (Figure 4-1), or between pins 10 and 11 on the control board J4 connector. Replace the sensor if you do not obtain a reading between 25.7 and 3.6 kOhms (20 C = 12.5 kOhms).

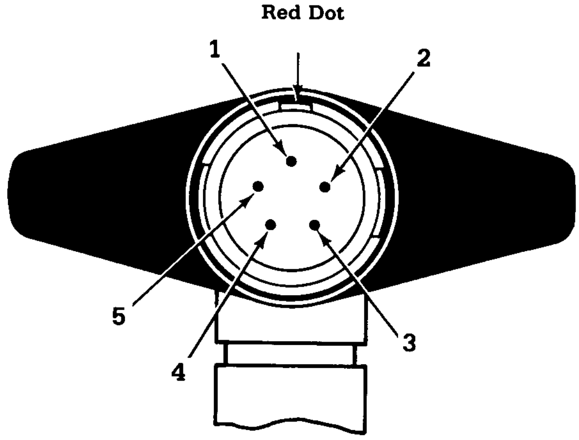


Figure 4-1 Air Temperature Sensor Connector (end view)

If the problem persists, check that the J4 connector is properly mated to the control board and then, replace the control board.

10. E11, Air Control Sensor Bad
The air control signal is outside the 5 to 50 C range (approximately 880 to 410 mV at TP2-7) for two consecutive ADC readings during which time the air display signal remains within the 5 to 50 C range.

Depress and hold the Override switch until the air control temperature appears in the air temperature display (approximately five seconds). If the displayed air control temperature is outside the 5 to 50 C range, replace the air temperature sensor. Alternatively, perform a continuity check on the sensor by measuring the resistance between pins 1 and 2 (Figure 4-1) on the sensor connector or between pins 6 and 7 on the control board J4 connector. Replace the sensor if you do not obtain a reading between 25.7 and 3.6 kOhms (20 C = 12.5 kOhms).

If the problem persists, check that the J4 connector is properly mated to the control board and then, replace the control board.

11. E12, Heater Not Switching On
The microcontroller has commanded the heater to switch on ($\overline{\text{Heat}}$ TP2-2 low), but the heater status signal from U7A pin 11 remains high, indicating that the heater is off.

This is a difficult code to troubleshoot, since the control signals and the continuity across the solid state relay change from those required to power the heater to those that shut down the heater as soon as this failure is detected.

The most probable cause of this failure is a faulty solid state relay. If the problem persists after relay replacement, replace the control board.

12. E13, Heater Not Switching Off

The microcontroller has commanded the heater to switch off ($\overline{\text{Heat}}$ TP2-2 high). However, the heater status signal from U7A pin 11 remains low, indicating that the heater is on.

This error code can be triggered without an actual failure having occurred, because of a thermal switch in the heater neutral that opens at a temperature of 76.7 C. When the thermal switch opens, it causes a logic low heater status signal, which illuminates the heater status LED and signals the microprocessor that the heater is on.

The thermal switch normally opens for a few minutes when a hot incubator is switched off because of residual radiant heat and the lack of a cooling air flow. If the incubator is restarted before the thermal switch has cooled, E13 may appear as soon as this alarm is enabled (approximately three and a half minutes after power up; normally, a period of three and a half minutes is sufficient to cool the incubator).

Check to see if the thermal switch has opened as soon as the error occurs, before it has had time to cool down. The thermal switch opens at a temperature of 76.7 C and is located on the back of the controller, adjacent to the air flow thermistors. Check the temperatures of the air flow thermistors to see if they are near this range by depressing and holding the F/C switch until the temperature of the unheated air flow thermistor appears in the air temperature display and the temperature of the heated thermistor appears in the control temperature display (approximately five seconds). Because the decimal point is not illuminated, you must divide the readings by 10 to obtain the temperature.

The second possibility is that the thermal switch has failed in an open position. Disconnect the power cord and do a continuity check between solid state relay pin 1 and the transformer phase (pin 2 on 120 volt units). If the resistance is not between 20 and 100 Ohms, replace the thermal switch.

The third possibility is a shorted solid state relay. Replace the relay. If the problem persists, replace the control board.

13. E14, Alarm Oscillator Failure

An alternating two tone alarm signal has been activated, but the 2 kHz signal at TP2-1 is not toggling.

To troubleshoot this failure, an alternating two tone alarm must be active. If there is no error code displayed, trigger an alarm by disconnecting the patient temperature probe while in the patient control mode.

If you hear the alarm (i.e. the 2 kHz signal is present), replace the I/O expander (U15), followed by the microcontroller (U19). If the problem persists replace the control board.

If you do not hear the alarm (i.e. the 2 kHz signal is missing), the timing circuit (U6B) or one of the circuits that gate the timing circuit inputs may be faulty. Since these chips are not socketed, control board replacement is recommended.

14. E15, Software Upset
A software upset has caused the watchdog timer to time out and the system is unable to recover because critical parameters (e.g. control temperature) stored in the RAM may have been altered.

This error does not necessarily indicate a hardware failure. Power the incubator up. If the error does not recur, allow the unit to run for half an hour. Then check the number of recoverable software upsets that have occurred by depressing and holding the Override switch until a new value appears in the control temperature display (approximately five seconds). If FF appears in the control temperature display, no software upsets have occurred. Complete the Checkout Procedure and return the unit to service.

If another value appears in the control display, replace the control board .

15. E17, Software Upset
The software is not cycling through all of the routines and is unable to recover.

Power the incubator up. If the error does not recur, allow the unit to run for half an hour. Then check the number of recoverable software upsets that have occurred by depressing and holding the Override switch until a new value appears in the control temperature display (approximately five seconds). If FF appears in the control temperature display, no software upsets have occurred. Complete the Checkout Procedure and return the unit to service.

If another value appears in the control display, replace the control board .

16. E18, Air Temperature Sensor Out of Tolerance
This failure is normally caused by a faulty air temperature sensor. Power the unit up from a cold start with an air control temperature of 39 C. When the error occurs, observe the difference between the air control and air display thermistor readings by pressing and holding the the Override switch until the air control temperature appears in the patient temperature display (approximately five seconds). Compare this temperature to the air display temperature. If the difference exceeds 0.5 C, replace the air temperature sensor and repeat the test. If the error persists, replace the control board.

17. E19, Software Upset
The watchdog timer has timed out 256 times since power up. This error can be caused by a software upset and does not necessarily indicate a hardware failure.

Power the incubator up. If the error does not recur, allow the unit to run for half an hour. Then check the number of recoverable software upsets that have occurred by depressing and holding the Override switch until a new value appears in the control temperature display (approximately five seconds). If FF appears in the control temperature display, no software upsets have occurred. Complete the Checkout Procedure and return the unit to service.

If another value appears in the control display, replace the control board.

18. E20, Air Flow Sensor Failure
The temperatures of the heated and the unheated air flow sensor thermistors differ by less than 5 C for two minutes.

Depress and hold the F/C switch until new values appear in the air temperature and control temperature displays (approximately five seconds). The heated thermistor signal appears in the air temperature display and the unheated thermistor signal appears in the control temperature display. Divide both values by 10 to convert them to degrees centigrade. If the resulting temperatures differ by less than 5 C, replace the air flow sensor. Check continuity across the sensor resistor (J5 pins 6 and 5) to verify that it contains a bad circuit. If the resistor has not opened or the problem persists, replace the control board.

19. E21, Air Flow Sensor Open or Shorted
Note: This failure can be triggered if a very cold incubator (<12 C) is put into service without being allowed to warm up.

The temperature of either thermistor in the air flow sensor is outside the 12 to 120 C range, indicating a short or open circuit.

Depress and hold the F/C switch until the heated thermistor signal appears in the air temperature display and the unheated thermistor signal appears in the control temperature display (approximately five seconds). If the readings are outside the specified range, replace the air flow sensor. Perform a continuity check on the thermistors in the old sensor to verify that it indeed contains a bad circuit. If the resistance indicates either an open or a short between J5, pins 8 and 7 or pins 4 and 3, discard the sensor. If the sensor tests out as good or the problem persists, replace the control board.

4.2 Power Up Tests

When power is first applied, the following self tests are performed. Specific test information for troubleshooting purposes is given in Section 4.1.B.

1. Instruction Test (E01)

2. EPROM Checksum Test (E04)

3. RAM Test (E05)

The power up test sequence is accompanied by a series of power up displays:

1. An alternating two tone audible alarm sounds for approximately five seconds, all the indicators illuminate and 188.88 appears in the temperature displays.

2. All indicators go out except the air control and the enable indicators. The temperature displays change to show from left to right:

Patient Temperature	Air Temperature	Control Temperature
XX.XX (software revision 01.01 etc.)	60.H (AC frequency 50.H for 50 Hz models)	39.0C (max. manual control temp.)

3. An operator prompt tone sounds and the control temperature display flashes 33.0 C. The operator prompt tone will sound every two seconds until a control temperature is entered.

4.3 On Line Testing

The incubator continuously performs the following tests during normal operation. An error in any of the tests triggers the system failure alarm. The corresponding error code will appear in place of the control temperature. Specific test information for troubleshooting purposes is given in Section 4.1.B.

1. ADC Calibration Test (E02 and E03)

2. ADC Failure (E07)

3. S/O Circuit Not Working (E08)

4. Incorrect Dipswitch Setting (E09)

5. Air Display Sensor Bad (E10)

6. Air Control Sensor Bad (E11)

7. Heater Not Switching On or Off (E12 or E13)

8. Alarm Oscillator Test (E14)
9. Software Upset, Watchdog Timer (E15)
10. Software Upset, Not Cycling Through All Routines (E17)
11. Air Temperature Sensor Out of Tolerance (E18)
12. Software Upset, Excessive Watchdog Resets (E19)
13. Air Flow Sensor Failure (E20)
14. Air Flow Sensor Open or Shorted (E21)

4.4 On Demand Testing

There are two types of on demand testing: a combination RAM Memory displa loop that cycles through the power up tests and checks display board function and special switch activated displays, which display various parameters to aid i diagnosing problems. The specific troubleshooting applications of individual o demand tests are discussed in Section 4.1.B.

A. RAM Memory Display Loop

1. Self Tests
To enter this loop depress and hold the Override switch while powering up the unit. Release the switch when a continuous alarm sounds. The microcontrolle cycles through a series of self tests, including:

All of the power up tests
Instruction Test (E01)
EPROM Checksum Test(E04)
RAM Test (E05)

The following on line self tests
ADC High Calibration Failure (E02)
ADC Low Calibration Failure (E03)
ADC Failure (E07)
Air Display Sensor Bad (E10)
Air Control Sensor Bad (E11)
Heater Not Switching On (E12)
Heater Not Switching Off (E13)
Alarm Oscillator Failure (E14)

Important : Unless you specifically want to repeat the power up tests, troubleshooting should be performed in the normal operational modes.

2. Displays

The display loop runs simultaneously with the self tests, displaying frames of data and testing for proper LED operation. Frames are cycled as follows:

Temperature Displays

Frame	Patient Temp.	Air Temp.	Control Temp.
1.	------- All displays blank; Alternating two tone alarm -------		
2.	Patient Temp.	Air Display Temp.	Air Control Temp.
3	Low Cal. Point	High Cal. Point	%Nom. Voltage x .1
4	------- All displays read 188.88 and all LEDs illuminate ------		

B. Switch Activated Displays

In normal operation, the Alarm Silence, the Enable, the Override, the F/C, the Patient Control, and the Air Control switches activate service displays when held down for more than five seconds. The high priority alarm also sounds to indicate that actual patient and air temperatures are not displayed. The normal display reappears when you release the switch.

The following table summarizes the data that will be displayed when each switch is depressed and held for at least five seconds. It is intended as a quick reference. Switch applications for troubleshooting are discussed in Section 4.1.B under the individual error codes.

Important: Continue to hold down the switch for as long as you wish to view the special, service display. The normal display reappears when you release the switch.

Switch	Patient Temperature	Air Temperature	Control Temperature
Alarm * Silence	188.88	188.88	188.88
Enable	Low cal. point (25.05+/-0.3 C)	High cal point (37.96+/-0.3 C)	% of nominal voltage XX.XX = XXX.X%; 100 +/- 2% at 115 VAC Ok if between 90 & 110%)
Override	Air control temp (XX.XX C Format)	Air display temp (XX.XX C Format)	FF - # software upsets (hexadecimal down counter)
Air Control	Patient temp (XX.XX C Format; includes temps outside normal range)	Air control temp or DET (updated every 10 min)	XX.YY (XX = avg. power, YY =% max. power)
F/C	Patient temp XX.XXC Format; includes temps outside normal range)	Heated air flow. sensor therm-istor (Decimal point not shown Divide by 10 to obtain degrees C.	Temp of reference air flow sensor thermistor (decimal point not shown. Divide by 10 to obtain degrees C.
Patient Control	ADC counts for patient temperature thermistor.	ADC counts for unheated air flow sensor thermistor	ADC counts for line voltage

*** All display board LEDs illuminate to test proper operation.**

4.5 Test Points

Control board test points are accessible when the controller is removed from the unit. Specific application of test point readings to various error codes is discussed in Section 4.1.B. Individual test points and their expected readings are as follows:

Important: The 1.0 reference voltage varies by up to 20 percent between units. Hence thermistor resistance rather than signal voltage should be used to check temperature measurements.

Reference the appendix tables for summaries of the resistance versus temperature or percent of nominal voltage for the various ADC inputs.

Test Point	Description & Reading
TP1-1	9.8 +/- 0.05 Vdc *
TP1-2	Line Compensation (0.7 Vdc) *
TP1-3	+ 5 Volts Disp (5 +/- 0.3 Vdc)
TP1-4	+ 5 Volts Stby (5 +/- 0.3 Vdc)
TP1-5	+ 8 Volts Unregulated (8 +/- 1.5 Vdc)
TP1-6	+ 9 Volts Stby (9 +/- 0.3 Vdc)
TP1-7	(not used)
TP1-8	Logic Ground
TP2-1	2 kHz Frequency (2 kHz +/- 100 Hz) * (measure during calibration loop)
TP2-2	Heater Control Signal (Low = Heater ON)
TP2-3	+ 1 Volt Thermistor Reference (1.0 +/- 0.2 Vdc)
TP2-4	+ 2 Volt A/D Reference Signal (about 2.0 Vdc)#
TP2-5	$\overline{SO}$ Air Display Sensor Short or OPEN SIGNAL (low = sensor circuit shorted or open)
TP2-6	OT Air Display Over Temperature Signal (high = high temp. alarm active)
TP2-7	Air Display Signal
TP2-8	Logic Ground
TP3-1	SW1-1 (U17, P6.0)
TP3-2	SW1-2 (U17, P6.1)
TP3-3	SW1-3 (U17, P6.2)
TP3-4	SW1-4 (U17, P6.3, not used)
TP3-5	SW1-5 (U17, P7.0, not used)
TP3-6	SW1-6 (U17, P7.1, not used)
TP3-7	SW1-7 (U17, P7.2)
TP3-8	SW1-8 (U17, P7.3)
TP3-9	+ 5 Volts Stby (5 +/- 0.2 Vdc)
TP3-10 to TP3-12 (not used)	

* Refer to calibration section for adjustment procedure.

Nominal value, adjusted as part of ADC calibration.

WARNING: Before any disassembly or repair, disconnect the electrical supply and any gas supply connections. Also remove any accessories. Do not perform any service or maintenance with the power applied unless specifically told to do so in the procedure.

WARNING: Disconnect power to the incubator and allow the heater to cool for at least 15 minutes before servicing or cleaning to avoid the danger of a burn.

WARNING: Never oil or grease oxygen equipment unless a lubricant that is made and approved for this type of service is used. Oils and grease oxidize readily, and in the presence of oxygen, will burn violently. Vac Kote is the oxygen service lubricant recommended (Stock No. 0220-0091-300).

CAUTION: Insulation on the electrical wiring can deteriorate with age. When performing the Checkout Procedure, check for brittle or deteriorated insulation on the power cord.

CAUTION: Use the Static Control Work Station (Stock No. 0175-2311-00) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

5.1 Hood Repair

Important: In cases where total disassembly is not required, replacing an end porthole for example, perform only the necessary steps.

Note: You must depress the hood tilt button while opening or closing the hood.

Refer to Figures 5-1, 5-2 and 5-3.

1. Turn the power switch OFF and unplug the unit.
2. If the incubator was previously on, allow it to cool for at least 15 minutes.
3. Remove the front door by opening it to reveal the two spring loaded hinge pins that attach the door to the lower unit. Pull both pins out towards the sides of the hood and lift off the door.
4 Remove the inner wall as shown in Figure 5-1:

CAUTION: Inner wall fasteners are permanently attached to the inner wall and cannot be removed without damaging them.

a. Remove the rear inner wall by pulling out the plunger portion of the inne
wall fasteners

b. To remove the upper inner wall, open the hood and pull out the plunger portion of the inner wall fasteners while supporting the wall.

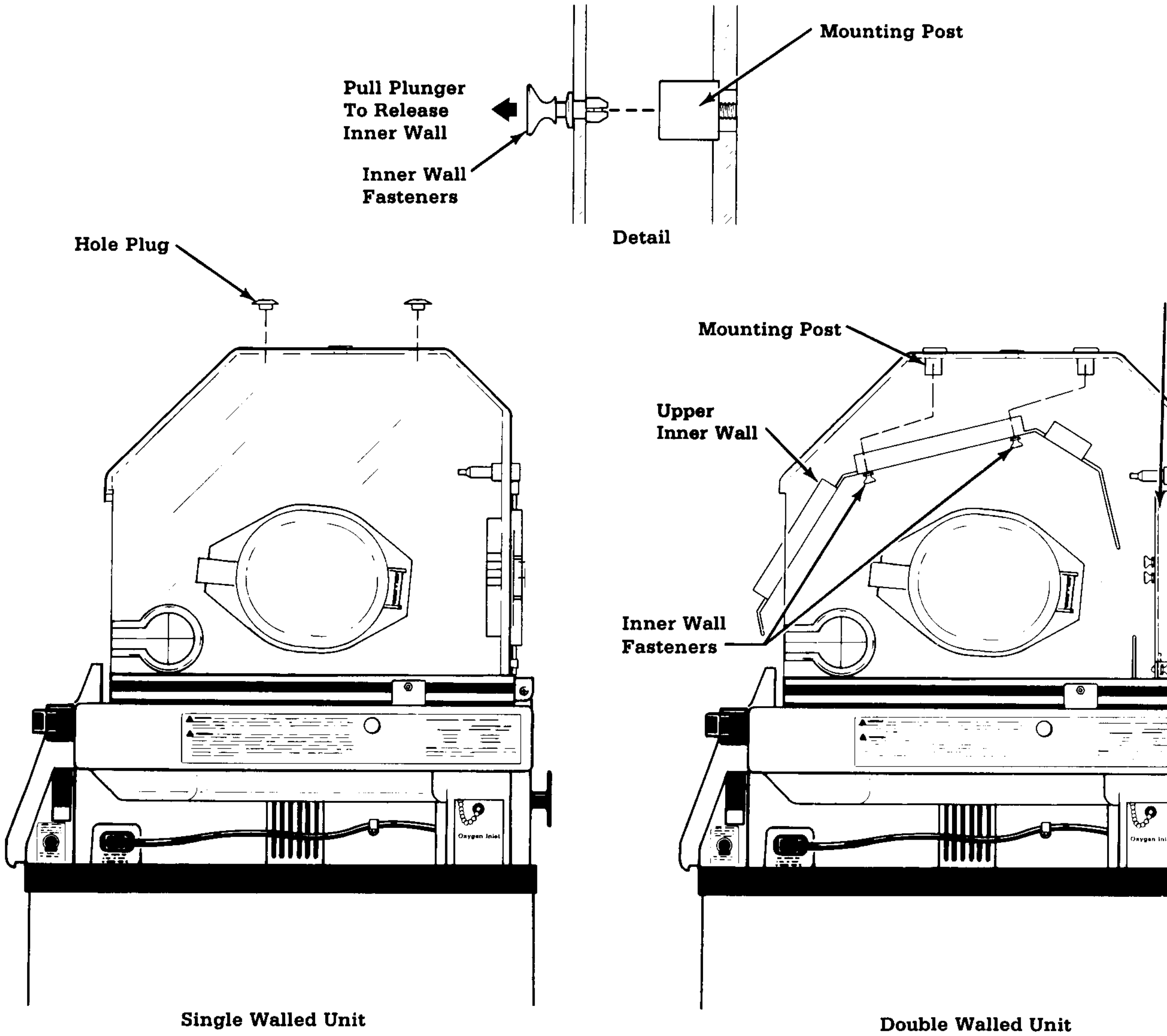


Figure 5-1 Remove the Inner Wall

5. To remove the outer hood (Figure 5-2):

a. Lower the outer hood.

b. Remove the air temperature sensor from the hood by: unscrewing the nut and screw that anchors the sensor cable; removing the two Phillips head screws that hold the sensor mounting blocks and spacers in position; and then sliding the air temperature sensor out of the hood.

c. Remove the nut and screw that attach the hood to the hood tilt latch (rear right hand corner of the incubator).

d. Remove the two Phillips head screws used to secure the back of the hoo
to the base hinges.

Note: When you replace the outer hood, fully tighten the hinge screws, then loosen one half turn.

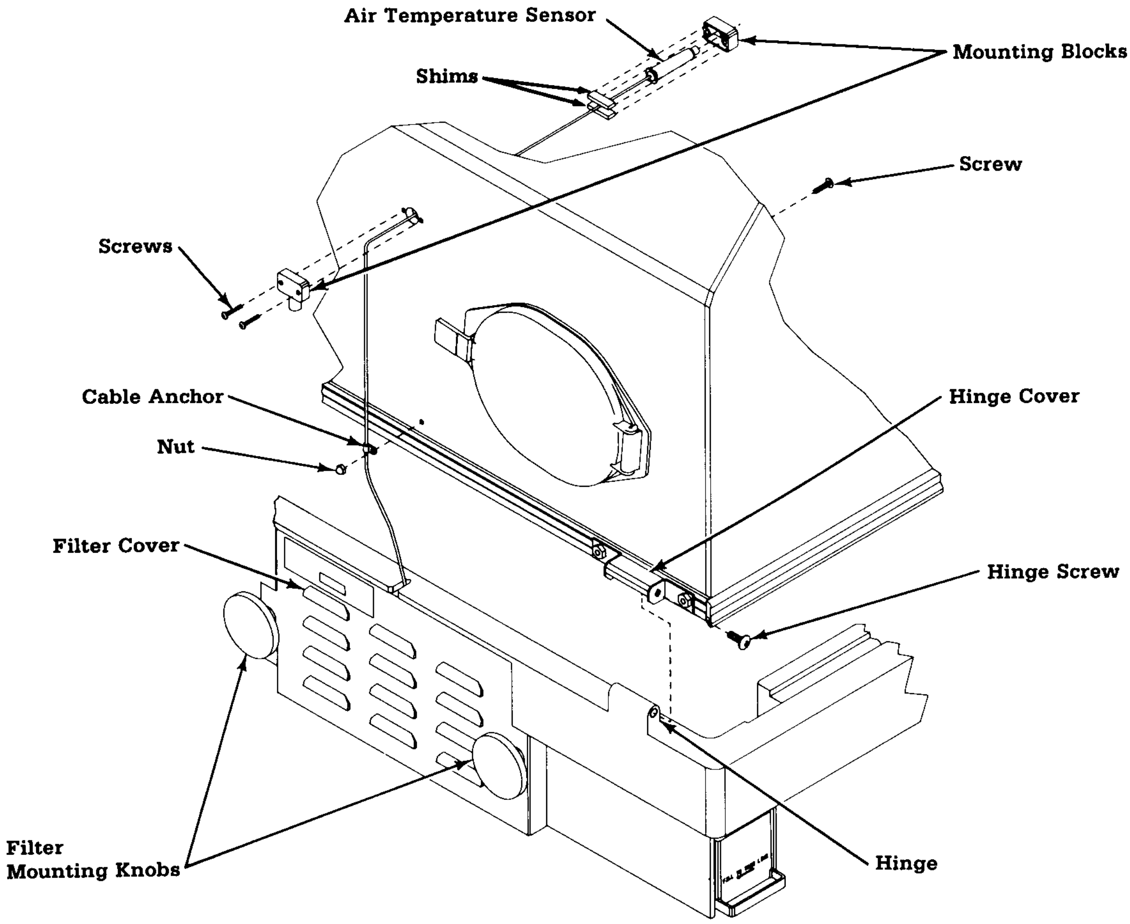


Figure 5-2 Remove the Outer Hood

6. Remove hood hardware as follows (Figure 5-3):

   a. To remove the portholes, unscrew the mounting posts on either side of the port. On double-walled units this means you may have to remove th
inner wall.

b. To remove the side or rear seals, first remove the outer hood. Then remove the hinge covers, the nut and screw that secure the hood tilt latch, and the Phillips head screws that hold the lower bars in position.

Note: When you replace the outer hood, fully tighten the hinge screws, then loosen one half turn.

Note: Since this is a lengthy procedure it is recommended that all seals be replaced at the same time.

c. Inner wall fasteners should not be removed. To install a new fastener, insert the socket portion into the proper hole and push the plunger in.

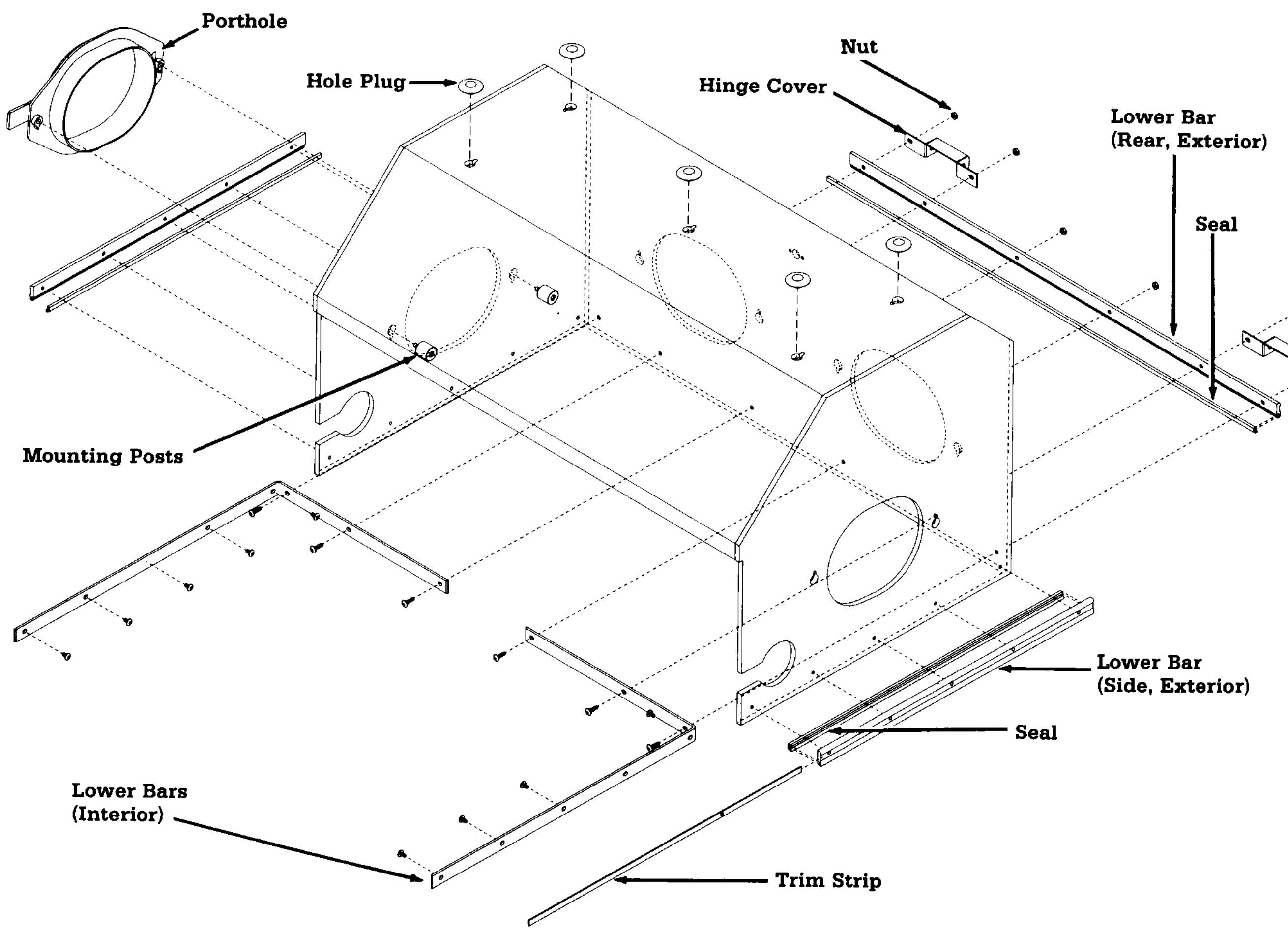


Figure 5-3 Remove Hood Hardware

d. To remove the disposable cuffs, open the porthole and slip the elastic band out from under the outer ring on the porthole housing.

Reverse the steps for assembly. To install new arm cuffs, slip the larger elastic ring over the outer ring of the porthole housing. To reattach the inner wall fasteners, line up the fasteners with the mating mounting posts and push in the plunger portion of the fastener. When reattaching the hood tilt latch, do not ove tighten the nut as this may inhibit the up and down movement of the hood.

5.2 Front Door Repair

Important: The front door seals are permanently attached and cannot be replaced individually. If they are damaged, a new outer front door must be installed.

1. Remove the front door by opening it to reveal the two spring loaded hinge pins that attach the door to the base. Pull both pins toward the sides of the hood and lift off the door.

2. Pull out the plunger portion of the inner wall fasteners to remove the inner wall.

CAUTION: Inner wall fasteners are permanently attached to the inner wall and cannot be removed without damaging them.

3. To remove the hinge pin and hinge pin assembly, remove the three Phillips head screws that secure it to the front door.

4. To remove a front door latch, loosen the set screw that secures the externa knob. The curved washer and the internal latch will then slide off as shown in Figure 5-4.

5. To remove the portholes, unscrew the mounting posts on either side of the port.

6. Inner wall fasteners should not be removed. To install a new fastener, inse the socket portion into the proper hole and push the plunger in.

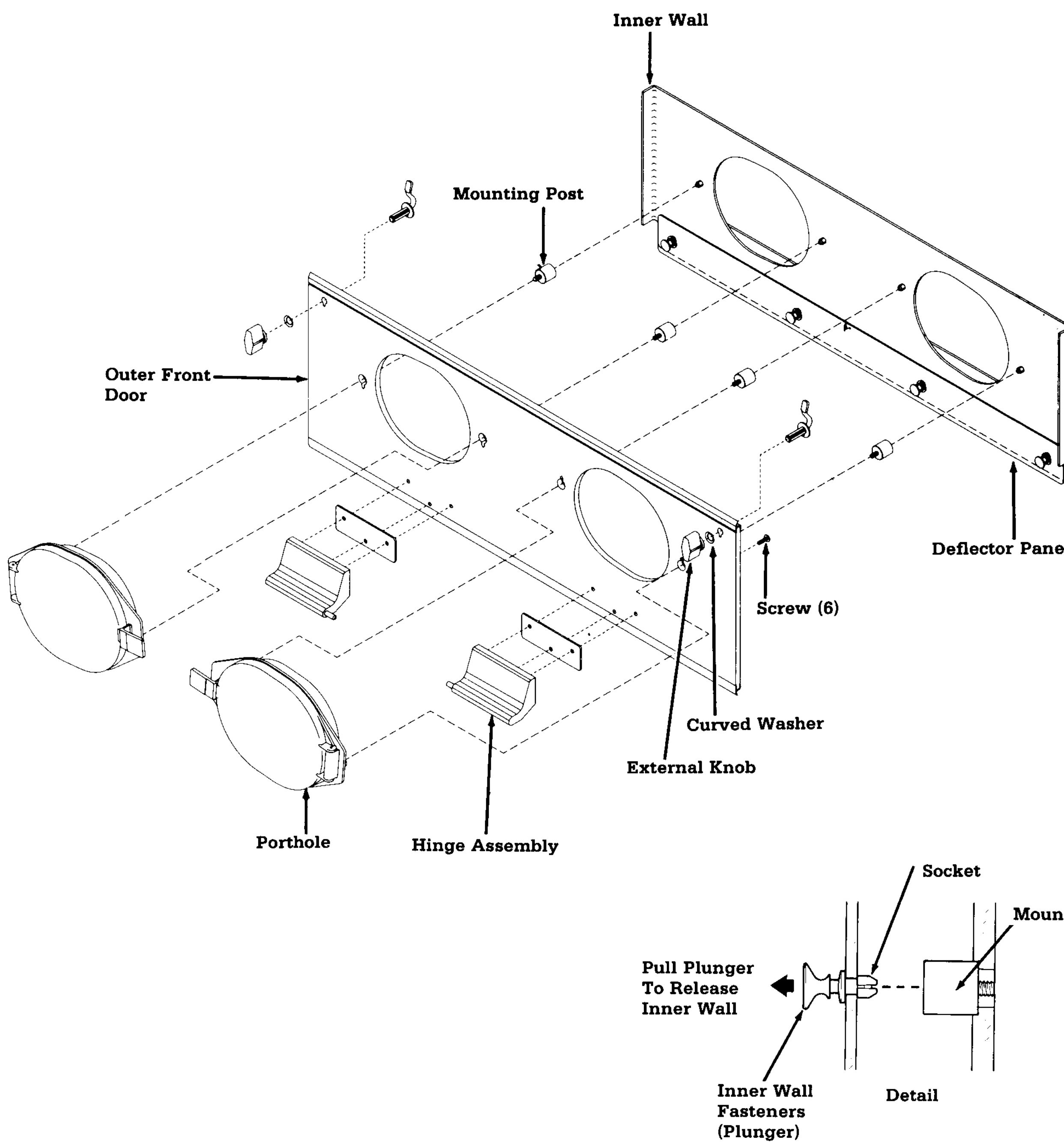


Figure 5-4 Front Door Disassembly

5.3 Air Temperature Sensor Replacement

(Figure 5-2)

WARNING: Two people are required to lift the Care Plus Incubator. Follow safe lifting techniques to avoid injury.

Note: The air temperature sensor is located inside the infant compartment and should not be confused with the air flow sensor on the rear of the controller.

1. Remove the inner walls on double walled units.
2. Lower the outer hood and close the front door.
3. Slip the sensor cable out of the retaining clip on the underside of the incubator.

Note: Early units use a screw and cable anchor to secure the cable. This requires that you unscrew the mounting knobs securing the incubator to the cabinet and lay the unit down on its side to remove the screw.

4. Remove the two Phillips head screws and shims that attach the air temperature sensor mounting blocks to the outer hood. Then slide the air temperature sensor out of the hood (Figure 5-2).
5. Unscrew the filter mounting knobs. Remove the filter cover and filter.
6. Unplug the air temperature sensor from the controller.
7. Pull the old air temperature sensor assembly out of the incubator.
8. Connect the new air temperature sensor to the controller.
9. Slip the new cable into the retaining clip. In older units, replace the screw and cable anchor with one of the new clips (Stock No. 6600-0145-400) and remount the incubator.
10. Route the cable out the rear of the base, through the hole near the air filter, and around the filter. Refer to Figure 6-8, page 6-13, for cable routing.
11. Replace the filter. Secure the filter cover with the filter mounting knobs. The hole on the top of the filter cover should line up with the cable.
12. Open the front door and rotate the hood to the open position.
13. Insert the air temperature sensor through the hole in the outer hood. Slide the symmetrical mounting block, backed by the two shims, over the sensor from the inside of the hood. Align the cable guard on the other block with the sensor cable on the outside of the hood. Secure the blocks with the two remaining Phillips head screws.
14. Anchor the sensor cable to the outer hood.
15. On double walled units, replace the inner wall.

5.4 Base Platform Disassembly

1. Remove the front door by opening it to reveal the two spring loaded hinge pins that attach the door to the base. Pull both pins toward the sides of the hood and lift off the door.

2. Depress the hood tilt release button and rotate the hood back into the locked position.

3. Remove the mattress and the mattress tray.

4. Remove each tilt assembly by pulling up on the tilt handle. The assemblie will slide out of their retaining sockets.

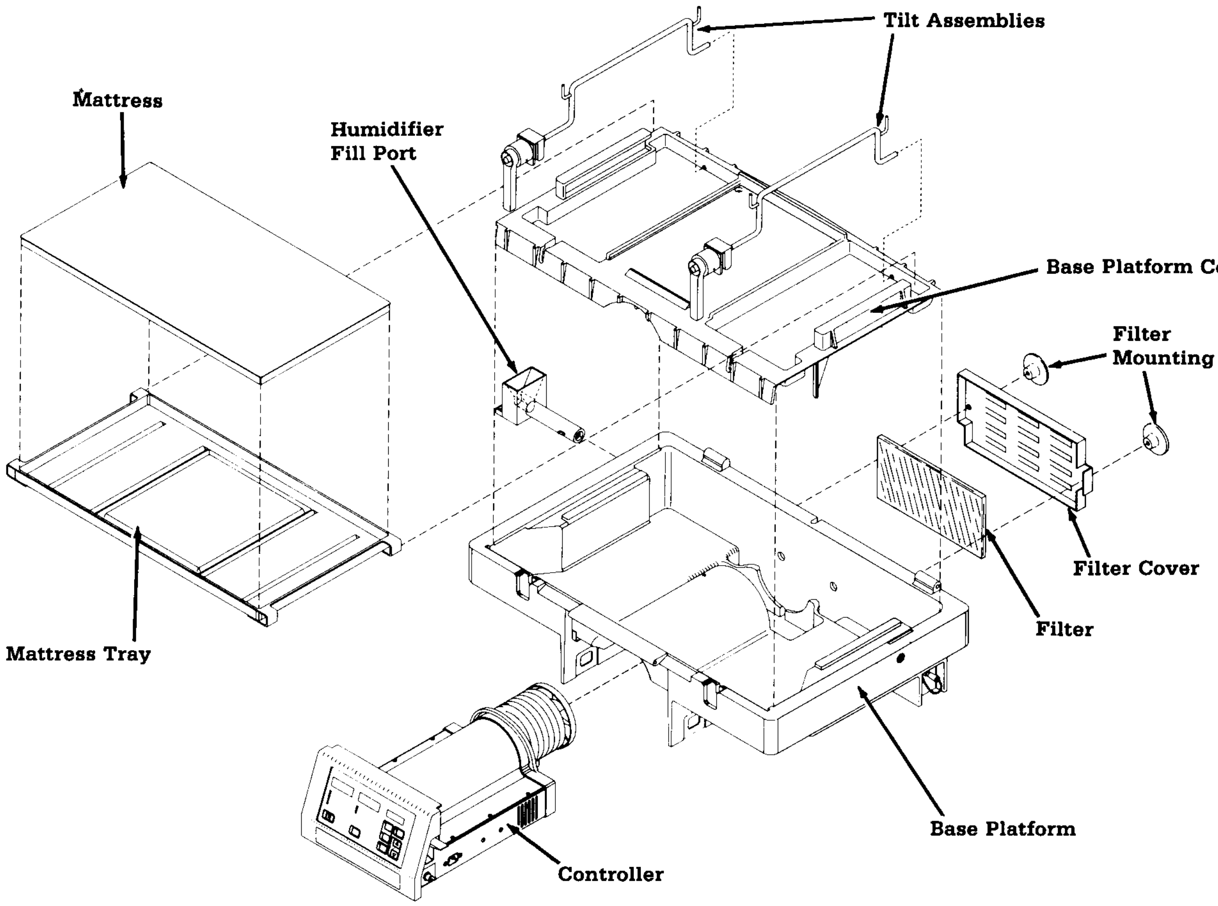


Figure 5-5 Base Platform Disassembly

5. Lift out the base platform cover.

6. Remove the humidifier fill port: pull it out to the fill position; rotate the spout clockwise about 45 degrees; and pull it out.

5.5 Controller Access

1. Disconnect the power cord, the patient probe, and the air temperature sensor from the controller.

2. Lift up the controller latches and slide the controller forward, out of the incubator.

CAUTION: When handling the controller, avoid bumping the fan or the heater. If these items are knocked out of alignment, the fan can grate against either the heater or the base.

3. Remove the six Phillips head screws and lock washers used to attach the controller cover.

4. Lift off the controller cover.

5.6 Control Board Replacement

CAUTION: Make sure the control board connectors are properly aligned before applying power.

1. Access the controller as described in Section 5.5.

2. Disconnect control board connectors J1, J2, J3, and J4.

3. Undo the four lock nuts that secure the control board.

4. Lift the board out of the controller.

5. Position the new control board so that J3 is at the front of the controller. Replace the four lock nuts to secure the board to its mounting standoffs (Figure 5-6).

6. Reconnect J1, J2, J3, and J4. Connector pins are numbered for proper alignment.

Note: Connectors J3 and J4 are identical except for the number of wires. J4 has 8 wires, J3 has 16 wires.

7. Make sure that switches 1, 2, 7 and 8 are set to OFF (open position). This selects a maximum control temperature of 39 C and disables the calibration and service loops. Make sure that dipswitches 3 and 4 are in the same position as on the previous board.

8. Perform the Calibration Procedure in Section 3.3.

9. Reattach the controller cover, using the six Phillips head screws and lock washers previously removed.

10. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.

11. Perform the Checkout Procedure in Section 2.2. Listen for any grating soun caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.

12. Perform the resistance and leakage current tests in Section 3.4.

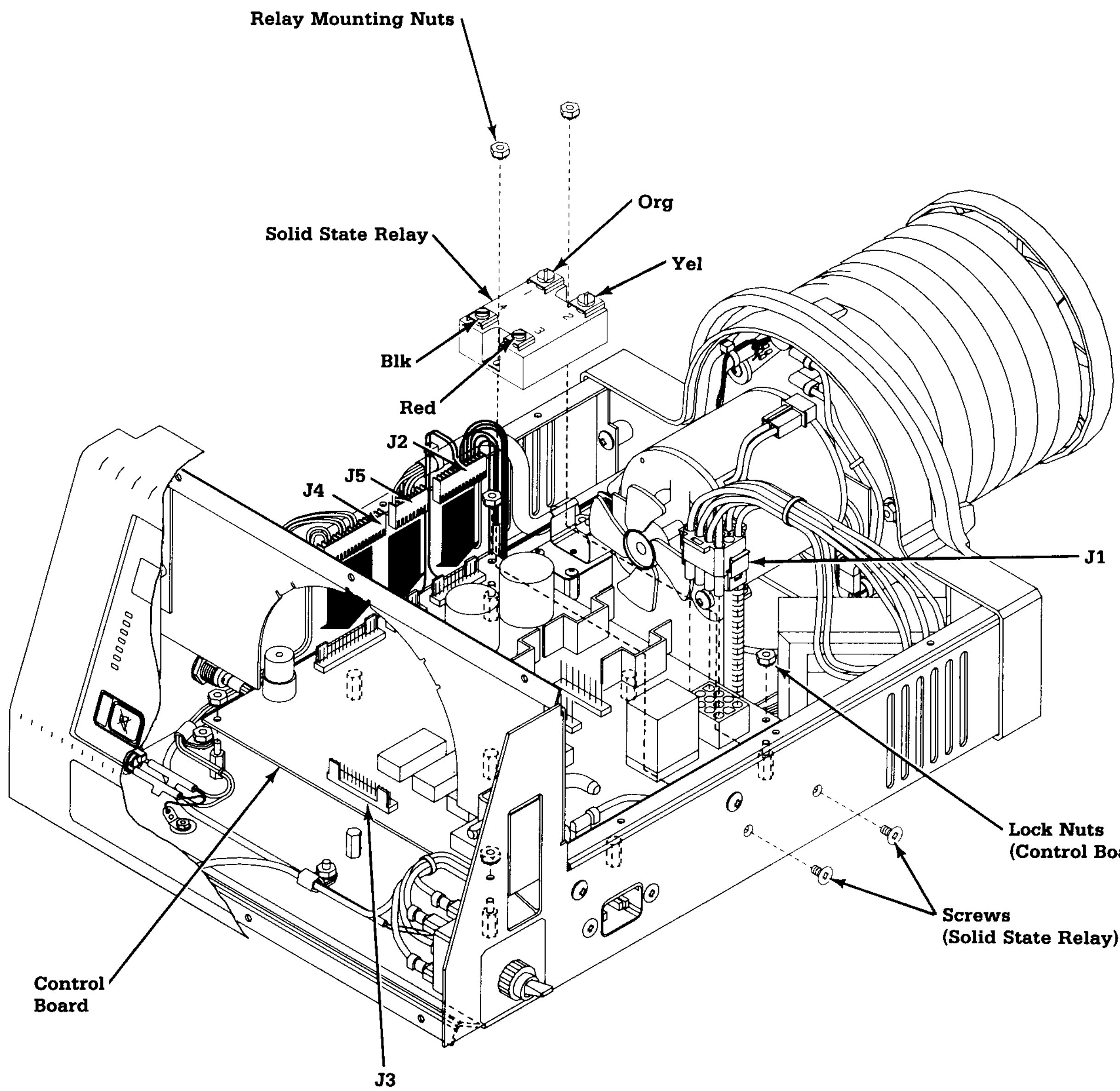


Figure 5-6 Controller Interior

5.7 Display Board Replacement

1. Access the controller as described in Section 5.5.

2. Disconnect J3 from the control board.

3 Remove the screw anchoring the controller plate ground wire to the controller front panel.

4. Turn the controller upside down and remove the lower three front panel mounting screws, shown in Figure 5-7.

5. Turn the controller right side up and remove the remaining front panel mounting screws, shown in Figure 5-7.

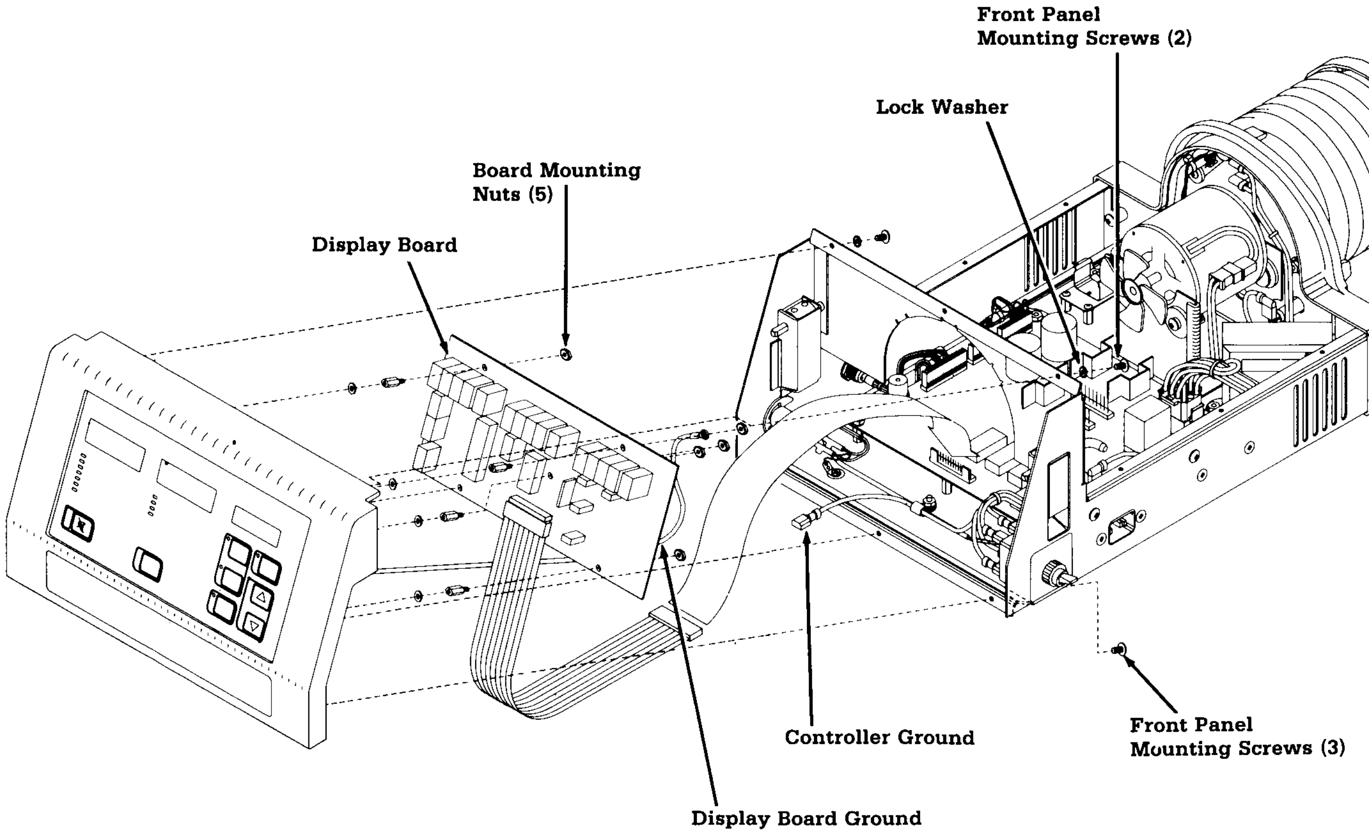


Figure 5-7 Replace the Display Board

6. Lift off the front panel.
7. Remove the five lock nuts used to mount the display board.
8. Remove the old display board.
9. Disconnect cable J8 from the old display board.

10. Connect J8 to the new display board.
11. Place the new board component side down on the board standoffs with J8 pointing toward the bottom of the controller.
12. Replace the five lock nuts to anchor the board. Use the upper left hand nut to anchor one end of the short (display board) ground wire (Figure 5-8).
13. Reattach the free ends of both ground wires to the metal bar below the display board (Figure 5-8).

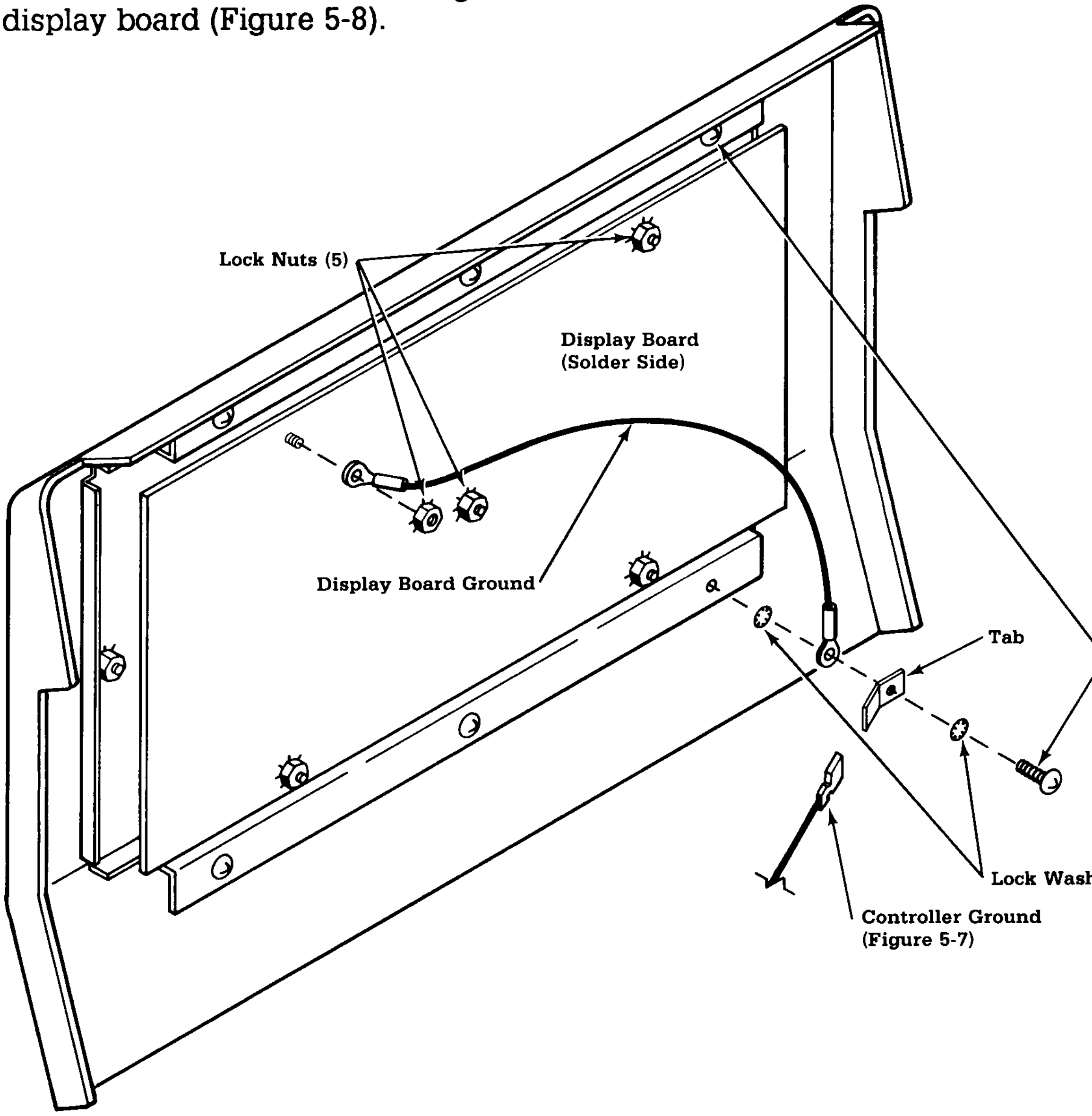


Figure 5-8- Display Panel Grounds

14. Connect the cable from J8 to control board connector J3.

15. Connect the air temperature sensor and the power cord to the controller. Plug the power cord into a power outlet and switch the controller ON.

16. If the display is too dim, complete Section 3.3.C to adjust the brightness.

17. Switch the controller OFF and reattach the front panel as shown in Figure 5-7.

18. Reattach the controller cover, using the six Phillips head screws and lock washers previously removed.

19. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.

20. Perform the Checkout Procedure in Section 2.2. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.

21. Perform the resistance and leakage current tests in Section 3.4.

5.8 Solid State Relay Replacement

(Figure 5-6)

The solid state relay is located on the same side of the controller as the power socket. It is attached to the controller with two Phillips screws and two lock nuts.

1. Access the controller as described in Section 5.5.

2. Remove the two Phillips screws used to mount the relay.

3. Lift the relay out of the controller.

4. Remove the screws that attach the wires to the solid state relay.

5. Connect the wires to the new solid state relay as follows:

Wire Color	Pin
Orange	1
Yellow	2
Red	3
Black	4

6. Use the two Phillips screws and the two lock nuts to attach the new relay to the side of the controller. Pins 3 and 4 should be toward the front of the controller.

7. Reattach the controller cover, using the six Phillips head screws and lock washers previously removed.

8. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.

9. Perform the Checkout Procedure in Section 2.2. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.

10. Perform the resistance and leakage current tests in Section 3.4.

5.9 Heater and/or Heater Gasket Replacement

CAUTION: If early model heaters are not installed with the nuts on the inside of the controller and the screws on the outside, water can leak in during cleaning and damage the electronics.

CAUTION: If gaskets are not installed properly, water can leak in during cleaning and damage the electronics.

1. Access the controller as described in Section 5.5.

2. Unscrew the fan mounting knob at the end of the fan shaft. Remove the fan.

3. Remove the top two heater mounting nuts on the back of the controller.

4. Disconnect the white wires from the heater.

Note: On some very early models, the heater wires are terminated with ring terminals. If you are replacing one of these heaters, remove the ring terminals from the wires and replace them with Faston 250 terminals.

5. Remove the lower heater mounting nut. The nut is accessed through a hole in the motor mounting bracket.

Note: On early units you must remove the control board and the motor bracket to install a new heater.

6. Pull off the old heater.

Note: The heater gasket will also come off.

7. Align the heater gasket with the new heater and slide the new heater into the back of the controller.

8. Secure the heater to the rear of the controller as shown in Figure 5-9.

9. If necessary, remount the motor bracket and the control board.

10. Reattach the white wires to the heater.

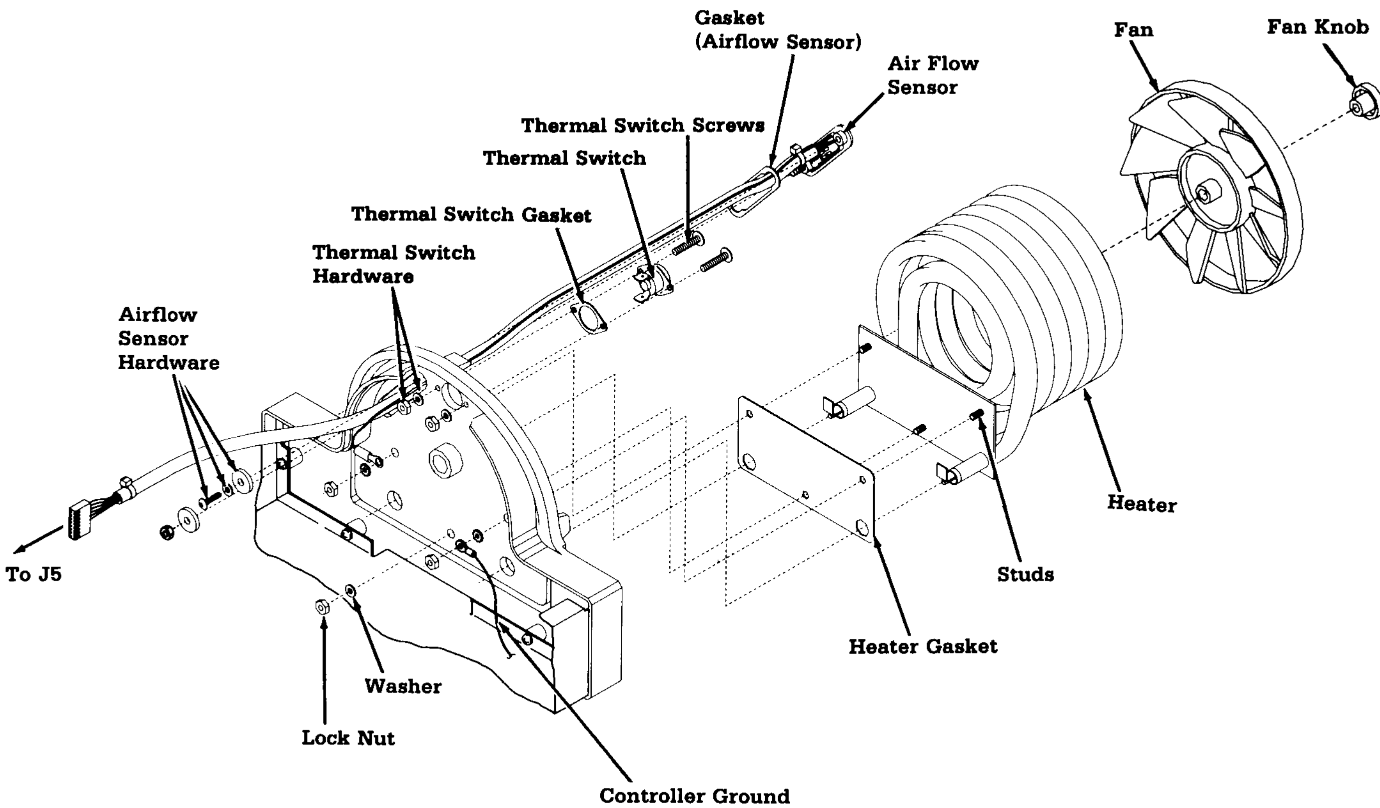


Figure 5-9 Heater, Thermal Switch and Air Flow Sensor Replacement

11. The fan is keyed to fit the shaft. Slide the fan back onto the shaft so that the collar points toward the heater.

12. Replace and tighten the fan mounting knob to secure the fan.

13. Reattach the controller cover, using the six Phillips head screws and lock washers previously removed.

14. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.

15. Perform the Checkout Procedure in Section 2.2. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.

16. Perform the resistance and leakage current tests in Section 3.4.

5.10 Thermal Switch Replacement

CAUTION: If gaskets are not installed properly, water can leak in during cleaning and damage the electronics.

Note: It is not necessary to remove the heater.

1. Access the controller as described in Section 5.5.
2. Unscrew the fan mounting knob and remove the fan.
3. Disconnect the wires attached to the thermal switch.
4. Remove the screws securing the thermal switch and pull the thermal switch out of the controller. Position your hand inside the controller to catch the mounting nuts and lock washers when you remove the screws. Retain the gasket for use with the new thermal switch.
5. Align the gasket with the new thermal switch and replace the mounting hardware as shown in Figure 5-9.
6. Reconnect the thermal switch to the wires from J1 pin 2 and the heater.
7. Perform Section 3.3.I of the calibration procedures.
8. Reattach the controller cover, using the six Phillips head screws and lock washers previously removed.
9. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.
10. Perform the Checkout Procedure in Section 2.2. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.
11. Perform the resistance and leakage current tests in Section 3.4.

5.11 Air Flow Sensor Replacement

CAUTION: If the gaskets are not properly installed, water can leak in during cleaning and damage the electronics.

Note: It is not necessary to remove the heater.

1. Access the controller as described in Section 5.5.
2. Remove all screws, (nuts on some units) and harness clips that hold the sensor in place.

3. Disconnect the air flow sensor cable from the control board.

4. Install the new sensor and gasket, making sure that the sensor is oriented as shown in Figure 5-10.

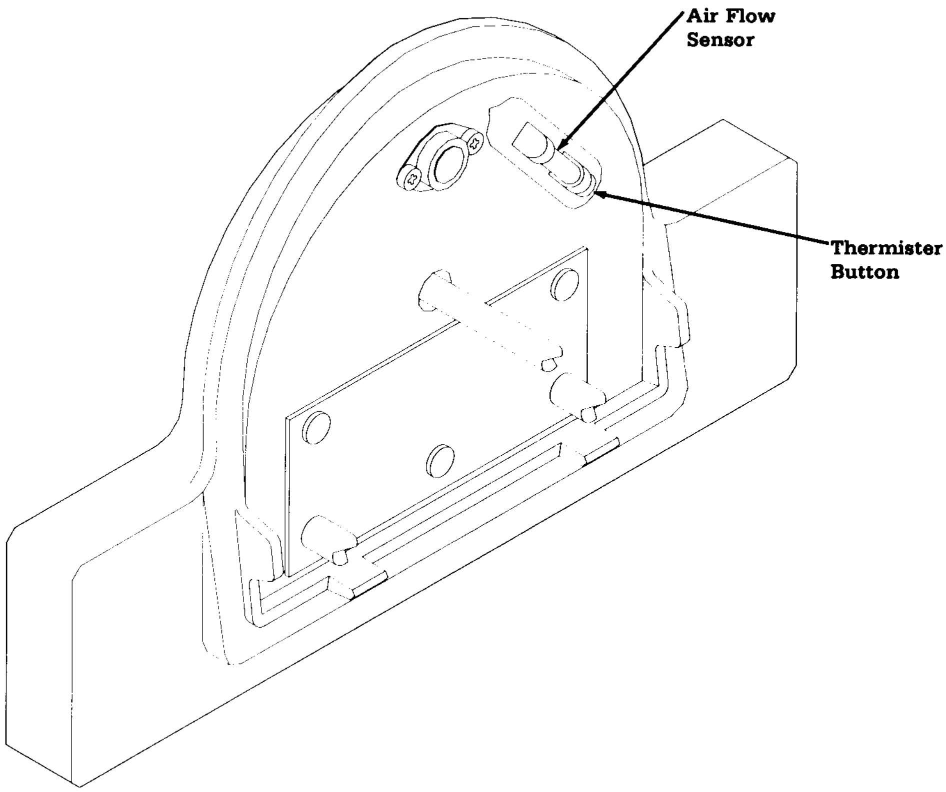


Figure 5-10 Air Flow Sensor Installation

5. Connect the air flow sensor cable to the control board and replace the controller cover.

6. Verify that the air flow sensor works as follows:

   a. Remove the controller from the rear of the unit and remove the fan. Replace the controller in the incubator and make sure that the air temperature sensor and the power cord are plugged in.

   b. Switch the incubator ON. The operator prompt tone will sound. **Do not adjust the control temperature;** running the incubator with the heater OFF provides a more thorough test of the air flow sensor.

   c. Allow the unit to run for 10 minutes. The front panel air circulation alarm indicator should illuminate and an alternating two tone alarm should sound.

d. Depress the F/C switch until a different pair of numbers appear in the ai temperature and control temperature displays (approximately five seconds). Continue pressing the F/C button and record the numbers that appear in the air and control temperature displays.

e. Subtract the two numbers. The difference must be greater than 230.

f. Switch the unit OFF. Remove the controller and replace the fan. Slide the controller back into the incubator and reconnect the power cord and air temperature sensor.

g. Switch the unit ON and adjust the control temperature to 39 C. Allow th incubator to run for 10 minutes.

h. Again depress the F/C switch until a different pair of numbers appears ir the air and control temperature displays (approximately five seconds). Continue pressing the F/C button and record the numbers that appear in the air and control temperature displays.

i. Subtract the two numbers. The difference must be less than 190.

7. If the conditions of steps "e" and "i" are not met, the air flow sensor must be replaced.

8. Perform the Checkout Procedure in Section 2.2. Listen for any grating soun caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.

9. Perform the resistance and leakage current tests in Section 3.4.

5.12 Fan Motor Replacement

1. Access the controller as described in Section 5.5.

2. Unscrew the fan mounting knob and remove the fan.

3. Turn the controller on its side and remove the four screws, standard washe and lock nuts used to attach the fan motor bracket to the controller.

4. Disconnect the fan motor connector from J1.

5. Remove the control board.

6. Slide the assembly toward the front of the controller, until the shaft clears the back of the controller. Then lift the assembly out of the controller.

7. Remove the four motor mounting screws and slide the motor out of the bracket.

8. Pull the small cooling fan off of the short motor shaft.

9. Attach the new motor to the bracket as shown in Figure 5-11.

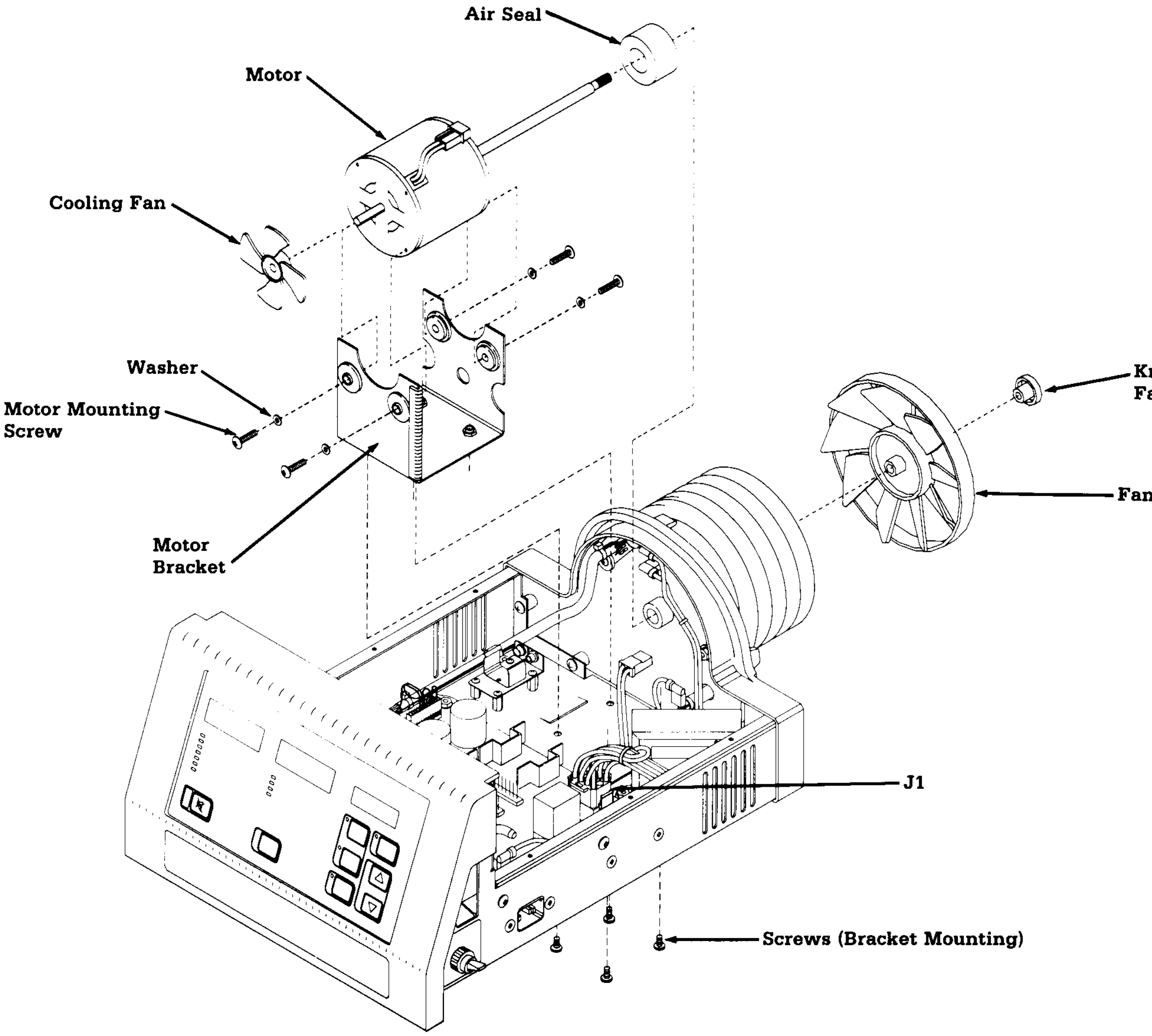


Figure 5-11 Fan Motor Replacement

10. Push the cooling fan onto the shorter motor shaft.

11. Slide the long motor shaft through the air seal and into the hole in the rear of the controller.

12. Secure the motor bracket to the controller with the four bracket mounting screws, shown in Figure 5-11.

13. The fan is keyed to slide onto the motor shaft. Slide the fan onto the shaft so the collar on the fan points toward the motor.

14. Replace the fan mounting knob. Fully tighten the knob.

15. Replace the control board.

16. Connect the motor connector to the connector from J1 on the control board

17. Reattach the controller cover, using the six Phillips head screws and lock washers previously removed.

18. Pull up on the controller latches. Carefully slide the controller back into th incubator. Push down on the latches to secure the controller.

19. Perform the Checkout Procedure in Section 2.2. Listen for any grating soun caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.

20. Complete the resistance and leakage current tests in Section 3.4.

5.12 Battery Replacement

1. Access the controller as described in section 5.5.

2. Remove the battery by sliding the battery away from the contacts.

3. Install the new battery by lining the terminals up with the contacts and sliding the battery into the bracket.

4. Reattach the controller cover, using the six Phillips head screws and lock washers previously removed.

5. Pull up on the controller latches. Carefully slide the controller back into t incubator. Push down on the latches to secure the controller.

6. Perform the Checkout Procedure in Section 2.2. Listen for any grating sou caused by the fan rubbing against the base platform. Adjust the heater anc fan position if rubbing is present.

7. Perform the resistance and leakage current tests in Section 3.4.

5.13 Caster Replacement

WARNING: Two people are required to safely replace a caster. Remove th incubator and all accessory equipment from the cabinet before replacing a caster.

1. Remove all accessories from the incubator.

2. Remove the incubator mounting knobs (located inside the cabinet), which attach the incubator to the cabinet.

3. Lift the incubator off of the cabinet

4. Lay the cabinet on its side.

5. Remove the four lock nuts that attach the caster to the cabinet.
6. Remove the old caster.
7. Slide the new caster over the mounting studs.
8. Replace and tighten the lock nuts to secure the caster. Torque to 75 in/lbs.
9. Turn the cabinet right side up.
10. Attach the incubator to the cabinet with the incubator mounting knobs.

6.1 Hood Components

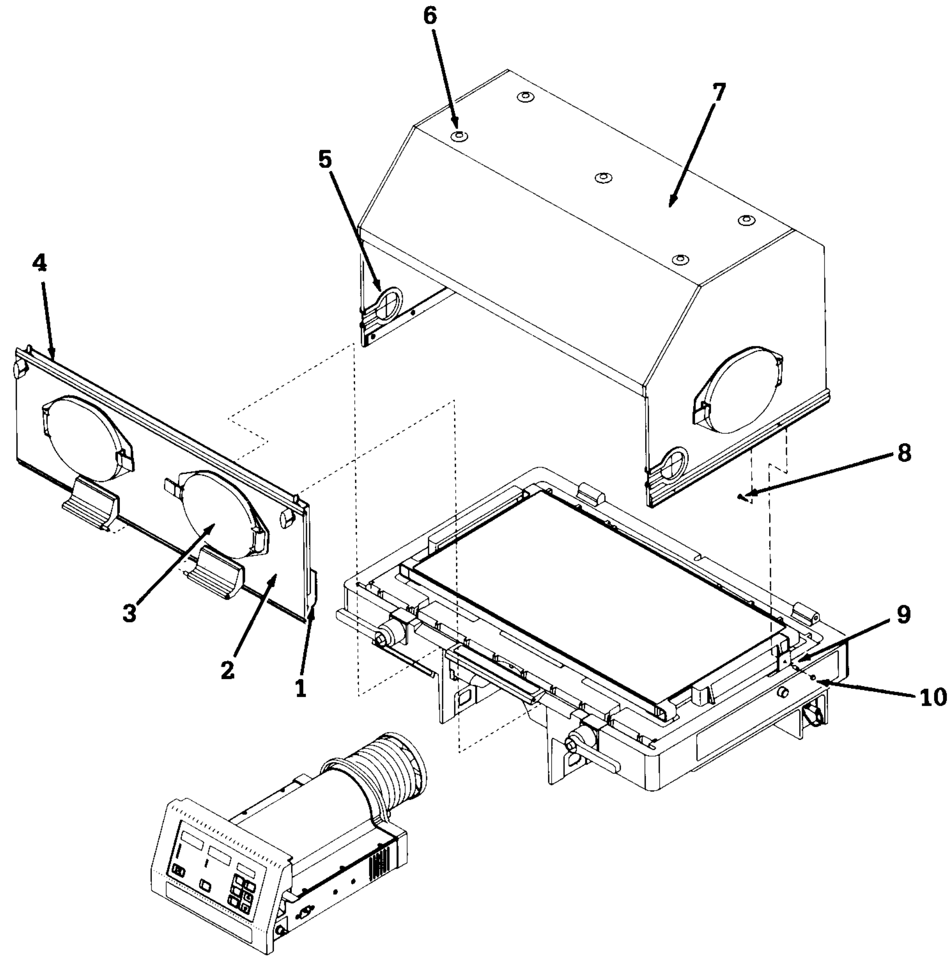


Figure 6-1 Incubator Assembly, Front View

	Item	Stock Numb
1.	Deflector panel w/ fasteners	6600-0155-7
2	Front door replacement kit (outer door w/o hardware)	6600-0086-4
3.	Porthole assembly	6600-0051-4
4	Lower wall (front or rear w/ deflector panel)	6600-0106-8
5.	Tubing access cover	6600-0156-5
6	Hole plug	6600-0174-5
7	Hood replacement kit (outer hood with hardware)	6600-0038-8
8.	Screw, 10-24 x 1.000	6600-0118-4
9.	Nylon washer, 0.192 in ID	6600-0103-4
10.	Nut, ESN, 10-24, SST	6600-0088-4

Misc. Hood Hardware	Stock Numb
Inner wall fastener (12/pkg)	6600-0102-8
Mounting post	6600-0161-7

Item		Stock Numbe
1.	Humidifier fill port kit (w/ o-ring)	6600-0070-80
2.	Filter cover	6600-0070-50
3.	Knob, filter cover mounting	6600-0068-50
4.	Nut, Hex, 8-32, FL MC	0144-3127-11
5.	Cable clamp	6600-0144-40
6.	Compartment probe kit, air temperature sensor (includes mounting blocks and screws)@	6600-0071-80
7.	Shim	6600-0222-50
8.	Screw, 8-32 x 5/8, TRS, P	0140-6627-11
9.	Screw, 1/4-20 x .500, R *	6600-0078-40

Not Shown	Stock Numbe
Humidifier o-ring	6600-0065-40
Filter w/ replacement date label	6600-0043-80
Probe pull, "T" handle air temperature sensor	6600-0240-50

*** Fully tighten, then loosen one turn.**

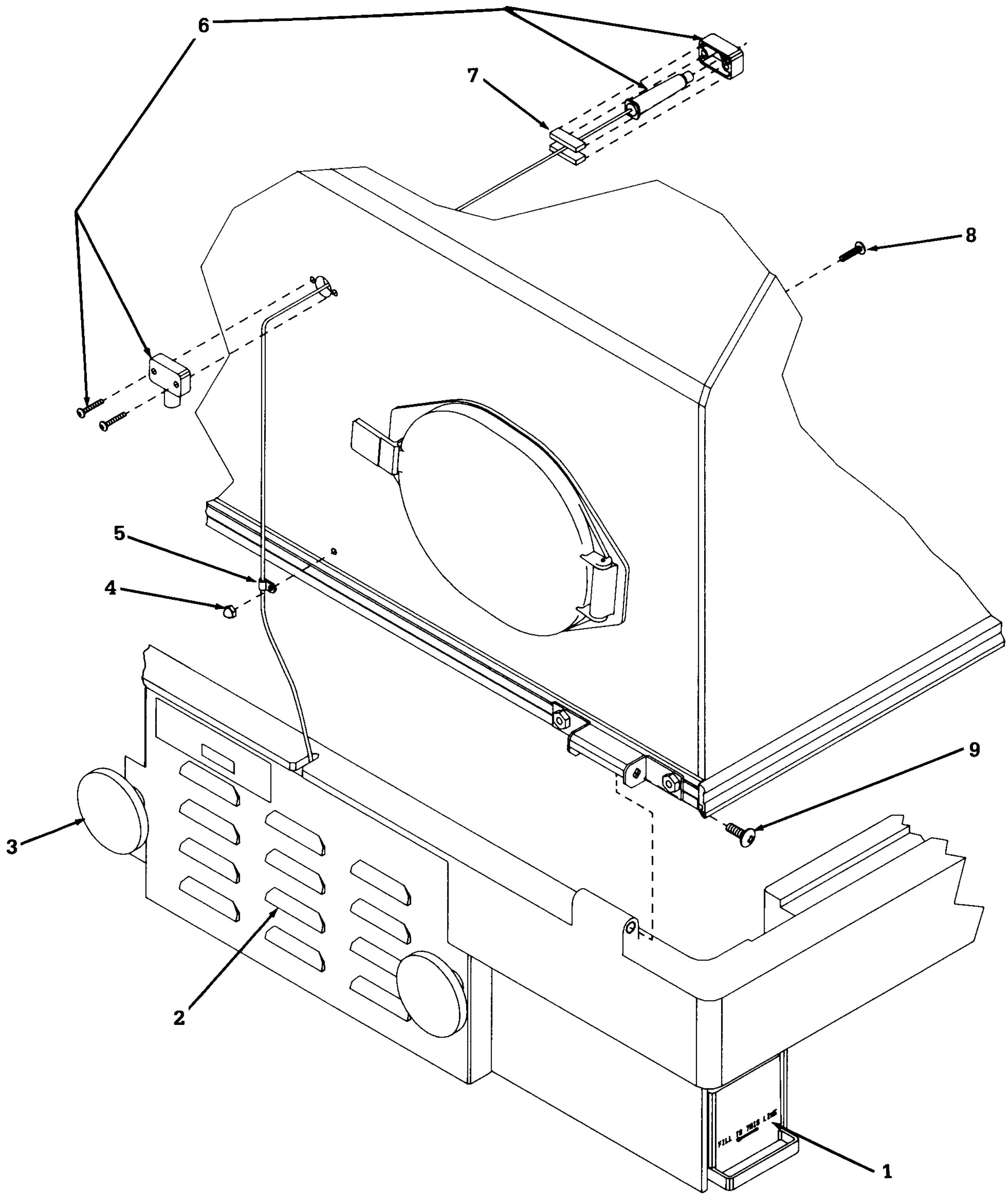


Figure 6-2 Incubator Assembly, Rear View

	Item	Stock Numbe
1.	Inner frame, hood (left or right half)	6600-0227-50
2.	Screw, 10-24 x .875	6600-0087-40
3.	Screw 10-24 x 1.00	6600-0118-40
4.	Screw, 10-24 x 1/2	0140-6630-10
5.	Hood seal (3 ft strip)	6600-0143-50
6.	Outer frame, left side	6600-0049-40
7.	Hole plug	6600-0174-50
8.	Hood replacement kit (all items shown above)	6600-0038-81
9.	Nut, ESN, 10-24, SST	6600-0088-40
10.	Hood hinge cover	6600-0165-50
11.	Outer frame, rear	6600-0048-40
12.	Outer frame, right side	6600-0050-40
13.	Trim, outer frame (3 ft strip)	6600-0166-50

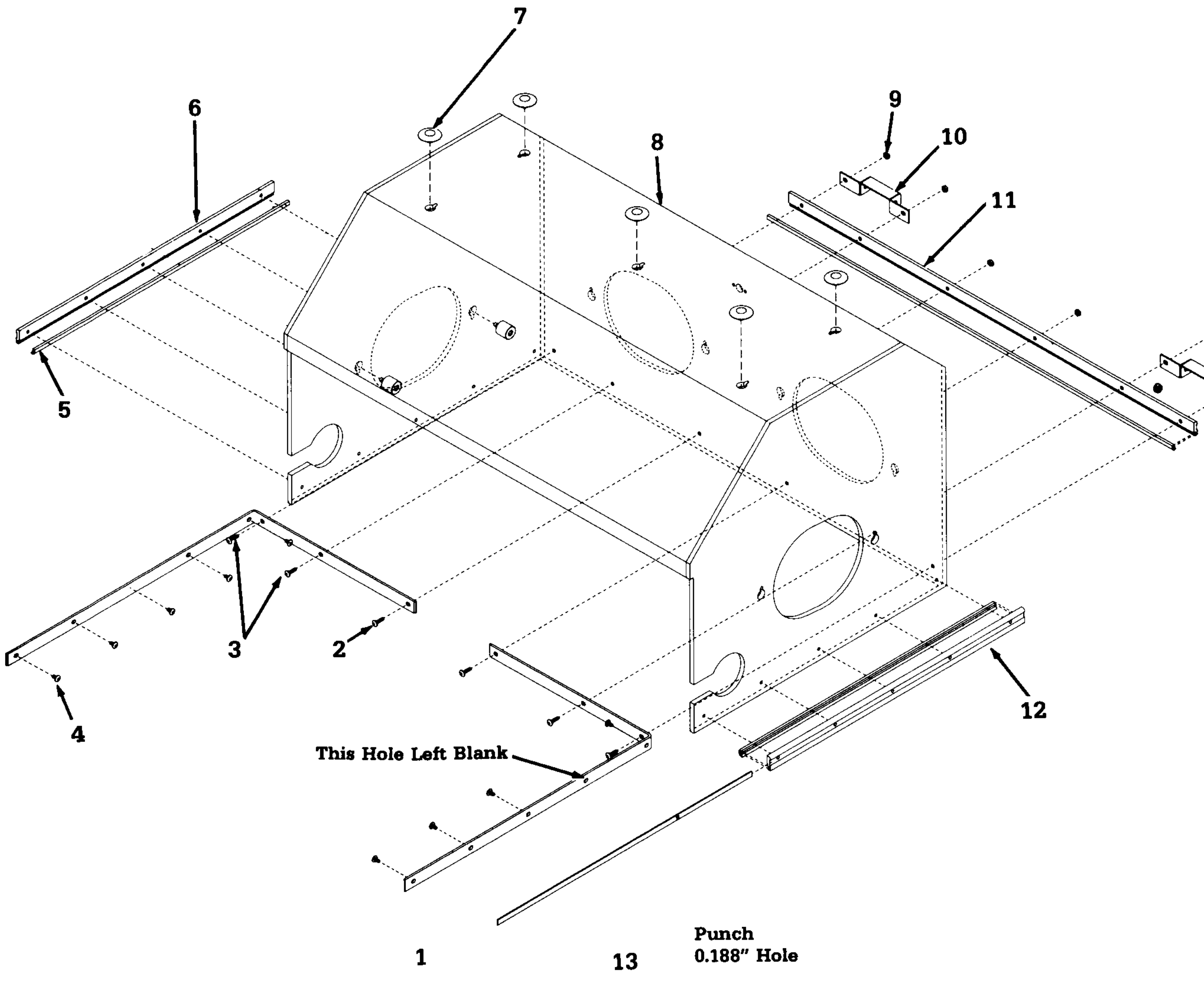


Figure 6-3 Hood Seals and Related Hardware

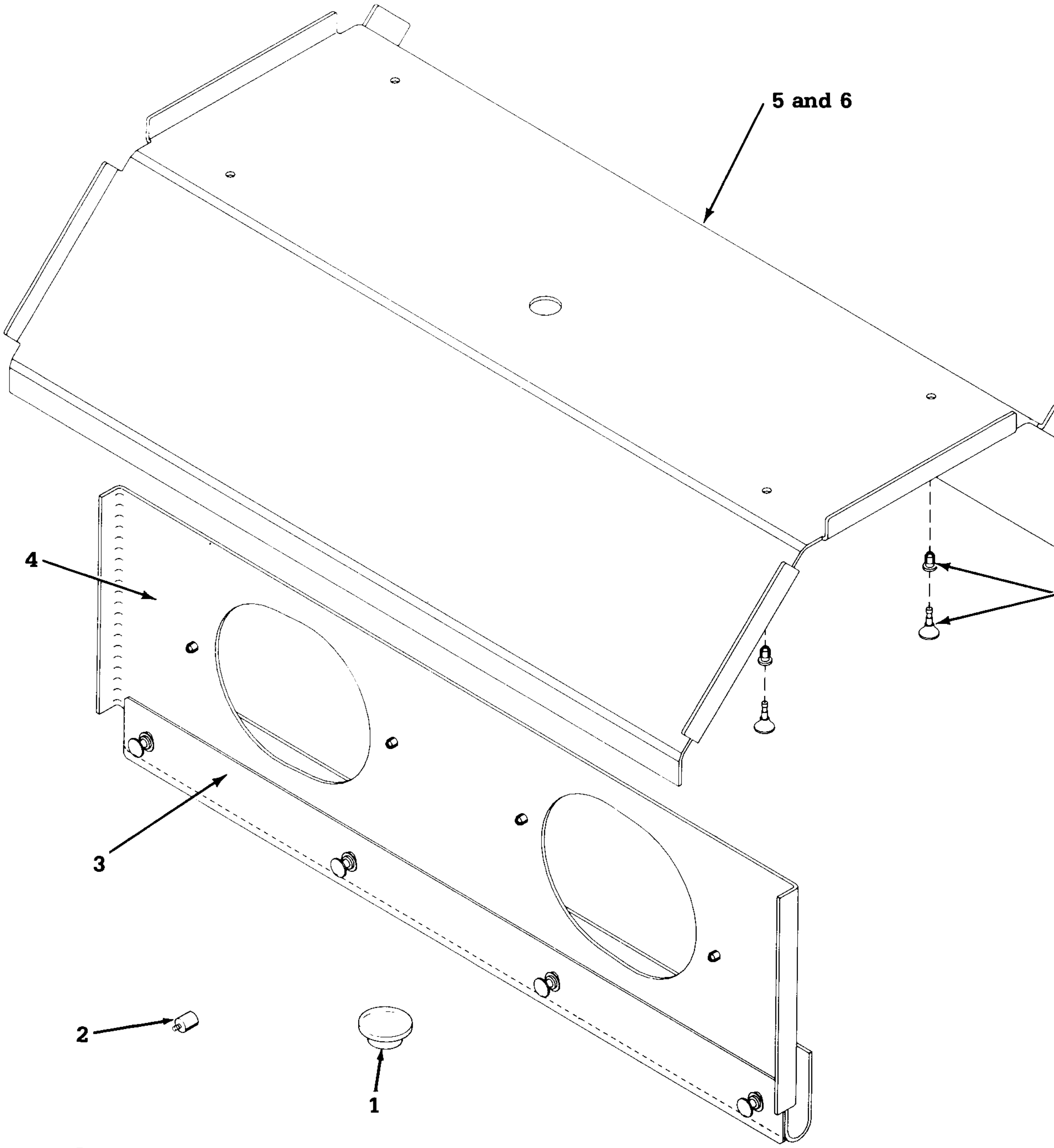


Figure 6-4 Inner Wall Assembly, Hood

Item		Stock Number
1.	Upper wall retainer (requires post and fastener)	6600-0148-500
2.	Mounting post	6600-0161-700
3.	Deflector panel w/ fasteners	6600-0155-700
4.	Lower wall (front or rear w/ deflector panel)	6600-0106-800
5.	Inner wall, hood (includes all items shown)	6600-0040-800
6.	Upper inner wall w/ fasteners	6600-0116-800
7.	Inner wall fastener (12/pkg)	6600-0102-800

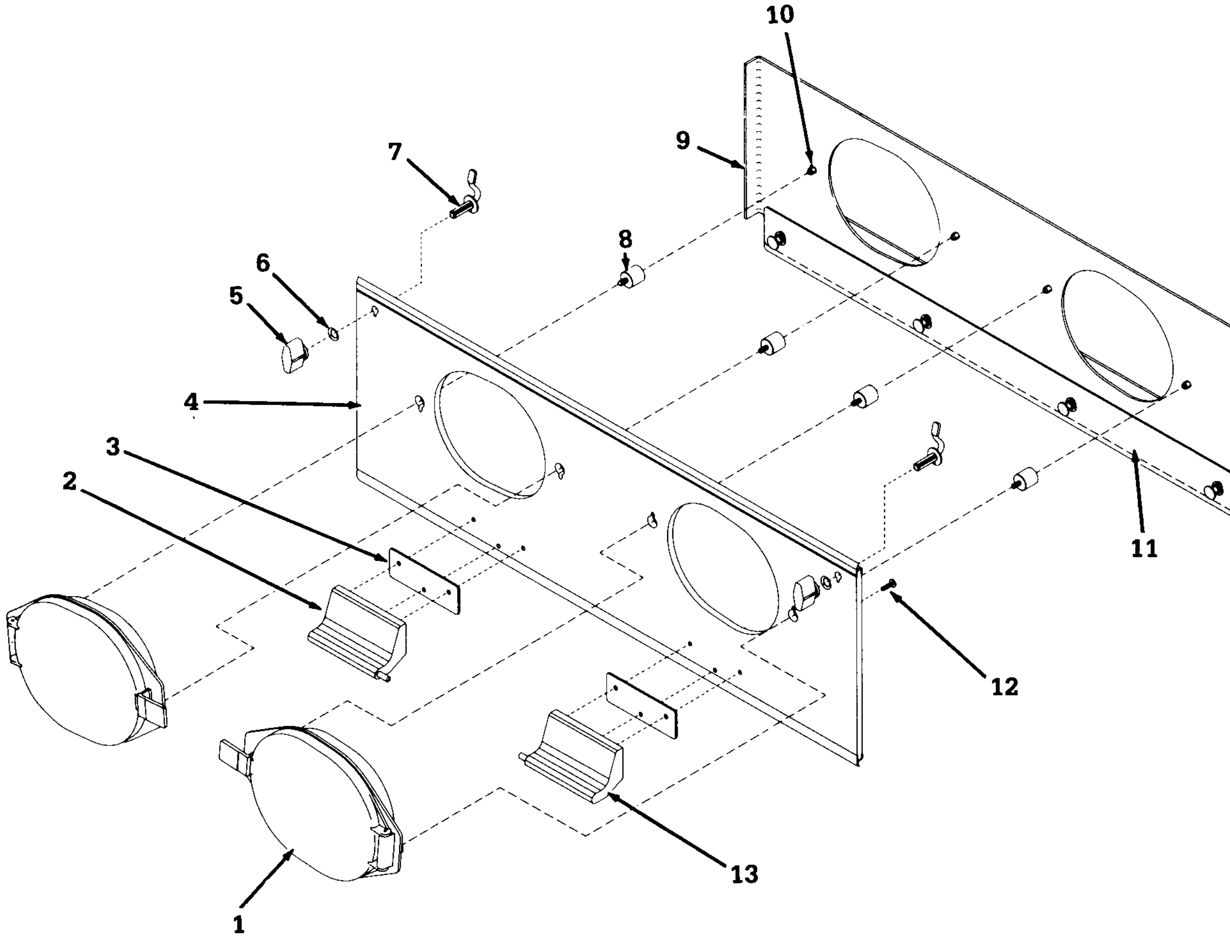


Figure 6-5 Front Door and Related Hardware

Item		Stock Numb
1.	Porthole	6600-0051-4
2.	Left hinge housing	6600-0036-4
3.	Gasket, hinge	6600-0069-5
4.	Front door replacement kit (outer door w/o hardware)	6600-0086-4
5.	Front door knob	6600-0168-5
6.	Washer, curved spring	6600-0077-4
7.	Inner latch, front door	6600-0157-5
8.	Mounting post	6600-0161-7
9.	Lower wall (front or rear w/ deflector panel)	6600-0106-8
10.	Inner wall fastener (12/pkg) *	6600-0102-8
11.	Deflector panel w/ fasteners	6600-0155-7
12.	Screw, 10-32 x .75, TR	6600-0089-4
13.	Right door hinge housing	6600-0035-4

*** Insert the socket into the proper hole in the inner wall and then push in the plunger.**

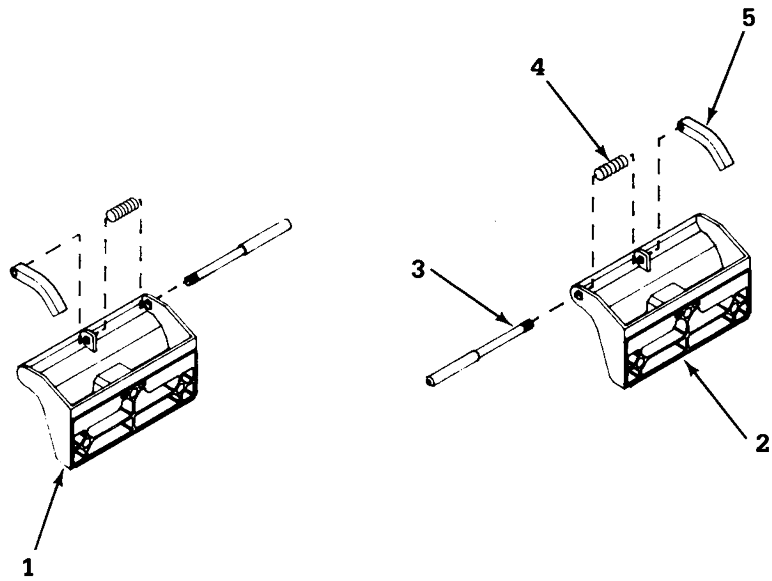


Figure 6-6 Hinge Detail

Item		Stock Number
1.	Left door hinge housing	6600-0036-400
2.	Right door hinge housing	6600-0035-400
3.	Hinge pin rod *	6600-0140-500
4.	Hinge pin spring, CPRSN	6600-0059-400
5.	Hinge pin release	6600-0141-500

*** Apply Loctite 27741 , Stock No. 0220-5025-300**

New Hood Components/Part Number Changes:

6.2 Base Platform Components

Item	Stock Numbe
1. Mattress tray	6600-0175-50
2. Mattress w/cover	6600-0152-50
3. Tilt handle assembly	6600-0078-80
4. Base platform cover service kit	6600-0111-80
5. Hood tilt latch	6600-0123-50
6. Base platform service kit w/ hardware ^	6600-0107-80
7. Spring, hood tilt release, CPRSN	6600-0061-40
8. Plunger, hood tilt release	6600-0125-50
9. Hair pin clip *	6600-0104-40

^ Includes items 5 through 10 from Figure 6-7 and items 20 through 31 from Figure 6-8.

*** Clip on after plunger is installed.**

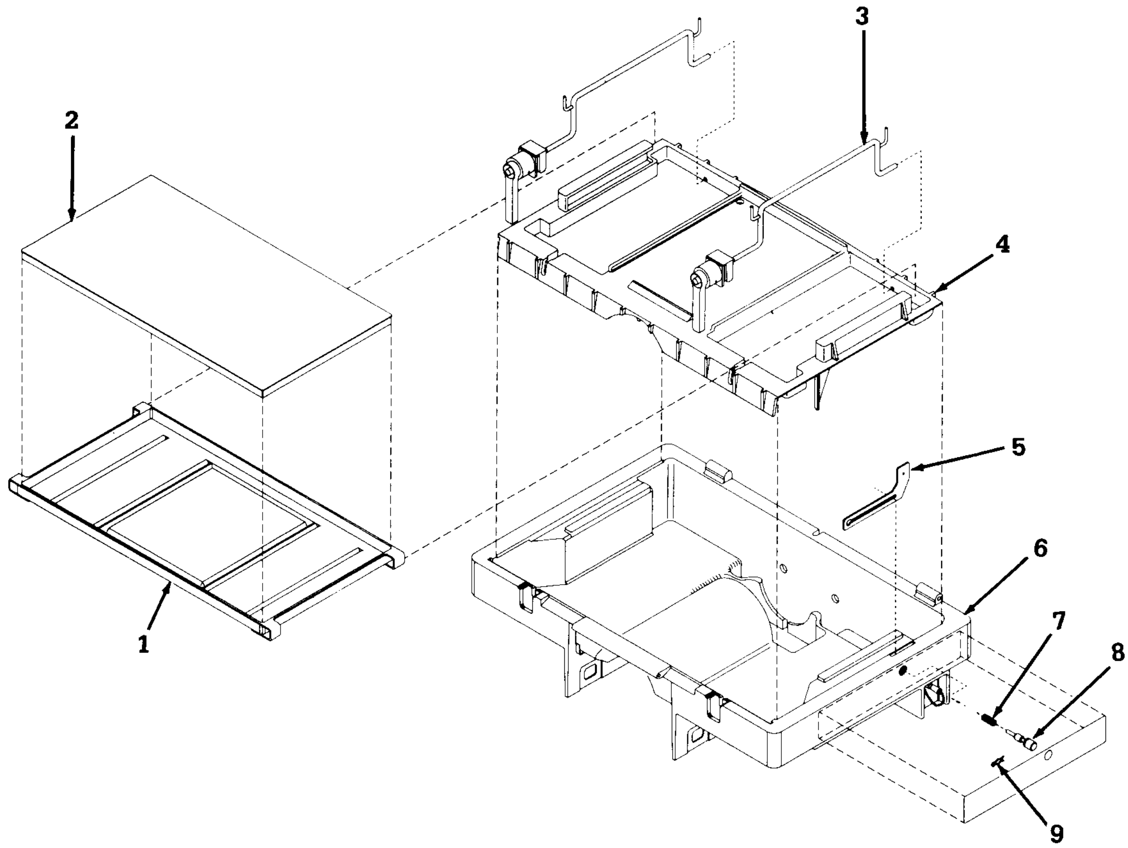


Figure 6-7 Base Platform and Cover Assembly

Item	Stock Numbe
1. Filter & replacement date sticker	6600-0043-80
2. Knob, filter cover mounting	6600-0068-50
3. Filter cover	6600-0070-50
4. Humidifier fill port kit (port & o-ring)	6600-0070-80
5. Humidifier o-ring	6600-0065-40
6. Compartment probe kit, air temperature sensor ^	6600-0071-80
7. Washer, Int. Lock #8	0144-1108-13
8. Screw, 8-32 x 1/4	0140-6627-10
9. Cover plate, base platform	6600-0160-50
10. Cable clamp	6600-0145-40
11. Screw, 8-32 x 3/8, TRS, P	0140-6627-10
12. Stop clip, sliding tray	6600-0162-50
13. Nut, elastic 4-40, ST	0202-1013-30
14. Screw, 4-40 x 1/4, TRS, P	6600-0125-40
15. Sliding tray	6600-0163-50
16. Instruction booklet, English #	6600-0022-00
17. Retainer, sliding tray	6600-0161-50
18. Nut, KEP, 4-40 W/E	6600-0073-40
19. Screw, 8-32 x 3/8	0140-6127-10
20. Washer, Int. Lock #8	0144-1108-13
21. Controller latch brackets (order separately)	
A. Controller latch bracket (left)	6600-0225-50
B. Controller latch bracket (right)	6600-0226-50
22. Screw 6-32 x 3/8	0142-4163-10
23. Cable clamp	0208-0335-30
24. Screw, #8 x 3/8, TR, PH	0142-2164-20
25. Base platform service kit @	6600-0107-80
26. Cap and chain	0217-3785-70
27. Nipple, 1/8 NPT x 3/16 hose	6600-0102-40
28. Nut, 1/8 NPT x .125	6600-0176-50
29. Power cord	0208-0950-30

^ Includes mounting blocks and hardware.

 # Stock Number varies with language , and/or frequency , and/or voltage. See Section 6-7 to obtain numbers for non domestic units.

@ Includes items 5 through 10 from Figure 6-7 and items 20 through 31 from Figure 6-8..

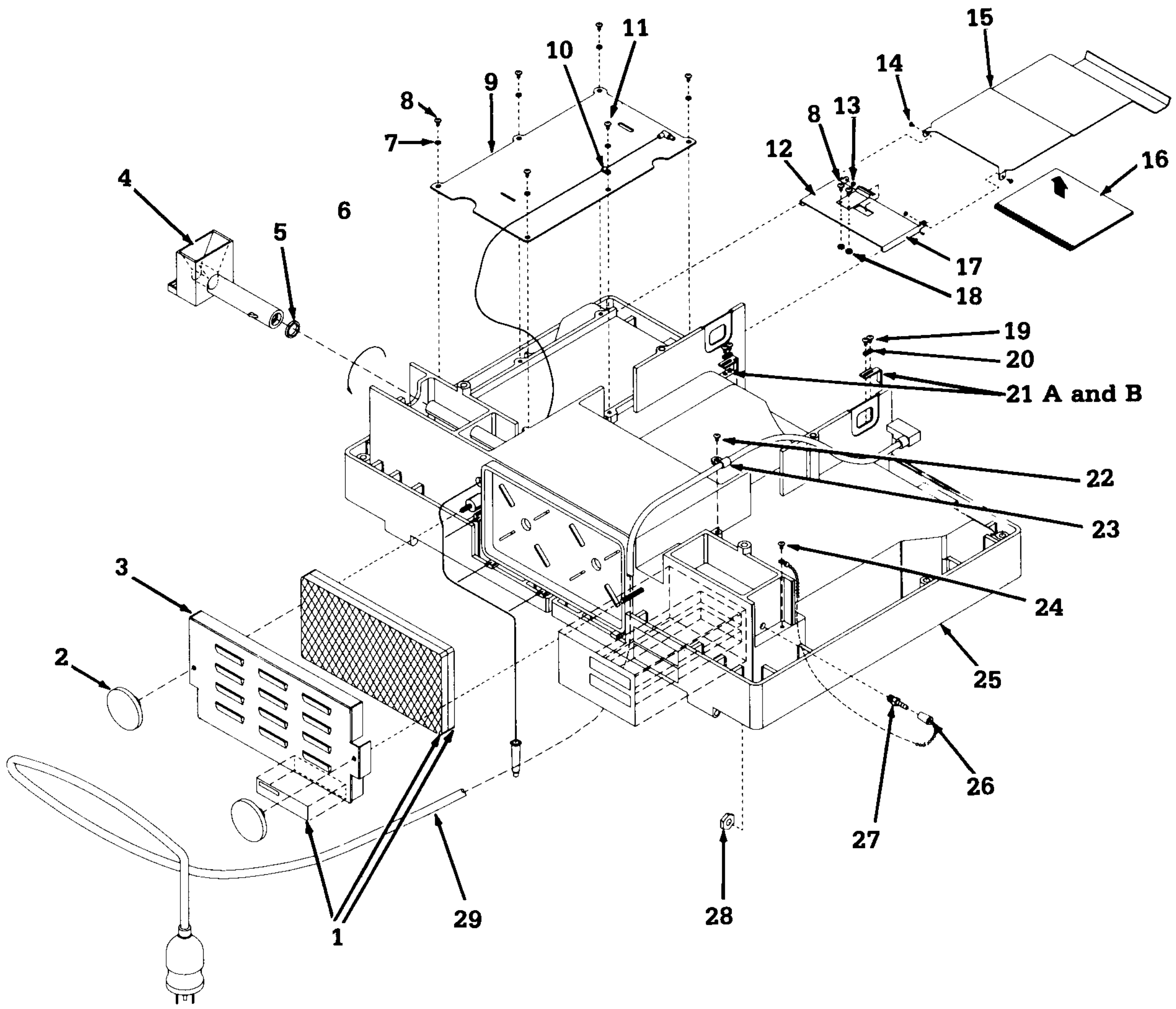


Figure 6-8 Base Platform Hardware (bottom view of platform)

6.3 Controller Components

Service Controller 120 V, 60 Hz, 6600-0084-810 #

	Item	Stock Number
1.	Screw, 4-40 x 1/4, TRS, P	6600-0125-400
2	Washer, int lock, #4, ST, N	0202-3407-340
3	Washer	6600-0151-400
4.	Nut, ext. lock, 6-32 x .31	0202-1130-300
5	Washer, #6, FL, SST	0144-1006-131
6	Gasket, thermal switch	6600-0209-500
7.	Thermal switch (170 F)	6600-0073-600
8.	Screw, 6-32, RD, PH	0140-6124-106
9.	Gasket, air flow sensor	6600-0208-500
10.	Air flow sensor, replacement kit*@	6600-0162-700
11.	Heater, 115 V # &	6600-0199-500
12.	Gasket, heater	6600-0142-500
13.	Washer, int. lock, #10	0144-1110-131
14.	Washer 0.219 ID x 0.500 OD	6600-0067-400
15.	Nut, KEP, 10-32, W/E	6600-0066-400
16.	Nut, KEP, 4-40, w/ext. lock washer	6600-0073-400

*** Install with thermistor button on the bottom.**

 # Stock Number varies with language , and/or frequency , and/or voltage. See Section 6-7 to obtain numbers for non domestic units.

& This version of the heater comes with mounting studs (as shown). Earlier versions mount with three, 10-32 x 5/8, TRS, screws (Stock No 0140-6631-110).

@ The air flow sensor is mounted on the back of the controller and should not be confused with the air temperature sensor located inside the infant compartment.

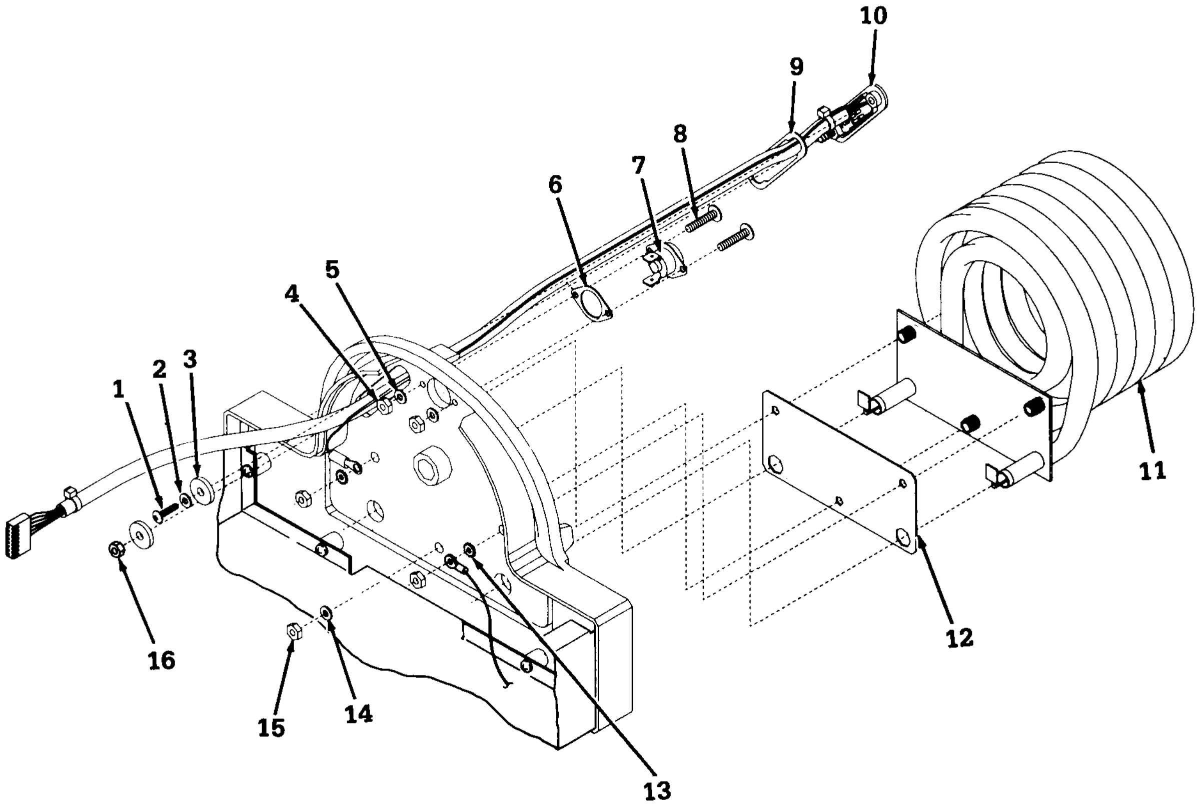


Figure 6-9 Controller Back Panel

Service Controller 120 V, 60 Hz, 6600-0084-810 #

Item		Stock Number
1.	Screw, 6-32 x 7/8, TRS, PH*	6600-0150-400
2.	Washer, #6, FL, SST	0144-1006-131
3.	Shock mount	6600-0105-400
4.	Bushing, shock mount	0217-2897-535
5.	Motor bracket, 60 Hz #	6600-0084-500
6.	Motor, 115 V, 60 Hz (includes shock mount and bushing) #	6600-0054-800
7.	Edge protector (specify 3 inches)	6600-0123-400
8.	Nut, ext. lock, 6-32 x 0.31	0202-1130-300
9.	Spacer, 6-32 x 1/2	0402-0233-300
10.	Spacer, threaded, 0.5	6600-0046-600
11.	Screw, 8-32 x 3/8, TRS, P	0140-6627-106
12.	Slide rail	6600-0167-500
13.	Screw, #6, FL, PH	0400-3103-300
14.	Screw, 6-32 x 1/4, TRS, P	0140-6624-104
15.	Washer, int. lock, #6	0144-1106-131

*** Use Loctite 24231 (Stock No. 0220-5016-300)**

 # Stock Number varies with language , and/or frequency , and/or voltage. See Section 6-7 to obtain numbers for non domestic units.

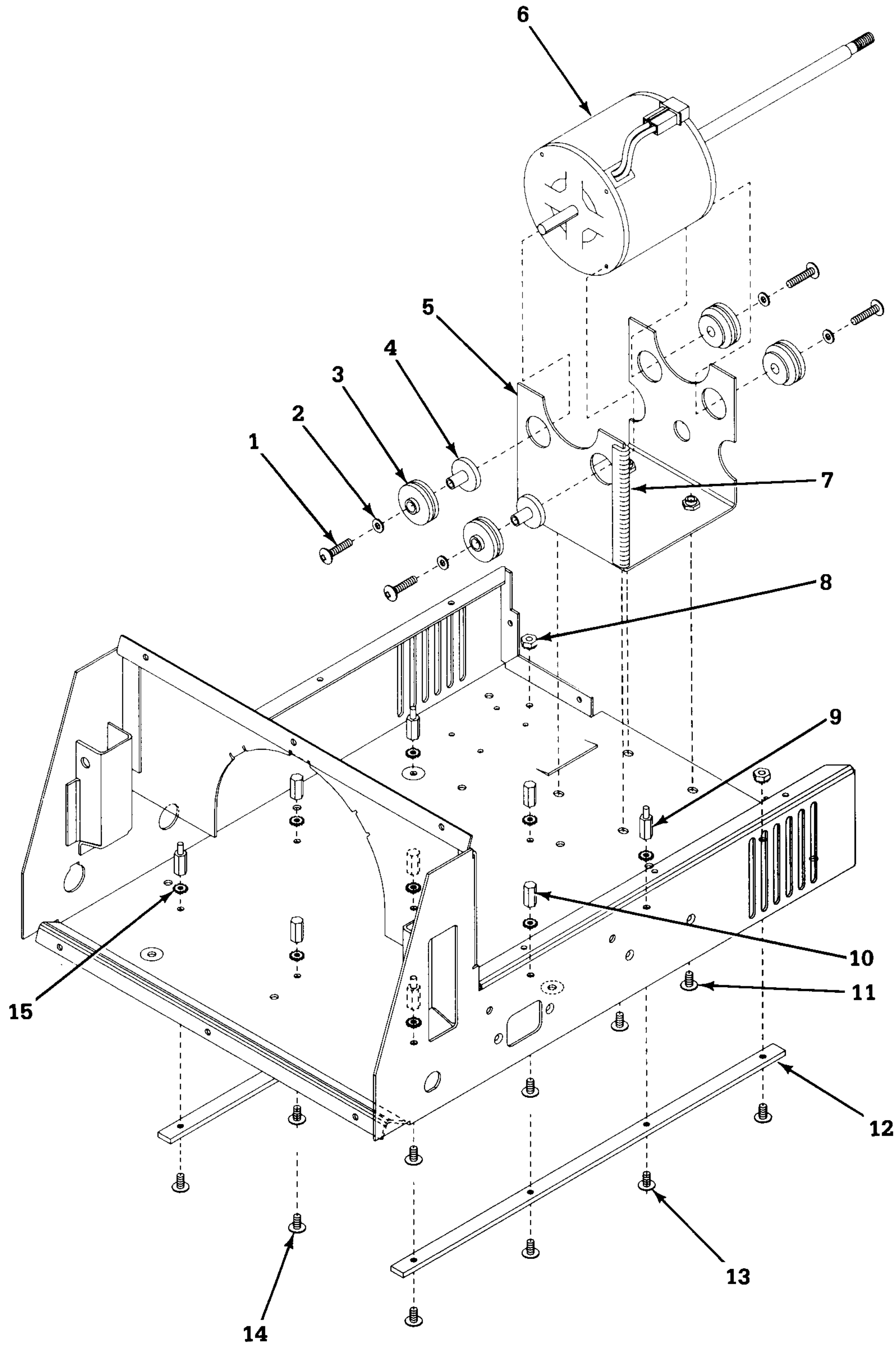


Figure 6-10 Controller Plate and Motor Mounting Hardware

Service Controller 120 V, 60 Hz, 6600-0084-810 #

Item		Stock Numbe
1.	Cooling fan (CCW rotation)	6600-0056-40
2.	Screw, 6-32 x 3/8, TRS, P	0140-6624-10
3.	Washer, int. lock, #6	0144-1106-13
4.	Blower fan (CW rotation)	6600-0141-40
5.	Fan knob, 1/4 x 20, THD	0402-1717-53
6.	Air seal, motor shaft *	0210-6566-30
7.	Controller latch kit (1/pkg)	6600-0108-80

*** Press Adhesive side against rear of controller.**

 # Stock Number varies with language , and/or frequency , and/or voltage. See Section 6-7 to obtain numbers for non domestic units.

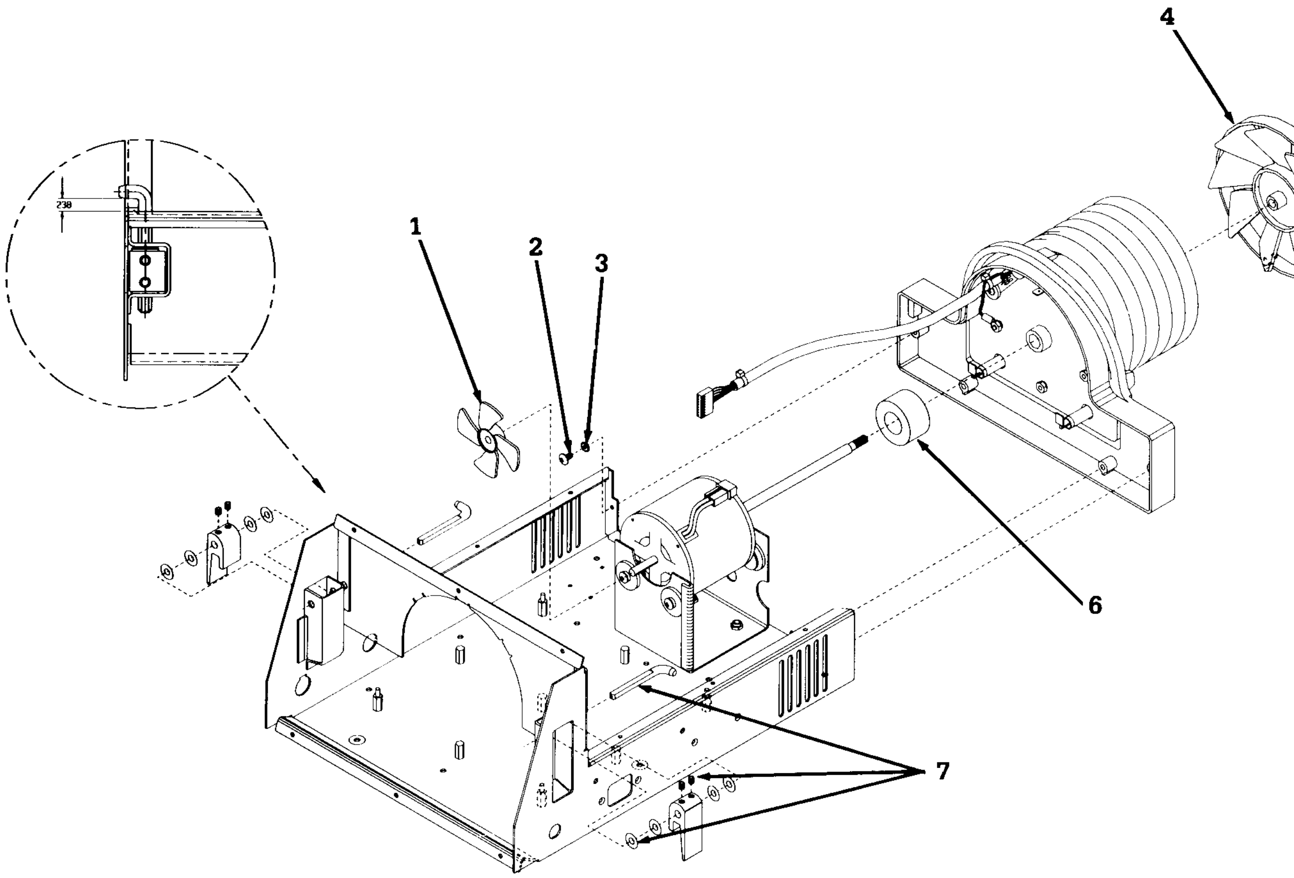


Figure 6-11 Controller Latch and Fan Assemblies

Service Controller 120 V, 60 Hz, 6600-0084-810 #

	Item	Stock Numbe
1.	Circuit breaker (On/Off) switch w/ bezel (DPST)	0690-2500-36
2.	Retaining ring	6600-0075-40
3.	Bezel, patient temp. probe connector	6600-0071-50
4.	Nut, ext. lock, 6-32 x 0.31	0202-1130-30
5.	Line filter, 6 amp (AC entrance)	6600-0094-70
6.	Solid state relay	6600-0096-60
7.	Nut, ext. lock, 8-32 x 0.34	0202-1131-30
8.	Spacer, threaded, #4-40 x 1/2	6600-0108-40
9.	Washer, int. lock, #4, ST, N	0202-3407-34
10.	Transformer (95, 115, 220, 240 V)	0208-7580-30
11.	Washer, int. lock, #8	0144-1108-13
12.	Screw, 8-32 x 3/8, TRS, P	0140-6627-10
13.	Screw, 8-32 x 0.375, F	6600-0071-40
14.	Screw, 6-32 x 3/8, OV, PH	0400-3135-30
15.	Screw, 4-40 x 1/4	0140-6517-10

 # Stock Number varies with language , and/or frequency , and/or voltage. See Section 6-7 to obtain numbers for non domestic units.

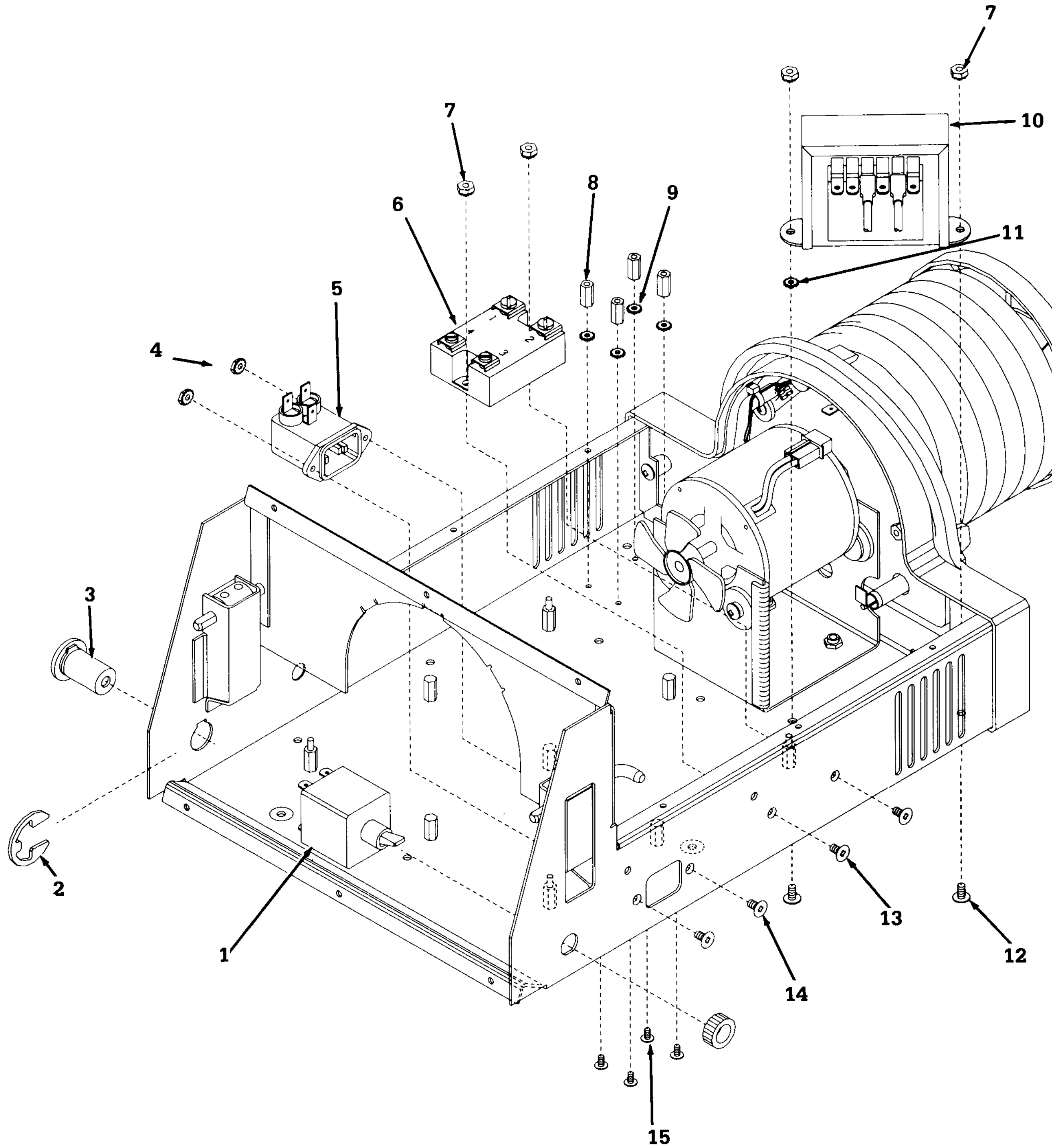


Figure 6-12 Battery and Side Mounted Controller Components

Service Controller 120 V, 60 Hz, 6600-0084-810 #

	Item	Stock Number
1.	Washer, int. lock, #6	0144-1106-131
2.	Screw, 6-32 x 1/4, RD, PH	0140-6124-104
3.	Battery, rechargeable	0690-1000-310
4.	Controller cover	6600-0066-500
5.	Screw, 6-32 x 3/8, RD, PH	0140-6624-106
6.	Rear seal controller (external) *.	6600-0067-500
7.	Screw, #6, FL, PH	0440-3103-300
8	High voltage harness (terminated AC entrance and solid state relay wires, J1 and J2)	6600-0102-700
9	Display board ground wire	6600-0118-700
10.	Control board, 120/100 V # (tested)	6600-0106-710
11.	Patient temp. probe/air temp. sensor harness (Includes probe jack, J4 and related wires)	6600-0122-700
12.	Intermediate harness (display/control board cable)	6600-0101-700

Not Show:

Item	Stock Number
Connector for air temp. sensor	6600-0091-700

*** Press Adhesive side against rear of controller.**

 # Stock Number varies with language , and/or frequency , and/or voltage. See Section 6-7 to obtain numbers for non domestic units.

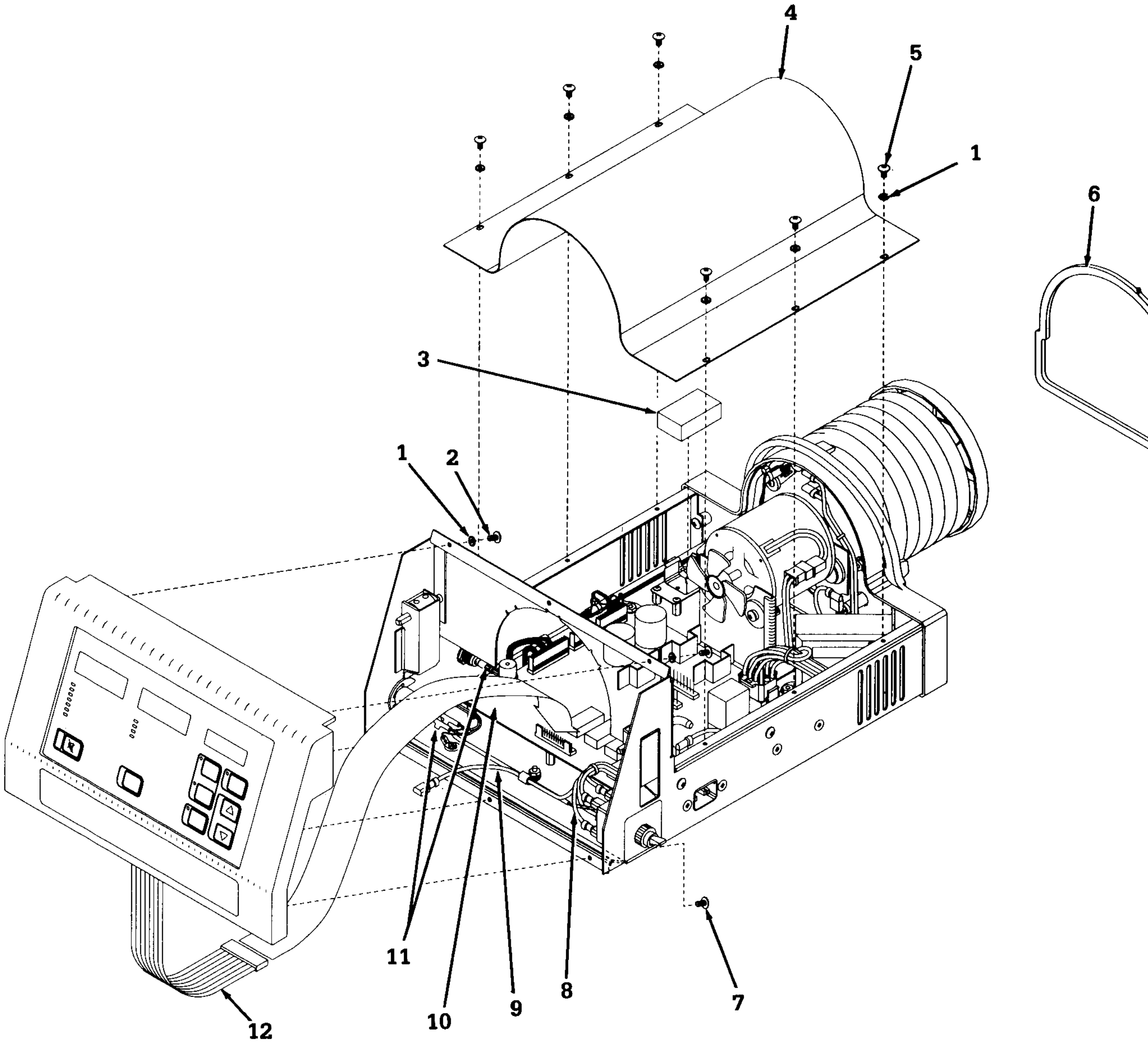


Figure 6-13 Wire Harnesses and Additional Controller Components

Service Controller 120 V, 60 Hz, 6600-0084-810 #

	Item	Stock Number
1.	Front cover, controller	6600-0064-500
2.	Display label, English #	6600-0053-100
3.	Switch panel	6600-0044-700
4.	Gasket, alarm LED *	6600-0210-500
5.	Support panel, display board	6600-0147-500
6.	Washer, int. lock, #6	0144-1106-131
7.	Screw, 6-32 x 3/8, TRS, P	0140-6624-106
8.	Display board (tested)	6600-0105-710
9.	Wire ground, display board	6600-0118-700
10.	Nut, ext. lock, 6-32 x 0.31	0202-1130-300
11.	Intermediate harness (display/control board cable)	6600-0101-700
12.	Spacer, 6-32 x 1/2	0402-0233-300
13.	Washer, 0.147 ID, 0.028 T	0202-4510-340
14.	Tab, faston	0208-0439-300

 # Stock Number varies with language , and/or frequency , and/or voltage. See Section 6-7 to obtain numbers for non domestic units.

*** Press Adhesive side against switch panel.**

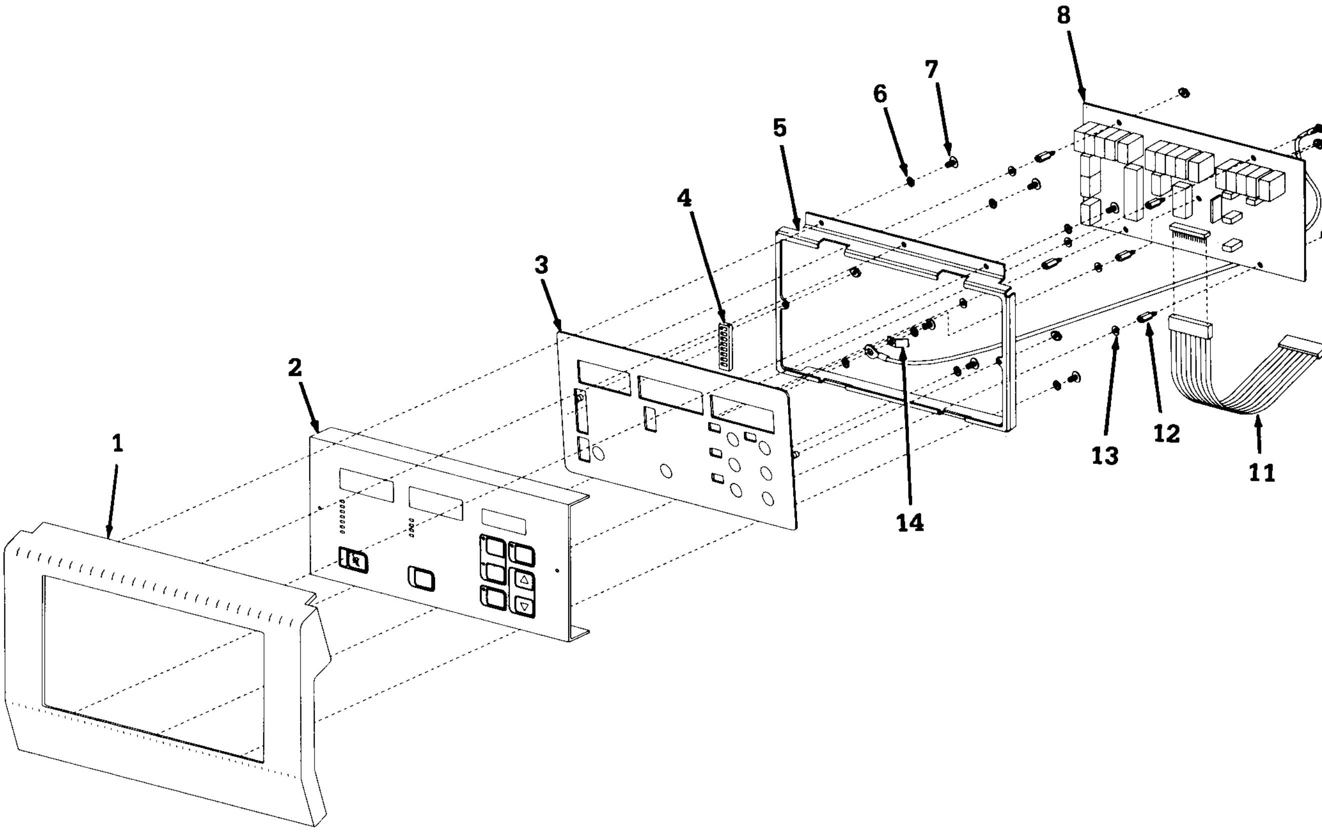


Figure 6-14 Control Panel Assembly

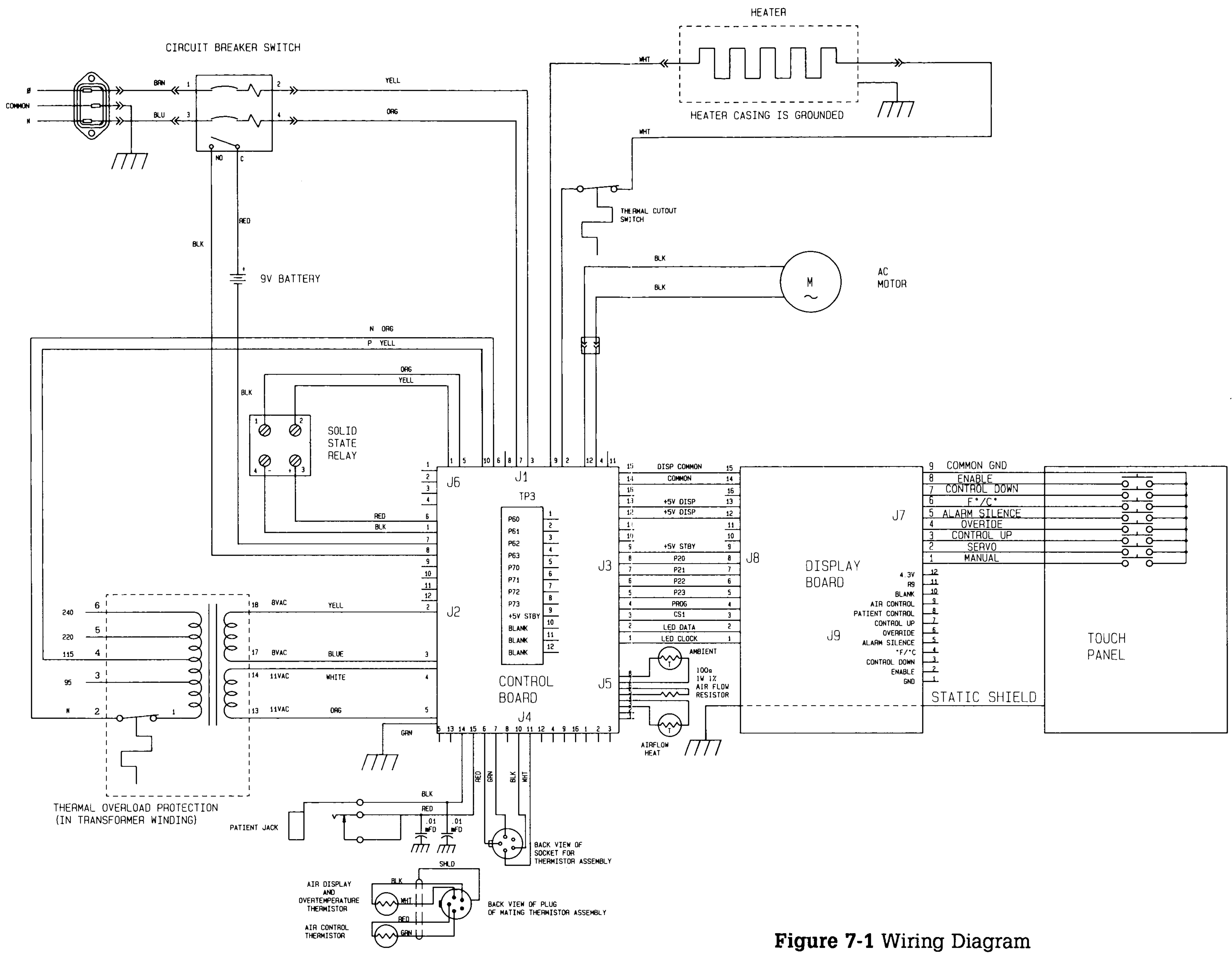


Figure 7-1 Wiring Diagram

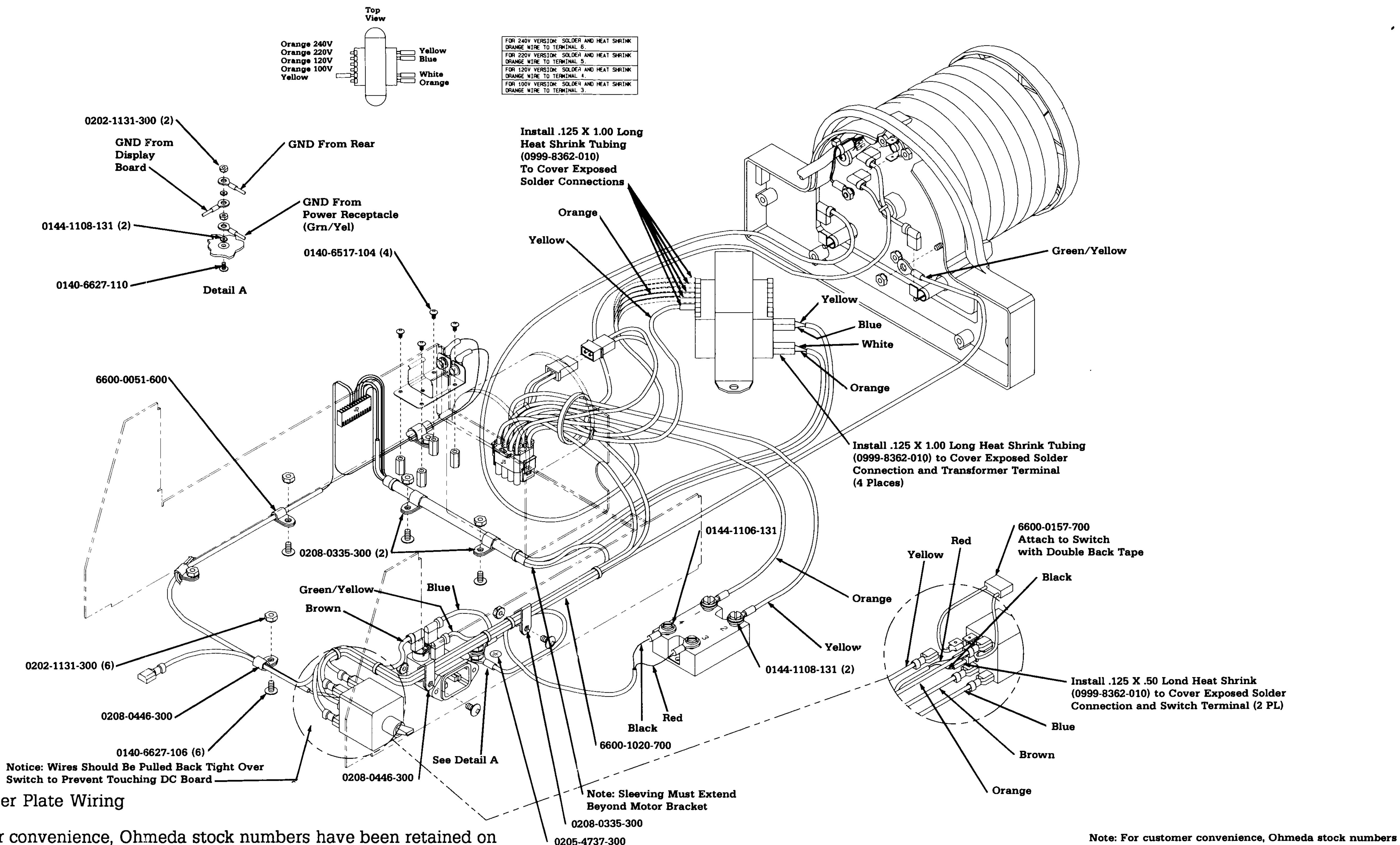


Figure 7-2 Controller Plate Wiring

Note: For customer convenience, Ohmeda stock numbers have been retained on the wiring diagrams.

Note: For customer convenience, Ohmeda stock numbers have been retained on the wiring diagrams.

The 6600-0102-700 wire harness includes J2, J1, the AC entrance wires and the relay wires.

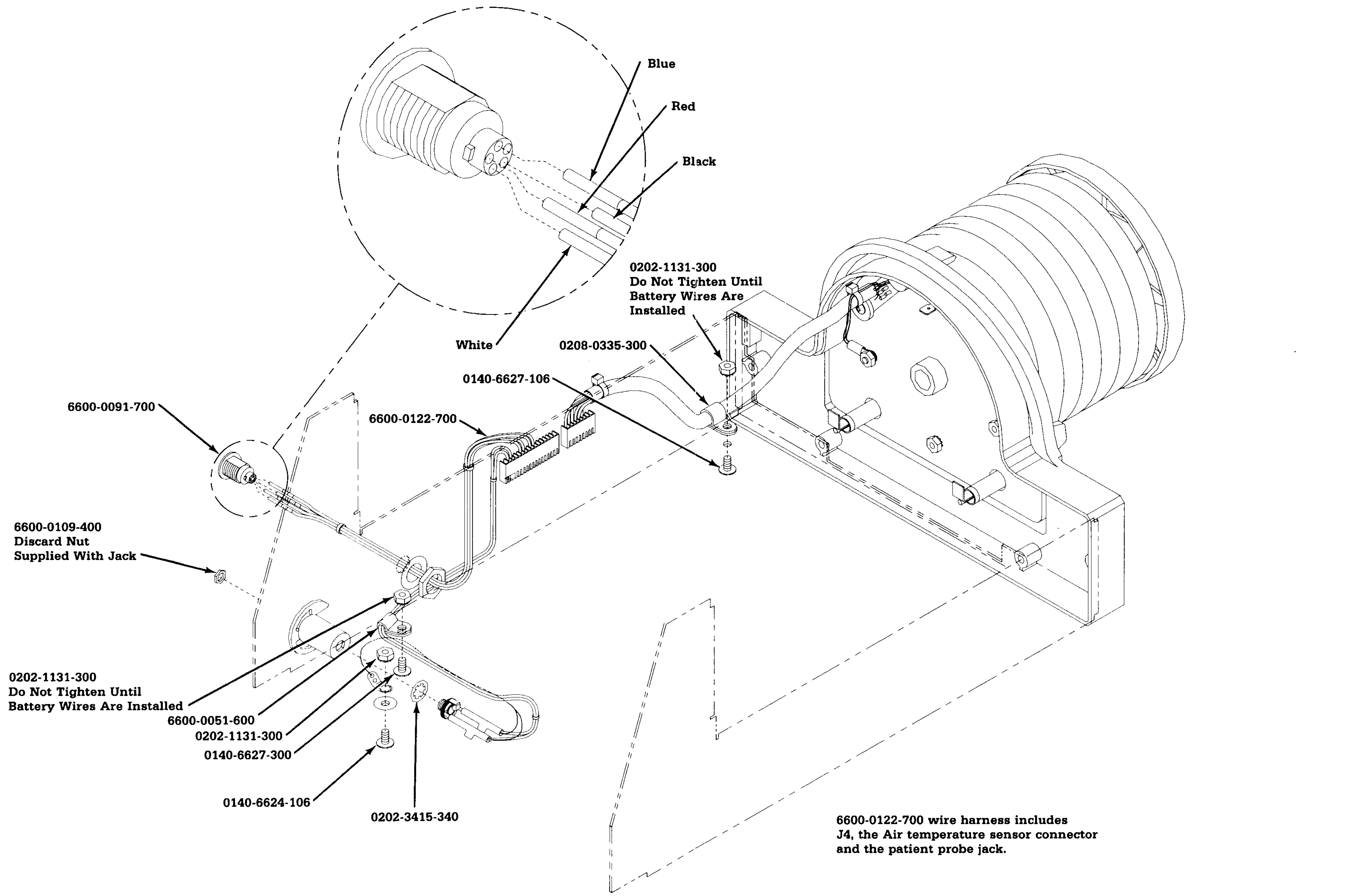
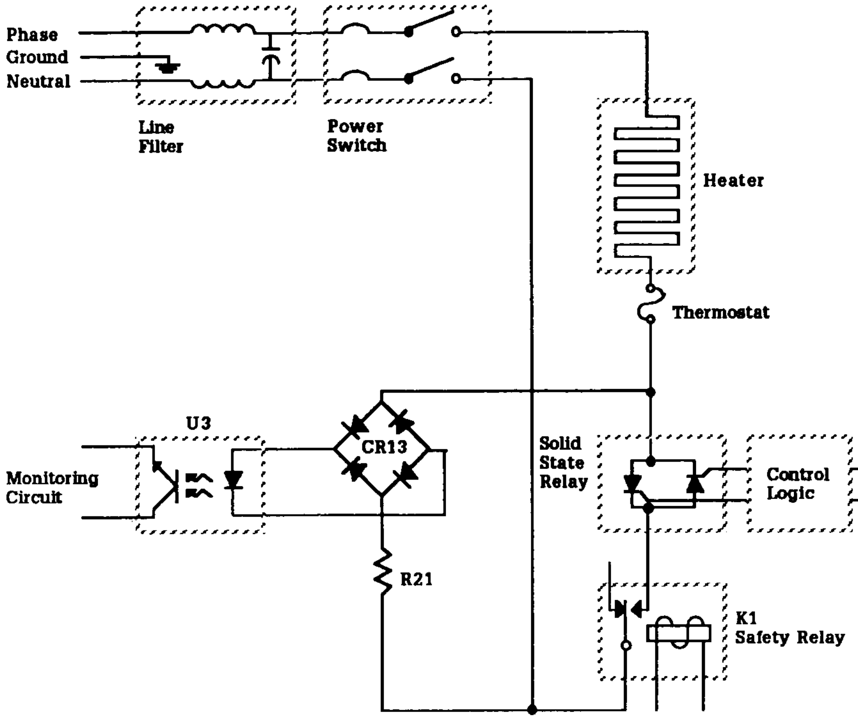
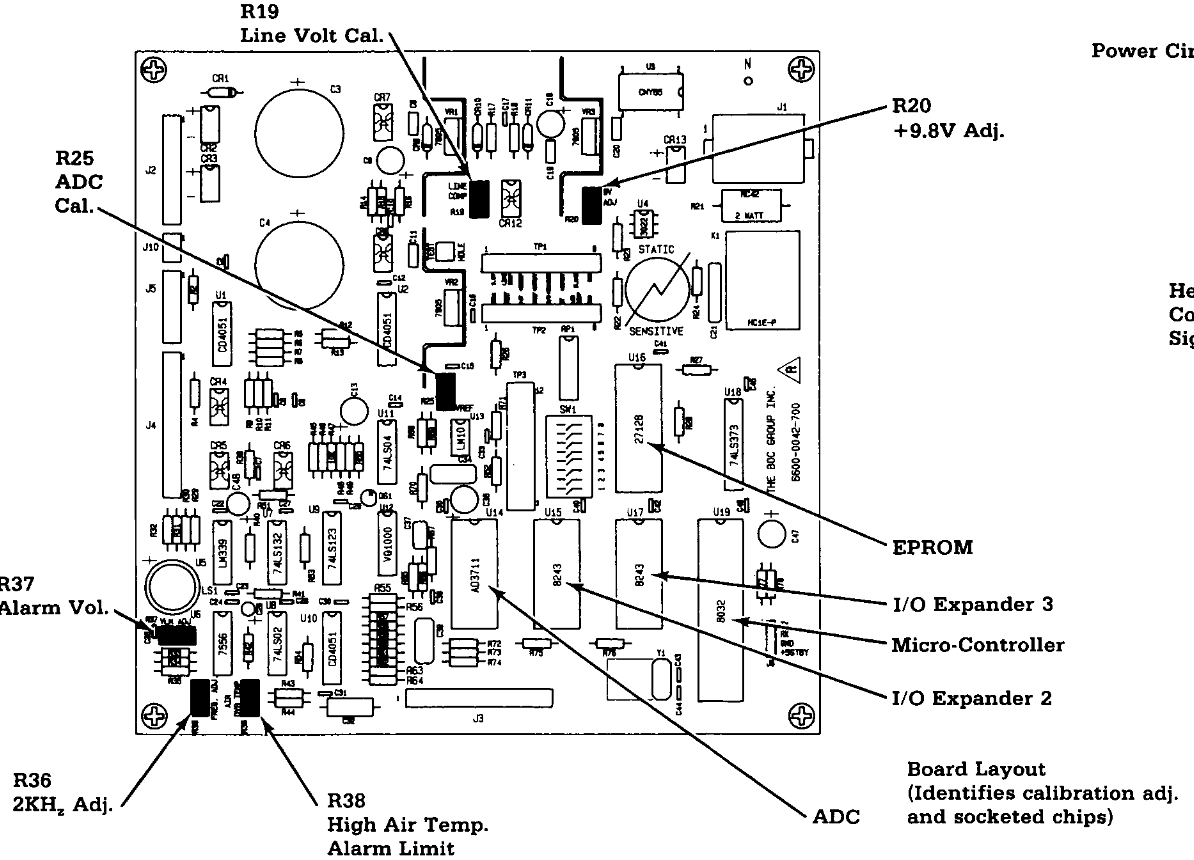
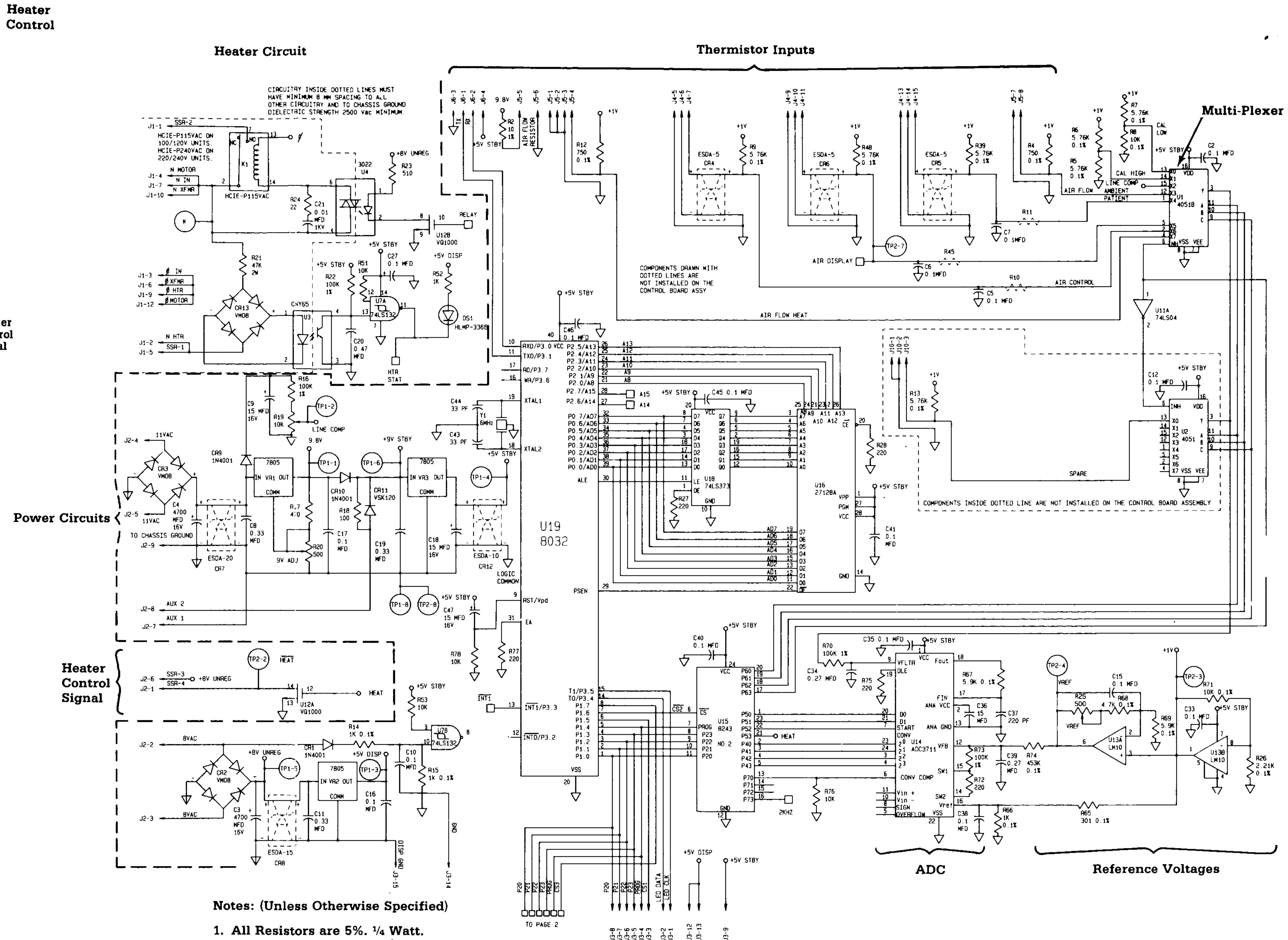


Figure 7-3 Detail, Air Temp. and Patient Temp. Wiring

Heater Block Diagram





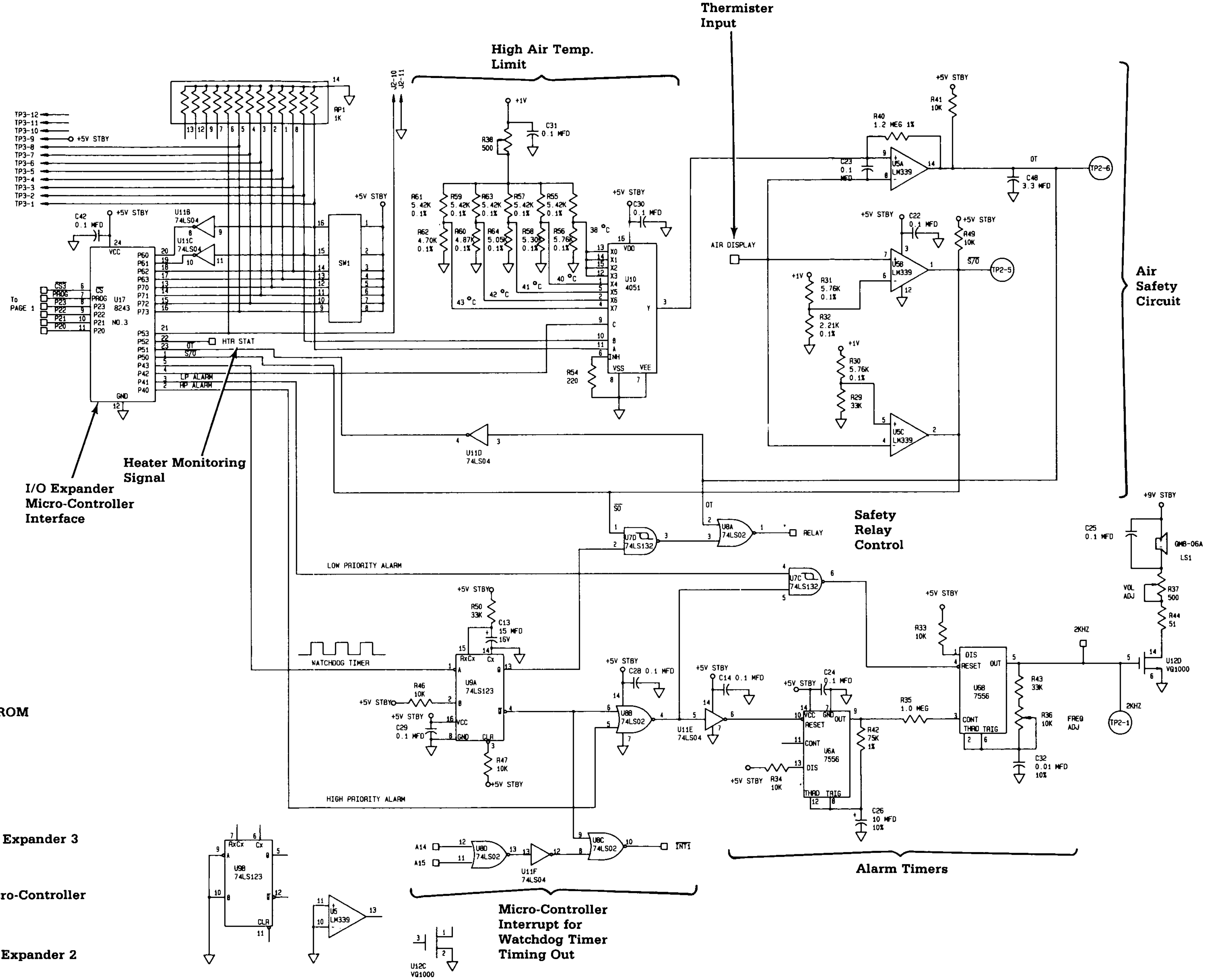


Notes: (Unless Otherwise Specified)

1. All Resistors are 5%. ¼ Watt.
2. Square Denotes Refer to Other Page □
3. GND Symbol With Line Denotes GNDS Tied Together
4. Potentiometer Used in Calibration

Figure 7-4a Control Board Schematic (page 1 of 2)

TEST POINTS		UNUSED CONNECTOR PINS
TP1-1	9.8V	J1-8, J1-11
TP1-2	LINE COMP	J2-12
TP1-3	+5V DISP	J3-10, 11, 16
TP1-4	+5V STBY	J4-4, 8, 12, 16
TP1-5	+8V UNREG	
TP1-6	+9V STBY	
TP1-7	BLANK	
TP1-8	GND	
TP2-1	2KHZ	
TP2-2	HEAT	
TP2-3	+1V	
TP2-4	V REF	
TP2-5	S/O	
TP2-6	OT	
TP2-7	AIR DISPLAY	
TP2-8	GND	
TP3-1	P60	
TP3-2	P61	
TP3-3	P62	
TP3-4	P63	
TP3-5	P70	
TP3-6	P71	
TP3-7	P72	
TP3-8	P73	
TP3-9	+5V STBY	
TP3-10	BLANK	
TP3-11	BLANK	
TP3-12	BLANK	



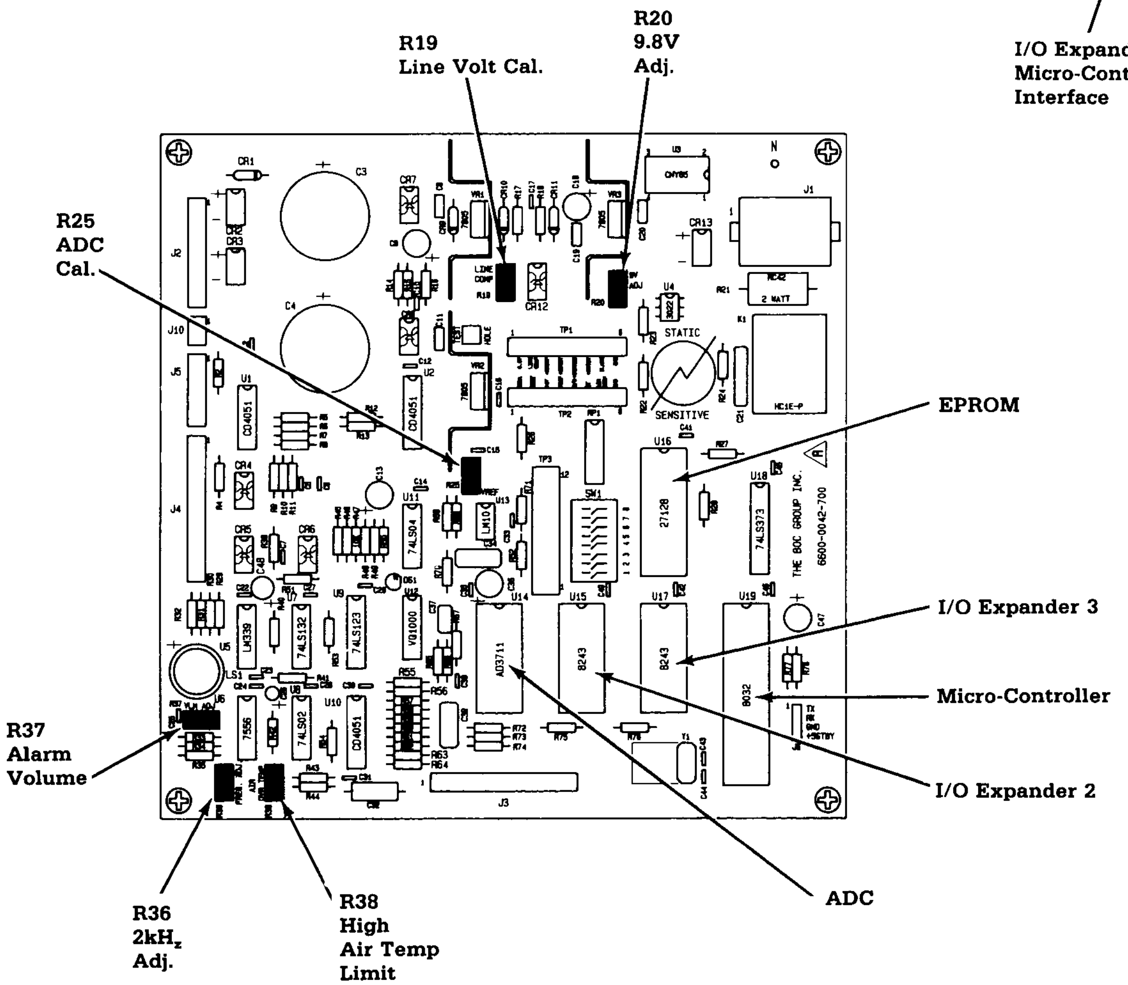


Figure 7-4b Control Board Schematic (page 2 of 2)

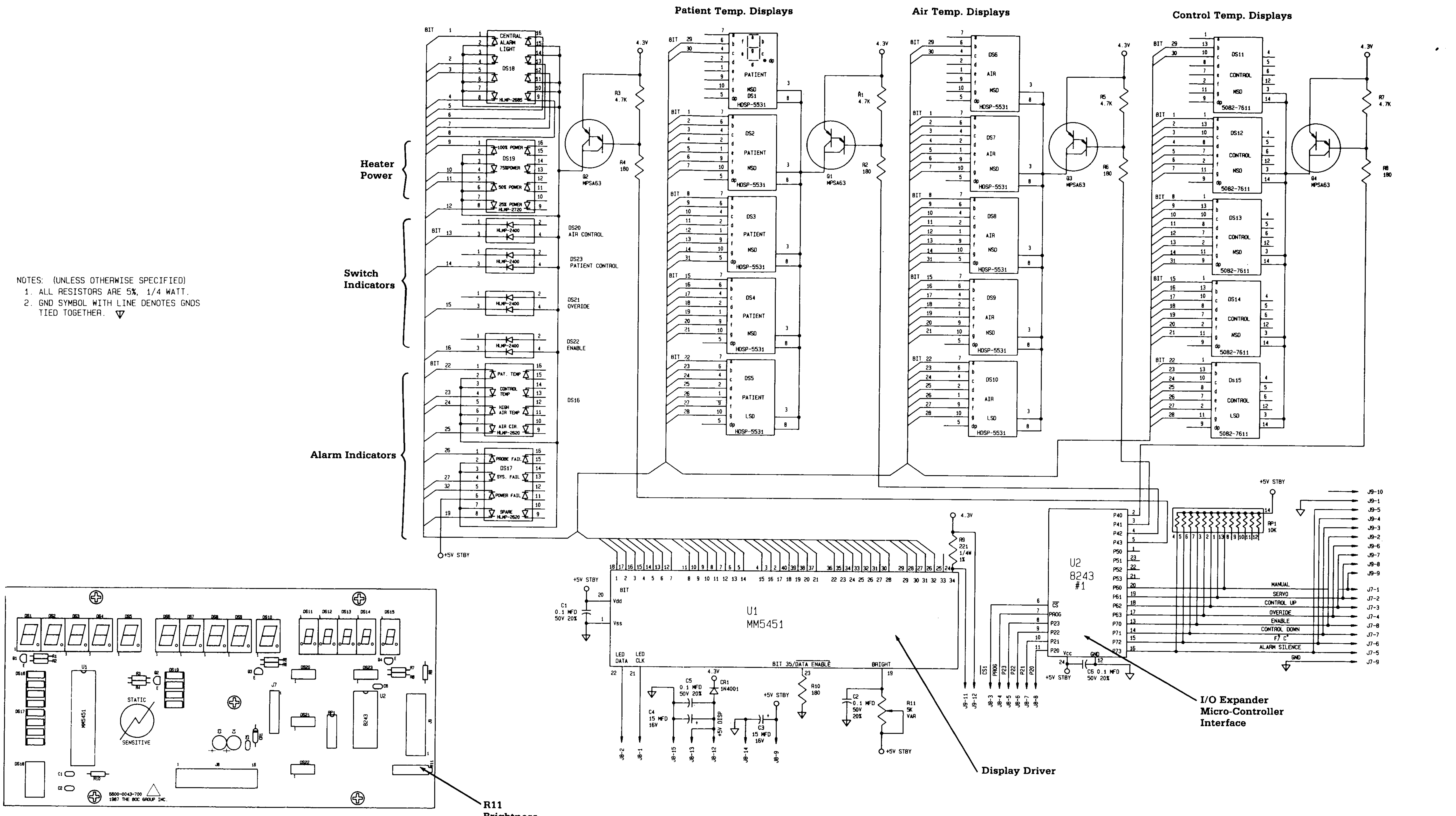


Figure 7-5 Display Board Schematic

Patient Temperature Probe and Air Temperature Sensor Characteristics

Temp °C	Res. Ohms	Temp °C	Res. Ohms	Temp °C	Res. Ohms	Temp °C	Res. Ohms
29.9	8049.1	34.0	6778.1	38.0	5731.3	42.0	4845.3
30.0	8015.4	.1	6749.8	.1	5707.3	.1	4825.0
.1	7981.9	.2	6721.5	.2	5683.5	.2	4804.8
.2	7948.5	.3	6693.4	.3	5659.7	.3	4784.6
.3	7915.2	.4	6665.4	.4	5636.0	.4	4764.6
.4	7882.1	.5	6637.5	.5	5612.4	.5	4744.6
.5	7849.2	.6	6609.8	.6	5588.9	.6	4724.7
.6	7816.3	.7	6582.1	.7	5565.4	.7	4704.9
.7	7783.7	.8	6554.6	.8	5542.1	.8	4685.1
.8	7751.1	.9	6527.1	.9	5518.9	.9	4665.5
.9	7718.7	35.0	6499.8	39.0	5495.8	43.0	4645.9
31.0	7686.4	.1	6472.6	.1	5472.8	.1	4626.4
.1	7654.3	.2	6445.6	.2	5449.9	.2	4607.0
.2	7622.2	.3	6418.6	.3	5427.1	.3	4587.7
.3	7590.4	.4	6391.7	.4	5404.3	.4	4568.5
.4	7558.6	.5	6365.0	.5	5381.7	.5	4549.3
.5	7527.0	.6	6338.3	.6	5359.1	.6	4530.2
.6	7495.5	.7	6311.8	.7	5336.7	.7	4511.2
.7	7464.2	.8	6285.4	.8	5314.3	.8	4492.3
.8	7432.9	.9	6259.1	.9	5292.1	.9	4473.4
.9	7401.9	36.0	6232.9	40.0	5269.9	44.0	4454.6
32.0	7370.9	.1	6206.8	.1	5247.8	.1	4436.0
.1	7340.1	.2	6180.9	.2	5225.8	.2	4417.3
.2	7309.4	.3	6155.0	.3	5203.9	.3	4398.8
.3	7278.8	.4	6129.2	.4	5182.1	.4	4380.3
.4	7248.3	.5	6103.6	.5	5160.4	.5	4361.9
.5	7218.0	.6	6078.0	.6	5138.8	.6	4343.6
.6	7187.8	.7	6052.6	.7	5117.3	.7	4325.4
.7	7157.8	.8	6027.3	.8	5095.8	.8	4307.3
.8	7127.8	.9	6002.0	.9	5074.5	.9	4289.2
.9	7098.0	37.0	5976.9	41.0	5053.2	45.0	4271.2
33.0	7068.3	.1	5951.9	.1	5032.0		
.1	7038.8	.2	5927.0	.2	5010.9		
.2	7009.3	.3	5902.2	.3	4989.9		
.3	6980.0	.4	5877.4	.4	4969.0		
.4	6950.8	.5	5852.8	.5	4948.2		
.5	6921.7	.6	5828.3	.6	4927.4		
.6	6892.8	.7	5803.9	.7	4906.8		
.7	6863.9	.8	5779.6	.8	4886.2		
.8	6835.2	.9	5755.4	.9	4865.7		
.9	6806.6						

Temperature Conversion Chart

°C	°F	°C	°F	°C	°F	°C	°F
20.0	68.0	31.5	88.70	36.3	97.34	38.3	100.94
21.5	70.70	32.0	89.60	36.4	97.52	38.4	101.12
22.0	71.60	32.5	90.50	36.5	97.70	38.5	101.30
22.5	72.50	33.0	91.40	36.6	97.88	38.6	101.48
23.0	73.40	33.5	92.30	36.7	98.06	38.7	101.66
23.5	74.30	34.0	93.20	36.8	98.24	38.8	101.84
24.0	75.20	34.5	94.10	36.9	98.42	38.9	102.02
24.5	76.10	35.0	95.00	37.0	98.60	39.0	102.20
25.0	77.00	35.1	95.18	37.1	98.78	39.5	103.10
25.5	77.90	35.2	95.36	37.2	98.96	40.0	104.00
26.0	78.80	35.3	95.54	37.3	99.14	40.5	104.90
26.5	79.70	35.4	95.72	37.4	99.32	41.0	105.80
27.0	80.60	35.5	95.90	37.5	99.50	41.5	106.70
27.5	81.50	35.6	96.00	37.6	99.68	42.0	107.60
28.0	82.40	35.7	96.26	37.7	99.86	42.5	108.50
28.5	83.30	35.8	96.44	37.8	100.04	43.0	109.40
29.0	84.20	35.9	96.92	37.9	100.22	43.5	110.30
29.5	85.10	36.0	96.80	38.0	100.40	44.0	111.20
30.0	86.00	36.1	96.98	38.1	100.58	44.5	112.10
30.5	86.90	36.2	97.16	38.2	100.76	45.0	113.00
31.0	87.80						

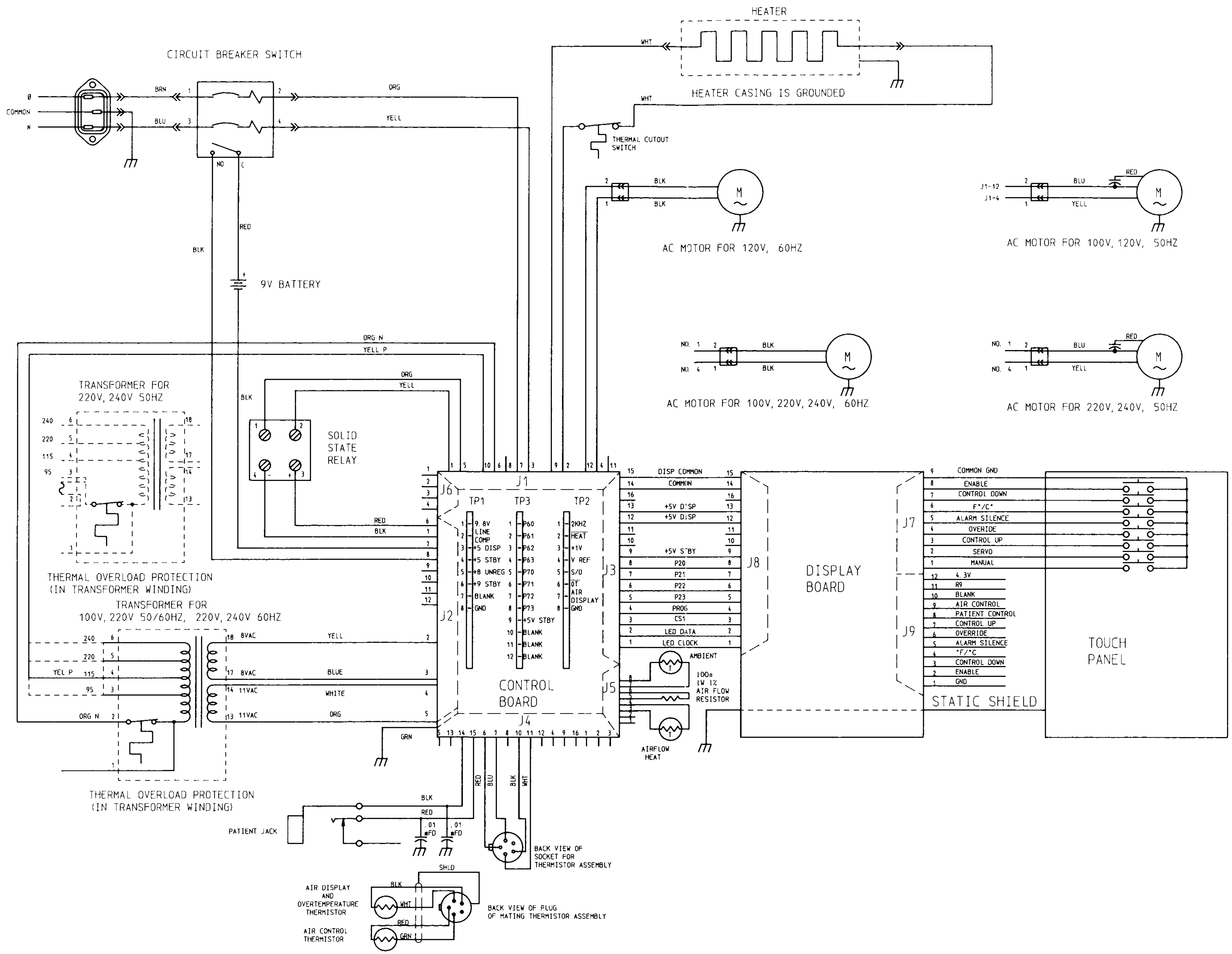


Figure 7-1 Wiring Diagram
Controllers without HBJ Serial Numbers

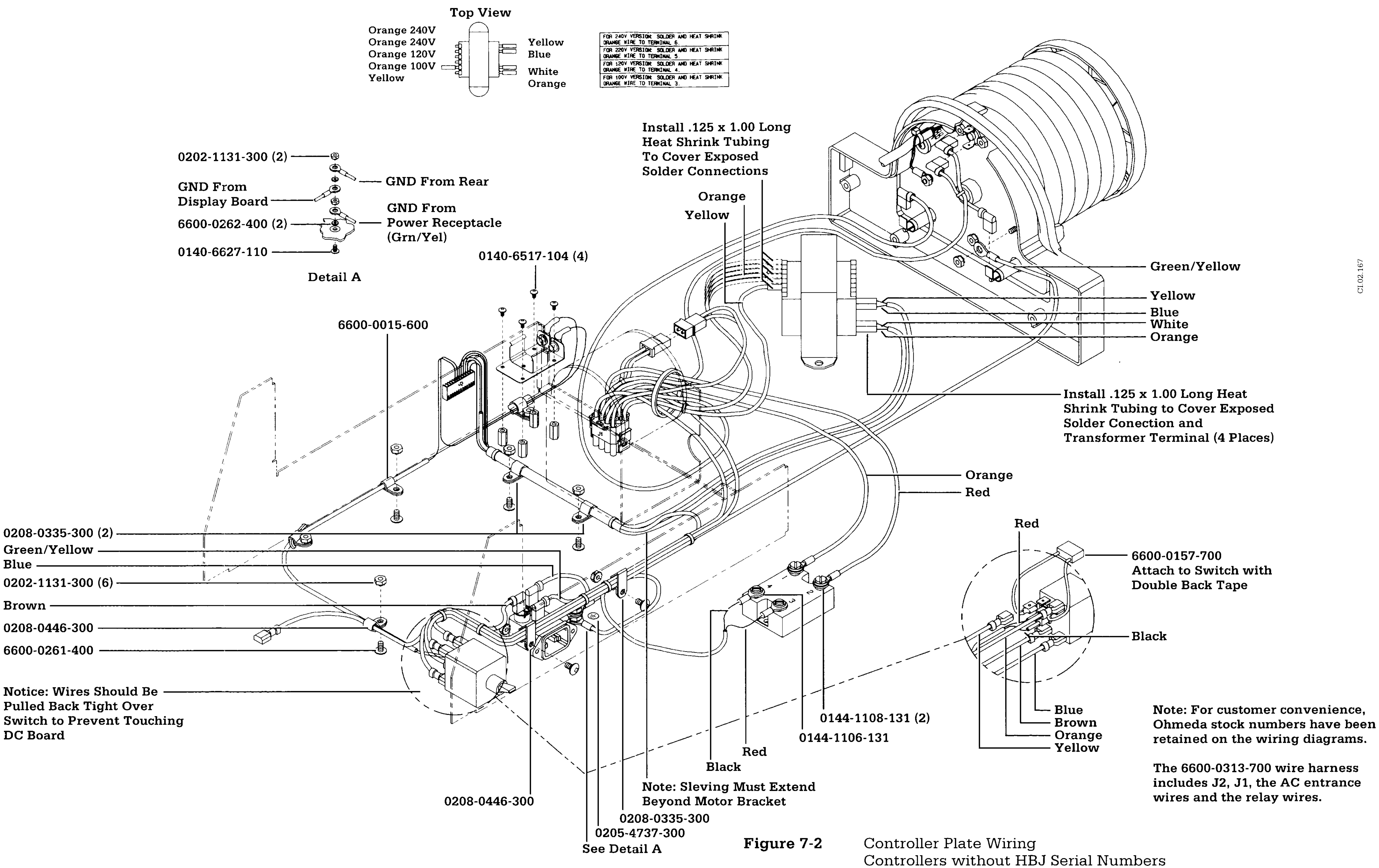


Figure 7-2 Controller Plate Wiring
Controllers without HBJ Serial Numbers

Note: For customer convenience, Ohmeda stock numbers have been retained on the wiring diagrams.

The 6600-0313-700 wire harness includes J2, J1, the AC entrance wires and the relay wires.

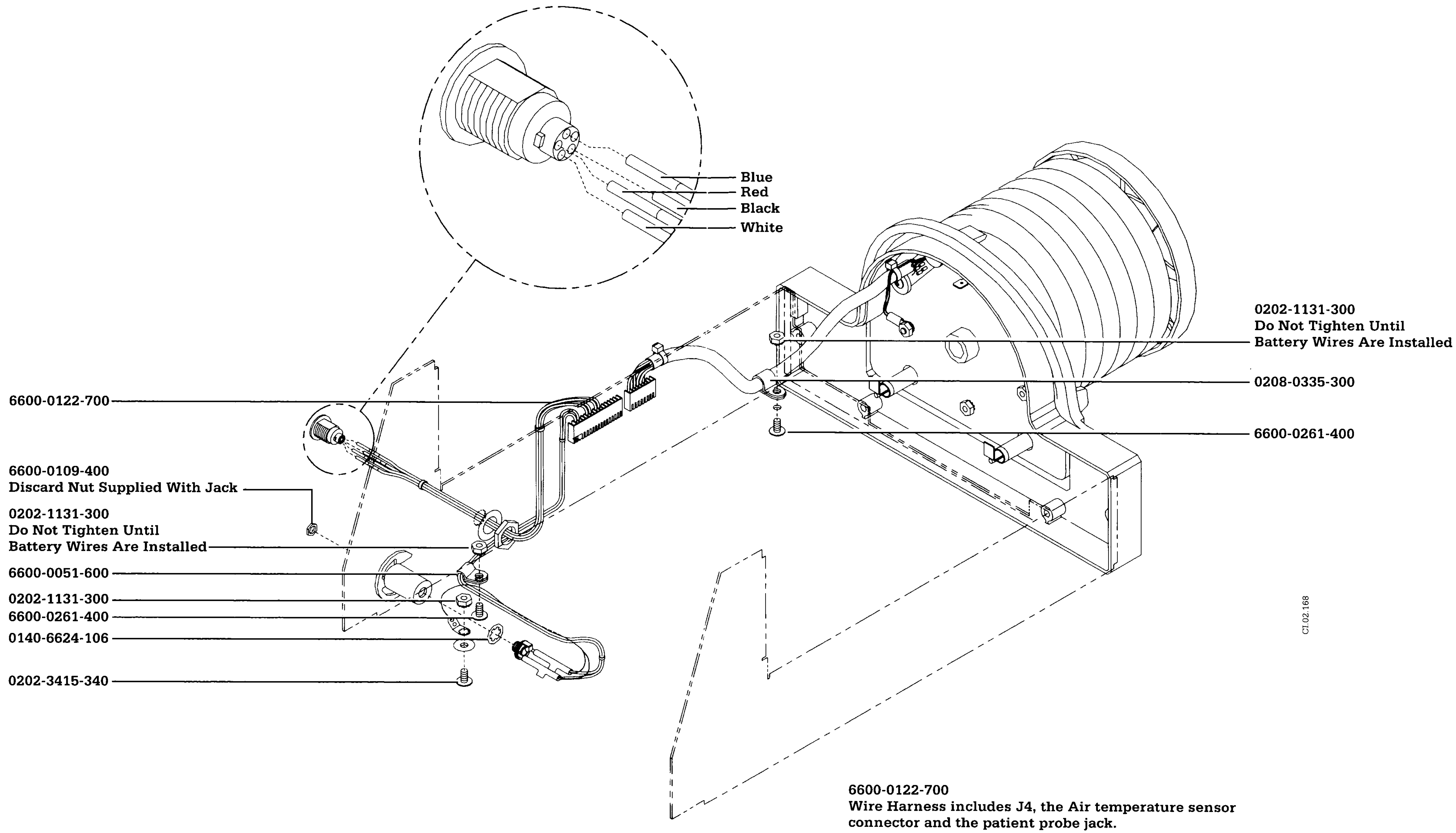
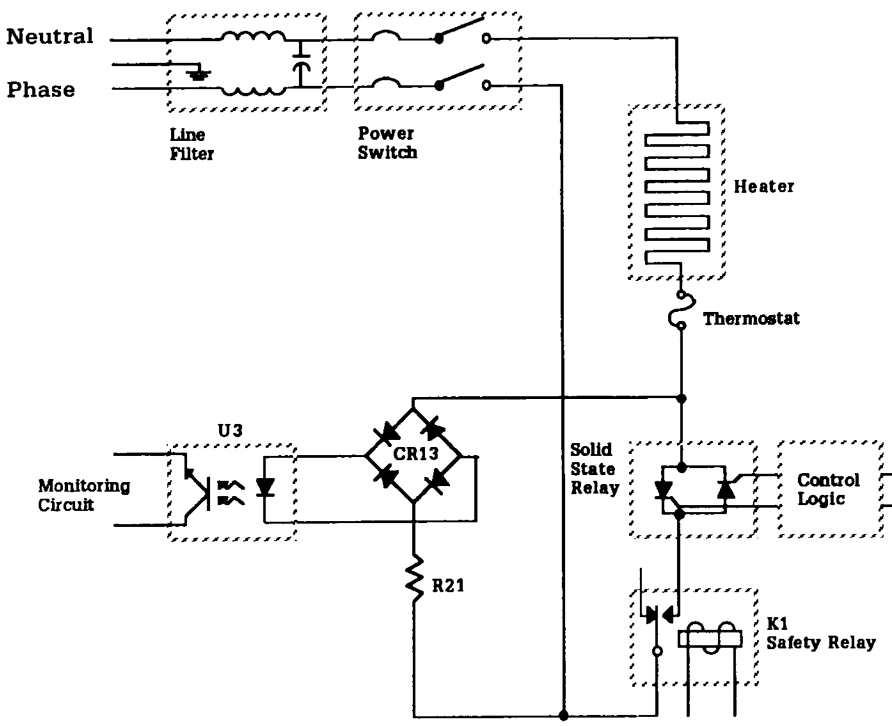
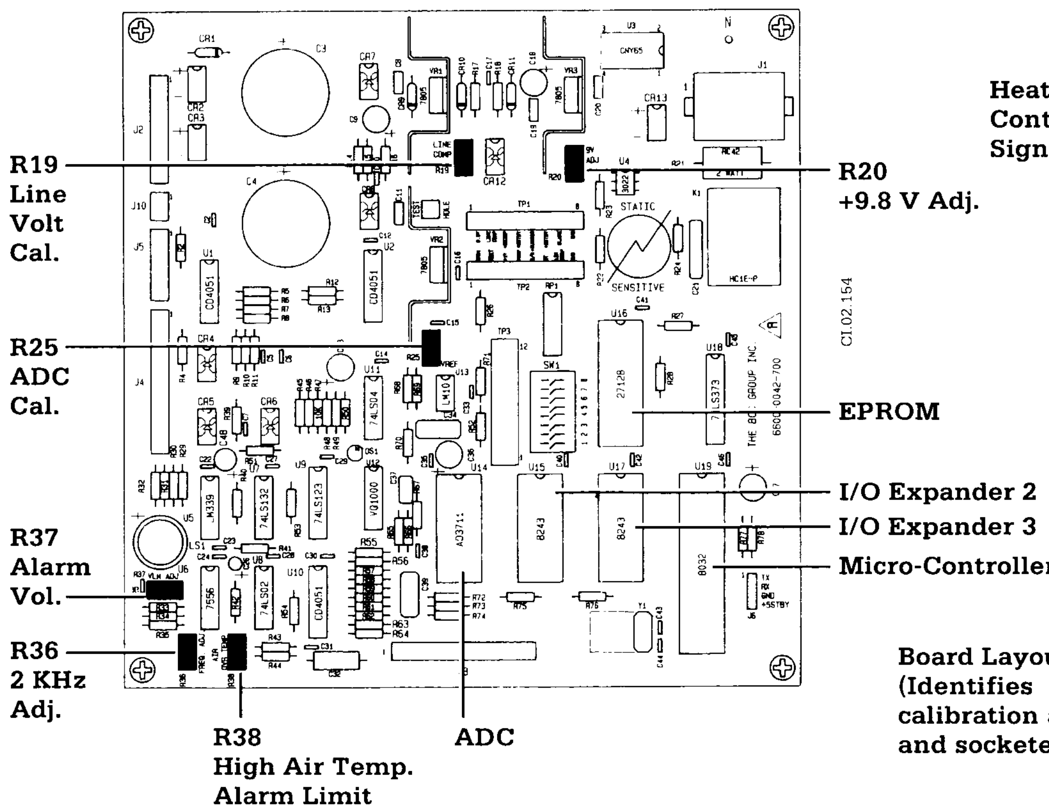


Figure 7-3 Detail, Air Temp. and Patient Temp. Wiring Controllers without HBJ Serial Numbers

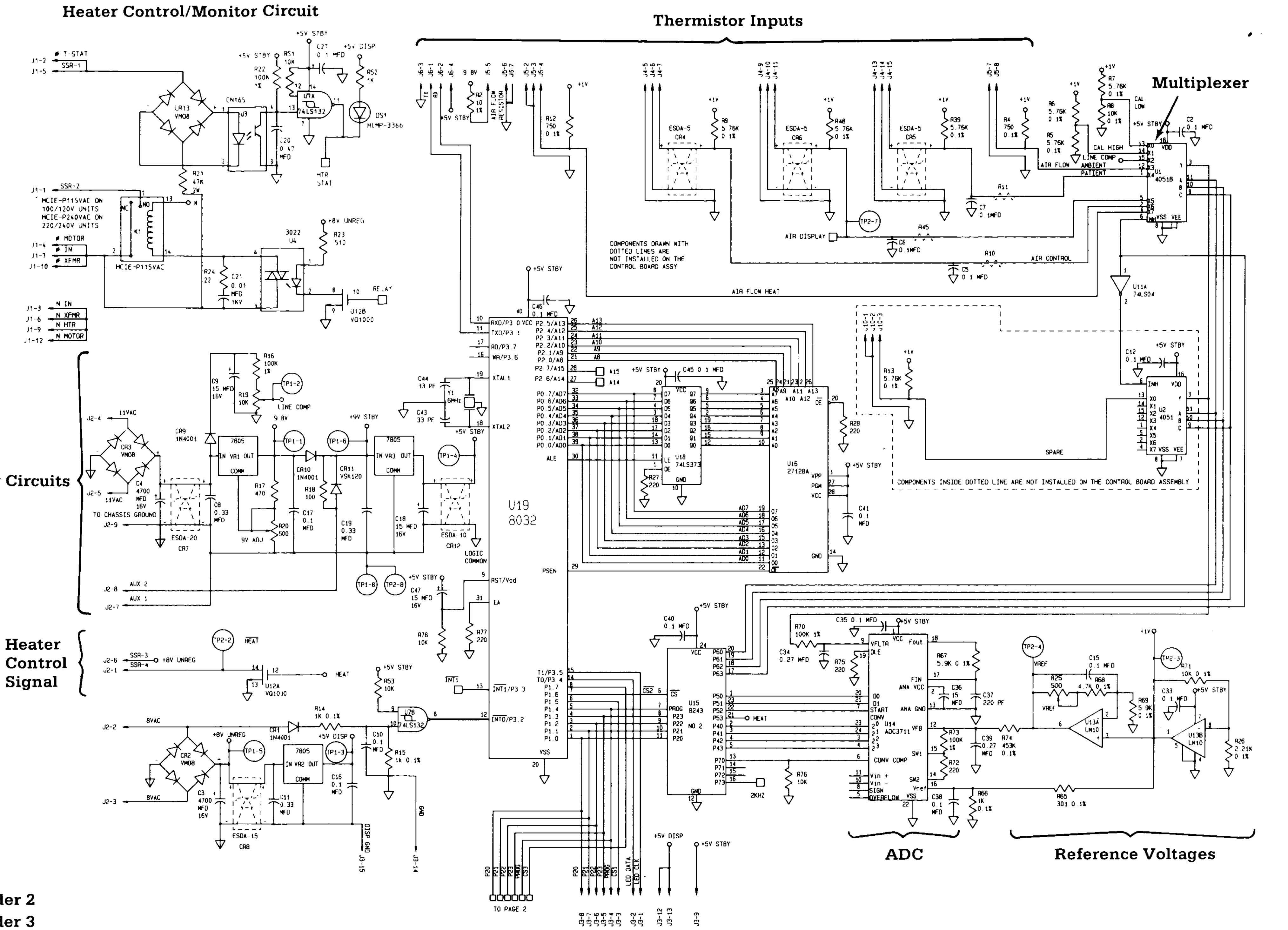
Controllers without HBJ Serial Numbers

Heater Block Diagram





Board Layout (Identifies calibration adj. and socketed chips)

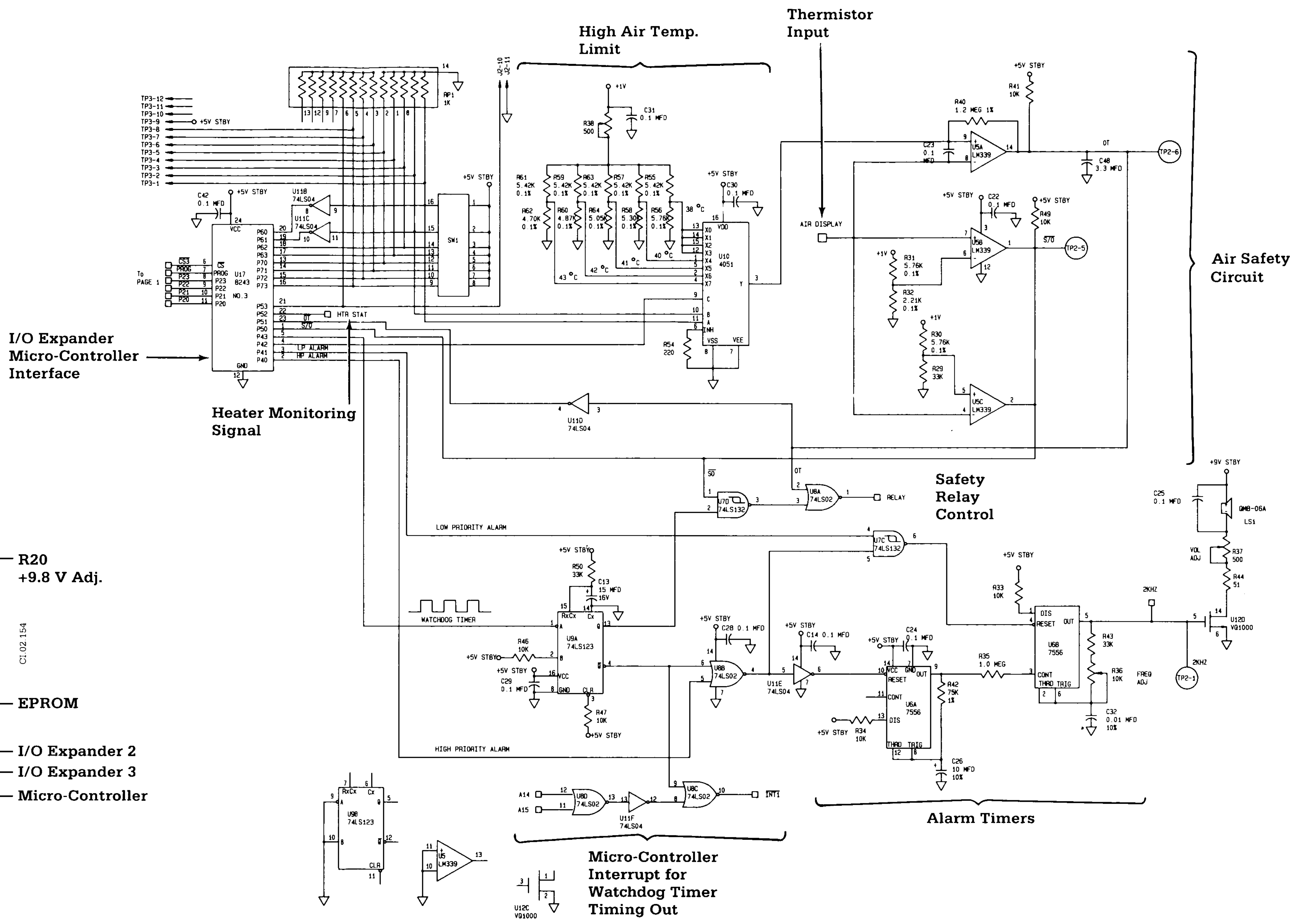


Notes: (Unless otherwise specified)

1. **All resistors are 5%. 1/4 Watt**
2. **Square denotes refer to other page** □
3. **GND symbol with line denotes GNDS tied together** ▽
4. **Potentiometer used in calibration**

Figure 7-4a Control Board Schematic (page 1 of 2)
Controllers without HBJ Serial Numbers

TEST POINTS		UNUSED CONNECTOR PINS
TP1-1	9.8V	J1-8, J1-11
TP1-2	LINE COMP	J2-12
TP1-3	+5V DISP	J3-10, 11, 16
TP1-4	+5V STBY	J4-4, 8, 12, 16
TP1-5	+8V UNREG	
TP1-6	+9V STBY	
TP1-7	BLANK	
TP1-8	GND	
TP2-1	2KHZ	
TP2-2	HEAT	
TP2-3	+1V	
TP2-4	V REF	
TP2-5	S/O	
TP2-6	OT	
TP2-7	AIR DISPLAY	
TP2-8	GND	
TP3-1	P60	
TP3-2	P61	
TP3-3	P62	
TP3-4	P63	
TP3-5	P70	
TP3-6	P71	
TP3-7	P72	
TP3-8	P73	
TP3-9	+5V STBY	
TP3-10	BLANK	
TP3-11	BLANK	
TP3-12	BLANK	



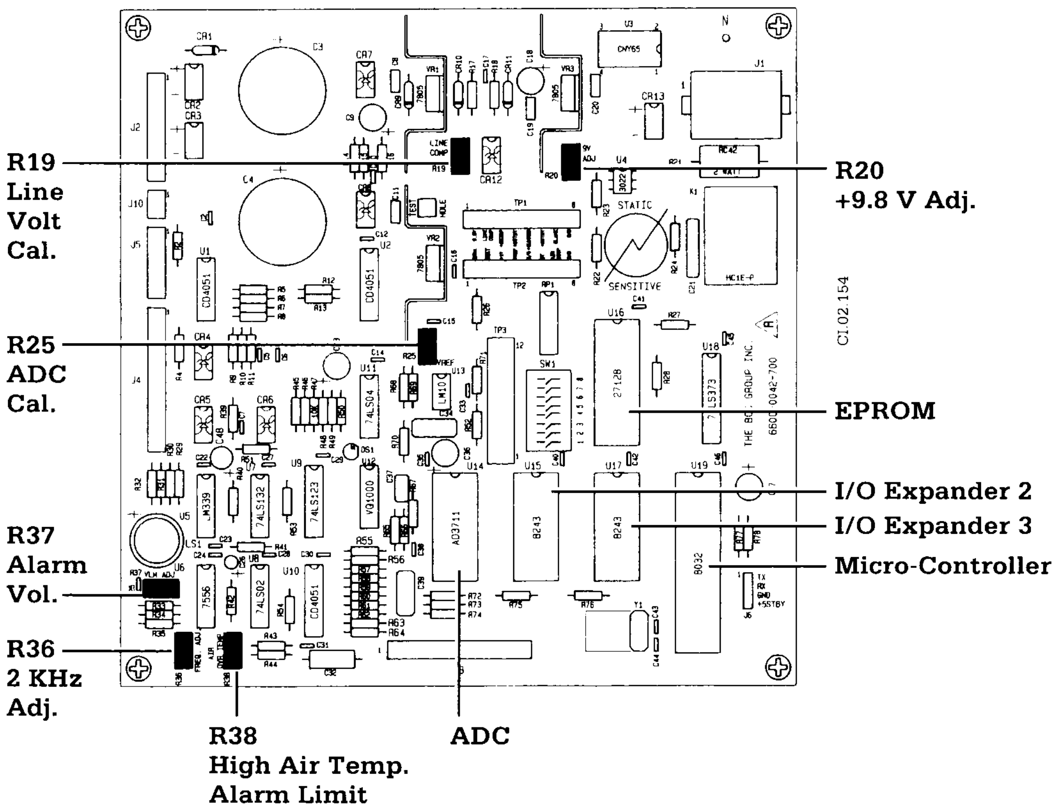
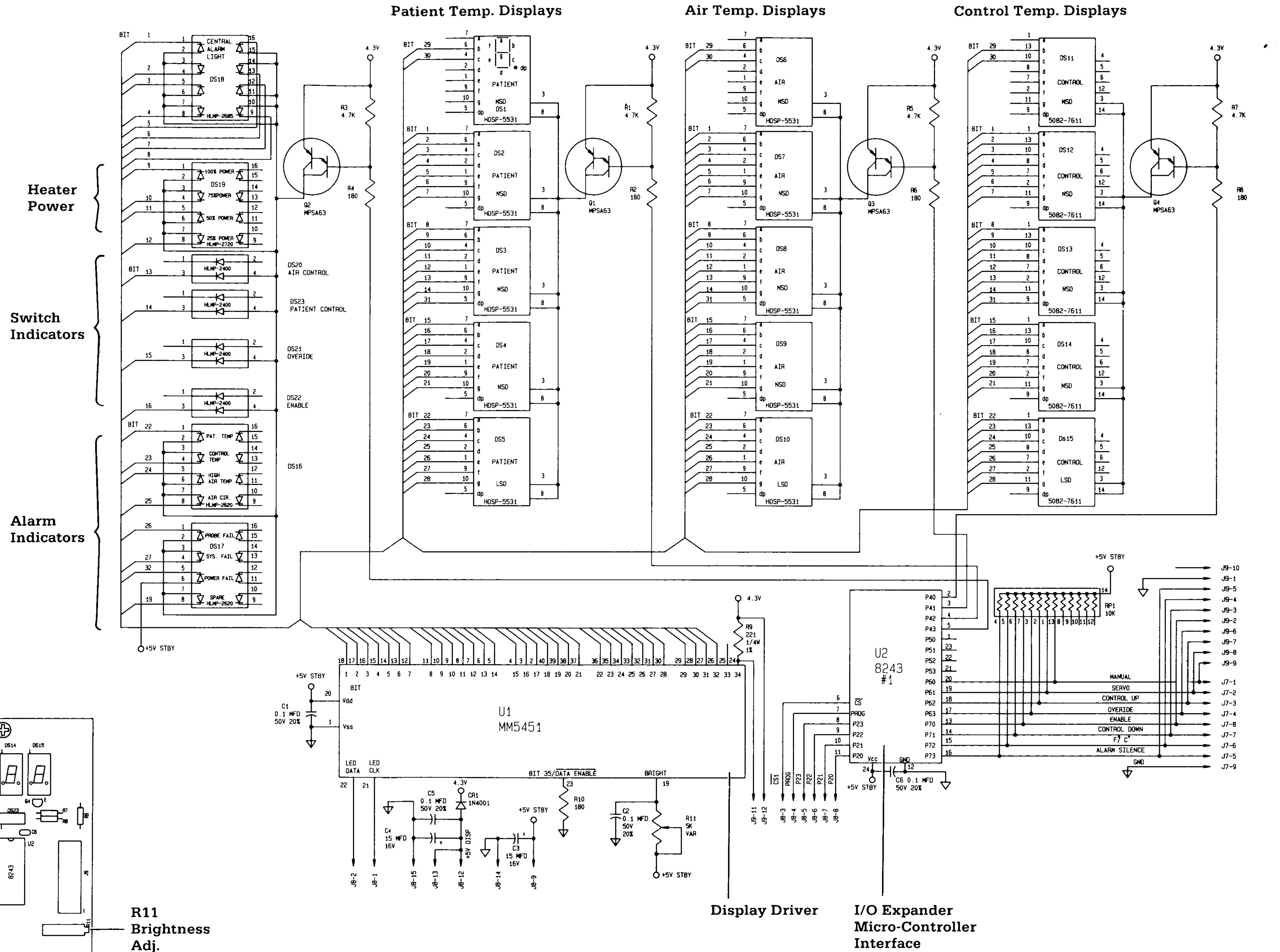


Figure 7-4b Control Board Schematic (page 2 of 2)
Controllers without HBJ Serial Numbers

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL RESISTORS ARE 5%, 1/4 WATT.
2. GND SYMBOL WITH LINE DENOTES GNDS TIED TOGETHER.



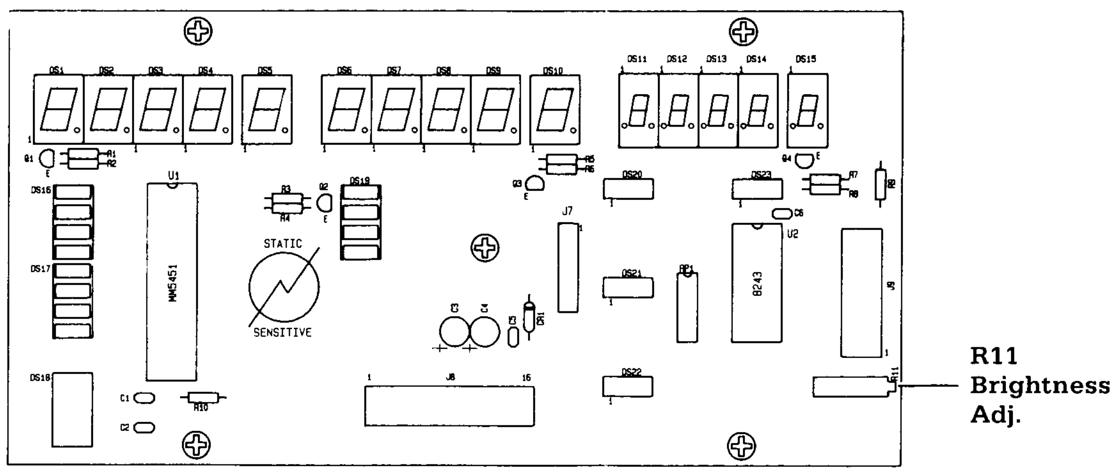


Figure 7-5 Display Board Schematic

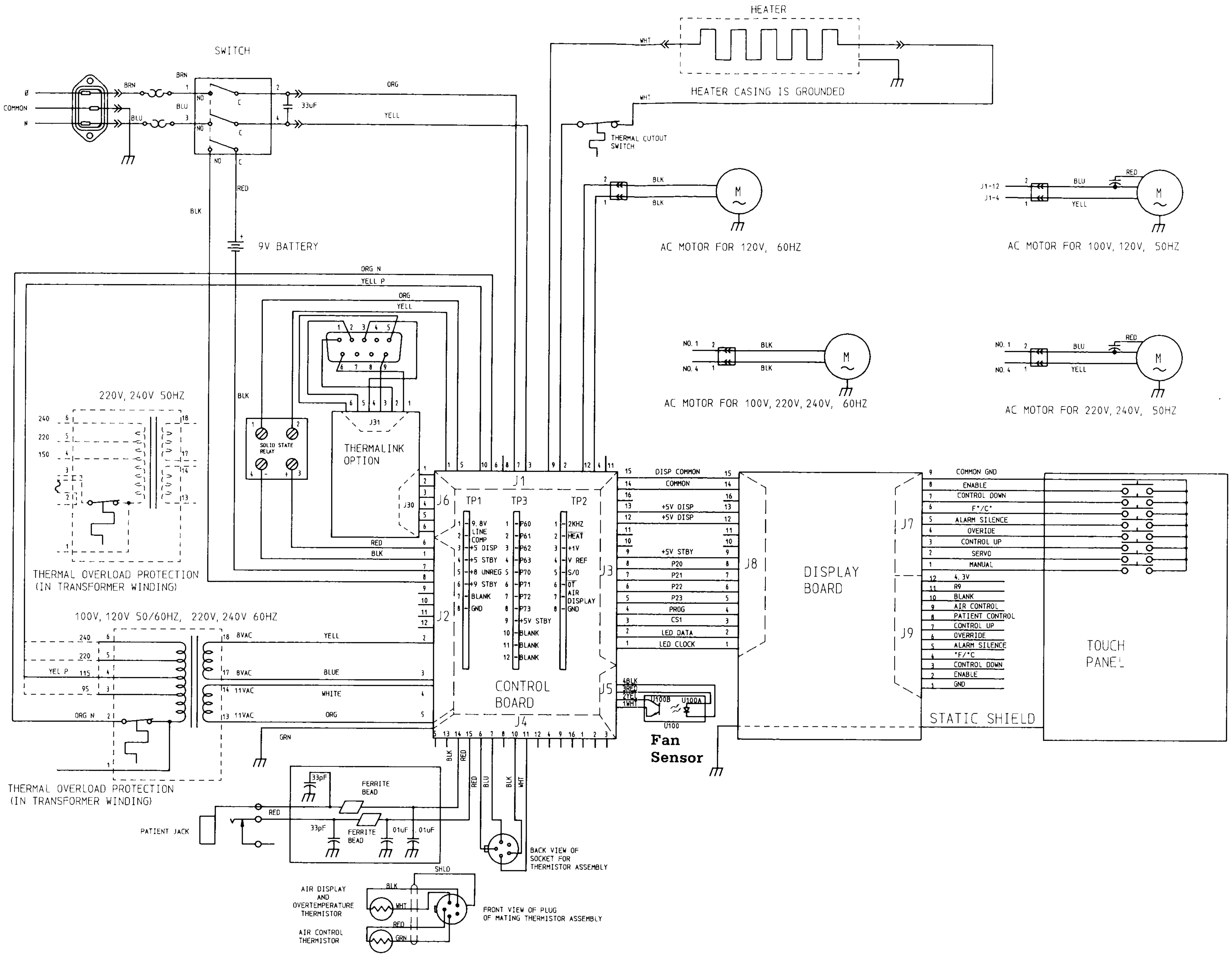


Figure 7-6 Wiring Diagram
Controllers with HBJ Serial Numbers

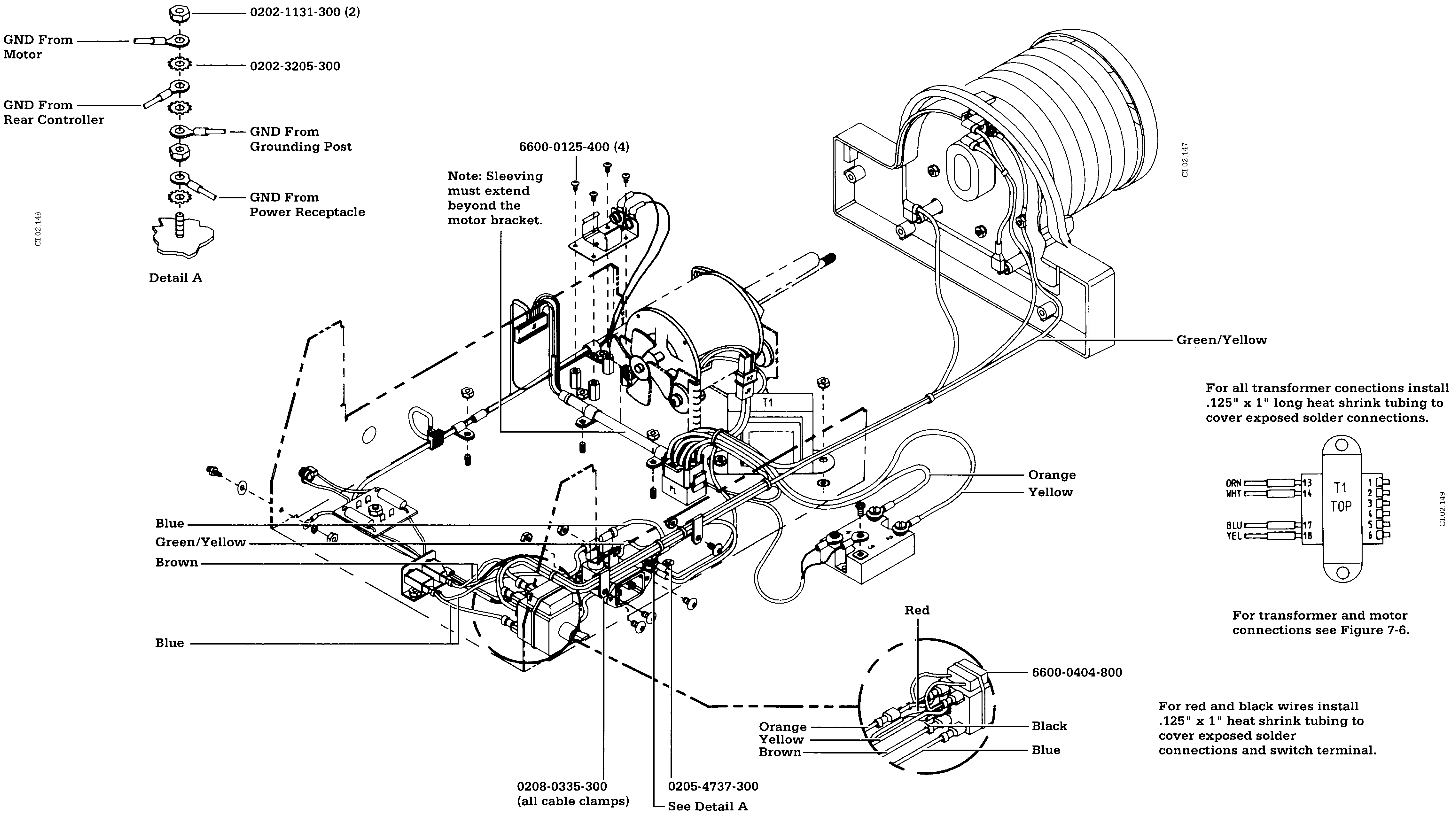
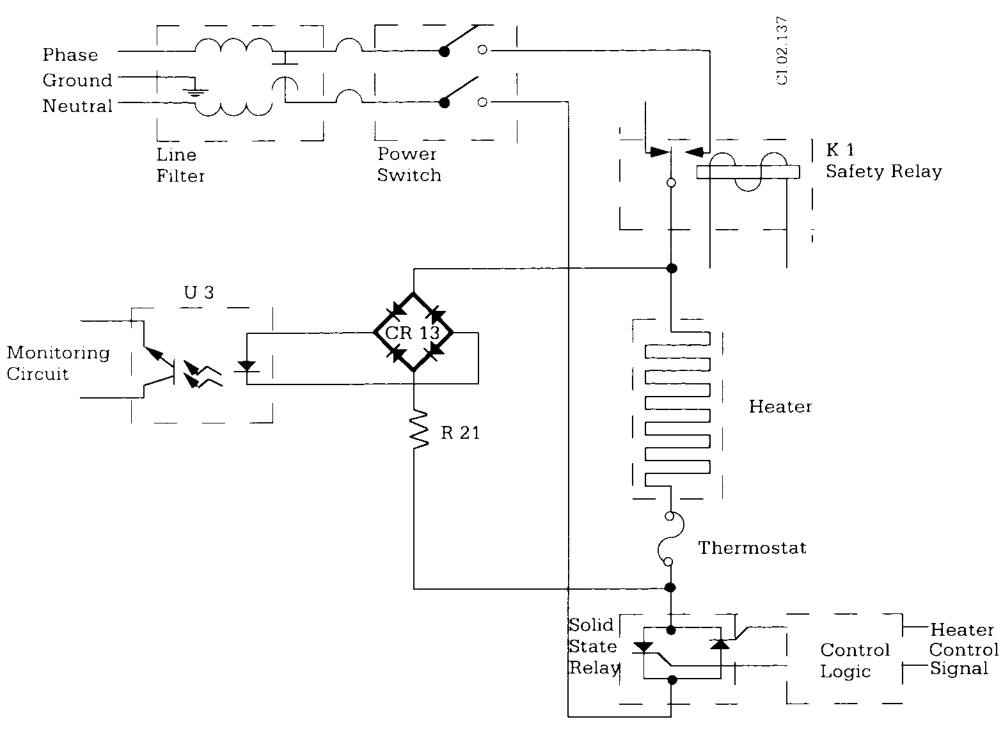
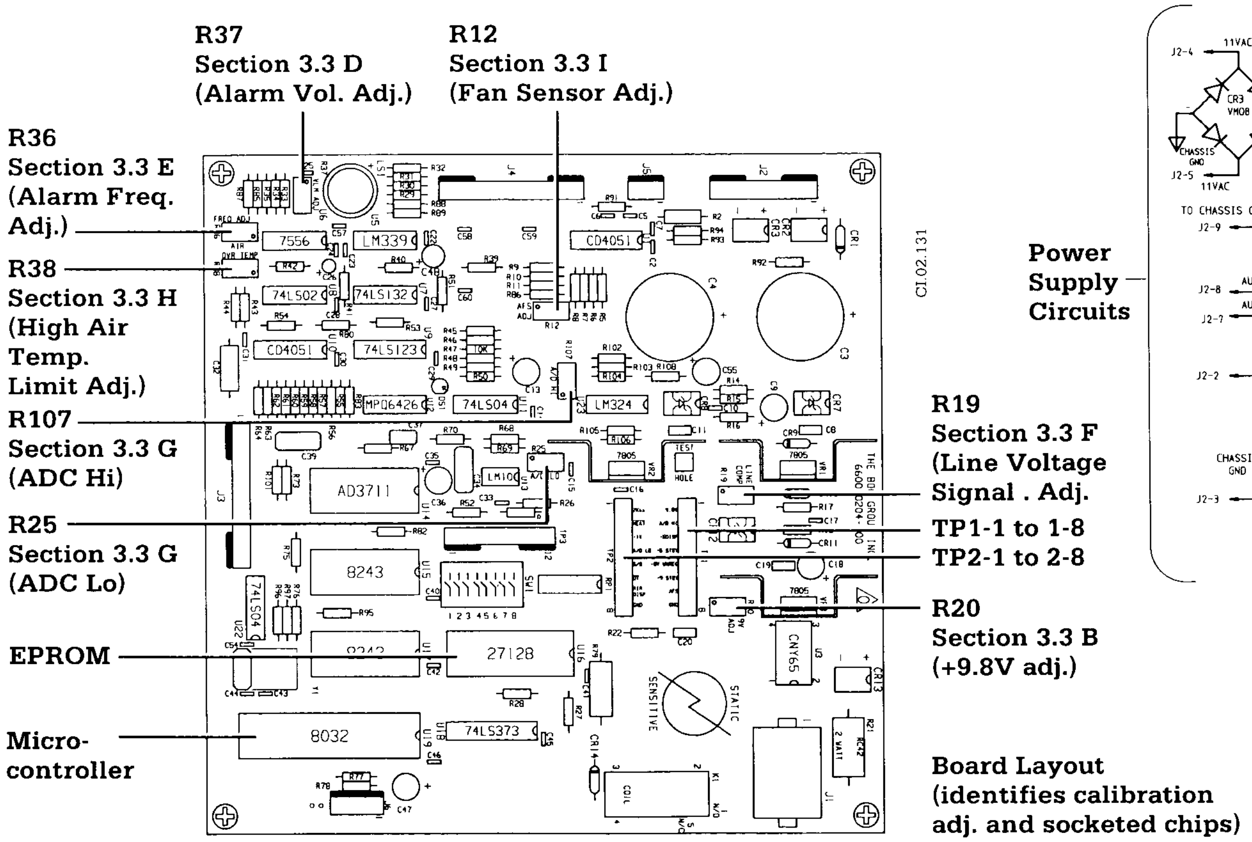


Figure 7-7 Controller Plate Wiring
Controllers with HBJ Serial Numbers





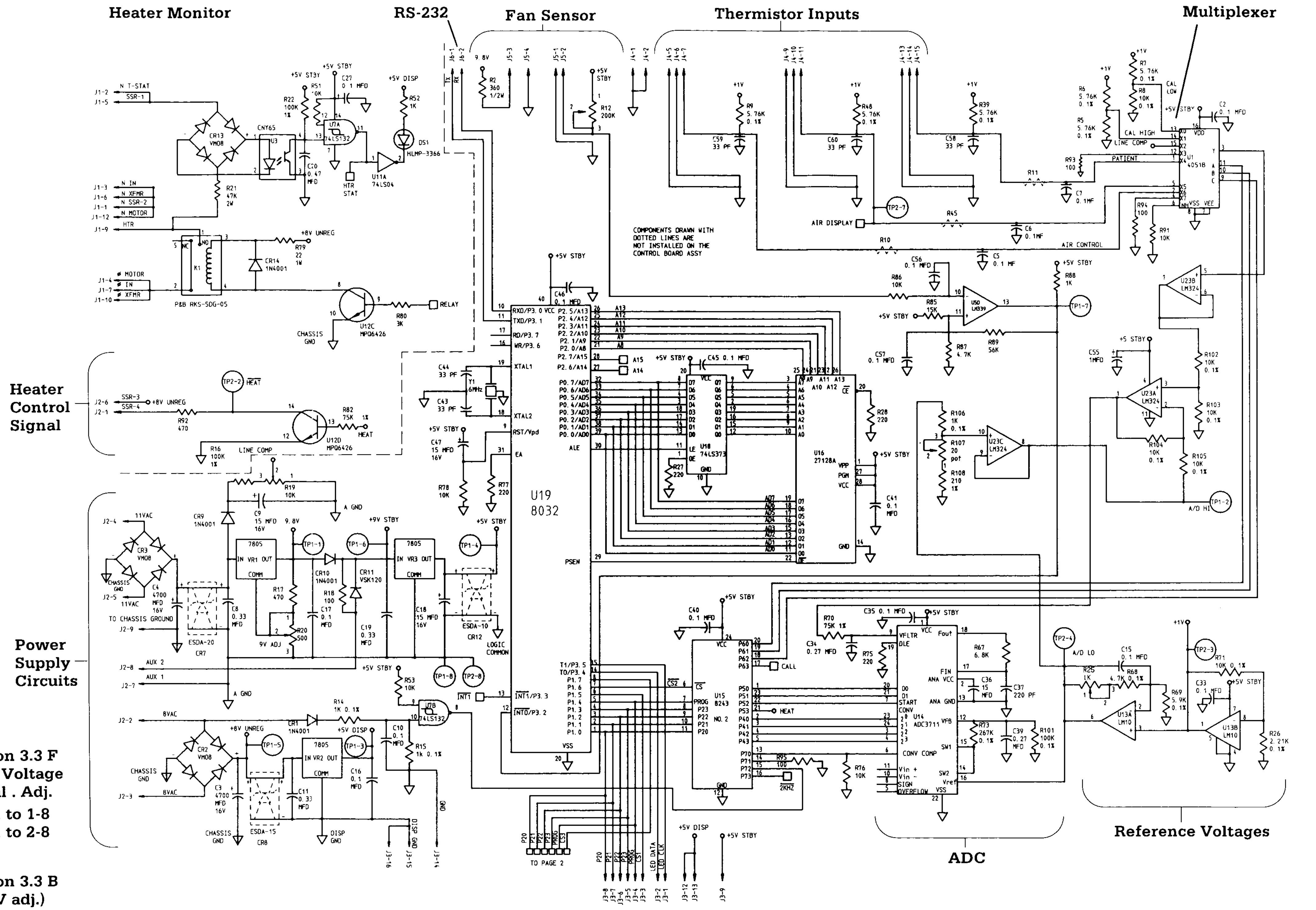
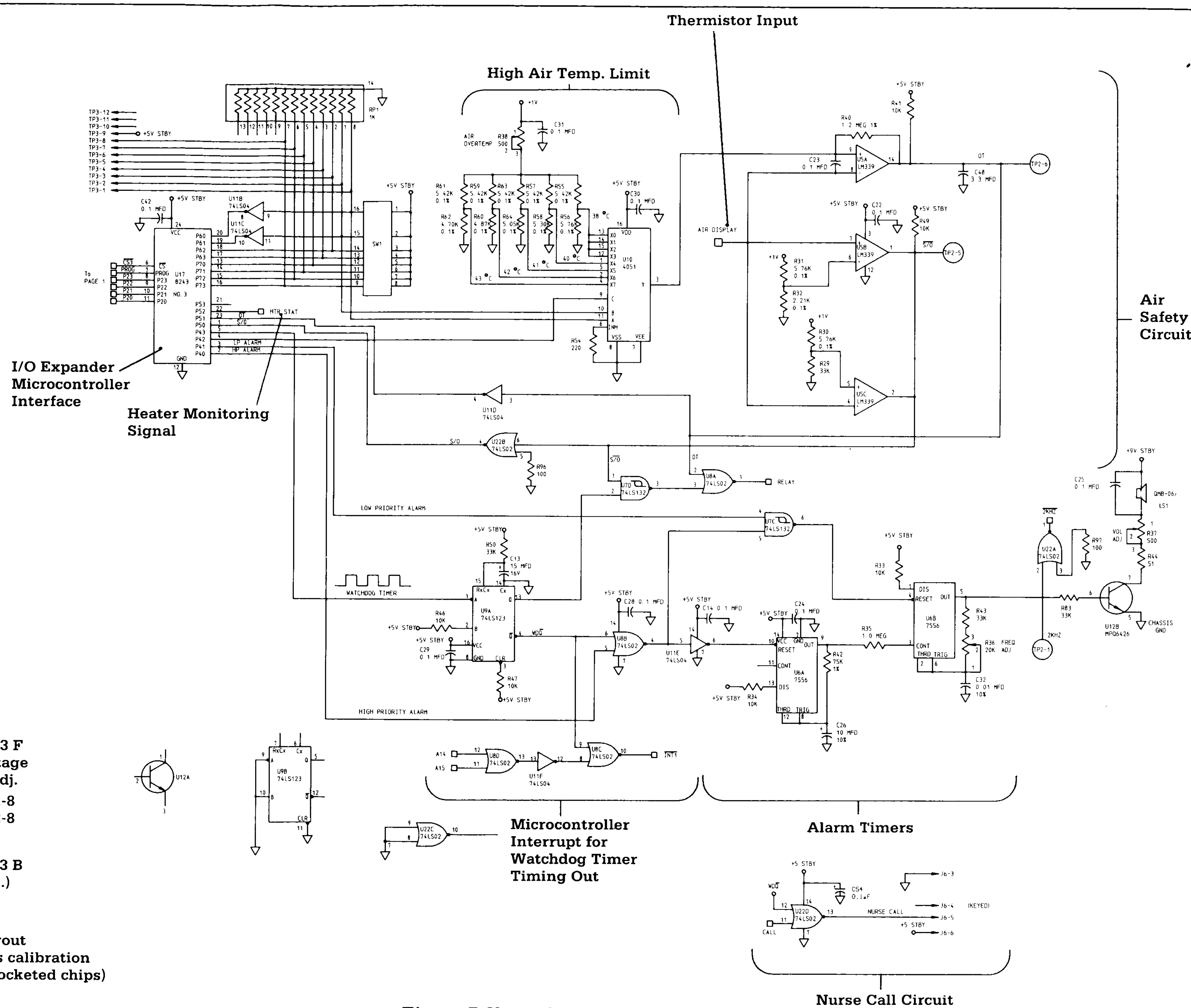


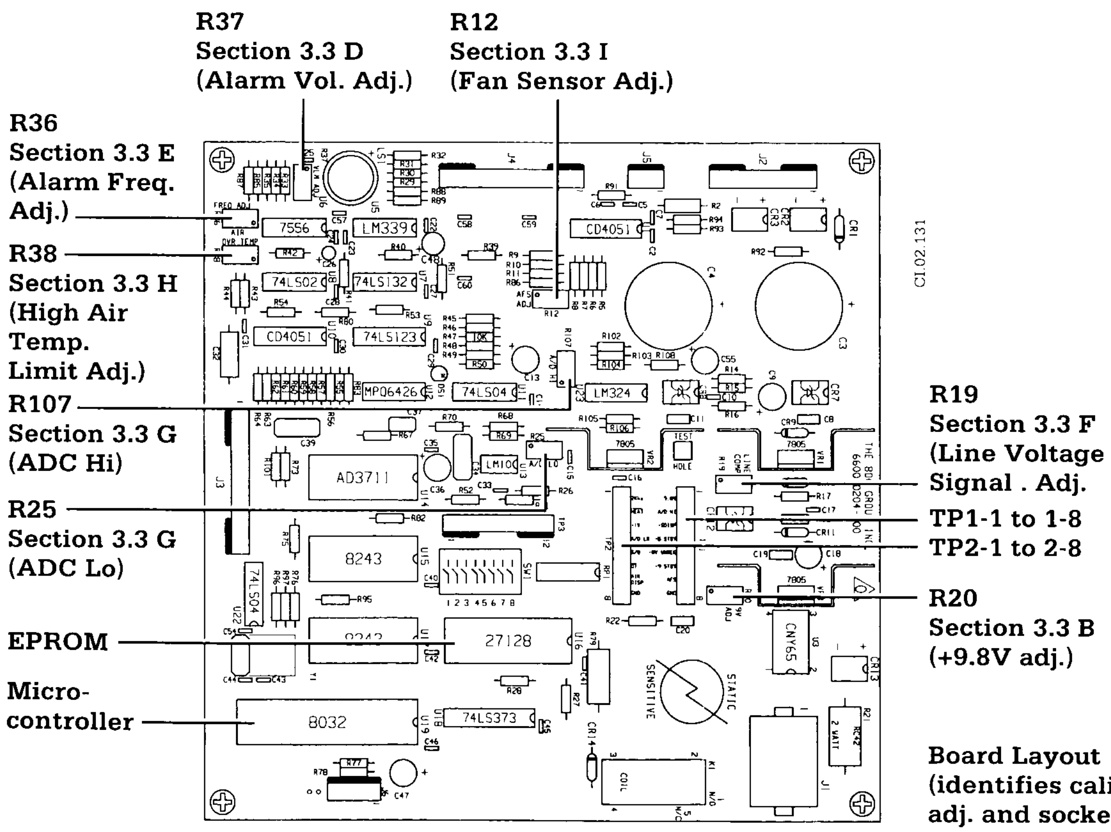
Figure 7-8a Control Board Schematic
Controllers with HBJ Serial Numbers (page 1 of 2)

Notes: (Unless otherwise specified)

1. **All resistors are 5%. 1/4 Watt**
2. **Square denotes refer to other page □**
3. **GND symbol with line denotes GNDS tied together ∇**
4. **Componants drawn with dotted lines are not installed**

TEST POINTS		UNUSED CONNECTOR PINS
TP1-1	9.8V	J1-8, 11
TP1-2	A/D HI	J2-10, 11, 12
TP1-3	+5V DISP	J3-10, 11
TP1-4	+5V STBY	J4-3, 4, 8, 12, 16
TP1-5	+8V UNREG	
TP1-6	+9V STBY	
TP1-7	AFS	
TP1-8	GND	
TP2-1	2KHZ	
TP2-2	HEAT	
TP2-3	+1V	
TP2-4	A/D LOW	
TP2-5	S/O	
TP2-6	OT	
TP2-7	AIR DISPLAY	
TP2-8	GND	
TP3-1	P60	
TP3-2	P61	
TP3-3	P62	
TP3-4	P63	
TP3-5	P70	
TP3-6	P71	
TP3-7	P72	
TP3-8	P73	
TP3-9	+5V STBY	
TP3-10	BLANK	
TP3-11	BLANK	
TP3-12	BLANK	



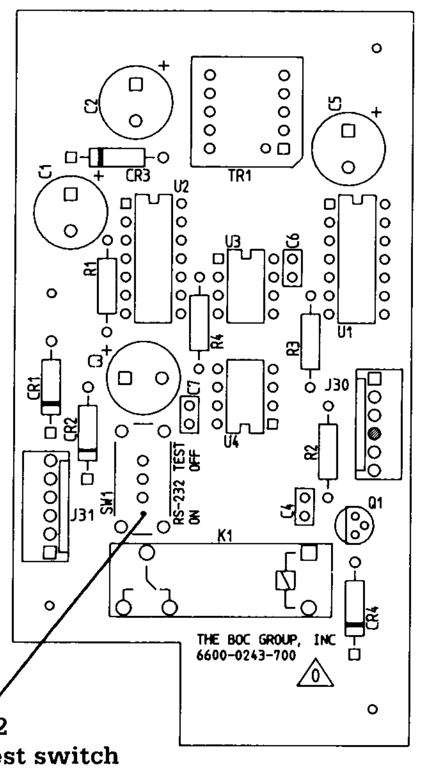


Board Layout (identifies calibration adj. and socketed chips)

Figure 7-8b Control Board Schematic
Controllers with HBJ Serial Numbers (page 2 of 2)

Board Components
ThermaLink Board (6600-0243-702)

DESCRIPTION	QTY	SYMBOL
RESISTOR 220 5%	1	R1
RESISTOR 3 K 5%	1	R2
RESISTOR 3.9 K 5%	2	R3, R4
CAPACITOR 1 UF	3	C1, C2, C5
CAPACITOR 4.7 UF	1	C3
CAPACITOR 0.1 UF	1	C4
TRANSISTOR MPSA14	1	Q1
BI-DIR ZENER SA24C	2	CR1, CR2
DIODE 1N4001	2	CR3, CR4
RELAY AM ZETTLER AZ696-1C-5DE	1	K1
TRANSFORMER SCHOTT 67122750	1	TR1
IC MAX250CPD	1	U1
IC MAX251CPD	1	U2
IC 6N136	2	U3, U4
HEADER 6 PIN	2	J30, J31
SLIDE SWITCH MSS-1200	1	SW1



RS-232
Self test switch

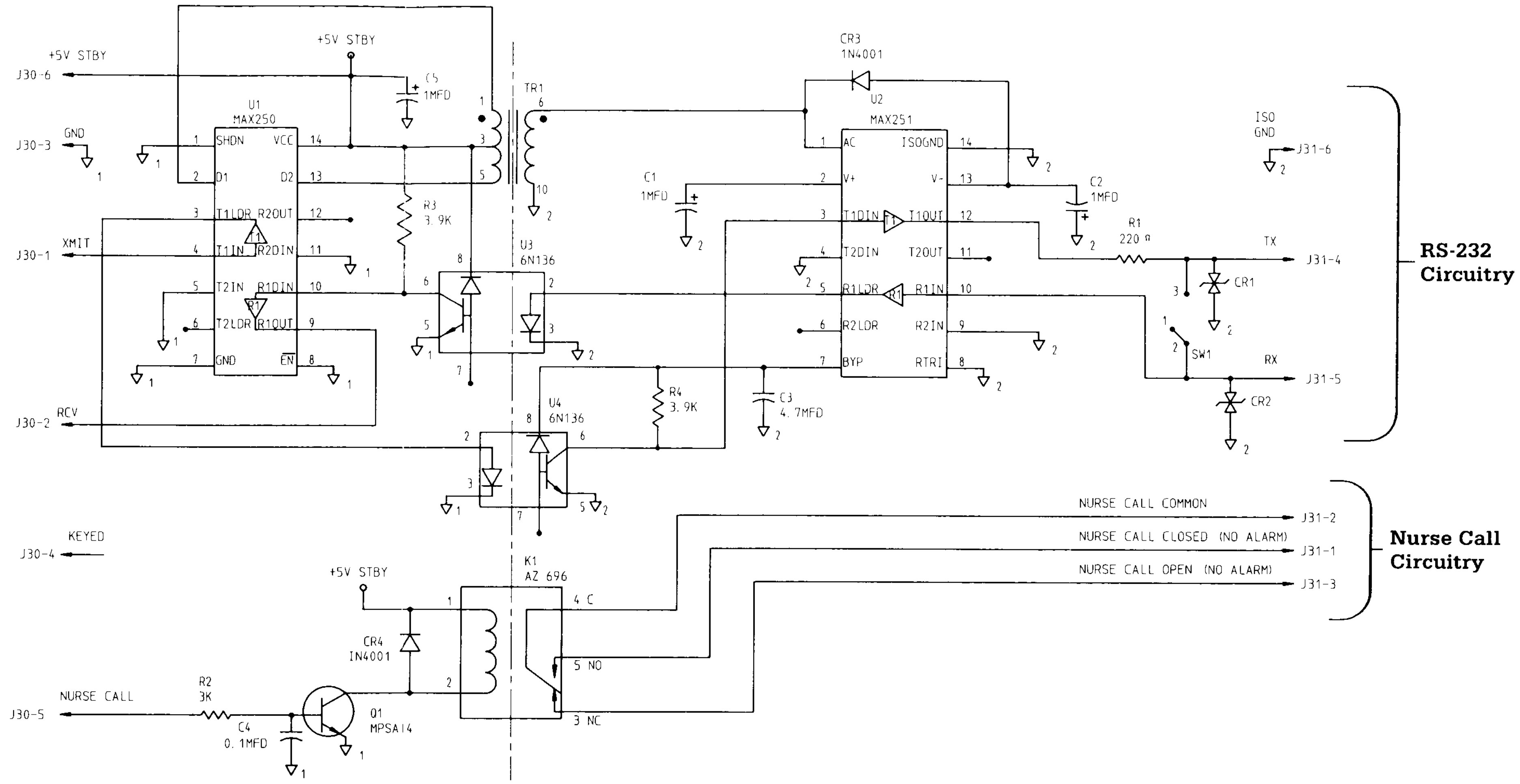


Figure 7-9 ThermaLink Board Schematic
Controllers with HBJ Serial Numbers

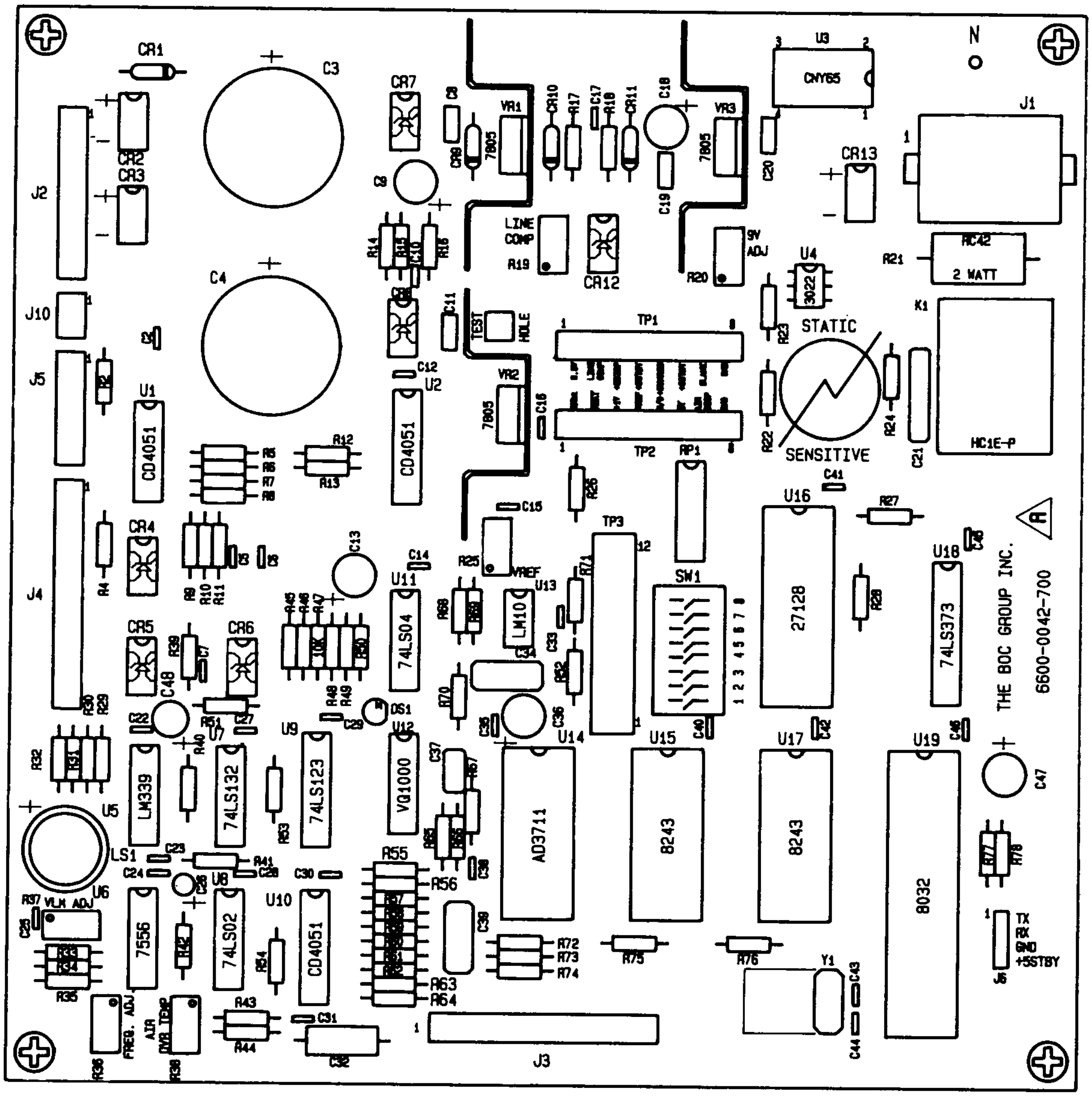


Figure 6-15 Control Board (tested and packaged)

Display Board

Tested and Packaged, Stock No. 6600-0105-710

STOCK NO.	DESCRIPTION	QTY	SYMBOL
6600-0043-600	PC BOARD BLANK	1	FOR ASSEMBLY 6600-0043-700
0690-1560-451	HEADER 12 PIN, RIGHT ANGLE	1	J9
0690-1560-452	HEADER 16 PIN, RIGHT ANGLE	1	J8
6600-0074-700	SOCKET 20 PIN	4	FOR DS-1-4, 6-9
6600-0073-700	SOCKET 16 PIN	2	FOR DS16, 17
6600-0076-700	SOCKET 8 PIN	4	FOR DS18, 19
0690-2400-316	SOCKET 4 PIN	4	FOR DS20-23
6600-0075-700	SOCKET 5 PIN	4	FOR DS5, DS10
6600-0072-700	SOCKET 9 PIN	1	J7
0690-2400-312	SOCKET 14 PIN	5	FOR DS11-15
0686-9000-408	SOCKET 40 PIN	1	FOR U1
0686-9000-406	SOCKET 24 PIN	1	FOR U2
6600-0070-700	DISPLAY HLMP-2685	1	DS-18
6600-0069-700	DISPLAY HLMP-2720	1	DS-19
0683-9020-304	DISPLAY HLMP-2400	4	DS20-23
0683-9020-303	DISPLAY HLMP-2620	2	DS16, 17
0690-2300-326	DISPLAY HDSP-5531	10	DS1-10
0690-2300-325	DISPLAY 5082-7611	5	DS11-15
0684-0800-002	IC 8243	1	U2
0684-0900-001	IC MM5451	1	U1
0685-0050-300	TRANSISTOR MPSA63	4	Q1-4
0683-0035-300	DIODE IN4001	1	CR1
0682-1189-313	CAPACITOR 0.1 MFD 50V 20%	4	C1, C2, C5, C6
0682-2600-300	CAPACITOR 15 MFD 16V	2	C3, C4
0681-0007-300	RESISTOR, VAR 5K	1	R11
0680-9000-312	RESISTOR NETWORK 10K	1	RP1
0680-0380-303	RESISTOR 180 1/4W 5%	5	R2, 4, 6, 8, 10
0680-0489-300	RESISTOR 4.7K 1/4W 5%	4	R1, 3, 5, 7
0680-2100-300	RESISTOR 221 1/4W 1.0%	1	R9

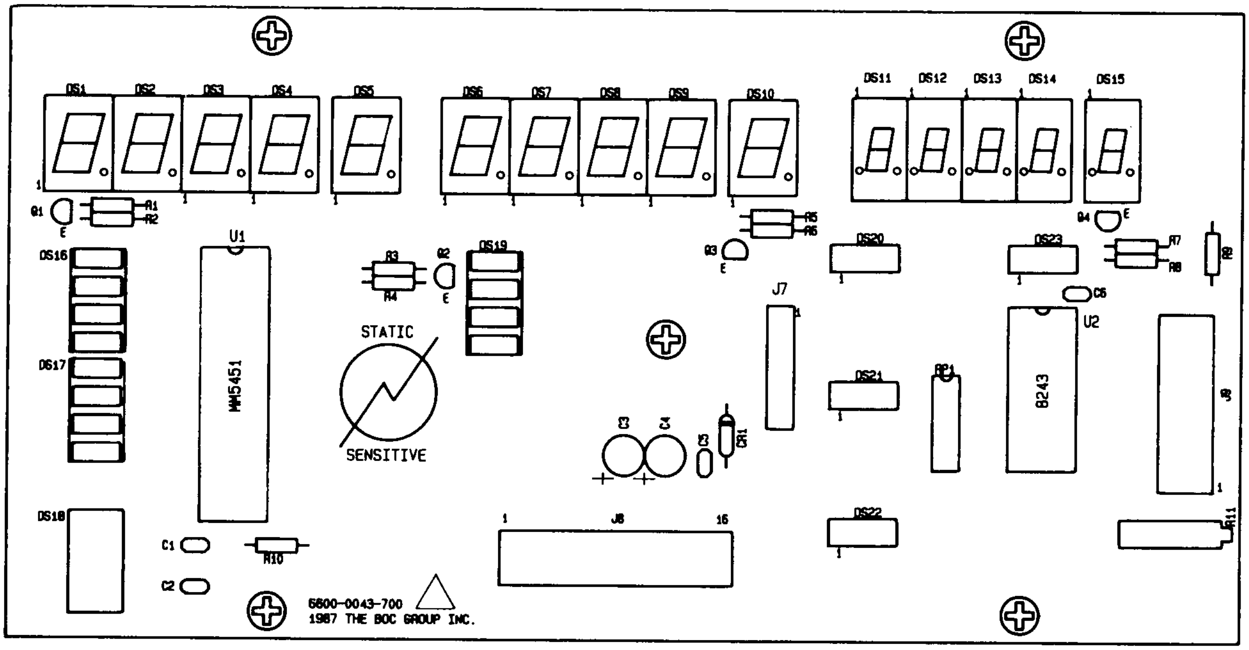


Figure 6-16 Display Board

6.5 Cabinet Components

	Item	Stock Number
1.	Screw, WD, #10 x 1 in	6600-0044-400
2.	Nut, 8-32 x .34	0202-1131-300
3.	Cabinet side, left	6600-0216-500
4.	Cabinet bottom	6600-0144-500
5.	Screw, 8-32 x 3/8	0140-6627-106
6.	Cabinet side, right	6600-0217-500

Not shown	Stock Number
Caster, locking	6600-0038-400
Caster, nonlocking	6600-0039-400

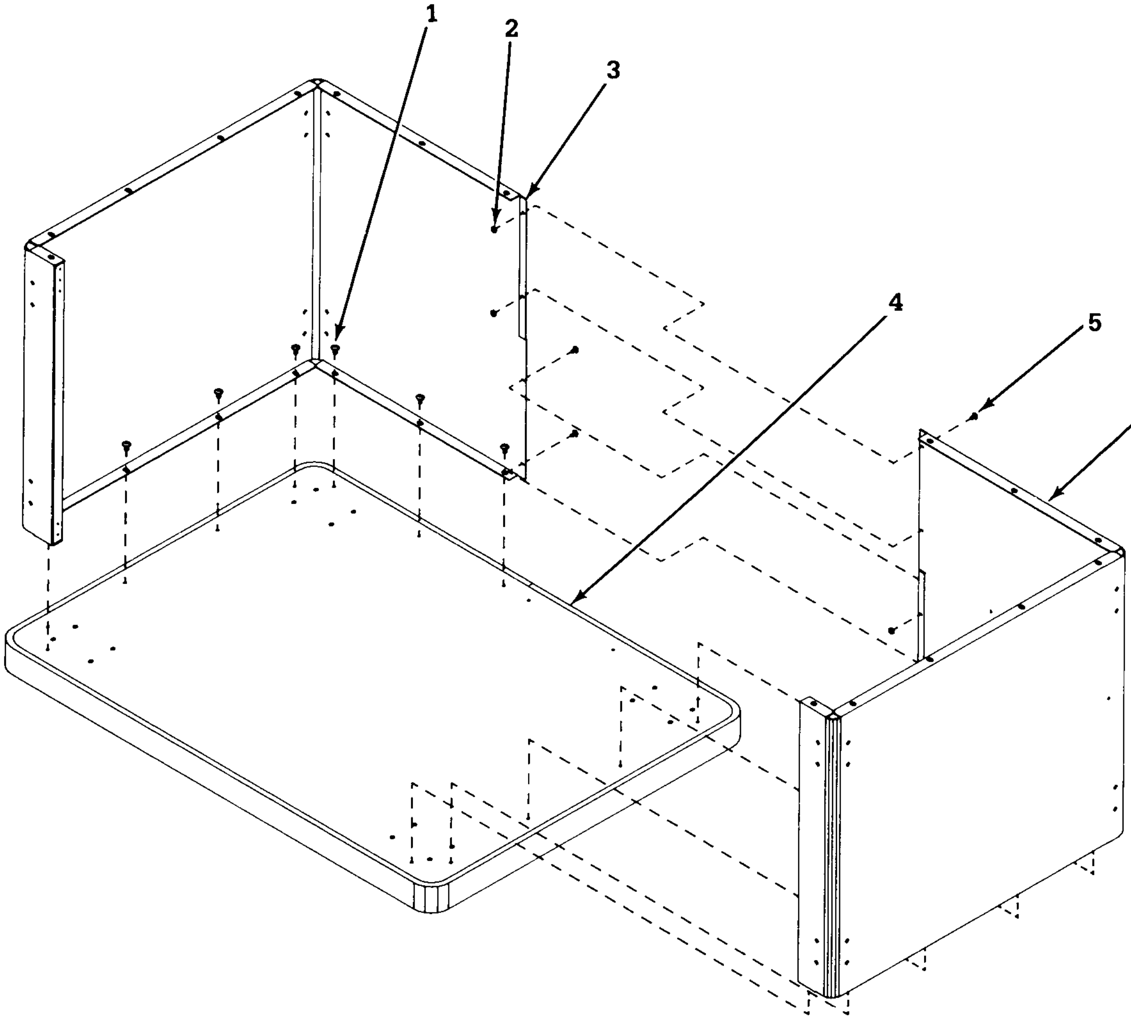


Figure 6-17 Cabinet Assembly (base and sides)

Item		Stock Number
1.	Cabinet top	6600-0145-500
2.	Incubator mounting knob (4)	6600-0154-700
3.	Screw, WD, #10 x 1 in *	6600-0044-400

*** Torque to 25 in/Lbs.**

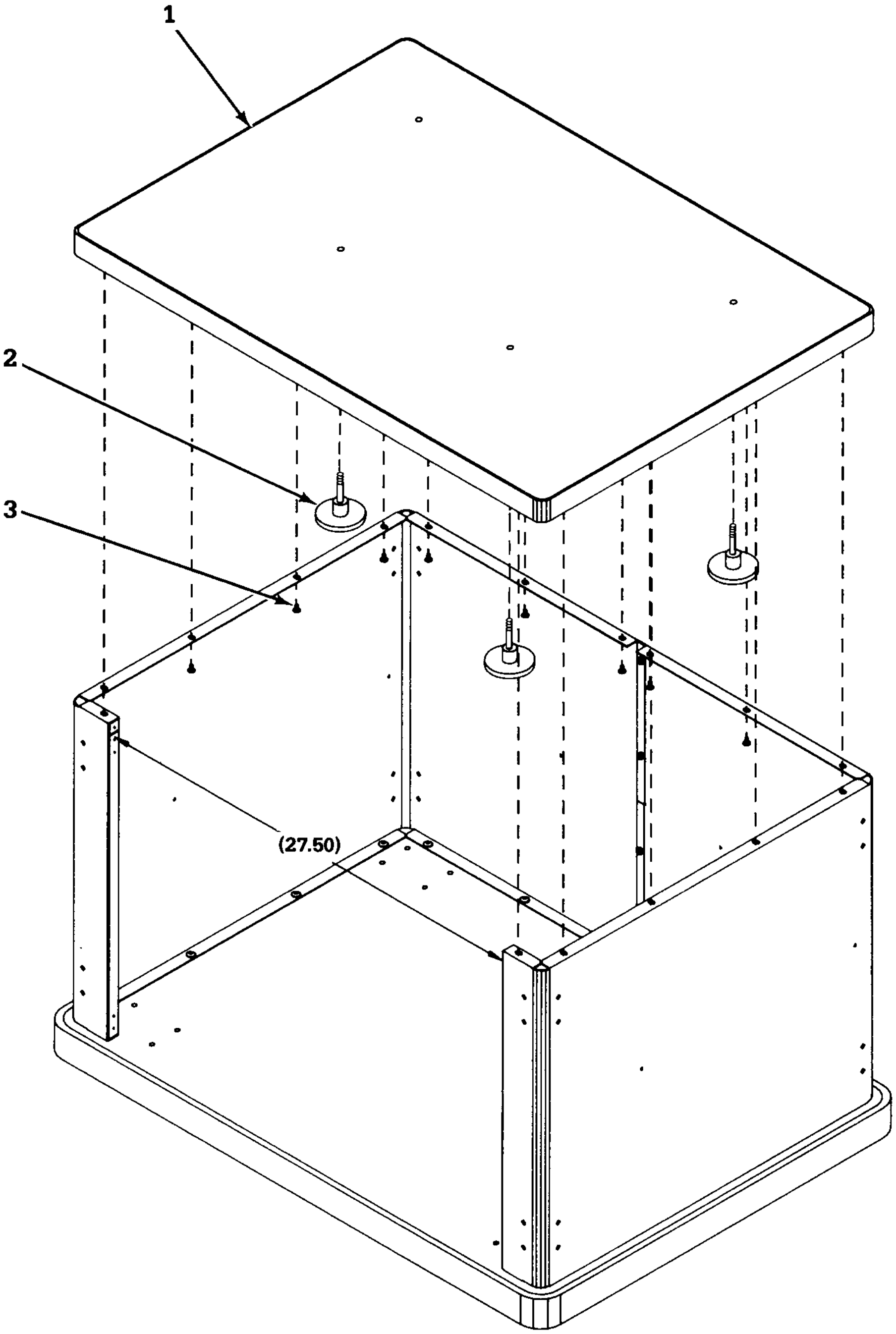


Figure 6-18 Cabinet Assembly (top)

Item		Stock Number
1.	Screw, 8-32 x 3/8, TRS, P	0140-6627-106
2.	Washer, 0.118 ID, 0.0.438 OD	6600-0080-400
3.	Nut, ext. lock, 8-32 x .34	0202-1131-300
4.	Cabinet shelf	6600-0075-500
5.	Cabinet apron	6600-0211-500
6.	Screw, WD, #10 x 1 in *	6600-0044-400
7.	Magnet	6600-0042-400
8.	Screw, #6, FL, PH **	0400-3103-300
9.	Left door	6600-0130-400
10.	Screw 8-32	6600-0045-400
11.	Screw 4-40	6600-0046-400
12.	Strike, cabinet door	6600-0043-400
13.	Plastic hole plug 0.375 in	6600-0085-400
14.	Right door	6600-0129-400
15.	Door hinge, (top right and bottom left)	6600-0128-400
16.	Door hinge, (top left and bottom right)	6600-0127-400
17.	Door handle	6600-0083-500

*** Torque to 25 in/Lbs.**

**** Apply Loctite 24231, Stock No. 0220-5016-300**

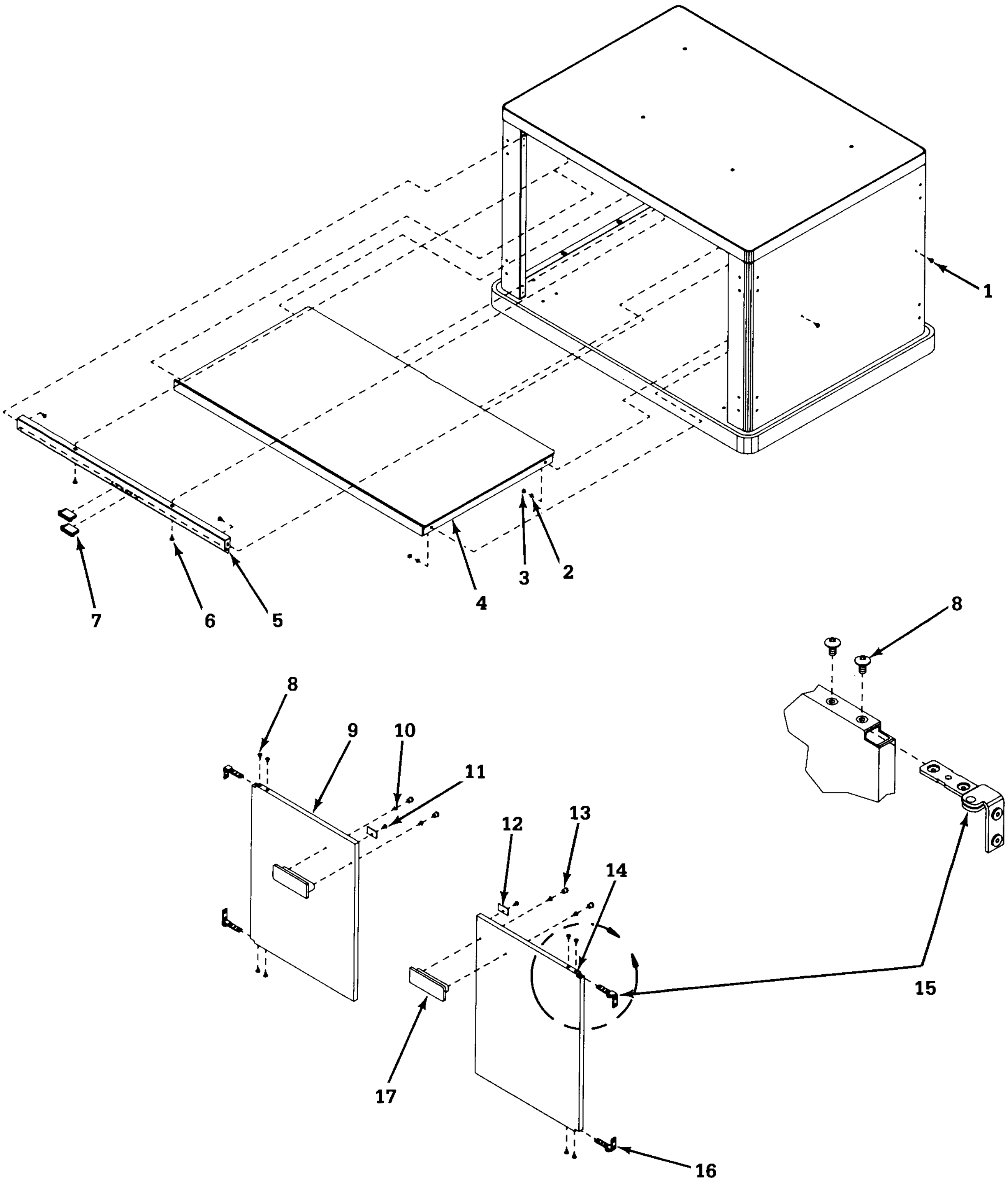


Figure 6-19 Cabinet Doors and Shelf

6.6 Accessories and Disposable Parts

Item	Stock Number
1. Instrument shelf	0217-5365-800
2. Ventilator mounting post	0217-5357-800
3. Oxygen flowmeter w/ bracket	0217-5370-800
4. Suction regulator w/ DISS connectors & safety trap	0306-1012-810
5. Overhead shelf & rails	6600-0042-800
6. I.V. pole	0217-5378-800
7. Standard M 2100 Oxygen Blender	6750-0022-900
8. Power cord	0208-0950-300
9. Cabinet w/ doors	6600-0036-900

Not Shown	Stock Number
Rail system	6600-0041-800
Cabinet w/o doors	6600-0037-900
Refresher instructions	6600-0022-000
Cleaning tank	6600-0202-500
Patient probe	0208-0697-700
Heat reflecting probe patch (50/pkg)	0203-1980-300
Wristlets (6/pkg)	6600-0164-500
Service Manual	6600-0017-000
Pleur-evac hanger	6600-0115-800

Note: Mounting the Standard M 2100 Oxygen Blender on the rail system requires the adapter plate (Stock No. 0217-5363-800) and the bird bracket (Stock No. 6600-0031-900).

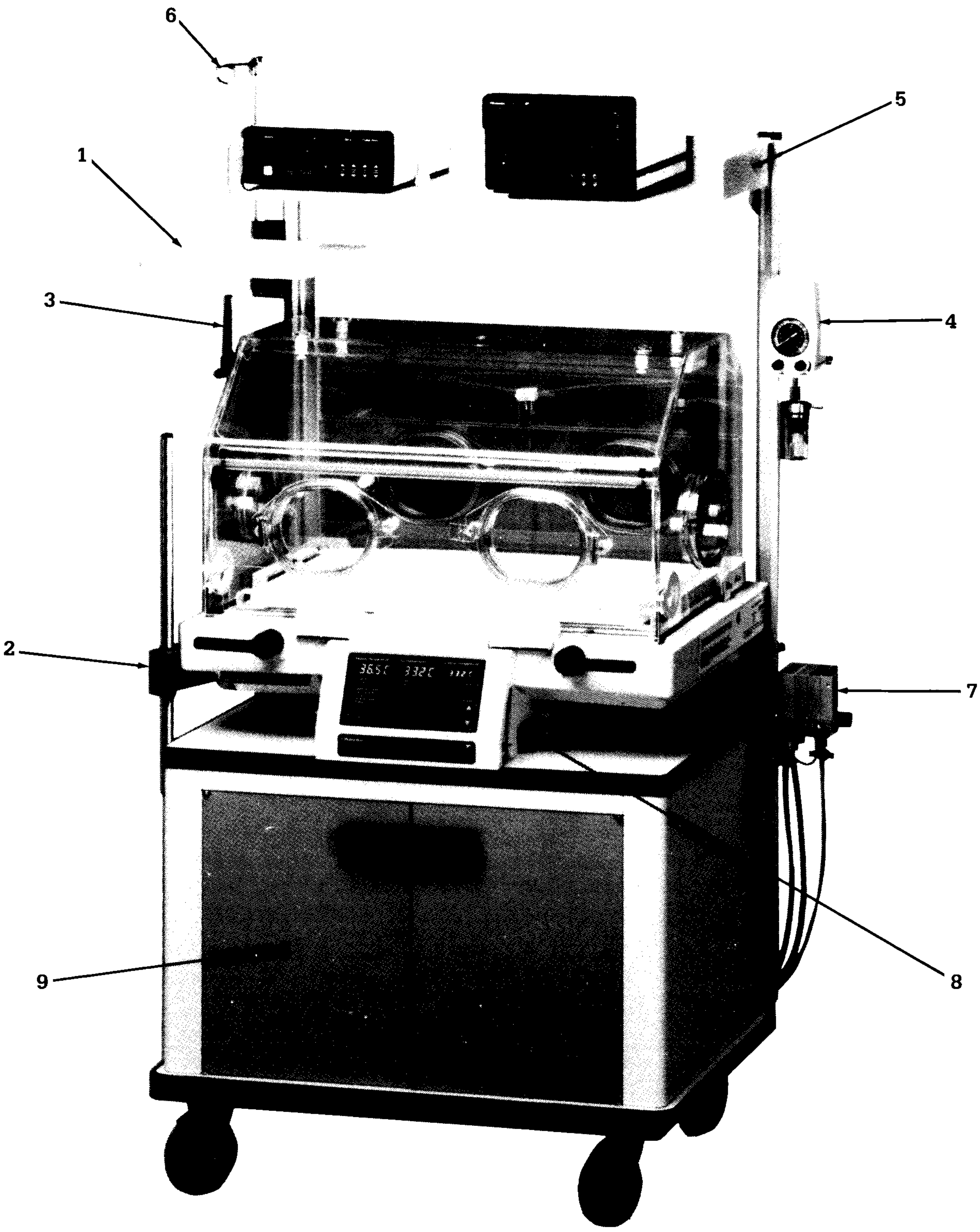


Figure 6-20 Care Plus Incubator with Accessories

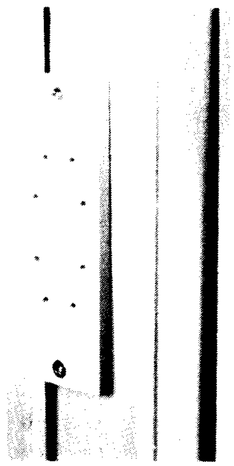


Figure 6-21 Adapter Plate Assembly 0217-5363-800

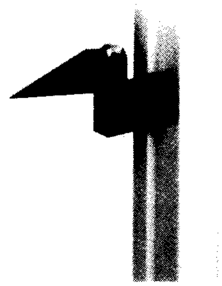


Figure 6-22 Instrument Shelf 0217-5365-800

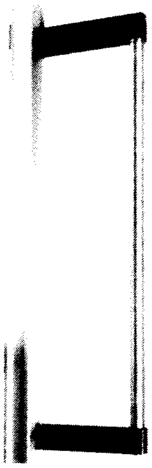


Figure 6-23 22 Inch Utility Post 0217-5376-800

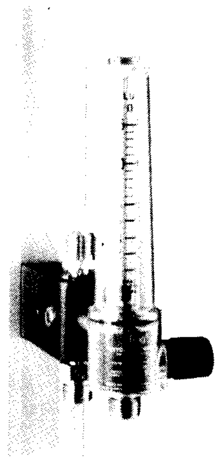


Figure 6-24 Oxygen Flowmeter, w/Bracket 0217-5370-800

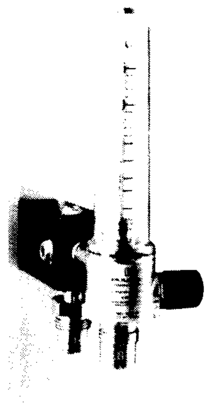


Figure 6-25 Air Flowmeter, w/ Bracket 0217-5372-800

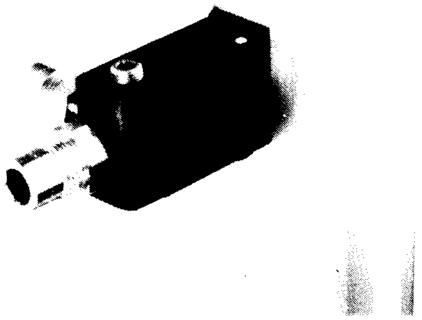


Figure 6-26 Vacuum Manifold w/DISS Adapters 0217-5369-800

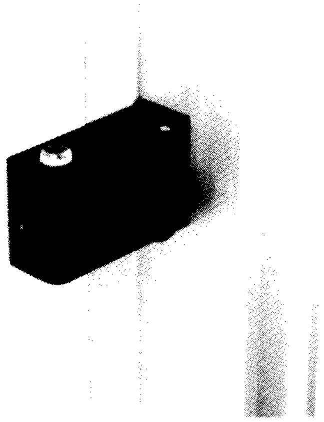


Figure 6-27 Manifold w/ 1/8 Inch Pipe Thread 0217-5359-800

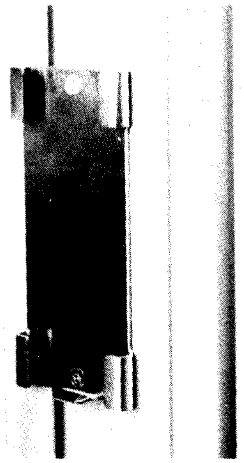


Figure 6-28 Vacuum Bottle Slide Bracket 0217-5367-800

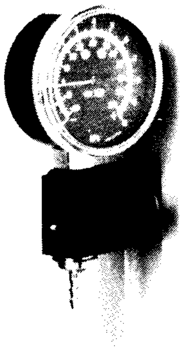


Figure 6-29 Manometer w/ Bracket 0217-5377-800

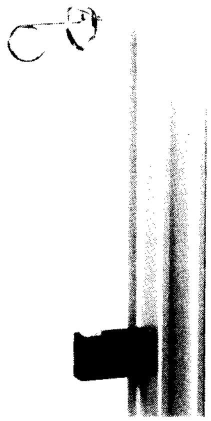


Figure 6-30 I.V. Pole 0217-5378-800

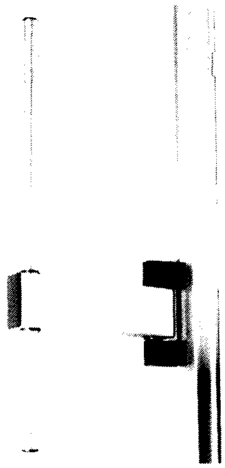


Figure 6-31 Ventilator Mounting Post 0217-5357-800

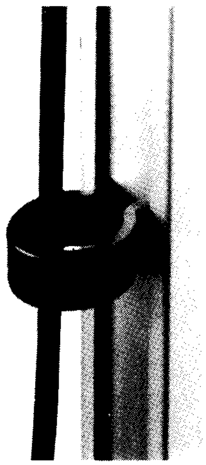


Figure 6-32 Retaining Clips 0217-5290-870

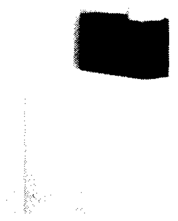


Figure 6-33 3.5 Inch Utility Post 0217-5374-800

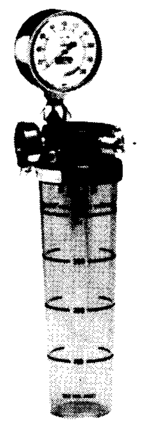


Figure 6-34 Twin-O-Vac 6600-0030-900

Not Shown	Stock Number
Phototherapy light II (free standing)	6600-0029-900
Phototherapy light II (rail/wall mounting)	6600-0055-900
Phototherapy light II rail mounting kit	6600-0051-800
Twin-O-Vac rail mounting kit	6600-0018-800
Pleur-evac hanger kit	6600-0115-800
In service video	6600-0066-000
Technical, service video	6600-0067-000

6.7 Voltage or Language Specific Parts

A. Top Level (complete Incubator) Stock Numbers

English Language Models

100 Vac 50 Hz Model (100 Vac +/- 10%, 6.6 Amps)	6600-0043-950*
120 Vac 60 Hz Model (115 Vac +/- 10%, 5.7 Amps)	6600-0040-900*
120 Vac 50 Hz Model (115 Vac +/- 10%, 5.7 Amps)	6600-0040-950*
220 Vac 60 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0041-960*
220 Vac 50 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0041-950*
240 Vac 60 Hz Model (240 Vac +/- 10%, 2.7 Amps)	6600-0042-960*
240 Vac 50 Hz Model (240 Vac +/- 10%, 2.7 Amps)	6600-0042-950*

Spanish Language Models

120 Vac 60 Hz Model (115 Vac +/- 10%, 5.7 Amps)	6600-0046-960*
120 Vac 50 Hz Model (115 Vac +/- 10%, 5.7 Amps)	6600-0046-950*
220 Vac 60 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0045-960*
220 Vac 50 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0045-950*

French Language Models

220 Vac 60 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0047-960*
220 Vac 50 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0047-950*

German Language Models

220 Vac 50 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0044-950*

*** Order cabinet and inner walls separately (Inner Wall Kit, Stock No. 6600-0040-800; Deluxe Cabinet, Stock No. 6600-0036-900).**

B. Service Controllers

English Language Models

100 Vac 60 Hz Model (100 Vac +/- 10%, 6.6 Amps)	6600-0087-861
100 Vac 50 Hz Model (100 Vac +/- 10%, 6.6 Amps)	6600-0087-851
120 Vac 60 Hz Model (115 Vac +/- 10%, 5.7 Amps)	6600-0084-810
120 Vac 50 Hz Model (115 Vac +/- 10%, 5.7 Amps)	6600-0084-851
220 Vac 60 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0085-861
220 Vac 50 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0085-851
240 Vac 60 Hz Model (240 Vac +/- 10%, 2.7 Amps)	6600-0086-861
240 Vac 50 Hz Model (240 Vac +/- 10%, 2.7 Amps)	6600-0086-851

Spanish Language Models

120 Vac 60 Hz Model (115 Vac +/- 10%, 5.7 Amps)	6600-0090-861
120 Vac 50 Hz Model (115 Vac +/- 10%, 5.7 Amps)	6600-0090-851
220 Vac 60 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0089-861
220 Vac 50 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0089-851

French Language Models

220 Vac 60 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0091-861
220 Vac 50 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0091-851

German Language Models

220 Vac 50 Hz Model (220 Vac +/- 10%, 3.0 Amps)	6600-0088-851

C. Heater

95 V heater (application on 100 V units)	6600-0231-500
115 V heater (application on 120 V units)	6600-0199-500
198 V heater (application on 220 V units)	6600-0177-500
216 V heater (application on 240 V units)	6600-0198-500

D. Motor

Motor Kit (includes screws, shock mounts, air seal, and bushings)

Motor, 115V, 60 Hz, 1550 RPM (used on all 60 Hz units)	6600-0054-800
Motor, 100/120V, 50 Hz, 1480 RPM	6600-0055-800
Motor, 220/240V, 50 Hz, 1480 RPM	6600-0056-800

Motor Mounts

For all 50 Hz Motors	6600-0239-500
For all 60 Hz Motors	6600-0084-500

Note: 50 and 60 Hz motors require different mounts.

E. Control Board

Control board 120V	6600-0105-710
Control board 220/240 V	6600-0126-710

Notes

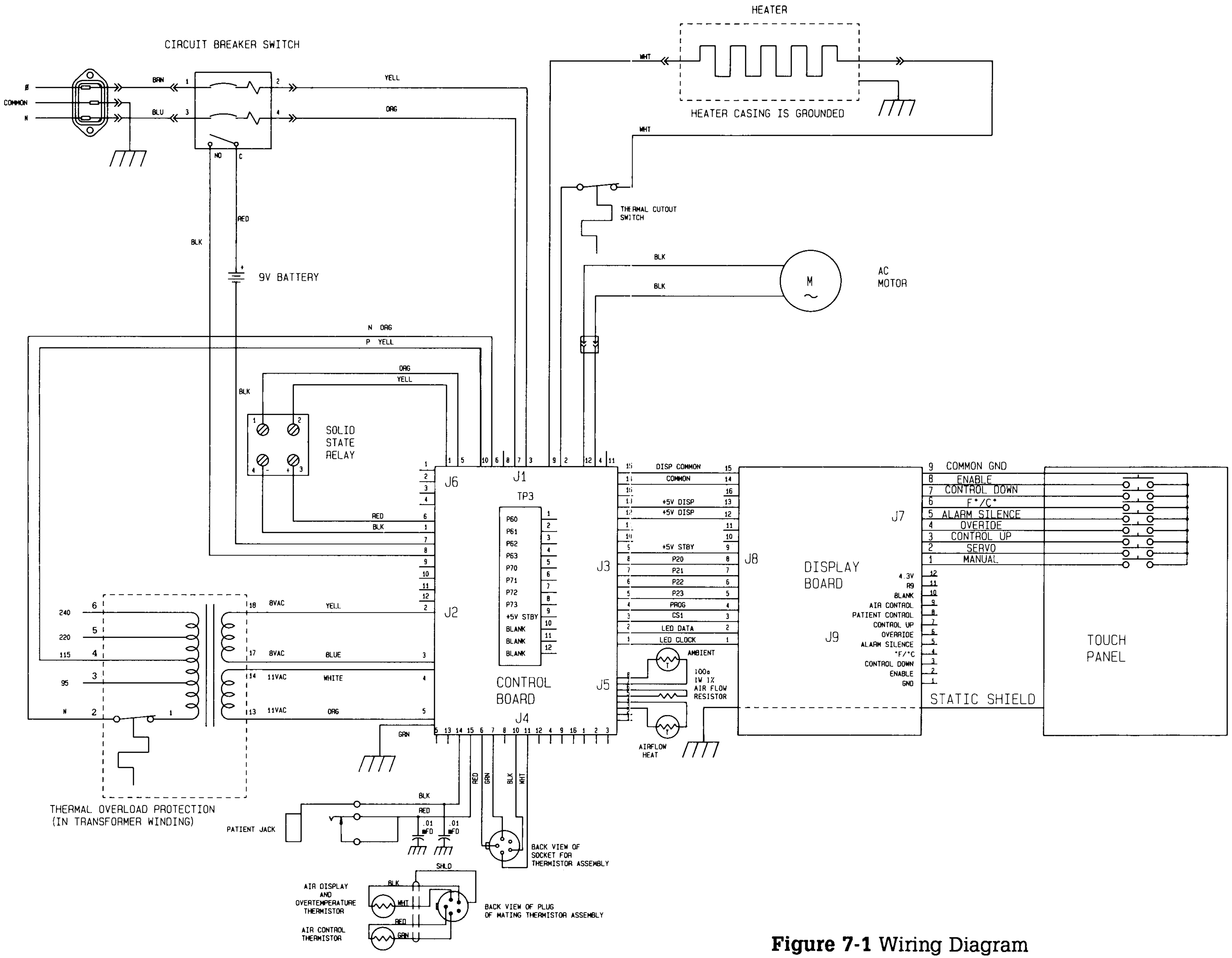


Figure 7-1 Wiring Diagram

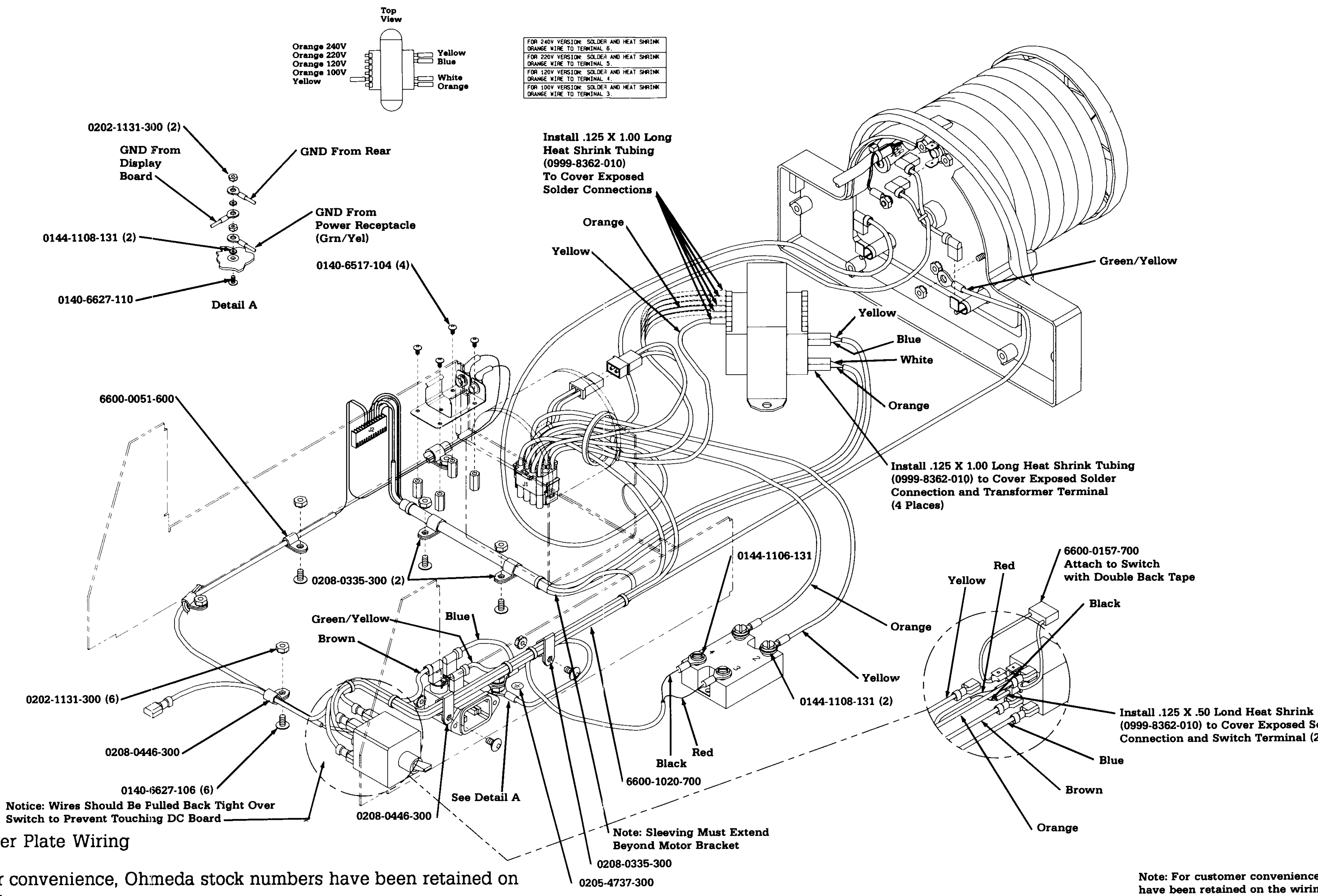


Figure 7-2 Controller Plate Wiring

Note: For customer convenience, Ohmeda stock numbers have been retained on the wiring diagrams.

Note: For customer convenience
have been retained on the wirin

The 6600-0102-700 wire harness
the AC entrance wires and the

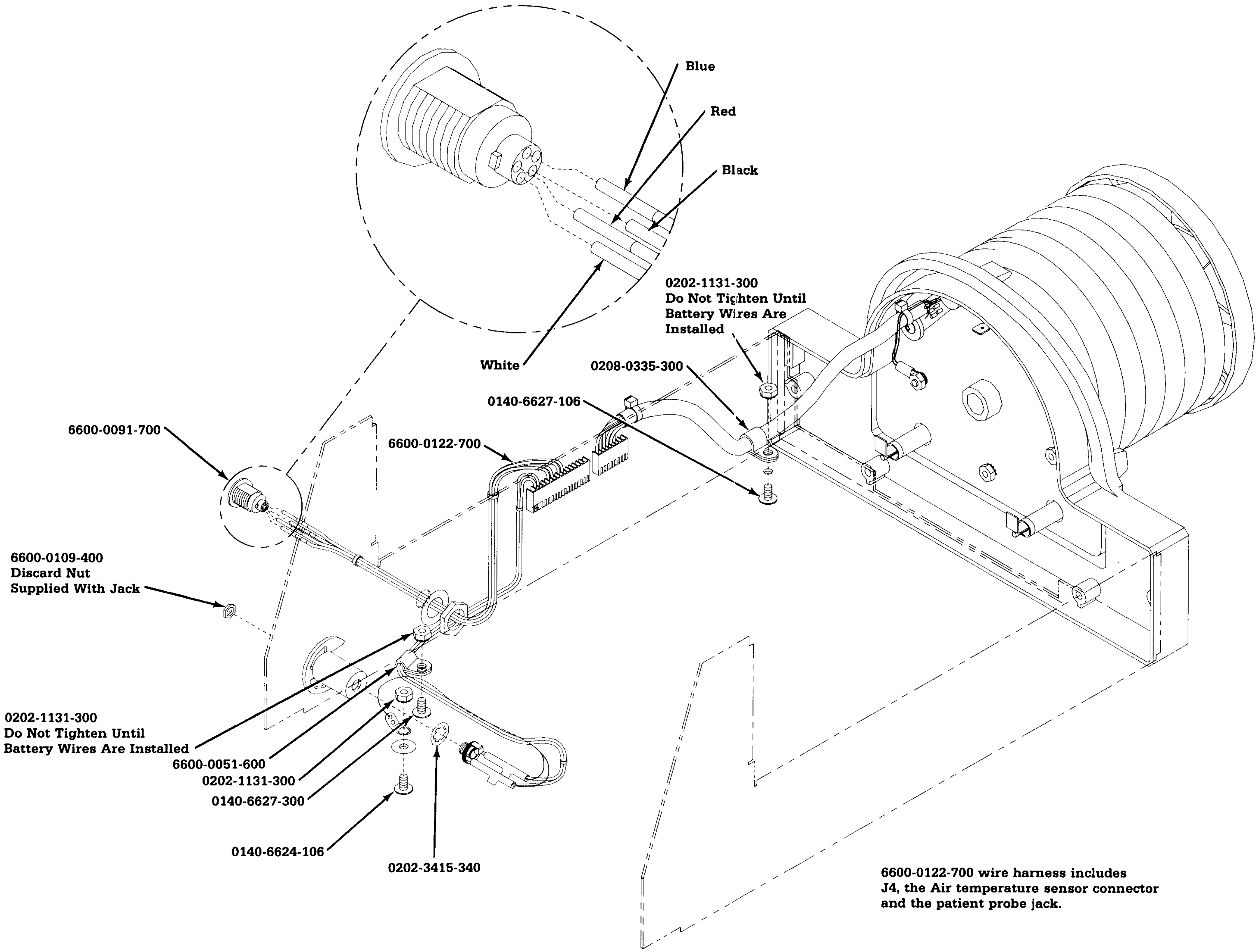
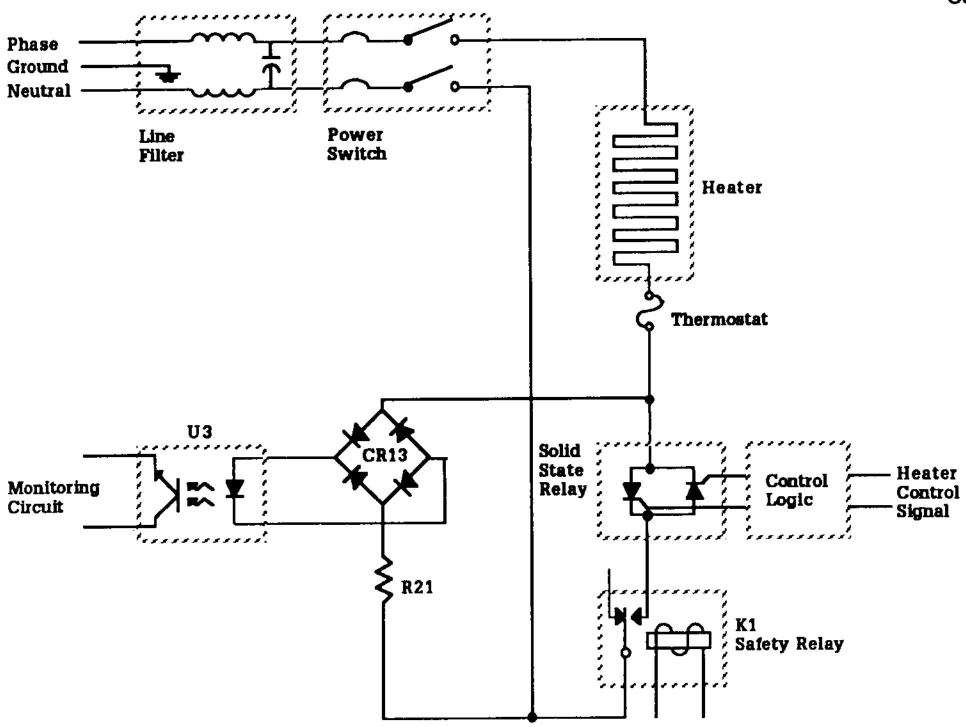
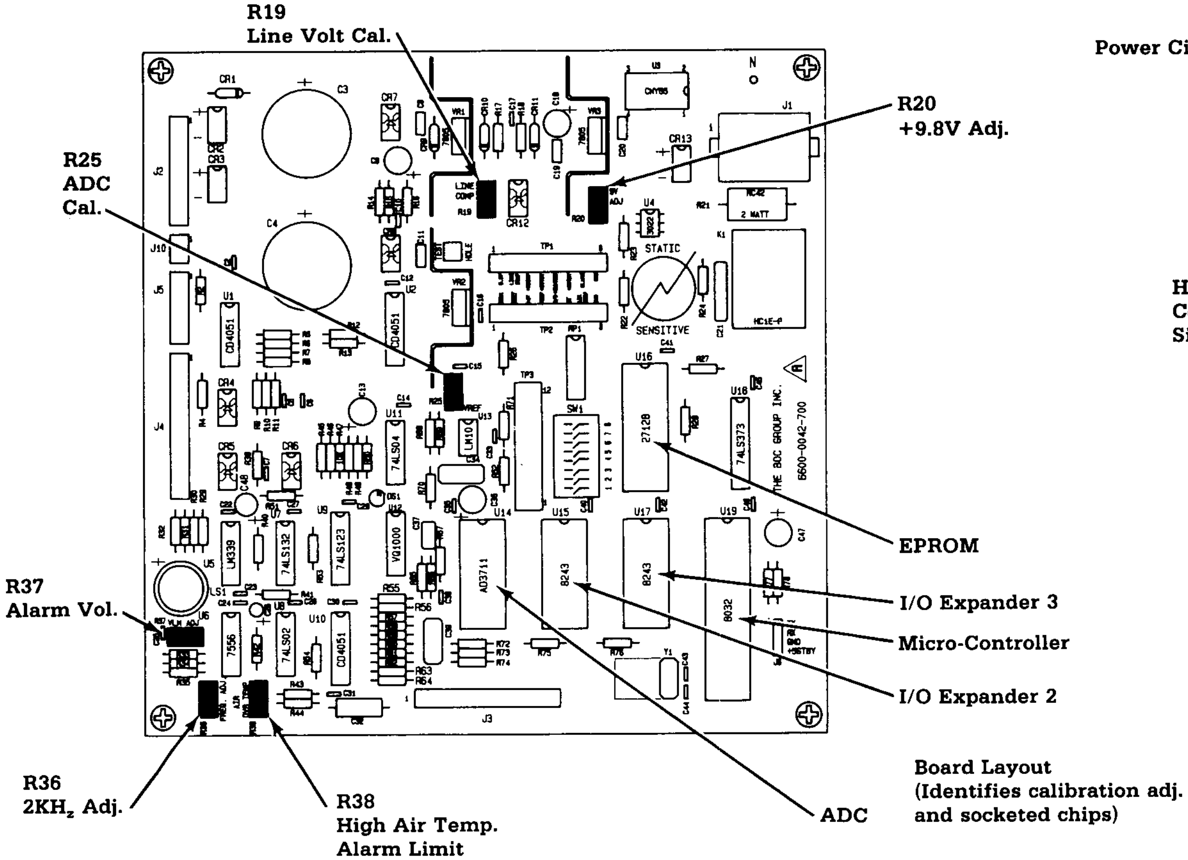


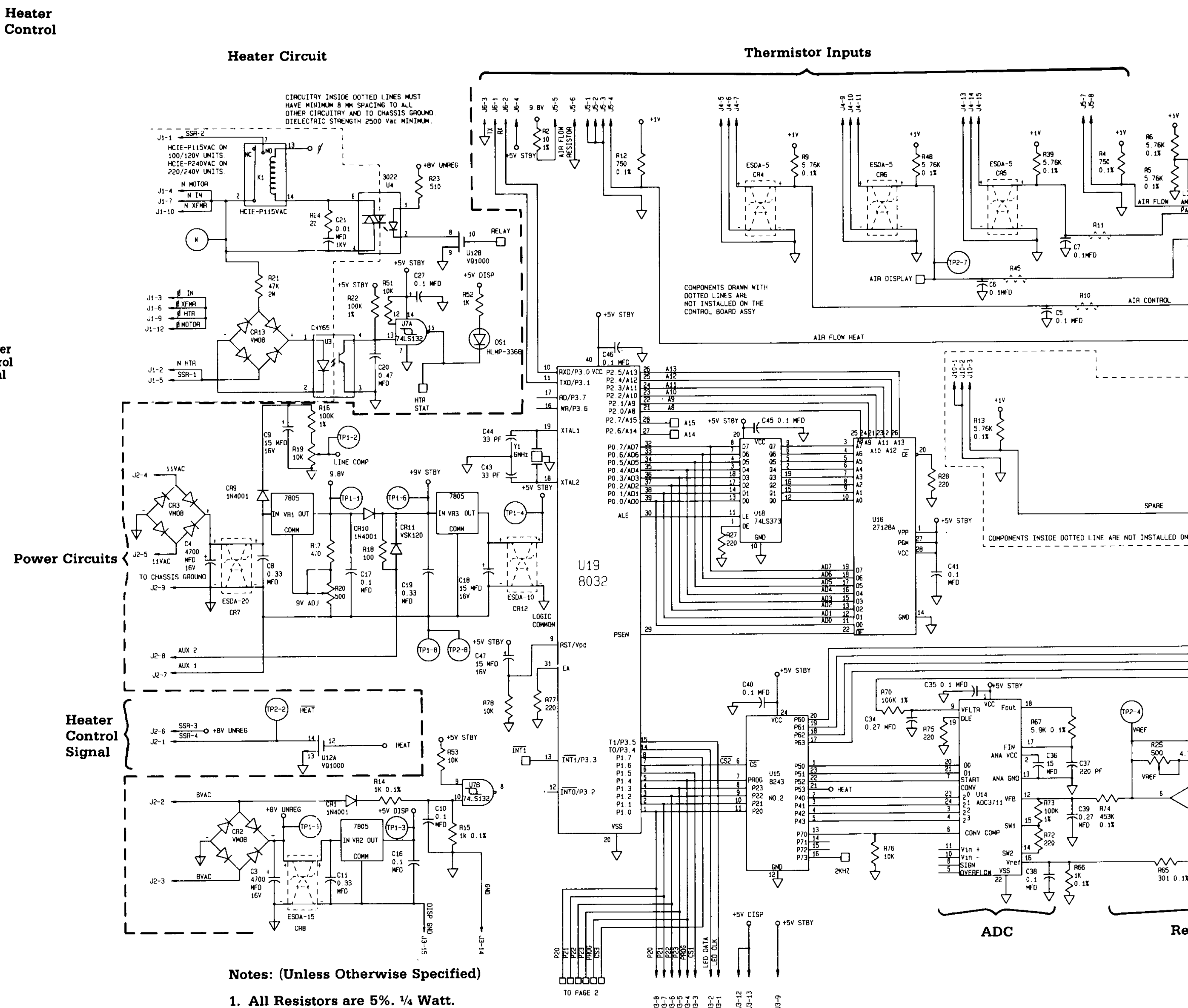
Figure 7-3 Detail, Air Temp. and Patient Temp. Wiring

Heater Block Diagram





Board Layout (Identifies calibration adj. and socketed chips)

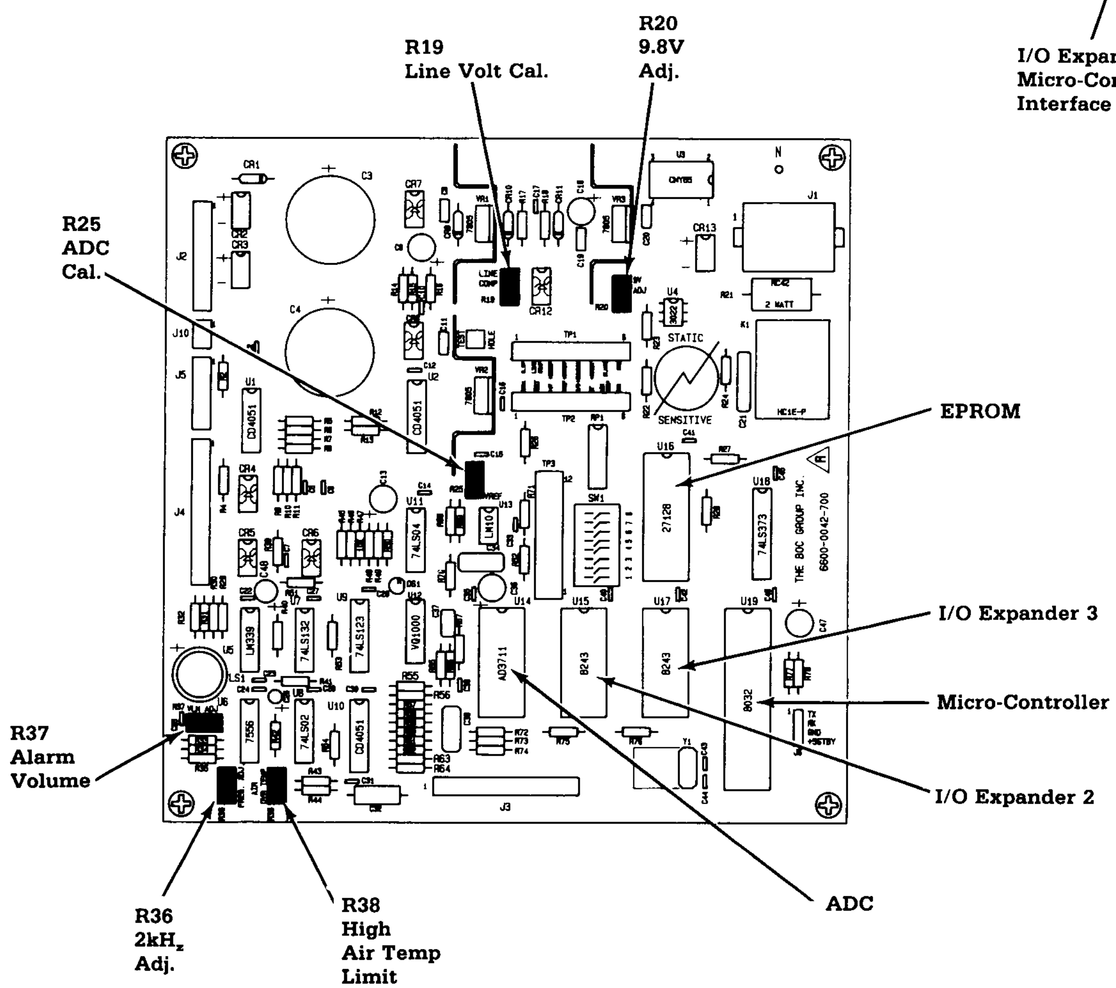


Notes: (Unless Otherwise Specified)

1. All Resistors are 5%. ¼ Watt.
2. Square Denotes Refer to Other Page □
3. GND Symbol With Line Denotes GNDS Tied Together
4. Potentiometer Used in Calibration

Figure 7-4a Control Board Schematic (page 1 of 2)

TEST POINTS		UNUSED CONNECTOR PINS
TP1-1	9.8V	J1-8, J1-11
TP1-2	LINE COMP	J2-12
TP1-3	+5V DISP	J3-10, 11, 16
TP1-4	+5V STBY	J4-4, 8, 12, 16
TP1-5	+8V UNREG	
TP1-6	+9V STBY	
TP1-7	BLANK	
TP1-8	GND	
TP2-1	2KHZ	
TP2-2	HEAT	
TP2-3	+1V	
TP2-4	V REF	
TP2-5	S/O	
TP2-6	OT	
TP2-7	AIR DISPLAY	
TP2-8	GND	
TP3-1	P60	
TP3-2	P61	
TP3-3	P62	
TP3-4	P63	
TP3-5	P70	
TP3-6	P71	
TP3-7	P72	
TP3-8	P73	
TP3-9	+5V STBY	
TP3-10	BLANK	
TP3-11	BLANK	
TP3-12	BLANK	



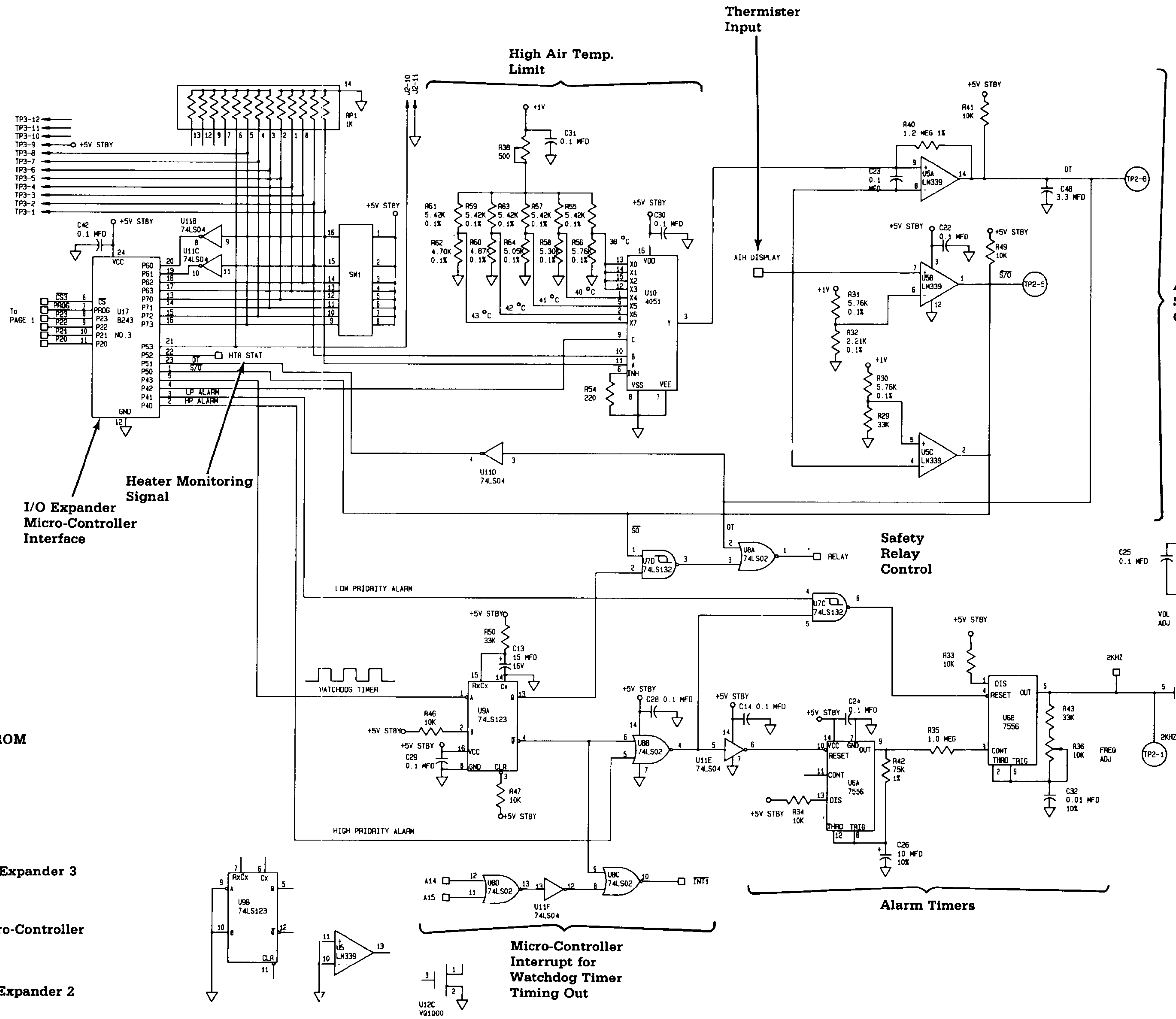


Figure 7-4b Control Board Schematic (page 2 of 2)

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL RESISTORS ARE 5%, 1/4 WATT.
2. GND SYMBOL WITH LINE DENOTES GNDS TIED TOGETHER.

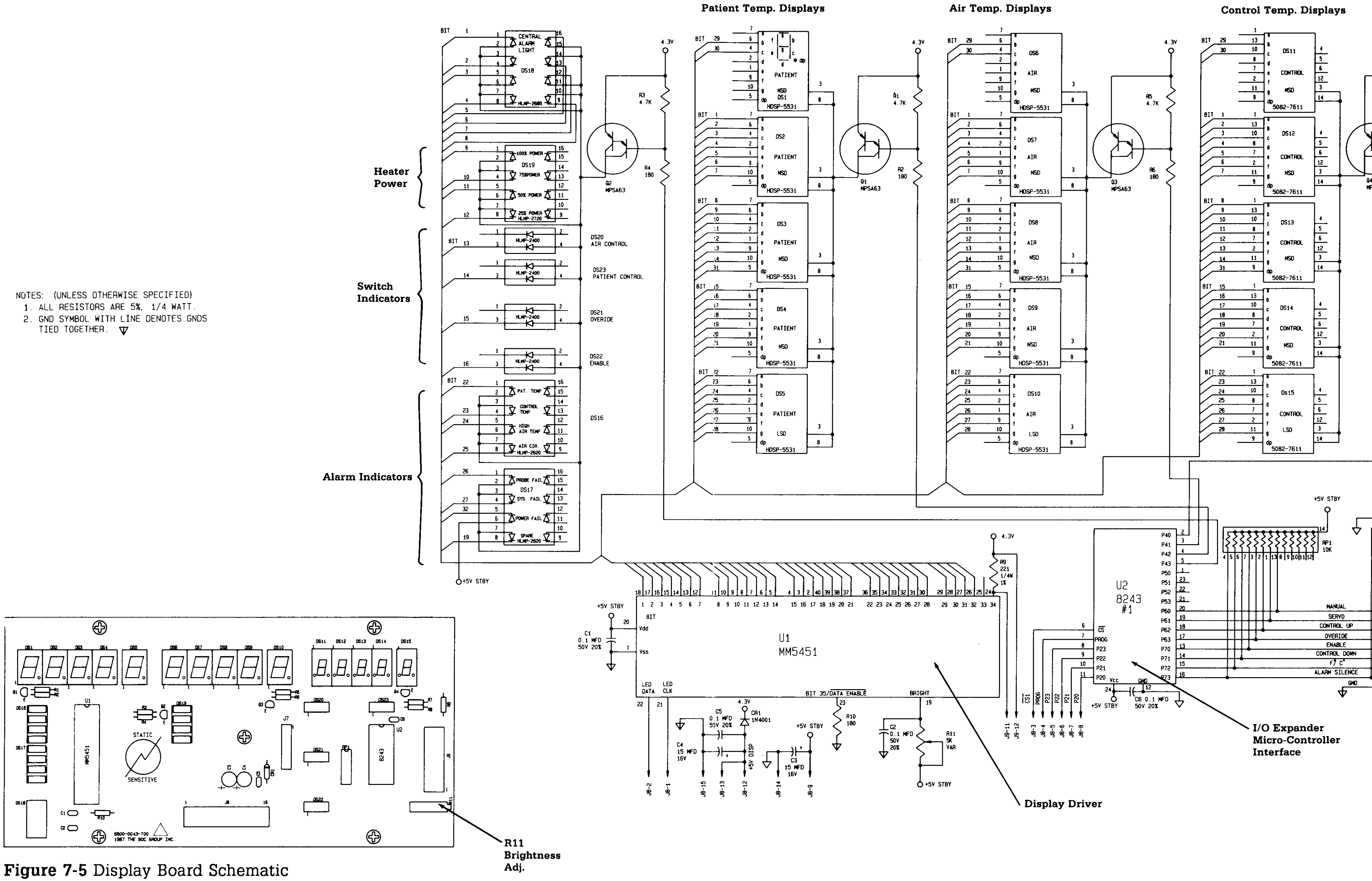


Figure 7-5 Display Board Schematic

Patient Temperature Probe and Air Temperature Sensor Characteristics

Temp °C	Res. Ohms	Temp °C	Res. Ohms	Temp °C	Res. Ohms	Temp °C	Res. Ohms
29.9	8049.1	34.0	6778.1	38.0	5731.3	42.0	4845.3
30.0	8015.4	.1	6749.8	.1	5707.3	.1	4825.0
.1	7981.9	.2	6721.5	.2	5683.5	.2	4804.8
.2	7948.5	.3	6693.4	.3	5659.7	.3	4784.6
.3	7915.2	.4	6665.4	.4	5636.0	.4	4764.6
.4	7882.1	.5	6637.5	.5	5612.4	.5	4744.6
.5	7849.2	.6	6609.8	.6	5588.9	.6	4724.7
.6	7816.3	.7	6582.1	.7	5565.4	.7	4704.9
.7	7783.7	.8	6554.6	.8	5542.1	.8	4685.1
.8	7751.1	.9	6527.1	.9	5518.9	.9	4665.5
.9	7718.7	35.0	6499.8	39.0	5495.8	43.0	4645.9
31.0	7686.4	.1	6472.6	.1	5472.8	.1	4626.4
.1	7654.3	.2	6445.6	.2	5449.9	.2	4607.0
.2	7622.2	.3	6418.6	.3	5427.1	.3	4587.7
.3	7590.4	.4	6391.7	.4	5404.3	.4	4568.5
.4	7558.6	.5	6365.0	.5	5381.7	.5	4549.3
.5	7527.0	.6	6338.3	.6	5359.1	.6	4530.2
.6	7495.5	.7	6311.8	.7	5336.7	.7	4511.2
.7	7464.2	.8	6285.4	.8	5314.3	.8	4492.3
.8	7432.9	.9	6259.1	.9	5292.1	.9	4473.4
.9	7401.9	36.0	6232.9	40.0	5269.9	44.0	4454.6
32.0	7370.9	.1	6206.8	.1	5247.8	.1	4436.0
.1	7340.1	.2	6180.9	.2	5225.8	.2	4417.3
.2	7309.4	.3	6155.0	.3	5203.9	.3	4398.8
.3	7278.8	.4	6129.2	.4	5182.1	.4	4380.3
.4	7248.3	.5	6103.6	.5	5160.4	.5	4361.9
.5	7218.0	.6	6078.0	.6	5138.8	.6	4343.6
.6	7187.8	.7	6052.6	.7	5117.3	.7	4325.4
.7	7157.8	.8	6027.3	.8	5095.8	.8	4307.3
.8	7127.8	.9	6002.0	.9	5074.5	.9	4289.2
.9	7098.0	37.0	5976.9	41.0	5053.2	45.0	4271.2
33.0	7068.3	.1	5951.9	.1	5032.0		
.1	7038.8	.2	5927.0	.2	5010.9		
.2	7009.3	.3	5902.2	.3	4989.9		
.3	6980.0	.4	5877.4	.4	4969.0		
.4	6950.8	.5	5852.8	.5	4948.2		
.5	6921.7	.6	5828.3	.6	4927.4		
.6	6892.8	.7	5803.9	.7	4906.8		
.7	6863.9	.8	5779.6	.8	4886.2		
.8	6835.2	.9	5755.4	.9	4865.7		
.9	6806.6						

Temperature Conversion Chart

°C	°F	°C	°F	°C	°F	°C	°F
20.0	68.0	31.5	88.70	36.3	97.34	38.3	100.94
21.5	70.70	32.0	89.60	36.4	97.52	38.4	101.12
22.0	71.60	32.5	90.50	36.5	97.70	38.5	101.30
22.5	72.50	33.0	91.40	36.6	97.88	38.6	101.48
23.0	73.40	33.5	92.30	36.7	98.06	38.7	101.66
23.5	74.30	34.0	93.20	36.8	98.24	38.8	101.84
24.0	75.20	34.5	94.10	36.9	98.42	38.9	102.02
24.5	76.10	35.0	95.00	37.0	98.60	39.0	102.20
25.0	77.00	35.1	95.18	37.1	98.78	39.5	103.10
25.5	77.90	35.2	95.36	37.2	98.96	40.0	104.00
26.0	78.80	35.3	95.54	37.3	99.14	40.5	104.90
26.5	79.70	35.4	95.72	37.4	99.32	41.0	105.80
27.0	80.60	35.5	95.90	37.5	99.50	41.5	106.70
27.5	81.50	35.6	96.00	37.6	99.68	42.0	107.60
28.0	82.40	35.7	96.26	37.7	99.86	42.5	108.50
28.5	83.30	35.8	96.44	37.8	100.04	43.0	109.40
29.0	84.20	35.9	96.92	37.9	100.22	43.5	110.30
29.5	85.10	36.0	96.80	38.0	100.40	44.0	111.20
30.0	86.00	36.1	96.98	38.1	100.58	44.5	112.10
30.5	86.90	36.2	97.16	38.2	100.76	45.0	113.00
31.0	87.80						

Ohmeda

Ohmeda
9065 Guilford Road
Columbia MD 21046 1801
USA

A Division of BOC Health Care Inc

Regional Service Offices
Eastern Region
Ohmeda
450 Raritan Center Parkway
Raritan Center
Edison NJ 08837
USA
Tel 800 922 0443

Midwestern Region
Ohmeda
2101 S Arlington Heights Rd
Suite 145
Arlington Heights IL 60005
USA
Tel 800 372 5867
Tel 708 364 7090

Southeastern Region
Ohmeda
4565 Winters Chapel Rd
Atlanta GA 30360
USA
Tel 800 241 4300
Tel 404 449 7990

Western Region
Ohmeda
831 Greenview Drive
Grand Prairie TX 75050
USA
Tel 800 433 5070
Tel 800 772 5420

International
UK, Europe, Africa and
Middle East
Ohmeda
Ohmeda House
71 Great North Road
Hatfield AL95EN
Hertfordshire
England
Tel 707 263570
Fax 707 260065/707 260191
Telex 915128

Latin America, Caribbean
Ohmeda
9200 S Dadeland Blvd
Suite 610
Miami FL 33156
USA
Tel 305 670 9938
Fax 305 670 4834

Southeast Asia
Ohmeda
78 Shenton Way
#09 03
Singapore 0207
Tel 65 222 6028
Fax 65 222 0725
Telex RS 35276

Service and Distribution Center
Ohmeda
7750 The Bluffs NW
Austell GA 30001
USA
Tel 800 999 6277
Tel 404 739 4774

Technical Support
Ohmeda
Ohmeda Drive
PO Box 7550
Madison WI 53707
USA
Tel 800 345 2700

Canada Service Centre
Ohmeda
5865 McLaughlin Road
Mississauga Ontario L5R 1B8
Canada
Tel 416 568 9533
Fax 416 568 9799

In the USA, please call Customer Service at 800 345 2700 for additional information or to place an order.

A BOC Health Care Company

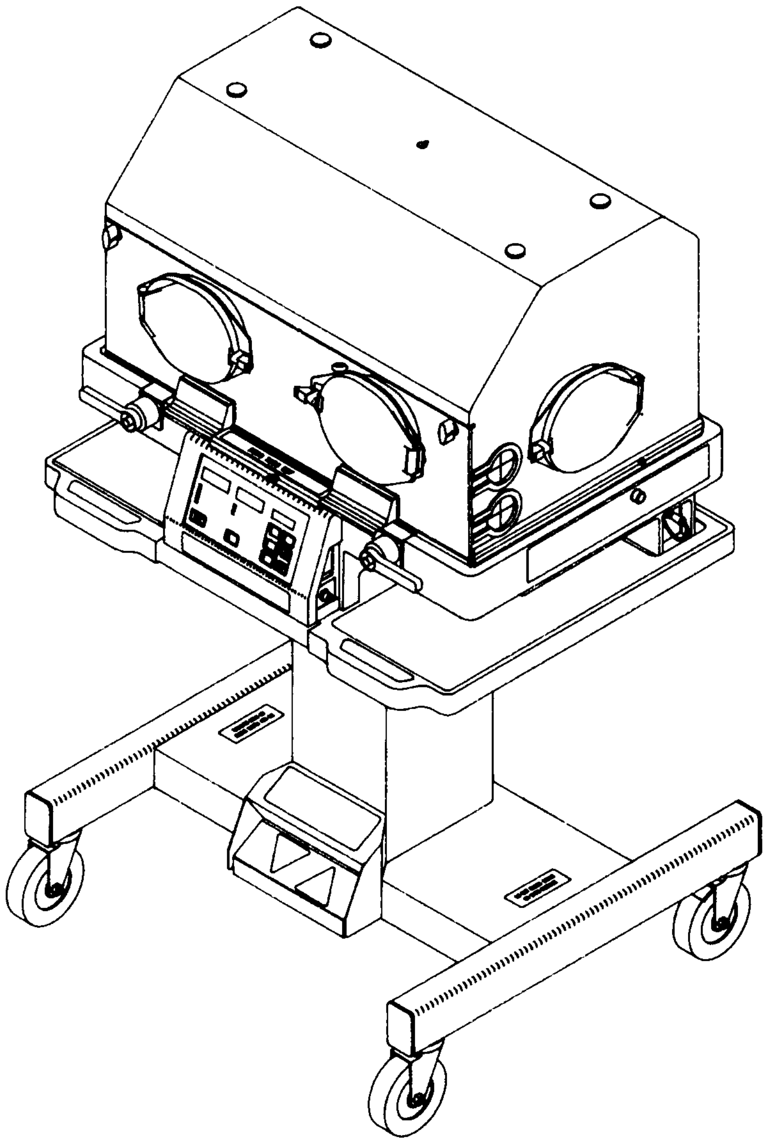
Cvr Chg
01 91

6600 0017 000

Ohmeda

Ohio® Care Plus™ Incubator

Service Manual



A BOC Health Care

Important

The information contained in this service manual pertains only to those models of products which are marketed by Ohmeda as of the effective date of this manual or the latest revision thereof. This service manual was prepared for exclusive use by Ohmeda service personnel in light of their training and experience as well as the availability to them of parts, proper tools and test equipment. Consequently, Ohmeda provides this service manual to its customers purely as a business convenience and for the customer's general information only without warranty of the results with respect to any application of such information. Furthermore, because of the wide variety of circumstances under which maintenance and repair activities may be performed and the unique nature of each individual's own experience, capacity, and qualifications, the fact that a customer has received such information from Ohmeda does not imply in anyway that Ohmeda deems said individual to be qualified to perform any such maintenance or repair service. Moreover, it should not be assumed that every acceptable test and safety procedure or method, precaution, tool, equipment or device is referred to within, or that abnormal or unusual circumstances, may not warrant or suggest different or additional procedures or requirements.

This manual is subject to periodic review, update and revision. Customers are cautioned to obtain and consult the latest revision before undertaking any service of the equipment.

⚠**CAUTION: Servicing of this product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision to this service manual which is clearly and thoroughly understood.**

This static control precaution symbol appears throughout this manual. When this symbol appears next to a procedure in this manual, static control precautions MUST be observed. Use the static control work station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

Technical Competence

The procedures described in this service manual should be performed by trained and authorized personnel only. Maintenance should only be undertaken by competent individuals who have a general knowledge of and experience with devices of this nature. No repairs should ever be undertaken or attempted by anyone not having such qualifications.

Genuine replacement parts manufactured or sold by Ohmeda must be used for all repairs.

Read completely through each step in every procedure before starting the procedure; any exceptions may result in a failure to properly and safely complete the attempted procedure.

Definitions

Note: A note provides additional information to clarify a point in the text.

Important: An Important statement is similar to a note, but is used for greater emphasis.

CAUTION: A CAUTION statement is used when the possibility of damage to the equipment exists.

WARNING: A WARNING statement is used when the possibility of injury to the patient or the operator exists.

Air Control Mode: Manual mode of operation. The interior incubator temperature is maintained at the air control temperature.

Desired Environmental Temperature (DET): The air temperature required to maintain the infant's temperature at the patient control temperature (patient control mode).

Incubator Temperature: The air temperature measured at a point 10 cm above the mattress.

Patient Control Mode: Servo mode of operation. The incubator changes the DET to maintain the desired patient skin temperature.

Patient Probe: The Ohio patient temperature probe, model LA003, or disposable probe LA005.

Temperature Rise Time: The time required for the incubator temperature to rise 10°C.

Temperature Equilibrium: The condition where the average incubator temperature does not vary by more than 0.2°C in a one hour period.

Temperature Variability: The maximum difference between the incubator temperature and the average incubator temperature at equilibrium.

Temperature Overshoot: The number of degrees by which the maximum incubator temperature exceeds the average incubator temperature at temperature equilibrium following a change in the air control temperature (air control mode).

Type B Electrical equipment

Protective ground

⏚ Functional Ground

~ Alternating Current (AC)

Static Control Precaution

Table of Contents

Table of Contents

Table of Contents

Table of Contents

List of Illustrations

List of Illustrations

List of Illustrations

Precautions

⚠Warnings

Two people are required to lift the Care Plus Incubator. Follow safe lifting techniques to avoid injury.

If the mounting knobs that attach the incubator to the cabinet are not securely fastened, the incubator could tip off of the cabinet when the hood is opened.

After completing a repair, the appropriate calibration procedure must be performed. After completing any portion of the calibration and adjustment procedures, perform the Checkout Procedure to make sure that the Care Plus Incubator is operating correctly. In addition, a final Electrical Safety Check , section 3.4, must be performed. Record the information for future reference.

Disconnect the power to the incubator for the mechanical portion of the Checkout Procedure.

Use extreme care while performing calibration and adjustment procedures, or while working on the Care Plus Incubator with power connected. An electrical shock hazard does exist; be certain to observe all standard safety precautions.

Before any disassembly or repair, disconnect the electrical supply and any gas supply connections. Also remove any accessories. Do not perform any service or maintenance with the power applied unless specifically told to do so in the procedure.

If a system failure alarm occurs, the unit must be removed from use until it has been serviced.

Disconnect power to the incubator and allow the heater to cool adequately before servicing or cleaning to avoid the danger of a burn.

Never oil or grease oxygen equipment unless a lubricant that is made and approved for this type of service is used. Oils and grease oxidize readily, and in the presence of oxygen, will burn violently. Vac Kote® is the oxygen service lubricant recommended (Stock No. 6700-0092-200).

Two people are required to safely replace a caster. Remove the incubator and all accessory equipment from the cabinet before replacing a caster.

The humidifier must be installed for proper incubator operation, even if you do not plan to use the humidifier.

® Vac Kote is a Registered trademark of Ball Brothers Corp.

Precautions

Safely mounting or dismounting the Care Plus Incubator requires two people. Remove the controller unit before mounting or dismounting the incubator.

If mounting hardware is not securely fastened, the incubator could tip off the Elevating Base or the cabinet.

The patient probe is not isolated from the earth ground. Any additional equipment used with the Care Plus must comply with UL 544, CSA 22.2, IEC 601 and VDE 750

If you use the normally open Nurse call connection, a disconnected Nurse Call cable will not trigger an alarm.

⚠Cautions

Servicing of this product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision of this service manual which is clearly and thoroughly understood.

This static control precaution symbol appears throughout this manual. When this symbol appears next to a procedure in this manual, static control precautions MUST be observed. Use the static control work station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

Use the Static Control Work Station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

When handling the controller, avoid bumping the fan or the heater. If these items are knocked out of alignment, the fan can grate against either the heater or the base.

Insulation on the electrical wiring can deteriorate with age. When performing the Checkout Procedure, check for brittle or deteriorated insulation on the power cord.

Inner wall fasteners are permanently attached to the inner wall and cannot be removed without damaging them.

Make sure the control board connectors are properly aligned before applying power.

If early model heaters are not installed with the nuts on the inside of the controller and the screws on the outside, water can leak in during cleaning and damage the electronics.

Precautions

If gaskets are not installed properly, water can leak in during cleaning and damage the electronics.

The tape on the stiffener plate used on the cabinet rail system will not support any weight. The only reason for the tape is to help you line the parts up.

Make sure that the rail support bracket is securely attached to the rails. The bolts must be torqued to 22.6 ± 0.6 Nm (200 ± 5 in-lbs or 16 ± 0.5 ft-lbs).

The total weight of all items placed in a storage module cannot exceed 12 kg (25 lbs).

The maximum load on cabinet rail systems must not exceed 23 kg (50 lbs). This includes the weight of items placed on rail mount or overhead shelves.

1/Functional Description

The incubator control circuitry is located inside the removable controller. The controller interfaces with the operator through the LEDs and switches on the display board, mounted behind the control panel.

The major portion of the control logic, switch interpretation, and power supply generation occurs on the control board.

For controllers with serial numbers beginning with HBJ, two external thermistor assemblies supply a total of three temperature signals to the control board.

For all other controllers, three external thermistor assemblies supply a total of five temperature signals to the control board.

The patient temperature probe attaches to the patient and plugs into the jack located on the left side of the controller. It contains one thermistor and outputs the patient temperature signal, which is used to generate the patient temperature display and to adjust heater output in the patient control mode.

The air temperature sensor mounts on the hood inside the infant compartment and attaches with the air temperature sensor connector, located on the left side of the controller. It contains two separate thermistor circuits: the air control thermistor signal is used by the control circuitry to adjust heater output and to trigger alarms; the air display thermistor signal is used by the control circuitry to generate the front panel air temperature display. The air display signal is also input to an independent air safety circuit, which shuts down the heater if the signal exceeds preset temperature safety limits.

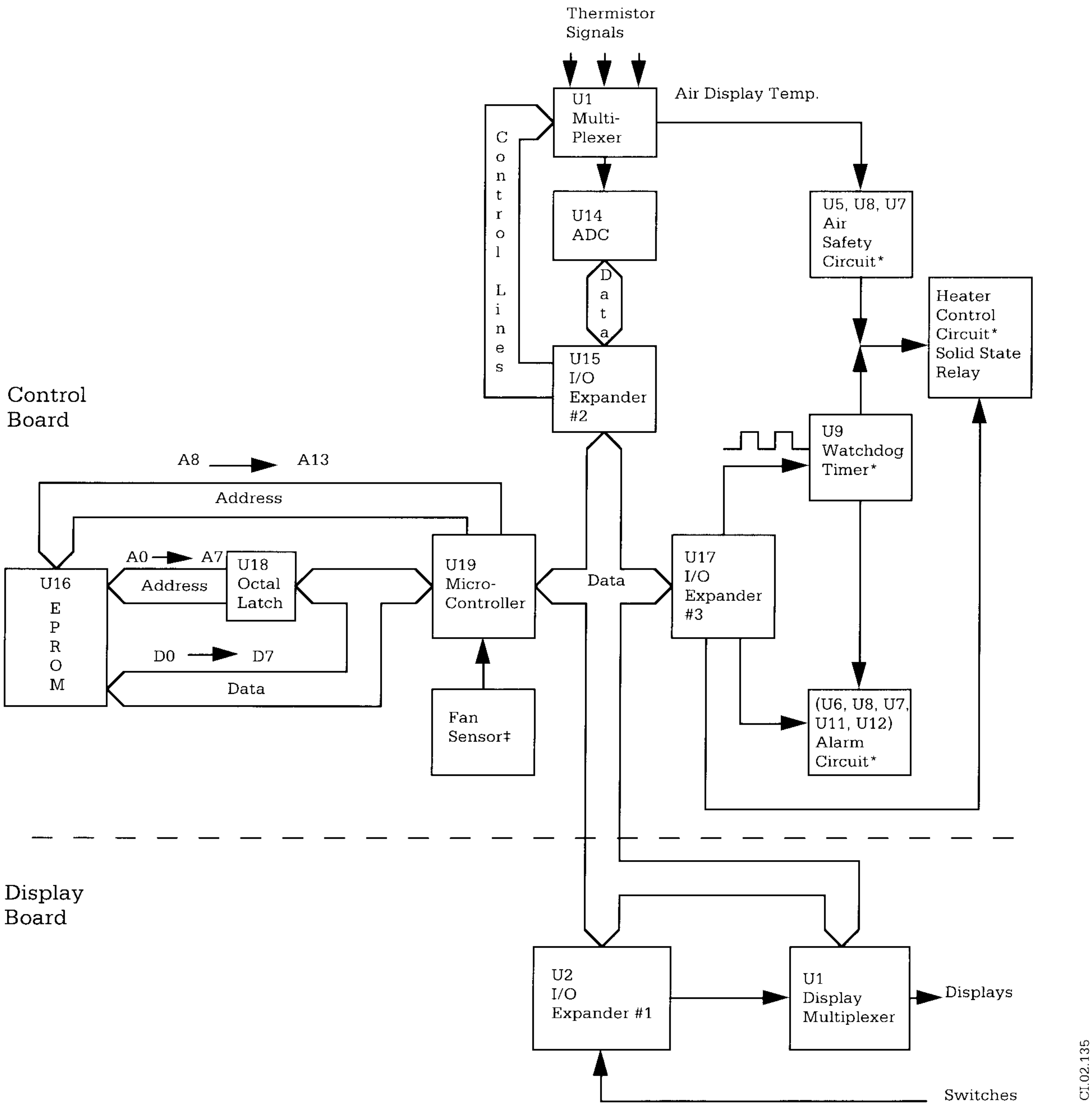
For controllers with serial numbers that do not begin with HBJ, an air flow sensor is mounted on the rear bulkhead of the controller and is used to verify that the heater fan is working. The air flow sensor contains two thermistor circuits, one of which is heated by a resistor inside the sensor assembly. Normally, the fan cools the heated thermistor to within several degrees of the unheated thermistor. If the fan fails to operate properly, the temperature difference between the unheated and the heated thermistors increases and triggers the air circulation alarm (Comparing the two thermistor readings cancels out any changes in room temperature. This means that air flow sensor operation is independent of ambient temperature within the operational range).

A separate thermal switch, mounted on the rear of the controller, shuts down the heater if the heater temperature (monitored at the thermal switch) exceeds 76.7°C (170°F).

1.1 Control Board

The control board contains the incubator logic circuitry, diagramed in Figure 1-1, as well as the power supply and distribution circuitry, diagramed in Figure 1-2.

The board centers around U19, the 8032 microcontroller. The microcontroller interfaces with its peripherals through three I/O expanders on the data bus. Analog signals are multiplexed to the Analog to Digital Converter (ADC), and the results of the conversion are read in through I/O expander U15. The microcontroller communicates with the air safety circuit, the watchdog timer, and the alarm tone generator through a second I/O expander, U17. A third I/O expander, U2, located on the display board, interfaces with the control panel touch switches and displays. As indicated in Figure 1-1, the heater control, the air safety, the watchdog timer, and the alarm circuits generate feedback signals to the microcontroller.



* Circuit produces feedback signal to microcontroller.

‡ Fan sensor applies to controllers with serial numbers beginning with HBJ.

Figure 1-1 Control Circuitry Block Diagram

The program memory is stored in the EPROM U16. A transparent octal latch connected to the EPROM address lines (A_0 through A_7) allows the microcontroller's bi-directional data bus port to both address the EPROM and then read out programmed data.

The power supply circuitry produces regulated low voltage dc supplies for the control circuitry and the display board. It also generates two monitoring signals used to compensate heater output for fluctuations in line voltage and to detect a power failure. In the event of a power failure, a NI-CAD battery inside the controller supplies the power failure alarm and maintains the standby control memory for up to 10 minutes (with the battery fully charged).

A. Power Supply Circuitry

The power supplies and power monitoring signals are generated as shown in Figure 1-2. The line frequency signal pulse that detects power failures, the +8 V unregulated supply to the heater control circuit safety relay, and the +5 V display supply to the display board are derived from the 8 Vac transformer secondaries.

The 11 Vac transformer secondaries supply:

1. The line voltage signal, which adjusts the number of heater power cycles to compensate for voltage fluctuations.

2. The 9.8 Vdc supply, which is used to:

    a. Charge the battery.

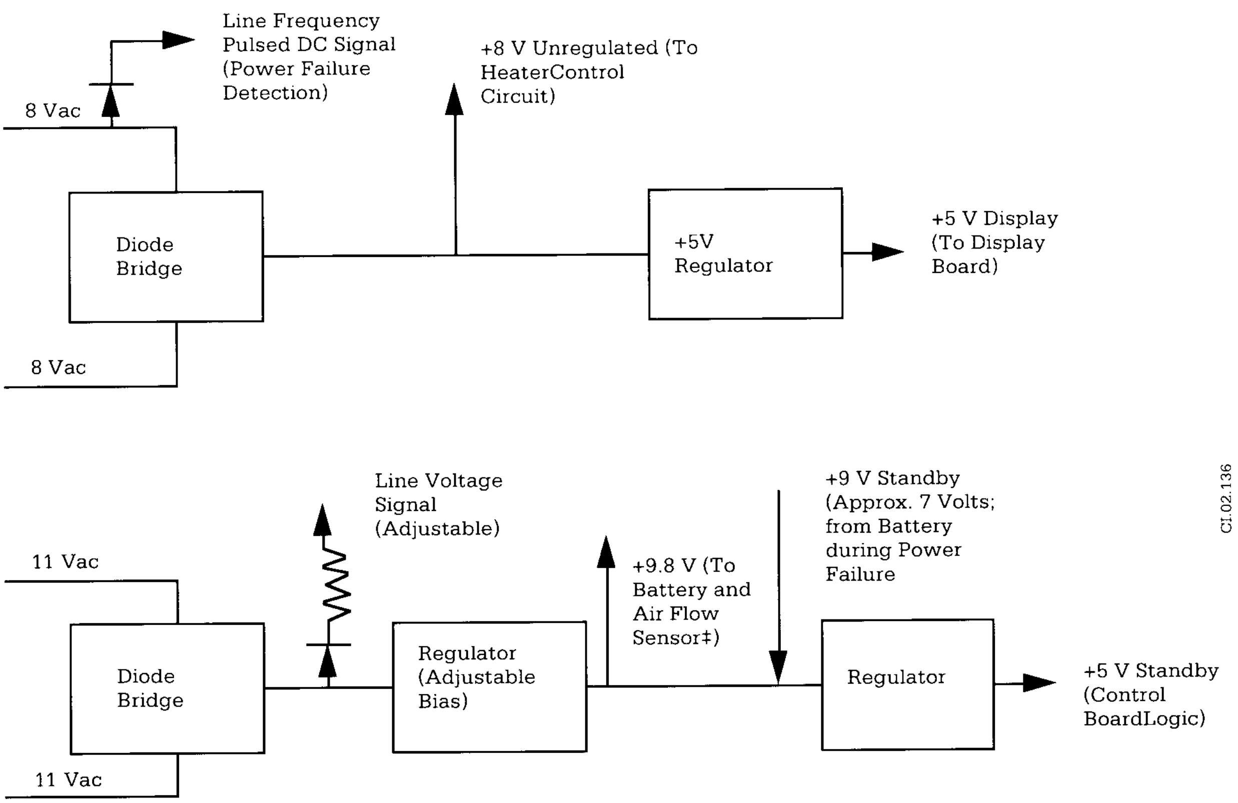
    b. Supply the fan sensor LED (on controllers with serial numbers beginning with HBJ)

    c. Heat the air flow sensor thermistor (on all other controllers)

    d. Provide the +5 V standby supply, used to power control board circuitry.

Signals that can be adjusted as part of the calibration procedure are indicated in Figure 1-2.

During a power failure a NI-CAD battery supplies two voltage levels (+5 V STBY and +9 V STBY). The +9 V STBY supply (actual voltage approximately 7 Vdc) activates the alarms, and the 5 volt supply powers the microcontroller and the associated integrated circuits.



‡ On controllers with serial numbers beginning with HBJ, Battery and Fan Sensor LED

Figure 1-2 Power Supply Circuitry

1. Line Frequency, +8 Volt Unregulated and +5 Volt Display Supplies

A nominal 8 Vac from the line voltage transformer secondary is input to the control board at J2 pins 2 and 3.

This signal is conditioned by CR1 and R14, and fed through a 1K resistor to a Schmitt trigger NAND gate, U7B. The other gate input is tied high, so the gate acts as an inverter. The gate will not respond until the input exceeds 1.9 Vdc minimally. The resulting signal pulse is input to the I/O expander U15 (on controllers with serial numbers beginning with HBJ) or is input to the microcontroller on P3.2 (on all other controllers). Absence of this signal is interpreted as a power failure.

Bridge rectifier CR2 and capacitor C3 provide a filtered, unregulated +8 Vdc, which supplies the coil controlling the heater control circuit's safety relay, and the +5 volt regulator (VR2). The unregulated +8 volt supply can be measured at TP1-5.

Regulator VR2 outputs a nominal +5 Vdc to power the display board LEDs. This output can be measured at J3 pin 12, 13 or TP1-3. When the line voltage is within

10% of the nominal voltage, the regulator output should range between 4.8 and 5.2 Vdc with a load of 500 mA. The maximum allowable ripple voltage is 150 mV.

2. Line Voltage Signal, +9.8 Volt, +9 Volt and +5 Volt Standby Supplies

A nominal 11 Vac from the transformer secondary is input to the control board at J2 pins 4 and 5. Bridge rectifier CR3 and capacitor C4 provide a full wave, unregulated voltage of approximately +12 Vdc.

This voltage is applied to resistor R19 to produce the line voltage monitoring signal. The line voltage signal is input to the ADC through the multiplexer (U1). The digital output is sent to the microcontroller where it adjusts heater power cycling to compensate for line voltage changes. When the incubator is operating at the rated voltage and R19 is properly adjusted, a reading of approximately 700 mV can be measured at U1 pin 15.

The nominal +12 volt supply is also applied to regulator VR1 to produce the 9.8 volt supply. Regulator output can be calibrated using R20. When R20 is properly adjusted, a reading of 9.8 ± 0.1 Vdc can be measured at TP1-1. This voltage is used for charging the NI-CAD battery through R18, and for supplying the fan sensor LED (on controllers with serial numbers beginning with HBJ) or for supplying the resistor used to heat the heated air flow sensor thermistor (on all other controllers). It also supplies +5 volt standby regulator, VR3.

When line voltage is available, current flows from the output of VR1 through CR10 to supply 9.0 volts at the input of VR3, (TP1-6). In turn, regulator VR3 outputs a voltage of 5.0 ± 0.2 Vdc to the control circuitry (TP1-4). The maximum allowable ripple voltage is 150 mV.

When power loss occurs, the 7.2 volt NI-CAD battery maintains power to control board regulator VR3 through CR11. The output of VR3 powers the incubator logic circuits and will remain at +5.0 ± 0.2 Vdc until the input to the regulator drops below +7.0 Vdc. When the input voltage falls below +7.0 Vdc, the regulator output (+5 Vdc supply) may not be within the allowed tolerance (±0.2 Vdc). The battery's + 9 Vdc standby output also supplies approximately +7 Vdc to the alarm speaker.

B. Analog to Digital Converter

The analog to digital conversion circuit shown in the Figure 1-1 block diagram, page 1-2, has three separate sections: the Analog to Digital Converter (ADC); a multiplexer used to select converter input; and a reference voltage generator.

1. Analog to Digital Converter (ADC)

The ADC, U14, operates asynchronously, continuously converting analog voltage inputs into a number of counts between 0 and 3999 (BCD format). The conversion rate is set by an internal oscillator whose frequency is determined by the external components R67 and C37. The exact oscillator frequency is not critical and may vary by ± 15% from the nominal 400 kHz. The oscillator frequency can be measured on pin 18 of U14. With a nominal 400 kHz clock frequency, conversions within the ADC 3711 will take place at an approximate rate of three per second.

The ADC communicates with the microcontroller through I/O expander U15. The ADC data latch is permanently enabled by tying pin 19 (DLE) low. The start conversion and the conversion complete signals synchronize the data conversion, which proceeds as follows:

1. The microcontroller's start conversion pulse triggers a new conversion, prematurely ending any conversion in progress.

2. The conversion complete output goes low on the falling edge of the start conversion pulse. It returns to a high level when the ADC completes the conversion. The low to high transition prompts the microcontroller to read the ADC output.

3. The first set of data, from the prematurely terminated cycle, is discarded since there is no way to determine if it represents an entire conversion.

4. The microcontroller waits until the new conversion cycle has been completed.

5. The data is read by the microcontroller, converted to temperatures or voltage percentages, and stored in RAM.

[illegible] on binary data lines, (bit 1 to bit 8, pins 23, 24, 3, and 4 [illegible]ce with the coded digit select signals applied to the ADC digit select inputs (D0 and D1, pins 20 and 21 respectively). The digit select codes are summarized below:

D0	D1	Selected Digit
L	L	Digit 0 (LSD)
L	H	Digit 1
H	L	Digit 2
H	H	Digit 3 (MSD)

2. Analog Inputs

Analog voltage signals are directed to the ADC inputs through an eight channel analog multiplexer, U1. Multiplexer switch selection is software controlled by the microcontroller, which toggles the A, B, and C input lines of the multiplexer through I/O expander U15.

Control Input

A	B	C	Switch	Pin No.	Signal
0	0	0	X0	13	CAL LOW
1	0	0	X1	14	CAL HIGH
0	1	0	X2	15	LINE COMP
1	1	0	X3	12	AIR FLOW UNHEATED*
0	0	1	X4	01	PATIENT
1	0	1	X5	05	AIR DISPLAY
0	1	1	X6	02	AIR CONTROL
1	1	1	X7	04	AIR FLOW HEATED*

* These channels are not used on controllers with serial numbers beginning with HBJ.

3. Reference Voltage

The LM-10 combination op-amp and voltage reference circuit (U13A and B) uses its 200 mV internal reference source to supply two reference voltages. The buffer portion of the LM-10, U13B, supplies a fixed, nominal 1 volt reference to the ADC input circuits. This is amplified by the op-amp portion of the LM-10 to provide an adjustable, nominal 2 volt reference to the ADC. During ADC calibration, the level of the 2 volt reference is adjusted using R25.

The nominal 1 volt supply should give a reading of about 1.1 Vdc at TP2-3. The nominal 2 volt ADC reference should give a reading of about 2.06 Vdc (on controllers with serial numbers beginning with HBJ) or 2.2 Vdc (on all other controllers) at TP2-4. The exact readings may vary between units.

C. Microcontroller

The heart of the control system is the 8032 microcontroller U19. It has been configured to operate from external memory by grounding the EA line, pin 31. The clock speed is 6 MHz and can be verified by measuring a frequency of 1 MHz at the Address Latch Enable (ALE), pin 30, (ON = 0.33 usec and OFF = 0.67 usec).

1. EPROM Read

Port 0 and port 2 are used to read instructions from EPROM U16 (27128A). Port 2 outputs the high level address bits (8 bits) directly to U16, while port 0 serves as a multiplexed lower level address (8 bits) and data bus.

At the start of the read, all address bits are output simultaneously. On the falling edge of the ALE signal, the lower eight address bits are latched into a transparent octal data latch, U18, and port 0 is set to input mode. Then, the program store enable signal (PSEN) goes low to enable data transfer from the EPROM.

2. Peripheral Interface

Port 1 goes directly to three 8243 I/O expanders. Bits 5-7 are connected to the chip select lines of display board expander U2 (bit 5), and control board expanders U15 (bit 6) and U17 (bit 7). Only one of the I/O expanders can be enabled at a time. Bits 0-3 hold the instructions to be carried out by the enabled integrated circuit when bit 4 goes from a high to a low logic level.

3. Miscellaneous Functions

Port 3 performs several miscellaneous tasks required by the control system: it provides a serial interface; monitors the fan speed (on controller with serial numbers beginning with HBJ) ; monitors the presence or absence of line power (on all other controllers) ; checks the status of the watchdog timer; and sends data and clock signals to the display board driver.

On controllers with serial numbers beginning with HBJ, the serial interface consists of the microcontroller transmit line (TXD/P3.1) and the receive line (RXD/P3.0). These lines are all connected to J6, along with a +5 Volt Standby connection, a connection to logic ground, and a nurse call signal . These signals can be connected to the ThermaLink board, whose functions are described in the ThermaLink Option section 1.3.

On all other controllers, the serial interface consists of the microcontroller transmit line (TXD/P3.1), the receive line (RXD/P3.0), a +5 Volt Standby connection and a connection to logic ground. These lines are all connected to J6 to allow factory testing.

On controllers with serial numbers beginning with HBJ, $\overline{\text{INT0}}$/P3.2 monitors the fan speed. Absence of fan speed signal pulse is used to detect an air circulation failure.

On all other controllers, $\overline{\text{INT0}}$/P3.2 is the line frequency signal pulse, which is derived from the +8 Vac nominal supply (discussed in Section A, Power Supply Circuitry). Absence of the line frequency signal pulse is used to detect a power failure.

$\overline{\text{INT1}}$/P3.3 monitors the status of the watchdog timer and the two unused address bits.

T0/P3.4 sends serial data to the display driver, U1 (display board), while T1/P3.5 clocks the driver.

D. Heater Control

The heater control algorithm ensures that line voltage variations will not affect the heater output as long as the voltage remains between 90 and 110% of the nominal voltage (115 volts for 120 volt units). For voltages outside this range, the line voltage is assumed to be either 90 or 110% depending on the violated limit.

Heater output is controlled by varying the number of ac cycles delivered to the heater. Depending on the line voltage and the percentage of the maximum heater output necessary to maintain the required temperature, between 0 and 60 cycles will be delivered to the heater every second. When the line voltage is within 10% (90% to 110%) of the nominal voltage, the number of heater power cycles is calculated proportionately:

$$\text{Number of cycles} = 50 \times \frac{(\text{rated voltage})^2}{(\text{line voltage})^2} \times (\text{required \% max. heater output})$$

If the line voltage is less than or equal to 90% of the nominal voltage, the number of cycles is calculated by multiplying the percentage of the maximum heater output required by 60. For example, at 90% of the nominal voltage, the heater would be on for 60 cycles out of 60 when 100% of the maximum heater output was required. Above 110% of the rated voltage, the number of cycles is calculated by multiplying the percentage of maximum heater output by 40.

Heat output is independent of line frequency.

1. Heater Control Circuit

As shown in Figure 1-3, the heater control circuit consists of a safety relay, a solid state relay, and a thermal switch wired in series. The heater is normally switched ON and OFF by closing or opening the solid state relay.

Safety Relay

The safety relay, K1, is controlled by the Relay signal, which is produced by gating the outputs of the air safety circuit and the watchdog timer circuit. The safety relay shuts down the heater if the watchdog timer fails to receive clock pulses, if the air probe shorts or opens, or if the air temperature exceeds the preset limit. On controllers with serial numbers that do not begin with HBJ, an opto-isolator triac driver, U4, isolates the low voltage and line voltage circuits.

Under normal conditions, the Relay signal is high (+2.4 Vdc minimum). This switches on transistor U12C (FET U12 B on controllers with serial numbers that do not begin with HBJ), causing the relay coil to energize and close the contacts.

Note: This requires a minimum 7.0 Vdc (7.32 Vdc on controllers with serial numbers that do not begin with HBJ) from the unregulated +8 volt supply (TP1-5).

If the air safety circuit or the watchdog timer triggers an alarm, the Relay signal goes low (0.5 Vdc Maximum), switching OFF the transistor (FET on controllers with serial numbers that do not begin with HBJ) and opening the safety relay contacts.

Solid State Relay

When the safety relay is closed, the solid state relay switches the heater ON and OFF under microcontroller control.

The microcontroller switches ON the heater by setting the Heat signal (U15 pin 21; P5.3) high. This switches ON U12D (U12 A on controllers with serial numbers that do not begin with HBJ), turning on the solid state relay and activating the zero crossing detection circuit inside the relay. Because this circuit switches ON or OFF only at zero voltage there may, in practice, be up to a half cycle switching delay.

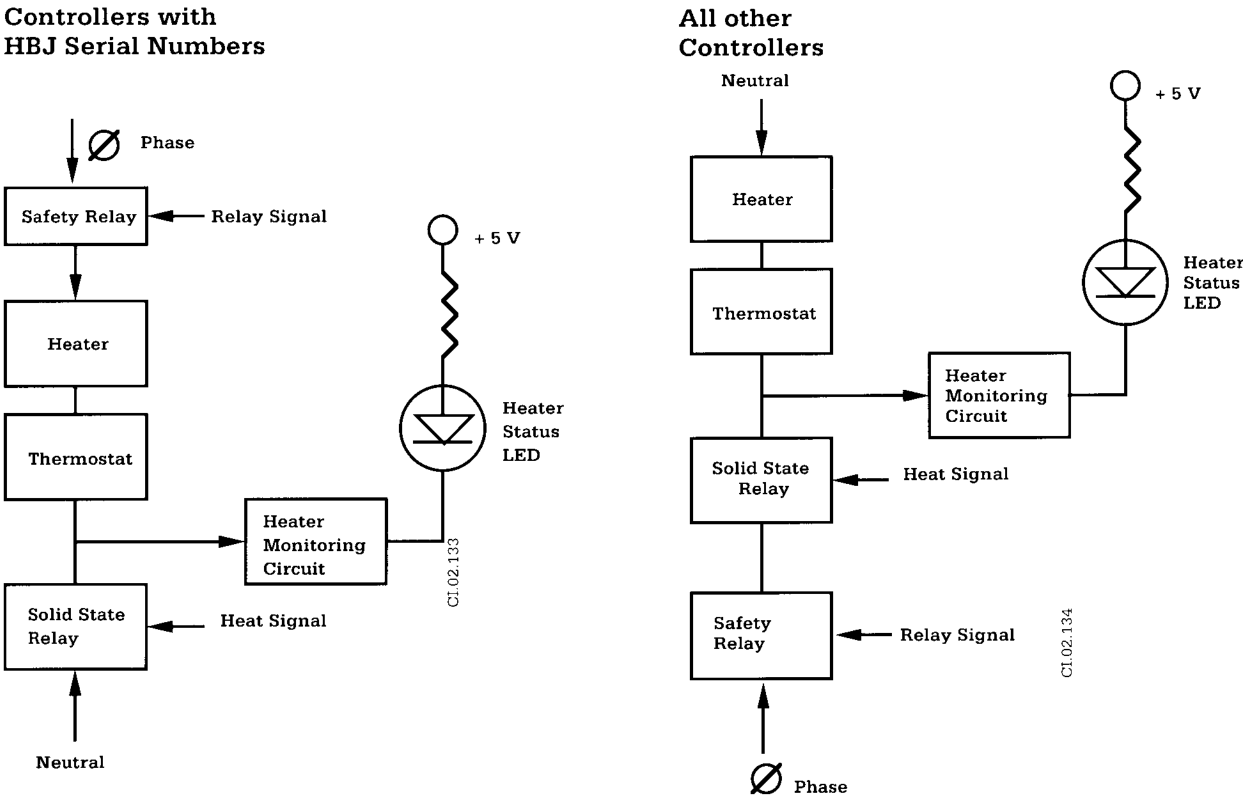


Figure 1-3 Heater Control and Monitoring Circuits

Thermal Switch

The thermal switch is mounted on the rear of the controller, near the heating element, and is set to open if its temperature exceeds 76.7°C (170°F). The thermal switch self resets (closes) when it has cooled.

2. Heater Monitoring Circuit

Note: On controllers with serial numbers beginning with HBJ, heater status is monitored across the thermal switch and heater. Due to the leakage current of the solid state relay, when the thermal switch is open, the feedback from the monitoring circuit may indicate that the heater is ON.

On all other controllers, heater status is monitored before the thermal switch. Hence when the thermal switch is open, the feedback from the monitoring circuit still indicates that the heater is ON.

The heater monitoring circuit outputs the heater status signal to the microcontroller through I/O expander U17. When the heater is ON, the heater status signal is high (signal is low on controllers that have serial numbers that do not begin with HBJ). As a diagnostic aid, a heater status LED on the control board illuminates whenever the heater is ON.

The heater status signal is derived from a portion of the heater ac signal input to CR13. On controllers with serial numbers beginning with HBJ, when the heater is OFF, there is insufficient voltage across CR13 to power the opto-isolator U13. This sets the U7A NAND gate input high. The NAND gate output goes low, is inverted by U11A, thereby turning off the heater status LED.

When the heater is ON, there is sufficient voltage potential across CR13 to power opto-isolator U13. The second NAND gate input is tied high, so the gate output goes high, is inverted by U11A, and turns on the heater status LED.

On all other controllers, when the heater is OFF, the dc output from CR13 powers opto-isolator U3 and sets the U7A NAND gate input low. The NAND gate output goes high, and the heater status LED goes out.

When the heater is ON, there is no voltage potential across CR13, and the opto-isolator is not powered. The second NAND gate input is tied high, so the gate output goes low, and the heater status LED illuminates.

Note: On all controllers, every half cycle the output U3 pin 4 will show small glitches caused by the charge/discharge of capacitor C20. These glitches do not affect circuit performance unless they exceed U7's (74LS132) trigger voltage of 1.4 Vdc.

E. Watchdog Timer

A watchdog timer circuit checks that the microcontroller is working properly. After every cycle through the system software, the microcontroller sends a low pulse to the A input of U9A, a retriggerable monostable timer (74LS123). This causes the output (Q) to go high and the inverted output ($\overline{Q}$) to go low for a period of time determined by the time constant of the RC network on the RxCx and Cx pins (Tau = 0.45 x R x C = 0.23 Sec). If another pulse from the microcontroller is not received at the A input before the time constant expires, both outputs change logic levels. The output, (Q), goes low and is gated by NAND gate U7D and NOR gate U8A to produce a logic low Relay signal. This de-energizes the safety relay and shuts down the heater. The inverted output, ($\overline{Q}$), serves 3 functions (on controllers with serial numbers that do not begin with HBJ, ($\overline{Q}$) serves the first two functions only). It sets the Reset pin on timer U6A high, triggering the high priority audio alarm. Secondly, it is gated through NOR gate U8C to produce the logic low interrupt signal that begins the microcontroller software recovery routine

($\overline{INT1}$). Thirdly, it is gated with the call signal from the microcontroller to produce the nurse call signal which controls the nurse call relay on the optional ThermaLink Call board.

F. Alarm Tone Generator

The alarm circuit consists of an alarm tone generator and control circuitry for high or low priority alarm conditions. Frequencies for the tone generator are produced by two timer circuits, U6A and U6B. If no alarm is present, the reset pins on both timers are held low and no signal is produced.

1. High Priority Alarms

Two timers are cascaded to generate the high priority audio alarm. They can be triggered either by the microcontroller through I/O expander U17 or by the watchdog timer. NOR gate U8B checks the output of both circuits. If either signal goes high, the reset pins for both timers go high. This causes U6B to generate a 2 kHz signal. A 1 Hz signal from the second timer (U6A) pulses the control line of the first timer through R35. This alters the frequency of the first timer (U6B) to produce a warbling effect (two tone alternating alarm).

U7C gates the output of NOR gate U8B with the low priority alarm line. This ensures that the high priority alarm will override the low priority alarm when both are active.

2. Low Priority Alarms

The low priority alarm is triggered by a 1 Hz pulse from the microcontroller through I/O expander U17. Before the command is executed, NAND gate U7C checks the low priority alarm signal against the output of NOR gate U8B to make sure that a high priority alarm is not already in effect. If no high priority alarm is active, (U7C pin 5 high), the reset line on timer U6B is pulsed once a second, producing a pulsed, 2 kHz signal (TP2-1). This results in a one second on, one second off (i.e. 2 kHz) audio alarm. The 2 kHz signal is adjusted to ±100 Hz by R36. The volume of the audio alarm is adjusted by R37. For maximum volume, R37 should be adjusted fully counterclockwise.

G. Air Safety Circuit

The air safety circuit opens the safety relay to shut down the heater if the air temperature exceeds the preset safety limit, or if a short or open circuit is detected in the air temperature sensor. The air safety circuit is completely independent of the microcontroller and has two subcircuits: the air probe test circuit, which monitors the air display signal to detect a short or open circuit; and the high air temperature circuit, which monitors the air display signal to detect high temperatures.

1. Air Probe Test Circuit

Important: The information on voltage input levels given in this section and in the appendices is approximate. It is based on an offset voltage of 1.99 Vdc measured at TP2-4 and will vary with the actual offset voltage.

The $\overline{SO}$ signal output by this circuit goes low when the air display thermistor circuit is open or shorted. Air display signals that exceed 880 mV (approximately equivalent to 25.69 kOhm, or 5°C) are interpreted as open circuits. Signals that fall below 410 mV (approximately equivalent to 3.563 kOhm, or 50°C) are interpreted as short circuits.

The air display signal is input in parallel to two open collector comparators U5B and U5C, which feature high outputs under normal conditions. If the air display thermistor opens, comparator U5C's output pulls $\overline{SO}$ low. If the air display thermistor shorts, comparator U5B's output pulls $\overline{SO}$ low.

The $\overline{SO}$ signal is gated by the relay circuit to produce the Relay signal. A logic low $\overline{SO}$ signal causes the Relay signal to go low, opening the safety relay to shut down the heater. The $\overline{SO}$ signal (TP2-5) is also fed back to the microcontroller through I/O expander U17, pin 1 (P5.0) for alarm generation.

2. High Air Temperature Circuit

Important: The information on voltage input levels given in this section and in the appendices is approximate. It is based on an offset voltage of 1.99 Vdc measured at TP2-4 and will vary with the actual offset voltage.

Comparator U5A compares the air display signal to a reference voltage supplied by one of five resistor networks. Each network corresponds to a different temperature limit. They are connected to the comparator through multiplexer U10. Microcontroller signals applied through I/O expander U17 select the appropriate network based on the mode of operation and the control temperature. If the air display thermistor voltage signal is less than the reference voltage, comparator output, OT (TP2-6), floats high and is gated through U8A to produce a logic low Relay signal, which opens the safety relay to shut down the heater.

The OT signal (TP2-6) is also fed back to the microcontroller through I/O expander U17, pin 23 (P5.1).

Maximum temperatures and the corresponding voltages are shown below.

Mode	Control Temperature	Alarm Temperature	Approx. Voltage	Resistance
Air Control	< 37°C	38°C	540 mV	5,740 Ohm
Air Control	> 37°C	40°C	520 mV	5,289 Ohm
Patient	All	40°C	520 mV	5,289 Ohm

Important: Control board dip switches 1 and 2 must both be set to OFF for the high air temperature circuit to function.

Note: The alarm has about 1°C hysteresis before resetting.

H. Relay Circuit

The relay circuit produces the Relay signal, which directly controls the heater safety relay. The relay circuit and all the signals used by the circuit are independent of the microcontroller.

The relay circuit consists of two gates: NAND gate U7D gates the output of the watchdog timer and the air probe test circuit signal ($\overline{SO}$); NOR gate U8A gates the NAND output with the OT signal to produce the Relay signal. The Relay signal goes low, opening the safety relay to shut down the heater if: the $\overline{SO}$ signal goes low; the OT signal goes high; or the watchdog timer output goes low.

1.2 Display Board

The display board is the interface between the operator and the control system. It informs the operator about the incubator and patient status. The operator controls the system by depressing the various switches on the front display. Two integrated circuits simplify display board operation: the 8243 I/O expander, used in conjunction with the switches; and the MM5451 LED driver for the displays.

A. Switch Decoding

Signals pass between the microcontroller and the display board through I/O expander U2, at a rate of approximately 1 MHz. The I/O port is activated by a logic low on the chip select line ($\overline{CS1}$). Command words are latched into port 2 on the high to low transition of the PROG line and decoded to set a high impedance on the selected port lines. Ports 6 and 7 are connected to the front panel switches. When a switch is depressed, the corresponding line is pulled low and loaded into the I/O expander's input buffer. The data in the buffer is transferred to the microcontroller on the low to high transition of the PROG line.

B. LED Displays

The LED display driver, U1, controls the LED displays. Data is input to pin 22 synchronously with the clock signal (pin 21). The first bit activates the driver, and 35 data bits follow. After the 35th bit is loaded, data is latched to provide direct output. Because the output is inverted, a logical 1 switches ON the appropriate LED at the output.

Display brightness is factory preset, but can be adjusted using R11.

C. Multiplexing of Displays

To minimize the number of driver lines required, displays are multiplexed through U1. Displays are divided into four groups: control temperature LEDs, air temperature LEDs, patient temperature LEDs and miscellaneous LEDs (mode, alarm and heater power). Port 4 of I/O expander U2 turns on a Darlington transistor to select the active display channel. The large gain of the Darlington allows a small current to sustain the load current from the LEDs.

Bits 1-32 supply the necessary information to each section. Bit 33 is unused. Bit 34 is tied to a 221 ohm ± 1% resistor, used for calibration. After each of the four display groups has been serviced, a string of 35 zeroes is sent on the data line to reset the driver for the next string of data; the driver operates with serial input and does not have a master reset.

The basic display circuit (one LED) includes: the +5 V DISP supply from the control board routed through the 1N4001 diode, the collector emitter junction of the enabled Darlington transistor, the LED, and the MM5451 decoder.

1.3 ThermaLink Option

The ThermaLink option allows direct output of serial data to various remote monitoring systems, such as a computer or commercial RS-232 monitor. This option is available only with controllers with serial numbers beginning with HBJ. The ThermaLink option board contains the electronic circuitry necessary to provide a 2500 VRMS isolated serial interface to meet the logic levels specified by EIA RS-232D and CCITTV.28.

The MAX250 and MAX251 (U1 and U2), together with two 6N136 optocouplers and transformer TR1, form an isolated RS-232 transmitter and receiver. The MAX250 connects to the non-isolated or "logic" side of the interface, translating logic signals to and from the optocouplers, while the MAX251 resides on the isolated or "cable" side, translating data between the optocouplers and RS-232 line drivers and receivers. In addition to the optocoupler drivers and receivers, the MAX250 also contains isolation transformer drive circuitry which supplies power to the isolated side of the interface, and the MAX251.

The transmit signal is input to the MAX250 driver (U1 pin 4) whose output (U1 pin 3) drives optocoupler U4. The optocoupler output (U4 pin 6) is then fed into the MAX251 driver (U2 pin 3).

The output of the MAX251 driver (U2 pin 12) is at the logic levels conforming to EIA RS-232D and CCITTV.28.

Conversely, the receive signal enters the MAX251 driver (U2 pin 10) and is stepped down to CMOS/TTL levels at U2 pin 5. This logic level drives optoisolator input (U3 pin 3) whose output is fed into U1 pin 10. The output (U1 pin 9) signal is then available to the control printed circuit board.

A slide switch SW1 is used as a "self test" for the RS-232 interface. In the closed position, the J30-1 transmit signal is sent through the MAX250/MAX251 transmitter and back into the receiver portions. The signal can be read at J30-2 and verified to be correct. Any external cable connection must be removed for this self test to function. CR1 and CR2 provide transient protection for MAX251. In normal operation SW1 should be in the open (OFF) position.

The nurse call signal is input at J30-5 as a TTL logic level. In the "no alarm" state, this signal is a logic high, which turns on Darlington Q1, energizing relay K1. This results in contact closure between J31-1 and J31-2. In the "alarm" state, J30-5 is a logic low, which turns off Q1, de-energizes K1 and results in contact closure between J31-2 and J31-3. K1 provides 2500 VRMS isolation between the relay coil inputs and contact outputs.

2/Set Up and Checkout

⚠ **WARNING: Two people are required to lift the Care Plus Incubator. Follow safe lifting techniques to avoid injury.**

2.1 Receiving

Refer to the setup instructions shipped with the Care Plus Incubator for initial unpacking and setup of the unit after shipment. If the unit was shipped with an elevating base, refer to the next section for mounting instructions.

⚠**WARNING: If the mounting knobs that attach the incubator to the cabinet are not securely fastened, the incubator could tip off of the cabinet when the hood is opened.**

Inspect the Care Plus Incubator and all accessory items for any signs of damage that may have occurred during shipment. File a damage claim with the shipping carrier if damage has occurred. Also confirm the presence of all accessory items as listed on the packing slip.

2.2 Mounting the Care Plus on the Elevating Base

1. Remove the controller from the Care Plus Incubator.

   ⚠**WARNING: Safely mounting or dismounting the Care Plus Incubator requires two people. Remove the controller unit before mounting or dismounting the incubator.**

2. Verify that O-rings or foam gaskets are installed in the depression around each of the incubator mounting holes in the incubator platform.

3. Lift the Care Plus Incubator onto the Elevating Base. Make sure that the front of the Elevating Base (foot pedals) faces the same direction as the front of the incubator. Refer to Figure 2-1.

4. Install the four mounting screws.

   ⚠**WARNING: If mounting hardware is not securely fastened, the incubator could tip off the Elevating Base or the cabinet.**

5. Install the controller. Lift the levers on the controller and slide it into the incubator as shown in Figure 2-1. Push the levers down to lock the controller in place.

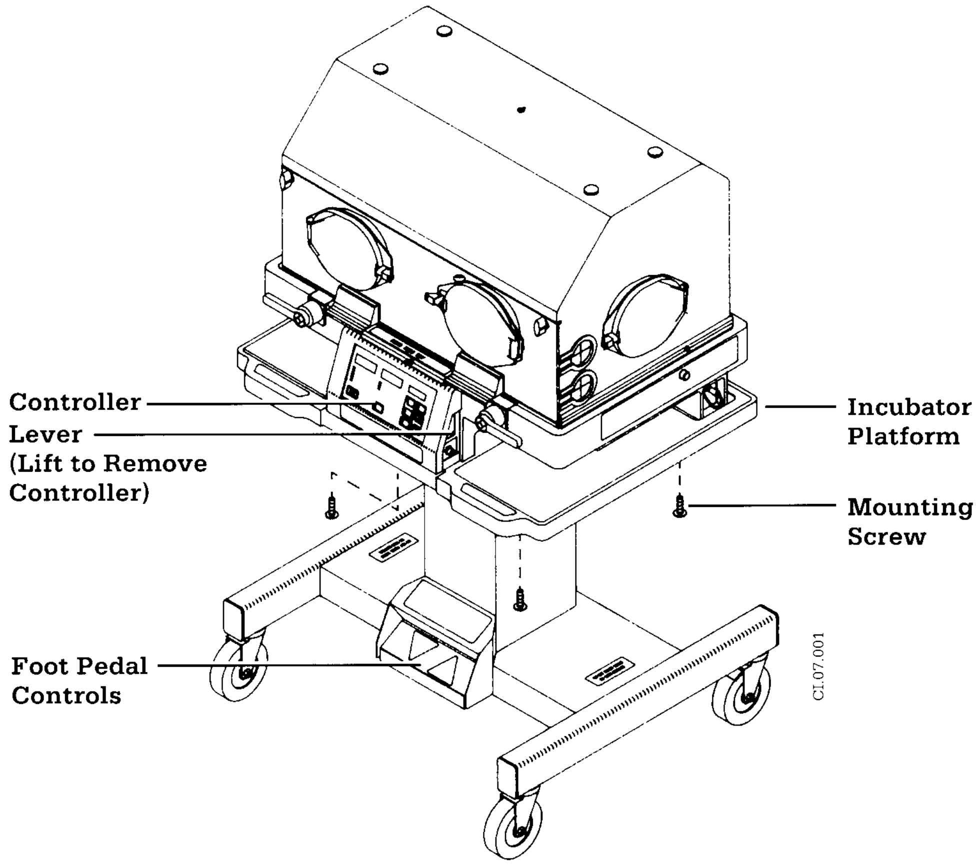


Figure 2-1 Mounting the Care Plus Incubator on an elevating base

2.3 Mounting the Care Plus on the Cabinet

1. Remove the controller from the Care Plus Incubator.

   ⚠**WARNING: Safely mounting or dismounting the Care Plus Incubator requires two people. Remove the controller unit before mounting or dismounting the incubator.**

2. Verify that O-rings or foam gaskets are installed in the depression around each of the incubator mounting holes in the cabinet top.

3. Lift the Care Plus Incubator onto the cabinet. Make sure that the cabinet doors face the same direction as the incubator's front door. Refer to Figure 2-2.

4. Install the four mounting knobs.

   ⚠**WARNING: If mounting hardware is not securely fastened, the incubator could tip off the Elevating Base or the cabinet.**

5. Install the controller. Lift the levers on the controller and slide it into the incubator as shown in Figure 2-2. Push the levers down to lock the controller in place.

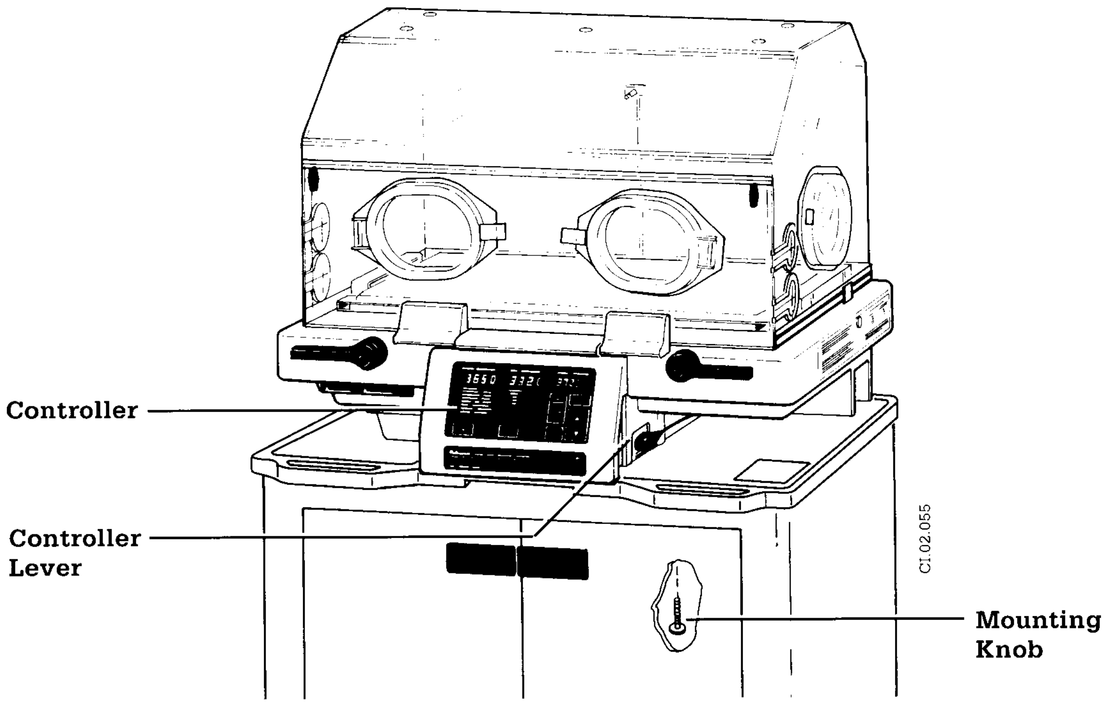


Figure 2-2 Mounting the Care Plus Incubator on a cabinet

2.4 Mounting the Cabinet Rail System

Note: This section applies to cabinets with threaded mounting holes. If your cabinet does not have four threaded mounting holes on each corner, refer to the rail mounting instructions 2.5.

⚠CAUTION: The maximum load on cabinet rail systems must not exceed 23 kg (50 lbs). This includes the weight of items placed on rail mount or overhead shelves.

A. Mounting the Basic Rails

The short and long rails, and the overhead shelf use the same basic assembly procedure.

Note: The rail kits include extra hardware to adapt them for the earlier cabinets. You will have eight, rectangular plates, 16 internal tooth lockwashers, and 16, #10 x 5/8 inch truss head screws left over.

1. Make sure that you have the correct rail. The rails are not symmetrical. Markings on each rail tell you which side of the cabinet to put it on (Right Front/ Left Rear or Left Front/Right Rear).

2. Remove the four screws and lockwashers from the corner of the cabinet where you intend to mount the rail.

3. Align a stiffener plate with the threaded mounting holes on the cabinet. Use the tape on the stiffener to hold it in place. Refer to Figure 2-3.

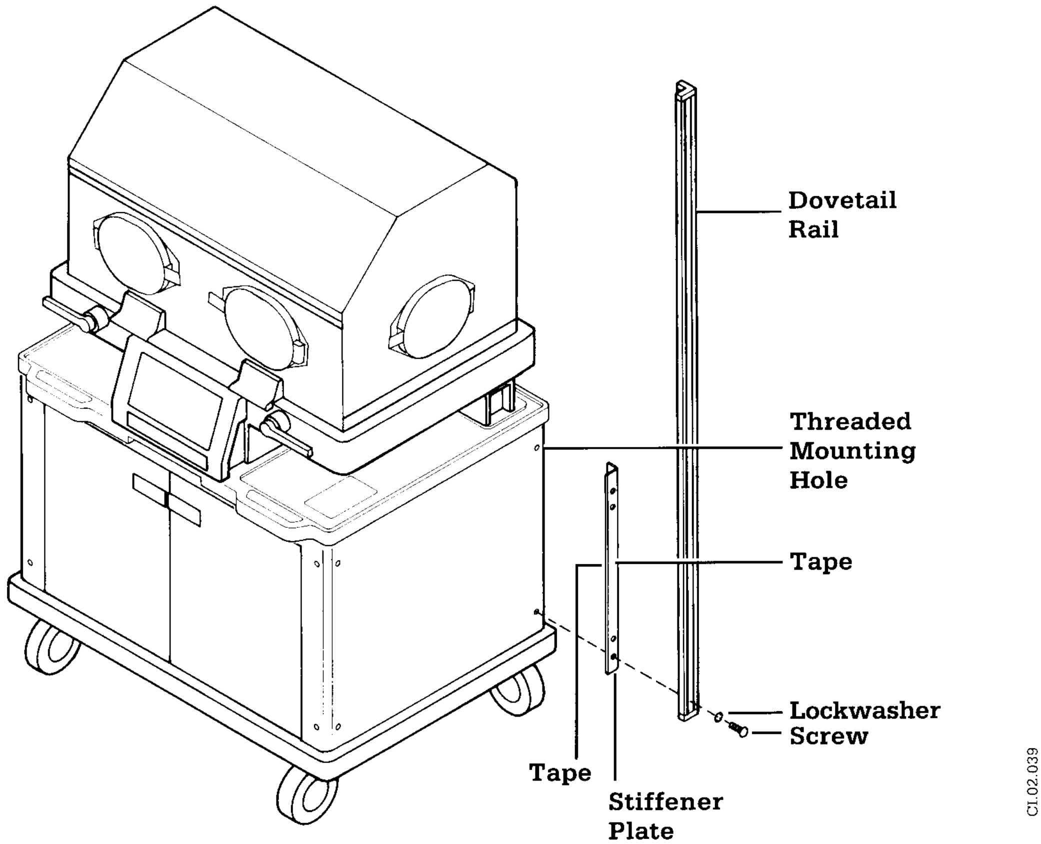


Figure 2-3 Mounting the basic rail system

4. Place the rail over the stiffener plate and align the holes in the rail with those in the stiffener plate. Use the tape on the stiffener to hold it in place.

   ⚠**CAUTION: The tape on the stiffener plate will not support any weight. The only reason for the tape is to help you line the parts up.**

5. Put split ring lockwashers on four, #10 x 3/4 inch socket head screws, and install the screws from the outside of the cabinet.

   Note: Verify that all four screws are tight before mounting any accessories on the rail.

6. Repeat steps 1 through 5 for the second rail.

B. Mounting the Overhead Shelf

1. Mount the basic rails.
2. Loosen the four acorn nuts on the inside of the overhead shelf. Refer to Figure 2-4.
3. Remove the plastic end caps from each rail.
4. Slide the locking lugs into the rails.
5. Align the top of the shelf with the top of the rails and hand tighten the acorn nuts.
6. Use a 9/16 inch wrench to tighten the acorn nuts to 22.6 ± 0.6 Nm (200 ± 5 in-lbs or 16 ± 0.5 ft-lbs). Make sure that the shelf remains level.
7. Replace the plastic end caps.

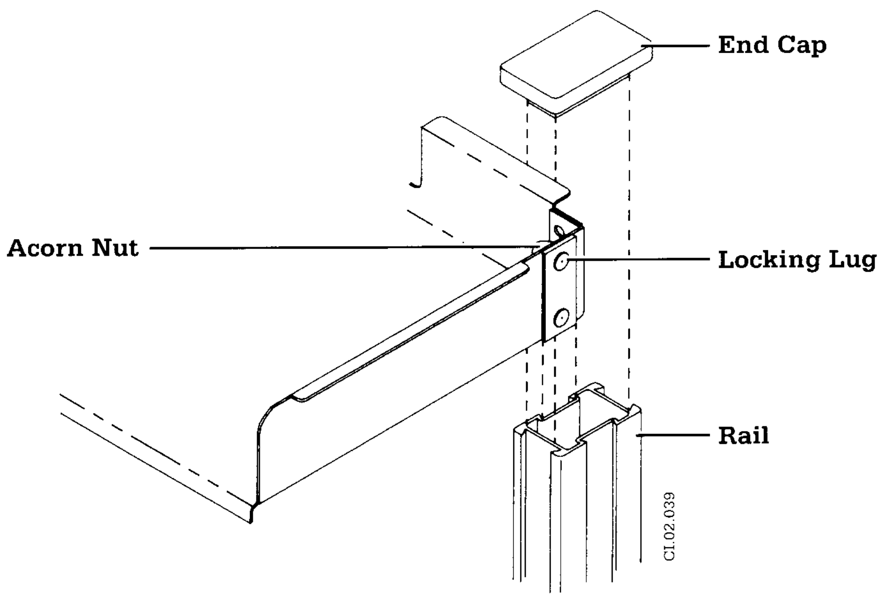


Figure 2-4 Mounting the overhead shelf

2.5 Mounting the rail system on cabinets with pre-stamped knock outs

⚠CAUTION: The maximum load on cabinet rail systems must not exceed 23 kg (50 lbs). This includes the weight of items placed on rail mount or overhead shelves.

Note: Check the rail markings before beginning. The rails are not symmetrical and will only align with the mounting holes on the cabinet corners marked on the rail, (Right Front/Left Rear or Left Front/Right Rear).

The rails attach to the corners of the cabinet with eight #10-32 screws supplied with each rail.

1. Located on each corner of the cabinet are eight pre-stamped knock outs. Use a punch and hammer to remove the knock outs. Twist off the tab and debur the holes.

2. Align a cabinet stiffener plate on the outside of the cabinet corner where you will mount the first rail.

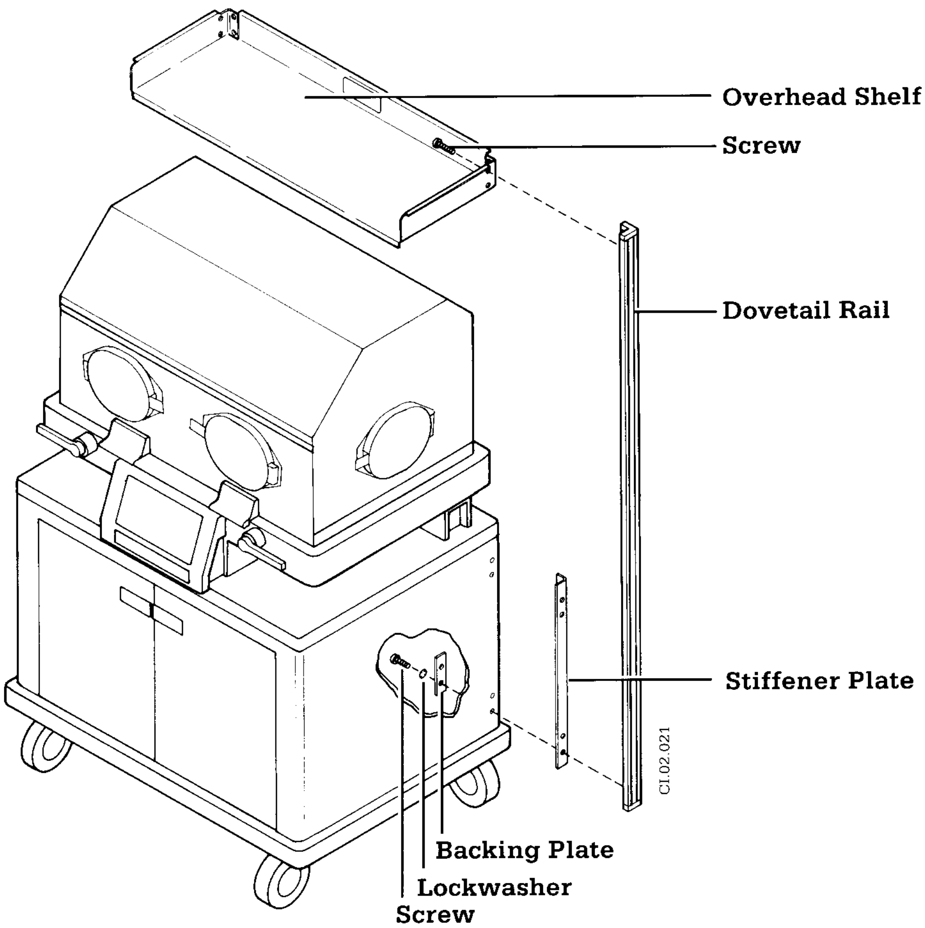


Figure 2-5 Mounting the rails and the overhead shelf

3. Place the rail to be mounted over the exterior stiffener plate and align the holes. Secure the rail from inside the cabinet using four backing plates, eight #10-32 screws and eight #10 lock washers.

4. Repeat steps 1 through 3 for the second rail.

5. Align the holes in the shelf with the holes at the top of the rails (four on each rail). Secure the shelf with the eight 1/4-20 mounting screws provided.

2.6 Checkout Procedure

⚠WARNING: After completing a repair the appropriate calibration procedure must be performed. After completing any portion of the calibration and adjustment procedures, perform the Checkout Procedure to make sure that the Care Plus Incubator is operating correctly. In addition, a final Electrical Safety Check, section 3.4, must be performed. Record the information for future reference.

Note: Refer to Section 3.3, Calibration, if the results of the Checkout Procedure indicate that the display brightness, the alarm volume, the alarm frequency, the air safety circuit trip point, or the ADC reference voltage need adjustment.

A. Mechanical Checks

⚠WARNING: Disconnect the power to the incubator for the mechanical portion of the Checkout Procedure.

Important: See Figure 2-6, for the location of mechanical controls and other incubator components.

1. Disconnect the power cord for the Care Plus Incubator for the mechanical portion of the Checkout Procedure.

2. Examine the power cord for damage. Replace the power cord if damage is evident.

3. Examine the incubator for obvious signs of damage.

4. Lock the two front casters and check that the unit is held in place.

5. Open the cabinet and verify that the four incubator mounting knobs, which attach the incubator to the cabinet, are secured tightly in place.

6. Check the front door seals. With the door closed, check that the clear plastic seals on the upper and lower edges fit tightly.

7. Rotate both front door latches toward the center of the incubator and lower the door. Make sure that the inner wall is securely fastened to the door and that the deflector panel (Figure 2-6) is installed on the inner wall.

8. Make sure that the front door is securely fastened to the incubator. Opening the door exposes the two spring-loaded metal hinge pins that slide into holes in the base platform. If the door is not properly attached, pull both pins out towards the sides of the incubator and line them up with the hinge. Release the pins and verify that they snap into position.

9. Check that the mattress and the mattress tray are properly installed. Verify that you must lift the tray slightly to slide it out of the hood. This prevents the tray from sliding out accidentally. Slide the mattress tray back into the hood.

10. Check the portholes. Open the portholes by pressing on the latch. The cover should swing open. If arm cuffs are installed, the cuff band should fit into the groove around the porthole without obstructing the cover. Close the porthole and verify that the latch holds it in place.

11. If the optional inner walls are installed, check that they are securely attached to the outer walls. To attach the inner wall, align the inner wall fasteners with the mounting posts on the outer hood and push in on the plunger portion of the fastener. Also verify that the deflector panel is attached to the rear inner wall.

12. If the upper inner wall is not used, make sure that hole plugs are inserted into the unused top mounting holes.

13. Check the hood seals. Examine the seals at the bottom of the left, right and back sides of the hood. They should seal tightly when the hood is closed.

14. Check that the tubing access covers are also installed on either side of the hood.

15. Check the hood tilt latch. Open the front door, depress the hood tilt release and rotate the hood back approximately 30 degrees, until it locks into position with an audible click. Push against the hood and make sure that it is held in place. To close the hood, support the hood and press the hood tilt release. Gently lower the hood.

    Note: The hood tilt release must be depressed to raiser or lower the hood.

16. Check the operation of the tilt mechanism. Press in the locking button in the center of the tilt handle and push down on the handle. Release the locking button and verify that the handle locks in the 45 degree position. Press the locking button again and rotate the handle downwards. Release the locking button and verify that the handle locks in the 90 degree position. Depress the locking button and lift up on the tilt handle to return to the horizontal position. Repeat this step for the second tilt handle.

17. Check that the controller is latched in position. The controller latches should be all the way down, parallel with the sides of the controller.

18. Depending on which model the unit is, locate the internal humidifier fill port, on the left side of the unit, or the external humidifier on the front of the unit to the left of the controller. For the internal humidifier:

    a. Grasp the handle on the lower edge of the fill port and pull it to the open position. Make sure that it does not come out all the way unless you rotate it clockwise.

    b. Rotate the handle and fill port clockwise and pull the fill port completely out.

    c. Inspect the O-ring for wear or damage. Replace it if necessary.

    d. Insert the fill port back into the unit.

    e. Rotate it counterclockwise to the drain position.

    f. Rotate the fill port back to the upright position and push it back into the lower unit.

For the external humidifier:

    a. Slide the humidifier assembly out of the front of the base.

    b. Inspect the reservoir, slide, lid, and seals for wear and damage. If necessary, replace components.

    c. Reassemble the humidifier.

    d. Slide the humidifier assembly back into the base. Push it until you feel a slight resistance, then push until it snaps into position.

19. Unscrew the two filter mounting knobs on the rear of the incubator, lift off the vented filter cover panel, and check the condition of the filter. If the filter is dirty, has been used with an infectious patient, or has been in use for three months it must be replaced. When you replace the filter, mark the date on the label supplied with the replacement filter. Affix the label to the exterior of the filter cover panel.

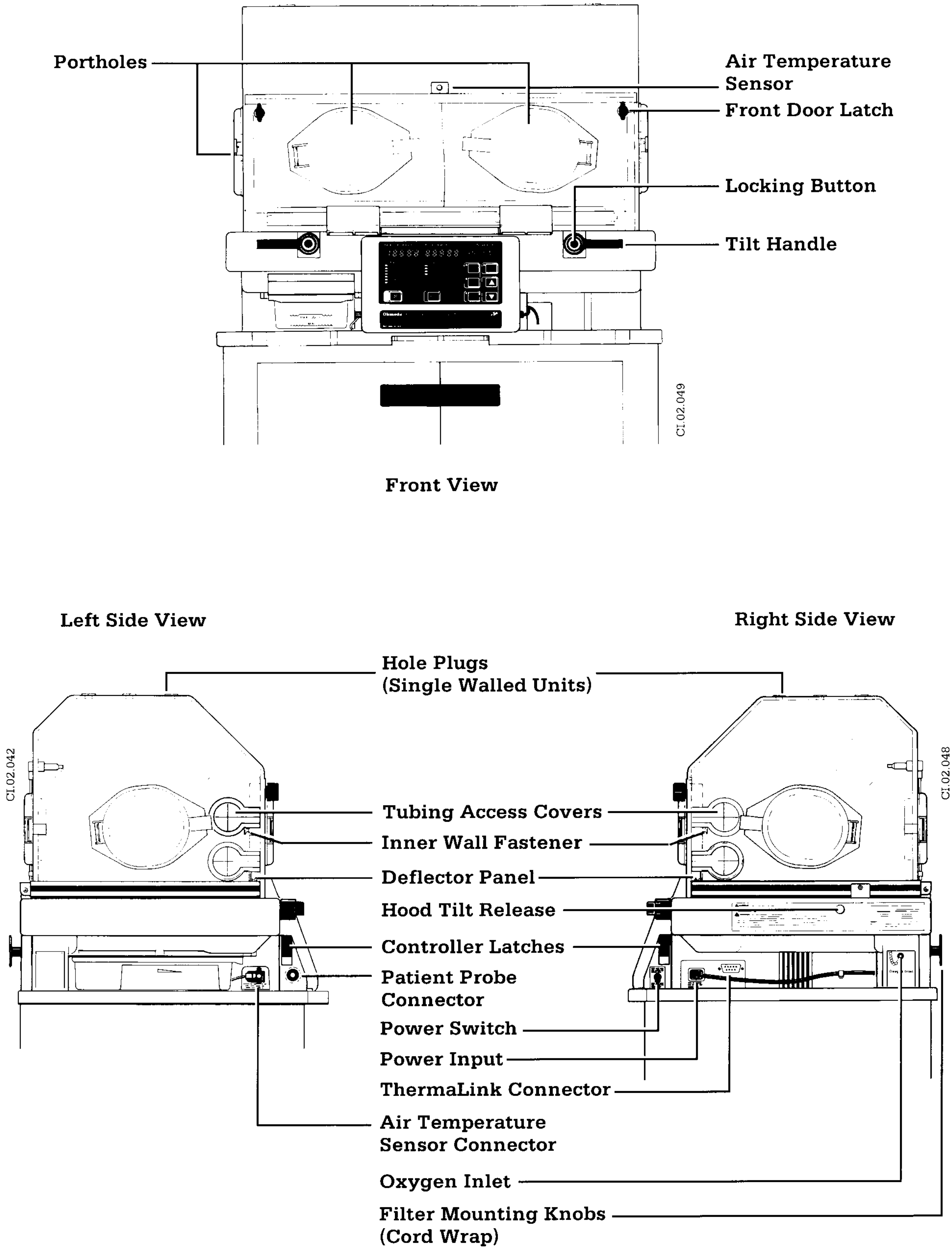


Figure 2-6 Operating Controls, Indicators and Connectors

Item (Figure 2-6)	Function
Hood tilt latch and hood tilt release	Prevents hood from opening accidently. Also secures hood in the tilted position; You must press and hold the hood tilt release button while *raising or lowering* the hood.
Door hinge pins (not shown)	Spring loaded metal pins inside the front door hinges. Open door and pull hinge pins toward the sides of the incubator to remove the door.
Tilt handles and locking buttons	Depress locking button in center of handle and rotate handle for Trendelenburg and Fowler positioning.
Portholes	Press the latch to open the porthole.
Tubing access covers	Route cables and tubes into or out of the unit through the tubing access covers.
Door latches	Turn door latches toward the center of the incubator to open the front door.
Oxygen inlet	Connect tubing between flowmeter outlet and oxygen inlet to raise hood oxygen concentration.
Patient probe connection	Push probe connector firmly into socket until it clicks. Grasp the connector and pull to disconnect.
Air temperature sensor connection	Keyed connector for air temperature sensor; to connect the air temperature sensor, align the connectors and push them together. Disconnect the sensor by pressing in the back of the connector while pulling back on the "T" handle.
Controller latches	Pull latches up (perpendicular to controller sides) to slide out the controller. Push down to secure controller.
Filter cover	Vented panel on rear of unit. Remove knobs and panel to access filter.
Power switch	Turns incubator on and off.
Inner wall fastener	Used to secure inner walls. Line up with mating mounting posts in outer hood and press in plunger to snap in place. Pull out the plunger to release.
Hole plugs	Used to plug the holes in the top of the hood on single walled units.

B. Accessory Checks

1. Check that all accessories are securely mounted.

2. Check the operation of any accessories with reference to the appropriate oper tion and maintenance manuals.

3. If an Ohmeda manometer will be used, verify that it reads 0 Kpa at atmospher pressure. If it is necessary to zero the manometer, unscrew the plastic bezel over the plastic cover. Adjust the zeroing screw located on top of the manometer, above the 4 Kpa marking.

4. Set up any required suction or gas supply systems. Check them for leaks as outlined in the appropriate operation and maintenance manuals.

C. Controller Checks

Important: Figure 2-7, identifies the individual control panel switches.

Important: The Enable switch must be pressed to activate the temperature adjust ment, the Override, or the control mode switches. These switches remain active a long as the enable indicator is illuminated (approximately 12 seconds after the last time one of these switches is pressed).

Note: When the patient probe is initially plugged in for checkout, LLLL will be displayed in place of the patient temperature, if its reading is below 22.0°C (71.6°F).

Note: On controllers with serial numbers beginning with HBJ, all alarms except power failure and system failure are preceded with a 30 second operator prompt tone.

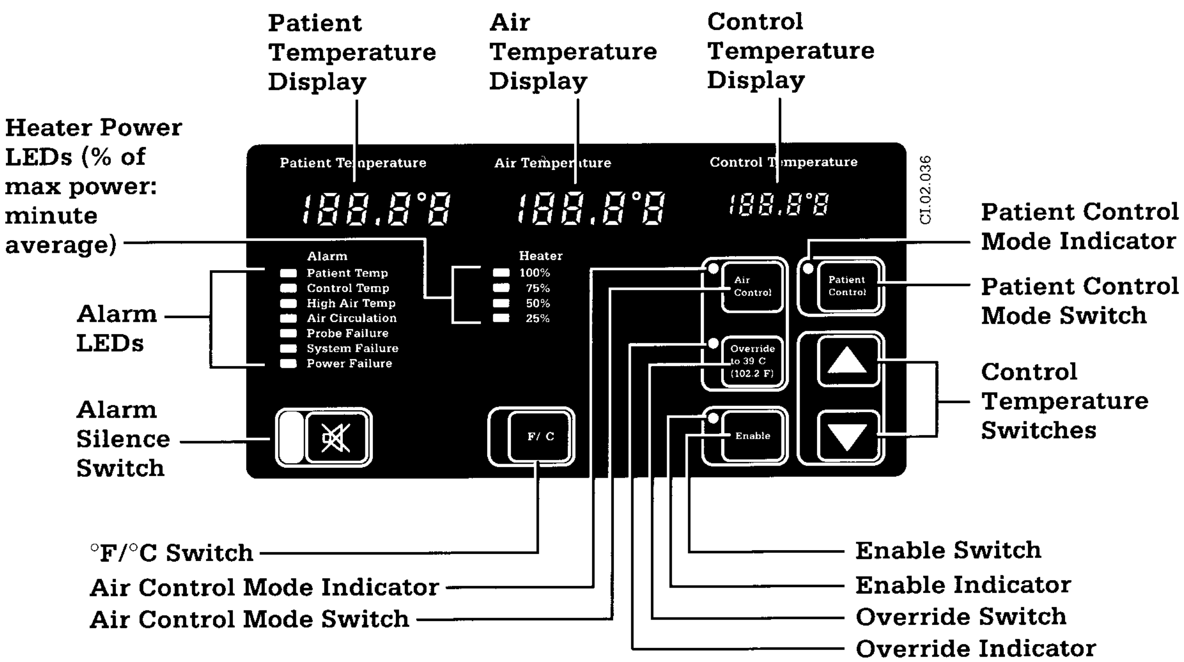


Figure 2-7 Control Panel

1. Make sure the power cord is connected to the socket on the right side of the controller.

2. Plug the patient probe into the labeled connection on the left side of the controller.

3. Line up the air temperature sensor connector. Plug the air temperature sensor into the labeled connection on the left side of the controller.

4. Route the patient probe cord through the tubing access cover and place the patient probe inside the incubator.

5. Plug the power cord into an appropriately rated power source (see rating plate for proper voltage etc.).

6. Switch the power ON and verify the following sequence:

   a. An alternating two tone audible alarm sounds for approximately five seconds, all the indicators illuminate and 188.88 appears in the three temperature displays.

   b. All indicators are extinguished except for the air control and the enable indicators. The temperature displays change to show from left to right:

Patient Temperature	**Air Temperature**	**Control Temperature**
XX.XX (software version no. for example 01.01)	60.H (AC freq. 50 Hz for 50 Hz models)	39.0°C (max. manual control temp.)

   c. An operator prompt tone sounds, and the control temperature display flashes 33.0°C. The operator prompt tone will sound every two seconds until a control temperature is entered by pressing either the ▲ or ▼ switch.

7. Adjust the control temperature to silence the prompt tone.

8. Check display illumination and the audible alarm by depressing and holding the Alarm Silence switch until all of the indicator LEDs illuminate, and 188.88 appears in the three temperature displays (approximately five seconds). The alternating two tone alarm should sound.

9. Check the Enable switch. Press the Enable switch. The enable indicator should illuminate and go out after approximately 12 seconds. Verify that pressing the ▲ and ▼ switches has no effect when the enable indicator is extinguished.

10. Check the analog to digital calibration and the line voltage. Depress and hold the Enable switch until the following values appear in the temperature displays (approximately five seconds):

Patient Temperature	Air Temperature	Control Temperature
25.05°C (± 0.2°C) (low calibration point)	37.95°C (± 0.2°C) (high calibration point)	From 09.00 to 11.00 (Service use only)

Note: An alarm will sound to indicate that the actual temperatures are not displayed.

11. Check the patient probe. Warm the patient probe by placing it between your fingers. Verify that the displayed patient temperature increases. If an AAMI approved thermometer is available, place both the thermometer and the patient probe in a glass of warm water. Stir the water and wait several minutes until the thermometer reading stabilizes. Verify that the patient temperature shown on the control panel is within 1°C of that shown on the thermometer. Replace the probe and repeat the check if the reading is outside the 1°C range.

12. Check the normal range of air control temperatures. Press the Enable switch to activate the ▲ and ▼ switches. The enable indicator will illuminate. Press and hold the ▼ switch. Verify that the lowest control temperature attainable is 20.0°C. If the enable indicator has gone out, press the Enable switch again. Depress the ▲ switch and verify that the air control temperature cannot be set above 37.0°C.

13. Check the extended range of air control temperatures. With the control temperature set to 37.0°C, sequentially press the Enable and Override switches. On controllers with serial numbers beginning with HBJ, the enable indicator should illuminate and the override indicator should blink (on all other controllers both the enable and the override indicators should illuminate and remain illuminated). Depress the ▲ switch and verify that the maximum air control temperature is now 39.0°C. The override indicator will blink or remain lit as long as the control temperature setting remains at, or above, 37.0°C.

14. Check the °F/°C switch. Adjust the control temperature to 36.0°C and press the F/C switch. Verify that the control temperature is now displayed as 96.8°F. Press the switch a second time to return to a Celsius display.

15. Switch to the patient control mode of operation. Press the Enable and the Patient Control switches. Then, verify the following sequence:

    a. The enable and the patient control indicators illuminate.

    b. The control temperature display flashes 36.5°C and an operator prompt tone sounds every two seconds. Adjust the control temperature to silence the prompt tone. The enable indicator will be extinguished approximately 12 seconds after the last time the ▲ or ▼ switch is pressed.

Note: A patient temperature alarm will be triggered if the patient probe temperature differs from the control temperature by more than 1.0°C. If the probe temperature is below 30.0°C or above 42.0°C the heater will not switch ON.

16. Change the range of patient control temperatures. Press the Enable switch tc activate the ▲ and ▼ switches. The enable indicator will illuminate. Press anc hold the ▼ switch. Verify that the lowest control temperature attainable is 35.0°C. If the enable indicator goes out, press the Enable switch again. Then depress the ▲ switch. Verify that the patient control temperature cannot be set above 37°C.

    Note: The maximum patient control temperature can be raised to 37.5°C by placing control board dipswitch 3 in the ON position. (Section 3.3.L)

17. Check the patient temperature alarm. Press the Enable switch and adjust the patient control temperature until it exceeds the patient temperature by more than 1.0°C. An intermittent single tone alarm should sound, the patient temperature should flash, and the patient temperature alarm indicator should illuminate. Press the Enable switch and adjust the patient control temperature until it is within 0.8° C of the patient temperature. The alarm should cancel.

    Note: Service personnel can configure the alarm to trigger if the difference exceeds 0.5°C, and to reset when the difference is less than 0.3°C. See Sectior 3.3K, Setting the Patient Temperature Alarm.

18. Check the probe failure alarm.

    a. Unplug the patient probe from the controller. Verify that an alternating two tone alarm sounds, the probe failure LED illuminates, HHHH flashes ir the patient temperature display, and the heater power LEDs are extinguished. Plug the probe back in and verify that the alarm cancels.

    b. Unplug the air temperature sensor from the controller. Verify that an alternating two tone alarm sounds, 00.0°C flashes in the air temperature display, the probe failure LED illuminates, and the heater power LEDs are extinguished. Align the connectors and plug the air temperature sensor back into the controller. Verify that the alarm cancels.

19. Check the power failure alarm and the battery backed memory. First verify that you are still in the patient control mode. Then adjust the patient control temperature to 36.0°C. Switch to the air control mode and adjust the control temperature to 35.0°C. Unplug the incubator. An intermittent, nonsilencable alarm should sound, and the power failure LED should illuminate. All other displays and indicators will be extinguished. Wait two minutes and plug the incubator back in. Verify that the alarm cancels and that the unit returns to the air control mode of operation with a control temperature of 35.0°C. Switch to the patient control mode and verify a control temperature of 36.0°C.

    Note: A fully charged battery should supply the power failure alarm for approximately 10 minutes. If the alarm is tested for the full 10 minutes, the incubator must be run for at least two hours to recharge the battery before it is used with a patient. Total recharge time is 8 to 10 hours.

20. Check the Alarm Silence switch. Unplug the air temperature sensor and press the Alarm Silence switch. Verify that the alarm is silenced for one minute. Reconnect the air temperature sensor.

21.‡ Check the RS-232 circuitry. Short pins 2 and 3 of the RS-232/Nurse Call connector. Press the override switch while powering up the unit. Release the switch when a continuous alarm sounds. If the RS-232 option is functioning, the temperature displays will cycle to a frame that shows "rs 232 PASS". Conversely, if the RS-232 circuitry is not functioning or is not installed, the temperature displays will cycle to frame that shows "rs 232 FAIL". Turn off the unit to exit this test mode. Remove short from pins 2 and 3.

22.‡ Check the Nurse Call circuitry. Under the "no alarm" condition, verify contact closure between pins 1 and 6 and no contact closure between pins 1 and 9 of the RS-232/Nurse Call connector. Trigger an alarm by unplugging the air temperature sensor. Verify contact closure between pins 1 and 9 and no contact closure between pins 1 and 6.

D. Operational Checks

1. Make sure that the incubator is in the air control mode.

2. Verify that the front door, the portholes, and the hood are closed.

3. Set the control temperature as close to the air temperature as possible. Allow the air temperature reading to stabilize. Verify that the air temperature remains within 0.5°C of the control temperature for five minutes after stabilization.

‡ Option available only on controllers with serial numbers beginning with HBJ.

3/Calibration and Adjustment

⚠**WARNING: Use extreme care while performing calibration and adjustment procedures, or while working on the Care Plus Incubator with power connected. An electrical shock hazard does exist; be certain to observe all standard safety precautions.**

3.1 Special Tools and Equipment

The following tools (or their functional equivalents) are required to complete the recommended service procedures. If you do not already have these items, they can be ordered from Ohmeda.

Description	Stock Number
Digital Multimeter, 3 1/2 digit	7000-0000-023
Leakage Current Tester with AAMI Test Load	0175-2305-000
Static Control Work Station (recommended)	0175-2311-000
0.1% Accuracy Variable Resistance Box	
Soldering Iron	
Hair dryer (1000 watts), or heat gun (glass of hot water, >45°C, can be used as substitute)	

Optional items include:

Description	Stock Number
Oscilloscope, 15 MHz, dual trace	0175-2302-000
Ohmeda Temperature Simulator Box (variable resistance box with switches preset to various temperatures)	0217-2788-800
Cable with 1/8" mini phone jack (5 ft. long)	6600-0203-700

Note: This cable has a phone jack on both ends. You may have to remove one of the jacks, because there is no one connector that will accommodate all types of variable resistance boxes.

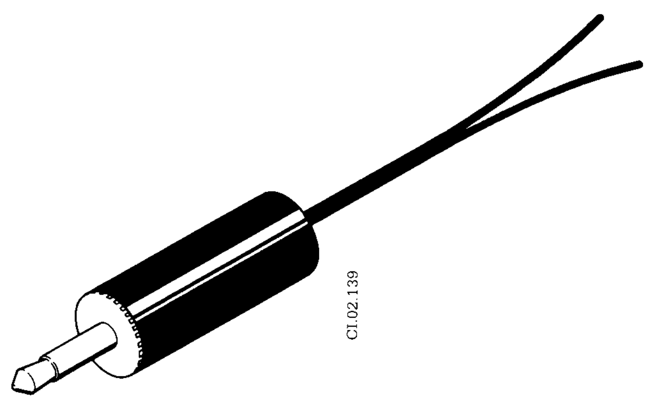


Figure 3-1 Cable for Variable Resistance Box 6000-0203-700

3.2 Calibration Loop (background information)

Note: The audible alarm sounds continuously in this loop, although the normal incubator alarms are disabled during the calibration loop.

This loop is used to adjust ADC converter calibration, the 2 kHz alarm frequency, the line voltage compensation, and display brightness. To enter the calibration loop, hold down the Enable switch during power up until a continuous alarm sounds. During the calibration loop:

1. The 2 kHz audio alarm sounds continuously. This allows frequency adjustments.

2. A four place (XX.XX°C) patient probe reading appears in the patient temperature display.

   Note: This display appears even if the patient temperature is outside the normal display range.

3. The percent of rated line voltage at which the unit is operating appears in the control temperature display (XX.XX = XXX.X%). When the correct percentage is displayed, the line voltage compensation is properly adjusted.

4. Output 34 on the display driver is activated. This allows the display brightness voltage to be read and adjusted.

3.3 Calibration Procedures

⚠WARNING: After completing a repair of the Care Plus, the appropriate calibration procedure must be performed. After completing any portion of the calibration and adjustment procedures for the Care Plus Incubator, perform the Checkout Procedure to make sure that the unit is operating correctly. In addition, a final Electrical Safety Check, section 3.4, must be performed. Record the information for future reference.

⚠WARNING: Before any disassembly or repair, disconnect the electrical supply and any gas supply connections. Also remove any accessories. Do not perform any service or maintenance with the power applied unless specifically told to do so in the procedure.

CAUTION: Use the Static Control Work Station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

Important: Reference Figure 3-2, for the location of control board potentiometers and test points.

3/Calibration and Adjustment

A. Preparation

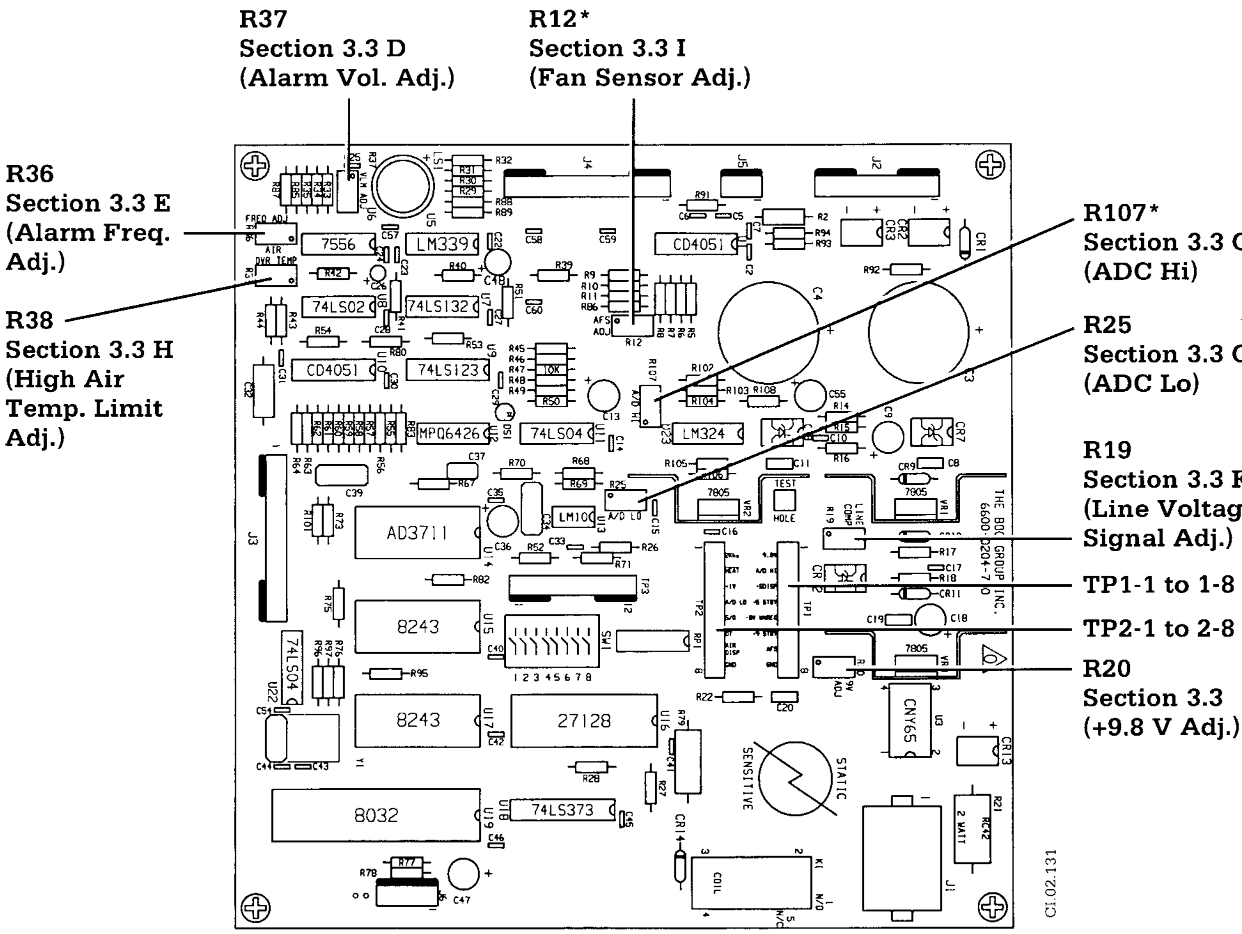
1. Remove the controller from the incubator. First unplug the patient probe, the air temperature sensor, the power supply cord, and the ThermaLink cable if applicable, from the controller. Then lift up the controller latches and slide it forward, out of the incubator. Place the controller on the anti-static mat.

   ⚠CAUTION: When handling the controller, avoid bumping the fan or the heater. If these items are knocked out of alignment, the fan can grate against either the heater or the base.

2. Remove the screws and lock washers used to attach the controller cover.
3. Reconnect the power cord and the air temperature sensor to the controller.
4. Verify that control board switches 1, 2, 7 and 8 are in the OFF (open) position.

   Note: Leave switch 4, which selects either a 0.5°C or a 1.0°C limit for the patient temperature alarm, in its original position.

   Note: Leave switch 3, which selects a maximum patient control temperature (patient control mode), in its original position.



* Adjustments for controllers with serial numbers beginning with HBJ.

Figure 3-2 Control Board Test Points and Potentiometers

B. Check Voltage Supplies

1. Switch ON the incubator. It will proceed through the normal power up tests. Enter a control temperature to silence the prompt tone.

2. Adjust control board potentiometer R20 until TP1-1 measures 9.8 ± 0.05 Vdc with respect to GND (TP1-8).

3. Verify the following voltages on the control board with respect to GND (TP1-8

Test Point	Voltage
TP1-3	5.0 ± 0.3 Vdc
TP1-4	5.0 ± 0.3 Vdc
TP1-6	9.0 ± 0.3 Vdc

Note: These voltages cannot be adjusted. The control board must be replaced when they are not within the specified range.

C. Display Brightness

Note: Because display brightness is factory calibrated for both replacement boards and complete controllers, brightness adjustments are only required if the LEDs appear to be dim.

1. Hold down the Alarm Silence switch until all the displays illuminate (approximately five seconds). Check that all displays are illuminated and of uniform brightness. If the displays are acceptable, proceed to Section D. Otherwise, continue with this adjustment procedure.

2. Switch OFF the power and remove the front controller panel.

   a. Turn the controller upside down and remove the lower three front panel mounting screws, shown in Figure 3-3.

   b. Turn the controller right side up and remove the remaining front panel mounting screws, shown in Figure 3-3.

   Note: Voltage measurements can be made between pins 11 and 12 of J9, on the connector on the back of the display board.

3. On controllers with serial numbers beginning with HBJ, remove the ESD shield.

4. Reconnect the power cord.

5. Enter the calibration loop by switching the unit ON while holding down the Enable switch. Continue to hold the Enable switch until a continuous single tone alarm sounds, indicating that the calibration loop is active.

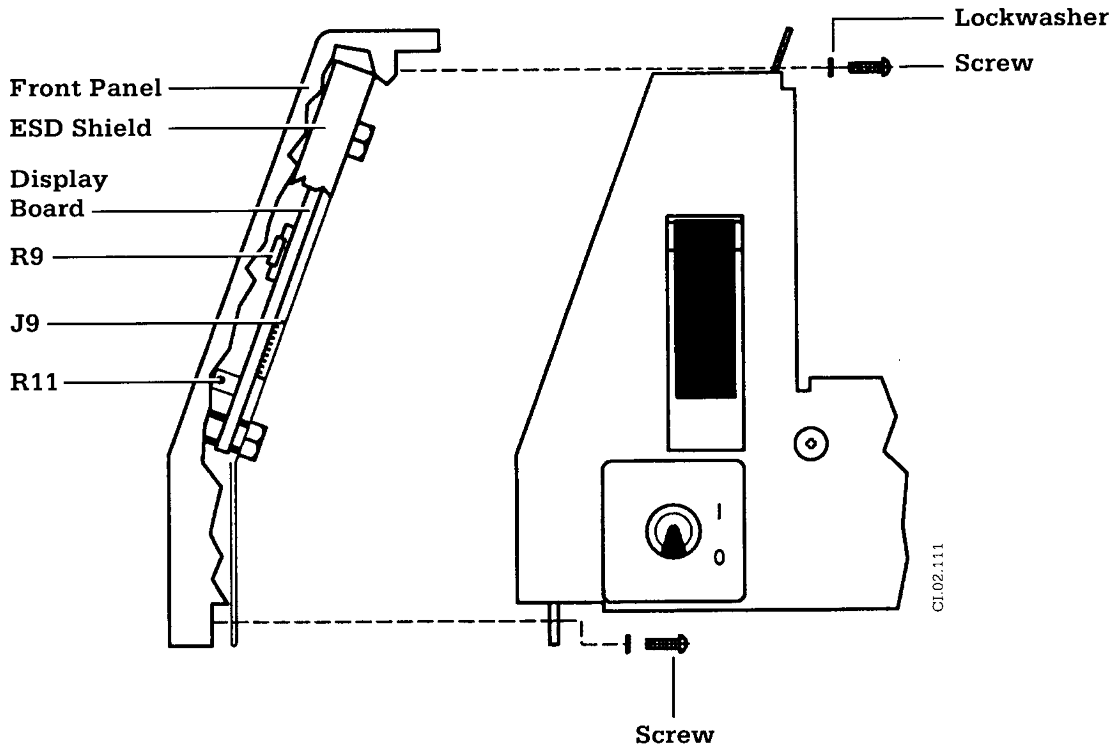


Figure 3-3 Display Brightness Adjustment

6. Monitor the voltage between pins 11 and 12 of J9, the connector on the rear of the display board. Adjust display board potentiometer R11 (accessible from the edge of the board) to obtain a reading of 3.30 ± 0.2 Vdc.

   Note: This voltage corresponds to the voltage drop across R9.

   Important: The voltage measured across R9 will differ if the calibration loop is not used.

7. Replace the display board if an acceptable level of brightness cannot be achieved.

8. Disconnect the power cord and reassemble by performing steps 2 and 3 in reverse order.

D. Alarm Frequency

Note: Because the alarm frequency is precalibrated at the factory for both replacement boards and complete controllers, frequency adjustments are only required when replacing a control board component that is part of the alarm circuit.

1. Verify that the incubator is in the calibration loop.

2. Verify that the frequency output at TP2-1 is 2 kHz ± 0.1 kHz. Adjust R36 on the control board as required.

   Note: If test equipment is not available to check the frequency, adjust R36 for maximum sound level.

E. Line Voltage Compensation

1. Verify that the incubator is in the calibration loop. In this loop the control temperature display continuously shows the percent of nominal input voltage at which the unit is operating.

   Note: Multiply the displayed value by ten to get the actual percentage (XX.XX = XXX.X%).

2. Determine the rated heater voltage of your unit from the serial number sticker on the back of the base platform.

3. Measure the line voltage between the appropriate transformer primaries (pins 4 and 2 on 120 volt units):

Rated Input Voltage (from serial number sticker)	Nominal Input Voltage	Measure Between Pins
240 volts	240 volts	6 and 2
220 volts	220 volts	5 and 2
120 volts	115 volts	4 and 2
100 volts	95 volts	3 and 2

4. Calculate the percent of the nominal input voltage by dividing the measured voltage by the nominal input voltage and multiplying by 100%.

$$\text{\% of line voltage} = \frac{\text{(Measured Voltage)}}{\text{(Nominal Input Voltage)}} \times 100\%$$

5. Adjust control board potentiometer R19 until the control temperature display shows the percentage calculated in the previous step ± 2%.

   Note: The control temperature reading appears in the format XX.XX, which must be multiplied by ten to give the actual percentage, XXX.X%.

F. Analog to Digital Converter (ADC)

1. Verify that the incubator is in the calibration loop.

2. Attach 0.1% accuracy resistance box to the patient probe jack. Adjust the box

settings for a resistance of 5900 ohms ± 0.1% (Ohmeda temperature simulator box setting I7). The patient temperatue should read 37.37°C.

Note: The Ohmeda temperature simulator box (Stock No. 0217-2788-800) is a variable resistance box with switch settings corresponding to predetermined temperatures.

On controllers with serial numbers beginning with HBJ, perform steps 3 through 6 and 8 through 13. On all other controllers perform steps 7 through 13.

3. If the temperature displays in the calibration check differed from the target value by less than half a degree centigrade, continue with step 4. Otherwise:

   a. Connect a voltmeter between pins 4 and 8 of the control board test connector TP2.

   b. Set the voltage at TP2-4 to 2.058 Vdc by adjusting R25. Then, disconnect the Voltmeter.

   c. Connect the voltmeter between pins 2 and 8 of the control board test connector TP1.

   d. Set the voltage at TP1-2 to 0.369 Vdc by adjusting R107. Then, disconnect the voltmeter.

4. Adjust R107 to obtain a reading of 37.37 ± 0.02°C in the Patient Temperature display.

   Note: Although the tolerance is ± 0.02, the readings should be adjusted as closely as possible to the nominal value; the ± 0.02°C allows for system noise, etc.

5. Connect a resistance of 7686 Ω ± 0.1% (Ohmeda Temperature Simulator Box setting I1) to the patient jack connector and adjust R25 to obtain a reading of 31.09 ± 0.02°C in the patient temperature display.

6. Repeat steps 4 and 5 until no further adjustment is required.

7. On controllers that have serial numbers that *do not* begin with HBJ, adjust control board potentiometer R25 until 37.37 ± 0.05°C appears in the patient temperature display.

8. On all controllers, switch OFF the power to exit the calibration loop.

9. Switch the incubator ON. After the normal power up sequence, enter a control temperature to silence the prompt tone.

10. Check the readings from the calibration resistors. Depress and hold the Enable switch until the proper calibration readings appear in the patient and air temperature displays (approximately five seconds):

Patient Temperature	25.05 ± 0.2°C
Air Temperature	37.97 ± 0.2°C

11. Adjust the resistance box settings for the following resistances. Verify that the corresponding temperature appears in the patient temperature display.

Resistance Input	**Temp. Sim. Box**	**Patient Temperature Display***
5496 Ω ± 0.1%	I2	39.0 ± 0.1°C
7060 Ω ± 0.1%	I3	33.0 ± 0.1°C
6190 Ω ± 0.1%	I11	36.2 ± 0.1°C

*Decimal point does not appear.

12. Disconnect the resistance box from the patient probe jack.

13. Switch the unit off. Calibration is complete.

G. Alarm Volume

Verify that control board potentiometer R37 is adjusted fully counterclockwise for maximum volume.

H. Air Safety Circuit Calibration (High Air Temperature Alarm)

This procedure requires a hot air source. Either a hair dryer (approximately 1000 watts), or a heat gun , or a glass of hot water (>45°C) can be used for this purpose.

1. Switch the controller ON.

2. In the air mode, adjust the control temperature to 36.9°C.

3. The heater should switch ON. Verify that the heater power LEDs on the display panel and the heater status LED on the control board are both illuminated. The heater status LED may flicker.

4. If you are using a glass of hot water (>45°C) as the heat source:

a. Unscrew the two mounting screws that attach the air temperature sensor to the hood. Remove the sensor mounting blocks and pull the sensor out of the hood.

b. Place the air temperature sensor in the glass of hot water (>45°C). The rate of temperature increase should not exceed 0.05°C per second.

5. If you are using a heat gun or blow dryer, switch it on and point it at the air temperature sensor. Observe how quickly the displayed air temperature increases. If necessary, reposition the heat gun (dryer) so that the rate of increase does not exceed 0.05°C per second.

6. Monitor the air temperature display. When the high air temperature alarm illuminates, verify an air temperature display of 38.0 ± 0.3°C. Also verify that the safety relay opens (audible click; heater status LED extinguished).

7. Press the alarm silence switch and remove the air temperature sensor from the glass of water or switch OFF the blow dryer.

   Important: This alarm will not reset unless the alarm silence switch is pressed.

8. Monitor the air temperature display and verify that the alarm resets.

9. If the alarm is triggered at an air temperature other than 38.0 ± 0.3°C, adjust R38 on the control board and repeat this procedure.

10. If necessary, remount the air temperature sensor on the hood.

I. Fan Sensor Adjustment

(On controllers with serial numbers beginning with HBJ)

Adjust R12 for the duty cycle shown in Figure 3-4 at TP1-7.

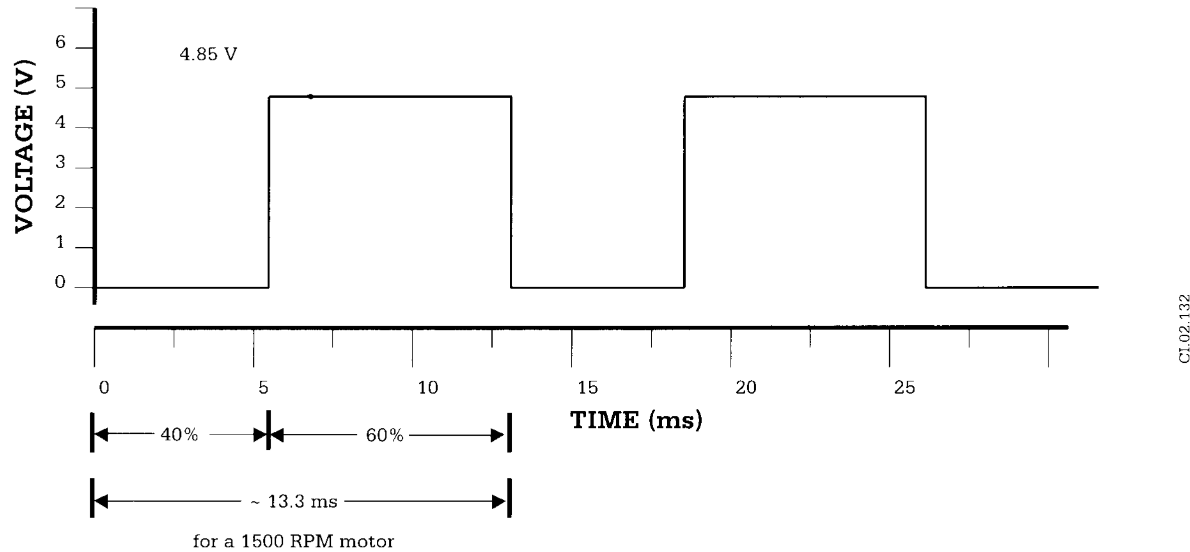


Figure 3-4 Typical Duty Cycle

This corresponds to a reading of 2.27 Vac on a true RMS meter (Fluke 8060A, Fluke 87 or HP 3468). Alternately, if a true RMS meter is not available, this reading corresponds to 3.0V on the DC scale if the meter response is much less than 75Hz.

Verify that the fan sensor is working by doing the following:

a. Replace the controller in the incubator. Plug in the air temperature sensor and the power cord.

b. Switch the incubator ON.

c. Depress the F/C switch approximately 5 seconds until different numbers appear in the control temperature display (approximately five seconds). This number will be the fan RPM (typically fan RPM should be between 1300 and 1650) .

J. Thermal Switch Operation

1. Hold a hot soldering iron (minimum temperature 76.7°C) against the thermal switch on the rear of the controller.

2. Listen for an audible click, indicating that the switch has opened. The click should occur within a few seconds. When the thermal switch has opened the heater indicator light on the control board should be constantly illuminated.

   Note: An open thermal switch makes it appear as if the heater is continuously enabled. This may trigger error code E13. Switch the unit OFF and continue with step 3.

3. Remove the soldering iron and allow the switch to cool.

4. Listen for a second click indicating that the switch has closed. When the thermal switch closes, the heater indicator LED may flicker depending on the status of the heater.

5. If the thermal switch fails these tests, it must be replaced.

K. Setting the Patient Temperature Alarm Threshold

If desired, reset the patient temperature alarm to trigger when the difference between the patient control temperature and the monitored patient temperature exceeds 0.5°C. This is done by setting dipswitch 4 to the ON position.

L. Setting the Maximum Patient Control Temperature

If desired, the maximum patient control temperature (patient control mode) can be set at 37.5°C instead of 37.0°C. This is done by setting dipswitch 3 to the ON position.

M. Closure

1. Switch OFF the controller.

2. Verify that the power cord, the air temperature sensor, and the patient probe are disconnected from the controller.

3. Make sure that the dipswitches are configured for normal operation. Switches 1, 2, 7 and 8 must be OFF. The position of switches 3 and 4 will vary depending on the maximum patient control temperature and the tolerance selected for the patient temperature alarm.

   Note: If dipswitches 1 and 2 are not OFF, error code E09 (incorrect dipswitch setting) will be triggered.

4. If the ThermaLink option is installed, make sure the slide switch on the ThermaLink board is in the OFF position.

⚠**CAUTION: When handling the controller, avoid bumping the fan or the heater. If these items are knocked out of alignment, the fan can grate against either the heater or the base.**

5. Replace the controller cover. Use the screws and lock washers removed in Section A to secure the cover.
6. With the controller release latches in the release position (perpendicular to the controller sides), carefully slide the controller back into the incubator.
7. Push the controller latches down into the locked position.
8. Connect the air temperature sensor and the power cord to the controller.
9. If the ThermaLink option is installed, connect the ThermaLink cable.
10. Turn the unit ON. Verify that the fan is circulating air and that the fan is not rubbing against the base platform.
11. Complete the Electrical Safety Check in Section 3.4.
12. Perform the Checkout Procedure in Section 2.8.

3.4 Electrical Safety Check

A. Leakage Current

Use approved equipment and techniques to test the unit's leakage current and ground continuity. Follow the directions supplied by the test equipment manufacturer to verify the following:

1. Less than 100 microamperes measured at any exposed metal surface for equipment rated at 120 Vac, 50/60 Hz.
2. Less than 200 microamperes measured at any exposed metal surface for equipment rated at 220 Vac, 50/60 Hz or 240 Vac, 50/60 Hz.

B. Ground Resistance Check

Use a low range ohmmeter or electrical safety analyzer to measure the resistance between the ground pin on the line cord plug and exposed metal of the controller. The ground resistance must be less than 0.1 ohms

4/Troubleshooting

⚠WARNING: Use extreme care while performing calibration and adjustment procedures, or while working on the Care Plus Incubator with power connected. An electrical shock hazard does exist; be certain to observe all standard safety precautions.

⚠CAUTION: When handling the controller, avoid bumping the fan or the heater. If these items are knocked out of alignment, the fan can grate against either the heater or the base.

CAUTION: Use the Static Control Work Station (Stock No. 0175-2311-00) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

Note: Self test programs stop when a system error code is detected. Therefore a second error code will not be displayed for another failure. The same failure can trigger more than one error code. The actual code that appears is determined by the point in the test loop where the fault occurs.

Note: SW1 on the ThermaLink board should be in the OFF position.

The Care Plus features three levels of testing for maximum reliability and ease of troubleshooting. Self tests are performed on power up to check microcontroller, EPROM, and RAM function. They are performed continuously during operation to verify proper ADC, heater control, safety circuit, temperature sensor, alarm, RAM, and software operation.

Control panel switches activate on demand tests that can be used to assess error codes. Specifically you can verify ADC calibration and check for drift; check the individual ADC channels; monitor the occurrence of any software upsets, and check the line voltage. On controllers with serial numbers beginning with HBJ, you can check the fan RPM. On all other controllers you can compare readings from both air flow or air temperature thermistors to verify a sensor failure. On all controllers, a separate RAM memory test loop continuously repeats the power up tests.

When required, you can operate the controller outside the incubator to directly measure control board signals. During controller testing, it is important to remember that the alarm criteria discussed in this section apply regardless of whether or not the controller is installed in the unit. Failure to connect the patient probe (or an equivalent load) in patient control mode, or the air temperature sensor in either operational mode will trigger the probe failure alarm. Air or patient temperature readings outside the alarm limits will still activate the corresponding alarms. In patient control mode the heater will not switch ON unless the patient temperature reading is within the 30 to 42°C range.

4/Troubleshooting

4.1 Alarms and Error Codes

There are two types of alarms on the Care Plus incubator. The first group of alarms are indicated by the alarm LEDs on the control panel. When one of these alarms is active the corresponding LED illuminates and an audible alarm sounds.

Error codes are a subset of the system failure alarm. When the system failure alarm illuminates for anything other than a gross microcontroller failure, the corresponding error code appears in the control temperature display.

A. Front Panel Alarms

Note: On controllers with serial numbers beginning with HBJ, all alarms, with the exception of the system failure and power failure alarms, are preceded by a 30 second operator prompt tone.

1. Patient Temperature Alarm (active in the patient mode only)

   This alarm is active only in the patient control mode. It is triggered when the difference between the patient temperature and the control temperature exceeds 1°C. The alarm self resets when the patient temperature returns to within 0.8°C of the control temperature.

   Note: The patient temperature alarm can be adjusted to trigger if the temperature difference exceeds 0.5°C and reset when the difference is less than 0.3°C (Refer to Section 3.3.K.).

   Note: If the patient temperature is outside the 22 to 42°C range, either HHHH or LLLL,respectively, will appear in the patient temperature display.

Audio Signal:	Intermittent single tone if patient temperature within the 30 to 42°C range. Outside this range, an alternating two tone alarm sounds.
Alarm Silence:	15 minutes if temperature difference is < 2°C
	5 minutes if temperature difference is 2°C or higher.
	1 minute if patient temperature < 30°C or > 42°C.
Heater Status:	Heater is automatically shut off if the patient temperature is not between 30 and 42°C.

2. Control Temperature Alarm (active in air control mode only)

   The control temperature alarm is active only in the air control mode. It is suppressed for 30 minutes when power is first applied and for 15 minutes after each mode or control temperature change. The alarm is triggered when the reading from the air control thermistor exceeds the control temperature by more than 1.5°C or falls more than 3°C below the control temperature. The alarm self resets with a hysteresis of 0.2°C.

Audio Signal:	Intermittent single tone
Alarm Silence:	15 minutes
Heater Status:	Normal heater operation, dependent on selected control temperature and air temperature.

3. High Air Temperature Alarm

This alarm is triggered if the air display temperature exceeds the maximum control temperature (air control mode) or the maximum DET (the temperature required to maintain the infant at the selected control temperature in patient control mode) by more than 1°C. This alarm is not self resetting; you must press the alarm silence switch before the alarm will reset.

To display the DET in patient control mode, wait for the enable light to go off, then depress and hold the Air Control switch until the DET appears in the air temperature display (approximately five seconds).

A transient alarm may be triggered if you change from a mode with a 40°C alarm limit to a mode that has a 38°C alarm limit.

Control Mode	**Temp. Range**	**Alarm Limit**
Patient Control	35.0 to 37.0° C (Max. DET 39.0°C)	40.0°C
	35.0 to 37.5°C (Dipswitch 3 ON; Section 3.3.L; Max. DET still 39.0°C)	40.0°C
Air Control	20.0 to 37.0°C (Normal Range)	38.0°C
	37.0 to 39.0°C (Override switch)	40.0°C

Audio Signal:	Alternating two tone
Alarm Silence:	5 minutes
Heater Status:	Heater is automatically shut off.

4. Air Circulation Alarm

On controllers with serial numbers beginning with HBJ, this alarm triggers when the fan sensor detects that the fan has stopped spinning or is not installed. The fan sensor is mounted facing the hub. The fan is designed with cutouts so that as the fan spins, the sensor "sees" alternating areas of reflectance and non-reflectance. This signal is then processed and input to the microcontroller as an interrupt. The microcontroller counts the interrupts for 10 second intervals to determine the fan's RPM. If the RPM drops below 800 for 2 consecutive intervals, the air circulation alarm is triggered. The alarm resets when the RPM is detected to be above 800.

To display the fan RPM, depress and hold the F/C switch approximately 5 seconds until the fan RPM appears in the control temperature display.

The air circulation alarm is most commonly triggered by a blower motor failure or a missing fan.

On controllers with serial numbers that do not begin with HBJ, this alarm triggers when the flow of cooling air over the air flow sensor stops. The air flow sensor contains a heated and an unheated thermistor. During normal operation, the air flow over the sensor cools the heated thermistor. If the air flow stops, the heated thermistor is no longer cooled and the temperature difference between the two thermistors increases. When the difference reaches 21°C, the air circulation alarm is triggered. The alarm resets when the difference drops below 19°C.

To display the temperature of both thermistors, depress and hold the F/C switch until the temperature of the heated thermistor appears in the air temperature display and the temperature of the unheated thermistor appears in the control temperature display (approximately five seconds). These displays do not have a decimal point so the readings must be divided by ten to convert to degrees C.

The air circulation alarm is most commonly triggered by a blower motor failure or a missing fan.

Audio Signal:	Alternating two tone
Alarm Silence:	5 minutes
Heater Status:	Heater is automatically shut off

5. Probe Failure Alarm

In the air control mode, the probe failure alarm is triggered by a disconnected air temperature sensor. In the patient control mode, the probe failure alarm is triggered by either a disconnected or faulty patient temperature probe (short or open) or a disconnected air temperature sensor. The alarm self resets when the condition is remedied.

The patient temperature probe is judged to be disconnected or faulty if its signal is outside the 5 to 50°C range (approximately 884 mV to 410 mV). The air temperature sensor is assumed to be disconnected if both the air control and the air display signals are outside this range. This means that the probe failure alarm will be triggered instead of error codes 10 or 11 if both circuits in the air temperature sensor are open or shorted.

If neither the probe (patient control mode only) nor the sensor are disconnected, one or the other is faulty. Check the patient temperature probe (patient control mode only) by observing the patient temperature display and verifying that it is consistent with the temperature of the probe. If LLLL or HHHH appear in the display, check the actual probe reading by depressing and holding the Air Control switch until a value appears in the patient temperature display (approximately five seconds). If the temperature is outside the 5 to 50°C range, replace the patient temperature probe.

Check the air temperature sensor by depressing and holding the Override switch until the air control thermistor reading appears in the patient temperature display and the air display thermistor reading appears in the air temperature display (approximately five seconds). If both readings are outside the 5 to 50°C range, replace the air temperature sensor.

Audio Signal:	Alternating two tone
Alarm Silence:	1 minute
Heater Status:	Heater is automatically shut off

6. System Failure Alarm

The system failure alarm is triggered if one or more of the system parameters monitored by the microcontroller self tests fail. This section describes the actual tests and gives a list of probable causes for each code.

If the microcontroller fails, there may be some cases where the only indication is a continuous, nonsilenceable audio alarm (i.e. no alarm indicator illuminates and no error code appears). This occurs because the microcontroller controls the display indicators. To ensure patient safety, a microcontroller independent safety relay will switch off the heater if the temperature exceeds preset safety limits.

⚠**WARNING: If a system failure alarm occurs, the unit must be removed from use until it has been serviced.**

Audio Signal:	Alternating two tone
Alarm Silence:	Cannot be silenced
Heater Status:	Heater is automatically shut off

7. Power Failure Alarm

   The power failure alarm is triggered when the line frequency signal pulse is absent on I/O expander U15 pin 15. (On controllers with serial numbers that do not begin with HBJ, the line frequency pulse is absent on the microcontroller U19, Pin 12.) During a power failure alarm the NI-CAD battery powers the control logic and RAM circuits for up to 10 minutes. If power is restored within this time, the unit will return to the mode of operation and the control temperature in effect before the power loss.

   The power failure alarm can be caused by a disconnected plug , faulty wiring, a faulty transformer, or, on controllers with serial numbers beginning with HBJ, an open circuit breaker.

Audio Signal:	Intermittent single tone
Alarm Silence:	Cannot be silenced
Heater Status:	There is no power to the heater

B. Error Codes

Important: The recommended service policy is to limit repair procedures to sensor or board replacement, or in some cases the replacement of socketed integrated circuits. Additional information is provided for the purpose of identifying the faulty assembly.

Error codes are a subset of the system failure alarm. When an error code is triggered, an alternating two tone alarm sounds, the heater is automatically shut off, and normal incubator operation stops. However, the patient and air temperature displays will continue to update, and the various on demand test functions are still available.

This section individually discusses each error code, specifically covering the triggering conditions, any applicable on demand tests, and test points.

1. E01, Instruction Test Failure

   A software routine executes selected instructions from the 8032 microcontroller. The results are then checked, and if any mistakes are found this error is triggered.

   There are no related test points, however the RAM memory test loop cycles repeatedly through this test. To begin the loop, switch off the unit. Then turn it back on while depressing the Override switch until a continuous alarm sounds (approximately five seconds). If the error recurs, replace the microcontroller (U19) and repeat the test. Replace the control board if the problem persists.

2. E02, ADC High Calibration Failure

The reading from the ADC calibrate high resistor (R5, 5.76 kOhm) has exceeded the limits of 37.96 ±0.3°C. This corresponds to a voltage of approximately 540 mV at the ADC input (U1 pin 14).

To see if the ADC requires calibration, depress the Enable switch until the low calibration reading (25.05 ±0.3°C) appears in the patient temperature display, and the high calibration reading (37.96 ±0.3°C) appears in the air temperature display (approximately five seconds). If either reading exceeds or nearly exceeds the limits, calibration is required. The second possibility is that resistor R5 may be out of tolerance. If the problem persists, replace the control board.

3. E03, ADC Low Calibration Failure

   The reading from the ADC calibrate low resistor (R8, 10 kOhm), has exceeded the limits of 25.05 ± 0.3°C. This corresponds to a voltage of approximately 690 mV at the ADC input (U1 pin 13).

   To see if the ADC requires calibration, depress the Enable switch until the low calibration reading (25.05 ± 0.3°C) appears in the patient temperature display and the high calibration reading (37.96 ± 0.3°C) appears in the air temperature display (approximately five seconds). If either reading exceeds or nearly exceeds the limits, calibration is required. The second possibility is that resistor R8 may be out of tolerance. If the problem persists, replace the control board.

4. E04, EPROM Checksum Failure

   The results of the EPROM memory checksum differ from the correct result stored at memory locations 3FFE and 3FFF on U16.

   There are no related test points, however the RAM memory test loop cycles repeatedly through this test. To begin the loop, switch off the unit. Then turn it back on while depressing the Override switch until a continuous alarm sounds. If the error recurs, replace the EPROM (U16), and repeat the RAM test loop. If the error still recurs, replace the control board.

5. E05, RAM Test Failure

   The data read out of a RAM memory location differs from the test pattern written to it.

   There are no related test points, however the RAM memory test loop cycles repeatedly through this test. To begin the loop, switch off the unit. Then turn it back on while depressing the Override switch. If the error recurs replace the control board.

6. E07, ADC Converter Failure

This alarm is triggered if the Conversion Complete Signal from the ADC does not occur within two seconds of the Start Conversion signal from I/O expander #2.

Do not attempt to monitor these signals; the Start Conversion and the Conversion Complete pulses are extremely narrow with durations of only a few nano seconds. Verify that no conversions are being completed by heating or cooling either the air temperature sensor or the patient temperature probe and observing that the temperature displays do not update.

Since the ADC (U14) is not a socketed chip, control board replacement is recommended.

7. E08, $\overline{S/O}$ Circuit Not Working

   The logic level of the safety circuit $\overline{S/O}$ signal does not agree with the level that would be expected based on the air display temperature. The $\overline{S/O}$ signal (TP2-5) should be low only when the air display temperature is outside the 5 to 50°C range (greater than 884 mV or less than 410 mV at TP2-7).

   If the air display temperature were actually outside this range, error code E10 would be triggered.

   The most probable cause is a faulty comparator circuit (U5) in the $\overline{S/O}$ circuit. Since this is not a socketed chip, control board replacement is recommended.

8. E09, Incorrect Dip Switch Setting

   The signals from dipswitches 1 and 2 are logic high (corresponds to logic low inputs at U17 for the inverted signals). The most probable cause is that dipswitches 1 and 2 are improperly configured. Set both dipswitches to the OFF (open) position.

   If the dipswitches are correctly configured, either the dipswitch or an inverter (U11B or U11C) may be faulty. Board replacement is recommended, since these circuits are not socketed.

9. E10, Air Display Sensor Bad

   The air display signal is outside the 5 to 50°C range (greater than 884 mV or less than 410 mV at TP2-7) while the air control signal remains within the 5 to 50°C range.

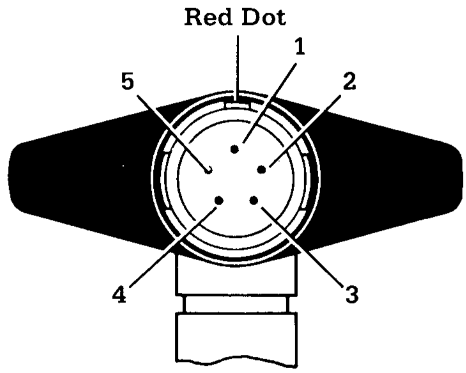


Figure 4-1 Air Temperature Sensor Connector (end view)

Observe the displayed air temperature. If it is outside the 5 to 50°C range, replace the air temperature sensor. Alternatively, perform a continuity check on the sensor by measuring the resistance between pins 4 and 5 on the sensor connector (Figure 4-1), or between pins 10 and 11 on the control board J4 connector. Replace the sensor if you do not obtain a reading between 25.7 and 3.6 kOhms (20°C = 12.5 kOhms).

Check that the J4 connector is properly mated to the control board. If the problem persists, replace the control board.

10. E11, Air Control Sensor Bad

The air control signal is outside the 5 to 50°C range (greater than 884 mV or less than 410 mV at TP2-7) while the air display signal remains within the 5 to 50°C range.

Depress and hold the Override switch until the air control temperature appears in the air temperature display (approximately five seconds). If the displayed air control temperature is outside the 5 to 50°C range, replace the air temperature sensor. Alternatively, perform a continuity check on the sensor by measuring the resistance between pins 1 and 2 (Figure 4-1) on the sensor connector or between pins 6 and 7 on the control board J4 connector. Replace the sensor if you do not obtain a reading between 25.7 and 3.6 kOhms (20°C = 12.5 kOhms).

Check that the J4 connector is properly mated to the control board. If the problem persists replace the control board.

11. E12, Heater Not Switching On

    The microcontroller has commanded the heater to switch on (Heat TP2-2 low), but the heater status signal from U7A pin 11 remains low (high on controllers that have serial numbers that do not begin with HBJ), indicating that the heater is off.

    This is a difficult code to troubleshoot, since the control signals and the continuity across the solid state relay change from those required to power the heater to those that shut down the heater as soon as this failure is detected.

    The most probable cause of this failure is a faulty solid state relay. If the problem persists after relay replacement, replace the control board.

12. E13, Heater Not Switching Off

    The microcontroller has commanded the heater to switch off (Heat TP2-2 high). However, the heater status signal from U7A pin 11 remains high (low on controllers that have serial numbers that do not begin with HBJ), indicating that the heater is on.

    This error code can be triggered without an actual failure having occurred, because of a thermal switch in the heater neutral that opens at a temperature of 76.7°C. When the thermal switch opens, it causes a logic high heater status signal (low on controllers that have serial numbers that do not begin with HBJ), which illuminates the heater status LED and signals the microprocessor that the heater is on.

    The thermal switch normally opens for a few minutes when a hot incubator is switched off because of residual radiant heat and the lack of a cooling air flow. If the incubator is restarted before the thermal switch has cooled, E13 may appear as soon as this alarm is enabled (approximately three and a half minutes after power up; normally, a period of three and a half minutes is sufficient to cool the incubator).

    Check to see if the thermal switch has opened as soon as the error occurs, before it has had time to cool down. The thermal switch opens at a temperature of 76.7°C and is located on the back of the controller. On controllers that have serial numbers that do not begin with HBJ, check the temperatures of the air flow thermistors to see if they are near this range by depressing and holding the F/C switch until the temperature of the unheated air flow thermistor appears in the air temperature display and the temperature of the heated thermistor appears in the control temperature display (approximately 5 seconds). Because the decimal point is not illuminated, you must divide the reading by 10 to obtain the temperature.

    The second possibility is that the thermal switch has failed in an open position. Disconnect the power cord and do a continuity check between the two terminals of the thermal switch. The resistance should be less than 1 Ohm.

The third possibility is a shorted solid state relay. Replace the relay. If the problem persists, replace the control board.

13. E14, Alarm Oscillator Failure

    An alternating two tone alarm signal has been activated, but the 2 kHz signal at TP2-1 is not toggling.

    To troubleshoot this failure, an alternating two tone alarm must be active. If there is no error code displayed, trigger an alarm by disconnecting the patient temperature probe while in the patient control mode.

    If you hear the alarm (i.e. the 2 kHz signal is present), replace the microcontroller (U19). If the problem persists, the I/O expander (U15) may be faulty. Since this is not a socketed chip, control board replacement is recommended.

    If you do not hear the alarm (i.e. the 2 kHz signal is missing), the timing circuit (U6B) or one of the circuits that gate the timing circuit inputs may be faulty. Since these chips are not socketed, control board replacement is recommended.

14. E15, Software Upset

    A software upset has caused the watchdog timer to time out and the system is unable to recover because critical parameters (e.g. control temperature) stored in the RAM may have been altered.

    This error does not necessarily indicate a hardware failure. Power the incubator up. If the error does not recur, allow the unit to run for half an hour. Then check the number of recoverable software upsets that have occurred by depressing and holding the Override switch until a new value appears in the control temperature display (approximately five seconds). If FF appears in the control temperature display, no software upsets have occurred. Complete the Checkout Procedure and return the unit to service.

    If another value appears in the control display, replace the control board .

15. E16, Safety Relay Test Failure (applies only to controllers with serial numbers beginning with HBJ)

    On power up, the safety relay does not open. Repeat the test by turning off the power, waiting approximately 5 minutes, and turning the power back on.

    If the failure recurs, replace the control board.

16. E17, Software Upset

    The software is not cycling through all of the routines and is unable to recover.

Power the incubator up. If the error does not recur, allow the unit to run for half an hour. Then check the number of recoverable software upsets that have occurred by depressing and holding the Override switch until a new value appears in the control temperature display (approximately five seconds). If FF appears in the control temperature display, no software upsets have occurred. Complete the Checkout Procedure and return the unit to service.

If another value appears in the control display, replace the control board .

17. E18, Air Temperature Sensor Out of Tolerance

    This failure is normally caused by a faulty air temperature sensor. Power the unit up from a cold start with an air control temperature of 39°C. When the error occurs, observe the difference between the air control and air display thermistor readings by pressing and holding the Override switch until the air control temperature appears in the patient temperature display (approximately five seconds). Compare this temperature to the air display temperature. If the difference exceeds 0.5°C, replace the air temperature sensor and repeat the test. If the error persists, replace the control board.

18. E19, Software Upset

    The watchdog timer has timed out 256 times since power up. This error can be caused by a software upset and does not necessarily indicate a hardware failure.

    Power the incubator up. If the error does not recur, allow the unit to run for half an hour. Then check the number of recoverable software upsets that have occurred by depressing and holding the Override switch until a new value appears in the control temperature display (approximately five seconds). If FF appears in the control temperature display, no software upsets have occurred. Complete the Checkout Procedure and return the unit to service.

    If another value appears in the control display, replace the control board.

19. E20, Air Flow Sensor Failure (applies to controllers that have serial numbers that do not begin with HBJ)

    The temperatures of the heated and the unheated air flow sensor thermistors differ by less than 5°C for two minutes.

    Depress and hold the F/C switch until new values appear in the air temperature and control temperature displays (approximately five seconds). The heated thermistor signal appears in the air temperature display and the unheated thermistor signal appears in the control temperature display. Divide both values by 10 to convert them to degrees centigrade. If the resulting temperatures differ by less than 5°C, replace the air flow sensor. Check continuity across the sensor resistor (J5 pins 6 and 5) to verify that it contains a bad circuit. If the resistor has not opened or the problem persists, replace the control board.

20. E21, Air Flow Sensor Open or Shorted (applies to controllers that have serial numbers that do not begin with HBJ)

    Note: This failure can be triggered if a very cold incubator (<12°C) is put into service without being allowed to warm up.

    The temperature of either thermistor in the air flow sensor is outside the 12 to 120°C range, indicating a short or open circuit.

    Depress and hold the F/C switch until the heated thermistor signal appears in the air temperature display and the unheated thermistor signal appears in the control temperature display (approximately five seconds). If the readings are outside the specified range, replace the air flow sensor. Perform a continuity check on the thermistors in the old sensor to verify that it indeed contains a bad circuit. If the resistance indicates either an open or a short between J5, pins 8 and 7 or pins 4 and 3, discard the sensor. If the sensor tests out as good or the problem persists, replace the control board.

4.2 Power Up Tests

When power is first applied, the following self tests are performed. Specific test information for troubleshooting purposes is given in Section 4.1.B.

1. Instruction Test (E01)
2. EPROM Checksum Test (E04)
3. RAM Test (E05)

The power up test sequence is accompanied by a series of power up displays:

1. An alternating two tone audible alarm sounds for approximately five seconds, all the indicators illuminate and 188.88 appears in the temperature displays.
2. All indicators go out except the air control and the enable indicators. The temperature displays change to show from left to right:

Patient Temperature	**Air Temperature**	**Control Temperature**
XX.XX (software revision 01.01 etc.)	60.H (AC frequency 50.H for 50 Hz	39.0°C (max. manual control temp.) models)

3. An operator prompt tone sounds and the control temperature display flashes 33.0°C. The operator prompt tone will sound every two seconds until a control temperature is entered.

4.3 On Line Testing

The incubator continuously performs the following tests during normal operation. An error in any of the tests triggers the system failure alarm. The corresponding error code will appear in place of the control temperature. Specific test information for troubleshooting purposes is given in Section 4.1.B.

1. ADC Calibration Test (E02 and E03)
2. ADC Failure (E07)
3. $\overline{S/O}$ Circuit Not Working (E08)
4. Incorrect Dipswitch Setting (E09)
5. Air Display Sensor Bad (E10)
6. Air Control Sensor Bad (E11)
7. Heater Not Switching On or Off (E12 or E13)
8. Alarm Oscillator Test (E14)
9. Software Upset, Watchdog Timer (E15)
10. Software Upset, Not Cycling Through All Routines (E17)
11. Air Temperature Sensor Out of Tolerance (E18)
12. Software Upset, Excessive Watchdog Resets (E19)
13. Air Flow Sensor Failure (E20) on controllers with serial numbers that do not begin with HBJ
14. Air flow Sensor Open or Shorted (E21) on controllers with serial numbers that do not begin with HBJ

4.4 ThermaLink Option Self Test

The RS-232 portion of the ThermaLink option, available only on controllers with serial numbers beginning with HBJ, can be tested by setting the switch SW1 on the optional ThermaLink board to the ON position. Disconnect cable to other equipment before testing. Press the override switch while powering up the unit. Release the switch when a continuous alarm sounds. If the RS-232 is functioning, the temperature displays will cycle to a frame that shows:

rs 232 PASS

Conversely, if the RS-232 is not functioning, the temperature displays will cycle to a frame that shows:

rs 232 FAIL

At the end of this test, be sure to set the SW1 to the OFF position for normal operation.

4.5 On Demand Testing

There are two types of on demand testing: a combination RAM Memory display loop that cycles through the power up tests and checks display board functions; and special switch activated displays, which display various parameters to aid in diagnosing problems. The specific troubleshooting applications of individual on demand tests are discussed in Section 4.1.B.

A. RAM Memory Display Loop

1. Self Tests

   To enter this loop depress and hold the Override switch while powering up the unit. The microcontroller cycles through a series of self tests, including:

   All of the power up tests
   Instruction Test (E01)
   EPROM Checksum Test (E04)
   RAM Test (E05)

   The following on line self tests
   ADC High Calibration Failure (E02)
   ADC Low Calibration Failure (E03)
   ADC Failure (E07)
   Air Display Sensor Bad (E10)
   Air Control Sensor Bad (E11)
   Heater Not Switching On (E12)
   Heater Not Switching Off (E13)
   Alarm Oscillator Failure (E14)
   ThermaLink Self Test*

   Important: Unless you specifically want to repeat the power up tests, troubleshooting should be performed in the normal operational modes.

2. Displays

   The display loop runs simultaneously with the self tests, displaying frames of data and testing for proper LED operation. Frames are cycled as follows:

Temperature Displays

Frame	Patient Temp.	Air Temp.	Control Temp.
1.	——— All displays blank; Alternating two tone alarm ———		
2.*	rs	232	PASS /FAIL
3.	Patient Temp.	Air Display Temp.	Air Control Temp.
4.	Low Cal. Point	High Cal. Point	%Nom. Voltage x .1
5.	——— All displays read 188.88 and all LEDs illuminate ———		

* Only on controllers with serial numbers beginning with HBJ.

B. Switch Activated Displays

In normal operation, the Alarm Silence, the Enable, the Override, the F/C, the Patient Control, and the Air Control switches activate service displays when held down for more than five seconds. An alarm also sounds to indicate that actual patient and air temperatures are not displayed. The normal display reappears whe you release the switch.

The following table summarizes the data that will be displayed when each switch is depressed and held for at least five seconds. It is intended as a quick reference. Switch applications for troubleshooting are discussed in Section 4.1.B under the individual error codes.

Important: Continue to hold down the switch for as long as you wish to view the special service display. The normal display reappears when you release the switch

Switch	Patient Temperature	Air Temperature	Control Temperature
Alarm * Silence	188.88	188.88	188.88
Enable	Low cal. point (nominal 25.05°C)	High cal point (nominal 37.96°C)	% of nominal voltage XX.XX = XXX.X%; 100 ± 2% at 115 VAC (Ok if between 90 & 110%)
Override	Air control temp (XX.XX C Format)	Air display temp (XX.XX C Format)	FF - # software upsets (hexadecimal down counter)
Air Control	Patient temp (XX.XX C Format; includes temps outside normal range)	XX.YY (XX = avg. power, YY =% max. power)	Air control temp or DET (updated every 10 min)
°F/°C	Patient temp XX.XX C Format; includes temps outside normal range)	Heated air flow sensor thermistor.† Decimal point not shown, divide by 10 to obtain °C	Temp of reference air flow sensor thermistor.‡ Decimal point not shown, divide by 10 to obtain °C
Patient Control	ADC counts for patient temperature thermistor.	ADC counts for unheated air flow sensor thermistor§	ADC counts for line voltage

* All display board LEDs illuminate to test proper operation.
† On HBJ serial number controllers, display shows 00.00
‡ On HBJ serial number controllers, display shows Fan RPM
§ On HBJ serial number controllers, display is blank

4.6 Test Points

Control board test points are accessible when the controller is removed from the unit. Specific application of test point readings to various error codes is discussed in Section 4.1.B. Individual test points and their expected readings are as follows:

Important: The 1.0 reference voltage varies by up to 20 percent between units. Hence thermistor resistance rather than signal voltage should be used to check temperature measurements.

Reference the appendix tables for summaries of the resistance versus temperature or percent of nominal voltage for the various ADC inputs.

Test Point	Description & Reading
TP1-1	9.8 ± 0.05 Vdc*
TP1-2	A/D Hi (.37 Vdc)† (On controllers that do not have HBJ serial numbers, TP1-2 is Line Compensation, reading 0.7 Vdc)
TP1-3	+ 5 Volts Disp (5 ± 0.3 Vdc)
TP1-4	+ 5 Volts Stby (5 ± 0.3 Vdc)
TP1-5	+ 8 Volts Unregulated (8 ± 1.5 Vdc)
TP1-6	+ 9 Volts Stby (9 ± 0.3 Vdc)
TP1-7	Fan Sensor (3.0 Vdc)* (controllers HBJ serial numbers only)
TP1-8	Logic Ground
TP2-1	2 kHz Frequency (2 kHz ± 100 Hz)* (measure during calibration loop)
TP2-2	Heater Control Signal (Low = Heater ON)
TP2-3	+ 1 Volt Thermistor Reference (1.0 ± 0.2 Vdc)
TP2-4	+ 2 Volt A/D Reference Signal (about 2.0 Vdc)†
TP2-5	$\overline{\text{S/O}}$ Air Display Sensor Short or Open Signal (low = sensor circuit shorted or open)
TP2-6	OT Air Display Over Temperature Signal (high = high temp. alarm active)
TP2-7	Air Display Signal
TP2-8	Logic Ground
TP3-1	SW1-1 (U17, P6.0)
TP3-2	SW1-2 (U17, P6.1)
TP3-3	SW1-3 (U17, P6.2)
TP3-4	SW1-4 (U17, P6.3)
TP3-5	SW1-5 (U17, P7.0, not used)
TP3-6	SW1-6 (U17, P7.1)
TP3-7	SW1-7 (U17, P7.2)
TP3-8	SW1-8 (U17, P7.3)
TP3-9	+ 5 Volts Stby (5 ± 0.2 Vdc)
TP3-10 to TP3-12 (not used)	

* Refer to calibration section for adjustment procedure.

† Nominal value, adjusted as part of ADC calibration.

Notes

5/Repair Procedures

⚠WARNING: Before any disassembly or repair, disconnect the electrical supply and any gas supply connections. Also remove any accessories. Do not perform any service or maintenance with the power applied unless specifically told to do so in the procedure.

⚠WARNING: Disconnect power to the incubator and allow the heater to cool adequately before servicing or cleaning to avoid the danger of a burn.

⚠WARNING: Never oil or grease oxygen equipment unless a lubricant that is made and approved for this type of service is used. Oils and grease oxidize readily, and in the presence of oxygen, will burn violently. Vac Kote is the oxygen service lubricant recommended (Stock No. 6700-0092-200).

⚠CAUTION: Insulation on the electrical wiring can deteriorate with age. When performing the Checkout Procedure, check for brittle or deteriorated insulation on the power cord.

CAUTION: Use the Static Control Work Station (Stock No. 0175-2311-00) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

5.1 Hood Repair

Important: In cases where total disassembly is not required, replacing an end porthole for example, perform only the necessary steps.

Note: You must depress the hood tilt button to open or close the hood.

Refer to Figures 5-1, 5-2 and 5-3.

1. Turn the power switch OFF and unplug the unit.

2. If the incubator was previously on, allow it to cool for at least 15 minutes.

3. Remove the front door by opening it to reveal the two spring loaded hinge pins that attach the door to the lower unit. Pull both pins out towards the sides of the hood and lift off the door.

4 Remove the inner wall as shown in Figure 5-1.

   ⚠CAUTION: Inner wall fasteners are permanently attached to the inner wall and cannot be removed without damaging them.

   a. Remove the rear inner wall by pulling out the plunger portion of the inner wall fasteners.

   b. To remove the upper inner wall, open the hood and pull out the plunger portion of the inner wall fasteners while supporting the wall.

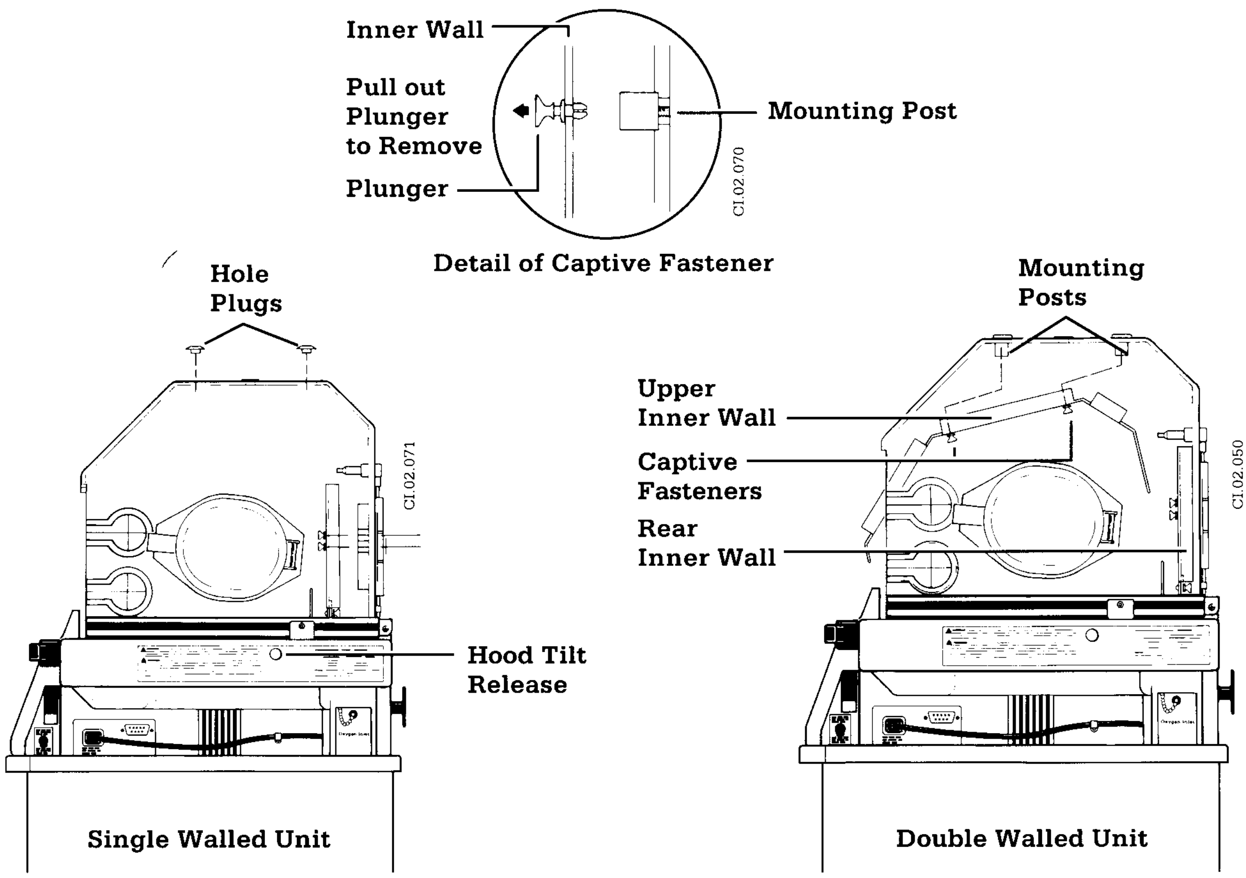


Figure 5-1 Remove the Inner Wall

5. To remove the outer hood (Figure 5-2):

   a. Lower the outer hood.

   b. Remove the air temperature sensor from the hood by: unscrewing the nut and screw that anchors the sensor cable; removing the two Phillips head screws that hold the sensor mounting blocks and spacers in position; and then sliding the air temperature sensor out of the hood.

   c. Remove the nut and screw that attach the hood to the hood tilt latch (rear, right hand corner of the incubator).

   d. Remove the two Phillips head screws used to secure the back of the hood to the base hinges.

   Note: When you replace the outer hood, fully tighten the hinge screws, then loosen one half turn.

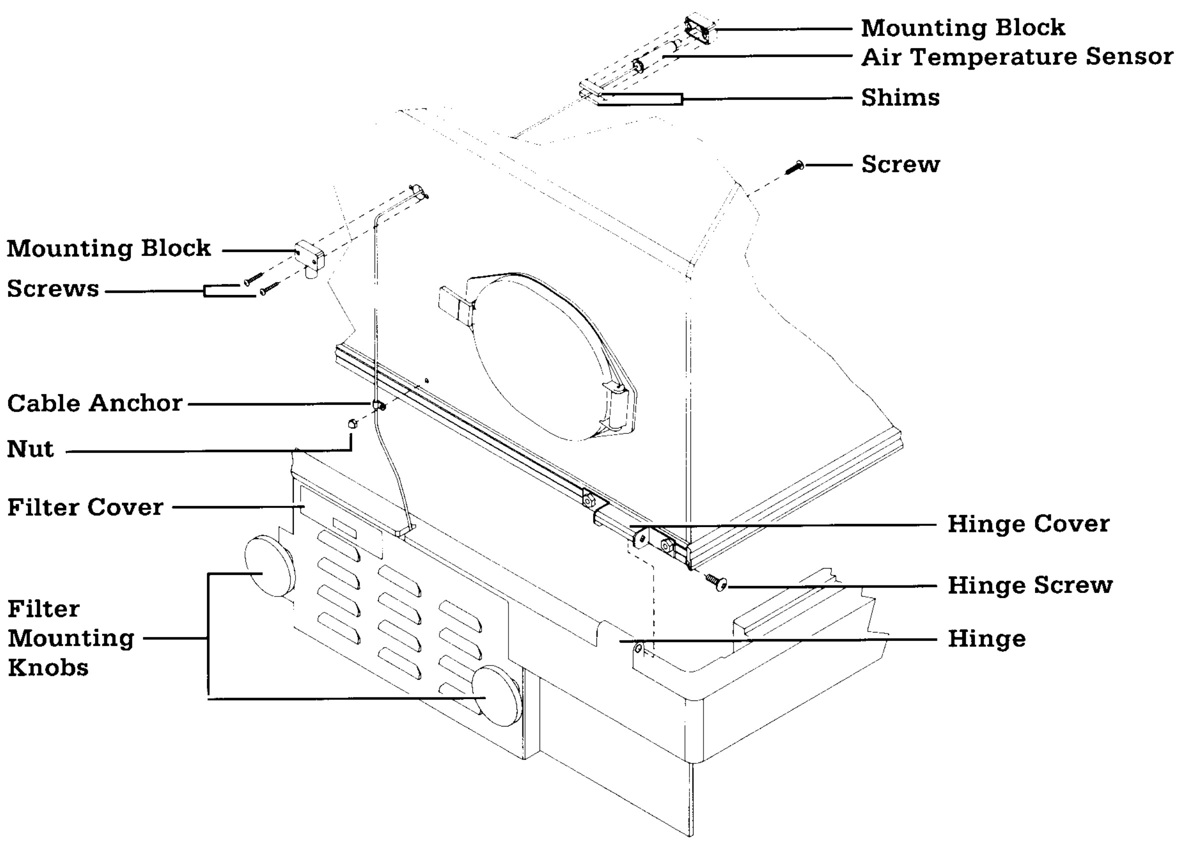


Figure 5-2 Remove the Outer Hood

6. Remove hood hardware as follows (Figure 5-3):

   a. To remove the portholes, unscrew the mounting posts on either side. On double-walled units this means you may have to remove the inner wall.

   b. To remove the side or rear seals, first remove the outer hood. Then remove the hinge covers, the nut and screw that secure the hood tilt latch, and the Phillips head screws that hold the lower bars in position.

      Note: When you replace the outer hood, fully tighten the hinge screws, then loosen one half turn.

      Note: Since this is a lengthy procedure it is recommended that all seals be replaced at the same time.

   c. Inner wall fasteners should not be removed. To install a new fastener, insert the socket portion into the proper hole and push the plunger in.

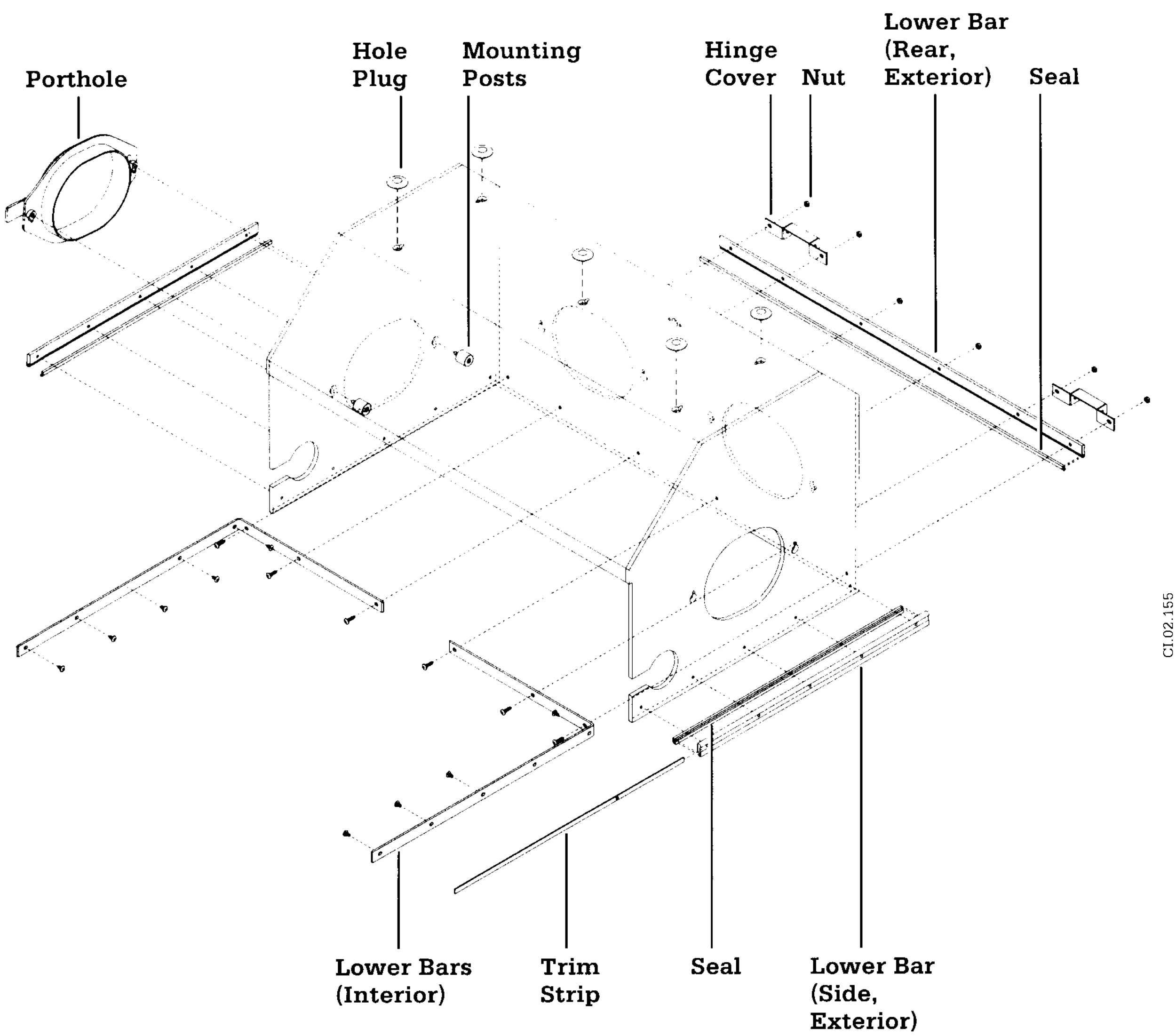


Figure 5-3 Remove hood hardware

d. To remove the porthole cuff, open the porthole and slip the larger cuff band out from under the outer ring on the porthole housing.

e. To remove the porthole seal, open the porthole and slip the seal over the outer ring of the porthole housing.

Reverse the steps for assembly. Slip the seal over the outer ring on the porthole housing. To install new porthole cuffs, slip the larger cuff band over the outer ring of the porthole housing. To reattach the inner wall fasteners, line up the fasteners with the mating mounting posts and push in the plunger portion of the fastener. When reattaching the hood tilt latch, do not over tighten the nut as this may inhibit the up and down movement of the hood.

5.2 Front Door Repair

Important: The front door seals are permanently attached and cannot be replaced individually. If they are damaged, a new outer front door must be installed.

1. Remove the front door by opening it to reveal the two spring loaded hinge pin that attach the door to the base. Pull both pins toward the sides of the hood a lift off the door.

2. Pull out the plunger portion of the inner wall fasteners to remove the inner wa

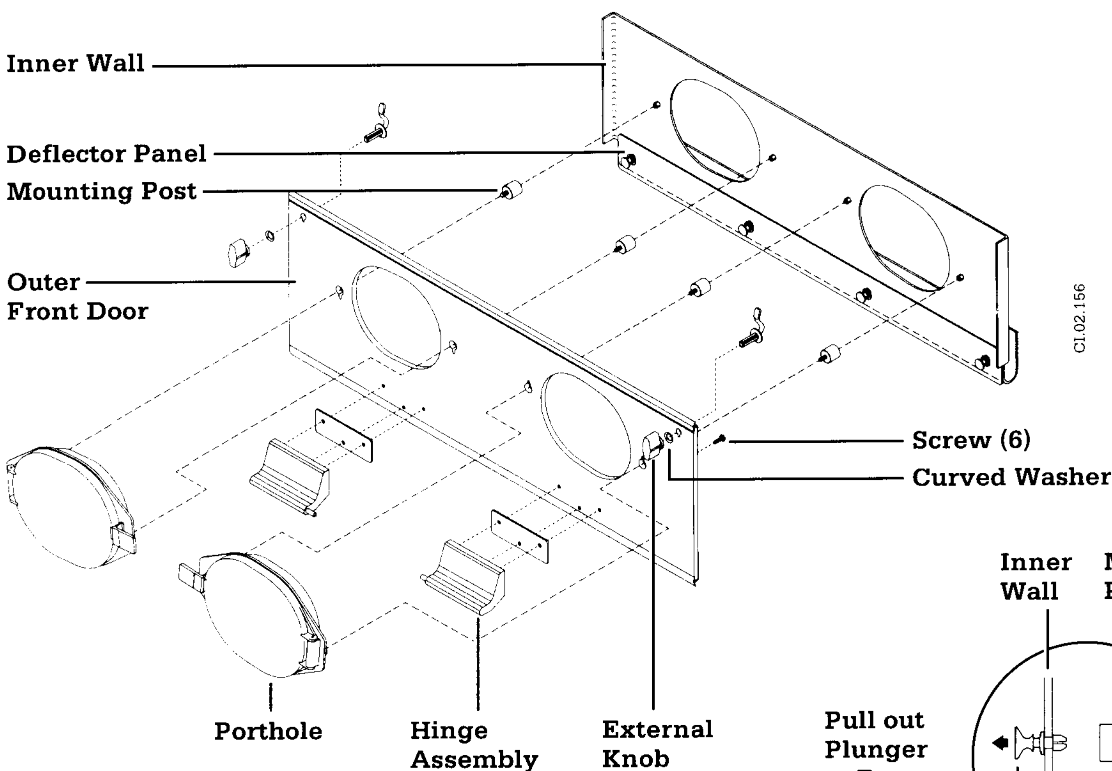
   ⚠CAUTION: Inner wall fasteners are permanently attached to the inner wa and cannot be removed without damaging them.

3. To remove the hinge pin and hinge pin assembly, remove the three Phillips he screws that secure it to the front door.

4. To remove a front door latch, loosen the set screw that secures the external knob. The curved washer and the internal latch will then slide off as shown in Figure 5-4.

5. To remove the portholes, unscrew the mounting posts on either side of the po

6. Inner wall fasteners should not be removed. To install a new fastener, insert t socket portion into the proper hole and push the plunger in.



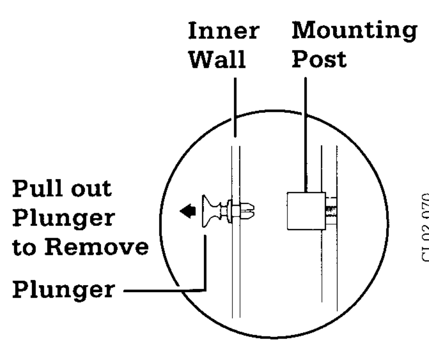


Figure 5-4 Front Door Disassembly

Detail of Captive Fastene

5.3 Air Temperature Sensor Replacement

⚠WARNING: Two people are required to lift the Care Plus Incubator. Follow safe lifting techniques to avoid injury.

Note: The air temperature sensor is located inside the infant compartment and should not be confused with the fan sensor (air flow sensor on controllers with serial numbers that do not begin with HBJ) on the rear of the controller.

1. Remove the inner walls on double walled units.

2. Lower the outer hood and close the front door.

3. Slip the sensor cable out of the retaining clip on the underside of the incubator

   Note: Early units use a screw and cable anchor to secure the cable. This requires that you unscrew the mounting knobs securing the incubator to the cabinet and lay the unit down on its side to remove the screw.

4. Remove the two Phillips head screws and shims that attach the air temperature sensor mounting blocks to the outer hood. Then slide the air temperature sensor out of the hood (Figure 5-2).

5. Unscrew the filter mounting knobs. Remove the filter cover and filter.

6. Unplug the air temperature sensor from the controller.

7. Pull the old air temperature sensor assembly out of the incubator.

8. Connect the new air temperature sensor to the controller.

9. Slip the new cable into the retaining clip. In older units, replace the screw and cable anchor with one of the new clips (Stock No. 6600-0145-400) and remount the incubator.

10. Route the cable out the rear of the base, through the hole near the air filter, and around the filter. Refer to Figure 6-8 for cable routing.

11. Replace the filter. Secure the filter cover with the filter mounting knobs. The hole on the top of the filter cover should line up with the cable.

12. Open the front door and rotate the hood to the open position.

13. Insert the air temperature sensor through the hole in the outer hood. Slide the symmetrical mounting block, backed by the two shims, over the sensor from the inside of the hood. Align the cable guard on the other block with the sensor cable on the outside of the hood. Secure the blocks with the two remaining Phillips head screws.

14. Anchor the sensor cable to the outer hood.

15. On double walled units, replace the inner wall.

5.4 Base Platform Cover Replacement

1. Remove the front door by opening it to reveal the two spring loaded hinge pins that attach the door to the base. Pull both pins toward the sides of the hood and lift off the door.
2. Depress the hood tilt release button and rotate the hood back into the locked position.
3. Remove the mattress and the mattress tray.
4. Remove each tilt assembly by pulling up on the tilt handle. The assemblies will slide out of their retaining sockets.
5. Lift out the base platform cover.
6. Remove the external humidifier, if applicable. Slide out the entire sump and cover assembly.
7. Reverse steps 1 through 6 for reassembly.

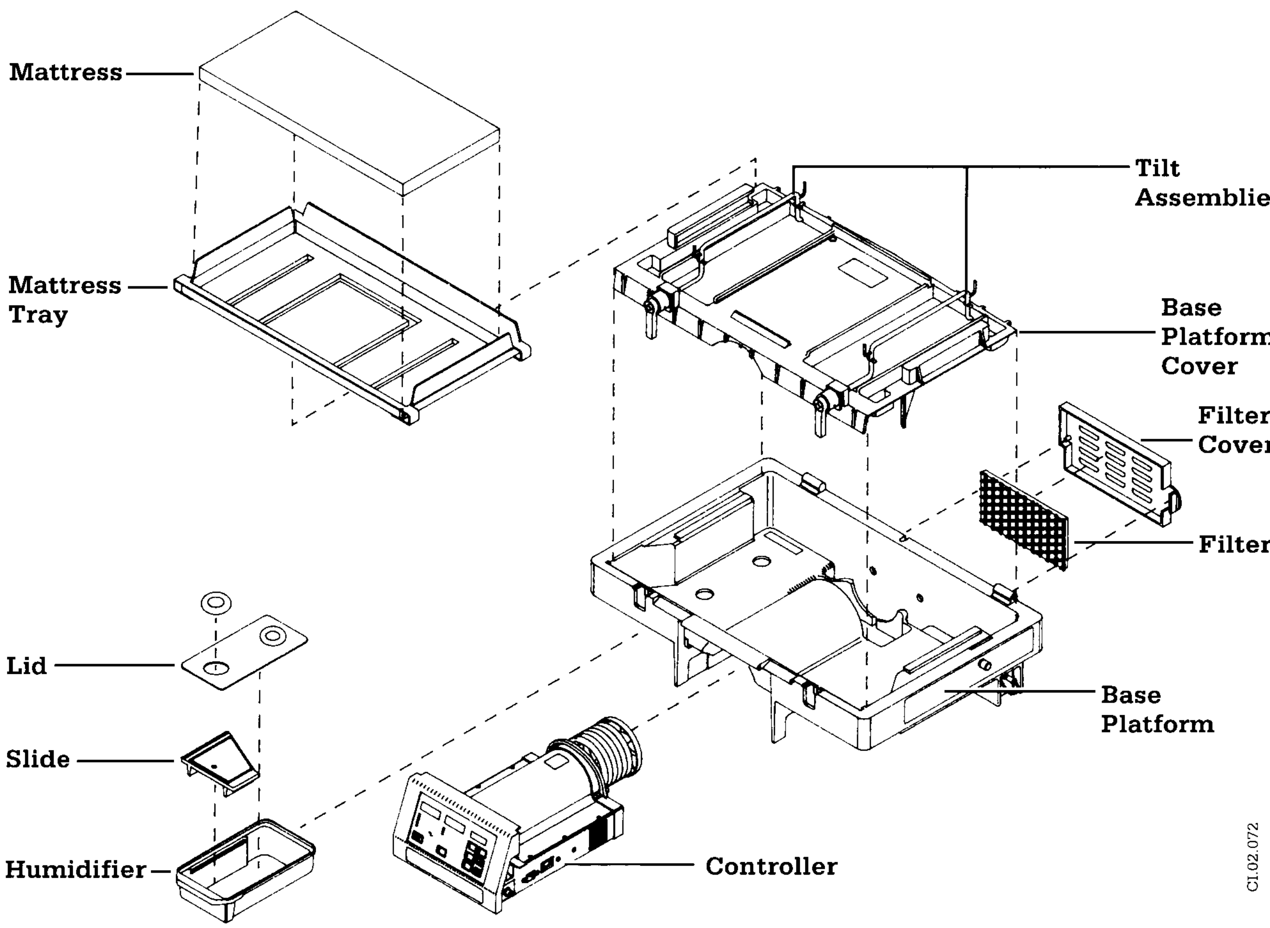


Figure 5-5 Base Platform Cover Removal

5.5 Controller Access

1. Disconnect the power cord, the patient probe, the air temperature sensor, and, if it is installed, the ThermaLink cable from the controller.

2. Lift up the controller latches and slide the controller forward, out of the incubator.

   ⚠CAUTION: When handling the controller, avoid bumping the fan or the heater. If these items are knocked out of alignment, the fan can grate against either the heater or the base.

3. Remove the Phillips head screws and lock washers used to attach the controller cover.

4. Lift off the controller cover.

ⓢ5.6 Control Board Replacement

⚠CAUTION: Make sure the control board connectors are properly aligned before applying power.

1. Access the controller as described in Section 5.5.

2. Disconnect control board connectors J1, J2, J3, J4, J5 and, if applicable, J6.

3. Remove the four lock nuts that secure the control board.

4. Lift the board out of the controller.

5. Position the new control board so that J3 is at the front of the controller. Replace the four lock nuts to secure the board to its mounting standoffs (Figure 5-6).

6. Reconnect J1, J2, J3, J4, J5 and, if applicable, J6. Connector pins are numbered for proper alignment.

7. Make sure that switches 1, 2, 7 and 8 are set to OFF (open position). This selects a maximum control temperature of 39°C and disables the calibration and service loops. Make sure that dipswitches 3 and 4 are in the same position as on the previous board.

8. Perform the Calibration Procedure in Section 3.3.

9. Replace the controller cover, using the Phillips head screws and lock washers previously removed.

10. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.

11. Perform the Checkout Procedure in Section 2.3. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the fan position if rubbing is present.

12. Perform the Electrical Safety Check in Section 3.4.

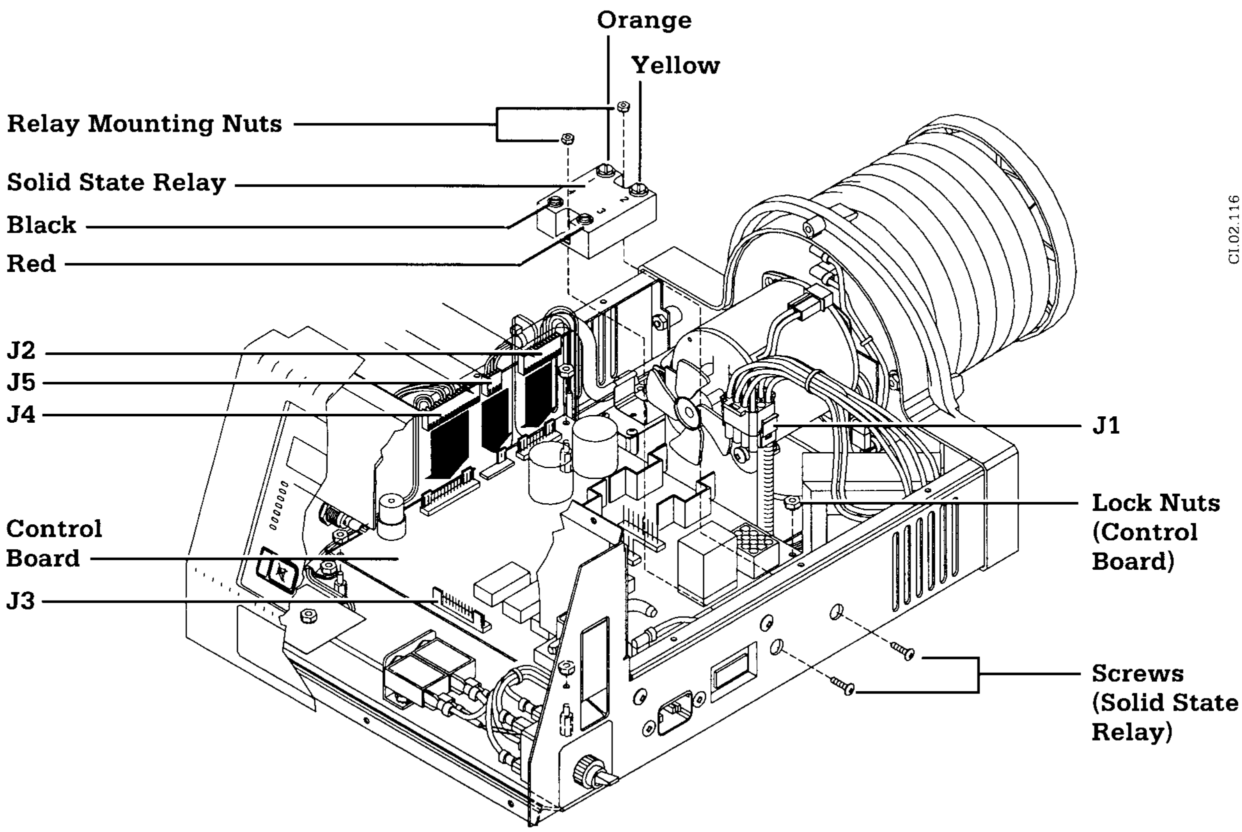


Figure 5-6 Controller Interior

5.7 Display Board Replacement

1. Access the controller as described in Section 5.5.

2. Turn the controller upside down and remove the lower three front panel mounting screws, shown in Figure 5-7.

3. Turn the controller right side up and remove the remaining front panel mounting screws, shown in Figure 5-7.

4. Lift off the front panel.

5. Disconnect J3 from the control board. On controllers that have serial numbers that do not begin with HBJ, remove the nut that anchors the ground wire to the upper left corner of the display board.

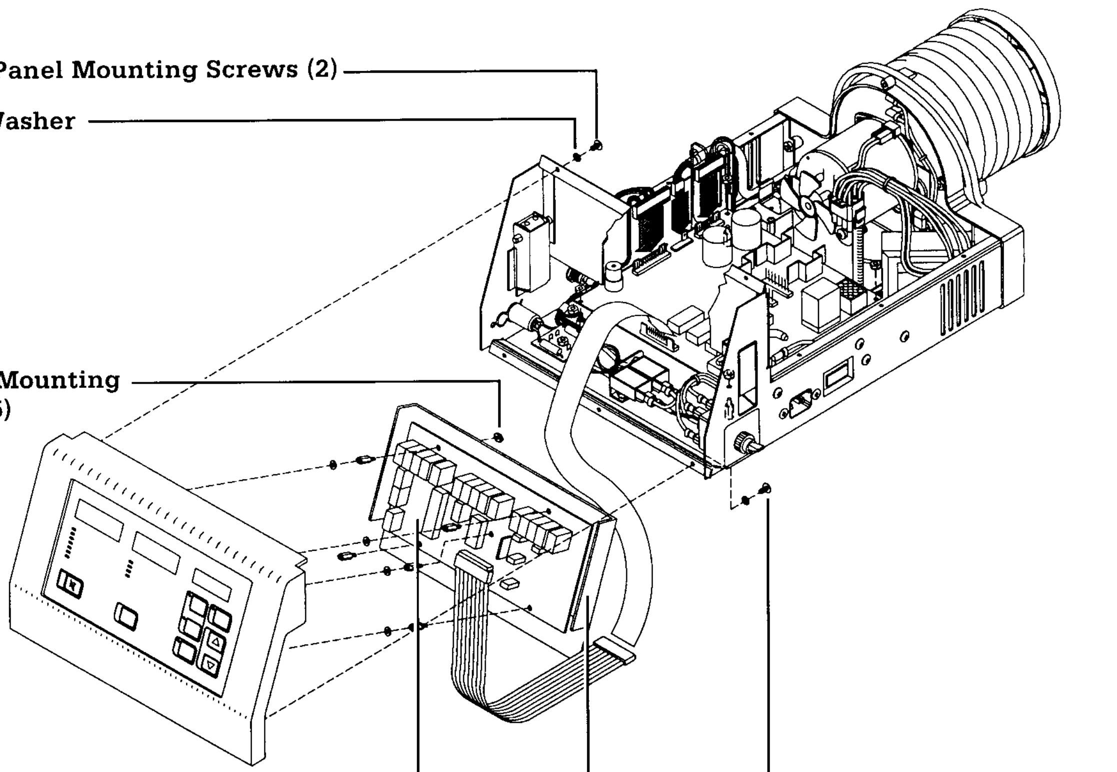


Figure 5-7 Replace the Display Board

6. On controllers that have serial numbers that begin with HBJ:

   a. Remove the screws, nuts and washers that secure the ESD shield.

   b. Remove the ESD shield and the nylon spacers.

7. Remove the existing display board.

8. Disconnect J8 from the existing display board.

9. Connect J8 to the replacement display board.

10. Place the new board component side down on the board standoffs with J8 pointing toward the bottom of the controller.

11. Connect the cable from J8 to control board connector J3.

12. Connect the temperature sensor and power cord to the controller. Plug the power cord into a power outlet and switch the controller ON.

13. If the display is too dim, complete section 3.3C to adjust the brightness.

14. Switch the controller OFF and unplug the power cord and temperature sensor

15. On HBJ serial number units:

    a. Replace the nylon spacers on the standoffs.

    b. Check to be sure there are no rips in the ESD shield. Thread the cable from J8 through the slot in the ESD shield.

    c. Replace the ESD shield, taking care not to rip it.

    d. Replace the five lock nuts that anchor the board to the controller.

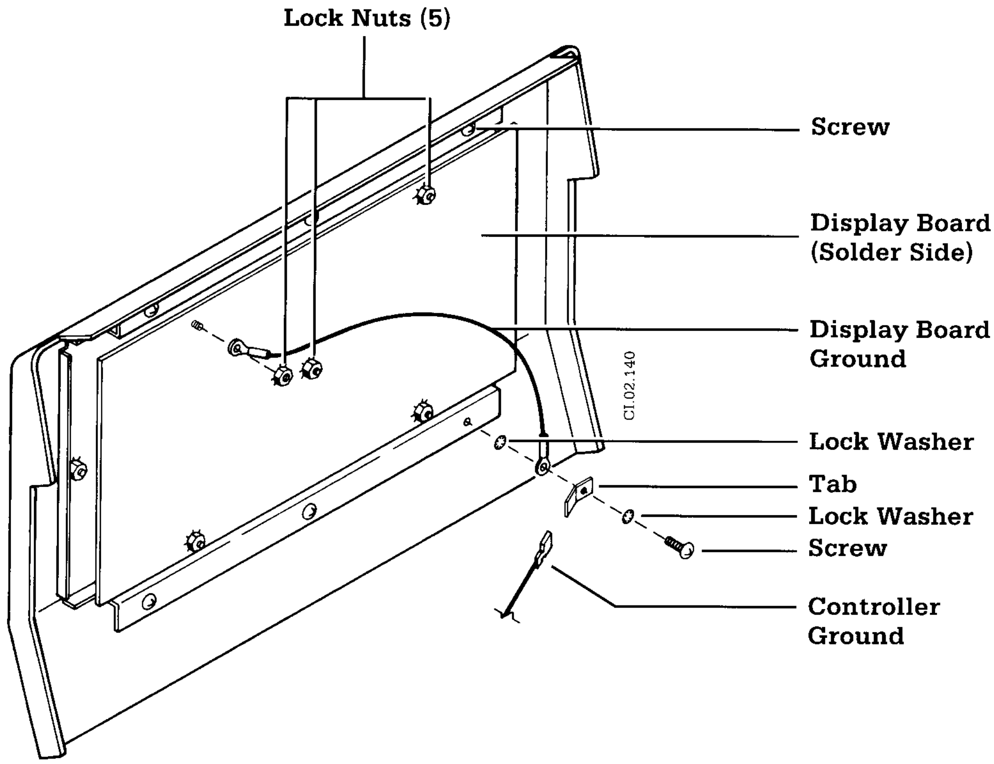


Figure 5-8 Display Panel Grounds controllers without HBJ serial number

16. On all other controllers:

    a. Replace the five lock nuts that anchor the board to the controller. Use the upper left hand nut to anchor one end of the short (display board) ground wire.

17. Replace the 5 mounting screws to reattach the front panel as in Figure 5-7.

18. Replace the controller cover, using the Phillips head screws and lock washers previously removed.
19. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.
20. Perform the Checkout Procedure in Section 2.3. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the fan position if rubbing is present.
21. Perform the Electrical Safety Check in Section 3.4.

5.8 Solid State Relay Replacement

(Figure 5-6)

Note: The Douglas Randall relay is a direct replacement for the Kodak relay.

The solid state relay is located on the same side of the controller as the power socket. It is attached to the controller with two Phillips screws and two lock nuts.

1. Access the controller as described in Section 5.5.
2. Remove the two screws used to mount the relay.
3. Lift the relay out of the controller.
4. Remove the screws that attach the wires to the solid state relay.
5. Connect the wires to the new solid state relay as follows:

Wire Color	Pin
Orange	1
Yellow	2
Red	3
Black	4

6. Use the two Phillips screws and the two lock nuts to attach the new relay to the side of the controller. Pins 3 and 4 should be toward the front of the controller.
7. Replace the controller cover, using the Phillips head screws and lock washers previously removed.
8. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.
9. Perform the Checkout Procedure in Section 2.3. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the fan position if rubbing is present.
10. Perform the Electrical Safety Check in Section 3.4.

5.9 Heater and/or Heater Gasket Replacement

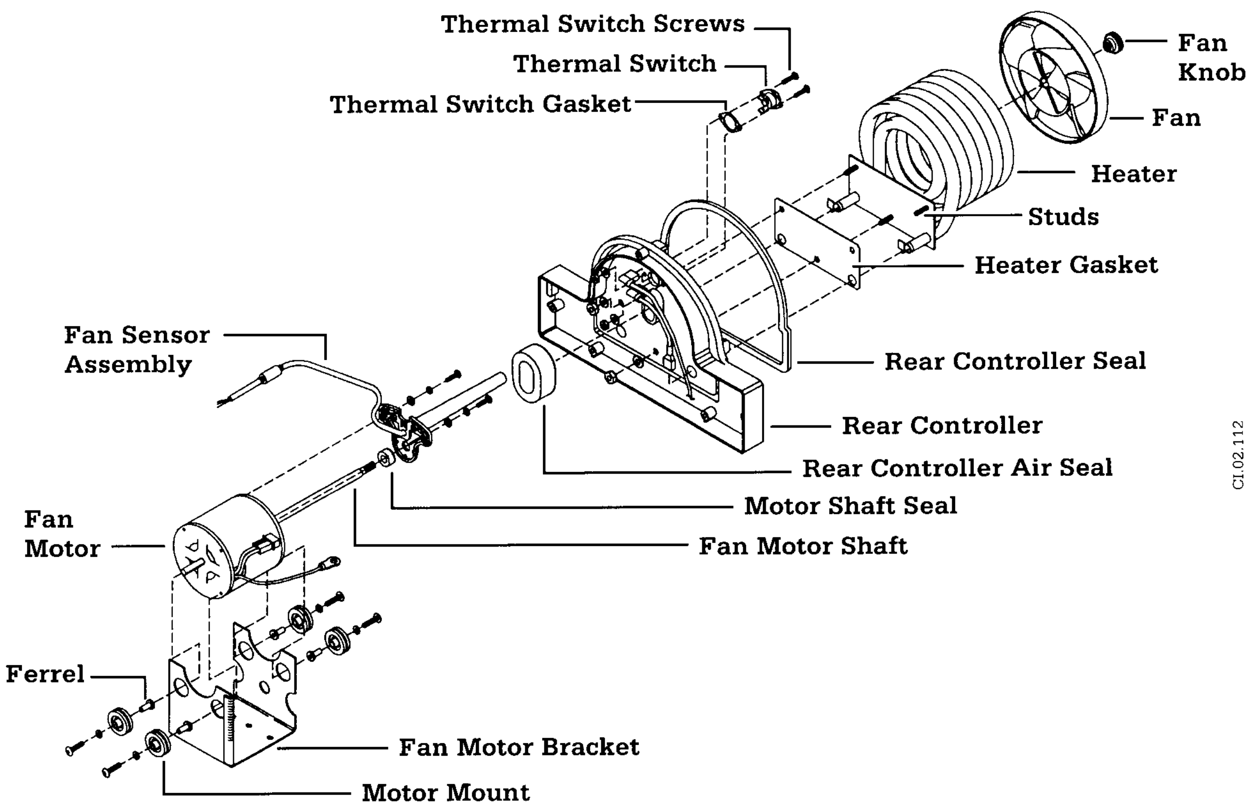
⚠CAUTION: If gaskets are not installed properly, water can leak in during cleaning and damage the electronics.

A. Heater and/or heater gasket replacement for controllers with serial numbers that begin with HBJ.

1. Access the controller as described in Section 5.5.
2. Unscrew the fan mounting knob at the end of the fan shaft. Remove the fan.
3. Disconnect the thermal switch wires and the heater wires.
4. Remove the right heater mounting nut to disconnect the harness ground wire.
5. Remove the four mounting screws that attach the back of the controller to the chassis.
6. Slide the back of the controller away from the chassis until it clears the motor shaft.
7. Remove the remaining two heater mounting nuts.
8. Pull off the heater.

   Note: The heater gasket will also come off.
9. Align the heater gasket with the new heater. Then slide the heater into the back of the controller.
10. Secure the heater to the back of the controller as shown in Figure 5-9.
11. Slide the back of the controller over the motor shaft and replace the four mounting screws into the chassis.
12. Reattach the thermal switch wires, heater wires, and ground wire.
13. The fan is keyed to fit the shaft. Slide the fan back onto the shaft so that the flat surface with the holes faces toward the heater.
14. Replace and tighten the fan mounting knob to secure the fan.
15. Replace the controller cover, using the Phillips head screws and lock washers previously removed.
16. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.
17. Perform the Checkout Procedure in Section 2.3. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the fan position if rubbing is present.
18. Perform the Electrical Safety Check in Section 3.4.

Controllers With Serial Numbers Beginning With HBJ



All Other Controllers

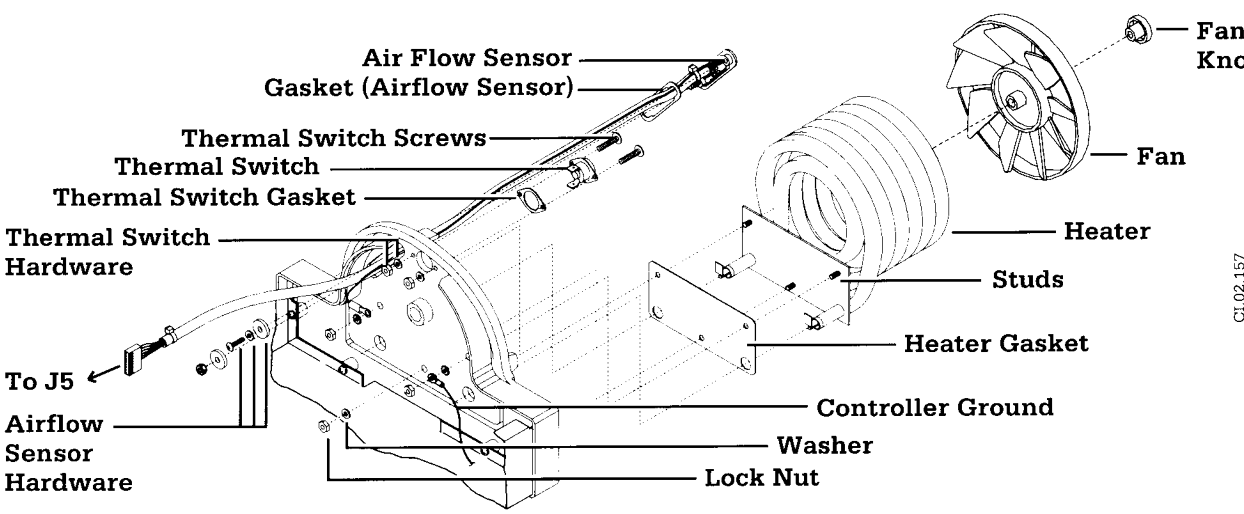


Figure 5-9 Heater, Thermal Switch and Fan Sensor Replacement

B. Heater and/or heater gasket replacement for all other controllers.

⚠CAUTION: If early model heaters are not installed with the nuts on the inside of the controller and the screws on the outside, water can leak in during cleaning and damage the electronics.

⚠CAUTION: If gaskets are not installed properly, water can leak in during cleaning and damage the electronics.

1. Access the controller as described in Section 5.5.

2. Unscrew the fan mounting knob at the end of the fan shaft. Remove the fan.

3. Remove the top two heater mounting nuts on the back of the controller.

4. Disconnect the white wires from the heater.

   Note: On some very early models, the heater wires are terminated with ring terminals. If you are replacing one of these heaters, remove the ring terminals from the wires and replace them with Faston 250 terminals.

5. Remove the lower heater mounting nut. The nut is accessed through a hole in the motor mounting bracket.

   Note: On early units you must remove the control board and the motor bracket to install a new heater.

6. Pull off the old heater.

   Note: The heater gasket will also come off.

7. Align the heater gasket with the new heater and slide the new heater into the back of the controller.

8. Secure the heater to the rear of the controller as shown in Figure 5-9.

9. If necessary, remount the motor bracket and the control board.

10. Reattach the white wires to the heater.

11. The fan is keyed to fit the shaft. Slide the fan back onto the shaft so that the collar points toward the heater.

12. Replace and tighten the fan mounting knob to secure the fan.

13. Reattach the controller cover, using the six Phillips head screws and lock washers previously removed.

14. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.

15. Perform the Checkout Procedure in Section 2.2. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.

16. Perform the Electrical Safety Check in Section 3.4.

5.10 Thermal Switch Replacement

⚠CAUTION: If gaskets are not installed properly, water can leak in during cleaning and damage the electronics.

Note: It is not necessary to remove the heater.

1. Access the controller as described in Section 5.5.

2. Unscrew the fan mounting knob and remove the fan.

3. Disconnect the wires attached to the thermal switch.

4. Remove the screws securing the thermal switch and pull the thermal switch out of the controller as shown in Figure 5-9. Position your hand inside the controller to catch the mounting nuts and lock washers when you remove the screws. Retain the gasket for use with the new thermal switch.

5. Align the gasket with the new thermal switch and replace the mounting hardware as shown in Figure 5-9.

6. Reconnect the thermal switch to the wires from J1 pin 2 and the heater. Make sure that there is clearance between the thermal switch wires and the motor.

7. Perform Section 3.3.J of the calibration procedures.

8. Replace the controller cover, using the Phillips head screws and lock washers previously removed.

9. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.

10. Perform the Checkout Procedure in Section 2.3. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.

11. Perform the Electrical Safety Check in Section 3.4.

5.11 Fan Sensor Replacement

(Applies only to controllers with serial numbers beginning with HBJ)

⚠**CAUTION: If the gaskets are not properly installed, water can leak in during cleaning and damage the electronics.**

Note: It is not necessary to remove the heater.

1. Access the controller as described in Section 5.5.
2. Remove the fan from the motor shaft, by removing the knob and sliding the fan off the shaft.
3. Disconnect the heater wires and the thermal switch wires and the harness ground wire. Then remove the back of the controller from the chassis by removing the four mounting screws.
4 Disconnect the fan sensor cable from the control board (J5) and remove the cable from the two p-clips.
5. Remove the two screws that hold the fan sensor mount to the motor.
6. Mount the replacement fan sensor assembly to the motor with the screws and washers from the existing assembly.
7. Route the replacement fan sensor cable through the two p-clips and connect it to J5 on the control board.
8. Attach the back of the controller to the chassis with the four mounting screws. Then reconnect the heater wires, the thermal switch wires and harness ground wire.
9. Slide the fan back on the motor shaft and secure by tightening the knob.
10. Calibrate the fan sensor as described in Section 3.3 I.
11. Replace the controller cover, using the Phillips head screws and lockwashers previously removed.
12. Perform the Checkout Procedure in Section 2.3 Controller Check. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.
13. Perform Electrical Safety Check in Section 3.4.

5.12 Air Flow Sensor Replacement

(Applies only to controllers with serial numbers that do not begin with HBJ)

⚠CAUTION: If the gaskets are not properly installed, water can leak in during cleaning and damage the electronics.

Note: It is not necessary to remove the heater.

1. Access the controller as described in Section 5.5.
2. Remove all screws, (nuts on some units) and harness clips that hold the sensor in place.
3. Disconnect the air flow sensor cable from the control board (J5).
4. Install the new sensor and gasket, making sure that the sensor is oriented as shown in Figure 5-10.
5. Connect the air flow sensor cable to the control board and replace the controller cover.
6. Replace the controller cover using the Phillips head screws and lockwashers previously removed.

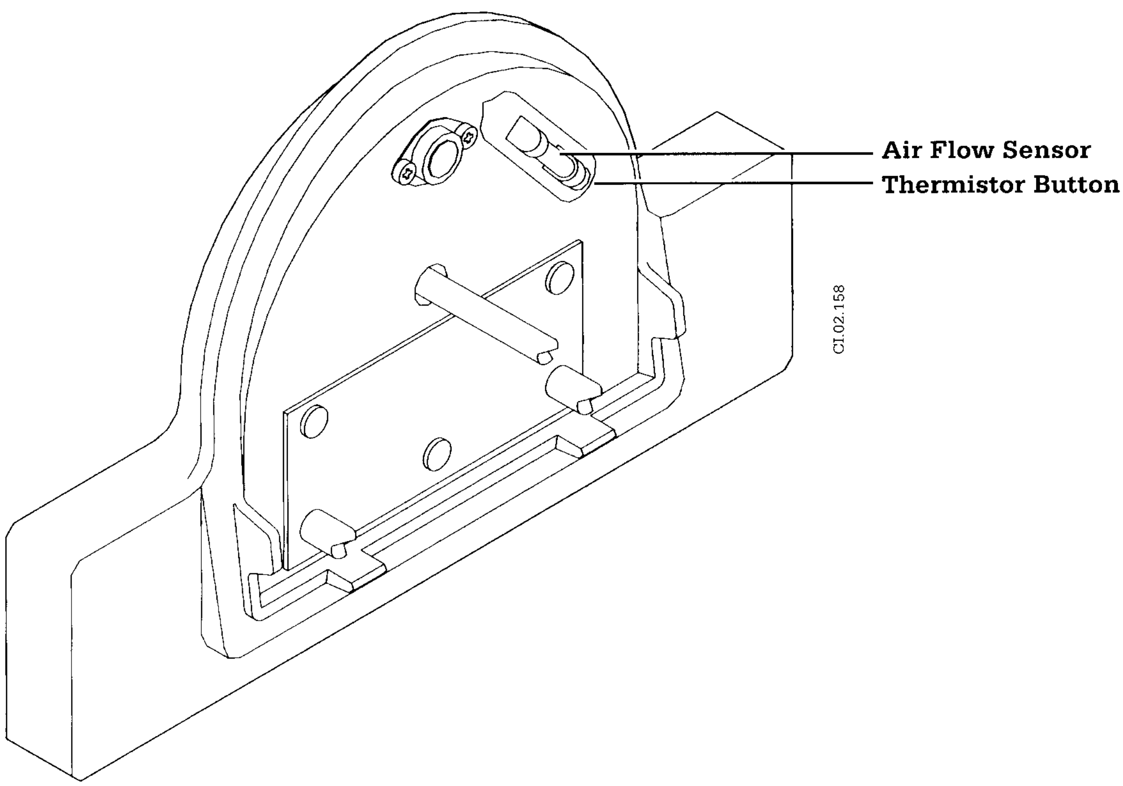


Figure 5-10 Air Flow Sensor Installation

7. Verify that the air flow sensor works as follows:

   a. Remove the fan and replace the controller in the incubator, making sure that the air temperature sensor and the power cord are plugged in.

   b. Switch the incubator ON. The operator prompt tone will sound. Do not adjust the control temperature; running the incubator with the heater OFF provides a more thorough test of the air flow sensor.

   c. Allow the unit to run for 10 minutes. The front panel air circulation alarm indicator should illuminate and an alternating two tone alarm should sound.

   d. Depress the °F/°C switch until a different pair of numbers appear in the air temperature and control temperature displays (approximately five seconds). Continue pressing the °F/°C button and record the numbers that appear in the air and control temperature displays.

   e. Subtract the two numbers. The difference must be greater than 230.

   f. Switch the unit OFF. Remove the controller and replace the fan. Slide the controller back into the incubator and reconnect the power cord and air temperature sensor.

   g. Switch the unit ON and adjust the control temperature to 39°C. Allow the incubator to run for 10 minutes.

   h. Again depress the °F/°C switch until a different pair of numbers appears in the air and control temperature displays (approximately five seconds). Continue pressing the °F/°C button and record the numbers that appear in the air and control temperature displays.

   i. Subtract the two numbers. The difference must be less than 190.

8. If the conditions of steps "e" and "i" are not met, the air flow sensor must be replaced.

9. Perform the Checkout Procedure in Section 2.3. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.

10. Perform the Electrical Safety Check in Section 3.4.

5.13 Fan Motor Replacement

A. Fan motor replacement for controllers with serial numbers beginning with HBJ .

1. Access the controller as described in Section 5.5.
2. Unscrew the fan mounting knob and remove the fan (refer to Figure 5-9).
3. Disconnect the heater wires, thermal switch wires and harness ground wire. Then remove the back of the controller from the chassis by removing the four mounting screws.
4. Remove the old air seal. Use isopropyl alcohol to remove any adhesive residue on the rear controller.
5. Remove the two mounting screws for the fan sensor.
6. Disconnect the fan motor connector from J1, and the motor ground wire from the controller chassis.
7. Remove the four motor mounting screws and slide the motor out of the bracket and the fan sensor assembly.
8. Pull the small cooling fan off the short motor shaft.
9. Note the orientation of the shock mounts before removing them from the motor bracket.

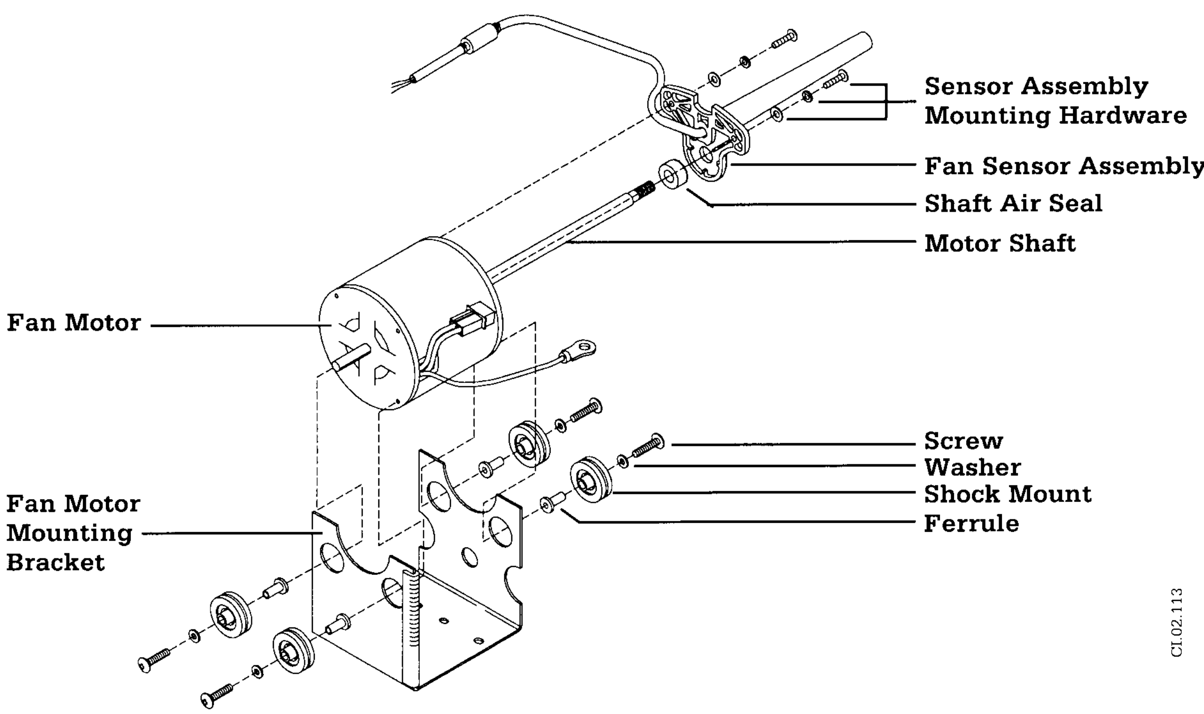


Figure 5-11 Fan Motor Replacement on HBJ controllers

10. Install the new shock mounts in the motor bracket. Then install the ferrules in the shock mounts.

11. Attach the new motor to the bracket as shown in Figure 5-11.

12. Push the cooling fan onto the shorter motor shaft.

13. Reinstall the fan sensor assembly on the motor.

14. Install the new air seal.

15. Slide the long motor shaft through the air seal and into the hole in the rear of the controller. Attach the back of the controller to the chassis.

16. Reconnect the heater, thermal switch and ground wires.

17. The fan is keyed to slide onto the motor shaft. Slide the fan onto the shaft so the flat surface with the holes on the fan points toward the motor.

18. Replace the fan mounting knob. Fully tighten the knob.

19. Connect the motor connector to the connector from J1 and the motor ground wire to the controller chassis.

20. Calibrate the fan sensor as described in Section 3.3 I.

21. Replace the controller cover, using the Phillips head screws and lock washers previously removed.

22. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.

23. Perform the Checkout Procedure in Section 2.3. Listen for any grating sound caused by the fan rubbing against the base platform. If rubbing is present, adjust the motor and fan position by loosening the motor bracket mounting screws and moving the motor and bracket.

24. Complete the Electrical Safety Check in Section 3.4.

B. Fan motor replacement for controllers with serial numbers that do not begin with HBJ

1. Access the controller as described in Section 5.5.

2. Unscrew the fan mounting knob and remove the fan.

3. Disconnect the fan motor connector going to J1 on the control board.

4. Turn the controller on its side and remove the four screws, standard washers and lock nuts used to attach the fan motor bracket to the controller.

5. Remove the control board.

6. Slide the motor assembly toward the front of the controller, until the shaft clears the back of the controller. Then lift the assembly out of the controller.

7. Remove the old air seal. Use isopropyl alcohol to remove any adhesive residue on the rear controller.

8. Install the new air seal.

9. Remove the four motor mounting screws and slide the motor out of the bracket.

10. Pull the small cooling fan off the short motor shaft.

11. Note the orientation of the shock mounts before removing them from the motor bracket.

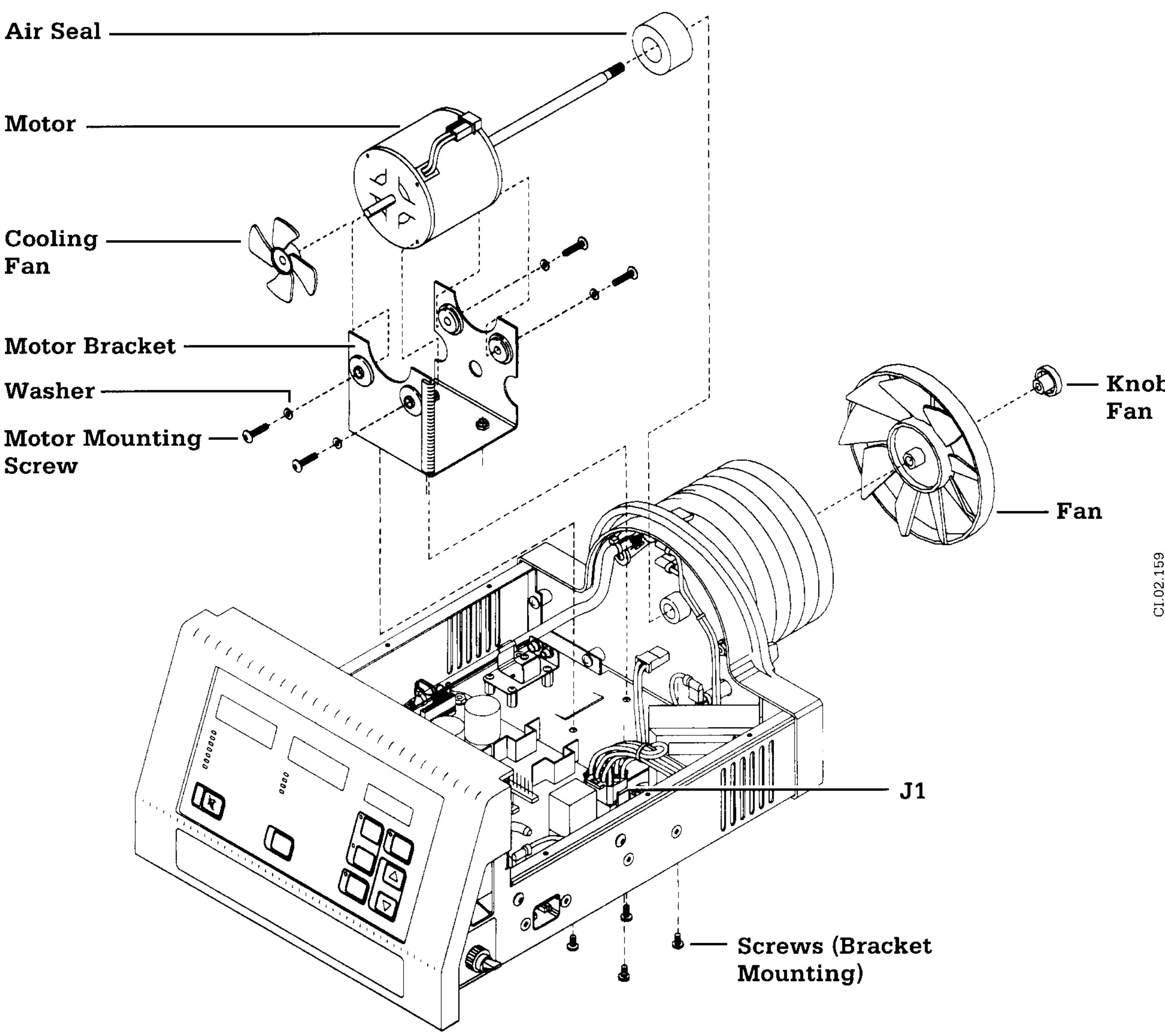


Figure 5-12 Fan Motor Replacement on controllers without HBJ serial numbers

12. Install the new shock mounts in the motor bracket. Then install the ferrules in the shock mounts.

13. Attach the new motor to the bracket as shown in Figure 5-12, making sure the motor wires reach the wire harness connector.

14. Push the cooling fan onto the shorter motor shaft.

15. Slide the long motor shaft through the air seal and into the hole in the rear of the controller.

16. Secure the motor bracket to the controller with the four bracket mounting screws, shown in Figure 5-12.

17. The fan is keyed to slide onto the motor shaft. Slide the fan onto the shaft so the collar on the fan points toward the motor.

18. Replace the fan mounting knob. Fully tighten the knob.

19. Replace the control board.

20. Connect the motor connector to the connector going to J1 on the control board.

21. Replace the controller cover, using the Phillips head screws and lock washers previously removed.

22. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.

23. Perform the Checkout Procedure in Section 2.3. Listen for any grating sound caused by the fan rubbing against the base platform. If rubbing is present, adjust the motor and fan position by loosening the motor bracket mounting screws and moving the motor and bracket.

24. Complete the Electrical Safety Check in Section 3.4.

5.14 Battery Replacement

1. Access the controller as described in Section 5.5.

2. Remove the battery by sliding the battery away from the contacts.

3. Install the new battery by lining the terminals up with the contacts and sliding the battery into the bracket.

4. Reattach the controller cover, using the Phillips head screws and lock washers previously removed.

5. Pull up on the controller latches. Carefully slide the controller back into the incubator. Push down on the latches to secure the controller.
6. Perform the Checkout Procedure in Section 2.3. Listen for any grating sound caused by the fan rubbing against the base platform. Adjust the heater and fan position if rubbing is present.
7. Perform the Electrical Safety Check in Section 3.4.

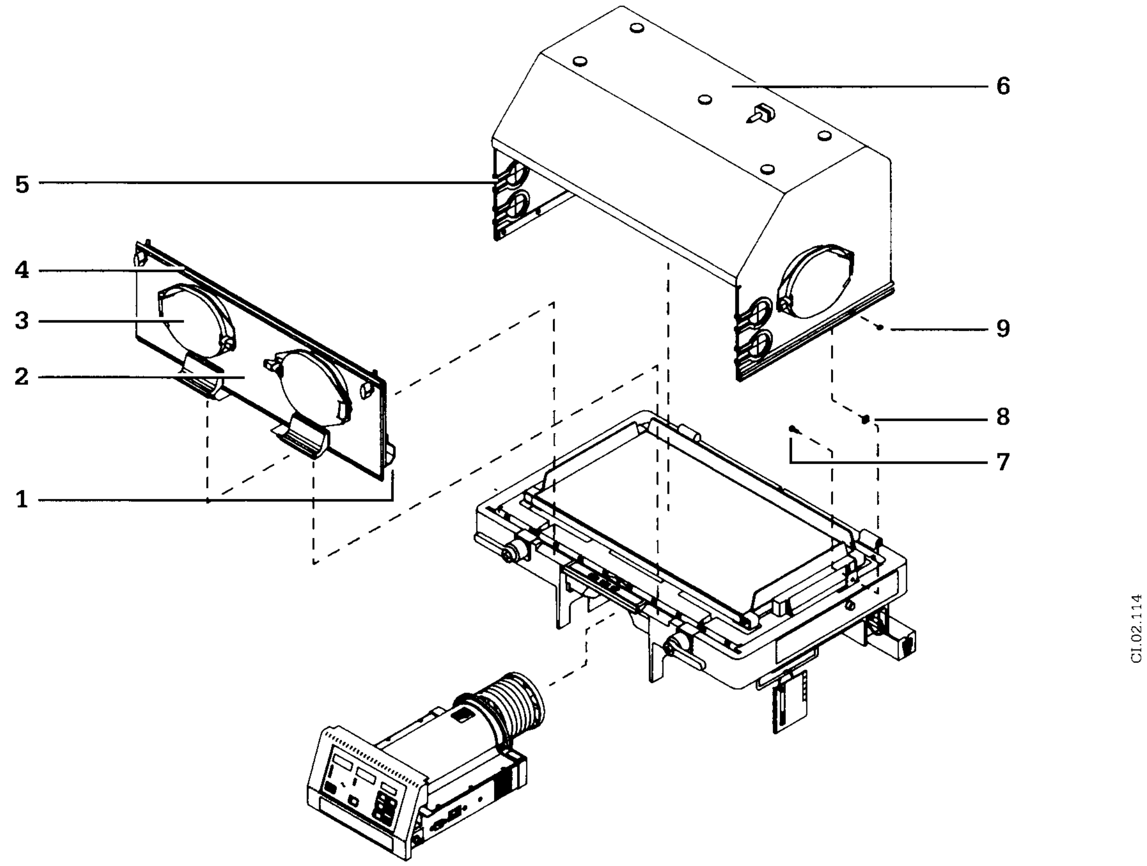
5.15 Cabinet Caster Replacement

⚠WARNING: Two people are required to safely replace a caster. Remove the incubator and all accessory equipment from the cabinet before replacing a caster.

1. Remove all accessories from the incubator.
2. Remove the incubator mounting knobs (located inside the cabinet), which attach the incubator to the cabinet.
3. Lift the incubator off the cabinet.
4. Lay the cabinet on its side.
5. Remove the four lock nuts that attach the caster to the cabinet.
6. Remove the old caster.
7. Slide the new caster over the mounting studs.
8. Replace and tighten the lock nuts to secure the caster. Torque to 75 in-lbs.
9. Turn the cabinet right side up.
10. Attach the incubator to the cabinet with the incubator mounting knobs.

6/Illustrated Parts List

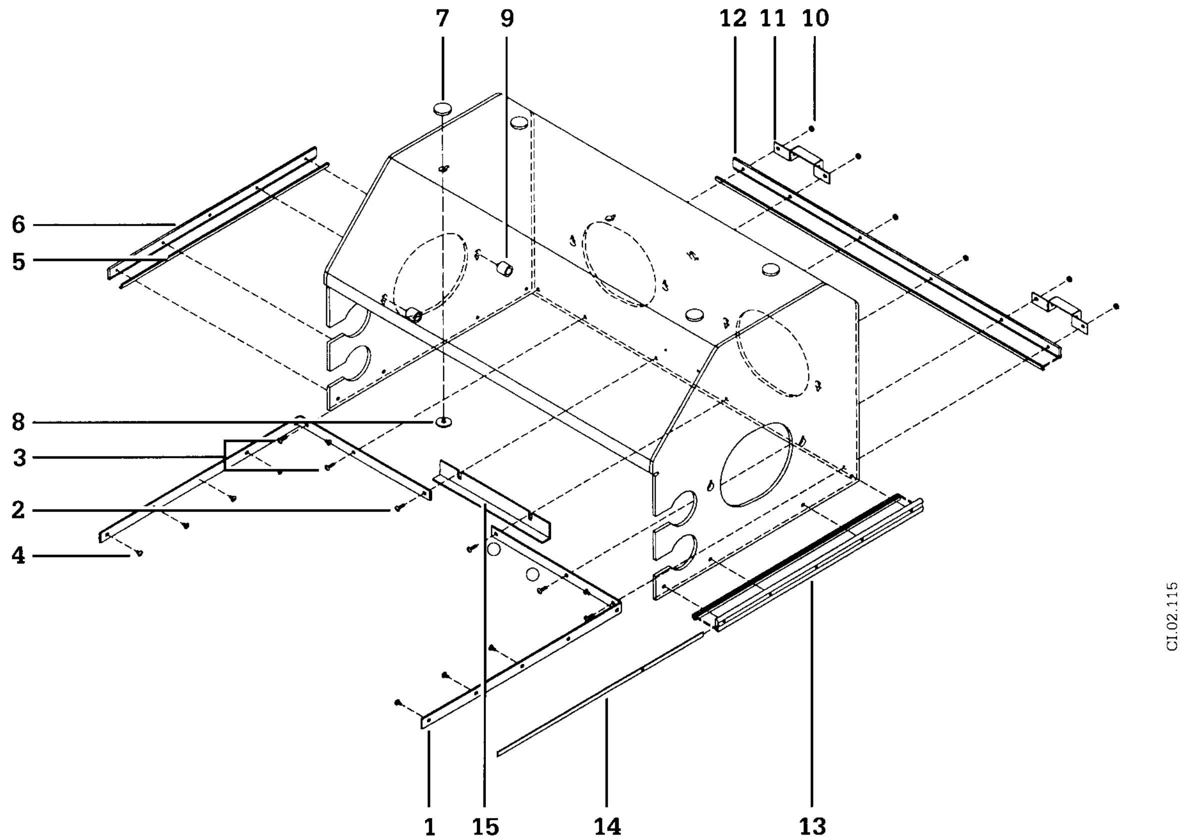
6.1 Hood Components



Item		Stock Number
1.	Deflector panel w/ fasteners	6600-0155-700
2	Front door replacement kit (outer door with hdwe)	6600-0148-800
3.	Porthole kit (1)	6600-0227-800
	Porthole kit (6)	6600-0226-800
4	Lower wall (front or rear w/ deflector panel).	6600-0106-800
5.	Tubing access cover	6600-0330-500
6.	Hood replacement kit (outer hood with hardware)	6600-0038-810
7.	Screw, 10-24 x 1.000	6600-0118-400
8.	Nylon washer, 0.192 in ID	6600-0103-400
9.	Nut, ESN, 10-24, SST	6600-0088-400

Misc. Hood Hardware	Stock Number
Inner wall fastener (12/pkg)	6600-0102-800
Mounting post	6600-0161-700
Replacement porthole bumpers (12/pkg)	6600-0401-800

Figure 6-1 Incubator Assembly, Front View

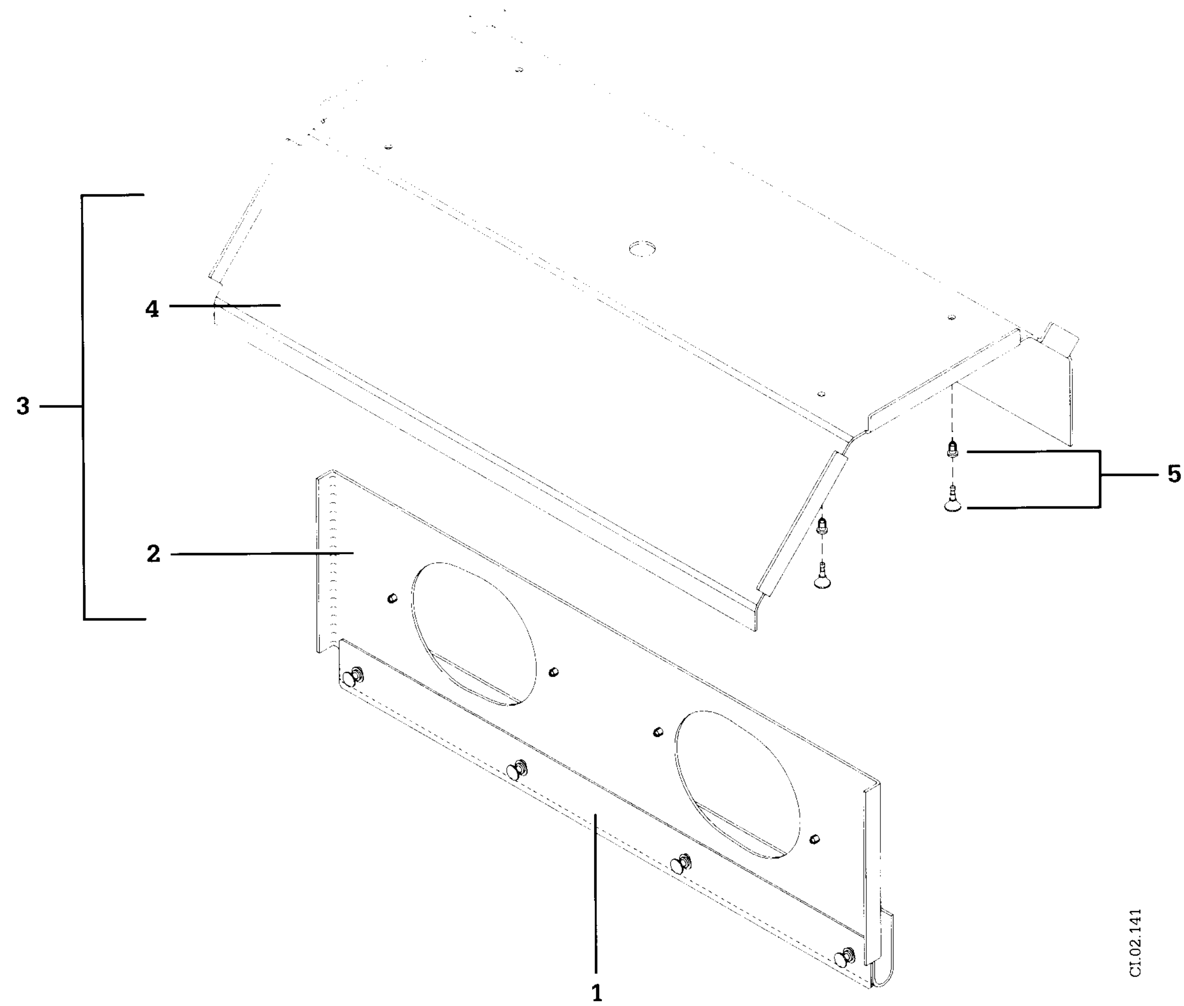


Item	Stock Number
1. Inner frame, hood (left or right half)	6600-0227-500
2. Screw, 10-24 x .875	6600-0087-400
3. Screw 10-24 x 1.00	6600-0118-400
4. Screw, 10-24 x 1/2	0140-6630-108
5. Hood seal (3 ft strip)	6600-0143-500
6. Outer frame, left side	6600-0049-400
7. Retainer, upper wall (sgle. & dble. wall units)	6600-0148-500
8. Hole plug (sgle. wall units)	6600-0189-700
9. Mounting Post (dble. wall units)	6600-0161-700
10. Nut, ESN, 10-24, SST	6600-0088-400
11. Hood hinge cover	6600-0165-500
12. Outer frame, rear	6600-0048-400
13. Outer frame, right side	6600-0050-400
14. Trim, outer frame (3 ft strip)	6600-0166-500
15. Baffle, acoustic	6600-0382-500

Not shown

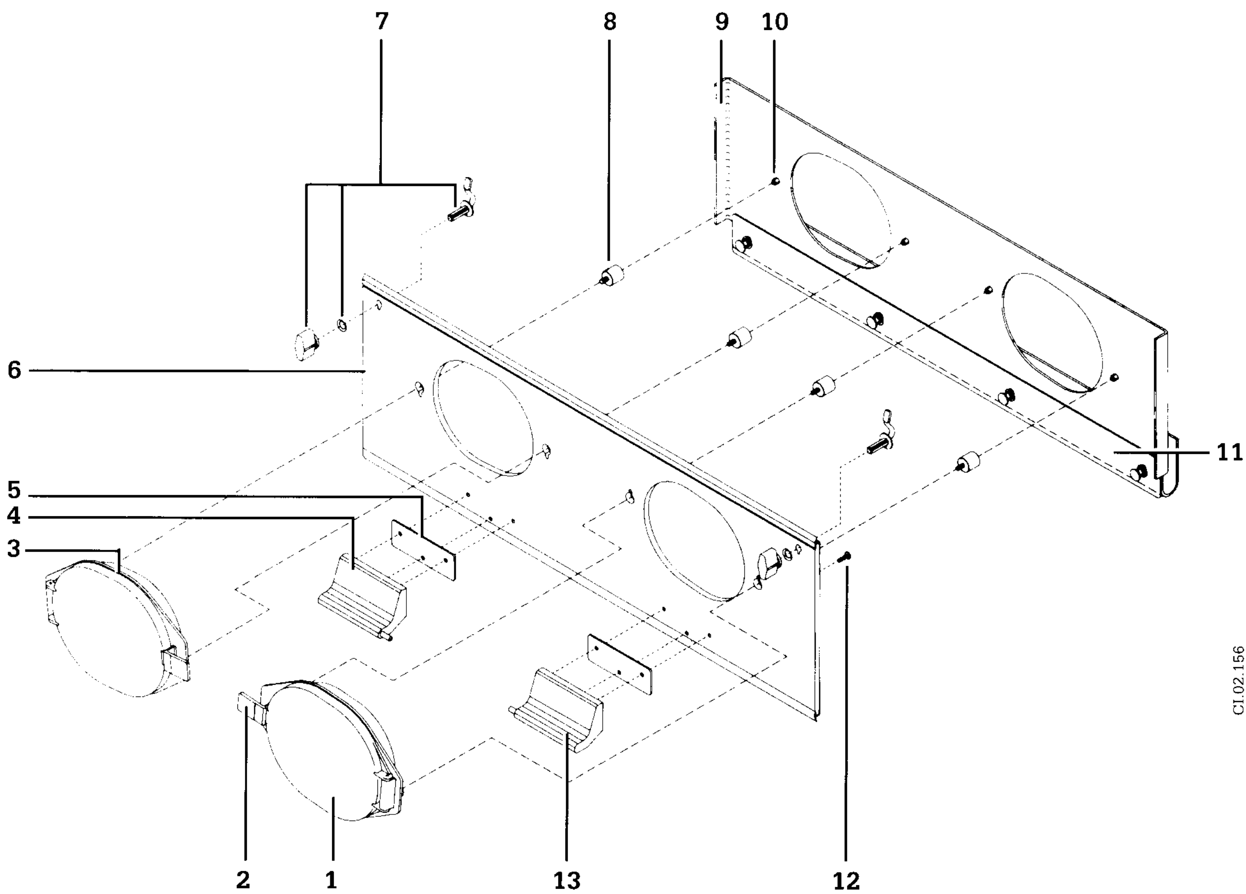
Hood replacement kit (items 1-9)	6600-0038-810

Figure 6-2 Hood Seals and Related Hardware



Item	Stock Numbe
1. Deflector panel w/ fasteners	6600-0155-70(
2. Lower wall (front or rear w/ deflector panel)	6600-0106-80(
3. Inner wall, hood (includes all items shown)	6600-0040-80(
4. Upper inner wall w/ fasteners	6600-0116-80(
5. Inner wall fastener (20/pkg)	6600-0102-80(

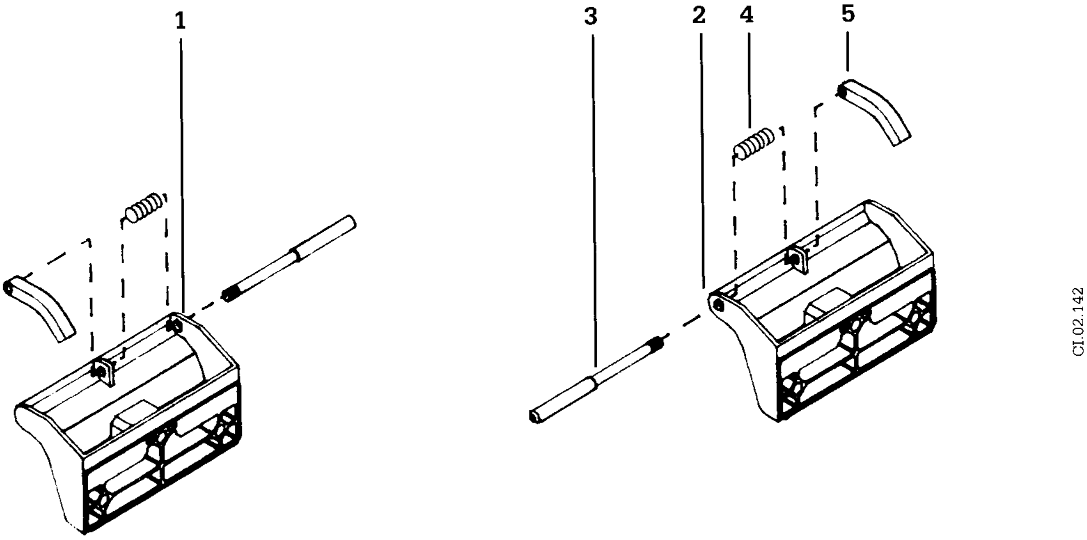
Figure 6-3 Inner Wall Assembly, Hood



Item	Stock Number
1. Porthole replacement kit(1/pkg)	6600-0227-800
Porthole replacement kit (6/pkg)	6600-0226-800
2. Latch assembly	6600-0273-800
3. Porthole seal (6/pkg)	6600-0221-800
4. Left door hinge housing	6600-0036-400
5. Gasket, hinge	6600-0069-500
6. Front door replacement kit (outer door with hdwe)	6600-0148-800
7. Latch, hood, replacement kit	6600-0146-800
8. Mounting post	6600-0161-700
9. Lower wall (front or rear deflector panel	6600-0106-800
10. Inner wall fastener (20/pkg)*	6600-0102-800
11. Deflector panel w/ fasteners	6600-0155-700
12. Screw, 10-32 x .75, TR	6600-0089-400
13. Right door hinge housing	6600-0035-400

* Insert the socket into the proper hole in the inner wall and then push in the plunger.

Figure 6-4 Front Door and Related Hardware



Item	Stock Numbe
1. Left door hinge housing	6600-0036-40(
2. Right door hinge housing	6600-0035-40(
3. Hinge pin rod*	6600-0140-50(
4. Hinge pin spring, CPRSN	6600-0059-40(
5. Hinge pin release	6600-0141-50(

* Apply Loctite 27741 , Stock No. 0220-5025-300

Figure 6-5 Hinge Detail

Compartment probe and related items

Item	Stock Number
1. Internal Humidifier fill port kit (w/ o-ring)	6600-0070-800
2. Filter cover kit	6600-0235-800
3. Knob, filter cover mounting	6600-0068-500
4. Nut, Hex, 8-32	0202-1008-300
5. Cable clamp	6600-0144-400
6. Compartment probe kit, air temperature sensor (includes mounting blocks, shim and screws)	6600-0071-800
7. Shim	6600-0222-500
8. Screw, 8-32 x 1/2, TRS, P	0140-6627-108
9. Screw, 1/4-20 x .500, R*	6600-0078-400

* Apply Loctite 24321, Sock No. 0220-5031-300 to threads, fully tighten, then loosen 1/4 turn.

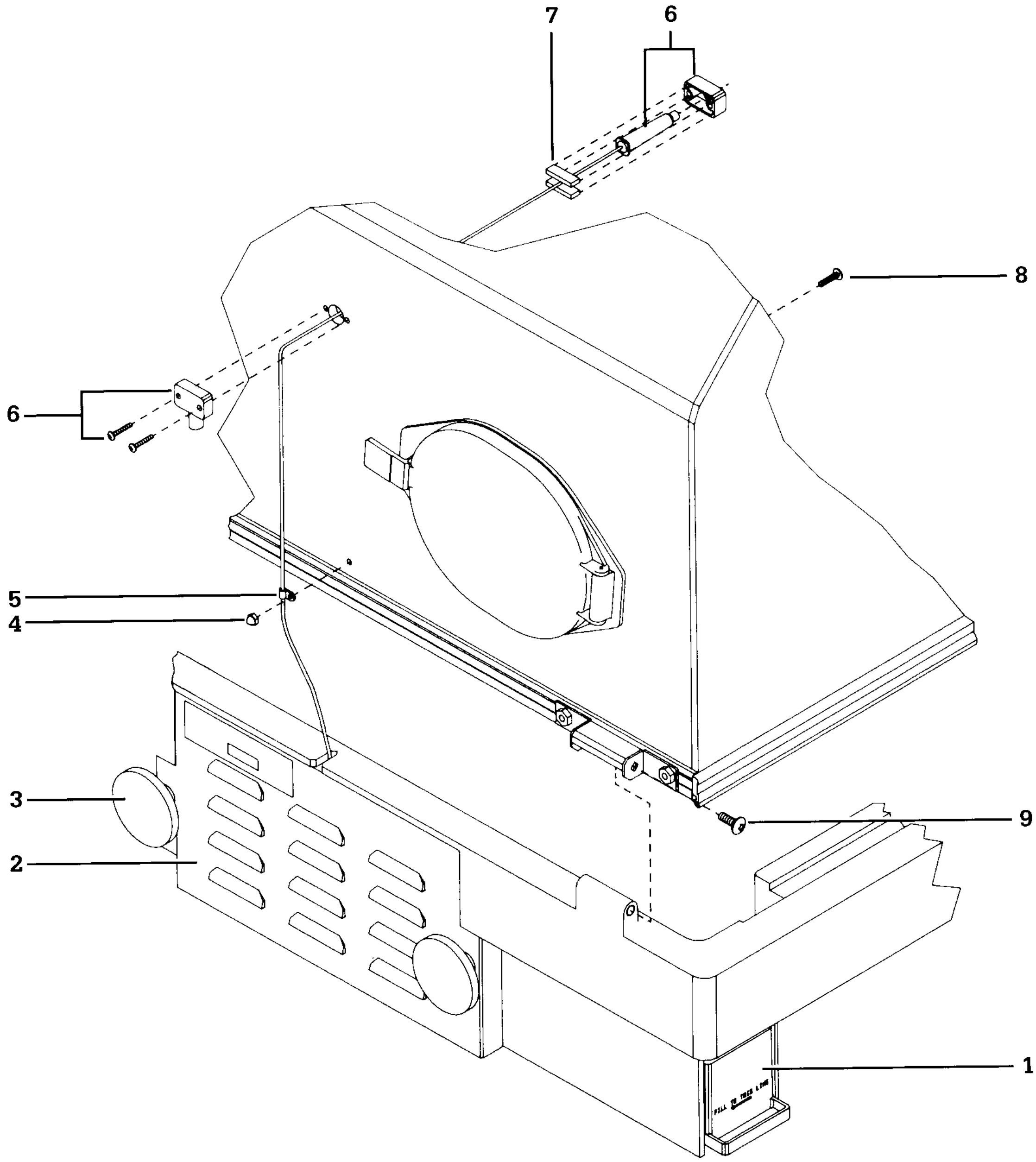


Figure 6-6 Incubator Assembly, Rear View

6.2 Base Platform Components

Item		Stock Number
1.	Mattress tray	6600-0175-500
2.	Mattress w/cover	6600-0152-500
3.	Tilt handle assembly	6600-0078-800
4.	Base platform cover service kit	6600-0111-800
	Base platform cover service kit, French 220/240 V	6600-0364-800
5.	Hood tilt latch	6600-0123-500
6.	Spring, hood tilt release, CPRSN	6600-0061-400
7.	Plunger, hood tilt release	6600-0125-500
8.	Hair pin clip*	6600-0104-400
9.	Base replacement kit (external humidifier) English^	6600-0237-800
	Base replacement kit (external humidifier) international^	6600-0238-800
10.	External humidifier complete (includes items 11-14)	6600-0218-800
11.	Humidifier sump (reservoir)	6600-0436-500
12.	Humidifier slide	6600-0435-500
13.	Humidifier lid	6600-0434-500
14.	Humidifier seals (2/pkg)	6600-0220-800
15	Filter cover replacement kit	6600-0235-800

* Clip on after plunger is installed.

^ Order this kit to replace a damaged base platform. To upgrade from an internal to an external humidifier base platform see parts listed on page 6-10.

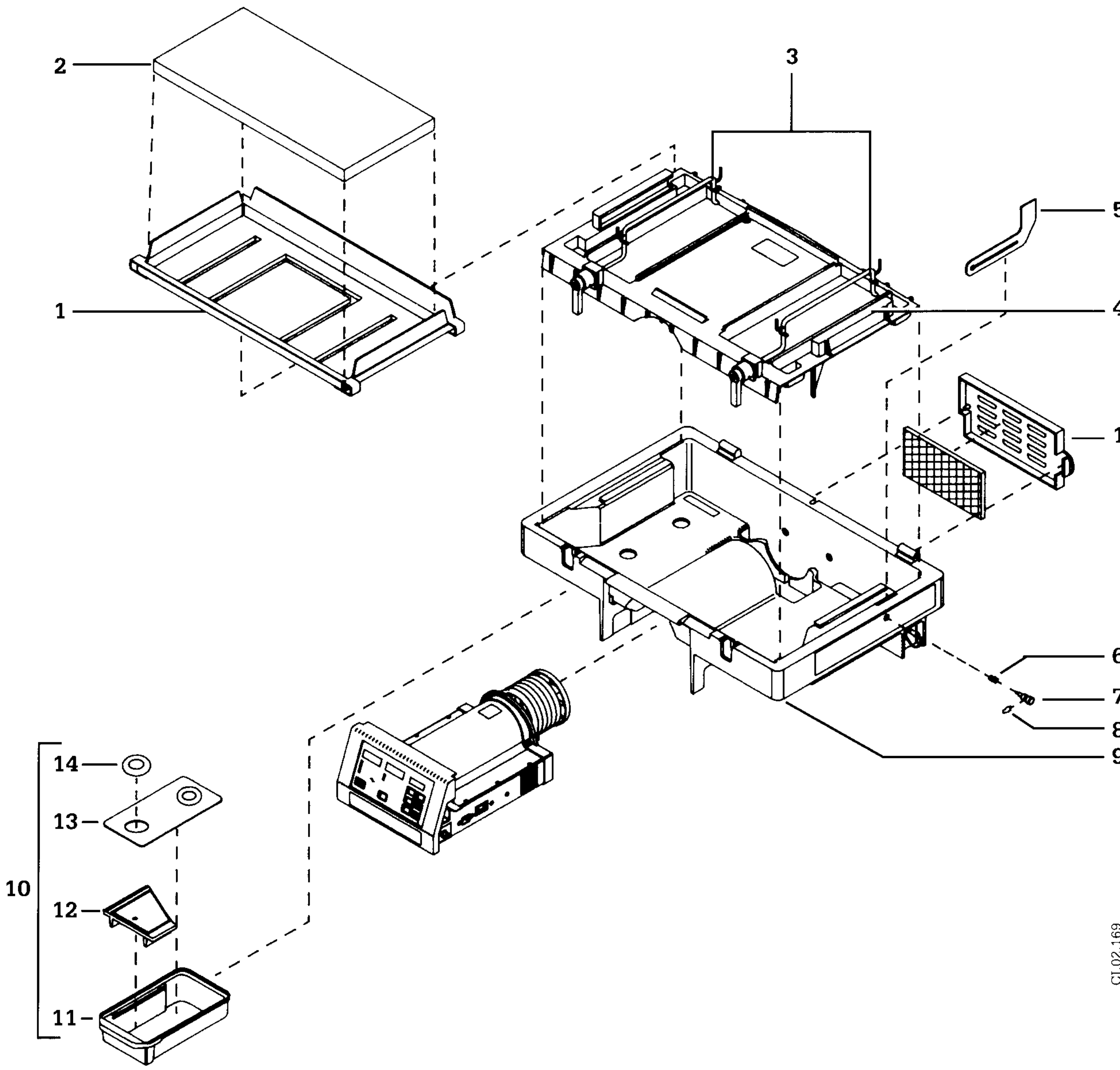


Figure 6-7 Base Platform, external humidifier and Cover Assembly

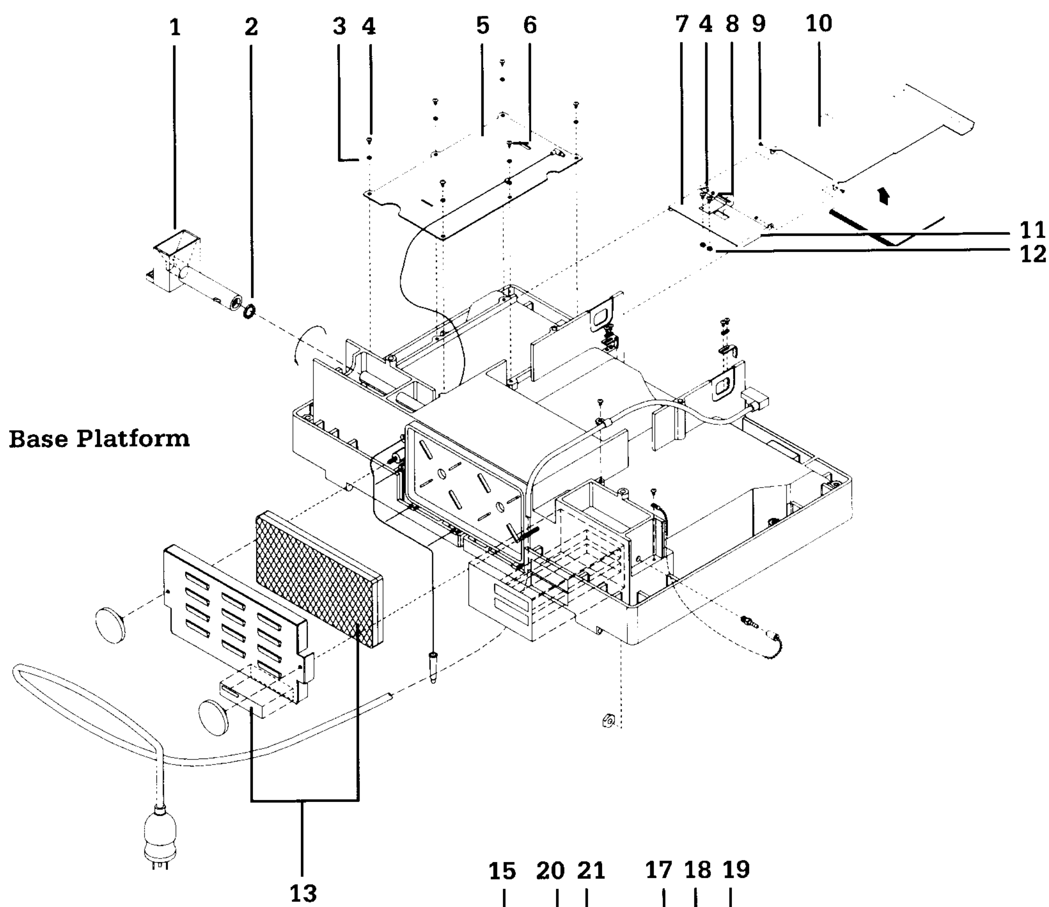
6/Illustrated Parts List

Item	Stock Number
1. Internal humidifier fill port kit (port & O-ring)*	6600-0070-800
2. Internal humidifier O-ring*	6600-0065-400
3. Washer, Int. Lock #8*	6600-0262-400
4. Screw, 8-32 x 1/4*	0140-6627-104
5. Cover plate, base platform*	6600-0160-500
6. Screw, 8-32 x 3/8, TRS, P*	6600-0261-400
7. Stop clip, sliding tray*	6600-0162-500
8. Nut, elastic 4-40, ST*	0202-1013-300
9. Screw, 4-40 x 1/4, TRS, P*	6600-0125-400
10. Sliding tray*	6600-0163-500
11. Retainer, sliding tray*	6600-0161-500
12. Nut, KEP, 4-40 W/E*	6600-0073-400
13. Filter & replacement date sticker	6600-0043-800
14 Filter cover assembly	6600-0235-800
15. Cable clamp	6600-0145-400
16. Compartment probe kit, air temperature sensor^	6600-0071-800
17. Screw, 8-32 x 3/8	0140-6127-106
18. Washer, Int. Lock #8	6600-0262-400
19. Controller latch brackets (order separately)	
A. Controller latch bracket (left)	6600-0225-500
B. Controller latch bracket (right)	6600-0226-500
20. Screw 6-32 x 3/8	0142-4163-106
21. Cable clamp	0208-0335-300
22. Screw, #8 x 3/8, TR, PH	0142-2164-206
23. Cap and chain	0217-3785-700
24. Nipple, 1/8 NPT x 3/16 hose .	6600-0102-400
25. Nut, 1/8 NPT x .125	6600-0176-500
26. External humidifier rails (2 with hardware)	6600-0219-800
27. Screw	6600-0078-400
28. Washer	0202-3216-300
29. Pleur-Evac hanger	6600-0301-500

Not Shown	Stock Number
Probe pull kit, "T" handle air temperature sensor	6600-0138-800
Base replacement/upgrade kit (external humidifier style base, labels all lang, complete humidifier, O&M manual)	6600-0107-800
Refresher instructions, English	6600-0022-000
Refresher instructions, French	6600-0057-000
Refresher instructions, Spanish	6600-0058-000
Refresher instructions, German	6600-0059-000
Refresher instructions, Swedish	6600-1255-100
Refresher instructions, Italian	6600-1257-100

^ Includes mounting blocks, shims and hardware.

* Items 1 - 12 are service parts for the old style internal humidifier base platform. If you must replace the base platform itself, you must order the upgrade kit listed in parts not shown. If your unit has the new external humidifier, to replace the base platform order the kits listed on page 6-8



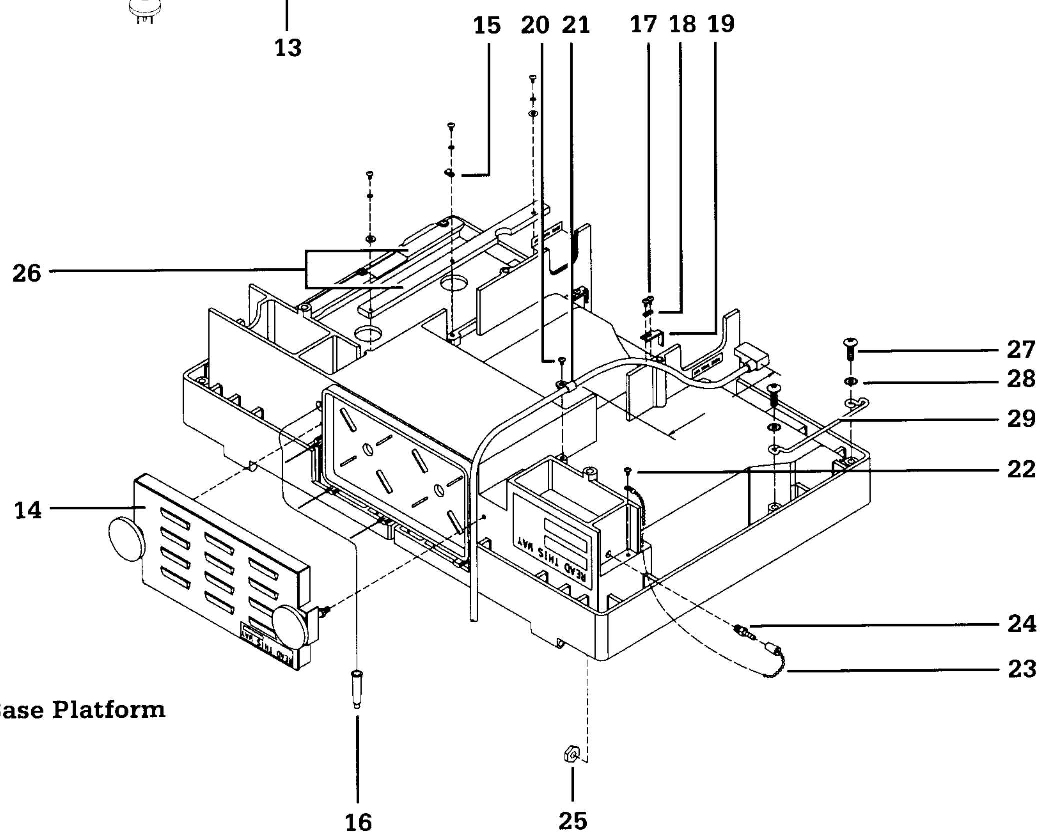
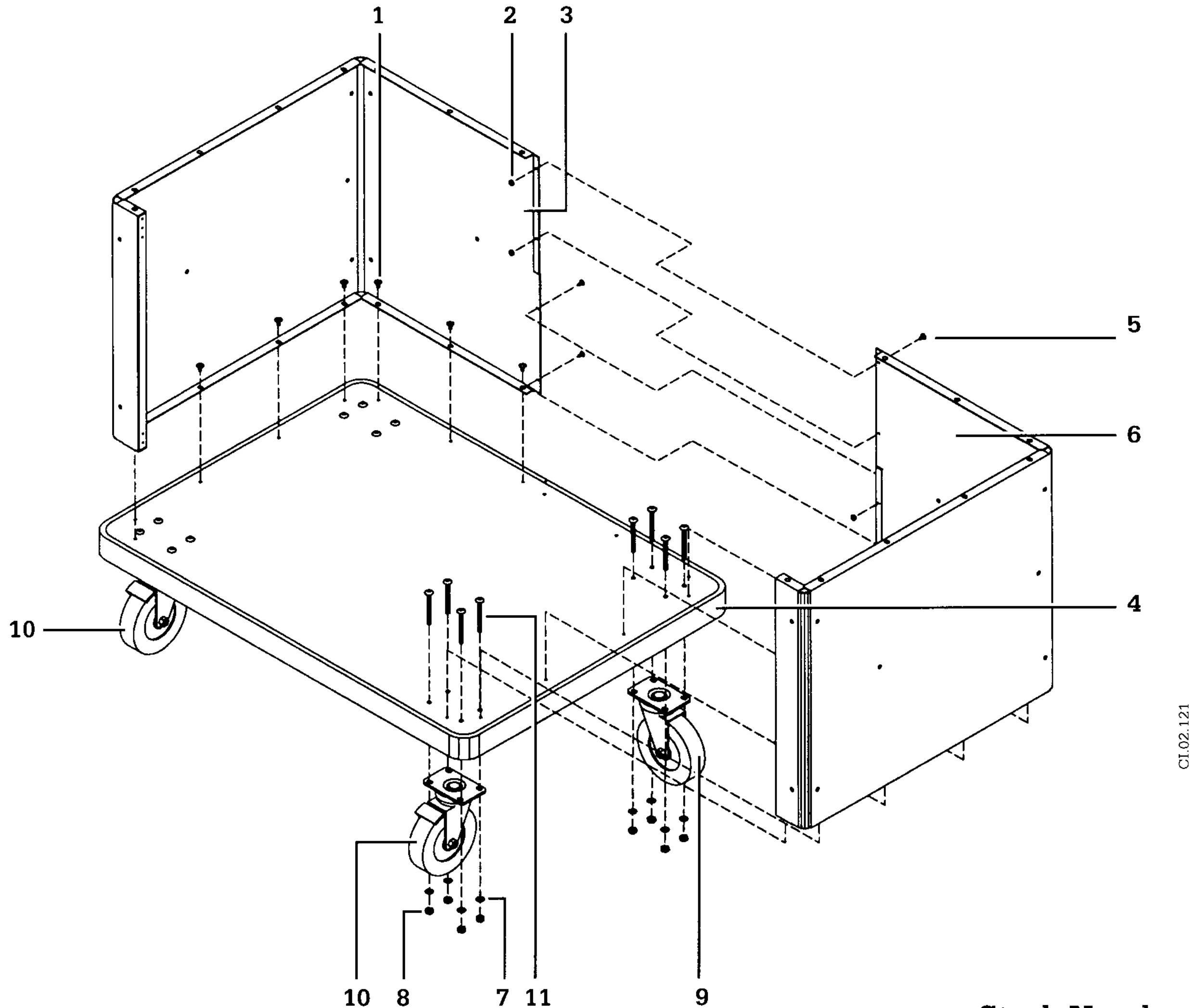


Figure 6-8 Base Platform Hardware (bottom view of platform)

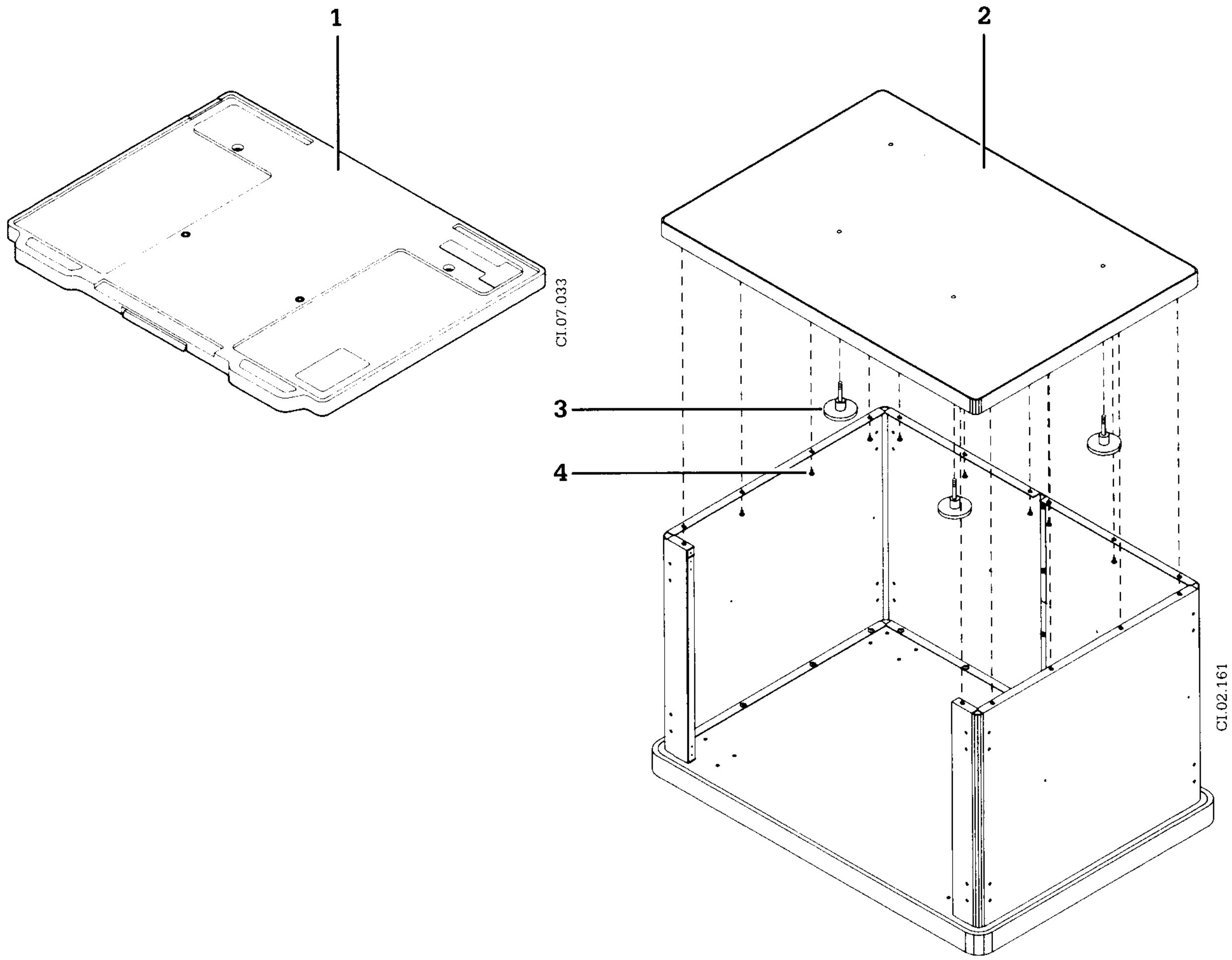
6.3 Cabinet Components



Item	Stock Number
1. Screw, WD, #10 x 1 in	6600-0044-400
2. Nut, 8-32 x .34	0202-1131-300
3. Cabinet side, left	6600-0216-500
4. Cabinet bottom	6600-0144-500
5. Screw, 8-32 x 3/8	6600-0261-400
6. Cabinet side, right	6600-0217-500
7. Washer, 1/4"	0202-4526-335
8. Nut, 1/4-20	6600-0074-400
9. Casters without locks	6600-0039-400
10. Casters with locks	6600-0038-400
11. Bolt, 1/4-20 x 2.25	6600-0047-400

Note: Item #1 - Torque all 16 screws to 25 in-lbs ± 5 in-lbs
Item #8 - Torque all 16 nuts to 50 in-lbs ± 5 in-lbs

Figure 6-9 Cabinet Assembly (base and sides)



Item	Stock Number
1. Cabinet top replacement (plastic)	6600-0199-800
2. Cabinet top replacement (wood)	6600-0131-800
3. Incubator mounting knob (4)	6600-0405-500
4. Screw, WD, #10 x .75 in*	6600-0225-400

Not shown

Complete cabinet with doors	6600-0036-900
Complete cabinet without doors	6600-0037-900
Molded top upgrade kit, (For replacement of wood top with plastic top, includes hdwe)	6600-0200-800

* Torque tc 25 in/Lbs.

Figure 6-10 Cabinet Assembly (shown with wooden top)

Item	Stock Number
1. Screw, 8-32 x 3/8, TRS, P	6600-0261-400
2. Washer, 0.118 ID, 0.438 OD	6600-0080-400
3. Nut, ext. lock, 8-32 x .34	0202-1131-300
4. Cabinet shelf	6600-0075-500
5. Cabinet apron	6600-0211-500
6. Screw, WD, #10 x 1 in*	6600-0044-400
7. Magnet	6600-0042-400
8. Screw, #6, FL, PH**	0400-3103-300
9. Left door	6600-0130-400
10. Screw 8-32	6600-0045-400
11. Screw 4-40	6600-0046-400
12. Strike, cabinet door	6600-0043-400
13. Plastic hole plug 0.375 in	6600-0085-400
14. Right door	6600-0129-400
15. Door hinge, (top right and bottom left)	6600-0128-400
16. Door hinge, (top left and bottom right)	6600-0127-400
17. Door handle	6600-0083-500

* Torque to 25 in-lbs

** Apply Loctite 24231, Stock No.6600-0058-300

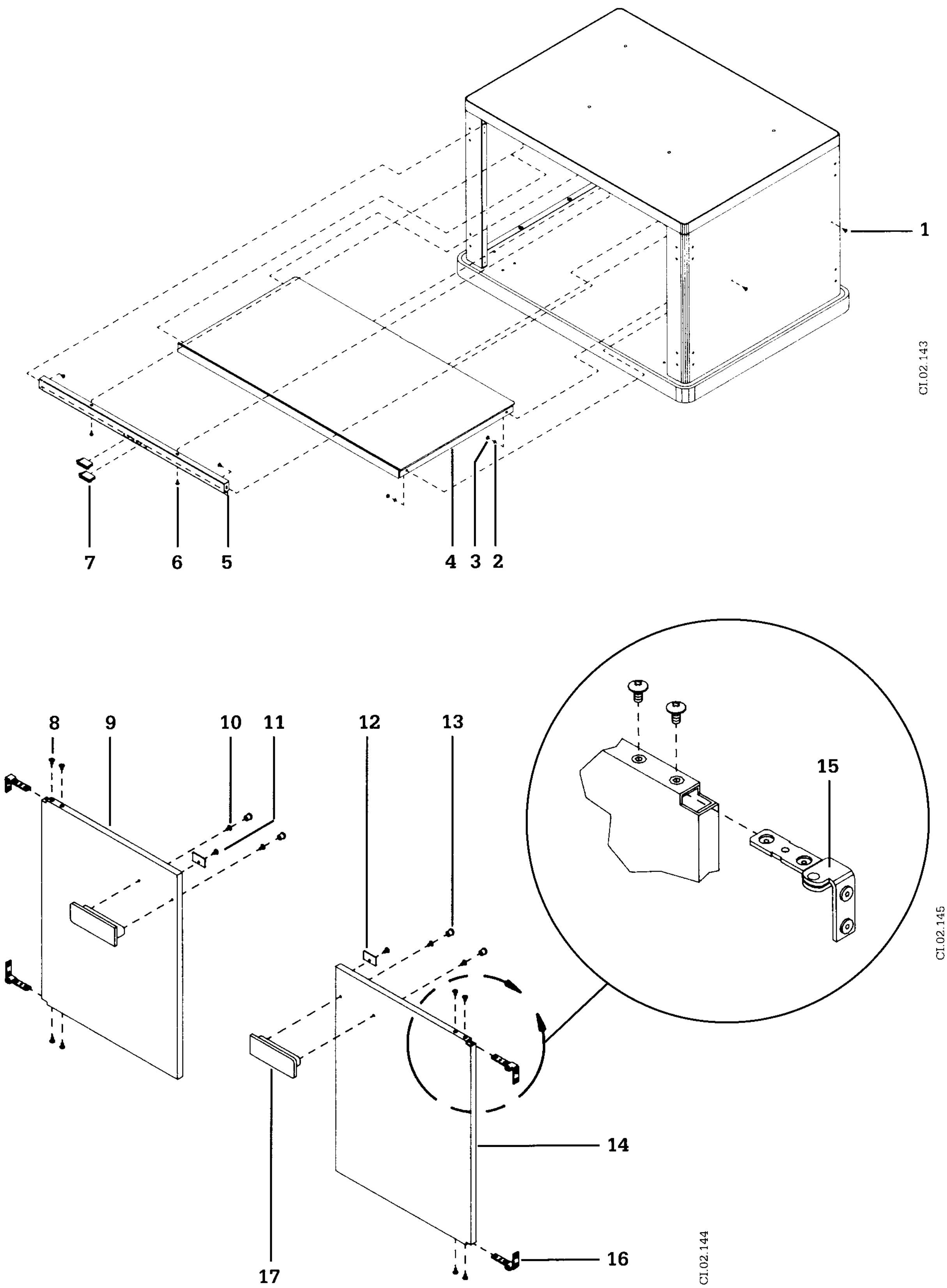


Figure 6-11 Cabinet Doors and Shelf

Cabinet Rail System and Overhead Shelf

Rail systems	Stock Number
Set short rails (kit)	6600-0041-800
Single short rail, right (kit)	6600-0210-800
Single short rail, left (kit)	6600-0211-800
Overhead shelf (kit)	6600-0214-800

Item		Stock Number
1	Screw 10-24 x 5/8*	0140-6630-110
2	Lockwasher internal, #10	0144-1110-131
3	Plate, rail back*	6600-0073-500
4	Stiffener plate	6600-0074-500
5	Rail, vertical long, left front/right rear	6600-0033-400
6	Cap cabinet rail, right	6600-0119-500
7	Screw 10-32 x 3/4	6600-0305-400
8	Split ring lockwasher	6600-0322-400
9	Nut, acorn	0144-3140-221
10	Lockwasher internal	0202-3418-300
11	Lug assembly	6600-0230-700
12	Overhead shelf kit (inclds 9, 10, & 11)	6600-0214-800

Not Shown	Stock Number
Rail, vertical short, left front/right rear	6600-0031-400
Rail, vertical long, right front/left rear	6600-0032-400
Rail, vertical short, right front/left rear	6600-0030-400
Cap cabinet rail, left	6600-0120-500

* Used only with knockout style cabinets.

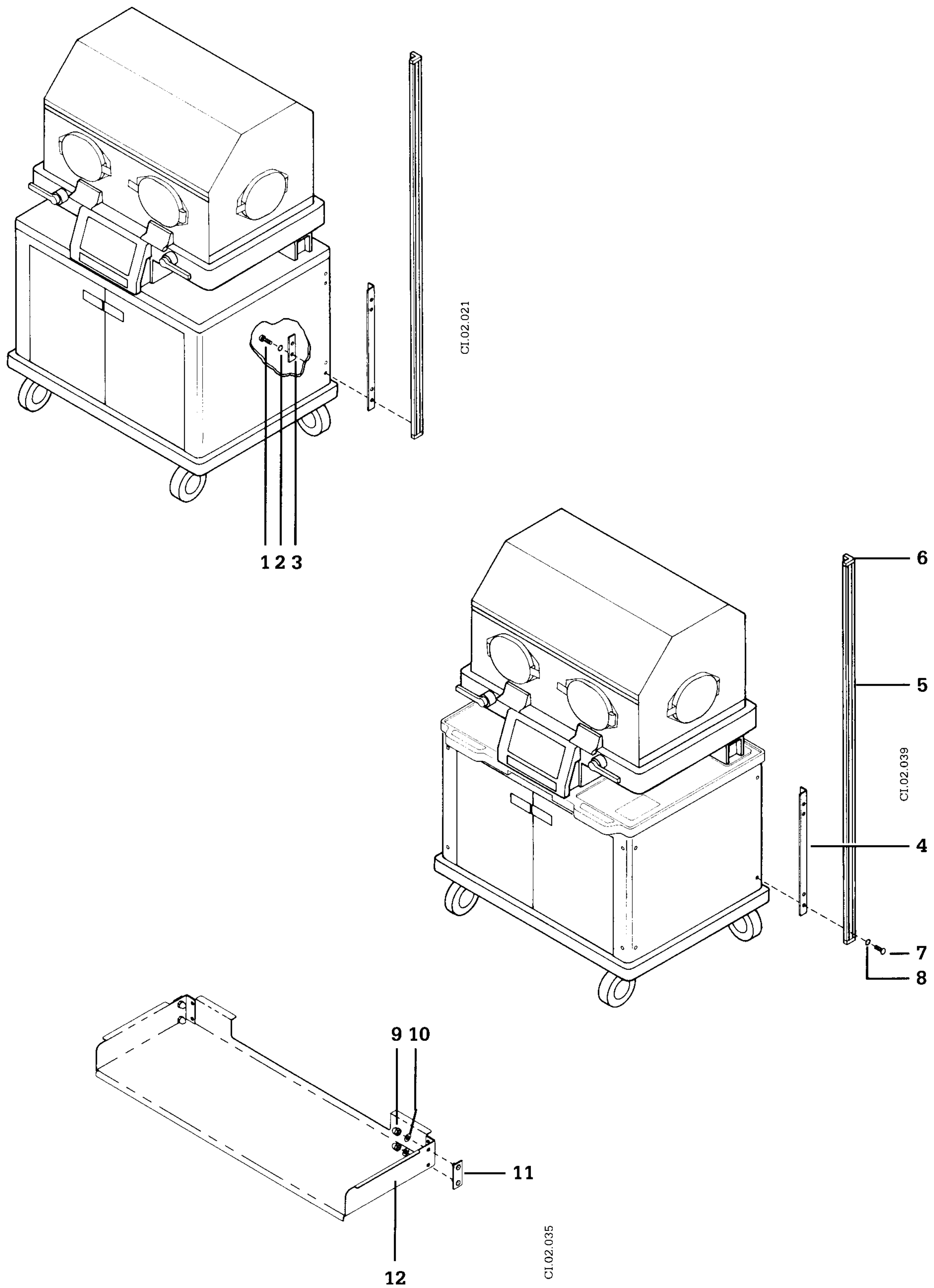
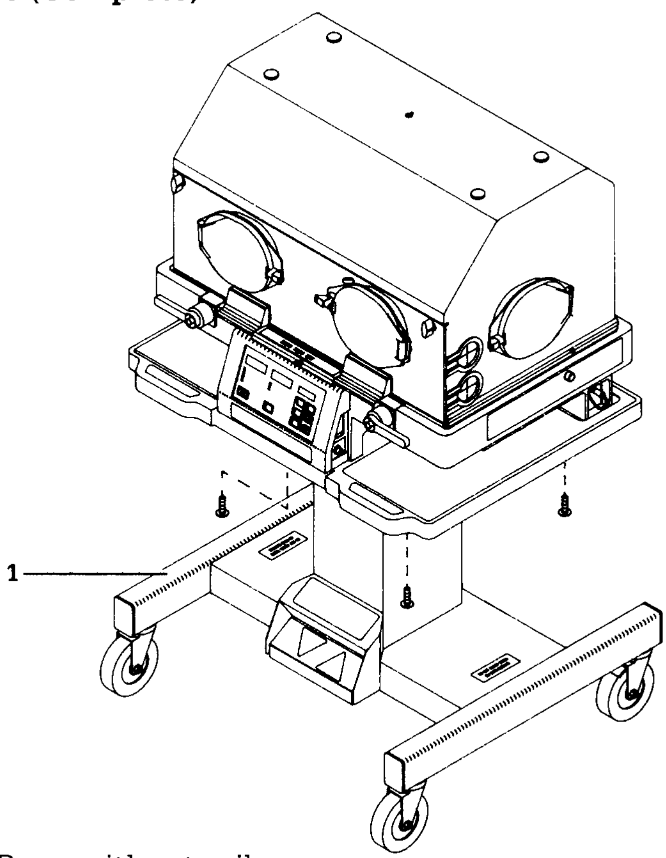


Figure 6-12 Cabinet rails and shelf

6.4 Elevating Base

Elevating Base (Complete)



Item	Stock Number
1. Elevating Base without rails	
120 V English	6600-0123-900
220/240 V English	6600-0123-901
120 V Spanish	6600-0123-910
220/240 V Spanish	6600-0123-911
220 V French	6600-0123-921
220 V German	6600-0123-931

Not Shown	Stock Number
Elev Base w/ rails, 120V, 60Hz, English @	6600-0172-900

@ All other voltage and language combinations require a rail system upgrade kit.

Note: The Elevating Base is compatible with either 50 or 60 Hz power supplies. The language listed for the base refers to the unit labeling.

Figure 6-13 Incubator with Elevating Base

6.5 Accessories and Disposable Parts

Item	Stock Number
1. Instrument shelf, 12 x 12	0217-5365-800
2. Ventilator mounting post	0217-5357-800
3. Oxygen flowmeter w/ bracket	0217-5370-800
4. Suction regulator w/ DISS connectors + safety trap	6702-1224-905
5. Overhead shelf & rails	6600-0042-800
6. I.V. pole	0217-5378-800
7. Standard M 2100 Oxygen Blender	6750-0022-900
8. Power cord	0208-0950-300
9. Cabinet w/ doors	6600-0036-900

Not Shown	Stock Number
Rail system, standard cabinet	6600-0041-800
Cabinet w/o doors	6600-0037-900
Refresher instructions	6600-0022-000
Cleaning tank	6600-0202-500
Reusable patient probe	0208-0697-700
Disposable patient probe(10/pkg)	6600-0208-700
Disposable patient probe (50/pkg)	6600-0196-700
Heat reflecting probe patch (50/pkg)	0203-1980-300
Wristlets (6/pkg)	6600-0507-500
Service Manual	6600-0017-000
Pleur-evac hanger	6600-0115-800
Ventilator cuff (2/pkg)	0217-3955-600
ThermaLink Upgrade Kit‡	6600-0399-800

‡ Available only on controllers with serial numbers beginning with HBJ

Note: Mounting the Standard M 2100 Oxygen Blender on the rail system requires the adapter plate (Stock No. 0217-5363-800) and the bird bracket (Stock No. 6600-0031-900).

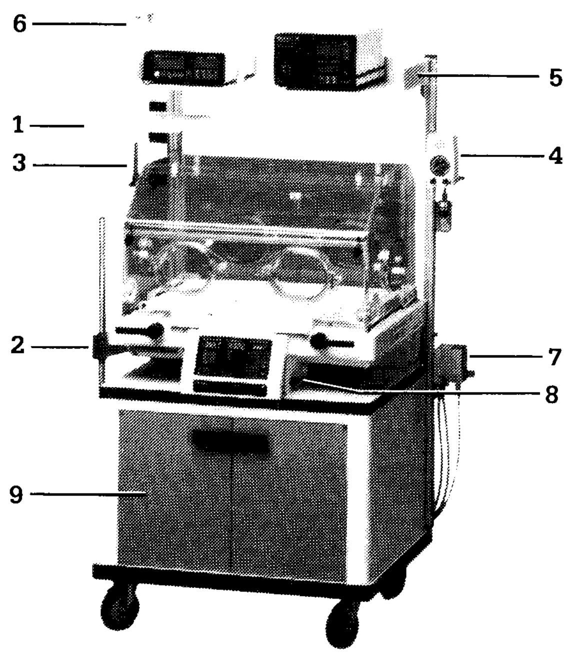
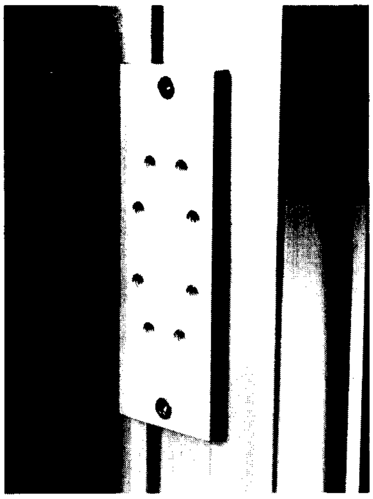


Figure 6-14 Care Plus Incubator with Accessories

Figure 6-15
Adapter Plate
Assembly
0217-5363-800

Figure 6-16
Instrument Shelf
0217-5365-800



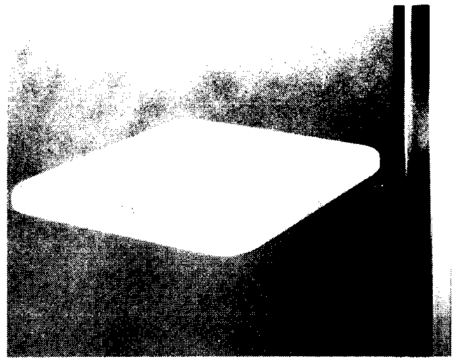
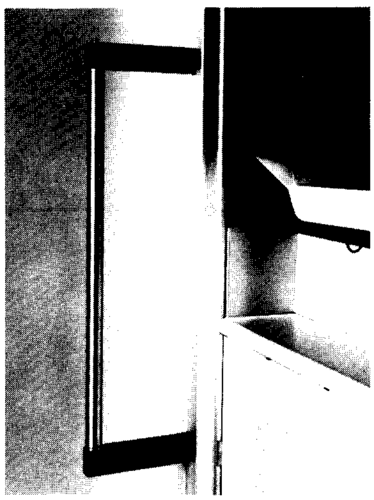


Figure 6-17
22 Inch Utility Post
0217-5376-800

Figure 6-18
Oxygen Flowmeter,
w/Bracket
0217-5370-800



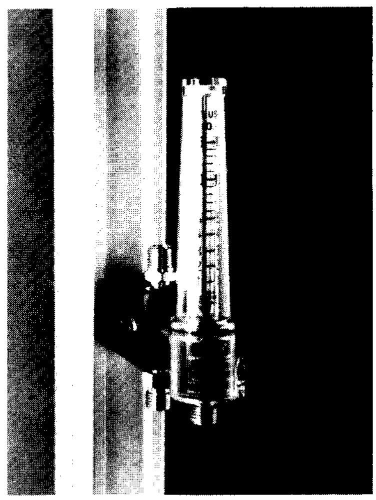
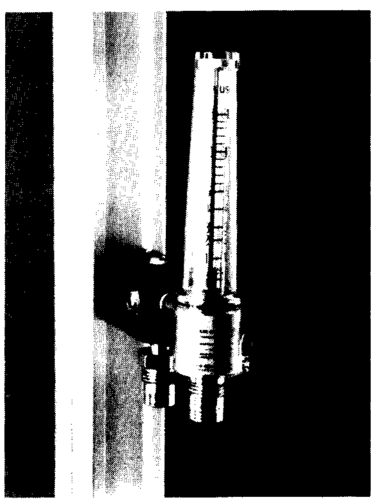


Figure 6-19
Air Flowmeter,
w/Bracket
0217-5372-800

Figure 6-20
Vacuum Manifold
w/DISS Adapters
0217-5369-800



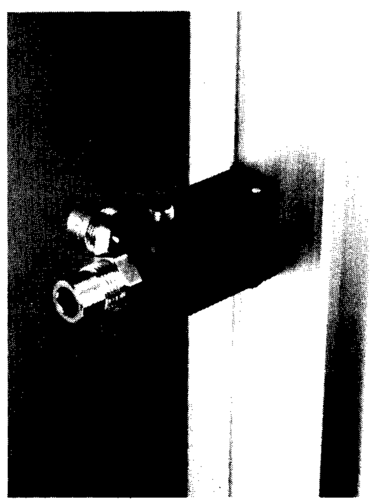


Figure 6-21
Manifold w/
1/8 Inch Pipe
Thread
0217-5359-800

Figure 6-22
Vacuum Bottle
Slide Bracket
0217-5367-800

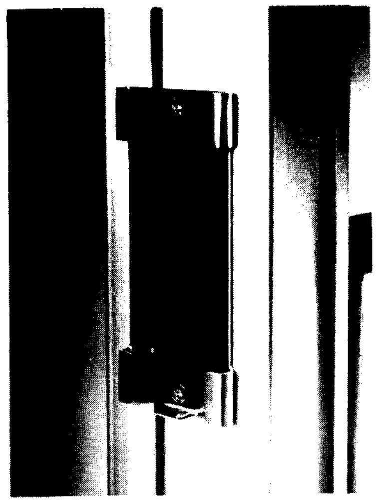
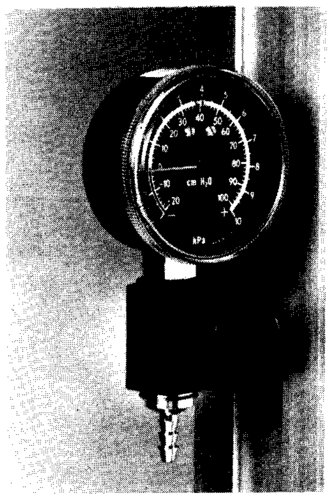


Figure 6-23
Manometer w/
Bracket
0217-5377-800

Figure 6-24
I.V. Pole
0217-5378-800



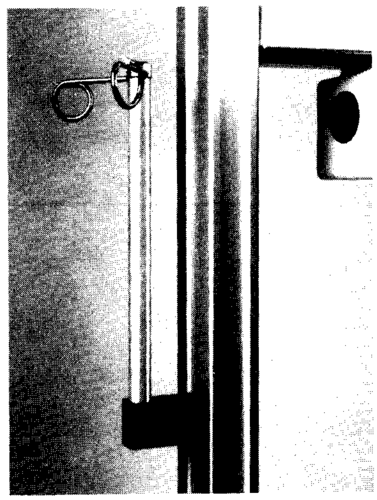


Figure 6-25
Ventilator
Mounting Post
0217-5357-800

Figure 6-26
Retaining Clips
0217-5290-870

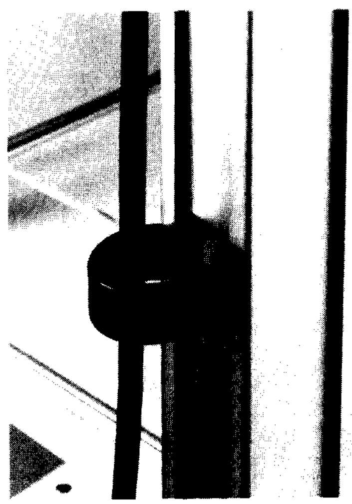


Figure 6-27
3.5 Inch Utility Post
0217-5374-800

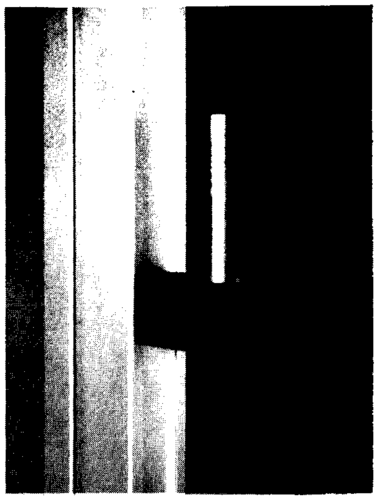


Figure 6-28
Twin-O-Vac
6600-0030-900

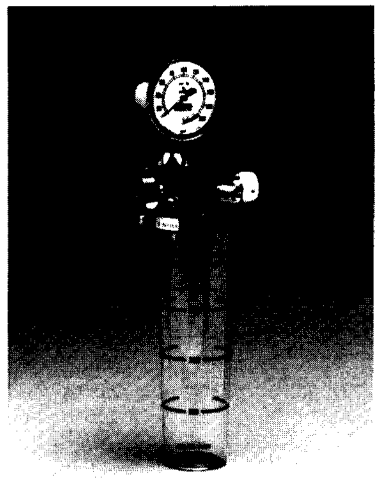
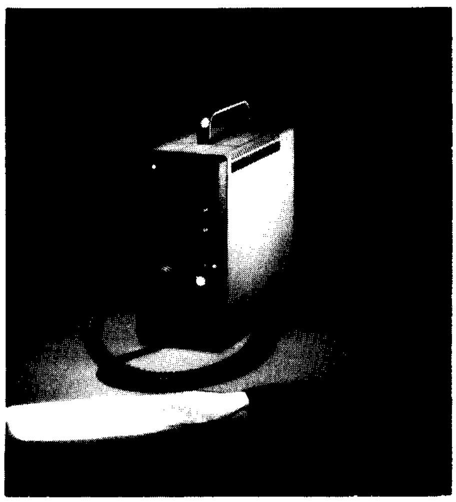


Figure 6-29
BiliBlanket™ phototherapy system
6600-0104-900



Not Shown	Stock Number
Phototherapy light II (free standing, 120V)	6600-0029-900
Phototherapy light II (rail/wall mounting, 120V)	6600-0055-900
Phototherapy light II (free standing, 220V)	6600-0085-900
Phototherapy light II (free standing, 240V)	6600-0176-900
Phototherapy light II (rail/wall mounting,220V)	6600-0084-900
Phototherapy light II (rail/wall mounting,240V)	6600-0175-900
Phototherapy light II rail mounting kit	6600-0051-800
Twin-O-Vac rail mounting kit	6600-0018-800
In service video	6600-0066-000
Technical, service video	6600-0067-000

6.6 Controller Components

Controllers without HBJ serial numbers

Item	Stock Number
1. Screw, 4-40 x 1/4, TRS, PH	6600-0125-400
2. Washer, int lock, #4	0202-3407-340
3. Washer	6600-0151-400
4. Nut, lock, 6-32 w/ ext	6600-0382-400
5. Washer, #6, FL	6600-0378-400
6. Gasket, thermal switch	6600-0209-500
7. Thermal switch	6600-0073-600
8. Screw, 6-32, 3/8 RD, PH	0140-6124-106
9. Gasket, air flow sensor	6600-0208-500
10. Air flow sensor replacement assembly †*	6600-0162-700
11. Heater, 120V ‡	6600-0199-500
Heater, 100V	6600-0231-500
Heater, 220V	6600-0177-500
Heater, 240V	6600-0198-500
12. Gasket, heater	6600-0142-500
13. Washer, int. lock, #10	0144-1110-131
14. Washer 0.219 ID x 0.500 OD	6600-0067-400
15. Nut,10-32 keps, w/ ext	6600-0066-400
16. Nut, 4-40 keps, w/ext.	6600-0073-400
17. Rear Controller Kit	6600-0405-800

* Install with thermistor button on bottom.

† The air flow sensor is mounted on the back of the controller and should not be confused with the air temperature sensor located inside the infant compartment.

‡ This version of the heater comes with mounting studs (as shown). Earlier versions mount with three, 10-32 x 5/8, TRS, screws (Stock No 0140-6631-110).

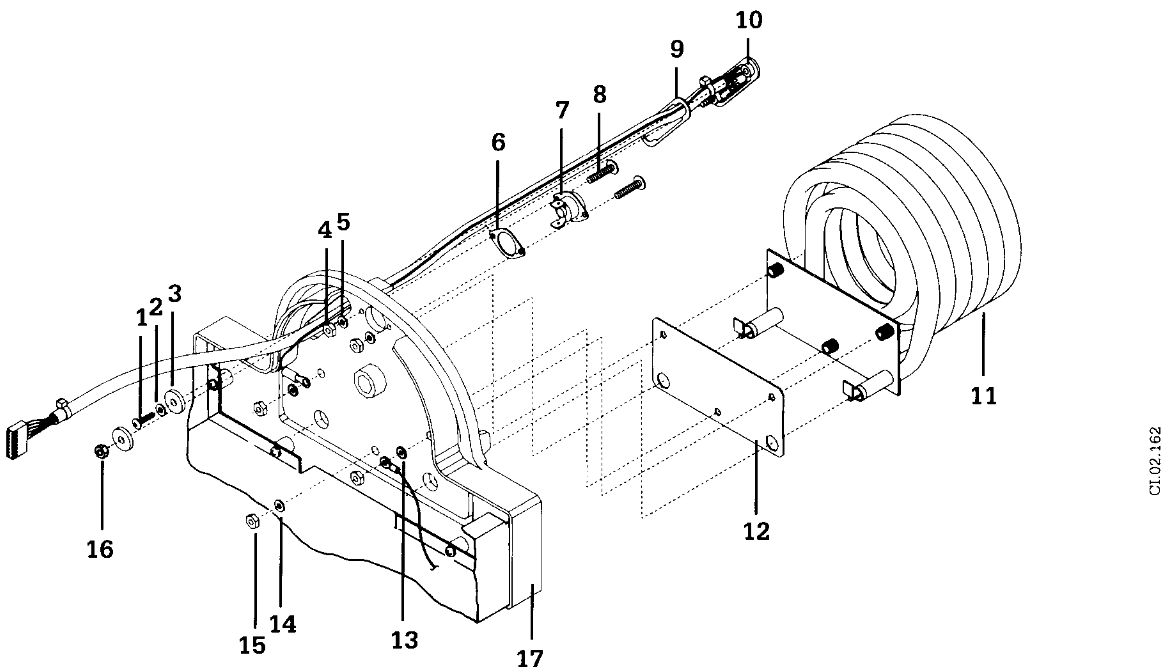


Figure 6-30 Controller Back Panel controllers without HBJ serial number

Controllers without HBJ serial numbers

Item	Stock Number
1. Screw, 6-32 x 7/8, TRS, PH*	6600-0150-400
2. Washer, #6, FL	6600-0378-400
3. Shock mount †	6600-0105-400
4. Bushing, shock mount †	6600-0341-500
5. Motor bracket, 60 Hz	6600-0084-500
Motor bracket, 50 Hz	6600-0239-500
6. Motor Kit (with shock mount and bushing) ‡	
Motor, 115V, 60 Hz, 1550 RPM	6600-0054-800
Motor, 100V/120V, 50 Hz, 1480 RPM	6600-0054-802
Motor, 220V/240V, 50 Hz, 1480 RPM	6600-0054-801
7. Bracket edge protector (specify 3 inches)	6600-0123-400
8. Nut, 6-32 keps w/ ext	6600-0382-400
9. Spacer, 6-32 x 1/2 x 1/4 hex	0402-0233-300
10. Spacer, threaded, .50"	6600-0046-600
11. Screw, 8-32 x 3/8, TRS, PH	6600-0261-400
12. Slide rail	6600-0167-500
13. Screw, 6-32, FL, PH	0400-3103-300
14. Screw, 6-32 x 1/4, TRS, PH	0140-6624-104
15. Washer, lock, #6 int tooth	0144-1106-131

* Use Loctite 24231 (Stock No. 0220-5016-300)

† Included in the bushing installation kit (6600-0149-800).

‡ Includes items 1 -4 in addition to the motor.

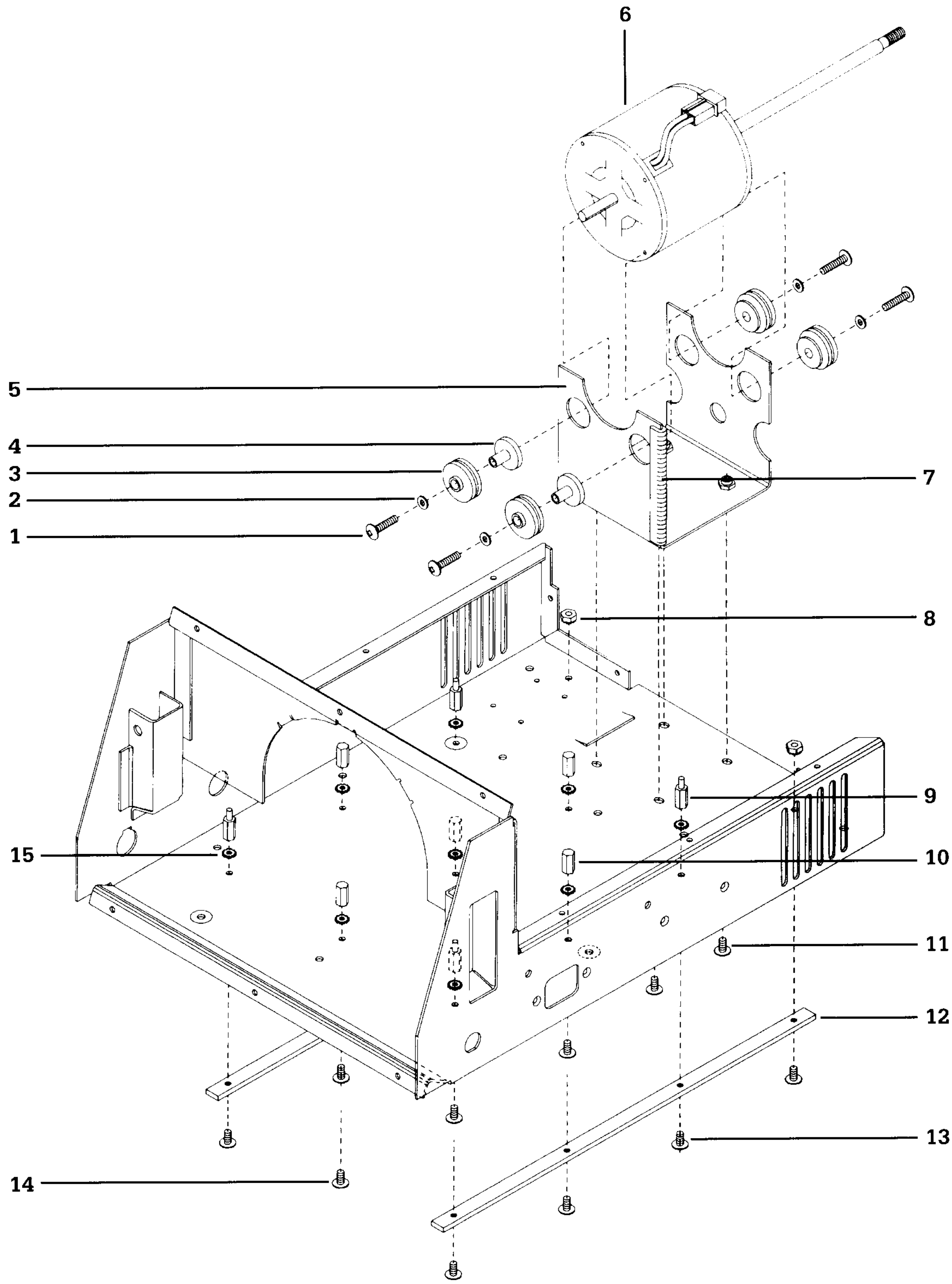


Figure 6-31 Controller Plate and Motor Mounting Hardware controllers without HBJ serial number

Controllers without HBJ serial numbers

Item	Stock Number
1. Cooling fan (CCW rotation)	6600-0056-400
2. Screw, 6-32 x 3/8, TRS, P	0140-6624-106
3. Washer, lock, #6 int tooth	0144-1106-131
4. Blower fan (black)	6600-0141-400
5. Fan knob	6600-0408-500
6. Air seal, motor shaft *	0210-6566-300
7. Controller latch kit (1/pkg)	6600-0108-800

* Press Adhesive side against rear of controller.

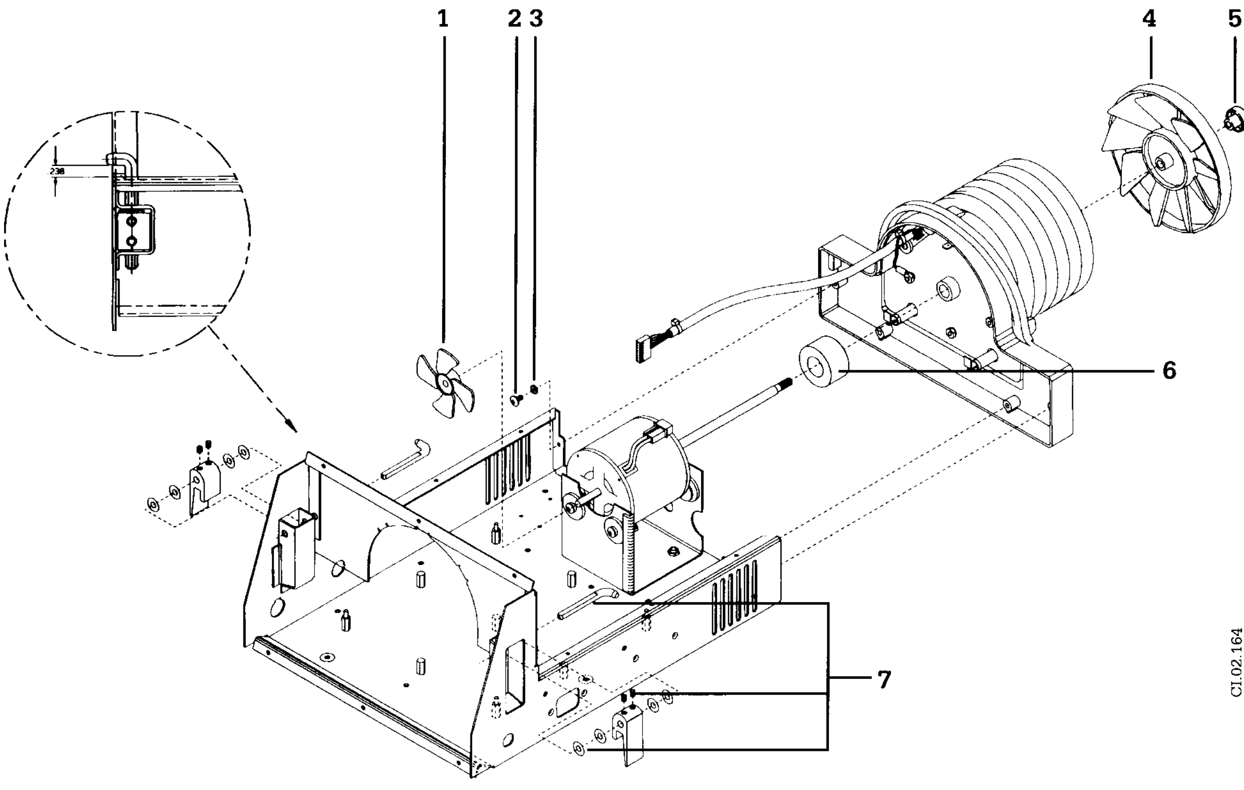


Figure 6-32 Controller Latch and Fan Assemblies controllers without HBJ serial number

Controllers without HBJ serial numbers

Item	Stock Number
1. Circuit breaker (On/Off) switch w/ bezel (DPST)	0690-2500-365
2. Retaining ring	6600-0075-400
3. Bezel, patient temp. probe connector	6600-0071-500
4. Nut, 6-32 keps w/ ext	0202-1130-300
5. Line filter, 6 amp (AC entrance)	6600-0094-700
6. Solid state relay	6600-0096-600
7. Nut, 8-32 keps w/ ext	0202-1131-300
8. Spacer, threaded, 4-40 x 1/2	6600-0108-400
9. Washer, lock, #4, int tooth	0202-3407-340
10. Transformer (100, 120V)	0208-7580-300
Transformer kit (220/240 V)	6600-0145-800
11. Washer, lock, #8 int tooth	6600-0262-400
12. Screw, 8-32 x 3/8, TRS, PH	6600-0261-400
13. Screw, 8-32 x 0.375, FH PH	6600-0071-400
14. Screw, 6-32 x 3/8, PH	0400-3135-300
15. Screw, 4-40 x 1/4 BD PH	0140-6517-104

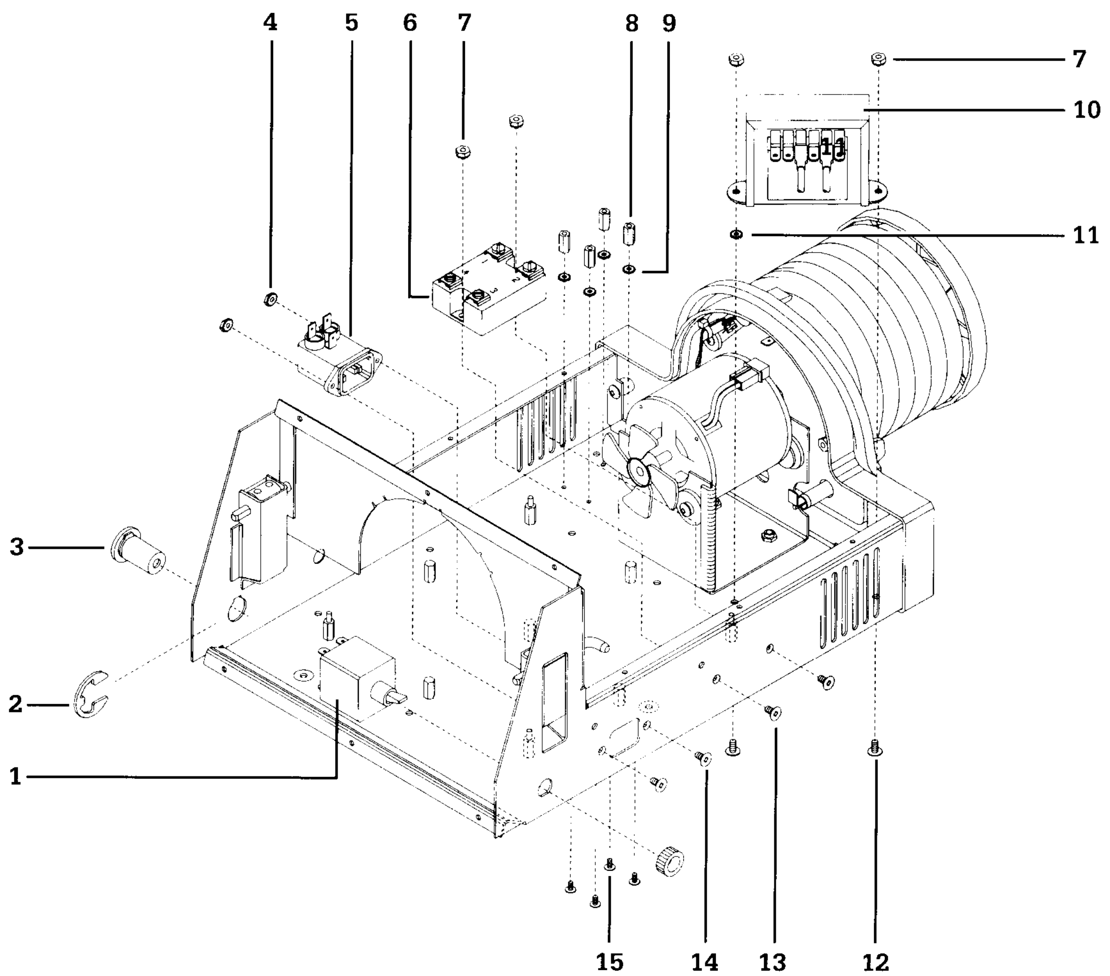


Figure 6-33 Transformer and Side Mounted Controller Components controllers without HBJ serial numbers

Controllers without HBJ serial numbers

Item	Stock Number
1. Washer, lock, #6 int tooth	0144-1106-131
2. Screw, 6-32 x 1/4, RD, PH	6600-0388-400
3. Battery, rechargeable, 6 cell, 7.2V	0690-1000-310
4. Controller cover	6600-0066-500
5. Screw, 6-32 x 3/8, RD, PH	0140-6624-106
6. Controller rear seal (external) *	6600-0067-500
7. Screw, #6, FL,PH	0400-3103-300
8. High voltage harness (terminated AC entrance and solid state relay wires, J1 and J2, battery holder)	6600-0206-700
9. Ground wire, display board	6600-0118-700
10. Control board, (tested),120V	6600-0106-710
Control board, (tested), 220/240V	6600-0126-710
11. Patient temp. probe/air temp. sensor harness (Includes probe jacks, J4 header, and related wires)	6600-0122-700
12. Intermediate harness (display/control board cable)	6600-0211-700
13. Battery holder	6600-0079-700

* Press Adhesive side against rear of controller.

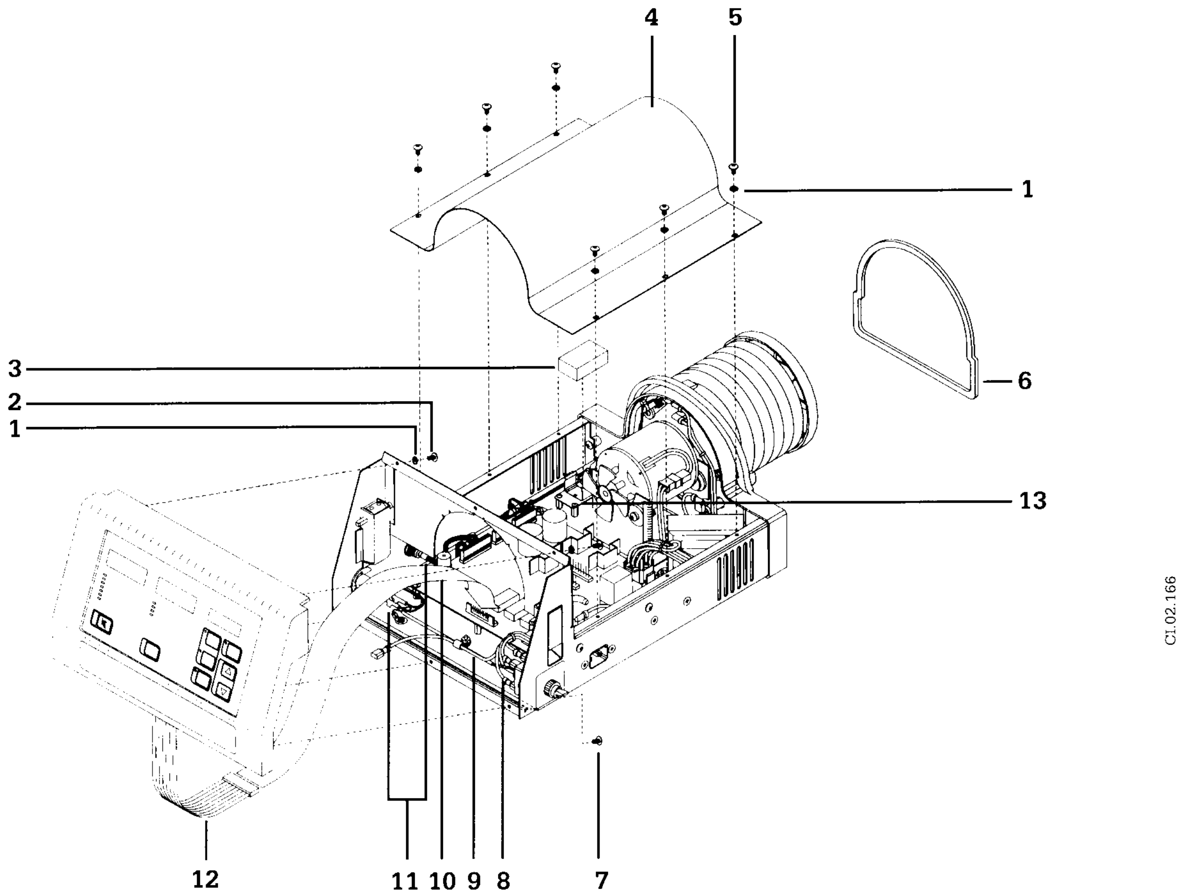


Figure 6-34 Wire Harnesses and Additional Controller Components controllers without HBJ serial number

Controllers without HBJ serial numbers

Item	Stock Number
1. Front cover, controller	6600-0064-500
2. Switch panel replacement kit(includes display panel, switch panel, and alarm LED gasket), English	6600-0136-800
Switch panel replacement kit, German	6600-0136-801
Switch panel replacement kit, Spanish	6600-0136-802
Switch panel replacement kit, French	6600-0136-803
Switch panel replacement kit, Swedish	6600-0136-804
Switch panel replacement kit, Italian	6600-0136-805
3. Gasket, alarm LED *.	6600-0210-500
4. Support panel, display board	6600-0147-500
5. Washer, #6 int. lock	0144-1106-131
6. Screw, 6-32 x 3/8, TRS, PH	0140-6624-106
7. Display board (tested)	6600-0105-710
8. Ground wire, display board	6600-0118-700
9. Nut, 6-32 keps w/ ext	6600-0382-400
10. Intermediate harness (display/control board cable)	6600-0211-700
11. Spacer, 6-32 x 1/2	0402-0233-300
12. Washer,flat #6	0202-4510-340
13. Tab, faston	0208-0439-300
14. Label, Ohmeda logo	6600-0142-100

* Press Adhesive side against Switch panel.

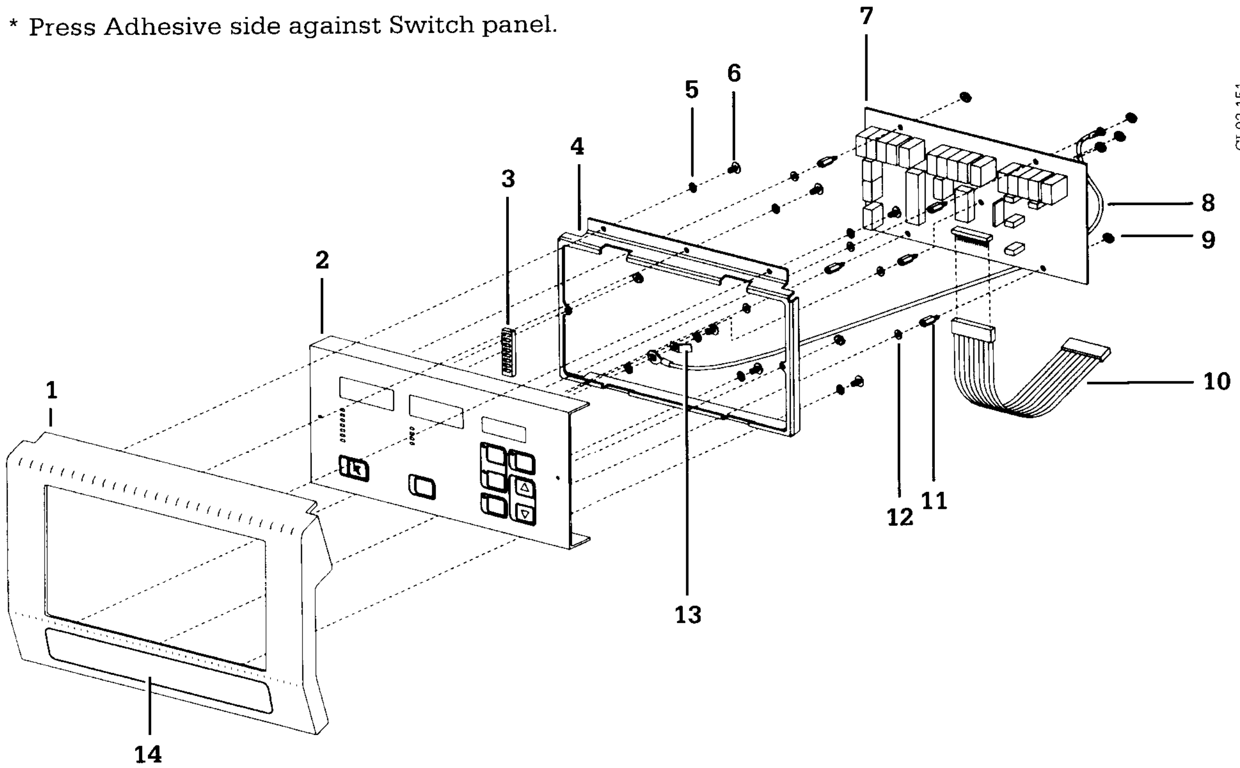


Figure 6-35 Control Panel Assembly controllers without HBJ serial numbers

Controllers with HBJ serial numbers

Item		Stock Number
1.	Screw, 6-32 x 7/8 TRS PH	6600-0150-400
2.	Washer, flat #6	0202-4510-340
3.	Shock mount	6600-0105-400
4.	Bushing, shock mount	6600-0341-500
5.	Motor bracket, 60 Hz	6600-0517-500
	Motor bracket, 50 Hz	6600-0518-500
6.	Motor kit, 100/120/220/240V, 60Hz†	6600-0054-800
	Motor kit, 100/120V, 50 Hz†	6600-0054-802
	Motor kit, 220/240V, 50 Hz†	6600-0054-801
7.	Bracket edge protector (3" long)	6600-0123-400
8.	Airseal, motor shaft*	6600-0471-500
9.	Washer, lock, #6 split ring	6600-0345-400
10.	Screw, 6-32 x 1/2, RD, PH	0140-6124-108
11.	Fan sensor kit (includes item 8).	6600-0403-800
12.	Washer, lock , #8 int tooth	6600-0262-400
13	Nut, 8-32, ext tooth lock	0202-1131-300
14.	Transformer, 100/120V	0208-7580-300
	Transformer kit, 220/240V	6600-0145-800
15.	Controller Latch Kit (1/pkg)	6600-0108-800
16.	Spacer, 6-32	6600-0367-400
17.	Washer, lock, # 6 int tooth ,	6600-0399-400
18.	Nut, 8-32, ext lock	0202-1131-300
19.	Circuit breaker bracket	6600-0474-500
20.	Screw, 6-32 x 1/4 TRS, PH	0140-6624-104
21.	Circuit breaker	6600-0214-600
22.	Spacer, threaded, 6-32 x 1/4	6600-0377-400
23.	Slide rail	6600-0167-500
24	Controller chassis	6600-0469-500
25.	Screw, 6 - 32 x 5/16, FL, PH	6600-0403-400

* Press adhesive side against the fan sensor.

† Motor kit contains motor and items 1-4.

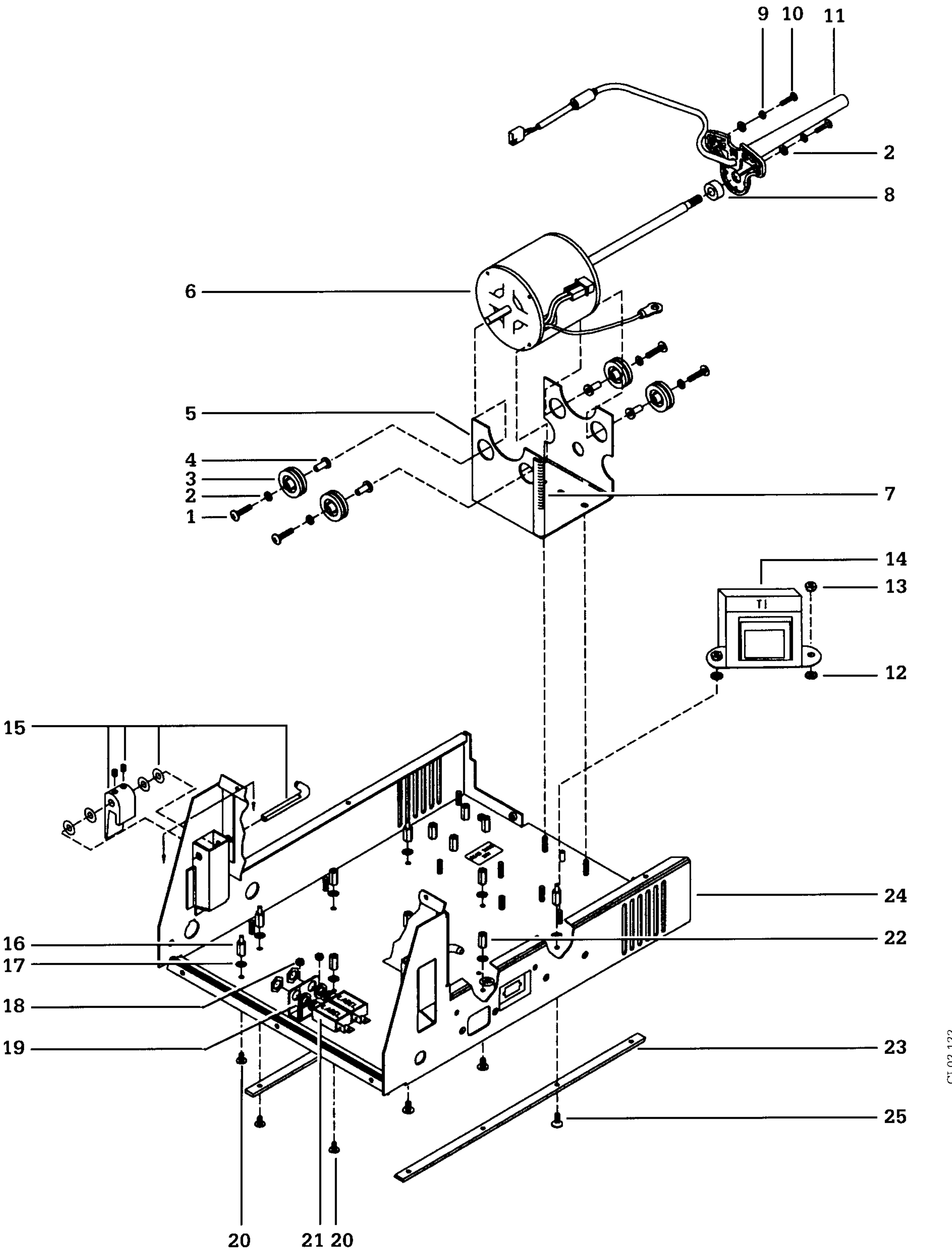


Figure 6-36 Motor, fan sensor, circuit breaker and transformer assembly controllers with HBJ serial numbers

6/Illustrated Parts List

Controllers with HBJ serial numbers

Item	Stock Number
1. Rear controller airseal*	6600-0472-500
2. Nut, 10-32 keps w/ ext	6600-0066-400
3. Washer flat .219 ID .50 OD	6600-0067-400
4. Nut, 6-32 keps w/ ext	6600-0400-400
5. Washer, #6	6600-0016-400
6. Gasket, thermal switch	6600-0209-500
7. Thermal switch	6600-0073-600
8. Screw, 6-32 x 1/2 RD PH	0140-6124-108
9. Controller rear seal (external)*	6600-0067-500
10. Heater, 120V	6600-0199-500
Heater, 100V	6600-0231-500
Heater, 220V	6600-0177-500
Heater, 240V	6600-0198-500
11. Gasket, heater	6600-0142-500
12. Rear controller	6600-0470-500

* Press adhesive side against the rear of the controller.

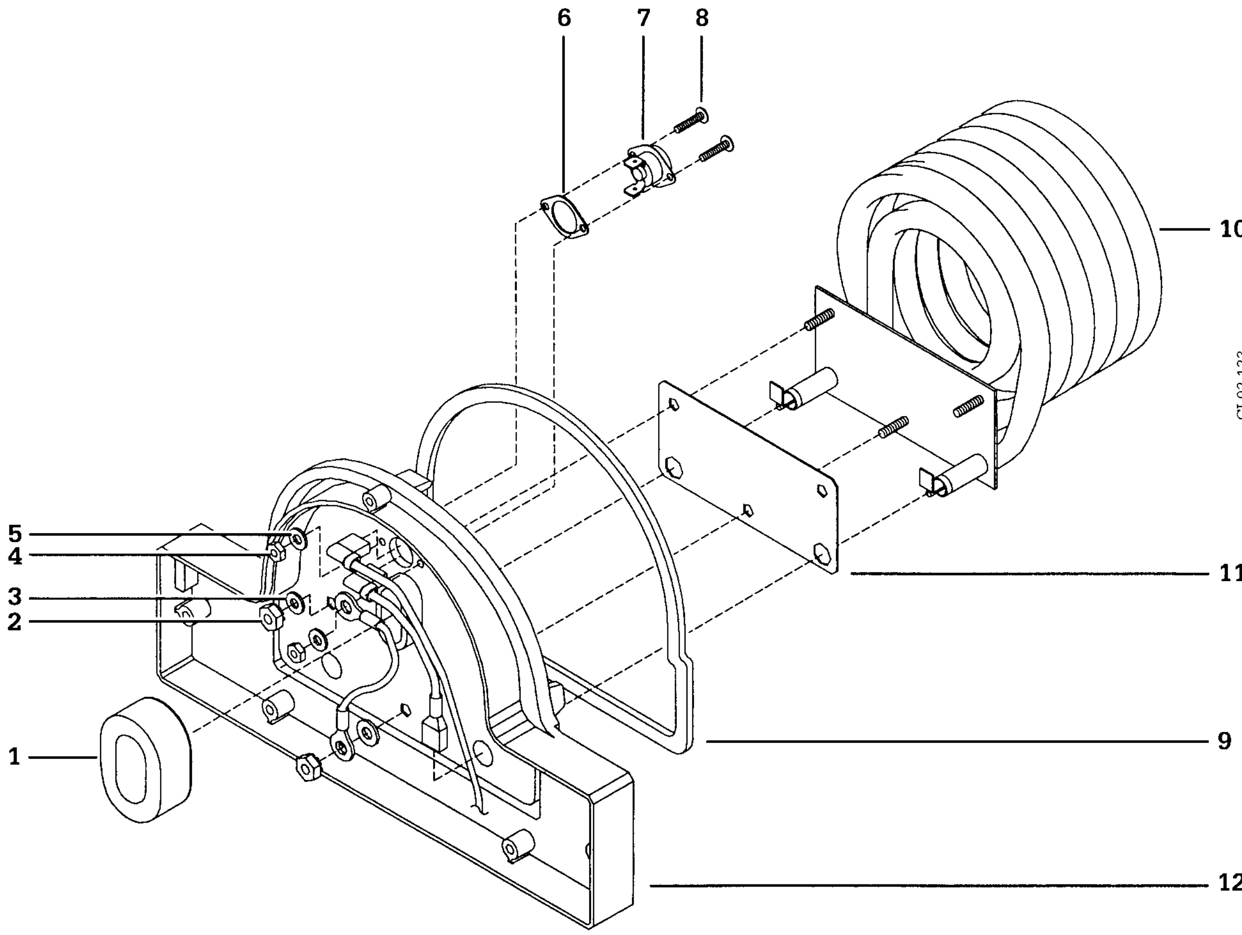


Figure 6-37 Back panel controllers with HBJ serial numbers

6/Illustrated Parts List

Controllers with HBJ serial numbers

Item	Stock Number
1. Nut, precision, 1/4 -32 NEF	6600-0109-400
2. Bezel, patient temp probe connector	6600-0071-500
3. Hairpin clip	6600-0104-400
4. Cable tie	6600-0364-400
5. ON/OFF switch with bezel (DPST)*	6600-0229-600
6. Capacitor assy kit	6600-0404-800
7. Line filter, 6A (AC entrance)	6600-0094-700
8. Screw, 6-32 x 3/8	0400-3135-300
9. Keps nut, #6 32	6600-0400-400
10. Connector cover plate	6600-0473-500
11. Screw, 8-32 x 3/8	0140-6127-106
12. External tooth lock nut, 8-32	0202-1131-300
13. Solid state relay	6600-0268-600
14. Washer	0202-0095-300
15. Washer, #6	6600-0016-400
16. Split lock washer, #6	6600-0345-400
17. Screw, 6-32 x 7/8	6600-0150-400
18. Fan knob	6600-0408-500
19. Blower fan, 5 blade (white)	6600-0394-500
20. Hex nut	0144-3127-113
21. Washer, lock , #10, split ring	6600-0322-400
22. Cooling fan (CCW rotation)	6600-0056-400
23. Patient temp probe sensor harness kit (includes air probe jack, J4 header, EMI filter board, related wires, and mounting hdwe)	6600-0407-800
24. Nut, 6-32 keps w/ ext	6600-0400-400
25. Washer, lock int tooth , 1/4	6600-0396-400
26. Grounding post kit	6600-0260-800
27. Washer	6600-0399-400
28. Patient probe jack	6600-0067-700

* This toggle switch does not contain circuit breakers, and should only be used on controllers that have external circuit breakers.

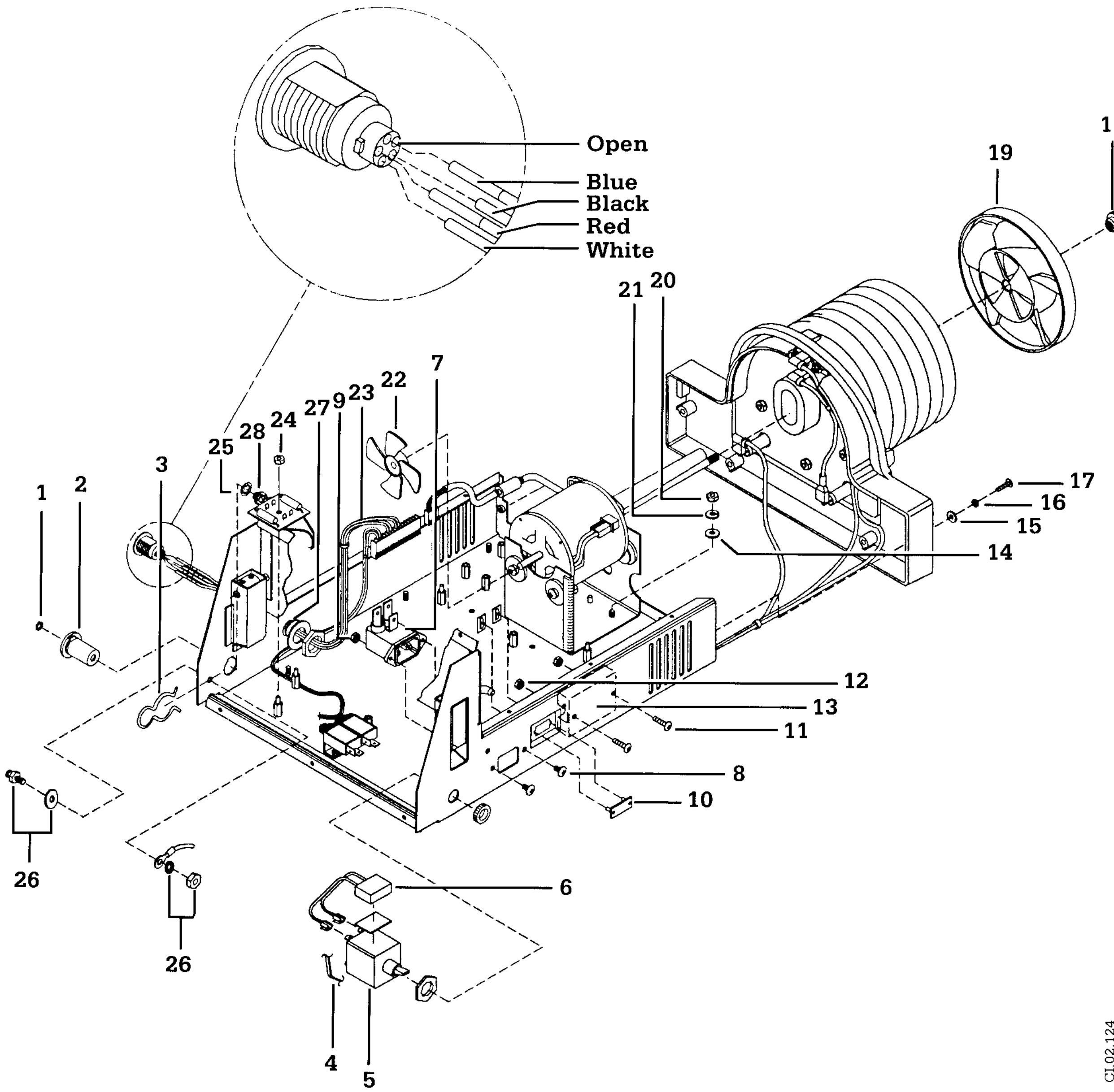


Figure 6-38 Controller chassis and fan assembly controllers with HBJ serial numbers

Controllers with HBJ serial numbers

Item	Stock Number
1. Control board (tested)	6600-0204-702
2 Internal tooth lock washer	6600-0399-400
3. Screw, 6-32	6600-0389-400
4. Screw, 6-32 x 3/8	0140-6624-106
5. Internal tooth lock washer, #6	6600-0399-400
6. Controller cover	6600-0066-500
7. High voltage harness (terminated AC entrance & solid state relay wires,J1 and J2, battery holder)	6600-0313-700

Parts not shown

Battery, rechargeable, 6 cell, 7.2V	0690-1000-310
Battery holder	6600-0079-000
Controller label set (English)	6600-1186-100
Controller label set (Spanish)	6600-1228-100
Controller label set (French)	6600-1227-100
Controller label set (German)	6600-1229-100
Controller label set (Swedish)	6600-1092-100
Controller label set (Italian)	6600-1095-100

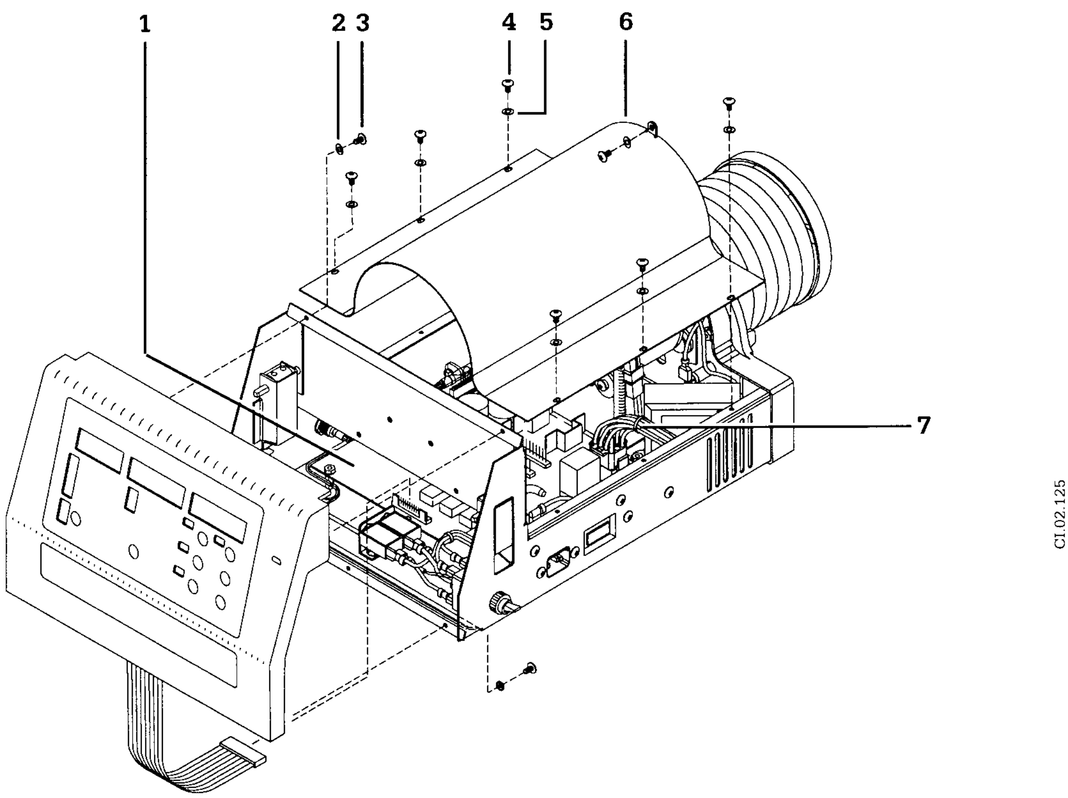


Figure 6-39 Cover assembly controllers with HBJ serial numbers

Controllers with HBJ serial numbers

Item	Stock Number
1. Screw, 6-32 x 3/8	0140-6624-106
2. Split lock washer, #6	6600-0345-400
3 Spacer	0402-0233-300
4. ThermaLink service board	6600-0243-702
5. Keps nut, 6-32	6600-0382-400
6. Ribbon cable	6600-0240-700
7. Anti-static cover	6600-0387-400
8. ThermaLink wire harness	6600-0239-700

Parts not shown

ThermaLink upgrade kit (includes items 1-8)	6600-0399-800

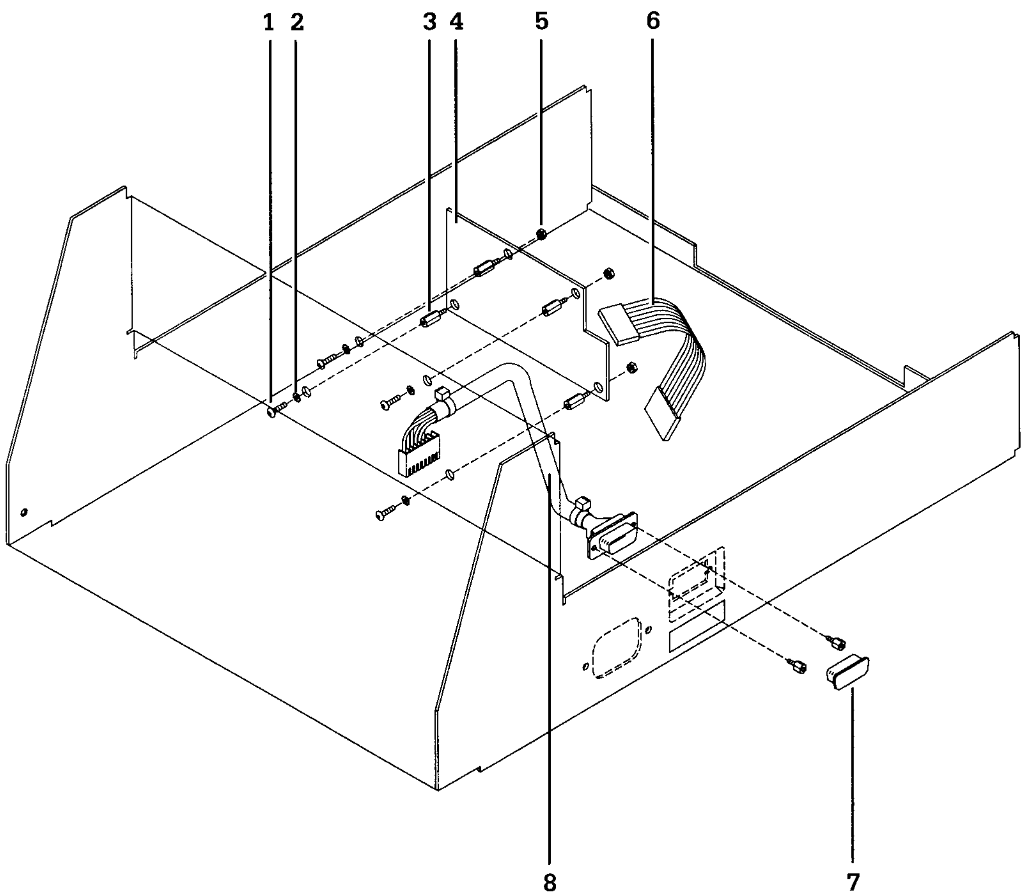


Figure 6-40 ThermaLink assembly controllers with HBJ serial numbers

Controllers with HBJ serial numbers

Item	Stock Number
1. Front cover, controller	6600-0064-500
2. Switch panel replacement kit(includes display panel, switch panel, and alarm LED gasket), English	6600-0136-800
Switch panel replacement kit, German	6600-0136-801
Switch panel replacement kit, Spanish	6600-0136-802
Switch panel replacement kit, French	6600-0136-803
Switch panel replacement kit, Swedish	6600-0136-804
Switch panel replacement kit, Italian	6600-0136-805
3. Gasket, alarm LED *.	6600-0210-500
4. Support panel, display board	6600-0147-500
5. Washer, #6 int. lock	0144-1106-131
6. Screw, 6-32 x 3/8, TRS, PH	0140-6624-106
7. Display board (tested)	6600-0105-710
8. Display board ESD shield	6600-0515-500
9. Nut, 6-32 keps w/ ext	6600-0400-400
10. Intermediate harness (display/control board cable)	6600-0211-700
11. Spacer, 6-32 x 1/2, 1/4 hex	6600-0242-600
12. Washer,lock, split ring #6	6600-0345-400
13. Washer, flat .156 x .312 nylon	0402-1127-300
14. Washer, #6, .375 OD	6600-0400-400
15. Washer, lock .156 x .035 int tooth	0202-4510-340
16. Ohmeda logo, label set	6600-0142-100

*Press adhesive against side against the LED bar.

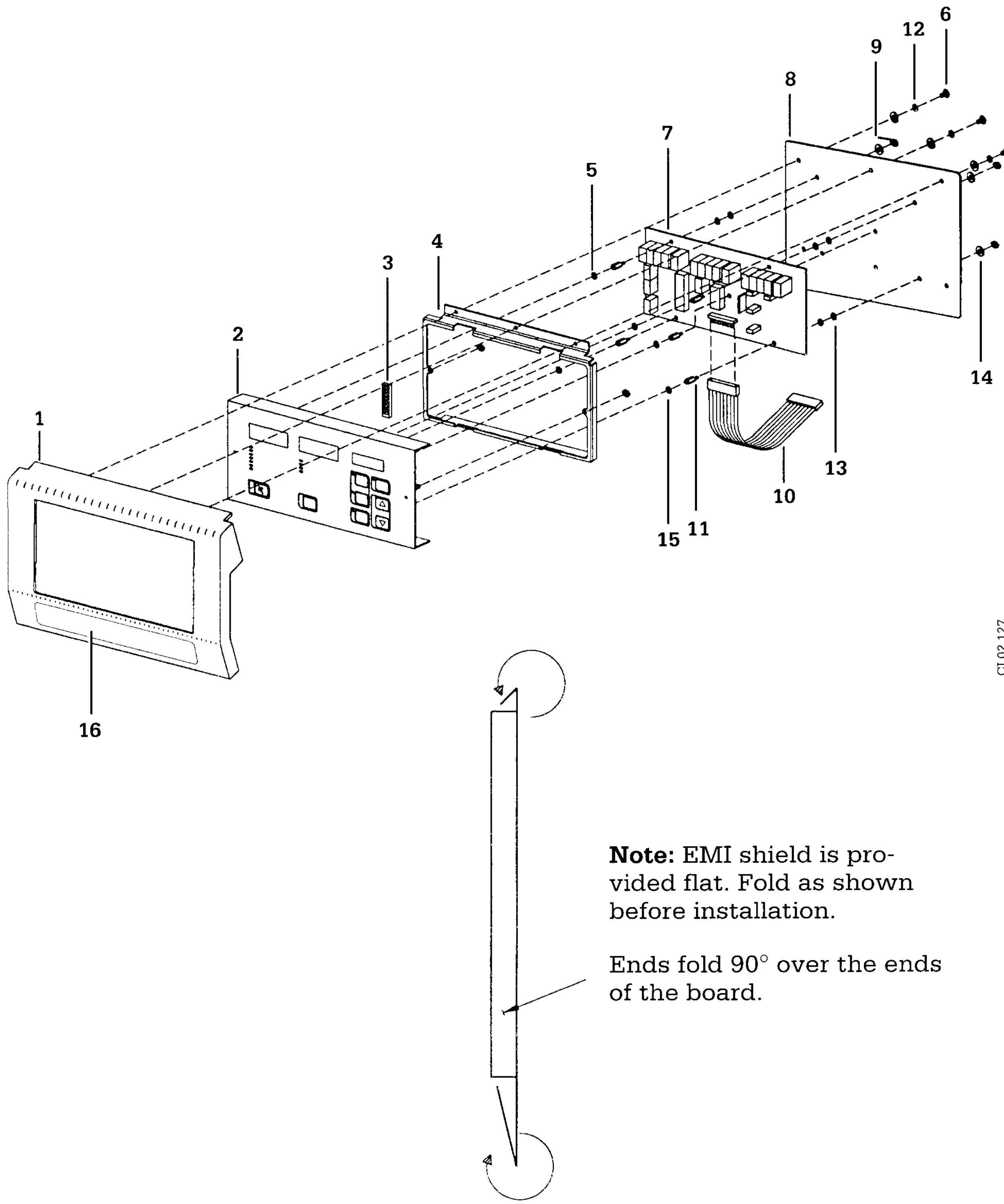


Figure 6-41 Control panel assembly controllers with HBJ serial numbers

6.7 Board Components

Display Board

Tested and Packaged, Stock No. 6600-0105-710

STOCK NO.	DESCRIPTION	QTY	SYMBOL
	HEADER 12 PIN,RIGHT ANGLE	1	J9
	HEADER 16 PIN,RIGHT ANGLE	1	J8
	SOCKET DIP 40 PIN	2	FOR DS-1-4, 6-9
	SOCKET STRIP 16 PIN	2	FOR DS16,17
	SOCKET DIP 16 PIN	2	FOR DS18,19
	SOCKET 4 PIN	4	FOR DS20-23
	SOCKET DIP 10 PIN	2	FOR DS5, DS10
	SOCKET 9 PIN	1	J7
	SOCKET 14 PIN	5	FOR DS11-15
6600-0070-700	LED, BAR, 8 ELEM, SOLID, RED	1	DS-18
6600-0069-700	LED, BAR, 8 ELEM, SEP, YELLOW	1	DS-19
0683-9020-304	LED, BAR, 2 ELEM, SOLID, YELLOW	4	DS20-23
0683-9020-303	LED, BAR, 8 ELEM, SEP, RED	2	DS16,17
0690-2300-326	LED, 7 SEGMENT, .56", RED	10	DS1-10
0690-2300-325	LED, 7 SEGMENT, .30", RED	5	DS11-15
	IC 8243	1	U2
	IC MM5451	1	U1
	TRANSISTOR MPSA63	4	Q1-4
	DIODE	1	CR1
	CAPACITOR 0.1 MFD 50V 20%	4	C1,C2,C5,C6
	CAPACITOR 15 MFD 16V	2	C3,C4
	RESISTOR, VAR 5K	1	R11
	RESISTOR NETWORK 10K	1	RP1
	RESISTOR 180 1/4W 5%	5	R2,4,6,8,10
	RESISTOR 4.7K 1/4W 5%	4	R1,3,5,7
	RESISTOR 221 1/4W 1.0%	1	R9

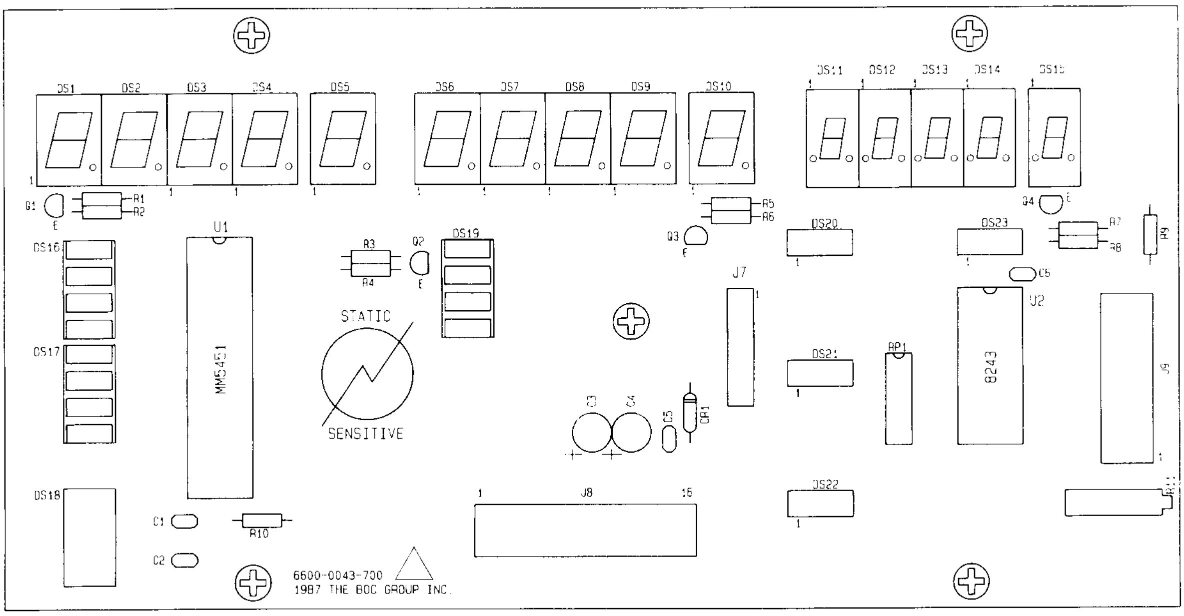


Figure 6-42 Display Board (tested and packaged) all controllers

6/Illustrated Parts List

Controllers without HBJ Serial Numbers

Control Board

100/120V Stock No. 6600-0106-710
220/240V Stock No. 6600-0126-710

DESCRIPTION	QTY	SYMBOL
CRYSTAL 6.0 MHZ	1	Y1
RELAY	1	K1
VOLTAGE REGULATOR 7805	3	VR1,VR2,VR3
BRIDGE VM08 OR VM28	3	CR2,CR3,CR13
DIODE	3	CR1,CR9,CR10
DIODE VSK120	1	CR11
CAPACITOR 3.3 MFD	1	C48
CAPACITOR 33 PF	2	C43,C44
CAPACITOR 220PF	1	C37
CAPACITOR 0.1 MFD	26	C2,C5,C6,C7,C10,
		C14,C15,C16,C17,
		C22,C23,C24,C25,
		C27,C28,C29,C30,
		C31,C33,C35,C38,
		C40,C41,C42,C45,
		C46
CAPACITOR 0.01 MFD 1KV	1	C21
CAPACITOR .27 MFD	2	C34,C39
CAPACITOR .33 MFD	3	C8,C11,C19
CAPACITOR .47 MFD	1	C20
CAPACITOR 10 MFD 10%	1	C26
CAPACITOR 15 MFD 16V	5	C9,C13,C18
		C36,C47
CAPACITOR 4700 MFD 16V	2	C3,C4
CAPACITOR 0.01 MFD 10%	1	C32
RESISTOR, VAR 20K	1	R36
RESISTOR, VAR 10K	1	R19
RESISTOR, VAR 500	4	R20,R25,R37,R38
RESISTOR PACK 1K	1	RP1
RESISTOR 301 0.1%	1	R65
RESISTOR 1K 0.1%	3	R14,R15,R66
RESISTOR 2.21K 0.1%	2	R26,R32
RESISTOR 4.70K 0.1%	2	R62,R68
RESISTOR 4.87K 0.1%	1	R60
RESISTOR 5.05K 0.1%	1	R64
RESISTOR 5.30K 0.1%	1	R58
RESISTOR 5.42K 0.1%	5	R55,R57,R59,R61,
		R63.
RESISTOR 5.76K 0.1%	9	R5,R6,R7,R9,R30,
		R31,R39,R48,R56
RESISTOR 10 1%	1	R2
RESISTOR 453K 0.1%	1	R74
RESISTOR 5.9K 0.1%	2	R67,R69
RESISTOR 10K 0.1%	2	R8,R71
RESISTOR 750 0.1%	2	R4,R12
RESISTOR 100K 1%	4	R16,R22,R70,R73
RESISTOR 75K 1%	1	R42
RESISTOR 1.21 MEG 1%	1	R40
RESISTOR 47K 2W 5%	1	R21
RESISTOR 100 5%	1	R18
RESISTOR 10K 5%	10	R33,R34,R41,R46,
		R47,R49,R51,R53,
		R76,R78
RESISTOR 1.0 MEG 5%	1	R35
RESISTOR 33K 5%	3	R43,R50,R29
RESISTOR 220 5%	6	R27,R28,R54,
		R72,R75,R77
RESISTOR 470 5%	1	R17
RESISTOR 22 5%	1	R24
RESISTOR 51 5%	1	R44
RESISTOR 510 5%	1	R23
RESISTOR 1K 5%	1	R52

STOCK NO.	DESCRIPTION	QTY	SYMBOL
	PC BOARD BLANK	1	FOR ASSEMBLY 6600-0042-700
	HEADER 4 PIN	1	J6
	HEADER 8 PIN	2	TP1,TP2
	HEADER 16 PIN	2	J3, J4
	HEADER 12 PIN	1	J2
	HEADER 12 PIN AMP	1	J1
	HEADER 12 PIN	1	TP3
	HEADER 8 PIN POLARIZED	1	J5
	SOCKET 40 PIN	1	FOR U19
	SOCKET 28 PIN	1	FOR U16
	HEAT SINK	3	H2
	NO.4-40 ELASTIC NUT	3	H1
	8 POS. DIP SWITCH	1	SW1
	ALARM QMB-06A	1	LS1
	LED HLMP-3366	1	DS1
	IC 4051B	2	U1, U10
	IC LM339	1	U5
	IC CNY65	1	U3
	IC VQ1000	1	U12
	IC 74LS123	1	U9
6600-0042-600	IC 27128 PROGRAMMED	1	U16
	IC 74LS373	1	U18
	IC 8243	2	U15, U17
6600-0038-600	IC 8032	1	U19
	IC ADC3711	1	U14
	IC LM10	1	U13
	IC 7556	1	U6
	IC 74LS132	1	U7
	IC 74LS04	1	U11
	IC 74LS02	1	U8
	IC 3022	1	U4

CI.02.129

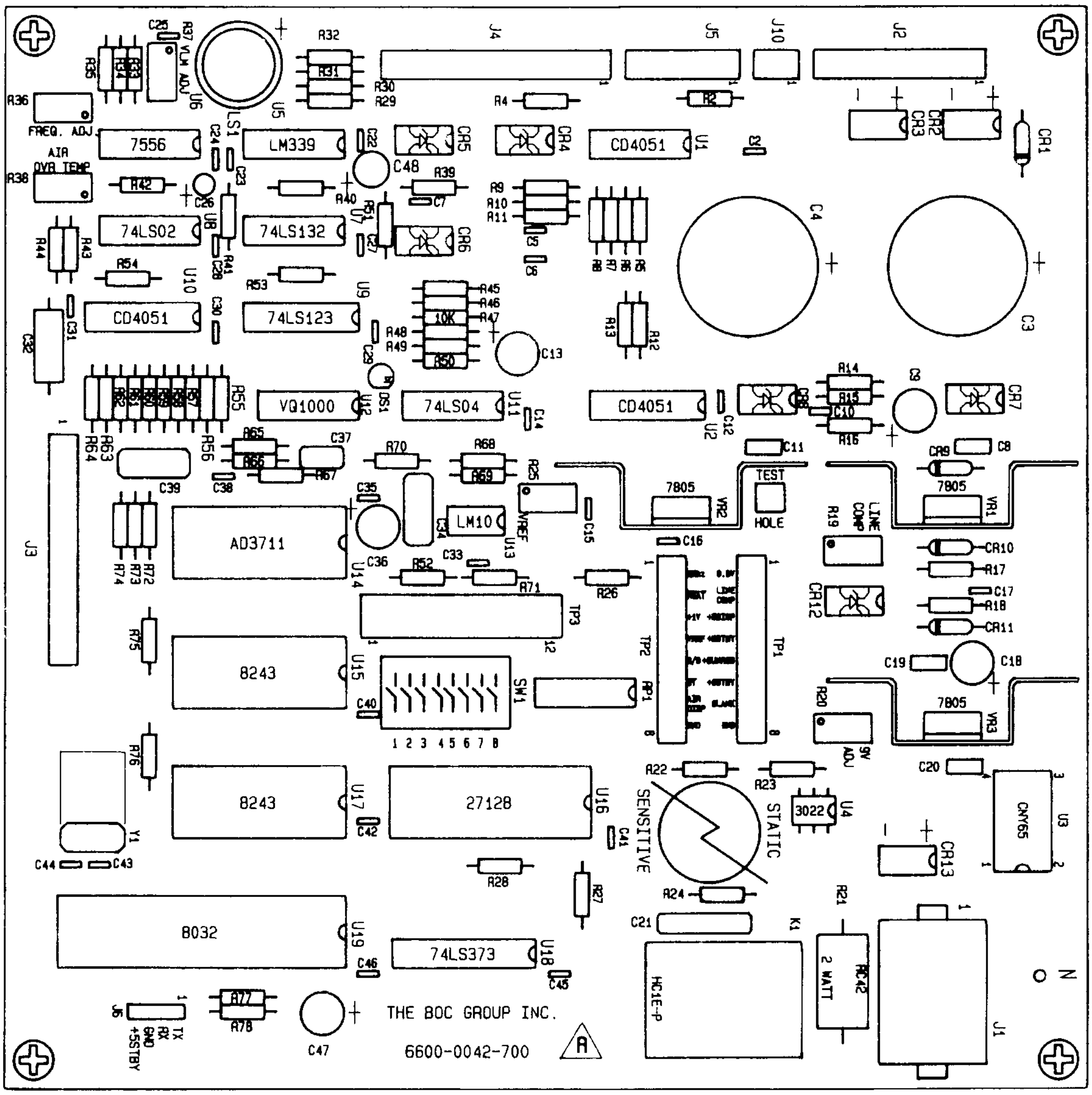


Figure 6-43 Control Board (tested and packaged) controllers without HBJ serial numbers

Controllers with HBJ Serial Numbers

Control Board

100/120/220/240V Stock No. 6600-0204-702

CRYSTAL 6.0 MHZ	1	Y1
RELAY RKS-5DG-05	1	K1
VOLTAGE REGULATOR 7805	3	VR1,VR2,VR3
DIODE	4	CR1,CR9,CR10,
		CR14
BRIDGE VM08 OR VM28	3	CR2,CR3,CR13
DIODE VSK120	1	CR11
CAPACITOR 0.1 MFD	28	C2,C5,C6,C7,C10,
		C14,C15,C16,C17,
		C22,C23,C24,C25,
		C27,C28,C29,C30,
		C31,C33,C35,
		C40,C41,C42,C45,
		C46,C54,C56,C57
CAPACITOR 4700 MFD 16V	2	C3,C4
CAPACITOR .33 MFD	3	C8,C11,C19
CAPACITOR 15 MFD 16V	5	C9,C13,C18
		C36,C47
CAPACITOR .47 MFD	1	C20
CAPACITOR 10 MFD 10%	1	C26
CAPACITOR 0.01 MFD 10%	1	C32
CAPACITOR .27 MFD	2	C34,C39
CAPACITOR 220PF	1	C37
CAPACITOR 33 PF	5	C43,C44,C58,C59,C60
CAPACITOR 3.3 MFD	1	C48
CAPACITOR 1 MFD	1	C55
RESISTOR 360 1/2W 5%	1	R2
RESISTOR 5.76K 0.1%	9	R5,R6,R7,R9,R30,
		R31,R39,R48,R56
RESISTOR 10K 0.1%	2	R8,R71
RESISTOR VAR 250K	1	R12
RESISTOR 1K 0.1%	3	R14,R15,R106
RESISTOR 100K 1%	2	R16,R22
RESISTOR 470 5%	2	R17,R92
RESISTOR 100 5%	6	R18,R93,R94,R95,
		R96,R97
RESISTOR VAR 10K	1	R19
RESISTOR VAR 500	3	R20,R37,R38
RESISTOR 47K 2W 5%	1	R21
RESISTOR VAR 1K	1	R25
RESISTOR 2.21K 0.1%	2	R26,R32
RESISTOR 220 5%	5	R27,R28,R54,
		R75,R77
RESISTOR 33K 5%	4	R29,R43,R50,R83
RESISTOR 10K 5%	12	R33,R34,R41,R46,
		R47,R49,R51,R53,
		R76,R78,R86,R91
RESISTOR 1.0 MEG 5%	1	R35
RESISTOR VAR 20K	1	R36
RESISTOR 1.21 MEG 1%	1	R40
RESISTOR 75K 1%	3	R42,R70,R82
RESISTOR 51 5%	1	R44
RESISTOR 1K 5%	2	R52,R88
RESISTOR 5.42K 0.1%	5	R55,R57,R59,R61,
		R63
RESISTOR 5.30K 0.1%	1	R58
RESISTOR 4.87K 0.1%	1	R60
RESISTOR 4.70K 0.1%	2	R62,R68
RESISTOR 5.05K 0.1%	1	R64
RESISTOR 6.8K 5%	1	R67
RESISTOR 5.9K 0.1%	1	R69
RESISTOR 267K 0.1%	1	R73
RESISTOR 22Ω 1W 5%	1	R79
RESISTOR 3K 5%	1	R80
RESISTOR 15K 5%	1	R85
RESISTOR 4.7K 5%	1	R87
RESISTOR 56K 5%	1	R89
RESISTOR 100K 0.1%	5	R101,R102,R103,
		R104,R105
RESISTOR VAR 20	1	R107
RESISTOR 210 1%	1	R108
RESISTOR PACK 1K	1	RP1
DESCRIPTION	QTY	SYMBOL

	LED HLMP-3366	1	DS1
	HEADER 12 PIN AMP	1	J1
	HEADER 12 PIN	1	J2
	HEADER 16 PIN	2	J3, J4
	HEADER 4 PIN	1	J5
	HEADER 6 PIN	1	J6
	ALARM QMB-06A	1	LS1
	8 POS. DIP SWITCH	1	SW1
	HEADER 8 PIN	2	TP1,TP2
	HEADER 12 PIN	1	TP3
	IC 4051B	2	U1, U10
	IC CNY65	1	U3
	IC LM339	1	U5
	IC 7556	1	U6
	IC 74LS132	1	U7
	IC 74LS02	2	U8,U22
	IC 74LS123	1	U9
	IC 74LS04	1	U11
	IC MPQ6426	1	U12
	IC LM10	1	U13
	IC ADC3711	1	U14
	IC 8243	2	U15, U17
6600-0167-600	IC 27128 PROGRAMMED	1	U16
	SOCKET 28 PIN	1	FOR U16
	IC 74LS373	1	U18
6600-0038-600	IC 8032	1	U19
	SOCKET 40 PIN	1	FOR U19
	IC LM324	1	U23
	NO. 4-40 ELASTIC NUT	3	FOR VR1,VR2,VR3
	HEAT SINK	3	FOR VR1,VR2,VR3
	THERMACOTE		
STOCK NO.	DESCRIPTION	QTY	SYMBOL

C1.02.130

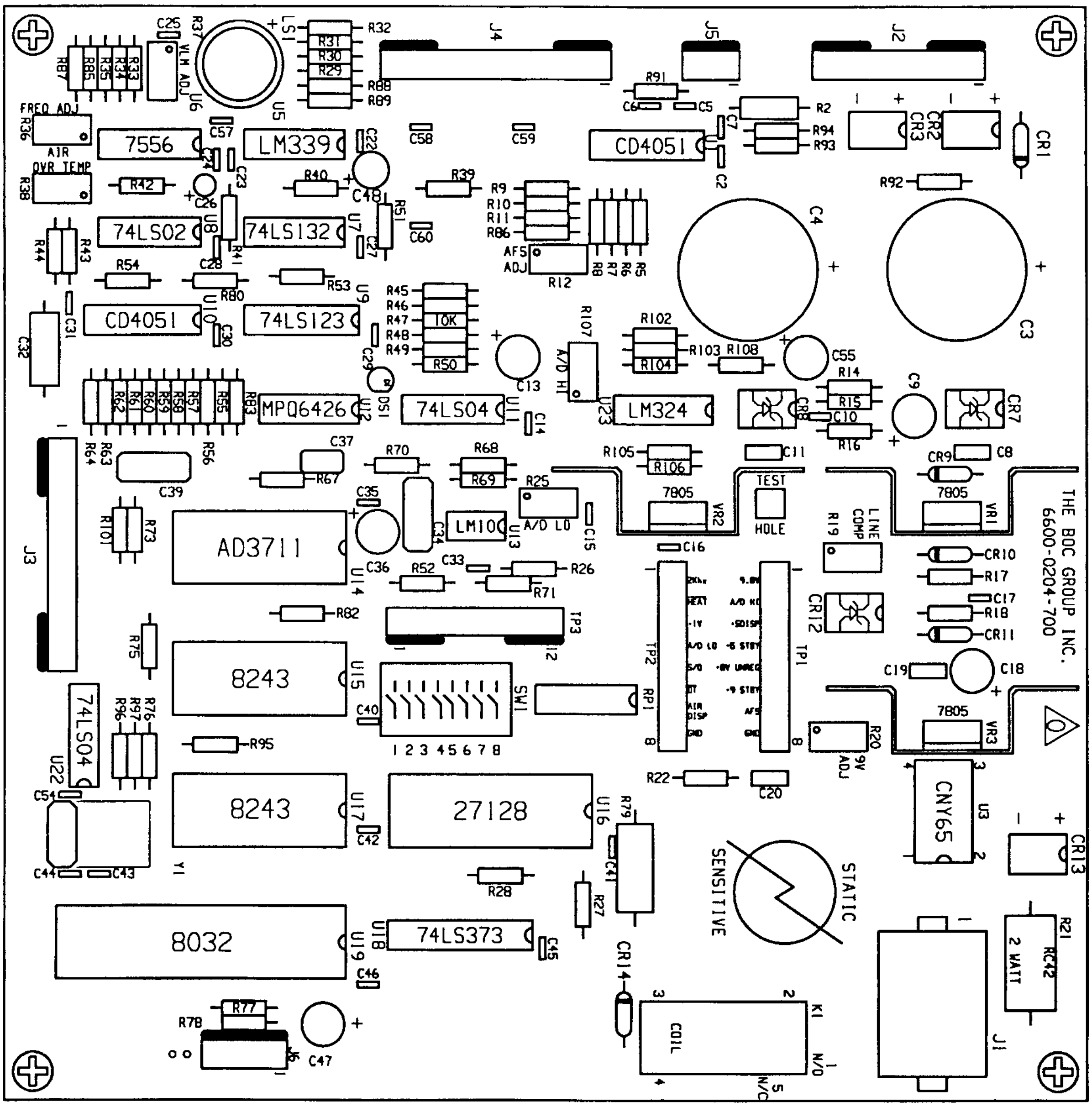


Figure 6-44 Contol Board controllers with HBJ serial Numbers

Appendix

Patient Temperature Probe and Air Temperature Sensor Characteristics

Temp (°C)	Resistance (Ohms)	Temp (°C)	Resistance (Ohms)	Temp (°C)	Resistance (Ohms)	Temp (°C)	Resistance (Ohms)
1.0	**31483.8**	31.6	7503.8	37.1	5956.4	42.6	4762.5
2.0	**29909.8**	31.7	7471.8	37.2	5931.8	42.7	4743.5
3.0	**28423.7**	31.8	7440.0	37.3	5907.4	42.8	4724.5
4.0	**27020.2**	31.9	7408.4	37.4	5883.1	42.9	4705.7
5.0	**25694.1**	**32.0**	**7376.9**	37.5	5858.9	**43.0**	**4686.9**
6.0	**24440.8**	32.1	7345.6	37.6	5834.8	43.1	4668.3
7.0	**23255.9**	32.2	7314.4	37.7	5810.8	43.2	4649.7
8.0	**22135.4**	32.3	7283.4	37.8	5786.9	43.3	4631.2
9.0	**21075.3**	32.4	7252.5	37.9	5763.1	43.4	4612.7
10.0	**20072.1**	32.5	7221.8	**38.0**	**5739.5**	43.5	4594.4
11.0	**19122.4**	32.6	7191.2	38.1	5716.0	43.6	4576.1
12.0	**18223.1**	32.7	7160.8	38.2	5692.5	43.7	4558.0
13.0	**17371.3**	32.8	7130.5	38.3	5669.2	43.8	4539.9
14.0	**16564.2**	32.9	7100.4	38.4	5646.0	43.9	4521.9
15.0	**15799.1**	**33.0**	**7070.4**	38.5	5622.9	**44.0**	**4503.9**
16.0	**15073.8**	33.1	7040.5	38.6	5599.9	44.1	4486.1
17.0	**14385.9**	33.2	7010.8	38.7	5577.0	44.2	4468.3
18.0	**13733.2**	33.3	6981.3	38.8	5554.3	44.3	4450.6
19.0	**13113.9**	33.4	6951.8	38.9	5531.6	44.4	4433.0
20.0	**12526.0**	33.5	6922.6	**39.0**	**5509.0**	44.5	4415.5
21.0	**11967.8**	33.6	6893.4	39.1	5486.6	44.6	4398.1
22.0	**11437.6**	33.7	6864.4	39.2	5464.2	44.7	4380.7
23.0	**10933.8**	33.8	6835.5	39.3	5441.9	44.8	4363.4
24.0	**10455.1**	33.9	6806.8	39.4	5419.8	44.9	4346.2
25.0	**10000.0**	**34.0**	**6778.2**	39.5	5397.7	**45.0**	**4329.1**
26.0	**9567.3**	34.1	6749.8	39.6	5375.8		
27.0	**9155.6**	34.2	6721.5	39.7	5354.0	**46.0**	**4161.9**
28.0	**8764.0**	34.3	6693.3	39.8	5332.2	**47.0**	**4002.1**
		34.4	6665.3	39.9	5310.6	**48.0**	**3849.3**
29.0	**8391.3**	34.5	6637.3	**40.0**	**5289.0**	**49.0**	**3703.1**
29.1	8355.1	34.6	6609.6	40.1	5267.6	**50.0**	**3563.3**
29.2	8319.0	34.7	6581.9	40.2	5246.2	**51.0**	**3429.5**
29.3	8283.0	34.8	6554.4	40.3	5225.0	**52.0**	**3301.4**
29.4	8247.3	34.9	6527.0	40.4	5203.9	**53.0**	**3178.8**
29.5	8211.7	**35.0**	**6499.8**	40.5	5182.8	**54.0**	**3061.3**
29.6	8176.4	35.1	6472.6	40.6	5161.9	**55.0**	**2948.9**
29.7	8141.1	35.2	6445.7	40.7	5141.0	**56.0**	**2841.1**
29.8	8106.1	35.3	6418.8	40.8	5120.2	**57.0**	**2737.8**
29.9	8071.2	35.4	6392.1	40.9	5099.6	**58.0**	**2638.9**
30.0	**8036.5**	35.5	6365.4	**41.0**	**5079.0**	**59.0**	**2544.0**
30.1	8002.0	35.6	6339.0	41.1	5058.5	**60.0**	**2453.0**
30.2	7967.6	35.7	6312.6	41.2	5038.2		
30.3	7933.4	35.8	6286.4	41.3	5017.9		
30.4	7899.4	35.9	6260.3	41.4	4997.7		
30.5	7865.6	**36.0**	**6234.3**	41.5	4977.6		
30.6	7831.9	36.1	6208.4	41.6	4957.6		
30.7	7798.3	36.2	6182.7	41.7	4937.7		
30.8	7765.0	36.3	6157.0	41.8	4917.9		
30.9	7731.7	36.4	6131.5	41.9	4898.1		
31.0	**7698.7**	36.5	6106.2	**42.0**	**4878.5**		
31.1	7665.8	36.6	6080.9	42.1	4858.9		
31.2	7633.1	36.7	6055.8	42.2	4839.5		
31.3	7600.5	36.8	6030.7	42.3	4820.1		
31.4	7568.1	36.9	6005.8	42.4	4800.8		
31.5	7535.9	**37.0**	**5981.1**	42.5	4781.6		

Appendix

Temperature Conversion Chart

°C	°F	°C	°F	°C	°F
20.0	68.0	34.5	94.1	37.6	99.7
21.5	70.7	35.0	95.0	37.7	99.9
22.0	71.6	35.1	95.2	37.8	100.0
22.5	72.5	35.2	95.4	37.9	100.2
23.0	73.4	35.3	95.4	38.0	100.4
23.5	74.3	35.4	95.7	38.1	100.6
24.0	75.2	35.5	95.9	38.2	100.8
24.5	76.1	35.6	96.1	38.3	100.9
25.0	77.0	35.7	96.3	38.4	101.1
25.5	77.9	35.8	96.4	38.5	101.3
26.0	78.8	35.9	96.6	38.6	101.5
26.5	79.7	36.0	96.8	38.7	101.7
27.0	80.6	36.1	97.0	38.8	101.8
27.5	81.5	36.2	97.2	38.9	102.0
28.0	82.4	36.3	97.3	39.0	102.2
28.5	83.3	36.4	97.5	39.5	103.1
29.0	84.2	36.5	97.7	40.0	104.0
29.5	85.1	36.6	97.9	40.5	104.9
30.0	86.0	36.7	98.1	41.0	105.8
30.5	86.9	36.8	98.2	41.5	106.7
31.0	87.8	36.9	98.4	42.0	107.6
31.5	88.7	37.0	98.6	42.5	108.5
32.0	89.6	37.1	98.8	43.0	109.4
32.5	90.5	37.2	99.0	43.5	110.3
33.0	91.4	37.3	99.1	44.0	111.2
33.5	92.3	37.4	99.3	44.5	112.1
34.0	93.2	37.5	99.5	45.0	113.0

CarePlus Specifications

A. Electrical Specifications

Power requirements

Domestic (Designed to UL 544 and CSA 22.2 specifications)
120 Vac 50/60 Hz Models (115 Vac ± 10%, 5.7 Amps)

Export (Designed to IEC 601-1 specifications)
220 Vac 50/60 Hz Models (220 Vac ± 10%, 3.0 Amps)
240 Vac 50/60 Hz Models (240 Vac ± 10%, 2.7 Amps)
100 Vac 50/60 Hz Models (95 Vac ± 10%, 6.6 Amps)

Nominal power consumption

450 watts at maximum heater output

Line voltage compensation

Heat output compensated for line voltage fluctuations up to 10% of nominal line voltage.

Circuit breakers on controllers with HBJ serial numbers

Rated Current: 7 Amps
Trip Point: 9.8 Amps Minimum
Type: Manual Resetting
Model: ETA 41-06-P10 7 Amps

Circuit breaker on all other controllers

Rated Current: 7 Amps
Trip Point: 9.45 Amps Minimum
Type: Manual Resetting
Model: Airpax Snapak

B. Performance Specifications

Patient temperature measurement

Range Displayed: +22 to 42°C (71.6 to 107.6°F)
Accuracy: ± 0.3°C (± 0.5°F) within a range of 30 to 42°C
Resolution: ± 0.1°C or °F

Probe Model Numbers: LA003 (reusable), LA005 (disposable)
Probe Interchangeability: ± 0.1°C (± 0.2°F)

Air temperature measurement

Range Displayed: 5 to 50°C (41.0 to 122.0°F)
Resolution: ± 0.1°C or °F
Accuracy: Varies over temperature range

Temperature Range	Accuracy
5 to 22°C (41-71.6°F)	± 0.5°C (0.9°F)
22.0 to 42.0°C (71.6-107.6°F)	± 0.3°C (0.5°F)
42.0 to 50.0°C (107.6-122.0°F)	± 0.5°C (0.9°F)

Control temperature ranges

Patient Control Mode: 35.0 to 37.0°C (95.0 to 98.6°F), up to 37.5°C (99.5°F) with internal adjustment

Air Control Mode: 20.0 to 37.0°C (68.0 to 98.6°F), up to 39.0°C (102.2°F) with control panel Override switch.

Thermal performance

Temperature Rise Time*: 25 to 30 min
Temperature Variability*: 0.2°C (0.4°F)
Temperature Overshoot*: Less than or equal to 0.8°C (1.4°F)

* These terms are defined in the Definitions section at the front of this manual.

Appendix

Alarms

1. Indicator and Nonsilenceable Audio Alarm

   Power Failure

2. Indicator and Silenceable Single Tone Alarm‡

   Difference between patient temperature and patient control temperature exceeds 1.0°C patient control mode (adjustable to 0.5°C).

   Air temperature is 1.5°C above or 3.0°C below air control temperature (air control mode; disabled for 15 minutes after control temperature change and for 30 minutes on power up).

3. Indicator, Silenceable Two Tone Alarm and Heater Shutdown‡

   Air temperature sensor disconnected (both modes)

   Patient probe disconnected or malfunctioning (patient control mode)

   Air circulation system failure

   Patient temperature > 42.0°C or < 30.0°C

   Air temperature > 38.0°C (air control mode w/o Override)

   Air temperature > 40.0°C (patient control mode or air control mode w/Override)

4. Indicator, Nonsilenceable Two Tone Alarm, Heater Shutdown and Possible Error Code

   System failure

Operator prompt tone

Intermittent audio tone sounds when the unit is first switched On and when the patient control mode is first selected. Tone is silenced when control temperature is entered. The heater will not operate until a control temperature has been entered. On controllers with serial numbers beginning with HBJ, the operator prompt tone sounds for the initial 30 seconds of any alarm except the system failure alarm or the power failure alarm.

Proportional heat control

Features zero voltage switching to minimize radiated and conducted EMI. Heater power compensated for line voltage fluctuations of up to 10% of the nominal voltage.

‡ On controllers with serial numbers beginning with HBJ, all silenceable alarms are preceded by a 30 second operator prompt tone.

Air velocity over mattress

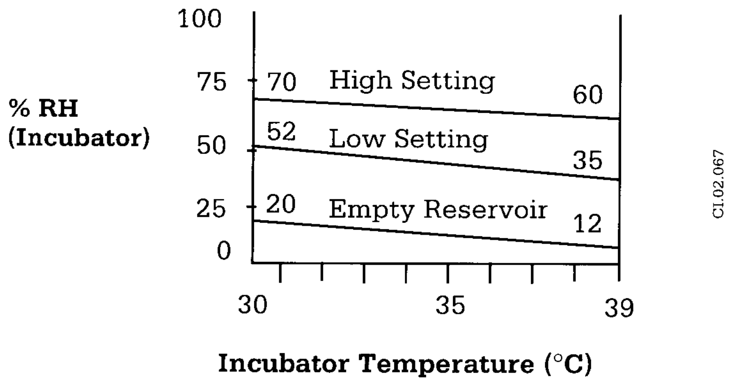
Less than 10 cm/sec. (Double Walled Units)
Less than 35 cm/sec. (Single Walled Units)

Noise level within unit

Less than 60 Decibels, A weighted

External humidifier specifications

High setting: 65 ± 10% RH
Low setting: 45 ± 10% RH
Empty humidifier: 15 ± 10% RH



Specification test conditions used to collect data:
Room temperature: 25°C
Room humidity: 50% RH
Readings taken two hours after reaching temperature equilibrium without an infant in the incubator.

Internal humidifier specifications

50% ± 10% RH, depending on operating conditions

Oxygen concentration within unit

25 to 45% with 5 L/min. oxygen input
35 to 65% with 10 L/min. oxygen input
45 to 75% with 15 L/min. oxygen input

Carbon dioxide concentration within unit

Less than 0.5% when a 4% carbon dioxide, 96% air mixture is fed into the infant compartment at rate of 0.75 l/min (simulated infant occupancy).

C. Safety Specifications

Isolation voltage

2500 V rms 60 Hz from the patient probe to the ac phase and neutral lines for one minute.

IEC 601-1 Class I Equipment

IEC 601-1 Type B Isolation

⚠WARNING: The patient probe is not isolated from earth ground. Any additional equipment used with the Care Plus must comply with UL 544, CSA 22.2, IEC 601, and VDE 750.

Leakage current

For all ground wire configurations with UL, CSA, or AAMI test load attached:

Power supply: 100/120V 50/60 Hz
Leakage current: less than 100 μA

Power supply: 220/240 V 50/60 Hz
Leakage current: less than 200 μA

Self test

The microprocessor performs self test and software verification functions when the power is switched On.

D. Electromagnetic Interference (EMI) Specifications

(Applies to controllers with serial numbers beginning with HBJ)

IEC 801-2	Electrostatic Discharge Requirements Level 2
IEC 801-3	Immunity to Radiated Radio-frequency Electromagnetic Fields Level 2
IEC 801-4	Electrical Fast Transient Burst Requirements Level 2
IEC 801-5	Surge Immunity Requirements Level 2
IEC 801-6	Immunity to Conducted Disturbances Induced by Radio-frequency Fields above 9 kHz Level 2
CISPR 11	Limits and Methods of Measurements of Radio Interference Characteristic of Industrial, Scientific and Medical Radio-frequency Equipment Class B

E. Environmental Specifications

Operating Temperature Range: 20 to 30°C (68 to 86°F)
Storage Temperature Range: -25 to 60°C (-13 to 140°F)
Operating & Storage Pressure Range: 500 to 1060 hPa
Operating & Storage Relative Humidity Range: 0 to 95%

F. Mechanical Specifications

Incubator with cabinet

Height:	135.9 cm (53.5 in)
Depth:	64.8 cm (25.5 in)
Width:	88.9 cm (35.0 in)
Weight:	84.04 kg (185 lbs)
Casters:	5 inch diameter, 2 locking, 2 non-locking

Incubator only

Height:	62.2 cm (24.5 in)
Depth:	61.5 cm (24.2 in)
Width:	83.1 cm (32.7 in)
Mattress:	34.8 x 65.0 cm (13.7 x 25.6 in)

Tilt Positions: ±6 degrees in 3 degree angular increments

Cabinet rail systems

Maximum total weight: 23 kg (50 lbs), including any items on overhead or rail mounted shelves.

G. ThermaLink Option Specifications

(Applies to controllers with serial numbers beginning with HBJ)

Serial data

⚠WARNING: The computer or RS-232 monitor's user program must continiously check the data link. The program should constantly verify connection to the incubator and check for updated data.

Note: In the event of a power failure, all serial communication will cease until power is restored.

RS-232 Connector

The Nurse Call and the serial data output share the same female, nine pin, d-type connector.

Pin 2: Receive Data (incubator input)
Pin 3: Transmit Data (incubator output)
Pin 5: Gnd (Signal Ground)

Cable requirements

The user interface cable must have capacitance less than 1500 pF. It should be a shielded cable such as Belden 9611 with AMP connector shielding kit 748046-1 and ferrule 747579-8

Data transmission

The incubator continuously sends data from the time that it is first powered up. Note that the incubator cannot be controlled through the serial port. Data output stops when the incubator receives a <cntrl>S (XOFF) and resumes when it receives a <cntrl>Q (XON).

Data format

1 start bit, 7 data bits (ASCII), 1 parity bit (odd), 1 stop bit, 1200 baud, full duplex

Serial data has the format: start text character, "<stx>"; Care Plus header, "CP"; software version; data string; checksum characters; carriage return, "<cr>"; line feed, "<lf>"; end of text character, "<etx>". Data elements are separated by spaces, "_". Each String contains 53 characters:

Sample data:

<stx>CP0300_36.52_34.20_P_34.80_36.50_00001000_E014_11<cr><lf><etx>

Data for discussion (use the following table):

<stx>CPxxxx_pt.pt_at.at_m_ac.ac_pc.pc_alrmleds_code_ck<cr><lf><etx>

<stx>

Start of text character (ASCII 2); indicates a string of data will follow.

CPxxxx

CP means the data is from the Care Plus; xxxx is the software version in the unit, e.g. 0300 for version 3.00.

pt.pt

This is the patient temperature in degrees centigrade. The patient temperature will always be sent even if it is outside the normal display range. Temperatures less than or equal to 1.00°C indicate an open or a disconnected probe. Any temperature greater than or equal to 50°C is a shorted probe.

at.at

This is the air temperature in degrees centigrade. The air temperature will always be sent even if it is outside the normal display range. Temperatures less than or equal to 1.00°C indicate an open or a disconnected probe. Any temperature greater than or equal to 50°C is a shorted probe.

m

This is the mode of operation. P means patient control mode. A means air control mode. Always check the mode of operation before evaluating the air and patient control temperatures.

ac.ac

In the air control mode, this is the air control temperature set with the ▲ and ▼ switches. In the patient control mode this is the air temperature that will maintain the patient control temperature (or DET). The DET is calculated by the software and changes in response to infant condition, incubator heat loss, etc. Both readings are in degrees centigrade.

pt.pt

In the patient control mode, this is the patient control temperature set with the ▲ and ▼ switches in degrees centigrade. It has no significance in the air control mode.

alrmleds

This series of bits represents the alarm LEDs. If an LED is illuminated, the corresponding bit is set to 1 (alarm active). If there is no alarm, the bit is set to 0. Audible alarm status bit is 1 if an alarm condition exists and if the alarm is not silenced. Audible alarm status bit is 0 if there are no active alarms, or if the active alarms are silenced.

00000100

Patient Temperature Alarm
Control Temperature Alarm
High Air Temperature Alarm
Air Circulation Alarm
Probe Failure Alarm
System Failure Alarm
Not Used
Audible Alarm Status Bit

code

This is the error code that appears in the control temperature display during a system failure alarm (e.g. E014). If the system is operating normally (no system failure), zeroes replace the error code (e.g. E000).

ck

This is the two byte ASCII representation of the byte that when added to the sum of all the ASCII data bytes in the string equals zero. Note that all over flows are dropped and the sum of the data bytes DOES NOT INCLUDE the <stx>, checksum, <etx>, <cr>, or <lf> characters or the parity bit of each byte.

<cr>

Carriage return character.

<lf>

Line feed character.

<etx>

End of transmission character (ASCII 3).

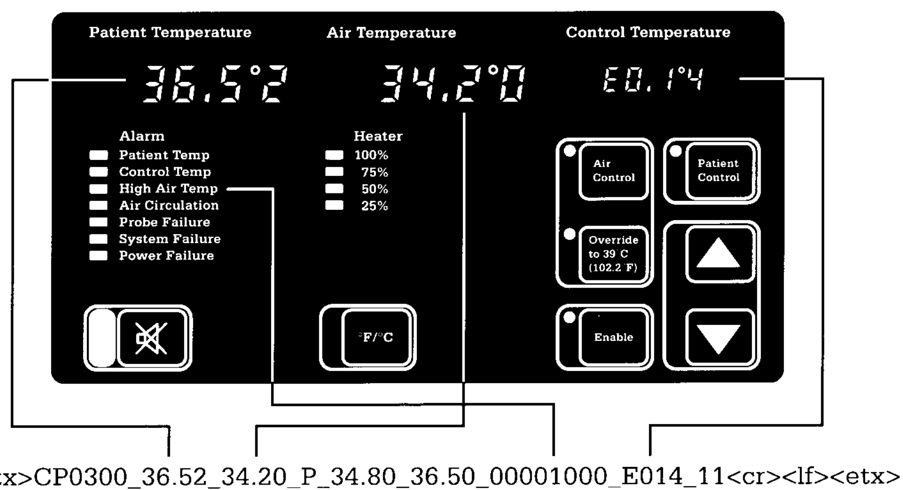


Figure A-1 Serial data

Nurse Call

Contact ratings

Maximum resistive load: 4 VA
Maximum DC switching voltage: 100 Vdc
Maximum switching current: 0.25 A
Maximum carrying current: 0.50 A.

Connector

The Nurse Call contacts and the serial data output share the same female, nine pin, d-type connector.

Pin 6: Closed contact under normal conditions, i.e. power on, no alarm (recommended configuration)
Pin 1: Common contact
Pin 9: Open contact under normal conditions, power on, no alarm

These contacts are not powered. They only provide closure.

Table A-1 *Nurse Call signals*

Incubator Status	**Nurse Call Signal** **Pins 1&6**	**Pins 1&9**
Normal	Closed	Open
Alarm	Open	Closed
Power switch off or power fails	Open	Closed
Nurse Call cable disconnected	Open	Open

⚠**WARNING: If you use the normally open Nurse call connection (pins 1 & 9), a disconnected Nurse Call cable will not trigger an alarm.**

Note: Any interruption of incubator power (deliberately switching off the incubator, accidentally unplugging the power cord, etc.) triggers a Nurse Call alarm.

External Humidifier

⚠**WARNING: The external humidifier must be installed for proper incubator operation, even if you do not plan to use the humidifier.**

The Care Plus offers three levels of humidification: none, low, and high. If you do not want humidification, do not put water in the humidifier.

Even at high humidification levels, the humidifier reservoir holds more than enough water to last for 24 hours.

1. Gently slide the humidifier out of the base. You will feel an initial resistance. Pull steadily to avoid spilling the contents of the sump.

2. Set the humidifier down on a level surface and add water to the fill level indicated on the label (1000 ml maximum).

   Note: Do not fill the humidifier past the fill level. Filling past the fill level actually DECREASES humidification.

3. Slide the humidifier back into the base.

4. Adjust the slide on the side of the humidifier to set the humidification level:

   - For high humidification move the slide completely back.

   - For low humidification move the slide completely forward.

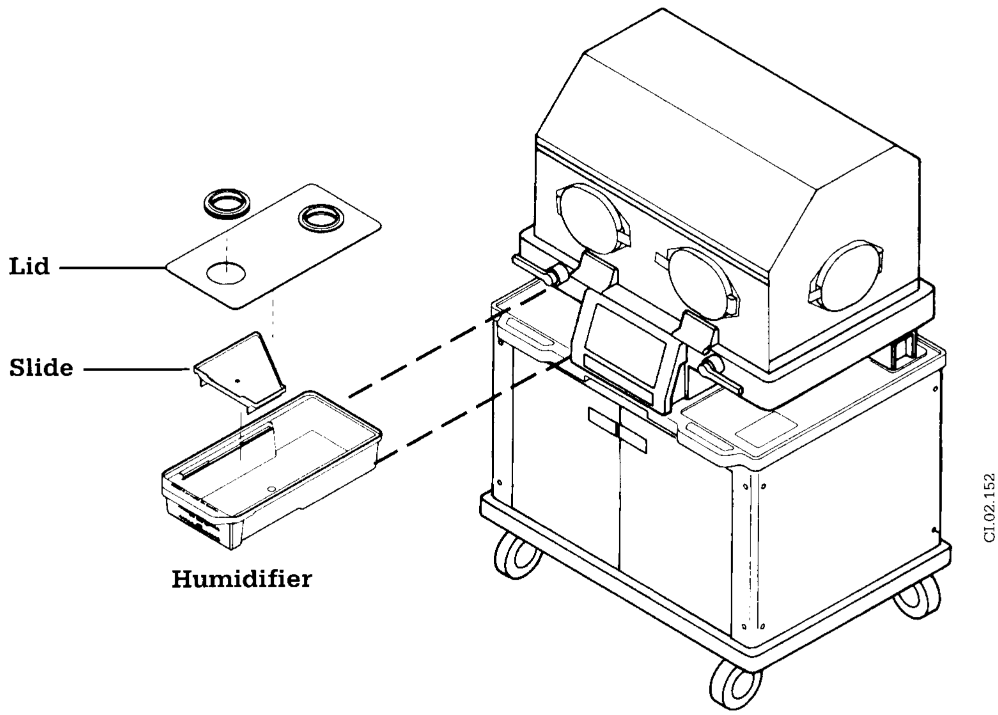


Figure A-2 Using the external humidifier

Upgrading Existing Units

To upgrade incubator with an internal humidifier, order the Care Plus base replacement/upgrade kit (Stock Number 6600-0107-800).

Parts Compatibility

The only difference between the external humidifier model and internal humidifier model is the incubator base and the humidifier. All other hood, infant compartment, mounting devices, and electrical components are identical.

Internal humidifier

Units with the old style internal humidifier have a fill port on the left side of the incubator.

To fill the reservoir:

1. Pull the fill port to the open position (Figure A-3)

2. Slowly fill the reservoir with distilled water until the water reaches the fill mark (approximately 700 ml).

3. Close fill port.

To empty the reservoir:

1. Place a catch basin under the fill port and pull the port out, into the open position.

2. Rotate the fill port counterclockwise and drain the water.

3. Rotate the fill port back to an upright position and push it back into the incubator base.

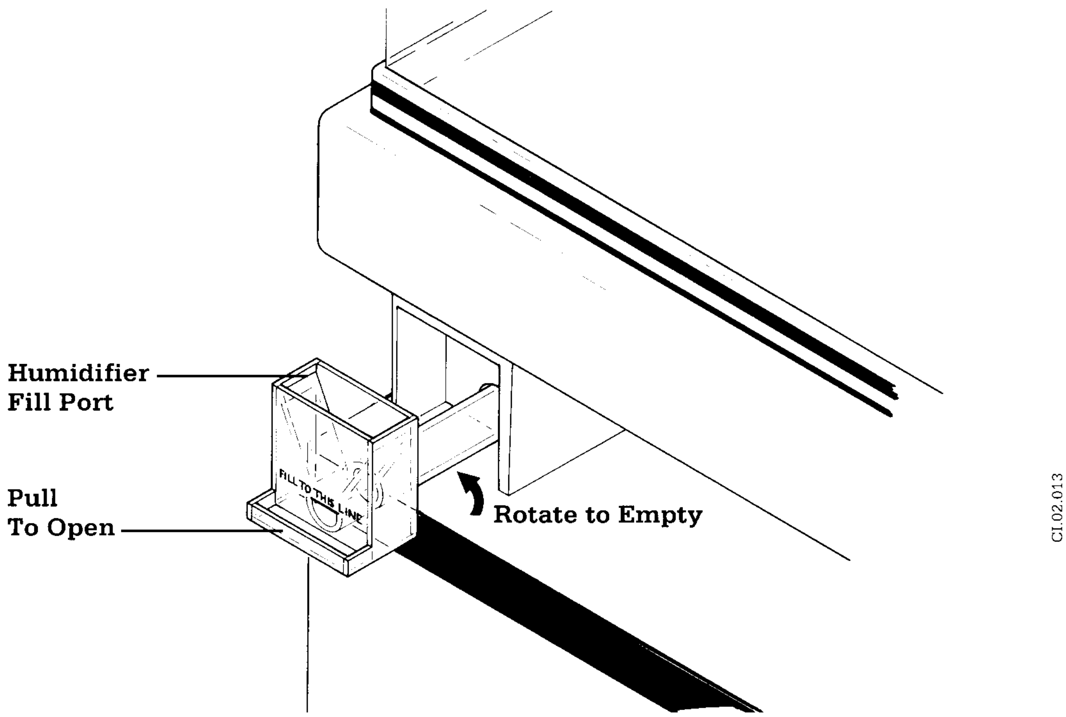


Figure A-3 Using the internal humidifier

Ohmeda

Ohmeda
Critical Care
9065 Guilford Road
Columbia MD 21046 1801
USA

A Division of BOC Health Care Inc

U.S. Customer Service and Technical Suport
Ohmeda
Ohmeda Drive
P.O. Box 7550
Madison, WI 53707
Tel 800 345 2700
Fax 608 222 9147

U.S. Service and Distribution Center
Ohmeda
7750 The Bluffs, NW
Austell, GA 30001
Tel 800 241 6442
Tel 404 739 4774
Fax 404 739 4770

Canada Customer Service and Service Center
Ohmeda
5865 McLaughlin Rd
Mississauga Ontario
L5R 1B8 Canada
Tel 416 568 9533
Fax 416 568 9799
Telex 06989362

International Europe, Africa, Middle East
Ohmeda House
71 Great North Rd
Hatfield Herts
AL9 5EN England
Tel 44 707 263570
Fax 44 707 260191
Telex 915128

Latin America, Caribbean
Ohmeda
9200 Dadeland Blvd
Suite 610
Miami, FL 33156
Tel 305 670 9938
Fax 305 670 4834

Southeast Asia
Ohmeda
78 Shenton Way
#0903
Singapore 0207
Tel 65 222 6028
Fax 65 222 0725
Telex RS 35276 OHMEDA

International Customer Service and Technical Suport
Ohmeda House
71 Great North Rd
Hatfield Herts
AL9 5EN England
Tel 44 707 263570
Fax 44 707 260191
Telex 915128

United Kingdom
Ohmeda House
71 Great North Rd
Hatfield Herts
AL9 5EN England
Tel 44 707 263570
Fax 44 707 260065
Telex 918179

France
Ohmeda
ZI de Cognières Maurepas
BP 186
Boulevard des Arpents
78313 Maurepas Cedex
France
Tel 33 1 30 62 41 07
Fax 33 1 30 62 25 35
Telex 698619

Spain
Ohmeda
C/Manuel Tovar 26
28034 Madrid
Spain
Tel 34 1 358 16 76
Fax 34 1 358 12 84
Telex 23795 Mameq E

Italy
Ohmeda
Via Carpaccio 33
20090 Trezzano sul Naviglio
Milan
Italy
Tel 39 2 445761
Fax 39 2 4455614
Telex 314479 I

Sweden
Ohmeda
Box 140
S 421 22 Västra Frölunda
Göteborg
Sweden
Tel 46 31 490520
Fax 46 31 497170
Telex 21083

Netherlands
Ohmeda
Larikslaan 6
3833 AM Leusden
Netherlands
Tel 31 33 94 86 95
Fax 31 33 94 86 93

Japan
Ohmeda
Marumasu Shinjuku Bldg
6 24 20 Shinjuku
Shinjuku-ku
Tokyo 160
Japan
Tel 81 3 5272 1881
Fax 81 3 5272 0773
Telex 2323106

A BOC Health Care Company

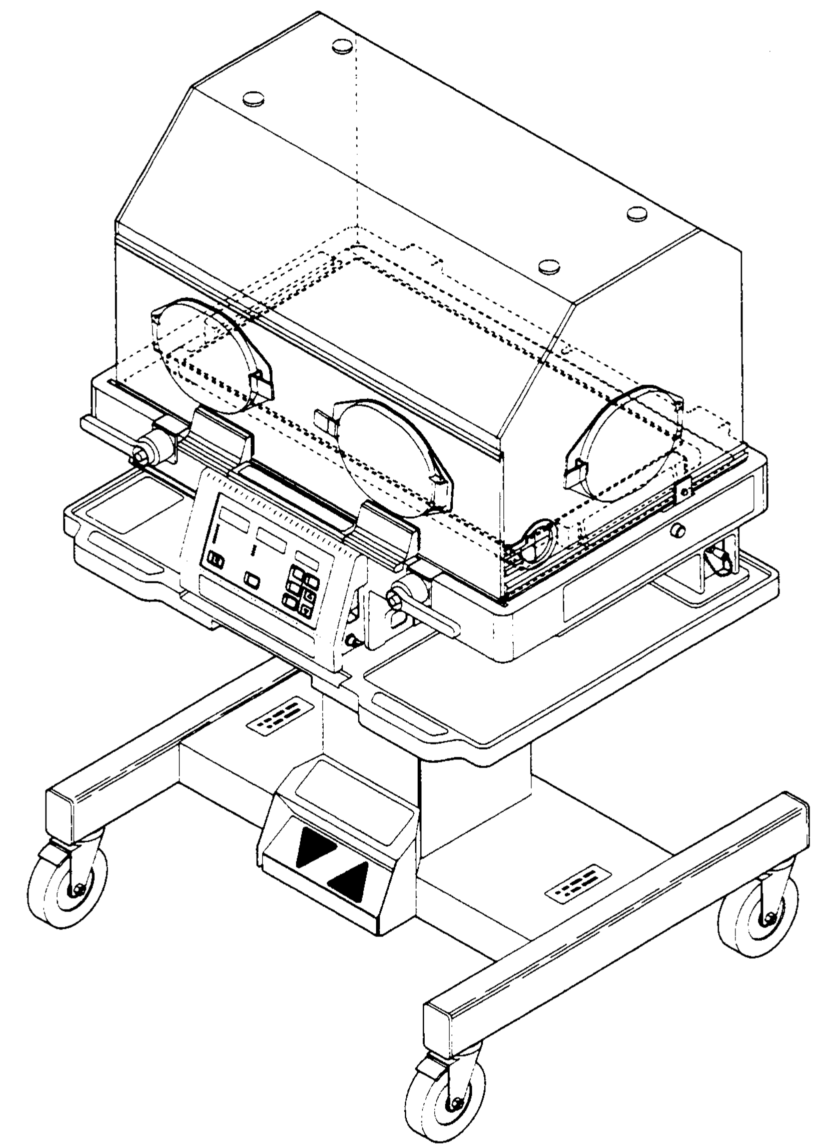
Critical Care Worldwide

6600 0017 000
10 92 A 13 10 06
Printed in USA

Ohmeda

Care Plus™ Elevating Base

Operation, Maintenance, and Service Manual



A BOC Health Care Company

Critical Care Worldwide

Important

This Product will perform in conformity with the description thereof contained in this operation manual and accompanying labels and/or inserts, when assembled, operated, maintained and repaired in accordance with the instructions provided. This Product must be checked periodically. A defective Product should not be used. Parts that are broken, missing, plainly worn, distorted or contaminated, should be replaced immediately. Should such repair or replacement become necessary, Ohmeda recommends that a telephonic or written request for service advice be made to the nearest Ohmeda Regional Service Office. This Product or any of its parts should not be repaired other than in accordance with written instructions provided by Ohmeda, or altered without the prior written approval of Ohmeda's Safety Department. The user of this Product shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, improper repair, damage, or alterations by anyone other than Ohmeda.

Important: This manual is subject to periodic review. Customers are cautioned to obtain and consult the latest manual revision. Suggestions are also invited from customers for consideration by Ohmeda in connection with these periodic reviews. Customers may contact product service at 1-800-345-2700 or by writing to Ohmeda at P.O. Box 7550, Madison, WI, 53707.

CAUTION: Federal law in U.S.A. and Canada restricts this device to sale by or on the order of a licensed medical practitioner.

Table of Contents

Definitions

⚠ **CAUTION:** A CAUTION statement is used when the possibility of damage to the equipment exists.

⚠ **WARNING:** A WARNING statement is used when the possibility of injury to the patient or the operator exists.

Precautions

Warnings

Do not use the Elevating Base in the presence of flammable anesthetics. A possible explosion hazard exists under these conditions.

Safely mounting or dismounting the Care Plus Incubator requires two people. Remove the controller unit before mounting or dismounting the incubator.

Always complete the Elevating Base checkout procedure and verify that the incubator is securely mounted before using the base.

Always set the brakes before placing a patient in the incubator.

Before raising or lowering the base, check that there is adequate slack in tubing and cable connections and that no obstructions (e.g. shelves, etc.) limit the range of motion.

When a patient occupies the incubator, always close the incubator door and portholes before raising or lowering the Elevating Base.

Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.

Cautions

Only competent individuals trained in the repair of this equipment should attempt to service it.

Rail mounted accessories should not exceed 20 lbs (9 kg) on either side. The total weight of rail mounted accessories must not exceed 40 lbs (18 kg). Total accessory weight, including items placed on rail mounted shelves, must not exceed 90 lbs (41 kg).

Continuously depressing the ▼ or ▲ pedals for long periods can cause the motor to overheat. To avoid damage, a thermal switch opens cutting the motor power. The switch remains open, preventing operation, until the motor cools.

Precautions

Do not use hydrogen peroxide solutions to clean the Elevating Base. Solvents, harsh chemicals, or abrasive cleaners may also damage the Care Plus Incubator or the Elevating Base. Always check the product information supplied with the cleaner before use. Never submerge any part of the Elevating Base.

Detailed information for more extensive repairs is included in the service section of this manual (Chapter 6, Service Information) solely for the convenience of users having proper knowledge, tools and test equipment, and for service representatives trained by Ohmeda.

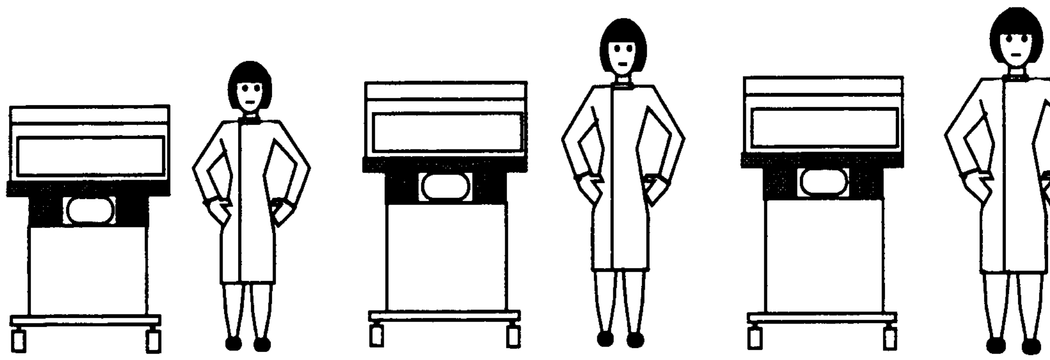
Notes:

1/Introduction

What the Elevating Base can do

The Elevating Base lets you adjust the Care Plus Incubator to the height that is most comfortable for you. The mattress can be as low as 34 inches (85 cm) or as high as 42 inches (107 cm) above the ground. The foot pedal controls leave your hands free to care for the patient.

Figure 1-1 Different elevations



How to use this manual

Thank you for adding the Elevating Base to your Care Plus system. Please take a moment to review the User Responsibility Statement on the inside of the front cover; it describes what is expected of you to maintain the Elevating Base. Also read the Warranty on the back inside cover; it outlines Ohmeda's responsibility in case of a functional defect.

This manual is divided into two sections. The first section tells you:

- How to use the Elevating Base controls
- How to test the Elevating Base before using it with a patient
- How to clean the Elevating Base

The second section describes specific service and troubleshooting procedures. Both sections feature individual tables of contents and precautions so that the first five chapters can be stored with the Elevating Base and the sixth chapter (Service Information) can be stored in the biomedical department.

Before you use the Elevating Base, make sure that you understand the warnings and cautions. Warnings alert you to situations that could injure the patient or the operator. For example:

WARNING: Do not use the Elevating Base in the presence of flammable anesthetics. A possible explosion hazard exists under these conditions.

Cautions alert you to conditions that may damage the equipment. For example:

CAUTION: Only competent individuals trained in the repair of this equipment should attempt to service it.

2/Getting Started

Incoming inspection

Inspect the Elevating Base for any signs of shipping damage immediately after unpacking. If the Elevating Base or its accessories appear to have been damaged in shipment, file a damage claim with the shipping carrier within 15 days of receipt. Keep all packaging materials until the claim is resolved.

Also check the packing slip against the shipment to verify that all accessory devices are present.

Mounting the Care Plus Incubator

1. Remove the controller from the Care Plus Incubator.

   ⚠ **WARNING: Safely mounting or dismounting the Care Plus Incubator requires two people. Remove the controller unit before mounting or dismounting the incubator.**

2. Fit o-rings into the depression around each of the incubator mounting holes in the incubator platform.

3. Lift the Care Plus Incubator onto the Elevating Base. Make sure that the foot pedals face the same direction as the incubator.

4. Install the four mounting screws.

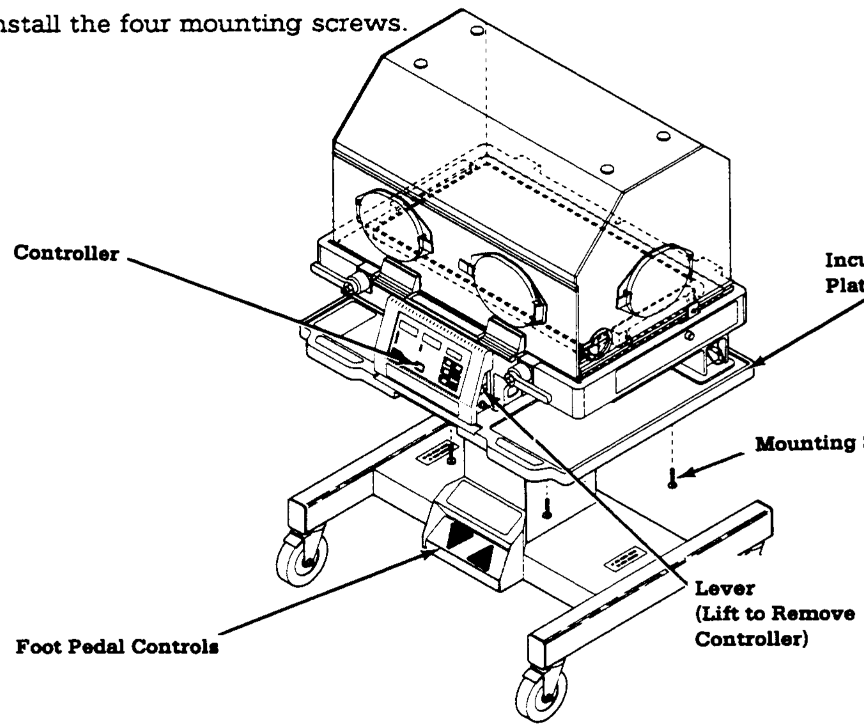


Figure 2-1 Mounting the Care Plus Incubator

5. Install the controller. Lift the levers on the controller and slide it into the incubator as shown in Figure 2-1. Push the levers down to lock the controller in place.

Checkout procedure

WARNING: Always complete the Elevating Base checkout procedure and verify that the incubator is securely mounted before using the base.

1. Check the Elevating Base for external damage.

2. Make sure that the incubator is securely mounted to the Elevating Base.

3. If a rail system is attached to the Elevating Base, check that accessories are securely mounted and that their weight is evenly distributed between the two rails.

   CAUTION: Rail mounted accessories should not exceed 20 lbs (9 kg) on either side. The total weight of rail mounted accessories must not exceed 40 lbs (18 kg). Total accessory weight, including items placed on rail mounted shelves, must not exceed 90 lbs (41 kg).

4. Make sure that the castors are securely attached.

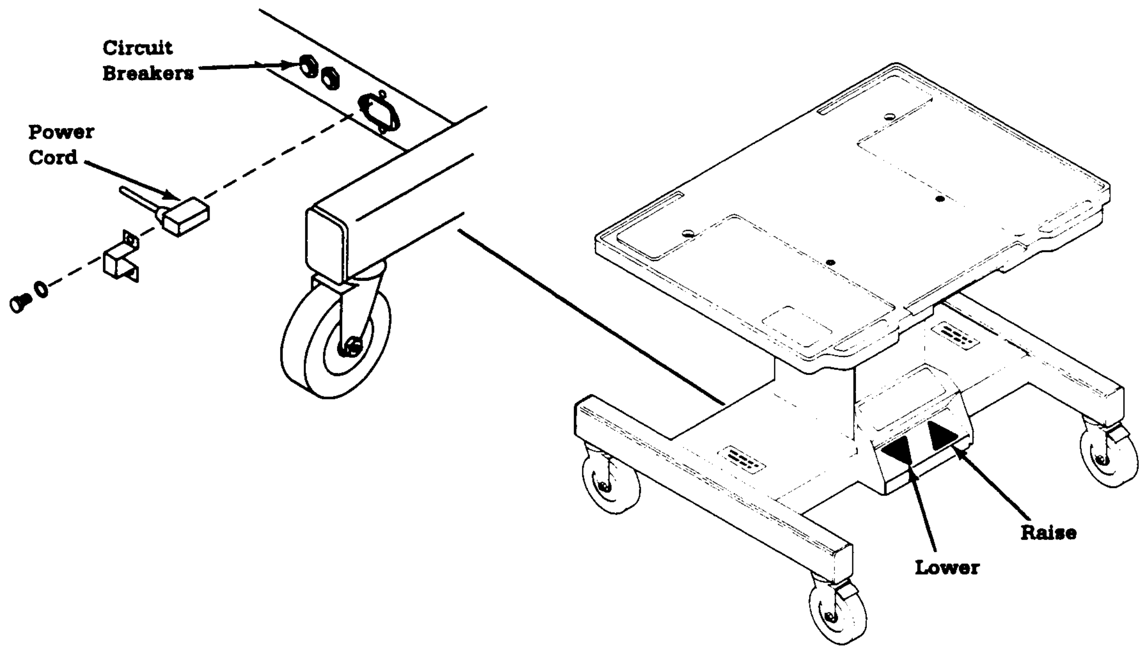
5. Verify that the Elevating Base rolls freely when the brakes are not set. Then, set the brakes and verify that the Elevating Base stays in place.

   WARNING: Always set the brakes before placing a patient in the incubator.

6. Verify that the area is free of flammable anesthetic agents and other flammable substances.

   WARNING: Do not use the Elevating Base in the presence of flammable anesthetics. A possible explosion hazard exists under these conditions.

Figure 2-2 Power connections and control locations



7. Verify that the power cord is tightly plugged into the Elevating Base's socket. If necessary, loosen the plug guard and connect the power cord. Then, reposition the plug guard and tighten the screws. Plug the other end of the cord into a power outlet (Figure 2-2).

8. Depress the ▲ pedal and verify that the incubator mattress rises to approximately 42 inches (107 cm) above the floor.

   ⚠ **WARNING: Before raising or lowering the base, check that there is adequate slack in tubing and cable connections and that no obstructions (e.g. shelves, etc.) limit the range of motion.**

9. Depress the ▼ pedal and verify that the incubator mattress lowers to approximately 34 inches (85 cm) above the floor.

10. Before using the Care Plus system with a patient, verify proper operation of the incubator and all other system components.

Notes:

3/Operating Procedure

CAUTION: Continuously depressing the ▼ or ▲ pedals for long periods can cause the motor to overheat. To avoid damage, a thermal switch opens cutting the motor power. The switch remains open, preventing operation, until the motor cools.

1. Complete the Checkout procedure in Chapter 2, Getting Started.

2. If a rail system is attached to the Elevating Base, check that accessories are securely mounted and that their weight is evenly distributed between the two rails.

   CAUTION: Rail mounted accessories should not exceed 20 lbs (9 kg) on either side. The total weight of rail mounted accessories must not exceed 40 lbs (18 kg). Total accessory weight, including items placed on rail mounted shelves, must not exceed 90 lbs (41 kg).

3. Move the incubator into position and set the brakes.

   WARNING: Always set the brakes before placing a patient in the incubator.

4. Verify that the area is free of flammable anesthetic agents and other flammable substances.

   WARNING: Do not use the Elevating Base in the presence of flammable anesthetics. A possible explosion hazard exists under these conditions.

5. Verify that one end of the power cord is plugged into the Elevating Base's socket. Plug the other end into a power outlet.

6. Use the ▼ and ▲ pedals to adjust the Elevating Base to the desired height.

   WARNING: When a patient occupies the incubator, always close the incubator door and portholes before raising or lowering the Elevating Base.

Notes:

4/Cleaning

WARNING: Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.

1. Unplug the incubator and the Elevating Base.

2. If separate incubator disinfection or cleaning is desired:

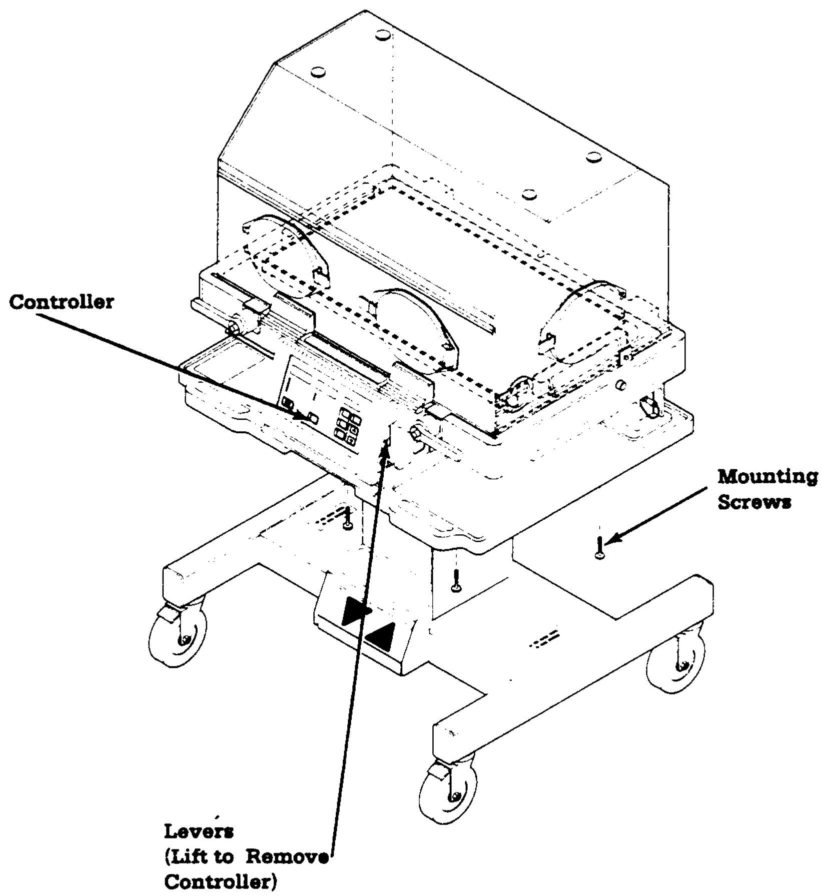
   - Disconnect any cables attached to the controller.

   - Lift the levers on the controller and slide it out of the incubator (Figure 4-1).

   - Remove the incubator from the Elevating Base. The incubator is attached to the base by four mounting screws, shown in Figure 4-1.

   WARNING: Safely mounting or dismounting the Care Plus Incubator requires two people. Remove the controller unit before mounting or dismounting the incubator.

Figure 4-1 Removing the Care Plus Incubator



3. Wipe the Elevating Base with a cloth dampened in a soap and water solution. If persistent stains require a stronger cleaning solution, always check the cleaning product label to make sure that it will not damage the Elevating Base.

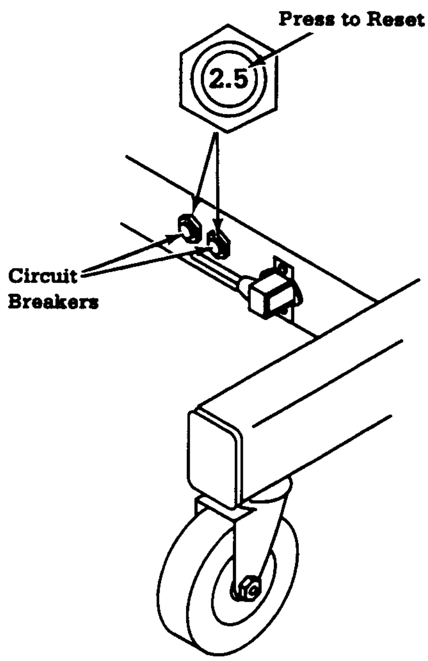
   CAUTION: Do not use hydrogen peroxide solutions to clean the Elevating Base. Solvents, harsh chemicals, or abrasive cleaners may also damage the Care Plus Incubator or the Elevating Base. Always check the product information supplied with the cleaner before use. Never submerge any part of the Elevating Base.

4. Wipe off the Elevating Base and replace the Care Plus Incubator. Again, two people are required to safely mount the incubator.

5. Verify that the Care Plus Incubator is securely mounted. Then, replace the controller.

6. Verify proper incubator operation, using the checkout procedure from the Care Plus Incubator Operation and Maintenance Manual.

Figure 5-1 Resetting the circuit breaker



Notes:

5/Customer Troubleshooting

WARNING: Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.

Repair Policy

Note: Service, other than that described in Chapter 5 of this manual, must be performed by a "Technically Competent" individual as described in the Service portion of this manual (Chapter 6, Service Information).

Do not use malfunctioning equipment. Make all necessary repairs, or have the equipment serviced by an Authorized Ohmeda Service Representative. After repair, test the equipment to ensure that it is functioning properly in accordance with manufacturer's published specifications.

CAUTION: Only competent individuals trained in the repair of this equipment should attempt to service it.

Replace damaged parts with components manufactured or sold by Ohmeda. Test the unit after repairs to ascertain that it complies with the manufacturer's published specifications.

Contact the nearest Ohmeda Service Office for service assistance. In all cases, other than where Ohmeda's warranty is applicable, repairs will be made at Ohmeda's current list price plus a reasonable labor charge.

CAUTION: Detailed information for more extensive repairs is included in the service section of this manual (Chapter 6, Service Information) solely for the convenience of users having proper knowledge, tools and test equipment, and for service representatives trained by Ohmeda.

Contact the nearest Ohmeda Regional Service Office, listed on the back cover, for assistance.

Customer troubleshooting

Symptom	Solution
The base will temporarily not raise or lower - - no motor sounds - - the base works normally after a few minutes.	The motor overheated, opening a thermal switch. Let the base cool. To avoid overheating in the future, do not continuously depress the ▲ or the ▼ pedal.
The base will not raise or lower - - no motor sounds - - the base does not resume normal operation	Make sure that: The unit is plugged into a working power outlet. Reset the two circuit breakers (Figure 5-1). If the circuit breakers open frequently, call for service.
The base will not raise - - motor sounds are present	The base may be at the upper limit, incubator mattress 42 inches (107 cm) above the ground. An obstruction is preventing further motion. Internal problem, call for service.
The base will not lower - - motor sounds are present	The base may be at the lower limit, incubator mattress 34 inches (85 cm) above the ground. An obstruction is preventing further motion. Internal problem, call for service.

6/Service Information - Table of Contents

6/Service Information - Precautions

Warnings

Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.

Safely mounting or dismounting the Care Plus Incubator requires two people. Remove the controller unit before mounting or dismounting the incubator.

Electroshock hazard; observe standard safety precautions. A capacitor connected to line voltage is mounted on the baseplate.

Always replace locking castors with locking castors. The Elevating Base requires two locking castors to hold it in place.

Always complete the Elevating Base checkout procedure and verify that the incubator is securely mounted before using the base.

Do not use the Elevating Base in the presence of flammable anesthetics. A possible explosion hazard exists under these conditions.

Before raising or lowering the base, check that there is adequate slack in tubing and cable connections and that no obstructions (e.g. shelves, etc.) limit the range of motion.

Cautions

Rail mounted accessories should not exceed 20 lbs (9 kg) on either side. The total weight of rail mounted accessories must not exceed 40 lbs (18 kg). Total accessory weight, including items placed on rail mounted shelves, must not exceed 90 lbs (41 kg).

6/Service Information

6.1 Electronic description and wiring diagrams

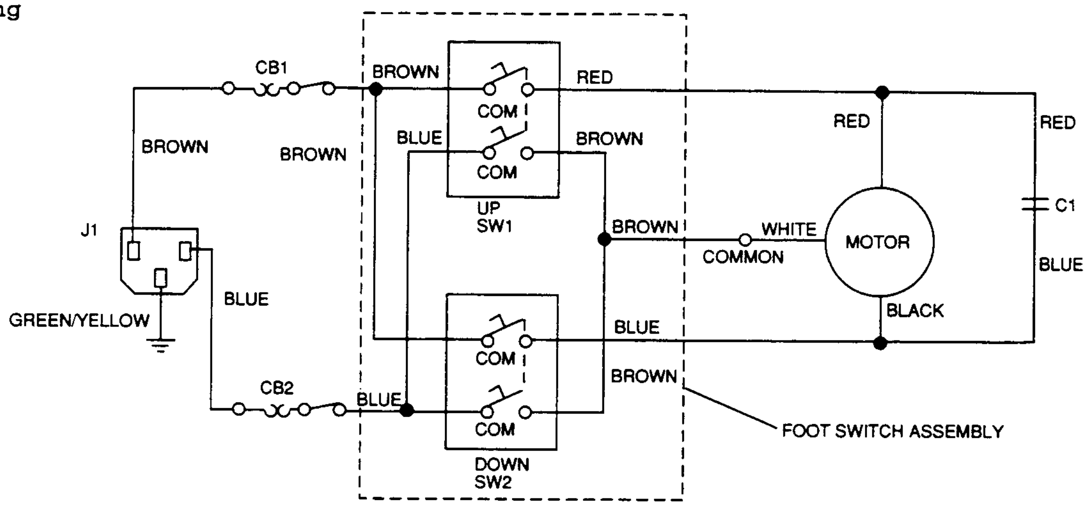
The Elevating Base uses a motor/gear shaft assembly and two switches to raise and lower the incubator. Wall outlet power charges a capacitor, which supplies the motor. Pressing the ▲ or the ▼ switch selects the motor windings to be energized:

▲ Causes the motor to turn clockwise, raising the base

▼ Causes the motor to turn counter-clockwise, lowering the base

Dual circuit breakers (neutral and hot lines) open if the current exceeds 3.5 amps. A thermal contact opens, temporarily cutting power, if the motor gets too hot.

Figure 6-1 Wiring diagram



6.2 Service procedures

WARNING: Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.

A. Removing the incubator platform

You must complete this procedure to access the actuator assembly (gearbox, shaft) or the motor.

1. Unplug the Elevating Base and the Care Plus Incubator.

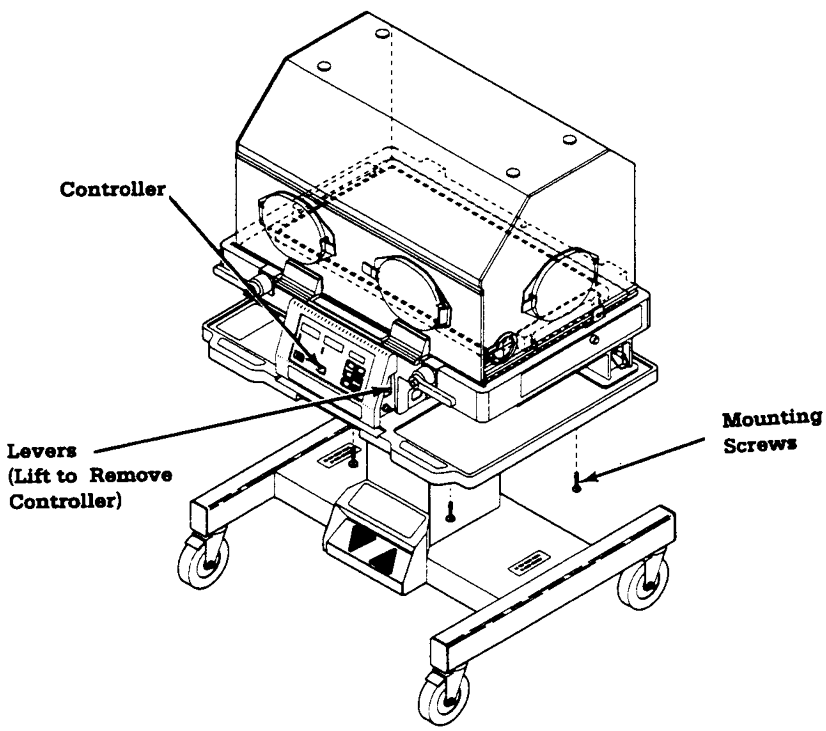
WARNING: Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.

2. If a rail system is attached to the Elevating Base, remove all rail mounted accessories.
3. Remove any storage units mounted on the Elevating Base.
4. Dismount the Care Plus Incubator:

WARNING: Safely mounting or dismounting the Care Plus Incubator requires two people. Remove the controller unit before mounting or dismounting the incubator.

- Disconnect any cables attached to the controller.
- Lift the levers on the controller and slide it out of the incubator (Figure 6-2).
- Remove the incubator from the Elevating Base. The incubator is attached to the base by four mounting screws, shown in Figure 6-2.

Figure 6-2
Dismounting the Care Plus Incubator



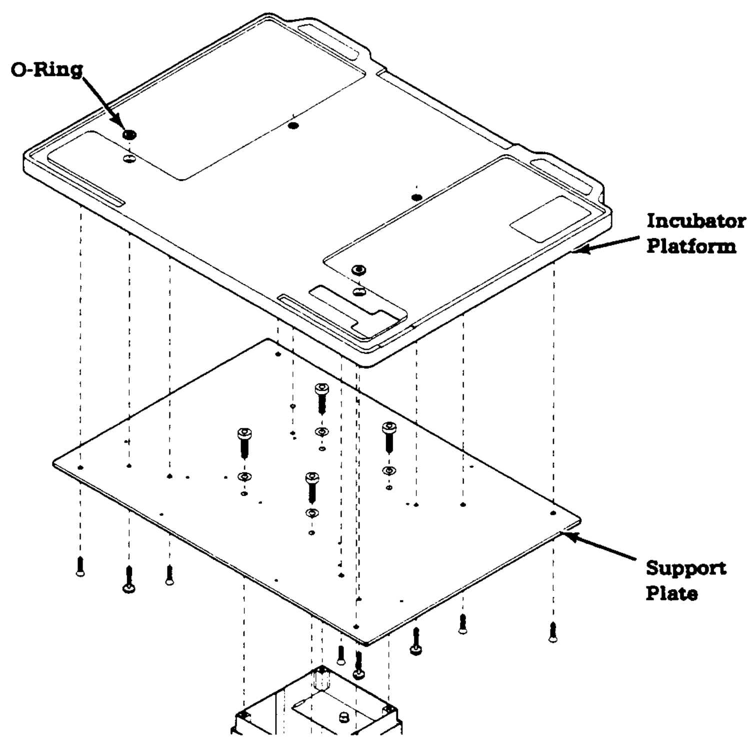
5. Remove the incubator platform and the underlying support plate (Figure 6-3).

Note: During reassembly, make sure that the counter bores in the support plate point down and torque the screws that attach the plate to 200 ± 5 in lbs. Torque the incubator platform screws to 50 ± 5 in lbs.

6. Remove the four o-rings around the incubator mounting holes and set them aside.

Reverse this procedure for reassembly.

Figure 6-3 Removing the incubator platform



B. Removing the baseplate

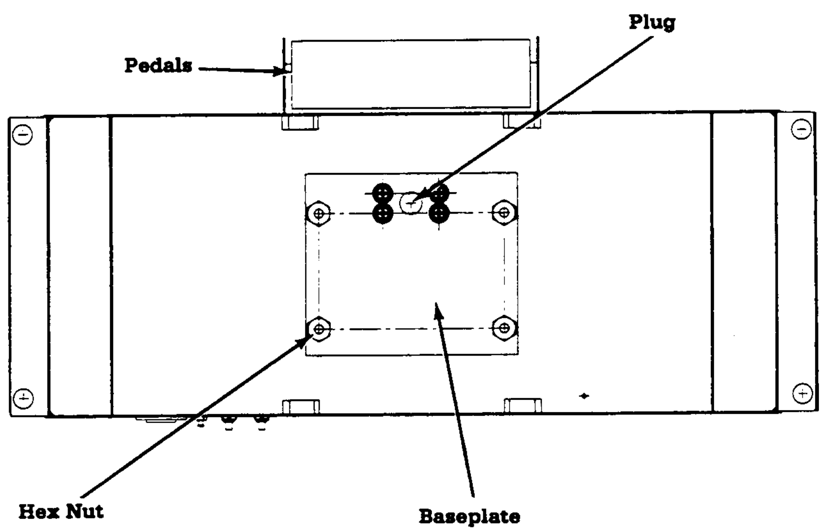
1. Dismount the incubator and remove any attached accessories as directed in steps 1-4 in the previous section (Section 6.2.A, Removing the incubator platform).

   WARNING: Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.

2. Set the caster brakes and lay the Elevating Base on its side.

3. Remove the plug from the access hole, insert a 1/2 inch socket wrench through the hole, and remove the lower actuator mounting bolt (Figure 6-4).

Figure 6-4 Bottom view of Elevating Base



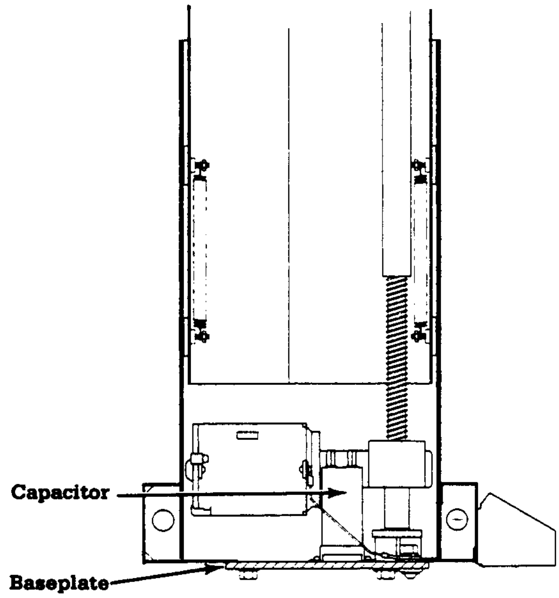
4. Use a 1/2 inch wrench to remove the four hex nuts and external lockwashers from the baseplate.

Note: Remove only the hex head nuts. DO NOT REMOVE THE PHILLIPS HEAD SCREWS.

5. Carefully pull off the baseplate. Use an insulated screwdriver or a similar insulated device to ground the capacitor.

WARNING: Electroshock hazard; observe standard safety precautions. A capacitor connected to line voltage is mounted on the baseplate.

Figure 6-5 Cut away side view of the Elevating Base



Reverse this procedure for reassembly.

C. Replacing the capacitor

1. Dismount the incubator and remove any attached accessories as directed in steps 1-4 of Section 6.2.A, Removing the incubator platform.

WARNING: Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.

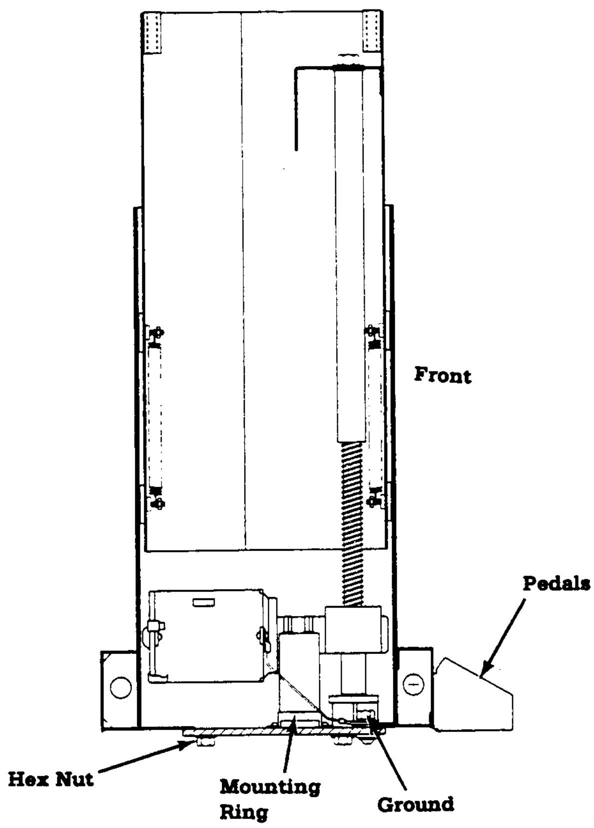
2. Complete Section 6.2.B, Removing the baseplate.

WARNING: Electroshock hazard; observe standard safety precautions. A capacitor connected to line voltage is mounted on the baseplate.

3. Disconnect the insulated connectors from the capacitor.

4. Slide the capacitor out of the mounting ring.

Figure 6-6 Replacing the capacitor



To reassemble:

1. Slide the capacitor into the mounting ring.

2. Reattach the insulated connectors to the capacitor. Ensure that the wires are paired by color (red opposite red and blue opposite black).

3. Install the baseplate:

   - Use a 1/2 inch wrench to firmly tighten the four hex nuts and external lockwashers.

   - Use a 1/2 inch socket wrench inserted through the access hole in the baseplate to replace the lower actuator mounting bolt.

   - Replace the access hole plug.

4. Set the Elevating Base upright.

5. Replace the underlying support plate, the incubator platform, and the incubator by reversing Section 6.2.A, Removing the incubator platform.

D. Removing the motor/actuator assembly

Although this procedure requires two people, it is the easiest method to remove the motor/actuator assembly.

1. Complete Section 6.2.A, Removing the incubator platform.

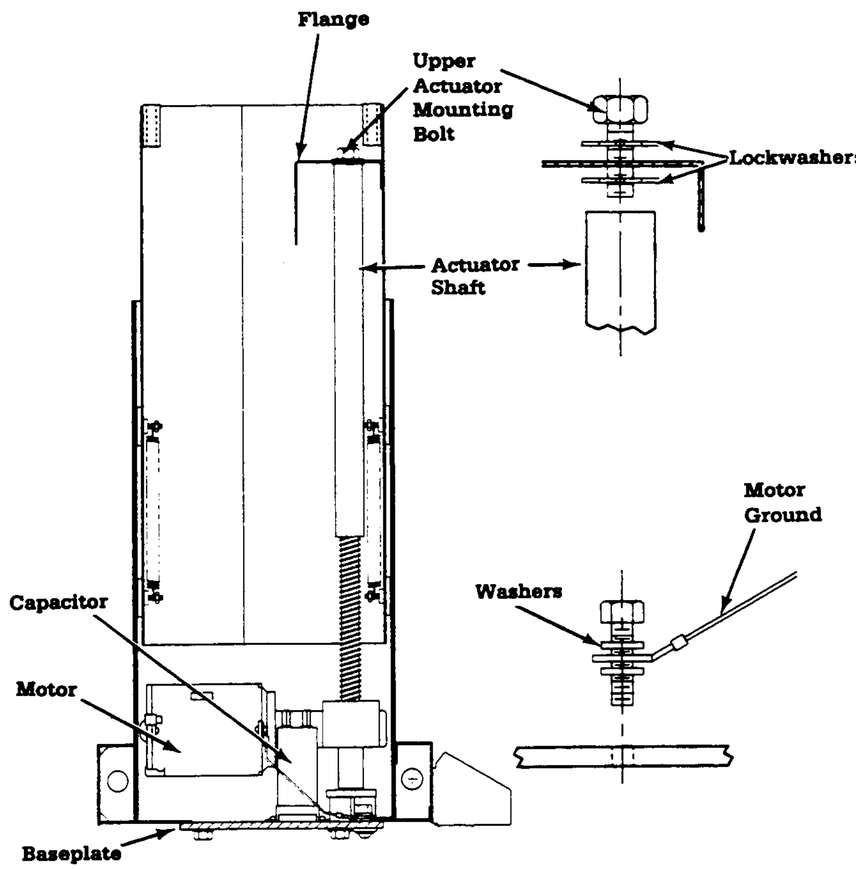
WARNING: Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.

2. Complete Section 6.2.B, Removing the baseplate.

WARNING: Electroshock hazard; observe standard safety precautions. A capacitor connected to line voltage is mounted on the baseplate.

3. Pull the baseplate out until it is clear of the four studs, swing the baseplate to the left, and disconnect the lug-screw that secures the motor housing ground wire (Figure 6-7).

Figure 6-7 Removing the motor/actuator assembly



4. Disconnect the insulated connectors from the capacitor (Figure 6-7). This leaves the baseplate free for removal.

5. Use a 1/2 inch wrench to loosen the upper actuator mounting bolt from the top while another person supports the motor/actuator assembly from the bottom.

6. Press the upper actuator mounting bolt against the flange and continue unscrewing it while the other person gently pulls on the motor/actuator assembly.

Note: The upper actuator mounting bolt holds two lockwashers, one between the bolt and the flange and the other between the flange and the actuator shaft. Pressing on the bolt while unscrewing it should prevent the lockwasher between the flange and the actuator from falling off the bolt.

7. When the motor/actuator assembly is free, continue to press the bolt against the flange while the other person removes the motor/actuator assembly from the elevator column.

Note: Some maneuvering is required to remove the motor/actuator assembly. Turn the motor clockwise until it clears the access hole. Gently move the assembly back and forth, as required, while pulling it out.

8. When the assembly is clear of the elevator column, check the top of the actuator shaft for the lockwasher. Remove the lockwasher and set it aside if it is there. Otherwise, reach into the elevating column and remove the lockwasher from the upper actuator mounting bolt.

9. Remove the bolt and the remaining lockwasher.

To service individual components, continue with Section 6.2.E, Replacing the motor or the actuator assembly. Instructions for installing the motor/actuator assembly are at the end of Section 6.2.E.

E. Replacing the motor or the actuator assembly

Although this procedure requires two people, it is the easiest method to replace the motor/actuator assembly.

1. Complete Section 6.2.A, Removing the incubator platform.

   ⚠ **WARNING: Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.**

2. Complete Section 6.2.B, Removing the baseplate.

   ⚠ **WARNING: Electroshock hazard; observe standard safety precautions. A capacitor connected to line voltage is mounted on the baseplate.**

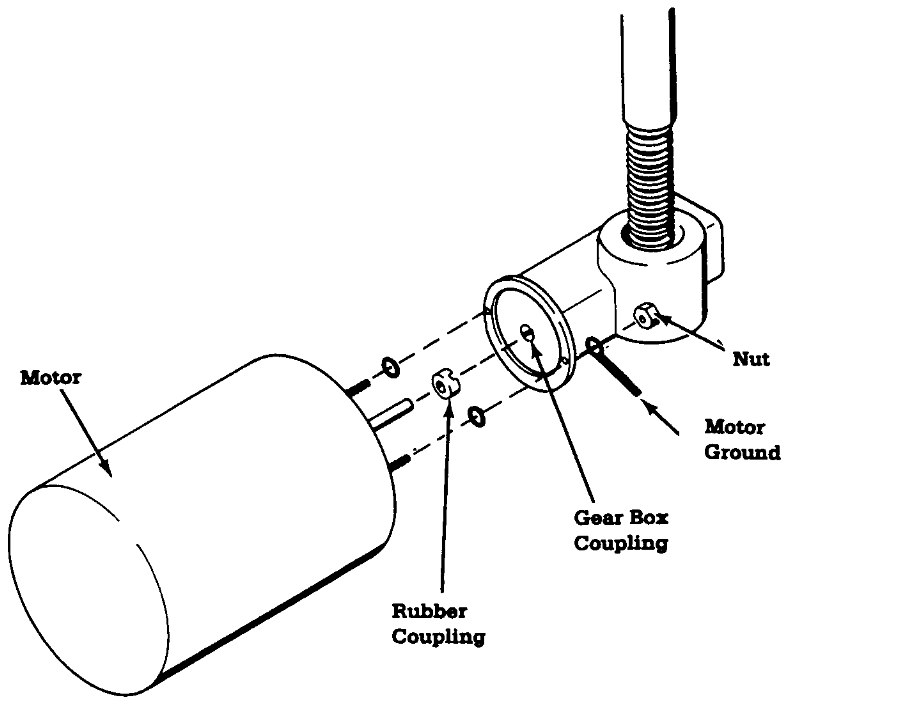
3. Complete Section 6.2.C, Removing the motor/actuator assembly.

4. Disconnect the single pin molex connector (white wire).

5. Use a 3/8 inch wrench to remove the two nuts that attach the motor to the actuator gearbox.

Note: One of these nuts also holds the motor housing ground.

Figure 6-8 Separating the motor from the actuator gearbox



6. Lift the motor away from the actuator gearbox. Remove and retain the hard rubber coupling.

To reassemble:

1. Slip the hard rubber coupling into the gearbox coupling and align the studs on the motor housing with the mounting holes on the actuator gearbox.

Note: Perfect alignment is not required. The slot in the motor coupling and the ridge in the gearbox coupling should be in approximately the same plane. The couplings will settle into final alignment when the actuator shaft is turned.

2. Start the nut on the right side (viewed from the shaft end of the motor). Do not tighten the nut.

3. Replace the motor housing ground and start the other nut.

4. Push the motor against the actuator gearbox and check the coupling alignment. If necessary, realign the couplings so that the motor and the actuator gearbox fit tightly together.

5. Tighten the two nuts.

6. Place a lockwasher on the upper actuator mounting bolt and slide it into the flange from the top.

7. Slide a second lockwasher onto the upper actuator mounting bolt from the bottom of the base.

8. Push the upper actuator mounting bolt against the flange while another person inserts the motor/actuator assembly from the bottom and aligns the actuator shaft with the bolt.

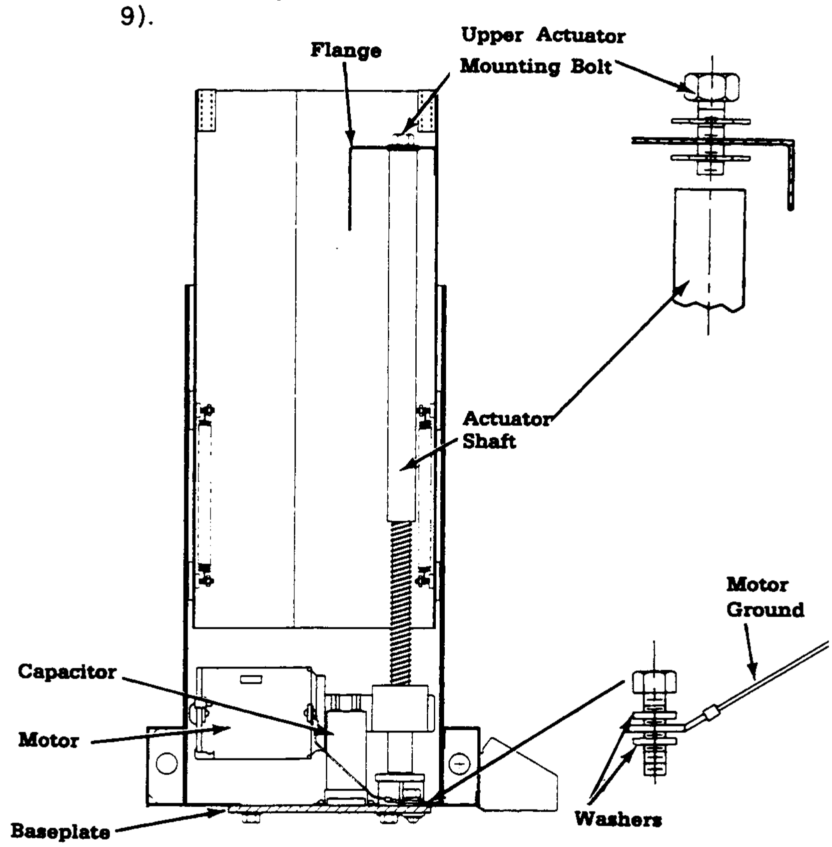
9. Use a 1/2 inch wrench to tighten the bolt while the other person holds the motor/actuator assembly.

10. Attach the insulated connectors to the capacitor. Ensure that the wires are paired by color (red opposite red and blue opposite black).

11. Connect the single pin molex connector (white wire).

12. Anchor the ground wire ring terminal to the baseplate (Figure 6-9).

Figure 6-9 Installing the motor/actuator assembly



13. Verify that the capacitor is mounted on the baseplate.

14. Plug the Elevating Base into a power outlet and operate the ▲ and ▼ switches until the bottom of the actuator protrudes from the bottom of the base.

15. Unplug the Elevating Base. Use an insulated screwdriver or a similar insulated device to ground the capacitor.

⚠ **WARNING: Electroshock hazard; observe standard safety precautions. A capacitor connected to line voltage is mounted on the baseplate.**

16. Align the hole on the bottom of the actuator with the access hole in the baseplate. Using a 1/2 inch socket wrench, insert and tighten the lower actuator mounting bolt. Replace the access hole plug.

17. If necessary, reposition the baseplate so that the studs on the bottom of the base line up with the holes in the baseplate.

18. Plug the Elevating Base into a power outlet and operate the ▲ and ▼ switches to pull the baseplate up against the bottom of the base.

19. Use a 1/2 inch wrench to replace the four nuts and lockwashers that secure the baseplate.

F. Replacing the ▲ and the ▼ switches

1. Unplug the Elevating Base and the Care Plus Incubator.

⚠ **WARNING: Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.**

2. If a rail system is attached to the Elevating Base, remove all rail mounted accessories.

3. Remove any storage units mounted on the Elevating Base.

4. Dismount the Care Plus Incubator:

⚠ **WARNING: Safely mounting or dismounting the Care Plus Incubator requires two people. Remove the controller unit before mounting or dismounting the incubator.**

- Disconnect any cables attached to the controller.

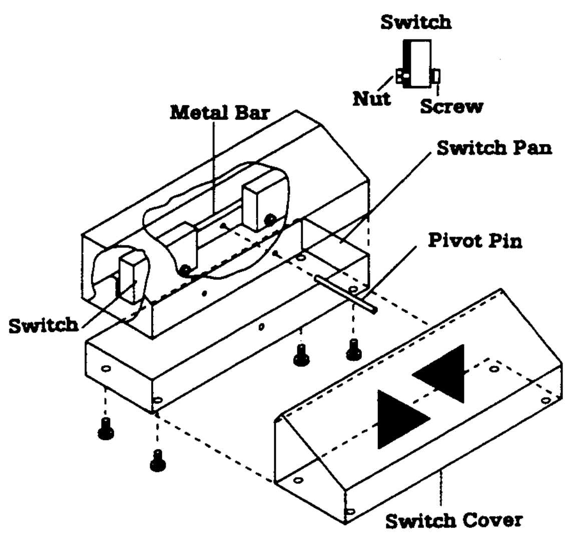
- Lift the levers on the controller and slide it out of the incubator.
- Remove the incubator from the Elevating Base. The incubator is attached to the base by four mounting screws.

5. Set the caster brakes and lay the Elevating Base on its side with the pedals pointing up.
6. Remove the four screws that attach the switch cover and slide the cover off the pedal assembly.

WARNING: Electroshock hazard; observe standard safety precautions. A capacitor connected to line voltage is mounted on the baseplate.

7. Slide out the pivot pin and remove the switch pan.
8. Remove the nut that attaches the switch to the metal bar and pull out the screw.
9. Connect the wires from the old switch to the new switch as you remove the wires from the old switch.

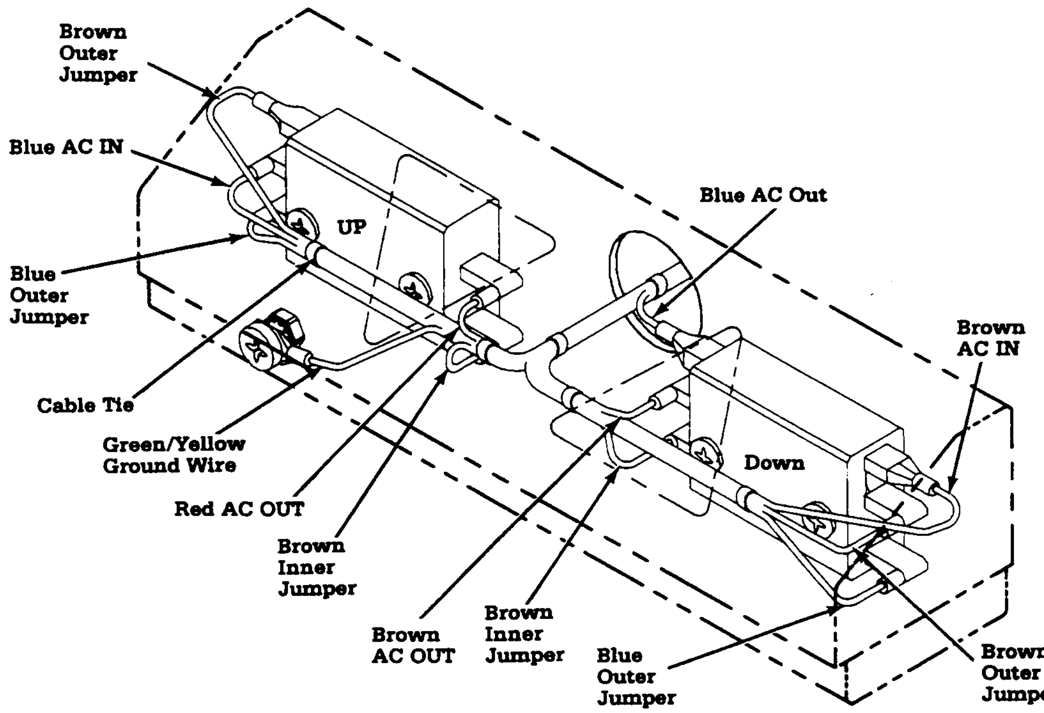
Figure 6-10 Replacing the ▲ and the ▼ switches



10. Thread the screw through the new switch and the metal bar. Replace and tighten the nut to secure the switch.
11. Replace the switch pan and insert the pivot pin.
12. Slide the cover over the foot pedal assembly and replace the four screws.

13. Set the Elevating Base upright and replace all removed items.

Figure 6-11 Switch wire connections



G. Replacing the castors

1. Unplug the Elevating Base and the Care Plus Incubator.

   WARNING: Always unplug the Elevating Base from the power outlet before any service, cleaning, or maintenance procedure. Plug the unit back in during the procedure only if you are specifically instructed to do so.

2. If a rail system is attached to the Elevating Base, remove all rail mounted accessories.

3. Remove any storage units mounted on the Elevating Base.

4. Dismount the Care Plus Incubator:

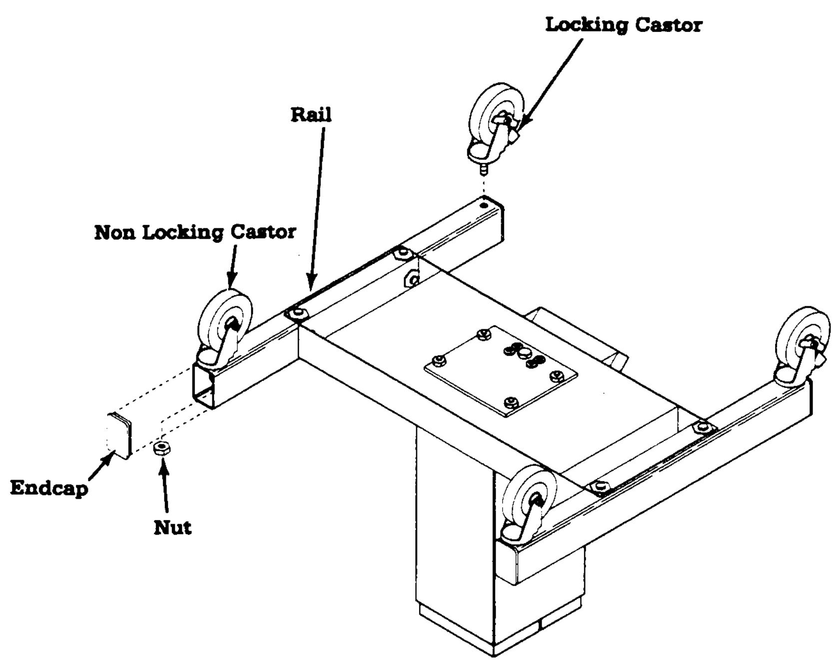
   WARNING: Safely mounting or dismounting the Care Plus Incubator requires two people. Remove the controller unit before mounting or dismounting the incubator.

   - Disconnect any cables attached to the controller.
   - Lift the levers on the controller and slide it out of the incubator.

- Remove the incubator from the Elevating Base. The incubator is attached to the base by four mounting screws.

5. Set the caster brakes and lay the Elevating Base on its side.
6. Remove the plastic end cap from the base rail.
7. Remove the old castor:
   - To replace a rear castor, use a 7/8 inch socket and ratchet to remove the castor mounting nut.
   - To replace a front castor, use a 3/4 inch open or box ended wrench to unscrew the castor.
8. Apply Loctite 242 to the new castor bolt. Attach the new castor to the rail and tighten the mounting nut (rear castor) or screw the castor into the rail (front castor).
9. Replace the plastic end cap.
10. Set the Elevating Base upright and replace all removed items.

Figure 6-12 replacing a castor



6.3 Post service checkout procedure

⚠ **WARNING: Always complete the Elevating Base checkout procedure and verify that the incubator is securely mounted before using the base.**

1. Check the Elevating Base for external damage.

2. Make sure that the incubator is securely mounted to the Elevating Base.

3. If a rail system is attached to the Elevating Base, check that accessories are securely mounted and that their weight is evenly distributed between the two rails.

   ⚠ **CAUTION: Rail mounted accessories should not exceed 20 lbs (9 kg) on either side. The total weight of rail mounted accessories must not exceed 40 lbs (18 kg). Total accessory weight, including items placed on rail mounted shelves, must not exceed 90 lbs (41 kg).**

4. Make sure that the castors are securely attached.

5. Verify that the Elevating Base rolls freely when the brakes are not set. Then, set the brakes and verify that the Elevating Base stays in place.

6. Verify that the area is free of flammable anesthetic agents and other flammable substances.

   ⚠ **WARNING: Do not use the Elevating Base in the presence of flammable anesthetics. A possible explosion hazard exists under these conditions.**

7. Verify that one end of the power cord is plugged into the Elevating Base's socket. Plug the other end into a power outlet.

8. Depress the ▲ pedal and verify that the incubator mattress rises to approximately 42 inches (107 cm) above the floor.

   ⚠ **WARNING: Before raising or lowering the base, check that there is adequate slack in tubing and cable connections and that no obstructions (e.g. shelves, etc.) limit the range of motion.**

9. Depress the ▼ pedal and verify that the incubator mattress lowers to approximately 34 inches (85 cm) above the floor.

10. Check the leakage current. Use approved test equipment and methods to verify that the leakage current is less than 100 microamperes for 120 volt units and less than 200 microamperes for 220/240 volt units.

11. Check the ground resistance. Use a low range ohmmeter or an electrical safety analyzer to verify that the grounding resistance between the ground pin on the power cord and an exposed metal surface on the Elevating Base is less than 0.1 Ohms.

12. Before using the Care Plus system with a patient, verify proper operation of the incubator and all other system components.

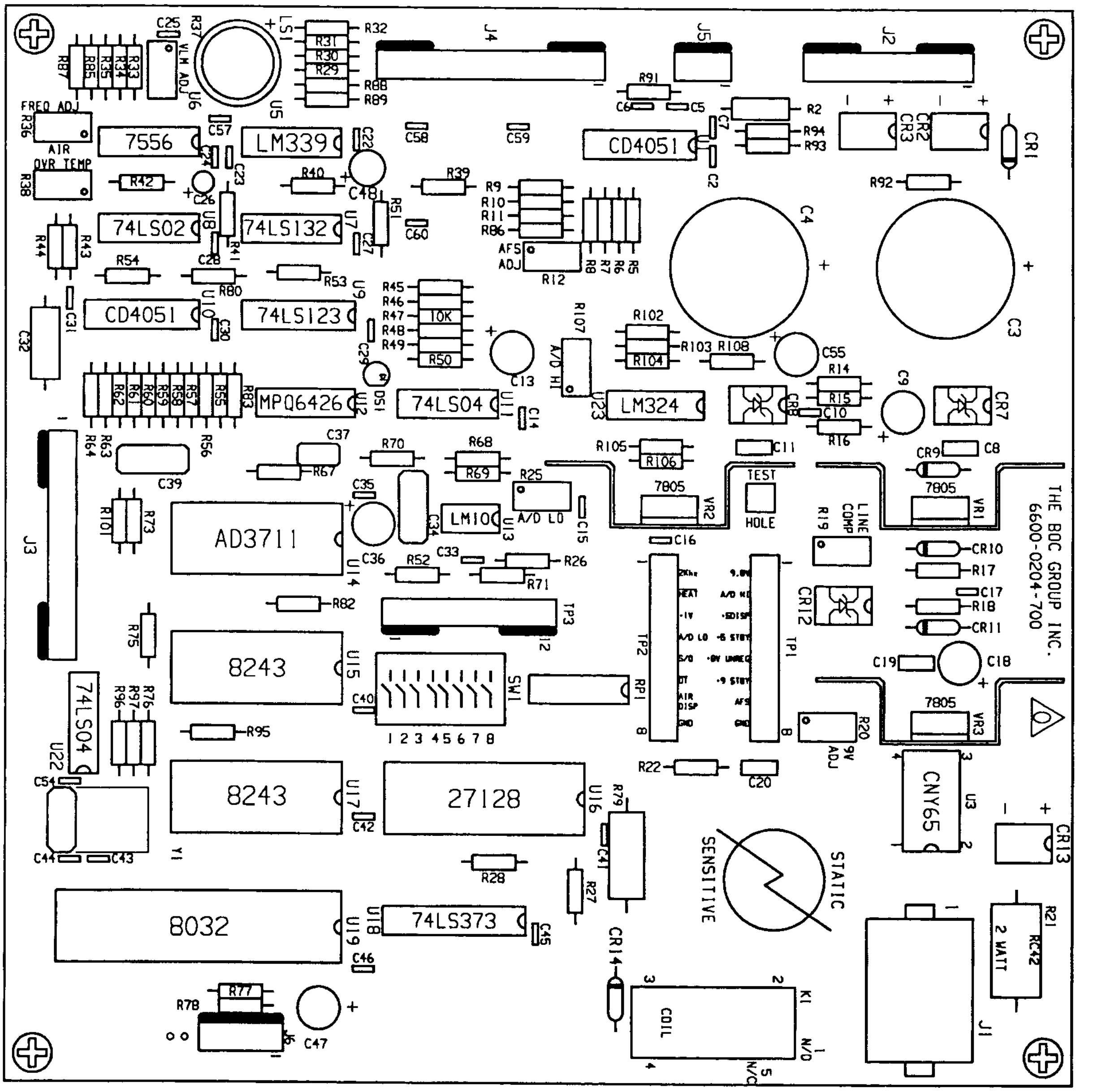


Figure 6-44 Contol Board controllers with HBJ serial Numbers

6.8 Package Systems

Note: Part number changes are limited to new system configurations. The new style Care Plus incubator retains the same stock number as the older version.

Systems without the ThermaLink Option

Language, voltage, frequency	Incubator only @ #	Incubator, inner wall, & cabinet top @	Incubator, inner wall, & cabinet	Incubator, inner wall, & Elevating Base w/o rails *	Incubator, inner wall, and Elevating base w/rails	Replacement controller
English						
100 Vac 60 Hz	6600-0043-960					6600-0087-861
100 Vac 50 Hz	6600-0043-950					6600-0087-851
120 Vac 60 Hz	6600-0040-900	6600-0120-900	6600-0121-900	6600-0122-900	6600-0171-900	6600-0084-810
120 Vac 50 Hz	6600-0040-950	6600-0120-903	6600-0121-903	6600-0122-903		6600-0084-851
220 Vac 60 Hz	6600-0041-960	6600-0120-904	6600-0121-904	6600-0122-904		6600-0085-861
220 Vac 50 Hz	6600-0041-950	6600-0120-901	6600-0121-901	6600-0122-901		6600-0085-851
240 Vac 60 Hz	6600-0042-960					6600-0086-861
240 Vac 50 Hz	6600-0042-950	6600-0120-902	6600-0121-902			6600-0086-851
Spanish						
120 Vac 60 Hz	6600-0046-960	6600-0120-910	6600-0121-910	6600-0122-910		6600-0091-861
120 Vac 50 Hz	6600-0046-950					6600-0091-851
220 Vac 60 Hz	6600-0045-960					6600-0089-861
220 Vac 50 Hz	6600-0045-950	6600-0120-911	6600-0121-911	6600-0122-911		6600-0089-851
French						
220 Vac 60 Hz	6600-0047-960	6600-0120-920	6600-0121-920	6600-0122-920		6600-0090-861
220 Vac 50 Hz	6600-0047-950	6600-0120-921	6600-0121-921	6600-0122-921		6600-0090-851
German						
220 Vac 50 Hz	6600-0044-950	6600-0120-931	6600-0121-931	6600-0122-931		6600-0088-851
Swedish						
220 Vac 50 Hz	6600-0184-932					6600-0356-832
Italian						
220 Vac 50 Hz	6600-0184-933					6600-0356-833

Systems with the ThermaLink Option

Language, voltage, frequency	Incubator only @ #	Incubator, inner wall, & cabinet top @	Incubator, inner wall, & cabinet	Incubator, inner wall, & Elevating Base w/o rails *	Incubator, inner wall, and Elevating base w/rails	Replacement controller
English						
100 Vac 60 Hz	6600-0184-901					6600-0356-801
100 Vac 50 Hz	6600-0184-900					6600-0356-800
120 Vac 60 Hz	6600-0184-903	6600-0189-901	6600-0190-901	6600-0191-901	6600-0192-900	6600-0356-803
120 Vac 50 Hz	6600-0184-902	6600-0189-900	6600-0190-900	6600-0191-900		6600-0356-802
220 Vac 60 Hz	6600-0184-905	6600-0189-903	6600-0190-903	6600-0191-903		6600-0356-805
220 Vac 50 Hz	6600-0184-904	6600-0189-902	6600-0190-902	6600-0191-902		6600-0356-804
240 Vac 60 Hz	6600-0184-907					6600-0356-807
240 Vac 50 Hz	6600-0184-906	6600-0189-904	6600-0190-904			6600-0356-806
Spanish						
120 Vac 60 Hz	6600-0184-911	6600-0189-905	6600-0190-905	6600-0191-904		6600-0356-811
120 Vac 50 Hz	6600-0184-910					6600-0356-810
220 Vac 60 Hz	6600-0184-913					6600-0356-813
220 Vac 50 Hz	6600-0184-912	6600-0189-906	6600-0190-906	6600-0191-905		6600-0356-812
French						
220 Vac 60 Hz	6600-0184-909	6600-0189-908	6600-0190-908	6600-0191-907		6600-0356-809
220 Vac 50 Hz	6600-0184-908	6600-0189-907	6600-0190-907	6600-0191-906		6600-0356-808
German						
220 Vac 50 Hz	6600-0184-914	6600-0189-909	6600-0190-909	6600-0191-908		6600-0356-814
Swedish						
220 Vac 50 Hz	6600-0184-915					6600-0356-815
Italian						
220 Vac 50 Hz	6600-0184-916					6600-0356-816

@ Customer provides table or cabinet
# Does not include inner wall (double wall)
* Customer must order Rail Upgrade Kit (Stock Number 6600-0206-800) if they want rails.

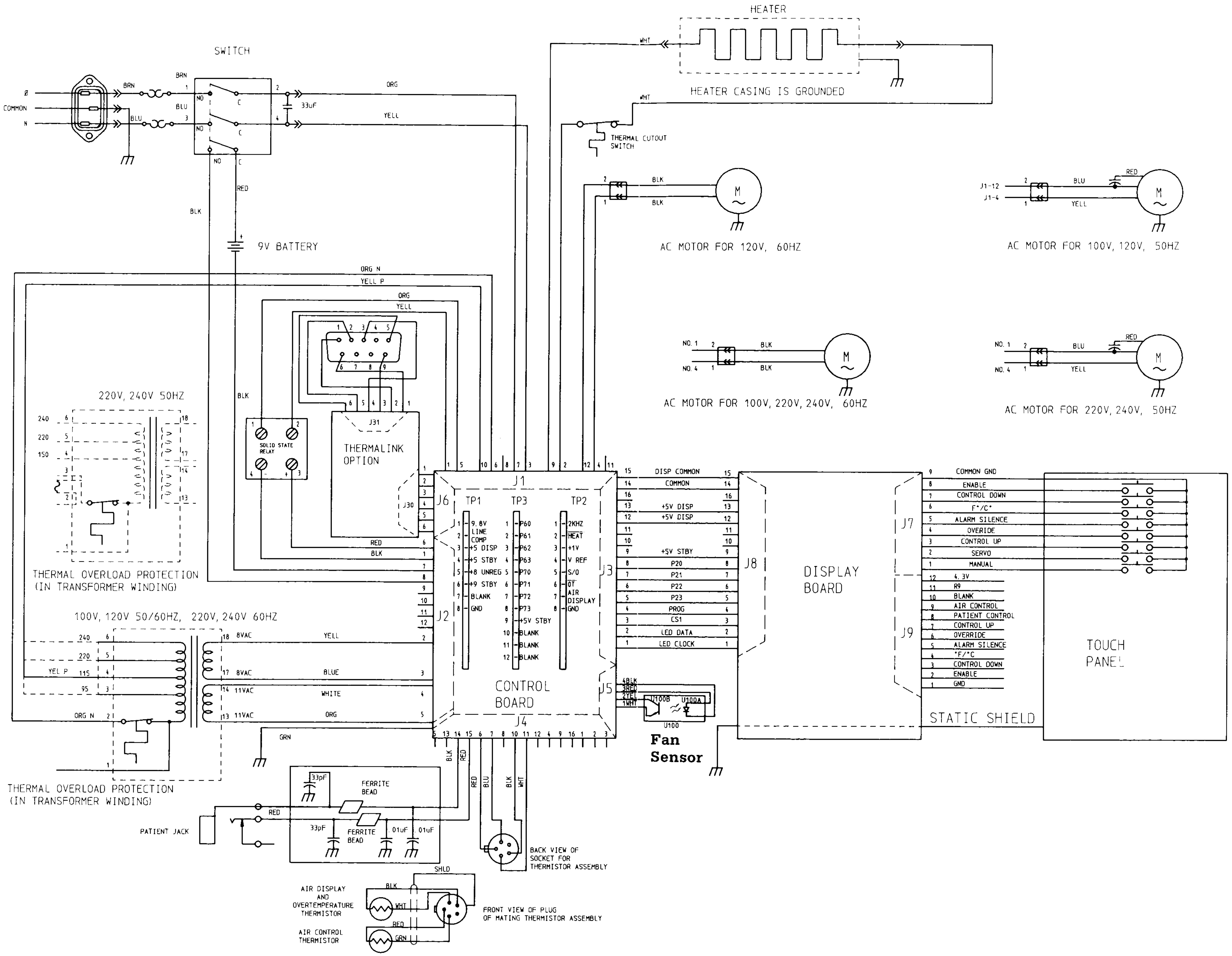
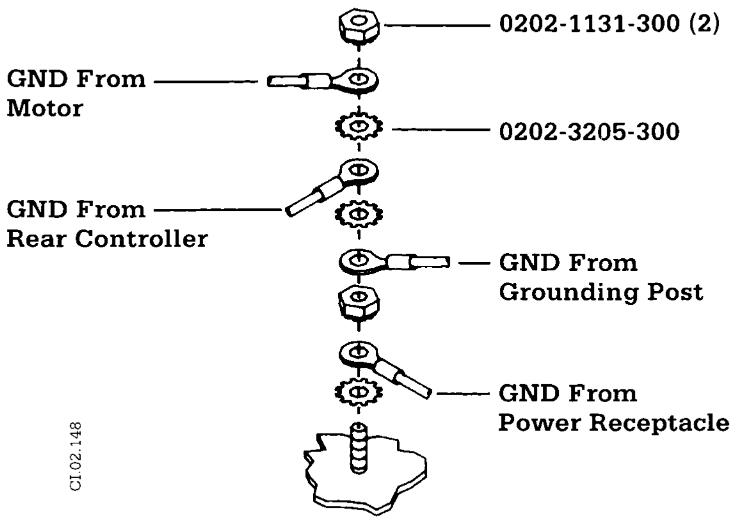
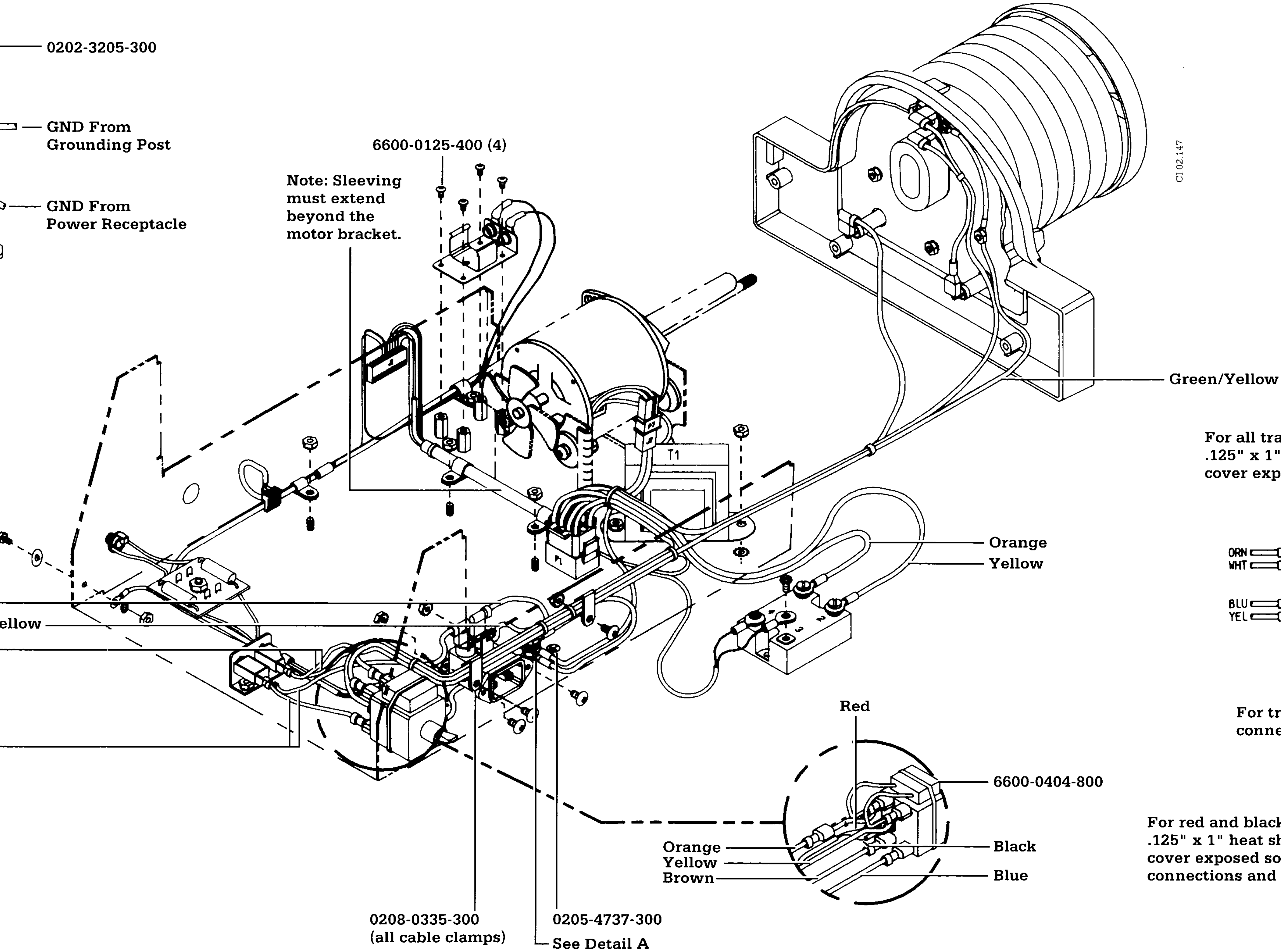


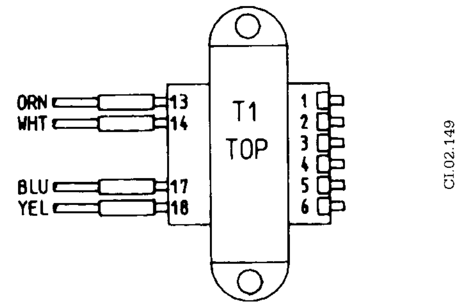
Figure 7-6 Wiring Diagram
Controllers with HBJ Serial Numbers



Detail A



For all transformer conections install .125" x 1" long heat shrink tubing to cover exposed solder connections.

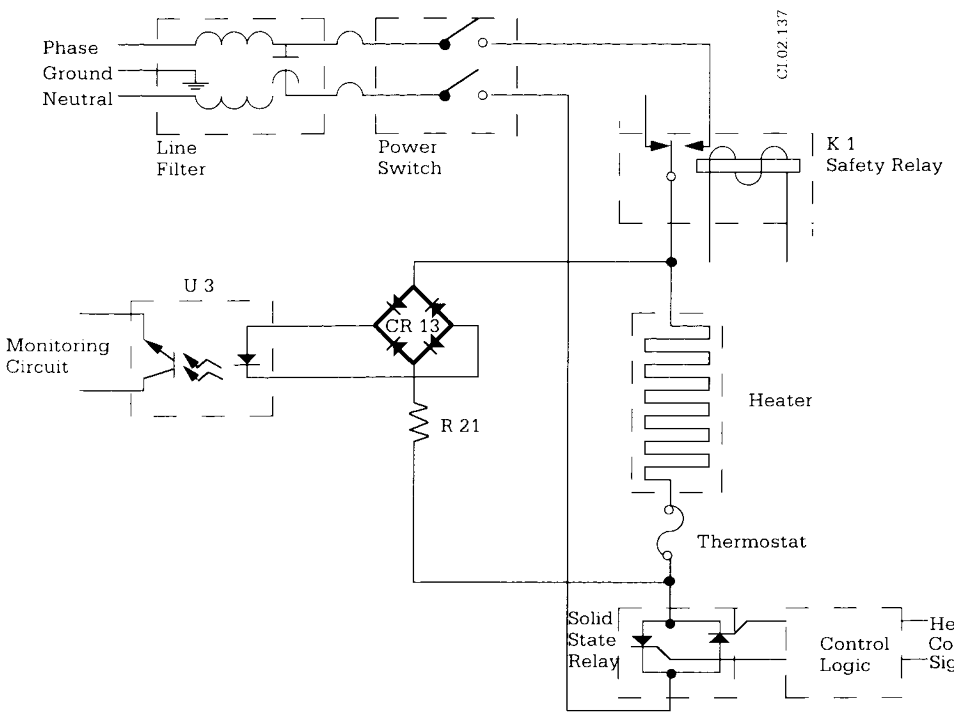


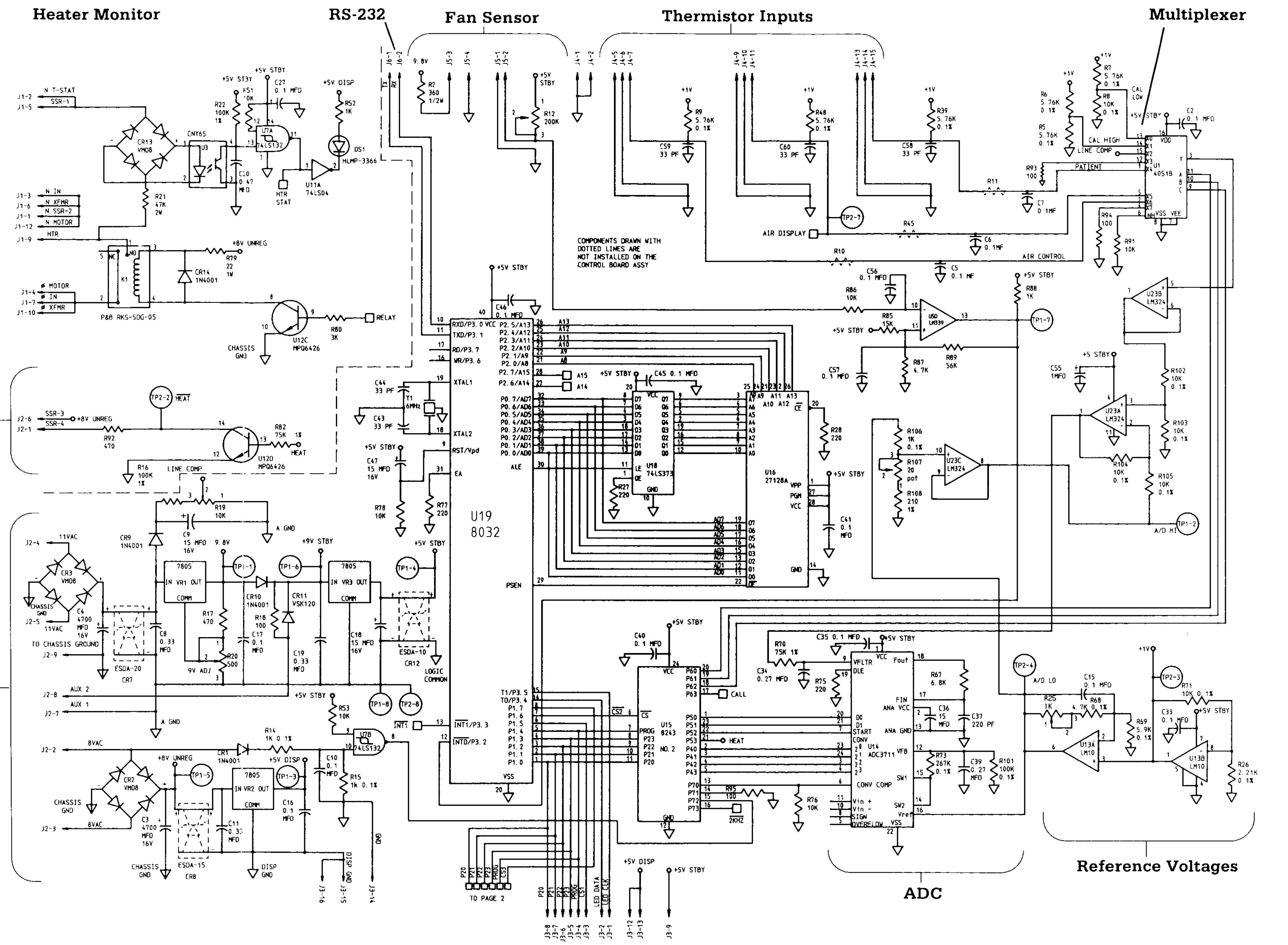
For transformer and motor connections see Figure 7-6.

For red and black wires install .125" x 1" heat shrink tubing to cover exposed solder connections and switch terminal.

Figure 7-7 Controller Plate Wiring
Controllers with HBJ Serial Numbers

Heater Block Diagram





R37
Section 3.3 D
(Alarm Vol. Adj.)

R12
Section 3.3 I
(Fan Sensor Adj.)

R36
Section 3.3 E
(Alarm Freq. Adj.)

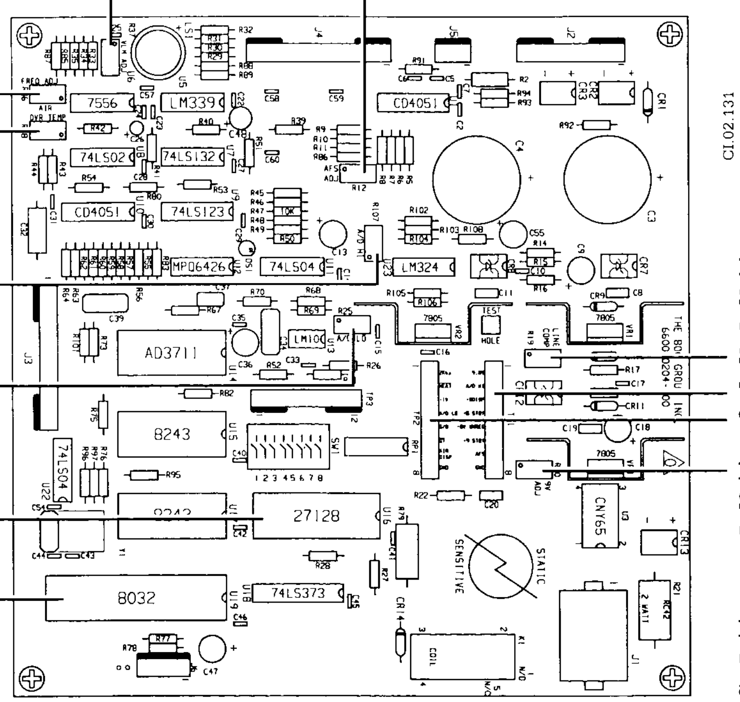
R38
Section 3.3 H
(High Air Temp. Limit Adj.)

R107
Section 3.3 G
(ADC Hi)

R25
Section 3.3 G
(ADC Lo)

EPROM

Micro-controller



R19
Section 3.3 F
(Line Voltage Signal . Adj.

TP1-1 to 1-8
TP2-1 to 2-8

R20
Section 3.3 B
(+9.8V adj.)

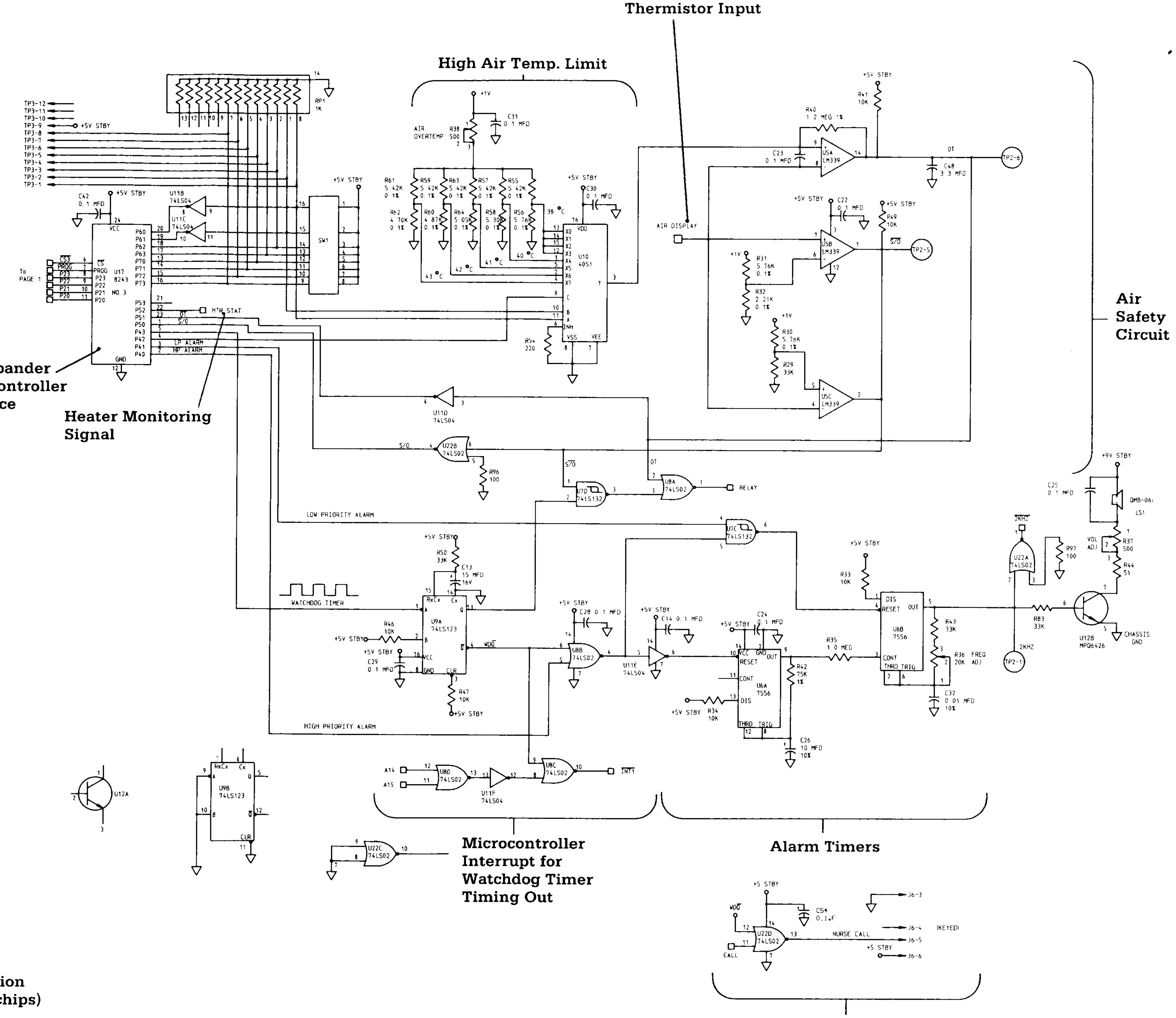
Board Layout
(identifies calibration adj. and socketed chips)

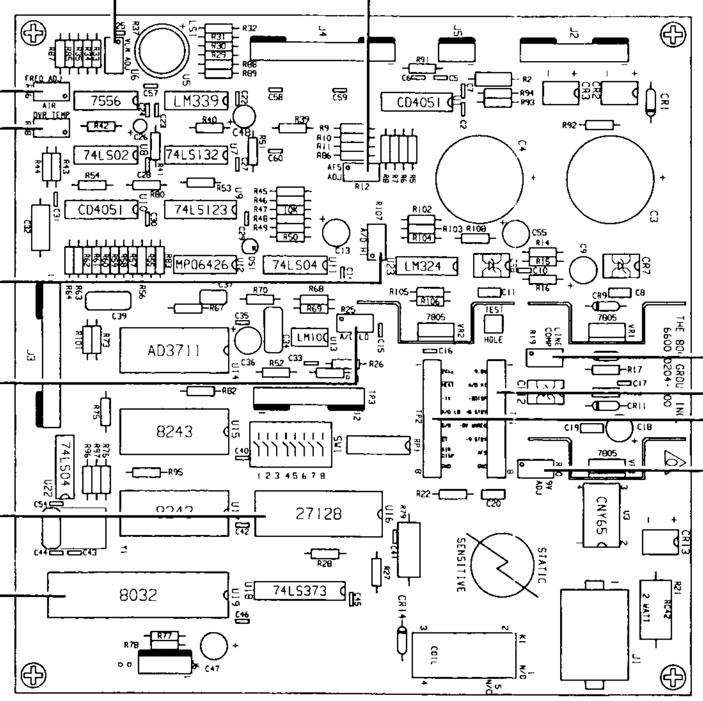
Figure 7-8a Control Board Schematic
Controllers with HBJ Serial Numbers (page 1 of 2)

Notes: (Unless otherwise specified)

1. **All resistors are 5%. 1/4 Watt**
2. **Square denotes refer to other page □**
3. **GND symbol with line denotes GNDS tied together ∇**
4. **Componants drawn with dotted lines are not installed**

TEST POINTS		UNUSED CONNECTOR PINS
TP1-1	9.8V	J1-8, 11
TP1-2	A/D HI	J2-10, 11, 12
TP1-3	+5V DISP	J3-10, 11
TP1-4	+5V STBY	J4-3, 4, 8, 12, 16
TP1-5	+8V UNREG	
TP1-6	+9V STBY	
TP1-7	AFS	
TP1-8	GND	
TP2-1	2KHZ	
TP2-2	HEAT	
TP2-3	+1V	
TP2-4	A/D LOW	
TP2-5	S/O	
TP2-6	OT	
TP2-7	AIR DISPLAY	
TP2-8	GND	
TP3-1	P60	
TP3-2	P61	
TP3-3	P62	
TP3-4	P63	
TP3-5	P70	
TP3-6	P71	
TP3-7	P72	
TP3-8	P73	
TP3-9	+5V STBY	
TP3-10	BLANK	
TP3-11	BLANK	
TP3-12	BLANK	



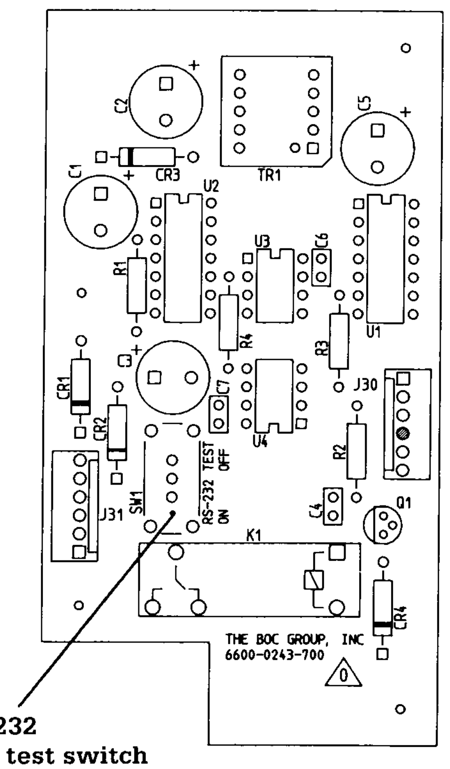


Board Layout (identifies calibration adj. and socketed chips)

Figure 7-8b Control Board Schematic
Controllers with HBJ Serial Numbers (page 2 of 2)

Board Components
ThermaLink Board (6600-0243-702)

RESISTOR 220 5%	1	R1
RESISTOR 3 K 5%	1	R2
RESISTOR 3.9 K 5%	2	R3, R4
CAPACITOR 1 UF	3	C1, C2, C5
CAPACITOR 4.7 UF	1	C3
CAPACITOR 0.1 UF	1	C4
TRANSISTOR MPSA14	1	Q1
BI-DIR ZENER SA24C	2	CR1, CR2
DIODE 1N4001	2	CR3, CR4
RELAY AM ZETTLER AZ696-1C-5DE	1	K1
TRANSFORMER SCHOTT 67122750	1	TR1
IC MAX250CPD	1	U1
IC MAX251CPD	1	U2
IC 6N136	2	U3, U4
HEADER 6 PIN	2	J30, J31
SLIDE SWITCH MSS-1200	1	SW1
DESCRIPTION	QTY	SYMBOL



RS-232
Self test switch

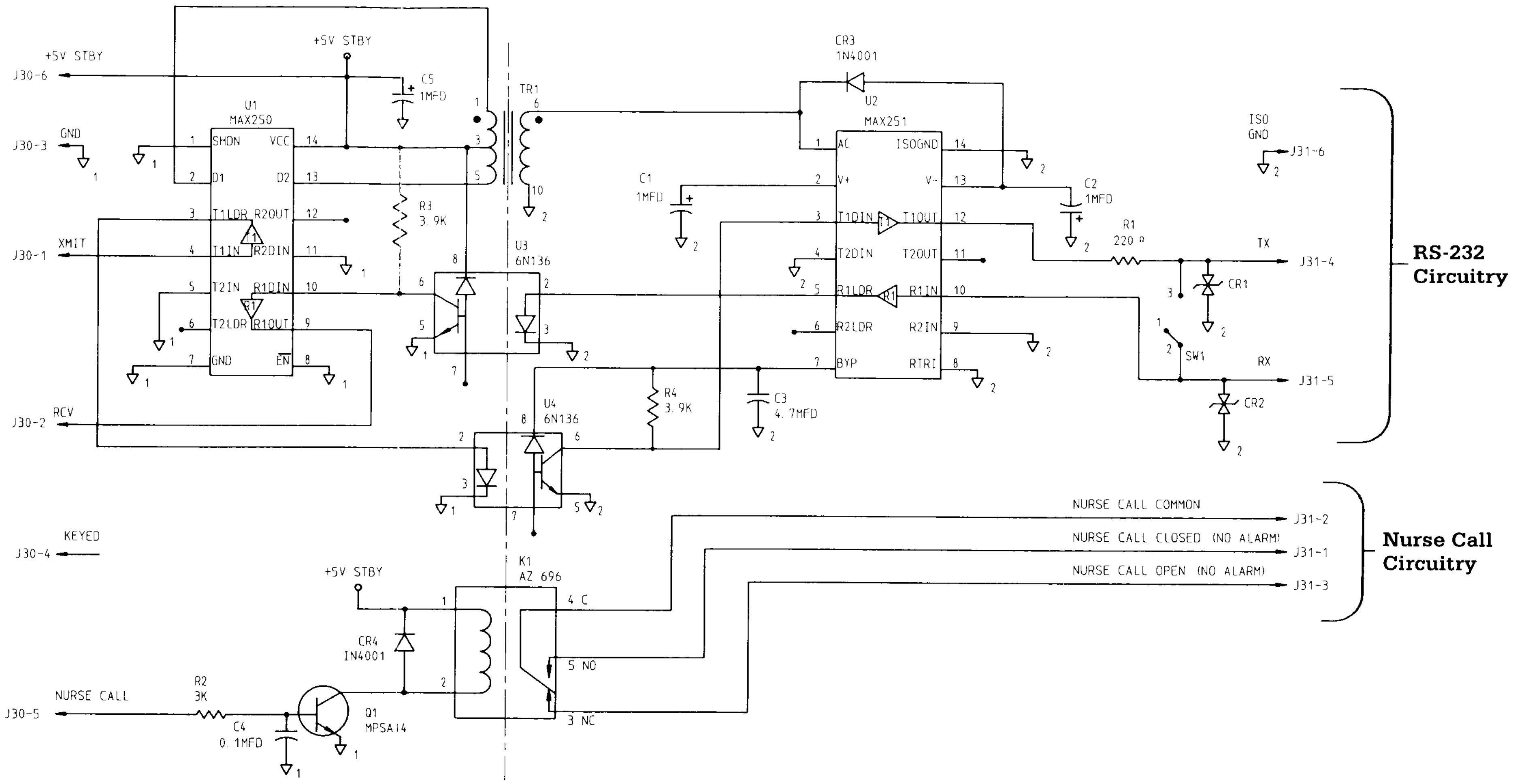


Figure 7-9 ThermaLink Board Schematic
Controllers with HBJ Serial Numbers

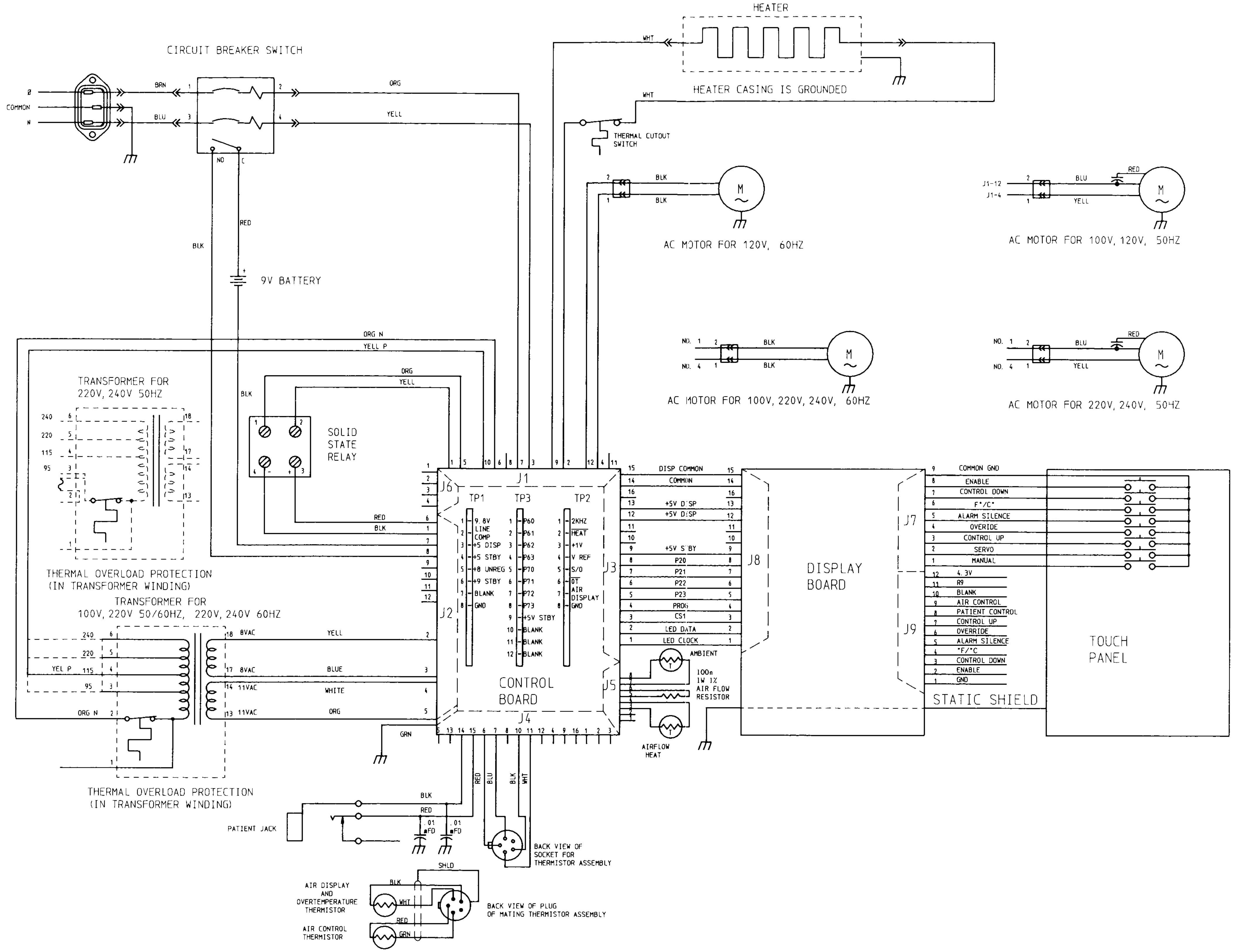


Figure 7-1 Wiring Diagram
Controllers without HBJ Serial Numbers

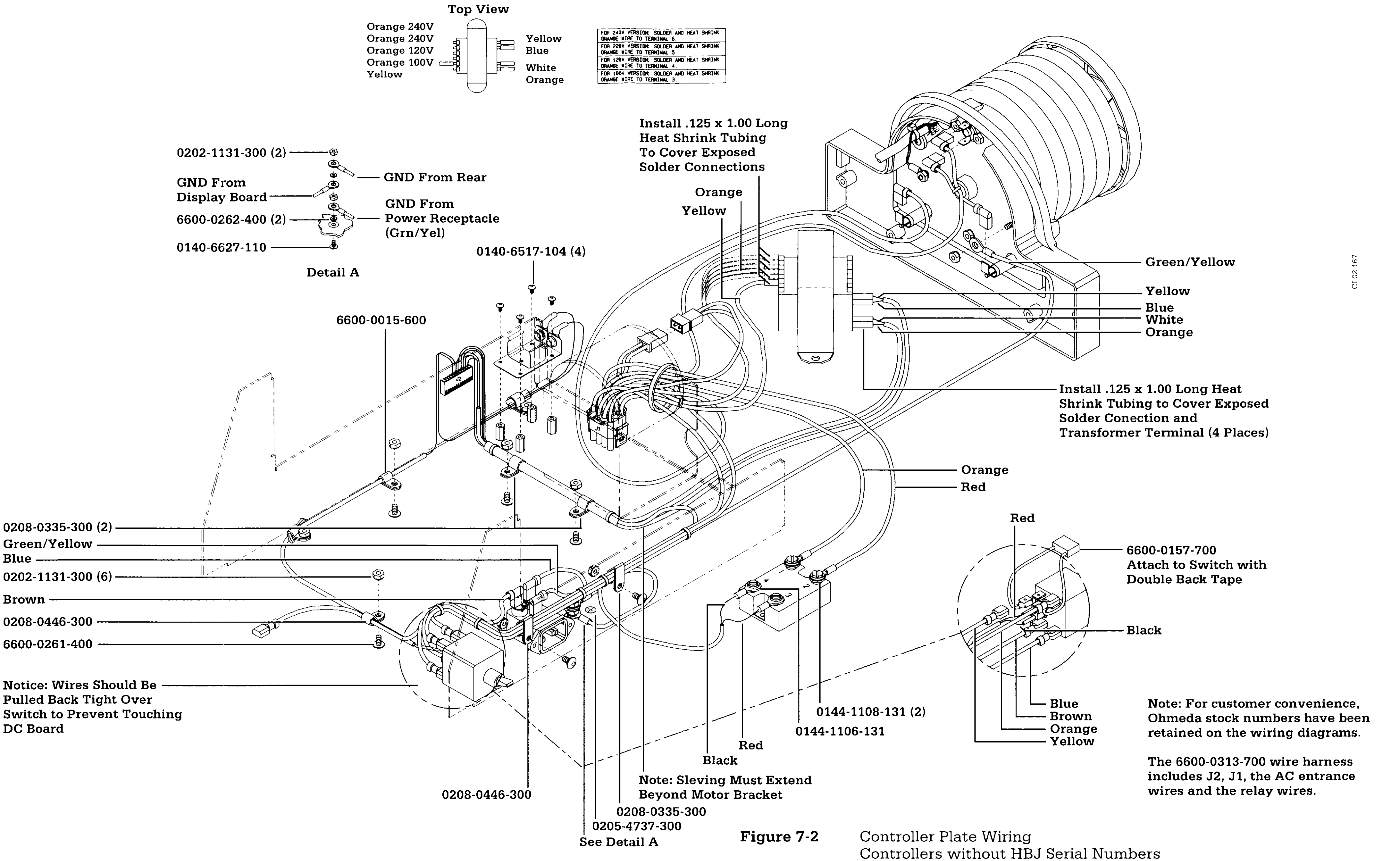


Figure 7-2 Controller Plate Wiring
Controllers without HBJ Serial Numbers

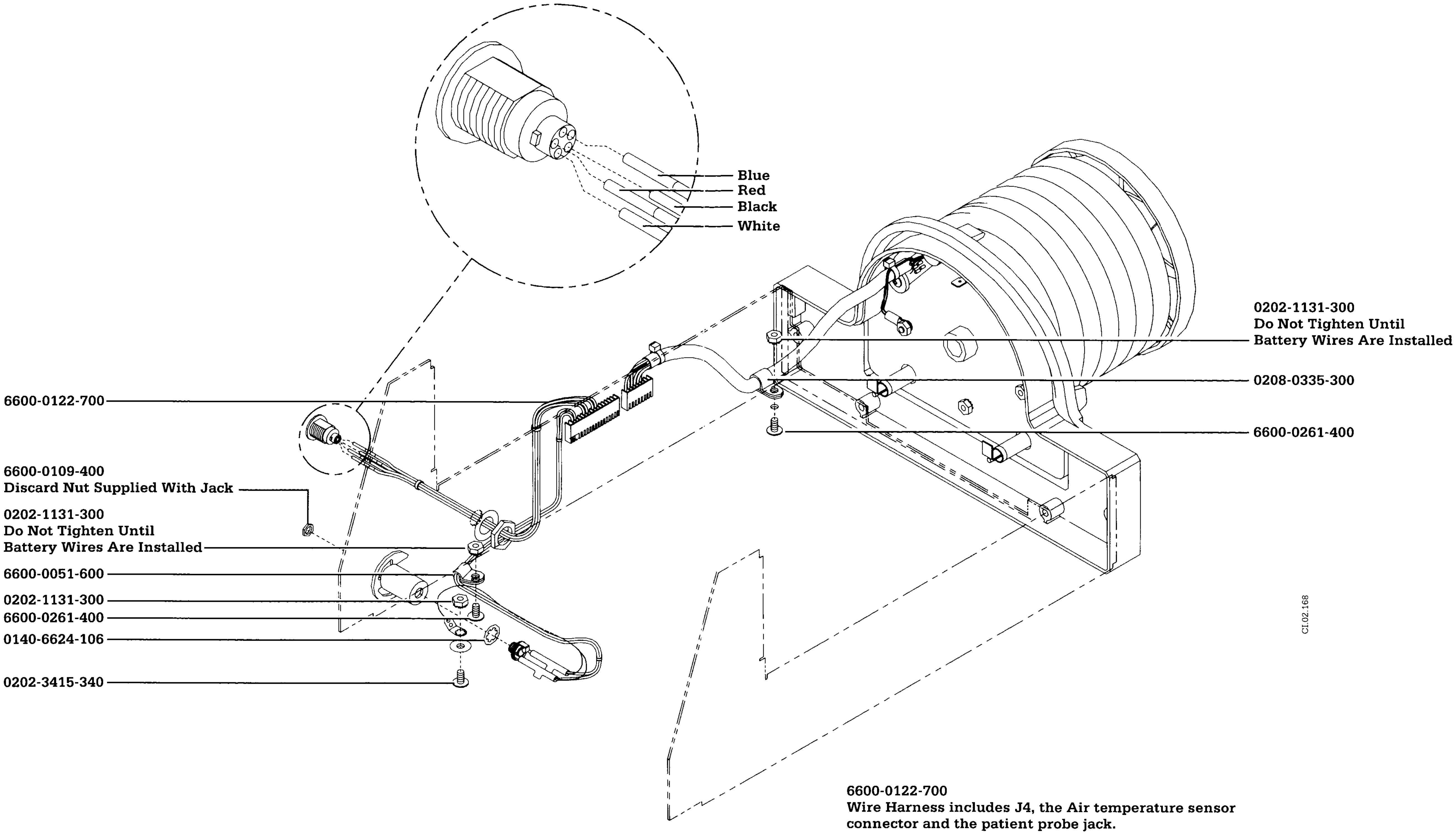
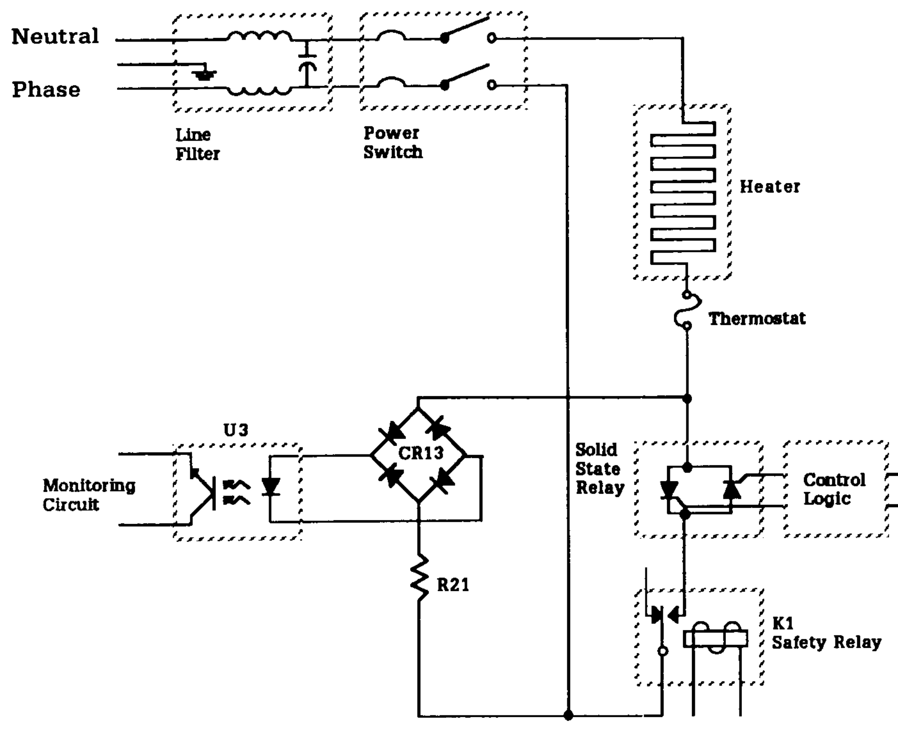
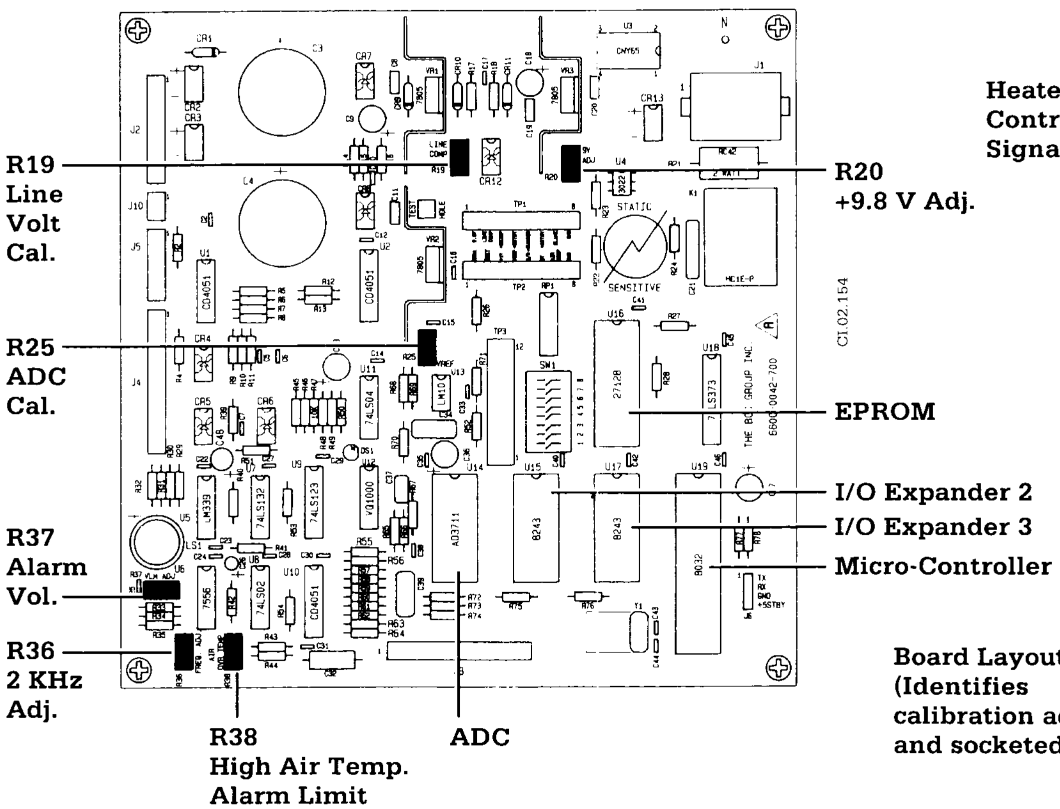


Figure 7-3 Detail, Air Temp. and Patient Temp. Wiring Controllers without HBJ Serial Numbers

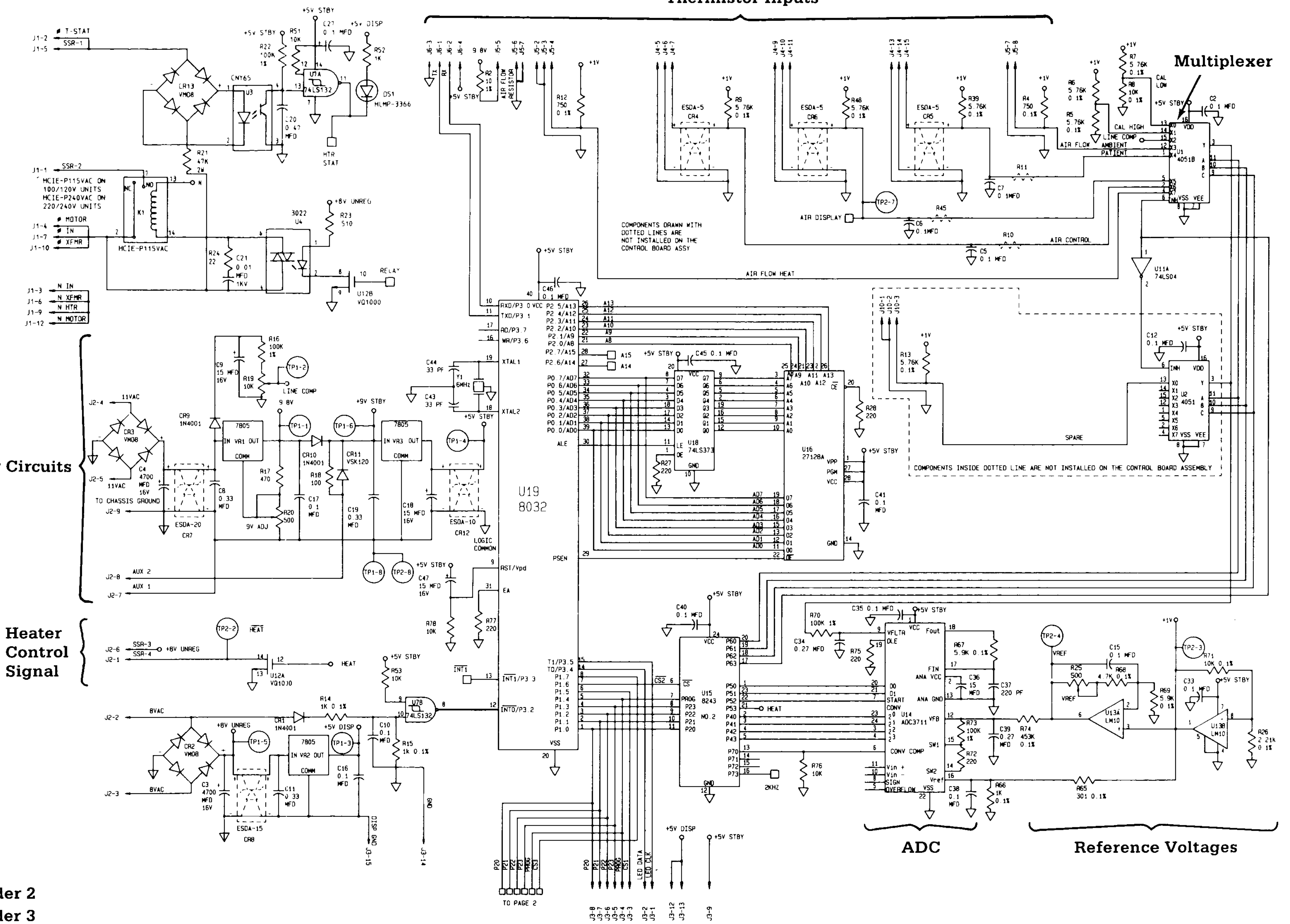
Controllers without HBJ Serial Numbers

Heater Block Diagram





Board Layout (Identifies calibration adj. and socketed chips)

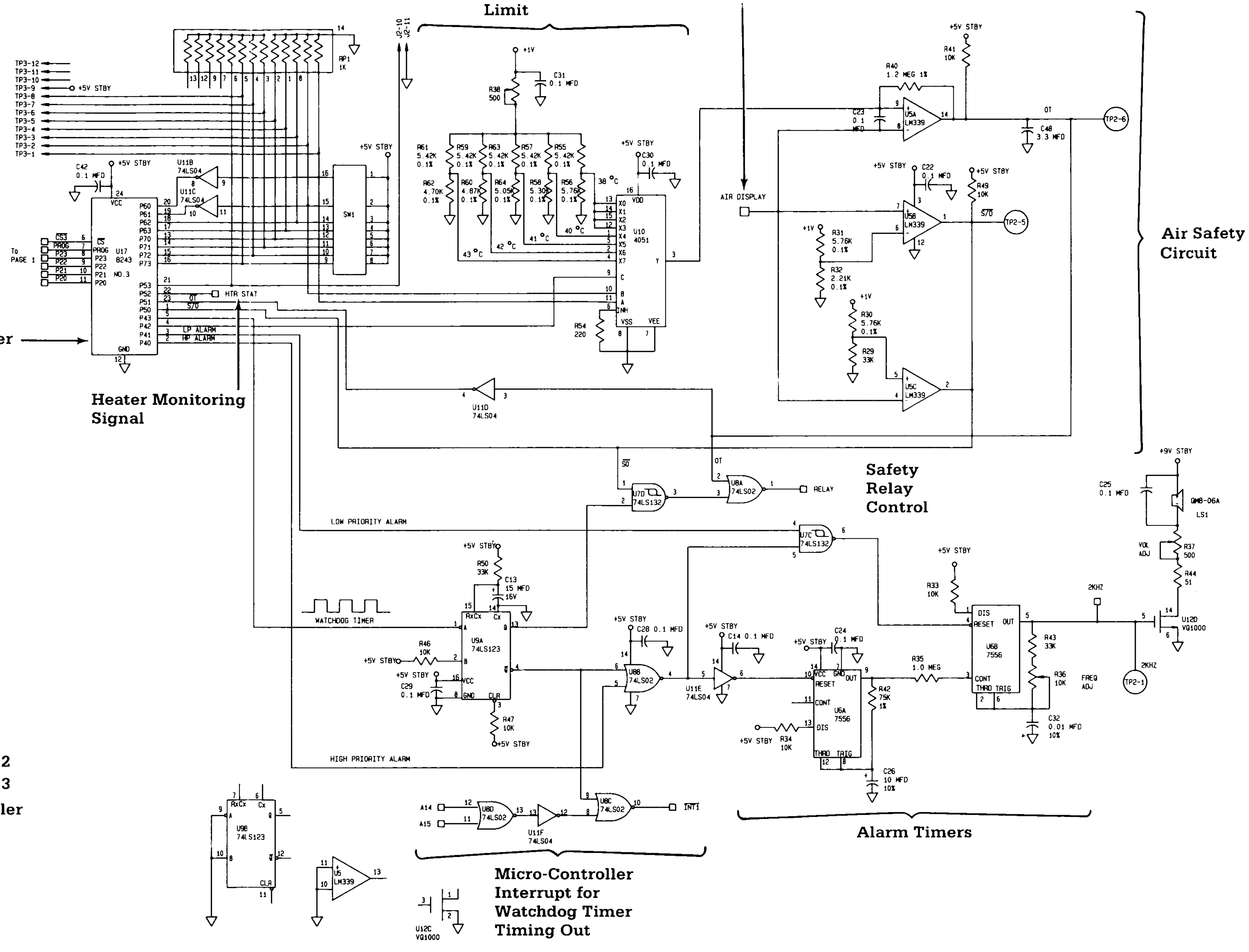


Notes: (Unless otherwise specified)

1. **All resistors are 5%. 1/4 Watt**
2. **Square denotes refer to other page □**
3. **GND symbol with line denotes GNDS tied together ∇**
4. **Potentiometer used in calibration**

Figure 7-4a Control Board Schematic (page 1 of 2)
Controllers without HBJ Serial Numbers

TEST POINTS		UNUSED CONNECTOR PINS
TP1-1	9.8V	J1-8, J1-11
TP1-2	LINE COMP	J2-12
TP1-3	+5V DISP	J3-10, 11, 16
TP1-4	+5V STBY	J4-4, 8, 12, 16
TP1-5	+8V UNREG	
TP1-6	+9V STBY	
TP1-7	BLANK	
TP1-8	GND	
TP2-1	2KHZ	
TP2-2	HEAT	
TP2-3	+1V	
TP2-4	V REF	
TP2-5	S70	
TP2-6	OT	
TP2-7	AIR DISPLAY	
TP2-8	GND	
TP3-1	P60	
TP3-2	P61	
TP3-3	P62	
TP3-4	P63	
TP3-5	P70	
TP3-6	P71	
TP3-7	P72	
TP3-8	P73	
TP3-9	+5V STBY	
TP3-10	BLANK	
TP3-11	BLANK	
TP3-12	BLANK	



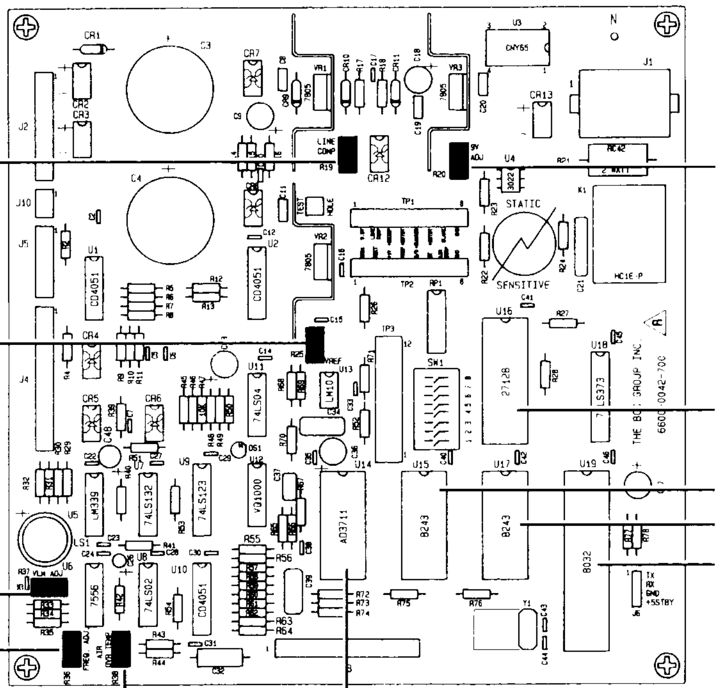


Figure 7-4b Control Board Schematic (page 2 of 2)
Controllers without HBJ Serial Numbers

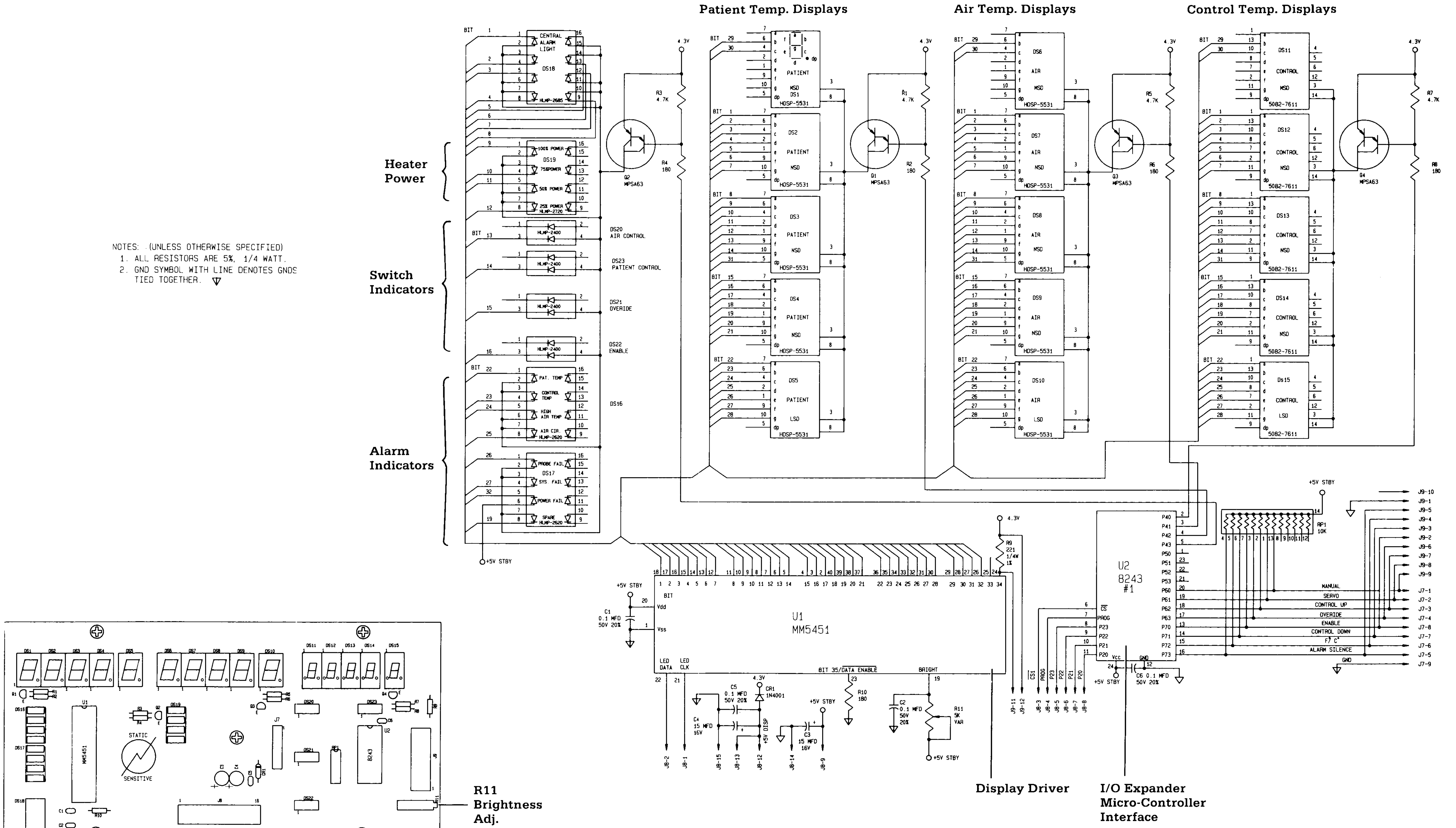
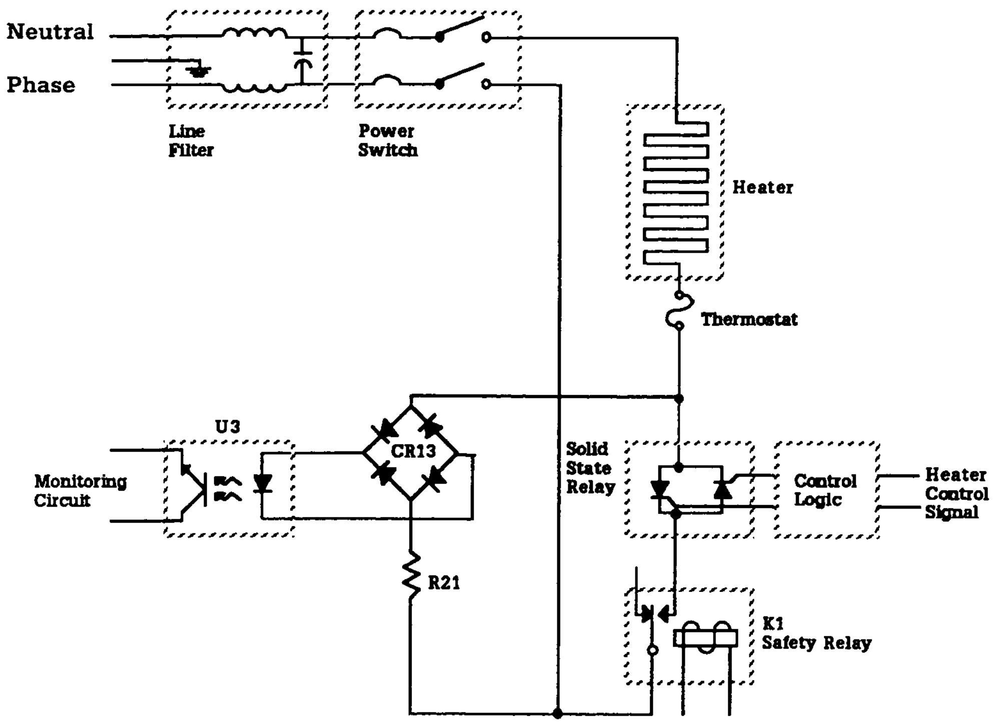


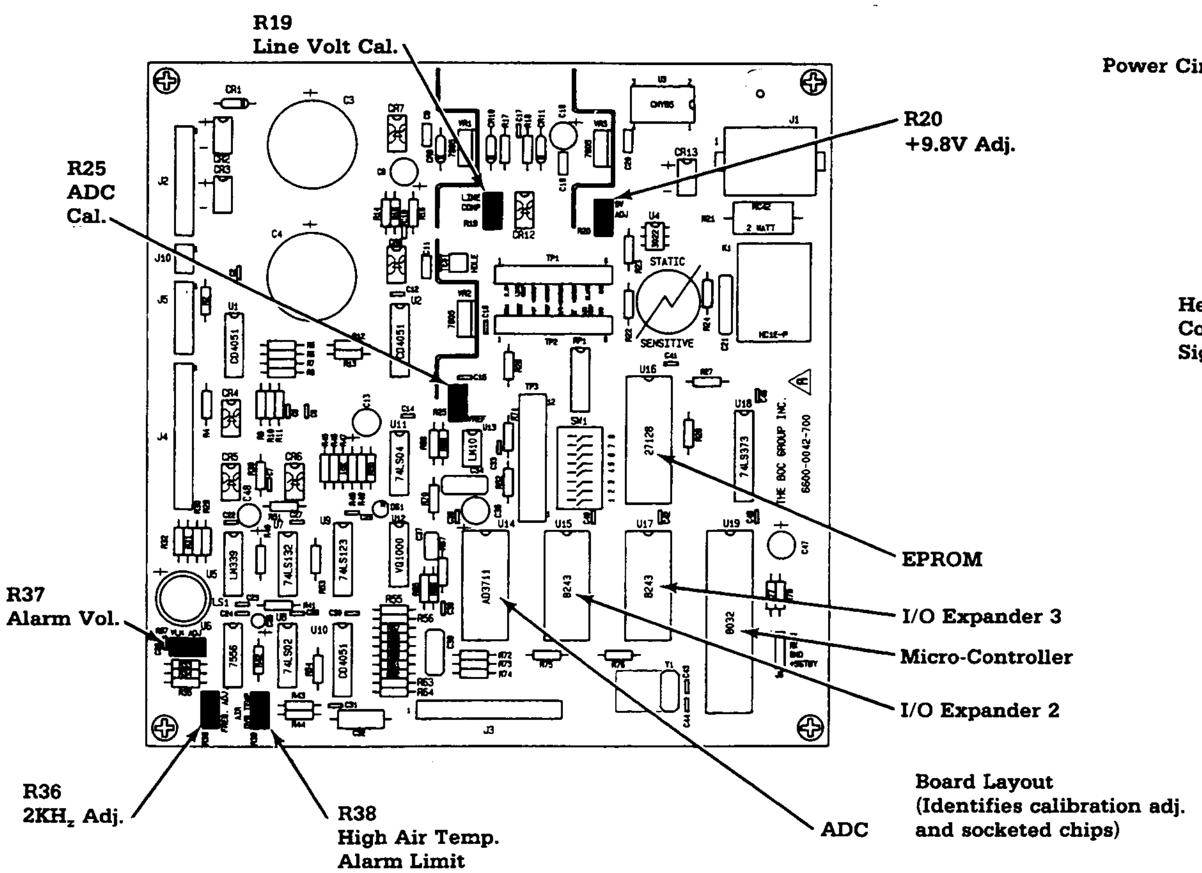
Figure 7-5 Display Board Schematic

5.4 Control Board Schematic

Note: The heater circuit has changed.

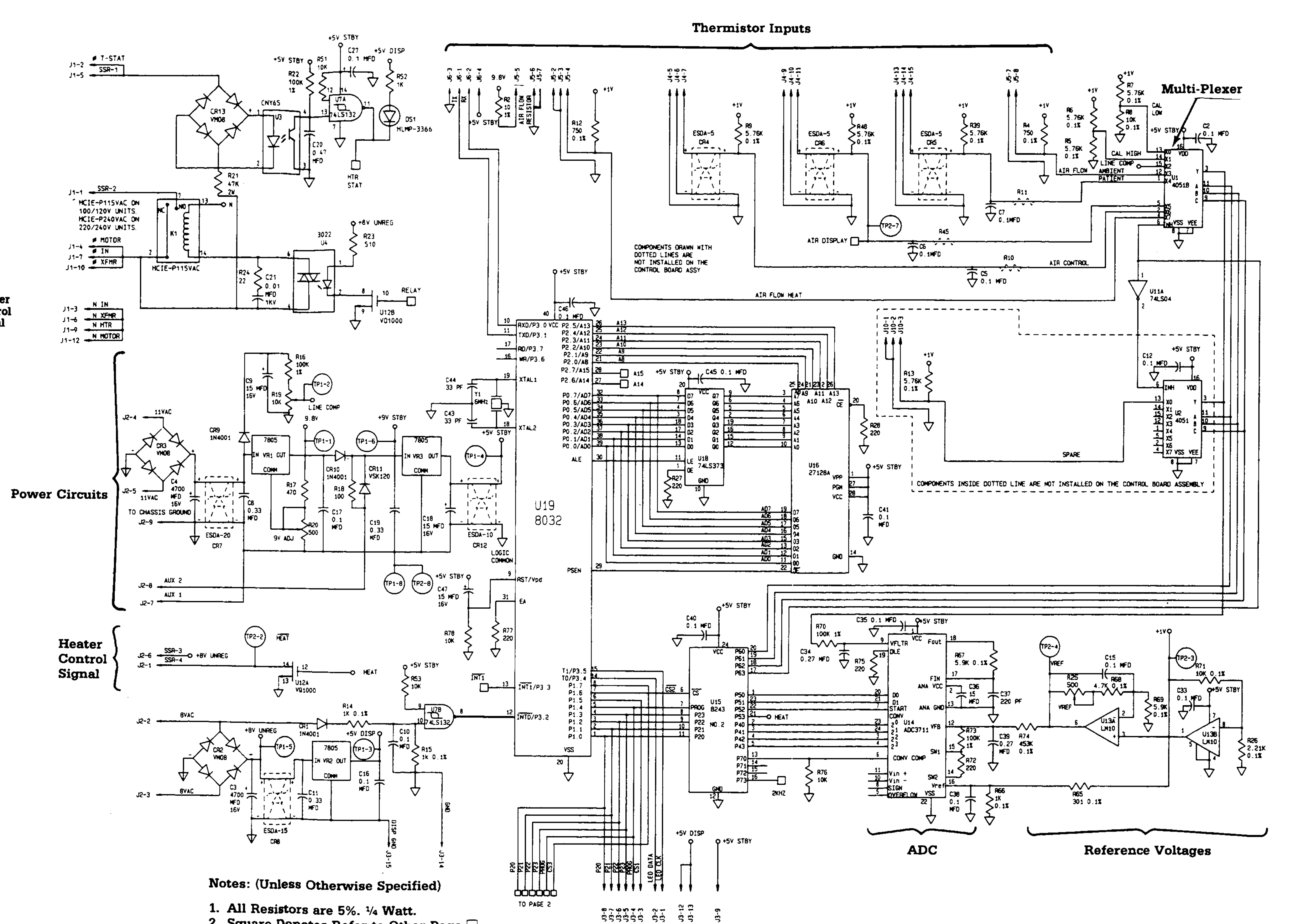
Heater Block Diagram





Board Layout (Identifies calibration adj. and socketed chips)

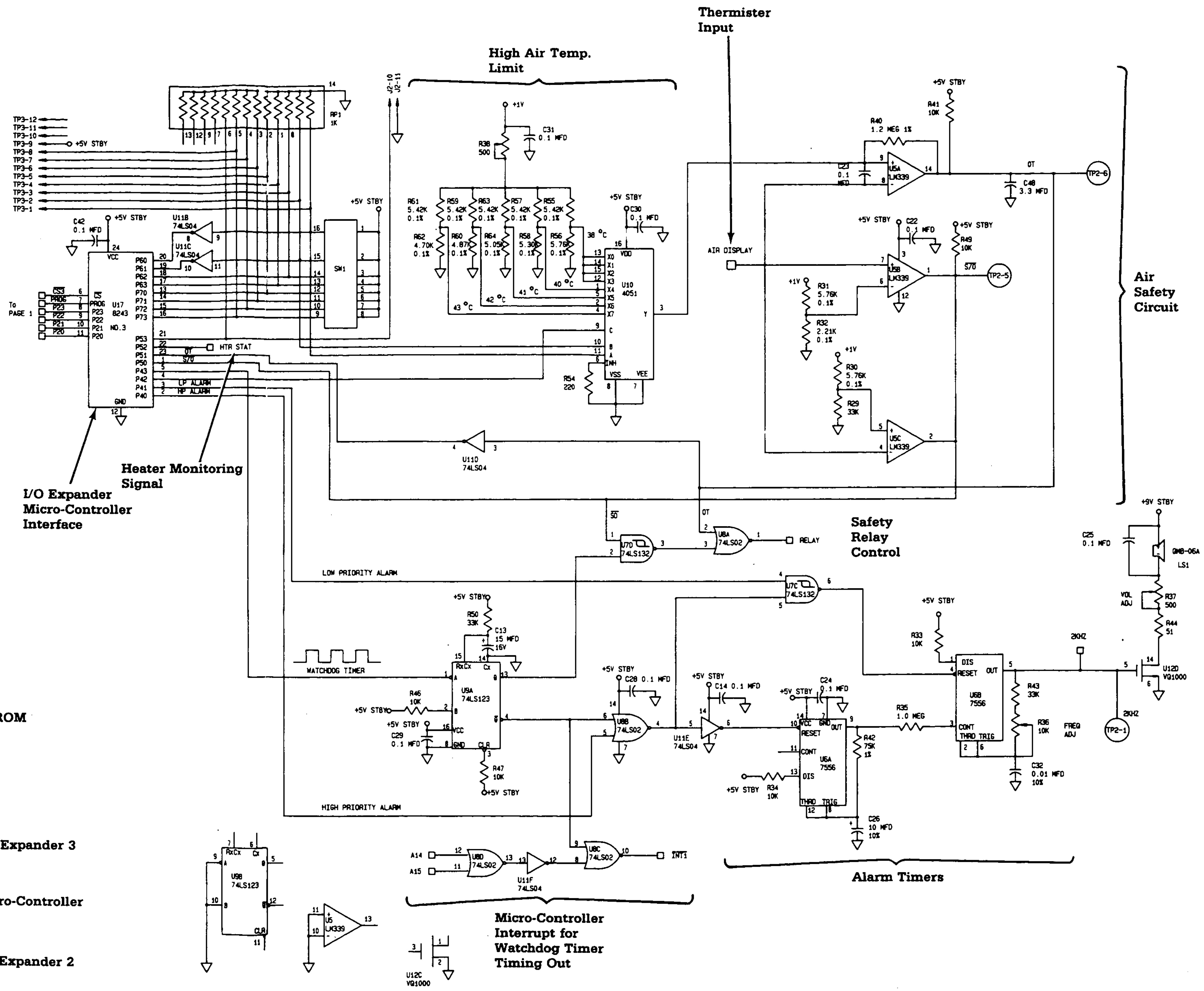
Heater Control/Monitor Circuit

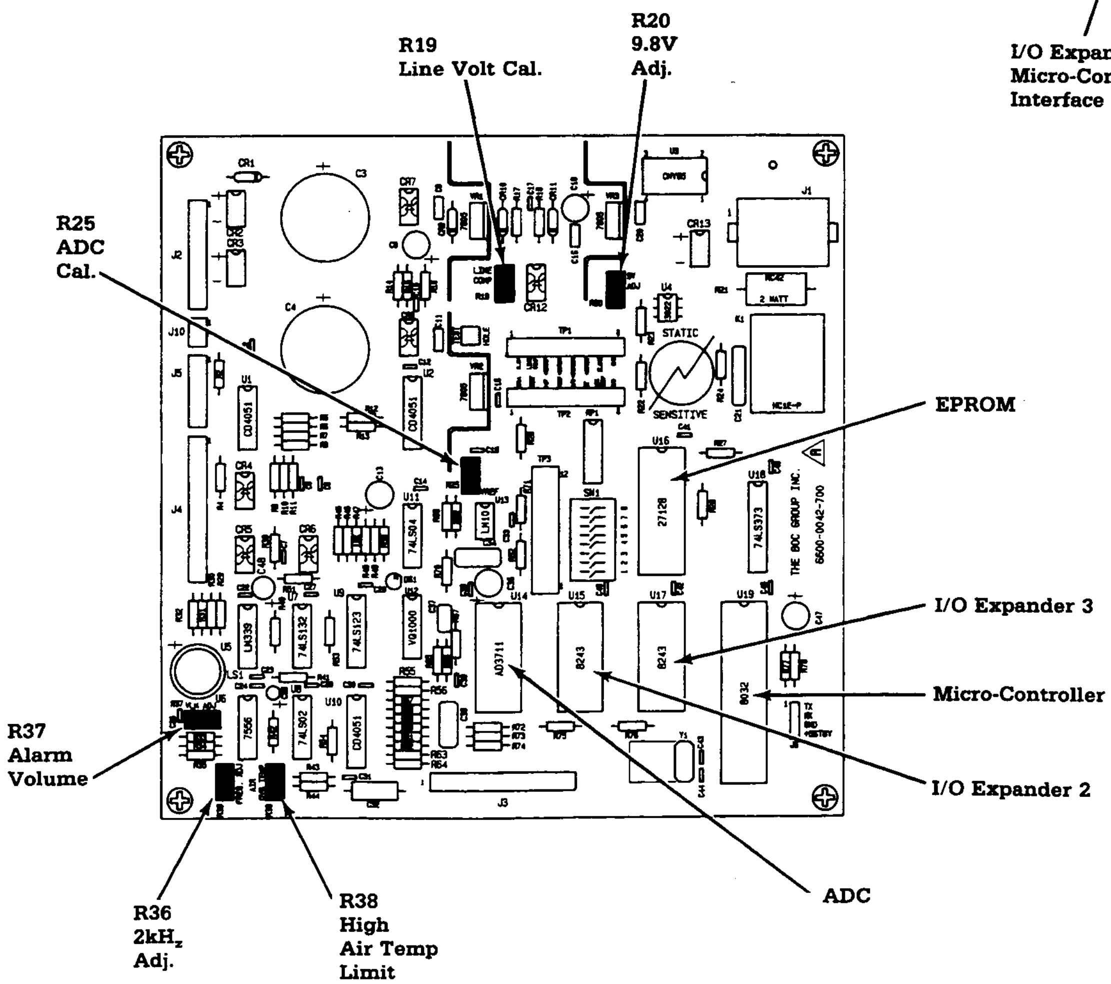


Notes: (Unless Otherwise Specified)

1. All Resistors are 5%. ¼ Watt.
2. Square Denotes Refer to Other Page □
3. GND Symbol With Line Denotes GNDS Tied Together
4. Potentiometer Used in Calibration

TEST POINTS		UNUSED CONNECTOR PINS
TP1-1	9.8V	J1-8, J1-11
TP1-2	LINE COMP	J2-12
TP1-3	+5V DISP	J3-10, 11, 16
TP1-4	+5V STBY	J4-4, 8, 12, 16
TP1-5	+8V UNREG	
TP1-6	+9V STBY	
TP1-7	BLANK	
TP1-8	GND	
TP2-1	2KHZ	
TP2-2	HEAT	
TP2-3	+1V	
TP2-4	V REF	
TP2-5	S/O	
TP2-6	OT	
TP2-7	AIR DISPLAY	
TP2-8	GND	
TP3-1	P60	
TP3-2	P61	
TP3-3	P62	
TP3-4	P63	
TP3-5	P70	
TP3-6	P71	
TP3-7	P72	
TP3-8	P73	
TP3-9	+5V STBY	
TP3-10	BLANK	
TP3-11	BLANK	
TP3-12	BLANK	

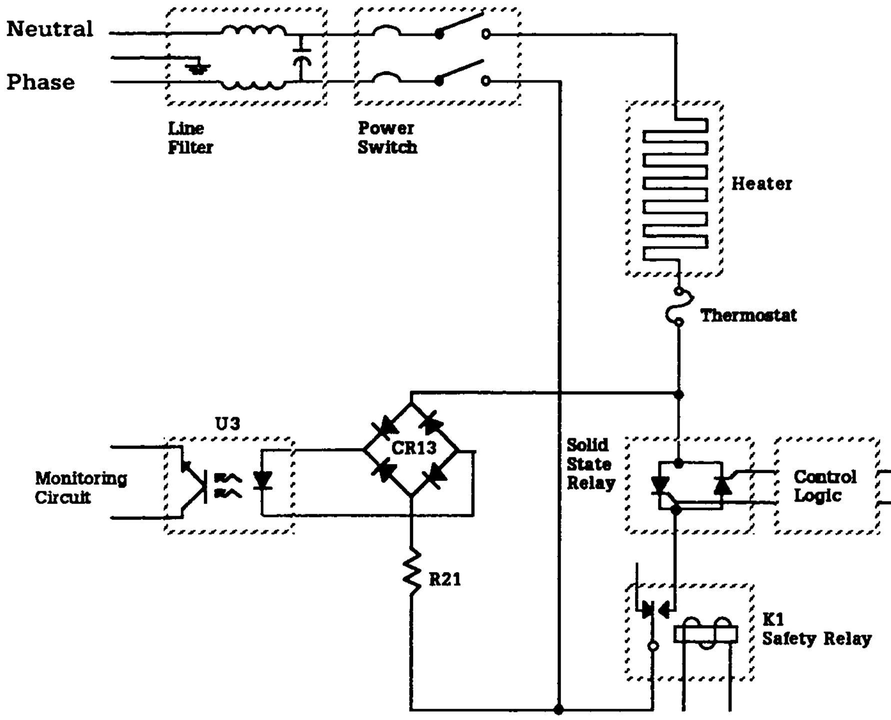




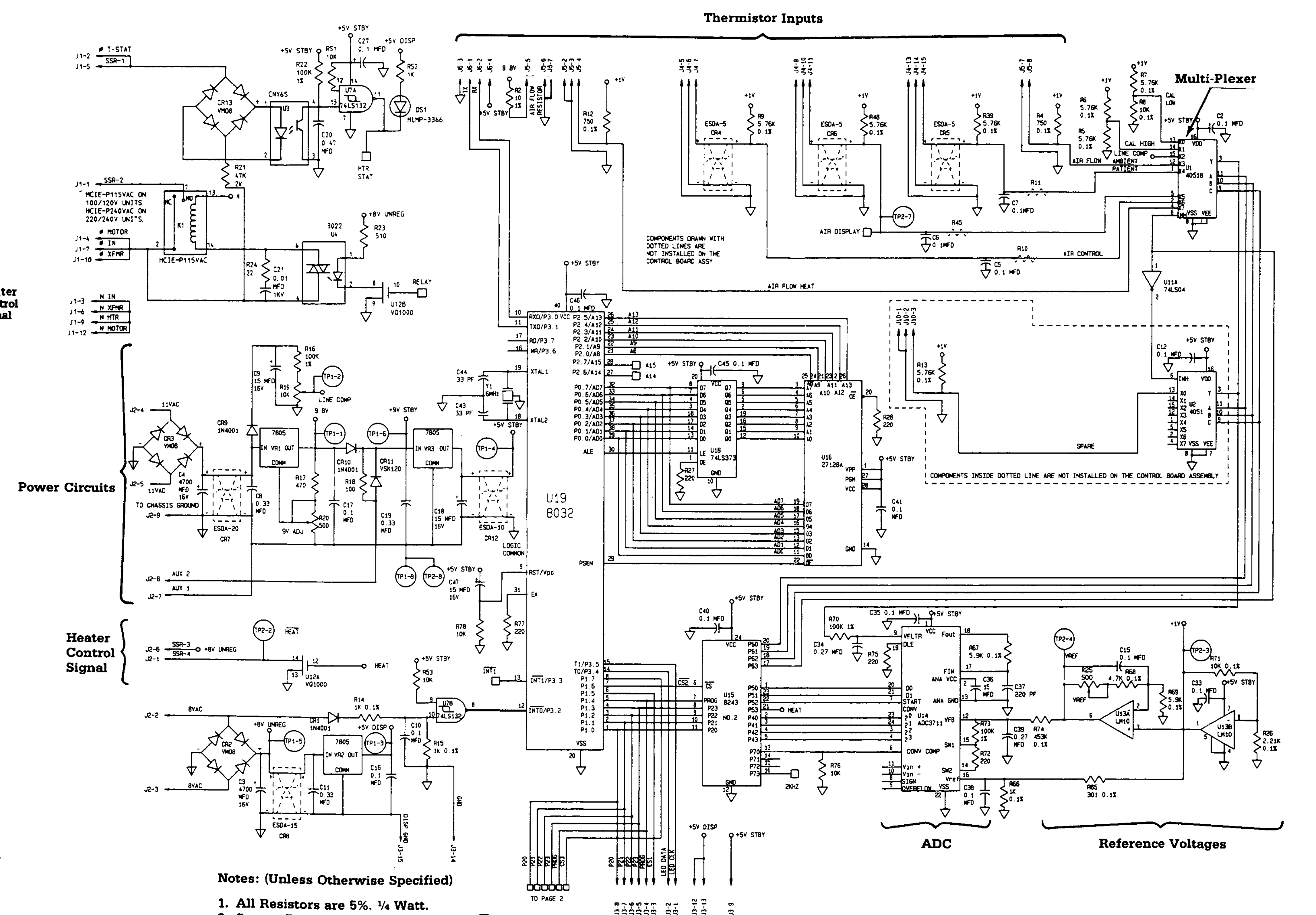
5.4 Control Board Schematic

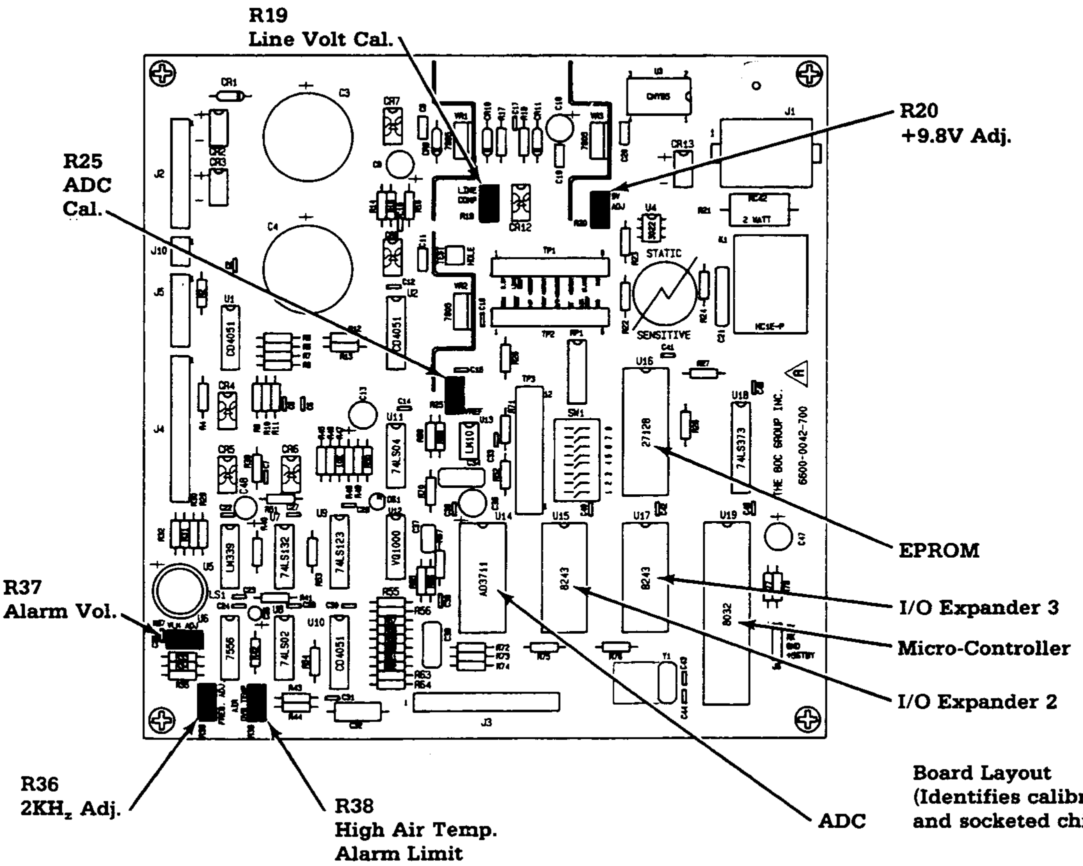
Note: The heater circuit has changed.

Heater Block Diagram



Heater Control/Monitor Circuit





Board Layout
(Identifies calibration adj.
and socketed chips)

Notes: (Unless Otherwise Specified)

1. **All Resistors are 5%. ¼ Watt.**
2. **Square Denotes Refer to Other Page □**
3. **GND Symbol With Line Denotes GNDS Tied Together**
4. **Potentiometer Used in Calibration**

TEST POINTS		UNUSED CONNECTOR PINS
TP1-1	9.8V	J1-8, J1-11
TP1-2	LINE COMP	J2-12
TP1-3	+5V DISP	J3-10, 11, 16
TP1-4	+5V STBY	J4-4, 8, 12, 16
TP1-5	+8V UNREG	
TP1-6	+9V STBY	
TP1-7	BLANK	
TP1-8	GND	
TP2-1	2KHZ	
TP2-2	HEAT	
TP2-3	+1V	
TP2-4	V REF	
TP2-5	S/O	
TP2-6	OT	
TP2-7	AIR DISPLAY	
TP2-8	GND	
TP3-1	P60	
TP3-2	P61	
TP3-3	P62	
TP3-4	P63	
TP3-5	P70	
TP3-6	P71	
TP3-7	P72	
TP3-8	P73	
TP3-9	+5V STBY	
TP3-10	BLANK	
TP3-11	BLANK	
TP3-12	BLANK