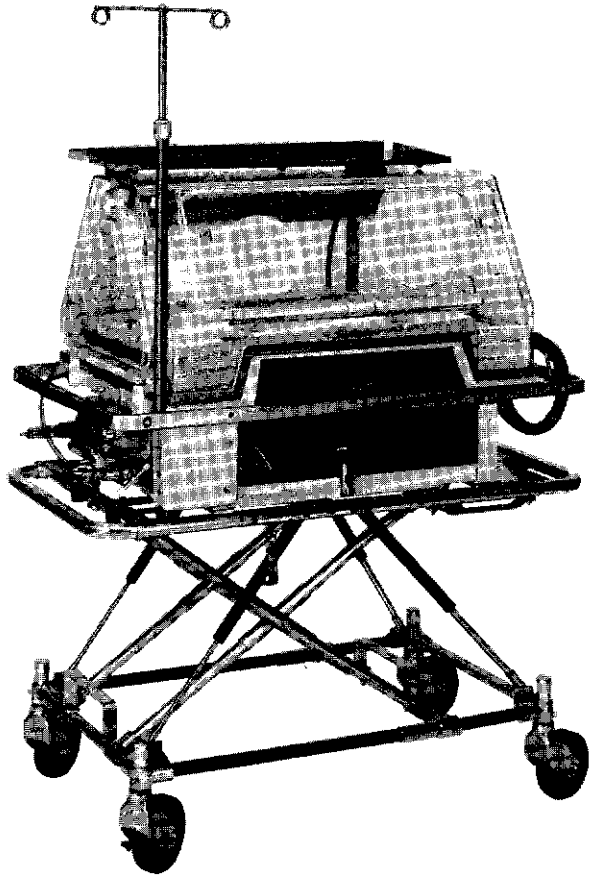
AIR-SHIELDS®
TRANSPORT INCUBATOR
MODELS TI100-1 AND -1E



SERVICE MANUAL

LIMITED

WARRANTY

The product being described in this manual is warranted against defects in materials or workmanship for one year from the date of shipment from Air-Shields, Hatboro, with the following exceptions:

All consumable and disposable products are guaranteed to be free from defects upon shipment only.

Calibrations are considered normal maintenance and are not included in the 1 year warranty.*

During the warranty period any defective parts other than those listed above will be replaced at no charge to the customer. There will be no labor charge for replacing the parts within the continental U.S.

This warranty is rendered void and Air-Shields cannot be held liable for conditions resultant therefrom if:

1. Damage to the unit is incurred as a result of mishandling.
2. The customer fails to maintain the unit in a proper manner.
3. The customer uses any parts, accessories, or fittings not specified or sold by Air-Shields.
4. Sale or service is performed by a non-certified service/dealer agency.

This warranty is in lieu of all other warranties, expressed or implied, and Air-Shields shall in no event be liable for incidental or consequential damages including loss of use, property damage, or personal injury resulting from breach of warranty.

*The Accreditation Manual for Hospitals, Standard II of the Function Safety and Sanitation section, requires that the testing interval for this equipment not exceed six months. To comply with this standard, we recommend that you participate in our Accreditation Testing Compliance Program during the warranty period. This service can be performed by certified technicians through our Product Service Group and authorized dealers.

SERVICE

For optimal performance, product service should be performed only by qualified service personnel. Product Service Group instrumentation specialists are located throughout the United States and are dispatched for required maintenance by calling 800-523-2404. Customers outside the U.S. should contact their local factory-authorized Air-Shields distributor for service.

AIR-SHIELDS
A HEALTHDYNE COMPANY
HATBORO PENNSYLVANIA 19040 U.S.A.

CAT. NO. 67 990 45-2

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A 1 2 3 4 5 6 7 8 9
E 1 2 3 4 5 6 7 8 9

PLEASE READ

Please check the A page for change information.

Since Air-Shields, Inc. conducts a continuous product improvement program, circuit and component improvements are sometimes incorporated into equipment before they can be incorporated into the printed manuals. When this occurs, changed material is provided on separate sheets at the rear of the manual or under separate cover in the form of a change package. Changed material on each page of text is indicated by a vertical bar on the margin next to the changed material, as shown on the right.

THIS MANUAL CONTAINS PROPRIETARY INFORMATION. REPAIRS AND AUTHORIZED MODIFICATIONS SHOULD BE PERFORMED ONLY BY QUALIFIED SERVICE PERSONNEL TO MAINTAIN YOUR WARRANTY AND TO AVOID CREATING SAFETY HAZARDS. WE CANNOT ASSUME RESPONSIBILITY FOR ANY CONDITIONS AFFECTING THE PROPER OPERATION OF THIS EQUIPMENT WHICH MAY RESULT FROM UNAUTHORIZED REPAIR OR MODIFICATION.

NOTE ON REPLACEMENT PARTS

Some parts used in your equipment may be different than those which appear in the Parts List of this manual. This sometimes occurs because of difficulty in parts procurement, but does not alter the function of the equipment. Order the part listed in the Parts List.

NOTE: ALSO SEE PAGE 2.

LIST OF AVAILABLE MODIFICATION KITS

ITEM	DESCRIPTION AND PURPOSE	PART NO.
1	End Access Door Safety Spring Retrofit Kit. Forces End Access Door to open if not positively latched.	67 900 90
2	EMI Retrofit Kit Modifies Series 00 Incubators to conform with MIL STD 461B regarding Electrical Interference.	67 900 76
3	EMI Retrofit Kit Modifies Series 00 Incubators to conform with MIL STD 461B regarding Electrical Interference.	67 900 77
4	Fan Motor Replacement Kit. Used for replacing fan motors in the Incubator.	67 905 57
5	Air Intake Plate Replacement Kit. Used for replacing the air intake plate in the Incubator.	67 905 55

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TECHNICAL DEFINITIONS

SET POINT. Incubator Temperature selected for operation during use.

INCUBATOR TEMPERATURE. Air temperature at a point 10 cm (4 in.) above and centered over the mattress surface.

TEMPERATURE EQUILIBRIUM. The condition reached when the average Incubator Temperature does not vary more than 0.2°C over a period of one hour.

TEMPERATURE OVERSHOOT. The amount by which Incubator Temperature exceeds average Incubator Temperature at Temperature Equilibrium when the set point is changed from 30°C to 34°C.

TEMPERATURE RISE TIME. The time required for the Incubator Temperature to rise to 34°C from an ambient of 23°C with a 35°C set point.

TEMPERATURE UNIFORMITY. The amount by which the average temperature at each of four points 10 cm (4 in.) above the mattress surface differs from the average Incubator Temperature at Temperature Equilibrium. The four points are the centers of four areas formed by lines that divide the width and length of the mattress surface.

TEMPERATURE VARIABILITY. The variability of the Incubator Temperature that will be observed over a one-hour period after Temperature Equilibrium has been reached.

NOTE, IMPORTANT, CAUTION AND WARNING

NOTE. A Note is inserted in text to point out procedures or conditions which may otherwise be misinterpreted or overlooked. A Note may also be used to clarify apparently contradictory or confusing situations.

IMPORTANT. Similar to a Note but used where greater emphasis is required.

CAUTION. A Caution is inserted in text to call attention to a procedure which, if not followed exactly, can lead to damage or destruction of the equipment.

WARNING. A Warning is inserted in text to call attention to dangerous or hazardous conditions inherent to the operation, cleaning, and maintenance of the equipment which may result in personal injury or death of the operator or patient.

TABLE OF DEFINITIONS AND SYMBOLS (CONT.)

SYMBOLS

Attention; consult accompanying documents.

Type B equipment with an F-type isolated (floating) applied part.

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SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

This manual provides instructions for installation, maintenance, and repair of the Air-Shields® Transport Incubator, Model TI100. The manual is intended for use only by trained, qualified, service personnel. Instructions for the operator of the equipment are provided in a separate Operator's manual.

1.2 DESCRIPTION

The Transport Incubator, Model TI100, is intended for transport of high risk, premature, low birth-weight, or critically ill newborns. It provides a means to control air temperature, oxygen concentrations, and relative humidity. A double walled hood permits full visibility and provides an effective thermal barrier from the environment. Front and head access is provided by arm ports and door panels and the mattress tray slides out of the head end for additional access. Tubing access grommets are provided on both sides of the front access panel and at the head end panel. Also included is an observation lamp.

The incubator is designed to operate from either a sine or square wave AC power source. In addition, the Incubator can operate from an external 12 VDC source or an integral 12 volt battery. The batteries are automatically charged whenever the unit is connected to an AC voltage source and the Main AC POWER switch is set to the ON-1 position; a CHARGING indicator is provided. A comprehensive visual and audible fault alarm system with a test function to verify proper alarm operation is included.

1.3 MODEL IDENTIFICATION/SERIES CHANGE

The Air-Shields® Transport Incubator, Model TI100 data tag is located on the rear of the molding next to the Power Chassis cover. The data tag lists model identification and series number. Example:

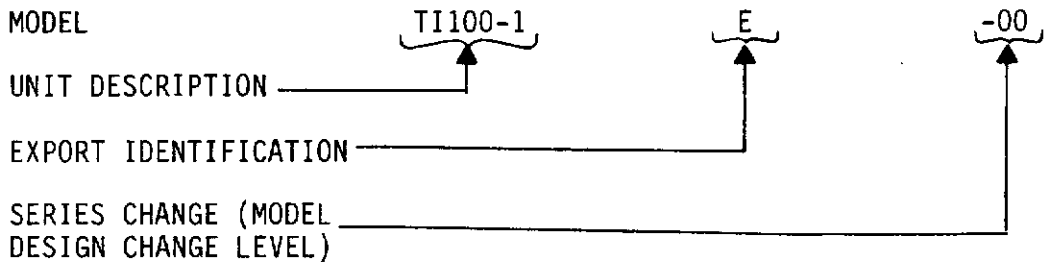
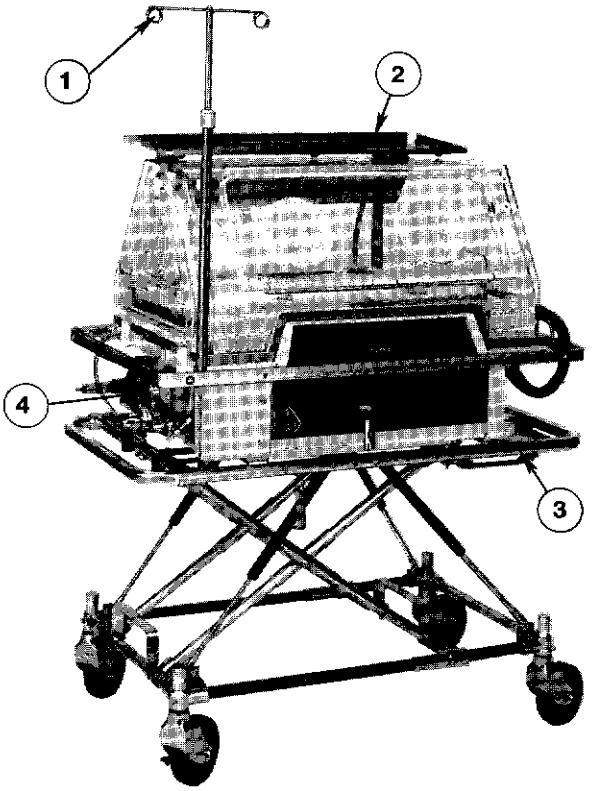


TABLE 1.1 SERIES CHANGE — TRANSPORT INCUBATOR MODEL TI100

SERIES NO.	DESCRIPTION OF CHANGE	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None
01	EMI Modification. Required to meet military requirements of MIL STD 461B.	Charger assembly circuit board. Changed to Revision 4 by addition of capacitor 4C6 (0.10 µf). Added 1.5 µF capacitor to Line Choke Filter board.

1.4 ACCESSORIES

Accessories available for use with the Model TI100 are illustrated in Figure 1.1. Part numbers for the accessories are listed in Section 6 of this manual.



1. I.V. Pole
2. Accessory Shelf
3. Adjustable Stand
4. Pressure Regulator and Flowmeter
5. DC Power Cord Receptacle (not shown)

FIGURE 1.1 ACCESSORIES

SECTION 2
INSTALLATION

2.1 UNPACKING

The Hood and Base Assembly and the Adjustable Stand Assembly (Accessory) are shipped in separate cartons. When removing the equipment from the cartons, take care not to scratch or otherwise damage unprotected surfaces. Remove all packing materials.

CAUTION: DO NOT RELEASE THE FRAME RETAINING LATCHES or raise the Adjustable Stand Assembly until after the Incubator has been installed on the Stand; damage to the Stand may result.

2.2 ASSEMBLY

To install the Transport Incubator on an Air-Shields® Adjustable Stand (accessory) refer to Figures 2.1 and 2.2.

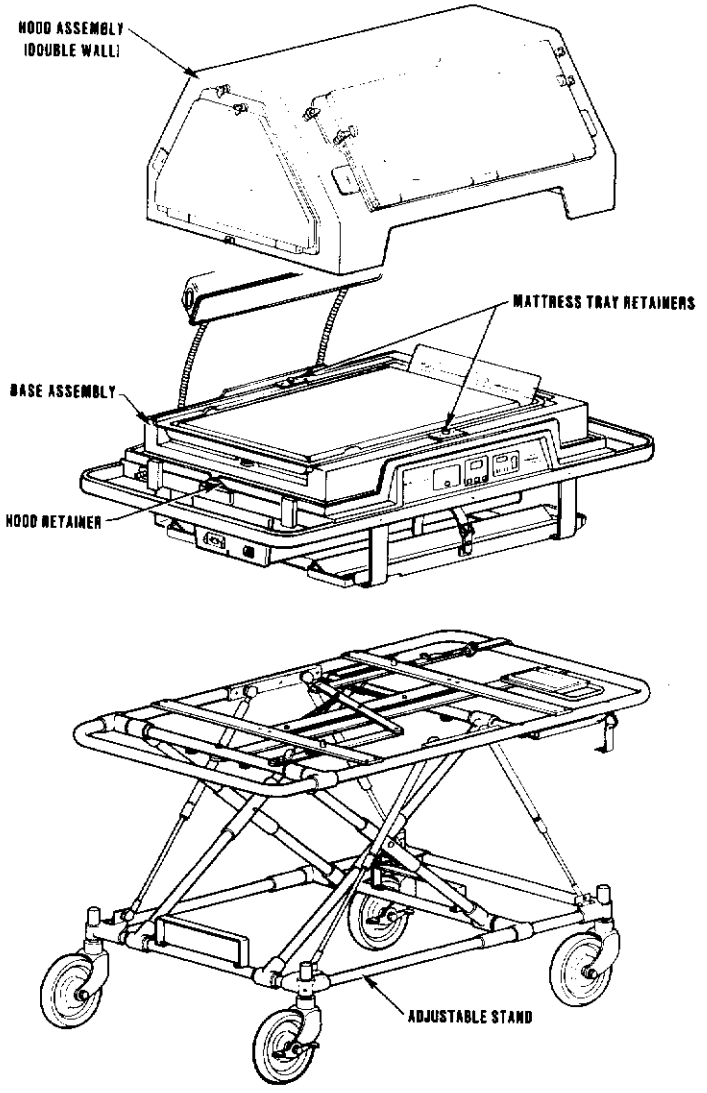


FIGURE 2.1 ASSEMBLY

CAUTION: DO NOT RELEASE THE FRAME RETAINING LATCHES or raise the Adjustable Stand Assembly until after the Incubator has been installed on the Stand; damage to the Stand may result.

1. INSTALL THE HOOD ON THE BASE ASSEMBLY as shown in Figure 2.1. Make sure that the Hood is secured to the Base with the two rubber retainers.

2. PULL THE INCUBATOR LOCKING HANDLE to the UNLOCK position and hook the Retaining Latch to the top frame of the Stand.

3. POSITION THE HOOD AND BASE ASSEMBLY on the Stand so that the Battery Tray faces the end of the Stand with the Height Adjustment Latch. Set the Base Assembly down on the alignment pins.

   CAUTION: Make sure that the Base Assembly is firmly seated on the alignment pins. Failure to do so will prevent the Incubator from being correctly mounted on the Stand and could result in the Incubator separating from the stand if sufficiently tilted.

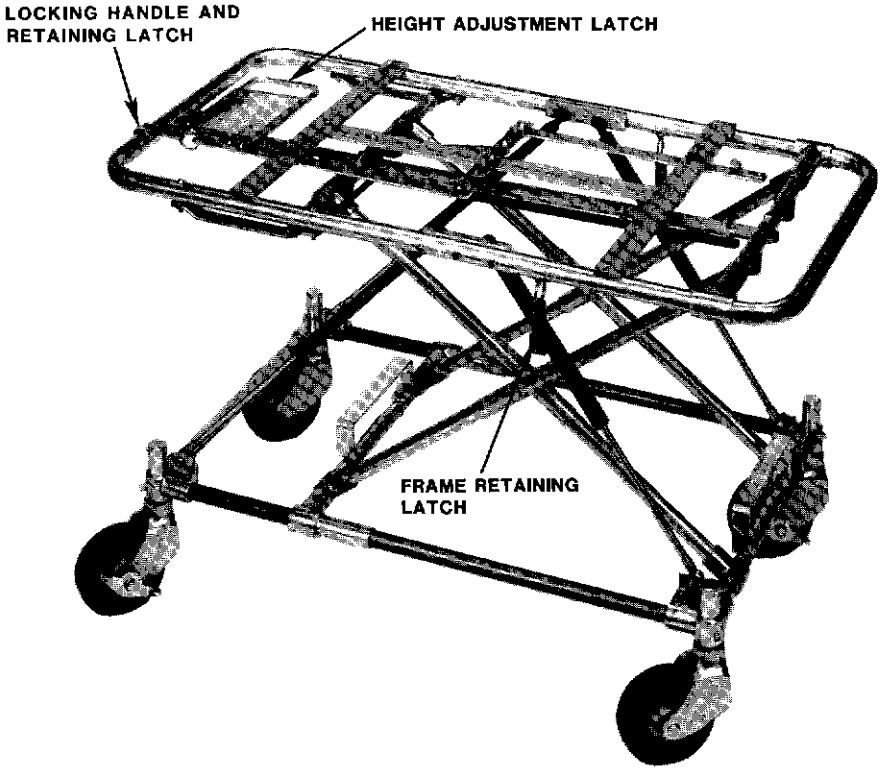


FIGURE 2.2 ADJUSTABLE STAND ASSEMBLY

4. RELEASE THE RETAINING LATCH and allow the Locking Handle to return to the lock position. Make sure the Base Assembly is secured by lifting it up at both ends.

5. RELEASE the two Frame Retaining Latches.

> WARNING: For safety, the Transport Incubator should always be handled by two persons.

6. WITH AN ATTENDANT AT EACH END, firmly grasp the four corners of the top frame of the Stand, with palms of hands upward.

> WARNING: Keep fingers clear of rollertracks and other moving parts.

7. LIFT SLIGHTLY to take the weight off the Height Adjustment Latch, then unlock the Height Adjustment Latch by pulling and holding the Latch Unlocking Handle outward with fingers of left hand.

8. RAISE THE STAND to the desired position.

9. RELEASE THE HEIGHT ADJUSTMENT LATCH and continue raising slightly until the Height Adjustment Latch engages with a positive click.

> WARNING: The Incubator weight must be fully supported until the Height Adjustment Latch is firmly locked in the desired position. The integral gas springs on the stand assist in supporting this weight.

10. TO LOWER THE INCUBATOR, reverse the above procedure:

    IMPORTANT: When the Stand is in the lowest position, always latch the Frame Retaining Latches to the lower bar.

2.3 CONNECTION TO EXTERNAL POWER SOURCES

CAUTION:

- Check continuity of ground between chassis and AC plug grounding pin before use.
- To ensure grounding reliability, connect AC Power Cable only to a properly grounded 3-wire hospital grade or hospital use outlet of the proper voltage and frequency. DO NOT USE EXTENSION CORDS.

1. THE AC POWER CABLE (Figure 2.3) can be connected to a standard 3-wire hospital outlet.

2. THE DC POWER CABLE (Figure 2.3) should be connected to the transporting vehicle using the DC Power Cord Receptacle (accessory part number 67 010 76). Refer to Figure 2.4 for proper voltage polarities.

   CAUTION: For adequate external DC voltage, DO NOT USE the cigarette lighter for the terminal point. The ambulance wiring leading to the terminal point should be at least 10 gauge and kept as short as possible.

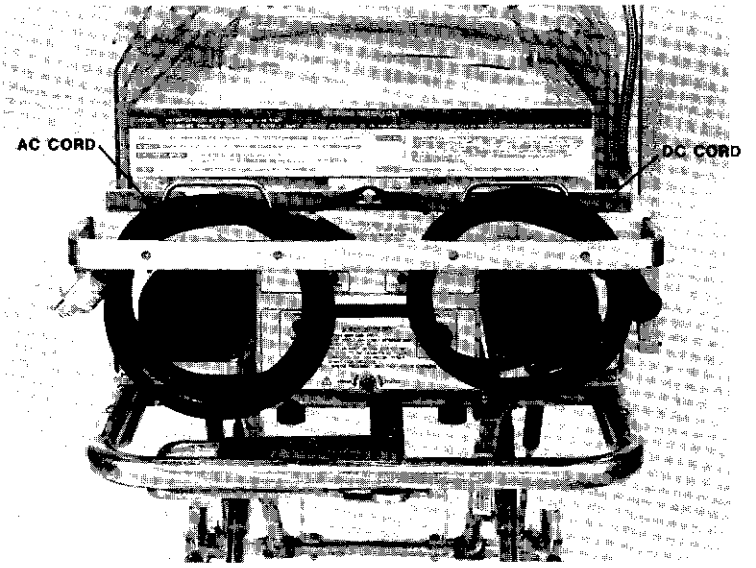


FIGURE 2.3 AC AND DC POWER CORD STORAGE LOCATIONS

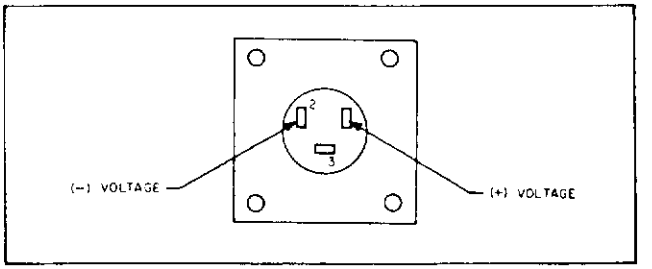


FIGURE 2.4 DC POWER CORD RECEPTACLE ELECTRICAL CONNECTIONS

2.4 INSTALLATION OF OXYGEN CYLINDERS

> WARNING: Compressed gas cylinders, such as oxygen cylinders, can become hazardous projectiles if the gas is released rapidly due to damage or other causes. Cylinders must be securely fastened to prevent movement or damage from shock or impact to the Stand or Incubator. Tighten clamp screw as required to prevent cylinder movement.

1. SLIDE THE OXYGEN CYLINDERS, valve end toward the Head end of the Incubator, into the compartments provided (Figure 2.5). Tighten the yokes on the cylinders, make sure that the cylinders are firmly clamped (Figure 2.6).

2. TO ADJUST THE LATCH TENSION turn the drawhook (Figure 2.6) clockwise to increase tension or turn the drawhook counterclockwise to decrease tension.

3. ATTACH AN APPROPRIATE REGULATOR/FLOWMETER (such as Air-Shields part number 67 090 75) to the cylinder.

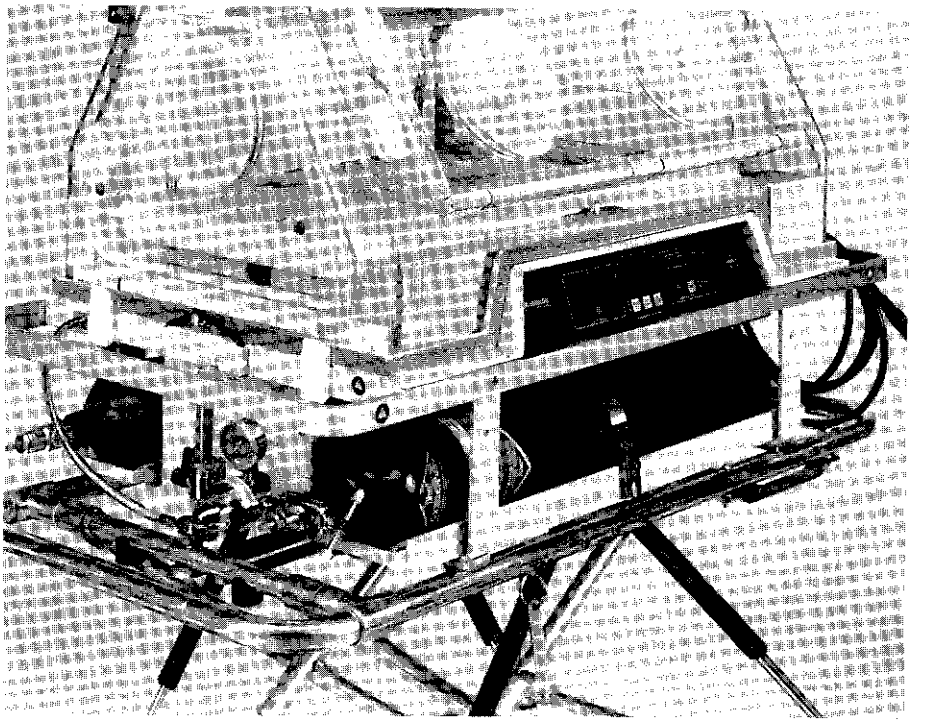


FIGURE 2.5 OXYGEN CYLINDER INSTALLED IN INCUBATOR

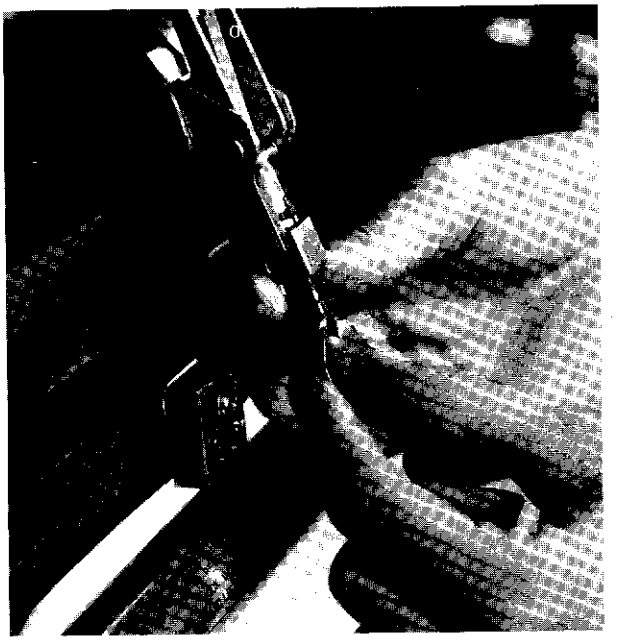


FIGURE 2.6 CYLINDER CLAMP TENSION ADJUSTMENT

2.5 CLEANING

The Incubator should be cleaned as necessary using the procedures described in Section 4 of this manual.

2.6 OPERATIONAL CHECKOUT PROCEDURE

> WARNING: The Incubator should not be used if it fails to function properly. Hazardous operating conditions could occur and fail to be detected.

The Operational Checkout should be performed before the Incubator is first placed into use and after any disassembly for cleaning or maintenance. Upon completion of this procedure, the unit should be connected to an AC power source and the AC POWER switch on the Power Chassis set to the ON-1 position so that the batteries can maintain a full charge.

2.6.1 ELECTRICAL CHECKOUT

NOTE: The Electrical Checkout procedure may be performed with the Incubator connected to an AC power source, an external DC power source, or internal batteries. In the following procedure the Incubator is connected to an AC power source.

CAUTION: Make sure that the building power source is compatible with the electrical specifications shown on the unit. For proper grounding reliability, connect the power cord only to a properly marked hospital grade receptacle. DO NOT USE EXTENSION CORDS. If any doubt exists as to the grounding connection, do not operate the equipment.

1. CONNECT THE AC POWER CORD. Insert one end of the power cord into the receptacle on the Power Chassis and the other into a wall receptacle.

2. SET THE MAIN AC POWER SWITCH on the Power Chassis to the ON-1 position; the AC POWER MODE indicator on the Controller should light. The CHARGING indicator on the Battery Tray will light if the internal batteries require charging; the indicator will be off if the batteries are fully charged.

3. DEPRESS THE CONTROLLER ON SWITCH ON THE CONTROLLER. Whenever turned on, a 7 second auto test sequence is automatically initiated as follows:

IMPORTANT: The auto test checks the lamps and display by simulating functional failures of each of the alarm sensors.

> WARNING: Do not place the Incubator in service if all indicators are not displayed and the audible alarm does not sound briefly at the end of the test cycle. Hazardous operating conditions could occur and fail to be detected.

A. The °C digital display should display all eights (88.8).

B. All HEATER POWER indicators should light.

C. The POWER FAILURE Alarm and AC DC POWER MODE indicators should light steady.

NOTE: The AC POWER MODE indicator will not light if the unit is tested while operating from DC power.

D. The HIGH TEMP, SENSOR, HEATER TEMP, and LOW DC Alarm indicators should flash.

E. At the end of the auto test sequence, a short beep should be heard. The AC POWER MODE indicator should remain on and one or more of the HEATER POWER indicators may remain on depending on Incubator temperature.

F. The SET POINT indicator should light and the °C digital display should indicate 35°C ± 0.1°C for approximately 15 seconds. This is the automatically set initial set point. The unit will heat to this temperature unless the set point is changed.

4. CHECK SET POINT ADJUST as follows:

A. Depress the SET TEMP switch, a short "beep" should be heard and the SET POINT indicator should light indicating that the °C temperature display is indicating the set point.

B. Depress and hold the raise (△) switch until the °C display indicates maximum (38°C).

C. Repeat Step A.

D. Depress and hold the lower (▽) switch until the °C display indicates 34°C.

5. CHECK TEMPERATURE CONTROL. With all access openings closed, allow the Incubator to warm up to the set point temperature setting (34°C); it should take less than 30 minutes, nominal. When the temperature display has stabilized, the number of HEATER POWER indicator lamps illuminated will typically be reduced to no more than two. Check that the digital display remains within 0.5°C of set point for 15 minutes after Temperature Equilibrium has been reached.

6. CHECK OPERATION OF OBSERVATION LIGHT. The Observation light is turned on and off by the ON-OFF switch located in the center of the light housing. The light is mounted on flexible tubes and may be positioned as required. The light should be turned off between uses to extend battery life. The light will not operate if the Battery Tray is not inserted.

7. CHECK THAT THE INCUBATOR SWITCHES FROM AC TO DC OPERATION by disconnecting the AC power cord. The unit should continue to operate, and maintain set point, and the DC POWER MODE indicator should light.

> WARNING: When disconnecting the Battery Tray to test the POWER FAILURE alarm, avoid contact with internal components of the battery charger. The components may be hot enough to cause burns.

8. CHECK POWER FAILURE ALARM by disconnecting external AC and DC power from the Incubator; slide the Battery Tray out approximately two inches to disconnect the internal batteries. The POWER FAILURE lamp on the Controller should light and a steady audible alarm should sound. The alarm should terminate when power is restored or the CONTROLLER OFF switch is depressed.

9. CHECK HIGH TEMPERATURE ALARM as follows:

   A. Depress the SET TEMP switch, the SET POINT indicator should light and a short "beep" should be heard indicating that the temperature display is indicating set point.

   B. Within 15 seconds after performing step A, simultaneously depress and hold both the raise (△) and lower (▽) switches and observe the temperature display.

   C. When the temperature display indicates 40.0°C, release the raise and lower switches.

   D. Allow the Incubator to heat up.

   E. The displayed Incubator temperature should be 39°C ± 1°C when the High Temperature alarm activates. The HIGH TEMP indicator should flash, an intermittent audible tone should sound, and the heater and HEATER POWER indicators should turn off.

      NOTE: The actual Incubator Temperature may not necessarily correlate to display temperature, within 1.0°C during this test.

F. Turn the Incubator off by depressing the CONTROLLER OFF switch and then setting the AC POWER switch to the OFF-O position unless battery charging is required.

IMPORTANT: The CONTROLLER OFF switch only removes power from the control electronics. To remove main AC power from the Incubator, the AC POWER switch on the power chassis must be set to the OFF-O position.

10. THE ELECTRICAL CHECKOUT IS COMPLETE.

2.6.2 MECHANICAL CHECKOUT

1. CHECK FRONT AND HEAD END ACCESS PANELS. Rotate access panel latches (Figure 2.7 and open the access panel. Pivot the access panel to the full open position (hanging straight down).

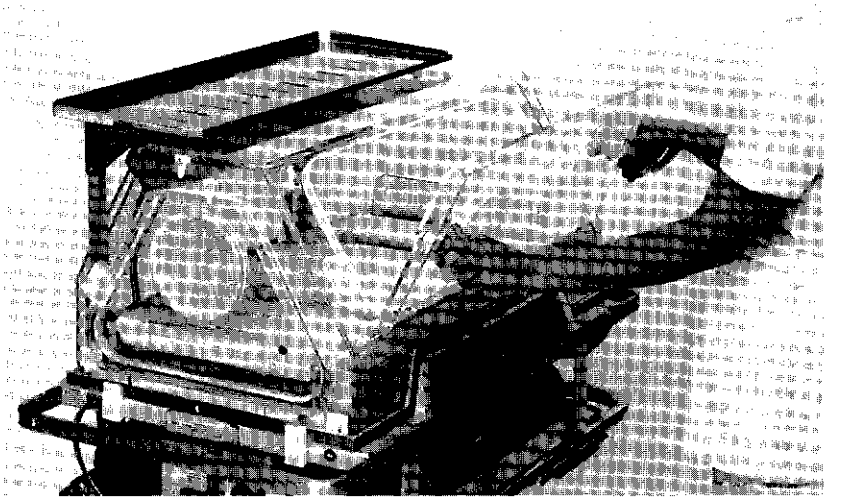


FIGURE 2.7 ACCESS PANEL OPERATION

2. CHECK SHELL LATCHES AND RUBBER HOOD RETAINERS. Check the shell latches and rubber hood retainers (Figure 2.8). All four latches should be properly secured and both rubber hood retainers should be free from cracks and intact.

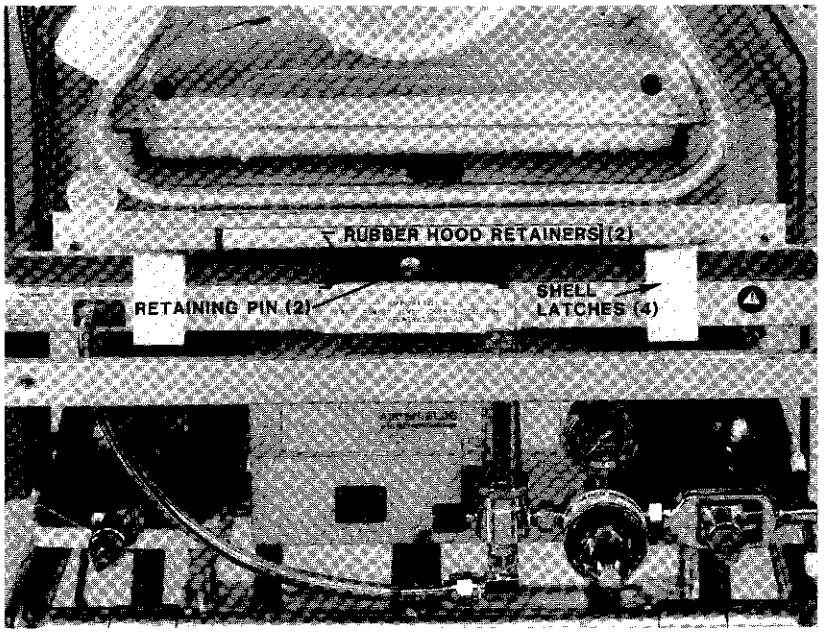


FIGURE 2.8 SHELL LATCHES AND RUBBER HOOD RETAINERS

3. CHECK FRONT AND HEAD END ACCESS PANEL LATCHES by closing the access panels and rotating the latches until fully engaged. The latches must be fully engaged to avoid accidental opening of the access panels.

4. CHECK MATTRESS TRAY. Open the Head End Access Door. Slide the tray out of the Incubator until it reaches its mechanical stop (Figure 2.9). Check that the tray is stable when force is applied to the extended portion. Return the mattress tray to the Incubator. Check that the restraining straps are in good working order. Close the access door.

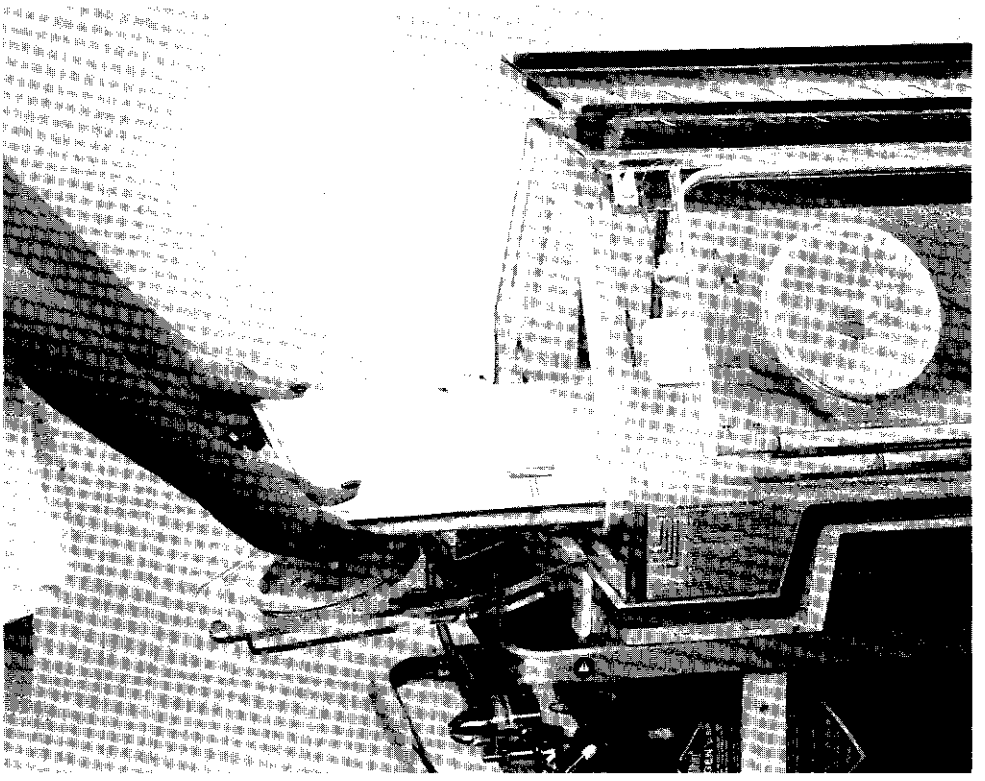


FIGURE 2.9 MATTRESS TRAY OPERATION

5. CHECK THE CONDITION OF THE AIR FILTER by first loosening the two thumbscrews on the air filter cover (Figure 2.10) and then remove the cover. Remove the filter, if the filter is visibly dirty it should be replaced.

> WARNING: A dirty air intake filter may affect the oxygen concentrations and/or cause carbon dioxide buildup. The filter must be checked on a routine basis and changed at least every three months.

FIGURE 2.10 AIR FILTER AND COVER

6. CHECK AIR/OXYGEN SYSTEM. Connect the output of a flowmeter to the OXYGEN INLET connector on the left side of the Incubator using 3/16-inch ID surgical tubing. Introduce 6 LPM of oxygen, then monitor levels within the hood to verify that they reach the predicted levels as indicated on the Oxygen Concentration Guide located on the front lower left side of the hood.

7. MECHANICAL CHECKOUT IS COMPLETE.

IMPORTANT: Upon satisfactory completion of the Operational Checkout Procedure, the Transport Incubator should be connected to an AC power source with the Main AC POWER switch on the Power Chassis set to the ON-1 position to maintain the batteries at full charge.

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SECTION 3
TECHNICAL INFORMATION

3.1 SPECIFICATIONS

Specifications for the Air-Shields® Transport Incubator, Model TI100 are provided in Table 3.1. The use of infant seats, head hoods, or other accessories within the Incubator which can alter the air flow pattern may affect temperature uniformity, temperature variability, the correlation of the Incubator temperature reading to center mattress temperature and infant skin temperature. All specifications are subject to change without notice.

TABLE 3.1 SPECIFICATIONS

ELECTRICAL	
EXTERNAL POWER REQUIREMENTS:	
Model TI100-1:	
AC	110/120VAC 50/60 Hz, 170/200 Watts and 225/270 Watts with batteries charging.
DC	12 VDC, 115 Watts*
Model TI100-1E:	
AC	220/240VAC 50/60 Hz, 170/200 Watts and 225/270 Watts with batteries charging.
DC	12 VDC, 115 Watts*
Model TI100-1E:	
AC	100VAC 50/60 Hz, 170 Watts 225 Watts with batteries charging.
DC	12 VDC, 115 Watts*
INTERNAL BATTERY SPECIFICATIONS:	
Type	Gel Type, Sealed and rechargeable.
Voltage	12 VDC (nominal).
Quantity	2
Charging Time (from full discharge)	Two batteries: 20 hours.
Life Expectancy	Minimum 200 full charge/ discharge cycles.
Battery Performance	See Figure 3.1.
CHASSIS LEAKAGE CURRENT	100 uA or less.

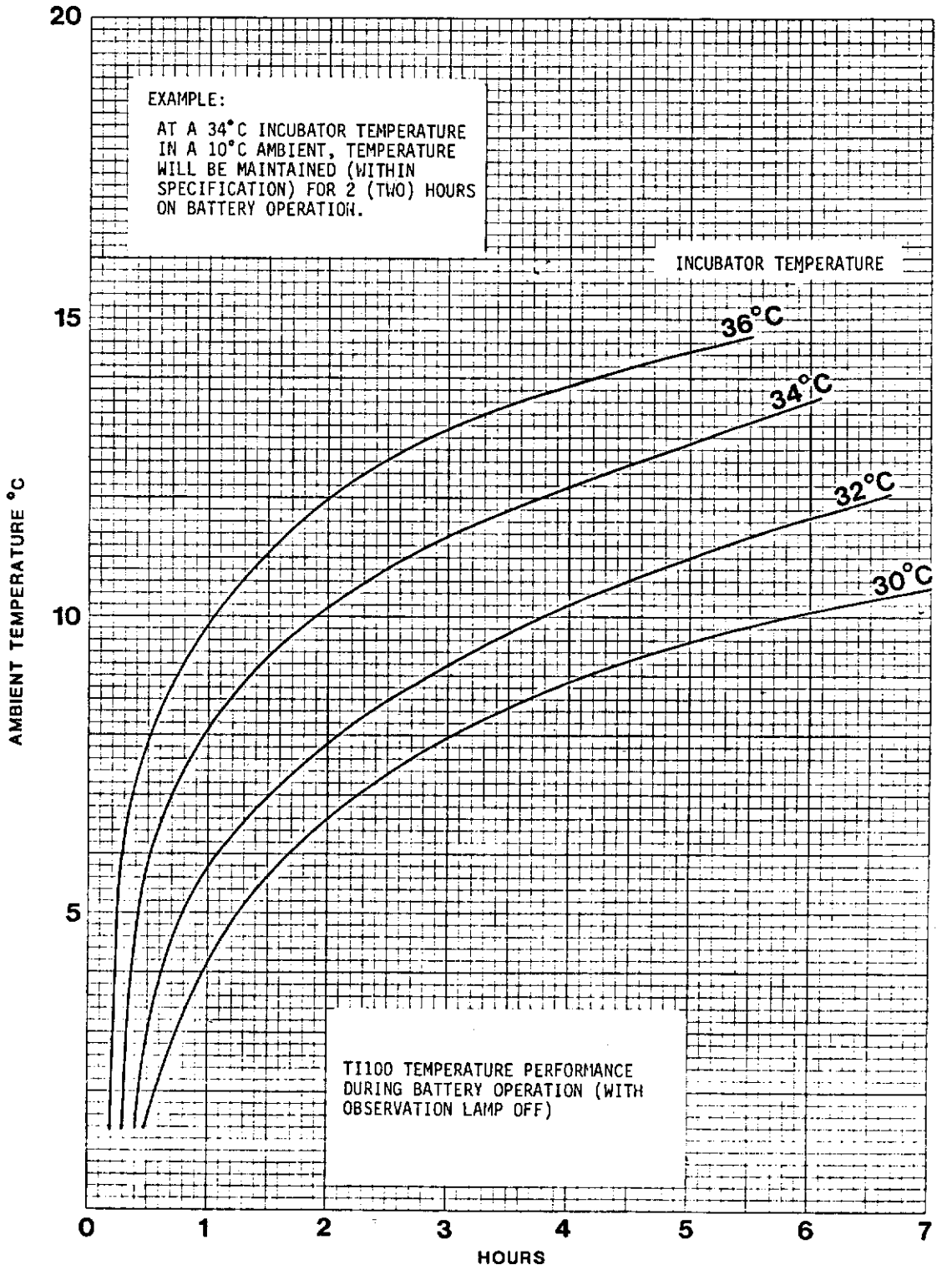


FIGURE 3.1 BATTERY LIFE CURVE

TABLE 3.1 SPECIFICATIONS (CONT.)

ELECTRICAL (CONT.)	
ALARMS:	
HIGH TEMP	Actuates at Displayed Incubator Temperature of 39 ± 1.0°C.
SENSOR	Actuates if HIGH TEMP alarm sensor is electrically open or shorted.
POWER FAILURE	Actuates if main AC power fails and no DC back-up power is present.
HEATER TEMP	Actuates if heater temperature exceeds 77°C (nominal).
LOW DC	Actuates if Incubator DC voltage has fallen below 10.5 VDC (nominal).
TEMPERATURE SET POINT RANGE	21.5°C ± 1.0°C to 38°C.
TEMPERATURE RISE TIME**	30 minutes.
TEMPERATURE VARIABILITY**	0.2°C
TEMPERATURE OVERSHOOT**	1.5°C maximum.
TEMPERATURE UNIFORMITY**	1°C
CORRELATION OF DISPLAYED INCUBATOR TO ACTUAL INCUBATOR TEMPERATURE** AT TEMPERATURE EQUILIBRIUM**	1°C
CORRELATION OF DISPLAYED INCUBATOR TEMPERATURE** TO SET POINT AT TEMPERATURE EQUILIBRIUM**	±0.5°C
OBSERVATION LIGHT OUTPUT	10 foot candles at mattress level.

TABLE 3.1 SPECIFICATIONS (CONT.)

ENVIRONMENTAL	
RELATIVE HUMIDITY (TYPICAL)	50% - 70% at 6 LPM Flow Rate.
OXYGEN CONCENTRATION RANGE	21% to at least 58%.
NOISE LEVEL WITHIN HOOD ENVIRONMENT	Less than 65 dBA.

MECHANICAL	
NOMINAL DIMENSIONS (With Stand):	
Length	102 cm (40.25 in.)
Width	56.5 cm (22.25 in.)
Height	118.7 cm (46.75 in.) maximum 88.3 cm (34.75 in.) minimum
NOMINAL WEIGHT (Including Hood, Stand, and Batteries)	86.7 kg (191 lbs.)
NOMINAL WEIGHT, BATTERY TRAY, WITH BATTERIES	22.7 kg (50 lbs.)

* At full heater power with observation lamp operating.

**Refer to Table of Definitions.

3.2 THEORY OF OPERATION

3.2.1 SYSTEM FUNCTIONAL DESCRIPTION

Refer to Figure 3.2. The control of temperature, humidity, and oxygen concentration is achieved by means of a forced air circulation system. A controlled amount of room air is drawn through the air/oxygen intake filter by means of a motor driven impeller. Supplemental oxygen which is introduced through the Oxygen Inlet Connector on the left side of unit displaces a portion of room air to maintain the total gas intake (including oxygen) at the same level. Since the amount of room air is controlled by the impeller/filter characteristics and the amount of oxygen is controlled by the flowmeter setting, predictable oxygen concentration within the Incubator can be attained.

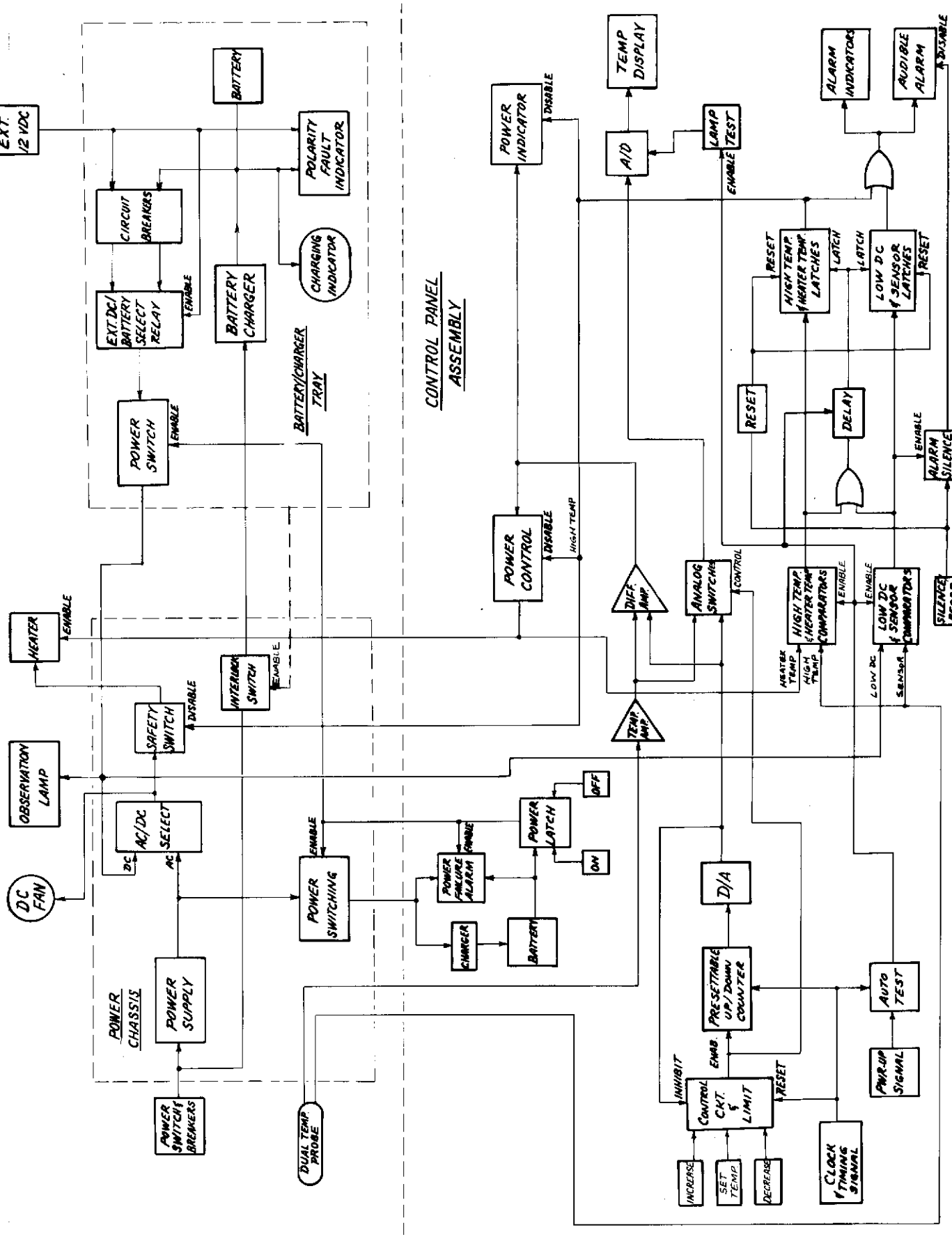
In addition to drawing fresh filtered air into the Incubator, the impeller provides an internal recirculation at a much greater flow than that of the fresh gas inflow. The air is directed over the humidity reservoir for humidification. When the access panel of the hood is closed, the air enters the infant compartment up through the slots at the right end of the housing. After circulating within the infant compartment, the air is then recirculated down the left end of the housing, past the temperature sensing probe and back to the impeller.

The Air-Shields® Model TI100 Transport Incubator is designed to operate from one of three power sources which may be connected to the Incubator simultaneously. Power selection is determined in the following priority sequence: external AC, external DC, or internal battery. If a higher priority source is connected to the unit during operation from a lower priority source, the unit will automatically switch to the higher priority power source. Conversely, if a higher priority source is disconnected, the unit will automatically switch to the next lower priority source.

3.2.2 TEMPERATURE CONTROL

Incubator Temperature is regulated by means of a temperature sensor, located in the recirculation air path, and a proportional control circuit which determines the heater output required to maintain the desired Incubator Temperature. The relative amount of heat provided is indicated by the number of HEATER POWER lamps lit on the control panel.

The Incubator Temperature can be maintained from 21.5°C to 38°C as selected by the temperature controls on the control panel. The temperature as sensed by a sensor located within the housing is compared with the set point. The information from this sensor is supplied to the heater control circuitry which proportions the heater output to maintain the set point. The temperature is displayed on the front panel


EXT. 12 VDC
BATTERY
POLARITY FAULT INDICATOR
CIRCUIT BREAKERS
CHARGING INDICATOR
EXT. DC/ BATTERY SELECT RELAY
ENABLE
BATTERY CHARGER
BATTERY/CHARGER TRAY
POWER SWITCH
ENABLE
CONTROL PANEL ASSEMBLY
POWER INDICATOR
DISABLE
TEMP DISPLAY
A/D
LAMP TEST
ENABLE
ALARM INDICATORS
AUDIBLE ALARM
DISABLE
RESET
HIGH TEMP HEATER TEMP LATCHES
LATCH
LOW DC SENSOR LATCHES
RESET
RESET
DELAY
ENABLE
ALARM SILENCE
POWER CONTROL
DISABLE
HIGH TEMP
DIFF. AMP.
ANALOG SWITCHES
CONTROL
HEATER
ENABLE
INTERLOCK SWITCH
ENABLE
SAFETY SWITCH
DISABLE
HIGH TEMP HEATER TEMP COMPARATORS
ENABLE
LOW DC SENSOR COMPARATORS
ENABLE
HEATER TEMP
HIGH TEMP
LOW DC SENSOR
TEMP. AMP.
OBSERVATION LAMP
AC/DC SELECT
DC
AC
DC FAN
POWER SWITCHING
ENABLE
POWER FAILURE ALARM
ENABLE
POWER LATCH
OFF
ON
CHARGER
BATTERY
D/A
POWER CHASSIS
POWER SUPPLY
PRESETTABLE UP/DOWN COUNTER
AUTO TEST
INHIBIT
ENAB.
CONTROL CKT. & LIMIT
RESET
PWR-UP SIGNAL
CLOCK & TIMING SIGNAL
INCREASE
SET TEMP.
DECREASE
POWER SWITCH BREAKERS
DUAL TEMP PROBE

temperature display. The initial set point is preset to 35°C ± 0.1°C and the Incubator will heat to this temperature unless the setting is changed. The set point can be changed to a prescribed temperature by using the SET TEMP controls on the control panel. An additional sensor within the housing serves as a backup to limit the Incubator maximum air temperature to 40.0°C; at this limit an alarm is activated and the heater is shut off.

3.2.3 ALARMS

Each time the unit is turned on, the unit automatically activates a test sequence to verify that the visual display and the audible alarm are functional.

HIGH TEMPERATURE ALARM. A sensor located below the deck sounds this alarm and Incubator Temperature is limited to less than 40°C. A high temperature alarm is indicated by a flashing light and an intermittent audible tone. This alarm is non self-resetting and cannot be cancelled by the SILENCE/RESET switch until the alarm condition is corrected.

SENSOR ALARM. Circuitry is provided to monitor the high temperature alarm sensor for shorted or open condition. A SENSOR alarm is indicated by a flashing light and an intermittent audible tone. This alarm is non self-resetting and it cannot be cancelled by the SILENCE/RESET switch until the sensor is replaced; however, an open sensor alarm may be silenced by the SILENCE/RESET switch for a nominal 5 minutes. If a HIGH-TEMP alarm occurs simultaneously with a SENSOR alarm a shorted probe is probably the true cause of the alarm since a shorted probe will appear as a high temperature condition.

HEATER TEMPERATURE ALARM. The HEATER TEMP alarm flashes and an intermittent audible tone sounds to indicate that the heater temperature has exceeded a predetermined temperature. When this condition occurs, the heater and HEATER POWER indicator are turned off.

LOW DC ALARM. The LOW DC alarm flashes and an intermittent alarm sounds to indicate that the Incubator DC power source has fallen below a predetermined value. If operation is continued, the POWER FAILURE alarm indicator will begin to glow when battery voltage drops sufficiently. The audible alarm may be silenced by the SILENCE/RESET switch for a nominal 5 minutes.

POWER FAILURE ALARM. The POWER FAILURE alarm circuit is powered by a separate internal battery. The alarm indicator lights and a continuous tone sounds if AC power is lost and no DC back-up power is present.

3.2.4 ADJUSTABLE STAND (ACCESSORY)

The Adjustable Stand is designed to provide a convenient means of moving the Transport Incubator. The stand is adjustable to three height positions, and is designed to lock into the litterbar latch of an ambulance.

3.3 DETAILED THEORY OF OPERATION

3.3.1 POWER CHASSIS AND SYSTEM (FIGURE 7.1)

Primary AC power is connected to AC receptacle (2J1). This input voltage is passed to the main AC power switch (2S1) via the three (3) amp circuit breaker(s).

Power switch, 2S1, is the master power switch for the TI100 Incubator and delivers the line voltage to terminal block (2TB1) for distribution to the power transformer (2T1) and interface connector (2J2) via interlock switch (2S2). Line filter (2FL1) and line chokes (2L1 and 2L2) reduce conducted noise on the power lines. The interlock switch is provided to remove AC line voltage from interface connector (2J2) if no battery pack is inserted. AC line voltage is present at 2J2 only if the battery pack is in place.

Power transformer (2T1) provides a nominal 32 volt center-tapped output voltage to terminal block (2TB1).

Chassis battery pack interface connector (2J2) interfaces the battery pack to the power chassis to provide DC operation.

3.3.2 POWER BOARD ASSEMBLY (FIGURE 7.1)

AC OPERATION

The Power Board is located in the Power Chassis and generates the power supply voltages required to operate the Control Board. It also contains the relays necessary to switch the relatively high heater current.

1CR1, 1CR2, 1CR3 and 1C1 rectify and filter the transformer secondary voltage and provide a DC input voltage to the 1VR2 and 1VR3 12 volt voltage regulators. Two (2) regulators are used to divide the power dissipation so that both regulators can use the chassis for heatsinking.

Outputs of the regulators are switched through Power Relay 1K1 which is activated by a signal from the Control Board. This is possible since selected circuitry on the Control Board is kept active by the output of 1VR2 which is presented to Terminals 11 and 12 of the Interface Connector 1J1. The outputs of 1VR2 and 1VR3 are active as long as the chassis master AC Power switch is on.

When Power Relay 1K1 is activated, activating AC/DC Select Relay 1K2, 12 volt power is supplied to Pins 7, 8, 13 and 14 of the Interface Connector 1J1.

Relay 1K2 (via 1J7 and 1J8) also provides full wave rectified power from 1CR1 and 1CR2 to the heater through Heater Disable Relay 1K3. Relay 1K3 is controlled by a signal from the Control Board.

Relays 1K1 and 1K2 also provide power to the DC fan motor through 6V Regulator 1VR1. The 6 VDC supply runs the fan at a nominal 2600 RPM. Diodes 1CR8 and 1CR9 divide the fan motor load between Regulators 1VR2 and 1VR3. Capacitors 1C6 and 1C7 reduce conducted fan noise to meet EMI/RFI requirements.

DC OPERATION

The Power Board is also compatible with DC power operation. DC power is provided by a battery pack which interfaces to the Power Board through 1J6.

Selected circuitry on the Control Board is kept active through 1CR7. When Relay 1K1 is activated from the Control Board, Relay 1K2 remains inactive since no AC power is present and no voltage is present at the outputs of Regulators 1VR2 and 1VR3. Battery power is then presented to Pins 3, 4, 7 and 8 of the Interface Connector 1J2. Battery power is also provided to the heater through Heater Disable Relay 1K3.

3.3.3 CONTROL BOARD ASSEMBLY (FIGURE 7.2)

BRIDGE AMPLIFIER

Sensor 2TR1-b of the dual thermistor probe measures the incubator hood temperature and forms part of a bridge circuit consisting of R54, R55, R56, R57 and R58. Bridge output voltage is amplified by bridge amplifier U16-A. This amplifier provides gain and linearization for the thermistor probe's output.

Nominal range of output voltage is 2V to 4V for a 20°C to 40°C temperature range. This corresponds to a sensitivity of 100mV/°C.

DIFFERENTIAL AMPLIFIER

Temperature information from the probe amplifier is presented to one input of differential amplifier U16-C. This amplifier compares the probe temperature information with the temperature reference voltage from the set-point temperature circuitry. The output of the differential amplifier is a voltage proportioned to the difference between the measured temperature and the set-point temperature reference. The gain of 50 provides an output sensitivity of 5V/°C.

The output from this amplifier provides the input to the power control circuit and the heater power indicator circuitry.

TEMPERATURE SET-POINT CIRCUITRY

The output of the temperature set-point circuit is biased to provide the same output range as the bridge amplifier. This voltage establishes the reference temperature for the temperature control circuitry.

Two functional blocks make up the main part of this circuit: pre-settable up/down counter (U13, U14 and U12-A) and D/A converter (RN1 and U16-B & D). Control over this circuit is provided by the "Set Temp" switch (S3), and temperature "Increase" and "Decrease" switches (S4 and S2, respectively). These switches work in conjunction with the control and limit circuitry (comprised of U15-A & D, U8, U11-A, B & C, U6-A & C and U23-B) to establish the incubator's control temperature.

The binary output of the pre-settable up/down counter is converted to an analog voltage by R/2R ladder network (RN1). Output of the ladder network is buffered by U16-B so as not to load the relatively high impedance output of RN1. The voltage at U16-7 ranges from 0V to 5V for counter outputs of binary 0 to binary 512. U13 and U14 form an 8-bit binary counter. Flip-flop U12-A adds a 9th bit for better resolution. These nine bits give a resolution of:

$$\text{RESOLUTION} = \frac{T_{MAX} - T_{MIN}}{2^9}$$

$$\text{RESOLUTION} = \frac{40° - 20°C}{512}$$

$$\text{RESOLUTION} = .039°C/BIT$$

This is an adequate resolution since the resolution of the temperature display is only 0.1°C.

The 0V to 5V output voltage of the D/A converter must be converted to a 2V to 4V range to be compatible with the bridge amplifier output. This is done using amplifier U16-D as a non-inverting summing amplifier which adds a DC bias voltage to the D/A output to obtain the desired output voltage range. R33 is adjusted to provide a nominal 1.25V at the junction of R33 and R32.

The incubator is set to 35.0°C at power-up by a pulse on U13-1, U14-1 and U12-6. This sets the counter outputs to a predetermined state equivalent to a 35.0°C set-point temperature. R24 and C19 form a "deglitching" filter to guard against a spurious "carry-out" signal from the U14 counter.

Control over the counters is provided by output U23-6. The 9Hz nominal clock to the counters is always running. U23-6 is normally high, disabling the counters. Output U23-6 is controlled by three inputs:

- Read/Set Latch Output (U6-11)
- Increase/Decrease Switches (U11-10)
- Limit Circuit Output (U8-11)

All three inputs must be high in order for the counters to be enabled. Thus pressing either the "Increase" or "Decrease" switch cannot change the set-point temperature unless the Read/Set latch (U6-A & D) has been set by pressing the "Set Temp" switch (S3) first. Assume Limit circuit output (U8-11) is high for the time being. To change the set-point temperature, the "Set Temp" switch (S3) is pressed. This initiates a timer, lights "Set-Point" indicator (DS10) and displays the temperature set-point on the digital temperature display. If nothing else is done, the timer will time out and the display will automatically revert to indicating the hood temperature after about 15 seconds. If, after pressing S3, it is desired to change the temperature set-point, either S2 or S4 is pressed and held until the desired temperature set-point is indicated on the display. If reaching the desired temperature takes longer than the 15 second automatic timeout, U11-10 "locks-out" the timeout pulse and maintains the display in the temperature set-point mode until the "Increase" or "Decrease" switch is released.

Latch U11-A & B is the counting direction latch and its outputs are coupled to the Limit Circuitry and to the up/down input of the counters. The state of the counter's up/down input determines the direction of counting, increasing or decreasing.

End-point Limit Circuitry consists of U15-A & D and U8-A, B & D. This is required to provide high and low temperature set-point limits and to prevent the counter from "rolling over" when maximum and minimum counts are reached.

Comparators U15-A & D monitor D/A converter output voltage at U16-7. R31 is set to obtain a maximum control temperature limit of 38.0°C while the voltage at U15-13 is chosen to provide a minimum set-point of about 22.0°C. When either of these extremes is reached, output U8-11 goes low, disabling the counter via U23-6. Signals at U8-2 and U8-6 from the up/down latch force the state of U8-11 high again so that if a limit is reached, the direction of count may be reversed.

The 38°C limit may be overridden to perform an incubator high temperature ring-out test. First press the "Set Temp" switch and then the "Increase" and "Decrease" switches simultaneously; under these conditions, a temperature set-point of 40°C may be achieved.

A/D CONVERTER AND TEMPERATURE DISPLAY

Temperature data from bridge amplifier output (U16-1) and D/A converter output (U16-14) is fed to the A/D converter via analog switches U32-B & C.

Which of these switches is selected is controlled by the outputs of the Read/Set latch (U6-A & D) which forms part of the control circuitry to be discussed in more detail later.

A/D converter (U20) is a multiplexed output A/D, thereby reducing display power consumption considerably. Input voltage to the A/D is reduced by a factor of 10 by R69 and R70 since the A/D can only operate for input voltage from 0 to 999mV. C31 filters the A/D input voltage for stable display readings.

The A/D presents BCD information to the BCD to seven segment decoder/ driver (U18) which drives the cathodes of the temperature display (DS7 through DS9). The anodes of the display are driven by the digit strobe outputs (U20-3, 4 and 5) of the A/D through drive transistors Q7, Q8 and Q9.

Analog switches (U19) provide the display lamp test function during the Auto-Test cycle at power-up. R61 and R76 allow A/D calibration.

Pin 6 of the A/D is the "hold" input which, if biased properly, holds the display reading to the last converted number. Diodes CR14 and CR15 provide this 1.2V bias voltage. NOR gate U7-D provides control over the "hold" mode. This input is used to eliminate display flickering when the temperature is at a transition point. Output U7-11 is normally high, keeping the A/D in the "hold" mode. Every few seconds, a pulse is provided through C26 which forces U7-11 low and updates A/D temperature information. Duration of this pulse is determined by the C26 and R63 time-constant.

When the display is used to indicate the set-point temperature, this "hold" mode must be overridden to provide fast response during the temperature setting operation.

Components CR13, R46 and C16 provide control of the hold input during the "Set-Point" temperature mode. When the set-point temperature is being displayed, the anode of CR13 goes high, forcing U7-11 low. This puts the A/D into the fast-conversion mode to allow temperature setting. R46 and C16 provide a delay after the anode of CR13 goes low again. This delay keeps U7-11 low and allows time for the analog switches to change and for the A/D to convert the hood temperature and display it rather than holding the control temperature on the display for a few seconds before the hood temperature is again displayed.

READ/SET CONTROL LATCH

The temperature shown on the digital display is selected by the Read/Set latch (U6-A & D). In its normal state, the latch selects the hood temperature to be displayed by keeping U32-5 high. Control temperature is displayed on demand either during the Auto-Test cycle or by pressing the "Set Temp" switch (S3).

The control temperature is displayed until the latch is reset by a low level at U6-1. This happens at power-up via U7-1 and when U7-2 goes high (about 14 seconds after "Set Temp" switch (S3) is pressed) or when switches S2 or S4 are released.

POWER CONTROL CIRCUITRY

The 5V/°C output from the differential amplifier provides the input for the power control circuit at U2-5. This circuit consists of a 555 timer configured as a pulse width modulator whose function it is to provide an output duty cycle proportional to the voltage at its input. Components R9, R10, R11 and Q4 form a constant current source to charge capacitors C12 and C13 linearly. This provides an output duty cycle linear with input control voltage. U2 output (Pin 3) is set high by the trigger pulse occurring approximately every 106mS at U2-2. THe output remains high until the voltage at U2-6 equals the control voltage at U2-5. At that time, U2-3 goes low and C12 and C13 are discharged. The output stays low until again forced high by the trigger pulse at U2-2. When the output is high, the heater is energized.

Resistor R12 provides an offset at U2-6 preventing Pin 6 from going to ground potential when C12 and C13 are discharged. This allows a lower minimum duty cycle than would be possible if R12 were not used.

U11-D provides trigger pulses, as well as providing a means to shut down heater power if the "High Temp" alarm activates. When the "High Temp" alarm activates, U11-11 goes high and holds U2-2 and 4 low. This keeps the output in the low state, disabling the heater.

The "High Temp" and "Heater Temp" alarm outputs also deactivate Q6 via gate U4-D which disables relay 1K3 on the power board and removes power from the heater.

HEATER POWER INDICATOR

Output of the differential amplifier is also fed to the heater power indicator circuitry consisting of four comparators (U27), their reference voltage resistors (R102, R104, R106, R109 and R112) and "Heater Power" indicator (DS13).

Gate U26-B pulls all comparator signal inputs low via the disable line when the "High Temp" and "Heater Temp" alarm activates. This shuts off all indicators in DS13 and indicates that heater power has been shut off due to the "High Temp" and "Heater Temp" alarms activating.

Gate U26-A pulls the comparator reference voltage to ground during Auto-Test via the ENABLE 2 line. This lights all indicators in DS13 to provide the lamp test function.

ALARM COMPARATORS AND CONTROL

Alarms are provided for:

- Hood and heater over-temperature conditions ("High Temp" and "Heater Temp");
- Open and shorted safety sensor ("Sensor");
- Low battery or external DC voltage ("Low DC");
- Loss of incubator power ("Power Failure").

The alarm circuitry is tested during the Auto-Test cycle by analog switches, U32 and transistors Q2, Q10 and Q12. When these switches are enabled during Auto-Test, they simulate the alarm conditions and activate all alarm circuits.

High Temperature and Heater Temperature Alarms

High temperature alarm condition is detected by comparator U24-C and is set by R103. High heater temperature detection is done by components CR17, CR18, R126, C42, Q13 and R124. CR17, CR18 and C42 form a peak detector circuit with Q13 acting as a level comparator, comparing its base voltage to its emitter voltage. As long as the heater is operating normally, the voltage at the base of Q13 is below the approximate 4.4V threshold voltage. This keeps Q13 turned on and the collector high. If the heater's thermal cutout were to open indicating a high heater temperature, the voltage at the base of Q13 rises and turns Q13 off. Q13's collector then goes low, indicating a high heater temperature.

The Heater Temperature comparator output is inverted by U31-B and is presented to the "D" input of latch U5-B. The high temperature comparator output connects to the "D" input of latch U5-A. Both comparator outputs are also presented to two inputs of alarm detection gate U36-A whose output resets the timer circuitry (to be discussed later) via reset gate U23-A. The alarm condition will not be passed to the alarm latches until U30-9 goes high, forcing U34-1 high about seven seconds after an alarm occurs. This guards against false alarms due to momentary level transitions. If the alarm condition clears before the seven second time period, U34-4 goes high again and no alarm will sound.

This alarm delay is bypassed during Auto-Test cycle. If the alarm condition is still present after the delay, the appropriate alarm latch of U5 will activate. This enables the corresponding alarm indicator driver of U9 and its associated indicator, DS2 or DS3. The alarm signal is gated with a square wave from the clock circuitry to flash the indicators at a 1.2Hz frequency.

Both outputs are gated through U4-D to disable the heater and heater power indicators via Q28 and U26-B, respectively. Either alarm also enables the audible alarm at a 1.2Hz rate via U4-D, U28-B, U28-C and Q11 until the alarm condition has been cleared and the latches manually reset.

Sensor and Low DC Alarms

An open or shorted safety sensor is detected by comparators U24-D and U24-A, respectively.

Resistors R82 and R83 determine at what input voltage the "Low DC" comparator (U24-B) switches. The ratio is selected to give alarm activation when battery voltage is 10.5VDC nominal. C36 provides filtering to give accurate alarm activation. The "Low DC" comparator output is gated with the "AC ON" voltage via U21-D and U29-D so as not to give a "Low DC" alarm if the battery pack is removed from the incubator while the unit is operating on AC power.

The comparator outputs are presented to the alarm latches and reset gate as before and operate in a similar manner.

Latch outputs enable the appropriate alarm indicator, DS5 or DS6, via driver U10. The indicators flash at a nominal 1.2Hz rate.

Both latch outputs are gated through U4-C to enable the audible alarm via U28-A, U28-C and Q11. The audible alarm is enabled about 0.5 seconds every 14 seconds for the "Low DC" and "Sensor" alarms.

Power Failure Alarm

Power Failure alarm circuitry consists of Q3, R6, R7, CR6 and CR5. Q3 acts as a comparator which compares its base voltage to its emitter voltage. When incubator power (AC or DC) is present, PFA battery (connected at J2) charges through resistor R7 and diodes CR5 and CR6. Power latch output U1-4 enables the PFA when low. If incubator power fails, CR6 becomes reverse biased and R6 turns on Q3. Q3's collector then provides supply voltage V1 to the audible alarm and lights "Power Failure" indicator (DS4). The audible alarm energizes due to the disappearance of the +5V logic power supply.

The PFA is silenced by depressing Controller "OFF" switch (S5) which resets the power latch and turns off Q3 via R6.

Audible Alarm

The audible alarm consisting of U3, DS1, R15, R16, CR10, CR11 and C14 is a free-running oscillator. A low level at U3-3, 5 and 7 disables the oscillator. U28-10 is normally high due to low levels at U4-11 and U4-10. The alarm is disabled during Auto-Test via R110.

The audible alarm is also enabled momentarily when the "Set Temp" switch (S3) is pressed, alerting the user that the set-point temperature is being displayed on the digital display. This is done on the leading edge of the Read/Set latch transition via flip-flop U35-B. U35-B is configured as a monostable whose output (Pin 13) enables the audible alarm for about 53mS via gate U28-C.

During calibration, TP8 and TP9 are shorted. This causes the audible alarm to be enabled for 53mS when the "High Temp" alarm level is calibrated via R103.

Alarm Silence and Reset

Switch S1 performs both the alarm reset and alarm silence functions.

The alarm latches are reset after Auto-Test via U4-A, Pin 1, and at power-up by C115. The latch reset is enabled by the signal at U4-6. If the alarm condition has cleared, the latches are reset when S1 is pressed. If the alarm condition is still present, no reset occurs. However, if the alarm condition is either the "Open Sensor" or "Low DC" alarm or both, the audible alarm may be silenced for about five minutes via the alarm silence circuitry consisting of U36-B, U33, U37-A & D, U35-A and U23-D. The timer is non-resettable and cannot be reactivated until the five minute time period has elapsed.

The timer is held disabled by a high level on U35-4 as long as no alarm is present. The timer is enabled via U23-D when an alarm occurs. If the alarm is either a "Sensor" or "Low DC" alarm or both, it is detected by U29-B which enables U36-B. If the Silence/Reset switch (S1) is then pressed, counter U33 is reset and flip-flop U35-A is set. This disables the audible alarm via U28-8 and enables U37-D. When the outputs of counter U33 both go high, U35-A receives a clock signal, toggling the flip-flop and terminating the alarm silence.

If the "Sensor" and "Low DC" alarm condition terminates during the alarm silence period, the alarm silence timer is reset via U23-12. Likewise, if the "Sensor" alarm condition occurs while the "Low DC" alarm is silenced or vice-versa, the alarm silence will be reset indicating that a second alarm condition has occurred. This is done by gate U30-D.

CLOCK AND TIMING CIRCUITRY

All delay and timing signals are derived from a master 150Hz nominal clock oscillator consisting of components U21-E & F, R91, R92 and C27. This base frequency is counted down by binary counter U17. U17 provides:

- 9.4Hz frequency to increment the set-point temperature up/down counters, provide trigger pulses to the power control circuit and modulate the "High Temp" and "Heater Temp" audible alarm.
- 2.4Hz signal used with a 14 second period output to terminate the Auto-Test, provide the alarm delay and enable the "Sensor" and "Low DC" audible alarm.
- 1.2Hz alarm flash and audible alarm enable signal.
- 0.3Hz signal to update the A/D converter every 3.5 seconds.
- 28 second period clock for the alarm silence circuit.

U6-B & C form a latch which acts as a 14 second monostable to reset the set-point latch (U6-A & D).

When an alarm occurs, U36-1 goes low. This high to low transition is coupled to U23-1 through C34 and resets U17. When U17-15 goes high after seven seconds, U34-B generates a 0.4 second long low pulse which clocks U34-A via U30-C, providing a clock pulse to the alarm latches at U5-9.

A counter reset is also initiated by the set-point temperature display cycle. Pressing "Set Temp" switch (S3) sets the Read/Set latch whose output pulls U23-8 low, causing a counter reset. The counter cycles through until U17-1 goes high after 14 seconds, resetting the Read/Set latch via U6-B & C. During the 14 second cycle, the "Set-Point" indicator is lit and the display shows the temperature set-point.

AUTO-TEST CYCLE

The Auto-Test cycle is initiated when power is first applied to the control panel.

A power-up signal is provided by C41, R123 and U31-A & C. This power-up pulse initiates several functions:

- Sets Read/Set latch to "Read" mode;
- Sets Auto-Test latch (U30A & B);
- Resets counter U17 via U23-2.

Setting of the Auto-Test latch at power-up:

- Activates analog switches U19 to provide reading of 88.8°C on temperature display;
- Disables U26-B and prevents the "High Temp" alarm from blanking the "Heater Power" indicators;
- Enables U26-A and lights all "Heater Power" indicators;
- Disables audible alarm via R110;
- Activates U32-A & D, Q2, Q10 and Q12 providing the alarm test functions at power-up.

When U17-15 goes high (after about 7 seconds), the Auto-Test latch is reset through U34-B. When this occurs, Alarm-Test switches are disabled and monostable U25-B is triggered. U25-13 output sets Read/Set latch to the "Set" mode, via U8-9, enabling indicator DS10 and displaying the 35.0°C nominal power-up temperature set-point on the temperature display.

The U6-3 output provides a reset signal to counter U17 through U23-8. The alarm latches are reset via U4-1 by the U25-13 output pulse.

The Read/Set latch will remain in this state until U6-10 goes low (about 14 seconds), resetting the latch through U7-A & B. When this occurs, the Auto-Test cycle is complete and the temperature display reverts to normal operation, indicating hood temperature.

POWER CIRCUITRY

Power to the control board is controlled by two switches on the control panel (S5 and S6).

Power latch U1-A & B is powered continuously either by the PFA battery of +12V from the power chassis.

Front panel Controller "ON" switch (S6) sets power latch (U1-A & B) to the "ON" state, enabling Q1 and PFA and providing power to the control board via power board relay 1K1. Controller "OFF" switch (S5) shuts off power to the control panel by resetting the power latch and disabling the PFA.

Regulator VR1 provides 5V power for the digital CMOS circuitry and voltage references. This allows back-up battery operation, if desired.

Two 12V supply inputs are brought to the control board. One powers the operational amplifiers and signal components, while the other powers the components requiring relatively high power (LED's, 555 timer, etc.) via 8V regular VR2. This enables less heat-sinking to be used in the power chassis and also provides noise isolation in the control panel circuitry while giving flicker-free control panel displays.

Set-point retention during power failure is provided by 5V voltage regulator VR3 whose output is maintained during incubator power failure as long as the power latch (U1-A & B) is maintained in the "ON" state.

3.3.4 BATTERY/CHARGER TRAY ASSEMBLY

The Battery Charger Assembly is used to permit charging of gel cell rechargeable batteries whenever primary power (AC) is available. The Battery Charger Assembly essentially consists of a bridge rectifier, a switching-type voltage regulator circuit, and DC circuitry. All references are to the Battery Charger schematic, Figure 7.3.

When the primary power source is applied to the system, AC at the secondary of a transformer located in the Tray Assembly, is applied to Bridge Rectifier (3CR1) which provides unregulated DC for input to the Switching Regulator Circuit. AC is also applied to Relay Coil 4K3 which switches the Charger On and Off. As long as primary power (AC) is applied to the system, Charger Relay 4K3 will be energized. Should the primary power fail or be disconnected from the power source, AC will no longer be supplied to the Battery Charger Assembly; as a result, Charger Relay 4K3 will de-energize and disconnect the circuit between the battery and the Switching Regulator Charging Circuit.

When the primary power source is restored or reconnected, Charger Relay 4K3 will be energized to complete the circuit between the battery and the Switching Regulator Charging Circuit.

The rectified DC output from the Bridge Rectifier (3CR1) is filtered by Capacitor 4CR1 and is applied as DC (approximately 30 VDC) to the emitter of Series Switching Transistor 4Q1.

The Switching Regulator Circuit achieves voltage regulation by varying the ON/OFF duty cycle of Series Switching Transistor 4Q1. Because Transistor 4Q1 is always saturated when conducting and is always cut off when non-conducting (except for the commutation time between ON/OFF states), the power dissipated in the Switching Regulator Circuit is much less than that for a comparable Series-Pass Transistor Regulator Circuit with the same input and output requirements.

Positive Switching Regulator 4U1 controls Switching Transistor 4Q1; Transistor 4Q1 is switched on and off at a relatively high frequency. When 4Q1 conducts at the beginning of the switching cycle, the unregulated DC is applied to an LC filter consisting of Inductor 4L1 and Capacitor 4C3; as a result, current flows through Inductor 4L1 to the load and to charge Capacitor 4C3. When 4Q1 is cut off, the magnetic field which has built up about Inductor 4L1 now collapses; the collapsing magnetic field maintains current flow to the load out through Commutation Diode 4CR7. The voltage input to the LC filter then decreases to zero and the switching cycle is repeated as Transistor 4Q1 is again switched on to saturate and apply DC to the LC filter.

Voltage Regulator 4U1 senses and regulates the output voltage by controlling the Series Switching Transistor 4Q1 duty cycle. If the input voltage increases, Voltage Regulator 4U1 causes a corresponding decrease in the duty cycle to maintain a constant voltage output; conversely, if the input voltage decreases, Voltage Regulator 4U1 causes a corresponding increase in the duty cycle to maintain the voltage output.

Resistor 4R9, Potentiometer 4R10 and Resistor 4R11 form a voltage divider across the output of the Switching Regulator Circuit. Potentiometer 4R10 is normally adjusted to maintain the voltage output of the Switching Regulator Charging Circuit at + 13.8 ± 0.1 VDC. A portion of the DC output voltage taken from Potentiometer 4R10 is fed back through Resistor 4R13 to the inverting input of 4U1, Pin 4. This DC voltage at the inverting input is compared to a reference voltage within 4U1 and, thus, the output voltage is regulated such that the DC voltage fed back to inverting input 4U1, Pin 4, is essentially equal to the internal reference voltage.

A portion of the AC voltage waveform at the input to the LC Filter (4Q1 collector output) is fed back from a voltage divider made up of Resistors 4R4 and 4R5 to the non-inverting input of 4U1, Pin 5. This feedback voltage is added to the internal reference voltage, thereby introducing hysteresis to the comparator input which results in a chatter-free turn-on threshold for Transistor 4Q1.

Current-sensing and current-limiting action is achieved by sensing the DC voltage drop across Resistor 4R7; Resistors 4R6 and 4R8 form a voltage divider across Inductor 4L1 and Resistor 4R7 to provide sense input at 4U1, Pin 3. A voltage-drop comparison is made between the current-limit input at 4U1, Pin 2, and the current-sense input at 4U1, Pin 3, to limit the average load current at the design limit.

As long as the primary power source is applied to the Battery Charger Assembly, Charger Relay 4K3 is energized to connect the Switching Regulator Circuit to the rechargeable batteries.

"Charging" indication is provided by Indicator 4DS1. 4U2 amplifies the voltage across 4R7 by a factor of 10. Output voltage of 4U2 is proportional to charge current. 4Q2 provides power gain to drive 4DS1.

Also contained on the circuit board is the DC switching circuitry to select between external DC and internal battery operation. Relays 4K1 and 4K2 provide this selection. 4K1 is the external DC/battery select relay energized by the presence of an external DC voltage. Diode 4CR9 prevents 4K1 from becoming energized if the external DC polarity should be wrong. If no external DC is present or the voltage is below the sustaining voltage for the 4K1 coil, the internal batteries are selected to power the Incubator. Both external DC and battery voltages are applied to the Circuit Board Terminal Block (4TB1) through 10 amp circuit breakers. Capacitor 4C4 helps reduce conducted emissions to the external DC cable.

Relay 4K2 is the DC power relay and is controlled by a signal from the Control Board via the Power Chassis. When Relay 4K2 is energized, switched DC power is applied to the Control Board and Power Chassis via Interface Connector 3P2. 4K2's coil voltage is provided by 4CR8 and 4CR11 which provide continuous unswitched DC power from the external DC and battery lines. The unswitched DC voltage is presented to the Control Board via the Power Chassis Interface Connector (3P2).

The remaining circuitry is included to provide visual and audible indication of a reversed polarity condition for both DC voltage sources. If either external DC or battery voltages are reversed, Indicator 4DS2 and Buzzer 3DS3 are energized calling attention to the polarity fault condition.

SECTION 4
PREVENTIVE MAINTENANCE

4.1 GENERAL

This section provides preventive maintenance procedures for Transport Incubator Model TI100. Included are cleaning instructions, sterilization procedures and a calibration schedule.

WARNING:

- Make sure that the oxygen supply to the Incubator is turned off and that the Incubator is disconnected from the oxygen supply when performing cleaning and maintenance procedures; a fire and explosion hazard exists when performing cleaning and/or maintenance procedures in an oxygen enriched environment.
- An electrical shock hazard exists when performing service procedures, unplug power cord (AC or DC) from power source. Loosen the Battery Compartment Fastening Knob and slide the compartment out approximately 5 cm (2 inches); this disconnects the batteries and charger from the Incubator.

WARNING: Components in the battery charger may be hot enough to cause burns. Avoid contact with charger components until the unit has cooled for at least 20 minutes.

4.2 CLEANING

When an infant is discharged, or at least once a week, the Incubator should be thoroughly disinfected. Cleaning can most effectively be accomplished by disassembling, then grouping the parts and/or assemblies in categories according to the method of cleaning required.

4.3 DISASSEMBLY FOR CLEANING

4.3.1 ACCESS PANEL CUFFS

1. UNLATCH THE FRONT AND HEAD-END ACCESS PANELS and open the panels until they hang down on the guard rail.

2. REMOVE THE ACCESS PANEL CUFFS and retaining rings (Figure 4.1).

FIGURE 4.1 ACCESS PANEL CUFF REMOVAL

4.3.2 TUBING ACCESS GROMMETS

1. GRASP THE CENTER OF EACH TUBING ACCESS GROMMET and remove from access port.

4.3.3 HOOD

1. CLOSE AND LATCH the access panels.
2. RELEASE THE RUBBER HOOD RETAINERS located at the head and foot ends of the Incubator.
3. CAREFULLY LIFT THE HOOD straight up and set aside.

4.3.4 MATTRESS TRAY

1. SLIDE THE TRAY TO THE LEFT until it reaches its mechanical stop.
2. REMOVE THE MATTRESS from the tray.
3. DEPRESS THE MATTRESS TRAY STOP (Figure 4.2) and slide the tray off the upper shell.

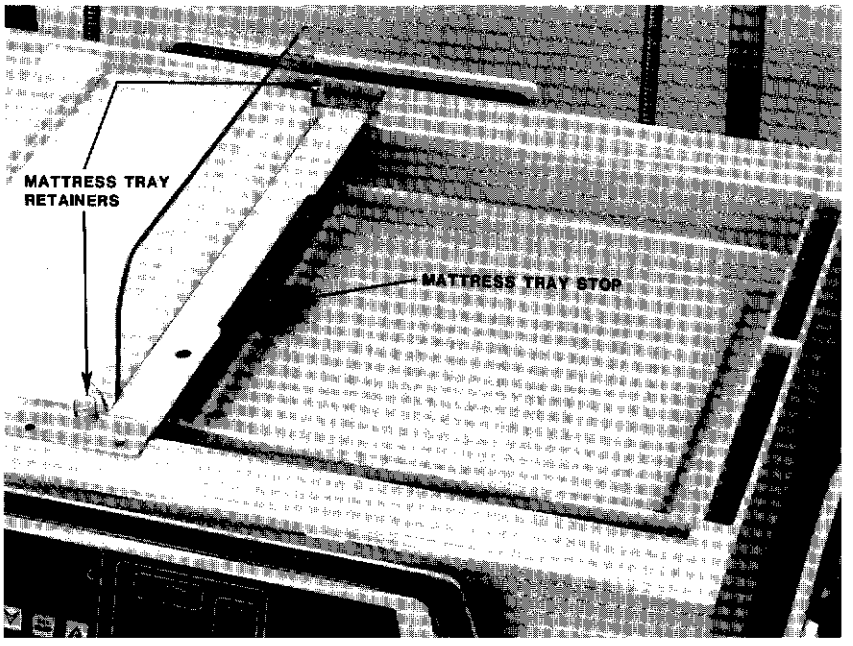


FIGURE 4.2 MATTRESS TRAY STOP AND RETAINERS

4.3.5 UPPER SHELL

1. REMOVE AND DISCARD THE HUMIDITY PAD.

2. RELEASE AND PULL BACK THE FOUR SHELL LATCHES at the head and foot end of the Incubator (Figure 4.3).

3. LIFT THE UPPER SHELL straight up.

> WARNING: The heater fins may be hot enough to cause burns; avoid touching the heater fins until the unit has cooled for at least 20 minutes.

4.4 CLEANING PROCEDURES

4.4.1 CLEANING AGENTS

An iodophor or quaternary disinfectant-detergent registered by the U.S. Environmental Protection Agency should be used, but only after the Incubator is empty and disassembled as described elsewhere in this section. A cleanser such as Air-Shields Kleenaseptic® Germicidal Surface Cleanser may be used. When using any cleaning agent follow the manufacturer's direction for use. Before cleaning, remove all solid wastes and contaminants from the disassembled parts.

4.4.2 CLEANING LOWER SHELL

The lower shell should be cleaned every 3 to 4 months during routine service, maintenance, or when contamination is known or suspected.

> WARNING: The heater fins may be hot enough to cause burns; avoid touching the heater fins until the unit has cooled for at least 20 minutes.

To gain access to the Incubator Lower Shell the unit should be disassembled as described in paragraph 4.3.

1. REMOVE ANY LINT from the heater fins, fan motor impeller, and air temperature probe (Figure 4.3.).

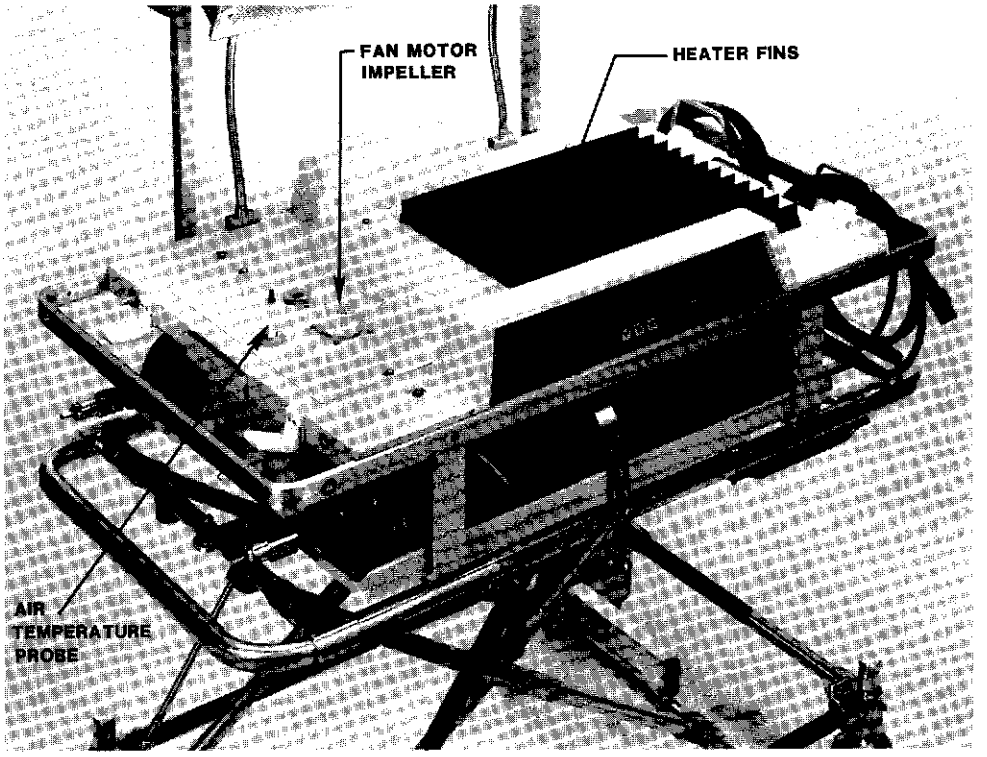


FIGURE 4.3 LOWER SHELL

2. WIPE THE HEATER FINS, air temperature probe, fan motor impeller, and adjacent surfaces with detergent germicidal solution, wipe with a clean paper towel moistened with hot water and wipe dry.

> WARNING: After cleaning, be sure to replace impeller on the motor shaft. Failure to do so will cause the heater to overheat, disabling the heater. If impeller is installed improperly, oxygen and temperature will be adversely affected. Make sure impeller turns freely after installation.

3. SPRAY EXPOSED SURFACES with Vapaseptic® Air Sanitizer.

4.4.3 CLEANING HUMIDITY CHAMBER AND UPPER SHELL

Use a disinfectant-detergent to thoroughly clean all surfaces, then dry with a clean cloth or paper towel. Inspect black rubber gasket on under side of upper shell for obvious physical damage.

4.4.4 CLEANING MATTRESS TRAY AND DECK

Use a disinfectant-detergent to clean all surfaces thoroughly, then dry with a clean cloth or paper towel.

4.4.5 CLEANING HOOD AND ADJUSTABLE STAND (ACCESSORY)

CAUTION:

- Alcohol can cause crazing of the clear Plexiglas® Hood. Do not use alcohol, acetone, or any organic solvents for cleaning.
- Do not expose the hood assembly to direct radiation from germicidal lamps. Ultraviolet radiation from these sources can cause cracking of gaskets, fading of paint, and crazing of the clear Plexiglas® hood.

Use a disinfectant-detergent to clean all surfaces of the hood thoroughly, including the inner wall and access panels. Make sure to clean all holes, indentations, baffles, etc., then dry with a clean cloth or paper towel. Clean all surfaces of the stand.

4.4.6 CLEANING TUBING ACCESS PORT GROMMETS

Thoroughly clean the three tubing access port grommets using a disinfectant-detergent. Rinse with warm water and dry with a clean cloth or paper towel.

4.4.7 AIR-INTAKE FILTER

WARNING: A dirty filter may affect oxygen concentration and/or cause carbon dioxide buildup. Be sure the filter is checked on a routine basis commensurate with local conditions.

Do not attempt to clean or reverse the filter. If visibly dirty, or older than 3 months, it should be replaced. Before installing a new filter, clean the filter chamber and filter cover with a disinfectant-detergent. Replace only with the correct filter.

4.5 REASSEMBLY AFTER CLEANING

Perform the reassembly of the Incubator in the following sequence. During the reassembly spray all surfaces with air sanitizer.

CAUTION: Exercise care when lowering the upper shell onto the lower shell to avoid damage to the air temperature probe.

1. ALIGN THE AIR TEMPERATURE PROBE with the hole on the upper shell. Secure the latches at the head and foot ends of the unit (Figure 4.3). Make sure impeller is approximately 1.6mm (1/16") from cover and rotates freely.

2. PLACE A NEW HUMIDITY PAD in the humidity reservoir.

3. PLACE THE MATTRESS TRAY on the left end of the upper shell, then slide the Tray to the right, under the mattress tray retainers. (Figure 4.2), until it passes the mattress tray stop and stops at the right end of the upper shell.

4. PLACE THE MATTRESS (in mattress cover) in the mattress tray.

5. INSTALL HOOD on upper molding.

6. SECURE THE RUBBER HOOD RETAINERS at the head and foot ends to the pins on the hood; open the front and head-end access panels of the hood.

7. INSTALL AN ACCESS PORT GASKET behind each access port as shown in Figure 4.4.

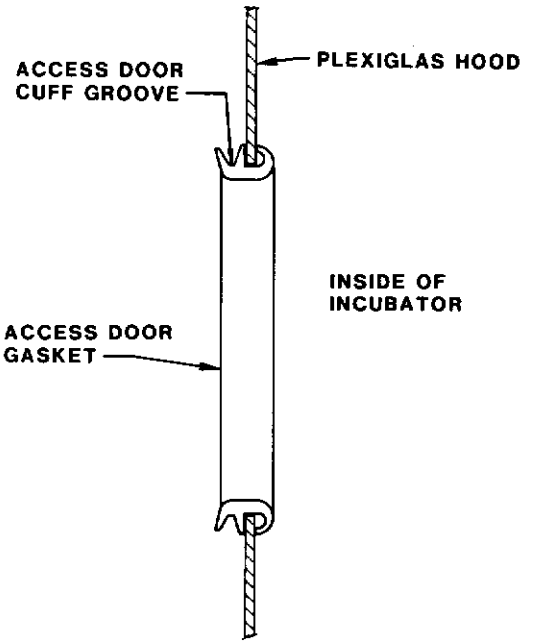


FIGURE 4.4 INSTALLATION OF ACCESS PORT GASKET

8. INSTALL A NEW ACCESS PORT CUFF onto each access port gasket by stretching the larger diameter elastic band into the groove in the gasket as shown in Figure 4.5. When installed correctly, the cuff has a small opening at its center.

   NOTE: If the Incubator is to be gas sterilized, wait until after sterilization to install new cuffs.

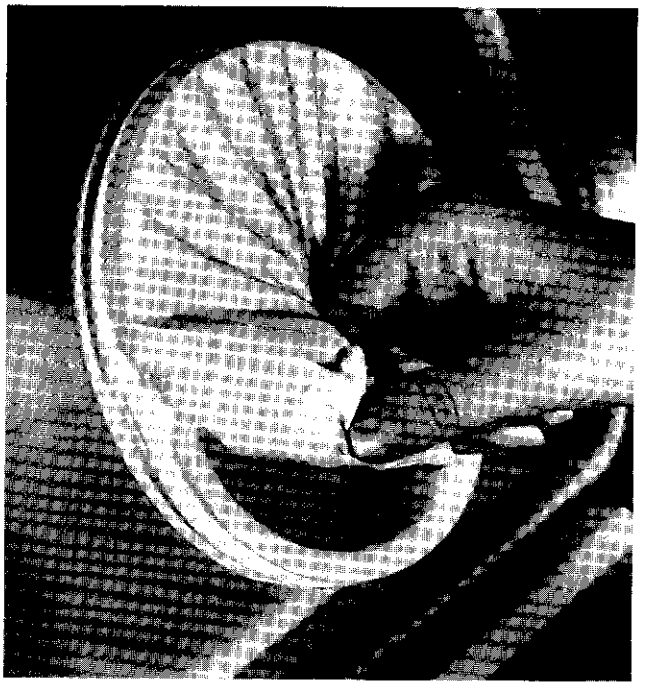


FIGURE 4.5 ACCESS PORT CUFF REPLACEMENT

9. INSTALL THE TUBING ACCESS PORT GROMMETS by inserting the grommets into the slots in the outer hood.

10. CLOSE AND LATCH the front and head-end access panels.

11. INSTALL A NEW AIR-INTAKE FILTER if necessary. Replace the air intake filter cover and tighten the two thumbscrews. If a new filter is installed, indicate the date on the place provided on the cover. Replace only with the correct filter.

    IMPORTANT: A complete operational checkout (paragraph 2.6) should be performed before returning the unit to service).

4.6 STERILIZATION

CAUTION: Do not steam autoclave. Gas sterilization temperature should not exceed 54.4°C (130°F).

Sterilization can be accomplished with the following agents:

4.6.1 COLD STERILIZATION

CAUTION: Do not expose the hood assembly to direct radiation from germicidal lamps. Ultraviolet radiation from these sources can cause cracking of gasket surfaces, fading of paint, and ultimately, crazing of the clear plastic hood.

4.6.2 GAS STERILIZATION (ETHYLENE OXIDE)

Prior to gas sterilization, the entire Incubator should be thoroughly cleaned as described elsewhere in this section. Unlatch and open hood access panels. Remove and discard all used disposable elements such as access panel cuffs and mattress covers. New disposable elements should be installed after sterilization. The air-intake filter may be left in place.

NOTE: Gas sterilization does not eliminate the need for routine replacement of the air intake filter.

Standard gas sterilization procedures as programmed by automatic equipment such as made by American Sterilizer and Wilmot Castle are satisfactory as these do not normally exceed 54.4°C (130°F).

Upon completion of sterilization, an aeration period of 16 to 24 hours should be allowed. The Incubator should be operated in a dry condition for the entire period of aeration at a temperature of 32°C to 35°C (90°F to 95°F). After aeration, if the unit is not to be used immediately, a disposable dust cover should be placed on the Incubator.

IMPORTANT: A complete operational checkout (paragraph 2.6) should be performed before returning the unit to service.

4.7 BATTERY MAINTENANCE

Check the condition of the batteries before first use and at three month intervals thereafter as follows:

IMPORTANT: If the Incubator has not been connected to an AC power source for 20 hours prior to this test, the batteries should be recharged by connecting the Incubator to an AC power source for 20 hours with the AC POWER switch in the ON-1 position; when the recharge period is complete; disconnect the AC power cord.

1. OPEN ALL ACCESS DOORS.

2. TURN THE OBSERVATION LIGHT ON.

3. DEPRESS THE SET TEMP SWITCH, the SET POINT indicator should light and a short "beep" should be heard indicating that the °C Temperature Display is indicating the set point.

4. OBSERVE THE TEMPERATURE DISPLAY and depress the raise switch (△) to raise the set point to maximum (38°C).

5. WITH FULLY CHARGED BATTERIES, the Incubator should operate for at least 2 hours before the LOW DC alarm activates.

6. IF THE LOW DC ALARM ACTIVATES in less than two hours, replace the batteries.

7. IMMEDIATELY, UPON SUCCESSFUL COMPLETION OF THE TEST, recharge the batteries for 20 hours as described above.

4.8 BATTERY AND BATTERY TRAY REMOVAL/REPLACEMENT

If battery replacement is required, refer to Section 5 of this manual.

4.9 CALIBRATION SCHEDULE

It is recommended that the Model TI100 Incubator be tested and calibrated at least every four months and after repairs have been made. Calibration and test procedures are provided in Section 5 of this manual.

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SECTION 5
SERVICE

5.1 GENERAL

This section provides calibration, troubleshooting, and removal and replacement instructions for the Model TI100 Incubator.

5.2 CALIBRATION PROCEDURES

This paragraph provides calibration and test procedures for the Model TI100 Incubator.

5.2.1 GENERAL

Unless otherwise indicated, all calibration procedures are performed under the following condiitons:

1. THE CONTROLLER IS UNMOUNTED to provide access to the calibration adjustments. (The PC board need not be removed from the Controller).

2. THE INCUBATOR IS CONNECTED TO A PRIMARY POWER SOURCE of the correct voltage and frequency (see data tag).

3. AMBIENT TEMPERATURE FOR CALIBRATION AND TEST is 23°C ± 4°C (73°F ± 7°F).

5.2.2 TEST EQUIPMENT REQUIRED

The test equipment listed below is required for calibration and performing oxygen concentration tests. Equivalent test equipment may be substituted.

- Probe Simulator, Part No. 67 902 80
- Digital VOM, Fluke Model 8000A
- Oscilloscope - Tektronix 465
- Oxygen Analyzer, Sybron/Taylor Model QA580
- Flowmeter, Victor - Model 1099-0025
- Leakage Tester, Bio-Tek 501
- Jumper Plug, Part No. 17 731 98
- External Battery Charger Adapter (100V, 110/120V) Part No. 67 325 70
- External Battery Charger Adapter (220/240V) Part No. 67 325 75

NOTE: The External Battery Charger Adapter is required for supplying power to the Battery/Charger Tray during calibration.

5.2.3 OVERALL CALIBRATION

TEST SET-UP

1. REMOVE SENSOR CONNECTOR and connect the Probe Simulator to 1J1-1, -2, and -3 on the Power Board.

2. ON THE PROBE SIMULATOR, set the ALARMS switch to NORM and the °C switch to 35.3°C.

3. APPLY MAIN POWER to the Incubator by setting the AC POWER switch on the Power Chassis to the ON-1 position.

4. APPLY POWER TO THE CONTROLLER by pressing the CONTROLLER ON switch; allow the Incubator to complete the auto-test cycle.

5. ALLOW THE INCUBATOR TO RUN FOR AT LEAST 15 MINUTES before proceeding with calibration procedures.

6. CHECK 150 HZ CLOCK by connecting an oscilloscope to TP10 (Figure 5.1). The clock period should be 430 ms ± 30 ms. If necessary, adjust R92 until period is within specifications. (See Note below).

   NOTE: In early production TI100 Incubators, R92 is a fixed resistor; therefore no adjustment can be made in these units.

BRIDGE AMPLIFIER CALIBRATION

1. CONNECT DVM between TP2 and TP1 (ground).

2. ADJUST R58 for a reading of 3.50 Vdc ± 0.01 Vdc at TP2.

3. DISCONNECT THE DVM.

A/D CONVERTER CALIBRATION

1. CONNECT JUMPER PLUG (part no. 17 731 98) between TP6 and TP7.

2. ON THE PROBE SIMULATOR, set the °C switch to 20.3°C.

3. ADJUST R76 for a reading of 20.0°C on the temperature display.

4. ON THE PROBE SIMULATOR, set the °C switch to 40.3°C.

5. ADJUST R61 for a reading of 40.0°C on the temperature display.

6. REPEAT THIS PROCEDURE, as required, to obtain accurate adjustments.

7. DO NOT DISCONNECT the jumper plug from TP6 and TP7.

TEMPERATURE OFFSET ADJUSTMENT

1. ON THE PROBE SIMULATOR, set the °C switch to 20.3°C.
2. ADJUST R76 for a reading of 20.3°C on the temperature display.
3. DISCONNECT THE JUMPER PLUG from TP6 and TP7.

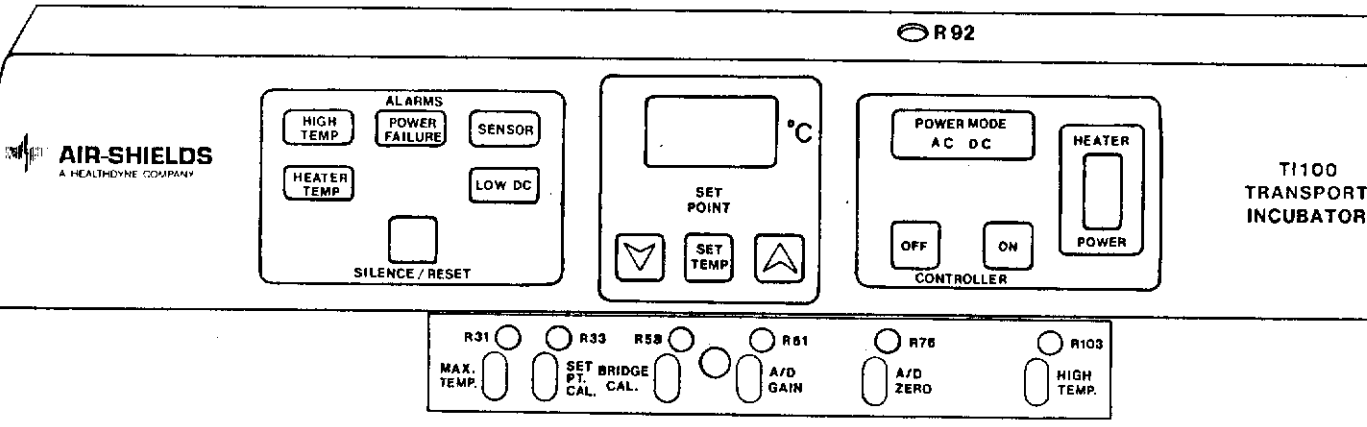


FIGURE 5.1 ADJUSTMENTS AND TEST POINTS

PRESET TEMPERATURE CALIBRATION

NOTE: This adjustment must be completed within 15 seconds after the SET TEMP switch is pressed (SET POINT indicator lit). If the SET POINT indicator goes out before the adjustment is completed, the procedure must be repeated.

1. PRESS THE SET TEMP SWITCH; the SET POINT indicator should light.
2. ADJUST R33 for a reading of 35.0°C on the temperature display.
3. IF THE SET POINT INDICATOR GOES OFF during the adjustment, repeat Steps 1 and 2.

MAXIMUM SET POINT TEMPERATURE CALIBRATION

1. ADJUST R31 several turns counterclockwise. Press the SET TEMP switch; the SET POINT indicator should light.
2. PRESS AND HOLD THE SET POINT RAISE SWITCH (△) until the temperature display stops changing; do not release the SET POINT raise switch.
3. SLOWLY ADJUST R31 clockwise until the temperature display indicates 38.0°C. If the display reading is inadvertently adjusted to a reading higher than 38.0°C, perform the following step; otherwise proceed to step 5.
4. ADJUST R31 slightly counterclockwise. Press the SET TEMP switch and then the SET POINT lower switch (▽) until the temperature display indicates 37.5°C. Repeat steps 1 through 3 of this procedure until the temperature display indicates 38.0°C.
5. PRESS THE SET TEMP SWITCH; the SET POINT indicator should light.
6. PRESS AND HOLD THE SET POINT LOWER SWITCH (▽) until the temperature display stops changing; the display should indicate 21.5°C ± 1.0°C.
7. PRESS THE SET TEMP SWITCH; the SET POINT indicator should light.
8. PRESS AND HOLD THE SET POINT RAISE SWITCH (△) until the temperature display indicates 30.0°C ± 0.5°C; release the switch.

HIGH TEMPERATURE ALARM CALIBRATION

1. ADJUST R103 counterclockwise several turns.
2. CONNECT JUMPER PLUG (Part No. 17 731 98) between TP8 and TP9.

3. ON THE PROBE SIMULATOR, set the ALARMS switch to HI TEMP.

4. SLOWLY ADJUST R103 clockwise until the audible alarm "beeps".

5. DO NOT DISCONNECT JUMPER PLUG from TP8 and TP9.

ALARM CHECK

High Temperature

1. WAIT SEVERAL SECONDS until the HI TEMP alarm activates. The audible alarm should sound and the HEATER POWER indicator should be disabled.

2. PRESS THE SILENCE/RESET SWITCH. The alarm should not reset.

3. SET PROBE SIMULATOR ALARMS switch to NORM.

4. PRESS THE SILENCE/RESET SWITCH. The HIGH TEMP alarm should reset.

5. CHECK R103 ADJUSTMENT by setting Probe Simulator ALARMS switch back to HIGH TEMP position. The audible alarm should beep.

6. SET PROBE SIMULATOR ALARMS switch to NORM position and disconnect jumper from TP8 and TP9.

Open Sensor

1. SET PROBE SIMULATOR ALARMS switch to the OPEN position.

2. THE SENSOR ALARM SHOULD ACTIVATE in about 7 seconds. The audible beep should be heard every 15 seconds.

3. PRESS THE SILENCE/RESET SWITCH. The visual alarm should continue flashing and the audible alarm should be silenced.

4. SET THE PROBE SIMULATOR ALARMS switch to NORM position.

5. PRESS THE SILENCE/RESET SWITCH; the alarm should reset.

Shorted Sensor

1. SET PROBE SIMULATOR ALARMS switch to SHORT position.

2. THE SENSOR AND HIGH TEMP ALARMS should activate in about 7 seconds.

3. SET PROBE SIMULATOR ALARMS SWITCH to NORM position.

4. PRESS THE SILENCE/RESET SWITCH; the alarm should reset.

Power Failure and Set-Point Retention

1. DISCONNECT THE BATTERY TRAY by sliding it out of the Incubator about two inches.

2. PRESS THE SET TEMP switch and then press the set point raise (△) switch and raise the set point display to 36.0°C.

3. SET THE MASTER AC POWER SWITCH on the Power Chassis to the OFF-O position. The POWER FAILURE alarm should be enabled and a continuous audible alarm should sound.

4. SET THE MASTER AC POWER SWITCH on the Power Chassis to the ON-1 position. The POWER FAILURE alarm should cease and the auto test sequence should be initiated.

5. WAIT FOR THE AUTO TEST SEQUENCE TO END and then check the set point display; it should read 36.0°C.

6. SET THE MASTER AC POWER SWITCH on the Power Chassis to the OFF-O position. The POWER FAILURE alarm should be enabled and a continuous audible alarm should sound.

7. PRESS THE CONTROLLER OFF SWITCH on the Controller, the POWER FAILURE alarm should cease.

8. RECONNECT AND SECURE the Battery Tray.

9. DISCONNECT THE PROBE SIMULATOR from 1J1 and reconnect plug 1P1.

10. REASSEMBLE THE INCUBATOR.

11. SET THE MASTER AC POWER SWITCH on the Power Chassis to the ON-1 position, and depress the CONTROLLER ON switch on the Control Panel to restore operation.

5.2.4 BATTERY CHARGER CALIBRATION PROCEDURE

The Incubator is equipped with a Battery/Charger Tray; calibrate the battery charger as follows:

1. Set the master AC POWER switch on the Power Chassis to the OFF-O position and depress the CONTROLLER OFF switch on the Controller front panel.

2. Loosen the Battery/Charger Tray retaining screw completely.

3. Grasp the handle and very slowly withdraw the tray approximately 6 inches (15 cm).

> WARNING: The Battery/Charger Tray weighs approximately 50 lbs. (22.7 Kg) with two batteries. The tray must be well supported during removal and installation. Exercise care to prevent pinching of fingers during removal or installation of Battery/ Charger Tray.

4. Position a hand on each side of the tray and as close as possible to the Incubator.

5. Slowly remove the tray from the Incubator. Place the tray on a surface that will support its weight.

6. Disconnect the red and black leads from the two batteries.

7. Connect the Battery/Charger tray to the primary ac power source using the External Battery Charger Adapter, part number 67 325 70 for 100V and 110/120 units, or part number 67 325 75 for 220/240V units.

8. Using a digital voltmeter, measure the voltage at 4J2-11 (see Figure 7.3). The reading should be 13.8 VDC ± 0.1 VDC; adjust 4R10 if required to obtain correct reading.

9. Disconnect all test equipment, reconnect the red and black wires to the batteries and reinstall the Battery/Charger Tray in the Incubator.

5.2.5 CHASSIS LEAKAGE CURRENT TEST

TEST SET-UP

1. Connect the Power Chassis to the primary power source through an ungrounded adapter plug, so that the unit is ungrounded. Set the AC POWER switch to ON-1 position.

2. The leakage test standards provided in the procedure below assume leakage through a resistance of 1000 ohms. If the Leakage Tester being used does not provide this resistance, the test set-up must be adjusted to provide it.

PROCEDURE.

1. USE THE LEAKAGE TESTER to measure between the chassis of the unit under test and a known ground such as the ground connection of a wall receptacle. The leakage must not exceed 100 microamps.

2. REVERSE THE PLUG and repeat step 1.

3. PERFORM STEPS 1 AND 2 with the Power Chassis AC POWER switch in the OFF-0 position.

5.2.6 OXYGEN CONCENTRATION TEST

TEST SETUP.

1. Place a calibrated oxygen analyzer on the mattress in the Incubator.

2. Connect an oxygen supply, through a flowmeter, to the OXYGEN INLET connector on the side of the Incubator.

PROCEDURE.

1. TURN THE INCUBATOR ON and adjust oxygen flow rate to 2.0 LPM + 0.5 LPM, -0.0 LPM.

2. THE HOOD OXYGEN CONCENTRATION SHOULD ATTAIN 32 TO 47% oxygen within 30 minutes and stabilize.

3. INCREASE THE OXYGEN FLOW RATE to 6.0 LPM +0.5, -0.0 LPM. The hood oxygen concentration should attain 58 to 90% oxygen within 30 minutes and stabilize.

5.2.7 OPERATIONAL CHECKOUT

Perform the Operational Checkout Procedure given in paragraph 2.6.

5.3 TROUBLESHOOTING

5.3.1 GENERAL

Troubleshooting guides for the TI100 Incubator are presented under paragraph 5.3.3 in the form of flowcharts. It is assumed that an attempt has been made to calibrate the unit and that all cables are in good condition.

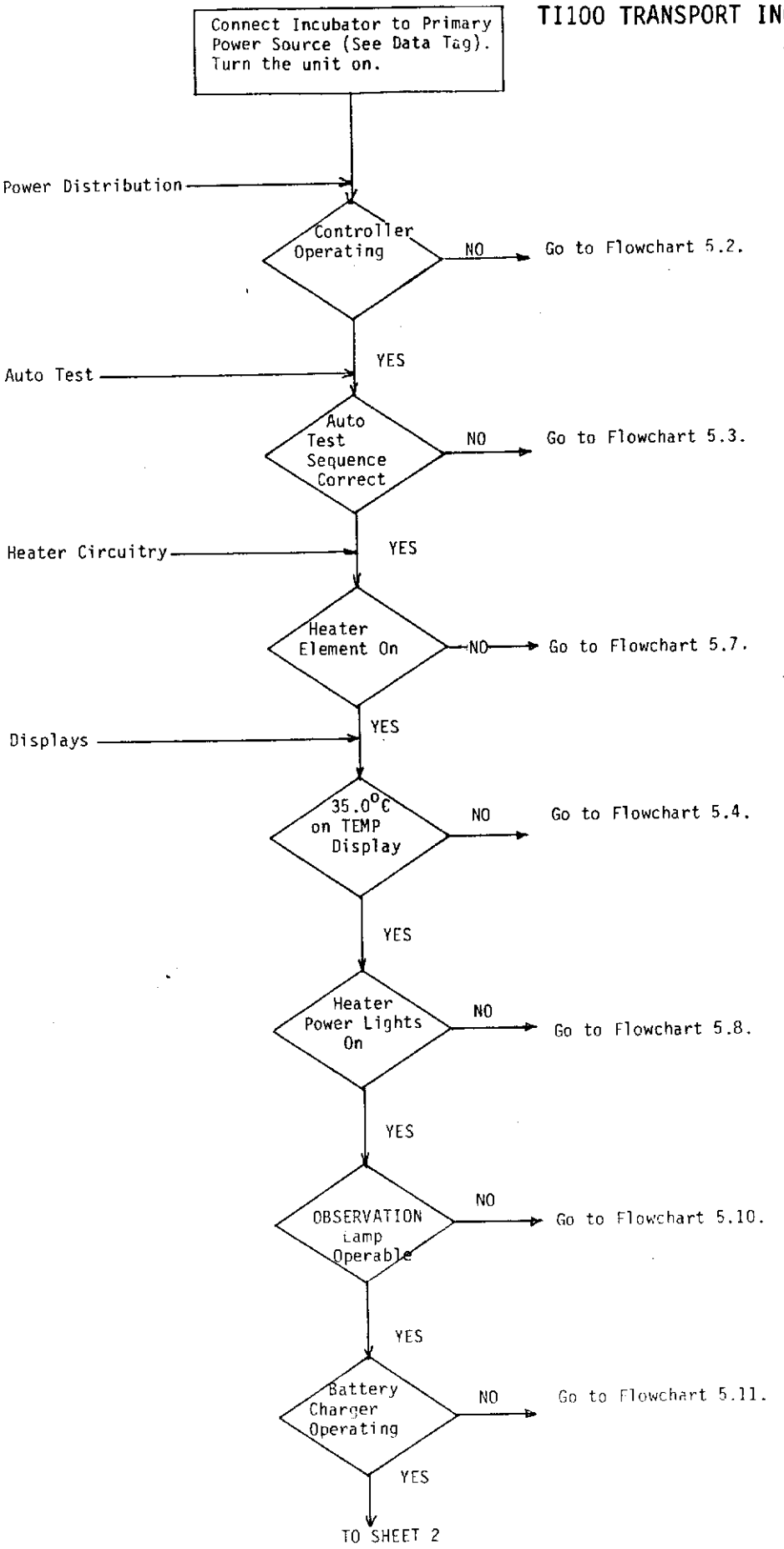
5.3.2 TEST EQUIPMENT REQUIRED

The test equipment listed below is required for troubleshooting the TI100 Incubator. Equivalent test equipment may be substituted.

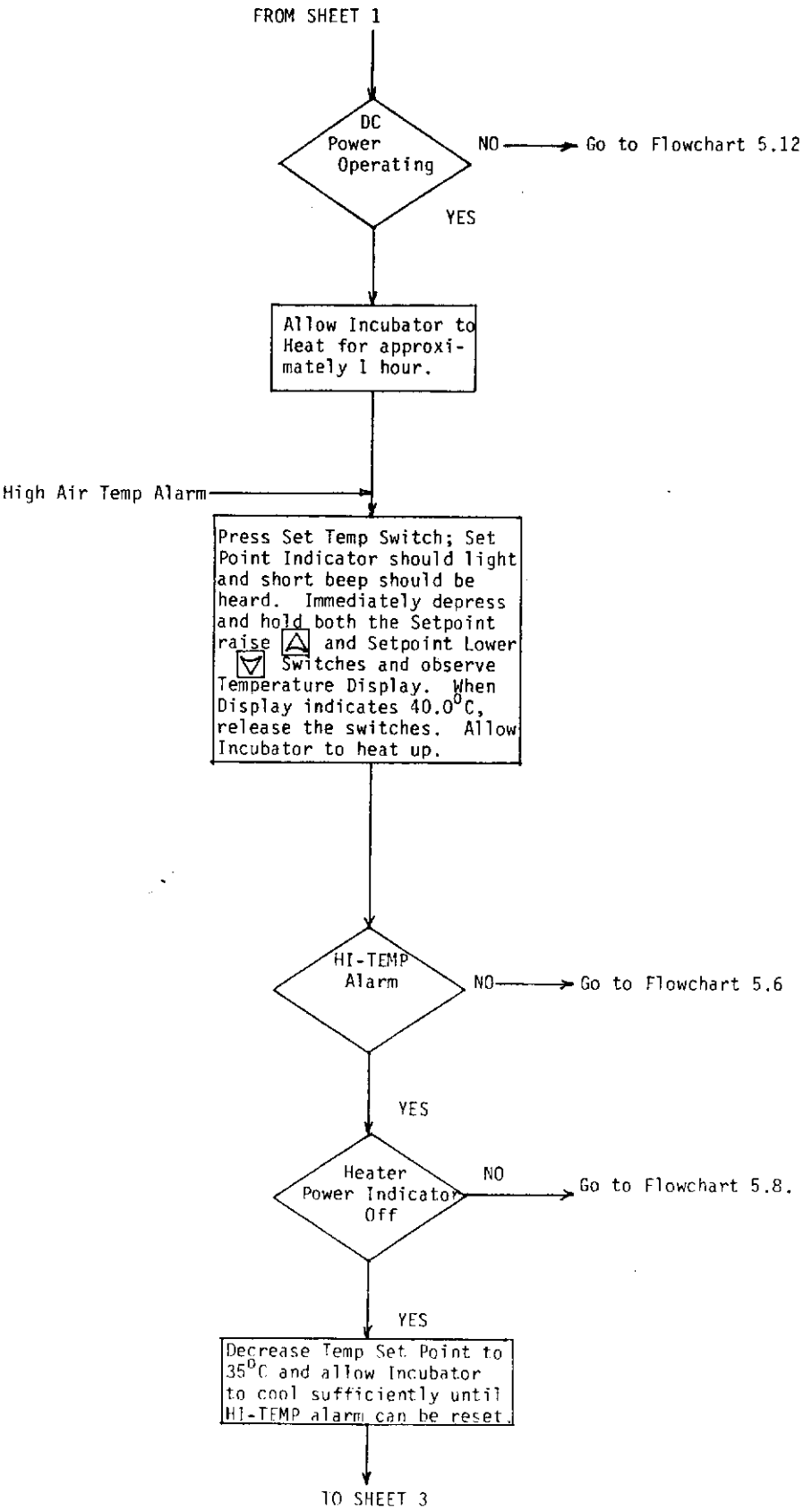
- Digital VOM, Fluke Model 8000A
- Logic Probe - capable of ± 12 VDC
- Oscilloscope, Tektronix 465
- Probe Simulator, Part No. 67 902 80
- Jumper Plug, Part No. 17 731 98

5.3.3 TROUBLESHOOTING PROCEDURES

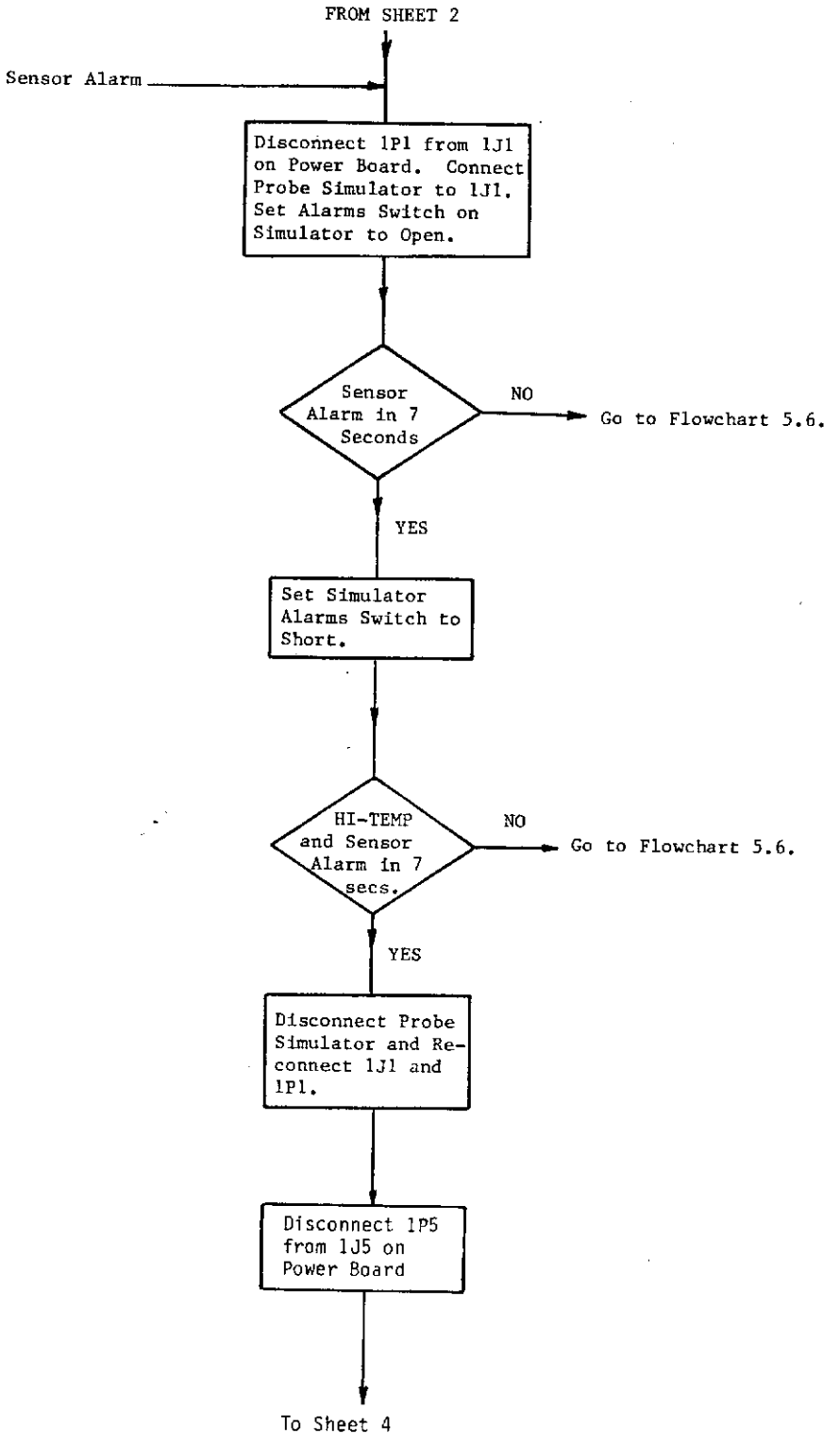
The following flowcharts are provided as an aid in localizing the cause of equipment malfunctions. The charts are intended for use in conjunction with the equipment theory of operation (Section 3) and the schematic diagrams (Section 7). It is assumed that the Operational Checkout (paragraph 2.6) has been performed, and that the Calibration Procedures (paragraph 5.2) have been attempted.



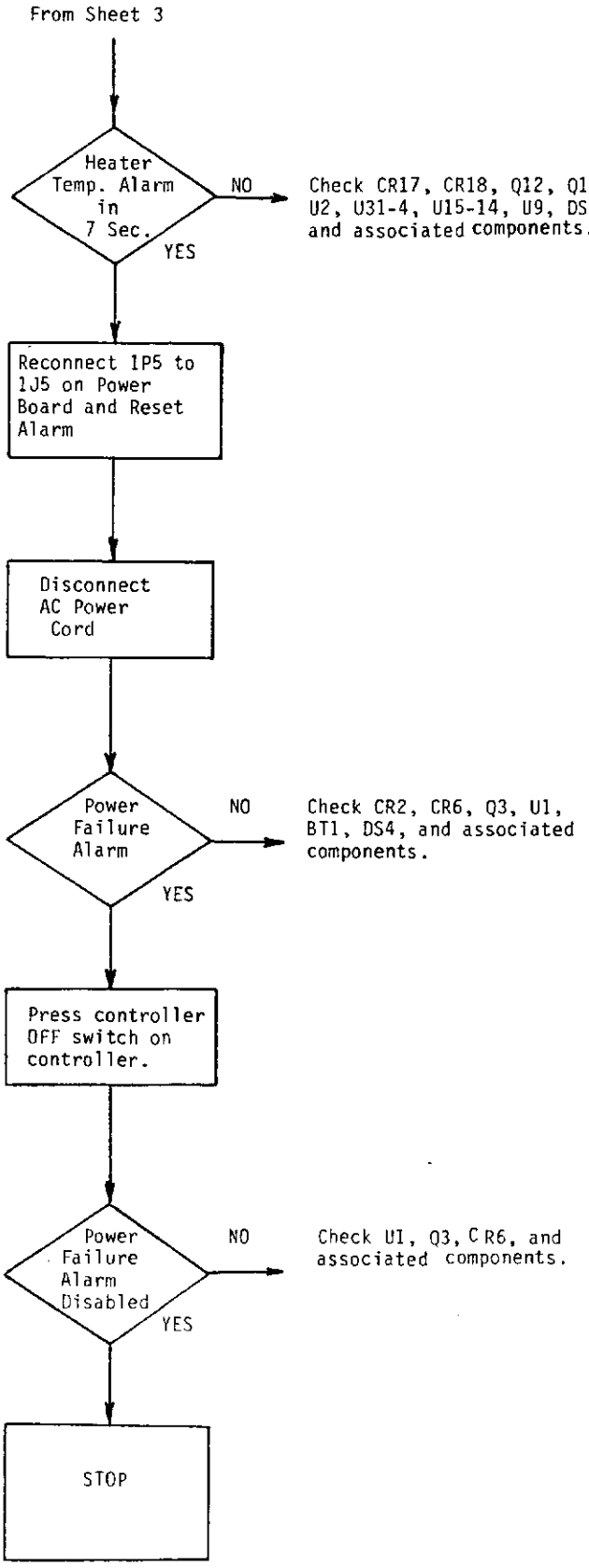
FLOWCHART 5.1 OVERALL CHECKS (Sheet 1 of 4)



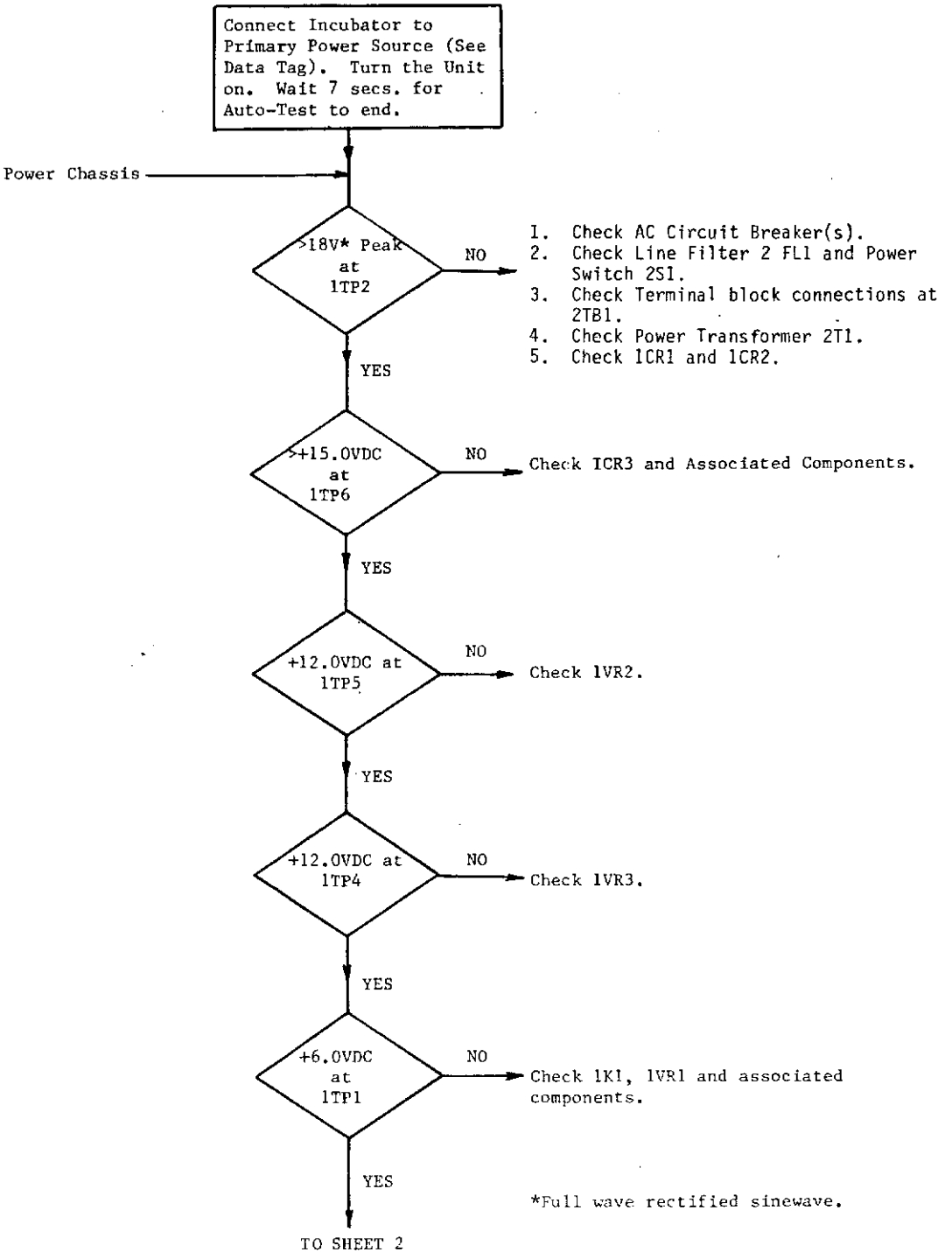
FLOWCHART 5.1 OVERALL CHECKS (Sheet 2 of 4)



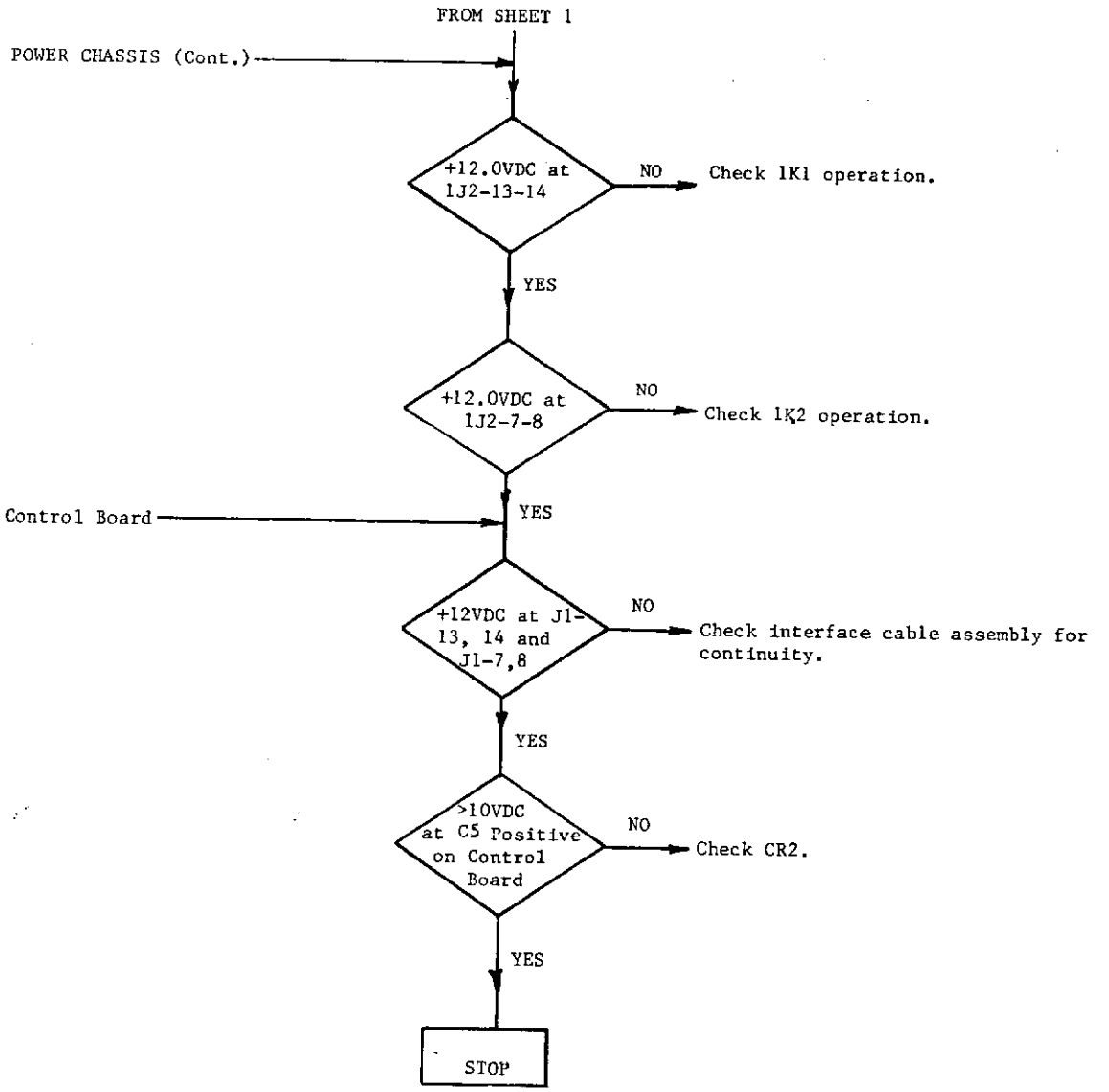
FLOWCHART 5.1 OVERALL CHECKS (Sheet 3 of 4)



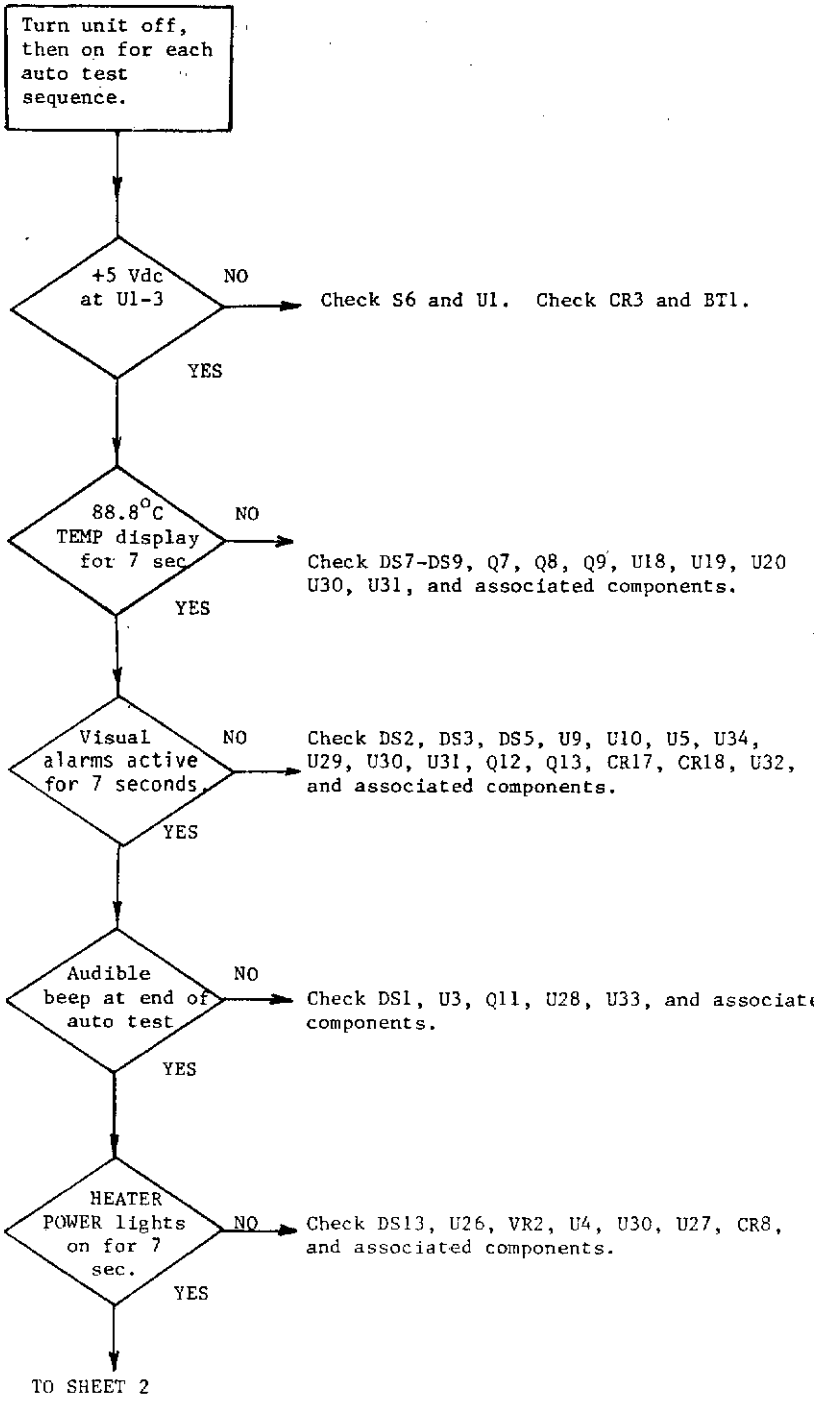
FLOWCHART 5.1 OVERALL CHECKS (Sheet 4 of 4)



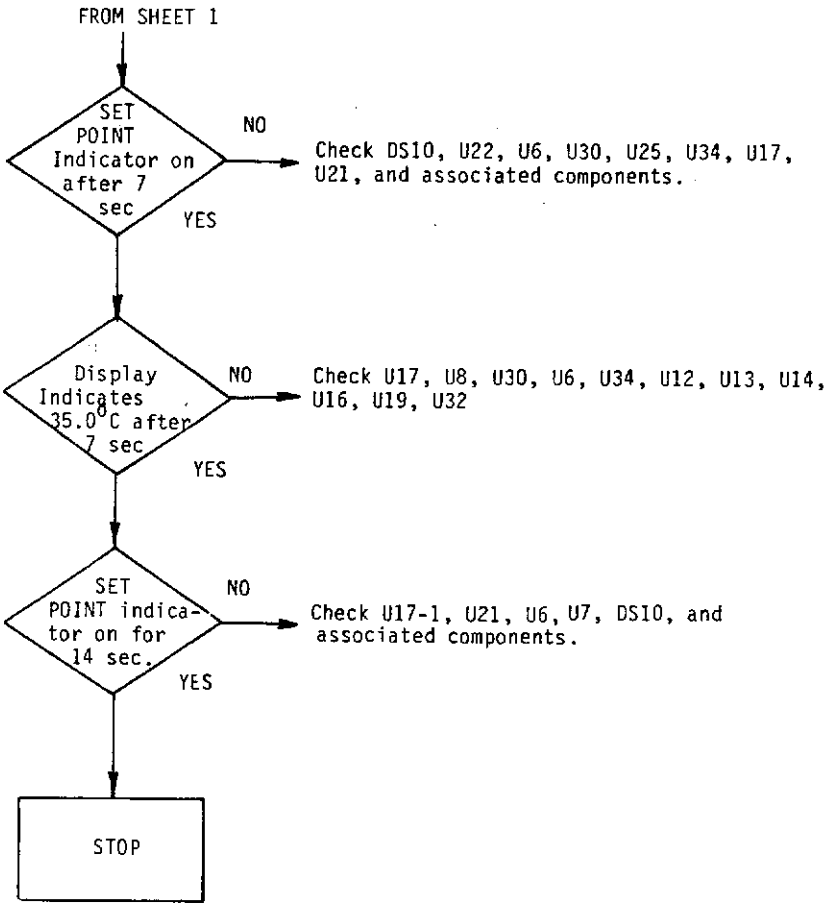
FLOWCHART 5.2 POWER DISTRIBUTION TROUBLESHOOTING (Sheet 1 of 2)



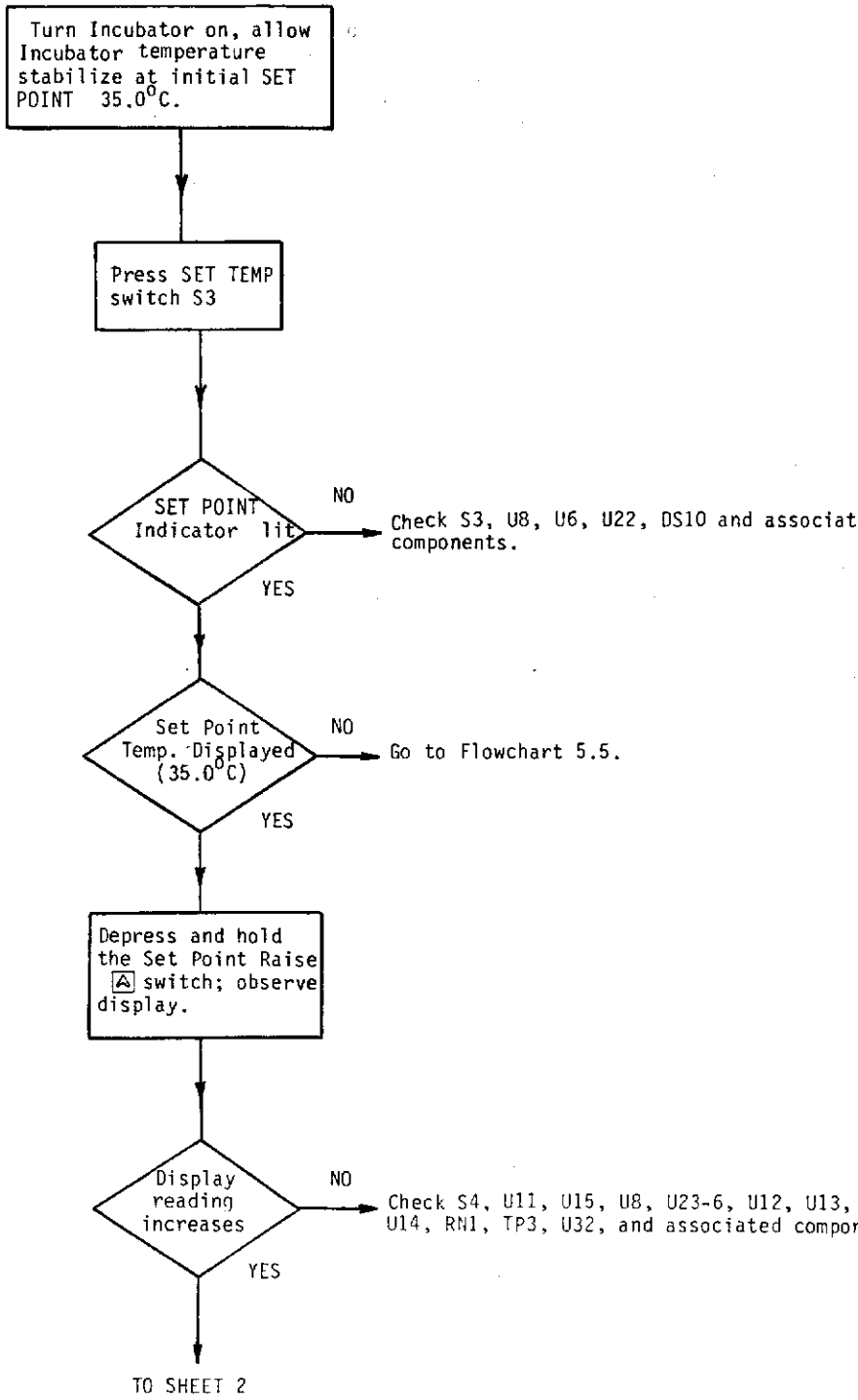
FLOWCHART 5.2 POWER DISTRIBUTION TROUBLESHOOTING (Sheet 2 of 2)



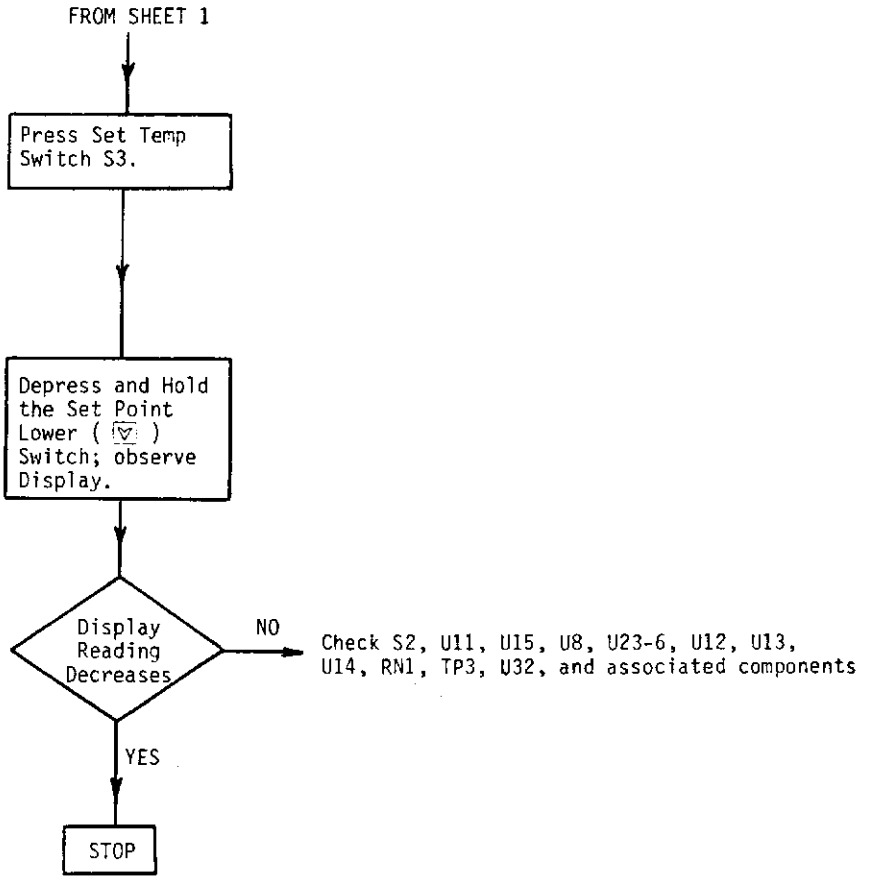
FLOW CHART 5.3 AUTO-TEST CYCLE TROUBLESHOOTING (Sheet 1 of 2)



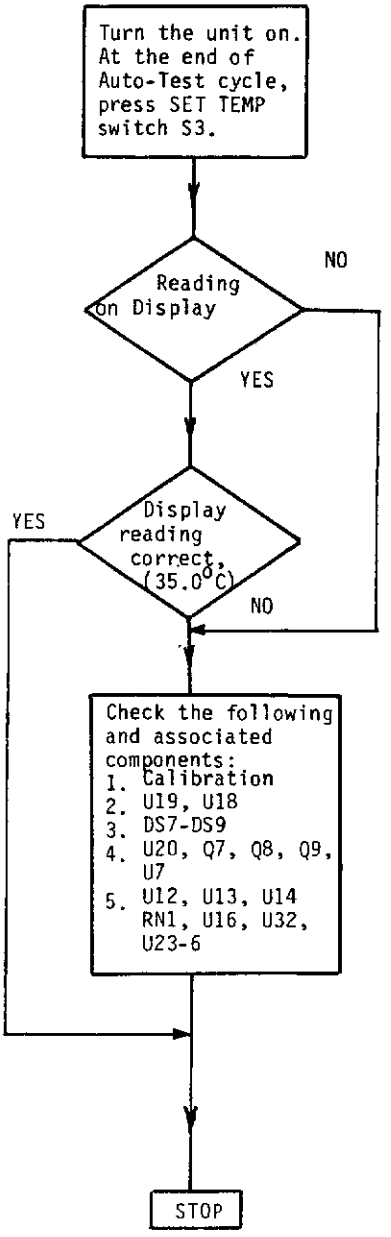
FLOW CHART 5.3 AUTO-TEST CYCLE TROUBLESHOOTING (Sheet 2 of 2)



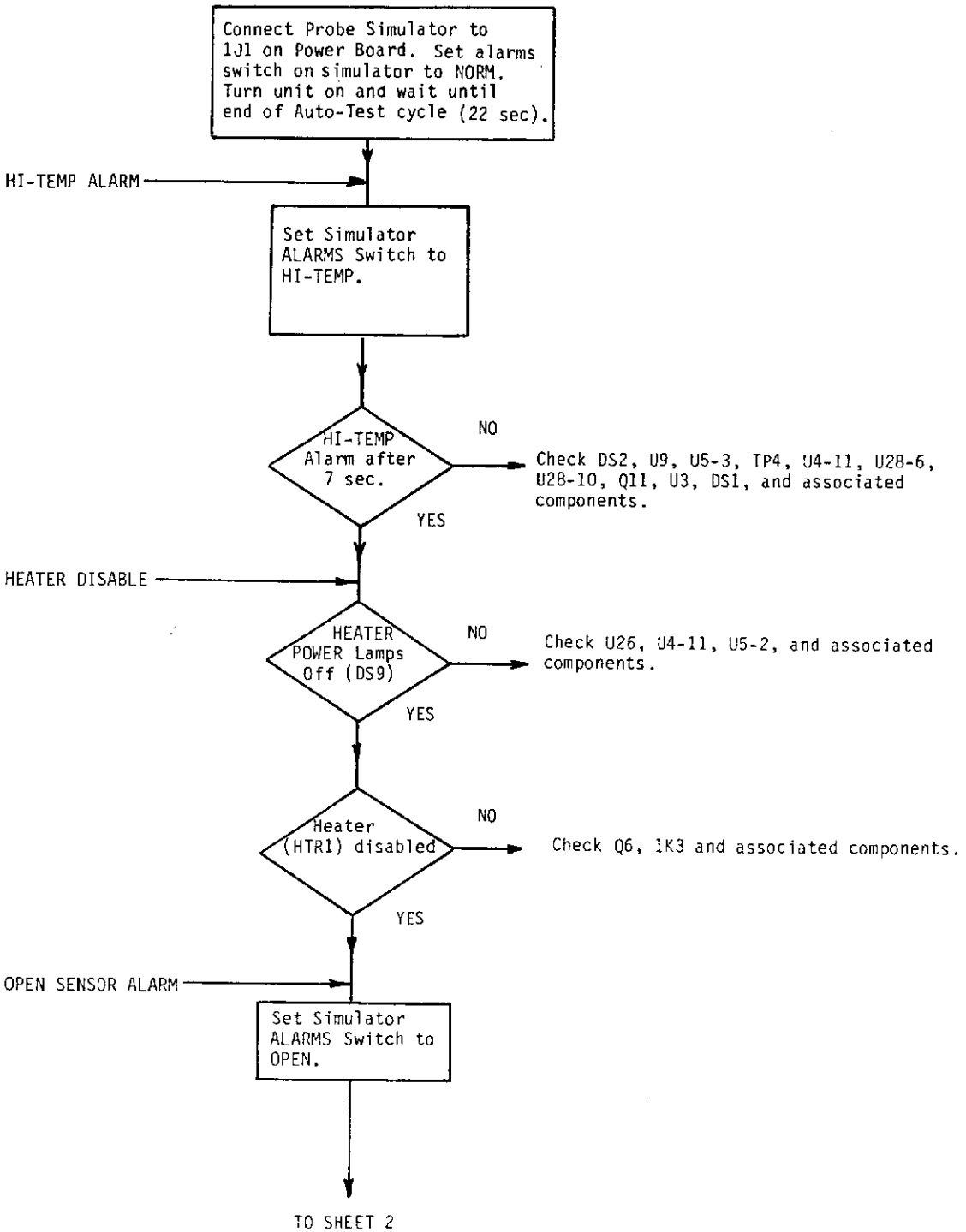
FLOWCHART 5.4 TEMPERATURE SET POINT CIRCUITRY TROUBLESHOOTING (Sheet 1 of 2)



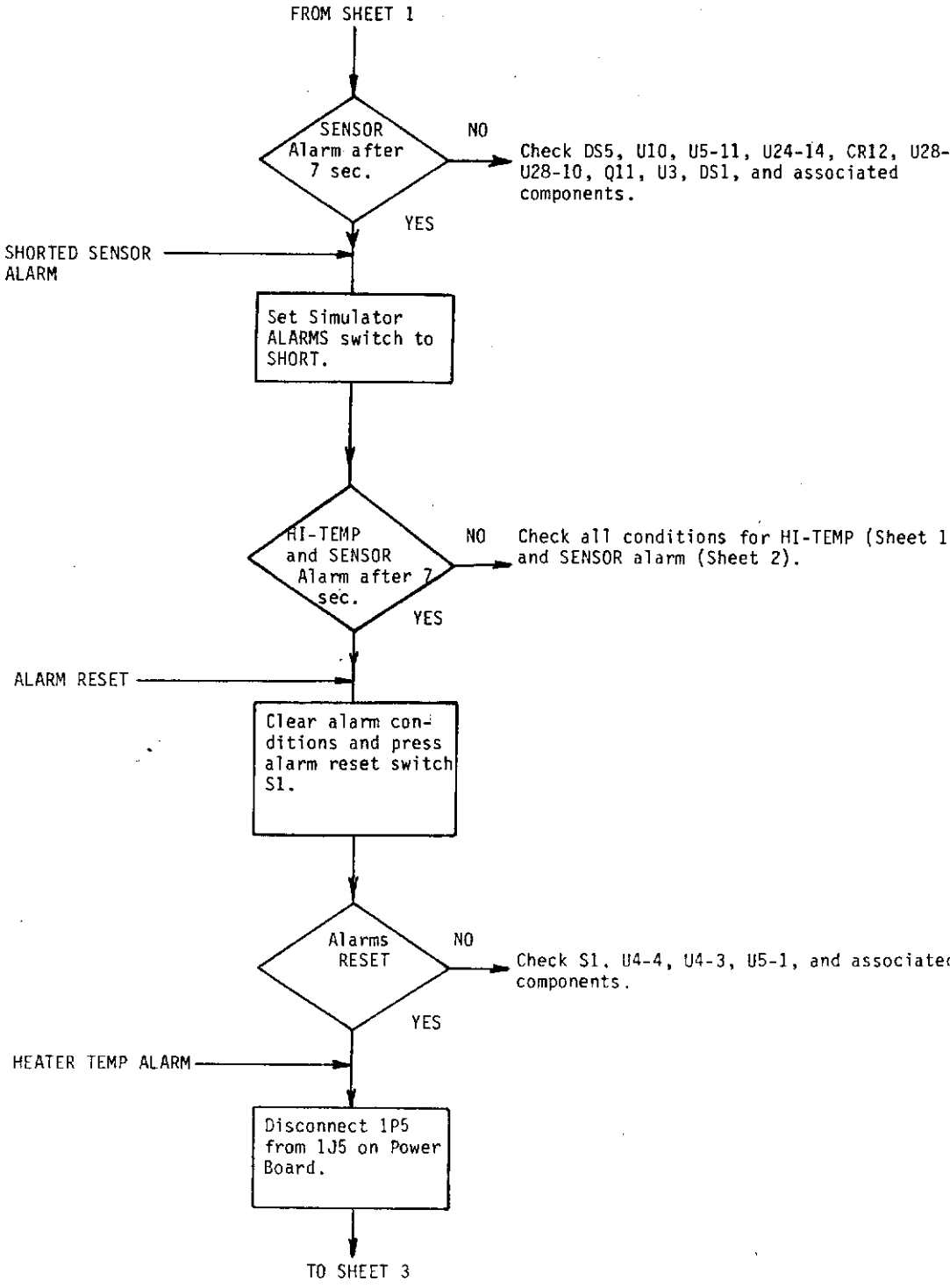
FLOWCHART 5.4 TEMPERATURE SET POINT CIRCUITRY TROUBLESHOOTING (Sheet 2 of 2)



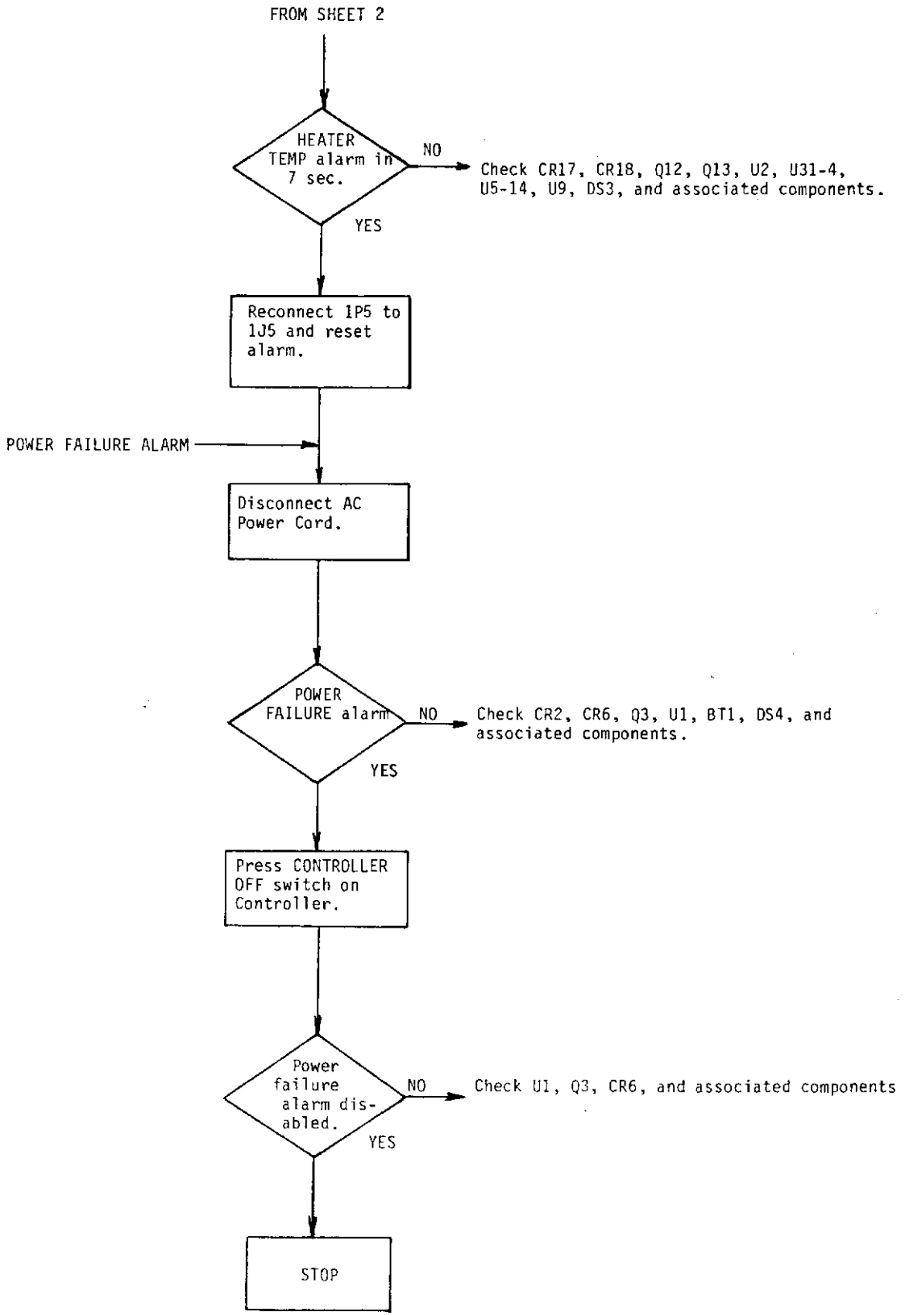
FLOWCHART 5.5 A/D CONVERTER AND TEMPERATURE DISPLAY TROUBLESHOOTING



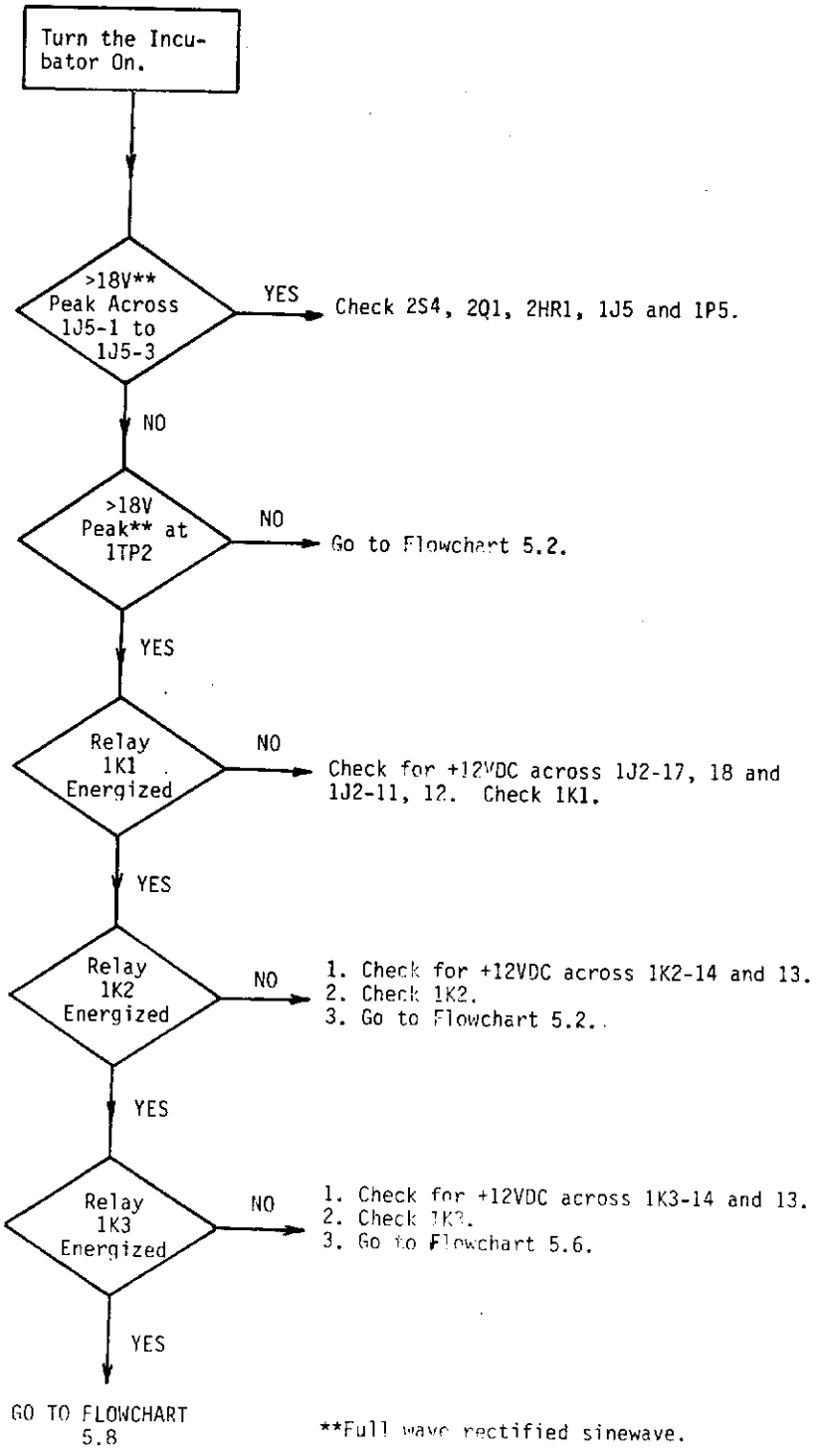
FLOWCHART 5.6 ALARM CIRCUITRY TROUBLESHOOTING (Sheet 1 of 3)



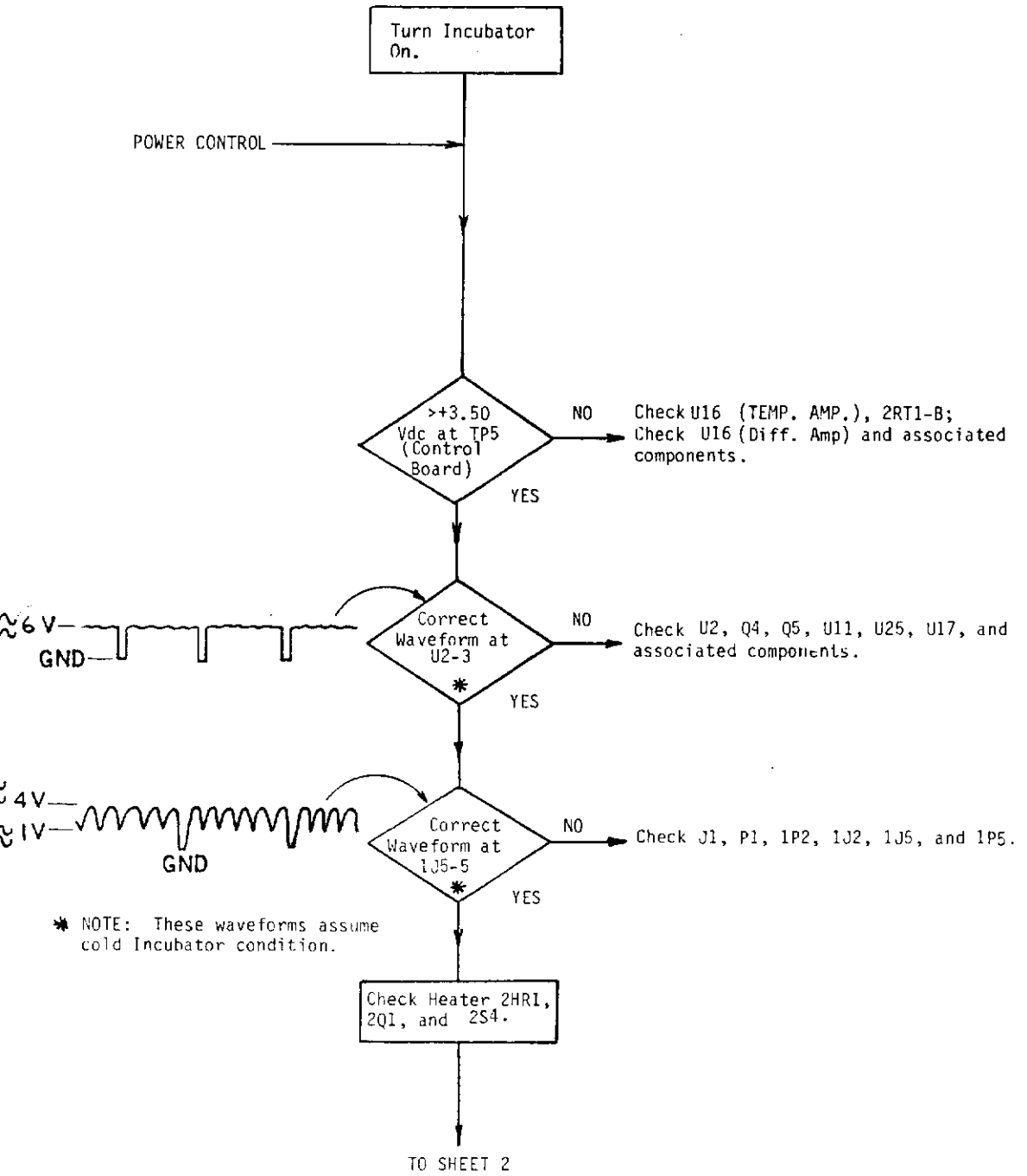
FLOWCHART 5.6 ALARM CIRCUITRY TROUBLESHOOTING (Sheet 2 of 3)



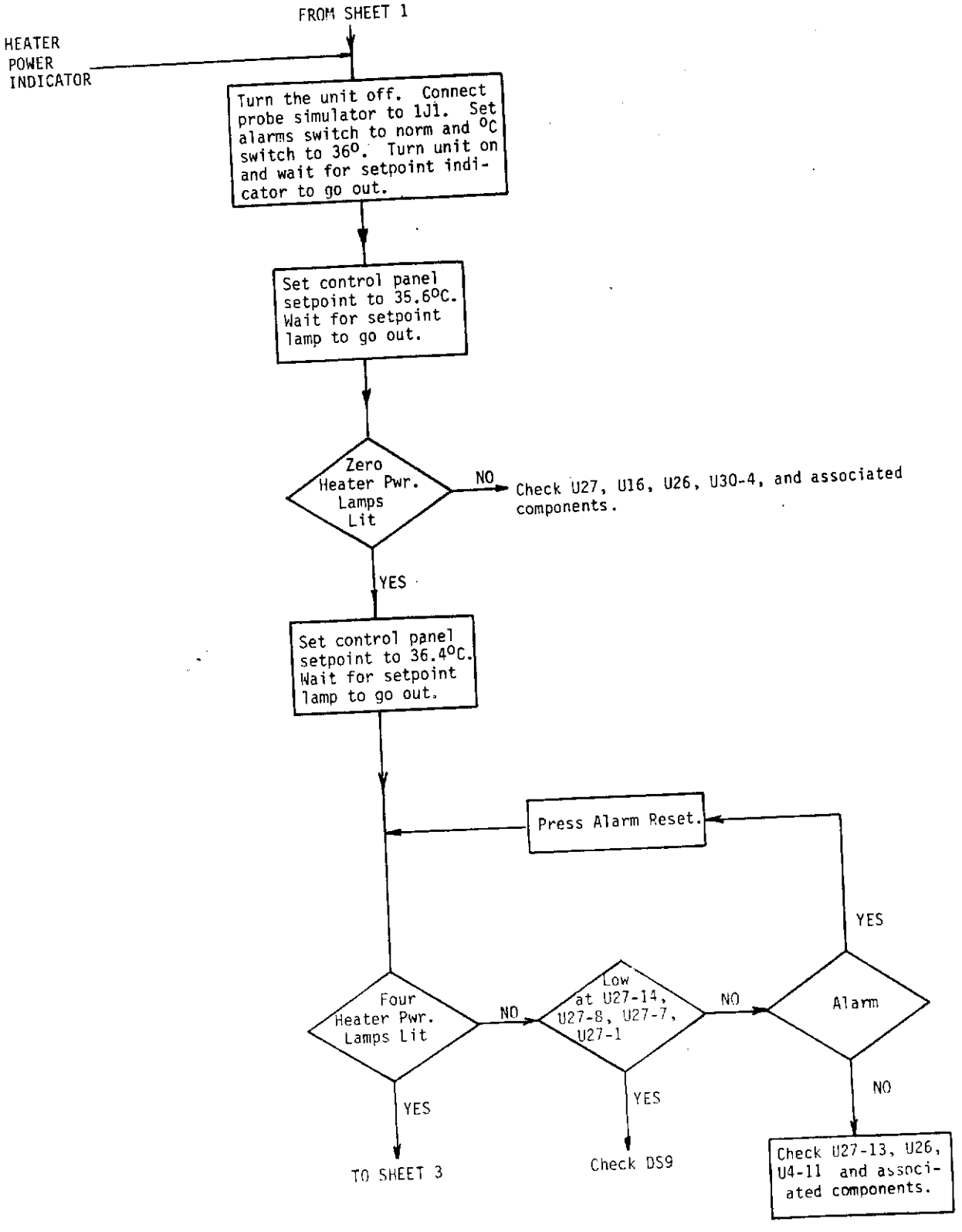
FLOWCHART 5.6 ALARM CIRCUITRY TROUBLESHOOTING (Sheet 3 of 3)



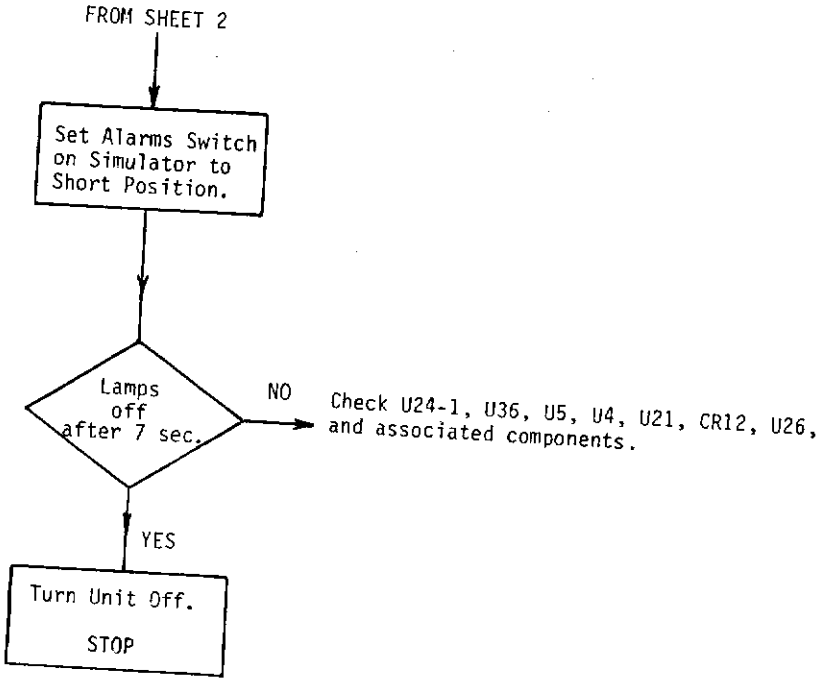
FLOWCHART 5.7 HEATER POWER CIRCUITRY TROUBLESHOOTING



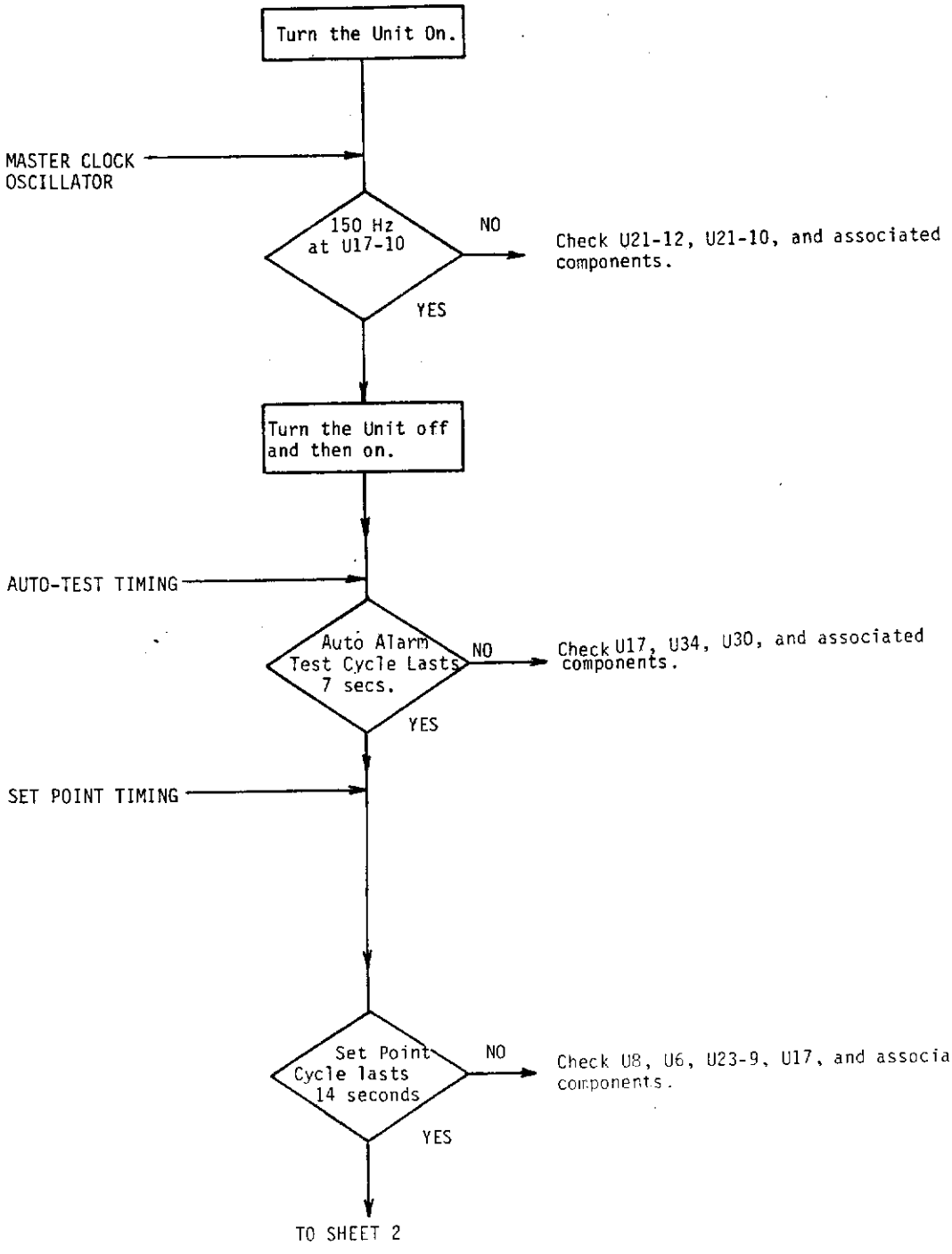
FLOWCHART 5.8 POWER CONTROL AND INDICATOR CIRCUITRY TROUBLESHOOTING (SHEET 1 of 3)



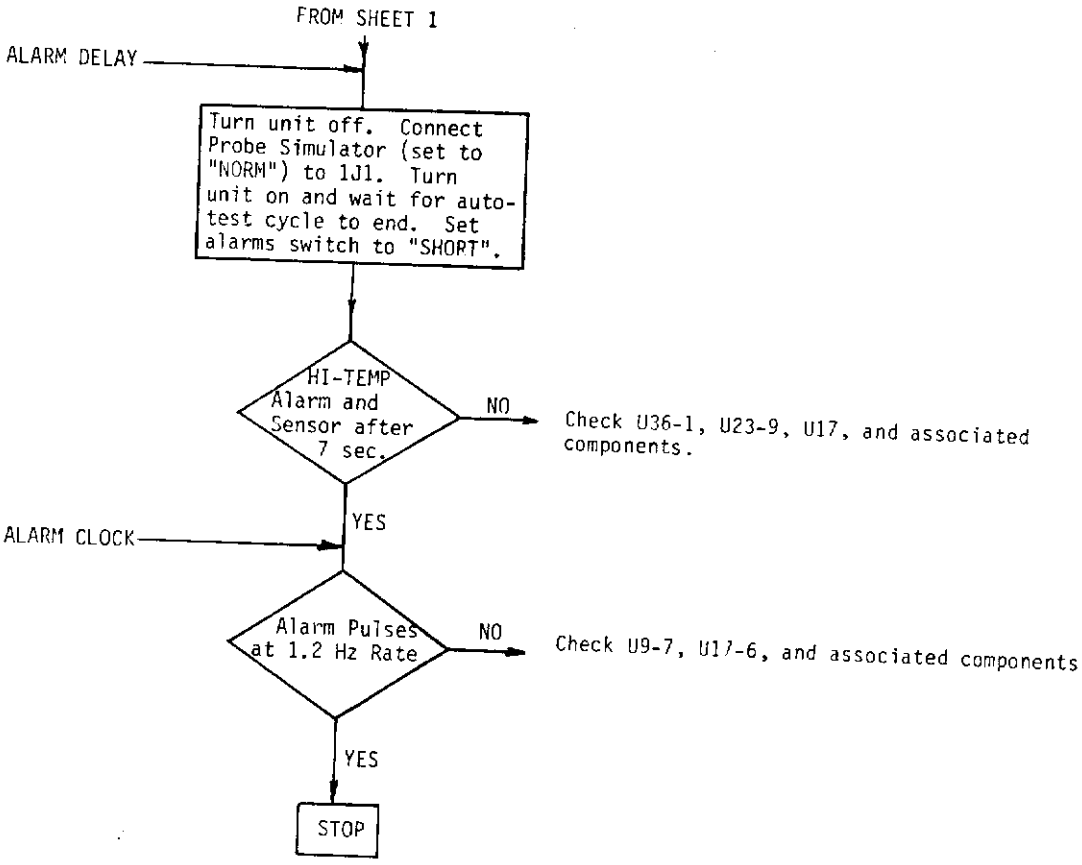
FLOWCHART 5.8 POWER CONTROL AND INDICATOR CIRCUITRY TROUBLESHOOTING (Sheet 2 of 3)



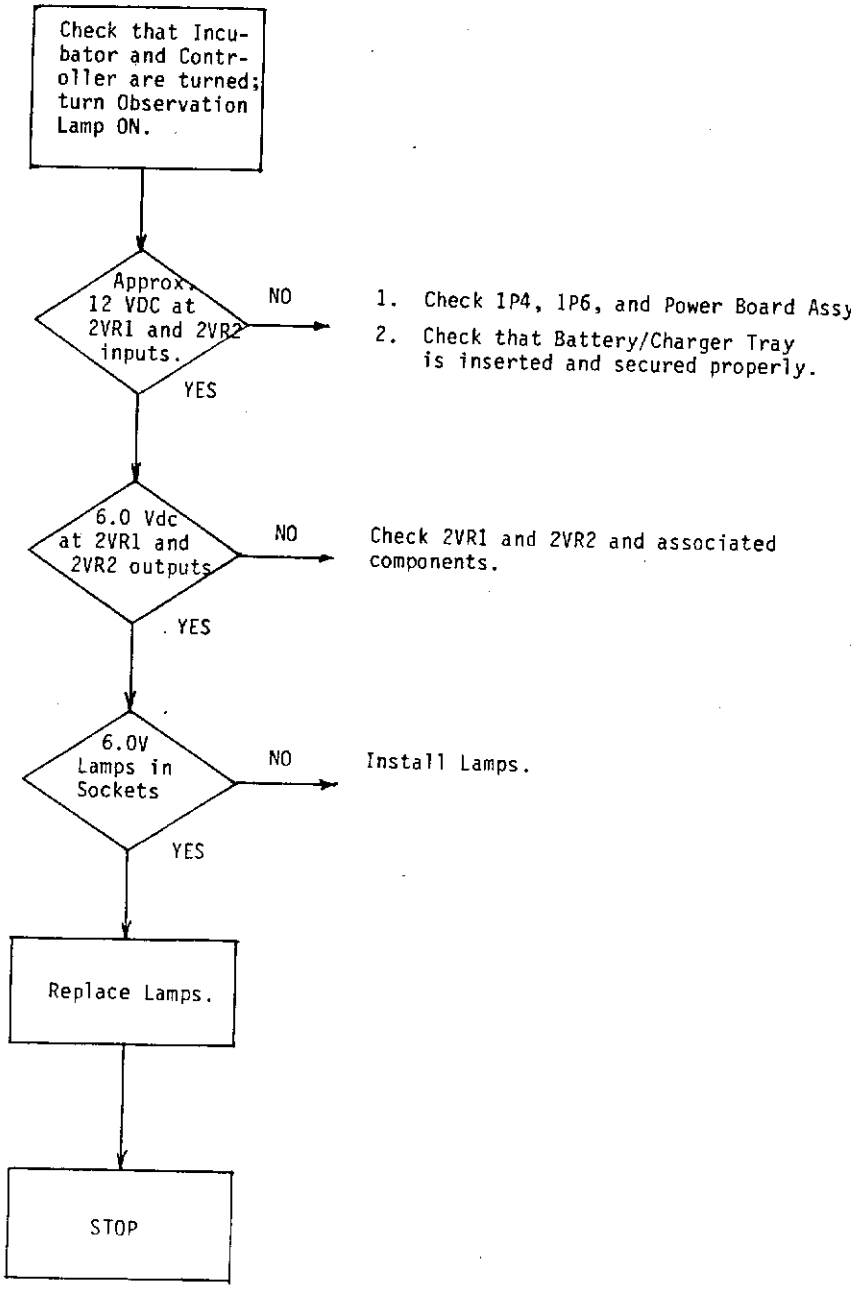
FLOWCHART 5.8 POWER CONTROL AND INDICATOR CIRCUITRY TROUBLESHOOTING (Sheet 3 of 3)



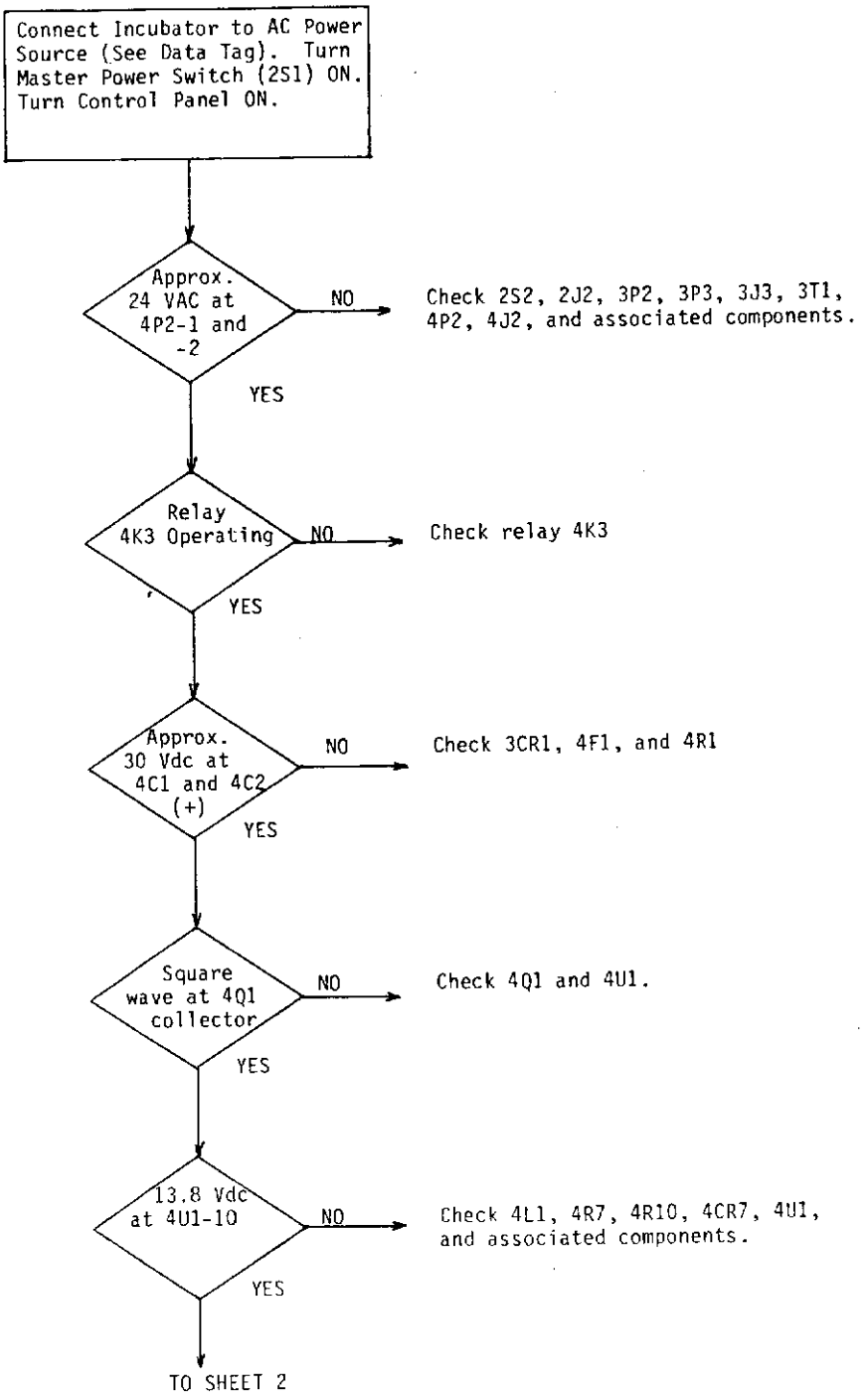
FLOWCHART 5.9 CLOCK AND TIMING CIRCUITRY TROUBLESHOOTING
(Sheet 1 of 2)



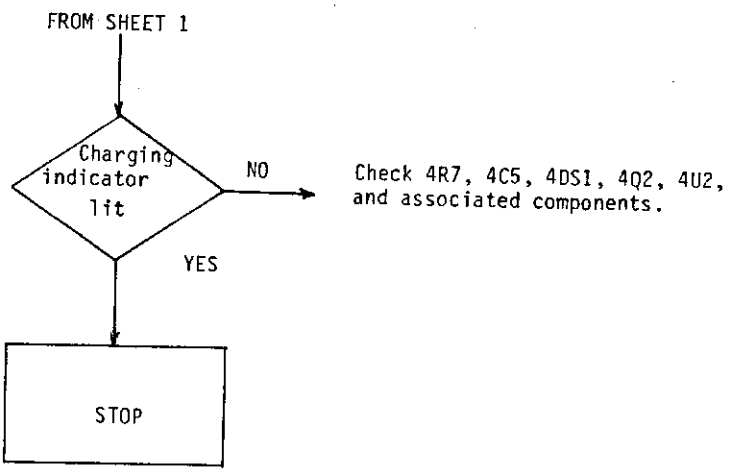
FLOWCHART 5.9 CLOCK AND TIMING CIRCUITRY TROUBLESHOOTING
(Sheet 2 of 2)



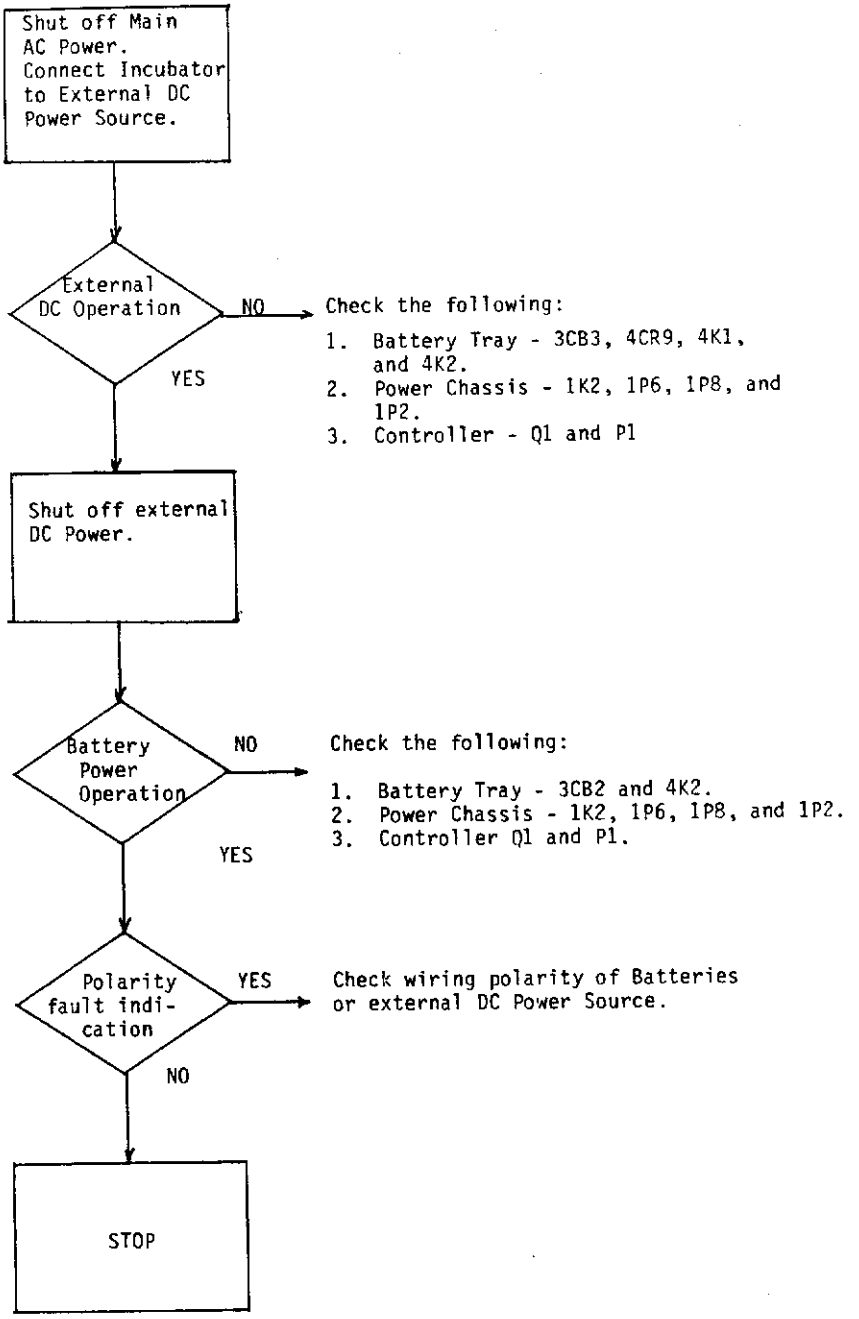
FLOWCHART 5.10 OBSERVATION LAMP TROUBLESHOOTING



FLOWCHART 5.11 BATTERY CHARGER TROUBLESHOOTING
(Sheet 1 of 2)



FLOWCHART 5.11 BATTERY CHARGER TROUBLESHOOTING
(Sheet 2 of 2)



FLOWCHART 5.12 DC POWER TROUBLESHOOTING

5.4 REMOVAL AND REPLACEMENT PROCEDURES

5.4.1 GENERAL

This section provides removal and replacement procedures for components of the Model TI100 Transport Incubator. Removal and replacement procedures for components other than those provided are obvious upon inspection.

5.4.2 CONTROLLER

1. REMOVE THE TWO SCREWS that secure the Controller to the underside of the Base Assembly.

2. SUPPORT THE CONTROLLER with one hand and remove the screw that secures the Controller to the center of the front rail.

3. LOWER THE CONTROLLER to the front shelf of the Base Assembly.

4. TO REPLACE THE CONTROLLER, reverse the above procedure.

5.4.3 POWER CHASSIS

1. REMOVE THE TWO SCREWS that secure the cover to the front of the Power Chassis.

2. DISCONNECT THE CABLES located behind the cover.

3. REMOVE THE SCREW from the bottom center of the Power Chassis and slide the chassis out of the Incubator.

4. TO REPLACE THE POWER CHASSIS, reverse the above procedure.

5.4.4 FAN MOTOR REPLACEMENT KIT, PART NUMBER 67 905 57

IMPORTANT: Fan Motor Replacement Kit, Part Number 67 905 57 is used for replacing defective fan motors in the TI100 Transport Incubator. It should be noted that two different fan motors have been used in this Incubator; the motor will be either cylindrical in shape or square in shape. The kit can be used to replace either type of motor. This paragraph contains two separate procedures, one for each type of motor. Use the appropriate procedure.

1. REPLACEMENT OF CYLINDRICAL MOTOR

NOTE: Except as indicated, retain all hardware for reuse.

A. Remove the Hood and Upper Structure Assemblies from the Incubator.

B. Refer to Figure 5.2. Remove the Impeller (item 1) from the Fan Motor shaft (item 2) and discard the Impeller.

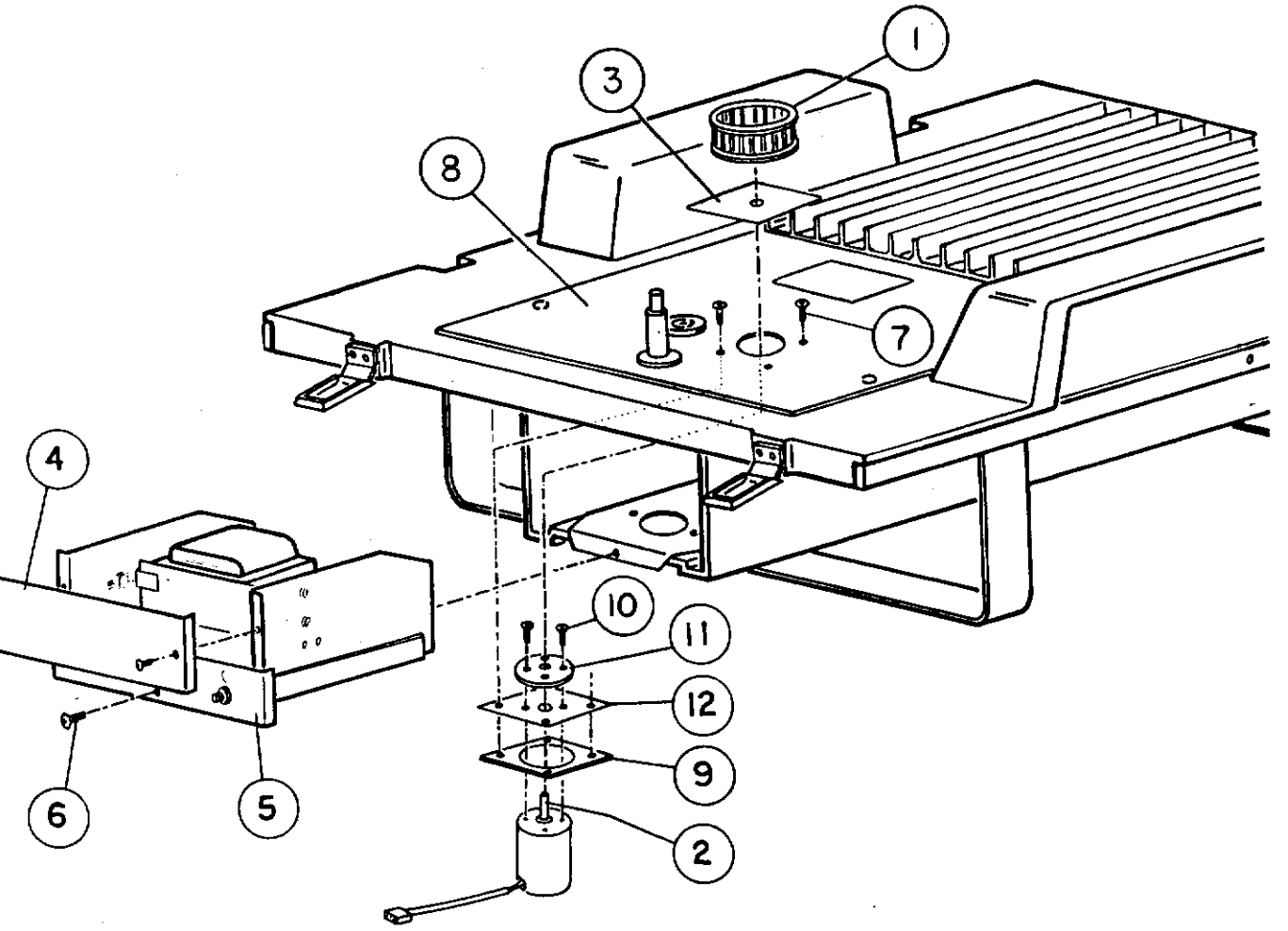


FIGURE 5.2 REMOVAL OF CYLINDRICAL MOTOR ASSEMBLY

C. If an adhesive backed motor dust cover (item 3) is in place over the Fan Motor opening, remove the cover and discard.

D. Remove the two screws that secure the cover (item 4) to the front of the Power Chassis (item 5).

E. Disconnect and tag the cables located behind the cover.

F. Remove the screw (item 6) from the bottom center of the Power Chassis and slide the chassis out of the Incubator.

G. Remove the four Motor Assembly mounting screws (item 7) from the Air Inlet Cover Plate (item 8) and remove the Motor Assembly through the Power Chassis opening.

H. Remove the square Motor Clamp Plate (item 9) from the motor and discard the Clamp Plate.

I. Remove the four 6-32 flat head screws (item 10) from the round Motor Clamp Plate (item 11), remove the clamp plate and rubber Mounting Pad (item 12) from the motor shaft and discard the old motor.

J. Refer to Figure 5.3. Install the rubber Mounting Pad (item 1) on the shaft of the replacement Motor Assembly (item 2) and secure in place with the round Motor Clamp Plate (item 3) and the four 6-32 flat head screws (item 4).

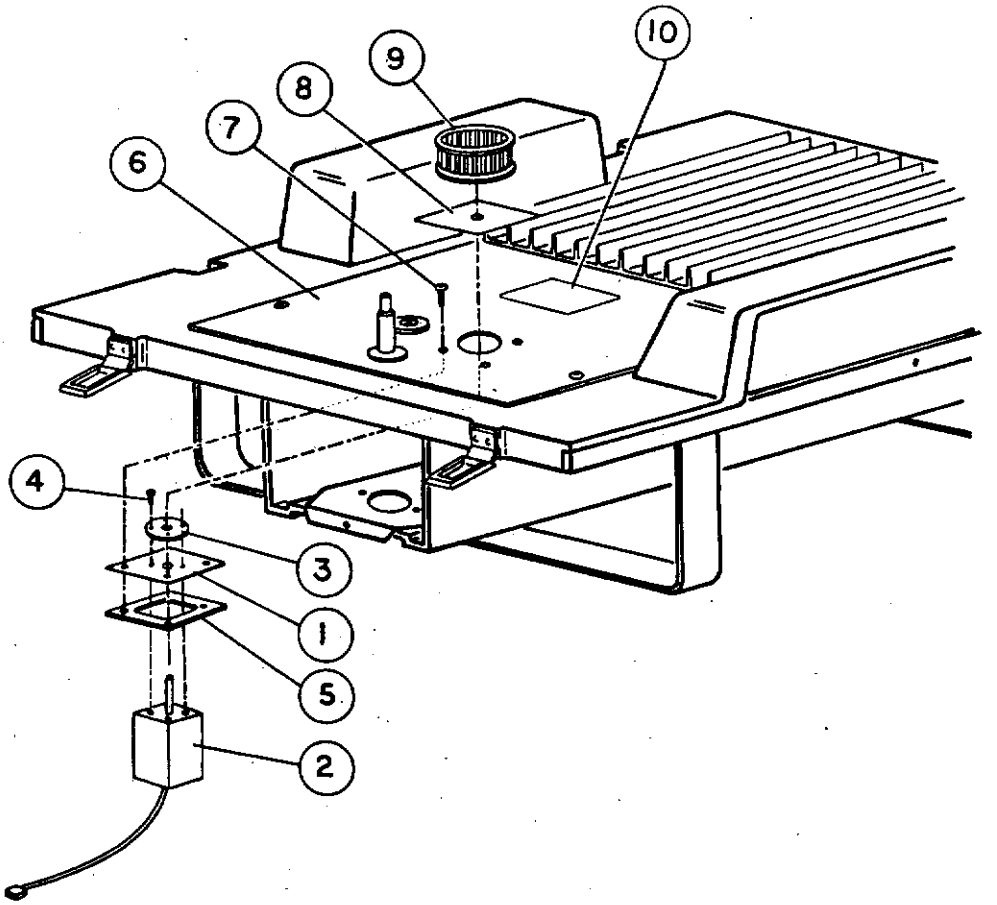


FIGURE 5.3 INSTALLATION OF REPLACEMENT MOTOR ASSEMBLY

K. Slide the new square Clamp Plate (item 5) onto the motor from the underside and secure Motor Assembly to Air Inlet Plate (item 6) using the four 4-40 screws (item 7).

L. Install the new adhesive backed motor dust cover (item 8) over the Fan Motor opening on the Air Inlet Plate.

NOTE: The dust cover must be installed before the Impeller is installed. If the mounting screws (item 7) that secure the Motor Assembly to the cover plate assembly are round head screws, it will be necessary to cut the corners from the cover before installing; if the screws are countersunk, install the cover as shipped.

M. Install the new Impeller (item 9) on the Fan Motor Shaft following the directions given on the label (item 10).

CAUTION: Avoid placing excessive axial force on the motor shaft when installing the Impeller. Damage to the motor bearings may result.

N. Reinstall the Power Chassis and reconnect all connectors.

IMPORTANT: When connecting the Fan Motor plug 1P3 to Power Board Connector 1J3, make sure that the red lead (pin 2) and the gray lead (pin 1) of the plug are connected to the corresponding pins on the connector.

O. Connect one end of the main AC power cord to primary power connector on Power Chassis and the other end to a wall receptacle.

P. Set the AC POWER switch on the Power Chassis to the ON-1 position.

Q. Depress the CONTROLLER ON switch on the Controller and verify that the Impeller turns freely.

R. Depress the CONTROLLER OFF switch on the Controller and reassemble the Incubator.

S. Depress the CONTROLLER ON switch on the Controller and allow Incubator temperature to stabilize to verify proper operation.

2. REPLACEMENT OF SQUARE MOTOR

NOTE: Except as indicated, retain all hardware for reuse.

A. Remove the Hood and Upper Structure Assemblies from the Incubator.

B. Refer to Figure 5.4. Remove the Impeller (item 1) from the Fan Motor shaft (item 2) and discard.

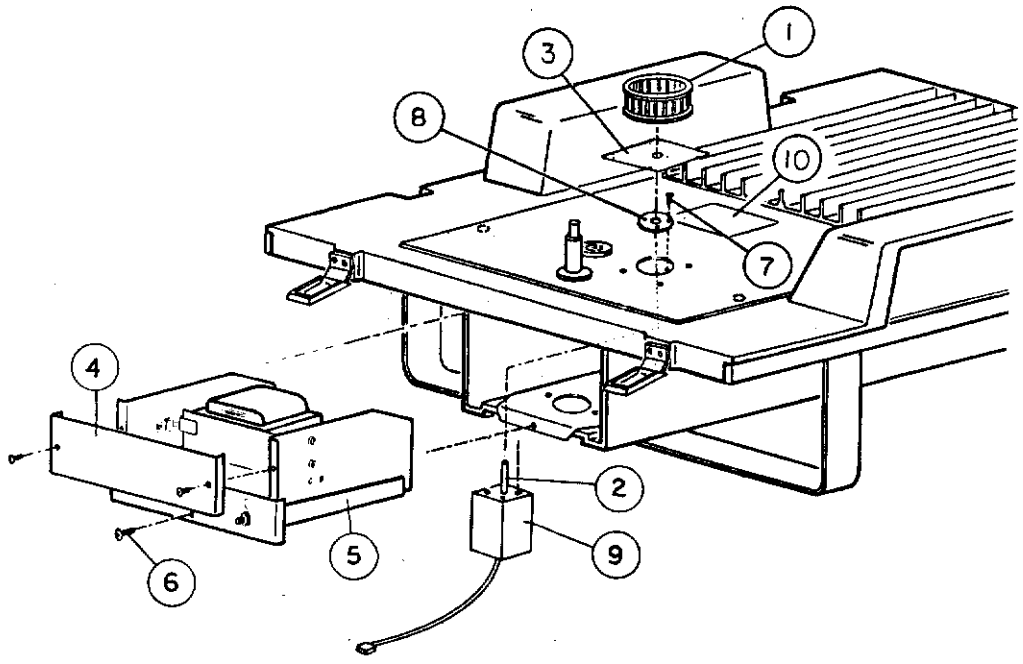


FIGURE 5.4 INSTALLATION OF REPLACEMENT MOTOR

C. Remove the adhesive backed motor dust cover (item 3) from the Fan Motor opening and discard the cover.

D. Remove the two screws that secure the cover (item 4) to the front of the Power Chassis (item 5).

E. Disconnect and tag the cables located behind the cover.

F. Remove the screw (item 6) from the bottom center of the Power Chassis and slide the chassis out of the Incubator

G. Remove the four 6-32 flat head screws (item 7) that secure the round Motor Mounting Plate (item 8) to the Fan Motor.

H. Remove the Fan Motor Assembly (item 9) through the Power Chassis opening; discard the old motor.

I. Install the replacement Fan Motor by reversing the procedure given in Steps D through H.

IMPORTANT: When connecting the Fan Motor plug 1P3 to Power Board Connector 1J3, make sure that the red lead (pin 2) and the gray lead (pin 1) of the plug are connected to the corresponding pins on the connector.

J. Install the new adhesive backed motor dust cover (item 3) over the Fan Motor opening on the Air-Inlet plate.

K. Install the new Impeller (item 1) on the Fan Motor Shaft following the directions given on the label (item 10).

CAUTION: Avoid placing excessive axial force on the motor shaft when installing the Impeller. Damage to the motor bearings may result.

L. Connect one end of the main AC power cord to primary power connector on Power Chassis and the other end to a wall receptacle.

M. Set the AC POWER switch on the Power Chassis to the ON-1 position.

N. Depress the CONTROLLER ON switch on the Controller and verify that the Impeller turns freely.

O. Depress the CONTROLLER OFF switch on the Controller and reassemble the Incubator.

P. Depress the CONTROLLER ON switch on the Controller and allow Incubator temperature to stabilize to verify proper operation.

5.4.5 AIR INLET PLATE REPLACEMENT KIT, PART NUMBER 67 905 55

1. REMOVE THE HOOD AND UPPER STRUCTURE ASSEMBLY (ITEM 2) from the Incubator.

2. REFER TO FIGURE 5.5 and proceed as follows:

   A. Remove the Impeller (item 1) from the Fan Motor Shaft (item 2).

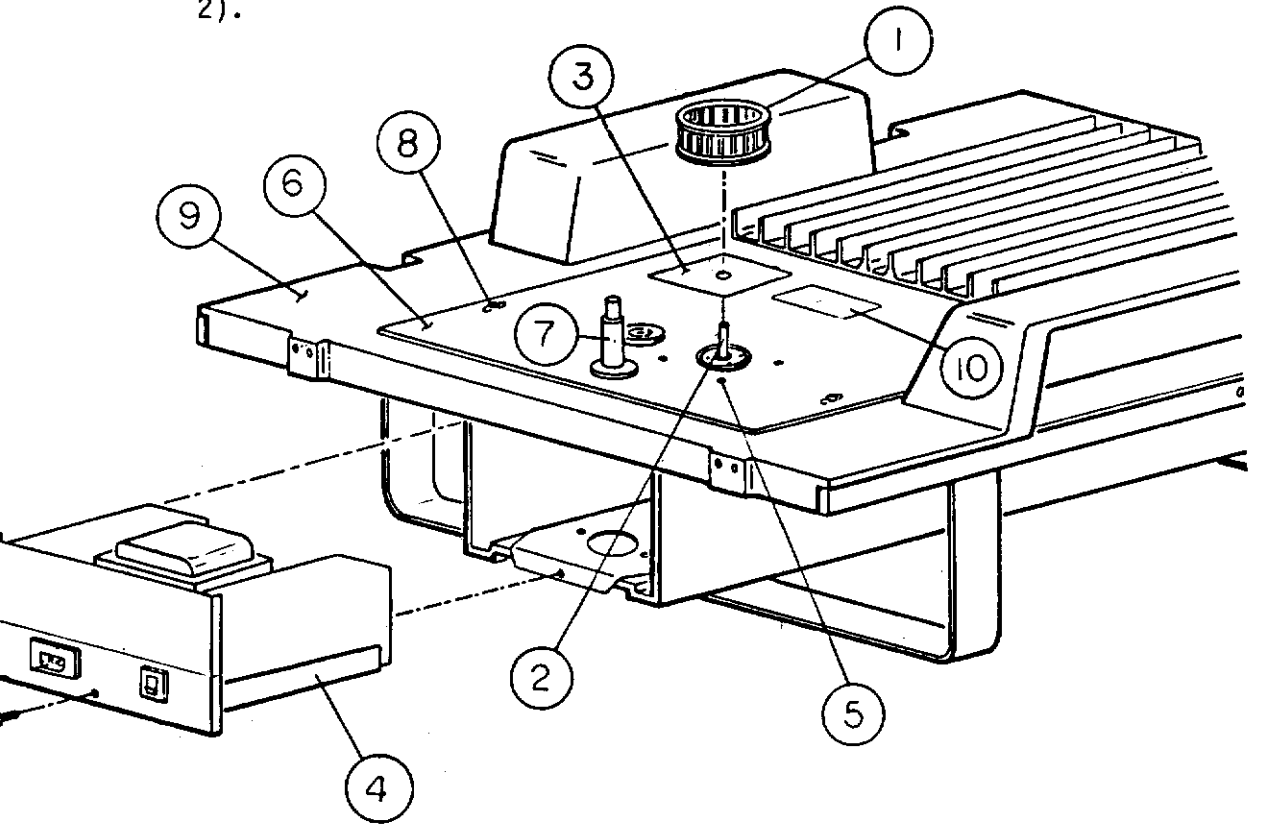


FIGURE 5.5 AIR INLET PLATE REPLACEMENT

B. If an adhesive backed cover (item 3) is in place over the Fan Motor opening, remove the cover and discard.

C. Remove the Power Chassis (item 4) using the procedure given in paragraph 5.4.3.

D. Remove and discard the four screws (item 5) that secure the square Fan Motor clamp plate and mounting pad to the Air Inlet Plate (item 6) and remove the clamp plate, mounting pad, and Fan Motor.

E. Remove the thermistor assembly (item 7) from the Air Inlet Plate.

F. Remove the two screws (item 8), flat washers, lockwashers, and nuts that secure the Air Inlet Plate to the Base Molding (item 9); save the hardware for reuse.

G. Remove the air inlet plate from the Base Molding.

H. Reinstall the fan motor, clamp plate, and mounting pad on the new Air Inlet Plate using the four 1/4 in. flat head screws supplied in the kit.

I. Reinstall the thermistor on the Air Inlet Plate.

J. Reinstall the air inlet plate on the Base Molding using the two screws, flat washers, lockwashers, and nuts saved in step F.

K. Install the new adhesive backed cover (item 3) supplied with the kit over the Fan Motor opening and mounting screws.

L. Install the fan impeller on the Fan Motor shaft by following the directions given on the label (item 10).

M. Reassemble the Incubator.

5.4.6 HEATER ASSEMBLY AND COMPONENT REPLACEMENT

1. HEATER ASSEMBLY

A. Remove the Hood and Upper Structure Assembly from the Incubator.

B. Remove the Controller as described in paragraph 5.4.2.

C. Remove the Power Chassis as described in paragraph 5.4.3.

D. Refer to Figure 6.3 and remove the two 3/4 in. screws and lockwashers (items 38 and 34) that secure the Heater Assembly to the right hand Base Support (item 2).

E. Refer to Figure 6.3 and remove the two 5/8 in. screws (item 42), flat washers (item 33), and lockwashers (item 34) that secure the Heater Assembly to the Base Molding (item 1).

F. Refer to Figure 6.3 and remove the Heater Assembly (item 22) from the Incubator.

G. Replace the Heater Assembly and reassemble the Incubator by reversing the above procedure.

2. POWER TRANSISTOR

A. Remove the Heater Assembly as described in step 1 above, then refer to Figure 6.4 and proceed as follows:

B. Remove the Heat Sink Bracket (item 16) by removing the four screws and washers (items 6 and 5).

C. Remove the Transistor (item 18) from the socket (item 15) on the Heat Sink Bracket by removing the two screws and washers (items 19 and 20).

NOTE: In some units the emitter lead of the Transistor is soldered to the socket pin and must be unsoldered to permit removal of the Transistor.

D. Install the new transistor and reassemble the Heater Assembly by reversing the above procedure. Be sure to solder the emitter lead to the socket pin before reassembling.

E. Reassemble the Incubator.

3. THERMOSTAT

A. Remove the Heater Assembly as described in step 1 above, then refer to Figure 6.4 and proceed as follows:

B. Disconnect the two wires from the Thermostat (item 14).

C. Remove the two screws and lockwashers (items 6 and 5) that secure the thermostat to the Heatsink (item 1), and remove the thermostat.

D. Install the new thermostat and reassemble the Heater Assembly by reversing the above procedure.

E. Reassemble the Incubator.

5.4.7 BATTERY/CHARGER TRAY REMOVAL

CAUTION: To prevent damage to electronics, all power must be removed from the Incubator before removing the Battery/Charger Tray.

1. SET THE MASTER AC POWER SWITCH on the Power Chassis to the OFF-O position and depress the CONTROLLER OFF switch on the Controller front panel.

2. LOOSEN THE BATTERY/CHARGER TRAY retaining screw completely.

3. GRASP THE HANDLE and VERY SLOWLY withdraw the tray approximately 6 inches (15 cm).

> WARNING: The Battery/Charger Tray weights approximately 50 lbs. (22.7 Kg) with two batteries. The tray must be well supported during removal and installation. Exercise care to prevent pinching of fingers during removal or installation.

4. POSITION A HAND ON EACH SIDE of the tray and as close as possible to the Incubator.

5. SLOWLY REMOVE THE TRAY from the Incubator. Place the tray on a surface that will support its weight.

6. TO REINSTALL the Battery/Charger Tray, using both hands carefully insert the tray into the Incubator and slide the tray all the way into the compartment. Tighten the fastening retaining screw completely.

5.4.8 BATTERY REPLACEMENT

1. REMOVE THE BATTERY/CHARGER TRAY from the Incubator using the procedure given in paragraph 5.4.7.

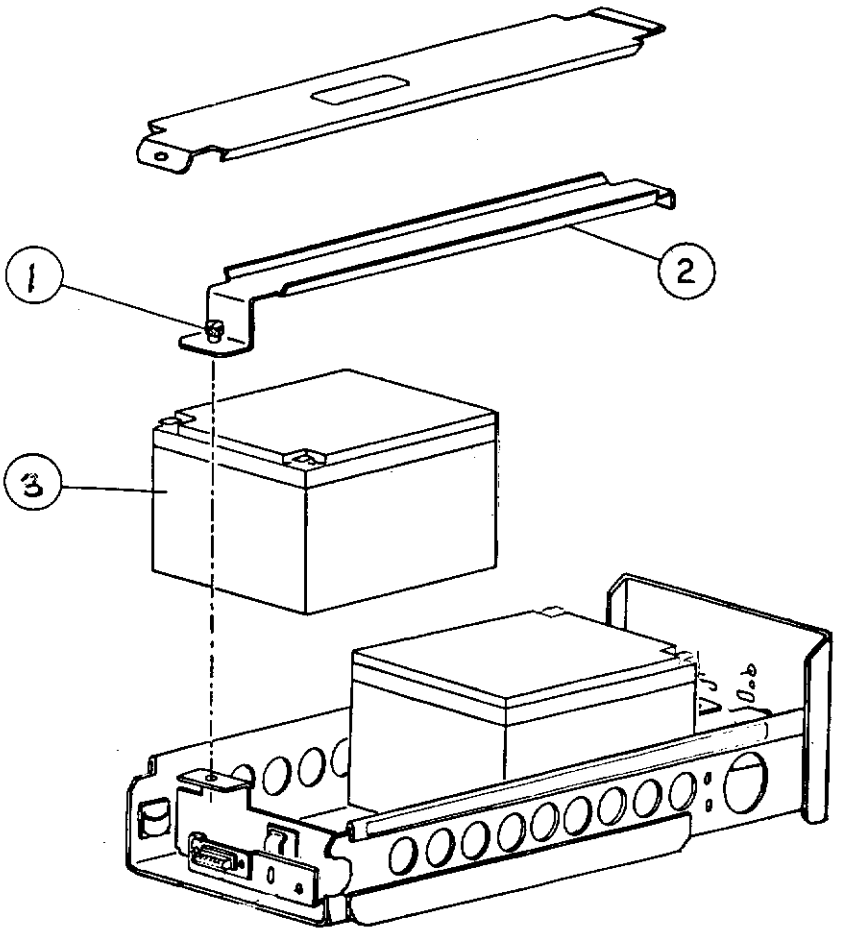


FIGURE 5.6 BATTERY REPLACEMENT

2. REFER TO FIGURE 5.6, loosen the battery clamp retaining thumbscrew (item 1) and remove battery clamp (item 2) by raising the rear end of the clamp until it unhooks from the front of the tray.

3. DISCONNECT THE RED AND BLACK LEADS from the defective battery (item 3) and remove the battery from the tray.

4. INSTALL THE NEW BATTERY and reconnect the red and black leads.

5. REASSEMBLE THE BATTERY/CHARGER TRAY and re-install in the Incubator; tighten the Battery/Charger Tray retaining screw securely.

6. CHECK THE INSTALLATION by depressing the CONTROLLER ON switch on the Controller front panel. The Incubator should operate normally from DC power supplied by the battery power source.

SECTION 6
PARTS LIST

6.1 GENERAL

This section provides parts lists for Transport Incubator, Model TI100. Part numbers of accessories and single use items are provided below.

ACCESSORIES:

I.V. Pole	67 091 75
Adjustable Stand Assembly	67 090 71
Accessory Shelf	67 142 70
Restraint Straps (10 per case)	67 903 95
Oxygen Regulator/Flowmeter	67 090 75
Probe Simulator	67 902 80
External Battery Charger Adapter	
100V, 110/120V	67 325 70
220/240V	67 325 75
DC Power Cord Receptacle	67 010 76

SINGLE USE ITEMS:

Mattress, Disposable (Case of 10)	67 903 85
Access Port Cuffs, Disposable (Case of 100)	26 934 81
Air Filter (Box of 6)	67 070 75
Humidity Pad (Case of 25)	67 903 75

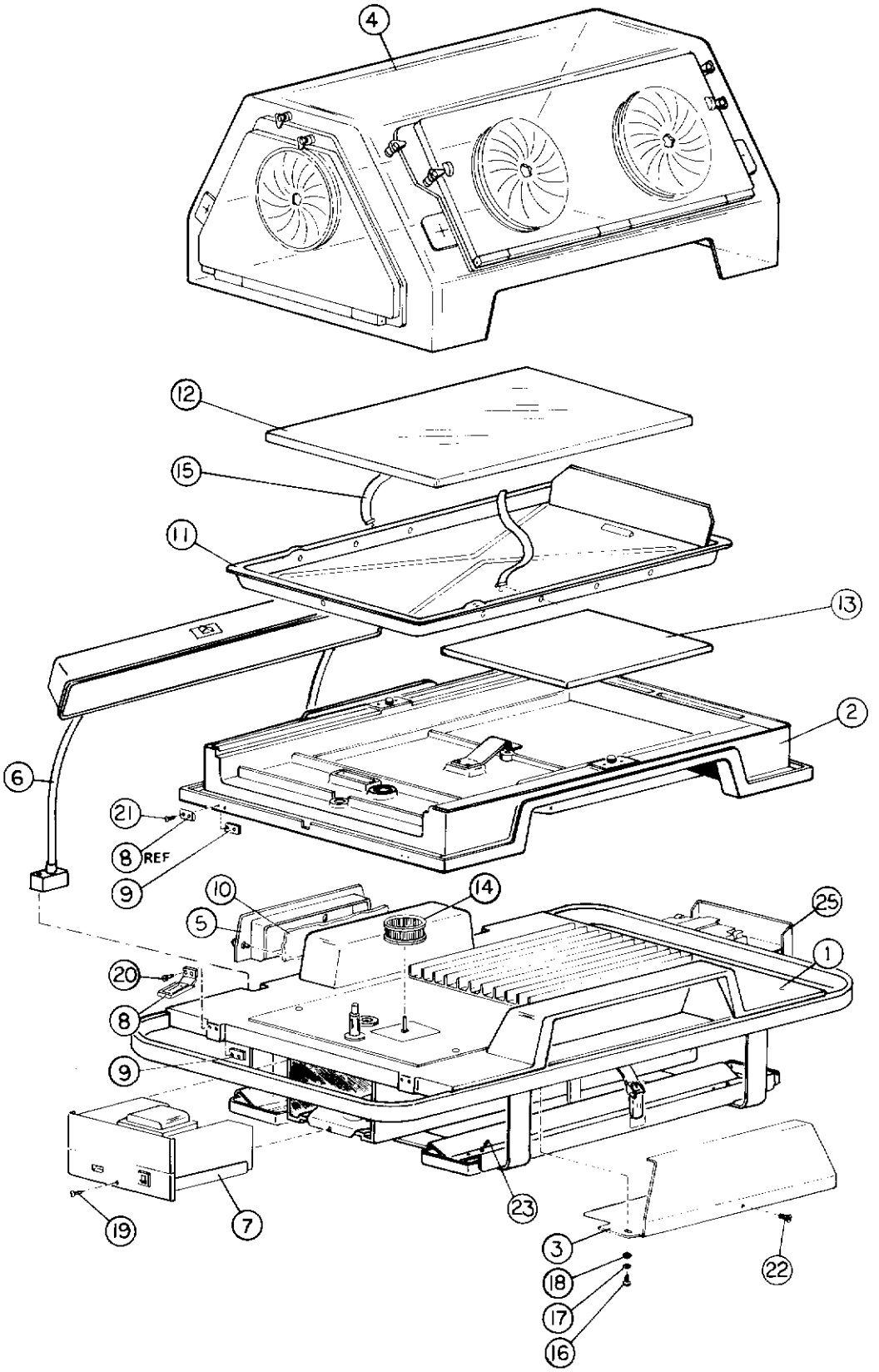


FIGURE 6.1 PARTS LOCATION DIAGRAM, BASIC ASSEMBLY

TABLE 6.1 BASIC ASSEMBLY, PARTS LIST
(Sheet 1 of 1)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		BASIC ASSEMBLY	
		110/120 Volt	67 301 70
		220/240 Volt	67 301 80
		100 Volt	67 301 90
1		Base Assembly (Refer to Table 6.3)	REF
2		Upper Structure Assembly (Refer to Table 6.5)	REF
3		Controller Assembly (Refer to Table 6.9)	REF
4		Hood Assembly (Refer to Table 6.2)	REF
5		Cover, Filter	
		English Labeling	67 905 60
		Spanish Labeling	67 905 61
		French Labeling	67 905 62
		German Labeling	67 905 63
6		Lamp Assembly (Refer to Table 6.16)	REF
7		Power Chassis (Refer to Table 6.6)	REF
8		Latch, Draw	67 000 51
9		Plate, Tapped	67 000 52
10		Air Filter (Box of 6)	67 070 75
11		Tray Assembly Mattress	67 020 01
12		Mattress Assembly (Case of 10)	67 903 86
13		Humidity Pad (Case of 25)	67 903 75
14		Impeller (for round motor)	67 100 17
		Impeller (for square motor)	67 100 48
15		Restraint Straps (Case of 10)	67 903 95
16		Screw, 8-32 x 3/8 TR PH SS	99 031 38
17		Washer #8 LK SP SS	99 122 95
18		Washer #8 FL SS	99 122 62
19		Screw, 10-32 x 5/16 TR PH SS	99 040 86
20		Screw, 4-40 x 7/8 FL SL SS	99 012 27
21		Screw, 4-40 x 7/16 FL SL SS	99 011 36
22		Screw, 10-32 x 5/8 FL PH SS	99 042 62
23		Screw, 10-32 x 1/4 TR PH SS	99 040 51
24		Interconnect Cable (Not Shown)	67 100 18
25		Battery Tray Assembly (Refer to Table 6.12)	REF

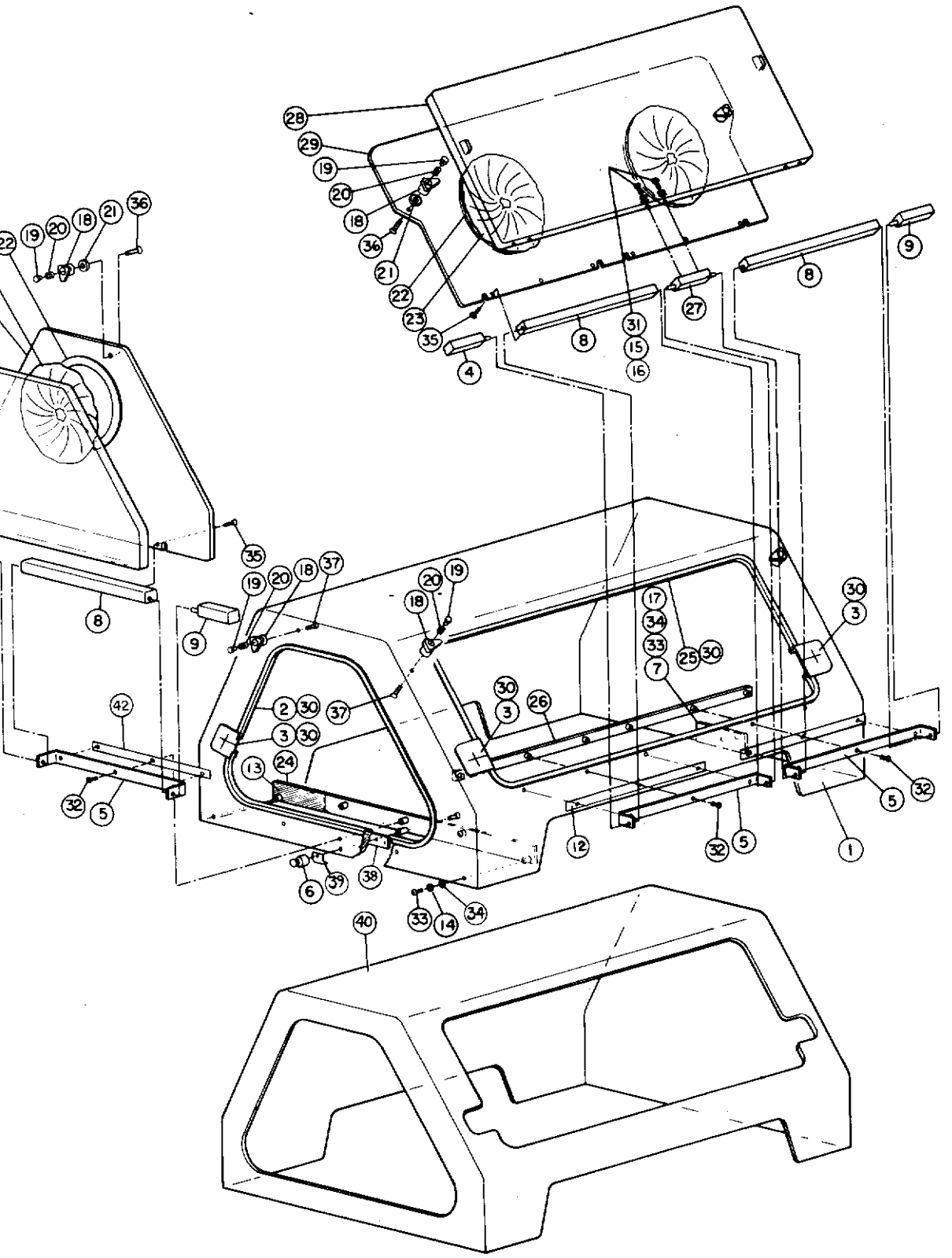


FIGURE 6.2 PARTS LOCATION DIAGRAM, HOOD ASSEMBLY

TABLE 6.2 HOOD ASSEMBLY PARTS LIST
(Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		HOOD ASSEMBLY, OUTER, COMPLETE	
		English Labeling	67 906 90
		Spanish Labeling	67 906 91
		French Labeling	67 906 92
		German Labeling	67 906 93
1		HOOD ASSEMBLY, OUTER, PLEXGLAS® ONLY	
		English Labeling	67 906 95
		Spanish Labeling	67 906 96
		French Labeling	67 906 97
		German Labeling	67 906 98
2		Gasket, Door End	67 030 13
3		Grommet, Access	67 000 38
4		Hinge, Left, Assembly	67 030 71
5		Bracket, Hinge	67 000 21
6		Stud, Hood Retainer	67 030 16
7		Plate, Support	67 000 57
8		Pivot, Hinge, Long	67 000 22
9		Hinge, Right Assembly	67 030 72
10		Door, End, Inner	67 034 70
11		Door, End, Outer	67 033 70
12		Pad, Hinge	67 030 23
13		Pad, Head End	67 030 24
14		Washer, #4 LK SP SS	99 121 36
15		Washer, #6 FL NL	99 122 04
16		Washer #6 LK SP SS	99 122 16
17		Strip, Pad, Foam	67 030 26
18		Latch, Door	67 000 66
19		Stud, Latch Guide	67 000 67
20		Spring, Compression	67 000 68
21		Spacer, Latch	67 030 15
22		Gasket, Access	68 120 00
23		Cuff, Access Port	68 120 55
24		Strip, Tapped, End	67 030 21
25		Gasket, Door, Front	67 030 14
26		Strip, Tapped, Front	67 000 47

TABLE 6.2 HOOD ASSEMBLY PARTS LIST
(Sheet 2 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
27		Hinge, Center, Assembly	67 030 73
28		Door, Front, Outer	67 032 70
29		Door, Front, Inner	67 000 09
30		Adhesive, Plastic	99 901 67
31		Screw, 6-32 x 1/2 RD PH SS	99 023 88
32		Screw, 4-40 x 5/16 FL PH SS	99 010 77
33		Screw, 4-40 x 5/16 TR PH SS	99 010 76
34		Washer, #4 FL NL	99 121 23
35		Screw, 6-32 x 7/16 FL PH SS	99 023 58
36		Screw, 8-32 x 5/8 FL PH SS	99 032 58
37		Screw, 8-32 x 1/2 FL PH SS	99 032 09
38		Pad, Foot End	67 030 22
39		End Access Door Safety Spring Kit	67 900 90
40*		Hood, Inner	67 093 75

* Must be Ordered Separately.

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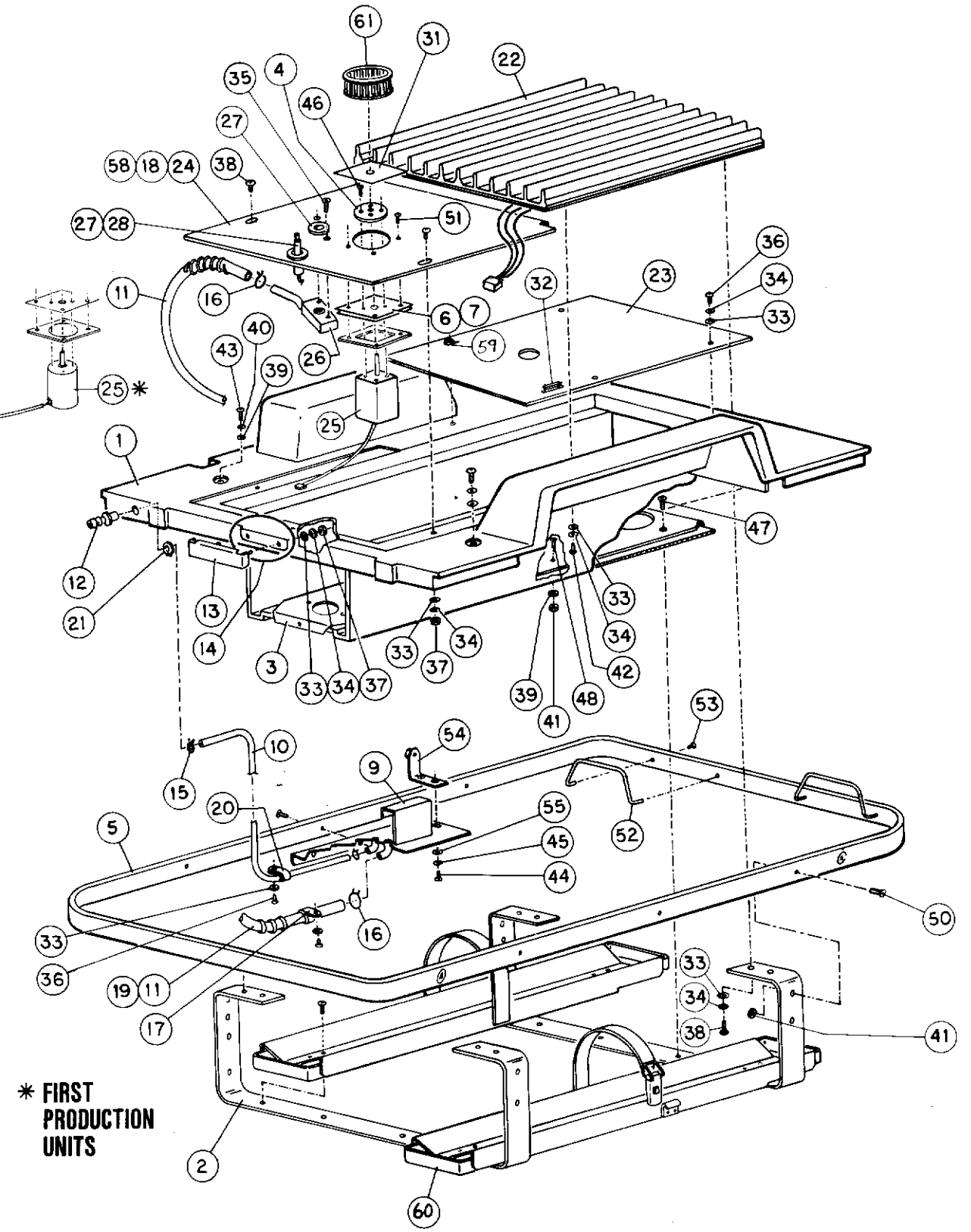

* FIRST PRODUCTION UNITS

FIGURE 6.3 PARTS LOCATION DIAGRAM, BASE ASSEMBLY

TABLE 6.3 BASE ASSEMBLY PARTS LIST
(Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		BASE ASSEMBLY	67 302 70
1		Molding, Base	67 000 53
2		Support, Base	67 100 01
3		Plate, Support	67 100 02
4		Clamp Plate, Round, Motor	67 101 11
5		Handle, Carrying	67 300 01
6		Clamp Plate, Square, Motor	67 101 09
7		Mounting Pad, Motor	67 101 12
8		Not Used	
9		Plenum, Filter	67 000 15
10		Tubing, Clear, PVC, 1/4 I.D. x 3/8 O.D. x 14 LG	67 010 07
11		Tubing, Clear, PVC, 1/2 I.D. x 11/16 O.D. x 10 .50 LG	67 010 08
12		Fitting, Hose Conn.	67 000 25
13		Cover, Retainer "O" Ring	
		English Labeling	67 906 65
		Spanish Labeling	67 906 66
		French Labeling	67 906 67
		German Labeling	67 906 68
14		"O" Ring	99 163 03
15		Clamp, Hose	20 015 12
16		Clamp, Hose	20 015 14
17		Clamp, Cable, 11/16 I.D.	17 061 76
18		Clip, Plastic, Self-Adhesive, .25 Dia	77 000 65
19		Spring, Compression	67 010 46
20		Clamp, Cable, 3/8 Dia.	17 720 37
21		Ring, Retaining, Ext.	99 182 05
22		Heater Assembly (Refer to Table 6.4)	67 305 75
23		Plate, Cover	67 300 07
24		Cover Assembly, Air Inlet Replacement Kit	67 905 55
25		Fan Motor Replacement Kit	67 905 57
26		Air Inlet Assembly	67 010 83
27		Gasket, Air Intake	67 000 50
28		Thermistor Assembly 104F	67 108 70

TABLE 6.3 BASE ASSEMBLY, PARTS LIST
(Sheet 2 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
29		Not Used	
30		Not Used	
31		Cover, Adhesive Back	67 100 44
32		Clamp, Flat Cable	17 062 14
33		Washer, #8 FL SS	99 122 62
34		Washer, #8 LK SP SS	99 122 95
35		Screw, 6-32 x 5/16 FL PH SS	99 022 99
36		Screw, 8-32 x 3/8 TR PH SS	99 031 38
37		Nut, 8-32 HEX, SS	99 106 01
38		Screw, 8-32 x 3/4 TR PH SS	99 032 85
39		Washer, #10 FL SS	99 123 62
40		Washer, #10 LK SP S CA	99 124 16
41		Nuts 10-32 HX KEPS CAD PL	99 107 36
42		Screw, 8-32 x 5/8 TR PH SS	99 032 57
43		Screw, 10-32 x 1/2 TR PH SS	99 042 01
44		Screw, 6-32 x 3/8 TR PH SS	99 023 31
45		Washer, #6 LK SP SS	99 122 16
46		Screw, 6-32 x 3/8 FL PH SS	99 023 39
47		Screw, 10-32 x 3/4 FL PH SS	99 042 90
48		Screw, 10-32 x 5/8 FL PH SS	99 042 62
49		Screw, 10-32 x 5/8 TR PH SS	99 031 99
50		Screw, 10-32 x 7/8 FL PH SS	99 043 19
51		Screw, 4-40 x 1/4 FL PH SS	99 010 62
52		Cleat, Cable	67 010 03
53		Screw, 8-32 x 1/2 FL PH SS	99 032 09
54		Bracket, Plenum	67 070 04
55		Washer, #6 FL SS	99 122 03
56		Cable Assy, D.C. Power (Not Shown)	67 302 76
57		Not Used	
58		Clip, Cable	67 300 14
59		Clamp, Cable	17 061 63
60		Oxygen Tank Support Shelf (See Table 6.15 for breakdown).	REF
61		Impeller (For Round Motor) (See Note)	67 100 17
		Impeller (For Square Motor) (See Note)	67 100 48
		NOTE: Not part of Base Assembly; must be ordered separately.	

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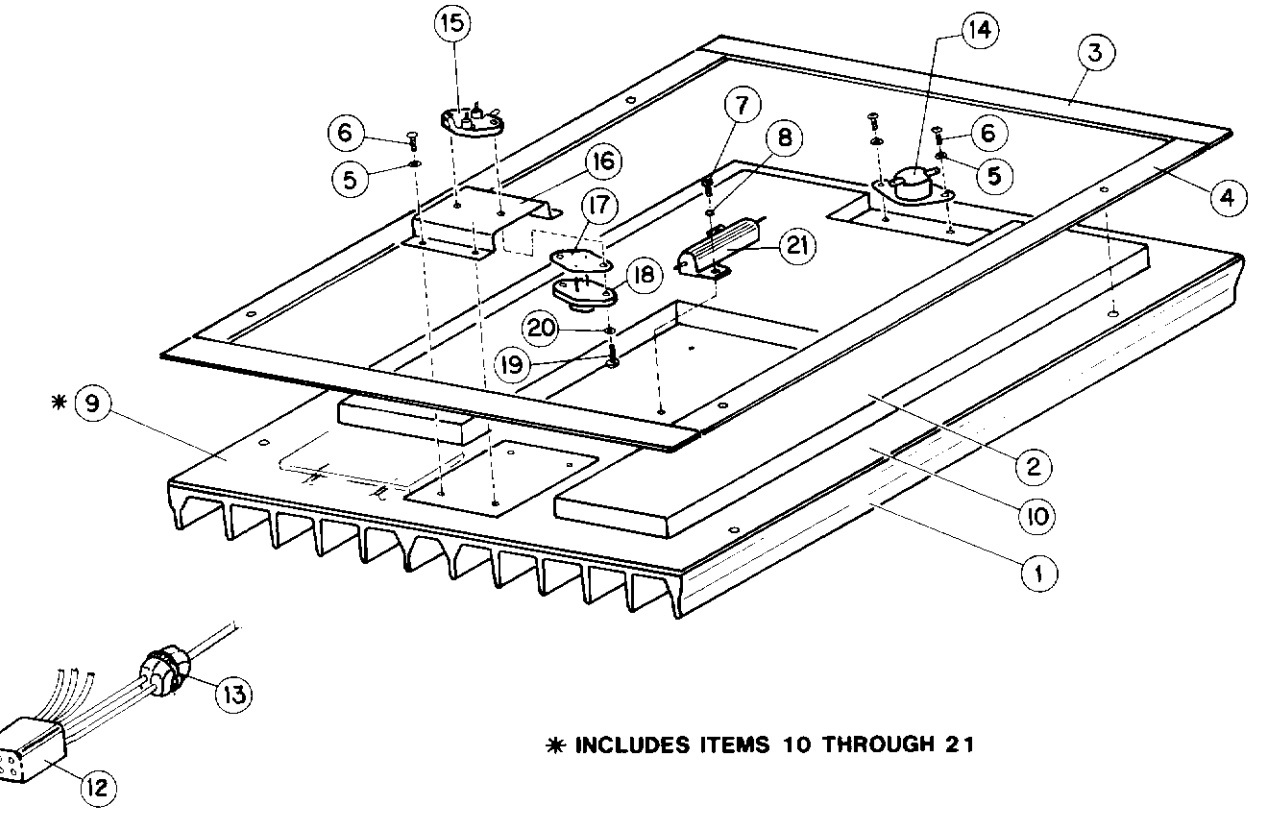


* INCLUDES ITEMS 10 THROUGH 21

FIGURE 6.4 PARTS LOCATION DIAGRAM, HEATER ASSEMBLY

TABLE 6.4 HEATER ASSEMBLY PARTS LIST
(Sheet 1 of 1)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		HEATER ASSEMBLY	67 305 75
1**		Heat Sink	67 100 33
2**		Insulator, Heater	67 300 04
3		Gasket, End	67 001 07
4		Gasket, Side	67 001 08
5		Washer, #6 LK SP SS	99 122 15
6		Screw, 6-32 x 1/4 RD PH SS	99 022 66
7		Screw, 4-40 x 1/4 TR PH SS	99 010 56
8		Washer, #4 LK SP SS	99 121 36
9*		Electrical Assembly	67 305 77
10**		Heater	67 300 03
11		Wire Set, Electrical Assembly (Not Shown)	67 305 76
12		Housing, Conn, Plug, 6 Conn.	17 725 32
13		Conn, Electric, Tapwire Splice	17 AP 205
14		Thermostat, 170°F	67 300 08
15		Socket, Transistor	17 732 10
16		Bracket, Heat Sink	67 100 32
17		Insulator, Trans, Therm. Cond	17 062 00
18		Transistor, Power, NPN, 2N6576	17 627 91
19		Screw, 6-32 x 1/2 RD PH SS	99 023 88
20		Washer, #6 LK SP SS	99 122 15
21		Resistor, Fixed, .36 Ω ± 1%, 50W	17 AN 222

* Includes items 10 through 21
** If replacement of any of these items is required, order Heater Assembly, Part Number 67 305 75.

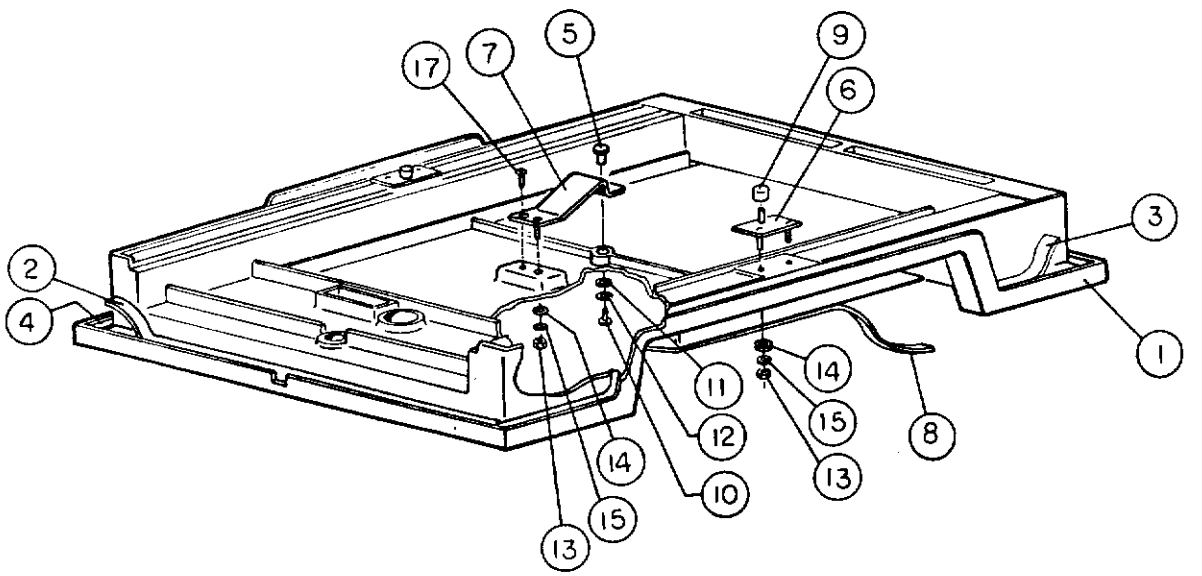
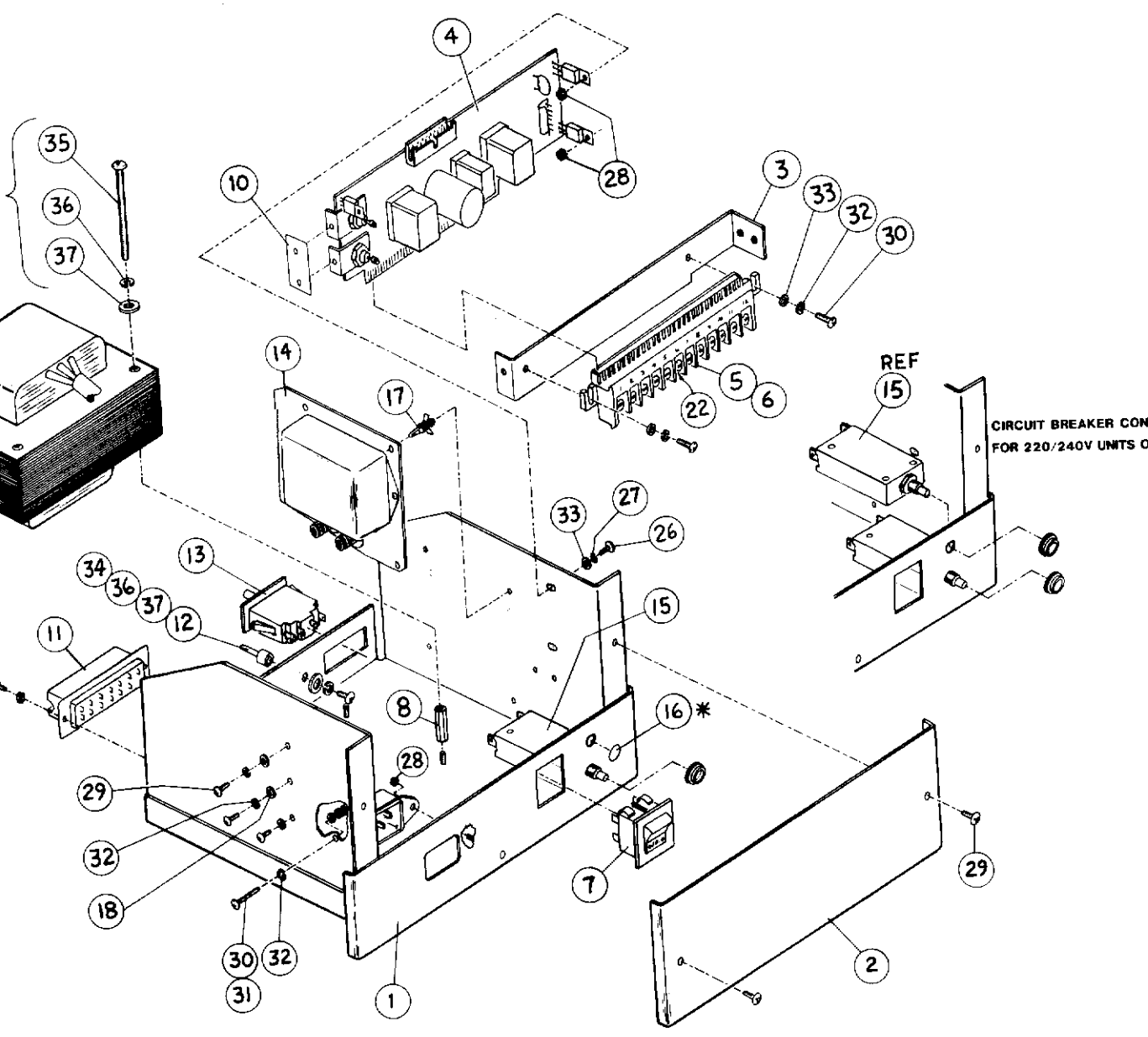


FIGURE 6.5 PARTS LOCATION DIAGRAM, UPPER STRUCTURE ASSEMBLY

TABLE 6.5 UPPER STRUCTURE ASSEMBLY, PARTS LIST

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		UPPER STRUCTURE ASSEMBLY	67 020 70
1		Molding, Upper Structure	67 000 54
2		Gasket, Side	67 001 06
3		Gasket, Front	67 001 04
4		Gasket, Rear	67 001 05
5		Stud, Stop	67 000 34
6		Plate, Anti-Tilt	67 000 32
7		Spring, Latch	67 000 61
8		Gasket, Strip (74.00 LG)	67 001 15
9		Stud	12 402 00
10		Screw, 6-32 x 5/8 TR PH SS	99 024 43
11		Washer, #6 FL SS	99 122 03
12		Washer, #6 LK SP SS	99 122 16
13		Nut, 8-32 HX SS	99 106 01
14		Washer, #8, LK SP SS	99 122 62
15		Washer, #8 LK SP SS	99 122 95
16		Not Used	
17		Screw, 8-32 x 5/8 TR PH SS	99 032 57



* ITEM 16 FOR 100V,110V/120V UNITS ONLY

FIGURE 6.6 PARTS LOCATION DIAGRAM, POWER CHASSIS ASSEMBLY

TABLE 6.6 POWER CHASSIS ASSEMBLY PARTS LIST
(Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		POWER CHASSIS ASSEMBLY, 110/120V:	
		English Labeling	67 906 80
		Spanish Labeling	67 906 81
		French Labeling	67 906 82
		German Labeling	67 906 83
-		POWER CHASSIS ASSEMBLY, 100V	
		English Labeling	67 906 84
-		POWER CHASSIS ASSEMBLY, 220/240V:	
		English Labeling	67 906 85
		Spanish Labeling	67 906 86
		French Labeling	67 906 87
		German Labeling	67 906 88
1		Chassis Fabricated	67 300 18
2		Front Plate	67 100 22
3		Bracket, Terminal Board Mounting	67 300 19
4		Power Board Assembly	67 262 71
5	2TB1	Term. Block, Card Edge, 12 Pt.	17 BG 272
6		Label, Pin I.D. Terminal Block	67 100 29
7	2S1	Switch, Rocker, DPST	17 682 34
8		Spacer, Tapped	67 100 25
9	2T1	Transformer Assy, Power, 110/120V	67 307 71
	2T1	Transformer Assy, Power, 220/240V	67 307 72
	2T1	Transformer Assy, Power, 100V	67 307 73
10		Insulator	67 100 23
11	2J2	Conn, Assy, Batt Interface, 100V, 110/120V	67 307 74
	2J2	Conn, Assy, Batt Interface, 220/240V	67 307 75
12		Pin, Guide	67 040 01
13	2S2	Switch, PB Line Interrupt, 2SPDT	17 682 45
14	2FL1	PCB Assy, Line Choke Filter, (Refer to Table 6.8)	67 320 70
15	2CB1, 2CB2*	Circuit Breaker, 3 AMP	17 BH 146
		* 220/240V Units Only.	

TABLE 6.6 POWER CHASSIS ASSEMBLY PARTS LIST
(Sheet 2 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
16		Plug, Hole, Nylon, 3/8 Dia	17 306 31
17		Support, Snap-In, Nylon, 1/4 Dia	17 AZ 502
18		Washer, Shoulder, Nylon	76 100 45
19		Not Used	
20		Not Used	
21		Not Used	
22		Jumper, Terminal Block, 3 Posn.	17 BG 451
23		Not Used	
24		Not Used	
25		Not Used	
26		Screw, 4-40, 5/16 TR PH SS	99 010 76
27		Washer, #4 LK SP SS	99 121 36
28		Nut, 4-40 HEX "KEPS" S CAD PL	99 103 33
29		Screw, 6-32 x 5/16 TR PH SS	99 022 98
30		Screw, 6-32 x 5/8 TR PH SS	99 024 43
31		Nut, 6-32 HEX KEPS S CAD PL	99 105 34
32		Washer, #6 LK SP SS	99 122 16
33		Washer, #6 FL SS	99 122 03
34		Screw, 8-32 x 1/4 TR PH SS	99 030 69
35		Screw, 8-32 x 2½ RD SL SS	99 035 56
36		Washer, #8 LK SP SS	99 122 95
37		Washer, 5/32 x 1/2 O.D. x .04 TK FL BR NI	99 122 54

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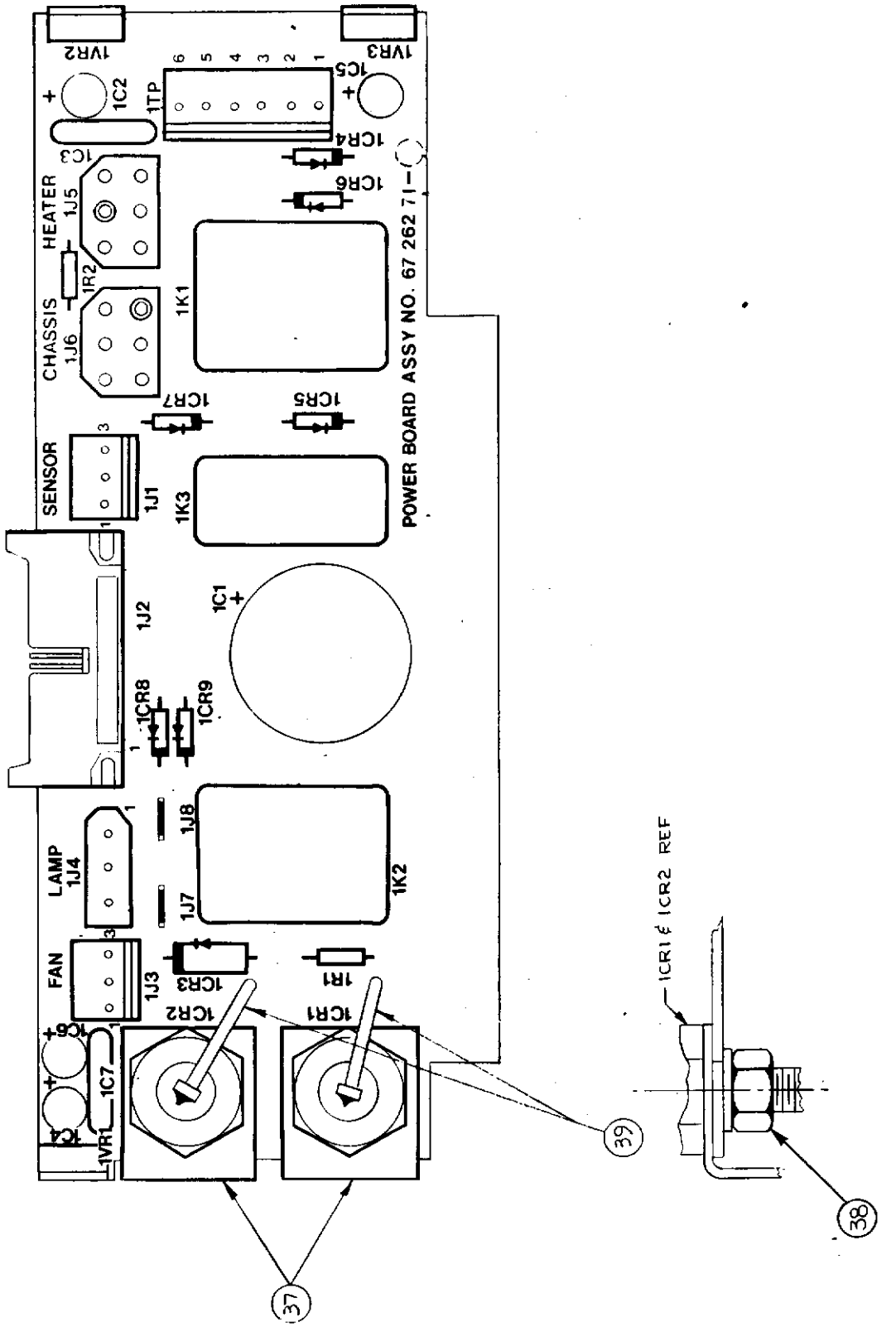

FIGURE 6.7 PARTS LOCATION DIAGRAM, POWER BOARD ASSEMBLY

TABLE 6.7 POWER BOARD ASSEMBLY PARTS LIST
(Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		POWER BOARD ASSEMBLY	67 262 71
1		Not Used	
2		Not Used	
3		Not Used	
4		Not Used	
5		Not Used	
6	1C2,4, 5,6	Cap, Fixed Alum 10 uf, +50 -10%, 35V	17 AW 741
7	1C1	Cap, Fixed Alum. 4700 uf, +50 -10%, 35V	17 AW 887
8	1C3,7	Cap, Cer. Dsc. .1 uf, +80 -20%, 50V	17 BF 397
9		Not Used	
10		Not Used	
11	1CR4,5, 6,7, 8,9	Diode, 1N4001	17 AS 000
12	1CR3	Diode, S3A05	17 AS 010
13	1CR1,2	Diode, 1N248 BR	17 550 81
14		Not Used	
15		Not Used	
16	1J2	Conn. Rcpt, PC Term., 20 POS	17 AP 101
17	1J1,3	Conn, Rcpt, Male, PC Term., 3 pos.	17 BP 026
18	1J4	Conn, 3 Term., PCB Mtg.	17 724 66
19	1J5	Conn, 6 Term., PCB Mtg.	17 724 67
20	1J6	Conn, Rcpt, PC Term., 6 pos.	17 732 15
21		Not Used	
22		Not Used	
23	1K3	Relay, Form "C" SPDT, 12V, 188 Ohms, 13 AMP	17 652 66
24	1K1,2	Relay, Form "C" DPDT, 12V, 160 Ohms, 10 AMP	17 652 67
25		Not Used	
26		Not Used	
27	1R2	Res, Carbon Film, 1K, 1/4W, 5%	17 AA 217
28	1R1	Res, Carbon Film, 10K, 1/4W, 5%	17 AA 289
29		Not Used	
30		Not Used	

TABLE 6.7 POWER BOARD ASSEMBLY PARTS LIST
(Sheet 2 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
31	1TP1,2, 3,4,5,6	Conn, Rcpt, Male, PC Term. 6 pos.	17 BP 029
32		Not Used	
33		Not Used	
34	1VR2,3	Regulator, Volt, Pos. 12V, 1 AMP	17 AT 023
35	1VR1	Regulator, Volt, Pos, 6V, 1 AMP	17 AT 021
36		Not Used	
37		Bracket, Heat Sink	67 100 24
38		Nut, HX, 1/4-28, "KEPS", S, CAD, PL	99 109 82
39		Wire Set, PCB Assy, Power	67 262 30
40	1J7,8	Terminal, Slip-On, Male PCB, 0.187W	17 731 91

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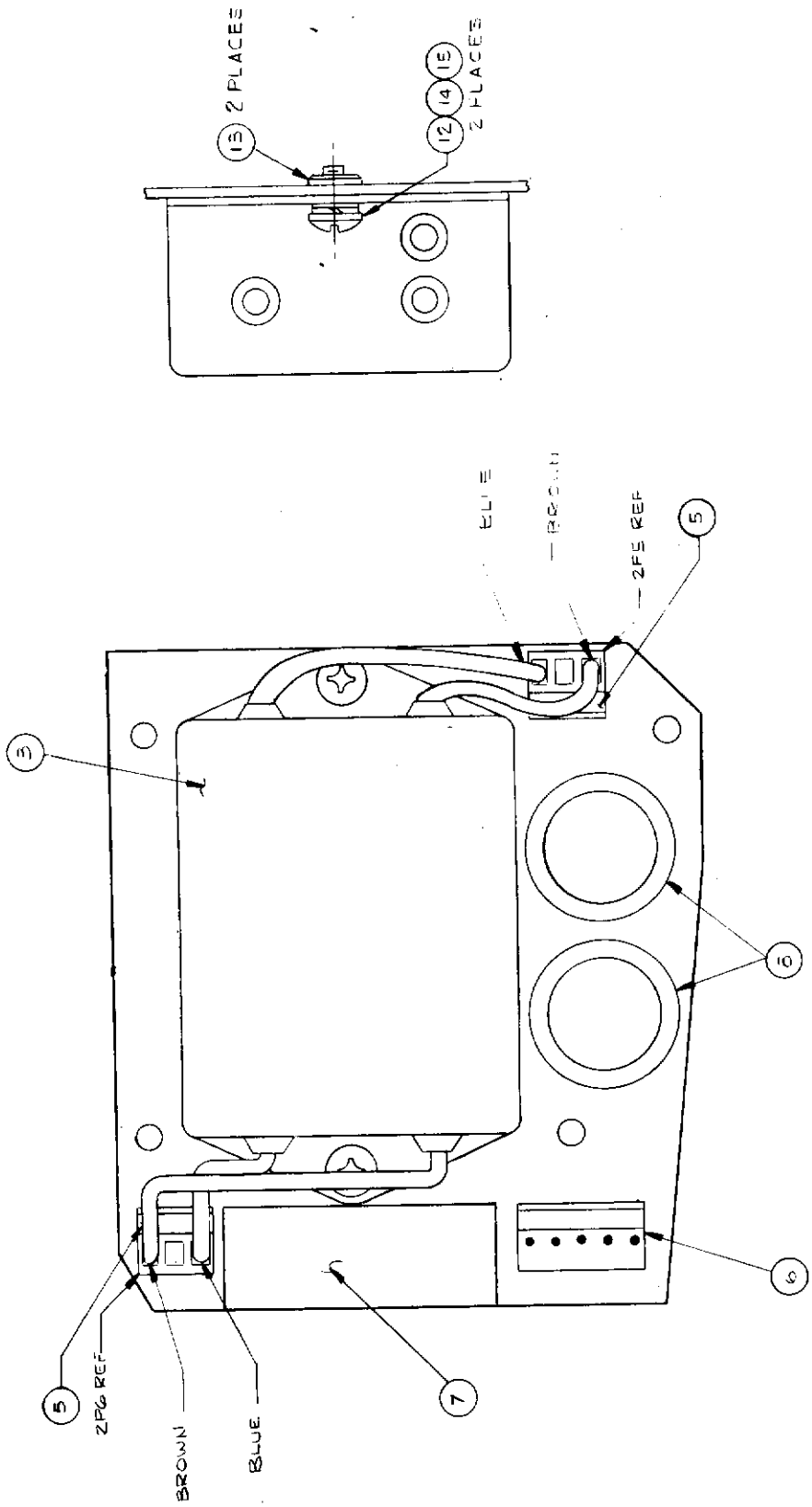

FIGURE 6.8 PARTS LOCATION DIAGRAM, PCB ASSEMBLY LINE/CHOKE FILTER

TABLE 6.8 PCB ASSEMBLY, LINE/CHOKE FILTER PARTS LIST

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		PCB ASSEMBLY LINE/CHOKE FILTER	67 320 70
1		Not Used	
2		Not Used	
3	2FL1	Line Filter Assy	67 321 70
4		Not Used	
5	2J5,2J6	Conn, Rcpt, Male, PCB Mtg, 3 Posn	17 BP 026
6	2J4	Conn, Rcpt, Male, PCB Mtg, 6 Posn	17 BP 028
7*	2C1	Cap, 1.5 µF, ± 10%, 250 VAC	17 420 42
8	2L1,2L2	Choke, Pwr Filter, 100 µH, 5 Amp	17 585 45
9		Not Used	
10		Not Used	
11		Not Used	
12		Screw, 6-32 x 5/16 TR PH SS	99 022 98
13		Nut, Self-Clinching, 6-32	99 105 65
14		Washer, FL, No. 6, SS	99 122 03
15		Washer, LK, No. 6, SP SS	99 122 16

* Used only with Series 01 Incubators.

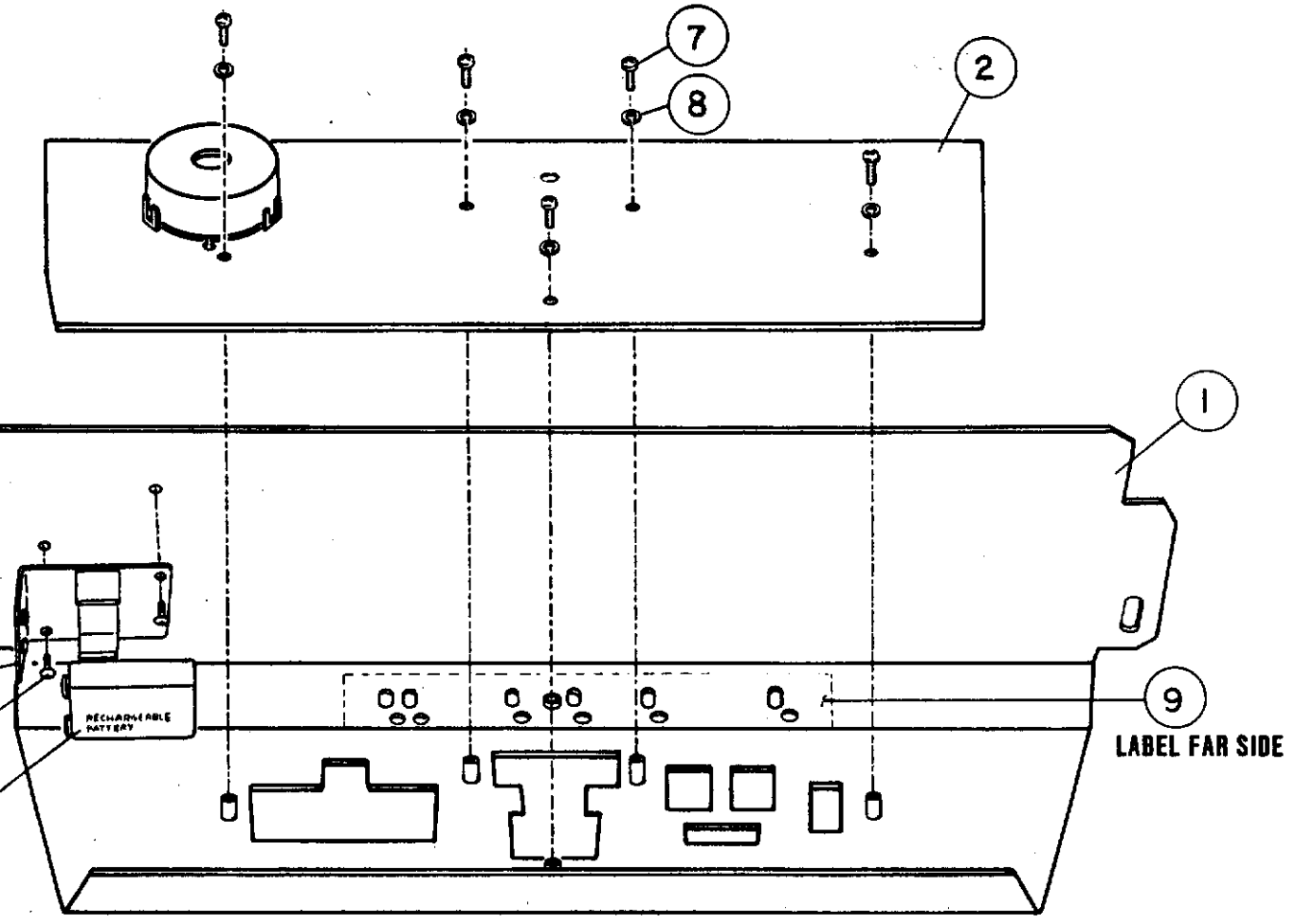

FIGURE 6.9 PARTS LOCATION DIAGRAM, CONTROLLER ASSEMBLY

TABLE 6.9 CONTROLLER ASSEMBLY PARTS LIST

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		CONTROLLER ASSEMBLY	
		English Labeling	67 906 75
		Spanish Labeling	67 906 76
		French Labeling	67 906 77
		German Labeling	67 906 78
1		Support, Controller	67 300 15
2		PCB Assy, Controller - Refer to Table 6.10	67 310 70
3		Battery Assembly, Controller	67 303 75
4		Battery 7.2V	67 308 70
5		Not Used	
6		Screw 4-40 x 1/8 TR PH SS	99 010 18
7		Screw, 6-32 x 1/4 RH PH SS	99 022 66
8		Washer, #6 LK SP SS	99 122 16
9		Label, Identification, Pot Adjust	67 300 16

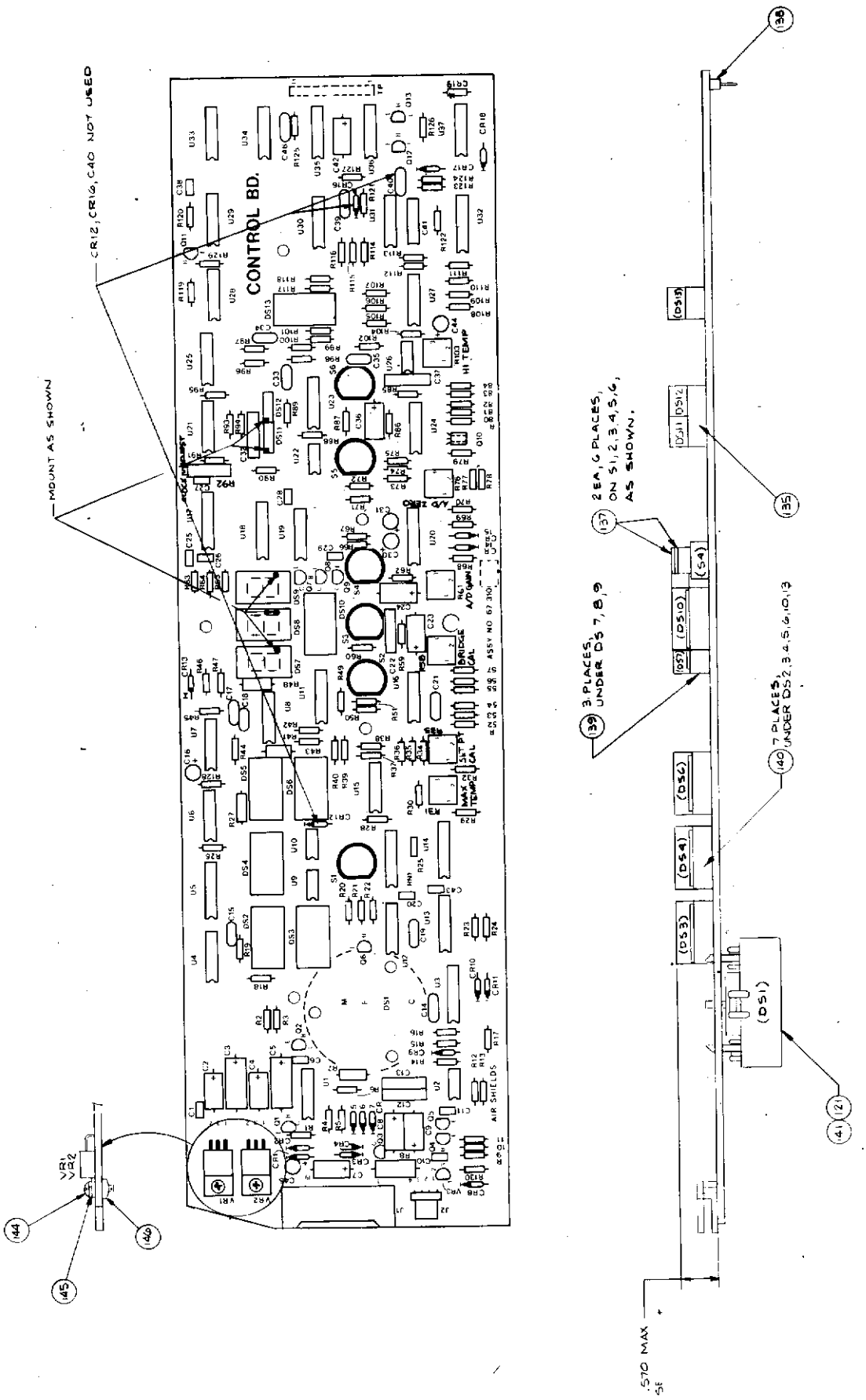

FIGURE 6.10 PARTS LOCATION DIAGRAM, CONTROL BOARD ASSEMBLY

TABLE 6.10 CONTROL BOARD ASSEMBLY PARTS LIST
(Sheet 1 of 5)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		CONTROL BOARD ASSEMBLY	67 310 70
1		Not Used	
2		Not Used	
3		Not Used	
4		Not Used	
5		Not Used	
6		Not Used	
7		Not Used	
8		Not Used	
9		Not Used	
10		Not Used	
11	C30	Cap, Tant, 0.27 µf, 50V	17 AW 205
12	C16, 31, 44, 45	Cap, Tant, 1.0 µf, 35V	17 AW 212
13		Not Used	
14	C2,4,7, 8,9, 23, 24,42	Cap, Alax, 10 µf, 25V	17 AW 534
15	C3,5	Cap, Alax, 47 µf, 25V	17 AW 567
16	C14,21, 46	Cap, Cer Disc, 0.001 µf, 1KV	17 BF 083
17	C15,17, 18, 33, 34,35,39	Cap, Cer Disc, 0.01 µf, 50V	17 BF 388
18	C1,6,10, 11,20,25, 26,27,28, 29,38,43	Cap, ML Cer, 0.1 µf, 50V	17 BF 217
19	C12,13,22 32,37,41	Cap, ML PLYST, 0.47 µf, 100V	17 AY 615
20	C19	Cap, Cer Disc, 470 pf, 1KV	17 BF 067
21		Not Used	
22		Not Used	
23	CR3,4,5, 6,7,8,9, 10,11,12, 13,14,15, 17,18	Diode, 1N914	17 AR 500

TABLE 6.10 CONTROL BOARD ASSEMBLY PARTS LIST
(Sheet 2 of 5)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
24	CR1,2	Diode, 1N4001	17 AS 000
25	DS7,8,9	Display, LED, 7 Seg Org	17 BE 247
26		Not Used	
27	U2	IC555	17 629 56
28	U18	IC3161	17 631 82
29	U20	IC3162	17 631 80
30	U15,16, 24,27	IC3403	17 629 70
31	U9,10,26	IC3633	17 629 52
32	U22	IC CMOS 3634	17 630 11
33	U4,7,8,29	IC CMOS 4001	17 629 75
34	U36	IC CMOS 4002-B	17 630 80
35	U1,6,11, 30,37	IC CMOS 4011	17 629 77
36	U12,25, 34,35	IC CMOS 4013	17 629 57
37	U17	IC CMOS 4020-B	17 631 35
38	U23	IC CMOS 4023	17 629 83
39	U33	IC CMOS 4024	17 629 84
40	U28	IC CMOS 4025	17 629 85
41	U13,14	IC CMOS 4029	17 629 88
42	U3	IC CMOS 4049	17 630 45
43	U19,32	IC CMOS 4066	17 630 76
44	U21,31	IC CMOS 4069	17 629 92
45	U5	IC CMOS 40175	17 629 73
46		Not Used	
47		Not Used	
48		Not Used	
49	DS10	Lamp, LED, Grn, 16 Pin	17 BE 240
50	DS2,3,4, 5,6	Lamp, LED, Red, 16 Pin	17 BE 241
51	DS13	Lamp, LED, Yel, 16 Pin	17 BE 252
52	DS11,12	Lamp, LED, Grn, 4 Pin	17 807 34
53		Not Used	
54	RN1	Res, Network, 100K/200K, 2%, 0.05W	17 217 64
55		Not Used	

TABLE 6.10 CONTROL BOARD ASSEMBLY PARTS LIST
(Sheet 3 of 5)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
56	R31,33, 58,103	Res, Var, 2.0K, Horiz., Adj.	17 AN 121
57	R61	Res, Var, 10K, Horiz., Adj.	17 AN 127
58	R76	Res, Var, 50K, Horiz., Adj.	17 AN 133
59	R92*	Res, Carbon, 27K, 5% 1/4W	17 AA 319
	R92	Res, Var, 50K, .75 LG	17 AN 292
60	R8	Res, Carbon, 47Ω, 5%, 1W	17 AC 121
61		Not Used	
62	R48	Res, Carbon, 39 Ω, 5%, 1/2W	17 AB 115
63	R27,43	Res, Carbon, 56Ω, 5%, 1/2W	17 AB 127
64	R7	Res, Carbon, 470Ω, 5%, 1/2W	17 AB 193
65		Not Used	
66		Not Used	
67	R130	Res, Carbon, 68 Ω, 5%, 1/4W	17 AA 133
68	R2	Res, Carbon, 100 Ω, 5%, 1/4W	17 AA 145
69	R100,101, 117,118	Res, Carbon, 120 Ω, 5%, 1/4W	17 AA 151
70	R65	Res, Carbon, 130 Ω, 5%, 1/4W	17 AA 154
71	R88	Res, Carbon, 150 Ω, 5%, 1/4W	17 AA 157
72	R90	Res, Carbon, 360 Ω, 5%, 1/4W	17 AA 184
73	R106,109, 112	Res, Carbon, 820 Ω, 5%, 1/4W	17 AA 211
74	R30	Res, Carbon, 1K, 5%, 1/4W	17 AA 217
75	R104	Res, Carbon, 1.8K, 5%, 1/4W	17 AA 235
76	R102	Res, Carbon, 2.4K, 5%, 1/4W	17 AA 244
77	R73	Res, Carbon, 2.7K, 5%, 1/4W	17 AA 247
78	R38	Res, Carbon, 5.6K, 5%, 1/4W	17 AA 271
79		Not Used	
80		Not Used	
81		Not Used	
82	R3,6,13, 14,17,18, 24,25,44, 47,64,66, 67,68,71, 72,75,77, 79,81,85, 94,98,99 119,120, 121,122, 127,129	Res, Carbon, 10K, 5%, 1/4W	17 AA 289

* Fixed resistor on Revision 2 printed circuit boards.

TABLE 6.10 CONTROL BOARD ASSEMBLY PARTS LIST
(Sheet 4 of 5)

	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
		Not Used	
	R12	Res, Carbon, 43K, 5%, 1/4W	17 AA 334
		Not Used	
	R1,4,5,16, R19,20,23, 26,40,41, 42,49,60, 89,91,95, 96.97,105, 107,108, 110,111, 114,115, 116,124, 125,126, 128	Res, Carbon, 100K, 5%, 1/4W	17 AA 361
		Not Used	
	R113	Res, Carbon, 470K, 5%, 1/4W	17 AA 409
	R45,46, 80,93	Res, Carbon, 1M, 5%, 1/4W	17 AA 433
	R15,63,86	Res, Carbon, 3.9M, 5%, 1/4W	17 AA 475
	R123	Res, Carbon, 27K, 5%, 1/4W	17 AA 319
		Not Used	
		Not Used	
	R29	Res, Film, 150Ω, 1%, 1/8W	17 AF 113
	R39	Res, Film, 1.10K, 1%, 1/8W	17 AF 196
	R32	Res, Film, 2.21K, 1%, 1/8W	17 AF 225
	R50,62	Res, Film, 3.01K, 1%, 1/8W	17 AF 238
8	R54	Res, Film, 4.12K, 1%, 1/8W	17 AF 251
9	R84	Res, Film, 5.36K, 1%, 1/8W	17 AF 262
00	R78	Res, Film, 5.62K, 1%, 1/8W	17 AF 264
01	R87	Res, Film, 6.34K, 1%, 1/8W	17 AF 269
02	R74	Res, Film, 9.09K, 1%, 1/8W	17 AF 284
03	R28,55, 56,57	Res, Film, 10.0K, 1%, 1/8W	17 AF 288
04	R69	Res, Film, 11.0K, 1%, 1/8W	17 AF 292
05	R53	Res, Film, 16.2K, 1%, 1/8W	17 AF 308
06	R82	Res, Film, 46.4K, 1%, 1/8W	17 AF 352
07	R83	Res, Film, 47.5K, 1%, 1/8W	17 AF 353
08	R10	Res, Film, 68.1K, 1%, 1/8W	17 AF 368
09	R22,35, 36,52,70	Res, Film, 100K, 1%, 1/8W	17 AF 384

TABLE 6.10 CONTROL BOARD ASSEMBLY PARTS LIST
(Sheet 5 of 5)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
110	R59	Res, Film, 150K, 1%, 1/8W	17 AF 401
111	R21	Res, Film, 200K, 1%, 1/8W	17 AF 413
112	R9	Res, Film, 255K, 1%, 1/8W	17 AF 423
113	R37,R51	Res, Film, 301K, 1%, 1/8W	17 AF 430
114	R34	Res, Film, 402K, 1%, 1/8W	17 AF 442
115	R11	Res, Film, 422K, 1%, 1/8W	17 AF 444
116		Not Used	
117		Not Used	
118		Not Used	
119		Not Used	
120		Not Used	
121	DS1	Transducer, Tone, 2.9 KHZ	17 652 72
122		Not Used	
123	Q2,5, 10,11	Transistor, 2N4401	17 627 38
124	Q3,4,7,8, 9,12,13	Transistor, 2N4403	17 627 46
125	Q1,6	Transistor, MPS A-13	17 627 96
126		Not Used	
127		Not Used	
128	VR1	Regulator, +5V, 7805	17 AT 020
129	VR3	Regulator, +5V 78L05	17 AT 041
130	VR2	Regulator, +8V, 7808	17 AT 022
131		Not Used	
132		Not Used	
133	J1	Conn, Rcpt, Male, 20 Position	17 AP 101
134	J2	Conn, Rcpt, Male, 4 Position	17 BP 163
135		Conn, Rcpt, Female, 8 Position	17 BP 306
136	S1,2,3,4, 5,6	Switch, Pushbutton, SPST, N.O.	17 682 47
137		Shim Switch	38 230 25
138	TP1 thru TP11	Conn, P.C. Header, 11 Position	17 BP 381
139		Socket, IC DIP, 14 Pin	17 732 18
140		Socket, IC DIP, 16 Pin	17 732 17
141		Socket, Transducer	17 652 71
142		Not Used	
143		Not Used	
144		Screw, 4-40 x 5/16 RD PH SS	99 010 75
145		Washer, #4 LK SP SS	99 121 36
146		Nut, Self-Clinching 4-40	99 103 34

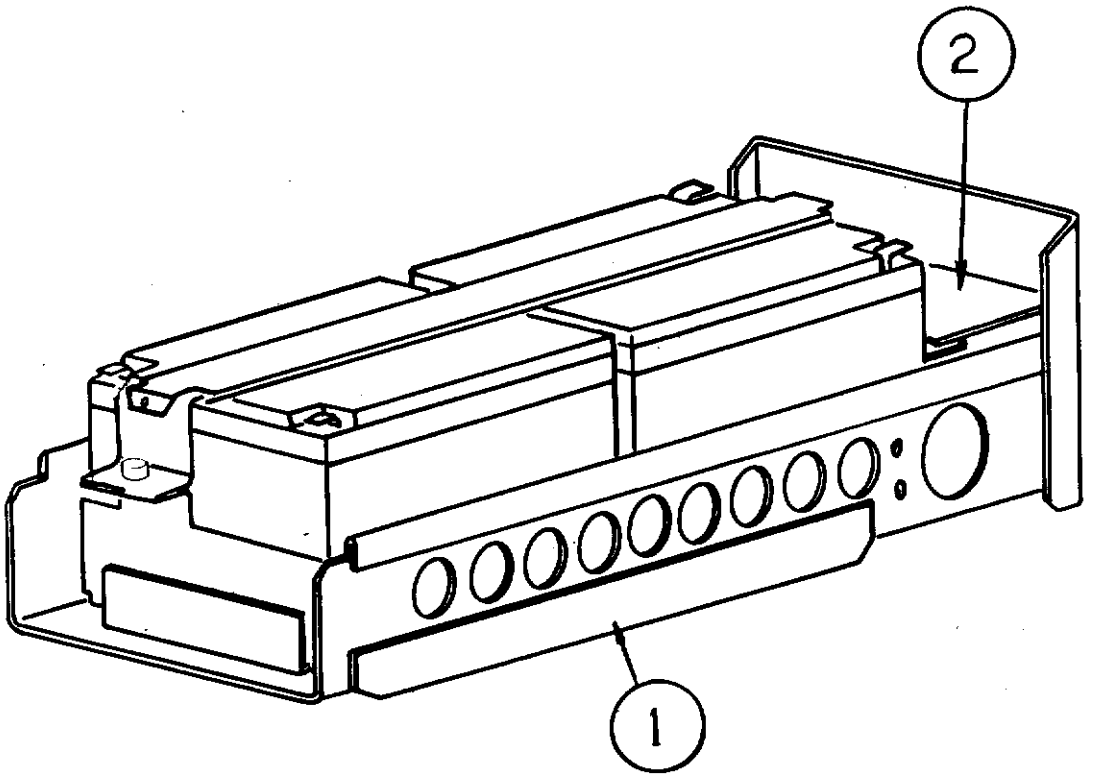

FIGURE 6.11 PARTS LOCATION DIAGRAM, BATTERY/CHARGER TRAY ASSEMBLY

TABLE 6.11 BATTERY/CHARGER TRAY ASSEMBLY PARTS LIST

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		BATTERY/CHARGER TRAY ASSEMBLY WITH BATTERIES (110/120V or 220/240V)	
		English Labeling	67 906 70
		Spanish Labeling	67 906 71
		French Labeling	67 906 72
		German Labeling	67 906 73
-		BATTERY/CHARGER TRAY ASSEMBLY, WITH BATTERIES (100V)	
		English Labeling	67 906 74
-		BATTERY/CHARGER TRAY ASSEMBLY, WITHOUT BATTERIES (110/120V or 220/240V)	
		English Labeling	67 906 60
		Spanish Labeling	67 906 61
		French Labeling	67 906 62
		German Labeling	67 906 63
-		BATTERY/CHARGER TRAY ASSEMBLY, WITHOUT BATTERIES (100V)	
		English Labeling	67 906 64
1		Battery Tray Assembly (Refer to Table 6.12)	REF
2*		Battery Charger Assembly (Refer to Table 6.13)	REF
		* Part of Item 1	

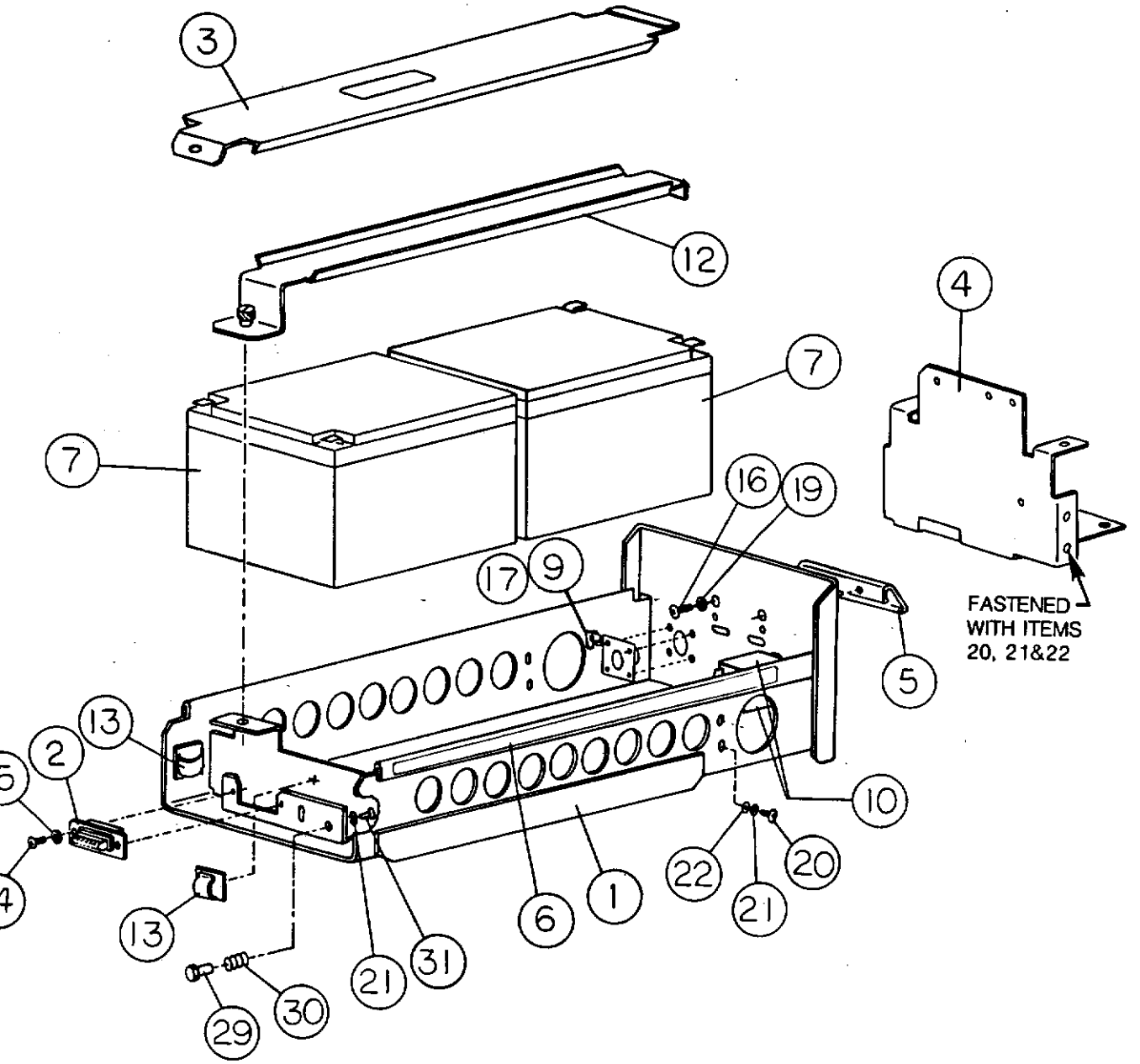

FIGURE 6.12 PARTS LOCATION DIAGRAM, BATTERY TRAY ASSEMBLY

TABLE 6.12 BATTERY TRAY ASSEMBLY PARTS LIST
(Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		BATTERY/TRAY ASSEMBLY, WITH BATTERIES (110/120V and 220/240V)	67 304 70
-		BATTERY TRAY ASSEMBLY, WITH BATTERIES (100V)	67 304 90
-		BATTERY TRAY ASSEMBLY, WITHOUT BATTERIES (110/120V and 220/240V)	67 304 80
-		BATTERY TRAY ASSEMBLY, WITHOUT BATTERIES (100V)	67 304 81
1		Tray, Weldment	67 300 05
2		Wiring Harness, Battery Charger	67 304 71
3		Cover, Charger Leads	67 300 09
4		Battery Charger Assembly (Refer to Table 6.13)	REF
5		Pull, 29° Angle	67 300 12
6		Not Used	
7*		Battery, Gel-Cel, Marked	67 060 10
8		Not Used	
9		Nut, Corner, Clip-on 4-40	67 300 17
10		Circuit Breaker, 10 Amp	17 BH 154
11		Not Used	
12		Clamp, Battery	67 300 06
13		Clip, Cord	17 725 44
14		Screw, 4-40 x 1/4 TR PH SS	99 010 56
15		Washer, #4 Lk SHI S4	99 121 35
16		Screw, 8-32 x 1/4 TR PH SS	99 030 69
17		Screw, 4-40 x 1/4 FL PH SS	99 010 62
18		Not Used	
19		Washer, #8 LK SP SS	99 122 95
20		Screw, 6-32 x 3/8 TR PH SS	99 023 31
21		Washer, #6 LK SP SS	99 122 16
22		Washer, #6 FL SS	99 122 03
23		Wire Tie (Not Shown)	12 995 00
24		Not Used	
25		Not Used	

TABLE 6.12 BATTERY TRAY ASSEMBLY PARTS LIST
(Sheet 2 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
26		Not Used	
27		Not Used	
28		Not Used	
29		Stud	67 300 37
30		Spring	67 000 68
31		Screw, 6-32 x 1/4 TR PH SS	99 022 72
		* Not supplied with Battery Tray Assemblies 67 304 80 and 67 304 81; must be ordered separately.	

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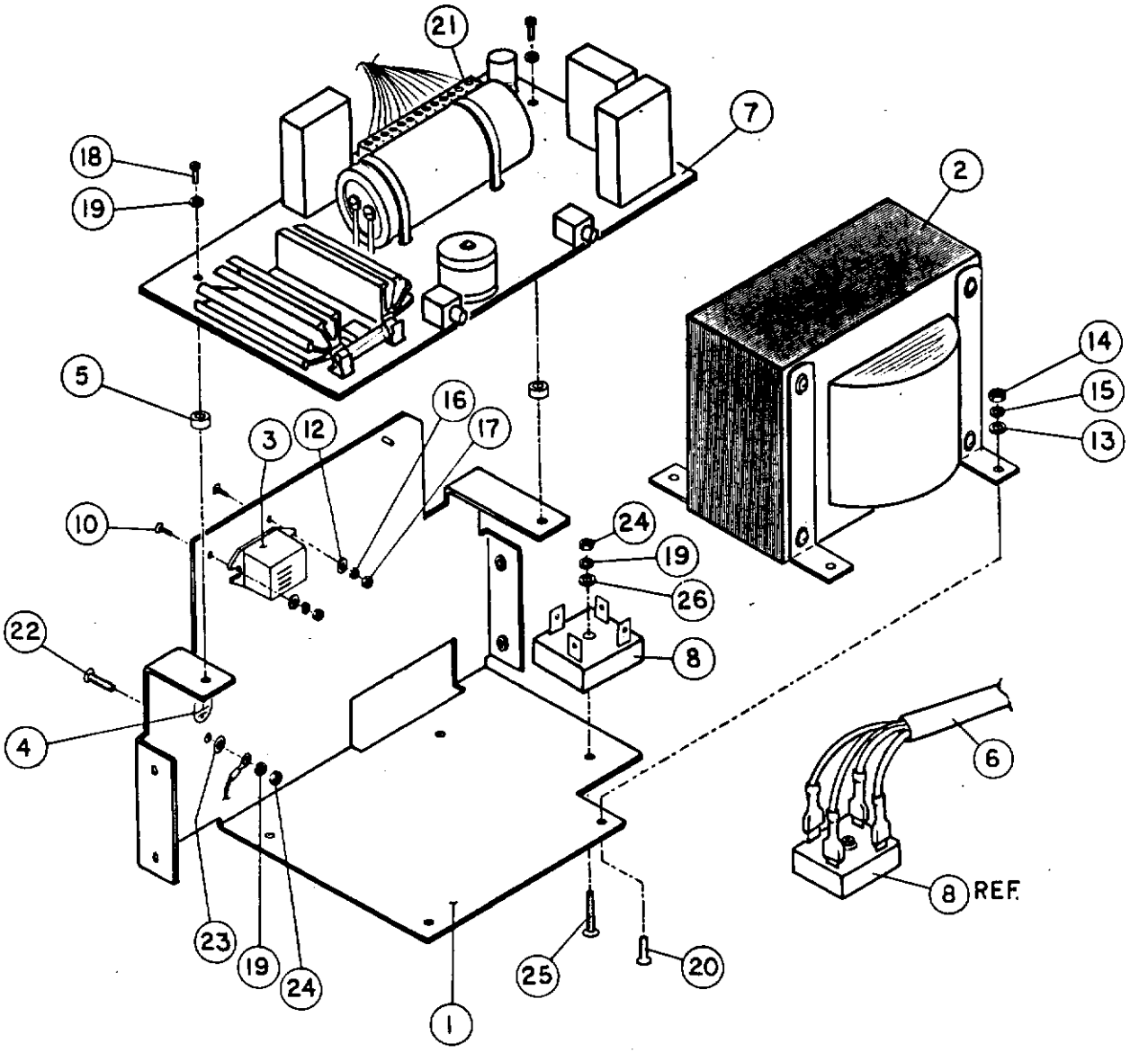

FIGURE 6.13 PARTS LOCATION DIAGRAM, BATTERY CHARGER ASSEMBLY

TABLE 6.13 BATTERY CHARGER ASSEMBLY PARTS LIST

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		BATTERY CHARGER ASSEMBLY	67 304 75
1		Bracket, Support, Batt. Charger	67 300 10
2		Transformer Assembly (110/120V and 220/240V)	67 304 77
		Transformer Assembly (100V)	78 304 79
3		Audio Alarm	17 652 87
4		Not Used	
5		Spacer, .146 ID x .44 OD x .125 TK Nylon	99 122 40
6		Cable Assembly, Bridge	67 304 78
7		PCB Assembly, Charger, (Refer to Table 6.14)	67 315 70
8		Diode, Bridge	17 502 59
9		Not Used	
10		Screw, 2-56 x 1/4 FL SL SS	99 003 38
11		Not Used	
12		Washer, #2 FL SS	99 120 20
13		Washer, #8, FL SS	99 122 62
14		Nut, 8-32 HEX SS	99 106 01
15		Washer, #8 LK SP SS	99 122 95
16		Washer, #6 LK SP SS	99 120 35
17		Nut, 2-56 HEX SS	99 101 01
18		Screw, 6-32 x 3/8 TR PH SS	99 023 31
19		Washer, #6 LK SP SS	99 122 16
20		Screw, 8-32 x 3/8 FL SL SS	99 031 41
21		Connector, Plug, 13 Position	17 BR 113
22		Screw, 6-32 x 7/16 FL PH SS	99 023 58
23		Washer, #8 LK SHI SS	99 122 92
24		Nut, 6-32 HEX SS	99 105 02
25		Screw, 6-32 x 5/8 FL PH SS	99 024 47
26		Washer, #6 FL SS	99 122 03

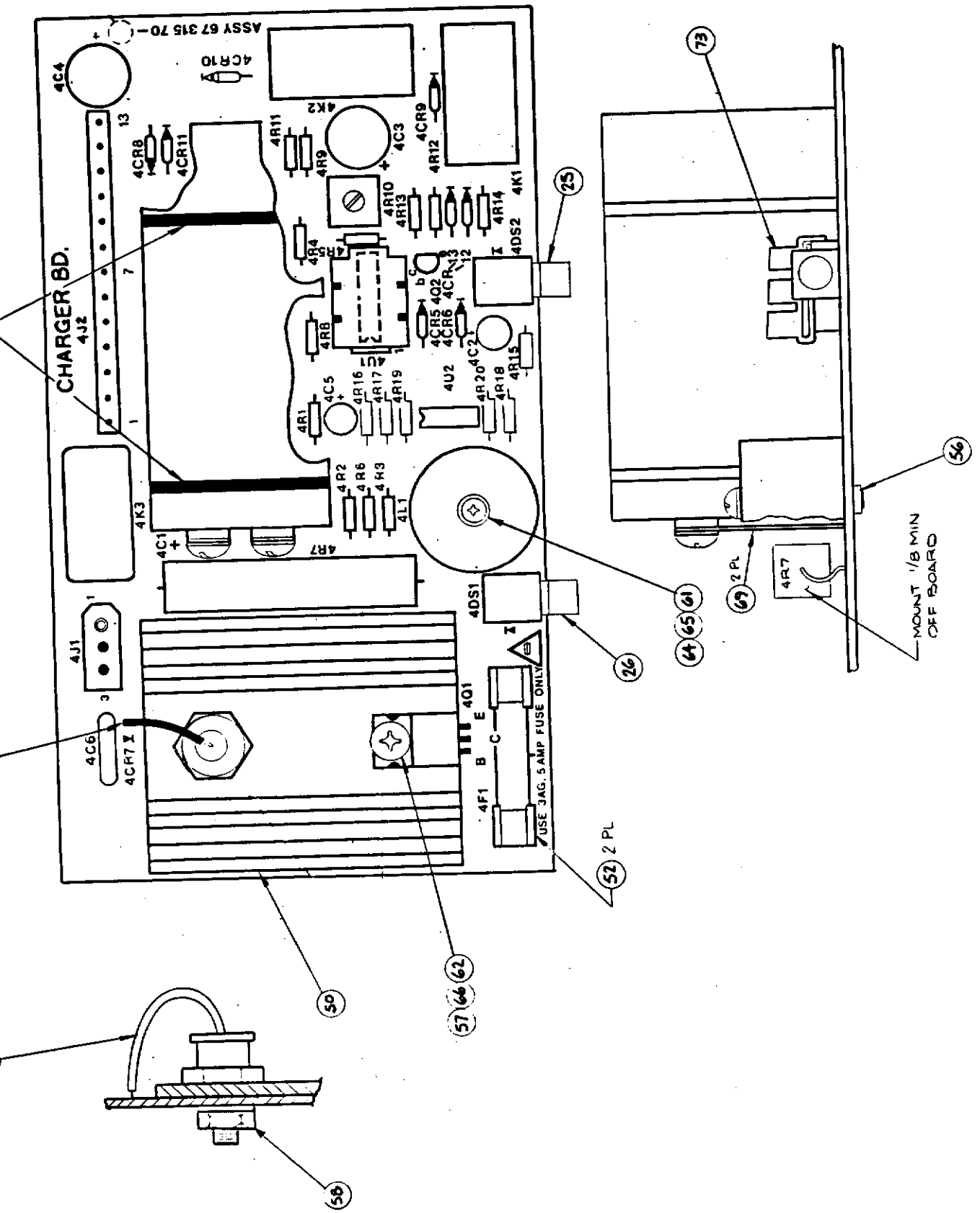

FIGURE 6.14 PARTS LOCATION DIAGRAM, BATTERY CHARGER PCB ASSEMBLY

TABLE 6.14 BATTERY CHARGER PCB ASSEMBLY PARTS LIST
(Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		BATTERY CHARGER PCB ASSEMBLY	67 315 70
1		Not Used	
2		Not Used	
3		Not Used	
4		Not Used	
5		Not Used	
6		Not Used	
7		Not Used	
8		Not Used	
9		Not Used	
10		Not Used	
11	4C2, 4C5	Cap, Tant, 10 µf, 35V	17 AW 741
12	4C3, 4C4	Cap, Alum, 100 µf, 50V	17 AW 796
13	4C1	Cap, Alum, 5800 µf, 40V	17 AW 946
14*	4C6	Cap, Cer, Disc, 0.1 µF	17 BF 397
15	4L1	Choke, 470 µH	17 585 41
16		Not Used	
17	4CR7	Diode, 1N3879	17 AR 220
18	4CR5, 4CR6, 4CR12, 4CR13	Diode, 1N914	17 AR 500
19	4CR8, 4CR9 4CR11, 4CR10	Diode, 1N4001	17 AS 000
20		Not Used	
21	4U1	I.C., Voltage, Regulator, 723	17 631 48
22	4U2	I.C., Op Amp, 358A	17 631 85
23	4DS2	Lamp, Led, Red	17 BE 261
24	4DS1	Lamp, Led, Green	17 BE 263
25		Lampholder, Red Lens	17 BD 005
26		Lampholder, Green Lens	17 BD 006
27	4R19, 4R20	Res, 100K, 5%, 1/4W	17 AA 361
28	4R1	Res, 100 Ohms, 5%, 1/4W	17 AA 145
29	4R12	Res, 270 Ohms, 5%, 1/4W	17 AA 175
30	4R14	Res, 750 Ohms, 5%, 1/4W	17 AA 208
31	4R5,4R13	Res, 1K, 5%, 1/4W	17 AA 217
32	4R3	Res, 2K, 5%, 1/4W	17 AA 238
33	4R2	Res, 3K, 5%, 1/4W	17 AA 250
		* Used only with Series 01 Incubators.	

TABLE 6.14 BATTERY CHARGER PCB ASSEMBLY PARTS LIST
(Sheet 2 of 2)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
34	4R4	Res, 1M, 5%, 1/4W	17 AA 433
35	4R15, 4R17, 4R18	Res, 10K, 5%, 1/4W	17 AA 289
36	4R8	Res, 30.1 Ohms, 1%, 1/8W	17 AF 046
37	4R9	Res, 1.15K, 1%, 1/8W	17 AF 198
38	4R11	Res, 1.30K, 1%, 1/8W	17 AF 203
39	4R6	Res, 3.01K, 1%, 1/8W	17 AF 238
40	4R16	Res, 20K, 5%, 1/4W	17 AA 310
41	4R7	Res, 0.18 Ohms, 10%, 10W	17 AN 200
42		Not used	
43	4R10	Res, Var, 200 Ohms, 0.5W	17 AN 009
44		Not Used	
45	4K1,4K2	Relay, 12 Vdc, 188 Ohms, 10 Amp	17 652 66
46	4K3	Relay, 24 Vac, 300 Ohms, 10 Amp	17 652 86
47		Not Used	
48	4Q2	Transistor, 2N4401	17 627 38
49	4Q1	Transistor, 2N6040	17 627 44
50		Heatsink	17 062 13
51	4F1	Fuse, 5 Amp, 250V (3AG)	17 718 60
52		Clip, Fuse, PCB Mtg.	17 729 49
53	4J1	Conn, 3 Terminal, PCB Mtg.	17 724 66
54	4J2	Conn, PC Hor, Sgl Row, .197 Ctrs, 13 Posn.	17 BR 133
55		Not Used	
56		Nut, Self-Clinching, 4-40	99 103 34
57		Nut, Self-Clinching, 6-32	99 105 65
58		Nut, Hex, 10-32 KEPS, S CA	99 107 36
59		Not Used	
60		Not Used	
61		Scr, 4-40 x 1", RD, SL, SS	99 012 30
62		Scr, 6-32 x 7/16, RD, PH, SS	99 023 56
63		Not Used	
64		Wshr, Flat, #4, .031 THK SS	99 121 20
65		Wshr, Lock SP #4, SS	99 121 36
66		Wshr, Loc, SP, #6, SS	99 122 16
67		Wire Set, PCB Assy, Charger	67 315 25
68		Not Used	
69		Terminal Lug	17 732 39
70		Socket, 14 Pin Dip	17 AP 191
71		Not Used	
72		Wire Tie, 11.00 LG	12 995 01
73		Heat Sink, 14 or 16 Pin I.C.	17 062 25

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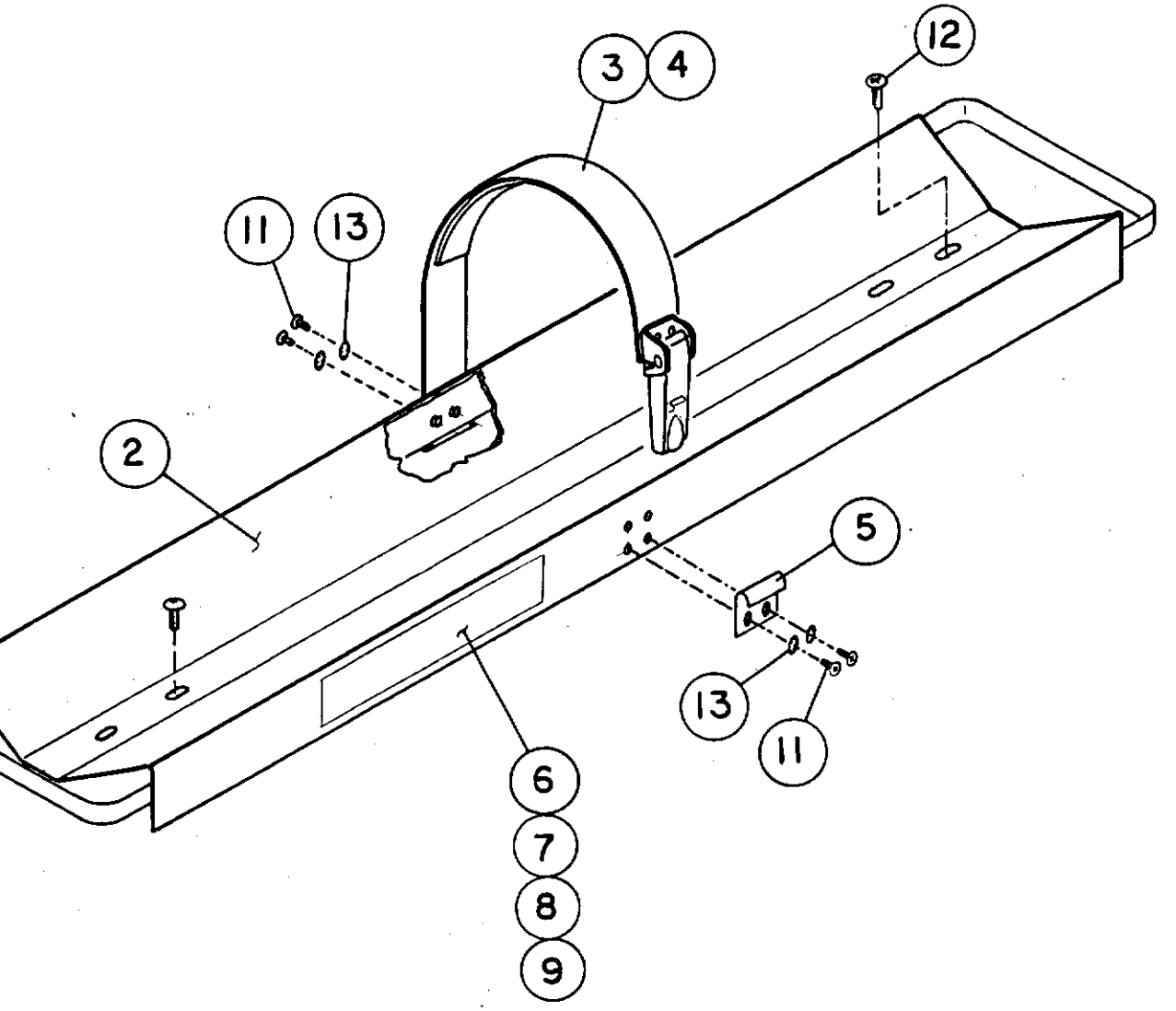

FIGURE 6.15 PARTS LOCATION DIAGRAM, OXYGEN TANK SUPPORT SHELF

TABLE 6.15 OXYGEN TANK SUPPORT SHELF PARTS LIST

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		OXYGEN TANK SUPPORT SHELF:	
		TANK DIAMETER 4 3/8 in. (111 mm)	67 135 70
		TANK DIAMETER 5 1/2 in. (140 mm)	67 135 71
1		Not Used	
2		Support, Tank (also order appropriate language label, item 6, 7, 8, or 9)	67 100 07
3		Clamp Assembly, 4 3/8 in (111 mm)	67 010 80
4		Clamp Assembly, 5½ in. (140 mm)	67 010 81
5		Strike, Draw Latch	67 010 25
6		Label, Cylinder Clamp, English	67 101 24
7		Label, Cylinder Clamp, Spanish	67 101 25
8		Label, Cylinder Clamp, French	67 101 26
9		Label, Cylinder Clamp, German	67 101 27
10		Not Used	
11		Screw, 6-32 x 1/4 TR PH SS	99 022 72
12		Screw, 10-32 x 1/4 TR PH SS	99 040 51
13		Washer, #6 LK SHI S4	99 122 19

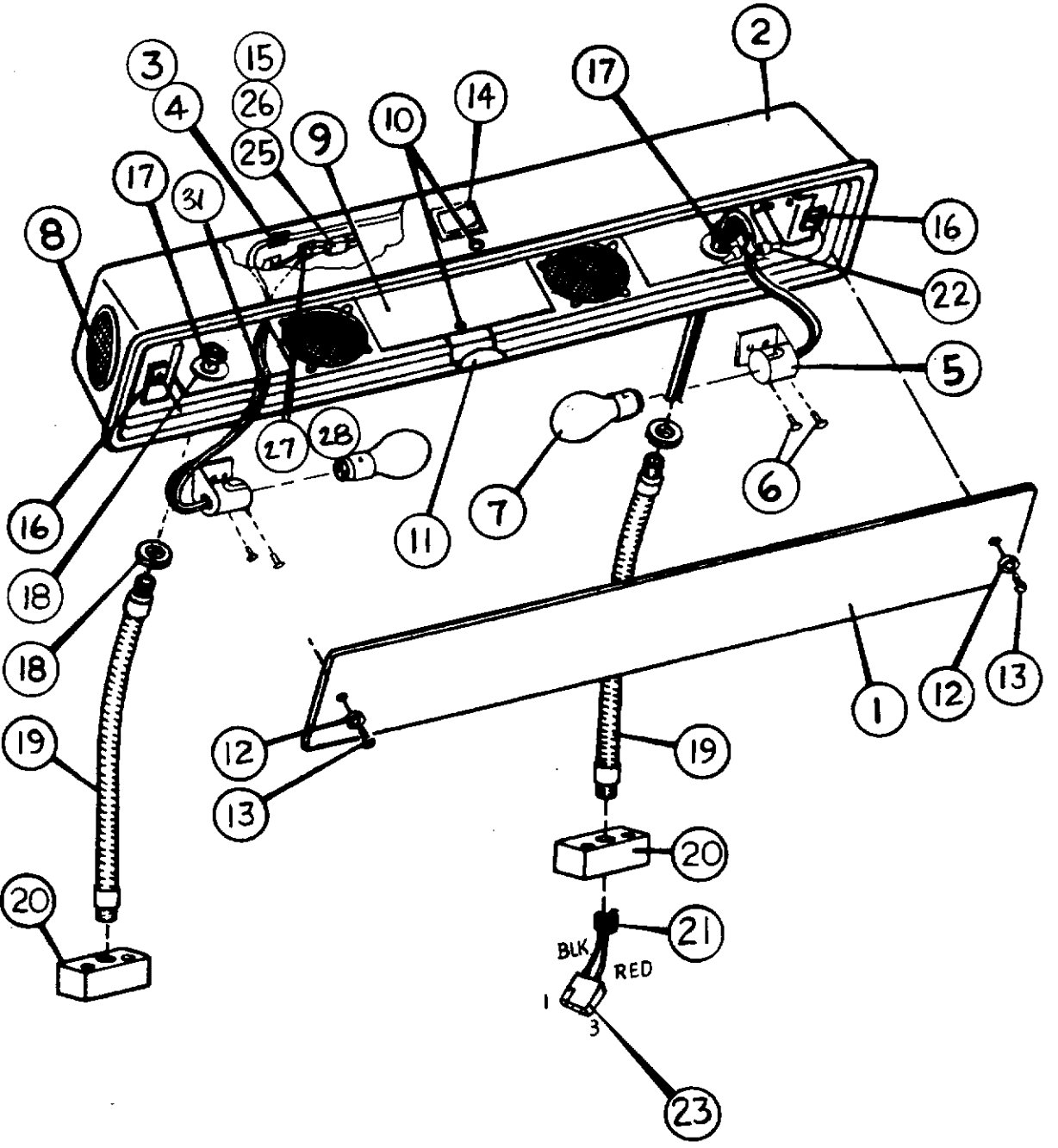

FIGURE 6.16 PARTS LOCATION DIAGRAM, OBSERVATION LAMP ASSEMBLY

TABLE 6.16 OBSERVATION LAMP ASSEMBLY PARTS LIST

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		OBSERVATION LAMP ASSEMBLY	67 305 70
1		Panel, Diffuser	67 080 05
2		Housing, Lamp	67 080 14
3		Mount, Cable Tie	17 061 87
4		Wire Tie, 4.50 LG	12 995 00
5		Holder, Lamp	17 806 91
6		Rivet, .1560 x .290L, Dome Head, Blind	99 132 71
7		Bulb, Incandescent, 6.5V	17 806 92
8		Plug, Button	67 080 11
9		Bracket, Lamp Support	67 080 13
10		Rivet, 1/8 x 3/16 Semi-Tubular OV SS	99 131 02
11		Retainer	67 080 10
12		Bumper	67 080 07
13		Screw, 8-32 x 1/2 TR PH SS	99 031 99
14		Switch, Rocker, DPDT	17 682 43
15		Washer, No. 4, LK SP SS	99 121 36
16		Nut, SH, Spring, 8-32	99 106 66
17		Nut, 1/8-27 NPSM BR NI	99 115 25
18		Washer, 3/8 LK SHI S Z1	99 126 93
19		Arm, Flexible	67 080 03
20		Block, Mounting, Lamp	67 080 08
21		Cable Assembly, Light	67 302 75
22		Connector, Crimp, 18-16 AWG	16 035 00
23		Housing, Connector Plug, 3 Cont.	17 725 31
24		Not Used	
25		Regulator, Voltage, Fixed, Pos	17 AT 021
26		Screw, 4-40 x 3/16, TR PH SS	99 010 36
27		Connector, Hsg, Plug, 3 Posn	17 AP 534
28		Contact, Female, Crimp Type	17 AP 443
29		Not Used	
30		Not Used	
31		Wire Set, Lamp Assembly	67 305 00

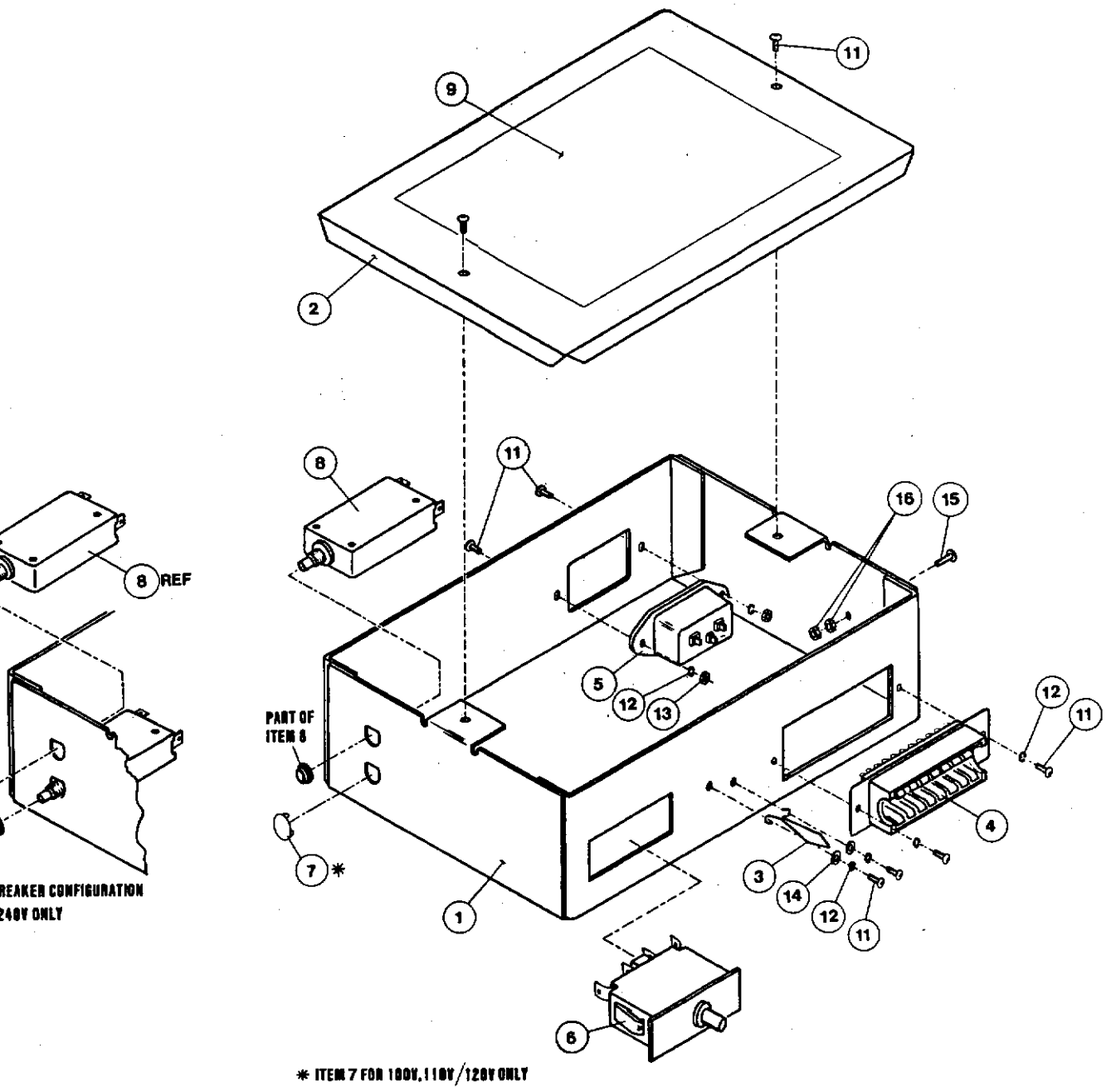

FIGURE 6.17 PARTS LOCATION DIAGRAM, EXTERNAL BATTERY CHARGER

TABLE 6.17 EXTERNAL BATTERY CHARGER PARTS LIST (ACCESSORY)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		EXTERNAL BATTERY CHARGER:	
		100V, 110/120V MODEL	67 325 70
		220/240V MODEL	67 325 75
1		Chassis	67 235 00
2		Cover	67 325 01
3		Spring	67 325 05
4	J2	Conn. Assy. Bat. Interface:	
		100V, 110/120V Model	67 325 72
		220/240V Model	67 325 77
5	J1	Conn. Assy. Pwr. Rcpt:	
		100V, 110/120V Model	67 325 71
		220/240V Model	67 325 76
6	S1	Switch, P.B. Line Interrupt, SPDT	17 682 45
7		Plug, Hole, Nylon, 3/8 Dia (100V, 110/120V Model)	78 306 31
8	CB1, CB2*	Circuit Breaker, 3 Amp	17 BH 146
9		Label, Ext. Battery Charger	67 325 02
10		Not Used	
11		Screw, 4-40 x 3/8 TR PH SS	99 011 07
12		Washer, #4 LK SP SS	99 121 36
13		Nut, 4-40 HEX SS	99 103 00
14		Washer, 1/8 I.D. x 5/16 O.D. x .031 THK, SS	99 121 20
15		Screw, 6-32 x 1/2 TR PH SS	99 023 92
16		Nut, 6-32 HEX, KEPS, S, CAD PL	99 105 34
17		Power Cord, Domestic (Not Shown)	17 AZ 100
		Power Cord, Export (Not Shown)	17 AZ 200

* 220/240V Model Only.

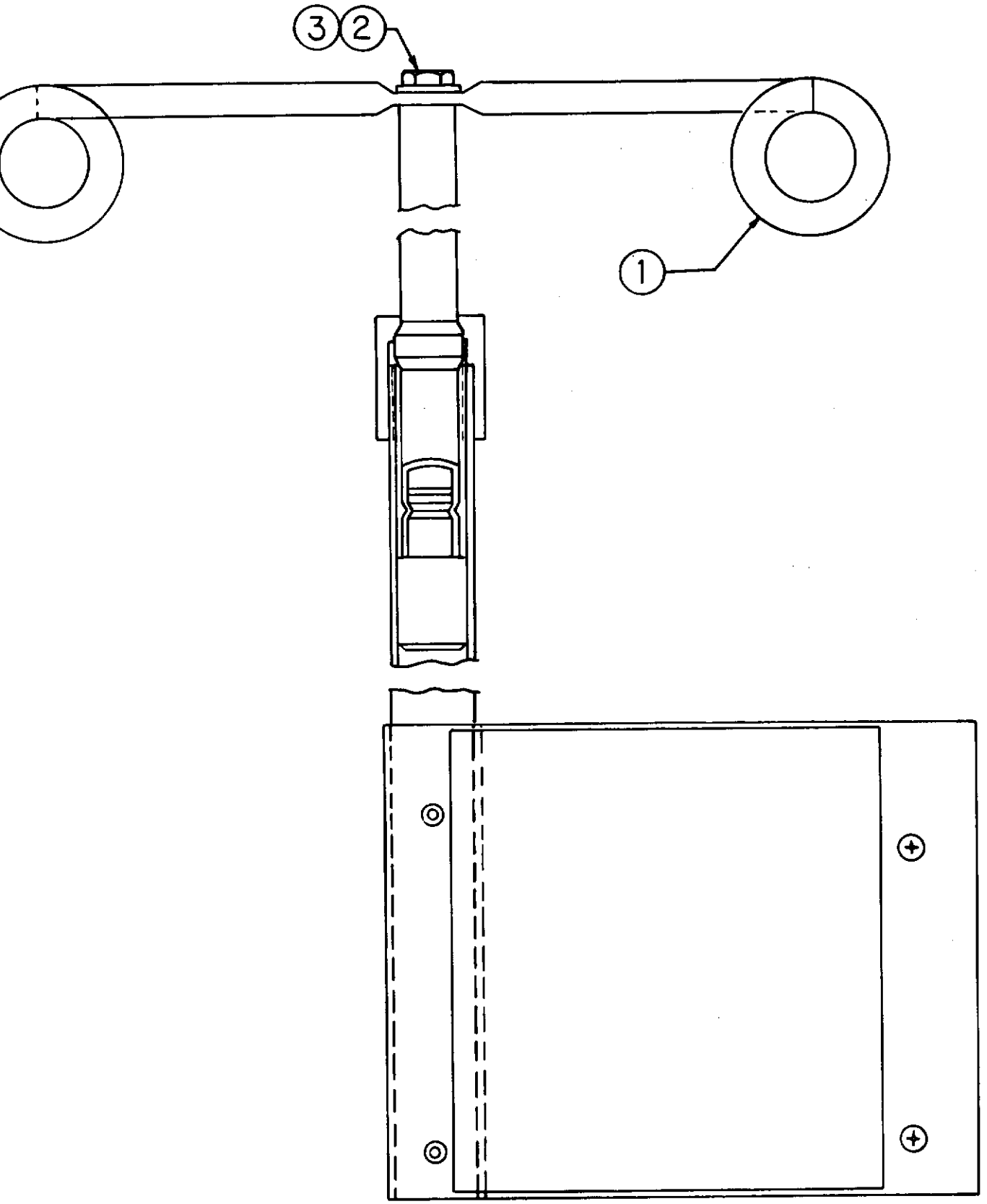

FIGURE 6.18 PARTS LOCATION DIAGRAM, I.V. POLE ASSEMBLY

TABLE 6.18 I.V. POLE ASSEMBLY PARTS LIST (ACCESSORY)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		I.V. POLE ASSEMBLY	67 091 75
1		Cross Arm	26 822 00
2		Screw, 5/16-18 x 1/2 HEX S CA	99 064 21
3		Washer, 5/16 LK SP S CA	99 126 32
4*		Screw, 1/4-20 x 1/2 TR SL SS	99 055 84
5*		Washer, 1/4 LK SP SS	99 125 53
6*		Nut, 1/4-20 AC SS	99 109 17
7*		Nut, 1/4-20 HEX, SS	99 109 00

* Mounting Hardware not shown.

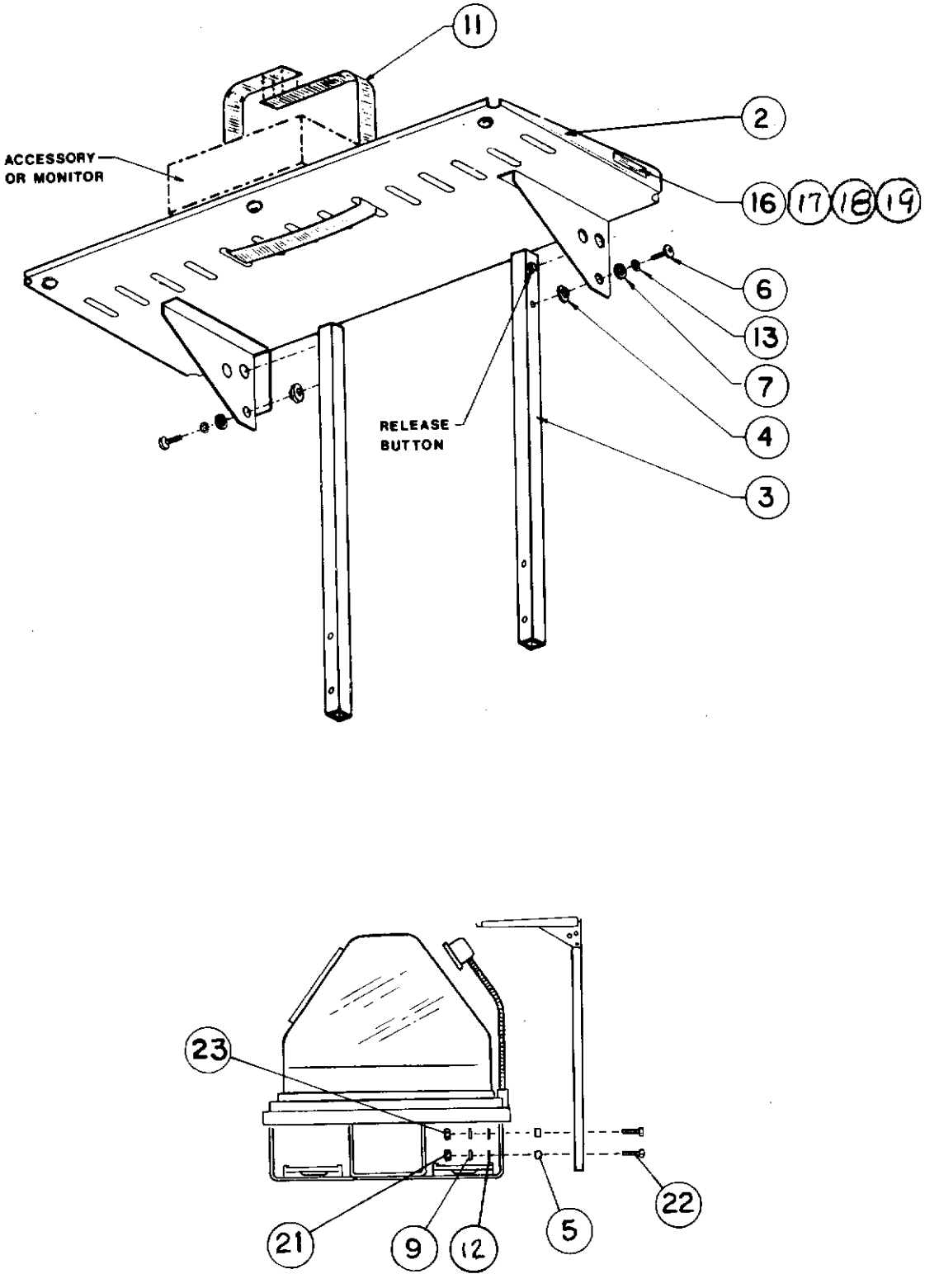

FIGURE 6.19 PARTS LOCATION DIAGRAM, ACCESSORY SHELF

TABLE 6.19 ACCESSORY SHELF PARTS LIST (ACCESSORY)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		ACCESSORY SHELF	67 142 70
1		Not Used	
2		Shelf Assembly	67 092 71
3		Support Pole Assembly	67 092 72
4		Bushing	67 092 15
5		Spacer	67 092 20
6		Screw, 10-32 x 1/2 TR PH SS	99 042 01
7		Wash, #10 x .75 O.D., FL S CA	99 123 32
8*		Screw, 1/4-20 x 7/8 CP HX S NI	99 057 30
9		Washer, 1/4 LK SP SS	99 125 53
10*		Screw, 1/4 -20 x 1 PN PH SS	99 057 67
11		Strap, Nylon, "VELCRO"	17 021 01
12		Washer, 1/4 x 1/2 x 1/32 FL SS	99 125 23
13		Washer, #10 LK SP S CA	99 124 16
14		Not Used	
15		Not Used	
16		Label, Caution, Accessory Shelf (English)	67 092 25
17		Label, Caution, Accessory Shelf (Spanish)	67 092 26
18		Label, Caution, Accessory Shelf (French)	67 092 27
19		Label, Caution, Accessory Shelf (German)	67 092 28
20*		Support, Accessory Shelf	67 100 58
21		Nut, Hex, 1/4-20 SS	99 109 00
22		Screw, 1/4-20 x 1-3/4 HX S CA	99 059 05
23		Nut, 1/4-20 AC SS	99 109 17
		* This is a Universal Accessory Shelf designed for use with several Incubators. These parts are not used when the shelf is installed on the TI100 Transport Incubator.	

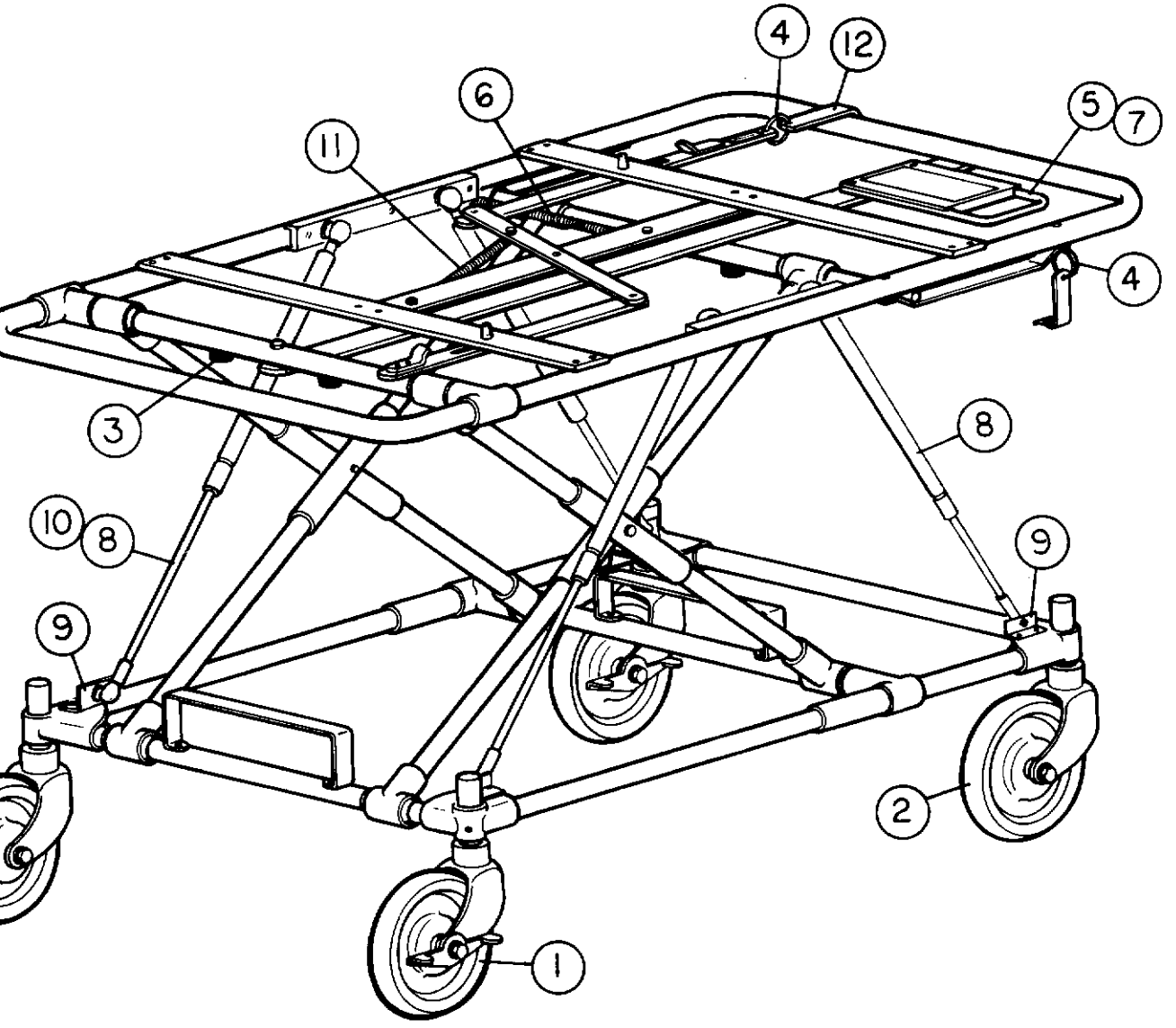

FIGURE 6.20 PARTS LOCATION DIAGRAM, ADJUSTABLE STAND ASSEMBLY

TABLE 6.20 ADJUSTABLE STAND ASSEMBLY PARTS LIST (ACCESSORY)

ITEM NO.	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
-		ADJUSTABLE STAND ASSEMBLY	67 090 71
1		Caster with Brake, 5" D Wheel	03 500 95
2		Caster w/o Brake, 5" D Wheel	03 500 96
3		Bumper, Rubber	03 500 63
4		Ring, Split	03 500 66
5		Handle, Height Adjust Latch Assembly	03 500 67
6		Spring, Height Adjust	03 500 70
7		Nut, Hex, ST	03 500 69
8		Gas Spring, 60 lb.	03 501 14
9		Ball Stud, Gas Spring #A9007	03 501 18
10		Safety Clip, Gas Spring #A9036	03 501 19
11		Spring, Incubator Latch	03 500 80
12		Latch, Retaining	03 500 65

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SECTION 7
DIAGRAMS

7.1 GENERAL

This section provides schematic and wiring diagrams for the TI100 Transport Incubator.

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LAST USED	OMITTED
IC7	—
ICR9	—
IJ3	—
IR3	—
IR2	—
ITP6	—
IVR3	—
IP-	—
2B1	—
2E2	—
2J6	2J13
2L2	—
2Q1	—
2R1	—
2S5	2S3
2T1	—
2CB2	—
2DS2	—
2FL1	—
2HR1	—
2TB1	—
2VR2	—
2C1	—
2P6	—

1	ISSUE ORN 990 -23	
2 NOV 83	11/9/83 MDS	CW
2. ECN 7411 (DS) ADD JUMPER BETWEEN 2TB1-6, 7 & 8.		
CW 3 AUG 84	MDS	
3. ECN 7405 (SCA) ADDED 2J5, 2P5, 2J6, 2P6 AND 2C1 TO LINE CHOKE PCB.		
CW 8 AUG 84	MDS 8/23/84	
4. ECN 7386 (C2) IJ3/IP3-1 WAS IJ3/IP3-3. IJ3/IP3-3 WAS IJ3/IP3-1. GRAY LEAD WAS BLACK. 2B1 WAS 12V DC. REMOVED SHIELD FROM 2B1 CABLE.		
CW 28 AUG 84	MDS 8/24/84	

POWER BOARD ASS'Y 67 262 71

PCB, LINE CHOKE - 67 320 70

AC POWER

CONTROL BD (SEE SCHEMATIC FIGURE 7.2)

220/240V CONFIGURATION
SAME AS 120V EXCEPT AS SHOWN

100V CONFIGURATION
SAME AS 120V EXCEPT AS SHOWN

* Series 01 Incubators only.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES .XX .XXX ALL SURFACE FINISH 125 MAX DO NOT SCALE DRAWING MATERIAL	SIGNATURES	DATE
NEXT ASSY 67 [illegible] 70/80		

FIGURE 7.1 POWER CHASSIS AND SYSTEM, SCHEMATIC DIAGRAM

NOTES: 1. ALL RESISTORS ARE 5% 1/4W UNLESS OTHERWISE SPECIFIED.
2. ALL 1% RESISTORS ARE 1/8 W.

ITEM NO.	DWG SIZE	IDENT NO.	DESCRIPTION	QTY	U/M
			1. ISSUE, DRN 880-18		
			12-SEPT-83 PBS CW		
			2. SEE SHE		

LAST USED	OMITTED
C46	C40
CR19	CR12,16
DS12	—
U27	—
RN1	—
R130	—
Q13	—
VR3	—
TP11	—

THIS DOCUMENT IS PROPRIETARY INFORMATION. REPAIRS AND MODIFICATIONS SHOULD BE PERFORMED ONLY BY AUTHORIZED SERVICE PERSONNEL TO MAINTAIN YOUR WARRANTY AND TO AVOID CREATING SAFETY HAZARDS. WE CAN NOT ASSUME RESPONSIBILITY FOR ANY CONDITIONS AFFECTING THE PROPER OPERATION OF THIS EQUIPMENT WHICH MAY RESULT FROM UNAUTHORIZED REPAIR OR MODIFICATION.	UNLESS OTHERWISE SPECIFIED – DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRACTIONS ± — DECIMALS .XX ± — .XXX ± — ANGLES ± — ALL SURFACE FINISH √MAX. DO NOT SCALE DRAWING	SIGNATURES	DATE
		DRAWN L Burgmon	8 APR 83
		CHKD C. Wright	14 SEP 83
		ENG	9/14/83
		APVD	20 Sept 83
NEXT ASSY: 67 310 70	MATERIAL	FINISH	

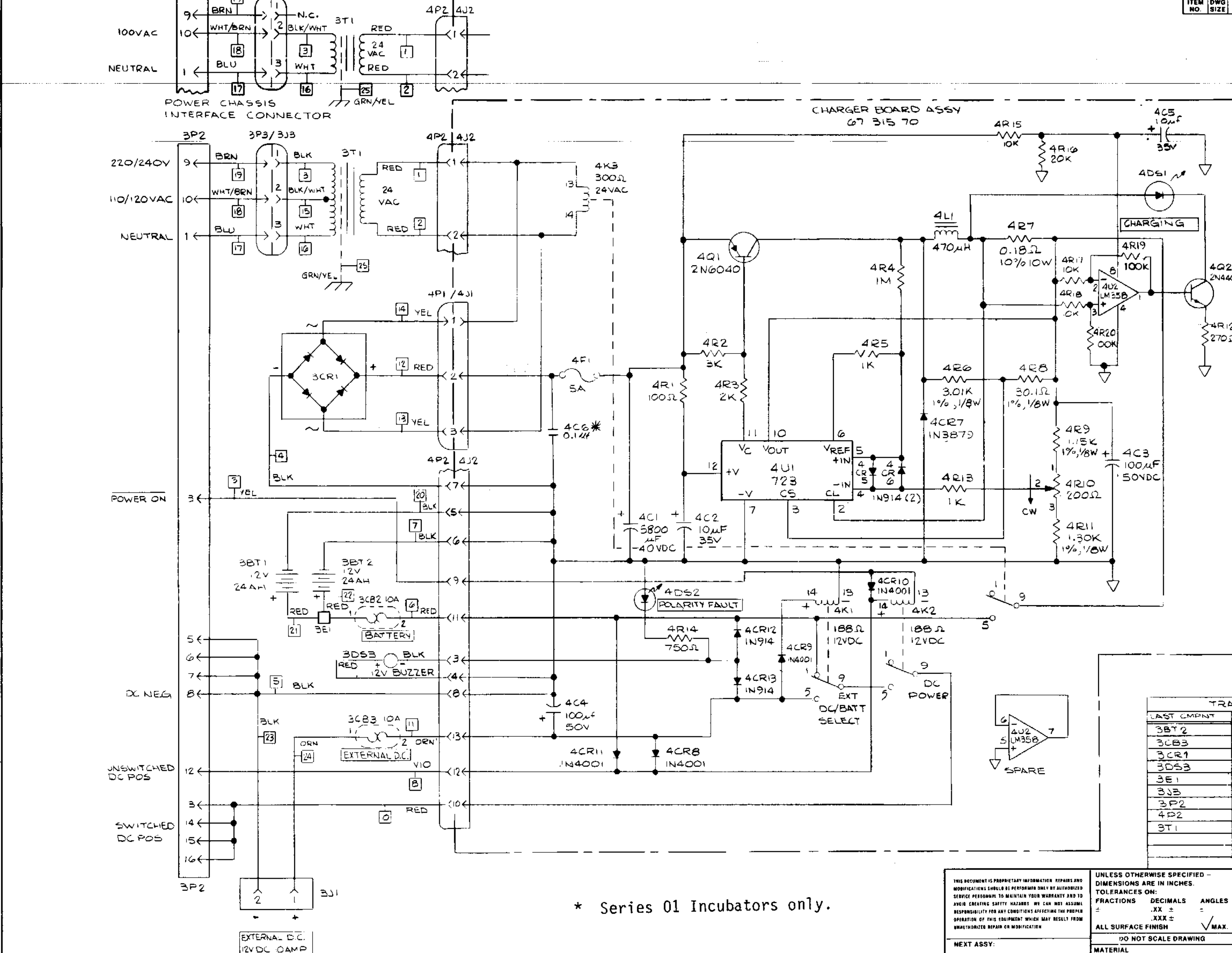
FIGURE 7.2 CONTROLLER AND CONTROL BOARD, SCHEMATIC DIAGRAM (Sheet 1 of 2)

ITEM NO.	DWG SIZE	IDENT NO.	DESCRIPTION	QTY	U/M

REVISIONS

1. ISSUE DAN 880-18 — K. W... 7/19/83 — 12-28-83 — PBS — GW
2. ECN 7306 — R92 WAS 27K FIXED RES — ZONE A-8. — K. W... 10-MAY-84 — PBS — GW

FIGURE 7.2 CONTROLLER AND CONTROL BOARD, SCHEMATIC DIAGRAM (Sheet 2 of 2)



NOTES –

1. ALL RESISTORS 5%, 1/4W, UNLESS OTHERWISE SPECIFIED.
2. NUMBERS IN SQUARES □, ARE WIRE NUMBERS.

TRAY	
LAST CMPNT	NOT USED
3BT2	
3CB3	3CB1
3CR1	
3DS3	3DS1,2
3E1	
3J3	3J2
3P2	3P1
4P2	
3T1	

PCB	
LAST CMPNT	NOT USED
4C6	
4CR13	4CR1,2,3,4
4U2	
4DS2	
4R20	
4K3	
4Q2	
4F1	
4J2	
4L1	

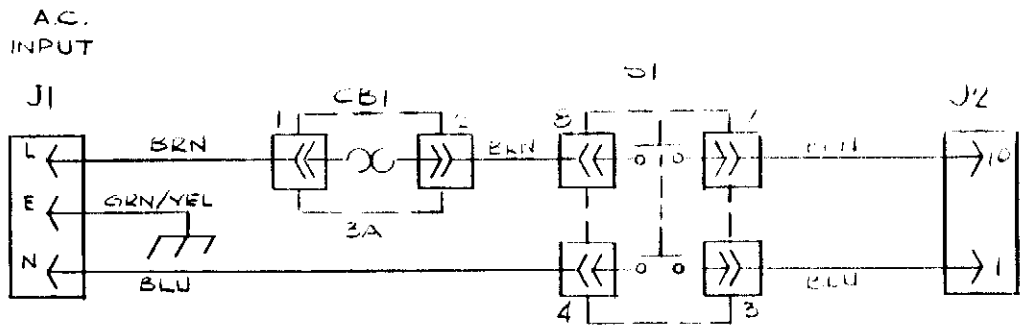
* Series 01 Incubators only.

NEXT ASSY: 67 315 70, 67 304 70/90

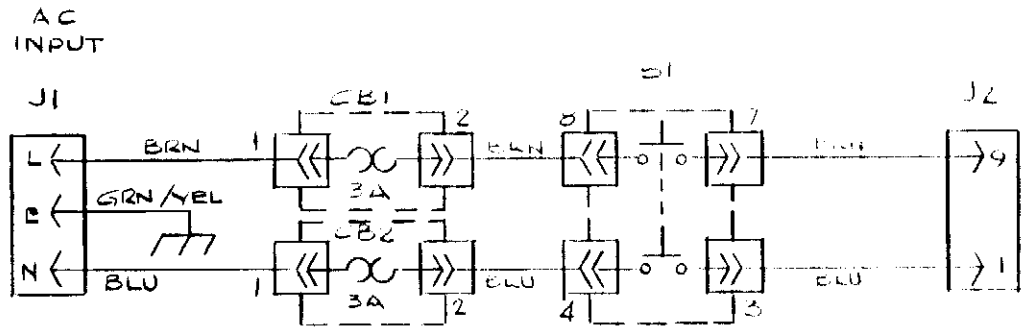
FIGURE 7.3 BATTERY/CHARGER TRAY ASSEMBLY, SCHEMATIC DIAGRAM

PARTS LIST					
ITEM NO	DWG SIZE	IDENT NO	DESCRIPTION	QTY.	U/M

REVISIONS
PER ECN 7110
2-ECN 7217 ADDED 100 VAC TO CALLOUT



100VAC & 110/120VAC

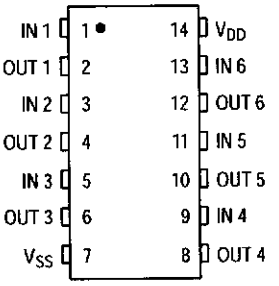


220/240 VAC

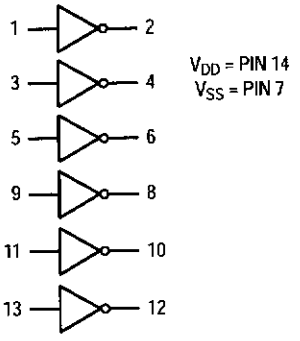
This document is proprietary information. Repairs and modifications should be performed only by authorized service personnel to maintain your warranty and to avoid creating safety hazards. We can not assume responsibility for any conditions affecting the proper operation of this equipment which may result from unauthorized repair or modification.	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± — DECIMALS .XX ± — .XXX ± — ANGLES ± — ALL SURFACE FINISH — ✓MAX. DO NOT SCALE DRAWING	SIGNATURES	DATE
		DRAWN	12 JAN 84
		CHKD C. Wright	17 JAN 84
NEXT ASSY. 67820-70, 75	MATERIAL —	ENG	1/11/84
		APVD	JAN 20 84
		FINISH —	

FIGURE 7.4 EXTERNAL BATTERY CHARGER, SCHEMATIC DIAGRAM

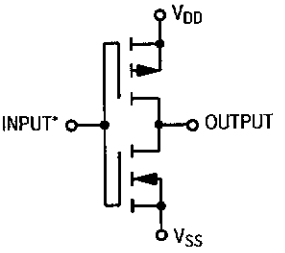
PIN ASSIGNMENT



LOGIC DIAGRAM



CIRCUIT SCHEMATIC
(1/6 OF CIRCUIT SHOWN)



*Double diode protection on all inputs not shown.

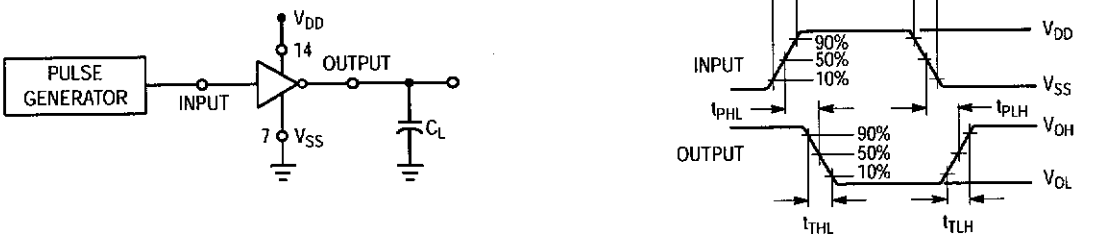
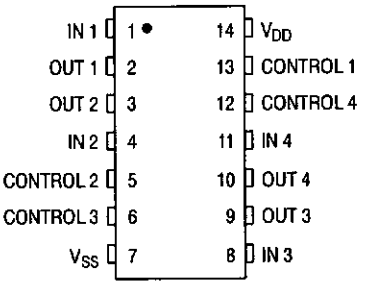
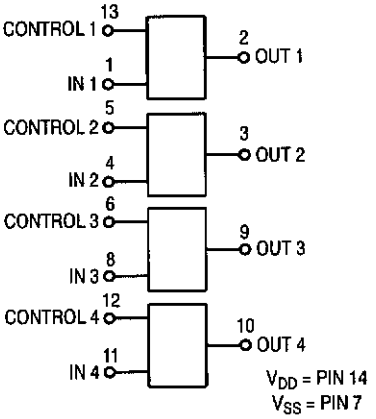


Figure 1. Switching Time Test Circuit and Waveforms

PIN ASSIGNMENT

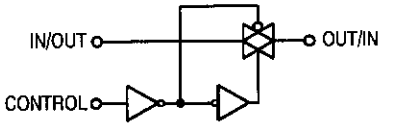


BLOCK DIAGRAM



LOGIC DIAGRAM AND TRUTH TABLE

(1/4 OF DEVICE SHOWN)



Control	Switch
0 = V_{SS}	OFF
1 = V_{DD}	ON

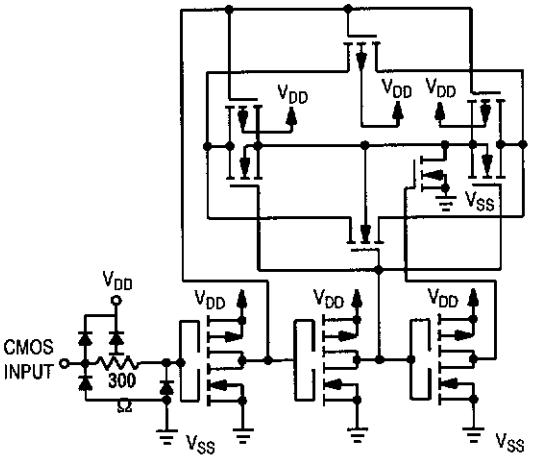
Logic Diagram Restrictions

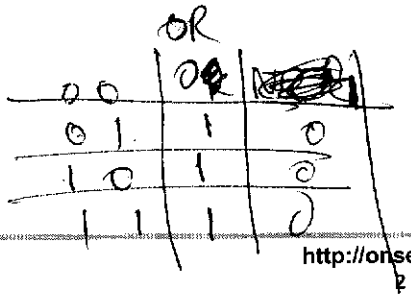
$V_{SS} \le V_{in} \le V_{DD}$

$V_{SS} \le V_{out} \le V_{DD}$

CIRCUIT SCHEMATIC

(1/4 OF CIRCUIT SHOWN)





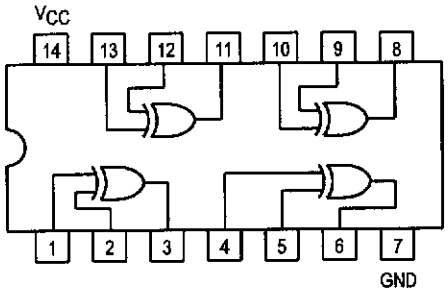
MOTOROLA

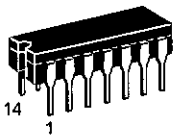
SN54/74LS86

QUAD 2-INPUT EXCLUSIVE OR GATE

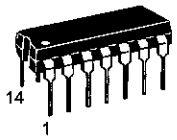
QUAD 2-INPUT EXCLUSIVE OR GATE

LOW POWER SCHOTTKY

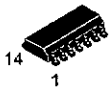




J SUFFIX
CERAMIC
CASE 632-08



N SUFFIX
PLASTIC
CASE 646-06



D SUFFIX
SOIC
CASE 751A-02

ORDERING INFORMATION

SN54LSXXJ	Ceramic
SN74LSXXN	Plastic
SN74LSXXD	SOIC

TRUTH TABLE

IN		OUT
A	B	Z
L	L	L
L	H	H
H	L	H
H	H	L

GUARANTEED OPERATING RANGES

Symbol	Parameter		Min	Typ	Max	Unit
V_{CC}	Supply Voltage	54 74	4.5 4.75	5.0 5.0	5.5 5.25	V
T_A	Operating Ambient Temperature Range	54 74	−55 0	25 25	125 70	°C
I_{OH}	Output Current — High	54, 74			−0.4	mA
I_{OL}	Output Current — Low	54 74			4.0 8.0	mA

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

Symbol	Parameter		Limits Min	Typ	Max	Unit	Test Conditions	
V_{IH}	Input HIGH Voltage		2.0			V	Guaranteed Input HIGH Voltage for All Inputs	
V_{IL}	Input LOW Voltage	54			0.7	V	Guaranteed Input LOW Voltage for All Inputs	
		74			0.8			
V_{IK}	Input Clamp Diode Voltage			−0.65	−1.5	V	V_{CC} = MIN, I_{IN} = −18 mA	
V_{OH}	Output HIGH Voltage	54	2.5	3.5		V	V_{CC} = MIN, I_{OH} = MAX, V_{IN} = V_{IH} or V_{IL} per Truth Table	
		74	2.7	3.5		V		
V_{OL}	Output LOW Voltage	54, 74		0.25	0.4	V	I_{OL} = 4.0 mA	V_{CC} = V_{CC} MIN, V_{IN} = V_{IL} or V_{IH} per Truth Table
		74		0.35	0.5	V	I_{OL} = 8.0 mA	
I_{IH}	Input HIGH Current				40	μA	V_{CC} = MAX, V_{IN} = 2.7 V	
					0.2	mA	V_{CC} = MAX, V_{IN} = 7.0 V	
I_{IL}	Input LOW Current				−0.8	mA	V_{CC} = MAX, V_{IN} = 0.4 V	
I_{OS}	Short Circuit Current (Note 1)		−20		−100	mA	V_{CC} = MAX	
I_{CC}	Power Supply Current				10	mA	V_{CC} = MAX	

Note 1: Not more than one output should be shorted at a time, nor for more than 1 second.

AC CHARACTERISTICS (T_A = 25°C)

Symbol	Parameter	Limits Min	Typ	Max	Unit	Test Conditions
t_{PLH} t_{PHL}	Propagation Delay, Other Input LOW		12 10	23 17	ns	V_{CC} = 5.0 V C_L = 15 pF
t_{PLH} t_{PHL}	Propagation Delay, Other Input HIGH		20 13	30 22	ns	

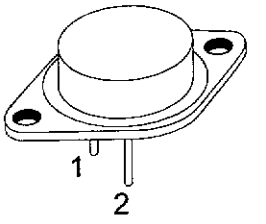
2N5886

HIGH CURRENT SILICON NPN POWER TRANSISTOR

- STMicroelectronics PREFERRED SALESTYPE
- HIGH CURRENT CAPABILITY

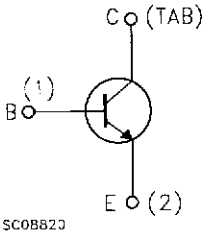
APPLICATIONS
- GENERAL PURPOSE SWITCHING AND AMPLIFIER
- LINEAR AND SWITCHING INDUSTRIAL EQUIPMENT

DESCRIPTION
The 2N5886 is a silicon Epitaxial-Base NPN power transistor mounted in Jedec TO-3 metal case. It is inteded for use in power linear amplifiers and switching applications.



TO-3

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-Base Voltage (I_E = 0)	80	V
V_{CEO}	Collector-Emitter Voltage (I_B = 0)	80	V
V_{EBO}	Emitter-Base Voltage (I_C = 0)	5	V
I_C	Collector Current	25	A
I_{CM}	Collector Peak Current	50	A
I_B	Base Current	7.5	A
P_{tot}	Total Dissipation at $T_c \leq 25$ °C	200	W
T_{stg}	Storage Temperature	-65 to 200	°C
T_j	Max. Operating Junction Temperature	200	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	0.875	°C/W

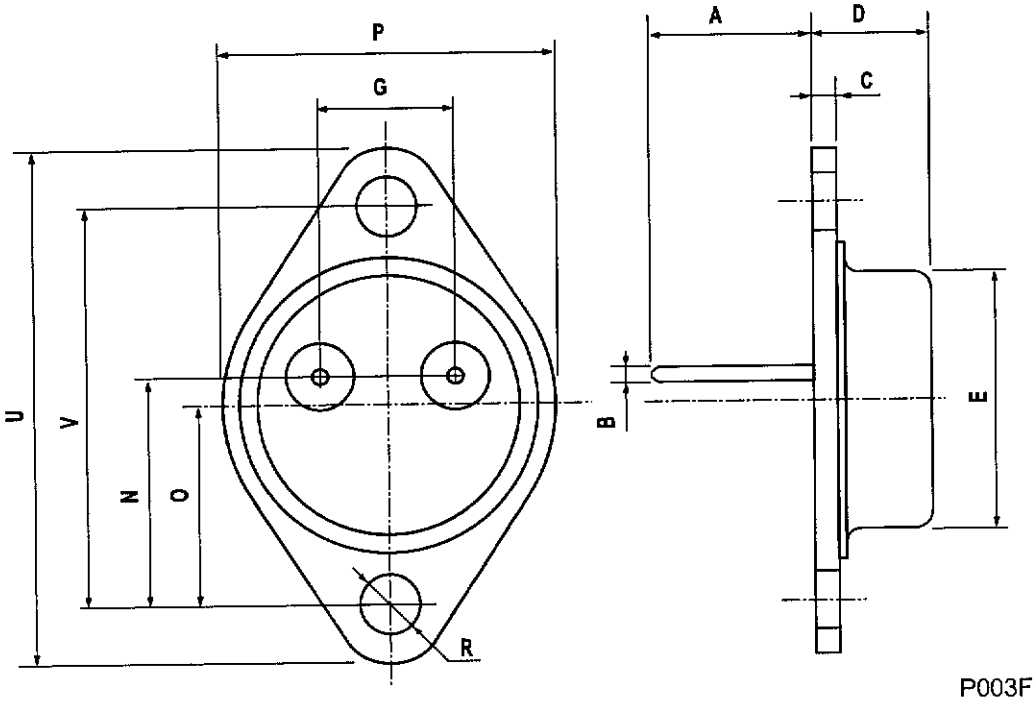
ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CEV}	Collector Cut-off Current (V_{BE} = -1.5V)	V_{CE} = 80 V V_{CE} = 80 V T_c = 150 °C			1 10	mA mA
I_{CBO}	Collector Cut-off Current (I_E = 0)	V_{CB} = 80 V			1	mA
I_{CEO}	Collector Cut-off Current (I_B = 0)	V_{CE} = 40 V			2	mA
I_{EBO}	Emitter Cut-off Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-Emitter Sustaining Voltage (I_B = 0)	I_C = 200 mA	80			V
$V_{CE(sat)}$*	Collector-Emitter Saturation Voltage	I_C = 15 A I_B = 1.5 A I_C = 25 A I_B = 6.25 A			1 4	V V
$V_{BE(sat)}$*	Base-Emitter Saturation Voltage	I_C = 25 A I_B = 6.25 A			2.5	V
V_{BE}*	Base-Emitter Voltage	I_C = 10 A V_{CE} = 4 V			1.5	V
h_{FE}*	DC Current Gain	I_C = 3 A V_{CE} = 4 V I_C = 10 A V_{CE} = 4 V I_C = 25 A V_{CE} = 4 V	35 20 4		100	
h_{fe}	Small Signal Current Gain	I_C = 3 A V_{CE} = 4 V f = 1KHz	20			
f_T	Transition frequency	I_C = 1 A V_{CE} = 10 V f =1 MHz	4			MHz
C_{CBO}	Collector Base Capacitance	I_E = 0 V_{CB} = 10 V f = 1MHz			500	pF
	RESISTIVE LOAD	I_C = 10 A V_{CC} = 30 V				
t_r	Rise Time	I_{B1} = -I_{B2} = 1A			0.7	µs
t_s	Storage Time				1	µs
t_f	Fall Time				0.8	µs

* Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %

TO-3 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	11.00		13.10	0.433		0.516
B	0.97		1.15	0.038		0.045
C	1.50		1.65	0.059		0.065
D	8.32		8.92	0.327		0.351
E	19.00		20.00	0.748		0.787
G	10.70		11.10	0.421		0.437
N	16.50		17.20	0.649		0.677
P	25.00		26.00	0.984		1.023
R	4.00		4.09	0.157		0.161
U	38.50		39.30	1.515		1.547
V	30.00		30.30	1.187		1.193



P003F

TEXAS INSTRUMENTS

a sheet acquired from Harris Semiconductor
HS032C – Revised October 2003

CD4027B Types

MOS Dual J-K aster-Slave Flip-Flop

gh-Voltage Types (20-Volt Rating)

■ CD4027B is a single monolithic ip integrated circuit containing two iden- al complementary-symmetry J-K master- ve flip-flops. Each flip-flop has provi- ons for individual J, K, Set, Reset, and ock input signals. Buffered Q and $\overline{Q}$ gnals are provided as outputs. This input- tput arrangement provides for compatible eration with the RCA-CD4013B dual D- pe flip-flop.

he CD4027B is useful in performing con- ol, register, and toggle functions. Logic vels present at the J and K inputs along ith internal self-steering control the state each flip-flop; changes in the flip-flop ate are synchronous with the positive- oing transition of the clock pulse. Set and eset functions are independent of the clock nd are initiated when a high level signal is resent at either the Set or Reset input.

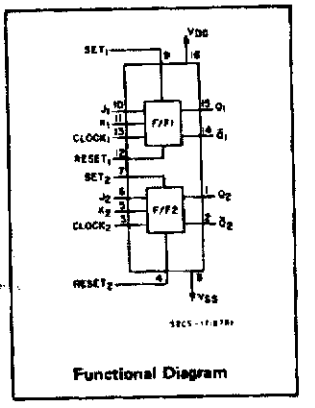
The CD4027B types are supplied in 16-lead ermetic dual-in-line ceramic packages F3A suffix), 16-lead dual-in-line plastic ackages (E suffix), 16-lead small-outline ackages (M, M96, MT, and NSR suffixes), and 16-lead thin shrink small-outline packages (PW nd PWR suffixes).

Features:

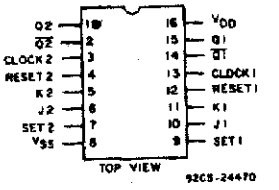
- Set-Reset capability
- Static flip-flop operation – retains state indefinitely with clock level either "high" or "low"
- Medium speed operation – 16 MHz (typ.) clock toggle rate at 10 V
- Standardized symmetrical output characteristics
- 100% tested for quiescent current at 20 V
- Maximum input current of 1 μA at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- Noise margin (over full package-temperature range):
  1 V at V_{DD} = 5 V
  2 V at V_{DD} = 10 V
  2.5 V at V_{DD} = 15 V
- 5-V, 10-V, and 15-V parametric ratings
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

Applications:

- Registers, counters, control circuits



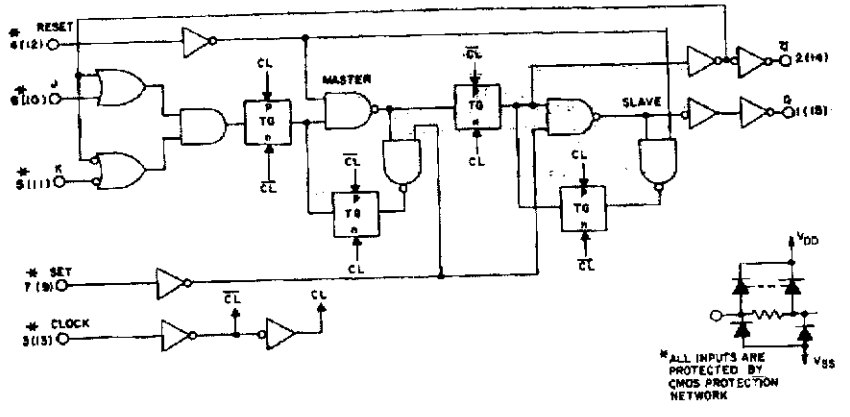
Functional Diagram



TERMINAL ASSIGNMENT

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC SUPPLY-VOLTAGE RANGE, (V_{DD})
(Voltages referenced to V_{SS} Terminal) ..... -0.5V to +20V
INPUT VOLTAGE RANGE, ALL INPUTS ..... -0.5V to V_{DD} +0.5V
DC INPUT CURRENT, ANY ONE INPUT ..... ±10mA
POWER DISSIPATION PER PACKAGE (P_D):
For T_A = -55°C to +100°C 500mW
For T_A = +100°C to +125°C ..... Derate Linearity at 12mW/°C to 200mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR 100mW
FOR T_A = FULL PACKAGE-TEMPERATURE RANGE (All Package Types) ..... -55°C to +125°C
OPERATING-TEMPERATURE RANGE (T_A) ..... -65°C to +150°C
STORAGE TEMPERATURE RANGE (T_{stg}) ..... +265°C
LEAD TEMPERATURE (DURING SOLDERING):
At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10s max .....



PRESENT STATE					CL▲	NEXT STATE	
INPUTS				OUTPUT		OUTPUTS	
J	K	S	R	Q		Q	Q̄
1	X	0	0	0		1	0
X	0	0	0	1		1	0
0	X	0	0	0		0	1
X	1	0	0	1		0	1
X	X	0	0	X		NO CHANGE	
X	X	1	0	X	X	1	0
X	X	0	1	X	X	0	1
X	X	1	1	X	X	1	1

LOGIC 1=HIGH LEVEL
LOGIC 0=LOW LEVEL
▲ = LEVEL CHANGE
X = DON'T CARE

92CM-27591R1

Fig. 1 – Logic diagram and truth table for CD4027B (one of two identical J-K flip flops).

RECOMMENDED OPERATING CONDITIONS at T_A = 25°C, Except as Noted.
For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	V_{DD} (V)	LIMITS All Packages Min.	LIMITS All Packages Max.	UNITS
Supply-Voltage Range (For T_A = Full Package Temperature Range)	–	3	18	V
Data Setup Time t_S	5	200	–	ns
	10	75	–	
	15	50	–	
Clock Pulse Width t_W	5	140	–	ns
	10	60	–	
	15	40	–	
Clock Input Frequency (Toggle Mode) f_{CL}	5	dc	3.5	MHz
	10		8	
	15		12	
Clock Rise or Fall Time t_rCL^*, t_fCL	5	–	45	μs
	10	–	5	
	15	–	2	
Set or Reset Pulse Width t_W	5	180	–	ns
	10	80	–	
	15	50	–	

* If more than one unit is cascaded in a parallel clocked operation, t_rCL should be made less than or equal to the sum of the fixed propagation delay time at 15 pF and the transition time of the output driving stage for the estimated capacitive load.

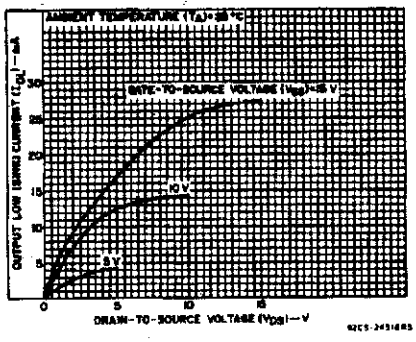


Fig.2 – Typical output low (sink) current characteristics.

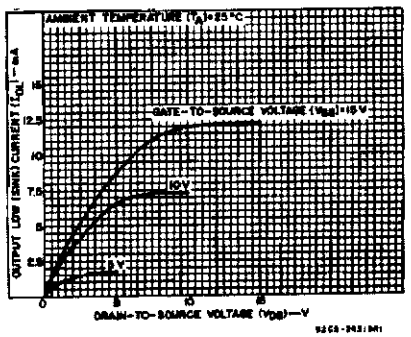


Fig.3 – Minimum output low (sink) current characteristics.

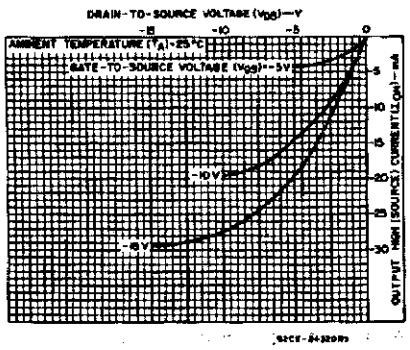


Fig.4 – Typical output high (source) current characteristics.

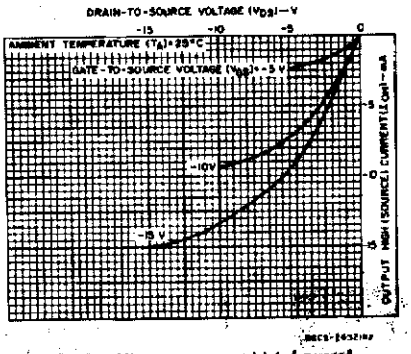


Fig.5 – Minimum output high (source) current characteristics.

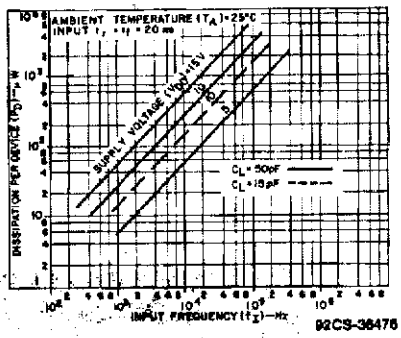


Fig.6 – Typical power dissipation vs. frequency.

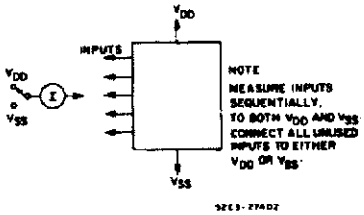


Fig.7 – Input current test circuit.

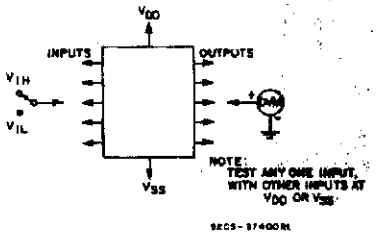


Fig.8 – Input-voltage test circuit.

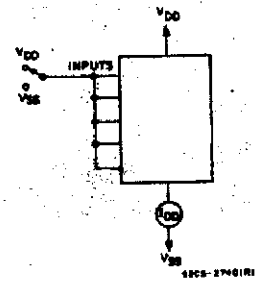
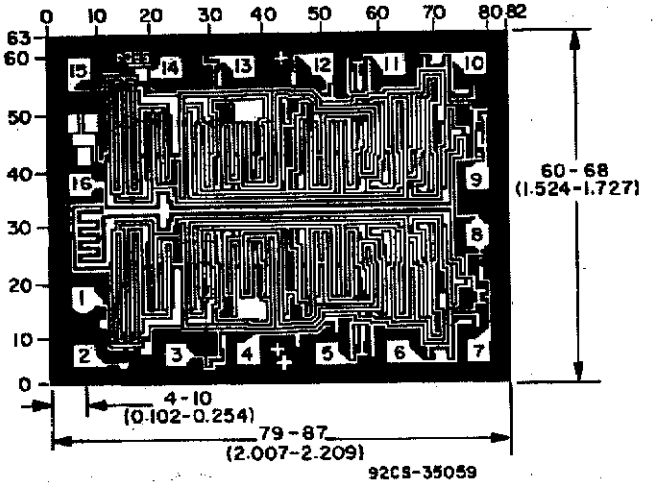


Fig.9 – Quiescent device current test circuit.

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
								+25			
	V_O (V)	V_{IN} (V)	V_{DD} (V)	−55	−40	+85	+125	Min.	Typ.	Max.	
Quiescent Device Current I_{DD} Max.	–	0,5	5	1	1	30	30	–	0.02	1	μA
	–	0,10	10	2	2	60	60	–	0.02	2	
	–	0,15	15	4	4	120	120	–	0.02	4	
	–	0,20	20	20	20	600	600	–	0.04	20	
Output Low (Sink) Current, I_{OL} Min.	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1	–	mA
	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	–	
	1.5	0,15	15	4.2	4	2.8	2.4	3.4	6.8	–	
Output High (Source) Current, I_{OH} Min.	4.6	0,5	5	−0.64	−0.61	−0.42	−0.36	−0.51	−1	–	
	2.5	0,5	5	−2	−1.8	−1.3	−1.15	−1.6	−3.2	–	
	9.5	0,10	10	−1.6	−1.5	−1.1	−0.9	−1.3	−2.6	–	
	13.5	0,15	15	−4.2	−4	−2.8	−2.4	−3.4	−6.8	–	
Output Voltage: Low-Level, V_{OL} Max.	–	0,5	5	0.05				–	0	0.05	V
	–	0,10	10	0.05				–	0	0.05	
	–	0,15	15	0.05				–	0	0.05	
Output Voltage: High-Level, V_{OH} Min.	–	0,5	5	4.95				4.95	5	–	
	–	0,10	10	9.95				9.95	10	–	
	–	0,15	15	14.95				14.95	15	–	
Input Low Voltage, V_{IL} Max.	0.5,4.5	–	5	1.5				–	–	1.5	V
	1,9	–	10	3				–	–	3	
	1.5,13.5	–	15	4				–	–	4	
Input High Voltage, V_{IH} Min.	0.5,4.5	–	5	3.5				3.5	–	–	
	1,9	–	10	7				7	–	–	
	1.5,13.5	–	15	11				11	–	–	
Input Current, I_{IN} Max.	–	0,18	18	±0.1	±0.1	±1	±1	–	$\pm 10^{-5}$	±0.1	μA



Dimensions in millimeters are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3}).

Dimensions and Pad Layout for CD4027BH

DYNAMIC ELECTRICAL CHARACTERISTICS at T_A = 25°C; Input t_r, t_f = 20 ns, C_L = 50 pF, R_L = 200 kΩ

CHARACTERISTIC	V_{DD} (V)	LIMITS (All Packages) Min.	Typ.	Max.	UNITS
Propagation Delay Time: Clock to Q or $\bar{Q}$ Outputs t_{PHL}, t_{PLH}	5	–	150	300	ns
	10	–	65	130	
	15	–	45	90	
Set to Q or Reset to $\bar{Q}$ t_{PLH}	5	–	150	300	ns
	10	–	65	130	
	15	–	45	90	
Set to $\bar{Q}$ or Reset to Q t_{PHL}	5	–	200	400	ns
	10	–	85	170	
	15	–	60	120	
Transition Time t_{THL}, t_{TLH}	5	–	100	200	ns
	10	–	50	100	
	15	–	40	80	
Maximum Clock Input Frequency# (Toggle Mode) f_{CL}	5	3.5	7	–	MHz
	10	8	16	–	
	15	12	24	–	
Minimum Clock Pulse Width t_W	5	–	70	140	ns
	10	–	30	60	
	15	–	20	40	
Minimum Set or Reset Pulse Width t_W	5	–	90	180	ns
	10	–	40	80	
	15	–	25	50	
Minimum Data Setup Time t_S	5	–	100	200	ns
	10	–	35	75	
	15	–	25	50	
Clock Input Rise or Fall Time t_{rCL}, t_{fCL}	5	–	–	45	μs
	10	–	–	5	
	15	–	–	2	
Input Capacitance C_I		–	5	7.5	pF

Input t_r, t_f = 5 ns.

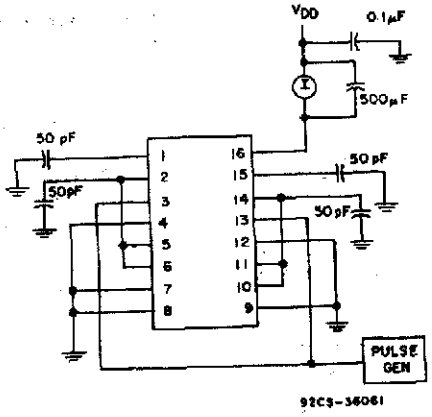


Fig. 13—Dynamic power dissipation test circuit.

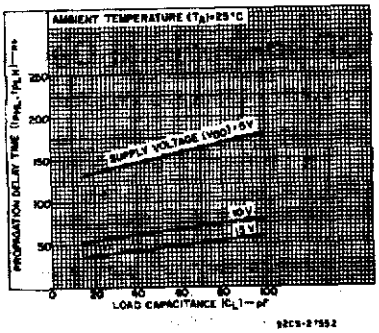


Fig. 10 — Typical propagation delay time vs. load capacitance (CLOCK or SET to Q, CLOCK or RESET to $\bar{Q}$.

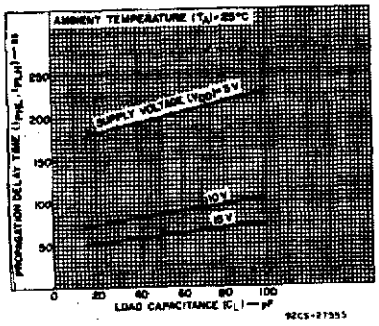


Fig. 11 — Typical propagation delay time vs. load capacitance (SET to $\bar{Q}$ or RESET to Q).

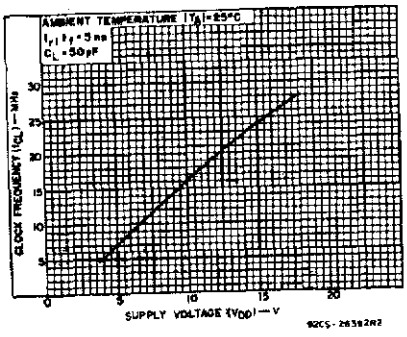


Fig. 12 — Typical maximum clock frequency vs. supply voltage (toggle mode).

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
CD4027BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD4027BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD4027BF	ACTIVE	CDIP	J	16	1	TBD	Call TI	N / A for Pkg Type
CD4027BF3A	ACTIVE	CDIP	J	16	1	TBD	Call TI	N / A for Pkg Type
CD4027BM	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4027BM96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4027BM96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4027BME4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4027BMT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4027BMTE4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4027BNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4027BNSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4027BPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4027BPWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4027BPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4027BPWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
JM38510/05152BEA	ACTIVE	CDIP	J	16	1	TBD	Call TI	N / A for Pkg Type

[1] The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

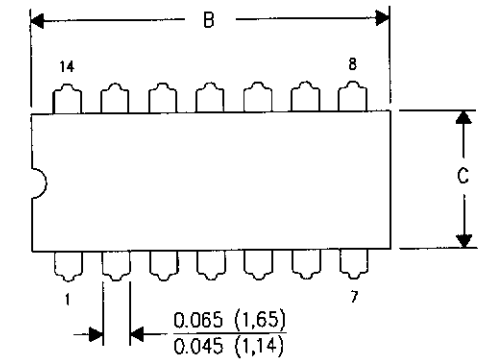
[2] Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

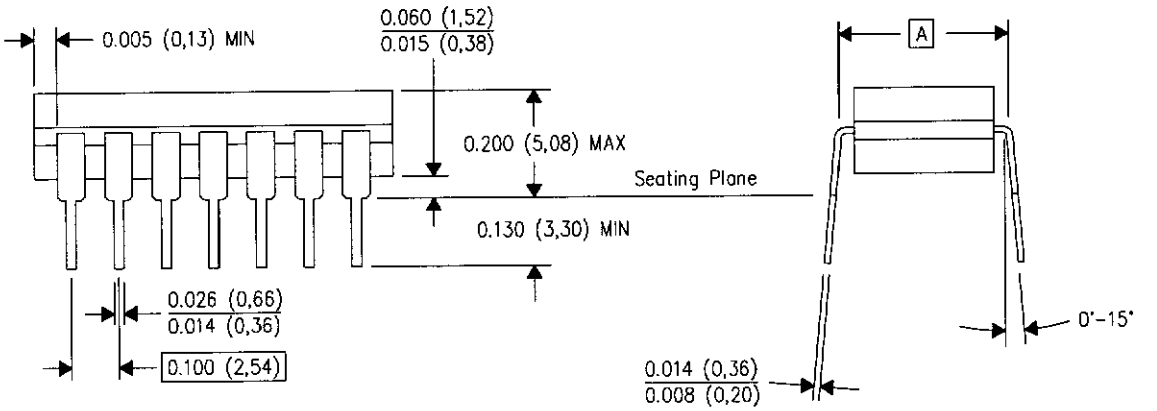
J (R–GDIP–T**)

14 LEADS SHOWN

CERAMIC DUAL IN–LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



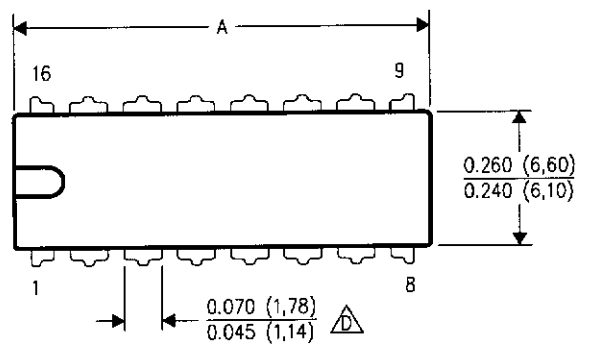
4040083/F 03/03

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls within MIL STD 1835 GDIP1–T14, GDIP1–T16, GDIP1–T18 and GDIP1–T20.

N (R–PDIP–T**)

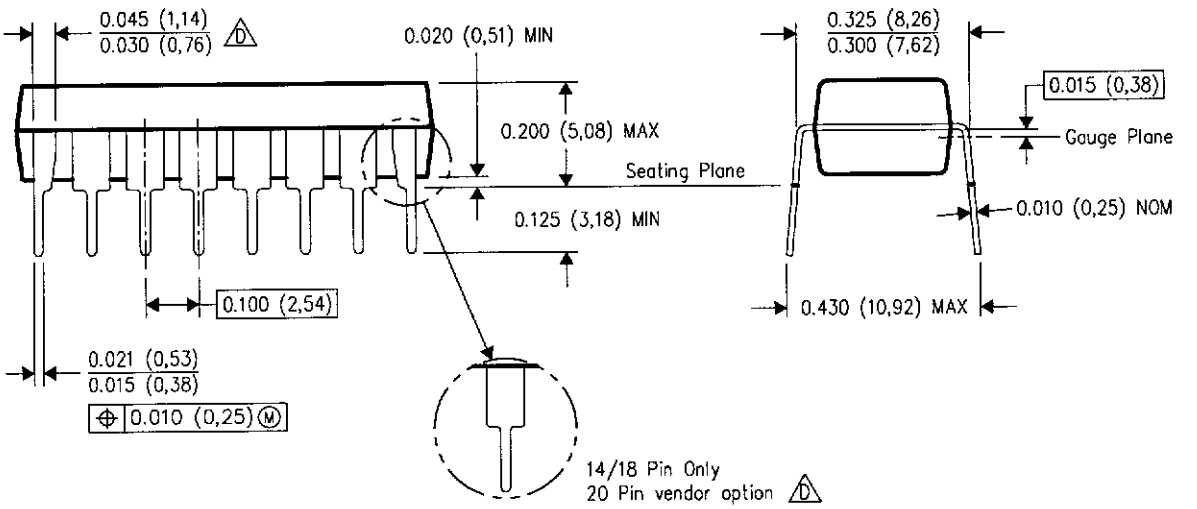
PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION	AA	BB	AC	AD

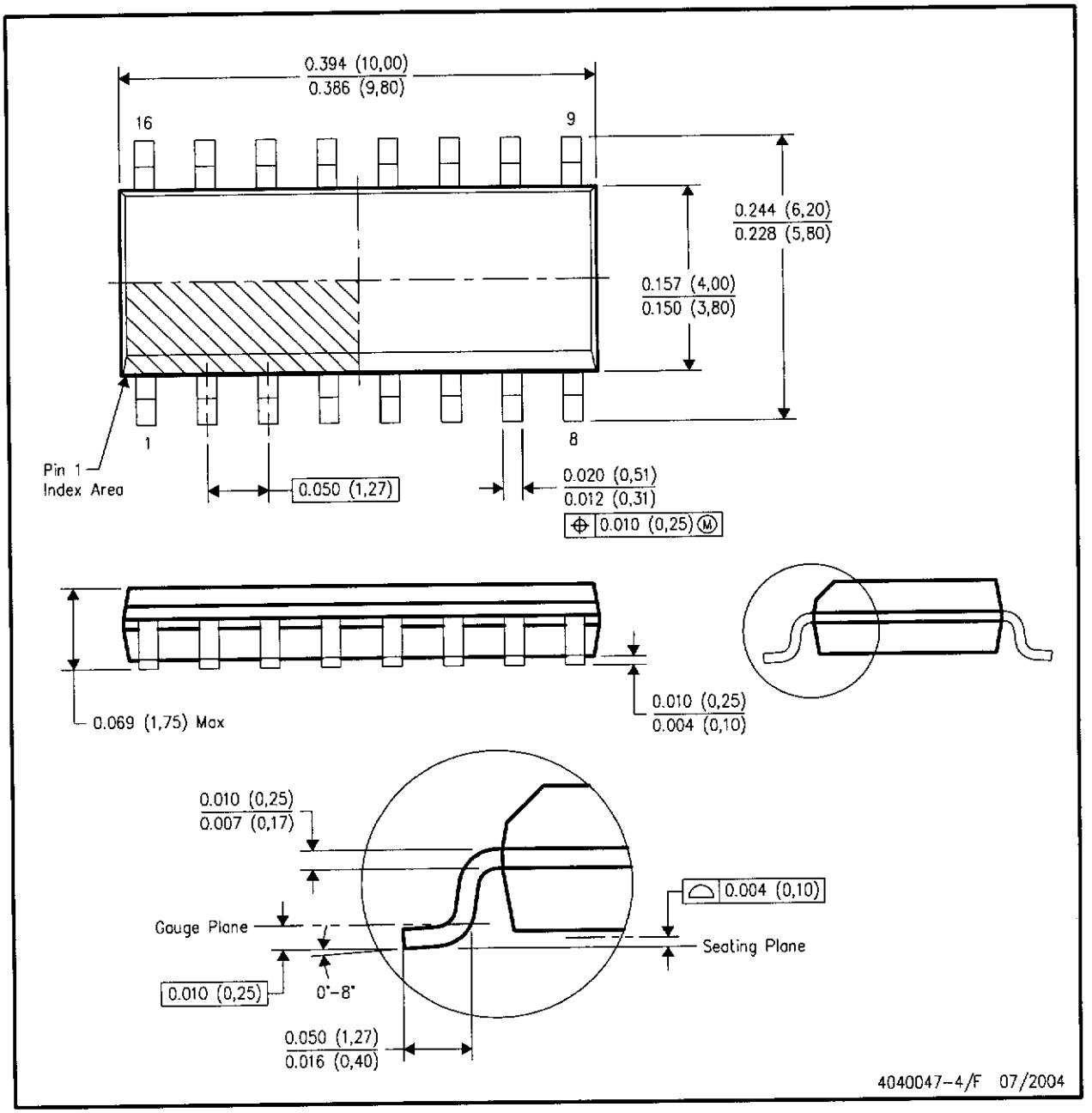
C



4040049/E 12/2002

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R–PDSO–G16) PLASTIC SMALL–OUTLINE PACKAGE

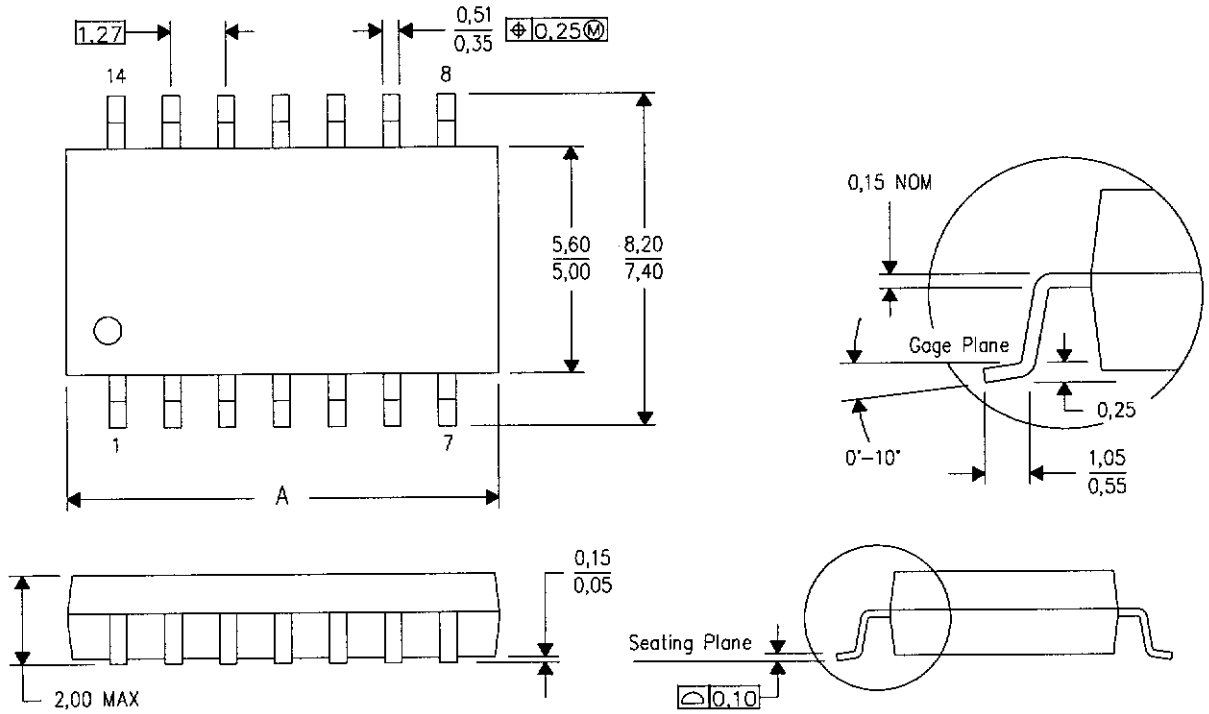


NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS–012 variation AC.

MECHANICAL DATA

NS (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14-PINS SHOWN



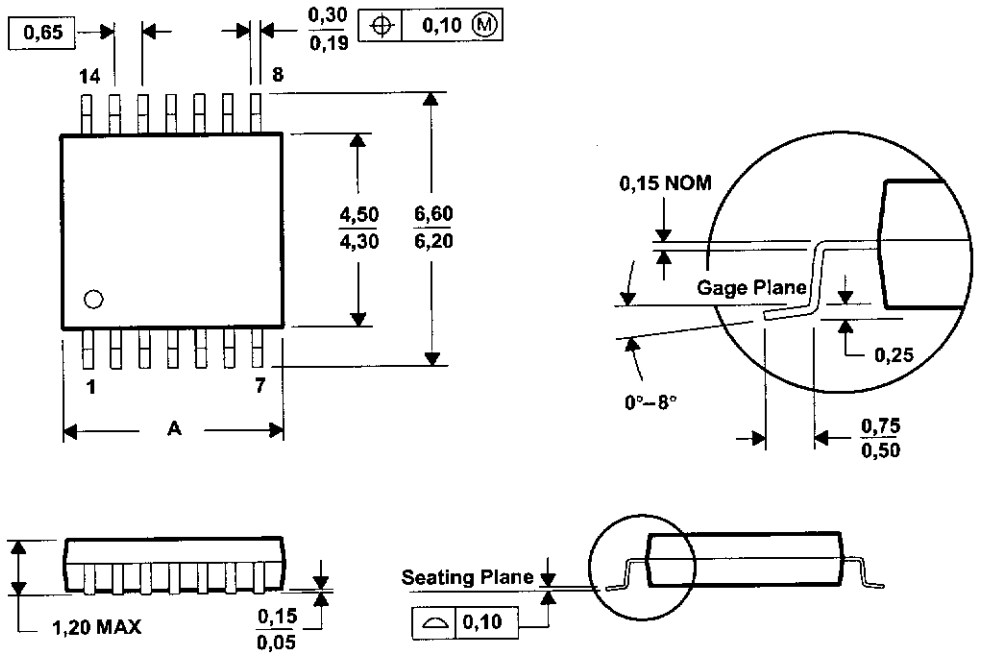
DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

4040062/C 03/03

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

PW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PINS SHOWN



DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

4040064/F 01/97

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

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National Semiconductor

July 1992

DS1631/DS3631/DS1632/DS3632/DS1633/DS3633/ DS1634/DS3634 CMOS Dual Peripheral Drivers

General Description

The DS1631 series of dual peripheral drivers was designed to be a universal set of interface components for CMOS circuits.

Each circuit has CMOS compatible inputs with thresholds that track as a function of V_{CC} (approximately ½ V_{CC}). The inputs are PNPs providing the high impedance necessary for interfacing with CMOS.

Outputs have high voltage capability, minimum breakdown voltage is 56V at 250 μA.

The outputs are Darlington connected transistors. This allows high current operation (300 mA max) at low internal V_{CC} current levels since base drive for the output transistor is obtained from the load in proportion to the required loading conditions. This is essential in order to minimize loading on the CMOS logic supply.

Typical V_{CC} = 5V power is 28 mW with both outputs ON. V_{CC} operating range is 4.5V to 15V.

The circuit also features output transistor protection if the V_{CC} supply is lost by forcing the output into the high impedance OFF state with the same breakdown levels as when V_{CC} was applied.

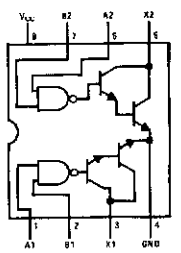
Pin-outs are the same as the respective logic functions found in the following popular series of circuits: DS75451, DS75461. This feature allows direct conversion of present systems to the MM74C CMOS family and DS1631 series circuits with great power savings.

The DS1631 series is also TTL compatible at V_{CC} = 5V.

Features

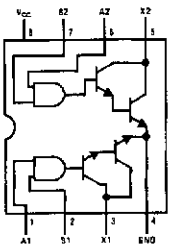
- CMOS compatible inputs
- High impedance inputs — PNP's
- High output voltage breakdown — 56V min
- High output current capability — 300 mA max
- Same pin-outs and logic functions as DS75451 and DS75461 series circuits
- Low V_{CC} power dissipation (28 mW both outputs "ON" at 5V)

Connection Diagrams (Dual-In-Line and Metal Can Packages)



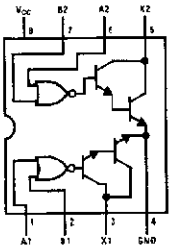
TL/F/5816–1

Top View
Order Number DS1631J-8 or DS3631N



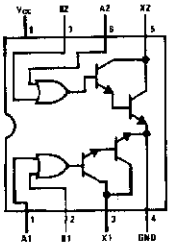
TL/F/5816–2

Top View
Order Number DS1632J-8 or DS3632N



TL/F/5816–3

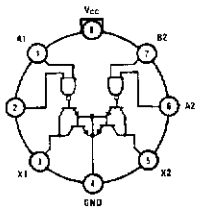
Top View
Order Number DS1633J-8 or DS3633N



TL/F/5816–4

Top View
Order Number DS1634J-8 or DS3634N

See NS Package Number J08A or N08E

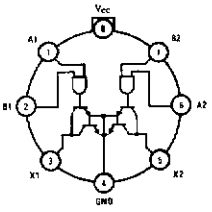


TL/F/5816–5

Top View

(Pin 4 is electrically connected to the case.)

Order Number DS1631H

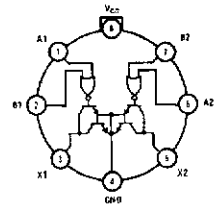


TL/F/5816–6

Top View

(Pin 4 is electrically connected to the case.)

Order Number DS1632H

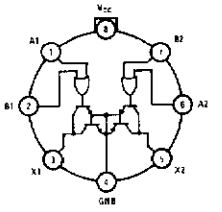


TL/F/5816–7

Top View

(Pin 4 is electrically connected to the case.)

Order Number DS1633H



TL/F/5816–8

Top View

(Pin 4 is electrically connected to the case.)

Order Number DS1634H

See NS Package Number H08C

RRD-B30M105/Printed in U. S. A.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage	16V
Voltage at Inputs	−0.3V to V_{CC} + 0.3V
Output Voltage	56V
Storage Temperature Range	−65°C to +150°C
Maximum Power Dissipation* at 25°C	
Cavity Package	1133 mW
Molded Package	1022 mW
TO-5 Package	787 mW
Lead Temperature (Soldering, 4 sec.	260°C

*Derate cavity package 7.6 mW/°C above 25°C; derate molded package 8.2 mW/°C above 25°C; derate TO-5 package 5.2 mW/°C above 25°C.

Operating Conditions

	Min	Max	Units
Supply Voltage, V_{CC}			
DS1631/DS1632/ DS1633/DS1634	4.5	15	V
DS3631/DS3632/ DS3633/DS3634	4.75	15	V
Temperature, T_A			
DS1631/DS1632/ DS1633/DS1634	−55	+125	°C
DS3631/DS3632/ DS3633/DS3634	0	+70	°C

Electrical Characteristics (Notes 2 and 3)

Symbol	Parameter	Conditions			Min	Typ	Max	Units
ALL CIRCUITS								
V_{IH}	Logical "1" Input Voltage	(*Figure 1*)	V_{CC} = 5V		3.5	2.5		V
			V_{CC} = 10V		8.0	5		V
			V_{CC} = 15V		12.5	7.5		V
V_{IL}	Logical "0" Input Voltage	(*Figure 1*)	V_{CC} = 5V			2.5	1.5	V
			V_{CC} = 10V			5.5	2.0	V
			V_{CC} = 15V			7.5	2.5	V
I_{IH}	Logical "1" Input Current	V_{CC} = 15V, V_{IN} = 15V, (*Figure 2*)				0.1	10	μA
I_{IL}	Logical "0" Input Current	V_{IN} = 0.4V, (*Figure 3*)	V_{CC} = 5V			−50	−120	μA
			V_{CC} = 15V			−200	−360	μA
V_{OH}	Output Breakdown Voltage	V_{CC} = 15V, I_{OH} = 250 μA, (*Figure 1*)			56	65		V
V_{OL}	Output Low Voltage	V_{CC} = Min, (*Figure 1*), DS1631, DS1632, DS1633, DS1634	I_{OL} = 100 mA			0.85	1.1	V
			I_{OL} = 300 mA			1.1	1.4	V
		V_{CC} = Min, (*Figure 1*), DS3631, DS3632, DS3633, DS3634	I_{OL} = 100 mA			0.85	1.0	V
			I_{OL} = 300 mA			1.1	1.3	V
DS1631/DS3631								
$I_{CC(0)}$	Supply Currents	V_{IN} = 0V, (*Figure 4*)	V_{CC} = 5V	Output Low		7	11	mA
			V_{CC} = 15V	Both Drivers		14	20	mA
$I_{CC(1)}$		(*Figure 4*)	V_{CC} = 5V, V_{IN} = 5V	Output High		2	3	mA
			V_{CC} = 15V, V_{IN} = 15V	Both Drivers		7.5	10	mA
t_{PD1}	Propagation to "1"	V_{CC} = 5V, T_A = 25°C, C_L = 15 pF, R_L = 50Ω, V_L = 10V, (*Figure 5*)				500		ns
t_{PD0}	Propagation to "0"	V_{CC} = 5V, T_A = 25°C, C_L = 15 pF, R_L = 50Ω, V_L = 10V, (*Figure 5*)				750		ns
DS1632/DS3632								
$I_{CC(0)}$	Supply Currents	(*Figure 4*)	V_{CC} = 5V, V_{IN} = 5V	Output Low		8	12	mA
			V_{CC} = 15V, V_{IN} = 15V			18	23	mA
$I_{CC(1)}$		V_{IN} = 0V, (*Figure 4*)	V_{CC} = 5V	Output High		2.5	3.5	mA
			V_{CC} = 15V			9	14	mA
t_{PD1}	Propagation to "1"	V_{CC} = 5V, T_A = 25°C, C_L = 15 pF, R_L = 50Ω, V_L = 10V, (*Figure 5*)				500		ns
t_{PD0}	Propagation to "0"	V_{CC} = 5V, T_A = 25°C, C_L = 15 pF, R_L = 50Ω, V_L = 10V, (*Figure 5*)				750		ns

Electrical Characteristics (Notes 2 and 3) (Continued)

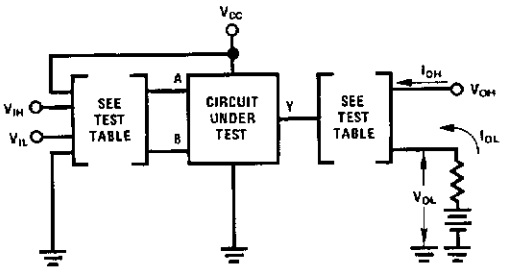
Symbol	Parameter	Conditions			Min	Typ	Max	Units
DS1633/DS3633								
$I_{CC(0)}$	Supply Currents	V_{IN} = 0V, (*Figure 4*)	V_{CC} = 5V	Output Low		7.5	12	mA
			V_{CC} = 15V			16	23	mA
$I_{CC(1)}$		(*Figure 4*)	V_{CC} = 5V, V_{IN} = 5V	Output High		2	4	mA
			V_{CC} = 15V, V_{IN} = 15V			7.2	15	mA
t_{PD1}	Propagation to "1"	V_{CC} = 5V, T_A = 25°C, C_L = 15 pF, R_L = 50Ω, V_L = 10V, (*Figure 5*)				500		ns
t_{PD0}	Propagation to "0"	V_{CC} = 5V, T_A = 25°C, C_L = 15 pF, R_L = 50Ω, V_L = 10V, (*Figure 5*)				750		ns
DS1634/DS3634								
$I_{CC(0)}$	Supply Currents	(*Figure 4*)	V_{CC} = 5V, V_{IN} = 5V	Output Low		7.5	12	mA
			V_{CC} = 15V, V_{IN} = 15V			18	23	mA
$I_{CC(1)}$		V_{IN} = 0V, (*Figure 4*)	V_{CC} = 5V	Output High		3	5	mA
			V_{CC} = 15V			11	18	mA
t_{PD1}	Propagation to "1"	V_{CC} = 5V, T_A = 25°C, C_L = 15 pF, R_L = 50Ω, V_L = 10V, (*Figure 5*)				500		ns
t_{PD0}	Propagation to "0"	V_{CC} = 5V, T_A = 25°C, C_L = 15 pF, R_L = 50Ω, V_L = 10V, (*Figure 5*)				750		ns

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

Note 2: Unless otherwise specified min/max limits apply across the −55°C to +125°C temperature range for the DS1631, DS1632, DS1633 and DS1634 and across the 0°C to +70°C range for the DS3631, DS3632, DS3633 and DS3634. All typical values are for T_A = 25°C.

Note 3: All currents into device pins shown as positive, out of device pins as negative, all voltages referenced to ground unless otherwise noted. All values shown as max or min on absolute value basis.

Test Circuits



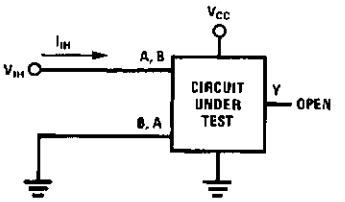
TL/F/5816–9

Circuit	Input Under Test	Other Input	Output	
			Apply	Measure
DS3631	V_{IH} V_{IL}	V_{IH} V_{CC}	I_{OH} I_{OL}	V_{OH} V_{OL}
DS3632	V_{IH} V_{IL}	V_{IH} V_{CC}	I_{OL} I_{OH}	V_{OL} V_{OH}
DS3633	V_{IH} V_{IL}	GND V_{IL}	I_{OH} I_{OL}	V_{OH} V_{OL}
DS3634	V_{IH} V_{IL}	GND V_{IL}	I_{OL} I_{OH}	V_{OL} V_{OH}

Note: Each input is tested separately.

FIGURE 1. V_{IH}, V_{IL}, V_{OH}, V_{OL}

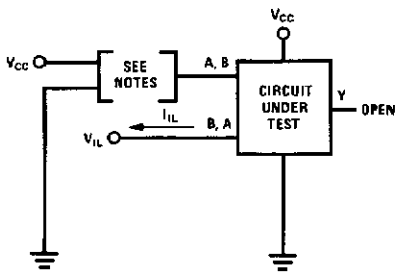
Test Circuits (Continued)



TL/F/5816–10

Each input is tested separately.

FIGURE 2. I_{IH}

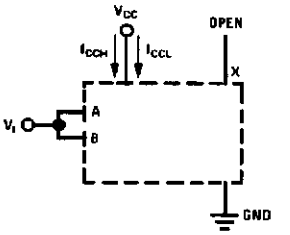


TL/F/5816–11

Note A: Each input is tested separately.

Note B: When testing DS1633 and DS1634 input not under test is grounded. For all other circuits it is at V_{CC}.

FIGURE 3. I_{IL}

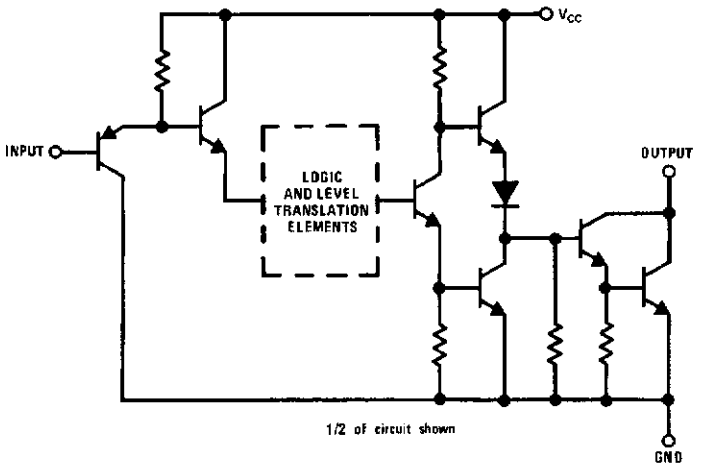


TL/F/5816–12

Both gates are tested simultaneously.

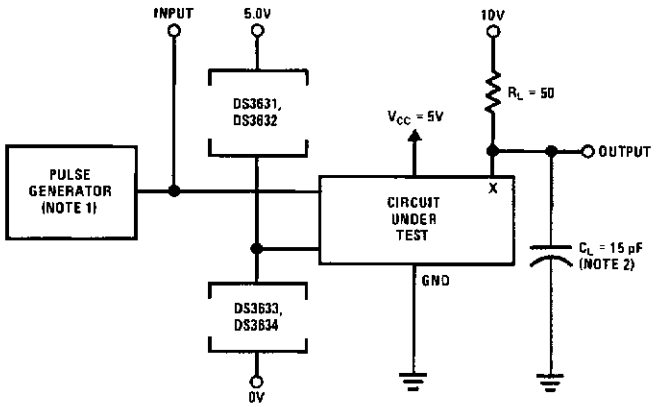
FIGURE 4. I_{CC} for AND and NAND Circuits

Schematic Diagram (Equivalent Circuit)

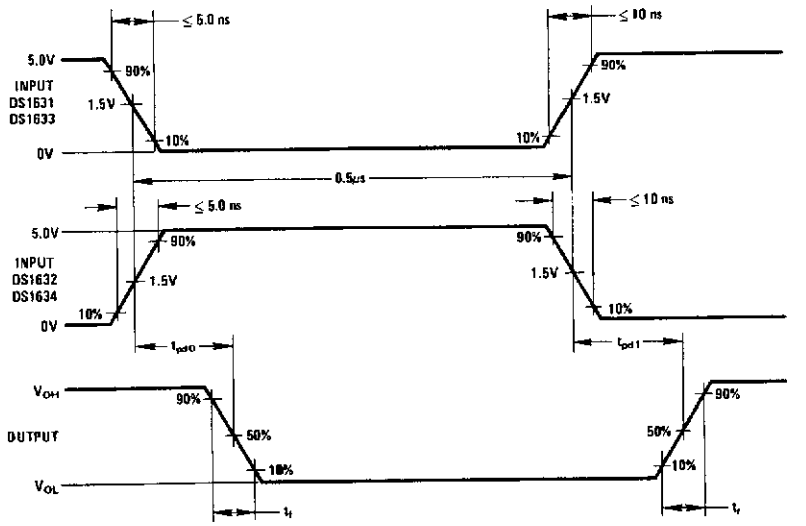


TL/F/5816–15

Switching Time Waveforms



TL/F/5816–13



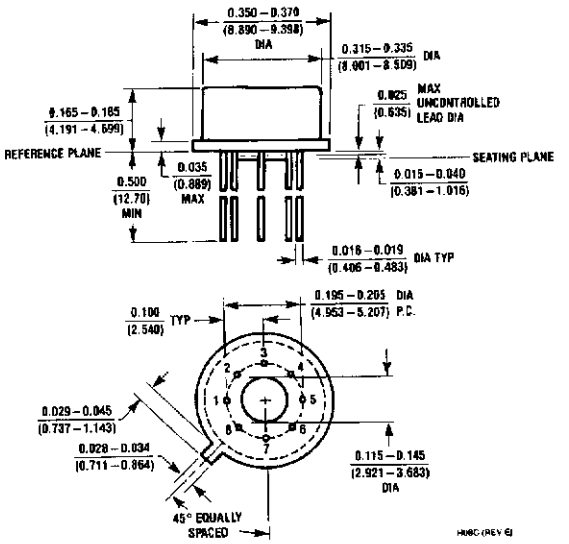
TL/F/5816–14

Note 1: The pulse generator has the following characteristics: PRR = 500 kHz, $Z_{OUT} \approx 50\Omega$

Note 2: C_L includes probe and jig capacitance

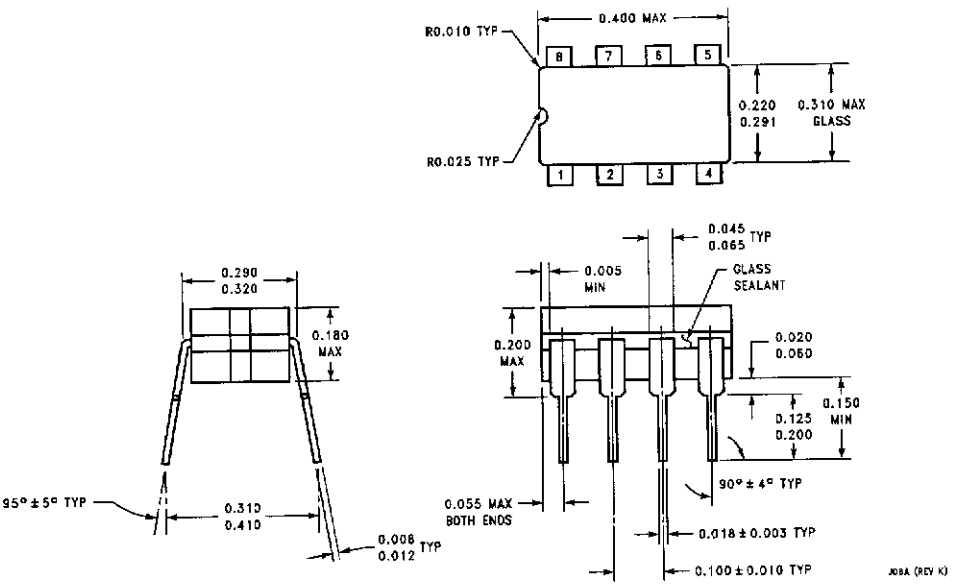
FIGURE 5. Switching Times

Physical Dimensions inches (millimeters)



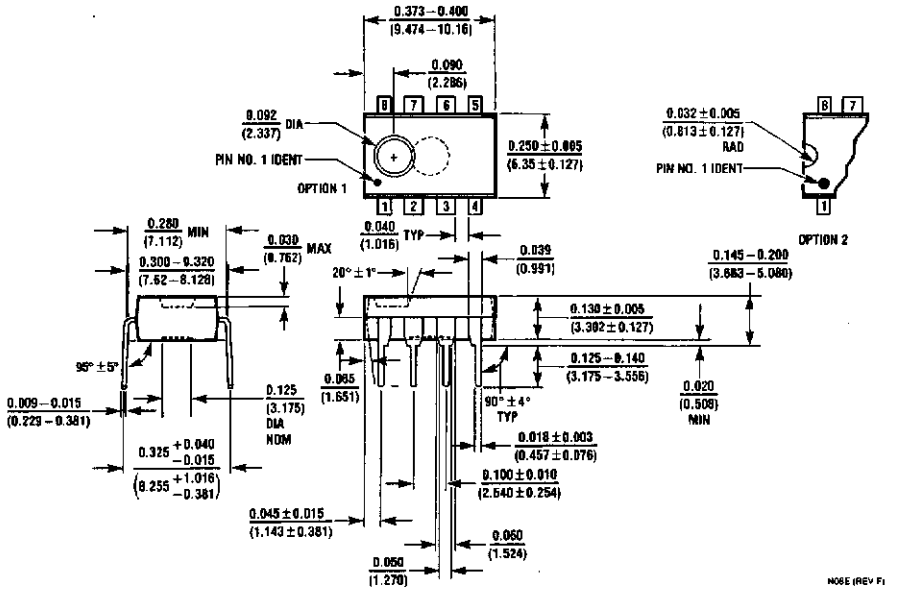
Metal Can Package (H)
Order Number DS1631H, DS1632H, DS1633H or DS1634H
NS Package Number H08C

Physical Dimensions inches (millimeters) (Continued)



Ceramic Dual-In-Line Package (J)
Order Number DS1631J-8, DS1632J-8, DS1633J-8 or DS1634J-8
NS Package Number J08A

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number DS3631N, DS3632N,
DS3633N and DS3634N
NS Package Number N08E

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