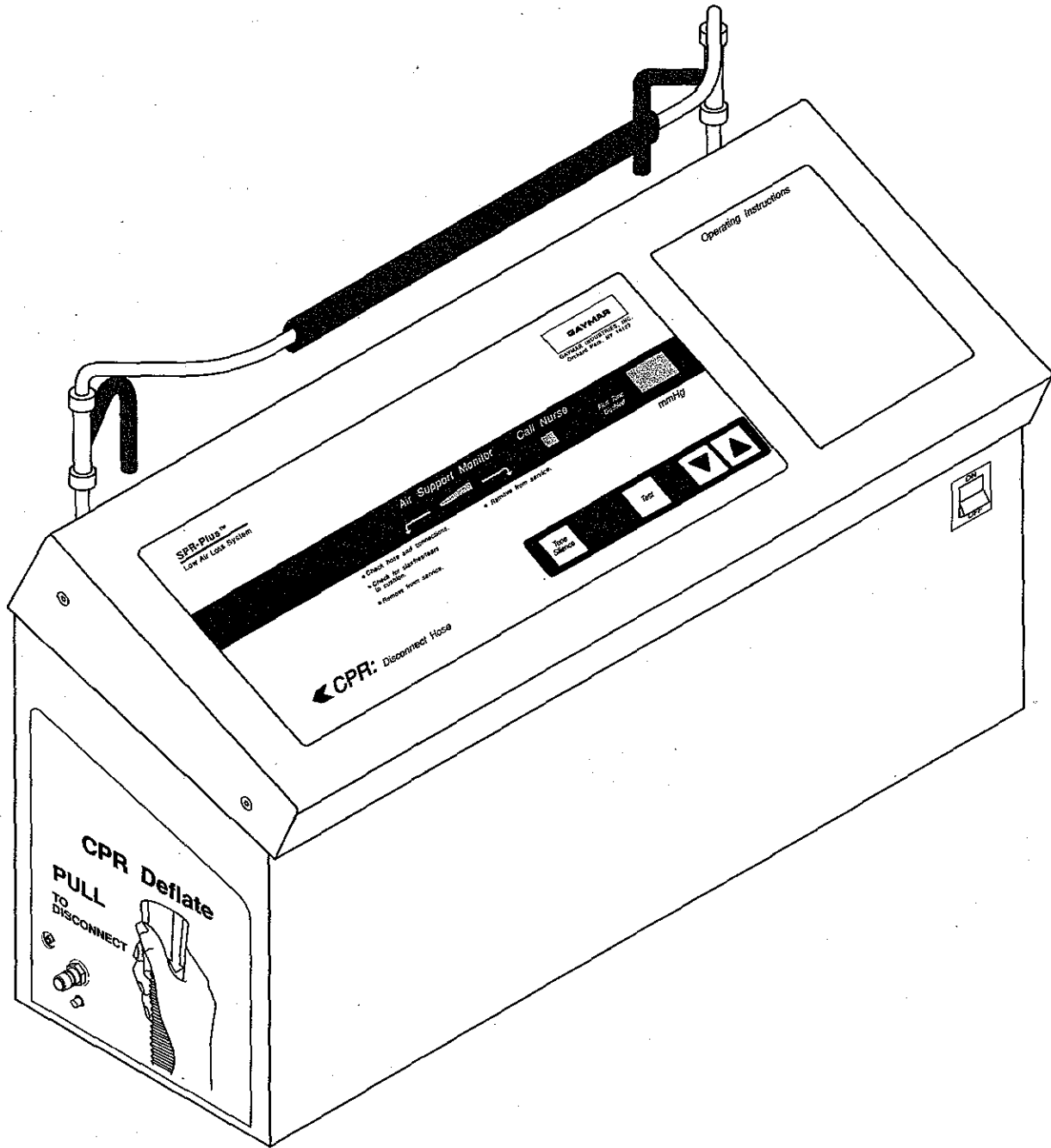
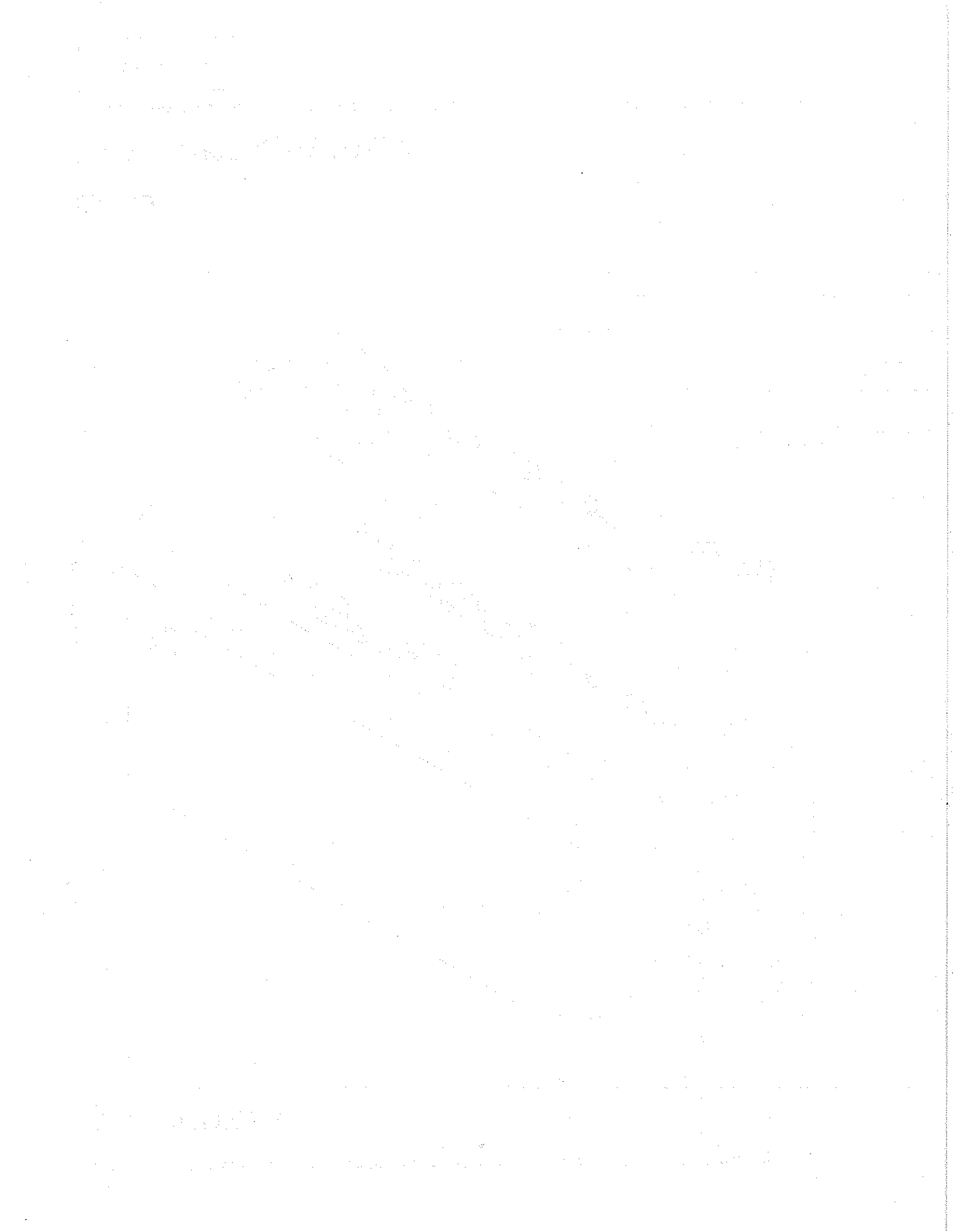


SPR•Plus™ Control Unit

CL-150



SERVICE MANUAL



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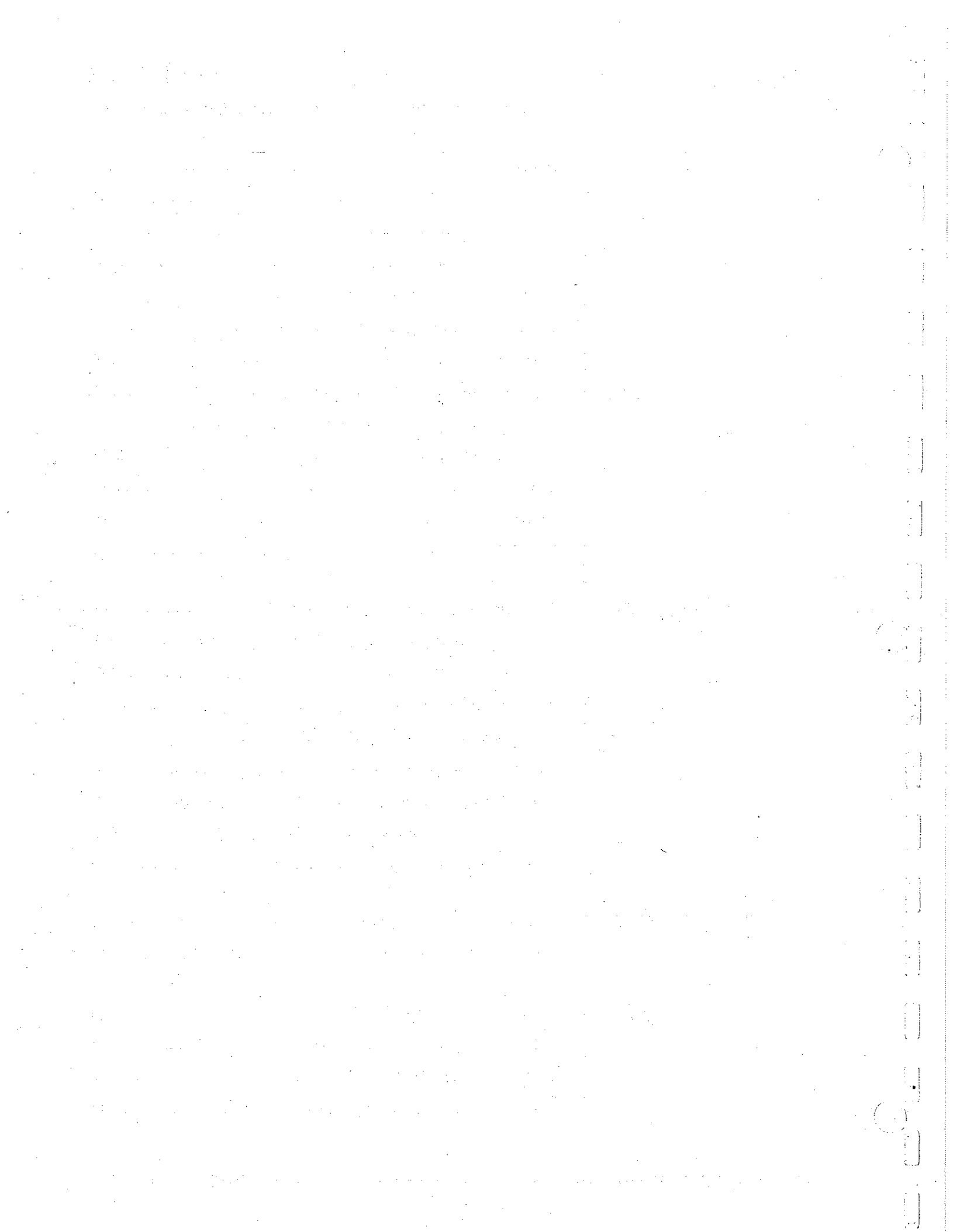
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**SAFETY
PRECAUTIONS**

IMPORTANT

- Use the **SPR•Plus Control Unit** only under the direction of a physician.
- Before using the **SPR•Plus Control Unit**, read and understand the precautions contained in the *SPR•Plus Operator's Manual*.
- Always perform the **FUNCTIONAL CHECK AND SAFETY INSPECTION** (pp. 10-14) **after** making repairs and **before** returning the **SPR•Plus Control Unit** to patient use. Failure to perform the functional check could result in damage to or malfunction of the **SPR•Plus Control Unit**.

DANGER

Do not operate the system in the presence of flammable anesthetics. **Risk of explosion may occur.**

Electrical Shock Hazard: Do not remove covers.
Refer servicing to qualified and authorized personnel.

WARNING

The **SPR•Plus Control Unit** is equipped with a "hospital grade" AC plug. **Failure to connect it to a hospital grade outlet may compromise the control unit's electrical grounding integrity and result in electric shock.**

Be sure that the cushion is securely installed on mattress.
Be sure straps are securely positioned under corners of mattress.
Failure to secure cushion may permit cushion shifting and may cause improper therapy or patient injury.

Do not operate system with bed side rails down. **Patients should never be left unattended with lowered side rails, since patient injury could occur.**

Do not reuse the **SPR•Plus Cushion**.
Reuse of cushion may result in cross-contamination and infection.

Disinfect the control unit and hose between patient installations, utilizing standard hospital protocol and disinfectants. **Failure to disinfect may result in cross-contamination and infection.**

Keep bedding dry. Use incontinence pads if necessary. **Failure to keep patient's skin clean and dry may lead to maceration.**

CAUTION

Use minimal layers of sheeting and incontinence pads. **Too many layers between the patient's skin and the **SPR•Plus Cushion** will reduce the pressure-relieving capabilities of the therapy system.**

Do not pull linens tightly over cushion, but leave loose. **Tight sheets may cause "hammocking" and reduce effectiveness of therapy.**

Disconnect power before servicing the **SPR•Plus Control Unit.**

Repairs should be performed only by qualified personnel such as certified biomedical electronics technicians or certified clinical engineers familiar with repair practices for servicing medical devices. **Do not attempt to repair the **SPR•Plus Control Unit** unless you possess these skills. Otherwise, damage to or malfunction of the control unit may result.**

**RECEIVING
INSPECTION**

Upon receipt, unpack the SPR•Plus Control Unit and inspect for concealed damage. Save all packing material. If any damage is found, notify the carrier at once and ask for a written inspection. Prepare a written description of any damage. Photograph any damage.

Failure to take the above action within 15 days of receipt may result in loss of claim.

**Do not return the SPR•Plus Control Unit to GAYMAR.
Contact Gaymar's Technical Service Department for
instructions.**

Telephone: Direct (716) 662-2551
Within New York State, 1 800 848-4806
Outside New York State, 1 800 828-7341

REPAIR POLICY

The SPR•Plus Control Unit (CL-150) is warranted free of defects in material and workmanship for a period of one (1) year.

The SPR•Plus Low Air Loss Cushion (CL-252) is warranted free of defects in material and workmanship for a period of thirty (30) days.

The Control Unit and Low Air Loss Cushion are warranted under the terms and conditions of the Gaymar warranty in place at the time of purchase. A copy of the warranty is available upon request. Gaymar disclaims all implied warranties including, but not limited to, the implied warranties of merchantability and of fitness for a particular purpose.

Control Units may be returned to the factory for servicing. See "RETURN AUTHORIZATION" below.

For customers who choose to repair Gaymar SPR•Plus Control Units at their location, this manual contains information to allow a qualified biomedical technician to make necessary repairs. Service training for the SPR•Plus Control Unit is recommended and is available from Gaymar. For details, contact your Gaymar representative or Gaymar's Technical Service Department.

IN-WARRANTY REPAIRS

All in-warranty field repairs must be authorized by Gaymar's Technical Service Department before proceeding.

OUT-OF-WARRANTY REPAIRS

The following repair options are available when servicing SPR•Plus Control Units:

1. **Defective Components** - replacement parts may be ordered by specifying the Gaymar part number as shown in the parts lists (pp. A-1, A-2, A-4, and A-6).
2. **Defective Printed Circuit Board** - defective PC boards may be exchanged for replacement boards at a fixed cost directly from the factory.
3. **SPR•Plus Control Unit Repairs** - If the SPR•Plus Control Unit becomes inoperative and the cause cannot be determined, the complete control unit may be returned to the factory for servicing at the purchaser's expense (see "RETURN AUTHORIZATION" below).

RETURN AUTHORIZATION

Please be sure to obtain a return goods (RG) authorization number from GAYMAR's Customer Service Department before returning the SPR•Plus Control Unit or any component parts to GAYMAR.

Telephone: Direct (716) 662-2551
Within New York State, 1 800 848-4806
Outside New York State, 1 800 828-7341

PHYSICAL

Dimensions	20" x 9" x 16" (51 cm x 23 cm x 41 cm)
Weight	25 pounds (11.3 kg)
Chassis	16 gauge steel with painted enamel finish
Operating Ambient Temperature Range	50°F to 90°F (10°C to 32°C)

Note: *If the SPR•Plus Control Unit is stored at temperatures below 50°F or above 90°F, the control unit must be allowed to stabilize for one hour within the operating ambient temperature range before use.*

OUTPUT

Pressure	8 to 32 mmHg
Flow Rate	1.41 SCFM (40 lpm) minimum @ 25 mmHg

PRESSURE INDICATOR

Resolution	1 mmHg
Height	9/16"
Update Rate	1 Hz

ELECTRICAL

Input	120 V (± 10%), 60 Hz, 100 W (nominal), 380 W (maximum), 2.9 A (nominal)
Power Cord	15 ft, 16 AWG cord with hospital grade plug
Circuit Breaker	5 A
Current Leakage	100 µA maximum (chassis)
Ground Resistance	0.15 ohms or less nominal 0.5 ohms maximum

CUSHION

Dimensions (inflated)	33½" wide x 75¼" long
Weight	5 pounds, 10 ounces
Material	Polyvinyl chloride

Note: *If the SPR•Plus Cushion is stored at temperatures below 50°F or above 90°F, the cushion must be allowed to stabilize for one hour within the operating ambient temperature range before use.*

The SPR•Plus SYSTEM

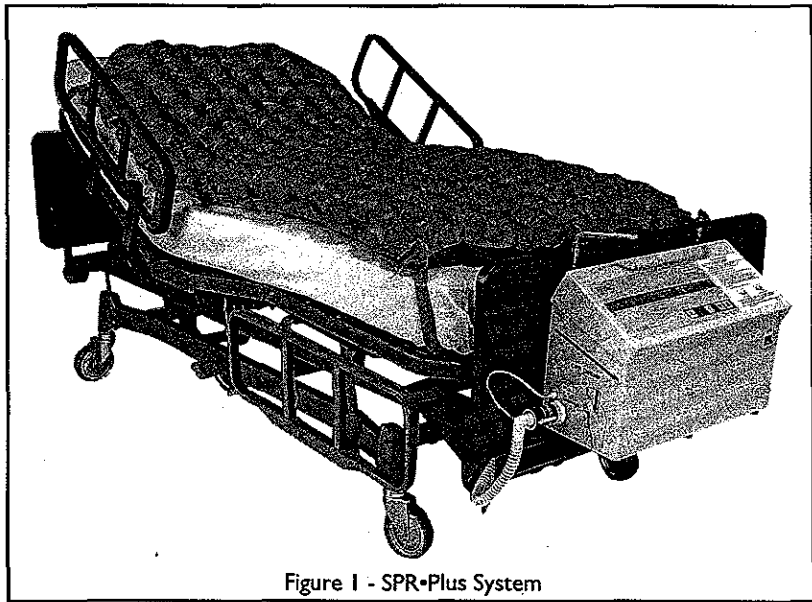


Figure 1 - SPR•Plus System

The **SPR•Plus Low Air Loss System** (fig. 1) consistently relieves tissue interface pressure under bony prominences to below capillary closure pressures of 32 mmHg. Existing pressure ulcers can heal and new ones can be prevented.

The system consists of a control unit (CL-150), connecting hose with a pressure sensor tube (CL-121), and a low air loss cushion (CL-252). The connecting hose conducts air from the control unit to the cushion.

The **SPR•Plus Control Unit** circulates air through a cushion, maintaining cushion pressure at a level selected by the operator.

The control unit is equipped with a handle at the top and two swinging brackets for hanging the unit on the bed. The control unit is operated from a top control panel. Fittings on the lower left side panel connect the control unit to the hose. An ON/OFF switch is located just below the operator control panel.

For transport and storage, the power cord and hose should be coiled and secured to the back panel with the attached strap.

The **hose** conducts air from the control unit to the cushion. A sensor tube runs through the hose, protrudes from the cushion end, and connects to the control unit. The sensor tube provides pressure feedback to the control unit.

The **SPR•Plus Cushion** supports the patient. In addition, small holes in the cushion's top surface allow air flow around the patient to help reduce the potential for maceration. If airflow is not desired, the cushion is placed with the holes down.

ELECTRICAL SYSTEM

See the appendices for the locations of control/display board-to-power supply board connections (p. A-2), system wiring diagram (p. A-3), electrical schematics (pp. A-5, A-7, and A-8), and component layouts and part designations (pp. A-4 and A-6).

The SPR•Plus control unit uses two printed circuit boards:

- The **control/display board** contains the microprocessor circuits, the display circuits, and all other low voltage control circuits.
- The **power supply board** contains the power supply and interface circuitry.

**COMPONENT
INTERCONNECTIONS**

The **control/display board** connects to the CPR disconnect switch with a 4-pin, 2-wire connector at J1, and connects to the operator control panel with a 9-pin, 8-wire connector at J3.

All other connections from the system's peripheral devices to the control/display board are made through the **power supply board**:

- A **14-pin cable** connects the control/display board at J2 to the power supply board at J2.
- A **6-pin, 4-wire cable** connects the blower to the power supply board at J3.
- A **2-pin, 2-wire cable** connects the EMI filter to the power supply board at J4.
- A **6-pin, 5-wire cable** connects transformer T1 to the power supply board at J5.
- **Green ground wires** connect the power supply board to the chassis, the blower to the chassis, the EMI filter to the chassis, and the power supply cord to the chassis.

POWER SUPPLY

Power enters the SPR•Plus Control Unit through a circuit breaker, power switch, and EMI filter. It then enters the power supply board at J4 to feed the blower and transformer.

Power to drive the low voltage circuits on the control/display board is derived from the power supplies which reside entirely on the power supply board. The transformer output is rectified and filtered to generate unregulated positive and negative voltages. The voltage regulators deliver nominal outputs of +12 volts DC (U1), -12 volts DC (U3), and +5 volts DC (U2), respectively.

CONTROL / DISPLAY

The U6 microprocessor is fully dependent on the code stored in the U5 EPROM. When the SPR•Plus Control Unit is on, the microprocessor continually cycles through its main program loop to perform the following:

- **Operator control panel input**
User input is entered via an operator control panel (4 x 4 matrix of five front panel switches). The input from the switches is processed by keypad encoder U15.
- **Pressure sensor input measurement**
The pressure transducer PSI converts the pressure into an analog voltage, which is read by the A/D converter U21.
- **Display update**
The display controller U16 controls the lighting of each LED on the PCB, including two 7-segment digits, a 10-segment bar LED, and four box LED's. The controller is an 8-digit LED display driver.
- **Audible alert output**
The audible alert is activated by a signal from the microprocessor through buffer U1 and transistor Q1.
- **CPR deflate switch input**
The input buffer U1 is the interface between the microprocessor and the input signal from the CPR switch. The lines to the buffer from the peripheral devices are default high (via pull-up resistors). The normally open CPR switch will pull its buffer input line low when it senses that the hose has been connected.

**OPERATOR CONTROL
PANEL (see p. A-9)**

The **pressure indicator** displays the cushion and setpoint pressures in millimeters of mercury (*mmHg*). As the patient moves on the cushion, the value shown on the display rises and falls as the control unit adjusts to maintain the setpoint pressure.

The **air support monitor bar display** indicates the cushion pressure is at setpoint pressure when the first 5 bars are lit. Cushion pressures more than 3 mmHg below setpoint pressure will extinguish all bars. Cushion pressures more than 3 mmHg above setpoint pressure will light all bars.

The **left arrow light** flashes when the sensed cushion pressure is more than 3 mmHg below the setpoint pressure for longer than 15 seconds.

The **right arrow light** flashes when the sensed cushion pressure is more than 3 mmHg above the setpoint pressure for longer than 15 seconds.

The **Call Nurse** indicator lights whenever the right or left arrow flashes.

The **tone silence switch** silences the alert tone for 30 minutes. The switch also unlocks the up/down arrow switches when depressed for 5 seconds, which permits setting the pressure within the 8 to 17 mmHg range.

The **down/up arrow switch** lowers/raises the cushion setpoint pressure in 1 mmHg steps. Pressing either arrow will display the setpoint pressure for 5 seconds before displaying cushion pressure. Depressing either arrow for more than 5 seconds will scroll the setpoint pressure at a rate of 1 Hz.

The **test switch** initiates a test sequence that confirms the control panel lamps and the alert tone are functioning properly.

A **hidden tone disable switch** under the letter "M" in the GAYMAR logo may be used to disable and enable the alert tone. When the alert tone is disabled, the Alert Tone Disable indicator is lit. The switch will also cause the alert tone state and setpoint pressure to be logged into system memory.

MISCELLANEOUS

The **connector hose with integral pressure sensor tube** provides a means for conducting air from the control unit to the cushion. The sensor tube provides pressure feedback to the control unit.

The **pressure sensor** is a differential pressure transducer (resistive bridge) that provides a resolution of approximately 0.25 mmHg.

The **motor control amplifier** is a low impedance output (op-amp) providing 0-11 VDC for blower speed control.

The **blower** is a brushless, thermally protected, centrifugal blower with variable VDC input for speed control.

The **HEPA filter** is a high efficiency, low restriction filter for fine particulate screening (> 0.3 microns).

The **mechanical overpressure relief valve** bleeds air when the system pressure exceeds approximately 45 mmHg. It provides mechanical overpressure control in the event of electrical failure or misuse.

The **EMI filter** filters excessive electromagnetic interference from the AC power line.

Unplug the power cord before performing preventive maintenance.

EXTERNAL DUST FILTER

Replace or clean the filter weekly, or more frequently if needed. Dust that has accumulated on the external filter may reduce the efficiency of the blower.

To replace or clean the external filter:

1. Unplug power cord.
2. Snap the plastic grill off the filter.
3. Remove the foam filter and screen.
4. Clean or replace the foam filter:
 - a. To clean, brush any lint off the screen. Rinse the foam filter under running water and squeeze it dry.
 - b. To replace, discard dirty filter. Replace with new foam filter (item 28, p. A-1).
5. Reinstall the screen, then the foam filter.
6. Snap the plastic grill back into position.

BLOWER

The blower motor and fan do not require any maintenance.

CHASSIS EXTERIOR

Clean and disinfect the control panel and control unit exterior according to hospital procedure with non-staining hospital disinfectant at time of functional checkout. Do not autoclave.

CUSHIONS

Outside surfaces of cushions may be cleaned with a damp cloth and mild detergent or non-staining hospital disinfectant. Do not disinfect with alcohol, which may accelerate cushion deterioration.

Cushions are made of PVC. If it is necessary to sterilize cushions, use ETO sterilization and handle like any other PVC product. Sterilization temperatures must not exceed 57°C (135°F).

HOSE

Clean and disinfect the hose according to hospital procedure. Do not autoclave.

FUNCTIONAL CHECK AND SAFETY INSPECTION

INSPECTION FORM

To assure optimum performance, dependability and safety, perform the following check-out procedures before initial use and every 6 months, or as specified in your facility's preventive maintenance program.

A *FUNCTIONAL CHECK AND SAFETY INSPECTION FORM* (p. 14) is provided at the end of this section to facilitate and document the inspection process. Each of the following procedure numbers correspond to a *FUNCTIONAL CHECK AND SAFETY INSPECTION FORM* item number.

WARNING

Always perform the *FUNCTIONAL CHECK AND SAFETY INSPECTION* after making repairs and before returning the SPR•Plus Control Unit to patient use.

Failure to perform the functional check and safety inspection could result in damage to or malfunction of the control unit.

TEST EQUIPMENT

The following equipment (or equivalent) is required in order to perform the preventive maintenance procedures:

- Cushion Simulator (CL-151)
- Current Leakage/Ground Resistance Tester
- Grounding Wrist Strap (Electrostatic Control Device)
- Manometer (0-100 mmHg)
- Inspection Form

NOTE: Test equipment should be calibrated to NIST (National Institute of Standards and Technology) guidelines to insure accurate test readings.

Before performing the functional check and safety inspection, be sure to recheck your test setup, procedure, and test equipment for correctness.

Follow all procedures carefully, paying particular attention to test setups. Any deviation from the setups, procedures, or test equipment may lead to improper results.

1. ENCLOSURE

Examine the exterior of the SPR•Plus Control Unit for overall condition:

1. Examine the chassis. It should be clean and relatively free of rust and corrosion.
2. Check that exterior screws are tight.
3. Check that legends and markings are legible.

2. HOSE

Examine hose for cracks and restrictions. Replace if necessary.

**3. PLUG, LINE CORD,
AND STRAIN RELIEF**

4. ON/OFF SWITCH

5. AUTOMATIC TEST

(Check items 5 to 15 with the power cord plugged in.)

Examine the plug, line cord, and strain relief for wear or damage:

1. Examine the line cord plug to be sure it is in good condition.
2. Examine the line cord along its entire length for physical damage, such as cut or cracked insulation. Replace (rather than repair) damaged line cord. A cord length of 15 feet is recommended in order to reach an electrical outlet at the head of the bed.
3. Check the tightness of the strain relief.

Verify the on/off switch function:

1. Examine the physical condition of the on/off switch.
2. Cycle the switch on and off several times. The switch should have a positive engagement ("click") for the "ON" and "OFF" positions.

Verify the automatic test sequence:

1. Connect the Cushion Simulator to the SPR•Plus Control Unit and a manometer (fig. 2). Place the Cushion Simulator stopcock in the Normal Feedback position.
2. Turn the control unit on. The control unit will initiate an automatic test sequence to verify that it is working properly. All lights should flash, the alert tone should sound momentarily, and the pressure indicator should show "8.8." momentarily in the display.

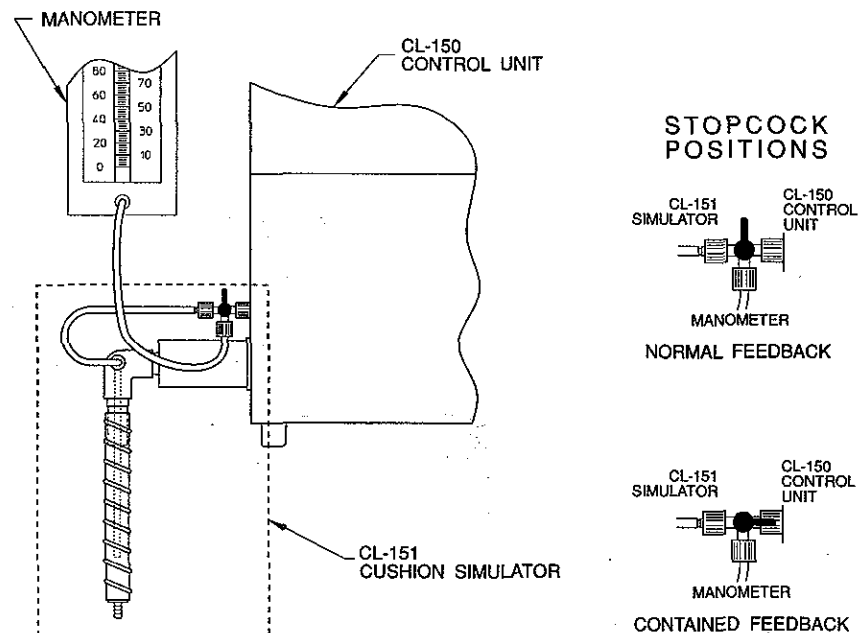


Figure 2 - Cushion Simulator (CL-151)

6. TEST SWITCH

Verify the test switch functions:

1. Press and hold the "Test" switch.
2. All lights should turn on, the display should read "8.8.", and the alert tone should sound.

7. PRESSURE INDICATOR RANGE AND ACCURACY

Verify that the pressure indicator and up/down arrows function:

1. Press the up arrow switch until the value in the pressure indicator peaks. The display should indicate 32 mmHg. After a moment, verify that the reading on the manometer connected to the Cushion Simulator (fig. 2) is within 3 mmHg of the display.
2. Unlock the arrow controls by pressing the "Tone Silence" switch for 5 seconds (until it beeps). Press the down arrow switch until the value in the pressure indicator bottoms. The display should indicate 8 mmHg. After a moment, verify that the manometer reading is within 3 mmHg of the display.

8. ALERT TONE

Verify that the alert tone functions:

1. Disconnect the stopcock from the control unit. Wait 15 seconds.
2. Verify that the alert tone sounds, "Call Nurse" light turns on, and left arrow light flashes. (Alerts will not function for 2 minutes after initial startup.)

9. ALERT TONE DISABLE

Disable the alert tone and check the "Alert Tone Disable" switch:

1. Press the "M" in the GAYMAR logo. The "Alert Tone Disabled" light should turn on and the alert tone should silence.
2. Press the "M" in the GAYMAR logo. The "Alert Tone Disabled" light should go off and the alert tone should sound.

10. TONE SILENCE

Verify that the tone silence functions:

1. Press the "Tone Silence" switch. The alert tone should turn off.
2. Connect the stopcock to the control unit to clear the alert condition. Verify that the "Call Nurse" light and the left arrow light turn off.
3. Disconnect the stopcock from the control unit and wait 15 seconds to reinstate the alert condition.

11. LOW PRESSURE ALERT

Verify that the low pressure alert functions:

1. Connect the stopcock to the control unit. (Unlock the arrow controls if necessary.)
2. Adjust the setpoint pressure to 25 mmHg.
3. Place the stopcock on the Cushion Simulator in the *Contained Feedback* position (fig. 2).
4. Press the up arrow switch until no green bars are lighted on the Air Support Monitor 9-bar display.
5. Wait 15 seconds. The alert tone should sound, the "Call Nurse" light should turn on, and the left arrow light should flash.

12. HIGH PRESSURE ALERT

Verify that the high pressure alert functions:

1. Press the down arrow switch until all green bars are lighted on the Air Support Monitor.
2. Wait 15 seconds. The alert tone should sound, the "Call Nurse" light should turn on, and the right arrow light should flash.

13. CPR DEFLATE SWITCH

Verify that the CPR deflate switch functions:

1. Place the stopcock on the Cushion Simulator in the *Normal Feedback* position (fig. 2).
2. Disconnect the Cushion Simulator from the SPR•Plus Control Unit. The "Call Nurse" and "Alert Tone Disable" lights should turn on and the left arrow light should flash; the blower and alert tone should be off.

14. MAXIMUM CUSHION PRESSURE

Verify that the maximum cushion pressure is within allowable limits:

1. Reconnect the Cushion Simulator to the SPR•Plus Control Unit.
2. Place the stopcock on the Cushion Simulator in the *Contained Feedback* position (fig. 2).
3. Disconnect the stopcock from the control unit. The maximum manometer reading should be less than 75 mmHg.

15. CURRENT LEAKAGE

Verify current leakage is within safe limits:

1. Measure the maximum current leakage between the chassis and the ground in all operating conditions (i.e., blower on, blower off, normal and reverse polarity with the control unit grounded and ungrounded).

The current leakage should not exceed 100 microamps in either the grounded or ungrounded condition.

Note: *If additional information is required, refer to AAMI American National Standard, Safe Current Limits for Electromedical Apparatus or contact GAYMAR's Technical Service Department.*

16. GROUND RESISTANCE

Verify grounding resistance is within allowable limits:

1. Use a ground resistance meter to measure the resistance between the grounding pin on the line cord attachment plug and an exposed metal point on the chassis.
2. Maximum value is 0.5 ohms.

COMPLETING THE FUNCTIONAL CHECK AND SAFETY INSPECTION

This completes the recommended *FUNCTIONAL CHECK AND SAFETY INSPECTION* for the SPR•Plus Control Unit.

If the SPR•Plus Control Unit passes all requirements of items 1 through 16, it should be considered operational and suitable for return to service.

FUNCTIONAL CHECK

**SPR-Plus Control Unit (CL-150)
Functional Check / Safety Inspection Form**

Initials _____ Date _____

Location _____

Serial Number _____

Item(s)	Action	Observation	Results (1)		Troubleshooting Codes (2)
			Yes	No	
1 Enclosure	Unplug power cord. Examine chassis.	Physical condition OK?	Yes	No	1
2 Hose	Examine hose.	Physical condition OK?	Yes	No	2
3 Plug, cord, strain relief	Examine plug, cord, strain relief.	Physical condition OK?	Yes	No	2
4 ON/OFF switch	Examine ON/OFF switch.	Physical condition OK?	Yes	No	3
5 Automatic test	Connect CL-151 Cushion Simulator (fig. 2). Place stopcock in Normal Feedback position. Turn SPR-Plus Control Unit ON. Verify automatic test sequence.	a. All lights flash momentarily?	Yes	No	4, 5
		b. Alert tone sounds momentarily?	Yes	No	6
		c. Does number "8.8." momentarily show in display?	Yes	No	7
6 Test	Press and hold "Test" switch.	a. All lights ON and display reads "8.8."?	Yes	No	8, 5
		b. Alert tone sounds?	Yes	No	8, 6
7 Pressure display range and accuracy	Push up/down arrow switches. (Press and hold "Tone Silence" switch for 5 seconds to permit setting pressures below 18 mmHg.) Verify setpoint pressure range and display accuracy.	a. Does pressure display indicate range of 8 to 32 mmHg?	Yes	No	9, 10
		b. Is manometer reading within 3 mmHg of display?	Yes	No	11, 12
8 Alert tone	Disconnect stopcock from control unit. Wait 15 seconds. (NOTE: Since alerts are inactive during the first 2 minutes of pump operation, alerts may not trigger immediately.)	a. Alert tone sounds?	Yes	No	6
		b. "Call Nurse" light ON?	Yes	No	5
		c. Left arrow light flashes?	Yes	No	5
9 Alert tone disable	Press "M" in GAYMAR logo.	a. "Alert Tone Disabled" light ON?	Yes	No	13, 5
		b. Alert tone OFF?	Yes	No	13
	Press "M" in GAYMAR logo, again.	a. "Alert Tone Disabled" light OFF?	Yes	No	13
		b. Alert tone sounds?	Yes	No	13, 6
10 Tone silence	Press "Tone Silence" switch.	Alert tone OFF?	Yes	No	14
	Connect stopcock to control unit. (Clear the alert condition.)	a. "Call Nurse" light OFF?	Yes	No	14
		b. Left arrow light OFF?	Yes	No	14
	Disconnect stopcock from control unit. Wait 15 seconds. (Reinstate the alert condition.)	a. Alert tone sounds?	Yes	No	6
		b. "Call Nurse" light ON?	Yes	No	5
		c. Left arrow light flashes?	Yes	No	5
11 Low pressure alert	Connect stopcock to control unit. Adjust setpoint pressure to 25 mmHg. Place stopcock in Contained Feedback position. Press up arrow switch until no green bars are lighted on Air Support Monitor. Wait 15 seconds.	a. Alert tone sounds?	Yes	No	11, 6
		b. "Call Nurse" light ON?	Yes	No	11, 5
		c. Left arrow light flashes?	Yes	No	11, 5
12 High pressure alert	Press down arrow switch until all green bars are lighted on Air Support Monitor. Wait 15 seconds.	a. Alert tone sounds?	Yes	No	11, 6
		b. "Call Nurse" light ON?	Yes	No	11, 5
		c. Right arrow light flashes?	Yes	No	11, 5
13 CPR deflate switch	Place stopcock in Normal Feedback position. Disconnect cushion simulator.	a. "Call Nurse" and "Alert Tone Disable" lights ON?	Yes	No	15, 5
		b. Left arrow light flashes?	Yes	No	15, 5
		c. Blower and alert tone OFF?	Yes	No	15
14 Maximum cushion pressure	Reconnect CL-151 Cushion Simulator. Place stopcock in Contained Feedback position. Disconnect stopcock from control unit.	Does manometer read less than 75 mmHg?	Yes	No	16
15 Current Leakage	Measure current leakage.	Is current leakage less than 100 μ A?	Yes	No	17
16 Ground Resistance	Unplug power cord. Measure ground resistance.	Is ground resistance less than 0.5 ohms?	Yes	No	18

NOTES:

- (1) If any "No's" are checked, repair the SPR-Plus Control Unit before returning it to service.
- (2) See table 2, "Troubleshooting Chart," for explanation of troubleshooting codes.

Table I - Inspection Form

TROUBLESHOOTING

WARNING

Always perform the *FUNCTIONAL CHECK AND SAFETY INSPECTION* after making repairs and before returning the SPR•Plus Control Unit to patient use.

Failure to perform the functional check and safety inspection could result in damage to or malfunction of the control unit.

In addition to the following troubleshooting chart, refer to the specific repair procedures (pp. 16-19) and cleaning procedures (p. 9).

Troubleshooting Code	Action
1	Repair chassis.
2	Replace hose, power cord, and/or strain relief.
3	Replace ON/OFF switch.
4	Verify that the power cord is plugged in and the circuit breaker has not tripped. Check the internal wiring and verify that connections are terminated properly (see system wiring diagram, page A-3). Verify power supply voltage levels (see table 4, p. 18).
5	Check that lamps are socketed properly.
6	Check that the buzzer is connected properly. Verify that a ~1Hz square wave signal is present at the buzzer's negative terminal and that a ~12VDC level is present at the buzzer's positive terminal (ref. DGND). Otherwise, replace buzzer.
7	Refer to "ERROR CODES", page 16.
8	Verify that electrical continuity exists between pins 3 & 6 of keypad connector J3 when the "TEST" key is depressed.
9	Verify that electrical continuity exists between pins 3 & 7 of keypad connector J3 when the down arrow key is depressed.
10	Verify that electrical continuity exists between pins 3 & 8 of the keypad connector J3 when the up arrow key is depressed.
11	Verify that the internal pressure sensing tubing is not kinked, cracked, or disconnected. Verify that the HEPA filter is not restricting flow.
12	Verify that the blower is operating. Verify that a voltage between zero and 11 VDC (for blower speed control) is present at the blower connector (red wire zero to 11 VDC, purple wire GND). Verify that operating power is present on blower connector (black wire 120 VAC, white wire neutral).
13	Verify that electrical continuity exists between pins 2 & 5 of the keypad connector J3 when the "M" in the GAYMAR logo is depressed.
14	Verify that electrical continuity exists between pins 3 & 5 of the keypad connector J3 2 when the "Tone Silence" key is depressed.
15	Verify that electrical continuity exists between pins 1 & 2 of the limit switch connector J1 when the CPR switch is depressed.
16	Replace relief valve (item 56, page A-1).
17	Disconnect blower connector J3 on the power supply board. Repeat the current leakage test. If the leakage current is less than 50 μ A (see p. 13), replace the blower. If the leakage current is greater than 50 μ A, continue to investigate components to determine current leakage source.
18	Verify that the green lead from the power cord is securely attached to the chassis. If ground resistance is greater than 0.5 ohms (see p. 13), replace the power cord.

NOTE: If the preceding steps fail to correct the problem, replace the control/display board and/or power supply board.

Table 2 - Troubleshooting Chart

ERROR CODES

When the SPR•Plus Control Unit is turned on, the control unit will initiate an automatic test sequence to confirm that the controller is working properly. If the controller fails any test, one of four error codes will appear in the pressure indicator display and the control unit will not operate (see table 3).

Error Code	IC	Reason
E0	U6	CPU error
E1	U5	EPROM error
E2	U5	EPROM checksum error
E3	U4	nonvolatile RAM checksum error

Table 3 - Error Codes

Check that the appropriate IC is seated properly in its socket. If reinserting the IC does not eliminate the error code, replace the control/display board.

REMOVING LOWER COVER ASSEMBLY

To remove the lower cover assembly:

1. Unplug the control unit power cord.
2. Remove the six screws holding the lower cover on.
3. Remove four screws in top cover.
4. Flex back edges of lower cover off chassis, and from the front, pull cover down and forward.
5. Remove push connectors from on/off switch. Note color and location of each wire.
6. Reverse steps 2-5 to replace lower cover assembly.

**REMOVING TOP COVER
AND CONTROL
PANEL**

To remove the top cover and control panel:

1. Unplug the control unit power cord.
2. Remove four screws holding top cover to chassis.
3. Lift upward carefully, taking care not to put strain on pressure tubing and electrical wires.

CAUTION Wear a grounding wrist strap to ensure that any accumulated electrostatic charge will be discharged from your body to ground. **Electrostatic discharge can damage PC board components.**

4. Remove pressure tubing from center fitting on pressure transducer.
5. Unplug 14 pin connector at J2 on the control/display board.
6. Unplug 4 pin connector at J1 on the control/display board.
7. Reverse steps 2-6 to reinstall top cover and control panel.
8. Perform the *FUNCTIONAL CHECK AND SAFETY INSPECTION*.

**REMOVING THE
BLOWER**

To remove the blower:

1. Unplug the control unit power cord.
2. Remove lower cover assembly.
3. Lean unit backward. Remove the four screws, lockwashers, and fender washers holding blower to chassis. Do not remove vibration isolators.

CAUTION Wear a grounding wrist strap to ensure that any accumulated electrostatic charge will be discharged from your body to ground. **Electrostatic discharge can damage PC board components.**

4. Unplug 6-pin, 4-wire connector from power supply board.
5. Disconnect ground wire from blower housing.
6. Cut wire tie holding blower hose to electrical wiring.
7. Remove blower hose from top of blower barbed fitting. Remove blower and blower bracket.
8. Remove two screws holding blower to blower bracket.
9. Reverse steps 2-8 to reinstall blower.
10. Perform the *FUNCTIONAL CHECK AND SAFETY INSPECTION*.

**REPLACING THE
HEPA FILTER**

To replace the HEPA filter:

1. Unplug the control unit power cord.
2. Remove lower cover assembly.
3. Remove blower hose from top of HEPA filter barbed fitting (p. A-1).
4. Unscrew HEPA filter from PVC fitting.
5. Reverse steps 2-4 to install new HEPA filter (item 55, p. A-1).
6. Perform the *FUNCTIONAL CHECK AND SAFETY INSPECTION*.

**REPLACING THE POWER
SUPPLY BOARD**

CAUTION Wear a grounding wrist strap to ensure that any accumulated electrostatic charge will be discharged from your body to ground. **Electrostatic discharge can damage PC board components.**

The following procedures describe replacement of the power supply board. A digital voltmeter is required.

To remove the power supply board (see pp. A-2, A-4):

1. Unplug control unit and remove the lower cover assembly.
2. Disconnect the 14-conductor cable harness assembly from the power supply board at J2.
3. Disconnect the three cable harness connectors from J3, J4, and J5.
4. Disconnect the ground wire from T1.
5. Remove the power supply board mounting screw.
6. Slide the board to the right and lift it out of the chassis.

To install the power supply board (see pp. A-2, A-4):

1. Unplug control unit.
2. Place the new power supply board over posts and slide it to the left.
3. Install the board mounting screw.
4. Connect the ground wire to T1.
5. Reconnect the 14-conductor cable assembly from the power supply board to the control/display board at J2.
6. Connect the three cable harness connectors to J3, J4, and J5 on the power supply board.
7. Reinstall the lower cover assembly.
8. Perform the *FUNCTIONAL CHECK AND SAFETY INSPECTION*.

**REPLACING THE
CONTROL / DISPLAY
BOARD**

CAUTION Wear a grounding wrist strap to ensure that any accumulated electrostatic charge will be discharged from your body to ground. **Electrostatic discharge can damage PC board components.**

The following procedures describe replacement of the control/display board:

To remove the control/display board (see pp. A-2, A-6):

1. Unplug the control unit.
2. Remove top cover from chassis (4 screws).
3. Disconnect the 14-conductor wire harness assembly from the control/display board at J2.
4. Disconnect the wire harness at J1.
5. Disconnect the 9-pin control panel connector from the control/display board at J3.
6. Disconnect the tubing from the center fitting of the pressure transducer on the control/display board.
7. Remove the six board mounting screws.
8. Lift the control/display board out of top cover carefully.

To install the control/display board (see pp. A-2, A-6):

1. Unplug the control unit.
2. Place the new control/display board in top cover.
3. Connect the tubing to the center fitting of the pressure transducer on the control/display board.
4. Install the board within the top cover by inserting the six board screws through the board. Tighten the screws.
5. Connect the 9-pin connector from the control panel to the control/display board at J3.
6. Connect the wire harness to the board at J1.
7. Perform a voltage check of the power supply board (see "REPLACING THE POWER SUPPLY BOARD," items 5, 6, and 7). Turn control unit off.
8. Connect the 14-conductor wire assembly from the power supply board to the control/display board at J2.
9. Reinstall the top cover.
10. Perform the *FUNCTIONAL CHECK AND SAFETY INSPECTION*.

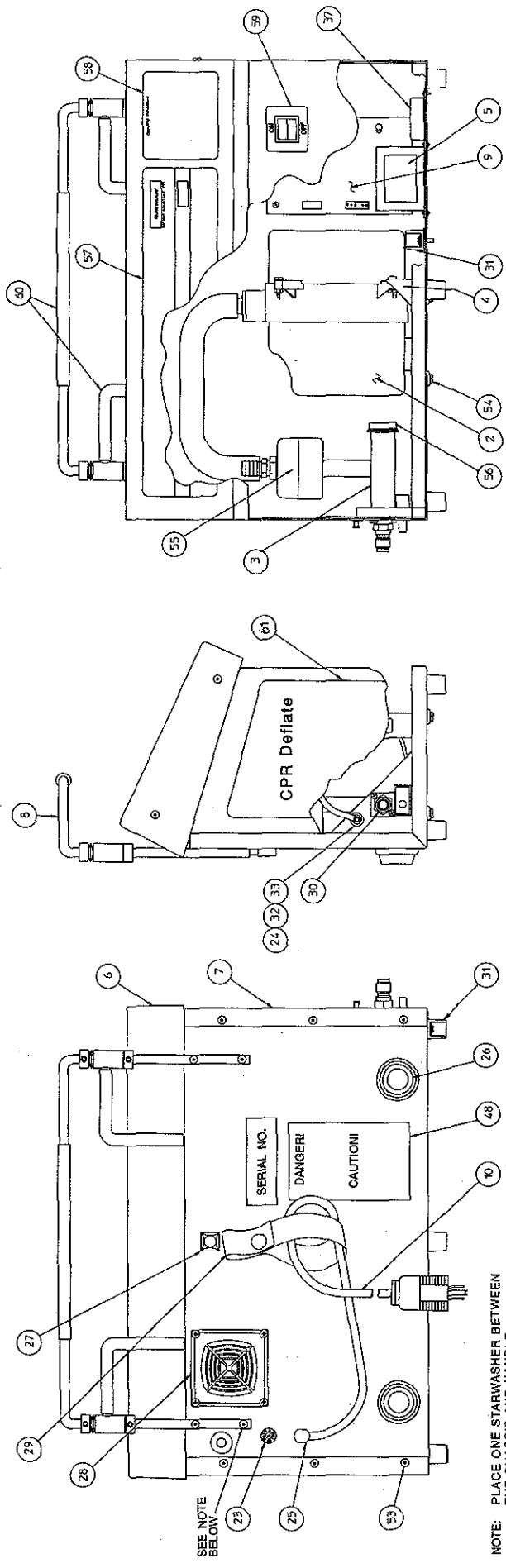
REPLACEMENT PARTS

To order replacement parts, contact GAYMAR's Customer Service Department:

Telephone: Direct (716) 662-2551
Within New York State, 1 800 848-4806
Outside New York State, 1 800 828-7341

To identify replacements parts, refer to pages A-1, A-2, A-4, and A-6.

CL-150 Pump/Parts List



Front View

Left Side View

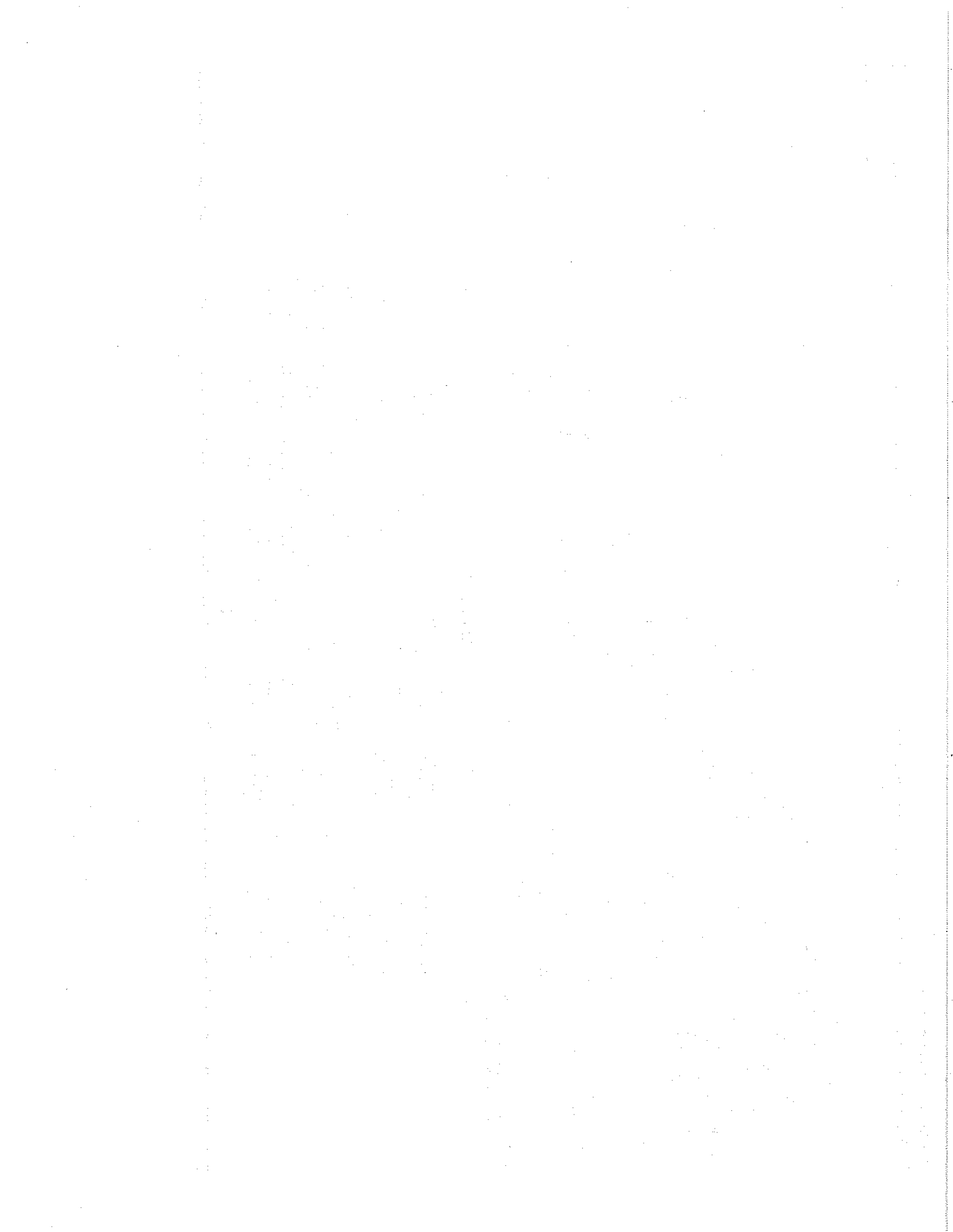
Back View

ID	Description	Gaymar P/N
48	UL label	07715-000
53	Cover screws	91042-001
54	Vibration Isolator kit	77784-000
55	HEPA filter	91039-000
56	Relief valve	91040-000
57	Digital control panel	07733-000
58	Operating instruction label	07716-000
59	On/off label	07466-000
60	Neoprene handle/bracket cover (24" length)	80637-192
61	CPR label	07638-000
	Connector hose (not shown)	CL-121

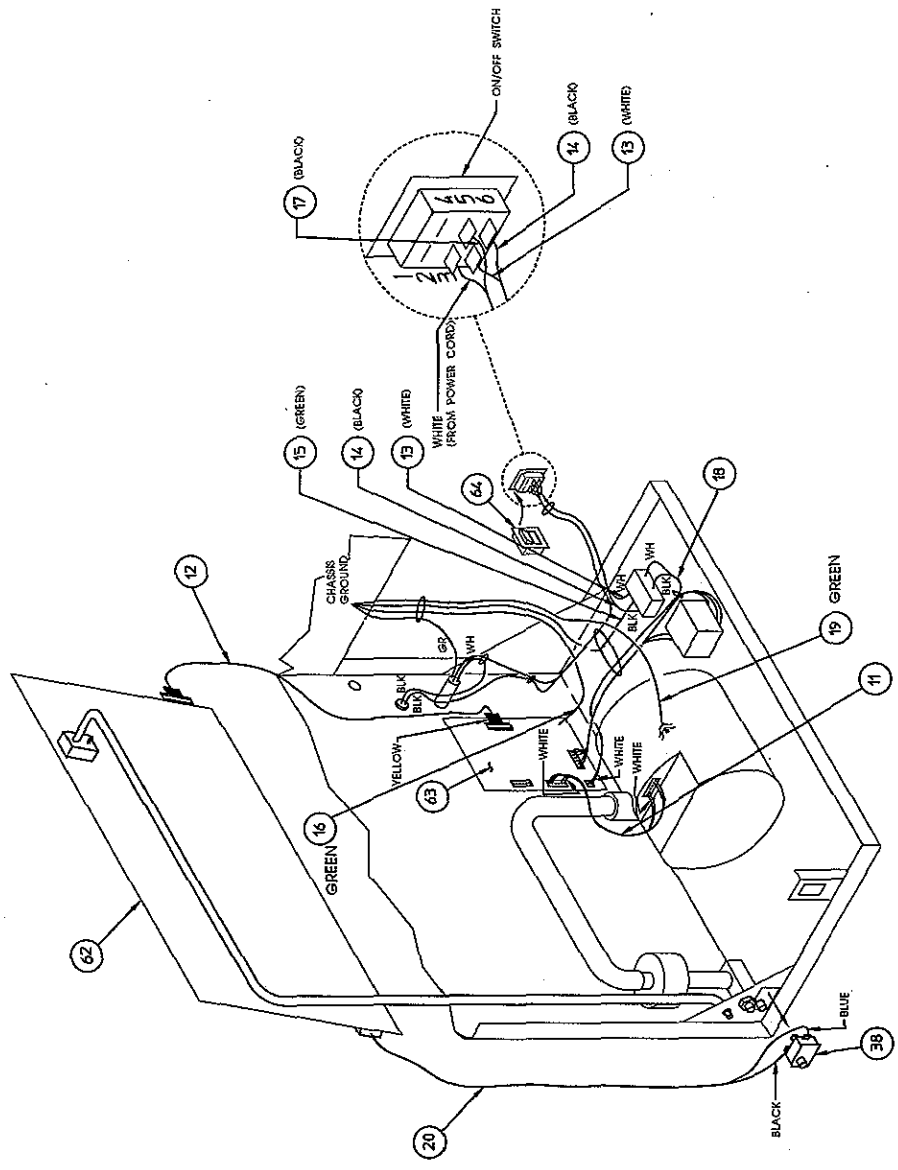
ID	Description	Gaymar P/N
25	Strain relief bushing	90426-000
26	Bumper (circular)	91036-000
27	Bumper (square)	91035-000
28	Filter assembly	90835-000
29	Foam filter (package of 10)	77555-000
29	Strap assembly, power cord	07678-000
30	Connector	91046-000
31	Rubber foot	91044-000
32	Locking bulkhead	91121-000
33	Locknut, bulkhead	91122-000
37	EMI Filter	91270-000

ID	Description	Gaymar P/N
2	Blower assembly	06806-000
3	Manifold assembly	06605-000
4	Blower bracket	06568-000
5	Transformer assembly	03075-002
6	Top cover assembly	07550-000
7	Lower cover assembly	07541-000
8	Handle assembly	06757-000
9	Power supply PCB assembly	07435-000
10	Power cord assembly	06606-000
23	Circuit breaker	90500-001
24	Fitting, bulkhead	91119-000

Parts List



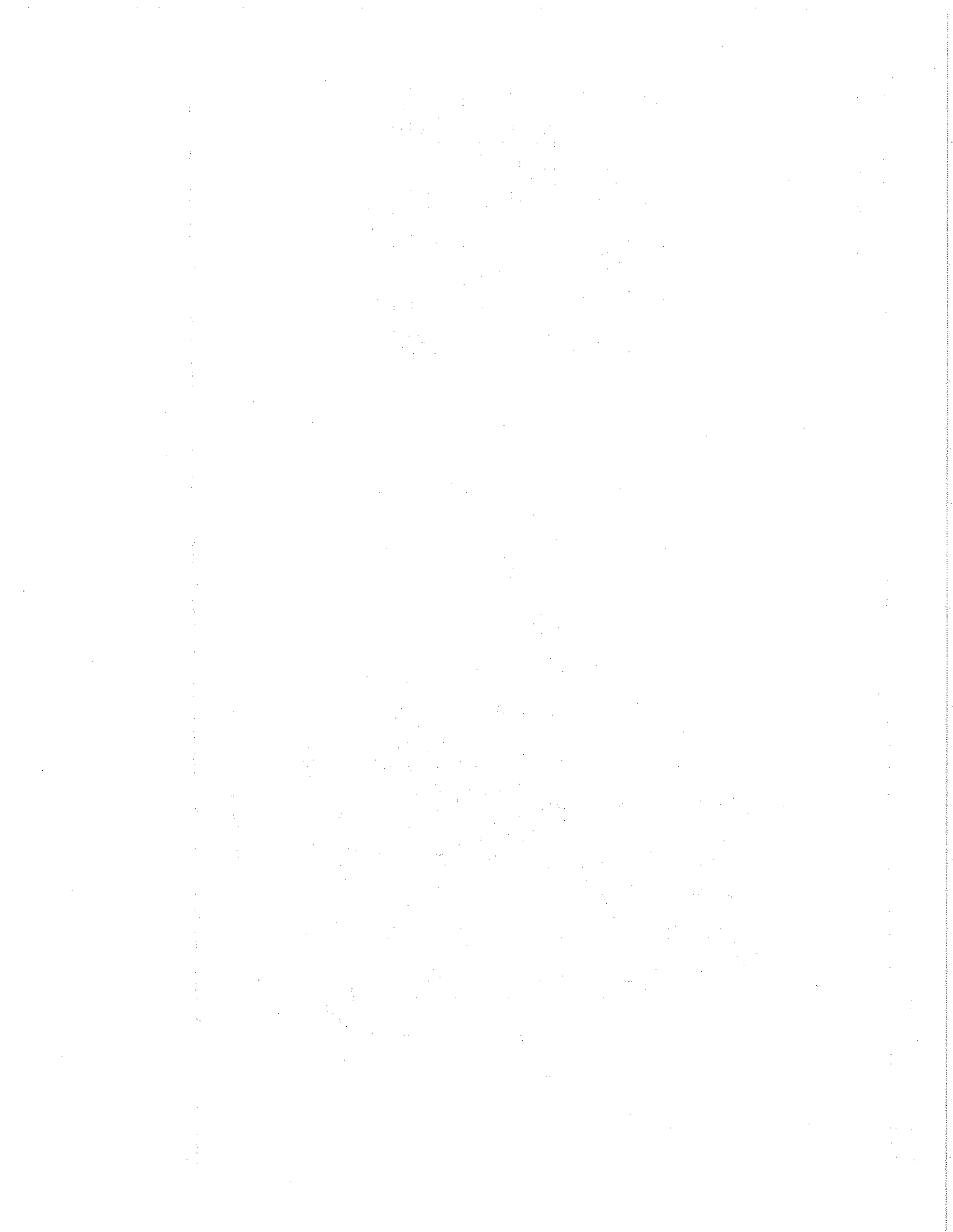
CL-150 Electrical/Pneumatic Diagram



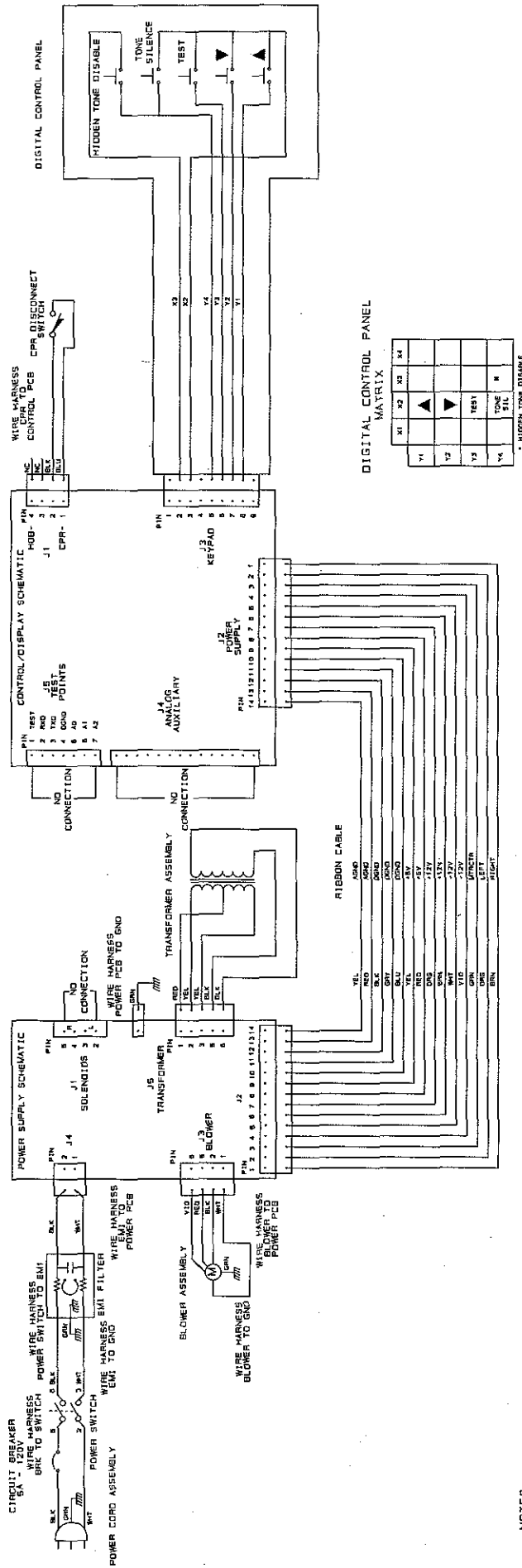
Electrical/Pneumatic Diagram

ID	Description	Gaymar P/N
11	Wire harness, blower to power supply PCB	06617-000
12	Wire harness, power supply PCB to control PCB	07227-900
13	Wire harness, on/off SW to EMI filter	07228-000
14	Wire harness, on/off SW to EMI filter	07228-001
15	Wire harness, EMI filter to ground	07228-002
16	Wire harness, power supply PCB to ground	07228-003
17	Wire harness, circuit breaker to on/off SW	07228-004
18	Wire harness, power supply PCB to EMI filter	07228-005
19	Wire harness, blower to chassis ground	07228-006
20	Wire harness, CPR disconnect to control PCB	07347-000
38	Switch	07361-000
62	Control/display PC board	07616-000
63	Power supply PC board	07435-000
64	On/off switch	90278-000

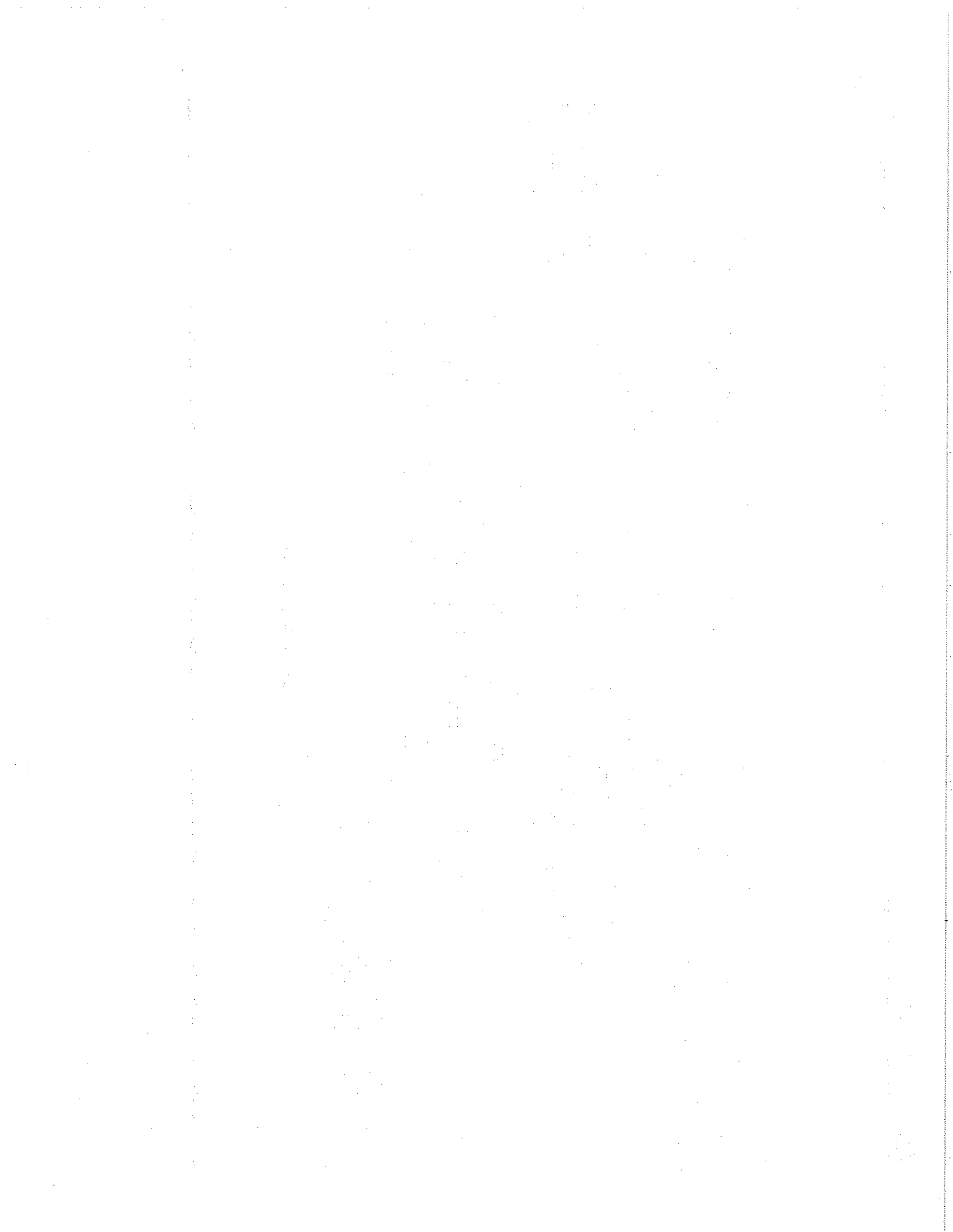
Parts List



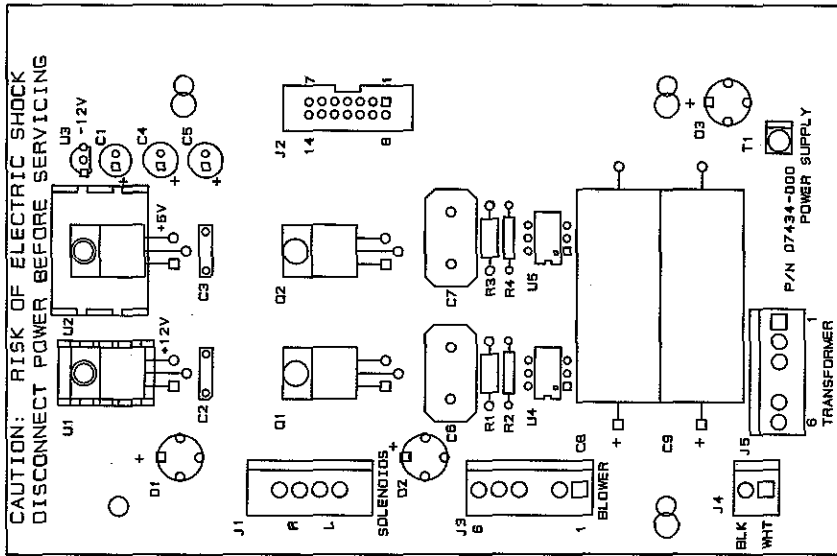
System Wiring Diagram



System Wiring Diagram



Power Supply Board (A1) Assembly
and Parts List



CAUTION: RISK OF ELECTRIC SHOCK
DISCONNECT POWER BEFORE SERVICING

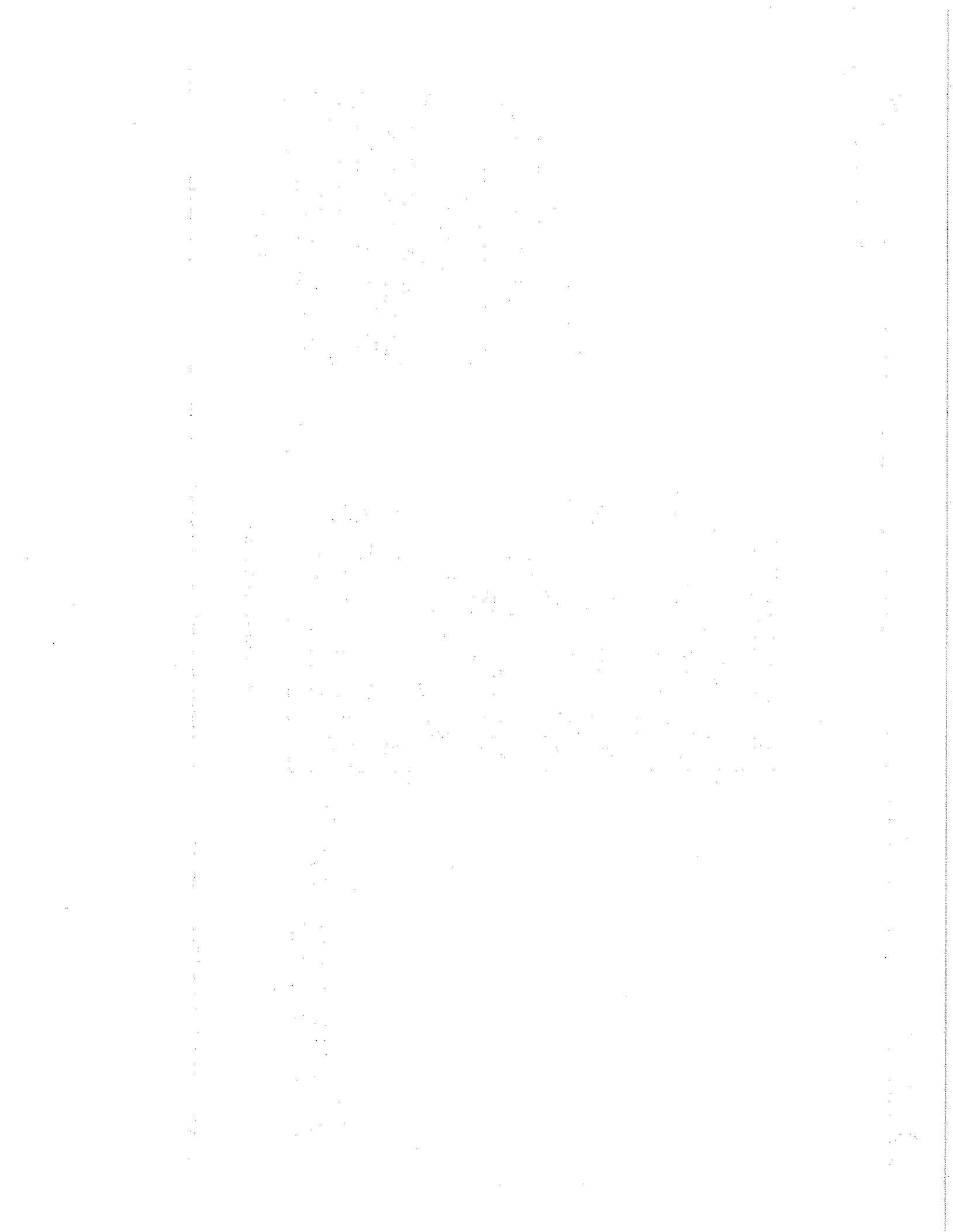
CAUTION: THIS PRODUCT IS SUSCEPTIBLE TO DAMAGE FROM
ELECTROSTATIC DISCHARGE. HANDLING OF THIS PRODUCT SHALL BE
ACCOMPLISHED ONLY WITH ADEQUATE GROUNDING PROVISION TO
PREVENT ELECTROSTATIC DISCHARGE DAMAGE.

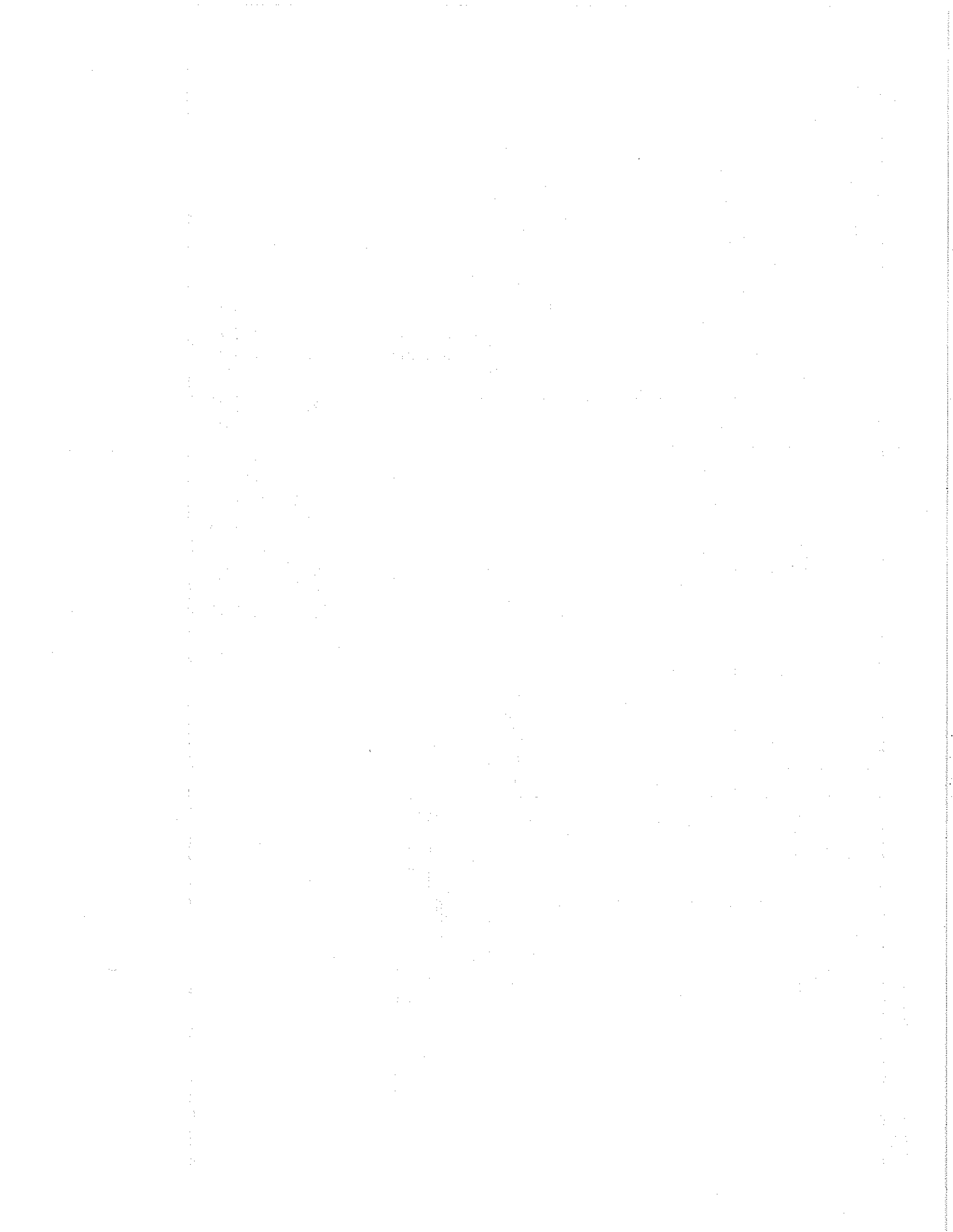


Designator	Description	GAYMAR PIN
U4, U5	IC, MOC3010	90886-001
U3	VOLT REG, LM320LZ12	90712-001
U2	VOLT REG, LM340T5	90712-017
U1	VOLT REG, LM340T-12	90712-015
Q1, Q2	TRIAC, 2N6346A	90709-000
D1, D2, D3	DIODE, BRIDGE W04M	90717-042
R1, R3	RESISTOR, 100K 1/2W 5%	90092-257
R2, R4	RESISTOR, 390R 1/4W 5%	90092-039
C8, C9	CAPACITOR, 2200uF @35V	90701-059
C4, C5	CAPACITOR, 10uF @50V	90701-071
C1	CAPACITOR, 2.2uF @63V	90701-070
C3, C3	CAPACITOR, 0.1uF	90701-169
C6, C7	CAPACITOR, 0.001uF 600V	90701-097
	POWER SUPPLY BOARD ASSEMBLY	07435-000

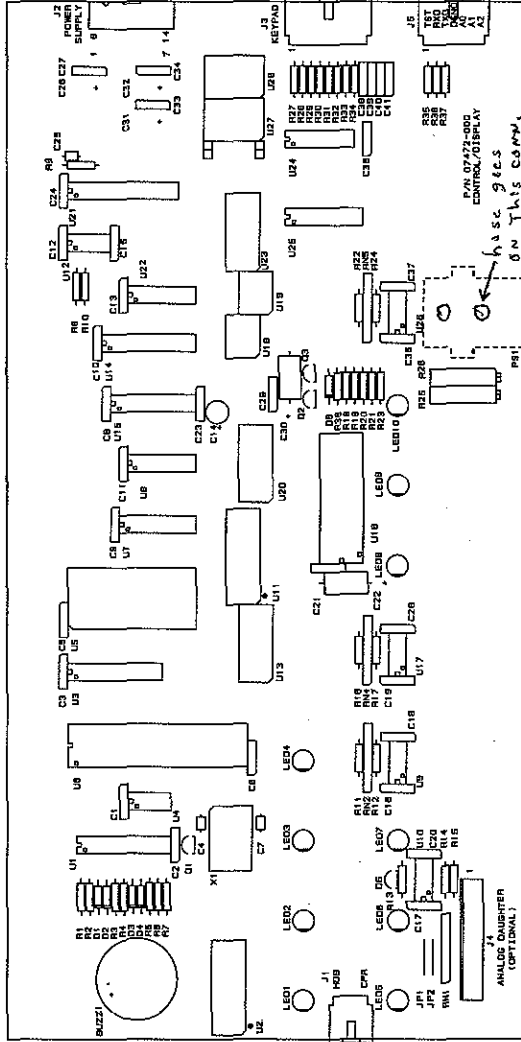
Parts List

Power Supply Board Assembly





Control/Display Board (A2) Assembly and Parts List



CAUTION: THIS PRODUCT IS SUSCEPTIBLE TO DAMAGE FROM ELECTROSTATIC DISCHARGE. HANDLING OF THIS PRODUCT SHALL BE ACCOMPLISHED ONLY WITH ADEQUATE GROUNDING PROVISION TO PREVENT ELECTROSTATIC DISCHARGE DAMAGE.



ATTENTION
Read the following
instructions

Control/Display Board Assembly - 07616-000

Designator	Description	Gaymar PIN
C1-C3, C5, C6, C8-C13, C15, C17, C20, C21, C23, C24, C27, C29, C33-C37	CAPACITOR, 0.1µF	9070-169
C4, C7	CAPACITOR, 22µF	9070-168
C14, C26, C31, C32	CAPACITOR, 10µF @35V	9070-071
C22, C30	CAPACITOR, 47µF @16V	9070-063
C25	CAPACITOR, 50µF	9070-171
C38-C41	CAPACITOR, 50µF	9070-170
D1-D4	DIODE, 1N914	9071-002
D5	DIODE, 3A2-5.0	9071-057
D6	DIODE, 1N4004	9071-001
Q1, Q3	TRANSISTOR, 2N3904	9068-015
Q2	TRANSISTOR, 2N6727	9068-030
R1, R4, R7, R27-R34	RESISTOR, 4.7K, 1/4W 5%	9092-065

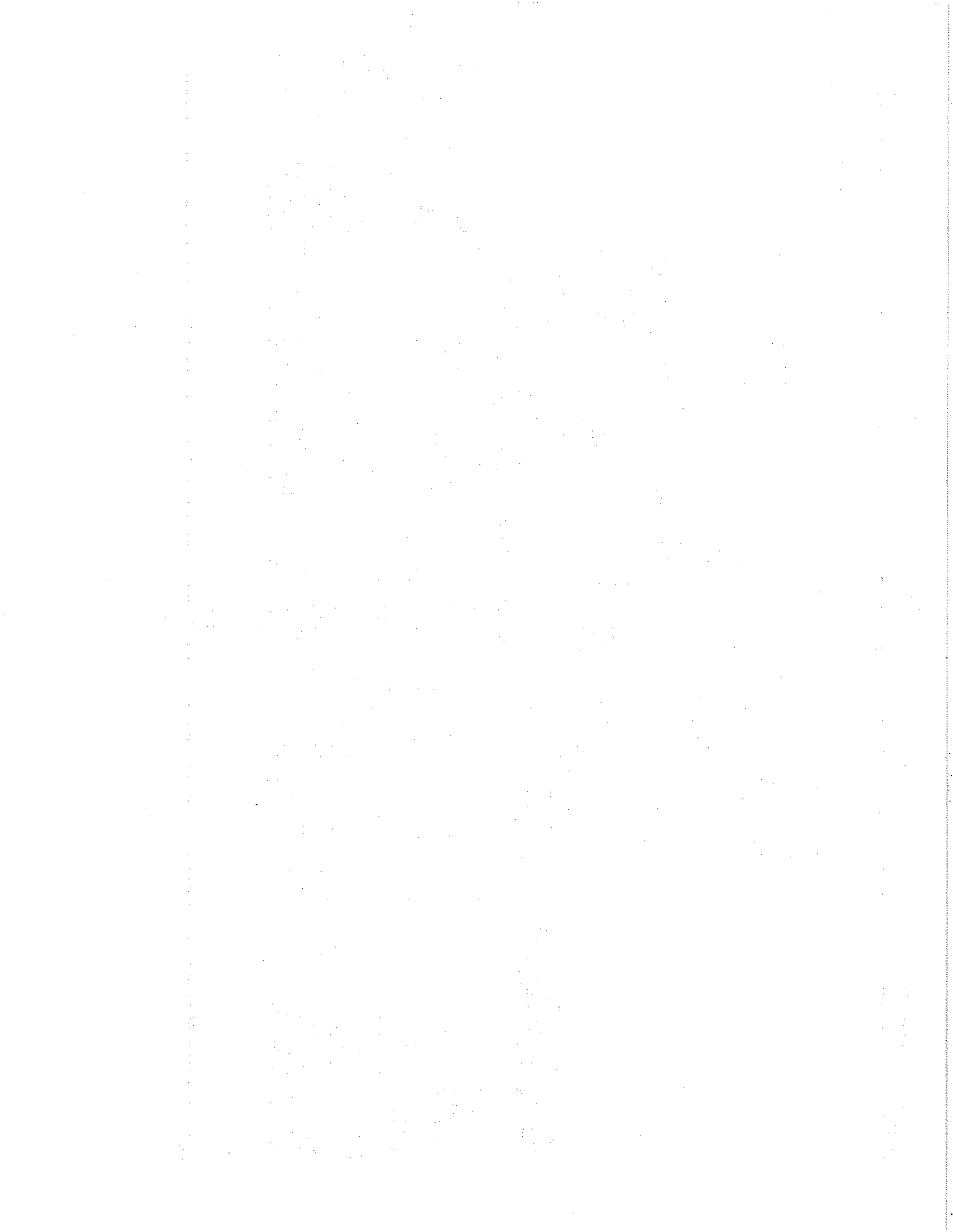
Designator	Description	Gaymar PIN
R2, R3, R14, R16, R20, R21, R23, R25, R26	RESISTOR, 100K, 1/8W 1%	9092-368
R5, R6, R37	RESISTOR, 270R, 1/4W 5%	9092-035
R8	RESISTOR, 7.87K, 1/8W 1%	9092-342
R9	RESISTOR, 6.81K, 1/8W 1%	9092-341
R10, R38	RESISTOR, 1.00K, 1/8W 1%	9092-361
R13, R24	RESISTOR, 33R, 1/8W 1%	9092-337
R15	RESISTOR, 121R, 1/8W 1%	9092-349
R19	RESISTOR, 47R, 1/8W 1%	9092-338
R22	RESISTOR, 150R, 1/8W 1%	9092-336
RN1	RESISTR. NETWORK, 10K BUSSED	91248-004
RN5	RESISTR. NETWORK, 10K ISOLATED	91248-017
U1	IC, 74C244	9088-085
U3	IC, 74HC373	9088-086

Designator	Description	Gaymar PIN
U4	IC, 35C102	9088-021
U5	EPROM, PROGRAMMED	***
U6	IC, 80C32	9088-071
U7	IC, 74HC138	9088-051
U8	IC, 74HC20	9088-036
U10, U12, U16	IC, LTT1013A	90761-037
U11	LED, BAR, LTA1000G	90761-003
U13, U20	LED, LIGHT BAR, 2785	90761-003
U14	IC, 74HC4551	9088-087
U15	IC, 74C922	9088-058
U16	IC, 7218	9088-114
U18	LED, LIGHT BAR, 2785	90761-005
U21	IC, 7569	9088-099
U22, U24	DIODE ARRAY, FSAS501	90717-070

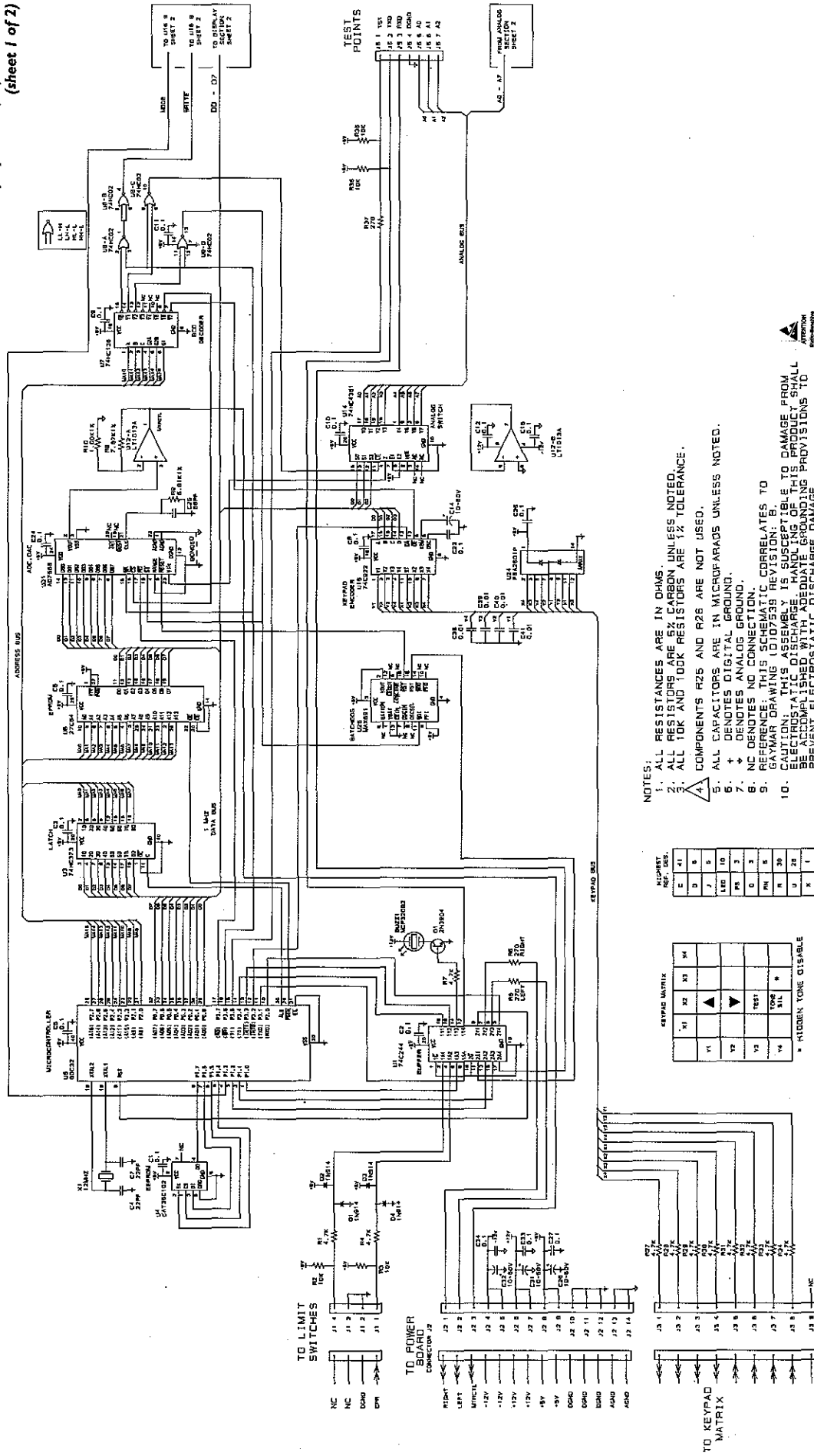
Designator	Description	Gaymar PIN
U23	LED, LIGHT BAR, 2885	90761-026
U25	IC, 691	9088-052
U27, U28	LED, DIGIT, 5551	90761-000
PS1	TRANSDUCER, PRESSURE SCX01	91116-001
BUZZ1	AUDIO ALARM	90919-001
J1, J92	CRYSTAL KIT, 12MHZ	77783-000
	WIRE JUMPER	90878-007
U5	PC BOARD, CONTROL/DISPLAY ASSY	07616-000
U6	SOCKET, DIP, 28 PIN	90754-009
U11	SOCKET, DIP, 40 PIN	90754-004
U13, U20, U23	SOCKET, DIP, 20 PIN	90754-034
U18	SOCKET, DIP, 16 PIN	90754-029
U27, U28	SOCKET, DIP, 8 PIN	90754-028
	SOCKET, DIP, 24 PIN	90754-031

*** Not a service part. Call Gaymar Technical Services.

Parts List



Control/Display Board (A2) Schematic
(sheet 1 of 2)



- NOTES:
1. ALL RESISTANCES ARE IN OHMS.
 2. ALL RESISTORS ARE 5% CARBON UNLESS NOTED.
 3. ALL 10K AND 100K RESISTORS ARE 1% TOLERANCE.
 4. COMPONENTS R25 AND R26 ARE NOT USED.
 5. ALL CAPACITORS ARE IN MICROFARADS UNLESS NOTED.
 6. † DENOTES DIGITAL GROUND.
 7. ‡ DENOTES NOT CONNECTED.
 8. REFERENCE THIS SCHEMATIC CORRELATES TO GAYMAR DRAWING 1012538 REVISION: B.
 9. CAUTION: THIS ASSEMBLY IS SUSCEPTIBLE TO DAMAGE FROM ELECTROSTATIC DISCHARGE. HANDLING OF THIS PRODUCT SHALL BE ACCOMPISHED WITH ADEQUATE GROUNDING PROVISIONS TO PREVENT ELECTROSTATIC DISCHARGE DAMAGE.

KEYPAD MATRIX

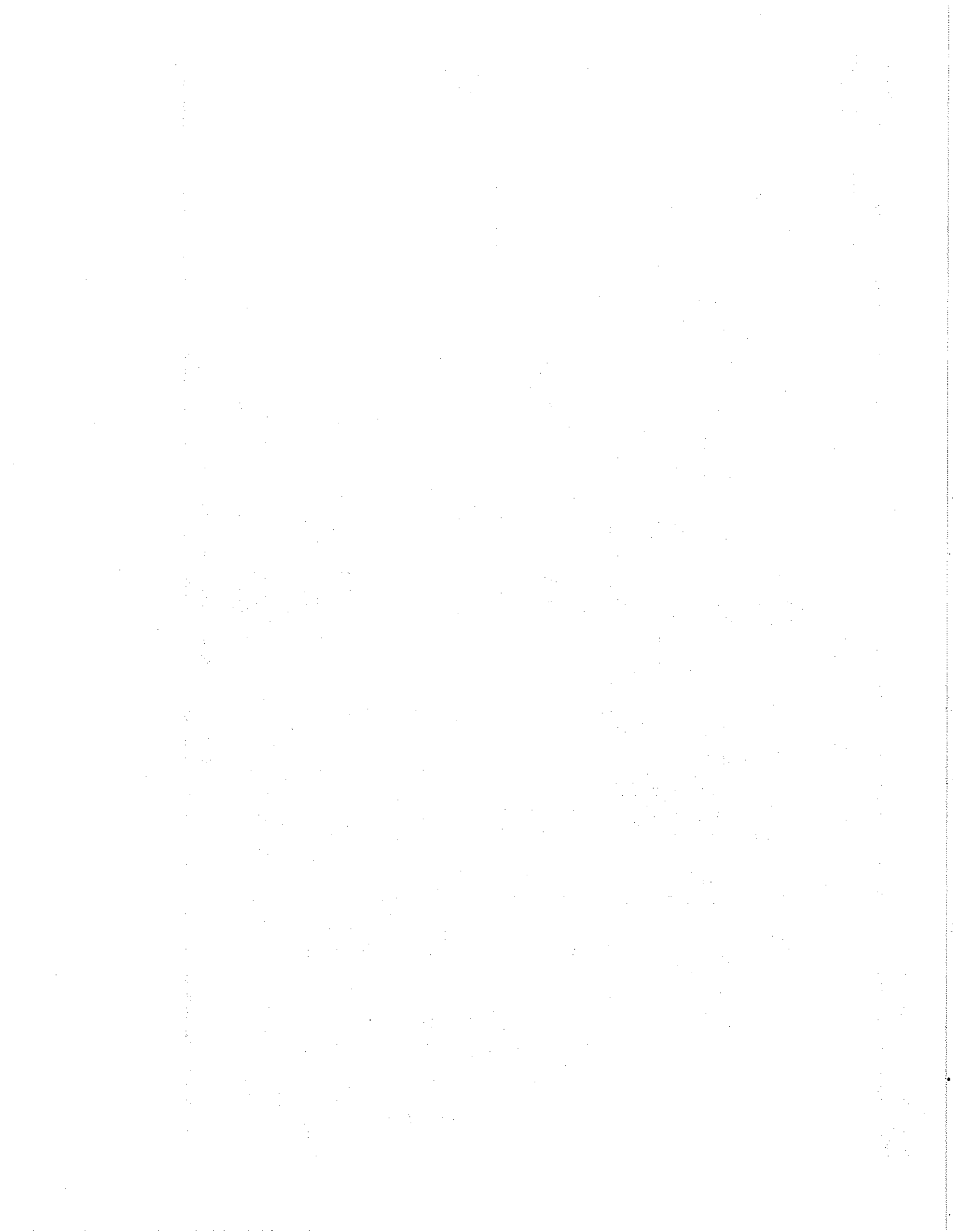
Y1	X1	TEST	Y4
Y2	X2	TEST	Y4
Y3	X3	TEST	Y4
Y4	X4	TEST	Y4

† HIDDEN, TONE DISABLE

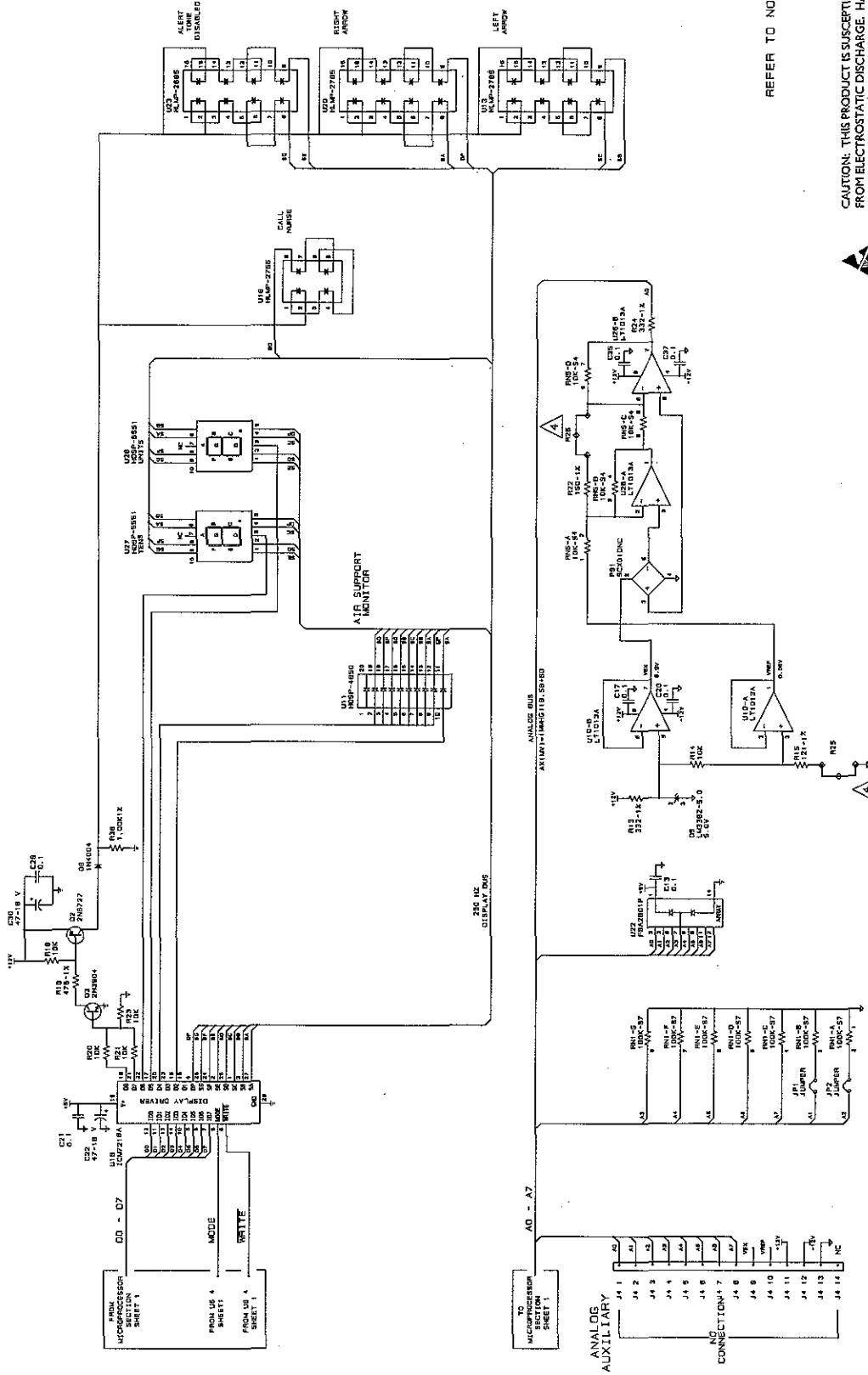
ALPHABET

C	41
D	5
J	5
L	10
M	3
O	3
P	5
U	28
X	1

Control/Display Board Schematic (A2) (sheet 1 of 2)



Control/Display Board (A2) Schematic
(sheet 2 of 2)

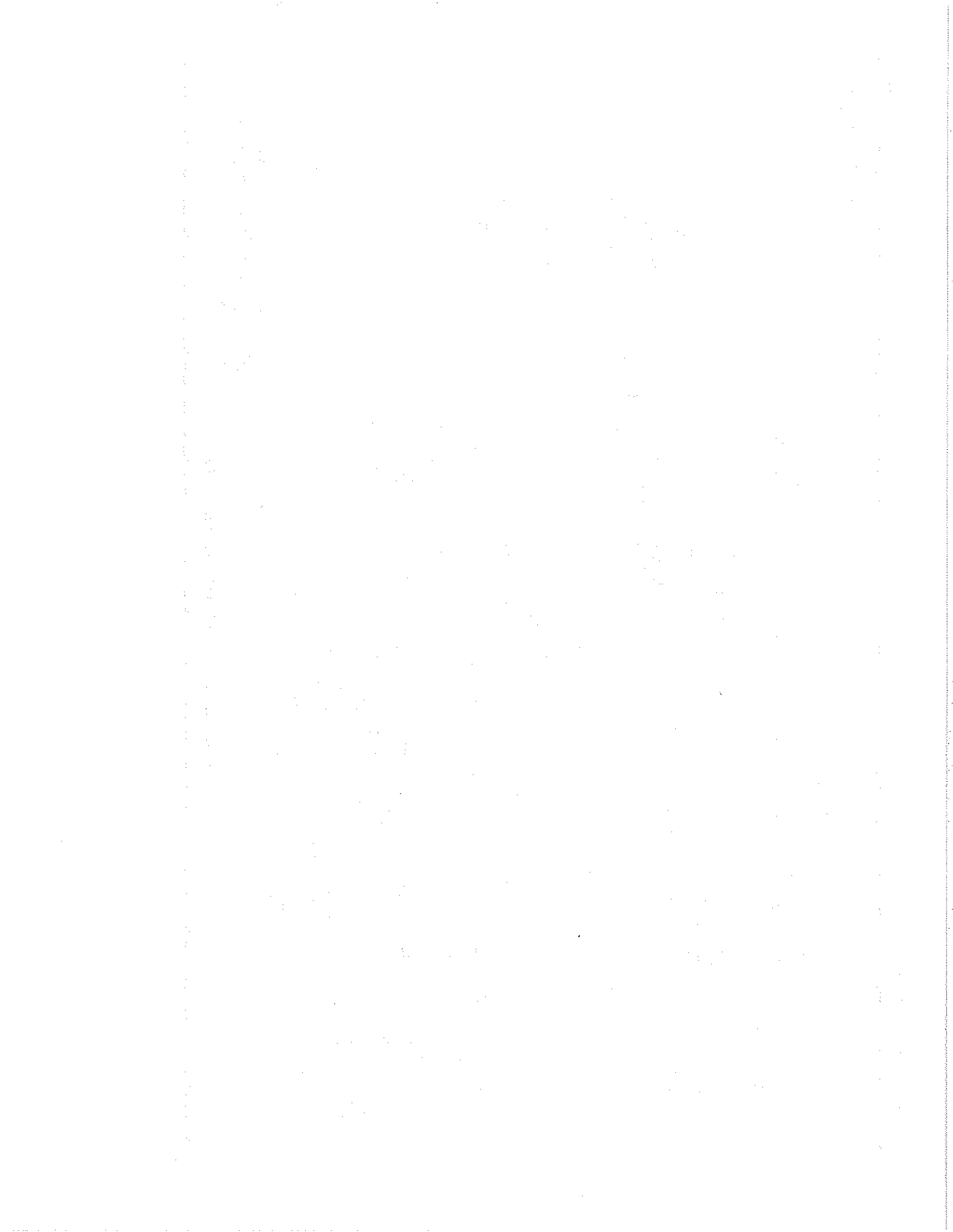


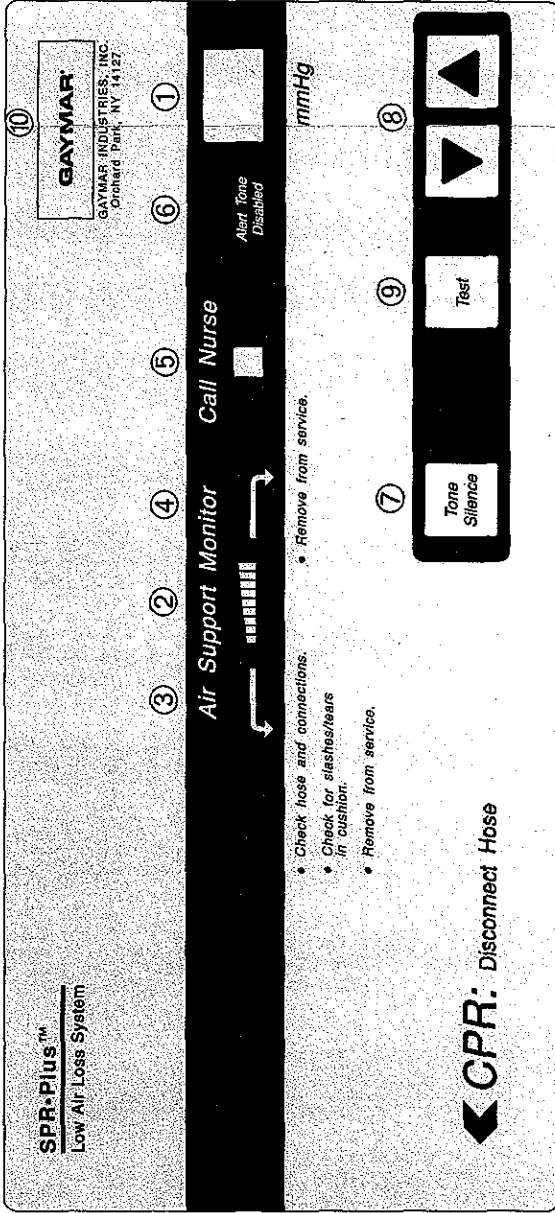
REFER TO NOTES ON SHEET 1

CAUTION: THIS PRODUCT IS SUSCEPTIBLE TO DAMAGE FROM ELECTROSTATIC DISCHARGE. HANDLING OF THIS PRODUCT SHALL BE ACCOMPLISHED ONLY WITH ADEQUATE GROUNDING PROVISION TO PREVENT ELECTROSTATIC DISCHARGE DAMAGE.

ATTENTION
Static-Sensitive
Device

Control/Display Board Schematic (A2) (sheet 2 of 2)





Operator Control Panel

Item	Name	Function	Item	Name	Function
1	PRESSURE INDICATOR	Displays setpoint and cushion pressure in millimeters of mercury (mmHg). Patient movement may cause the display value to fluctuate. The control unit will compensate to maintain the setpoint.	6	ALERT TONE DISABLED (normally hidden)	Indicates alert tone has been deactivated. Triggered by pressing the hidden tone disable button under the letter "M" in the GAYMAR logo.
2	AIR SUPPORT MONITOR - 9-bar display	Indicates sensed cushion pressure is at setpoint pressure when first 5 bars are lit. Cushion pressures more than 3 mmHg below setpoint will extinguish all bars. Cushion pressures more than 3 mmHg above setpoint will light all bars.	7	TOUR SILENCE SWITCH	Silences the alert tone for 30 minutes. Depressing the tone silence control for 5 seconds unlocks the arrow keys for the 8 to 17 mmHg cushion pressure range.
3	AIR SUPPORT MONITOR - Left arrow	Flashes when sensed cushion pressure is 3 mmHg less than setpoint pressure for longer than 15 seconds.	8	UP/DOWN ARROW SWITCHES	Raises or lowers the cushion pressure in 1 mmHg steps. Depressing either arrow displays the setpoint pressure for 5 seconds; then the display reverts to internal cushion pressure. Holding either arrow down for several seconds will cause the pressure setpoint to change until the arrow is released.
4	AIR SUPPORT MONITOR - Right arrow	Flashes when sensed cushion pressure is 3 mmHg more than setpoint pressure for longer than 15 seconds.	9	TEST SWITCH	Initiates a test sequence which lights all control panel indicators and sounds the alert tone.
5	CALL NURSE	Indicator lights and tone sounds whenever left or right arrows flash. An intermittent alert tone accompanies this light.	10	HIDDEN TONE DISABLE BUTTON (activates "Alert Tone Disabled")	Disables and enables the alert tone. Triggered by pressing the letter "M" in the GAYMAR logo.

