FLEXIFLO®

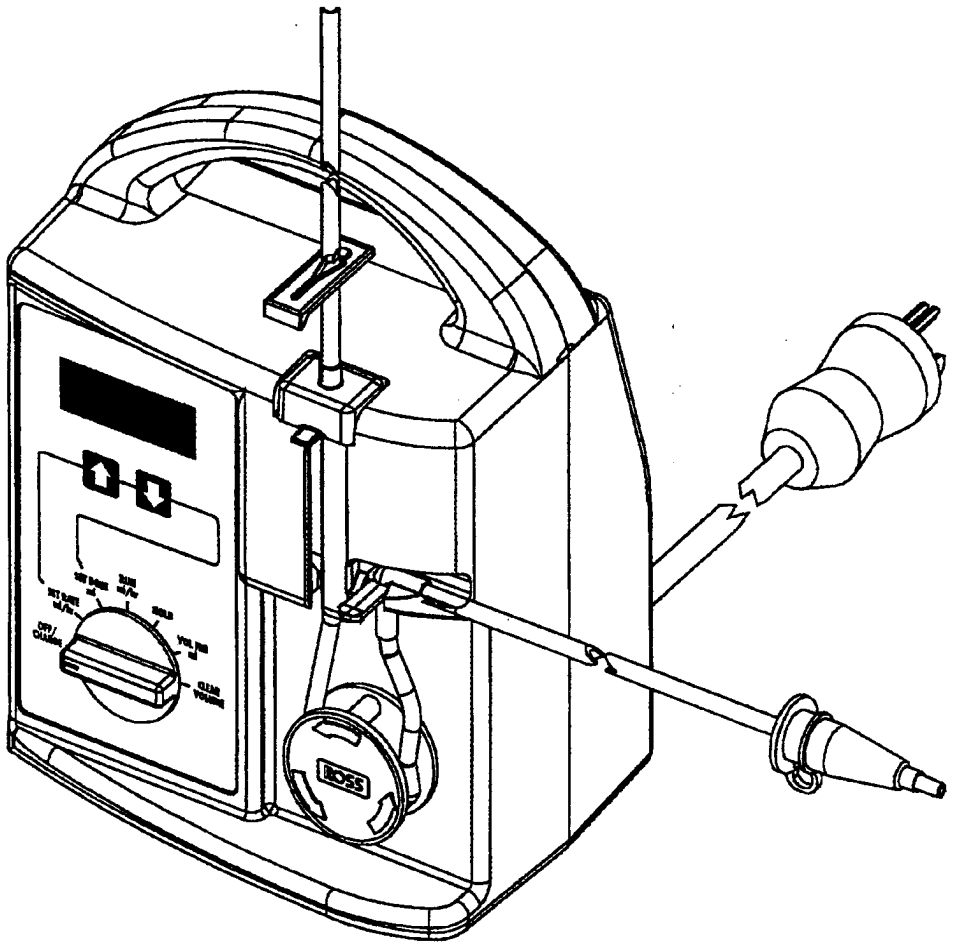
PATROL™

ENTERAL PUMP

Technical Service Manual

For Enteral Use Only
Not for Parenteral Use

For use with the following list numbers:
52034-04 52034-09 52034-15 52034-22
52034-27 52034-29 52034-36 52034-42
52034-54 52034-88 52034-A24 52034-A14
52034-99 52034-85



Abbott Laboratories
North Chicago, IL 60064
USA

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CHANGE HISTORY

Part Number	Date	Description of Change	Remove and Destroy Pages	Insert Change Pages	C/R
62-HF-0311-01	21 Apr 1998	Changed Cover Page	Cover Page	Cover Page	F/00088
		Added New Page Change History	N/A	i	
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		Renumbered Warranty Page	v	vi	
		Updated Fuse Rating from 100mA to 500mA	2-1	2-1	
		Added New Section 6.2.2.7.2.4	6-27	6-27	
62-HF-0311-02	25 Jan 1999	Changed sub-sections in section 4	4.1,4.4, 4.6,4.7	4.1,4.4,4.6,4.7	F/00115
		Changed Cover Page	Cover Page	Cover Page	
		Change Font Size of Pages	i, ii, iii, 1.7,1.8	i, ii, iii, 1.7,1.8,1.9	
		Changed all to 110VAC and 220VAC	3.6, 3.7, 3.9, 3.14, 6.24, 6.26, 6.30, 6.31, 7.1		
		Added New Section 1.8 ARTIFACTS	1.7	1.7	

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WARRANTY

Subject to the terms and conditions herein, Abbott Laboratories, herein referred to as Abbott, warrants that (a) the product shall conform to Abbott's standard specifications and be free from defects in material and workmanship under normal use and service for a period of one year after purchase, and (b) the replaceable battery shall be free from defects in material and workmanship under normal use and service for a period of 90 days after purchase. Abbott makes no other warranties, express or implied, as to merchantability, fitness for a particular purpose, or any other matter.

Purchaser's exclusive remedy shall be, at Abbott's option the repair or replacement of the product. In no event shall Abbott's liability arising out of any cause whatsoever (whether such cause be based in contract, negligence, strict liability, other tort, or otherwise) exceed the price of such product, and in no event shall Abbott be liable for incidental, consequential, or special damages or losses or for lost business, revenues, or profits. Warranty product returned to Abbott must be properly packaged and sent freight prepaid.

The foregoing warranty shall be void in the event the product has been misused, damaged, altered, or used other than in accordance with product manuals so as, in Abbott's judgment, to affect its stability or reliability, or in the event the serial number or lot number has been altered, effaced, or removed.

The foregoing warranty shall also be void in the event any person, including the Purchaser, performs or attempts to perform any major repair or other service on the product without having been trained by an authorized representative of Abbott and using Abbott documentation and approved spare parts. For purposes of the preceding sentence, "major repair or other service" means any repair or service other than the replacement of accessory items such as batteries and detachable AC power cords.

In providing any parts for repair or service of the product, Abbott shall have no responsibility or liability for the actions or inactions of the person performing such repair or service, regardless of whether such person has been trained to perform such repair or service. It is understood and acknowledged that any person other than an Abbott representative performing repair or service is not an authorized agent of Abbott.

SECTION 1 INTRODUCTION

The Flexiflo® Patrol™ Enteral Pump (shown in Figure 1-1) is a microprocessor-(computer-) controlled, rotary peristaltic pump that provides for accurate, controlled enteral feeding in a safe, user-friendly system. It has a large, easy-to-read display and simple controls. The Patrol™ Pump uses a specially designed feeding set, which includes a bolus-prevention feature to provide safe, accurate control of enteral feeding.

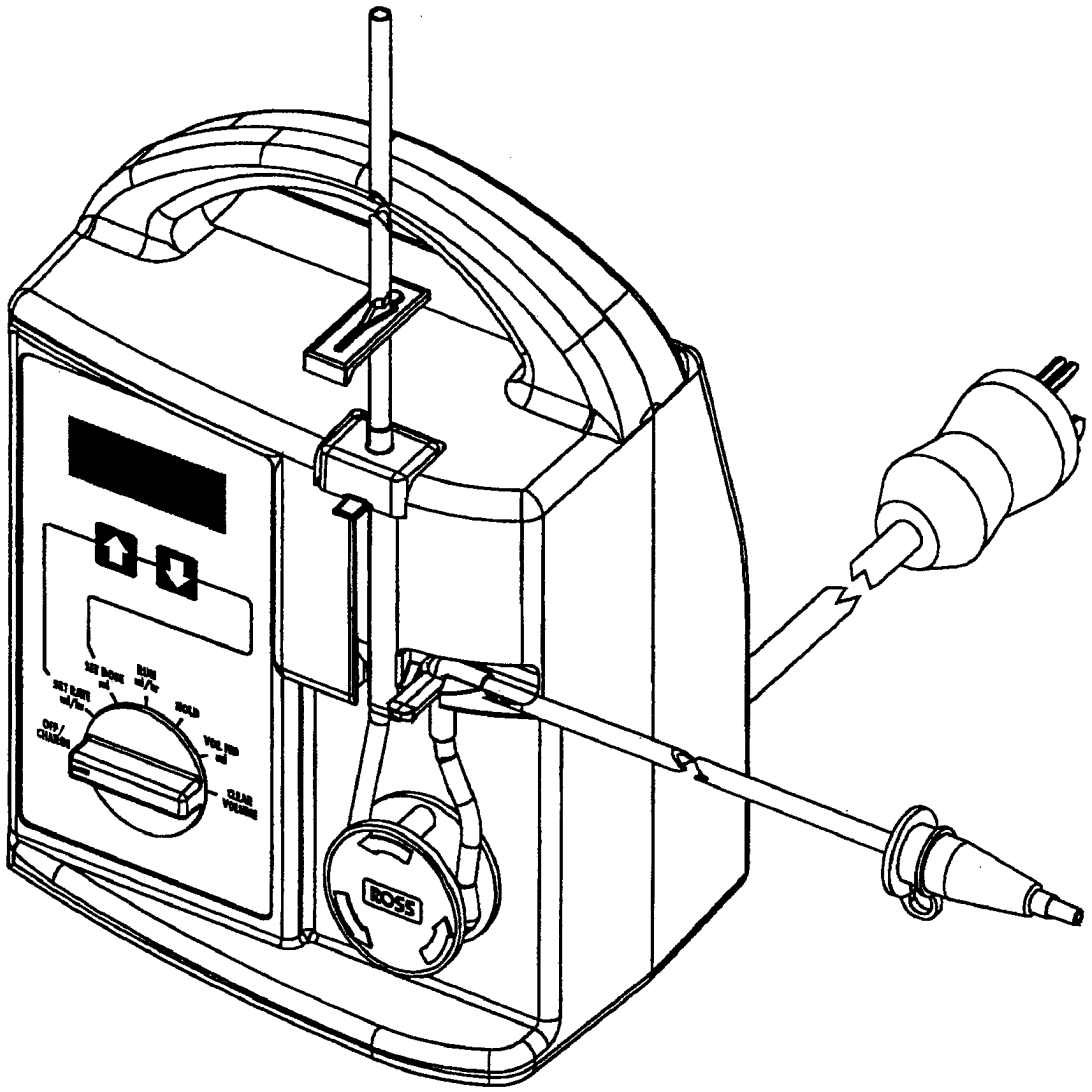

Figure 1-1. Flexiflo Enteral Pump and Pump Set

1.1 ABOUT THIS MANUAL

The purpose of this Technical Service Manual is to provide instructions necessary for testing the Flexiflo® Patrol™ Enteral Pump, troubleshooting alarms, and replacing field-replaceable assemblies and components. Refer to the Flexiflo® Patrol™ Enteral Pump Operating Manual for detailed operating instructions.

This manual is organized into the following seven sections:

Section 1	Introduction
Section 2	Specifications
Section 3	Theory of Operation
Section 4	Maintenance and Service Tests
Section 5	Troubleshooting
Section 6	Replaceable Parts and Repair
Section 7	Drawings

CAUTION: This pump is designed to deliver only liquid enteral feeding product (standard liquid product, infant formula, or reconstituted powder that has been thoroughly mixed into solution), and water.

1.2 WARNINGS, CAUTIONS, AND NOTES

Three types of alert messages are used throughout this manual: warnings, cautions, and notes. Pay attention to all alert messages. The following information explains the scope of warnings, cautions, and notes. This subsection also illustrates how each type of alert message appears when it occurs in the manual.

WARNING

A WARNING CONTAINS A SPECIAL SAFETY EMPHASIS AND MUST BE OBSERVED AT ALL TIMES. FAILURE TO OBSERVE A WARNING IS POTENTIALLY DANGEROUS.

CAUTION: When a CAUTION is used, it usually appears in front of a procedure or statement. It contains information that could prevent irreversible damage or hardware failure.

Note: A Note highlights information that helps explain a concept or a procedure.

1.3 INDICATIONS FOR USE

The Flexiflo® Patrol™ Pump can be used for adult and pediatric patients, provided the patients can tolerate a feeding range equivalent to the pump operational specifications.

These specifications are:

- The flow rate range is 1-300 mL/hr in 1 mL/hr increments.
- The flow rate accuracy is ±10% or ± 0.5 mL/hr, whichever is greater.
- The occlusion pressure range is 15-23 psi.

If these specifications are not appropriate for a given patient, the Patrol™ Pump should not be used.

WARNINGS

IN VOLUME-SENSITIVE PATIENTS, A VOLUME OF PRODUCT NO MORE THAN FOUR TIMES THE HOURLY FEEDING RATE SHOULD BE HUNG.

NOT FOR IV USE

1.4 PRECAUTIONS

This subsection describes precautions that should be followed when using the Pump.

1.4.1 EXPLOSION HAZARD

WARNING

POSSIBLE EXPLOSION HAZARD EXISTS IF USED IN THE PRESENCE OF FLAMMABLE ANESTHETICS.

1.4.2 TYPE OF FEEDING PRODUCT TO USE

The Flexiflo® Patrol™ Enteral Pump is designed to deliver only a liquid enteral feeding product such as standard liquid product, infant formula, reconstituted powder product that has been thoroughly mixed into solution, or water.

1.4.3 WARNING AGAINST IV USE

WARNING: The Patrol™ Pump is not intended for IV use.

1.4.4 CONFIRM PLACEMENT AND FUNCTION OF FEEDING TUBE

Confirm proper placement and function of patient's enteral feeding tube (nasogastric, nasojejunal, gastrostomy, etc.). Failure to do so may result in vomiting and/or aspiration. Verify the following before initiating feeding:

1. *Only* a Flexiflo® Patrol™ Pump Set is being used.

2. Pump insert is properly stretched counter-clockwise under rotor and blue connector is secured in the pump.

3. If the Safe-T-Valve™ is missing or damaged in any way (e.g.,, cut or torn) replace the set immediately.

4. Flow rate is set at the prescribed mL/hr.

1.5 SCOPE

The material contained in this manual is limited to technical information necessary for performing preventive maintenance, periodic testing functions, various service tests, interpreting system alarms, and troubleshooting to the level of subassembly replacement. Replacement of parts is limited to those parts listed in Section 6, Replaceable Parts and Repair. Specific instructions for operating this product are contained in the Flexiflo® Patrol™ Enteral Pump Operating Manual.

1.6 USER QUALIFICATIONS

The Flexiflo® Patrol™ Enteral Pump is for use at the direction of or under the supervision of licensed physicians, and by licensed or certified health care professionals who are trained in the use of the Pump and the administration of enteral fluids.

WARNING

SERVICE INSTRUCTIONS ARE ONLY FOR USE BY QUALIFIED BIOMEDICAL ENGINEERS (BME), BIOMEDICAL ELECTRONICS TECHNICIANS (BMET), OR ABBOTT SERVICE PERSONNEL. TO AVOID PERSONAL INJURY OR INSTRUMENT DAMAGE, DO NOT PERFORM ANY REPAIR OR CORRECTIVE ACTION UNLESS FULLY TRAINED AND AUTHORIZED TO DO SO. USER-SERVICEABLE PARTS ARE LIMITED TO THOSE ITEMS LISTED IN SECTION 6.

Note: Abbott will make available on request circuit diagrams, component part lists, descriptions, calibration instructions or other information which will assist the user's appropriately qualified technical personnel, to repair those parts of the equipment which are designated by the manufacturer as repairable.

1.7 RECEIVING PROCEDURE

The receiving procedure consists of three steps: unpacking, inspection, and Pump operational self-test. The procedures for performing these steps are provided below.

CAUTION: Product damage may occur unless proper care is exercised during the unpacking and installation process. Do not place the Pump in service if it fails the operational self-test.

Note: The battery pack may not be fully charged upon receipt. Charged battery for a minimum of 12 hours before use.

1.7.1 UNPACKING

Use care when unpacking the Pump. Retain the packing slip and save all original packing material for returning the Pump to the Abbott Service Center, in the event that the Pump is damaged or fails the operational self-test. For information on returning a Pump, see Section 5.1, Technical Assistance.

1.7.2 INSPECTION

Inspect the packing container thoroughly for possible damage. Do not use the Pump if it appears to be damaged in any way. If the Pump appears to be damaged, contact the Abbott Service Center for further instructions.

1.7.3 CHARGE THE BATTERY

Before initial use on battery power and after extended storage periods, the pump must be connected to an AC/Mains source for a minimum of 12 hours (pump may be operated during this time). Use AC/Mains whenever possible. Plug in during storage to assure a fully charged battery for emergencies. The battery charger test, which takes at least 60 hours to complete, is explained in Section 4.2.10.

1.7.4 PUMP OPERATIONAL SELF-TEST

Note: Do not place the Pump in service until the operational self-test has been conducted, whether the Pump has just been unpacked or has been repaired. Perform the operational self-test that is described and illustrated in Figure 1-2, Operational Self-Test and Figure 3-1 Disposable Pump Set.

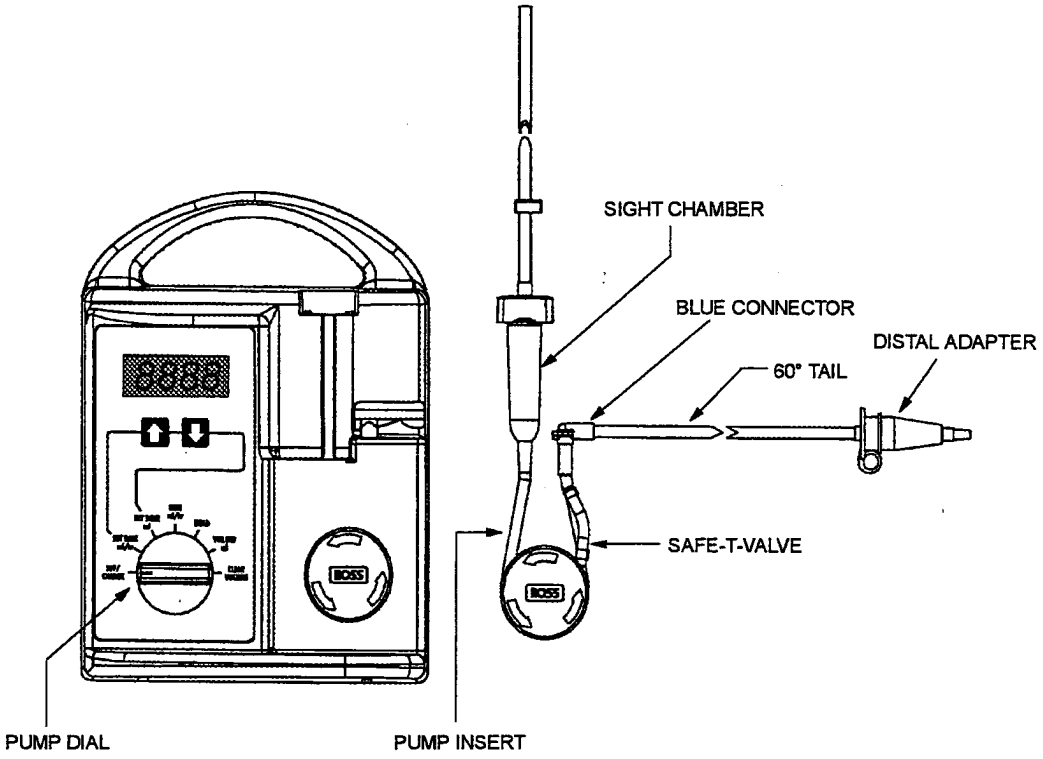

Figure 1-2. Operational Self-Test.

1. Attach pump to stand, using the pole clamp. Connect to AC/Mains. Ensure that green mains indicator on bottom of front panel is illuminated on 220 - 240 volt versions of the pump.

2. Attach the Flexiflo® Patrol™ Pump Set securely onto a filled enteral nutrition container, if it is not preattached. Suspend the bottom of the container 20 inches above and to the side, or behind pump.

3. Place sight chamber into drop detector and seat in place before priming.

4. **Remove cover** from adapter and discard or place into set cover holder on the pump pole clamp. With one hand on the blue connector of the pump set, **gently** pull until fluid flows.

5. Completely prime the set by allowing fluid to expel air from the tubing.

6. Let fluid slowly enter sight chamber to fill line (1/4 full). NOTE: If sight chamber is filled above the line after priming (overfilled), invert container, holding **all** tubing above sight chamber and container; with one hand on the sight chamber and the other hand on the blue connector, **gently** pull until fluid drains from tubing. Suspend container and reprime.

7. Grasp the blue connector on the pump insert. Loop the pump insert under the rotor (counterclockwise).

8. **Gently** pull up and then seat the blue connector in the slot above the rotor.

9. Turn the Pump dial to SET RATE. Pump will initiate system self-check procedure. Observe all segments of the display are visible ("8888") and alarm beeps.

10. Select the flow rate from 1 to 300 mL/hr by pressing the arrows and observing the number on the display (holding down an arrow will cause the numbers to scroll).

CAUTION: Never use sharp objects such as pens, pencils, fingernails, or paper clips to depress the keypad arrows.

11. If desired, turn dial to SET DOSE and select a dose by pressing the arrows.

Note: The Pump will operate without a DOSE selected (Set Dose at 0000.)

12. Turn dial to RUN to start pumping.

13. To see the feeding volume that is delivered, turn dial to VOL FED.

14. To clear the volume delivered, turn dial to CLEAR VOL. (This occurs after four beeps.)

15. When procedure is complete, turn pump dial to OFF/CHARGE.

Note: If an alarm sounds, turn the pump dial to HOLD. Correct alarm condition indicated on the visual display, then turn dial to RUN to restart pumping. (See Section 5.3, Troubleshooting.)

1.8 ARTIFACTS

Non hazardous, low-level electrical potentials are commonly observed when fluids are administered using infusion devices. These potentials are well within accepted safety standards, but may create artifacts on voltage-sensing equipment such as ECG, EMG, and EEG machines. These artifacts vary at a rate that is associated with the infusion rate. If the monitoring machine is not operating correctly or has loose or defective connections to its sensing electrodes, these artifactsmay be accentuated so as to simulate actual physiological signals. To determine if the abnormality in the monitoring equipment is caused by the infuser instead of some other source in the environment, set the infuser to that it is temporarily not delivering fluid. Disappearance of the abnormality indicates that it was probably caused by electronic noise generated by the infuser. Proper setup and maintenance of the monitoring equipment should eliminate the artifact. Refer to the appropriate monitoring system documentation fro setup and maintenance instructions.

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SECTION 2.1 SPECIFICATIONS (220 - 240 VOLT VERSION)

POWER:	**Voltage:**	220 - 240 VAC, 48 - 63 Hz, Single Phase
	Power:	12 Watts nominal while charging.
	Fuse:	2 x 500mA, 5 x 20mm slow-blow, 250V
	AC line cord:	Detachable, 3 meters
	Leakage:	Less than 100 microamperes
MECHANICAL:	**Height:**	21.6 cm (8.50 inches)
	Width:	16.5 cm (6.50 inches)
	Depth:	12.2 cm (7.75 inches)
	Weight:	3 Kgs (5.3 pounds)
OPERATIONAL SPECIFICATIONS:	**Range:**	Rate 1-300 mL/hr; Dose Limit 1 - 9999 mL*
	Increments:	1 mL
	Accuracy:	± 10% or ± 0.5 mL/hr of the set flow rate, whichever is greater (see Section 4.2.9 for accuracy test).
	Pressure:	Generates 103 - 158 kPa (15-23 psi) to overcome occlusion
	*	**A dose setting of 0 mL allows the pump to run indefinitely.**
BATTERY OPERATION:	**Type:**	6 V, 4.0 Ah rechargeable sealed-lead acid
	Charging:	The Pump will recharge within 4.5 hours for a 6-hour run-time capacity (with the Pump turned to OFF/ CHARGE). The Pump will fully charge after 24 hours.
	Expected Life:	6 hours at 125 mL/hr from full charge until "LO bAt" alarm
	STANDARDS:	Designed and manufactured to meet requirements of IEC 601-1.
ENVIRONMENT:	**Operating:**	+ 10°C to 40°C (+50°F to 104°F), 20% to 80% relative humidity
	Shipping/Storage:	-20°C to 60°C (-4°F to140°F), 10% to 90% relative humidity , 0-3000 m (0-10000 ft) pressure equivalent

Class 1	Mains supply equipment using protective earth
	Equipment providing adequate degree of protection against electric shock.
Type CF:	
IPX1:	Equipment protected against dripping water
	Attention, consult ACCOMPANYING DOCUMENTS

Protective earth (ground)

SECTION 2.2 SPECIFICATIONS: (115 VOLT VERSION)

POWER:	**Voltage:**	100 to 130 VAC, 47 - 63 Hz, Single Phase
	Power:	12 Watts nominal while charging.
	Fuse:	2 X 200mA, 5 x 20 mm slow-blow, 250 Volt
	AC line cord:	Hospital grade, nondetachable (10 feet)
	Leakage:	Less than 100 microamperes
MECHANICAL:	**Height:**	21.6 cm (6.50 inches)
	Width:	16.5 cm (6.50 inches)
	Depth:	12.2 cm (7.35 inches)
	Weight:	3 Kgs (5.3 pounds)
OPERATIONAL SPECIFICATIONS	**Range:**	Rate 1-300 mL/hr; Dose Limit 1 - 9999 mL*
	Increments:	1 mL
	Accuracy:	± 10% or ± 0.5 mL/hr of the set flow rate, whichever is greater (see Section 4.2.9 for accuracy test).
	Pressure:	Generates 103 - 158 kPa (15-23 psi) to overcome occlusion
	*	**A dose setting of 0 mL allows the pump to run indefinitely.**
BATTERY OPERATION:	**Type:**	6 V, 4.0 Ah rechargeable sealed-lead acid.
	Charging:	The Pump will recharge within 4.5 hours for a 6-hour run-time capacity (with the Pump turned to OFF/ CHARGE). The Pump will fully charge after 24 hours.
	Expected Life:	6 hours at 125 mL/hr from full charge until "LO bAt" alarm
	STANDARDS:	Designed and manufactured to meet requirements of UL 544. (Label Code 04 only)

SECTION 3 THEORY OF OPERATION

This section describes the Flexiflo® Patrol™ Enteral Pump's theory of operation and includes the following subjects:

- General description
- Mechanical overview
- Electronics overview

3.1 GENERAL DESCRIPTION

The Flexiflo® Patrol™ Enteral Pump includes the following features:

- Dose setting
- Safeguards to protect against overdelivery:
  - — Motor runs at the selected rate
  - — Drop sensor free-flow alarm
- Volume-fed accumulation for fluid delivered
- Flow-rate selection from 1 to 300 mL/hr in 1- mL/hr increments
- Accuracy to ±0.5 mL/hr or ± 10% of the set flow rate, whichever is greater
- Six-hour battery operation at 125 mL/hr — when fully charged — before "LO bAt" alarm
- AC indicator and detachable power cord on 220 volt version.
- Pump self-test
- An adjustable Hold timer — When control knob is turned to HOLD, the arrow keys can be used to set a Hold period for 1 to 90 minutes. Pump will sound an alarm when this period is over.
- Simple setup
- Memory — Automatic retention of the following settings until Pump is turned off and disconnected from AC/Mains:
  - — Volume Fed
  - — Runtime (retained in maintenance mode until battery is removed)
  - — Set Rate
  - — Set Dose
  - — Lockout Feature Status
- Alarms that include the following:
  - — No flow
  - — Dose Fed
  - — Select run (automatic if Pump is idle in the SET RATE, SET DOSE, VOL FED, and CLEAR VOL modes for more than 5 Minutes; HOLD period adjustable from 1 to 90 minutes)
  - — Low battery
  - — Discharged battery
  - — Free flow
  - — Select rate (a flow rate of zero has been set)

- — Pump errors: E1 (RAM failure), E2 (ROM failure), E5 (Control knob failure), E6 (Hardware Stack Overflow), E7 (C-Stack Overflow)

- Maintenance mode that supplies the following information to pump service:

  - — Software version
  - — Runtime
  - — Current battery status (not low battery, low battery, or discharged battery)
  - — Last major alarm (no error, E1-E7, or discharged battery).

- Lockout feature to prevent tampering.

3.1.1 INSTRUCTIONS FOR USE

Note: Do not place the Pump in service until the operational self-test has been conducted, whether the Pump has just been unpacked or has been repaired. Perform the operational self-test that is described and illustrated in Figure 1-2, Operational Self-Test.

TO ASSEMBLE:

1. Attach pump to stand using pole clamp. Plug in cord if power is available. If using battery power, do not let battery run down. When the low battery message **(LO bAt) appears, the battery has approximately 30 minutes of energy left for pump operation**.

2. Attach the Patrol™ Pump Set securely onto a filled enteral nutrition container, if it is not preattached. Suspend container 20 inches above and to the side or behind pump.

3. Place sight chamber into drop detector and seat in place before priming.

4. **Remove cover** from adapter and discard or place into set cover holder on the pump pole clamp.

TO PRIME SET:

5. With one hand on the blue connector of the pump set, **gently** pull until fluid flows.

6. Completely prime the set by allowing fluid to expel air from the tubing.

7. Let fluid slowly enter sight chamber to fill line (1/4 full). (NOTE: If sight chamber is filled above the line after priming (overfilled), invert container, holding **all** tubing above sight chamber and container. With one hand on the sight chamber and the other hand on the blue connector, **gently** pull until fluid drains from tubing. Suspend container and reprime.

8. Grasp the blue connector on the pump insert. Loop the pump insert under the rotor (counterclockwise).

9. **Gently** pull up and then seat the blue connector in the slot above the rotor.

10. Confirm proper placement and function of enteral feeding tube.

11. Attach feeding set adapter to enteral feeding tube.

NOTE: If adapter is used with cover in place, assure that set is connected **only** to an enteral feeding tube (e.g., needle-catheter jejunostomy).

TO START PUMP:

12. Turn pump dial to SET RATE. Pump will initiate system self-check procedure.

13. Select flow rate, from 1 to 300 mL/hr by pressing the arrows and observing the entry on the display. Holding down an arrow will cause the numbers to scroll. Never use sharp objects such as pens, pencils, fingernails or paper clips to depress the keypad arrows.

14. If desired, turn dial to SET DOSE and select dose by pressing the arrows.

NOTE: Pump will operate without a DOSE selected (Set Dose at 0000).

15. Turn dial to RUN to start feeding.

16. To see feeding volume delivered, turn dial to VOL FED.

17. To clear the volume delivered, turn dial to CLEAR VOL. (This occurs after four beeps.)

18. When feeding is complete, turn pump dial to OFF.

NOTE: If alarm sounds, turn pump dial to HOLD. Correct alarm condition indicated by visual display, then turn dial to RUN to restart feeding.

3.2 MECHANICAL OVERVIEW

The principal mechanical elements of the Flexiflo® Patrol™ Enteral Pump include the disposable pump set, the rotor pumping mechanism, the housing, the pole clamp assembly, interconnect/interface electronics (and detachable power cord on 220 volt version).

3.2.1 DISPOSABLE PUMP SET

As shown in Figure 3-1, the disposable pump set consists of a fluid bag, PVC tubing that connects the bag to the sight chamber assembly, a sight chamber assembly (sight chamber and cap), a slide clamp, a pump insert (silicone stretch tubing), an anti-bolus Safe-T-Valve™, a blue distal connector, PVC tubing that connects the blue connector to the orange feeding adapter, a label, and a cover.

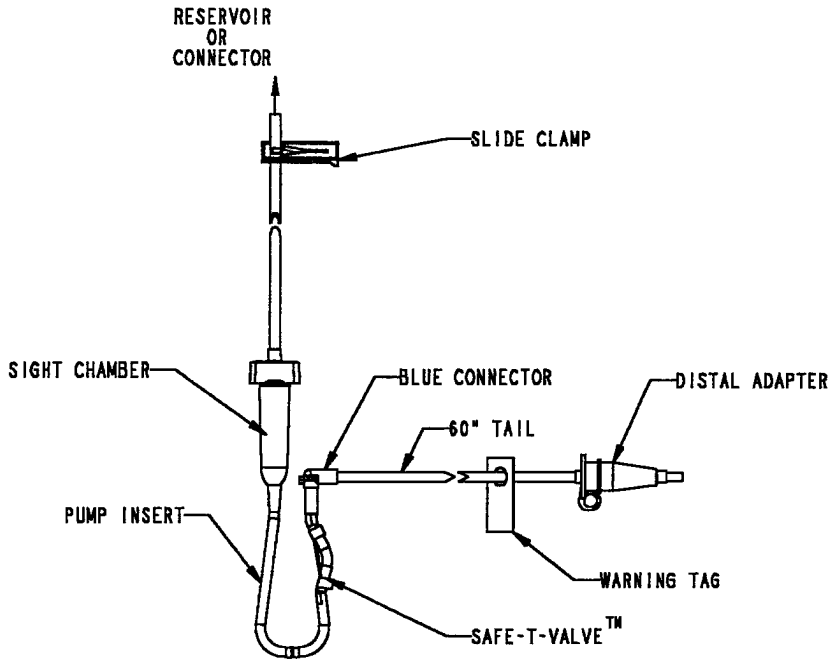

Figure 3-1. Disposable Pump Set. (Set detail may vary)

The sight chamber allows for drop detection by the Pump during operation. The Pump's drop sensor, which straddles the sight chamber, will detect "no FLO"(eg, empty container or in-line occlusions) or "FREE FLO" (gross overdelivery) conditions.

The anti-bolus Safe-T-Valve™ opens when the pump insert is stretched and loaded around the rotor. If the set is dislodged from the Pump, the Safe-T-Valve™ returns to its unstretched shape, folding the pump insert over and closing the tubing off to prevent bolus feeding (see Figure 3-2 for open and closed states of the Safe-T-Valve™).

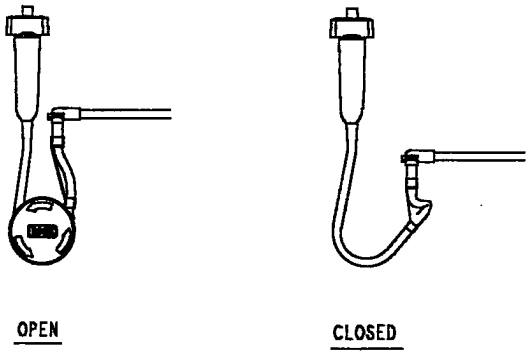

Figure 3-2. Disposable Pump Set. (Set detail may vary)

Load the pump set using the following procedures:

1. Seat the sight chamber assembly into the slot at the top of the Pump until the square sight chamber cap sits into the matching shoulder in the housing. The top of the sight chamber cap should be approximately flush with the top of the Pump housing (excluding the handle) when properly installed.

2. Stretch the pump insert downward by grabbing the handle on the blue connector. Wrap the insert counterclockwise around the rollers on the blue rotor.

3. Insert the blue connector into the trough in the front housing so that the PVC tubing leading to the orange adapter sits in the groove exiting the right side of the Pump (Figure 1-1). The handle on the blue distal connector must be forward and horizontal.

3.2.2 MECHANISM ASSEMBLY

The mechanism assembly consists of a stepper motor and a rotor assembly. During operation, the stepper motor turns, which drives the rotor. The rotor turns counter-clockwise, but the rollers turn clockwise on the roller pins relative to the pump insert tubing.

When the pump insert is stretched and loaded on the Pump, the rollers occlude the tubing at the points where they contact the tubing. The tubing between the rollers is not occluded. This allows a small volume of fluid to accumulate between the rollers. This volume is pushed through the tubing as the rollers roll, which generates a peristaltic pumping action. Approximately 0.38 mL of fluid is delivered with each revolution of the rotor.

3.3 ELECTRONICS OVERVIEW

The Flexiflo® Patrol™ Enteral Pump's electronic circuits include the battery monitor/charger, display and control, drop sensor, and motor drive. This subsection describes each functional circuit block. The 115 VAC and 220 VAC versions of the pump differ mainly with the input AC/Mains. The 115 VAC version has a non- detachable hospital-grade power cord which enters the enclosure and connects to the printed wire board (PWB); the fuses are hence located on the PWB. The 220 VAC version has an AC receptacle assembly at the rear of the pump. The AC receptacle has integral fuse holders for each mains. The AC receptacle will accept a standard detachable power cord.

The transformer/fuse combination differs with each version of the pump. The 115 VAC version has a UL recognized transformer and fuses. The 220 VAC version has a transformer constructed per IEC 601-1 and fuses constructed per IEC-127.

Section 7, Schematics, contains the electronics block diagram and schematic.

3.3.1 BLOCK DIAGRAM

The schematic block diagram (schematic sheet 2 of 10) details the control and status signals associated with the various functions. All the connections external to the circuit card are shown at this level.

3.3.2 BATTERY CHARGER

The battery charger (schematic sheet 3 of 10) is a current-limited, constant-voltage power supply connected directly to the battery module. The AC/Mains line provides direct input power. The charger module indicates to the microprocessor whether the Pump is connected to the AC/Mains.

On the 115VAC version of the pump, both AC primary lines are overcurrent-protected with UL recognized metric size fuses (5 x 20 mm) that are held by clips soldered to the printed wire board (PWB). The AC/Mains is overvoltage-protected by a varistor across-the-line. A filter capacitor is used across-the-line to suppress conducted harmonics that are produced by the rectifier.

On the 220VAC version of the pump, both mains are short circuit protected with 5 x 20 mm fuses constructed per IEC-127. These fuses are located within the AC receptacle assembly on the rear of the pump. The fuses are replaceable without opening the pump.

The Pump enclosure design incorporates ventilation to keep hydrogen concentrations from building up inside the enclosure whenever battery outgassing occurs.

3.3.2.1 TRANSFORMER - RECTIFIER

115VAC Version

The transformer (T1) (schematic sheet 3 of 10) is a 12 VA, split-bobbin transformer. The transformer mounts directly to the PWB by means of two screws.

The transformer uses a single primary for 115 VAC power. The secondary has a pair of coils wired in parallel. The transformer provides the necessary isolation between the primary and secondary, which eliminates the need to ground the secondary.

220 VAC Version

The transformer (T1) (Int'l schematic sheet 3 of 10) is rated at 10 VA with dual 10 volt secondaries. The construction is of dual-bobbins with insulating shrouds to provide the required creepage and clearance distances. One-time thermal cutouts (115 degree Celsius) are wound into each of the two primary coils to provide overload protection.

The positive temperature coefficient (PTC) resistor (R2) at the secondary output of the transformer limits the power available to less than 15 watts. The PTC resistor has a normally low resistance value. The PTC conducts current according to the value specified for it. If the current rises above the specified value, the PTC will begin to self-heat. The self-heating has an avalanche effect and the device trips — creating a dramatic increase in the resistance of the device. The PTC then passes just enough current to keep itself tripped but the circuit is protected by the current-limiting effect. The PTC resets when power is removed and it cools.

The next stage is the full wave bridge rectifier, which consists of four discrete, general-purpose rectifier diodes (D1 - D4). The rectifier output connects to the large, aluminum electrolytic storage capacitor (C2). There is a large DC leakage current associated with

the large value of capacitance; therefore, a series diode (D8) is placed before the linear regulator to block the DC leakage from the battery. The battery drains through the regulator when AC/Mains is removed. A smaller-value capacitance with lower leakage (C5) is placed at the regulator's input to compensate for the impedance of the series diode.

3.3.2.2 REGULATOR

The low dropout linear regulator (U1) (schematic sheet 3 of 10) is similar in function to the generic LM117 regulator. The package resembles the TO-220 with its tab soldered to the PWB to transfer heat to the board. Surface copper on the board dissipates the heat.

3.3.2.2.1 VOLTAGE FEEDBACK

A resistive divider (R6, R7) on the output provides the voltage feedback (schematic sheet 3 of 10). The divider is a low-impedance circuit connected directly across the battery; therefore, a transistor (Q2) opens the discharge path when AC/Mains is not present. If this transistor fails to open, the output loses voltage regulation and the battery overcharges.

The voltage feedback path switches off when it receives no AC/Mains from the transformer secondary. This circuit is necessary to reduce the current drain to the battery when the Pump is off. The feedback resistors must be of sufficiently low impedance to provide the necessary feedback to the regulator adjustment terminal; thus the need to switch this path off when the regulator is not used.

3.3.2.2.2 CURRENT FEEDBACK

A series sense resistor (R3) (schematic sheet 3 of 10) provides current feedback to the regulator. As the current increases, the voltage across the sense resistor becomes greater than the base-emitter voltage of the transistor (Q1). The transistor then conducts, which lowers the voltage at the regulator's adjustment terminal. The regulator's output then drops.

The current limit is related to the value of the sense resistor and transistor's base- emitter voltage. The current limit profile knee is related to the gain of the feedback loop. The feedback loop includes the transistor and its base resistor (R8). The transistor gain directly affects the feedback, whereas the series base resistance has an inverse effect. There is a trade-off between the sharpness of the knee and the stability of the feedback. There is also a tradeoff when one increases the base resistance to stabilize the output; the response time to abrupt current changes increases.

The power normally dissipated by the sense resistor is the product of the base-emitter voltage and sense current, about 360 mW. Current-limiting ceases to function when the feedback transistor enters saturation. At the point of saturation, the regulator output is pulled down to about 4.2 volts. The current is limited only by the circuit losses upstream, which are estimated at 6 volts dropped across the bridge, pass diode, regulator, and sense resistor. The 6 volts subtracted from the 10 volts rms generated by the transformer leaves

4 volts across the impedance of the transformer, about 1.8 ohms. The current-limiting polyswitches will trip at current levels beyond 1.1 amp. Tests on one pump showed the brief short-circuit current at about 1.7 amps.

The current-limiting capability is reduced during a voltage feedback failure. The current-limiting curve knee is severely rounded when voltage feedback is lost. As a result, the current limit value depends on the regulator input voltage and output impedance. Tests have shown that the current may rise to over 800 milliamps with a battery that is not fully charged. If the battery is sufficiently discharged — i.e., low impedance — the current may remain at this elevated level for a period of time. This eventually trips the transformer PTC, which is rated at 1.1 amp rms. Sufficient current will still pass through the PTC to continue to overcharge the battery, but at a much reduced rate.

The current has been shown to remain above 700 milliamps as the battery terminal voltage climbs to over 8 volts in this unregulated voltage-charging mode. As the system continues, the battery warms in temperature, which reduces its impedance; however, the circuit temperature warms and its impedance rises. The power delivered to the transformer does not vary significantly over time in the overcharge condition.

3.3.2.2.3 HEAT DISSIPATION

The surface area of the copper needed for the heat sink is maximized to decrease the thermal resistance of the regulator. The heat ultimately dissipates by convection to the air within the Pump. Some heat dissipates from the surface copper directly to the air by convection. Some heat is conducted to the internal board copper planes and spreads across the board to be dissipated to the air.

3.3.2.3 AC/MAINS INDICATOR

220 VAC Version

A front panel green LED has been included for the 220 VAC version of the pump. This will illuminate whenever a mains voltage greater than about 30 volts is present. The pump can be either On or Off.

Voltage at the transformer output indicates the presence of AC/Mains. The indication is applied to two parts of the circuitry. The first enables the voltage feedback for the regulator and the second signals to the microcontroller the presence of AC/Mains.

The AC-indicator/feedback-switch (schematic sheet 3 of 10) operates as a second full-bridge rectifier in combination with the main power rectifier of D1-D4. The return current from D6 and D7 is through D3 and D4 respectively. The current is regulated by R10 and R48 and the voltage regulated by D5 and C3. The charge is bled off by R9 to give a relatively quick response to a loss of AC/Mains; however a brown-out condition or the situation where a few cycles of the main power are missed does not trigger the circuit. The circuit operates with the loss of either diode and resistor.

Not only must the circuit indicate the presence of AC/Mains, it must also provide an interrupt to the microcontroller when AC/Mains is removed. This interrupt must be provided when the Pump is in the OFF/CHARGE state. The interrupt minimizes drain to the battery by differentiating the interrupt signal with a series pass capacitor (C27) to the microcontroller.

3.3.2.4 NOMINAL CURRENT MEASUREMENTS

When connected to an AC/Mains supply, the line current drawn by the Pump is nominally 18mA without the battery connected and with the Pump off. This current is supplied to the across-the-line capacitor (3mA) and to the transformer core loss (15mA). A very small current supplies the secondary circuitry while the Pump is in the OFF/CHARGE mode — 7mA DC to the charger's resistor divider and 60uA DC to the other circuitry. The primary current will total approximately 23mA AC when the battery is connected and accepting about 50mA DC of charge current.

Note: These values are informative when troubleshooting. An elevated current delivered to the circuitry may indicate a failed part. Excess current delivered to the transformer without an increased load signals a transformer coil failure.

3.3.3 BATTERY

The battery (schematic sheet 4 of 10) is a 6 volt, sealed lead acid battery with a 4 ampere-hour (1C) nominal capacity. The battery has an adjusted capacity for the rate of discharge.

The battery is not allowed to fully discharge when operating, which helps insure the reliability of the Pump. Deep-cycling the battery decreases its usable life; the discharged battery indication activates when 30-50% of the capacity still remains.

The battery threshold detection circuitry uses positive feedback to produce a hysteresis for the Low and Discharge levels. The resistive dividers (R15 - R16 and R17 - R18) connect directly to the battery and are high impedance. This reduces the quiescent drain to the battery. The comparators (U3A - B) and voltage reference (V2) connect to the switched 5 volt supply, which shuts them down when the Pump is off.

A current-limiting PTC (R12) is used in series with the battery to limit the available power to less than 15 watts. Section 3.3.2, Battery Charger, discusses this device.

NOTE: During service, the Pump will usually detect a discharged (and low) battery alarm if the battery is reconnected while the control knob is *not* in the OFF/CHARGE position. This is normal for the circuit operation. The comparator and voltage reference power up more quickly than the resistor dividers can charge the capacitors (C9 and C10).

3.3.3.1 BATTERY STATE OF CHARGE DETECTION

The Pump detects the Low and Discharged battery conditions with two comparator circuits that utilize voltage dividers comprised of 1% resistors. With a Pump run time of 6 hours, the circuit is designed to activate a low battery (LO bAt) alarm, which allows at least 30 minutes of operation prior to shutting down the Pump.

When the Pump has been stored for an extended period of time, the battery discharges. When first recharged after storage, the battery voltage rises quickly, as though it already had a significant charge. Then the battery impedance starts to decrease and the battery voltage may fall below the point of the Discharge Battery threshold. This can cause the Pump to shut down. The Pump should be turned off and charged for 24 hours to correct this condition.

3.3.4 POWER SUPPLY

There are two independent 5 volt regulators (U4 and U5) (schematic sheet 5 of 10) connected directly to the battery. Each has a shutdown input, but one (U4) is hardwired to always be on. Only the microcontroller and some associated peripherals are connected to the constant 5 volt supply (VCC). The other regulator (U5, + 5V) powers most of the devices that may be shut down when the Pump is turned off and the microcontroller goes into stop mode.

Each regulator is capable of supplying 150 mA. Power dissipation of either regulator is limited to 0.32 watts with the battery voltage at a maximum 7.1 volts. A 22 microfarad capacitor is placed on each output to ensure regulation at any load current.

3.3.5 MICROCONTROLLER

The microcontroller (uC) (U6, schematic sheet 6 of 10) has 3 bi-directional 8-bit ports with a fourth port that is a combination of bi-directional, input, and output. All memory is internal. The maximum oscillator frequency for the device is 4 megahertz. Most of the I/O is configured as output. Unused pins are configured as inputs and are tied to VCC with pull-up resistors.

The reset signal is supplied by a voltage detector IC (U7) (integrated circuit). When power is first applied to the Pump (installation of the battery), the voltage detector holds the RESET low until the voltage reaches the set threshold. An applied RESET erases all information stored in RAM on the uC. If the uC supply voltage drops below the set threshold, RESET is driven low by a CMOS output.

The output pins are configured according to Table 3-1. Most of the output pins are reconfigured as inputs before disabling POWER_ON by the software. This prevents the microcontroller ports from driving inactive peripheral device inputs. Driving inactive devices wastes power and possibly damages the peripherals. There is one unused I/O signal — PC7 (pin 24). A pull-up resistor is included on this unused signal.

Table 3-1. OUTPUT Pin Configurations

Schematic Information		Microcontroller Reference		uC Operating Mode	
Signal Name	Active State	Pin #	Pin Name	Sleep	Run
POWER_ON	High	26	PC5	OL	OH
ALARM_ENABLE	Low	25	PC6	I	OX
MOTOR_x	High	12..9	PA0..PA3	OL	OX
LED_DIG_x	Low	8..5	PA4..PA7	I	OX
LED_SEG_x	Low	13..17,19..21	PB0..PB7	I	OX

Pin Configuration: I, O: Input, Output; H, L: High, Low; X: Don't Care

All I/O port pins are configured as inputs when the microcontroller goes into reset. There is a pull-down resistor on the POWER_ON signal to prevent it from floating high and becoming active when the uC is held in reset.

Table 3-2 describes the input states while the auxiliary 5 VDC power is disabled or enabled.

Table 3-2. INPUT Pin States

Schematic Reference		Microcontroller Reference		POWER_ON	
Signal Name	Active State	Pin #	Pin Name	Disabled	Enabled
INTERRUPT	Low	2	IRQ	H/L	X
AC_ON	Low	31	PC0	H/L	X
LOW_BATT	Low	30	PC1	H	X
DIS_BATT	Low	29	PC2	H	X
DROP_PULSE	Low	41	TCAP	H	X
IRQ_RTE	Low	28	PC3	H/L	X
KNOB_x	Low	32..34, 37,39, 27	PD0..PD2, PD5,PD7, PC4	H	X
ARROW_x	Low	3,536	PD3,PD4	H/L	X

Pin Configuration: H, L: High, Low; X: Don't Care

The states of two signals — AC_ON, and IRQ_RTE (the interrupt signal) — are required to determine the presence of AC/Mains or the SET RATE state of the Pump. The Pump must exit the stop mode when either AC/Mains is lost or when the SET RATE state is entered. The IRQ signal is the only external I/O that wakes the microcontroller without the loss of data. The AC_IRQ and SET RATE state signals are therefore tied together.

3.3.6 DROP SENSOR

The sensor (schematic sheet 7 of 10) responds to changes in radiant energy at the detector. The emitter focuses a beam of infrared at the detector. The detector also focuses on emissions. The focused beam increases the circuit's resistance to ambient light. Drops, splash, etc., block light onto the detector, which causes the detector to sense multiple edges on the drops. The change in detector output from changes in light is low pass filtered by C19 and R37 and integrated by C20. If the change is sufficient, set by R38, the voltage at the inverting input of the comparator (U8A) rises higher than the non-inverting input; thus the output of the comparator is low. The voltage at the inverting input decays through R37 and the comparator's output returns to the high state. The inverting input voltage may also be forced low through C19 if the detector's output quickly drops to a lower voltage.

The resistor/diode pair of R36 and D10 forms a voltage reference for the non-inverting input of the comparator.

Lowering R38 increases the sensitivity to smaller changes in emissions as seen by the detector. With the inverting input at about 440 mV and R38 at 100 kohm, the sensor responds to 38 mV changes at the output of the detector, provided the rate of change is enough to pass through the low pass filter of C19 and R37.

The circuit is biased to maximize the emitter signal at the detector, which maximizes the signal-to-noise ratio. The detector output is biased (N37) at a midpoint voltage to allow for factors such as ambient light and aging of the emitter.

3.3.7 OPERATOR'S CONTROLS

A single Neodymium (Nd) magnet in the control knob (schematic sheet 8 of 10) is sensed by the reed-switch (S3) or one of the six Hall-Effect sensors (U9 -U11, U18 - U20) on the printed wire board. The reed switch provides the wake-up interrupt to the microcontroller as well as a signal to identify the SET RATE position of the control knob. Power to the reed- switch pull-up resistor is constant whereas power to the Hall-Effect sensors is switched off when the Pump is turned off.

The arrow controls, UP and DOWN, operate two mechanical key-switches on the printed wire board. The states of the switches are read directly by the microcontroller and power is constantly applied to the switches' pull-up resistors.

3.3.8 MOTOR

The gearmotor (schematic sheet 9 of 10) is a 15 degree per step DC stepper motor with a 20:1 gear reduction. The gearmotor yields 960 steps per revolution of the output shaft and is rated at 3.5 watts by the manufacturer.

The motor has two center-tapped coils of 35 ohms each. The four motor phases are assigned to the four halves of the two coils. Each of the four phases is driven by an N-channel MOSFET (Q6 and Q7). The MOSFETs have very low on-resistance at low-gate voltages for logic level control directly from the microcontroller. Phase timing and sequence are determined by the software. The energy stored in a coil produces a flyback voltage when a phase is turned off. There is a flyback diode (D13 - D16) for each phase with each of these diodes connected to a Zener diode (D12) to the battery voltage. The Zener diode increases the flyback voltage which shortens the duration of the flyback current pulse. Slightly higher torque is the result from shortening the flyback pulse. The loss of protection by a Zener diode will place the full stress of the flyback energy upon the corresponding MOSFET. The motor circuitry has power supplied directly from the battery.

3.3.9 DISPLAY / ALARM

The Pump display includes two dual-digit LED displays (schematic sheet 10 of 10). Each digit is constructed of seven hi-efficiency red, common-cathode segments. The four digits are multiplexed at 25% duty cycle; the software enables only one digit at a time at a frequency high enough to eliminate flickering. The high-side segment drivers are powered by the constant 5-volt supply while the low side drivers are powered by the switched auxiliary supply. There is relatively no current drain through the display when the low-side digit drivers are powered off.

The buzzer is driven by the same IC used for the low side of the display. The buzzer is powered from the switched 5-volt supply.

Note: The digits are oriented with the decimal point segments (unused) on the top side.

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SECTION 4 PREVENTIVE MAINTENANCE PROCEDURES AND SERVICE TESTS

This section contains preventive maintenance information, a performance verification test procedure, and battery maintenance information for the Flexiflo® Patrol™ Enteral Pump.

4.1 PREVENTIVE MAINTENANCE

A preventive maintenance program promotes longevity and trouble-free operation of the Flexiflo® Patrol™ Enteral Pump. The preventive maintenance program should include periodic inspection of the unit, cleaning and sanitizing of the exterior, fully charging the battery, and checking for proper Pump operation by the administration of performance tests (see Section 4.2, Performance Verification Test).

A minimum requirement is to clean the Pump after each use. Establish a regular cleaning schedule during use. In addition, clean the Pump and complete the performance verification test described in Section 4.2, as a part of any scheduled service procedure or after any repair procedure.

4.1.1 INSPECTING THE EXTERIOR

The Pump should be visually inspected periodically for signs of defects, such as worn accessories, broken components, or damaged power cord. This visual inspection should be done during any normal cleaning procedures or after any repair. Replace any damaged or defective external parts.

Inspect the following subassemblies for missing or damaged parts and for cosmetic defects:

- Labels
- AC/Mains cord
- Velcro power cord retainer strap (110VAC version only)
- Rotor and rollers
- Front panel overlay
- All keypad switches
- Rotary control knob
- Pole clamp knob, screw, and insert
- Housing
- All external screws

4.1.2 CLEANING AND SANITIZING THE PUMP

CAUTIONS:

While cleaning, the Pump should be turned off and unplugged.

Do not submerge, autoclave, heat, steam, ETO or radiation-sterilize the Pump.

100% concentration of isopropyl alcohol may scar the housing and rotor.

Use only a non-chlorine-based dishwashing detergent.

Note: These recommendations are not substitutes for official procedures that may differ between institutions.

For trouble-free operation, check the Pump daily and clean immediately after spills occur. Use the following procedures:

- Outside surfaces — Clean all outside surfaces with a soft cloth and warm water mixed with non-chlorine-based dishwashing detergent.

- General cleaning — Use dishwashing detergent (non-chlorine-based) or 50% concentration isopropyl alcohol. A cotton swab may be used to reach into the sight chamber assembly slot and into the groove for the blue connector and tubing.

- General disinfecting — Use 50% concentration isopropyl alcohol. A cotton swab may be used to reach into the sight chamber assembly slot and into the groove for the blue connector and tubing.

- Disinfecting after exposure to AIDS or hepatitis — Use 10% concentration of 5.25% sodium hypochlorite (household bleach). This solution may discolor the pole clamp, the rotor, and the housing. A cotton swab may be used to reach into the sight chamber assembly slot and into the groove for the blue connector and tubing.

- Disinfecting after exposure to tuberculosis — After exposure to tuberculosis, use 70% concentration isopropyl alcohol. A cotton swab may be used to reach into the sight chamber assembly slot and into the groove for the blue connector and tubing.

4.1.3 FULLY CHARGING THE BATTERY

CAUTION: Never charge the Pump while it is upside down.
Note: Connect the Pump into AC/Mains whenever possible to extend the battery life.

Proper charging and storage insures that the Pump will continue to provide dependable battery backup operation. The system used in this Pump is designed to always maintain a charge on the battery. The sealed-lead acid battery should never be completely discharged; the microcontroller is designed to shut the Pump off if the battery is discharged too much.

Note: The Pump may be connected to AC/Mains for indefinite periods of time without damage to the battery.

The Pump should be fully charged prior to resumed use following prolonged periods of storage (greater than one month) whether the Pump is to be operated from battery or AC. To fully charge the battery, leave the Pump off and connect to AC/Mains for at least 24 hours.

4.2 PERFORMANCE VERIFICATION TESTS

This subsection explains each performance verification test. Call the Abbott Service Center for further instructions if the Pump fails a performance verification test.

4.2.1 POWER-ON TEST

1. Turn the control knob from the OFF/CHARGE position to the SET RATE position to turn power on.

2. A self-test sequence executes. All segments of the four LED digits light twice ("8888"), accompanied by two long beeps of the buzzer.

3. After the self-test is completed, the LED display reads "0000" if the pump has been disconnected from AC. If the pump has not been disconnected from AC, it reads whatever the previous SET RATE value was before turning the control knob to OFF/CHARGE.

4.2.2 LED DISPLAY VISUAL CHECK

1. Turn the control knob to SET RATE and verify the display is clearly readable at eye level from approximately 6 feet.

2. Set the rate to 1 mL/hr and turn the Pump to RUN.

3. Verify the scrolling horizontal bar, indicating RUN, on the left side of the display is clearly readable at eye level from approximately 6 feet.

4.2.3 KEY SWITCH CHECK

1. Return the control knob to the SET RATE position.

2. Press the up arrow key five times and verify that the Set Rate increments by 1 mL/hr per key stroke.

3. Press the down arrow key five times and verify that the Set Rate decrements by 1 mL/hr per key stroke.

4. Press and hold the up arrow key and verify that the Set Rate increments at three speeds (slow for the first 10 mL/hr, faster for the next 90 mL/hr, and fastest after a 100 mL/hr increment). The Set Rate stops scrolling when it reaches "300."

5. Press and hold the down arrow key and verify the Set Rate decreases in the same manner. The Set Rate stops scrolling when it reaches "0000".

4.2.4 BATTERY INDICATION CHECK

The display indicates battery-powered operation by periodically flashing only the Set Rate while continuously showing just the horizontal scrolling bar. The display continuously shows the Set Rate and the scrolling bar when the Pump is powered by AC. For the 220 VAC version the green mains indicator illuminates when the pump is connected to mains.

Use the following steps to check the battery indication:

1. With the Pump connected to AC/Mains and rate set to 1 mL/hr, turn the control knob to RUN.

2. Observe the Set Rate of 1 mL/hr is displayed continuously, on the 220 VAC version observe that the mains LED is illuminated on the front panel.

3. Disconnect the Pump from AC/Mains and observe the Set Rate of 1 mL/hr is displayed only 3 times per minute for just 10 seconds each time (the display will cycle on for 10 seconds, then off for 10 seconds). The scrolling horizontal bar on the left side of the display indicates RUN whether or not the Pump is connected to AC. On the 220 VAC version the mains indicator is not illuminated.

4.2.5 DISTAL OCCLUSION TEST

1. Load a primed disposable pump set, turn the control knob to SET RATE, and set the rate to 300 mL/hr.

2. Turn the control knob to RUN to start pumping fluid.

3. Once drops are observed through the sight chamber, occlude the tubing distal to the rotor.

4. After drops stop falling through the sight chamber, verify that a "no FLO" alarm occurs within 2.5 minutes.

4.2.6 PROXIMAL OCCLUSION TEST

1. Load a primed pump set, turn the control knob to SET RATE, and set the rate to 300 mL/hr.

2. Turn the control knob to RUN to start pumping fluid.

3. Once drops can be observed through the sight chamber, occlude the tubing proximal to the sight chamber.

4. After drops stop falling through the sight chamber, verify that a "no FLO" alarm occurs within 2.5 minutes.

4.2.7 EMPTY CONTAINER TEST

1. Load a disposable pump set with no fluid and turn the control knob to SET RATE.

2. Set rate to 300 mL/hr and turn the control knob to RUN.

3. Verify that a "no FLO" alarm occurs within 60 seconds.

4.2.8 MAINTENANCE MODE — VERIFY SOFTWARE VERSION AND PUMP RUN TIME

1. With Pump off, depress and hold the down arrow.

2. Turn the Pump to SET RATE.

3. After self-test, the Pump shows the software version.

4. Depress the down arrow to show run time in tens of hours.

5. Depress the down arrow to show current battery status (not low battery, low battery, or discharged battery).

6. Depress the down arrow to show the last major alarm (no error, E1-E7 or discharged battery).

7. Depress the down arrow to show software version number again and repeat the sequence, if desired.

8. Turn Pump off.

4.2.9 DELIVERY ACCURACY TEST

Fluid head height and viscosity are two variables that can affect flow rate. Use the recommended products and suspend the container as instructed below in order to assure meaningful results.

Items needed:

- A graduated cylinder for volume measurement — not an enteral container
- Ensure® Complete, Balanced Nutrition™, Osmolite® Isotonic Liquid Nutrition, or tap water.

1. Fill the feeding container only, using Ensure, Osmolite or tap water.
2. Set up the Pump according to instructions (refer to Section 3.1.1).
3. Suspend the container so the top level of the fluid is about 20 inches above the center of the rotor.
4. Program a flow rate of 125 ml/hr and a dose of 20 ml.
5. Verify that the disposable pump set is completely primed. With the Pump connected to AC/Mains, start the Pump and let it run.
6. Run product into a graduated cylinder until the "doSE FED" alarm sounds. Ensure that, 18ml to 22ml, has been delivered into the graduated cylinder.
7. If the amount delivered is incorrect carry out troubleshooting, and repair the device.

Note: The Pump duty cycles on and off at a rate less than 184 ml/hr, therefore for this test the rotor will duty On / Off.

4.2.10 BATTERY CHARGER TEST (OPTIONAL)

There is no quick test to check the operation of the battery charger. The following test will take at least 60 hours to complete. The following test should be carried out if there is any doubt over the battery capacity.

Charge battery for 24 hours. Time the operation of the Pump in battery mode at 300 mL/hr until the "LO bAt" alarm. Charge again for 24 hours. Time the battery operation again at 300 mL/hr until the "LO bAt" alarm. The second battery operation time should be no less than 90% of the first.

4.2.11 ELECTRICAL SAFETY TEST

To perform the Electrical Safety Test, proceed as follows:

1. Check the leakage current per approved local standards, pertaining to patient-care equipment. Leakage current must not exceed 100 microamperes (AC RMS).

2. Check the grounding impedance per approved local standards using the Pole Clamp Bracket on the rear of the Pump. See the following test values.

Table 4-2 Grounding Impedance

PUMP VERSION	GROUND IMPEDANCE	TEST CURRENT	STANDARD
110 - 120V	0.2Ω	30 Amps	UL544
220 - 240V	0.1Ω	10 - 25 Amps	IEC 601-1

SECTION 5 TROUBLESHOOTING

This section contains information concerning how to obtain technical assistance from the Abbott Service Center, audible alarm messages, malfunction code history, and how to troubleshoot problems with the Flexiflo® Patrol™ Enteral Pump.

5.1 TECHNICAL ASSISTANCE

Contact Abbott Service Center for technical assistance and to order parts, accessories, or manuals. Do not return a Pump without first obtaining authorization from Abbott Service Center.

5.2 AUDIBLE ALARMS

Alarms signify a condition that requires immediate attention by the operator. Alarms consist of a pulsed audible tone and a flashing display message. The following conditions cause alarms:

- Empty container (no FLO alarm)
- Occlusion (no FLO alarm)
- Low battery (LO bAt alarm)
- Discharged battery (LO bAt alarm with continuous audible tone)
- Dose delivery completed (doSE FEd alarm)
- Turn to RUN (SEL run alarm)
- RUN mode with Set Rate at zero (SEL rAtE alarm)
- RAM memory test failed (E1 alarm)
- ROM memory test failed (E2 alarm)
- Knob failed (E5 alarm)
- Hardware stack overflow (E6 alarm)
- C stack overflow (E7 alarm)
- Gross overdelivery (FrEE FLO alarm)

5.3 TROUBLESHOOTING

Table 5-1. Troubleshooting the Pump

Problem/Symptom	Visual Display	Corrective Action
Flow has stopped due to occlusion or empty container	no FLO	▪ Turn to HOLD ▪ Clear obstruction and check for kinked tubing or empty container ▪ Refill container, if necessary ▪ Turn dial to RUN to start pump

Table 5-1. Troubleshooting the Pump

Problem/Symptom	Visual Display	Corrective Action
Dose complete — Volume Fed is equal to the Set Dose	doSE FEd	▪ Turn dial to HOLD ▪ Turn dial to SET DOSE and a) Depress up arrow to increase dose; or b) Depress down arrow to zero the dose setting; or c) Turn dial to CLEAR VOL (after 4 beeps, the volume is cleared) ▪ Turn dial to RUN to start the pump
Dial turned to RUN without selecting a rate	SEL rAtE	▪ Turn dial to SET RATE ▪ Enter a rate using the up or down arrow
Hold time-out	SEL run	Turn dial to RUN
Microprocessor electronics error	E1 or E2	Remove pump from patient immediately, contact Abbott.
Control Knob circuit failed — invalid detection	E5	Remove pump from patient immediately, contact Abbott.
Hardware or C stack overflow	E6 or E7	Remove pump from patient immediately, contact Abbott.
Approximately 30 minutes of battery operation remain Note: After 30 minutes, the Pump sounds an alarm continuously for one minute and then the Pump shuts down.	LO bAt	▪ Turn dial to HOLD then RUN ▪ Connect power cord into AC outlet for 12 hours, while continuing feeding.
Hold countdown	H5	▪ Turn dial to HOLD ▪ If desired, program the Hold timer for 1-90 minutes by depressing the up or down arrow
Display test	8888	All segments should be illuminated.

Table 5-1. Troubleshooting the Pump

Problem/Symptom	Visual Display	Corrective Action
Free-flow alarm	FrEE FLO	▪ Remove from service immediately. ▪ Verify pump set is properly installed. Replace set if necessary. ▪ Confirm no drops fall when in HOLD. ▪ Check accuracy per Section 4.2.9.
Lock-out disables SET RATE, SET DOSE and CLEAR VOL dial settings	LOC	▪ Turn dial to SET RATE. ▪ Depress up and down arrows simultaneously to activate. ▪ Repeat steps above to deactivate.

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SECTION 6 REPLACEABLE PARTS AND REPAIR

This section details replacement procedures.

6.1 REPLACEABLE PARTS LIST

Replaceable parts are itemized in the spare parts price list. To request a copy of the current spare parts price list, contact Abbott Laboratories. For convenient reference, insert a copy of the spare parts price list here.

6.2 REPAIR AND REPLACEMENT PROCEDURES

WARNING

DISCONNECT THE PUMP FROM AC/Mains BEFORE PERFORMING ANY DISASSEMBLY AND REPAIR PROCEDURES.

CAUTION: Use Electrostatic Discharge (ESD) safety and precautionary methods while working with electrostatic-sensitive parts or assemblies.

6.2.1 REQUIRED TOOLS AND MATERIALS

A list of the standard hand tools and materials that are required for the repair and replacement procedures follows. Specific tools and materials that are required for a specific procedure are listed at the beginning of the procedure.

6.2.1.1 STANDARD HAND TOOLS

The following list specifies the standard hand tools that are required for the repair and replacement procedures:

- 1/16 Allen wrench
- Electrician's knife
- Electronics tools
- Needle-nose pliers
- Phillips screwdrivers, various sizes
- Strain-relief bushing installation and removal tool (for 110 volt version only).
- Thin, round-bladed knife
- Tool with a narrow tip, such as a scribe (the tip should be at least ½ inch long)
- Wide head pliers

6.2.1.2 MATERIALS

Materials required for certain procedures are as follows:

- Plastic or aluminum rod, 1-inch diameter and at least 2 inches in length
- Electricians' tape
- Mild solvent

6.2.2 REPAIR PROCEDURES

Most of the following procedures are illustrated. The text for each illustrated procedure may contain numbers between parentheses ( ) that refer to a part. These numbers correspond to circled numbers in the illustration that point to a depiction of the part.

6.2.2.1 SEPARATING FRONT AND REAR ASSEMBLIES

This procedure requires a standard-sized Phillips screwdriver.

To separate the front and rear assemblies, proceed as follows using Figure 6-1 as a reference:

1. Turn control knob to OFF/CHARGE and confirm Pump is disconnected from AC/Mains.

2. With the pump sitting upright, use the Philips screwdriver to remove 4 pan head screws (1) and one pan head screw (2).

3 Slowly separate the front and rear assemblies. Disconnect the battery from the J1 plug (3) on the circuit card assembly. Disconnect the buzzer from the plug (4) on

the circuit card assembly. The position of the buzzer plug may not be the same on all versions of the pump.

4. Holding the two halves upright, rotate the front and rear assemblies open, using the side opposite the control knob as the pivot point.

5. Disconnect the AC live (5) and neutral (6) connections from the circuit card assembly.

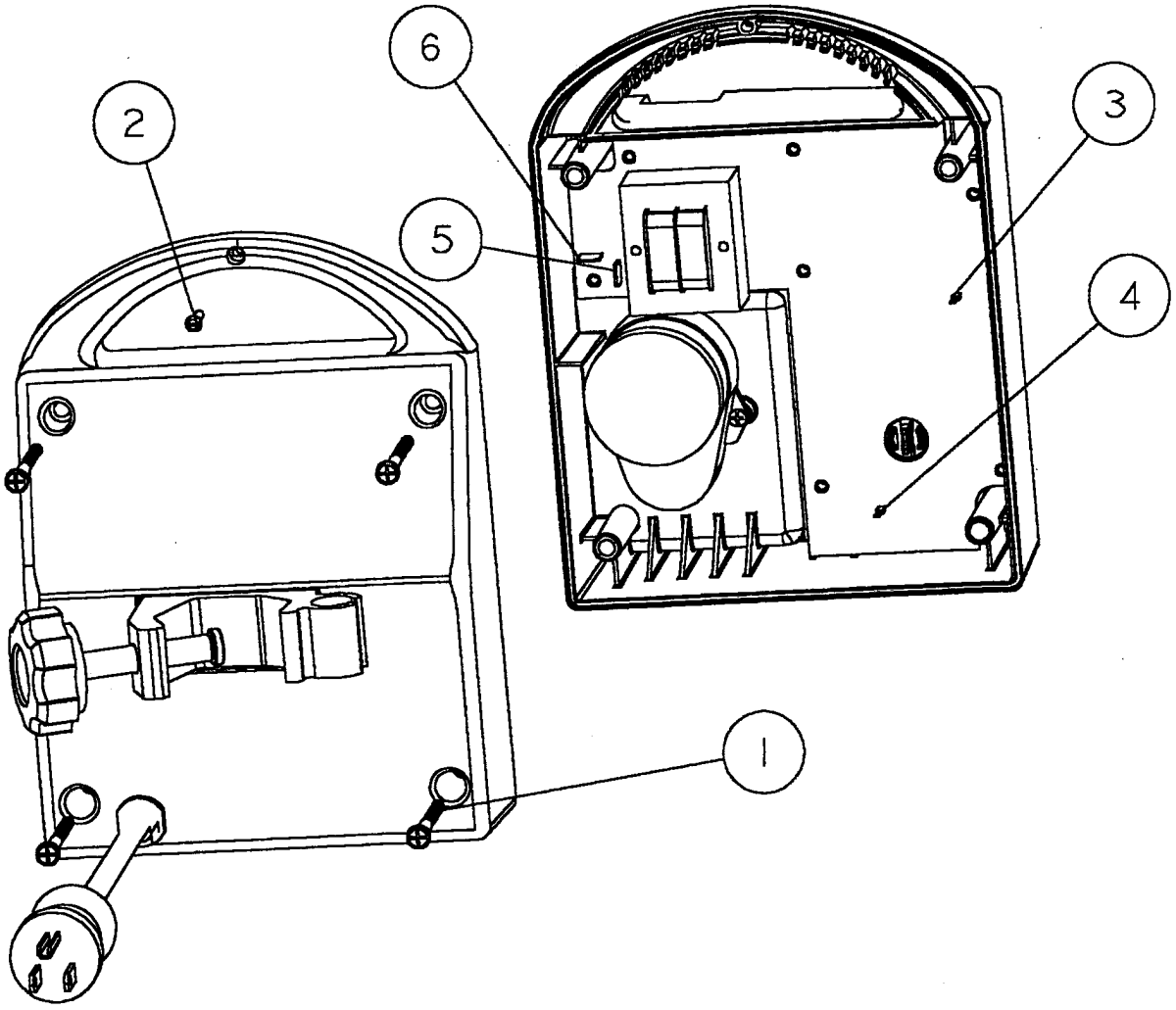

Figure 6-1. Separating Front and Rear Assemblies (115 VAC)

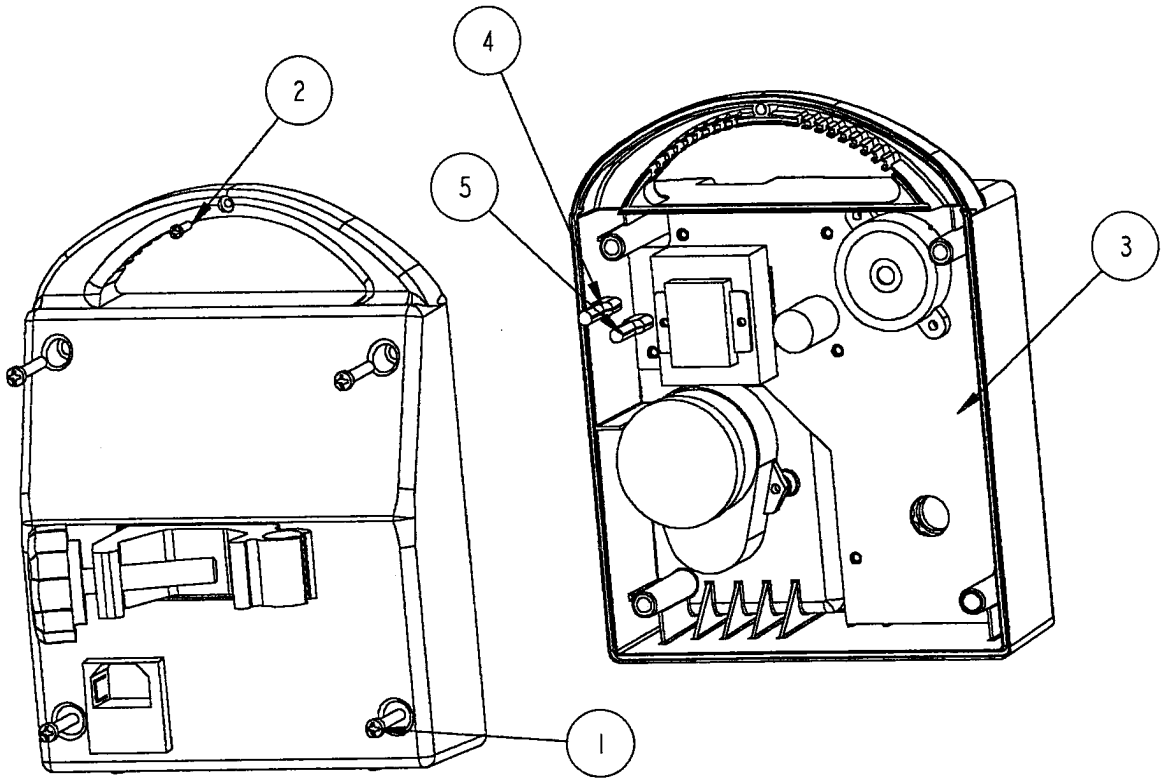

Figure 6-1a. Separating Front and Rear Assemblies (220 VAC)

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6.2.2.2 REATTACHING FRONT AND REAR ASSEMBLIES

This procedure requires a standard-sized Phillips screwdriver.

Note: The circuit card assembly is marked (J3 as BLK and J4 as WHT for 110 volt version of the pump and J3 as BROWN and J4 as BLUE for the 220 volt version of the pump) for the proper connection of the AC/Mains cord.

Note: The buzzer, battery, and motor connectors are keyed for mating in only one direction.

To attach the front and rear assemblies, proceed as follows, using Figure 6-2 as a reference:

1. Connect the AC/Mains cord to the J3 and J4 receptacles (1,2) in the circuit card assembly.

2. Slowly close the front and rear assemblies, reconnecting the buzzer to the receptacles (3) on the circuit card assembly. The position of the buzzer plug may not be the same on all versions of the pump.

3. Reconnect the battery to the J1 receptacles (4) on the circuit card assembly.

Note: The Pump should beep when the battery is connected.

Note: The AC/Mains cord must be captured in the groove between the aligning ribs on the side opposite the control knob.

4. With Pump sitting upright on a flat surface, use the Phillips screwdriver to replace the four large pan head screws (5) and one small pan head screw (6) that fasten the front and rear assemblies together. The heads of these screws face the rear of the Pump.

5. Perform the Performance Verification Test (PVT) as described in Section 4.2.

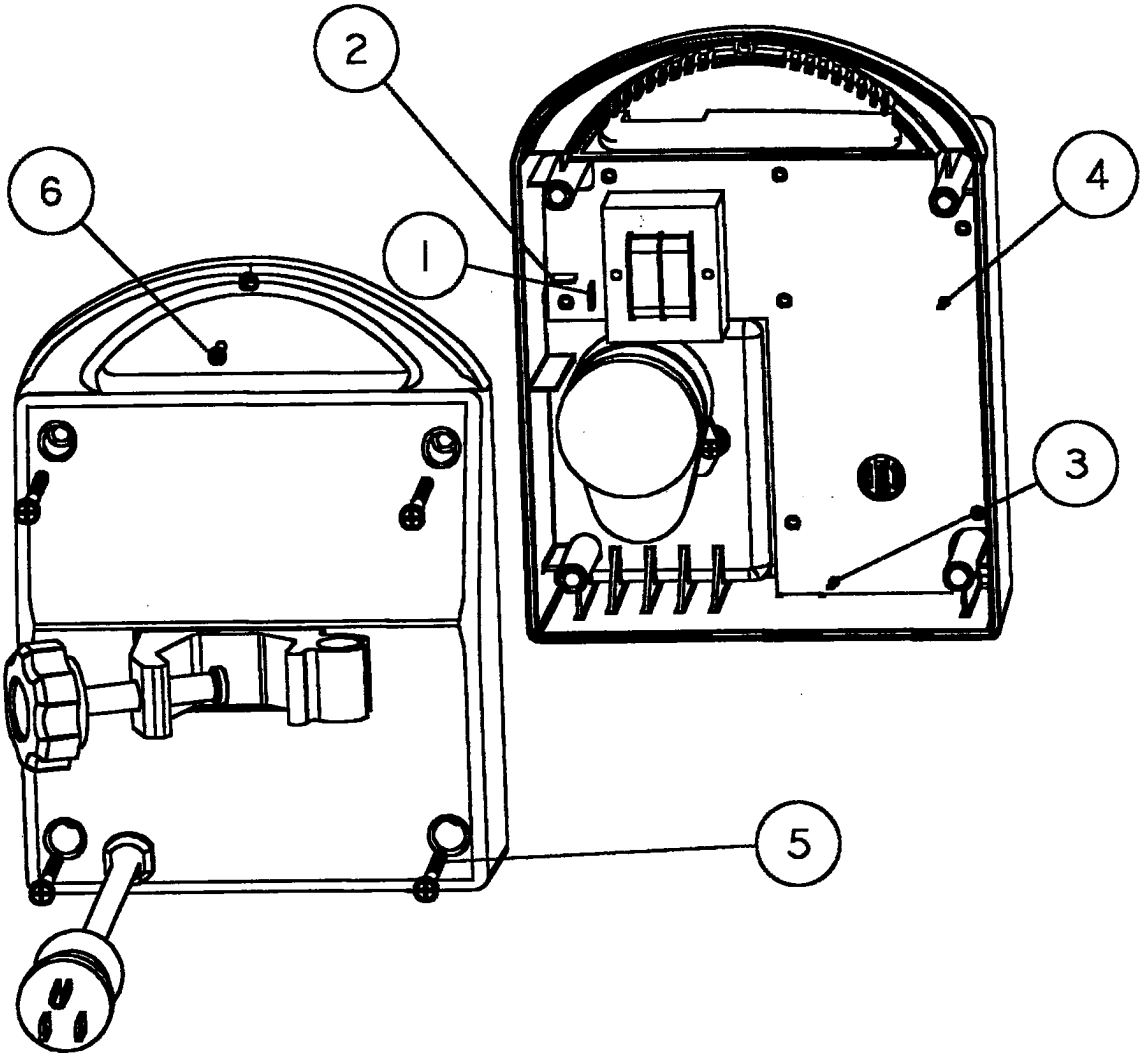

Figure 6-2. Re-attaching Front and Rear Assemblies

6.2.2.3 ROTOR ASSEMBLY REPLACEMENT

This procedure requires a 1/16 inch Allen wrench.

To replace the rotor assembly, proceed as follows, using Figure 6-3 as a reference:

1. Turn the Pump to OFF/CHARGE and confirm the Pump is disconnected from AC/Mains.

2. Manually turn the rotor assembly (1) until the head of the set screw (2) securing the rotor assembly to the motor shaft faces the right side of the Pump.

Note: The Ross logo on the rotor will be upright when the set screw faces the right side of the Pump.

3. Using the Allen wrench, loosen the set screw until the rotor assembly can be pulled off the motor shaft.

4. Pull the rotor assembly off the motor shaft (3).

5. Obtain replacement rotor assembly.

6. Turn the set screw fully home into the centre hole at the rear of the rotor assembly.

7. Apply 1 - 2 drops (maximum) of the Loctite 270 using the dispensing needle onto the threads of the set screw.

8. Retract the set screw outwards sufficiently to allow assembly onto the motor shaft.

9. Slide the rotor assembly onto the motor shaft and tighten set screw using the torque driver set at 5 +/- 1lbs/in.

10. Wait at least ten minutes before operating the pump to allow the Loctite to cure.

11. Complete the local repair record form and indicate TSB has been performed, by marking the TSB number on the TSB label (ref. TSB 52034-004).

12. Perform the Performance Verification Test (PVT) as described in Section 4.2.

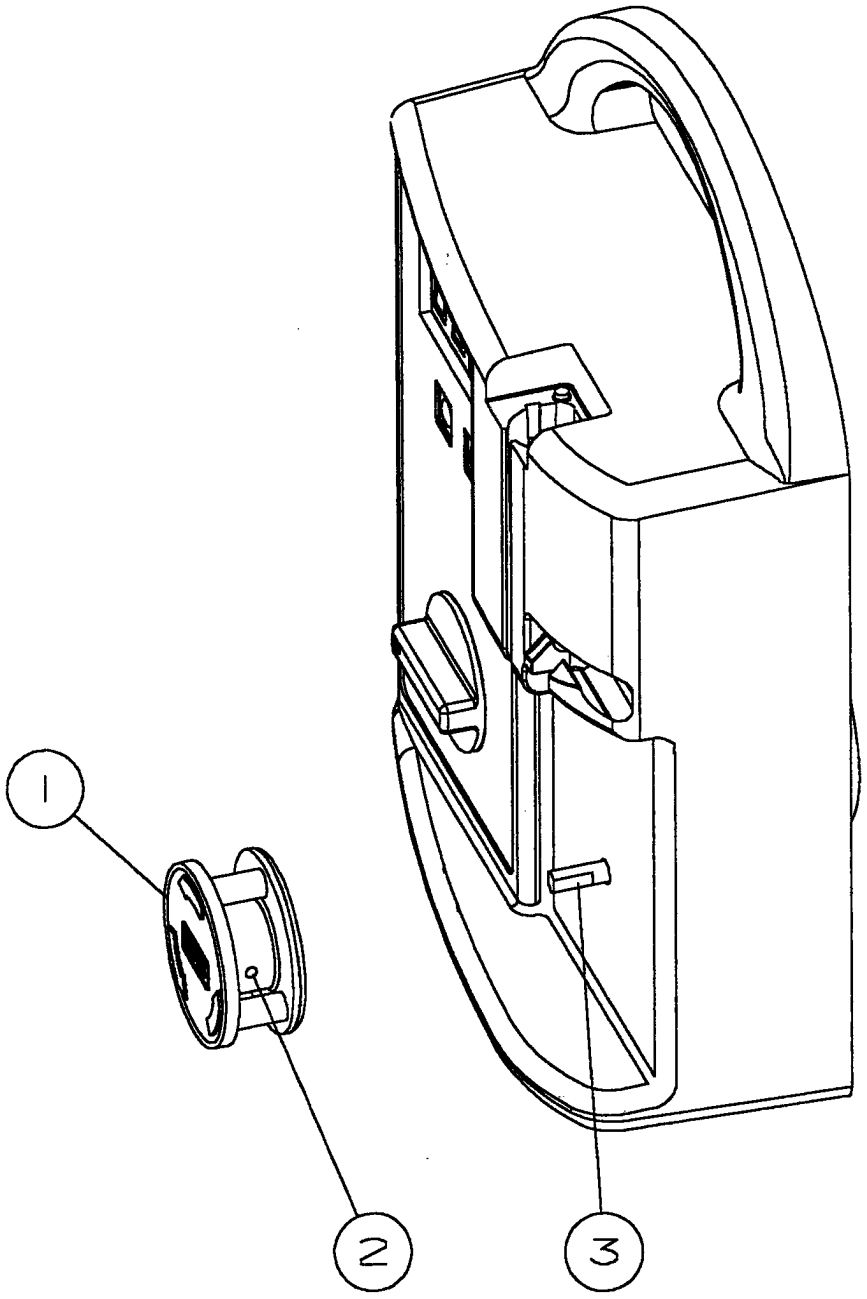

Figure 6-3. Rotor Assembly Replacement

6.2.2.4 POLE CLAMP KNOB/SCREW ASSEMBLY AND TIP INSERT REPLACEMENT

This procedure requires a solid 1-inch diameter plastic or aluminum rod.

The pole clamp assembly consists of three items: the pole clamp knob/screw assembly, the black tip insert, and the aluminum extrusion. Only the pole clamp knob/screw assembly and tip insert are field serviceable without opening the front and rear assemblies of the Pump. Refer to Section 6.2.2.7.3 for removal and replacement of the pole clamp extrusion.

To remove and replace the pole clamp knob/screw assembly and/or black tip insert, proceed as follows, using Figure 6-4 as a reference:

1. Turn the control knob to OFF/CHARGE and confirm the Pump is disconnected from AC/Mains.

2. Turn the pole clamp knob (1) counterclockwise until the screw (2) is removed from the pole clamp extrusion (3).

Note: The tip insert (4) has a post that is press-fit into a hole in the end of the screw. Because the tip insert diameter is greater than the screw's diameter, the black tip insert will be pushed off the screw as the knob is turned counterclockwise and the screw is backed out through the extrusion.

3. Catch the tip insert when it is dislodged from the screw. Continue to turn the pole clamp knob counterclockwise until the pole clamp knob/screw assembly is free of the extrusion.

Note: If the tip insert is in good condition, it may be reused with a new screw/knob assembly. If defective, the tip insert must be replaced.

4. Reassemble by turning the original or a new (if the original was defective), knob/screw assembly clockwise into the extrusion. Turn the knob until the threaded portion of the screw just goes through the extrusion. Press the tip insert into the hole in the end of the screw.

5. The tip must be forced onto the screw. In order to do this, place a rod in the extrusion cradle (5) opposite the screw. Turn the pole clamp knob/screw assembly (with tip insert) clockwise until the post of the insert is pushed into the hole in the screw and the knob cannot be turned further.

6. Place the Pump on an IV pole and secure the pole clamp assembly to the pole. Confirm that the Pump does not slide on the IV pole.

7. Perform the PVT as described in Section 4.2.

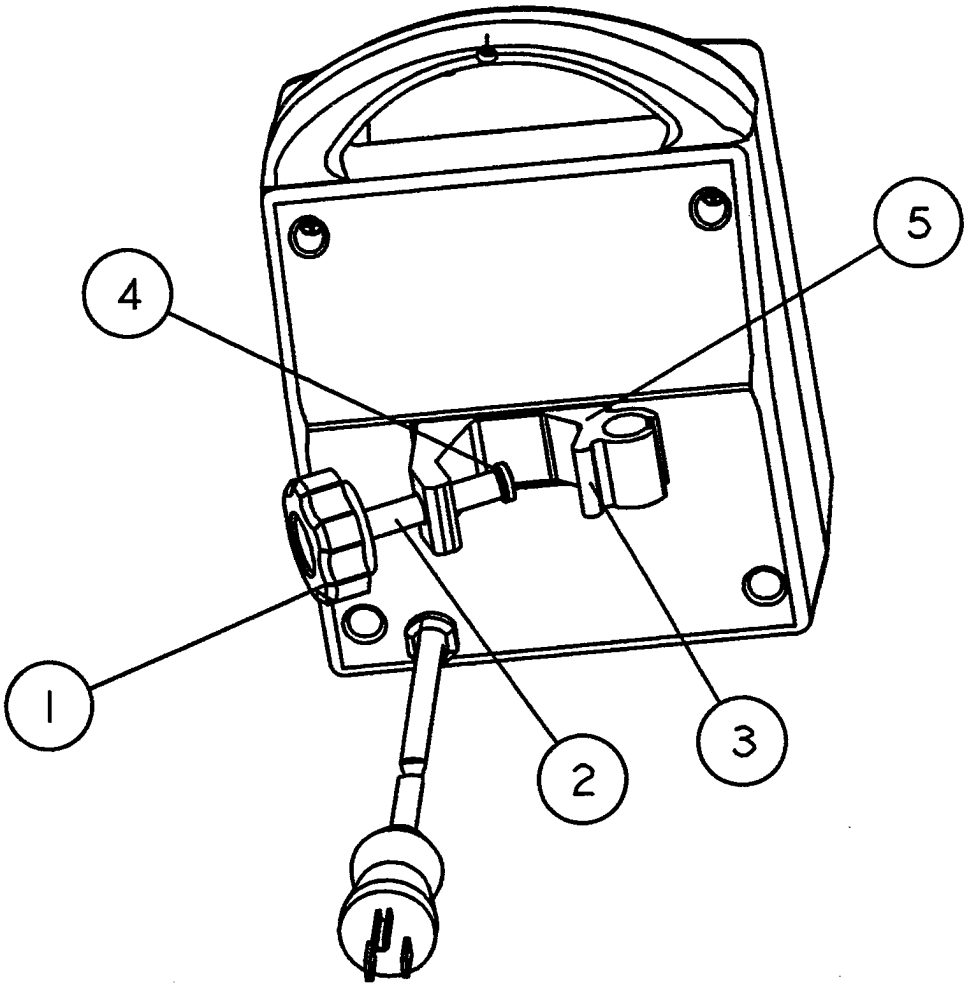

Figure 6-4. Pole Clamp Knob/Screw Assembly and Tip Insert Replacement

6.2.2.5 FRONT OR REAR HOUSING ASSEMBLY REPLACEMENT

This procedure requires a standard-sized Phillips screwdriver, a large Phillips screwdriver (for replacement of the rear housing assembly only), and a 1/16-inch Allen wrench.

To remove and replace the front or rear housing assembly, proceed as follows:

1. Follow the procedure detailed in Section 6.2.2.1 for separating the front and rear assemblies.

2. Remove the subassembly components. Refer to the specific procedure under Section 6.2.2.6 , Front Assembly, or Section 6.2.2.7, Rear Assembly.

3. Replace the damaged front or rear housing assembly with the new housing assembly.

4. Reassemble the subassembly components. Refer to the specific procedure under Section 6.2.2.6, Front Assembly, or Section 6.2.2.7, Rear Assembly.

5. Reattach the front and rear assemblies, as described in Section 6.2.2.2, Reattaching Front and Rear Assemblies.

6.2.2.6 FRONT ASSEMBLY

The front assembly includes the following parts that may be removed and replaced separately:

- Front housing assembly
- Front panel overlay (adhesive backed)
- Circuit Card Assembly
- Keys, molded, switch activated (2)
- Control knob kit: control knob, snap retainer, knob gasket, knob washer
- Detent disk (includes magnet)
- Rotor assembly
- Motor assembly
- Drop-sensor window

6.2.2.6.1 FRONT PANEL OVERLAY REPLACEMENT

This procedure requires a thin, round-bladed knife and a mild solvent.

To remove and replace the front panel overlay, proceed as follows, using Figure 6-5 as a reference:

1. Confirm Pump is disconnected from AC/Mains. Remove the front panel label (1) using a thin, round-bladed knife. Remove excess adhesive residue using a soft cloth dampened with a mild solvent. Dry the label area thoroughly.

Note: Do not damage the front housing during overlay removal and replacement.

2. Center the new, adhesive-backed overlay on the front housing recess. Smooth the overlay so that no air bubbles are present.

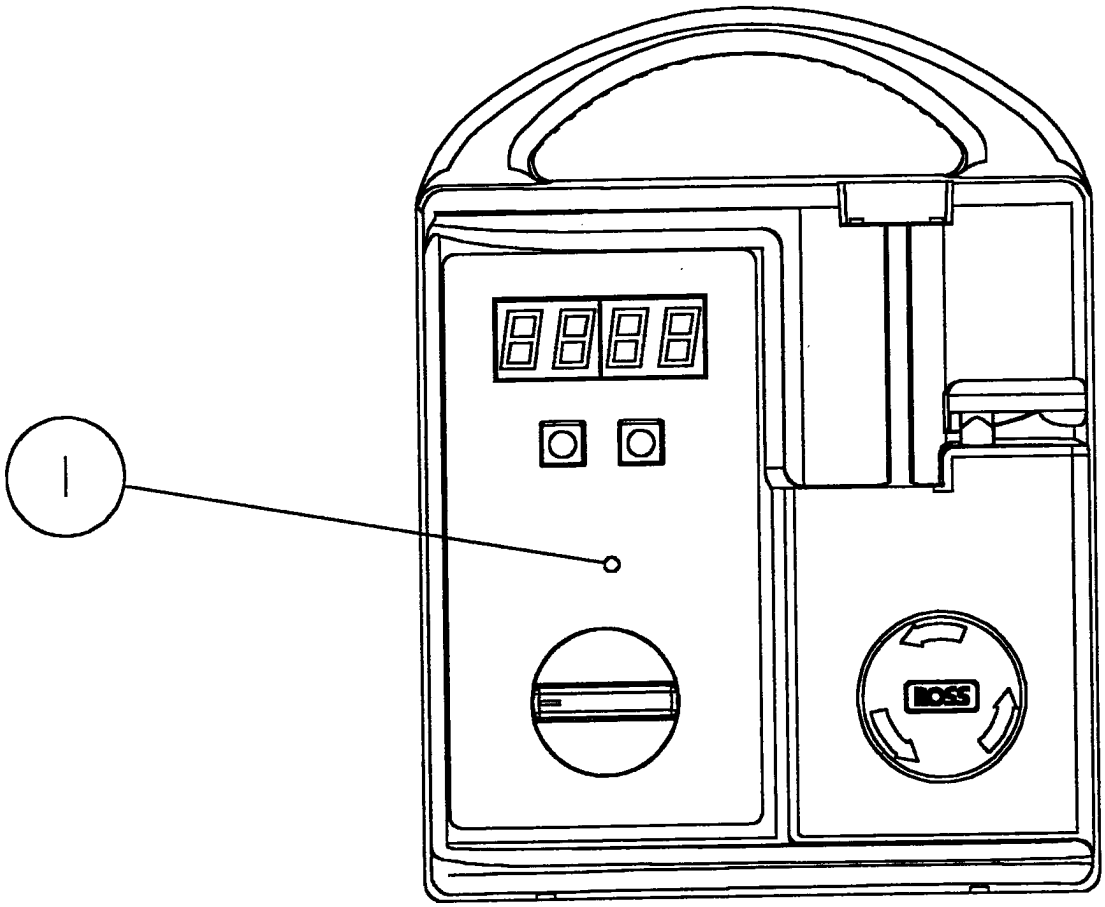

Figure 6-5. Front Panel Overlay Replacement

6.2.2.6.2 CIRCUIT CARD ASSEMBLY REPLACEMENT

This procedure requires a standard-sized Phillips screwdriver.

To remove and replace the Circuit Card Assembly, proceed as follows, using Figure 6-6 as a reference:

1. Follow the procedure detailed in Section 6.2.2.1 for separating the front and rear assemblies.

2. Set the rear assembly aside. Lay the front assembly face down on a soft cloth.

3. Disconnect the motor assembly cable (1) from the J2 receptacle (2) on the circuit card assembly.

4. Remove the seven self-tapping screws (3) that secure the circuit card assembly to the front housing assembly.

5. Remove the defective circuit card assembly.

6. Using the seven self-tapping screws, reassemble the new circuit card assembly and the front housing assembly. The circuit card assembly should seat on the shoulders of the front housing bosses. Tighten the self-tapping screws until snug.

CAUTION: Over-tightening the screws can strip the threads in the bosses.

7. Reconnect the motor assembly and the circuit card assembly.

8. Reassemble the front and rear enclosure assemblies as described in Section 6.2.2.2.

9. Perform the PVT as described in Section 4.2.

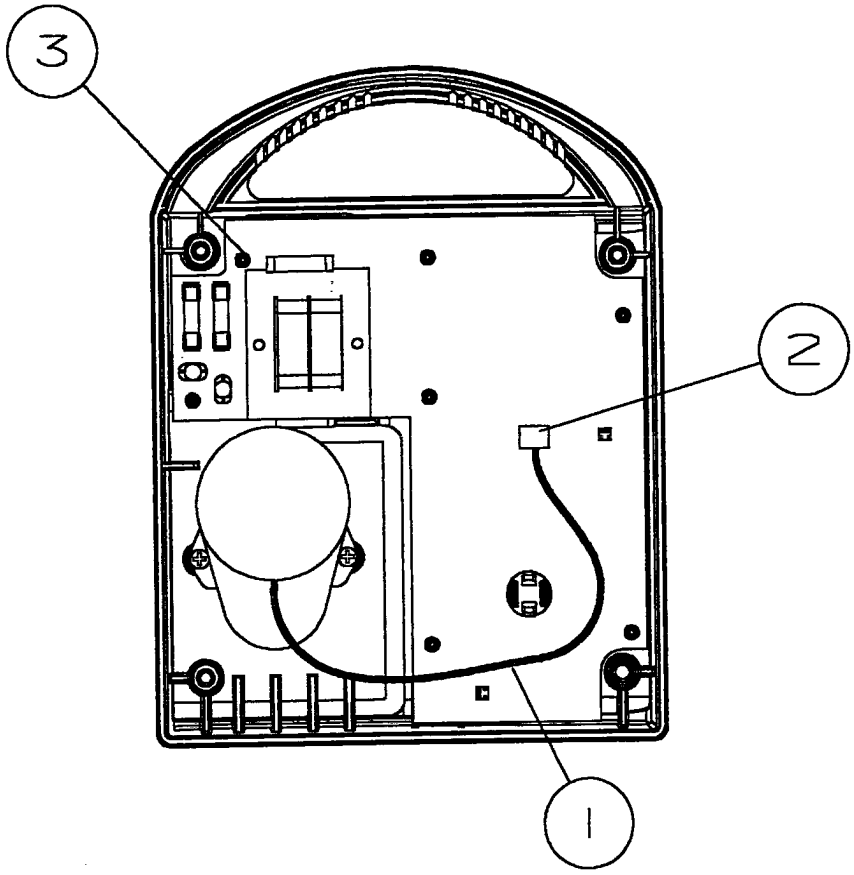

Figure 6-6. Circuit Card Assembly Replacement

6.2.2.6.3 MOLDED KEYS REPLACEMENT

To remove and replace the molded keys, proceed as follows, using Figure 6-7 as a reference:

1. Follow the procedure detailed in Section 6.2.2.1 for separating the front and rear assemblies.
2. Remove the circuit card assembly from the front housing assembly as described in Section 6.2.2.6.2
3. Remove the keys (1). Replace the keys in the two recesses (2) in the front housing.
4. Replace the circuit card assembly as described in Section 6.2.2.6.2
5. Reassemble the front and rear assemblies as described in Section 6.2.2.2.
6. Perform the PVT as described in Section 4.2.

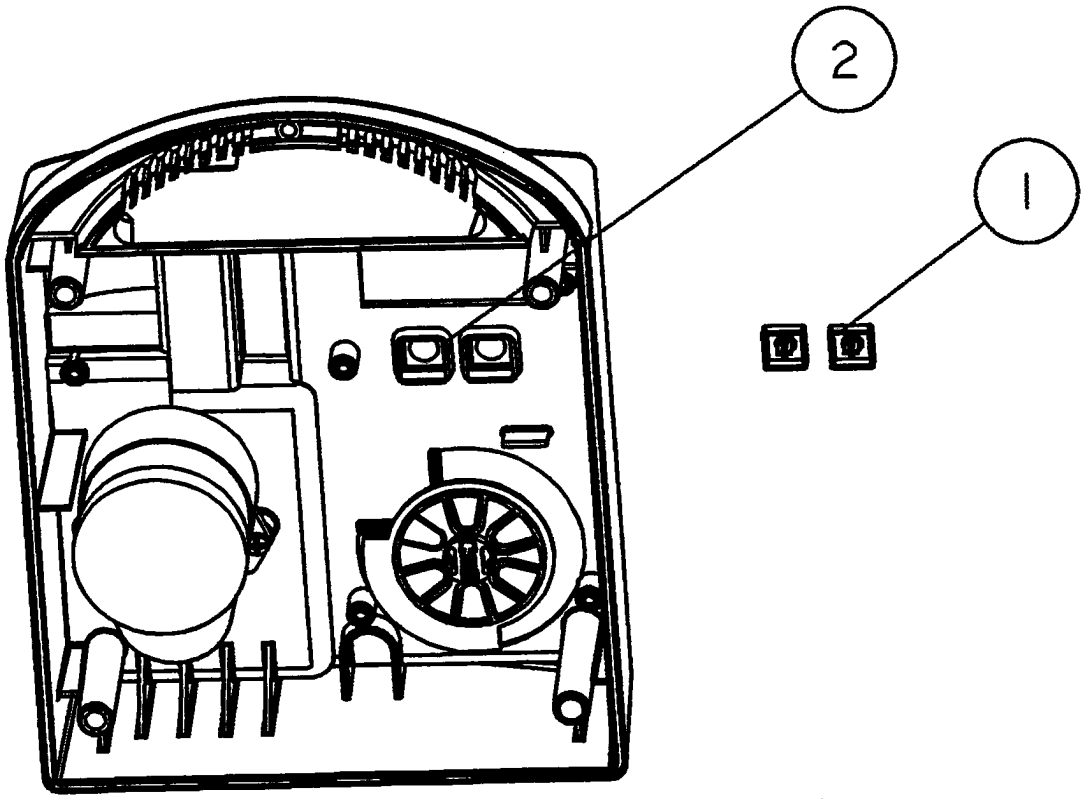

Figure 6-7. Molded Keys Replacement

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6.2.2.6.4 CONTROL KNOB KIT, DETENT DISK, AND MAGNET REPLACEMENT

This procedure requires a standard-sized Phillips screwdriver, wide head pliers, and needle-nose pliers.

Note: The control knob kit consists of control knob, snap retainer (keeper), gasket, and washer. This kit should be replaced as a single unit.

To remove and replace the control knob kit, detent disk, and/or magnet, proceed as follows, using Figure 6-8 as a reference:

1. Follow the procedure detailed in Section 6.2.2.1 for separating the front and rear assemblies.

2. Remove the circuit card assembly following the procedure in Section 6.2.2.6.2.

3. Using a pair of Wide head pliers, grasp the center of the snap retainer (1). Pull the snap retainer out of the control knob (2).

Note: The snap retainer is easily damaged. Use caution during snap retainer removal.

4. Using a pair of needle-nose pliers, move the two angled retainer clips (3) towards each other. The control knob, detent disk and magnet (4), gasket (5), and washer (6) are released from the front housing. Remove all parts.

5. If the magnet is replaced, make certain the new magnet is snapped into the same position on the detent and that the white side of the magnet is facing out from the detent.

6. If replacing the control knob kit, assemble the kit as follows:

   — Install the washer on the control knob.
   — Place the sponge foam gasket on the washer's outer diameter.
   — Place the control knob, washer, and gasket through the hole in the front housing.

7. Turn the control knob to CLEAR VOL.

Note: When the control knob is at CLEAR VOL, the snap retainer and angled retainer clips are vertical.

8. Place the front housing face down on a soft work surface, being careful that the control knob, washer, and gasket remain in place.

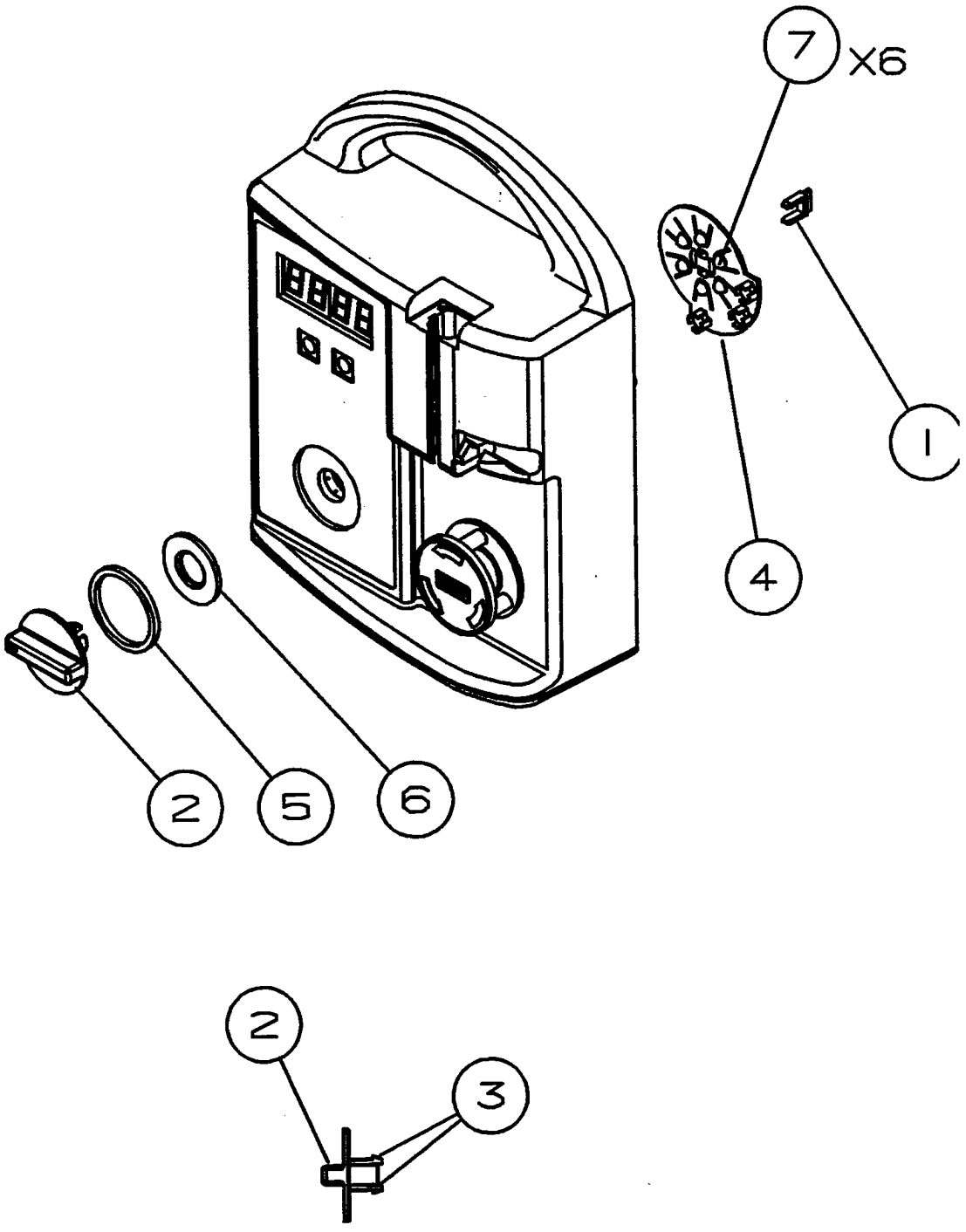


Figure 6-8. Control Knob Kit, Detent Disk, and Magnet Replacement

9. Place the detent disk (with magnet and six hemispherical balls (7) face down) on the angled retainer clips and splines. Confirm the one-quarter extended span of the detent disk is positioned to the top and right of the angled retainer clips. Press the detent disk down; it is secured by the angled retainer clips.

10. Confirm the detent disk is properly positioned. Turn the control knob to OFF/CHARGE. Rotate the control knob clockwise through all positions to CLEAR VOL. Confirm the disk detentes at each position.

11. Install a snap retainer between the angled retainer clips. Press firmly until the snap retainer is secured.

12. Replace the two molded keys if dislodged during this procedure.

13. Reassemble the circuit card assembly following the procedure in Section 6.2.2.6.2.

14. Reassemble the front and rear assemblies as described in Section 6.2.2.2.

15. Perform the PVT, as described in Section 4.2.

6.2.2.6.5 MOTOR ASSEMBLY REPLACEMENT

This procedure requires a standard-sized Phillips screwdriver.

To remove and replace the motor assembly, proceed as follows, using Figure 6-9 as a reference:

1. Follow the procedure detailed in Section 6.2.2.1 for separating the front and rear assemblies.

2. Set the rear assembly aside. Remove the rotor assembly following the procedure in Section 6.2.2.3.

3. Lay the front assembly face down on a soft cloth. Disconnect the motor assembly cable (1) from the J2 plug (2) on the circuit card assembly.

4. Using the Phillips screwdriver, remove the two screws (3) securing the motor assembly to the front housing.

5. Reassemble the new motor assembly and the front housing, firmly tightening the two screws. Connect the motor assembly cable to the J2 plug in the circuit card assembly.

6. Reassemble the rotor assembly and motor following the procedure in Section 6.2.2.3.

7. Reassemble the front and rear assemblies as described in Section 6.2.2.2.

8. Perform the PVT as described in Section 4.2.

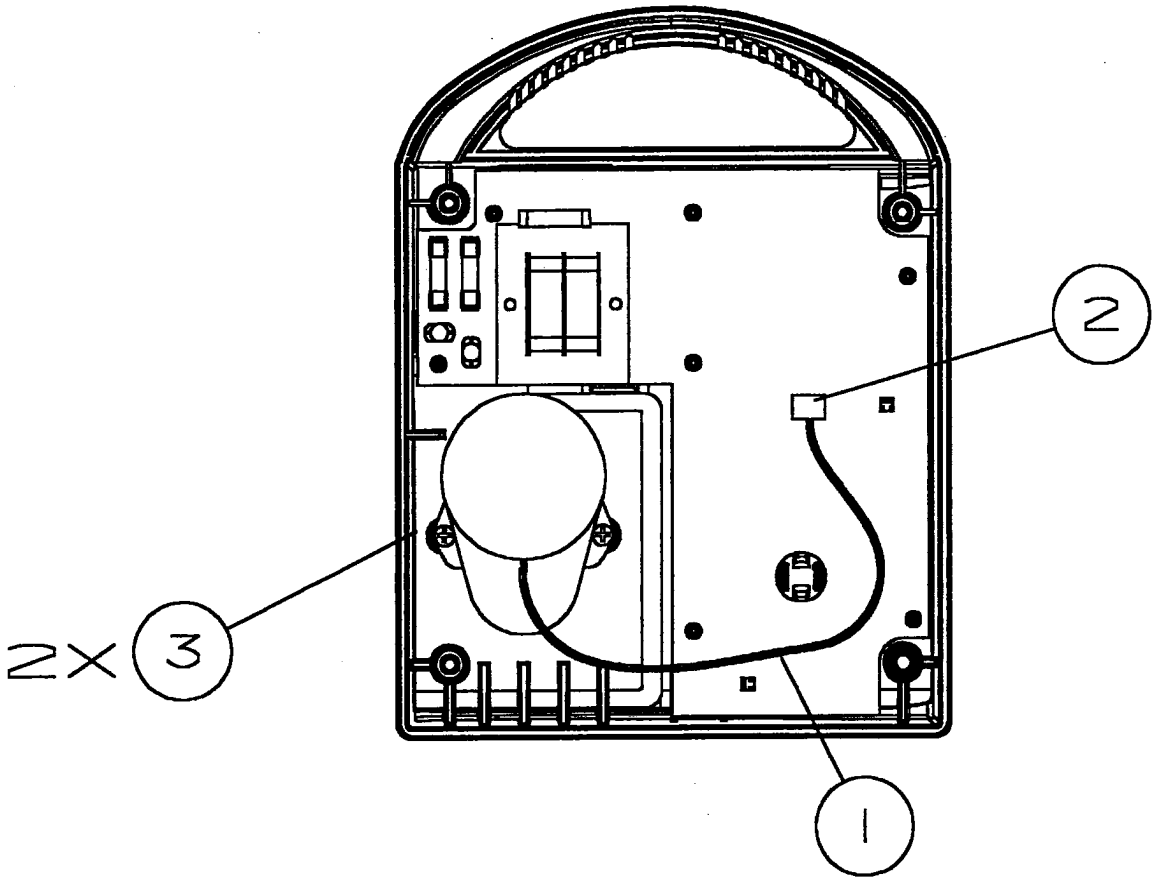


Figure 6-9. Motor Assembly Replacement

6.2.2.6.6 DROP-SENSOR WINDOW REPLACEMENT

This procedure requires a standard-sized Phillips screwdriver and any tool with a narrow tip (the tip should be at least ½ inch long).

To remove and replace the drop-sensor window, proceed as follows, using Figure 6-10 as a reference:

1. Follow the procedure detailed in Section 6.2.2.1 for separating the front and rear assemblies.

2. Remove the circuit card assembly from the front housing assembly as described in Section 6.2.2.6.2

3. Using the scribe or similar tool, push one side of the sensor window (1) from its snapped-in position in the front housing. The scribe should reach into the slot (2) for the sight chamber and push into one of the two holes (3) for the sensor window. The sensor window can then be pushed or dislodged from the front housing.

4. Push a new drop-sensor window into the grooves (4) in the front housing until it snaps into place, straddling the slot for the sight chamber.

5. Replace the two molded keys if dislodged during this procedure.

6. Reassemble the circuit card assembly following the procedure in Section 6.2.2.6.2

7. Reassemble the front and rear assemblies as described in Section 6.2.2.2.

8. Perform the PVT as described in Section 4.2.

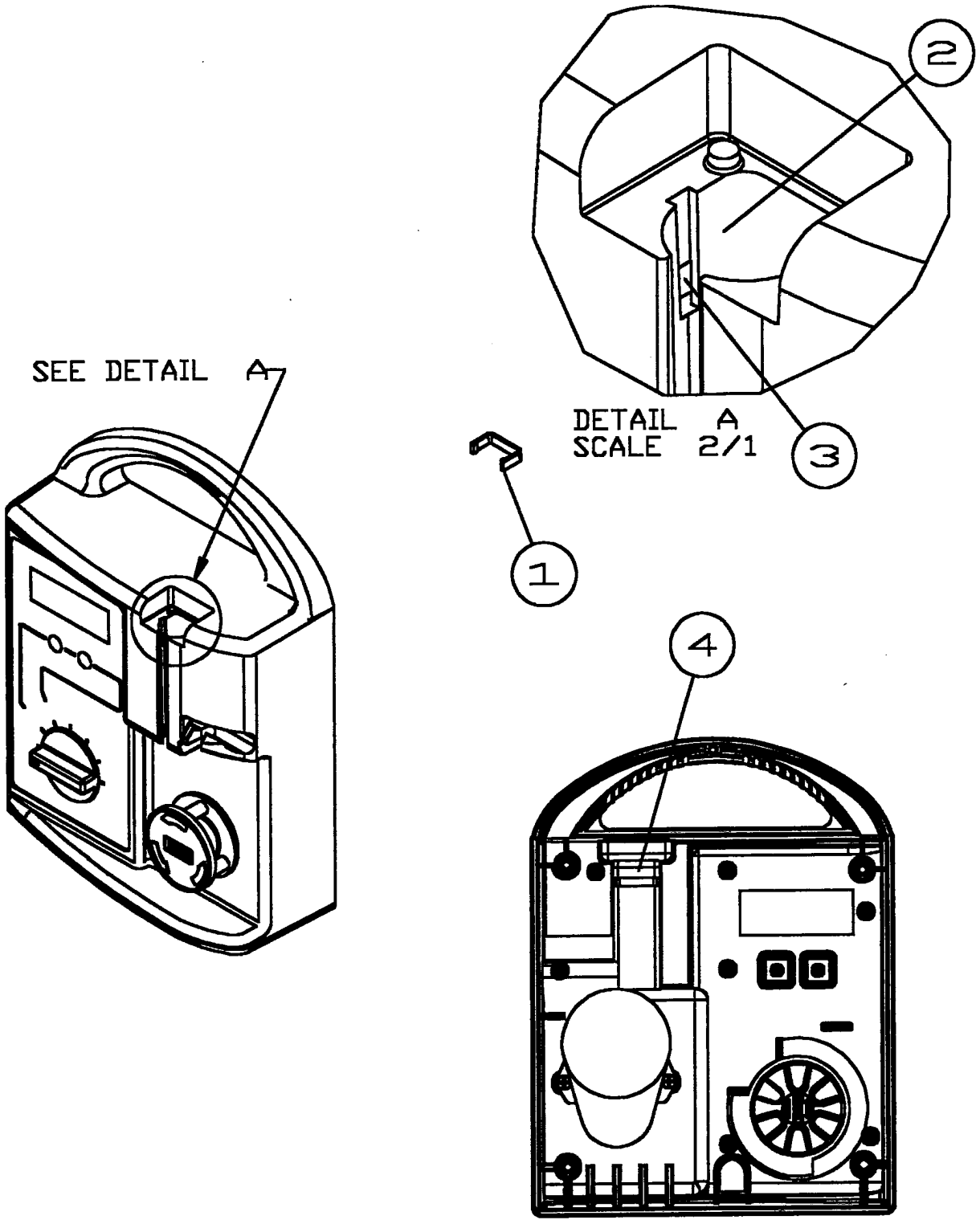


Figure 6-10. Drop Sensor Window Replacement

6.2.2.7 REAR ASSEMBLY

The rear assembly consists of the following components and subassemblies:

- Rear housing assembly
- Battery and battery strap
- AC/Mains cord and strain-relief bushing (110 VAC)
- AC receptacle assembly (220 VAC)
- Pole clamp extrusion
- Buzzer assembly (110 VAC)

Specific disassembly and replacement procedures for these components follow.

6.2.2.7.1 BATTERY AND BATTERY STRAP REPLACEMENT

This procedure requires a standard Phillips screwdriver.

To remove and replace the battery and/or battery strap, proceed as follows, using Figure 6-11 as a reference:

1. Follow the procedure detailed in Section 6.2.2.1 for separating the front and rear assemblies.

2. Set the front assembly aside. Using the Phillips screwdriver, remove the two pan-head screws (1) that fasten the battery strap (2) to the rear housing.

3. If defective, replace the old battery (3) with an Abbott approved battery.

4. If defective, replace the battery strap.

5. With the battery in place, use the two pan-head screws to fasten the battery strap to the rear housing.

6. Reassemble the front and rear assemblies as described in Section 6.2.2.2.

7. Perform the PVT as described in Section 4.2.

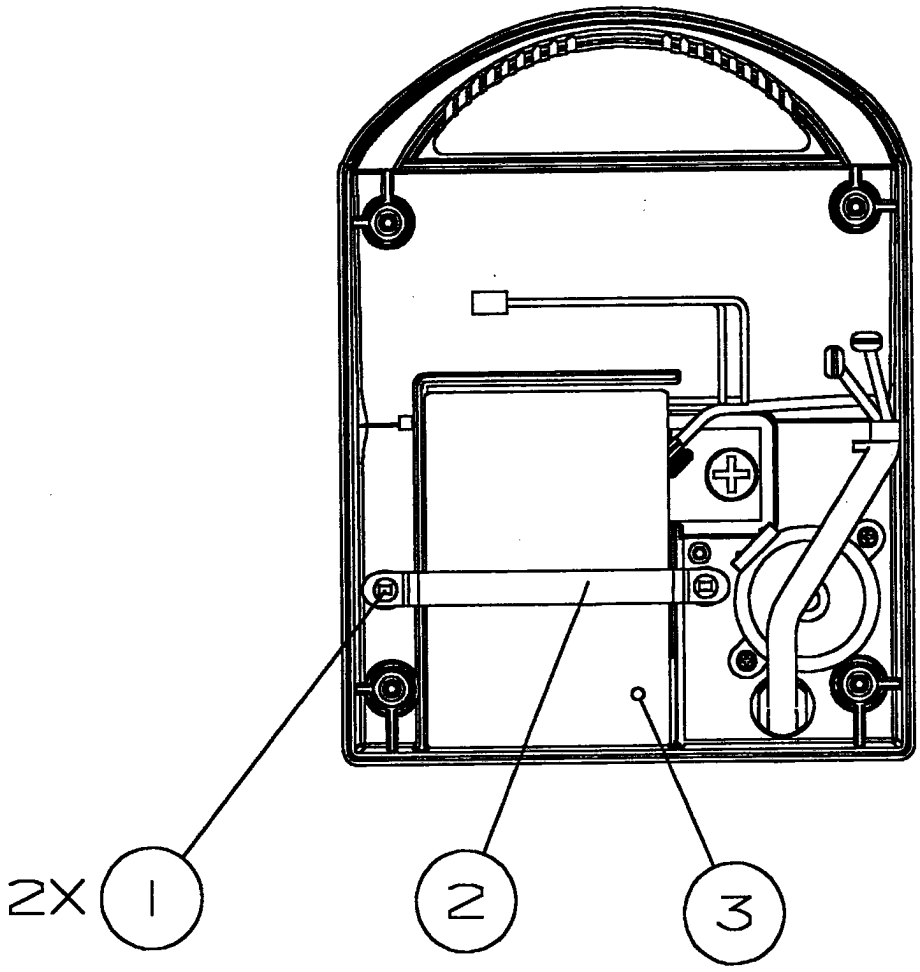


Figure 6-11. Battery and Battery Strap Replacement

6.2.2.7.2 AC/MAINS CORD AND STRAIN-RELIEF BUSHING REPLACEMENT AND AC RECEPTACLE REPLACEMENT

6.2.2.7.2.1 115 VAC DEVICES AC/MAINS CORD

This procedure requires a standard-sized Phillips screwdriver and strain-relief bushing installation and removal tool.
To remove and replace the AC/Mains cord and/or strain relief bushing, proceed as follows, using Figure 6-12 as a reference:

1. Follow the procedure detailed in Section 6.2.2.1 for separating the front and rear assemblies.

2. Remove the battery and battery strap following the procedure described in Section 6.2.2.7.1.

3. Using a Phillips screwdriver, remove the screw (1) connecting the grounding lug (2) of the AC/Mains cord to the pole clamp extrusion. Set the screw aside for reassembly.

4. Using a strain-relief bushing tool, remove and discard the defective bushing (3).

5. Pull the defective AC/Mains cord through the hole in the rear housing.

6. Push the new AC/Mains cord assembly through the hole in the rear housing. Leave about five inches of cord inside the rear housing for grounding and connection to the circuit card assembly.

Note: Measure five inches from the end of the cord's outer jacket to the inside surface of the housing.

7. Assemble the strain-relief bushing around the AC/Mains cord and snap into the rear housing using the bushing tool.

8. Attach the new AC/Mains cord's grounding lug to the pole clamp extrusion.

6.2.2.7.2.2 220 VAC (IEC QUANTIFIED) DEVICES AC/MAINS CORD

No tools are recommended for this procedure.

To replace the AC/Mains power cord, disconnect the power cord from the rear of the infusion system and connect the new power cord.

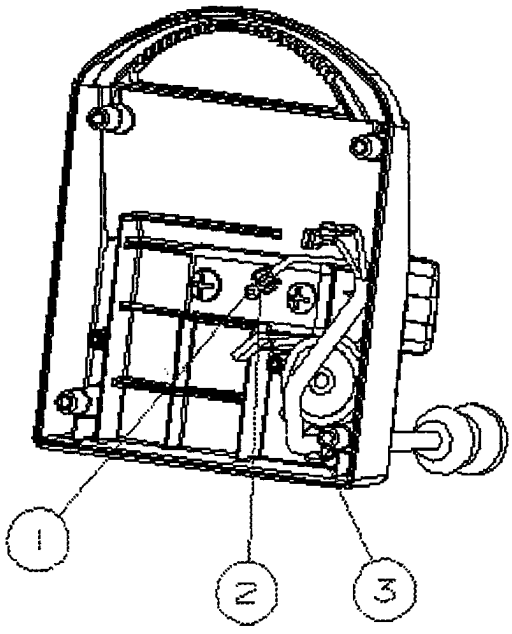
Replacement of the IEC qualified AC/mains power cord is a routine maintenance procedure and no verification procedure is normally required.

6.2.2.7.2.3 AC Receptacle Replacement

1. Follow the procedure detailed in Section 6.2.2.7.2.1 and/or 6.2.2.7.2.2 for removing the AC/Mains cord.
2. Refer to Figure 6-12a and depress AC receptacle retaining lugs (1) to release the AC receptacle and remove from the rear housing assembly.
3. Reassemble in reverse order to install a new AC receptacle.
4. Reassemble the front and rear assemblies as described in Section 6.2.2.2.
5. Perform the PVT as described in Section 4.2.

6.2.2.7.2.4 Fuse Replacement

1. Prise fuse drawer open with a small flathead screwdriver.
2. Pull out drawer as far as possible.
3. Remove the old/blown fuses by prising them from their locations with the screwdriver.
4. Dispose of the old/blown fuses appropriately to avoid inadvertently mixing with replacement fuses.
5. Insert the new fuses into the fuse drawer (ref. TSB 52034-005).
6. Slide the fuse drawer closed.
7. Connect the device to a mains outlet supply. Check mains LED is lit on the front panel.



0**Figure 6-12. AC/Mains Cord and Strain Bushing Replacement**

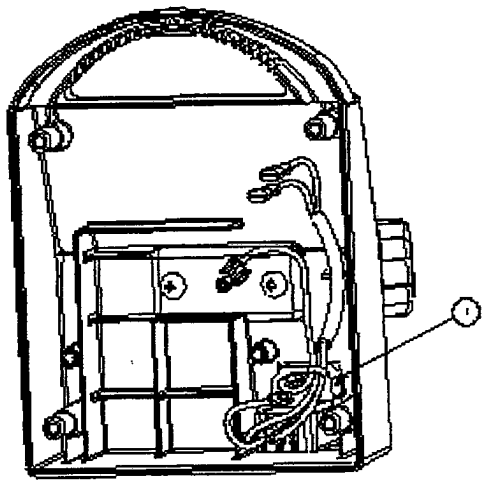


Figure 6.12a. AC Receptacle Assembly Replacement

6.2.2.7.3 POLE CLAMP EXTRUSION REPLACEMENT

This procedure requires a standard-sized Phillips screwdriver and a large Phillips screwdriver.

To remove and replace the pole clamp extrusion, proceed as follows, using Figure 6-13 as a reference:

1. Follow the procedure detailed in Section 6.2.2.4 for removing the pole clamp knob/screw assembly and black tip insert. Set these aside for reassembly.

2. Follow the procedure detailed in Section 6.2.2.1 for separating the front and rear assemblies.

3. Remove the battery and battery strap following the procedure described in Section 6.2.2.7.1.

4. Using the Phillips screwdriver, remove the screw (1) and shake proof washer connecting the grounding lug of the AC/Mains cord to the pole clamp extrusion. Discard the screw unless it can be verified that it is off the stainless steel type (ref. TSB 52034-003).

   NOTE: Indicate on the TSB Control Label that this TSB has been performed.

5. Using the large Phillips screwdriver, remove the two screws (2) and washers (3) securing the pole clamp extrusion (4) to the rear housing.

6. Place the new pole clamp extrusion in the recess in the back of the rear housing in the same orientation as the old pole clamp extrusion (from the front of the pump, the pole clamp knob/screw assembly should angle toward the right side of the pump).

7. Attach the new pole clamp extrusion to the rear housing using the two screws. Place the washers on the screws before attaching the screws to the extrusion.

8. Reattach the grounding lug of the power cord to the new pole clamp extrusion.

9. Reassemble the battery and battery strap to the rear housing following the procedure described in Section 6.2.2.7.1.

10. Reassemble the front and rear assemblies as described in Section 6.2.2.2.

11. Perform the Performance Verification Test (PVT) as described in Section 4.2.

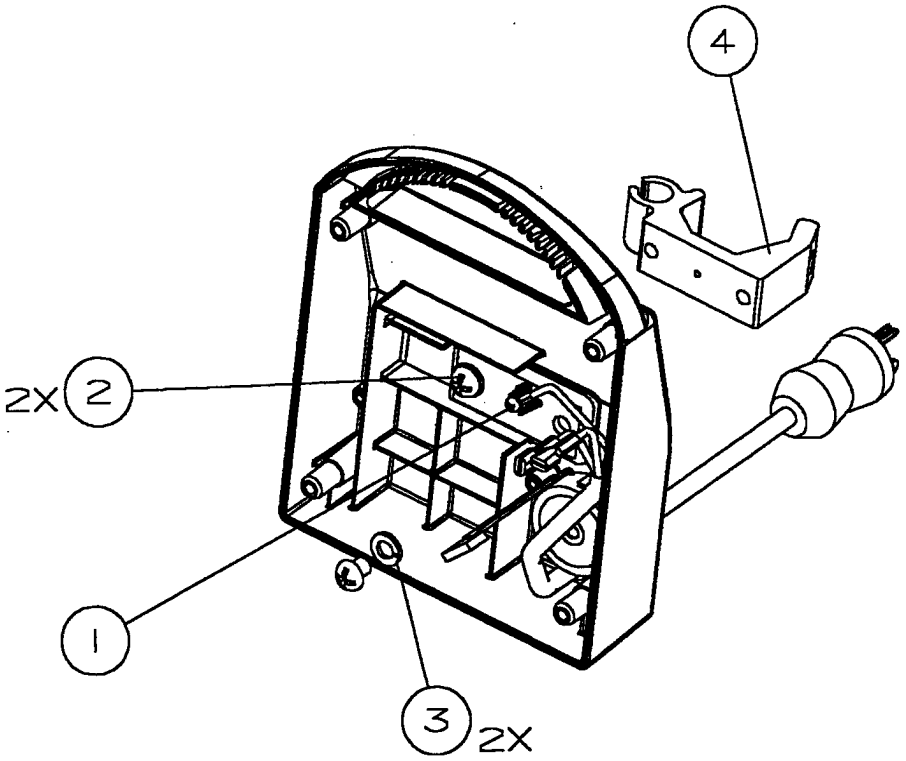


Figure 6-13. Pole Clamp Extrusion Replacement

6.2.2.7.4 BUZZER ASSEMBLY REPLACEMENT

115 VAC VERSION

This procedure requires a standard-sized Phillips screwdriver.

To remove and replace the buzzer assembly, proceed as follows, using Figure 6-14 as a reference:

1. Follow the procedure detailed in Section 6.2.2.1 for separating the front and rear assemblies.
2. Set the front assembly aside. Place the rear assembly on a soft cloth with the inside of the housing facing up.
3. Using the Phillips screwdriver, remove the two self-tapping screws (1) that secure the buzzer (2) to the rear housing.
4. Attach the new buzzer assembly to the rear housing using the two self-tapping screws. Make certain the new buzzer is oriented in the housing exactly as the old buzzer.
5. Reassemble the front and rear assemblies as described in Section 6.2.2.2.
6. Perform the Performance Verification Test (PVT) as described in Section 4.2.

CAUTION: Overtightening the screws can strip the threads in the housing bosses. Tighten the screws until they are just snug.

220 VAC VERSION

Note: On the 220 VAC version of the pump the buzzer is located on the printed circuit board.

1. Follow the procedure detailed in Section 6.2.2.1 for separating the front and rear assemblies.
2. Set the front assembly aside. Place the rear assembly on a soft cloth with the inside of the housing facing up.
3. Remove the two nuts securing the buzzer to the stand-off's on the circuit board and disconnect the buzzer lead from the connector on the board.
4. Place the replacement buzzer on the stand-off's and secure with the two nuts removed in section 5. Connect buzzer lead to the connector on the board.
5. Reassemble the front and rear assemblies as described in Section 6.2.2.2.
6. Perform the Performance Verification Test (PVT) as described in Section 4.2.

CE 0050

2P47
LISTED
ENTERAL
PUMP

Code 04

Authorized Representatives
Edisco B.V. (Subsidiary of Abbott Laboratories)
8000 AJ Zwolle
Netherlands

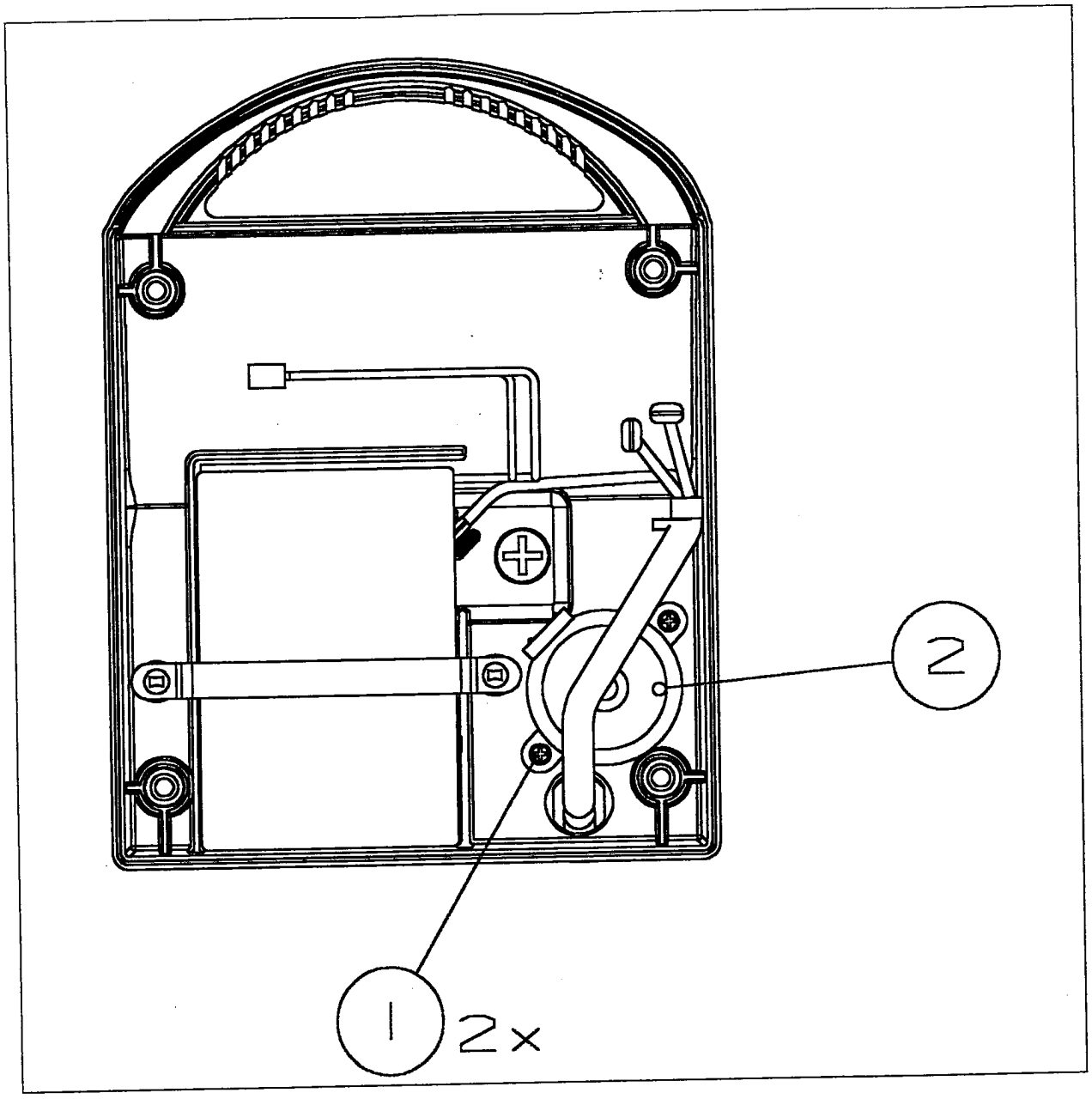
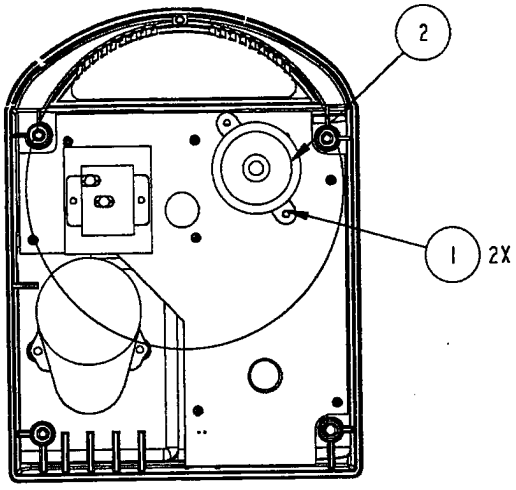


Figure 6-14. Buzzer Assembly Replacement 115 VAC Version



6-14a. Buzzer Assembly Replacement 220 VAC Version

SECTION 7 SCHEMATICS

This section includes the 20 pages that constitute the schematic drawing of the Flexiflo® Patrol™ Enteral Pump, 115 VAC version and 220 - 240 VAC version.

For technical assistance contact the local Abbott sales office.

WARNING

POSSIBLE EXPLOSION HAZARD EXISTS IF USED IN
THE PRESENCE OF FLAMMABLE ANESTHETICS

Abbott Laboratories, North Chicago, Illinois, 60064, U.S.A.

NOTES:

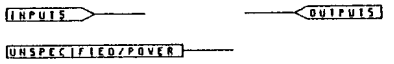
1. (DELETED)

2. (DELETED)

3. THIS SCHEMATIC IS USED IN CONJUNCTION WITH A1B1-12, CIRCUIT CARD ASSEMBLY, CONTROLLER.

4. SHEET 2 OF THIS DRAWING IS A BLOCK DIAGRAM AND SHOWS THE SOURCE AND DESTINATION FOR ALL NON-POWER SIGNALS (NOT EXCLUDING POWER SIGNALS) FOR THE REMAINING SHEETS.

5. THE FOLLOWING REPRESENT THE CONVENTIONS USED FOR INTER-SHEET CONNECTIONS.



6. THE FOLLOWING (X) REPRESENTS THE CONVENTION USED FOR A PIN WITH NO CONNECTION.

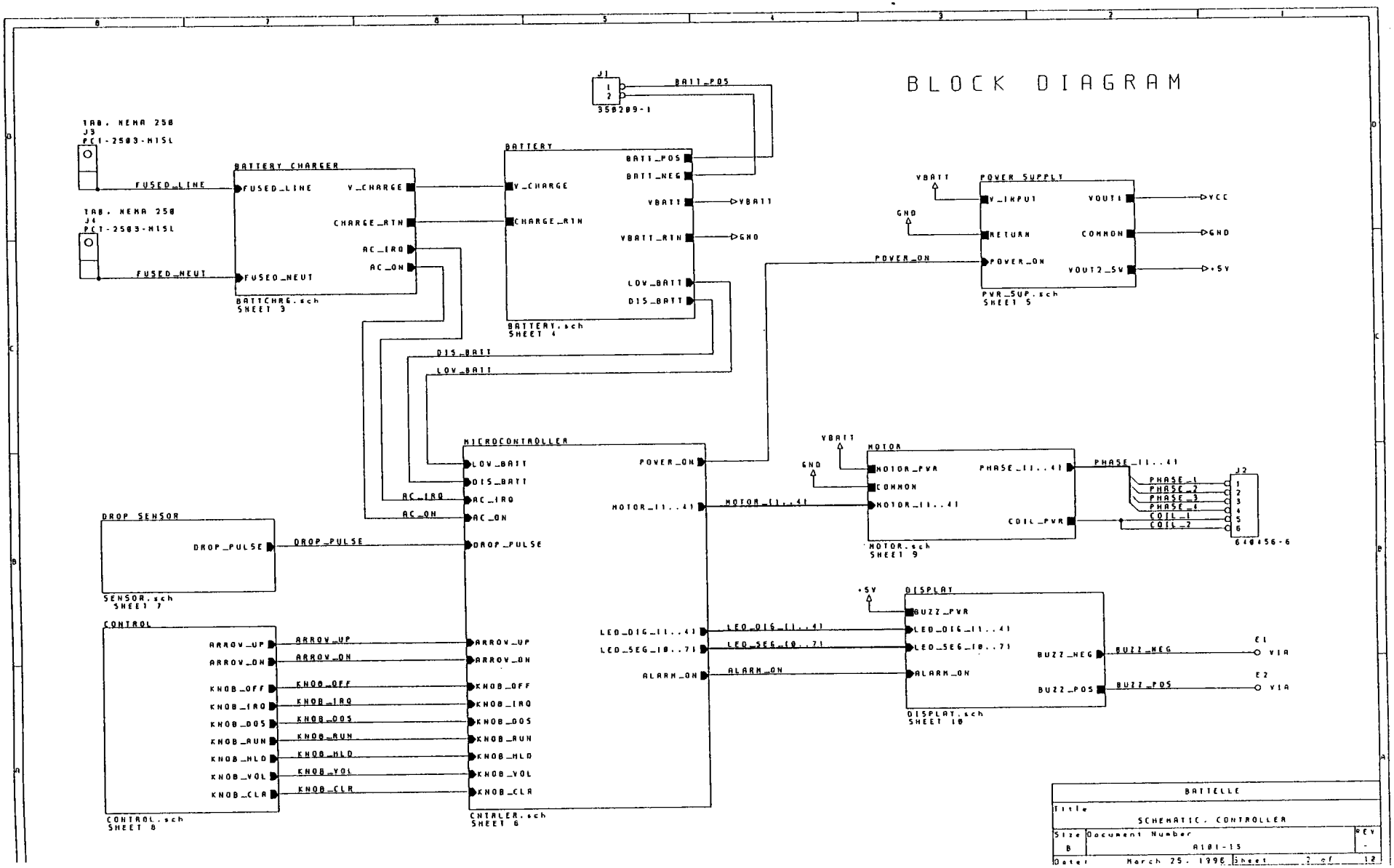
7. THE FOLLOWING (TERMINAL) REPRESENTS A TEST-POINT WHICH TERMINATES AT A VIA OR SURFACE COPPER PAD ON THE PWB. NO PART ON THE CIRCUIT CARD ASSEMBLY IS ASSOCIATED WITH THE PART "VIA" ON THE SCHEMATIC.

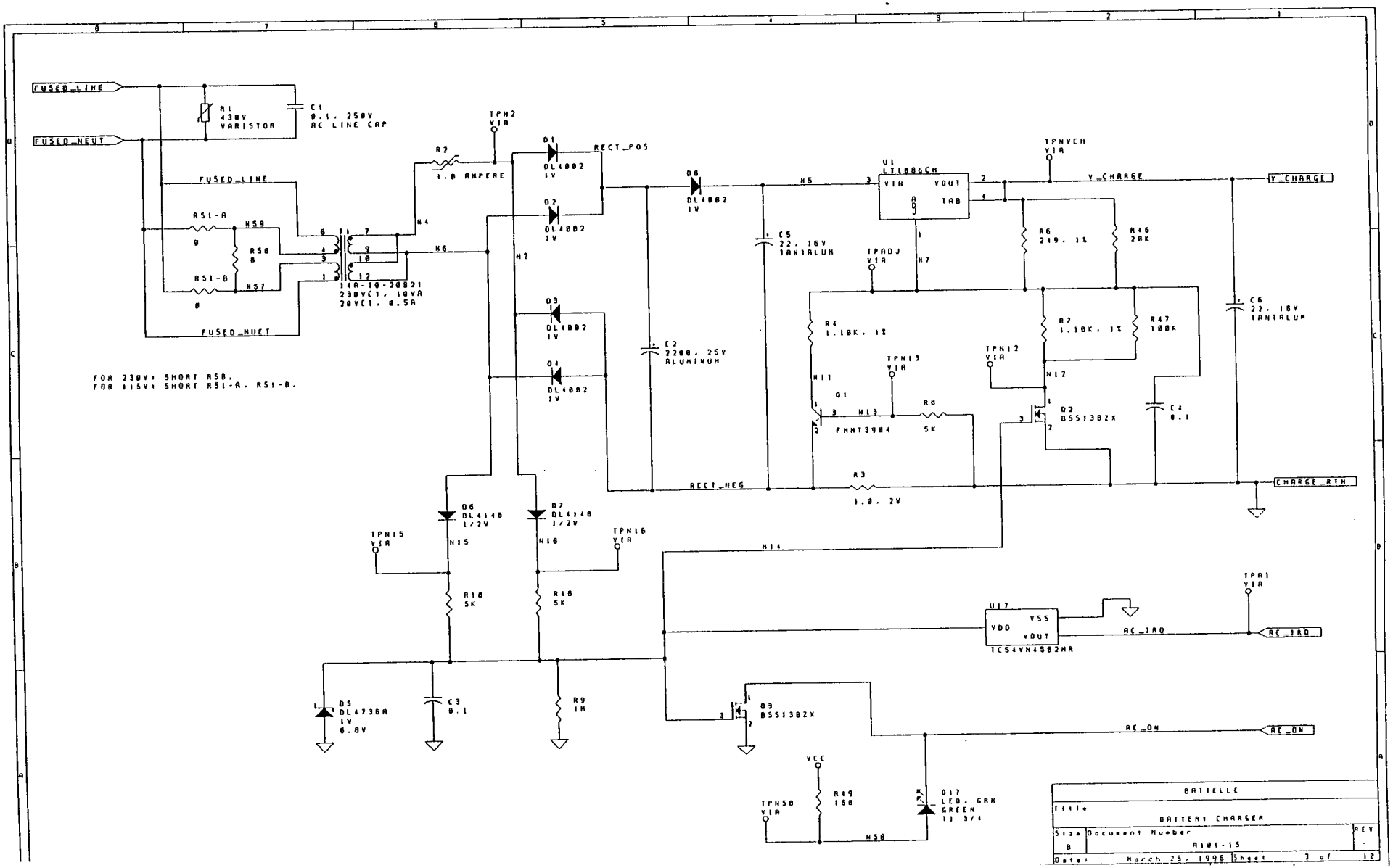
8. THE FOLLOWING (ARROW) REPRESENTS A CONNECTION TO ONE OF THE POWER PLANE NODES: VCC, +5V, VBATT, OR GND. THE POWER SOURCES ARE SHOWN ON SHEET 2 AS HORIZONTAL ARROWS.

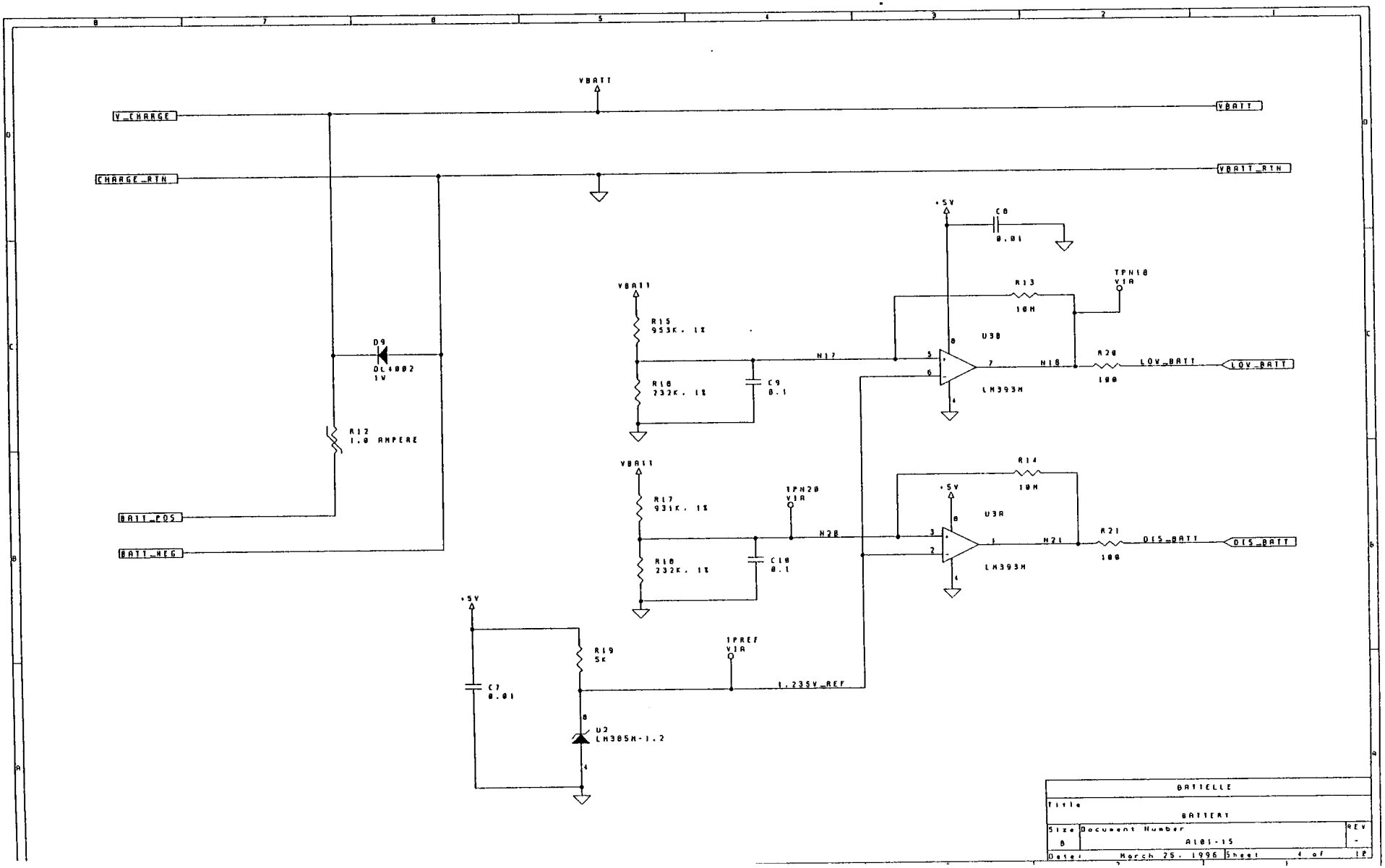
9. RESISTOR VALUES ARE IN OHMS, 5%, 1/8 WATT UNLESS OTHERWISE SPECIFIED.

10. CAPACITOR VALUES ARE IN MICROFARADS, 10%, 50 VOLT UNLESS OTHERWISE SPECIFIED.

BATTELLE		
Title: SCHEMATIC NOTES		
Size: B	Document Number: A1B1-1S	REV: -
Date: March 25, 1996	Sheet 1 of 18	


BLOCK DIAGRAM
J1
350209-1
BATT_POS
TAB, NEMA 250
J3
PCI-2503-M1SL
FUSED_LINE
TAB, NEMA 250
J4
PCI-2503-M1SL
FUSED_NEUT
BATTERY CHARGER
FUSED_LINE
FUSED_NEUT
V_CHARGE
CHARGE_RTN
AC_IRQ
AC_ON
BATTCHRG.sch
SHEET 3
BATTERY
V_CHARGE
CHARGE_RTN
BATT_POS
BATT_NEG
VBATT
VBATT_RTN
LOW_BATT
DIS_BATT
VBATT
GND
BATTERY.sch
SHEET 4
VBATT
GND
POWER_ON
POWER SUPPLY
V_INPUT
RETURN
POWER_ON
VOUT1
COMMON
VOUT2_5V
VCC
GND
+5V
PWR_SUP.sch
SHEET 5
DIS_BATT
LOW_BATT
MICROCONTROLLER
LOW_BATT
DIS_BATT
AC_IRQ
AC_ON
DROP_PULSE
POWER_ON
MOTOR_[1..4]
ARROW_UP
ARROW_DN
KNOB_OFF
KNOB_IRQ
KNOB_DOS
KNOB_RUN
KNOB_HLD
KNOB_VOL
KNOB_CLR
LED_DIG_[1..4]
LED_SEG_[0..7]
ALARM_ON
CNTRLER.sch
SHEET 6
DROP SENSOR
DROP_PULSE
SENSOR.sch
SHEET 7
CONTROL
ARROW_UP
ARROW_DN
KNOB_OFF
KNOB_IRQ
KNOB_DOS
KNOB_RUN
KNOB_HLD
KNOB_VOL
KNOB_CLR
CONTROL.sch
SHEET 8
VBATT
GND
MOTOR
MOTOR_PWR
COMMON
MOTOR_[1..4]
PHASE_[1..4]
COIL_PWR
MOTOR.sch
SHEET 9
PHASE_[1..4]
PHASE_1
PHASE_2
PHASE_3
PHASE_4
COIL_1
COIL_2
J2
640456-6
+5V
DISPLAY
BUZZ_PWR
LED_DIG_[1..4]
LED_SEG_[0..7]
ALARM_ON
BUZZ_NEG
BUZZ_POS
BUZZ_NEG
BUZZ_POS
E1
VIA
E2
VIA
DISPLAY.sch
SHEET 10
BATTELLE
Title
SCHEMATIC, CONTROLLER
Size
B
Document Number
A181-15
REV
-
Date: March 25, 1996
Sheet 2 of 12


FUSED_LINE
FUSED_NEUT
R1
430V
VARISTOR
C1
0.1, 250V
AC LINE CAP
R2
1.0 AMPERE
TPH2
VIA
D1
DL4002
1V
D2
DL4002
1V
D3
DL4002
1V
D4
DL4002
1V
RECT_POS
RECT_NEG
D8
DL4002
1V
N5
U1
LT1086CM
VIN
VOUT
TAB
ADJ
TPNVCH
VIA
V_CHARGE
R6
249, 1%
R46
20K
C6
22, 16V
TANTALUM
TPADJ
VIA
N7
R4
1.10K, 1%
R7
1.10K, 1%
R47
100K
TPNI3
VIA
TPNI2
VIA
N11
N12
Q1
FMMT3904
N13
R8
5K
Q2
BSS138ZX
C4
0.1
C5
22, 16V
TANTALUM
C2
2200, 25V
ALUMINUM
R3
1.0, 2V
CHARGE_RTN
N14
D6
DL4148
1/2V
D7
DL4148
1/2V
TPNI5
VIA
TPNI6
VIA
N15
N16
R10
5K
R48
5K
U17
VDD
VSS
VOUT
TC54VN4502MR
AC_IRQ
TPA1
VIA
D5
DL4736A
1V
6.8V
C3
0.1
R9
1K
Q3
BSS138ZX
AC_ON
VCC
R49
150
D17
LED, GRN
GREEN
T1 3/4
TPN50
VIA
N50
FOR 230V: SHORT R50.
FOR 115V: SHORT R51-A, R51-B.
R51-A
0
R50
0
R51-B
0
N59
N57
14A-10-20021
230VCT, 10VA
20VCT, 0.5A
N4
N6
N7
BATTELLE
Title
BATTERY CHARGER
Size
B
Document Number
A101-15
REV
-
Date: March 25, 1996
Sheet 3 of 12


VBATT
V_CHARGE
VBATT
CHARGE_RTN
VBATT_RTN
D9
DL4002
1V
R12
1.0 AMPERE
BATT_POS
BATT_NEG
+5V
C8
0.01
VBATT
R15
953K, 1%
R16
232K, 1%
C9
0.1
N17
U3B
LM393M
R13
10M
TPN18
VIA
N18
R20
100
LOV_BATT
LOV_BATT
R14
10M
R17
931K, 1%
R18
232K, 1%
C10
0.1
IPN20
VIA
N20
U3A
LM393M
N21
R21
100
DIS_BATT
DIS_BATT
+5V
R19
5K
C7
0.01
IPREF
VIA
1.235V_REF
U2
LM385M-1.2
BATTELLE
Title
BATTERY
Size
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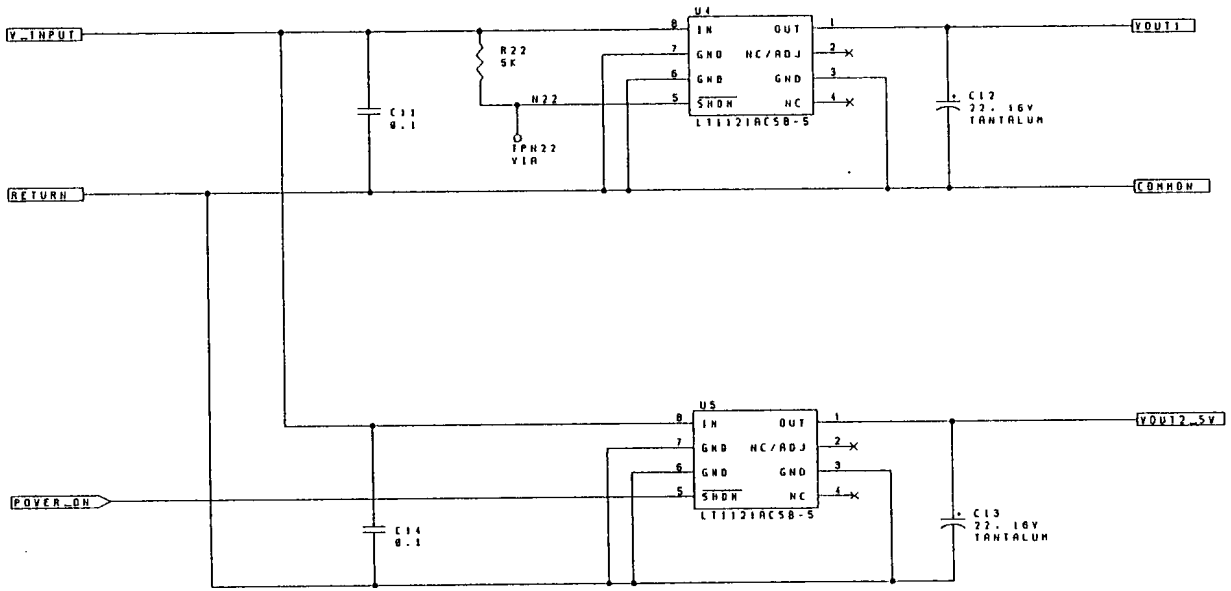
Document Number
A101-15
REV
-
Date: March 25, 1996
Sheet 4 of 12

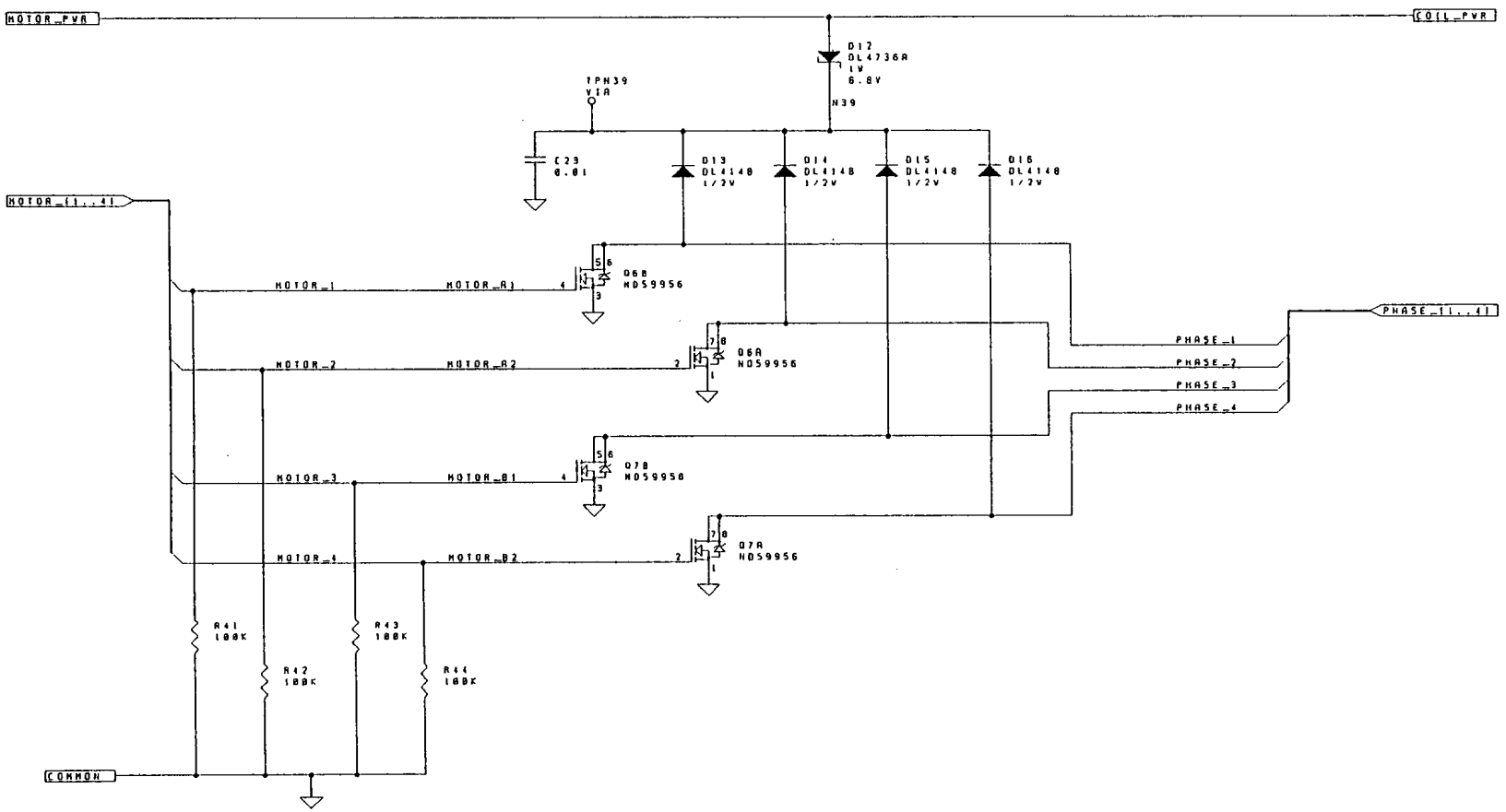


BATTELLE		
Title: POWER SUPPLY		
Size: B	Document Number: A101-15	REV: -
Date: March 25, 1996	Sheet 5 of 12	

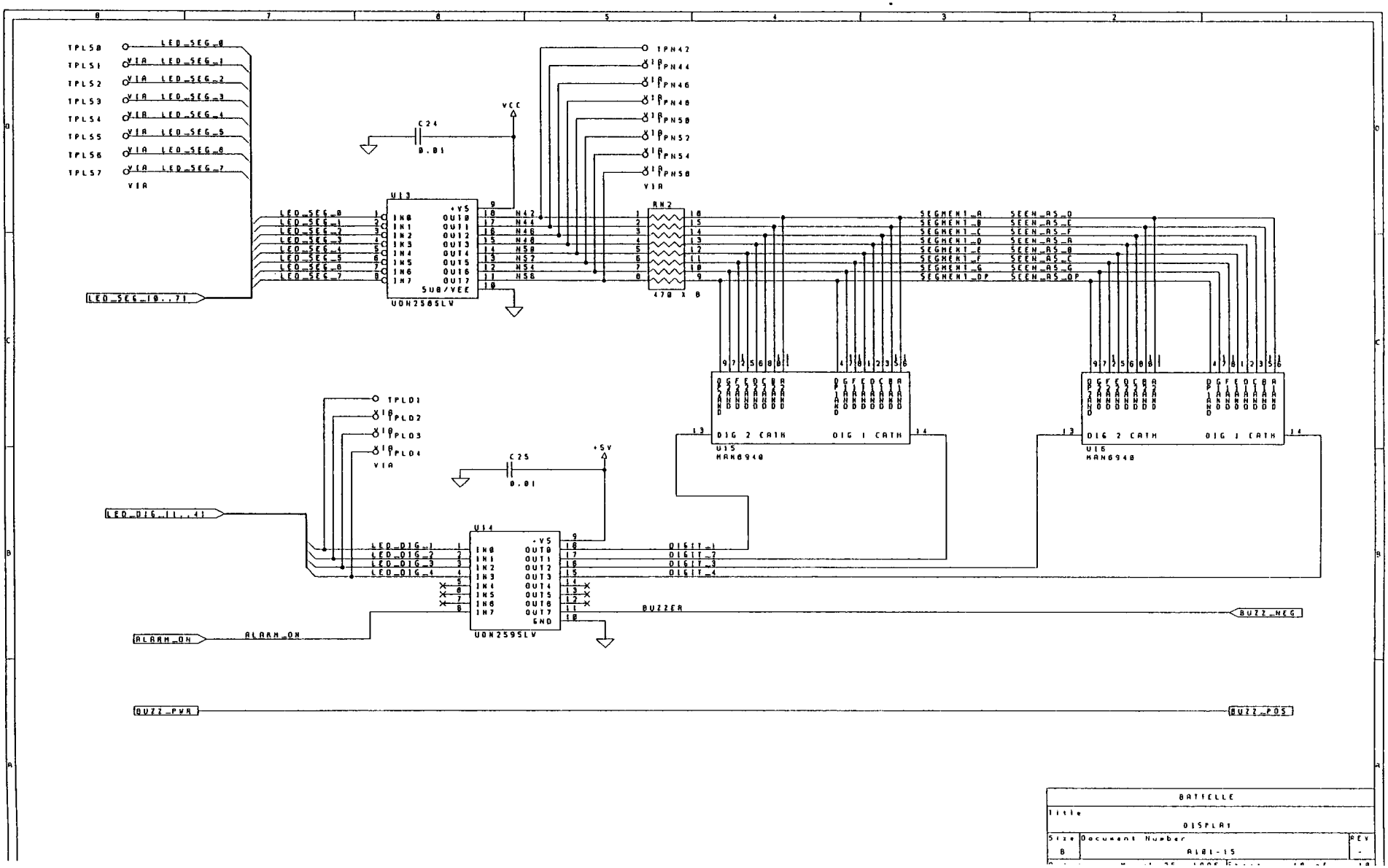
KNOB_CLR
KNOB_VOL
KNOB_HLD
KNOB_RUN
KNOB_DOS
KNOB_IRQ
KNOB_OFF
DIS_BATT
LOW_BATT
AC_ON
ARROW_DN
ARROW_UP
DROP_PULSE
AC_IRQ
KNOB_IRQ
R31
100
C27
0.1
VCC
R26
5K
R27
5K
R25
5K
KNOB_0
KNOB_1
KNOB_2
RN1
10K x 15
IPN30
VIA
IPN28
VIA
U7
TC51V(C)832H
VDD
VOUT
VSS
C17
0.01
RESET
IPN26
VIA
INTERRUPT
VPP
R23
10M
N28
N27
C18
0.01
C15
27pf
C16
27pf
11
4.000MHZ
20pF
ST NPO
R28
100K
U6
68HC05C8FN1
5917245S5
'C9' swaps pin 40 with 39.
and pin 18 with 17.
VDD
OSC1
OSC2
TCAP
HC
RESET
IRQ
NC/VPP
VSS
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
PC0
PC1
PC2
PC3
PC4
PC5
PC6
PC7
PD0/AD1
PD1/TDO
PD2/MISO
PD3/MOSI
PD4/SCK
PD5/SS
ICAP
PD7
KNOB_RUN
KNOB_HLD
KNOB_VOL
ARROW_UP
ARROW_DN
DROP_PULSE
KNOB_DOS
KNOB_CLR
KNOB_IRQ
KNOB_OFF
POWER_ON
ALARM_ON
AC_ON
LOW_BATT
DIS_BATT
IRQ_RTC
N30
N29
N28
N31
N32
N33
N34
N35
N36
N37
N38
N39
LED_SEG_0
LED_SEG_1
LED_SEG_2
LED_SEG_3
LED_SEG_4
LED_SEG_5
LED_SEG_6
LED_SEG_7
LED_DIG_1
LED_DIG_2
LED_DIG_3
LED_DIG_4
MOTOR_1
MOTOR_2
MOTOR_3
MOTOR_4
LED_SEG_[0..7]
LED_DIG_[1..4]
MOTOR_[1..4]
POWER_ON
ALARM_ON
Title
BATTELLE
MICROCONTROLLER
Size
B
Document Number
A101-15
REV
-
Date:
March 25, 1996
Sheet
6
of
10

+5V
C21
0.01
R32
332.1K
R33
332.1K
R34
332.1K
D11
SFH205-003
N35
TPN35
VIA
SIGNAL THRESHOLD & LIGHT FILTER
TPN37
VIA
Q5
SDP8100-003
R35
2.00K.1%
N37
C19
0.1
D10
DL1110
1/2W
R36
100K
R37
1M
R38
100K
TPN34
VIA
N36
C20
0.01
N34
U8A
LH393M
+5V
C22
0.01
N38
TPN38
VIA
R39
100
DROP_PULSE
UNUSED
U8B
LH393M
+5V
BATTELLE
DROP SENSOR
A1A1-15
Size
B
Document Number
REV
-
Date: March 25, 1996
Sheet 7 of 10

KNOB_IRQ
S3
CS-12738
(HSR-8691I)
(CLOCK, RATE
10-ZBH)
+5V
U9
VCC
GND
OUT
SG-CLOCK, RUN
U10
VCC
GND
OUT
SG-CLOCK, CLEAR VOL
U18
VCC
GND
OUT
SG-CLOCK, HOLD
U19
VCC
GND
OUT
SG-CLOCK, BOOST
U11
VCC
GND
OUT
SG-CLOCK, VOL FEO
U28
VCC
GND
OUT
SG-CLOCK, OFF/CHARGE
S1
S2
ARROW_UP
ARROW_ON
KNOB_CLR
KNOB_BOOS
KNOB_OFF
KNOB_VOL
KNOB_HLD
KNOB_RUN
KNOB_IRQ
BRIEFLE
CONTROL
Size
B
Document Number
A101-15
REV

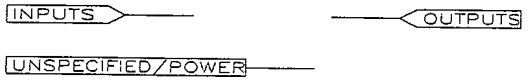


BATTELLE		
Title: MOTOR		
Size: B	Document Number: A101-15	REV: -
Date: March 25, 1996	Sheet 9 of 12	


TPL50
TPL51
TPL52
TPL53
TPL54
TPL55
TPL56
TPL57
VIA
LED_SEG_0
LED_SEG_1
LED_SEG_2
LED_SEG_3
LED_SEG_4
LED_SEG_5
LED_SEG_6
LED_SEG_7
LED_SEG_[0..7]
C24
0.01
VCC
U13
UDN2585LV
SUB/VEE
TPN42
TPN44
TPN46
TPN48
TPN50
TPN52
TPN54
TPN56
RN2
470 X 8
SEGMENT_A
SEGMENT_B
SEGMENT_C
SEGMENT_D
SEGMENT_E
SEGMENT_F
SEGMENT_G
SEGMENT_DP
SEEN_AS_D
SEEN_AS_E
SEEN_AS_F
SEEN_AS_A
SEEN_AS_B
SEEN_AS_C
SEEN_AS_G
SEEN_AS_DP
DIG 2 CATH
DIG 1 CATH
U15
HAN6948
U16
HAN6948
TPLD1
TPLD2
TPLD3
TPLD4
C25
0.01
+5V
LED_DIG_[1..4]
U14
UDN2595LV
DIGIT_1
DIGIT_2
DIGIT_3
DIGIT_4
BUZZER
BUZZ_NEG
ALARM_ON
BUZZ_PWR
BUZZ_POS
BATTELLE
Title
DISPLAY
Size
B
Document Number
A101-15
REV
-

NOTES:

1. INTERPRET DRAWING PER DOD-STD-100.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ANSI Y.14.5.
3. THIS SCHEMATIC IS USED IN CONJUNCTION WITH 13131, CIRCUIT CARD ASSEMBLY, CONTROLLER.
4. SHEET 2 OF THIS DRAWING IS A BLOCK DIAGRAM AND SHOWS THE SOURCE AND DESTINATION FOR ALL NON-POWER SIGNALS (NOT EXCLUDING POWER SIGNALS) FOR THE REMAINING SHEETS.
5. THE FOLLOWING REPRESENT THE CONVENTIONS USED FOR INTER-SHEET CONNECTIONS.



6. THE FOLLOWING (X) REPRESENTS THE CONVENTION USED FOR A PIN WITH NO CONNECTION.

7. THE FOLLOWING (TERMINAL) REPRESENTS A TEST-POINT WHICH TERMINATES AT A VIA OR SURFACE COPPER PAD ON THE PWE. NO PART ON THE CIRCUIT CARD ASSEMBLY IS ASSOCIATED WITH THE PART "VIA" ON THE SCHEMATIC.

8. THE FOLLOWING (ARROW) REPRESENTS A CONNECTION TO ONE OF THE POWER PLANE NODES: VCC, +5V, VBATT, OR GND. THE POWER SOURCES ARE SHOWN ON SHEET 2 AS HORIZONTAL ARROWS.

9. RESISTOR VALUES ARE IN OHMS, 5%, 1/8 WATT UNLESS OTHERWISE SPECIFIED.
10. CAPACITOR VALUES ARE IN MICROFARADS, 10%, 50 VOLT UNLESS OTHERWISE SPECIFIED.

LTR	ZONE	DATE	DESCRIPTION	DRAWN BY	CHK'D	APP'D
			REVISIONS			
A		01/06/95	ISSUED FOR APPROVAL	B. GARNES	M. PFOUTS	

SCHEMATIC, CONTROLLER

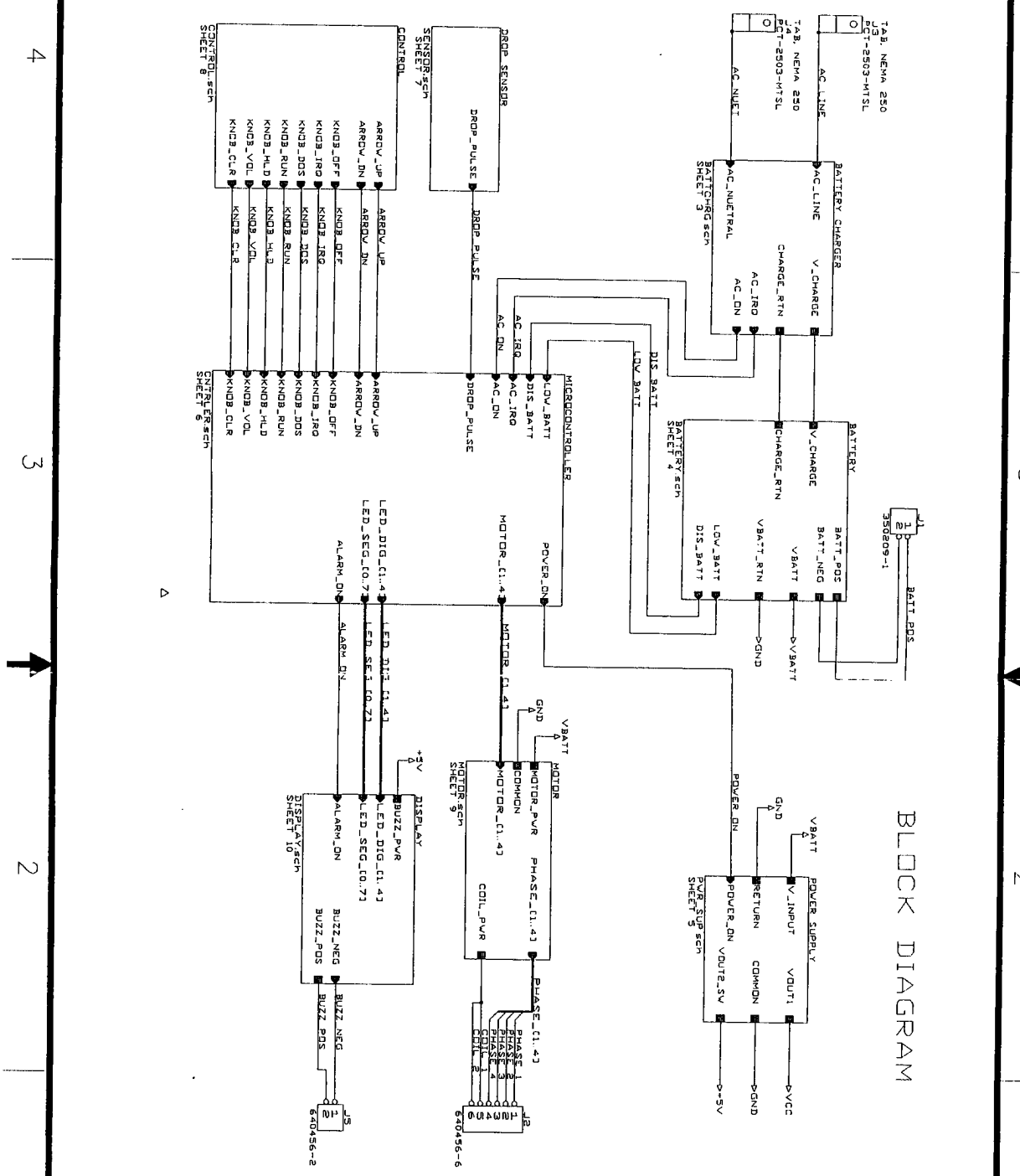
SHEET 1 OF 10

PACKAGING
SYSTEM: ACAD
FILE NAME: BPK29693
PLOTTED SCALE: 1=1.5

APPROVED BY C.ROOT | ISSUE DATE 01/06/95
CHECKED BY S.OSBORNE | SCALE N/A
DRAWN BY B.GARNES | PROJECT PDEDE81

ROSS PRODUCTS DIVISION
ABBOTT LABORATORIES

CORRESPONDING DWG NUMBER SCO. #503016
DWG. SIZE B | REV. A
NO. B-DVEO-PK29693



A		01/06/95	ISSUED FOR APPROVAL	B. GARNES	M. PFOUTS
LTR	ZONE	DATE	DESCRIPTION	DRAWN BY	CHK'D / APPV'D

REVISIONS

SCHEMATIC, CONTROLLER

SHEET 2 OF 10

PACKAGING
SYSTEM: ACAD
FILE NAME: BPK29694
PLOTTED SCALE: 1=2.5

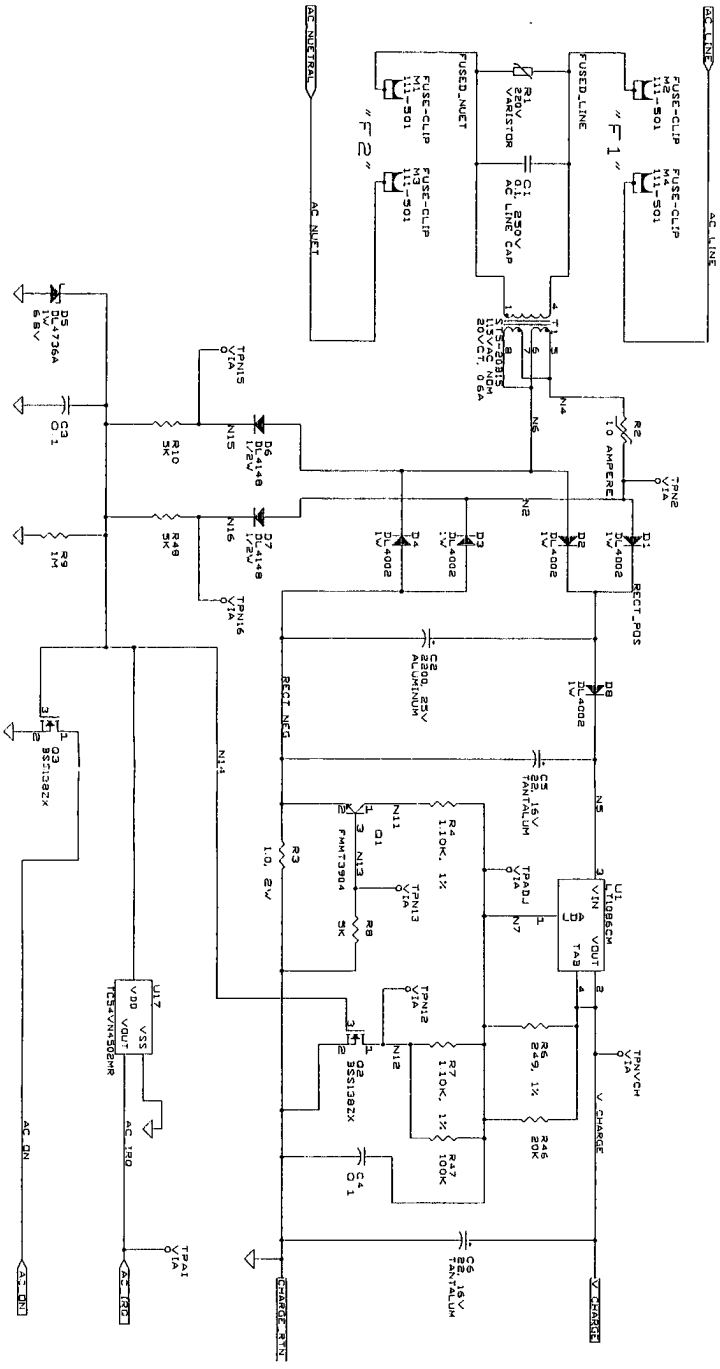
ROSS PRODUCTS DIVISION
ABBOTT LABORATORIES

APPROVED BY	C.ROOT	ISSUE DATE	01/06/95
CHECKED BY	S.OSBORNE	SCALE	N/A
DRAWN BY	B.GARNES	PROJECT	PDEDE81

CORRESPONDING DWG NUMBER SCO. #503016

DWG. NO. B-DVEO-PK29694 SIZE D REV. A

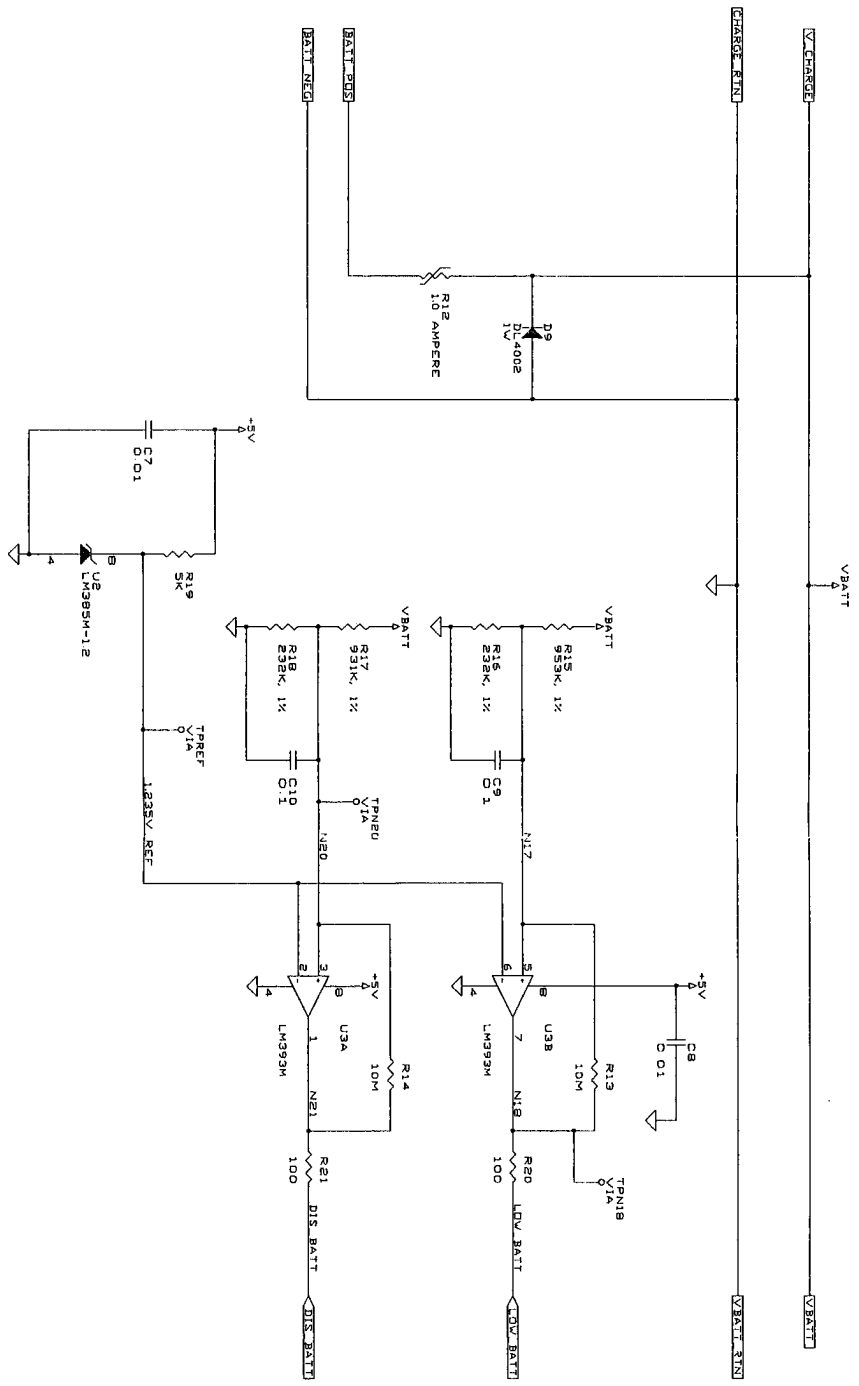
NOTICE!
THIS IS A COMPUTER PLOT AND NOT AN ORIGINAL. ALL CHANGES MUST MADE ON ON THE APPROVED CAD FILE ONLY.



SCHEMATIC, CONTROLLER	PACKAGING				
SHEET 3 OF 10	SYSTEM: ACAD FILE NAME: BPK29695 PLOTTED SCALE: 1=2.5				
			A	01/06/95	ISSUED FOR APPROVAL
ROSS PRODUCTS DIVISION ABBOTT LABORATORIES	APPROVED BY C.ROOT	ISSUE DATE 01/06/95	LTR	ZONE	DATE
	CHECKED BY S.OSBORNE	SCALE N/A	REVISIONS		
CORRESPONDING DWG NUMBER SCO. #503016					
DWG. NO. B-DVE0-PK29695 SIZE	DRAWN BY B.GARNES	PROJECT PDEDE81			

B. GARNES	M. PEDUTS	
DRAWN BY	CHK'D / APPV'D	

NOTICE!
THIS IS A COMPUTER PLOT AND NOT AN ORIGINAL. ALL CHANGES MUST MADE ON ON THE APPROVED CAD FILE ONLY.



SCHEMATIC, CONTROLLER

SHEET 4 OF 10

PACKAGING

SYSTEM: ACAD
FILE NAME: BPK29696
PLOTTED SCALE: 1=2.5

ROSS PRODUCTS DIVISION
ABBOTT LABORATORIES

APPROVED BY	ISSUE DATE
C.ROOT	01/06/95
CHECKED BY	SCALE
S.OSBORNE	N/A
DRAWN BY	PROJECT
B.GARNES	PDEDE81

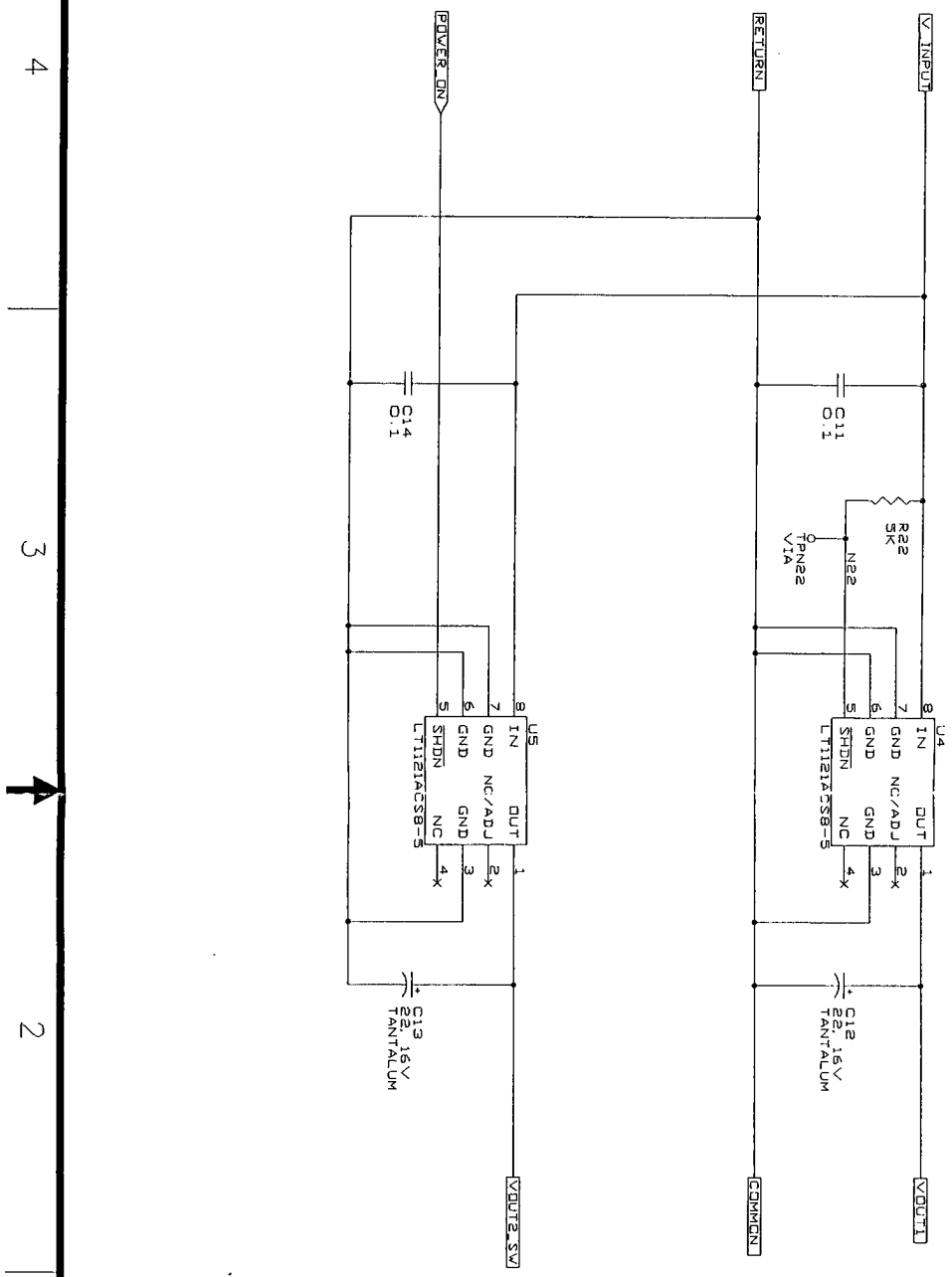
CORRESPONDING DWG NUMBER SCO. #503016

DWG. NO. B-DVEO-PK29696 | SIZE D | REV. A

LTR	ZONE	DATE	DESCRIPTION	DRAWN BY	CHK'D APPV'D
A		01/06/95	ISSUED FOR APPROVAL	B. GARNES	M. PFOUTS

REVISIONS

NOTICE!
THIS IS A COMPUTER PLOT AND NOT AN ORIGINAL. ALL CHANGES MUST MADE ON ON THE APPROVED CAD FILE ONLY.



SCHEMATIC, CONTROLLER

SHEET 5 OF 10

PACKAGING

SYSTEM: ACAD
FILE NAME: BPK29697
PLOTTED SCALE: 1=2

ROSS PRODUCTS DIVISION
ABBOTT LABORATORIES

APPROVED BY	ISSUE DATE
C.ROOT	01/06/95
CHECKED BY	SCALE
S.OSBORNE	N/A
DRAWN BY	PROJECT
B.GARNES	PDEDE81

CORRESPONDING DWG NUMBER SCO. #503016

DWG. NO. SIZE B-DVEO-PK29697 REV. A

LTR	ZONE	DATE	DESCRIPTION	DRAWN BY	CHK'D / APPV'D
A		01/06/95	ISSUED FOR APPROVAL	B. GARNES	M. PFOUTS

REVISIONS

NOTICE!
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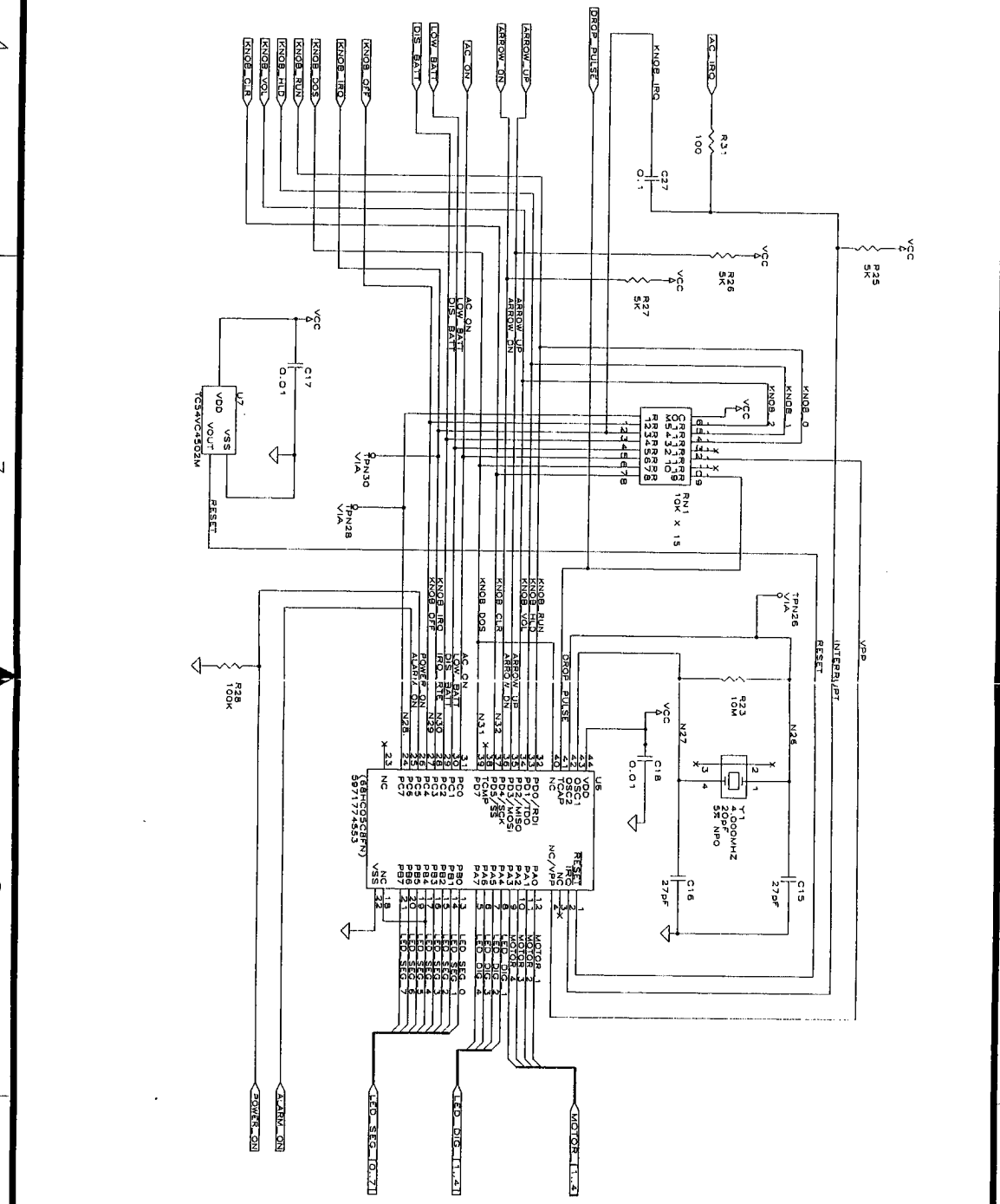

B		07/17/95	REVISED DWG. PER MARK-UP	B. PAYNE	M. PFOUTS
A		01/06/95	ISSUED FOR APPROVAL	B. GARNES	M. PFOUTS
LTR	ZONE	DATE	DESCRIPTION	DRAWN BY	CHK'D APPV'D

REVISIONS

SCHEMATIC, CONTROLLER

SHEET 6 OF 10

PACKAGING

SYSTEM: ACAD
FILE NAME: BPK29689
PLOTTED SCALE: 1=2.5

ROSS PRODUCTS DIVISION
ABBOTT LABORATORIES

APPROVED BY C.ROOT	ISSUE DATE 01/06/95
CHECKED BY S.OSBORNE	SCALE N/A
DRAWN BY B.GARNES	PROJECT PDEDE81

CORRESPONDING DWG NUMBER SCO. #507022

DWG. NO. B-DVEO-PK29698 SIZE B REV. B

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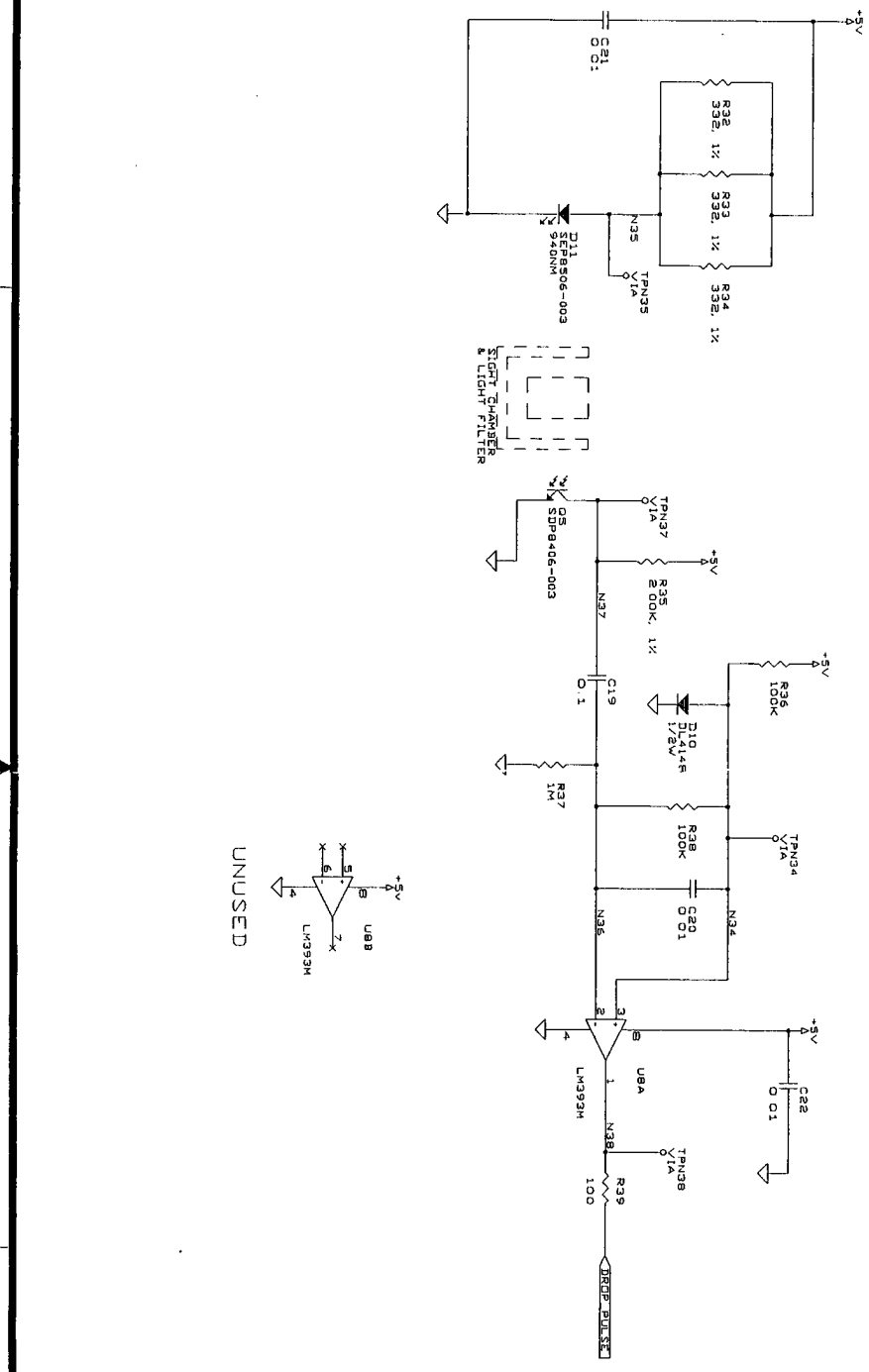

SCHEMATIC, CONTROLLER

SHEET 7 OF 10

PACKAGING

SYSTEM: ACAD
FILE NAME: BPK29699
PLOTTED SCALE: 1=2.5

ROSS PRODUCTS DIVISION
ABBOTT LABORATORIES

APPROVED BY	ISSUE DATE
C.ROOT	01/06/95
CHECKED BY	SCALE
S.OSBORNE	N/A
DRAWN BY	PROJECT
B.GARNES	PDEDE81

CORRESPONDING DWG NUMBER SCO. #503016

DWG. NO. B-DVE0-PK29699 REV. A

LTR	ZONE	DATE	DESCRIPTION	DRAWN BY	CHK'D - APPV'D
A		01/06/95	ISSUED FOR APPROVAL	B. GARNES	M. PFOUTS

REVISIONS

NOTICE!
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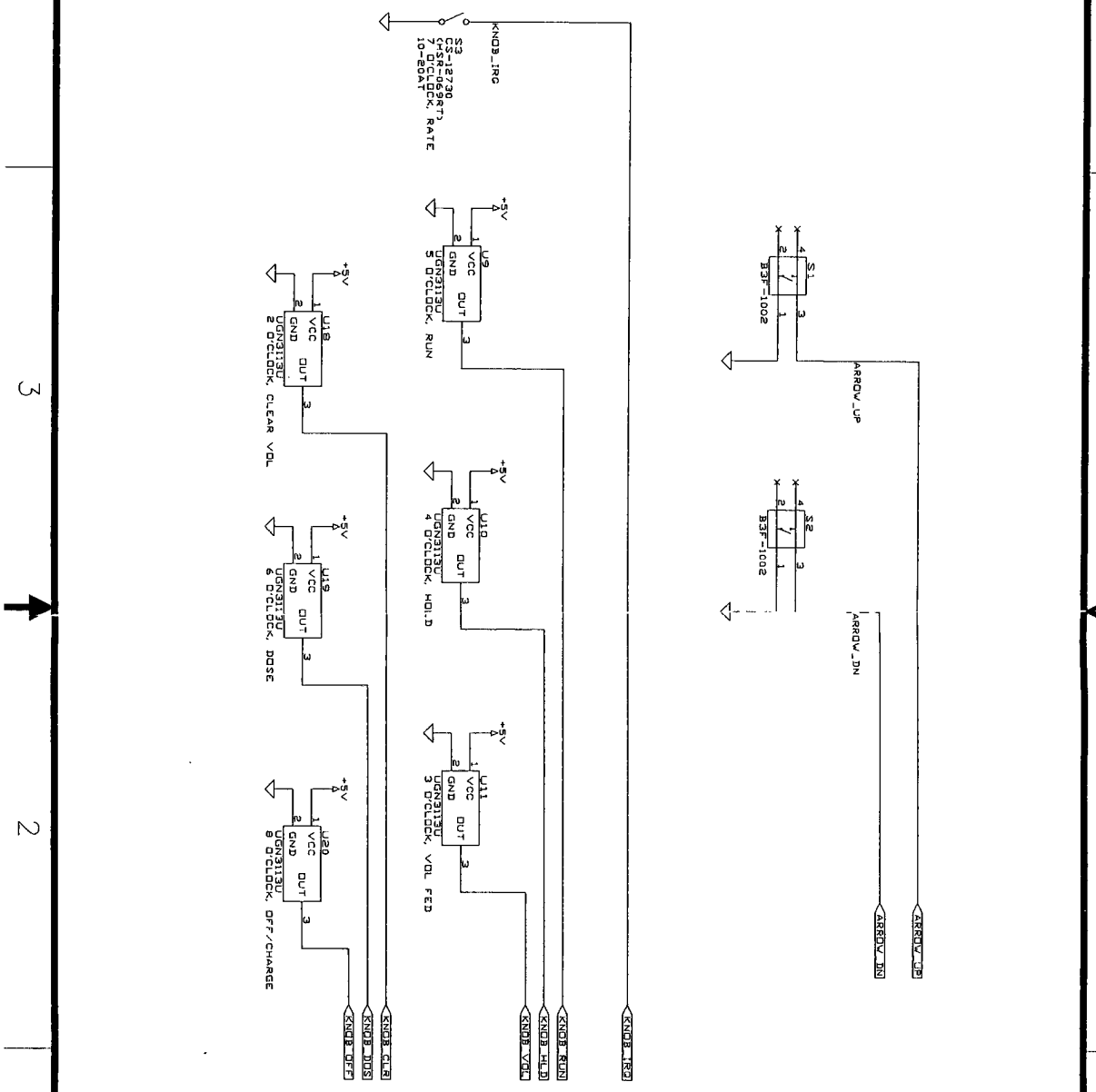

SCHEMATIC, CONTROLLER

SHEET 8 OF 10

PACKAGING

SYSTEM: ACAD
FILE NAME: BPK29700
PLOTTED SCALE: 1=2.5

LTR	ZONE	DATE	DESCRIPTION	DRAWN BY	CHK'D / APPV'D
A		01/06/95	ISSUED FOR APPROVAL	B. GARNES	M. PFOUTS

REVISIONS

ROSS PRODUCTS DIVISION
ABBOTT LABORATORIES

APPROVED BY: C.ROOT	ISSUE DATE: 01/06/95
CHECKED BY: S.OSBORNE	SCALE: N/A
DRAWN BY: B.GARNES	PROJECT: PDEDE81

CORRESPONDING DWG NUMBER: SCO. #503016

DWG. NO.: B-DVEO-PK29700 | SIZE: D | REV.: A

NOTICE!
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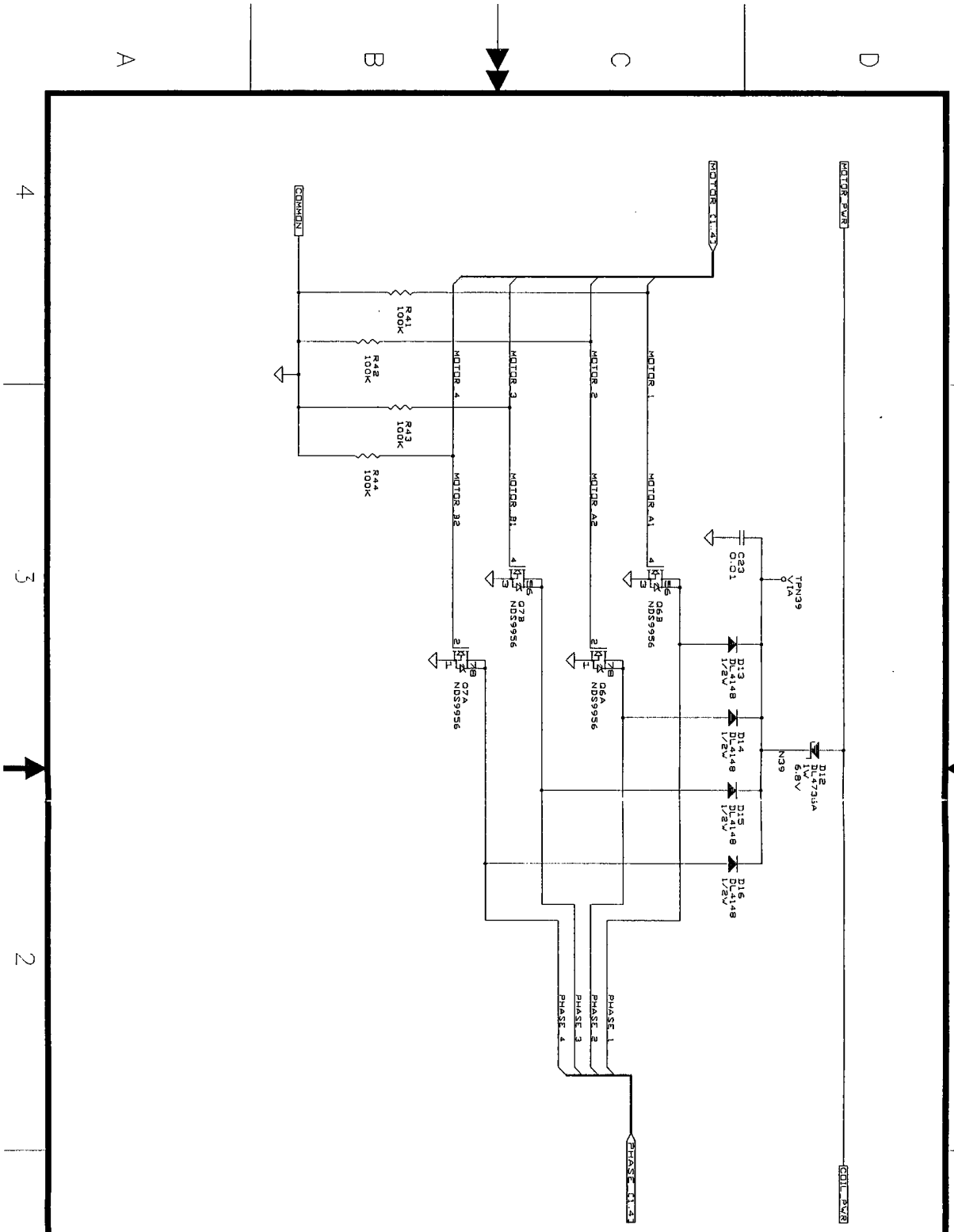

SCHEMATIC	PACKAGING				
SHEET 9 OF 10	SYSTEM: ACAD FILE NAME: BPK29701 PLOTTED SCALE: 1=2.5				
			A	01/06/95	ISSUED FOR APPROVAL
			LTR	ZONE	DATE
ROSS PRODUCTS DIVISION ABBOTT LABORATORIES	APPROVED BY: C.ROOT	ISSUE DATE: 01/06/95			REVISIONS
	CHECKED BY: S.OSBORNE	SCALE: N/A			
CORRESPONDING DWG NUMBER: SCO. #503016	DRAWN BY: B.GARNES	PROJECT: PDEDE81			
DWG. NO.: B-DVEO-PK29701	SIZE: I	REV.: A			

B. GARNES	M. PFOUTS	
DRAWN BY	CHK'D / APPV'D	

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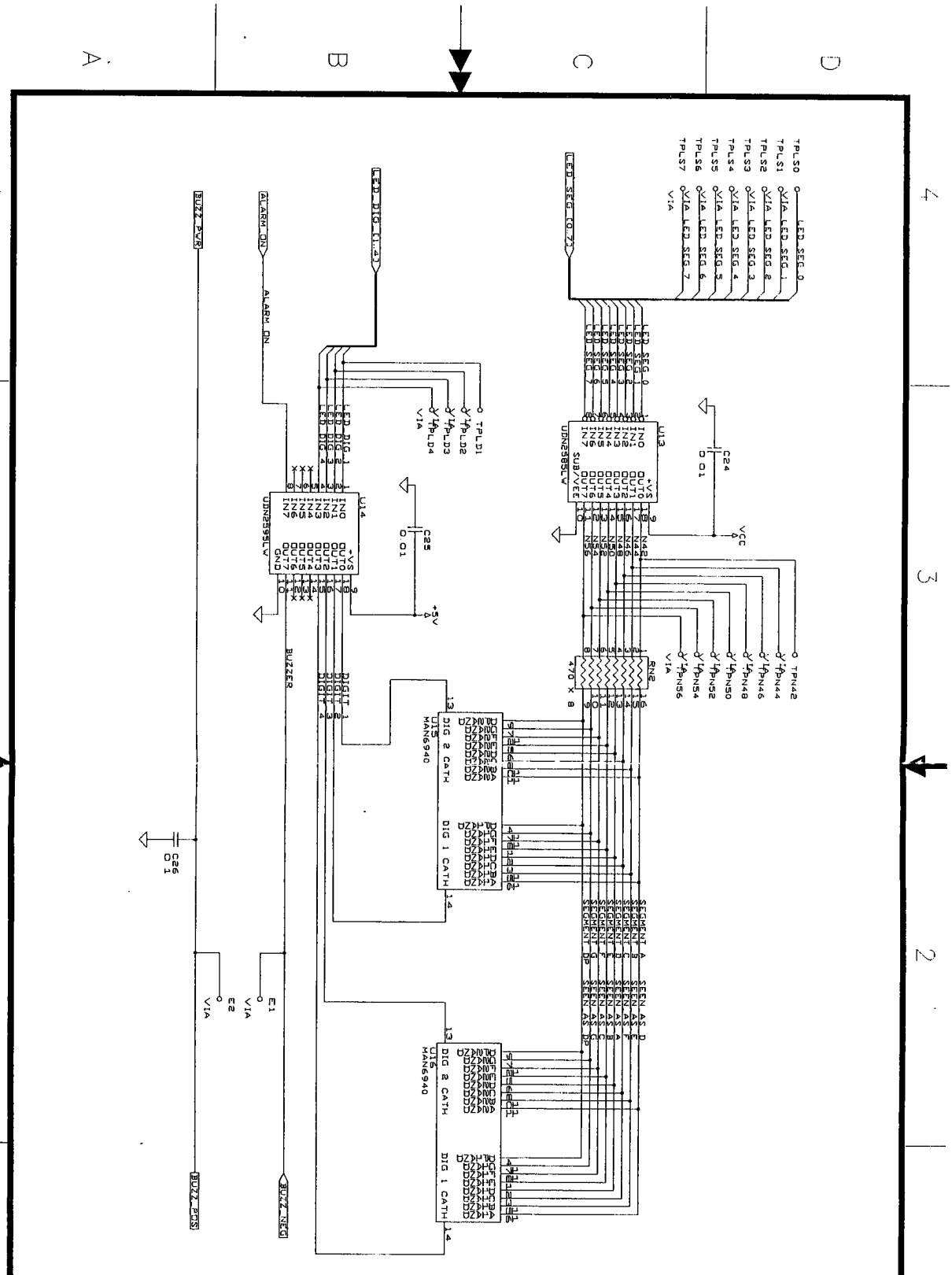

A		01/06/95	ISSUED FOR APPROVAL	B. GARNES	M. PFOUTS
LTR	ZONE	DATE	DESCRIPTION	DRAWN BY	CHK'D / APPV'D

REVISIONS

SCHEMATIC, CONTROLLER

SHEET 10 OF 10

PACKAGING

SYSTEM: ACAD
FILE NAME: BPK29702
PLOTTED SCALE: 1=2.5

ROSS PRODUCTS DIVISION
ABBOTT LABORATORIES

APPROVED BY	C.ROOT	ISSUE DATE	01/06/95
CHECKED BY	S.OSBORNE	SCALE	N/A
DRAWN BY	B.GARNES	PROJECT	PDEDE81

CORRESPONDING DWG NUMBER SCO. #503016

DWG. NO. B-DVE0-PK29702 SIZE J REV. A

NOTICE!
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