Cut and insert

into label holder
on spine of
binder

PC-4

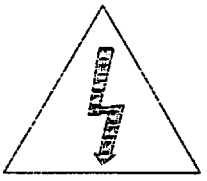
WARNINGS, CAUTIONS AND NOTICES

CAUTION: FEDERAL (USA) LAW RESTRICTS THIS DEVICE TO SALE BY OR ON THE ORDER OF A PHYSICIAN.

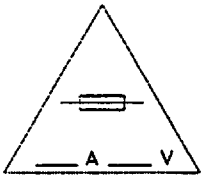
USE ONLY HOSPITAL GRADE POWER SUPPLY CORD TO INSURE PROPER GROUNDING. GROUNDING RELIABILITY CAN ONLY BE ACHIEVED BY CONNECTION TO A RECEPTACLE MARKED "HOSPITAL GRADE".

DANGER: **EXPLOSION HAZARD, DO NOT USE IN THE PRESENCE OF FLAMMABLE ANESTHETICS.**

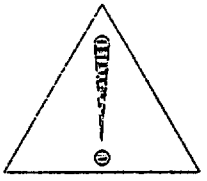
WARNING: **TO PREVENT UNRESTRICTED FLOW, CLOSE CLAMP WHEN FLO-STOP IS OPEN.**



CAUTION: **TO REDUCE RISK OF ELECTRICAL SHOCK, DO NOT REMOVE COVER OR BACK. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.**



WARNING: **REPLACE FUSE AS MARKED.**



CAUTION: **BEFORE CONNECTING "REFER TO MANUAL"**

NOTE

TO MAXIMIZE THE SERVICE LIFE OF THE INSTALLED BATTERY, IT IS RECOMMENDED THAT THIS INSTRUMENT BE STORED AND OPERATED IN AN ENVIRONMENT THAT IS TEMPERATURE CONTROLLED BETWEEN 68°F (20°C) AND 77°F (25°C).

WARNING

IN THE EVENT THE INSTRUMENT IS DROPPED AT ANY TIME, IT MUST BE CHECKED BY A BIOMEDICAL TECHNICIAN PRIOR TO USE FOR PATIENT CARE.

WARNING: TO PREVENT UNRESTRICTED FLOW, CLOSE ROLLER CLAMP WHEN FLO-STOP® IS OPEN.

CAUTION: REFER TO MANUAL

CLASS 1

TYPE CF (Equipment useable for direct cardiac applications)

ALTERNATING CURRENT

REPLACE FUSE ONLY WITH SAME TYPE AND RATING

EQUIPOTENTIAL GROUND POINT: IF THE INTEGRITY OF THE EQUIPOTENTIAL EARTH CONNECTION OR HOSPITAL EARTH SYSTEM IS IN QUESTION, OPERATE THE INSTRUMENT USING INTERNAL BATTERY POWER.

IPX1 DRIP PROOF

CAUTION

ONLY equipment that has been qualified to IEC 601-1 standards should be connected to the PC-4's RS-232-C Data Port and the connection should ONLY be performed by qualified personnel.

CAUTION

Only systems that have been qualified to IEC 601-1 standards should be connected to the PC-4's Nurse Call connector and the connection should ONLY be performed by qualified personnel.

NOTICE

Product design and/or specifications are subject to change without notice. The information contained in this manual is current as of the date of issue.

This publication contains ALARIS Medical Systems™ proprietary data provided solely for the use of technical personnel in repairing IMED® Gemini infusion pump/controllers.

None of the information contained herein may be duplicated nor may it be utilized in any manner other than for the repair and maintenance of IMED® Gemini infusion pump/controllers and the component parts thereof. Any unauthorized use of the information contained herein may subject the user to substantial liability.

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10221 Wateridge Circle
San Diego, CA 92121 USA
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U.S. Patents 4,617,014; 4,689,043; 4,690,673; 4,725,205; 4,728,265; 4,836,752; 4,909,710; 4,920,336; 4,954,046; 4,859,927; 4,764,166; 5,219,330; D305,060; D305,151; D352,778. AU 580,184; 586,594; 590,179; 601,664; 607,112; 622,088; 596,552; 604,477. CA 1,235,033; 1,258,212; 1,300,977; 1,280,647; 1,296,791; 2,020,926; 1,296, 092; 1,238,832. AT 0,225,158. BE 0,225,158. FR 0,225,158 283,614; 315,312; 0,431,726; 0,238,277. GB 0,225,158; 283,614; 315,312; 0,431,726; 0,238,277. NL 0,225,158 283,614. IT 0,225,158; 283,614. SE 0,225,158 283,614. CH 0,225,158. DE P3686558.3; P3772,556.9; 3871721T2; P6908208; P3774598. TW UM52721. JP 特許第１７５４４７０号; 特許第１８１６８７２号; 特許第１９０２３８７号; 特許第１９６７１６８号; 特許第１７９３１１９号; 特許第１７３０３９５号.
Other US and Foreign Patents Issued and Pending.

PREFACE

This manual contains operation and maintenance instructions for the IMED® GEMINI PC-4® series of Volumetric Infusion Pumps/Controllers ("PC-4"). The information provided herein is intended for use by technical personnel responsible for servicing these products. The material is divided into seven sections and is presented as follows: Section 1 - Description; Section 2 - Preparation for Use; Section 3 - Operation; Section 4 - Principles of Operation; Section 5 - Maintenance; Section 6 - Illustrated Parts Breakdown; Section 7 - Calibration and Preventative Maintenance.

Additional copies of this manual may be obtained by contacting your nearest ALARIS Medical Systems Customer Service Department.

This manual P/N 143649 supersedes PC-4 Maintenance Manual, Part No. 1340-9201-00 and PC-4 International Addendum, Part No. 1340-9213-00 and PC-4 Maintenance Manual, Part No. 1340-9217-00 and PC-4 Technical Update, Part No. 1340-9217-01.

The features of the 220V model of the PC-4 have been incorporated into this manual. Text or graphics that are related exclusively to the 220V model are identified with a 220V symbol.

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LIST OF FIGURES

LIST OF TABLES

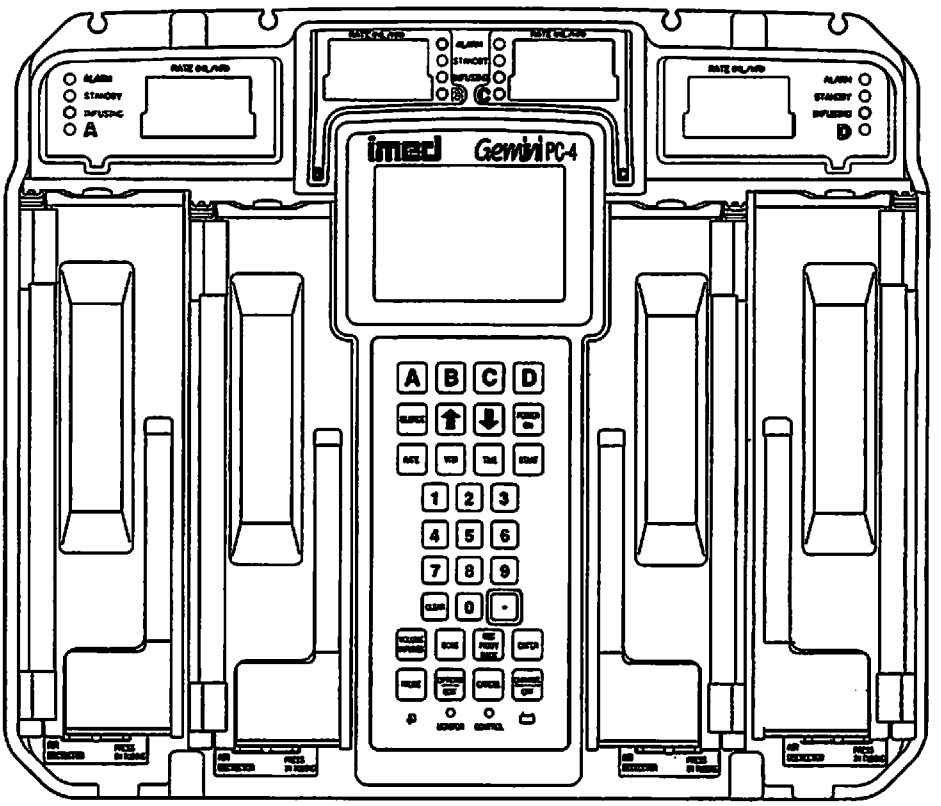


Figure 1-1. IMED® GEMINI PC-4® Volumetric Infusion Pump/Controller.

SECTION 1 - DESCRIPTION

1.1 INTRODUCTION

This section includes general operating characteristics, physical description and operating specifications for all versions of the IMED® GEMINI PC-4® Volumetric Infusion Pump/Controller ("PC-4").

1.2 OPERATING CHARACTERISTICS

The GEMINI Model PC-4 is a four channel volumetric infusion pump/controller used in the administration of intravascular drugs and fluids. Each channel is capable of independent operation in either the Pump or Controller delivery mode. The pumping mechanism employs linear peristaltic action. The peristaltic action is provided by a series of 12 cam-actuated fingers that sequentially collapse then release, in a ripple like action, the soft pumping segment of a GEMINI administration set. This action produces a positive pressure at the outlet side and a vacuum on the inlet side of the pump, thereby, delivering a continuous flow of infusion solutions reliably, accurately and with a high degree of safety.

The four channel configuration enables a variety of infusion techniques including independent primary, simultaneous primary and sequential secondary. Independent and simultaneous primary infusions can deliver either a specified volume or the entire contents ("ALL") of a solution container. Use of the ALL setting requires installation and connection of an Empty Container Detector (ECD) which is available as an optional accessory. Sequential secondary (piggyback) infusions with independently defined delivery parameters, for both the primary and secondary solutions, can be provided on each channel.

Operational control of the PC-4 is effected through the control and indicator panel on the front of the instrument and the Audio Control switch on the rear of the instrument. Basic operating instructions are printed on the right side of the instrument case. Functional control is provided by a 16 bit micro-processor with a stored program that includes a Maintenance mode to monitor instrument performance, an audio/visual alarm subsystem to alert operators to abnormal conditions and redundancy checks to confirm system accuracy.

1.3 OPERATING CONDITIONS

The PC-4 can be operated independently (Normal Operation) or as a computer controlled device (Computer Operation). Normal operation includes the Controller and Pump modes plus a Maintenance mode. Computer operation includes Monitor and Computer Control modes.

NORMAL OPERATION

SYSTEM OPTIONS
The systems option mode allows the operator to:

- Adjust contrast of the LCD display
- Set the Time of Day clock
- Enable Anesthesia Mode
- Set up Computer Control
- Check System Configuration

The system configuration screen displays the current status of the following selectable features:

NOTES

To enter the Configuration Setup mode: press and hold the "OPTIONS/EDIT" switch at power up.

Bold face type indicates factory default settings.

- Clock Setup: **Military** or AM/PM
- Factory Set: Factory default settings **YES** or NO
- Maximum Rate: Max usable rate 1-**999** mL/hr
- C2 Port: Baud 300, 600, 1200, 2400, 4800, **9600**, 19200; (Data Frame is set to N81); Serial No. XXXX.
- Aux Port: No Port
- PCS Mode: **P** or C or S Channel delivery mode selection plus mode lock/unlock
- Delayed Start: **Enabled** or Disabled
- Drug Calc: **Enabled** or Disabled
- Multidose: **Enabled** or Disabled
- Dose Display: **Fixed** or Temp
- Battery Mode: Disabled Normal **High**
- Key Audio: **Enabled** or Disabled
- Alarm Audio: **Profile 1**, 2 or 3
- Switch(over) Audio: **Enabled** or Disabled

- Tamper Mode: Enabled or **Disabled**
- Language: **English**
- Anesth. Mode: Enabled or **Disabled**
- Comp. Ctrl.: **Enabled** or Disabled
- Dynamic Press: **Enabled** or Disabled
- Press. Trend: **Enabled** or Disabled
- Vol. Time Inf: **Enabled** or Disabled
- S/W Version: SCX.XX.XX.X
- MC Version: X.XX
- C2S/N: XXXX
- CRC: XXXX/Checksum: XXXX

CONTROLLER MODE

In the CONTROLLER mode, the PC-4 is programmed to control the infusion of a specific volume of IV solution. The instrument senses and responds to patient side pressure and container height in a manner similar to a gravity infusion. The instrument's pressure sensor measures the hydrostatic pressure from the bottle and compares that pressure against distal tubing in-line pressure. When in-line pressure exceeds pump input pressure, an occlusion condition exists and an alarm is initiated. Actual delivery pressure is directly proportional to container height; increasing container height raises and decreasing the height reduces occlusion pressure. Controller mode occlusion pressure tolerance is ±12 inches (30.5 cm) from the bottle height. Transient surges in patient side pressure of <60 seconds duration will produce a LOW FLOW condition which stops the infusion while the pressure is above the occlusion threshold. Pressure transients above the occlusion threshold >60 seconds duration or cumulative time required to compensate for volumetric deficiency caused by periods of Low Flow in excess of 30 minutes will cause the instrument to occlude.

PUMP MODE

In the PUMP mode of operation, the instrument employs a preset occlusion pressure limit of 10 ±2 psi (69 ±14 kPa) predicated on a nominal container height of 24 inches (61 cm) and a delivery rate >30 mL/hr. For delivery rates <30 mL/hr, the occlusion pressure is rate dependent to ensure timely detection of occlusion conditions. Any transient distal in-line pressure above this limit will generate a patient side occlusion alarm.

<u>Software Releases through 3.9.9.4</u>
The PC-4, when operating in the Pump Mode, can be locked into a rate-independent (10 psi) occlusion pressure mode. This mode will result in significantly increased time-to-occlusion for rates <30 mL/hr.

<u>Software Release 4.10.14.0 and Subsequent</u>
A Selectable (S) pressure mode allows an occlusion pressure to be selected between 25 mmHg (0.5 psi) and 517 mmHg (10 psi) in 25 mmHg (0.5 psi) increments. A high occlusion pressure selection coupled with a slow infusion rate will result in an increase in time-to-occlusion.

MAINTENANCE MODE

The maintenance mode is intended solely for use by biomedical technicians to perform servicing and maintenance actions and **must never be used when the PC-4 is connected to a patient.** The maintenance mode provides biomedical service personnel access to the closed loop maintenance test routines and operating history logs.

Maintenance mode menu includes:
- S/C board test and displays
- M/C board test and displays
- Press [off] to exit

The S/C board test and display sub-menu includes an Error Log display with a 100 entry register.

COMPUTER OPERATION

MONITOR MODE

The Monitor mode allows a host computer to monitor infusion status and instrument performance. Monitor mode is enabled when a host computer is connected to the PC-4 through the Communications Data Port and the Monitor indicator is illuminated.

COMPUTER CONTROL

The Computer Control mode allows an infusion, once set up, to be controlled and monitored by a host computer installation.

1.4 USER INTERFACE

Instrument control and operation is accomplished through the 32 keypad controls, the central information display and the independent channel information displays. Infusion parameters are programmed into the instrument using the appropriate keypad controls. Rate and Volume-to-be-Infused (VTBI) are input separately for each channel. Rate and VTBI for secondary infusions (piggyback) are also programmable, independent of the primary infusion parameters, for each channel. Visual Prompt and Advisory messages with accompanying audio alerts are provided to assist operators in setting up the instrument for operation. Infusion completions, alarm conditions and software-detected malfunctions are signaled by both audio and visual alerts; hardware-detected malfunctions are signaled by an audio warning. Delayed Start, Multidosing and Drug Calculation infusions, when these features are enabled, are programmed via the Channel Options menu.

The rear panel of the PC-4 is configured with an ECD connection for each channel, a connector to accept a Nurse Call line, a standard RS-232-C communications data port for interfacing with a host computer and an auxillary RS-232-C port for interfacing with ancillary equipment.

ALARIS Medical Systems GEMINI Series disposable administration sets are required for use with the GEMINI family of Infusion Pump/Controllers. The GEMINI Series of instruments uses sets with part numbers in the 2000 number series.

1.5 PHYSICAL DESCRIPTION

The PC-4 instrument has the following physical characteristics:

Height:	12 inches (30.5 cm)
Width:	14.75 inches (37.5 cm) with pole clamp
Depth:	7.5 inches (19.1 cm) with pole clamp
Weight:	≈22 pounds (10 kg) including power cord

The PC-4 instrument consists of two major assemblies: the front and rear cases.

FRONT CASE

The front case consists of an investment-cast aluminum shell which houses and supports: the pumping chamber access doors, the peristaltic pumping mechanisms, pressure transducers (strain beam), Air-in-line and Slide clamp detectors, keypad, the channel and central displays, the display circuit card assemblies (CCAs), logic CCA and motor control CCAs.

REAR CASE

The rear case assembly consists of an investment-cast aluminum shell which mounts and supports internally: the transformer harness assembly, audio oscillator, power supply CCA and communication harness assembly. The exterior of the rear case supports the pole clamp, power entry module, ECD storage, battery access with covers, power cord retention strap, power cord retention bracket and the equipotential grounding point on the 220V model.

1.6 PRODUCT HISTORY

The initial release of the GEMINI PC-4® Infusion Pump/Controller was in December 1992. Since that time a number of changes have occurred. Refer to Table 1-1 for product history.

1.7 OPERATING SPECIFICATIONS

The PC-4 Operating Specifications are subordinated into Operating Requirements and Performance Specifications which are delineated in Tables 1-2 and 1-3 respectively. Tables 1-2 and 1-3 respectively.

1.8 ACCESSORIES

The accessories approved for use with the PC-4 are listed in Table 1-4.

Table 1-1. Product History

Model	History
1340A	• Initial release of product Software version 1.12.11.1.
	• ECD Support, Drug Amount, Drug Dose Support, paused walkaway feature Nursecall fully functional introduced with Software version 3.2.8.0.
	• C2 Monitoring, Anesthesia mode, Pop-up Window, Prompts Split Screen Pri/Sec Replace Battery, Service Charger error message introduced with Software version 3.9.1.0.
	• ADDED TX Feature set - Volume/time dosing, Selectable output pressure, Dynamic Pressure Readout, pressure Trending (History), 7 segment display checking added with Software version 4.10.14.0.
	• Rate display test enabled, Audio Failure "Pop-up box", added with Software version 5.10.18.4.
1340B	• Battery extension housing implemented 12 Battery system with Software version 5.11.17.0.
1340C	• Incorporated Corrective Drug Application with Software version 7.05.05.0.
1340D	• Software versions 7.05.05.0 and earlier, will not recognize a year entry beyond 1999 in the Clock Entry Menu. Introduced Software version 1.85.

The current PC-4 System Configuration may be viewed by pressing Options/Edit key to bring up the systems Options menu, then pressing #5 Keypress, to access the System Configuration listing.

Revision Matrix:

Revision #	PC-4 1.12.11.1, 3.2.8.0, 3.9.1.0, 3.9.9.1, 3.9.9.4, 4.10.14.0, 4.12.9.0, 5.1.18.0, 5.2.4.0, 5.10.18.4	PC-4 5.11.17.0	PC-4 7.05.05.0	PC-4 1.85	PC-4 CE 1.86
1340A	X				
1341AX (220V)		X	X		
1340B		X			
1340BX (220V)		X			
1341BX					X
1340C			X	X	
1340D					

Revision "A" - Initial Revision
Revision "B" - Software Upgrade for conversion to 12 Volt Battery System Units to enhance operation.
Revision "C" - Software Upgrade to correct a specific drug calculation concentration for the drug Esmolol (Brevibloc), to be incorrectly displayed.
Revision "D" - Mandatory Upgrade to incorporate 12 Volt Battery System (same as Revision B) with Software Revision 1.85, or 1.86.

Note[1]: 1340/134x = a number associated with a particular model, and software version, i.e., 1340A could be 5.10.18.4 or 3.9.9.4, etc.

Note[2]: All PC-4s have a Maintenance or Diagnostic Mode. To access this mode: hold in the Audio control switch on the panel and then press Power On.keypress.

CAUTION: The "Fractional" and "Integer" Pumping Mechanisms are not interchangeable.

Table 1-2. Operating Requirements

Parameter	Specification
Power Required:	**110V:** 90-132 VAC, current draw 0.10 amps nominal (.36 amps max), 10 Watts, fused at 0.4 A, 50-60 Hz, 3 wire, Single ϕ **220V:** 220-240 VAC, 0.15 amps nominal, fused at 200mA, 50/60 Hz, 3 wire, Single ϕ
Rated Input Power:	45 VA
Electrical Leakage:	Less than 100 microamps
Electrical Shock Protection:	Class 2, Internally powered equipment
Level of Protection against Electrical Shock:	Type CF equipment
Level of Protection against fluid ingress:	IPX1
Battery:	Two, sealed lead-acid, 12 VDC, 3.4 amp-Hr
Battery Recharge:	8 hours will recharge a new battery to the battery operation specification level (≈90% capacity). 24 hours will restore a new battery to a fully charged condition. For maximum battery life, battery should be fully recharged after each discharge.
Nurse Call System Power Limitations:	Maximum recommended Voltage/Current 24 VDC/500 mA
Operating Temperature Range:	40°F (5°C) to 104°F (40°C)
Operating Humidity Range:	0% to 95% Relative Humidity, non-condensing
Storage Temperature:	-40°F (-40°C) to 158°F (70° C)
Storage Humidity:	0% to 95% Relative Humidity, non-condensing

Table 1-3. Performance Specifications

Parameter	Specification
Operating Principle:	Linear Peristaltic
Mode of Operation:	Continuous
Operating Range:	
Pump and Controller modes:	
Rate:	0.1 - 999 mL/hr in 0.1 mL/hr increments to 99.9 mL/hr and 1 ml/hr increments from 1 to 999 mL/hr **(Controller mode maximum recommended rate is 500 mL/hr)**
Volume-to-be-Infused (VTBI):	0.1 - 9999 mL in 0.1 mL increments to 999.9 mL and 1 mL increments from 1 to 9999 mL **NOTE** **Fractional VTBI values cannot be used with rate values ≥100 mL/hr.**
Keep Vein Open (KVO) Rate:	1 mL/hr for delivery rates ≥1 mL/hr, or set delivery rate if <1.0 mL/hr
Occlusion Pressure:	
Controller Mode:	Container height (±12" or 30.5 cm)

Pump Mode:	10 ±2 psi (69 ±14 kPa) [at delivery Rates below 30 mL/hr, occlusion pressure is flow rate dependent to ensure rapid response to occlusion conditions]. The "10 psi mode" can be invoked during SYSTEM CONFIGURATION thereby setting occlusion pressure to 10±2 psi (69±14 kPa) for all rates. (Time to occlusion at rates <30 mL/hr will be significantly increased).
Selectable Mode:	25-517 mmHg (0.5-10.0 psi) in 25 mmHg (0.5 psi) increments
Air-In-Line Detection:	Ultrasonic (75 to 100 mL)
Secondary (Piggyback):	Dual rate programmable
Nurse Call Feature:	Activates an externally powered system in the event of an Alarm, Malfunction or selected Advisories
Communications Data Port:	EIA Standard RS-232-C. Requires standard 9 pin subminiature D connector
Auxillary Data Port:	EIA Standard RS-232-C. Requires standard 9 pin subminiature D connector
Channel Display Indicators:	
ALARM:	Red LED - flashes during alarm condition
STANDBY:	Amber LED - illuminates when channel is programmed for a delayed start and awaiting start time
INFUSING:	Green LED - flashes when channel is actively infusing
Battery Operation:	With a new, fully charged battery, approximately 3.5 hours before a "BATTERY DISCHARGED" message

NOTES

To maximize battery life, recharge battery for at least 12 hours between consecutive battery operations.

Failure to fully recharge the battery between consecutive battery operations will reduce battery life.

Audio Characteristics:

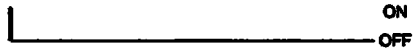
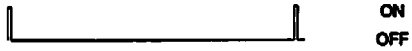
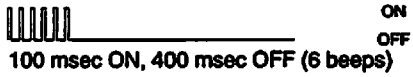
AUDIO TYPE	AUDIO PERIOD	VOLUME VAR/FIXED	SILENCE YES/NO
(1) MALFUNCTION	 ON OFF 600 msec ON, 0.5 sec OFF, 600 msec ON, 3 sec OFF...	MAXIMUM 75db FIXED	NO
(2) KEY CLICK	 ON OFF 30 msec ON (Once)	VARIABLE	NO
(3) ALARM Profile 1	 ON OFF 500 msec ON, 1500 msec OFF, 500 msec ON, 1500 msec OFF...	VARIABLE	YES
Profile 2	 ON OFF 400 msec ON, 1 sec OFF, 100 msec ON, 100 msec OFF...	VARIABLE	YES
Profile 3	 ON OFF 400 msec ON, 500 msec OFF, 400 msec ON, 500 msec OFF...	VARIABLE	YES
(4) PROMPT	 ON OFF 100 msec ON, 2 sec OFF...	VARIABLE	YES
(5) ADVISORY	 ON OFF 100 msec ON, 15 sec OFF...	VARIABLE	YES
(6) CHANGEOVER	 ON OFF 100 msec ON, 400 msec OFF (6 beeps)	VARIABLE	YES
(7) ILLEGAL KEY	 ON OFF 100 msec ON, 100 msec OFF (2 beeps)	VARIABLE	NO

Figure 1-2. Audio Characteristics

Table 1-4. Accessories

Part No.	Description
1303	Communications Emulator Plug (optional)
3299-100	Calibrated Tubing (optional)
1308	Universal Empty Container Detector (ECD)
40-2066-7	Syringe holder

SECTION 2 - PREPARATION FOR USE

2.1 INTRODUCTION

This procedure contains information relative to the initial inspection and pre-operational checkout of the IMED® GEMINI PC-4® Volumetric Infusion Pump/Controller("PC-4"). These procedures include a mechanical inspection, electrical inspection, pre-operational battery charge and a performance check to ensure that the instrument operates properly and has not been damaged during shipment or storage.

2.2 PRE-OPERATIONAL MECHANICAL INSPECTION

The PC-4 has undergone thorough production control and quality assurance testing prior to shipment from the factory. The shipping container has been designed to protect the instrument against damage under normal shipping conditions; nevertheless, internal physical and/or electronic component damage could have occurred without leaving a visible signature. Therefore, it is recommended that the following inspection procedure be performed upon receipt of the instrument at the user's facility.

1. Carefully remove the PC-4 from the shipping container. (Save the shipping material for reuse in the event the instrument must be returned to the factory for service or repair).

2. Inspect the exterior case, front and rear, for holes, cracks, scratches, spalling, broken or damaged controls, missing components and/or screws.

3. Inspect the green tinted windows covering the channel information displays and the screen covering the LCD for scratches or cracks.

4. Ensure the pumping chamber access doors fit flush with the case at the top, bottom, and sides.

5. Check the door handle/cam locks for ease of operation and flush fit with door when latched.

6. Inspect the pumping mechanism seals for damage and to ensure they are properly attached to the front case.

7. Inspect the Air-in-line sensors and Flo-Stop® recesses for damage or obstructions.

8. Install an approved ALARIS Medical Systems GEMINI administration set to ensure the Flo-Stop assembly seats correctly and the door closes and latches properly.

9. Inspect the power cord for damage, bent prongs or deformed connector.

10. Exercise the pole clamp mechanism to ensure freedom of movement.

11. Check the Equipotential grounding point for damage and security. 220V

NOTE

In the event the PC-4 shows evidence of shipping damage, notify the carrier's agent immediately. Do not return a damaged instrument to the factory before the carrier's agent has authorized repairs. Contact ALARIS Medical (refer to Sales and Service Offices page for a list of phone numbers) for authorization to return the instrument for repair regardless of liability for repair costs.

2.3 OPERATIONAL PERFORMANCE CHECK

Prior to the first operational use and following any routine maintenance or servicing of the PC-4, it is strongly recommended that an abbreviated operational performance check be performed. The operational performance check consists of two phases; a Pre-operational Electrical Inspection to check the electrical integrity of the instrument for compliance with regulatory agency requirements and an operational performance test to verify pump/controller performance.

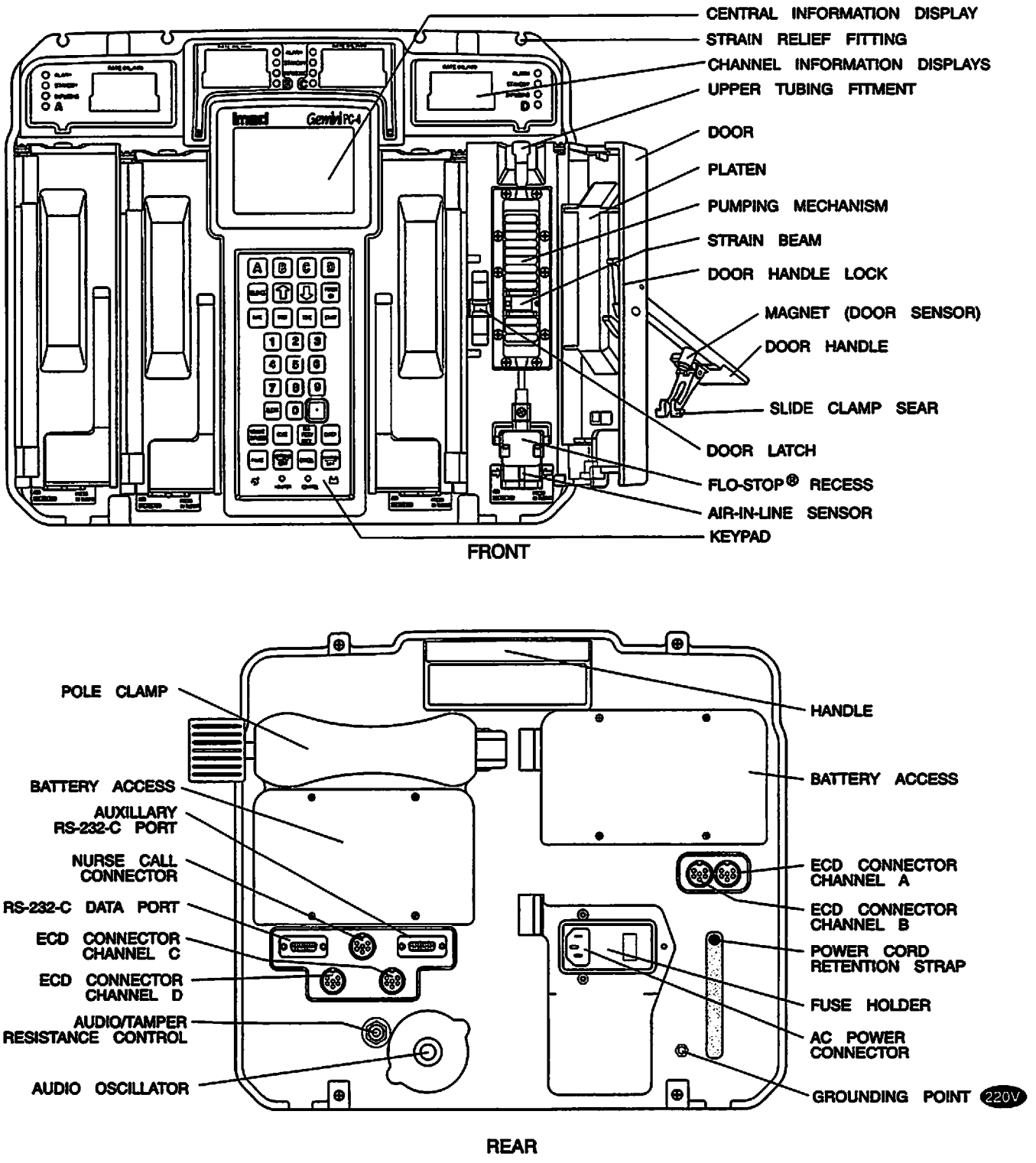


Figure 2-1. PC-4 Front and Rear Panel Operating Features

2.3.1 Pre-operational Check Battery Charge

The batteries are in a fully charged condition upon completion of the post manufacturing quality assurance inspection. However, since considerable time could elapse between manufacture and first use, a pre-operational battery charge is recommended. Connect the AC power cord to a suitable AC outlet and allow the battery to charge for 24 hours.

2.3.2 Pre-operational Electrical Inspection

The pre-operational electrical inspection includes an electrical leakage test and a ground continuity check.

CAUTION

Some of these tests are inherently hazardous. Safeguards for personnel and property should be employed when conducting such tests. Tests should only be performed by qualified personnel.

2.3.2.1 Electrical Leakage Test

Perform an electrical leakage current measurement in compliance with Underwriters Laboratories (UL) 544 for Patient Care Equipment or Canadian Standards Association (CSA) Standard C22.2 No. 125 for Risk Class 2G Equipment or IEC 601-1. Leakage currents are to be less than 100 microamperes.

2.3.2.2 Electrical Ground Test

Perform an electrical ground impedance measurement in compliance with UL 544 for Patient Care Equipment or CSA Standard C22.2 No. 125 for Risk Class 2G Equipment or IEC 601-1. The impedance between the grounding pin on the power cord plug and the grounding point on the rear case should not exceed 100 milliohms.

2.3.3 Abbreviated Operational Performance Test

The following operational performance test is designed to ensure that the PC-4's controls and indicators are functioning properly and all pumping mechanisms are in working order.

2.3.3.1 Test Requirements

The following items of laboratory equipment and supplies are required to conduct the operational performance tests:

1. Four (4) ALARIS Medical Systems GEMINI administrative sets (set # 2212) with upper injection sites.
2. Four (4) IV Solution Containers.
3. Standard IV Pole.
4. 10 mL burette.
5. Open-ended Air-in-line simulator (see Figure 2-2).
6. Pressure gauge of at least 0-20 psig (0-150 kPa) capability.
7. Safety Analyzer - Dynatech-Nevada Model 231D or equivalent.
8. Air-in-line simulator (see Figure 2-2).

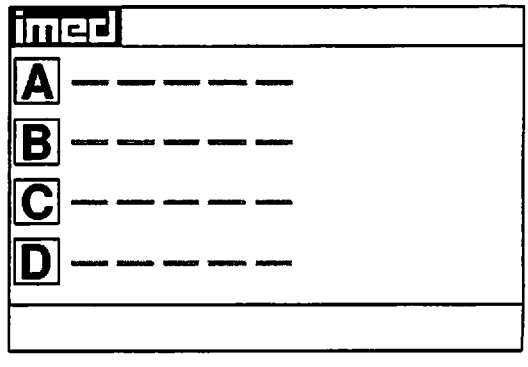
2.3.3.2 Test Procedures

The following tests and associated procedures are presented in a sequence that provides an efficient, qualitative check of instrument operability.

INITIAL SETUP

PC-4 keypad control locations are shown in Figure 3-1 and are functionally described in Table 3-1.

1. Mount pump on IV pole (leave AC power cord unplugged).
2. Fill IV fluid containers with water and hang on IV pole 24" (61 cm) above PC-4.
3. Spike and prime administration sets.
4. Press POWER ON Control and check:
   - Verify all LEDs illuminate then extinguish
   - Ensure all segments of the channel Rate displays illuminate
   - Ensure the channel information displays show [illegible] then extinguish
   - A single audio prompt sounds
   - The channel A rate display shows "- - - -"
   - Check the Central display for the IMED logo pattern, followed by the setup screen shown below:



7. Press SYSTEM OPTIONS/EDIT to select the Systems Options menu, then press 5 to select System Configuration.

8. Use the ↑ ↓ controls to toggle through the system configuration display to determine options available and the status of each option.

9. Press CANCEL twice to return to the Setup screen shown above.

CHARGING INDICATION

1. Connect AC Power cord to an AC power source and check:
   - AC Power Indicator - Illuminates.
2. Unplug AC Power cord from the AC power source and check:
   - AC Power Indicator - extinguishes.
3. Press POWER ON; following instrument initialization:
   - Battery Operation indicator - flashes.
4. Reconnect AC Power cord to the the instrument.
   - AC Power indicator - illuminates
   - Battery Operation indicator - extinguishes.

PUMP MODE TEST

NOTE

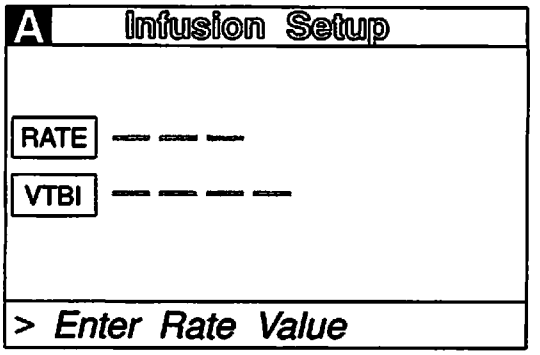
The following procedures are described for channel A and are applicable to all PC-4 channels.

1. Open the channel A access door and check:
   - The pumping mechanism "homes", i.e. pump mechanism rotates to a position where the #11 finger in fully extended.

2. Install a prepared GEMINI set in channel A and close the door. Ensure the fluid level in the container is 24" (61 cm) above the height of the strain beam.

3. Connect the distal end of the tubing set to the 10 mL burette.

4. Press A and check the Infusion Setup screen:



   - Press SYSTEM OPTIONS/EDIT, followed by 4 then use ↑ ↓ controls to select Pump mode
   - Press ENTER to confirm selection
   - Press CANCEL to exit channel options
   - Press RATE, then use the numeric data entry controls to input a rate parameter of 125 mL/hr
   - Press VTBI, then use the numeric data entry controls to input a VTBI parameter of 5 mL
   - Press VOLUME INFUSED, while the volume infused presentation is displaying press CLEAR to "0" the channel A primary, secondary and total volume infused.

5. Record the fluid level in the burette (there must be sufficient capacity in the burette to accept 5 mL of fluid).

6. Press START and observe:
   - "125" displays in the Channel Information rate display
   - INFUSING indicator - flashes
   - "5 mL" displays for channel A in the Central Information display.

7. When audio alert sounds and "INFUSION COMPLETE-KVO" scrolls, immediately press A followed by PAUSE and check:
   - Rate display shows "1"
   - "STANDBY" indicator - flashes
   - "INFUSING" indicator - extinguishes
   - VTBI value in Central display shows "0 mL".

8. Press VOLUME INFUSED and check:
   - PRI volume infused shows 5.0.

9. Record the fluid level in the burette; then compare that value from the initial reading in step 5. The difference should be between 4.75 and 5.25 mL.

10. Repeat steps 1 through 9 for channels B, C and D.

OUTPUT PRESSURE TEST

1. Connect the distal end of the tubing set to the pressure gauge.
2. Reset the channel A VTBI to 25 mL.
3. Press START and observe:
   - Pumping mechanism stops
   - Audio Alarm sounds
   - ALARM indicator - flashes
   - "OCCLUDED-PATIENT SIDE" scrolls continuously
   - Central Information displays shows ALARM for channel A.
4. Record pressure gauge reading on the data sheet immediately following alarm (reading must be between 8 and 12 psi [55.2 and 82.8 kPa]).
5. Press SILENCE to silence the audio, then press A followed by PAUSE.
6. Turn the stopcock on the pressure gauge to relieve the pressure.
7. Repeat steps 1 through 7 for channels B, C and D.
8. When all channels have been tested, press A or as appropriate, then CHANNEL OFF to power down the channel.

MAXIMUM PRESSURE TEST

1. Initialize instrument in the Maintenance Mode.
2. Press 2 to select M/C Board Tests and Displays.
3. Press 1 to select maximum pressure test.
4. Press A to select channel A.
5. Press START and allow the pump to operate for at least 30 seconds and wait until the peak pressure stabilizes.
6. Record the highest pressure reading obtained. **Resultant pressure must be ≥17 psi (117.3 kPa).**
7. Press CANCEL twice to return to the Maintenance Mode screen.
8. Turn stopcock on the pressure gauge to relieve the pressure.
9. Repeat steps 1 through 7 for channels B, C and D.
10. Press CANCEL twice, then 3 to power down the instrument.

AIR IN LINE TEST

1. Open the channel A access door and remove the administration set.
2. Install the pumping segment of the Air-in-line simulator into the channel A pumping mechanism, then press the tubing into the AIL detector.
3. Push the slide clamp in (the instrument will auto power on in Alarm mode).
4. Use the AIL simulator plunger to raise the fluid level to the top of the slide clamp fitment.
5. Close the door.
6. Set the rate to 125 mL/hr and VTBI to 50 mL and press START.
7. Use the AIL simulator plunger to draw the fluid level below the AIL detector.
8. Verify that within 2 seconds the PC-4 goes into AIL alarm:
   - Pumping stops
   - Operating LED indicator stops flashing
   - Alarm audio sounds
   - Alarm LED flashes
   - Channel Information display scrolls "AIR IN LINE"
   - Central Information display shows "ALARM" for appropriate channel.
9. Select the test channel and press CHANNEL OFF to power down or PAUSE to set up another channel for test.

If further quantitative testing is required to comply with hospital protocol for acceptance/qualification of new equipment, refer to the Comprehensive Operational Test Procedures described in Section 7 of this manual.

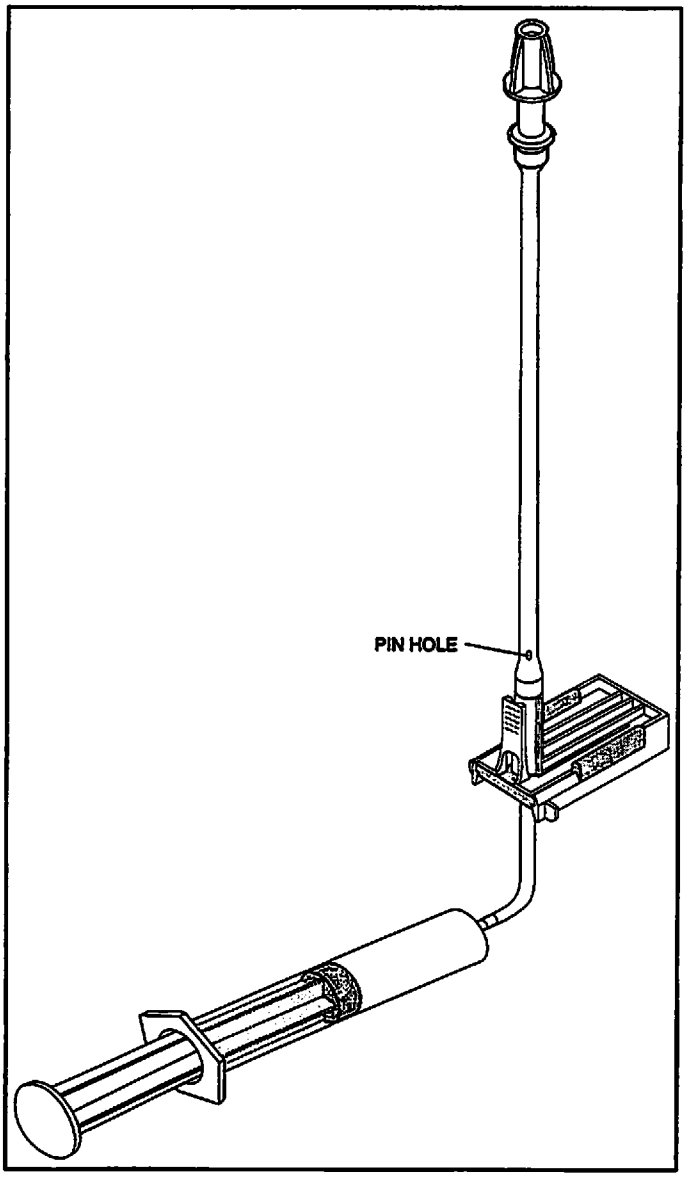


Figure 2-2. Air-in-line Simulator

PC-4 TEST DATA SHEET

Instrument Serial No._____ Software Version _____

Date _____ Technician _____

Test No.	Description	Reference	Record Result	Pass/Fail
1	Electrical Leakage Test	2.3.2.1	_____	Pass___/Fail___
2	Electrical Ground Test	2.3.2.2	_____	Pass___/Fail___
3	Initialization (INITIAL SETUP)	2.3.3.2	_____	Pass___/Fail___
4	Charging indication	2.3.3.2	_____	Pass___/Fail___
5	Pump Mode Tests	2.3.3.2	_____	Pass___/Fail___ Ch A
			_____	Pass___/Fail___ Ch B
			_____	Pass___/Fail___ Ch C
			_____	Pass___/Fail___ Ch D
	Output Pressure Test	2.3.3.2	_____	Pass___/Fail___ Ch A
			_____	Pass___/Fail___ Ch B
			_____	Pass___/Fail___ Ch C
			_____	Pass___/Fail___ Ch D
	Maximum Pressure Test	2.3.3.2	_____	Pass___/Fail___ Ch A
			_____	Pass___/Fail___ Ch B
			_____	Pass___/Fail___ Ch C
			_____	Pass___/Fail___ Ch D
	Air-In-Line Test	2.3.3.2	_____	Pass___/Fail___ Ch A
			_____	Pass___/Fail___ Ch B
			_____	Pass___/Fail___ Ch C
			_____	Pass___/Fail___ Ch D

Figure 2-3. PC-4 Abbreviated Test Data Sheet

SECTION 3 - OPERATION

3.1 INTRODUCTION

This section describes the recommended procedures for operation of the IMED® GEMINI (PC-4®) Volumetric Infusion Pump/Controller with software release 5.10.18.4. For operating procedures for instruments with earlier software releases, refer to the Operator's Manual provided with the instrument. The information is intended to provide maintenance technicians with a basic understanding of instrument operation including the audio alerts and visual displays.

NOTE

Although the PC-4 is built and tested to exacting specifications, it is not intended to replace the role of medical personnel in the supervision of IV infusions. The user is urged to exercise vigilance in the utilization of the PC-4.

3.2 CONTROLS AND INDICATORS

The controls and indicators used to set up and operate the PC-4 are illustrated in Figure 3-1 with the functional descriptions listed in Table 3-1.

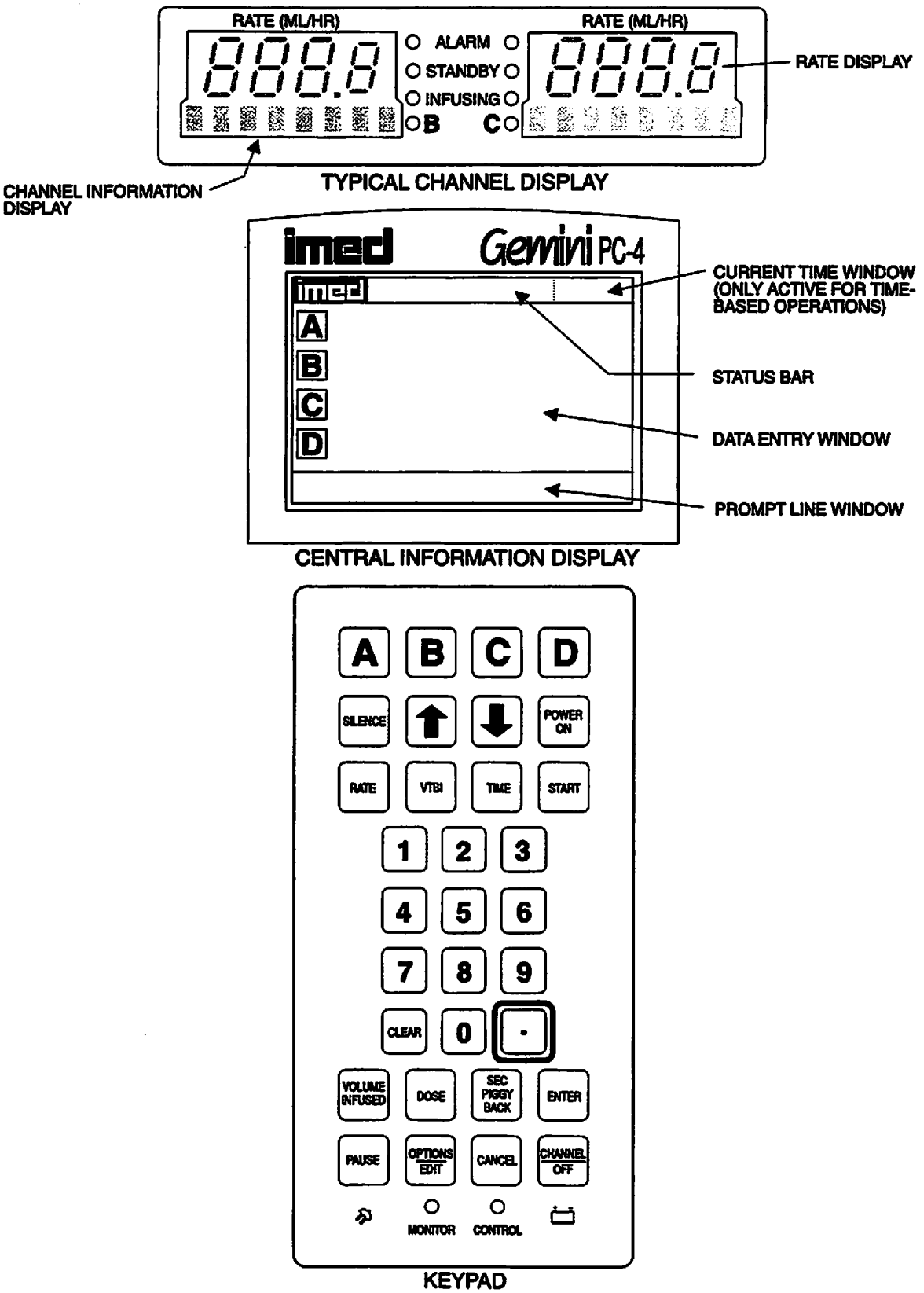


Figure 3-1. PC-4 Front Panel Controls and Indicators

Table 3-1. DESCRIPTION OF CONTROLS AND INDICATORS

Channel Information (Alarm/Status) Display - Channel A,B,C,or D displays various advisories, alarms, and malfunctions. (Refer to CHANNEL, CENTRAL INFORMATION DISPLAY AND ALARM RESPONSE PROCEDURES section of this manual for specific response procedures.)

RATE display - Channel A, B, C, or D - displays primary and secondary rate infusion parameters.

Channel Select A,B,C, or D indicators - when illuminated, indicate that the corresponding channel is selected for infusion parameter entry and infusion setup.

Standby indicator - illuminates when the channel is programmed for a future start time.

Alarm indicator - illuminates when the channel is in an alarm or infusion complete condition.

Infusing indicator - flashes when the channel is actively infusing.

Central Information Display - displays VTBI (volume-to-be-infused), current time of day and other operating parameters during operation of the instrument. During set up procedures, provides display for data entry, editing, confirmation and display of prompts, advisories and alarm conditions. The display backlight will extinguish 2 minutes after the last keypress.

Keypad

A to D — controls - when pressed once, selects the corresponding channel for infusion parameter entry and infusion setup.

PAUSE — when pressed during an infusion, the infusion for the selected channel is stopped. (After ≈2 minutes, the "PRESS START" visual and audio prompt begins.)

CHANNEL OFF or STOP OFF — when pressed, stops the infusion for the selected channel, deselects the selected channel, and if only that channel had been infusing, powers off the PC-4. Repeat for all other running channels to power off the PC-4. When pressed during a software-detected system malfunction, it powers off the PC-4.

RATE — when pressed, allows the rate infusion parameter on the selected channel to be changed using the appropriate data entry controls.

VTBI — when pressed, allows the VTBI parameter on the selected channel to be changed using the appropriate data entry controls.

0 to 9 — data entry controls - when pressed, allows sequential entry of Rate, VTBI and other numerical operating parameters.

. — when pressed, inserts a decimal point in numeric data.

TIME — when pressed, allows entry of time-related data inputs for delayed start and multidose infusions.

CLEAR — when pressed, clears the currently selected infusion parameter setting to "0". When pressed following a press of the Volume Infused control, clears the total, primary and secondary volume infused displays for the selected channel.

SILENCE — when pressed during an alarm, silences the audio for ≈2 minutes.

↑ and ↓ — when pressed, will increase or decrease the rate parameter with each keypress or will scroll up or down when pressed and held. Also used to select options in infusion setup sequences and to adjust contrast on the Central Information display through the options menu.

POWER ON — when pressed, applies electrical power to PC-4. If pressed during a hardware malfunction, silences audio alarm and turns off electrical power to all circuits.

START — when pressed, starts the infusion on the selected channel.

ENTER — when pressed following data entry in the Central Information display, confirms the entry and allows entry of data for the next step of the programming sequence.

+ − — indicator - when flashing, indicates the PC-4 is operating on battery power.

indicator - when illuminated, indicates the PC-4 is connected to an external power source.

VOLUME INFUSED — when pressed, will cause primary, secondary and total volume infused and secondary volume infused to display for all channels. With a channel selected, pressing will display primary, secondary and total volume infused and enable primary, secondary and total volume infused registers for clearing.

SEC PIGGY BACK — when pressed, allows the entry of secondary infusion parameters on the selected channel.

DOSE — when pressed, allows the entry of a medication dose in the drug calculation mode.

OPTIONS EDIT — when pressed, allows access to the available system or channel options and editing functions.

CANCEL — when pressed, discontinues the current programming sequence and returns the Central Information display to the previous display screen.

AUDIO/PANEL LOCK CONTROL (on rear panel) - when rotated, varies the audio volume; when pressed and held for 3 seconds with the tamper-resistant feature enabled, will lock out all of the keypad controls except VOLUME INFUSED and SILENCE; a repeat 3 second press will unlock the keypad controls.

Equipotentiality Grounding Point - Chassis ground.

3.3 OPERATING CONDITIONS

The GEMINI PC-4 is configured for independent (Normal Operation) or as a computer controlled device (Computer Operation). Normal operation includes two patient care delivery modes - Pump and Controller. A Maintenance Mode is also provided to allow biomedical personnel to troubleshoot and service the instrument. Computer operation encompasses a Monitor and Computer Control mode. Operating procedures for both normal and computer controlled operation are described in detail in paragraphs 3.3.1 and 3.3.2 respectively. Maintenance Mode capability and operation is addressed in paragraph 5.3.1 of Section 5 of this manual.

The PC-4 utilizes a Systems Configuration Mode to enable biomedical and other trained personnel to enable specific PC-4 operating features. Procedures for utilizing the System Configuration Mode are discussed in Section 3.3.1.2.

3.3.1 Normal Operation

The instrument's four channels are identical in all respects. A common keypad is used for programming and control. Individual channel select controls serve to interconnect the keypad with a specific channel for setting up specific infusion programs, inputting infusion parameters, starting, pausing and/or stopping instrument operation. The following procedural steps are applicable to all channels.

The Tamper-resistant feature is enabled in the System Configuation Mode and actuated with the Audio Control switch to lock out all the keypad controls except VOLUME INFUSED and SEC/PIGGYBACK which permit monitoring infusion progress, viewing infusion parameters and CLEAR/SILENCE to clear audio alerts when permitted.

3.3.1.1 Pump Controller and Selectable Modes

The decision to use the PC-4's Pump or Controller delivery mode for specific IV infusions resides with the patient's attending medical personnel. The instrument's occlusion parameters are predicated on the delivery mode selected and the positioning of the IV solution container to provide a nominal head height of 24 inches. With a 24 inch pressure head height and the instrument operating in the Controller mode, an occlusion will be sensed when the distal tubing in-line pressure exceeds bottle height pressure ±12 inches (30.5 cm) of bottle height. In the Pump mode, occlusion pressure is pre-set to 10 ±2 psi (69 ±14 kPa) for rates >30 mL/hr. At rates <30 mL/hr occlusion pressure is rate dependent to ensure timely occlusion detection. Instruments with software release 3.9.9.4 or earlier allow the PUMP mode occlusion pressure to be locked to 10 psi for all rates in System Configuration. This selection will effect all channels and will significantly extend time to occlusion for rates <30 mL/hr. Instruments with software release 4.10.14.0 and subsequent provide a Selectable mode, which allows the occlusion pressure to be set between 25 and 517 mmHg (0.5 and 10 psi) in 25 mmHg (0.5 psi) increments.

3.3.1.2 System Configuration

To enable the System Configuration mode press and hold the OPTIONS/EDIT control, then press POWER ON. System Configuration screen 1 of 4 will display. The ⏫⏬ controls are utilized to toggle between screens 1 through 4. The numeric keys are used to access a specific feature on the active screen. The selectable options are listed numerically by screen (default values are in bold print):

Clock Setup: **Military** AM/PM
- Use ⏫⏬ controls to select
- Press ENTER to confirm
- Use numeric controls to enter date mm/dd/yy
- Press ENTER to confirm
- Use numeric controls to enter time, if in AM/PM mode, use ⏫⏬ to select
- Press CANCEL to exit

Factory Set: **Yes** No
- Use ⏫⏬ to select Yes or No
- Press ENTER to Confirm

Maximum Rate: **999 mL/hr** 0-999 mL/hr
- Use numeric controls to enter rate
- Press ENTER to confirm and exit

C2 Port:

Baud Rate: 300, 600, 1200, 2400, 4800, **9600**, 19200
- Use ⏫⏬ to select baud rate
- Press ENTER to confirm

Data Frame: **N81** (Parity, Data bits and Stop bit) Factory set

Serial No.:
- Use numeric controls to enter Serial Number
- Press ENTER to confirm and exit

Comp. Ctrl.: **Enabled** Disabled
- Use ⏫⏬ to select
- Press ENTER to confirm

P/C/S Mode: **Pump** or Controller or Selectable
- Use ⏫⏬ controls to select then press ENTER for each channel

PC Mode Setup: **Unlocked** Locked
- Use ⏫⏬ to select
- Press ENTER to confirm and exit

Delay Start: **Enabled** Disabled
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

Drug Calc: **Enabled** Disabled
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

Multidose: **Enabled** Disabled
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

Dose Display: **Fixed** Temp
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

Battery Mode: Disabled Normal **High**
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

Key Audio: **Enabled** Disabled
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

Alarm Audio: **Profile 1** Profile 2 Profile 3
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

Switch Audio: **Enabled** Disabled
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

Tamper Mode: **Enabled** Disabled
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

Language: **English** (Only selection available)

Anesth. Mode: Enabled **Disabled**
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

Comp. Ctrl.: **Enabled** Disabled
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

Dynamic Press: **Enabled** Disabled
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

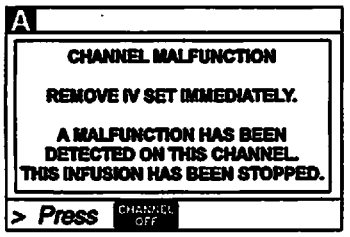
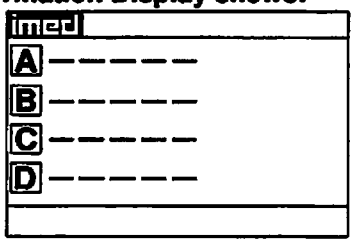
Press. Trend: **Enabled** Disabled
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

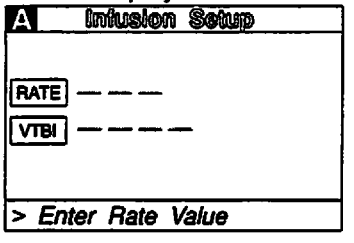
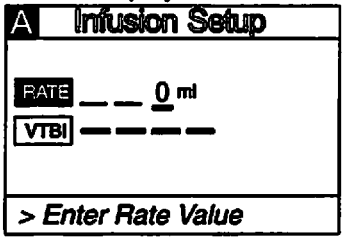
Vol. Time Inf: **Enabled** Disabled
- Use ⇧⇩ to select
- Press ENTER to confirm and exit

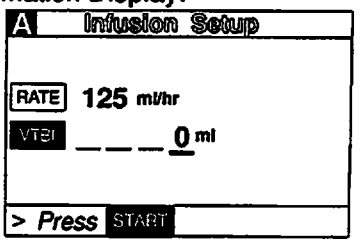
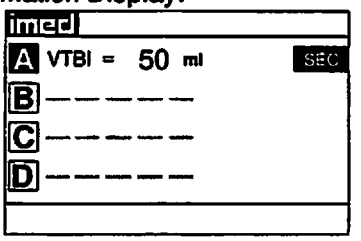
Press CHANNEL OFF to exit System Configuration Setup mode.

3.3.1.3 Independent Setup and Operating Procedures

The detailed procedures necessary to set up and operate the PC-4 are described in the following section.

ACTION/PROMPT	DISPLAY RESPONSE
To Set Up a Primary Infusion	
1. Connect the PC-4 to an external AC power source using the power cord supplied by ALARIS Medical.	• AC Power indicator - illuminates • Battery operation indicator - extinguishes
2. Press POWER ON.	
• If the following screen displays, remove the instrument from service. 	**NOTE** **During initialization, ensure the following occur:** **Channel Information Display:** • **All LEDs illuminate for 3 seconds** • **Rate displays show "888.8" then extinguish, except channel A which shows "----"** • **Message displays illuminate then extinguish.** **Central Information Display shows:** 
• An audio tone sounds once.	
NOTES **If displays appear abnormal, remove pump from service.** **If CHANNEL SELECT A,B,C or D control is not pressed within two minutes of pressing POWER ON, the PC-4 will automatically power down.**	

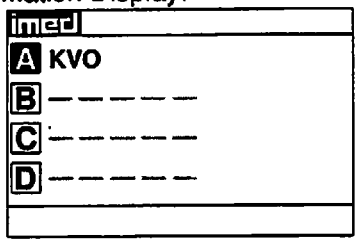
ACTION/PROMPT	DISPLAY RESPONSE
3. Open the GEMINI administration set package, remove set, and close the roller clamp. **Refer to the Directions For Use provided on the set packaging.**	
4. Insert the set spike into the prepared fluid container following accepted hospital procedure and hang the container a minimum of 24 inches above the PC-4.	
5. Fill the drip chamber approximately 2/3 full.	
6. Open the roller clamp slowly to prime the tubing and clear air from the injection sites and tubing fitments.	
7. Close the roller clamp.	
8. Open the door. Install the administration set pumping chamber by properly positioning the upper fitment into the upper fitment recess, and then inserting the Flo-Stop® fitment into the Flo-Stop recess below the pump mechanism, with the arrow pointing into the pump.	• Pump mechanism homes
9. ***Press the tubing into the Air-In-Line detector.***	
10. Close the door and open the roller clamp.	
11. Press **A**: • After 3 seconds "> *Enter Rate Value*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: • Channel indicator - illuminates • Rate display shows "- - - -" Central Information Display: 
12. Set the rate and VTBI.	
a. Press **RATE**: • After 3 seconds "> *Enter Rate Value*" displays • After 12 seconds audio prompt - sounds	Central Information Display: 
b. Use numeric data entry controls to enter rate parameter	• New rate value displays

ACTION/PROMPT	DISPLAY RESPONSE
c. Press VTBI • After 3 seconds "> *Enter VTBI Value*" displays • After 12 seconds audio prompt - sounds	Central Information Display: 
d. Use numeric data entry controls to enter VTBI parameter • After 3 seconds "> *Press* START" displays	• New VTBI value displays
13. Attach the set to the patient's vascular access device following accepted hospital procedure.	
14. Press START.	Channel Information Display: • INFUSION indicator - flashes • Rate display - Rate value displays Central Information Display: 
NOTES **Immediate air-in-line alarm after initial setup and operation may indicate that the administration set is not properly installed in the Air-In-Line detector.** **If enabled in System Configuration, the tamper-resistant feature may be initiated at this point. Press and hold the AUDIO control (rear panel) for 3 seconds until an audio tone sounds. The front panel is now locked out, and "PANEL KEYPAD LOCKED" will display for 3 seconds. The only controls that are operable are SILENCE and VOLUME INFUSED (for viewing only). The infusion may not be altered in any way until the tamper-resistant feature is canceled by repeating the 3 second AUDIO control press.**	
During infusion: **NOTE** **Various Advisories, Alarms, and Malfunctions may be displayed. Refer to the CHANNEL, CENTRAL INFORMATION DISPLAY AND ALARM RESPONSE PROCEDURES section in this manual for an explanation and appropriate response.**	Channel Information Display: • INFUSING indicator - flashes Central Information Display: • VTBI value - decrements
Upon completion of the infusion: • Audio prompt sounds.	Channel Information Display: • "INFUSION COMPLETE-KVO" scrolls • Rate display - shows 1 or set rate if <1.0 mL/hr • ALARM indicator - flashes

ACTION/PROMPT

DISPLAY RESPONSE

Central Information Display:



To Set Up a Primary Infusion with Volume/Time Option Enabled

1. Connect the PC-4 to an external AC power source using the power cord supplied by ALARIS Medical.

   - AC Power indicator - illuminates
   - Battery operation indicator - extinguishes

2. Press POWER ON.

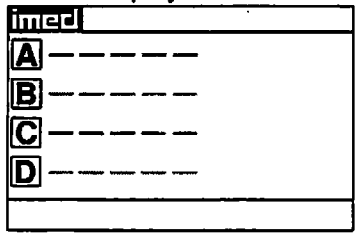
   - An audio tone sounds once.

   NOTE

   If CHANNEL SELECT A, B, C or D control is not pressed within two minutes of pressing POWER ON, the PC-4 will automatically power down.

   Channel Information Display:
   - All LEDs illuminate for 3 seconds
   - Rate displays show "888.8" then extinguish, except channel A which shows "- - - -"
   - Message displays illuminate then extinguish.

   Central Information Display shows:



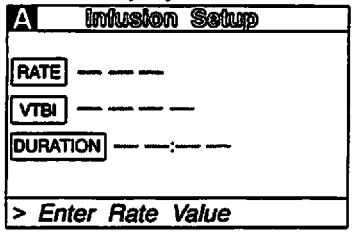
3. Prime and load the Gemini administration set as previously described under: **To Set up a Primary Infusion.**

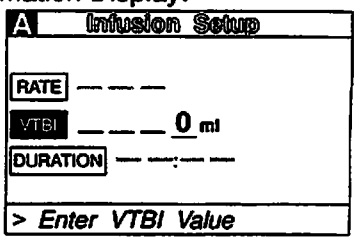
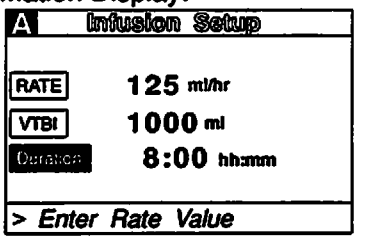
4. Press A:

   - After 3 seconds "> *Enter Rate Value*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   - Channel indicator - illuminates
   - Rate display shows "- - - -"

   Central Information Display:

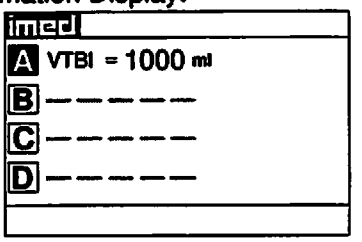


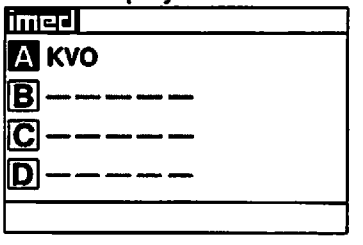
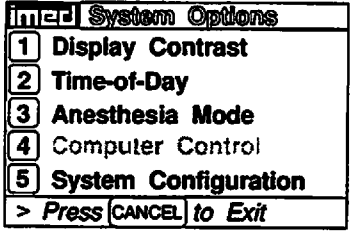
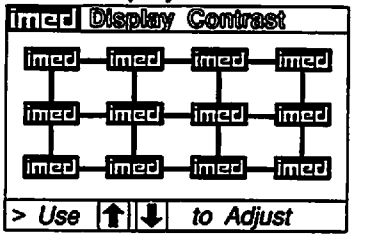
ACTION/PROMPT	DISPLAY RESPONSE
5. Set the VTBI and duration	Central Information Display: 
a. Press VTBI: • After 3 seconds "> *Enter VTBI Value*" displays • After 12 seconds audio prompt - sounds	
b. Use numeric data entry controls to enter VTBI parameter	• New VTBI value displays
c. Press TIME or ENTER • After 3 seconds "> *Enter Rate Value*" displays • After 12 seconds audio prompt - sounds	Central Information Display: 
d. Use numeric data entry controls to enter duration parameter • As Duration parameters are entered, the rate value displays • After 3 seconds "> *Press* START" displays	• New duration value displays • Calculated rate value displays

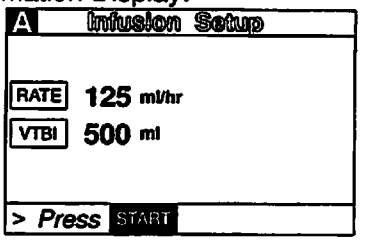
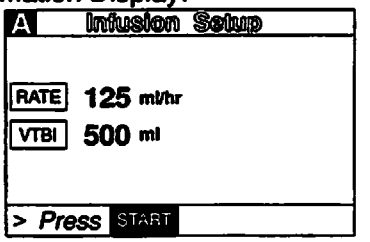
NOTES

It is acceptable to enter either a rate and VTBI or a VTBI and duration. If a rate and VTBI are entered that result in a duration of less than 1 minute, the duration will display as "<1 minute".

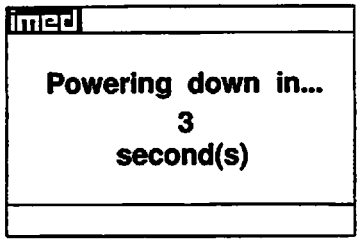
The rate calculation resulting from a Volume/Time parameter input is rounded to the nearest whole number for rates greater than 20 mL/hr.

6. Attach the set to the patient's vascular access device following accepted hospital procedure.	
7. Press START.	Channel Information Display: • INFUSION indicator - flashes • Rate display - Rate value displays Central Information Display: 

ACTION/PROMPT	DISPLAY RESPONSE
During infusion:	
NOTE **Various Advisories, Alarms, and Malfunctions may be displayed. Refer to the CHANNEL, CENTRAL INFORMATION DISPLAY AND ALARM RESPONSE PROCEDURES section in this manual for an explanation and appropriate response.**	Channel Information Display: • INFUSING indicator - flashes Central Information Display: • VTBI value - decrements
Upon completion of the infusion: • Audio prompt sounds.	Channel Information Display: • "INFUSION COMPLETE-KVO" scrolls • Rate display - shows "1" or set rate if <1.0 mL/hr • ALARM indicator - flashes Central Information Display: 
To Adjust Central Information Display Contrast	
1. Press SETUP/EDIT. • After 3 seconds "> *Press* CANCEL *to Exit*" displays	Central Information Display: 
2. Press 1:	Central Information Display: 
3. Use the ↑ ↓ controls to adjust the contrast of the central display. • After 3 seconds "> *Press* ENTER *to confirm*" displays	Central Information Display: • Display contrast increases with each press of ↑ and decreases with each press of ↓.
4. Press ENTER.	Central Information Display: • Returns to System Options screen
5. Press CANCEL to return to initial screen.	Central Information Display: • Returns to initial screen

ACTION/PROMPT	DISPLAY RESPONSE
To Pause an Infusion	
1. Press A...D to select channel. • After 3 seconds "> *Press* START" displays • After 12 seconds audio prompt - sounds	Channel Information Display: • Channel indicator - illuminates • INFUSING indicator - flashes Central Information Display: 
2. Press PAUSE. • After 3 seconds "> *Press* START" displays • After 12 seconds audio prompt - sounds	Channel Information Display: • INFUSING indicator - extinguishes • STANDBY indicator - flashes • "PAUSE" advisory scrolls. Central Information Display: NO CHANGE
3. Press START to resume the infusion.	Channel Information Display: • STANDBY indicator - extinguishes • INFUSING indicator - flashes • Message display - blanks Central Information Display: • Returns to infusing screen
To Stop a Primary Infusion	
1. Press A...D to select channel. • After 3 seconds "> *Press* START" displays • After 12 seconds audio prompt - sounds	Channel Information Display: • Channel indicator - illuminates Central Information Display: 
	• Channel indicator - flashes
2. Press CHANNEL OFF. **NOTE** **If only one channel is in use, the PC-4 will automatically power down.**	Channel Information Display: • INFUSING indicator - extinguishes • Channel indicator - extinguishes • Rate display - blanks

ACTION/PROMPT	DISPLAY RESPONSE
	Central Information Display: • Selected channel display - extinguishes **or** if only one channel active:



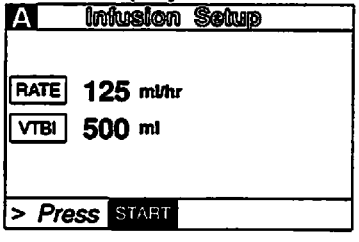
- Time value decrements from 3 to 1, then the PC-4 powers down

To Change Rate or VTBI During Primary Infusion

1. Press A ... D to select channel.
   - After 3 seconds "> *Press* START" displays
   - After 12 seconds audio prompt - sounds

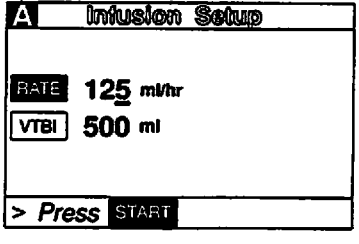
Channel Information Display:
- Channel indicator - illuminates

Central Information Display:



2. Press RATE or VTBI.
   - After 3 seconds "> *Press* START" displays
   - After 12 seconds audio prompt - sounds

Central Information Display:



3. Use the numeric data entry controls to change rate or VTBI. The ↑ ↓ controls can also be used to change rate.
   - After 3 seconds "> *Press* START" displays
   - After 12 seconds audio prompt - sounds

Channel Information Display:
NO CHANGE

Central Information Display:
- Rate or VTBI parameter changes to new value

4. Press START.

Channel Information Display:
- New rate value displays

Central Information Display:
- Returns to active infusion screen

NOTE

If new rate and/or VTBI parameters have been selected, but not confirmed by pressing START or PAUSE; the currently confirmed parameters can be recalled by pressing Rate (VTBI), then pressing the CANCEL control.

ACTION/PROMPT	DISPLAY RESPONSE

If the Volume/Time infusion option has been enabled, the duration parameter may also be changed as described above for Rate and VTBI.

NOTE

An infusion setup sequence may be interrupted to respond to a situation on another channel by selecting the other channel, taking appropriate action and then pressing START. To return to the interrupted infusion setup, re-select the channel, press ENTER to continue the programming sequence or press CANCEL to return to the original operating parameters.

To Titrate RATE

1. Press A...D to select channel.

   Channel Information Display:
   - Channel indicator - illuminates

   Central Information Display:
   - Infusion Setup screen displays

2. Use ↑ control to increase or ↓ control to decrease the rate parameter in 1 or 0.1 mL/hr increments
   or
   Press and hold the ↑ or ↓ control to scroll to a new rate parameter
   - After 3 seconds "> *Press* START" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE

   Central Information Display:
   - Rate graphic is highlighted
   - New rate value is displayed

3. Press START.

   Channel Information Display:
   - New rate value displays

   Central Information Display:
   - Returns to active infusion screen

To Change the Pressure Limit Mode (PCS Mode control unlocked)

NOTE

There are three operating pressure limits that can be enabled: the Pump mode (P) which automatically sets the occlusion pressure based on the rate of infusion, the Controller mode (C) which senses the gravity pressure and adjusts the occlusion detection to this measurement and the Selectable (S) mode which allows the operator to set the occlusion detection pressure from 25 to 517 mm Hg (0.5 to 10 psi). During operation in the P and S pressure modes, the dynamic pressure detected at the pump is displayed for each channel. To ensure accuracy of this measurement, set the height of the IV fluid 24 inches (61 cm) above the mid-point of the instrument.

1. Press A...D to select channel.

   Channel Information Display:
   - Channel indicator - illuminates

   Central Information Display:
   - Infusion Setup screen displays

ACTION/PROMPT	DISPLAY RESPONSE
2. Press OPTIONS/EDIT. • After 3 seconds "> *Press 1-5 or* ↑ *or Cancel"* displays • After 12 seconds audio prompt - sounds **NOTE** **Selected mode displays next to pressure limits (i.e. P, S)**	Channel Information Display: NO CHANGE Central Information Display: A Chan Options 1 of 2 1 Delayed Start 2 Drug Calculation Setup 3 Pressure History 4 Pressure Limits - P 5 Stop Infusion > *Press 1-5 or* ↑ *or Cancel*
3. Press 4. • After 3 seconds "> *Press 1-5 or* ↑ *or Cancel"* displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: A Chan Options 1 of 2 1 Delayed Start 2 Drug Calculation Setup 3 Pressure History 4 Pressure Limits - P 5 Stop Infusion > *Press 1-5 or* ↑ *or Cancel*
4. Use ↑ ↓ to select "Pump", "Controller" or "Selectable". • After 3 seconds "> *Press Enter to Confirm"* displays	Channel Information Display: NO CHANGE Central Information Display: • When option is selected, option screen is entered.

NOTE

If selectable pressure mode is chosen, press ENTER and then use ↑ ↓ controls to select the desired patient side occlusion pressure limit (between 25 and 517 mm Hg in 25 mm Hg increments), then press ENTER to confirm.

5. Press ENTER. • After 3 seconds "> *Press 1-5 or* ↑ *or Cancel"* displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • Channel Options screen displays
6. Press CANCEL. • If PCS Mode is changed during an active infusion, press START to resume infusion.	Channel Information Display: NO CHANGE Central Information Display: • Infusion Setup screen displays

ACTION/PROMPT | DISPLAY RESPONSE

To View Pressure History for Selected Channel

NOTE

The pressure history screen provides the previous 2 hours of average operating pressure. Each vertical line represents a 2 minute average. The – on the right side represents the occlusion pressure set point. A "+" in the upper portion of the screen indicates one or more occlusion alarms occurred during the 2 minute history period. The history display is reset when the channel is turned off. The number in the right margin is the current pressure readout in mm Hg.

1. Press A ... D to select channel.
   - After 3 seconds "> *Press* START" displays
   - After 12 seconds audio prompt - sounds

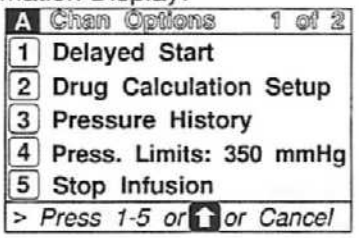
   Channel Information Display:
   - Channel indicator - illuminates

   Central Information Display:
   - Infusion Setup screen displays

2. Press OPTIONS/EDIT.
   - After 3 seconds *"> Press 1-5 or ↑ or Cancel"* displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE

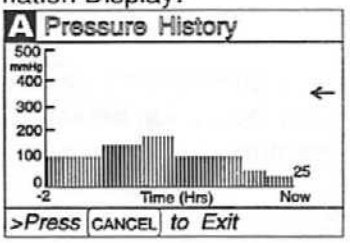
   Central Information Display:



3. Press 3.
   - After 3 seconds "> *Press* CANCEL *to Exit*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE

   Central Information Display:



4. Press CANCEL.

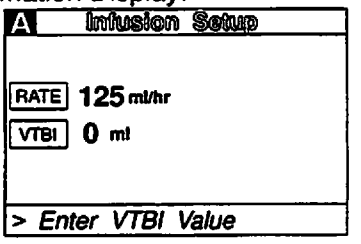
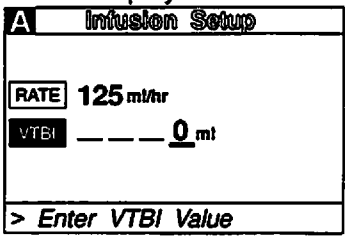
   Channel Information Display:
   - Channel indicator - illuminates

   Central Information Display:
   - Returns to active infusion screen

To Restart an Infusion Following an "INFUSION COMPLETE - KVO" or "EMPTY CONTAINER-KVO" advisory

1. Press A ... D to select channel.
   - After 3 seconds "> *Enter VTBI Value*" displays

   Channel Information Display:
   - Rate display - shows "1" or set rate if <1.0 mL/hr
   - "INFUSION COMPLETE-KVO" or "EMPTY CONTAINER-KVO" scrolls

ACTION/PROMPT	DISPLAY RESPONSE
	Central Information Display: 
2. Press VTBI.	Channel Information Display: NO CHANGE Central Information Display: 
3. Use the numeric data entry controls to set a new VTBI.	Channel Information Display: NO CHANGE Central Information Display: • New VTBI displays
4. Replace solution container and refill drip chamber, if necessary.	
5. Change rate, if necessary.	
6. Press START.	Channel Information Display: • Set rate displays • INFUSING indicator - flashes • Message display - blanks Central Information Display: • Returns to active infusion screen

NOTE

If the Volume/Time infusion option has been enabled, the duration parameter may also be changed as described above for Rate and VTBI.

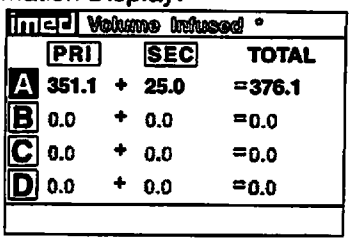
To View Primary, Secondary and Total Volume Infused for all Channels Simultaneously

1. Press VOLUME INFUSED. • Active channel indicators are highlighted	Channel Information Display: NO CHANGE

ACTION/PROMPT

DISPLAY RESPONSE

Central Information Display:

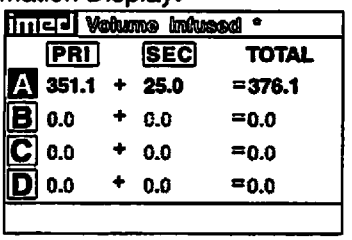


* Example Values

To Clear Primary, Secondary and Total Volume Infused for all Channels Simultaneously

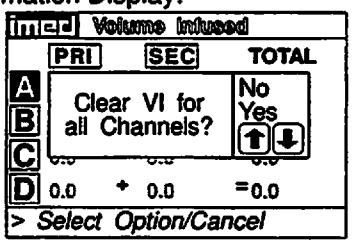
1. Press VOLUME INFUSED.
   - Active channel indicators are highlighted

   Channel Information Display:
   NO CHANGE
   Central Information Display:



2. Press CLEAR.
   - After 3 seconds "> *Select Option/Cancel*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE
   Central Information Display:



3. Use ↑ ↓ to select "Yes".
   - After 3 seconds "> *Press* ENTER *to confirm*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE
   Central Information Display:
   - Selected option is highlighted

4. Press ENTER.

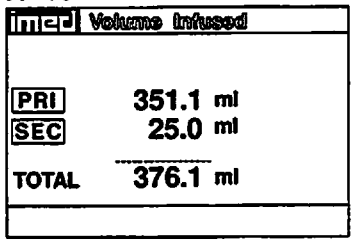
   Channel Information Display:
   NO CHANGE
   Central Information Display:
   - Returns to active infusion screen

To View Primary, Secondary and Total Volume Infused on Selected Channel

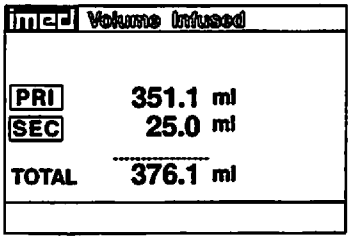
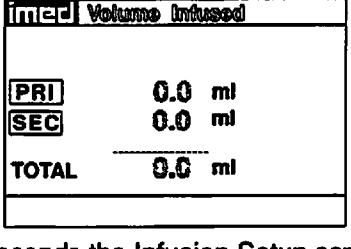
1. Press A...D to select channel.
   - After 3 seconds "> *Press* START" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   - Channel indicator - illuminates

   Central Information Display:
   - Infusion Setup screen displays

ACTION/PROMPT	DISPLAY RESPONSE
2. Press VOLUME INFUSED.	Channel Information Display: NO CHANGE Central Information Display: • Channel specific volume infused screen displays for 10 seconds:  • After 10 seconds the Infusion Setup screen re-displays
3. Press START or CANCEL to deselect channel.	Channel Information Display: • Channel indicator - extinguishes Central Information Display: • Returns to active infusion screen

To Clear Primary, Secondary and Total Volume Infused on Selected Channel

1. Press A...D to select channel. • After 3 seconds "> *Press* START" displays • After 12 seconds audio prompt - sounds	Channel Information Display: • Channel indicator - illuminates Central Information Display: • Infusion Setup screen displays
2. Press VOLUME INFUSED.	Channel Information Display: NO CHANGE Central Information Display: • Channel specific volume infused screen displays for 10 seconds: 
3. Press CLEAR while the Volume Infused screen is displaying to clear all Values to "0".	Channel Information Display: NO CHANGE Central Information Display:  • After 3 seconds the Infusion Setup screen re-displays

ACTION/PROMPT	DISPLAY RESPONSE
4. Press START or CANCEL to deselect channel.	Channel Information Display: • Channel indicator - extinguishes Central Information Display: • Returns to active infusion screen

To Set Up Secondary (Piggyback) Infusion With Dual Rates

NOTE

The PC-4 will only allow Secondary infusion rate and VTBI parameters in the same delivery modes (PUMP/CONTROLLER/SELECTABLE) and numerical values (fractions vs integer) as the Primary rate and VTBI infusion parameters.

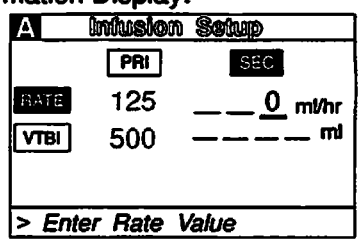
1. Set up and start the Primary infusion (using a check valve administration set) as previously described.
   - The Secondary infusion may be set up prior to or after starting a Primary infusion.
2. Open the GEMINI Secondary administration set package, remove set, and close clamp.
3. Insert the set spike into the prepared fluid container and hang the Secondary container following accepted hospital procedure.
4. Fill the drip chamber ≈2/3 full.
5. Open the Secondary set and prime the set. Close clamp.
6. Attach the Secondary set to the upper injection site on the Primary set.
7. Lower the Primary fluid container using the hanger provided with the Secondary set.
8. Press A ... D to select channel.

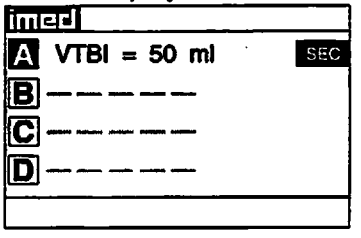
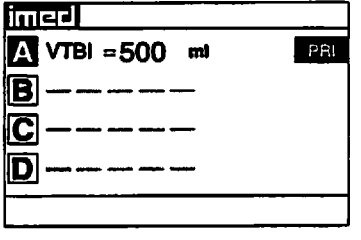
   Channel Information Display:
   - Channel indicator - illuminates
   - INFUSING indicator - continues flashing

   Central Information Display:
   - Infusion Setup screen displays
9. Press SEC PIGGY BACK.
   - After 3 seconds "> *Enter Rate Value*" displays
   - Rate parameter is automatically selected

   Channel Information Display:
   NO CHANGE

   Central Information Display:



ACTION/PROMPT	DISPLAY RESPONSE
10. Use numeric data entry or ⬆ ⬇ controls to enter or change rate value. • After 3 seconds ">Enter VTBI Value" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display • New rate value displays
11. Press VTBI. • After 3 seconds "> *Enter VTBI Value*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • Last programmed secondary VTBI value displays
12. Use numeric data entry controls to enter or change VTBI value, then press ENTER to confirm. • After 3 seconds "> *Press* START" displays • After 12 seconds audio prompt - sounds	
13. Open clamp on the Secondary set.	
14. Press START.	Channel Information Display: • Channel indicator - extinguishes • Secondary rate - displays • "SECONDARY" message scrolls Central Information Display: 
During Infusion: **NOTE** **Various Advisories, Alarms, and Malfunctions may be displayed. Refer to the CHANNEL, CENTRAL INFORMATION DISPLAY AND ALARM RESPONSE PROCEDURES section in this manual for an explanation and appropriate response.**	Channel Information Display: • INFUSING indicator - flashes • Secondary rate - displays Central Information Display: • VTBI (Secondary) - decrements
Upon Completion of the Secondary infusion: • Switchover audio alert (6 beeps) - sounds (unless disabled in System Configuration) **NOTE** **Actual changeover from the Secondary to the Primary IV solution is accomplished independently of pump/controller operation and occurs when the fluid level in the Secondary container drops to the same level as the fluid level in the Primary fluid container.**	Channel Information Display: • Primary rate displays • Message screen clears Central Information Display: 

ACTION/PROMPT	DISPLAY RESPONSE

To Set Up Secondary (Piggyback) Infusion With Dual Rates and Volume/Time Infusion Option Enabled

1. Set up and start the Primary infusion (using a check valve administration set) as previously described.
   - The Secondary infusion may be set up prior to or after starting a Primary infusion.
2. Set up the GEMINI Secondary administration set as previously described.
3. Press A...D to select channel.

   Channel Information Display:
   - Channel indicator - illuminates
   - INFUSING indicator - continues flashing

   Central Information Display:
   - Infusion Setup screen displays
4. Press SEC PIGGY BACK.
   - After 3 seconds "> *Enter Rate Value*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE

   Central Information Display:

   A Infusion Setup
   PRI SEC
   RATE 125 ——— ml/hr
   VTBI 500 ——— ml
   Duration ———
   > *Enter Rate Value*
5. Press VTBI.
   - After 3 seconds "> *Enter VTBI Value*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE

   Central Information Display:

   A Infusion Setup
   PRI SEC
   RATE 125 ——— ml/hr
   VTBI 500 ___0 ml
   Duration ———
   > *Enter VTBI Value*
6. Use numeric data entry controls to enter or change VTBI value.
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE

   Central Information Display:
   - New VTBI value displays
7. Press TIME or ENTER.
   - After 3 seconds "> *Press* START" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE

   Central Information Display:
   - Last programmed duration displays
8. Use numeric data entry controls to enter or change duration.
   - Rate value is calculated and displayed
   - After 3 seconds "> *Press* START" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE

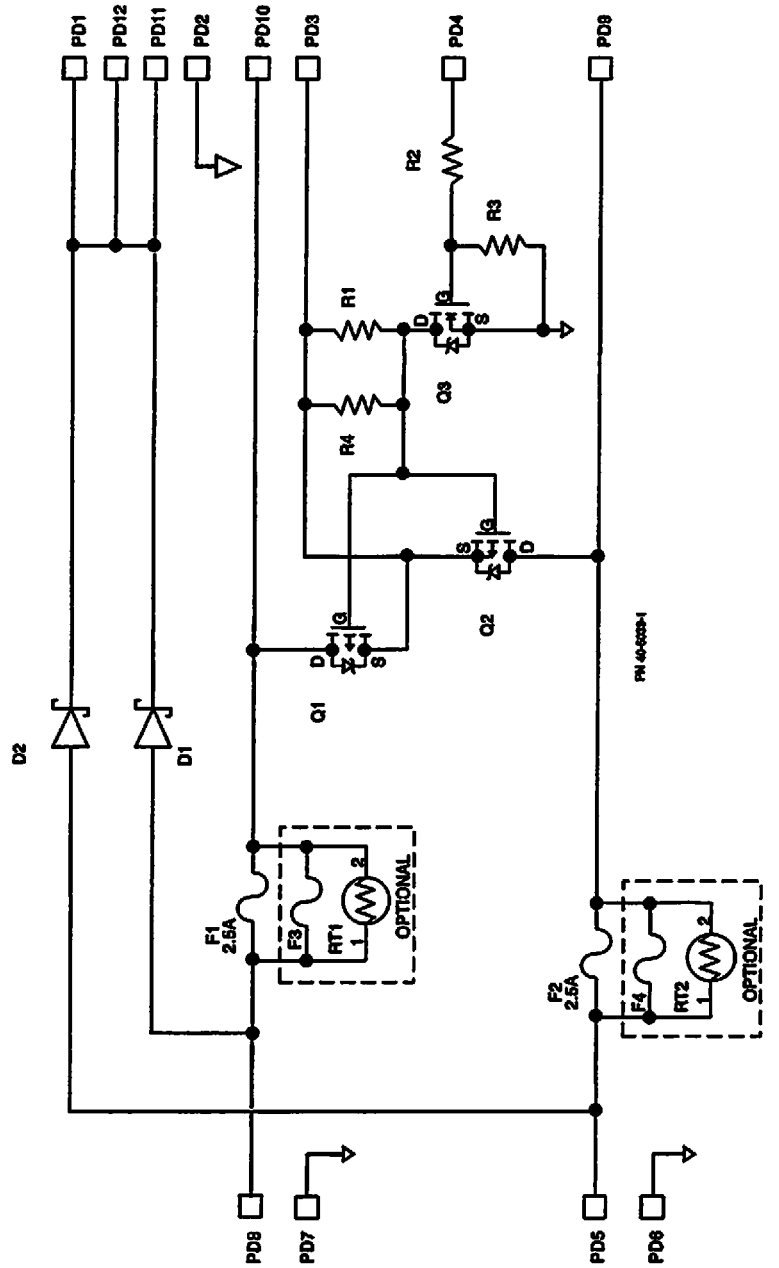


Figure 4-7. Schematic, SPC, PC-4XL, P/N 1340-5039-1

NOTE: No parts on this board are stocked.
If board is defective it must be replaced.

With the spring clips in place, the M.A.C. assembly forms an electrical circuit connecting J-1, pin 2 on the AIL board connector to J-1, pin 3 (+5 volts) on the appropriate motor control board. If the instrument is subjected to an impact load above a preset magnitude, the spring clip(s) will be dislodged; thereby, interrupting the circuit and causing a "HELP INTERNAL ERROR" message to scroll on the Channel information display for the affected channel(s) when the instrument is powered on. In addition, an error code will appear on the Central Information Display. The error code will be one of those associated with an air-in-line problem since the circuit is part of the AIL subsystem.

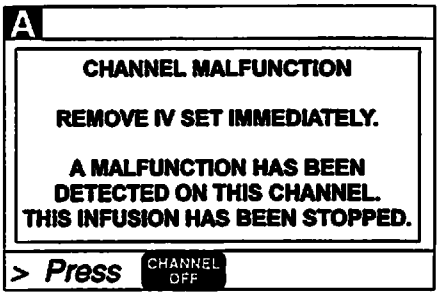


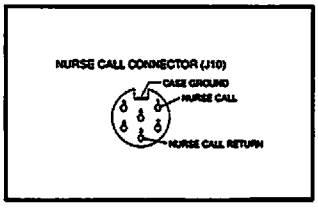
Table 4-1. RS-232-C Communications Data Port Signal Definitions

Signal Name	Number	Direction	Definition
GND (Ground)	1	Host	Not tied to chassis ground on the PC-4. To be used only for protective shielding. The shield should only be connected to chassis ground on the host computer end.
TxD (Transmit Data)	3	PC-4 to Host	Serial data transmitted to host computer from PC-4.
RxD (Receive Data)	2	Host to PC-4	Serial data transmitted to PC-4 from host computer.
RTS (Request to Send)	7	PC-4 to Host	When asserted, RTS indicates to the host computer that the PC-4 has information to transmit. Can be used to tell the host computer to wait.
CTS (Clear to Send)	8	Host to PC-4	Asserted by the host computer to enable the PC-4 to transmit data.
DSR (Data Set Ready)	6	Host to PC-4	DSR indicates to the PC-4 that the host computer is capable of communications. (Connected and power on).
Signal Ground	5	PC-4 to Host	Common signal return to TxD, RxD, DTR, DSR, RTS and CTS.
DTR (Data Terminal Ready)	4	PC-4 to Host	DTR indicates to the host computer that the PC-4 is capable of communication. (Connected and power on).
Not Connected	9		

The LCD display is a self-contained module that interfaces to the main processor via the data bus. The module looks like RAM to the main processor. The backlight and contrast control logic reside on the main logic board. Q4 and Q5 (Figure 4-13 Series, Sheet 3) of the logic board control the backlight. U4, U24 and U26 control the contrast adjustment.

4.3.2.15 Nurse Call System

During normal instrument operation (Nurse Call system - not activated) processor output to the Nurse Call circuit is high. When the processor detects a condition (malfunction, alarm or "Press Start" prompt) that dictates activation of the Nurse Call system, a high is sent through the I/O expander (U16, pin 13), to pin 10 of OR gate U37. The output of U37 at pin 3 goes high and is inverted by Q1 allowing current to flow through the K1 relay coil, closing the contacts and actuating the Nurse Call system. A watchdog malfunction will input a high at U37 pin 9 causing the output of the gate to also go high, subsequently energizing the K1 relay coil and activating the Nurse Call system.



4.3.2.16 Keyboard Interface

The PC-4 keyboard consists of an integrated module with the keypad controls on one side of the board and the control circuits mounted on the other side of the board. The control circuitry consists of two keyboard decoders and an eight bit comparator. The decoders control all keyboard scanning functions and generates an interrupt signal, ("data available 1/2"), to the main processor when a key has been depressed. The keyboard interfaces to the main processor via the data bus and two decoded read lines. When a control is pressed, one of two data available lines will interrupt the main processor. The main processor will respond by asserting one of the encoded read lines, "readkbd1 or readkbd2", and then reading the output of the keyboard encoders on the data bus.

If a watchdog condition exists, the logic board will issue a "watchdog enabled" signal to the keyboard enabling the 8 bit comparator. The comparator compares the hardwired code for the stop key and the output of the appropriate keyboard decoder for a match. Once the stop key has been pressed, the comparator issues the "watchdog power off" signal to U25 (Figure 4-13 Series, Sheet 3) of the logic board. U25 then removes the power on drive to the power supply turning off the instrument.

4.3.2.17 Communications Interface and Signal Definitions

To interface a host computer system with the PC-4, the interface cable must be configured with a 9-pin 'D' subminiature male connector with jackscrews for mechanical interconnection. Figure 4-13 Series illustrates the circuit for the RS-232-C Communications Data Port connector. Signal voltage levels are ±8VDC. Signal characteristics conform to RS-232-C Standards. Pin 5 of the Communications Data Port connector is connected to logic ground on the power supply board and is only to be used for common signal return for TxD, RxD, DTR, DSR, RTS and CTS. Pin 1 of the Data Port connector is connected. Flash EPROM programming circuitry is not to be used. The interface cable shield should only be attached to chassis ground on the host computer end of the cable. Pin 9 is also for Flash programming and should not be used. Table 4-1 defines the signals and identifies the pin numbers used to interface a host computer to the PC-4. The instrument utilizes ALARIS Medical C2 Communications Protocol which can be found in the C2 Programmers Guide.

NOTE

Maximum leakage current to chassis ground from connected ancillary equipment must not exceed 100µA.

4.3.2.18 Mechanism Alarm Circuit (M.A.C.)

The mechanism alarm circuit is an integral feature of the PC-4 pumping mechanism installation. The copper-bronze spring clips which are part of the upper and lower M.A.C. top plate are attached to the hinged side of the pump mechanism housing.

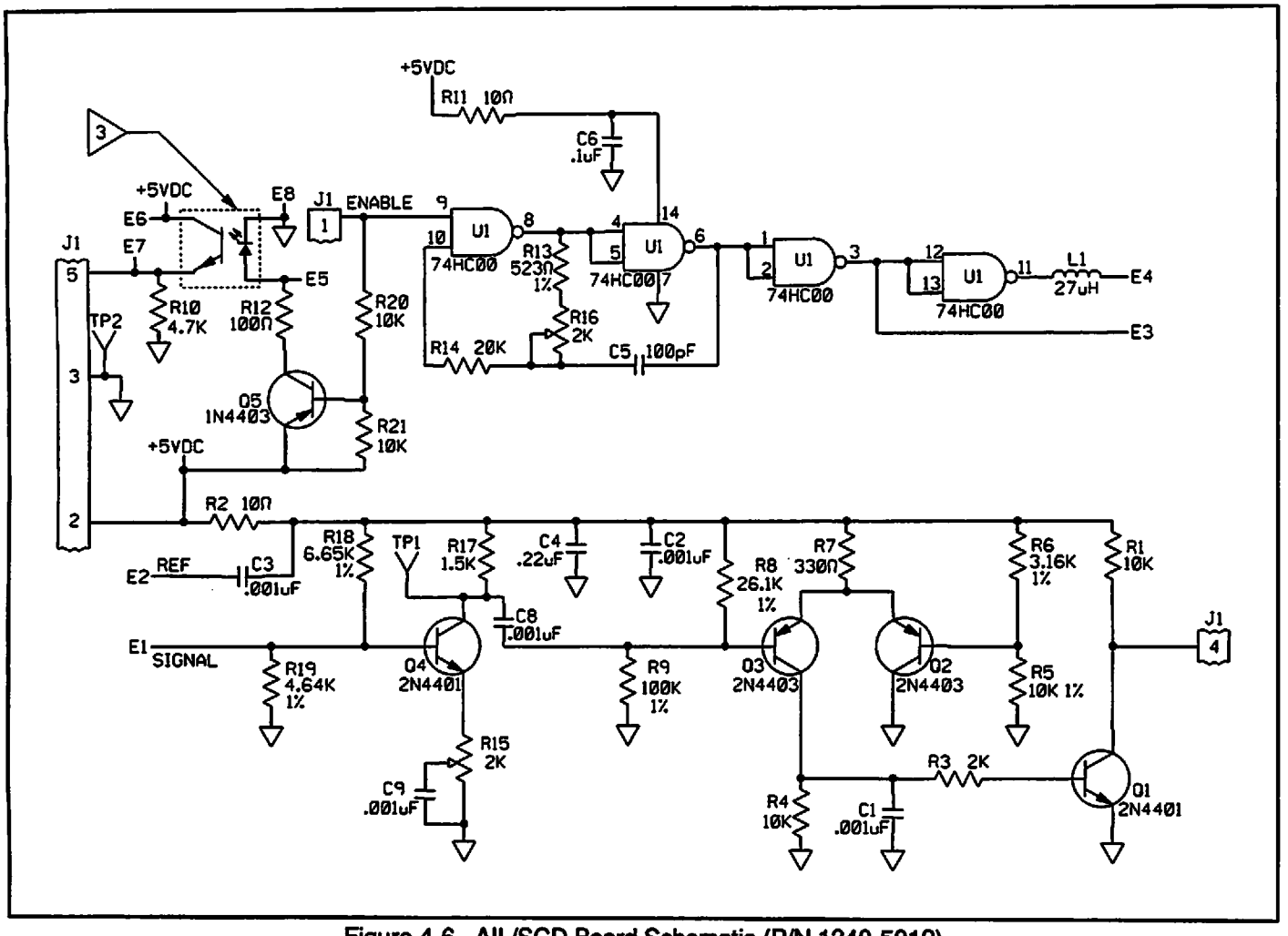


Figure 4-6. AIL/SCD Board Schematic (P/N 1340-5012)

4.3.2.14 Display Subsystem

The display subsystem consists of four rate and message displays, one for each channel, four led indicators per channel and a LCD central message display.

The channel A rate display consists of the four 7-segment displays, DS4 to DS7, RA1 and U1. U1 interfaces to the main processor via the lower four bits of the data bus, D0 to D3 and the data bus line D7. The driver IC controls all drive and multiplexing functions for the rate displays.

The message display consists of IC U2, an eight *digit dot matrix* display. All character control, drive and multiplexing functions are implemented within U2. U2 interfaces to the main processor via the data bus and six address lines.

Each channels rate and message works the same as channel A except that the rate displays for channels B and C use the same driver IC while channels A and D each have their own driver.

The channel select LEDs and the four LED indicators on the keyboard for battery operation, AC power operation, communications enabled and communications traffic are driven by the unused decimal point locations of channel B and C's driver IC.

The segment error circuitry is located on the center display board and consists of Q1 and associated diodes and resistors. The error circuit detects open segments.

	AIL HI	AIL LO
TRANSITION A	AIR	LIQUID
TRANSITION C	CKT OK	CKT FAULT

The calculation of air bolus size is based on the assumption that at a given delivery rate air and fluid will pass through the sensor at a uniform rate. The length of time required for an air bolus to pass through the detector is measured by counting the number of motor pulses when the sensor is "seeing" air. Time is therefore measured in number of interrupts per bolus. When the resultant time exceeds the time required for 38 motor steps, the instrument enters an "AIR-IN-LINE" alarm condition.

4.3.2.11 Slide Clamp Detector (SCD)

The slide clamp detection subsystem consists of a photo diode and transistor plus a signal control and comparator circuit. The photo diode and transistor are mounted diametrically on the sides of the slide clamp recess on the AIL/SCD housing (see Figure 4-5). The signal processing circuitry for the slide clamp is incorporated into the AIL/SCD printed circuit board. When the slide clamp circuit is energized, a beam of light is projected across the slide clamp recess. The beam is positioned at a point where movement of the slide clamp towards "open" will interrupt the light beam just before free flow occurs in the tubing. If the light path is interrupted with the pumping chamber access door open, the instrument will enter a "FLO-STOP" OPEN / CLOSE DOOR alarm condition.

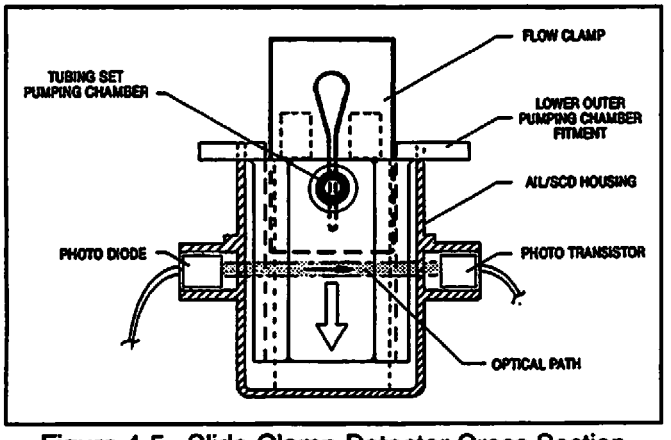


Figure 4-5. Slide Clamp Detector Cross Section

The photo diode is driven by the same micro-processor strobe used by the AIL detector. When the strobe is low and the optical path is not obstructed (Flo-Stop closed or set not installed), current is induced in the photo-transistor which produces a high-stop logic level signal to the microprocessor. When the optical path is obstructed (set installed and Flo-Stop open), the output of the photo-transistor provides a low logic level signal to the microprocessor. By comparing the slide clamp detector circuit output resulting from a high strobe condition against the output from a low strobe, enables the system to verify proper operation of the SCD detector.

4.3.2.12 Door Sensor

The door sensor subsystem consists of a Hall Effect sensor and the logic circuitry necessary to query the sensor and to determine Open or Closed status and report the existing condition to the processor. The Hall Effect sensors are located on the rear of the front case insert assembly 2.4 inches directly below each anchor bracket assembly. The magnet is attached to a pedestal on the backside of the door latch handle. The components of the door sensor logic circuit are incorporated on the Motor Controller PC board. The door sensor is enabled by a strobe from the controller micro processor during normal operation. When in sleep mode, the main logic board provides the strobe.

4.3.2.13 Audio Subsystem

The audio subsystem consists of an audio oscillator, audio system control circuitry, volume control and silence switch. The audio oscillator is mounted on the rear case over the audio alert aperture. The system circuitry and oscillator are incorporated on the power supply board. The audio volume control is mounted on the rear panel and the silencing feature is a function of the keypad CLEAR/SILENCE control. During normal instrument operation, all audio signals are initiated by the EPLD. An audio pulse is sent from the EPLD (U25) to the base of transistor Q3, Q4 or Q5 to produce an audio signal of the required period and intensity. Audio signals that permit volume adjustment and silencing are routed through Q3. Keypress signals are routed through Q5 and are limited in volume intensity by RA2-7,8. Malfunction audio which is projected at maximum, volume is routed through Q4.

The conditioning circuit's primary amplifier is a balanced differential to single ended instrumentation type with a gain of 511. An offset adjust in provided.

The output is further amplified through a subsequent stage with a gain variable between 1 and 6. This stage incorporates a diode (D11) between the output and the feedback divider which prevents the output from going negative. A post amplification filter consisting of R22 and C31 rolls off the gain at about 40Hz. The diode (D9) clamps the output voltage at V_{CC}. This signal is then supplied to the Analog input on the microprocessor for digital conversion.

The microprocessor's internal A/D converter has 10 bit resolution capability; however, in this application the least significant bit is discarded leaving 9 bits usable which yields a per bit resolution ratio of 1:512. Using a reference voltage set at 5V, each bit is equal to $^5/_{512}$ or ≈9.76 mV. The strain beam calibration process involves applying known pressures and then adjusting the gain and offset (SPAN and ZERO) balance of the signal conditioner to yield set voltages. Since the converter is unipolar and will only process signals in the range of 0 to V_{REF}, the calibration points are established at 0 and 10 psi (69 kPa) which correspond to nominal values of 1.5 and 4.0 volts respectively. The 10 psi (69 kPa) differential between calibration limits equates to 2.5 volts. On a 5 volt scale this equates to using $^3/_5$ of the available scale, i.e. $^1/_2$ of the 512 bits or 256 bits. Converting psi to inches of water pressure, the 10 psi (69 kPa) differential equals 332 inches (843 cm) of water pressure. This establishes the resolution of the converter at 1.30 inches (3.29 cm) per bit. Setting the 0 psi value equal to 1.5 volts allows the system to recognize and measure pressures less than atmospheric which can occur during an upstream occlusion. In addition, the strain beam will also detect the presence of an administration set in the pumping chamber.

4.3.2.10 Air-In-Line Detector

The active elements of the PC-4's air-in-line detection system include two piezo-electric (PE) crystals and a signal processing circuit. The PE crystals and acoustic lenses are bonded into recesses in the AIL/SCD housing (see Figure 4-4). The signal processing circuit is part of the AIL/SCD printed circuit board. Ultrasonic sensing is used for air-in-line detection since ultrasonic wave transmission is independent of fluid capacity. Ultrasonic signal transmission (acoustic impedance) through all IV compatible solutions falls within a very discrete range which is easily discernable from passage through air.

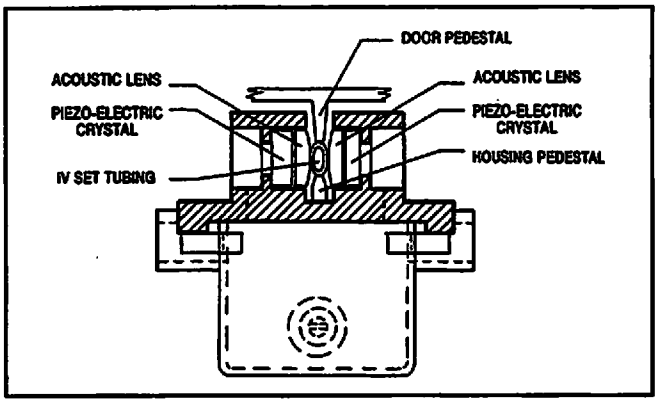


Figure 4-4. AIL Detector Cross Section

The air-in-line detector is located below the pumping mechanism and checks the integrity of the fluid column entering the patient side (distal portion) of the tubing set. The acoustic lenses and installed tubing set provide a coupling path for the continuous wave ultrasonic transmission to travel from the transmitting to the receiving crystal. When the tubing contains an IV solution, the acoustic impedance is low and maximum energy is coupled to the receiving element which generates a voltage signal that is proportional in amplitude and frequency to the coupled energy. If an air bolus is interposed between the lenses, the acoustic impedance is significantly increased as the acoustic wave is reflected by the liquid-air interface. The energy received is reduced and the voltage output is commensurately reduced. This signal differentiation combined with the instrument's programmed delivery rate is used to measure the volume of the air bolus.

The AIL detector's signal processing circuit drives the transmitter and amplifies, detects and performs a threshold comparison on the received signal. The system is strobed by a software generated signal to validate system operation.
The output of the AIL circuit is sampled just prior to the strobe changing state which yields the following truth table:

4.3.2.6 System Reset Circuit

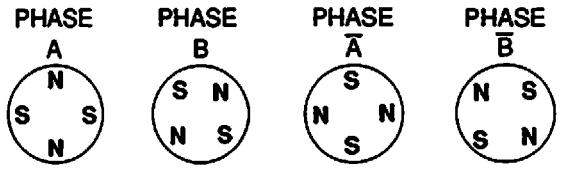
A system reset output is provided at U7-7. When 5 volt power comes on, comparator U7-7 switches low until capacitor C30 charges to 2.5 volts via R66, R67, (≈300ms).

4.3.2.7 Battery Depleted Circuit

A low battery detection circuit is provided which when active, forces a system shut-down with a continuous audio alarm. The low battery detector consists of comparator U7 and associated components. When the battery voltage becomes less than ≈10.9 volts, the output becomes high. Hysterysis is provided so that the output will not return low until the battery has been charged above the low battery threshold and the system may be turned back on.

4.3.2.8 Pumping Mechanism

The pumping mechanism employs a hybrid stepper motor to provide the torque to turn the camshaft and operate the pumping fingers. The hybrid motor employs a multi-toothed rotor and stator with an axially magnetized concentric magnet mounted on the rotor shaft. The teeth on the iron cups attached to the opposite ends of the concentric, permanent magnet are offset from each other one half tooth pitch. The rotor to stator tooth ratio is 50:48. This provides 7.5° stator and 7.2° rotor inter-tooth spacing. The 0.3° differential across a six stator tooth span (45° of arc) provides a 1.8° rotor to stator offset. The stator is wound in a four-pole four-phase configuration. Stator polarity changes 45° as each of the four phases is sequentially energized (see following diagram).



The positional relationship between the central tooth on a stator pole and the rotor is shown with the A phase energized in Figure 4-11. When the B phase is energized and the stator polarity changes 45°, the rotor turns to align teeth 7/7' and 32'/31, a 1.8° rotation. Rotational realignment occurs as each motor winding phase is sequentially energized and the stator polarity changes 45° clockwise. This stepper motor configuration provides 200 incremental motor steps per revolution.

The PC4 contains two dual motor control boards, each contain the circuits necessary to control two of the four pumping channels.

Each controller utilizes its own 80C198 16 bit microcontroller with an integral A/D converter. The logic subsystem includes a programmed memory containing the operating code; and an 8k x 8 ram. A decoder is provided to provide chip selects to define ROM, RAM, and I/O memory space. The microcontroller operates at a frequency of 10 MHz.

All the sensor and motor drive circuits are duplicated for the two channels of each controller. When reference designators are mentioned they refer to the channel 'A' circuits.

MOTOR DRIVE CONTROL
The stepper motor is bipolar driven with the microcontroller controlling the motor phase sequence. Each of the windings are driven via an 'H' bridge utilizing FETs as the switching elements. A current source controls the current as sensed across a .25 ohm resistor R36. Each time the motor is stepped, a higher 'step' current (approximately 300 ma.) is applied for 14 ms. The motor current then reverts to a 'holding' current of 145 ma. The current is produced by an efficient step down switching regulator (U17 and associated components).

4.3.2.9 Strain Beam

The PC-4 employs a strain gauge subsystem to input administration set pressures to the microprocessor through its integral Analog to Digital converter. The subsystem incorporates a matched resistor bridge on the pressure sensing beam and a signal conditioning circuit. Each leg of the resistor bridge is nominally 1200Ω. The Zero Balance Specification is 0.3 mV/V_{EX}. With no load applied to the beam and 5 volts excitation, the Zero offset output will be ≤1.5 mV. Application of a positive force, up to the 1 pound maximum load capacity of the strain beam, will lower the resistivity of the resistors in compression and increase the resistivity of the resistors in tension. At full force applied the bridge will produce a 5 to 10 mV change in output voltage. The signal conditioning circuit provides amplification and offset compensation to the low level signal output by the bridge circuit.

4.3.2.3 ±8 Volt DC Power Supply Subsystem

The ±8 volt power supply circuit resides on the power supply board (Figure 4-11 Series, Sheet 2) and is implemented with a LM3578 switching regulator. Battery is supplied to transformer (T1) at pin #2. Pin #5 of the transformer primary winding is routed to regulator (U2) pin #6 the collector of the internal pass element. When the transistor is turned on, energy is stored in the primary of T1 until U2 turns off the transistor. The voltage induced in the transformer's secondary is blocked by diodes D11 and D12. When the transistor is turned off, the current in the transformer primary is maintained by the collapsing magnetic field inducing current in the transformer secondary which forward biases diodes D11 and D12 charging capacitors C13 and C14. The charged capacitors provide approximately +8 and -8 volt outputs. These outputs are monitored by R41 and R44 respectively and are fed back into the chip-resident comparator which adjusts the duty cycle of the transistor to maintain a 16 volt differential across the transformer output terminals.

4.3.2.4 5 Volt Protected Subsystem

The 5 volt protected voltage is required to provide power to the non-volatile random access memory (RAM) located on the main logic board when system power is turned off. It is also used by the circuits in the backup audio and power on control (including auto power on).

Under normal operation, the 5 volt protected voltage is generated from the main system battery via a step down 6 volt switching regulator (U3 and associated components.) This voltage is further regulated to 5 VDC by U6 (U11 on 7022 board). The 6 volt regulator operates all the time that the system battery is available and also provides charging current to the backup NiCad battery B1 via R38. Should the main battery be removed or fail, the NiCad battery supplies the source to the 5 volt protected regulator via D15.

4.3.2.5 Battery Charger Subsystem

The battery charger consists of components mounted on the power supply board. The circuit utilizes a switching regulator concept based on the UC2524A (U19) regulator chip. Unregulated AC voltage is rectified through the diode bridge (D1, D3,D5,D7). The unregulated DC output from the rectifier bridge charges capacitor C10. C10 provides filtered DC voltage to the regulator chip and the switching circuit consisting of Q9, Q19, Q21 and Q12.

Battery charger output is reduced by the resistor divider consisting of R70, R23 and R21 and then applied to U19-1. U19 compares this voltage against a 5 volt reference voltage at U19-2 and adjusts the duty cycle of U19-12 and U19-13, when these two voltages are unequal. This variable duty cycle is level shifted through Q9, Q19, and Q21 and applied to the gate of FET Q12. This results in Q12 having a duty cycle equal to that on U19-12/13. The voltage input to L1 is approximately a 40 volts p-p square wave at a switching frequency of ≈25KHz. The AC component is filtered out by the L1/C12 low pass filter and is applied to the battery.

Charger output is monitored by a circuit consisting of U9, Q11, R3 and R4. When the battery voltage exceeds ≈15.9 volts, the voltage at the divider consisting of R3 and R4 exceeds the reference voltage of U9 (2.5VDC). When this occurs, the output of U9 begins to draw current thus turning off FET Q11. Turning on Q11 turns on the gate of Q16 via R7 and R10. This has the effect of shorting out the rectified voltage supply. While the short is applied, large currents are drawn from the transformer thus blowing the primary fuse and disabling the charger completely.

Battery current is monitored by U1 and limited to ≈1 amp by adjusting the duty cycle of FET Q12 as discussed above. Battery current is sensed by R11 and applied differentially to U19-5 and U19-4. When this voltage exceeds 0.2VDC, U1 reduces the duty cycle to yield a current limit of ≈1 amps.

Battery voltage is adjusted by R70 to produce an output voltage of 13.8VDC when the battery current is below ≈300 ma. Battery current is monitored by the main processor from the drop across R13. When the battery current exceeds ≈350 ma, the main processor applies 5V to Q17 gate thus connecting R24 in parallel with R21. This has the effect of increasing the charger output voltage to 14.8VDC. Power is always applied to the system when plugged in so that the main processor can monitor battery charging.

functions and is battery backed to maintain time when the pump is off. The digital to analog convertor, U26 (Figure 4-13 Series, Sheet 2) is used to control the contrast on the LCD main display. The output is translated to the correct voltages required by the LCD by U24 and U4 (Figure 4-13 Series, Sheet 2). U32 (Figure 4-13 Series, Sheet 2) implements the analog to digital I/O functions. Channel 0 senses the contrast level, channel 1 the programming flash voltage, channel 2 the main power reference voltage, channel 3 the audio test signal from the power supply board, channel 4 the NiCad battery voltage, channel 5 the main battery voltage, channel 6 the main battery current and channel 7 is a 2.5 volt reference supplied by U34, used to validate A-D inputs. U20 with Y3 and associated components on Figure 4-13, Sheet 2 generate the clock required by the analog to digital converter (U32).

Q6 and R43 form the NiCad test circuit which are used to determine the state of the NiCad battery.

U13, U15 and U16 (Figure 4-13 Series, Sheet 3) form the digital I/O expansion with U13 and U16 serving as output ports and U15 as an input port.

The watchdog timer function is implemented by U5, R22, R17 and C25 (Figure 4-13 Series, Sheet 3). The main processor reset pulse is coupled via C23 and OR'ed with the power on reset in U11. Q2 serves as the slave controllers reset disable. The output of the watchdog timer is latched in the EPLD, U25. The watchdog signal is then gated with the main processor I/O in U11 and U37 (Figure 4-13 Series, Sheet 3). The output of these two gates is distributed to the slave controllers where it is used to disable the motor drive circuitry. The inverted latched watchdog output from U12 labeled "watchdog enable" is used by the keyboard to enable the "Power On" key to power the pump off in case of a watchdog condition.

4.3.2 Functional Operation

4.3.2.1 Power On/Power Off Subsystem

The power on/off control signal is generated by U25 (Figure 4-13 Series, Sheet 3). Power On can result from one of three sources, the POWER ON key, auto power on or main power connected.

Two power off states can exist: sleep mode or power off mode. The instrument is in the sleep mode any time it is plugged in and not being used; outward appearance is off, but the main processor is powered on and is monitoring system functions. The auto power on feature activates the instrument whenever a disposable is installed with the Flo-Stop and door open. The auto power on signal is generated by the slave controllers. The sensor strobe clock is generated by U21 (Figure 4-13 Series, Sheet 3) and distributed to the slave controllers where it is used to sample the appropriate sensors. In the sleep mode, the power on signal to the power supply from U25 is always active. The instrument is awakened by pressing the power on key and sensed by the main processor or communications from the slave processor.

In the true power off state, signals issued by the slave controllers (auto power on), power on key actuation or AC power connected causes U25 to issue the power on signal to the power supply board.

4.3.2.2 5 Volt Regulator Subsystem

The 5 volt power supply regulates the battery to provide the system 5 volts. The regulator utilizes a UC2524A (U21) switching regulator chip in a similar manner to the battery charger circuit. The output is applied to U21-1 and compared to a 5V reference at U21-2. U21 adjusts the duty cycle of U21-12 and 13 when these two voltages are unequal. The variable duty cycle is level shifted via Q6 and Q13. The result is a square wave voltage input applied to L3. The amplitude is equal to the battery voltage with a switching frequency of ≈25KHz. The AC component is filtered by L3 and C16 and is applied to the system directly. The 5V regulator becomes active when SW BATT is applied to U21-15.

A crowbar circuit similar to that in the battery charger is provided. When the 5 volt output exceeds approximately 5.4 VDC, transistor Q8 is turned on via Q14 and U10. This has the effect of shorting out the battery voltage, thus drawing high current and blowing fuse F1.

5 volt current is monitored via R32. When the 5 volt current exceeds about 4 Amps, the regulator modifies the duty cycle of the pulse output to limit the current.

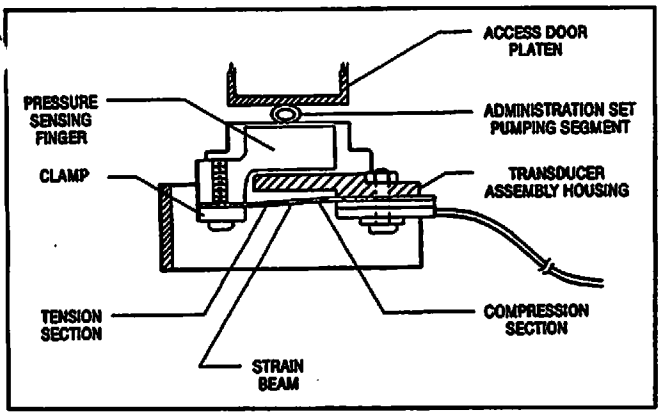


Figure 4-3. Cross Section of Strain Beam Assembly

During a pumping cycle, between motor steps 0 through 20 and 120 through 199, the strain beam measures the pressure in the distal end of the tubing. Any restriction to flow in the distal tubing will cause the pressure to increase and the tubing to expand. The strain beam will sense this increasing pressure and when it exceeds a predetermined value, will cause the pump/controller to invoke either an OCCLUSION (Controller mode) or an OCCLUSION-PATIENT SIDE (Pump mode) alarm condition. During any alarm condition, the pumping mechanism stops and appropriate audio and visual alerts are issued. (Between motor steps 21-62 and 77-119, the pressure sensor can not read distal or proximal pressure).

4.2.2.2 Strain Beam (Pressure Transducer)

When the pumping segment of a primed administration set is installed in the PC-4 pumping chamber and the access door is closed, the strain beam will sense the pressure in the tubing. Actual pressure values are determined by pumping finger position within a pumping cycle and the hydrostatic pressure in the tubing at the time of measurement. A typical amplified strain beam voltage would be in the range of 1 to 2 volts if the strain beam was looking at the patient. During pump operation, a positive pressure decrease in the fluid column above or an increase in the fluid column below the pump will cause the tubing to contract/expand respectively resulting in deflection of the strain beam. This deflection will result in a change in the potential measured across the bridge. A decrease in pressure within the tubing set's fluid column will result in a reduction in the potential measured across the bridge circuit. An increase in pressure within the tubing set's fluid column will result in an increase in the potential measured across the bridge circuit.

4.3 ELECTRICAL/ELECTRONIC OPERATION

An understanding of the electrical/electronic theory of operation can be acquired by reading the ensuing subsystem descriptions while following the functional schematic for the respective subsystem.

The PC-4 has a distributed processor type architecture with a 80C188EB serving as the main processor and two 80C198's serving as slave controllers. The main processor controls all interface and organizational functions while the slave controllers control the pumping mechanism and access door, air-in-line and slide clamp sensor data. The slaves are divided such that controller one controls pump channels A & B, while controller two controls channels C & D. The slaves communicate with the main processor via a serial port. The main processor processes data from the keypad, slave controllers, C2 and auxiliary (optional) serial ports and the empty container detectors. This data is then used to determine the state of the pump.

4.3.1 Functional Description

PC-4 main logic board

A 80C188EB microcontroller with its accompanying program and data memory form the core of the PC-4 main logic board. The 80C188EB is a highly integrated processor that includes the 8088 processor core, two serial ports, timer counter, interrupt controller, chip select and ready logic. These functions are expanded externally to include additional digital I/O and interrupt capability to form the main controller core. Additional functions added to augment the main processor core include an 8 channel analog to digital converter, a single channel digital to analog converter, real time clock, watchdog timer and power on logic. U9 (Figure 4-13 Series, Sheet 2) buffers the processor bus for off board peripherals.

The 80C188EB (U1, Figure 4-13 Series, Sheet 1) is supported by up to 512K bytes of program memory, U31 & U30, and up to 256K bytes of data memory, U7 & U8. The entire data memory block has NiCad battery backup to prevent data loss when power is removed. U27 expands the 80C188EB's interrupts via INT0 and INT2 of U1. These expanded interrupts include the keyboard input, real time clock, optional communications ports, A-D converter and the slave controllers. U29 (Figure 4-13 Series, Sheet 2) supports the real time clock

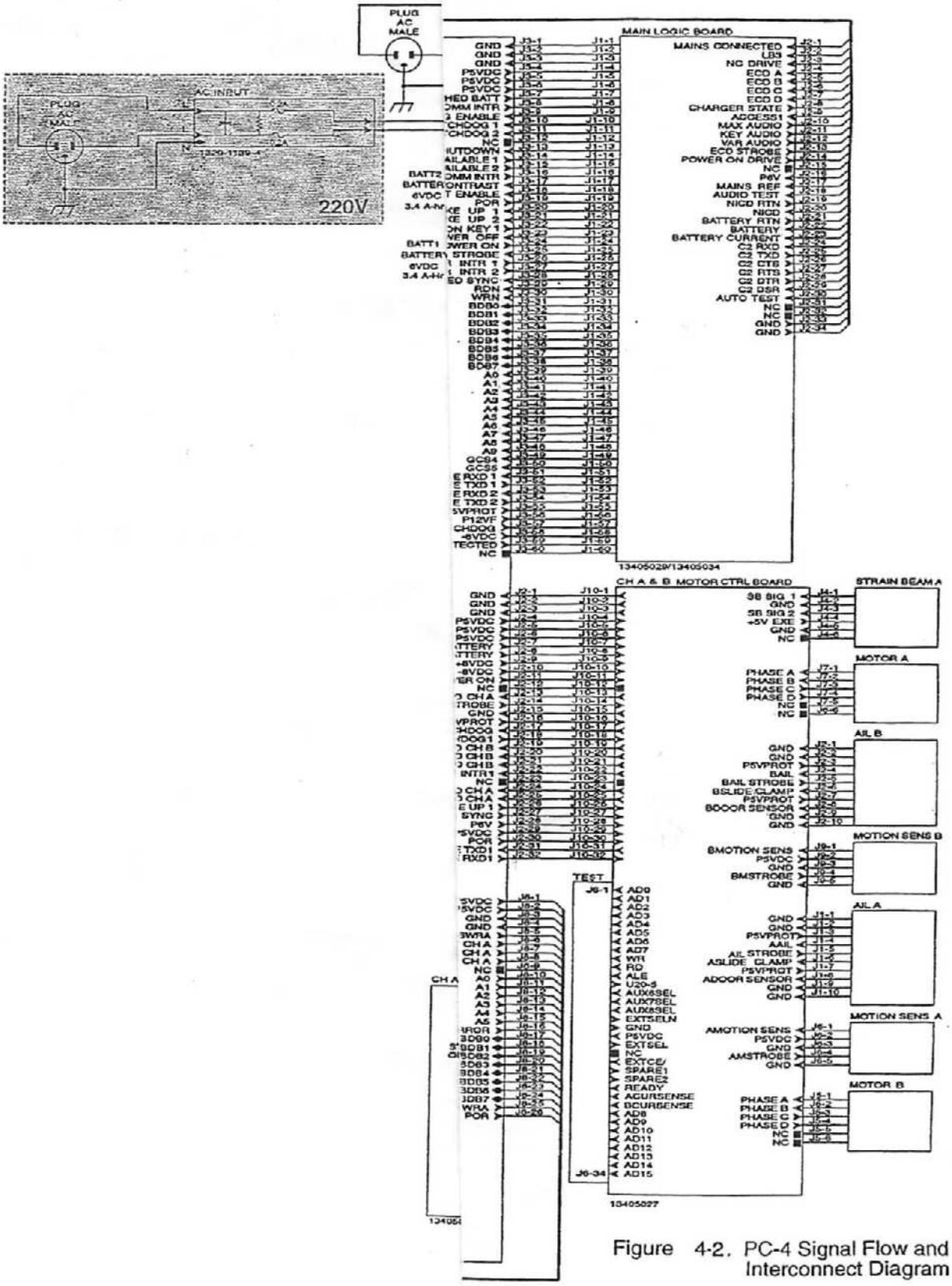


Figure 4-2. PC-4 Signal Flow and Interconnect Diagram

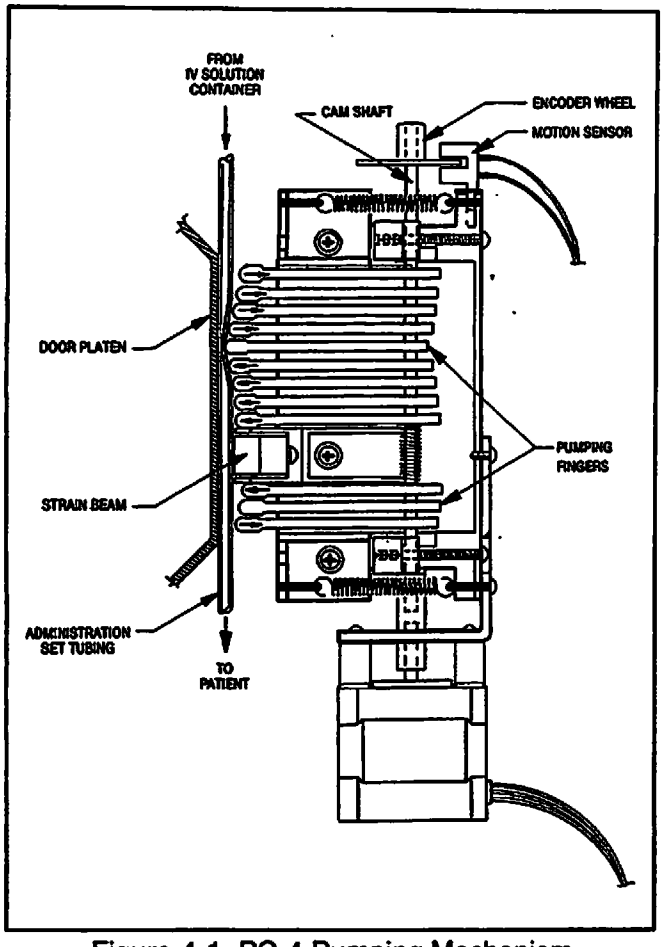


Figure 4-1. PC-4 Pumping Mechanism

parameters are programmed and the START control is actuated. The camshaft is coupled directly to the stepper motor. Stepper motor speed is variable and is proportional to the infusion rate programmed for the selected channel. Volume to be infused (VTBI) is a function of the total number of steps issued to the motor for a programmed infusion rate. The encoder wheel and motion sensor located on top of the pumping mechanism's top plate assembly provides the electronic control system with camshaft position and direction.

When an administration set is installed in the pumping chamber and the access door is closed and latched, the set's Flo-Stop is opened and the pumping segment tubing is compressed between the fully extended pumping finger and the door platen, thus preventing free flow. The pumping mechanism is activated following actuation of the START control in conjunction with normal instrument operating procedures. The stepper motor rotates the camshaft at a cyclical rate proportional to the programmed infusion rate. Each pumping cycle consists of 200 motor steps of 1.8° each. Inter-step timing of the motor is varied as necessary to dampen the inherent non-linearity of peristaltic pumping mechanisms and produce a uniform rate of fluid flow across each pumping cycle. The sequential extension and retraction of the pumping fingers from top to bottom results in a downward moving compression zone within the administration set's pumping segment (see Figure 4-1) which creates positive pressure on the outlet side (distal end) of the tubing set. The elastomeric resilience of the pumping segment tubing causes it to return to its cylindrical shape as each of the pumping fingers recede from the extended position. This reshaping creates a vacuum in the inlet (proximal end) of the tubing and causes fluid from the IV solution container to refill the tubing. This peristaltic like action results in a constant, controlled flow of IV solution from the bottle to the patient. During the pumping cycle, between motor steps 62 through 77, the strain beam senses the hydrostatic pressure in the column of fluid above the strain beam. In the event there is restricted flow in the tubing set between the bottle and the pump and the tubing can not refill completely, the strain beam will sense a lower than normal pressure and cause the pump/controller to enter either a LOW FLOW condition when operating in the Controller mode or either a PARTIAL OCCLUSION-FLUID SIDE or OCCLUSION-FLUID SIDE condition when in the Pump mode.

In the Controller mode if the pressure differential between patient and bottle drops to less than 6 inches of water pressure (0.25 psi, 1.7 kPa), the pumping mechanism will stop. The microprocessor monitors the duration of a `low flow' condition, automatically increases the programmed delivery rate by ten percent and resumes pumping once the bottle to patient pressure differential exceeds 12 inches of water pressure (0.5 psi, 3.45 kPa). The increased flow rate allows the instrument to compensate for the period of `low flow' and bring the actual volume infused in line with the programmed infusion parameters. Once the pump has completed this catch-up cycle, the delivery rate reverts to the programmed rate. Should the `low flow' condition persist for more than 1 minute or the calculated time necessary to compensate for the under-infusion condition exceeds 30 minutes, the instrument will enter an Occlusion alarm condition.

SECTION 4 - PRINCIPLES OF OPERATION

4.1 INTRODUCTION

This section describes the functional operation of the mechanical and electrical/electronic sub-systems of the IMED® GEMINI PC-4® Volumetric Infusion Pump/Controller ("PC-4"). The material is presented in a manner and format that is complementary to the troubleshooting routines delineated in Section 5 - Maintenance. The technical descriptions are referenced to the electrical schematics, mechanical diagrams and illustrated parts breakdowns presented in Sections 4, 5 and 6.

The functional descriptions presented in this section are divided into two subsections. The first addresses the mechanical system operation and the second describes the electrical/electronic control circuits and operational displays. The electrical theory of operation is described in relation to the Functional Block Diagram depicted in Figure 4-2, and can be best understood by following the description on the logic diagrams, display board schematic and interconnect diagram.

4.2 MECHANICAL OPERATION

The following material is presented in a manner that assumes the reader has a basic understanding of the information provided in Sections 1 through 3 of this manual and in addition has hands-on experience in setting up and operating the PC-4. Direct observation of the mechanical sequence of events that take place during instrument operation is not possible with the pumping mechanism and strain beam installed in the PC-4. However, by reading the following text while referring to the appropriate figures, a thorough understanding of the instrument's mechanical operation can be acquired.

4.2.1 Physical Description

4.2.1.1 Pumping Mechanism

The pumping mechanism assembly consists of three principle subassemblies: the stepper motor, the camshaft/pumping finger housing and the motion sensor (see Figure 4-1). The stepper motor drive shaft is connected to the camshaft by a flexible coupling. The encoder wheel of the motion sensing assembly is connected directly to the top of the camshaft. The camshaft is configured with 12 vertically staged cam lobes. The eccentric axis of each lobe is offset 30° counterclockwise from the lobe directly above. This positioning provides full forward travel for each pumping finger sequentially from top to bottom during each counterclockwise (when viewed from above) revolution of the camshaft. The cam lobes are evenly spaced except numbers 9 and 10 which are separated by 5/8" (15.9 mm) to accommodate a strain beam type pressure sensor.

4.2.1.2 Strain Beam (Pressure Transducer)

The strain beam assembly consists of the housing assembly, a strain beam and sensing finger (see Figure 4-3). The housing assembly is mounted on the front case assembly behind the urethane pump seal and is positioned between fingers 9 and 10 of the pumping mechanism. Four strain sensitive resistors are deposited on the strain beam, two on the tension section and two on the compression section.

4.2.2 Functional Operation

4.2.2.1 Pumping Mechanism

In the Normal operating mode, the PC-4 is initialized when the POWER ON control is actuated. The selected channel's pumping mechanism begins operating when an administration set is installed, 'legal' infusion

3.5 AUDIO ALERT SYSTEM

The PC-4 is programmed to produce seven distinct audio alerts.

The characteristics of the accompanying audio sounds are as follows:

Type	Sound	Notes
switchover	six short beeps	variable volume; can be silenced and disabled in the SYSTEM CONFIGURATION
prompt	one short beep every two seconds	variable volume; can be silenced
key click	one short beep	fixed minimum volume; cannot be silenced; can be disabled via the SYSTEM CONFIGURATION
illegal keypress	two short beeps	variable volume; cannot be silenced, can be disabled via SYSTEM CONFIGURATION
advisory	one short beep every fifteen seconds	variable volume; can be silenced
alarm	three selectable profiles (selectable in System Configuration) **Profile 1** - 500msec ON, 1500msec OFF, 500msec ON, 1500msec OFF... **Profile 2** - 50msec ON, 50msec OFF, 400msec ON, 1sec OFF... **Profile 3** - 400msec ON, 500msec OFF, 400msec ON, 500msec OFF...	variable volume; can be silenced
malfunction (software detected)	pairs of long beeps	fixed 75 decibel volume; cannot be silenced
malfunction (hardware detected)	constant audio tone	fixed 75 decibel volume; cannot be silenced

3.6 NURSE CALL FEATURE

The PC-4 incorporates a Nurse Call feature that will activate an externally powered nurse call system when the instrument initiates any of the following conditions:

Alarms:	All
Malfunctions:	All
Prompts:	PRESS START
Advisories:	INFUSION COMPLETE-KVO, EMPTY CONTAINER-KVO, LOW BATTERY and REPLACE BATTERY.

Malfunction	Meaning	Response
RATE DISPLAY FAILURE Audio: malfunction Visual: Channel Display: • Rate(s) flash • "Rate Display Error - Rate = xxx" scrolls Central Display: A Rate Display failure has been detected. Infusion(s) will continue as programmed. Service pump as soon as possible. (Press ENTER to continue)	Software has detected a malfunction in one or more of the rate displays. Infusions on all currently operating channels continue.	Replace with operable unit as soon as possible. Press STOP/CHANNEL OFF to power down the PC-4.
AUDIO FAILURE Audio: malfunction Visual: Channel Display: • Audio Failure Central Display: AUDIO FAILURE A PROBLEM HAS BEEN DETECTED WITH THE PUMP'S AUDIO. TAKE PUMP OUT OF SERVICE (Press ENTER to continue)	Software has detected a malfunction of the audio system. Infusions on all currently operating channels continue.	Replace with operable unit as soon as possible. Press STOP/CHANNEL OFF to power down the PC-4.
(HARDWARE-DETECTED MALFUNCTION) Audio: malfunction Visual: none	A hardware-detected malfunction has occurred. Infusion on all channels stops.	Ensure that the AC power cord is connected to an external power source. Press POWER ON or STOP/CHANNEL OFF control to reset the audio and turn off electrical power to the PC-4. (If audio persists, press POWER ON, then SILENCE. Perform normal power off procedures and replace PC-4 with operable unit.)

MALFUNCTION

A **MALFUNCTION** is a signal to alert the operator that a failure has been detected. Immediate action is required. The audio cannot be silenced without powering off the affected channel(s).

Malfunction	Meaning	Response
SYSTEM MALFUNCTION Audio: malfunction Visual: Channel Display: • Rate displays flash "- - - -", • Channel ALARM and STANDBY indicators flash Central Display: **For Battery Operation** SYSTEM MALFUNCTION ALL CHANNELS STOPPED PRESS OFF TO POWER OFF CODE NUMBER: XXX **For AC Power Operation** SYSTEM MALFUNCTION ALL CHANNELS STOPPED PRESS OFF TO RESET PUMP OR UNPLUG PUMP AND PRESS OFF TO POWER OFF CODE NUMBER: XXX	A software detected malfunction has occurred. Depending on the type of malfunction, infusion stops on the affected channel or all channels.	Press STOP/CHANNEL OFF control to turn off the PC-4. Note Error Code, then refer to Table 5-2 Error Code Listing to determine probable cause.
CHANNEL MALFUNCTION Audio: malfunction Visual: Channel Display: • Rate displays flash "- - - -" • ALARM and STANDBY indicators flash Central Display: CHANNEL MALFUNCTION REMOVE IV SET IMMEDIATELY. A MALFUNCTION HAS BEEN DETECTED ON THIS CHANNEL. THIS INFUSION HAS BEEN STOPPED.	A software-detected malfunction has occurred on the indicated channel. Infusion on affected channel stops.	Immediately, remove IV set(s) and press CHANNEL OFF to silence alarm. Infusion(s) on non-affected channels may be continued pending availability of a fully operational pump. Central Display: • "ERROR XXX" displays for appropriate channel.

Alarm	Meaning	Response
"FLO-STOP" OPEN/CLOSE DOOR Audio: alarm Visual: continuous scroll, channel alarm indicator flashes	Flo-Stop open (in free-flow position) with door open.	Close roller clamp on set or close door and resume infusion by pressing appropriate CHANNEL SELECT control, then pressing START control. (If alarm occurs when the door is opened, check position of Flo-Stop slide clamp; if open, inspect slide clamp sear for damage and replace as necessary).
BATTERY DISCHARGED Audio: malfunction Visual: Channel Display: • Rate Display flashes "- - - -" • Channel STANDBY indicators flash • "PAUSE - RESTART CHANNEL" scrolls Central Display: BATTERY DISCHARGED ALL CHANNELS PAUSED PLUG IN TO RESUME OR PRESS OFF TO POWER DOWN	Low battery voltage detected. Infusions PAUSE on all currently operating channels.	Connect AC power cord to power source and wait for "PAUSED" to appear in the Central Display. Select each channel and press START to resume the infusion(s), or Press the OFF control to power down the PC-4.

ALARM

An **ALARM** is an audio and visual signal to the user that a potentially unsafe condition is present. Immediate action is required. The audio may be silenced except during a "FLO-STOP" OPEN/CLOSE DOOR condition for approximately 2 minutes by pressing the SILENCE control.

Alarm	Meaning	Response
CHECK ECD Audio: alarm Visual: Continuous scroll, channel alarm indicator flashes	START control pressed with VTBI set to "ALL" and ECD not connected, or ECD has been disconnected during an "ALL" infusion, or ECD has failed. Infusion stops.	Connect or replace ECD, then press START control.
CHECK IV SET Audio: alarm Visual: continuous scroll, channel alarm indicator flashes	Administration set not properly installed. Infusion stops on affected channel.	Close roller clamp, remove and reinstall administration set, close door, open roller clamp.
DOOR OPEN Audio: alarm Visual: continuous scroll, channel alarm indicator flashes	Door opened during an infusion. Infusion stops on affected channel.	Close door, press appropriate CHANNEL SELECT control, then press START control.
RESTART CHANNEL Audio: alarm Visual: continuous scroll, channel alarm indicator flashes	Door was opened during an infusion and then closed. Infusion stops on affected channel.	Press the appropriate CHANNEL SELECT control, then press START control.
AIR-IN-LINE Audio: alarm Visual: continuous scroll, channel alarm indicator flashes	Air has been detected in set during an infusion. Infusion stops on affected channel.	Ensure tubing is properly installed in air-in-line detector. If air is present, clear air from administration set. Press appropriate CHANNEL SELECT control, then press START control.
OCCLUSION PATIENT SIDE Audio: alarm Visual: continuous scroll, channel alarm indicator flashes seconds	Increased back pressure sensed while infusing in the pump delivery mode. Infusion stops on affected channel.	Clear occlusion, press appropriate CHANNEL SELECT control, then press START control.
OCCLUSION Audio: alarm Visual: continuous scroll, channel alarm indicator flashes	Occlusion is detected on either fluid or patient side while infusing in controller delivery mode. Infusion on affected channel stops.	Clear occlusion, raise the fluid container or change to pump mode, if enabled. Press the appropriate CHANNEL SELECT control, then press the START control. (If the occlusion recurs, open and close door. Press CHANNEL SELECT and START control.)
PARTIAL OCCLUSION-FLUID SIDE Audio: alarm Visual: continuous scroll, channel alarm indicator flashes	Partial upstream occlusion detected while infusing in pump delivery mode. Infusion on affected channel stops.	Remove cause of reduced flow in fluid side of administration set, press appropriate CHANNEL SELECT control, then press START control.

Prompt	Meaning	Response
Delay Mode is Active Audio: illegal key Visual: continuous display for 3 seconds	The Time-of-Day option was selected from the Systems Options menu while a Delayed start or Multidose infusion was active.	Time-of-Day cannot be changed unless all Delayed Start and Multidose infusions are stopped.
Channel in KVO Audio: none Visual: continuous display for 3 seconds	An attempt was made to setup a Secondary infusion while the Primary infusion was in KVO.	Reset the Primary rate and VTBI values within the normal operating range.
Dose Exceeds 24 hours Audio: illegal key Visual: continuous display for 3 seconds	A Multidose rate and VTBI/dose that results in an infusion interval >24 hours was entered.	Change rate and/or VTBI values such that the time required for infusion is <24 hours.
Press OFF or ENTER Audio: prompt Visual: continuous display	A Multidose or Drug Calculation infusion has been turned off. Pressing ENTER retains the infusion program; pressing OFF deletes the program.	Press ENTER retains the program; pressing OFF deletes the program and turns off the channel.
Press ENTER or CANCEL Audio: prompt Visual: continuous display	Part of the Drug Calculation setup program.	Press ENTER to confirm the drug dosing units; press CANCEL to edit the drug calculation parameters.
Delay Exceeds 8 Hours Audio: illegal key Visual: continuous display for 3 seconds	A start time >8 hours ahead of current time was selected for either a Delayed Start or Multidose infusion.	Enter a Start Time 8 hours or less ahead of current time-of-day.
Press CANCEL to Exit Audio: prompt Visual: continuous display	The Systems Options menu was accessed.	Select an option or press CANCEL to return to the main display menu.
Press ENTER to continue Audio: prompt Visual: continuous display	The channel was selected following a completed Multidose infusion.	To continue the same infusion, press ENTER to gain access to the Multidose infusion setup screen. Enter the desired Start time and press START.

Prompt	Meaning	Response
PRI/SEC Rate Mismatch Audio: illegal key Visual: continuous display for 3 seconds	During a Secondary setup, a fractional secondary rate value was entered with a primary rate ≥100 mL/hr or a secondary rate value ≥100 mL/hr was entered with a fractional primary value.	Primary and Secondary rate values must both be either fractional or non-fractional.
Stop Infusion First Audio: illegal key Visual: continuous display	A mode of operation that is incompatible with the current mode of operation was selected from the channel options menu.	Select #5 - stop infusion, to stop the current infusion prior to selecting a different operating mode.
Confirm Time-of-Day Audio: prompt Visual: continuous display	Appears the first time that the Time control is pressed in Delayed Start or multidose setup following instrument power up.	Confirm that the time-of-day displayed is correct. If not, enter correct time of day.
Mode Not Available Audio: illegal key Visual: continuous display for 3 seconds	A selection of a disabled or unavailable option was made from the Channel Options menu.	If disabled option is required, refer to Section 3.3.1.2 to change system configuration.
Use ⊡ ⊡ to adjust Audio: none Visual: continuous display	The display contrast option was selected from the Systems Option menu.	Use the ⊡ or ⊡ controls to adjust the central information display for optimum viewing, then press ENTER.
Max Dose Exceeded Audio: illegal key Visual: continuous display for 3 seconds	In Drug Calculation, a dose that exceeds the display limits was entered.	Enter a lower dose or rate value. Verify correct entry of drug amount and diluent volume.
Min Dose Exceeded Audio: illegal key Visual: continuous display for 3 seconds	In Drug Calculation, a dose that is less than the allowable limit was entered.	Enter a higher rate or dose value. Verify correct entry of drug amount and diluent volume.
Invalid Dose Audio: illegal key Visual: continuous display for 3 seconds	In Drug Calculation, the patient weight input was changed so significantly that the dose/rate on another channel would be forced out of allowable range.	Enter an appropriate patient weight value.
Invalid Rate Audio: illegal key Visual: continuous display	In Drug Calculation, a rate that is less than the allowable limit was entered.	Enter a higher rate or dose value. Verify correct entry of drug amount and diluent volume.
Check Amount and Diluent Audio: illegal key Visual: continuous display for 3 seconds	In Drug Calculation, a combination of drug amount and diluent volume were entered that resulted in an invalid drug concentration.	Enter appropriate drug amount and diluent volume values.
Enter Fractional Value Audio: illegal key Visual: continuous display for 3 seconds	During a Secondary infusion setup a Secondary rate value ≥100 mL/hr was entered when the Primary rate was fractional.	Enter a fractional Secondary rate value or change the Primary rate value to a non-fractional value.

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Prompt	Meaning	Response
Select Unit of Measure Audio: prompt Visual: continuous display	Part of drug calculation infusion set up sequence.	Select the appropriate units for the drug added to the container (gm, mg, mcg, or units).
Enter Diluent Volume Audio: prompt Visual: continuous display	Part of drug calculation infusion set up sequence.	Enter the volume of the drug container in milliliters.
Dose Based on Pt. Wt? Audio: prompt Visual: continuous display	Part of drug calculation infusion set up sequence.	Select "Yes" or "No" based on whether patient weight is required.
Enter Patient Weight Audio: prompt Visual: continuous display	Part of drug calculation infusion set up sequence.	Enter patient weight in kilograms (kg).
Select Time Units Audio: prompt Visual: continuous display	Part of drug calculation infusion set up sequence.	Select appropriate time interval for drug dosing (minutes or hours).
Enter Rate or Dose Audio: prompt Visual: continuous display	Part of drug calculation infusion set up sequence.	Press RATE and enter infusion rate, or press DOSE and enter the desired drug dosage.
Max Rate Exceeded Audio: illegal key Visual: continuous display	Flow rate parameters which result in an infusion rate that is out of range have been entered.	Enter appropriate flow rate parameters.
Press Enter to Confirm Audio: prompt Visual: continuous display	The current parameter entry(s) must be confirmed to enable proceeding to the next programming step.	Press ENTER.
Reenter VTBI value Audio: Illegal key Visual: continuous display	A VTBI value of ≥1000 mL was entered with a fractional rate value.	Enter a VTBI value <1000 mL or change rate to a non-fractional value.
Press 1-5 or ⇧ or Cancel	The desired option can be selected by pressing the apppropriate selection number or pressing ⇧ to move to the next menu screen.	Select desired entry or Press CANCEL to exit screen.
Enter Dose Value Audio: prompt Visual: continuous display	Dose control was pressed during a Drug Calculation.	Enter the desired medication dose
Dose Interval >24 hours Audio: illegal key Visual: continuous display for 3 seconds	During Multidose setup, a dose interval >24 hours was entered.	Enter a dose interval that is <24 hours.
Invalid Minute Entry Audio: illegal key Visual: continuous display	During a Delayed Start or Multidose setup, a start time or current time entry >59 minutes was selected.	Enter a minute time value ≤59.
Invalid Hour Entry Audio: illegal key Visual: continuous display	During a Delayed Start or Multidose setup, a start time or current time of day >23 (military time) was entered.	Enter an hour value ≤23 hours (military) or ≤11 hours (AM/PM).
P/C Mode Locked Audio: illegal key Visual: continuous display for 3 seconds	Channel Option #4 was selected when the P/C Mode was locked.	If P/C Mode change is desired, refer to Section 3.3.1.2 to change system configuration.

PROMPTS

A **PROMPT** is an audio and/or visual signal appearing on the bottom line of the Central Information display to the user to perform some action. The audio may be silenced for 2 minutes by pressing the SILENCE control.

Prompt	Meaning	Response
Select Option/Cancel Audio: prompt Visual: continuous display	The OPTIONS/EDIT key was pressed.	Select the appropriate System or Channel option. Press CANCEL to exit menu.
24 Hour Limit Exceeded Audio: prompt Visual: continuous display for 3 seconds	A combination of Time Interval and Number of Doses that would exceed the maximum allowable 24 hour Multidose infusion was entered.	Reenter an appropriate combination of Time Interval and Number of Doses to result in a total duration of 24 hours or less.
Enter Rate Value Audio: prompt Visual: continuous display	Begins following press of POWER ON and CHANNEL SELECT controls, or if START control is pressed with rate set to "0".	Press RATE control and enter rate.
Enter VTBI Value Audio: prompt Visual: continuous display	Begins following press of VTBI control, or if START control is pressed with VTBI set to "0".	Press VTBI control and enter VTBI.
Press START Audio: prompt Visual: continuous display	Begins approximately 3 seconds after last press of data entry controls if neither parameter is zero, or approximately 12 seconds after an alarm is cleared, or approximately 2 minutes after PAUSE is pressed.	Press START control.
Select Channel Audio: none Visual: continuous	Begins when attempt is made to set parameters or start infusion prior to selecting a channel.	Press appropriate CHANNEL SELECT control.
Enter All Parameters Audio: none Visual: continuous display for 3 seconds	The START control was pressed prior to entering valid parameters.	Follow prompts and enter valid parameters for all data entry fields.
Enter Start Time Audio: prompt Visual: continuous display	The TIME control was pressed after entering rate and VTBI parameters.	Press ENTER to confirm the current data entry, and move to the next programming step.
Enter Dose Interval Audio: prompt Visual: continuous display	Part of multidosing infusion set up sequence.	Enter the desired dose interval (range 1-24 hours).
Dose Interval too Short Audio: prompt Visual: continuous scroll for 3 seconds	A multidose interval was entered that the pump could not infuse based on the Rate & VTBI/dose setting.	Enter appropriate interval Rate & VTBI/dose setting.
Enter Number of Doses Audio: prompt Visual: continuous display	Part of multidosing infusion set up sequence.	Enter the desired number of doses (range 1-24).
Enter Drug Amount Audio: prompt Visual: continuous display	Part of drug calculation infusion set up sequence.	Enter the amount of drug added to the IV fluid container.

Advisory	Meaning	Response
Battery Replacement Do not use on battery. Operate on AC only. Battery Replacement Required. Contact Biomed.	The pump has detected a battery that is no longer capable of sustaining a charge.	Replace with an operable pump as soon as possible. Send pump to Biomedical department to have batteries checked.
Replace Battery Audio: On AC - None On DC - Prompt Visual: continuous display in Central Information display	The pump has detected a battery that is no longer capable of sustaining a charge.	Replace with an operable pump as soon as possible. Send pump to Biomedical department to have batteries checked.
PAUSE Audio: advisory, then prompt after 2 minutes Visual: continuous scroll in Channel Information display	PAUSE control has been pressed.	Press START control to resume infusion, or press OFF to stop infusion.
Panel/Keypad Locked Audio: key click Visual: continuous display for 3 seconds	Audio control has been pressed and held for 3 seconds to initiate tamper-resistant feature.	None. (Repeat to cancel tamper-resistance).
Panel/Keypad Unlocked Audio: key click Visual: continuous display for 3 seconds	Audio control has been pressed and held for 3 seconds to deactivate tamper-resistant feature.	None. (Repeat to re-initiate tamper-resistance).
LOW FLOW Audio: advisory Visual: continuous scroll in channel information display	Flow has slowed due to back pressure equalling container height in Controller mode. An occlusion alarm will occur within one minute.	Check tubing for restriction, raise container, press START, or change to pump delivery mode (if P/C mode control unlocked).
Start = XX:XX Audio: none Visual: continuous display	Delayed start program initiated. XX:XX is the programmed start time.	None. When current time = start time, the infusion will start.
SECONDARY Audio: none Visual: continuous scroll in channel information display	A secondary infusion is in progress on the affected channel.	None. When secondary VTBI = "0", the infusion will revert to the programmed primary parameters.
Dose n = XX:XX Audio: none Visual: continuous display	Multidose infusion is either infusing or in standby. Dose n = the sequential number of the next (if in standby) or currently infusing dose. XX:XX is the programmed start time for the next dose.	None. Infusion will proceed as programmed. Press appropriate channel select to review infusion status.
Anesthesia Mode-Pause Audio: none Visual: continuous scroll in channel information display	PAUSE control was pressed while Anesthesia mode was selected.	Select channel, if necessary, then press START to resume or press CHANNEL OFF to stop infusion.
Powering down in X second(s) Audio: prompt Visual: timed display in central information display	The CHANNEL OFF control has been pressed.	None. To stop power down, press any control except POWER ON.

3.4 CHANNEL, CENTRAL INFORMATION DISPLAYS AND ALARM RESPONSE PROCEDURES

In the normal operating mode, four types of visual displays are presented to the operator: prompts, advisories, alarms and malfunctions. These messages may be scrolled or flashed on the Channel Information message display or presented statically in conjunction with the specific Central Information Display screens.

Table 3-2 lists the Message Displays presented by the PC-4, identifies the meaning and defines the recommended operator response.

Table 3-2. Visual Message Displays

ADVISORIES

An **ADVISORY** is a sequence of audio and/or visual signals to advise the user of the operating status of the PC-4. The audio may be silenced for approximately two minutes by pressing the SILENCE control.

Advisory	Meaning	Response
INFUSION COMPLETE - KVO Audio: prompt Visual: continuous scroll in channel information display	VTBI has been infused; PC-4 is infusing at KVO rate.	Stop channel, or set up new infusion.
EMPTY CONTAINER-KVO Audio: prompt Visual: continuous scroll in channel information display	Empty container detected by ECD before programmed VTBI delivered, or when "ALL" has been used as the VTBI parameter. PC-4 is infusing at KVO rate. ECD plugged into PC-4, but not attached to drip chamber.	Replace IV container, turn off PC-4, or set up a new infusion. Attach ECD to drip chamber.
DELAYED START COMPLETE Audio: none, unless callback was selected Visual: continuous scroll in channel information display	The delayed start infusion has been infused.	Stop channel or set up a new infusion.
MULTIDOSE COMPLETE Audio: none Visual: continuous scroll in channel information display	All doses of the multidose infusion have been infused.	Stop channel or set up a new infusion.
LOW BATTERY Audio: prompt Visual: continuous display in central information display	Low battery threshold sensed, remaining battery operational life is limited.	Connect AC power cord to outlet; alarm will be silenced.
Maintenance Mode Audio: key click Visual: continuous display in central information display	Instrument powered up in the Maintenance mode.	DO NOT USE ON PATIENT. Check with Biomedical Department.
Paused Audio: advisory, then prompt after 2 minutes Visual: continuous display in central information display	PAUSE control has been pressed.	Press START control to resume infusion, or press OFF to stop infusion.

The operating procedures listed below are identical for both MONITOR operation and Independent operation. Refer to the Independent Setup section of this manual for the detailed descriptions.

To Adjust Central Information Display Contrast
To Pause an Infusion
To Stop a Primary Infusion
To Change Rate or VTBI During Infusion
To Titrate Rate
To Change the Pump/Controller Mode (P/C Mode control unlocked)
To Restart an Infusion Following an "INFUSION COMPLETE-KVO" or "EMPTY CONTAINER-KVO" Advisory
To View Primary, Secondary and Total Volume Infused on all Channels Simultaneously
To View Primary, Secondary and Total Volume Infused on Selected Channel
To Clear Primary, Secondary and Total Volume Infused on Selected Channel
To Set Up a Secondary (Piggyback) Infusion With Dual Rates
To Change Primary Infusion Parameters During a Secondary Infusion
To Stop a Secondary Infusion and Return to the Primary Infusion
To Change the Time of Day
To Set Up a Delayed Start Infusion
To Set Up a Multidose Infusion
To Use Drug Calculation
To Infuse Using an Empty Container Detector (ECD)
To Select Anesthesia Mode
To Clear Alarms

During COMPUTER CONTROL operation, these procedures are performed through the host computer. Appropriate computer control procedures are described in the ALARIS Medical C2 Communications Protocol Programmer's Guide.

ACTION/PROMPT | DISPLAY RESPONSE

To Power Off the PC-4 in MONITOR operation

1. Press A...D as appropriate.
2. Press CHANNEL OFF.

Channel Information Display:
- All displays and indicators for selected channel - extinguish

Central Information Display:
- Selected channel display reverts to un-programmed status.

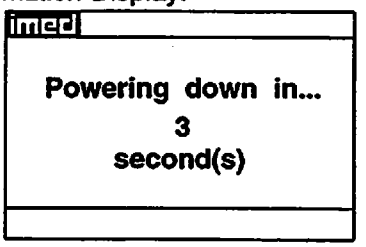
3. Repeat steps 1 and 2 until all channels are stopped.

During the power off sequence:

NOTE

To interrupt the power off sequence, press the PAUSE control prior to the count-down timer in the central information display reaching "1". To resume the infusion, select the appropriate channel, confirm Rate and VTBI, then press START and verify that the channel operating indicator is flashing.

Central Information Display:



- Time value decrements from 3 to 1, then the PC-4 powers down.

To Power Off the PC-4 in COMPUTER CONTROL Operation

1. Repeat procedure listed above under "To Change PC-4 Operation from COMPUTER CONTROL to MONITOR".
2. Press A...D as appropriate.
3. Press CHANNEL OFF.

Channel Information Display:
- All displays and indicators for selected channel - extinguish

Central Information Display:
- Selected channel display reverts to un-programmed status.

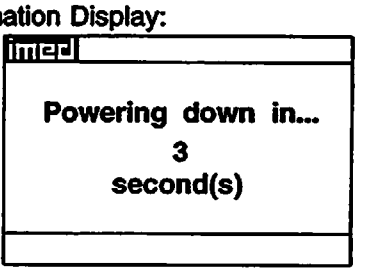
4. Repeat steps 1 and 2 until all channels are stopped.

During the power off sequence:

NOTE

To interrupt the power off sequence, press the PAUSE control prior to the count-down timer in the central information display reaching "1". To resume the infusion, select the appropriate channel, confirm Rate and VTBI, then press START and verify that the channel operating indicator is flashing.

Central Information Display:



- Time value decrements from 3 to 1, then the PC-4 powers down.

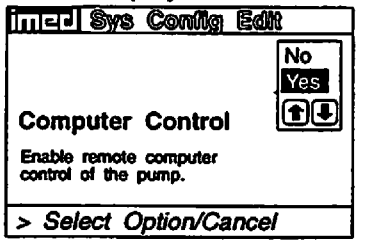
ACTION/PROMPT | DISPLAY RESPONSE

NOTE

If "Computer Control" is displayed in half-tone on the Systems Options display, Computer Control is not enabled and is not available for use.

2. Press 4.
   - After 3 seconds *"> Select Option/Cancel"* displays
   - After 12 seconds Audio prompt - sounds

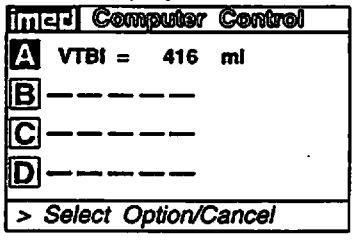
Central Information Display



3. Select "Yes" using the ↑ ↓ controls.

4. Press ENTER.
   - **COMPUTER CONTROL** and Computer Control indicator - flash
   - The PC-4 keypad is inoperative, except for the PAUSE SILENCE VOLUME INFUSED OPTIONS EDIT CANCEL CHANNEL OFF controls

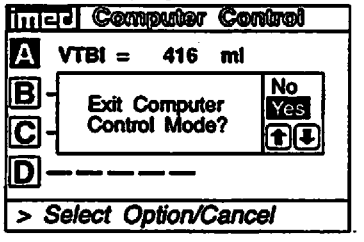
Central Information Display



To Change PC-4 Operating Condition from COMPUTER CONTROL TO MONITOR

1. Press OPTIONS EDIT or CANCEL.
   - After 3 seconds *"> Select Option/Cancel"* displays

Central Information Display

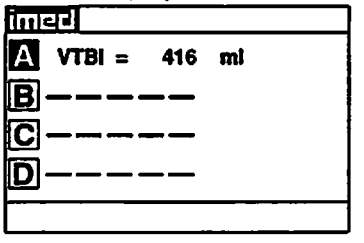


2. Select the "Yes" option by using the ↑ ↓ controls.

Central Information Display
- "Yes" option is highlighted

3. Press ENTER.
   - Infusions in progress under computer control continue as programmed

Central Information Display



- MONITOR indicator - illuminates

3.3.1.4 Independent Setup and Operating Procedures

The steps necessary to operate the PC-4 in Monitor or Computer Control Operation are described in the following section.

CAUTION

ONLY equipment that has been qualified to IEC 601-1 standards should be connected to the PC-4's RS-232-C Data Port and the connection should ONLY be performed by qualified personnel.

To Establish PC-4/Host Computer Interface

1. Set computer communication parameters.

NOTE

Before the PC-4 can be used in the Monitor or Computer Control Operation conditions, the computer communication parameters must be set by hospital technical personnel, both in the host computer and in the PC-4. Thorough familiarity with independent operation of the PC-4 is a prerequisite for technical personnel responsible for configuring the pump/controller for remote operation. The procedures for setting the computer communication parameters for the PC-4 are provided in this PC-4 Maintenance Manual. The procedures for setting the computer communication parameters for the host computer are provided in the ALARIS Medical C2 Programmer's Guide.

2. Connect the communication interface cable to the RS-232-C communication DATA PORT connector (rear panel) of the PC-4 and to the host computer.

NOTE

Before the PC-4 can be set up for either Monitor or Computer Control Operation, the communication interface cable must be connected to the RS-232-C communication DATA PORT connector on the rear panel of the PC-4. The technical data necessary to interface the host computer interface cable to the PC-4's RS-232-C Communication DATA PORT connector is provided in this manual.

When power is then applied to the PC-4's circuits, the MONITOR indicator will illuminate.

ACTION/PROMPT	DISPLAY RESPONSE

To Change PC-4 Operating Condition from Independent to MONITOR

1. Connect the communication interface cable to the RS-232-C communications DATA PORT connector on the rear panel.	The MONITOR indicator illuminates.

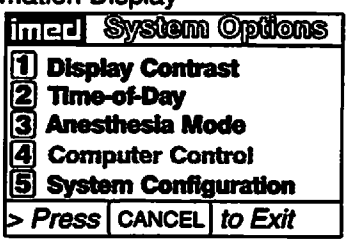
To Change PC-4 Operating Condition from MONITOR to Independent

1. Disconnect the communication interface cable from the RS-232-C communications DATA PORT connector on the rear panel.	The MONITOR indicator extinguishes.

To Change PC-4 Operating Condition from MONITOR to COMPUTER CONTROL

1. Press  .

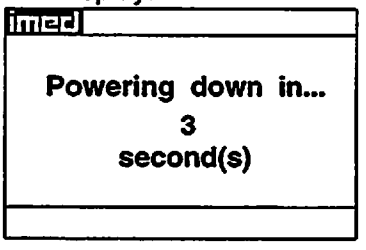
Central Information Display



ACTION/PROMPT	DISPLAY RESPONSE
To Clear Alarms	
1. Check the Channel Information Display to determine the type of alarm condition.	
2. Refer to the CHANNEL, CENTRAL INFORMATION DISPLAY AND ALARM RESPONSE PROCEDURES section in this manual for the proper procedures for responding to a specific alarm condition.	
To Power Off the PC-4	
1. Press A ... D as appropriate.	
2. Press CHANNEL OFF.	Channel Information Display: • All displays and indicators for selected channel - extinguish Central Information Display: • Selected channel display reverts to un-programmed status.
3. Repeat steps 1 and 2 until all channels are stopped.	
During the power off sequence:	Central Information Display:

NOTE

To interrupt the power off sequence, press the PAUSE control prior to the count-down timer in the central information display reaching "1". To resume the infusion, select the appropriate channel, confirm Rate and VTBI, then press START and verify that the channel operating indicator is flashing.



- Time value decrements from 3 to 1, then the PC-4 powers down.

ACTION/PROMPT | DISPLAY RESPONSE

To Select Anesthesia Mode

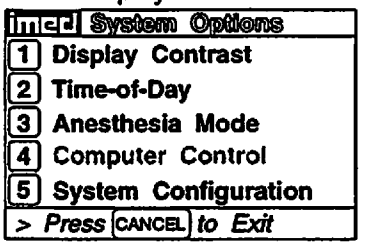
NOTE

Anesthesia mode is intended for use in the operating room where critical IV infusions are under constant surveillance by Anesthesia personnel. Anesthesia mode allows the user to PAUSE an infusion with no audible prompting or "walkaway" alarms associated with normal PC-4 operation. It also decreases the number of steps required to restart a saved Drug Calculation program. Anesthesia mode must be enabled in the System Configuration in order to be selected.

1. Power on the PC-4 as previously described.

2. Press OPTIONS/EDIT.

Central Information Display

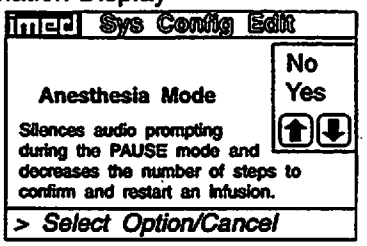


NOTE

If "Anesthesia Mode" is displayed in half-tone on the System Options display, Anesthesia mode has not been enabled and is not available for use.

3. Press 3.
   - *"> Select Option/Cancel"* displays
   - After 12 seconds audio prompt sounds

Central Information Display



4. Use ↑ ↓ to select the "Yes" option.
   - *"> Press ENTER to Confirm"* displays
   - After 12 seconds audio prompt sounds

Central Information Display
- "Yes" option is highlighted

5. Press ENTER.

Central Information Display
- System option screen displays

6. Press CANCEL.

Central Information Display
- Infusion Setup or Active Infusion screen displays

NOTE

Anesthesia mode is "selected" until either the above procedure is repeated and "No" selected or until the PC-4 unplugged.

ACTION/PROMPT DISPLAY RESPONSE

Changing Channel Selection Before Completing Programming

NOTE

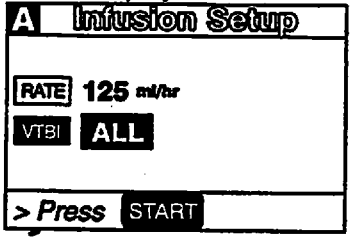
Prior to completing a program change, it is possible to exit one channel and program another. Upon starting another channel, the previous channel is automatically selected along with a dialog box that alerts the user to complete the program change.

Programming on channel A **has not been completed** Press ENTER to complete/ confirm Press CANCEL to clear program

To Infuse Using an Empty Container Detector (ECD)

1. Set up a primary infusion on any channel.
2. Connect an ECD to the appropriate ECD connector on the rear panel of the PC-4.
   - The appropriate channel indicator LED on the ECD will illuminate.
3. Attach the ECD to the drip chamber of the primary set.
4. Press VTBI, then 0 or CLEAR to clear the VTBI value.
5. Press 1 to select "ALL" or program a specific VTBI using the numeric data entry controls.

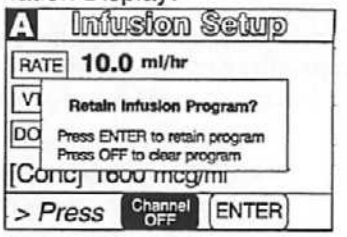
Central Information Display:



6. Press START.

When the ECD senses an empty container:

- An audio prompt sounds
- "EMPTY CONTAINER-KVO" SCROLLS
- RATE display shows "1" or set rate if <1.0
- Channel ALARM indicator - flashes
- Channel INFUSING indicator - continues to flash.

ACTION/PROMPT	DISPLAY RESPONSE
2. Press CHANNEL OFF.	Channel Information Display: • Rate display - blanks • INFUSING indicator - extinguishes Central Information Display: 
3. Press ENTER to save current Drug Calculation Infusion Program or press CHANNEL OFF to clear program.	Channel Information Display: • Channel displays - blank Central Information Display: • Active Infusion screen displays, if other channels are operating; or Powerdown screen displays

To Edit a Drug Calculation Setup

WARNING

It is the responsibility of the user to adjust infusion rate, if required. Changing drug concentration (e.g. switching to a higher drug concentration) may require adjustment of the infusion rate. Use accepted hospital procedure which may involve changing IV tubing or repriming existing tubing when drug concentration is changed.

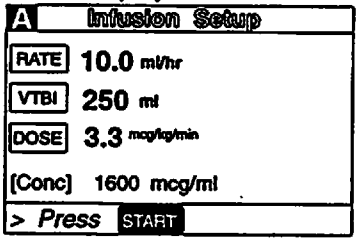
Editing the setup parameters during a running drug calculation will result in a recalculation of the dosage. Rate will remain as programmed.

If Amount, Diluent or Time Unit parameters are changed, the following dialog box appears:

> Drug concentration change recalculates dose. Rate remains as programmed. Adjust Rate/Dose if required. Re-prime line if necessary.
>
> Press Enter to continue

If only weight is changed, the following dialog box appears:

> **Note:** Weight change does not change rate. Dose recalculates based on new weight. Adjust Dose or Rate if required.
>
> Press Enter to continue

ACTION/PROMPT	DISPLAY RESPONSE
15. Use numeric data entry or controls to enter either a rate or dose (↑ ↓ can be used to enter rate). • After 3 seconds "> Enter VTBI Value" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • Entered Rate value and calculated Dose value are displayed **or** Entered Dose value and calculated Rate display
16. Press VTBI. • After 3 seconds "> *Enter VTBI Value*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • VTBI and 0 ml are highlighted
17. Use numeric data entry controls to enter VTBI value. • After 3 seconds"> *Press* START " displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: 
18. Attach the set to the patient's vascular access device following accepted hospital procedure.	
19. Press START.	Channel Information Display: • Channel indicator - extinguishes • INFUSING indicator - flashes • Selected or calculated rate displays • Selected or calculated dose scrolls Central Information Display: • Active infusion screen displays
During the Infusion • Changes made to the rate result in corresponding changes to the drug dose. • Changes made to the dose result in corresponding changes to the rate.	Channel Information Display: • Drug dose continues to scroll (unless drug dose display is set to "Temporary" in System Configuration) Central Information Display: • VTBI value decrements
Stopping and saving a Drug Calculation Infusion: 1. Press A ... D to select channel. • After 3 seconds "> *Enter VTBI Value*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: • Channel indicator - illuminates Central Information Display: • Drug Calculation Infusion Setup screen displays

ACTION/PROMPT | DISPLAY RESPONSE

NOTE

Drug dose units default values are delineated in the following table:

Drug amount entered as:	Drug will be dosed in:	Example:
micrograms	micrograms	500 mcg in 50 ml, Weight = no, Time units = Min [Conc] = 10 mcg/ml Drug dose is mcg/min
milligrams (where concentration is ≤ 10 mg/ml)	micrograms	500 mg in 50 ml, Weight = yes, Time units = Min [Conc] = 10000 mcg/ml Drug dose is mcg/kg/min
milligrams (where concentration is > 10 mg/ml)	milligrams	1000 mg in 50 ml, Weight = yes, Time units = Min [Conc] = 20 mg/ml Drug dose is mg/kg/min
grams	milligrams	2 gm in 250 ml, Weight = no, Time units = min [Conc] = 8 mg/ml Drug dose is mg/min
units (where concentration is ≥ 1 unit/ml)	units	25000 units in 250 ml, Weight = no, Time units = Hour, [Conc] = 100 units/ml Drug dose is units/hour
units (where concentration is < 1 unit/ml)	milliunits	10 units in 1000 ml, Weight = no, Time units = Min, [Conc] = 10 milliunits/ml Drug dose is milliunits/min

If the default drug dose unit does not meet the requirement for the drug to be infused, press the OPTIONS/EXIT control and use the ↑ ↓ controls to select an alternate drug dosing unit. Press ENTER to confirm.

13. Press ENTER to confirm the drug calculation dosing parameters or press CANCEL to edit drug calculation parameters.
    - After 3 seconds "> *Enter Rate or Dose*" displays
    - After 12 seconds audio prompt - sounds

Channel Information Display:
NO CHANGE
Central Information Display:

A Infusion Setup	
RATE	___ 0 ml/hr
VTBI	— — — —
DOSE	0 mcg/kg/min
[Conc]	1600 mcg/ml
> *Enter Rate or Dose*	

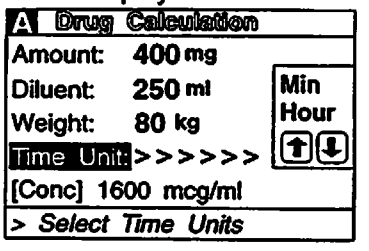
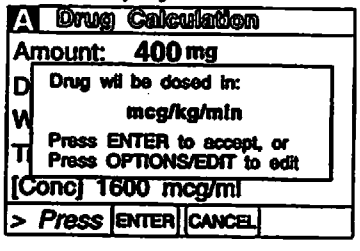
14. Press RATE or DOSE.
    - If rate, after 3 seconds "> Enter Rate Value" displays
      or
      If dose, after 3 seconds "> Enter Dose Value" displays
    - After 12 seconds audio prompt - sounds

Channel Information Display:
NO CHANGE
Central Information Display:
- If rate, RATE and 0 ml/hr are highlighted
  or
  If dose, DOSE and 0 mcg/kg/min are highlighted

ACTION/PROMPT	DISPLAY RESPONSE
9. Use ↑ or ↓ to select Yes or No in response to query "Dose based on Pt Wt?". • After 3 seconds "> *Press* [ENTER] *to confirm*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • Yes or No selection is highlighted

NOTE

Do not enter a patient weight if weight is not used in the calculation. If setting up a second Drug Calculation also using patient weight, changing weight on one channel recalculates dosage (not infusion rate) on all other channels. When dialog box appears, press ENTER to confirm weight for all channels.

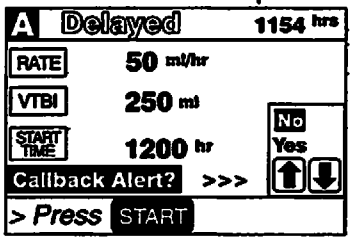
10. Press ENTER to confirm selection. • If Yes is selected, use numeric data entry controls to enter patient weight in kilograms (kg) and press ENTER to confirm **or** • If No is selected, press ENTER to confirm. (Screen will show "Weight: Not used") • After 3 seconds "> *Select Time Units*" displays	Channel Information Display: NO CHANGE Central Information Display: 
11. Use ↑ or ↓ to select Min or Hour. • After 3 seconds "> *Press* [ENTER] *to confirm*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • Min or Hour is highlighted
12. Press ENTER to confirm selection. • After 3 seconds "> *Press* [ENTER] [CANCEL]" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: 

ACTION/PROMPT	DISPLAY RESPONSE
4. Press **2**. • After 3 seconds "*> Enter Drug Amount*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: A Drug Calculation Amount: _ _ _ _ 0 mcg Diluent: ---- mg Weight: --- gram Time Unit:---- units [Conc]-------- ⬆⬇ *> Enter Drug Amount*
5. Use numeric data entry controls to enter the amount of drug added to the IV container. • After 3 seconds "*> Select Unit of Measure*" displays Use ⬆ or ⬇ to select a unit of measure (mcg, mg, gram or units) • After 3 seconds "*> Press [ENTER] to confirm*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • Selected Amount displays
6. Press **ENTER**. • After 3 seconds "*> Enter Diluent Volume*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: A Drug Calculation Amount: 400 mg Diluent: _ _ _ 0 ml Weight: --- Time Unit:---- [Conc]------- *> Enter Diluent Volume*
7. Use numeric data entry controls to enter the Diluent Volume (when originally prepared). • After 3 seconds "*> Press [ENTER] to confirm*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • Diluent Volume displays
8. Press **ENTER**. • After 3 seconds "*> Dose based on Pt Wt?*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: A Drug Calculation Amount: 400 mg Diluent: 250 ml No Yes Weight: >>>>>> ⬆⬇ Time Unit:---- [Conc] 1600 mcg/ml *> Dose based on Pt Wt?*

ACTION/PROMPT

DISPLAY RESPONSE

Channel Information Display:
ENTER Option
- Multidose infusion program screen displays
CHANNEL OFF Option



3. Press ENTER to save Multidose Infusion Program or press CHANNEL OFF to clear program.

Channel Information Display:
- Channel displays - blank

Central Information Display:
- Active Infusion screen displays for other operating channels or Powerdown screen displays

To Use Drug Calculation

WARNING

The Drug Calculation feature is to be used only by personnel properly trained in the administration of continuously infused medications. Extreme caution should be exercised to insure correct entry of drug calculation infusion parameters. Refer to specific drug product labeling for information concerning appropriate administration techniques and dosages.

1. Prime and load the primary administration set as previously described.

2. Press A ... D to select channel.
   - After 3 seconds "*Enter Rate Value*" displays
   - After 12 seconds audio prompt - sounds

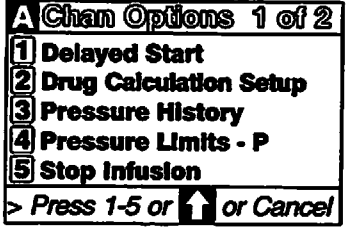
Channel Information Display:
- Channel indicator - illuminates
- RATE display shows "- - - -".

Central Information Display:
- Infusion Setup screen displays

3. Press OPTIONS EDIT.
   - After 3 seconds "*> Press 1-5 or ↑ or Cancel*" displays
   - After 12 seconds audio prompt - sounds

Channel Information Display:
NO CHANGE

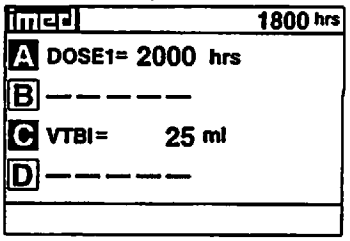
Central Information Display:



ACTION/PROMPT

DISPLAY RESPONSE

Central Information Display:

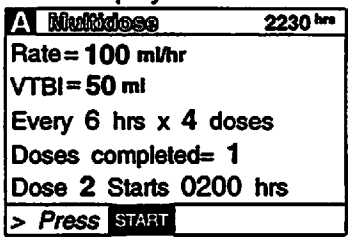


* Delayed start
** Immediate start

When a Multidose infusion is in progress:

- Following completion of a dose infusion, DOSE"X"=(START TIME) displays (where X = number of next dose followed by its scheduled start time)
- The VTBI for an active dose infusion decrements
- To review the selected multidose infusion, press A ... D to call up the selected channel multidose status summary screen.

Central Information Display



When the Multidose infusion is completed:

- The infusion stops (with no KVO).

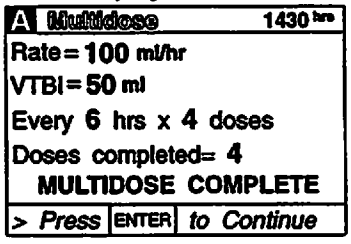
Channel Information Display:
- INFUSING indicator - extinguishes
- Rate display - blanks
- "MULTIDOSE COMPLETE" scrolls

Central Information Display:
- "COMPLETE" displays for the appropriate channel

1. Press A ... D to select channel.
   - After 3 seconds "> *Press* ENTER *to continue*" displays
   - After 12 seconds audio prompt - sounds

Channel Information Display:
- Channel indicator - illuminates

Central Information Display:



2. Press ENTER to reset and resume same Multidose infusion or press CHANNEL OFF to shut down channel
   - To resume - reset start time

Channel Information Display:
NO CHANGE

ACTION/PROMPT	DISPLAY RESPONSE
13. Press ENTER (If this is the first Multidose Set Up following POWER ON, Confirm Time dialog box displays). • After 3 seconds "> *Confirm Time-of-Day*" displays • Press ENTER to confirm Time-of-Day or use numeric data entry controls to set time (use ↑ or ↓ to select AM or PM, if required) then press ENTER **or** • "> *Enter Start Time*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: A Multidose 1754 hrs Rate: 100 ml/hr VTBI/Dose: 50 ml Interval: 6 hrs # Doses: 4 doses Start At: _ _ _ _ hrs > *Enter Start Time*
14. Use numeric data entry controls to enter Start Time (Current time + 8 hours maximum) for initial dose (use ↑ or ↓ to select AM or PM, if required). • After 3 seconds "> *Press* ENTER to confirm" displays • An audio prompt sounds after 12 seconds	Channel Information Display: NO CHANGE Central Information Display: • Start Time displays

NOTE

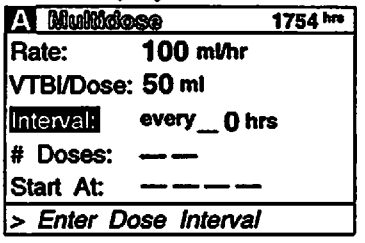
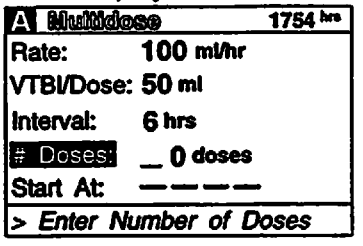
To start a Multidose infusion immediately, enter the current time, as the start time.

15. Press ENTER. • "> *Press* START" displays • After 12 seconds audio prompt - sounds **NOTE** **To edit the Multidose infusion parameters, press RATE to return to the top of the Multidose setup screen. Use numeric data entry controls to change highlighted parameter. Use ENTER to move to the next parameter.**	Channel Information Display: NO CHANGE Central Information Display: A Multidose 1754 hrs Rate: 100 ml/hr VTBI/Dose: 50 ml Interval: 6 hrs # Doses: 4 doses Start At: 2000 hrs > *Press* START
16. Attach the set to the patient's vascular access device following accepted hospital procedure.	
17. Confirm the dosing parameter entries, then press START.	Channel Information Display: **IMMEDIATE START OF MULTIDOSE** • INFUSING indicator - flashes • Set Rate is displayed **DELAYED START OF MULTIDOSE** • Channel indicator - extinguishes • STANDBY indicator - illuminates • Rate display shows "- - - -"

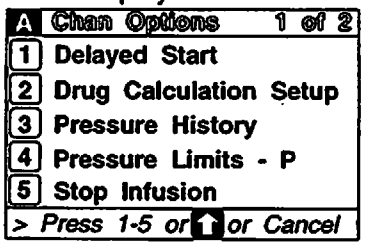
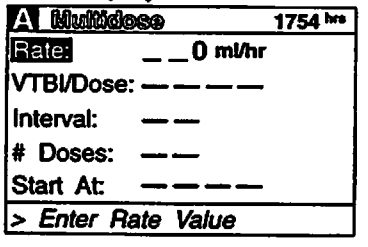
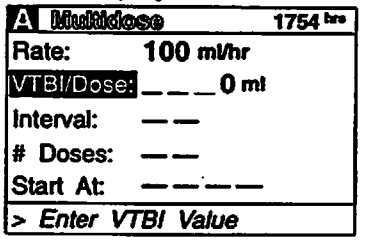
ACTION/PROMPT	DISPLAY RESPONSE
8. Use numeric data entry controls to enter the VTBI/Dose for each dose to be infused. • After 3 seconds "*> Press [ENTER] to confirm*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • VTBI/Dose displays

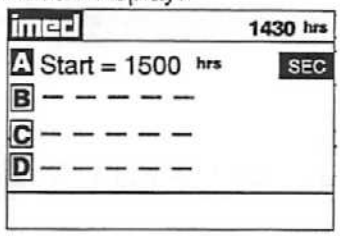
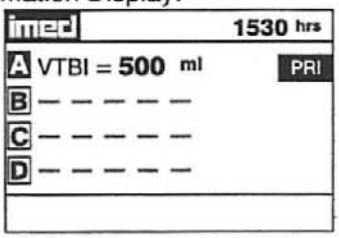
NOTE

When an Empty Container Detector (ECD) is connected to the channel, a dialog box questions if last DOSE is to be delivered until container is empty.

9. Press ENTER. • "*> Enter Dose Interval*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: 
10. Use numeric data entry controls to enter the Dose Interval (1-24 hours) for each dose to be infused. • After 3 seconds "*> Press [ENTER] to confirm*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • Dose Interval displays
11. Press ENTER. • "*> Enter Number of Doses*" displays • After 12 seconds audio prompt - sounds **NOTE** **Maximum allowable Multidose delivery schedule (number of doses times interval) is 24 hours.**	Channel Information Display: NO CHANGE Central Information Display: 
12. Use numeric data entry controls to enter the Number of Doses (1-24) to be infused. • After 3 seconds "*> Press [ENTER] to confirm*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • Number of Doses displays

PC-4

ACTION/PROMPT	DISPLAY RESPONSE
1. Prime and load the primary administration set as previously described.	
2. Press A...D to select channel. • "*Enter Rate Value*" displays after 3 seconds. • After 12 seconds audio prompt - sounds	Channel Information Display: • Channel indicator - illuminates • RATE display shows "- - - -". Central Information Display: • Infusion Setup screen displays
3. Press OPTIONS/EDIT. • After 3 seconds "*> Press 1-5 or ↑ or Cancel*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: 
4. Press ↑ to go to page 2 of Channel Options.	
5. Press 1. • "*> Enter Rate Value*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: 
6. Use numeric data entry or ↑ ↓ controls to enter the rate at which each dose is to be infused. • After 3 seconds "*> Press ENTER to confirm*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: • Rate displays
7. Press ENTER or VTBI. • "*> Enter VTBI Value*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: 

ACTION/PROMPT	DISPLAY RESPONSE
15. Press START .	Channel Information Display: • Rate display shows "- - - -" • STANDBY indicator illuminates • Channel indicator - extinguishes Central Information Display: 
When START TIME = Current time • Infusion Starts	Channel Information Display: • Programmed rate displays • INFUSING indicator - flashes Central Information Display: • Active infusion screen displays including Time-of-Day display • Secondary VTBI decrements
When the Secondary Infusion is complete • Switchover audio (6 beeps) sounds (unless disabled in System Configuration) • Primary infusion begins	Channel Information Display: • Primary rate displays • Message screen clears Central Information Display: 

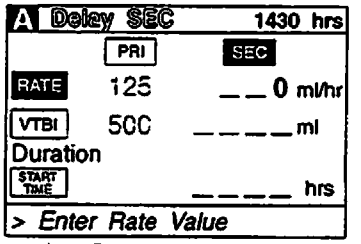
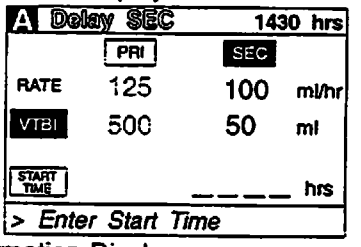
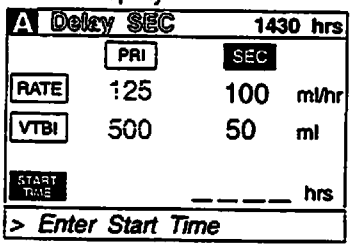
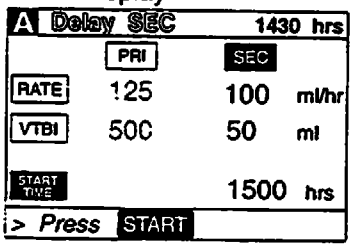
To Set Up a Multidose Infusion

WARNING

The Multidose feature is to be used only by personnel properly trained in using multidose containers. Caution labels which clearly differentiate single dose and multidose containers must be utilized. Single dose piggyback systems employing check valve sets are not designed for use with multidose containers.

NOTE

Since by definition, a Multidose infusion will not be infusing for a programmed period of time, it is assumed that another infusing IV line will keep the vein open until the beginning of the first dose and between subsequent doses. No KVO (Keep Vein Open) infusion precedes or follows a Multidose infusion program.

ACTION/PROMPT	DISPLAY RESPONSE
The duration parameter is calculated based upon rate and VTBI parameter inputs. A duration value can not be entered directly in the Delayed Start Secondary mode.	
10. Use numeric data entry or ⇧ ⇩ controls to enter Secondary rate value. • After 3 seconds "> Enter VTBI Value" displays • After 12 seconds audio prompt - sounds	Channel Information Display NO CHANGE Central Information Display • New Secondary rate displays
11. Press VTBI. • After 3 seconds "> Enter VTBI Value" displays • After 12 seconds audio prompt - sounds	Channel Information Display NO CHANGE Central Information Display • VTBI is highlighted
12. Use numeric data entry controls to enter Secondary VTBI value. • After 3 seconds "> Enter Start Time" displays • After 12 seconds audio prompt - sounds	Channel Information Display NO CHANGE Central Information Display 
13. Press TIME or ENTER control. • After 3 seconds "> *Enter Start Time*" displays • After 12 seconds audio prompt - sounds	Channel Information Display NO CHANGE Central Information Display 
14. Use numeric data entry controls to enter Start Time. (Use ⇧ ⇩ to select AM or PM, if appropriate). • After 3 seconds "> *Press* START " displays • After 12 seconds audio prompt - sounds	Channel Information Display NO CHANGE Central Information Display 

ACTION/PROMPT	DISPLAY RESPONSE

NOTE

A Delayed Start Secondary Infusion may also be programmed by entering the Primary infusion parameters, press SEC PIGGY BACK and enter the Secondary parameters then press OPTIONS EDIT and select Option #1 to select Delayed Start Secondary.

5. Press RATE.
   - After 3 seconds "> *Enter Rate Value*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE
   Central Information Display:
   - RATE is highlighted
   - Last entered rate or "0" displays

6. Use numeric data entry or ↑ ↓ controls to input or change rate value.
   - After 3 seconds "> *Enter VTBI Value*" displays
   - After 12 seconds audio prompt - sounds

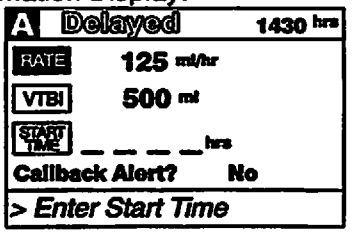
   Channel Information Display:
   NO CHANGE
   Central Information Display:
   - New rate value displays

7. Press VTBI.
   - After 3 seconds "> *Enter VTBI Value*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE
   Central Information Display:
   - VTBI is highlighted
   - Last VTBI value or "0" displays

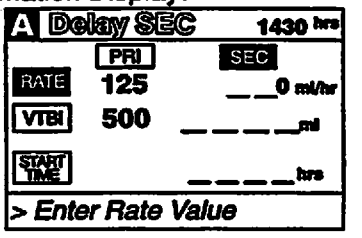
8. Use numeric data entry controls to input or change VTBI value.
   - After 3 seconds "> *Enter Start Time*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE
   Central Information Display:



9. Press SEC PIGGY BACK.
   - After 3 seconds "> *Enter Rate Value*" displays
   - After 12 seconds audio prompt - sounds
   - The Rate field is highlighted

   Channel Information Display:
   NO CHANGE
   Central Information Display:



NOTE

If the Volume/Time infusion option is enabled, the Delayed Start Secondary set up screen will include a "Duration" parameter displayed between VTBI and START TIME as shown below:

ACTION/PROMPT | DISPLAY RESPONSE

To Set Up a Delayed Start Secondary Infusion

Since by definition, a Delayed Start Infusion will not be infusing for a programmed period of time, it is assumed that another infusing IV line will keep the vein open until the delayed start infusion begins. In a Delayed Start Secondary Infusion, no KVO (Keep Vein Open) infusion precedes or follows completion of the primary infusion.

1. Prime and load the Secondary administration set as previously described.

2. Press A ... D to select channel.
   - After 3 seconds "*Enter Rate Value*" displays
   - After 12 seconds audio prompt - sounds

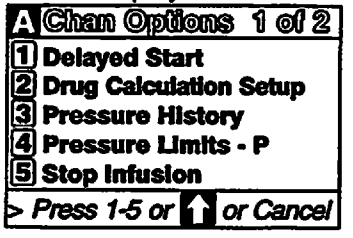
   Channel Information Display:
   - Channel indicator - illuminates
   - RATE display shows "- - - -".

   Central Information Display:
   - Infusion Setup screen displays

3. Press OPTIONS EDIT.
   - After 3 seconds "> *Press 1-5 or ↑ or Cancel*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE

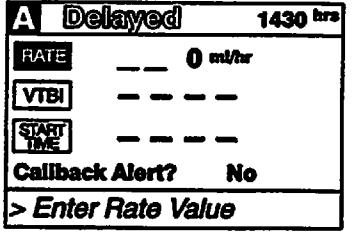
   Central Information Display:



4. Press 1.
   - After 3 seconds "> *Enter Rate Value*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE

   Central Information Display:

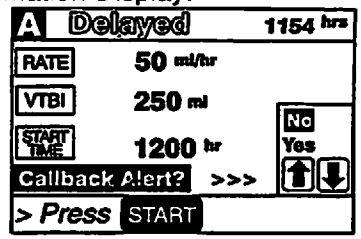
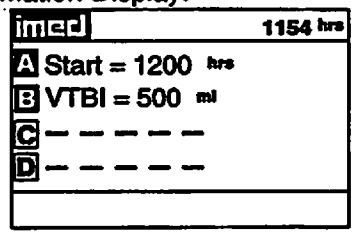
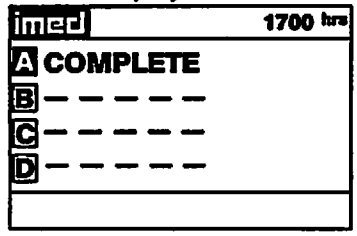


NOTE

If this is the first Delayed Start (or Multidose) Setup following POWER ON, the following pop-up display appears:

If the time displayed in the upper right corner of the display is correct, press ENTER to continue. If the time displayed is incorrect press OPTIONS EDIT. The following pop-up display appears:

Enter the correct Time of Day and press ENTER.

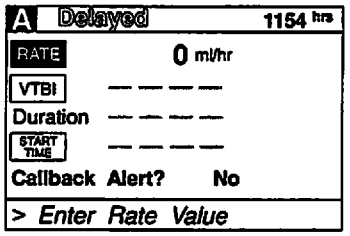
ACTION/PROMPT	DISPLAY RESPONSE
11. Press ENTER to change Callback Alert option. • Use ↑ or ↓ to select "Yes" (No is default setting) then press ENTER to confirm. • After 3 seconds "> *Press* START" displays. • After 12 seconds audio prompt - sounds.	Channel Information Display: NO CHANGE Central Information Display: 
NOTE **Callback is an audio alert sounding at completion of a Delayed Start Infusion.**	
12. Attach the set to the patient's vascular access device following accepted hospital procedure.	
13. Press START.	Channel Information Display: • Rate display shows "- - - -" • STANDBY indicator - illuminates • Channel indicator - extinguishes Central Information Display: 
When START TIME = Current time • Infusion Starts	Channel Information Display: • Programmed rate displays • INFUSING indicator - flashes Central Information Display: • Active infusion screen displays including Time-of-Day display • VTBI decrements
When the infusion is complete • Infusion Stops (No KVO) • If Callback Alert was selected, an audio alert sounds	Channel Information Display: • Channel indicator - extinguishes • Rate display - blanks • "DELAYED START COMPLETE" scrolls Central Information Display: 

ACTION/PROMPT | DISPLAY RESPONSE

NOTE

If the Volume/Time infusion option is enabled, the Delayed Start Infusion setup screen will include a "Duration" parameter that will display between the VTBI and START TIME lines as shown below:

The duration parameter is calculated based upon the Rate and VTBI inputs. A duration value can not be entered directly in the Delayed Start mode.



5. Press RATE.
   - After 3 seconds "> *Enter Rate Value*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display: NO CHANGE
   Central Information Display:
   - RATE is highlighted
   - Last entered rate or 0 displays

6. Use numeric data entry or ⇧ ⇩ controls to input or change rate value.
   - After 3 seconds "> *Enter VTBI Value*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display: NO CHANGE
   Central Information Display:
   - New rate value displays

7. Press VTBI.
   - After 3 seconds "> *Enter VTBI Value*" displays
   - After 12 seconds audio prompt - sounds

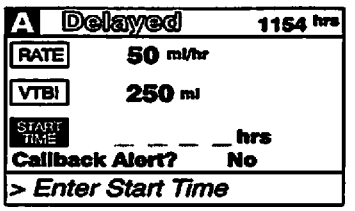
   Channel Information Display: NO CHANGE
   Central Information Display:
   - VTBI is highlighted
   - Last VTBI value or 0 displays

8. Use numeric data entry controls to input or change VTBI value.
   - After 3 seconds "> *Enter Start Time*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display: NO CHANGE
   Central Information Display:
   - New VTBI value displays

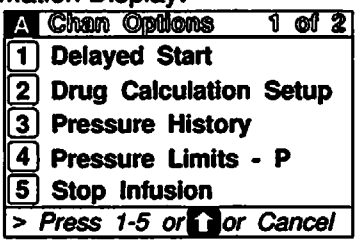
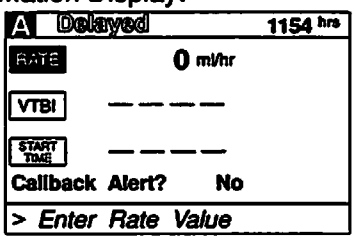
9. Press TIME.
   - After 3 seconds "> *Enter Start Time*" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display: NO CHANGE
   Central Information Display:



10. Use numeric data entry controls to enter start time (use ⇧ ⇩ to select AM or PM, if required). Maximum delay is 23 hours 59 minutes from current time.
    - After 3 seconds "> *Press* ENTER" displays
    - After 12 seconds audio prompt - sounds

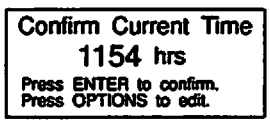
    Channel Information Display: NO CHANGE
    Central Information Display:
    - New Start Time displays

ACTION/PROMPT	DISPLAY RESPONSE
2. Press A...D to select channel. • *"Enter Rate Value"* displays after 3 seconds. • After 12 seconds audio prompt - sounds	Channel Information Display: • Channel indicator - illuminates • RATE display shows "- - - -". Central Information Display: • Infusion Setup screen displays
3. Press OPTIONS/EDIT. • After 3 seconds *"> Press 1-5 or ↑ or Cancel"* displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: 
4. Press 1. • After 3 seconds "> *Enter Rate Value*" displays • After 12 seconds audio prompt - sounds	Channel Information Display: NO CHANGE Central Information Display: 

NOTE

If this is the first Delayed Start (or Multidose) Setup following POWER ON, the following pop-up display appears:

If the time displayed in the upper right corner of the display is correct, press ENTER to continue. If the time displayed is incorrect press OPTIONS/EDIT. The following pop-up display appears:



Enter the correct Time of Day and press ENTER.

ACTION/PROMPT	DISPLAY RESPONSE

To Change the Time of Day

1. Press [MENU].

Central Information Display:

imed System Options
1 Display Contrast
2 Time-of-Day
3 Anesthesia Mode
4 Computer Control
5 System Configuration
> Press CANCEL to Exit

2. Press [2].
   - After 3 seconds "> *Press* ENTER *to confirm*" displays
   - After 12 seconds audio prompt - sounds

NOTE

If a Delayed Start or Multidose is active, "> *Delay Mode is Active*" will display and Time-of-Day display screen can not be accessed.

Central Information Display:

imed Time
Time-of-Day
TIME: 1000 hrs
> Press ENTER to Confirm

3. Use numeric data entry controls to enter the new time.

Central Information Display:
- New time displays

4. Use [↑] or [↓] to select AM or PM, if clock is in the AM/PM mode.

5. Press [ENTER].

Channel Information Display:
NO CHANGE
Central Information Display:
- System Options screen displays

6. Press [CANCEL].

Channel Information Display:
NO CHANGE
Central Information Display:
- Infusion setup or active screen displays

To Set Up a Delayed Start Infusion

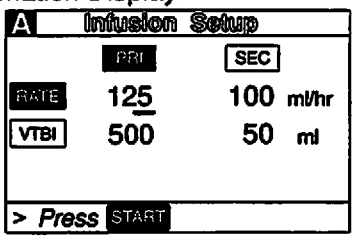
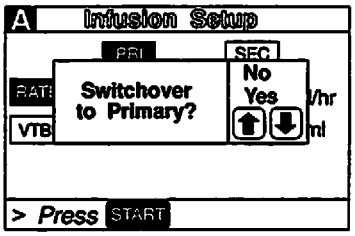
NOTE

Since by definition, a Delayed Start Infusion will not be infusing for a programmed period of time, it is assumed that another infusing IV line will keep the vein open until the delayed start infusion begins. No KVO (Keep Vein Open) infusion precedes or follows a Delayed Start program.

1. Prime and load the primary disposable administration set as previously described.

ACTION/PROMPT	DISPLAY RESPONSE
7. Press START.	Channel Information Display: • Channel indicator - extinguishes Central Information Display: • Active Secondary Infusion screen displays

To Stop a Secondary Infusion and Return to the Primary Infusion

1. Press A...D to select channel. • After 3 seconds "> *Press* START" displays • After 12 seconds audio prompt - sounds	Channel Information Display: • Channel indicator - illuminates Central Information Display: • Secondary Infusion Setup screen displays
2. Press SEC PIGGY BACK. • "> *Press* START" displays	Channel Information Display: NO CHANGE Central Information Display: 
3. Close Secondary clamp.	
4. Press START.	Channel Information Display: NO CHANGE Central Information Display: 
5. Use ↑ or ↓ to select "Yes" option.	Central Information Display: • "Yes" option is highlighted
6. Press START. • The secondary infusion stops and the primary infusion starts. • The audio tone sounds six times (unless the primary switchover alert is disabled).	Channel Information Display: • Rate changes to Primary value • Channel indicator - extinguishes Central Information Display: • Primary active infusion screen displays

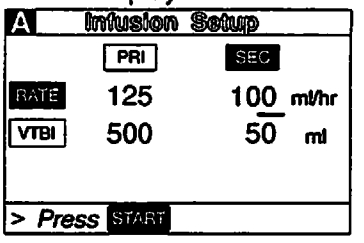
ACTION/PROMPT	DISPLAY RESPONSE

To Change Primary Infusion Parameters During Secondary Infusion

1. Press A ... D to select channel.
   - After 3 seconds "> *Press* START" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   - Channel indicator - illuminates

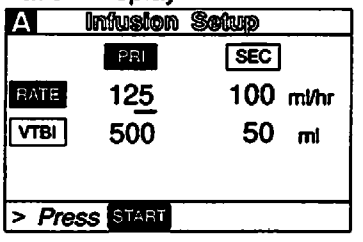
   Central Information Display:



2. Press SEC PIGGY BACK.
   - After 3 seconds "> *Press* START" displays

   Channel Information Display:
   NO CHANGE

   Central Information Display:



3. Use numeric data entry or ↑ ↓ controls to change primary rate value.

   Channel Information Display:
   NO CHANGE

   Central Information Display:
   - New primary rate value displays

4. Press VTBI to change primary VTBI.

   Channel Information Display:
   NO CHANGE

   Central Information Display:
   - Cursor displays under VTBI value
   - VTBI is highlighted

5. Use numeric data entry controls to change primary VTBI.
   - After 3 seconds "> *Press* START" displays
   - After 12 seconds audio prompt - sounds

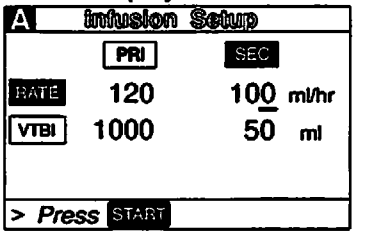
   Channel Information Display:
   NO CHANGE

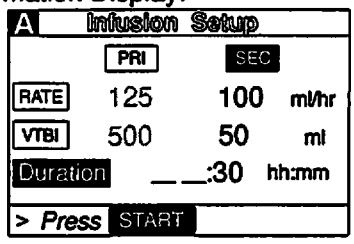
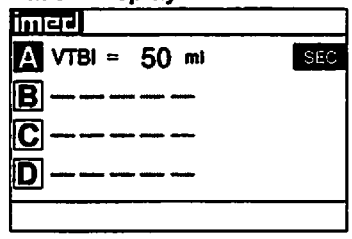
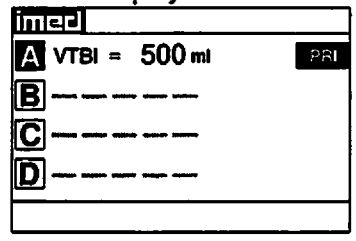
   Central Information Display:
   - New primary VTBI value displays

6. Press SEC PIGGY BACK.
   - After 3 seconds "> *Press* START" displays
   - After 12 seconds audio prompt - sounds

   Channel Information Display:
   NO CHANGE

   Central Information Display:



ACTION/PROMPT	DISPLAY RESPONSE
NOTE **It is acceptable to enter either a VTBI/Duration or a Rate/VTBI as the Secondary infusion parameters when the Volume/Time infusion option is enabled.**	Central Information Display: 
9. Open clamp on the Secondary set.	
10. Press START.	Channel Information Display: • Channel Indicator - extinguishes • Secondary rate - displays • "SECONDARY" message scrolls Central Information Display: 
During Infusion: **NOTE** **Various Advisories, Alarms, and Malfunctions may be displayed. Refer to the CHANNEL, CENTRAL INFORMATION DISPLAY AND ALARM RESPONSE PROCEDURES section in this manual for an explanation and appropriate response.**	Channel Information Display: • INFUSING indicator - flashes • Secondary rate - displays Central Information Display: • VTBI (Secondary) - decrements
Upon Completion of the Secondary infusion: • Switchover audio alert (6 beeps) - sounds (unless disabled in System Configuration) **NOTE** **Actual changeover from the Secondary to the Primary IV solution is accomplished independently of pump/controller operation and occurs when the fluid level in the Secondary container drops to the same level as the fluid level in the Primary fluid container.**	Channel Information Display: • Primary rate displays • Message screen clears Central Information Display: 

SECTION 5 - MAINTENANCE

5.1 INTRODUCTION

This section contains preventive maintenance instructions, maintenance mode operating procedures, troubleshooting routines and disassembly and reassembly procedures for the IMED® GEMINI PC-4® Volumetric Pump/Controller ("PC-4").

WARNING

Potentially lethal voltages are present within the PC-4 case when the instrument is operated using external AC power. When the case is opened for maintenance action, it is recommended the instrument be operated using the internal battery.

CAUTION

Printed circuit boards (PCBs) are easily damaged when integrated circuits are removed and replaced. Excessive heat applied to the circuit board traces and pads can cause de-lamination of the metal foil and base material. Damage of that type is essentially irreparable; therefore, only low-temperature soldering irons and vacuum solder removal tools should be used when removing and replacing components on PCBs. Leads on integrated circuit components should be cut before attempting un-soldering and removal.

NOTE

CMOS devices are sensitive to static electrical charges and may be damaged during repair if the repair activity is not performed in an ESD protected environment using approved ESD protective procedures including personnel grounding.

5.2 PREVENTIVE MAINTENANCE

The GEMINI PC-4 is designed and assembled with the goal of minimizing maintenance requirements. The integral microprocessor incorporates a diagnostic routine that monitors the instrument's subsystems and operating parameters. Detection of operating system irregularities or failures that affect the instrument's functional operation activates audio and visual Alarms or Malfunction alerts for operator notification. Problems of this nature are recorded in the non-volatile RAM error log for subsequent use by biotechnical personnel in performing troubleshooting and repair actions.

Maintenance-free operation between regularly scheduled preventive maintenance inspections can be enhanced by performing routine cleaning on an `as required' basis. The recommended interval for preventive maintenance inspections is once a year based on normal use and operation. Verification of proper operation is the responsibility of the user. At the user's option, such tests and verification may be performed at the factory at nominal cost. The following paragraphs describe in detail the procedures for performing general maintenance on the PC-4.

5.2.1 Cleaning Instructions

CAUTION

DO NOT SPRAY the instrument with any fluids. DO NOT immerse or stand the instrument in any fluids. Always unplug the AC power cord before cleaning. DO NOT attempt to sterilize with Ethylene Oxide gas, heat, steam, radiation, or autoclaving. To do so may damage the pump and void the warranty.

Exterior surfaces of the PC-4 may be cleaned using any of the following recommended solutions. This list is considered adequate to permit cleanup of all expected contaminates.

Isopropyl alcohol
Warm soapy water
Household Bleach (10% solution, i.e. 1 part household bleach to 9 parts water)

These solutions may be applied using a soft, lint free cloth; a soft bristle brush and/or a cotton swab. Once the contamination has been removed, a cloth wet with fresh water should be used to rinse the entire instrument removing and diluting all of the residual cleaning solution.

Then the entire instrument surface should be completely rinsed using another cloth thoroughly moistened with fresh water. Following the fresh water rinses, the instrument must be thoroughly dried with a soft, lint free cloth. If this is not done the plastic could be damaged.

WARNING

Prior to reattaching the AC power cord to the instrument, ensure that the male base of the power input module is clean of any electrolyte and dry thoroughly. Check the female contacts on the power cord for contamination; if contaminated, replace the power cord.

5.2.2 Mechanical Inspection

Perform the mechanical inspection described in Section 2.2 of this manual, plus the following checks:

- Inspect the urethane pumping seal for excessive wear and/or holes every 90 days or 1000 hours of instrument operating time. If damaged or worn, replace the seal.
- Perform a pumping mechanism extension spring integrity test by closing the IV set roller clamp while the pump is operating in the Pump mode. If only one spring is functioning, the channel will not occlude. Replace damaged or missing spring.
- Inspect the exterior case, front and rear, for holes, cracks, scratches, spalling, broken or damaged controls, missing components and/or screws.
- Inspect the green tinted windows covering the channel information displays and the screen covering the LCD for scratches or cracks.
- Ensure the pumping chamber access doors fit flush with the case at the top, bottom, and sides.
- Check the door handle/cam locks for ease of operation and flush fit with door when latched.
- Inspect the Air-in-line sensors and Flo-Stop® recesses for damage or obstructions.
- Install an approved IMED® GEMINI administration set to ensure the Flo-Stop® assembly seats correctly and the door closes and latches properly.
- Inspect the power cord for damage, bent prongs or deformed connector.
- Exercise the pole clamp mechanism to ensure freedom of movement.
- Check the Equipotential grounding point for damage and security.

5.3 MAINTENANCE MODE

The PC-4 is configured with a Maintenance Mode that allows biomedical technicians to access the software diagnostic subsystem.

5.3.1 Maintenance Mode Operation

WARNING

Prior to operating the PC-4 in the Maintenance Mode, ensure that the instrument is not connected to a patient.

1. To initialize the instrument in the Maintenance Mode, press and hold the Audio Control switch on the rear panel and then press POWER ON.
   - Upon completion of initialization, the Central Information display will show the following screen:

Maintenance Mode

[1] S/C board test and displays
[2] M/C board tests and displays
[3] Press [off] to exit

2. To access the System Controller board Tests and Displays, press 1:
   - Central Information screen displays:

```
                                  []
S/C Board Tests and Displays
  [1] error log display
  [2] ROM signatures
  [3] A/D voltages
  [4] audio tests
```

   - Use the ↑ ↓ controls to toggle the display to the second and/or third screens, as shown below:

```
                                  []
S/C Board Tests and Displays
  [5] NiCad battery voltages
  [6] Keypad test
  [7] IPC Log Download
  [8] Battery Statistics
```

```
                                  []
S/C Board Tests and Displays
  [9] Discharge History
```

3. To view the Error Log Display, press 1:
   - Central Information screen displays:

```
            Error Log

index:          n
event:          xxx
time:           hh:mm:ss.ss
repeats:        n
```

   where: n = index no. of entry (0 - 31)
   xxx = Error Code (100 - 9999)
   hh:mm:ss.ss - time of occurrence since power on
   r = number of times that error has repeated (0 - 65,536)

   - Use ↑ ↓ controls to toggle forward or back through the error log. "No older entry" or "No newer entry" displays when all entries have been viewed.

4. Press CANCEL to return to the S/C Board Tests and Display screen.

5. To view ROM signatures screen, press 2:
   - Central Information screen displays:

```
          ROM Signatures


CRC:                xxxx

checksum            xxxx
```

   - The CRC value shows "wait" until the value is calculated, then the value is displayed as a hexadecimal value. The checksum is a redundant check to confirm ROM integrity.

6. Press CANCEL once to return to the S/C Board Tests and Display screen.

7. To view A/D voltages display, press 3:
   - Central Information screen displays:

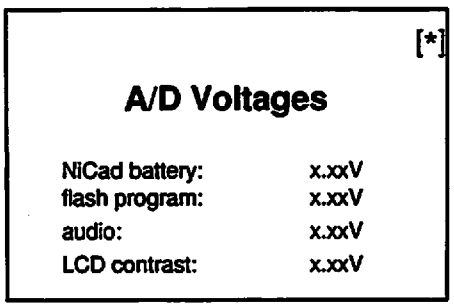
```
                                  [*]
          A/D Voltages

mains:              x.xxV
V ref:              x.xxV
current:            x.xxA
system battery:     x.xxV
```

   Acceptable ranges:

mains:	0.00 to 0.10 volts (unplugged)
	2.30 to 2.70 volts (plugged)
V ref:	2.5 ±0.125
current:	-0.45 to -0.10 amps (unplugged)
	0.00 to 1.25 amps (plugged in)
Sys batt:	13.50 to 14.85 volts (plugged in)

- Use ↑ ↓ controls to toggle to second A/D voltage screen

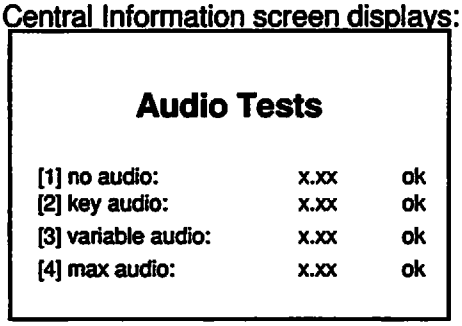


Acceptable ranges:

NiCad batt:	>5.00 <6.00 volts
flash prog:	<1.00 volt
audio:	variable (check for failure)
LCD cont:	1.5 ±0.5

8. Press CANCEL once to return to the S/C Board Tests and Display screen.

9. To view Audio Tests screen, press 4:
   - Central Information screen displays:



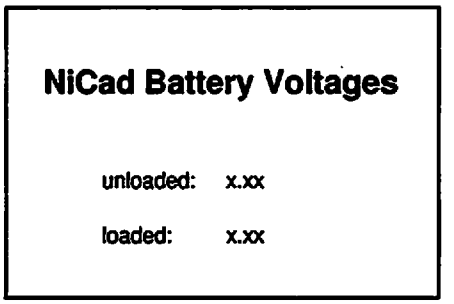
   - Test runs when Audio test display is selected and can be re-run by pressing START.

Acceptable ranges:

no audio:	<0.5
key audio:	>0.85
variable audio:	>0.85
max audio:	>1.25

10. Press CANCEL once to return to the S/C Board Tests and Display screen.

11. To view NiCad battery voltages, press 5:
    - Central Information screen displays:

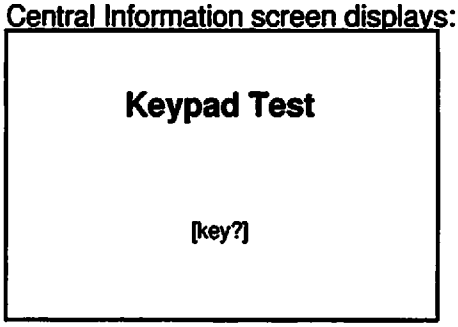


Acceptable ranges:

Unloaded:	5.00 to 6.00
Loaded:	5.00 to 6.00

12. Press CANCEL once to return to the S/C Board Tests and Display screen.

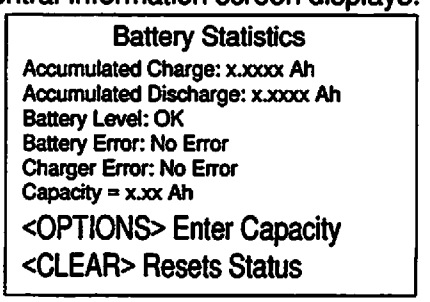
13. To activate the Keypad Test, press 6:
    - Central Information screen displays:



    - Press each keypad control:
      - The key name displays between the brackets (except CANCEL, which causes display to return to S/C Board Test and Display screen).

14. The IPC Download feature is for use by ALARIS Medical internal use only.

15. To access Battery Statistics, press 8:
    - Central Information screen displays:



Acceptable ranges:

Accumulated Charge:	N/A
Accumulated Discharge:	N/A
Capacity:	3.40 Ah

16. To access Battery Discharge History, press 9:
    - Central Information screen displays:

Battery Discharge History	
12.400 - 0	12.200 - 0
12.000 - 0	11.800 - 0
11.600 - 0	11.400 - 0
11.200 - 0	11.000 - 0

Threshold = 12.40V
Voltage = 14.76V
<CLEAR> Resets History

This screen indicates the depth to which the battery has been discharged by changing the 0 to 1 as each level is detected. The displayed threshold is the next lower undetected level. Displayed voltage is the current battery voltage.

17. Press CANCEL once to return to the S/C Board Tests and Display screen or twice to return to Maintenance Mode screen.

18. To access the M/C Board Tests and Displays, press 2:
    - Central Information screen displays:

M/C Board Tests and Displays

[1] maximum pressure test

[2] strain beam voltages

19. To perform maximum pressure test, press 1:
    - Central Information screen displays:

Maximum Pressure Test

A	halted	x.xx
B	halted	x.xx
C	halted	x.xx
D	halted	x.xx

20. Install a GEMINI disposable in the channel pumping mechanism and connect the distal end to a 0-60 psi (0-400 kPa) pressure gauge. *Note: Use water for this test.*

21. Press A then press START:
    - "running" will replace "halted" for channel A on the Central Information display screen.
    - Allow pump to operate until the pressure stabilizes at the highest obtainable pressure.
    - Record the stabilized pressure reading. This reading should be ≥17 psi (117.3 kPa). *Note: If test fails, replace mechanism.*

22. Press CHANNEL OFF.

23. Release the pressure in the tubing, and repeat the test as necessary for the other channels.

24. Press CANCEL to return to the M/C Board Tests and Display screen.

25. To access the Strain Beam Voltage test screen, press 2:
    - Central Information screen displays:

Strain Beam Voltages

A	homed	x.xx
B	- - - - -	
C	- - - - -	
D	- - - - -	

    - Channel A pumping mechanism homes - "homing" displays for channel A
    - "homed" and "x.xx" (voltage should be within ±0.30 volts of V_i value for installed calibrated tubing ALARIS Medical P/N 3299-100).

26. Press B .. D to check the strain beam voltage for the other channels.

27. Press CANCEL once to return to the M/C Board Tests and Display screen or twice to return to the Maintenance Mode screen.

28. Press 3 to exit maintenance mode, then press CHANNEL OFF to power down the PC-4.

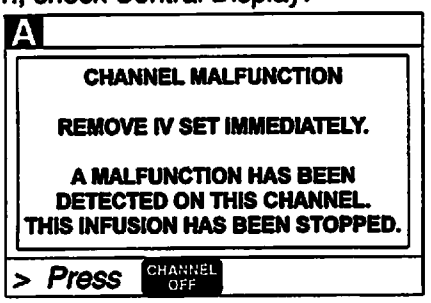
5.4 TROUBLESHOOTING

The troubleshooting routines presented in the Table 5-1 are correlated directly to the maintenance mode test sequence described in section 5.3.

5.4.1 Mechanism Alarm Circuit (M.A.C.)

The PC-4 instruments are manufactured with a pump mechanism alarm circuit (M.A.C.) to enhance detection of impact damage to the instrument as the result of dropping or other abnormal handling.

If a PC-4 goes into an alarm condition following Power On, check Central Display:



This alarm condition is associated with a disconnect in the pump mechanism alarm circuit. To determine the specific problem, perform the following troubleshooting procedures.

1. Turn off the instrument and remove the AC power cord from the AC outlet.

2. Separate the case (refer to Maintenance Manual Section 5.5.1).
   - Use a 5/32" Allen driver or wrench to remove the four socket head screws that connect the front and rear case assemblies. (Do not leave screws on work surface. Front panel could be damaged if front case is laid on the screws).

   NOTE

   When separating and positioning the front and rear cases for M.A.C. installation, ensure that no tension is applied to the harnesses connecting the case assemblies.

3. Inspect the upper and lower M.A.C. assembly contacts on each pump mechanism for a disconnected condition.

4. If the M.A.C. contacts (spring clips) are in place, inspect the M.A.C. wires and connectors for a cut or break.

5. If the M.A.C. circuit is intact, then the alarm condition can be attributed to an AIL hardware problem. Follow maintenance manual procedures for troubleshooting, removal and replacement of the AIL/SCD assembly.

6. If the M.A.C. contacts are disconnected, the instrument has been subjected to an abnormal impact condition. Visually inspect the pump mechanism(s) for severe cracks or breaks in the areas around the mounting flanges and housing pivot points. Small cracks do not affect functionality.

7. If no visual damage is detected, attempt to move the top of the pump mechanism laterally (side to side). If the mechanism is intact, there will be very little lateral motion. If the mechanism is broken, the lateral movement will be easily discernible.

   NOTE

   Do not mistake movement of the top of the pump mechanism along the hinge axis as lateral movement.

8. If the mechanism is intact, with no severe cracks or breaks, inspect the M.A.C. components for obvious damage; e.g., severely bent copper components. If all components are intact and undamaged, reconnect the upper and lower M.A.C. spring clips.

   NOTE

   It is important that the M.A.C. spring clips be compressed only the amount necessary to allow the contacts to be inserted into the slots on the top plate.

9. If a mechanism is severely cracked or broken, or if the M.A.C. system is damaged, replace the damaged components.

Table 5-1. Troubleshooting Guide

Test/Fault	Probable Cause	Corrective Action
INITIALIZATION		
LEDs fail to illuminate at power up	Battery <10.5 volts	Connect AC power
	F1 on Power Supply PCB blown	Replace fuse
	F2 on Power Supply PCB blown	Replace fuse
	POWER ON switch inoperative	Check keypad cable connector
		Test/Replace keypad
	Digital Logic failure	Replace Digital Logic Board
Unable to enter Maintenance Mode	ACCESS switch failure	Replace ACCESS switch
	ACCESS switch harness disconnected	Reconnect ACCESS switch harness
LEDs stay ON	Digital Logic failure	Replace Digital Logic Board
Display Corrupted	Digital Logic Board failure	Replace Digital Logic Board
	Display Board failure	Replace Display Board
ERROR LOG DISPLAY		See Table 5-2 for a listing of Error Log Codes
A/D VOLTAGES		
"mains:" reading <1.25 volts on AC power	Power Supply Board failure	Replace Power Supply Board
"V ref:" reading other than 2.50 ±0.125	Power Supply Board failure	Replace Power Supply Board
	Digital Logic Board failure	Replace Digital Logic Board
"current:" reading other than =<4.00 depending on battery charge; plugged-in ≈ -0.200 unplugged	Power Supply Board failure	Replace Power Supply Board
	Digital Logic Board failure	Replace Digital Logic Board
"system battery:" reading >10.9 or <15.5 volts	System Battery failure	Replace System Battery
	Power Supply Board failure	Replace Power Supply Board
	Digital Logic Board failure	Replace Digital Logic Board
"NiCad battery:" reading volts other than >5.00 <6.00	NiCad Battery failure	Replace NiCad Battery

Test/Fault	Probable Cause	Corrective Action
"flash program:" reading <0.00 or >1.00 volts	Display Board failure	Replace Display Board
	Digital Logic Board failure	Replace Digital Logic Board
"audio:" reading (see Audio tests)	Power Supply Board failure	Replace Power Supply Board
	Digital Logic Board failure	Replace Digital Logic Board
"LCD contrast:" reading <0.00 or >2.04 volts	Digital Logic Board failure	Replace Digital Logic Board
AUDIO TESTS		
"No audio:" reading >0.20 volts	Power Supply Board audio oscillator circuit failure	Replace Power Supply Board
"Key audio:" reading <0.50	Audio Transducer failure	Replace Audio Transducer
	Power Supply Board Audio oscillator circuit failure	Replace Power Supply Board
"Variable audio:" reading <0.50	Audio Control Switch failure	Replace Audio Control Switch
	Audio Transducer failure	Replace Audio Transducer
	Power Supply Board failure	Replace Power Supply Board
	Audio Transducer failure	Replace Audio Transducer
"Max audio:" reading <1.25	Power Supply Board Audio oscillator circuit failure	Replace Power Supply Board
No audio adjust	Audio Control Switch failure	Replace Audio Control Switch
NiCad BATTERY VOLTAGE		
"Unloaded:" <5.00	NiCad Battery needs charging	Connect AC power
	NiCad Battery failure	Replace NiCad battery
"Loaded:" <5.00	NiCad Battery needs charging	Connect AC power
	NiCad Battery failure	Replace NiCad battery
KEYPAD TEST		
Key/Display Mismatch or Invalid Key	Keypad failure	Replace Keypad
	Decoder failure	Replace Digital Logic Board
MAXIMUM PRESSURE TEST		
Motor stopped when "running" is displayed	Motion Sensor harness disconnected	Connect Motion Sensor harness
	Motion Sensor failure	Replace Motion Sensor
	Digital Logic Board failure	Replace Digital Logic Board

Test/Fault	Probable Cause	Corrective Action
Motor continues to run when "halt" is displayed	Motion Sensor harness disconnected	Connect Motion Sensor harness
	Motion Sensor failure	Replace Motion Sensor
	Digital Logic Board failure	Replace Digital Logic Board
STRAIN BEAM VOLTAGES		
A, B, C, or D strain beam reading >0, set not installed	Strain Beam out of calibration	Recalibrate Strain Beam (see Section 7.3)
	Strain Beam failure	Replace Strain Beam
	Digital Logic Board failure	Replace Digital Logic Board
A, B, C, or D strain beam reading <1.0 or >2.0 with dry set installed	Strain Beam out of calibration	Recalibrate Strain Beam (see Section 7.3)
	Strain Beam failure	Replace Strain Beam
	Digital Logic Board failure	Replace Digital Logic Board
Motor continually runs	Motion Sensor harness disconnected	Connect Motion Sensor Harness
	Motion Sensor failure	Replace Motion Sensor
	Digital Logic Board failure	Replace Digital Logic Board

Table 5-2. PC-4 Error Log Codes

The Error Codes listed below represent the results of software initiated subsystem tests. The tests are evaluated on Pass/Fail logic with an error code generated for a fail condition. The Error Code prefix (x) identifies the specific channel with the problem, in accordance with the following coding: 1xx for Channel A, 2xx for Channel B, 3xx Channel C and 4xx for Channel D. Malfunction types are categorized as follows with their respective instrument responses:

Channel Malfunction:
- Appropriate error code is placed in the Event and Error logs
- "Channel Malfunction" message appears on the Central Information display
- Alarm LEDs flash for affected channel
- "- - - -" flashes in the rate display for the affected channel
- Audio alarm is sounded
- All controls are disabled except channel select and STOP/CHANNEL OFF controls
- Pressing STOP/CHANNEL OFF turns the channel off.

Board Malfunction:
- Appropriate error code is placed in the Event and Error logs
- "Channel Malfunction" message appears on the Central Information Display
- Alarm LEDs flash for affected channel
- "- - - -" flashes in the rate display for the affected channel
- Audio alarm is sounded
- All controls are disabled except channel select and STOP/CHANNEL OFF controls
- Pressing STOP/CHANNEL OFF turns the channel off.

System Malfunction:
- Appropriate error code is placed in the Event and Error logs
- "System Malfunction" message appears on the Central Information Display
- Alarm LEDs flash for affected channel
- "- - - -" flashes in the rate display for the affected channel
- Audio alarm is sounded
- All controls are disabled except channel select and STOP/CHANNEL OFF controls
- Pressing STOP/CHANNEL OFF turns the channel off.

Code No.	Description	Malfunction	Probable Cause
The following error codes are channel specific with 1xx pertaining to channel A, 2xx to channel B, 3xx to channel C and 4xx to channel D.			
x00	Analog-Digital (runtime)	Channel Malfunction. At power-up (and during every subsequent runtime A/D conversion), after completing an A/D reading, an A/D interrupt is programmed. Failure to detect this interrupt within a prescribed time frame will cause an A/D conversion error.	Motor Controller Board (processor)
x01	AIL Sensor (runtime)	Channel Malfunction. During runtime, the Motor Controller software detects a failure of the AIL sensor.	AIL/Slide Clamp Harness AIL Board Motor Controller Board
x02	Door Sensor (runtime)	Channel Malfunction. During runtime, the Motor Controller software detects a failure of the door sensor.	Door Harness Assembly Motor Controller Board Door Sensor Interface
x03	Motor Revolution Time (runtime)	Channel Malfunction. During runtime, the Motor Controller software detects the actual time required to complete a pumping mechanism revolution differs from calculated value by ±12% for a three revolution sample.	Sticking pumping mechanism Motor Controller Board
x04	Motor Speed (runtime)	Channel Malfunction. Motor Controller software has detected an out of range motor speed variable (divide-by-zero error).	Pumping Mechanism
x05	Motor Sync. Off (runtime)	Channel Malfunction. Motor Controller software has detected when an error >1.5% in a sample of 50 motor revolutions is detected by the motion sensor.	Pumping Mechanism
x06	Motor Table (runtime)	Channel Malfunction. Motor Controller software has detected a calculation error in a motor table value >200msec.	Motor Controller Board (processor failure)
x07	No Motor Sync. (runtime)	Channel Malfunction. Occurs 120 motor steps after the motion sensor fails to confirm motor sync. The motion sensor is inoperative or the motor is not turning.	Pumping Mechanism Motor Controller Board
x08	Strain Beam (runtime)	Channel Malfunction. Occurs when the Motor Controller software does not detect ≥100 mV variance between the highest and lowest readings during any two revolutions of pumping mechanism.	Strain Beam Assembly Motor Controller Board Battery Supply Board (switch battery circuitry)
x09	Channel Fault (runtime)	Channel Malfunction. Motor Controller (MC) software during runtime has detected a "status" differential between its condition and that provided by System Controller (SC) software that has persisted for two consecutive transactions (or 2 seconds).	Logic Board Motor Controller Board Software Error *

Code No.	Description	Malfunction	Probable Cause
x10	Slide Clamp Sensor (startup/runtime)	Channel Malfunction. Motor Controller software during startup or runtime has detected three consecutive failures of the slide clamp circuitry test.	AIL Board AIL/SCD harness Motor Controller Board
x11	Motion Sensor (startup/runtime)	Channel Malfunction. Motor Controller software has detected two consecutive failures of the motion sensor circuitry test.	Motion Sensor Motor Controller Board Pumping Mechanism
x12	Illegal Infusion Request (runtime)	Channel Malfunction. Motor Controller software during runtime has detected one or more of four illegal infusion conditions: Maintenance Mode mismatch; KVO flag detected, but rate is not at KVO rate; VTBI All mode is set, but VTBI field contains a value; or if the motor controller is in a fault state.	Motor Controller Board Software Error *
The following error codes pertain to the PC-4's Motor Controller Boards. Error codes with a prefix (x) of 5 pertain to Motor Controller Board #1 and those with a 6 pertain to Motor Controller Board #2.			
x00	Invalid Error Type	Board Malfunction. Motor controller software reported an error outside of the boundaries of active error codes. A corrupt data transfer of a valid error message has occurred.	Motor Controller Board Software Error *
x01	Startup ROM Error (runtime)	Board Malfunction. ROM test calculates a CRC on the entire ROM. A mismatch between test and precalculated ROM CRC has occurred.	Motor Controller Board
x02	Startup RAM Error	Board Malfunction. Start up RAM test fails verification.	Motor Controller Board
x03	Startup Testing Error	Board Malfunction. Motor Controller software failed to complete all of its startup testing.	Motor Controller Board Software Error *
x04	Runtime ROM Error	Board Malfunction. ROM CRC mismatch between runtime cumulated sample total and startup ROM CRC.	Motor Controller Board
x05	Runtime RAM Error	Board Malfunction. Runtime RAM test fails verification.	Motor Controller Board
x06	Timebase Error	Board Malfunction. Motor controller software has not detected a "sync" signal from the System Controller for 2 seconds.	Logic Board Motor Controller Board Oscillator
x07	Controller State Error	Board Malfunction. (Watchdog alarm may result). Motor controller software has detected a routine range check to be outside of predicted boundaries.	Motor Controller Board Software Error *
x08	Extinct Malfunction 8		
x09	Extinct Malfunction 9		
x10	Case Error		

Code No.	Description	Malfunction	Probable Cause
x11	General Error	Board Malfunction. (Watchdog alarm may result). Motor controller software has detected an unexpected event or instruction.	Logic Board Motor Controller Board (processor failure) Oscillator Software Error *
x12	Execution Fault		
x13	Extinct Malfunction 13		
x14	Version No. Mismatch (startup)	Board Malfunction. At startup Motor Controller software has detected a mismatch between sent and expected software version numbers.	Incompatible software versions installed (EPROM)
x15	MC Stuck Bits 0	Board Malfunction. The motor controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Logic Board Motor Controller Board Software Error *
x16	MC Stuck Bits 1		
x17	MC Stuck Bits 2		
x18	MC Stuck Bits 3		
x19	MC Stuck Bits 4		
x20	MC Stuck Bits 5		
x21	MC Stuck Bits 6		
x22	MC Stuck Bits 7		
x23	MC Stuck Bits 8		
x24	MC Stuck Bits 9		
x25	MC Stuck Bits 10		
x26	MC Stuck Bits 11		
x27	MC Stuck Bits 12		
x28	MC Stuck Bits 13		
x28	MC Stuck Bits 14		
x30	Extinct Malfunction 30		
x70	Homing While Infusing	Board Malfunction. The motor controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error condition exists.	Logic Board Motor Controller Board Software Error *
x71	Watchdog IPC Silence A	Board Malfunction. Watchdog alarm is generated (loud continuous tone). The System Controller software and Motor Controller software exchange status information at one second intervals. As the Motor Controller (MC) software receives status from the System Controller (SC), it compares the received status information against it's own status. If there is a disagreement, a counter is started to indicate the disagreement. Disagreements will be normal at times due to message propagation delays between the two processors, but they should not persist for more than a safe time interval.	Logic Board Motor Controller Board Software Error *
x72	Watchdog IPC Silence B		
x73	Watchdog Bad Mode Req		
x74	Watchdog Alarm OFF		
x75	Watchdog Alarm ON		
x76	Watchdog Flo-Stop OFF		
x77	Watchdog Flo-Stop ON		
x78	Watchdog Infusing OFF		
x79	Watchdog Infusing ON		
x80	Watchdog Low Flow OFF		
x81	Watchdog Low Flow ON		

Code No.	Description	Malfunction	Probable Cause
x82	Watchdog KVO OFF	Board Malfunction. Watchdog alarm is generated (loud continuous tone). The System Controller software and Motor Controller software exchange status information at one second intervals. As the Motor Controller (MC) software receives status from the System Controller (SC), it compares the received status information against it's own status. If there is a disagreement, a counter is started to indicate the disagreement. Disagreements will be normal at times due to message propagation delays between the two processors, but they should not persist for more than a safe time interval.	Logic Board Motor Controller Board Software Error *
x83	Watchdog KVO ON		
x84	Watchdog Fault OFF		
x85	Watchdog Fault ON		
x86	Watchdog Stealth OFF		
x87	Watchdog Stealth ON		
x88	Watchdog All OFF		
x89	Watchdog All ON		
x90	Watchdog Fract OFF		
x91	Watchdog Fract ON		
x92	Watchdog PSI OFF		
x93	Watchdog PSI ON		
x94	Watchdog Pump State OFF		
x95	Watchdog Pump State ON		
x96	Watchdog INF Step OFF		
x97	Watchdog INF Step ON		
x98	Watchdog Reset Stealth		
x99	Watchdog INF Stealth		
Error Codes beginning with 700 and subsequent relate to System errors.			
700	ROM Checksum Error (startup)	System Malfunction. The flash loader code calculates and stores the ROM checksum into a NVRAM location (STARTUP_ROM_CHECKSUM). After the pump is flashed, this checksum may be displayed (using maintenance mode), and the value hard-coded into romcheck.asm (ROM_CHECKSUM). At power-up, the NVRAM and ROM checksum values are compared against each other and a disagreement causes an error to be reported.	EPROM Logic Board
701	Analog to Digital Error (startup)	System Malfunction. At power-up, an A/D converter test is performed as part of a suite of system hardware tests. An A/D reading is requested from each of the eight A/D channels. If the converter is unable to perform a conversion and return EOC within 150µsec on any channel, an A/D failure is reported.	Logic Board A/D Circuitry Oscillator
702	V_{REF} Error (startup)	System Malfunction. At power-up, an A/D voltage reference test reading is taken and if the reference voltage falls below 2.5V or above 2.5V+12%, an A/D failure is reported.	Logic Board A/D Circuitry

Code No.	Description	Malfunction	Probable Cause
703	NiCad Differential Error (startup)	System Malfunction. At power-up, a NiCad battery test is performed as part of a suite of system hardware tests. First, the load is detached (charging) and a 30msec delay permits the voltage to stabilize. Five unloaded battery voltage readings are averaged. Next, the load is attached (no charging) and a 30 msec delay permits the voltage to stabilize. Five loaded battery voltage readings are averaged. If the difference between loaded and unloaded voltages fails to meet the required minimum (20mV), a NiCad difference error is reported.	Battery Power Supply Board Logic Board Power Supply/Logic Board interconnect harness
704	NiCad Voltage Level Error (startup)	System Malfunction. At power-up, a NiCad battery test is performed as part of a suite of system hardware tests. Five "loaded" NiCad battery voltage readings are averaged, and if the average voltage is below 10.9V (Low Battery 2), a NiCad level error is reported.	Battery Power Supply Board Logic Board Power Supply/Logic Board interconnect harness
705	Startup Audio Error (detected at power-up)	System Malfunction. At power-up, an audio test is performed as part of a suite of system hardware tests. Each audio level is asserted (i.e. max, variable, key, silence), and then after a delay time elapses, an A/D reading is taken. This reading is then compared against a pre-defined limit. If any of these limits are exceeded, an error is reported.	Power Supply Board Logic Board Power Supply/Logic interconnect harness Audio Sensor Audio 70-1331-1 Audio potentiometer
706	System Battery Low (startup)	System Malfunction. The A/D converter is used to read the voltage level from the battery. If the voltage reading indicates the battery level is below 10.9 volts (LB2), a System Low Battery condition is reported.	Battery A/C fuse Logic Board (A/D)
707	System Battery High (startup)	System Malfunction. The A/D converter is used to read the voltage level from the battery. If the voltage reading indicates the battery level is above 15.5 volts (LB2), a System High Battery condition is reported.	Power Supply Board Logic Board (A/D)
710	Runtime RAM Error (runtime)	System Malfunction. The runtime RAM test exercises pieces of RAM and verifies that the RAM location can hold an assigned pattern. A Butterfly, Inverse Butterfly, All Ones and All Zeroes pattern are each written to the location, and then verified. If any of these tests fail, a runtime RAM failure is reported.	Logic Board
711	Runtime ROM Error (runtime)	System Malfunction. The runtime ROM test continuously "walks" through ROM, calculating partial CRCs. Once the entire ROM has been covered, the final CRC is compared to the CRC calculated at power up time. If there is a mismatch, a ROM failure is reported.	Logic Board

704 Audio Failure Audio Drive Trans Pow Sup Board

Q3, Q4, Q5 Audio Drive

Code No.	Description	Malfunction	Probable Cause
713	S/C Watchdog (runtime)	System Malfunction. Every 5 seconds, the System Controller services the watchdog. Before the watchdog is asserted however, system health must be verified. If the results of the runtime ROM or RAM test fail, or if all expected tasks have not executed within the last 5 seconds, then a watchdog malfunction is declared. Note: The runtime ROM and RAM tests go to system malfunction as soon as a failure is detected, so the Task qualifier check is the most likely the source of this malfunction.	Logic Board (processor failure)
723	Action Fault	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Logic Board Motor Controller Board Software Error *
724	Illegal Parameter Fault		
725	ITC Sender Fault		
726	Unknown Status Message		
727	Illegal Startup Data 0 Cmd		
728	Illegal Startup Data 1 Cmd		
729	Conversion Error		
730	Switch 1 Fault		
731	Switch 2 Fault		
732	Get Messages is Null		
733	Get Messages Illegal NON FB		
734	Get Messages illegal FB		
735	IPC Main Null FB PTR		
736	Filled Block Alloc Failure		
737	ITCGET MSGPTRIS Null		
738	Illegal Audio Arguments		
739	Audio State Error		
740	Illegal Argument Value		
741	Contrast Range Error		
742	Switch 1 Fault		
743	Cursor Range Fault		
744	Display OFF ARG Range Error		
745	Display ON ARG Range Error		
746	Overlay ARG Range Error		
747	System Set ID Error		
748	Draw Box Illegal ARG		
749	Draw Icon Illegal ARG		
750	Draw Line Illegal ARG		

Code No.	Description	Malfunction	Probable Cause
751	Erase Illegal ARG	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Logic Board Motor Controller Board Software Error *
752	Erase Illegal ARG		
753	Fill Illegal ARG		
754	Scroll Set ID Error		
755	Cursor Illegal ARG		
756	Print Null String PTR		
757	Set Font Illegal ARG		
758	Switch 1 Fault		
759	Switch 2 Fault		
760	Schedule Illegal PTR		
761	Schedule No More Blocks		
762	Delete Service Illegal Timer		
763	Pause Service Illegal Timer		
764	Resume Service Illegal Timer		
765	Restart Service Illegal Timer		
766	Timer 2 Queue Err		
767	Initial Rate Illegal ARG		
768	Rate Illegal ARG		
769	Bad Segment		
770	Blank Rate Illegal ARG		
771	Canned Rate Illegal ARG		
772	Set LED Illegal ARG		
773	CHID Disp Illegal ARG		
774	CHID Brightness Illegal ARG		
775	CHID Brightness Illegal ARG		
776	Initial CHID Disp Illegal ARG		
778	Key Down Illegal Value	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Keypad Software Error *
784	Read AD Illegal ARG	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Logic Board Motor Controller Board Software Error *
785	Power ON Source Illegal		
786	Battery Charge Level Illegal		
787	Test NiCad Value Illegal		
789	Read Date Time Illegal ARG	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Logic Board Motor Controller Board Software Error *
790	Read RTC DateTime Read Fail		
791	Set Date Time Illegal ARG		
792	Set Time Illegal ARG		
793	Set Alarm Illegal ARG		

Code No.	Description	Malfunction	Probable Cause
794	Delete Alarm Illegal ARG	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Logic Board Motor Controller Board Software Error *
795	Set Time Execute Illegal ARG		
796	Del Time Execute Illegal ARG		
797	Find Alarm Slot Failure		
798	Get Update Entry Failure		
799	S Main Switch 1 Fault		
800	S Main Switch 2 Fault		
801	Illegal PRI Infusion Request		
802	Illegal SEC Infusion Request		
803	Illegal Delay Start Request		
804	Illegal Drug Calc Request		
805	Illegal Multidose Request		
806	Start Switch 1 Fault		
807	Util1 Switch 1 Fault		
808	Util4 Switch 1 Fault		
809	Util4 Switch 2 Fault		
810	Util4 Switch 3 Fault		
812	CMDS Draw 1 Illegal ARG	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Logic Board Motor Controller Board Software Error *
813	CMDS Draw 2 Illegal ARG		
814	CMDS Erase Illegal ARG		
815	CMDS Update Illegal ARG		
816	CMDS Setmask Illegal ARG		
817	CMDS Illegal Command ID		
818	ECD Connected Illegal ARG		
819	Container Empty Illegal ARG		
820	Clobbered Function PTR		
821	Ch Alarm Switch 1 Fault		
822	Ch Alarm Illegal Alarm		
823	Ch Alarm Switch 2 Fault		
824	Ch CMD Switch 1 Fault		
825	Ch CMD Switch 2 Fault		
826	Ch CMD Rate Display Blanks		
827	Ch CMD Rate Display Error		
828	Ch CMD Dashes Display Error	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Logic Board Motor Controller Board Software Error *
829	Ch CMD Switch 3 Fault		
830	Ch CMD Switch 4 Fault		
831	Ch MON IPC Timeout		
832	Ch MON VTBI Accuracy Error		
833	Ch STATS Infusion Type Error		
834	Ch STATS Switch 1 Fault		

Code No.	Description	Malfunction	Probable Cause
835	Ch STATS MC Rate Error		
836	Ch STATS MC VTBI Error		
838	CH STATS MC Not Halted Error		
839	Ch STATS MC Internal State Err		
840	CH STATS MC Mode Error		
841	Ch STATS MC Ready Error		
842	Ch STATS MC Infusing Error		
843	Ch STATS MC KVO Error		
844	Ch STATS MC Alarm Error		
845	Ch STATS MC Malfunction Error		
846	Ch STATS Switch 2 Fault		
847	Ch STATS MC STBY LED Error		
848	Ch STATS MC Run LED Error		
849	Ch STATS MC Alarm LED Error		
850	Ch STATS MC Maint Mode Err		
851	Ch STATS Switch 3 Fault		
852	Ch STATS Switch 4 Fault		
853	Ch STATS Switch 5 Fault		
854	UI Util3 Switch 1 Fault		
873	SYSCHALM Chan Alarm Fault	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Logic Board Motor Controller Board Software Error *
874	SYSCHST Channel State Fault		
875	SYSDEVST Device State Fault		
876	SYSRATE Rate Fault		
877	SYSVTBI VTBI Fault		
878	Ch STATS VTBI Int Error		
879	Ch STATS VTBI Frac Error		
880	SYSVINF Primary VINF Fault		
881	SYSVINF SEC VINF Fault		
882	SYSSETUP Setup Fault		
883	SYSSTART Start Time Fault		
884	SYSPATWT Patient Wt Fault		
885	SYSDEVST Illegal Powerdown		
886	Ch MGR Data IPC Silence		
887	Ch MGR State IPC Silence	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Logic Board Motor Controller Board Software Error *
888	RTC DRV Read RAM Time Read Failure		
889	RTC DRV Read Time Illegal ARG		
890	RTC DRV Get Run Time Secs Failure		
891	Ch CMD SC Pri Rate Error		

870 Deals with fractional entries, Possibly entering
878 caused by tech too fast. If board quantities - possible continues or software upgrade.

Code No.	Description	Malfunction	Probable Cause
892	Ch CMD SC Pri VTBI Error		
893	Ch CMD SC Sec Rate Error		
894	Ch CMD SC Sec VTBI Error		
902	Ch STATS MC All Mode	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error condition is reported.	Logic Board Motor Controller Board Software Error *
903	Ch STATS VI Total Negative Error		
904	Ch STATS VI Dif Negative Error		
906	Ch STATS Rep VI Total Negative Error		
910	Bad INT Unexpected Interrupt	System Malfunction. The system controller processor automatically interrupts software execution, if an unexpected event or instruction is encountered.	Logic Board (processor failure) Software Error *
911	Bad INT Divide Error Interrupt		
912	Bad INT Single Step Interrupt		
913	Bad INT NMI Interrupt		
914	Bad INT Breakpoint Interrupt		
915	Bad INT Overflow Interrupt		
916	Bad INT Array Bounds Interrupt		
917	Bad INT Unused OpCode Interrupt		
918	Bad INT ESC OpCode Interrupt		
919	Malfunct ISR Sleep Fault	System Malfunction. The system controller software routinely performs range checks on internal data, internal message traffic format and content, and other system parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	Logic Board Motor Controller Board Software Error *
920	S MDREV Illegal Multidose Start		
1000	C2 DRV Init Cable Report Failure	System Malfunction. The system controller software routinely performs range checks on C2 communications internal data, internal message traffic format and content, and other parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	C2 cable (or connections) C2 port, circuitry or connections Software Error *
1001	C2 DRV Cable Report Failed		
1002	C2 DRV RX Frame Report		
1003	C2 DRV Frames Sent MSG Failed		
1004	C2 DRV Error Report Failed		
1005	C2 DRV Frame Too Long Report Failed		
1006	C2 DRV Buffer Alloc Error		
1007	C2 DRV Buffer Free1 Error		
1008	C2 DRV Buffer Free2 Error		
1009	C2 DRV Buffer Free3 Error		
1010	SYSC2ST C2 State Range		

Code No.	Description	Malfunction	Probable Cause
1011	SYSC2ST C2 State Fault	System Malfunction. The system controller software routinely performs range checks on C2 communications internal data, internal message traffic format and content, and other parameters. If any of this data falls outside of it's predicted boundaries, an error is reported.	C2 cable (or connections)
1012	S CCMAIN Switch 1 Fault		C2 port, circuitry or connections
1013	S CCMAIN Switch 2 Fault		Software Error *
1015	C2 BUF Switch 1 Fault		
1016	C2 MGR Unexpected ITC Message		
1017	C2 MGR Port Status Type Error		
1018	C2 MSG C@ Port BUF Alloc Failed		
1019	C2 MSG C2 Port BUF Free Failed		
1020	C2 MSG MSG State Fault		
1021	C2 QRY Infusion Type Error		
1022	C2 QRY2 Channel State Error		

* Software Diagnostics. If this condition is detected in field use, please contact your local ALARIS Medical office for further information.

5.5 DISASSEMBLY

The following procedures are presented in a sequence that provides the most efficient means of accessing and removing the subassemblies that comprise the PC-4 pump/controller.

CAUTION

Before attempting to disassemble the PC-4, unplug the AC power cord from the wall outlet, remove the power cord retention bracket and disconnect the cord from the rear of the case and check that the instrument is in the power off condition. SEE THE WARNING UNDER REASSEMBLY PARAGRAPH 5.6 BEFORE REATTACHING THE AC POWER CORD TO THE INSTRUMENT.

NOTE

It is recommended that all maintenance actions be performed on an anti-static surface, preferably a grounded anti-static mat.

5.5.1 Separating the Case (Figure 6-1)

Prior to removing the screws which mate the front and rear case assemblies, it is necessary to stabilize the rear case. Insert a 7 inch (18 cm) long piece of 1 to 1.25 inch (2.5 to 3.2 cm) round stock (dowel or PVC pipe) in the pole clamp so the bottom of the stock rests on the working surface. Tighten the pole clamp. This brace will prevent the rear case from falling over once the front case is detached.

NOTE

The rear case is unstable when disconnected from the front case due to the location of the battery within the rear case. Should the rear case fall, the multi-card assembly could be damaged by forces exerted through the various harness assemblies connected to the circuit boards.

1. Use a 5/32" Allen driver or wrench to remove the four socket head screws that connect the front and rear case assemblies. (Do not leave screws on work surface. Front panel could be damaged if front case is laid on the screws).
2. Carefully separate the front and rear case assemblies along the right side (as viewed from the rear) of the instrument. Use a #2 Phillips screwdriver to disconnect the left side ground harness cable from the threaded lug on the rear case.
3. Disconnect the display board interface cable from connector J1 on the power supply board.
4. Disconnect the logic board interface cable from connector J2 on the power supply board.

The front and rear cases are now physically and electrically separated and each can be disassembled independently.

5.5.2 Front Case Disassembly (Figure 6-2)

The following disassembly procedures are predicated on complete disassembly of the front case. Several front case assemblies are not directly accessible and require sequential disassembly for access. Those assemblies are identified with a note addressing the prerequisite procedure.

5.5.2.1 CCA Board Removal and Disassembly (Figure 6-2)

CAUTION

When removing, replacing or making contact with printed circuit boards, be sure to work on an anti-static surface and use a grounded wrist strap.

CIRCUIT CARD MOUNTING BRACKET

1. Use a #2 Phillips screwdriver to remove the two screws attaching the upper and lower CCA mounting brackets.
2. Remove the brackets.

LOGIC BOARD REMOVAL

1. Carefully unplug the logic board from the connector on the front display board assembly.

MOTOR CONTROLLER BOARD REMOVAL

1. Unplug the motor control, strain beam, motion sensor and AIL/Door connectors from the right side motor controller board.
2. Carefully unplug the right side motor controller board from the connector on the front display board assembly.
3. Repeat steps 1 and 2 to remove the left side motor controller board.

DISPLAY BOARD ASSEMBLY

1. Use a #2 Phillips screwdriver to remove the six screws that attach the display board assembly to the front case.

2. Unplug the keypad cable from J6 on the front display board.

3. Unplug the LCD display cable from J5 on the front display board.

4. Lift out the display board assembly.

LCD DISPLAY REMOVAL

1. Use a 1/4" hex driver to remove the threaded standoffs.

2. Lift LCD Display from the front case.

KEYPAD ASSEMBLY REMOVAL

1. Use a #2 Phillips to remove the six screws that attach the keypad retention bracket to the front case.

2. Remove the retention bracket.

3. Remove the keypad.

5.5.2.2 Pumping Mechanism Assembly Removal (Figure 6-2)

1. Place the front case assembly face down on the work surface. (Ensure work area is clear of foreign objects that could damage the front panel).

2. Use a #2 Phillips screwdriver to remove the four screws and washers that attach the pumping mechanism assembly to the front case.

3. Lift the pumping mechanism out of the front case.

4. Repeat steps 2 and 3 to remove the other pumping mechanisms.

NOTE

When reinstalling the pumping mechanism, place the pumping mechanism in position and start the four mounting screws. Then push the pumping mechanism assembly to the left (looking inboard) against the mounting screws and tighten the screws.

5.5.2.3 Door Sensor Assembly Removal (Figure 6-2)

1. Use a #1 Phillips screwdriver to remove the screw and washer that attach the door sensor harness to the front case.

NOTE

Refer to Torque Table for reinstallation of pumping mechanism screw torque specifications.

5.5.2.4 AIL/SCD Assembly Removal and Disassembly (Figure 6-2)

NOTE

Removal of the pumping mechanism (see paragraph 5.5.2.2) is required to provide access to the AIL/SCD Assembly mounting screws.

1. Use a #1 Phillips screwdriver to remove the four screws and washers that attach the AIL/SCD assembly to the front case.

2. Tilt the front case assembly to the upright position and open the door latch. This will prohibit the sear from engaging the ramp projections on the slide clamp housing.

3. Remove the AIL/SCD assembly from the front case.

5.5.2.5 Transducer Assembly Removal (Figure 6-2)

NOTE

Removal of the pumping mechanism (see paragraph 5.5.2.2) is required to provide access to the Transducer Assembly mounting screws.

The transducer is not supported below the assembly level. DO NOT ATTEMPT TO REPAIR AND REINSTALL.

1. Use a #1 Phillips screwdriver to remove the four screws and washers that attach the transducer assembly to the front case.

2. Lift the transducer assembly out of the front case.

5.5.2.6 Anchor Bracket Assembly Removal (Figure 6-2)

1. Use pliers to grasp the washer, then press down and compress the spring, and remove the hairpin cotter. *Carefully release the downward press on the spring allowing it to expand to full length, then remove the washer and spring from the anchor bracket.

NOTE

Spring can fly out at you if you are not careful.

2. Tilt the front case to the upright position, open the door latch, swing the door open and remove the anchor bracket.

5.5.2.7 Access Door Assembly Removal and Disassembly (Figures 6-2 and 6-3)

1. Unlatch and open the door.
2. Use a 1/32 inch or 1 mm drift punch to depress the tip of the upper hinge pin below the lower surface of the front case hinge pivot projection, then ease the upper edge of the door away from the front case while using a finger to trap the hinge pin in its recess. Once the hinge pin is clear, lift the door out of the lower hinge pivot projection.

NOTE

The dowel pin that attaches the cam lock to the door is retained by a spring washer. When removed, the spring washer must be replaced.

3. Use a 1/8 inch (4 mm) drift punch to knock out the dowel pin that attaches the cam lock assembly (door latch) to the door.
4. Use a 1/8 inch (4 mm) drift punch to knock out the spring pin that attaches the sear to the cam lock.
5. Use a 1/16 inch (2 mm) drift punch to knock out the spring pin that attaches the cam lock pawl to the door.

5.5.2.8 Pump Seal Removal (Figure 6-2)

NOTE

To remove the pump seal bezel, it is necessary to first remove the pumping mechanism (see paragraph 5.5.2.2) to provide access to the bezel grounding connection.

1. Use a #1 Phillips screwdriver to remove the ten screws from the bezel.
2. Use a straight slot screwdriver to pry the top edge of the bezel out of the front case recess.
3. Pull the urethane pump seal from the front case.

NOTES

Prior to installing a replacement pump seal, coat the inside of the seal with 100 µl of Silicone oil.

When reinstalling the pump seal assembly, torque the bezel mounting screws to 3 lb-in.

5.5.2.9 Snap Bracket Removal (Figure 6-2)

1. Use a #1 Phillips screwdriver to remove the screw that attaches the snap bracket to the front case.

5.5.3 Rear Case Disassembly

The following disassembly procedures are sequenced for complete disassembly of the rear case. All subassemblies installed on the interior rear case are directly accessible and can be independently removed and replaced.

5.5.3.1 Audio Harness Assembly Removal (Figure 6-4)

1. Unplug the audio harness from J7 on the power supply board.
2. Use a #1 Phillips screwdriver to remove the two screws and washers that attach the audio oscillator to the rear case.
3. Lift the audio harness assembly out of the rear case.

5.5.3.2 Transformer Harness Assembly Removal (Figure 6-4)

1. Unplug the harness from J15 on the power supply board, unplug the brown wire from terminal G and the blue wire from the remaining terminal (**110V**) or the blue wire from terminal H and the brown wire from terminal G (**220V**) on the respective power entry module.
2. Use a #2 Phillips to remove the four screws that attach the transformer harness assembly to the rear case.
3. Lift the transformer harness assembly from the rear case.

5.5.3.3 AC Power Input Module Assembly Removal (Figure 6-4)

1. Use a #2 Phillips screwdriver to remove the ground wire from the threaded lug on the rear case.
2. Depress the latching fingers on one side of the module and remove it from the exterior side of the rear case.

5.5.3.4 Power Supply Board Removal

1. Unplug the battery harnesses from J3 and J8 on the power supply board.

2. Unplug the audio harness from J6 on the power supply board.

3. Use a #2 Phillips screwdriver to remove the eleven screws that attach the power supply board to the rear case.

4. Lift the power supply board from the rear case.

5.5.3.5 Audio Control Removal

1. Remove the 3/8" dress nut from the exterior of the case.

2. Unplug the audio harness from the power supply board, if required.

3. Remove the audio control from the mounting hole in the rear case.

5.5.3.6 Pole Clamp Assembly Removal and Disassembly (Figure 6-5)

NOTE

The power supply board must be removed to allow access to the four pole clamp assembly mounting screws.

1. Use a 5/32 inch Allen driver or wrench to remove the four screws that attach the pole clamp assembly to the rear case. The upper housing and lead screw assembly separate from the rear case.

2. Unscrew the lead screw from the wedge.

3. Remove the bumper from the end of the knob.

4. Use a #6 straight blade screwdriver to remove the screw that attaches the knob to the lead screw.

5. Pull the knob off of the lead screw shaft.

5.5.3.7 Battery Removal

1. Use a #2 Phillips screwdriver to remove the upper two access cover screws and loosen the lower screws.

2. Remove the battery access covers.

3. Disconnect the fast-ons from the battery terminals.

4. Lift the batteries from the battery recesses.

5.5.3.8 Equipotential Ground Stud Removal

1. Use a 3/8" open end or box wrench to immobilize the grounding stud.

2. Use a 3/8" nut driver to loosen and remove the nut that attaches the grounding stud to the rear case.

3. Remove the grounding stud.

5.6 REASSEMBLY

The procedures for reassembly of the PC-4 are the reverse of the preceding disassembly procedures. In those cases where a procedure(s) unique to reassembly is required, a note is provided following the last step in the disassembly procedure.

WARNING

Prior to reattaching the AC power cord to the instrument, ensure the male base of the power input module is clean of any electrolyte and thoroughly dry. Check the female contacts on the power cord connector for presence of any electrolyte; clean as required and thoroughly dry.

When removal of washers is specified during disassembly, ensure that all washers are reinstalled during reassembly.

Ensure that all ground wire connections are complete before re-mating the front and rear case.

During reassembly, tighten all screws in accordance with the torque values set forth in Table 5-3.

Table 5-3. Table of Torque Values

Functional Application	Item Description	Figure/Item Reference	Torque Value
FINAL ASSEMBLY			
Front Case to Rear Case	#10-32 x 3/8	6-1 / 310	10.0 ±0.5 in lb
Ground wire to Rear Case	#10-24 x 0.38	6-1 / 320	14.0 ±0.5 in lb
Power Cord Strap to Rear Case	#6-32 x 0.37	6-1 / 300	7.0 ±0.5 in lb
Power Cord Bracket to Rear Case	#4-40 x 0.37	6-1 / 290	3.0 ±0.5 in lb
FRONT CASE			
CCA Board Bracket to Front Case			
Pumping Mechanism to Front Case	#6-32 x 0.38 (self locking)	6-2 / 510	7.0 in lb
Door Sensor to Front Case	#4-40 x 0.25	6-2 / 500	3.0 ±0.5 in lb
Transducer Assy. to Front Case	#4-40 x 0.25 (self locking)	6-2 / 500	16 ±0.5 oz lb[1] 32 ±0.5 oz lb[2]
AIL/Slide Clamp to Front Case	#4-40 x 1/4 EL	6-2 / 500	3.0 ±0.5 in lb
Pump Seal Bezel to Front Case	#4-40 x 0.37	6-2 / 520	3.0 ±0.5 in lb
Snap Bracket to Front Case	#4-4- x 0.18	6-2 / 530	3.0 ±0.5 in lb
CCA Board Mounting Brkt to Front Case	#6-32 x 0.37	6-2 / 540	7.0 ±0.5 in lb
Keypad Bezel to Front Case	#6-32 x 0.25	6-2 / 560	7.0 ±0.5 in lb
LCD Assy to Front Case	Stndoff 1/4" x 1.125	6-2 / 450	7.0 ±0.5 in lb
Display CCA to Standoff	6-32 x 0.25	6-2 / 560	3.0 ±0.5 in lb
REAR CASE			
Audio Oscillator to Rear Case	#4-40 x 0.37	6-4 / 210	3.0 ±0.5 in lb
Transformer Assy to Rear Case	#6-32 x 1.0	6-4 / 230	7.0 ±0.5 in lb
Ground Wire AC Module to Rear Case	#10-24 x 0.38	6-4 / 240	10.0 ±0.5 in lb
Power Supply Board to Rear Case	#6-32 x 0.38	6-4 / 220	7.0 ±0.5 in lb
Audio Control Switch to Rear Case	Nut, 3/8-33	6-4 / 150	14.0 ±0.5 in lb
Pole Clamp Housing to Rear Case	#10-32 x 1	6-5 / 110	20.0 ±0.5 in lb
Pole Clamp Knob to Lead Screw	5/16-18 x 0.5	6-5 / 120	N/A
Battery Covers to Rear Case	#6-32 x 0.38	6-4 / 220	7.0 ±0.5 in lb
Grounding Stud to Rear Case 220V	Nut, M-6	6-4 / 155	N/A

1. Stage 1: Torque each screw to 16 ±0.5 oz lb in clockwise pattern.
2. Stage 2: Torque each screw to 32 ±0.5 oz lb in counterclockwise pattern.

NOTE

When ever the NyLok screws that attach the pumping mechanism to the front case are removed, new NyLok screws should be used for the re-installation of the pumping mechanism.

SECTION 6 - ILLUSTRATED PARTS BREAKDOWN

6.1 INTRODUCTION

The tables and figures presented in this section identify the sub-assemblies and list the component parts of each sub-assembly in the IMED® GEMINI PC-4® Volumetric Pump/Controller ("PC-4"). Any part listed without an accompanying part number is not field-replaceable, and is available only as an integral part of the next higher assembly.

NOTE

Use of parts procured from sources other than ALARIS Medical Systems will void the product warranty.

Each tabular listing of parts is supplemented with either an exploded view illustration of the respective assembly or a component location diagram. These drawings are provided solely for use by biomedical technicians and engineers to service, maintain and/or repair the PC-4. Customers experiencing repair requirements beyond their local capability are encouraged to return those items or assemblies to ALARIS Medical Systems for repair or replacement. The ALARIS Medical Systems Service Department maintains facilities to troubleshoot, repair and test all PC-4 integrated circuit boards.

In the event difficulty is encountered in identifying any part, ALARIS Medical Systems' Customer Service Department should be contacted for assistance.

Table 6-1. Parts List - PC-4 Pump Assembly

Fig No/Item	Qty	Description	Part No	Reference
6-1	1	Pump Assembly, PC-4, 110V, v3.9.9.1	40-1055-4	
	1	Pump Assembly, PC-4, 220V,BSI,v3.9.9.1	40-1055-5	
	1	Pump Assembly, PC-4, 110V, v3.9.9.4	40-1055-6	
	1	Pump Assembly, PC-4, 220V,BSI,v3.9.9.4	40-1055-7	
	1	Pump Assembly, PC-4, 110V, v5.02.04	40-1086-1	
	1	Pump Assembly, PC-4, 110V, v5.02.04	40-1090-1	w/new mac
	1	Pump Assembly, PC-4, 220V, v5.02.04	40-1090-2	w/new mac
	1	Pump Assembly, PC-4, 110V, v5.10.18.4	40-1090-3	w/new mac
	1	Pump Assembly, PC-4, 220V, v5.10.18.4	40-1090-4	w/new mac
	1	Pump Assembly, PC-4, 110V, v5.11.17.0, XL	40-1092-1	
	1	Pump Assembly, PC-4, 220V, v5.11.17.0, XL	40-1092-2	
6-1/S1 10	1	Case Assembly, Front PC-4 (110V)	40-2060-9	w/40-1055-4/5
6-1/S1 10	1	Case Assembly, Front PC-4 (110V)		w/40-1055-6/7
6-1/S1 20	1	Pole Clamp Assembly	40-1088-1	
6-1/S1 20	1	Case Assembly, Rear, 110V	40-2030-9	w/40-1055-4/6
6-1/S1 20	1	Case Assembly, Rear, 220V		w/40-1055-5/7
6-1/S2 520	1	Power Cord wrap Assembly	980-1015-1	
6-1/S1 530	1	Harness Assembly, Power Supply	40-1107-1	
6-1/S1 590	4	Label, Warning Roller Clamp (English)	20-2407-7	not 40-1055-7
6-1/S1 600	1	Harness Assembly, Logic Board	40-1106-1	
6-1/S2 610	1	Label, Serial Number, Replacement	125569	
6-1/S1 620	1	Label, Operating Instructions	40-2039-7	
6-1/S1 630	1	Label, Generic Warning, PC-2TX/PC4	25-2005-7	w/40-1090-2/3 w/40-1092-1
6-1/S2 640	1	Label, PC-4, RTNG/PWR SPECS, 220V	40-2057-7	220V ONLY
6-1/S2 650	1	Label, Nameplate, PC-4, 220V, English	40-2056-7	220V ONLY
6-1/S1 660	1	Kit, Front Labels	40-1037-1	
6-1/S2 670	1	Kit, Rear Labels	40-1018-1	
6-1/S2 680	1	Hood, A/C Receptacle, Domestic	10-2037-7	110V ONLY
6-1/S2 690	1	Power Cord Universal	142758	
6-1/S2 700	1	Power, Cord, 5 Amp, U.K.	848009	220V ONLY
	1	Power, Cord, 220V/240V, Australia	848012	220V ONLY
6-1/S2 910	3	Screw, Mach 4-40 x 0.37, XREX PNH	801003	
6-1/S1 1050	1	Screw, THDFRMG, 10-24 x 0.38 XREC PNH	801059	
6-1/S2 1200	1	Stud, Snap	809061	
6-1/S1 1220	4	Foot, Rubber Bumper	303724	
6-1/S1 1210	1	Seal Cord, 0.103 Conductive	834042PK4	
6-1/S2 1280	1	Screw, Mach 6-32 x 0.37, XREX .82FLH	801116	
6-1/S1 1290	4	Screw, Cap 10-32 x 0.37 Hex STDHD	801326	

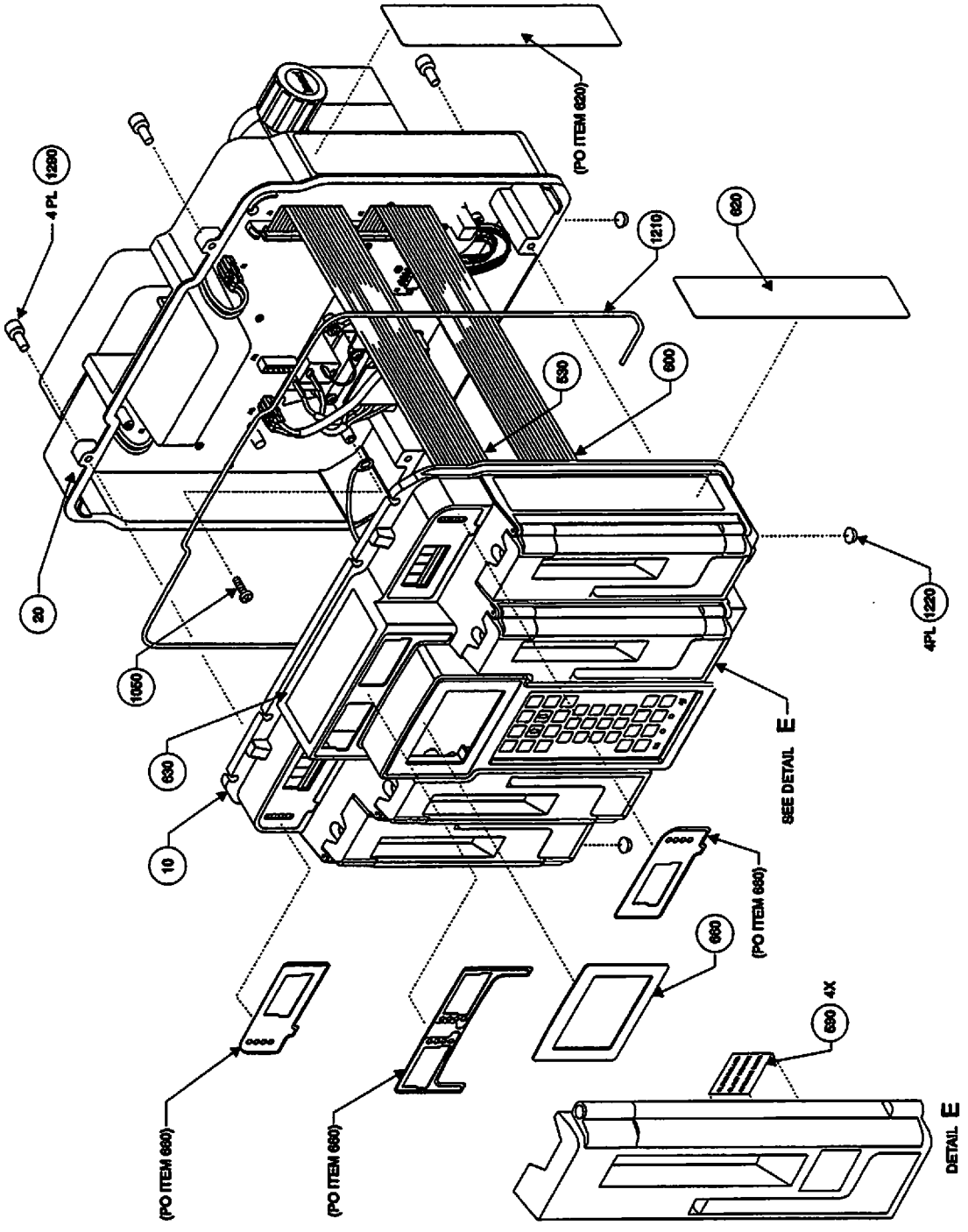


Figure 6-1. Parts Identification
PC-4 Pump Assembly (Sheet 1)

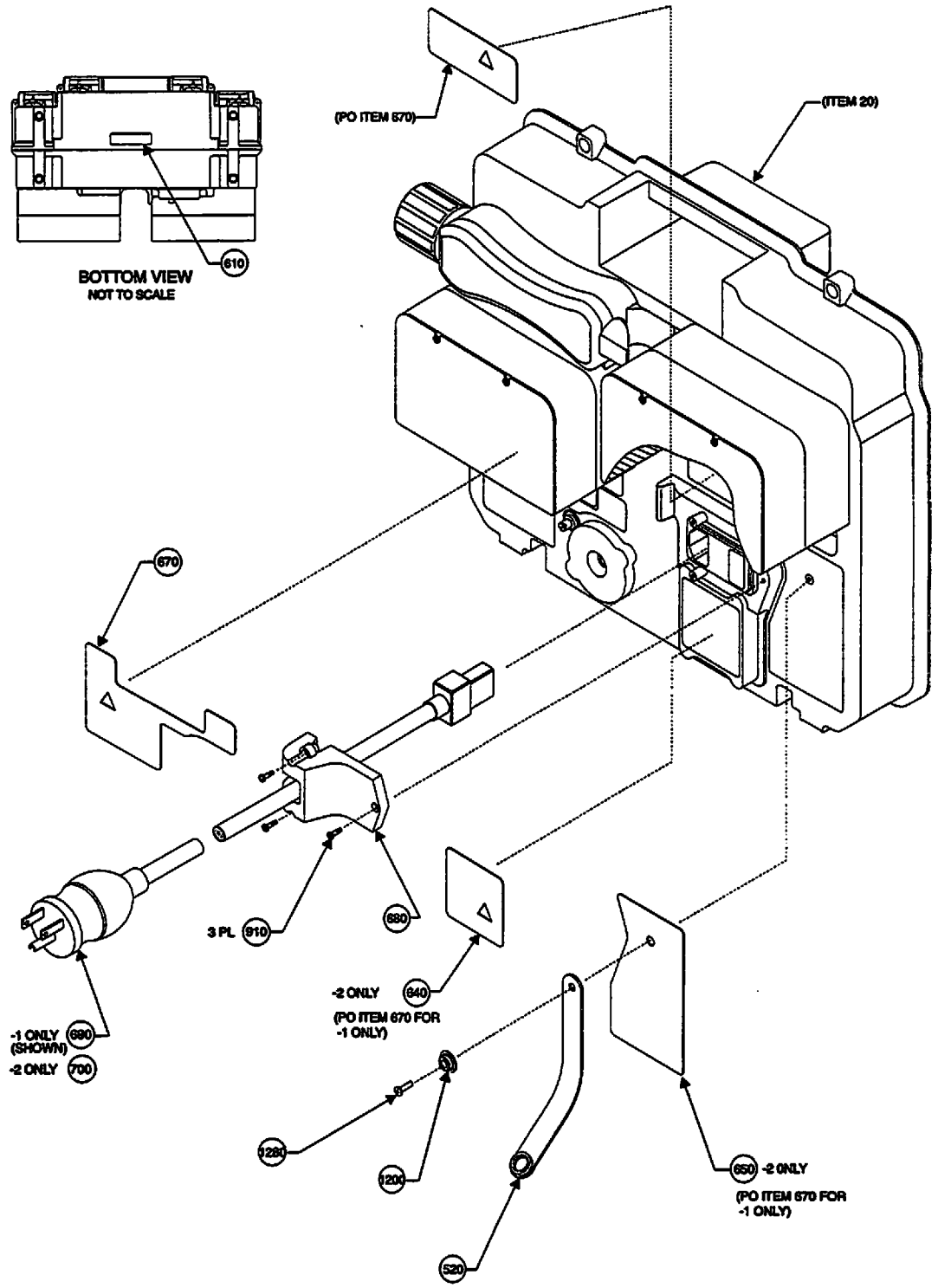


Figure 6-1. Parts Identification
PC-4 Pump Assembly (Sheet 2)

Table 6-2. Parts List - Front Case Assembly

Fig/Sht No	Item	Qty	Description	Part No	Reference
		X	Front Case Assembly (110V)	40-1056-3	w/40-1055-4
		X	Front Case Assembly (110V)	40-1056-4	w/40-1055-6
6-2/S1	10		Case, Front, PC-4 (as painted)	40-2060-9	
6-2/S1	30	1	Door Assy., Inner, Right	20-1317-3	
6-2/S1	40	1	Door Assy., Inner, Left	20-1317-2	
6-2/S1	50	1	Door Assy., Outer, Left	20-1317-1	
6-2/S1	60	1	Door Assy., Outer, Right	20-1317-4	
6-2/S1	70	4	Label, Air-in-line	20-2369-7	
6-2/S2	85	1	Guard	10-3041-7	
6-2/S1	100	4	Bezel, Seal Retaining	20-2121-7	
6-2/S1	110	4	Seal, Pump-Urethane	20-2284-7	
6-2/S2	120	1	Harness, Ground, PC-4	40-1104-1	
6-2/S2	125	1	Shield, Display, PC-4	40-2042-7	
6-2/S1	130	8	Pin, Hinge	20-2105-7	
6-2/S1	140	4	Bracket, Lower Fitment PC-4	40-2069-7	
6-2/S1	150	4	Anchor Bracket, TPRD, Zn-Ni Pltd	20-2198-10	
6-2/S1	160	4	Roller, Anchor Bracket	20-2150-7	
6-2/S2	180	4	Plate Assembly, Top	10-1164-1	
6/2/S2	190	4	Pump Mechanism Assy, Fractional	10-1132-4	w/40-1090-1/2/3 w/40-1092-1/2
6-2/S2	200	4	Transducer Assy, W/UV Coating	20-1194-2	
6-2/S2	210	4	Housing Assy., AIL	20-1314-1	
6-2/S2	220	4	Gasket, AIL	10-2094-7	
6-2/S2	230	4	Harness Assy, Door, PC-4	40-1110-1	
6-2/S2	235	2	Foam, PCB Bracket	40-2038-7	
6-2/S2	240	4	Bracket, Mounting, Hall Sensor	20-2426-7	
6-2/S2	250	1	Harness Assy, LCD	40-1108-1	
6-2/S2	260	1	CCA, Display Front	142335	
6-2/S2	270	1	Bezel, Keypad, PC-4	40-2016-7	
6-2/S2	280	1	Seal Keypad	40-3002-7	
6-2/S2	290	16	Spacer, Stainless Steel #4	20-3043-7	
6-2/S2	310	1	Gasket, LCD	40-2020-7	
6-2/S2	320	4	Mech. Alarm Ckt. Assy. Upper (MAC II)	143895	
6-2/S2	330	1	Display Assy. Crystal, PC-4	40-3001-7	
6-2/S2	340	4	Mech. Alarm Ckt. Assy. Lower (MAC II)	10-3046-1	
6-2/S2	345	1	CCA, Logic EMEM, PC-4	142337 - 143183	w/40-1092-1/2
6-2/S2	355	2	CCA, Controller, PC-4	142327	w/40-1055-4/5/6/7
6-2/S2	360	1	CCA, PC-4 Display Ch. A	142339	
6-2/S2	365	1	CCA, PC-4 Display Ch. D	142338	
6-2/S2	370	1	Keypad, PC-4 Bowman Domes	40-3013-7	
6-2/S2	380	2	Bracket, Mounting, PC-4	40-2040-7	
6-2/S1	710	4	Screw 4-40 x 0.18, XREX PNH	801042	
6-2/S2	720	4	Screw, Mach 6-32 x 0.37, XREC, PNH	801048	

Table 6-2. Parts List - Front Case Assembly (Cont'd)

Fig/Sht	No Item	Qty	Description	Part No	Reference
6-2/S2	730	14	Screw, THDROLL, 6-32 x 0.25, XREC PHN	801061	
6-2/S2	740	20	Washer, FL, 4, Carbon Stl, Galv	803000	
6-2/S2	750	16	Washer, FL, 6, Carbon Stl, Galv	803002	
6-2/S2	760	16	Washer, FL, 6, NY	803010	
6-2/S1	770	4	Washer, FL, 10, NY	803026	
6-2/S1	780	4	Pin, Dowel, 3/32 x 0.50, SST	804001	
6-2/S1	790	8	Washer, 1/4" I.D. 1/2" O.D. SS	803619	
6-2/S1	800	4	Pin, Hairpin Cotter, 1/4 x 1.0 Spr w/Zn	804201	
6-2/S2	810	4	Spacer, 1" long, #6, Thru hole	809104	
6-2/S2	820	AR	Loctite 416 Gap Fill Instant	832004	
6-2/S2	830	AR	Adhesive, Loctite 425	832059	
6-2/S2	840	1	Cable, Clip, Plastic, 0.312 dia x 0.203 Hole	809030	
6-2/S1	850	4	Spring, Door 2.5 lb/in SST	809039	
6-2/S2	870	36	Screw, Mach 4-40 x 0.25, XREX, PHN	801002	
6-2/S2	880	16	Screw, Mach 6-32 x 0.38, PHN, SLFLKG	801062	
6-2/S1	890	40	Screw, Mach 4-40 x 0.37 XREX, 82FLH	801131	
6-2/S1	900	AR	Grs Silicone Molykote 33 MDM	831014	
6-2/S2	910	1	Screw, Mach 4-40 x 0.37, XREC, PNH	801003	
6-2/S1	920	4	Spring, Compression 13.2 lb/in	809088	
6-2/S2	930	2	Standoff, M/F 1/4" Hex x 1.125, 6-32 SS	805084	
6-2/S2	940		Tape, Adhesive, 2-sided, 0.187W	830025	
6-2/S2	950		Cable tie, 4" auto feed	834031	
6-2/S2	960		Tie CD PVC 0.020 - 0.080 dia	834000	
6-2/S2	1230	1	Clip, SKT, RTNR, 34 Pin	845036	
6-2/S2	1240	1	Clip, SKT, RTNR, 26 Pin	845037	
6-2/S1	1320		Fluid, Med Dow 360 - 1000CS	1025-100	

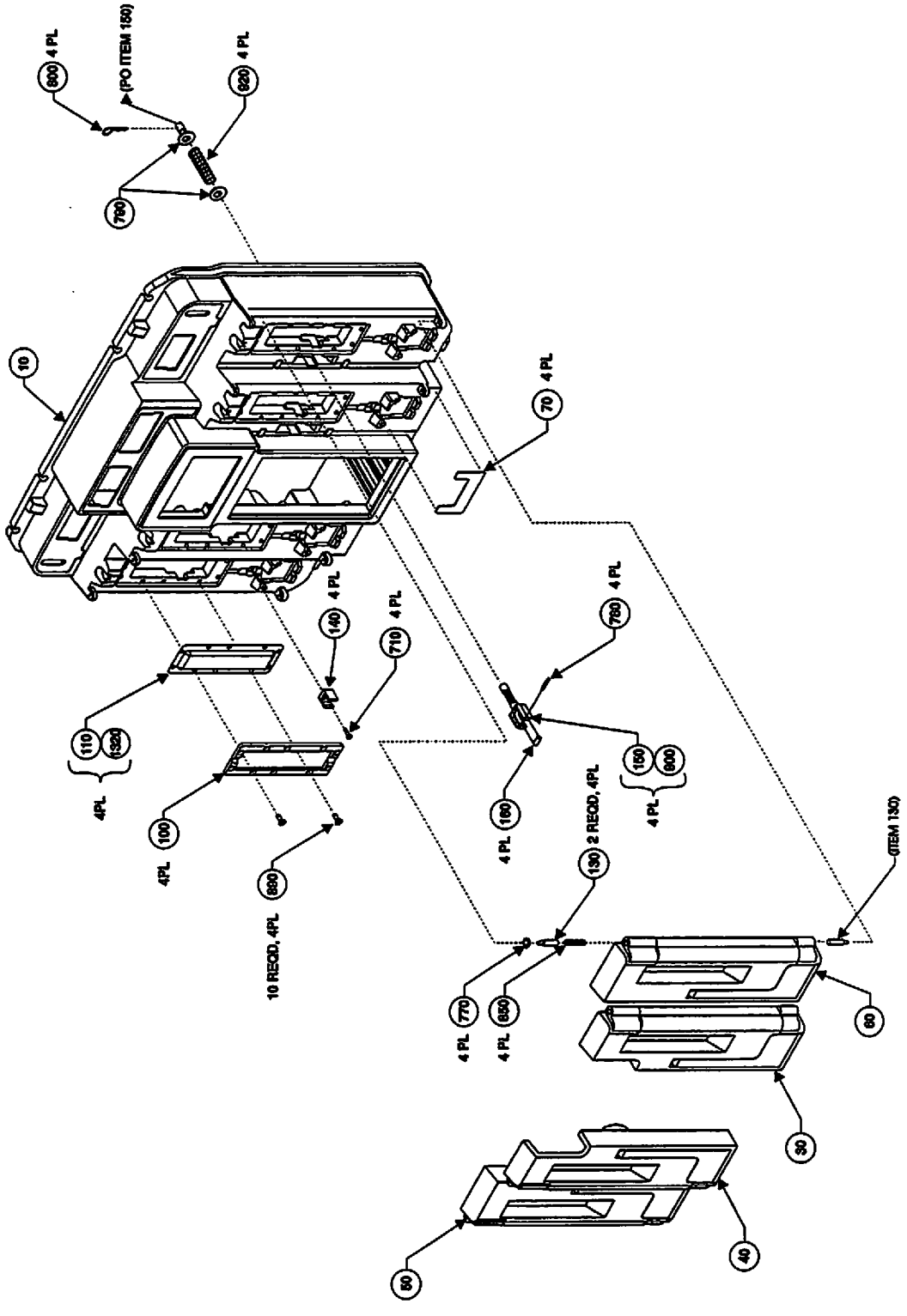


Figure 6-2. Parts Identification
Front Case Assembly (Sheet 1)

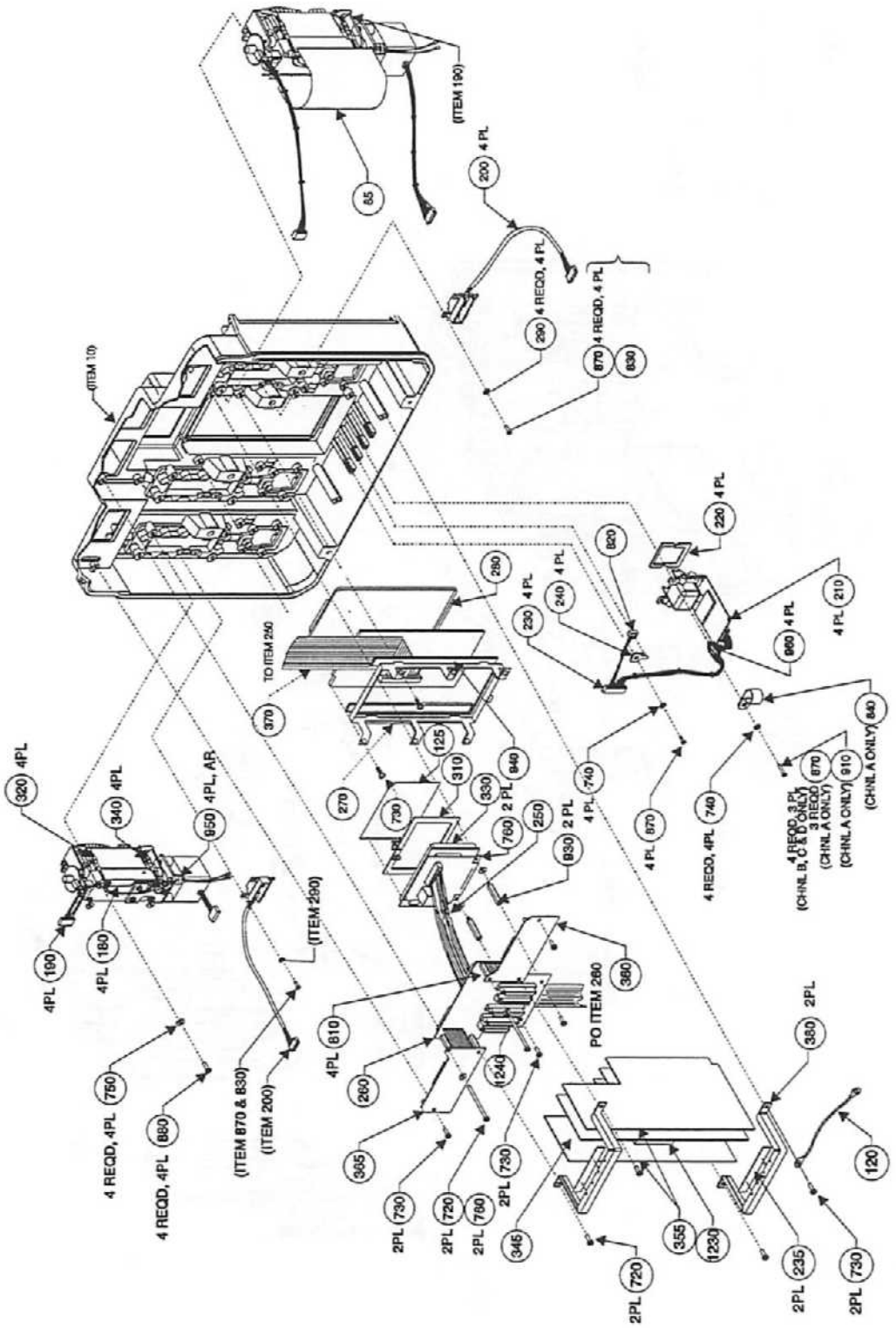


Figure 6-2. Parts Identification
Front Case Assembly (Sheet 2)

Table 6-3. Parts List - Door Assembly

Fig No/Item		Qty	Description	Part No	Reference
6-3	1	1	Door Assy, Right, Outer	20-1317-4	Table 6-2
			Door Assy, Right, Inner	20-1317-3	
			Door Assy, Left, Outer	20-1317-1	
			Door Assy, Left, Inner	20-1317-2	
6-3		1	Door, Left, Inner, Isoplast	20-2425-15	w/20-1317-2
6-3		1	Door, Left, Outer, Isoplast	20-2425-13	w/20-1317-1
6-3		1	Door, Right, Inner, Isoplast	20-2425-16	w/20-1317-3
6-3		1	Door, Right, Outer, Isoplast	20-2425-14	w/20-1317-4
6-3	1	2	Cam Lock Assembly - Right (not shown)	40-1039-2	
6-3	1	2	Cam Lock Assembly - Left	40-1039-1	
6-3	2	2	Cam Lock - Right (not shown)	20-2165-8	
6-3	2	2	Cam Lock - Left	20-2165-7	
6-3	3	4	Pin, Spring 5/32 x 0.75 Light Duty	804004	
6-3	3a	4	Ring, Retaining 5/32 SST	806214	
6-3	4	4	Magnet	809125	
		AR	Adhesive, Plstc Met Bndg 2-Pt	832043	
6-3	5	4	Sear, Machined, Extended	20-2279-8	
6-3	6	4	Pin, Dowel, 5/32 x .87, SST	804003	w/40-1092-1
6-3	7	4	Spring, Torsion 0.5 in-lb	809071	
6-3	8	4	Screw, Set #2-56 x 0.18, HEX, OVAL	801421	
6-3	9	4	Pawl, Cam Lock, Flat Nosed	20-2385-7	
6-3	10	4	Spring, Cam Lock Latch	20-2154-7	
6-3	11	4	Pin, Spring 3/32 x 1/2 LG	804001	

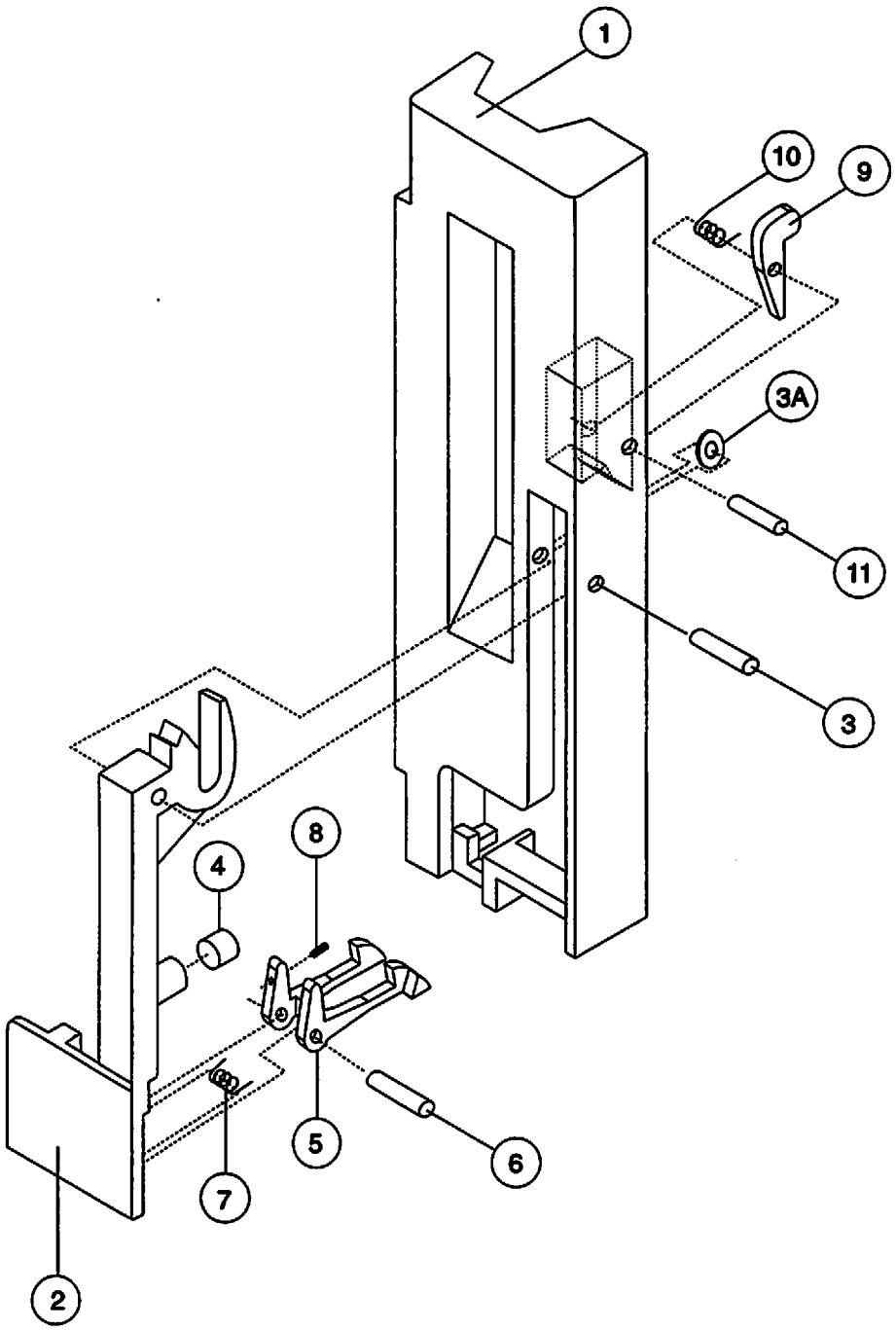


Figure 6-3. Parts Identification - Door Assembly

Table 6-4. Parts List - Rear Case Assembly

Fig/Sht	No Item	Qty	Description	Part No	Reference
6-4/S1	15	2	Harness Assy, wire SPC, PCB	40-1096-1	w/40-1092-1/2
			w/CCA, Daughter, PC-4XL	40-7048-1	
		2	Harness Assy, Battery, PC-4	40-1012-1	
6-4/S1	20	1	Pole Clamp Assembly, PC-4	40-1088-1	see Table 6-5
6-4/S1	20	1	Rear Case Assembly, 110V	40-2030-9	w/40-1055-4/6
		1	Rear Case Assembly, 220V		w/40-1055-5
6-4/S2	80	2	Label, Battery Shield	40-2070-7	w/40-1092-1/2
6-4/S1	90	2	Cable Assembly, Ground	40-1103-1	w/40-1092-2
6-4/S2	170	2	Housing, Battery Extension, PC-4	40-2067-7	w/40-1092-1/2
6-4/S1	390	1	Harness, Audio PC-2	20-1331-1	
6-4/S2	400	1	AC Receptacle Assy, Domestic 0.4A fuse	20-1335-1	
6-4/S2	405	1	Power Entry Module, Int'l w/40-1055-5	20-1333-1	220V ONLY
6-4/S1	410	1	Harness Assy, PC-1T Audio/Switch	10-1180-1	
6-4/S1	420	1	Transformer Harness Assy, PC-4 (110V)	10-1181-1	w/40-1086-1
					w/40-1090-1
					W/40-1092-1
6-4/S1	425	1	Transformer Harness Assy. PC-4 (220V)	10-1178-1	w/40-1090-2
		1	Transformer Harness Assy, PC-4 (220V)	40-1014-2	w/40-1055-5
6-4/S1	430	1	CCA, Power Supply	142326	w/40-1092-1/2
6-4/S2	435	2	Cover, Battery, PC-4	40-2041-7	
6-4/S2	440	2	Label, Battery History	10-2101-7	
6-4/S2	470	2	Spring AC Receptacle Locking	10-2004-7	
6-4/S2	480	1	Gasket, Seal AC Receptacle	10-2102-7	
6-4/S2	490	1	Handle, Rubber	142550	
6-4/S1	500	1	Gasket, Comm Ch A & B	40-2026-7	
6-4/S1	510	1	Gasket, Comm Ch C & D	40-2025-7	
6-4/S1	840	1	CA CLP 3305	809030	
6-4/S1	910	2	Screw, Mach. 4-40 x 0.37, CREX, PHn	801003	
6-4/S1	950	1	Cable Tie 4"	834031	
6-4/S1	970	1	Nut, 3/8-33, Dress	802007	
6-4/S1	980	3	Washer, 6, SST	803021	
6-4/S1	1000	1	Lock Washer, Intl, A/B, 3/8, CS,Galv	803216	
6-4/S1	1010	2	Grommet, Split, 0.187 ID x 0.562 OD RBR	809102	
6-4/S1	1030	8	Screw, THDERM 6-32 x 0.38 XREX PHN	801057	
6-4/S1	1040	4	Screw, THDERM 6-32 x 1.0 XREX, PHN	801058	
6-4/S1	1050	1	Screw, THDERM 10-24 x 0.38 XREX, PHN	801059	
6-4/S1	1060	2	Battery, 6V, 3.4 AH, Sealed Lead Acid	841025	
		2	Battery, 12V, 3.4 AH, Panasonic	841030	w/40-1092-1/2
6-4/S1	1075	2	Cable Clamp, Nyl w/adh mt 1/8 dx	845023	w/40-1092-1/2
6-4/S1	1080	3	Lock Washer, APR, SPT 6 STL	803207	
6-4/S2	1090	8	Scr,6-22x1 7/8,Pnh,xrec,sst	801074	w/40-1092-2
6-4/S2	1120	4	Lock Washer, EXT, 82CTSK, #6, STL, GALV	803220	
6-4/S2	1130	1	Washer, FLat 3/8 STL NKL	803017	
6-4/S2	1140	8	Foot, Battery	40-2050-7	
6-4/S2	1141	8	Bumper-Strip, 1/2 x 1/8 x 1	809095	alt item 1140

Table 6-4. Parts List - Rear Case Assembly (Cont'd)

Fig/Sht	No Item	Qty	Description	Part No	Reference
6-4/S2	1150	1	Stud Earth Pot Equalization	809097	220V ONLY
6-4/S2	1160	2	Fuse, 5x20mm 0.2A 250V Slo-Blow	842020	220V ONLY
6-4/S2	1170	1	Nut, M-6, HEX, BRS, NKL PLD	802012	220V ONLY
6-4/S2	1180	1	Washer, Flat 6.4mm	803032	220V ONLY
6-4/S2	1190	1	Washer, SHPRF, 6.4mm	803217	220V ONLY
6-4/S1	1300	3	STDF, LCBS, .38, Nyl, Snap-In	805097	w/40-1092-2
6-4/S1	10	AR	Sealant, Adhesive RTV 162 White Paste	832020	
	1350	AR	Solder, SN 60 0.031: dia wire	832011	

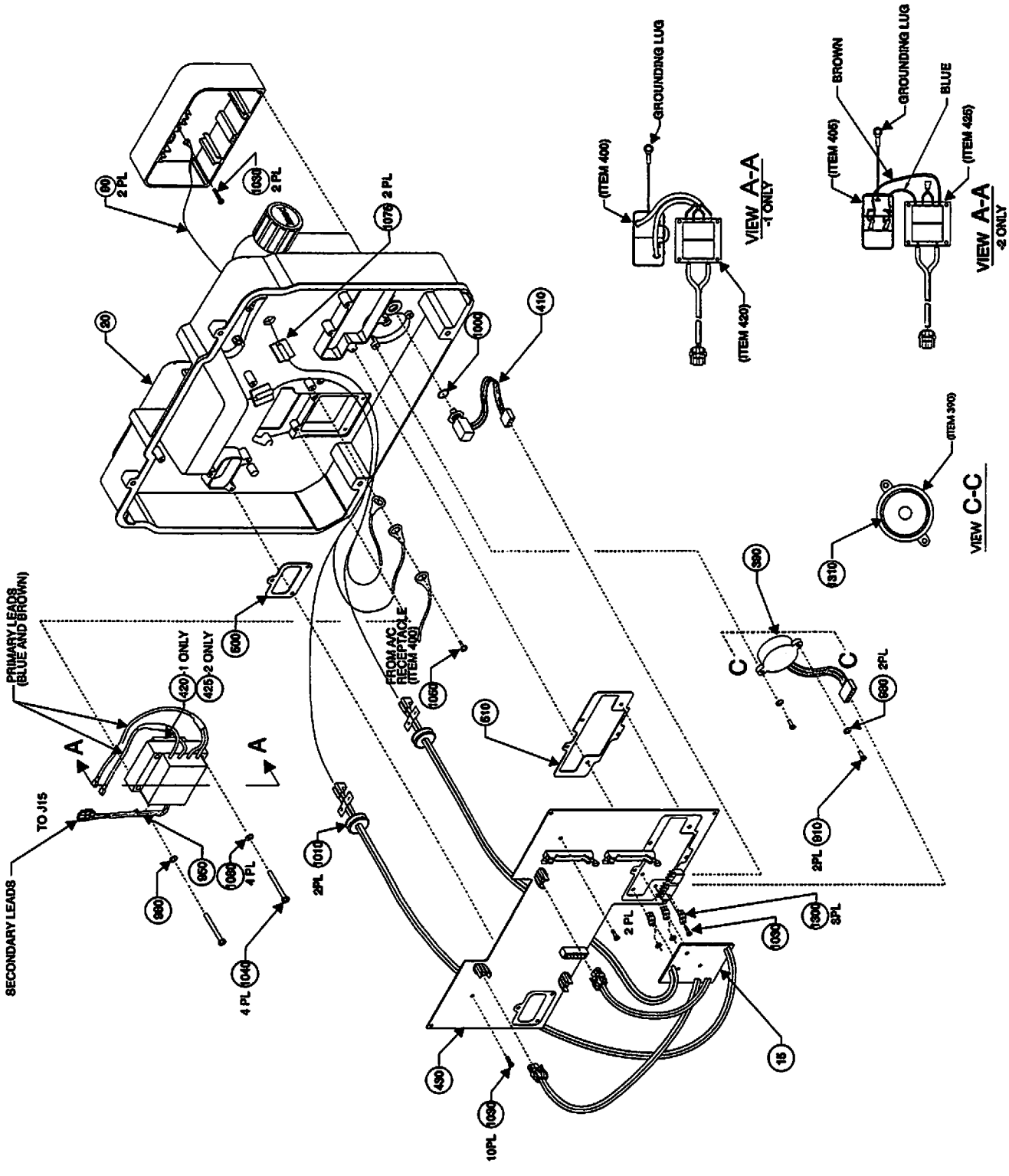


Figure 6-4 Parts Identification - Rear Case Assembly (Sheet 1)

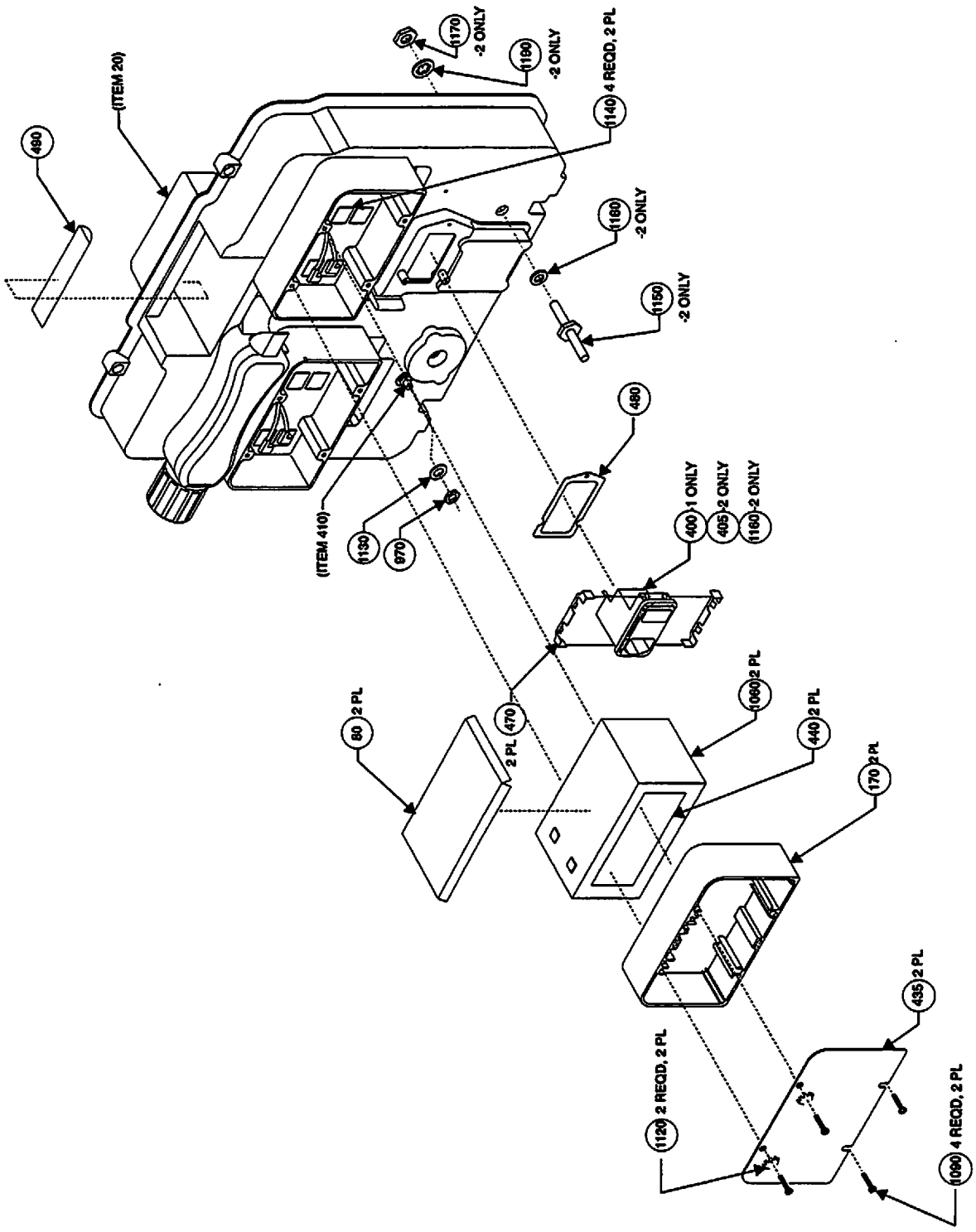


Figure 6-4 Parts Identification - Rear Case Assembly (Sheet 2)

Table 6-5. Parts List - Pole Clamp Assembly

Fig No/Item		Qty	Description	Part No	Reference
6-5		x	Pole Clamp Assembly, PC-4	40-1088-1	
6-5	11		Retainer, Pole Clamp, Painted	40-2055-9	
6-5	20	1	Leadscrew, PC-4	20-1318-2	
6-5	30	1	Case, Rear, PC-4, Painted	40-2030-9	
6-5	40	1	Friction Strip, Pole Clamp	40-2013-7	
6-5	50	1	Wedge, Pole Clamp	20-2266-10	
6-5	60	1	Label, Pole Clamp	143896	
6-5	80	2	Thrust Washer, Pole Clamp	10-3003-7	
6-5	90	1	Foam Insert, Pole Clamp	40-3003-7	
6-5	100	1	Knob Round Shaft, Pole Clamp	10-2150-1	
6-5	110	4	Screw, Cap, 10-32 x 1, Hex, STL	801321	
6-5	120	1	Screw, Mach, 5/16 -18 x 0.5, SLTD, PNH	801019	
6-5	130	1	Lock Washer, 5/16, Carbon Stl, Galv.	803210	
6-5		1	Leadscrew Assy, Pole Clamp, Acme	20-1318-2	NOT 40-1055-5
6-5		AR	Locktite 242, Threadlocking	832008	
6-5		AR	Lube MLYGRES BR2	831003	

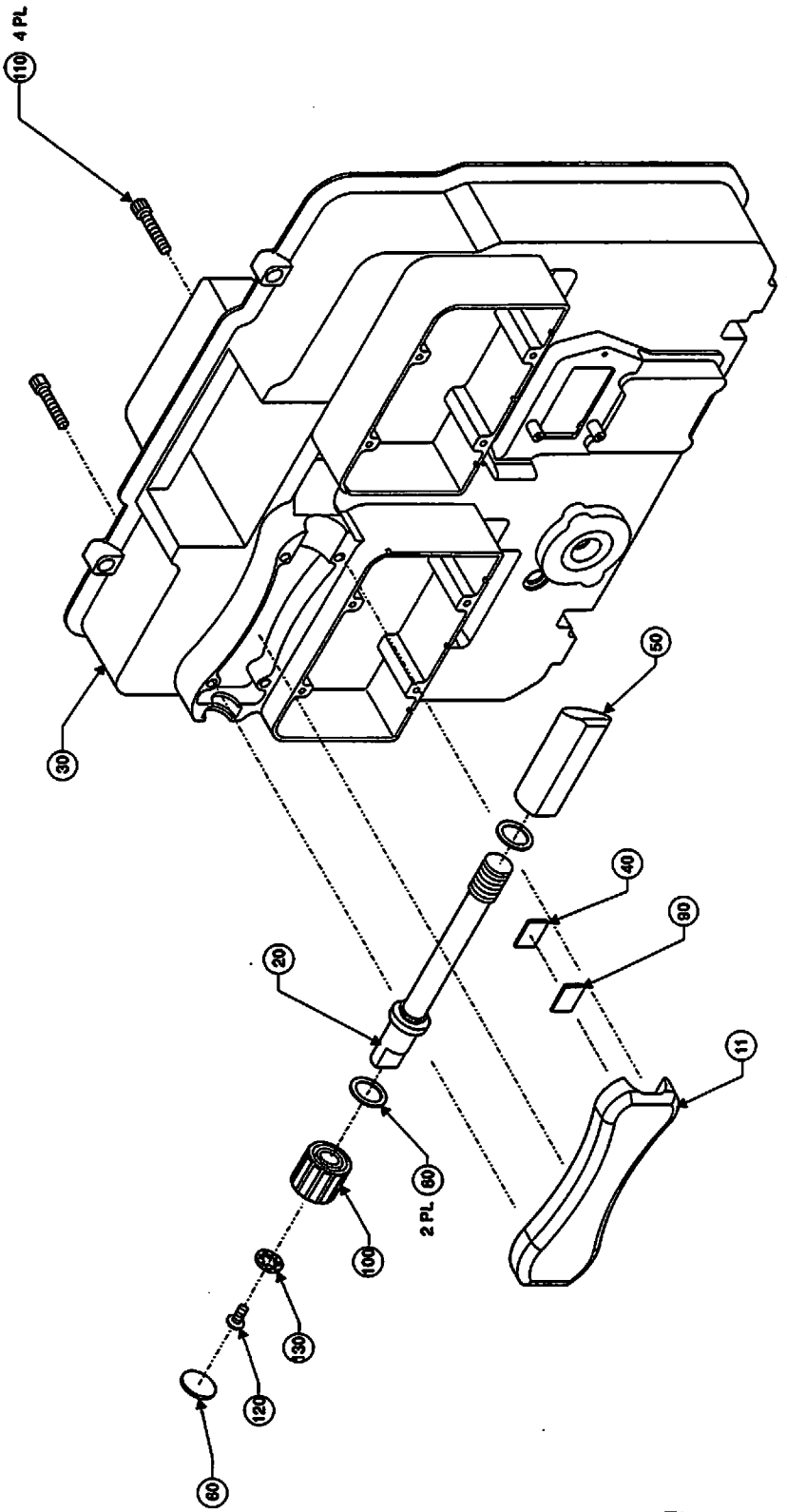


Figure 6-5 Parts Identification
Rear Case - Pole Clamp Assembly

Table 6-6. Parts List - Power Supply Board CCA

Fig No	Ref Desig.	Qty	Description	Part Number	Reference
6-6	10	X	CCA,PC-4 POWER SUPPLY	142326	
			Integrated Circuits		
6-6	U1	1	IC, TL431 PROGRAMMABLE PRCN	812190	
6-6	U2	1	IC, LM3578 SWITCHING RGLTR	812191	
6-6	U3	1	IC, MAX638 SWITCHING REGULATOR	812253	
6-6	U4,U5	2	IC, CMOS RS-232/CCITT V.28	812146	
6-6	U6	1	IC,2950,5V REGULATOR	812229	-7014 ONLY
6-6	U7	1	IC,TLC393,DUAL VOLT COMPARATOR	812218	
6-6	U8	1	IC,TLC27M2A,VIO,5MV,OP-AMP	812219	
6-6	U9,U10	2	IC, TL431 PROGRAMMABLE PRCN	812190	
	U11	1	IC, 2954,5V REGULATOR	812266	-7022/7028/7043/7049-1
6-6	U12-U18		NOT USED		
6-6	U19	1	IC, 2524A REGULATING PULSE WD	812168	
6-6	U20		NOT USED		
6-6	U21	1	IC, 2524A REGULATING PULSE WD	812168	
6-6	U22	1	IC,LM385-2.5,1.5% VOLTAGE REF	812234	
			Capacitors		
6-6	C1	1	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-6	C2	1	CAP,CER,Z5U,50V,20%,.22UF,AX	811247224A	
6-6	C3	1	CAP,CER,X7R,50V,10%,.01UF AX	811246103A	
6-6	C4	1	CAP,CER,100V,10%,AXIAL,150PF	811256151A	
6-6	C5	1	CAP,CER,COG,50V,5%,220PF,AX	811245221A	
6-6	C6,C7	2	CAP,CER,50V,10%,.022UF,RAD	811246-223	
6-6	C8,C9	2	CAP,TANT,10V,10%,10UF,AX	811116106A	
6-6	C10	1	CAP,AL ELCTLT,63V,20%,1000UF	811397-108	
6-6	C11	1	CAP,TANT,20V,20%,4.7UF,AX	811137475A	
6-6	C12-15	4	CAP,AL ELCTLT,25V,20%,220UF,	811397-227	
6-6	C16	1	CAP,AL ELCTLT,10V,20%,330UF	811317-337	
6-6	C17	1	CAP,TANT,10V,10%,100UF,AX	811116107A	
6-6	C18	1	CAP,TANT,20V,20%,4.7UF,AX	811137475A	
6-6	C19	1	CAP,TANT,10V,10%,10UF,AX	811116106A	
6-6	C20	1	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-6	C21	1	CAP,CER,X7R,50V,10%,.01UF AX	811246103A	
6-6	C22,C23	2	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	-7014, C23 ONLY
6-6	C24	1	CAP,CER,100V,10%,AXIAL,150PF	811256151A	
6-6	C25	1	CAP,CER,100V,10%,3300PF,AX	811256332A	
6-6	C26-C29	4	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	-7014 ONLY
6-6	C27,C29	4	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-6	C30	1	CAP,TANT,10V,10%,6.8UF,AX	811116685A	
6-6	C31	1	CAP,TANT,20V,10%,1UF,AX	811136105A	

PC-4

Fig No	Ref Desig.	Qty	Description	Part Number	Reference
6-6	C33-C34	3	CAP,TANT,10V,10%,10UF,AX	811116106A	
	C32	1	CAP,TANT,10V,10%,10UF,AX	811116106A	-7014 ONLY
	C32	1	CAP, AL ELCTLT, 16V, 20%,330UF	811397-337	
6-6	C35	1	CAP,AL ELCTLT,25V,20%,220UF,	811397-227	
6-6	C36-C40	5	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-6	C41,C42	2	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-6	C43	1	CAP,CER,COG,100V,10%,10PF,AX	811256100A	
6-6	C44	1	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-6	C45	1	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-6	C46	1	CAP,CER,X7R,100V,10%,820PF,AX	811256821A	
6-6	C47	1	CAP,CER,COG,100V,10%,10PF,AX	811256100A	
6-6	C48	1	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-6	C49,C50	2	CAP,CER,50V,10%,.022UF,RAD	811246-223	
6-6	C51	1	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-6	C52	1	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-6	C53	1	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
			Diodes		
6-6	D1	1	DIO,10A,MBR1060	813203	
6-6	D2	1	DIO,20A,MBR2060	813204	
6-6	D3	1	DIO,10A,MBR1060	813203	
6-6	D4	1	DIO 1N5711 SCHOTTKY	813019	
6-6	D5	1	DIO,10A,MBR1060	813203	
6-6	D6	1	DIO,1N5711 SCHOTTKY	813019	
6-6	D7	1	DI0,10A,MBR1060	813203	
6-6	D8	1	DIO,MBR120P SCHOTTKY BARR RECT	813503	
6-6	D9	1	DIO,SILICONE SWITCHING 75V	813500	
6-6	D10-D12	3	DIO,1N5819 SCHOTTY	813505	
6-6	D13-D15	3	DIO,MBR120P SCHOTTKY BARR RECT	813503	
6-6	D16	1	DIO,SILICONE SWITCHING 75V	813500	
6-6	D17	1	DI0,10A,MBR1060	813203	
6-6	D18	1	DIO,SILICONE SWITCHING 75V	813500	
	D19	1	DIO,MBR120P SCHOTTKY BARR RECT	813503	142326
6-6	D21, D22	2	DIO,ZENER 7.5V 1W	813023	
6-6	D23	4	DIO,SILICONE SWITCHING 75V	813500	
6-6	D24	1	DIO,MBR120P SCHOTTKY BARR RECT	813503	-7014/7022 ONLY
			Resistors		
6-6	R1	1	RES,MET FLM,1/4W,1%,768K	8102297683	-7014 ONLY
	R1	1	RES,MET FLM,1/4W,1%,100K	810229-104	
6-6	R2	1	RES,MET FLM,1/4W,1%,61.9K	8102296192	-7014 ONLY

Fig No	Ref Desig.	Qty	Description	Part Number	Reference
	R2	1	RES,MET FLM,1/4W,1%,8.06K	8102238061	
6-6	R3	1	RES,MET FLM,1/4W,1%,15.4K	8102291542	-7014 ONLY
	R3	1	RES,MET FLM,1/4W,0.1%,15.4K	8102211542	
6-6	R4	1	RES,MET FLM,1/4W,1%,80.6K	8102298062	-7014 ONLY
	R4	1	RES,MET FLM,1/4W,0.1%,82.5K	8102218252	
6-6	R5	1	CFR,1/4W,5%,1K	810125-102	
6-6	R6	1	RES,MET FLM,1/4W,1%,10K	810229-103	-7014 ONLY
	R6	1	RES,MET FLM,1/4W,1%,6.98K	8102236981	
6-6	R7	1	CFR,1/4W,5%,120	810125-121	
6-6	R8	1	RES,MET FLM,1/4W,1%,332	8102293320	
6-6	R9	1	RES,MET FLM,1/4W,1%,10K	810229-103	
6-6	R10	1	CFR,1/4W,5%,100	810125-101	
6-6	R11	1	RES,3W,1%,.05,WW	810563-R05	-7014 ONLY
6-6	R11	1	RES,WW,1/4W,1%,.1	810563-OR1	
6-6	R12	1	RES,MET FLM,1/4W,1%,27.4K	8102292742	-7014 ONLY
	R12	1	RES,MET FLM,1/4W,1%,60.4K	8102296042	
6-6	R13	1	RES,3W,1%,.05,WW	810563-R05	
6-6	R14	1	CFR,1/4W,5%,100	810125-101	-7014 ONLY
	R14	1	CFR,1/4W,5%,0	810125-000	
6-6	R15	1	CFR,1/4W,5%,5.1K	810125-512	
6-6	R16	1	CFR,1/4W,5%,4.7K	810125-472	
6-6	R17	1	CFR,1/4W,5%,100	810125-101	-7014 ONLY
	R17	1	CFR,1/4W,5%,0	810125-000	
6-6	R18	1	CFR,1/4W,5%,47K	810125-473	
6-6	R19	1	CFR,1/4W,5%,100	810125-101	-7014 ONLY
	R19	1	CFR,1/4W,5%,0	810125-000	
6-6	R20	1	RES,MET FLM,1/4W,1%,10K	810229-103	
6-6	R21	1	RES,MET FLM,1/4W,1%,100K	810229-104	
6-6	R22	1	CFR,1/4W,5%,5.1K	810125-512	
6-6	R23	1	RES,MET FLM,1/4W,1%,150K	810229-154	-7014 ONLY
	R23	1	RES,MET FLM,1/4W,.1%,162K	8102211623	
6-6	R24	1	RES,MET FLM,1/4W,1%,768K	8102297683	
6-6	R25	1	CFR,1/4W,5%,47	810125-470	-7014 ONLY
	R25	1	RES,MET FLM,1/4W,1%,200	810229-201	
6-6	R26	1	CFR,1/4W,5%,47K	810125-473	
6-6	R27	1	RES,MET FLM,1/4W,1%,10K	810229-103	
6-6	R28	1	CFR,1/4W,5%,47K	810125-473	
6-6	R29	1	CFR,1/4W,5%,4.7K	810125-472	
6-6	R31	1	RES,MET FLM,1/4W,1%,200	810229-201	
6-6	R32	1	RES,3W,1%,.05,WW	810563-R05	
6-6	R33	1	CFR,1/4W,5%,300K	810125-304	
6-6	R34	1	CFR,1/4W,5%,20K	810125-203	-7014 ONLY

Fig No	Ref Desig.	Qty	Description	Part Number	Reference
	R34	1	RES,MET FLM,1/8W,0.25%,20K	810219-203	
6-6	R35,R36	1	CFR,1/4W,5%,15K	810125-153	-7014 ONLY
	R35,R36	2	RES,MET FLM,1/4W,0.1%,15.4K	8102211542	
6-6	R37	1	CFR,1/4W,5%,4.7K	810125-472	
6-6	R38	1	CFR,1/4W,5%,1.5K	810125-152	
6-6	R39	1	RES,MET FLM,1/4W,1%,10K	810229-103	
6-6	R40	1	CFR,1/4W,5%,51K	810125-513	-7014 ONLY
	R40	1	RES,MET FLM,1/4W,1%,51.1K	8102295112	
6-6	R41	1	RES,MET FLM 1/4 W 1% 200K	810229-204	
6-6	R42	1	RES,MET FLM,1/4W,1%,100K	810229-104	
6-6	R43	1	CFR,1/4W,5%,47	810125-470	-7014 ONLY
	R43	1	CFR,1/4W,5%,100	810125-101	
6-6	R44	1	RES,MET FLM,1/4W,1%,150K	810229-154	
6-6	R45	1	RES,MTL FLM,1/4W,1%,357K	8102233573	
6-6	R46	1	RES,MET FLM,1/4W,1%,10K	810229-103	
6-6	R47	1	RES,MET FLM,1/4W,1%,100K	810229-104	
6-6	R48	1	RES,WW,.4W,1%,.1	810591-0R1	
6-6	R49	1	CFR,1/4W,5%,20K	810125-203	-7014 ONLY
	R49	1	RES,MET FLM,1/8W,0.25%,20K	810219-203	
6-6	R50	1	RES,MET FLM,1/4W,1%,10K	810229-103	
6-6	R51	1	CFR,1/4W,5%,47K	810125-473	
6-6	R52	1	CFR,1/4W,5%,470K	810125-474	
6-6	R53	1	CFR,1/4W,5%,15K	810125-153	-7014 ONLY
	R53	1	RES,MET FLM,1/8W,0.25%,24.9K	8102192492	
6-6	R54	1	RES,MET FLM,1/4W,1%,3.4K,50PPM	810229-342	
6-6	R55	1	CFR,1/4W,5%,1K	810125-102	
6-6	R56	1	RES,MET FLM,1/8W,0.25%,24.9K	8102192492	142326
6-6	R56	1	RES,MET FLM,1/4W,1%,24.9K	8102292492	-7014 ONLY
6-6	R57	1	RES,MET FLM,1/4W,1%,100K	810229-104	
6-6	R58	1	RES,MET FLM,1/8W,.25%,20K	810219-203	
6-6	R59	1	RES,MET FLM,1/4W,1%,100K	810229-104	-7014/7022/7028-1
	R59	1	RES,MET FLM,1/4W,0.25%,100K	810219-104	-7043/7049-1
6-6	R60	1	CFR,1/4W,5%,12K	810125-123	
6-6	R61	1	RES,MET FLM,1/4W,1%,10K	810229-103	-7022 ONLY
	R61	1	CFR,1/4W,5%,910	810125-911	142326
6-6	R62	1	CFR,1/4W,5%,100	810125-101	
6-6	R63	1	CFR,1/4W,5%,6.2M	810125-625	
6-6	R64	1	RES,MET FLM,1/4W,1%,24.9K	8102292492	-7014 ONLY
	R64	1	RES,MET FLM,1/4W,1%.27.4K	8102292742	-7022/7028
	R64	1	RES,MET FLM,1/4W,0.25%,24.9K	8102192492	-7043 ONLY
	R64	1	RES,MET FLM,1/8W,.1%,26.1K	8102112612	142326
6-6	R65	1	CFR,1/4W,5%,100	810125-101	

Fig No	Ref Desig.	Qty	Description	Part Number	Reference
6-6	R66	1	CFR,1/4W,5%,20K	810125-203	-7014 ONLY
	R66	1	RES,MET FLM,1/8W,0.25%,20K	810219-203	
6-6	R67	1	RES,MET FLM,1/4W,1%,24.9K	8102292492	-7014 ONLY
	R67	1	RES,MET FLM,1/8W,0.25%,24.8K	8102192492	-7022/7028/7043-1
6-6	R68	1	CFR,1/4W,5%,4.7K	810125-472	
6-6	R69	1	CFR,1/4W,5%,20K	810125-203	-7014 ONLY
	R69	1	RES,MET FLM,1/8W,0.25%,20K	810219-203	
6-6	R70	1	RES,POT,TRMR,50K 20-TURN	810336503Y	-7014 ONLY
	R70	1	RES,POT,CMRT,20K,20-TURN,TOP	810336203Y	
6-6	R71-R75	5	CFR,1/4W,5%,47K	810125-473	
6-6	R76	1	CFR,1/4W,5%,1K	810125-102	
6-6	R77-R80	4	RES,MET FLM,1/4W,1%,100K	810229-104	
6-6	R81,R82	2	CFR,1/4W,5%,0	810125-000	-7014 ONLY
	R81	1	RES,MET FLM,1/4W,1%,51.1K	8102295112	
6-6	RA1	1	RES,SIP,.2W,2%,10K,10 BUS	810900-103	
6-6	RA2	1	RES,SIP,.2W,2%,4.7K,10 ISOL	810900472M	
			Transistors		
6-6	Q1,Q2	2	XSTR,FET,N-CHA,VN22	814006	
6-6	Q3-Q6	4	XSTR 2N4401 NPN SIL GENL PRP	814103	
6-6	Q7	1	XSTR,MPS6513,OR SELECTED2N4401	814103-1	-7014 ONLY
	Q7	1	XSTR, MPS6514, NPN	814112	
6-6	Q8	1	SCR,MCR68,100V,12A	814900	
6-6	Q9	1	XSTRS PNP BJT 60V 10MA	814111	
6-6	Q10	1	XSTR 2N4401 NPN SIL GENL PRP	814103	
6-6	Q11	1	XSTR,VP0206N3,P-CHA,FET	814001	
6-6	Q12,Q13	2	P CHNNL ENHNCEMENT M PWR FET	814109	
6-6	Q14	1	XSTR,VP0206N3,P-CHA,FET	814001	
6-6	Q15	1	P CHNNL ENHNCEMENT M PWR FET	814109	
6-6	Q16	1	SCR,MCR68,100V,12A	814900	
6-6	Q17,Q18	2	FET,N-CHNNL,3.0 AMP,VN0206	814005	
6-6	Q19	1	XSTR 2N4403 PNP SIL GENL PRP	814104	
6-6	Q20	1	XSTRS NPN BJT 60V 10MA	814110	
6-6	Q21	1	XSTR DARLINGTON MPS A13	814301	

PC-4

Fig No	Ref Desig.	Qty	Description	Part Number	Reference
			Connectors		
6-6	J1	1	CONN,HDR 4-WALL .1" X .1" CTR	851006	-7014/7022-1
	J1	1	CONN,HDR 4-WALL LATCHING .1" X	851046	142326
6-6	J2	1	CONN,4WL HDR,PC MT,34CKT .1X.1	851079	-7014/7022-1
	J2	1	CONN,HDR, 2 X 17, LATCHING	851080	142326
6-6	J3	1	CONN,10A LKG PLZD HDR/HSG/CRP	851051	
6-6	J4,J5	2	CONN,D-SUBMIN PCB MT 9-SKT MET	856061	
6-6	J6	1	CONN,0.1" SPACED CRP-TO-W	851044	
6-6	J7	1	CONN,HDR RT ANGLE 3 CKT	851077	
6-6	J8	1	CONN,10A LKG PLZD HDR/HSG/CRP	851051	
6-6	J9-13	5	CONN,6 PIN FEM RECPT,DIN,PC MT	856075	
6-6	J14	1	CONN,HDR 4-WALL .1" X .1" CTR	851001	
6-6	J15	1	CONN,10A LKG PLZD HDR/HSG/CRP	851051	
			Miscellaneous		
6-6	F1	1	FUSE,3AG, 2A 1/4"X1 1/1/4"	842013	
6-6	F2	1	FUSE,PICO, 4A, 125V,PC-MT	842037	142326
6-6	L1	2	INDUCTOR TOROID	10-3007-7	
6-6	L2	1	IDCTR AXIAL 56MH Q=23	815049	
6-6	L3	2	INDUCTOR TOROID	10-3007-7	
6-6	L4	1	INDUCTOR 250 UH TOROID	20-3080-7	
6-6	K1	1	RLY DIP REED SPST N.O.10W	812080	
		4	HTSK,PCB MT,TO-220 PKG	847015	-7014 ONLY
	K1	4	HTSK,PCB MT,TO-220 PKG	847088	
6-6	TP1	1	TST PT,YEL,.063 DIA	815064	
6-6	TP3	1	TST PT,YEL,.063 DIA	815064	
	TP9	1	TST PT,YEL,.063 DIA	815064	142326
6-6	TP10	1	TST PT,YEL,.063 DIA	815064	
6-6	TP13	1	TST PT,YEL,.063 DIA	815064	
6-6	TP15-TP17	3	TST PT,YEL,.063 DIA	815064	
6-6	TP19	1	TST PT,YEL,.063 DIA	815064	
6-6	TP22	1	TST PT,YEL,.063 DIA	815064	
6-6	T1	1	XFMR PWR INV +/- 12V	847069	
6-6	XF1	2	FUSE CL 5X20MM 3AG PCB MT	845026	
6-6	B1	1	BTRY NICAD 4.8V 40MAH PC MT	841018	

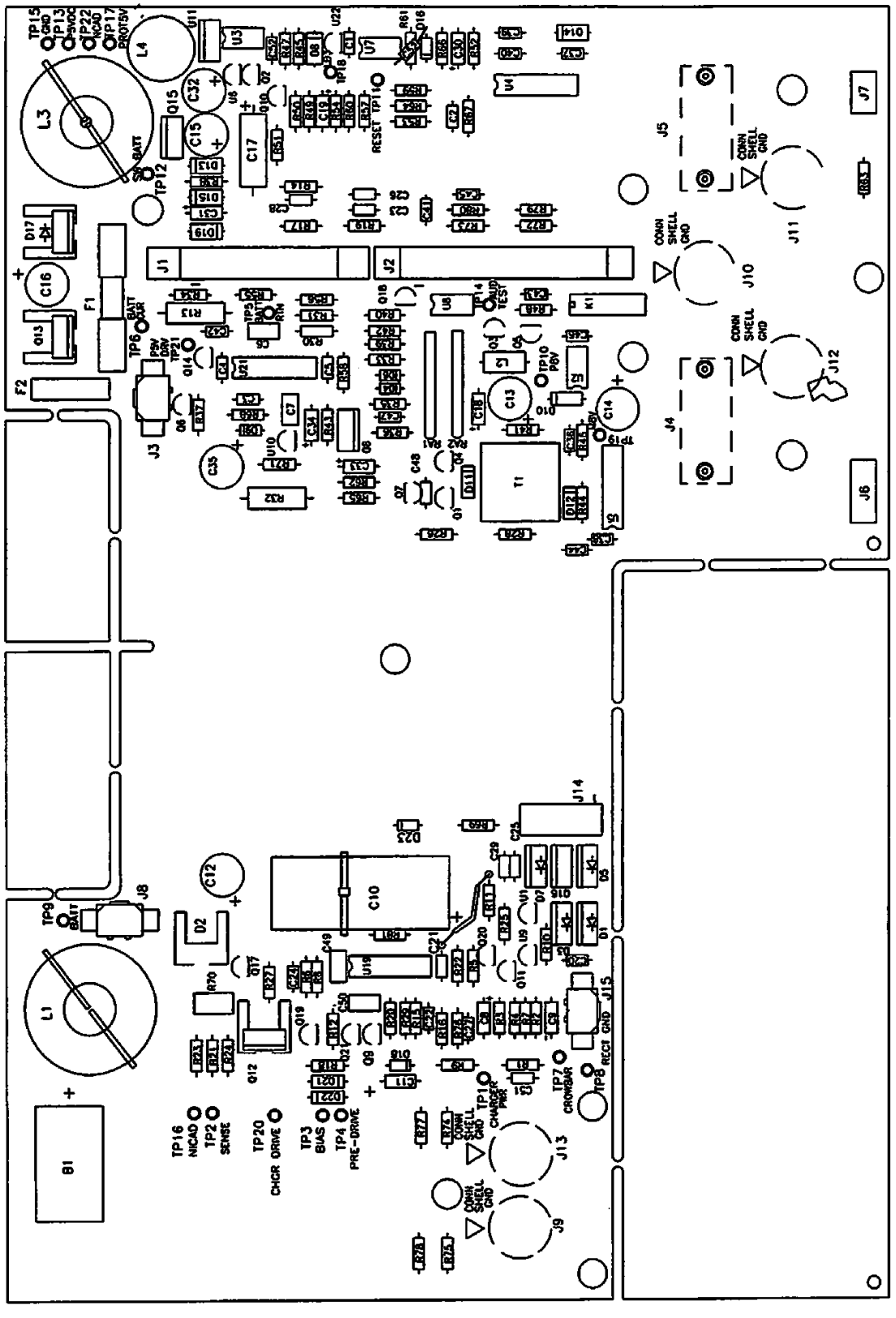


Figure 6-6. Parts Identification - Power Supply Board CCA

Table 6-7. Parts List - Display Board CCA Channels B & C

Fig No	Ref Desig.	Qty	Description	Part Number	Reference
6-7	10	1	CCA, DISPLAY FRONT, CH B & C	142335	Fig 6-2/S2
			Capacitors		
6-7	C1	1	CAP,TANT,20V,20%,3.9UF,AX	811137395A	
6-7	C2	1	CAP,CER,X7R,50V,10%,.01UF AX	811246103A	
6-7	C3	1	CAP,TANT,10V,10%,47UF,AX	811116476A	
6-7	C4	3	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-7	C5	3	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-7	C6	1	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-7	C7	3	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
			Integrated Circuits		
6-7	U1	1	IC,7218C/7228C 8DIGT LED CTRL	812197	
6-7	U2,U3	2	DSPLY,DOT MATRIX,HDSP-2531	815067	
6-7	U4	1	IC,HS CMOS/TTL LGC FAMILY	812057	
6-7	U5	1	IC,2951,5V REG W/SHUTDOWN	812261	
6-7	U6	1	IC,HS CMOS/TTL LGC FAMILY	812057	
			Displays		
6-7	DS1	1	DSPLY,7 SEG,GRN,7.6 MM HT	813319	
6-7	DS2-4	3	DSPLY,7 SEG,GRN,10 MM HT	813320	
6-7	DS5	1	LED,4 MM,FL TOP,YEL,HIGH BRT	813403	
6-7	DS6	1	DSPLY,7 SEG,GRN,7.6 MM HT	813319	
6-7	DS7-9	3	DSPLY,7 SEG,GRN,10 MM HT	813320	
6-7	DS10	1	LED,4 MM,FL TOP,YEL,HIGH BRT	813403	
6-7	DS11	1	LED,4MM FL TOP GRN HIGH BRT	813305	
6-7	DS12	1	LED,4 MM,FL TOP,YEL,HIGH BRT	813403	
6-7	DS13	1	LED,4MM,FL TOP,RED,HIGH BRT	813400	
6-7	DS14	1	LED,4 MM,FL TOP,YEL,HIGH BRT	813403	
6-7	DS15	1	LED,4MM,FL TOP,RED,HIGH BRT	813400	
6-7	DS16	1	LED,4MM FL TOP GRN HIGH BRT	813305	
			Resistors		
6-7	RA1	1	RES,SIP .2W,2%,100K,10 BUS -	810994104L	
6-7	RA2	1	RES,ARRAY DIP 39 2% 1/4W 8 SEP	812085	
6-7	R2-R4	3	CFR,1/4W,5%,220	810125-221	
6-7	R5	1	RES,MET FLM,1/4W,1%,9.31K	8102299311	
6-7	R6	1	RES,MET FLM,1/4W,1%,82.5K	8102298252	
6-7	R7-R9	3	CFR,1/4W,5%,10K	810125-103	
6-7	R10-R12	3	CFR,1/4W,5%,220	810125-221	
			Diodes		
6-7	D1	1	DIO,SILICONE SWITCHING 75V	813500	
6-7	D3	1	DIO,SILICONE SWITCHING 75V	813500	

Fig No	Ref Desig.	Qty	Description	Part Number	Reference
6-7	D7-D13	7	DIO,SILICONE SWITCHING 75V	813500	
			Transistor		
6-7	Q1	1	XSTR 2N4401 NPN SIL GENL PRP	814103	
			Connectors		
6-7	J1,J2	2	CONN,2 ROW RCPT,32 PIN,BD MT	851031	
6-7	J3	1	CONN,PLUG,60 PIN	855050	
6-7	J5	1	CONN,HDR 4-WALL .1" X .1" CTR	851004	
6-7	J6	2	CONN,HDR 4-WALL .1" X .1" CTR	851006	
	J7,J8	2	CONN,HDR,2X13 .980"LG	851081	-7037 ONLY
6-7	J9	2	CONN,HDR 4-WALL .1" X .1" CTR	851006	
			Miscellaneous		
		Ref	Schematic, Display Board Ch B & C	40-5037-1	

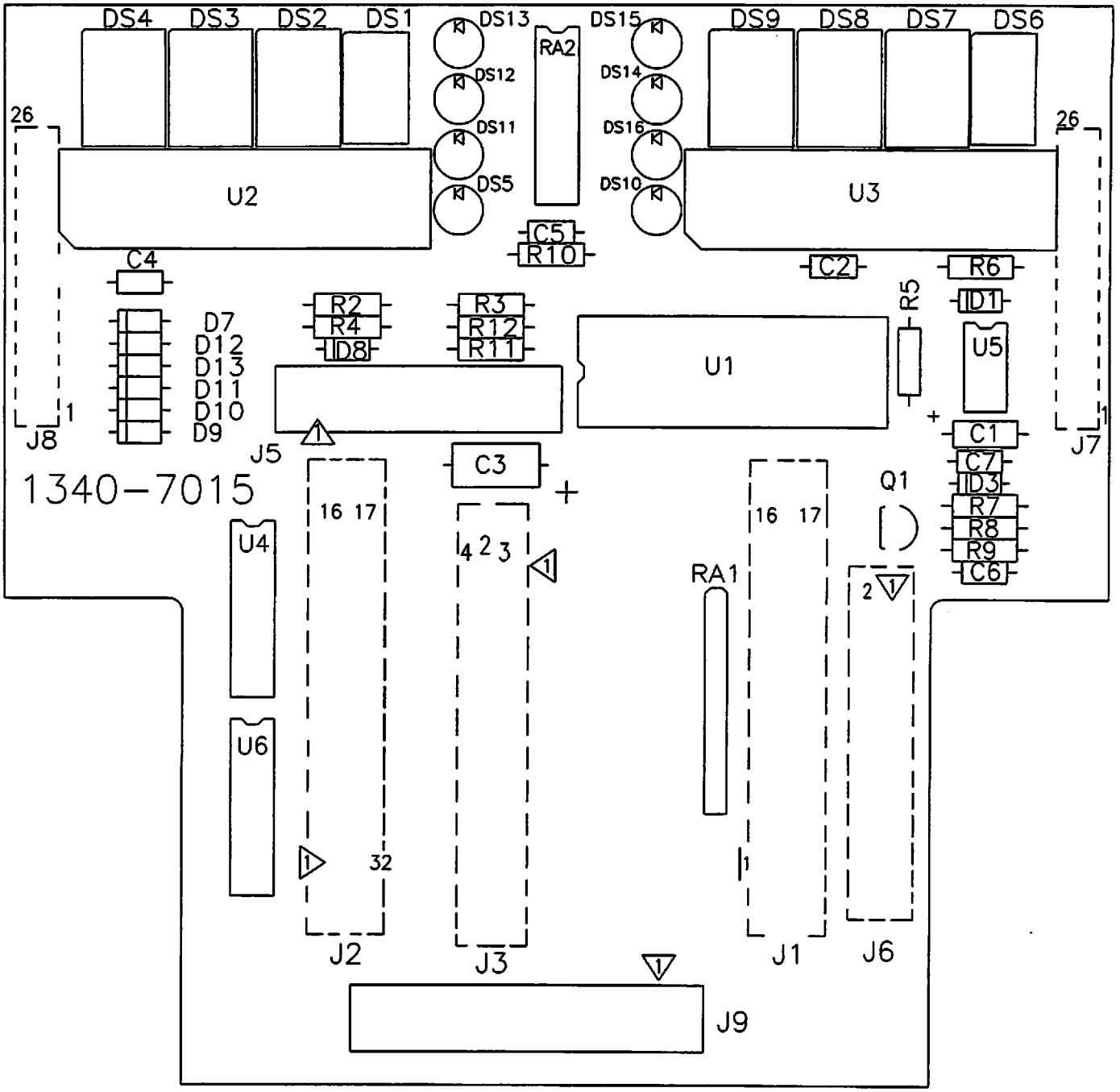


Figure 6-7. Parts Identification - Display Board CCA Channels B & C

Table 6-8. Parts List - Display Board CCA Channel A

Fig No	Ref Desig	Qty	Description	Part Number	Reference
6-8	11	0	CCA, DISPLAY CHANNEL A	142339	Fig 6-2/S2
			Capacitors		
6-8	C1,C2	2	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-8	C3	1	CAP,TANT,10V,10%,47UF,AX	811116476A	
			Displays		
6-8	DS1	1	LED,4MM FL TOP GRN HIGH BRT	813305	
6-8	DS2	1	LED,4 MM,FL TOP,YEL,HIGH BRT	813403	
6-8	DS3	1	LED,4MM,FL TOP,RED,HIGH BRT	813400	
6-8	DS4	1	DSPLY,7 SEG,GRN,7.6 MM HT	813319	
6-8	DS5-DS7	3	DSPLY,7 SEG,GRN,10 MM HT	813320	
6-8	DS8	1	LED,4 MM,FL TOP,YEL,HIGH BRT	813403	
			Integrated Circuit		
6-8	U1	1	IC 7218C/7228C 8DIGT LED CTRL	812197	
6-8	U2	1	DSPLY,DOT MATRIX,HDSP-2531	815067	
			Resistors		
6-8	R1-R3	3	CFR,1/4W,5%,220	810125-221	
6-8	RA1	1	RES ARRAY DIP 39 2% 1/4W 8 SEP	812085	
			Diodes		
6-8	D1-D8	8	DIO,SILICONE SWITCHING 75V	813500	
			Miscellaneous		
6-8	J1	1	CONN,SKT,2X13,PCB MT	856086	-7035 ONLY
		Ref	Schematic, PC-4 Display CCA Channel A	40-5000-1	
		Ref	Schematic, PC-4 Display CCA Channel A	40-5035-1	

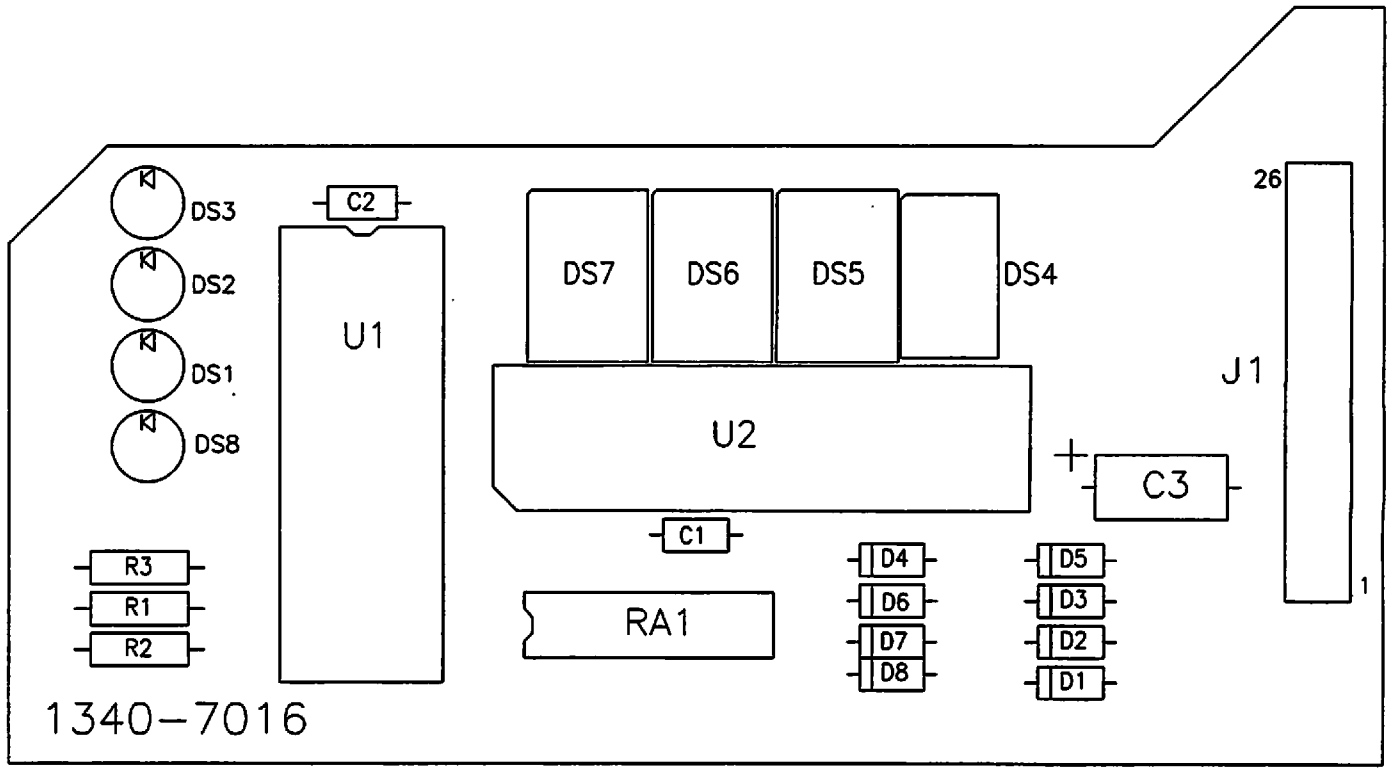


Figure 6-8. Parts Identification - Display Board CCA Channel A

Table 6-9. Parts List - Display Board CCA Channel D

Fig No	Ref Desig	Qty	Description	Part Number	Reference
6-9	10	1	CCA, DISPLAY CHANNEL D	142338	Fig 6-2/S2
			Capacitors		
6-9	C1	2	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-9	C2	1	CAP,TANT,10V,10%,47UF,AX	811116476A	
6-9	C3	2	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
			Displays		
6-9	DS1	1	DSPLY,7 SEG,GRN,7.6 MM HT	813319	
6-9	DS2-DS4	3	DSPLY,7 SEG,GRN,10 MM HT	813320	
6-9	DS5	1	LED,4MM FL TOP GRN HIGH BRT	813305	
6-9	DS6	1	LED,4 MM,FL TOP,YEL,HIGH BRT	813403	
6-9	DS7	1	LED,4MM,FL TOP,RED,HIGH BRT	813400	
6-9	DS8	1	LED,4 MM,FL TOP,YEL,HIGH BRT	813403	
			Integrated Circuits		
6-9	U1	1	IC 7218C/7228C 8DIGT LED CTRL	812197	
6-9	U2	1	DSPLY,DOT MATRIX,HDSP-2531	815067	
			Resistors		
6-9	R1-R3	3	CFR,1/4W,5%,220	810125-221	
6-9	RA1	1	RES ARRAY DIP 39 2% 1/4W 8 SEP	812085	
			Diodes		
6-9	D1-D8	8	DIO,SILICONE SWITCHING 75V	813500	
			Miscellaneous		
6-9	J1	1	CONN,SKT,2X13,PCB MT	856086	-7036 ONLY
		Ref	Schematic, PC-4 Display Channel D	40-5001-1	
		Ref	Schematic, PC-4 Display Channel D	40-5036-1	

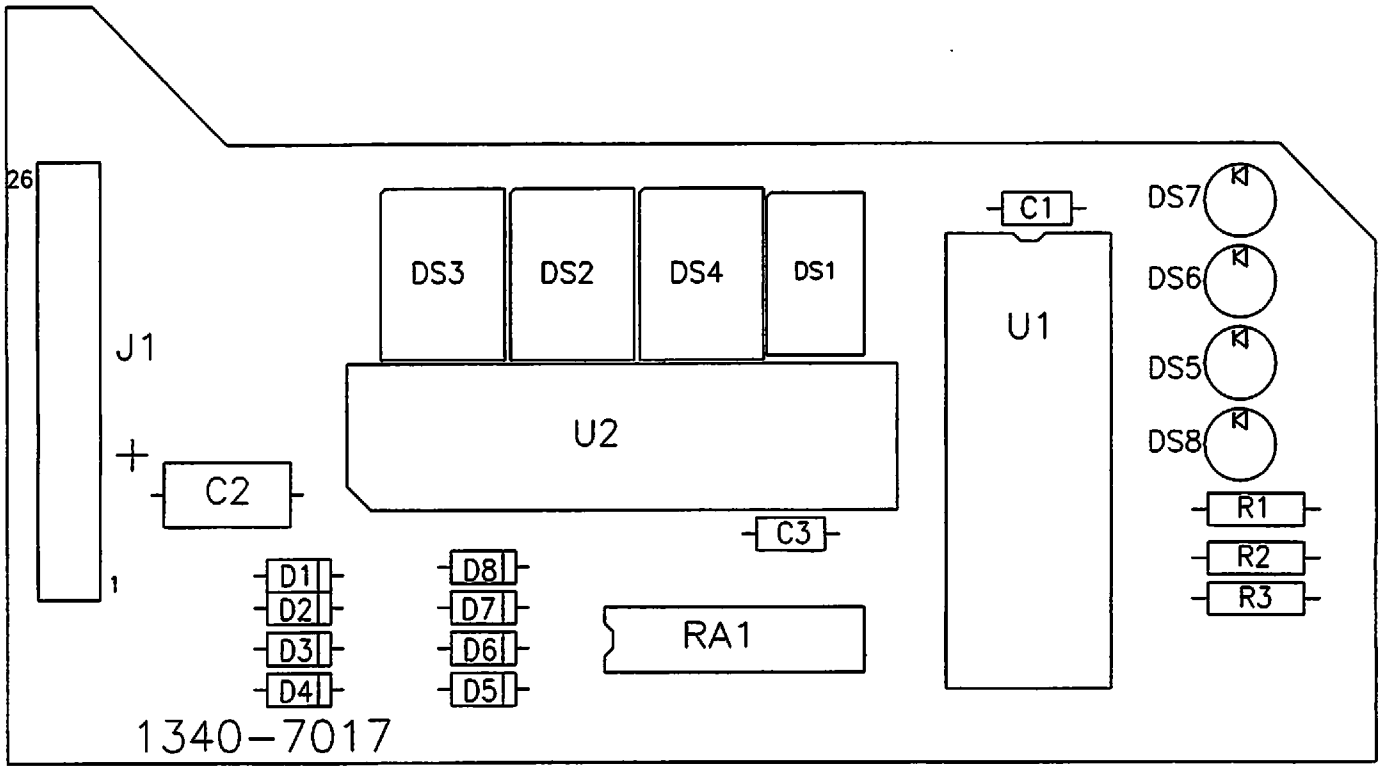


Figure 6-9. Parts Identification - Display Board CCA Channel D

Table 6-10. Parts List - Logic Board CCA

Fig No	Ref Desig	Qty	Description	Part Number	Reference
6-10	10	1	CCA, PC-4 LOGIC	40-7050-1	142337/143183 Fig 6-2/S2
			Capacitors		
6-10	C1,C2	2	CAP,CER,COG,50V,15%,30PF,AX	811245300A	
	C3	1	CAP,TANT,20V,20%,4.7UF,AX	811137475A	
6-10	C4	2	CAP,TANT,10V,10%,10UF,AX	811116106A	
6-10	C5	1	CAP,TANT,10V,10%,39UF,AX	811116396A	
6-10	C6	1	CAP,TANT,10V,10%,10UF,AX	811116106A	
6-10	C7	1	CAP,CER,X7R,100V,10%,820PF,AX	811256821A	
6-10	C8-C15	8	CAP,CER,X7R,50V,10%,.01UF AX	811246103A	
6-10	C16	1	CAP,TANT,10V,10%,10UF,AX	811116106A	
6-10	C17-C25	9	CAP,CER,X7R,50V,10%,.01UF AX	811246103A	
6-10	C26	1	CAP,CER,100V 2% 22PF COG AX	811257220A	
6-10	C27	1	CAP,CER,COG,100V,10%,10PF,AX	811256100A	
6-10	C28	1	CAP,CER,Z5U,50V,20%,.22UF,AX	811247224A	
6-10	C29-C31	3	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
550	C32	1	CAP,CER,Z5U,50V,20%,.47UF,AX	811247474A	
6-10	C33	1	CAP,CER,X7R,50V,10%,.01UF AX	811246103A	
6-10	C34	1	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-10	C35	1	CAP,CER,COG,50V,20%,15PF,AX	811247150A	
6-10	C36	1	CAP,CER,COG,50V,10%,100PF,AX	811246101A	
6-10	C37	1	CAP,TANT,20V,10%,1UF,AX	811136105A	
6-10	C38	1	CAP,CER,X7R,50V,10%,.01UF AX	811246103A	
6-10	C39	1	CAP,CER,COG,50V,5%,220PF,AX	811245221A	
6-10	C40-C47	8	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	-7018 ONLY
	C40-C43	4	CAP,CER,Z5U,50V,20%,0.1UF AX	811247104A	
	C44	1	CAP,CER,X7R,50V,10%,0.01UF AX	811246103A	
6-10	C45	1	CAP,CER,X7R,50V,10%,0.01UF AX	811246103A	7034/7044/7045 /7046/7047
6-10	C48	1	CAP,TANT,20V,10%,1UF,AX	811136105A	
6-10	C49	1	CAP,TANT,10V,10%,100UF,AX	811116107A	
6-10	C50	1	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-10	C51-C59	9	CAP,CER,X7R,50V,10%,0.01UF AX	811947-103	
6-10	C60	1	CAP,CER.X7R,100V,10%,820PF,AX	811256821A	
6-10	CA1	1	CAP,50V 20% 0.01UF SIP	811947-103	
			Diodes		
6-10	D1	1	DIO,SILICONE SWITCHING 75V	813500	
6-10	D2	1	DIO,1N5711 SCHOTTKY	813019	
6-10	D3	1	DIO,SILICONE SWITCHING 75V	813500	

Fig No	Ref Desig	Qty	Description	Part Number	Reference
6-10	D4	1	DIO,SILICONE SWITCHING 75V	813500	
6-10	D5	1	DIO,SILICONE SWITCHING 75V	813500	
6-10	D6	1	DIO,1N5711 SCHOTTKY	813019	
6-10	D8	1	DIO,SILICONE SWITCHING 75V	813500	
6-10	D9	1	DIO,1N5711 SCHOTTKY	813019	
6-10	D10	1	DIO,SILICONE SWITCHING 75V	813500	-7023 ONLY
			Transistors		
6-10	Q1	1	FET,N-CHNNL,3.0 AMP,VN0206	814005	
6-10	Q2	1	FET,N-CHNNL,3.0 AMP,VN0206	814005	
6-10	Q3	1	FET,N-CHNNL,3.0 AMP,VN0206	814005	-7023 ONLY
6-10	Q4	1	XSTR,FET,N-CHA,VN22	814006	-7023 ONLY
6-10	Q5	1	FET,N-CHNNL,3.0 AMP,VN0206	814005	
6-10	Q6	1	XSTR,FET,N-CHA,VN22	814006	-7023 ONLY
			Integrated Circuits		
6-10	U1	1	IC,80C188 EMBEDDED PROCESSOR	812260	
6-10	U2,U3	2	IC,27M7,500UV,OP-AMP	812265	
6-10	U4	1	IC,CMOS VOLTAGE CONVERTER	812061	
6-10	U5	1	IC,74HC4060 HS CMOS LGC FAMILY	812095	
6-10	U6	1	IC,74ACT573,OCTAL LATCH	812227	
6-10	U8	1	IC,STATIC RAM,128X8	812249	
6-10	U9	1	IC,74HC245 HS CMOS LGC FAMILY	812138	
6-10	U10	1	IC,74ACT573,OCTAL LATCH	812227	
6-10	U11	1	IC,74HC32 HS CMOS LGC FAMILY	812103	
6-10	U12	1	IC,74ACT04,HEX INVERTOR	812258	
6-10	U13	2	IC,74ACT574,OCTAL FLIP FLOP	812259	
6-10	U15	1	IC,74HC573 HS CMOS LGC FAMILY	812139	
6-10	U16	2	IC,74ACT574,OCTAL FLIP FLOP	812259	
6-10	U17	1	IC,74ACT08,QUAD 2 IN AND GATE	812255	
6-10	U19	1	IC,74ACT14,HEX INV,SCHMIDT	812262	
6-10	U20	1	IC,74ACT04,HEX INVERTOR	812258	
6-10	U21	1	IC,74HC132 HS CMOS LGC FAMILY	812205	
6-10	U22	1	IC,74ACT139,2 TO 4 LINE DECODR	812254	
6-10	U23	1	IC,74HCT367 HEX BUFFER 3 STATE	812252	
6-10	U24	1	IC,LM358 DUAL OP AMP	812042	
6-10	U25	1	EPLD, PROGRAMMED VER ELO4244	20-1037-1	
6-10	U26	1	IC,CMOS,8-BIT,BFR,MULT,DAC	812245	
6-10	U27	1	IC,PRGMMBL INTRPT CONTROLLER	812243	
6-10	U28	1	IC,2950,5V REGULATOR	812229	
6-10	U29	1	IC,CLOCK,REAL TIME,WITH RAM	812248	
6-10	U30	1	IC,PROGRAMMED VER 1.85	143383	
6-10	U31	1	IC,PROGRAMMED VER 1.85	143383	
6-10	U32	1	IC,ADC0808,8-BIT A/D CONVERTER	812251	

Fig No	Ref Desig	Qty	Description	Part Number	Reference
6-10	U34	1	IC,3503 2.5 VOLT REF	812022	
	U35	1	IC,74ACT32,QUAD2 INPUT OR GATE	812220	
6-10	U37	1	IC,74ACT32,QUAD2 INPUT OR GATE	812220	
			Resistors		
6-10	R1	1	CFR,1/4W,5%,10K	810125-103	
6-10	R2,R3	2	RES,MET FLM,1/4W,.1%,40.2K	8102214022	
6-10	R4,R5	2	RES,MET FLM,1/4W,.1%,2.15K	8102212151	
6-10	R6	1	RES,MET FLM,1/4W,.1%,100K	8102211003	
6-10	R7	1	RES,MET FLM,1/8W,.25%,182K	8102191823	
6-10	R8	1	CFR,1/4W,5%,100K	810125-104	
6-10	R9	1	CFR,1/4W,5%,10K	810125-103	
6-10	R10	1	CFR,1/4W,5%,3.3.M	810125-335	
6-10	R11	1	CFR,1/4W,5%,1K	810125-102	
6-10	R12,R13	2	RES,MET FLM,1/8W,.25%,24.9K	8102192492	
6-10	R14	1	RES,MET FLM,1/4W,.1%,100K	8102211003	
6-10	R15	1	RES,MET FLM,1/4W,1%,82.5K	8102298252	
6-10	R16	1	CFR,1/4W,5%,10K	810125-103	
6-10	R17	1	RES,MET FLM,1/8W,.25%,182K	8102191823	
6-10	R18,R19	2	RES,MET FLM,1/4W,.1%,100K	8102211003	
6-10	R20	1	RES,MET FLM,1/4W,1%,332K	8102233323	
6-10	R21	1	CFR,1/4W,5%,100K	810125-104	
6-10	R22	1	CFR,1/4W,5%,470K	810125-474	
6-10	R23	1	RES,MET FLM,1/8W,.25%,182K	8102191823	
6-10	R24	1	CFR,1/4W,5%,18M	810125-186	
6-10	R25	1	RES,MET FLM,1/4W,.1%,40.2K	8102214022	
6-10	R26	1	CFR,1/4W,5%,390K	810125-394	
6-10	R27	1	CFR,1/4W,5%,100K	810125-104	
6-10	R28	1	CFR,1/4W,5%,10K	810125-103	
6-10	R29	1	CFR,1/4W,5%,10K	810125-103	
6-10	R30	1	CFR,1/4W,5%,2.2M	810125-225	
6-10	R31	1	CFR,1/4W,5%,200K	810125-204	
6-10	R32	1	CFR,1/4W,5%,100K	810125-104	
6-10	R33	1	RES,MET FLM,1/4W,1%,100K	810229-104	
6-10	R34	1	RES,MET FLM,1/4W,1%,332K	8102233323	
6-10	R35	1	CFR,1/4W,5%,47K	810125-473	
6-10	R36	1	CFR,1/4W,5%,18M	810125-186	
6-10	R37	1	CFR,1/4W,5%,10K	810125-103	
6-10	R38	1	CFR,1/4W,5%,100K	810125-104	
6-10	R39	1	CFR,1/4W,5%,10K	810125-103	
6-10	R40	1	RES,MET FLM,1/4W,1%,15K	810229-153	
6-10	R41,R42	2	CFR,1/4W,5%,100K	810125-104	
6-10	R43	1	CFR,1/4W,5%,56	810125-560	

Fig No	Ref Desig	Qty	Description	Part Number	Reference
6-10	R44	1	CFR,1/4W,5%,200K	810125-204	
6-10	R45-R50	6	CFR,1/4W,5%,100K	810125-104	
6-10	R51,R52	2	CFR,1/4W,5%,10K	810125-103	
6-10	R53	1	CFR,1/4W,5%,0	810125-000	-7023/7029 ONLY
6-10	R54	1	CFR,1/4W,5%,0	810125-000	-7034/7044/7045 7046/7047-1
6-10	R56	1	CFR,1/4W,5%,0	810125-000	-7018 N/A
6-10	R57	1	CFR,1/4W,5%,0	810125-000	-7018 N/A
6-10	R59-62	4	CFR,1/4W,5%,100	810125-101	-7018 N/A
6-10	R63	1	CFR,1/4W,5%,1K	810125-102	7034/7044/7045 /7046/7047
6-10	RA1	1	RES,SIP,.2W,2%,47K,10 BUS	810900-473	
6-10	RA3 -RA6	4	RES,SIP,.2W,2%,47K,10 BUS	810900-473	
			Miscellaneous		
6-10	J1	1	CONN,RT ANGLE SKT RCPT,60PIN	856083	
6-10	J2	1	CONN,4WL HDR,PC MT,34CKT .1X.1	851079	
6-10	W1-5	6	JMPR,SHTG,2POS,.1"	847089	-7034/7044/7045 /7046/7047
6-10	W7	6	JMPR,SHTG,2POS,.1"	847089	S/A W1-5
6-10	W1-7	7	CONN, UNSHRD HDR,1X3	851083	SA W1-5
6-10	Y1	1	XTAL,32MHZ,3RD OVERTONE,.199H1	815072	-7034-2 N/A
6-10	Y1	1	XTAL,199 HI,32MHZ,3RD OVERTONE	815089	-7034-2/7044/7045 /7046/7047
6-10		0	XTAL,AT CUT 32 MHZ	815069	Alt item Y1
6-10	Y2	1	XTAL,TUN FK RESN,32.786 KHZ	815060	
6-10	Y3	1	RESONATOR,PIEZO ELECTRIC 480KHZ	815012	
6-10	XU1	1	CONN,SKT,84 PIN PLCC	856085	
6-10	XU7	4	SKT, IC, PLCC, 32PIN	856035	S/A W1-5
6-10	XU14	4	SKT, IC, PLCC, 32PIN	856035	S/A W1-5
6-10	XU25	1	SKT LOW PF DIP OPEN FR 24 PIN	815002-4	
6-10	XU30,XU31	2	SKT,IC,PLCC,32 PIN	856035	
6-10	TP2	1	TST PT,YEL,.063 DIA	815064	
6-10	L1	1	IDCTR,4.7UH 10% 1.2 OHM AXIAL	815070	
		Ref	Schematic, PC-4 Logic Board	40-5018	
		Ref	Schematic, PC-4 Logic Board	40-5023-2	
		Ref	Schematic, PC-4 Logic Board	40-5029-1	
		Ref	Schematic, PC-4 Logic Board	40-5034-1	

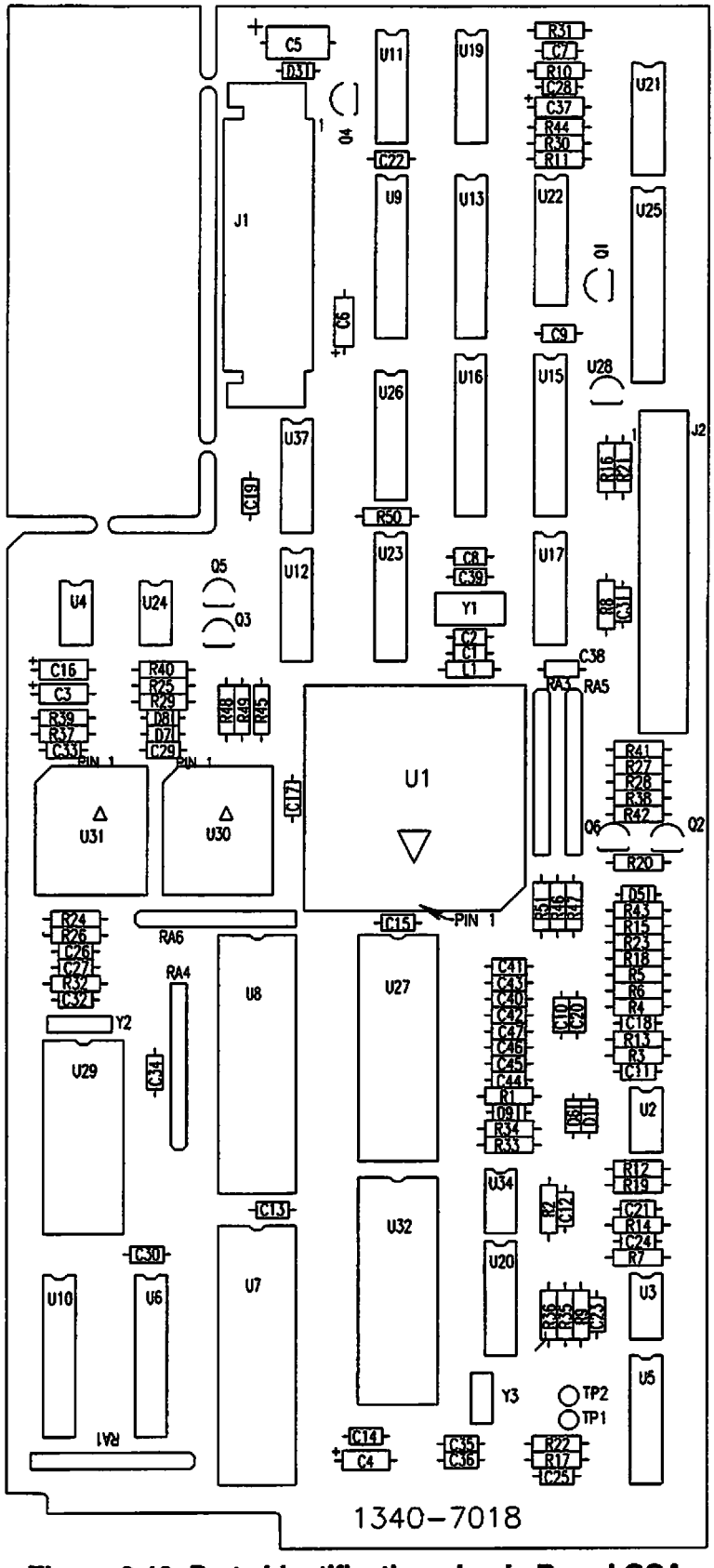


Figure 6-10. Parts Identification - Logic Board CCA

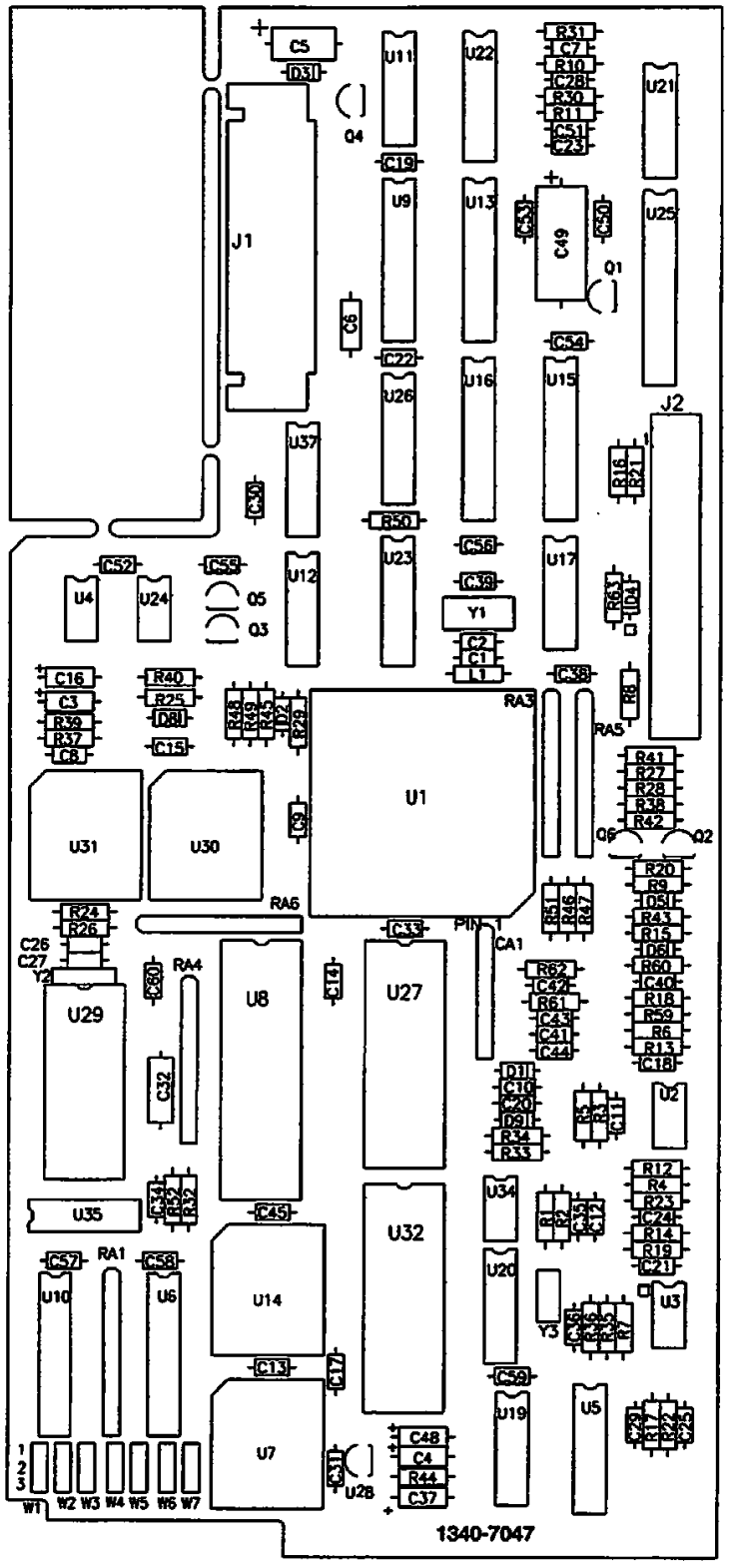


Figure 6-10. Parts Identification - Logic Board CCA (Cont'd)

Table 6-11. Parts List - Motor Controller Board CCA

Fig No	Ref Desig	Qty	Description	Part Number	Reference
6-11	10	1	CCA, PC-4 Motor Controller Board	142327	
			Capacitors		
6-11	C1-C4	4	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-11	C5,C6	2	CAP,CER,50V,20%,0.1 UF,RAD	811247-104	
6-11	C7	1	CAP,CER,X7R,50V,10%,1000PF RAD	811246-102	
	C8	1	CAP,TANT,20V,20%,4.7UF,AX	811137475A	
6-11	C9	3	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-11	C10	1	CAP,CER,50V,20%,0.1 UF,RAD	811247-104	
6-11	C11	1	CAP,50V,10%,.047UF,RAD	811246-473	
6-11	C12	1	CAP,CER,X7R,50V,10%,1000PF RAD	811246-102	
6-11	C13	1	CAP,CER,100V,2%,100PF,.1LS	811254-101	
6-11	C14	1	CAP,50V,10%,.047UF,RAD	811246-473	
6-11	C15-C19	5	CAP,CER,100V,2%,100PF,.1LS	811254-101	
6-11	C20,C21	2	CAP,CER,X7R,50V,10%,1000PF RAD	811246-102	
6-11	C22	1	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-11	C23,C24	2	CAP,CER,X7R,50V,10%,1000PF RAD	811246-102	
6-11	C25	1	CAP,TANT,20V,10%,1UF,AX	811136105A	
6-11	C26	1	CAP,TANT,10V,10%,10UF,AX	811116106A	
6-11	C27	1	CAP,TANT,20V,20%,AXIAL,39UF	811137396A	
6-11	C28	1	CAP,TANT,20V,10%,1UF,AX	811136105A	
6-11	C29	1	CAP,TANT,20V,20%,AXIAL,39UF	811137396A	
6-11	C30	1	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-11	C31,C32	2	CAP,TANT,20V,10%,1UF,AX	811136105A	
6-11	C33,C34	2	CAP,CER,COG,50V,15%,30PF,AX	811245300A	
6-11	C35,C36	2	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-11	C37,C38	2	CAP,CER,X7R,50V,20%,.047UF,AX	811247473A	
6-11	C39	1	CAP,CER,COG,50V,15%,30PF,AX	811245300A	
6-11	C41	1	CAP,CER,COG,50V,15%,30PF,AX	811245300A	
6-11	C43,C44	2	CAP,CER,X7R,50V,10%,1000PF RAD	811246-102	
6-11	C45	1	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-11	C46-C48	3	CAP,CER,X7R,50V,10%,1000PF RAD	811246-102	
6-11	C49	1	CAP,CER,Z5U,50V,20%,.1UF AX	811247104A	
6-11	C50	1	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-11	C51,C52	2	CAP,CER,X7R,50V,10%,1000PF RAD	811246-102	
6-11	C53,C54	2	CAP,TANT,20V,20%,AXIAL,39UF	811137396A	
6-11	C55,C56	2	CAP,CER,X7R,50V,10%,1000PF RAD	811246-102	
6-11	C57,C58	2	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	
6-11	C59,C60	2	CAP,CER,X7R,50V,10%,1000PF RAD	811246-10	
6-11	C61	1	CAP,CER,X7R,50V,20%,.001UF,AX	811247102A	

Fig No	Ref Desig	Qty	Description	Part Number	Reference
6-11	C62	1	CAP,CER,X7R,50V,10%,1000PF RAD	811246-102	
6-11	C63	1	CAP,TANT,20V,20%,4.7UF,AX	811137475A	
6-11	C64,C65	2	CAP,CER,50V,20%,0.1 UF,RAD	811247-104	
6-11	C66	1	CAP,CER,Z5U,50V,20%,0.1UP,AX	811247104A	
6-11	C67	1	CAP,TANT,10V,10%,10UF,AX	811116106A	
			Integrated Circuits		
6-11	U4	2	IC,74ACT32,QUAD2 INPUT OR GATE	812220	
6-11	U5	2	IC,TLC27M2A,VIO,5MV,OP-AMP	812219	
6-11	U6,U7	2	FET,P-CHNNL,1.6AMP	814004	
6-11	U8	1	IC,80C198 MICROPROCESSOR	812250	
6-11	U9	2	IC,74ACT32,QUAD2 INPUT OR GATE	812220	
6-11	U10	1	IC,74ACT20,DUAL 4-INPUT NAND	812263	
6-11	U11	1	IC,74ACT08,QUAD 2 IN AND GATE	812255	
6-11	U12	1	IC,74ACT138 3 TO 8 LINE DECODR	812256	
6-11	U1,U2	2	IC,LT1079,QUAD OP AMP	812062	
6-11	U13	1	IC,74HCOO QUAD 2 INP CMOS NAND	812171	
6-11	U14	1	IC,HS CMOS/TTL LGC FAMILY	812057	
6-11	U15	2	IC,HS CMOS/TTL LGC FAMILY	812122	
6-11	U16	2	IC,74ACT573,OCTAL LATCH	812227	
6-11	U17, U18	2	IC,4190,SWITCHING REGULATOR	812238	
6-11	U19	1	IC,PROGRAMMED, V1.31	40-1072-1	-7042 ONLY
6-11	U20	2	IC,74ACT573,OCTAL LATCH	812227	
6-11	U21, U22	2	IC,74HC02 HS CMOS LGC FAMILY	812203	
6-11	U23	1	IC,2950,5V REGULATOR	812229	
6-11	U24	2	IC,HS CMOS/TTL LGC FAMILY	812122	
6-11	U25, U26	2	IC,40109 V LVL SHF	812209	
6-11	U27	1	IC,74ACT574,OCTAL FLIP FLOP	812259	
6-11	U28	1	IC,8K X 8,SRAM,.3 PKG	812231	
6-11	U29	2	IC,TLC27M2A,VIO,5MV,OP-AMP	812219	
			Resistors		
6-11	R1	1	CFR,1/4W,5%,240K	810125-244	
6-11	R2	1	CFR,1/4W,5%,4.7K	810125-472	
6-11	R3	1	CFR,1/4W,5%,240K	810125-244	
6-11	R4	1	CFR,1/4W,5%,4.7K	810125-472	
6-11	R5	1	RES,MET FLM,1/4W,1%,1K	810229-102	
6-11	R6	1	CFR,1/4W,5%,0	810125-000	
6-11	R7-R9	3	RES,MET FLM,1/4W,1%,511K	8102295113	
6-11	R10	1	RES,MET FLM,1/4W,1%,1K	810229-102	
6-11	R11	1	RES,MET FLM,1/4W,1%,511K	8102295113	
6-11	R12-R14	3	RES,MET FLM,1/4W,1%,1K	810229-102	
6-11	R15	1	RES,MET FLM,1/4W,1%,30.1K	8102233012	
6-11	R16,R17	2	RES,MET FLM,1/4W,1%,1K	810229-102	

Fig No	Ref Desig	Qty	Description	Part Number	Reference
6-11	R18	1	RES,MET FLM,1/4W,1%,2K	810229-202	
6-11	R19	1	CFR,1/4W,5%,10	810125-100	
6-11	R20	1	RES,MET FLM,1/4W,1%,1K	810229-102	
6-11	R21	1	RES,MET FLM,1/4W,1%,30.1K	8102233012	
6-11	R22	1	CFR,1/4W,5%,3.9K	810125-392	
6-11	R23	1	RES,MET FLM,1/8W,.25%,1.47K	8102191471	
6-11	R24	1	RES,MET FLM,1/4W,1%,1K	810229-102	
6-11	R25	1	RES,MET FLM,1/4W,1%,2K	810229-202	
6-11	R26	1	CFR,1/4W,5%,10	810125-100	
6-11	R28	1	CFR,1/4W,5%,300K	810125-304	
6-11	R29	1	RES,MET FLM,1/8W,.25%,182K	8102191433	
6-11	R30	1	CFR,1/4W,5%,3.9K	810125-392	
6-11	R31	1	RES,MET FLM,1/8W,.25%,1.47K	8102191471	
6-11	R32	1	RES,MET FLM,1/4W,1%,10K	810229-103	
6-11	R33	1	RES,MET FLM 1/4 W 1% 200K	8102191623	
6-11	R34	1	CFR,1/4W,5%,300K	810125-304	
6-11	R35	1	RES,MET FLM,1/8W,.25%,182K	8102191433	
6-11	R36	1	RES,WW,.4W,1%,.25	810591-R25	
6-11	R37	1	RES,MET FLM 1/4 W 1% 200K	8102191623	
6-11	R38	1	RES,WW,.4W,1%,.25	810591-R25	
6-11	R39,R40	2	CFR,1/4W,5%,4.7K	810125-472	
6-11	R41	1	RES,MET FLM,1/4W,1%,10K	810229-103	
6-11	R42	1	RES,MET FLM,1/4W,1%,100K	810229-104	
6-11	R43	1	CFR,1/4W,5%,4.7K	810125-472	
6-11	R44,R45	2	RES,MET FLM,1/4W,1%,10K	810229-103	
6-11	R46	1	CFR,1/4W,5%,4.7K	810125-472	
6-11	R47	1	RES,MET FLM,1/4W,1%,100K	810229-104	
6-11	R48-R50	3	RES,MET FLM,1/4W,1%,10K	810229-103	
6-11	R51-R54	4	RES,POT,10K,20-TURN,SIDE ADJ,	810336-103	
6-11	R55	1	RES,MET FLM,1/4W,1%,1K	810229-102	
6-11	R56-R59	4	RES,MET FLM,1/4W,1%,100K	810229-104	
6-11	R60	1	CFR,1/4W,5%,0	810125-000	
6-11	R62,R63	2	RES,MET FLM,1/4W,1%,100K	810229-104	
6-11	R64,R65	2	RES,MET FLM,1/4W,1%,10K	810229-103	
6-11	R68-R71	3	RES,MET FLM,1/4W,1%,100K	810229-104	
6-11	R72,R73	2	CFR,1/4W,5%,220	810125-221	
6-11	RA1,RA2	2	RES,SIP,.2W,2%,20K,10 PIN,ISOL	810994203M	
6-11	RA3	1	RES,SIP .2W,2%,100K,10 BUS -	810994104L	
6-11	RA4,RA5	2	RES,SIP,.2W,2%,47K,10 BUS	810900-473	
			Transistors		
6-11	Q1	1	XSTR,FET,N-CHA,VN22	814006	
6-11	Q4,Q5	2	XSTR,FET,N-CHA,VN22	814006	

Fig No	Ref Desig	Qty	Description	Part Number	Reference
6-11	Q7	1	XSTR,FET,N-CHA,VN22	814006	
6-11	Q9	1	XSTR,FET,N-CHA,VN22	814006	
6-11	Q11	1	FET,N-CHNNL,3.0 AMP,VN0206	814005	
6-11	Q13	1	XSTR,VP0206N3,P-CHA,FET	814001	
6-11	Q15-Q21	7	XSTR,VP0206N3,P-CHA,FET	814001	
6-11	Q24,Q25	2	XSTR,2N4401 NPN SIL GENL PRP	814103	
6-11	Q27,Q28	2	XSTR,FET,N-CHA,VN22	814006	
6-11	Q30,Q31	2	XSTR,FET,N-CHA,VN22	814006	
6-11	Q32	1	FET,N-CHNNL,3.0 AMP,VN0206	814005	
6-11	Q33	1	XSTR,FET,N-CHA,VN22	814006	
6-11	Q35	1	XSTR,FET,N-CHA,VN22	814006	
6-11	Q36	1	FET,N-CHNNL,3.0 AMP,VN0206	814005	
6-11	Q37	1	XSTR,FET,N-CHA,VN22	814006	
6-11	Q39	1	XSTR,FET,N-CHA,VN22	814006	
6-11	Q41	1	XSTR,FET,N-CHA,VN22	814006	
6-11	Q43	1	FET,N-CHNNL,3.0 AMP,VN0206	814005	
6-11	Q44	1	XSTR,FET,N-CHA,VN22	814006	
6-11	Q46	1	XSTR,FET,N-CHA,VN22	814006	
			Diodes		
6-11	D1, D2	2	DIO,SILICONE SWITCHING 75V	813500	
6-11	D3, D4	2	DIO,1N5711 SCHOTTKY	813019	
6-11	D5 -D8	4	DIO,MBR120P SCHOTTKY BARR RECT	813503	
6-11	D9, D10	2	DIO,1N5711 SCHOTTKY	813019	
6-11	D11-D15	5	DIO,SILICONE SWITCHING 75V	813500	
			Connectors		
6-11	J1, J2	2	CONN,0.1" SPACED CRP-TO-W	851045	
6-11	J3, J4	2	CONN,RT ANGLE HDR, 6CKT, GOLD	851007	
6-11	J5	2	CONN,RT ANGLE HDR, 6CKT, TIN	851016	
6-11	J7	2	CONN,RT ANGLE HDR, 6CKT, TIN	851016	
6-11	J6	1	CONN,HDR 4-WALL .1" X .1" CTR	851006	
6-11	J8, J9	2	CONN,0.1" SPACED CRP-TO-W	851044	
6-11	JX	1	CONN,RT ANGLE HDR, 32 PIN	851029	
			Miscellaneous		
6-11	XU8	1	CONN,SKT,52 PIN PLCC	856084	
6-11	TP1-7	7	TST PT,YEL,.063 DIA	815064	
6-11	Y1	1	XTAL MIPRCS AT CUT 10 MHZ	815043	
6-11	L1,2	2	INDUCTOR,1 MH TOROID	40-3006-7	
6-11	XU19	1	SKT LOW PF DIP OPEN FR 28 PIN	815002-3	
		Ref	Schematic, PC-4 Motor Controller	40-5019	
		Ref	Schematic, PC-4 Motor Controller	40-5027-1	

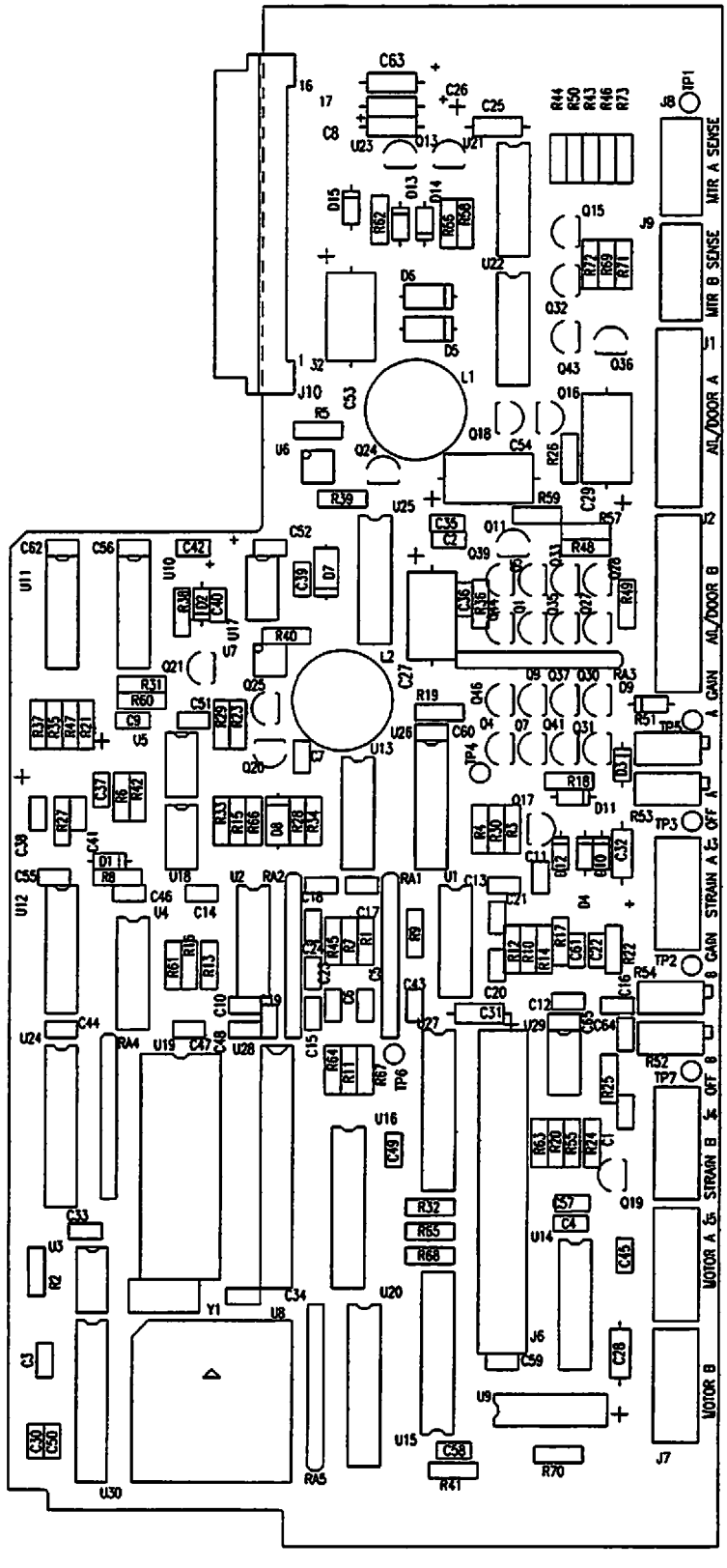


Figure 6-11. Parts Identification - Motor Controller CCA

SECTION 7 - CALIBRATION AND PREVENTATIVE MAINTENANCE

7.1 INTRODUCTION

This section contains calibration and preventive maintenance instructions and a comprehensive operational performance test for the IMED® GEMINI PC-4® Volumetric Pump/Controller ("PC-4").

WARNING

Potentially lethal voltages are present within the PC-4 case when the instrument is operated using external AC power. When the case is opened for maintenance action, it is recommended the instrument be operated using the internal battery.

CAUTION

Printed circuit boards (PCBs) are easily damaged when integrated circuits are removed and replaced. Excessive heat applied to the circuit board traces and pads can cause de-lamination of the metal foil and base material. Damage of that type is essentially irreparable; therefore, only low-temperature soldering irons and vacuum solder removal tools should be used when removing and replacing components on PCBs. Leads on integrated circuit components should be cut before attempting un-soldering and removal.

NOTE

CMOS devices are sensitive to static electrical charges and may be damaged during repair if the repair activity is not performed in an ESD protected environment using approved ESD protective procedures including personnel grounding.

7.2 PREVENTIVE MAINTENANCE

The PC-4 is designed and assembled with the goal of minimizing maintenance requirements. The integral microprocessor incorporates a diagnostic routine that monitors the instrument's subsystems and operating parameters. Detection of operating system irregularities or failures that affect the instrument's functional operation activates audio and visual Alarms or Malfunction alerts for operator notification. Problems of this nature are recorded in the non-volatile RAM error log for subsequent use by biotechnical personnel in performing troubleshooting and repair actions.

Maintenance-free operation between regularly scheduled preventive maintenance inspections can be enhanced by performing routine cleaning on an 'as required' basis per Section 5.2.1. The recommended interval for preventive maintenance inspections is once a year based on normal use and operation. Verification of proper operation is the responsibility of the user. At the user's option, such tests and verification may be performed at the factory at nominal cost. The following paragraphs describe in detail the procedures for performing general maintenance on the PC-4.

7.3 CALIBRATION PROCEDURES

7.3.1 Strain Beam Calibration

Any time a Strain Beam (pressure transducer) assembly has been removed from the front case assembly or replaced, the appropriate Motor Controller PC Board is changed or a component in the strain beam circuitry (see figure 4-13) is replaced; the following calibration/adjustment procedure **MUST** be performed prior to returning the instrument to patient care service.

7.3.1.1 Calibration Equipment Requirements

NOTE

Calibrated tubing must be obtained from the ALARIS Medical Systems San Diego Corporate Office.
(ALARIS Medical P/N 3299-100)

1. Calibrated tubing with specified LOW and HIGH Reference Voltage constants between 1.0 and

2. Digital Voltmeter with 1 millivolt resolution.

3. Digital Pressure Gauge, 0-30 psi range and 0.1 psi resolution or a Mercury (Hg) manometer.

4. Stopwatch.

5. Regulated, stable air source adjustable to 10 ±0.1 psi.

WARNING

The following calibration procedure is performed with the instrument case open. The preferred procedure is to perform the calibration using a fully charged battery. If AC power is used, potentially lethal voltages are present in the rear case assembly. Use caution when connecting meter leads to the Motor Controller PC Board.

7.3.1.2 Calibration Procedures

1. Separate the case (see Section 5.5.1).

2. If the batteries are not fully charged, connect the AC power cord.

3. Initialize the instrument in the Maintenance Mode (see Section 5.3.1 for procedure).

4. Press 2 to select "MC board tests and displays".

5. Press 2 to select "strain beam voltages".

6. Attach the DVM black lead (-) to TP1 and the red lead (+) to TP3 on the appropriate Motor Controller board.

7. Press A to select channel A.

8. Open the channel A door.

9. Verify the #4 pumping finger is fully extended.

10. Install the calibrated disposable into the channel A pump chamber and close the door. Write down tubing constant # from CAL SET.

CAUTION

The front case must be in the upright position when this calibration procedure is performed. DO NOT put any pressure on the pumping chamber door during the calibration process.

11. Wait 20 seconds, then adjust the channel A offset potentiometer R53 on the Motor Controller board to obtain a reading of 0 ±0.01 volts on the DVM.

12. Apply and maintain 10.0 ±0.1 psi (69 ±0.7 kPa) to the distal end of the calibrated disposable (allow 15 seconds for the system to stabilize).

13. Move DVM red lead to TP5, read the channel A voltage on the DVM and PC-4s Central Display, adjust the channel A gain potentiometer R51 to obtain a reading of 2.50 ±0.01 volts.

14. Readjust the channel A offset potentiometer R53 until the Central Display reads [2.50 + (tubing constant ±0.05)] volts.

15. Shut off and remove the pressure source from the distal end of the calibrated disposable.

16. Wait 25 seconds, then read the voltage on the Central Display. The reading should equal the tubing constant voltage ±0.3 volts. **If the displayed voltage value is not within the stated tolerance, repeat steps 10 through 15 above.**

17. Open and close the door leaving the disposable in place, wait 20 seconds then read the Central Information Display voltage again. The reading should be the disposable constant ±0.2 volts.

18. Open the door and remove the disposable.

NOTE

Do not use a sharp object or fingernail to push on the bezel seal.

19. With the channel A door open, use a knuckle or pencil eraser to gently press on the stain beam finger. Check the DVM reading is 5.05 ±0.1 volts.

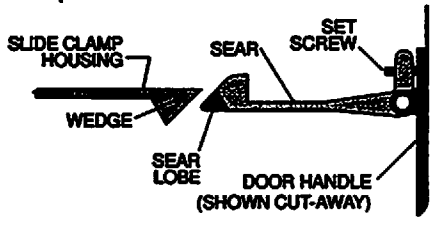
20. With the door still open, record the voltage on the DVM; if > -0.075 volts, recalibrate the channel with a new calibrated disposable. If second calibration produces an out of specification reading, replace the strain beam.

NOTE

To calibrate channel B, connect the DVM red (+) lead to TP7, use R52 for OFFSET adjustments and TP2 use R54 for GAIN adjustments.

7.3.2 Door Sear Adjustment

Anytime a pumping chamber access door, any of the door components or the air-in-line assembly are replaced, the slide clamp sear must be re-rigged. Refer to the following figure: use the set screw on the sear to raise or lower the sear lobe as necessary to align the top of the sear lobe with the top of the slide clamp wedge (as shown). After adjusting the sear, install a Gemini set, close and open the door to verify the slide clamp closes.



7.4 COMPREHENSIVE OPERATIONAL PERFORMANCE TEST

The comprehensive operational performance test should be performed on any PC-4 that has been removed from service for repair or has been subjected to servicing that required the case to be opened. In the event an instrument should fail to meet specified test performance criteria, it will be necessary to troubleshoot specific areas of deficiency and perform the repairs needed to restore full operational capability prior to returning the instrument to service.

7.4.1 Electrical Inspection

CAUTION

Some of these tests are inherently hazardous. Safeguards for personnel and property should be employed when conducting such tests. Tests should only be performed by qualified personnel.

7.4.1.1 Electrical Leakage Test

Perform an electrical leakage current measurement in compliance with Underwriters Laboratories (UL) 544 for *Patient Care Equipment* or Canadian Standards Association (CSA) Standard C22.2 No. 125 for *Risk Class 2G Equipment* or IEC 601-1. Leakage currents are to be less than 100 microamperes.

7.4.1.2 Electrical Ground Test

Perform an electrical ground impedance measurement in compliance with UL 544 for *Patient Care Equipment* or CSA Standard C22.2 No. 125 for *Risk Class 2G Equipment* or IEC 601-1. The impedance between the grounding pin on the power cord plug and the grounding point on the rear case should not exceed 100 milliohms.

7.4.1.3 Dielectric Test (Optional)

Perform a dielectric withstand test in compliance with UL 544 for *Patient Care Equipment* and/or CSA Standard C22.2 No. 125 for *Risk Class 2G Equipment*. Leakage current to be <1mA at 1500 volts.

7.4.1.4 Battery Runtime Test

Sealed lead-acid batteries lose capacity over time, dependent on usage patterns such as frequency and depth of discharge. Since rate of loss increases as capacity diminishes, ALARIS Medical recommends replacement of batteries if the run-time for one channel operation at 125 mL/hr is <3.5 hours. To check run-time: Ensure that instrument is fully charged by connecting to AC power for a minimum of 16 hours. Disconnect pump from AC. Power pump on and verify that battery icon flashes on the front panel. Set up a primary infusion, set the rate to 125 mL/hr and VTBI to 9999 mL and start the instrument. When the instrument system voltage falls below 11.9 VDC, a "Low Battery" message will flash in the Central Information Display (CID) accompanied by a short beep every 2 seconds. At 11.5 VDC the pump will pause all channels, display a "Battery Discharged" screen in the CID, and emit a constant alarm audio. This indicates a Low Battery-2 condition and constitutes completion of the run-time test.

Charge battery at least 16 hours before returning to service.

7.4.2 Qualitative Operational Performance Test

The qualitative operational performance test is performed via the Maintenance Mode (see Section 5.3.1). The S/C board test and displays feature includes sub-routines for keypad and audio tests, A/D voltage displays, NiCad battery voltages, battery statistics and battery discharge history.

7.4.3 Quantitative Operational Performance Test

The following operational performance tests are designed to ensure the PC-4 is functioning in accordance with design specifications. Test procedures are provided to evaluate specific areas of instrument performance.

7.4.3.1 Equipment Requirements

1. Universal test station: (see Figure 7-1).
   - Selector valve manifold
   - 10 mL Volumetric burette
   - Pressure gauge with at least 0-20 psig capability
   - 36" (1 m) view tube (macrobore tubing on yard/meter stick).
2. Air in line simulator (see Figure 7-2)
3. Stopwatch with minimum resolution of 1 second.
4. Vented bottle or bag of Normal Saline.
5. GEMINI Non-vented administration set(s) with 2 injection sites (Reorder No. 2212).
6. Waste fluid catch basin.
7. Test Data Sheet (see Figure 7-3).

7.4.3.2 Test Procedures

The following test procedures are presented in a sequence that will allow the required test protocols to be accomplished accurately and in an expeditious and efficient manner. Tests are identical for all channels; upon completion of channel A testing, repeat for channels B, C and D.

TEST SETUP

1. Spike a vented bottle or bag of Normal Saline or tap water with a GEMINI administration set and hang on the IV solution test stand. Check to ensure the roller clamp is closed.
2. Connect the distal end of the tubing set to the input side of the stopcock manifold.
3. Set the stopcocks to allow fluid to pass through the manifold to the fluid catch basin.
4. Flood the drip chamber, open the roller clamp, prime the set then close the second stopcock.
5. Adjust the height of the solution container to provide a measured head height of 24" (61 cm) i.e., 24" of vertical displacement between the strain beam and the fluid level in the container.
6. Install the tubing set in channel A of the PC-4; close and latch the access door.
7. Ensure the tubing segment between the stopcock manifold and the pressure gauge is primed.
8. Press POWER ON, then press A to select channel A.
9. Select CONTROLLER mode, set RATE to 125 mL/hr and set VTBI to 100 mL.

LOW-FLOW HEIGHT TEST

1. Turn stopcock #3 to direct the pump output to the 36" view tube only. Ensure the 18" mark on the view tube is level with the fluid in the solution container.
2. Press START and observe:
   - Fluid column rises in the view tube
   - Pumping mechanism stops
   - Audio Advisory sounds
   - "LOW FLOW" advisory scrolls for 1 minute
   - After 1 minute audio alert changes to Alarm and "OCCLUDED" scrolls continuously.
3. Record the height of the fluid column in the view tube on the data sheet (reading must be between 6 and 30 inches).
4. Press SILENCE to silence the audio, then press A followed by PAUSE.
5. Turn stopcock #3 to drain the fluid column to waste; drain to the 0 graduation, then turn the stopcock to the bypass position.

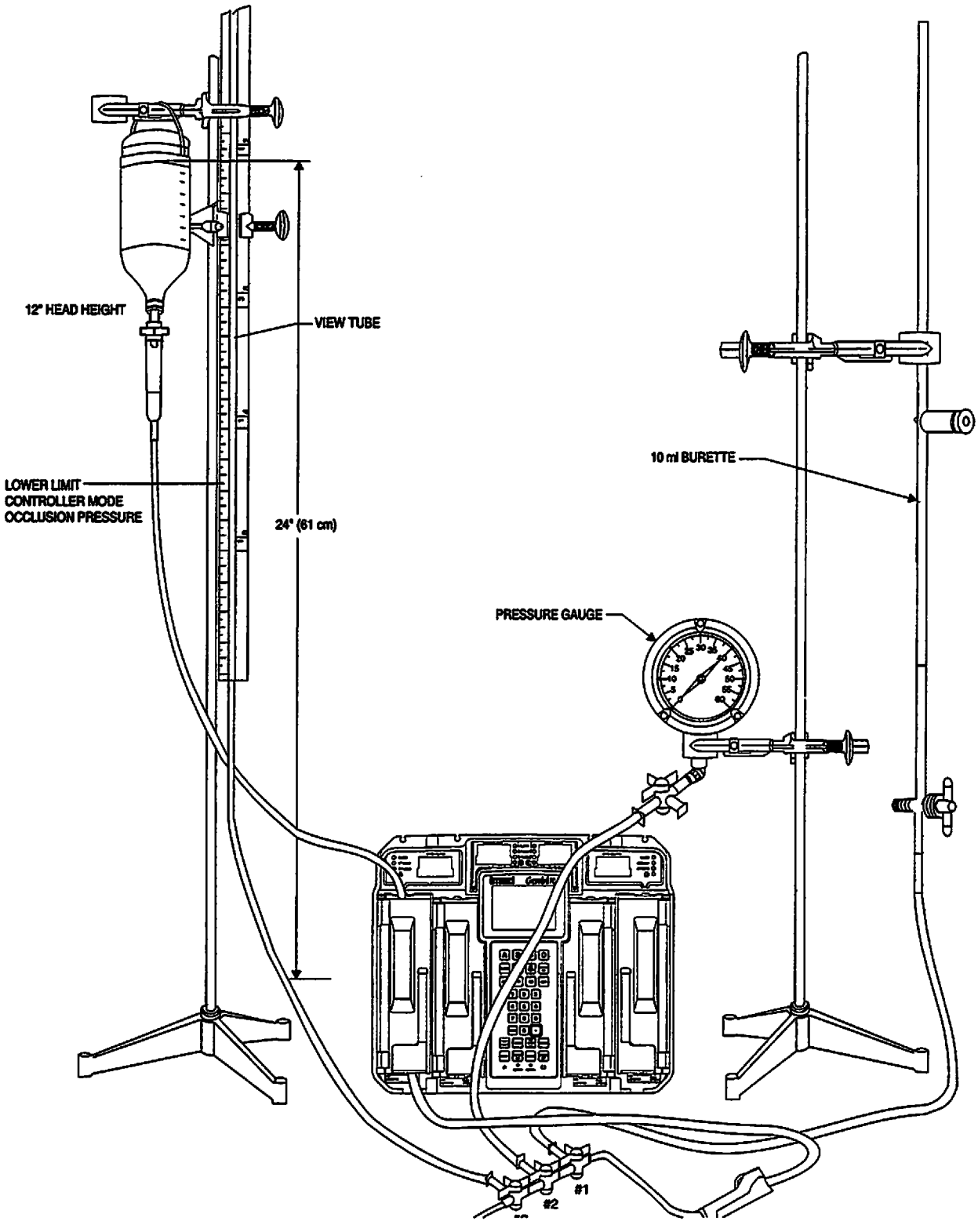


Figure 7-1. Universal Test Station Setup

OUTPUT PRESSURE TEST

1. Turn stopcock #2 to direct pump output to the pressure gauge.
2. Select PUMP mode.
3. Press START and observe:
   - Pumping mechanism stops
   - Audio Alarm sounds
   - ALARM indicator - flashes
   - "OCCLUDED-PATIENT SIDE" scrolls continuously.
   - Central Information displays shows ALARM for channel A.
4. Record pressure gauge reading on the data sheet immediately following alarm (reading must be between 8 and 12 psi or 55.2 and 82.8 kPa).
5. Press SILENCE to silence the audio, then press A followed by PAUSE.
6. Turn stopcock #2 to the bypass position momentarily to relieve the pressure and then turn back to the pressure gauge position.

VOLUME/RATE/TIME TEST

1. Home channel A by opening pumping chamber access door.
2. Turn stopcock #1 to direct fluid flow to the 10mL burette.
3. Press START to fill the burette to the 10mL line, then press A and PAUSE.
4. Press VOLUME INFUSED followed by CLEAR to reset the Volume Infused registers to "0".
5. Set VTBI to 5mL and verify the RATE is set to 125 ml.
6. Press START and start the stopwatch simultaneously.
7. When audio Advisory sounds and "INFUSION COMPLETE-KVO" scrolls, immediately stop the stopwatch and press A followed by PAUSE.

CAUTION

Failure to stop the pump immediately will induce a volume accuracy error into the test.

8. Read the fluid level in the burette.
9. Record the volume delivered (10 mL minus fluid level from step #7) and elapsed time on the data sheet. (Volume delivered must be between 4.75 and 5.25 mL and elapsed time must be within 2:17 and 2:31 (min:sec) limits).
10. Turn stopcock #1 to drain the fluid in the burette down to the 10mL line.

AIR IN LINE TEST

1. Open the channel A access door and remove the administration set.
2. Install the pumping segment of the AIL simulator (see Figure 7-2) into the channel A pumping mechanism, then press the tubing into the AIL detector.
3. Push the slide clamp in (the instrument will auto power on in Alarm mode).
4. Use the AIL simulator plunger to raise the fluid level to the top of the slide clamp fitment.
5. Close the door.
6. Set the rate to 125 mL/hr and VTBI to 50 mL and press START.
7. Use the AIL simulator plunger to draw the fluid level below the AIL detector.
8. Verify that within 2 seconds the PC-4 goes into AIL alarm:
   - Pumping stops
   - Operating LED indicator stops flashing
   - Alarm audio sounds
   - Alarm LED flashes
   - Channel Information display scrolls "AIR IN LINE"
   - Central Information display shows "ALARM" for appropriate channel.
9. Select the test channel and press CHANNEL OFF to power down or PAUSE to set up another channel for test.

MAXIMUM PRESSURE TEST

1. Initialize instrument in the Maintenance Mode.
2. Press 2 to select M/C Board Tests and Displays.
3. Press 1 to select maximum pressure test.
4. Press A to select channel A.
5. Press START control and allow the pump to operate for at least 30 seconds and wait until the peak pressure stabilizes.
6. Record the highest pressure reading obtained. **Resultant pressure must be ≥17 psi.**
7. Press CANCEL twice to return to the Maintenance Mode screen.
8. Turn stopcock #1 to the bypass position momentarily to relieve the pressure.
9. Press 3 then POWER OFF to power down the instrument.

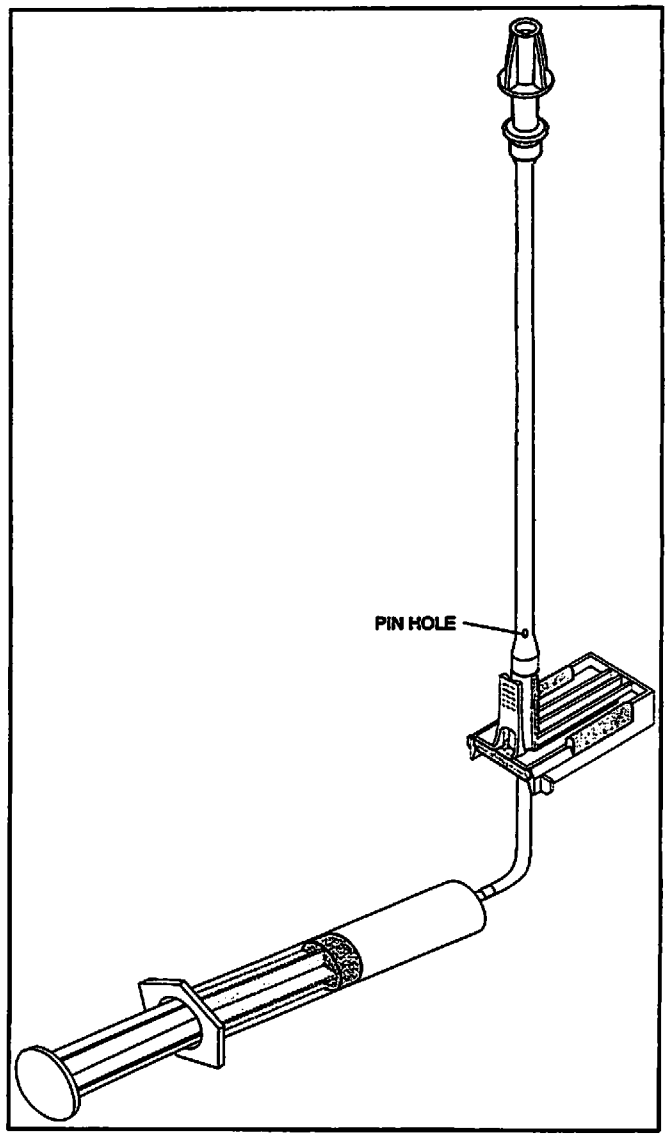


Figure 7-2. Air-in-line Simulator

PC-4 TEST DATA SHEET

Instrument Serial No._____ Software Version _____

Date _____ Technician _____

Test No.	Description	Reference	Record Result	Pass/Fail
1	Mechanical Inspection	5.2.2	_____	Pass___/Fail___
2	Electrical Leakage Test	7.4.1.1	_____	Pass___/Fail___
3	Electrical Ground Test	7.4.1.2	_____	Pass___/Fail___
4	Battery Voltage Check	7.4.1.4	_____	Pass___/Fail___
5	LOW-FLOW HEIGHT TEST	7.4.3.2	_____	Pass___/Fail___ Ch A
			_____	Pass___/Fail___ Ch B
			_____	Pass___/Fail___ Ch C
			_____	Pass___/Fail___ Ch D
	OUTPUT PRESSURE TEST	7.4.3.2	_____	Pass___/Fail___ Ch A
			_____	Pass___/Fail___ Ch B
			_____	Pass___/Fail___ Ch C
			_____	Pass___/Fail___ Ch D
	VOLUME/RATE/TIME TEST	7.4.3.2	_____	Pass___/Fail___ Ch A
			_____	Pass___/Fail___ Ch B
			_____	Pass___/Fail___ Ch C
			_____	Pass___/Fail___ Ch D
	AIR-IN-LINE TEST	7.4.3.2	_____	Pass___/Fail___ Ch A
			_____	Pass___/Fail___ Ch B
			_____	Pass___/Fail___ Ch C
			_____	Pass___/Fail___ Ch D
	MAXIMUM PRESSURE TEST	7.4.3.2	_____	Pass___/Fail___ Ch A
			_____	Pass___/Fail___ Ch B
			_____	Pass___/Fail___ Ch C
			_____	Pass___/Fail___ Ch D

PC-4 OPTIONAL TESTS

These tests are to be performed at the discretion of the repairing facility

1	Dielectric Test	7.4.1.3	_____	Pass___/Fail___
2	Maintenance Mode Test	5.3	_____	Pass___/Fail___
3	ECD Test (when applicable)	3.3.1.3	_____	Pass___/Fail___

Figure 7-3. PC-4 Test Data Sheet

WARRANTY

ALARIS Medical Systems, Inc. (hereinafter referred to as "ALARIS Medical") warrants that:

a. Each new IMED® GEMINI PC-4® volumetric Infusion Pump/Controller, excluding the battery, is free from defects in material and workmanship under normal use and service for a period of one (1) year from the date of delivery by ALARIS Medical to the original purchaser.
b. The battery and each new accessory are free from defects in material and workmanship under normal use and service for a period of ninety (90) days from the date of delivery by ALARIS Medical to the original purchaser.

If any product requires service during the applicable warranty period, the purchaser should communicate directly with ALARIS Medical headquarters (San Diego, CA) to determine the appropriate repair facility. Except as provided otherwise in this warranty, repair or replacement will be carried out at ALARIS Medical's expense. The product requiring service should be returned promptly, properly packaged and postage prepaid by purchaser. Loss or damage in return shipment to the repair facility shall be at purchaser's risk.

In no event shall ALARIS Medical be liable for any incidental, indirect or consequential damages in connection with the purchase or use of any ALARIS Medical product. This warranty shall apply solely to the original purchaser. This warranty shall not apply to any subsequent owner or holder of the product. Furthermore, this warranty shall not apply to, and ALARIS Medical shall not be responsible for, any loss or damage arising in connection with the purchase or use of any ALARIS Medical product which has been:

(a) repaired by anyone other than an authorized ALARIS Medical service representative:
(b) altered in any way so as to affect, in ALARIS Medical's judgement, the product's stability or reliability:
(c) subjected to misuse or negligence or accident, or which has had the product's serial or lot number altered, effaced or removed:

or

(d) improperly maintained or used in any manner other than in accordance with the written instructions furnished by ALARIS Medical.

This warranty is in lieu of all other warranties, express or implied, and of all other obligations or liabilities of ALARIS Medical, and ALARIS Medical does not give or grant, directly or indirectly, the authority to any representative or other person to assume on behalf of ALARIS Medical any other liability in connection with the sale or use of ALARIS Medical products.

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See packing inserts for international warranty, if applicable.

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