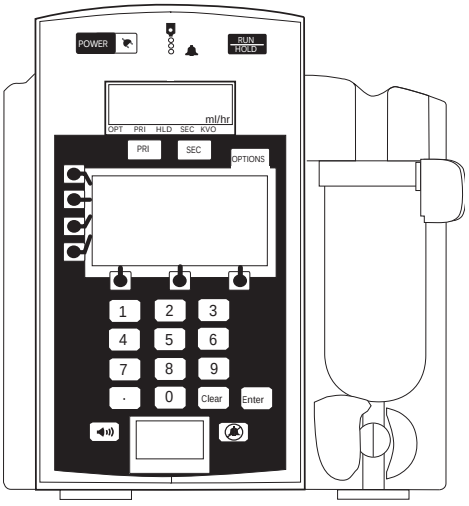
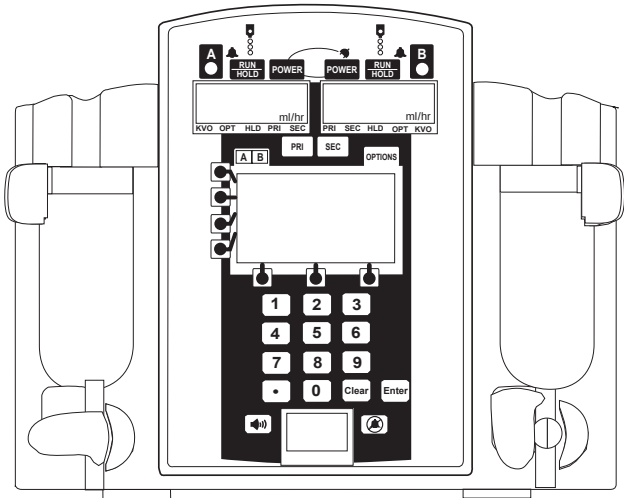
ALARIS®
MEDICAL SYSTEMS





Signature Edition® GOLD Infusion System

Models 7130/7131 and 7230/7231

Technical Service Manual

GENERAL CONTACT INFORMATION

ALARIS Medical Systems, Inc.
10221 Wateridge Circle
San Diego, California 92121

Customer Advocacy - North America

Clinical and technical feedback.

Phone: (800) 854-7128, Ext. 7812
E-Mail: CustomerFeedback@alarismed.com

Technical Support - North America

Maintenance and service information support; troubleshooting.

United States:
Phone:
(858) 458-6003
(800) 854-7128, Ext. 6003

Canada:
Phone:
Eastern: (800) 908-9918
Western: (800) 908-9919

Customer Care - North America

Instrument return, service assistance, and order placement.

United States:
Phone:
(800) 482-4822

Canada:
Phone:
(800) 387-8309

Technical Support and Customer Care - UK

Maintenance and service information support.
Instrument return, service assistance, and order placement.

Customer Service:
Freephone: 0800 917 8776
Fax: 01256 330 860

Technical Support:
Freephone: 0800 389 6972

This Technical Service Manual is subject to change without notification.

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1 GENERAL INFORMATION

Chapter 1 — GENERAL INFORMATION

CAUTION

Do not use sharp objects (pens, pencils, etc.) to activate switches, as this will damage the keypad.

CAUTION

Any attempt to service an ALARIS Medical Systems instrument by anyone other than an authorized ALARIS Medical Systems Service Representative while the instrument is under warranty may invalidate the warranty.

1.1 INTRODUCTION

This manual covers Signature Edition® GOLD Infusion Systems, with software versions 2.78, 4.06 and 4.08. It is used in conjunction with an applicable Signature Edition® GOLD Infusion System Directions for Use (DFU).

This manual contains instructions for maintenance, repair, and configuration of the instrument. It is intended for personnel experienced in the analysis, troubleshooting, and repair of analog/digital microprocessor-based electronic equipment.

If the instrument requires service while under warranty, it is to be serviced only by ALARIS Medical Systems authorized service personnel. Refer to the “Service Information” and “Warranty” sections of the applicable Signature Edition® GOLD Infusion System DFU.

The Signature Edition® GOLD Infusion System includes:

- Single-Channel, Models 7130/7131
- Dual-Channel, Models 7230/7231
- AccuSlide® Flow Regulator administration sets

The Signature Edition® GOLD Infusion System series includes the following configurations:

- 7130B, 7130D, 7130E
- 7131A, 7131B
- 7230B, 7230D, 7230E
- 7231A, 7231B

1.1 INTRODUCTION (Continued)

7130/7131 and 7230/7231 Series:

- is a 100-240 VAC, 50/60 Hz instruments family that supports both single and dual channel fluid delivery
- features user-interactive software
- displays prompts, alarms and alert messages, and troubleshooting information on main LCD display
- can be configured to specific operational requirements
- allows upgrades for future instrument enhancements
- has been designed to interface with accessory equipment.

7131/7231 Series key differences from 7130/7230 Series are:

- **HARDWARE**

  The 7131/7231 Series is labeled for 220V with two power cord options and has isolated RS-232 Board, potential equalization (PE) connector, and drop sensor board installed.

  There is no Nurse Call option.

  Keypads, other than English, have symbols instead of words.

- **SOFTWARE**

  The 7131/7231 Series has a drug list only if the software version is 4.08 or higher and profiles are enabled. Some defaults are different in configuration mode and there are several languages to choose from in version 2.78.

Refer to the applicable Signature Edition® GOLD Infusion System DFU for complete setup and operation information.

1.2 PRECAUTION DEFINITIONS

A **WARNING** is an alert to a potential hazard which could result in serious personal injury and/or instrument damage if proper procedures are not followed.

A **CAUTION** is an alert to a potential hazard which could result in minor personal injury and/or instrument damage if proper procedures are not followed.

1.3 SPECIFICATIONS

Refer to Table 1-1.

1.4 ACCESSORIES

Accessory items are available for use with the instrument. These items are described in the following paragraphs.

1.4.1 Nurse Call (7130/7230 only)

All instruments are equipped with the nurse call feature. Alarms and some alerts from the instrument will be relayed to the facility's existing nurse call system. No operating features of the instrument are changed and it will alarm with or without the nurse call. The only additional item needed is a cable with a 9-pin to mono phone jack (ALARIS P/N 136111).

1.4.2 Learn/Teach RS-232 Cable

This is a standard commercially available 9-pin Null Modem RS-232 cable (ALARIS P/N 133450). The Learn/Teach RS-232 cable is used to connect two instruments for the purpose of transferring (downloading) configuration data from/to another instrument.

> **NOTE:** Guardrails® Safety Software data sets cannot be transferred via the Learn/Teach function. They must be downloaded directly from a PC.

Table 1-1. Specifications

Administration Sets:

Use only ALARIS Medical Systems® 72 Series administration sets. All disposable IV set and IV set accessory models are defined on a separate card.

Air-in-Line Accuracy:

Configured Threshold	Air Volume Detection Range
50µL	15µL - 85µL
100µL	35µL - 140µL
200µL	100µL - 235µL
500µL	275µL - 565µL

Alarms:

- Accumulated Air in Line
- Air in Line
- Battery Depleted
- Channel Malfunction
- Computer Link Failure
- Flow Sensor Unplugged
- Hold Time Exceeded
- Instrument Malfunction
- Key Stuck
- Latch Open
- No Upstream Flow Detected
- Occlusion Downstream
- Occlusion Upstream
- Primary Flow Detection During Secondary
- Set Out
- Set Up Time Exceeded

Altitude:

Operating Altitude: -500 ft. (-150m) to 7,500 ft. (2285m)

Battery:

Rechargeable nickel-cadmium (NiCad). Use only NiCad 12V, 1.8 ampere-hour (Ah) (minimum) batteries. A single channel instrument will operate for 4 hours nominal and a dual channel instrument will operate for 3 hours nominal, under the following conditions:

- new, fully-charged battery
- ambient room temperature 73 ± 7°F (23 ± 4°C)
- resistance monitoring modes
- rate: 100 mL/h on a single channel instrument and 50 mL/h on each channel of a dual channel instrument.

Battery run time is affected by operating mode, rate, monitoring options, and back pressure.

Table 1-1. Specifications (Continued)

Bolus Volume Limits:

Time Bolus Volume Released Upon Correcting Downstream Occlusion (mL)		Monitoring Options			
		Pressure		Resistance and High Resistance	
Threshold Settings		25 mmHg	600 mmHg	100% 25 mmHg	100% 600 mmHg
1 mL/h	Maximum	0.5	0.5	0.5	0.5
	Typical	<0.1	0.3	<0.1	<0.1
25 mL/h	Maximum	0.5	0.5	0.5	0.5
	Typical	<0.1	0.3	<0.1	<0.1

NOTE: When the occlusion alarm pressure limit is set to the maximum threshold setting, the maximum infusion pressure generated into a hard occlusion at 25 mL/h is 11.6±3.9 psi. Testing performed using IV set Model 72003, at 68±4°F (20±2°C).

Case: Impact and flame resistant plastic.

Critical Volume: Maximum incremental volume in case of single point failure will not exceed 1.0 mL at 999.9 mL/h.

Dimensions (Nominal):

	7130/7131	7230/7231
Width	7.6 in/19.3 cm	10.7 in/26.7 cm
Height	8.6 in/21.8 cm	8.6 in/21.8 cm
Depth §	5.0 in/12.7 cm	5.0 in/12.7 cm
Weight §§	6.6 lbs/3.0 kg	8.4 lbs/3.8 kg
Power Cord	10 ft/3 m	10 ft/3 m

§ without pole clamp
§§ without power cord

Environmental Conditions:

	Operating	Storage/Transport
Temperature Range	5 to 40°C (41 to 104°F)	-40 to 60°C (-40 to 104°F)
Relative Humidity	20 to 90% Non-condensing	5 to 95% Non-condensing
Atmospheric Pressure	700 to 1060 hPa	500 to 1060 hPa

Fluid Ingress Rating: Drip proof IPX1

Table 1-1. Specifications (Continued)

Ground Current Leakage:

Electrical leakage current, enclosure: <100 microamperes
Electrical leakage current, patient: <10 microamperes

Log Capacity:

Software version 2.78:
2000 Event History Log

Software version 4.06/4.08:
300 Continuous Quality Improvement (CQI)
1500 Event History Log

Maximum Infusion Pressure:

16 psi

NOTE: Testing performed per proposed standard IEC 601-2-24 using IVAC® IV sets.

Maximum Time to Alarm:

Time to Detect Downstream Occlusion (minutes)		Monitoring Options			
		Pressure		Resistance and High Resistance	
Threshold Settings		25 mmHg	600 mmHg	100% 25 mmHg	100% 25 mmHg
1 mL/h	Maximum	2	75	2	7
	Typical	0.6	30	0.6	4
25 mL/h	Maximum	1	25	1	3
	Typical	0.1	1	1.0	1

NOTE: When the occlusion alarm pressure limit is set to the maximum threshold setting, the maximum infusion pressure generated into a hard occlusion at 25 mL/h is 11.6±3.9 psi. Testing was performed using IV set Model 72003, at 68±4°F (20±2°C).

Memory:

4.06 and higher: Maintains infusion perimeters indefinitely until the instrument is reprogrammed.

2.78: Interrupted secondary or advanced operating modes retain special program settings up to 6 hours. Resistance/pressure trending information is retained for 6 hours.

Mode of Operation:

Continuous

Number of Instruments per Pole:

3 (713X), 2 (723X), single pole, weighted base, 5 legs.

Table 1-1. Specifications (Continued)

Occlusion Alarm Pressure: 12 ± 4 psi maximum

Parts per mL: Precision Flow 3600 steps to deliver 1 mL Pressure Mode (rate < 50 mL/h). All other occlusion monitoring options 1150 steps to deliver 1 mL (Cal # = 0.0) steps will vary with Cal #.

Power Requirements: 100-240 VAC, 50-60 Hz (40 W), 3-wire grounded system. Class 1 with internal power source.

Rate Accuracy: For rates greater than 1 mL/h, up to 999.9 mL/h: ±5%, 95% of the time with 95% confidence, under the conditions listed below.

For rates equal to or less than 1 mL/h: ±6.5%, 95% of the time with 95% confidence, under the conditions listed below.

Infusion rate range: 0.1 to 999.9 mL/h	Head height: 24 ± 1 in. (61 ± 2.5 cm)
Environment temperature: 68±8°F (20±4°C)	Back pressure: 0 psi.
Test solution: distilled water	Set Model: 72003
Needle: 18 gauge	Minimum collection volume: 6 mL

CAUTION

Variations of head height, back pressure, time, monitoring mode option, instrument tilt, or any combination of these, may affect rate accuracy. Factors that can influence head height and back pressure are: IV set configuration, IV solution viscosity and IV solution temperature. Back pressure may also be affected by type of catheter.

Rate Range: 0.1 to 999.9 mL/h in 0.1 mL/h increments (primary)
0.1 to 270.0 mL/h in 0.1 mL/h increments (secondary)

RFI: Tolerance < 10 V/m across frequency range.

Temperature: Operating above 30°C, for extended periods will reduce battery life.

Volume to Be Infused Range: 0.1 to 9999.9 mL in 0.1 mL increments (primary and dose rate)
0.1 to 999.9 mL in 0.1 mL increments (secondary and loading dose)
0.1 to 999.9 mL per step in 0.1 mL increments (multi-step)
0.1 to 999.9 mL per dose in 0.1 mL increments (multi-dose)

WARNINGS (Alerts):

- Battery Low
- Checking Line
- Complete Entry
- Computer Control Released
- Dose Complete
- Infusion in KVO
- Load Dose Complete
- Multi-Step Complete
- Resistance Alert
- Secondary Complete
- VTBI = 0

NOTE: The Signature Edition® GOLD Infusion System has been assessed and complies with the following Technical Standards: IEC 60601-1 / BS 5724, including amendments A1 and A2; IEC 60601-2-24; CISPR 11, Group 1, Class B Emissions; IEC 60601-1-2.

1.4 ACCESSORIES (Continued)

1.4.3 Flow Sensor

Flow sensor capability is available with an upgrade kit for the 7130/7230 (refer to the “Illustrated Parts Breakdown” chapter). For 7131/7231, all that is needed is a flow sensor.

The flow sensor attaches to the administration set's drip chamber. It detects an empty solution container and verifies fluid flow. When installed, it will allow VTBI to be turned off. The flow sensor will not see drops falling if the drip chamber is tilted more than 24°.

1.5 ALARMS, ERRORS, MESSAGES

Alarm messages are displayed on the Main Display. Refer to the applicable Signature Edition® GOLD Infusion System DFU for detailed information.

1.5.1 Silencing Alarms

All alarms can be temporarily silenced by pressing the **Silence** Key.

1.6 BATTERY MANAGEMENT SYSTEM

This section contains general information on the battery management system. Included is information on how the Battery Manager monitors and maintains the battery, controls the power on/off for the rest of the instrument, and provides support functions for the main processor. Refer to the “Principles of Operation” chapter for more detailed functional descriptions.

The battery management system consists of the Battery Manager IC and various sensors and signal processing circuits. The Battery Manager IC (Rev. 3.06) is a custom-programmed microcontroller that performs the following functions:

- Controls battery charger
- Provides a battery status "battery gauge"
- Monitors voltage and temperature of battery
- Controls instrument power source (on/off function)
- Drives Lower LCD Display (refer to Figure 1-2)
- Includes a relative-time clock

The Battery Manager communicates with the main processor via a serial data channel. The main processor issues commands to the Battery Manager which then responds with status information and data using this channel.

1.6.1 Fan

The internal fan is used for cooling, mainly to help prolong battery life. It is a ball-bearing, brushless DC fan. The fan is always on when the battery is charging with "Fast" or "Top-up" charge. The fan will go on any time battery temperature is over 22°C.

1.6.2 Battery and Charging Process

The battery is a ten-cell (1.2V per cell), high capacity nickel-cadmium type rated at 12 volts and 1.8 amp-hours (with a minimum of 500 charge cycles).

The battery pack (10 to 18V) has a built-in temperature sensor which allows the Battery Manager to monitor the temperature of the battery. The pack also includes a temperature-limiting thermostat which opens the circuit if the battery temperature gets too hot and closes again when the temperature returns to normal.

1.6 BATTERY MANAGEMENT SYSTEM (Continued)

1.6.2 Battery and Charging Process (Continued)

The battery charge circuit charges the battery with a constant current of 1 ampere whenever the Battery Manager turns the charger on. The Battery Manager regulates average charge current by turning the charger on and off with the appropriate duty ratio. The battery charge cycle consists of four modes; fast charge, top-up charge, float charge, and hot charge.

- Fast Charge: Fast charge is initiated whenever the battery is less than 36°C, and has been discharged by more than 200 Ampere-seconds through actual use or self discharge. Leaving the instrument unplugged for a day would cause about 200 Ampere-seconds of self discharge. The charge current is a continuous 1 Ampere. The end of a fast charge is detected when the temperature of the battery rises 7°C above its temperature at start of charge and is at least 30°C, or when the battery voltage declines by 192mV below its peak value, or total charge time exceeds 3.2 hours. Refer to “Battery Charge Regulator” section in the “Principles of Operation” chapter for further details.
- Top-Up Charge: The top-up charge phase begins at the end of the fast charge phase and finishes adding the last few percent of charge to the battery and balances individual cell charges. This phase charges at an average rate of 180 mA (1 A for 0.9 seconds every 5 seconds) for 180 minutes. At that time, the instrument will go into float charge mode.

  The charger will suspend top-up if the battery temperature exceeds 37°C. The time spent to cool down to below 37°C is in addition to the 180 minutes top-up charge time. If top-up cool down time exceeds 5 1/2 hours, the instrument will go into float charge mode.
- Float Charge: The float charge phase begins at the end of the top-up phase and helps maintain a fully charged battery. This phase charges at an average rate of 40 mA (1A for 0.2 seconds every 5 seconds). The fan remains on or turns on when battery temperature exceeds 22°C.
- Hot Charge: The hot charge mode occurs when the instrument determines that the battery is >36°C (normally due to ambient temperature being >27°C) to allow a charge after waiting 3 hours for it to cool down. Hot charge mode charges at an average rate of 180 mA (1A for 0.9 seconds every 5 seconds) for a total charge time of 18 hours. If the battery temperature exceeds 43°C, the charging is turned off until the temperature falls below 43°C.

  Note that the cool down time is in addition to the 18-hour charge time. The float charge cycle begins at the end of the hot charge cycle.

1.6.3 Refresh Cycle

A battery refresh cycle performs a full charge, discharge, and recharge to condition and measure the capacity of the battery. This refresh results in a new "Measured Capacity" in the battery diagnostics and can be used to judge the condition of the battery.

1.6 BATTERY MANAGEMENT SYSTEM (Continued)

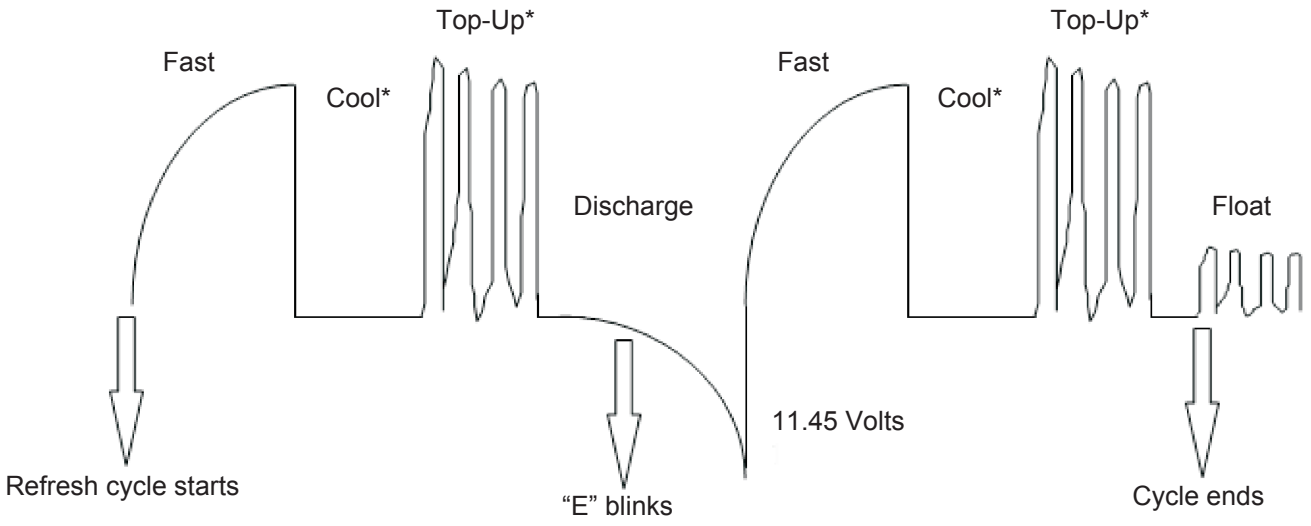
1.6.3 Refresh Cycle (Continued)

The refresh cycle must be initiated manually, either by disconnecting/ reconnecting the battery or by loading 0.0 Ah as the rated capacity in the battery diagnostics page. After the zero rated capacity is loaded and the **OK** soft key is pressed, the original rated capacity must be reloaded to preserve the battery gauge. The empty ("E") icon will flash during the discharge part of the refresh cycle (see Figure 1-1). Important: The AC power must remain connected and uninterrupted during the discharge cycle. If the AC power is removed during this cycle, the discharge cycle will be terminated and another refresh cycle will have to be initiated. The time for complete refresh is dependent upon battery

Table 1-2. Battery Trip Points

Battery Voltage	Instrument Response
12.0V (Single) 12.1V (Dual)	• One tick mark left on gauge • Instrument continues to function • Warning tone activated • Low battery warning
11.45V	• Instrument does not pump • Constant alarm • Low battery alarm (depletion)
10.25V	• 1 minute or longer (nominal 5 min.) after low battery alarm • Backup speaker activated • Instrument shutdown (5 min. after alarm)
9.75V	• No AC power applied • Battery disconnected from circuit by shutdown signal

Figure 1-1. Battery Refresh Cycle



* Cool and Top-Up portions of cycle will vary with temperature. The complete cycle could last 24 hours if instrument turned on with the Fan running most of the time.

1.6 BATTERY MANAGEMENT SYSTEM (Continued)

1.6.3 Refresh Cycle (Continued)

temperature and takes an average of 20 hours to complete (refer to Figure 1-1).

Two ways to initiate a manual refresh cycle are:

- Disconnect from AC, unplug battery, and then press power switch. Lower LCD will go blank. Reconnect battery and then reconnect instrument to AC.
- Enter Diagnostics Mode, go to page D2, Select Battery Status, and enter 0.0 Ah for battery-rated capacity. Press **Enter** and **ok**. Turn instrument off and back on, and then reconnect to AC. Once the fan turns on (indicating start of a refresh cycle), return to page D2 and reset battery rated capacity to 1.3 Ah.

1.6.4 Battery Gauge

The battery gauge provides an indication of the approximate amount of charge remaining on the battery. It will usually indicate less charge than is actually available with a new battery. This is displayed in a bar graph format on the lower LCD Display and is active as long as the battery is connected to the instrument. (Refer to Figure 1-2, Lower LCD Display Layout.)

The battery gauge circuitry measures the current flow into and out of the battery and maintains a record of the state of charge of the battery. This record is reset each time the instrument completes a full refresh cycle. The battery gauge uses this record, together with a measurement of the present power requirements of the instrument, to estimate the charge available on battery power at the current infusion rate.

NOTES:

- The instrument label and battery gauge are always displayed, even when the instrument is turned off; however, the battery gauge does not represent the battery charge remaining when the instrument is turned off.
- To ensure a more accurate battery gauge reading, review the battery gauge five minutes after starting an infusion. The gauge updates for each program change while infusing. Battery run time may be affected by the operating mode, rate, monitoring options and back pressure.

1.6.5 Power On/Off

The Battery Manager provides the interface between the power on/off switch(es) and the main processor. When the instrument is off, the Battery Manager interprets either power switch as a turn on command and applies power to the rest of the instrument, informing the main processor which switch was pressed. Once power is on, further presses of a power switch are passed on to the main processor which determines the appropriate response under the existing conditions. If the response is to turn the power off, the main processor requests that the Battery Manager remove power from the rest of the instrument.

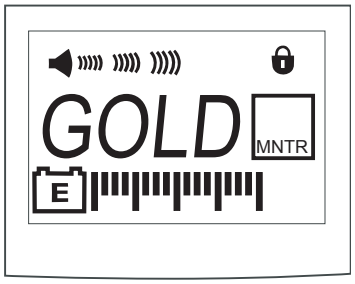
If an error has been detected which causes the watchdog to be in alarm, pushing the power switch (or for dual channel instruments, either power switch) immediately causes the power to be turned off, without intervention by the Battery Manager.

1.6 BATTERY MANAGEMENT SYSTEM (Continued)

1.6.6 Lower LCD Display

The Battery Manager also contains the driver for the Lower LCD Display. In addition to the battery gauge, this display contains a four-character alphanumeric "configuration" display and several icons. The information for these other displays is controlled by the main processor and is communicated to the Battery Manager through the serial channel. The Battery Manager also uses the four-character display to indicate errors detected in the Battery Manager system itself.

Figure 1-2. Lower LCD Display Layout



1.6.7 Clock

The Battery Manager provides a "relative time" clock which the main processor can set and read. This clock consists of a 32-bit counter which is incremented once a second under all conditions. The main processor uses this counter as a means of determining elapsed time even when power has been turned off. The clock is used to compensate for normal battery capacity degradation over time.

1.6.8 Battery Maintenance

CAUTIONS

- Use only batteries approved by ALARIS Medical Systems, due to Battery Manager requirements and the thermostat contained in the battery assembly. If the instrument has been in storage, connect it to AC power before turning it on. Usually one refresh cycle is sufficient to restore battery capacity. If necessary, repeat the procedure at 24-hour intervals, 2 or 3 times, to increase capacity.
- Battery replacement should be performed by qualified service personnel while instrument is not in use. DO NOT open, incinerate or short circuit the battery. Worn-out batteries must be disposed of properly, according to local regulations.

Several features have been included in the Battery Manager to help properly maintain the battery.

- A battery capacity measurement is available in diagnostic mode.
- A special circuit removes all load from battery when voltage falls too low, preventing damage from over discharge due to long-term storage.

NiCad batteries can be stored indefinitely with no load but will self-discharge from a charged state in about 100 days. This does not damage the battery as it would if it were a lead acid-type battery. Connect instrument to AC to recharge batteries.

1.6 BATTERY MANAGEMENT SYSTEM (Continued)

1.6.8 Battery Maintenance (Continued)

> **NOTE:** If under load (inside instrument), the maximum storage time would be about 130 days before electrolyte extrusion occurs past the battery seal.

If the battery exhibits short run times, a reconditioning procedure can be used:

1. Disconnect battery and AC
2. Press On/Off switch and verify lower LCD goes blank.
3. Reconnect battery.
4. Reconnect instrument to AC. A refresh cycle will be initiated.
5. Repeat this procedure at 24-hour intervals, 2 or 3 times, to increase capacity or use a battery conditioner.

1.7 NICAD BATTERY CAPACITY INFORMATION

All batteries have specific conditions under which they are guaranteed to meet their published specifications. Deviations from these conditions typically result in a reduction of available capacity. Manufacturers of NiCad batteries rate capacities, usually expressed in Ah, based on a specified "ideal" charge and discharge condition, as well as the use of a "new" battery. Battery manufacturers do not use the calendar year for battery date codes. The battery date code year starts on September 1. The first two digits of the date code are for the year and the last two digits are for the week of the year (for example, date code 0411 = the year 2004 and the eleventh week from September 1).

An ideal charge cycle starts with a fully discharged battery charged at C/10 (*C* is the rated capacity in Ah) constant current for 15 hours while at room temperature. For instance, a 1.8Ah battery would be charged for 15 hours at 180mA constant current with a room temperature of 23°C.

The ideal discharge starts with a fully charged battery under a C/5 constant current load at room temperature, discharging to a cell voltage of 0.9V. The rated capacity is then calculated as the time to discharge divided by 5. Again, a 1.8Ah cell would be discharged at 360mA constant current and not reach 0.9V for at least 5 hours. Note that a given battery type has different capacities based on the load. For instance, a battery rated at 1.8Ah at a 360mA load may have only 1.6Ah at a 1600mA load.

As can be seen from the preceding ideal conditions, there are many conditions which can affect the battery capacity. The following conditions have the most practical impact on battery capacity delivered in this instrument.

- Temperature During Charge:
  As the effective ambient temperature of the battery increases, the amount of charge that the battery will accept is decreased. At an ambient temperature of 35°C, an enclosed battery will temporarily accept only about 90% of the charge it would otherwise accept at 23°C. Because the batteries are internal to the instrument case and the instrument itself generates heat, the batteries will be exposed to temperatures above room temperature. Some of the ways the instrument limits the temperatures that the battery sees include forcing air across it (an internal fan) and turning off the charger when the battery temperature gets too high.

1.7 NICAD BATTERY CAPACITY INFORMATION (Continued)

- Cycle Life and Aging:
  As batteries get older and go through many charge/discharge cycles, batteries "wear out," in that the chemicals and materials used to construct the cell break down. The way the instrument deals with this is to assume that a battery will continually reduce capacity at a rate equivalent to 30% over 4 years, and continually reduce capacity at a rate equivalent to 30% per 200 full charge cycles. These calculated values are used to reduce the displayed runtime on the battery gauge.
- Partial Discharge/Charge:
  When a battery is partially discharged, then charged for less than the full time, differences between individual cell capacities result in cells completing charge at different times. If the full charge sequence is not then completed, the cell "mismatch" becomes progressively greater. This is viewed by the user as low apparent runtimes and premature low battery warning and alarms.

  The problem is cumulative in that the mismatch increases for every partial cycle. The lowered capacity is not permanent, but may require 2-3 full charge cycles to recover. The way the instrument deals with this is to reduce the displayed runtime based on a limited history of partial cycles.
- Charge Rate:
  The ideal charge rate requires 15 hours to get to full charge, which is undesirable from the user's perspective. The instrument provides a multiphase charge cycle which results in about 80% capacity in the first 2 hours after fast charge. The next charge phase, top-up, is designed to finish the charge and to bring all individual cells to the fully charged state, essentially rematching them. Refer to “Battery and Charging Process” section in this chapter for “Fast Charge” and “Top-up Charge” information. If the top–up charge is not completed, then the cell mismatch is not reduced and the cumulative capacity reduction occurs. Top-up is a 3-hour charge, but the elapsed time to complete it may be over 5 hours, as the charger is turned on and off to keep the battery cool during that time.
- Battery Alarm Voltage:
  The battery alarm voltage is the voltage at which the instrument stops operating and generates an alarm indicating the instrument needs to be connected to AC power. As noted in the ideal discharge condition, the end of discharge is determined by 0.9V/cell.

  Under perfect conditions, a battery of 10 cells connected in series would reach the end of discharge at 9.0V; however, cells are not perfectly matched so some will reach 0.9V before others. The problem occurs when a cell in series with other cells can go below 0.9V and actually can go into cell reversal, which permanently damages the particular cell. On the other hand, increasing the alarm voltage to compensate for imperfectly matched cells results in reduced runtimes with available capacity.

1.7 NICAD BATTERY CAPACITY INFORMATION (Continued)

The user sees this as premature low battery warnings and alarms. The way the instrument deals with this is to increase the alarm voltage to guarantee the battery is not damaged and to reduce the assumed capacity to below that printed on the battery. The battery gauge is intended to show the minimum run time left on the battery taking all these factors into account.

NOTE: In the event ALARIS Medical Systems provides different battery packs in the future, the replacement battery may have a different rated capacity. Therefore, the Battery Manager of the instrument needs to know that a new battery has been added and the rated capacity has changed. Refer to the "Removing Battery" section of "Corrective Maintenance" chapter and the "Changing Rated Capacity of Battery" section of "Troubleshooting" chapter.

1.8 DYNAMIC MONITORING® SYSTEM (DMS)

The following is general information regarding the Dynamic Monitoring® System.

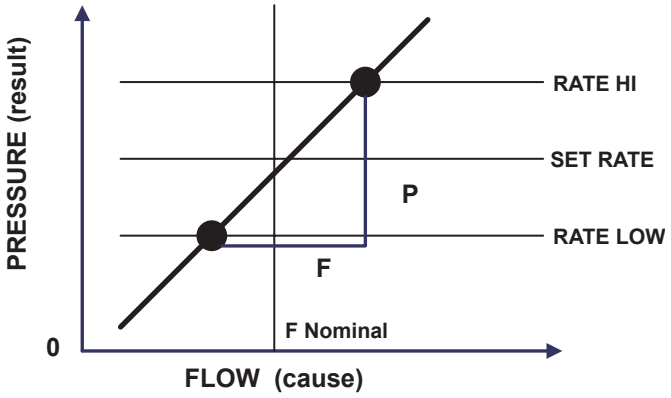
In order for fluid to move through the administration set, a pressure difference (gradient) must exist. In a gravity setup, this is done by head height. In a pump, the instrument will develop pressure to overcome downstream effects on fluid flow.

The fundamental concept behind the Dynamic Monitoring® System is that the resistance to fluid flow from the mechanism to the patient's infusion site can be measured. This is done by intentionally varying the flow rate while monitoring the resulting changes in fluid pressure (refer to Figure 1-3 "Resistance Graph"). Signal processing of the pressure and flow data can then produce the fluid impedance value. Such measurements can be made continuously at short intervals and be independent of the selected rate. Head height and resulting pressure variations, likewise, will not affect the measurement.

When a complete occlusion occurs, the resistive part of the fluid impedance is very large (theoretically infinite). Elevated resistances due to clotting, clogged filters, partial occlusions or infiltrations can be measured.

The Dynamic Monitoring® System provides a means to measure the mechanical properties of the downstream flow path.

Figure 1-3. Resistance Graph



Pressure =
Effect when a force is against a restriction.

Resistance =
Caused when impediment to fluid flow occurs.

Resistance = $\frac{\text{Change in Pressure } (\Delta P)}{\text{Change in Flow } (\Delta F)}$

Refer to Figure 1-4 "Pressure and Resistance Graph".

1.8 DYNAMIC MONITORING® SYSTEM (DMS) (Continued)

Features include:

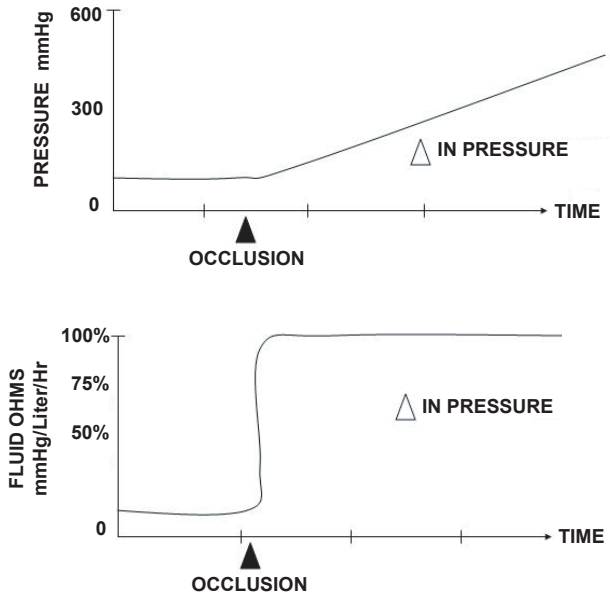
- Alarm setting is based on dynamic system impedance (pressure changes, not absolute pressure).
- Detection of complete occlusions.
- Reduced nuisance alarms by minimizing artifact effects such as head height and patient movement.
- AutoRestartPlus feature allows instrument to automatically continue operation if an occlusion is cleared within self-check period (40 seconds). A warning tone and “Checking Line” message will occur for up to 40 seconds. The feature can be turned off (set restarts to zero), or number of restarts may be set from 1 to 9.

NOTES:

- The restart counter is reset whenever Run/Hold is pressed, the instrument or channel is turned off or an alarm occurs.
- When infusion is started, the resistance may be other than 0%, depending on solution viscosity, catheter/tubing size and filters.

- Resistance Alert provides an early warning of slow or gradual changes in resistance of IV line/site. Resistance Alert marker can be set from 5 to 100%. It allows resistance to be monitored and provides a tone every 30 seconds if percent resistance exceeds resistance alert mark.
- Resistance display may be turned off. If off, system continues to monitor downstream resistance and alarm appropriately.

Figure 1-4. Pressure and Resistance Graph



Pressure rise is quite small with site complication, especially with low flow rates.

Resistance rises dramatically with site complication.

1.9 DATA COMMUNICATIONS FUNCTION

The instrument has built-in remote monitoring capability. This allows features and their data to be monitored by a computer, providing a means to create advanced clinical systems. A separate manual on data communications is available and organized to support technical personnel with a wide range of experience and needs. The separate manual includes:

- General Information: Includes phone number for technical support.
- Operation: Instrument's communications modes, controls, indicators, and procedures from user's point of view.
- Instrument Setup: How to set the baud rate, enable or disable computer monitoring, and other parameters.
- Electrical Interfacing: RS-232 background information, connectors and recommended wiring for common computers.
- Communications Protocol: Inquiry, response, and command codes, data formats, message sequences, and error detection.

1.10 TRUMPET AND START-UP CURVES

Refer to the applicable Signature Edition® GOLD Infusion System DFU.

Table 1-3. Abbreviations, Acronyms, Symbols

Various abbreviations, acronyms and symbols are used throughout this manual. The following are those that are not commonly known or easily recognized.

*	"active Low" logic signal	VAO	voltage alternating oscillator
AIL	air-in-line	VBKUP	voltage backup
DFU	directions for use	VNEG	negative voltage
DS	display	VMEAS	voltage measured
ECD	empty container detection	VMOTOR	voltage to motor
F	fuse	VPOS	positive voltage
FB	ferrite bead	VRAW	voltage raw (unregulated voltage)
H	hexadecimal	VTBI	volume to be infused
KVO	keep vein open	VTHRES	voltage threashold
PM	preventive maintenance	WD	watchdog
PR	power regulator	WDI	watchdog input
PRI/SEC	primary to secondary	WDO	watchdog output
SCU	serial control unit		

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2A CHECKOUT & CONFIGURATION

CHAPTER 2A — CHECKOUT AND CONFIGURATION
Software Versions 4.06 and 4.08

CAUTION

Keep latch closed when instrument is not in use.

CAUTION

Should an instrument be jarred severely or dropped, remove it from use immediately. It should be thoroughly tested and inspected by qualified service personnel to ensure proper function prior to reuse.

2.1 INTRODUCTION

This chapter describes the initial setup and configuration of an instrument with software versions 4.06 and 4.08.

2.2 NEW INSTRUMENT CHECKOUT

Refer to the instrument's Directions For Use (DFU) for instructions regarding unpacking and setting up the instrument for the first time.

When turning on the instrument, verify the instrument beeps and that all display LED segments flash. This confirms that the instrument has performed its self test and is operating correctly. During operation, the instrument continually performs a self test, and will alarm and display a message if it detects an internal malfunction.

Contact ALARIS Medical Systems authorized service personnel if the instrument has physical damage, fails to satisfactorily pass startup sequence, fails a self test or continues to alarm.

For new instrument checkout refer to the applicable Signature Edition® GOLD Infusion System DFU.

2.3 CONFIGURABLE OPTIONS AND DEFAULTS

A hospital/facility biomedical technician has the capability to set all configuration parameters to their startup defaults in a single operation. The terms "configuration parameters" and "programmable features" are interchangeable and have the same meaning. Refer to the applicable Signature Edition® GOLD Infusion System DFU for more information.

2.4 CONFIGURATION PROCEDURE

WARNINGS

- When an instrument's configuration is changed, the configuration name should also be changed in order to document the new parameter settings. The intent of the configuration name is to have only one set of parameters for each alpha-numeric code. Refer to "Pop-Up Displays" section.
- Powering down in configuration mode during an alarm or error will NOT save any configuration changes.

The configuration procedure is for use by qualified service personnel only. The configuration mode is intended for programming the technical and clinical features in accordance with current procedures and practices.

Table 2-1, "Record of Configured Instruments", can be reproduced and used to record and track instrument configuration settings.

A map of all the configuration screens is located at the end of this chapter (Figure 2-1).

Software version 2.78 is not Guardrails® Safety Software compatible and the configuration mode is different. Refer to Chapter 2 for "Software Version 2.78" for detailed calibration information.

The configuration mode for versions 4.06 and 4.08 are identical except when Profiles is enabled. When Profiles is enabled, the only configuration settings that can be changed in version 4.08 are Regional Settings, Profiles, Computer Link and Optional Features, because the Guardrails® Safety Software profile overrides every other setting in the configuration mode.

NOTES:

- Pressing a soft key at the side of the Main Display the first time, selects it for editing. Some features are edited by subsequent presses of the soft key to cycle through available options. Other features are edited by means of the numeric keypad entry.
- Pressing **undo** undoes any edits made to that page, and stays on the page.
- Pressing **ok** accepts all information on the page, and returns to menu page.
- Pressing the **POWER** switch after editing a configurable item evokes an invalid key tone and a message to "ok entry". **ok** must be selected to accept the edit before the instrument can be powered off.
- The page number is located in the upper-right corner of the display.

CAUTION

The instrument's configuration information is not lost when disconnected from AC power. However, error history and infusion program settings may be lost. If this information is to be saved, be sure to record it before disconnecting power.

2.4 CONFIGURATION PROCEDURE (Continued)

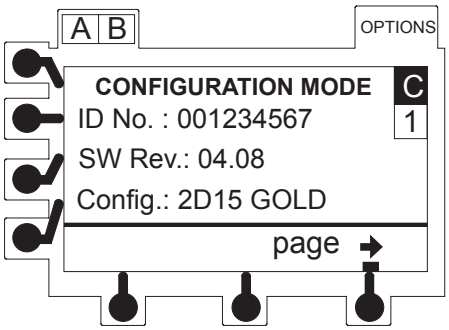
2.4.1 Entering Configuration Mode

The instrument must be off (both channels must be off for dual channel).

The procedure for the single and dual channel is the same. Any configuration in the dual channel sets the same value for both channels.

1. Press and hold left-bottom display soft key.
2. Press **POWER** switch. Continue to press display soft key until configuration mode display appears, then release.

   Page C1 of configuration mode is displayed. This is a read-only display.



3. Press **page** → to advance to page to be configured.

> **NOTE:** For 7131/7231, the default code will be 5B44 for instruments set to factory defaults (instead of 2D15).

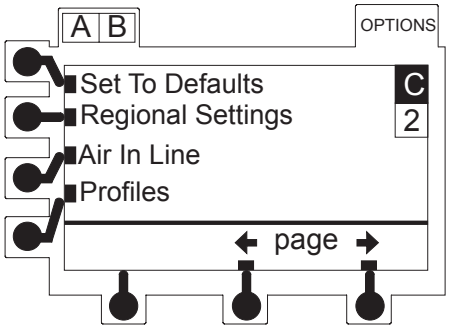
2.4.2 Setting to Defaults

The Set To Defaults mode programs all configuration items to their default values.

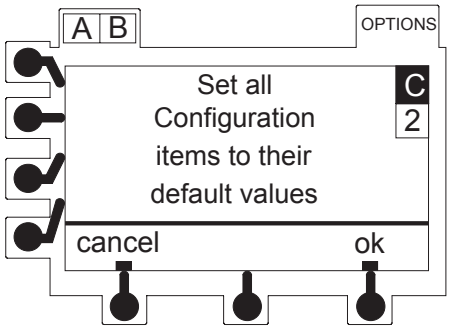
CAUTION

It is strongly recommended that the Configurable Options be reviewed for a complete list of defaults before using this feature.

1. Advance to C2 page.



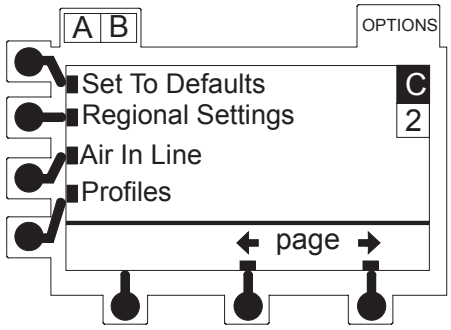
2. Press **Set to Defaults** soft key.



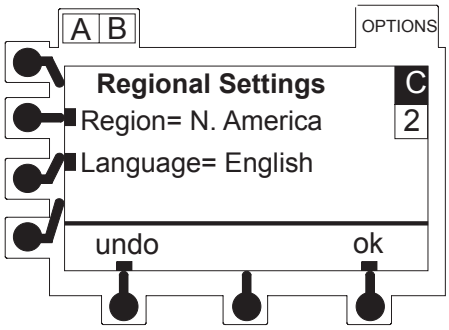
3. Press **ok** to accept change and return to beginning of C2 page. Pressing **cancel** leaves all items set to their previous values and returns to beginning of C2 page.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.3 Regional Settings



1. From C2 page, press **Regional Settings** soft key.
2. Press **Region** soft key to select for editing. Press again to cycle through region choices (N. America, European).



3. Press **Language** soft key to select for editing. Press again to cycle through language choices .

NOTES:

- If there is no tick mark next to **Language**, English is the only option.
- Instruments configured in European Regional Settings (with profiles OFF) do not have a drug list. When Dose Rate Calculator is chosen (from OPTIONS menu), followed by Enter New Program, the instrument defaults to generic drug dose rate calculation.

4. Press **ok** to accept change and return to beginning of C2 page.

2.4.4 Setting Air-in-Line Threshold

The air-in-line threshold sets the bubble size sensitivity. The air-in-line reset allows the clinician to respond to an AIR IN LINE alarm, assess its clinical significance, and choose whether or not to continue the infusion without removing the air. The reset feature allows only the current bubble to proceed without tripping an alarm. The air in line threshold value choices are 50, 100, 200 and 500 microliters.

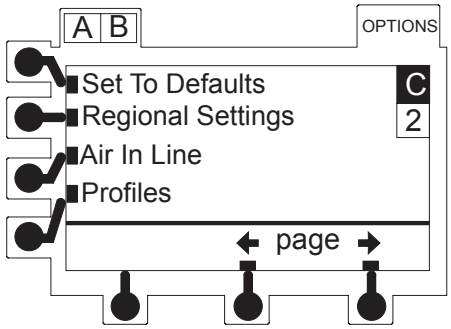
The Accumulator setting, when on, looks for 10% to 15% of the downstream path to be air before giving an **ACCUMULATED AIR IN LINE** alarm. The amount of air that causes the alarm will vary with the threshold setting and rate.

An AIR IN LINE alarm is the result of the bubble size exceeding the Threshold setting. An **ACCUMULATED AIR IN LINE** alarm is the result when 10 to 15% of the downstream path is filled with air, exceeding the accepted level looked for when the Accumulator is set to **On**.

2.4 CONFIGURATION PROCEDURE (Continued)

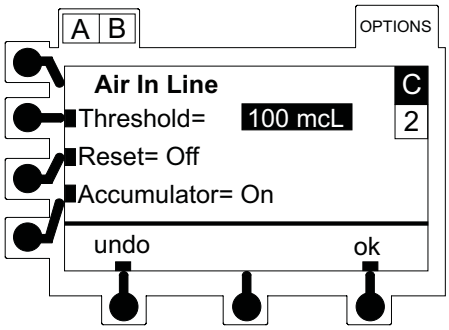
2.4.4 Setting Air-in-Line Threshold (Continued)

1. From C2 page, press **Air In Line** soft key.



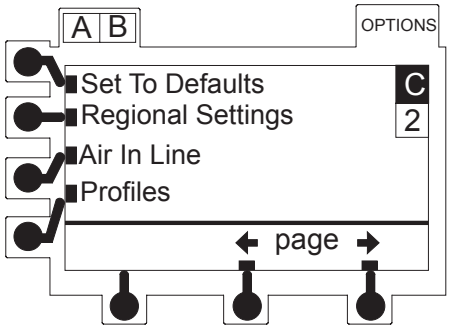
2. Press **Threshold** soft key to select for editing. Press again to cycle through **50 mcL**, **100 mcL**, **200 mcL** and **500 mcL**.

> **NOTE:** Use a 50 microliters setting on microbore tubing. The other three settings may be used on macrobore tubing.

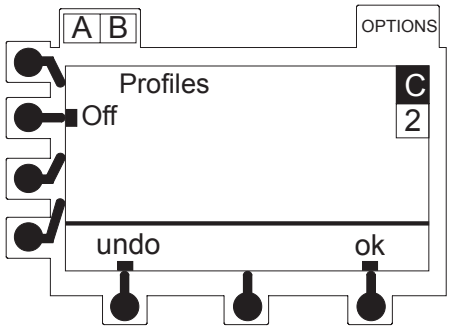


3. Press **Reset** soft key to select for editing. Press again to cycle between **On** and **Off**.
4. Press **Accumulator** soft key to select for editing. Press again to cycle between **On** and **Off**.
5. Press **ok** to accept change and return to beginning of C2 page.

2.4.5 Profiles



1. From C2 page, press **Profiles** soft key.



2. Press **Off** or **On** soft key to select for editing. Press again to cycle between **On** and **Off**.

> **NOTES:**
>
> - The data set for Guardrails® Safety Software must be loaded to set Profiles to **On**. For the Guardrails® Safety Software to function, Profiles and Dose Rate must be **On**.
> - When Profiles is turned on, the configuration mode will have limited access. Access will be limited to Regional Settings, Profiles, Computer Link and Optional Features, due to the data set overriding the configuration settings as part of the Guardrails® Safety Software.

2.4 CONFIGURATION PROCEDURE (Continued)

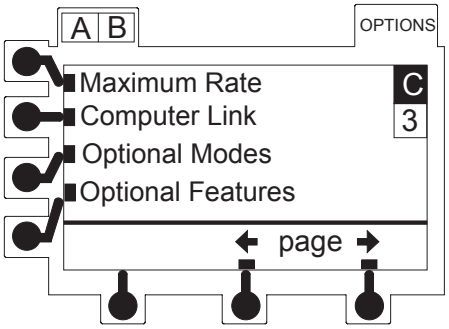
2.4.6 Setting Maximum Rate

This sets the maximum selectable rate. The range for Maximum Rate is 0.1 to 999.9 mL/h.

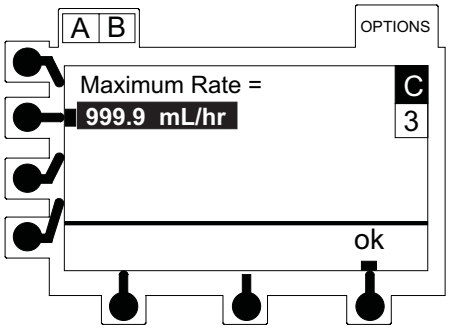
NOTES:

- The maximum rate setting applies to all infusion modes.
- Setting the Maximum Rate below the preset KVO Rate will lower the KVO Rate. The KVO Rate will not exceed the Maximum Rate.

1. Advance to C3 page.

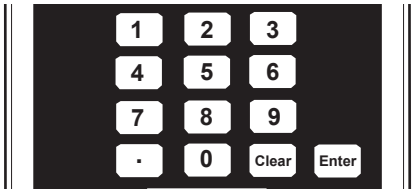


2. Press **Maximum Rate** soft key.



3. Press the soft key to select the value for editing.

4. Use numeric keypad to enter maximum rate. Press **Enter**.



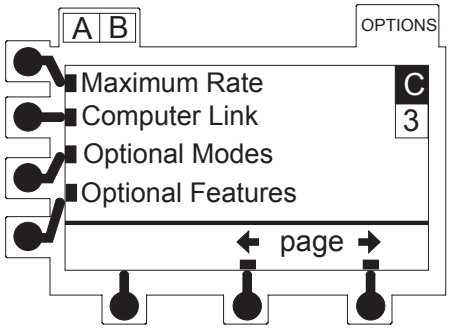
5. Press **ok** to accept change and return to beginning of C3 page.

2.4.7 Setting Computer Link

The Computer Link feature allows a hospital/facility computer to interact with the instrument and programs the level of computer control available. If the feature is off, the computer cannot communicate with the instrument.

Monitor Mode allows computer to only receive information from instrument. Enabling of monitoring mode automatically places it in options menu.

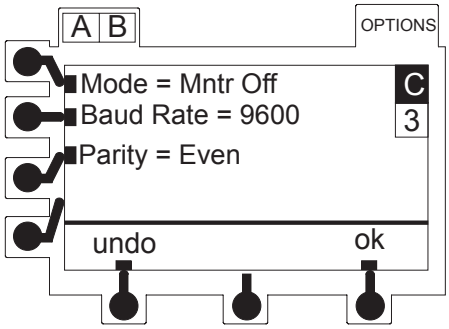
Off Mode does not allow any communication between instrument and a computer.



1. On C3 page, press **Computer Link** soft key.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.7 Setting Computer Link (Continued)



2. Press **Mode** soft key to select for editing. Press again to cycle through **Off** and **Mntr**.
3. Press **Baud Rate** soft key to select for editing. Press again to cycle through choices (300, 600, 1200, 1800, 2400, 4800 and 9600).
4. Press **Parity** soft key to select for editing. Press again to cycle through **Even**, **Odd**, and **None**.
5. Press **ok** to accept changes and return to beginning of C3 page.

2.4.8 Setting Optional Modes

The Optional Modes feature allows the options menu to be configured to how it will appear in normal mode. Enabling of these modes will automatically place them in the option menu.

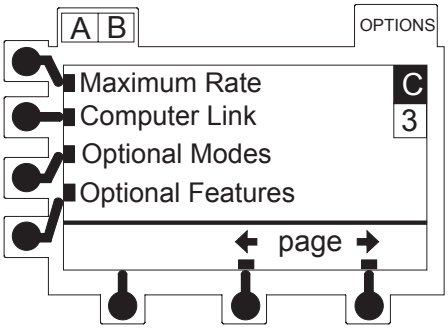
When **Loading Dose, Multi-Step,** and **Multi-Dose** are on, they appear in the menu when **options** key is pressed in normal mode.

For **Dose Rate** to appear in the options menu, it must be turned on.

Universal Rate: If the DRC mode is discontinued, the instrument's primary setting will now be the same as the last rate and VTBI used in the DRC mode.

NOTES:

- Dose Rate must be on in order to use Guardrails® Safety Software drug selection capability.
- Instruments configured in European Regional Settings (with profiles OFF) do not have a drug list. When Dose Rate Calculator is chosen (from OPTIONS menu), followed by Enter New Program, the instrument defaults to generic drug dose rate calculation.



1. On C3 page, press **Optional Modes** soft key.
2. Press **Loading Dose** soft key to select for editing. Press again to cycle between **On** and **Off**.

NOTE: This feature allows an initial infusion rate to be set up for a specific volume, automatically followed by a maintenance rate from the same container.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.8 Setting Optional Modes (Continued)

3. Press **Dose Rate** soft key to select for editing. Press again to cycle between **On** and **Off**.

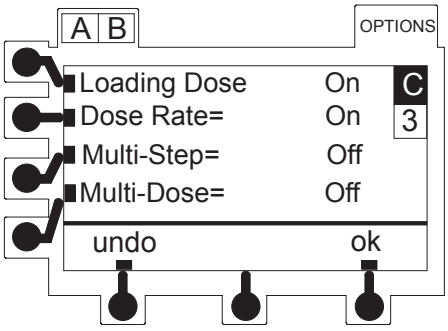
> **NOTE:** This feature allows dose parameters to be programmed so that the instrument then calculates the volumetric rate.

4. Press **Multi-Step** soft key to select for editing. Press again to cycle between **On** and **Off**.

> **NOTE:** This feature allows a sequential program to deliver up to nine steps; fluid volumes and delivery rates may be programmed for each step.

5. Press **Multi-Dose** soft key to select for editing. Press again to cycle between **On** and **Off**.

> **NOTE:** This feature allows multiple infusions to be programmed over a period of up to 24 hours; the fluid volume and delivery rate is repeated for each delivery.



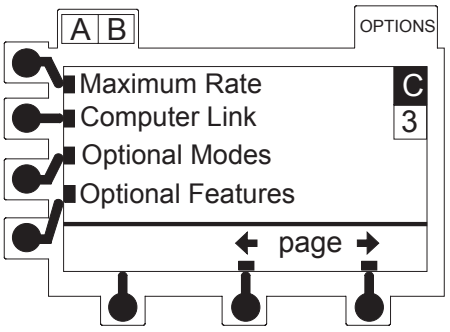
6. Press **ok** to accept changes and return to beginning of C3 page.

2.4.9 Setting Optional Features

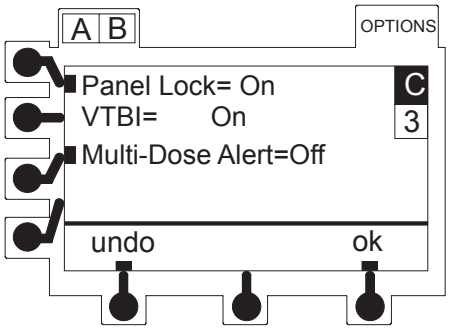
The Panel Lock feature allows the front panel to be locked and unlocked to help prevent tampering.

When VTBI (volume to be infused) is on, a volume to be infused must be entered; otherwise, the last remaining VTBI or last entered VTBI, depending on the channel's last usage, will be in effect. When VTBI is off, there is no VTBI line capability.

When the Multi-Dose Alert feature is on, the option is available to set an alert at the end of every dose when in the Multi-Dose mode.



1. On C3 page, press **Optional Features** soft key.



2. Press **Panel Lock** soft key to select for editing. Press again to cycle between **On** and **Off**.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.9 Setting Optional Features (Continued)

3. Verify **VTBI** is **On**.

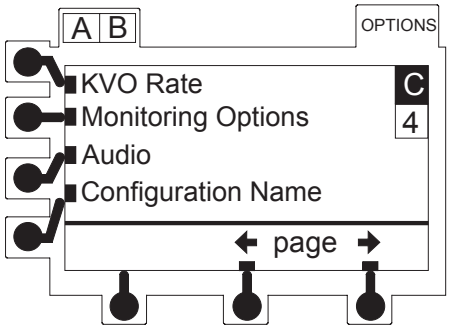
> **NOTE:** The flow sensor option (empty container detector) needs to be installed to be able to turn VTBI off.

4. Press **Multi-Dose Alert** soft key to select for editing. Press again to cycle between **On** and **Off**.
5. Press **ok** to accept changes and return to beginning of C3 page.

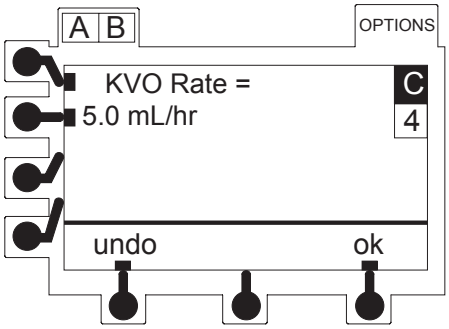
2.4.10 Setting KVO Rate

The instrument will automatically operate at the KVO rate (or current rate, whichever is less) once the primary VTBI has counted down to zero. The KVO rate range is 0.1 to 20.0 mL/h.

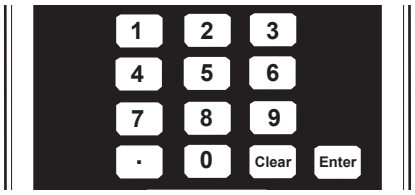
1. Advance to C4 page.



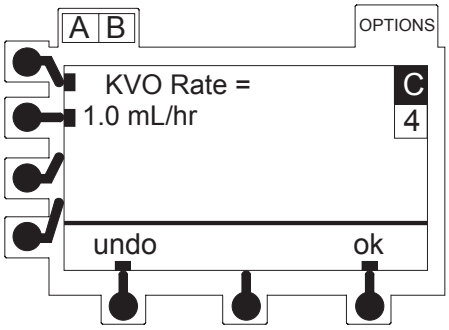
2. Press **KVO Rate** soft key.



3. Press soft key next to rate value once to select for editing.



4. Use numeric keypad to enter KVO rate. Press **Enter**.



5. Press **ok** to accept change and return to beginning of C4 page.

> **NOTE:** The KVO Rate will NOT exceed the present Maximum Rate.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.11 Setting Dynamic Monitoring® System Features

The Signature Edition® Infusion System incorporates the Dynamic Monitoring® System, a versatile intravenous site monitoring system for detection of both full and partial occlusions of the fluid pathway.

This system includes both precision pressure sensing and continuously computed Flow Resistance.

Flow Resistance measurement dramatically improves the ability to detect partial and full occlusions, particularly at low flow rates. Resistance monitoring eliminates the impact of patient elevation and flow rate, to provide the most direct assessment of patient.

Both the Pressure and Flow Resistance monitoring modes feature numeric and bar graph displays of current values plus easily selectable trend graphs, displaying up to twelve hours of monitored values.

The Pressure Mode provides 1 mmHg display resolution, with manual baseline setting, and a user-adjustable alarm limit.

The Resistance Mode provides two ranges and user-alert limit adjustment, to meet neonatal to adult patient needs.

Many monitoring features and functions are configurable, by qualified technical personnel, to meet specific needs by allowing customization.

Monitoring Mode Options

IV lines, catheters, and applications create various levels of resistance to flow. Monitoring mode options are available to meet each clinical application, as follows:

- **Monitoring Options**: To select IV line/site monitoring modes of resistance, high resistance, and adjustable pressure.

  Pressure: Highest occlusion method, when set to a default of 600 mmHg, when Resistance and High Resistance modes are not sufficient.

  Resistance: Designed to monitor IV line/site resistance, providing optimum sensitivity. Used for larger catheter sizes (up to 24 gauge).

  High Resistance: Designed to monitor IV line/site resistance, with optimum sensitivity where smaller (higher resistance) catheters (26 or 28 gauge) are used.

AutoRestartPlus

The AutoRestartPlus feature provides the ability to automatically continue an infusion if downstream resistance or pressure measurements indicate that an occlusion condition has cleared with a 40-second **Checking Line** period (excluding High Resistance monitoring mode). If the condition is not cleared, the **OCCLUSION DOWNSTREAM** alarm occurs and infusion is stopped until manually restarted.

The **Checking Line** message and tone are presented whenever a resistance or pressure measurement exceeds its alarm threshold.

- In resistance monitoring modes, the **Checking Line** period is caused by a measured resistance of 100% or a pressure level exceeding a configured threshold. This pressure threshold is separate from the Pressure mode threshold.

2.4 CONFIGURATION PROCEDURE (continued)

2.4.11 Setting Dynamic Monitoring® System Features (Continued)

If resistance measurements initiate the **Checking Line** condition, the channel will continue infusing in order to determine if the measured flow resistance has changed. In Resistance monitoring mode, if the measured flow resistance falls to any value below 100%, the channel will resume normal operating conditions automatically (excluding High Resistance monitoring mode).

In resistance monitoring modes, pressure measurements initiate the **Checking Line** period when the pressure exceeds the limit. If the pressure falls to less than one third of the configured limit with 40 seconds, normal flow resumes.

- In pressure monitoring mode, the **Checking Line** period is caused by pressure exceeding the alarm limit. If the pressure falls to less than one third of the alarm limit within 40 seconds, normal flow resumes.

Qualified service personnel can turn off this feature (set restarts to zero), or program from 1 to 9 restarts.

- In High Resistance monitoring mode, restarts do not occur for resistance measurements.

After the programmed number of restarts has occurred, the channel will immediately alarm **OCCLUSION DOWNSTREAM**, if pressure or flow resistance conditions indicate an occlusion. The programmed number of restarts become available again when RUN/HOLD or the **run** soft key is pressed.

NOTE: The restart counter is reset whenever RUN/HOLD is pressed, the instrument or channel is turned off or an alarm occurs.

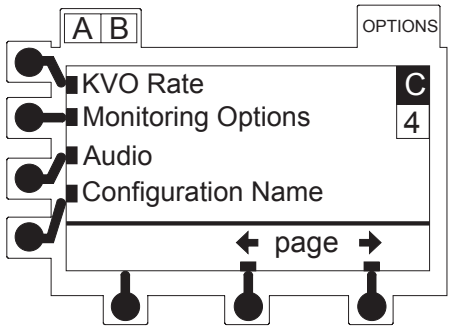
Trend Graphs

Trend graphs display downstream pressure or flow resistance over time (up to 12 hours).

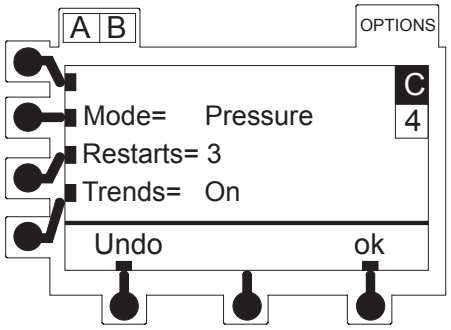
In Pressure, Resistance, and High Resistance monitoring modes, the trend graph displays the flow pattern over time. Downstream occlusions, which occur in the

Pressure or Resistance modes, will be indicated by a vertical tick mark at the top of the trend screen.

Trend graphs of **fifteen minutes, one hour, four hours** and **twelve hours** are available during normal operation.



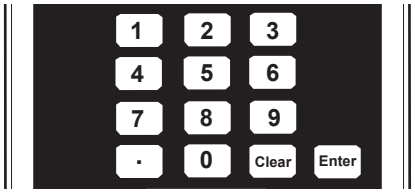
1. On C4 page, press **Monitoring Options** soft key.



2.4 CONFIGURATION PROCEDURE (Continued)

2.4.11 Setting Dynamic Monitoring® System Features (Continued)

2. Press Mode soft key to select for editing. Press again to cycle between Hi Resist, Resist and Pressure.



3. Press **Restarts** soft key. Use numeric keypad to enter number of restarts, from "0" (which turns feature off) to "9", then press **Enter**.
4. Press **Trends** soft key to select for editing. Press again to cycle between **On** and **Off**.
   - In Pressure mode, graph displays in mmHg.
   - Trend data is lost when:
     - ♦ graph information is cleared
     - ♦ instrument is off for more than 12 hours
   - Trend data is maintained when:
     - ♦ rate is changed
     - ♦ battery is depleted
   - Trend data is scaled (by 3 times or 1/3, as applicable) when cycling between Resistance and Hi Resistance modes.
5. Press **ok** to accept changes and return to beginning of C4 page.
6. Precision Flow: Selecting **Pressure Mode** and running below 50 mL/h will place instrument into **Precision Flow Mode**.

   Precision Flow addresses both flow resolution (parts or pulses per mL) and flow continuity (time between pulses). The instrument will divide each mL into 3600 parts and equally space these parts into a virtually continuous delivery. With Precision Flow, the longest time between a part/pulse at 0.1 mL/h is 10 seconds. As the rate increases, this time will become shorter.

> **NOTE:** Resistance measurement is restarted at 0% when:
> - RUN/HOLD is pressed to put on hold and again to start.
> - Dose ends in Multi-Dose mode.
> - **Checking Line** message appears.

   Checking Line alert applies to pressure, resistance and upstream occlusion, with one tone at the beginning and a flashing popup display (on for 4 seconds, off for 6 seconds).

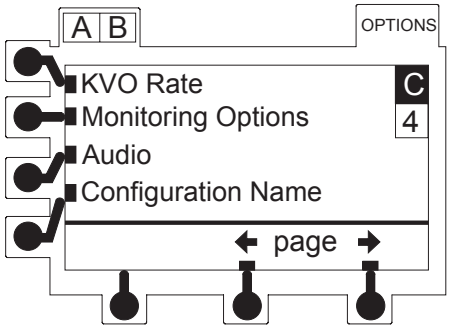
2.4.12 Setting Audio Volume

The volume settings determine which range of audio volume is available. For example, "Low" may be too low, therefore "Med Hi" would be chosen. A transition tone, if enabled, will sound upon completion of a secondary VTBI, step in multi-step mode, dose beginning and ending in multi-dose mode, and completion of a loading dose in loading-dose mode.

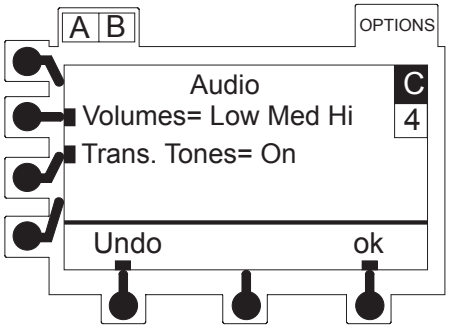
The speaker volumes are approximately: Low = 60 dB, Med = 65 dB, and Hi = 70 dB at one meter.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.12 Setting Audio Volume (Continued)



1. On C4 menu, press **Audio** soft key.



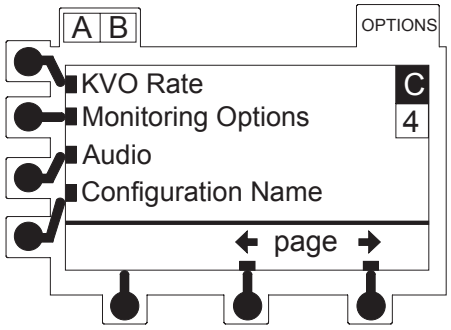
2. Press **Volumes** soft key to select for editing. Press again to cycle between **Low, Med, Hi, Med Hi,** or **Hi**.
3. Press **Trans. Tone** soft key to select for editing. Press again to cycle between **On** and **Off.**
4. Press **ok** to accept changes and return to beginning of C4 page.

2.4.13 Setting Configuration Name (Instrument ID Label)

The characters entered here will be shown in the lower LCD display. This electronic label is normally displayed, even when the instrument is off.

The configuration name can be used to uniquely identify the instrument's configuration, facility location, or reference number. It is a 4-character alpha-numeric name; for example, PICU (Pediatric Intensive Care Unit), ICU (Intensive Care Unit), or 2400.

NOTE: A 4-digit alpha-numeric code can be seen next to the configuration name upon entering Configuration Mode (refer to "Entering Configuration Mode" section in this chapter). This code is only a hexadecimal reflection of the instrument's configuration.

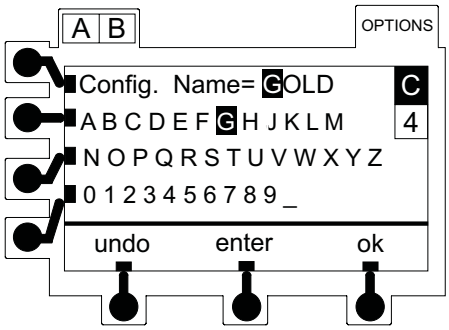


1. On C4 menu, press **Configuration Name** soft key.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.13 Setting Configuration Name (Instrument ID Label) (Continued)

2. Press **Config. Name** soft key to position highlight on character to be changed.



3. Press **character** soft keys aligned with rows **A to M**, **N to Z** or **O to "_"** to highlight needed character.
4. Press **Enter**. Up to 4 characters can be programmed in this way. Repeat steps 2, 3, 4 as necessary.
5. Press **ok** to accept changes and return to beginning of C4 page.

NOTES:

- If the configuration has been changed but not the name, the instrument will display the option to rename before turning off or proceeding to the Teach Mode. Refer to “Pop-Up Displays” section for further explanation.
- There must be 4 characters in the configuration name. Use the space symbol (_) to fill in any open characters.

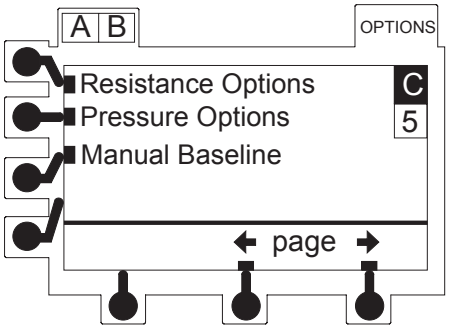
2.4.14 Resistance Options

Resistance Display: Provides a bar graph and indication of resistance in the line while monitoring a single channel.

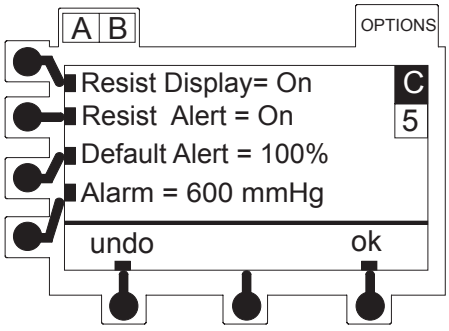
Resistance Alert: Provides an early warning of increases in downstream flow resistance by allowing the level to be adjusted in 5% increments during operation.

Default Alert: Provides a starting point for occlusion detection if a different level has not been chosen. The selected level will remain in effect while the instrument is on, until another option is selected from the Monitoring Options page.

Alarm: Provides the option to lower the pressure occlusion setting that is still active, even in resistance modes.



1. Advance to C5 page.
2. Press **Resistance Options** soft key.



2.4 CONFIGURATION PROCEDURE (Continued)

2.4.14 Resistance Options (Continued)

3. Press **Resist Display** soft key to select for editing. Press again to cycle between **On** and **Off**.

> **NOTE:** Setting **Resist Display** to **Off** will clear **Default Alert** from the screen and change **Resist Alert** to **Off**.

4. Press **Resist Alert** soft key to select for editing. Press again to cycle between **On** and **Off**.

> **NOTES:**
>
> - Setting **Resist Alert** to **Off** will clear **Default Alert** from the screen.
> - Resistance alert will give an alarm tone every thirty seconds, with a popup display (on for 4 seconds, off for 6 seconds). This occurs when the resistance measurement is above the alert threshold or at 100%, even when checking the line. If the display is off, the alert feature will automatically be turned off.

5. Press **Default Alert** soft key to select for editing. Enter a number using keypad, then press **Enter**. Instrument will round up or down to nearest 5% increment.

> **NOTE:** To set the **Default Alert** level, both **Resist Display** and **Resist Alert** need to be **On**.

6. Press **Alarm** soft key to select for editing. Enter a number using keypad, then press **Enter**.
7. Press **ok** to accept change and return to beginning of C5 page.

2.4.15 Pressure Options

Pressure Display: Provides a bar graph and indication of pressure in the line while monitoring a single channel.

Pressure Alarm: Allows the choice of a fixed pressure mode or an adjustable pressure mode.

- Adjustable Pressure: Provides an early warning of increases in downstream pressure. Designed to monitor IV line/site based on pressure, and provide user-adjustable pressure alarm limits. Used for the smallest of catheter sizes and special applications; such as, infusion through transducers, into dialysis systems, and for the highest resistance catheters (including some neonatal PICC catheters).
- Fixed Pressure: Designed to monitor IV line/site pressure and alarm, based on a fixed pressure limit of 600 mmHg. Used when adjustable pressure is not wanted. Used for the smallest of catheter sizes and special applications; such as, infusion through transducers, into dialysis systems, and for the highest resistance catheters (including some neonatal PICC catheters).

Maximum Pressure: Provides the maximum pressure alarm limit if the Pressure Alarm mode is set to Adjustable. Any value between 25 mmHg and 600 mmHg (in increments of 25 mmHg) inclusively can be entered.

If **Max Press** is set to a value less than **Def Alarm**, the **Def Alarm** threshold will automatically be set to the **Max Press** value and **Default Alarm Must Be Less Than or Equal to XXX mmHg** (which is Max Press level) will be displayed.

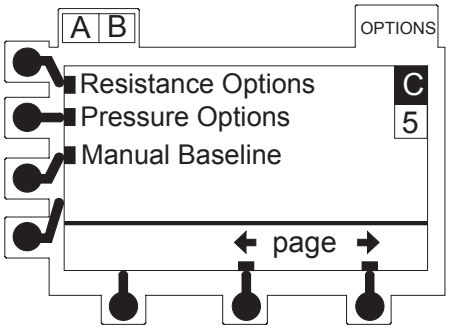
2.4 CONFIGURATION PROCEDURE (Continued)

2.4.15 Pressure Options (Continued)

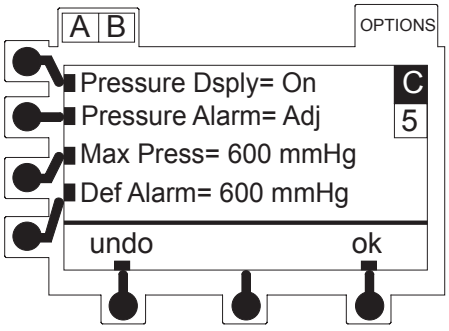
Default Alarm: Provides an adjustable pressure setting in 25 mmHg increments (25-600 range). This value can not exceed the Maximum Pressure that was set above. If an attempt is made to enter a **Def Alarm** value greater than **Max Press**, the entry will be rejected with a popup screen and an audible tone.

In addition, the **Def Alarm** edit field will be highlighted and set to the **Max Press** value. **Pressure Alarm = Adj** must be selected to change from 600 mmHg.

1. Advance to C5 page.



2. Press **Pressure Options** soft key.



3. Press **Pressure Dsply** soft key to select for editing. Press again to cycle between **On** and **Off**.
4. Press **Pressure Alarm** soft key to select for editing. Press again to cycle between **Adj** and **Fix**.
5. Press **Max Press** soft key to select for editing. Enter a number using keypad, then press **Enter**. Instrument will round up or down to nearest 25 mmHg increment.
6. Press **Def Alarm** soft key to select for editing. Enter a number using keypad, then press **Enter**. Instrument will round up or down to nearest 25 mmHg increment.

> **NOTE:** Enter the Def Alarm value that is less than or equal to the Max Press value.

7. Press **ok** to accept change and return to beginning of C5 page.

2.4.16 Manual Baseline

Auto Baseline: The instrument reads a baseline at startup and then adds the alarm limit, to determine the point of alarm.

For example, if an alarm limit of 300 mmHg was selected, the instrument would alarm at baseline + 300 mmHg. Auto Zeroing occurs the first time RUN/HOLD is pressed; this will be the maximum baseline. Subsequent presses of RUN/HOLD will only lower (not raise) the baseline.

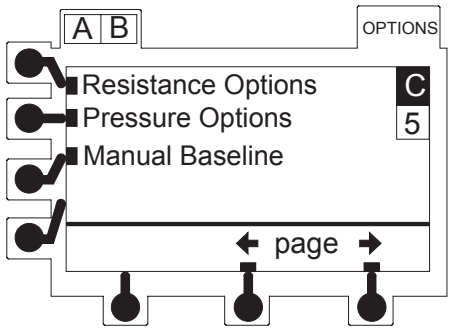
Manual Baseline: Sets a fixed baseline and overrides the Auto Zero level until the instrument is turned off, the latch is opened, the set is reloaded, or the pressure baseline function is performed again. This allows the instrument to display the actual pressure required for an IV to infuse. To get this real time readout, **Manual Baseline** must be **On**.

2.4 CONFIGURATION PROCEDURE (Continued)

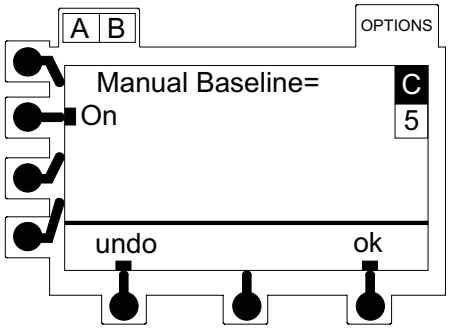
2.4.16 Manual Baseline (Continued)

To activate this mode with the instrument on hold, or at startup, press the **OPTIONS** key and then select **Set Pressure Baseline** and press **ok**.

When **RUN/HOLD** is pressed, the bar graph will show the alarm point with a tic mark on the bar graph, and the actual pressure in the line will be displayed below the bar graph.



1. Advance to C5 page
2. Press **Manual Baseline** soft key to select for editing.



3. Press **On** or **Off** soft key to cycle between **On** and **Off**.
4. Press **ok** to accept change and return to beginning of C5 page.

2.5 TRANSFERRING SETTINGS TO ANOTHER INSTRUMENT

Once an instrument has been programmed to meet technical and clinical needs, the settings can be transferred to other instruments. The programmed instrument is referred to as the "Teacher" and the other instrument is referred to as the "Learner".

NOTE: Only the configuration settings will be transferred. The instrument ID number, periodic maintenance settings and other settings from the diagnostics mode will not be transferred. The Guardrails® Safety Software data sets will NOT be transferred.

Connect a standard 9-pin Null Modem RS-232 cable (ALARIS P/N 133450) to the RS-232 ports on the instruments.

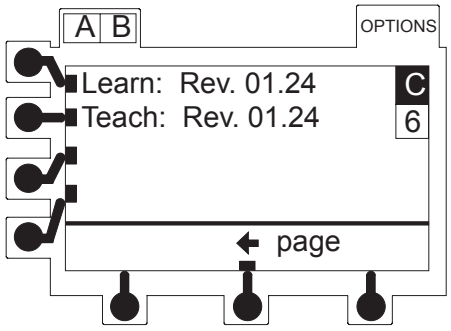
NOTE: Instrument software versions 4.06 and 4.08 use same "Rev.01.24" and can be used to learn/teach one instrument to the next.

2.5 TRANSFERRING SETTINGS TO ANOTHER INSTRUMENT (Continued)

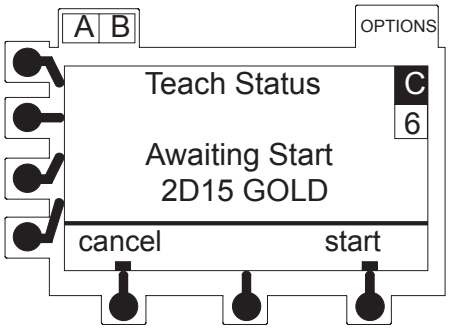
2.5.1 Learn/Teach Instrument Procedure

NOTE: The Learn/Teach function will not work if the version level for Learn/Teach is not the same on both instruments. It is not recommended to Learn/Teach different model families; such as, using a Model 7130/7230 to Learn/Teach a Model 7131/7231.

1. Access **Configuration Mode** for both "teacher" and "learner" instruments and advance to C6 page.



2. Press **Teach** soft key of "teacher" instrument and Press **Learn** soft key of "learner" instrument.



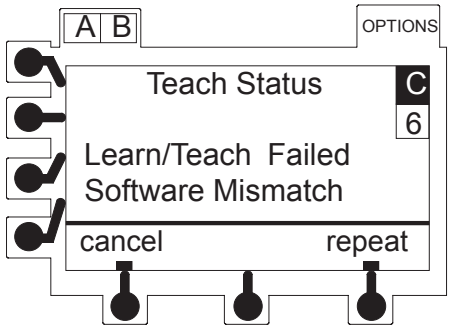
3. Press **start** soft key of "teacher" instrument.

Downloading displays until transfer is complete, and then display indicates if transfer was successful or unsuccessful.

NOTES:

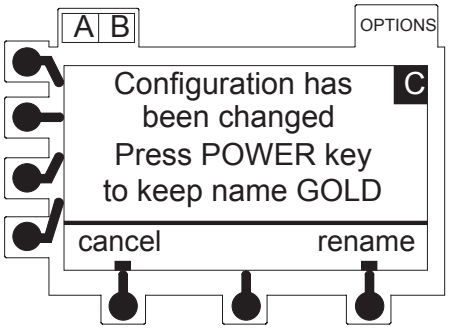
- **Repeat** allows the operator to reattempt teaching the current instrument or to teach the next instrument.
- Reattach the cover, and/or cover and screws, over the RS-232 port after disconnecting the cable.
- When the profile/data sets are used they will override (replace) the selection in the Configuration Mode. Learn/Teach will need to be done after the profile/data set is loaded to ensure proper use (Profiles On).
- Learn/Teach can be used for transferring the Configuration Mode settings, but not the Guardrails® Safety Software data set (flashed from computer only).

When a Learn/Teach operation is unsuccessful due to incompatible versions, the “teacher” or “learner” instrument will display the message "Learn/Teach Failed Software Mismatch".



2.5.2 Pop-Up Displays

The pop-up screens appear when an attempt is made to turn off an instrument or execute the teach mode after changing the configuration (or accessing a configured item), but not changing the configuration name. If the instrument's configuration is changed and not the configuration name, instruments with the same name may have different configurations. The pop-up menus ask if the configuration should be renamed.



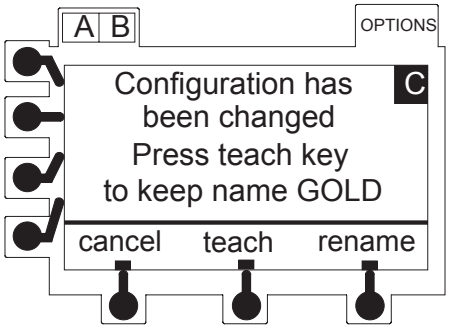


Table 2-1. Record of Configured Instruments

	#1	#2	#3	#4	#5
§ Instrument ID/Serial #					
Config Name (Instr Label)					
Location					
Regional Settings					
Air-In-Line: Threshold Reset Accumulator	µl	µl	µl	µl	µl
Profiles					
Dose Rate Calculator	Generic Dose Rate Calculator only				
Maximum Rate mL/h	mL/h	mL/h	mL/h	mL/h	mL/h
Computer Link: Mode Baud Rate Parity					
Optional Modes: Loading Dose Dose Rate Multi-Step Multi-Dose					
Optional Features Panel Lock VTBI Multi-Dose Alert					
KVO Rate mL/h	mL/h	mL/h	mL/h	mL/h	mL/h

--- Table Continued on Next Page ---

Table 2-1. Record of Configured Instruments (Continued)

	#1	#2	#3	#4	#5
Monitoring Options: Mode Restarts Trends					
Audio: Volume Trans. Tone					
Resistance Options: Resist Display Resist Alarm Default Alarm Alarm	 % mmHg	 % mmHg	 % mmHg	 % mmHg	 % mmHg
Pressure Options: Pressure Display Pressure Alarm Maximum Pressure Default Alarm	 mmHg mmHg	 mmHg mmHg	 mmHg mmHg	 mmHg mmHg	 mmHg mmHg
Manual Baseline					

§ Instrument ID/Serial # is accessed through Diagnostic Mode. Refer to the “Entering Diagnostic Mode” section in the “Troubleshooting” chapter.

Figure 2-1. Map of Configuration Screens

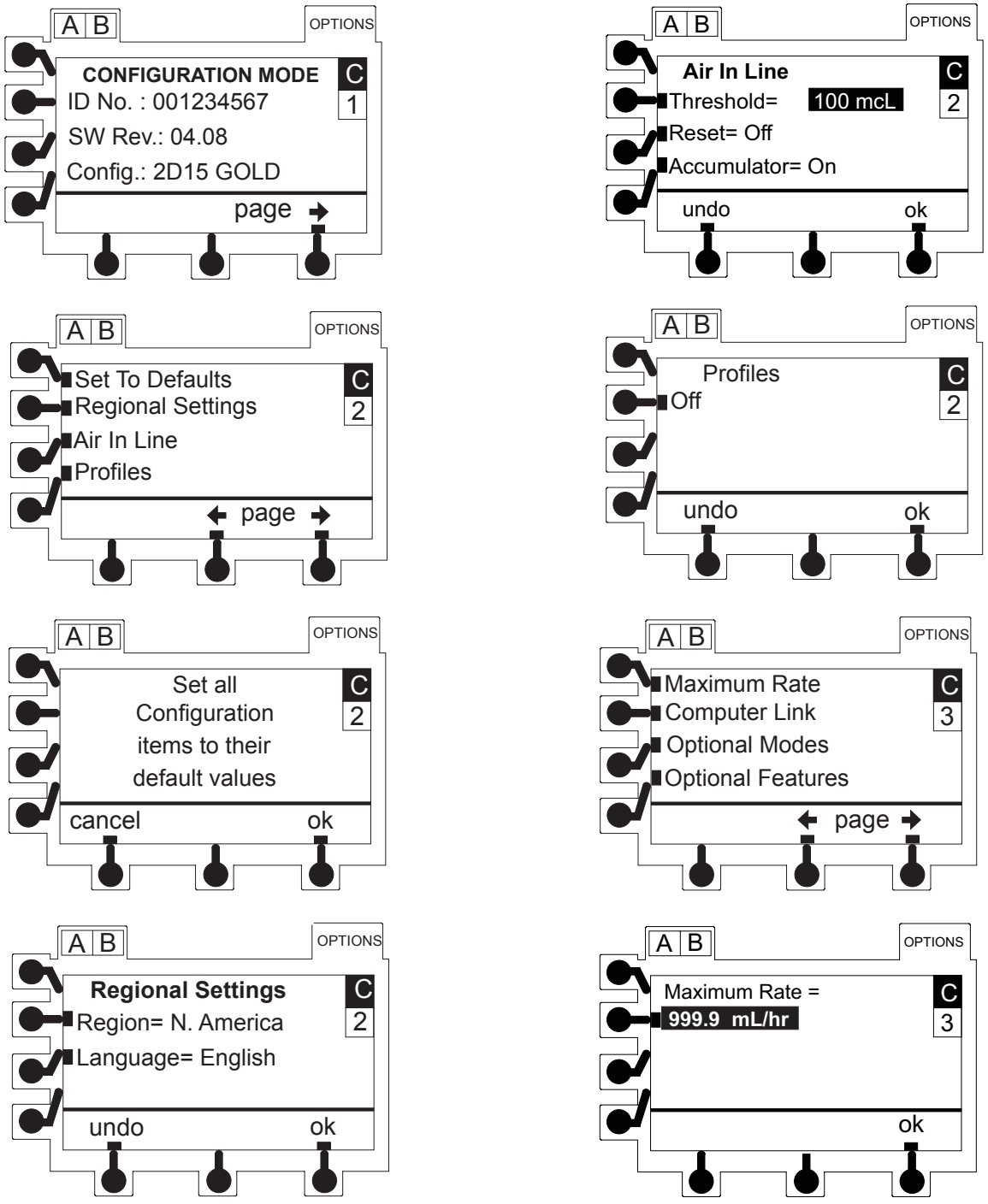


Figure 2-1. Map of Configuration Screens (Continued)

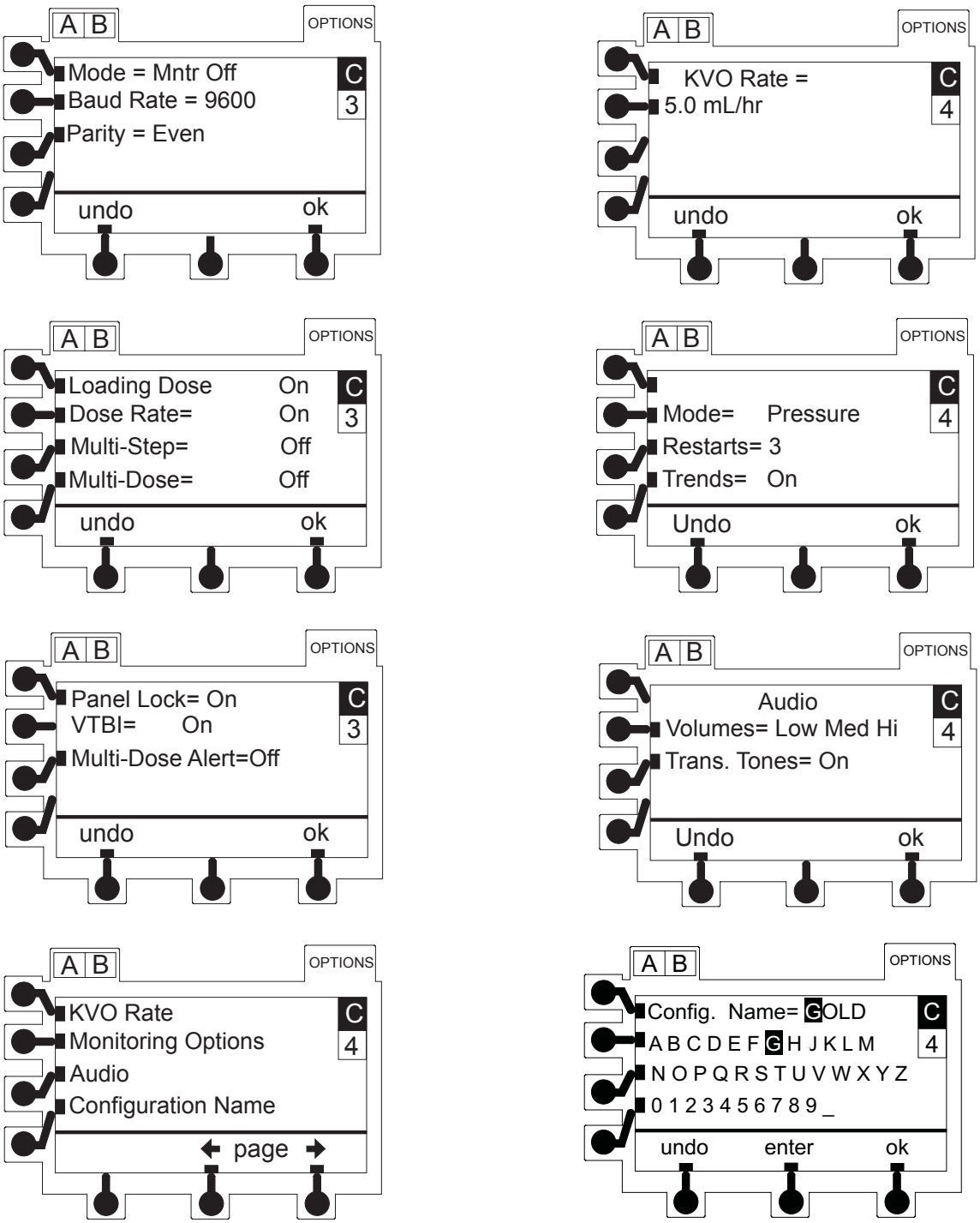
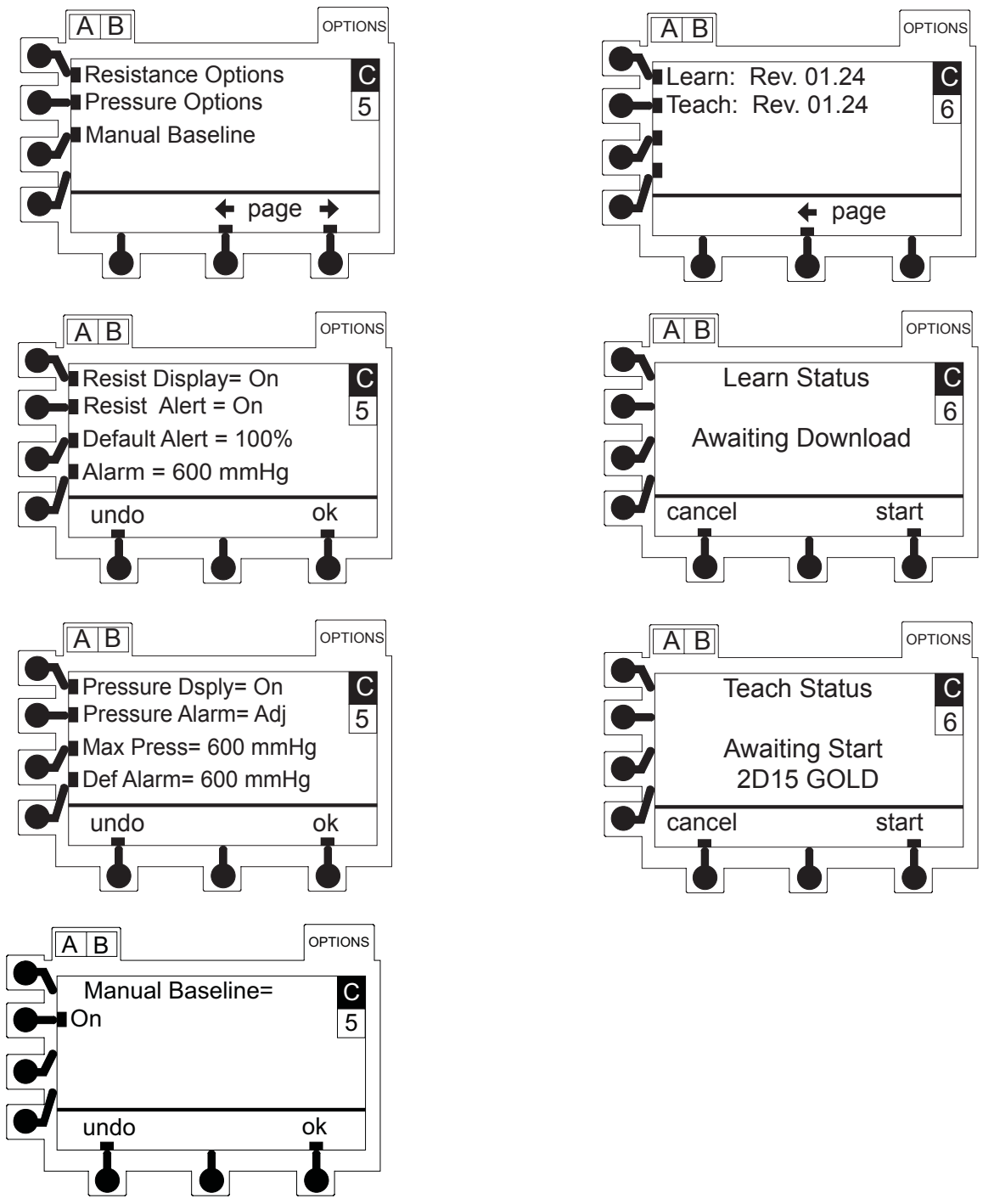


Figure 2-1. Map of Configuration Screens
(Continued)



Chapter 2B — CHECKOUT AND CONFIGURATION
Software Version 2.78

CAUTION

Keep latch closed when instrument is not in use.

CAUTION

Should an instrument be jarred severely or dropped, remove it from use immediately. It should be thoroughly tested and inspected by qualified service personnel to ensure proper function prior to reuse.

2.1 INTRODUCTION

This chapter describes the initial setup and configuration of an instrument with software version 2.78.

2.2 NEW INSTRUMENT CHECKOUT

Refer to the instrument's Directions For Use (DFU) for instructions regarding unpacking and setting up the instrument for the first time.

When turning on the instrument, verify the instrument beeps and that all display LED segments flash. This confirms that the instrument has performed its self test and is operating correctly. During operation, the instrument continually performs a self test, and will alarm and display a message if it detects an internal malfunction.

Contact ALARIS Medical Systems authorized service personnel if the instrument has physical damage, fails to satisfactorily pass startup sequence, fails a self test or continues to alarm.

For new instrument checkout refer to the applicable Signature Edition® GOLD Infusion System DFU.

2.3 CONFIGURABLE OPTIONS AND DEFAULTS

A hospital/facility biomedical technician has the capability to set all configuration parameters to their startup defaults in a single operation. The terms "configuration parameters" and "programmable features" are interchangeable and have the same meaning. Refer to the applicable Signature Edition® GOLD Infusion System DFU for more information.

2.4 CONFIGURATION PROCEDURE

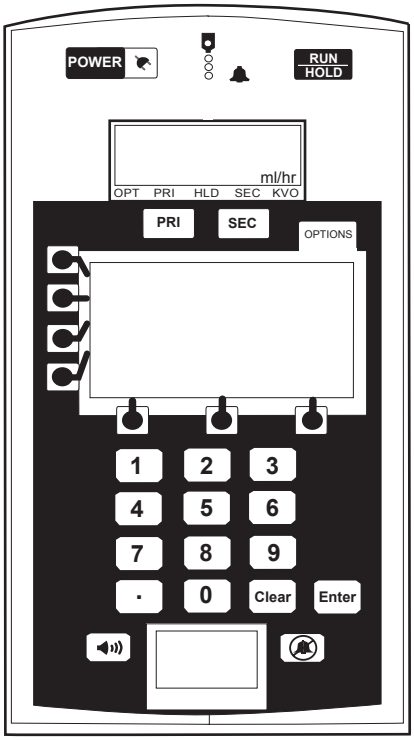
WARNINGS

- When an instrument's configuration is changed, the configuration name should also be changed in order to document the new parameter settings. The intent of the configuration name is to have only one set of parameters for each alpha-numeric code. Refer to "Pop-Up Displays" section.
- Powering down in configuration mode during an alarm or error will NOT save any configuration changes.

The configuration procedure is for use by qualified service personnel only. The configuration mode is intended for programming the technical and clinical features in accordance with current procedures and practices.

Table 2-3, "Record of Configured Instruments," can be reproduced and used to record and track instrument configuration settings.

A map of all the configuration screens is located at the end of this chapter (Figure 2-2).



NOTES:

- Pressing a soft key at the side of the Main Display the first time, selects it for editing. Some features are edited by subsequent presses of the soft key to cycle through available options. Other features are edited by means of the numeric keypad entry.
- Pressing **undo** undoes any edits made to that page, and stays on the page.
- Pressing **ok** accepts all information on the page, and returns to menu page.
- Pressing the **POWER** switch after editing a configurable item evokes an invalid key tone and a message to "ok entry". **ok** must be selected to accept the edit before the instrument can be powered off.
- The page number is located in the upper-right corner of the display.

2.4 CONFIGURATION PROCEDURE (Continued)

CAUTION

The instrument's configuration information is not lost when disconnected from AC power. However, error history and infusion program settings may be lost. If this information is to be saved, be sure to record it before disconnecting power.

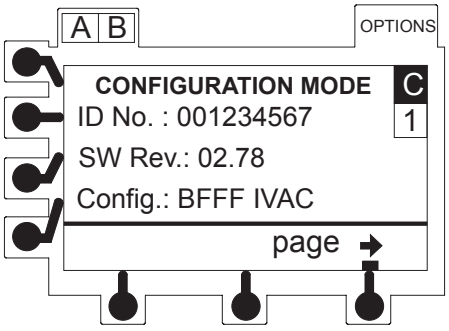
2.4.1 Entering Configuration Mode

The instrument must be off (both channels must be off for dual-channel).

The procedure for the single and dual channel instrument is the same. Any configuration in the dual channel sets the same value for both channels.

1. Press and hold left-bottom display soft key.
2. Press **POWER** switch. Continue to press display soft key until configuration mode display appears, then release.

   Page C1 of configuration mode is displayed. This is a read-only display.



3. Press **page →** to advance to page to be configured.

NOTE: For 7131/7231, the default code will be 4EF3 (instead of BFFF) for instruments set to factory defaults.

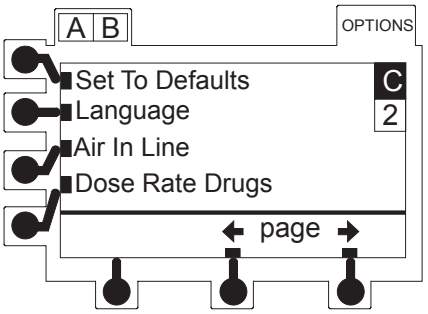
2.4.2 Setting to Defaults

The **Set To Defaults** mode programs all configuration items to their default values.

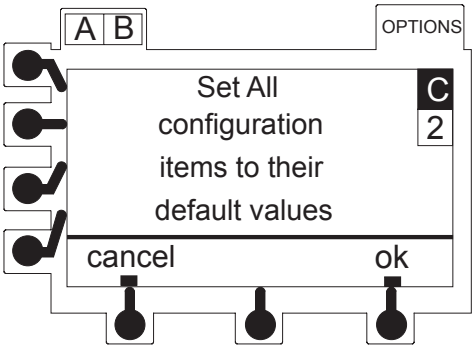
CAUTION

It is strongly recommended that the Configurable Options be reviewed for a complete list of defaults before using this feature.

1. Advance to C2 page.



2. Press **Set to Defaults** soft key.

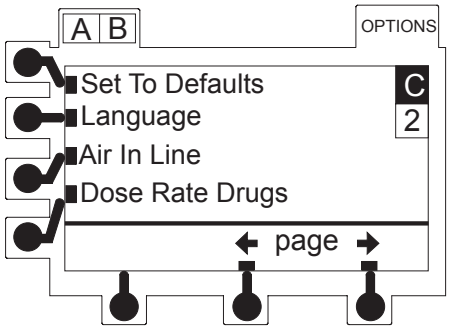


3. Press **ok** to accept change and return to beginning of C2 page. Pressing **cancel** leaves all items set to their previous values and returns to beginning of C2 page.

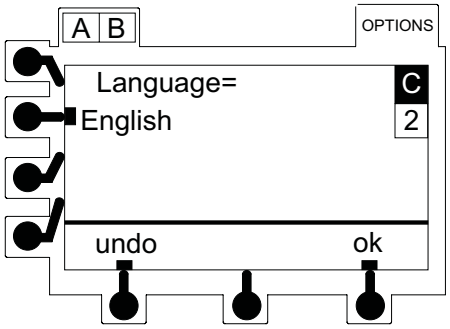
2.4 CONFIGURATION PROCEDURE (Continued)

2.4.3 Setting Language

Language choices for Models 7130/7230 are English and Canadian French. Language choices for Models 7131/7231 are Dutch, English, French, German, Italian, Spanish and Swedish. All displays will be in language selected, except diagnostic and configuration modes, which remain in English.



1. From C2 page, press **Language** soft key.



2. Press soft key to select for editing. Press again to cycle through language choices.

> **NOTE:** Dutch and German are choices in the language options, but labels and DFUs are not available in these languages for this software version.

3. Press **ok** to accept change and return to beginning of C2 page.

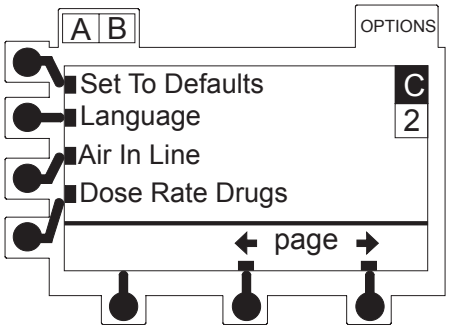
2.4.4 Setting Air-in-Line Threshold

The air-in-line threshold sets the bubble size sensitivity. The air-in-line reset allows the clinician to respond to an “Air-in-Line” alarm, assess the clinical significance of the air, and choose whether or not to continue the infusion without removing the air. The reset feature allows only the current bubble to proceed without tripping an alarm. The air in line threshold value choices are 50, 100, 200 and 500 microliters.

The Accumulator setting, when on, looks for 10% to 15% of the downstream path to be air before giving an “Accumulated Air-in-Line” alarm. The amount of air that causes the alarm will vary with the threshold setting and rate.

An “Air-in-Line” alarm is the result of the bubble size exceeding the Threshold

setting. An “Accumulated Air-in-Line” alarm is the result when 10 to 15% of the downstream path is filled with air, exceeding the accepted level looked for when Accumulator is set to **On**.

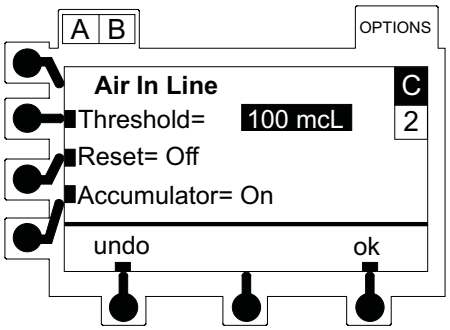


1. From C2 page, press **Air In Line** soft key.
2. Press **Threshold** soft key to select for editing. Press again to cycle through **50 mcL**, **100 mcL**, **200 mcL** and **500 mcL**.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.4 Setting Air-in-Line Threshold (Continued)

NOTE: Use a 50 microliters setting on microbore tubing. All other settings may be used on macrobore tubing.

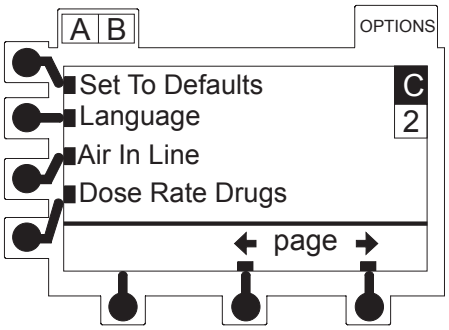


3. Press **Reset** soft key to select for editing. Press again to cycle between **On** and **Off**.
4. Press **Accumulator** soft key to select for editing. Press again to cycle between **On** and **Off**.
5. Press **ok** to accept change and return to beginning of C2 page.

2.4.5 Setting Dose Rate Drugs

NOTE: In Models 7131/7231, Drug? is used instead of a drug list option. There is no tick mark next to Dose Rate.

The Dose Rate Drugs feature allows selection of a drug name to program a dose rate calculated infusion while in normal mode.



1. From C2 page, press **Dose Rate Drugs** soft key.

   Introduction screen appears and displays legend used when selecting a drug.

2. Page forward to select drug or select **done** to go to Summary Page.
   - Use short list symbol "**s**" to select drugs that appear in short list. This is a convenient way to display frequently used drugs immediately in normal drug selection process (startup mode, press options key).
   - Use extended list symbol "**e**" when selecting drugs to appear in extended list. Extended list, if configured, provides a secondary list of drug names not normally used.

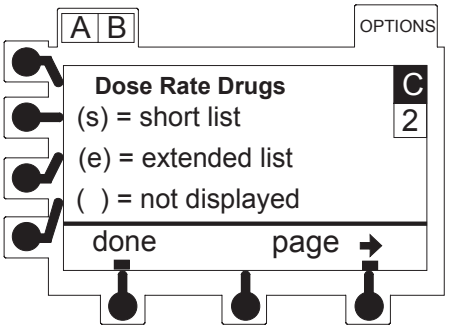


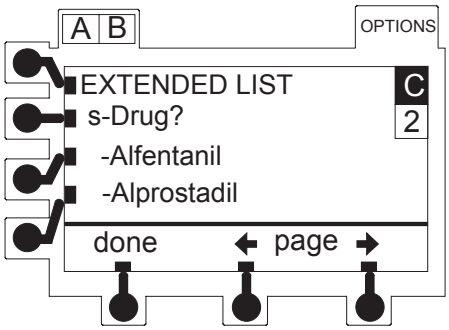
Table 2-2. Drug List (7130/7230 only)

Alfentanil (Alfent)	Methylprednisolone
Alprostadil (Prostin) (PGE-1)	Milrinone
Alteplase (Activase)	Morphene
Aminophylline	Nitroglucerin (Tridil)
Amrione (Inocar)	Nitroprusside (Nipride)
Atracurium (Tracurium)	Norepinephrine (Levophed)
Bretylium (Bretylol)	Oxytocin
Cimetidine (Tagamet)	Phenylephrine (Neo-Synephrine)
Diltiazem (Cardizem)	Potassium Chlor
Dobutamine (Dobutrex)	Procainamide
Dopamine (Intropin)	Propofol (Diprivan)
Esmilol (Brevibloc)	Ranitidine (Zantac)
Heparin	Streptokinase (Streptase)
Isoproterenol (Isuprel)	Succinylcholine (Anectine)
Labetalo (Normodyne) (Trandate)	Theophylline
Lidocaine (Xylocaine)	Urokinase (Abbokinase)
Magnesium Sulfate	Vecuronium (Norcuron)

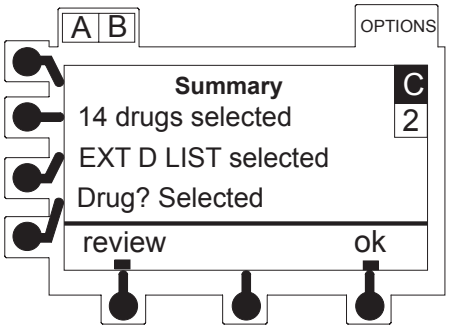
2.4 CONFIGURATION PROCEDURE (Continued)

2.4.5 Setting Dose Rate Drugs (continued)

3. Press **done** at any time to display Summary Page. Press **page →** to advance to next page.
4. Press **Extended List** soft key to cycle between "**s**" and "**blank**". If "**blank**" is selected, extended list will not be available.



5. Press **Drug?** soft key to cycle between "**s**", "**e**" and "**blank**". Use "**s**" for commonly used drugs.
6. Press a soft key next to a drug to cycle between "**s**", "**e**" and "**blank**". Press **Page →** to continue viewing drug list. Refer to Table 2-2 "Drug List" to view full list of drugs.
7. Press **done** to display Summary Page.



8. Press **review** to return to introduction screen or press **ok** to accept selections and return to C2 page.

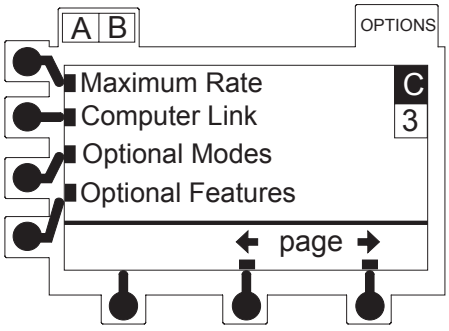
2.4.6 Setting Maximum Rate

This sets the maximum selectable rate. The range for Maximum Rate is 0.1 to 999.9 mL/h.

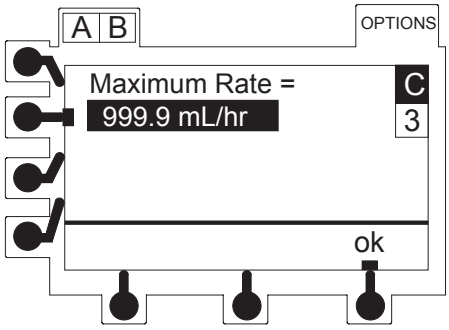
NOTES:

- The maximum rate setting applies to all infusion modes.
- Setting the Maximum Rate below the preset KVO Rate will lower the KVO Rate. The KVO Rate will not exceed the Maximum Rate.

1. Advance to C3 page.



2. Press **Maximum Rate** soft key.

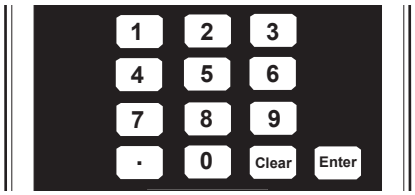


3. Press the soft key to select the value for editing.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.6 Setting Maximum Rate (Continued)

4. Use numeric keypad to enter maximum rate. Press **Enter**.



5. Press **ok** to accept change and return to beginning of C3 page.

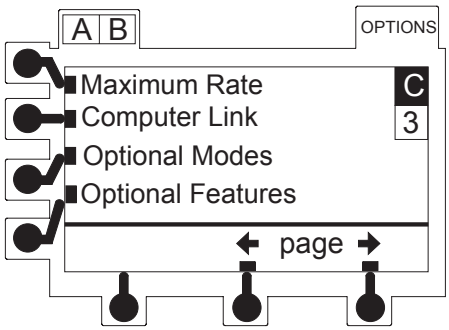
2.4.7 Setting Computer Link

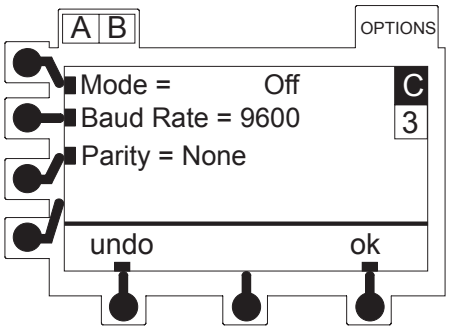
The Computer Link feature allows a hospital/facility computer to interact with the instrument and programs the level of computer control available. The computer cannot start or stop the instrument, set the rate, or make any change in status. If the feature is off, the computer cannot communicate with the instrument.

Control Mode allows computer to send information to instrument's display.

Monitor Mode allows computer to only receive information from instrument. Enabling of monitoring mode automatically places it in options menu.

Off Mode does not allow any communication between instrument and a computer.





1. On C3 page, press Computer Link soft key.
2. Press **Mode** soft key to select for editing. Press again to cycle through **Off**, **Mntr Off** and **Ctrl Mntr Off**.
3. Press **Baud Rate** soft key to select for editing. Press again to cycle through choices (300, 600, 1200, 1800, 2400, 4800 and 9600).
4. Press **Parity** soft key to select for editing. Press again to cycle through **Even**, **Odd**, and **None**.
5. Press **ok** to accept changes and return to beginning of C3 page.

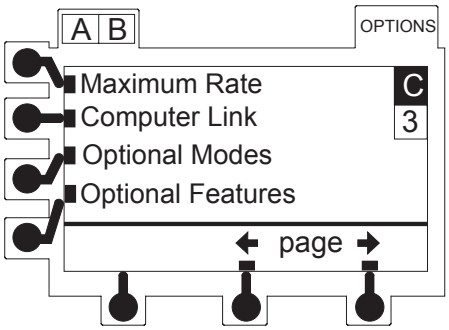
2.4 CONFIGURATION PROCEDURE (Continued)

2.4.8 Setting Optional Modes

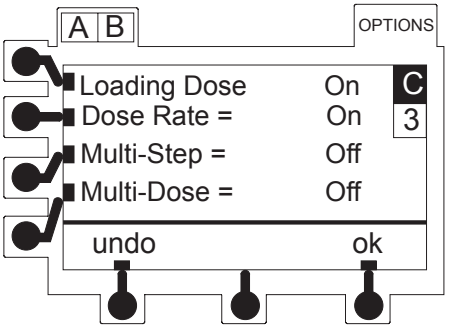
The Optional Modes feature allows the options menu to be configured to how it will appear in normal mode. Enabling of these modes automatically places them in the option menu.

When **Loading Dose**, **Multi-Step**, and **Multi-Dose** are on, they appear in the menu when the **OPTIONS** key is pressed in normal mode.

For **Dose Rate** to appear in the options menu, it must be turned on.



1. On C3 page, press **Optional Modes** soft key.



2. Press **Loading Dose** soft key to select for editing. Press again to cycle between **On** and **Off.**

> **NOTE:** This feature allows an initial infusion rate to be set up for a specific volume, automatically followed by a maintenance rate from the same container.

3. Press **Dose Rate** soft key to select for editing. Press again to cycle between **On** and **Off**.

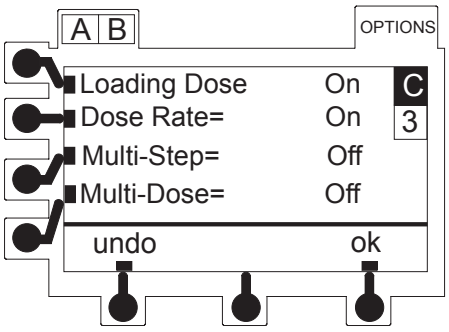
> **NOTE:** This feature allows dose parameters to be programmed so that the instrument then calculates the volumetric rate.

4. Press **Multi-Step** soft key to select for editing. Press again to cycle between **On** and **Off**.

> **NOTE:** This feature allows a sequential program to deliver up to nine steps; fluid volumes and delivery rates may be programmed for each step.

5. Press **Multi-Dose** soft key to select for editing. Press again to cycle between **On** and **Off**.

> **NOTE:** This feature allows multiple infusions to be programmed over a period of up to 24 hours; the fluid volume and delivery rate is repeated for each delivery.



6. Press **ok** to accept changes and return to beginning of C3 page.

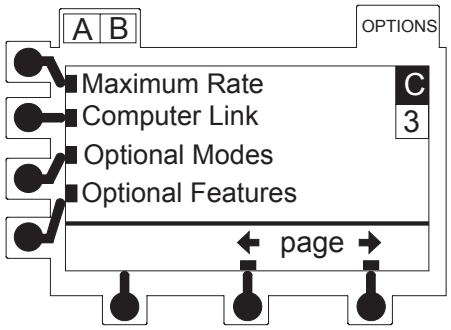
2.4 CONFIGURATION PROCEDURE (Continued)

2.4.9 Setting Optional Features

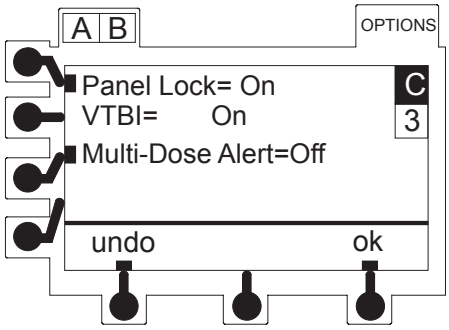
The Panel Lock feature allows the front panel to be locked and unlocked to help prevent tampering.

When VTBI (volume to be infused) is on, a volume to be infused must be entered; otherwise, the last remaining VTBI or last entered VTBI, depending on the channel's last usage, will be in effect. When VTBI is off, there is no VTBI line capability.

When the Multi-Dose Alert feature is on, the option is available to set an alert at the end of every dose when in the Multi-Dose mode.



1. On C3 page, press **Optional Features** soft key.



2. Press **Panel Lock** soft key to select for editing. Press again to cycle between **On** and **Off**.
3. Verify **VTBI** is **On**.

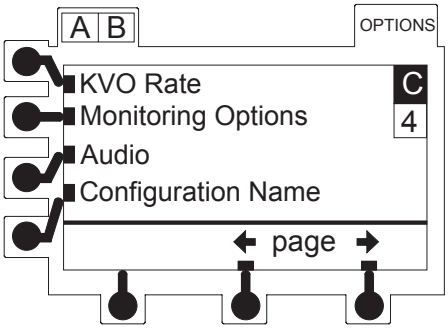
> **NOTE:** The flow sensor option (empty container detector) needs to be installed to be able to turn VTBI off.

4. Press **Multi-Dose Alert** soft key to select for editing. Press again to cycle between **On** and **Off**.
5. Press **ok** to accept changes and return to beginning of C3 page.

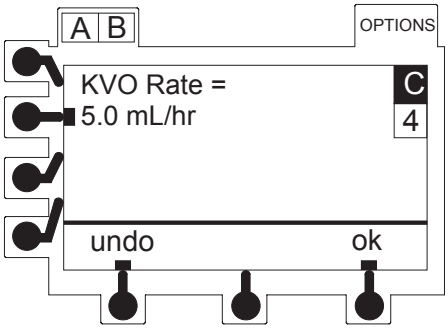
2.4.10 Setting KVO Rate

The instrument will automatically operate at the KVO rate (or current rate, whichever is less) once the primary VTBI has counted down to zero. The KVO rate range is 0.1 to 20.0 mL/h.

1. Advance to C4 page.

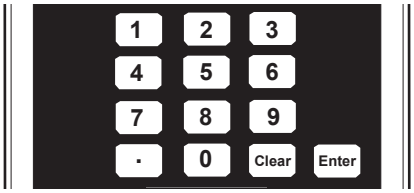


2. Press KVO Rate soft key.

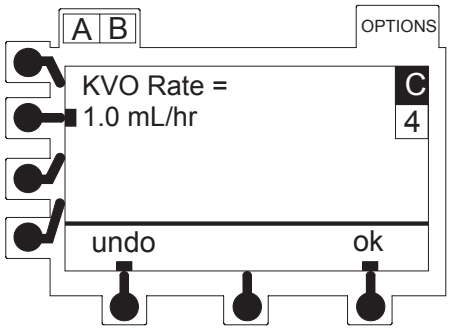


2.4 CONFIGURATION PROCEDURE (Continued)

2.4.10 Setting KVO Rate (Continued)



3. Press soft key next to rate value once to select for editing.
4. Use the numeric keypad to enter KVO rate. Press **Enter**.



5. Press **ok** to accept change and return to beginning of C4 page.

> **NOTE:** The KVO Rate will NOT exceed the present Maximum Rate.

2.4.11 Setting Dynamic Monitoring® System Features

The Signature Edition® Infusion System incorporates the Dynamic Monitoring® System, a versatile intravenous site monitoring system for detection of both full and partial occlusions of the fluid pathway.

This system includes both precision pressure sensing and continuously computed Flow Resistance.

Flow Resistance measurement dramatically improves the ability to detect partial and full occlusions, particularly at low flow rates. Resistance monitoring eliminates the impact of patient elevation and flow rate, to provide the most direct assessment of patency.

Both the Pressure and Flow Resistance monitoring modes feature numeric and bar graph displays of current values plus easily selectable trend graphs, displaying up to twelve hours of monitored values.

The Pressure Mode provides 1 mmHg display resolution, either manual or auto baseline setting, and a user-adjustable alarm limit.

The Resistance Mode provides two ranges and user-alert limit adjustment, to meet neonatal to adult patients' needs.

Many monitoring features and functions are configurable, by qualified technical personnel, to meet specific needs by allowing customization.

Monitoring Mode Options

IV lines, catheters, and applications create various levels of resistance to flow. Monitoring mode options are available to meet each clinical application, as follows:

- **Monitoring Options**: to select IV line/site monitoring modes of resistance, high resistance, and adjustable pressure.

  Pressure: highest occlusion method, when set to a default of 600 mmHg, when Resistance and High Resistance modes are not sufficient.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.11 Setting Dynamic Monitoring® System Features (Continued)

Resistance: designed to monitor IV line/site resistance, providing optimum sensitivity. Used for larger catheter sizes (up to 24 gauge).

High Resistance: designed to monitor IV line/site resistance, with optimum sensitivity where smaller (higher resistance) catheters (26 or 28 gauge) are used.

AutoRestartPlus

The AutoRestartPlus feature provides the ability to automatically continue an infusion if downstream resistance or pressure measurements indicate that an occlusion condition has cleared with a 40-second **Checking Line** period (excluding High Resistance monitoring mode). If the condition is not cleared, the **OCCLUSION DOWNSTREAM** alarm occurs and infusion is stopped until manually restarted.

The **Checking Line** message and tone are presented whenever a resistance or pressure measurement exceeds its alarm threshold.

- In resistance monitoring modes, the **Checking Line** period is caused by a measured resistance of 100% or a pressure level exceeding a configured threshold. This pressure threshold is separate from the Pressure mode threshold.

  If resistance measurements initiate the **Checking Line** condition, the channel will continue infusing in order to determine if the measured flow resistance has changed. In Resistance monitoring mode, if the measured flow resistance falls to any value below 100%, the channel will resume normal operating conditions automatically (excluding High Resistance monitoring mode).

  In resistance monitoring modes, pressure measurements initiate the Checking Line period when the pressure exceeds the limit. If the pressure falls to less than one third of the configured limit within 40 seconds, normal flow resumes.

- In Pressure monitoring mode, the **Checking Line** period is caused by pressure exceeding the alarm limit. If the pressure falls to less than one third of the alarm limit within 40 seconds, normal flow resumes.

Qualified service personnel can turn off this feature (set restarts to zero), or program from 1 to 9 restarts.

- In High Resistance monitoring mode, restarts do not occur for resistance measurements.

After the programmed number of restarts has occurred the channel will immediately alarm **OCCLUSION DOWNSTREAM**, if pressure or flow resistance conditions indicate an occlusion. The programmed number of restarts become available again when **RUN/HOLD** or the **run** soft key is pressed.

> **NOTE:** The restart counter is reset whenever RUN/HOLD is pressed, the instrument or channel is turned off or an alarm occurs.

2.4 CONFIGURATION PROCEDURE (Continued)

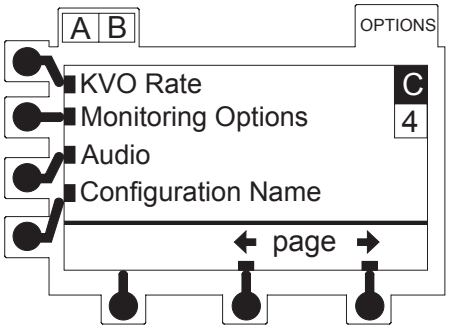
2.4.11 Setting Dynamic Monitoring® System Features (Continued)

Trend Graphs

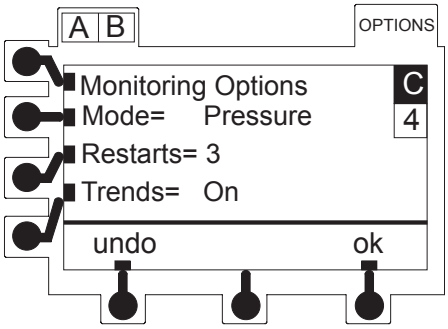
Trend graphs display downstream pressure or flow resistance over time (up to 12 hours).

In Pressure, Resistance, and High Resistance monitoring modes, the trend graph displays the flow pattern over time. Downstream occlusions, which occur in the Pressure or Resistance modes, will be indicated by a vertical tick mark at the top of the trend screen.

Trend graphs of **fifteen minutes**, **one hour**, **four hours**, and **twelve hours** are available during normal operation.



1. On C4 page, press **Monitoring Options** soft key.



2. Press **Mode** soft key to select for editing. Press again to cycle between **Hi Resist**, **Resist**, and **Pressure**.
3. Press **Restarts** soft key. Use numeric keypad to enter number of restarts, from "0" (which turns feature off) to "9", then press **Enter**.
4. Press **Trends** soft key to select for editing. Press again to cycle between **On** and **Off**.
   - In Pressure mode, graph displays in mmHg.
   - Trend data is lost when:
     - ♦ graph information is cleared
     - ♦ instrument is off for more than 6 hours
   - Trend data is maintained when:
     - ♦ rate is changed
     - ♦ instrument is off for less than 6 hours
   - Trend data is scaled (by 3 times or by 1/3, as applicable) when cycling between Resistance and Hi Resistance modes.
5. Press **ok** to accept changes and return to beginning of C4 page.
6. Precision Flow: Selecting **Pressure Mode** and running below 50 mL/h will place instrument into **Precision Flow Mode**.

   Precision Flow addresses both flow resolution (parts or pulses per mL) and flow continuity (time between pulses). The instrument will divide each mL into 3600 parts and equally space these parts into a virtually continuous delivery. With Precision Flow the longest time between a part/pulse at 0.1 mL/h is 10 seconds. As the rate increases, this time becomes shorter.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.11 Setting Dynamic Monitoring® System Features (Continued)

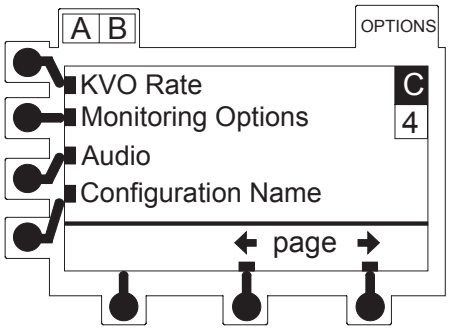
> **NOTE:** Resistance measurement is restarted at 0% when:
>
> - RUN/HOLD is pressed to put on hold and again to start.
> - Dose ends in Multi-Dose mode.
> - **Checking Line** message appears.

Checking Line alert applies to pressure, resistance and upstream occlusion, with one tone at the beginning and a flashing popup display (on for 4 seconds, off for 6 seconds). No nurse call activation.

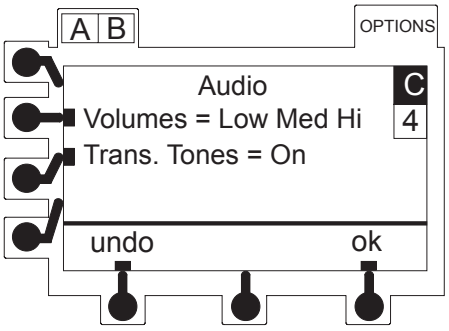
2.4.12 Setting Audio Volume

The volume settings determine which range of audio volume is available. For example, "Low" may be too low, so "Med Hi" would be chosen. A transition tone, if enabled, will sound upon completion of a secondary VTBI, step in multi-step mode, dose beginning and ending in multi-dose mode, and completion of a loading dose in loading-dose mode.

The speaker volumes are approximately: Low = 60 dB, Med = 65 dB, and Hi = 70 dB at one meter.



1. On C4 menu, press **Audio** soft key.



2. Press **Volumes** soft key to select for editing. Press again to cycle between **Low**, **Med, Hi, Med/Hi**, or **Hi**.
3. Press **Trans. Tone** soft key to select for editing. Press again to cycle between **On** and **Off**
4. Press **ok** to accept changes and return to beginning of C4 page.

2.4.13 Setting Configuration Name (Instrument ID Label)

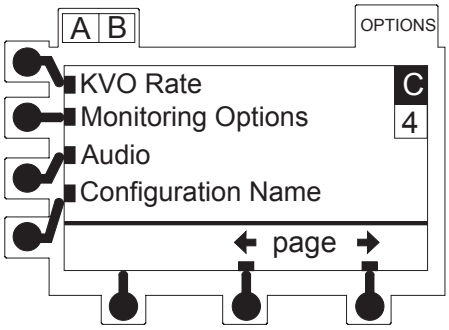
The characters entered here will be shown in the lower LCD display. This electronic label is normally displayed, even when the pump is off.

The configuration name can be used to uniquely identify the instrument's configuration, facility location, or reference number. It is a 4 character alpha-numeric name. For example, PICU (Pediatric Intensive Care Unit), ICU (Intensive Care Unit), or 2400.

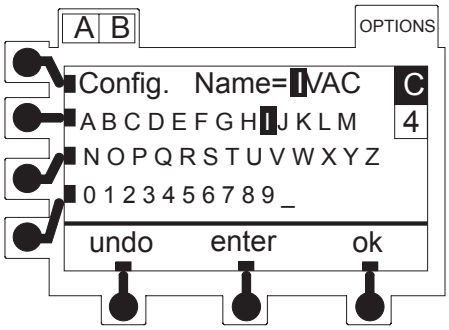
> **NOTE:** A 4-digit alpha-numeric code can be seen next to the configuration name upon entering Configuration Mode (refer to “Entering Configuration Mode” section in this chapter). This code is only a hexadecimal reflection of the instrument’s configuration.

2.4 CONFIGURATION PROCEDURE (Continued)

2.4.13 Setting Configuration Name (Instrument ID Label) (Continued)



1. On C4 menu, press **Configuration Name** soft key.



2. Press **Config. Name** soft key to position highlight on character to be changed.
3. Press character soft keys aligned with rows A to M, N to Z or O to "_" to highlight desired character.
4. Press **Enter**. Up to 4 characters can be programmed in this way. Repeat steps 2, 3, 4 as necessary.
5. Press **ok** to accept changes and return to beginning of C4 page.

NOTES:

- If the configuration has been changed, but not the name, the instrument will display the option to rename before turning off or proceeding to the Teach Mode. Refer to “Pop-Up Displays” section for further explanation.
- There must be 4 characters in the configuration name. Use the space symbol (_) to fill any open characters.

2.5 TRANSFERRING SETTINGS TO ANOTHER INSTRUMENT

Once an instrument has been programmed to meet technical and clinical needs, the settings can be transferred to other instruments. The programmed instrument is referred to as the "Teacher" and the other instrument is referred to as the "Learner".

NOTE: Only the configuration settings will be transferred. The instrument ID number, periodic maintenance settings, and other settings from the diagnostics mode will not be transferred.

Connect a standard 9-pin Null Modem RS-232 cable (ALARIS P/N 133450) to the RS-232 ports on the instruments.

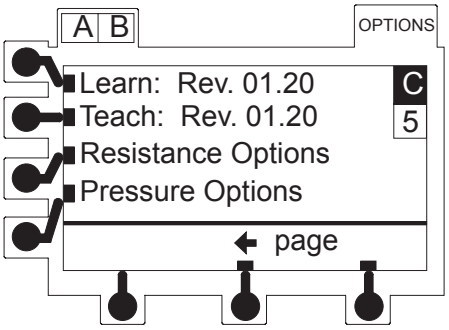
2.5.1 Learn/Teach Instrument Procedure

NOTE: The Learn/Teach function will not work if the revision level for Learn/Teach is **not** the same on both instruments. It is **not** recommended to Learn/Teach different model families; such as, using a Model 7130/7230 to Learn/Teach a Model 7131/7231.

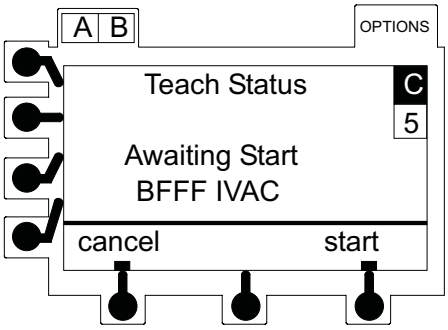
2.5 TRANSFERRING SETTINGS TO ANOTHER INSTRUMENT (Continued)

2.5.1 Learn/Teach Instrument Procedure (Continued)

1. Access **Configuration Mode** for both "teacher" and "learner" instruments and advance to page C5.



2. Press **Teach** soft key of "teacher" instrument and Press the **Learn** soft key of "learner" instrument.



3. Press **start** soft key on "teacher" instrument.

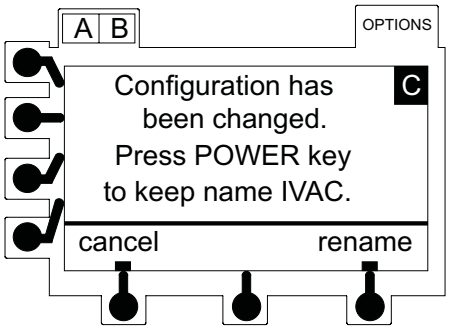
   Downloading displays until transfer is complete, and then displays if transfer was successful or unsuccessful.

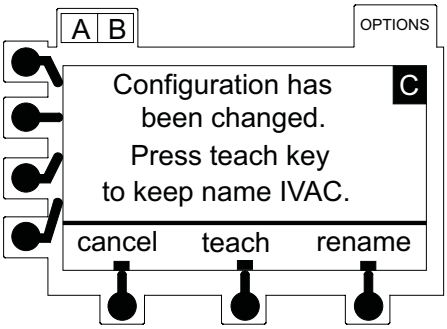
NOTES:

- **Repeat** allows the operator to reattempt teaching the current instrument or to teach the next instrument.
- Reattach the cover, and/or cover and screws, over RS-232 port after disconnecting the cable.

2.5.2 Pop-Up Displays

The pop-up screens appear when an attempt is made to turn off an instrument or execute the teach mode after changing the configuration (or accessing a configured item) but not changing the configuration name. If the instrument's configuration is changed and not the configuration name, instruments with the same name may have different configurations. The pop-up menus ask if the configuration should be renamed.





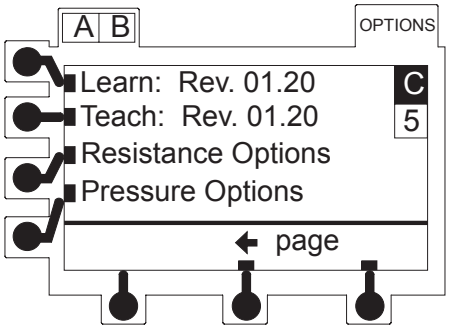
2.6 RESISTANCE OPTIONS

Resistance Display: Provides a bar graph and indication of resistance in the line while monitoring a single channel.

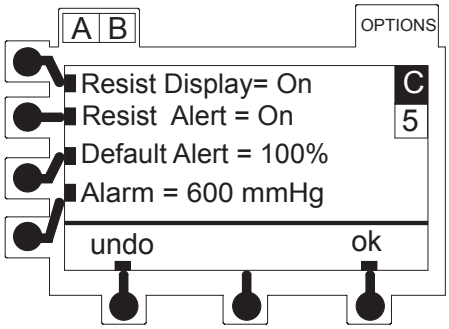
Resistance Alert: Provides an early warning of increases in downstream flow resistance by allowing the level to be adjusted in 5% increments during operation.

Default Alert: Provides a starting point for occlusion detection if a different level has not been chosen. The selected level will remain in effect while the instrument is on, until another option is selected from the Monitoring Options page. The channel will retain the selected option up to six hours after the instrument is turned off. After six hours the channel will return to the default setting.

Alarm: Provides the option to lower the pressure occlusion setting that is still active, even in resistance modes.



1. Advance to C5 page.



2. Press **Resist Display** soft key to select for editing. Press again to cycle between **On** and **Off**.

> **NOTE:** Setting **Resist Display** to **Off** will clear **Default Alert** from the screen and change **Resist Alert** to **Off**.

3. Press **Resist Alert** soft key to select for editing. Press again to cycle between **On** and **Off**.

> **NOTES:**
>
> - Setting **Resist Alert** to **Off** will clear **Default Alert** from the screen.
> - Resistance alert will give an alarm tone every thirty seconds, with a popup display (on for 4 seconds, off for 6 seconds). Nurse call activated. This occurs when the resistance measurement is above the alert threshold or at 100%, even when checking the line. If the display is off, the alert feature will automatically be turned off.

4. Press **Default Alert** soft key to select for editing. Enter a number using keypad, then press **Enter**. The instrument will round up or down to the nearest 5% increment.

> **NOTE:** To set the **Default Alert** level, both **Resist Display** and **Resist Alert** need to be **On**.

5. Press **Alarm** soft key to select for editing. Enter a number using keypad, then press **Enter**.
6. Press **ok** to accept change and return to beginning of C5 page.

2.7 PRESSURE OPTIONS

Pressure Display: Provides a bar graph and indication of pressure in the line while monitoring a single channel.

Pressure Alarm: Allows the choice of a fixed pressure mode or an adjustable pressure mode.

- Adjustable Pressure: Provides an early warning of increases in downstream pressure. Designed to monitor IV line/site based on pressure, and provide user- adjustable pressure alarm limits. Used for the smallest of catheter sizes and special applications; such as infusion through transducers, into dialysis systems, and for the highest resistance catheters (including some neonatal PICC catheters).
- Fixed Pressure: Designed to monitor IV line/site pressure and alarm, based on a fixed pressure limit of 600 mmHg. Used when adjustable pressure is not wanted. Used for the smallest of catheter sizes and special applications; such as, infusion through transducers, into dialysis systems, and for the highest resistance catheters (including some neonatal PICC catheters).

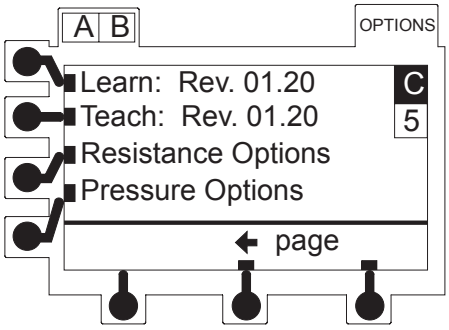
Alarm: Provides an adjustable pressure setting in 25 mmHg increments (25-600 range). This acts as the default setting after the instrument has been off for more than 6 hours and the previous setting was cleared. Pressure Alarm = Adj must be selected to change from 600 mmHg.

Auto Baseline: The instrument reads a baseline at startup and then adds the alarm limit, to determine the point of alarm. For example, if an alarm limit of 300 mmHg was selected, the instrument would alarm at baseline + 300 mmHg. Auto Zeroing occurs the first time RUN/HOLD is pressed; this will be the maximum baseline. Subsequent presses of RUN/HOLD will only lower (not raise) the baseline.

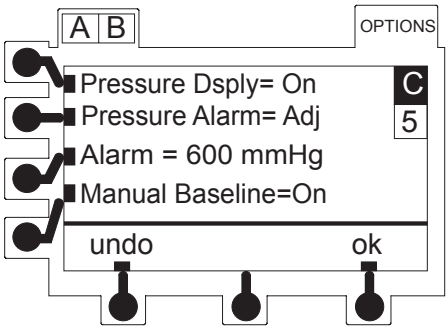
Manual Baseline: Sets a fixed baseline and overrides the Auto Zero level until the instrument is turned off, the latch is opened, the set is reloaded, or the pressure baseline function is performed again. This allows the instrument to display the actual pressure required for an IV to infuse. To get this real time readout, **Manual Baseline** must be **On**.

To activate this mode with the instrument on hold, or at startup, press the **Options** key and then select **Set Pressure Baseline** and press **ok**.

When RUN/HOLD is pressed, the bar graph will show the alarm point and the actual pressure in the line will be displayed below the bar graph.



1. Advance to C5 page.



2.7 PRESSURE OPTIONS (Continued)

2. Press **Pressure Dsply** soft key to select for editing. Press again to cycle between **On** and **Off**.
3. Press **Pressure Alarm** soft key to select for editing. Press again to cycle between **Adj** and **Fix**.
4. Press **Alarm** soft key to select for editing. Enter a number using keypad, then press **Enter**. Instrument will round up or down to nearest 25 mmHg increment.
5. Press **Manual Baseline** soft key to select for editing. Press again to cycle between **On** and **Off**.
6. Press **ok** to accept change and return to beginning of C5 page.

Table 2-3. Record of Configured Instruments

	#1	#2	#3	#4	#5
§ Instrument ID/Serial #					
Config Name (Instr Label)					
Location					
Language					
Air-In-Line: Threshold Reset Accumulator	µl	µl	µl	µl	µl
Dose Rate Drugs	(See Table 2-4 “Drug List “)				
Maximum Rate mL/h	mL/h	mL/h	mL/h	mL/h	mL/h
Computer Link: Mode Baud Rate Parity					
Optional Modes: Loading Dose Dose Rate Multi-Step Multi-Dose					
Optional Features Panel Lock VTBI Multi-Dose Alert					
KVO Rate mL/h	mL/h	mL/h	mL/h	mL/h	mL/h

--- Table Continued on Next Page ---

Table 2-3. Record of Configured Instruments (Continued)

	#1	#2	#3	#4	#5
Monitoring Options: Mode Restarts Trends					
Audio: Volume Trans. Tone					
Resistance Options: Resist Display Resist Alarm Default Alarm Alarm	 % mmHg	 % mmHg	 % mmHg	 % mmHg	 % mmHg
Pressure Options: Pressure Display Pressure Alarm Alarm Manual Baseline	 mmHg	 mmHg	 mmHg	 mmHg	 mmHg

§ Instrument ID/Serial # is accessed through Diagnostic Mode. Refer to the “Entering Diagnostic Mode” section in the “Troubleshooting” chapter.

Table 2-4. Drug List Configuration

Facility: _____
Unit: _____

DRUG NAME/OPTION	TRADE NAME	NOT SELECTED	SHORT LIST	EXTENDED LIST
Extended List Access				
DRUG?				
Alfentanil	Alfenta			
Alprostadil	Prostin (PGE-1)			
Alteplase	Activase			
AminoPhylline				
Amrinone	Inocar			
Atracurium	Tracurium			
Bretylium	Bretylol			
Cimetidine	Tagamet			
Diltiazem	Cardizem			
Dobutamine	Dobutrex			
Dopamine	Intropin			
Esmolol	Brevibloc			
Heparin				
Isoproterenol	Isuprel			
Labetalol	Normodyne /Trandate			
Lidocaine	Xylocaine			
Magnesium Sulfate				
Methylprednisolone				
Milrinone				
Morphine				
Nytroglycerin	Tridil			
Nitroprusside	Nipride			
Norepinephrine	Levophed			
Ocytocin				
Phenlyphrine	Neo-Synephrine			
Potassium Chlor				
Procainamide				
Propofol	Dipravan			
Ranitidine	Zantac			
Streptokinase	Streptase			
Succinylcholine	Anectine			
Theophylline				
Urokinase	Abbokinase			
Vecuronium	Norcuron			

Figure 2-2. Map of Configuration Screens

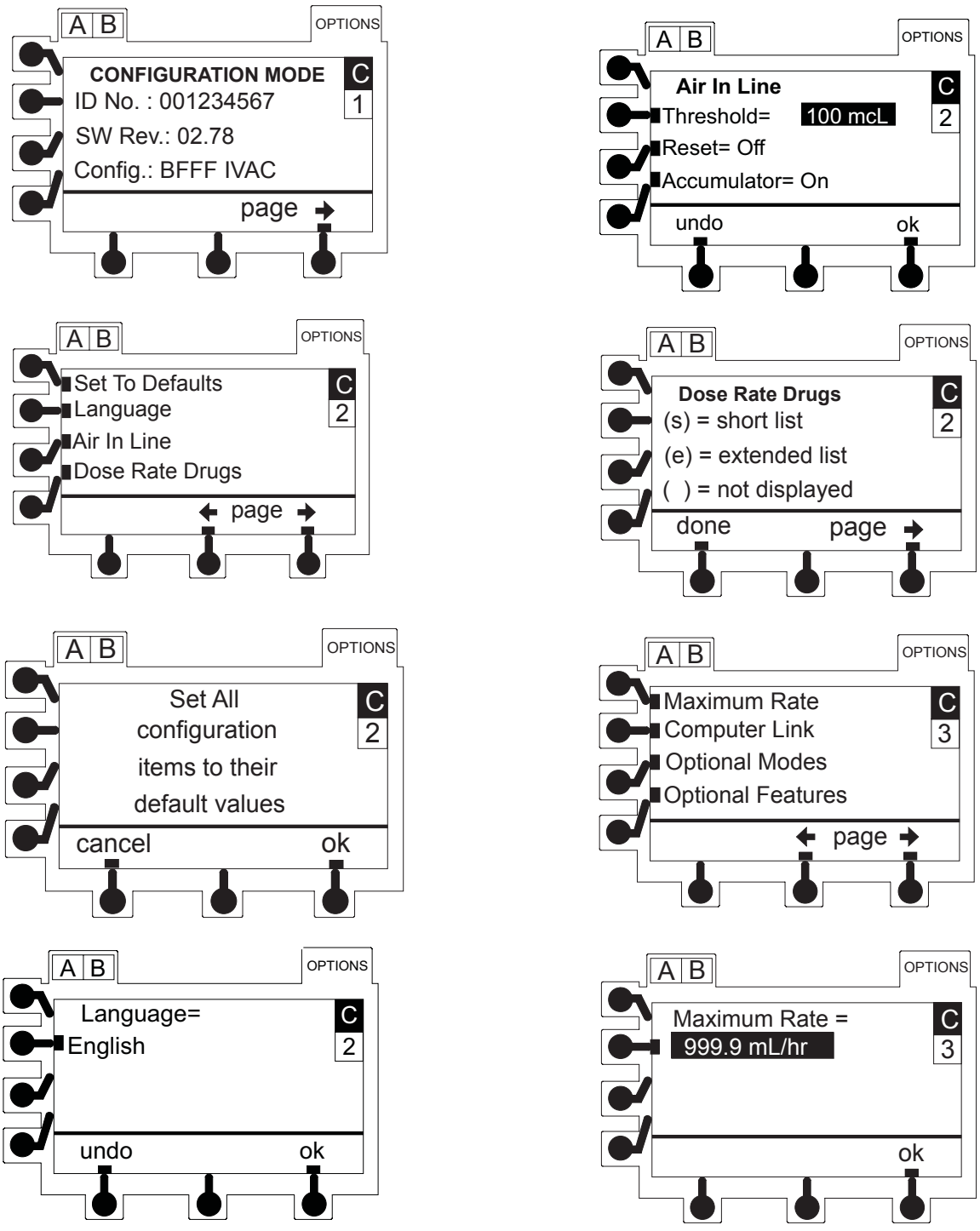


Figure 2-2. Map of Configuration Screens (Continued)

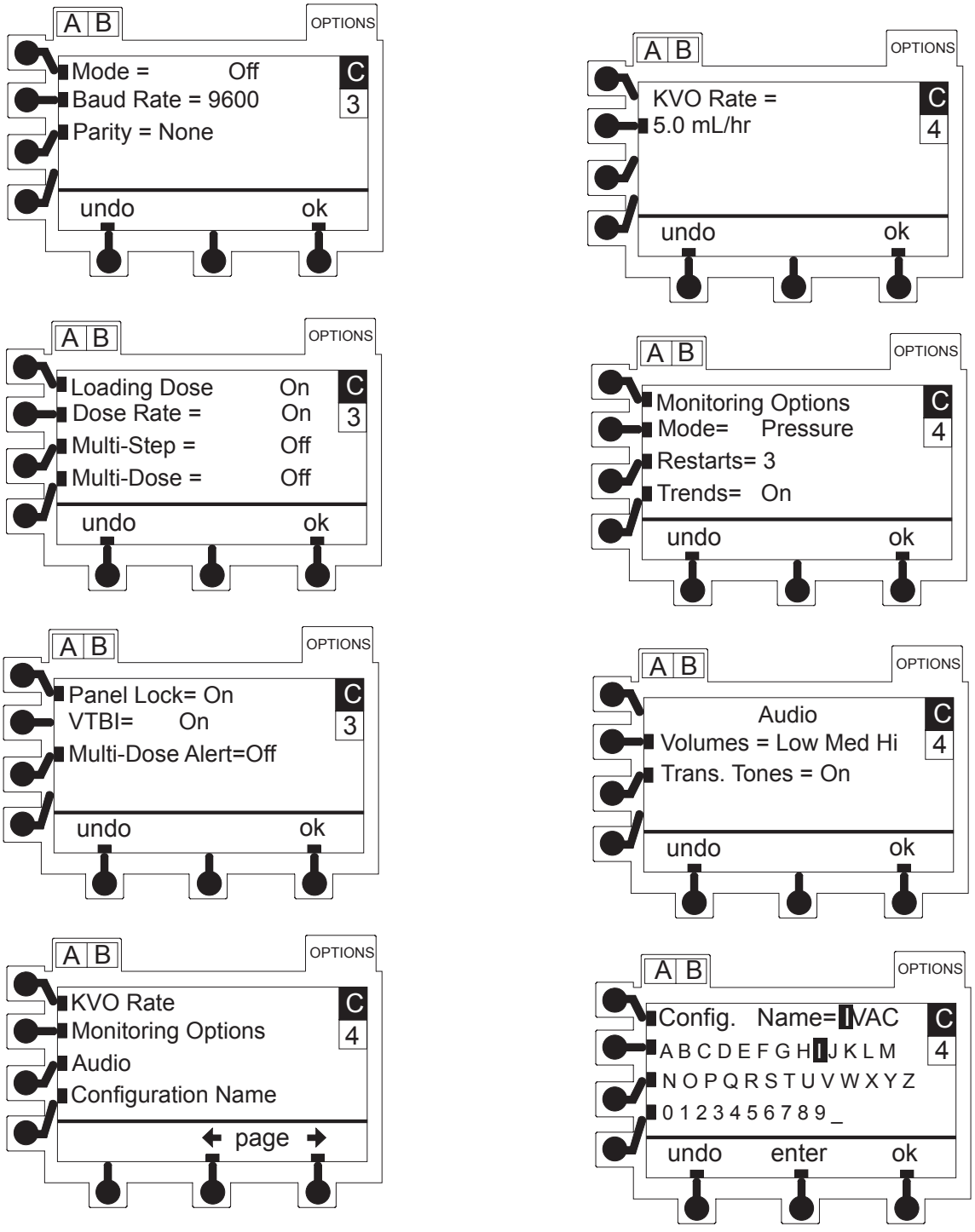
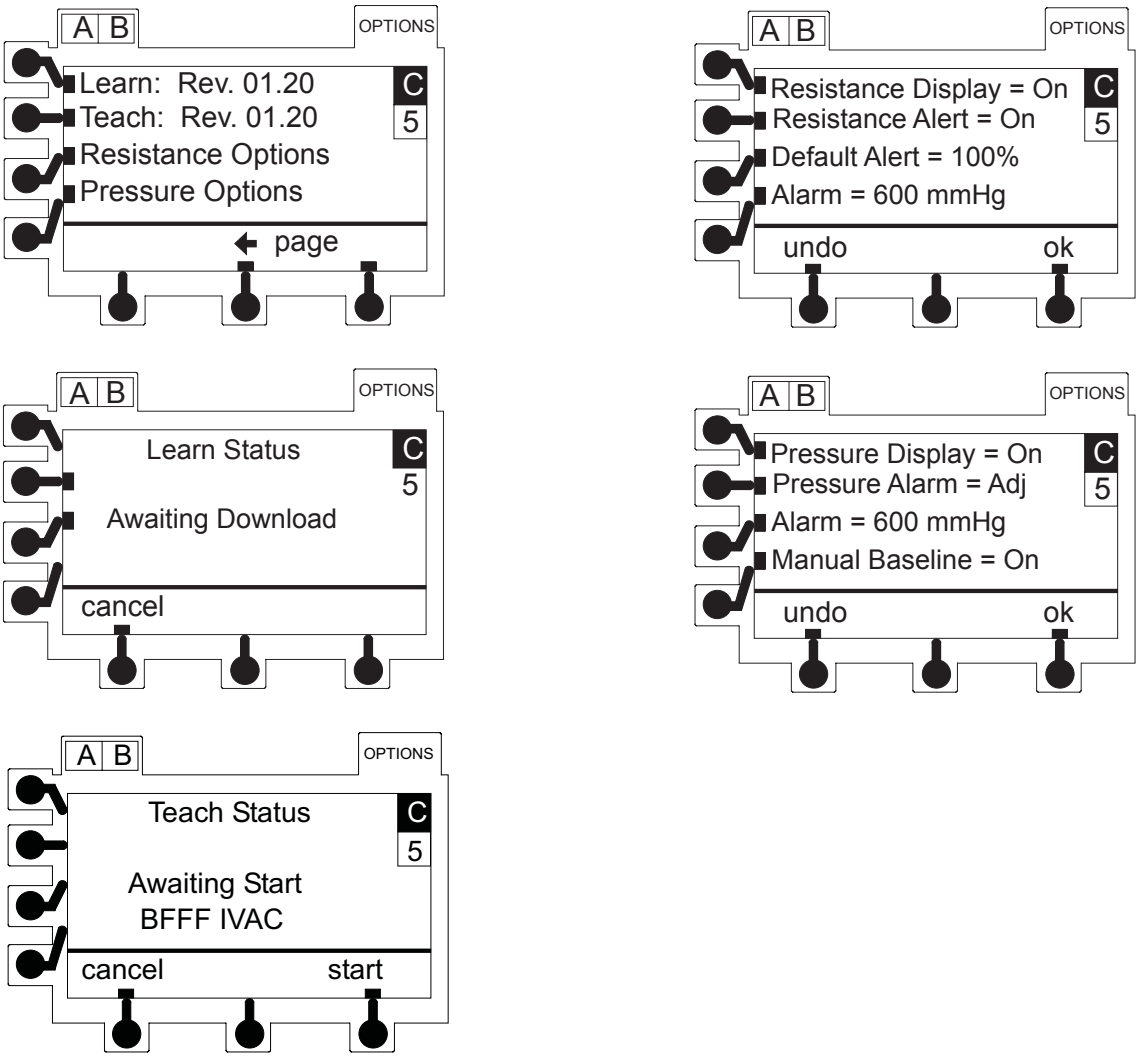


Figure 2-2. Map of Configuration Screens (Continued)



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Chapter 3 — PREVENTIVE MAINTENANCE

WARNING

Failure to perform regular and preventive maintenance inspections may result in improper instrument operation.

3.1 INTRODUCTION

To ensure the Signature Edition® GOLD Infusion System remains in good operating condition, regular and preventive maintenance inspections are required. Regular inspections must be performed by hospital/facility before each use.

Preventive maintenance inspections should be performed once a year in accordance with ALARIS Medical Systems requirements and guidelines. A maintenance reminder will occur after 52 weeks, unless the feature has been changed to select a different time interval or has been disabled. These inspections are also intended to complement the intent of JCAHO requirements.

Use Table 3-1, "PM Inspections," to record the completion of preventive maintenance inspections.

3.2 PREVENTIVE MAINTENANCE INSPECTIONS

A message can be set through the diagnostics mode which automatically reminds the user when preventive maintenance inspections are due. Refer to "Setting Preventive Maintenance Interval" section in the “Troubleshooting” chapter.

3.2.1 Regular Inspection

Regular inspections consist of a visual inspection for damage and cleanliness, and performing the procedure described in the “Start-Up” section of the Directions for Use (DFU), before each usage of the instrument.

3.2 PREVENTIVE MAINTENANCE INSPECTIONS (Continued)

3.2.1 Regular Inspection (Continued)

Case

Examine the instrument for overall condition. The case should be clean and free from IV solution residue, especially near moving parts. Also check for dried solution deposits on accessible areas of air-in-line sensor, pressure transducer, and latch mechanism. Check that labels and markings are legible.

Mounting Bracket

Pole mounting bracket should be secure and functioning. If the instrument is mounted on a pole or stand, examine the condition of the mount. Also, examine the pole and stand.

Power Cord Assembly

Examine the power cord assembly for:

- Signs of damage, cuts or deformities in the cord. If damaged, replace the entire cord.
- Integrity of hospital grade power plug. Attempt to wiggle blades to ensure they are secure. If any damage is suspected, replace entire cord.
- Appropriate tension and connection. Applicable only if IV pole has electrical receptacles for accessories.
- Strain reliefs. Examine strain reliefs at both ends of line cord. Be sure they hold cord securely.

Keypad

Check membrane switches for damage, such as from fingernails and pens. During the course of the inspection, be sure to check that each switch performs its proper function. Refer to "Testing Switches" section of the “Troubleshooting” chapter.

Mechanism

Clean any surfaces where solution or obstructions have accumulated. Verify:

- Mechanism seal is not torn or worn.
- Cam followers are not broken or cracked and are free of foreign matter.
- Proper operation of latching mechanism. Cam followers should retract and extend smoothly.
- Air-in-line arm moves smoothly from opened to closed position.
- Fluid Control Actuator rotates 180°.

3.2.2 Functional Test

1. Turn instrument on without set installed. Verify it "beeps" and red alarm light flashes.
2. Set infusion rate to 460 mL/h and VTBI to 100 mL.
3. Press **RUN/HOLD** switch with latch closed, and rate and VTBI ≠ 0 to cause "set out" and "air in line" messages.
4. Open latch.
5. Install primed administration set with latch open.
6. Verify instrument displays "air in line" and "latch open" messages.
7. Close latch and verify display returns to setup page.
8. Perform upstream occlusion test as follows:

   a. Verify infusion rate is set to 460 mL/h.

3.2 PREVENTIVE MAINTENANCE INSPECTIONS (Continued)

3.2.2 Functional Test (Continued)

b. With instrument on hold, or at start-up, verify primary VTBI is set to 100.

c. Press **RUN/HOLD** switch to begin infusion.

d. Clamp off IV line just above instrument to simulate an upstream occlusion. Verify instrument stops running, alarms, and displays OCCLUSION UPSTREAM within 60 seconds.

e. Press **RUN/HOLD** switch to silence alarm and put instrument on hold.

f. Remove or open clamp on line.

g. Press **RUN/HOLD** switch to resume infusion. Alarm should not reoccur.

9. Perform downstream occlusion test as follows:

a. Continue infusing from above step.

b. Verify rate is set to 460 mL/h. Clamp off set just below instrument.

c. Allow instrument to run until it alarms OCCLUSION DOWNSTREAM within 60 seconds.

d. Press **RUN/HOLD** switch to silence alarm and put instrument on hold.

e. Release or open clamp.

f. Press **RUN/HOLD** switch to resume infusion. Alarm should not reoccur.

3.2.3 Flow Stop Test

1. Turn power off with administration set primed and loaded in instrument.
2. With all tubing clamps open and fluid container 2 or more feet above instrument, verify no fluid flows out of set.
3. Remove set. Verify no fluid flows out of set.

3.2.4 Rate Calibration Procedure

To maintain system accuracy, the rate calibration should be done first, followed by a verification rate test, when doing Preventive Maintenance or post repair testing.

1. Change **Cal** # to "0.0" to run rate calibration and calculate a new calibration number.

NOTES:

- Once the Rate Cal # is set to "0.0" and accepted, the instrument will need to be run for at least two seconds before the Rate Cal # can be changed to a non-zero value. If not, the instrument will display **Do Rate Accuracy Test at 0%**. The instrument will not allow one non-zero value to be changed to another non-zero value.
- Rate Calibration is run at the nominal value (0.0%) so that the percentage can be directly entered in the instrument without another calculation.

2. Run rate calibration (using an 80VCS set) at 400 mL/h, with a VTBI of 40 mL and VI reset to zero. Follow procedure in “Post Calibration Rate Accuracy Verification” section, steps 1-23, and then determine rate calibration number (in %), as shown below.

3.2 PREVENTIVE MAINTENANCE INSPECTIONS (Continued)

3.2.4 Rate Calibration Procedure (Continued)

Calculate volume accuracy as follows:

Volumetric Volume Accuracy Error Computation

Vcollected =
volume in burette in milliliters

Vexpected =
characterized volume printed on 80VCS set insert

Step 1:
A = Vcollected / Vexpected

Step 2:
B = A x 100

Step 3:
% Error (Round % Error to nearest tenth of a percent.) = B - 100

NOTES:

- The range of the percent error can be from -5.3 to +15.6%, based on mechanism to mechanism differences and performing the initial run for calibration at 0.0%.
- In addition to performing this process during Preventive Maintenance, this process would also apply when replacing a mechanism or installing a new main board assembly.

3. Do not remove 80VCS set from instrument until one of following is determined:
   - Instrument has passed Post Calibration Rate Accuracy Verification and calibration is not needed.
   - Rate calibration number was changed and instrument now passes Post Calibration Rate Accuracy Verification.
   - Mechanism replacement is required.

4. Reverse sign (+/-) of % Error value from Rate Calibration results in step 3.

   Example:

   Result is 4% high (+4%). Reverse the sign (to get -4%). Number to enter for Rate Cal # is -4%.

NOTES:

- In the example above, the new Rate Cal # tells the instrument to count more volume per revolution of the mechanism, so that the output will be less due to fewer revolutions.
- The limits for the rate calibration entry are -15.6 to +5.3%, to adjust for differences from mechanism to mechanism. If the Rate Cal # is outside this range, then the mechanism needs to be replaced.

5. Enter new Rate Cal # for applicable channel using keypad and bottom center soft key (+/-) for sign. Press **ENTER**.

NOTES:

- Make sure the "+/- " sign is used with the percent change when doing rate calibration.
- To change the rate calibration number, refer to “Viewing/Changing Rate Calibration Information” section in “Troubleshooting” chapter.

3.2 PREVENTIVE MAINTENANCE INSPECTIONS (Continued)

3.2.4 Rate Calibration Procedure (Continued)

6. Press **ok** soft key to accept change and return to beginning of D4 page.

> **NOTE:** When the main board is changed, the Rate Cal # defaults to 100% and 0.0 mL/rev. Reset the Rate Cal # to "0.0%" or previous Cal #, to clear an Instrument Malfunction message.

3.2.5 Post Calibration Rate Accuracy Verification

Perform the following steps without removing the 80VCS set or turning the instrument off.

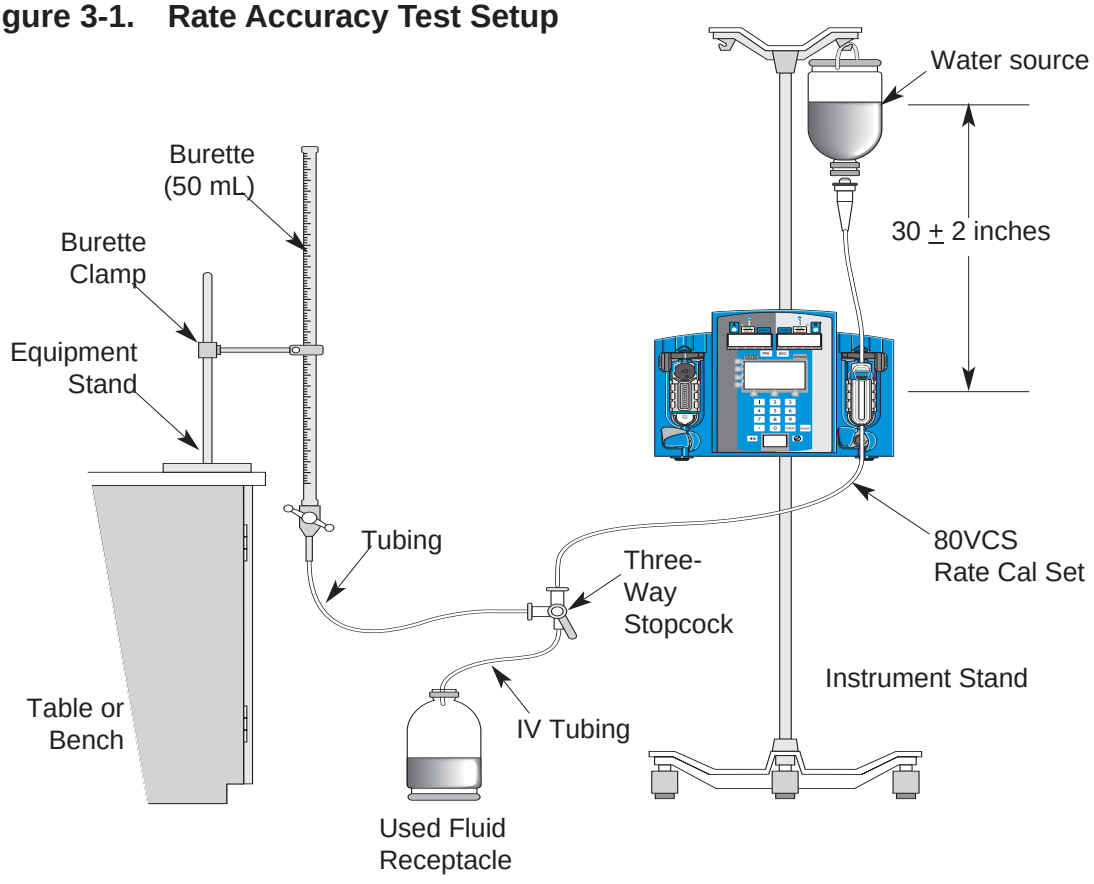
CAUTION

Due to the Dynamic Monitoring® Feature, the rate is varied during operation. For this reason, ALARIS Medical Systems does not recommend using automatic testers to check rate accuracy. Generally, these devices collect small samples and may cause results to be incorrect, even though the instrument is accurate.

It is recommended, with the initial use of the 80VCS set on each instrument, to perform rate calibration first, to save time.

Do not use the Model 80VCS Calibration Set for more than 15 rate calibration and post calibration rate accuracy verifications (count one use for both calibration and verification of the same instrument).

Figure 3-1. Rate Accuracy Test Setup



3.2 PREVENTIVE MAINTENANCE INSPECTIONS (Continued)

3.2.5 Post Calibration Rate Accuracy Verification (Continued)

Keep track of the number of times the set is used by recording each use on the 80VCS insert or on a separate record.

1. Fill solution container with clean tap water. Close AccuSlide® Flow Regulator clamp on 80VCS Calibration Set and then insert spike into solution container.
2. Open AccuSlide® Flow Regulator clamp and prime set. Pay particular attention to ensure all air is expelled from set. Close AccuSlide® Flow Regulator clamp.
3. Connect output of set to one side of three-way stopcock.
4. Load set into instrument.
5. Close latch.
6. Verify there is no fluid flow or drops falling in drip chamber.
7. Plug instrument into a properly grounded AC outlet.
8. Set stopcock to output into a class A or B burette.
9. Press POWER to turn channel on.
10. Set primary infusion rate to 400 mL/h.
11. Set VTBI to 20 mL.
12. Ensure instrument (both channels if dual channel) is set to Pressure mode.

> **NOTE:** The factory default for the Monitoring Options mode is Pressure.

13. Press RUN/HOLD to start primary infusion. Infuse until tubing and burette are fully primed (approximately 1 minute).
14. Press RUN/HOLD to stop infusion.
15. Adjust height of instrument and/or fluid container to attain a head height of 30 ±1 inches / 76.2 ±2.5 centimeters between middle of pumping mechanism and fluid level in either the:

> **NOTE:** A 30" head height was used in the initial qualification of this process and is the recommended head height. Based on observed field use, a 24" head height was also tested and verified for the Rate Accuracy Specification.

- bag or vented bottle (vent closed on administration set)

  or

- drip chamber (unvented bottle with vent open on administration set).

16. Adjust fluid level in burette until meniscus is level with zero mark on burette.

> **NOTE:** The instrument may need to be run to prime the line to the zero level of the burette (step 13).

17. Verify primary infusion rate is 400 mL/h.
18. Reset VTBI to 40 mL and clear volume infused.
19. Press RUN/HOLD to start primary infusion.
20. Instrument will run approximately 360 seconds (6 minutes) to complete delivery and then go into KVO mode. Stop instrument within 1 second of its entering KVO mode.
21. Make a note of volume collected in burette.
22. Note expected volume, as identified on 80VCS calibration set insert.

3.2 PREVENTIVE MAINTENANCE INSPECTIONS (Continued)

3.2.5 Post Calibration Rate Accuracy Verification (Continued)

23. Do not remove 80VCS set from instrument until one of following is determined:
    - Instrument has passed rate verification and calibration is not needed.
    - Rate calibration number was changed and instrument now passes verification.
    - Mechanism replacement is required.
24. Calculate volume accuracy as follows:

    Volumetric Volume Accuracy Error Computation

    Vcollected = volume in burette in mL
    Vexpected = characterized volume printed on 80VCS set insert

    Step 1: A = Vcollected ' Vexpected
    Step 2: B = A x 100
    Step 3: % Error (Round % Error to nearest tenth of a percent.) = B - 100
25. Result should be 0.0±1%.
26. If volume accuracy does not fall within required range of ±1% from expected volume and test results were:
    - inside a range of -5.5 to +7.0% from expected volume, perform "Rate Calibration Procedure". Set rate calibration number to 0.0% before running rate test, to determine a new calibration number.
    - outside a range of -5.5 to +7.0% from expected volume, return instrument to ALARIS Medical Systems for repair or replace mechanism.
27. Set stopcock to drain fluid in burette to zero level, in preparation for next test.

> **NOTE:** If additional low rate (5 to 20 mL/h) testing is desired, use an 80VCS set and collect at least 6 mL of fluid. The results should be ±5% of the expected output. At lower rates (less than 5 mL/h), evaporation may need to be prevented or accounted for in the results. Calibration must be performed at 400 mL/h and collecting 40 mL of fluid.

3.2.6 Pressure Calibration

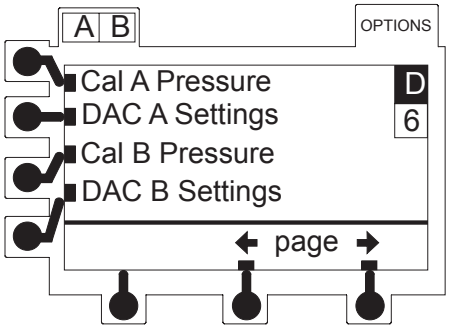
1. Place instrument on bench or other flat surface and connect to AC power.
2. Connect pressure meter, pressure source, and reservoir to pressure calibration set. Refer to Figure 3-2 "Pressure Test Setup".
3. Install a pressure cal set (70ISS) into instrument.
4. Enter Diagnostics Mode by pressing and holding top soft key, then turn instrument on and release soft key when diagnostics display appears. Refer to "Entering Diagnostics Mode" section in “Troubleshooting” chapter.

3.2 PREVENTIVE MAINTENANCE INSPECTIONS (Continued)

3.2.6 Pressure Calibration (Continued)

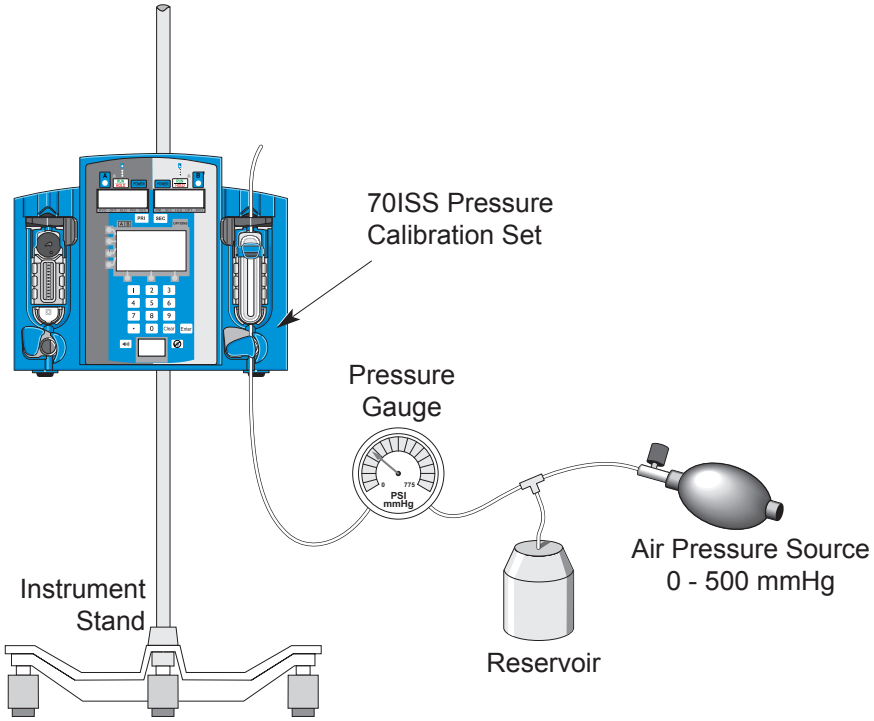
5. Advance to D6 page by pressing **page** soft key 5 times.

   On D6 page, press **Cal A Pressure** or **Cal B Pressure** (dual channel). D6A or D6B will be displayed, depending on which channel was selected.



6. Adjust pressure to "0 mmHg" from test fixture. Press and release 0 mmHg soft key. If readings are in a valid range, it will display **Pass**.
7. Apply 500 mmHg (±2 mmHg) from test fixture. Press and release 500 mmHg soft key. If readings are in a valid range, it will display Pass.
8. Remove 500 mmHg pressure applied to instrument, then remove set.
9. Press **ok** soft key to accept calibration and return to main D6 page.
10. Set sensor check/calibration verification:
    a. Press Cal A Pressure or Cal B Pressure (dual) soft key to re-enter the same Cal Pressure screen.
    b. Verify both 0 mmHg and 500 mmHg readings display **Pass**.
    c. Install a standard set and close latch. Verify reading is over 170.

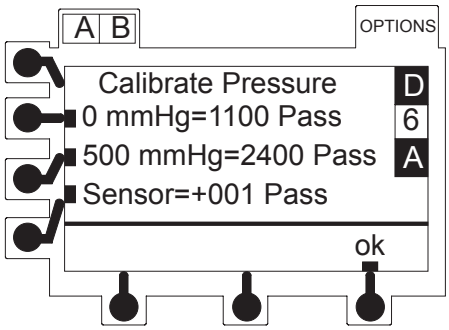
Figure 3-2. Pressure Test Setup



3.2 PREVENTIVE MAINTENANCE INSPECTIONS (Continued)

3.2.6 Pressure Calibration (Continued)

d. Remove set. Verify Sensor = reading is in -80 to +30 mmHg range without set installed. If instrument will not soft cal, perform Hard Pressure Cal Procedure (“Corrective Maintenance” chapter).



3.2.7 Ground Current Leakage Test

Refer to the applicable Signature Edition® GOLD Infusion System DFU.

3.2.8 Ground Resistance Test

Refer to the applicable Signature Edition® GOLD Infusion System DFU.

3.2.9 Battery Refresh Cycle

METHOD ONE

1. Connect instrument to AC power.
2. Enter Diagnostics mode by holding top left soft key while powering instrument on.
3. Press **page** soft key (bottom right) to advance to D2 page.
4. Press lower left soft key to access Battery Status screen.
5. Press lower left soft key to highlight Rated Cap value.
6. Using numeric keypad, enter 0.0 (in Rated Cap value).
7. Press the **ok** soft key (bottom right).
8. Repeat step 4 to access 'Battery Status'.
9. Repeat step 5 to highlight Rated Cap value.
10. Using numeric keypad, enter 1.3 in Rated Cap.
11. Press ok soft key.
12. Press and hold POWER key for a second to power instrument down.

    Battery Refresh procedure has been initiated and will continue to run until complete, whether instrument is on or off, generally 12 to 24 hours. Instrument needs to be connected to AC power during this period. Disconnecting instrument from AC power will stop refresh cycle.

METHOD TWO

1. Disconnect instrument from AC power.
2. Disconnect battery from instrument.
3. Press and hold **POWER** key for 5 seconds.
4. Reconnect battery and connect instrument to AC power.

   Battery Refresh procedure has been initiated and will continue to run until complete, whether instrument is on or off, generally 12 to 24 hours. Instrument needs to be connected to AC power during this period. Disconnecting instrument from AC power will stop refresh cycle.

3.2 PREVENTIVE MAINTENANCE INSPECTIONS (Continued)

3.2.10 Reset Time

1. Enter Diagnostic Mode and advance to D2 page.
2. Reset hours and minutes as needed from time reference. Refer to “Setting Time (and Date)” in the “Troubleshooting” chapter.

> **NOTE:** Clock will lose about 3 minutes per month since it is not a true real-time clock. Once reset, the previous loop will not be affected or adjusted.

3.2.11 Reset PM Due

Enter Diagnostic Mode and go to D2 page. Access PM Setup and reset PM Due by pressing lower-left soft key.

3.3 STORAGE AND CLEANING

Refer to the applicable Signature Edition® GOLD Infusion System DFU.

3.3.1 Storage

The instrument may be stored without connection to AC power. It will automatically disconnect the battery when the voltage gets too low. To reuse the instrument after storage, connect it to AC power for a minimum of three (3) hours before placing it back into service. When temporarily taking the instrument out of service, connect it to AC power to ensure a fully charged battery when needed.

Table 3-1. PM Inspections

I.D. Number _____ Instrument Serial Number _____				
	Ref. Section	Frequency	Date Completed	Date Completed
Regular Inspection (record every 12 months)	3.2.1	Every Use		
Functional Test	3.2.2	12 Months		
Flow Stop Test	3.2.3	12 Months		
Rate Calibration Procedure	3.2.4	12 Months		
Post Calibration Rate Accuracy Verification	3.2.5	12 Months		
Pressure Calibration	3.2.6	12 Months		
Ground Current Leakage Test	3.2.7	12 Months		
Ground Resistance Test	3.2.8	12 Months		
Battery Refresh Cycle	3.2.9	12 Months		
Reset Time	3.2.10	12 Months		

I.D. Number _____ Instrument Serial Number _____				
	Ref. Section	Frequency	Date Completed	Date Completed
Regular Inspection (record every 12 months)	3.2.1	Every Use		
Functional Test	3.2.2	12 Months		
Flow Stop Test	3.2.3	12 Months		
Rate Calibration Procedure	3.2.4	12 Months		
Post Calibration Rate Accuracy Verification	3.2.5	12 Months		
Pressure Calibration	3.2.6	12 Months		
Ground Current Leakage Test	3.2.7	12 Months		
Ground Resistance Test	3.2.8	12 Months		
Battery Refresh Cycle	3.2.9	12 Months		
Reset Time	3.2.10	12 Months		

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4 PRINCIPLES OF OPERATION

Chapter 4 — PRINCIPLES OF OPERATION

4.1 INTRODUCTION

This chapter describes the mechanical and electrical systems that comprise the Signature Edition® GOLD Infusion System.

4.2 GENERAL INFORMATION

The main PCB for both the single and dual channel instrument is a double-sided multi-layered Surface Mount Technology (SMT) board. If a board is determined to have failed, it can be replaced or the instrument can be returned to ALARIS Medical Systems for repair. ALARIS Medical Systems does not provide replacement components for repair of SMT boards nor does ALARIS Medical Systems recommend attempting field service of the instrument's SMT circuit boards.

Full board assembly schematics are not included with this service manual.

The AC off-line switcher and RS-232 boards are replaced as an assembly. If a board is determined to have failed, it is replaced with a new board (for part number refer to “Illustrated Parts Breakdown” chapter). ALARIS Medical Systems does not provide replacement components for repair of these boards.

Both single and dual channel instruments function in the same manner; however, they use two different main PCBs. The component reference designations are therefore different for each board. To help distinguish between the single and dual channel instrument reference designations in this chapter, the dual channel instrument will be represented in parenthesis; for example, (U13).

4.2 GENERAL INFORMATION (Continued)

The instrument contains a peristaltic pumping mechanism and support circuitry to ensure controlled flow. The peristaltic mechanism consists of a linear array of 12 cam followers which travel perpendicular to the administration set. These cam followers act like "fingers" kneading the membrane. When the fluid-filled disposable is placed against the array of cam followers, the coordinated, sinusoidal motion of the cams causes a peristaltic wave of fluid displacement in the instrumenting segment of the disposable.

The instrument will alarm at signs of internal problems and at preset thresholds for external problems (for example, when battery charge falls below a critical level, or instrument output pressure exceeds a programmed limit). All alarms provide visual and auditory signals to alert the operator.

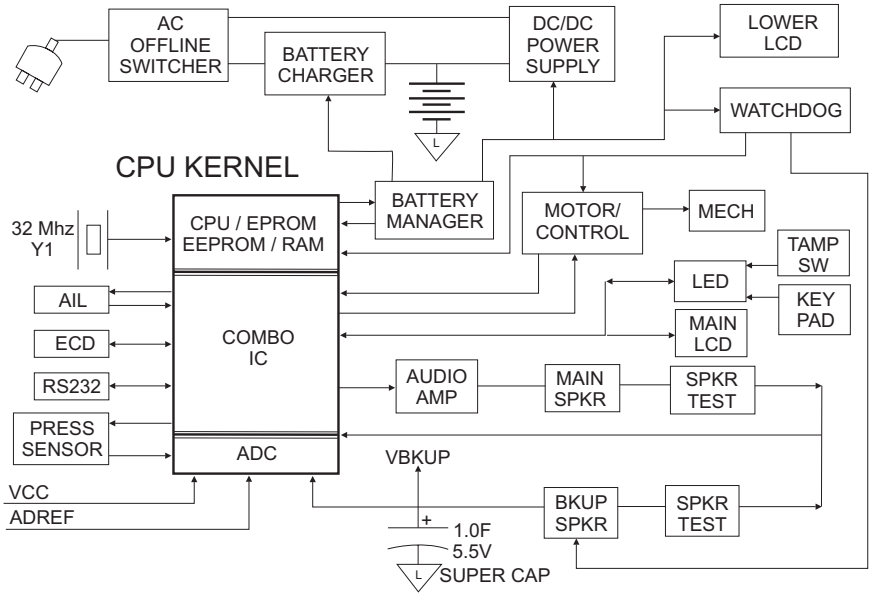
Accuracy of fluid delivery is a function of the microprocessor-controlled rotation cycle of the camshaft, and the administration set section compressed by the cam followers.

4.3 OVERVIEW

The instrument contains one main PCB and several modules that interface to it. The interfacing modules are as follows:

- LED module
- Graphic LCD module (MAIN)
- Lower LCD module
- Battery
- AC off-line switcher
- Keypad
- Nurse Call / RS-232 board
- Motor
- Air-in-line sensors
- Pressure module
- Motor rotation sensor and mechanism latch detector (optocouplers)
- ECD board

Figure 4-1. Main Block Diagram



4.3 OVERVIEW (Continued)

The instrument power is supplied through the AC off-line switcher module and the battery.

The main PCB contains all the control circuitry required for the instrument. The board can be broken down into four main sections, as follows:

- **CPU Kernel**
  The microprocessor, RAM, ROM, data communication, and COMBO IC make up the heart of the system. These are collectively referred to as the CPU kernel. The CPU kernel is responsible for controlling the motor actuation, sensing and responding to user input, monitoring various system sensors, and performing start-up and ongoing system operational testing.
- **Power System**
  The power system is responsible for charging the battery, generating the DC power, displaying battery status and performing watchdog (clock sync checks) functions. The power system includes the Battery Manager custom IC.
- **Motor Drive and Sensor Control**
  The motor drive and sensor control circuitry drives the motors, the air-in-line sensors, the mechanism latch sensors, and the rotation sensors. The circuit is also responsible for monitoring the pressure sensors, the power supply voltages, the motor current, and the air-in-line sensor outputs.
- **User Interface Circuitry**
  The user interface circuitry connects to the keypad, LED modules, and LCD modules to the kernel circuitry for monitoring and control. This circuitry also contains the audio interface, and audio test.

4.4 MAIN PCB

4.4.1 CPU Kernel

The CPU kernel is responsible for controlling the motor actuation, sensing and responding to user input, monitoring various system sensors, and performing start-up and on-going system operational testing. The kernel is based on a 16-bit 80C188 microprocessor U11 (U15), 1Mbytes of Flash EEPROM program storage, and 128K bytes of battery backed up RAM data storage. In addition, the kernel has 2K bits of EEPROM memory and a selectable baud rate for serial communications interface.

The COMBO IC U10 (U14) is a custom ASIC (Application Specific Integrated Circuit) which incorporates timing, address decoding, digital I/O, and other system "glue" functions. The Combo IC has a 16-bit CRC generator which is used to periodically test the Flash EEPROM data. The COMBO IC also contains the local serial interface control logic used to interface to serially-accessed peripherals, such as the A/D, EEPROM, LED Module(s), and Battery Manager. Additional information can be found in the section below "COMBO IC".

4.4 MAIN PCB (Continued)

4.4.1 CPU Kernel (Continued)

The kernel data communications function supports RS-232 level serial communications up to 19200 baud. The UART function is embedded in the COMBO IC, while the RS-232 interface is based on an industry standard RS-232 level converter chip.

4.4.2 COMBO IC

The COMBO IC, U10 (U14), is a 160-pin PQFP device which supports a variety of kernel functions, primary audio support, digital I/O and other functions. The COMBO latches the address bus and outputs the latched addresses as A19-A16, and A7-A0. The COMBO IC has a 16-bit CRC generator which is used to periodically test the Flash EEPROM data. The RAMTEST circuit provides redundant storage and error detection of RAM data. The local serial interface control logic is used to interface with serial accessed peripherals; such as the A/D converter, EEPROM, LED Module(s), and Battery Manager. The device also generates the Main LCD interface control signals. The UART (Intel 8251 equivalent) and three 16-bit counters (Intel 8254 equivalent) are also provided inside the COMBO chip. Six pulse width modulators for motor control and LCD backlight and contrast are also within the custom IC.

4.4.3 EEPROM

The EEPROM is used to store all configuration and diagnostic settings. The EEPROM, U9 (U11) is accessed using the serial control unit within the COMBO IC. Data is written and read back from the device through the serial data registers within the COMBO chip.

This device holds 256, 16-bit words. It is used to store data that will not be destroyed if power is lost to the instrument. The EEPROM will store configuration mode, calibration (LCD contrast) settings, and certain diagnostic information e.g., instrument ID number, PM interval, PM on/off, battery run time, and total instrument run time.

NOTE: The Guardrails® CQI log and Event Log are NOT stored in the EEPROM.

4.4.4 RAM

The RAM is used to store user set parameters, for example, volume to be infused (VTBI), mode, rate, and PRI/SEC, as well as the logs. The instrument provides read/write memory integrity by using redundant storage and automatic comparison. Data written to RAM is stored in both of the RAM devices, main RAM, U8 (U9), and phantom RAM, U4 (U5). The processor reads data directly from the main RAM. The phantom RAM data only goes to the COMBO IC. The COMBO IC compares the data from the two RAMs on each read. If the data does not match, a bit will be set in a register within the COMBO IC.

4.4 MAIN PCB (Continued)

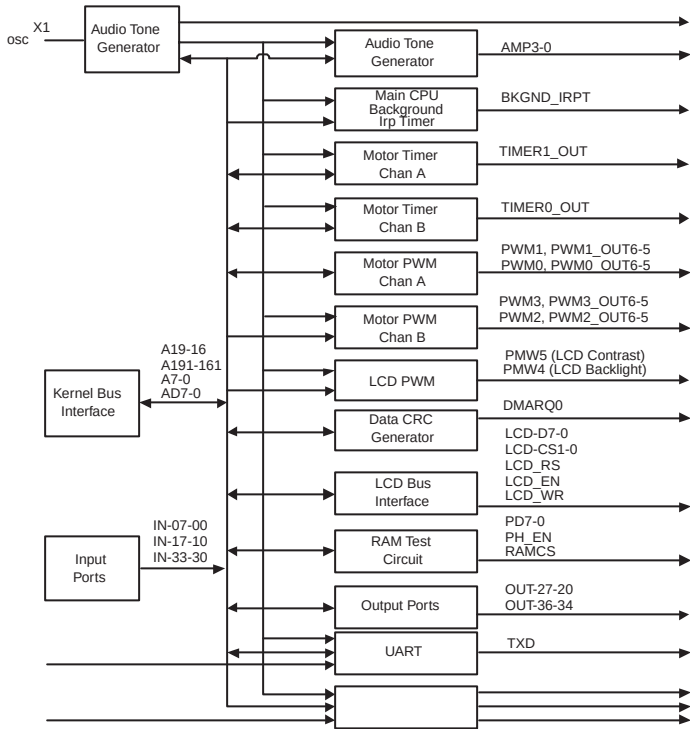
4.4.4 RAM (Continued)

When the instrument is off, the VRAM supply is still on, preserving the contents of the RAMs. The second chip select line, CS2, of the RAMs is tied to RST_CPU*, so that the RAMs can not be selected during power down sequence.

4.4.5 Flash EEPROM

The Flash EEPROM, U42 (U48), contains 1M bytes (x8) of program memory. The Flash EEPROM is programmed through the RS-232 interface.

Figure 4-2. COMBO IC Block Diagram



4.4.6 RS-232 Interface

7130/7230 Models

The RS-232 serial communications interface is supported by a UART which is located inside the COMBO IC. The UART is equivalent to an Intel 8251. The UART's outputs drive interface U22 (U45), which converts the logic level signals to RS-232 levels. The system can support up to 19200 baud rate.

The communications channel is EMI filtered and ESD protected to 10 kV with components on the RS-232/Nurse Call board and is not electrically isolated. The interface supports two signals (TxD and RxD) along with ground.

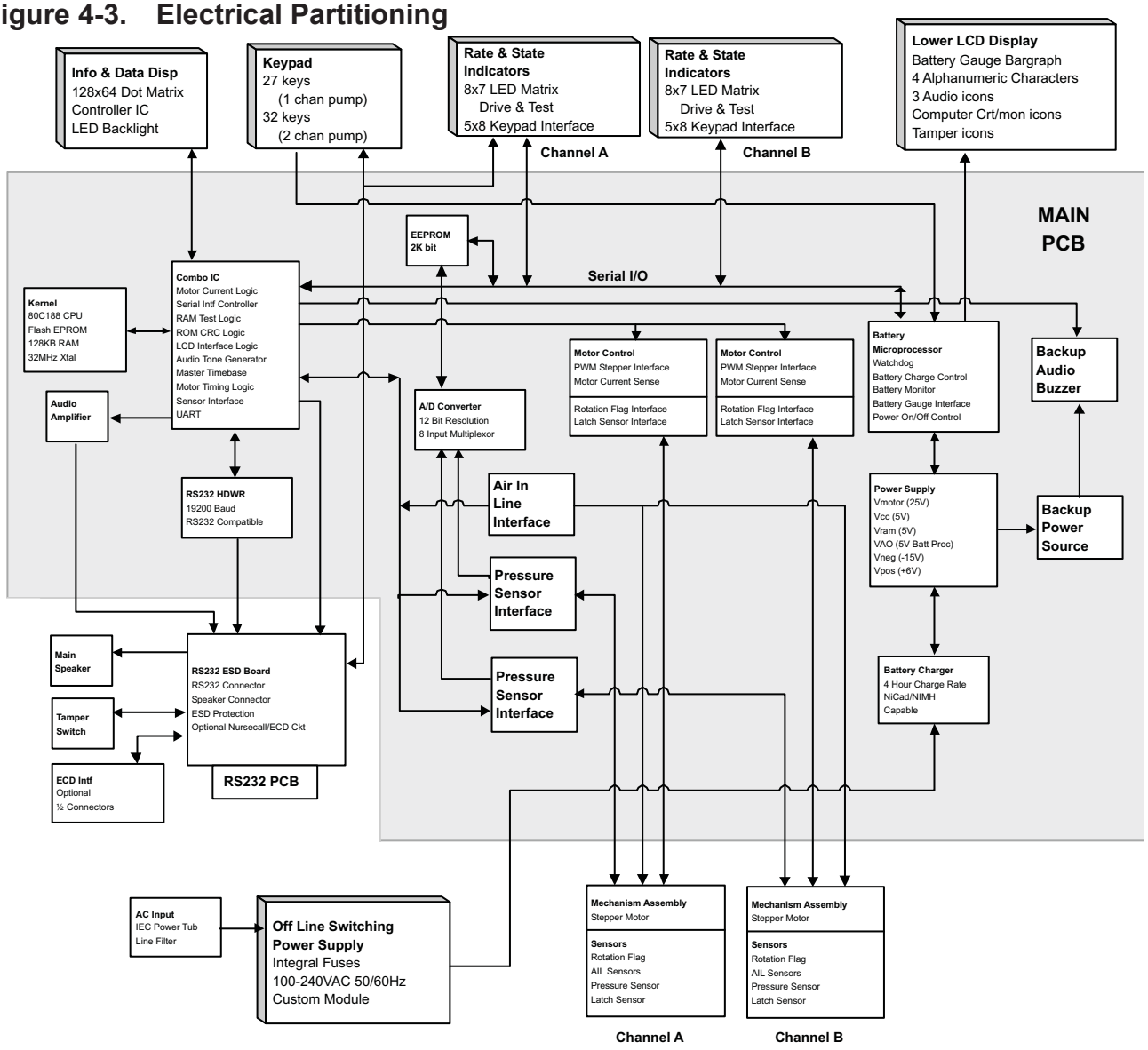
4.4 MAIN PCB (Continued)

4.4.6 RS-232 Interface (Continued)

7131/7231 Models

The isolated RS-232 interface provides 500VAC electrical isolation between the RS-232 signals on the RS-232 connector and the rest of the instrument. The isolation is created using optical isolators for the signals and an isolation power transformer for isolated circuit power. Voltage level conversions are generated by the MAX25O/25 1 chip set, to generate the appropriate signal conditioning. The limit resistor converts the RS-232 signal levels, nominally ±6V, to match the input signal range required by the chip set.

Figure 4-3. Electrical Partitioning



4.4 MAIN PCB (Continued)

4.4.6 RS-232 Interface (Continued)

> **NOTE:** The RS-232 board in Models 7131/7231 does not have the Nurse Call option.

4.5 POWER SYSTEM

4.5.1 Battery Manager

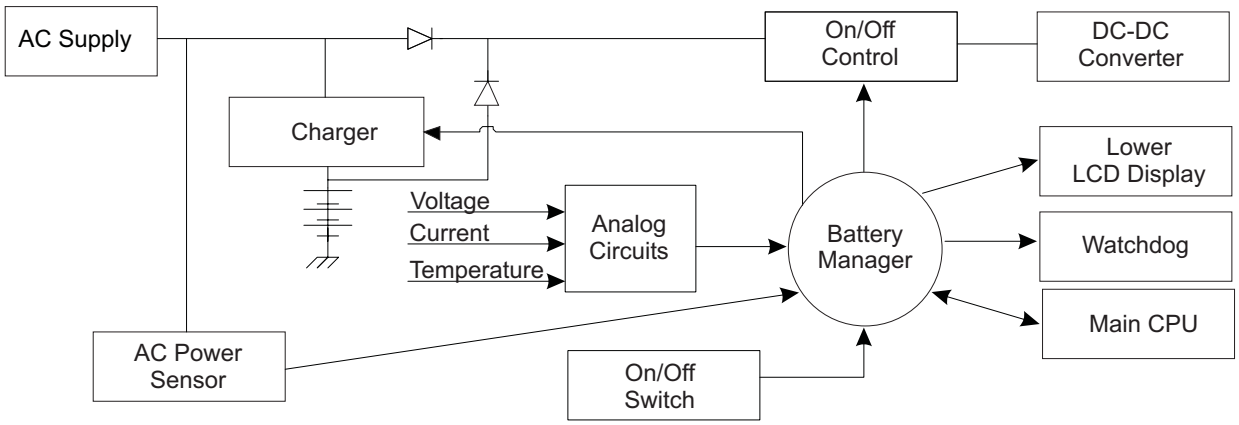
Refer to “Battery Management System” in “General Information” chapter.

The Battery Manager is a custom programmed microcontroller with 4K of ROM and 1K of RAM memory. The Battery Manager has two system time bases, a 32 kHz crystal and a 4 MHz ceramic resonator. In normal operation, the Battery Manager operates at 4 MHz. Under low power condition (instrument is off and AC is unplugged) the Battery Manager switches to the lower frequency to save power. The battery manager is turned on for three seconds every minute when the instrument is off and connected to AC power.

The Battery Manager has the following functions:

- Instrument on/off
- Battery charge control
- Battery gauge
- Battery warning and alarm
- Real time clock
- Displays configuration name
- Instrument icon display
- Inter-processor communications
- Processor self test
- Error detection (battery, temperature input, current integrator, power on/off, and watchdog faults)
- In-circuit test

Figure 4-4. Battery Manager Block Diagram



4.5 POWER SYSTEM (Continued)

4.5.2 AC Off-Line Switcher

Refer to Figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

The AC off-line switcher is an AC to DC power converter capable of running the instrument and supplying 22-24V @ 1.5A to the battery charging circuit from an input of 100-240 VAC 50/60 Hz. The module has foldback current limiting to protect against output shorts. It contains two input fuses which are designed for worst case hospital line transients and they will only blow if there is a fault in the module. There are no user adjustments in the module.

4.5.3 Battery Charge Regulator

Refer to Figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

The battery charger circuit is a step-down (buck type) switching regulator, U20 (U28), configured to provide a constant current of 1A through the battery whenever the charge control signal, CHARGE*, is low. The input to the battery charger regulator is DC_INPUT, which is generated by the off-line switcher between 22-24V.

The circuit measures the battery charge current through a 0.1 ohm resistor, R29 (R43), between the battery and "P" ground. This voltage is amplified and sent to the feedback input of the switching regulator U20 (U28). The regulator will keep the voltage at the feedback pin at 1.23V by adjusting its output pulse width. The gain of the amplifier is set so that an average current of 1A through the 0.1 ohm sense resistor will result in the 1.23V feedback voltage.

The Battery Manager controls the average current into the battery by varying the duty cycle of the charge control. There are four possible phases for the average current charge cycle.

- **Fast Charge:** This phase charges at 1 amp within limits on the ambient temperature. The Battery Manager charges with this phase until one of the following charge criteria are met.
  - ♦ Battery voltage drops at least 192mV below the peak value.
  - ♦ Battery temperature is more than 7°C above starting temperature and at least 30°C.
  - ♦ Total charge time exceeds 3.2 hours.
- **Top-Up Charge:** This phase starts after fast charge if the battery temperature is less than 37°C, at an average of 180mA for 180 minutes. This average current is produced by charging at 1 Ampere for 0.9 seconds every 5 seconds.

  NOTE: The charger will turn off if the battery gets too hot (>37° C) to let the battery cool down. Cool down time is NOT included in the 180-minute charge time.
- **Float Charge:** This phase charges at an average current of 40mA in a fully charged battery. This average current is produced by charging at 1A for 0.2 second every 5 seconds.
- **Hot Charge:** This phase charges at a rate of 180mA for a total time of 18 hours if battery temperature is more than 36°C. Charge stops above 43°C and starts below 43°C. The cool down time is in addition to the 18-hour charge time.

4.5 POWER SYSTEM (Continued)

4.5.4 Refresh Cycle Load

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

The battery refresh feature uses the refresh cycle load circuit to add an additional resistive load across the battery. This accelerates the discharge when the instrument is plugged into AC and is either on or off.

The signal DUMP_RES, generated by the Battery Manager, is used to turn on the transistor, Q9 (Q34*),* to apply the 47 ohm, 7 Watt, R273 (R353) load to the battery.

4.5.5 VAO Shutdown

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

VAO_SOURCE is used to supply power to the Battery Manager, its supporting circuitry and the RAMs. When the instrument is turned off, these supplies remain active. If AC is unplugged, and the battery has decreased to approximately 9.75V, the Battery Manager has the ability to remove these supplies from the battery load. This circuit is designed to protect the battery by preventing the battery from getting fully discharged. The Battery Manager generates the signal SHUT_DOWN* to remove the VAO_SOURCE from the battery load. When the SHUT_DOWN* command has been given the Battery Manager will lose power, as well as the RAMs and Lower LCD display. This power will only be restored when AC power is connected.

NOTES:

- The instrument's operation, after the battery is disconnected, is the same as the Battery Manager generating a SHUT_DOWN* signal and requires the instrument to be plugged into AC after the battery has been reconnected.
- After reconnecting the battery and connecting the instrument to AC, wait 15 minutes before powering up.

When the SHUT_DOWN* signal is asserted low, Q37 (Q39) will turn off, which opens the path from the battery to VAO_SOURCE.

4.5.6 AC Line Sense

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

The AC power sense circuit detects the presence of AC power and notifies the user and the Battery Manager of its status. The DC_INPUT is the output of the AC off-line switcher and should be between 22 to 24V. When the input voltage, DC_INPUT, reaches at least 15V, the circuit will recognize that AC has been plugged in. When AC power is detected, the AC LED on the LED module is lit and a status input to the Battery Manager, AC_PWR, is asserted high. The circuit is designed to switch off the LED quickly when AC power is removed.

When DC_INPUT is at least 15V, the voltage through the sense circuit is high enough to turn on the AC LED within the LED module. The AC_LED signal will be about 1.5 to 2.4V when the LED is on.

4.5.7 System Power Source Select

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

4.5 POWER SYSTEM (Continued)

4.5.7 System Power Source Select (Continued)

The system power source, DC_DC_SOURCE, is used to drive three switching power supplies. It is controlled by the Battery Manager through the signal PWR_ON. When the instrument is on, the DC_DC_SOURCE is normally supplied by either the battery or the AC off-line switcher if the instrument is plugged into AC. The Battery Manager disconnects the AC source during the battery refresh cycle.

When the Battery Manager asserts PWR_ON high, Q24 (Q41) will turn on. If PWR_AC is high, Q7 (Q25*)* will turn on, and DC_DC_SOURCE will be supplied by the DC_INPUT.

If PWR_AC is high, Q8 (Q21) is on and DC_DC_SOURCE will be supplied by the battery.

4.5.8 Battery Voltage Monitor

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

The battery voltage can range from 10 to 18V. The Battery Manager monitors the battery voltage through its internal A/D converter. The valid input range of the A/D converter is 0 to 4.1V. The battery voltage must be reduced to meet the input requirements. The 4.1V reference and the voltage subtracter-multiplier amplifier circuit U29-5 (U37-5) scale the battery voltage and maintain an accuracy of ±15 counts (1 count = lmV).

The Battery Manager uses the battery voltage for its charging, battery gauge, error detection, and battery alarm and warning features.

When MEASURE is low, Q27 (Q43) will open and remove BATT_PLUS from input to U29 (U37). Also MEASURE, being low, will open Q26 (*Q45)* so that VMEAS is removed as well.

4.5.9 VMEAS

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

VMEAS is the supply used to power the REF 4.1V reference circuit, the voltage monitor circuit, and the current monitor circuit. The Battery Manager turns VMEAS off by setting the MEASURE signal low when the instrument is off and AC is unplugged to reduce the load on the battery. In this condition, the Battery Manager turns VMEAS on once a minute to check the battery's voltage and temperature.

The 12V Zener CR31 (CR41) is placed between the gate and source of the FET, Q26 (Q45), to limit the gate to source voltage. The FET can see up to 24V but the Vgs (Voltage gate to source) of the FET is only rated to 20V.

4.5.10 Voltage Reference 4.1V

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

The 4.1V reference is used in the voltage monitor circuit, the battery temperature sensor circuit, the ambient temperature sensor circuit, and is the reference voltage for the A/D converter in the Battery Manager. The reference voltage is 4.096V ±2%. VMEAS, which can be between 7.7 to 24V, turns on the precision reference Zener U27 (U47).

4.5 POWER SYSTEM (Continued)

4.5.11 System Current Monitor

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

The circuit to measure the supply current uses a 0.1 ohm resistor, R32 (R86), to generate a voltage drop. The resistor is placed between "P" ground, the ground from the AC off-line switcher, and "L" ground, the ground to the rest of the instrument (battery charger circuit is tied to "P" ground so that battery charge current is not measured as system load current). The amplifier, U29-7 (U37-7), is designed as an integrator. Because the "P" ground voltage will be less than the "L" ground voltage, a current will be generated in a resistor tied to the operational amp's negative input, to maintain equal voltage levels at the operational amp inputs. This current charges the feedback capacitor, C52 (C56), thereby integrating the current as long as the feedback transistor, Q30 (Q48), is off.

The Battery Manager integrates the current for 100 ms, 1 ms before resetting the integrator by pulsing the signal RESET_I high for 1 ms. Forcing RESET_I high will turn on Q30 (Q48) thereby placing a short across the feedback capacitor, C52 (C56). The resulting output voltage, I_MON, is fed to an A/D input of the Battery Manager. At a 1 A load current the output voltage is about 2.7V. The Battery Manager samples I_MON once before the RESET_I signal is pulsed high and once after. The difference between the two samples becomes the current measurement. The Battery Manager uses the current measured for the following:

- charging
- to monitor current in and out of battery
- battery gauge
- gauge updates under present power requirements
- error detection functions

4.5.12 Always On Supply (+5VAO)

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

The always on supply, U39 (U43), is used to power devices that remain powered when the instrument is off, for example, Battery Manager circuitry and VRAM. The supply is regulated at 5V ±5%.

4.5.13 System Switching Supplies

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

The system switching supplies provide regulated +5V, +29V, and -15V power to the logic, display, motor, and sensor circuits. Each of the supplies uses an integrated switching regulator IC which provides thermal overload protection, internal oscillator, internal reference, and current limit functionality. The DC_DC_SOURCE voltage is applied to three switching power supplies:

- **+5V supply U17 (U31):** A step-down ("buck") configuration switching regulator which provides a lower output voltage (5V ±5%) than input voltage (10V-24V). The supply can provide in excess of 1A peak. Output clamp Zener diodes limit circuit damage in the event of regulator failure.

4.5 POWER SYSTEM (Continued)

4.5.13 System Switching Supplies (Continued)

The regulator has an internal pass element which turns on current to the output inductor until the output voltage, as sensed through the sense resistors, reaches the internal 1.23V reference voltage. It then turns off and the inductive flyback voltage created is clamped by a catch diode.

- **VMOTOR supply U21 (U26):** A step-up ("boost") supply which provides a higher output voltage (29V ±1.5V) than the input supply (9V-24V). The supply can provide up to 1A peak and has a soft start feature to limit inrush current upon starting. The internal pass element shorts the output side of the power inductor to ground, then releases it, generating about 29V at the cathode of a diode. This voltage is sensed by a resistor pair and the loop controlled to generate a 1.23V reference signal level.
- **VNEG supply U16 (U30):** A buck-boost supply which generates a negative supply (-15V ±1V) from a positive supply (9V-24V). The supply can provide about 100mA. The IC ground pin is bootstrapped to the negative output voltage. Then, referencing the feedback signal to ground potential allows the chip to sense the negative voltage and therefore regulate it.

Figure 4-5. Battery Monitor

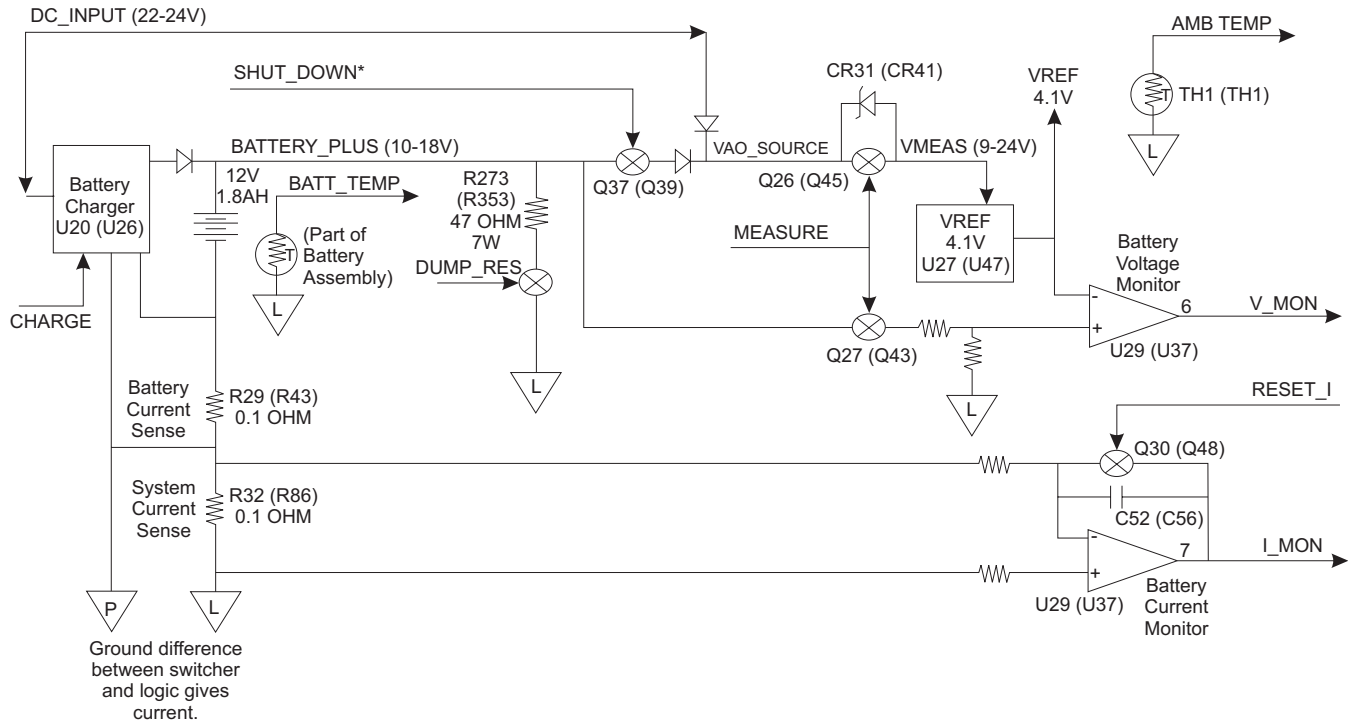
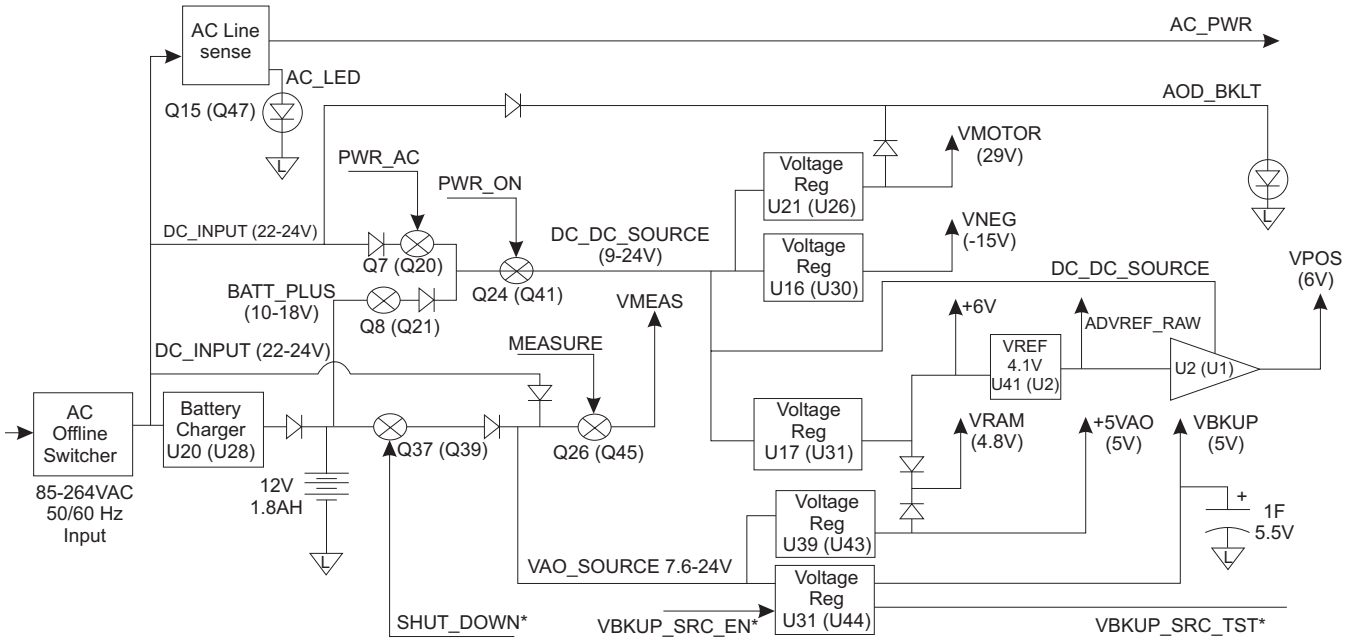


Figure 4-6. Main Power Supply



4.5 POWER SYSTEM (Continued)

4.5.13 System Switching Supplies (Continued)

In operation, the internal pass element provides current through the inductor while on. When the pass element turns off, the flyback action of the inductor generates a negative voltage spike which is captured across a capacitor though a steering diode.

4.5.14 VRAM Supply

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

The VRAM supply is a 4.8V supply generated for the RAMs to keep them active when the instrument is turned off. When the instrument is off, VRAM is sourced by +5VAO through a diode. When the instrument is on, VRAM is sourced by +5V through a diode.

4.5.15 VPOS Supply

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

A linear regulator, U2 (U1), from a DC-DC Source provides a 7.5V supply for the pressure transducer and A/D circuits. The power is supplied by the DC_DC_ SOURCE.

4.5.16 Battery Temperature Sensor

Refer to figures 4-5 "Battery Monitor" and 4-6 "Main Power Supply".

The battery temperature sense circuit measures the temperature in the battery pack through a nominal 10 kilohm @ 25°C thermistor. The sensor will measure, with a 2.5°C accuracy, over the temperature range 0° to 65°C. The circuit is a voltage divider between a resistor and the thermistor with a 4.1V reference voltage used as the input voltage. The output BATI_TEMP drives an A/D input to the Battery Manager.

4.5 POWER SYSTEM (Continued)

4.5.16 Battery Temperature Sensor (Continued)

The Battery Manager uses the battery temperature in its error detection and charging functions.

4.5.17 System Watchdog

Refer to figure 4-7 "System Watchdog".

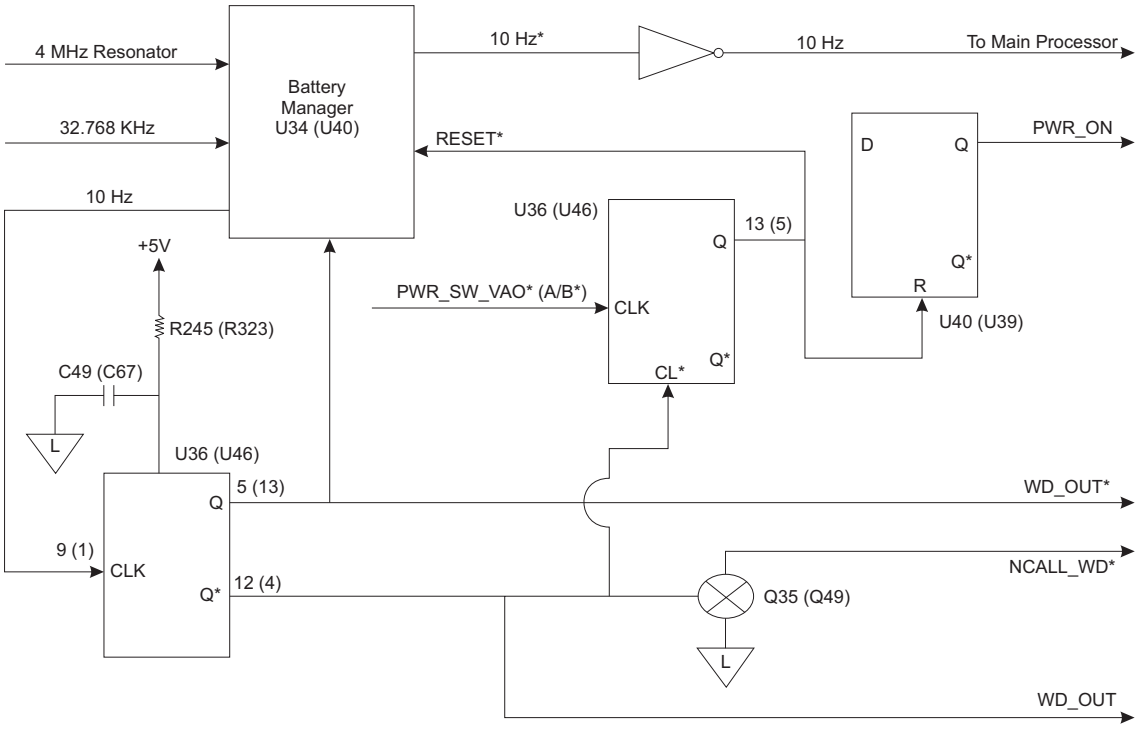
The system watchdog provides a monitor on the operation of the Main Processor and the Battery Manager. It also provides an independent clock signal to the Main Processor for continuous comparison with the main time base. The Battery Manager controls an output signal (10 Hz) that performs multiple functions.

The 10 Hz* has three states:

- **Continuous High:** Instrument is off or watchdog error has been caused by the Main Processor.
- **Continuous Low:** Battery Manager detects an error within the Battery Manager itself.
- **Oscillating at 10 Hz.:** Instrument is on or no watchdog errors have occurred.

When the 10 Hz signal begins to oscillate the watchdog outputs, WD_OUT and WD_OUT* will be deactivated. The one shot, U36-9 (U46-13), keeps its output Q high as long as the falling edges of the signal (10 Hz*) are faster than the pulse width of the pulse generated by R245 (R323) and C49 (C67), which is 105 to 220 ms. The Q* output of the one shot, U36-12 (U46-4), disables the second one shot U36-13 (U46-5). The second one shot is only enabled when the watchdog is in alarm.

Figure 4-7. System Watchdog



4.5 POWER SYSTEM (Continued)

4.5.17 System Watchdog (Continued)

When 10 Hz* is not oscillating, the one shot, U36-5 (U46-13), will not trigger, therefore, output Q is low and Q* is high. The watchdog outputs, WD_OUT* and WD_OUT, are activated until the Battery Manager releases them, by generating the 10 Hz* output. The NCALL_WD* signal is also brought low because WD_OUT turns on Q35 (Q49). Whenever the 10 Hz* stops oscillating and is high, a watchdog error has occurred within the Battery Manager itself. The 10 Hz* signal being high, prevents clock pulses to U36-9 (U46-1) and the one shot to time-out so the output Q (WD_OUT*) goes to zero and Q* (WD_OUT) goes to a high. Once WD_OUT is high, the second one shot, U36-13 (U46-5), is enabled.

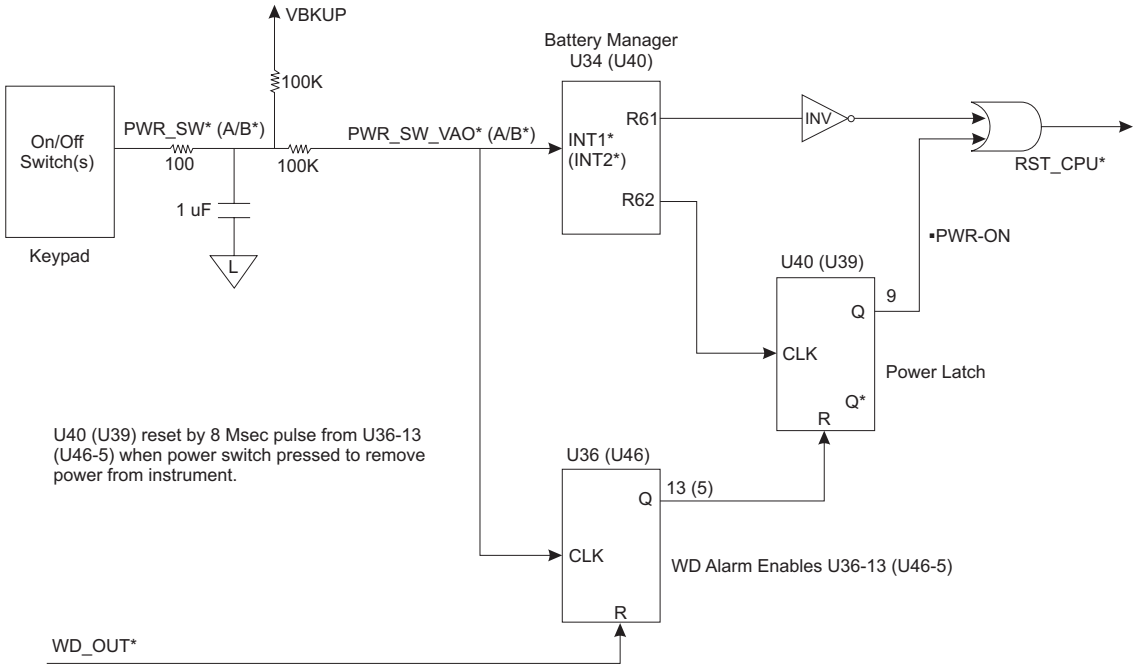
If the user presses either on/off switch, U29-10 (U42-10) output will go high, sending a 4 to 11 ms pulse to the Battery Manager reset input. This allows the user to reset the Battery Manager through hardware when the Battery Manager is stuck in a watchdog error. The system power is also turned off at this time because the pulse resets the power latch,U40-9 (U39-9), bringing PWR_ON low.

The 10 Hz* signal also goes to an interrupt input of the Main Processor. It is used to compare the time base of the Main Processor with the time base of the Battery Manager. Nominally, the timebase is 100 ms ±1 ms from falling edge to falling edge.

4.5.18 Power Switch (refer to Figure 4-8)

The power on/off switch(es) are located on the keypad. The switch(es) are not included in the standard keypad matrix. One (Two) output(s) is generated, PWR_SW* (PWR_SW_A/B*), one for each channel.

Figure 4-8. System Reset/Power On



4.5 POWER SYSTEM (Continued)

4.5.18 Power Switch (Continued)

The signals are pulled up to 5V, by VBKUP supply, through two pull-up resistors. (VBKUP is the supply for the backup audio.) These signals are decoupled from the signals that drive the Battery Manager logic, PWR_SW* (PWR_SW_A/B*), through two 100K resistors. The PWR_SW*

(PWR_SW_A/B*) signals drive interrupt inputs in the Battery Manager, U34 (U40), and are used by the error reset and power on circuits. Upon recognition of the power switch, the Battery Manager controls when the Main Processor and the rest of the circuit will receive power.

4.5.19 System Reset/Power On
(refer to Figure 4-8)

System Reset is controlled by the Battery Manager. Either the lack of a reset inactive signal from the Battery Manager, U34 (U40), signal R61 or the lack of the PWR_ON signal being asserted will initiate a RST_CPU*.

Power on is also controlled by the Battery Manager. Under normal conditions the Battery Manager uses its output R62 to toggle the power latch, U40-9 (U39-9), to turn the instrument on/off. The Battery Manager turns PWR_ON high when the instrument is on and turns PWR_ON low when the instrument is off.

If the instrument is on and a watchdog error is active, WD_OUT* is asserted low. The second one shot, U36-13 (U46-5), will be enabled. When the power switch is pressed, an 8 ms pulse is generated at the Q output of U36-13 (U46-5). The pulse resets the power latch, U40-9 (U39-9).

4.5.20 Lower LCD Display Backlight Drive

The backlight for the Lower LCD display contains 6 LEDs in series. The signal AOD_BKLT is tied to the anode of the first LED in the series. Each led has about a 2V forward drop. So AOD_BKLT will be about 12-13V when the LEDs are turned on.

The Lower LCD display backlight drive circuit controls the amount of current supplied to the LEDs. The circuit contains two current sources "or'd" together. One current source is powered from DC_INPUT, the voltage supply from the AC off-line switcher. The second source is powered from VMOTOR which is generated when the instrument is on.

The circuit has four modes of operation:

- The instrument is off and unplugged. In this mode, the backlight driver is off and the two power supplies that drive the circuit are both off.
- The instrument is off but plugged into AC. In this mode, the current to the LEDs is limited by a resistor. VMOTOR will not be on, so only the DC_INPUT path generates the current for the LEDs and the current to the LEDs will be about 4 mA.
- The instrument is on and plugged into AC. In this mode, both current sources are on, driving the LEDs for maximum brightness, and the current to the LEDs should be around 6 mA.
- The instrument is on and not plugged into AC. In this mode, only VMOTOR is on, so the driver generates the current to turn on the LEDs and the current to the LEDs should be around 2 mA.

4.6 MOTOR DRIVE/SENSORS

4.6.1 Motor Drive (refer to Figure 4-9)

The stepper motor drive circuit consists of a dual H bridge to provide voltage to each winding of the hybrid stepper motor, and a voltage comparator to control the duration that voltage is applied to each motor winding.

The sequence of operation for a single phase [Phase 1 (A)] of the motor is as follows:

1. Phase A, MTR_PH_1 (MTRA_PH_1) is active, which causes the high side switch and low side switch (diagonally opposite the high side switch), to close. This presents the motor supply voltage across the motor winding. The MTR_1A (MTRA_IA) and MTR_1B (MTRA_1B) signals are used to drive the motor.
2. Current will begin to increase at a rate determined by the ratio of the motor voltage to the inductance of the motor; for example, about 0.5 amps/millisecond, and flow in the direction indicated by the arrow shown. The current will increase in the sense resistor at the same rate and result in a voltage sensed by the comparator.
3. Once the sense resistor voltage MTR_I1 (MTR A/B_I_1) rises above the reference voltage at the comparator inputs, U14 (U27), the comparator output, U14-1 (U27-7), will switch low forcing the high side switch to open. The low side switch will always remain closed until a phase change occurs. With the supply voltage now removed from the coil, the coil current and the sense resistor current will decay. Once the sense resistor voltage drops below the reference voltage, the comparator will turn the high side switch back on.

   The comparator circuit has been designed with a fixed turn on delay of 50 microseconds. This is a result of the RC network on the output of the sense comparator stage. A second comparator stage will sense when the output of the first stage rises above 3.3 volts. The turn on delay results in a maximum chopping frequency of 20 kHz. The lowest chopping frequency is a function of the motor current, at a maximum motor current of 240 milliampere, the chopping frequency is 14 kHz. Inserted between the sense resistor and the comparator input is an RC network needed for filtering of the short circuit current caused by the distributed capacitance of the motor winding.
4. The chopping action results in a steady state current in the winding for a given phase duration. When the phase is reversed the opposite high side and low side switch will turn on. This forces current to flow in the opposite direction. The reference, MTR_I1 (MTRA_I_1), is controlled to ramp the motor current exponentially, minimizing step oscillation and reducing mechanical noise.

4.6 MOTOR DRIVE/SENSORS (Continued)

4.6.1 Motor Drive (Continued)

The following table illustrates the phase sequence and the respective power, high side and low side switches that are enabled.

Table 4-1. Motor Control Signals

Control Signal Logic	Logic State	Active Switches	Winding Effected
MTR_EN_1	H	Q4-6, Q3-1	
MTR_PH_1	L	(Q17-6), (Q19-3)	MTR_1A/B
MTR_EN_2	H	Q6-6, Q5-3	
MTR_PH_2	L	(Q8-6), (Q10-3)	MTR_2A/B
MTR_EN_1	H	Q4-7, Q3-3	
MTR_PH_1	H	(Q17-7), (Q19-1)	MTR_1A/B
MTR_EN_2	H	Q6-5, Q5-1	
MTR_PH_2	H	(Q8-7), (Q10-1)	MTR_2A/B

To assist the down stream pressure algorithm and reduce mechanical noise, the motor is stepped in packets, a series of motor steps followed by a short resting period.

5. The efficiency of the motor driver is determined by the low on resistance in the MOSFET switches, and the speed at which they are switched on and off. Since only the high side switches are involved in regulating the motor current, a bipolar network has been designed around these switches to keep switching times below a microsecond. An example of a switching sequence is described as follows:

To activate the following circuit requires MTR_PH_1 (MTRA_PH_1), MTR_EN_1 (MTRA_EN_1), and WD_OUT* to be at a logic high. When the second comparator output U14-7 (U27-1) switches low, this turns on transistor Q18 (*Q23*), which turns off Q4 (Q17) immediately, thereby removing the motor voltage from the motor winding. When U14-7 (U27-1) switches high, this causes the output of comparator U13-7 (U25-1) to switch low and transistor Q18 (Q23) to turn off. This quickly turns on Q4 (Q17). A 1000 pF capacitor is in series with the output of U13-7 (U25-1) to speed up the switching time of Q4 (Q17) when the comparator output goes low. Two motor current sense comparators are included in the motor drive circuit to provide a means for the instrument to detect an instrument malfunction that results in a “watchdog” alarm that will shut off current to the motor. The WD_OUT* signal, when at a logic low, is the indicator for a "watchdog" alarm. When motor current of approximately 20 milliampere or greater flows through either motor winding the motor current sense comparator output MTR_SNS*, U12-7/U12-1 (U17- 1/U17-7), will be at a logic low. Both motor windings would have to have a motor current of less than 100 milliampere for the motor current sense comparator output to go to a logic high.

Figure 4-9. Motor Drive Circuit, Phase 1(A)

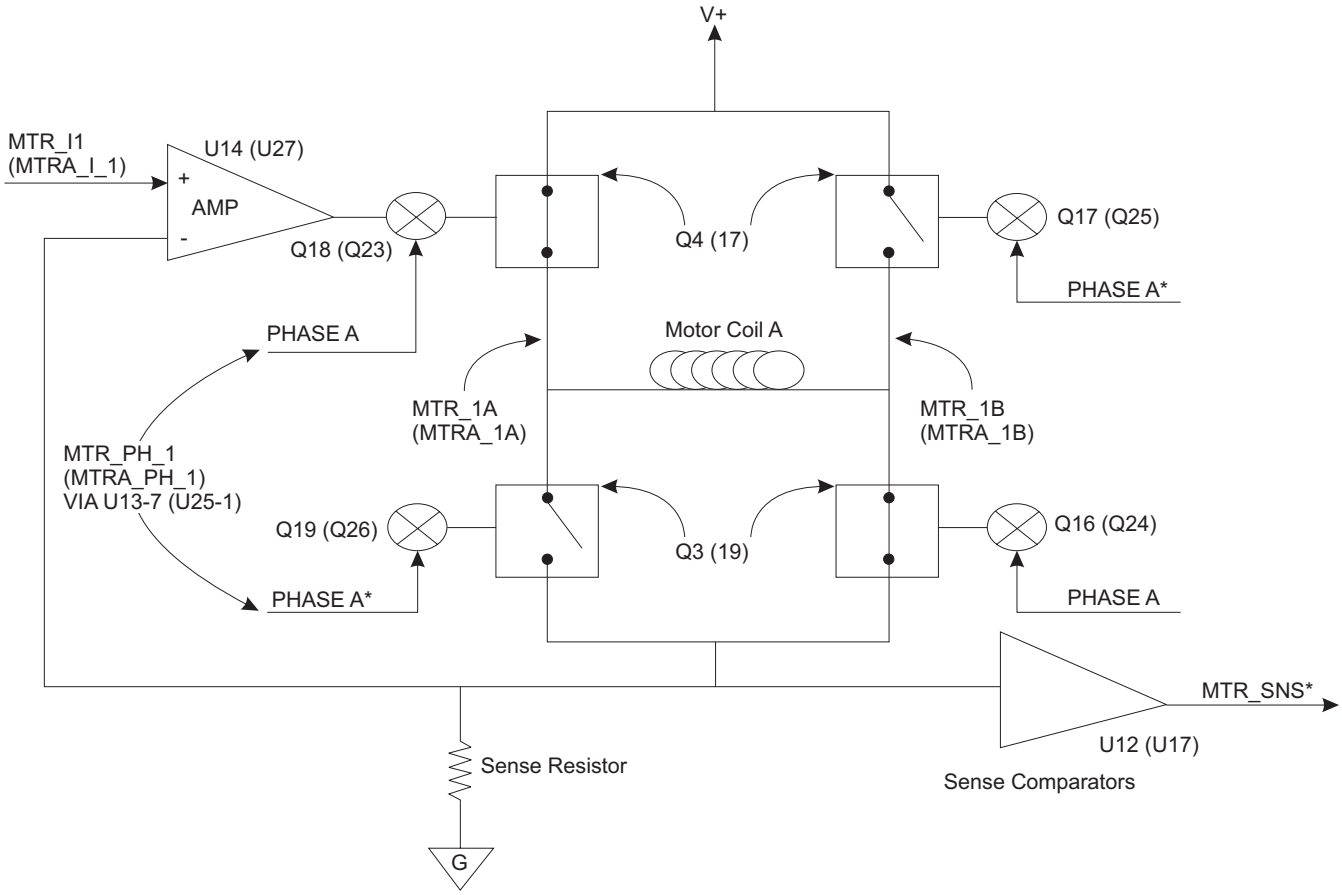
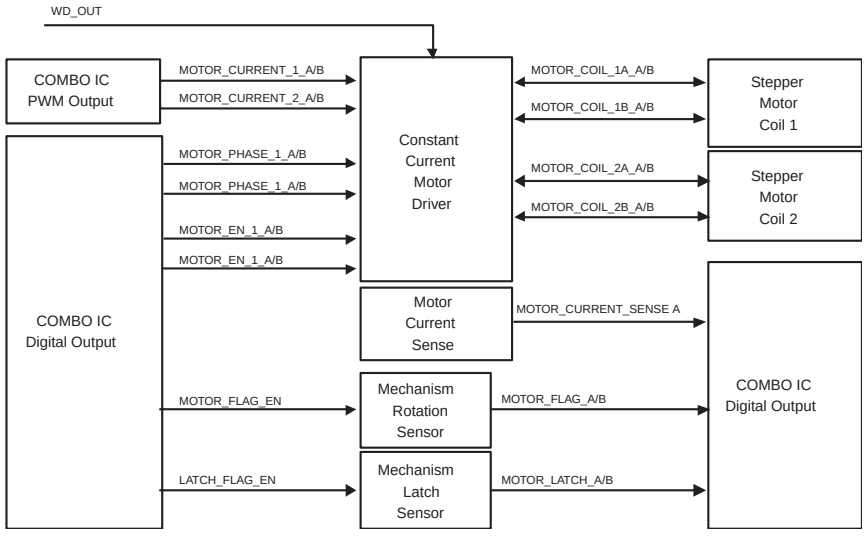


Figure 4-10. Motor and Mechanism Sensors Block Diagram



4.6 MOTOR DRIVE/SENSORS (Continued)

4.6.2 Air-in-Line Sensor (refer to Figure 4-11)

The Air-in-Line (AIL) Detector System consists of:

- Transmitter arm that also loads set in position to monitor for air.
- Receiver which is mounted in mechanism.
- Voltage control oscillator (VCO).
- COMBO IC and associated circuits.

The voltage control oscillator will sweep a frequency range of 1 to 4 MHz and serve as the excitation for the ultrasonic AIL transducer. This frequency sweep is necessary to ensure that the piezoceramic elements will achieve resonance over assembly and temperature variances. The AIL Gate signal will initiate the VCO to sweep. The detector is scanned at a 10 msec rate (40 msec to check bubble) and once a second to test the AIL hardware. On the receiver side, the signal envelop will be seen if fluid is in the set. This signal is then returned to the COMBO IC and eventually to the processor to determine if air is present (no signal) and to compute the size of the air bubble. With accumulator on, the instrument will consider air bubbles separated by less than 70 microliters of fluid as one bubble and alarm accordingly. The instrument will also alarm if 10% to 15% of downstream tubing is filled with air (varies with alarm set point).

4.6.3 Transducer (refer to Figure 4-12)

The transducer assembly is a silicon based resistor bridge producing a linear output. The sensing area is in the front of the assembly and directly in contact with the tubing (no gel). It is used to measure stress, not absolute pressure. A film over the transducer provides a means to protect the sensor from electrostatic discharge.

The transducer is used to sense upstream and downstream occlusions as well as sensing if the set is installed or removed. To accomplish these tasks the transducer is calibrated with a special set. The pressure

Figure 4-11. Air-in-Line Detector Block Diagram

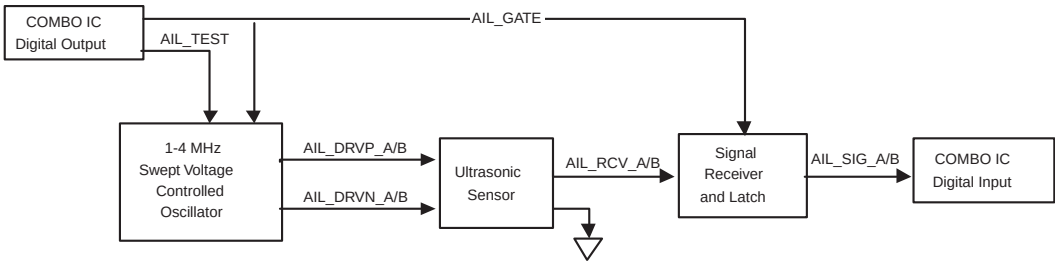
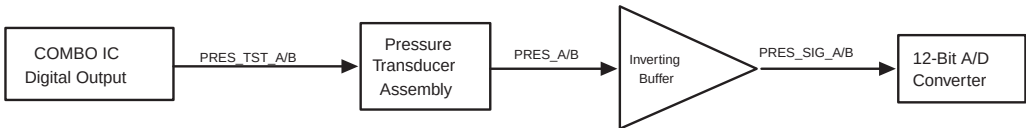


Figure 4-12. Pressure Sensor Interface Block Diagram



4.6 MOTOR DRIVE/SENSORS (Continued)

4.6.3 Transducer (Continued)

calibration set has a hole drilled into the dome of the AccuSlide® Flow Regulator. This enables the pressure to be applied directly to the transducer for calibration (0 and 500 mmHg).

After pressure calibration, the reading shown in the diagnostic mode for the sensor is corrected for any offset /stress from loading the set outside of the pressure sensing area.

When the set is installed, with dome intact, the instrument looks for an increase in stress (greater than 55 mmHg with auto zero enabled, >90 mmHg with auto zero disabled). Drift is checked periodically to ensure the transducer is accurate. If not, a "Cal Reqd" message will appear. This is done by asking the operator to remove the set before powering down the instrument. The time period of this test is selectable in the diagnostic mode under the Self Check timer.

PRES_TST_A/B is used to take the transducer out of balance by inducing a known positive offset. This is the means by which the transducer is tested.

The "Cal Reqd" message will appear if the transducer shifts more than 170 counts positive or 200 counts negative from last "0" cal level.

4.7 USER INTERFACE (refer to Figure 4-13)

The user input interface consists of a keyboard organized as a 4x8 matrix which is scanned and controlled through the LED Module on a single channel instrument and the Channel A LED Module on the dual channel instrument. The keyboard is scanned approximately every 10 ms and key data updated when there is a change due to any key or keys being pressed or released. Note that the panel lock is scanned as part of the scan sequence even though it is located on the back of the instrument. Switches are scanned every 10 msec, two cycles are required to be a true switch actuation. This provides a debounce function to eliminate mechanical noise and EMI/RFI interference. The power switch(es) are sensed separately by the Battery Manager. During normal operation, the power switch(es) are monitored like the other keys so that inadvertent instrument turnoff can be avoided. In a system alarm state (for example, watchdog alarm active), the keys directly control turning power off to the instrument.

The user output interface consists of three display modules. The LED Module(s) provide rate data visible from a distance, along with operating mode annunciators, AC/Battery operation notice, and visual alarm indication. The Graphic LCD Module provides user information on a 128x64 dot matrix display with LED backlight. The Lower LCD display shows the current battery charge level along with the current audio level selected, communications interface status, panel lock status, and battery refresh status.

4.7 USER INTERFACE (Continued)

4.7.1 Main Speaker Driver
(refer to Figure 4-14)

The main speaker driver is based on an LM386 low voltage speaker drive chip, U32 (U29), driven by an exponentially weighted 4-bit control signal (AMP 0 to 3) modulated at the desired frequency (200 Hz - 4 kHz) by the COMBO IC U10 (U14). The speaker is pulsed at 3 to 50 mA with a 50% duty cycle (max. 100 mA). The driver has a fixed 26dB gain which provides up to 3VPP AC coupled into an 8Ω speaker. The speaker is tested by monitoring the speaker current with a 0.511Ω resistor.

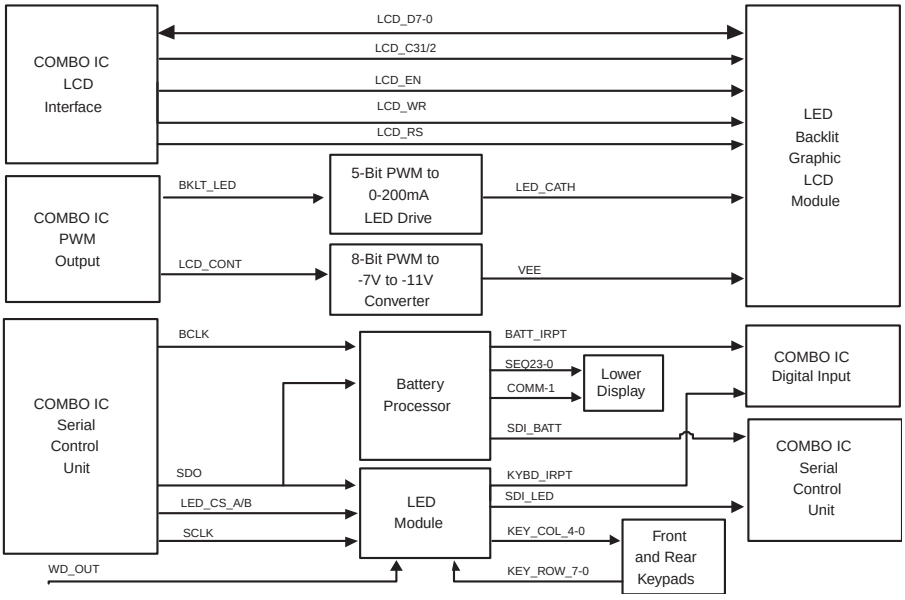
The voltage across the resistor is amplified, rectified, and compared to low and high threshold values by a window comparator, U38 (U16). The speaker is tested when an alarm or error occurs, while the test circuit is verified at power up. The speaker audio volume settings are approximately:

Low = min 45 dB
Med = 65 dB
Hi = approx. 70 dB

4.7.2 Backup Audio Buzzer and Test Circuit
(refer to Figure 4-15)

A backup audio generation capability is provided to allow the instrument to generate an audible alarm in the event that the main speaker is unable to do so. It is supplied through VBKUP, a 1.0 Farad "supercap" C146 (C179) energy storage device charged by a 5V linear regulator, U32 (U44), on the VAO SOURCE supply. The buzzer is a self oscillating audio generator and speaker module which produces a 3 to 4 kHz tone when energized. A logic circuit, U30 (U41), powered by VBKUP arms the circuit using the BKUP_ALARM_ARM signal

Figure 4-13. User Interface Block Diagram



4.7 USER INTERFACE (Continued)

4.7.2 Backup Audio Buzzer and Test Circuit (Continued)

once the instrument has powered up so that the watchdog WD_OUT* signal will not generate an alarm if the unit is turned on or off properly. Additional logic is provided to allow the power switch(es) to turn off the backup audio if the main CPU or battery processor no longer have control over the instrument.

The circuit has two test functions. The VBKUP supply is tested at power up to verify that the supercap can drive the buzzer when the regulator is disabled through VBKUP_SRC_EN signal. The buzzer operation is tested by sensing the oscillating current waveform generated by a normally operating buzzer. The buzzer current is sampled by a sense resistor, whose voltage is amplified. The DC level is compared to VTHRES Hi by a comparator, U33 (U33), whose output (BKUP_SPKR_TST*) drives a digital input on the COMBO IC.

4.8 LED MODULE

The LED Module(s) provide rate data, along with operating mode annunciators, AC/Battery operation notice, and visual alarm indication. The modules have 58 individual LEDs controlled by a custom IC. The IC performs LED scanning and test functions along with keyboard scanning circuits and interfaces to the main CPU through the local serial interface. The LED intensity is controlled by the Main Processor to limit power use while running on battery.

Figure 4-14. Main Speaker

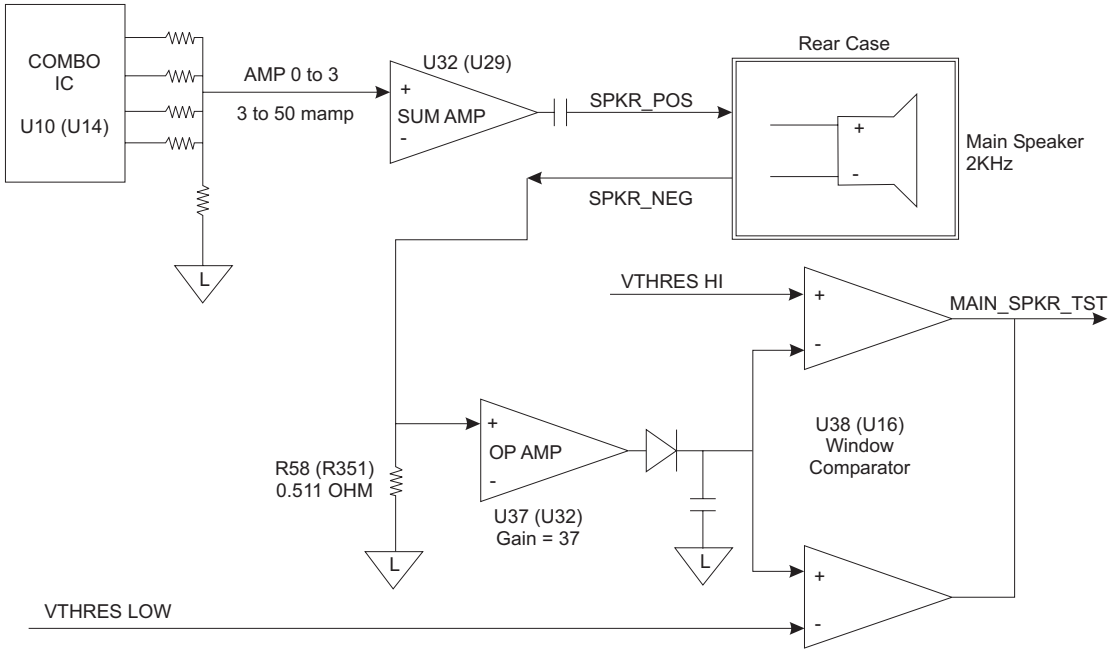
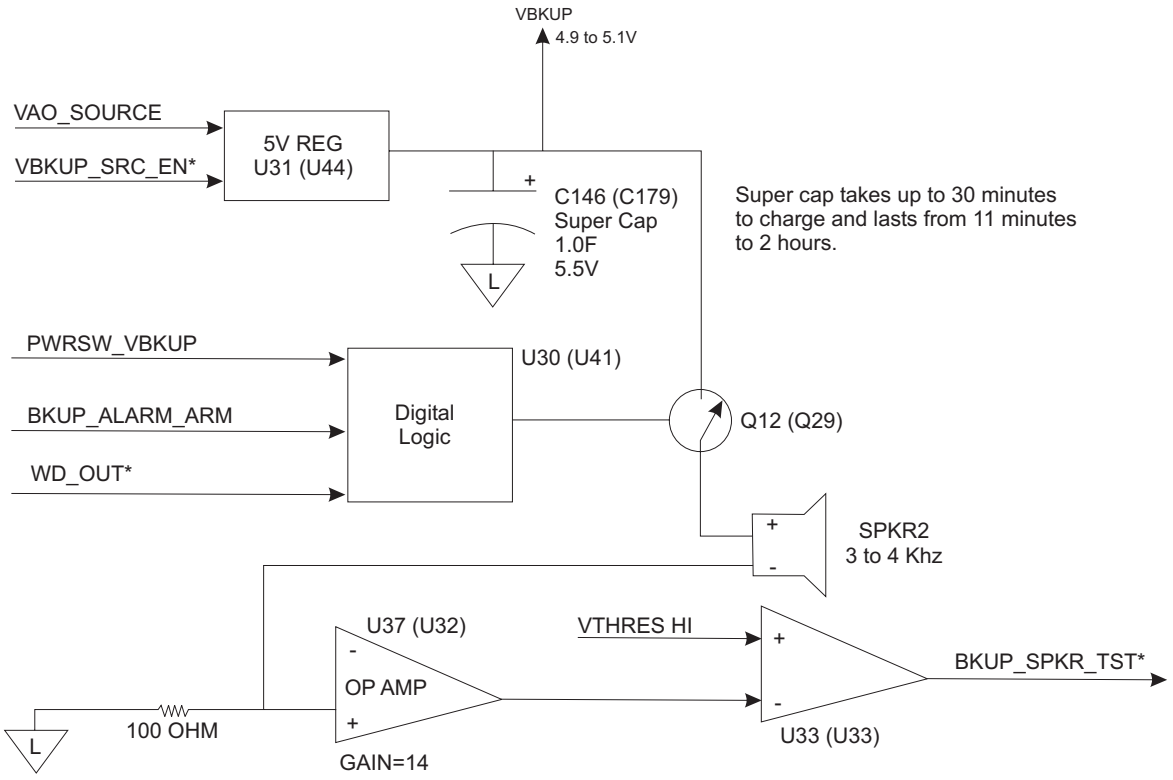


Figure 4-15. Backup Audio



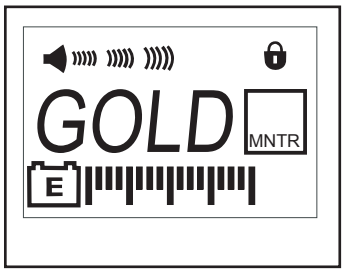
4.9 LOWER LCD DISPLAY

The Lower LCD Display is visible whether the instrument is on or off, AC or battery operation. It shows the current battery charge available along with the current audio level selected, communications interface status, panel lock status, and battery refresh status. It is driven by the Battery Manager and is back lit when the instrument is on or plugged into AC.

4.10 MAIN LCD MODULE

The Main LCD Module provides user information on a 128x64 dot matrix display with LED backlight. The Main Processor generates all text and symbols in bit mapped form, then compares data read back from the display memory to that which was generated to find and avoid problems. Screen updates occur every 100 mSec. The backlight intensity is controlled by the Main Processor to limit power use while running on battery. The LCD contrast is controlled by the main CPU and can be adjusted from factory default through the diagnostics mode. Refer to "Changing Main LCD Contrast" section in “Troubleshooting” chapter.

Figure 4-16. Lower LCD Display



4.10 MAIN LCD MODULE (Continued)

4.10.1 Main LCD Backlight

The graphic LCD backlight is an array of LEDs driven by an adjustable constant current source controlled by a PWM signal from the COMBO IC. The LED current can be adjusted stepwise linearly over a 0-200 mA range. The current source consists of a low on resistance FET, 0.511Ω sense resistor, and op amp to set the sense resistor voltage based on the filtered PWM input voltage BKLT_LED. The backlight intensity is not user adjustable.

4.10.2 Graphic LCD Contrast

The graphic LCD contrast is controlled by varying the VNEG supply to the module over a -7V to -11V range. The drive circuit inverts and scales the filtered PWM LCD_CONT signal from the COMBO IC to cover this range. Nominally, the contrast voltage is -9V, but can be adjusted through Diagnostics Mode in software.

4.11 NURSE CALL CIRCUIT (7130/7230 ONLY)

An optional nurse call circuit is located on the RS-232/Nurse Call board and provides a 35V @ 1A rated relay contact on system alarms through pins 6 and 9 of the RS-232 connector.

4.12 PANEL LOCK SWITCH

The instrument can be protected from unauthorized changes with the Panel Lock Switch. A lock symbol is shown in the Lower LCD display whenever the feature is active. When activated, access to all front panel keys is restricted (except channel select and split screen viewing key).

4.13 ECD BOARD (refer to Figure 4-17)

The ECD board (optional for 7130/7230) provides empty container detection using standard ALARIS® Model 180 Flow Sensors.

The flow sensor interface is a separate board assembly which drives a standard ALARIS® Model 180 Flow Sensor, performs ambient light rejection on the resulting signals, and provides digital output signals for a detected drop and sensor attached detection. The board consists of 2 separate ambient light discriminator loops and drop detectors for independent Model 180 Flow Sensors along with common timing and control logic. The board assembly is common to both single and dual channel instruments, where the "B" channel is not available externally and is ignored in the software of the single channel instruments. Note that the "A" channel is used for both the "A" channel in the dual channel instrument as well as the single channel instrument, even though the mechanisms are on opposite sides of the case.

- **Common Timing Logic:**
  The common timing and control logic generates the necessary discriminator timing signals to drive the flow sensor LED and sample signals representing room ambient light and LED driven light outputs from the flow sensor. The main system CLK_32MHz is used as the timebase and decade counter U3 that generates non-overlapping "A" and "B" channel drive and sense signals. This reduces the peak LED current load and flow sensor crosstalk during normal operation. Transistors Q5 and Q6 provide logically inverted control signals for the LED drive circuits.

4.13 ECD BOARD (Continued)

- **Ambient Light Discriminator Loop:** The flow sensor drive current is set to maintain a 2.8V level normally at DROP_A/B. This level is determined by the difference in input signal from a Model 180 Flow Sensor when the emitter is undriven and driven. Analog multiplexor U4 normally grounds the output of the sense capacitor C18/23 so that room ambient light signal voltage is set across it. When the LED drive is turned on, the output of the sense capacitor, representing the driven signal voltage less the ambient signal voltage, is transferred to sample capacitor C28/C26. This signal is amplified by U8/U7 with a gain of about 23 and is the DROP_A/B signal.

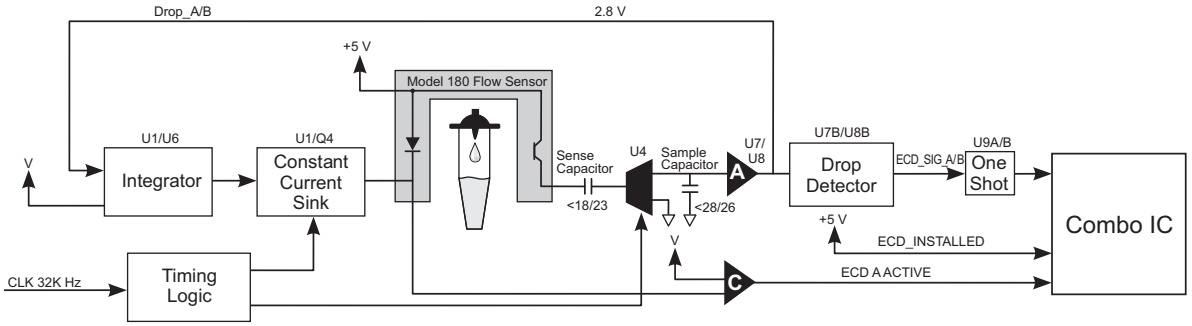
  The DROP_A/B signal is sensed by integrator U1/U6 and C9/C10 to generate an appropriate LED drive level to maintain DROP_A/B at about 2.8V. The integrator output signal is controlled by drive enable FET Q1/Q2 to drive the LED constant current sink U1/Q4 and relate components. The constant current source generates a 0-200mA sink current with a 0V-1V input signal.

  To prevent a drop from skewing the LED drive signal, a long time constant filter, consisting of CR1/CR2, R31/R13, and C9/C10, is enabled on a negative going output signal DROP_A/B.

- **Drop Detector:** The drop detector circuit generates a digital pulse when a valid drop event is detected. A drop event occurs when a fluid drop passes between the emitter and detector of the Model 180 Flow Sensor and appears as a generally negative going short duration pulse on the DROP_A/B signal. Detector comparators U8B/U7B generate a 0 to 5V pulse when a drop "signature" of appropriate length and duration occurs. One shots U9A/B generate a nominal 20ms pulse which indicates a valid drop (ECD-SIG-A/ECD-SIG-B). The main system processor processes the pulse stream and determines whether the drops are occurring properly for the current instrument rate and operating mode (for example, primary/secondary).

  EMC filtering is provided by filters C4-8 to limit EMI into or out of the flow sensor connection pins.

Figure 4-17. Flow Sensor Interface Block Diagram



4.13 ECD BOARD (Continued)

- **Option Installed and Sensor Installed Circuit:**
  The installed option detection consists of the input signal on pin 7 of J3 tied to +5V on the board. The Main Processor has a pulldown resistor on the ECD_INSTALLED signal which generates a logic low signal if the option is not installed. Flow sensor installed signals are generated by monitoring the LED current sink drive transistor collector voltage. Comparator U2A/U2B monitor the voltage and generate a 5V output signal if they drop below about 1.7V. Note that, nominally, the collector voltage should not go below about 2.2V with a flow sensor attached and driven at maximum current.

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5 CORRECTIVE MAINTENANCE

Chapter 5 — CORRECTIVE MAINTENANCE

WARNING

The instrument case should only be opened by qualified personnel using proper grounding techniques. Disconnect instrument from AC prior to performing maintenance. Hazardous voltages are present when AC power is connected, regardless of the ON/OFF Switch setting.

CAUTION

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

5.1 INTRODUCTION

This chapter contains procedures required to properly disassemble, repair and replace parts as well as to test, calibrate, and reassemble a Signature Edition® GOLD Infusion System.

A thorough familiarization with the function and operation of the mechanical assemblies and electrical circuits of the pump will enable repair and calibration to be accomplished more efficiently (refer to “Principles of Operation” chapter).

The circuit boards used in the instrument are fitted with surface mount devices and are deemed nonfield repairable. Therefore, ALARIS Medical Systems requires that all circuit boards be returned to an authorized ALARIS Medical Systems Service Center

Table 5-1. Test Equipment

NAME	MANUFACTURER	MODEL NUMBER	APPLICATION
Electrical Safety Tester	BIO-TEK	260*	Used to test AC wiring and pump grounding.
IV Infusion Set	IVAC	80 VCS	Rate accuracy test
Nurse Call Cable	IVAC	136111	Nurse call option
Pressure Cal Set	IVAC	70ISS	Pressure verification and calibration
Pressure Gauge (-400 to +750mmHg)	Dresser Industries: 203-406-3115 (Heise) BIO-TEK: 802-655-4040	PTE1/901M1* DPM III*	Pressure verification and calibration
Burette 50mL, 0.1mL increment	Fisher Scientific Keynex	Class A or B* 113 Sec A*	Rate calibration and verification
RS-232 (9-pin, Null modem)	IVAC	133450*	Connects between 2 instruments to download configuration.
Silicon Tubing	IVAC	303109*	Pressure calibration setup
T-Fitting	IVAC	313815*	Pressure calibration setup
NiCad Battery Optomizer	Alexander Batteries 800-577-2539	Model 2006* 2003*	Test and condition batteries (optional)
Hand-Held Vacuum	Any	Any	Main board assembly cleaning

* or equivalent

5.1 INTRODUCTION (Continued)

for repair. If circuit board repairs are attempted, all warranties will be void.

ALARIS Medical Systems recommends that parts within the instrument be replaced rather than repaired when not working properly. Boards, mechanism and display modules must be replaced as an assembly.

The tests to be performed on a just-repaired instrument depend on the level of repairs made to the instrument. See Table 5-2, Level of Testing Guidelines.

NOTE: Due to instrument changes over time, components/assemblies illustrated in this chapter may be different than those in the instrument being disassembled. If there are any questions, look for Service Bulletins related to this chapter or contact ALARIS Medical Systems, Technical Support.

5.2 DISASSEMBLY/REASSEMBLY

The following procedures are presented in a sequence that provides the most efficient means of accessing and removing the subassemblies. To reassemble, perform the steps in their reverse order. Refer to the "Routing and Connecting Cables" section before closing. Figure 5-1, "Instrument Assembly Organization", provides the instrument's hierarchy.

Though a dual channel instrument is depicted in the following procedures, both instruments disassemble in the same manner. Channel B will be the same as a single channel instrument.

WARNING

Disconnect instrument from AC power before disassembling.

Disconnecting Cables

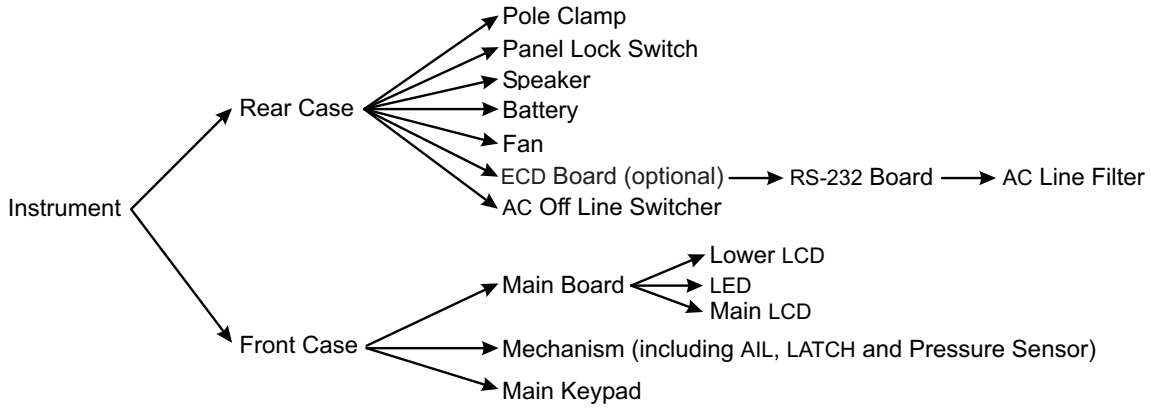
Pay close attention to cable routing when disassembling the instrument. The cables are specifically routed to ensure they are not pinched or stressed when reassembled. Channel A (ChA) and Channel B (ChB) wires are routed in the opposite direction to connect to the board assembly.

NOTE: Single channel pump routing is similar to Channel B (ChB).

CAUTION

Exercise caution when removing connectors. Pulling on wires can break them. Wires and connectors must be replaced as part of an assembly. They cannot be repaired separately.

Figure 5-1. Instrument Assembly Organization



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.1 Removing Battery (Figures 5-2 and 5-3)

> **NOTE:** Instrument configuration will not be lost when disconnecting power; however, error history and infusion program settings may be lost. To save error history, record before proceeding.

1. Disconnect AC power from instrument.
2. Remove screw from Power Cord Retainer, on rear case, using a Phillips screw driver.
3. Remove Power Cord and Power Cord Retainer.

CAUTION

When there is no AC power available, DO NOT replace dead battery for the purpose of re-powering the instrument. The instrument will not operate unless it is first connected to AC power after battery replacement.

4. Lift and remove Battery Cover.
5. Lift cable for battery out of compartment.
6. Pull battery from compartment and disconnect.

> **NOTE:** The instrument will not run with battery disconnected.

During Reassembly:

1. Connect and install battery. Note the rated capacity of the battery.
2. Reassemble battery cover, power cable and power cord retainer.
3. If battery has been replaced:

a. New battery may have a different rated capacity (current battery has rated capacity of 1.8 Ah, with 1.3 Ah entered in Diagnostics Mode).

if it does, proceed to Diagnostics Mode (D2), select Battery Status and enter new rated capacity. Refer to “Changing Rated Capacity of Battery” section in “Troubleshooting” chapter.

> **NOTE:** In the event ALARIS Medical Systems provides different battery packs in the future, the replacement battery may have a different rated capacity. The battery manager needs to know if a new battery, possibly with a new rated capacity, has been installed.

b. Clear battery run time via Diagnostics Mode after installing new battery. Refer to "Viewing Battery and Total Run Times" section in “Troubleshooting” chapter.

> **NOTE:** The instrument will attempt to refresh the battery when it is first installed and connected to AC power. This refresh may take in excess of 24 hours if the instrument is turned on.

5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.1 Removing Batteries (Continued)

Figure 5-2. View From Back of Instrument

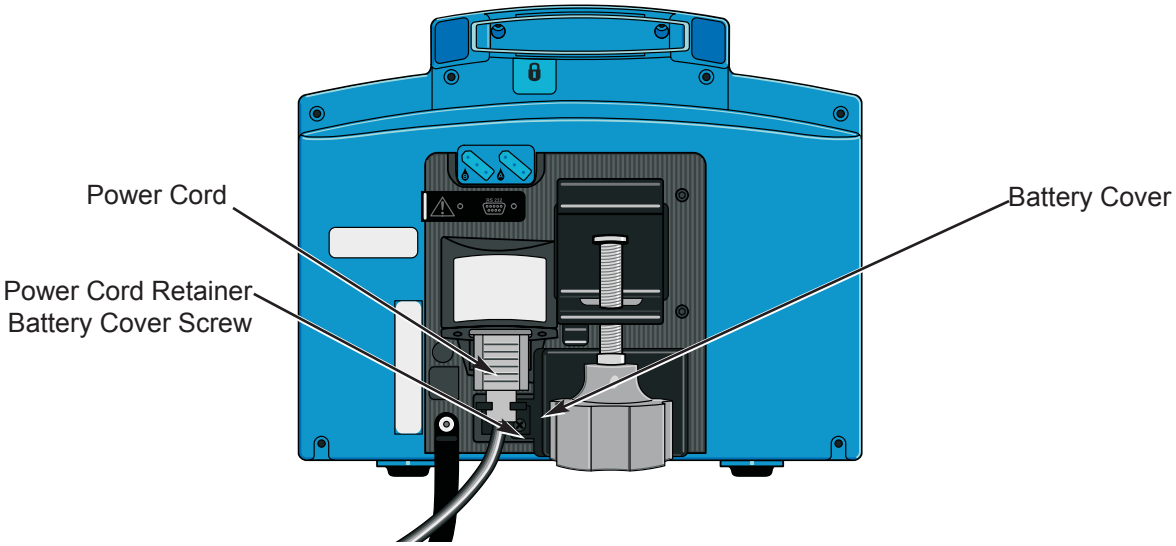
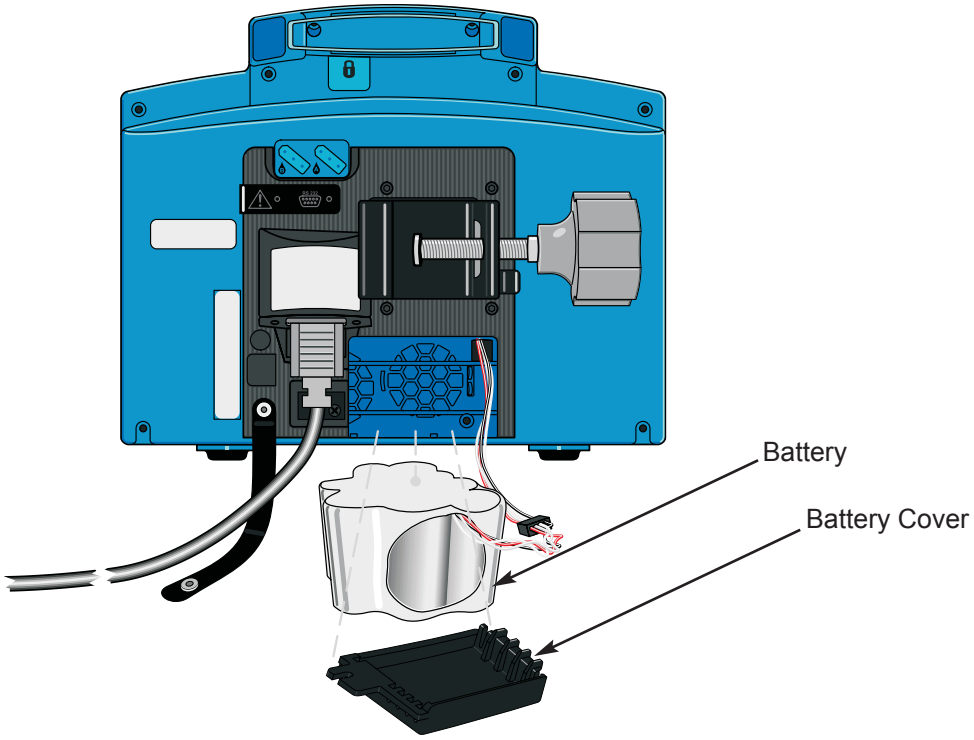


Figure 5-3. Alternate View From Back of Instrument



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.2 Separating Case Assemblies (Figures 5-4 through 5-9b)

1. Press on cutouts to pop off cap for handle from inside (between handle and case) to access two screws to open instrument. Remove 2 screws using a Phillips screw driver (Figure 5-4).
2. Remove hidden case screw inside battery compartment (Figure 5-5).
3. Remove remaining case screws (6 for dual, 4 for single) (Figure 5-6).
4. Lay instrument face down.
5. Position pole clamp knob down (Figure 5-6).
6. Lift rear case to access inside of instrument.
7. Disconnect power supply board connector/battery cable (Figure 5-7).
8. Lift up locking bar and remove RS-232 flex cable from front case (Figures 5-7 and 5-8).
9. Disconnect ground wires (1 for single channel) from under motor (Figure 5-7).
10. Inspect and clean main board assembly, as follows, whenever instrument is opened and prior to performing repair/maintenance procedures.

> **NOTE:** Dust may be brought into the instrument through the cooling fan. If instruments are consistently used in a dusty environment, perform cleaning yearly as part of the preventive maintenance procedure.

   a. Examine main board assembly for any signs of dust and clean, as necessary, using a natural bristle brush or hand-held vacuum.
   b. Using a natural bristle brush or hand-held vacuum, remove dust from the fan.

> **NOTE:** Seal the vacuum contents in an appropriate bag and dispose according to hospital protocol.

   c. Perform a visual check of mechanism springs (Refer to “Mechanism Visual Check” section”).

During Reassembly:
(Figures 5-9a and 5-9b)

1. Refer to “Routing and Connecting Cables” section.
2. Install and tighten case screws as follows:
   a. Install and snug each screw, beginning with #1 screw, until all screws are snug and case halves are flush.
   b. Tighten each screw a 1/4 turn more beginning with #1 screw installed.
   c. Close latch when assembly is complete.
   d. If ECD feature is not being used, install rubber plug in flow sensor receptacle.

5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.2 Separating Case Assemblies
(Figures 5-4 through 5-9b)

Figure 5-4. Cap Handle Screws

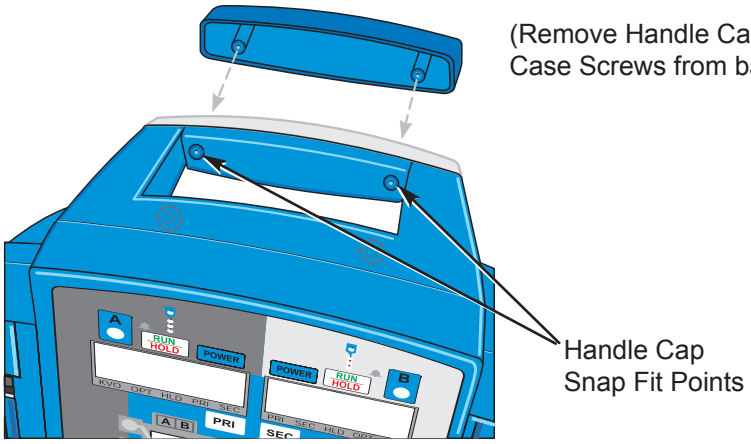
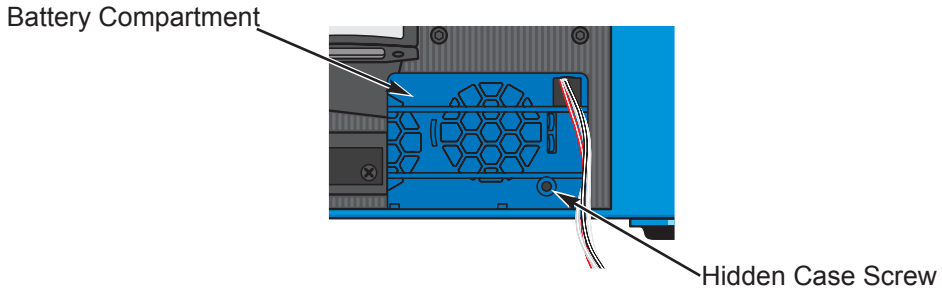


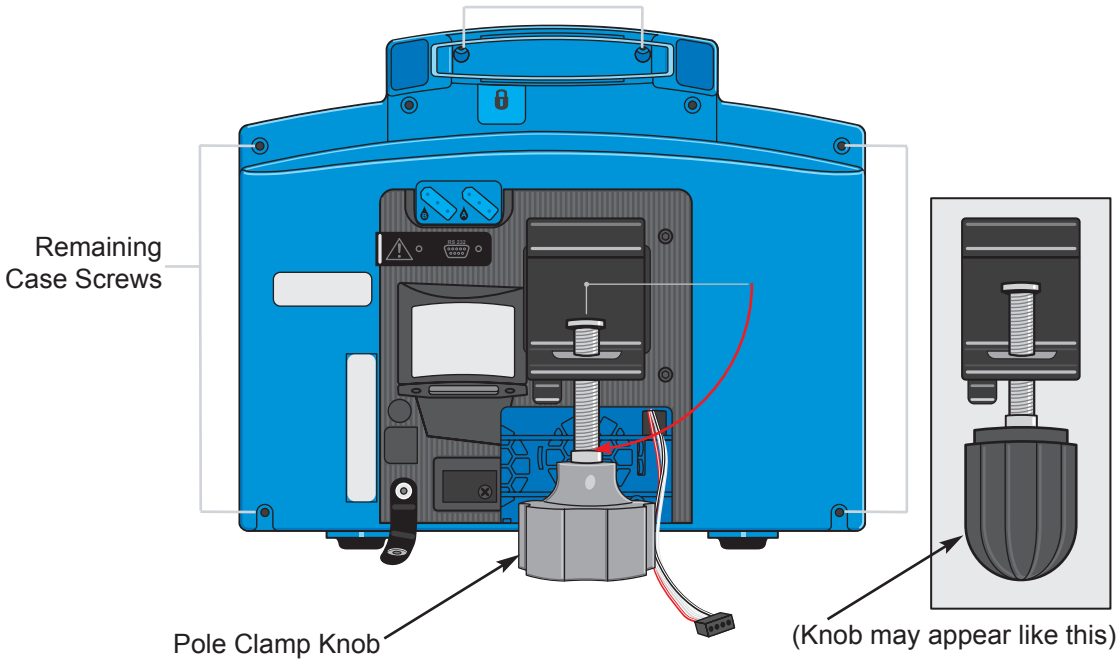
Figure 5-5. Hidden Case Screw in Battery Compartment



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.2 Separating Case Assemblies (Continued)

Figure 5-6. Case Screw and Pole Clamp Position



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.2 Separating Case Assemblies (Continued)

Figure 5-7. Separating Case Assemblies

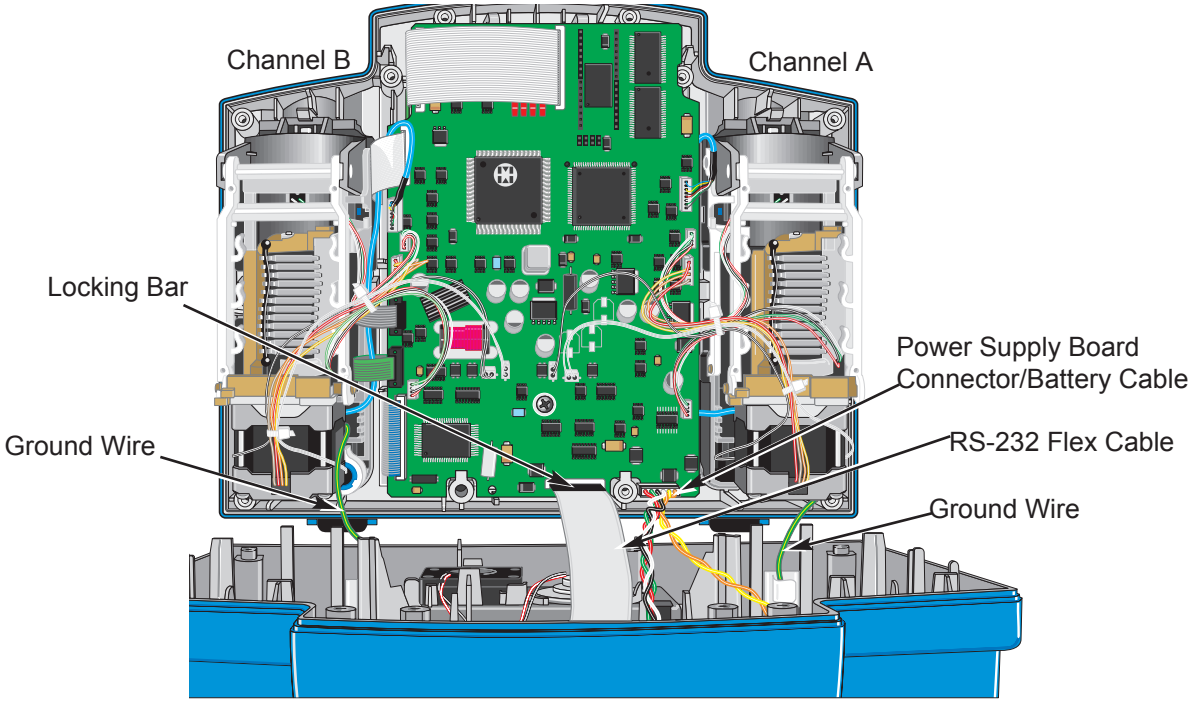
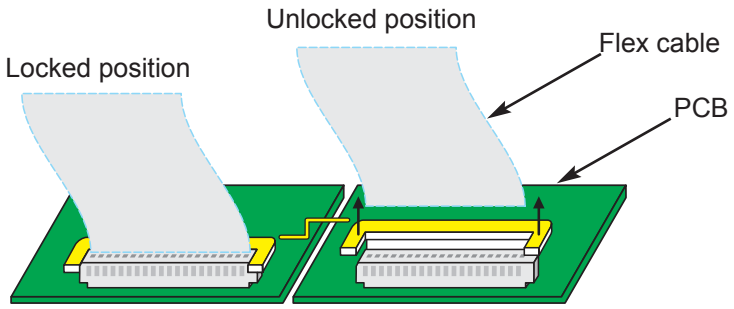


Figure 5-8. Locking Bar

Locking Bars are used wherever flex cables connect to Main PCB (7 places)

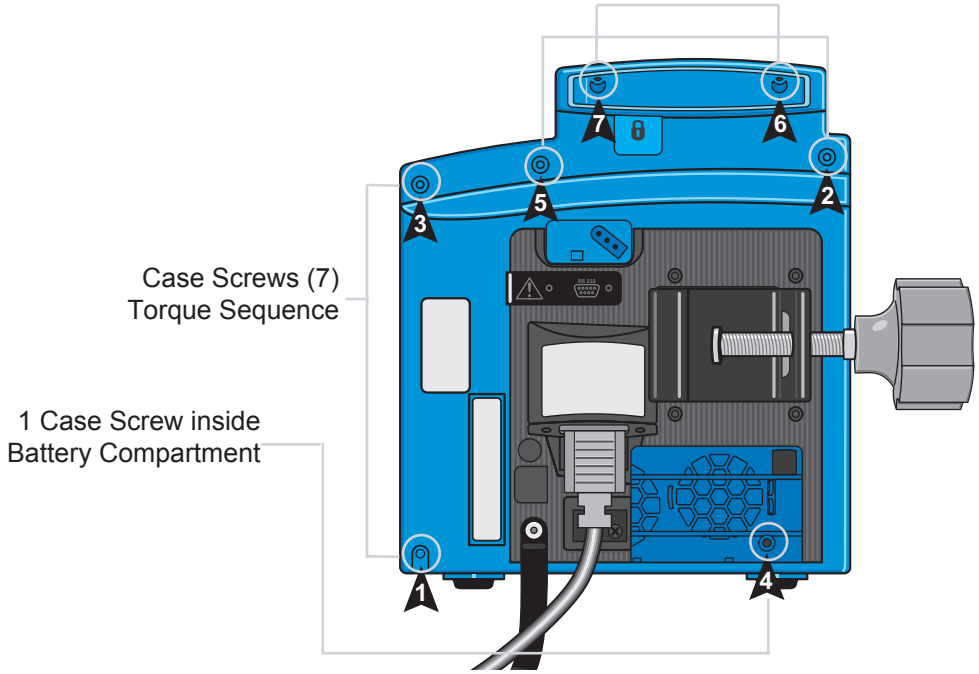
Locking Bars must be unlocked for disassembly and locked for reassembly



5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.2 Separating Case Assemblies (Continued)

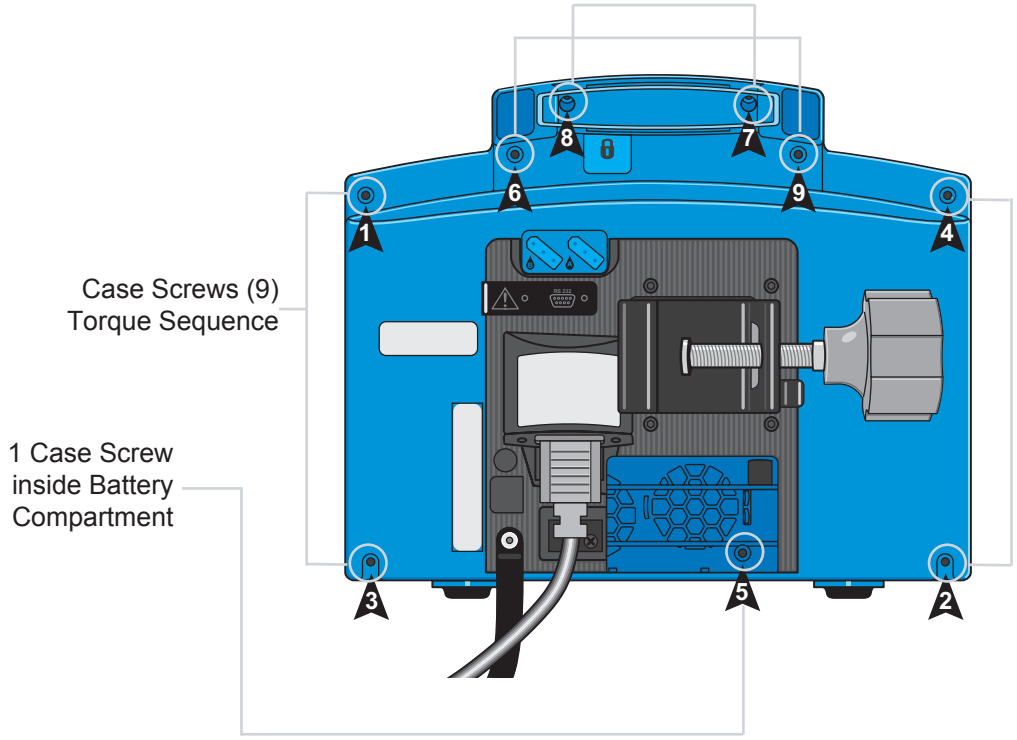
Figure 5-9a. Torque Sequence (Single)



5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.2 Separating Case Assemblies
(Continued)

Figure 5-9b. Torque Sequence (Dual)



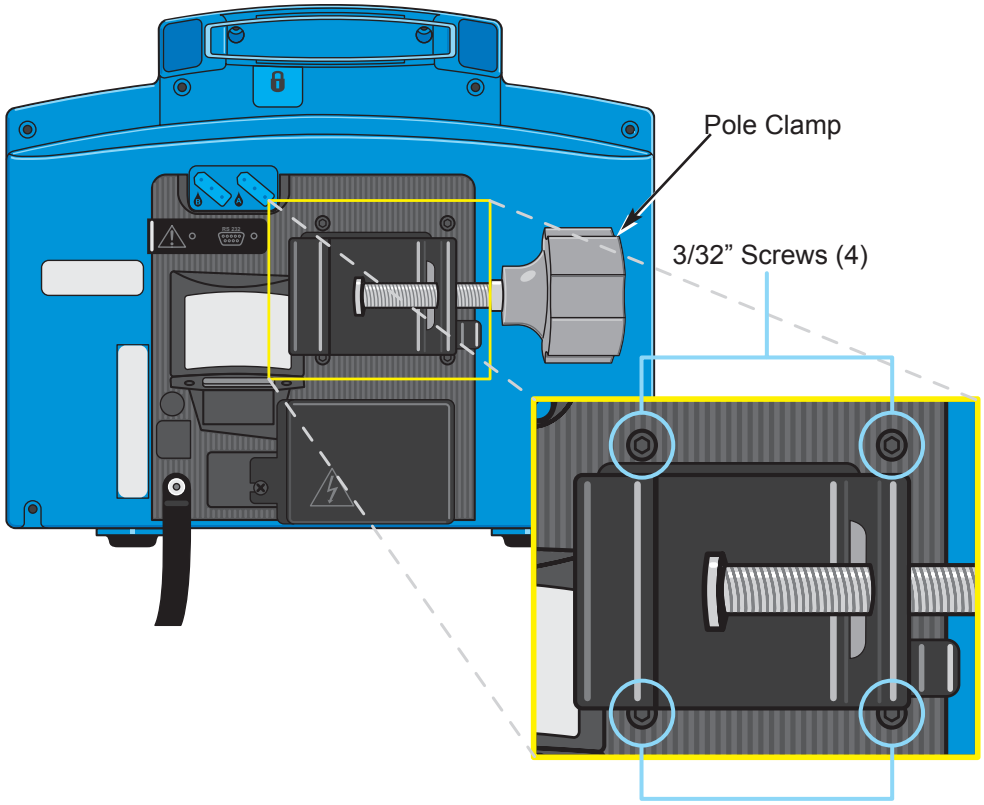
5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.3 Removing Power Supply Board Assembly (Figures 5-10a and 5-10b)

1. Remove 4 screws from Heat Sink using Torx 3/32" (or 2.5mm) driver to separate power supply board from inside of rear case.
2. Disconnect cable from power supply board.

NOTE: DO NOT remove cover from back of power supply board. If it is loose, reinstall with RTV.

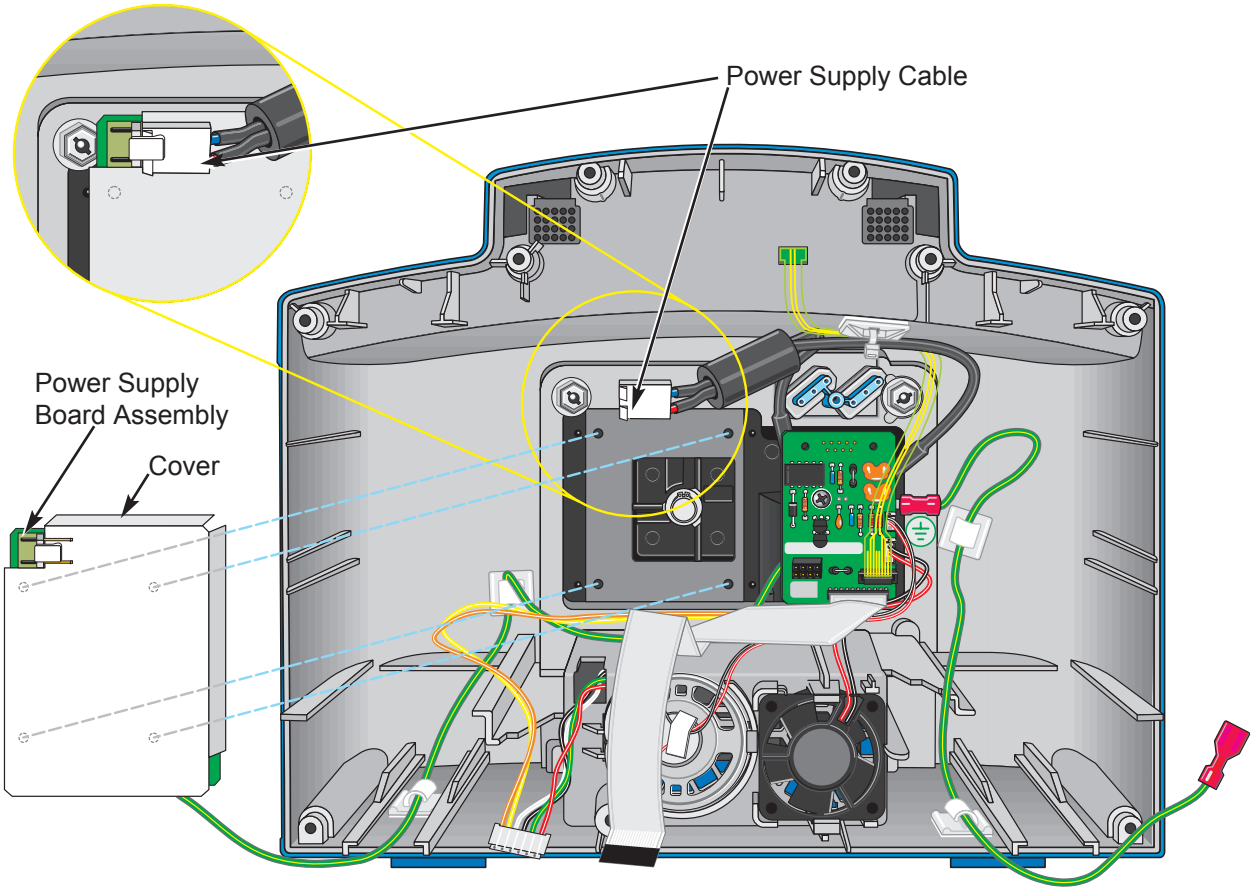
Figure 5-10a. Removing Power Supply Board Assembly



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.3 Removing Power Supply Board Assembly (Continued)

Figure 5-10b. Disconnecting Cable

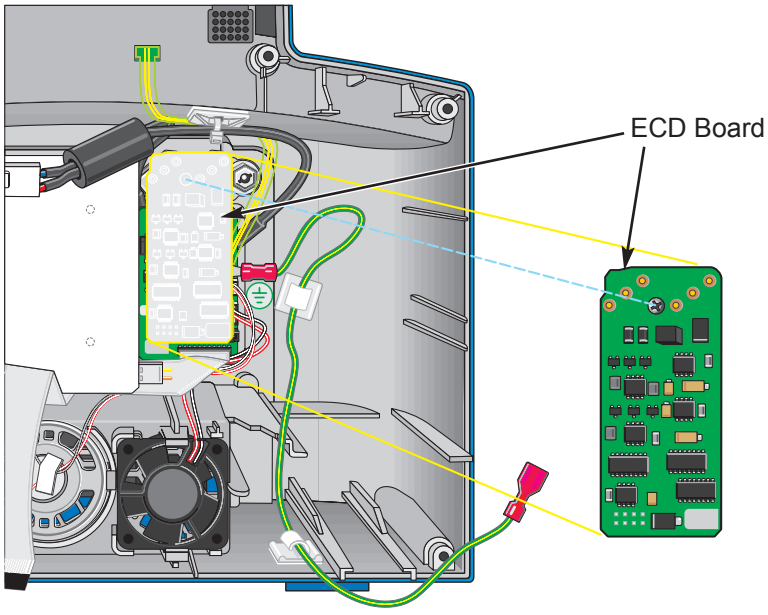


5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.4 Removing ECD and RS-232 Board Assemblies (Figures 5-11 through 5-13)

1. If installed, remove screw on ECD board using Phillips screw driver, then remove ECD board.
2. Pull RS-232 cover away from connector and remove 2 hex nuts using 3/16" socket wrench .
3. Disconnect Panel Lock Key Pad flex cable by lifting up on locking bar.
4. Disconnect speaker and fan from RS-232 Board.
5. Remove screw on RS-232 board using Phillips screw driver, then remove RS-232 board.

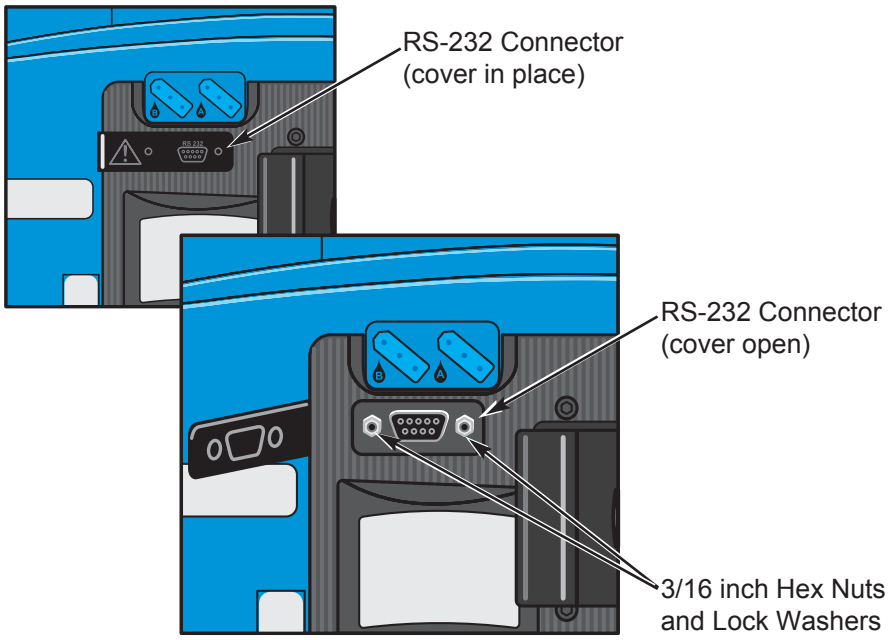
Figure 5-11. Rear Case ECD Board



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.4 Removing ECD and RS-232 Board Assemblies (Continued)

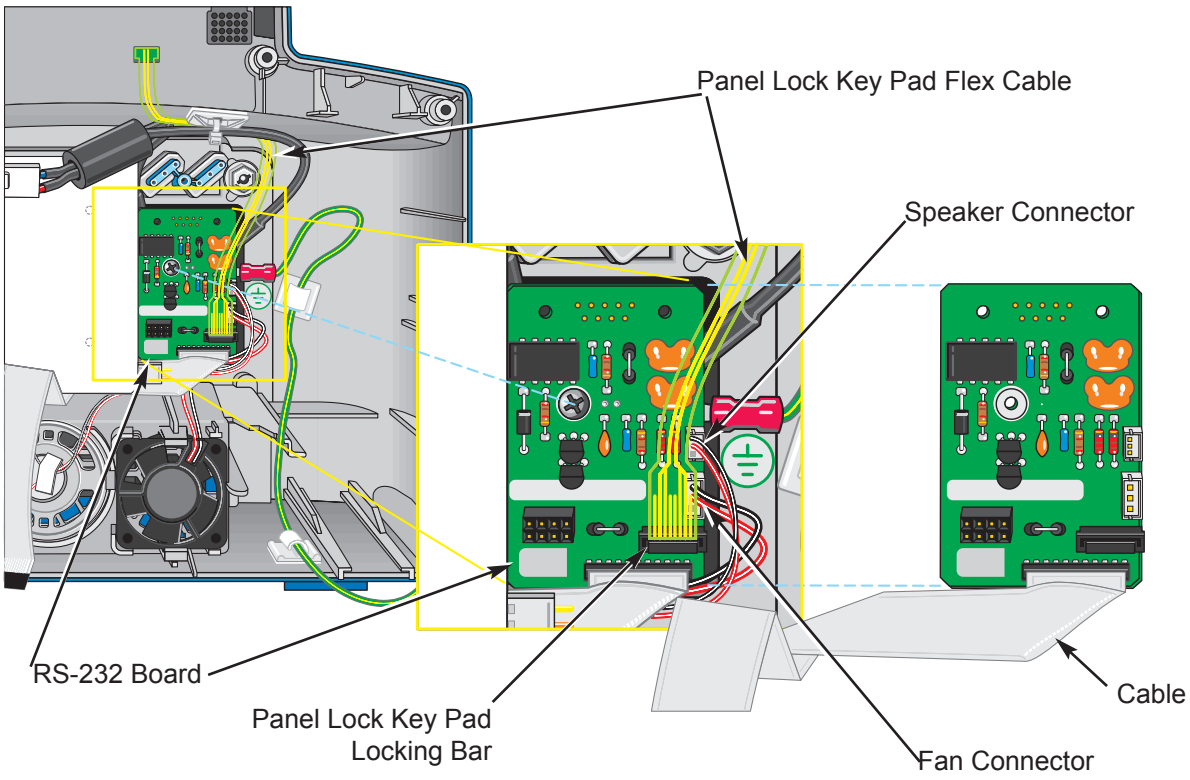
Figure 5-12. RS-232 Cover



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.4 Removing ECD and RS-232 Board Assemblies (Continued)

Figure 5-13. RS-232 Board

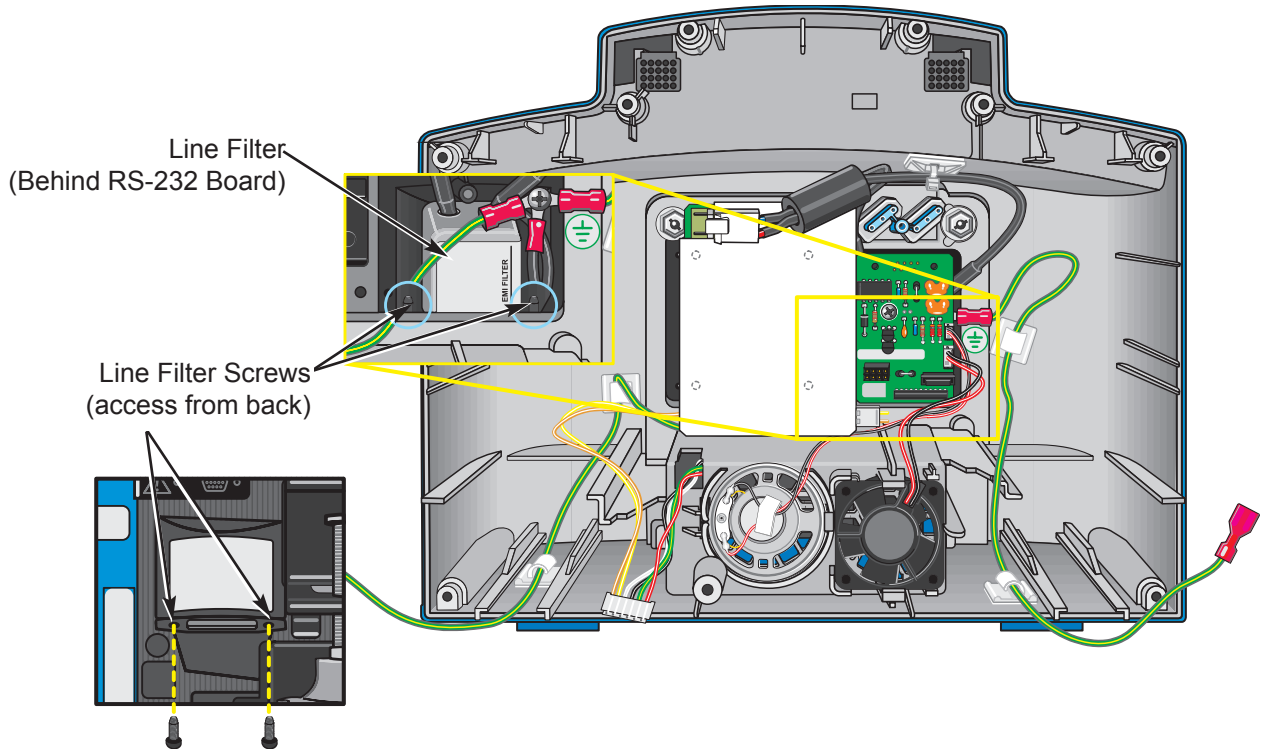


5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.5 Removing Line Filter (Figure 5-14)

1. Remove screw from Line Filter using Phillips screw driver.
2. Remove two screws from exterior power connector using Phillips screw driver.
3. Cut zip tie.
4. Remove exterior power connector and Line Filter assembly.

Figure 5-14. Line Filter Assembly

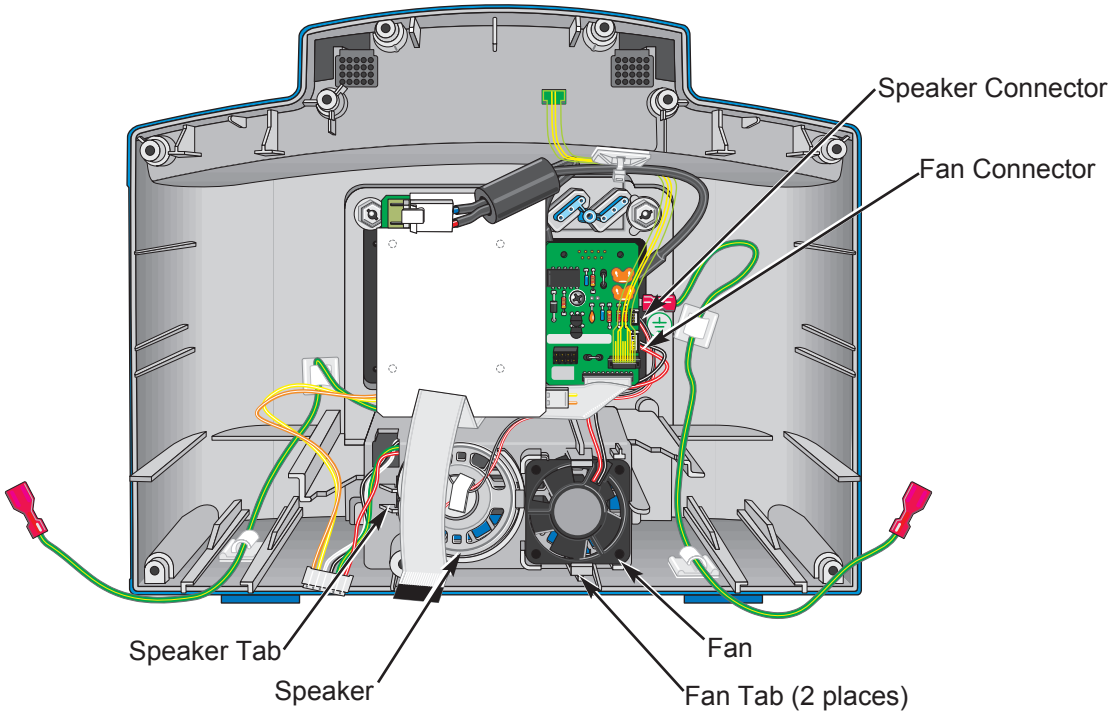


5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.6 Removing Speaker and Fan
(Figure 5-15)

1. Spread speaker tabs and remove speaker.
2. Spread fan tabs and remove fan.

Figure 5-15. Speaker and Fan Assembly



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.7 Removing Pole Clamp (Figures 5-16 and 5-17)

1. Remove power supply board assembly.
2. Remove hardware securing pole clamp to heat sink.

> **NOTE:** If an older version of the pole clamp was installed using a shoulder screw and wave washer, use a 3/16" allen wrench to remove shoulder screw. Discard shoulder screw and wave washer.

3. Remove tip from end of pole clamp knob by pressing spiral pin out of opening in end of brass thread.
4. Unscrew knob from pole clamp.

During Reassembly:

1. Screw knob into pole clamp assembly.
2. Attach pole clamp tip to end of thread on knob and press spiral roll pin into opening, through thread and tip.

> **NOTE:** Press pin in so both ends of pin are below bottom of threads on stud.

3. Reinstall compression spring into spring release switch.
4. Install spring release switch onto pole clamp assembly.

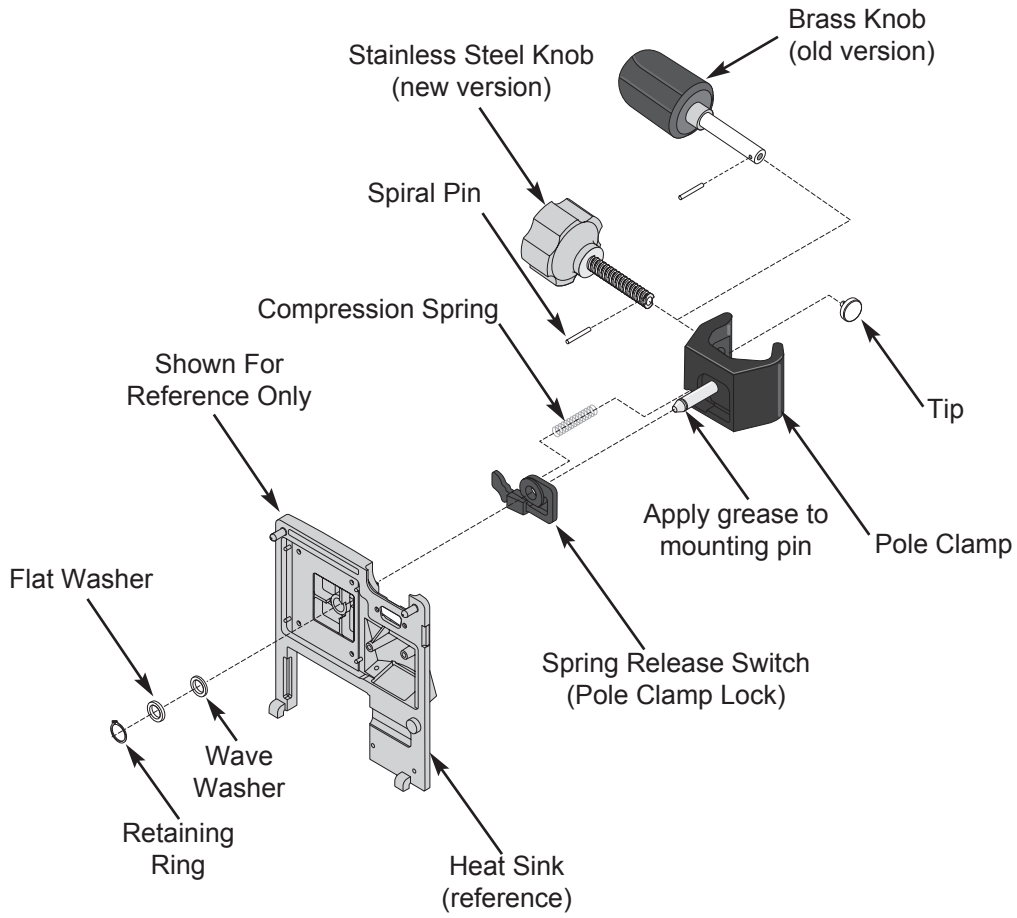
> **NOTE:** Ensure compression spring seats properly in pole clamp channel.

5. Apply lubricant (Dow Corning MolyKote 33 or Novagard Versilube G321) to portion of pole clamp mounting pin that protrudes through spring release switch.
6. Insert pole clamp mounting pin through opening in heat sink.
7. Install wave washer over end of pole clamp mounting pin.
8. Install flat washer over end of pole clamp mounting pin, on top of wave washer.
9. Place retaining ring over end of pole clamp mounting pin, on top of flat washer. Press downward on retaining ring, compressing flat washer and wave washer downward until retaining ring snaps into groove on mounting pin.
10. Verify retaining ring is correctly installed. Rotate retaining ring inside groove to ensure correct installation.

5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.7 Removing Pole Clamp
(Continued)

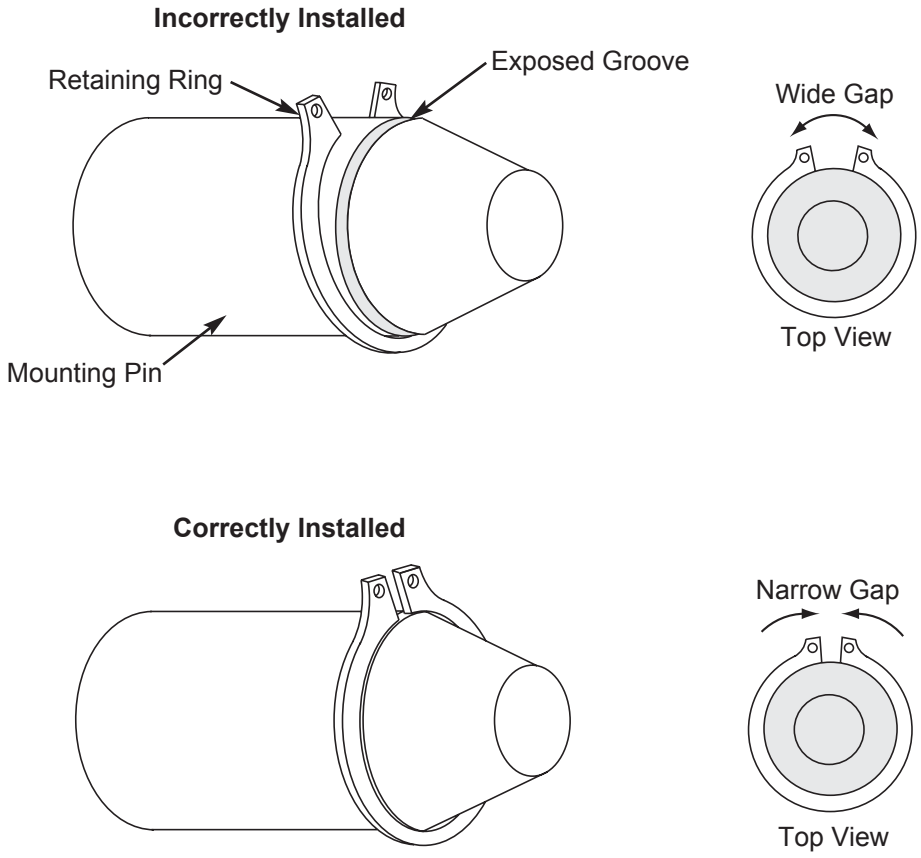
Figure 5-16. Pole Clamp Assembly



5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.7 Removing Pole Clamp
(Continued)

Figure 5-17. Retaining Ring Installation



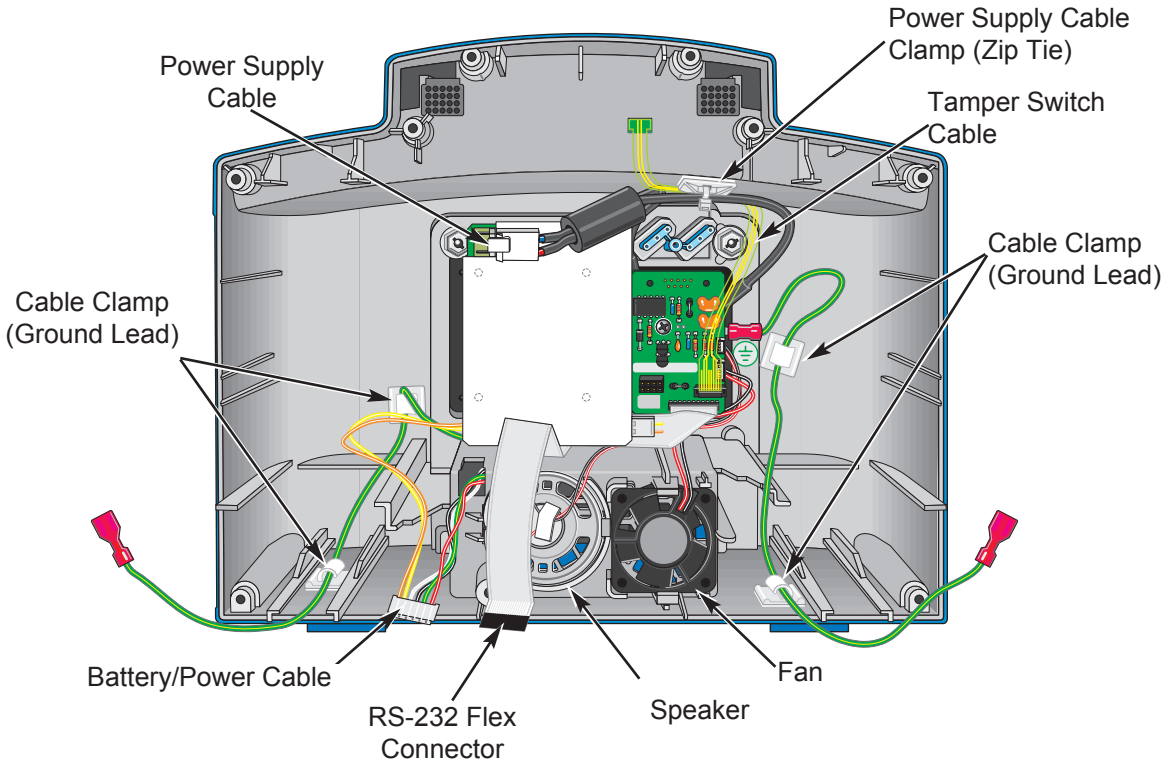
5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.8 Disconnecting Cables (Figures 5-18a through 5-18c)

Rear Case

1. Disconnect flex cable for RS-232 board assembly. Lift up on locking bar before attempting to remove flex cable from main board assembly.
2. Disconnect power supply cable from power supply board.
3. Disconnect fan and speaker cable.
4. Disconnect battery/power cable from main board.
5. Disconnect ground wires from mechanism assembly. If needed, unhook ground wires from cable clamps (4 places on dual channel, 2 places on single channel).
6. Continue disassembly as required.

Figure 5-18a. Rear Case Cable Routing



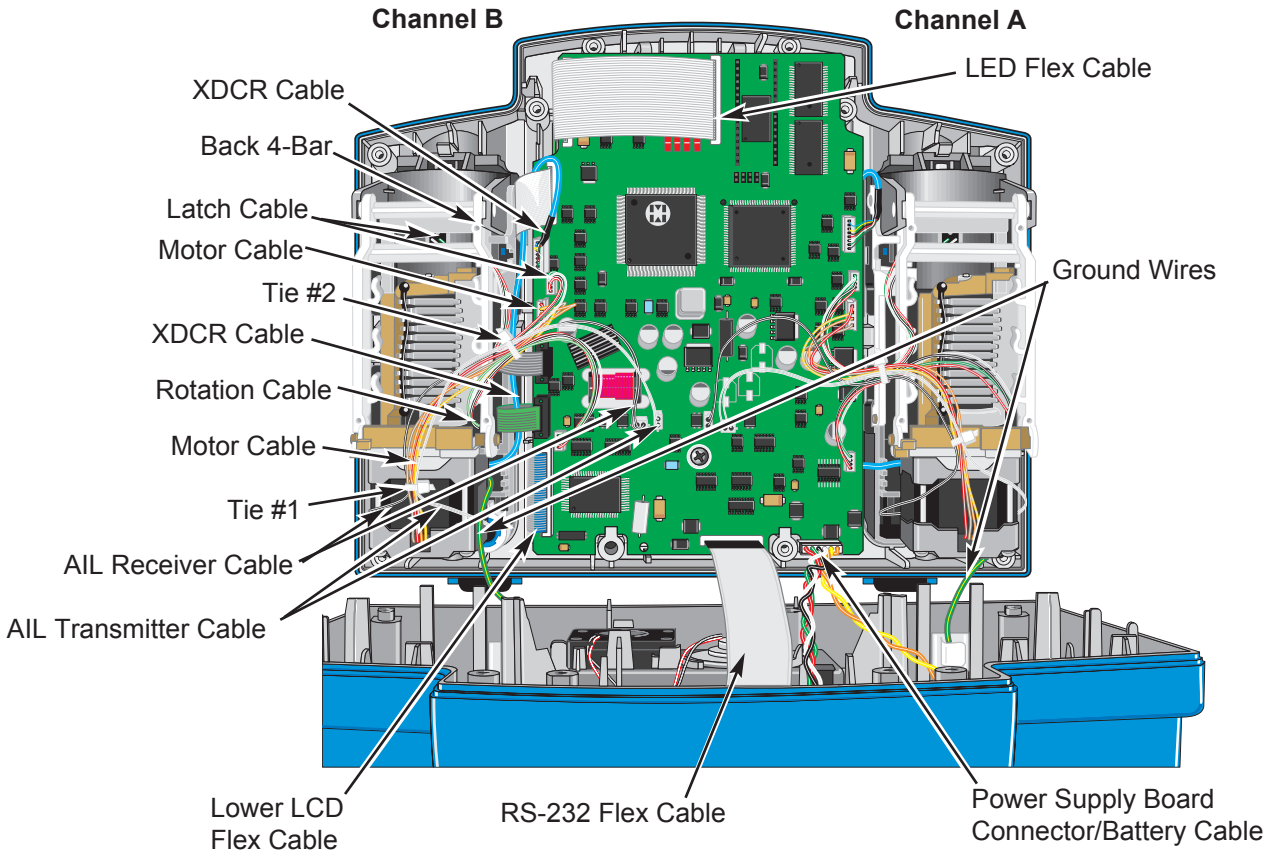
5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.8 Disconnecting Cables (Continued)

Front Case

1. Cut tie #l for ChB motor and AIL receiver (black).
2. Cut tie #2 for ChB motor, Latch, Rotation and AIL receiver (black).
3. Cut tie #4 for ChA motor, Latch, Rotation and AIL receiver (white).
4. Cut tie #5 for ChA motor and AIL receiver (white).
5. Disconnect ChA and ChB transducer wires (blue) from the board.
6. Disconnect ChA and ChB ground wires (black) going to the mechanism assembly.
7. Disconnect flex cables for front panel, LED modules, main LCD, RS-232 board assembly and lower LCD as needed. Lift up on locking bar before attempting to remove flex cable.
8. Continue disassembly as required.

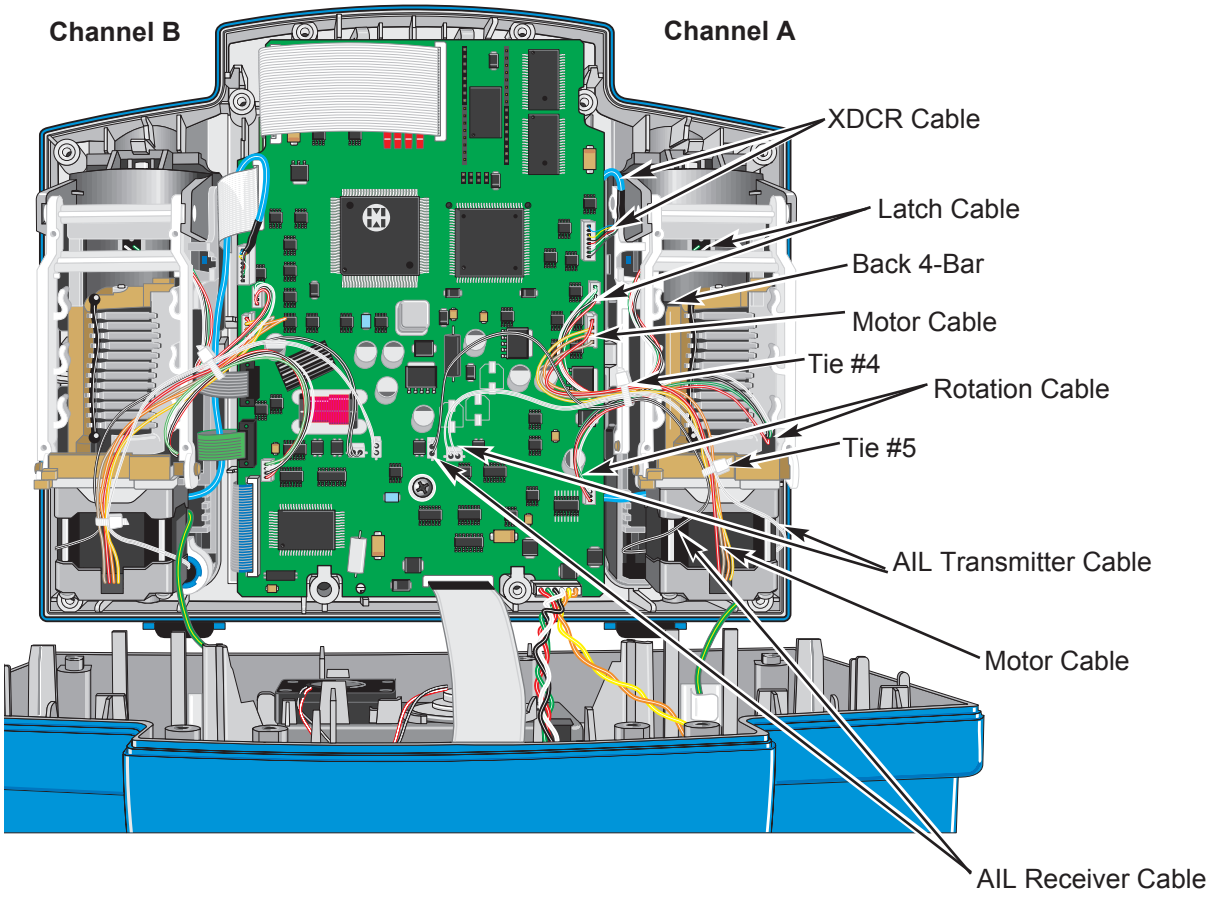
Figure 5-18b. Front Case Cable Routing



5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.8 Disconnecting Cables
(Continued)

Figure 5-18c. Front Case Cable Routing



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.9 Removing Main Board (Figure 5-19)

1. Disconnect all wire connections to main board. Refer to “Disconnecting Cables” section.

> **NOTES:**
>
> - When removing flex cables, carefully lift locking bar to remove cable from connector.
> - Pay particular attention to wire routing. Wires should be routed back to initial scheme and similar to the example shown. This will prevent them from getting pinched and jamming the mechanism.

2. Remove screw from main board using Phillips screw driver. Slide main board to top, then lift and remove.

> **NOTE:** The large capacitor for the backup speaker may be discharged after removing the board. Jumper across terminals of capacitor C-146 (C-179) for one minute. Refer to “Troubleshooting” chapter for more information.

During Reassembly:

After installing the new main board, perform the following:

1. Check Rate Cal number in Diagnostic Mode.

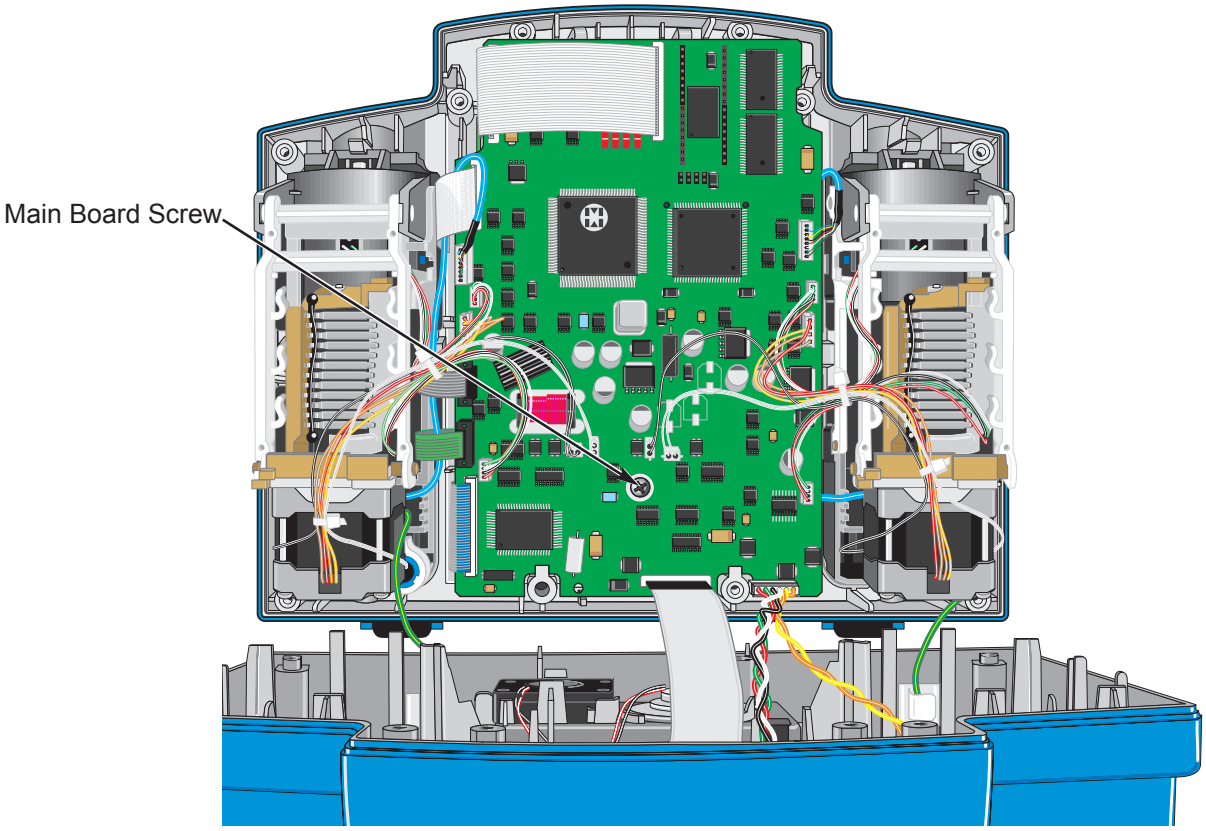
   D4 screen should have a Rate Cal # of 0% (refer to “Preventive Maintenance” chapter for “Rate Calibration Procedure”, if needed, and “Troubleshooting” chapter for procedure to change).

2. Perform Soft Pressure Calibration after 30 minutes warm-up.

5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.9 Removing Main Board (Continued)

Figure 5-19. Removing Main Board

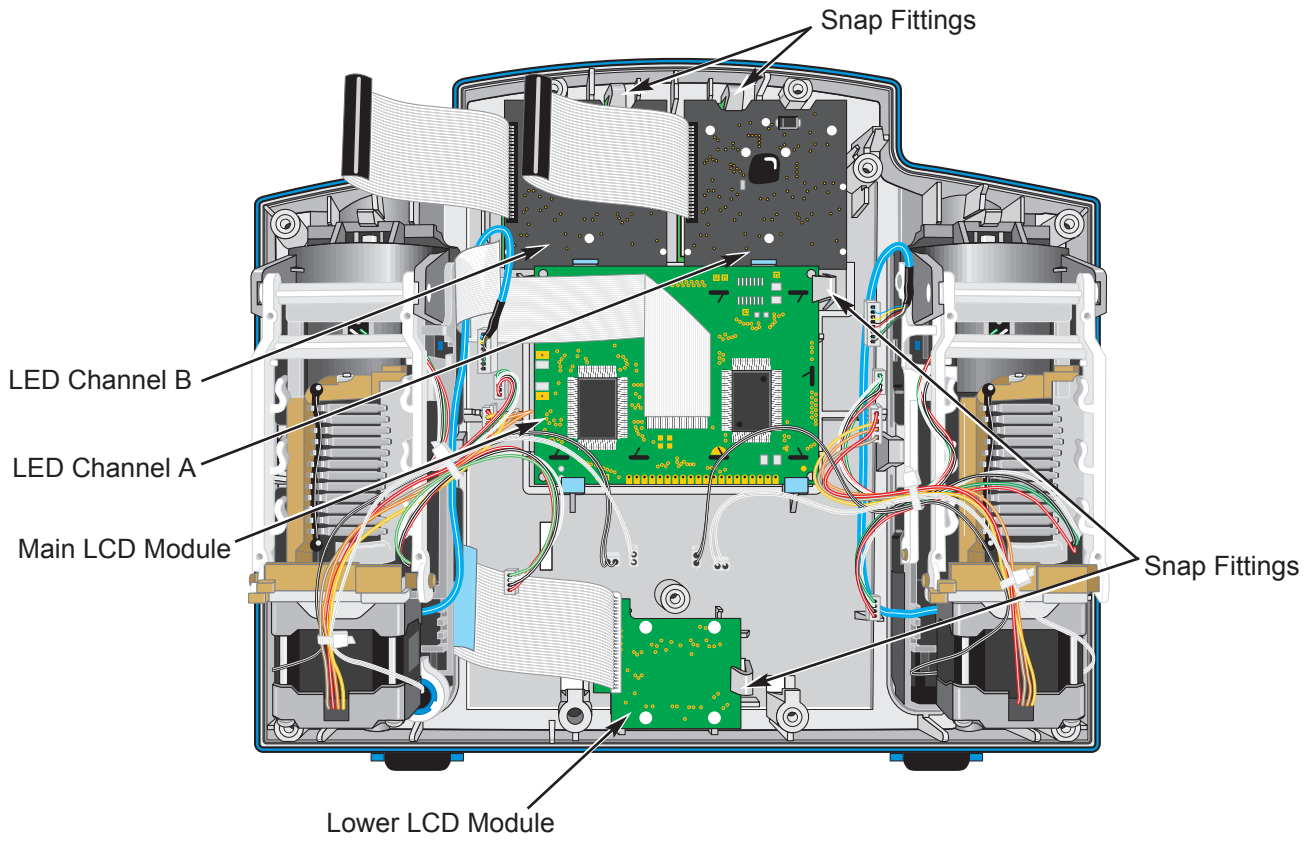


5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.10 Removing LED and LCD Modules
(Figure 5-20)

1. Use fingers to compress and push back snap fittings holding upper LEDs (only 1 on single channel), then lift and remove.
2. Use fingers to compress and push back snap fittings holding main LCD module, then lift and remove.
3. Use fingers to compress and push back snap fittings holding lower LCD module, then lift and remove.

Figure 5-20. LED / LCD Modules and Snap Fittings

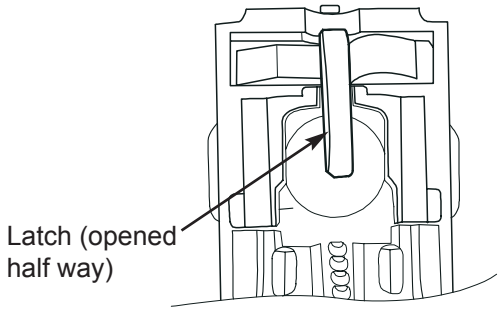


5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.11 Removing Mechanism (Figures 5-21 and 5-22)

1. Move mechanism latch to middle position. This will allow air-in-line sensor to clear case when extracted.

Figure 5-21. Mechanism Latch in Middle Position

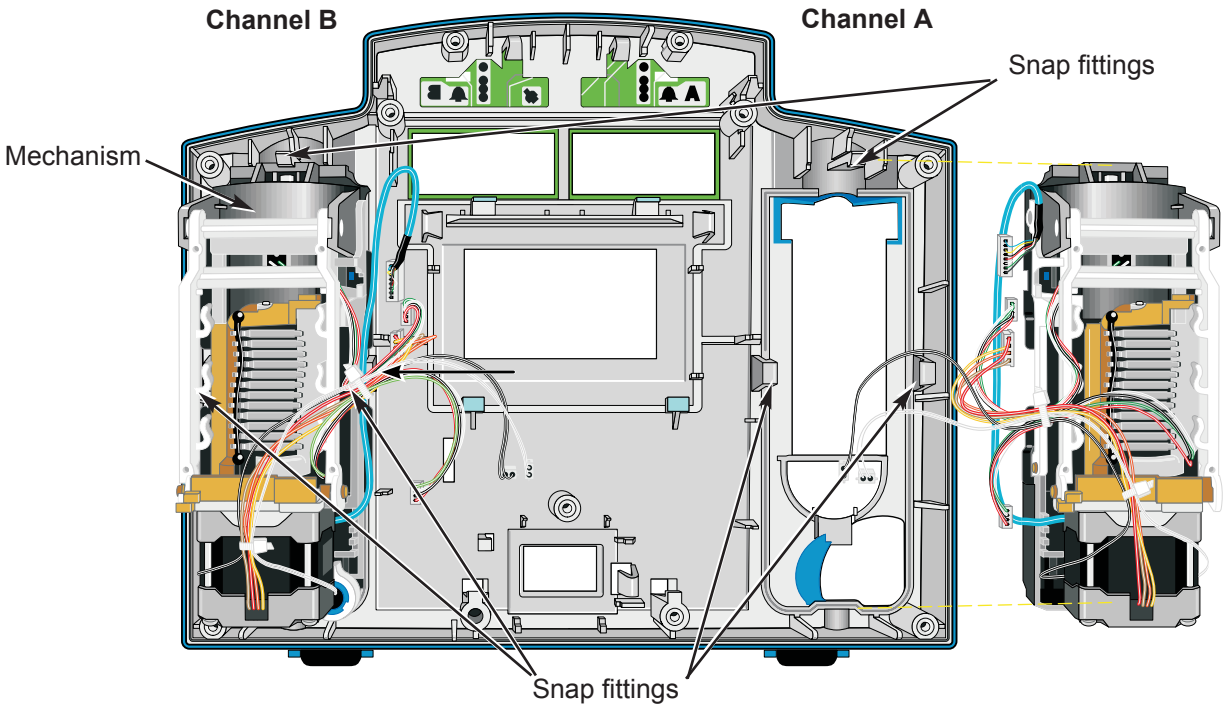


2. Disconnect wiring harnesses from main board. Note their location. They will be reconnected to same location.
3. Using a flat head screwdriver, unsnap 3 snap fittings (top and both sides) holding mechanism to front case, then remove mechanism.
4. Mark mechanism(s) latch housing "A" or "B" with permanent ink to ensure reinstallation in proper location on dual channel pumps.

During Reassembly:

1. Install mechanism.
2. Perform pressure and rate calibration (“Preventive Maintenance” chapter).

Figure 5-22. Remove Mechanism



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.12 Removing AIL Transmitter (Arm) (Figures 5-23 through 5-25)

NOTE: Observe placement of cable ties (for reinstallation). Cut and remove them from cables.

1. Use needle-nose pliers to unlock AIL gear tab (Figure 5-23).
2. If replacing AIL receiver, replace before continuing with AIL transmitter removal/replacement.
3. Remove AIL gear and AIL transmitter from mechanism.
4. Move mechanism latch to right (open position).

During Reassembly:

1. Slide AIL transmitter through faceplate. Rotate AIL transmitter to open (vertical) position (Figure 5-24).
2. Thread AIL transmitter wire through AIL gear.

CAUTION

Grease is applied to a new AIL transmitter for lubrication purposes. Do not remove grease when installing a new AIL transmitter into the mechanism. Do not apply additional grease to the AIL gear.

3. Slide on AIL gear and align AIL gear tab.
4. Press AIL gear into place.

NOTE: When AIL gear is pressed onto AIL transmitter, AIL transmitter may shift slightly as gear locks into place.

5. Use needle-nose pliers to lock gear tab into place.
6. Turn mechanism latch to far left (closed position) and check AIL transmitter alignment. AIL transmitter must be in closed position (horizontal) (Figure 5-25).
7. If AIL transmitter is not properly aligned: unlock, realign and relock gear tab until transmitter is properly aligned.

NOTE: AIL transmitter may need to be aligned with inner edge of mechanism seal before locking gear into place.

8. Move mechanism latch to middle position. Install mechanism into front case.
9. Route and connect cables. Install cable tie straps on cables as before.

5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.12 Removing AIL Transmitter (Arm)
(Continued)

Figure 5-23. Unlocking AIL Gear Tab

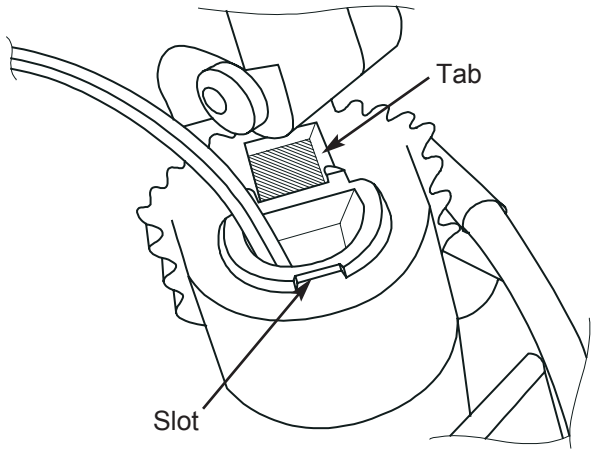


Figure 5-24. AIL Transmitter in Open Position

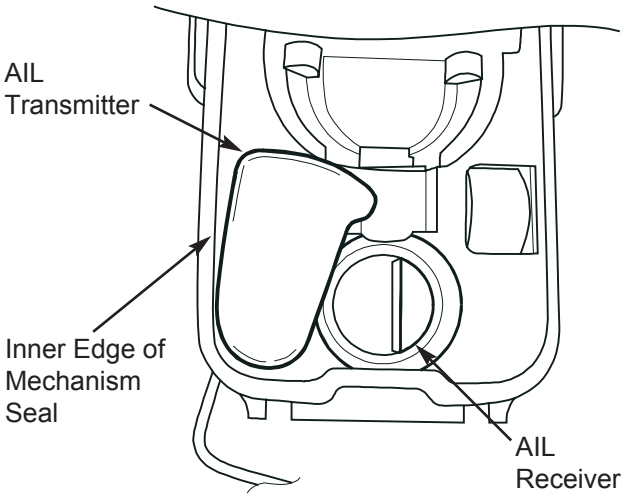
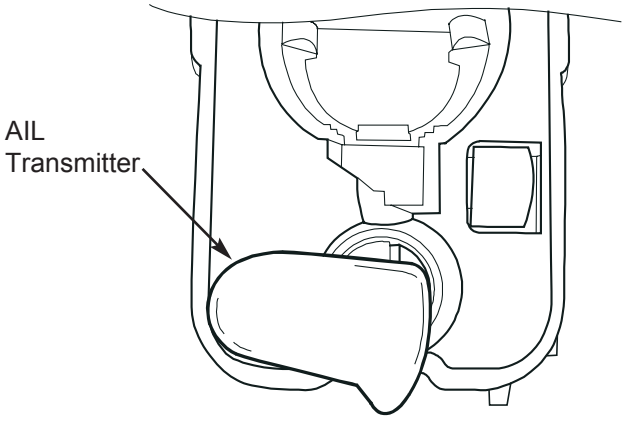


Figure 5-25. AIL Transmitter in Closed Position



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.13 Removing AIL Receiver (Button)
(Figures 5-26 and 5-27)

NOTE: Observe placement of cable ties (for reinstallation). Cut and remove existing straps from cables.

1. Turn mechanism latch to far right. AIL transmitter will be in open position.
2. Push AIL receiver in and rotate about 90° clockwise. AIL receiver should pop out.
3. Remove AIL receiver wire from faceplate's hook and remove receiver from mechanism.

NOTE: Leave AIL spring in place for new AIL receiver.

During Reassembly:

1. Thread AIL receiver wire through opening.
2. Install AIL receiver with flat edge of assembly positioned as shown in Figure 5-26.

NOTE: Mechanism seal may be lifted up to position AIL receiver accurately.

3. Push AIL receiver in and rotate 90° counter-clockwise to lock into place.
4. Tuck mechanism seal under AIL receiver.
5. Proceed with AIL transmitter replacement, if needed, and continue following steps for AIL receiver replacement.
6. Close and open mechanism latch several times to ensure AIL transmitter and receiver open and close properly.
7. Route AIL receiver's wire under faceplate's hook (Figure 5-27).
8. With mechanism latch opened halfway, install mechanism into front case.
9. Route and connect cables. Install cable tie straps onto cables.

Figure 5-26. Flat Edge of AIL Receiver

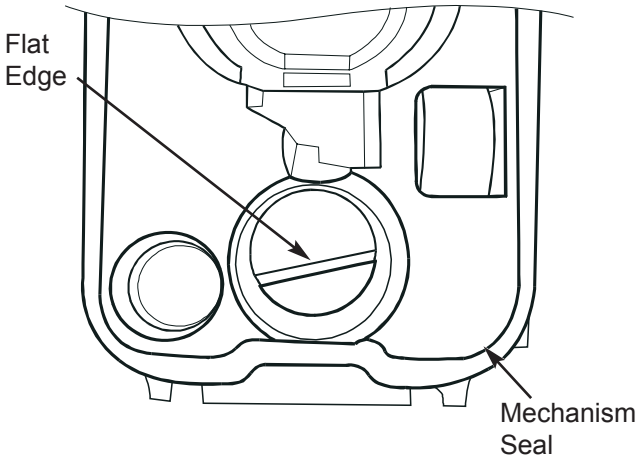
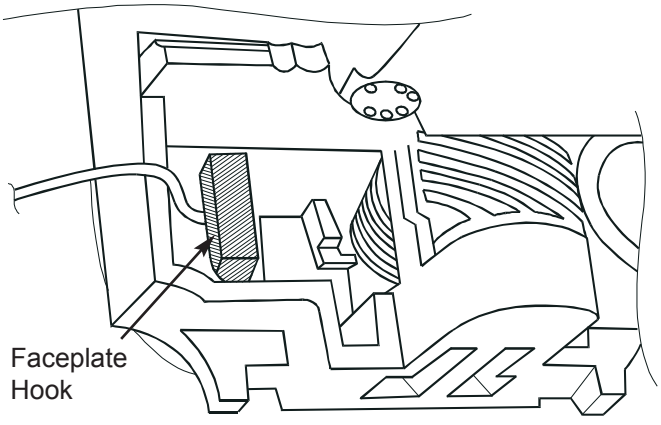


Figure 5-27. Faceplate Hook



5.2 DISASSEMBLY/REASSEMBLY (Continued)

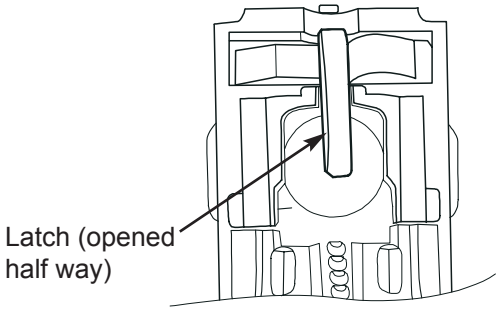
5.2.14 Removing Seal Clip (Figure 5-28)

1. Put latch in middle position to remove seal clip.
2. Use an orange stick to push 2 lower tabs inward while pulling out on seal clip to unsnap seal clip.
3. Remove seal clip.

During Reassembly:

Align seal clip and snap it in place.

Figure 5-28. Mechanism Latch in Middle Position



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.15 Removing Mechanism Seal

1. Peel off mechanism seal from mechanism.
2. Peel and clean off any RTV adhesive remaining around pressure sensor area.

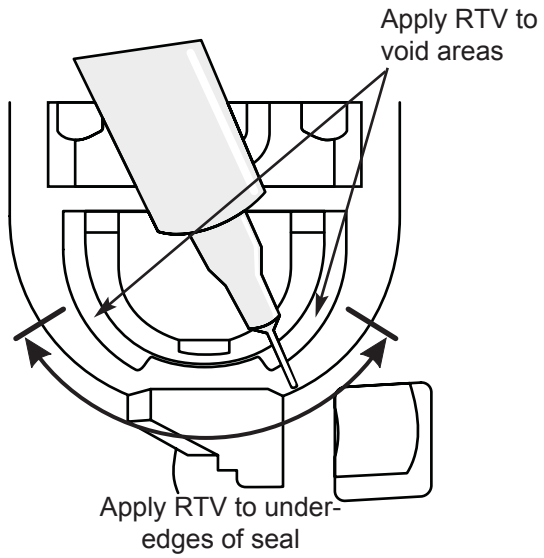
CAUTION

To avoid damage, be careful not to apply excessive pressure on the pressure transducer.

During Reassembly: (Figure 5-29)

1. Apply mechanism seal on mechanism.
2. Use an orange stick to tuck seal in around flow control actuator, clamp arms, cam follower and AIL receiver.
3. Reinstall seal clip and AIL transmitter.
4. Use RTV 3140 under edges of seal and secure in place.
5. Remove any excess RTV with a cotton swab, Kimwipes or equivalent. Verify no RTV is exposed to open area.
6. Allow RTV to dry and reinstall mechanism.

Figure 5-29. Apply RTV Under Edges of Seal



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.16 Removing Keypad Assembly

CAUTION

Remove the keypad only if it is defective. Removing a good keypad will ruin it.

1. Take a corner of keypad and peel it away from front case.
2. Remove any remaining residue from surface before applying new keypad.

During Reassembly:

1. Fold back a small portion of protective backing along right side of keypad.
2. Insert keypad flex cables into slot and guide them through.
3. Align right edge of keypad and affix. Once aligned, position keypad and remove remaining protective backing.
4. Press around perimeter of keypad to assure adhesion to front case and prevention of fluid ingress.
5. Remove any protective covering from front of keypad.

5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.17 Routing and Connecting Cables (Figures 5-30a through 5-31)

> **NOTE:** Cable routing may change over time to ensure wires are not pinched and ease of assembly and disassembly is maintained. If the cable routing is different when the instrument is opened, follow that cable routing scheme.

Front Case

1. Ensure main board and mechanism are installed. Route ground wires through cable clamps, if present, and connect to transducer.
2. Route transducer cable (blue) under motor assembly out left side for CH A (dual) and out right side for CH B (single). Bend wire up and lay along mechanism frame. Connect to main board.
3. Route channel A AIL transmitter wire (white) up over motor and install tie wrap #5 with motor wires for CH A. Connect to main board.
4. Route CH A AIL receiver cable (black) out to left side of mechanism. Route CH B AIL transmitter cable (white) to right of mechanism. Connect both to main board.
5. Route CH A rotation sensor cable out to right side and over back 4-bar (mechanism). Connect to main board.
6. Route CH A latch sensor to left under back 4-bar. Connect to main board.
7. Connect CH A motor assembly cable to main board.
8. Install tie #4 around CH A motor, latch, rotation and AIL transmitter (white) wires.
9. Route CH B AIL receiver cable (black) up over motor assembly and connect to main board. Install tie #1 to motor cable and CH B AIL receiver cable (black).
10. Route CH B rotation sensor cable out to right side and under back 4-bar (mechanism). Connect to main board.
11. Route CH B latch sensor to right under back 4-bar. Connect to main board.
12. Install tie #2 around CH B motor, latch, rotation and AIL receiver cable (black) wires.
13. Ensure locking bars are up on flex cable connectors. Install flex cables for front panel, LED modules, main LCD, RS-232 board assembly and lower LCD as needed to main board.
14. Install battery/power cable to main board.

WARNING

Always perform a Rate Accuracy Verification after mechanism and board have been removed and reinstalled, or cables have been disconnected and reconnected.

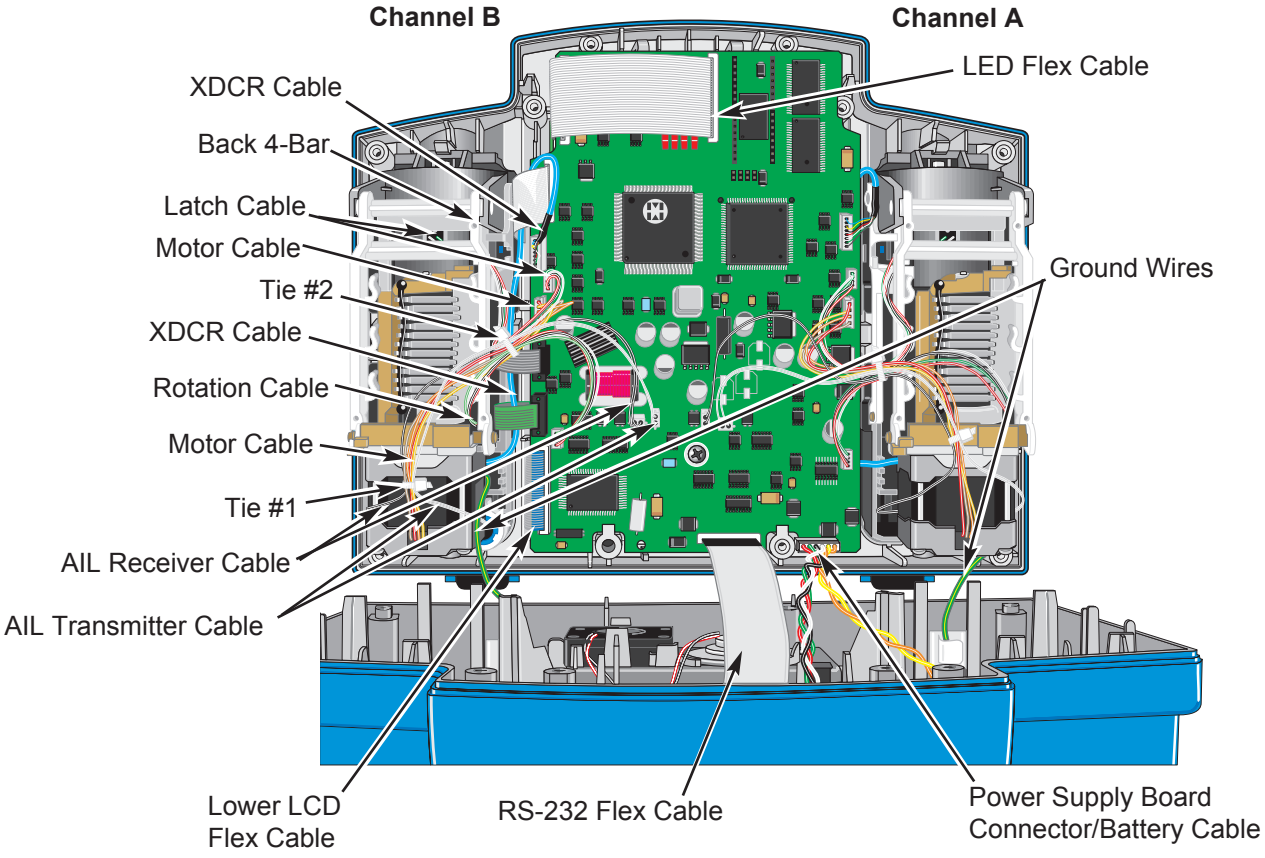
Rear Case

1. If needed, re-hook ground wires to cable clamps (4 places on dual channel, 2 places on single channel). Reconnect ground wires from mechanism assembly.
2. Reconnect battery/power cable to main board.
3. Reconnect fan and speaker cable.
4. Reconnect power supply cable to power supply board.
5. Reconnect flex cable for RS-232 board assembly and resecure locking bar.

5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.17 Routing and Connecting Cables
(Continued)

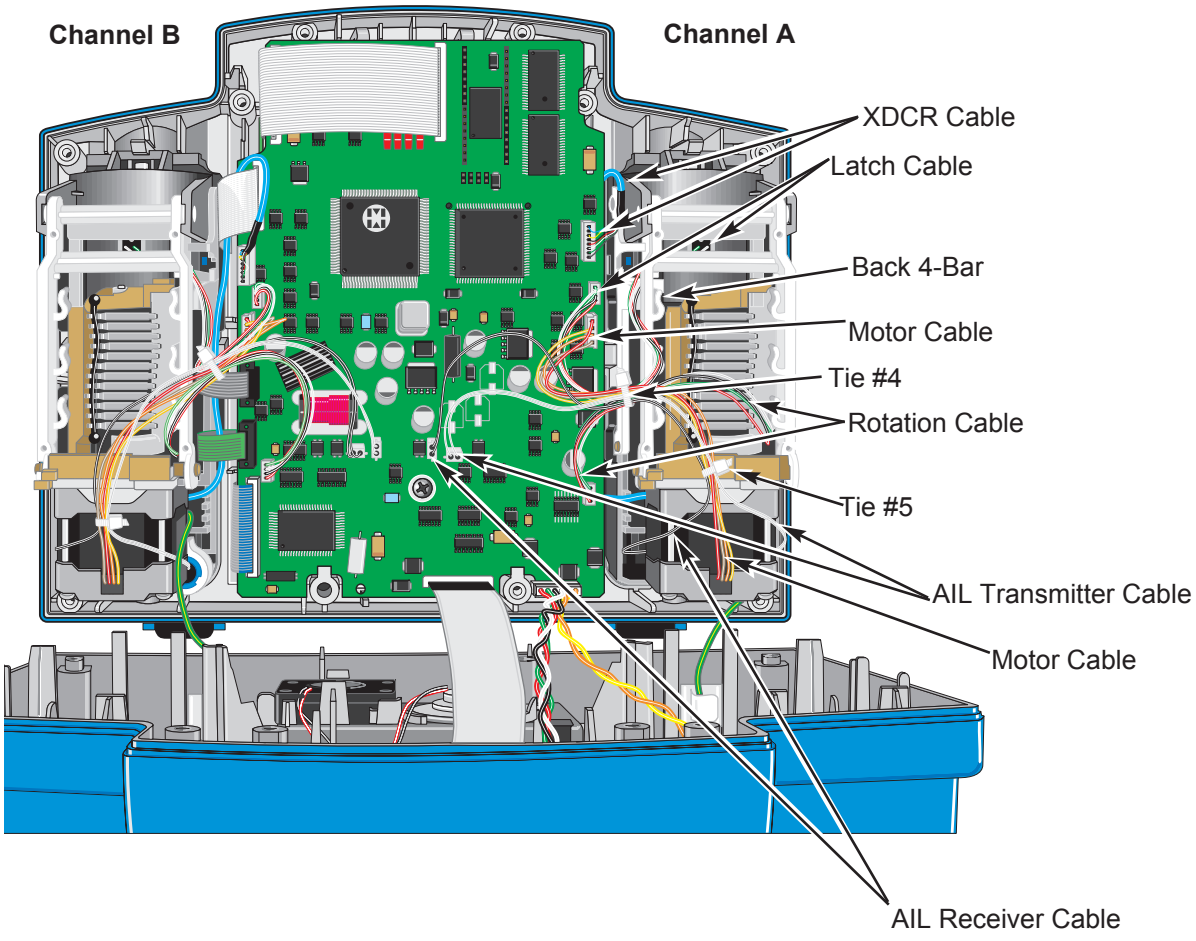
Figure 5-30a. Front Case Cable Routing



5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.17 Routing and Connecting Cables
(Continued)

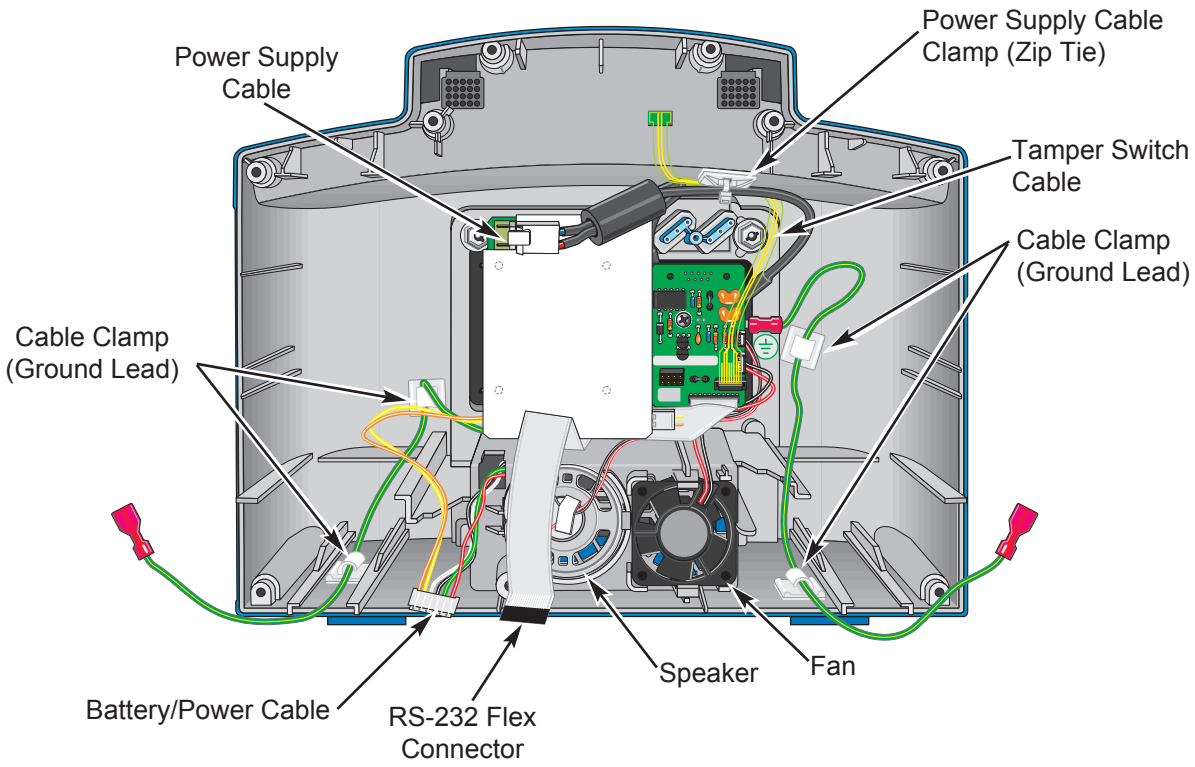
Figure 5-30b. Front Case Cable Routing



5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.17 Routing and Connecting Cables
(Continued)

Figure 5-31. Rear Case Cable Routing



5.3 TEST AND CALIBRATION

NOTE: Calibration coefficients for the transducer are stored in the EPROM on the main board assembly. Once they have been calibrated, the mechanism and board assemblies become a matched set. Replacement of either requires pressure and rate calibration.

Additional testing and calibration may be required after certain repairs are completed. These tests are in addition to the Preventive Maintenance tests. See Table 5-2, "Level of Testing Guidelines", for more information.

5.3.1 Power-On Self Test

The power-on self test deals with determining the proper operating condition of the fully assembled instrument. The instrument contains extensive self-testing software. The self test is a final test.

The self test is initiated each time the instrument is turned on. The instrument continually tests itself during operation, as well. An alarm or error message will appear if there is a problem.

When turning on the instrument, verify that the instrument beeps and that all display segments and LEDs flash. This confirms that the instrument has performed its self tests and is operating correctly.

5.3.2 Mechanism Visual Check
(Figures 32 through 35)

Parts and Tools Required:

- Pen light, or equivalent inspection light
- Spring Installation Tool; ALARIS P/N 144107

  or

  Spring Installation Tool Kit; ALARIS P/N 145098 (includes tool and instructions for use)

Perform a visual check of the mechanism prior to installing it into the front case. Each time the instrument is opened, verify the mechanism springs are properly positioned.

1. Verify all 12 followers are in place and that mechanism is flush to front case.
2. Rotate latch handle and check for full, uninterrupted range of motion.
3. Verify seal is correctly in place.

WARNINGS

- Do not attempt to reinstall springs or repair a mechanism assembly by any means not specified in the following procedure. Springs can be damaged if improperly installed, which can reduce rate accuracy or lead to an "uncontrolled flow" condition.
- Repair of a mechanism assembly requires fixturing not available for field use. Replace (do not repair) a mechanism assembly that is found to have an improperly installed spring after completing the following procedure.

5.3 TEST AND CALIBRATION (Continued)

5.3.2 Mechanism Visual Check (Continued)

4. Use an inspection light to visually inspect each of the 4 spring attachment points on mechanism assembly (both mechanisms if a dual channel).
   a. Verify each spring is properly installed onto each clamp arm. If each spring is properly installed, continue with next step; otherwise, proceed to step 6 to replace mechanism assembly.
   b. Verify spring is properly installed onto motor plate (brown colored part). If spring is properly installed, continue with next step; otherwise, proceed to step 6 to replace mechanism assembly.
   c. Verify whether or not spring is properly installed onto back guide (white colored part with a metal insert at spring attachment). Continue with next step.
5. Use spring installation tool to ensure proper installation of spring to back guide attachment point.
   a. Firmly press groove of installation tool over rib just below spring connection point on back guide.
   b. If visual inspection of spring in step 4c found it to be properly positioned, and there is no spring movement when pressing installation tool in place, spring connection is acceptable and inspection is complete.
   c. If visual inspection of spring in step 4c found it to NOT be properly positioned, and spring snaps into place with firm pressure, spring connection is now acceptable and inspection is complete.
   d. If visual inspection of spring in step 4c found it to NOT be properly positioned, and it does NOT snap into place with firm pressure, spring connection is NOT acceptable. Continue with step 6, for replacement and return of mechanism assembly.
6. If, after inspecting mechanism spring connections per steps 4 and 5, it has been determined that mechanism needs replacement:
   a. Replace mechanism assembly.
   b. Return mechanism to ALARIS Medical Systems (refer to “General Contact Information” at beginning of this manual).

5.3 TEST AND CALIBRATION (Continued)

5.3.2 Mechanism Visual Check (Continued)

Figure 5-32. Mechanism Assembly Spring Location: Between motor plate and clamp arm (Partial sketched view of mechanism, for spring location reference only.)

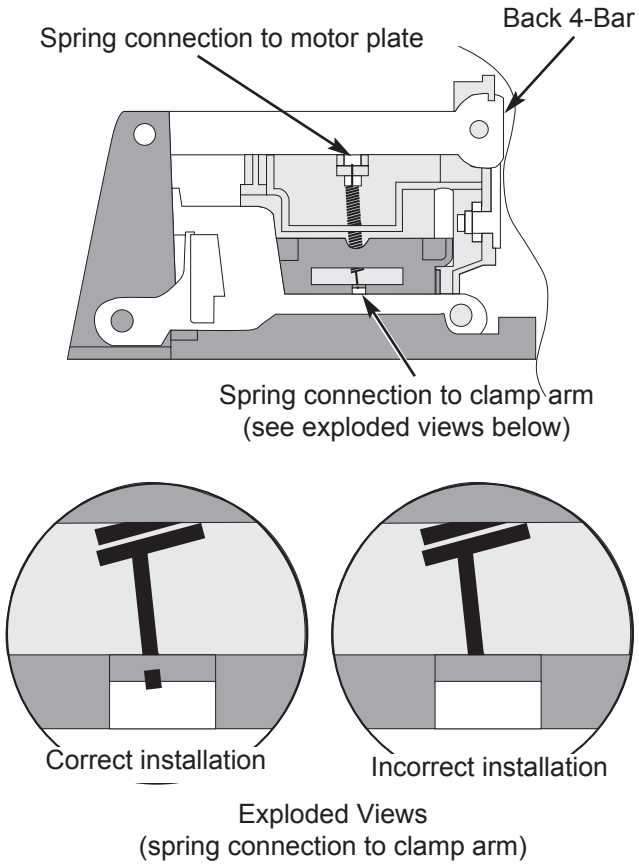
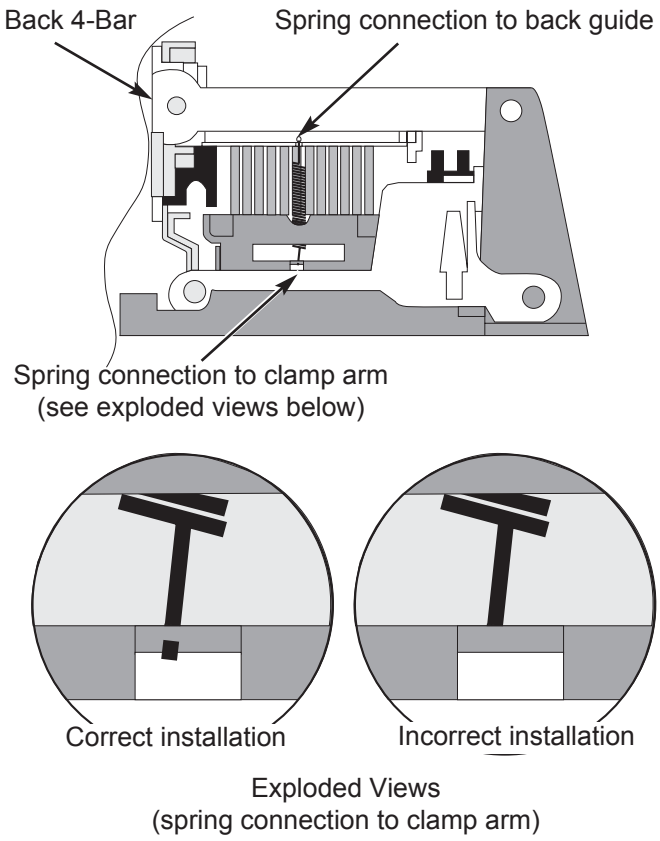


Figure 5-33. Mechanism Assembly Spring Location: Between back guide and clamp arm (Partial sketched view of mechanism, for spring location reference only.)



5.3 TEST AND CALIBRATION (Continued)

5.3.2 Mechanism Visual Check (Continued)

Figure 5-34. Detail of Proper Mechanism Spring Position

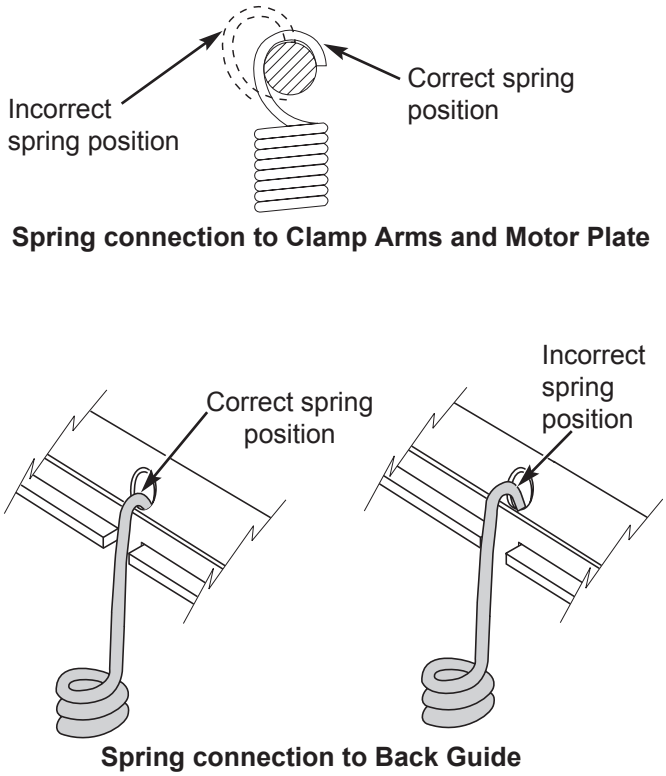
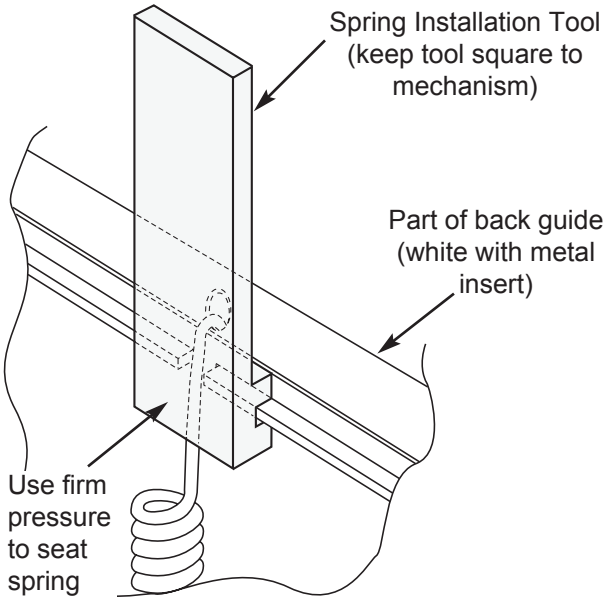


Figure 5-35. Spring Installation Tool Position (Partial view of mechanism assembly, for spring location reference only.)



CAUTION

The spring installation tool is for use only at the spring attachment to the back guide.

5.3 TEST AND CALIBRATION (Continued)

5.3.3 Mechanical Leak Test (Figure 5-36)

1. Use a variable pressure air source (squeeze ball or equivalent), reservoir, and pressure gauge. Install non-check valve set (72013) into instrument.

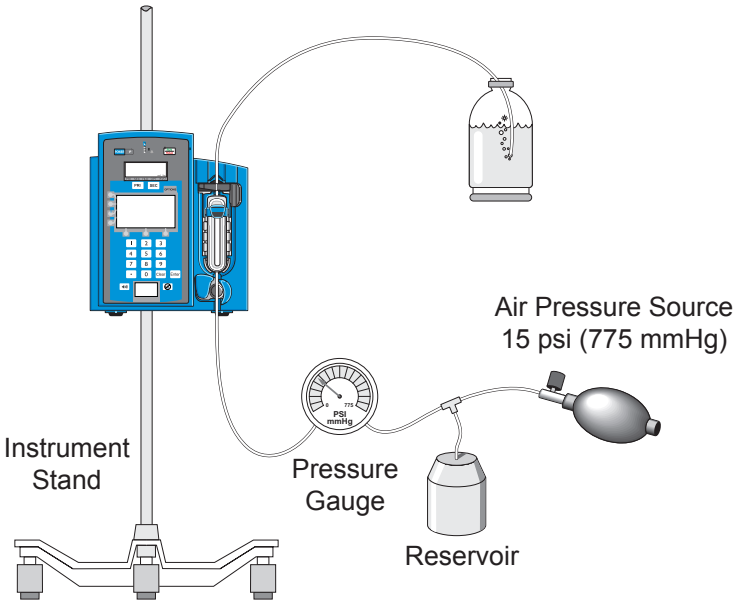
   NOTE: No fluid in set for mechanical leak test.

2. Cut off drip chamber of set, if needed, to place into a fluid container filled with water.
3. Install set in instrument and close latch.
4. Connect variable pressure air source, reservoir, and pressure meter to set at bottom of instrument.
5. Apply pressure of 15 ± 1 psi (775 ± 50 mmHg) for 1 minute.
6. Verify air bubbles do not continue to show up in fluid container.

   NOTE: When air pressure is first applied, a few bubbles are acceptable during mechanical leak test.

7. If bubbles continue to show in fluid container, return instrument to factory or replace mechanism or case, as needed.

Figure 5-36. Leak Test Setup



5.3 TEST AND CALIBRATION (Continued)

5.3.4 Pressure Verification and Calibration Test

Refer to “Pressure Calibration” section in “Preventive Maintenance” Chapter for soft cal procedure.

5.3.5 Set Sensor Check

1. Enter Diagnostic Mode and advance to D6 page.
2. Install set and allow a 30-minute warm-up while in Diagnostic Mode.
3. Sensor reading with set in should be greater than 170 mmHg
4. Remove set and close latch. Sensor reading with set out should be -80 to +30 mmHg. If not, perform soft pressure calibration detailed in “Troubleshooting” chapter.

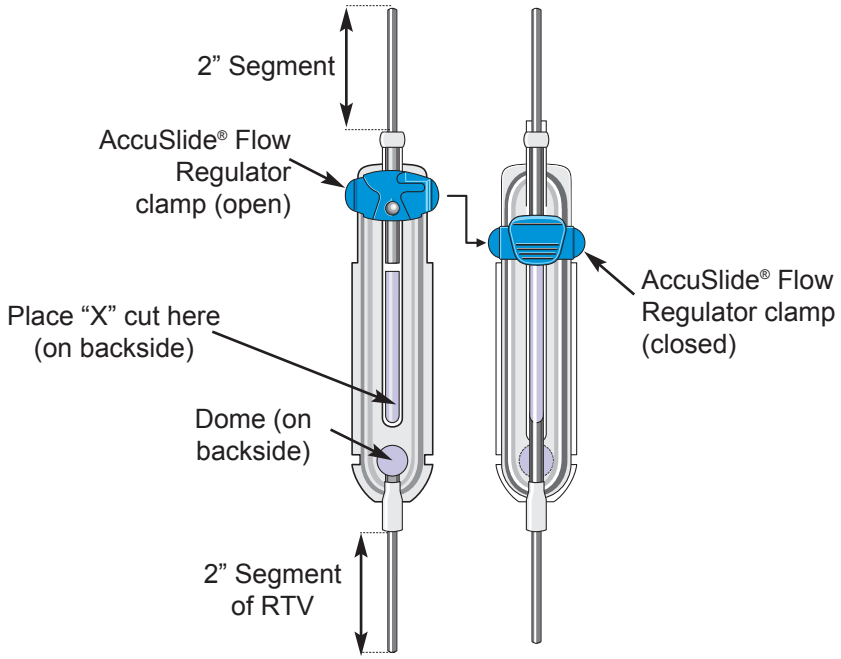
5.3 TEST AND CALIBRATION (Continued)

5.3.6 Test Run Mode (Figure 5-37)

The test run mode enables the instrument to run without fluid after being repaired. To run the instrument without fluid, perform the following:

1. Cut AccuSlide® Flow Regulator segment out of standard set. Leave 2 inches of tubing at top and bottom.
2. Cut membrane on backside of AccuSlide® Flow Regulator clamp at bottom of pumping segment. Use knife or other appropriate tool and cut an 'X' into membrane to relieve pressure that will build up during testing.
3. Move AccuSlide® Flow Regulator clamp up to open position.
4. Fill lower portion of tubing with RTV. Do not let RTV enter dome area.
5. Allow to dry (48 hours). Move AccuSlide® Flow Regulator clamp down until it "clicks" into closed position, and install test set into instrument.
6. Select rate and run for desired time period, for example 100 mL/h for 15 minutes.
7. Remove test set.

Figure 5-37. Run-In Set



5.3 TEST AND CALIBRATION (Continued)

5.3.7 Hard Pressure Cal Procedure

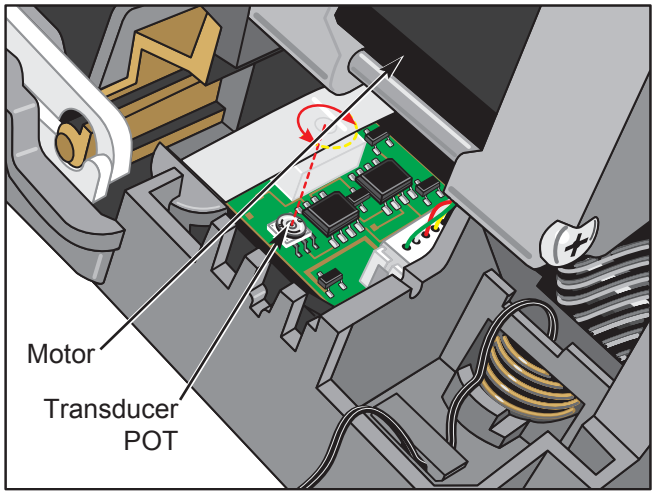
> **NOTE:** When performing the Hard Pressure Calibration, take care not to press downward on the transducer. The pot is a one-turn, surface-mount pot with a rivet in the middle. Use a small screwdriver or scribe to push sideways on the two slots in the pot. If the Count = value is 0 or 4095, this could indicate a bad transducer and necessitate replacement of the mechanism.

1. Ensure warm-up of 1 hour minimum.
2. Leave instrument on and connected to AC power and battery.
3. Follow procedure to disassemble instrument.

> **NOTE:** There is one case screw inside the battery compartment.

4. Do not disconnect any cables. Adjust pole clamp so knob is facing downward. Lay front case on desk/bench top.
5. Locate pot under motor and on backside of transducer (Figure 5-38).

Figure 5-38. Transducer Pot



6. Evaluate sensor in D6 Pressure Calibration page (see “Troubleshooting” chapter), as follows:
   a. Press lower left soft key 4 times to see Count = value.
   b. If Count = value is between 875 and 1275, go to start of Pressure Cal screen. Verify Sensor = reading is between -80 and +30 mmHg after set is removed (repeat for other channel if necessary). If not, perform soft pressure calibration.
   c. If Count = value is less than 875 or more than 1275, perform hard cal for this channel.
7. Adjust transducer pot for a Count = value of 1175±25 counts.
8. Once transducer is adjusted for proper reading, press **ok** to accept value.
9. Close instrument by setting bottom of front case onto rear case, using case bosses for alignment. For a dual channel instrument, route long ground wire into corner of case boss. Ensure ground wires do not rub against mechanism.
10. Check for proper routing of cables.
11. Close case by following pattern and tightening procedure outlined earlier in this chapter.
12. Wait 30 minutes for transducer to warm up again and check that compensated value is still in range, as noted earlier.
13. Perform soft pressure cal procedure (after 30-minute warm-up) as follows:
    a. Install 70ISS Press Cal Set.

5.3 TEST AND CALIBRATION (Continued)

5.3.7 Hard Pressure Cal Procedure (Continued)

b. Advance to D6 page in diagnostics mode. Select **Cal Pressure** for desired channel.

c. Press soft key next to 0 mmHg. Verify display reads **Pass** to right of 0 mmHg value and **Fail** for 500 mmHg, and **Complete Press Cal** now replaces Sensor = reading.

d. Attach pressure meter and squeeze ball to end of pressure cal set. Apply 500±2 mmHg.

e. Press soft key next to 500 mmHg. Verify both 0 and 500 values now say **pass**.

f. Press **ok** to accept. Soft Cal is now complete.

5.3.8 Checking Pressure Calibration Set

1. Go to Diagnostics Mode, D6 page, to access Pressure Calibration section.
2. Note sensor reading.
3. Install pressure calibration set.
4. If sensor reading has had a greater than ±20 count shift, or pressure calibration leaks, replace set.

5.4 LEVEL OF TESTING GUIDELINES

Table 5.2. Level of Testing Guidelines

This table provides minimum test requirements. If instrument operation is at all doubtful, perform a complete Preventive Maintenance Inspection.

NOTE: The number in parentheses is the chapter that describes the test/action.

Tests to Perform → ● = Required **X** = Recommended A/R = As Required N/A = Not Applicable Blank = Optional **Repair/Replacement of ↓**	Functional Test (3)	Flow Stop Test (3)	Rate Accuracy Verification (3)	Ground Current Leakage and Resistance Tests (3)	Main LCD Test (6)	Leak Test (mechanical) (5)	Configuration Procedure (2)	Clear Battery Time (6)	Set Sensor Check (5) (part of Pressure Cal)	Pressure Calibration (soft) (3)	Pressure Calibration (hard) (5)	Perform Rate Cal (3)	Set Time, Date, ID# (6)	Set PM Interval, Auto Zero (6)	Test Channel Sensors (6)	Mechanism Visual Check (complete) (5)	Mechanism Visual Check (springs) (5)	Test Run Mode (5)
Battery								●										
Case	●	●	●	●	●	**X**			●						●	**X**	●	**X**
Keyboard Assy.	●		●	●					**X**								●	
LCD Module, Lower	●		●	●	●				**X**								●	
LCD Module, Main	●		●	●	●				**X**								●	
LED Module	●		●	●	●				**X**								●	
Main Board	●		●	●	**X**		●		●	●	A/R	●	●	●			●	**X**
Mechanism	●	●	●	●		●			●	●	A/R	●			●	●		**X**
Panel Lock Keypad	●		●	●											**X**		●	
Power Switcher	**X**		●	●											●		●	
Software	●		●	●	**X**		●		●	●	A/R	●	●	●			●	**X**
Speaker	●		●	●													●	
Other repairs	●	**X**	●	●	●				●		A/R				**X**		●	**X**
Miscellaneous: ↓																		
Instrument Dropped	●	●	●	●	●	●			●						●	●		**X**
New Instrument Checkout	●	●	●	●	●		●		●				**X**	**X**	**X**			
Rate Accuracy failure after Rate Cal.			N/A			●											●	
No Fault Found (instrument opened)	●	**X**	●	●	●				●						**X**		●	**X**
No Fault Found (instrument <u>not</u> opened)	●		●						●									**X**

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6 TROUBLESHOOTING

Chapter 6 — TROUBLESHOOTING

WARNING

Use extreme caution in servicing the instrument when connected to AC power. Hazardous voltages are present when AC power is connected, regardless of the setting of the power switch.

CAUTION

Before disconnecting the battery, disassembling, troubleshooting or testing the instrument, record the alarm history. Refer to "Viewing Alarm or Event History (Event Log)" section of this chapter.

6.1 INTRODUCTION

This chapter contains descriptions of possible operating errors and technical problems that may be encountered during use of the instrument. Refer to this chapter before attempting to service the Signature Edition® GOLD Infusion System.

To facilitate troubleshooting, the instrument will alarm and display prompts that direct attention to the problem. Alarms that relate to operating problems are listed in the applicable Signature Edition® GOLD Infusion System Directions for Use (DFU).

Table 6-1. Technical Troubleshooting Guide

This table contains information for troubleshooting possible technical problems. The steps in the "Remedy" column are listed in the sequence in which the specified actions are to be taken.

Before making a final diagnosis, visually inspect the instrument for damage. Pay particular attention to the power cord and plug. Verify the instrument is electrically safe by performing the Ground Current Leakage and Ground Resistance tests (refer to the applicable Signature Edition® GOLD Infusion System DFU).

PROBLEM	REMEDY
Accuracy Verification Fails	1. Try new 80VCS Rate Cal set and repeat test a second time. 2. Check for mechanical damage and proper loading of administration sets. 3. Perform Rate Calibration. 4. Replace mechanism. 5. Return to factory.
Air-in-Line	1. Air in set. Remove air or press RESET to move air through line. 2. Change AIL setting. 3. Clean AIL transducer/receiver. 4. Check connector. 5. Replace AIL transmitter. 6. Replace AIL receiver. 7. Return to factory.

Table 6-1. Technical Troubleshooting Guide (Continued)

PROBLEM	REMEDY
Backup Speaker Activated while handling main PCB	1. Discharge capacitor C146 (C179) by placing jumper across capacitor terminals.
Batt Refresh	A charge/discharge/recharge cycle was initiated. This can occur: 1. When battery is disconnected and reconnected to AC power. 2. By entering 0.0Ah in rated capacity, connecting to AC, then change rated capacity back to 1.3Ah.
Battery Low Battery Failed	1. Plug into AC power. 2. Recondition battery with 2 or 3 charge/discharge cycles. 3. Replace battery. 4. Replace main PCB. 5. Return to factory.
Downstream Occlusion	1. Check setup and tubing (kinked, clogged filter, etc.). 2. Check pressure calibration.
Display Problem	1. Check cable connections. 2. Replace LCD/LED module. 3. Replace main PCB. 4. Return to factory.
FAN is noisy	1. Check cable routing and snap fits. 2. Replace fan. 3. Replace main PCB. 4. Return to factory.
Hold/Setup Time Exceeded	1. Press Run/Hold to resume operation. 2. Turn off instrument if not in use.
Intermittent Operation	1. Check cable connections to main PCB. 2. Replace main PCB. 3. Return to factory.
Instrument/Channel Malfunction	1. Turn instrument/channel off and back on to see if problem clears. 2. Refer to alarm history for fault detected and Table 6-2: Error Messages.
Key Stuck Alarm	1. Turn instrument off and back on to see if problem clears. 2. Replace channel A LCD module. 3. Replace keypad assembly. 4. Replace main PCB. 5. Return to factory.
Latch Open Alarm	1. Check for proper set installation. 2. Verify latch closed and moves easily back and forth. 3. Verify sensor not loose. 4. Verify connector not loose. 5. Replace mechanism. 6. Return to factory.

Table 6-1. Technical Troubleshooting Guide (Continued)

PROBLEM	REMEDY
LCD Contrast is Dark or Light	1. Change contrast setting to 80, tilt unit to help view or follow information in Diagnostics Mode. 2. Replace main LCD. 3. Replace main PCB. 4. Return to factory.
Mechanical Leak Test Fails	1. Check mechanism for damage and proper mounting into snap fittings. 2. Replace mechanism. 3. Return to factory.
No Power	1. Wait 15 seconds after connecting to AC power. 2. Check/replace battery. 3. Replace power supply board (AC off line switcher). 4. Replace keypad. 5. Replace main PCB. 6. Return to factory.
Press Restart	In alarm history, this indicates infusion reached occlusion alarm point in pressure or resistance modes, but cleared within 40 seconds.
Pressure Calibration (Soft) Fails	1. Check setup and warmup time of at least 30 minutes. 2. Retry with new 70ISS set. 3. Perform pressure calibration (hard). 4. Replace mechanism. 5. Replace main PCB. 6. Return to factory.
Pressure Verification Fails	1. Check for damage and proper loading of 70ISS set. 2. Perform pressure calibration (soft). 3. Perform pressure calibration (hard). 4. Replace mechanism. 5. Return to factory.
Program Lost	Normal condition if battery disconnected or in a low state of charge. Reprogram settings and continue operation.
Resis Restart	In alarm history, this indicates infusion reached 100% resistance or alarm point, but cleared within 40 seconds.
Self Check Due	1. Install set, wait one minute and remove set. 2. Check latch sensor for proper operation. 3. Check pressure calibration (soft). 4. Perform Hard Pressure Cal. 5. Replace mechanism. 6. Return to factory.

Table 6-1. Technical Troubleshooting Guide (Continued)

PROBLEM	REMEDY
Set Out Alarms	1. Try another set. 2. Lower instrument closer to patient level. 3. Perform pressure calibration (soft). 4. Perform pressure calibration (hard). 5. Replace mechanism. 6. Return to factory.
Set Sensor Check Fails	1. Try a second set. 2. Perform pressure verification.
SW APPL	Software error. Turn instrument off and back on. If problem reoccurs, return instrument to factory or replace main PCB.
SW Shutdown	Battery voltage reached 10.2 volts, or five minutes elapsed since low battery alarm, and battery manager told CPU to turn off instrument. Charge or replace battery as needed.
Switches Inoperative	1. Replace (Channel A) LED Module. 2. Replace keypad. 3. Replace main PCB. 4. Return to factory.
Upstream Occlusion Alarm	1. Try another set. 2. Raise container higher to patient. 3. Check for downstream occlusion. 4. Check pressure cal (soft). 5. Could be high resistance in catheter, positional IV, etc.
USO Restart	In alarm history, this indicates a resistance condition exists making it difficult to distinguish between upstream and downstream occlusion, but cleared in a few seconds.

Table 6-2. Error Messages

The following hardware error messages can be generated by the instrument. These display messages indicate that the instrument has detected an internal malfunction. Use tables 6-2 and 6-3 to diagnose and correct technical problems. Steps in the “Remedy” column are listed in the sequence in which the specified actions are to be taken.

MESSAGE	PROBABLE CAUSE	REMEDY
AIL DETECTOR	Air-in-Line detector failed. Broken wire or loose connection.	1. Clean AIL. 2. Test in diagnostic mode. 3. Replace AIL transmitter or receiver. 4. Return to factory.
BATTERY OPEN	Battery Manager reported battery open.	1. Check connector/replace battery cable. 2. Replace battery. 3. Replace main PCB. 4. Return to factory.
BATTERY SHORT	Battery Manager reported battery shorted.	1. Check connector. 2. Replace battery. 3. Replace main PCB. 4. Return to factory.
BK SPKR CONECT	Backup speaker power didn’t connect (start-up).	1. Replace main PCB. 2. Return to factory.
BK SPKR DISCON	Backup speaker power didn’t disconnect (start-up).	1. Replace main PCB. 2. Return to factory.
BKUP SPKR ERR	Backup speaker didn’t operate (start-up and run).	1. Replace main PCB. 2. Return to factory.
CLOCK SYNC ERR	Main CPU and watchdog clocks do not agree.	1. Replace main PCB. 2. Return to factory.
CPU TEST FAIL	CPU test failed (start-up and run).	1. Replace main PCB. 2. Return to factory.
DATASET CRC	Error occurred when software and data set CRC do not match. Error text message in event log should read “DATASET CRC”.	1. Try to reload data set. If this does not work, data set will need to be recreated.
ECD UNINSTALLED	Fault in Flow Sensor interface.	1. Check ECD Board and connections. 2. Replace main PCB. 3. Return to factory.
EEPROM BAD CRC	Unrecoverable EEPROM CRC error.	1. Reconfigure and recalibrate. 2. Replace main PCB. 3. Return to factory.
EPROM CRC	CRC generator output did not equal CRC value in ROM.	1. Reflash embedded software. 2. Replace main PCB. 3. Return to factory.
HW CRC GEN	CRC generator did not return zero after last byte.	1. Replace main PCB. 2. Return to factory.

Table 6-2. Error Messages (Continued)

MESSAGE	PROBABLE CAUSE	REMEDY
HW MALFUNCTION	Battery Manager reported hardware malfunction.	1. Replace main PCB. 2. Return to factory.
ILLEGAL RESET	Processor reset while running.	1. Replace main PCB. 2. Return to factory.
LATCH ERR	Latch sensor failed.	1. Check placement and connections. 2. Replace mechanism. 3. Return to factory.
LCD RAM ERROR	LCD controller memory didn't match image in main RAM.	1. Replace LCD module. 2. Replace main PCB. 3. Return to factory.
LCD TURNED OFF	LCD Controller is off.	1. Replace LCD module. 2. Replace main PCB. 3. Return to factory.
LED CH TEST	LED error (start-up).	1. Replace LED module. 2. Replace main PCB. 3. Return to factory.
LED SEG CHAN	LED stuck row detect failure (start-up). Stuck row (start-up or run). Segment failure (start-up or run).	1. Replace LED module. 2. Replace main PCB. 3. Return to factory.
LED SEG INST	LED stuck row detect failure (start-up). Stuck row (start-up or run). Segment failure (start-up or run).	1. Replace LED module. 2. Replace main PCB. 3. Return to factory.
MOTOR BEHIND	Motor didn't step correct number of steps.	1. Check optics. 2. Replace mechanism. 3. Replace main PCB. 4. Return to factory.
MOTOR MID	Motor too slow for fast bi-rate or too fast for slow bi-rate.	1. Check optics. 2. Replace mechanism. 3. Replace main PCB. 4. Return to factory.
MOTOR SYNC	Motor didn't step correct number of steps.	1. Check optics and connections. 2. Check motor screws not loose. 3. Replace mechanism. 4. Replace main PCB. 5. Return to factory.
MOTOR TOO FAST	Motor running too fast.	1. Check optics. 2. Replace mechanism. 3. Replace main PCB. 4. Return to factory.

Table 6-2. Error Messages (Continued)

MESSAGE	PROBABLE CAUSE	REMEDY
MOTOR TOO SLOW	Motor running too slow or not running.	1. Check optics. 2. Replace mechanism. 3. Replace main PCB. 4. Return to factory.
MTR CURR SENSE	Motor current sense failed.	1. Replace mechanism. 2. Replace main PCB. 3. Return to factory.
PM BAD COMMAND	Battery manager or SCU error.	1. Replace main PCB. 2. Return to factory.
PM BAD CRC	Battery manager or SCU error.	1. Replace main PCB. 2. Return to factory.
PM ERROR	Battery manager error (start-up or shutdown).	1. Replace main PCB. 2. Return to factory.
PRESSURE CAL REQ	Pressure Calibration required.	1. Perform pressure cal (soft). 2. Perform pressure cal (hard). 3. Replace mechanism. 4. Replace main PCB. 5. Return to factory.
PRESSURE ERR	Pressure sensor test failed.	1. Try another set. 2. Check for downstream occlusion. 3. Perform pressure cal (soft). 4. Perform pressure cal (hard). 5. Replace mechanism if TC=0 or 4095 (±5). 6. Return to factory.
PRI SPEAKER ERR	Primary audio failed.	1. Replace speaker and check connections. 2. Check flex cable to main PCB connected. 3. Replace main PCB. 4. Return to factory.
RAM ADDR BUS	Address bus test failed (start and run).	1. Replace main PCB. 2. Return to factory.
RAM CLEARED	Recoverable RAM error. All data lost. Normal occurrence for manually initiated refresh cycle.	1. Turn power off and back on, should get “program lost” message, continue operation. 2. Replace main PCB. 3. Replace LED module. 4. Return to factory.
RAM COMPARATOR	RAM comparator failed to detect a forced phantom RAM error (start-up and run).	1. Turn power OFF/ON to reset. 2. Replace main PCB. 3. Return to factory.

Table 6-2. Error Messages (Continued)

MESSAGE	PROBABLE CAUSE	REMEDY
RAM DATA BUS	RAM data test (dedicated byte) failed (start-up and run).	1. Replace main PCB. 2. Return to factory.
RAM DMA WRITE	DMA write to RAM detected (start-up and run).	1. Replace main PCB. 2. Return to factory.
RAM PHANTOM RD	Phantom RAM didn't compare equal (start-up and run).	1. Replace main PCB. 2. Return to factory.
RAM TEST WHOLE	Unrecoverable phantom RAM compare error at start-up.	1. Replace main PCB. 2. Return to factory.
RATE CAL REQ.	Channel requires rate calibration.	1. Perform/Check rate cal (0%). 2. Replace mechanism. 3. Replace main PCB. 4. Return to factory.
SCU ERROR	Serial control unit error (start-up and shut-down).	1. Replace main PCB. 2. Return to factory.
SENSOR RNG ERR	Pressure sensor failed during calibration.	1. Replace main PCB. 2. Return to factory.
SPURIOUS INT	Spurious interrupt or bad jump.	1. Replace main PCB. 2. Return to factory.
STUCK POWER KEY	Power key stuck or held down too long (over 6 seconds).	1. Replace keyboard and front panel assy. 2. Replace main PCB. 3. Return to factory.
S/W SHUTDOWN	Battery voltage less than 10.2V.	1. Connect to AC power. 2. Replace battery. 3. Replace main PCB. 4. Return to factory.
Vbackup HIGH	VBKUP HIGH over 6.5V.	1. Replace main PCB. 2. Return to factory.
Vbackup LOW	VBKUP LOW less then 4.85V.	1. Replace main PCB. 2. Return to factory.
VBRIDGE ERROR	Bridge voltage on pressure sensor incorrect.	1. Let instrument warm up for 1 hour. 2. Check for downstream occlusion. 3. Try another set. 4. Perform pressure cal (soft). 5. Perform pressure cal (hard). 6. Replace mechanism. 7. Return to factory.

Table 6-2. Error Messages (Continued)

MESSAGE	PROBABLE CAUSE	REMEDY
Vcc HIGH	Vcc high. Over 5.469 Volts.	1. Replace main PCB. 2. Return to factory.
Vcc LOW	Vcc Low. Less than 4.632 Volts.	1. Replace main PCB. 2. Return to factory.
Vref HIGH	Vref high. Over 4.240 Volts.	1. Replace main PCB. 2. Return to factory.
Vref LOW	Vref low. Less than 3.964 Volts.	1. Replace main PCB. 2. Return to factory.
WD ALARM	Watchdog has fired.	1. Replace main PCB. 2. Return to factory.
WD EARLY ERROR	Watchdog didn't fire when stroked early (start-up).	1. Replace main PCB. 2. Return to factory.
WD FORCE ERROR	Watchdog didn't fire when forced (start-up).	1. Replace main PCB. 2. Return to factory.
WD LATE ERROR	Watchdog didn't fire when stroked late(start-up).	1. Replace main PCB. 2. Return to factory.
WD MOTOR ON	Watchdog couldn't disable motor (start-up).	1. Replace main PCB. 2. Return to factory.
WD MTR OFF ERROR	Watchdog couldn't disable motor (start-up).	1. Replace main PCB. 2. Return to factory.
WD RESET OFF ERROR	Watchdog power-on test failed.	1. Replace main PCB. 2. Return to factory.

Table 6-3. Battery Manager Error Codes (not in Alarm History)

The following error codes relate to codes displayed in the lower LCD. These codes are not stored in memory. The steps in the "Remedy" column are listed in the sequence in which the specified actions are to be taken.

MESSAGE	PROBABLE CAUSE	REMEDY
ERR 1 - ROM CRC	Battery Manager code failure.	1. Replace main PCB. 2. Return to factory.
ERR 2 - RAM TEST	Battery Manager code failure.	1. Replace main PCB. 2. Return to factory.
ERR 3 - CPU	Battery Manager code failure.	1. Replace main PCB. 2. Return to factory.
ERR 4 - WATCHDOG ONE-SHOT TIMINGS	Watchdog circuit logic failure.	1. Replace main PCB. 2. Return to factory.
ERR 5 - ON/OFF FLIP-FLOP WRONG STATE	Cannot set/clear flip-flop condition.	1. Replace main PCB. 2. Return to factory.
ERR 6 - CURRENT INTEGRATOR	Battery current monitor circuit bad or system has excess current draw.	1. Charge battery. 2. Replace battery. 3. Replace main PCB. 4. Return to factory.
BATT	Battery temperature outside 0° - 60°C or battery voltage <10V or >18.8V.	1. Disconnect and reconnect battery to initiate a refresh cycle. 2. Replace battery. 3. Replace main PCB. 4. Return to factory.

6.2 DIAGNOSTICS MODE

The Diagnostic Mode allows a hospital/facility to manage periodic preventive maintenance of the instrument and view the instrument's history. It allows testing of functions and entry of the instrument's ID number. For quick reference, a map of all diagnostic screens is located at the end of this chapter.

Pressing a soft key at the side of the main display the first time selects it for editing. Some features are edited by subsequent presses of the soft key to cycle through available options. Other features are edited by means of the numeric keypad.

NOTE: Pressing **undo** or **cancel** will undo any edits made to that page, and stay on the page. Pressing **ok** will accept all information on the page, and return to the menu page.

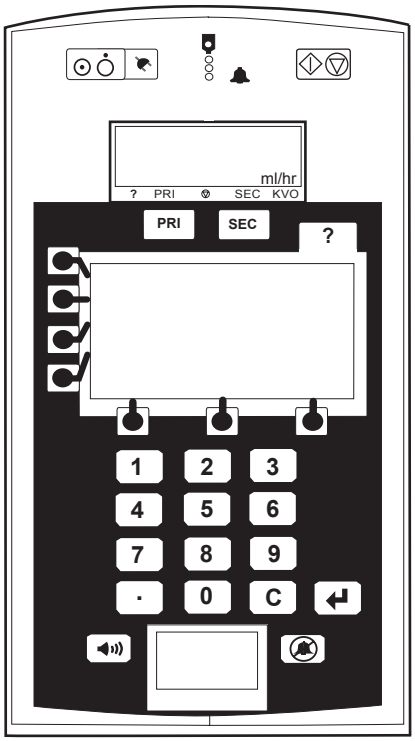
6.2.1 Entering Diagnostics Mode

The instrument must be off (both channels on a dual channel instrument).

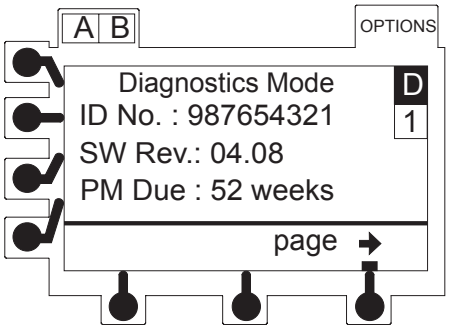
Though the figures in this procedure depict a single channel instrument, the procedure for the dual channel instrument is the same. Channel-specific items will display "A" or "B" in upper left corner.

1. Press and hold left-top display soft key.
2. Press and release **POWER** switch. Continue to press display soft key until Diagnostic Mode display appears, then release.

   Page D1 of Diagnostics Mode is displayed. This is a read-only display.
3. Press **page** → to advance to page to be configured.



NOTE: Some 7131/7231 keypads use symbols instead of words.

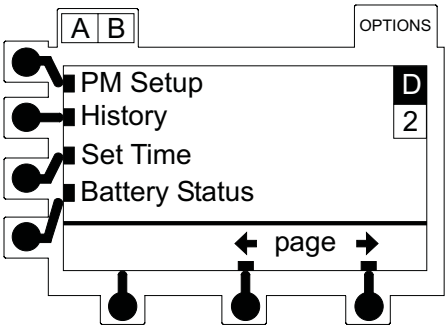


6.2 DIAGNOSTICS MODE (Continued)

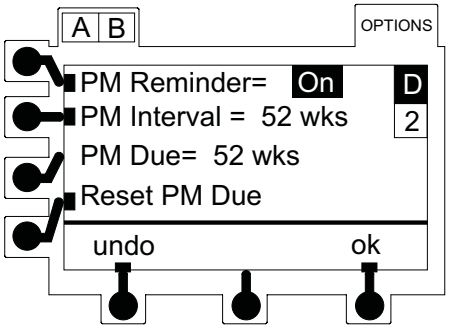
6.2.2 Setting Preventive Maintenance Interval

The preventive maintenance reminder is a message that appears upon start-up, indicating the maintenance cycle has elapsed. If the reminder message is bypassed, the instrument will operate as normal but the reminder will continue to appear at start-up until it is reset.

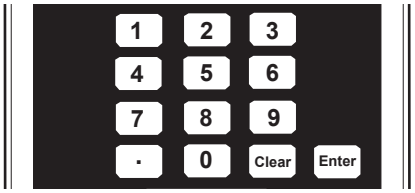
1. Advance to D2 page.



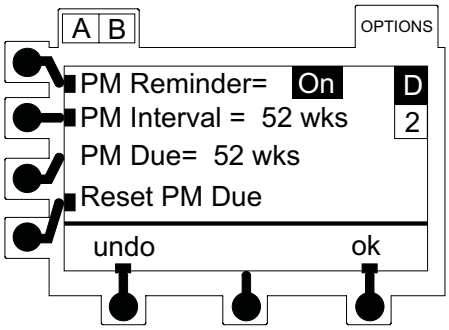
2. Press **PM Setup** soft key.
3. Press and release **PM Reminder** soft key to cycle between **On** and **Off**.



4. Press **PM Interval** soft key.
5. Use numeric keypad to enter desired maintenance interval (1 to 52 weeks). Press **enter**. Setting PM Interval always resets PM Due to same value as PM Interval.
   - PM Due decrements with calendar time and is displayed to the nearest week.
   - Pressing **Reset PM Due** soft key resets the PM Due to the displayed PM Interval.

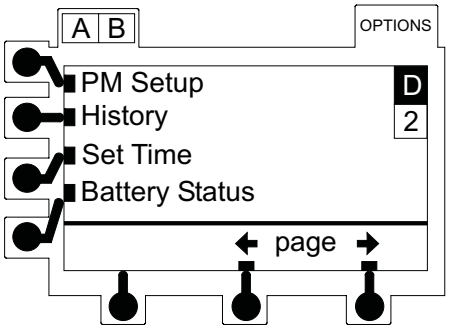


6. Press **ok** to accept change and return to beginning of D2 page.



6.2 DIAGNOSTICS MODE (Continued)

6.2.3 Viewing Alarm or Event History (Event Log)



1. From D2 page, press **History** soft key.
   - For mode/state changes, first line will read Misc. Inst. (Miscellaneous Instruction). Key Inst. will be displayed to indicate a key/switch activation. Alarms and errors may be channel-specific or instrument related, which will also appear on first line.
   - Second line will give month, day, year, hour and minute that entry/event took place.
   - Third line will show event/entry that occurred.

NOTES:

- History Log will keep 1500 entries in memory. Entry 0001 will be most recent and entry 1500 will be oldest. No More Events will be displayed if less than 1500 events are recorded.
- Memory will clear when new main software is installed.

2. To scroll to previous/next event screen press **page** soft key. (Events are listed on a last in, first out basis.)
3. Press **return** soft key to return to D2 page.

NOTE: If AC and battery power are disconnected from the instrument, event history may be lost.

Following is a list of entries and samples of displays.

Alarms:
ALL

Errors:
ALL

User Initiated Events:

Alarm Cleared	Panel Unlocked
Channel Off	Silence On
Channel On	Latch Open
Configuration Complete	AC Connected
Diagnostic Complete	AC Disconnected
Panel Locked	

6.2 DIAGNOSTICS MODE (Continued)

6.2.3 Viewing Alarm or Event History (Event Log) (Continued)

Data Entry Events:

Dose (Rate) Calc VTBI Set to xxxx.x mL	Dose (Rate) Calc Set to Off
Load (Dose) VTBI Set to xxxx.x mL	Load VTBI Set to xxxx.x mL
Primary VTBI Set to Off	Secondary VTBI Set to xxx.x mL
Vi Cleared	Dose Rate Set to xxxxx uuu
Drug Amount Set to ccccc uuu	Diluent Volume Set to xxxx mL
Patient Weight Set to xxxxx uuu	Patient Height (DRC) Set to xxx uuu
Set Time	Dose Rate Drug Name

Infusion State Change Events:

Dose (Rate) Running at xxx.x mL/h	(Multi) Dose Started at xxx.x mL/h
In KVO at xx.x mL/h	Loading (Dose) Running at xxx.x mL/h
Multi-Dose Complete	On Hold, VI = xxx.x mL
Primary Running at xxx.x mL/h	Secondary Running at xxx.x mL/h
(Mult) Step Started at xxx.x mL/h	Timer Started, VI = xxxx.x mL
Timer Stopped, VI = xxxx.x mL	

Notifications:

Battery refresh	Battery Low
Computer Released	Memory Erased
Pressure Restart	Preventative Maintenance Reminder
Resistance Restart	Resistance Alert
Self-Check required	Software Shutdown
Upstream Occlusion restart	VI = xxxx.x mL *(logged every hour while infusing)*

Keys Logged:

Audio	Left Soft Key 1	Run/Hold A	Three
Bottom Soft Key 1	Left Soft Key 2	Run/Hold B	Four
Bottom Soft Key 2	Left Soft Key 3	Secondary	Five
Bottom Soft Key 3	Left Soft Key 4	Select A	Six
Clear	On/Off A	Select B	Seven
Decimal Point	On/Off B	Silence	Eight
Enter	Options	Split Screen	Nine
Hidden Key 1	Panel Lock	One	Zero
Hidden Key 2	Primary	Two	

Configuration Events Logged:

Air-inLine Accumulator Enable/Disable	Multi-Dose Mode Enable/Disable
Air-in-Line Reset Enable/Disable	Multi-Step Mode Enable/Disable
Computer Link Mode Changed	Pressure Alarm Fixed/Adjustable
Default Monitoring Option Changed	Pressure Display On/Off
Dose Rate Calculator Mode Enable/Disable	Resistance Alert On/Off
Dose Rate Drug List Items Changed	Resistance Display On/Off
Loading Dose Mode Enable/Disable	Trend Graphs Enable/Disable
Manual Baseline Option On/Off	VTBI On/Off
Multi-Dose Alert Enable/Disable	

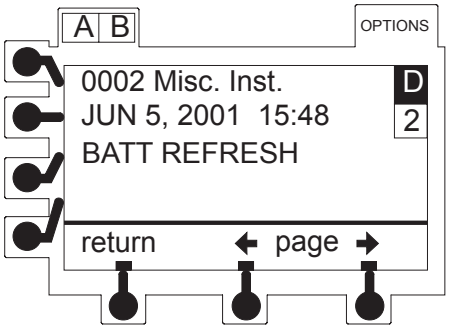
6.2 DIAGNOSTICS MODE (Continued)

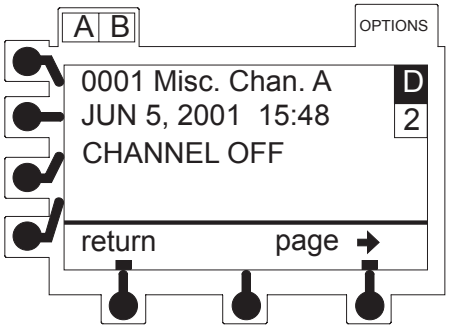
6.2.3 Viewing Alarm or Event History (Event Log) (Continued)

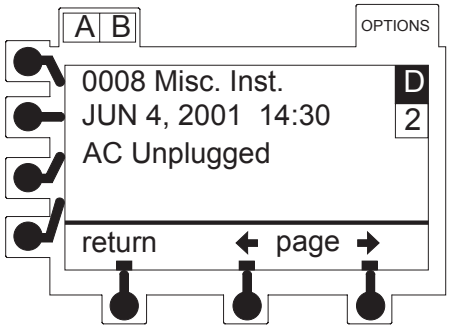
Guardrails® Safety Software Events:

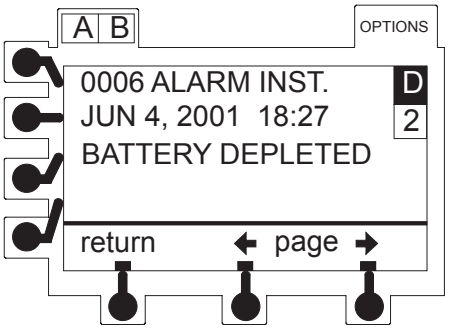
GR DRUG NAME IS
HARD DOSE LIMIT HIGH
HARD DOSE LIMIT LOW
SOFT DOSE LIMIT HIGH
SOFT DOSE LIMIT LOW
DOSE OVERRIDE YES
DOSE OVERRIDE NO
MAX PATIENT WEIGHT
MAX RATE EVENT
DRUG SELECT-CANCELED
PROFILES OFF
PROFILES ON
EVENT COUNTER RESET
NEW DATASET LOADED
DATASET CLEARED

Display Examples



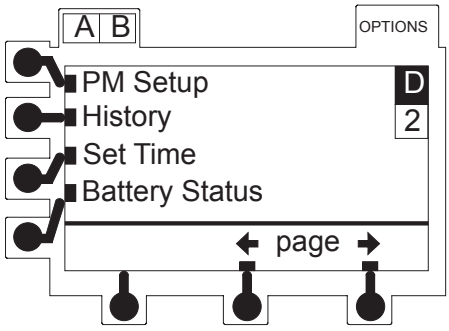




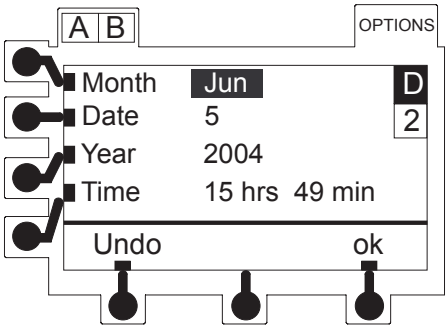


6.2 DIAGNOSTICS MODE (Continued)

6.2.4 Setting Time (and Date)



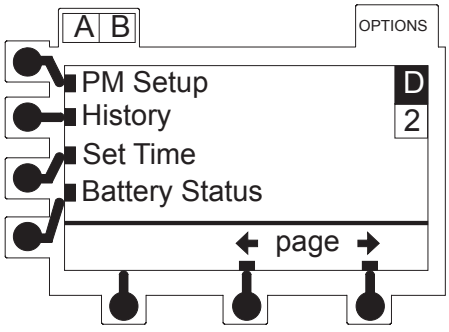
1. On D2 page, press **Set Time** soft key.
2. Press **Month** soft key to highlight. Press **Month** soft key as needed to get desired month.



3. Press **Date** soft key to highlight. Enter date on keypad and press **Enter**.
4. Press **Year** soft key to highlight. Enter year on keypad and press **Enter**.
5. Press **Time** soft key to highlight hours (military time, 24 hours) on keypad and press **Enter**. If the value for hours is correct and only minutes are to be changed, press **Time** soft key again to highlight minutes.
   - Year setting is four digits and will accept year entries of 2000 and beyond. Default date and time is Jan 1, 1970 00:00
   - Software clock may lose up to 3 minutes per month. Reset time as part of Preventive Maintenance or more often, as desired.
   - When clock is reset for current date/time, previous logs will not be adjusted retroactively, but will remain the same.
   - Clock will NOT automatically adjust for time changes, such as, daylight savings.
6. Press **ok** to accept change and return to beginning of D2 page. Press **Undo** soft key to reinstate time/date.

> **NOTE:** Information stored in the Flash EEPROM will not be lost when Version 4.08 software is flashed into the instrument. This includes Rate Calibration, Pressure Calibration, ID number (serial number), time/date and PM data.

6.2.5 Viewing Battery Status



6.2 DIAGNOSTICS MODE (Continued)

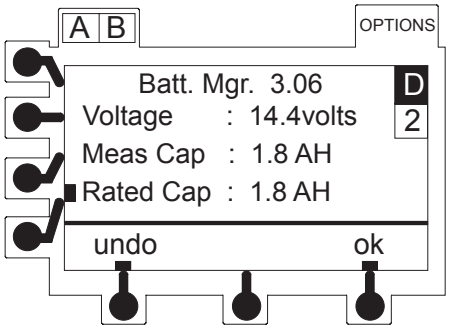
6.2.5 Viewing Battery Status (Continued)

1. On D2 page, press **Battery Status** soft key.

   Voltage may range from 10V to 18V. Ampere-hours may range from 0.0 to 3.0.

   NOTE: Voltage will flash when updated by software.

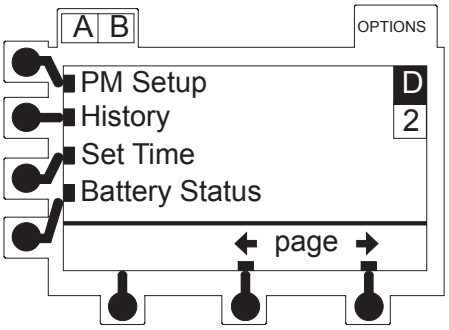
2. Press **return** soft key to return to D2 page.



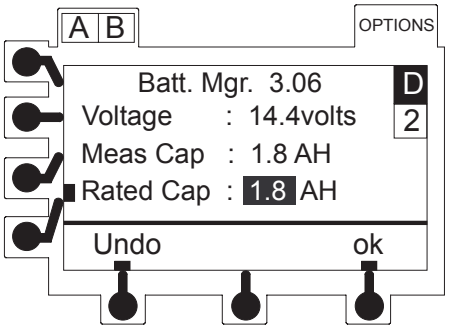
6.2.6 Changing Rated Capacity of Battery

This step is only required if a different type or different capacity battery is later approved for use. As long as battery is NiCad and rated at 1.3 Ah, no action is required.

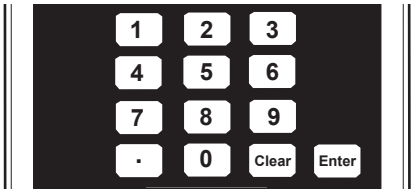
NOTE: Battery is rated at 1.8 Ah under ideal conditions. 1.3 Ah will be entered here to help compensate for uneven cell capacity and ensure getting a "low battery alarm" with 30 minutes or more use on battery.



1. On D2 page, press and release **Battery Status** soft key.
2. Press and release **Rated Capacity** soft key to highlight.

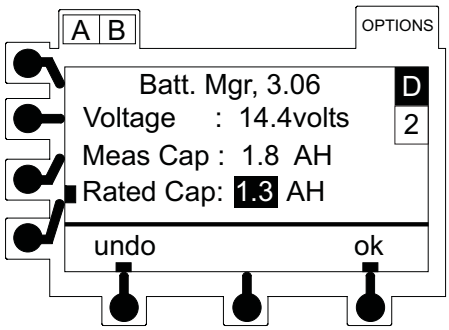


3. Use numeric keypad to enter rated capacity of new battery. Press **Enter**.



6.2 DIAGNOSTICS MODE (Continued)

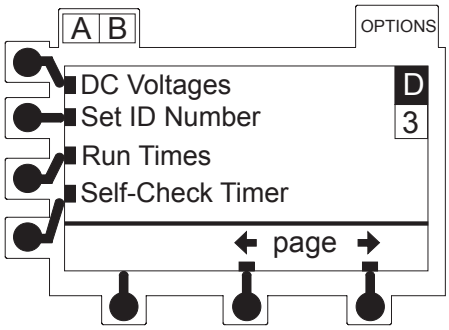
6.2.6 Changing Rated Capacity of Battery (Continued)



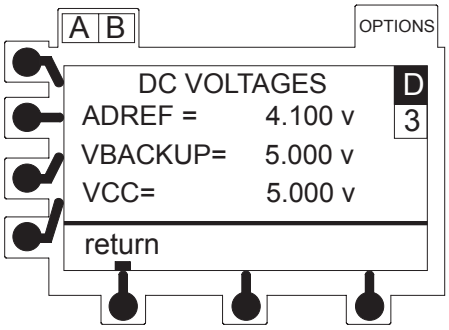
4. Press **ok** to accept change and return to beginning of D2 page.

6.2.7 Viewing DC Voltages

1. Advance to D3 page.



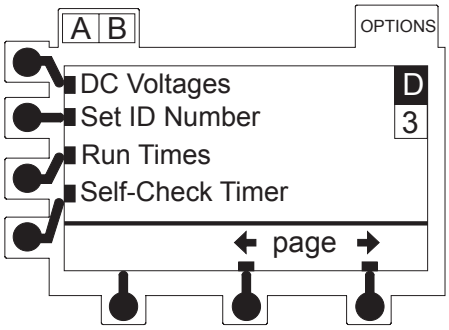
2. Press **DC Voltages** soft key.



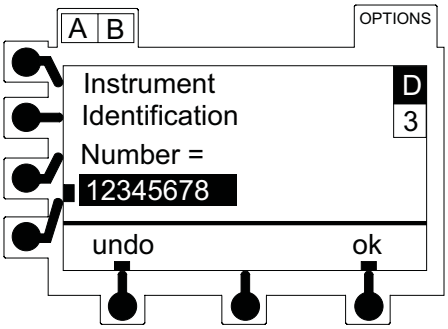
3. Press **return** soft key to return to D3 page.

6.2.8 Setting ID Number

An ID number may be useful for asset tracking, maintenance records, etc.



1. On D3 page, press **Set. ID Number** soft key.
2. Press bottom-left soft key to highlight.

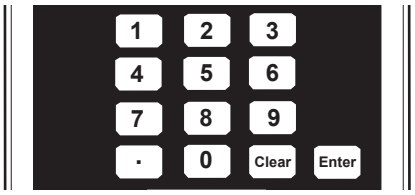


3. Use numeric keypad to enter desired identification number. Press **Enter**.

NOTE: The ID Number can be up to 9 digits.

6.2 DIAGNOSTICS MODE (Continued)

6.2.8 Setting ID Number (Continued)

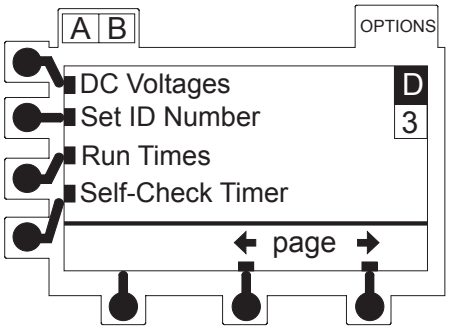


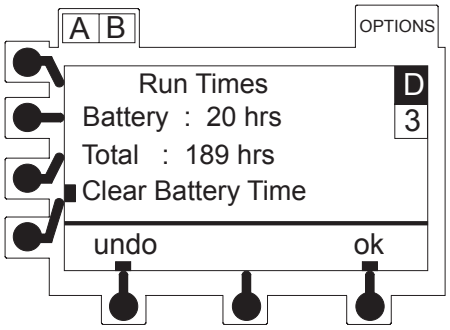
4. Press **ok** to accept change and return to beginning of D3 page.

> **NOTE:** Information stored in the EEPROM will not be lost when Version 4.08 software is flashed into the instrument. This includes Rate Calibration, Pressure Calibration, ID number (serial number), time/date and PM data.

6.2.9 Viewing Battery and Total Run Times

1. On D3 page, press **Run Times** soft key.

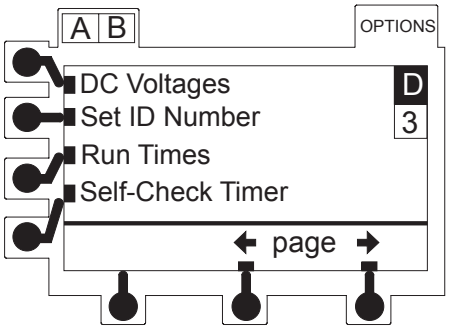




2. Press **Clear Battery Time** soft key to clear battery run time. (Total run time will not clear.)
3. Press **ok** to accept change and return to beginning of D3 page.

6.2.10 Viewing Self-Check Timer

The self-check timer is an interval at which the software checks the pressure sensor offset drift when it can be determined a set is not loaded and no other external forces are being applied to the pressure sensor. This periodic check ensures the set can be sensed as it is installed and removed. The instrument will give instructions to remove the set before powering down.

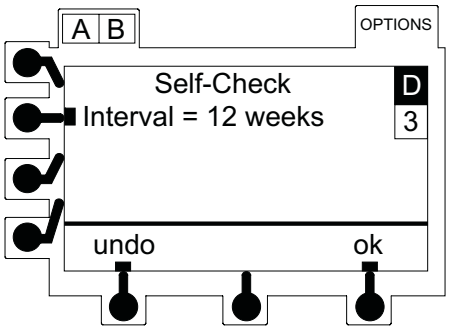


1. On D3 page, press **Self - Check Timer** soft key.

6.2 DIAGNOSTICS MODE (Continued)

6.2.10 Viewing Self-Check Timer (Continued)

2. Verify interval is set to 12 weeks.



3. Press **ok** to return to beginning of D3 page.

NOTES:

- This setting is factory set (4 to 12 weeks) and should NOT be changed. This feature can be enabled/disabled via Diagnostics Mode on D7 Page.
- If a self-check due message appears, press continue to keep the instrument running.

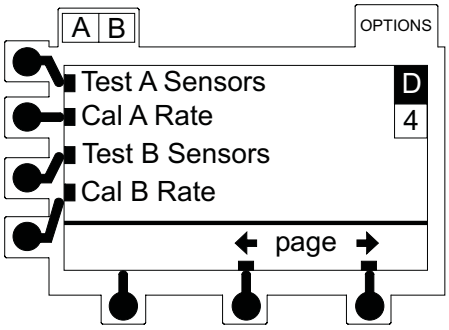
The self-check timer is set to 12 weeks. This is a rolling 12-week interval. To establish a new 12-week period, remove the set with the instrument power on and wait one to two seconds before turning the power off. Refer to “Calibrating Channel Pressure” section for a sample display showing the number of hours since the last self-check was performed.

Ensure the instrument is on when the set is removed, wait one to two seconds, and then power off. If the instrument is powered off without following this sequence of steps, it will not run on the next power up. If the instrument displays, "Self Check is Due. Please Eject the Set," this 12-week interval has elapsed. If that occurs:

1. Turn instrument on and install set.
2. Wait one minute.
3. Remove set and watch screen for a message that self-check is in progress.
4. When test is done, screen will go back to parameter page, and instrument operation can continue as desired.

6.2.11 Testing Channel Sensors

1. Advance to D4 page.

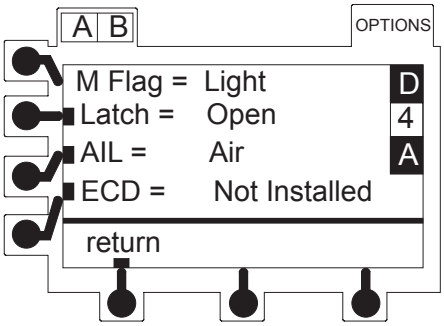


2. Press **Test A Sensors** or **Test B Sensors** soft key (dual channel instrument).
   - **Display** reads “**D4A**” or “**D4B**” depending on which channel was selected.
   - **M Flag** reads Light or Dark (Dark with 5th cam in).
   - **Latch** reads Open or Closed.
   - **AIL** reads Air or Fluid.
   - **ECD** reads Air, Fluid, Unplugged or Not Installed.

6.2 DIAGNOSTICS MODE (Continued)

6.2.11 Testing Channel Sensors (Continued)

Displayed:	Means:
Not Installed	ECD board assembly not installed.
Unplugged	ECD board assembly installed. Flow sensor not connected.
Air	ECD board assembly installed. Flow sensor detects air.
Fluid	ECD board assembly installed. Flow sensor detects fluid.

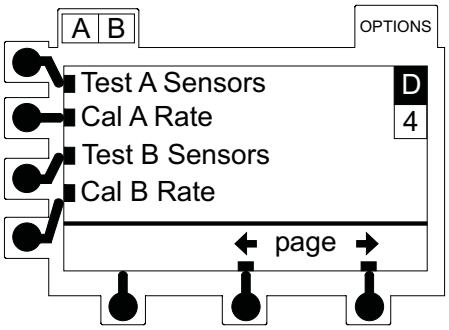


3. Press **return** soft key to return to D4 page.

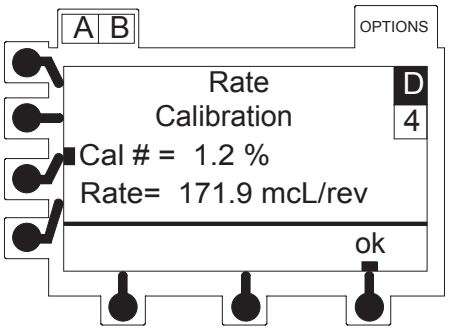
6.2.12 Viewing/Changing Rate Calibration Information

Use the following procedure to view or change the Rate Cal # setting.

1. Advance to D4 page.



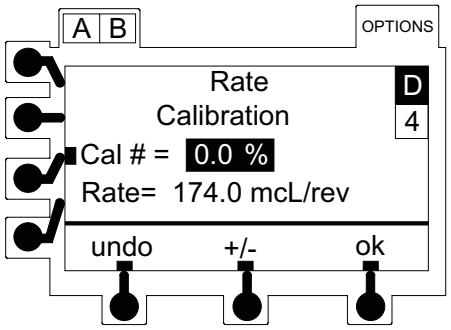
2. Press **Cal A Rate** or **Cal B Rate** soft key, depending on which channel is to be viewed.



3. To change Rate Cal # (%), press **Rate** soft key two times.
   - Instrument will beep but display will not change.
4. Press **Cal #** soft key to highlight and select for editing.
5. Change Cal # based on results of calibration rate run (refer to “Rate Calibration Procedure” section in “Preventive Maintenance” chapter).

6.2 DIAGNOSTICS MODE (Continued)

6.2.12 Viewing/Changing Rate Calibration Information (Continued)



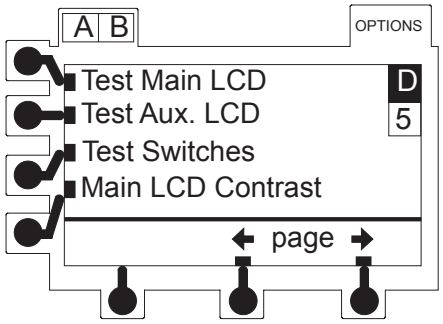
6. Press **Enter** then **ok** to accept change or press **undo** to return to old cal number.

NOTES:

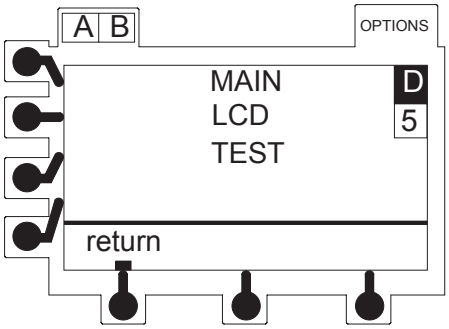
- Information stored in the EEPROM will not be lost when Version 4.08 software is flashed into the instrument. This includes Rate calibration, Pressure Calibration, ID number (serial number), time/date and PM data.
- Once the Rate Cal # is set to 0.0 and accepted, the instrument will need to be run for at least 2 seconds before the Rate Cal # can be changed to a non-zero value. If not, the instrument will display “Do Rate Accuracy Test at 0%”. The instrument will not allow one non-zero value to be changed to another non-zero value.

6.2.13 Testing Main LCD

1. Advance to D5 page.

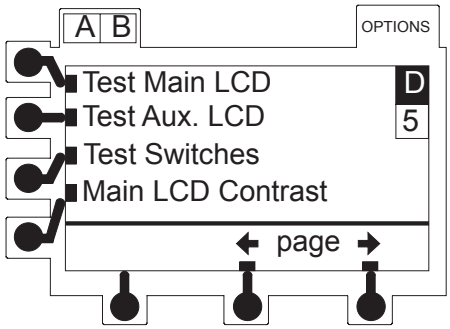


2. Press **Test Main LCD** soft key.
   - Test consists of Main LCD alternating between normal and reverse video every 2 seconds.
   - All LEDs also flash on and off at a 2-second rate.



3. Press **return** soft key to return to D5 page.

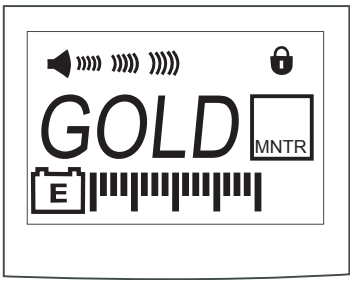
6.2.14 Testing Aux (Lower) LCD

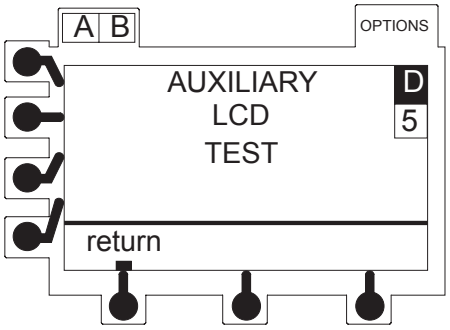


6.2 DIAGNOSTICS MODE (Continued)

6.2.14 Testing Aux (Lower) LCD (Continued)

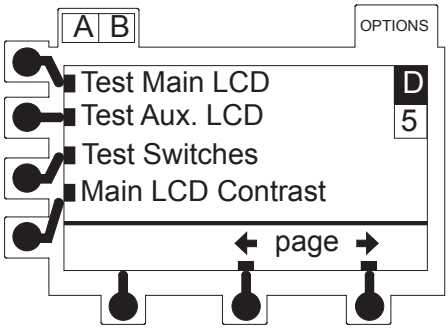
1. On D5 page, press **Test Aux. LCD** soft key.
   - This tests Lower LCD display, lighting all display segments.



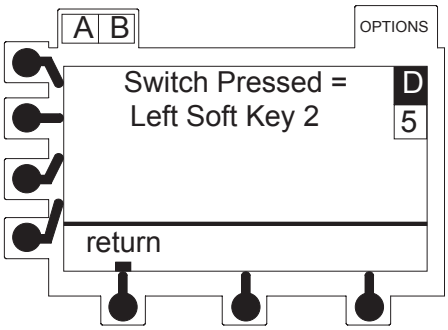


2. Press **return** soft key to return to D5 page.

6.2.15 Testing Switches

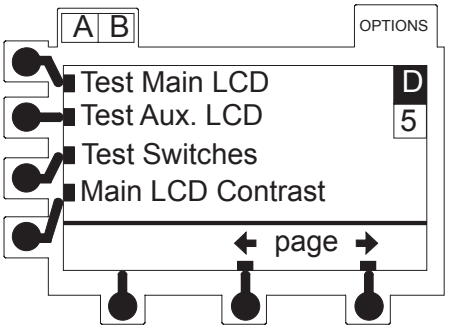


1. On D5 page, press **Test Switches** soft key.
2. Proceed to press all keys on instrument.
   - As a key is pressed, key's name will appear.
   - Proper functionality of **return** soft key is tested only by key performing its function; for example, returning LCD to D5 page.
   - When **POWER** key is pressed, it will display “Press and hold key to turn off”.



3. Press return soft key to return to D5 page.

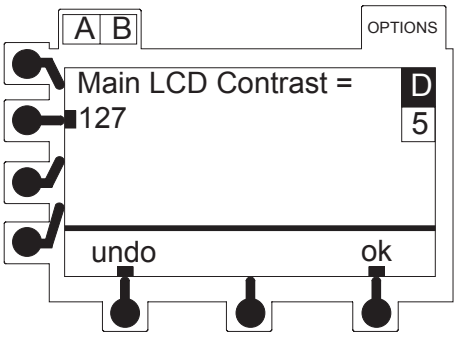
6.2.16 Changing Main LCD Contrast



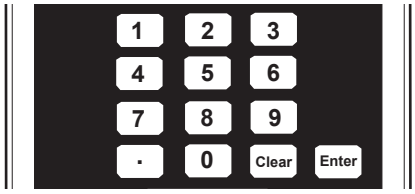
6.2 DIAGNOSTICS MODE (Continued)

6.2.16 Changing Main LCD Contrast (Continued)

1. On D5 page, press **Main LCD Contrast** soft key.

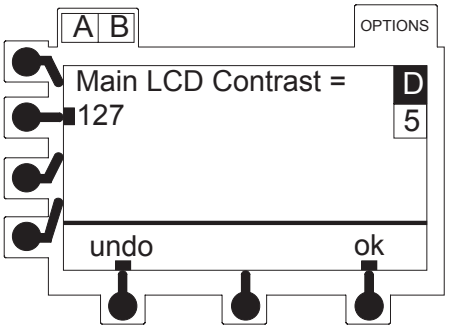


2. Press soft key next to contrast number to highlight.



3. Use numeric keypad to enter desired LCD contrast (contrast range is 1 to 256). Press **Enter**.

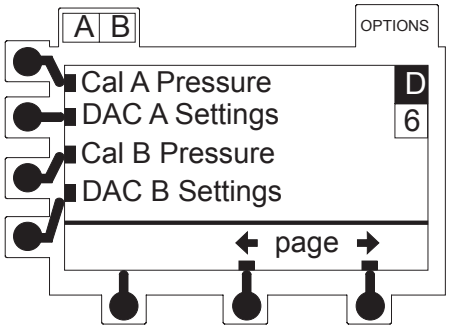
> **NOTE:** Decreasing number lightens contrast.



4. Press **ok** to accept changes and return to beginning of D5 page.

6.2.17 Calibrating Channel Pressure

1. Install a Pressure Cal Set (70ISS) to apply pressure to each channel. Allow instrument to warm up for a minimum of 30 minutes while in Diagnostics Mode.



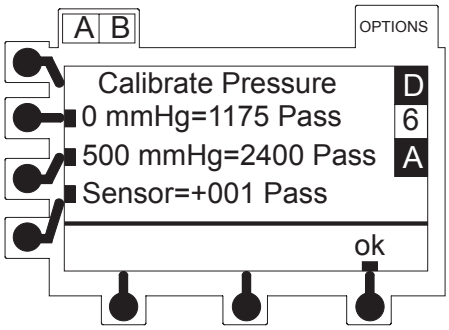
2. On D6 page, press **Cal A** Pressure or **Cal B** Pressure (dual channel).

   D6A or D6B will be displayed, depending on which channel was selected.

6.2 DIAGNOSTICS MODE (Continued)

6.2.17 Calibrating Channel Pressure (Continued)

3. Both "0" and "500" should display a number and read Pass. Sensor= should have a value between -80 and +30 (mmHgs), with no set installed. If Xs appear or sensor reading is out of range, instrument will require soft pressure calibration, as follows (for setup, reference “Preventive Maintenance” chapter):



   a. Adjust pressure to "0 mmHg" from test fixture. Press and release **0 mmHg** soft key. If readings are in a valid range, it will display Pass.

   b. Apply 500 mmHg (±2 mmHg) from test fixture. Press and release **500 mmHg** soft key. If readings are in a valid range, it will display Pass.

   c. Remove 500 mmHg pressure applied to instrument, then remove set.

   d. Press **ok** soft key to accept calibration and return to main D6 page.

4. Set sensor check/calibration verification:

   a. On D6 page press **Cal A Pressure** or **Cal B Pressure** (dual channel).

   b. Verify both 0 mmHg and 500 mmHg readings display **Pass**.

   c. Install a standard set and close latch. Verify reading is over 170.

   d. Verify Sensor = reading is in -80 to +30 mmHg range. If instrument will not soft cal, perform Hard Pressure Cal Procedure (see “Corrective Maintenance” chapter).

> **NOTE:** Information stored in the EEPROM will not be lost when Version 4.08 software is flashed into the instrument. This includes Rate Calibration, Pressure calibration, ID number (serial number), time/date and PM data.

5. Additional messages for pressure calibration include:

   - **COMPLETE PRESS CAL** - need to do both "0" and "500" pressure cal points.
   - **FAIL 500 LOW/HIGH LIMIT** - pressure reading seen by ADC is out of range. Retry soft pressure cal, perform hard cal, replace mechanism or return to ALARIS Medical Systems for repair.
   - **FAIL ZERO LOW/HIGH LIMIT** - pressure reading seen by ADC is out of range. Retry soft pressure cal, perform hard cal, replace mechanism or return to ALARIS Medical Systems for repair.
   - **FAIL ZERO LOW/HIGH RANGE** - pressure reading is outside relative limits. Retry soft pressure cal, perform hard cal, replace mechanism or return to ALARIS Medical Systems for repair.

6.2 DIAGNOSTICS MODE (Continued)

6.2.17 Calibrating Channel Pressure (Continued)

- **SENSOR TOO NOISY** - electrical interference is detected in pressure signal. Retry soft pressure cal, perform hard cal, replace mechanism or return to ALARIS Medical Systems for repair.

  Reference “Hard Pressure Cal Procedure” in “Corrective Maintenance” chapter.

6. Messages that require an instrument to be returned to ALARIS Medical Systems for repair or mechanism replacement are:

   FAIL SENSOR GAIN LOW/HIGH

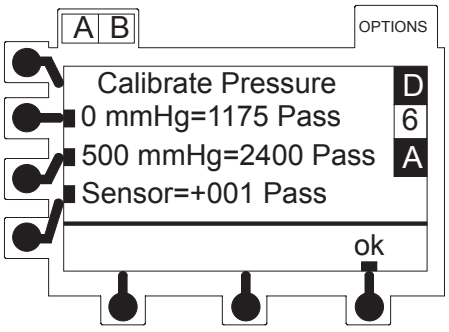
   FAIL VBRIDGE LOW/HIGH

   XDCR TEST FAIL LOW/HIGH

   ZERO RANGE TOO SMALL

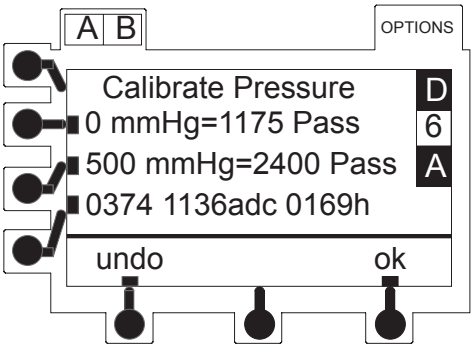
7. Additional self-check information may also be viewed.

   a. Press **Sensor =** soft key.



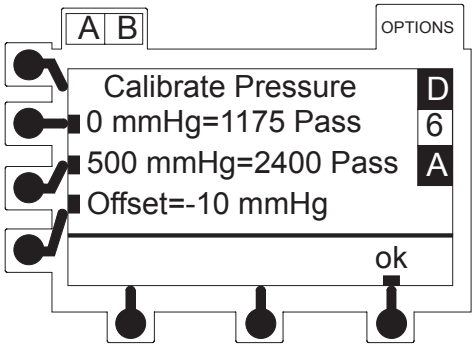
   b. **Pass** will be displayed. Press soft key again.

   - Three numbers will appear on last line in display window.



   - Number on left represents number of times self-check has been performed since last soft pressure calibration.
   - Center number represents zero pressure reading at time of last self-check.
   - Number on right represents number of hours since last self-check was performed. If this exceeds 2016 hours, “Self Check is Due, Please Eject the Set” will be displayed.

   c. Press lower left soft key again.



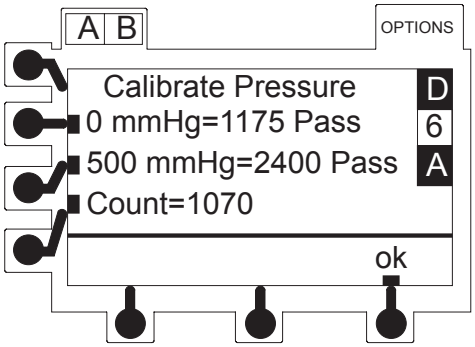
6.2 DIAGNOSTICS MODE (Continued)

6.2.17 Calibrating Channel Pressure (Continued)

Offset level will be displayed. This value is used to help determine when instrument will go into a SET OUT alarm. With Auto-Zero feature on (enabled - automatically through Diagnostic Mode factory default), level must be less than 55 mmHg. Offset level plus Sensor = value (looked at in step 3) should equal less than 55 mmHg (with no set installed), to prevent SET OUT alarm.

> **NOTE:** Offset level is updated when instrument does SELF CHECK on set eject. This level will be set to zero when soft pressure calibration is performed.

d. Press lower left soft key again.

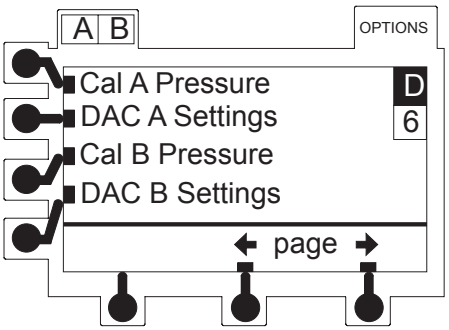


Count number will be displayed. This number is uncompensated sensor value in ADC counts and number that will be used to perform hard pressure calibration. This number should be between 875 and 1275 (with no set installed); if not, a hard pressure calibration should be performed (see “Hard Pressure Cal Procedure” section in “Corrective Maintenance” chapter).

e. Press **ok** soft key to return to main D6 page or press lower left soft key again to return to **Sensor = value**.

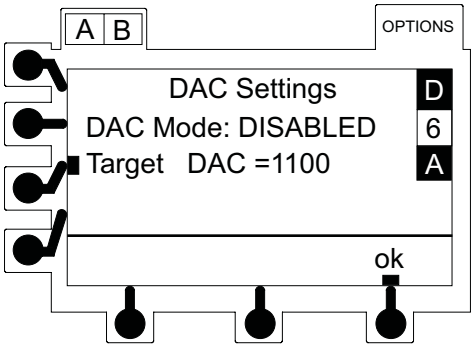
6.2.18 DAC Settings

1. On D6 page, press **DAC A Settings** or **DAC B Settings** (dual channel) soft key.



- D6A or D6B will be displayed, depending on which channel was selected.

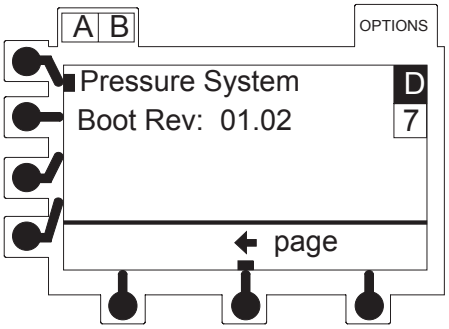
> **NOTE:** The display illustrated below is for a transducer that is not yet available (as of the date of this manual). The DAC transducer will automatically perform hard pressure calibration when soft pressure calibration is completed. When the new transducer is available, it will be part of the mechanism assembly and sensed by the software. Do not, at the present time, change these settings.



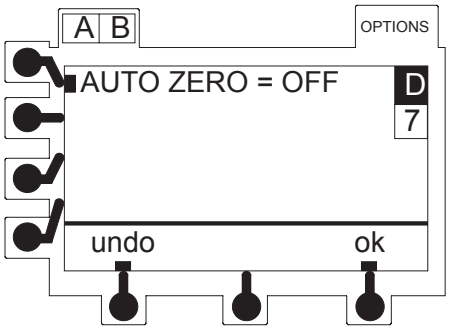
6.2 DIAGNOSTICS MODE (Continued)

6.2.19 Configuring Pressure System Auto Zero

1. Press upper left soft key to access Auto Zero option.



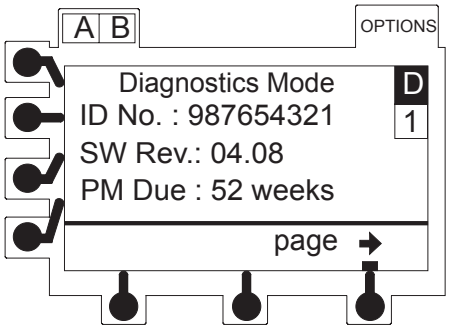
2. Press **Auto Zero** soft key to highlight settings. Press **Auto Zero** soft key again to change between **On** and **Off**.

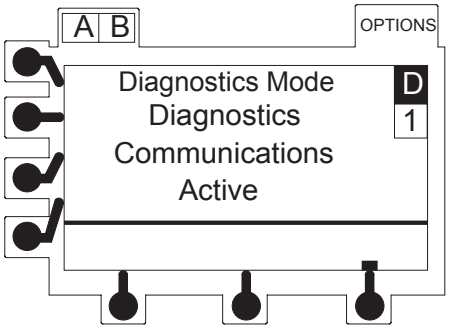


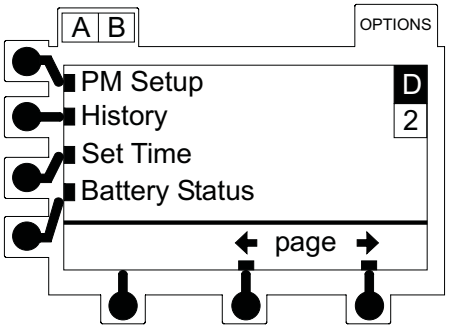
3. Press **ok** to accept change and return to main D7 page. Press **undo** to return to previous setting.

> **NOTE:** The Boot Rev: xxxx refers to the flash EPROM boot program and cannot be changed.

Figure 6-1. Map of Diagnostic Screens







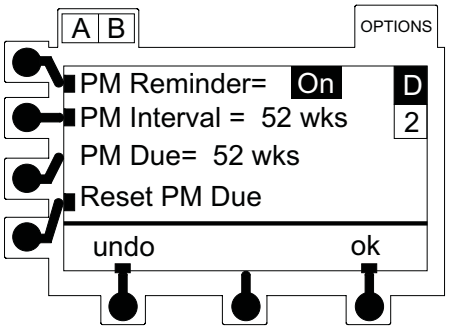


Figure 6-1. Map of Diagnostic Screens (Continued)

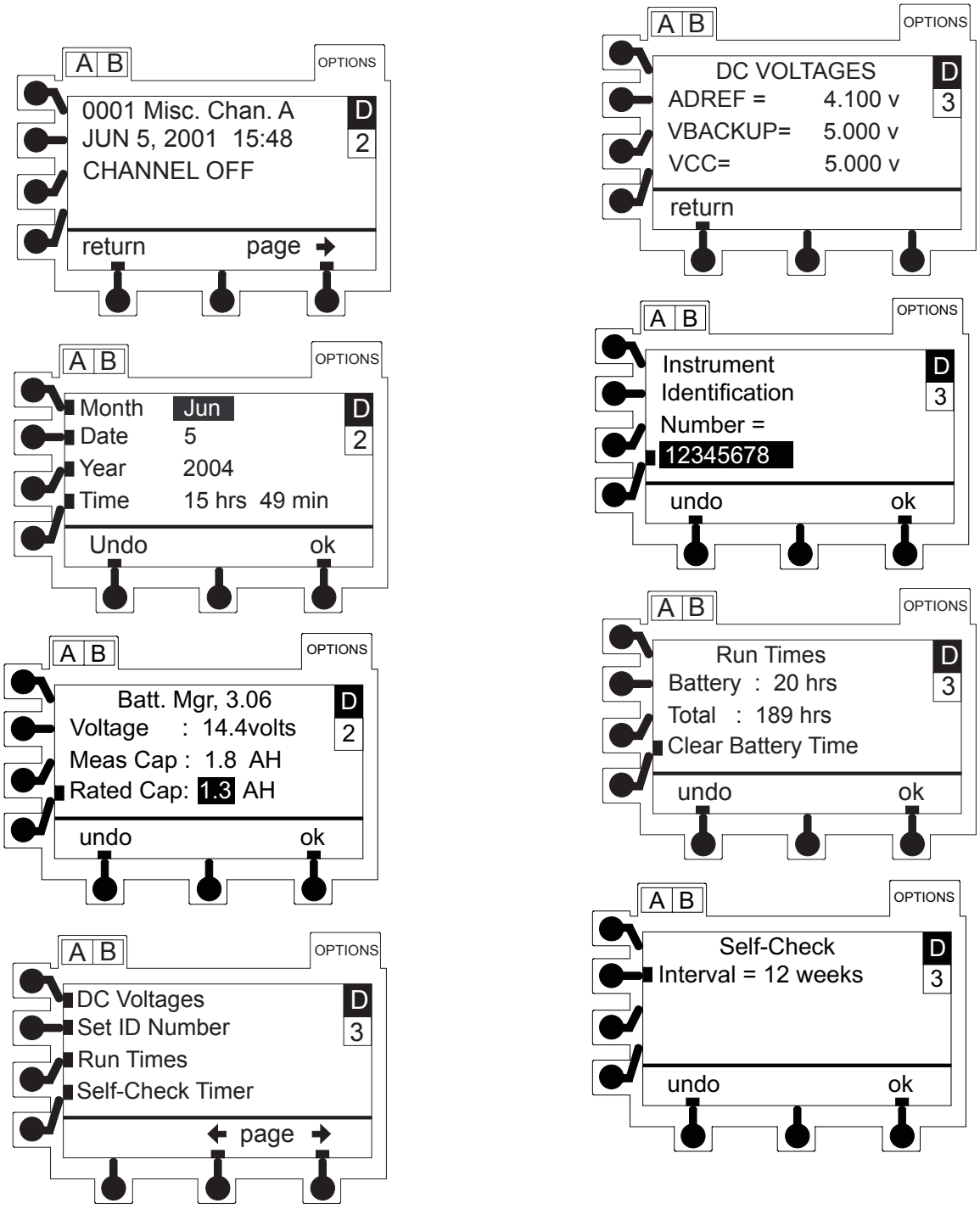


Figure 6-1. Map of Diagnostic Screens (Continued)

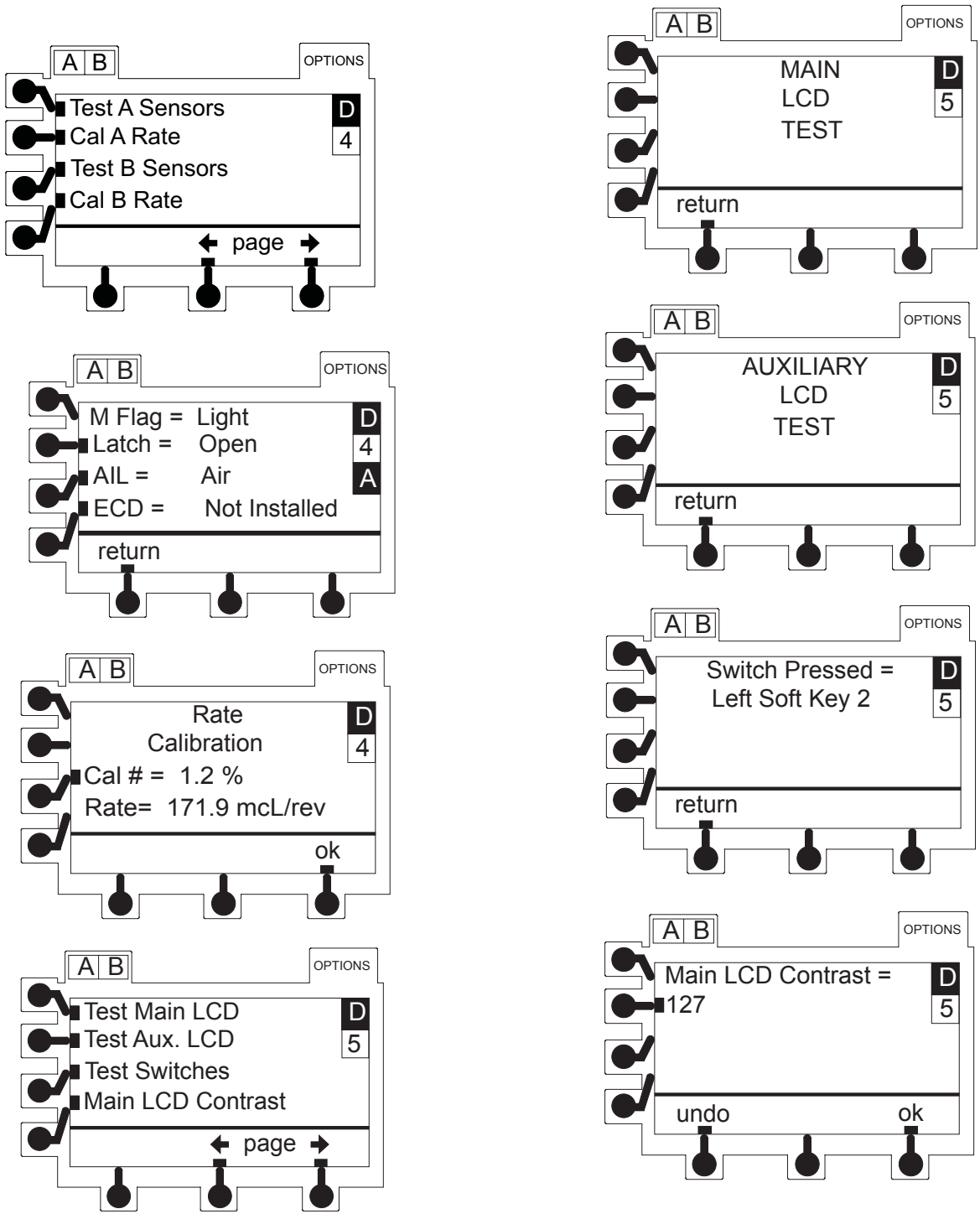
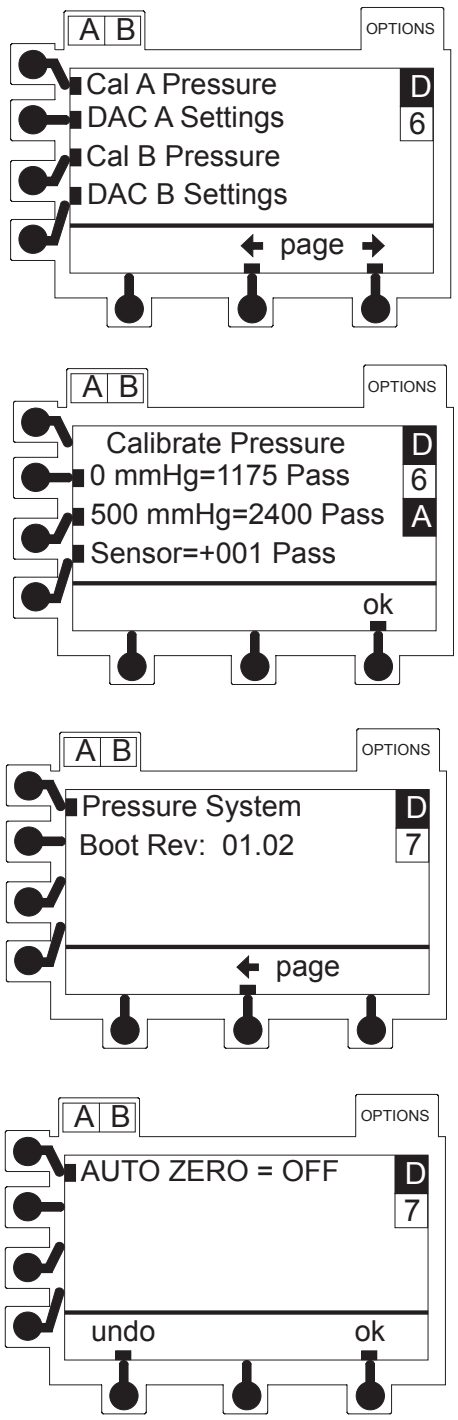


Figure 6-1. Map of Diagnostic Screens (Continued)



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Chapter 7 — ILLUSTRATED PARTS BREAKDOWN

7.1 INTRODUCTION

The illustrated parts breakdown for the instrument is divided into major assemblies and individual parts.

7.2 ILLUSTRATIONS

The exploded views serve as visual aids for identifying the parts of each assembly. If a part/assembly is identified with an item number (appearing in a bubble), that number corresponds to the item number on the parts list. If a part/assembly is not identified with an item number, it is part of a higher assembly or kit.

NOTE: Due to instrument changes over time, components/assemblies illustrated in this chapter may be different than those in the instrument being disassembled. If there are any questions, look for Service Bulletins related to this chapter or contact ALARIS Medical Systems, Technical Support.

7.3 PARTS LIST

The parts lists provide the following information for saleable parts and assemblies.

ITEM: This number corresponds with item number in illustration.

PART NUMBER: This is the ALARIS Medical Systems number, needed when placing an order. There are two categories of part numbers, as follows:

- Custom built parts all have 1 XXXXX series part numbers.
- Commercially available parts all have 3XXXXX or 8XXXXX series numbers. It is recommended that such parts be purchased from ALARIS Medical Systems whenever possible.

7.3 Parts List (Continued)

PART NUMBER (Continued)

When a part number is not provided, that part is either not sold by ALARIS Medical Systems or can only be replaced/repaired by ALARIS Medical Systems authorized service personnel.

DESCRIPTION: Descriptive information that may be helpful when placing an order.

QTY: Total number of each item used.

7.4 ORDERING PARTS

Parts can be ordered by writing or calling ALARIS Medical Systems Customer Service (refer to “General Contact Information” page at the beginning of this manual). When requesting a part, provide the following information:

- Instrument name and model number.
- Instrument software version. Refer to applicable Signature Edition® GOLD Infusion System Directions for Use (DFU) for directions on viewing software version.
- Part number.
- Part description, as provided in parts list.
- For labels, specify required language.

Table 7-1. Other Parts

Item	Part Number	Description*	QTY
	148023-100	Kit, Flash, S/W, 4.08	
	148134-100	Kit , Flash, S/W, 2.78	
	133450	Learn/Teach Cable	1
	136111	Nurse Call Cable (7130X, 7230X only)	A/R
	301044	Tie Strap	A/R
	70ISS	Pressure Cal Set	A/R
	80VCS	Rate Calibration Set	A/R
	145096	Kit , Flow Sensor / ECD, 713X	
	145097	Kit , Flow Sensor / ECD, 723X	
	145094	Kit , Flow Sensor / Handle Cap, 7131 / 7130	
	145095	Kit , Flow Sensor / Handle Cap, 7231 / 7230	

NOTE: If model is not specified, the part can be used on all versions.

* **7130X** = 7130B, 7130D, 7130E 120V Version; **7131X** = 7131A, 7131B 220V Version; **7230X** = 7230B, 7230D, 7230E 120V Version.

Table 7-2. Case Assembly

Item	Part Number	Description	QTY
090	141788	Battery Pack, Conditioned	1
250	141496-100	Case Front, Single Channel (order keypad, labels and feet separately)	
	141498-100	Case Front, Dual Channel (order keypad, labels and feet separately)	
300	144375	Case Rear, Assy Single Channel (7130) (order keypad, labels and feet separately)	
	144126	Case Rear, Assy Single Channel (7131) (order keypad, labels and feet separately)	
	144376	Case Rear, Assy Dual Channel (7230) (order keypad, labels and feet separately)	
	144127	Case Rear, Assy Dual Channel (7231) (order keypad, labels and feet separately)	
305	141717	Screen Handle, Single Channel	2
	141689	Screen Handle, Dual Channel	
399	142578	Single Channel Case Seal	1
	142579	Dual Channel Case Seal	
403	147949-100	Kit, Power Cord Wrap	1
406*	320919	M3 x 10mm Phillips Flat Head Screw	1
409*	980-1015-1	Power Cord Wrap	1
410*	809061	Eyelet Stud Snap	1
413	136777	Battery Door	1
414	140444-000	Power Cord Holder (7131 / 7231 only)	1
420	148450-100	Power Cord Kit (7130, 7230 comes with holder)	1
	134745	Power Cord, EUR (7131X / 7231X, 220V)	
	134748	Power Cord, UK (7131X / 7231X, 220V)	
435	136761	Handle Cap, Single Channel without Flow Sensor Holder	1
	136762	Handle Cap, Dual Channel without Flow Sensor Holder	
	141104	Handle Cap, Single Channel with Flow Sensor Holder	
	141105	Handle Cap, Dual Channel with Flow Sensor Holder	
437	140718	Cover, Conn, Flow Sensor, SE	A/R
463	305237	Screw, Mach, M3 x 10mm, PH	3
464	305235	Screw, Mach, M3 x 16mm, PH	1

***** Included in item 403 - Power Cord Wrap Kit.

Figure 7-1. Power Cord Wrap Kit (Item 403)

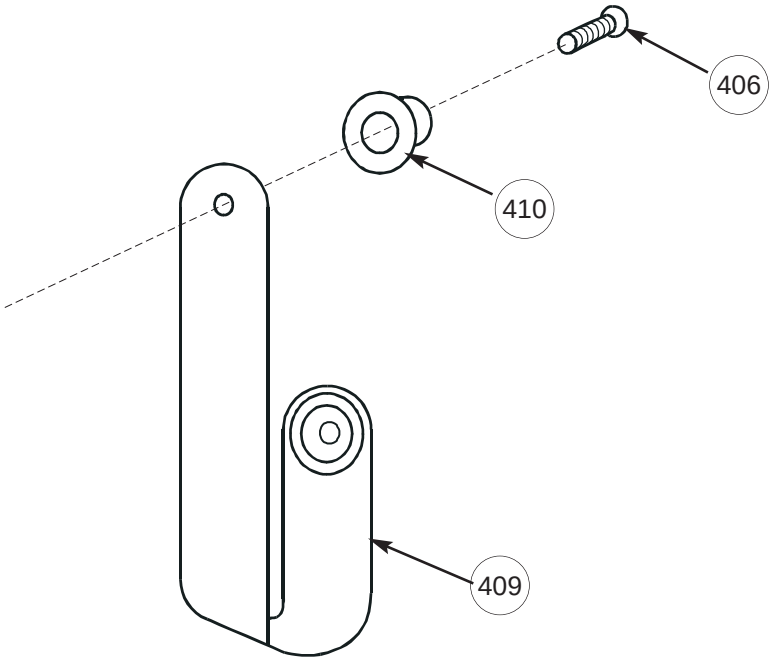


Figure 7-2a. Case Assembly, Single Channel

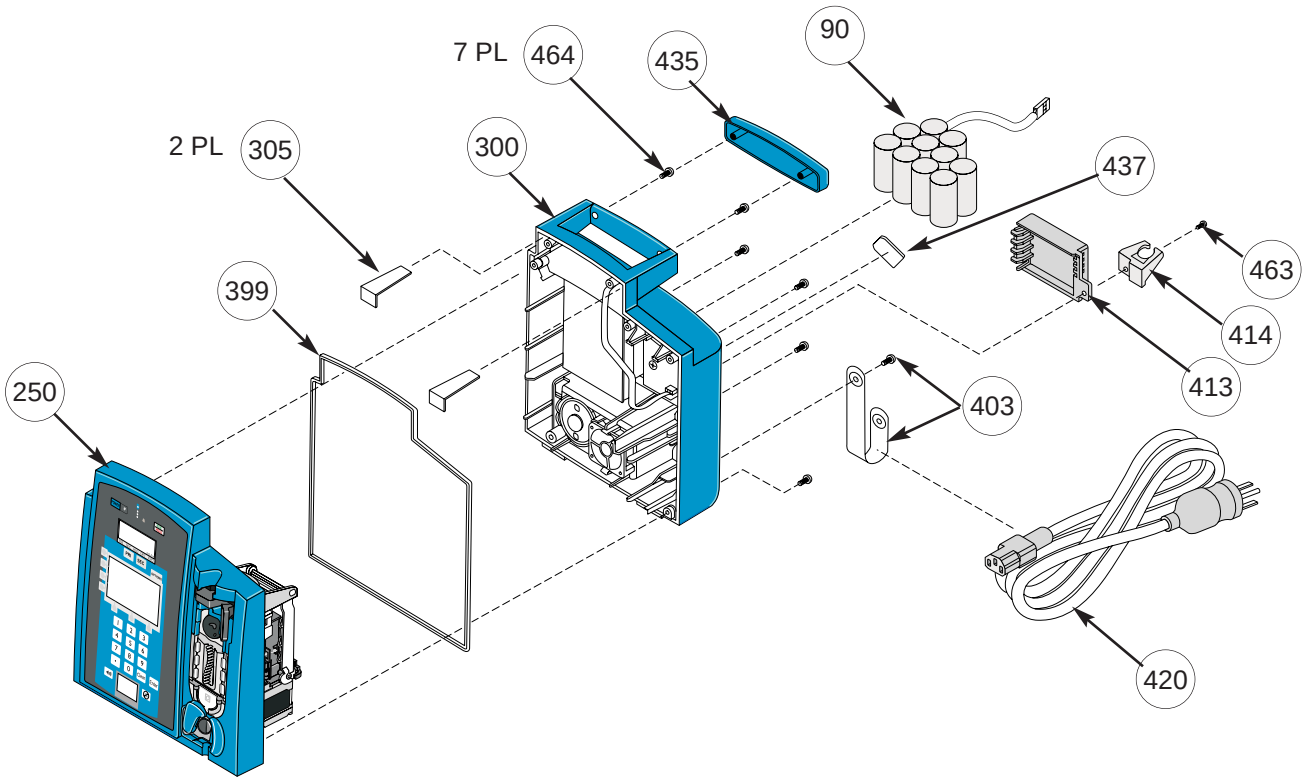


Figure 7-2b. Case Assembly, Dual Channel

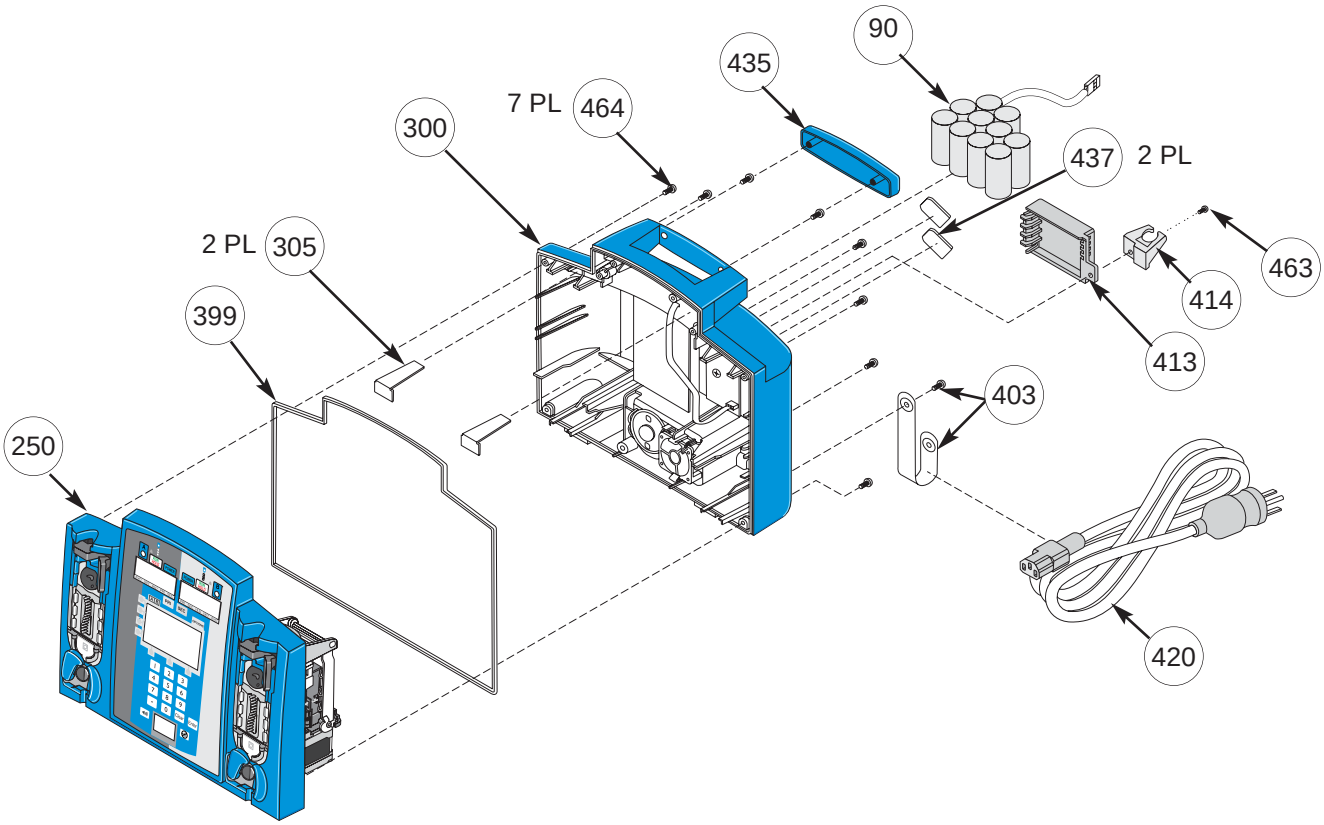


Table 7-3. Front Case Assembly

Item	Part Number	Description	QTY
040	143251-001	Keypad, Main, 7130	1
	143252-001	Keypad, Main, 7230	
	143255-001	Keypad, Main, ENG, 7131	
	143256-001	Keypad, Main, ENG, 7231	
	143253-001	Keypad, Main, Global, Symbols only, 7131	
	143254-001	Keypad, Main, Global, Symbols only, 7231	2
	146618-002	Keypad, Main, UK, Primary only, 7131	
	146619-002	Keypad, Main, UK, Primary only, 7231	1
055	144308	Single Channel Board Assembly 2.78, 7130B	
	144128	Single Channel Board Assembly 2.78, 7131A	1
	147941-100	Single Channel Board Assembly 4.06, 7130D	1
	147941-101	Single Channel Board Assembly 4.08, 7130E, 7131B	1
	144307	Dual Channel Board Assembly 2.78, 7230B	1
	144129	Dual Channel Board Assembly 2.78, 7230A	
	147942-100	Dual Channel Board Assembly 4.06, 7230D	
	147942-101	Dual Channel Board Assembly 4.08, 7230E, 7231B	1
070	142850	LCD Module, Graphic	1
080	142475	LCD Module, Lower	1
100	141004	LED Module	1
201	141468	Mechanism Assembly	1 or 2
250	141496-100	Case, Front, Single Channel (order keypad, label and feet separately)	1
	141498-100	Case Kit, Front, Dual Channel (order keypad, label and feet separately)	
416	305318	Rubber Feet	2
463	305237	Screw, Mach, M3 x 10mm, PNH	1

NOTE: If model is not specified, the part can be used on all versions.

Figure 7-3a. Front Case Assembly, Single Channel

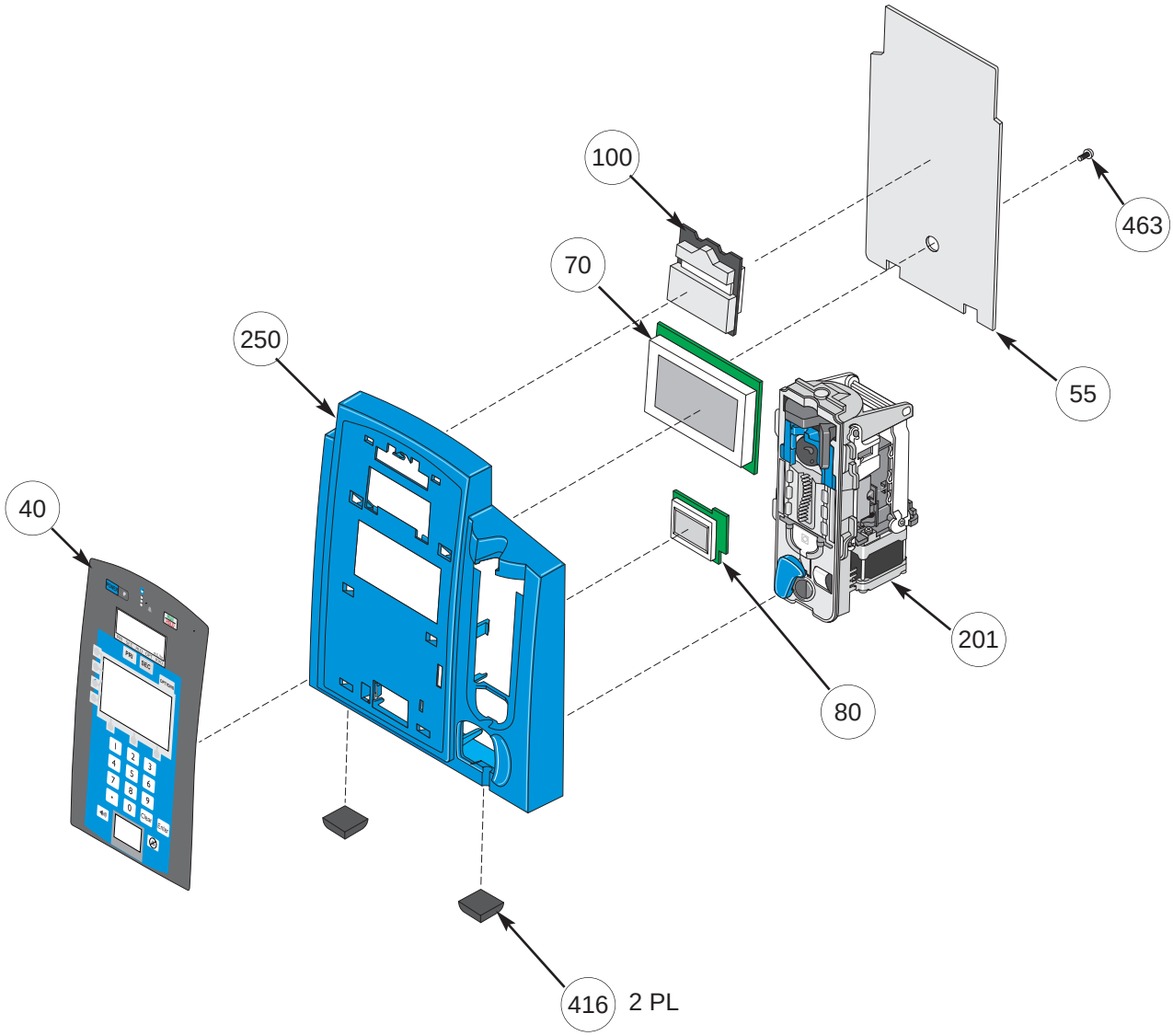


Figure 7-3b. Front Case Assembly, Dual Channel

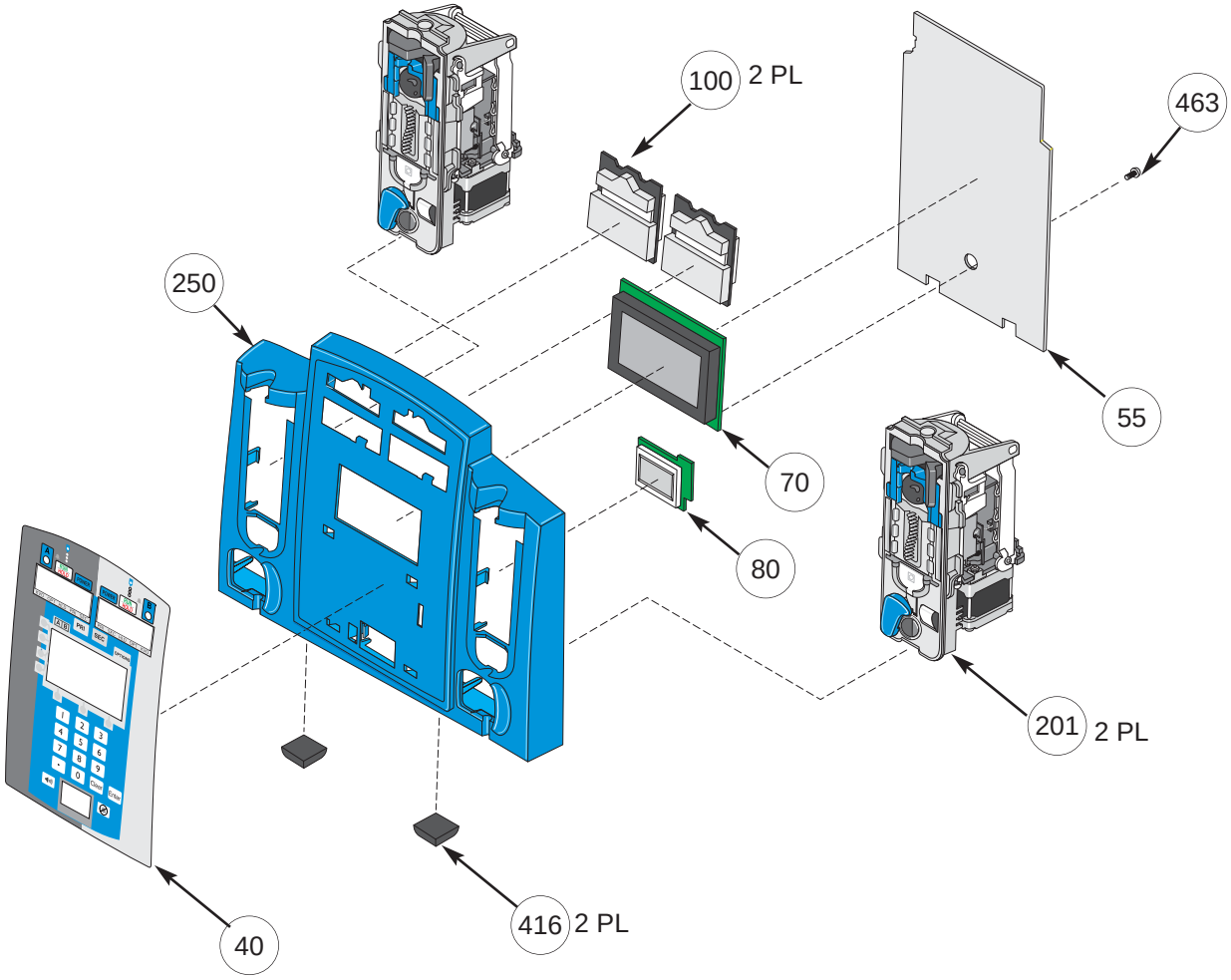


Table 7-4. Mechanism Assembly

Item	Part Number	Description	QTY
	147507-100	AIL Repair Kit (kit includes AIL Button, AIL Arm and installation instructions)	
203	136836	AIL Button (Receiver)	1
204	141734-100	AIL Arm (Transmitter)	1
383	136255	Mechanism Seal	1
392	141144	Transducer Cable	1
397	133228	AIL Spring	
404	136721	Seal Clip	1
405	136656-000	AIL Gear	

Figure 7-4. Mechanism Assembly

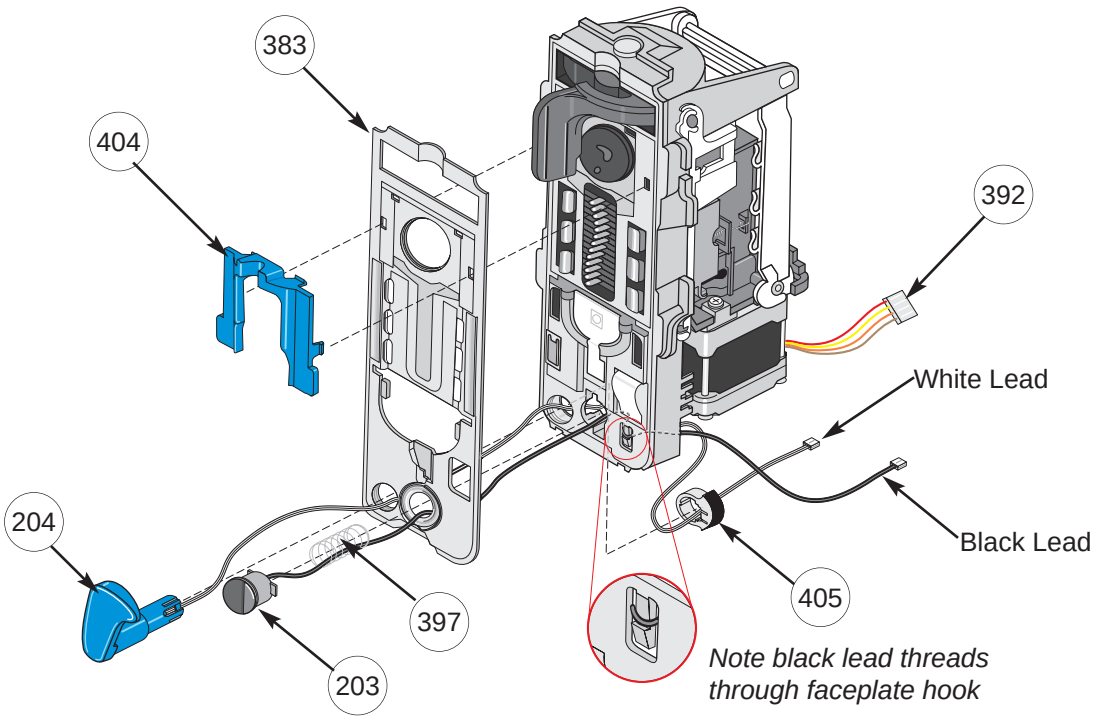


Table 7-5. Rear Case Assembly

Item	Part Number	Description	QTY
035	142858	RS-232 Board Assembly with Nurse Call (7130X/7230X)	1
	145062	Isolated RS-232 Board Assembly (7131X/7231X)	1
041	144378	ECD Board (Discriminator Board) (7131X/7231X and 7130X/7230X with Flow Sensor Kit added)	
050	140077-000	Panel Lock Keypad	1
060	141371	Power Supply/AC Off-Line Switcher	1
061	139930	Battery Cable Interface	1
140	303106	Clip, Cord	2
300	144375	Rear Case Assembly, Service (7130)	1
	144126	Rear Case Assembly, Service (7131)	1
	144376	Rear Case Assembly, Service (7230)	1
	144127	Rear Case Assembly, Service (7231)	1
365	141369	Ground Wire, Mechanism	1
386	143320	Insulator, RS-232 (7131/7231)	1
401	141117	Speaker Assembly	1
408	141865	Fan	1
416	305318	Rubber Feet	2
417	305417	Washer, Flat	2
423	303745	Connector, PEC (7131X/7231X)	1
424	305572	Washer, Lock, 1/4” (7131X/7231X)	1
427	305316	Lock Washer (RS-232)	2
430	146008-100	Line Filter	1
437	140718	Cover, Flow Sensor Connector	A/R
461	305234	Fastener, Speed Nut	2
462	305239	Standoff, The, Hex (RS-232)	2
463	305237	Screw, Mach. M3 x 10mm, PH	2
465	305236	Screw, Mach. M3 x 10mm, HXSO	4
466	305501	Screw, TPG, 6-32 x 5/16”	2
469	305531	Washer, Internal Tooth (use if line filter lug does not have a washer built in)	1
477	305526	Cable Clamp	1
479	303655	Screw, Hx40, 5/16” (for ECD Board)	1

NOTE: If model is not specified, the part can be used on all versions.

Figure 7-5a. Rear Case Assembly, Single Channel

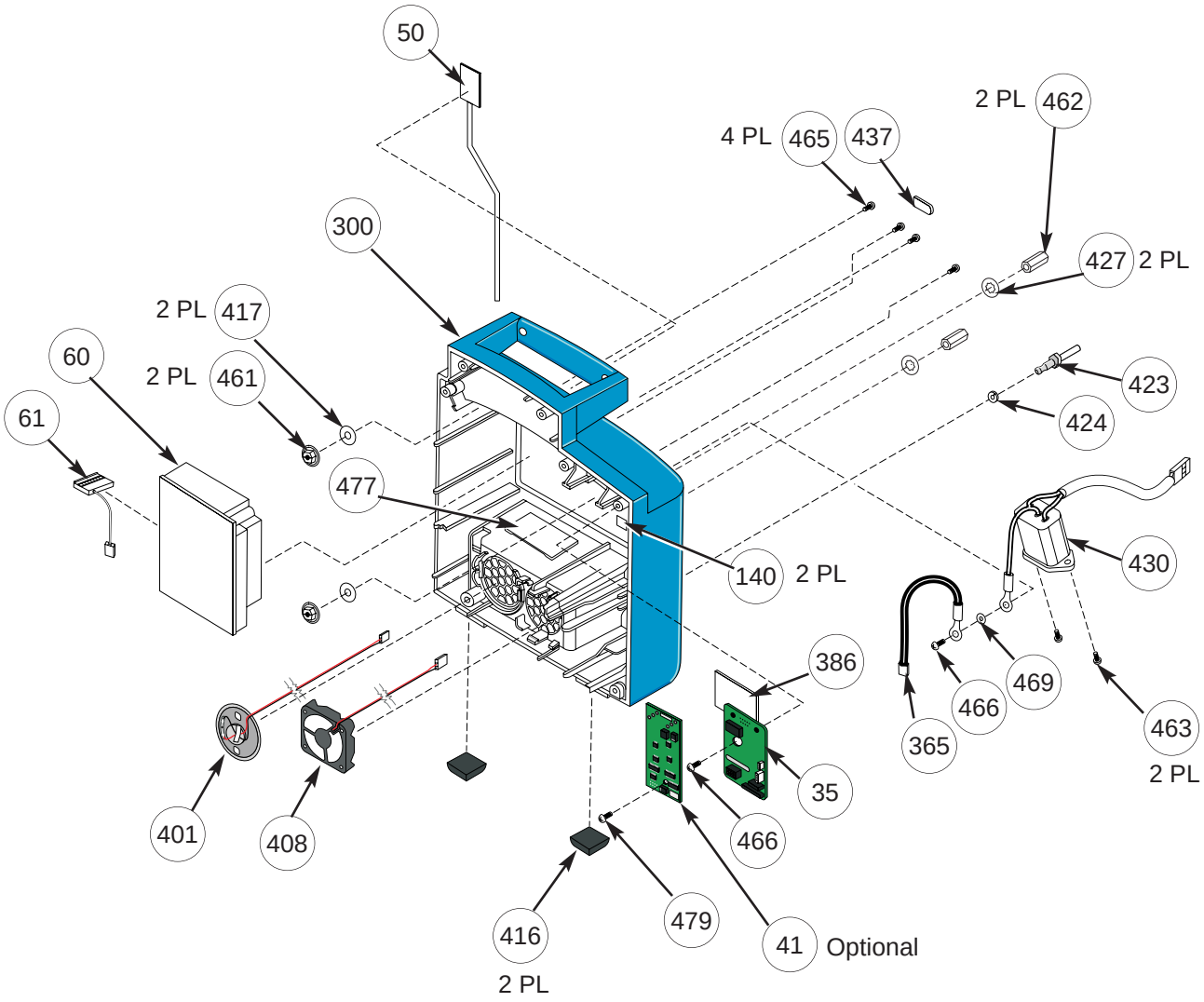


Figure 7-5b. Rear Case Assembly, Dual Channel

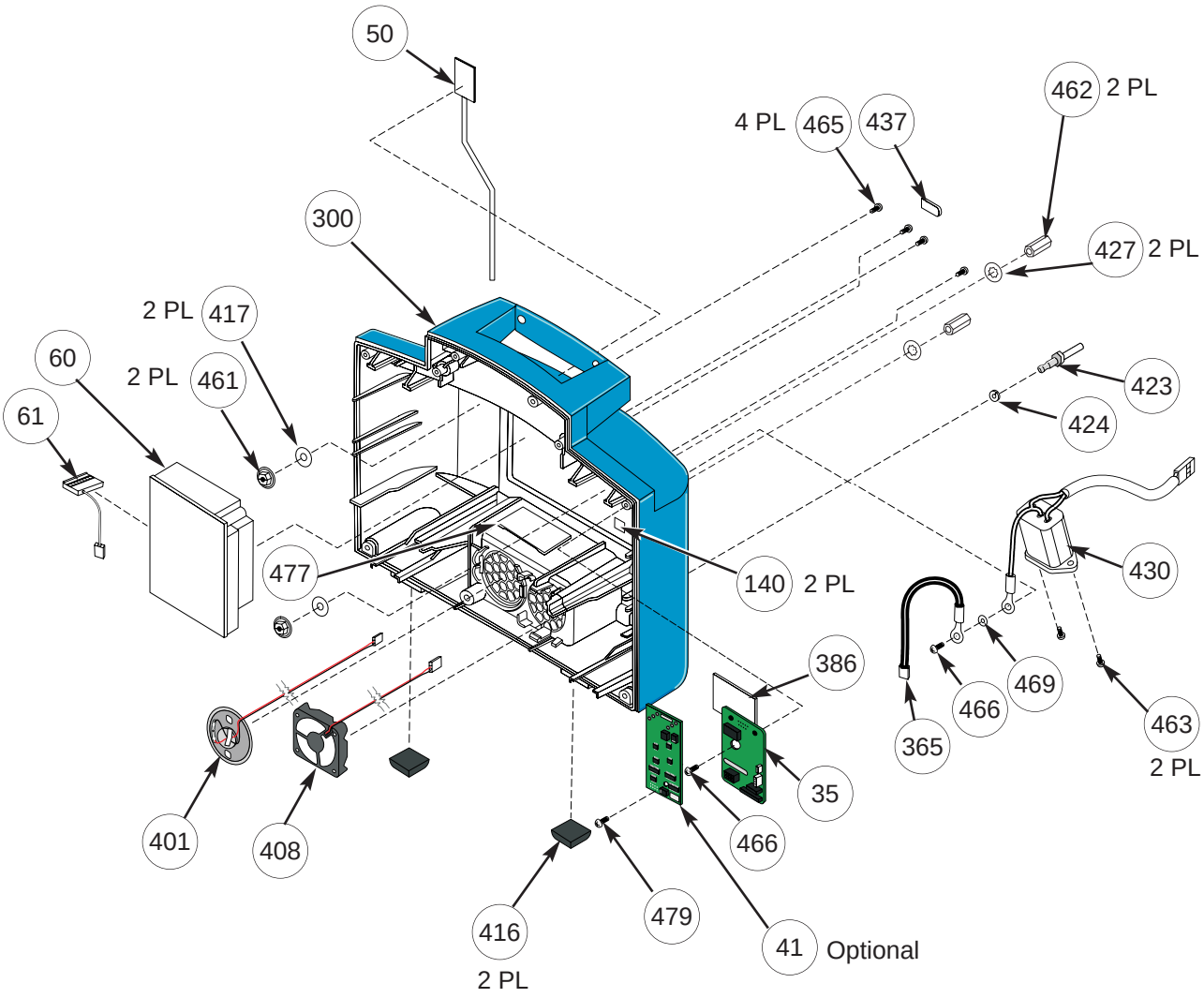


Table 7-6. Pole Clamp Assembly

Item	Part Number	Description	QTY
	147950-100	Battery Pole Clamp and Knob Kit (includes all items below)	1
421	144334	C-Clamp Assembly Kit (new version) Kit consists of Pole Clamp, Retaining Ring and Washer	1
425	140408-000	Pole Clamp Lock	1
426	142793-000	Pole Clamp Knob w/Lead Screw (newer version)	1
428	305317	Wave Washer	1
431	139900	Pole Clamp Tip	1
432	305414	Spiral Roll Pin, .078X.3125,SS	1
471	305436	Compression Spring	1
483	320154	Retaining Ring	1
484	320155	Flat Washer	1

Item	Part Number	Description	QTY
426	140380	Pole Clamp Knob (older version)	1

When replacing:	Order:
Old version brass lead screw	Brass knob lead screw, P/N: 140380 (limited to existing inventory)
New version steel lead screw	Steel knob lead screw, P/N: 142793-000
Old C-clamp (no sleeve)	Pole clamp and knob kit, P/N: 147950-100
New C-clamp (silver sleeve)	C-clamp kit, P/N: 144334

Figure 7-6. Pole Clamp Assembly

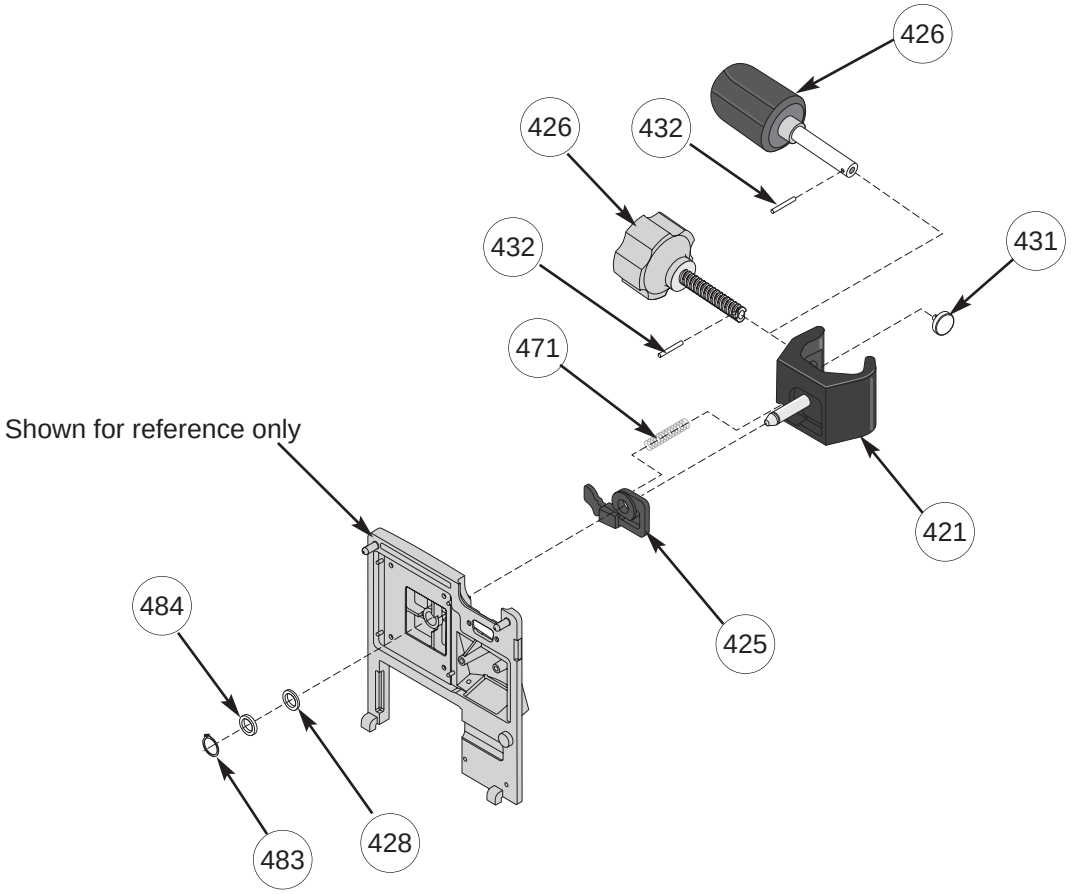


Table 7-7. Label/Literature

Item	Part Number	Description	QTY
603	125569	Label, Serial Number Replacement	1
604	§	UL Label	
605	§	CSA Label	
606	147167-000	Label, Name Rating, ENG, 7130	1
	142847-000	Label, Name Rating, ENG, 7230	
	142848	Label, Name Rating, ENG, 7131	
	147166-000	Label, Name Rating, ENG, 7231	
	145075	Label, Name Rating, SPAN, 7131	
	145077	Label, Name Rating, ITAL, 7131	
	145079	Label, Name Rating, SWED, 7131	
	145083	Label, Name Rating, SPAN, 7231	
	145085	Label, Name Rating, ITAL, 7231	
	145087	Label, Name Rating, SWED, 7231	
	145081	Label, Name Rating, FREN, 7131	
	145089	Label, Name Rating, FREN, 7231	
607	145827	Directions for Use, English version 2.78, 7130B, 7230B	
	143243	Directions for Use, English version 2.78, 7131A, 7231A	
	144790	Directions for Use, English version 2.78 International with Symbols 7131AX02EE, 7231AX02EE	
	147859-103	Directions for Use, English version 4.06/4.08 Guardrails Compatible 7130D/E, 7230D/E, 7131B, 7230B	
	147860-103	Directions for Use, English version 4.06/4.08 with Guardrails 7130D/E, 7230D/E, 7131B, 7230B	
	144793	Directions for Use, Swedish version 2.78, 7131A, 7231A	
	144795	Directions for Use, Spanish version 2.78, 7131A, 7231A	
	144797	Directions for Use, Italian version 2.78, 7131A, 7231A	

Table 7-7. Label/Literature (Continued)

Item	Part Number	Description	QTY
608	140676	Label , Start-up, No symbols, English, 713X/723X	1
	141541	Label , Start-up, French/Canadian, 7130/7230	
	141701	Label , Start-up, French, 7X31	
	141702	Label , Start-up, Spanish, 7X31	
	147171-000	Label , Start-up, Swedish, 7X31	
	147183-000	Label , Start-up, Italian, 7X31	
610	140296	Label, Flow Sensor A	1
611	140297	Label, Flow Sensor B (7230)	1
613	123273	Ground Symbol Label	1
623	142844-000	Patent Label	1
625	146136	Label, Cleaning, Warning, English	
626	§	Label, CE Mark	
627	133318	Label, PE Connector (7131X/7231X)	1
630	142173	Label, RS-232 Warning, Spanish, 7X31	1
	142961	Label, RS-232 Warning, English, 7X3X	
	143172	Label, RS-232 Warning, French, 7X31	
	143174	Label, RS-232 Warning, Swedish, 7X3X	
	143176	Label, RS-232 Warning, Italian, 7X31	
654	§	QC Seal	

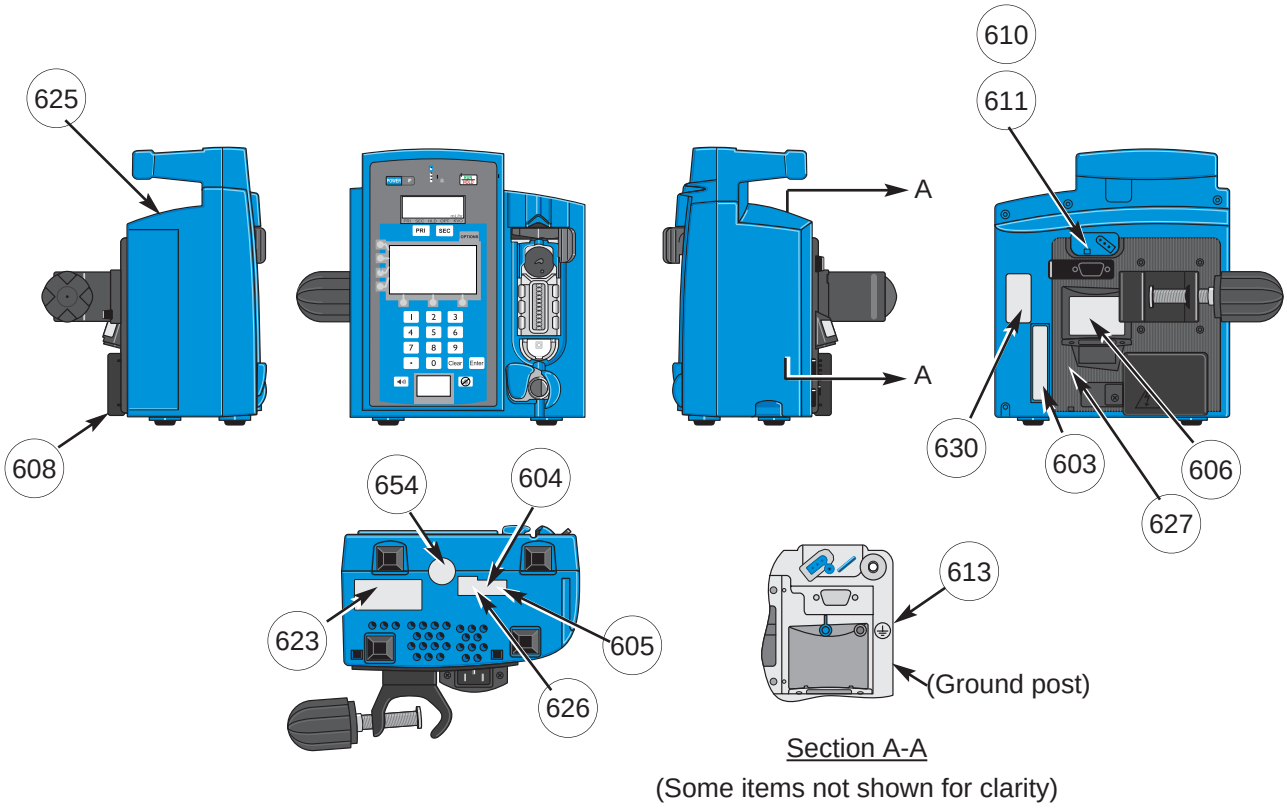
Table 7-8. Packing Materials

Item	Part Number	Description	QTY
707	142694	Packing Material (713X)	
	142695	Packing Material (723X)	

NOTE: If model is not specified, the part can be used on all versions.

§ Labels not sold. Placed on instrument at ALARIS Medical Systems only.

Figure 7-7. Label/Literature Locations



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ALARIS®
MEDICAL SYSTEMS

ALARIS Medical Systems, Inc.
10221 Wateridge Circle
San Diego, California 92121 U.S.A.

Mail:
P.O. Box 85335
San Diego, California 92186-5335
U.S.A.

Authorized EU Representative
ALARIS Medical UK Ltd.
The Crescent, Jays Close
Basingstoke, Hampshire
RG22 4BS, UK

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Patents, Breveté, Brevets, Brevetti, Πατέντες, Patente, Patenten, Patenter, Patentes, Patentit, 特許, 專利:
AU – 686942. **CA** – 78,376; 78,377; 78,378; 2,029,267; 2,125,693; 2,175,021; 2,199,156; 2,199,157; 2,199,160; 2,199,405; 2,199,631; 2,233,640. **CH** – +122,210; +122,211; +122,212. **DE** – M9501995.2; M9501996.0; M9501997.9; P3778211.8–08; P69004833.5-08; P690244923; 69329774; 69402231T3; 69624982.0-08. **DK** - 0649316. EP248,632 (**CH, FR, UK**). EP387,724 (**FR, SE, UK**). EP431,310 (**FR, UK**). EP612,004 (**FR, UK**). EP748,635 (**AT, BE, CH, DK, FI, FR, GR, IE, IT, LU, MC, NL, PT, SE, UK**). **ES** - 2154651. **FR** – 951,426; 951,427; 951,428. **HK** – 1006005; 1006006; 1006041. **JP** – 1,003,444; 1,003,445; 1,006,528; 1,924,062; 2,553,557; 2,802,171; 3,025,018; 3,025,019; 3,064,014; 7502.678. **NZ** – 286445. **SG** - 49695. **UK** – 2,045,812; 2,045,813; 2,045,814. **US** – 4,898,576; 5,087,245; 5,096,385; 5,360,413; 5,534,691; 5,537,853; 5,542,826; 5,563,347; 5,568,912; 5,575,632; 5,601,420; 5,603,613; 5,609,576; 5,676,346; 5,681,285; 5,699,821; 5,712,795; 5,716,194; 5,719,761; 5,781,442; 5,803,917; 5,827,223; 6,211,642; 6,269,340; 6,358,225; D367,527; D367,528; D371,194; RE35,841. Other Patents Pending

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