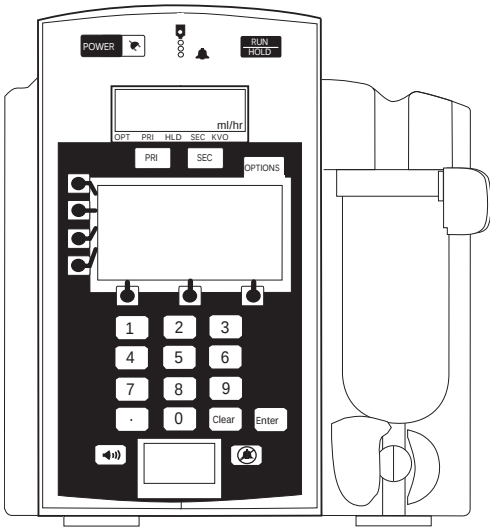
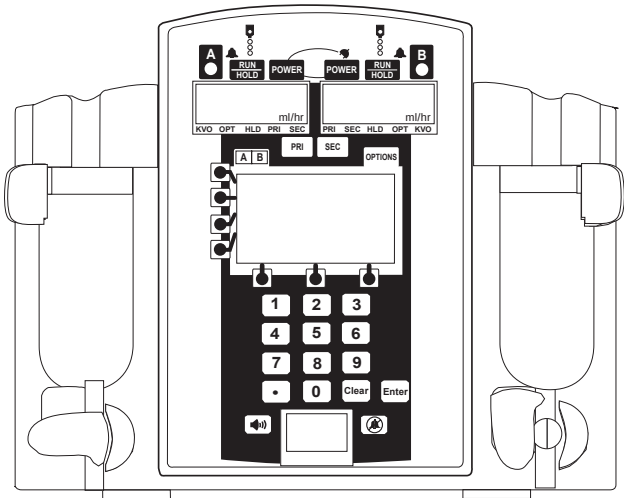
ALARIS®
MEDICAL SYSTEMS





Signature Edition® GOLD

Models 7130/7131 and 7230/7231

Technical Service Manual

GENERAL CONTACT INFORMATION

ALARIS Medical Systems, Inc
10221 Wateridge Circle
San Diego, CA 92121

Customer Advocacy

For clinical and Technical questions, feedback and troubleshooting assistance.

Phone, toll-free, from within the United States and Canada: (800) 854-7128, Ext 7812
E-Mail: CustomerFeedback@alarismed.com

Technical Support - North America

For technical information related to maintenance procedures and service manual support.

United States:

Phone:

(858) 458-6003
Toll-free: (800) 854-7128, Ext 6003

Canada:

Phone, toll-free:

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

Customer Service

To check the status of an order or to place an order for administration sets, parts, accessories, etc.

United States:

Phone, toll-free:

(800) 482-4822

Canada:

Phone, toll-free:

(800) 387-8309

This Technical Service Manual is subject to change without notice.

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Chapter 1 — GENERAL INFORMATION

Chapter 2 — CHECKOUT AND CONFIGURATION

Chapter 2 for Software Version 2.78 — Checkout and Configuration

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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® product by anyone other than an authorized ALARIS Medical Systems Service Represenatative while the product is under warranty may invalidate the warranty.

1.1 INTRODUCTION

This manual covers Signature Edition® Gold Infusion Pumps, with software versions 2.78, 4.06, 4.08 and higher. It is used in conjunction with an applicable Signature Edition® GOLD 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 DFU.

The Signature Edition® Infusion System includes:

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

The Signature Edition® GOLD series includes the following configurations:

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

1.1 INTRODUCTION (Continued)

The key differences 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.

The keypad has 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.

The 7130/7230 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 product enhancements
- has been designed to interface with accessory equipment including nurse call system and/or computer monitoring system.

Refer to the applicable Signature Edition® Gold DFU for complete setup and operation information.

1.2 PRECAUTION DEFINITIONS

A **WARNING** is an alert describing the potential for serious consequences to the patient or user; such as death, injury, adverse reactions.

A **CAUTION** is an alert to take special care for the safe and effective use of the device.

1.3 SPECIFICATIONS

Refer to the applicable Signature Edition® Gold DFU.

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 from one instrument to another via the Learn/Teach function. They must be downloaded directly from a PC.

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 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 1-1)
- 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.

The battery charge circuit charges the battery with a constant current of 1 ampere whenever the Battery Manager turns the

Table 1-2. Abbreviations, Acronyms, Symbols

*	"active Low" logic signal
A/D	analog to digital
ADC	analog to digital converter
A/R	as required
AIL	air-in-line
BATT	battery
CRC	cyclical redundancy check
D/A	digital to analog
DAC	digital to analog converter
DFU	directions for use
DS	display
ECD	empty container detection
F	fuse
FB	Ferrite bead
H	hexadecimal
Hex	hexagonal
ISA	Industry Standard Architecture
KVO	keep vein open
LCS	lower chip select
NPN	negative-positive-negative
NSW	not switched
O/S	operating system
PM	preventive maintenance
PNP	positive-negative-positive
POST	power on self test
PR	power regulator
PRI/SEC	primary to secondary
PWB	printed wiring board
PWM	pulse width modulator
R/R	remove/replace
RST	reset
RxD	receive data
SCR	silicon controlled rectifier
SCU	serial control unit
SMD	surface mount device
SMT	surface-mount technology
SSD	static sensitive device
TTL	transistor-transistor logic
TxD	transmit data
VAO	voltage alternating oscillator
VBKUP	voltage backup
Vgs	voltage gate to source
VNEG	negative voltage
VMEAS	voltage measured
VMOTOR	voltage to motor
VPOS	positive voltage
VPP	volts peak-to-peak
BVRAW	voltage raw (unregulated voltage)
VTBI	volume to be infused
VTHRES	voltage threashold
WD	watchdog
WDI	watchdog input
WDO	watchdog output

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CHAPTER 2 — CHECKOUT AND CONFIGURATION
Software Versions 4.06 and Higher

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 4.06 or higher.

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 satisfactorialy pass startup sequence, fails a self test or continues to alarm.

For new instrument checkout refer to the applicable Signature Edition® GOLD 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 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 fold-out 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)

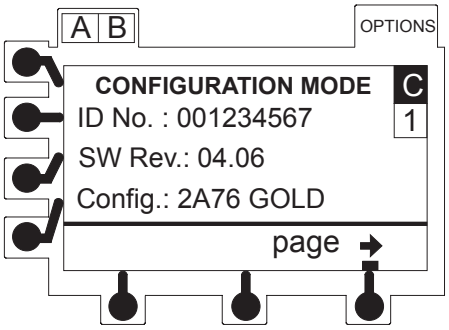
2.4.1 Entering Configuration Mode

The instrument must be off (both channels must be off for 72XX dual channel series).

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 and release **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).

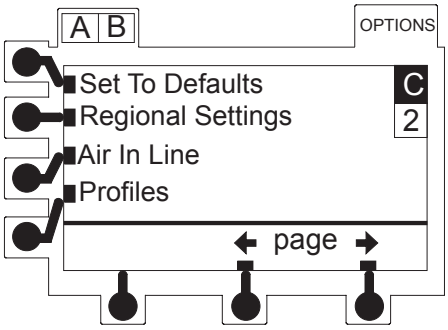
2.4.2 Setting to Defaults

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

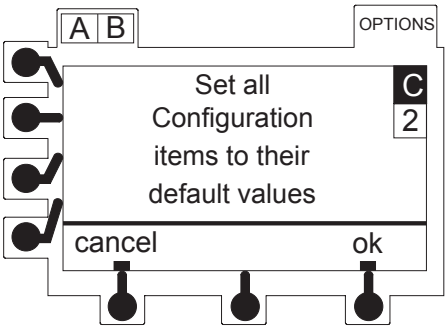
CAUTION

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.



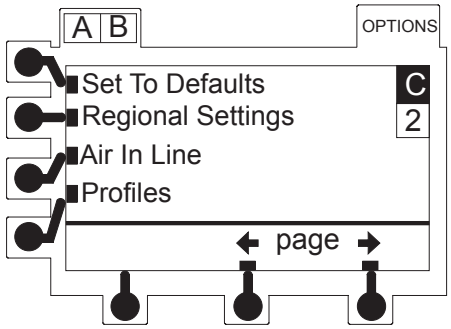
3. Press **ok** to accept the change and return to beginning of C2 page. Pressing **cancel** leaves all items set to their previous values and returns to beginning of C2 page.



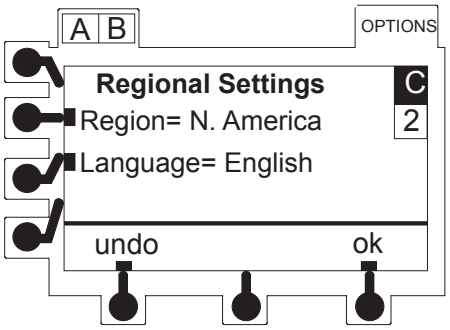
2.4 CONFIGURATION PROCEDURE (Continued)

2.4.3 Regional Settings

1. From C2 page, press **Regional Settings** soft key.



2. Press and release **Region** soft key to select for editing. Press again to cycle through region choices (N. America, European).



NOTES:

- Language has only English options at this time.
- 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.

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.

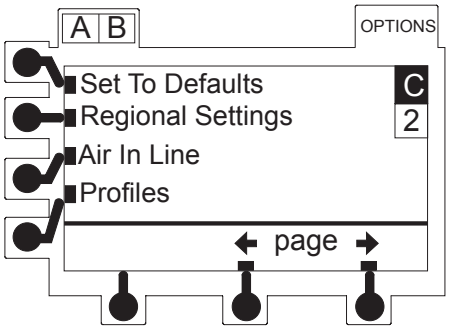
The Accumulator setting, when on, looks for 10% to 15% of the downstream path to be air before giving an AIR IN LINE alarm. The amount of air that causes the alarm will vary with the threshold setting and rate.

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**.

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

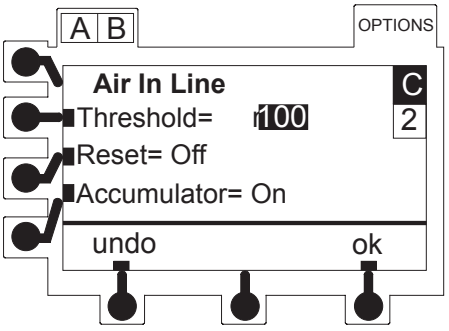
2.4 CONFIGURATION PROCEDURE (Continued)

2.4.4 Setting Air-in-Line Threshold (Continued)



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

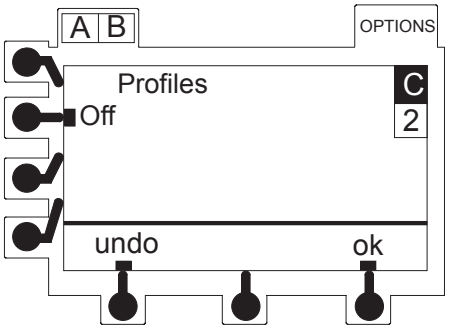
> **NOTE:** Use a 50 microliters setting on microbore tubing. The other three settings may be used on macrobore tubing.



3. Press and release **Reset** soft key to select for editing. Press again to cycle between **On** and **Off**.
4. Press and release **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 and release 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 VTBI (with ECD) only, due to the data set overriding the configuration settings as part of the Guardrails® Safety Software.

2.4 CONFIGURATION PROCEDURE (Continued)

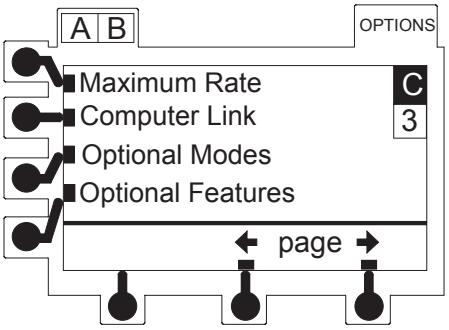
2.4.6 Setting Maximum Rate

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

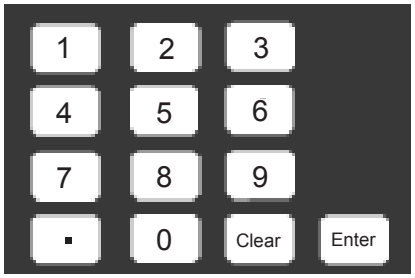
NOTES:

- 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 and release soft key to select 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.

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.

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

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

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

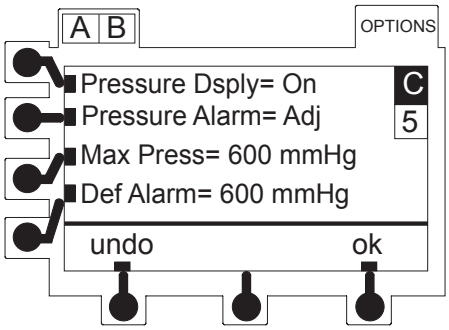
2.4 CONFIGURATION PROCEDURE (Continued)

2.4.15 Pressure Options (Continued)

6. Press and release **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.

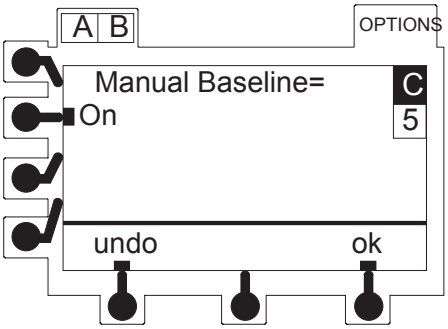
For example, if an alarm limit of 300 mmHg was selected, the instrument would alarm at baseline + 300 mmHg. Auto Zeroing occurs the first time RUN/HOLD is pressed; this will be the maximum baseline. Subsequent presses of RUN/HOLD will only lower (not raise) the baseline.

Manual Baseline: This 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 instrument on hold, or at startup, press **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 and release **Manual Baseline** soft key to select for editing.
3. Press **On** 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 Datasets will NOT be transferred.

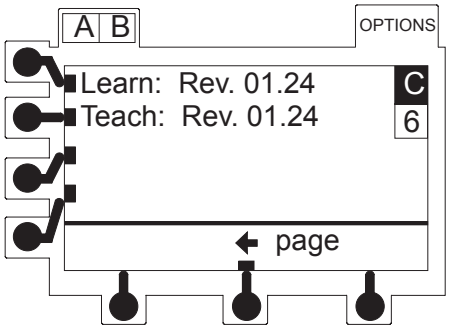
Connect a standard 9-pin Null Modem RS-232 cable, double male, (ALARIS P/N 133450) to the RS-232 ports on the instruments.

> **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.

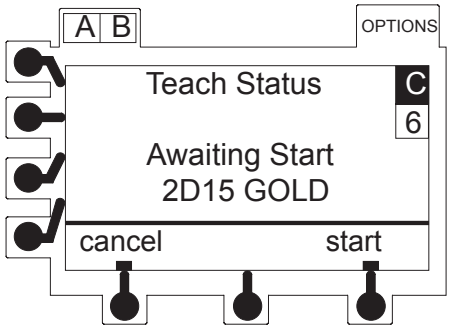
2.5.1 Learn/Teach Instrument Procedure

> **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 page C6.
2. Press and release **Teach** soft key of "teacher" instrument and press and release **Learn** soft key of "learner" instrument.



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



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

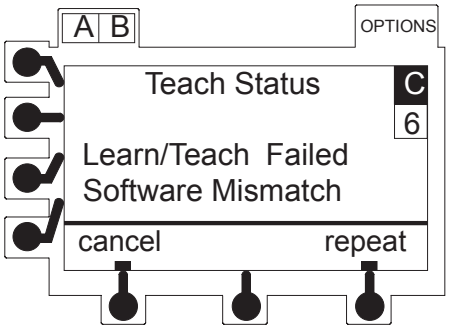
2.5 TRANSFERRING SETTINGS TO ANOTHER INSTRUMENT (Continued)

2.5.1 Learn/Teach Instrument Procedure (Continued)

NOTES:

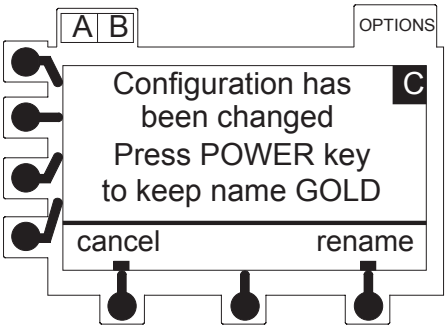
- **Repeat** allows the operator to reattempt teaching the current instrument or to teach the next instrument.
- Reattach the cover, and/or cover and screws, over the RS-232 port after disconnecting the cable.
- When the profile/data sets are used they will override (replace) the selection in the Configuration 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.



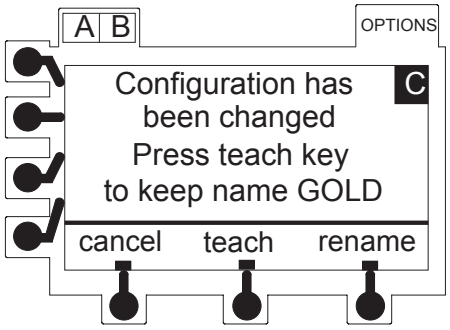


Table 2-3 Record of Configured Instruments

	#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

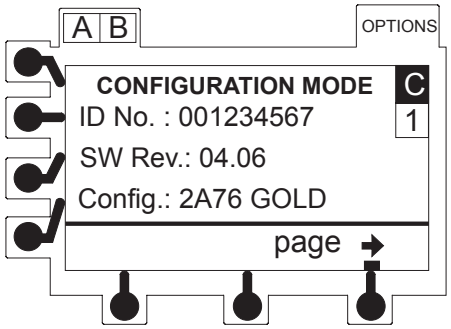
--- Table Continued on Next Page ---

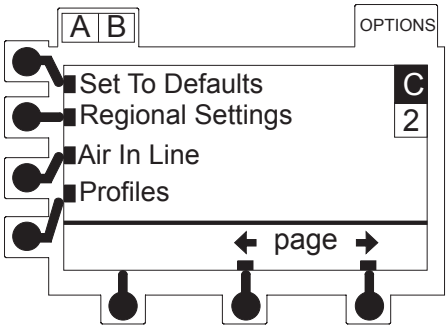
Table 2-3 Record of Configured Instruments (Continued)

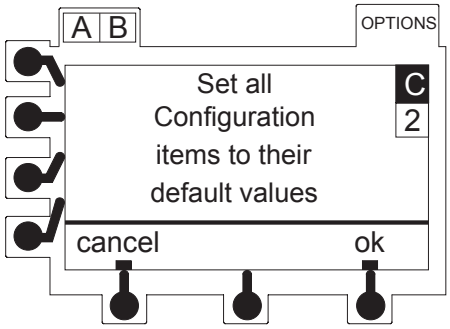
	#1	#2	#3	#4	#5
Monitoring Options: Mode Restarts Trends					
Audio: Volume Trans. Tone					
Resistance Options: Resist Display Resist Alarm Default Alarm Alarm	 % mmHg	 % mmHg	 % mmHg	 % mmHg	 % mmHg
Pressure Options: Pressure Display Pressure Alarm Maximum Pressure Default Alarm	 mmHg mmHg	 mmHg mmHg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

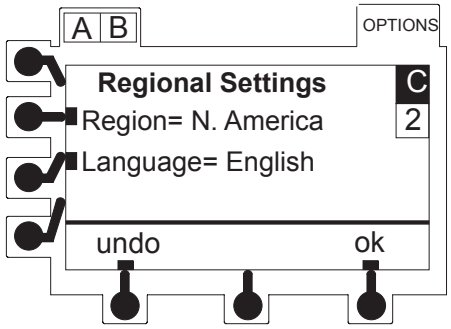
§ Instrument ID/Serial # is accessed through Diagnostic Mode. Refer to the “Entering Diagnostic Mode” section in the “Troubleshooting” chapter.

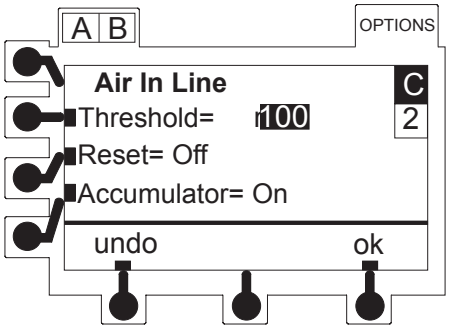
Map of Configuration Screens

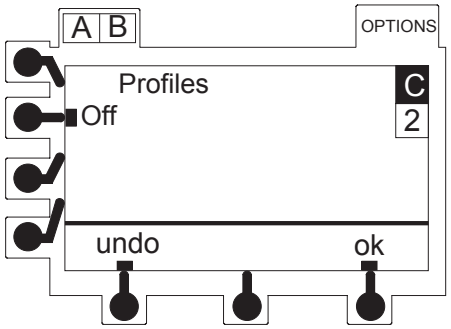


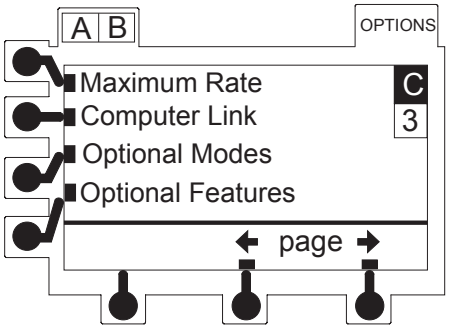


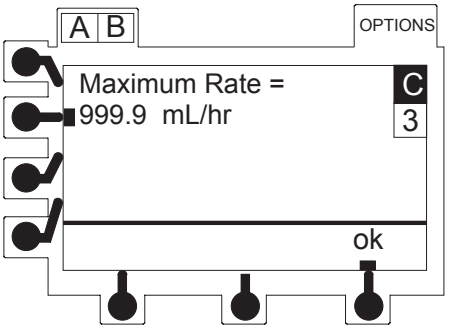




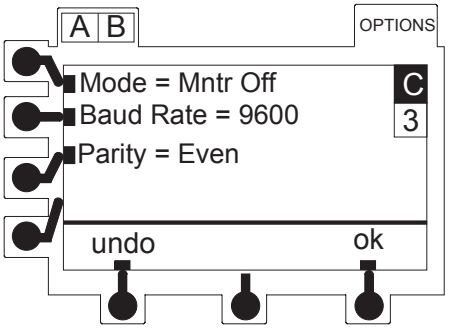


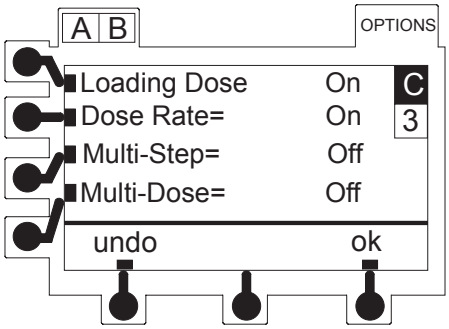


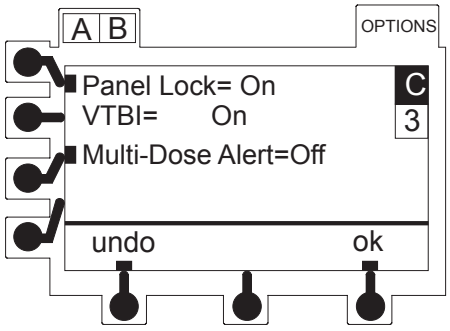


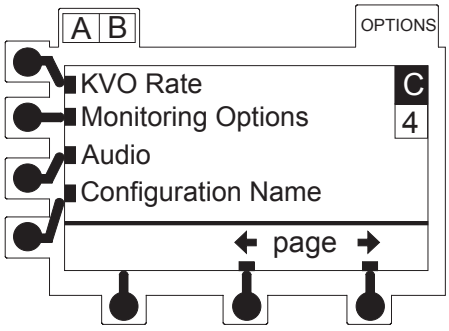


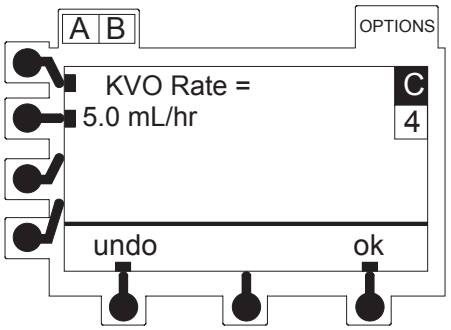
Map of Configuration Screens (Continued)

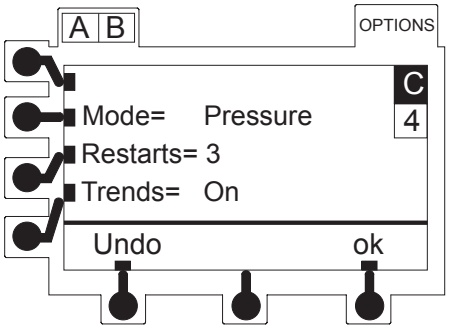


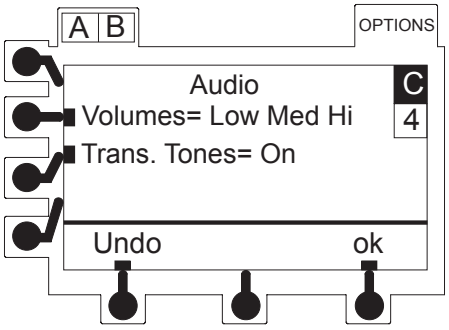


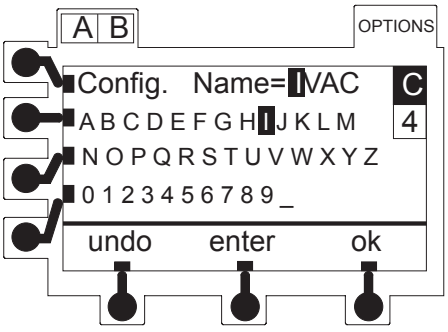




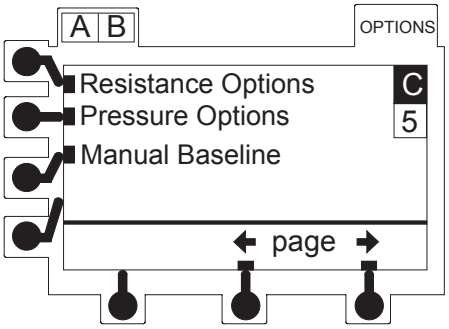


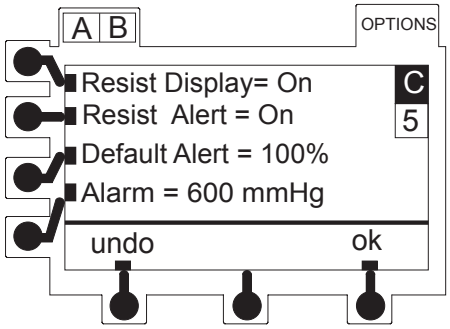


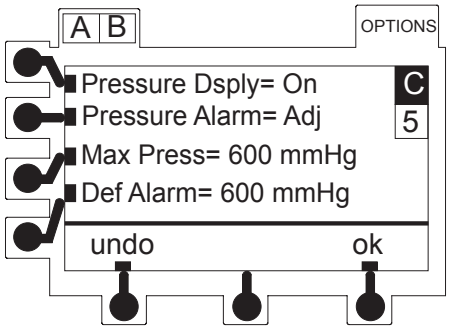


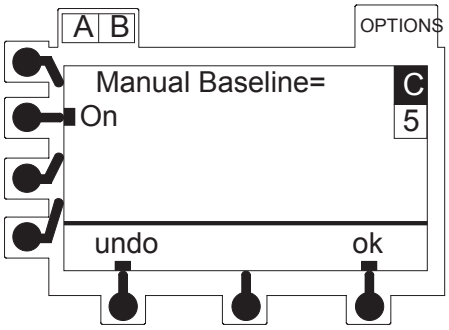


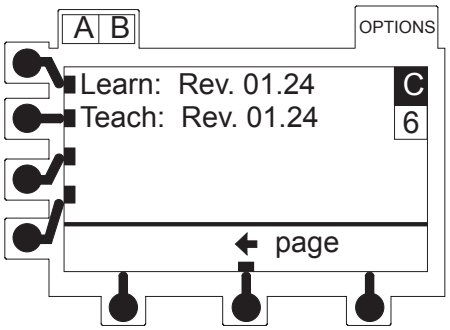
Map of Configuration Screens (Continued)

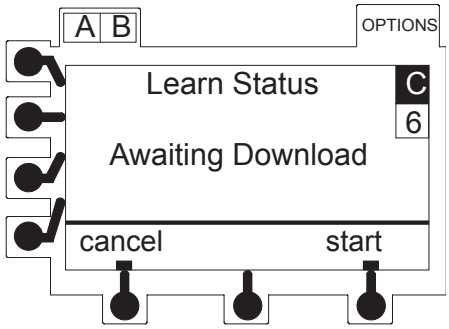


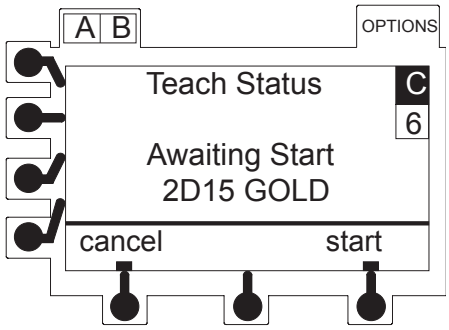












Chapter 3 — PREVENTIVE MAINTENANCE

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/hr 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/hr.

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/hr. 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 the 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.

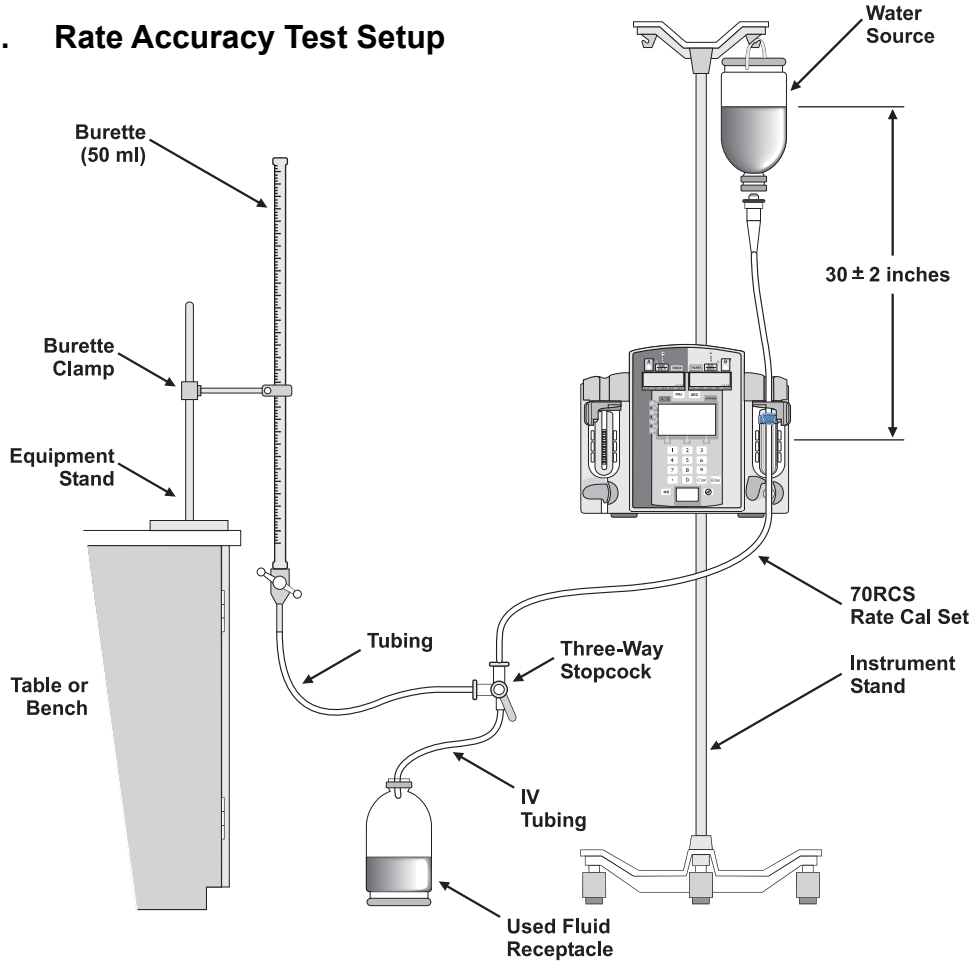
CAUTION

Due to the Dynamic Monitoring® Feature, the rate is varied during operation. For this reason, ALARIS Medical Systems does not recommend using sutomatic 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). Keep

Figure 3-1. Rate Accuracy Test Setup



3.2 PREVENTIVE MAINTENANCE INSPECTIONS (Continued)

3.2.5 Post Calibration Rate Accuracy Verification (Continued)

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.

3.2 PREVENTIVE MAINTENANCE INSPECTIONS (Continued)

3.2.5 Post Calibration Rate Accuracy Verification (Continued)

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.

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

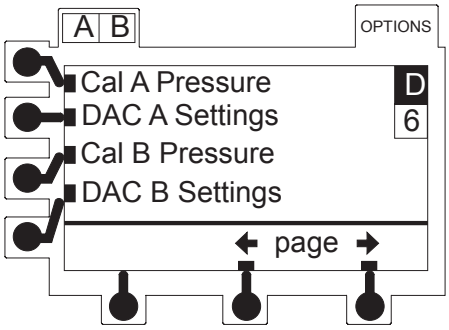
1. Place instrument on bench or other flat surface and connect to AC power.
2. Connect pressure meter, pressure source, and reservoir to pressure calibration set. Refer to Figure 3-1 "Pressure Test Setup".
3. Install a pressure cal set (70ISS) into instrument.
4. Enter Diagnostics Mode by pressing and 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)

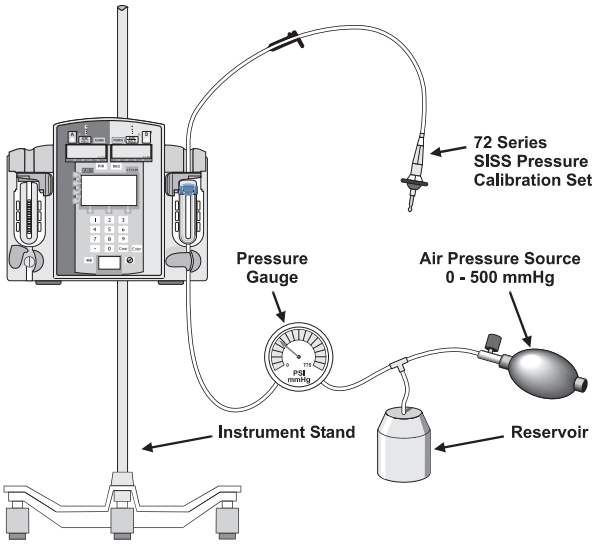
5. Advance to D6 page by pressing **Page** soft key 5 times.

   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.

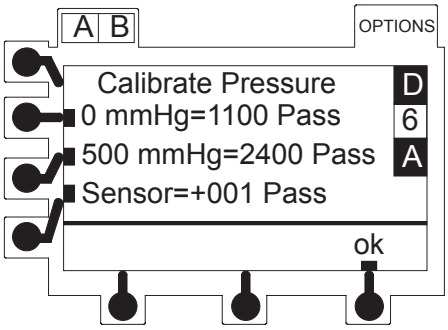
Figure 3-1. Pressure Test Setup



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 Signature Edition® GOLD DFU.

3.2.8 Ground Resistance Test

Refer to the Signature Edition® GOLD 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 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 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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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.

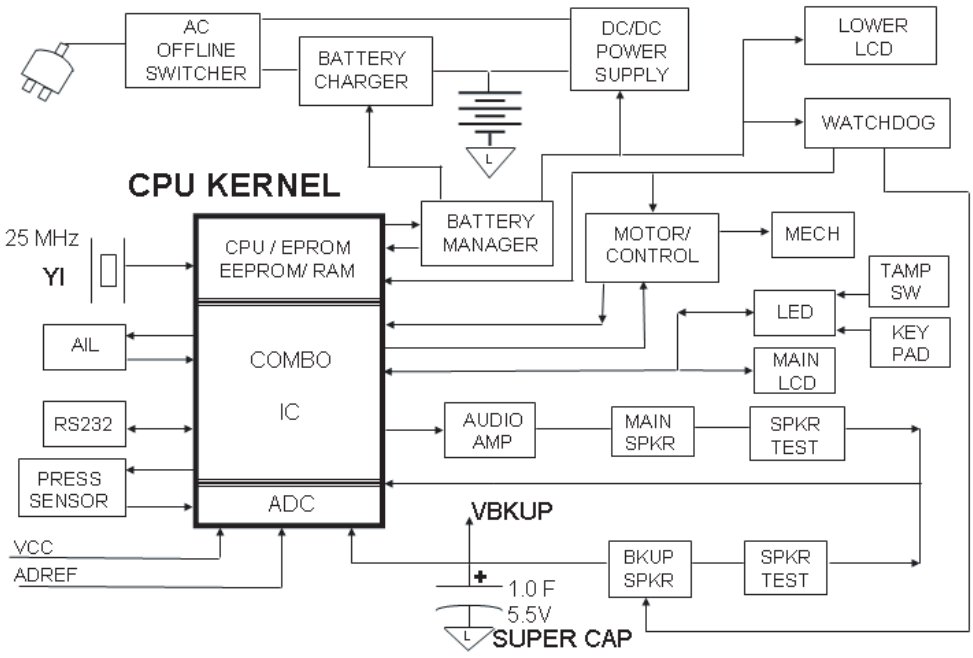
Accuracy of fluid delivery is a function of the microprocessor-controlled rotation cycle of the camshaft, and the administration set section compressed by the cam followers.

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.
- **Unser 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".

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. 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)

4.4.2 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 Event Log is 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 event log. 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.

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.

4.4 MAIN PCB (Continued)

4.4.6 RS-232 Interface

7130/7230 Models

The RS-232 serial communications 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.

4.4.7 RS-232 Interface

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 U3 and U4 for the signals and an isolation power transformer T1 for isolated circuit power. Voltage level conversions are generated by the MAX25O/25 1 chip set, U1 and U2, to generate the appropriate signal conditioning. Limit resistor R1 converts the RS-232 signal levels, nominally ±6V, to match the input signal range required by U1.

Figure 4-2a. COMBO IC Block Diagram

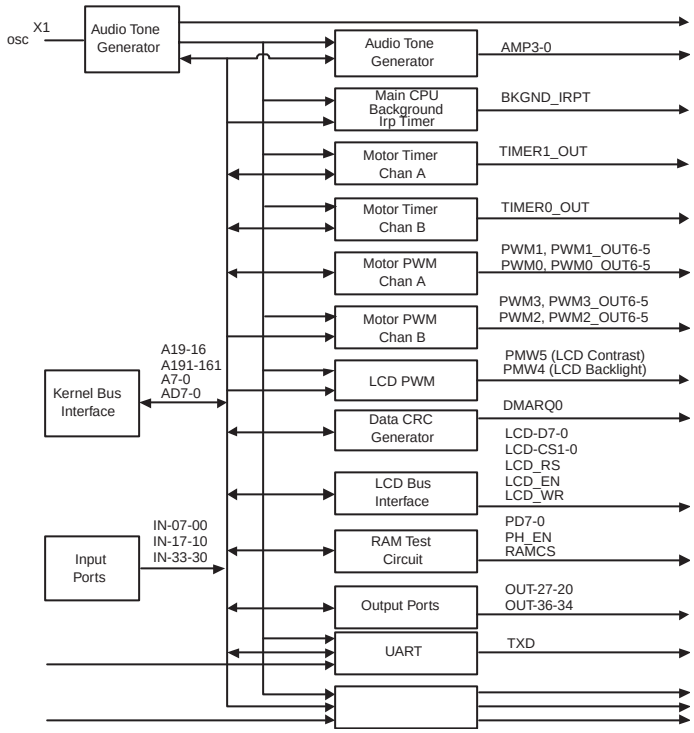
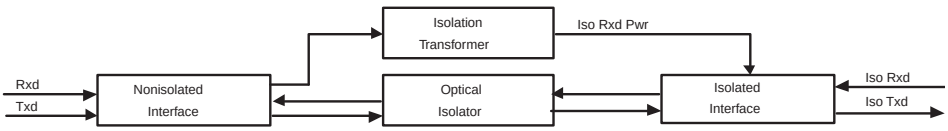


Figure 4-2b. COMBO IC Block Diagram



4.4 MAIN PCB (Continued)

4.4.7 RS-232 Interface (Continued)

NOTE: The RS-232 board in Models 7131/7231 is isolated and hence cannot have the Nurse Call option.

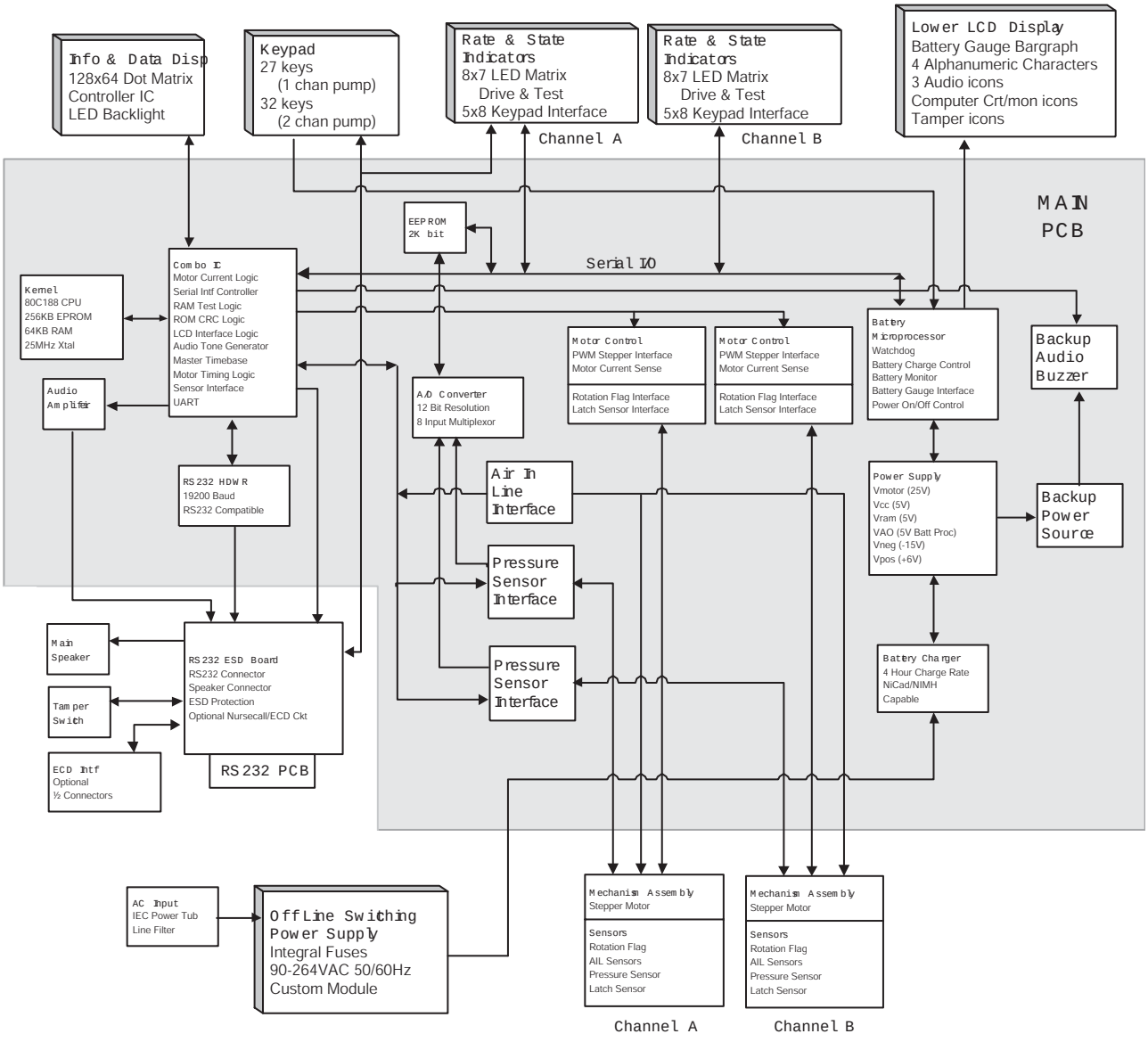
4.5 POWER SYSTEM

4.5.1 Battery Manager

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

The Battery Manager, U34 (U40), 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, Y2, and a 4 MHz

Figure 4-3. Electrical Partitioning



4.5 POWER SYSTEM (Continued)

4.5.1 Battery Manager (Continued)

ceramic resonator, RESN1. 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

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 85-264VAC 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.

Figure 4-4. Battery Manager Block Diagram

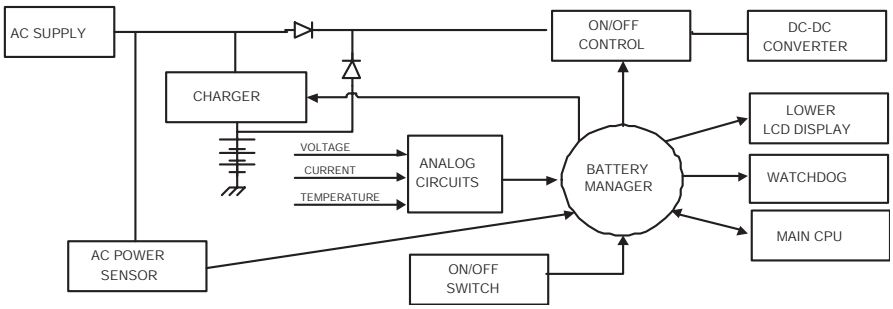
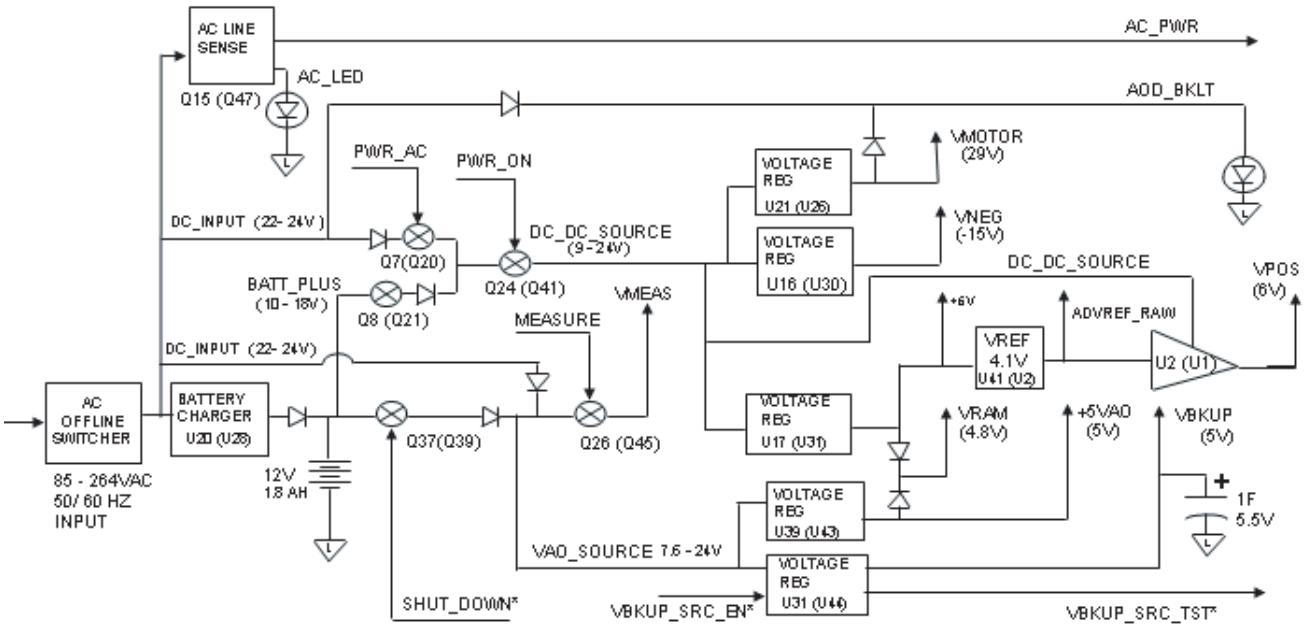


Figure 4-6. Main Power Supply



4.5 POWER SYSTEM (Continued)

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.

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

4.5 POWER SYSTEM (Continued)

4.5.17 System Watchdog

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

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.

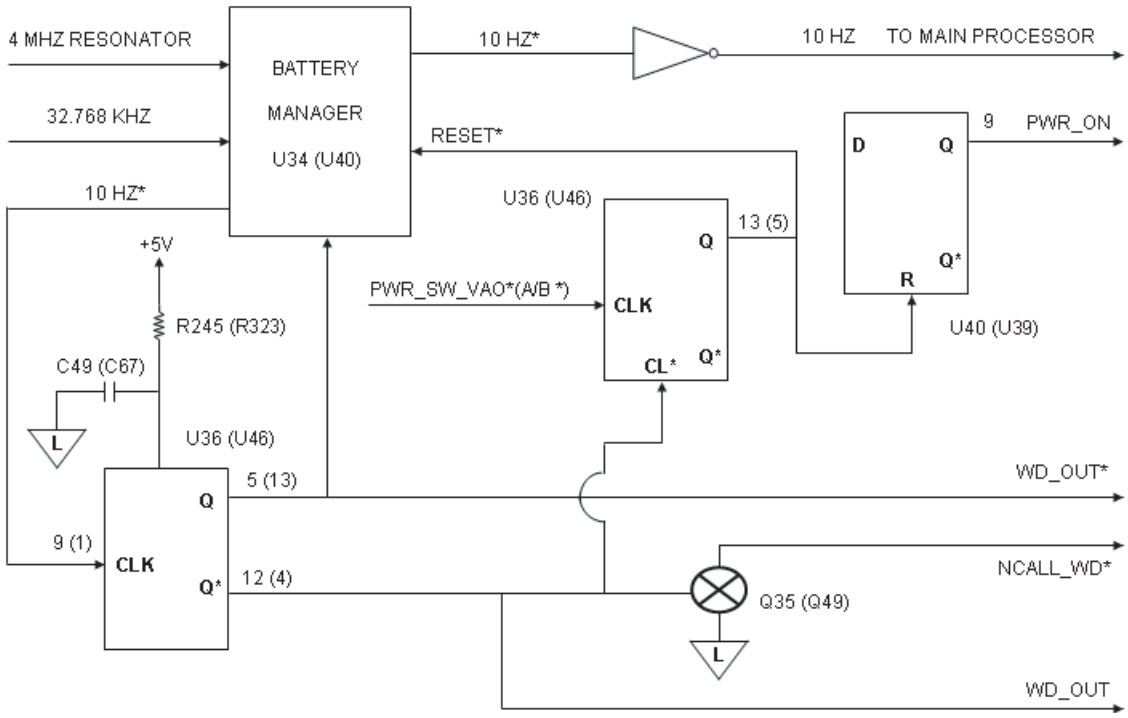
The 10 Hz* has three states:

- **Continuous High:** Instrument is off or watchdog error has been caused by the Main Processor.
- **Continuous Low:** Battery Manger 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.

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

Figure 4-7. System Watchdog



4.5 POWER SYSTEM (Continued)

4.5.17 System Watchdog (Continued)

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.

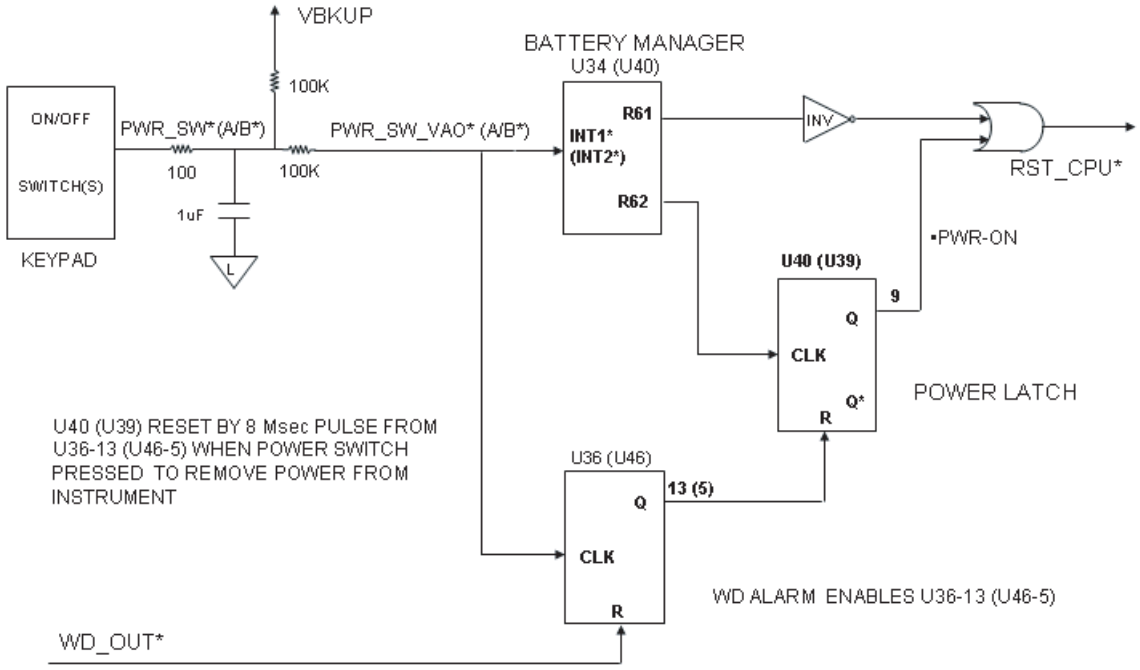
If the user presses either on/off switch, U29-10 (U42-10) output will go high, sending a 4 to 11 ms pulse to the Battery Manager reset input. This allows the user to reset the Battery Manager through hardware when the Battery Manager is stuck in a watchdog error. The system power is also turned off at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

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. 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*

Figure 4-8. System Reset/Power On



4.5 POWER SYSTEM (Continued)

4.5.18 Power Switch (Continued)

(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

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

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.

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

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 run time 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

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.

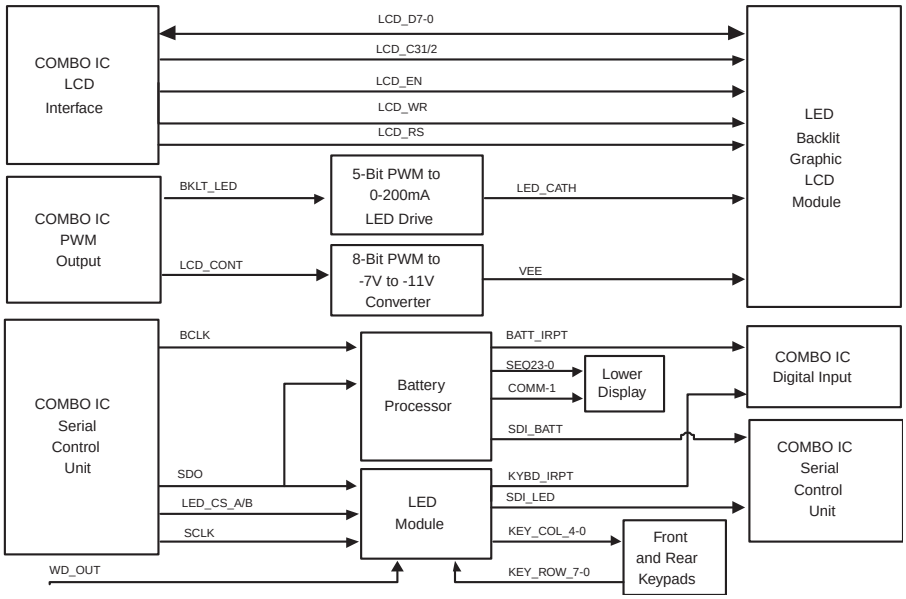
The voltage across the resistor is amplified, rectified, and compared to low and high threshold values by a window comparator, U38 (U16). The speaker is tested when an alarm or error occurs, while the test circuit is verified at power up. The speaker audio volume settings are approximately:

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

4.7.2 Backup Audio Buzzer and Test Circuit

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



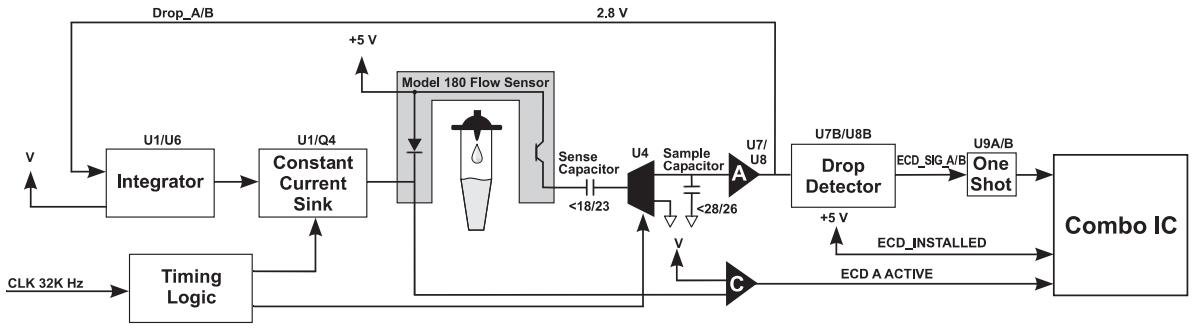
4.13 ECD BOARD (Continued)

4.13.2 7131/7231 Option (Continued)

- **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_32KHz 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.

- **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.

Figure 4-17. Flow Sensor Interface Block Diagram



4.13 ECD BOARD (Continued)

4.13.2 7131/7231 Option (Continued)

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.

- **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.

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 Pump.

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		Class A or B* 113 Sec A*	Rate calibration and verification
RS-232 (9-pin, Null modem)		133450*	Connects between 2 instruments to download configuration.
Silicon Tubing		303109*	Pressure calibration setup
T-Fitting		313815*	Pressure calibration setup
NiCad Battery Optomizer		Model 2006* 2003*	Test and condition batteries (optional)

* or equivilent

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 product 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 Servie Bullitens 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. 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.

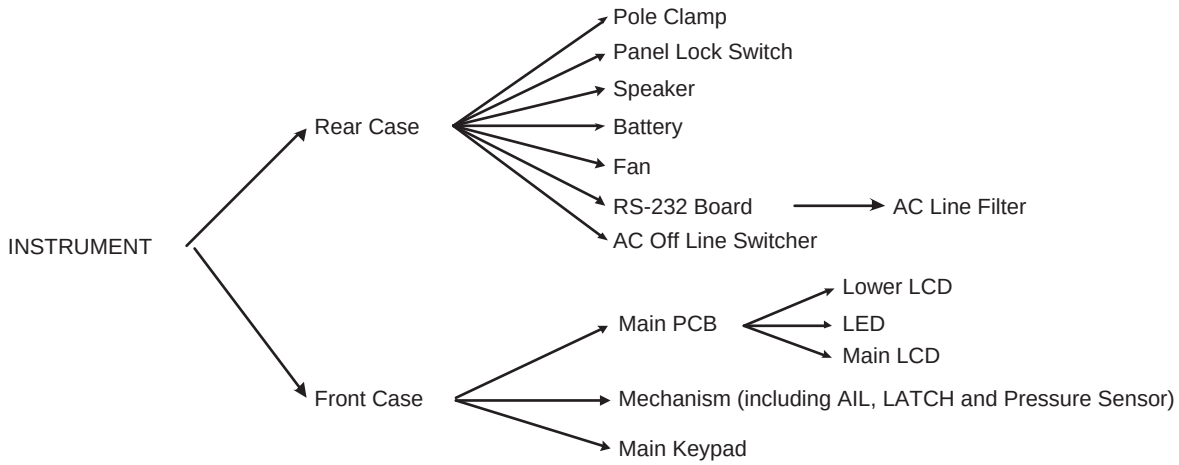
5.2.1 REPLACING BATTERY

A Phillips screw driver will be needed to remove battery.

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 the instrument.
2. Remove screw from Power Cord Retainer, on rear case, using a Phillips screw driver.

Figure 5-1. Instrument Assembly Organization



5.2 DISASSEMBLY/REASSEMBLY
(Continued)

Figure 5-2. View From Back of Instrument

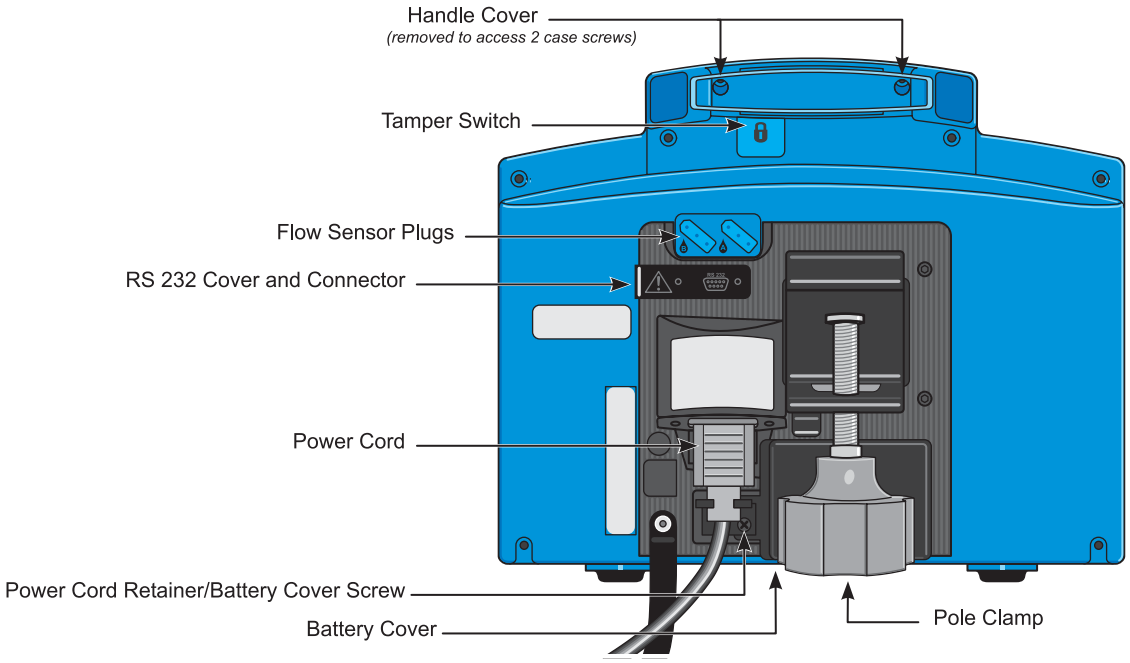
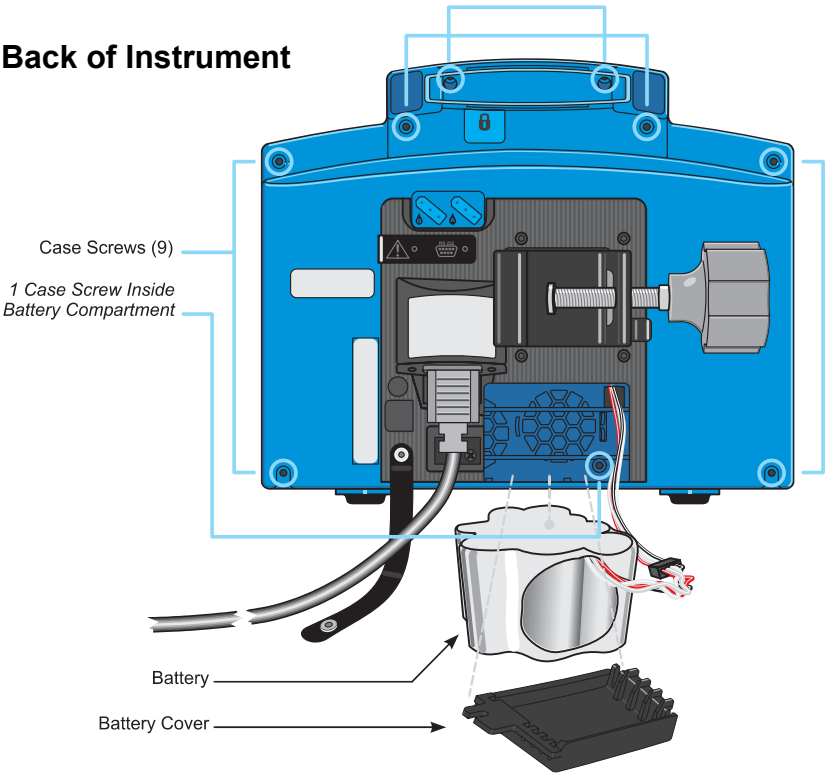


Figure 5-3. Alternate View From Back of Instrument



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.1 Replacing Battery (Continued)

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.

7. Connect and install new battery. Note the rated capacity of the new battery.
8. Reassemble the battery cover, power cable and power cord retainer.

   The replacement 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 the Diagnostics Mode (D2), select Battery Status and enter new rated capacity. Refer to Section 6.4.6 "Changing Rated Capacity of Battery".

   In the future, ALARIS Medical Systems may provide different battery packs. The battery manager needs to know if a new battery, possibly with a new rated capacity, has been installed.
9. Clear battery run time via Diagnostics Mode after installing new battery. Refer to Section 6.4.9 "Viewing Battery and Total Run Times".

Battery replacement is now complete.

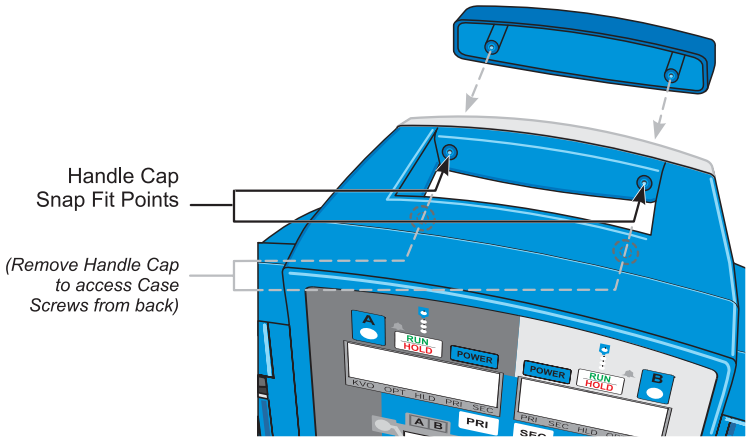
> **NOTE:** The instrument will attempt to refresh the battery when it is first installed and connected to AC power. This refresh may take in excess of 24 hours if the instrument is turned on.

5.2 DISASSEMBLY/REASSEMBLY
(Continued)

Front Case

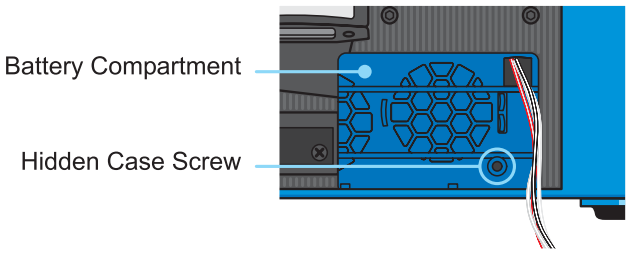
1. Lift and remove the battery cover. Refer to "Replacing Battery" section earlier in this chapter.
2. Press on Cutouts to pop off cap for handle from inside (between handle and case) to access two screws to open unit. Remove the two screws using a Phillips screw driver.

Figure 5-4. Cap Handle Screws



3. Remove the battery to get the hidden case screw inside the battery compartment. Remove the screw.

Figure 5-5. Hidden Case Screws in Battery Compartment



5.2 DISASSEMBLY/REASSEMBLY (Continued)

Front Case (Continued)

4. Remove remaining case screws (6 for dual, 4 for single).
5. Lay pump face down.
6. Position pole clamp knob down.
7. Lift rear case to access the inside of the pump.
8. The following step should be included whenever opening the instrument for repairs or other maintenance. The main board assembly should be inspected for dust and cleaned whenever the instrument is opened. Perform this new step prior to performing the repair procedures.

NOTE: If instruments are consistently used in a dusty environment, cleaning should be performed yearly as part of the preventive maintenance procedure.

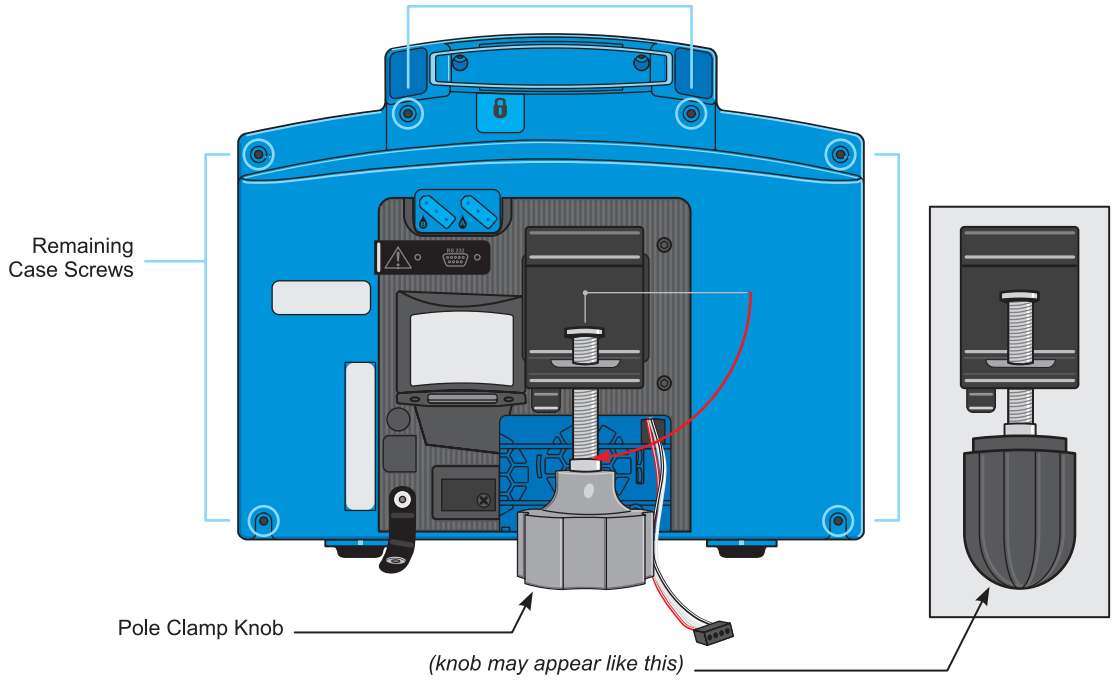
Main Board Assembly

a. Examine the 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.

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

Figure 5-6. Case Screws and Pole Clamp Position



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.2 Disassembly of the Rear Case

1. Disconnect power supply board connector/battery cable. Lift up the locking bar (refer to figure detail) and remove the RS232 flex cable from front case. Disconnect ground wires (1 for single channel) from under motor.
   - The rear case is now completely separated from the front case. Set front case aside.

Figure 5-7. Locking Bar

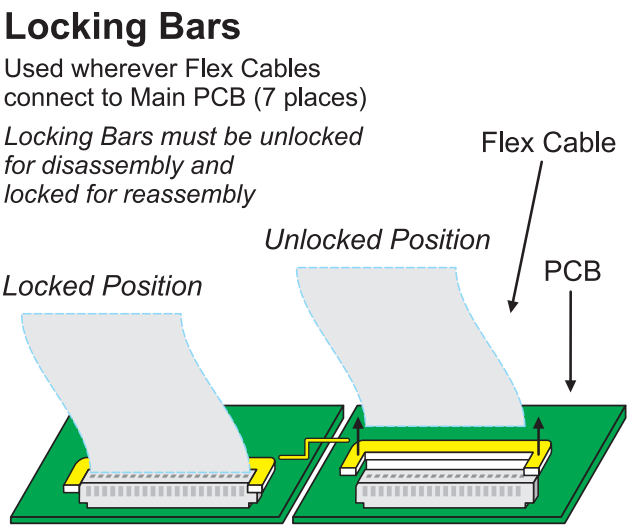
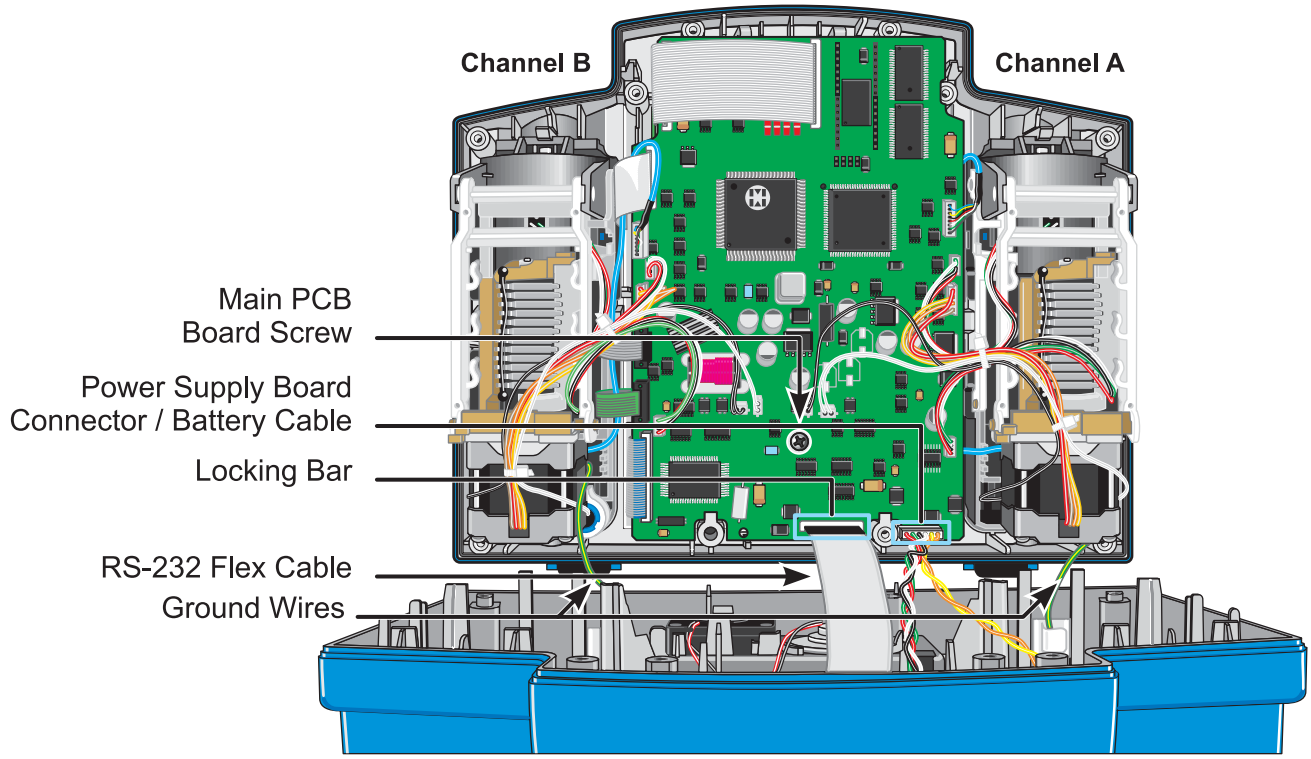


Figure 5-8. Disassembly of Rear Case, Steps 1-2



5.2 DISASSEMBLY/REASSEMBLY (Continued)

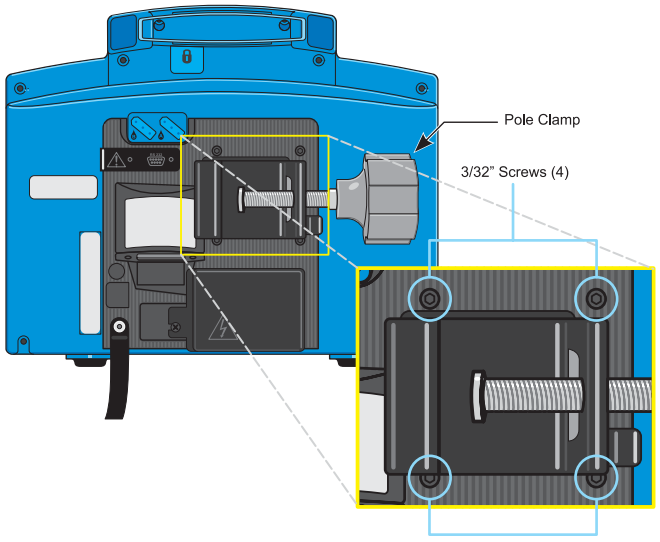
5.2.2 Disassembly of the Rear Case (continued)

2. To replace the power supply board assembly:

   Remove the four screws from Heat Sink using Torx 3/32" (or 2.5mm) driver to separate power supply board from the inside of the rear case (Figure 5-9a). Disconnect the cable from the power supply board (Figure 5-9b).

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

Figure 5-9a. Power Supply Board



3. To replace ECD board assembly (if installed):

   a. Remove screw on ECD board using Phillips screw driver, then remove the RS-232 board (Figure 5-10).

4. To replace RS-232 board assembly:

   a. Pull the RS-232 cover away from the connector then remove two hex nuts using 3/16" socket wrench (Figures 5-11 and 5-12).

   b. Disconnect the Panel Lock Key Pad flex cable by lifting up on locking bar.

   c. Disconnect speaker and fan from RS-232 Board.

   d. Remove screw on RS-232 board using Phillips screw driver, then remove the RS-232 board.

5. To replace the line filter: remove screw from Line Filter using Phillips screw driver (Figure 9-13).

   Remove two screws from exterior power connector using Phillips screw driver.

   Remove exterior power connector and Line Filter assembly.

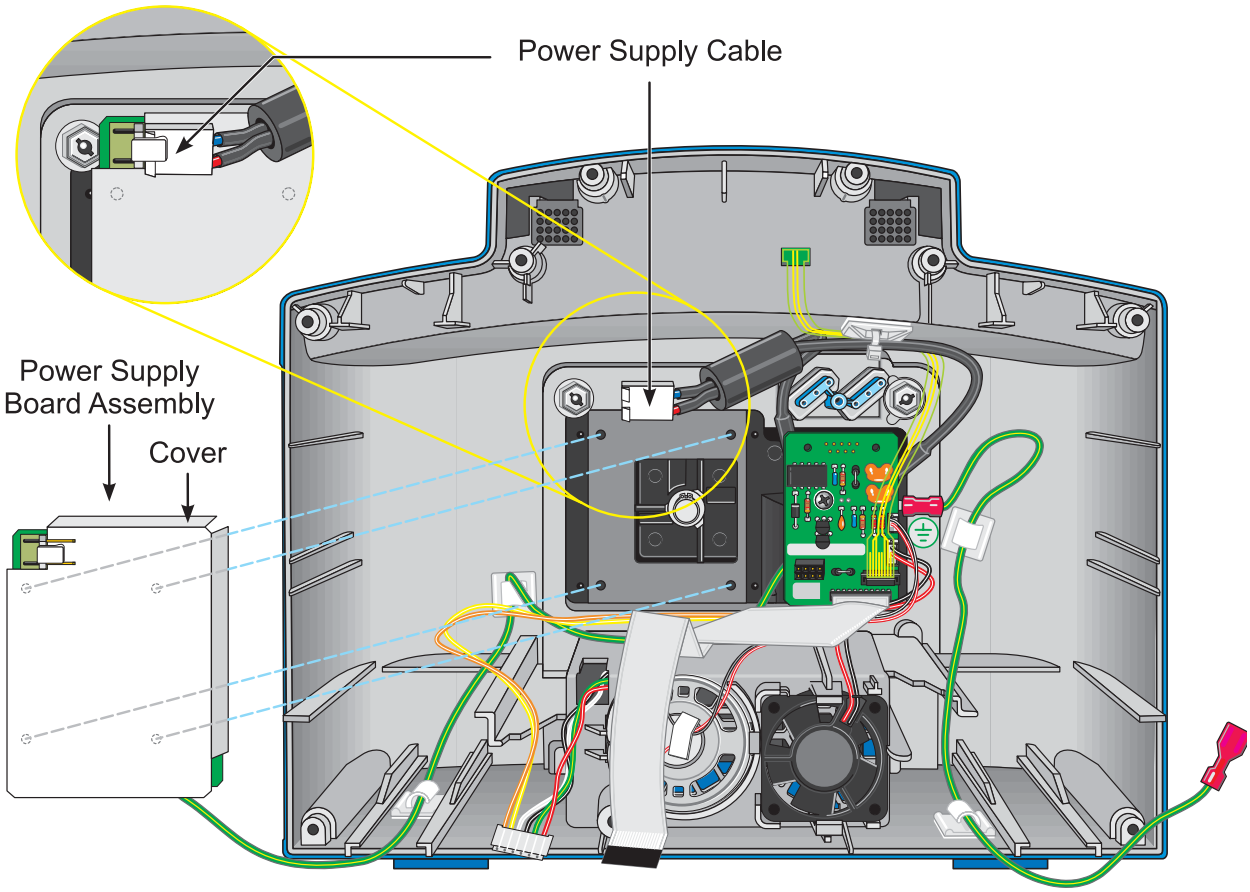
6. To replace speaker/fan assemblies: spread clips and remove the fan or speaker.

   Disconnect from RS-232 Board, if necessary.

5.2 DISASSEMBLY/REASSEMBLY
(Continued)

5.2.2 Disassembly of the Rear Case
(continued)

Figure 5-9b. Rear Case Power Supply



5.2 DISASSEMBLY/REASSEMBLY (Continued)

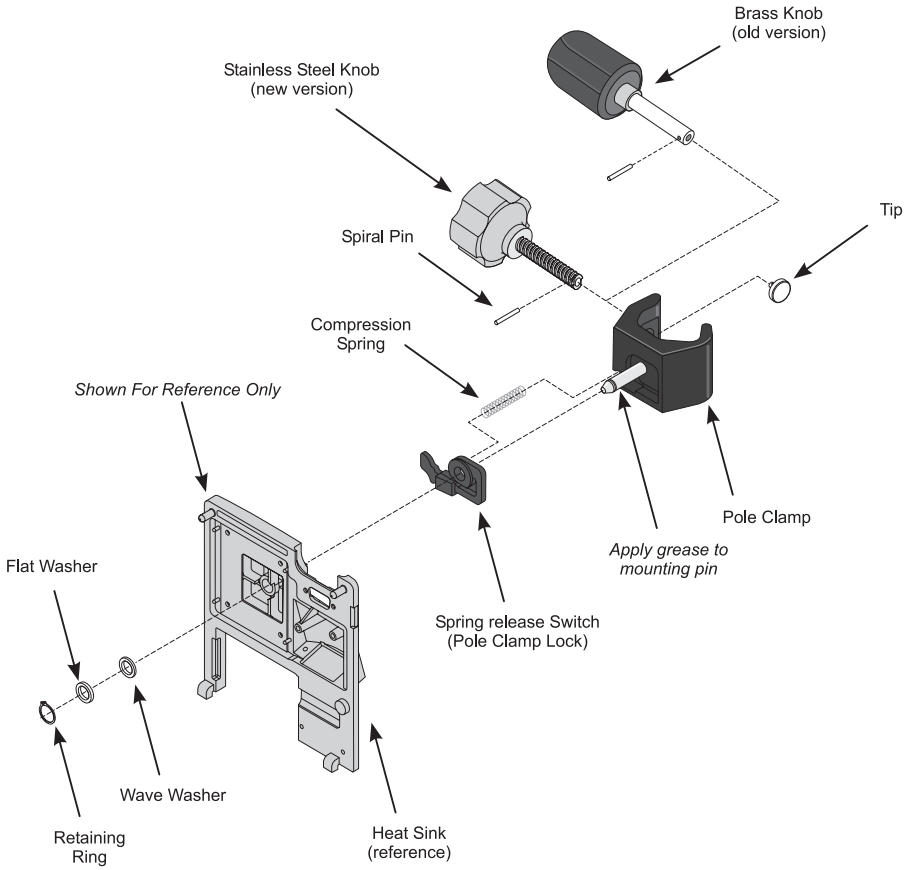
5.2.2 Disassembly of the Rear Case (continued)

7. To replace Pole Clamp.
   a. Remove power supply board assembly.
   b. Remove hardware securing pole clamp to heat sink.

NOTE: An older version of the pole clamp was installed using a shoulder screwand wave washer. A 3/16” allen wrench is needed to remove shoulder screw. Discard shoulder screw and wave washer.

   g. Remove tip from end of pole clamp knob by pressing spiral pin out of opening in end of brass thread.
   h. Unscrew knob from pole clamp.
   i. Screw new knob into new pole clamp assembly (included in kit).

Figure 5-14. Pole Clamp Assembly



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.2 Disassembly of the Rear Case (continued)

j. Attach pole clamp tip to end of brass 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 brass stud.

k. Reinstall compression spring into spring release switch.

l. Install spring release switch onto pole clamp assembly.

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

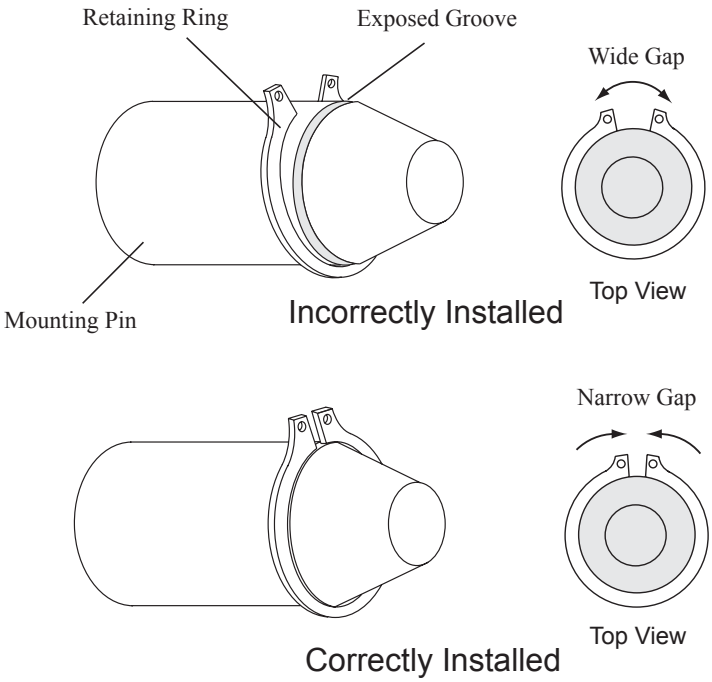
m. Apply lubricant (Dow Corning MolyKote 33 or Novagard Versilube G321) to portion of pole clamp mounting pin that protrudes through spring release switch.

n. Insert pole clamp mounting pin through opening in heat sink.

o. Install wave washer over end of pole clamp mounting pin.

p. Install flat washer over end of pole clamp mounting pin, on top of wave washer.

Figure 5-15. Retaining Ring Installation



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.4 Disassembly of Front Case (Continued)

e. If replacing AIL receiver, perform step 8 before continuing with AIL transmitter replacement.

f. Remove AIL gear and AIL transmitter from mechanism.

g. Move mechanism latch to right (open position).

h. Slide new AIL transmitter through faceplate. Rotate AIL transmitter to open (vertical) position (Figure 5-22). Thread AIL transmitter wire through AIL gear.

CAUTION

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

i. Slide on AIL gear and align AIL gear tab. (Figure 5-21)

j. Press AIL gear into place.

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

k. Use needle-nose pliers to lock gear tab into place.

l. Turn mechanism latch to far left (closed position) and check AIL transmitter alignment. AIL transmitter must be in closed position (horizontal). (Figure 5-23)

m. If AIL transmitter is not properly aligned: unlock, realign and relock gear tab until transmitter is properly aligned. (Figure 5-23)

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

n. Open latch halfway (Figure 5-19), install mechanism into front case.

o. Route and connect cables. Install cable tie straps (included in kit) on cables as before.

p. Reassemble instrument, as described in Section "Assembling Pump" later in this chapter.

Figure 5-25. Flat Edge of AIL Receiver

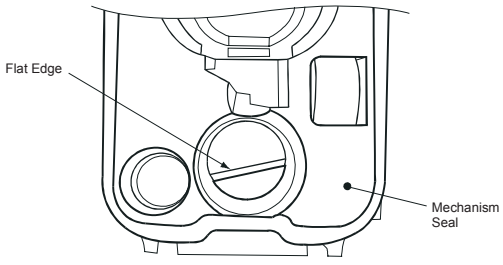
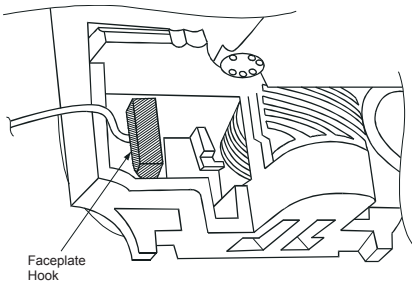


Figure 5-26. Faceplate Hook



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.4 Disassembly of Front Case (Continued)

8. Replace AIL Receiver (Button)
   a. Disassemble instrument, as described earlier in this chapter, to allow removal of mechanism.
   b. Remove mechanism - as described in section "To Replace/Repair the Mechanism" earlier in this chapter.

> **NOTE:** To remove mechanism, place latch in center position (figure 5-20).

   c. Observe placement of cable tie straps (for reinstallation) cut and remove existing straps from cables.
   d. Turn mechanism latch to far right. AIL transmitter will be in open position.
   e. Push AIL receiver in and rotate about 90 degrees clockwise. AIL receiver should pop out.
   f. Remove AIL receiver wire from faceplate's hook (Figure 5-25) and remove receiver from mechanism.

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

   g. Thread new AIL receiver wire through opening.
   h. Install AIL receiver with flat edge of assembly positioned as shown in Figure 5-22.

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

   i. Push AIL receiver in and rotate 90 degrees counter-clockwise to lock into place.
   j Tuck mechanism seal under AIL receiver.
   k. Proceed with AIL transmitter replacement, if needed, continue the following steps for AIL receiver replacement.
   l. Close and open mechanism latch several times to ensure AIL transmitter and receiver open and close properly.
   m. Route AIL receiver's wire under faceplate's hook. (Figure 5-26)
   n. With mechanism latch opened halfway (Figure 5-20), install mechanism into front case.
   o. Route and connect cables. Install cable tie straps (included in kit) onto cables.
   p. Reassemble instrument, as described in Section "Assembling Pump" later in this chapter.
9. Replace Seal Clip
   a. Disassemble instrument to allow removal of mechanism (as described earlier in this chapter).
   b. Remove mechanism. (Refer to "To Replace the Mechanism" section and Figures 5-19 through 5-26.)
   c. Put latch in the middle or center position to remove mechanism.
   d. Use an orange stick to push on the two lower tabs inward while pulling out on the seal clip to un-snap the seal clip.
   e. Remove seal clip from the assembly.

5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.4 Disassembly of Front Case (Continued)

f. Align a new seal clip in place and snap it in place.

10. Replace mechanical seal.

a. Disassemble instrument to allow removal of mechanism

b. Remove seal clip and AIL-transmitter (as described earlier in this chapter).

c. Peel off old mechanism seal from the mechanism.

d. Peel and clean off any RTV adhesive remaining around the pressure sensor area.

CAUTION

Be careful not to apply excessive pressure on the pressure transducer to avoid damage.

e. Apply new mechanism seal on the mechanism.

f. Use an orange stick to tuck the seal in around the flow control actuator, clamp arms, cam follower and AIL-Receiver.

g. Reinstall the seal clip and AIL-Transmitter.

h. Use RTV 3140 under edges of the seal and secure in place. (Figure 5-27).

i. Remove any excess RTV with a cotton swab, Kimwipes or equivalent. Verify no RTV is exposed to the open area.

j. Allow the RTV to dry and reinstall mechanism to the front case.

11. To replace the key pad assembly: remove
the Key Pad only if it is defective. Removing a good Key Pad will ruin it.

NOTE: Keypad pictures are for reference only and may not match your instrument.

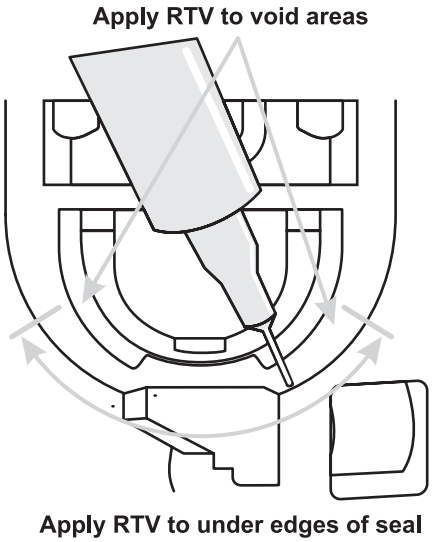
a. First, separate the front and rear case halves following the disassembly instructions in "Disassembling Pump" section of this chapter.

b. Disconnect power supply board connector/ battery cable and RS-232 flex cable from front case.

The rear case is now completely separated from the front case. Set it aside.

c. Disconnect the Key Pad Assembly flex cables from the Main PCB.

Figure 5-27. Apply RTV Under Edges of Seal



5.2 DISASSEMBLY/REASSEMBLY (Continued)

5.2.4 Disassembly of Front Case (Continued)

d. The Key Pad Assembly is removed by peeling it off the front case. Take a corner of the Key Pad and peel it away from the front case.

e. Adhesive will remain on the surface of the front case. Remove any remaining residue from surface before applying new Key Pad.

f. Position the front case so that it faces you. Fold back a small portion of the protective backing along the right side of the Key Pad. Insert the Key Pad Assembly flex cables into the slot and guide them through.

g. Align the right edge of the Key Pad Assembly and affix. If aligned, proceed to remove the remaining protective backing as you lay it into place. With your fingers, press around the perimeter of the Key Pad Assembly to assure adhesion to the front case and prevention of fluid ingress.

h. It may be necessary to loosen the Main PCB to gain access to the flex cables from inside the front case. To do so, remove screw from Main PCB using Phillips screw driver. Lift and move the Main PCB to the side to gain access to the flex cables. Pull the flex cables through and to the side of the Main PCB. Reattach the Main PCB to the front case. Connect the flex cables to the Main PCB.

i. Reconnect power supply board connector/battery cable, and RS-232 flex cable from front case.

j. Reassemble both case halves following the instructions in Section 5.4" Disassembling Pump", but in reverse sequence. See section 5.4.4 on cable routing before closing the pump.

k. Remove any protective covering from the front of the Key Pad Assembly.

l. Turn on the instrument, verify thatthe instrument beeps and that all display segments flash. This confirms that the pump has performed its self-tests, and is operating correctly. The instrument configuration values remain that same as those before power was disconnected. It is not necessary to reconfigure the instrument.

m. Test the switches. Refer to Section "Testing Switches" to confirm that each switch is functional.

The replacement of the Key Pad assembly is complete.

5.4 TEST AND CALIBRATION (Continued)

5.4.3 Mechanical Leak Test (Continued)

5. Apply pressure of 15 psi +1 psi (775 mmHg +50 mmHg) for one 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.

5.4.4 Pressure Verification and Calibration Test

Refer to "Calibrating Channel Pressure" section in “Troubleshooting” chapter for soft cal procedure.

5.4.5 Set Sensor Check

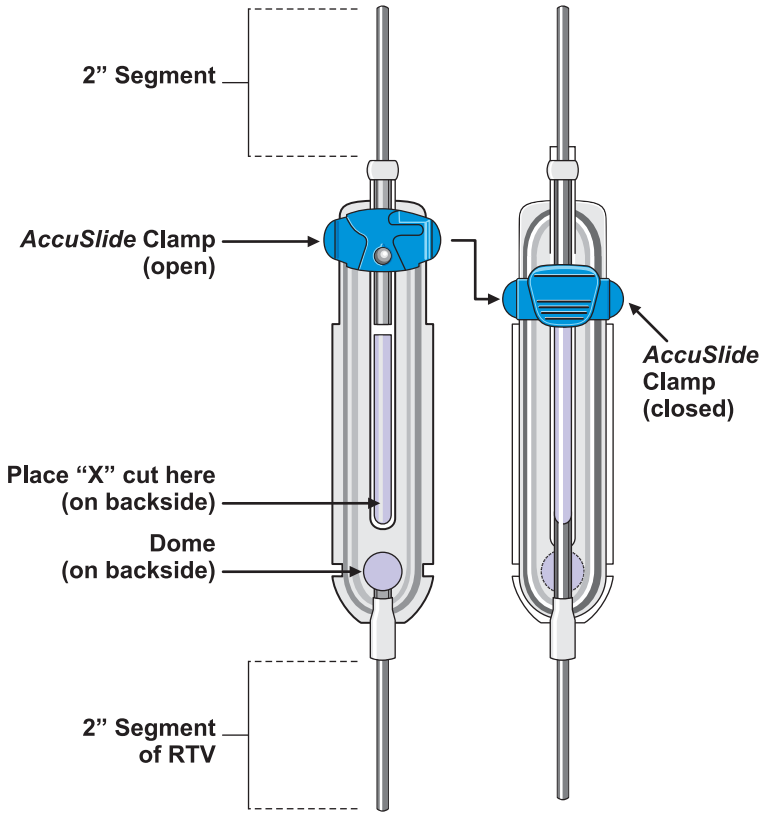
1. Enter Diagnostic Mode and advance to D6 page.
2. Install set and allow a 30-minute warm-up while in Diagnostic Mode.
3. Sensor reading with set in should be greater than 170 mmHg
4. Remove set and close latch. Sensor reading with set out should be -80 to +30 mmHg. If not, perform soft pressure calibration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

5.4.6 Test Run Mode

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.

Figure 5-35. AccuSlide® Flow Regulator



5.4 TEST AND CALIBRATION (Continued)

5.4.6 Test Run Mode (Continued)

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/hr for 15 minutes.
7. Remove test set.

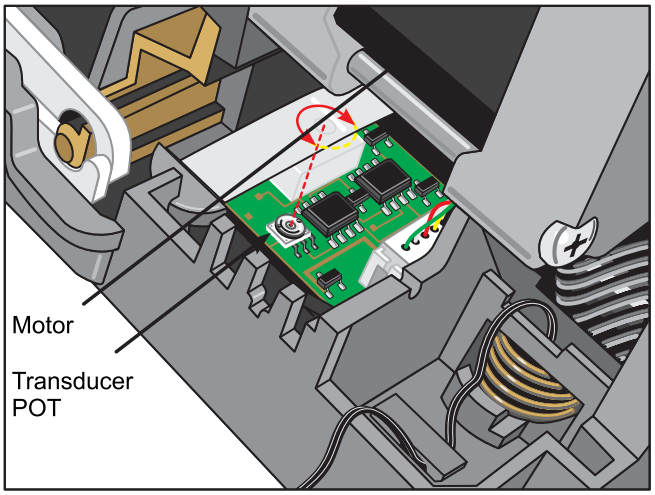
5.4.7 Hard Pressure Cal Procedure

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 one 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.

Figure 5-36. Transducer Pot



5.4 TEST AND CALIBRATION (Continued)

5.4.7 Hard Pressure Cal Procedure (Continued)

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.
6. Evaluate sensor in D6 Pressure Calibration page (see “Troubleshooting” chapter), as follows:
   a. Press lower left soft key four 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 in “Assembling Pump” section 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.
    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.

5.4.8 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 set leaks, replace set.

> **NOTE:** The disposable set (80VCS) cannot be used for more than 30 rate accuracy verification runs (15 rate cal number changes).

5.5 LEVEL OF TESTING GUIDELINES

The following tests should be performed whenever the instrument is updated, repaired or checked out in response to anything that would impair operation of the instrument. For details see “Preventive Maintenance” chapter.

NOTES:

- The disposible set, 70RCS, cannot be used for more that 40 rate accuracy verification runs (20 rate cal number changes).
- If instrument operation is at all doubtful, perform a complete PM procedure. This table provides minimum test requirements.

Table 5.2. Level of Testing Guidelines

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 Verification Test (3)	Ground Current Leakage and Resistance Tests (3)	Display Test (6)	Leak Test (mechanical) (5)	Instrument Configuration (2)	Clear Battery Hours (6)	Set Sensor Check (3) (Part of Pressure Cal)	Pressure Calibration (soft) (3,6)	Pressure Calibration (hard) (5)	Perform/Enter Rate Cal # (5,6)	Enter Tc = 0 (6)	Set Time, Date, ID# (6)	Set PM Setup, Auto Zero (6)	Test Channel Sensors (6)	Mechanism Visual Check (all)	Mechanism Visual Check (springs)	Test Run Mode (5)
Battery								●											
Case	●	●	●	●	●	X			●							●	X	●	X
Instrument dropped	●	●	●	●	●	●			●							●	●		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
New Instrument Checkout	●	●	●	●	●		●		●					X	X	X			
Panel Lock Keypad	●		●	●												X		●	
Power Switcher	X		●	●												●		●	
Rate Accuracy failure after rRate Cal.			N/A			●												●	
Software	●		●	●	X		●		●	●	A/R	●	●	●	●			●	X
Speaker	●		●	●														●	
No Fault Found (instrument opened)	●	X	●	●	●				●							X		●	X
No Fault Found (instrument <u>not</u> opened)	●		●						●										X
Other repairs	●	X	●	●	●				●		A/R					X		●	X

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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 product 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® GOLDDirections 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, 7XXX	
	147718-102	Kit , Flash, S/W, 4.06, 7XXX	
	148134-100	Kit , Flash, S/W, 2.78, 7XXX	
	133450	Learn/Teach Cable (All Models)	1
	136111	Nurse Call Cable (7130X, 7230X only)	A/R
	301044	Tie Strap (All Models)	A/R
	70ISS	Pressure Cal Set	A/R
	80VCS	Rate Calibration Set	A/R
	145096	Kit , Flow Sensor / ECD, 71XX	
	145097	Kit , Flow Sensor / ECD, 72XX	
	145094	Kit , Flow Sensor / Handle Cap, 71X1 / 7130	
	145095	Kit , Flow Sensor / Handle Cap, 72X1 / 7230	

NOTE: If model is not specified, the part can be used on all versions.

* **7130X** = 7130B, 7130D, 7130F 120V VERSION; **7131X** = 7131A, 7131B 220V 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 seperately)	
	141498-100	Case Front, Dual Channel (order keypad, labels and feet seperately)	
300	144375	Case Rear, Assy Single Channel (7130) (order keypad, labels and feet seperately)	
	144126	Case Rear, Assy Single Channel (7131) (order keypad, labels and feet seperately)	
	144376	Case Rear, Assy Dual Channel (7030) (order keypad, labels and feet seperately)	
	144127	Case Rear, Assy Dual Channel (7131) (order keypad, labels and feet seperately)	
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
409*	980-1015-1	Assembly Power Cord Wrap	1
410*	809061	Eyelet Stud Snap	1
406*	320919	M3 x 10mm Phillips Flat Head Screw	1
413	136777	Battery Door	1
414**	140444-000	Power Cord Holder (713X / 723X only)	1
420	148450-100	Power Cord Kit (723X, 120V)	1
	134745	Power Cord, EUR (7101X / 7201X, 220V)	
	134748	Power Cord, UK (7101X / 7201X, 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.
** Included in item 420 - Power Cord Kit (723X).

Figure 7-1. Power Cord Wrap Kit (Item 403)

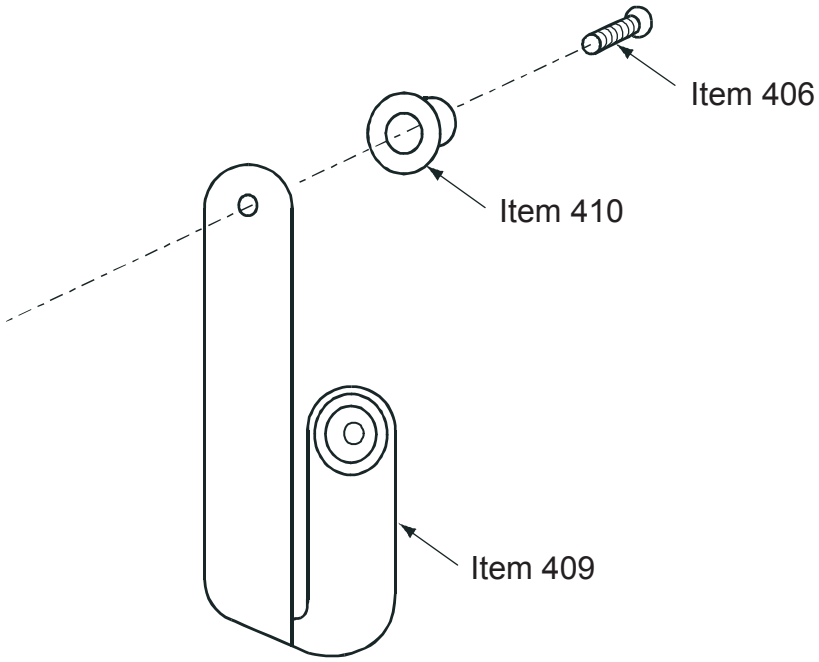

Table 7-3. Front Case Assembly

Item	Part Number	Description*	QTY
040	143251-001	Keypad, Main, 7130 / 2	1
	143252-001	Keypad, Main, 7230 / 2	
	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	A/R
201	141468	Mechanism Assembly, New	1
250	141496-100	Case, Front, Single Channel (oreder keypad, label and feet seperately)	1
	141498-100	Case Kit, Front, Dual Channel (oreder keypad, label and feet seperately)	
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.

* **7100X** = 7100E, 7100F, 7100G 120V VERSION; **7101X** = 7101A 220V VERSION.

Figure 7-3a. Front Case Assembly, Single Channel

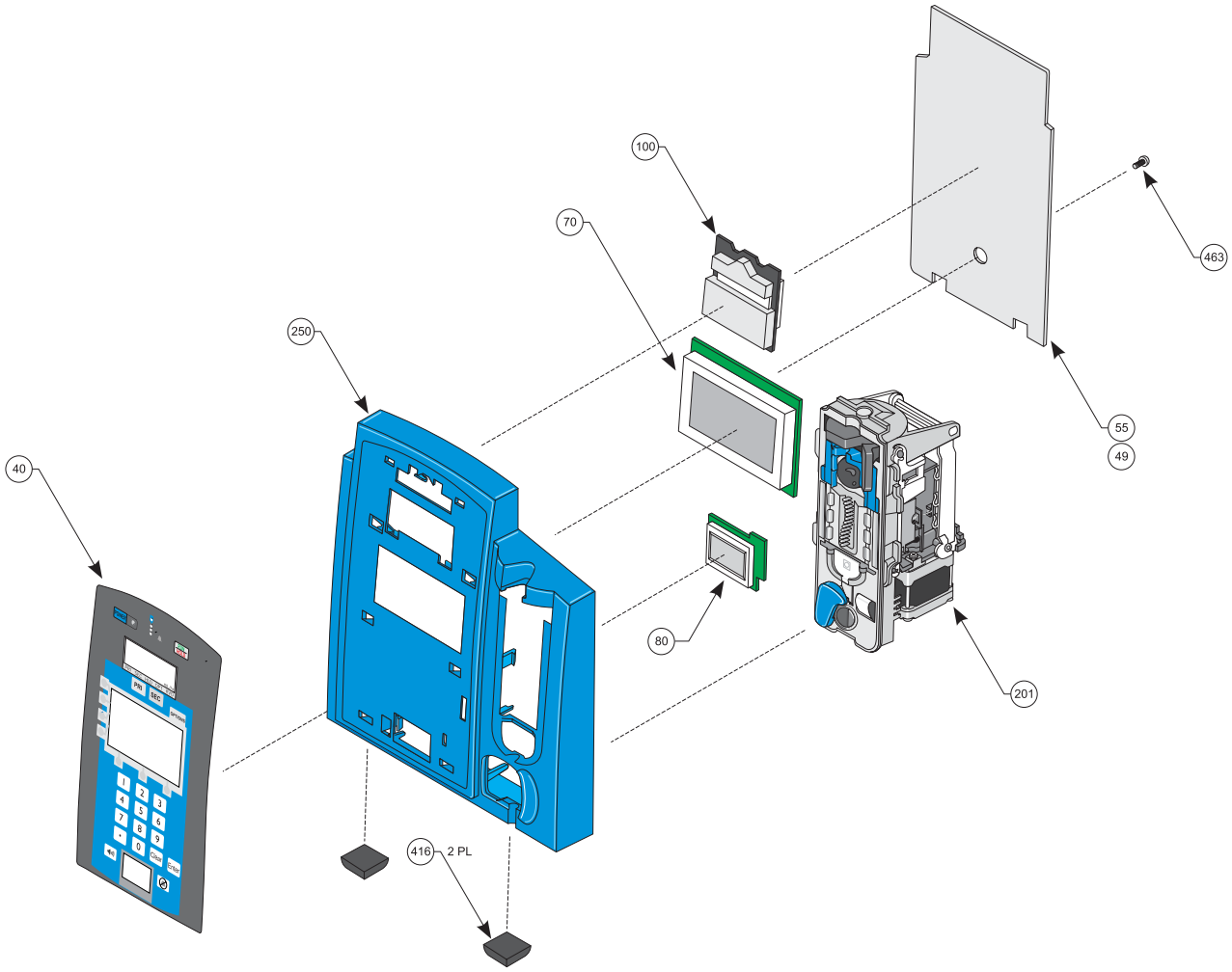

Figure 7-3b. Front Case Assembly, Dual Channel