BD Alaris™ PCU, Model 8015

BD Alaris™ Pump Module, Model 8100

Technical Service Manual

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BD Alaris™ PCU Module, Model 8015/ BD Alaris™ Pump Module, Model 8100 Technical Service Manual

The information in this document is subject to change and does not represent a commitment on the part of BD to provide additional services or enhancements. The screens illustrated in the document are for reference purposes only and might be different than the screens displayed on your computer. Documentation provided with this product might reference product not present in your facility or not yet available for sale in your area.

If difficulties are encountered while using this software, refer to the user manual, service manual, or related service bulletin(s) before contacting BD. Provide a description of the difficulty experienced, any messages that were displayed at the time of the difficulty, and the software version. Before you return the software to BD, contact BD to get a return authorization number. Put the software in its original packaging (if available), write the return authorization number on the package, and return to the nearest facility.

To request a printed copy of this document, contact BD at 800.482.4822, or contact your local BD representative. Provide the document's part number listed on the cover page. Allow approximately two weeks for shipment to a location within the United States. Shipments to locations outside the United States may take longer.

Within the United States: Any adverse reactions experienced with the use of this product, and/or quality problems should be reported to the FDA's MedWatch Program:
www.fda.gov/medwatch

Report any serious incident that has occurred in relation to this product to your BD representative (or manufacturer).

Caution: Federal law restricts this device to sale by or on the order of a physician, dentist, or other licensed practitioner.

North America

BD Designated Complaint Handling Unit - North America
(Clinical and technical feedback.)
Phone: 844.823.5433
E-mail: ProductComplaints@bd.com

Customer Order Management - North America
(Product return, service assistance, and order placement.)
Phone, United States: 800.482.4822
Phone, Canada: 800.387.8309

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About this Guide

Indications for Use

The BD Alaris™ System with Guardrails™ Suite MX is a modular infusion pump and monitoring system for the continuous or intermittent administration of fluids to adult, pediatric, and neonatal patients through clinically accepted routes of administration: intravenous (IV), intra-arterial (IA), subcutaneous, epidural, or irrigation of fluid spaces. See Pediatric, Neonate, and Adult Patient Population Tables for the module-specific variations. Administered fluids include pharmaceutical drugs, red blood cells, and other blood components (platelets and fresh frozen plasma) as required for patient therapy. The BD Alaris™ System is an interoperable system capable of communicating and exchanging data with compatible information technology systems.

The BD Alaris™ System includes the PC Unit (PCU) and one or more of the following: Pump Module, Syringe Module, end-tidal CO_2 ($EtCO_2$) Module, Auto-ID Module, patient-controlled analgesia (PCA) Module, and associated software applications. $EtCO_2$ Module is a capnograph that continuously monitors end-tidal carbon dioxide ($EtCO_2$), fractional inspired carbon dioxide ($FiCO_2$), and respiratory rate (RR).

BD Alaris™ Pump Module and Syringe Module and Alaris™ PCA Module are indicated for varying patient populations, routes of administration, and infusates.

Pediatric* and Neonate** Patient Populations

Module	Route of Administration	Infusates
BD Alaris™ Pump Module	Intravenous	Fluids, pharmaceutical drugs including high-alert medications, chemotherapy, and parenteral nutrition; red blood cells, platelets, and fresh frozen plasma.
	Subcutaneous	Fluids and pharmaceutical drugs approved for subcutaneous use.
	Epidural	Pharmaceutical drugs approved for epidural use.
	Intra-arterial	Pharmaceutical drugs approved for intra-arterial use.
BD Alaris™ Syringe Module	Intravenous	Fluids, pharmaceutical drugs including high-alert medications, chemotherapy, and parenteral nutrition; red blood cells, platelets, and fresh frozen plasma.
	Subcutaneous	Pharmaceutical drugs approved for subcutaneous use.
	Epidural	Pharmaceutical drugs approved for epidural use.
	Intra-arterial	Pharmaceutical drugs approved for intra-arterial use.
Alaris™ PCA Module	Intravenous	Pain management drugs approved for intravenous use.
	Epidural	Pain management drugs approved for epidural use.

*Pediatric Patient Population: one month to 21 years

**Neonate Patient Population: Newborns up to one month, includes preterm or term

Adult Patient Population

Module	Route of Administration	Infusates
BD Alaris™ Pump Module	Intravenous	Fluids, pharmaceutical drugs including high-alert medications, chemotherapy, and parenteral nutrition; red blood cells, platelets, and fresh frozen plasma.
	Subcutaneous	Fluids and pharmaceutical drugs approved for subcutaneous use.
	Epidural	Pharmaceutical drugs approved for epidural use.
	Intra-arterial	Pharmaceutical drugs approved for intra-arterial use.
	Irrigation of fluid spaces	Fluids approved for irrigation.
BD Alaris™ Syringe Module	Intravenous	Pharmaceutical drugs used for intravenous use.
	Subcutaneous	Pharmaceutical drugs approved for subcutaneous use.
	Epidural	Pharmaceutical drugs approved for epidural use.
	Intra-arterial	Pharmaceutical drugs approved for intra-arterial use.
Alaris™ PCA Module	Intravenous	Pain management drugs approved for intravenous use.
	Subcutaneous	Pain management drugs approved for subcutaneous use.
	Epidural	Pain management drugs approved for epidural use.

Intended Use Environment

The following BD Alaris™ System devices are intended to be used in a professional healthcare facility. These devices may be disconnected from the AC source and transported within the healthcare setting.

- BD Alaris™ PCU
- BD Alaris™ Pump Module
- BD Alaris™ Syringe Module
- Alaris™ PCA Module
- BD Alaris™ $EtCO_2$ Module
- Alaris™ Auto-ID Module

The following software are intended to support the BD Alaris™ PCU and its connected modules within the healthcare setting:

- BD Alaris™ Guardrails™ Editor
- BD Alaris™ Systems Manager
- BD Alaris™ Systems Maintenance
- BD Care Coordination Engine
- Infusion Adapter
- Calculation Services

The BD Alaris™ Guardrails™ Editor software is intended to be used by a healthcare professional in their desired workspace. The BD Alaris™ System Maintenance software is intended to be used by service personnel in their desired workspace.

Contraindications

Situations in which the device should not be used because the risk of use clearly outweighs the benefits.

BD Alaris™ System Contraindications

- The BD Alaris™ System is contraindicated for enteral route of administration.

Warnings, Cautions, and Notes

Product-specific warnings and cautions, covered in the applicable sections of this user manual, provide information needed to safely and effectively use the system.

WARNING

A statement that alerts the user to the possibility of injury, death, or other serious adverse reactions associated with the use or misuse of the device.

CAUTION

A statement that alerts the user of a potentially hazardous situation which, if not avoided, may result in minor or moderate injury to the user or patient or damage to the equipment or other property.

NOTE:
Notes contain supplementary information or emphasize a point or procedure.

Chapter 1
General Information

1.1 Summary of Warnings and Cautions

WARNING

- **Use BD manufactured parts in the operation and maintenance of your BD equipment. Use of repair or service parts, accessories, or syringes, dedicated infusion sets, or disposables that are not approved by BD is at customer's own risk and could exposed patients to risk of device failure, injury, or even death. In addition, use of such parts, accessories, or disposables may void the product warranty provided by BD.**
- **Inserting a finger or other object into the inter-unit interface (IUI) connector when the module is attached to the PCU could result in electrical shock.**
- **Do not modify the device. Modifying the device could affect the safety and efficacy of the BD Alaris™ System.**
- **Routine and proper battery maintenance must be followed to ensure safe operation of the BD Alaris™ System. Not performing proper battery maintenance according to the following instructions can impact the ability of the BD Alaris™ System to accurately generate battery runtime alarms, which may lead to interruption of therapy and cause patient harm.**
- **Use only BD batteries. The use of third-party batteries could affect the safety and efficacy of BD Alaris™ System and Alaris™ System products, leading to a risk of device failure, patient injury, or even death.**
- **Worn-out batteries must be disposed of properly, according to local regulations. To prevent electrical shock, exposure to battery chemicals or fire, do not open, incinerate, or short circuit.**
- **The battery cannot be repaired and should not be opened.**

CAUTION

To avoid damaging the keypads of the BD Alaris™ System, do not use sharp objects (such as pens or pencils) to activate switches.

1.2 Introduction

This manual describes how to service the:

- BD Alaris™ PCU model 8015
- BD Alaris™ Pump Module model 8100

This manual is used in conjunction with the following BD Alaris™ System documents and software:

- *BD Alaris™ System with Guardrails™ Suite MX User Manual*
- BD Alaris™ System Maintenance software
- *BD Alaris™ System Maintenance Software User Manual*

NOTE: BD Alaris™ refers to the PCU and pump modules that look like the following examples. BD Alaris™ also refers to all hardware components unique to these devices.

WARNING

Use BD manufactured parts in the operation and maintenance of your BD equipment. Use of repair or service parts, accessories, or syringes, dedicated infusion sets, or disposables that are not approved by BD is at customer's own risk and could exposed patients to risk of device failure, injury, or even death. In addition, use of such parts, accessories, or disposables may void the product warranty provided by BD.

NOTE:
Any 510(k) clearance from the Food and Drug Administration (FDA) or regulatory approval secured by BD to market the BD Alaris™ System was based on use of BD manufactured parts and equipment and BD validated and authorized disposables. A list of BD approved disposables that are validated to be compatible with the BD Alaris™ System is provided in the BD Alaris™ System user manual. BD has not validated any non-BD parts or accessories for the maintenance, repair or operation of the BD Alaris™ System and Alaris™ System Products. Because unauthorized parts and accessories were not included in the review and approval/clearance of the products, their use may adulterate and misbrand the product in violation of applicable laws.

WARNING

Inserting a finger or other object into the inter-unit interface connector when the module is attached to the PCU could result in electrical shock.

WARNING

Do not modify the device. Modifying the device could affect the safety and efficacy of the BD Alaris™ System.

CAUTION

To avoid damaging the keypads of the BD Alaris™ System, do not use sharp objects (such as pens or pencils) to activate switches.

NOTE:
If the PCU or Pump Module requires service while under warranty, it must be serviced only by BD-authorized service personnel. Refer to the Warranty and General Service sections in the *BD Alaris™ System with Guardrails™ Suite MX User Manual*.

NOTE:
The **SYSTEM ON** key becomes the *Power Off* key any time the BD Alaris™ system is in a watchdog state. The watchdog state is identified by:

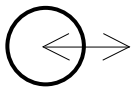
- a constant loud audio tone that cannot be silenced
- a non-responsive keypad
- a flashing red arrow above the **SYSTEM ON** key

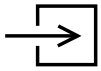
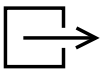
1.2.1 Symbols Glossary

The following table shows the symbols and the applicable standards used in this service manual.

Symbol (Graphical Image)	Definition	Symbol Title	Symbol Location	Ref. No. Standard
	The infusion Alarm silence symbol indicates that infusion alarms have been acknowledged and silenced. Press the CANCEL SILENCE soft key to reactivate a previously silenced alarm audio. If the alarm condition has not been resolved, the alarm audio will resume.	Bell Canceled Acknowledge (Alarm Cancel)	PCU Interface	Ref 5576-1 IEC 60417-1 Graphical Symbols for use on equipment. Part 1: Overview and Application
	The infusion alarm silence symbol indicates the module that has been acknowledged and silenced.	Bell Cancel (Alarm Cancel)	PCU Interface	Ref 5576-1 IEC 60417-1 Graphical Symbols for use on equipment. Part 1: Overview and Application

Symbol (Graphical Image)	Definition	Symbol Title	Symbol Location	Ref. No. Standard
	Type CF defibrillation-proof patient applied part.	Defibrillation-proof Type CF Applied Part.	PCU, Pump Module, Syringe Module, PCA Module device labels	Ref 5336 IEC 60417-1 Graphical Symbols for use on equipment. Part 1: Overview and Application
	Products bearing this mark have been tested and certified in accordance with applicable U.S. and Canadian electrical safety and performance standards.	Canadian and U.S. Certification Mark	PCU and all modules device labels	NA
	Indicates the need for the user to consult the instructions for use for important cautionary information such as warnings and precautions that cannot, for a variety of reasons, be presented on the medical device itself.	Follow instructions for use	PCU and all modules device labels	Ref. 10: IEC 60601-1, Table D.2, Medical electrical equipment — Part 1: General requirements for basic safety and essential performance.
	Alternating Current: Indicates device should be attached to alternating current source, 50/60 Hz only.	Alternating Current	PCU device label	Ref 5032 IEC 60417-1 Graphical Symbols for use on equipment. Part 1: Overview and Application
	Caution: Refer to accompanying documentation.	Caution	PCU and all modules, PCA handset, device labels, and external packaging	Ref 0434A IEC-TR-60878 Graphic symbols for electrical equipment used in a medical practice
	General Warning Sign: Symbols to be used with medical device labels, labeling, and information to be supplied.	Warning	PCU, Pump Module, Syringe Module, PCA Module, $EtCO_2$ Module, Auto-ID Module, PCA handset, device labels, and external packaging	Ref ISO-GRS-7010-W001 Medical devices. Symbols to be used medical device labels, labeling, and information to be supplied.
IPX1	Degree of particle and water ingress protection.	Degrees of ingress protection provided by enclosure	SpO_2 Module device label	Ref. 2: IEC 60601-1, Table D.3, General requirements for basic safety and essential performance
IPX2	Degree of particle and water ingress protection.	Degrees of ingress protection provided by enclosure	PCU and all modules, PCA handset device labels	Ref. 2: IEC 60601-1, Table D.3, General requirements for basic safety and essential performance

Symbol (Graphical Image)	Definition	Symbol Title	Symbol Location	Ref. No. Standard
	IUI Connector: Inter-Unit Interface connector used to establish power and communications between PCU and attached modules.	Input-output	PCU, all modules side panel	Ref. 5448 EC-TR-60878 Graphic symbols for electrical equipment in a medical practice
	Indicates the date on which a product was manufactured.	Date of manufacturer	Unique device identification (UDI) label for PCU, and all modules	Ref. 2497 EC-TR-60878 Graphic symbols for electrical equipment in a medical practice
	Indicates generally elevated, potentially hazardous, levels of non-ionizing radiation, or to indicate equipment or systems e.g. in the medical electrical area that include RF transmitters or that intentionally apply RF electromagnetic energy for diagnosis or treatment.	Non-ionizing electromagnetic radiation	PCU front panel and technical service manual	Ref. 5140 EC-TR-60878 Graphic symbols for electrical equipment in medical practice
	Federal Law restricts device to sale by or on the order of a licensed health provider.	Prescription use only	PCU device label, user manual and external packaging	21 CFR 801.109
	Complies with Australian Communications Requirements.	Australian Communications Authority	PCU device label and user manual	NA
	Meets FCC requirements per 21 CFR Part 15.	Federal Communication Authority	PCU and all modules device labels	Meets FCC requirements per 21 CFR Part 15
	Plug the PCU into an AC outlet during storage to ensure a fully charged battery. The AC indicator light () is on when the PCU is plugged in.	Power plug	PCU front panel	Ref 5334 IEC-TR-60878: Graphical symbols for electrical equipment in a medical practice
	Protective earth (ground)	Protective earth (ground)	PCU back panel	Ref 5019 IEC-TR-60878 Graphic symbols for use on electrical equipment in medical practice
	Identifies a connector for a serial data connection.	Serial interface	PCU back panel	Ref 5850 IEC 60417 Graphic symbols for use on electrical equipment
	Indicates that a control function is locked or to show the locked status.	Locking, general	PCU back panel	Ref 5569 IEC 60417 Graphic symbols for use on electrical equipment

Symbol (Graphical Image)	Definition	Symbol Title	Symbol Location	Ref. No. Standard
	Indicates that a function is not locked or to show the unlocked status.	Unlocking	PCU back panel	Ref 5570 IEC 60417 Graphic symbols for use on electrical equipment
	Identifies the manufacturer of a product.	Manufacturer	PCU and all modules device labels, user manual	Ref. 3082 EC-TR-60878 Graphic symbols for electrical equipment in a medical practice
	Defibrillation-proof type BF applied part complying with IEC 60601-1.	Defibrillation-proof Type BF applied part	PCA handset	Ref. 5334 EC-TR-60878 Graphic symbols for electrical equipment in a medical practice
	Type BF applied part complying with IEC 60601-1.	Type BF applied part	SpO_2 Module, $EtCO_2$ Module, Auto-ID Module device labels	Ref. 0795 EC-TR-60878 Graphic symbols for electrical equipment in a medical practice
	Gas inlet	Input; entrance	$EtCO_2$ Module front panel	Ref. 0794 EC-TR-60878 Graphic symbols for electrical equipment in a medical practice
	Gas outlet	Output; exit	$EtCO_2$ Module front panel	Ref. 0795 EC-TR-60878 Graphic symbols for electrical equipment in a medical practice
	Indicates packages contain electrostatic sensitive devices.	Electrostatic sensitive devices	Technical service manual, user manual	Ref. 5134 EC-TR-60878 Graphic symbols for electrical equipment in a medical practice
	Battery, general	To identify a device related to the power supply by primary or secondary battery, for instance a cover for the battery compartment, or the connector terminals.	PCU battery	Ref. 5101B IEC 60417 Graphical symbols for use on equipment

Symbol (Graphical Image)	Definition	Symbol Title	Symbol Location	Ref. No. Standard
⎓	Direct current	To indicate on the rating plate that the equipment is suitable for direct current only; to identify relevant terminals.	PCU battery	Ref. 5031 IEC 60417 Graphical symbols for use on equipment

Refer to the PCU and Pump Module chapters in the *BD Alaris™ System with Guardrails™ Suite MX User Manual* for the list of specifications.

1.2.2 Defined Terms

The following table identifies the defined terms or certain trademarked products and product features used throughout this document.

Product / Feature	Defined Term
Alaris™ Auto-ID Module	Auto-ID Module
Alaris™ $EtCO_2$ Module	$EtCO_2$ Module
Alaris™ PCA Module	PCA Module
BD Alaris™ $EtCO_2$ Module	$EtCO_2$ Module
BD Alaris™ Guardrails™ Suite MX data set	Data set

Product / Feature	Defined Term
BD Alaris™ PCU	PCU 
BD Alaris™ Pump Module	Pump Module 
BD Alaris™ Syringe Module	Syringe Module

1.2.3 Abbreviations, Acronyms, Symbols

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

Abbreviation	Description
*	“Active low” logic signal
/	Not true when signal is low
ADC	Analog-to-digital converter
Ah	Ampere-hours
AIL	Air-in-line
AKB	PCU keypad processor
APM	Advanced programming module
CBIT	Continuous built-in test
CF	CompactFlash (Radio card: Motorola, Symbol LS5137A2, Ambicom)
CI	Communication interface
CIB	Communication interface board
CMOS	Complementary metal oxide semiconductor
CODEC	Coder/decoder
CPLD	Complex programmable logic device
CQI	Continuous quality improvement
CSP	Critical security parameter
DAC	Digital-to-analog converter
DBG	Debug
DS	Display
DUART	Dual universal asynchronous receiver/transmitter
ESD	Electrostatic discharge
FDSA	Fluid delivery subassembly
FET	Field effect transistor
FIPS	Federal information processing standards
FPGA	Field-programmable gate array
IUC	Inter-unit connector
IUI	Inter-unit interface
IC	Integrated circuit
KBPOST	Keyboard power-on self test

Abbreviation	Description
KVO	Keep vein open
LCD	Liquid crystal display
LCS	Loser chip-select (signal)
LKB	Pump module keyboard
LED	Light-emitting diode
mA	milliamps
mL	milliliters
mmHG	millimeters mercury
NiMH	Nickle metal hydride
NMI	Nonmaskable interrupt
NSW	Nonswitched
POST	Power on self test
PKB	Keyboard processor
PSI	pounds per square inch
PSP	Power supply processor
PWM	Pulse width modulation
PWN	Pulse Width N: Signal method for generating an analog signal, using a digital source. Cycling the signal off and on creates the output that will behave as a constant voltage.
RAM	Random access memory
RE	Receiver enable (signal)
RoHS	Restriction of hazardous substances
ROM	Read-only memory
RTC	Real time clock
RxD	Receive data
SDRAM	Synchronous dynamic access memory
SEC-PRI	Secondary to primary
SIO	Serial input/output
SRAM	Static random access memory
TE	Transmitter enable (signal)
TH	Thermistor
TXxD	Transmit data
UCS	Upper chip select (signal)
VDAC	Voltage digital-to-analog converter

Abbreviation	Description
VDC	Direct current voltage
VEE	Voltage emitter
VRAW	Voltage raw (unregulated voltage)
VTBI	Volume to be infused
WDI	Watchdog input
WDO	Watchdog output
YKB	Logic keyboard processor

1.3 Alarms and Messages

Infusion alarm messages appear on the scrolling Message Display bar of the module or the PCU. When an alarm condition occurs, an audible alarm sounds, and the Alarm Status Indicator flashes red or yellow, or maintains a steady yellow appearance depending upon the priority of the alarm. PCU technical alarms include audio tones, and the title bar may flash red or yellow, or maintain a steady yellow appearance depending upon the priority of the alarm. Refer to the *BD Alaris™ System with Guardrails™ Suite MX User Manual* for detailed information.

1.4 Battery Management System

This section contains general information on the battery management system. Included is information on how the power supply processor monitors and maintains the battery, controls the system on/off for the rest of the instrument, and provides support functions for the main processor.

The battery management system consists of the power supply processor integrated circuit (IC) and various sensors and signal processing circuits. The power supply processor performs the following functions:

- Controls the battery charger
- Provides a battery status “battery gauge”
- Monitors battery voltage and temperature
- Controls instrument power source (on/off function)

The power supply processor communicates with the main processor through a serial data channel. The main processor issues commands to the battery manager, which then responds with status information and data using this channel.

1.4.1 Battery Maintenance

WARNING

Routine and proper battery maintenance must be followed to ensure safe operation of the BD Alaris™ System. Not performing proper battery maintenance according to the following instructions can impact the ability of the BD Alaris™ System to accurately generate battery runtime alarms, which may lead to interruption of therapy and cause patient harm.

WARNING

The battery cannot be repaired and should not be opened.

WARNING

Worn-out batteries must be disposed of properly, according to local regulations. To prevent electrical shock, exposure to battery chemicals or fire, do not open, incinerate, or short circuit.

NOTE:
For PCUs with version 12.1.1 and later, follow the instructions mentioned in all of the following sections:

- *Battery Maintenance* on page *1-15*.
- *Replacement of Batteries with New Batteries* on page *1-17*.
- *Removing Batteries from the BD Alaris™ PCU* on page *1-17*.
- *Performing Battery Conditioning (Fast or Optimal) in Maintenance Mode (v12.1.1 and Later)* on page *1-17*.

NOTE:
For PCUs with any other version of software, follow the procedures in Service Bulletin 592A (P/N P00000213).

For optimum battery performance, follow the instructions given below:

- The PCU is shipped with the battery in a discharged condition. Before the PCU is released for use, the battery must be appropriately charged by plugging the PCU into a hospital-grade AC outlet, and executing one of the following steps . This ensures proper battery operation when the PCU is first set up for patient use.
  - *Performing Battery Conditioning (Fast or Optimal) in Maintenance Mode (v12.1.1 and Later)* on page *1-17*.

    Or
  - Charge the battery for 16 hours.

  The battery must be replaced every two years from the date of initial battery charge/conditioning.
- Leave the power cord connected to a hospital-grade AC power source whenever available. The battery is intended as a backup system should the PCU need to be disconnected from AC power.

- If the device has been used on battery power, ensure that the battery is fully charged prior to using the device on battery power again. To fully charge a depleted battery, connect the device to a hospital-grade AC power source for 16 hours.
- Do not store a PCU with a battery installed in excess of 86°F (30°C) or less than 50°F (10°C). If the PCU is stored at temperatures outside of this range, the battery must be removed and stored at 50–86°F (10–30°C).
- If the batteries are to be stored for more than one year, they should be conditioned before the PCU is released for use by following the procedure in *Performing Battery Conditioning (Fast or Optimal) in Maintenance Mode (v12.1.1 and Later)* on page *1-17*.
- In the following situations, the battery capacity must be restored to ensure proper battery operation by executing the steps in *Performing Battery Conditioning (Fast or Optimal) in Maintenance Mode (v12.1.1 and Later)* on page *1-17*.
  - When a PCU with a battery has been out of use and not plugged into AC power for one or more months, it will not have full capacity and/or charge.
  - The battery should be conditioned every 12 months regardless of use.

1.4.2 Replacement of Batteries with New Batteries

BD requires replacing the battery every two years at minimum, even if used and maintained under proper conditions.

WARNING

Use only BD batteries. The use of third-party batteries could affect the safety and efficacy of BD Alaris™ System and Alaris™ System products, leading to a risk of device failure, patient injury, or even death.

When replacing an existing battery with a new battery received from BD, the new battery must be appropriately charged after installation by plugging the PCU into a hospital-grade AC outlet, and executing one of the following steps. This ensures proper battery operation when the PCU is first set up for patient use.

- *Performing Battery Conditioning (Fast or Optimal) in Maintenance Mode (v12.1.1 and Later)* on page *1-17*.

  Or

- Charge the battery for 16 hours.

1.4.3 Removing Batteries from the BD Alaris™ PCU

If the battery has been removed from the PCU during maintenance or repair and a battery is reinstalled, the battery capacity needs to be checked by executing *Performing Battery Conditioning (Fast or Optimal) in Maintenance Mode (v12.1.1 and Later)* on page *1-17*.

NOTE:

- Batteries provided with a PCU should be retained with that PCU and not used in another device.
- The start date for determining a two-year use period is based on the date of initial installation in a PCU.

1.4.4 Performing Battery Conditioning (Fast or Optimal) in Maintenance Mode (v12.1.1 and Later)

NOTE:
For PCUs using v12.1.0 or earlier software versions, refer to the battery conditioning procedures documented in *Service Bulletin 592A* (P/N P00000213).

The Battery Conditioning (Fast or Optimal) in Maintenance Mode on the PCU may only be used with the following steps, and may only performed by qualified service personnel:

1. Attach the PCU to the IV pole.
2. Plug the PCU into a hospital-grade AC outlet.
3. Access Maintenance Mode. To access Maintenance Mode options, hold down the Tamper Resist switch on the rear of the PCU during power-up (refer to *Maintenance Mode* on page *6-3*).

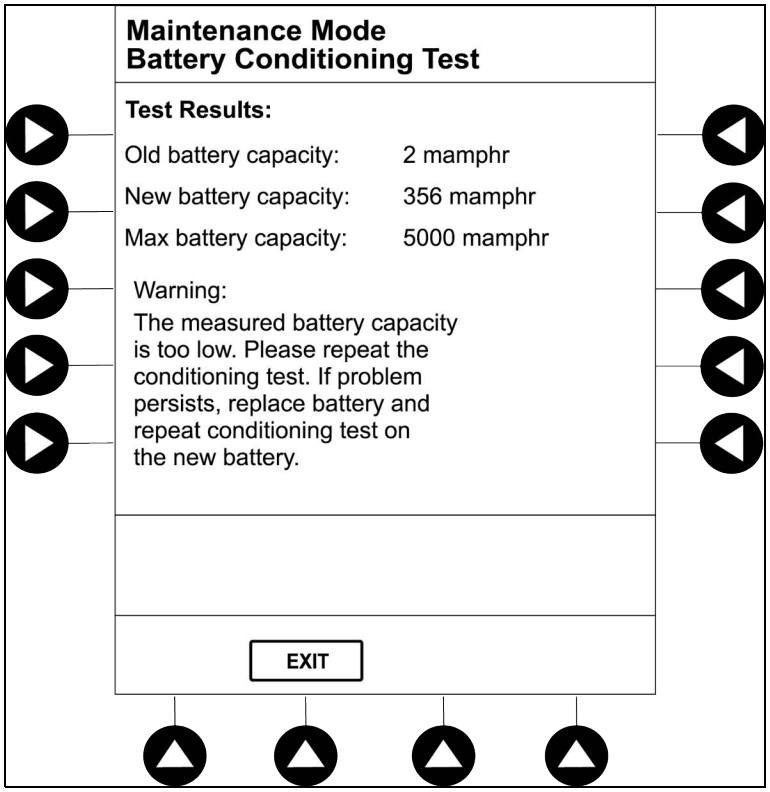
4. Press the **Proceed** soft key on Maintenance Mode.
5. Press the **Standalone Test/Maintenance** soft key.
6. Press the **Hardware Tests** soft key.
7. Press the **Battery Conditioning** Test soft key.
8. Press the **Fast Conditioning** or **Optimal Conditioning soft key**. Fast Conditioning is more time efficient and may take up to 12 hours, depending on the health of the battery. Optimal Conditioning may take 20 hours or more to complete.

   NOTE
   During the conditioning process, do not disconnect AC power. If AC power is disconnected during conditioning, the process must be restarted.

9. Press the **Confirm** soft key to start conditioning.

   At the completion of the conditioning process, a display screen with the old and new battery capacity appears. It is not necessary to run the battery conditioning test a second time.

   After battery conditioning, if the PCU displays the following message, the battery needs to be replaced:



1.4.5 Battery and Charging Process

The battery pack is a 10-cell (1.2V per cell), high-capacity nickel metal hydride (NiMH) type, rated at 12 volts and 4 amp-hours (with a minimum of 500 charge cycles). It has a built-in temperature sensor that allows the battery manager to monitor battery temperature.

- Self-resetting thermal fuse at 70°C.
- Self-resetting current limit sense at 5A.

The battery charge circuit charges the battery with a constant current of 2A whenever the power supply processor turns on the charger. The power supply processor regulates the average charge current by turning the charger on and off with the appropriate duty ratio. The battery charge cycle consists of four modes: fast charge, top-up charge, float charge, and terminates charge.

- **Fast Charge:** Fast charge is initiated whenever the battery is between 10°C and 27°C, and has been discharged by more than 200 amp-seconds through actual use or self-discharge. Leaving the instrument unplugged for a day would cause about 200 amp-seconds of self-discharge. The charge current is a continuous 2A.

  The end of a fast charge is detected when:

  - Battery temperature rises (at a rate of 0.7°C/min) above its start-of-charge value to 30°C*
  - Battery voltage declines by 50mV below its peak value
  - Total charge time exceeds 2.6 hours

  *With a 1.4A system load, the rate can be 0.6°C/min

- **Top-Up Charge:** The top-up charge phase begins at the end of the fast charge phase, finishes adding the last few percent of charge to the battery, and balances individual cell charges. This phase charges at an average rate of 400mA.
- **Float Charge:** The float charge phase begins at the end of the top-up phase and helps maintain a fully charged battery. This phase charges at an average rate of 225mA and 1 second per minute.
- **Terminates Charge:** The power supply processor does not allow charging to begin unless the battery temperature is 10–40°C. The power supply processor terminates the charge if the battery temperature drops below 10°C or rises above 55°C.

1.4.6 System On/Off

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

If an error has been detected that causes the watchdog to be in alarm, a push of either power switch immediately causes the power to be turned off, without intervention by the power supply processor.

1.4.7 Real Time Clock with NVRam Control Lithium Battery-Backed RTC

The real time clock (RTC) switches the SRAM voltage to prevent memory loss during a power loss.

WARNING

Use only BD batteries. The use of third party batteries could affect the safety and efficacy of BD Alaris™ and Alaris™ products.

Several features are included in the battery manager to help properly maintain the battery.

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

Storing the battery does not damage the battery as it would if it were a lead-acid type battery. Connect the PCU to AC power to recharge batteries.

1.4.7.1 Disposal

WARNING

Worn-out batteries must be disposed of properly, according to local regulations. To prevent electrical shock, exposure to battery chemicals or fire, do not open, incinerate, or short circuit.

There are no federal, state, or local laws managing the disposal of NiMH batteries. NiMH batteries are recyclable. To learn about recycling batteries at INMETCO, visit their website at http://www.inmetco.com.

Table 1-1: Battery Trip Points

Battery Voltage	Instrument Response

Coulomb Control	• Low Battery Alarm message: 30 minutes left plug in now.
	  • 30 minutes left on battery gauge
	  • Instrument continues to function
	  • Warning tone activated
	• Very low battery alarm message:5 minutes to shut down plug in now.
	  • 5 minutes left on gauge
	  • Instrument continues to function
	  • Silence able alarm

11.20V	• Battery discharged (depletion)
	  • Instrument does not pump
	  • Silence able alarm

11.00V	• Battery Discharged Powering Down • Backup speaker activated (watchdog alarm)
10.8V	• Disconnect battery • Backup speaker continues to alarm until super cap is discharged.

1.4.8 Battery Capacity

Batteries have specific conditions where they are guaranteed to meet their published specifications. Deviations from these conditions typically result in a reduction of available capacity. Manufacturers of NiMH batteries rate capacities, usually expressed in Ah (Ampere-hours), based on a specified ideal charge and discharge condition, as well as the use of a new battery.

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

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

Many conditions can affect the battery capacity. The following conditions have the most practical impact on the battery capacity delivered in this instrument.

- **Battery Alarm Voltage:** The battery alarm voltage is the voltage where the PCU stops operating and generates an alarm indicating that the PCU needs to be connected to AC power. Under perfect conditions, a battery of 10 cells connected in series reaches the end of discharge at 9.0V. However, the cells are not perfectly matched, so some will reach 0.9V before others. The problem occurs when a cell in series with other cells goes below 0.9V and into cell reversal, which permanently damages that cell. On the other hand, setting the alarm voltage to a higher value to compensate for imperfectly matched cells results in reduced run times with available capacity. The user sees this as premature low-battery warnings and alarms. The PCU deals with this by increasing the alarm voltage to guarantee that the battery is not damaged and by reducing the assumed capacity to below that printed on the battery. The battery gauge is intended to show the minimum run time left on the battery, taking all these factors into account.
- **Charge Rate:** The ideal charge rate requires 15 hours to fully charge the battery, which is undesirable from the user's perspective. The instrument provides a multiphase charge cycle which results in about 80% capacity in the first 2 hours after a fast charge. The next charge phase, top-up, is designed to finish the charge and to bring all individual cells to the fully charged state, essentially rematching them. See the *Battery and Charging Process* on page *1-19* for fast charge and top-up charge information. If the top-up charge is not completed, the cell mismatch is not reduced and the cumulative capacity reduction occurs. Top-up is a 3-hour charge, but the elapsed time to complete it may be over 5 hours, as the charger is turned on and off to keep the battery cool during that time.
- **Cycle Life and Aging:** Batteries wear out as they get older and go through many charge/discharge cycles; the chemicals and materials used to construct the cell break down.
- **Partial Discharge/Recharge:** When a battery is partially discharged and then charged for less than the full time, differences between the individual cell capacities result in cells completing their charges at different times. If the full charge sequence is not completed, the cell mismatch becomes progressively greater. This is viewed by the user as low apparent run times and premature low-battery warnings and alarms. The problem is cumulative in that the mismatch increases for every partial cycle. The lowered capacity is not permanent, but may require two to three full discharge/charge cycles to recover. The instrument deals with this by reducing the run time displayed based on a limited history of partial cycles.

- **Temperature During Charge:** As the effective ambient temperature of the battery increases, the amount of charge that the battery accepts decreases. At an ambient temperature of 35°C, an enclosed battery temporarily accepts only about 90% of the charge it would otherwise accept at 23°C.

1.5 Pole Clamp Features

The pole clamp of the PCU adapts to a wide variety of surfaces, to provide versatility. The pole clamp features include:

- Ergonomically designed knob.
- Accommodates pole diameters from 5/8 to 1 3/8 inches (15.9 to 34.9mm).
- Vertical or horizontal orientation, allowing it to adapt to both IV poles and bed rails.

The BD Alaris™ System should be in the vertical position during operation.

NOTE:
When attaching the BD Alaris™ or Alaris™ System to an IV pole, ensure the pole clamp is securely tightened to prevent the system from slipping down the pole.

1.6 Memory

- Flash 16 MB (nonvolatile): Stores boot and application codes for the PCU, CQI logs, event logs, error logs, and battery logs.
- CompactFlash (CF) 64 MB (nonvolatile): Stores audio tones, the data set, and “restorable” patient data.
- SDRAM 128 MB (volatile): Executes transferred application code from flash. Stores patient-specific program and instantaneous information.

Chapter 2
Checkout and Configuration

2.1 Summary of Warnings and Cautions

WARNING

If a device has been dropped or severely jarred, remove it from use immediately. It should be thoroughly tested and inspected by qualified service personnel to ensure proper functioning prior to reuse.

CAUTION

- Keep the Pump Module door closed when not in use to avoid damage to the door components.

2.2 Introduction

This chapter describes initial setup and configuration of the PCU and Pump Module. Due to product changes over time, configurations described in this chapter may differ from the instrument being serviced.

2.3 New Instrument Checkout

Before placing a new instrument in use, perform a check-in procedure, using the BD Alaris™ System Maintenance software.

When powering up the PCU, verify that the instrument beeps and all display LED segments flash. This confirms that the PCU has performed its self test and is operating correctly.

During operation, the PCU continually performs a self test, and sounds an alarm and displays a message if it detects an internal malfunction.

Contact BD-authorized service personnel if the PCU or Pump Module has physical damage, fails to satisfactorily pass the startup sequence, fails a self test, or continues to alarm.

WARNING

If a device has been dropped or severely jarred, remove it from use immediately. It should be thoroughly tested and inspected by qualified service personnel to ensure proper functioning prior to reuse.

CAUTION

- Keep the Pump Module door closed when not in use to avoid damage to the door components.

2.4 Configuration Options and Setup - General

Refer to the *BD Alaris™ System with Guardrails™ Suite MX User Manual* for the following system and Pump Module settings information.

2.4.1 Configuration Notes

- Changes to factory default values are retained after a power cycle. Factory Default status is shown on the **System Configuration - Module** screen of the PCU (see section *Access System Configuration Options* on page *2-5*).
- If **Factory Default** is **Yes**, then all configuration settings are set to their factory default.
- If **Factory Default** is **No**, then one or more configuration settings have been changed.
- If desired, select **Factory Default** and set it to **Yes**, which sets all configuration settings to their factory default.
- With the Profiles feature enabled, settings are configured independently for each profile. A hospital-defined, best-practice data set must be loaded to enable the Profiles feature. Date and Time is a system setting and is the same in all profiles.
- If Guardrails™ Editor software is being used to load data sets into the PCU, leave the configuration settings at the factory defaults. When a data set is loaded, it overrides configuration settings as each profile in the data set has its own individual configuration settings.

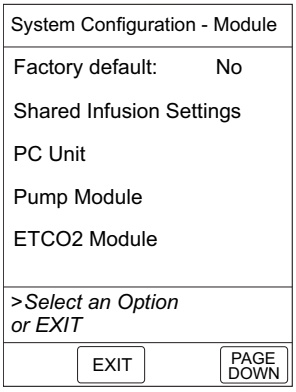
2.4.2 Configuration Setup Notes

- Disabling the **Profiles** option disables the loaded data set and allows a configuration option to be changed. (See section *Profiles* on page *2-13* for instructions on setting the Profiles option.)
- Pressing the **EXIT** soft key while in a **System Configuration - Module** screen immediately powers down the system, with no Powering Down display.
- Pressing the **EXIT** soft key while in a **System Configuration** screen returns the display to the main **System Configuration - Module** screen (shown in Section *Access System Configuration Options* on page *2-5*).
- Pressing the **Confirm** soft key while in a **System Configuration** options screen:
  - Accepts the existing setting or setting change
  - Displays the next option setting screen (if applicable) or returns the display to the **System Configuration** screen
- Pressing the **CANCEL** key on the PCU while in a **System Configuration** option screen:
  - Leaves a setting unchanged
  - Returns the display to the **System Configuration** screen

2.5 Configuration Setup - PC Unit

2.5.1 Access System Configuration Options

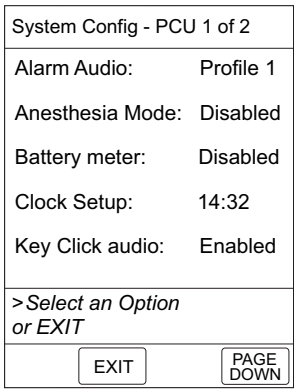
1. Hold the **OPTIONS** key at power up.



For PC Unit software versions 12.3.1 and later

2. Press the **PC Unit** soft key.

   The first page of the PCU configuration options appears.



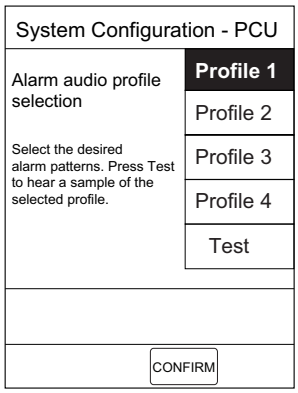
3. To view additional options, press the **PAGE DOWN** soft key.

2.5.2 Alarm Audio

NOTE:
Profile 4 audio setting supports standards compliance. Setting the Alarm Audio Profile to Profile 4 could potentially result in the BD Alaris™ alarms sounding similar to other medical devices, such as respirators and monitoring services that are compliant with the same safety standards.

There are different alarm profiles available for use in specific hospital environments.

1. On **the System Configuration - PCU** options screen, press the **Alarm audio profile selection** soft key.



2. To change the profile selection, press the soft key next to the desired profile. To hear a sample of the selected audio alarm, press the **Test** soft key.
3. To accept the profile selection, press the **Confirm** soft key.

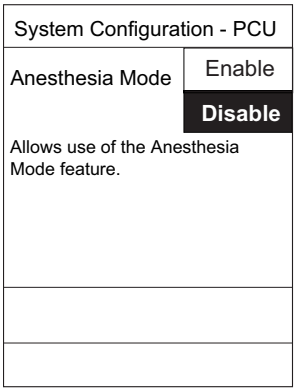
2.5.3 Anesthesia Mode

Anesthesia Mode allows access to additional drugs in each profile that are appropriate to anesthesiology. This mode also features permanent pause and the ability to set higher air-in-line settings.

When Anesthesia Mode is enabled:

- A channel can be paused indefinitely without an alarm.
- The air-in-line setting associated with the profile can be set up to 500µl.
- All Guardrails™ limits are set to Soft.
- Limit checking mode is set to Smart.
- Key-press audio is turned off.
- Auto-Restart for Anesthesia Mode is set to 9 and is not configurable.
- Panel Lock through Tamper Resist Mode or Authorized User Mode is not available.
- Guardrails™ drug list defaults to drugs designated by editor software as anesthesia only. All Guardrails™ drugs in a profile can be viewed by pressing the ALL DRUGS soft key.
- Bolus Dose is automatically available for:
  - Guardrails™ drugs that have Bolus Dose limits defined
  - Generic drug calculation setup
- Anesthesia Mode, alternating with other required prompts, appears on the Main Display.
- Callback audio for paused module is permanently silenced.
- Review of drug calculation setup page is omitted when restoring a stopped drug calculation.
- Clinical Advisories are not displayed.

1. On the **System Configuration - PCU** options screen, press the **Anesthesia Mode** soft key.

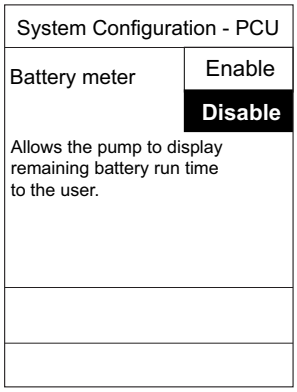


2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

2.5.4 Battery Meter

When **Enable** is selected, the approximate run time remaining on the battery is displayed (as a numeric value). The run time depends on the battery charge/condition and the load on the battery at the time. Run time may also be affected by the operating mode, rate, monitoring options, and back pressure. The battery meter reading may take up to 5 minutes to stabilize after starting an infusion.

1. On the **System Configuration - PCU** options screen, press the **Battery meter** soft key.

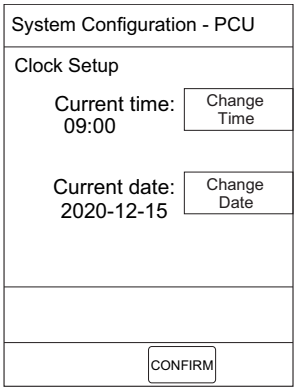


2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

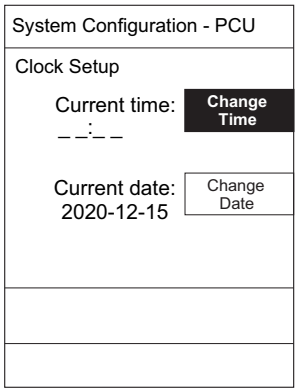
2.5.5 Clock Setup

The **Clock setup** option is used to set the time and date.

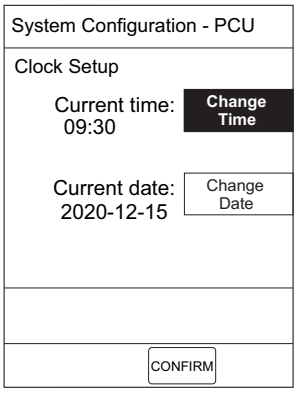
1. On the **System Configuration - PCU** options screen, press the **Clock setup** soft key.



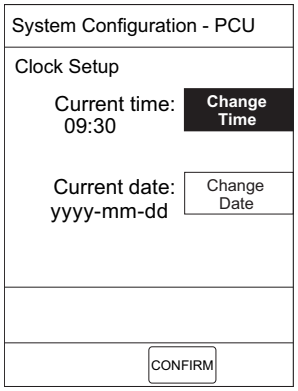
2. To change the time:
   a. Press the **Change Time** soft key.



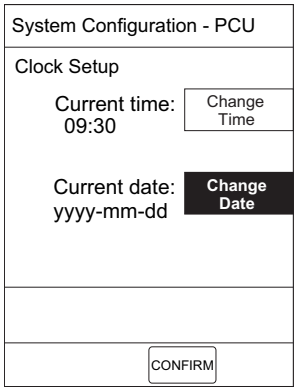
   b. Enter the current time.



3. To change the date:
   a. Press the **Change Date** soft key.



b. Enter the date.

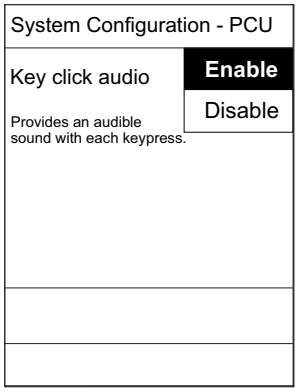


4. To accept the settings, press **t**he **CONFIRM** soft key.

2.5.6 Key Click Audio

The **Key click audio** option is used to **Enable** or **Disable** the keypress audio feedback.

1. On the **System Configuration - PCU** options screen, press the **Key click audio** soft key.

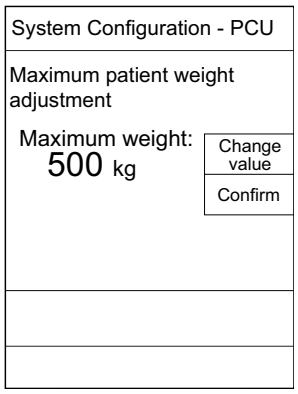


2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

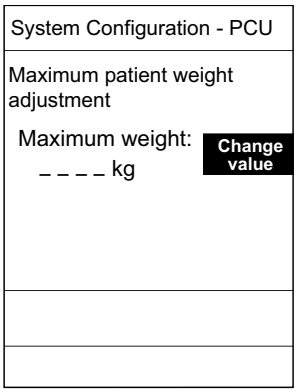
2.5.7 Maximum Patient Weight

The **Maximum Patient Weight** option is used to set the maximum patient weight. The range of allowable values is 0.1 kg to 500 kg.

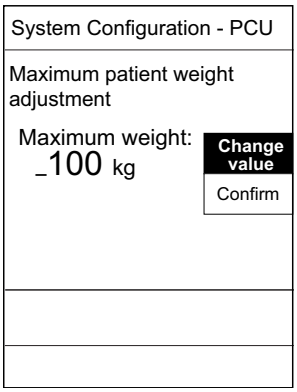
1. On **the System Configuration - PCU** options screen, Page 2, press the **Maximum patient weight** adjustment soft key.



2. To change maximum patient weight:
   a. Press the **Change value** soft key.



   b. Enter the new weight.

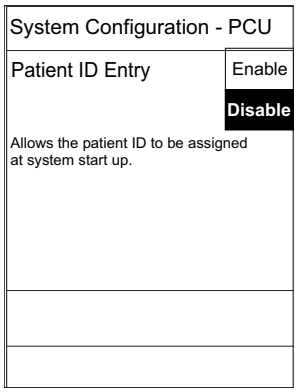


3. To accept the setting, press the **Confirm** soft key.

2.5.8 Patient ID Entry

Enabling the Patient ID Entry feature allows an alphanumeric patient identifier to be entered in the **Patient ID Entry** screen that displays after responding **Yes** to **New Patient?**. When the Patient ID Entry feature is disabled, the **Patient ID Entry** screen can be accessed only through the **Systems Options** menu.

1. On the **System Configuration - PCU** options screen, Page 2, press the **Patient ID Entry** soft key.



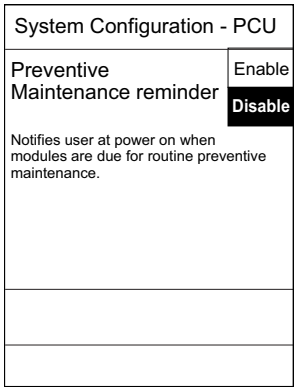
2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

NOTE:
Do not use protected health information (PHI) identifiers (for example, patient name, social security number, and so on) for Patient ID entries.

2.5.9 Preventative Maintenance (PM) Reminder

Enabling the PM reminder feature allows a maintenance reminder message to appear when the PCU or an attached module is due for routine scheduled preventive maintenance.

1. On the **System Configuration - PCU** options screen, Page 2, press the **Preventive Maintenance reminder** soft key.

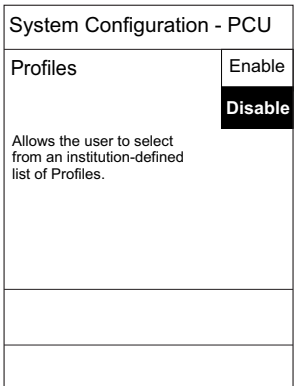


2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

2.5.10 Profiles

A profile is a unique set of system configuration settings and best-practice guidelines for a specific patient population or patient type. Profiles are established prior to system implementation and are defined in the data set that can be loaded into the PCU. Thus, the **Profiles** option can be enabled only when a data set is loaded. If a data set is loaded, disabling the **Profiles** option here disables the loaded data set. When the Profiles option is re-enabled, the data set is again accessible.

1. On the **System Configuration - PCU** options screen, page 2, press the **Profiles** soft key.



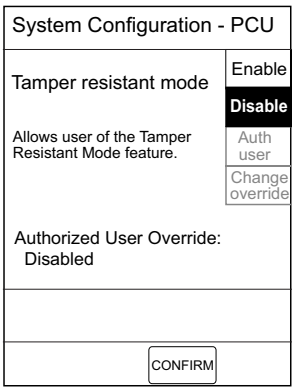
2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

2.5.11 Tamper Resist

Tamper resist provides a quick, one-touch lockout of the front panel keypad when an infusion is running or during a delay state. When **Enable** is selected, the tamper resist mode can be activated or deactivated by pressing and holding the Tamper Resist switch on the back of the PCU for 3 to 4 seconds. If the infusion is not running or paused, pressing the tamper resist button will only produce a double error beep.

Refer to the *BD Alaris™ System with Guardrails™ Suite MX User Manual* for more detailed information.

Before accessing the Tamper resist mode, make sure that all modules that are to be operating are set up because module setup cannot be modified when Tamper Resist mode is disabled.

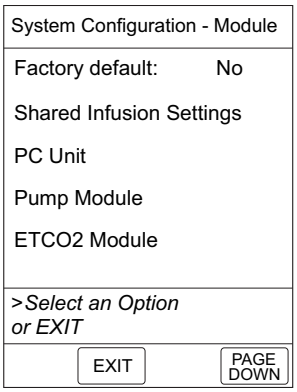


1. On the **System Configuration - PCU** options screen, Page 2, press the **Tamper resistant mode** soft key.
2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

2.6 Configuration Setup - Pump Module

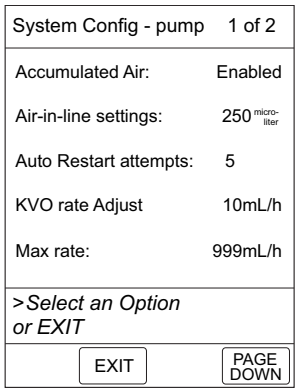
2.6.1 Access System Configuration Options

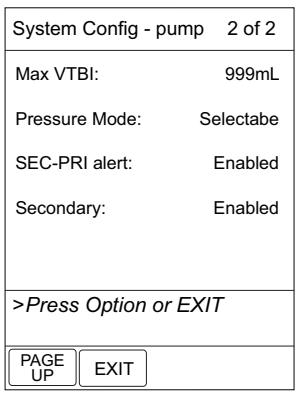
1. Hold the **OPTIONS** key at power up.



For PCU software versions 12.3.1 and later

2. Press the **Pump Module** soft key. To view additional options, press the **PAGE DOWN** soft key.



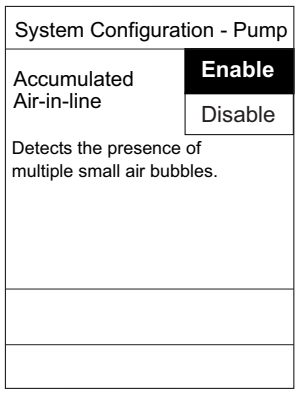


2.6.2 Accumulated Air-in-line

When the accumulated air-in-line option is set to **Disable**, the system sounds an alarm only when it detects an air-in-line bubble larger than the bubble size set as the air-in-line detection threshold listed in *Threshold* on page *2-16* . (In Anesthesia mode only, the threshold value can be set to 500µl.) See Section *Air-in-Line Settings* on page *2-16*.

When **Enable** is selected, the air-in-line system detects and responds to anair-in-line bubble size greater than the selected air-in-line threshold listed in *Threshold* on page *2-16* . The **Enable** setting also detects and responds to multiple small bubbles of a predetermined number, depending on the bubble size selected as the **Air-in-line** detection threshold. For more information on the Accumulated Air-in-Line feature, see the *BD Alaris™ System with Guardrails™ Suite MX User Manual v12.3.1*, Chapter 3, Specifications section.

1. On the **System Configuration - Pump** options screen, press the **Accumulated Air-in-line** soft key.



2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

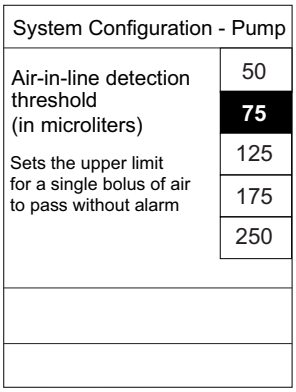
2.6.3 Air-in-Line Settings

The air-in-line detection threshold specifies the amount of air that can pass through the detector in a single bolus before an alarm sounds. In normal use, the threshold can be set to a value listed in Table 2-1. The default setting is 75µl. (In Anesthesia mode only, the threshold value can be set to 500µl.)

Table 2-1: Threshold

Air-in-Line Bubble Size	PCU Software Versions
50	All versions
75 (Default setting)	All versions
125	Version 12.x only
175	Version 12.x only
250	All versions
500	All versions in Anesthesia mode only

1. On the **System Configuration - Pump** options screen, press the **Air-in-line detection threshold** soft key.



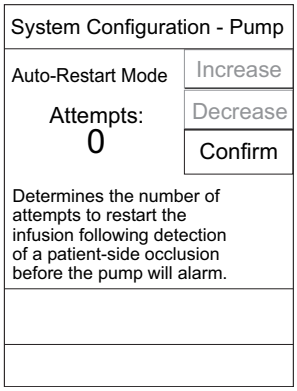
For PCU software version 12.3 and later

2. To change the Air-in-line detection threshold setting, press the soft key next to the applicable option.

2.6.4 Auto-Restart Attempts

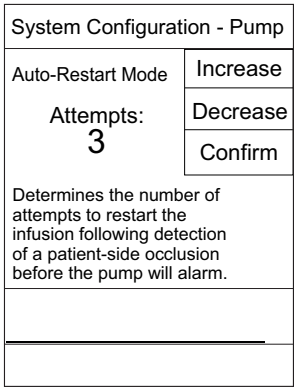
The Auto-Restart Mode setting determines the number of attempts (0 to 9) that the PCU makes to restart the infusion (following detection of a patient-side occlusion) before it alarms “Occlusion.”

1. On the **System Configuration - Pump** options display, press the **Auto-Restart Mode Attempts** soft key.



2. To set the number of attempts, press the **Increase** or **Decrease** soft key.

   When the maximum number of attempts (9) is selected, **Increase** is unavailable (disabled).

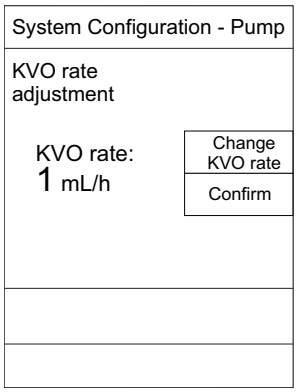


3. To accept the setting, press the **Confirm** soft key.

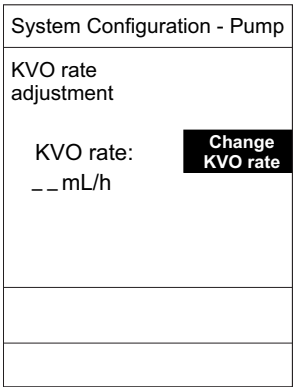
2.6.5 KVO Rate Adjustment

The KVO (Keep Vein Open) Rate Adjustment option is used to select the KVO rate (0.1 to 20mL/h). This determines the rate of fluid flow after "Infusion Complete" has occurred.

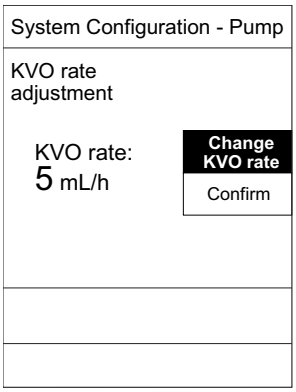
1. On the **System Configuration - Pump** options screen, press the **KVO rate adjustment** soft key.



2. To change the KVO rate:
   a. Press the **Change KVO rate** adjustment soft key.



   b. Enter the desired rate.



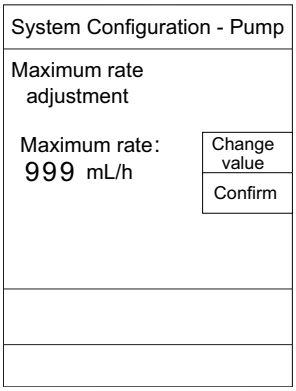
3. To accept the KVO rate setting, press the **Confirm** soft key.

NOTE:
If the programmed rate is less than the KVO rate, the pump will go into KVO alert, but continue to run at the programmed rate.

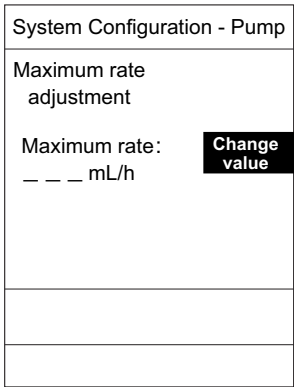
2.6.6 Maximum Rate

The maximum rate option is used to select the maximum rate of the infusion flow (0.1 to 999mL/h).

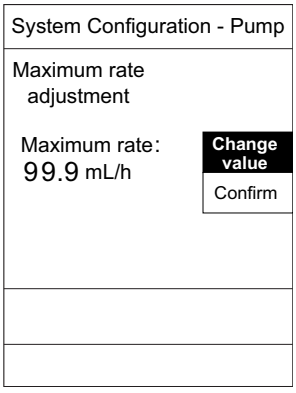
1. On the **System Configuration - Pump** options screen, press the **Maximum rate** soft key.



2. To change the rate:
   a. Press the **Change value** soft key.



   b. Enter the desired rate.

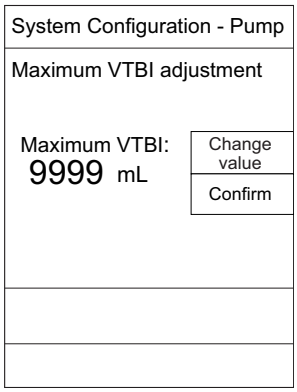


3. To accept the setting, press the **Confirm** soft key.

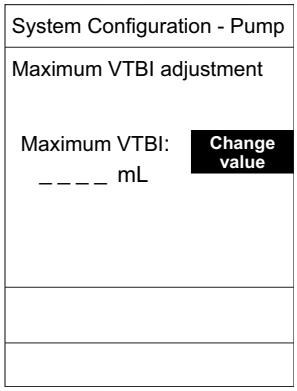
2.6.7 Maximum VTBI

The Maximum VTBI option is used to select the maximum volume to be infused (0.1 to 9999mL).

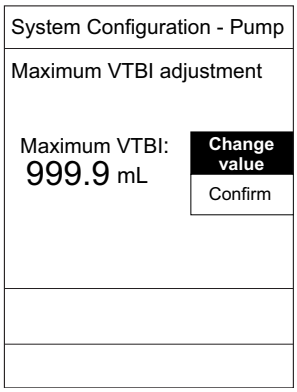
1. On the **System Configuration - Pump** options screen, Page 2, press the **Maximum VTBI** adjustment soft key.



2. To change the VTBI:
   a. Press the **Change value** soft key.



   b. Enter the desired VTBI.



3. To accept the setting, press the **Confirm** soft key.

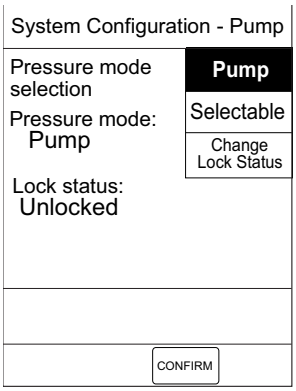
2.6.8 Pressure Mode

There are two pressure modes available that determine the patient-side occlusion limit. The selected pressure mode can be **Unlocked** or **Locked** after being confirmed.

Pump: The occlusion alarm threshold is 525 mmHg at flow rates of 30ml/h or greater. For rates less than 30ml/h, occlusion pressure is rate-dependent.

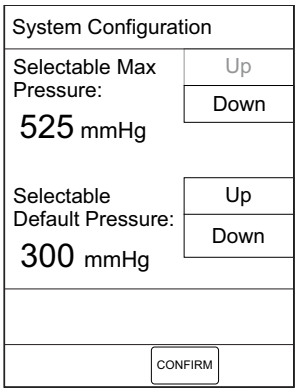
Selectable: An occlusion limit of 50 to 525 mmHg (approximately 1 to 10.2 psi) can be selected in 25 mmHg increments.

1. On the **System Configuration - Pump** options display, Page 2, press the **Pressure mode selection** soft key.



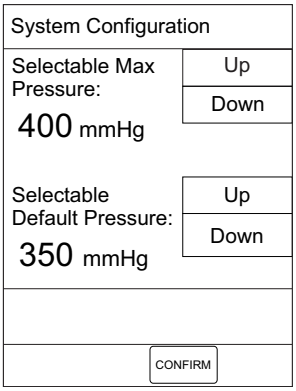
2. To change the Pressure mode setting:
   a. Ensure that the Lock status is **Unlocked**.
   b. Press the soft key next to the applicable option (**Pump** or **Selectable**).

      If **Selectable** mode is selected, the following screen appears.

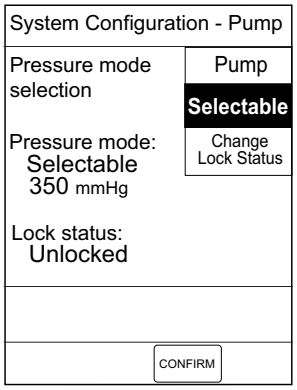


3. To change the pressure setting:
   a. Press the **Up** or **Down** soft key next to the applicable option.

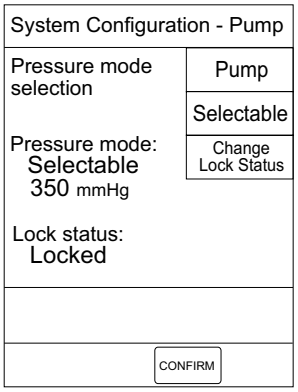
      When the maximum value for a pressure setting is selected, **Up** is unavailable (disabled). When the minimum value for a pressure setting is selected, **Down** is unavailable (disabled).



   b. To accept the setting, press the **CONFIRM** soft key.



   c. To lock the selection, press the **Change Lock Status** soft key.

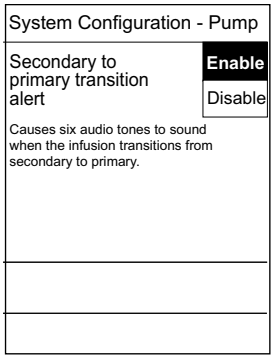


4. To accept the setting, press the **CONFIRM** soft key.

2.6.9 SEC-PRI Alert

When the SEC-PRI Alert option is set to **Enable**, an alarm sounds when the pump switches from Secondary to Primary mode.

1. On the **System Configuration - Pump** options screen, Page 2, press the **SEC-PRI alert** soft key.

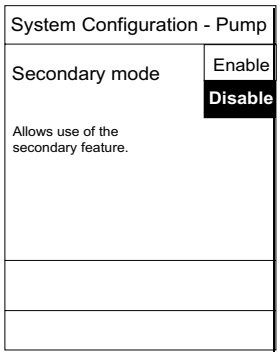


2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

2.6.10 Secondary Mode

The Secondary mode is used to deliver two different fluids sequentially through the same line.

1. On the **System Configuration - Pump** options screen, Page 2, press the **Secondary** soft key.

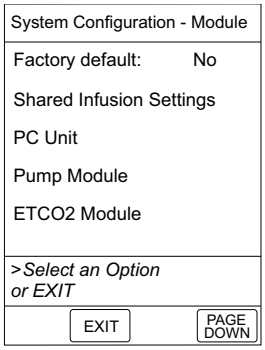


2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

2.7 Configuration Setup - Shared Infusion

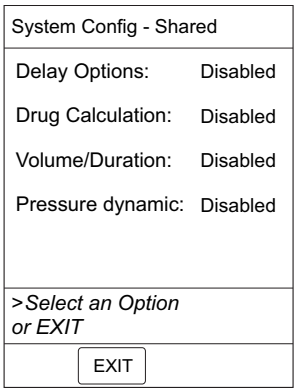
2.7.1 Access System Configuration Options

1. Hold the **OPTIONS** key at power up.



For PCU software versions 12.3.1 and later

2. Press the **Shared Infusion Settings** soft key.



PCU software version 12.x and later

2.7.2 Delay Options

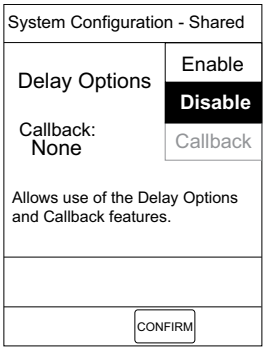
Enabling Delay Options allows the system to be programmed to delay the start of an infusion as follows:

- For PCU v12.3.1 and higher:
  - Delay for: delayed duration for 1 minute up to 11 hours 59 minutes.

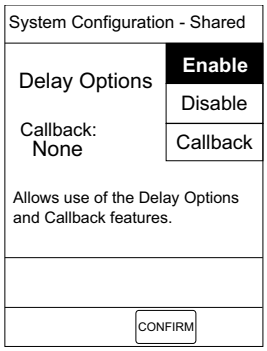
A callback for a programmed delay can be scheduled to give an alert either *before* an infusion is to be initiated, *after* an infusion is completed, both *before and after* an infusion, or to give no alert (*None*).

In the following procedure, changing the option setting to **Disable** disables the **Callback** soft key, as displayed in step 1. The **Delay Options** setting is changed to **Enable** in Step 2.

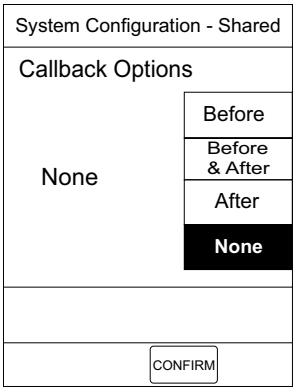
1. On the **System Configuration - Shared** options display, press the **Delay Options** soft key.



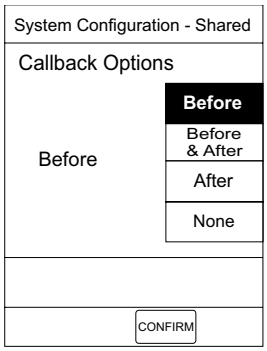
2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).



3. To change the callback setting:
   a. Press the **Callback** soft key.



   b. Press the soft key next to the applicable setting (the following example displays **Before** selected).



4. To accept the setting, press the **CONFIRM** soft key.

2.7.3 Drug Calculation

Enabling **Drug Calculation** allows:

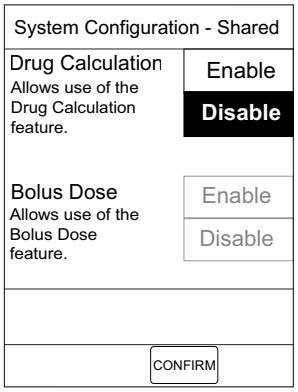
- Entry of drug dose (the correct flow rate to achieve the desired dose is automatically calculated)

  OR

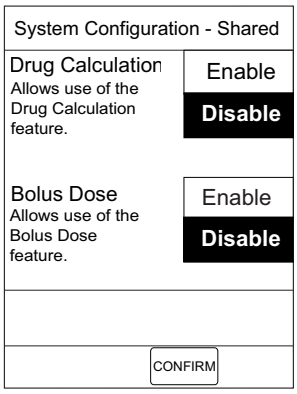
- Entry of flow rate (the corresponding drug dose is automatically calculated).

In the following procedure, changing the option setting to **Disable**, disables the **Bolus Dose** soft keys, as shown in Step 1. The **Drug Calculation** option is changed to **Enable** in Step 2.

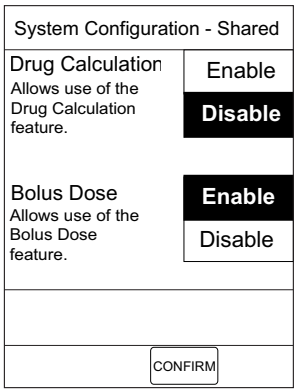
1. On the **System Configuration - Shared** options display, press the **Drug Calculation** soft key.



2. To change the **Drug Calculation** setting, press the soft key next to the applicable option (**Enable** or **Disable**).



3. To change the **Bolus Dose** setting, press the soft key next to the applicable option (**Enable** or **Disable**).



4. To accept the setting, press the **CONFIRM** soft key.

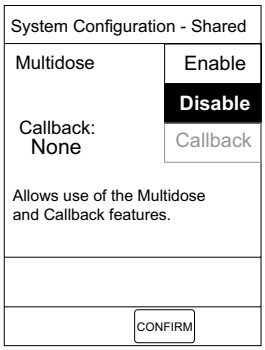
2.7.4 Multidose

NOTE:
Multidose infusions are not available with PCU v12.x and later.

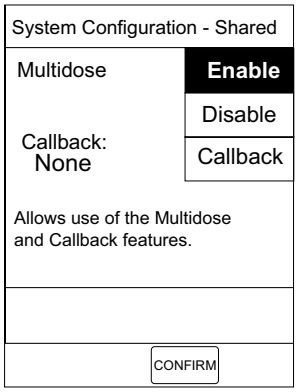
Enabling **Multidose** allows 2 to 24 doses to be programmed at equally spaced intervals on the same Pump Module over a 24-hour period. This mode is designed to allow delivery of multiple, equal doses from the same administration set at regularly scheduled intervals.

In the following procedure, the **Multidose** option is changed to **Enable**. Changing the option setting to **Disable** disables the **Callback** soft key, as displayed in Step 1.

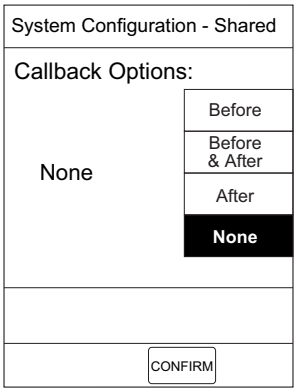
1. On the **System Configuration - Shared** options screen, press the **Multidose** soft key.



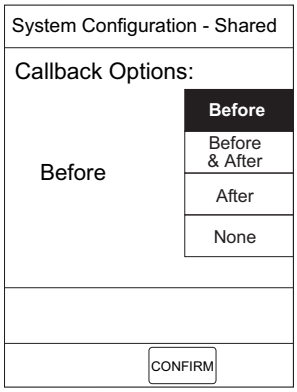
2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).



3. To change the callback setting:
   a. Press the **Callback** soft key.



b. Press the soft key next to the applicable setting (the following example displays **Before** selected).

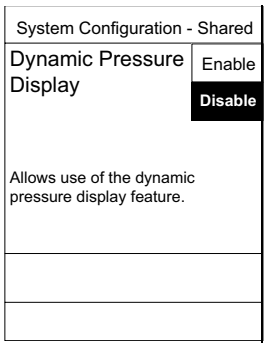


4. To accept the setting, press the **CONFIRM** soft key.

2.7.5 Pressure Dynamic

Enabling **Dynamic Pressure Display** displays the current patient-side occlusion pressure set point and the patient-side operating pressure for that module.

1. On the **System Configuration - Shared** options screen, press the Dynamic **Pressure Display** soft key.

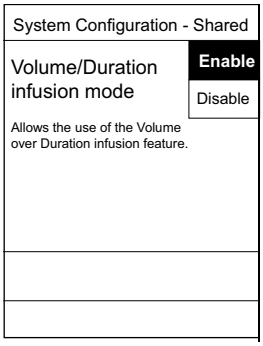


2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

2.7.6 Volume/Duration

Enabling **Volume/Duration infusion mode** allows a volume-to-be-infused (VTBI) and duration (infusion time) to be programmed, automatically calculating the flow rate.

1. On the **System Configuration - Shared** options screen, press the **Volume/Duration** soft key.



2. To change the setting, press the soft key next to the applicable option (**Enable** or **Disable**).

Chapter 3
Preventive Maintenance

3.1 Summary of Warnings and Cautions

WARNING

- **Failure to perform regular and preventive maintenance inspections may result in improper device operation.**
- **Do not perform the cleaning procedures or maintenance on any BD Alaris™ or Alaris™ System device while the device is connected to a patient. Cleaning and maintaining a device while it is connected to a patient can lead to patient harm.**

3.2 Introduction

WARNING

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

Perform regular and preventive maintenance inspections to ensure that the BD Alaris™ System remains in good operating condition.

- Perform regular inspections before each use.
- Perform preventive maintenance inspections once a year.

Use the BD Alaris™ System Maintenance software to check in, upgrade/repair, diagnose, calibrate, and perform preventive maintenance.

BD does not recommend the use of automatic testers to check rate accuracy. Generally, these devices collect small samples and the test results may incorrectly indicate a rate accuracy failure. Use of the following BD Alaris™ products is recommended:

- 8100-RCS (Rate Cal Set), to perform rate verification and/or calibration.

These requirements and guidelines are intended to complement the intent of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requirements.

3.3 Cleaning

WARNING

Do not perform the cleaning procedures or maintenance on any BD Alaris™ or Alaris™ System device while the device is connected to a patient. Cleaning and maintaining a device while it is connected to a patient can lead to patient harm.

The BD Alaris™ System Cleaning and Disinfecting Procedures is a separate document. See *BD Alaris™ with Guardrails™ Suite MX Cleaning and Disinfecting Procedures* (P/N P00000454).

Devices should be cleaned and disinfected before each patient use.

Chapter 4
Principles of Operation

4.1 Introduction

This chapter describes the principles of operation for the PCU and Pump Module.

4.2 PCU

Circuit boards are not field repairable and must be returned to a BD Service Center for repair.

4.2.1 Logic Board Assembly

The logic board has:

- **Main audio:** Has an audio Coder.Decoder (CODEC) device that converts audio files into an audio signal.
- **Auxiliary connector:** Provides the communication needed to debug the PCU. This connection can be used, if needed, for future options.
- **Complex programmable logic device (CPLD):** Provides glue logic for the compact flash bus. Has miscellaneous logic that allows for the proper reset to the on-board flash, and divides the clock associated with the DUART.
- **Dual universal asynchronous receiver/transmitter (DUART):** Provides a serial communication link to the Auto-ID Module through SPARE_A and SPARE_B ports. Interfaces with the main processor through the Intel bus. These signals are needed on the IUI connector.
- **Keypad processor:** Uses a high-end microcontroller. Senses keypad activity and handles IUI communication and sends this information to the main processor. Provides pulse width modulation (PWM) signals that are used to adjust the LCD display and keypad LED backlights.
- **Compact flash memory:** Stores the application software, audio wave files, data set, and hex files data for operating system software, which are all needed to operate the BD Alaris™ System.
- **On-board flash memory:** Contains the software needed to initially turn on the BD Alaris™ System. Stores the boot software application and events, errors, and battery logs.
- **Intel microprocessor (32-bit):** The main processor that controls all user interface and communications, and provides digital control of the LCD display.
- **Real-time clock (RTC):** Manages the timed functions. The lithium battery keeps the clock running when there is no AC or DC power.
- **SDRAM (128 MB):** Has volatile memory used primarily to execute the application code stored in the compact flash memory. Stores the variables associated with the software and the BD Alaris™ System.
- **Watchdog and backup circuits:** A watchdog device is used to ensure proper software operation. Backup circuits are logic that activates audio and visual indicators if software problems occur. The output of the backup circuit drives a front panel and a backup speaker at a 0.5Hz rate. A super capacitor provides power to this circuit if AC and DC power fails.
- **Compact flash bus for wireless connectivity:** Interfaces between the main processor and compact flash memory card.

4.2.2 Power Supply Board Assembly

The power supply board charges the primary (NiMH) battery and supplies all voltages to run the BD Alaris™ System. All voltages needed by an attached module are supplied by the PCU. An attached module does, however, regulate some voltages supplied by the PCU for its own use.

The output of the charger section of the power supply board is used to charge the battery. The PCU power cord plugs into a hospital-grade AC receptacle. AC power is applied to the AC input module in the rear of the PCU. The AC input module has a line filter and AC fuse holder built in. The fused and filtered output of the AC input module is applied to the input of an off-line switching power supply having an output of 24VDC. The power supply is connected to the input, power supply board J3. Certain circuits are powered continually, either from the battery or line power, allowing the System On to be active even with the power off. This is essential, considering the fact that the PCU uses a soft on circuit to power on. When the PCU is powered on, unregulated voltage (VRAW) is applied to the input of several regulators through two power field effect transformers (FETs). The outputs of these regulators supplies the BD Alaris™ System with required voltages. VRAW is supplied directly to +5 nonswitched (NSW), even while the power is off. This allows +5 NSW to be available for the System On circuitry, even with the power off.

Power is obtained from the AC Mains power and self-contained battery. Backup power for alarms and the RTC is located on the PCU logic board. Further backup power for the RTC is supported by a lithium battery, which is switched in if all other forms of power are removed or depleted.

Battery charging while on AC Mains power is completely separate from power supply conversion and the battery is automatically switched in when the AC Mains power is removed. The power sources used by the PCU are identified in *Table Power Sources* and voltages supplied by the power supply board are identified in *Table Power Supply Board Voltages*. The charger section of the power supply board is used to charge the NiMH battery.

The PCU uses a 12V 4Ah NiMH battery. The charger uses a constant current (limited to approximately 2.0A) until the battery reaches the end of charge, allowing the charger to quick-charge the battery without undue stress. The NiMH battery is charged from VRAW through a current-regulating circuit, assuring that the NiMH battery is charged according to the manufacturer's specifications. These voltages (except for battery charge voltage checked at J3 or at battery terminals) may be checked at power supply board J4 or logic board J8.

4.2.3 Power Requirements

+5V This supply is generated on the power supply board and is used to power the LCD and keypad backlight, watchdog circuits, and RS-232 communication.

3.3V This supply is generated on the power supply board.

Main supply used to the power microprocessor, memory, interface, RS-485 connectors, keypad controller, wireless card, and main audio.

NSW +5 This supply is generated on the power supply board. It is used to provide power at all times for powering on the PCU. It is regulated to provide 3.3V and is not switched off until AC power is removed and the NiMH battery is fully discharged. The RTC is further backed up by a lithium battery.

Power supply communications are provided by the TxD (transmit data) and RxD (receive data) lines, which can be configured to send/receive any information desired.

Table 4-1: Power Sources

Power Source	How Used
+12V AMP @3.4Ah NiMH Battery	Powers the PCU when it is unplugged. It is monitored by the power supply processor (PSP) to ensure it discharges and charges correctly.
Lithium Battery	Backs up the RTC.
Super Capacitor	Provides power to the backup alarm.

Table 4-2: Power Supply Board Voltages

Voltage	Where Used
+3.3V	Supply to the logic board for all circuits requiring +3.3V.
+5V	Supply to the logic board for all circuits requiring +5V, including the LCD display.
+5V NSW	Supply to the logic board to maintain SRAMs and RTC, and to the power supply board for the System On circuits. It is present even with the system powered off. It must be there to enable the System On circuits or the system will not power on.
+8V	Supply to the attached modules through the IUI interconnects. Powers the main audio circuit and LCD backlight circuit.
+12V (nominal)	Battery connection for the battery charge and discharge.
+24V (VRAW)	Supply to the regulators to supply regulated voltages and to charge the NiMH battery. Current-limited for the NiMH charge.

4.2.4 Mechanical

The PCU is made up of the following sub-assemblies:

Battery Pack and Feet

Front Case Assembly—consists of:

- Front case (high-impact plastic)
- Hardware
- Keypad (data entry)
- LCD (displays user information)
- Backlight inverter board

Internal Frame Assembly—aluminum and consists of:

- AC input module
- Battery discharge resistor
- Logic board
- Off-line switching power supply
- Power supply board
- Compact flash memory card

NOTE
The new logic boards have the memory card glued on the logic board. As a result, the memory card can no longer be ordered separately as a replaceable part. If the memory card fails, you will need to order a new logic board.

IUI—consists of:

- IUI circuit boards, right and left
- IUI module connectors, right and left
- Hardware

See Section *Inter-Unit Interface* on page *4-17* for a more detailed description.

Pole Clamp Assembly—consists of:

- BD Alaris™ pole clamp (one-piece assembly)
- Alaris™ pole clamp:
  - Knob lead screw
  - Lead screw tip
  - Lead screw tip pin
  - Pole clamp C clamp
- Pole clamp mounting plate
- Pole clamp mounting plate screws
- Hardware (screws)

Power Cord Retainer—consists of:

- Brass snap
- Hardware

- Retainer
- Wrap

Rear Case Assembly—consists of:

- Backup speaker
- Battery interface connector
- Gasket
- Latch block and hook
- Latch spring and release lever
- Rear case (high impact plastic)

Serial I/O board—consists of:

- Main speaker
- RS-232 interface
- Tamper switch

Wireless Network Card Assembly (802.11 a/c)—consists of:

- Back panel cover
- Strip gasket panel
- Wireless network card label

4.3 Pump Module

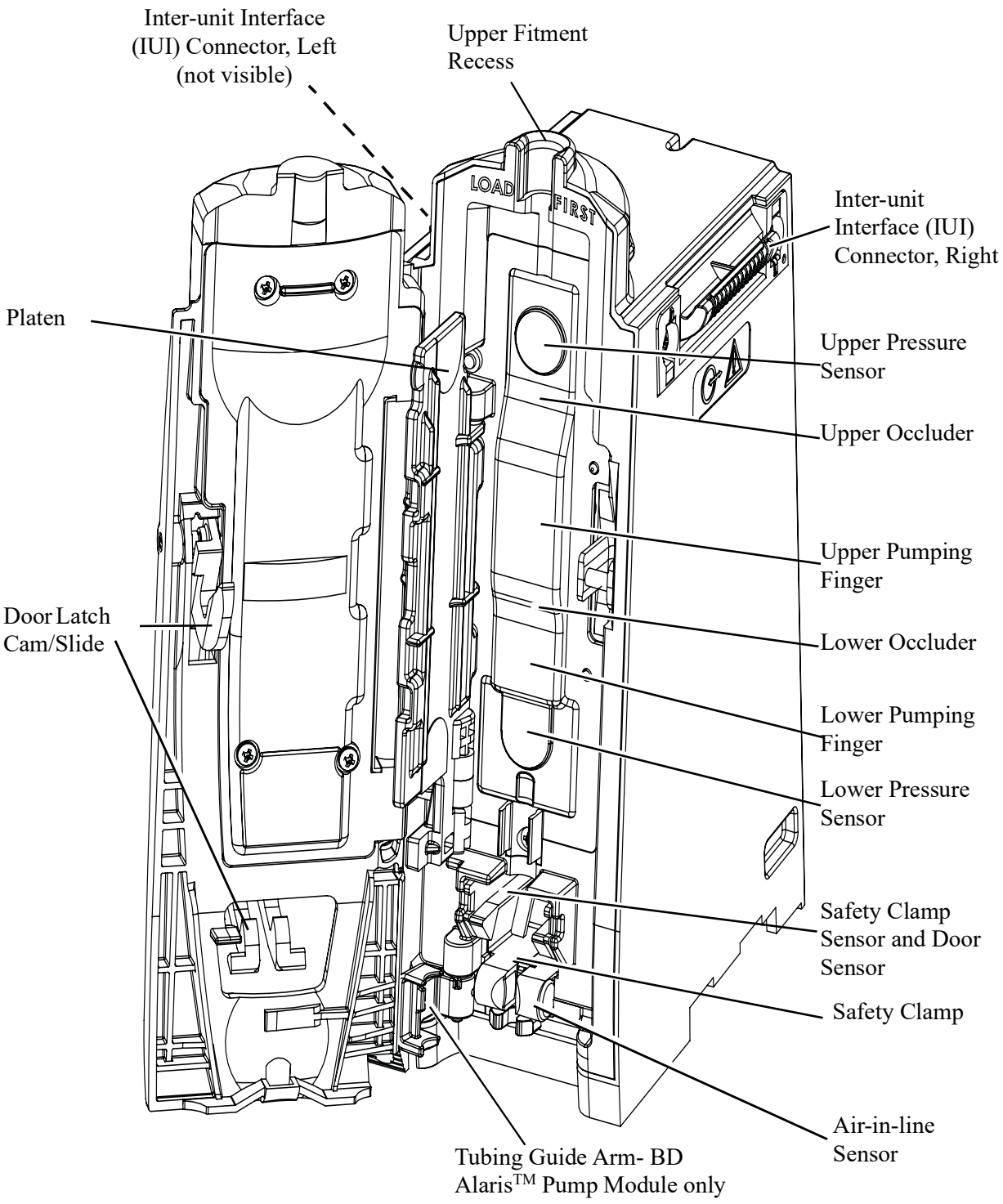
Circuit boards are not field repairable and must be returned to a BD Service Center for repair.

The Pump Module is used to pump fluid to the patient in a controlled manner. The PCU supplies the Pump Module with all the power requirements and interface logic control. Even though the Pump Module has its own logic board, it must receive its commands from a PCU to function.

The Pump Module has an internal high-strength frame that supports all internal and external assemblies. When the door is opened, a spring-loaded platen swings back with the door, allowing an administration set to be installed. The set interface is visible with the door open and interfaces with the Pump Module through the following devices.

- **Air-in-line Detector:** The air-in-line detector uses two sensor assemblies. When the administration set is installed, the lower portion of the set (just below the pumping segment) is installed into the air-in-line detector. When the tubing is installed into this detector, the transmitting transducer sends an ultrasonic signal through the tubing. If there is fluid in the tubing, the receiver receives a strong signal and a low signal (through a logic circuit), which indicates to the logic board that there is fluid in the tubing and pumping can continue. If there is air in the tubing, the receiver receives a very weak signal and a high signal (through a logic circuit), which indicates to the logic board that there is air in the tubing. This prompts the logic board to stop pumping and sounds the air-in-line alarm.
- **Tubing Guide Arm:** The tubing guide arm secures the administration set in place within the air-in-line detector. Available only on BD Alaris™ Pump Module.
- **Door Open Sensor:** This sensor is part of the sensor assembly and is comprised of an LED/ photo-transistor pair, which is biased by the end of the sear when the door is fully closed.
- **Safety Clamp Detector:** The safety clamp detector has an LED/photo transistor pair that is biased when the safety clamp detector is installed, allowing the logic board to determine if a set is installed. When the door is closed on the administration set, the safety clamp detector automatically opens, pump fingers are engaged to stop fluid flow, and the Pump Module is ready to pump fluid. When the door is opened, the safety clamp detector automatically closes and stops fluid flow.
- **Pressure Sensors, Upper and Lower:** The pressure sensors sense the pressure in the tubing by converting the pressure to a voltage. The logic board detects bottle-side as well as patient-side pressures by analyzing these voltages. If the voltage (pressure) is too high or low, the Pump Module signals an occlusion alarm.
- **Pumping Fingers:** There are four pumping fingers. Two of these are considered occluders (identified by their small profile), in that their primary function is to prevent fluid flow by the phasing of the two pumping fingers. The primary function of the two pumping fingers (identified by their larger profile) is to pump fluid.

  The pumping fingers cycle toward the tubing to push fluid to the patient and then cycle back to fill the tubing. The occluders cycle toward the tubing to control flow throughout the delivery. The occluders and pumping fingers work together to form two chambers. Both the upper occluder and the upper (larger) finger form the upper chamber, and the lower occluder and lower (smaller) finger form the lower chamber, which is open-ended to the patient.



At the start of the pumping cycle:

- Upper occluder is pushed forward, blocking flow.
- Lower occluder is pulled back, allowing flow.

- Upper finger is cycling forward, pushing fluid from upper chamber past lower occluder and lower finger (toward patient).

When the upper finger has cycled forward as far as it can:

- Lower occluder cycles forward to stop flow.
- Lower finger starts to cycle forward to keep fluid flowing from lower chamber toward patient.
- Upper occluder cycles back to allow fluid flow, and upper finger cycles back to fill upper chamber.

When the lower finger gets to the point where it can no longer move forward to displace fluid:

- Upper occluder moves forward to stop flow (upper chamber should now be full).
- Lower occluder moves back to allow flow.
- Upper finger starts to move forward to push fluid to patient.
- Lower finger cycles back to fill lower chamber, preparing for next cycle.

4.3.1 Display Board Assembly

The display board interface is a serial communications interface between the microprocessor on the logic board and the display board controller (through the door harness assembly). The interface also provides the SYNC signal to the display board and a power-on reset signal for initialization of all display board logic. The channel-off signal from the keypad is provided as an input to the microprocessor on the logic board.

The display board processor is the interface from the keypad to the logic board. When a key is pressed on the keypad, it is read by the display board processor. The processor then relays this information (through the door harness) to the Pump Module microprocessor, which in turn relays this information to the PCU main processor (through the IUI).

The display board has four 7-segment LEDs used to display rate information, four discrete LEDs, and one alpha-numeric LED capable of displaying a module identification letter (A to H). One white LED is for keypad backlight through fiber optic. The other three LEDs are: yellow for *Standby*, green for *Infusing,* red for *Alarm*. The display board also has an 8-character 5 × 7 dot-matrix display for displaying information pertaining to that particular Pump Module.

All communications between the display board processor and the Pump Module microprocessor are through the door harness assembly, which is a serial interface consisting of two logic interface lines, TxD and RxD.

4.3.1.1 Interface

The display board interface is a serial-communications interface between the microprocessor on the logic board and the display board controller. The interface also provides the SYNC signal to the display board and a power-on reset signal for initialization of all display board logic. The channel-off signal from the Pump Module keypad is provided as input to the field-programmable gate array (FPGA) on the logic board.

4.3.2 Logic Board Assembly

The logic board consists of a processor core using an Intel microprocessor running at 16MHz, a 1M × 8 Flash ROM and a 512K × 8 static RAM. A watchdog timer circuit is used to put the Pump Module into a safe state (puts the microprocessor in RESET state) if the microprocessor has a hard failure.

The board also has a safety processor using an Intel controller running at 3.58MHz, an internal 8-KB ROM and an internal 256-byte static RAM. The safety processor is used to monitor Pump Module operations and is capable of putting the module into a safe state if a failure occurs independent of the microprocessor. The safety processor and microprocessor communicate with each other through a serial interface.

The FPGA uses an Actel IC. This device contains digital logic for controlling the parallel communications interface, analog-to-digital converter (ADC), digital-to-analog converter (DAC), pressure transducers, and sensors circuit interface. It is also used to generate the master RESET signal and provide signals to the motor controller board for driving the motor.

4.3.2.1 ADC

A 12-bit ADC is used to monitor various Pump Module analog signals, including the pressure sensor and motor signals. It has an 8-bit parallel interface to the main processor's data bus, and its control signals are generated by the FPGA. It uses an external 2.5V reference, which is buffered by an operational amplifier, and is used to drive the DAC reference.

Initially the 1.333 MHz clock must be enabled by the FPGA so that the ADC can perform conversions. The specific ADC input channel is selected by writing the module number to the ADC. To read the voltage of a specific module, a low-going pulse must be applied to the /START_CONVERSION signal. The microprocessor monitors the ADC BUSY signal and can read the voltage when the ADC BUSY signal is asserted low.

The ADC contains self-calibration and system calibration options to ensure accurate operation over time and temperature. The system calibration calibrates for system offset or system gain errors. To perform an ADC calibration, a low-going pulse is applied to the ADC_CAL signal.

4.3.2.2 DAC

An 8-bit DAC is used to generate the VDAC analog signal for driving the motor controller board. The DAC has an 8-bit parallel interface to the microprocessor's data bus and its control signals are generated by the FPGA. The DAC produces a current output, which is converted to a voltage output by an operational amplifier.

The DAC has an 8-bit input latch that contains data written to it from the microprocessor. The DAC_WRITE signal from the FPGA is asserted low when this data is written to it. The DAC converts the digital value to a proportional current on its output. This current is then converted to a voltage signal VDAC, which drives the motor controller board.

4.3.2.3 FPGA

The FPGA uses an Actel IC. This device contains digital logic for controlling the parallel communications interface, ADC, DAC, and sensor circuit interface. It is also used to generate the master RESET signal and provide signals to the motor controller board for driving the motor.

The processor interface section of the FPGA produces the signals for controlling the ADC, chip-selects for controlling the digital I/O ports in the FPGA, signals for controlling the parallel communications interface between the safety processor and microprocessor, logic for demultiplexing the address/data bus from the microprocessor, and circuitry to produce the /_188_RESET signal that resets the microprocessor. It also has an input port for reading the SYNC, safety clamp detector, pump encoder, air-in-line, and door sensor signals. The processor interface also uses the 76 MHz system clock to produce a 1.33 MHz clock signal for driving the ADC.

The I/O interface section of the FPGA produces signals for controlling the motor interface section, chip-selects for controlling the output ports in this section, and logic to shut down the motor if the logic board has a hardware failure. The chip-selects enable the output ports that produce signals to enable and test the air-in-line detection circuitry, enable the pump encoder, enable the safety clamp detector, and enable the pressure sensor. It also generates signals to control the motor interface to the motor controller board.

The motor interface section of the FPGA produces the various phase signals to the motor controller board in order to drive the motor.

4.3.2.4 Main Processor

The logic board consists of a processor core using an Intel microprocessor running at 16 MHz, a 1MB × 8 flash ROM and a 512 Kb × 8 static RAM. A watchdog timer circuit is used to put the Pump Module into a safe state (puts the microprocessor in RESET state) if the microprocessor has a hard failure.

The microprocessor generates the upper chip-select signal (/UCS) in order to enable the flash ROM IC when doing read or write operations, or when programming new software into the device. The microprocessor generates the lower chip-select signal (/LCS) in order to enable the static RAM when doing read or write operations.

The address bus is demultiplexed by transparent latches in order to generate the address lines, A0 through A7 and A16 through A19.

On power up, the watchdog timer IC generates the /RESET signal, which is taken by the FPGA, and generates the /_188_RESET signal to reset the microprocessor. The microprocessor then generates the RESET signal that is used to reset the safety processor. The microprocessor must strobe the watchdog timer IC every 1 second or less by generating a low-going pulse on the /WDI signal line, in order to prevent it from timing out. If the watchdog IC times out due to a hardware failure on the logic board, the /WDO output of the microprocessor is asserted low. This is applied to the FPGA, which generates a nonmaskable interrupt (NMD) to the microprocessor and asserts the /_188_RESET signal low a few seconds later, in order to put the microprocessor into a safe (RESET) state.

4.3.2.5 RS-485 IUI Interface

The logic board contains interface circuitry for the IUI. Two RS-485 transceiver chips are used to interface the serial port of the microprocessor to the IUI. The transmit and receive enable signals to the RS-485 transceiver chips are lines from the I/O port of the microprocessor or DUART.

The microprocessor port2 signals, TE1 and TE2, are used to enable the transmitters. The microprocessor signals, RE1 and RE2, are used to enable the receivers. Data is transmitted and received on the microprocessor serial port when communicating with the Pump Module or PCU.

4.3.2.6 Safety Processor

The safety processor uses an Intel controller running at 3.58 MHz, an internal 8-KB ROM, and an internal 256-byte static RAM. The safety processor is used to monitor Pump Module operations and is capable of putting the module into a safe state if a failure occurs independent of the microprocessor. The safety processor and microprocessor communicate with each other through a serial interface. The safety processor monitors the door sensor, safety clamp detector, pump encoder sensor, and air-in-line sensor. If a failure occurs, the safety processor shuts down the motor in order to put the Pump Module into a safe state.

4.3.2.7 Sensor Circuit Interface

The sensor interface consists of signals generated and received by the FPGA. These include signals from the air-in-line, door sensor, safety clamp detector, pressure sensor, and pump encoder.

The air-in-line signal is read by the microprocessor and safety processor. The AIL SUPPLY must be enabled and the /ALE_TEST signal must be asserted low in order to read this signal.

The door sensor signal is read by the microprocessor and safety processor. The DOOR_SENSOR_ENABLE signal must be asserted high in order to read this sensor.

The safety clamp signal is read by the microprocessor and safety processor. The DOOR_SENSOR_ENABLE signal must be asserted high in order to read these signals.

The pressure sensor voltages from the bottle-side and patient-side sensors are read by the microprocessor. The PRESSURE_SENSOR_SUPPLY voltage must be enabled in order to read these sensors. The pump encoder sensor signal is read by the microprocessor and safety processor. The PUMP_ENCODER_LED voltage must be enabled in order to read the encoder.

4.3.3 Motor Controller Board Assembly

The motor drive logic signals are generated by the logic board and fed to the power drive circuits on the motor controller board. These circuits drive the 5-phase stepper motor, which is used to drive a cam shaft that biases the pumping fingers, to generate pressurized fluid flow to the patient (the pressure depends on many variables, but will not exceed maximum design pressure). The motor controller board also monitors the motor's needs and supplies the correct amount of motor drive voltage, depending on a number of variables, not the least of which is load. This ensures that an adequate amount of power is available to the motor at all times. The motor speed is based on the rate settings signal sent by the microprocessor.

4.3.4 Mechanical

The Pump Module consists of the following major assemblies.

Fluid Delivery Subassembly (FDSA)—uses a very high-strength plastic frame and mechanically supports the following parts:

- Air-in-line sensor
- Bezel
- Bezel seal
- Cam shaft
- Door hinges (break away)
- Encoder sensor (detects motor movement)
- Gear train
- Hardware
- Harnesses
- Latch yoke (door catch)
- Logic board
- Motor
- Motor controller board
- Platen
- Tubing guide arm
- Pressure sensors, upper and lower
- Pumping and occluding fingers
- Safety clamp detector

Door Assembly—attaches to the FDSA with two hinges and consists of the following parts:

- Covers, front and rear
- Display board
- Door lever (latch)
- Hardware
- Harness
- Keypad
- Protective lens
- Seals

IUI—consists of:

- Hardware
- IUI circuit boards, right and left
- IUI module connectors, right and left

See *Inter-Unit Interface*, *Mechanical Interface* on page *4-17* for a more detailed description.

4.4 Power Control Circuit

The power control circuitry prevents power from being applied to module connections when a module is not attached to the BD Alaris™ System. The same circuitry connects power to the IUI connections when a module is attached to the BD Alaris™ System (see *Table IUI Logic* on page *4-18*). Each interface and attached module contains two separate power switching circuits to control power to modules attached to the left or right.

Left power circuit: Power to modules on the left is controlled by the module detect left signal (MODDETL) to the gate of field effect transistor (FET). When the MODDETL signal is logically high, power is not applied to the left IUI. When a module is attached to the left, circuitry in the newly attached module pulls the MODDETL signal logically low, and power is connected to the left IUI to operate the newly attached module.

Right power circuit: Power to modules on the right is controlled by the module detect right signal (MODDETR) to the gate of the FET. When the MODDETR signal is logically high, power is not applied to the right IUI. When a module is attached to the right, circuitry in the newly attached module pulls the MODDETR signal logically low, and power is connected to the right IUI to operate the newly attached module.

When a previously attached module is detached from the right or left, the respective module detect signal (MODDETL or MODDETR) changes from the low state (module attached, power applied to IUI) to the high state (no module attached, power not applied to IUI). Software within the PCU or remaining attached module detects the high state of the module detect signal and determines that one or more previously attached modules is no longer attached.

4.5 Inter-Unit Communications Circuit and Connections

Software within the PCU and all attached modules provides bidirectional communications between a PCU and one or more attached modules. Two pairs of signal lines are provided in both the left and right IUI connectors for this purpose:

- Transmit +(TXD [+])
- Transmit -(TXD [-])
- Receive +(RXD [+])
- Receive -(RXD [-])

Each pair of signals (transmit or receive) is a differential pair, which allows rejection of common mode noise appearing on the signal pairs. The transmit pair originates communications from the PCU to one or more attached modules. The receive pair originates communications from one or more attached modules to the PCU, in response to a communications request from the PCU. This allows the PCU to coordinate communications from multiple functioning modules on a common transmit/receive bus.

Bidirectional communications between the PCU and each attached module can range from a simple “report status” interaction to an extensive dialogue, to change operational parameters or transfer operating event history. At the start of each attempted dialogue, the PCU software sets a timer at the maximum time allowed for the attached module to respond. If the attached module does not respond in the allotted time, the timer expires and the PCU software determines a communications failure.

Software within the PCU and attached modules provides for communications during the following times.

Prior to logical unit ID assignment: Communications consist only of that required to assign unit IDs. The UNIT_ID_ENABLE signals control access to the communication channels.

After logical unit ID assignment: Communications between the PCU and attached modules use the assigned unit ID to communicate to, and receive responses from, one attached module at a time.

4.5.1 Software

Software running within the interface and attached module performs the following key aspects of IUI functionality:

- Controls state of unit detect line.
- Reads state of incoming ID_ENABLE_IN line.
- Controls state of outgoing ID_ENABLE_OUT line.
- Performs bidirectional communications between PCU and one or more attached modules.

4.5.2 Unit Detection and Identification Circuitry

Unit (module) detection is required to detect:

- Presence of attached modules
- New module attachment
- Module detachment

Unit (module) identification is used to:

- Identify the attached module type
- Logically assign the module designation based on the physical location
- Designate the inter-unit communications to and from a specific module

A combination of two signal lines is used to accomplish module detection and, in conjunction with inter-unit communications, accomplish module identification.

4.5.2.1 Unit Detect Line

The unit detect line from the IUI connectors is read by PCU software as UNIT_DETECT. This allows the PCU to determine when modules are attached to the left or to the right.

The UNIT_DETECT line originates from the PCU and passes through each attached module. The UNIT_DETECT signal is normally logically high due to circuitry within the PCU. Circuitry connected to the UNIT_DETECT line within each attached module is able to pull the UNIT_DETECT line logically low under control of the microprocessor within the PCU. The logical state of the UNIT_DETECT signal is able to be read by the microprocessor to determine if any module attached to the left is pulling the signal low.

4.5.2.2 ID ENABLE IN Line

Software within each attached module reads the state of the incoming ID_ENABLE_IN line. The state of this signal is used by the software to determine whether the module can respond to unit ID assignment messages from the PCU. If this signal is high, the attached module is able to respond to unit ID assignment messages. If this signal is low, the module is not able to respond to unit ID assignment messages.

The ID_ENABLE line originates from the attached module and passes on to either an operating module or PCU attached to the right. Circuitry connected to the ID_ENABLE line within each attached module receives the incoming signal (ID_ENABLE_IN) from the left IUI connector and outputs an outgoing signal (ID_ENABLE_OUT) to the right IUI connector.

The incoming signal (ID_ENABLE_IN) is connected to one input of an FPGA and then read by the microprocessor. The ID_ENABLE_IN is also pulled logically high when no module is attached to the left.

The ID_ENABLE_OUT of an attached module is directly connected to the ID_ENABLE_IN of the module on its right. Using this scheme, the micro-processor in the module attached on the left allows the ID_ENABLE_OUT to be high only after the left module has completed its identification with the PCU.

4.5.3 Inter-Unit Interface

When a module is attached to the PCU, it is connected through the inter-unit interface (IUI). The limit is four attached modules per PCU. The exception is the Auto-ID Module, which can be a fifth module.

The IUI consists of a left connector and a right connector, with spring contacts. These connectors are used to attach a module to a PCU or another module, and provide physical support and electrical connections.

4.5.3.1 Mechanical Interface

The mechanical interface consists of mechanically supporting electrical connectors, male on one module and female on the other. These connectors mechanically interface to attach a module to the PCU, or one module to another module (for example, when two modules are attached to one side of the PCU). In conjunction with these connectors, there is a latching mechanism on the bottom of each module that helps secure the two modules together. Pushing on the latching mechanism disengages an attached module. Refer to the *BD Alaris™ System with Guardrails™ Suite MX User Manual* for module attachment and detachment instructions.

4.5.3.2 Electrical Interface

The electrical interface between an attached module and the PCU is an integral part of the mechanical connector, consisting of 15 gold-plated pins. The pins on the module interface with the pins on the PCU, or another module if more than one module is attached to the same side of the PCU.

Table 4-3: IUI Logic is a snapshot of the IUI connector pin-outs. The electrical portion of the IUI consists of the following elements:

- Power control circuitry and connections
- Module detection, and identification circuitry and connections
- Logical module assignment circuitry and connections
- Inter-unit communications circuitry and connections
- Spare I/O

All inter-unit connections are accomplished through the IUI connectors located on the left and right side of each PCU and attached module.

4.5.4 Module Detection and Logical Designation

Three situations may occur within the IUI, which require software functionality for the assignment of a logical designation to an attached module, based on its physical position within the BD Alaris™ System:

- System On
- Attachment of one or more modules to the left after System On
- Attachment of one or more modules to the right after System On

Two additional situations may require either reassignment of logical designations and/or enunciation of alarms. (see section *Module Detachment* on page *4-20*):

- Attachment of one or more modules to the left after System On
- Attachment of one or more modules to the right after System On

4.5.5 Unit ID Assignment at System On

The basic scheme for assigning unit (module) position identification at System On involves the following sequence of events:

1. The PCU and each attached module execute a Power On Self Test (POST), during which each attached module clears its unit ID and, when the POST is complete, pulls the unit detect line low.
2. As each module completes its POST, it releases its unit detect line.
3. When all attached modules have released their unit detect lines, the PCU senses all the unit detect lines in a high state.
4. The PCU sends a message to all modules to pull the unit detect line low.
5. The PCU sequentially assigns unit IDs from left to right, starting with "A" and ending when the PCU senses the unit detect line in high state.

When modules are attached on both sides of the PCU, the PCU controls the UNIT_D_ENABLE_R line to modules on the right until all modules attached to the left have been identified (UNIT_ID_DETECT_L line goes high). The PCU allows the UNIT_ID_ENABLE_R line to go high and sequentially sets unit IDs for modules to the right, still going left to right.

The sequential assignment of the unit ID from left to right makes use of the fact that an attached module only senses a high state on the ID_ENABLE_IN signal (also called CONNECT_SENSE) when:

- The attached module is farthest to the left.

  OR

- The module to the left has completed its unit ID and sets the ID_ENABLE_OUT signal.

Table 4.3 IUI Logic and its accompanying diagram show the IUI signals for the logical module assignment in a system with two modules attached to the left and two modules attached to the right of the PCU

All modules have been identified and the sequence completes when the PCU receives the ID complete message from the last module and the unit detect line goes high. This same scheme is used for any configuration of up to four modules (exception: Auto-ID Module can be recognized as a fifth module), ranging from all on the left, all on the right, or a mix of left and right modules.

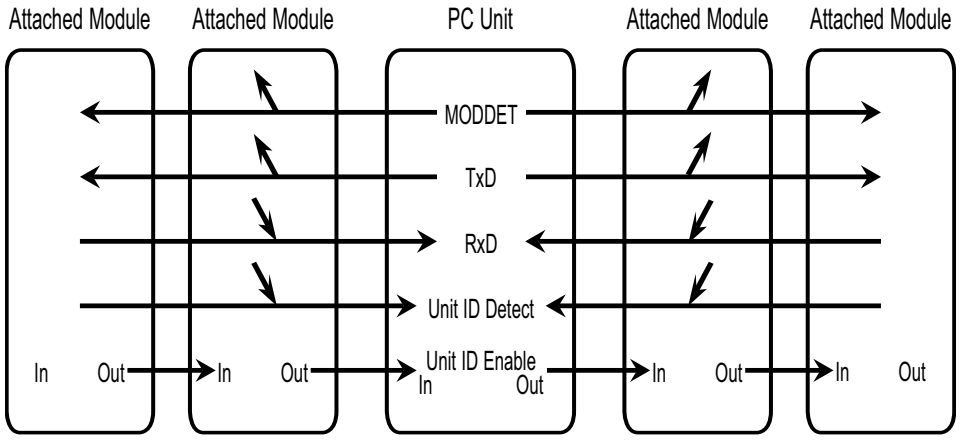
Table 4-3: IUI Logic

Pin #	Left IUI Pin Description	Left IUI Signal Name	Right IUI Pin Description	Right IUI Signal Name
1	System ground	Ground	System ground	Ground
2	+8V output	+8V_L	+8V output	+8V_R
3	Input	MODDETL*	System ground	Signal ground
4	Input from Auto-ID Module	Spare A	Input from Auto-ID Module	Spare B
5	Input	ID_ENABLE_L	Output	ID_ENABLE_R
6	RS485 TXD output to all modules	TXD+	RS485 TXD output to all modules	TXD+
7	RS485 TXD return	TXD-	RS485 TXD return	TXD-
8	Output	SYNC	Output	SYNC

Table 4-3: IUI Logic (Continued)

Pin #	Left IUI Pin Description	Left IUI Signal Name	Right IUI Pin Description	Right IUI Signal Name
9	RS485 RXD input from all modules	RXD+	RS485 RXD input from all modules	RXD+
10	RS485 RXD return	RXD-	RS485 RXD return	RXD-
11	Input	ID_DETECT_L	Input	ID_DETECT_R
12	Output to Auto-ID Module	Spare B	Output to Auto-ID Module	Spare B
13	Signal ground	Signal ground	Input	MODDETR*
14	+8V output	+8V_L	+8V output	+8V_R
15	System ground	Ground	System ground	Ground

The PC Unit only recognizes four modules at any one time, even though more than four modules may be attached. The exception is the Auto-ID Module, which can be recognized as a fifth module. The following diagram illustrates the system communications described in detail in the "Inter-Unit Communication Circuit and Connections" section.



4.5.6 Module Attachment After System On

When one or more modules is attached to the PCU after System On, the following events must occur:

- Assignment of logical unit IDs to all newly attached modules.
- Reassignment of all other modules within the system to the next logical letter; "A" becomes "B", "B" becomes “C”, and so on.

The assignment of logical unit IDs to a module newly attached to the left follows a scheme similar to the power up scheme:

1. The newly attached module pulls the UNIT_DETECT line low.
2. The newly attached module executes its POST, during which its unit ID is cleared.
3. When each module completes its POST, it releases the UNIT_DETECT line.
4. When all newly attached modules release the UNIT_DETECT line, the PCU senses UNIT_DETECT in high state.
5. The PCU sends a message to all modules to pull UNIT_DETECT line low.
6. The PCU assigns a unit ID of “A” to the left-most newly attached module.
7. When the left-most newly attached module completes setting its unit ID, it sets the UNIT_ID_ENABLE line high, which sets the ID_ENABLE_OUT high and sends an ID_COMPLETE message to the PCU.
8. The attached module assigns a unit ID of “B” to the next left-most newly attached module.
9. When the next module completes setting its unit ID, it sets the UNIT_ID_ENABLE line high, which sets the ID_ENABLE_OUT high and sends an ID_COMPLETE message to the PCU.

When all newly attached modules have completed the unit ID, the PCU sequentially assigns a logical unit ID to the remaining modules. However, during the ID assignment communications dialogue between the PCU and the other attached modules, each attached module notifies the PCU that it already had a valid unit ID and that the new unit ID is merely a position reassignment. The PCU is therefore able to reassign all historical and operational data from the previous unit ID to the new unit ID, to maintain data continuity.

4.5.7 Module Detachment

If modules are detached while operating, upon detecting the detachment, the PCU gives visual and audible indications requesting verification. If a verification is received, the PCU reassigns logical unit IDs similar to attaching a new module. If a verification is not received within a prescribed time period, the PCU places the system into an alarm state with audible and visual alarms. This alarm is detected by the communications time-out between the PCU and the detached modules.

4.5.8 Communications Time-Out

After all modules in the system have been identified, the PCU begins systematic bidirectional communication with each attached module. These communications can range from a simple “report state” interaction to an extensive dialogue, to change operational parameters or transfer operating event history. In either case, the PCU software initiates communications with each attached module on a periodic basis, to ensure system integrity.

At the start of each attempted dialogue, the PCU software sets a timer at the maximum time allowed for the attached module to respond. If the attached module does not respond in the allotted time, the timer expires and the PCU software determines a communications failure.

When one or more modules are detached, the PCU detects the detachment as a communications time-out with the detached modules.

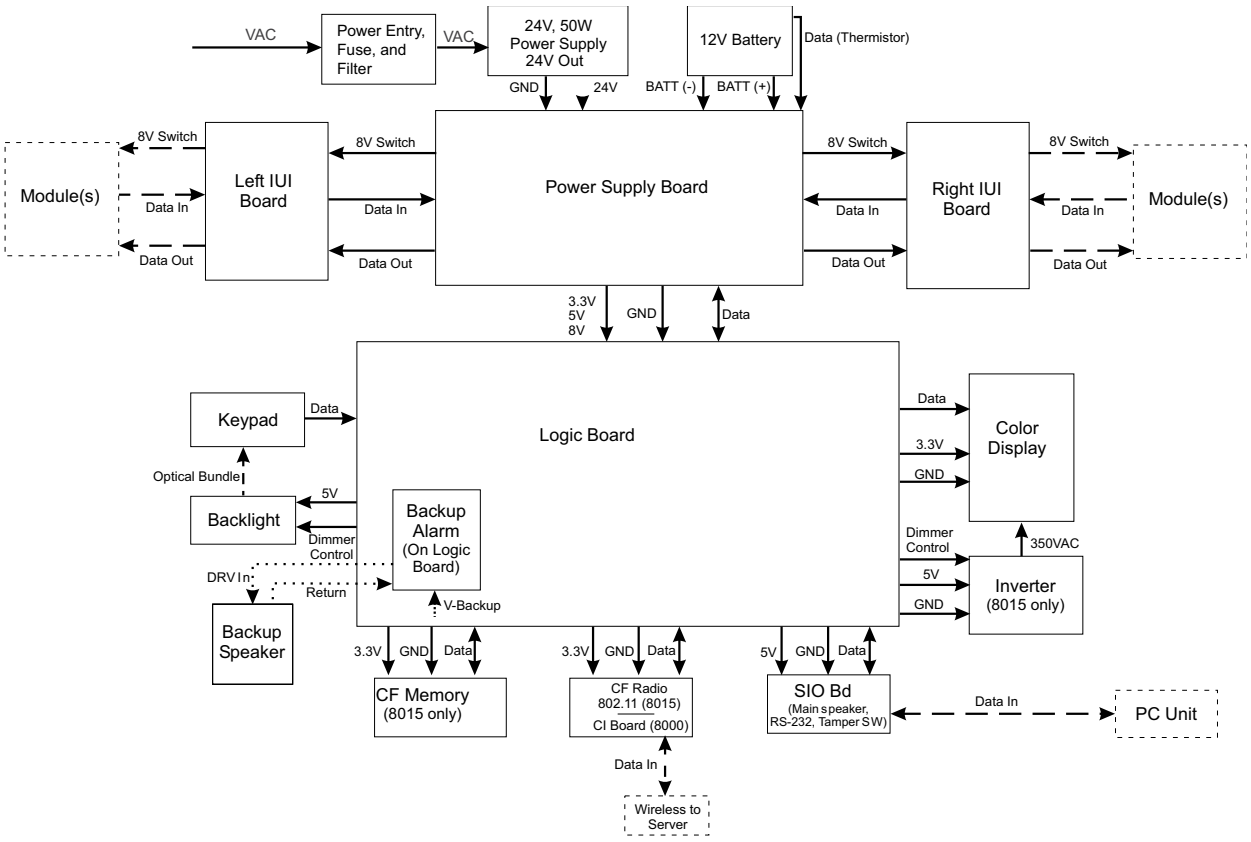


Figure 4-1. Block Diagram—PCU model 8015

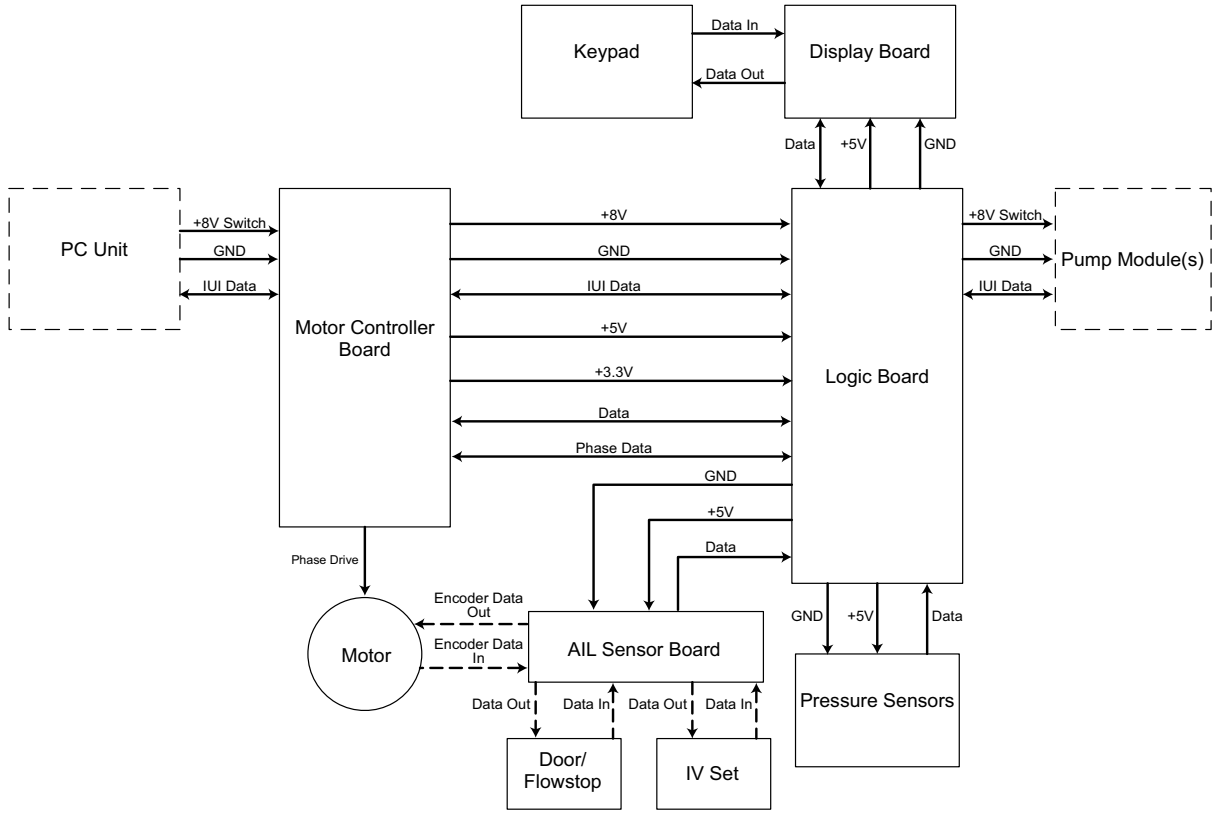


Figure 4-2. Block Diagram—Pump Model 8100

Chapter 5
Corrective Maintenance

5.1 Summary of Warnings and Cautions

WARNING

- **Use BD manufactured parts in the operation and maintenance of your BD equipment. Use of repair or service parts, accessories, or syringes, dedicated infusion sets, or disposables that are not approved by BD is at customer's own risk and could exposed patients to risk of device failure, injury, or even death. In addition, use of such parts, accessories, or disposables may void the product warranty provided by BD.**
- **Use only BD approved parts when performing corrective maintenance or repairs. Use of third-party parts can affect the safety and efficacy of the BD Alaris™ and Alaris™ devices, leading to risk of device failure, patient injury, or even death.**
- **If it becomes necessary to replace the following cables or accessories, use only approved parts that are listed in the technical service manual. Use of other parts may affect the safety and efficacy of the BD Alaris™ System, leading to risk of device failure, patient injury, or even death.**
  - **PCU Power Cord**
  - **PCU Serial Cable**
  - **PCA Dose Request Cord**
  - **Auto-ID Handheld Scanner**
- **Do not dispose of the BD Alaris™ System or any of its components prior to cleaning and disinfecting to prevent exposure to biohazardous substances left on the devices.**
- **Detach the module from the BD Alaris™ or Alaris™ System before performing corrective maintenance. To avoid damage to the device, only qualified personnel using proper grounding techniques should open the device case.**
- **To avoid the risk of an electrical hazard or damage to the device circuitry, do not spray fluids directly onto the device or allow fluids to enter the device.**
- **Failure to correctly follow the battery installation instructions may lead to intermittent battery connection, which could result in a loss of power and interruption in patient therapy.**

WARNING

- **To ensure secure mounting of the BD Alaris™ System on the IV pole, DO NOT REUSE the screws used to mount the pole clamp plate. Use new screws any time the pole clamp plate is removed from the rear case of a BD Alaris™ PCU Model 8015. Use the pole clamp plate screws kit (P/N 10016082), or the screws included in replacement kits, as needed. Reuse of screws can result in harm to people and/or damage to devices.**
- **Be sure to follow the torque sequence exactly as shown. It is important that the screws are torqued in the sequence shown in pole clamp plate illustration. Follow required Torque Sequence to avoid the possibility of a screw backing out, resulting in harm to people and/or damage to devices.**
- **Inserting a finger or other object into the inter-unit interface (IUI) connector when the module is attached to the PCU could result in electrical shock.**
- **To prevent electromagnetic emissions, use parts that are shielded. To ensure electromagnetic (EMC) compatibility:**
  - **When installing a power supply board in the PCU, ensure that the board is shielded in two places.**
  - **Replacement Rear Case Kits have a metallized Rear Case.**
  - **Replacement power supply board is shielded.**
  - **Non-metallized Rear Cases and an unshielded power supply board are not available as field replacement parts.**
- **Use care when removing small components such as the e-clip and torsion spring, as these components may pop out of the assembly and result in possible eye injury. Be careful when using a dental pick or any sharp tool to perform this procedure.**
- **The E-ring applicator for Ring SE-17 is required for installation of the e-clip; use of any other tool could damage the parts and cause malfunction within the assembly.**
- **Wear PPE (personal protective equipment) when cutting the torsion spring. Pieces of the torsion spring may pop out and result in possible eye injury.**
- **Avoid pinching or creasing the flex cables. If a device with damaged cables is put into service, it could result in delay or interruption of infusion that could cause patient harm.**
- **Complementary Metal Oxide Semiconductor (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.**

CAUTION

- To avoid damage, when removing a component that contains a snap rivet, do not cut the rivet.
- To avoid Pressure Sensor damage, do not apply pressure to the center of the Pressure Sensors.
- Dispose of the system at an electronic waste recycler per federal, state, and local regulations. Failure to comply with these regulations may result in risks to the environment and/or hospital.

5.2 Introduction

This chapter describes how to disassemble and reassemble the PCU and Pump Module. This manual applies to the following products.

- BD Alaris™ PCU model 8015
- Alaris™ PCU model 8015
- BD Alaris™ Pump Module model 8100
- Alaris™ Pump Module model 8100

After disassembling and reassembling a device, perform the minimum required tests in *Table 5-3, Level of Testing Guidelines - PCU Model 8015 on page 5-58* for PCU or *Table 5-4, Level of Testing Guidelines - Pump Module Model 8100 on page 5-60* for Pump Module.

The circuit boards are fitted with surface mount devices and are not field repairable. Return circuit boards to an authorized BD Service Center for repair. Attempting circuit board repairs voids all warranties.

For replacement part information, see Chapter 7, *Illustrated Parts Breakdown* on page *7-1*. Following any level of maintenance, perform the applicable tests, as identified in *Table 5-3, Level of Testing Guidelines - PCU Model 8015 on page 5-58.*

Due to product changes over time, components/assemblies illustrated in this manual may differ from the instrument being serviced.

5.2.1 Expected Service Life

The BD Alaris™ System has been tested for a seven year serviceable life. There are some components which experience wear, and are expected to need periodic attention and replacement within that serviceable life. Examples of these components include:

- PCU Battery
- Pump Module Membrane Frame Seal
- IUI Connectors

NOTE:
The seven year serviceable life applies to the following hardware configurations:

- BD Alaris™ PCU
- BD Alaris™ Pump Module
- BD Alaris™ Syringe Module
- Alaris™ PCA Module
- BD Alaris™ $EtCO_2$ Module

WARNING

Do not dispose of the BD Alaris™ System or any of its components prior to cleaning and disinfecting to prevent exposure to biohazardous substances left on the devices.

5.3 Disassembly/Reassembly Procedures

WARNING

Use BD manufactured parts in the operation and maintenance of your BD equipment. Use of repair or service parts, accessories, or syringes, dedicated infusion sets, or disposables that are not approved by BD is at customer's own risk and could exposed patients to risk of device failure, injury, or even death. In addition, use of such parts, accessories, or disposables may void the product warranty provided by BD.

NOTE:
Any 510(k) clearance from the Food and Drug Administration (FDA) or regulatory approval secured by BD to market the BD Alaris™ System was based on use of BD manufactured parts and equipment and BD validated and authorized disposables. A list of BD approved disposables that are validated to be compatible with the BD Alaris™ System is provided in the BD Alaris™ System user manual. BD has not validated any non-BD parts or accessories for the maintenance, repair or operation of the BD Alaris™ System and Alaris™ System Products. Because unauthorized parts and accessories were not included in the review and approval/clearance of the products, their use may adulterate and misbrand the product in violation of applicable laws.

WARNING

Use only BD approved parts when performing corrective maintenance or repairs. Use of third-party parts can affect the safety and efficacy of the BD Alaris™ and Alaris™ devices, leading to risk of device failure, patient injury, or even death.

WARNING

If it becomes necessary to replace the following cables or accessories, use only approved parts that are listed in the technical service manual. Use of other parts may affect the safety and efficacy of the BD Alaris™ System, leading to risk of device failure, patient injury, or even death.

- **PCU Power Cord**
- **PCU Serial Cable**
- **PCA Dose Request Cord**
- **Auto-ID Handheld Scanner**

WARNING

Detach the module from the BD Alaris™ or Alaris™ System before performing corrective maintenance. To avoid damage to the device, only qualified personnel using proper grounding techniques should open the device case.

WARNING

Complementary Metal Oxide Semiconductor (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.

WARNING

To avoid the risk of an electrical hazard or damage to the device circuitry, do not spray fluids directly onto the device or allow fluids to enter the device.

The disassembly procedures in this chapter are presented by model and in a sequence that provides the most efficient means of disassembling an instrument. To disassemble, perform the steps in order beginning with step 1. To reassemble, perform the steps in their reverse order.

Before adhering gaskets and labels to the instrument, clean the surface with a cotton swab or soft cloth lightly dampened with 70% isopropyl alcohol

5.3.1 Required Materials, Supplies and Tools

NOTE:
The contact/source information is subject to change.

- Silicone Grease, Dow Corning Molykote 33, or equivalent (http://www.dowcorning.com)
- #1 Phillips Screwdriver
- #2 Phillips Screwdriver
- Needle-Nose Pliers
- Small Diagonal Cutters
- E-ring Applicator for Ring SE-17
- Dental pick or equivalent tool
- Lint-free Cloth (such as, Kimwipes or lint-free tissue)

The following items can be purchased from Techni-Tool (800.832.4866; http://www.techni-tool.com)

- 7/16 Nut Driver, TT 272SC036
- 3/16 Nut Driver, TT 272SC116
- 1/4 Nut Driver, TT 272SC144
- Torque Screwdriver with a minimum range of 3-16 in/lb. Recommend torque screwdriver, micro-adjustable, TT 844SC5002 or TT 304TO034.
- T10 Torx™ Bit used with torque screwdriver capable of 6 in-lb TT 758SC0305

The following items can be ordered through Grainger at www.grainger.com:

- Impact Driver, Dewalt Model DCF895D2 DCB203
- Torque Screwdriver, SK Professional Tools Model SKT0587
- Torque Wrench, 150in/lb CDI Torque Products Model 1502MRMH

5.4 PCU

5.4.1 Battery Pack Assembly

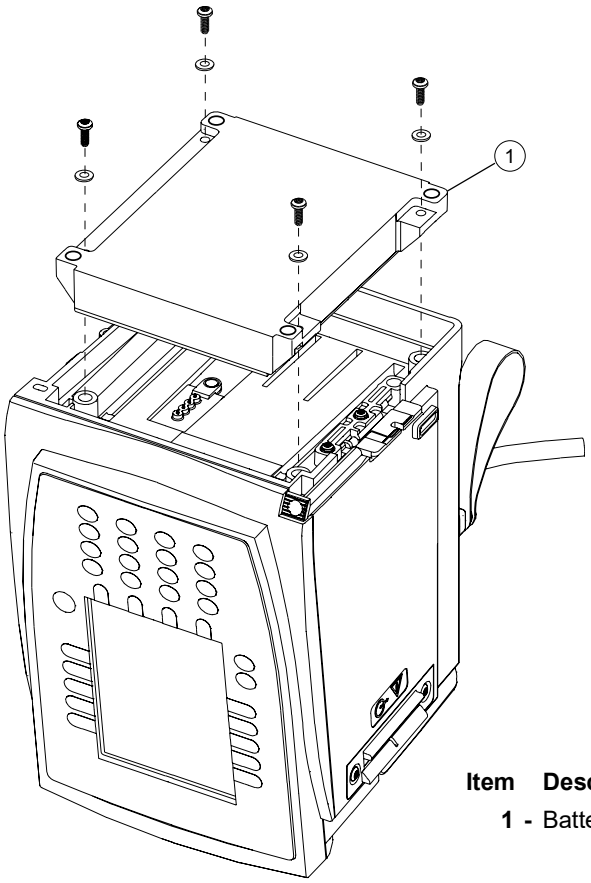
CAUTION

Dispose of the system at an electronic waste recycler per federal, state, and local regulations. Failure to comply with these regulations may result in risks to the environment and/or hospital.

NOTE:
The battery pack assembly should be replaced every two years.

5.4.1.1 Battery Pack Removal

1. Remove the four screws and washers from the bottom of the PCU.
2. Remove the battery pack assembly.



Item Description

1 - Battery Pack Assembly

5.4.1.2 Battery Pack Reassembly

WARNING

Failure to correctly follow the battery installation instructions may lead to intermittent battery connection, which could result in a loss of power and interruption in patient therapy.

1. Line up the battery connectors.
2. Place the battery carefully in the battery well.
3. Add a washer to each of the four battery screws.
4. Place one screw with a washer in each of the four battery screw wells.
5. Torque each of the four battery screws to 6 in./lb.

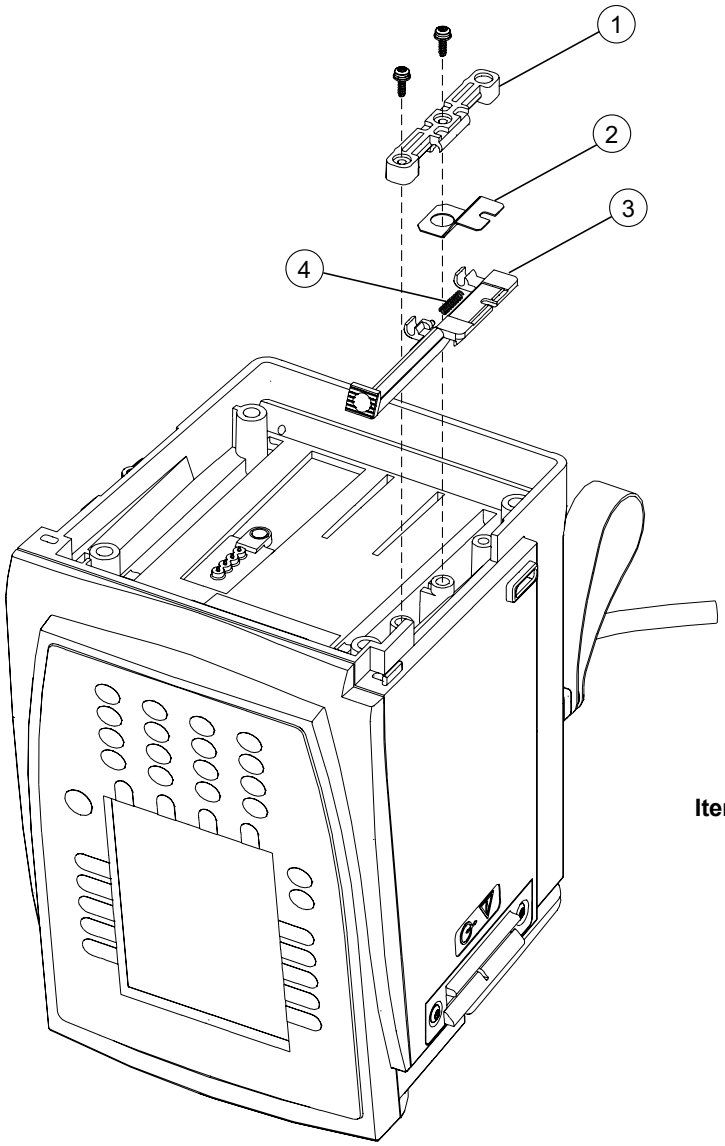
NOTE
Refer to Table 5-1: *Torque Values - PCU Model 8015*.

NOTE:
There is an updated battery pack assembly for the Alaris™ PCU, Model 8015. This is the same assembly currently used by the BD Alaris™ PCU. The updated assembly for the Alaris™ PCU now has a medium gray color, but there are no other physical changes to the battery pack assembly. There are no electrical, environmental, functional, or performance changes from the previous battery pack assembly.
If the battery has been removed from the PCU during maintenance or repair, and the same or other used battery is reinstalled, the battery capacity must be checked by performing the procedure in *Performing Battery Conditioning (Fast or Optimal) in Maintenance Mode (v12.1.1 and Later)* on page *1-17* for PCU v12.1.1 or later. For PCUs with any other version of software, follow the procedures in Service Bulletin 592A (P/N P00000213).

5.4.2 Latch Assembly

NOTE:
The appearance of the PCU keypad may vary from this drawing.

1. Remove the screws (2) attaching the Latch Assembly to the bottom of the Rear Case.
2. Remove the Latch Assembly components (items 1, 2, 3, and 4) from the bottom of the Rear Case. Pay close attention to the location of the Compression Spring, to ensure proper installation during reassembly.



Item	Description
1 -	Latch Support
2 -	Leaf Spring
3 -	Latch
4 -	Compression Spring

5.4.3 Power Cord

NOTE:
Pole clamp may differ from this drawing.

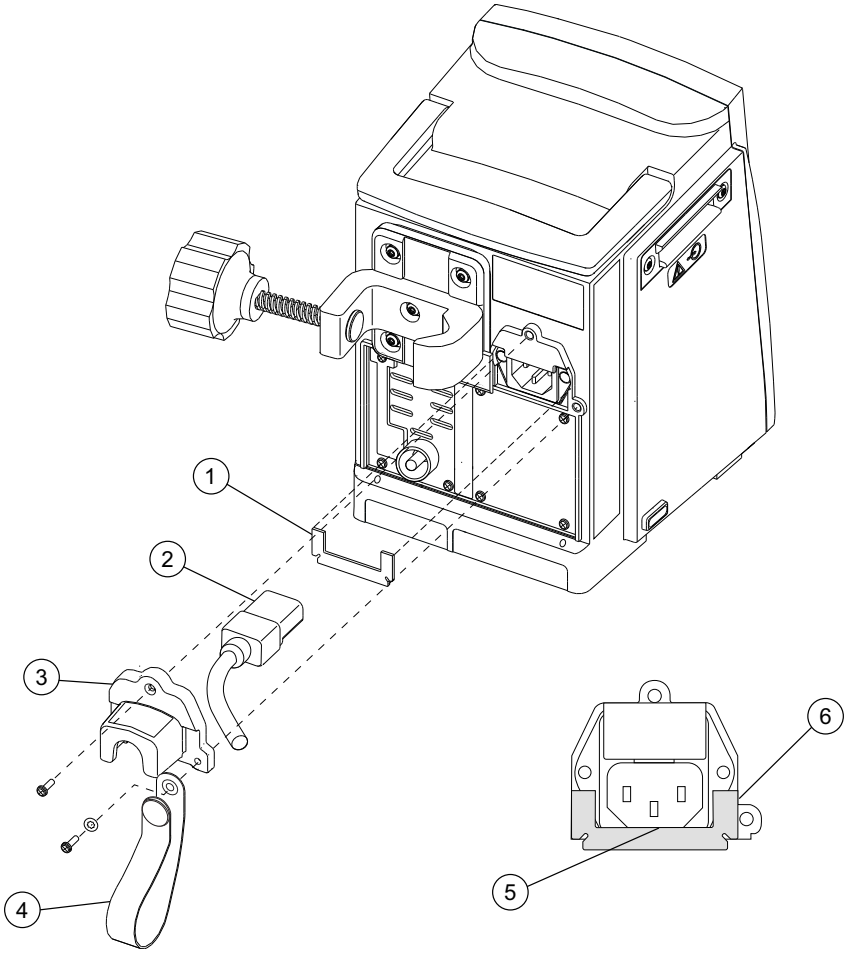
1. Remove the screw attaching the Power Cord Wrap to the PCU and remove the Power Cord Wrap.
2. Remove the screw attaching the Power Cord Retainer to the PCU and remove the Power Cord Retainer.

   NOTE
   The Pole Clamp Mounting Plate may need to be loosened to remove the retainer (see *Pole Clamp Assembly* on page *5-14*).

3. Unplug the Power Cord from the PCU and remove the power cord to ensure that the device is isolated from AC power.

5.4.3.1 During Reassembly

If it is not present, install the External AC Filter Gasket.



Item	Description
1 -	External AC Filter Gasket (see 5 & 6)
2 -	Power Cord
3 -	Power Cord Retainer
4 -	Power Cord Wrap
5 -	Ensure that this edge of the gasket completely covers the gap between the AC Filter and the Rear Case.
6 -	Align this edge of the gasket with the edge of the AC Filter housing, as shown above.

5.4.4 Pole Clamp Assembly

NOTE:
These instructions apply to all supported pole clamps.

1. Remove the screw attaching the Pole Clamp to the Pole Clamp Mounting Plate.
2. Remove the four screws attaching the Pole Clamp Mounting Plate to the PCU. Use of an impact driver (Dewalt DCF895D2 DCB203) or equivalent is recommended.
3. Perform the following steps on the BD Alaris™ pole clamp:
   a. Use a small punch and hammer to drive the Pin out of the tip of the Lead Screw Tip.
   b. Remove the knob from the Pole Clamp.

5.4.4.1 During Reassembly

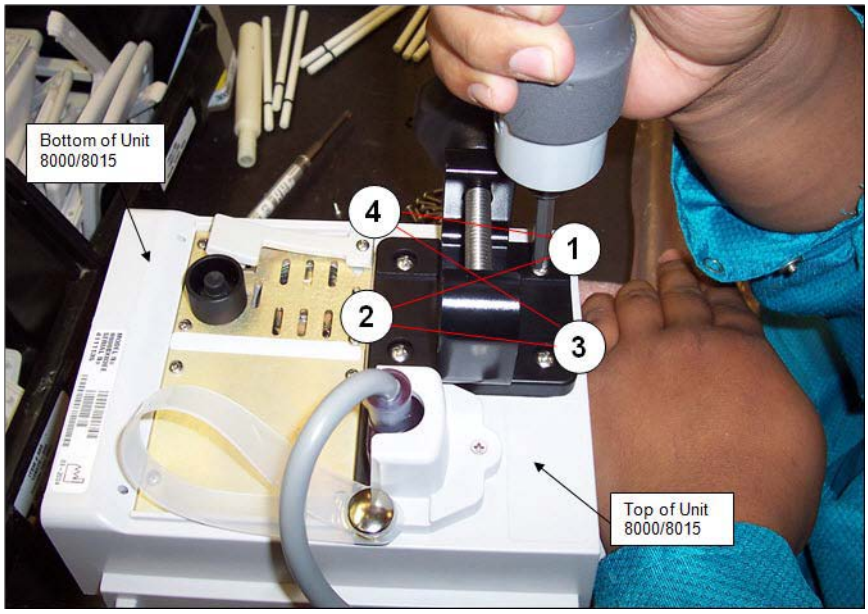
WARNING

- **To ensure secure mounting of the BD Alaris™ System on the IV pole, DO NOT REUSE the screws used to mount the pole clamp plate. Use new screws any time the pole clamp plate is removed from the rear case of a BD Alaris™ PCU Model 8015. Use the pole clamp plate screws kit (P/N 10016082), or the screws included in replacement kits, as needed. Reuse of screws can result in harm to people and/or damage to devices.**
- **Be sure to follow the torque sequence exactly as shown. It is important that the screws are torqued in the sequence shown in pole clamp plate illustration. Follow required Torque Sequence to avoid the possibility of a screw backing out, resulting in harm to people and/or damage to devices.**

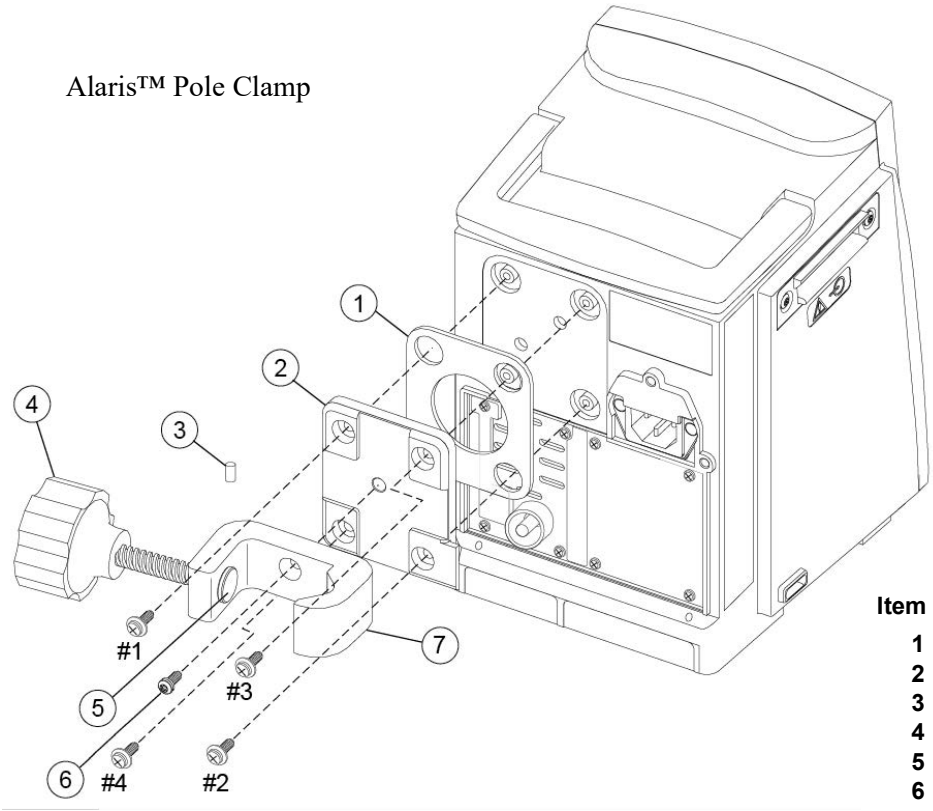
NOTE:
The BD Alaris™ pole clamp assembly cannot be disassembled into sub-components.

1. For the BD Alaris™ pole clamp: Use a small punch and hammer to reinstall the Pin in the tip of the Knob/Lead Screw.
2. When installing the Pole Clamp Plate:
   a. Use the new plate screws containing blue epoxy.
   b. Hand-tighten the plate screws in the sequence shown in the illustration.
   c. Use a torque wrench to tighten the plate screws to 16 in-lb in the sequence shown in the pole clamp plate torquing pattern illustration.
   d. Use a torque wrench to tighten the Pole Clamp screw to 150 in-lb.

Pole clamp plate torquing pattern

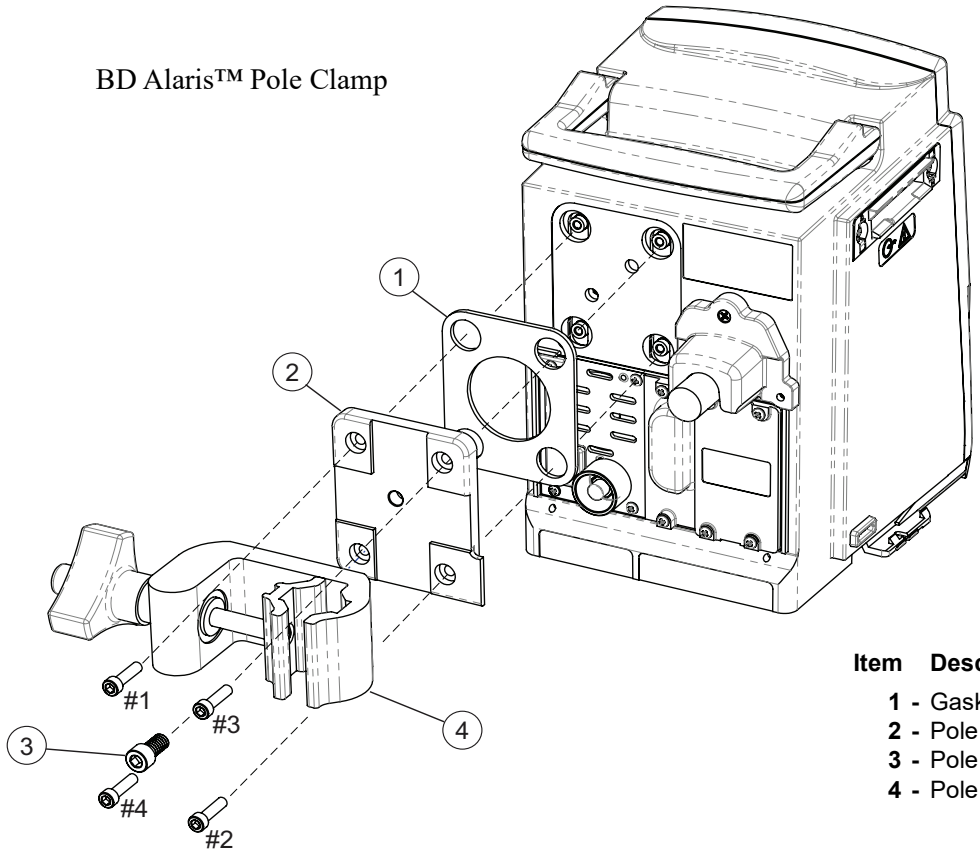


Alaris™ Pole Clamp



Item	Description
1 -	Gasket
2 -	Pole Clamp Plate
3 -	Pin
4 -	Knob / Lead Screw
5 -	Lead Screw Tip
6 -	Pole Clamp Screw
7 -	Pole Clamp

BD Alaris™ Pole Clamp



Item	Description
1 -	Gasket
2 -	Pole Clamp Plate
3 -	Pole Clamp Screw
4 -	Pole Clamp

5.4.5 SIO Board Assembly

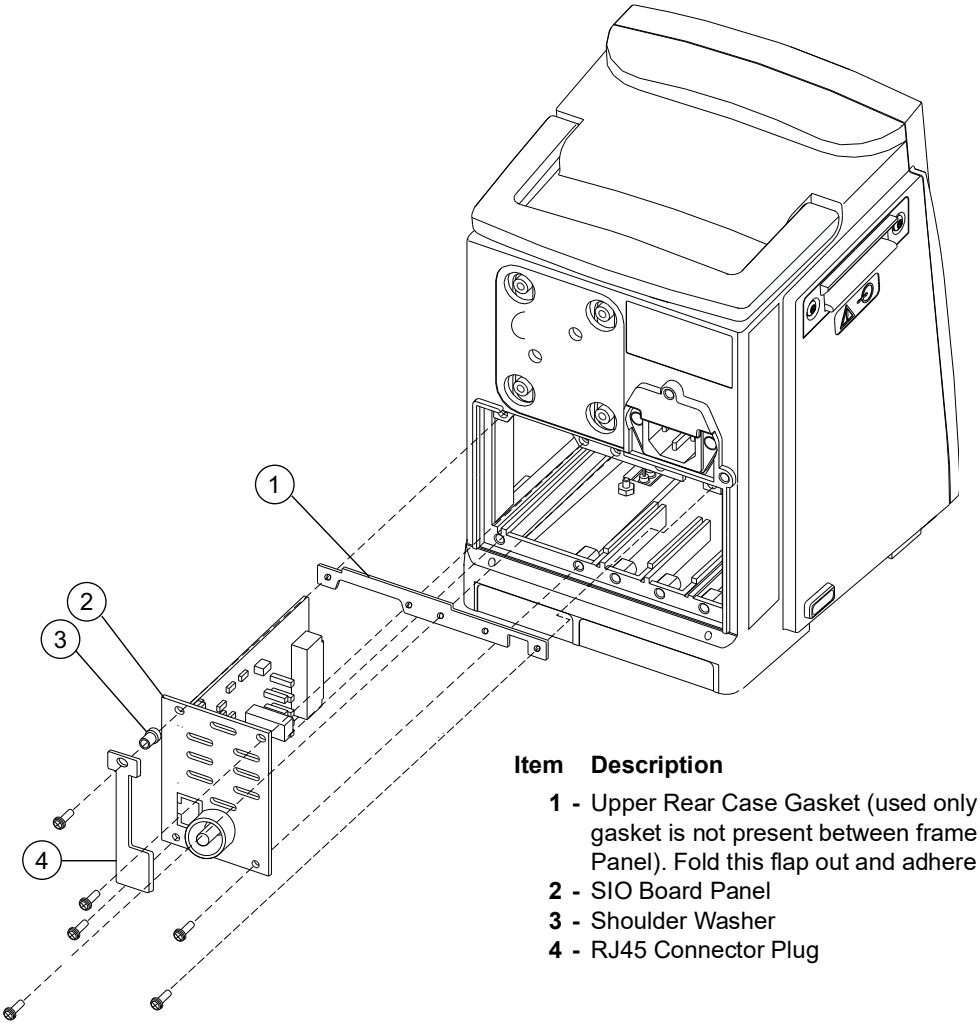
1. Remove and discard the Gasket Strip.

NOTE
To remove the wireless network card, see Section *Wireless Network Card Assembly* on page *5-20*.

2. Remove the screws (4) securing the SIO Board to the Rear Case Frame.
3. Gently slide the SIO Board out of the PCU.

5.4.5.1 During the Reassembly:

1. If a gasket is not visible along the upper mounting on the frame, install an Upper Rear Case Gasket.
2. Slide the SIO Board along the left guide, raising it slightly as necessary to align the board connection and pushing it into the logic board connector. The connector is fully seated when the panel is flush with the mounting frame.
3. Ensure that the panels are flush to the Rear Case and tighten the mounting screws.
4. Install a new Gasket Strip.



Item	Description
1 -	Upper Rear Case Gasket (used only when a gasket is not present between frame and Rear Panel). Fold this flap out and adhere to Rear Case.
2 -	SIO Board Panel
3 -	Shoulder Washer
4 -	RJ45 Connector Plug

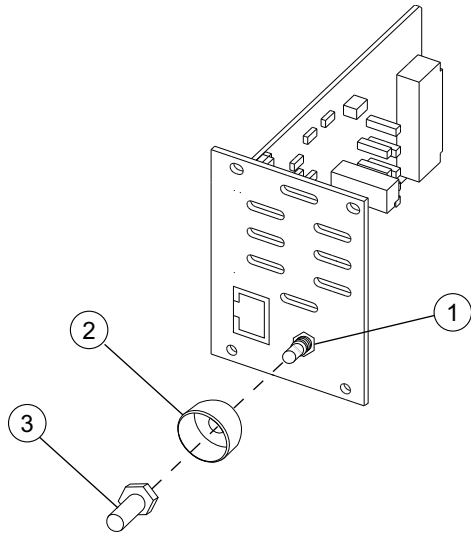
5.4.6 SIO Board Panel Parts

1. Cut the cable tie holding the Speaker and Tamper Resist Switch wiring together.
2. Unscrew the Boot Seal from the Tamper Resist Switch.
3. Remove the Tamper Resist Switch Shroud.
4. Disconnect the Tamper Resist Switch from J4 of the RS-232 Board.
5. Remove the Tamper Resist Switch.
6. Disconnect the Speaker from J2 of the Isolated RS-232 Board.
7. Remove the screws (2) from the RS-232 Board.
8. Remove the RS-232 Board, Speaker Bracket, and Speaker.
9. Remove and discard the Speaker Gasket.

NOTE:
The Speaker Gasket is adhered to both the Speaker and SIO Board Panel.

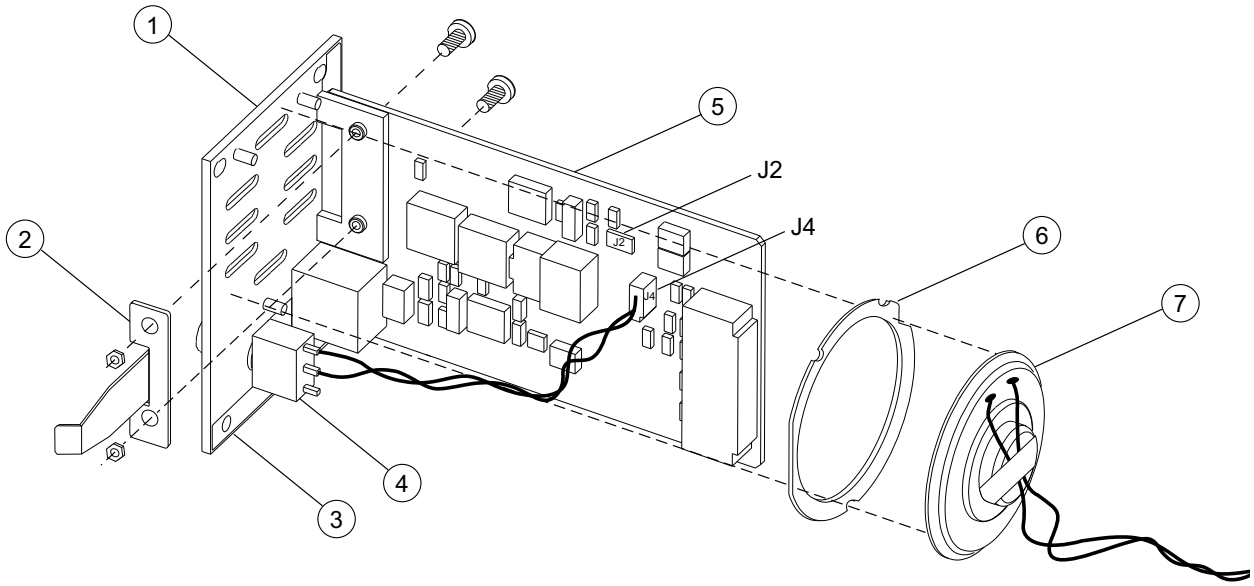
5.4.6.1 During the Reassembly:

1. Install the Speaker Gasket:
   a. Remove the protective backing from the side facing the SIO Board Panel.
   b. Orient the notches to line up with the standoffs on the SIO Board Panel.
   c. Adhere it to the Rear Panel.
2. Remove the remaining protective backing from the Speaker Gasket and adhere the Speaker to the Gasket.
3. Tie the Speaker and Tamper Resist Switch wiring together with a cable tie.



Item	Description
1 -	Tamper Resist Switch
2 -	Tamper Resist Switch Shroud
3 -	Boot Seal

5.4.7 SIO Board Panel Parts



Item	Description
1 -	SIO Board Panel
2 -	Speaker Bracket
3 -	Rear Panel Gasket (runs along two edges; not used if the Lower Rear Case Gasket is present)
4 -	Tamper Resist Switch
5 -	SIO Board Assembly
6 -	Gasket
7 -	Speaker

5.4.8 Wireless Network Card Assembly

This section describes two kinds of wireless network card assemblies. The assembly shown below is used with wireless network cards that conform to Institute of Electrical and Electronics Engineers (IEEE) specification 802.11 a/c.

5.4.8.1 Disassembly for Wireless Cards 802.11 a/c

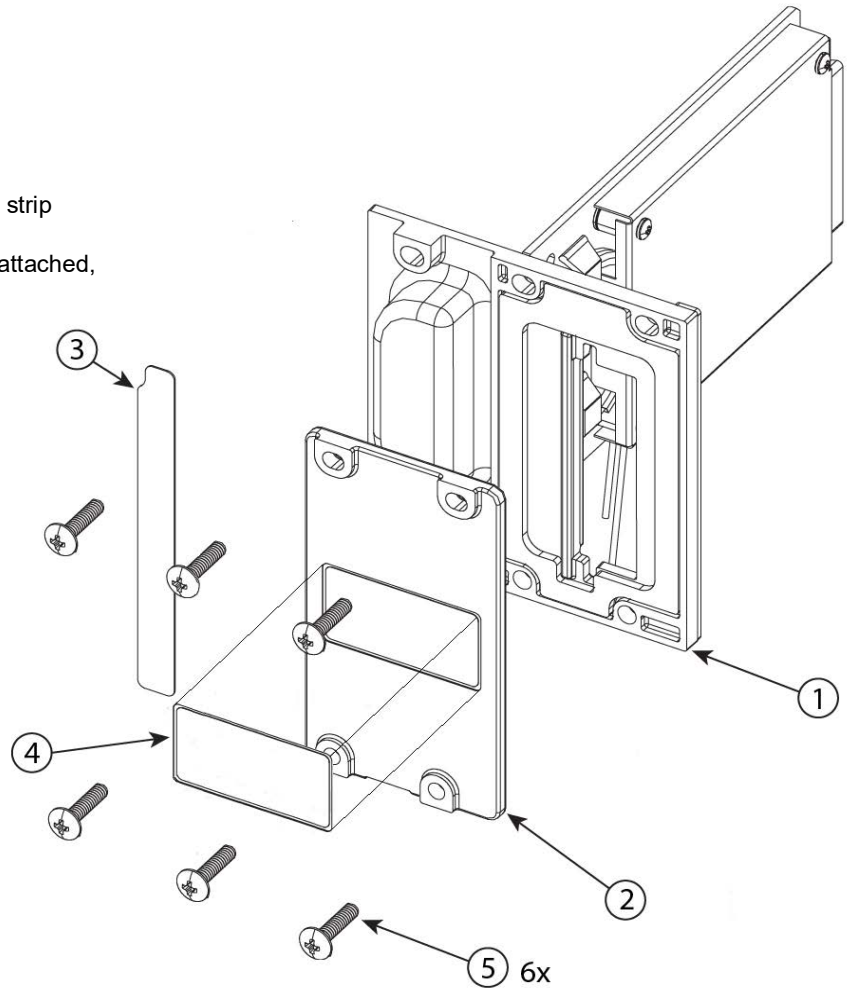
1. Remove and discard the Gasket Strip.
2. Remove the fours screws that attach the Wireless Network Card Cover to the Rear Case Frame.
3. Remove the Wireless Network Card Cover.
4. Remove the two screws that attach the PCU Rear Panel Assembly.
5. Remove the PCU Rear Panel Assembly.

During Reassembly

1. Before tightening cover screws, ensure that the network card is flush to Rear Case.
2. Install a new Gasket Strip.

Item Description

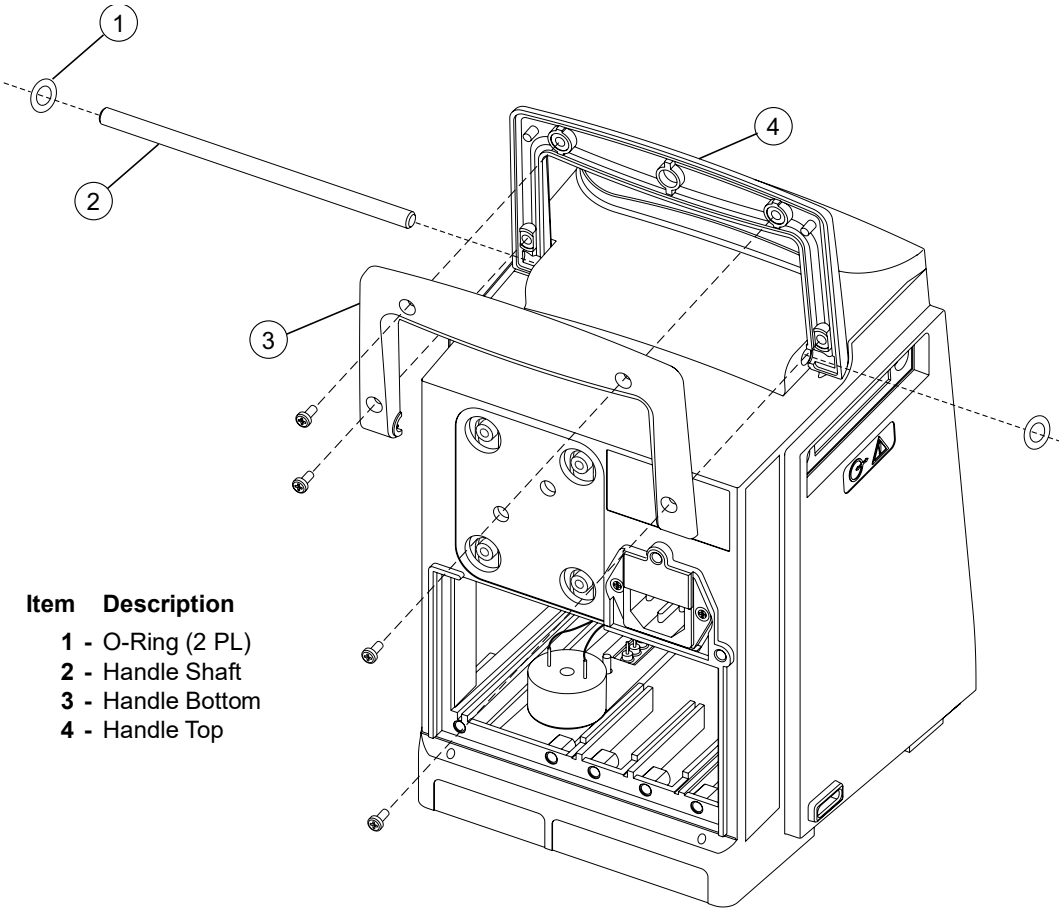
1 - PCU Rear Panel Assembly
2 - PCU Rear Cover
3 - Strip Gasket Panel (Gasket strip color may vary.)
4 - PCU Wireless Card Label (attached, but replaceable)
5 - Machine Screws



5.4.9 Handle

NOTE:
The handle color may vary.

1. Remove the screws (4) attaching the handle halves to each other.
2. Remove the Handle Top and Bottom.
3. Remove the Handle Shaft and O-rings by sliding the shaft to one side.



Item	Description
1 -	O-Ring (2 PL)
2 -	Handle Shaft
3 -	Handle Bottom
4 -	Handle Top

5.4.10 Front and Rear Case Separation

1. Remove the screws (4) attaching the Front Case to the Rear Case.
2. Carefully disconnect the Keypad Backlight LED connector from the logic board (J9).
3. Disconnect the harnesses/cables.
   - LCD/Display - logic board J7
   - Keypad - logic board J4
   - Ground - Ground Plate
   - Inverter Display - logic board J9

5.4.10.1 During the Reassembly

Ensure that the Silicone Tubing is in place and is not damaged (see Figure *Model 8015 - Rear Case Assembly).*

WARNING

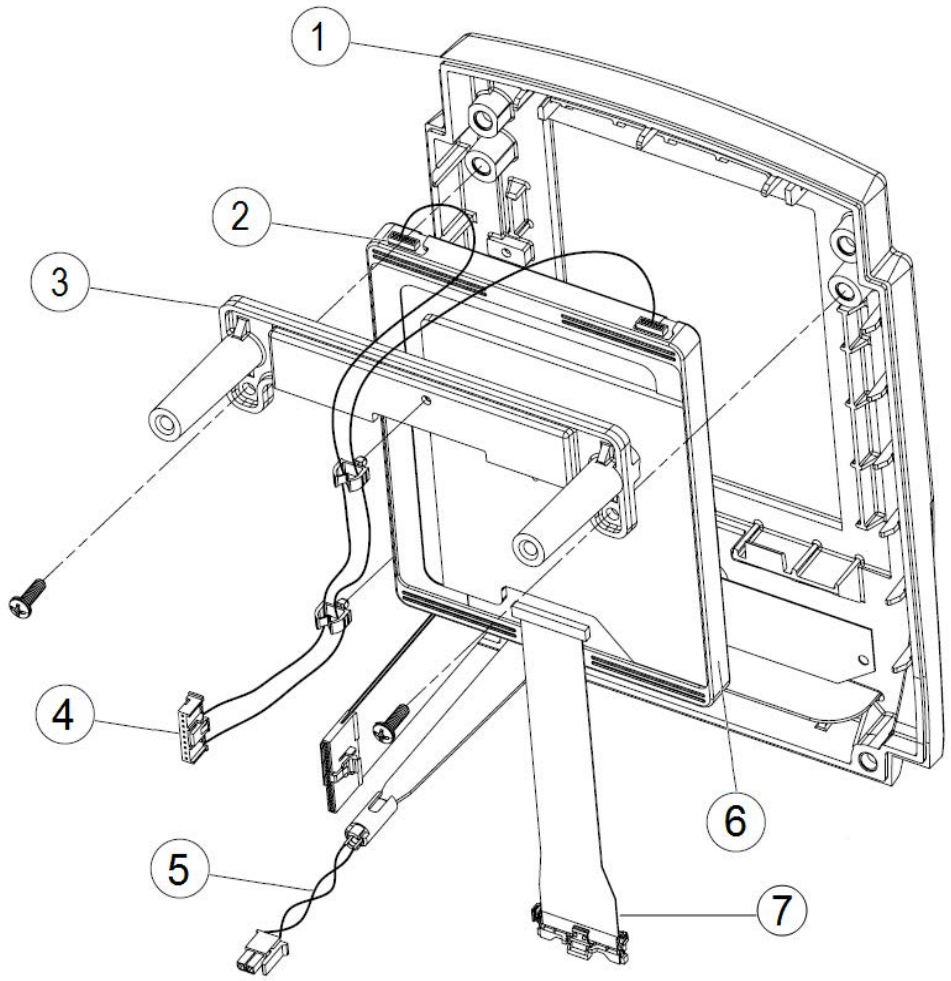
Avoid pinching or creasing the flex cables. If a device with damaged cables is put into service, it could result in delay or interruption of infusion that could cause patient harm.

5.4.11 Display and Retainers

5.4.11.1 Display Instructions

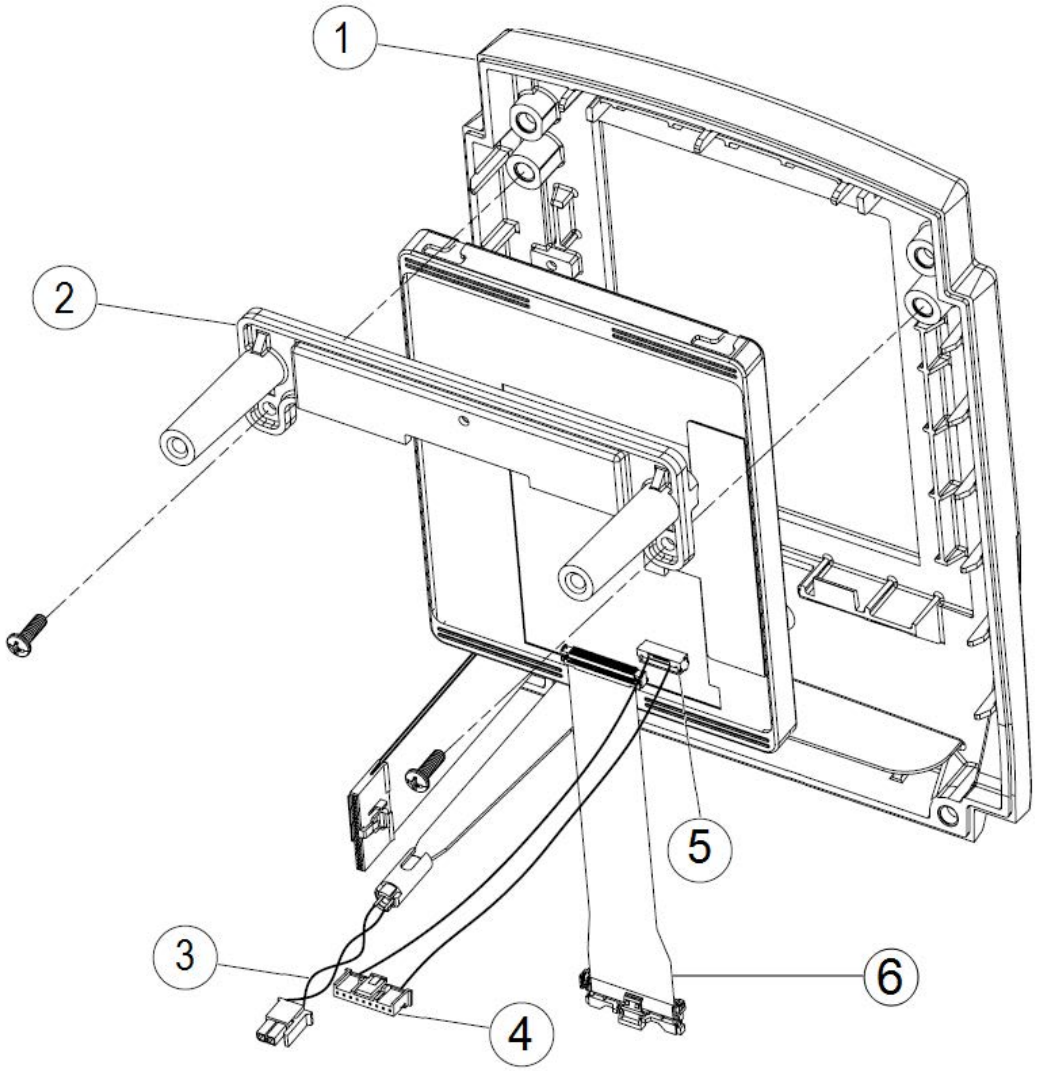
1. Remove the screws (2) from the Upper Retainer.
2. Remove the Display/Retainer from the Front Case.

NOTE:
Both older and newer Backlight Harness Assembly configurations are shown below.



Older Style Cable Wiring

Item	Description
1 -	Front Case/Keypad Assembly
2 -	Display
3 -	Upper Retainer
4 -	Backlight Harness Assembly
5 -	LED Harness
6 -	Molded Gasket
7 -	Flex cable



Newer Style Cable Wiring

Item	Description
1 -	Front Case/Keypad Assembly
2 -	Upper Retainer
3 -	LED Harness
4 -	Backlight Harness Assembly
5 -	Backlight Harness Assembly Connector
6 -	Flex cable

5.4.12 IUI Connectors

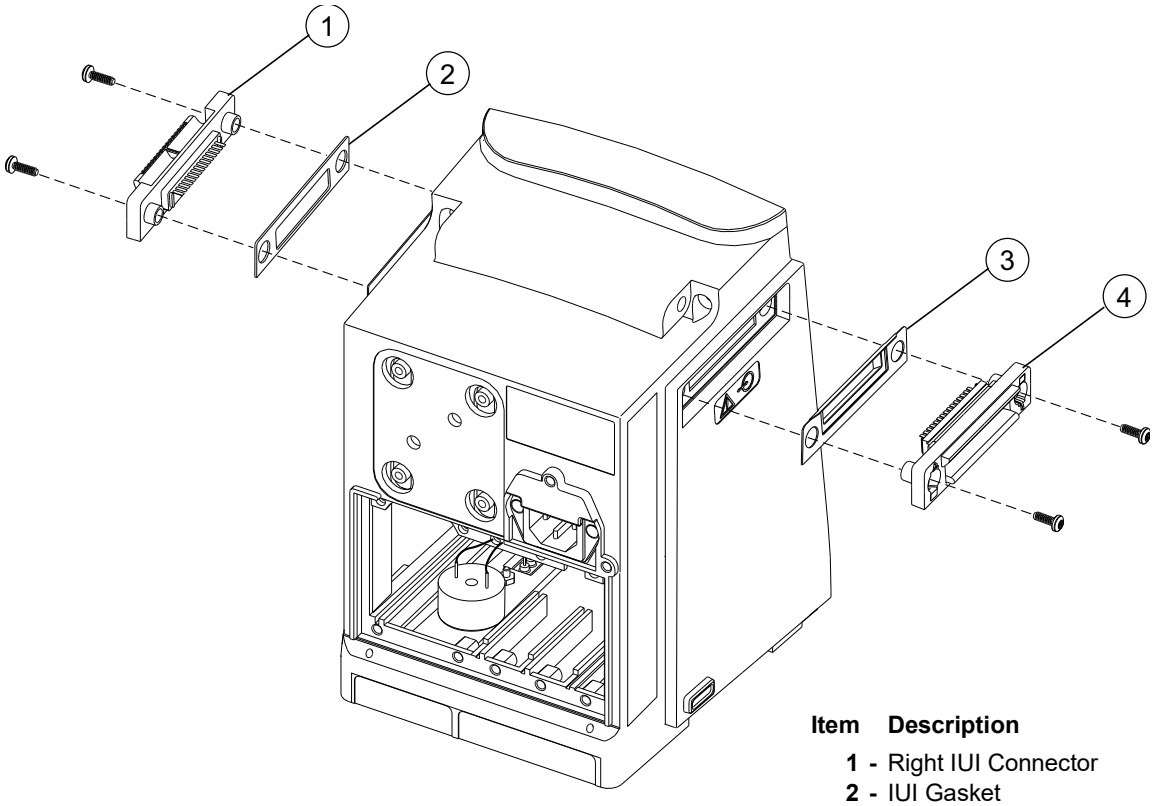
WARNING

Inserting a finger or other object into the inter-unit interface (IUI) connector when the module is attached to the PCU could result in electrical shock.

1. Remove the screws (2) attaching each IUI (left and right) to the PCU.
2. Remove the IUI Connectors and Gaskets.

5.4.12.1 During the Reassembly:

- Ensure that the ground clips are still installed on both IUI connectors.
- To install the Right IUI Connector Gasket, remove the protective backing and adhere it to the IUI Connector.
- To install the Left IUI Connector Seal, position the seal on one end of the connector and stretch it to the other end to conform to the connector body. Gently press on the seal to seat it completely. Use a lint-free swab to apply alcohol to the top, sides, and bottom of seal for lubrication, while installing it to the Rear Case. Do not apply alcohol to the contacts or connector.



Item	Description
1 -	Right IUI Connector
2 -	IUI Gasket
3 -	IUI Seal
4 -	Left IUI Connector

5.4.13 Rear Case Assembly Parts

1. Remove the screw from the Ground Plate.
2. Gently slide the assembly partially out of the rear case.
3. Disconnect the harnesses.
   - Battery Connector Assembly - logic board J4
   - Backup Speaker - logic board J701
   - Battery Discharge - power supply board J5
   - DC Output - power supply board J3
4. Remove the screw attaching the Ground Strap to the Ground Plate.
5. Remove the screws (2) from the power supply board.
6. Separate the Board/Ground Plate Assembly from the Chassis Assembly.
7. Remove the remaining screws (4) from the Ground Plate.
8. Separate and remove the Ground Plate, logic board, and power supply board.
9. Remove the Ground Clip.
10. If the Rear Case is being replaced:
    a. Remove the Backup Speaker (adhered to the inside of the Rear Case).
    b. Remove the screw attaching the Battery Connector Assembly to the bottom of the Rear Case and remove the Connector Assembly.
    c. Retain the Backup Speaker and Battery Connector Assembly for use with the new Rear Case.
    d. Make note of the model/reference number and serial number found on the serial number label.

5.4.13.1 During the Reassembly

WARNING

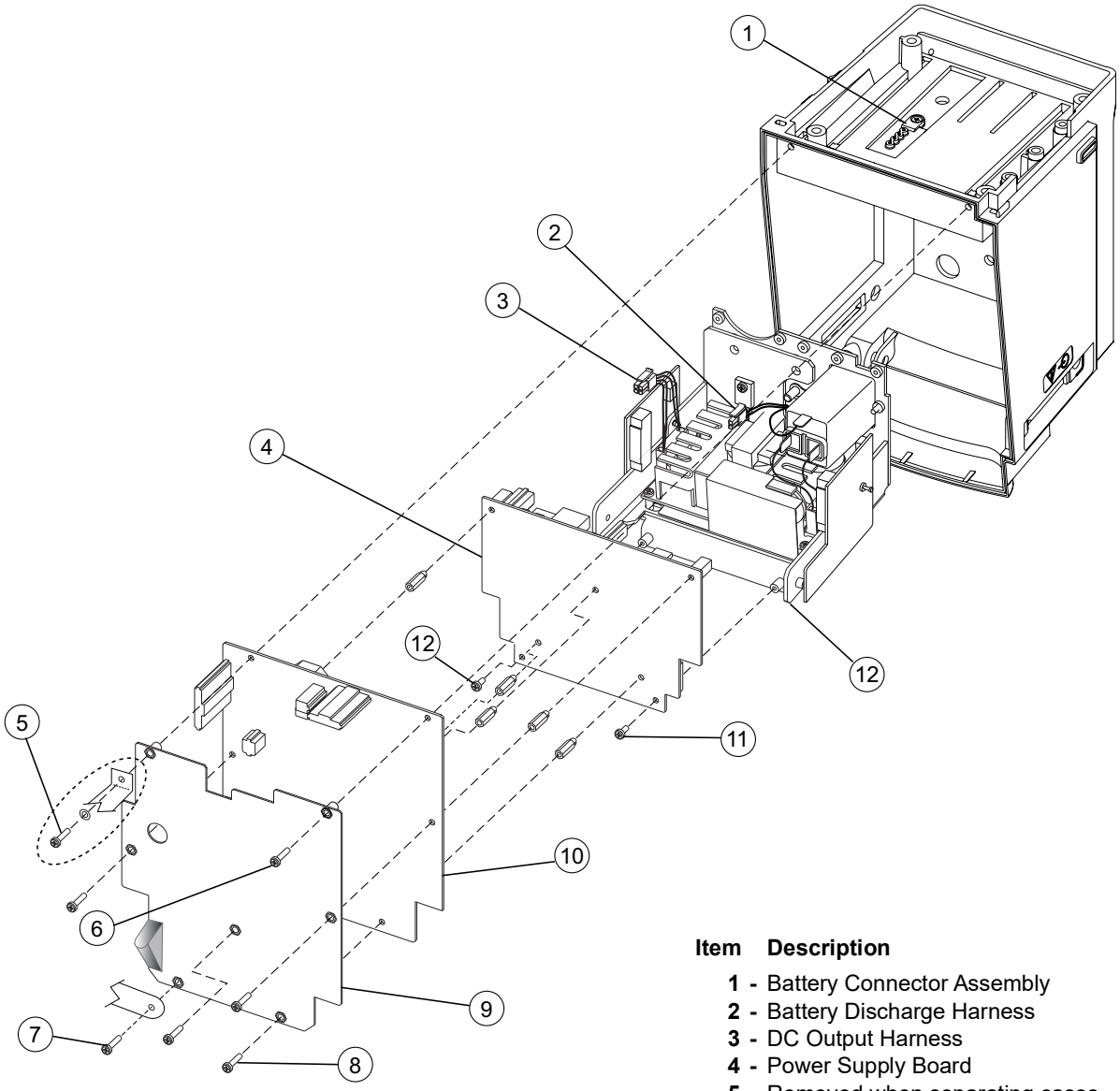
To prevent electromagnetic emissions, use parts that are shielded. To ensure electromagnetic compatibility (EMC) compatibility:

- **When installing a power supply board in the PCU, ensure that the board is shielded in two places.**
- **Replacement Rear Case Kits have a metallized Rear Case.**
- **Replacement power supply board is shielded.**
- **Non-metallized Rear Cases and an unshielded power supply board are not available as field replacement parts.**

If the Rear Case has been replaced:

1. Adhere the Backup Speaker to the gasket on the inside of the Rear Case.
2. Using permanent black ink, print the instrument's model/reference number and serial number on the Serial Number Replacement Label.
3. Apply the Serial Number Replacement Label to the instrument.

4. Adhere the transparent label over the Serial Number Replacement Label.

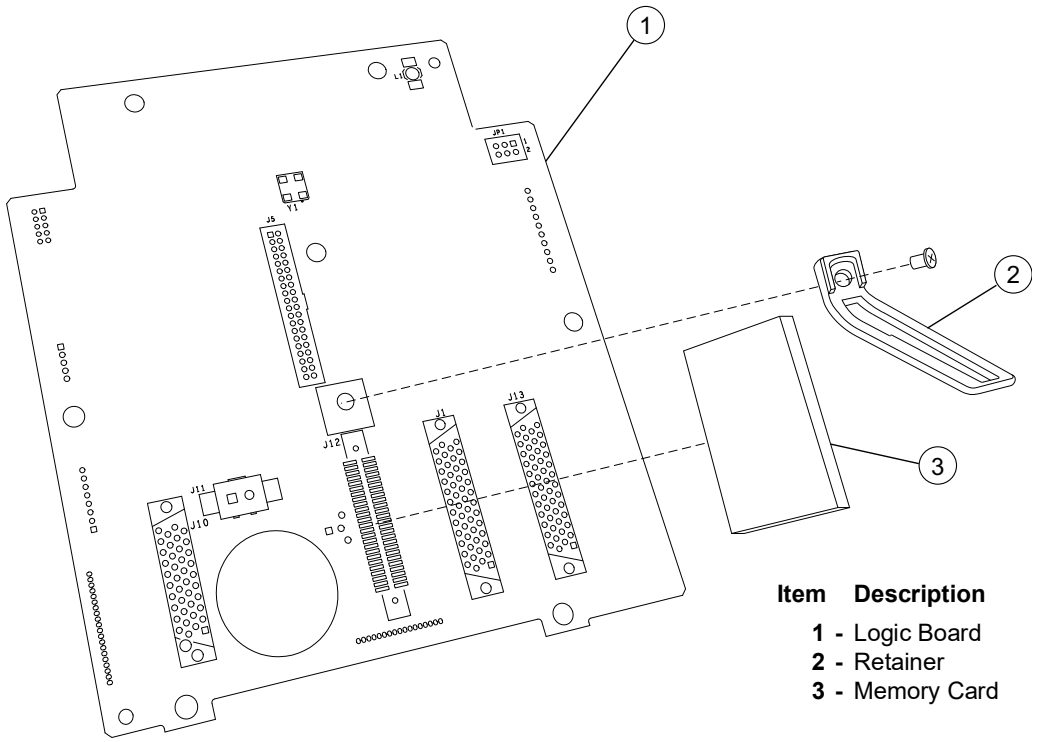


Item	Description
1 -	Battery Connector Assembly
2 -	Battery Discharge Harness
3 -	DC Output Harness
4 -	Power Supply Board
5 -	Removed when separating cases
6 -	First screw to remove from the Ground Plate (Step 1)
7 -	Screw holding the Ground Strap to the Ground Plate
8 -	Last screws to remove from Ground Plate (1 of 4) (Step 7).
9 -	Ground Plate (With Clip)
10 -	Logic Board
11 -	One of two screws to remove from the Power Supply Board
12 -	Chassis Assembly

5.4.14 Model 8015: Memory Card

The new logic boards have the memory card glued on the logic board. As a result, the memory card can no longer be ordered separately as a replaceable part. If the memory card fails, you will need to order a new logic board.

1. Remove the screw from the Retainer and remove the Retainer from the logic board.
2. Remove the Memory Card.



Item	Description
1 -	Logic Board
2 -	Retainer
3 -	Memory Card

5.4.15 Chassis Assembly and Power Supply Switcher Parts

Use small diagonal cutters to lift and remove the Snap Rivets from the Left and Right IUI Board Assemblies, and remove the Board Assemblies.

CAUTION

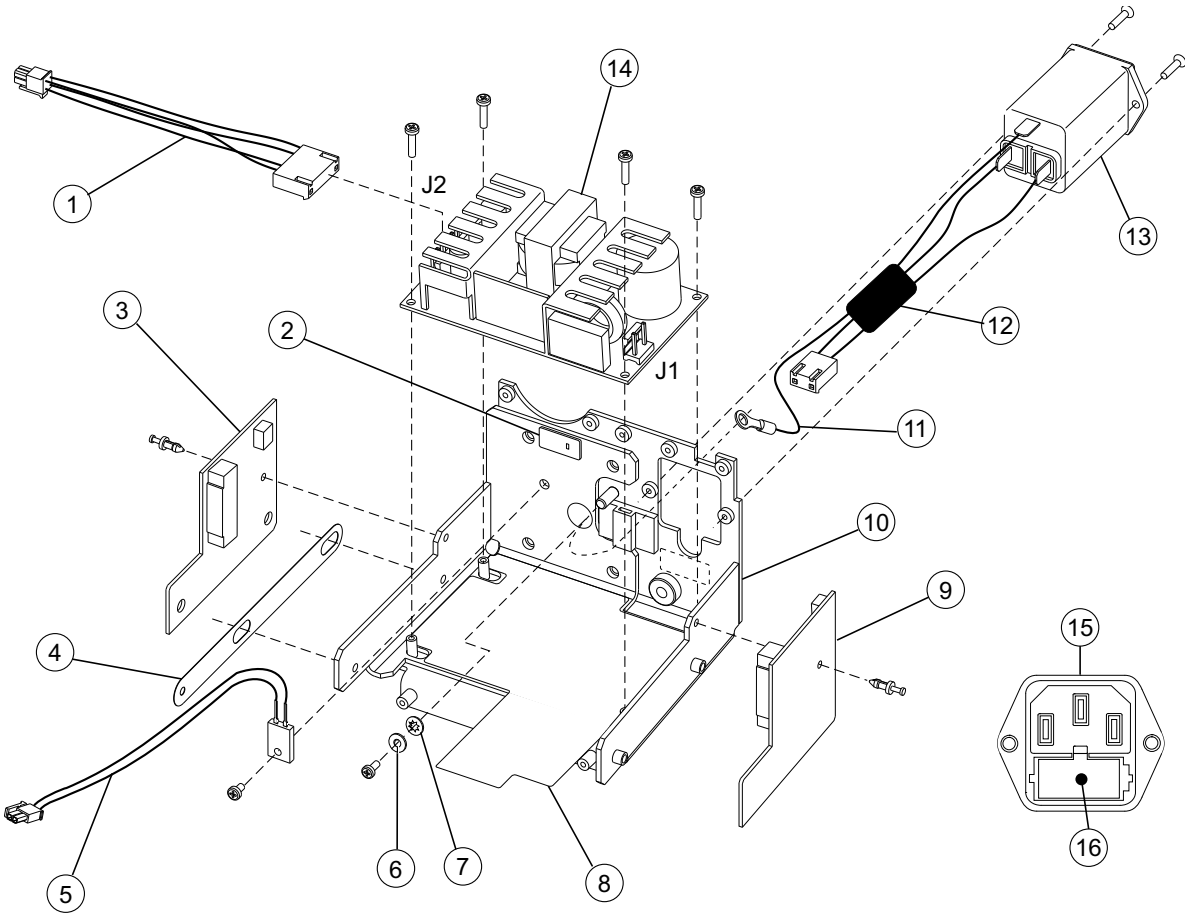
To avoid damage, when removing a component that contains a snap rivet, do not cut the rivet.

1. Cut the cable tie securing the Ferrite Bead to the Power Supply.
2. Disconnect the AC Filter from the Power Supply J1.
3. Remove the lock washers (2) and screw securing the AC Filter ground wire to the Frame Assembly.
4. Remove the screws (2) attaching the AC Filter to the Frame Assembly and remove the AC Filter.
5. To access the fuses, remove the Fuse Holder from the AC Filter. If fuses need replacing, the Power Supply Switcher must also be replaced.

6. Cut the cable tie securing the Battery Discharge Harness Assembly to the Frame Assembly.
7. Remove the screw attaching the Battery Discharge Harness Assembly to the Frame Assembly and remove the Harness.
8. Remove the screws (4) attaching the Power Supply to the Frame Assembly and remove the Power Supply.

5.4.15.1 During the Reassembly:

1. Install the AC Filter with two AC wire connectors oriented toward the Power Supply.
2. Angle the Ground Wire toward the AC Filter prior to applying torque.
3. Use a cable-tie to fasten the Ferrite bead over the Cable Tie Mount or cooling fins, depending on the type of Power Supply installed.
4. Tuck the Dielectric Insulator between the Ferrite Bead and Power Supply.
5. Use a cable-tie to fasten the Battery Discharge Harness over the Cable Tie Mount.



Item	Description	Item	Description
1 -	DC Output Harness	**9** -	IUI Board, Left
2 -	Cable Tie Mount	**10** -	Frame Assembly
3 -	IUI Board, Right	**11** -	Ground Wire
4 -	Ground Strap	**12** -	Ferrite Bead
5 -	Battery Discharge Harness	**13** -	AC Filter
6 -	Split Lock Washer	**14** -	Power Supply
7 -	Internal Lock Washer	**15** -	AC Filter
8 -	Dielectric Insulator	**16** -	Fuse Holder

5.5 Pump Module

5.5.1 Latch Assembly and Feet

WARNING

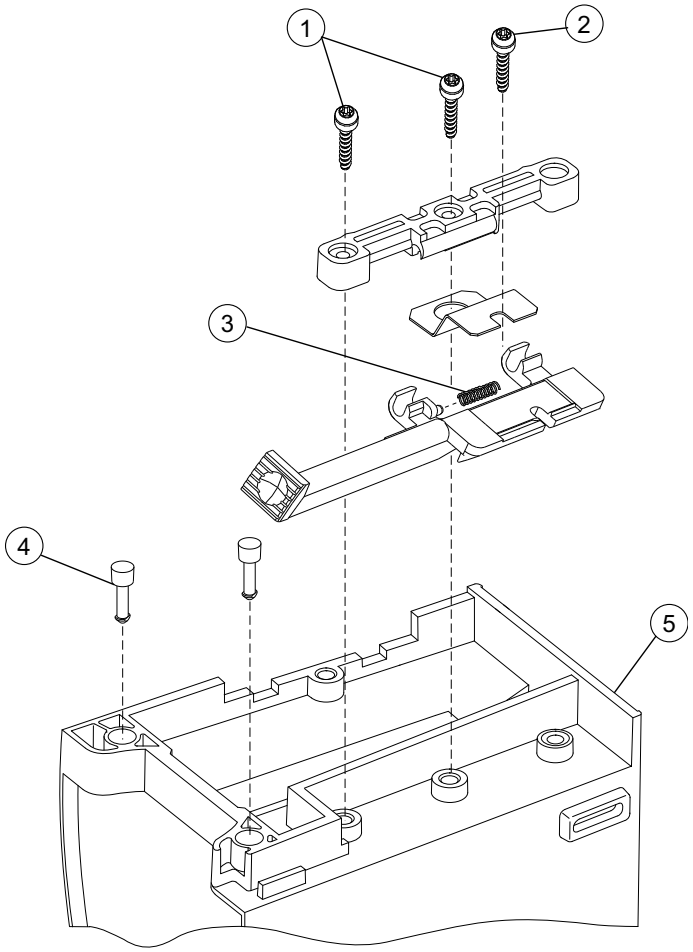
Detach the module from the BD Alaris™ or Alaris™ System before performing corrective maintenance. To avoid damage to the device, only qualified personnel using proper grounding techniques should open the device case.

1. Remove the screws (2) attaching the Latch Assembly to the bottom of the Rear Case.
2. Remove the Latch Assembly components. Pay close attention to the Compression Spring location, to ensure proper installation during reassembly.
3. Pull the Feet (2) from the underside of the module.

5.5.1.1 During the Reassembly:

Apply a thin layer of Dow Corning Molykote™ 33 (or equivalent) silicone grease to the Feet.

NOTE:
The Feet press-fit into the module.



Item Description

1 - Latch Screws
2 - Screw for locking the Pump Module to the PCU, for fixed configurations
3 - Compression Spring
4 - Foot (2 PL)
5 - Rear Case

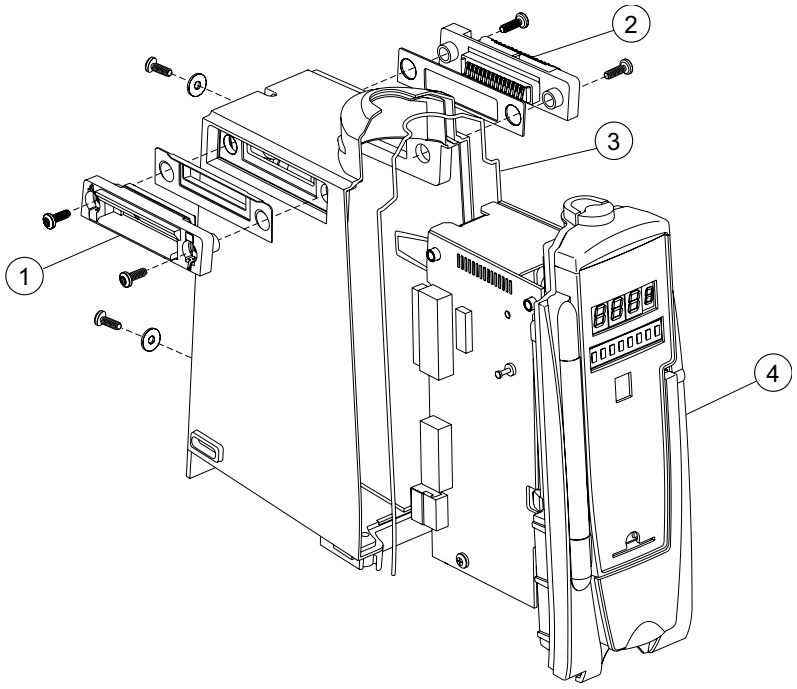
5.5.2 IUI Connectors and Rear Case

NOTE:
Rear case color may vary.

1. Remove the screws (2) attaching each IUI (left and right) to the module.
2. Remove the IUI Connectors and Gaskets.
3. Remove the screws (2) and associated washers attaching the Rear Case to the Chassis Assembly.
4. Remove the Rear Case by pulling it away from the Chassis Assembly.
5. If the Rear Case is being replaced, make note of the model/reference number and serial number found on the serial number label.

5.5.2.1 During the Reassembly:

- Ensure that the ground clips are still installed on both IUI connectors.
- To install the Right IUI Connector Gasket, remove the protective backing and adhere it to the IUI Connector.
- To install the Left IUI Connector Seal, position the seal on one end of the connector and stretch it to the other end to conform it to the connector body. Gently press on the seal to seat it completely. Use a lint-free swab to apply alcohol to the top, sides, and bottom of the seal for lubrication, while installing it to the Rear Case. Do not apply alcohol to the contacts or connector.
- Ensure that the Silicone Tubing in the Rear Case is in place and not damaged.
- If the Rear Case has been replaced:
  a. Using permanent black ink, print the instrument's model/reference number and serial number on the Serial Number Replacement Label.
  b. Apply the Serial Number Replacement Label to the instrument.
  c. Adhere the transparent label over the Serial Number Replacement Label.



Item	Description
1 -	IUI Connector, Left
2 -	IUI Connector, Right
3 -	Silicone Tubing
4 -	Chassis Assembly

5.5.3 Door/Display Board Assembly

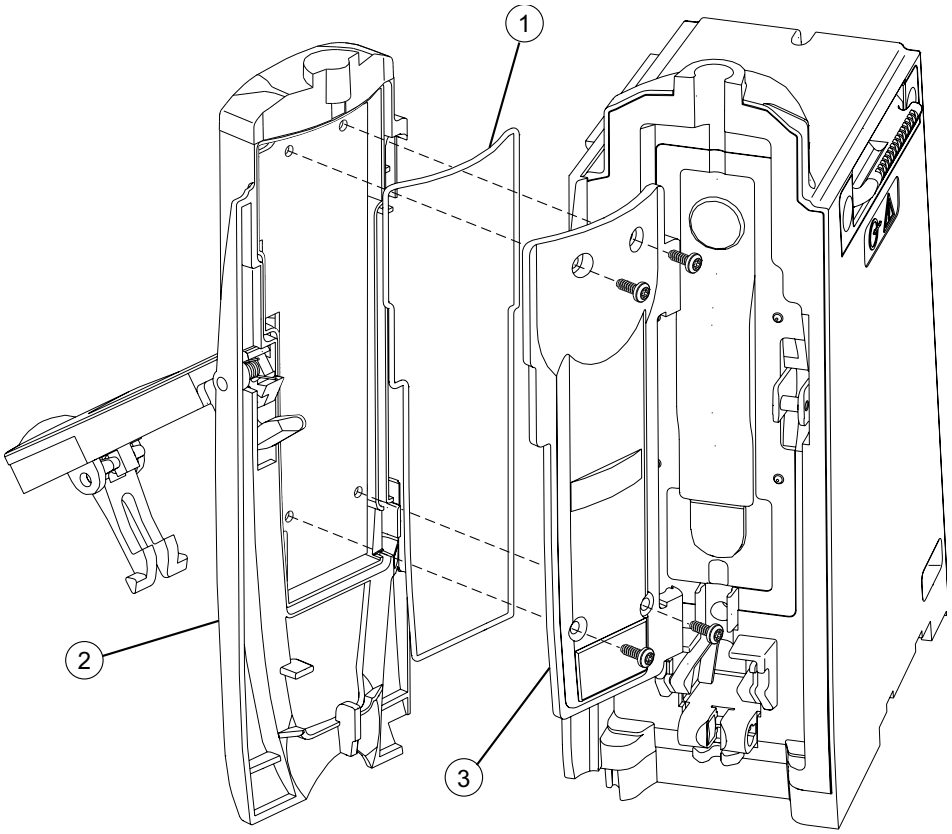
NOTE:
BD Alaris™ door parts are unique to BD Alaris™ devices and are not interchangeable with older parts.

1. Remove the screws (4) from the Door Cover and remove the Door Cover from the Door/display board Assembly.
2. Disconnect the Door Harness (not illustrated) from display board J2 and J4.
3. Remove the Door/display board Assembly.

5.5.3.1 During the Reassembly:

Ensure that the Silicone Tubing is in place and not damaged.

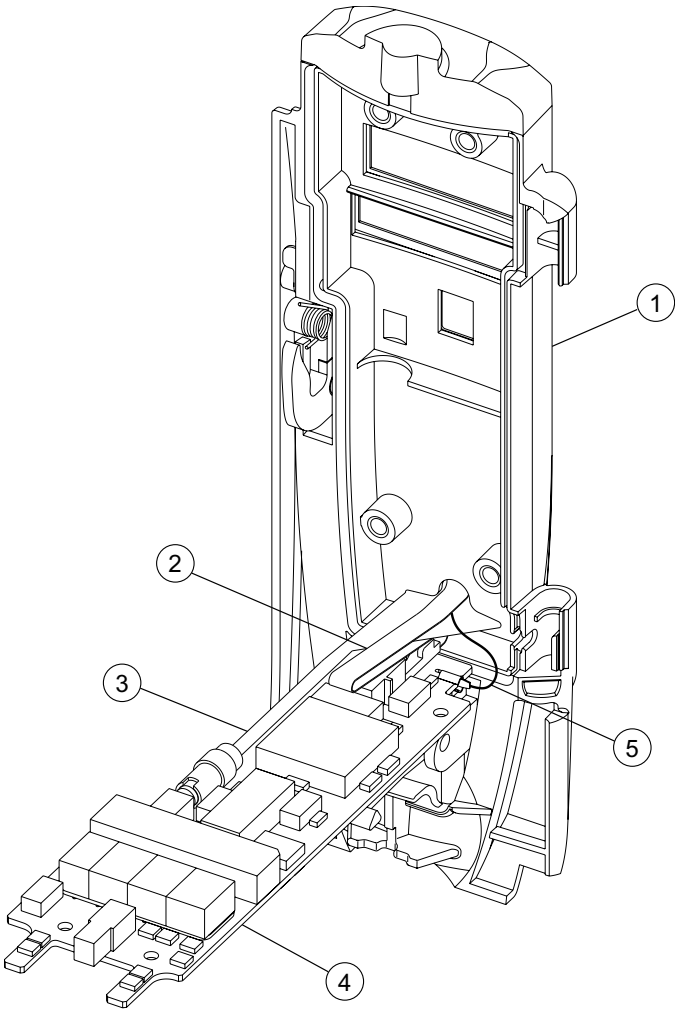
NOTE:
The Platen Assembly is not illustrated. For BD Alaris™ Pump Modules, the tubing guide arm is not illustrated.



Item	Description
1 -	Silicone Tubing
2 -	Door / Display Board Assembly
3 -	Inner Door

5.5.4 Display Board Assembly

1. Disconnect the Harnesses from the display board:
   - Keypad LED Backlight - D8
   - Keypad Connector - J1
   - Keypad Ground - J3
2. Remove the display board.



Item	Description
1 -	Door Assembly
2 -	Keypad Harness
3 -	Keypad LED Backlight Harness
4 -	Display Board
5 -	Keypad Ground Wire

5.5.5 Door Latch Assembly

5.5.5.1 Pivot Latch Screw Maintenance

1. Always examine the Pivot Latch Screw during repair or preventative maintenance of a Pump Module.
2. Check that the screw is properly installed and working:
   - A correctly installed screw appears recessed within the outer casing.

NOTE:
The color of the PCU, Pump Module cases, and the keypads may vary.

   - Any loose or backed-out screws appear extended toward or beyond the casing.

Backed out Pivot Latch Screws

3. Replace loose or backed-out screws, using *only* the Pump Module Pivot Latch Screw P/N 49000250.

WARNING

Use only BD approved parts when performing corrective maintenance or repairs. Use of third-party parts can affect the safety and efficacy of the BD Alaris™ and Alaris™ devices, leading to risk of device failure, patient injury, or even death.

5.5.5.2 Before the Disassembly:

NOTE:
The door latch color may vary.

1. Slowly (the Torsion Spring is loaded) remove the Pivot Latch Screw from the Door Assembly and discard it.
2. Remove the Door Latch Assembly.

5.5.5.3 During the Reassembly:

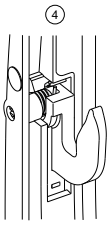
NOTE:
Do not reuse the Torsion Spring or the Pivot Latch Screw. The Torsion Spring and Pivot Latch Screw are single-use only.

.

1. Assemble Latch Spring (P/N 320907), to Latch Door Assembly, then insert Latch Door Assembly to Door Assembly. Insert Pivot Latch Screw (P/N 49000250) through the component holes and torque to 10 in-lb.
2. Ensure the top spring leg is seated in the groove of the door as shown (Figure 1). Hold the end of the spring so it does not fly off, cut off excess spring legs with wire cutters flush with the surface (Figure 2).

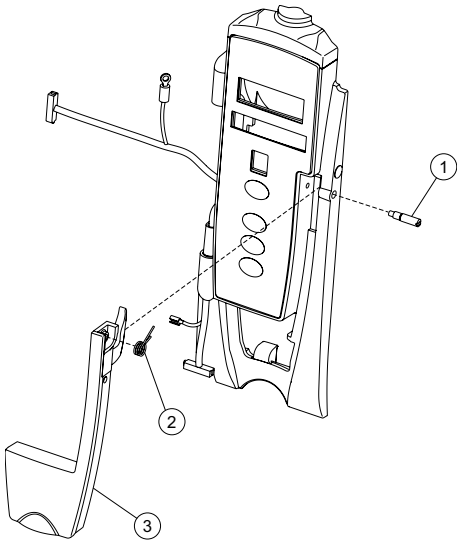
Figure 1

Figure 2



Item Description

1 - Latch Pivot Screw
2 - Torsion Spring
3 - Door Latch Assembly
4 - Door Latch Assembly Installed (Groove for Spring)

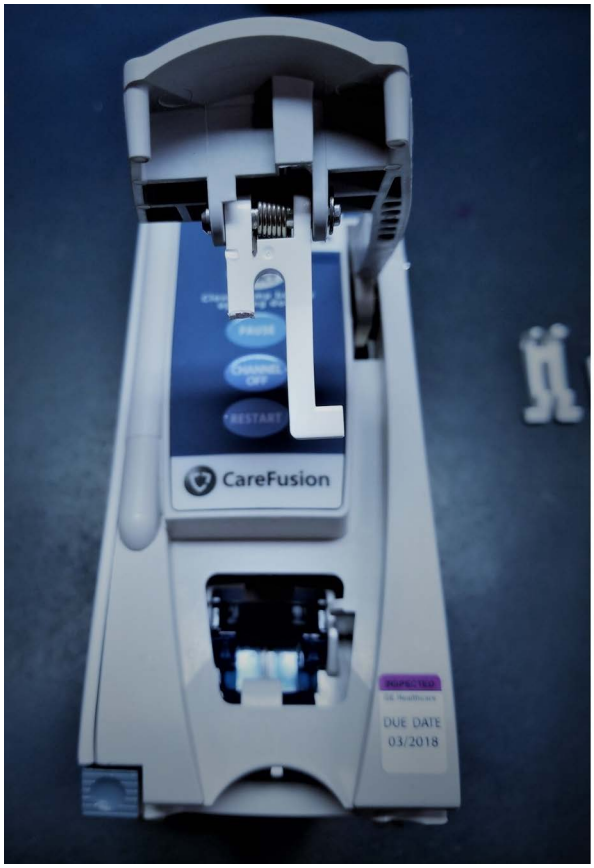


5.5.5.4 Sear Assembly

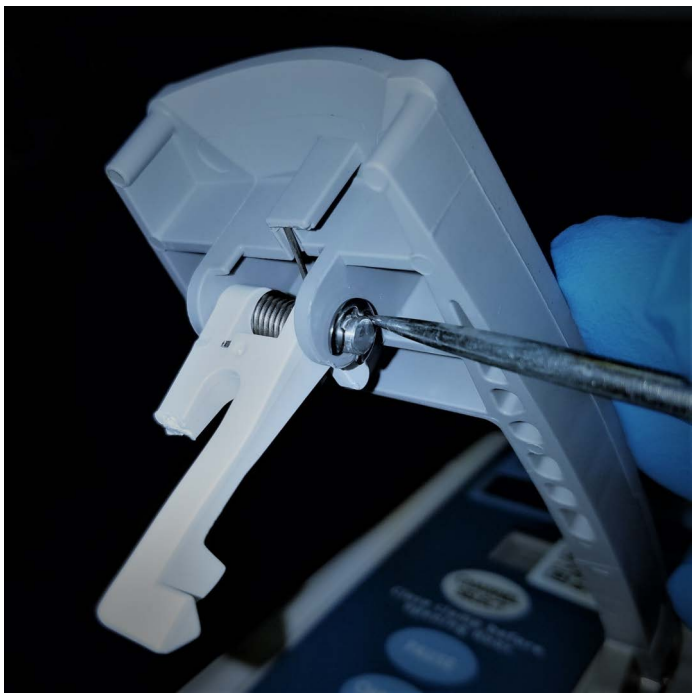
WARNING

Use care when removing small components such as the e-clip and torsion spring, as these components may pop out of the assembly and result in possible eye injury. Be careful when using a dental pick or any sharp tool to perform this procedure.

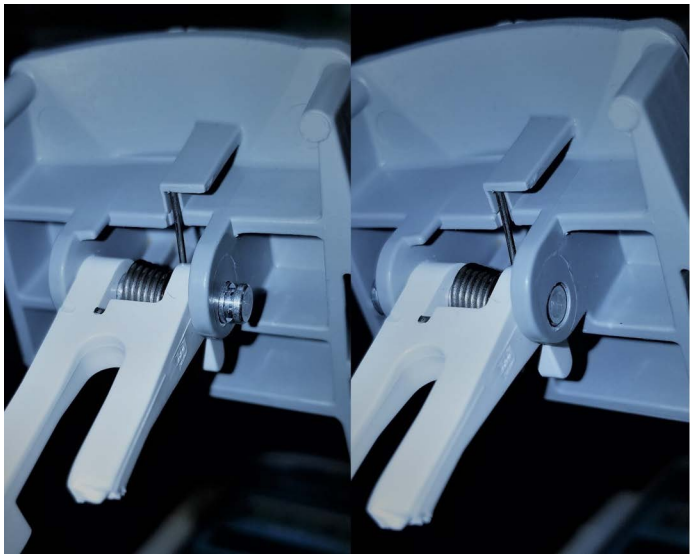
1. Place the Pump Module on a flat surface, as pictured.



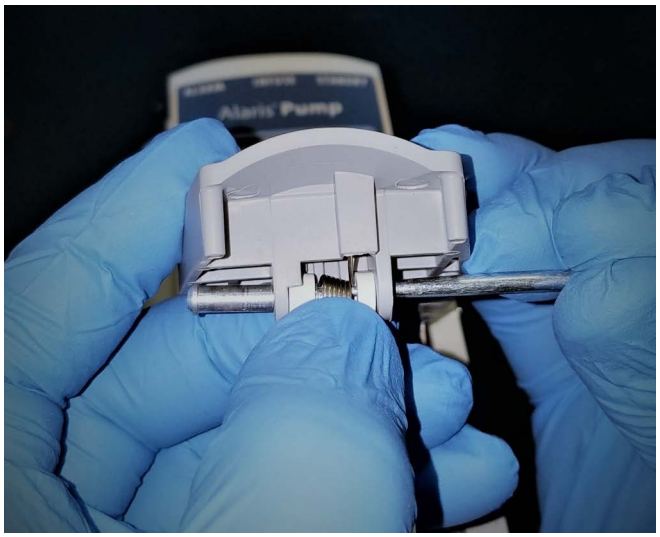
2. Using the dental pick, rotate the e-clip as shown. Remove the e-clip towards the latch.



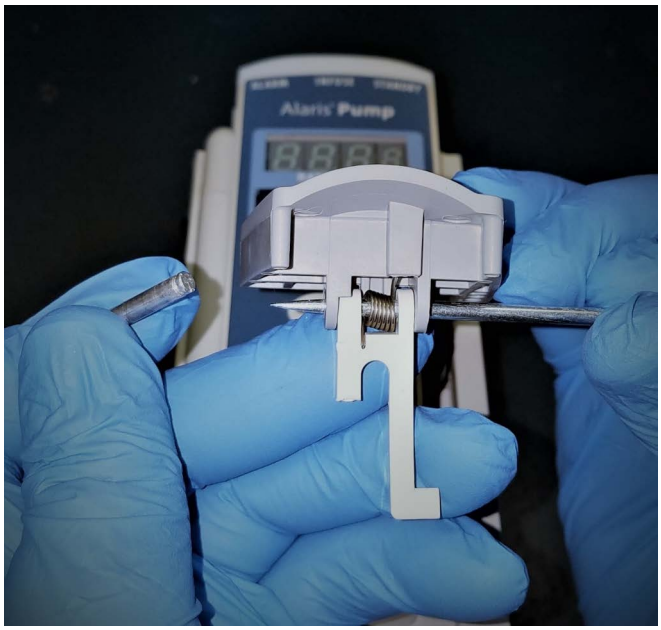
3. Use your finger to push the pin flush with the right side.



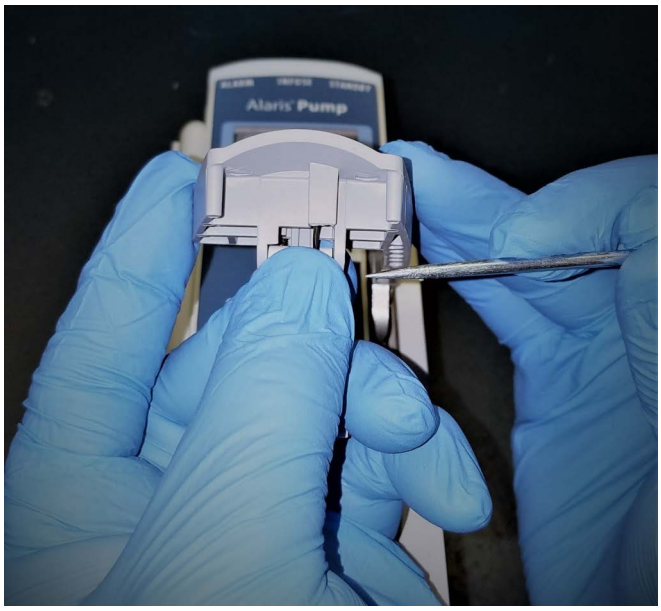
4. Insert the dental pick from the right side to push the pin out.



5. Pull the pin out while keeping the dental pick inserted.



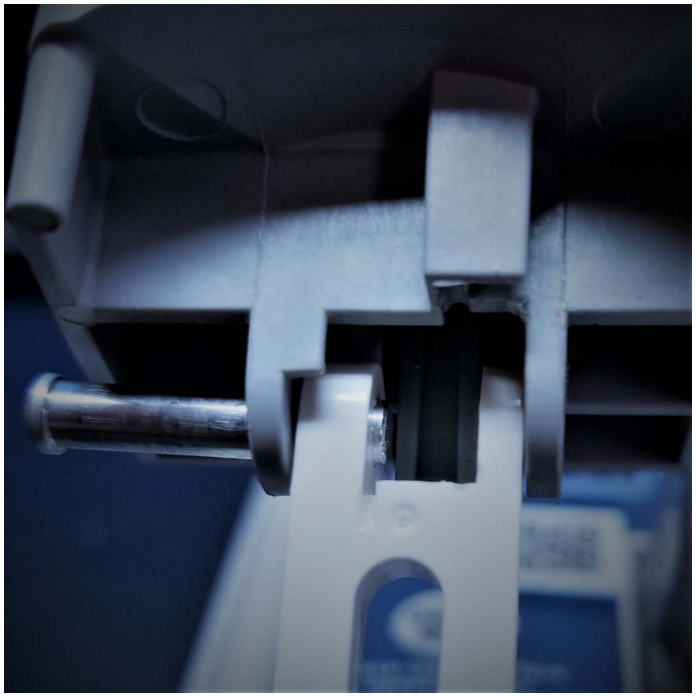
6. Hold the torsion spring in place and pull the dental pick out to the right.

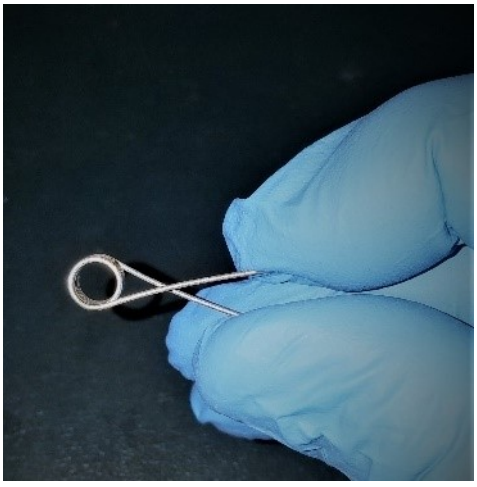


7. Collect and discard all of the old hardware and parts.

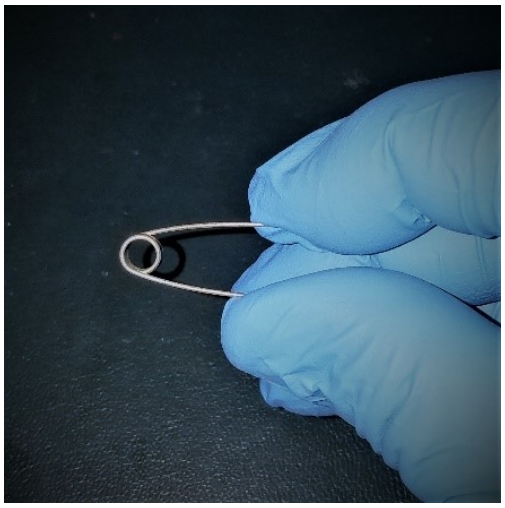
5.5.5.5 Sear Reassembly

1. Insert the smaller diameter end of pin into the latch and left sear elbow.





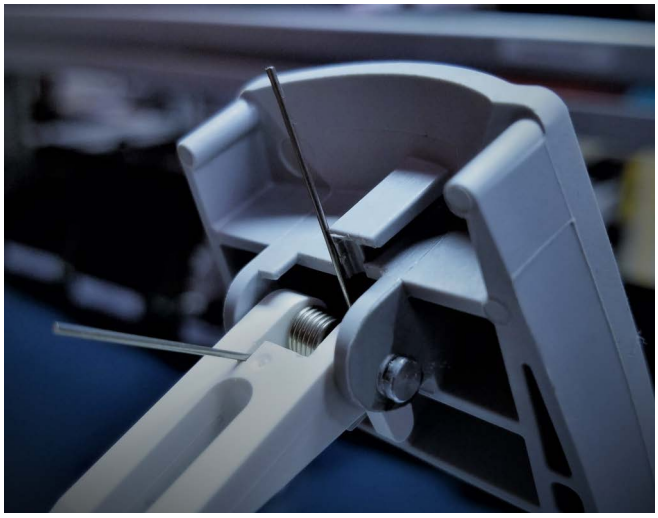
Incorrect Torsion Spring Insertion



Correct Torsion Spring Insertion

2. Insert the torsion spring, then push the pin through from the left to hold torsion spring in place. *Reference the correct torsion spring configuration.*

3. Release the torsion spring and place the legs as shown.

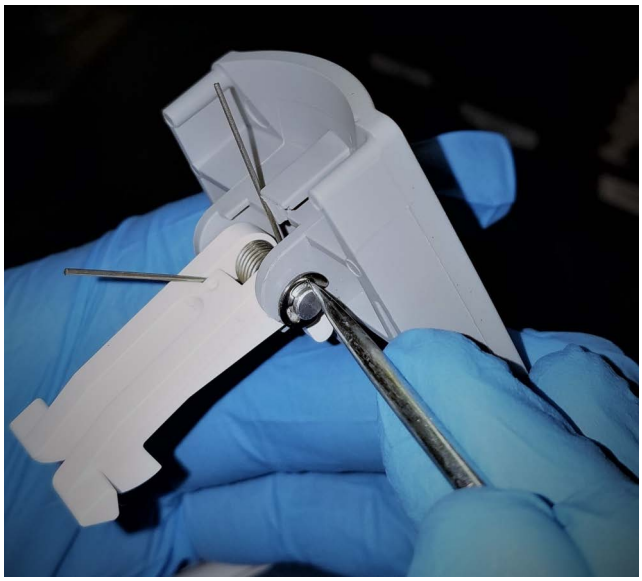


WARNING

The E-ring applicator for Ring SE-17 is required for installation of the e-clip; use of any other tool could damage the parts and cause malfunction within the assembly.

4. Use the E-ring applicator tool to insert the e-clip into the groove of the pin.

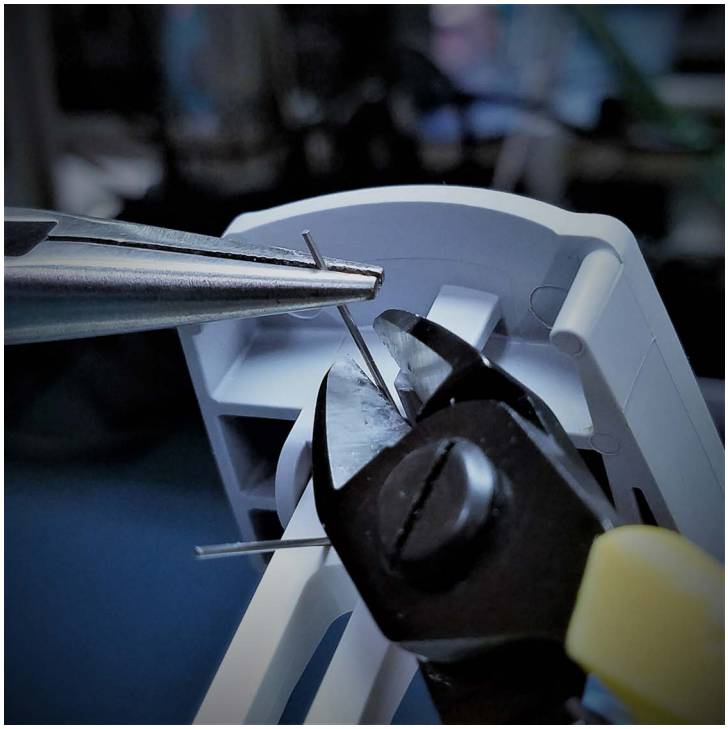
5. Rotate the e-clip in place to verify installation. The e-clip and pin must be concentric.



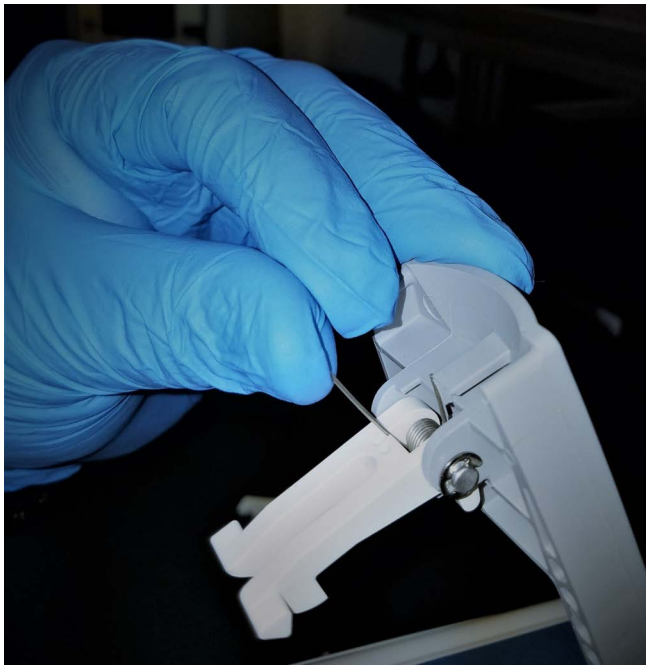
WARNING

Wear PPE (personal protective equipment) when cutting the torsion spring. Pieces of the torsion spring may pop out and result in possible eye injury.

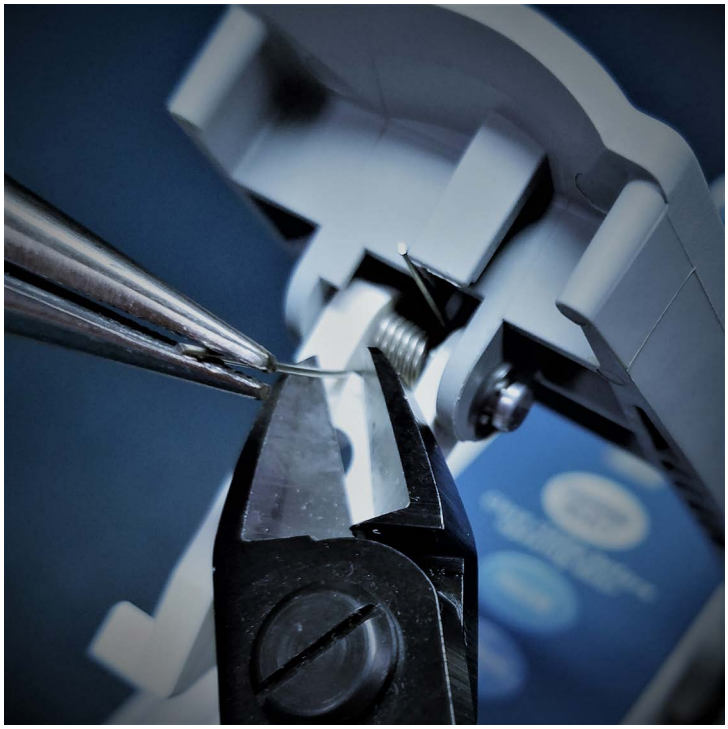
6. Cut the top torsion spring leg by placing the cutters diagonally against latch as shown. Pliers may be used to hold the cut part of torsion spring.

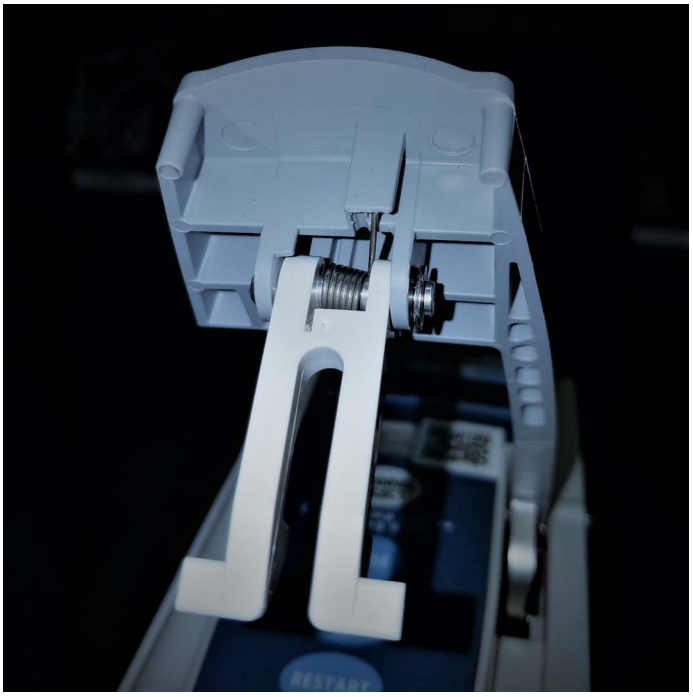


7. Lift the bottom torsion spring leg to top of sear notch. Ensure the leg stays in the notch and sear does not rotate up.



8. Place the diagonal cutters flat on the sear and cut the torsion spring. Pliers may be used to hold the cut part of torsion spring.





Example of installation through this step

9. Use the pliers to move the top torsion spring leg into the notch, as shown.

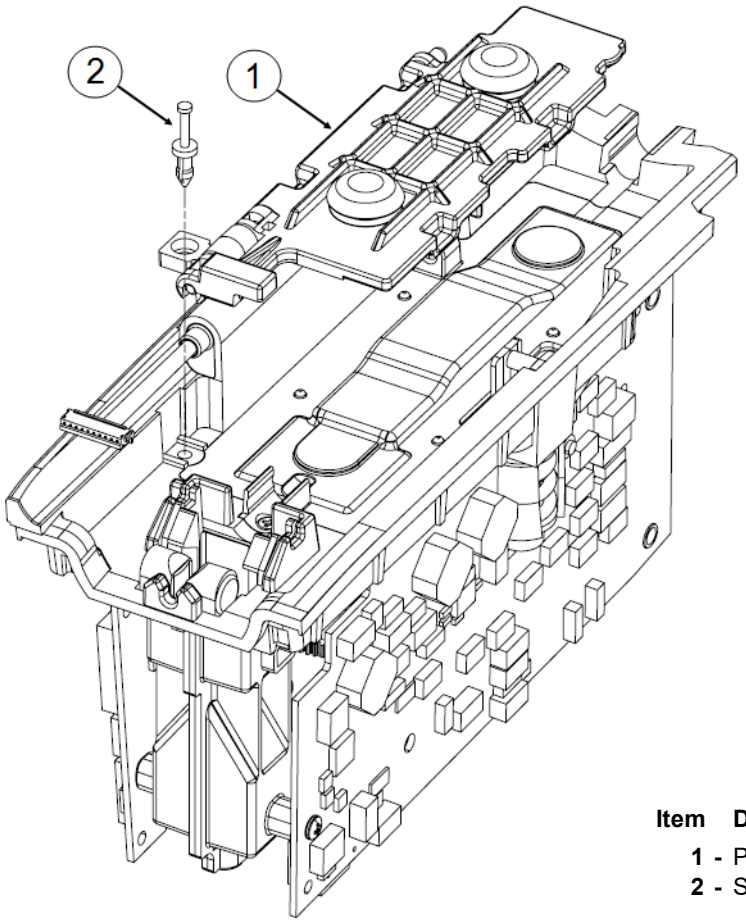
5.5.6 Platen Assembly

NOTE:
Color of the platen and bezel assembly may vary.

CAUTION

To avoid damage, when removing a component that contains a snap rivet, do not cut the rivet.

1. Use small diagonal cutters to lift and remove the Snap Rivet from the hinge block.
2. Remove the Platen Assembly.



Item	Description
1 -	Platen Assembly
2 -	Snap Rivet

5.5.7 Logic and Motor Controller Board Assemblies

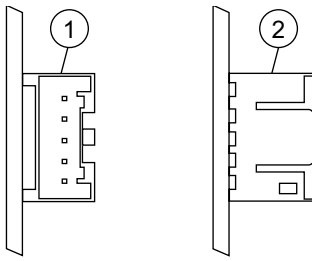
If the motor controller board is being replaced, identify the J3 connector type (see illustration below) before ordering the replacement (see the figure below for the location of J3 and see *Table 7-2, Parts List - Model 8100 on page 7-35* for part numbers).

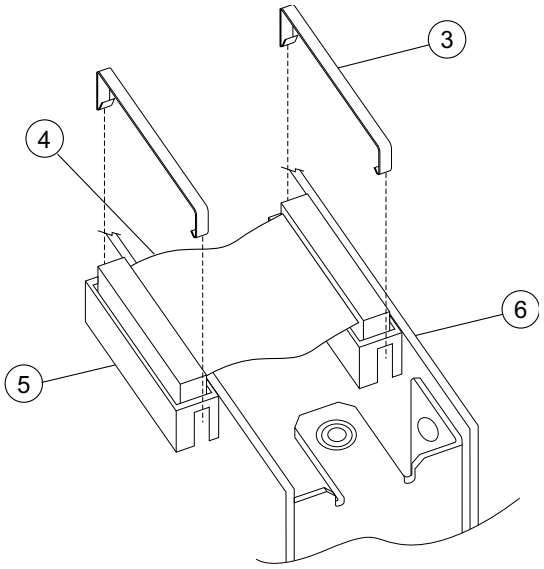
Style	Replacement
Old	Motor controller board / Motor Kit
New	Motor controller board with new-style connector

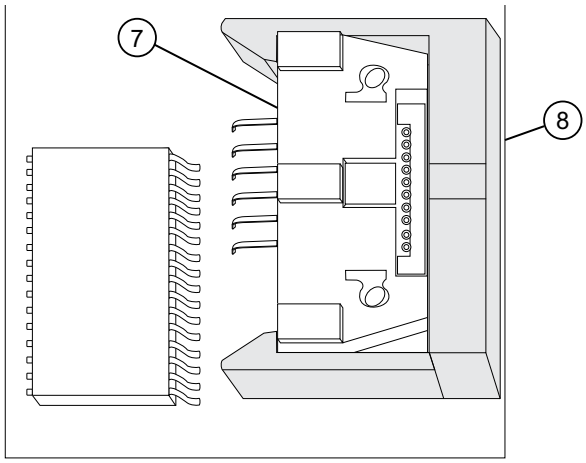
1. Remove the Retainer Clips from the Dual Cable Assembly.
2. Disconnect the Dual Cable Assembly from the logic board J3 and motor controller board J4.
3. Remove the Retainer Cap from the logic board J8 connection.
4. Remove the screw securing the Door Ground to the logic board (near J4).

Item Description

1 - Motor Controller Board J3—New Style Connector
2 - Motor Controller Board J3—Old Style Connector
3 - Retainer Clip (2 PL)
4 - Dual Cable Assembly
5 - Logic Board J3
6 - Motor Controller Board J4
7 - Logic Board J8
8 - Retainer Cap







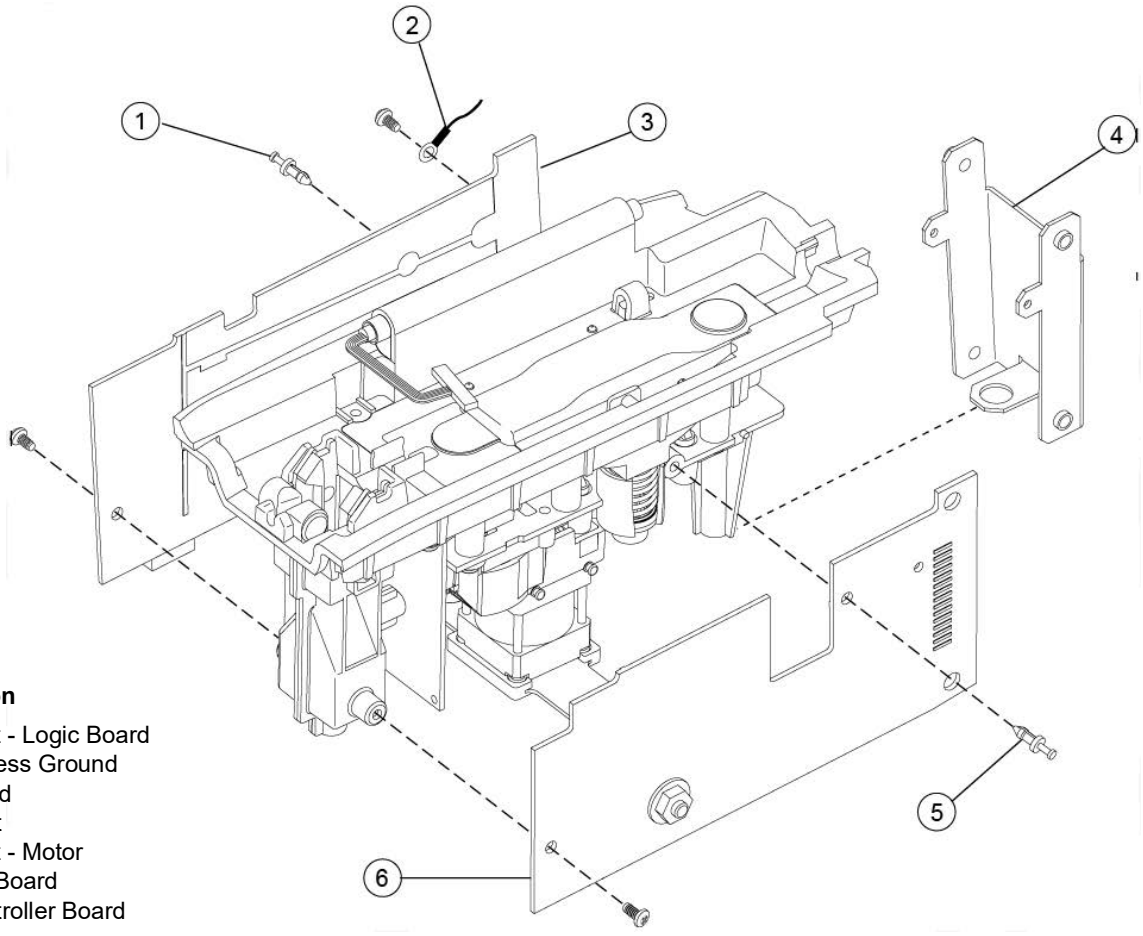
Logic and Motor Controller Board Assemblies (Continued)

5. Disconnect the Harnesses:
   - AIL Sensor Assembly - logic board J8
   - Door - logic board J2, E1
   - Pressure Transducer - logic board J7
   - Motor - motor controller board J3

CAUTION

To avoid damage, when removing a component that contains a snap rivet, do not cut the rivet

6. Use small diagonal cutters to lift and remove the Snap Rivets (one each) from the logic board and motor controller board.
7. Remove the screws (3) from the logic and motor controller boards.
8. Remove the logic and motor controller boards.



Item	Description
1 -	Snap Rivet - Logic Board
2 -	Door Harness Ground
3 -	Logic Board
4 -	IUI Bracket
5 -	Snap Rivet - Motor Controller Board
6 -	Motor Controller Board

5.5.8 Motor, Air-in-Line (AIL) Sensor Assembly, and Bezel Assembly

NOTE:
When both BD Alaris™ and Alaris™ parts are listed:

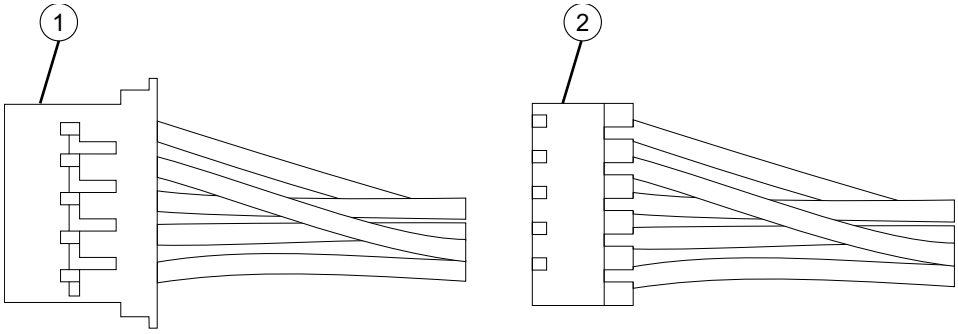
- Alaris™ parts cannot be used with BD Alaris™ devices.
- BD Alaris™ parts are unique to BD Alaris™ devices, and are not interchangeable with older parts.

If replacing the Motor, identify the connector type (see illustration below) before ordering the replacement (see Illustrated Parts Breakdown, *Table 7-2, Parts List - Model 8100 on page 7-35*. The replacement must have the same style connector as the existing Motor.

1. Remove the Hex Standoff from the AIL Sensor Assembly.
2. Remove the screws (4) from the AIL Sensor Assembly.
3. Remove the Motor Mount from the Gear Box and Motor.
4. Remove the Motor from the Bezel Assembly.

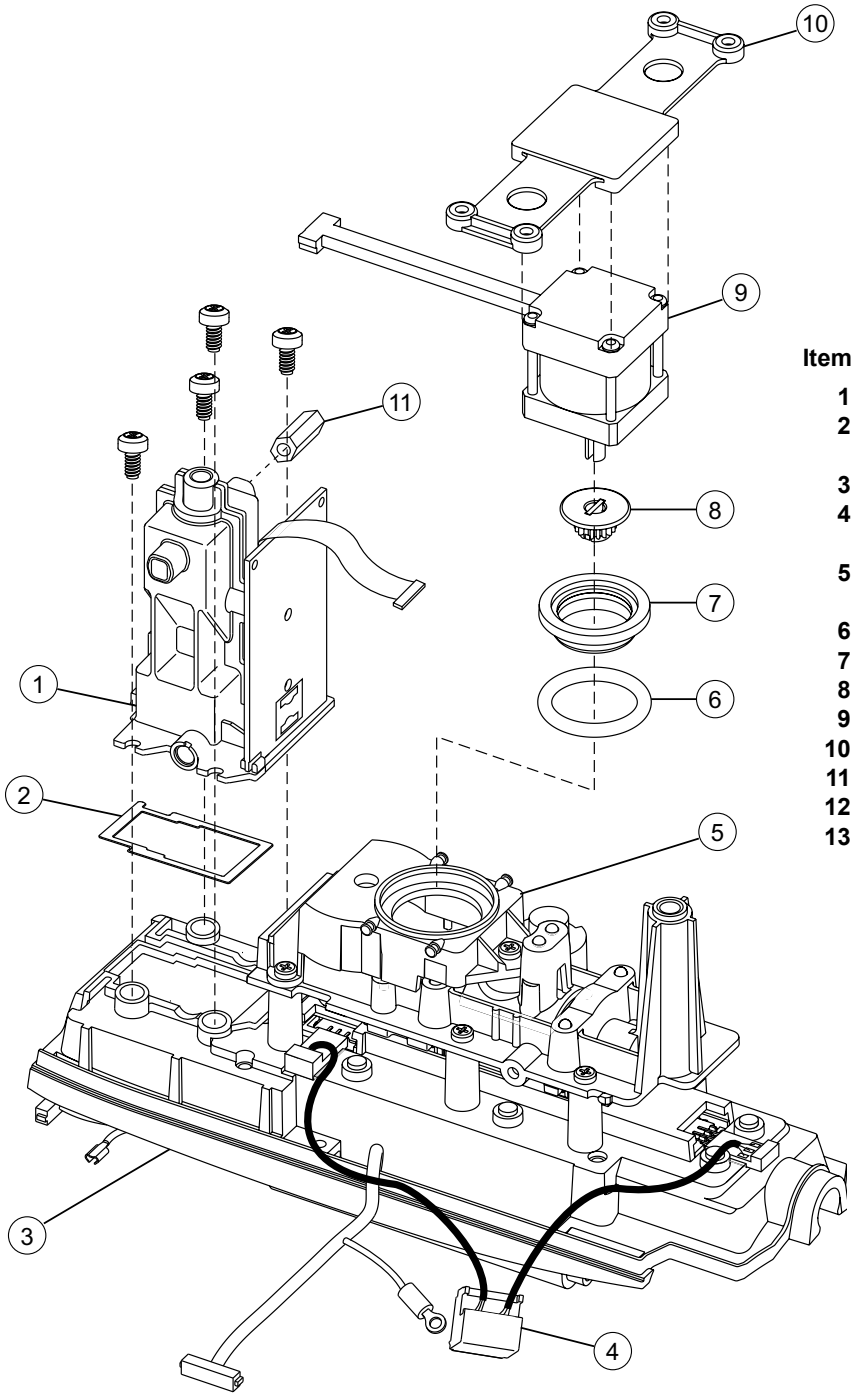
5.5.8.1 During the Reassembly:

1. Secure the Motor Mount to the four mounting pins on the Gear Box.
2. Before installing the AIL Sensor Assembly:
   a. Ensure that the Pinion Gear is properly installed by rotating the Cluster Gear by hand and feeling for a vibration as the Motor steps through its rotation.
   b. To prevent LED damage, rotate the Cluster Gear until the Motor Encoder is in position, illustrated on following page.

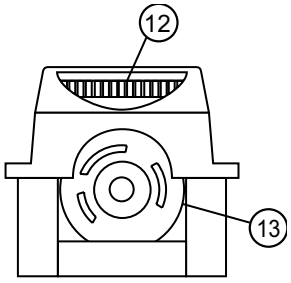


Item	Description
1 -	Motor Harness—New Style Connector
2 -	Motor Harness—Old Style Connector

Motor, Air-in-Line (AIL) Sensor Assembly, and Bezel Assembly
(Continued)



Item	Description
1 -	AIL Sensor Assembly
2 -	Gasket (adhered to the AIL Sensor Assembly)
3 -	Bezel Assembly
4 -	Pressure Transducer Harness Assembly
5 -	Gear Box (part of the Bezel Assembly)
6 -	O-Ring
7 -	Torsion Bearing
8 -	Pinion Gear / Coupling Assembly
9 -	Motor
10 -	Motor Mount
11 -	Hex Standoff
12 -	Cluster Gear
13 -	Motor Encoder



5.5.9 Membrane Frame Assembly and Pressure Sensors

1. Disconnect the Pressure Transducer Harness Assembly from the Pressure Sensors.
2. Remove the screw from the Membrane Frame Assembly.

CAUTION

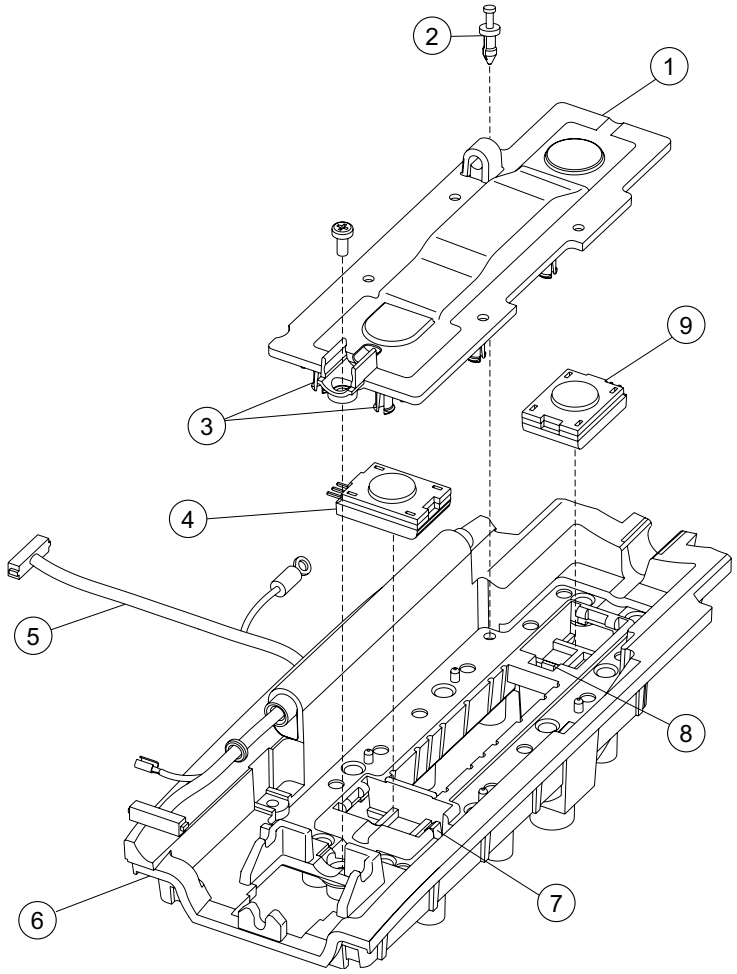
To avoid damage, when removing a component that contains a snap rivet, do not cut the rivet.

3. Use small diagonal cutters to lift and remove the Snap Rivet from the Membrane Frame Assembly.
4. Remove the Membrane Frame Assembly from the Bezel by releasing the snaps and hooks.

CAUTION

To avoid Pressure Sensor damage, do not apply pressure to the center of the Pressure Sensors.

5. Push on the Pressure Sensor release tabs and remove the Pressure Sensors from the Bezel.



NOTE:
BD Alaris™ Pump Module Tubing Guide Arm is not included in this drawing. Tubing Guide Arm is part of the bezel assembly and is factory repair only.

Item	Description
1 -	Membrane Frame Assembly
2 -	Snap Rivet
3 -	Snaps and Hooks
4 -	Pressure Sensor, Lower
5 -	Door Harness
6 -	Bezel Assembly
7 -	Release tab for the Lower Pressure Sensor
8 -	Release tab for the Upper Pressure Sensor
9 -	Pressure Sensor, Upper

Table 5-1: Torque Values - PCU Model 8015

Functional Application	Item Description	Torque Value
FINAL ASSEMBLY		
Battery Pack	6-32 x 7/16	6 in-lb
Carry Board (Model 8015)	4-40 x 5/16	6 in-lb
Ground Cable (Front Case - Ground Plate)	4-40 x 5/16	6 in-lb
Handle	4-40 x 1/4	6 in-lb
I/O Rear Panel Assembly	4-40 x 1/4	6 in-lb
Network Card Cover (Model 8015)	4-40 x 1/2	6 in-lb
Pole Clamp (to plate)	1/4-20 x 1/2	150 in-lb
Pole Clamp Plate	8-32 x 5/8	16 in-lb
Power Cord Retainer	4-40 x 1/2	6 in-lb
Power Cord Wrap	4-40 x 1/2	8 in-lb
Rear Panel	4-40 x 1/4	6 in-lb
RJ45 Connector Plug	4-40 x 1/2	6 in-lb
FRONT CASE		
Inverter Board Assembly (Model 8015)	2 x 5/16	3 in-lb
Retainer, LCD Upper Display	6-32 x 7/16	6 in-lb
INTERNAL SUPPORT FRAME		
AC Filter Assembly	4-40 x 1/2	6 in-lb
AC Filter Ground Wire	10-32	12 in-lb
Battery Discharge Harness Assembly	4-40 x 5/16	6 in-lb
Ground Strap	4-40 x 9/16	6 in-lb
Logic Board Assembly - Ground Plate	4-40 x 9/16	6 in-lb
Power Supply	4-40 x 1/2	6 in-lb
Power Supply Board Assembly	4-40 x 1/2	6 in-lb
Retainer, Memory Card (Model 8015	4-40 x 1/4	6 in-lb
Standoffs to Power Supply Board Assembly	4-40 x 1/4	6 in-lb
REAR CASE		
Battery Connector Assembly	4-40 x 1/4	6 in-lb
Internal Support Frame Assembly	4-40 x 9/16	6 in-lb
IUI Connectors	6-32 x 7/16	12 in-lb
Latch Mechanism	4-40 x 5/16	6 in-lb
Rear Case (lower mountings)	6-32 x 1/4	12 in-lb
Rear Case (upper mountings)	6-32 x 2-3/8	12 in-lb
REAR PANEL		
I/O Rear Panel	4-40 x 1/4	6 in-lb
RS-232 Board Assembly	4-40 x 5/16	6 in-lb
Speaker Bracket	Kep Nuts	6 in-lb
Tamper Switch	Boot Seal	6 in-lb

Table 5-2: Torque Values - Pump Module Model 8100

Functional Application	Item Description	Torque Value
CHASSIS ASSEMBLY		
AIL Sensor Assembly	4-40 x 3/16	6 in-lb
Logic Board Assembly	4-40 x 1/4	6 in-lb
Membrane Frame Assembly	4-40 x 3/16	3 in-lb
Motor Controller Board Assembly	4-40 x 1/4	6 in-lb
FINAL ASSEMBLY		
Chassis to Rear Case Assembly	6-32 x 7/16	12 in-lb
Door Cover	4-40 x 3/8	6 in-lb
Door Harness Ground to IUI Bracket	4-40 x 1/4	6 in-lb
Door Latch Pivot Screw	----	10 in-lb
IUI Connector	6-32 x 7/16	12 in-lb
Latch Mechanism	4-40 x 5/16	6 in-lb

Table 5-3: Level of Testing Guidelines - PCU Model 8015

Use the applicable maintenance software to perform the testing.

If any test fails, perform the applicable steps in *Troubleshooting* on page *6-1*.

Perform →

I = Required
8 = Optional
Blank = Not Applicable
* = See Note

Repair/Replacement of: ↓	Alarm Test	Battery Conditioning Test	Channel ID/IUI Connectors Test	Charge Battery	Display Test	Ground Leakage Test	Keypad Test	Network Connectivity (if installed)	Upload data set	Instrument Inspection
Battery		*		*						I
Battery Connector		I		8	I					I
Front Case/Keypad Assembly	I	I		8	I		I			I
IUI Boards	I	I		8	I	I	I		I	I
IUI Connectors			I							I
Logic Board	I	I	I	8	I	I	I	I	I	I
Main LCD Module	I	I	I	8	I		I			I
Pole Clamp				8						I
Power Supply		I	I	8	I	I	I		I	I
Power Supply Board		I		8	I	I	I	I	I	I
Rear Case		I	I	8	I	I	I			I
Main Speaker	I			8			I			I
Backup Speaker	I									
Tamper Resist Switch				8			I			I
Miscellaneous: ↓										
Instrument Dropped		8	I	8	I	I	I		I	I
New Instrument Check-in	I		I	8	I	I	I		I	I
No Fault Found	8		I	8	I	I	I		I	I
Software Flashed				8					I	I

WARNING

If a device has been dropped or severely jarred, remove it from use immediately. It should be thoroughly tested and inspected by qualified service personnel to ensure proper functioning prior to reuse.

NOTE:
When you replace the old battery with a brand new BD Alaris™ battery, you can either perform a battery conditioning (Fast or Optimal), or charge the battery for 16 hours.

NOTE:
When replacing the wireless card, verify that the PCU connects to your network before returning the PCU to clinical use.

Table 5-4: Level of Testing Guidelines - Pump Module Model 8100

Use the applicable maintenance software to perform the testing and calibration.

If any test fails, perform the applicable steps in *Troubleshooting* on page *6-1*.

Perform → / I = Required / Blank = Not Applicable / Repair/Replacement of: ↓	Air-in-Line Sensor Test	Alarm Test	Channel ID/IUI Connectors Test	Display Test	Door Ajar/Safety Clamp Sensors Test	Fluid Side Occlusion Test	Keypad Test	Patient Side Occlusion/ Pressure Verification	Rate Accuracy Verification	Rate Calibration	Instrument Inspection
Air-in-Line Assembly	I	I	I		I						I
Bezel Assembly	I		I		I			I	I	I	I
Display Board		I		I			I	I	I		I
Door/Keypad Assembly				I	I		I	I	I	I	I
Door Latch											I
IUI Connectors			I								I
Logic Board		I	I	I		I	I	I	I	I	I
Membrane Frame Assembly								I	I		I
Motor			I	I				I	I		I
Motor Controller Board			I	I				I	I		I
Platen Assembly						I		I	I		I
Pressure Sensors		I				I		I	I	I	I
Rear Case			I								I
Sear											I
Miscellaneous: ↓											
Instrument Dropped	I		I	I	I	I	I	I	I		I
New Instrument Check-in	I	I	I	I	I	I	I	I	I		I
No Fault Found	I		I	I	I	I	I		I		I
Software Flashed											I

Chapter 6
Troubleshooting

6.1 Introduction

This chapter covers possible technical problems that can occur while using the BD Alaris™ System. Refer to this chapter before attempting to service the PCU or Pump Module. Refer to the applicable module's service manual before attempting to service another module attached to the BD Alaris™ System.

To facilitate troubleshooting when an operating malfunction occurs, the instrument sounds an alarm and displays an error message and/or error code. Use the information in this chapter to help diagnose and correct technical problems. Use the applicable maintenance software to perform preventive maintenance, calibration, and verification procedures.

6.2 Maintenance Mode

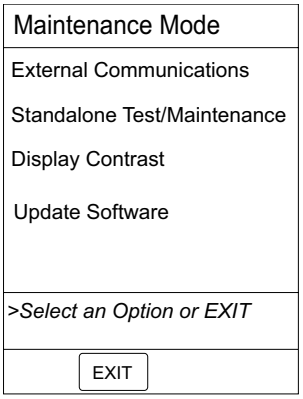
When in Maintenance Mode:

- To exit, power off system.
- To return to a previous screen, press the **EXIT** soft key.
- To power off the system immediately (with no Powering Down display), press the **EXIT** soft key in the Maintenance Mode option screen.

Access the Maintenance Mode options:

1. Hold down the Tamper Resist switch on the rear of the PCU during power-up. (Refer to the *BD Alaris™ System with Guardrails™ Suite MX User Manual* for an illustration showing Tamper Resist switch location.)

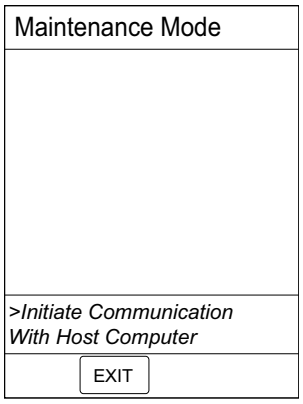
2. Press the **PROCEED** soft key.



PCU software versions 12.x and later

6.2.1 External Communications

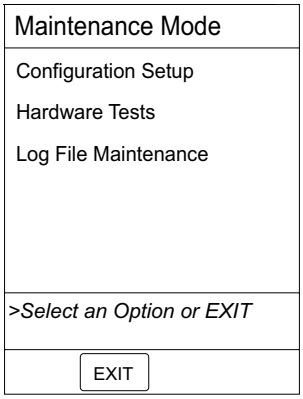
Access the **Maintenance Mode** options and press the **External Communications** soft key.



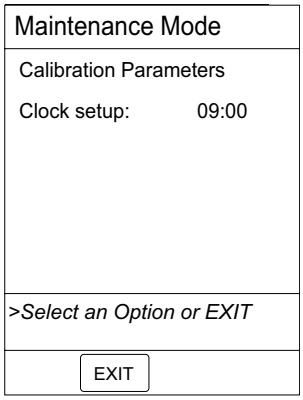
The data download/upload can now be initiated.

6.2.2 Calibration Parameters

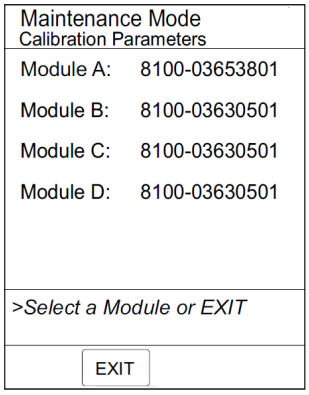
1. Access the **Maintenance Mode** options and press the **Standalone Test/Maintenance** soft key.



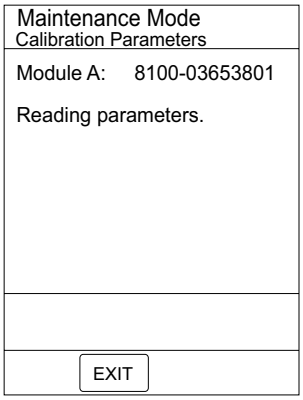
2. Press the **Configuration Setup** soft key.

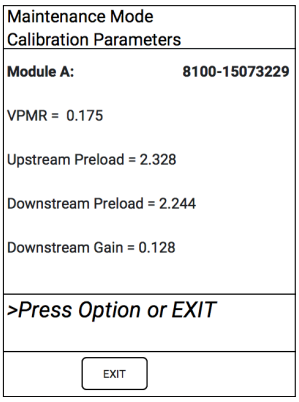


3. Press the **Calibration Parameters** soft key.



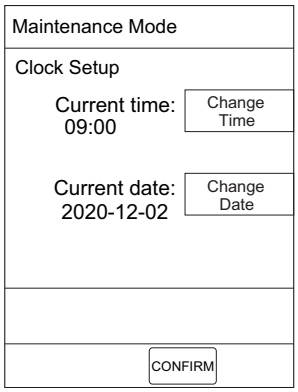
4. Select a channel by pressing the soft key next to the applicable **Module** identifier (**A**, **B**, **C,** or **D**).





6.2.3 Clock Setup

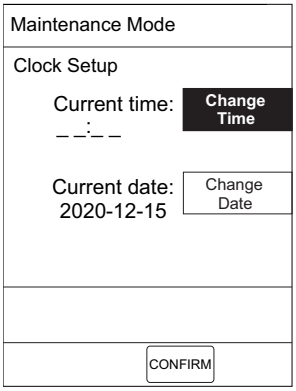
1. Access the **Maintenance Mode** options and press the **Standalone Test/Maintenance** soft key.
2. Press the **Configuration Setup** soft key.
3. Press the **Clock setup** soft key.



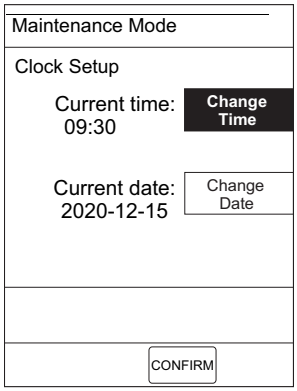
4. To accept the current settings, press the **CONFIRM** soft key.

   OR

   To make a change, continue with the following steps.
5. To change the **Current time**:
   a. Press the **Change Time** soft key.



   b. Enter the new time and press the **ENTER** key on the PCU.



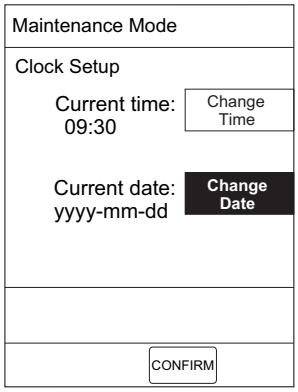
c. To accept the current settings, press the **CONFIRM** soft key.

OR

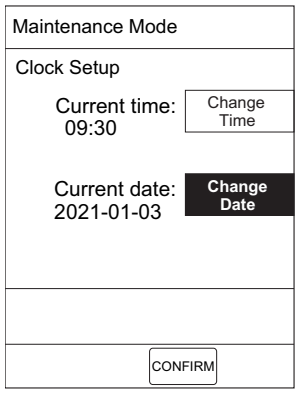
To change the **Current date**, continue with the following step.

6. To change the **Current date**:

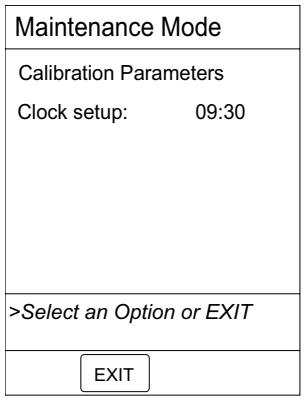
a. Press the **Change Date** soft key.



b. Enter the new date and press the **ENTER** key on the PCU.



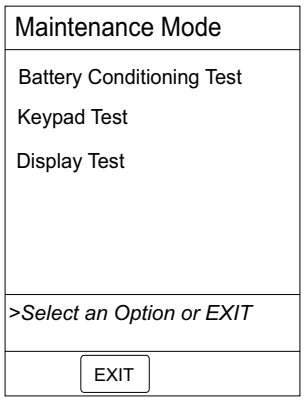
c. To accept the current settings, press the **CONFIRM** soft key.



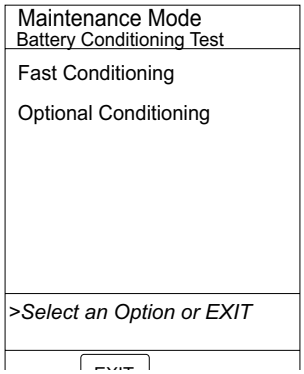
6.2.4 Battery Conditioning Test

NOTE:
For more information about battery conditioning, see *Performing Battery Conditioning (Fast or Optimal) in Maintenance Mode (v12.1.1 and Later)* on page *1-17.* If using PCU software version other than v12.1.1 or later, see Service Bulletin 592A (P/N P00000213).

1. Access the **Maintenance Mode** options and press the **Standalone Test/Maintenance** soft key.
2. Press the **Hardware Tests** soft key.

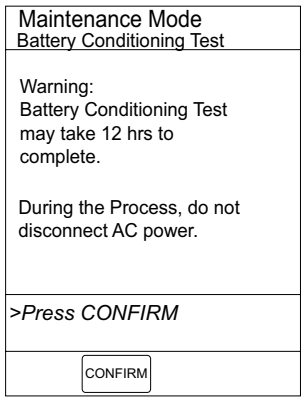


3. Press the **Battery Conditioning Test** soft key.



4. Press the **Fast Conditioning** soft key.

   Fast Conditioning is preferred because it is more time efficient. Optimal Conditioning may take up to 20 hours to complete.

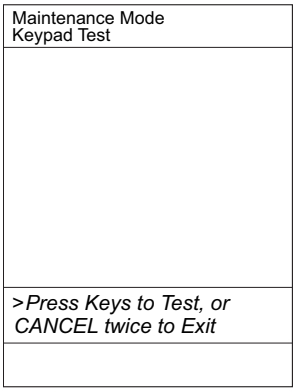


5. Press **Confirm** to proceed with the battery conditioning test.

6.2.5 Keypad Test

NOTE:
Refer to the *BD Alaris™ System with Guardrails™ Suite MX User Manual* for a list of soft keys on the keypad.

1. Access the **Maintenance Mode** options and press the **Standalone Test/Maintenance** soft key.
2. Press the **Hardware Tests** soft key.
3. Press the **Keypad Test** soft key.

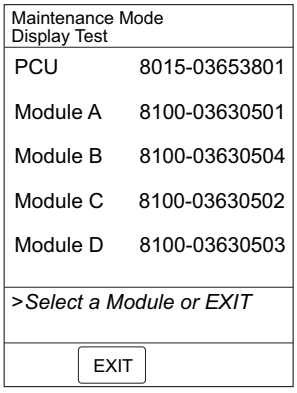


4. Press the keys to test them.

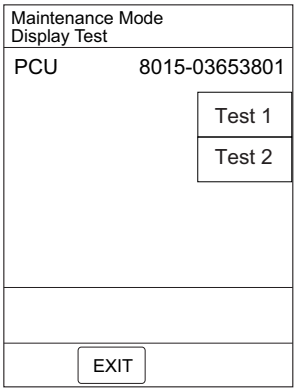
   As each key is pressed, it appears on the screen. The Pump Module keys give a double beep when pressed.

6.2.6 Display Test

1. Access the **Maintenance Mode** options and press the **Standalone Test/Maintenance** soft key.
2. Press the **Hardware Tests** soft key.
3. Press the **Display Test** soft key.



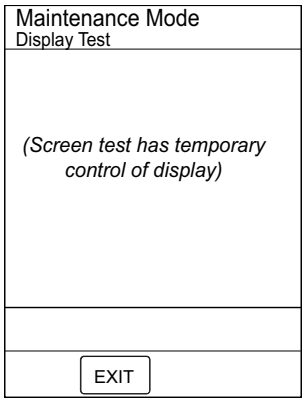
4. Select the PCU by pressing the **PCU** soft key, or select an attached module by pressing the soft key next to applicable **Module** identifier (**A**, **B**, **C,** or **D**).

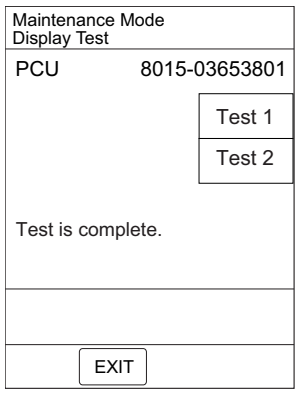


5. To perform the display test, press the applicable soft key (the test takes approximately 10 seconds to complete):
   - PCU (LCD test):

     Test 1: Checkerboard pattern test.

     Test 2: Gray scale pattern test.

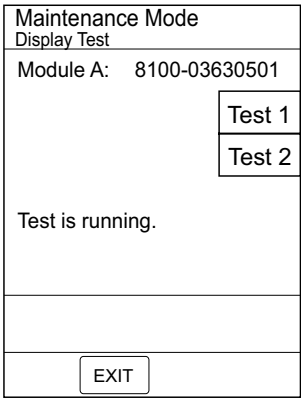


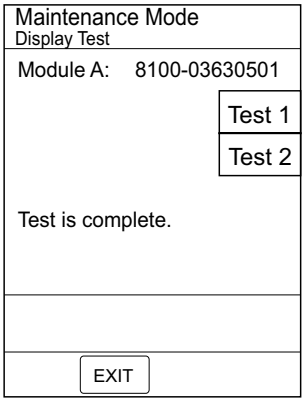


- Attached module (LED test):

  Test 1: Light in sequence.

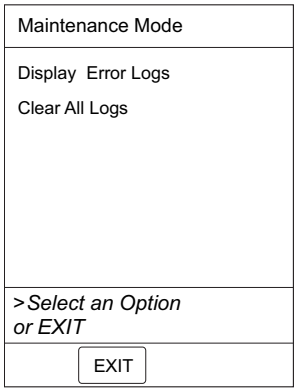
  Test 2: Light in a pattern.





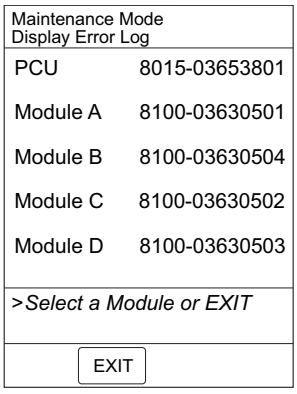
6.2.7 Display Error Log

1. Access the **Maintenance Mode** options and press the **Standalone Test/Maintenance** soft key.
2. Press the **Log File Maintenance** soft key.

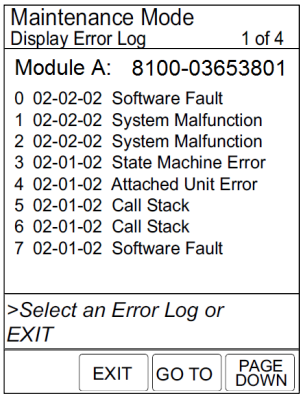


Maintenance Mode screen version 12.3.1and later versions

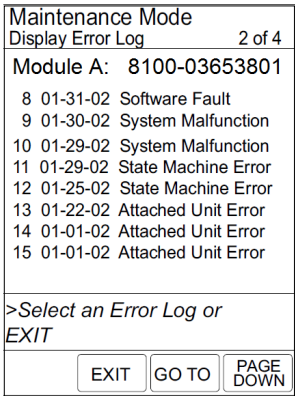
3. Press the **Display Error Log** soft key.



4. Select a channel by pressing the soft key next to the applicable **Module** identifier (**A**, **B**, **C,** or **D**).

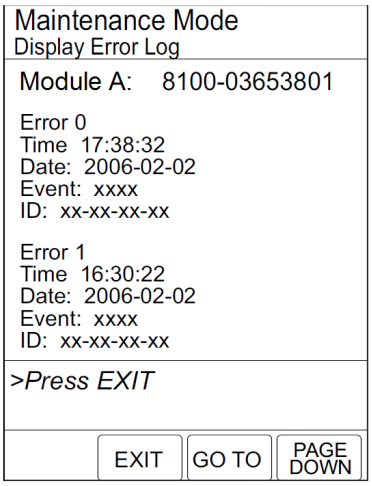


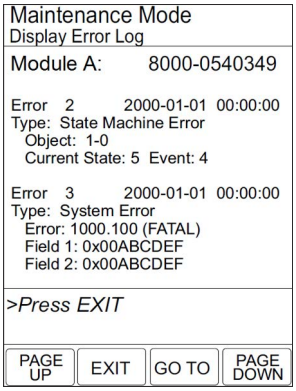
- To move between the first and last error log entry, press the **GO TO** soft key and select **First** or **Last**.
- To view additional error logs, press the **PAGE DOWN** soft key.



- To view previous or additional error logs, press the **PAGE UP** or **PAGE DOWN** soft key.

5. To view expanded error log data, press the soft key next to the applicable error log.
   - Each error log soft key is associated with two error logs. The most recent logs appear first.





NOTE:
For more information on the Error Log, refer to the *BD Alaris™ System Maintenance User Manual.*

6.2.8 Clearing All Logs

This feature is available starting in v12.3.1 and later versions.

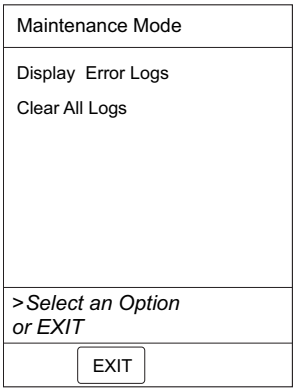
The PCU stores electronic protected health information (ePHI) data that requires HIPAA compliance. The ePHI data must be cleared from the historical log on the system when the PCU is transferred or moved as follows:

- When the PCU is moved from one hospital to another hospital that is outside the integrated delivery network (IDN)
- Between the rental company and hospital

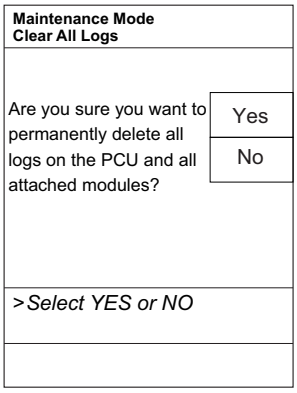
HIPAA requires the implementation of policies and procedures:

- To address the final disposition of ePHI, and/or the hardware or electronic media on which it is stored;
- For removal of ePHI from electronic media before the media is made available for re-use (45 CFR 164.310(d)(2)(i)).

1. Access the **Maintenance Mode** options.
2. Press the **Standalone Test/Maintenance** soft key.
3. Press the **Log File Maintenance** soft key.



4. Press the **Clear All Logs** soft key.

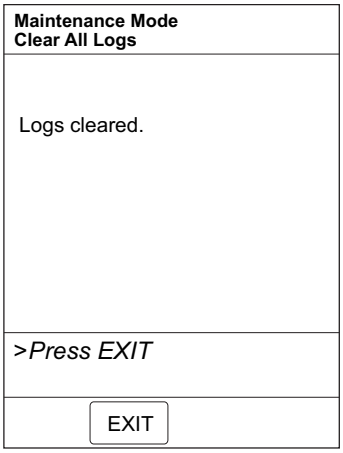


NOTE
If you press Yes on this screen, all of the logs on the PCU and the attached modules will be deleted and cannot be recovered.

5. Press **Yes** to clear all logs.

   The “Clearing all logs” message displays. This process can take about 5-10 seconds.

   The “Logs cleared” message displays when this process is completed.



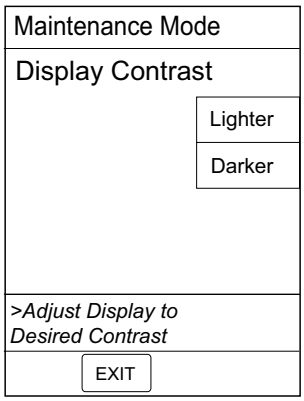
6. Press **EXIT** to return to the Log File Maintenance screen.

6.2.9 Display Contrast

1. Access the **Maintenance Mode** and press the **Display Contrast** soft key.

   OR

   Access the **Maintenance Mode** options and press the **Display Contrast** soft key.



2. To adjust the contrast, press the **Lighter** or **Darker** soft key until the desired contrast is obtained.

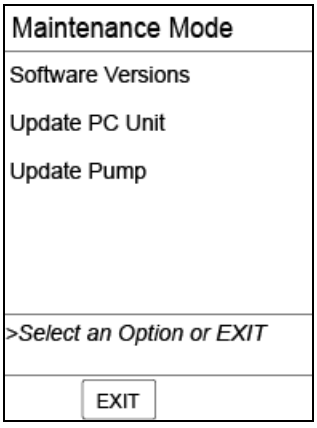
6.2.10 Update Software

The update software option is displayed in Maintenance Mode. The software versions option is available within the software settings. The software versions option shows the software version of the PC unit and PC unit components such as the keyboard and all attached modules.

NOTE:
The feature of Update Software to activate software on the device is not available. Update software is reserved for a future feature enhancement. As this is an unreleased product, we are required to include that BD may or may not make the feature enhancement commercially available.

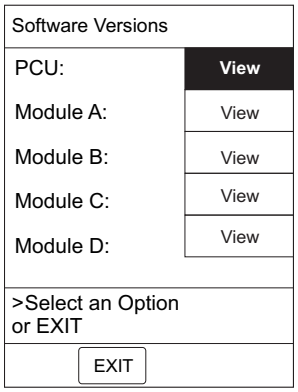
To view the software version of the PC unit and all attached modules:

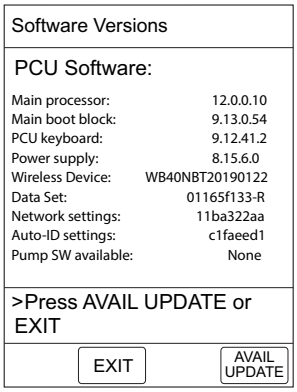
1. Access the **Maintenance Mode** and press the **Update Software** soft key.
2. Press the **Software Versions** soft key.



NOTE
Update PC Unit and Update Pump are for future feature enhancement and displays “No available updates.”

3. Do one of the following:
   - To view software components and configurations on the PCU, press the **View** soft key for the PCU.

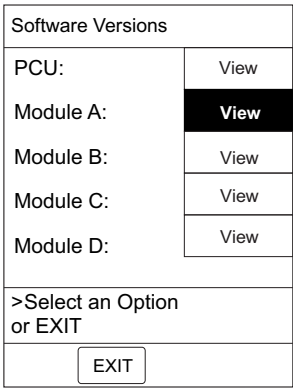


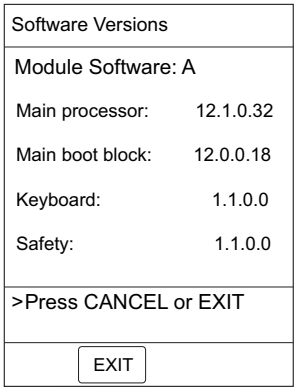


The PCU Software screen appears.

NOTE:
The illustrations shown are examples and may not reflect the software versions or configuration IDs on your device.

- To view the active software components for the desired module, press the **View** soft key for the module





The Module Software screen appears.

NOTE:
The illustrations shown are examples and may not reflect the software versions or configuration IDs on your device.

- To return to the main screen, press the **EXIT** soft key.

Table 6-1. Technical Troubleshooting Guide

Perform the steps in the order they are listed until the problem/fault is corrected. Before making a final diagnosis, visually inspect the instrument for damage. Following a repair, use the BD Alaris™ System Maintenance software to perform the required tests.

PCU

Problem	Remedy
Battery Depleted Battery Low	1. Plug into AC power. 2. Recondition the battery with two or three charge/discharge/charge cycles. 3. Replace the battery. 4. Replace the logic board. 5. Return the module to the factory.
Display Problem	1. Check the cable connections. 2. Replace the display. 3. Replace the logic board. 4. Return the module to the factory.
Instrument Malfunction	1. Turn the instrument off and back on to see if the problem clears. 2. Refer to the alarm history for any detected fault and see *Error Codes* on page *6-36*.
Intermittent Operation	1. Check the connections to the logic board. 2. Replace the logic board in the PCU. 3. Replace the logic board in the affected module. 4. Return the module to the factory.
Key Stuck Alarm	1. Turn the instrument off and back on to see if the problem clears. 2. Replace the Keypad Assembly. 3. Replace the logic board. 4. Return the module to the factory.
LCD Contrast is Dark or Light	1. Change the contrast setting or tilt the instrument to help clear viewing. 2. Replace the main LCD 3. Replace the logic board. 4. Return the module to the factory.
Will Not Turn On	1. Plug the instrument into AC. 2. Check and/or replace the battery. 3. Check the fuses. 4. Replace the Off-Line Switcher. 5. Replace the power supply board. 6. Return the module to the factory.

Table 6-1. Technical Troubleshooting Guide (Continued)

Pump Module

Problem	Remedy
Accuracy Verification Fails	1. Check for any mechanical damage and that the administration set is correctly installed. 2. Perform rate calibration. 3. Replace the mechanism. 4. Return the module to the factory.
Air-in-Line	1. Remove the air from the administration set or press RESET to move the air through the line. 2. Change the AIL setting. 3. Clean the AIL transmitter/receiver. 4. Check the connector. 5. Replace the AIL Assembly. 6. Return the module to the factory.
Check IV Set	1. Ensure that the administration set is correctly installed. 2. Using the BD Alaris™ System Maintenance software: a. Select Door Ajar/FLO-Stop Sensor test and perform the test. b. Select Patient Side Occlusion and perform the test. c. Select Fluid Side Occlusion and perform the test. 3. Return the module to the factory.
Close Door	1. Close the door. 2. Using the BD Alaris™ System Maintenance software: a. Select the Door Ajar/FLO-Stop Sensor test and perform the test. b. Perform the identified repairs and/or calibrations. 3. Return the module to the factory.
Door Open Alarm	1. Check that the administration set is correctly installed. 2. Verify that the latch is closed and moves easily. 3. Verify that the door sear is intact. 4. Replace the AIL Assembly. 5. Return the module to the factory.
Downstream Occlusion	1. Check the setup and tubing (such as kinked or clogged filter). 2. Perform the pressure verification.
Safety Clamp Open/ Close Door	1. Close the roller clamp on the administration set or close the door. 2. Using the BD Alaris™ System Maintenance software: a. Select the Door Ajar/FLO-Stop Sensor test and perform the test. b. Perform the identified repairs and/or calibrations. 3. Return the module to the factory.

Table 6-1. Technical Troubleshooting Guide (Continued)

Pump Module (Continued)

Problem	Remedy
Occluded - Fluid Side/ Empty Container	1. Clear the occlusion on the fluid side of the instrument. If necessary, refill the drip chamber. 2. Using the BD Alaris™ System Maintenance software: a. Perform the Fluid Side Occlusion test. b. Perform the calibration and/or replace the pressure sensor. 3. Return the module to the factory.
Occluded - Patient Side	1. Clear the occlusion. 2. Using the BD Alaris™ System Maintenance software: a. Perform the Patient Side Occlusion test. b. Perform the calibration and/or replace the pressure sensor. 3. Return the module to the factory.
Pump Chamber Blocked	1. Open the door and inspect the pump chamber. To open the blockage as required, massage the tubing. 2. Using the BD Alaris™ System Maintenance software: a. Select the Patient Side Occlusion and perform the test. Perform the calibration and/or replace the pressure sensor. b. Select Fluid Side Occlusion and perform the test. Perform the calibration and/or replace the pressure sensor. 3. Return the module to the factory.

Table 6-1. Technical Troubleshooting Guide (Continued)

PCA Module and Syringe Module

Problem	Remedy
Channel Disconnected	1. Reconnect the module to the PCU. Syringe Module only: reprogram the infusion setup. 2. Visually inspect the IUIs on the module and PCU. If necessary, replace the IUI connector. 3. Return the module to the factory.
Channel Errors	1. See *Error Codes* on page *6-36* to diagnose and correct the problem. 2. Perform the applicable preventive maintenance, calibration, and verification. 3. Return the module to the factory.
Check Syringe	1. Check the drive arm and syringe travel. 2. Lower the plunger head onto the syringe. 3. Close the Barrel Clamp over the syringe. 4. Ensure that the flange detect sensor is engaged. 5. Using the BD Alaris™ System Maintenance software, perform the Binary Switches Test. 6. Open the module to perform the following steps. 7. Check the force sensor harness connection to the drive head. If necessary, reconnect the harness or replace the Force Sensor Assembly. 8. Check the Syringe Size Sensor Assembly harness connection to J4 on the IUI Board. If necessary, reconnect the harness or replace the Force Sensor Assembly. 9. Check the Linear Sensor harness connection to J12 on the logic board. If necessary, reconnect the harness or replace the Force Sensor Assembly. 10.Return the module to the factory.
Drive Not Engaged	1. Using the BD Alaris™ System Maintenance software, perform the Binary Switch Test and calibrate the module if necessary. 2. Replace the Lower Housing/Carriage Assembly. 3. Rotate the Actuator Knob and slide the plunger head up and down to check for full plunger head travel and for Cam Lock engagement and disengagement. Repair or replace the Lower Housing/Carriage Assembly, if necessary. 4. Return the module to the factory.
Occlusion	1. Check that the administration set is correctly installed. Check the tubing to ensure that there are no obstructions (such as kinked or pinched tubing or a clogged filter). 2. Using the BD Alaris™ System Maintenance software: a. Perform the Binary Switches Test. b. Perform Pressure Disc Verification; calibrate the module if necessary. If necessary, replace the Pressure Sensor Board and/or Pressure Sensor Harness. c. Perform Plunger Force Accuracy Verification and if necessary, calibrate the module. Replace the Force Sensor Assembly or Lower Housing/Carriage Assembly if necessary. 3. Return the module to the factory.
PCA Handset Stuck (PCA Module only)	1. Verify that the handset is correctly connected to the PCA Module. 2. Replace the handset.

Table 6-1. Technical Troubleshooting Guide (Continued)

PCA Module and Syringe Module (Continued)

Problem	Remedy
Syringe Drive-Head Error	1. Remove the drive-train blockage. If necessary, repair or replace the Lower Housing/ Carriage Assembly. 2. Rotate the Actuator Knob and slide the plunger head up and down, to check for full plunger head travel and Cam Lock engagement and disengagement. If necessary, repair or replace Lower Housing/Carriage Assembly. 3. Return the module to the factory.
Syringe Empty	1. Using the BD Alaris™ System Maintenance software, perform Binary Switches Test. Replace Force Sensor Assembly or Linear Sensor if necessary. 2. Rotate Actuator Knob and slide plunger head up and down, to check for full plunger head travel and for Cam Lock engagement and disengagement. Repair or replace the Lower Housing/Carriage Assembly, if necessary. 3. Return the module to the factory.
Syringe Not Recognized	1. Replace the syringe with a compatible syringe (refer to the *user manual*). 2. Using the BD Alaris™ System Maintenance software, perform the Binary Switches Test. Replace the Syringe Size Sensor Assembly, if necessary. 3. Replace the logic board and flash with the appropriate software version. 4. Return the module to the factory.

‡ Replacing the Force Sensor Assembly or logic board Assembly in a PCA Module or Syringe Module with version 7 or earlier software must be performed at the depot. Refer to the PCA Module / Syringe Module service manual for further information.

Table 6-1. Technical Troubleshooting Guide (Continued)

$EtCO_2$ Module

Problem	Remedy
Autozero (in progress)	Wait for the instrument to complete its auto-zeroing function. After the auto-zero cycle is complete, the instrument begins the measurement again. No intervention is required.
Channel Error	1. Respond as appropriate, to any error code (see *Error Codes* on page *6-36*). 2. Return the module to the factory.
Clearing Disposable	1. Check the Microstream™ Disposable. Wait for the purging to complete. 2. Using the BD Alaris™ System Maintenance software, perform the Disposable Connected test. 3. Perform all identified repairs or calibrations. 4. Return the module to the factory.
Display Problem	1. Check the cable connections. 2. Replace the Display. 3. Replace the logic board. 4. Return the module to the factory.
Disposable Disconnected	1. Attach the Microstream™ Disposable to the instrument. 2. Using the BD Alaris™ System Maintenance software, perform the Disposable Connected test. 3. Perform all identified repairs or calibrations. 4. Return the module to the factory.
Instrument Malfunction	1. Turn the instrument off and back on to see if the problem clears. 2. Refer to the alarm history for any fault detected and see *Error Codes* on page *6-36*.
Intermittent Operation	1. Check the connections to the logic board. 2. Replace the logic board. 3. Return the module to the factory.
Key Stuck Alarm	1. Turn the instrument off and back on to see if the problem clears. 2. Replace the keypad assembly. 3. Replace the logic board. 4. Return the module to the factory.
Patient Not Detected	1. Check the disposable. 2. Using the BD Alaris™ System Maintenance software, perform the Disposable Connected test. 3. Perform all identified repairs or calibrations. 4. Return the module to the factory.

6.3 Errors

Through the use of diagnostic hardware testing and software error trapping, the BD Alaris™ System ensures that all hardware and software errors are logged and the appropriate action is taken. The error log, in contrast to all other logs, is required to take steps that ensure logging still proceeds correctly in the face of a compromised software system. Space is allocated in the error log for the storage of a small amount of error-specific data. All errors are recorded in this log; specifically these are: soft faults (or similar) system and channel errors, audio failure, and rate display failure.

Errors fall into two broad categories, software and hardware. All software errors (soft faults) are considered very serious because they indicate that the system has become unstable and cannot be relied on to execute the software correctly, or the software has detected an illegal software condition and the software system has been compromised. A hardware error is external to the CPU or memory, and does not indicate an unstable computing environment. The integrity of the software is still sound and it can be relied on to handle or report the error condition.

6.3.1 Error Numbering Scheme

All errors share a common numbering system:

Subsystem Code

XXX.XXXN

XXX represents the three-digit code that identifies the hardware subsystem to which the error appears most closely related, such as logic board or pressure sensor.

XXXN represents the subcode that describes the subsystem failure. N represents the numeral that indicates whether the error was detected at the Power On Self Test (POST) (1) or at run time (0 or zero), or if it is a log-only event (5). The system monitors and logs “log only” events, which do not affect the overall operation of the BD Alaris™ System. These non-malfunction events are logged for tracking. All error events that end with a value of 5 or 5.5 fall into the log only category (for example, 100.6075 or 100.6075.5). A soft-fault error code cannot happen in POST and in this case, the subcode is defined as the domain that logged the fault.

There are two additional 32-bit data items associated with errors. This data is displayed only in debug builds but is always logged.

Table 6-2. Subsystem Codes

PCU Codes

100 Main Safety System
110 Keypad Processor Safety System
111 Keypad Processor Comm Safety System
120 Power Supply Processor Safety System
121 Power Supply Processor Comm Safety System
130 Keypad Safety System
131 Display Safety System
132 Tamper Switch Safety System
133 Audio Safety System
150 IUI Safety System
151 Comm Safety System
160 Power Supply Safety System
161 Battery Safety System
162 Compact Flash Safety System

Pump Module, PCA Module, Syringe Module Codes

200 Main Safety System
210 Keypad Processor Safety System
211 Keypad Processor Comm Safety System
220 Safety Processor Safety System
221 Safety Processor Comm Safety System
222 Safety Processor Cross-check Safety System
230 Keypad Safety System
231 Channel INFO Display Safety System
232 Rate Display Safety System
240 Bottle Pressure Safety System
241 Patient Pressure Safety System
242 Motor Encoder Safety System
243 Air-In-Line Safety System
244 Flow Stop Safety System
245 Door Sensor Safety System
246 ADC Safety System
250 IUI Safety System
260 Power Supply Safety System

PCA Module and Syringe Module Codes

350 Keypad Processor Safety System
351 Motor Safety System
352 Plunger Force Safety System
353 Plunger Position Safety System
354 Patient Pressure Safety System
355 Syringe Size Safety System
356 Digital Sensor Safety System
357 Keypad Processor Comm Safety System
358 Comm Safety System

Table 6-3. Subsystem Codes (Continued)

$EtCO_2$ Module Codes

500 Main Safety System
510 Keypad Safety System
511 Comm Safety System
530 Keypad Safety System
550 IUI Safety System
560 Power Supply Safety System
570 Board Safety System
571 Board Comm Safety System

CI Board and Auto-ID Module Codes

600 CI Board Safety System
610 Bar Code Scanner Safety System

PCU (Model 8015) Codes

800 Operating System Safety System
810 POLO Safety System

Table 6-4. Failure Codes

1000 General Failure
1010 CPU Failure
1020 ROM Failure
1030 RAM Failure
1040 Flash Failure
1050 Timebase Failure
1060 Watchdog Failure
1070 Watchdog Test Failure
1080 Protected RAM Failure
1090 DRAM Failure

1100 SRAM Failure
1110 Flash File Failure
1120 Flash Boot Failure
1130 Timer Stall Failure
1140 Timer Range Failure
1150 Time Base Failure
1160 Internal RAM Failure
1170 External RAM Failure
1180 Timer Sync Failure

1200 Un-initialized (UNINIT) Interrupt Failure
1210 Option Board Multiple ID
1220 Processor Exception
1230 Processor Reset
1240 Processor Power On Reset
1250 Option Board Unknown Type

2000 Comm Failure
2010 Comm Watchdog Failure
2020 Comm Incorrect Response Failure
2030 Comm Corrupted Response Failure
2040 Comm Unexpected Response Failure
2050 Comm Bad Command
2060 Comm Heartbeat Failure
2070 Comm No Response Failure
2080 Comm Poll Sync Failure
2090 Comm Too Many Units Failure

2100 Comm Transmit Failure
2200 Comm Break Interrupt
2210 Comm Timer Interrupt
2230 Comm Modem Interrupt

2300 Comm Lost End of Interrupt

3000 Stuck Closed Failure
3010 Stuck Open Failure
3020 Bad Unpowered State Failure
3030 Power Supply Failure

4000 General Rate Failure
4010 High Rate Failure

Table 6-4. Failure Codes (Continued)

4020 Low Rate Failure
4030 Motor Stall Failure
4040 Sync Failure
4050 AIL Check Failure
4060 Over Infused Failure
4070 Sensor Test Failure
4080 ADC 3 Volt Low Voltage Failure
4090 ADC 3 Volt High Voltage Failure

4100 ADC 5 Volt Low Voltage Failure
4110 ADC 5 Volt High Voltage Failure
4120 Sensor Supply Low Voltage Failure
4130 Sensor Supply High Voltage Failure
4140 Sensor Broken Low Failure
4150 Sensor Broken High Failure
4160 Safety Switch Test Failure
4170 Parameter Range Failure
4180 Door or Safety Clamp State Failure
4190 Safety Switch State Failure

4200 Illegal Motion Failure

4310 Low 24V Failure
4320 High 24V Failure
4330 Low NSW 5V Failure
4340 High NSW 5V Failure
4350 Low 5V Failure
4360 High 5V Failure
4370 Low 8V Failure
4380 High 8V Failure
4390 Low 3P3V Failure

4400 High 3P3V Failure
4410 Low Backup Voltage Failure
4420 High Backup Voltage Failure
4430 Low Battery Voltage Failure
4440 High Battery Voltage Failure
4450 Low WD3P3V Failure
4460 High WD3P3V Failure
4470 Power Supply Processor Parameter Failure
4490 Power Supply Processor Set Charge Level Failure

4500 Power Supply Processor Charge Level High Failure
4510 Power Supply Processor Missing Battery Failure
4520 Power Supply Processor Precharge Failure
4530 Power Supply Processor Charge Voltage High Failure
4540 Power Supply Processor Watchdog Failure
4550 Low VREF Plus Failure
4560 High VREF Plus Failure
4570 Low VREF Minus Failure
4580 High VREF Minus Failure
4590 Low VREF Average Failure

Table 6-4. Failure Codes (Continued)

4600 High VREF Average Failure
4610 Power Supply Processor Charge Level Low Failure
4620 Power Supply Processor Charge Voltage Low Failure
4630 Power Supply Processor Charger FET Error

4700 ADC Calibration Timeout Failure
4710 ADC Conversion Timeout Failure

5000 Hardware-Software Compatibility Failure
5010 Software Version Compatibility Failure
5020 Peripheral Version Response Failure
5030 Unknown Device Type
5040 Module Software Version Compatibility Failure
5050 Duplicate Serial Number Failure
5060 Unsupported Module Type Failure
5070 Invalid Software Access Key Failure
5080 Module Software Version Timeout Failure

6000 Post General Failure
6010 Post RAM Failure
6020 Keypad Failure
6030 Alarm LED Failure
6040 Display Failure
6050 Encoder Failure
6060 ADC Failure
6070 RTC Battery Failure
6080 Backup Speaker Failure
6090 Main Speaker Failure

6100 Backup Speaker Power Supply Failure
6110 Compliance Timeframe Failure
6120 Data Integrity Failure
6130 System Configuration Data Integrity Failure
6140 Unexpected Interrupt or Exception Failure
6150 Operating System Error
6160 Unexpected Hardware Interrupt Failure
6170 Charger Battery Temp Too High Failure
6180 Charger Battery Box Temp Too High Failure
6190 Hospital Profile Data Integrity Failure

6200 CBIT Failure
6210 Comm Down Failure
6220 Config Settings Failure
6230 Received Value Out-of-Range
6240 Missing Sensor Status

6300 Shorted Segment in 7-Segment Display
6310 Open Segment in 7-Segment Display
6320 Shorted Alarm LED
6330 Open Alarm LED
6340 7-Segment Failure
6350 7-Segment Failure Clear

Table 6-4. Failure Codes (Continued)

6400 CBIT General Failure

6500 Serious Module Error
6510 Module Error Requires Power Cycle
6520 Module Error Requires Reset
6530 Transient Error
6540 Informational Report
6550 Digital Error
6560 Module-Specific Error
6570 Warmer Error
6580 Unknown Error

6600 Syringe Module Motor Watchdog Test Failure
6610 Syringe Module Watchdog Failure
6630 Syringe Plunger Force Not Tracking Pressure
6640 Syringe Plunger Force Sensor Failure
6650 Syringe Plunger Position Sensor Failure
6660 Syringe Plunger Position Failure
6670 Syringe Pressure Disc Sensor Failure
6680 Syringe Timebases Out of Sync
6690 Syringe Pressure Sensor Current Monitor Failure

6700 Syringe Force Sensor Circuit Test Failure
6710 Syringe Digital Sensors Illegal State
6720 Syringe Module Motor Step Rate Failure
6730 Syringe Module Motor Step Sample Too Many Steps
6740 Syringe Nut Disengaged
6750 Syringe Nut Engage Failure
6760 Syringe Module Not Calibrated
6770 Syringe Module Pressure Sensor Circuit Test Failure
6780 PCA Handset Stuck

6800 Wireless Network POST Failure
6810 Wireless Network Not Configured
6820 Wireless Network Initialization Failure
6830 Wireless Network Configuration Failure
6840 Wireless Network Connect Failure
6850 Wireless Network Not Responding
6860 Wireless Network Disconnect Failure
6870 Wireless Network Communication Error
6880 Wireless Network Hardware Failure

6900 Wireless Network Data Link Went Down
6910 Wireless Network Communication Timed Out
6920 Wireless Network Rebooted

7000 Auto-ID Module Message Corrupted
7010 Auto-ID Comm Error
7020 Auto-ID Interrupt Error
7030 Auto-ID General Error
7040 Auto-ID Command Buffer Error
7050 Auto-ID Internal Command Error

Table 6-4. Failure Codes (Continued)

7060 Auto-ID External Command Error
7070 Auto-ID Internal Not Responding
7080 Auto-ID External Not Responding
7090 Auto-ID POST General Error

7100 Auto-ID Keypad Failure
7110 Auto-ID Software Version Compatibility Failure
7120 Auto-ID Internal Version Compatibility Failure
7130 Auto-ID External Version Compatibility Failure

7200 Syringe Plunger Position Sensor Contaminated
7210 Syringe Plunger Position Reset Calibration
7220 Syringe Plunger Position Sensor Illegal Motion

7500 Invariant Time Failure

8000 Model 8015 General Operating System Failure
8010 Model 8015 Compact Flash File System Corrupted
9000 POLO General Failure
9010 POLO ELF File Not Found
9020 POLO ELF File Invalid
9030 POLO ELF File CRC Error
9040 POLO Parameter File Not Found
9050 POLO Parameter File Update Error
9060 POLO Incompatible Board
9070 POLO Compact Flash Card Missing
9080 POLO Compact Flash Card Not Ready
9090 POLO Compact Flash Card Invalid

9100 POLO Compact Flash Card Not Supported
9110 POLO Compact Flash Card Initialization Failure
9120 POLO Compact Flash Card Mount Failure
9130 POLO Compact Flash Card Configuration Error
9140 POLO Compact Flash Card Functional ID Error
9150 POLO Make Directory Failure
9160 POLO Watchdog Test Failure
9170 POLO Read Tuple Failure

Table 6-5. Error Codes

If the error is repeatable, perform the response steps in the order they are listed until the error is corrected. Following the repair, use the applicable maintenance software to perform the required tests.

NOTE:
If you have identified the subsystem, but you choose not to repair it yourself, return the module to the factory.

PCU

Error Code	Subsystem	Explanation	Response
100.1130	Logic Board	The time read from the battery-backed RTC is not changing.	Replace the logic board.
100.1180	Logic Board	The RTC differs from the operating system clock by more than one minute.	Replace the logic board.
100.1200	Logic Board	Indicates main processor has trapped undefined interrupts.	Replace the logic board.
100.1230	Logic Board	The power supply or auxiliary processor unexpectedly reset.	Replace the logic board.
100.1240	Logic Board	The power supply lost power.	Replace the logic board.
100.1250	Logic Board	An unknown board type is detected in the option board slot.	1. Remove the option board. 2. Replace the option board. 3. Replace the logic board.

PCU (Continued)

Error Code	Subsystem	Explanation	Response
100.2070	Logic Board	Power is lost.	Replace the logic board.
100.2200	SIO	A communications interrupt break occurs in response to a break received on the incoming serial line.	
100.5010	Logic Board	The boot block software version is not compatible with the software flashed into the PCU.	1. Reflash the PCU. 2. Replace the logic board.
100.5020	Logic Board	One or more peripheral processors are not reporting the software version data immediately after System On. An 8051 is missing, failed, or flashed with a version that does not support the reporting software version.	1. Reflash the PCU. 2. Replace the logic board.
100.5050	Logic Board	Code appears when two attached modules report the same serial number.	Replace the logic board.
100.5070	Logic Board	The system is powered on in system configuration mode and the software access key is invalid.	1. Reflash the PCU. 2. Power up in system configuration mode.
100.6010	Logic Board	The attempt to write to the battery-backed RAM failed.	1. Replace the SRAM battery (lithium). 2. Replace the logic board.
100.6020	Logic Board	The critical value data had an integrity failure.	Replace the logic board.
100.6040	Logic Board	Indicates main processor has trapped a bad display command.	Replace the logic board.
100.6070	Logic Board	The Real Time Clock battery failed.	Replace the logic board.
100.6110	Logic Board	The time/date reported by the operating system exceeds the maximum RTC date.	1. Reset the date. 2. Replace the SRAM battery (lithium). 3. Replace the logic board.
100.6130	Logic Board	The system is powered on in normal mode and the configuration data is invalid.	Power up the system in system configuration mode.
100.6140	Logic Board	An unexpected interrupt or exception is detected.	Replace the logic board.
100.6160	Logic Board	The main processor or keypad processor experiences an unexpected hardware interrupt.	Replace the logic board.
100.6190	Logic Board	The current facility data set is damaged.	1. Load the new data. 2. Replace the logic board.

PCU (Continued)

Error Code	Subsystem	Explanation	Response
100.7500	Logic Board	An invariant timer failure when system time is over the limit.	Replace the logic board.
110.1000	Logic Board	Code reports failures other than communication or interrupt errors.	Replace the logic board.
110.1010	Keypad Processor	A CPU failure is detected during the POST.	Replace the logic board.
110.1020	Keypad Processor	A ROM failure is detected during the POST.	Replace the logic board.
110.1160	Keypad Processor	An internal RAM failure is detected during the POST.	Replace the logic board.
110.1170	Logic Board	PCU keypad processor detects an external RAM failure during POST.	Replace the logic board.
110.2000	Keypad Processor	A communication error occurs.	Replace the logic board.
110.5010	Keypad Processor	The 8051 software is version not compatible with the software flashed into the PCU.	1. Reflash the PCU. 2. Update the keypad processor. 3. Replace the logic board.
110.5020	Keypad Processor	The processor is not reporting the software version data immediately after the system is turned on. The processor is missing, failed, or flashed with aversion that does not support the reporting software version.	1. Reflash the PCU. 2. Update the keypad processor. 3. Replace the logic board.
110.6000	Keypad Processor	One or more failures is detected during the POST.	Replace the logic board.
110.6010	Keypad Processor	A RAM failure is detected during the POST.	Replace the logic board.
110.6020	Keypad Processor	A Keypad failure is detected during the POST.	1. Replace the keypad. 2. Replace the logic board.
110.6110	Keypad Processor	The projected life span of the device is exceeded. The system time rolled over the past maximum date possible in the device.	Replace the logic board.
110.6160	Logic Board	Spurious interrupts in the AKB or PKB detected.	Replace the logic board.
111.2000	Keypad Processor Communications	This is a communication error. The Keypad Processor has quit responding.	Replace the logic board.

PCU (Continued)

Error Code	Subsystem	Explanation	Response
111.2040	Logic Board	A communication response failure.	Replace the logic board.
120.1010	Power Supply Processor	A CPU failure is detected during the POST.	Replace the logic board.
120.1020	Power Supply Processor	A ROM failure is detected during the POST.	Replace the logic board.
120.1030	Power Supply Processor	The power supply processor detects a RAM failure during the POST.	Replace the PSP Board.
120.1200	Hardware	Unexpected interrupts or unused interrupt lines are triggered.	Replace the PSP Board.
120.4310	Power Supply Processor	The Off-Line Switcher is defective, producing low voltage on the 24V supply line.	Replace the power supply.
120.4320	Power Supply Processor	The Off-Line Switcher is defective, producing high voltage on the 24V supply line.	Replace the power supply.
120.4330	Power Supply Processor	A low voltage is detected on the non-switched 5V supply line.	Replace the power supply board.
120.4340	Power Supply Processor	A high voltage is detected on the non-switched 5V supply line.	Replace the power supply board.
120.4350	Power Supply Processor	A low voltage is detected on the 5V supply line.	Replace the power supply board.
120.4360	Power Supply Processor	A high voltage is detected on the 5V supply line.	Replace the power supply board.
120.4370	Power Supply Processor	A low voltage is detected on the 8V supply line.	Replace the power supply board.
120.4380	Power Supply Processor	A high voltage is detected on the 8V supply line.	Replace the power supply board.
120.4390	Power Supply Processor	A low voltage is detected on the 3.3V supply line.	Replace the power supply board.
120.4400	Power Supply Processor	A high voltage is detected on the 3.3V supply line.	Replace the power supply board.
120.4410	Power Supply Processor	A low backup voltage at the capacitor is used to power the backup alarm.	Replace the logic board.
120.4420	Power Supply Processor	A high backup voltage at the capacitor is used to power the backup alarm.	Replace the logic board.
120.4430	Power Supply Processor	A low battery voltage at the capacitor is powering the backup alarm.	Replace the logic board.

PCU (Continued)

Error Code	Subsystem	Explanation	Response
120.4440	Power Supply Processor	A high battery voltage at the capacitor is powering the backup alarm.	Replace the logic board.
120.4460	Power Supply Processor	The supply voltage on the watchdog timer is above 3.3V.	1. Replace the power supply board. 2. Replace the logic board.
120.4470	Power Supply Processor	Error updating processor charging parameter.	1. Replace the power supply board. 2. Replace the logic board.
120.4490	Power Supply Processor	The processor could not set the charge current.	1. Replace the power supply board. 2. Replace the logic board.
120.4500	Power Supply Processor	The processor charge current is too high for the present charge level setting on the charger chip.	1. Replace the power supply board. 2. Replace the logic board.
120.4510	Power Supply Processor	The battery is missing or has been disconnected during use.	1. Replace the battery. 2. Replace the power supply board.
120.4520	Power Supply Processor	The battery did not respond appropriately to the precharge current.	1. Replace the battery. 2. Replace the power supply board.
120.4530	Power Supply Processor	The battery voltage exceeded the safe limits.	1. Replace the battery. 2. Replace the power supply board.
120.4540	Power Supply Processor	The charger chip could not be turned off by its watchdog.	Replace the power supply board.
120.4560	Power Supply Processor	The ADC failed during self test due to an incorrect high positive reference voltage.	1. Replace the battery. 2. Replace the power supply board.
120.4570	Power Supply Processor	The ADC failed during self test due to an incorrect low negative reference voltage.	1. Replace the battery. 2. Replace the power supply board.
120.4580	Power Supply Processor	The ADC failed during self test due to an incorrect high negative reference voltage.	1. Replace the battery. 2. Replace the power supply board.
120.4590	Power Supply Processor	The ADC failed during self test due to an incorrect low average reference voltage.	1. Replace the battery. 2. Replace the power supply board.

PCU (Continued)

Error Code	Subsystem	Explanation	Response
120.4600	Power Supply Processor	The ADC failed during self test due to an incorrect high average reference voltage.	1. Replace the battery. 2. Replace the power supply board.
120.4610	Power Supply Processor	The processor charge current is too low for the present charge level setting on the charger chip.	1. Replace the battery. 2. Replace the power supply board.
120.4620	Power Supply Processor	The battery voltage is too low when charging.	1. Replace the battery. 2. Replace the power supply board.
120.5010	Power Supply Processor	The 8051 software version is not compatible with the software flashed into the PCU.	1. Reflash the PCU. 2. Replace the power supply board. 3. Replace the logic board.
120.5020	Power Supply Processor	The processor is not reporting the software version data immediately after the System is turned on. The processor is missing, failed, or flashed with a version that does not support the reporting software version.	Replace the power supply board.
120.6000	Power Supply Processor	One or more failures is detected during the POST.	1. Replace the battery. 2. Replace the power supply board.
120.6010	Power Supply Processor	A RAM failure is detected during the POST.	Replace the power supply board.
120.6170	Power Supply Processor	The battery is not being charged and the compartment temperature is too high.	1. Replace the battery. 2. Replace the power supply board.
120.6180	Power Supply Processor	The battery is not being charged and the temperature is too high.	1. Replace the battery. 2. Replace the power supply board.
121.1010	PSP COMM	A PSP Communication Safety Software failure.	Replace the power supply board.
121.2000	Power Supply Processor Communications	The processor quit responding.	Replace the power supply board.
130.2000	Logic Board	An AKB Safety Software communication failure.	Replace the logic board.
130.6020	Logic Board	An AKB Safety Software keyboard failure.	1. Hold Key Down. 2. Replace the Front Case. 3. Replace the logic board.

PCU (Continued)

Error Code	Subsystem	Explanation	Response
132.3000	Tamper Resist	The Tamper Resist Switch is stuck.	Replace the SIO Board.
133.6080	Audio	The backup speaker failed.	Replace the backup speaker.
133.6090	Audio	The main speaker failed.	Replace the main speaker.
133.6100	Audio	The backup speaker power supply failed.	Replace the logic board.

Table 6-5. Error Codes (Continued)

PCU Model 8015 ‡

Error Code	Subsystem	Explanation	Response
150.2080	IUC	An IUI Safety Software communication poll sync failure on the attached module (slave) side.	1. Replace IUI Board. 2. Replace the logic board. 3. Replace the PSP Board.
150.2090	IUC	An attached module is disabled because the number of attached modules exceeds the limit.	Remove the extra module.
161.4610	Battery	There are thirty minutes or less of battery runtime available at the current power consumption rate.	1. Replace the battery. 2. Replace the PSP Board.
162.8010	Compact Flash	The unit information file or the application configuration file is missing or damaged.	1. Re-flash the operate software to the device. 2. Replace the logic board.
800.8000	Operating System	The software has a fault.	Contact BD Technical Support.
800.1040	Operating System	The Flashing Operate Software failed when writing or erasing PCU data to the flash memory.	1. Replace the CI Board. 2. Replace the logic board.
800.1250	Option Card	The PCU cannot recognize this type of Option Card.	1. Replace the CI Board. 2. Replace the logic board.
800.5010	Main Processor	The software version of the APM boot block is not compatible with the application.	Replace the logic board.
800.6110	Main Processor	An Operate Software compliance time-frame failure.	Replace the logic board.
810.9000	Logic Board	A software fault or operating system error occurred while running the POLO.	1. Reflash the POLO. 2. Replace the logic board.
810.9010	Logic Board	The POLO is not able to boot because of a nonexistent application ELF file.	1. Reflash the application. 2. Replace the compact flash card and reflash the application. 3. Replace the logic board.
810.9020	Logic Board	The POLO is not able to boot because of an invalid application ELF file.	1. Reflash the application. 2. Replace the compact flash card and reflash the application. 3. Replace the logic board.

Table 6-5. Error Codes (Continued)

PCU Model 8015 ‡

Error Code	Subsystem	Explanation	Response
810.9030	Logic Board	The POLO is not able to boot because the application ELF file has an invalid checksum.	1. Reflash the application. 2. Replace the compact flash card and reflash the application. 3. Replace the logic board.
810.9040	POLO /Main Boot Logic Board	The POLO parameter file is not found. (Application cannot boot.)	1. Reflash the application. 2. Replace the compact flash card and reflash the application. 3. Replace the logic board.
810.9050	Logic Board	An error occurred while updating the POLO parameter file. This occurs only while executing the BOOT or LOAD shell commands.	1. Reflash the application. 2. Reflash POLO. 3. Replace the compact flash card and reflash the application. 4. Replace the logic board.
810.9060	Logic Board	The POLO is running on a logic board for which it is not configured.	1. Reflash POLO. 2. Replace the logic board.
810.9070	Logic Board	The POLO did not detect the presence of an internal compact flash card in slot B.	1. Replace the compact flash card and reflash the application. 2. Replace the logic board.
810.9080	Logic Board	The POLO could not reset and access the internal compact flash card in slot B.	1. Replace the compact flash card and reflash the application. 2. Replace the logic board.

Table 6-5. Error Codes (Continued)

PCU Model 8015 ‡ (Continued)

Error Code	Subsystem	Explanation	Response
810.9090	Logic Board	The compact flash card in slot B is not a disk type card.	1. Replace the compact flash card and reflash the application. 2. Replace the logic board.
810.9100	Logic Board	The compact flash card in slot B is not supported by POLO.	1. Replace the compact flash card and reflash the application. 2. Replace the logic board.
810.9105	Logic Board	The wireless card is not supported by POLO.	1. Replace the wireless card. 2. Replace the wireless card extension board. 3. Replace the logic board.
810.9110	Logic Board	The POLO could not initialize the ATA driver for a disk type card in one of the compact flash card slots.	1. Replace the compact flash card and reflash the application. 2. Replace the logic board.
810.9120	Logic Board	The POLO could not mount the volume on a disk type card in one of the compact flash card slots.	1. Replace the compact flash card and reflash the application. 2. Replace the logic board.
810.9130	Logic Board	The configuration tuple read from the compact flash card in slot B is incorrect.	1. Replace the compact flash card and reflash the application. 2. Replace the logic board.
810.9135	Logic Board	The configuration tuple read from the card in the wireless card slot.	1. Replace the wireless card. 2. Replace the wireless card extension board. 3. Replace the logic board.
810.9140	Logic Board	The function ID tuple read from the compact flash card in slot B is incorrect.	1. Replace the compact flash card and reflash the application. 2. Replace the logic board.
810.9145	Logic Board	The function ID tuple read from the wireless card is incorrect.	1. Replace the wireless card. 2. Replace the wireless card extension board. 3. Replace the logic board.
810.9150	Logic Board	The POLO is not able to create the POLO directory in the internal FFX file system.	1. Reflash POLO. 2. Replace the logic board.

Table 6-5. Error Codes (Continued)

PCU Model 8015 ‡ (Continued)

Error Code	Subsystem	Explanation	Response
810.9160	Logic Board	The watchdog timer test failed while the POLO was booting an application.	Replace the logic board.
810.9170	Logic Board	The POLO is unable to read the attribute tuples from the compact flash card.	1. Replace the compact flash card and reflash the application. 2. Replace the logic board.
810.9175	Logic Board	The POLO is unable to read the attribute tuples from the wireless card.	1. Replace the wireless card. 2. Replace the wireless card extension board. 3. Replace the logic board.
810.9340	Logic Board	The POLO parameter file could not be opened while processing an update request. This occurs only while executing the BOOT or LOAD shell commands.	1. Reflash the application. 2. Reflash POLO. 3. Replace the compact flash card and reflash the application. 4. Replace the logic board.

‡ POLO refers to the operating system software after boot up (power up sequence).

Table 6-5. Error Codes (Continued)

Pump Module

Error Code	Subsystem	Explanation	Response
200.1010	Logic Board	An error was detected during the CPU test.	Replace the logic board.
200.1030	Logic Board	The 64K to flash file DRAM test failed.	Replace the logic board.
200.1040	Logic Board	Unable to write into the flash memory chip used for logging.	Replace the logic board.
200.1060	Logic Board	Watchdog failure.	Replace the logic board.
200.1070	Logic Board	Hardware watchdog test failure.	Replace the logic board.
200.1110	Logic Board	Flash file the device containing the application that failed the CRC test.	Replace the logic board.
200.1120	Logic Board	The Boot flash file device containing the boot code failed the CRC test.	Replace the logic board.
200.1200	Logic Board	An uninitialized interrupt occurred. The default handler was called.	Replace the logic board.
200.4160	Logic Board	The motor shutoff safety switch test failed.	Replace the logic board.
200.4190	Logic Board	Pump Module motor not running when motor safety switch is open.	Replace the logic board.
200.5010	Logic Board	The boot block software version is not compatible with the software flashed into the Pump Module.	1. Reflash the Pump Module. 2. Replace the logic board.
200.5020	Logic Board	One or more 8015 processors is not reporting the software version data immediately after the System is turned on. The 8015 is missing, failed, or flashed with a version that does not support the reporting software version.	Replace the logic board.
200.5030	Logic Board	The serial number reported by the Pump Module is not a recognized type.	Replace the logic board.
200.5040	Logic Board	The Pump Module software version is not compatible with the software flashed into the PCU.	Reflash the PCU or Pump Module.
200.6120	Logic Board	The logic board experienced a critical data failure due to received parameter values.	Replace the logic board.
200.6400	Logic Board	CBIT failure unrelated to any other error code.	Replace the logic board.

Table 6-5. Error Codes (Continued)

Pump Module

Error Code	Subsystem	Explanation	Response
210.1010	Keypad Processor	A CPU failure is detected during the POST.	Replace the logic board.
210.1020	Keypad Processor	A ROM failure is detected during the POST.	Replace the logic board.
210.1160	Keypad Processor	An internal RAM failure is detected during the POST.	Replace the logic board.
210.1170	Logic Board	An external RAM failure detected during POST.	Replace the logic board.
210.2040	Keypad Processor	A response message is received when it is not expected.	Replace the logic board.
210.3000	Logic Board	A keypad key is stuck closed.	1. Replace the Front Case keypad. 2. Replace the display board. 3. Replace the logic board.
210.4040	Keypad Processor	A clear Display BSYNC failure is detected during the POST.	Replace the logic board.
210.5010	Keypad Processor	The 8015 software version is not compatible with the software flashed into the Pump Module.	Reflash the PCU.
210.5020	Keypad Processor	The processor is not reporting the software version data immediately after the System is turned on. The processor is missing, failed, or flashed with a version that does not support the reporting software version.	Replace the logic board.
210.6000	Keypad Processor	One or more failures is detected during the POST.	Replace the logic board.
210.6010	Keypad Processor	A RAM failure is detected during the POST.	Replace the logic board.
210.6020	Keypad Processor	A keypad failure is detected during the POST.	Replace the Keypad.
210.6030	Keypad Processor	An alarm LED failure is detected during the POST.	Replace the defective alarm LED.
210.6040	Keypad Processor	A display failure is detected during the POST.	Replace the defective display.

Table 6-5. Error Codes (Continued)

Pump Module

Error Code	Subsystem	Explanation	Response
211.2000	Keypad Processor Communications	An unspecified communication error occurs.	Replace the logic board.
210.6200	Logic Board	Detects a common self-test failure in the PKB.	Replace the logic board.
220.1000	Safety Processor	An internal error occurs.	Replace the logic board.
220.1010	Safety Processor	A CPU failure is detected during the POST.	Replace the logic board.
220.1020	Safety Processor	A ROM failure is detected during the POST.	Replace the logic board.
220.1160	Safety Processor	An internal RAM failure is detected during the POST.	Replace the logic board.
220.1170	Safety Processor	An internal RAM failure was detected during POST.	Replace the logic board.
220.2000	Safety Processor	A safety processor failure	Replace the logic board.
220.2010	Safety Processor	The safety system processor did not send a reply message within the two-second time limit.	Replace the logic board.
220.2020	Safety Processor	The safety system processor replied with an incorrect message.	Replace the logic board.
220.2030	Safety Processor	The safety system processor replied with a corrupted message.	Replace the logic board.
220.2040	Safety Processor	The safety system processor did not send a message when the Pump Module expected one.	Replace the logic board.
220.2050	Safety Processor	The safety system processor stops the system due to a bad command sent to the application.	Replace the logic board.
220.2060	Safety Processor	The safety system processor stops the system due to an error message sent to the application.	Replace the logic board.
220.4010	Safety Processor	A high rate failure stops the system due to an error message sent to the application.	Replace the logic board.
220.4020	Safety Processor	A low rate failure stops the system due to an error message sent to the application.	Replace the logic board.

Table 6-5. Error Codes (Continued)

Pump Module

Error Code	Subsystem	Explanation	Response
220.4030	Safety Processor	A motor stall halted the system when an error message was sent to the application.	Replace the logic board.
220.4040	Safety Processor	A synchronization failure halted the system when an error message was sent to the application.	Replace the logic board.
220.4050	Safety Processor	An Air-In-Line failure halted the system when an error message was sent to the application.	Replace the logic board.
220.4060	Safety Processor	An over-infusion failure halted the system when an error message was sent to the application.	Replace the logic board.
220.4170	Safety Processor	A parameter range failure halted the system when an error message was sent to the application.	Replace the logic board.
220.4180	Safety Processor	A door or flow-stop state halted the system when an error message was sent to the application.	Replace the logic board.
220.4190	Safety Processor	A safety switch state halted the system when an error message was sent to the application.	Replace the logic board.
220.4200	Safety Processor	An illegal motion state halted the system when an error message was sent to the application.	Replace the logic board.
220.5010	Safety Processor	The 8015 software version is not compatible with the software flashed into the Pump Module.	Replace the logic board.
220.5020	Safety Processor	The processor is not reporting the software version data immediately after the System is turned on. The processor is missing, failed, or flashed with a version that does not support the reporting software version.	Replace the logic board.
220.6000	Safety Processor	One or more failures is detected during the POST.	Replace the logic board.
220.6010	Safety Processor	A RAM failure is detected during the POST.	Replace the logic board.
221.2000	Safety Processor Communications	An unspecified communication error occurs.	Replace the logic board.

Table 6-5. Error Codes (Continued)

Pump Module

Error Code	Subsystem	Explanation	Response
221.2010	Safety Processor Communications	A timely response to the watchdog message is not received.	Replace the logic board.
221.2020	Safety Processor Communications	An incorrect response message is received.	Replace the logic board.
221.2030	Safety Processor Communications	A corrupted response message is received.	Replace the logic board.
221.2040	Safety Processor Communications	A response message is received when not expected.	Replace the logic board.
221.2050	Safety Processor Communications	A command is received that cannot be interpreted.	Replace the logic board.
221.2060	Safety Processor Communications	Heartbeat messages are not being received in a timely manner.	Replace the logic board.
222.1000	Safety Processor Cross-Check	A measured illegal or inaccurate action by the main processor.	Replace the logic board.
222.2030	Safety Processor Cross-Check	A corrupted response message is received.	Replace the logic board.
222.2040	Safety Processor Cross-Check	A response message is received when not expected.	Replace the logic board.
222.4010	Safety Processor Cross-Check	A high infusion rate is detected.	1. Replace the AIL Assembly (the motor encoder is part of this assembly). 2. Replace the motor controller board. 3. Replace the logic board.
222.4020	Safety Processor Cross-Check	A low infusion rate is detected	1. Replace the AIL Assembly (motor encoder is part of this assembly). 2. Replace the motor controller board. 3. Replace the logic board.
222.4030	Safety Processor Cross-Check	A motor stall is detected.	1. Replace the AIL Assembly (the motor encoder is part of this assembly). 2. Replace the motor controller board. 3. Replace the logic board.

Table 6-5. Error Codes (Continued)

Pump Module

Error Code	Subsystem	Explanation	Response
222.4040	Safety Processor Cross-Check	The detected encoder is out-of-sync with the motor pulses.	1. Replace the AIL Assembly (the motor encoder is part of this assembly). 2. Replace the logic board.
222.4050	Safety Processor Cross-Check	Excessive air-in-line is detected.	1. Replace the AIL Assembly. 2. Replace the logic board.
222.4060	Safety Processor Cross-Check	An over-infusion state is detected (an infusion past the VTBI limit).	1. Replace the AIL Assembly (the motor encoder is part of this assembly). 2. Replace the Motor Controller Board. 3. Replace the logic board.
222.4160	Safety Processor Cross-Check	The motor shutoff safety switch test failed.	Replace the logic board.
222.4170	Safety Processor Cross-Check	The detected infusion parameter is out-of-range. The parameter possibilities include: rate, VTBI, AIL limit, VPMR, burst rate , maintenance mode flag, infuse all flag, and check air-in-line flag.	Replace the logic board.
222.4180	Safety Processor Cross-Check	An improper door and/or flow stop state is detected during infusion.	1. Replace the AIL Assembly. 2. Replace the Door Assembly.
222.4190	Safety Processor Cross-Check	The command is received to open the safety switch when the switch is already open, or to close the safety switch when it is already closed.	Replace the logic board.
222.4200	Safety Processor Cross-Check	Motor activity is detected when the motor should be idle.	1. Replace the AIL Assembly (the motor encoder is part of this assembly). 2. Replace the motor controller board. 3. Replace the logic board.
240.4120	Bottle-Side Pressure Sensor	The power to the pressure sensors is below the specified limit.	Replace the bottle-side pressure sensor.
240.4140	Bottle-Side Pressure Sensor	The voltage is too low. The sensor may be broken.	Replace the bottle-side pressure sensor.
240.4150	Bottle-Side Pressure Sensor	The voltage is too high. The sensor may be broken.	Replace the bottle-side pressure sensor.
241.4140	Patient-Side Pressure Sensor	The voltage is too low. The sensor may be broken.	Replace the patient-side pressure sensor.

Table 6-5. Error Codes (Continued)

Pump Module

Error Code	Subsystem	Explanation	Response
241.4150	Patient-Side Pressure Sensor	The voltage is too high. The sensor may be broken.	Replace the patient-side pressure sensor.
242.4000	Motor/Encoder	The encoder feature is not recognized; the software is unable to determine whether the mechanism rotation is too slow or too fast.	1. Replace the AIL Assembly (the motor encoder is part of this assembly). 2. Replace the motor controller board. 3. Replace the logic board.
242.4010	Motor/Encoder	The fluid delivery mechanism is turning too quickly (infusion rate high).	1. Replace the AIL Assembly (the motor encoder is part of this assembly). 2. Replace the motor controller board. 3. Replace the logic board.
242.4020	Motor/Encoder	The fluid delivery mechanism is turning too slowly (infusion rate low).	1. Replace the AIL Assembly (the motor encoder is part of this assembly). 2. Replace the motor controller board. 3. Replace the logic board.
242.4030	Motor/Encoder	A motor stall is detected.	1. Ensure that the motor connector is securely connected. 2. Replace the AIL Assembly (the motor encoder is part of this assembly). 3. Replace the motor controller board. 4. Replace the logic board.
243.4070	Air-in-Line	The self test failed.	Replace the AIL Assembly.
244.3020	Safety Clamp	The safety clamp was read in a safe state (CLOSED) when the sensor was unpowered and should have been read in an unsafe (OPEN) state.	1. Replace the AIL Assembly (the safety clamp is part of this assembly). 2. Replace the logic board.
245.3020	Door	The door sensor was read in a safe state (CLOSED) when the sensor was unpowered and should have been read in an unsafe (OPEN) state.	1. Replace the AIL Assembly (the door sensor is part of this assembly). 2. Replace the logic board.
246.4700	ADC Safety System	The A/D converter took too long to complete a calibration cycle.	Replace the logic Board.

Table 6-5. Error Codes (Continued)

Pump Module

Error Code	Subsystem	Explanation	Response
246.4710	ADC Safety System	The A/D detector was busy for too long to complete a conversion.	Replace the logic Board.
260.4080	Power Supply	The 3.3V AD voltage is at least 8.4% lower than the voltage in the specification.	Replace the motor controller board.
260.4090	Power Supply	The 3.3V AD voltage is at least 8.4% higher than the voltage in the specification.	Replace the motor controller board.
260.4100	Power Supply	The 5V AD voltage is at least 8.4% lower than the voltage in the specification.	Replace the logic board.
260.4110	Power Supply	The 5V AD voltage is at least 8.4% higher than the voltage in the specification.	Replace the logic board.
260.4120	Power Supply	The Pressure Sensor voltage is at least 8.4% lower than the voltage in the specification.	Replace the logic board.
260.4130	Power Supply	The Pressure Sensor voltage is at least 8.4% higher than the voltage in the specification.	Replace the logic board.
2XX.2080	Communications	The module poll is not in an odd/even sequence.	1. Replace the IUI connectors. 2. Replace the logic board.
2XX.2090	Communications	Too many modules attached.	None
2XX.3000	Keypad Processor	Keypad key is stuck closed.	Replace the Keypad.
2XX.4700	ADC	The ADC failed to calibrate itself within the specified time.	Replace the logic board.
2XX.4710	ADC	The ADC failed to complete a conversion within the specified time.	Replace the logic board.
2XX.6400	Logic Board or display board	This is a general CBIT failure, and not specifically tied to another malfunction code.	Replace the logic board or display board.

Table 6-5. Error Codes (Continued)

PCA Module and Syringe Module

Error Code	Subsystem	Explanation	Response
350.6600	Logic Board	The Watchdog circuit failed the POST.	Replace the logic board.
350.6630	Force Sensor	The pressure is not tracked by the force sensor.	Replace the Force Sensor Assembly.
350.6680	Logic Board	The clock frequency timer base is out of sync.	Replace the logic board.
351.6610	Motor Watchdog	This is an unexpected countdown interrupt.	Replace the Motor and/or logic board.
351.6660	Linear Sensor	This is a movement error. The predicted change in the Linear Sensor is inconsistent with the expected position.	Replace the Linear Sensor.
351.6720	Motor Logic Board	The motor steps are accumulating too fast or too slow.	Replace the Motor and/or logic board.
351.6730	Motor Logic Board	Too many steps have occurred in the motor step sample.	Replace the Motor and/or logic board.
351.6740	Engagement Nut	The nut is not engaged during the infusion. The lever is not open.	Replace the logic board, the nut engagement sensor, or the engagement nut.
351.6750	Engagement Nut	The split-nut carriage assembly is not engaged during an infusion.	Replace the logic board, the nut engagement sensor, or the engagement nut.
351.6760	Module	The calibration flag is not set. The module is not calibrated.	Calibrate, as required.
351.6770	Pressure Sensing Disc Logic Board (Syringe Module)	The pressure at the sensing disc circuit test failed during the POST.	Replace the pressure sensing disc and/or logic board.
352.6640	Force Sensor	The force sensor output is zero or is outside the acceptable range.	Replace the Force Sensor Assembly.
352.6700	Logic Board Force Sensor	The force sensor circuit check failed.	Replace the logic board or Force Sensor Assembly.
353.6650	Linear Sensor	The linear sensor output is zero or is outside the acceptable range.	Replace the Linear Sensor.
354.6670	Pressure Sensing Disc (Syringe Module)	The pressure sensor output is outside the acceptable range.	Replace the pressure sensing disc.

Table 6-5. Error Codes (Continued)

PCA Module and Syringe Module (Continued)

Error Code	Subsystem	Explanation	Response‡
354.6690	Logic Board	The Pressure Sensor current is outside the acceptable range.	Replace the logic board or Pressure Sensor.
3XX.2080	Communications	The module poll is not in an odd/even sequence.	1. Replace the IUI connectors. 2. Replace the logic board.
3XX.2090	Communications	A seventh or greater module is attached.	None
3XX.3000	Keypad	A keypad key is stuck closed.	Replace the Keypad.
3XX.4700	Logic Board	The ADC failed to calibrate itself within the specified time.	Replace the logic board.
3XX.4710	Logic Board	The ADC failed to complete a conversion within the specified time.	Replace the logic board.
3XX.5080	Communications	The module's version data is not validated by the PCU within the specified time.	None
3XX.6400	Display Board	This is a general CBIT failure. It is not specifically tied to another malfunction code.	Replace the logic board or the display board.
3XX.7200	Linear Sensor	The plunger position Linear Sensor readings indicate the potentiometer wiper is making intermittent contact with the resistive surface (log only).	Replace the Linear Sensor.
3XX.7210	Logic Board Linear Sensor	The plunger position sampler cleared the module's calibrated flag because the sensor readings indicate that a possible contamination occurred continuously for 1.08 mm of motion (log only).	1. Calibrate the Linear Sensor. 2. Replace the Linear Sensor. 3. Replace the logic board.
3XX.7220	Logic Board Linear Sensor	The motor is running and the plunger is about to contact the lower mechanical stop.	1. Calibrate the Linear Sensor. 2. Replace the Linear Sensor. 3. Replace the logic board.

‡ Replacing the Force Sensor Assembly or logic board Assembly in a PCA Module or Syringe Module with version 7 or earlier software must be performed at the depot. Refer to the *BDAlaris™ Syringe Module Model 8110 and Alaris™ PCA Module Model 8120 Technical Service Manual* for further information.

Table 6-5. Error Codes (Continued)

$EtCO_2$ Module

Error Code	Subsystem	Explanation	Response
5XX.2080	Communications	The module poll is not in an odd/even sequence.	1. Replace the IUI connectors. 2. Replace the logic board.
5XX.2090	Communications	A seventh or greater module is attached.	None
5XX.3000	Keypad Processor	A keypad key is stuck closed.	Replace the Keypad.
5XX.5080	Communications	The module's version data is not validated by the PCU within a specified time.	None
5XX.6200	$EtCO_2$ Board	The continuous built-in tests failed.	Replace the $EtCO_2$ Board.
5XX.6210	$EtCO_2$ Board	A communications error occurred.	1. Replace the $EtCO_2$ Board. 2. Replace the cable between the logic board and $EtCO_2$ Board. 3. Replace the logic board.
5XX.6220	$EtCO_2$ Board	A configuration error occurred.	Replace the $EtCO_2$ Board.
5XX.6230	$EtCO_2$ Board	A value is out of range.	1. Replace the Microstream™ Disposable device. 2. Replace the $EtCO_2$ Board.
5XX.6240	$EtCO_2$ Board	The sensor status is missing.	1. Replace the Microstream Disposable device. 2. Replace the $EtCO_2$ Board.
5XX.6400	Display Board	A general CBIT failure occurred. It is not specifically tied to another malfunction code.	Replace the display board.
5XX.6500	$EtCO_2$ Board	The $EtCO_2$ Board took too long to perform an action.	Replace the $EtCO_2$ Board.

Table 6-5. Error Codes (Continued)

Wireless Communication

Error Code	Subsystem	Explanation	Response
600.6835	CI Board Safety System	The PCU displays “Network Comm Error 600.6835. The PCU network settings have not been configured”.	1.Use BD Alaris™ System Maintenance to transfer a network configuration. 2.Re-test the wireless connection.
600.6815		The PCU network settings are not compatible with the current wireless card.	1.Use Alaris™ System Maintenance to transfer a network configuration. 2.Re-test wireless connection. If this procedure does not resolve the error code, contact BD Technical Support.
The PCU displays another Network Comm Error code		This is an unspecified network communication error.	Contact BD Technical Support.

Table 6.5. Error Codes (Continued)

Log Only

Error Code	Explanation
2100	An interrupt-check response was lost.
2200	2892 and 16x50 serial devices.
6070	The PCU RTC battery failed.
6140	An unexpected interrupt or exception occurred, after which a software fault is signaled.
6150	An operating system error occurred, after which a software fault is signaled.
6340	A 7-segment display status report occurs.
6350	A 7-segment display status report occurs.
6540	A SpO_2 informational report occurs.
6570	A SpO_2 warmer error occurs.
7500	A report that the system time cannot be corrected by adding a skew, after which a software fault is signaled.

Chapter 7
Illustrated Parts Breakdown

7.1 Summary of Warnings and Cautions

WARNING

- **Use only BD approved parts when performing corrective maintenance or repairs. Use of third-party parts can affect the safety and efficacy of the BD Alaris™ and Alaris™ devices, leading to risk of device failure, patient injury, or even death.**

- **Use BD manufactured parts in the operation and maintenance of your BD equipment. Use of repair or service parts, accessories, or syringes, dedicated infusion sets, or disposables that are not approved by BD is at customer's own risk and could exposed patients to risk of device failure, injury, or even death. In addition, use of such parts, accessories, or disposables may void the product warranty provided by BD.**

7.2 Introduction

The illustrated parts breakdown is divided into major assemblies and individual parts.

BD Alaris™ refers to PCUs and Pump Modules that have these visual characteristics. BD Alaris™ also refers to all hardware components unique to these devices.

7.2.1 Expected Service Life

WARNING

Use only BD approved parts when performing corrective maintenance or repairs. Use of third-party parts can affect the safety and efficacy of the BD Alaris™ and Alaris™ devices, leading to risk of device failure, patient injury, or even death.

The BD Alaris™ System has been tested for a seven year serviceable life. There are some components which experience wear, and are expected to need periodic attention and replacement within that serviceable life. Examples of these components include:

- PCU Battery
- Pump Module Membrane Frame Seal
- IUI Connectors

NOTE:
The seven year serviceable life applies to the following hardware configurations:

- BD Alaris™ PCU
- BD Alaris™ Pump Module

- BD Alaris™ Syringe Module
- Alaris™ PCA Module
- BD Alaris™ $EtCO_2$ Module

WARNING

Use BD manufactured parts in the operation and maintenance of your BD equipment. Use of repair or service parts, accessories, or syringes, dedicated infusion sets, or disposables that are not approved by BD is at customer's own risk and could exposed patients to risk of device failure, injury, or even death. In addition, use of such parts, accessories, or disposables may void the product warranty provided by BD.

NOTE:
Any 510(k) clearance from the Food and Drug Administration (FDA) or regulatory approval secured by BD to market the BD Alaris™ System was based on use of BD manufactured parts and equipment and BD validated and authorized disposables. A list of BD approved disposables that are validated to be compatible with the BD Alaris™ System is provided in the BD Alaris™ System user manual. BD has not validated any non-BD parts or accessories for the maintenance, repair or operation of the BD Alaris™ System and Alaris™ System Products. Because unauthorized parts and accessories were not included in the review and approval/clearance of the products, their use may adulterate and misbrand the product in violation of applicable laws.

7.3 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 with the item number on the parts list. If a part/assembly is not identified with an item number, it is available only as part of a higher assembly or kit.

Due to product changes over time, components/assemblies illustrated in this chapter may differ from the instrument being serviced.

7.4 Parts List

The parts list provides the following information for salable parts and assemblies:

- **Item:** This number corresponds with the callout number in the parts illustration.
- **Part Number:** This is the BD Alaris™ product number needed when placing an order.

  When a part number is not provided, that part is either not sold by BD, is provided as part of a kit or higher assembly, or can only be replaced or repaired by BD-authorized service personnel.
- **Description:** Descriptive information that may be helpful when placing an order.
- **QTY:** Total number of each item used.

7.5 Ordering Parts

Parts can be ordered by writing or calling BD Customer Service. (See the contact information at beginning of this manual.) When requesting a part, provide the following information:

- Product name and model number (for example, PCU, model 8015).
- Instrument software version. Refer to the *BD Alaris™ System with Guardrails™ Suite MX User Manual* for directions on how to view the software version.
- Part number.
- Part description, as provided in the parts list.

NOTE:
An “assembly” is a group of preassembled parts. A “kit” is a group of unassembled parts.

Table 7-1: Parts List - Model 8015

Item	Part Number	Description	QTY
002	TC10003916	Board Assembly, External Communications	1
011		Backlight Cable	1
	TC10006494	Older version	
	TC10008708	Newer version	
012	49000860	Kit, BD Alaris™ Wireless Assembly, 802.11 a/c, v12.3.1 and higher	1
018	TC10013789	BD Alaris™ Front Case / Keypad Assembly	1
020	TC10007990	Display Retainer (upper) (for 5.7" display measured diagonally)	1
022	12277151	Ground Clip (Ground Plate)	1
024	TC10006177	Display Flex Cable (for 5.7" Display measured diagonally)	1
030	10012918	Screw, 2 x 5/16, PHL PNH	2
031	321033	Screw, 6-32 x 7/16, PHL PNH	4
032	300345	Screw, 4-40 x 1/4, PHL PNH (zinc-plated steel)	6
050	Battery_Kit	BD Alaris™ Battery Pack Assembly, NIMH	1
085	145442-000	Shaft, Handle	1
088	806200	O-Ring, Handle Shaft	2
110	TC10008306	Rear Panel, RS-232 Assembly	1
113	147466-000	Gasket, RS-232 Assembly Rear Panel	1
120	TC10004047	SIO Board Assembly, (Isolated RS-232)	1
121	TC10010985	BD Alaris™ Gasket Strip, Rear Panel, Model 8015 (part of item 2027) (not interchangeable with older parts)	1
122	TC10004232	Switch Assembly, Tamper, Model 8015	1

Table 7-1: Parts List - Model 8015 (Continued)

Item	Part Number	Description	QTY
124	TC10010831	BD Alaris™ Plug, RJ45 Connector (not interchangeable with older parts)	1
125	TC10006640	Speaker	1
127	320937	Boot Seal, Tamper Switch	1
128	147780-000	Shroud, Tamper Switch	1
130	TC10011133	BD Alaris™ Rear Panel, a/c	1
131	TC10003665	Gasket, Rear Panel (for the Model 8015 Communications Board Panel)	1
133	148124-000	Gasket, Rear Panel	1
134	147744-001	Bracket, Speaker Retaining	1
135	300045	Nut, Kep 4-40	3
138	320911	Washer, Shoulder (RJ45 Connector Plug)	1
140	TC10010820	BD Alaris™ Retainer, Power Cord (not interchangeable with older parts)	1
150	834031	Cable Tie, 4" Auto Feed	4
155	304297	Cable Tie Mount	1
160	H0000249	BD Alaris™ Pole Clamp (one-piece assembly) (part of item 2010)	1
186	143360-000	Pole Clamp Gasket (part of item 2000)	1
195	320840	Standoff, 4-40 x $^{3}/_{16}$ Hex, F-F, ½"	5
210	TC10013054	Board Assembly, Left IUI	1
215	146735-000	Ground Strap	1
220	TC10013065	Board Assembly, Right IUI	1
230	TC10018763	Board Assembly, Logic, Model 8015 (for 5.7" display measured diagonally)	1
		NOTE: If the memory card is glued on the logic board, it can no longer be replaced on the logic board and you will need to order a new logic board.	
240	TC10013069	Power Supply Board Assembly	1
245	TC10008305	Plate, Ground 8015	1
280	146500-100	AC Filter Assembly	1
285	320140-020	Fuse, 2.0 Amp, Slow Blow, Melting Point (I^2t (A^2) = 14.450	2
304	143359-100	Harness Assembly, Battery Discharge	1
320	TC10003316	Harness Assembly, Battery Connector	1
363	320167	Washer, Flat, 0.125 x 0.312 x 0.032 Thick	1

Table 7-1: Parts List - Model 8015 (Continued)

Item	Part Number	Description	QTY
375	144424-100	LED Assembly, Keypad Backlight	1
432	806112	Snap Rivet, 0.125 Diameter, Black Nylon	2
468	146574-100	Harness Assembly, DC Output	1
470	H0000082	Power Supply, Switching	1
472	TC10011035	Power Cord, North America	1
473	980-1015-1	Wrap Assembly, Power Cord	1
474	809061	Snap, Eyelet Stud (Brass)	1
476	305316	Washer, #4 Internal Tooth Locking	1
600	P00000769	Serial Number Replacement Label	1
620	P00000768	Label, Ground Symbol (part of item 2007)	1
630	144350-000	Label, Battery Identification (part of item 2007)	1
635	144351-000	Label, Fuse Rating (part of item 2007)	1
645	10916654 P00000248	Label, Keypad Lockout/RS-232 (part of item 2007) BD Alaris™ Label, Keypad Lockout/RS-232 (part of item 2007) (not interchangeable with older parts)	1
665	P00000244	BD Alaris™ Label, Power Cord Retainer (part of item 2007) (not interchangeable with older parts)	1
670	P00000405	All Patent Label	1
800	10818224	Screw, 6-32 x ¼, PHL PNH	2
805	320856	Screw, 6-32 x $2\frac{3}{8}$, PHL PNH	2
810	304319	Screw, 4-40 x ¼, PHL PNH (stainless steel),	10
815	320853	Screw, 4-40 x ½, PHL FLH	4
825	320851	Screw, 4-40 x $\frac{5}{16}$, PHL PNH	4
826	300346	Screw, 4-40 x ½, PHL PNH	9
827	304576	Screw, 4-40 x ½, TRH PHL	7
830	320855	Screw, 6-32 x $\frac{7}{16}$, PHL PNH	8
833	320908	Washer, Flat, 0.146 x 0.27 x 0.03 Thick	6
835	TC10006429	Screw, 8-32 x $\frac{5}{8}$, Hex	4
840	320169	Screw, ¼-20 x ½ Cap	1
842	12276773	Ground Plate Screw, 4-40 x $\frac{9}{16}$ 6-Lobe, PNH	7
843	803215	Washer, Split Lock	1
844	803204	Washer, Internal Tooth Locking	1

Table 7-1: Parts List - Model 8015 (Continued)

Item	Part Number	Description	QTY
845	H0000063	Screw, 10-32 x 0.37	1
847	147765-000	Gasket, Lower Rear Case	11
848	320086	Fuse Block, 3.5A 125V SMD3820 (F1)	1
2000	49000220	8015 RoHS Pole Clamp Mounting Plate Kit (Consists of: items 170 (Pole Clamp Mounting Plate), 186 (Pole Clamp Gasket), and 835 8-32 x 5/8, Hex Screw)	1
2001	147075-100	Backup Speaker / Gasket Kit	1
2003	49000553	IUI Connector / Gasket Kit, Right	1
2004	147078-100	IUI Connector / Seal Kit, Left	1
2005	49000311	LCD Display Assembly	1
2006	49000432	Latch Kit, Module (Consists of: Compression Spring, Latch, Leaf Spring, and Support)	1
2008	49000223	RoHS Hardware / Parts Kit (Consists of the various quantities of the most commonly used parts and hardware.)	1
2009	147093-100	Silicone Tubing (10 Feet) (This length of tubing is enough for four PCUs.)	1
2010	H0000249	BD Alaris™ Pole Clamp Assembly (One-piece assembly)	1
2011	49000224	PCU RoHS Support Frame Assembly Kit, Left (Consists of: Fuse Rating Label, Line Filter Gasket, Left Support Frame Assembly, and item 835 (8-32 x 5/8, Hex Screw). All the items are assembled, except for item 835 (8-32 x 5/8, Hex Screw).)	1
2025	49000433	BD Alaris™ Handle Kit (not interchangeable with older parts)	1
2027	49000435	BD Alaris™ Gasket Kit, Rear Case	1
2028	10016082	Pole Clamp Plate Screws (qty. 8) Kit	1
2029	49000216	PCU RoHS Support Frame Assembly Kit, Right: (Consists of: Cable Tie Mount, Dielectric Insulator, Ground Symbol Label, Right Support Frame Assembly, and item 835 (8-32 x 5/8, Hex Screw). All the items are assembled except for item 835 (8-32 x 5/8, Hex Screw).	1
2031	10016038	Kit, Rear Panel / Gaskets Assembly	1
8043	49000888	BD Alaris™ Rear Case Assembly Kit, 4th Edition PCU, Model 8015, manufactured at v9.33, v12.x or higher (Not interchangeable with older parts)	1
	49000546	KIT ASM v12.5.0 8975 Alaris™ System Maintenance or BD Alaris™ System Maintenance software kit, Model 8975 (includes the BD Alaris™ System Maintenance or Alaris™ System Maintenance software CD, user manual, and serial cable)	

Table 7-1: Parts List - Model 8015 (Continued)

Item	Part Number	Description	QTY
	49000871	Point-of-Care Software Kit, Models 8955/8990 V12.3.1 (includes the software CD, serial cable, and upgrade instructions for both the RF card and Point-of-Care software)	
	49000691	Guardrails™ Editor Software Kit, Model 8961 V12.1.3 (includes the software CD, user manual, and serial cable)	
	P00000590	Quick Reference Guide (Hang Tags) v12 (8015/8100)	
	49000883	BD Alaris™ System user manual kit V12.3.1 printed copy	
	49000546	BD Alaris™ System Maintenance software user manual V12.5.0	
	P00000375	BD Alaris™ Systems Manager user manual V12.5.0	
	P00000602	Software Upgrade Instructions - BD Alaris™ PCU, Model 8015 V12.3.1 (available as part of the applicable Point-of-Care Software Kit)	

① Not sold by BD.

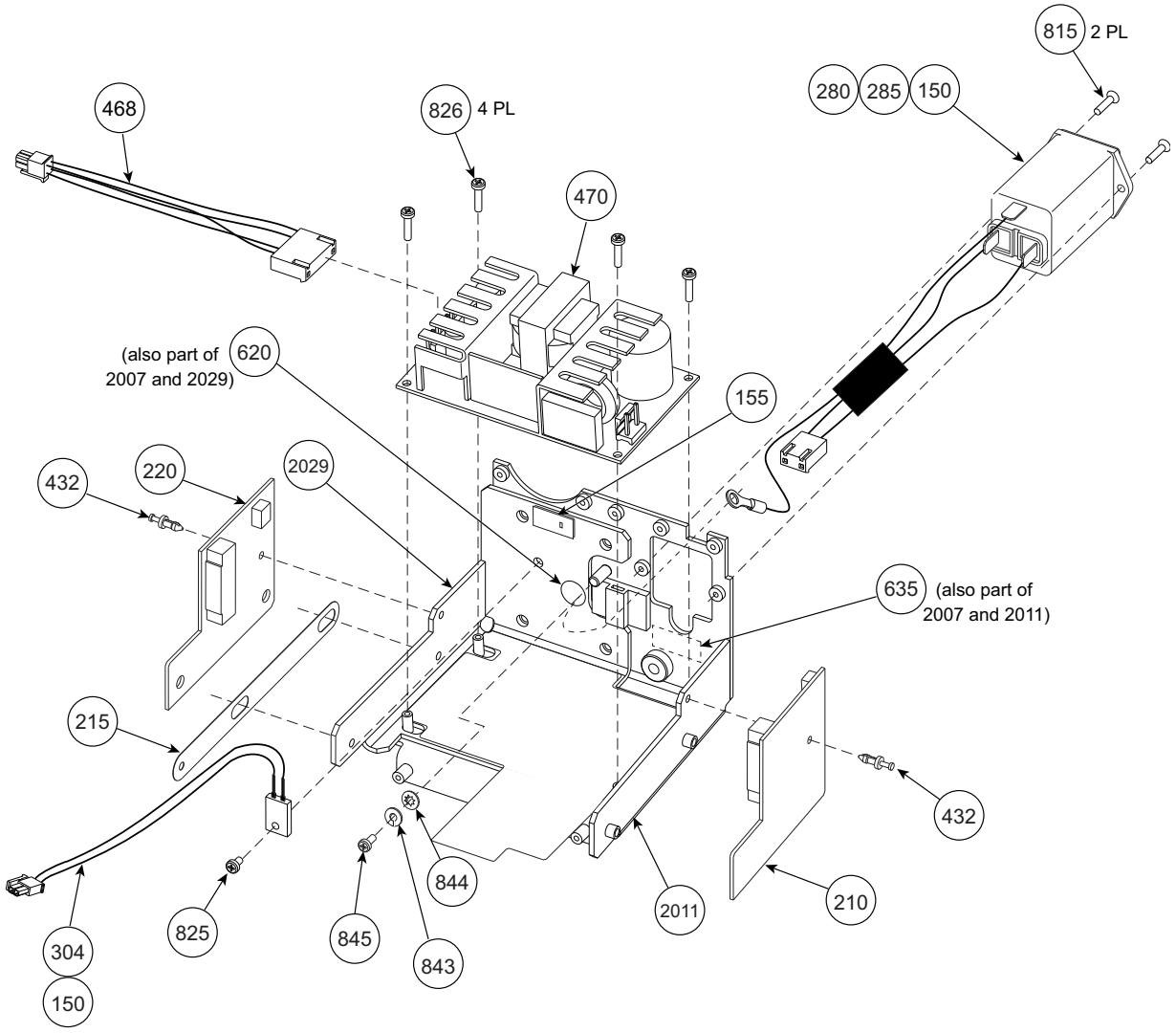


Figure 7-1. Model 8015 - Chassis Assembly

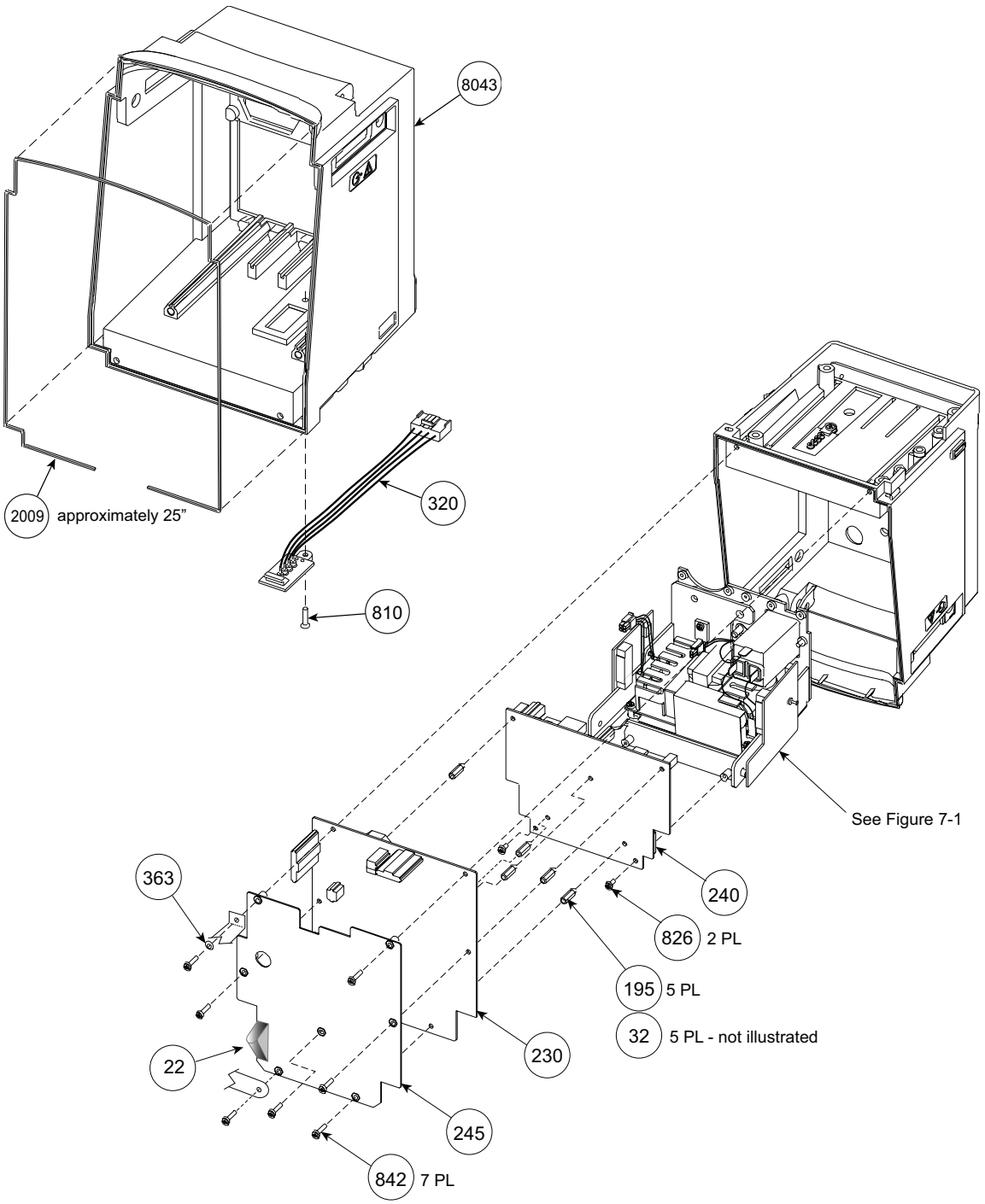


Figure 7-2. Model 8015 - Rear Case Assembly

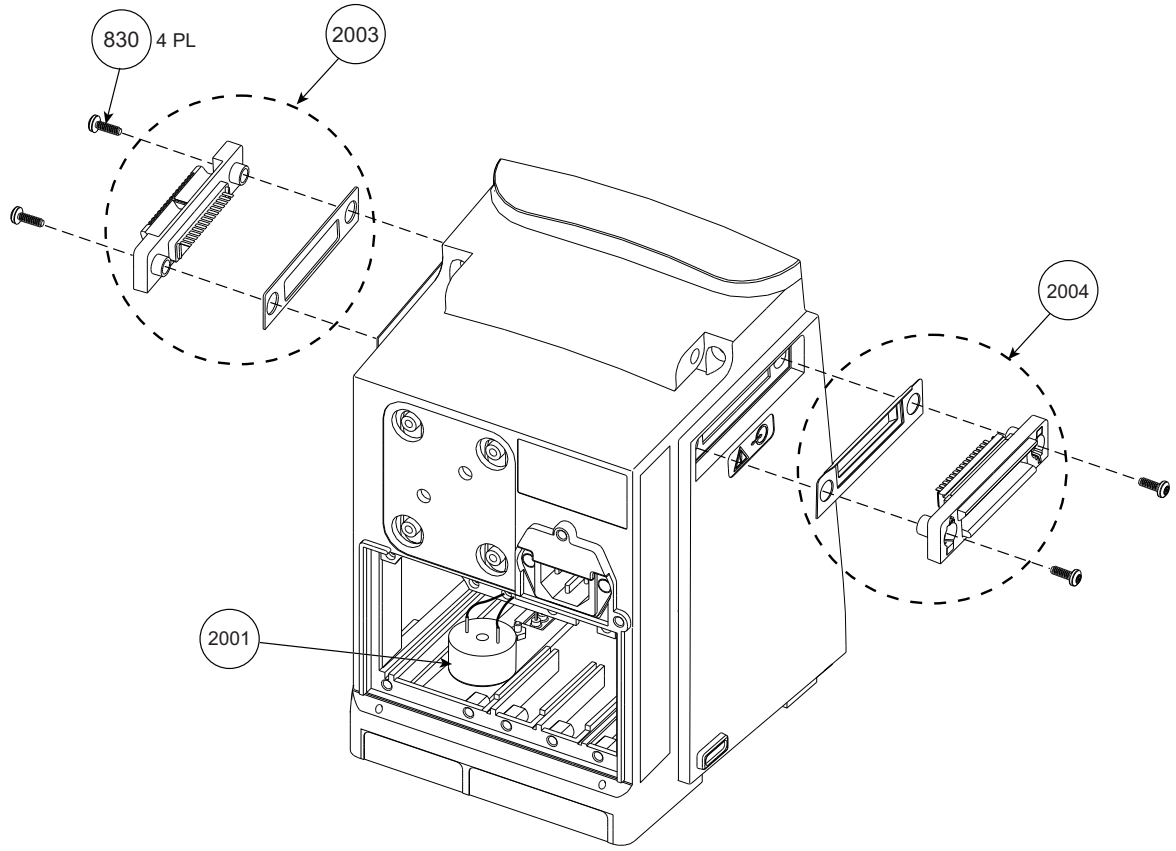


Figure 7-3. Model 8015 - IUI Connectors and Backup Speaker

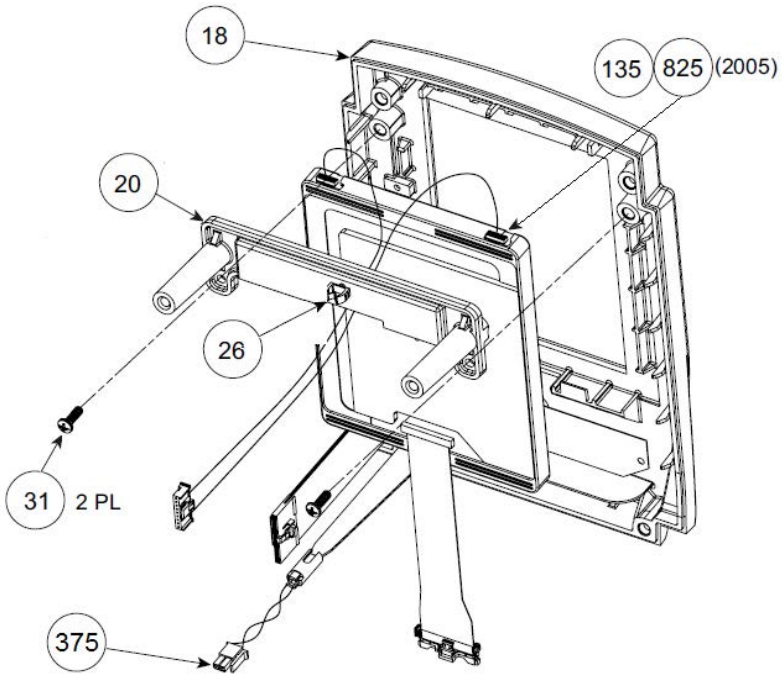


Figure 7-4. Model 8015 - LED Display Assembly

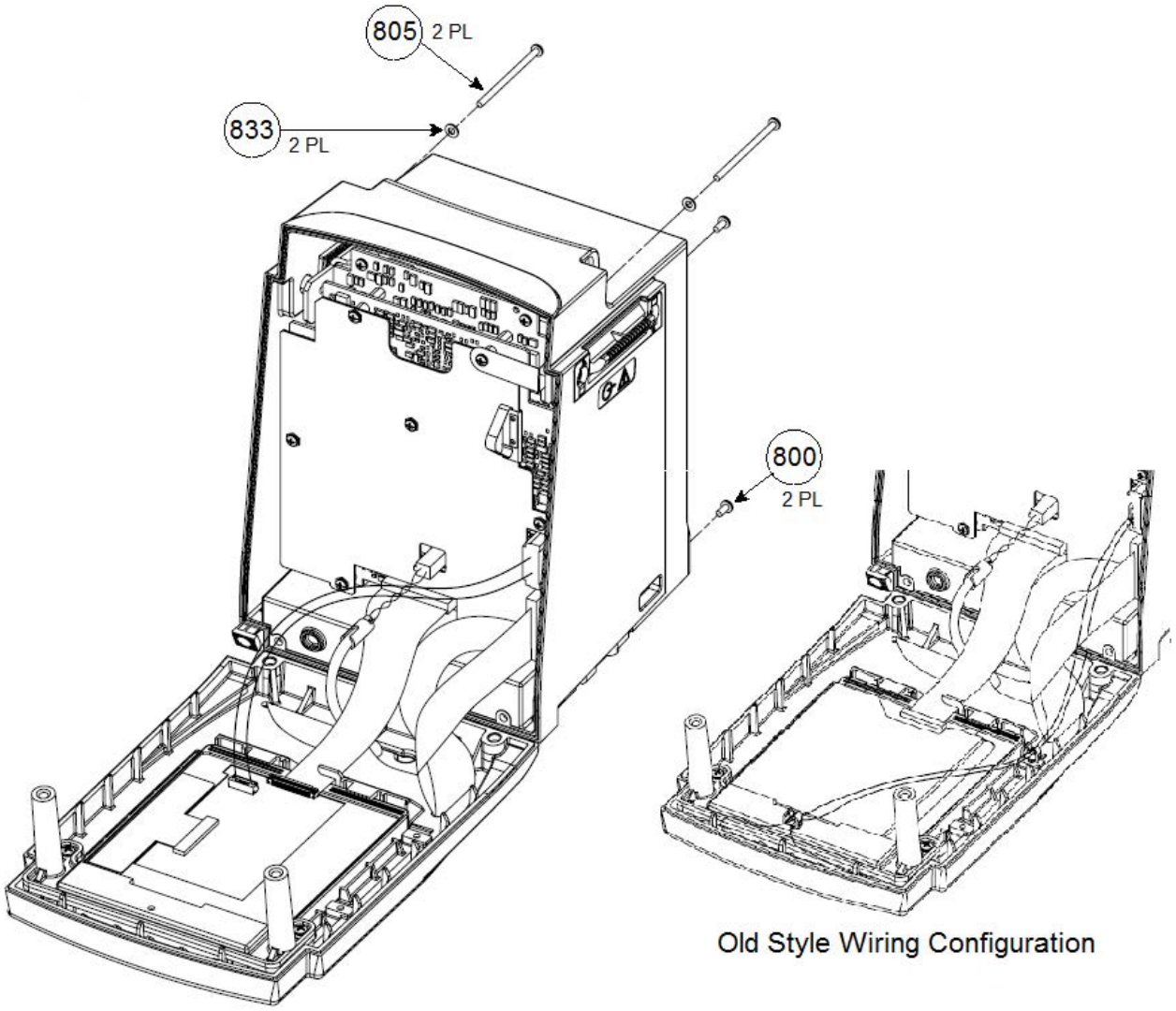


Figure 7-5. Model 8015 - Front to Rear Case Assembly

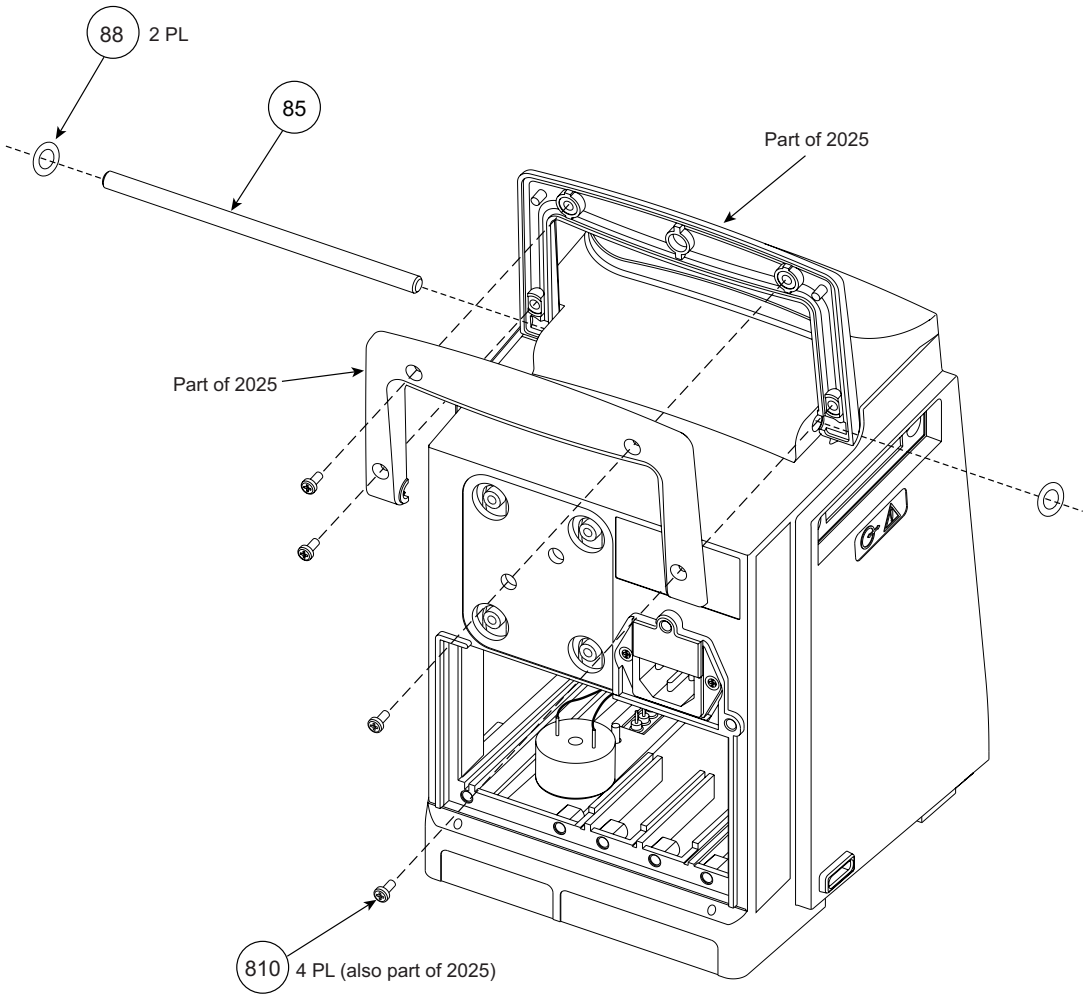


Figure 7-6. Model 8015 - Handle Assembly

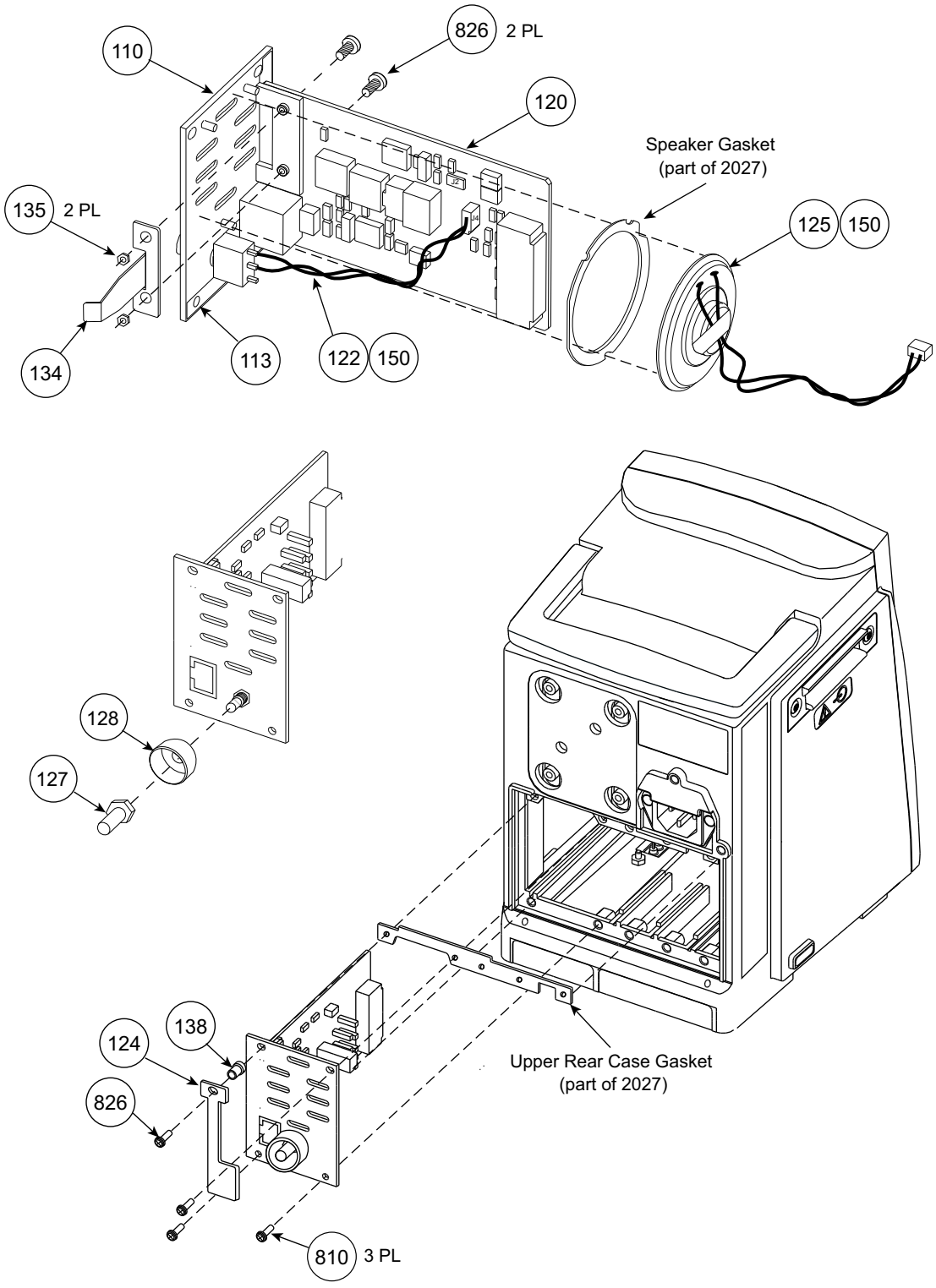


Figure 7-7. Model 8015 - Rear Panel Assembly

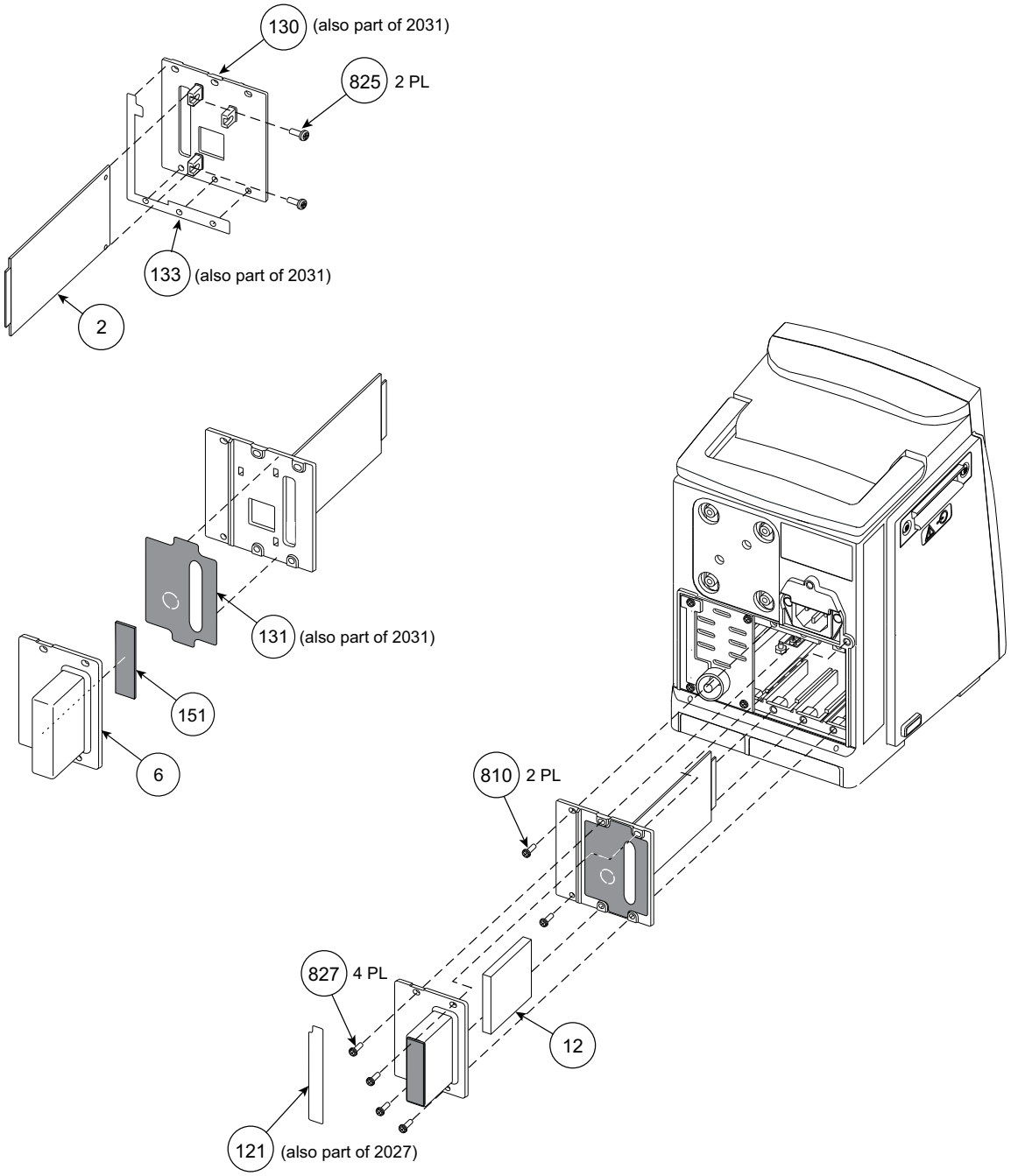
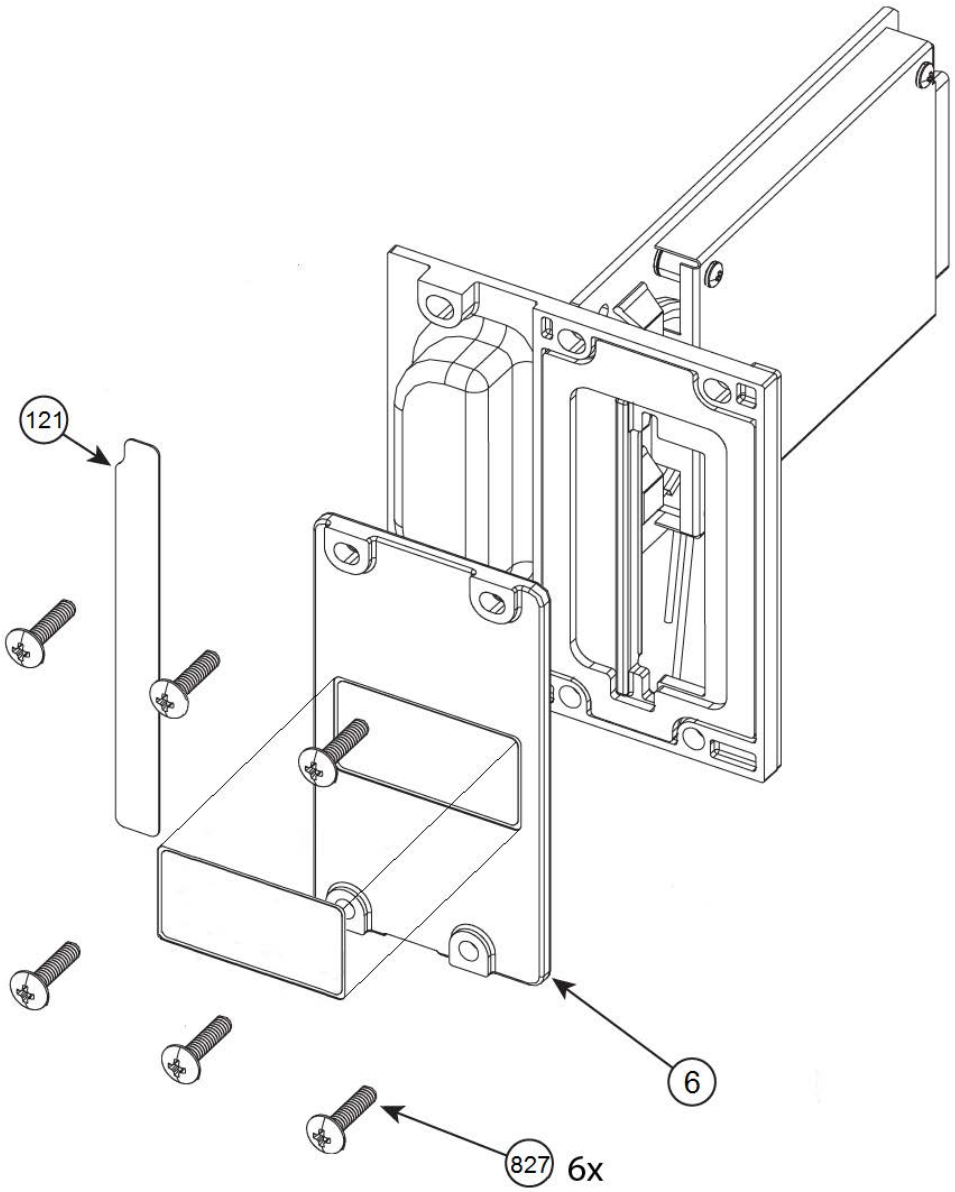


Figure 7-8. Model 8015 - Wireless Network Assembly



Model 8015 - Wireless Network Assembly (Continued)

Wireless cards 802.11 a/c

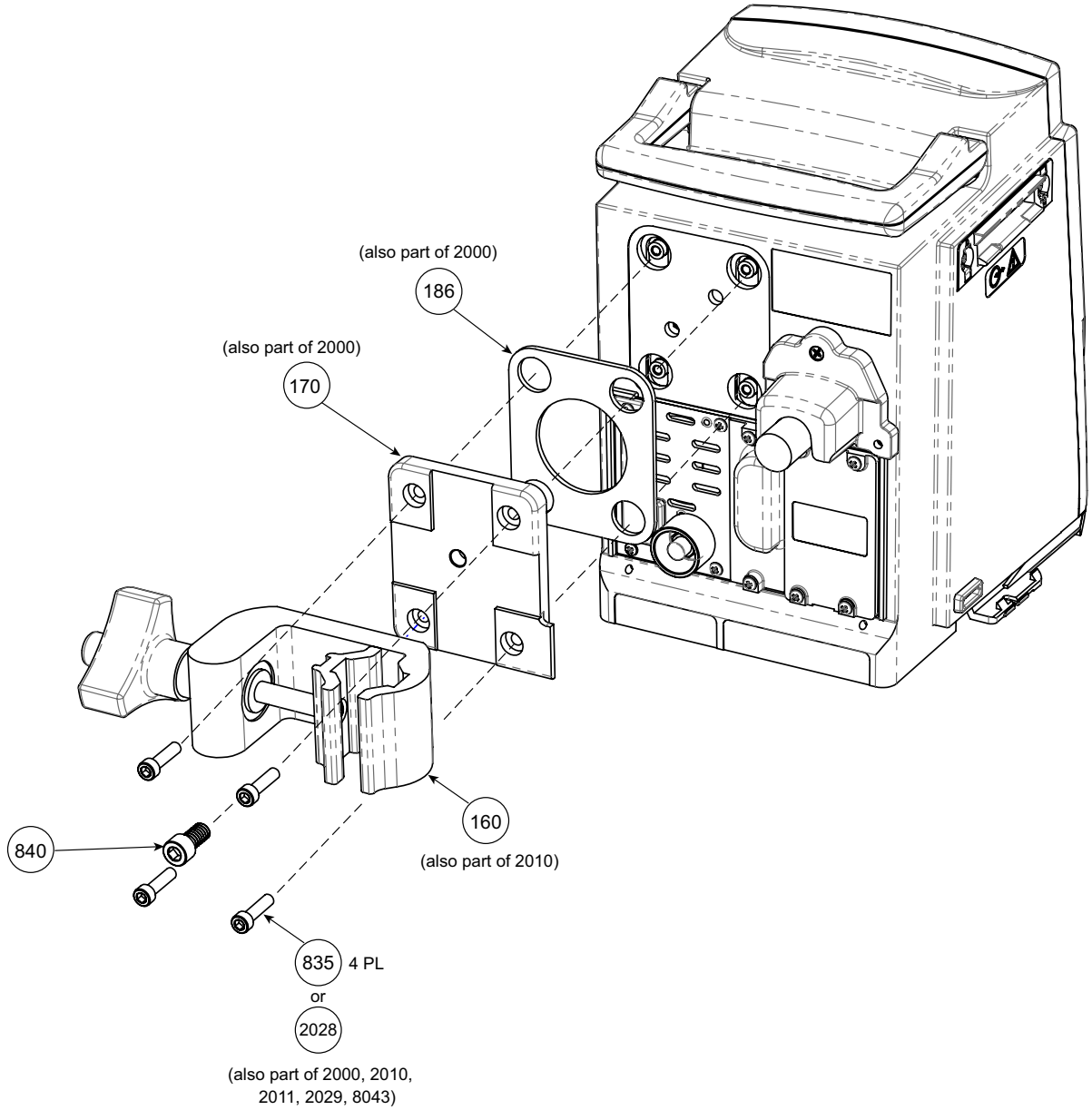


Figure 7-9. Model 8015 - BD Alaris™ Pole Clamp Assembly

1 The nameplate label, which has a regulatory mark, is not field replaceable as an individual item. It is available only as part of the Rear Case Assembly Kit (item 8043).

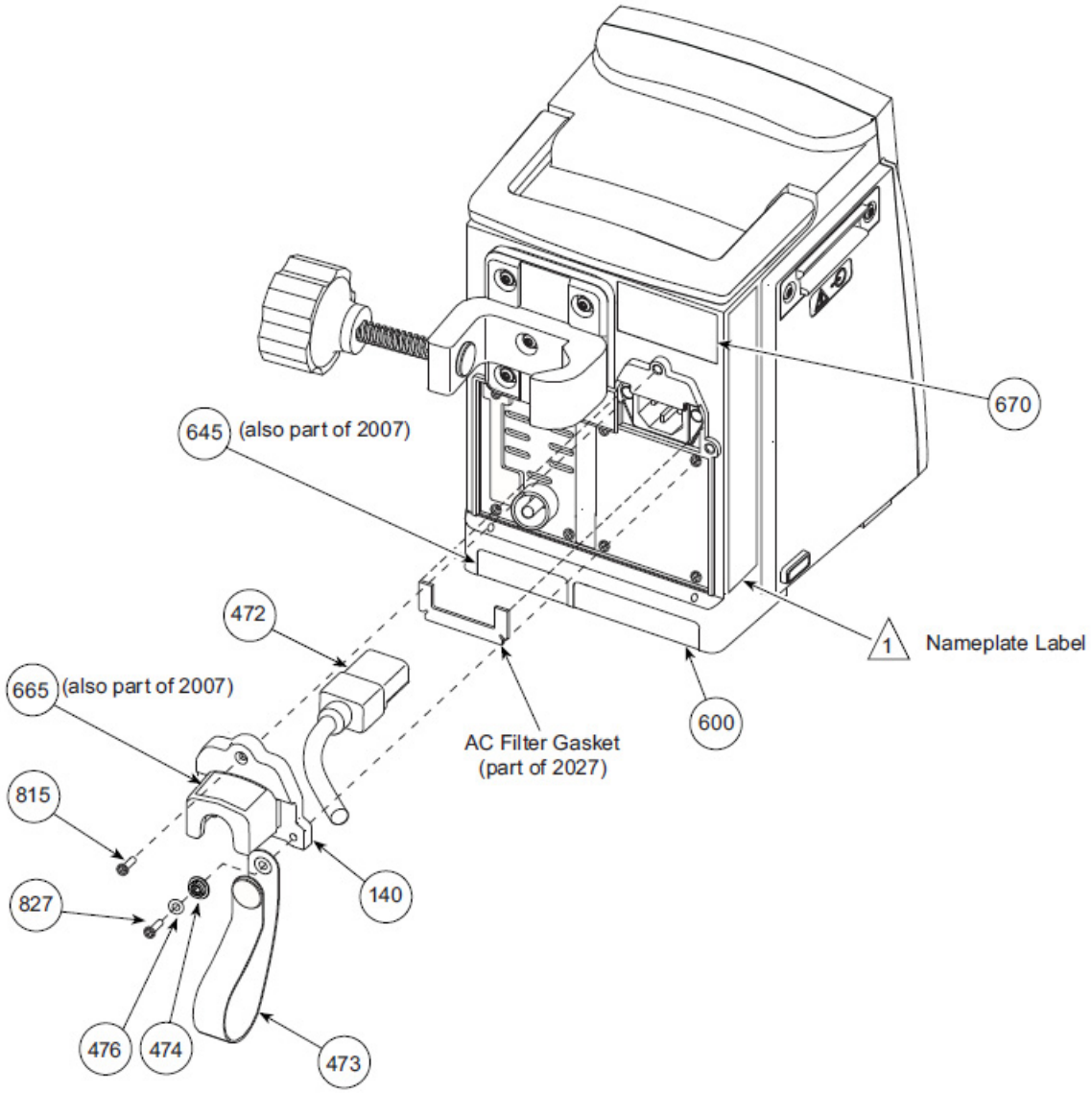


Figure 7-10. Model 8015 - Power Cord Assembly and Labels

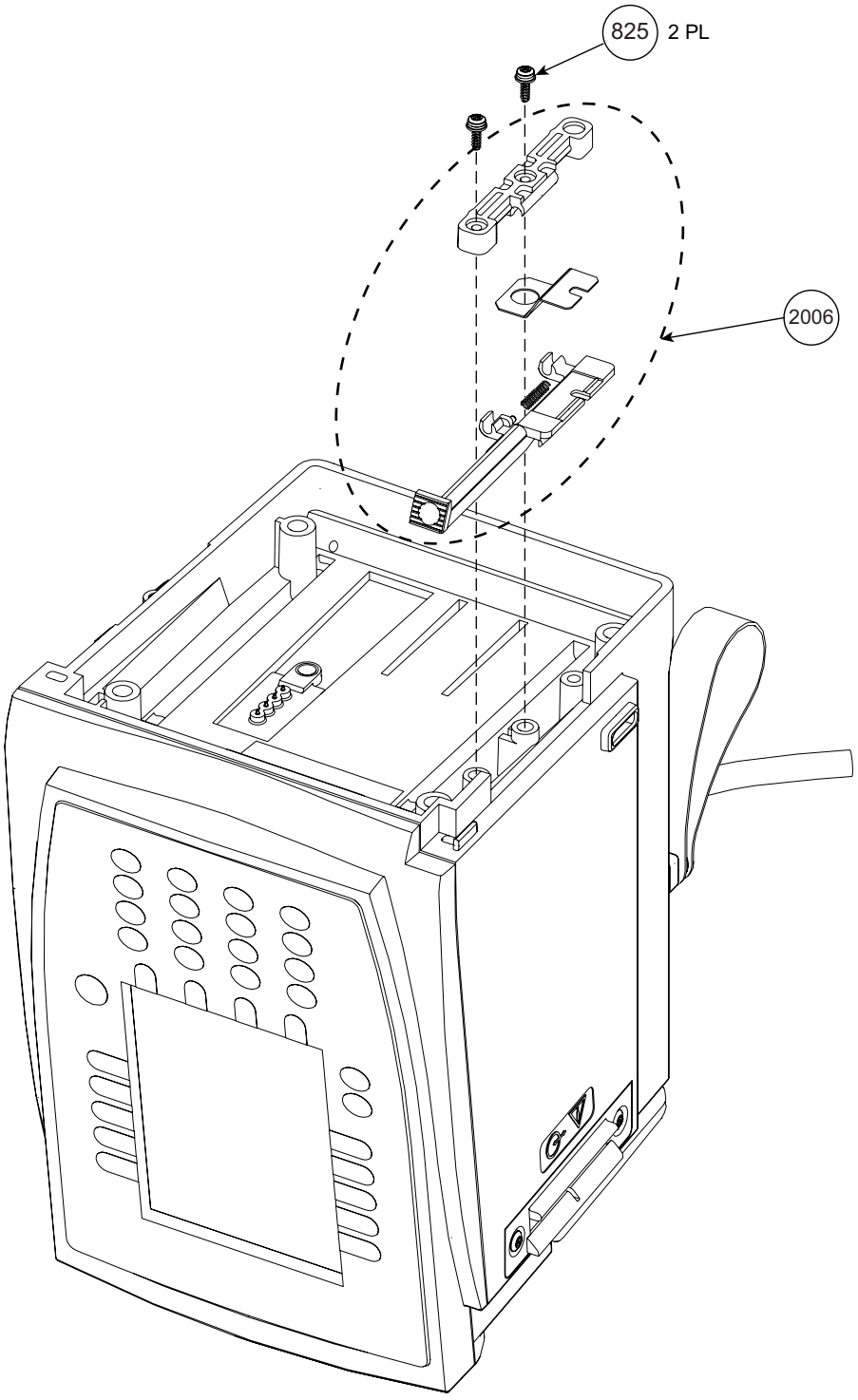


Figure 7-11. Model 8015 - Latch Assembly

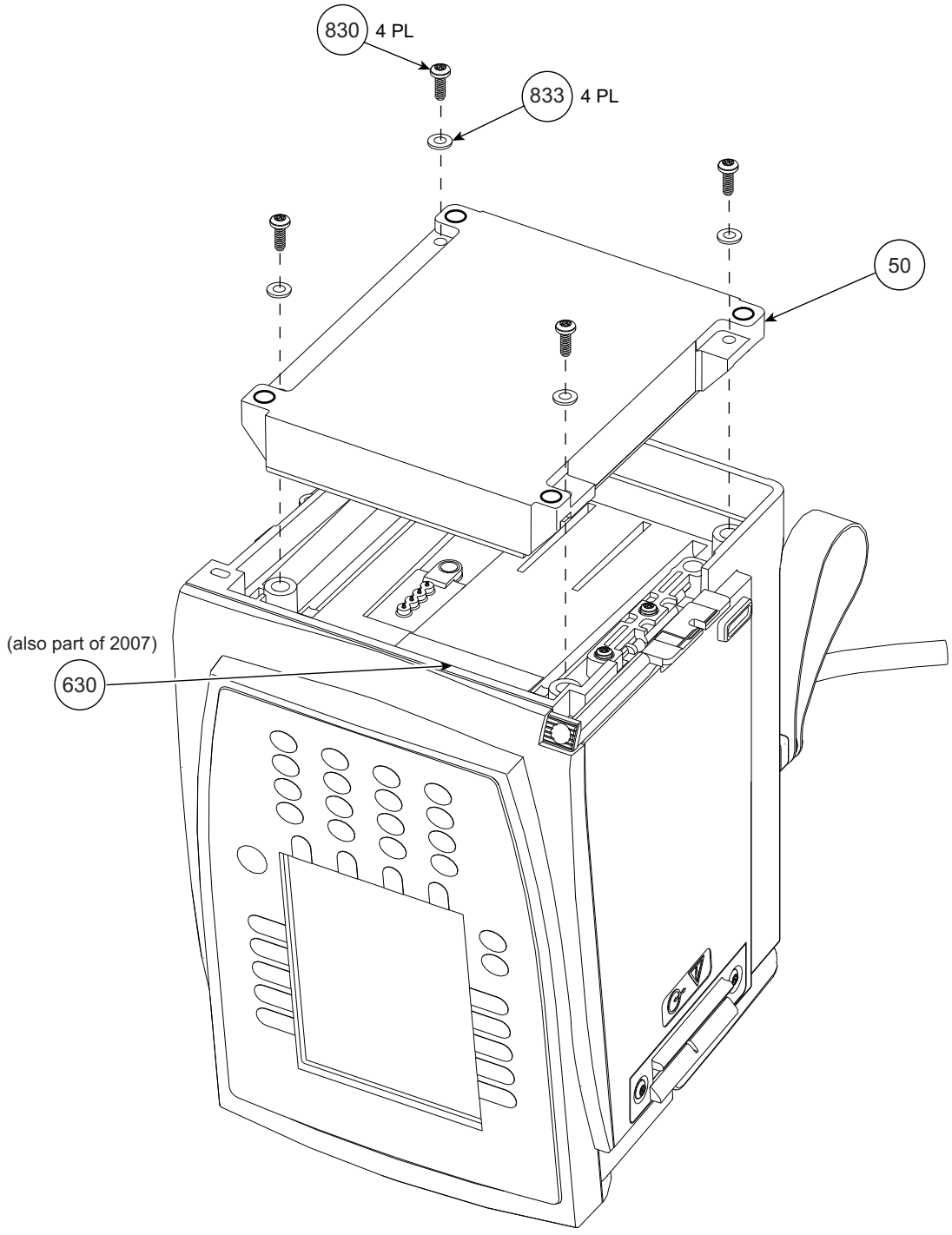


Figure 7-12. Model 8015 - Battery Pack Assembly

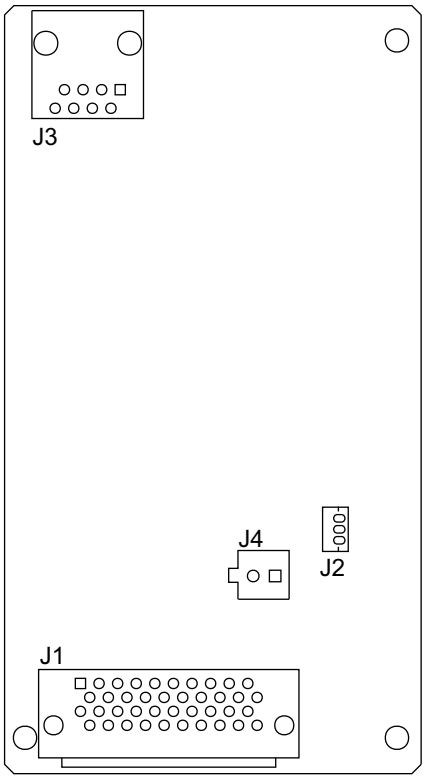


Figure 7-13. Model 8015 - Isolated RS-232 Board

This illustration is for board identification purposes only and does not represent the board's component layout.

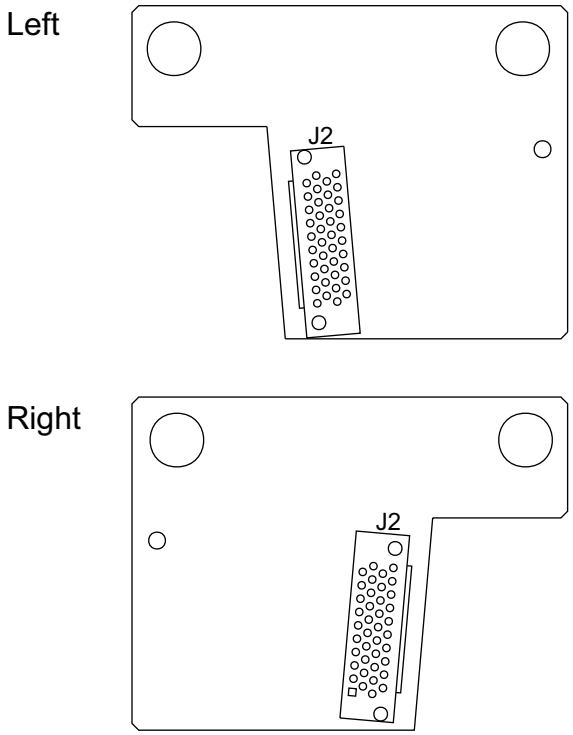


Figure 7-14. Model 8015 - IUI Boards

This illustration is for board identification purposes only and does not represent the board's component layout.

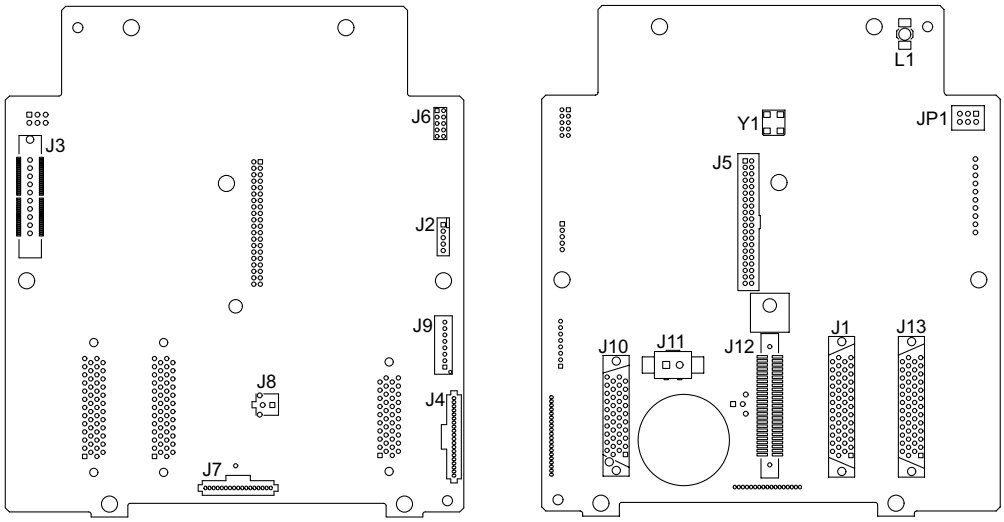
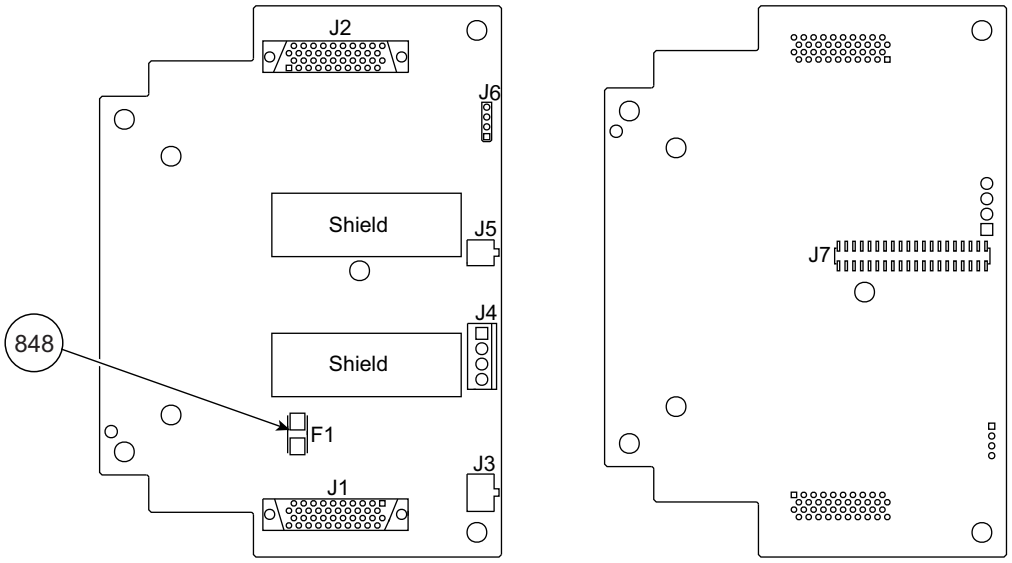


Figure 7-15. Model 8015 - Logic Board

This illustration is for board identification purposes only and does not represent the board's component layout.



When replacing a power supply board, ensure that the replacement board is shielded (as illustrated above).

Figure 7-16. Model 8015 - Power Supply Board

This illustration is for board identification purposes only and does not represent the board's component layout.

NOTE:
An "assembly" is a group of preassembled parts. A "kit" is a group of unassembled parts.

Table 7-2. Parts List - Model 8100

Item	Part Number	Description	QTY
018	142794-000	Foot Rubber	2
221	49000250	Latch Pivot, Screw	1
261	TC10009521	O-Ring, 0.859 x 0.139, 40 Durometer	1
280	TC10009523	Motor Mount Rubber	1
370	TC10010832	BD Alaris™ Door Cover	1
410	TC10008713	IUI Bracket	1
412	TC10017344	Board Assembly, Display	1
414	806112	Snap Rivet, 0.125 Diameter, Black Nylon	4
420	320129	Ribbon Cable, 50-Pin Dual Assembly	1
421	320789	Standoff, 3/16 Hex, 4-40, F-F, 1.67"	1
422	TC10013114	Board Assembly, Motor Controller ①	1
423	148035-001	Retainer Clip, Ribbon Cable	2
442	TC10010839	BD Alaris™ Membrane Frame Assembly	1
443	321112	Retainer Clip, 5-pin (logic board J8 Connection)	1
444	146332-100	Harness Assembly, Pressure Transducer	1
445	320729	Washer, Flat #5	1
451	320907	Torsion Spring, Door Latch	1
470	49000442	BD Alaris™ Board Assembly, Logic	1
480	143404-000	Torsion Bearing	1
482	146465-001	Motor Assembly (new style connector)	1
525	142815-000	Gasket, AIL Sensor Assembly	1
600	125569	Serial Number Replacement Label	1
643	P00000405	All Patent Label	1
750	49000540	Pressure Sensor Assembly	1
800	320851	Screw, 4-40 x 5/16, PHL PNH	2
815	320849	Screw, 4-40 x 3/16, PHL PNH	1
825	320850	Screw, 4-40 x 3/8, PHL PNH	4
830	320855	Screw, 6-32 x 7/16, PHL PNH	6
831	304319	Screw, 4-40 x 1/4, PHL PNH (stainless steel)	3
832	320848	Screw, 4-40 x 3/16, PHL Truss Head	4

Table 7-2. Parts List - Model 8100 (Continued)

Item	Part Number	Description	QTY
833	320908	Washer, Flat, 0.146 x 0.27 x 0.03 Thick	1
2000	147082-100	Hardware / Parts Kit (Consists of various quantities of the most commonly used parts and hardware.)	1
2001	49000355	Air-in-Line (AIL) Sensor Assembly / Gasket Kit, 8100 RoHS	1
2002	147093-100	Silicone Tubing (10 Feet) (This length of tubing is enough for three pump modules.)	
2003	49000441	BD Alaris™ Door Latch Kit, 8100BD	1
2004	49000439	BD Alaris™ Door/Keypad Assembly Kit, 8100BD	1
2005	147087-100	Pinion Gear / Coupling Assembly	1
2007	49000437	BD Alaris™ Bezel Assembly Kit	1
2015	49000440	BD Alaris™ Platen / Spring Hinge Assembly	1
2104	49000436	BD Alaris™ Rear Case Assembly, Pump Module, Model 8100 manufactured at v9.33, v12.x or higher	
2105	49000432	Latch Kit, Module (Consists of: Compression Spring, Latch, Leaf Spring, and Support)	1
2106	320079	Fuse Block, 0.75A 125V (F1)	1
2107	49000553	IUI Connector / Gasket Kit, Right	1
2108	147078-100	IUI Connector / Seal Kit, Left	1
2128	49000396	Kit 8100 Sear	

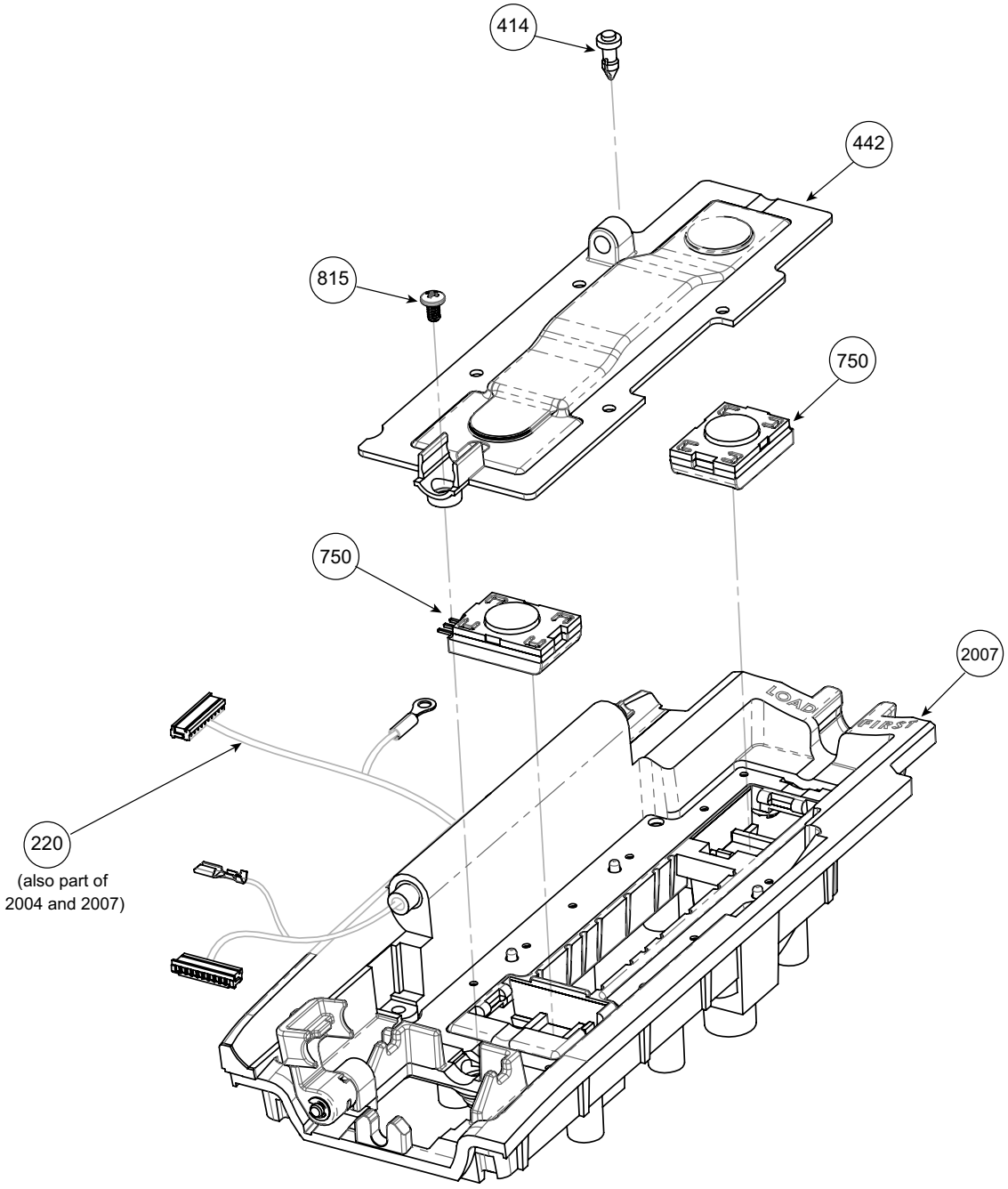


Figure 7-17. Model 8100 - BD Alaris™ Membrane to Bezel Assembly

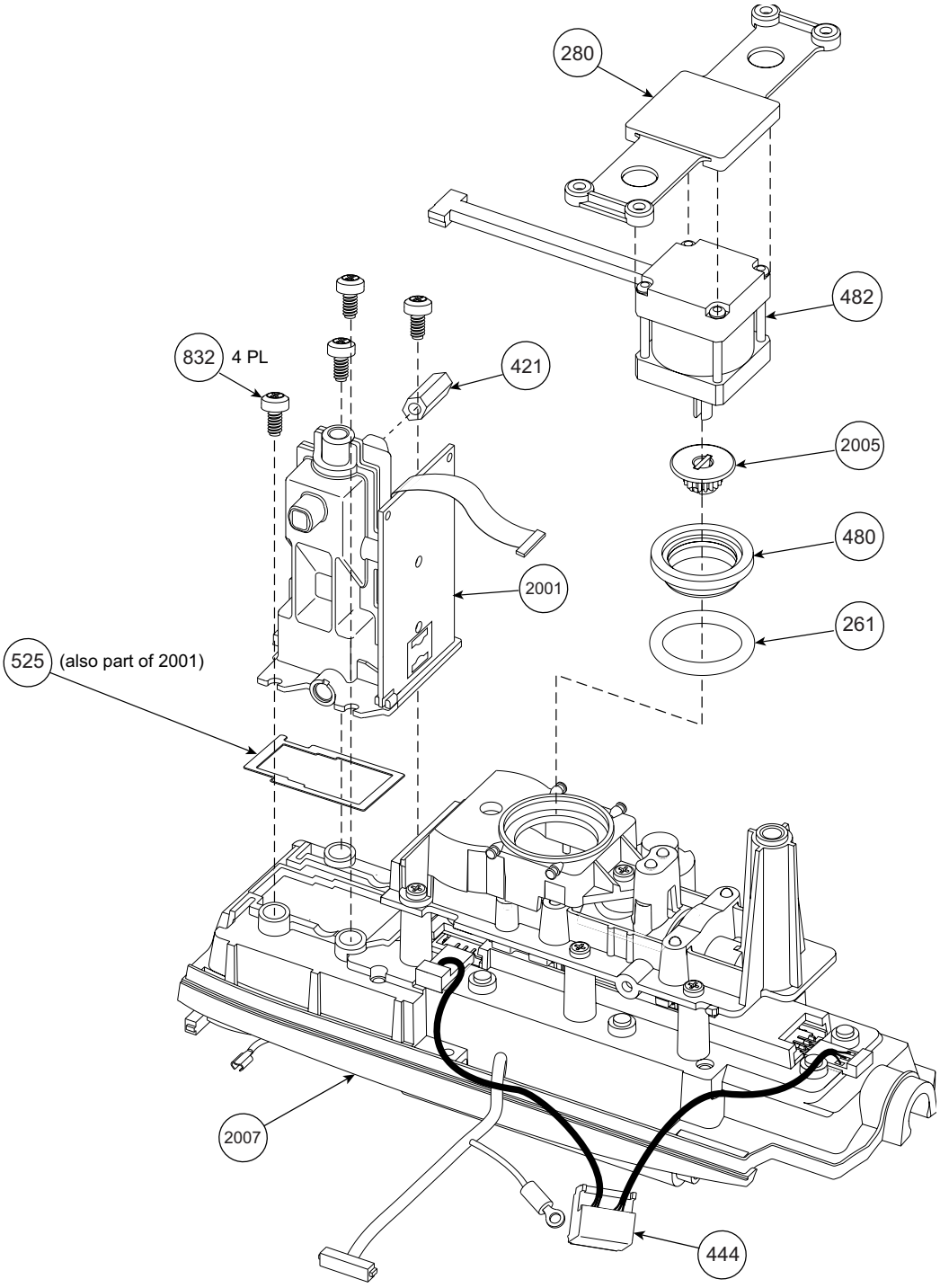


Figure 7-18. Model 8100 - Motor and AIL Sensor Assembly

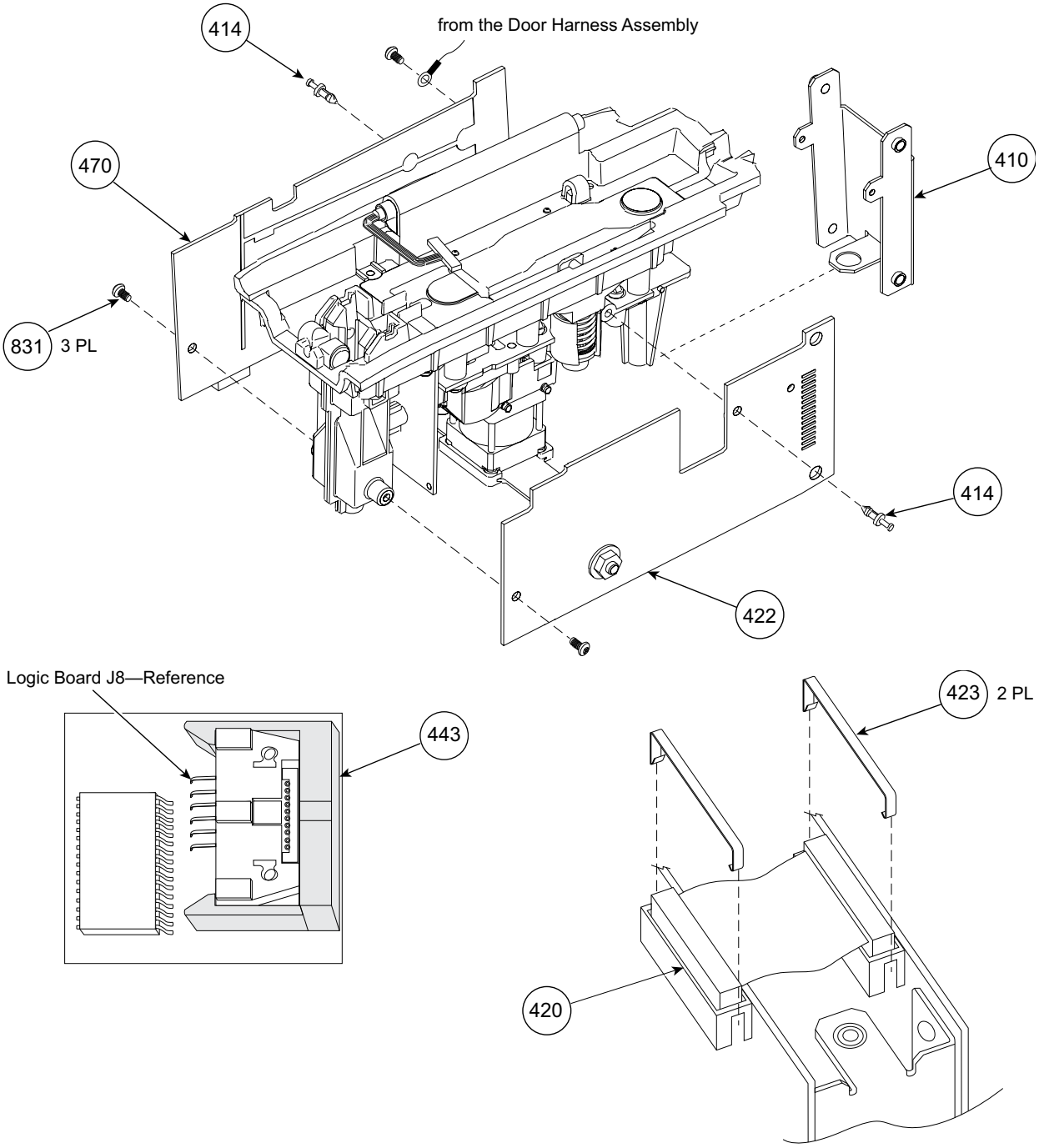


Figure 7-19. Model 8100 - Logic Board and Motor Controller Board Assembly

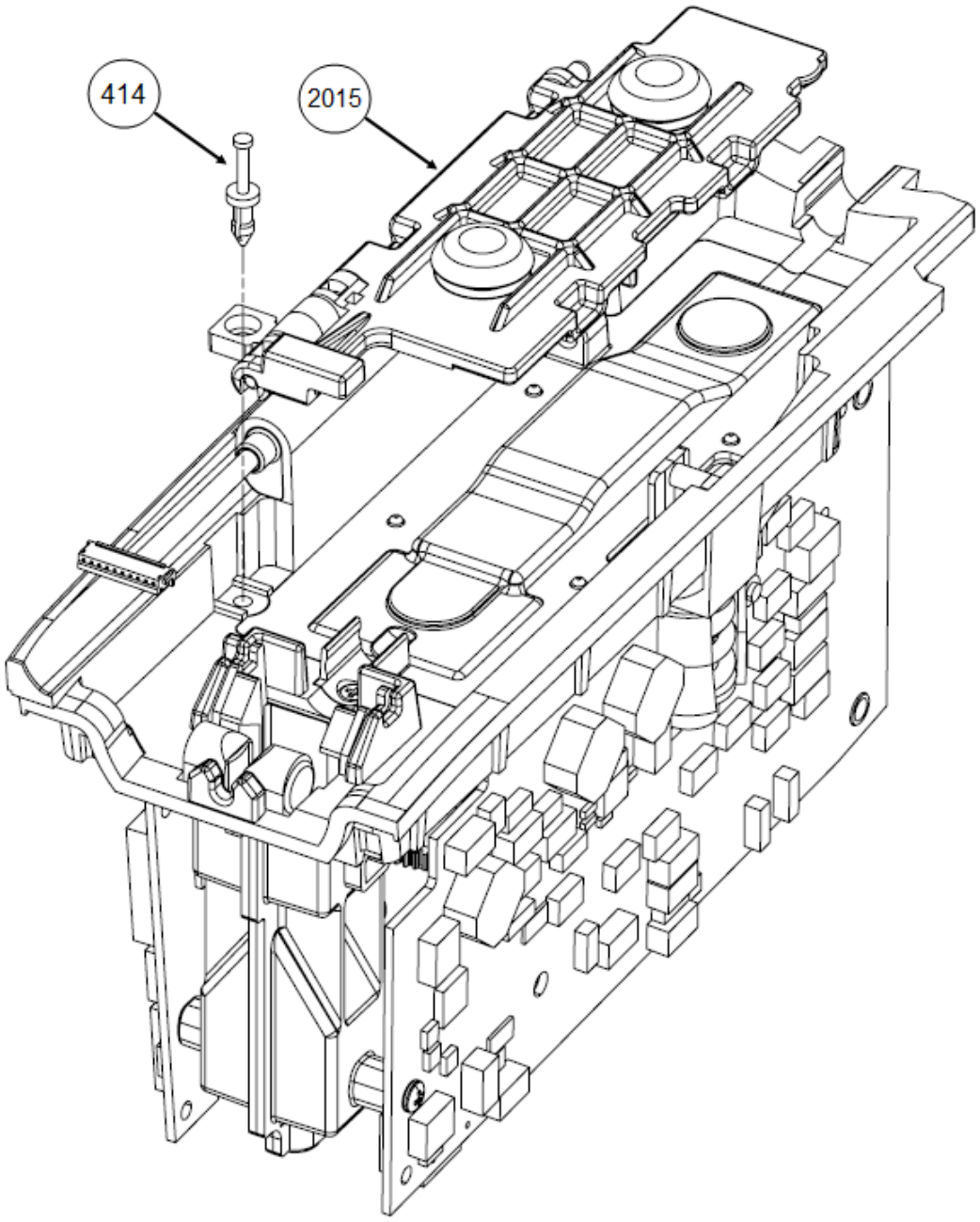


Figure 7-20. Model 8100 - Platen Assembly

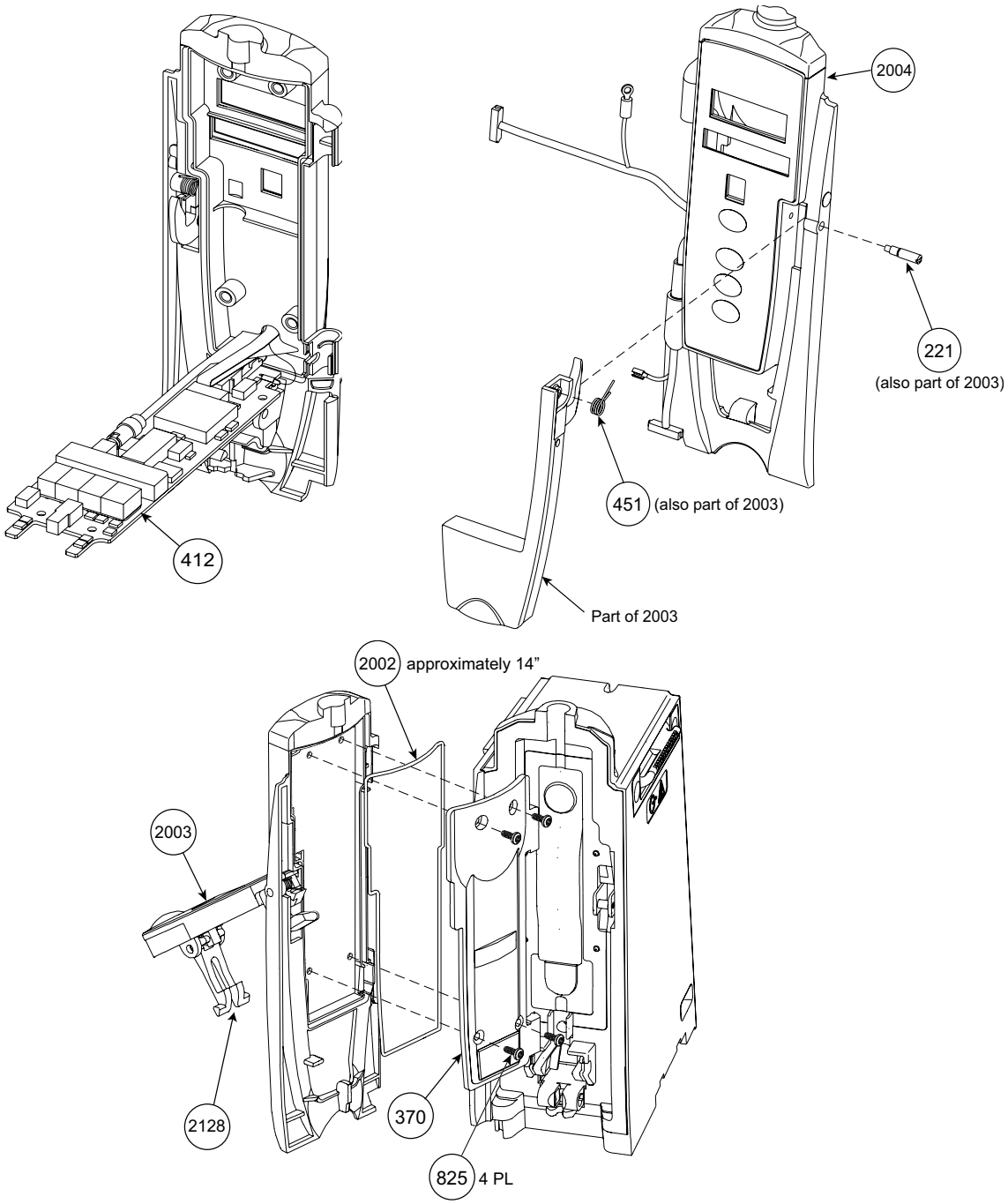


Figure 7-21. Model 8100 - Door and Display Board Assembly

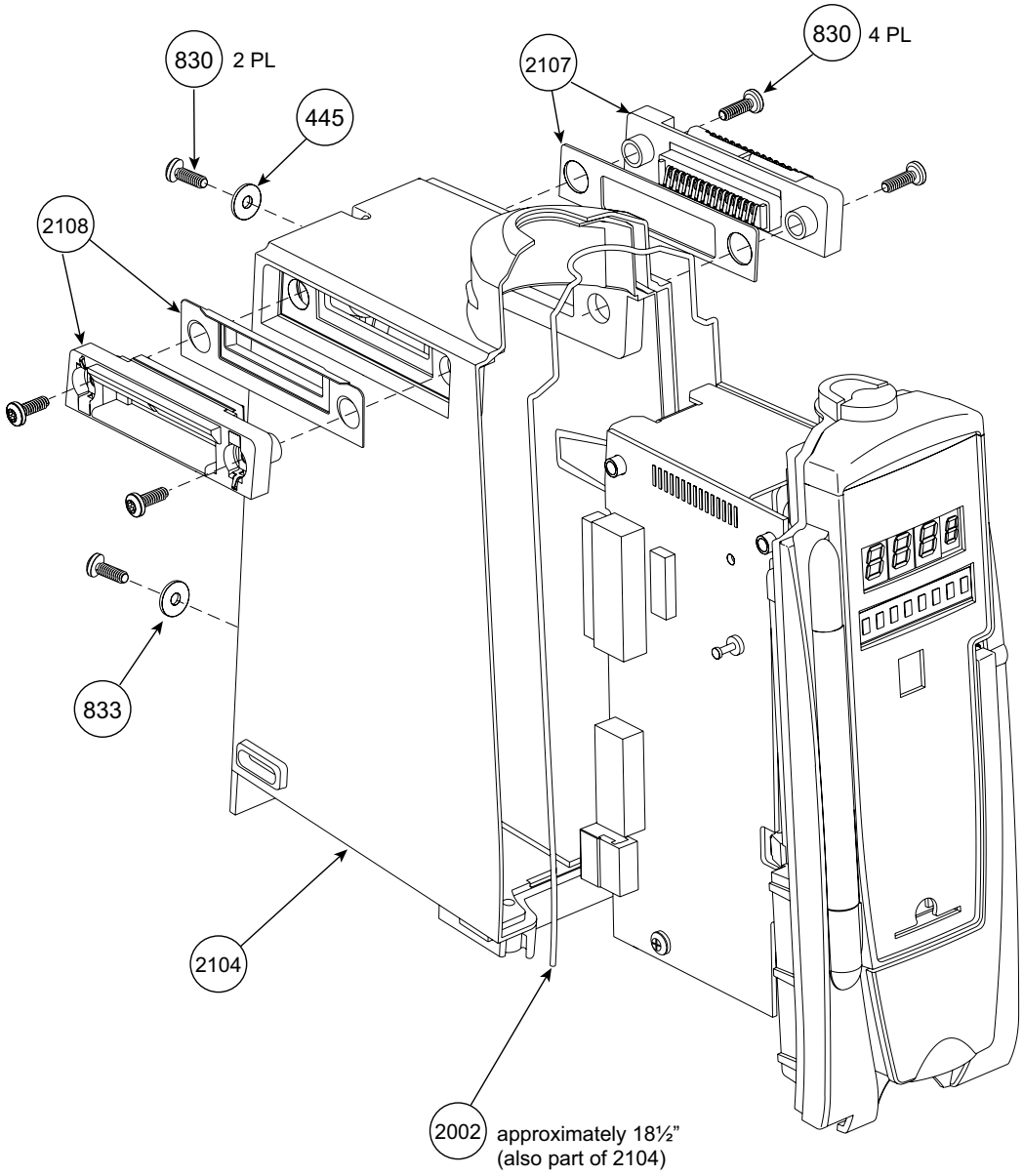


Figure 7-22. Model 8100 - Rear Case and IUI Connectors

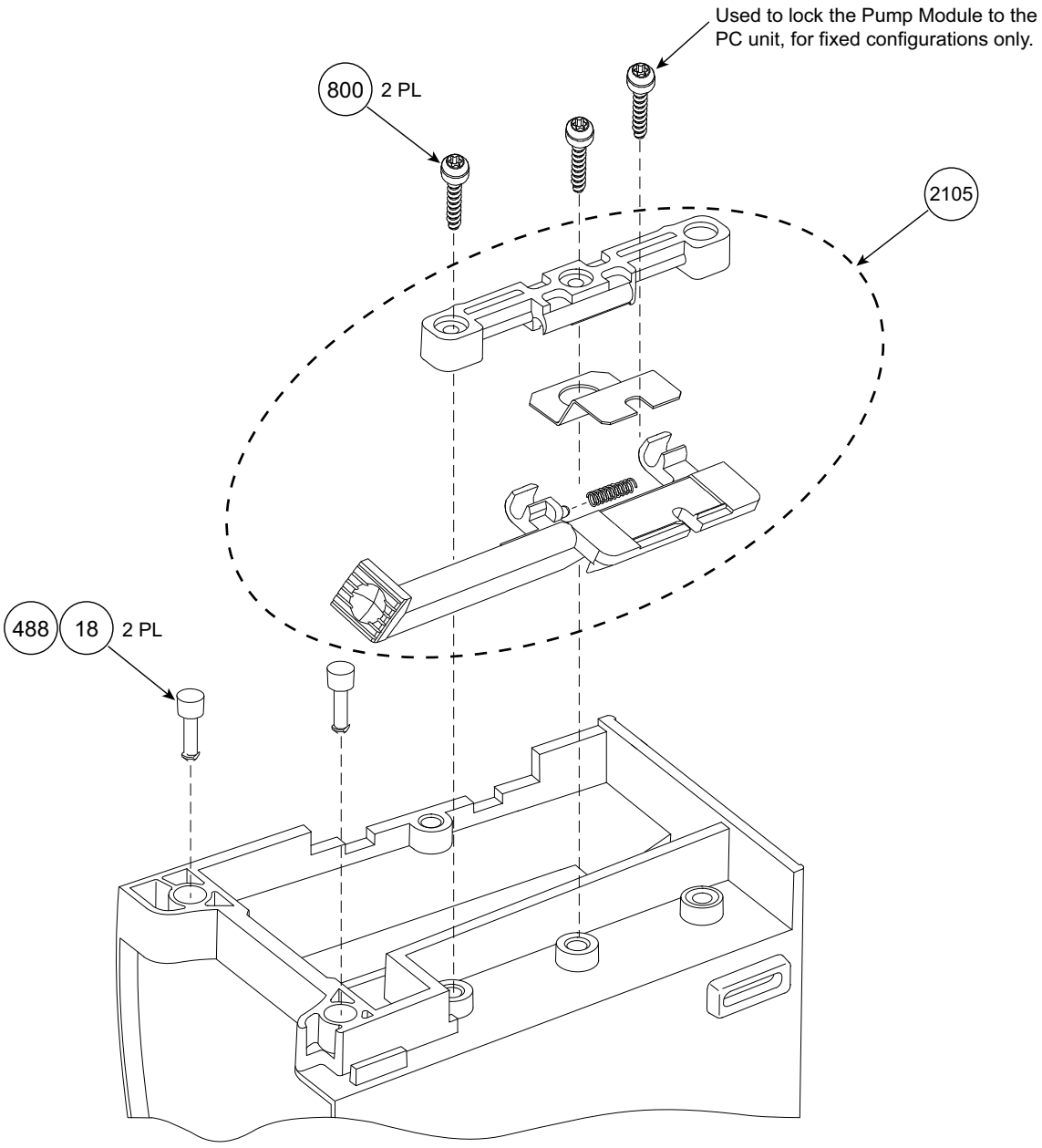


Figure 7-23. Model 8100 - Latch and Feet Assembly

1 The nameplate label, which has a regulatory mark, is not field replaceable as an individual item. It is available only as part of the Rear Case Assembly Kit (item 8043).

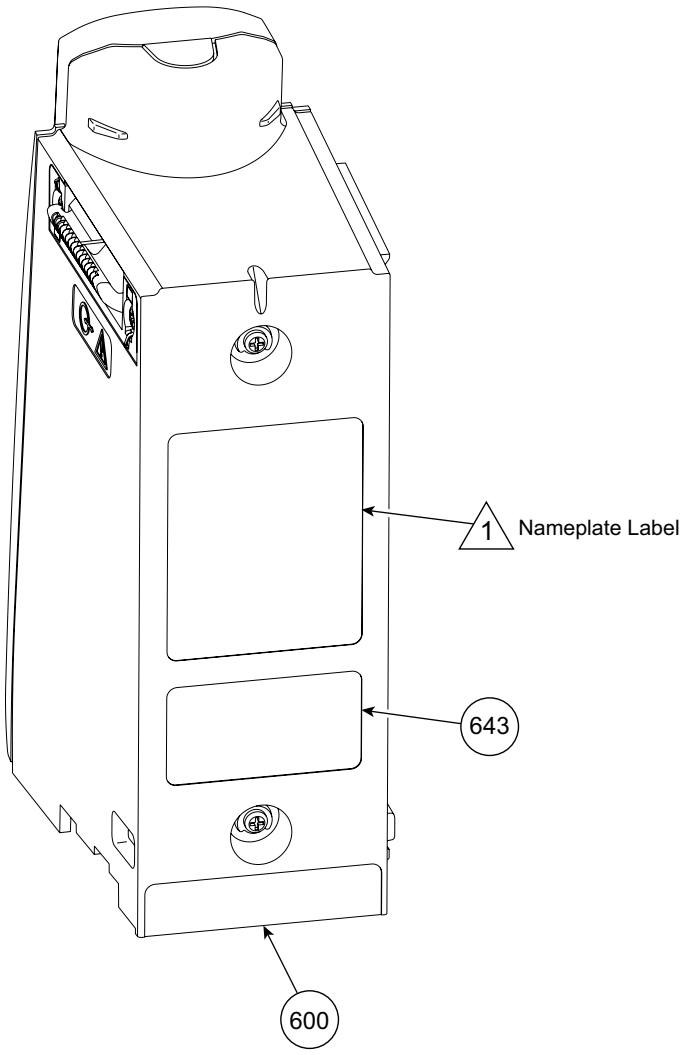


Figure 7-24. Model 8100 - Label Locations

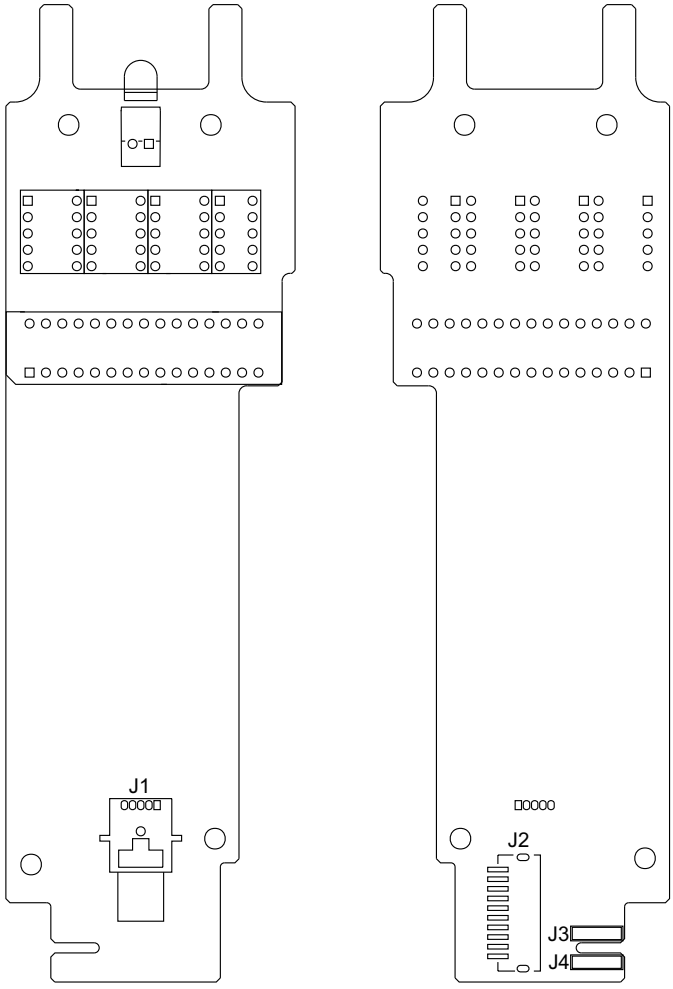


Figure 7-25. Model 8100 - Display Board

This illustration is for board identification purposes only and does not represent the board's component layout.

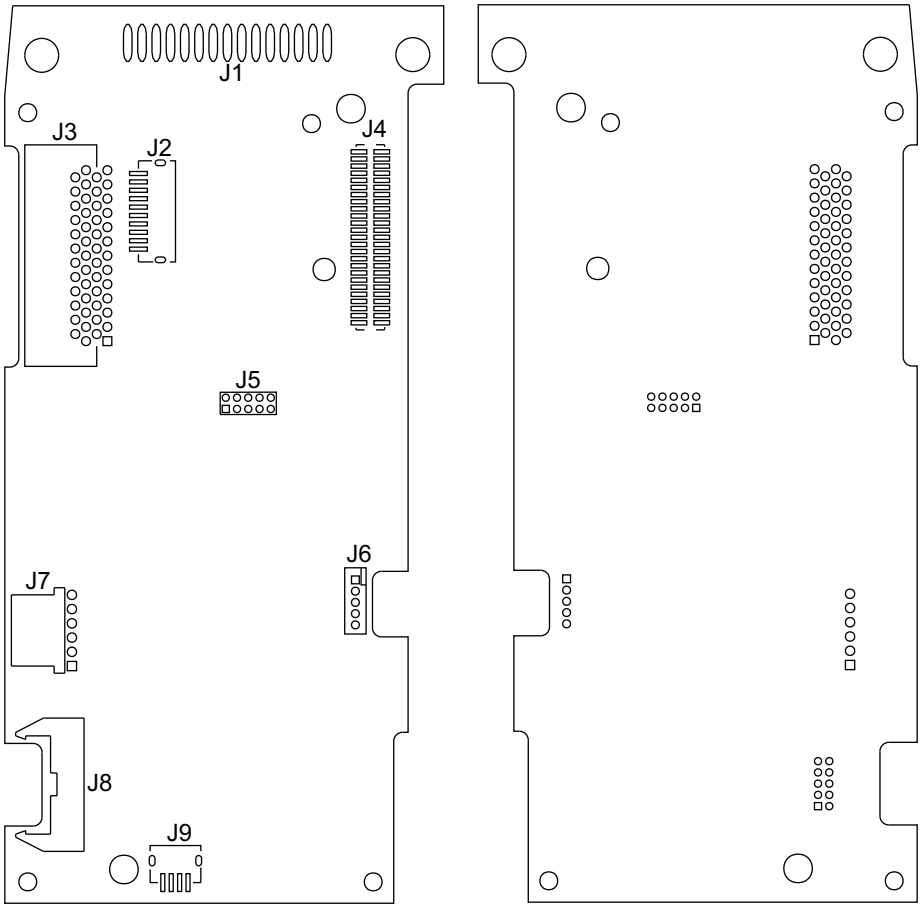


Figure 7-26. Model 8100 - Logic Board

This illustration is for board identification purposes only and does not represent the board's component layout.

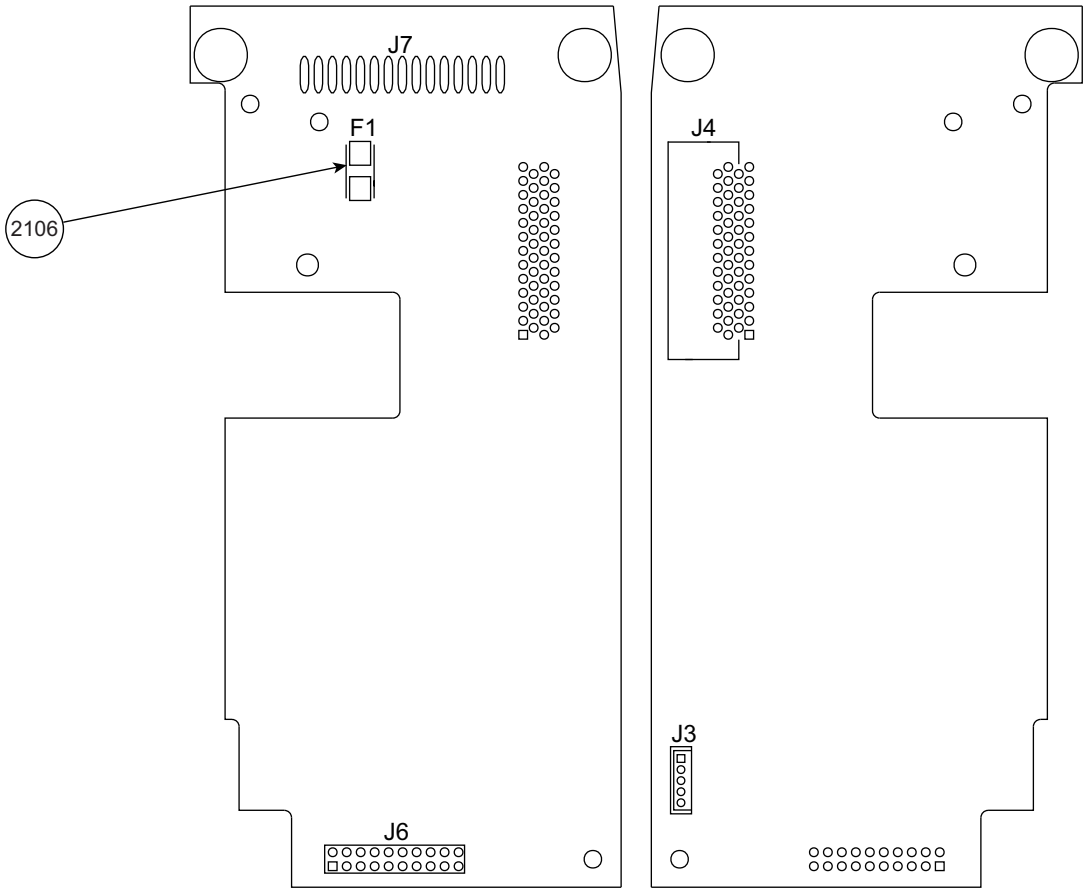


Figure 7-27. Model 8100 - Motor Controller Board

This illustration is for board identification purposes only and does not represent the board's component layout.