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Cardinal Health, 1180 Rolle, Switzerland

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Technician Mode uses the lwIP communication stack (http://www.sics.se/~adam/lwip/)
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Contents

Chapter
1. General Information 4
2. Configuration & Calibration 8
3. Preventative Maintenance 19
4. Troubleshooting 39
5. Circuit Descriptions 44
6. Corrective Maintenance 48

Appendix
A. Electromagnetic Compatibility 68
B. Disposal 73
C. Spare Parts Listings 75
D. Service Contacts 81
E. Document History 83
Chapter 1

General Information

In this chapter

Introduction 5
Features of the Pump 6
General Precautions 7
Introduction

The Alaris® GP Volumetric Pump and the Alaris® GP Guardrails® Volumetric Pump (hereinafter referred to as 'Pump') is a small lightweight volumetric infusion pump that provides accurate and reliable infusions over a range of rates.

The pump is designed to meet the infusion requirements as specified in the Directions For Use (DFU) for all hospital departments including general wards, critical and intensive care, operating rooms and accident and emergency rooms.

This pump is suitable for use by appropriately trained clinicians or nurses. This pump can be used for intravenous infusion modes. Supporting fluid & drug therapy, blood transfusions and parenteral feeding.

Product Familiarity

Ensure that you are fully familiar with the pump by carefully studying the Directions for Use (DFU) prior to operation and prior to attempting any repairs or servicing. As part of continuous improvement, product enhancements and changes are introduced from time to time.

Purpose of this Manual

This Technical Service Manual describes how to set up, test and maintain the Alaris® GP Volumetric Pump and the Alaris® GP Guardrails® Volumetric Pump.

This manual is intended for use by personnel experienced in medical equipment testing and maintenance procedures.

Conventions Used in this Manual

<table>
<thead>
<tr>
<th><strong>BOLD</strong></th>
<th>Used for Display names, self-test codes, controls and indicators referenced in this manual, for example, <strong>Battery Indicator</strong>, access code 212, <strong>ON/OFF</strong> button.</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Single quotes’</td>
<td>Used to indicate cross-references made to another section of this manual. For example, see Chapter 2, ‘Configuration &amp; Calibration’.</td>
</tr>
<tr>
<td>underline</td>
<td>Used to indicate a link to another section within this manual.</td>
</tr>
<tr>
<td><strong>Italics</strong></td>
<td>Used to refer to other documents or manuals. For example, refer to the relevant Directions for Use (DFU) for further information. Also used for emphasis, for example, ...if the gap <em>still</em> measures less than...</td>
</tr>
<tr>
<td><img src="image" alt="Hints &amp; Tips" /></td>
<td>Wherever this symbol is shown a Hints &amp; Tips note is found. These notes provide useful advice or information that may help to perform the task more effectively.</td>
</tr>
<tr>
<td><img src="image" alt="Toolbox" /></td>
<td>Wherever this symbol is shown a Toolbox note is found. These notes highlight an aspect of test or maintenance that is important to know about. A typical example is drawing attention to a software upgrade that you should check has been installed.</td>
</tr>
</tbody>
</table>
General Information

Features of the Pump

- Alarm indicator
- Flow sensor connector (cover removed for clarity)
- RS232/Nursecall connector (cover removed for clarity)
- Folded pole clamp
- Rotating cam to lock onto horizontal rectangular bars.
- Mains fuses
- Mains inlet
- IR communications port
- Potential Equalisation (PE) Connector
- AC power indicator
- Door Lever
- Handle
- Display
- Softkeys
- Chevrons
- Mute
- Pressure
- Battery indicator
- On/Off
- Door
- Release lever for rotating cam
- Medical device interface (MDI)
General Precautions

Attention consult accompanying documents: Prior to using this pump, carefully read the Operating Precautions described in the Directions for Use (DFU).

This pump contains static-sensitive components. Observe strict precautions for the protection of static sensitive components when attempting to repair and service the pump.

An explosion hazard exists if the pump is used in the presence of flammable anaesthetics. Exercise care to locate the pump away from any such hazardous sources.

Dangerous Voltage. An electrical shock hazard exists if the casing of the pump is opened or removed. Refer all servicing to qualified service personnel.

This pump is protected against the effects of high energy radio frequency emissions and is designed to be fail safe if extremely high levels of interference are encountered. Should false alarm conditions be encountered, either remove the source of the interference or regulate the infusion by another appropriate means.

If the pump is dropped, subjected to excessive moisture, humidity or high temperature, or otherwise suspected to have been damaged, remove it from service for inspection by qualified service personnel.

When connected to an external power source, a three-wire (Live, Neutral, Earth) supply must be used. If the integrity of the external protective conductor in the installation or its arrangement is in doubt, the pump should be operated from the battery.
Chapter 2

Configuration and Calibration

In this Chapter

- Entering Service Mode 9
- Service Mode - Factory Defaults 10
- Service Mode - Configuration 11
- Service Mode - Data Set Transfer 14
- Service Mode - Calibration 15
Entering Service Mode

**Warning** -
At no time should Service Mode be entered while the pump is connected to a patient. Service Mode should only be accessed by qualified and trained personnel.

Service Mode can be accessed via a three-digit access code that is entered using the following procedure:

1. Hold down a and turn the pump ON.
2. Enter the access code 212 using the b,c keys and the NEXT softkey.
3. When the code shows on screen, press OK to confirm.

Select the required option using the c,d,e keys and the OK softkey.

For the Alaris® GP Volumetric Pump the options will be as follows:

- **Factory Defaults** - Load a default data set. Confirm to perform a cold start.
- **Configuration** - This menu comprises a list of options which are configurable by the user.
- **Data Set Transfer** - Upload a data set to pump.
- **Calibration** - This menu comprises a list of calibrations which can be performed by the user.
- **Test Verification/PVP** - Performance Verification Procedure Tests.

For the Alaris® GP Guardrails® Volumetric Pump the options will be as follows:

- **CQI Events Download** - For future implementation
- **Data Set Transfer** - Upload a data set to pump.
- **Configuration** - This menu comprises a list of options which are configurable by the user.
- **Calibration** - This menu comprises a list of calibrations which can be performed by the user.
- **Test Verification/PVP** - Performance Verification Procedure Tests.
- **Factory Defaults** - Load a default data set. Confirm to perform a cold start.
Service Mode - Factory Defaults

Factory Defaults
Select the required option using the arrow keys and the OK softkey.

Default Data Set       Replace the current data set with a default data set.
Cold Start Confirm     Confirm clearing and resetting the data set and calibration data to the factory defaults.
Clear CQI Log File*    Confirm clearing all pump history and resetting the data set to the factory default.

* Alaris® GP Guardrails® Volumetric Pump only.

Default Data Set
1. Press OK to confirm loading the default data set.

Cold Start Confirm
1. Press OK to confirm performing a cold start.
Clear CQI Log File
1. Press OK to confirm clearing the CQI Log File.

SERVICE CONFIGURATION

Date/Time
Sets the current date and time used for event logging.

Software Versions
Displays the pump software versions.

Serial Number
Configure the displayed serial number.

Pump Reference
Pump specific text to be displayed in user mode at start up. (20 characters max.)

Language
Configure the Language used for display messages.

Backlight & Contrast
Adjust the Backlight and Contrast values

Current Data Set File
Displays the current data set file details.

Date/Time
1. Set the correct date and time using the keys.
2. Press NEXT to continue to next item to change.
3. Press OK to confirm.

CLEAR CQI LOG FILE

****** WARNING! ******
This will remove all instrument history and will restore the factory default data set by deleting the clinically approved installed data set.

Clear current log?
QUIT OK

DATE / TIME
AUG–04–2006 09:48

ADJUST WITH QUIT NEXT OK
Service Mode - Configuration (continued)

Software Versions

1. Press **OK** to exit after verifying Software Version fitted, display will vary depending on software version fitted.

<table>
<thead>
<tr>
<th>SOFTWARE VERSIONS</th>
<th>SOFTWARE VERSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRP 001.005.004</td>
<td>SWV 001.009.000</td>
</tr>
<tr>
<td>MP 001.005.004</td>
<td>PKG 001.009.000</td>
</tr>
<tr>
<td>FDP 001.005.004</td>
<td>MPU 001.009.000</td>
</tr>
<tr>
<td>SP 001.005.004</td>
<td>MPT 001.009.000</td>
</tr>
<tr>
<td></td>
<td>FDP 001.007.016</td>
</tr>
<tr>
<td></td>
<td>SP 001.005.000</td>
</tr>
<tr>
<td></td>
<td>LANGUAGE 001.004.005</td>
</tr>
</tbody>
</table>

Serial Number

1. Set the serial number required (maximum 9 characters) using the keys.
2. Press **NEXT** to continue to next item to change.
3. Press **OK** to confirm.

Pump Reference

1. Set the Pump Reference required using the keys.
2. Press **NEXT** to continue to next item to change.
3. Press **OK** to confirm.
Service Mode - Configuration (continued)

Language

1. Select the required Language using the keys.
2. Press OK to confirm.

Languages available will be dependant on the pump software version.

Backlight & Contrast

1. Use the keys to adjust Backlight and Contrast to required setting.
2. Press PARAM to change between Backlight and Contrast.
3. Press OK to confirm.

Select the Dimming parameter to see what the display would look like when dimmed.

Current Data Set File

1. Press OK to exit after verifying current data set information.
Configuration and Calibration

### Service Mode - Data Set Transfer

#### Upload data set to an Alaris® GP Volumetric Pump

Equipment required:
- Alaris® GP Editor Software Kit (1000SP01310) - includes the Alaris® GP Transfer Tool
- RS232 cable (1000SP01183)
- USB to RS232 Converter cable (1000EL00979) - optional
- USB to RS232 converter 4 way hub (1000EL00980) - optional
- PC - for requirements see Upgrading Firmware PC requirements

Using the Alaris® GP Transfer Tool allows a released data set to be uploaded to an Alaris® GP Volumetric Pump.

**Warning -**
At no time should the Alaris® GP Transfer Tool be used to upload to an Alaris® GP Volumetric Pump while the pump is connected to a patient.

In Service Mode select **Data Set Transfer** using the keys and the **OK** softkey.

1. Using the Alaris® GP Transfer Tool select data set to be uploaded.
2. Press the **RS232** or **IrDA** softkey to select the Comms mode being used.
3. Connect the pump to PC.
4. Press the **START** softkey to begin transfer.
5. Please ensure the data set ID shown on the pump is identical to the one transferred.
6. Press **PASS** softkey to confirm correct transfer and exit.
7. To transfer the data set to another pump repeat steps 2 to 6.

#### Upload data set to an Alaris® GP Guardrails® Volumetric Pump

Equipment required:
- Guardrails® Editor V3.1 Software Kit (1000SP01389) or Guardrails® Editor V3.1 Transfer Tool Software Kit (1000SP01390)
- RS232 cable (1000SP01183)
- USB to RS232 Converter cable (1000EL00979)
- USB to RS232 converter 4 way hub (1000EL00980) - optional
- PC - for requirements see Upgrading Firmware PC requirements

Using the Guardrails® Editor V3.1 Transfer Tool allows an approved data set to be uploaded to an Alaris® GP Guardrails® Volumetric Pump.

**Warning -**
At no time should the Guradrails® Editor V3.1 Transfer Tool be used to upload to an Alaris® GP Guardrails® Volumetric Pump while the pump is connected to a patient.

In Service Mode select **Data Set Transfer** using the keys and the **OK** softkey.

1. Using the Guardrails® Editor V3.1 Transfer Tool select data set to be uploaded.
2. Connect the pump to PC.
3. Press the **START** softkey to begin transfer.
4. Please ensure the data set ID shown on the pump is identical to the one transferred.
5. Press **ACCEPT** softkey to confirm correct transfer and exit.
6. To transfer the data set to another pump repeat steps 2 to 5.

**Caution: Loading the Data Set Transfer Tool software is considered a non-clinical service activity. Interconnecting the pump with a PC may cause the safety or electromagnetic environment to change while the connection exists. The threat of higher leakage currents or EMI disturbances may be present. Disconnect the IrDA or RS232 cable connection at both ends following software upload activities.**

For more information relating to the Alaris® GP Editor Software or the Guardrails® Editor V3.1 Software refer to the relevant Directions For Use supplied with the software.
Service Mode - Calibration

Zero Point Calibration
Select the required option using the keys and the OK softkey.
1. Wait for the pressure sensors to park.
2. Ensure that an infusion set is not installed.
3. Press the START softkey.
4. Pump will countdown for 15 seconds.
5. Press the ACCEPT softkey.
6. Press the PASS softkey.

Pressure Calibration
Equipment required:
- Calibrated Pressure Gauge, minimum specification of
  - Accuracy = 0.10% of full scale
  - Full scale = 1500mmHg
- Pressure Calibration Set (1000SP01422) Use to calibrate 10 pumps and then change

Set up equipment as per figure 2-1 and allow 30 seconds before proceeding.
Select the required option using the keys and the OK softkey.
Service Mode - Calibration (continued)

Pressure Calibration continued

1. Turn 3-way tap to close from atmosphere.
2. Press the START softkey.
3. Apply a pressure of 200mmHg and pump will countdown for 15 seconds.
4. Press the ACCEPT softkey.
5. Apply a pressure of 800mmHg and pump will countdown for 15 seconds.
6. Press the ACCEPT softkey.
7. Turn 3-way tap to vent to atmosphere.
8. Turn 3-way tap to close from atmosphere.
9. Press the NEXT softkey to proceed to Verification Procedure.

Verification Procedure

Software version v1.7.x and below

10. Apply a pressure of 200mmHg and wait for 5 seconds.
11. Press the NEXT softkey.
12. Apply a pressure of 400mmHg and wait for 5 seconds.
13. Press the NEXT softkey.
14. Apply a pressure of 600mmHg and wait for 5 seconds.
15. Press the NEXT softkey.
16. Apply a pressure of 800mmHg and wait for 5 seconds.
17. Press the NEXT softkey.
18. Turn 3-way tap to vent to atmosphere.
19. Press the PASS softkey.

Software version v1.9.0 and above

10. Apply a pressure of 500mmHg and wait for 5 seconds.
11. Press the NEXT softkey.
12. Turn 3-way tap to vent to atmosphere.
13. Press the PASS softkey.

Figure 2 - 1 Pressure Calibration Equipment Set Up

- Pressure Gauge
- Pressure source (50ml/100ml syringe or similar device)
- Vent to atmosphere
Volumetric Calibration

Select the required option using the keys and the OK softkey.

1. Load the primed Infusion Set (60793) into the Pump and set-up as shown in Figure 2-2 below and adjust the fluid level so that the meniscus is level with the zero mark.

2. Press START to begin. Test will run and fluid will be delivered into the burette.

3. When Volume delivered! is displayed, check accumulated air in line value is less than 100µl then enter the volume delivered into the burette using the keys and the OK softkey. If accumulated air in line value is greater than 100µl then repeat test.

If measured value is 19.3ml or less then enter 19.2ml and if value is 20.6ml or higher then enter 20.7ml.

4. If no calibration is required (Volume delivered within limits of 19.4ml to 20.5ml) then press PASS to confirm and exit.

5. If the Calibration value is changed automatically then press VERIFY and repeat steps 2 to 4.

6. If the pump still fails replace the Platen and Fingers then repeat the calibration procedure.

If measured value is 19.3ml or less then enter 19.2ml and if value is 20.6ml or higher then enter 20.7ml.
Battery Calibration

Select the required option using the keys and the OK softkey.
1. Connect AC Mains to the Pump and press CAL to begin.
2. When calibration is complete it will display CALIBRATION SUCCESS or CALIBRATION FAILURE. Press PASS to confirm successful calibration or REPEAT to perform calibration again.
Chapter 3

Preventative Maintenance

In this chapter

- Preventative Maintenance 20
- Visual Inspection 20
- Recommended Cleaning and Storage 21
- Updates 23
- Battery Test and Replacement 25
- Service Mode - Test Verification/PVP 25
- Performance Verification Procedure 38
Preventative Maintenance

To ensure the pump remains in good operating condition, routine and preventative maintenance inspections are required. Routine maintenance inspections should be performed by hospital/facility before each use, see Directions For Use for details.

Preventative maintenance inspections should be performed at least every year.

For the preventative maintenance inspection the following should be performed:

- Full visual inspection of the pump, internal and external
- Fitting of all updates required
- Battery test and/or replacement
- Clean the pump
- Performance Verification Procedures

Following all spare part replacement and repair activities, testing must be performed in accordance with the Performance Verification Procedure (PVP). Additional testing and calibration may be required after certain repairs are completed, see table in Chapter 6 ‘Corrective Maintenance’ for more information.

Visual Inspection

Open the pump, as per Chapter 6 ‘Corrective Maintenance’ and visually inspect the interior of the pump.

Visually inspect the exterior of the pump checking the following:

- Labels should be replaced as required if not flat, legible or fully adhered.
- Check Keypad for any sign of wear and replace as required.
- Case components must be checked for damage and replaced if necessary.
- Check the pole clamp is not damaged and that it functions correctly.
- Inspect the AC power supply plug and cable for damage.
- The case should be clean and free from IV solution residue, especially near moving parts.
- Check for dried solution deposits on accessible areas of pumping mechanism.
Cleaning the Pump:
Before the transfer of the Pump to a new patient and periodically during the use, clean the Pump by wiping over with a lint-free cloth lightly dampened with warm water and a standard disinfectant / detergent solution.

Recommended cleaners are:

<table>
<thead>
<tr>
<th>Brand</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hibiscrub</td>
<td>20% (v/v)</td>
</tr>
<tr>
<td>Virkon</td>
<td>1% (w/v)</td>
</tr>
</tbody>
</table>

Do not use the following disinfectant types:
- NaDcc (such as PRESEPT)
- Hypochlorites (such as CHLORASOL)
- Aldehydes (such as CIDEX)
- Cationic Surfactants (such as Benzalkonium Chloride)
- Iodine (such as Betadine)
- Concentrated Isopropyl alcohol based cleaners will degrade plastic parts.

Before cleaning always switch OFF and disconnect from the AC power supply. Never allow fluid to enter the casing and avoid excess fluid build up on the Pump. Do not use aggressive cleaning agents as these may damage the exterior surface of the Pump. Do not steam autoclave, ethylene oxide sterilise or immerse this Pump in any fluid.

Storing the Pump:
If the Pump is to be stored for an extended period it should be first cleaned and the internal battery fully charged. Store in a clean, dry atmosphere at room temperature and, if available, employ the original packaging for protection. Once every 3 months during storage, carry out functional tests as described in this technical service manual and ensure that the internal battery is fully charged.

Cleaning and storing the Infusion Set:
The Infusion Set is a disposable single use item and should be discarded after use according to hospital protocol.
Cleaning the door:
Periodically during use (as per hospital policy), clean the door by wiping over with a lint-free cloth, lightly dampened with warm water and a standard disinfectant / detergent solution. Dry door before use.
To aid cleaning of a door which has been heavily soiled, contaminated or if the door operation is not free moving, then the door may be removed (see procedure below) then immersed and soaked in warm water with a standard disinfectant / detergent.
The door should be allowed to dry fully prior to use.

Door Removal

1. Remove the screw securing the lower hinge lock.

2. Open the lower hinge lock.

3. Pull the door away from lower hinge pin and lift up to remove the door.

4. Clean the door.

5. Refit door in reverse order. Ensure screw is refitted with a torque of 70cNm.

Cleaning the Flow Sensor:
Before the transfer of the flow sensor to a new infusion set and periodically during use, clean the flow sensor by wiping over with a lint-free cloth lightly dampened with warm water and a standard disinfectant / detergent solution. Ensure the connector does not get wet. Dry flow sensor before use.
To aid cleaning of flow sensors which have been heavily soiled, contaminated or if the handle operation is not free moving, then the flow sensor may be immersed and soaked in clean soapy water (see note below). The inside of the spring mechanism can be cleaned by activating it whilst submerged in the water.
After cleaning, the sensor should be allowed to dry fully prior to use.

Warning -
The plug of the flow sensor must not be immersed in water as damage will occur.
Upgrading firmware
Requirements
- PC
- Minimum hardware system requirements:
  - 1GHz Pentium processor
  - 1GB of free space on the system hard drive
  - Available configurable RS232 9 pin serial or USB communications ports
  - Video resolution of 1024 X 768 pixels and 16 bit colour depth
  - The Software Maintenance Utility (SMU) (1000CD00028)
  - RS232 cable (1000SP01183)
  - USB to RS232 Converter cable (1000EL00979) - optional
  - USB to RS232 converter 4 way hub (1000EL00980) - optional
  - Firmware CD
Software requirements:
- Microsoft Windows 2000 (service pack 4), or XP (service pack 2)
Preparation
- Load the SMU software onto the PC
- Connect RS232 connector (using USB to RS232 converter if required) to each pump being updated
- Disconnect the Battery
- Remove the Battery Compartment Plug

Software Upload
1. Through the Rear Case, there is a set of three dip switches on the bottom of the Control PCB. Switch 1 should be ON and switches 2 and 3 should be OFF.
2. Using a small flat blade screwdriver or round ended tweezers configure the dip switch settings to:
   a. Switch 1 = OFF
   b. Switch 2 = ON
   c. Switch 3 = ON
3. Start the SMU facility to upload the software.
4. Select the Firmware zip file.
5. Select the Comm settings - Comm Port and Baud rate of 460800 (USB to RS232 converter) or 115200 (RS232).
6. Connect the Battery to the Battery Cable.
7. Press Start.

Switch 1 turns the safety battery circuit on but is not required for programming.
Switch 2 forces the pump to turn on.
Switch 3 turns the pump into ‘Boot Mode’, this is only used for programming.
Upgrading firmware continued

8. Once the green bar has reached the far right hand side and the time has reached 0:00 and the flashing green light is a steady green light, the RS232 connector can be removed from the pump.

9. Disconnect the Battery and turn OFF all dip switches.

10. Wait 5 seconds then reconnect the Battery.

11. Configure the Dip Switches to:
   a. Switch 1 = ON
   b. Switch 2 = ON then OFF
   c. Switch 3 = OFF

12. Refit the Battery Compartment Plug, this prevents fluid ingress.

13. Power up the pump in Service Mode, enter access code 212, then select **Configuration > Date/Time** and set the current date and time.

   *If the Control, Interface or RS232 PCB is replaced, the pump must be re-programmed.*
Battery Test and Replacement

To test the battery perform the battery calibration, as outlined in the procedure in Chapter 2 ‘Configuration and Calibration’, and verify that all pass criteria are met. If pass criteria are not met then replace the battery.

Battery charge retention will eventually degrade. So where retention is critical the internal battery should be replaced every three years.

Replace the Main Battery

1. Remove the two case screws in battery cover, remove cover and battery.
2. Fit new battery.
3. Replace battery cover and secure with 2 screws.

Warning -
At no time should Service Mode be entered while the pump is connected to a patient. Service Mode should only be accessed by qualified and trained personnel.

Battery Test and Replacement

To test the battery perform the battery calibration, as outlined in the procedure in Chapter 2 ‘Configuration and Calibration’, and verify that all pass criteria are met. If pass criteria are not met then replace the battery.

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Replace the Main Battery

1. Remove the two case screws in battery cover, remove cover and battery.
2. Fit new battery.
3. Replace battery cover and secure with 2 screws.

Service Mode - Test Verification/PVP

Enter access code 212 to view the Service Mode menu (see 'Entering Service Mode' in Chapter 2 for instructions).

Select the Test Verification/PVP option using the keys and the OK softkey. Press the Quit softkey to return the pump to the access code screen.

Select the required option using the keys and the OK softkey.

- **PVP Work Flow** Performance Verification Procedure (PVP) tests.
- **Alarms Functionality** Test the Alarms function correctly.
- **User Interface** Display, Keypad, LEDs and Audio Tests.
- **Power Supplies** Test AC Mains and Battery operation.
- **Sensor Tests** Perform tests on the pump sensors.
- **Comms Tests** RS232, IrDA and Nurse Call Tests.
PVP Work Flow

This test is used to confirm that the Pump is functioning correctly. Press the **START** softkey to begin.

The PVP Work Flow will iterate through the following tests:

- Software Versions
- Date/Time (read only)
- Serial Number (read only)
- Door Frame
- Safety Clamp
- Sear
- Audio Test
- Chequerboard
- LED’s
- Keypad
- Nurse Call
- RS232 Loop Back
- Pumping Efficiency Test
- Downstream Occlusion Pressure Test
- Alarms Functionality
- Volumetric (Accuracy Test) Calibration

See individual test details in this chapter or in Chapter 2 'Configuration and Calibration' for instructions.
Preventative Maintenance

Service Mode - Test Verification/PVP (continued)

Alarms Functionality
1. Press the START softkey to begin.

2. Pump starts an infusion.
3. Check all alarms sound and display correctly.
4. Alarms to test are:
   - AC Mains Disconnect
   - Door Open
   - Upstream occlusion
   - Air In Line

5. When all the alarms have been tested press the PASS softkey if all the alarms worked correctly or REPEAT softkey if alarms still need to be checked.
**Preventative Maintenance**

### Service Mode - Test Verification/PVP (continued)

**User Interface**

Select the required option using the \(\uparrow\downarrow\leftarrow\rightarrow\) keys and the OK softkey.

- **Chequerboard**
  - Display Chequerboard Test.

- **Keypad Tests**
  - Perform Keypad Test to check all keys work when pressed.

- **LED Tests**
  - Check all LEDs display in correct order.

- **Audio Tests**
  - Check Primary and Secondary Audio sounders.

**Chequerboard Pattern**

1. Check pattern is displayed correctly and \(✓\) to pass. If pattern is incorrect then press \(\times\) to fail.
2. Press PASS softkey to confirm pass and exit.

**Keypad Tests**

1. Press the START softkey to begin.
2. Press all the keys and a \(✓\) will indicate each key to pass.
3. Press PASS softkey to confirm pass and exit.
LED Tests
1. Press the START softkey to begin.
2. Check LEDs are displayed correctly and ✓ to pass. If an LED is not displayed then press ✗ to fail.
3. Press PASS softkey to confirm pass and exit.

Audio Tests
1. Press the START softkey to begin.
2. Check Audio sounds are correct and ✓ to pass. If Audio sounds are not correct then press ✗ to fail.
3. Press PASS softkey to confirm pass and exit.
Preventative Maintenance

Service Mode - Test Verification/PVP (continued)

Power Supplies

Select the required option using the ↑↓ keys and the OK softkey.

AC Mains Test Tests the AC mains removal detection.
Battery Test the battery. To perform calibration see Chapter 2 'Configuration & Calibration'.

AC Mains Test
1. Press the START softkey to begin.
2. Check AC Mains connected/disconnected is correctly indicated and press ✓ softkey or press ✗ softkey if not correctly detected.
3. Press PASS softkey to confirm pass and exit.

Battery
1. Review the battery information.
2. Press the DETAILS softkey to see further battery details.
3. Press QUIT softkey to exit.
**Sensor Tests**

In Sensor Tests menu select **required test** using the $\uparrow\downarrow$ keys and the **OK** softkey.

- **Flow Sensor Test**: Check Flow Sensor is connected and drops count.
- **Door Frame Test**: Check door registers as open and closed.
- **Safety Clamp Test**: Check Safety clamp detection registers clamp enabled or disabled.
- **Sear Test**: Check Sear detection registers sear enabled or disabled.
- **Air In Line Test**: Check Air In Line sensor detects fluid and air correctly.
- **Run-In Mode**: Performs a continuous infusion for burn in testing.
- **Pumping Efficiency Test**: This test is used to confirm that the Pump is able to generate sufficient pressure.
- **Pump Finger Height or Parking Test**: Allows the mechanism to be parked.

* Test name has changed to **Parking Test** for latest software versions however the procedure is the same.

**Flow Sensor Test**

1. Plug flow sensor into connector on rear of the pump.
2. Press the **START** softkey to begin.
3. Check Flow sensor operation is correct and press $\checkmark$ softkey if drops are displayed correctly or press $\times$ softkey if drops are not detected.
4. Press **PASS** softkey to confirm pass and exit.
Service Mode - Test Verification/PVP (continued)

Door Frame Test
1. Press the START softkey to begin.
2. Check Door open/closed is correctly indicated and press ✓ softkey or press ✗ softkey if not correctly detected.
3. Press PASS softkey to confirm pass and exit.

Safety Clamp Test
1. Press the START softkey to begin.
2. Check Clamp enabled/disabled is correctly indicated and press ✓ softkey or press ✗ softkey if not correctly detected.
3. Press PASS softkey to confirm pass and exit.

Sear Test
1. Press the START softkey to begin.
2. Check Sear in/out is correctly indicated and press ✓ softkey or press ✗ softkey if not correctly detected.
3. Press PASS softkey to confirm pass and exit.
Air In Line Test
1. Press the START softkey to begin.
2. Insert a fluid filled Infusion Set and an air filled Infusion Set.
3. Confirm pump detects fluid and air correctly and press ✓ softkey or press ✗ softkey if not correctly detected.
4. Press PASS softkey to confirm pass and exit.

Run-In Mode
1. Load an Infusion Set.
2. Set the rate required using the ▲▼ keys and press the START softkey to begin test.
3. Press STOP softkey when test is completed.
4. Press PASS softkey to confirm pass and exit.
Pumping Efficiency Test

This test is used to confirm that the Pump is able to generate sufficient pressure. This is done by infusing into a calibrated pressure gauge and checking that the correct line pressure is achieved. The test set-up is as per figure 3 - 1.

1. Insert the Infusion Set (60793) and the in-line roller clamp closed to prevent fluid flow.
2. Close the door and open the roller clamp on the set. Ensure that the 3-way tap to the transducer is closed to the atmosphere.
3. From the Pressure System Test menu screen, highlight Pumping Efficiency Test and press OK softkey.
4. Press the RATE softkey to select a rate of 50ml/h.
5. Press the START softkey and start the timer.
6. When 1000mmHg is reached stop the timer and then press the STOP softkey and open the 3-way tap to atmosphere.
7. Record that the time taken to reach 1000mmHg was 2 minutes or less.
8. Press the PASS softkey to confirm pass and exit.

Note: If a DRV2 fault code is encountered during the pumping efficiency test and the pressure has exceeded 1000mmHg, the fault should be ignored, and the pump power should be cycled to reset the condition.

Pump Finger Height (Parking Test)

1. Press the START softkey to begin.
2. Mechanism will run and park.
3. Press DONE softkey to confirm and exit.
Preventative Maintenance

Service Mode - Test Verification/PVP (continued)

COMMS Test

Select the required option using the ▲▼ keys and the OK softkey.

IrDA Test Check IrDA operates correctly.
RS232 Loop Back Check RS232 operates correctly.
Nurse Call Test Check Nurse Call operates correctly.

IrDA Test requires specialist equipment.
For further details please contact Cardinal Health.

RS232 Loop Back

1. Link pins 2 & 3 of the RS232 connector on rear of the pump.
2. Press the START softkey to begin.
3. Check RS232 operation is correct and ✓ for pass are shown after each item. If RS232 Test fails a × is displayed to indicate the failure.
4. Press PASS softkey to confirm pass and exit.

NURSE CALL TEST

1. Press the START softkey to begin.
2. Check Nurse Call operation is correct and ✓ for pass are shown after each item. If Nurse Call fails a × is displayed to indicate the failure.
3. Press PASS softkey to confirm pass and exit.
Occlusion Test

This test can be only done as part of the PVP Work Flow.

Use the Infusion Set ten times only and then replace. Record how many times the Infusion Set has been used.

**Note:** The Occlusion Pressure Test is carried out with fluid in the Infusion Set.

This test is used to confirm that the pressure sensor is correctly calibrated and able to detect an occlusion at the correct line pressure. This is done by pumping into a calibrated pressure gauge and checking that an alarm occurs at the correct line pressure. The test set-up is as per figure 3 - 1.

1. Put the fluid filled Infusion Set (60793) into the Pump.
2. Enter the **PVP Work Flow** and proceed to the **Occlusion Pressure Test**.
3. Open the 3-way tap to atmosphere then press the **LEVEL** softkey to adjust the alarm level to **L5**.
4. Configure the Calibrated Pressure Gauge to hold the Peak/MAX Pressure reading, in preparation for the test.
5. Press the **START** softkey to begin running the Pump at a rate of 125ml/h. Allow the Pump to run for 1 minute, so that the pressure reading stabilises.
6. Turn the tap to occlude the Infusion Set into the pressure gauge.
7. The Pump will continue to infuse and it will be observed that the pressure reading increases. Eventually a high-pressure alarm will occur and the Pump will stop infusing. Note the reading on the pressure gauge and confirm that it is **500mmHg ±100mmHg**.
8. Press **PASS** softkey if Pump passes test at all levels.

**If the pressure is outside of tolerance pressure calibration is required. Calibration should be performed as per procedure in Chapter 2 ‘Configuration and Calibration’. If the pump continues to fail the occlusion test then the pressure sensors should be replaced and perform the calibration procedure again.**

Occlusion Test (Optional)

This test can be done in normal operating mode to check the occlusion without having to perform the full PVP Work Flow.

Use the Infusion Set ten times only and then replace. Record how many times the Infusion Set has been used.

**Note:** The Occlusion Pressure Test is carried out with fluid in the Infusion Set.

This test is used to confirm that the pressure sensor is correctly calibrated and able to detect an occlusion at the correct line pressure. This is done by pumping into a calibrated pressure gauge and checking that an alarm occurs at the correct line pressure. The test set-up is as per figure 3 - 1.

1. Put the fluid filled Infusion Set (60793) into the Pump.
2. Press the ** Emma button to turn the pump on.
3. Open the 3-way tap to atmosphere.
4. Set the Rate to 125ml/h.
5. Press the ** VTBI** softkey and set VTBI to 10ml.
6. Press the ** Emma button and set the Pressure Alarm Limit to **L5**.
7. Configure the Calibrated Pressure Gauge to hold the Peak/MAX Pressure reading, in preparation for the test.
8. Press the ** Emma button to begin running the Pump at a rate of 125ml/h. Allow the Pump to run for 15 seconds, so that the pressure reading stabilises.
9. Turn the tap to occlude the Infusion Set into the pressure gauge.
10. The Pump will continue to infuse and it will be observed that the pressure reading increases. Eventually a high-pressure alarm will occur and the Pump will stop infusing. Note the reading on the pressure gauge and confirm that it is **500mmHg ±100mmHg**.
11. Open the 3-way tap to atmosphere.
12. Hold the ** Emma button down for approximately three seconds to turn the pump off.

**If the pressure is outside of tolerance pressure calibration is required. Calibration should be performed as per procedure in Chapter 2 ‘Configuration and Calibration’. If the pump continues to fail the occlusion test then the pressure sensors should be replaced and perform the calibration procedure again.**
Preventative Maintenance

Service Mode - Test Verification/PVP (continued)

Volumetric Accuracy
This test can be done as part of the PVP Work Flow or in the calibration menu.

1. Load the Infusion Set (60793) into the Pump and set-up as shown in Figure 3-2 below and adjust the fluid level so that the meniscus is level with the zero mark.

2. Press START to begin. Test will run and fluid will be delivered into the burette.

3. When Volume delivered! is displayed, check accumulated air in line value is less than 100μl then enter the volume delivered into the burette using the / / keys and the OK softkey. If accumulated air in line value is greater than 100μl then repeat test.

   If measured value is 19.3ml or less then enter 19.2ml and if values is 20.6ml or higher then enter 20.7ml.

4. If no calibration is required then press PASS to confirm and exit.

5. If the Calibration value is changed automatically then press VERIFY and repeat steps 2 to 4.

6. If the pump still fails replace the Platen and Fingers then repeat the calibration procedure.

VOLUMETRIC CALIBRATION

<table>
<thead>
<tr>
<th>Rate</th>
<th>125ml/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>VTBI</td>
<td>20.0ml</td>
</tr>
<tr>
<td>Cal Value</td>
<td>920</td>
</tr>
<tr>
<td>Acc’d Air</td>
<td>0μl</td>
</tr>
</tbody>
</table>

START to begin...

QUIT DETAILS START

Figure 3 - 2 Volumetric Accuracy Equipment Set Up
# Preventative Maintenance

## Performance Verification Procedure

<table>
<thead>
<tr>
<th>Model / Serial Number:</th>
<th>Service Order / Inventory Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Name / Reference:</td>
<td>Software Version:</td>
</tr>
</tbody>
</table>

### INSPECTION

**Physical inspection and clean**

- Check all functions in PVP Work Flow
  - Enter access code **212** and go to PVP Work Flow
    - Software Versions
    - Date/Time
    - Serial Number
    - Door Frame
    - Safety Clamp
    - Sear
    - Audio Test
    - Chequerboard
    - LED’s
    - Keypad
    - Nurse Call
    - RS232 Loop Back
    - Pumping Efficiency Test
      - Time taken = 2 minutes or less
      - Downstream Occlusion Pressure Test
        - Occlusion alarm = **500 ± 100 mmHg**
        - Alarms Functionality
    - Volumetric (Accuracy Test) Calibration
      - Delivery = **20 ml ± 0.6 ml (3%)**

### SELF TEST

- **Class I Type CF**
  - Earth Resistance Test <= **0.2 Ω**
  - Earth Leakage Current <= **500 μA**
  - Enclosure Leakage Current <= **100 μA**

### SETUP

- Set rate to zero (or lowest value possible), clear Volume Infused and VTBI

### ELECTRICAL SAFETY TESTS

- Alternatively attach printed test results
  - **Ω**
  - **μA**

### Verification Performed By

- **Sign**
- **Print**
- **Date**

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CH3 indicates the chapter number in the Technical Service Manual (TSM) - 1000SM00013.
E.G. CH2 = Refer to TSM Chapter 2.
Chapter 4

Troubleshooting

In this Chapter

- Log Downloads
- Introduction
- Software Fault Codes
- General Fault Diagnosis
- Exception Error Handling
Troubleshooting

Log Downloads

PC Setup (first time only)
1. Navigate through the Start menu, select Settings, then Network Connections.
2. Select New Connection Wizard.
3. Click Next.
4. Select Set up an advanced connection option and click Next.
5. Select Connect directly to another computer option and click Next.
6. Select Guest option and click Next.
7. Enter AlarisGP as the Computer Name and click Next.
8. Select the appropriate COM port and click Next.
9. Select the Connection Availability required and click Next.
10. Tick check box if a shortcut is required on the desktop and click Finish.
11. Connect AlarisGP Dialog box is displayed and click Properties.
12. On General tab click Configure.
13. Set Maximum speed (bps): to 115200, uncheck Enable Hardware flow control and click OK.
14. On Options tab check Display progress while connecting and uncheck Prompt for name and password, certificate, etc.
15. On Security tab click Settings.
16. Check Unencrypted password (PAP) only and click OK. Click Yes on the confirmation dialog that is displayed.
17. On Networking tab click Settings.
18. Check Enable LCP extensions and Enable software compression then click OK.
19. Check Internet Protocol (TCP/IP) and QoS Packet Scheduler, highlight Internet Protocol (TCP/IP) then click Properties.
20. Check Use the following IP address and enter an IP address of 192.168.3.2 then click Advanced.
21. Uncheck Use default gateway on remote network and click OK.
22. Click OK.
23. Click OK.
24. The PC will dial the pump, refer to download procedure.

PC Setup (second time)
1. Navigate through the Start menu, select Settings, then Network Connections AlarisGP.
2. The PC will dial the pump.
3. Refer to download procedure.

Event Log Download
1. Switch the pump on in Service Mode.
2. Once communication is established open a web browser and enter http://192.168.3.1 into the address bar.
3. Download log.

Warning -
At no time should the Event Log be downloaded while the pump is connected to a patient.

For pumps with software version v1.9.x and above also download the Presentation Style Sheet to enable the logs to be viewed (this file only needs to be downloaded once). Also the downloaded event log needs to be stored in the same directory as the Presentation Style Sheet. To view the downloaded event log open file with Microsoft Excel and select style sheet.
Introduction

Use this troubleshooting guide to help identify the cause of errors and faults which may occur as a result of damage to the pump or failure of an internal component. The following table lists the error messages and describes what action to take to resolve the problem. A general fault diagnosis checklist is also provided. For information on alarm procedures and messages, refer to the DFU.

Software Fault Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Module</th>
<th>Failure</th>
<th>Action/Replace</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFS1</td>
<td>Door Flow Stop</td>
<td>Flow Stop Sensor Fault</td>
<td>Clean AIL/Safety Clamp Housing.</td>
</tr>
<tr>
<td>DFS2</td>
<td></td>
<td>Sear Sensor Fault</td>
<td>Check connections and cables. AIL/Safety Clamp Housing.</td>
</tr>
<tr>
<td>DFS3</td>
<td></td>
<td>Platen Fault</td>
<td>Check door sensor and door are correctly positioned and not damaged. Door sensor, door or pressure sensors.</td>
</tr>
<tr>
<td>DFS4</td>
<td></td>
<td>Hall Fault</td>
<td></td>
</tr>
<tr>
<td>DFS5</td>
<td></td>
<td>Pressure System Fault</td>
<td>Pressure Sensors or Interface PCB.</td>
</tr>
<tr>
<td>DRV1</td>
<td>Drive</td>
<td>Park Fault</td>
<td>Chassis or Interface PCB.</td>
</tr>
<tr>
<td>DRV2</td>
<td></td>
<td>Motor Control Fault</td>
<td></td>
</tr>
<tr>
<td>DRV3</td>
<td></td>
<td>Linearisation Fault</td>
<td></td>
</tr>
<tr>
<td>DRV4</td>
<td></td>
<td>Inhibit Fault</td>
<td>Check Connections between Control and Interface PCBs. Chassis, Interface PCB or Control PCB.</td>
</tr>
<tr>
<td>DRV5</td>
<td></td>
<td>Rate Control Fault</td>
<td>Chassis or Interface PCB.</td>
</tr>
<tr>
<td>DRV6</td>
<td></td>
<td>Calibration Fault</td>
<td>Calibrate the pump. SD Card, Chassis or Interface PCB.</td>
</tr>
<tr>
<td>DSP1</td>
<td>Downstream Pressure Sensor Fault</td>
<td>Downstream pressure sensor, Interface PCB or cable.</td>
<td></td>
</tr>
<tr>
<td>DSP2</td>
<td></td>
<td>Calibration Fault</td>
<td>Calibrate pressure. SD Card, Downstream pressure sensor, Interface PCB or cable.</td>
</tr>
<tr>
<td>FLD1</td>
<td>Fluid Channel</td>
<td>Stale Fault</td>
<td>Check Connections between Control and Interface PCBs. Interface PCB.</td>
</tr>
<tr>
<td>FLD2</td>
<td></td>
<td>Volume Display Fault</td>
<td></td>
</tr>
<tr>
<td>FLW1</td>
<td>Drip Chamber</td>
<td>Measurement Fault</td>
<td>Check Flow Sensor. Try another Flow Sensor. Check cable connections to Interface PCB. Comms PCB or Interface PCB.</td>
</tr>
<tr>
<td>HDW1</td>
<td>Hardware</td>
<td>Excess Interrupts</td>
<td></td>
</tr>
<tr>
<td>HDW2</td>
<td></td>
<td>Stale</td>
<td>Control PCB or Interface PCB.</td>
</tr>
<tr>
<td>HDW3</td>
<td></td>
<td>Platform Fault</td>
<td></td>
</tr>
<tr>
<td>HDW4</td>
<td></td>
<td>Serial Number Corrupt</td>
<td></td>
</tr>
<tr>
<td>HDW5</td>
<td></td>
<td>ADC Reference Failure</td>
<td></td>
</tr>
<tr>
<td>IFS1</td>
<td>File System</td>
<td>Persistent Storage Fault</td>
<td>SD Card or Control PCB.</td>
</tr>
<tr>
<td>IFS2</td>
<td>Policies Cfg Fault</td>
<td></td>
<td>Configure and calibrate pump. SD Card or Control PCB.</td>
</tr>
</tbody>
</table>
## Software Fault Codes (continued)

<table>
<thead>
<tr>
<th>Code</th>
<th>Module</th>
<th>Failure</th>
<th>Action/Replace</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMI1</td>
<td>MMI</td>
<td>Primary Audio Fault</td>
<td>Speaker, Control PCB or Interface PCB.</td>
</tr>
<tr>
<td>MMI2</td>
<td>MMI</td>
<td>Stuck Key Fault_Stop</td>
<td></td>
</tr>
<tr>
<td>MMI3</td>
<td>MMI</td>
<td>Stuck Key Fault_Start</td>
<td></td>
</tr>
<tr>
<td>MMI4</td>
<td>MMI</td>
<td>Stuck Key Fault_OnOff</td>
<td></td>
</tr>
<tr>
<td>MMI5</td>
<td>MMI</td>
<td>Stuck Key Fault_IncInc</td>
<td></td>
</tr>
<tr>
<td>MMI6</td>
<td>MMI</td>
<td>Stuck Key Fault_Inc</td>
<td></td>
</tr>
<tr>
<td>MMI7</td>
<td>MMI</td>
<td>Stuck Key Fault_Dec</td>
<td></td>
</tr>
<tr>
<td>MMI8</td>
<td>MMI</td>
<td>Stuck Key Fault_DecDec</td>
<td></td>
</tr>
<tr>
<td>MMI9</td>
<td>MMI</td>
<td>Stuck Key Fault_Menu</td>
<td></td>
</tr>
<tr>
<td>MMI10</td>
<td>MMI</td>
<td>Stuck Key Fault_Bolus</td>
<td></td>
</tr>
<tr>
<td>MMI11</td>
<td>MMI</td>
<td>Stuck Key Fault_Soft1</td>
<td></td>
</tr>
<tr>
<td>MMI12</td>
<td>MMI</td>
<td>Stuck Key Fault_Soft2</td>
<td></td>
</tr>
<tr>
<td>MMI13</td>
<td>MMI</td>
<td>Stuck Key Fault_Soft3</td>
<td></td>
</tr>
<tr>
<td>MMI14</td>
<td>MMI</td>
<td>Stuck Key Fault_Mute</td>
<td></td>
</tr>
<tr>
<td>MMI15</td>
<td>MMI</td>
<td>Stuck Key Fault_Pressure</td>
<td></td>
</tr>
<tr>
<td>POW1</td>
<td>Power Monitor</td>
<td>Battery Fault</td>
<td>Battery or Control PCB.</td>
</tr>
<tr>
<td>POW2</td>
<td>Power Monitor</td>
<td>Charge Fault</td>
<td></td>
</tr>
<tr>
<td>PRG1</td>
<td>Program</td>
<td>Flow Control Fault</td>
<td></td>
</tr>
<tr>
<td>PRG2</td>
<td>Program</td>
<td>Abort Fault (Prg)</td>
<td>SD Card, Control PCB or Interface PCB.</td>
</tr>
<tr>
<td>PRG3</td>
<td>Program</td>
<td>Abort Fault (data)</td>
<td></td>
</tr>
<tr>
<td>PRG4</td>
<td>Program</td>
<td>Critical Data Corruption Fault</td>
<td></td>
</tr>
<tr>
<td>PRG5</td>
<td>Program</td>
<td>Image Corruption</td>
<td></td>
</tr>
<tr>
<td>PRG6</td>
<td>Program</td>
<td>Assertion Fault</td>
<td></td>
</tr>
<tr>
<td>REM1</td>
<td>Remote Comms</td>
<td>Nurse Call Failure</td>
<td>Check Comms connections. Comms PCB or Control PCB.</td>
</tr>
<tr>
<td>RTC1</td>
<td>Instrument</td>
<td>RTC Init Failure</td>
<td>Configure clock. Perform cold start. Control PCB.</td>
</tr>
<tr>
<td>RTC2</td>
<td>Instrument</td>
<td>RTC Overflow Imminent</td>
<td></td>
</tr>
<tr>
<td>SCM1</td>
<td>UpstreamPressure</td>
<td>Pump Crisis</td>
<td>Switch pump off and then back on. Control PCB or Interface PCB.</td>
</tr>
<tr>
<td>USP1</td>
<td>UpstreamPressure</td>
<td>Sensor Fault</td>
<td>Upstream pressure sensor, Interface PCB or cable.</td>
</tr>
<tr>
<td>USP2</td>
<td>UpstreamPressure</td>
<td>Calibration Fault</td>
<td>Calibrate pressure. SD Card, Upstream pressure sensor, Interface PCB or cable.</td>
</tr>
</tbody>
</table>
## Troubleshooting

### General Fault Diagnosis

<table>
<thead>
<tr>
<th>Failure</th>
<th>Action/Replace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display missing vertical lines</td>
<td></td>
</tr>
<tr>
<td>No response from keypad or LED</td>
<td>If Control PCB is issue 9 and below, then replace with latest issue Control PCB.</td>
</tr>
<tr>
<td>Safety alarm is activated</td>
<td></td>
</tr>
<tr>
<td>Failure of RS232 communications</td>
<td>Replace Comms PCB.</td>
</tr>
</tbody>
</table>

### Parts to Check/Test

<table>
<thead>
<tr>
<th>General Fault</th>
<th>Front Case</th>
<th>Rear Case</th>
<th>Labels &amp; Keypads</th>
<th>Mechanism</th>
<th>Control PCB</th>
<th>Interface PCB</th>
<th>Power PCB</th>
<th>Display PCB</th>
<th>Door</th>
<th>Battery</th>
<th>Mains Lead</th>
<th>Fuses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dropped or damaged</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Exposed to fluids</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No battery power</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No AC mains power</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Delivery rates out of tolerance</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

### Exception Error Handling

Exception errors include Assertion Errors and are used to trap logical errors in the software execution.

The pump will display the error type, the title of the software module in which the error occurred and the line number. The user should make a note of these for use in diagnosis. This information is stored in the event log.

After an error, the pump will not store information when powered down. When the pump is switched on again, the user should always confirm clear setup.
Chapter 5

Circuit Descriptions

In this chapter

- Functional Module Block Diagram 45
- Module Overview Functional Description 46
Module Overview Functional Description

The Pumps are designed to be serviced generally to major assembly level. The PCBs are designed as non-serviceable items and as such, can only be replaced as complete parts.

The major assemblies are:
- Control PCB
- Display PCB
- IrDA Flexible PCB
- Motor Encoder PCB
- Door Detect Flexible PCB
- Power Supply PCB
- AIL/Safety Clamp Housing
- Battery Pack
- Membrane Keypad
- Motor
- GP Pressure PCB x 2
- IEC Mains Inlet
- Comm PCB
- SD card

Cardinal Health will make available, on request, circuit diagrams which will assist appropriately qualified technical personnel to repair those parts of the device which are designated by the manufacturer as repairable.

Control PCB

The Control PCB is broken into a number of functional blocks. A description of each block follows:

- Main Processor Module
  At the heart of the system, the main processor provides all the high level control functionality. It processes data provided by the safety processor and fluid delivery processor and provides the interface to the user via the display, keypad, audible alarm and LED driver. It also provides external communications via the RS232 Nurse Call and IrDA interfaces. The main processors memory consists of a secure digital (SD) memory card (Industrial Grade) SDRAM and Boot Flash. The firmware is stored on the SD card and copied into the SDRAM at power-up and executed. Event logs, calibration information and other systems configuration information are also stored on the SD card.

- Safety Processor Module
  Running from an independent power supply provided by a rechargeable lithium coin cell battery the safety processor monitors the operation of the main processor and fluid delivery processor. In the event of a fault it is able to sound a secondary alarm, illuminate the alarm beacon and stop the motor. It also provides real time clock and power on/ off functionality.

- Power Management and Power Regulation Modules
  The power management module consists of a multi-chemistry smart battery charger controlled by the gas gauge within the battery pack. Power from the battery and the mains power supply unit is routed through a number of switches which provide a smooth transition between mains and battery operation. The power regulation module provides regulated supply rails for the display back light and the digital and analogue systems.

- Audible Alarm Module
  The primary audible alarm controlled by the main processor module and independently monitored by the safety processor. Alarm tones are derived from a PWM signal generated by the main processor. The signal is passed through a limiter and active filter before being amplified and output via the speaker. The safety processor measures the amount of current passing through the speaker to determine correct operation.

Interface PCB

The Interface PCB provides all the low level control and monitoring functionality of the system. It is broken into the following functional blocks:

- Fluid Delivery Processor Module
  This module provides the interface between the motor drive and sensor systems and the main processor.

- Drop Sensor Module
  This module provides the interface between the fluid delivery processor and an IVAC® 180 Flow Sensor. It incorporates automatic gain control to minimise the effects of fogging and changes in ambient light levels. Connection of the drop sensor is automatically detected.

- Pressure Measurement Module
  The fluid delivery processor connects to the upstream and downstream pressure transducers via its internal analogue to digital converter. The fluid delivery processor is able to determine if the sensors are working correctly by monitoring the voltage across the force transducer and by switching in a known offset to the amplifier.

- Encoder Interface Module
  Using optical encoders the fluid delivery processor is able to determine the direction and speed of the motor, the position of the cam, the status of the door seers and the flow stop device.

- Air In Line Module
  This is an ultrasonic system used to detect air bubbles in the line. A swept frequency signal is used to excite the piezo crystals in the AIL/Safety Clamp Housing. When fluid is present in the tube the signal is coupled across the gap and received by another piezo crystal. The received signal is amplified and passed through a detector to indicate whether air or fluid is present in the line.

- Motor Drive Module
  The fluid delivery processor generates three PWM control signals which are used to determine the amount of current flowing through each phase of the stepper motor. The motor is driven using micro steps. The Safety Processor is able to prevent operation of the motor if it believes that a system fault has occurred.
Module Overview Functional Description (continued)

**Display PCB**
This is an ISTN negative mode graphics display with built in temperature compensation.

**Comms PCB and IrDA Flexible PCB**
Data from the main processor is routed via this board to either the isolated RS232 interface or the IrDA interface. An isolated nurse call interface is also provided via the RS232 connector. The status of the nurse call relay is monitored and fed back to the safety processor.

**GP Pressure PCB**
Two pressure boards are used, one above the pumping mechanism to measure upstream pressure and one below to measure down stream pressure. The tubing is compressed against a force transducer. As pressure builds up in the line the tubing expands and hence the force measured increases. Similarly as the pressure falls the tubing contracts and the force decreases. The software converts the force into a relative pressure measurement. The pressure board contains a silicon bridge force sensor, an instrumentation amplifier and diagnostic systems to check gain and the voltage across the force sensor.

**Motor Encoder PCB**
The Motor Encoder PCB sits above the encoder wheel. The wheel consists of two discs one with multiple teeth the other with a single slot. The wheel with the multiple teeth runs through a dual channel slotted optical switch which produces two digital encoder signals. The fluid delivery processor is able to interpret the phase and frequency of these signals to determine the speed and direction of the cam shaft. The disc with the single slot runs through a single channel slotted optical switch that produces a single digital signal from which the mechanism can be set into the park position.

**Air In Line(AIL)/Safety Clamp Housing**
The AIL/Safety Clamp Housing contains the ultra sonic piezo transducers used by the air in line system. These transducers connect to the Interface PCB via the Air In Line Flexible PCB. A reflective optical sensor in the AIL/Safety Clamp Housing allows the fluid delivery processor to determine the status of the seers used to retract the flow stop. A photo transistor and a photo diode are used to determine if the Safety Clamp slide is open or closed. All the drives to the optical sensors are modulated to prevent cross talk and determine correct operation. The optical sensors connect to the Interface PCB via the Safety Clamp Detect Flexible PCB.

**Door Detect Flexible PCB**
The status of the door is monitored using a magnet embedded in the door frame and a digital Hall Effect device mounted on the end of the Door Detect Flexible PCB.

**Battery Pack**
The battery pack contains a smart gas gauge device that provides charge information to the charger and the status of the battery (capacity, voltage, current and temperature) to the main processor. The pack also contains a thermal fuse and thermal cut out. The battery will be charged when ever the unit is connected to the main supply.

**Power Supply**
A universal input switched mode power supply used to regulate the mains input voltage.

**Membrane Keypad**
The membrane keypad consists of fourteen keys and LED’s to indicate battery, mains, start and stop. The on / off key connects to the main processor and the safety processor. The safety processor manages the power up sequence and the main processor power down.

**IEC Mains Inlet**
A medical grade filtered mains inlet with fuses in the live and neutral lines. The fuses can be accessed by removing the external splash cover and opening the fuse draw.

**Motor**
A three phase stepper motor coupled to the cam shaft by a toothed drive belt. The motor does 5,689 microsteps per ml.
Corrective Maintenance

In this chapter

- Corrective Maintenance 49
- Torque Guide 50
- Access To Pump 51
- Rear Case and Subassemblies 53
- Front Case and Subassemblies 59
- Keypads and Labels 66
Corrective Maintenance

Ensure the pump is disconnected from the AC power supply and switched off before attempting to service.

⚠️ The pump contains static-sensitive components and therefore strict ESD precautions should be observed at all times.

Batteries should be disposed of as outlined by the local country regulations. Do not send batteries back to the manufacturer.

Only use Cardinal Health recommended spare parts.

This chapter contains procedures required to properly disassemble, repair and replace parts and then to reassemble the pump.

Following all spare part replacement and repair activities, testing must be performed in accordance with the Performance Verification Procedure (PVP), see Chapter 3, ‘Preventative Maintenance’. Additional testing and calibration may be required after certain repairs are completed, see table below for more information.

<table>
<thead>
<tr>
<th>Repair/Replacement of</th>
<th>Front Case</th>
<th>Rear Case</th>
<th>Labels &amp; Keypads</th>
<th>Chassis / Pump Mechanism</th>
<th>Control PCB</th>
<th>Power PCB</th>
<th>Display PCB</th>
<th>Interface PCB</th>
<th>Battery</th>
<th>Pressure Sensors</th>
<th>Door</th>
<th>AIL/Safety Clamp</th>
<th>Housing</th>
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<tr>
<td>Performance Verification Procedure</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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</tr>
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</tbody>
</table>

✓ = Required
Blank = Optional
Torque Guide

The torque levels established during the manufacturing process are outlined in this chapter, for example 40cNm. Torque levels selected apply throughout product life.

Use the information as a guide to the 'do not exceed' torque levels when servicing the pump. When servicing, it is recommended that torque is applied gradually until the component is secure. In any process do not exceed the stated levels.

If a torque driver is available for servicing this will help control the applied torque; otherwise, be aware that excess force may cause the component to fail.

- Always use the correct torque level when performing an assembly stage.
- Take care with the torque applied when re-assembling parts.
- The head patterns of the fasteners are of the following types:
  - Torx T8
  - Torx T10
  - Allen key 2mm
  - Small flat blade
  - Hex 4.5mm
  - Hex 10mm
- Always select the correct tool and bit pattern for the fastener.
Corrective Maintenance

Access To Pump

Replacement Procedure
1. Remove the two case screws with integral flat washer in battery cover, remove cover and battery.
2. Remove the five case screws with integral flat washer.
3. Carefully separate case halves.
4. Remove screw holding earth cable to mechanism and disconnect four other cables.
5. Where necessary, remove the feet and/or seal.
6. Reassemble in reverse order.

Spare parts

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Asena LVP Battery Pack</td>
<td>1000SP00487</td>
</tr>
<tr>
<td>B</td>
<td>Cover Battery Asena LVP</td>
<td>1000ME00589</td>
</tr>
<tr>
<td>C</td>
<td>Alaris GP Fastener Spares Kit</td>
<td>1000SP01252</td>
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<tr>
<td>D</td>
<td>Foot Battery Cover Asena LVP</td>
<td>1000ME00590</td>
</tr>
<tr>
<td>E</td>
<td>Foot Front Asena LVP</td>
<td>1000ME00649</td>
</tr>
<tr>
<td>F</td>
<td>Seal Case Nickel/graphite</td>
<td>1000ME01611</td>
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<tr>
<td>G</td>
<td>Alaris GP Rear Case Kit</td>
<td>1000SP01250</td>
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<tr>
<td>H</td>
<td>Alaris GP Front Case Kit</td>
<td>1000SP01248</td>
</tr>
</tbody>
</table>
Access To Pump (continued)

(C) Screw/Washer (x5) 40cNm

(E) Feet (x2)

(F) Case seal

(G) Rear Case kit

(H) Front Case kit

(C) Screw 70cNm
Power Supply Unit (PSU) & Speaker

Replacement Procedure
1. Disconnect the Mains Inlet cable.
2. Remove the three PSU screws.
3. Remove earth wire screw and washer.
4. Remove PSU and insulator.
5. Pull the speaker up and out.
6. Reassemble in reverse order.

Spare parts

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
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<tbody>
<tr>
<td>A</td>
<td>Alaris GP PSU PCB Kit</td>
<td>1000SP01305</td>
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<tr>
<td>B</td>
<td>Alaris GP Speaker KIt</td>
<td>1000SP01306</td>
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<tr>
<td>C</td>
<td>Alaris GP Fastener Spares Kit</td>
<td>1000SP01252</td>
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<tr>
<td>D*</td>
<td>Pad Self Adhesive Double Sided 12x12mm</td>
<td>0000ME00423</td>
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</table>

* Item not shown
Mains inlet, IrDA PCB, PE stud and magnet

Replacement Procedure
1. Remove nut and washer to remove PE stud.
2. Remove the two screws on Mains inlet retaining plate.
3. Remove mains inlet retaining plate.
4. Remove magnet by lifting one end.
5. Unclip IrDA PCB and remove.
6. Unclip Mains Inlet and remove.
7. Reassemble in reverse order.

Spare parts

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Alaris GP Mains Inlet Kit</td>
<td>1000SP01251</td>
</tr>
<tr>
<td>B</td>
<td>Alaris GP IrDA PCB Flexi Kit</td>
<td>1000SP01308</td>
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<tr>
<td>C</td>
<td>Alaris GP Fastener Spares Kit</td>
<td>1000SP01252</td>
</tr>
<tr>
<td>D</td>
<td>Magnet IR Detect</td>
<td>1000ME01303</td>
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<tr>
<td>E</td>
<td>Stud PE Connector M6 Thread X 15</td>
<td>0000ME00141</td>
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<td>*</td>
<td>BussmannFuse Gmd-1.25A</td>
<td>0000ME00770</td>
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</tbody>
</table>
Pole clamp

Replacement Procedure
1. Remove three pole clamp screws.
2. Reassemble in reverse order.

Spare parts

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<th>Item</th>
<th>Description</th>
<th>Part Number</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Asena SP, Assy, Pole Clamp</td>
<td>1000SP00115</td>
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<tr>
<td>B</td>
<td>Alaris GP Fastener Spares Kit</td>
<td>1000SP01252</td>
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</tbody>
</table>
Rear Case and Subassemblies (continued)

**Rail cam**

**Replacement Procedure**
1. Remove screw from lever release.
2. Remove screw from lever rail cam.
3. Remove spring from the lever rail cam.
4. Reassemble in reverse order.

**Spare parts**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Alaris GP Docking Station Kit</td>
<td>1000SP01307</td>
</tr>
<tr>
<td>B</td>
<td>Alaris GP Fastener Spares Kit</td>
<td>1000SP01252</td>
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<tr>
<td>C</td>
<td>Alaris SP Cam Rail Clamp Only Kit</td>
<td>1000SP01323</td>
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</table>
Rear Case and Subassemblies (continued)

RS232 Connector & Comms PCB

Replacement Procedure
1. Remove two retaining screws and washers from assembly.
2. Remove RS232 connector cover and two RS232 socket screws.
4. Reassemble in reverse order.

Spare parts

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>Alaris GP Comms PCB Kit</td>
<td>1000SP01256</td>
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<tr>
<td>B</td>
<td>Cover RS232</td>
<td>1000ME01745</td>
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<td>C</td>
<td>Alaris GP Fastener Spares Kit</td>
<td>1000SP01252</td>
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<tr>
<td>D</td>
<td>Asena GW, Assy, Cover Dust Drop Sensor</td>
<td>1000ME00291</td>
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<tr>
<td>E</td>
<td>Fuse Cover</td>
<td>1000ME00655</td>
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Rear Case and Subassemblies (continued)

Handle

Replacement Procedure
1. Remove two screw from handle block.
2. Remove handle block, handle spring and handle.
3. Reassemble in reverse order.

Refitting notes:
1) Make sure that the handle spring is in front of the handle and not behind it.

Spare parts

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Asena LVP Overmould Handle</td>
<td>1000ME01845</td>
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<tr>
<td>B</td>
<td>Handle Spring Asena LVP</td>
<td>1000ME00630</td>
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<tr>
<td>C</td>
<td>Asena LVP Handle Retaining Block</td>
<td>1000ME00632</td>
</tr>
<tr>
<td>D</td>
<td>Alaris GP Fastener Spares Kit</td>
<td>1000SP01252</td>
</tr>
</tbody>
</table>
Door

Replacement Procedure

1. Remove the two screws securing the hinge locks.
2. Open the two hinge locks.
3. Remove the door.
4. Unscrew the two hinge pins.
5. Reassemble in reverse order.

Spare parts

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
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<tbody>
<tr>
<td>A</td>
<td>Asena LVP Assembly Membrane</td>
<td>1000ME00667</td>
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<td>B</td>
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Door continued

**Spare parts**

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<tbody>
<tr>
<td>A</td>
<td>Alaris GP Hinge Pin Kit</td>
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</tr>
<tr>
<td>B</td>
<td>Alaris GP Door Kit</td>
<td>1000SP01244</td>
</tr>
</tbody>
</table>

(A) **Hinge pin (x2) 60cNm**

(A) **Hinge pin seal (x2)**

(B) **Door**
Front Case and Subassemblies (continued)

Chassis assembly

Replacement Procedure
1. Disconnect four cables from the Interface PCB and one cable from the Control PCB.
2. Remove the two screws securing the roller mounting.
3. Remove the roller mounting and gasket.
4. Remove the snap rivet securing the door detector flexible circuit.
5. Remove the two screws securing the chassis.
6. Carefully withdraw the chassis.
7. Reassemble in reverse order.

Spare parts

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Alaris GP Roller Mounting Bracket Kit</td>
<td>1000SP01303</td>
</tr>
<tr>
<td>B</td>
<td>Alaris GP Fastener Spares Kit</td>
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</tr>
</tbody>
</table>
Front Case and Subassemblies (continued)

Chassis assembly breakdown

Replacement Procedure
1. Carefully withdraw the chassis.
2. Remove four screws securing the motor.
3. Remove the motor and gasket.
4. Unclip and remove the pressure sensors.
5. Reassemble in reverse order.

Spare parts

<table>
<thead>
<tr>
<th>Item</th>
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<td>Alaris GP Fastener Spares Kit</td>
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<td>C</td>
<td>Alaris GP Pumping Mech (Minus Motor) Kit</td>
<td>1000SP01247</td>
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<td>D</td>
<td>Alaris GP Pressure Sensor Kit</td>
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<td>E</td>
<td>V Seals Hinge Pins V5a-NBR</td>
<td>0000ME00767</td>
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Control PCB and Interface PCB

Replacement Procedure

1. Disconnect display and keypad cables from Control PCB.
2. Remove the three retaining screws and washers.
3. Remove the three pillar supports.
4. When fitting Control PCB ensure all flexi and cables are routed clear of PCB.
5. Reassemble in reverse order.

Spare parts

<table>
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<tr>
<th>Item</th>
<th>Description</th>
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<tbody>
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<td>B</td>
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</tr>
</tbody>
</table>

Note: Three Pillar Supports are supplied with both PCB kits.
Front Case and Subassemblies (continued)

Display PCB

Replacement Procedure
1. Remove the two fixing screws from display frame.
2. Remove Display Frame and Gasket as required.
3. Reassemble in reverse order.

Spare parts

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Alaris GP Display Kit</td>
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<td>B</td>
<td>Alaris GP Display Accessories Kit</td>
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<tr>
<td>C</td>
<td>Alaris GP Fastener Spares Kit</td>
<td>1000SP01252</td>
</tr>
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</table>
**AIL/Safety Clamp Housing, Top Retainer & Door Sensor Flexible Circuit**

**Replacement Procedure**
1. Remove the four fixing screws from AIL/Safety Clamp Housing.
2. Remove AIL/Safety Clamp Housing and remove seal as required.
3. Remove one screw securing coloured insert as required.
4. Remove one screw from Top Retainer.
5. Remove Top Retainer and remove O ring as required.
6. Remove Door Sensor Flexible Circuit as required.
7. Reassemble in reverse order.

**Refitting notes:**
1) Door Sensor Flexible Circuit is retained using hot melt glue.
2) The Screw (F) for the insert torque is 25cNm instead of the original 10cNm due to the new insert plastic which is more tolerant and will not crack. Any cracked Inserts should be replaced by the kit part number 1000SP01417.

**Spare parts**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
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<td>A</td>
<td>Alaris GP AIL/Safety Clamp Housing Kit</td>
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<td>B</td>
<td>Door Detect Flexible Circuit</td>
<td>1000EL00643</td>
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<tr>
<td>C</td>
<td>Alaris GP Fastener Spares Kit</td>
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<tr>
<td>D</td>
<td>Asena LVP GP Top Retainer</td>
<td>1000ME00701</td>
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<td>E</td>
<td>Seal O Ring 6ID 1CSDIA Silicon</td>
<td>0000ME00691</td>
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<tr>
<td>F</td>
<td>Spares Kit (Orange Clip &amp; Screw)</td>
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Corrective Maintenance

Keypads and Labels

Replacement Procedure
1. Discard keypad when removed as it cannot be reused.
2. Fit replacement keypad after removing backing paper from underside. Handle replacement keypad carefully to avoid damage.
3. Remove label(s) from case as required.
4. Clean case where replacement label(s) are to be fitted.
5. Fit replacement label(s) taken from label sheet as required.
6. Ensure keypad membrane flexi tail is routed correctly.

Spare parts

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Alaris GP Keypad BOM</td>
<td>1000LB00623</td>
</tr>
<tr>
<td>B</td>
<td>Alaris GP Door Label Set</td>
<td>1000LB01040</td>
</tr>
<tr>
<td>B</td>
<td>Alaris GP Guardrails Door Label</td>
<td>1000LB01475</td>
</tr>
<tr>
<td>C</td>
<td>Alaris GP Label Set BOM</td>
<td>1000LB00614</td>
</tr>
</tbody>
</table>
Keypads and Labels (continued)

C.1

C.2

C.3

Serial Information box
Appendix A

Electromagnetic Compatibility
Warning:
- The use of any accessory, transducer, or cable with the Pump other than those specified may result in increased emissions or decreased immunity of the pump.
- The Pump should not be used adjacent to or stacked with other equipment, however if adjacent or stacked use is necessary, the Pump should be observed to verify normal operation in the configuration in which it will be used.

Caution:
- The Pump is a CISPR 11 Group 1 Class B Medical Equipment System and intended for use by healthcare professionals only.
- Medical Electrical Equipment needs special precautions regarding EMC and needs to be installed, put into service and used according to the EMC information provided in the accompanying documents.
- Portable and Mobile RF communications can affect Medical Electrical Equipment.
- Operating the Pump near equipment which radiates high energy radio frequencies (electro surgical or cauterizing equipment, portable radios, cellular telephones, etc.) may cause false alarm conditions. If this happens, reposition the Pump away from the source of interference or turn off the Pump and manually regulate the flow.

Guidance and Manufacturer’s Declaration – Electromagnetic Emissions
The Pump is intended for use in the electromagnetic environment specified below. The customer or the user of the Pump should assure that it is used in such an environment.

<table>
<thead>
<tr>
<th>Emissions Test</th>
<th>Compliance</th>
<th>Electromagnetic Environment – Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>CISPR 11 RF Emissions</td>
<td>Group 1</td>
<td>The pump uses RF energy only for its internal function in the normal product offering. Therefore, its RF emissions are very low and are not likely to cause any interface in nearby electronic equipment.</td>
</tr>
<tr>
<td>CISPR 11 RF Emissions</td>
<td>Class B</td>
<td></td>
</tr>
<tr>
<td>EN 61000-3-2 Harmonic Emissions</td>
<td>Class A</td>
<td>The pump is suitable for use in all establishments, including domestic, and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.</td>
</tr>
<tr>
<td>EN 61000-3-3 Voltage Fluctuations, Flicker Emissions</td>
<td>Complies</td>
<td></td>
</tr>
</tbody>
</table>
# Guidance and Manufacturer's Declaration - Electromagnetic Immunity

The Pump is intended for use in the electromagnetic environment specified below. The customer or the user of Pump should assure that it is used in such an environment.

<table>
<thead>
<tr>
<th>Immunity Test</th>
<th>Compliance Level EN 60601-2-24</th>
<th>Electromagnetic Environment – Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 61000-4-2 Electro-Static Discharge (ESD)</td>
<td>±8 kV contact (Note 2) ±15 kV air (Note 2)</td>
<td>Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.</td>
</tr>
<tr>
<td>EN 61000-4-4 Electrical Fast Transient, Burst (EFT) (Note 3)</td>
<td>±2 kV for power supply lines N/A (Note 4)</td>
<td>Mains power quality should be that of a typical commercial or hospital environment.</td>
</tr>
<tr>
<td>EN 61000-4-5 Power Line Surge (Note 3)</td>
<td>±1 kV Line(s) to Line(s) ±2 kV Line(s) to Earth</td>
<td>Mains power quality should be that of a typical commercial or hospital environment.</td>
</tr>
<tr>
<td>EN 61000-4-8 Power Frequency Magnetic Field (50/60 Hz)</td>
<td>400 A/m 50 Hz (Note 2)</td>
<td>Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.</td>
</tr>
<tr>
<td>EN 61000-4-11 Voltage Dips, Short Interruptions, and Voltage Variations (Note 3)</td>
<td>&lt;5 % ( U_T ) (&gt;95 % dip in ( U_T )) for 0.5 cycle 40 % ( U_T ) (60 % dip in ( U_T )) for 5 cycles 70 % ( U_T ) (30 % dip in ( U_T )) for 25 cycles &lt;5 % ( U_T ) (&gt;95 % dip in ( U_T )) for 5 sec</td>
<td>Mains power quality should be that of a typical commercial or hospital environment. If the user of the pump requires continued operation during power mains interruptions, it is recommended that the pump be powered from an uninterruptible power supply or a battery. The pump does employ an internal short duration battery.</td>
</tr>
</tbody>
</table>

Note 1—\( U_T \) is the AC mains voltage prior to application of the test level.

Note 2—Compliance levels raised by EN 60601-2-24.

Note 3—Performed at the Minimum and Maximum Rated Input Voltage.

Note 4—Cardinal Health recommends using signal cables of less than 3 meters in length and this requirement is applicable only if signal cables are 3 meters or more in length. (EN 60601-1-2:2002, Clause 36.202.4)
The Pump is intended for use in the electromagnetic environment specified below. The customer or the user of the Pump should ensure that it is used in such an environment.

<table>
<thead>
<tr>
<th>Immunity Test</th>
<th>Compliance Level</th>
<th>Electromagnetic Environment – Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 61000-4-6</td>
<td>10 V rms</td>
<td>Portable and mobile RF communications equipment should be used no closer to any part of the pump, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.</td>
</tr>
<tr>
<td>EN 61000-4-3</td>
<td>10 V/m</td>
<td>Recommended Separation Distance</td>
</tr>
</tbody>
</table>

Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range. Interference may occur in the vicinity of equipment marked with the following symbol:

Note 1—At 80 MHz and 800 MHz, the higher frequency range applies.
Note 2—These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.
Note 3—Compliance levels raised by EN 60601-2-24.

The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges.

Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the pump is used exceeds the applicable RF compliance level above, the pump should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the pump.

Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.
Recommended Separation Distances for LIFE SUPPORT Equipment between portable and mobile RF communications equipment and the Pump

The Pump is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The user of the Pump can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Pump as recommended below, according to the maximum output power of the communications equipment.

<table>
<thead>
<tr>
<th>Rated Maximum Output Power of Transmitter (W)</th>
<th>Separation Distance According to Frequency of Transmitter (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 kHz to 80 MHz Outside ISM bands 3.5</td>
<td>$d = \left[\frac{-}{\sqrt{P}}\right]$</td>
</tr>
<tr>
<td>150 kHz to 80 MHz In ISM bands 12</td>
<td>$d = \left[\frac{-}{\sqrt{P}}\right]$</td>
</tr>
<tr>
<td>80 MHz to 800 MHz 12</td>
<td>$d = \left[\frac{-}{\sqrt{P}}\right]$</td>
</tr>
<tr>
<td>800 MHz to 2.5 GHz 23</td>
<td>$d = \left[\frac{-}{\sqrt{P}}\right]$</td>
</tr>
<tr>
<td>0.01 W</td>
<td>0.03</td>
</tr>
<tr>
<td>0.1 W</td>
<td>0.11</td>
</tr>
<tr>
<td>1 W</td>
<td>0.35</td>
</tr>
<tr>
<td>10 W</td>
<td>1.11</td>
</tr>
<tr>
<td>100 W</td>
<td>3.50</td>
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<tr>
<td>0.12 W</td>
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<td>0.38 W</td>
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<td>1.20 W</td>
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<tr>
<td>3.80 W</td>
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<tr>
<td>12.00 W</td>
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<tr>
<td>0.23 W</td>
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<tr>
<td>0.73 W</td>
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<td>2.30 W</td>
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<tr>
<td>7.28 W</td>
<td>7.28</td>
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<tr>
<td>23.00 W</td>
<td>23.00</td>
</tr>
</tbody>
</table>

For transmitters rated at a maximum output power not listed above, the recommended separation distance $d$ in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where $P$ is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1—At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
Note 2—The ISM (Industrial, Scientific, and Medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.
Note 3—An additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas.
Note 4—These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.
Appendix B

Disposal
Disposal

Ensure the Pump is disconnected from the AC power supply and switched off before attempting to service.

⚠️ The Pump contains static-sensitive components and therefore strict ESD precautions should be observed at all times.

Only use Cardinal Health recommended spare parts.

Following all spare part replacement and repair activities, testing must be performed in accordance with the Performance Verification Procedure (PVP), see Chapter 3 ‘Preventative Maintenance’.

Information on Disposal for Users of Waste Electrical & Electronic Equipment

This symbol on the product and/or accompanying documents means that used electrical and electronic products should not be mixed with municipal waste.

If you wish to discard electrical and electronic equipment, please contact your Cardinal Health affiliate office or distributor for further information.

Disposing of this product correctly will help to save valuable resources and prevent any potential negative effects on human health and the environment which could otherwise arise from inappropriate waste handling.

Information on Disposal in Countries outside the European Union

This symbol is only valid in the European Union. The product should be disposed of taking environmental factors into consideration. To ensure no risk or hazard, remove the internal rechargeable battery and the Nickel Metal Hydride battery from the control board and dispose of as outlined by the local country regulations. All other components can be safely disposed of as per local regulations.

Battery Removal

Removal Procedure

Remove the two case screws with integral flat washer in battery cover, remove cover and battery.
Spare Parts Listing

In this chapter

- Spare Parts Kits 76
- Individual Components 77
- Keypad & Labels 77
- Software 77
- Test Equipment 77
- Kit Bill Of Materials (BOM) 78
## Spare Parts Kits

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000SP01244</td>
<td>Alaris GP Door Kit</td>
</tr>
<tr>
<td>1000SP01246</td>
<td>Alaris GP Hinge Pin Kit</td>
</tr>
<tr>
<td>1000SP01247</td>
<td>Alaris GP Pumping Mech (Minus Motor) Kit</td>
</tr>
<tr>
<td>1000SP01248</td>
<td>Alaris GP Front Case Kit</td>
</tr>
<tr>
<td>1000SP01249</td>
<td>Alaris GP AIL/Safety Clamp Housing Kit</td>
</tr>
<tr>
<td>1000SP01250</td>
<td>Alaris GP Rear Case Kit</td>
</tr>
<tr>
<td>1000SP01251</td>
<td>Alaris GP Mains Inlet Kit</td>
</tr>
<tr>
<td>1000SP01252</td>
<td>Alaris GP Fastener Spares Kit</td>
</tr>
<tr>
<td>1000SP01253</td>
<td>Alaris GP Battery Compartment Kit</td>
</tr>
<tr>
<td>1000SP01254</td>
<td>Alaris GP Pressure Sensor Kit</td>
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<tr>
<td>1000SP01255</td>
<td>Alaris GP Display Kit</td>
</tr>
<tr>
<td>1000SP01256</td>
<td>Alaris GP Comms PCB Kit</td>
</tr>
<tr>
<td>1000SP01296</td>
<td>Alaris GP Motor Kit</td>
</tr>
<tr>
<td>1000SP01297</td>
<td>Alaris GP Display Accessories Kit</td>
</tr>
<tr>
<td>1000SP01298</td>
<td>Alaris GP Control PCB Kit</td>
</tr>
<tr>
<td>1000SP01299</td>
<td>Alaris GP SD Card Kit</td>
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<tr>
<td>1000SP01300</td>
<td>Alaris GP Interface PCB Kit</td>
</tr>
<tr>
<td>1000SP01301</td>
<td>Alaris GP Encoder PCB Kit</td>
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<tr>
<td>1000SP01302</td>
<td>Alaris GP Battery Pack Kit</td>
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<tr>
<td>1000SP01303</td>
<td>Alaris GP Roller Mounting Bracket Kit</td>
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<tr>
<td>1000SP01304</td>
<td>Alaris GP Feet Kit</td>
</tr>
<tr>
<td>1000SP01305</td>
<td>Alaris GP PSU PCB Kit</td>
</tr>
<tr>
<td>1000SP01306</td>
<td>Alaris GP Speaker Kit</td>
</tr>
<tr>
<td>1000SP01307</td>
<td>Alaris GP Docking Station Kit</td>
</tr>
<tr>
<td>1000SP01308</td>
<td>Alaris GP IrDA PCB Flexi Kit</td>
</tr>
<tr>
<td>1000SP00115</td>
<td>Asena SP, Assy, Pole Clamp</td>
</tr>
<tr>
<td>1000SP00487</td>
<td>Asena LVP Battery Pack</td>
</tr>
<tr>
<td>1000SP01417</td>
<td>Spares Kit (Orange Clip &amp; Screw)</td>
</tr>
<tr>
<td>1000SP01323</td>
<td>Alaris SP Cam Rail Clamp Only Kit</td>
</tr>
</tbody>
</table>
### Individual Components

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<tr>
<th>Part Number</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>0000ME00141</td>
<td>Stud PE Connector M6 Thread X 15</td>
</tr>
<tr>
<td>0000ME00768</td>
<td>Cables Ties Hayco 3623793</td>
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<tr>
<td>0000ME00770</td>
<td>Bussmann Fuse Gmd-1.25a</td>
</tr>
<tr>
<td>1000EL00605</td>
<td>Drop Sensor Cable</td>
</tr>
<tr>
<td>1000EL00606</td>
<td>RS232 Nurse Call Cable</td>
</tr>
<tr>
<td>1000EL00607</td>
<td>PSU Cable</td>
</tr>
<tr>
<td>1000ME00291</td>
<td>Asena GW, Assy, Cover Dust Drop Sensor</td>
</tr>
<tr>
<td>1000ME00630</td>
<td>Handle Spring Asena LVP</td>
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<tr>
<td>1000ME00632</td>
<td>Asena LVP Handle Retaining Block</td>
</tr>
<tr>
<td>1000ME01845</td>
<td>Asena LVP Overmould Handle</td>
</tr>
<tr>
<td>1000ME00636</td>
<td>Asena LVP Mains Inlet Bracket</td>
</tr>
<tr>
<td>1000ME00655</td>
<td>Fuse Cover</td>
</tr>
<tr>
<td>1000ME01303</td>
<td>Magnet IR Detect</td>
</tr>
<tr>
<td>1000ME01745</td>
<td>Cover RS-232</td>
</tr>
<tr>
<td>1000ME00589</td>
<td>Cover Battery Asena LVP</td>
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<tr>
<td>1000ME00590</td>
<td>Foot Battery Cover Asena LVP</td>
</tr>
<tr>
<td>1000ME00649</td>
<td>Foot Front Asena LVP</td>
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<tr>
<td>1000ME01611</td>
<td>Seal Case Nickel/graphite</td>
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<tr>
<td>1000ME00667</td>
<td>Asena LVP Assembly Membrane</td>
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<tr>
<td>0000ME00767</td>
<td>V Seals Hinge Pins V5a-nbr</td>
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<tr>
<td>1000EL00643</td>
<td>Door Detect Flexible Circuit</td>
</tr>
<tr>
<td>1000ME00701</td>
<td>Asena LVP GP Top Retainer</td>
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<tr>
<td>0000ME00691</td>
<td>Seal O Ring 6id 1csdia silicon</td>
</tr>
<tr>
<td>0000ME00423</td>
<td>Pad Self Adhesive Double Sided 12x12mm</td>
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</tbody>
</table>

### Keypad & Labels

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1000LB00623</td>
<td>Alaris GP Keypad BOM</td>
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<tr>
<td>1000LB01040</td>
<td>Alaris GP Door Label Set</td>
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<tr>
<td>1000LB00614</td>
<td>Alaris GP Label Set BOM</td>
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<tr>
<td>1000LB01475</td>
<td>Alaris GP Guardrails Door Label</td>
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</tbody>
</table>

### Software

<table>
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<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000SP01412</td>
<td>Alaris LVP GP F/ware Upgrade V1.7.18 Kit</td>
</tr>
<tr>
<td>1000CD00028</td>
<td>Alaris SMU</td>
</tr>
<tr>
<td>1000SP01310</td>
<td>Alaris GP Editor Software Kit</td>
</tr>
</tbody>
</table>

### Test Equipment

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>60793</td>
<td>GP Series Infusion Set, 2 Y</td>
</tr>
<tr>
<td>1000EL00979</td>
<td>Converter Cable -USB To Serial</td>
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<td>1000EL00980</td>
<td>Converter Cable -USB To 4x Serial</td>
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<tr>
<td>1000SP01183</td>
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<tr>
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<td>1000SP01417</td>
<td>Spares Kit (Orange Clip &amp; Screw)</td>
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Service Contacts
## Service Contacts

For service, contact your local Affiliate Office or Distributor.

<table>
<thead>
<tr>
<th>Country</th>
<th>Address</th>
<th>Contact Information</th>
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<tr>
<td>AE</td>
<td>Cardinal Health, PO Box 5527, Dubai, United Arab Emirates.</td>
<td>Tel: (971) 4 28 22 842, Fax: (971) 4 28 22 914, <a href="http://www.cardinalhealth.com/alaris">www.cardinalhealth.com/alaris</a></td>
</tr>
<tr>
<td>DE</td>
<td>Cardinal Health, Pascalstr. 2, 52499 Baesweiler, Deutschland.</td>
<td>Tel: (49) 2401 604 0, Fax: (49) 2401 604 121, <a href="http://www.cardinalhealth.com/de">www.cardinalhealth.com/de</a></td>
</tr>
<tr>
<td>HU</td>
<td>Cardinal Health, Döbrentei tér 1, H-1013 Budapest, Magyarország.</td>
<td>Tel: (36) 14 88 0232, Fax: (36) 14 88 0233, <a href="http://www.alarisCE@cardinalhealth.com">www.alarisCE@cardinalhealth.com</a></td>
</tr>
<tr>
<td>SE</td>
<td>Cardinal Health, Hammarbacken 4B, 191 46 Sollentuna, Sverige.</td>
<td>Tel: (46) 8 544 43 200, Fax: (46) 8 544 43 225, <a href="http://www.cardinalhealth.com/se">www.cardinalhealth.com/se</a></td>
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<tr>
<td>AU</td>
<td>Cardinal Health, 3/167 Prospect Highway, PO Box 355, Seven Hills, NSW 2147, Australia.</td>
<td>Tel: (61) 2 9838 0255, Fax: (61) 2 9674 4444, <a href="mailto:techservice-au@cardinal.com">techservice-au@cardinal.com</a></td>
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<tr>
<td>BE</td>
<td>Cardinal Health, Leuvensesteenweg 248 D, 1800 Vilvoorde, Belgium.</td>
<td>Tel: (32) 2 267 38 99, Fax: (32) 2 267 99 21, <a href="http://www.cardinalhealth.com/be">www.cardinalhealth.com/be</a></td>
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<tr>
<td>CA</td>
<td>Cardinal Health, 235 Shields Court, Markham, Ontario L3R 8V2, Canada.</td>
<td>Tel: (1) 905-752-3333, Fax: (1) 905-752-3343, <a href="http://www.cardinalhealth.com/ca">www.cardinalhealth.com/ca</a></td>
</tr>
<tr>
<td>CN</td>
<td>Cardinal Health, Shanghai Representative Office, Suite 9B, Century Ba-Shi Building, 398 Huai Hai Rd(M.), Shanghai 200020, China.</td>
<td>Tel: (56) 8621-63844603, Fax: (56) 8621-63844493, <a href="mailto:techservice-nz@cardinal.com">techservice-nz@cardinal.com</a></td>
</tr>
<tr>
<td>ES</td>
<td>Cardinal Health, Edificio Veganova, Avenida de La Vega, nº1, Bloque 1 - Planta 1, 28108 Alcobendas, Madrid, España.</td>
<td>Tel: (34) 902 555 660, Fax: (34) 902 555 661, <a href="http://www.cardinalhealth.com/es">www.cardinalhealth.com/es</a></td>
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<tr>
<td>NL</td>
<td>Cardinal Health, De Molen 8-10, 3994 DB Houten, Nederland.</td>
<td>Tel: (31) 30 228 97 11, Fax: (31) 30 225 86 58, <a href="http://www.cardinalhealth.com/nl">www.cardinalhealth.com/nl</a></td>
</tr>
<tr>
<td>NO</td>
<td>Cardinal Health, Solbråveien 10 A, 1383 ASKER, Norge.</td>
<td>Tel: (47) 66 98 76 00, Fax: (47) 66 98 76 01, <a href="http://www.cardinalhealth.com/no">www.cardinalhealth.com/no</a></td>
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<td>NZ</td>
<td>Cardinal Health, 14B George Bourke Drive, Mt Wellington 1060, PO Box 14-518, Parnnure 1741, Auckland, New Zealand.</td>
<td>Tel: 09 270 2420, Freephone: 0508 422734, Fax: 09 270 6285, <a href="http://www.cardinalhealth.com/nz">www.cardinalhealth.com/nz</a></td>
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<td>FR</td>
<td>Cardinal Health, Immeuble Antares - Technoparc, 2, rue Charles-Edouard Jeanneret, 78300 POISSY, France.</td>
<td>Tel: (33) 1 30 06 74 60, Fax: (33) 1 39 11 48 34, <a href="http://www.cardinalhealth.com/fr">www.cardinalhealth.com/fr</a></td>
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<tr>
<td>GB</td>
<td>Cardinal Health, The Crescent, Jays Close, Basingstoke, Hampshire, RG22 4BS, United Kingdom.</td>
<td>Tel: (44) 0800 917 8776, Fax: (44) 1256 330860, <a href="http://www.cardinalhealth.com/alaris">www.cardinalhealth.com/alaris</a> <a href="mailto:uk-technical-support@cardinal.com">uk-technical-support@cardinal.com</a></td>
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Appendix E

Document History
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<th>Issue</th>
<th>Date</th>
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<tr>
<td>1</td>
<td>20/01/06</td>
<td>5999</td>
<td>Ian Tyler</td>
<td>Initial release</td>
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| 2     | December 06| 7111   | Ian Tyler | New Tech mode section.  
Spare Part Replacement Procedures chapter added.  
Troubleshooting chapter added.  
New Software features added.  
Spare Parts Listing appendix added. |
| 3     | September 08| 8587   | Ian Tyler | Introduce Calibration information.  
Update Preventative Maintenance information.  
Add information on the Alaris® GP Guardrails® Volumetric Pump.  
Update Corrective Maintenance information. |