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Important Information

WARNING: Read this entire manual before attempting and service or repair on a Medfusion® 3000 Series Syringe Infusion Pump. Failure to follow the instructions and important information contained in this manual, or improper/inadequate testing, service, repair or troubleshooting can lead to death or serious injury. Warnings, cautions and other important safety information can be found in this section, and throughout the manual (they are contained within lines at top and bottom).

The term WARNING is used to indicate a hazard that has the potential to cause injury or death to a technician, patient or user. The term CAUTION is used to indicate a hazard that has the potential to cause damage to the product or other property.

Note: This manual supersedes all previous revisions.

Warnings

- Attempts to repair or maintain a pump by personnel without proper qualifications or training may create a major hazard which could result in serious injury or death to the patient or the user.
- Use only approved parts and procedures for repair and maintenance of this pump. Failure to follow this manual may create a major hazard which could result in serious injury or death to the patient or the user.
- Repair Pump in ESD Controlled Work Area: The pump case should only be opened at a workstation with Electrostatic controls, including a grounded mat and wrist-strap.
- Pump Maintenance: Only trained biomedical service personnel may service this pump. Service personnel should disconnect the AC power cord before servicing the pump.
- AC Power: The only means of removing AC power is to disconnect the AC power cord. While the AC power cord is attached to the pump and plugged into an AC outlet, live mains voltage is present within the pump.
- Manufacturer Recommended Maintenance: Always maintain this pump following manufacturer recommended instructions in this Service Manual. An improperly maintained pump may cause serious injury to a patient or user.
- Safety Class II, Type CF Medical Equipment: The pump is listed as Safety Class II, Type CF equipment. Protection against electrical shock does not rely only upon basic insulation, but instead relies on double or reinforced insulation. As such, this equipment does not utilize a third wire ground (earth ground). Therefore, when doing line leakage test it is not necessary to measure leakage in both the open ground and closed ground setting. Nor is it necessary to perform a ground resistance test.
- Safety Class II with functional earth, Type CF Medical Equipment: The pump is listed as Safety Class II with functional earth, Type CF equipment. Protection against electrical shock does not rely only upon basic insulation, but instead relies on double or reinforced insulation. As such, this equipment utilizes a third wire ground (earth ground) lead of the power cord as earth return for electromagnetic energy and does not serve as a safety function. Therefore it is neither possible nor necessary to perform a ground resistance test.
- Battery Replacement: Observe ESD handling precautions when replacing the battery. Replace battery only with same Smiths Medical part/model number. Recycle batteries in compliance with applicable local regulations.
- Collect Separately. There are potential health hazards associated with improper disposal of batteries, electronics, and contaminated (used) infusion sets and syringes. Dispose of used batteries, infusion sets, syringes, and other used accessories, or a pump that has reached the end of its useful life, in an environmentally safe manner, and according to any regulations that may apply.
- Clean the Pump: Always clean the pump thoroughly before performing maintenance on it. This is recommended by the United States Occupational Safety & Health Administration (OSHA) as a protection from potential biohazard.
- External DC Power: Any power source connected to the external DC jack must be IEC 60601-1 certified for medical equipment: Type CF, Safety Class II. Connecting external power to the pump creates a medical system; therefore, the user is responsible for compliance with IEC 60601-1 standards. Refer all questions to Smiths Medical Technical Service department.
While servicing the Medfusion® 3000 Series infusion pump you should wear safety glasses as it contains springs and other small parts which may be a hazard.

Cautions

- **Avoid Organic Solvents:** Never use organic solvents (e.g., acetone), quaternary ammonia compounds, strong acids or strong bases to clean any portion of the pump.

- **Not Waterproof:** The Medfusion® 3000 Series is “spray resistant” but not “water proof”. Never spray cleaning or other fluids directly into openings on the bottom of the pump. Never immerse the pump in water or other fluids.

- **Avoid Spray Oils:** Never use light spray oils (e.g., WD40™) to clean or lubricate pump. These chemicals can damage the plastic of the pump.

- **Never Autoclave or Gas Sterilize:** Never sterilize the pump in a steam autoclave or gas. Using an autoclave or gas sterilization can seriously damage the Medfusion® 3000 Series pump and void the warranty.

- **Disconnect AC Mains & External DC Power:** Always disconnect the pump from AC Mains and from External DC power before disassembling the pump for maintenance.

- **Handle Batteries with Care:** Always handle the pump’s battery pack with care.

- **Don’t Over-tighten Screws:** Never over-tighten any screws in the pump. Unless otherwise specified, you should torque all screws to 60 in-oz (0.42 Nm).

- **Battery Disposal:** Always dispose of exhausted NiMH batteries in compliance with all pertinent local, state, national, and international regulations. If unsure of correct methods for compliance, you may return battery packs to Smiths Medical for recycling.

- **Keypad is NOT Flexible:** Whenever handling the keypad, always ensure it remains flat. Bending the keypad can damage keys or break LED contacts.
Contents of this manual

This is the technical service manual for Medfusion® 3000 Series Syringe Infusion Pumps manufactured by Smiths Medical. Its purpose is to provide the technical information necessary for maintenance, troubleshooting and repair of these pumps.

- This manual does not contain information on operating or configuring various models within the Medfusion® 3000 Series. Such information is found in manuals specific to each individual model, (e.g., Medfusion® 3500 Operations Manual and Medfusion® 3500 Configuration Manual). The sections of this manual are:
  
  **Introduction**
  - Overview of contents and purpose of this manual.

  **Scheduled Maintenance**
  - List of tests for required annual maintenance, and the procedure for completing each test.

  **Theory of Operations**
  - Descriptions of the systems which control the operation of Medfusion® 3000 Series pump.

  **Troubleshooting**
  - Tables of failure messages together with problem descriptions and possible solutions. Also includes an overview of Biomed Diagnostics & Utilities.

  **Parts Replacement**
  - Detailed procedures for removal and replacement of parts of Medfusion® 3000 Series pump.

  **Calibration**
  - Detailed procedures for calibration of Medfusion® 3000 Series pump.

  **Schematics and PCB Assemblies**
  - Contains board level schematics & PCB assembly drawings.

  **Assembly Drawings and Parts Lists**
  - Contains mechanical assembly parts lists and replacement parts lists for repairs.

  **Appendices**
  - Contains technical information relevant to Medfusion® 3000 Series pumps.

Authorized use of this manual

This manual is only intended for use by trained biomedical technicians who are authorized by their institution to perform maintenance and repair of critical medical devices.

**WARNINGS:**

- Attempts to repair or maintain a pump by personnel without proper qualifications or training may create a major hazard which could result in serious injury or death to the patient or the user.
- Use only approved parts and procedures for repair and maintenance of this pump. Failure to follow this manual may create a major hazard which could result in serious injury or death to the patient or the user.
Introduction

About the pump

Features and Controls
Following are several illustrations showing the various controls, connectors and features of the Medfusion® 3000 Series pump.

1 LCD Display: All pump operating and status information appears on the LCD display. The upper portion of the display provides instructions and alarm information. The middle portion of the display shows the current status of the operation in progress or the state of the data entry for pump programming. The lower portion of the display corresponds with the 4 ‘softkeys’ (their function changes depending on where you are in a pump program) on the keypad.

2 Tubing Holders: Thread infusion set tubing between holders to prevent kinking at syringe tip.

3 Carrying Handle

4 Syringe Barrel Clamp: The clamp holds the syringe barrel securely in place.

5 Syringe Barrel Flange Clip: When loading a syringe, slide the syringe flange into the clip.

6 Syringe Plunger Holders: Holds the syringe plunger securely in place.

7 Syringe Plunger Driver: Once loaded and delivery is started, the driver pushes the syringe plunger forward at a controlled, precise rate to deliver fluid.

8 Syringe Plunger Release Lever: Squeeze the release lever down to allow placement of the syringe plunger onto the holder during loading, or to remove it during unloading.

9 AC Power Connection Port: Plug the AC power cord into connection socket to allow pump to operate on AC (mains) power.

10 Keypad: See Keypad closeup for identification of the individual keypad buttons and what they are used for.
11 Optional Poleclamp Mount: If desired, attach the optional poleclamp here.

12 External DC Power Input Jack: Plug approved external DC power supply into jack.

13 RS232 Connection Port: Plug RS232 connector into the port to allow upload of data from and download of data to a pump from a PC. This port is also used to load the pump software.

Keypad closeup
<table>
<thead>
<tr>
<th>Button</th>
<th>When pump is paused</th>
<th>When pump is delivering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm Silence (A)</td>
<td>Silences audible alarm. Allows operator to switch the display backlight from bright to dim or dim to bright.</td>
<td>Silences audible alarm. Allows operator to switch the display backlight from bright to dim or dim to bright.</td>
</tr>
<tr>
<td>Power (ë)</td>
<td>Push and hold to turn pump Off.</td>
<td>Push and release, then push and hold to turn pump Off.</td>
</tr>
<tr>
<td>Menu buttons</td>
<td>Function is defined on the display.</td>
<td>Function is defined on the display.</td>
</tr>
<tr>
<td>Back (BACK)</td>
<td>Reverts to a previous step or level.</td>
<td>Reverts to a previous step or level if adjusting settings.</td>
</tr>
<tr>
<td>Numbers &amp; Decimal</td>
<td>Set number values or select options.</td>
<td>Set number values or select options.</td>
</tr>
<tr>
<td>Stop (ST)</td>
<td>N/A</td>
<td>Stops delivery (pump remains On).</td>
</tr>
<tr>
<td>Start (É)</td>
<td>Starts delivery.</td>
<td>N/A</td>
</tr>
<tr>
<td>Bolus (è)</td>
<td>Begins priming after confirmation.</td>
<td>Begins delivery of programmed bolus after confirmation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicator</th>
<th>What it means</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Alarm</td>
<td>The <strong>Alarm</strong> indicators (yellow or red) are on whenever the pump is in an alarm condition. The specific details of each alarm are covered in the Troubleshooting section later in this manual.</td>
</tr>
<tr>
<td>- AC Line</td>
<td>The <strong>AC Line</strong> indicator (green) is On whenever the pump is connected to “mains” line power. It is Off when the pump is not connected to an active AC line.</td>
</tr>
<tr>
<td>- Battery</td>
<td>The <strong>Battery</strong> indicator (green) blinks On &amp; Off whenever the pump is operating on internal battery power, and remains On when the battery is charging.</td>
</tr>
<tr>
<td>- Lock</td>
<td>The <strong>Lock</strong> indicator tells you the pump has been locked into its current operational mode. While this indicator is lighted, the keypad is locked and no changes can be made to settings. Attempting to stop or change an infusion while locked will result in an alarm and an advisory message.</td>
</tr>
<tr>
<td>- Infusing</td>
<td>The <strong>Infusing</strong> indicators are 3 green lights, which illuminate in sequence right to left when the pump is delivering fluid (the 4th LED indicator on the far left - on the tubing - is not used at this time). During intermittent delivery mode, a single Infusing indicator lights during the time between infusions. When the pump is Off or stopped, the Infusing indicator is not lit.</td>
</tr>
</tbody>
</table>
Understanding “Biomed” mode

Periodic maintenance and troubleshooting on Medfusion® 3000 Series infusion pumps are aided by use of the “Biomed” software interface.

What is biomed?
The Biomed feature is the special utility intended for use only by trained biomedical service technicians.

- Biomed has its own security access code.
- Biomed is for calibration of the pump's sensors.
- Biomed is for diagnosis of digital and analog sensors contained in the pump.
- Biomed allows access to infusion history log and alarm history log stored in the pump.
- Biomed is for testing of the pump's drive systems.
- Biomed is for monitoring the status of the pump battery.
- Biomed is for setting the pump's last (V3) or next (V4) preventive maintenance date.
- Biomed is for setting the time and date.

Authorized biomed access
Never use Biomed features unless you are trained in maintenance on the Medfusion® 3000 Series pumps and have been authorized by your facility to use the Biomed program.

Biomed software program – major options
The Biomed utility has four major modes on its Select the Mode screen. These are:

1. Calibration to check calibration values, re-calibrate sensors or set display contrast.
2. Diagnostics to examine analog and digital signal readings, or test the speaker, motor or display function.
3. Utilities to review alarm history, to review infusion history, to set time and date, to update periodic maintenance timestamp.
4. Update Firmware to reprogram the pump’s software version through the serial interface (only available with service upgrade software diskette and instructions on certain models).

The following is an outline of the Biomed software:

<table>
<thead>
<tr>
<th>Calibration</th>
<th>Diagnostics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• cal size and position</td>
<td>• Audio test</td>
</tr>
<tr>
<td>• cal force sensor</td>
<td>• Display test</td>
</tr>
<tr>
<td>• cal pressure sensor</td>
<td>• Indicator test</td>
</tr>
<tr>
<td>• cal plunger position</td>
<td>• Keypad test</td>
</tr>
<tr>
<td>• cal syringe size sensor</td>
<td>• Monitor analog sensors</td>
</tr>
<tr>
<td>• adjust contrast</td>
<td>• Monitor digital sensors</td>
</tr>
<tr>
<td>• view calibration data</td>
<td>• Monitor battery status</td>
</tr>
<tr>
<td>• save changes and exit</td>
<td>• Drive Train Test (V4)</td>
</tr>
<tr>
<td></td>
<td>• Motor drive test</td>
</tr>
<tr>
<td></td>
<td>• Monitor a2d self test</td>
</tr>
<tr>
<td></td>
<td>• Monitor 6811 a2d group1</td>
</tr>
<tr>
<td></td>
<td>• Monitor 6811 a2d group2</td>
</tr>
<tr>
<td></td>
<td>• Force sensor test (V3)</td>
</tr>
<tr>
<td></td>
<td>• Pressure sensor test (V3)</td>
</tr>
</tbody>
</table>

Utilities

- set/view last pm date
- OR set/view next pm date
- set time/date
- view alarm history
- view infusion history
- view software crcs
- view software versions
- view service data
- view EEPROM size (V4)

Update Firmware
(Special use only for software update - Not available on all pumps)

Set Language
(Medfusion® 3500 Only)
Symbols

The following is a list of symbols which may appear on the pump (or on it’s labeling or accessories), as well as certain technical terms, along with an explanation of what they mean.

- **SN** Serial number
- **!** Attention, See instructions for use
- **HEART** Type CF equipment (protection from electric shock)
- **□** Equipment in which protection against electric shock relies on double or reinforced insulation instead of basic insulation. Accessible metal components of pump enclosure use this higher level of insulation instead of safety grounding. *Medfusion® 3500BC pumps:* The earth ground of the power cord serves the purpose of providing a “functional earth” return for electromagnetic energy.
- **Date of manufacture**
- **Rx ONLY** CAUTION: Federal (USA) law restricts this device to sale by or on the order of a physician.
- **REF** Catalog number
- **Collect Separately**
- **Latex free**
- **Do not reuse**
- **Use by**
- **Authorized representative in the European Community**
- **AUS REP** Australian representative
- **EC REP** Indicates the product was designed and manufactured in accordance with applicable standards/guidelines and may be sold in the EU (European Union).
- **UL Mark for Canada and the United States.** Indicates the product was manufactured in accordance with the requirements of UL (Underwriter’s Laboratory).
- **Temperature limitation**
- **Humidity limitation**
- **Atmospheric pressure limitation**

⚠ Pins of connectors and other areas identified with this ESD Warning symbol should not be touched. Connections should only be made when ESD precautionary measures are used.

 kotlinx External DC jack connection. Tip (negative sign) is for power ground and ring (positive sign) is for positive power connection. (See warning that follows.)

 transmitter Symbol for infrared serial communications port on pump.

 V ~ Operating voltage range for alternating current (i.e. AC or mains) power source

 F2 *Medfusion® 3500BC pumps:* The designation “F2” indicated on the label, which is located on the AC input module connector assembly for the pump, is indicating a non-replaceable fuse that is part of the input module assembly. The fuse is located on the neutral side of the AC line.

uspenders Medfusion® 3500BC pumps: The “ground” symbol indicated on the label, which is located on the AC input module connector assembly for the pump, is indicating that the earth ground connection is providing a functional ground and not a safety ground.

IPX3 Equipment that is ingress protected from fluid spraying at vertical angle from above, and from angles to 60° on either side of vertical

Infusion Class 4 An infusion pump that combines the functions of continuous infusion flow, intermittent flow, and discrete bolus delivery

Infusion Class 5 An infusion pump that functions as a profile pump, providing a programmed sequence of delivery rates
# Glossary of Technical Terms

This is a glossary of technical terms relating to the Medfusion® 3000 Series pumps.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Line Leakage Test</td>
<td>The pump is listed as Safety Class II, Type CF equipment (Medfusion® 3500BC pumps are listed as Safety Class II with functional earth, type CF equipment). Protection against electrical shock does not rely only upon basic insulation, but instead relies on double or reinforced insulation. As such, this equipment does not use a third wire ground (earth ground). Therefore, when doing line leakage test it is not necessary to measure leakage in both the open ground and closed ground setting. Nor is it necessary or relevant to perform a ground resistance test. <strong>Medfusion® 3500BC</strong>: The third wire ground (earth ground) serves a functional and not a safety purpose. Therefore, it is neither necessary nor relevant to perform a ground resistance test. Protection against leakage current is the concern for any device (be it Class I or Class II) deriving power from AC mains. Leakage current is what flows from mains side to device component(s) that is conductive and accessible by the user or patient. Safety grounding of exposed metal does not protect the user from leakage current. Safety grounding causes a circuit breaker or fuse to open should a short occur between wall AC side and grounded metal. The Medfusion® 3000 Series pump achieves protection by double-isolating secondary power and exposed metal from AC power. The Medfusion® 3000 pump satisfies the UL requirement that 4000 volts can be applied between AC side and exposed metal without causing significant current to flow.</td>
</tr>
<tr>
<td>Alarm History</td>
<td><strong>See “view alarm history”.</strong></td>
</tr>
<tr>
<td>Alarm Message</td>
<td>The onscreen text which appears to indicate situations or circumstances requiring user attention.</td>
</tr>
</tbody>
</table>
| Backup Audio Buzzer       | The backup audio buzzer provides a means of generating an alarm during:  
  - instrument power loss (while the instrument was on)  
  - malfunction of the main microprocessor  
  - or failure of the primary speaker.  
  The backup audio buzzer activates during **Watchdog Alarm**, anytime there is a malfunction of the main microprocessor. During power-up self-tests, the buzzer function is verified by briefly allowing the watchdog alarm to activate. |
| Backup Super Capacitor    | A one (1) Farad Super Capacitor is part of the power control design to provide backup power to the audio buzzer in the loss of the primary power source.                                                         |
| Battery Gauge             | The gauge circuits monitor direction and magnitude of current flowing through the battery.  
  - The battery current is sensed by the gauge.  
  - The gauge then computes capacity.  
  To control charging the battery, the gauge uses battery temperature and battery voltage. The gauge changes to trickle charge in the event the battery temperature exceeds 50°C or if the battery voltage is lower than 5.7 volts. |
Battery Parameters

There are two battery parameters requiring periodic inspection to maintain good battery performance. They can be accessed by selecting Biomed > Diagnostics > Monitor Battery Status.

- **LMD (Last Measured Discharge)** – This is the learned capacity of the battery by the gauge following a calibration cycle. Replace the battery when this is < 1600 mA-hours.
- **CPI (Capacity Inaccurate)** – This is the number of shallow discharge cycles since the last calibration. Always recalibrate the battery when CPI is > 80 Hex. Refer to the Battery Calibration section of this manual.

Biomed Calibration

A set of functions for calibration/adjustment of the sensors within the Medfusion® 3000 Series pump.

Steps and processes for using Biomed > Calibration functions are found in the Adjustment & Calibration section.

Biomed Diagnostics

A set of functions which allow the detailed examination of the pump’s systems, sensors, indicators, and controls.

Steps for using Biomed > Diagnostics functions are found in the Scheduled Maintenance and Troubleshooting sections.

Biomed Utilities

The set of Biomed > Utilities contain a mixture of adjustment and troubleshooting options. These are:

- **Set / View Last PM Date (or Set / View Next PM Date)** – Used to view and set the Preventive Maintenance (PM) date.
- **Set Time / Date** – Used to set date and time for built-in real time system clock.
- **View Alarm History** – Used to view alarm and alert history stored in pump memory. This is a troubleshooting feature. You may page backward and forward through stored alarms in order to identify possible malfunction patterns.
- **View Infusion History** – Used to view programming and infusion information stored in pump memory. This can be a troubleshooting feature. You may page backward and forward through stored record of infusion types in order to identify how the pump has been used.
- **View Software CRCs** – For “factory use” only. Allows view of CRCs for each code bank.
- **View Software Versions** – Used to view both bootbank version and main version of software installed within the pump.

Configuration Cloning

Two pumps can communicate through their built-in infrared serial communications interface, with one teaching and the other learning, to copy pump configuration settings, and libraries.

CPI (Capacity Inaccurate)

This is the number of shallow discharge cycles since the last calibration. Always recalibrate the battery when CPI is > 80 Hex. Refer to the Battery Calibration section of this manual.

Depleted Battery Monitor

The circuitry which measures present battery charge status against stored battery capacity data to determine a “depletion” situation.

EN 475 Alarms

The EN 475 alarms use tones designed for use by customers following European standards. These generate High, Medium & Low Priority Alarms.
<table>
<thead>
<tr>
<th><strong>External Power Detector</strong></th>
<th>Circuitry which determines when and if external power (whether AC or DC) has been or is connected to the pump.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flash Memory</strong></td>
<td>The pump uses flash memory, which is re-programmable through the infrared (IR) port and a remote computer.</td>
</tr>
<tr>
<td><strong>High Priority Alarms</strong></td>
<td>A high priority alarm results from either any condition which halts an ongoing infusion, or any pump system fault which affects infusion. If the front panel controls are locked when a high priority alarm occurs, the pump controls unlock. High Priority alarms are signaled by a flashing red indicator and an audible signal. Press 🅰️ to pause the audible alarm for the preset alarm silence period.</td>
</tr>
<tr>
<td><strong>Infrared Serial Data Port</strong></td>
<td>The infrared serial port interfaces directly with the main microprocessor’s asynchronous serial communication pins. The infrared port supports short transmission distances of 2” or less and a maximum baud rate of 9600.</td>
</tr>
<tr>
<td><strong>Infusion Class 4</strong></td>
<td>An infusion pump which combines the functions of continuous infusion flow, intermittent flow, and discrete bolus delivery.</td>
</tr>
<tr>
<td><strong>Infusion Class 5</strong></td>
<td>An infusion pump which functions as a profile pump, providing a programmed sequence of delivery rates.</td>
</tr>
<tr>
<td><strong>Interconnect Board</strong></td>
<td>The interconnect printed circuit board interfaces to an intelligent NiMH Battery (or NiCad on older model pumps), the system speaker, the internal DC supply and supply conditioning for an external DC supply and the main PCB.</td>
</tr>
<tr>
<td><strong>IPX3</strong></td>
<td>Equipment which is ingress protected from fluid spraying at a vertical angle from above, and from angles to 60° on either side of vertical.</td>
</tr>
<tr>
<td><strong>Keypad Test</strong></td>
<td>Verifies individual function of each key on the keypad. Nonfunctioning keys indicate need for keypad replacement.</td>
</tr>
<tr>
<td><strong>LCD</strong></td>
<td>Liquid Crystal Display.</td>
</tr>
<tr>
<td><strong>LCD Backlight</strong></td>
<td>The LED fiber optic light source which illuminates the LCD display.</td>
</tr>
<tr>
<td><strong>Limit Priority Alarms</strong></td>
<td>A limit priority alarm is generated whenever a preset minimum or maximum limit has been violated. For example: when programming an infusion there are minimum and maximum limits preset rates assigned to syringes by size &amp; manufacturer.</td>
</tr>
<tr>
<td></td>
<td>• The limit priority alarms sound a tone and display an advisory message on-screen for 3 seconds. To re-display the message press 🅰️.</td>
</tr>
<tr>
<td><strong>LMD (Last Measured Discharge)</strong></td>
<td>This the learned capacity of the battery by the gauge following a calibration cycle. Replace the battery when this is &lt; 1600 mA-hours.</td>
</tr>
<tr>
<td><strong>Low Priority Alarms</strong></td>
<td>A low priority alarm indicates any condition not requiring immediate operator intervention. Low Priority alarms are announced with a continuous yellow indicator and an intermittent audible signal.</td>
</tr>
<tr>
<td></td>
<td>• Pressing 🅰️ permanently silences this alarm.</td>
</tr>
<tr>
<td></td>
<td>• If the front panel controls are locked when a low priority alarm occurs, the pump controls do not unlock.</td>
</tr>
<tr>
<td><strong>Medium Priority Alarms</strong></td>
<td>A medium priority alarm indicates any condition requiring operator intervention but does not halt infusion. Medium Priority alarms are signaled with a flashing yellow indicator and an audible signal. Pressing 🅰️ will silence the audible alarm for the programmed alarm silence period.</td>
</tr>
<tr>
<td></td>
<td>• If the front panel controls are locked when a medium priority alarm occurs, the pump controls do not unlock.</td>
</tr>
<tr>
<td><strong>Motor Rotation Sensor</strong></td>
<td>A optical sensor on the main board senses the movement of the motor worm shaft.</td>
</tr>
<tr>
<td>----------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>“Neglected Pump” or User Call Back</strong></td>
<td>The “Neglected Pump” or user call back alarm is a low priority alert which simply reminds you to finish what you started. Once you begin programming any infusion, the pump expects you to continue until programming is complete.</td>
</tr>
<tr>
<td><strong>Occlusion</strong></td>
<td>The blockage of the infusion line during delivery. Here, the pump detects an occlusion by sensing excessive force on the syringe plunger driver.</td>
</tr>
<tr>
<td><strong>Plunger Printed Circuit Board</strong></td>
<td>The plunger PCB provides pre-amplification of the force sensor output to the Main board, and contains two photo-interrupters with supporting circuitry for sensing each plunger flipper.</td>
</tr>
<tr>
<td><strong>Safety Class II, Type CF Equipment</strong></td>
<td>See “AC Line Leakage Test”.</td>
</tr>
<tr>
<td><strong>Serial EEPROM</strong></td>
<td>A non-volatile storage device (electrically-erasable programmable read-only memory) which is used on the main board to store calibration, configuration, and infusion history.</td>
</tr>
<tr>
<td><strong>Set / View Last (Next) PM Date</strong></td>
<td>This allows viewing the last (or Next on V4 pumps) recorded preventive maintenance date. This is where you also set the date when completing annual preventive maintenance.</td>
</tr>
<tr>
<td><strong>Stepper Motor</strong></td>
<td>A sequentially stepping motor used to drive the plunger head of the pump.</td>
</tr>
<tr>
<td><strong>System Failure</strong></td>
<td>A high priority alarm indicating that the pump self-tests have detected a failure in pump operation.</td>
</tr>
<tr>
<td><strong>Primary Speaker</strong></td>
<td>The main speaker located in the bottom housing of the pump. All normal alarm/alert tones are generated through this speaker.</td>
</tr>
<tr>
<td><strong>Update Firmware</strong></td>
<td>The firmware is the software installed in Medfusion® 3000 Series pumps v3 or lower, and which is used to operate the pumps. The software may only be updated with a software kit provided by Smiths Medical. The Biomed &gt; Update Firmware option is the utility provided for reinstalling software used to operate pumps. This can be used to upgrade to a newer version of system software. (Only available on pumps with the V3 software combined with the V1.6 boot loader provides this option.)</td>
</tr>
<tr>
<td><strong>Note:</strong></td>
<td>Instructions for updating pump operational software are not included in this technical service manual. Instead, they are part of individual software upgrade kit.</td>
</tr>
<tr>
<td><strong>View Alarm History</strong></td>
<td>This is a troubleshooting feature. In Biomed &gt; Utilities, you may page backward and forward through the stored alarms in order to identify possible malfunctions.</td>
</tr>
<tr>
<td><strong>View Infusion History</strong></td>
<td>This is a troubleshooting feature. In Biomed &gt; Utilities, you may page backward and forward through the stored record of infusions in order to identify how the pump has been used. The history will contain roughly 50 events.</td>
</tr>
<tr>
<td><strong>View Software CRCs</strong></td>
<td>For “factory use” only.</td>
</tr>
<tr>
<td><strong>View Software Versions</strong></td>
<td>This is where you identify both the bootbank version and the main version of the operational software installed in the Medfusion® 3000 Series pump. (Pumps with V4.1.5 software also shows the build number.)</td>
</tr>
</tbody>
</table>
Watchdog Circuit

While in the power on state, the auxiliary controller prevents the watchdog Alarm State from occurring by maintaining the AC signal, WATCHDOG_STRB.

- The main microprocessor periodically issues the AC signal, PET_WATCHDOG.
**Section 1: Scheduled Maintenance** of the service manual defines the required preventive maintenance for keeping the Medfusion® 3000 Series syringe infusion pump in good operating condition.

## Preventive Maintenance Planning

The recommended preventive maintenance plan allows you to service pumps in batches as their anniversary dates arrive. For example, if you have numerous pumps to service over the course of a year you may want to set the date on each pump so that 10 pumps are due for service each week of the year (this will prevent all pumps from giving the alert reminder at the same time).

Pumps with **V3 software**: enter the last PM date (the pump will calculate the next PM date). An example of a plan for the maintenance of pumps with V3 software is shown in the following table:

<table>
<thead>
<tr>
<th>Serial Numbers</th>
<th>Scheduled PM</th>
<th>Enter Last PM</th>
<th>Date of Alarm</th>
</tr>
</thead>
</table>

Pumps with **V4 software**: enter the next PM date. An example of a plan for the maintenance of pumps with V4 software is shown in the following table:

<table>
<thead>
<tr>
<th>Serial Numbers</th>
<th>Enter Next PM Date</th>
<th>Last PM</th>
<th>Date of Alarm</th>
</tr>
</thead>
<tbody>
<tr>
<td>M001011 to M001020</td>
<td>7/31/2008</td>
<td>8/1/2007</td>
<td>8/1/2008</td>
</tr>
</tbody>
</table>

The best approach is to set the date so that the alarm occurs only if a pump is missed in the normal PM schedule.

### Using a torque screwdriver

You **must** always use a *Torque Screwdriver* when re-assembling any Medfusion® 3000 Series pump. Where screws are used to secure components, over-tightening can strip threads or crack standoffs in the case.

- Unless otherwise specified, you should always torque all screws to 60 in-oz (approximately 0.42 Nm).

### Electrostatic-controlled workstation

Whenever you work on the Medfusion® 3000 Series pump – specifically whenever you open the pump for service – you must work in an electrostatic-controlled environment. This ensures you will not damage the electronic components in the pump.

**WARNING: Repair Pump in ESD Controlled Work Area:** The pump case should only be opened at a work-station with Electrostatic controls, including a grounded mat and wrist-strap.

### Biomed maintenance tools

In order to complete maintenance, parts replacement, diagnosis and calibration of Medfusion® 3000 Series infusion pumps, you will need the following:

- 1 ea – Calibration Kit (see service parts list): Small Calibration Slug, Large Calibration Slug & Force Gauge
- 1 ea – new 50 or 60 cc syringe (note: the lubrication in syringes evaporates, change “test” syringes monthly)
- 1 ea – 3-way Stopcock
- 1 ea – Electrical Safety Analyzer
- 1 ea – Torque Screwdriver w/Phillips & Standard bits.
- 1 ea – ¼” open end wrench
- 1 ea – 6” calipers with resolution of 0.001”
Service warnings

WARNINGS:

- **Pump Maintenance:** Only trained biomedical service personnel may service this pump. Service personnel should disconnect the AC power cord before servicing the pump.

- **AC Power:** The only means of removing AC power is to disconnect the AC power cord. While the AC power cord is attached to the pump and plugged into an AC outlet, live mains voltage is present within the pump.

- **Manufacturer Recommended Maintenance:** Always maintain this pump following manufacturer recommended instructions in this Service Manual. An improperly maintained pump may cause serious injury to a patient or user.
Periodic maintenance

This maintenance is **required** for the continued safe operation of Medfusion® 3000 Series pumps.

The Medfusion® 3000 Series pump must be tested **annually**, or whenever the pump has been damaged or dropped. Always check all sensor calibrations as a standard part of annual maintenance. No calibration is required to maintain pump flow delivery accuracy.

Installation/quick check-out

Each pump is inspected and tested prior to shipment from the factory. Some institutions require that devices entering a hospital be functionally checked before being placed into service. The following procedure is provided to meet this need.

Quick check-out test

1) Plug AC power cord into AC receptacle on side of pump, then plug pump into an AC power (100 to 240 V AC) source. Verify AC indicator and battery charge indicator are lit.

2) Press **Power**. Verify the following on power-up:
   - Verify alarm beeps.
   - Verify all the LED indicators are turned on & off (except AC and battery).
   - Verify that no self-tests fail.
   - Verify the display is legible and contrast is acceptable.

3) Unplug the AC power cord and verify that within several seconds the battery indicator begins to flash and AC indicator goes off. Re-plug the AC power cord into the unit.

4) Perform the “Flow Delivery Accuracy Test” from *Annual Maintenance* (which follows).

5) From the pump’s **Main** screen, use the number buttons to choose **Biomed** (press **More** for second page, if needed). Use the number buttons to enter passcode “**2580**”, then use the number buttons to choose **Utilities**. Then:

   **Set/view Last PM Date. Pumps with V3 software:** Set the PM date to today’s date. (Setting this PM date means that an advisory message will appear on the pump two years from this date.) - **OR** -

   **Set/view Next PM Date. Pumps with V4 software:** Set the date to the date you **want** the PM alert to occur.

   This message does not prevent normal operation of the pump, but advises the user that maintenance is recommended.) [Note: pumps are shipped from the factory with the date/time set to USA Central Standard Time; use the **Set Time/Date** utility to modify this if desired.]

6) Perform the “AC Line Leakage Test” from *Annual Maintenance* (which follows).

7) Consult the troubleshooting guide or contact Smiths Medical should the pump fail any steps in this test.

8) After the completion of these tests the pump should be plugged into AC power to recharge the battery. [This is recommended when the battery capacity is less than 90% – look at battery gauge displayed on the bottom of the power-up screen.]
Scheduled Maintenance

Cleaning and care

Standard cleaning of Medfusion® 3000 series pumps

Follow your institution’s guidelines for cleaning and disinfecting of devices. The syringe pump can be safely cleaned with the following agents:

- **Common chlorine bleach diluted with water.**
- **Mild detergent mixed with water.**
- **Isopropyl alcohol 70% solution.**
- **Other surface disinfectants which are compatible with plastic materials.**

**For best results:** Clean by spraying or pouring cleanser directly onto a soft cloth (not directly onto the pump) and then wiping surfaces until dry.

Cleaning cautions

Below are standard cautions you should follow when cleaning Medfusion® 3000 Series pump:

**CAUTIONS:**

- **Avoid Organic Solvents:** Never use organic solvents (e.g., acetone), quarternary ammonia compounds, strong acids or strong bases to clean any portion of the pump.
- **Not Waterproof:** The Medfusion® 3000 Series is “spray resistant” but not “waterproof.” Never spray cleaning or other fluids directly into openings on the bottom of the pump. Never immerse the pump in water or other fluids.
- **Avoid Spray Oils:** Never use light spray oils (e.g., WD40™) to clean or lubricate pump. These chemicals can damage the plastic of the pump.
- **Never Autoclave or Gas Sterilize:** Never sterilize the pump in a steam autoclave or gas. Using an autoclave or gas sterilization can seriously damage the Medfusion® 3000 Series pump and void the warranty.
Mandatory annual maintenance testing

All tests on this Required Annual Maintenance List must be performed annually in order to ensure the continued safe operation of the Medfusion® 3000 Series pump.

General inspection

☐ 1) If not already performed, clean and disinfect the pump as described in the “Cleaning and Care” section (see previous page).

☐ 2) Inspect for obvious physical damage, including cracked housings or torn keypads. Repair any physical damage.

☐ 3) Verify smooth operation of syringe plunger driver, syringe release lever, syringe flange clip, and syringe barrel clamp. Clean and/or repair any damaged components.

☐ 4) Verify the three tubing guides (hooks) on top left side are intact, and fully secured to pump housing. Replace any damaged guides.

☐ 5) Verify force sensor seal, located behind flippers on plunger driver head, is intact and not punctured. Replace damaged seal.

☐ 6) Inspect power cord for damage and wear. Replace damaged or worn power cord before performing any leakage current testing.

☐ 7) Inspect pole clamp for proper operation. Verify that the screws holding pole clamp components are tight.

☐ 8) Verify the Serial Number label is legible and intact. Replace if label is damaged.

☐ 9) Verify the Warning label is legible and intact. Replace if label is damaged.

☐ 10) Verify four rubber feet are attached to the bottom housing of the pump. Replace missing feet.

☐ 11) Turn the pump on all sides and check for any loose parts internally and externally.

☐ 12) Plug AC power cord into AC receptacle on side of pump, then plug pump into an AC power (100 to 240 V AC) source. Verify AC indicator and battery charge indicator are lit. Consult troubleshooting for any failed indicator.

Power-up test

Ensure that no syringe is loaded in the pump and the barrel clamp is fully down. Press \( \text{on/off} \). Verify the following on power-up:

☐ 1) Verify alarm beeps.

☐ 2) Verify all the LED indicators are turn on and off (except AC and battery).

☐ 3) Verify that battery capacity shown on screen is greater than 0%.

☐ 4) Verify that no self-tests fail.

☐ 5) Verify the display is legible and contrast is acceptable.

☐ 6) Unplug the AC power cord and verify that within several seconds the battery indicator begins to flash and AC indicator goes off. Re-plug the power cord into the unit.

Consult troubleshooting for any failed steps in this test.
Scheduled Maintenance

Calibration verification

From the pump’s Main menu, use the number buttons to choose Biomed (press More to find it, if needed).

Enter the passcode (numbers 2580), then press Enter.

Use the number buttons to choose Diagnostics, then Monitor Analog Sensors.

Force sensor check

1) Ensure that no syringe is loaded in the pump. Verify that the force reading on the screen is between –0.2 and +0.2 pounds.

2) Load the force gauge with the foot of the gauge positioned towards the head of the plunger driver. Zero the force gauge. Using the thumbscrew of the force gauge bracket, increase the force applied until the force gauge reads 15 pounds (6.8 kilograms). Verify that the force reading on the screen is between 14.0 and 16.0 pounds.

If either reading is out of specification, re-calibrate the sensor and then retest readings.

Syringe size sensor check

1) Load the small Calibration Slug into the barrel clamp (do not load the plunger driver). Keeping the barrel clamp perpendicular to the slug, move the barrel clamp head slightly back and forth to find the lowest size reading. Verify that the size reads between 0.256” and 0.272”, inclusive.

2) Load the large Calibration Slug into the barrel clamp (do not load the plunger driver). Keeping the barrel clamp perpendicular to the slug, move the barrel clamp head slightly back and forth to find the lowest size reading. Verify that the size reads between 1.244” and 1.260”, inclusive.

If either reading is out of specification, re-calibrate the sensor and then retest readings.
Plunger position sensor check

1) Load the small Calibration Slug into the barrel clamp. Load the plunger driver onto the end of the slug with flippers open, and about 0.1 lbs. applied to force sensor (as read from the screen). Verify that the position reads between 0.680” and 0.720”, inclusive. Unload the slug.

2) Load the large Calibration Slug into the barrel clamp. Load the plunger driver onto the end of the slug with flippers open, and about 0.5 lbs. applied to force sensor (as read from the screen). Verify that the position reads between 4.680” and 4.720”, inclusive. Unload the slug.

If either reading is out of specification, re-calibrate the sensor and then retest readings.

**Note:** Use a new syringe for the following tests as the lubrication within syringes evaporates. Change “test” syringes at least monthly.

Plunger travel test

Return the pump to the Main menu (press BACK to exit Biomed mode). Load an air-filled 50 or 60 cc syringe into the pump. Use the number buttons to choose ML/HR delivery mode and set the flow rate to 20 ml/hr. Clear the total infused. Press OK.

1) Verify the three green infusing indicators are lit in a repeating sequence from right to left. Continue running until at least 0.033 ml has been infused.

2) Press Lock and verify the Lock indicator lights. Press Unlock and verify the Lock indicator turns off.

3) Press CHG Rate and set a rate to the maximum rate available on the ml/hr control screen. Allow the unit to drive for the full length of the syringe.

4) When the syringe is empty, verify the Syringe Empty alarm message is displayed and the red alarm indicator lights. Verify the alarm tone quality. Press A to silence alarm.

If other alarms or system failures occur during this test use the troubleshooting guide for corrective actions.

Motor drive & occlusion operational test

Connect a three-way stopcock to an empty 50cc or 60cc Luer-lock syringe. Load the syringe with the syringe filled with approximately 30cc of air.

1) Use the number buttons to choose ML/HR mode and set the flow rate to the maximum rate as displayed on the ml/hr entry screen. From the Begin Delivery screen, press B to access the Prime screen. Press and hold B to prime the tubing set for at least 0.2 ml priming volume. Press Exit. Close the stopcock to the syringe.

2) Press Options, use the number buttons to choose Override Occl Limit, choose High, then press Enter.

3) Press Options, then use the number buttons to choose Disable Rapid Occl Detect, if available. (If not available, press BACK.)
Scheduled Maintenance

4) Press $\text{Enter}$ to begin the infusion.

5) Verify the pump operates until an occlusion alarm occurs. Open the stopcock to release the pressure, then remove the syringe.

If any alarm other than occlusion occurs during this test, see troubleshooting for corrective action.

Flow delivery accuracy test

Return the pump to the MAIN menu. Use the number buttons to choose ML/HR. Select a syringe manufacturer. Load a 50/60 cc Luer-lock syringe (air-filled) into the pump – use a syringe from the table below. Enter a rate of 300 ml/hr.

1) From the BEGIN INFUSION screen, press Options and use number buttons to choose VOLUME LIMIT. Enter a volume limit of 50 ml. (Note: if volume limit is not configured, press $\text{Enter}$ when TVD reaches 50.0 ml.)

From the BEGIN INFUSION screen, press $\text{Up}$ to access the PRIME screen. Press and hold $\text{Up}$ to prime the tubing set for at least 0.2 ml priming volume. Press Exit.

Use calipers to measure the distance from the outside of the syringe flange to the inside of the syringe plunger. Record this measurement as the starting position. _______________

2) Press $\text{Enter}$ and ensure delivery begins. Wait until the pump volume limit is reached in 10 minutes. (Press $\text{Enter}$ if volume limit is not active.)

Press $\text{Enter}$ to silence the audible alarm. Use a set of calipers to measure the distance from the outside of the syringe flange to the inside of the syringe plunger. Record this measurement as the ending position. _______________

3) Subtract the ending position from the starting position. Verify that this result is between 3.473” and 3.615” (inclusive) for a B-D 60cc syringe, consult table below for other syringes.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Minimum travel</th>
<th>Nominal travel</th>
<th>Maximum travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>B Braun Perfusor 50cc</td>
<td>3.146” (79.92mm)</td>
<td>3.211” (81.55mm)</td>
<td>3.275” (83.18mm)</td>
</tr>
<tr>
<td>B Braun Ominifix 50cc</td>
<td>3.146” (79.92mm)</td>
<td>3.211” (81.55mm)</td>
<td>3.275” (83.18mm)</td>
</tr>
<tr>
<td>B-D 60cc</td>
<td>3.473” (88.22mm)</td>
<td>3.544” (90.02mm)</td>
<td>3.615” (91.82mm)</td>
</tr>
<tr>
<td>Fresenius 50cc</td>
<td>2.904” (73.76mm)</td>
<td>2.964” (75.27mm)</td>
<td>3.023” (76.77mm)</td>
</tr>
<tr>
<td>Monoject 60cc</td>
<td>3.473” (88.22mm)</td>
<td>3.544” (90.02mm)</td>
<td>3.615” (91.82mm)</td>
</tr>
<tr>
<td>Terumo 60cc</td>
<td>2.901” (73.70mm)</td>
<td>2.961” (75.20mm)</td>
<td>3.020” (76.70mm)</td>
</tr>
</tbody>
</table>

Table of acceptable syringe travel for 50 and 60 cc syringes.

If this test fails use the troubleshooting guide for corrective action.

AC line leakage test

1) Connect the AC power cord to the Safety Analyzer. Set Safety Analyzer to Line Leakage mode of operation. Press $\text{Enter}$ to turn the pump on.

2) Using the ground reference probe of the Analyzer, make contact with either the plunger driver tube or the center post of the DC input jack. Verify the leakage in the normal setting is less than 100 micro-amps [note, this is equivalent to BF rating for this device].
If you wish to verify the CF rating of the pump, then fill a beaker with normal (0.9%) saline solution and load the pump with a syringe and tubing filled with normal saline. The saline-filled tubing should be in contact with the saline in the beaker. Place the ground reference of the leakage current Analyzer in contact with the saline in the beaker and verify the leakage current in the normal setting is less than 10 micro-amps. [This procedure is specified in IEC 60601-2-24, clause 19.]

Turn off pump and disconnect from safety analyzer.

WARNING: Safety Class II, Type CF Medical Equipment: The pump is listed as Safety Class II, Type CF equipment. Protection against electrical shock does not rely only upon basic insulation, but instead relies on double or reinforced insulation. As such, this equipment does not utilize a third wire ground (earth ground). Therefore, when doing line leakage test it is not necessary to measure leakage in both the open ground and closed ground setting. Nor is it necessary to perform a ground resistance test.

AC line leakage test - Medfusion® 3500BC

1) Connect the AC power cord to the Safety Analyzer. Set Safety Analyzer to Line Leakage mode of operation. Press to turn the pump on.

2) Enclosure Leakage - Using the ground reference probe of the Analyzer, make contact with the center post of the DC input jack. Verify the leakage in the normal setting is less than 100 micro-amps [note, this is equivalent to BF rating for this device].

3) Earth Leakage - Use the Safety Analyzer, to measure the leakage current flowing through the earth conductor of the AC power cord.

Verify the leakage in the normal setting is less than 100 micro-amps [note, this is equivalent to BF rating for this device].

If you wish to verify the CF rating of the pump, then fill a beaker with normal (0.9%) saline solution and load the pump with a syringe and tubing filled with normal saline. The saline-filled tubing should be in contact with the saline in the beaker. Place the ground reference of the leakage current Analyzer in contact with the saline in the beaker and verify the leakage current in both the normal and reversed settings is less than 10 micro-amps. [This procedure is specified in IEC 60601-2-24, clause 19.]

Turn off pump and disconnect from Safety Analyzer.

WARNING: Safety Class II with functional earth, Type CF Medical Equipment: The pump is listed as Safety Class II with functional earth, Type CF equipment. Protection against electrical shock does not rely only upon basic insulation, but instead relies on double or reinforced insulation. As such, this equipment utilizes a third wire ground (earth ground) lead of the power cord as earth return for electromagnetic energy and does not serve as a safety function.

Therefore it is neither possible nor necessary to perform a ground resistance test.
Scheduled Maintenance

Battery maintenance

This chapter discusses battery maintenance as recommended to ensure good battery performance.

1. The battery pack contains six 2100 mAH Nickel Hydride (NiMH) cells (older pumps may have Nickel Cadmium [NiCad] batteries) with a smart gauge for monitoring battery charge information.

**Notes:**
- The gauge is built into the battery pack, and the pump reads the battery capacity from the gauge on the pack.
- The battery pack has a shelf life of 4 months, after which it will require recharging. Once installed into a pump, the shelf life is 2 months, after which it will require recharging.

2. There are two measured battery parameters that must be reviewed to maintain good battery performance and accuracy of the battery gauge. From the MAIN menu, use the number buttons to choose BIOMED; use the number button to choose DIAGNOSTICS; use the number buttons to choose MONITOR BATTERY STATUS option.

   a) LMD (Last Measured Discharge) – This the learned capacity of the battery by the gauge following a calibration cycle. It is recommended the battery be replaced when this value is < 1600 mA-hours.

   b) CPI (Capacity Inaccurate) – This is the number of shallow discharge cycles since the last calibration. It is recommended that you recalibrate the battery when CPI is > 80 hex (i.e. >128 decimal). Refer to the battery calibration section below.

Shallow discharge (CPI) record

The battery gauge records the number of shallow discharges. A shallow discharge happens whenever the battery is partially discharged and then returned to AC power. The number of the shallow discharges appears on page two of the MONITOR BATTERY STATUS menu in the BIOMED > DIAGNOSTICS menu.

- This displays CPI as 0×DD, where 0×DD is a hexadecimal number representing the number of shallow discharges cycles.
- The value is reset to zero each time the battery is calibrated. It increments to a maximum count of 0×FF hex (255 decimal).

During the annual periodic maintenance if the number of shallow discharges, CPI, is 0×80 hex or higher [e.g. 0×90, 0×A5, 0×BB, etc.], then the battery should be re-calibrated.

Battery calibration procedure

The *battery calibration* procedure ensures the battery calibrates (or “re-learns”) the battery capacity. It does this by measuring the actual charge & discharge rates to determine the true capacity of the battery. With this correct information, the pump calculates “percentage of battery charge” and determines “low battery alarm”.

1. Connect the pump to AC power.

2. Turn the pump on and select BIOMED > DIAGNOSTICS > MONITOR BATTERY STATUS.

3. After the Charge Level gauge reaches 99 to 100%, wait at least 1 more hour, then remove AC power.

4. Using one of the methods listed here, fully drain the battery pack, until the pump sounds the BATTERY DEPLETED alarm (not the LOW BATTERY alarm). You can interrupt the discharge test by turning the pump off and continue discharge at a later time – as long as you do not plug the pump into AC power during the discharge cycle.

   a) The battery can be discharged by operating the pump on battery power and infusing at 5 ml/hr using a 60cc syringe. This takes approximately 10 hours from a full charge.

   b) A quicker method is holding open the clutch lever with an a clamp or vise grips to prevent the plunger flipper and clutch from closing. Then use BIOMED > DIAGNOSTICS > MOTOR DRIVE TEST, and set motor step period to 2 msec, and press É. This should deplete the battery within approximately 3 hours.

   c) A third method is to disconnect AC power, turn the pump on, and run BIOMED > DIAGNOSTICS > MONITOR BATTERY STATUS. This discharges the battery at about 130 ma, and takes approximately 13 hours from full charge.

5. Once the BATTERY DEPLETED alarm sounds, turn the pump off and plug into AC. This begins recharging the battery. [Do not unplug AC power until charging is complete.]

If left in “Depleted” alarm condition, the pump will draw power from the battery until its voltage drops.
to a level which disconnects the battery gauge. The pump then losses all its calibration information. From the time the Battery Depleted alarm occurs, the pump has approximately 5 minutes of operation on battery before the “fully-depleted disconnect” condition occurs. At this point, the audible alarm continues running from the super-capacitor on the main board.

6. After several minutes of recharging the gauge will show the learned capacity of the battery.
7. Turn the pump on and select Biomed > Diagnostics > Monitor Battery Status.
8. Verify LMD (last measured discharge) value is greater than 1600 ma-hours.
9. Press More and verify CPI is 0×00 or 0×01.
10. Turn the pump off and continue to charge pump until battery charge is complete (approximately 10 hours).
11. Turn on pump and select Biomed > Diagnostics > Monitor Battery Status.
12. Verify the LMD is greater than 1600 mA-hours. At 1600 mA-hours battery, the pump’s battery life is approximately 7-8 hours. It is recommended that the battery be replaced if its capacity is less than 1600 mA-hours.

Requirements for battery pack replacement

The battery must be replaced only by a trained Biomedical or service technician. Always dispose of depleted or defective batteries in compliance with all applicable regulations or you may return the battery pack to Smiths Medical for recycling.

WARNING: Battery Replacement: Observe ESD handling precautions when replacing the battery. Replace battery only with same Smiths Medical part/model number.

Recycle batteries in compliance with applicable local regulations.

Collect Separately

This product contains electrical and electronic components (including batteries) that may contain materials, which if disposed of with general waste, could be damaging to the environment.
Section 2: Theory of Operation of the manual contains definitions and descriptions of standard operation of the Medfusion® 3000 Series pumps.

Overview of operation

The Medfusion® 3000 Series pump design allows the precise control of the infusion rates over a wide range of syringe sizes and manufacturers as specified in the Operation Manual.

Controlling motor functions

A stepper motor driving the plunger driver controls the infusion rate. The motor receives electrical pulses from microcontroller with pulse frequency determined from the programmed flow rate.

- Forty-eight motor pulses turn the motor one full revolution.
- Five hundred and sixty full motor revolutions move the plunger driver one inch.
- Therefore, 26,880 motor steps move the plunger driver 1 inch (or 0.000037 inches per motor step) — providing very good flow continuity and precise delivery.

Infusion control & safety functions

Two sensors are used to verify that the infusion proceeds at the programmed rate. Specifically, the microcontroller uses:

a) the motor rotation sensor to verify proper motor speed;

b) the position sensor to verify proper syringe plunger driver motion over time.

If the microcontroller determines either motor or syringe plunger driver is running at a speed not equivalent to the programmed flow rate, then the infusion stops and a system fault alarm warns the user.

Four additional sensors verify the syringe parameters:

a) The plunger sensor, in the head of the plunger driver, detects proper engagement of syringe plunger with syringe plunger driver.

b) The flange clip detects the proper position of the syringe flange.

c) The syringe barrel clamp detects both syringe presence and syringe size.

d) A force sensor in the plunger driver head detects and reports the amount of force exerted on syringe plunger head. A large amount of force indicates an occlusion in the patient line to the microcontroller.

A Watchdog device checks for microcontroller malfunction including timebase errors, and can shutdown the motor and generate an alarm independent of the microcontroller operation. An internal power source (i.e., 1 Farad super-capacitor) allows the pump to alarm should failure occur in the pump’s power system or internal battery.
Theory of Operation

Pump design description

Listed in this chapter are descriptions of each functional block and its role in pump operation and system safety.

Logic core of Medfusion® 3000 Series pumps

The block diagram below shows interrelation between the different assemblies of the Medfusion® 3000 Series pump.

Main circuit board

Main microprocessor

The main circuit board has one main microprocessor, 68HC11, with responsibilities for the following tasks:

a) Controlling the graphical display of information.
b) Responding to the keypad and controlling visual indicators on the keypad.
c) Controlling the primary speaker.
d) Controlling the stepper motor which drives the syringe plunger.
e) Monitoring syringe sensors: syringe size, syringe flange (ear) loaded, syringe plunger loaded, syringe plunger position, and syringe plunger force.
f) Communicating with the smart battery gauge.
g) Controlling the external serial communication.
**Watchdog circuit**

A **watchdog circuit** has a separate power supply and separate (PIC) microcontroller/clock which monitors the main microprocessor. The watchdog circuit detects microprocessor timing failures and initiates a watchdog alarm through a dedicated “back-up” audible alarm which is separate from the primary speaker.

If a watchdog or “System Failure” alarm is generated, then watchdog circuit turns on the red alarm indicator and backup audible alarm, and turns off the motor current.

**DC power converter**

The **DC Power Converter** generates required system DC voltages from the available power source coming from the interconnect board. This power source can be either battery power, or AC power, or external DC power. The main microprocessor monitors these voltages and will detect failures in any system voltages.

**Real time clock**

A separate **Real Time clock** source provides the microprocessor with date and time information. The date and time are used for time-stamping records in alarm history and infusion history, and for determining the next recommended Periodic Maintenance date.

**Graphical display circuit board (LCD)**

A 240 × 64-pixel liquid crystal display provides the primary visual interface for pump operation.

- An always on LED driven back light in the LCD enhances viewing in low light areas.

**Keypad**

The **keypad** is a multi-layer polyester laminate providing buttons for controlling the pump, and indicator lights for identification of pump status.

**Plunger (driver) travel sensor**

The **plunger travel sensor** is a precision potentiometer producing a change in voltage (resistance) with the motion of the syringe plunger driver. This allows the microprocessor to determine:

- plunger speed
- near end of plunger travel (i.e., near empty alarm)
- end of plunger travel (i.e., empty alarm)

The microprocessor uses sensor output to verify plunger travel against set flow delivery rate. The sensor output is **not** used for rate correction.

**Motor rotation sensor**

The **motor rotation sensor** is an optical reflective sensor which senses 4 pulses per motor rotation. The microprocessor measures the frequency of this signal to:

- Verify rotation speed against the set flow delivery rate. It is not used for speed correction.

**Stepper motor**

The **stepper motor** drives the syringe plunger driver.

- Each motor step is controlled by the microprocessor using an open loop control method.

**Syringe flange loaded sensor**

The **syringe flange sensor** requires the flange be installed in the flange locating device on the pump.

- Reports a logic state to the microprocessor to indicate proper syringe flange loading.
- Uses self test signal to verify the sensor is not in an electrically “stuck” state.

**Syringe size sensor**

The **syringe size sensor** is a precision potentiometer which produces a voltage (resistance) proportional to the outside barrel diameter of the syringe loaded into the pump. This allows the microprocessor to measure:

- Voltage proportional to syringe barrel outside diameter to determine the syringe size (e.g. 10cc, 20cc etc.) or syringe not loaded.

**Interconnect printed circuit board**

Receives and directs the power source, either internal 12VDC power supply, internal battery, or external DC power to the “Main” board.

a) Generates status signals to “Main” board indicating source of power supplied.

b) Contains battery charger for charging the battery.

c) Contains an infrared drivers for serial communication interface with the pump.

d) Supplies the audio drive signal, originating from the “Main” board, to power the speaker.
**AC power input & power supply board**

This AC Power Input provides a receptacle for connecting an IEC 320-type AC power cord to the internal, universal input power supply. This Power Supply Board provides 12 VDC to operate the pump and charge the batteries.

**DC power input jack**

The DC Power Input Jack connects external DC power into the pump from external DC sources. This input is protected from over-voltage and reverse polarity.

- Always observe all **cautions and warnings** for connecting DC power to this input.

**Speaker**

The primary speaker serves as the primary audio source for generating alarms.

- The microprocessor senses speaker current to determine if speaker is operational.

**Rechargeable battery pack & battery gauge**

A rechargeable NiMH battery pack (NiCad battery pack on older model pumps) allows operation on battery, which also serves to provide backup power with the loss of externally applied AC or DC power

A gauge residing on the battery pack maintains present battery capacity during charge and discharge conditions. The gauge monitors battery temperature and controls the battery charger in setting the charge rate. The pack contains a resettable fuse which limits the current flowing through the battery.

**Plunger printed circuit board**

This plunger printed circuit board (PCB) provides connection and pre-amplification of sensors in the plunger driver to the main microprocessor board. The plunger PCB contains the force sensor amplifier and the plunger loaded sensors.

**Plunger force sensor**

The plunger force sensor is a full bridge strain gauge which generates a voltage proportional to the force applied by the plunger driver to push the syringe plunger. The allows the microprocessor to measure:

- Voltage proportional to force applied to the syringe plunger (i.e. occlusion detection).
- Uses self test control line to verify force sensor and circuitry are operating properly.

**Plunger Loaded Sensors**

The two plunger loaded sensors are located on the plunger PCB, and sense the state of each “flipper” on the plunger driver.

- Reports a logic state to the microprocessor to indicate proper syringe plunger loading.
- Uses self test signal to verify the sensor is not in an electrically “stuck” state.
Main Board – Schematic Level

The Main printed circuit board design has the following sub-circuits:

- Logic kernel
- Power control
- DC-DC Converter
- Front panel interface
- Graphic display interface
- Motor drive
- Motor speed detection
- Syringe sensing
- Plunger position sensor
- Force sensing
- Speaker drive

Each of the sub-circuit descriptions is presented in the order of the schematic pages of the Medfusion® 3000 Series “Main Printed Circuit Board”. The signal names marked with the asterisk symbol on the schematic indicate that those signals are “active-low”.

In the block diagrams for each section, the arrows indicate data flow direction referenced to the main microprocessor. In some cases, the arrows will identify a device other than the microprocessor to which the signal directly interfaces, (e.g., analog to digital converter).

Logic Kernel Description

The Medfusion® 3000 Series Logic Kernel Main PC flowchart is below. It shows linkage between the 68HC11K1 microprocessor and the main components of the system:

Flowchart of Logic Kernel for Medfusion® 3000 Series infusion pump

68HC11K4 Main Microprocessor Interface, U19

The main microprocessor’s direct signal interfaces are described in clockwise order taken from the Medfu-
**Theory of Operation**

The **sion® 3000 Series Main PC Schematic** of the microprocessor. The following table summarizes some of the microprocessor input / output signals.

<table>
<thead>
<tr>
<th>Signal name</th>
<th>Processor port</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IR_XMT_DATA</strong></td>
<td>PD1/TxD</td>
<td>The <strong>IR_XMT_DATA</strong> is used for transmitting asynchronous serial data.</td>
</tr>
<tr>
<td><strong>IR_RCV_DATA</strong></td>
<td>PD0/RxD</td>
<td>The <strong>IR_RCV_DATA</strong> is used for receiving asynchronous serial data.</td>
</tr>
<tr>
<td><strong>SPEAKER_FREQUENCY</strong></td>
<td>PH0/PW1</td>
<td>Sets the audio frequency of the main speaker. Generated as a fixed 50% duty cycle (square wave) with a variable frequency.</td>
</tr>
<tr>
<td><strong>SPEAKER_VOLUME</strong></td>
<td>PH1/PW2</td>
<td>Fixed frequency variable pulse widths signal that the speaker-driver hardware converts into a DC voltage for volume control.</td>
</tr>
<tr>
<td><strong>MTRPHA_IREF</strong></td>
<td>PH2/PW3</td>
<td>Pulse-width modulated output transformed by hardware into a DC level representing motor current for coil “A” of the motor.</td>
</tr>
<tr>
<td><strong>MTRPHB_IREF</strong></td>
<td>PH3/PW4</td>
<td>Pulse-width modulated output transformed by hardware into a DC level representing motor current for coil “B” of the motor.</td>
</tr>
<tr>
<td><strong>ADC_CS</strong></td>
<td>PG6</td>
<td>Chip select signal for SPI communication to the 10-bit analog to digital converter. This signal is active low.</td>
</tr>
<tr>
<td><strong>DAC_CS</strong></td>
<td>PG1</td>
<td>Chip select signal for SPI communication to the 8-bit digital to analog converter. This signal is active low.</td>
</tr>
<tr>
<td><strong>RESETPIO</strong></td>
<td>PG0</td>
<td>Allows the main processor to independently reset the two 24 bit I/O expansion devices. The reset is active high.</td>
</tr>
<tr>
<td><strong>POWER_STROBE</strong></td>
<td>PD5</td>
<td>Controls the power state of the system. Must be an AC signal to maintain the power on state. A stuck state of either logic high or low, is one of the conditions for enabling the power off state.</td>
</tr>
<tr>
<td><strong>PLUNGER_DETECT1</strong></td>
<td>PA6/OC2</td>
<td>Logic sense signal for detecting the respective plunger flipper state. A logic high indicates a syringe is loaded.</td>
</tr>
<tr>
<td><strong>PLUNGER_DETECT2</strong></td>
<td>PA5/OC3</td>
<td>Logic sense signal for detecting the respective plunger flipper state. A logic high indicates a syringe is loaded.</td>
</tr>
<tr>
<td><strong>ACU_PWR_STRB_ON</strong></td>
<td>PA4/OC4</td>
<td>This feedback signal to check that ACU is still controlling power to the system. When power is on, <strong>ACU_PWR_STRB_ON</strong> measures &gt; 4.0 volts nominally.</td>
</tr>
<tr>
<td><strong>ASYNC_BATTERY_DATA</strong></td>
<td>PA3/IC4/OC5</td>
<td>The single wire asynchronous data communication between the main processor and the battery gauge located on the battery pack. This port pin is bi-directional, both input &amp; output.</td>
</tr>
<tr>
<td><strong>IO_CS</strong></td>
<td>CSIO</td>
<td>Chip select for the two 24 bit I/O expansion devices. This signal is active low.</td>
</tr>
<tr>
<td><strong>RAM_CS</strong></td>
<td>CSGP1</td>
<td>Chip select for the main processor’s external random access memory (RAM). This signal is active low.</td>
</tr>
<tr>
<td><strong>EEPROM1_CS</strong></td>
<td>PH6</td>
<td>Chip select for SPI communication to the serial E2 PROM #1. This signal is active low.</td>
</tr>
<tr>
<td><strong>FLASH_CS</strong></td>
<td></td>
<td>Chip select for access to the main processor’s programmed memory (FLASH). This signal is active low.</td>
</tr>
<tr>
<td>Signal name</td>
<td>Processor port</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>WRITE*, e_CLOCK, XADDR[15:18], ADDR[0:14], DATA[0:7]</td>
<td>R/w*, E, XADDR15 - XADDR18, ADDR0 - ADDR14, and DATA0 - DATA7</td>
<td>The main processor control bus signals that route to the memory and I/O expansion devices. The address line addr15 is not used.</td>
</tr>
<tr>
<td>SPI_CLOCK, SPI_MOSI, and SPI_MISO</td>
<td>SCK, MOSI, MISO</td>
<td>These signals are used for SPI bus communication to the Serial EEPROM, Time of Day Clock, Analog to Digital Converter, and the Digital to Analog Converter.</td>
</tr>
<tr>
<td>ATOD_REF_BFRD</td>
<td>AN0</td>
<td>Input for main processor to verify the reference voltage used by the 10-bit analog to digital converter and system reference. The nominal measured reference voltage is 2.048 volts.</td>
</tr>
<tr>
<td>SUPERCAP_DETECT</td>
<td>AN1</td>
<td>Analog signal proportional to the Super Capacitor voltage. When fully charged, SUPERCAP_DETECT measures 2.5 volts nominally. The main processor read SUPERCAP_DETECT to verify the Super capacitor is present.</td>
</tr>
<tr>
<td>PWR_STRB_ON</td>
<td>AN2</td>
<td>Feedback signal is to check the proper operation of the power control circuit. When power is on, PWR_STRB_ON measures &gt; 4.0 volts nominally.</td>
</tr>
<tr>
<td>MOTOR_SPLY_MEAS</td>
<td>AN3</td>
<td>Signal is proportional to the motor supply voltage. The nominal DC voltage for this signal is 1.09 volts, exactly a sixteenth of the motor supply voltage.</td>
</tr>
<tr>
<td>ANALOG_SPLY_MEAS</td>
<td>AN4</td>
<td>Signal is proportional to the analog supply voltage. The nominal DC voltage for this signal would be 2.5 volts nominally, exactly one half of the analog supply voltage.</td>
</tr>
<tr>
<td>FORCE_PSV_ADJ</td>
<td>AN5</td>
<td>Feedback signal proportional to the offset voltage used on the force sensor pre-amplifier. Its voltage range dependent upon the offset voltage setting (a calibration value).</td>
</tr>
<tr>
<td>SPEAKER_DETECT</td>
<td>AN6</td>
<td>Feedback signal proportional to the current through the main speaker. Its level depends on the volume setting for the speaker.</td>
</tr>
<tr>
<td>VPOS_SPLY_MEAS</td>
<td>AN7</td>
<td>Signal is proportional to the positive supply voltage. The nominal DC voltage for this signal is 2.397 volts, exactly one fourth of the VPOS_SPLY supply voltage.</td>
</tr>
<tr>
<td>MTR_TIMER</td>
<td>PA7/OC1</td>
<td>Time base used by the main processor to control motor step timing and an input to the highest, maskable interrupt source.</td>
</tr>
<tr>
<td>MOTION_DETECT</td>
<td>PA2/IC1</td>
<td>Signal is the encoded output from the optical motor rotation detector.</td>
</tr>
<tr>
<td>BUZZER_DETECT</td>
<td>PA1/IC2</td>
<td>Feedback signal from the audio buzzer detection circuit. This signal is logic high whenever the audio buzzer is active.</td>
</tr>
<tr>
<td>TOD_INTRPT</td>
<td>PA0/IC3</td>
<td>An independent time base provided by the time of day clock. This is a 1 Hz frequency signal.</td>
</tr>
<tr>
<td>MOD_A, MOD_B</td>
<td></td>
<td>These inputs configure special processor operational modes.</td>
</tr>
</tbody>
</table>
**Theory of Operation**

<table>
<thead>
<tr>
<th>Signal name</th>
<th>Processor port</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESET*</td>
<td>Reset</td>
<td>Provided from the system-reset circuit located in the Power Control Logic section of the Main PCB.</td>
</tr>
<tr>
<td>AVDD, AVSS, and VRL</td>
<td>The main processor’s analog to digital conversion supply and reference pins.</td>
<td></td>
</tr>
</tbody>
</table>

**Flash memory, U22**

Flash program memory is 512 K × 8. It is addressed as 16 pages of 32 K × 8 each.

*Flash memory can be reprogrammed within the system.*

**Software upgrade method for programming flash memory**

The re-programmable feature of Flash Memory provides for software upgrades. The pump is placed in a special Biomed mode which allows reprogramming of the software through the infrared serial port.

**Static random access memory, U17**

Static RAM is 32 K × 8 bit.

**Serial EEPROM, U2 and U4**

The serial EEPROMs are used for storing manufacturing, calibration, configuration, libraries, the history event log, the PharmGuard® Safety Data, and the service data requiring non-volatile random access.

Medfusion® 3000 series pumps may have two 8K x 8 bit EEPROMs, two 16K x 8 EEPROMs, or two 32K x 8 EEPROMs.

**Time of day, U8**

The time of day, including calendar, is maintained by the RS5C316B which is continually powered as long as AC, external DC voltage, or internal battery is present, or the super capacitor is charged.

**Infrared transceiver**

An IR transceiver, located on the Interconnect board, provides an electrically isolated asynchronous serial communication link between the pump and an external system. The infrared link is intended for short distances of less than a few inches.
Analog to digital converter, U13
A four channel, unipolar, 10-bit converter obtains high resolution analog measurements.
The high resolution measurements in ascending channel order are:
- pressure sensing amplifier
- plunger force sensing amplifier
- syringe size sensing amplifier
- plunger travel sensor.
The converter uses precision 4.096-volt reference equating to a bit resolution of 4 millivolts. The converter interfaces to the Serial Peripheral Interface of the 68HC11.

Digital to analog converter, U20
A dual channel 8 bit digital-to-analog converter:
- Generates the contrast voltage for the Liquid Crystal display,
- Generates an offset to the force sensing amplifier.
Uses precision 4.096-volt reference equating to a nominal bit resolution of 16 millivolts. Channel A is the source for the force amplifier, and channel B is the contrast voltage reference.
**Theory of Operation**

### I/O port expansion, U3, U33

There are two 82C55 input/output port devices providing the additional input/output requirements for the microprocessor. They are accessed through the I/O chip selects PORT1_CS* and PORT2_CS*.

#### Expansion port # 1 (PORT1_CS)

<table>
<thead>
<tr>
<th>Signal name</th>
<th>Port location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEPROM2_CS*</td>
<td>PB7</td>
<td>A logic low enables accessing the 2nd serial EEPROM.</td>
</tr>
<tr>
<td>PET_WATCHDOG</td>
<td>PB6</td>
<td>A logic signal used as a handshake for indicating valid operational status to the auxiliary controller.</td>
</tr>
<tr>
<td>SUPERCAP_TEST</td>
<td>PB5</td>
<td>A logic high enables testing the super-capacitor, (i.e., backup power source).</td>
</tr>
<tr>
<td>TOD_CS</td>
<td>PB4</td>
<td>A logic high enables accessing the time of day IC.</td>
</tr>
<tr>
<td>TOD_WR_ENBL*</td>
<td>PB3</td>
<td>A logic low enables writing data to the time of day IC.</td>
</tr>
<tr>
<td>SPEAKER_ENVELOPE3</td>
<td>PB2</td>
<td>A logic high selects the audio envelope time constant of 35 milliseconds. Refer to the Main Speaker Drive description section.</td>
</tr>
<tr>
<td>SPEAKER_ENVELOPE2</td>
<td>PB1</td>
<td>A logic high selects the audio envelope time constant of 11 milliseconds. Refer to the Main Speaker Drive description section.</td>
</tr>
<tr>
<td>SPEAKER_ENVELOPE1</td>
<td>PB0</td>
<td>A logic high selects the audio envelope time constant of 2.5 milliseconds. Refer to the Main Speaker Drive description section.</td>
</tr>
<tr>
<td>WARNING_LED_ON*</td>
<td>PC7</td>
<td>A logic low turns the “Caution” LED indicator on.</td>
</tr>
<tr>
<td>INFUSING_LEDL_ON*</td>
<td>PC6</td>
<td>A logic low turns the left most (when viewing the keypad) “Infusing” LED indicator on.</td>
</tr>
<tr>
<td>INFUSING_LEDM_ON*</td>
<td>PC5</td>
<td>A logic low turns the middle “Infusing” LED indicator on.</td>
</tr>
<tr>
<td>INFUSING_LEDR_ON*</td>
<td>PC4</td>
<td>A logic low turns the right most “Infusing” LED indicator on.</td>
</tr>
<tr>
<td>PCELL_LED_ON*</td>
<td>PC3</td>
<td>A logic low turns the “Pressure Cell” LED indicator on.</td>
</tr>
<tr>
<td>BATTERY_LED_ON</td>
<td>PC2</td>
<td>A logic high turns the “Battery” LED indicator on.</td>
</tr>
<tr>
<td>CAUTION_LED_ON*</td>
<td>PC1</td>
<td>A logic low turns the “Caution” LED indicator on.</td>
</tr>
<tr>
<td>LOCKOUT_LED_ON*</td>
<td>PC0</td>
<td>A logic low turns the “Tamper Feature Active” LED indicator on.</td>
</tr>
<tr>
<td>KEYPAD_IN_COL(0-5)</td>
<td>PA0-PA5</td>
<td>Senses 1 of 6 columns of the keypad matrix. When the sense value is logic low, the indication is the corresponding button for the column is being pressed.</td>
</tr>
<tr>
<td>PWR_SW_MCU</td>
<td>PA6</td>
<td>Sense signal for the power switch. The signal is at a logic high when the power switch is being pressed.</td>
</tr>
<tr>
<td>MTR_CURRENT_DETECT*</td>
<td>PA7</td>
<td>Sense signal from the motor current detector circuit. If the motor is energized with sufficient current in any coil, this signal is at logic low.</td>
</tr>
</tbody>
</table>
## Expansion port # 2 (port2_cs)

<table>
<thead>
<tr>
<th>Signal name</th>
<th>Port Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SET_IN_SNSR_ENBL*</td>
<td>PB6</td>
<td>Set to logic low to enable the “set in” detector to sense the pressure cell being installed.</td>
</tr>
<tr>
<td>SYRINGE_EAR_SNSR_ENBL</td>
<td>PB5</td>
<td>Set to logic high to enable the “syringe” detector to sense the syringe flange (ears) being installed.</td>
</tr>
<tr>
<td>PLUNGER_SNSRS_ENBL</td>
<td>PB4</td>
<td>Set to logic high to enable the “plunger” detectors to sense the plunger flippers being properly engaged.</td>
</tr>
<tr>
<td>MOTION_SNSR_ENBL</td>
<td>PB3</td>
<td>Set to logic high to enable the motion sensor monitoring the motor speed.</td>
</tr>
<tr>
<td>FORCE_SNSR_TEST*</td>
<td>PB2</td>
<td>Set to logic low to activate the force sensor test circuit. This signal causes the sensor to generate a known offset if the sensor is operating properly.</td>
</tr>
<tr>
<td>PRESSURE_SNSR_TEST*</td>
<td>PB1</td>
<td>Set to logic low to activate the pressure sensor test circuit. This signal causes the sensor to generate a known offset if the sensor is operating properly.</td>
</tr>
<tr>
<td>LCD_RESET*</td>
<td>PB0</td>
<td>Allows the main processor to reset the LCD display independently of other system devices. The reset signal is active low.</td>
</tr>
<tr>
<td>MTR_PHB_DIR</td>
<td>PC7</td>
<td>Controls the direction (phase) of motor current in coil “B” of the stepper motor.</td>
</tr>
<tr>
<td>MTR_PHB_ENBL*</td>
<td>PC6</td>
<td>Set to logic low to enable motor current in coil “B”.</td>
</tr>
<tr>
<td>MTR_PHA_DIR</td>
<td>PC5</td>
<td>Controls the direction (phase) of motor current in coil “A” of the stepper motor.</td>
</tr>
<tr>
<td>MTR_PHA_ENBL*</td>
<td>PC4</td>
<td>Set to logic low to enable motor current in coil “A”.</td>
</tr>
<tr>
<td>KEYPAD_SEL_ROW3*</td>
<td>PC3</td>
<td>Control signal to select row 4 of the four-row keypad matrix. To select the row requires a logic low and only one row at a time.</td>
</tr>
<tr>
<td>KEYPAD_SEL_ROW2*</td>
<td>PC2</td>
<td>Control signal to select row 3 of the four-row keypad matrix. To select the row requires a logic low and only one row at a time.</td>
</tr>
<tr>
<td>KEYPAD_SEL_ROW1*</td>
<td>PC1</td>
<td>Control signal to select row 2 of the four-row keypad matrix. To select the row requires a logic low and only one row at a time.</td>
</tr>
<tr>
<td>KEYPAD_SEL_ROW0*</td>
<td>PC0</td>
<td>Control signal to select row 1 of the four-row keypad matrix. To select the row requires a logic low and only one row at a time.</td>
</tr>
<tr>
<td>BUZZER_ARMED</td>
<td>PA0</td>
<td>A logic high indicates the backup audio buzzer is ready to alarm should the “watchdog” alarm state become true. A series resistor is provided to prevent latching.</td>
</tr>
<tr>
<td>WATCHDOG_ALARM</td>
<td>PA1</td>
<td>A logic high indicates the “watchdog” alarm state is true.</td>
</tr>
<tr>
<td>EXTRNL_PWR_DETECT</td>
<td>PA2</td>
<td>A logic high indicates an external power source is connected to the pump. A series resistor is provided to prevent latching.</td>
</tr>
<tr>
<td>AC_PWR_DETECT</td>
<td>PA3</td>
<td>A logic high indicates AC line power is connected to the pump. A series resistor is provided to prevent latching.</td>
</tr>
<tr>
<td>SYRINGE_EAR_DETECT</td>
<td>PA5</td>
<td>A logic high indicates the syringe flange (ears) are installed properly in the pump and SYRINGE_EAR_SNSR_ENBL is active.</td>
</tr>
<tr>
<td>SET_IN_DETECT</td>
<td>PA6</td>
<td>A logic high indicates the pressure cell is installed and SET_IN_SNSR_ENBL is active.</td>
</tr>
<tr>
<td>VLOW_BATTERY</td>
<td>PA7</td>
<td>A logic high indicates the battery voltage has fallen below a fixed voltage level, independent of the battery being charged.</td>
</tr>
</tbody>
</table>
Power control description

The power control logic provides two functions, power management, and triggers alarms when the main microprocessor fails. Refer to the Power Control Logic section of the Main PC Schematic for details.

Flowchart of Power Control Description.

**Always on supply, U7**

A 5-volt linear regulator provides power to the time of day clock and auxiliary controller, while maintaining a charge on the super capacitor.

- This supply is always active provided a power source is present be it the regulated mains AC power, battery, or external DC.

**Backup super capacitor, C11**

This device provides backup power to the audio buzzer in the loss of the primary power source, a 1 Farad Super Capacitor is part of the power control design.

- The super capacitor voltage `SUPERCAP_DETECT`, is monitored through the microprocessor’s A/D converter channel by the microprocessor asserting `SUPERCAP_TEST` when the pump is turned on.

**Backup audio buzzer, XD1**

The audio buzzer provides a means to generate a backup audible alarm during:

- *instrument power loss* (while the instrument was on)
- *malfunction of the main microprocessor*
- *or failure of the primary speaker.*
The audio buzzer is enabled when the pump is turned on, and when the WATCHDOG_ALARM signal activates. The WATCHDOG_ALARM signal (from the auxiliary controller) activates anytime there is a malfunction of the main microprocessor. The main microprocessor can activate this buzzer indirectly by not providing the PET_WATCHDOG strobe to the auxiliary controller which causes a watchdog alarm.

- During power-up, the buzzer is tested by the watchdog alarm state being active, and the buzzer response verified through the BUZZER_DETECT signal.

System reset, U43

On startup, the microprocessor comes out of reset when the logic supply exceeds 4.6 volts plus the built-in delay of the reset IC.

Power management, U39

An embedded Auxiliary controller oversees the power control management, and serves as the main microprocessor watchdog. The behavior of the power management system depends on pump states:

- Power Off
- Power On
- Watchdog Alarm
- and a Battery Disconnect.

Power OFF state

You must press, hold, and release the power switch to turn OFF the power. In normal operation, both the auxiliary controller and the main microprocessor control power-off.

Power ON state

To enter the power on state the POWER_ENBL signal is initially set active by the auxiliary controller. This requires the auxiliary controller provide an AC strobe to the POWER_ENBL circuit. This POWER_ENBL signal also arms the backup audio buzzer. The POWER_ENBL signal is verified by the main microprocessor monitoring the BUZZER_ARMED signal.

Watchdog

During a watchdog alarm, the auxiliary controller has sole control of power-off.
**DC to DC converter**

The circuits for the DC-DC Converter provide all regulated voltages required by the hardware sub-circuits.

- A switched DC source, (battery, regulated mains supply, or external DC) powers the converter section under the control of the Power Control circuitry.
- The converter design provides stable supply operation from an unregulated DC source, simplifying the requirements for the switched sources.
- Refer to the DC-DC Converter section of the Main PCB schematic for details.

**Logic supply, U12**

The Logic Supply current-mode switching regulator provides a regulated output voltage of 5 volts (±5%) for the system logic.

**Motor supply, U34**

The Motor Supply is a current-mode switching regulator provides a regulated output voltage of 17 volts for the motor current regulators.

**Analog supply, U21**

The Analog Supply is provided specifically for low noise signal processing circuits. Being a linear supply, inherent noise rejection removes source input switching noise from its regulated output.
Positive & negative supply, U36

The negative supply is a charge pump DC-DC converter doubles the input voltage, then inverts the doubled voltage.

- Provides the contrast voltage to the graphic LCD display. The low current load for the contrast voltage allows use of an operation amplifier controlled by the D/A converter through the SPI bus.
- Provides negative supply for the amplifiers used in force and pressure sensing.
- The charge pump doubles the “Logic Supply” voltage to achieve a 10V nominal positive supply voltage. This supply is used for analog circuits needing a supply voltage higher than the “Analog Supply”.

LCD backlight supply, U1

A constant current regulator controls the primary LED backlight for the LCD display. On the Medfusion® 3500 pump, the secondary LED for the backlight is controlled by Q45.
Theory of Operation

Front panel interface description
The keypad interface has two circuits:
- the interface to the LED’s
- the interface to the keypad switch matrix, and power switch.

![Flow Chart of Front Panel Function](chart.png)

LED drive circuit, Q26, Q27, Q40, Q33 - Q37
Each LED drive circuit has a logic controlled switch providing a pseudo-current source to the LED when activated.
- All LED’s except the “Warning”, “Battery Charge”, and “AC Power” LEDs, are controlled exclusively by the main microprocessor.

Keypad matrix interface
A 4 row by 6 column scan matrix senses the front panel keys:
- A pressed button is read from column signals, KEYPAD_IN_COLX, through the 82C55 port expander #1. A button press is sensed as a logic low.
- The keypad row signals are output from port C of the 82C55 port expander #2.

Power switch interface
The power switch has a circuit separate from the keypad matrix because it is monitored by both the main microprocessor and the auxiliary controller.
**Graphic display interface description**

The graphic display interface circuits have the main microprocessor control signals, read write, the device select signal \( \text{LCD\_cs} \), a data output latch, a data input buffer, and a device reset.

**Data output to LCD, U32 / data input from LCD, U6**

The data from the LCD to the main microprocessor is buffered by U32 and U6.

**LCD contrast**

The contrast control is created from the 8-bit digital to analog converter buffered with a 2.5 gain amplifier to provide minus contrast voltage.

- The full scale range of 255 (FF hexadecimal) counts equals approximately *minus 10 volts*.

**LCD backlight**

The primary backlight for the LCD is an LED driven by a constant current source. This backlight is *always on* whenever the pump is on.

The secondary backlight is not present on Medfusion® 3010 and 3010a pumps. Its on-off state is controlled by the CPU. During normal conditions, it is off when the pump is powered via the internal battery.
Theory of Operation

Motor drive description

A two-phase bipolar stepper motor drives the syringe plunger. The motor control interface drives the stepper motor.

Flowchart of Motor Drive Description

The main microprocessor controls which motor winding is active, designated as A or B, the direction of current in each winding, and the magnitude of the current.

Coil A & B PWM current references

The pulse-width modulated signals from the main microprocessor are low pass filtered to create an analog voltages for control of motor current in each coil.

Motor current regulators, U26, U35

Two regulator ICS independently regulate the current for windings A and B.

- The watchdog_alarm signal activates the N-channel MOSFET to disable the motor current in both windings through the “BRAKE” pin of the regulator IC.

Motor current detector, U40

The watchdog alarm function is tested at power-up by verifying the mtr_current_detect* signal is at a logic high when the watchdog alarm condition is active.

- Similarly, the mtr_current_detect* signal should be at a logic low when either motor winding has sufficient current and the watchdog alarm condition is not present.
Sensors interface description

Motor speed detection
The digital sense signal is created by using a reflective infrared optical sensor to sense a motor-coupled encoder as the motor rotates. The microprocessor measures the period of the signal created by the encoder.

Syringe sensing description
The syringe sensing system senses the syringe barrel size, senses the plunger end cap is secured by the mechanical flippers, and the syringe flange (ears) are located in the pump’s syringe flange locating device.

- The circuit for sensing the plunger flippers is part of the plunger printed circuit function.

Syringe size sensing
Syringe sensing is accomplished by using a potentiometer which changes its resistance with the barrel diameter. The potentiometer is excited with a precision 4.096V voltage reference and the potentiometer’s output is monitored through channel 2 of the system A/D.

- The sensing system requires calibration to determine offset and gain. Calibration values are stored in non-volatile (serial EEPROM) memory.

Syringe flange (ear) sensing
Syringe flange (or ear) sensor is used to detect if the syringe flange is installed in the flange-holder on the side of the pump.

An infrared optical interrupter detects when the flange-locating device is in a valid position. A properly loaded flange causes the optical path to become uninterrupted allowing a direct path from the infrared emitter to the detector.

- The emitter is enabled by the signal syringe_ear_snsr_enbl when set to logic low.
- The sensor output, syringe_ear_detect, produces a high logic state when the flange is properly loaded.
- The state should be logic low anytime the syringe ear (flange) is not installed or syringe_ear_snsr_enbl is inactive.
Theory of Operation

Plunger position sensing description
Sensing syringe plunger position is required for the detection of an incorrect plunger speed, detecting near end of plunger travel, and detecting end of plunger travel.

The travel sensing circuits perform excitation and signal processing of the travel sensor. The travel sensor uses a linear potentiometer which produces a change in resistance with the motion of the syringe plunger.

- The sensing system requires calibration to determine offset and gain. Calibration values are stored in non-volatile (serial EEPROM) memory.

Speaker drive description
The speaker sounds the warning and caution alarm tones for the pump. The interface circuit controls the frequency and amplitude of the signal driving the speaker, and provides feedback for verifying speaker function.

Speaker control
- Tone duration is controlled by the interval the amplitude level is applied.
- The speaker_frequency signal is a fixed 50% duty cycle (square wave) with a variable frequency to 1 kHz.
- The speaker_volume is a pulse-width modulated signal converted by hardware to an analog voltage which controls the speaker volume.
- The rise and fall times of the volume are controlled by input signals from: speaker_envelope_1, speaker_envelope_2, and speaker_envelope_3.
Speaker test

The return signal from the speaker detects whether current is flowing in the Speaker from analog conditioning circuitry. The half-wave rectifier circuit uses the negative half-cycle of the sense signal to invert and amplify it.

- The amplified output is demodulated by the analog switch which creates a peak and hold circuit.
- The speaker_detect output signal from the conditioning circuitry goes to the microprocessor's analog input.

Plunger board – schematic level

The plunger PCB provides pre-amplification of the force sensor output to the Main system PCB, and contains two photo-interrupters with supporting circuitry, one for each plunger flipper.

The referenced schematic signals of the main board electronics are identified using names in SMALLCAPS.

Force preamplifier function

The force sensing system provides a measurement of the force required in moving the syringe plunger. The interface to the force sensor has an excitation source, test signal, and pre-amplification.

- The Main printed circuit board provides a fixed 4.096-volt excitation to the force sensor.
- The Main printed circuit board trims this offset range using the signal FORCE_PREAMP_OSAJD.
- The Main PCB provides additional gain to maximize measurement resolution.

Force sensing interface description

The force sensing element is a full bridge strain gage, and the plunger PCB pre-amplifies and filters the output of this bridge. The interface has: sensor excitation, electronic zero-offset adjustment, amplification and filtering, and a sensor test control signal

- FORCE_SNSR_EXH provides a constant voltage excitation of 4.096 volts DC to the sensor.
- Auto-Zero Adjustment Circuit provides a voltage to zero the pre-amplifier, FORCE_OSV_ADJ, from the 8 bit system D/A converter.
- Sensor Post Filter Amplifier is a second order low-pass filter with a 3.68x gain.
- The signal FORCE_SNSR_TEST when set active low causes Q2 to apply a resistance parallel to the force sensor’s bridge resulting in a positive shift of the sensor output.
- The sensing system requires calibration to determine zero adjustment, offset, and gain. Calibration values are stored in non-volatile (serial EEPROM) memory.
Plunger flipper sensor function

Plunger flipper sensing requires each sensor detect its respective flipper position. Each infrared optical interrupter provides a high logic state when the flipper is in a valid position determined by a loaded syringe plunger. The transmitters for both photo-interrupters are driven in series; however, the optical receivers are read in parallel.

- Output from each *photo-interrupter* is monitored individually so each sensor is independently checked.
- When a syringe plunger is correctly loaded, both `plunger_snsr1_out` and `plunger_snsr2_out` are at a *logic high*.
- The transistor Q1 allows the sensor output to be tested by turning the transmitter from both sensors on and off. This is controlled by the signal `plunger_snsrs_enbl` from the Main PCB.
Interconnect board – schematic level

The interconnect printed circuit design interfaces to an intelligent rechargeable Battery, the system speaker, the internal DC supply, connection for an external DC supply and the main PCB.

Flowchart of Interconnect Board at Schematic Level

Each sub-circuit description is presented in the order of the schematic pages of the Medfusion® 3000 Series “Interconnect Printed Circuit”.

AC power detection description

The AC power detector uses a zener diode regulator to provide a constant voltage to the signal AC_PWR_DETECT anytime AC power is provided to the pump. The regulated voltage is required for logic detection of AC power and is used to regulate the current through the AC LED indicator and the battery charge LED indicator.

- For AC_PWR_DETECT to be active, requires the DC input voltage (from the AC power supply) exceed 10 volts.

The AC_PWR_DETECT signal is also used to generate the signal BATTERY_SWX_ON* which controls a battery switch to turn ON using battery power when AC power and external DC power are removed.

- The other effect of BATTERY_SWX_ON* is delaying the battery charger from starting until the internal DC power supply reaches 10 volts.

A transient voltage suppressor protects the detection circuitry on the REG_DC_INTRNL.
Theory of Operation

External DC power conditioning / detection description
The external DC power input section limits current through a resettable fuse, both common and differential mode noise suppression and transient voltage protection. The resettable fuse limits current into the pump from an external DC source. Noise filtering is performed by input and output capacitors on the conditioning circuit together with a common mode choke.

The external power detector uses a zener diode to provide a valid logic high level when external DC power is applied. The active voltage for extrnl_pwr_detect is nominally 5 volts. The threshold detector U3 provides immediate detection, through the signal battery_swx_on*, of the external DC source being removed.

- A battery switch toggles to internal battery if both AC and external DC power are removed.
- The threshold detector also prevents the battery charger from charging the internal battery until the external DC power exceeds 5 volts.

Infrared serial data port description
The infrared serial port interfaces directly with the main microprocessor’s asynchronous serial communication pins. The infrared port supports short transmission distances of approximately 3” or less and a maximum baud rate of 9600.

The Infrared Receiver signal from U1 is conditioned by the comparator circuit of U4 to generate a valid logic state to the microprocessor.

The Infrared Transmitter signal ir_xmt_data is at a logic high during its inactive state. A logic low on ir_xmt_data enables the transmitting IR diode through the transistor Q3.
**Battery management description**

The battery management circuits are a 2-stage constant current battery charger, a charge detector, and a battery switch over control circuit. The interconnect board interfaces to a 6 cell NiMH battery pack (NiCad battery pack on older model pumps) with a “smart” battery gauge.

![Flowchart of Battery Management Description](image)

**Battery gauge interface**

The main microprocessor communicates to the battery through `Battery_Data` — a single bi-directional serial data line.

A very low battery capacity status, `vlow_battery*`, signal protects the battery pack by disconnecting the battery. This signal is at a logic low when the battery is depleted.

**Battery charger**

The battery charger allows charging a battery with an input supply voltage either above or below the battery voltage. Battery charging takes place when either the internal DC supply or external DC is present. The charger provides a charge current determined from three conditions:

- In normal operation the charge current is controlled by the gauge, providing two levels of constant charge current. If the battery capacity is less than 94% of its known capacity, the gauge will set `charge*` to a logic low. This results in a charge current rate of C/6, approximately 270 milliampere giving a 6-8 hour recharge time.
• The gauge sets charge* to logic high when the battery has been charged to 94% (or greater) of the battery’s capacity, this lowers the charge rate to 65 milliampere, or C/25.

• A separate charge control circuit is the voltage limit for the battery; here a battery voltage monitoring circuit in the charger limits the charger to a voltage limit of 1.55 volts per cell (nominal). The charger keeps reducing the charge current in order to remain below this voltage limit. This prevents damage to the cells from excessive battery voltage.

**Charge detector**
A charge detector circuit generates the control signal Charge_Detect to control the illumination of a battery charge LED indicator and to reset the very low battery detector circuit located within the battery pack.

• The main microprocessor does not monitor the Charge_Detect signal. However, the main microprocessor communicates with the gauge to determine charge status.

**Battery switchover**
A smart switch selects a reliable source of power for the system power supplies. This switches to internal battery power when AC power and external DC power are removed from the pump (or when these sources are below acceptable thresholds detailed above).

• In normal operation, the battery voltage can be at a higher voltage than the external DC – especially during battery charging.

**Battery board – schematic level**
The battery reports to the “Main” system microprocessor present status and controls battery charge from the Interconnect PCB. The battery PCB has:

• a 3-volt Linear Regulator
• a Gauge IC
• and a Depleted Battery Monitor IC.

The local circuit allows the battery to maintain its current capacity regardless of where the battery resides.

The referenced schematic signal nets of the main board electronics are identified using names in SMALLCAPS.

**Battery gauge function**
The gauge IC, BQ2012, monitors direction and magnitude of current flowing through the battery.

• The current is sensed by the gauge as a voltage across R4.
• The gauge computes capacity.

To control charging the battery, the gauge uses battery temperature and battery voltage to update the battery capacity – which is a function of current and temperature.

The charge* signal from the gauge controls the battery charger, located on the Main PC board, to charge at different rates depending on the state of the battery.

The gauge terminates standard charge in the event of the battery temperature exceeding 50°C or if the battery pack voltage is less than 5.7 volts.

**Severely depleted battery monitor**
The depleted battery monitor IC senses the battery voltage to prevent an over-discharged battery. When the battery pack voltage reaches a nominal voltage of 5 volts, the IC sets the vlow_battery signal to a logic low, which disconnects all battery loads with the exception of the battery monitor circuit.

The battery charger provides the signal charge_detect, which resets this monitor IC reconnecting the battery back to the system.
Problem solving alarms / alerts

This section defines basic problems and provides some standard problem solving procedures.

Types of alarms / alerts

The following table defines the alarms and alerts generated by the Medfusion® 3000 Series pumps, with suggested remedies and solutions.

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition and Remedy</th>
</tr>
</thead>
</table>
| High priority      | A *high priority alarm* results from any condition which halts an ongoing infusion, or any pump system fault which affects infusion. High Priority alarms are signaled by a flashing red indicator and an audible signal.  
                      Press ⏹️ to pause the audible alarm for the preset alarm silence period.                                                                                     |
| Medium priority    | A *medium priority alarm* indicates any condition requiring operator intervention but does not halt infusion. Medium Priority alarms are signaled with a flashing yellow indicator and an audible signal.  
                      Pressing ⏹️ silences the audible alarm for the programmed alarm silence period.                                                                                |
| Low priority       | A *low priority alarm* indicates any condition not requiring immediate operator intervention. Low Priority alarms are signaled with a continuous yellow indicator and an intermittent audible signal. 
                      Pressing ⏹️ permanently silences this alarm.                                                                                                                                                                      |
| Limit priority     | A *limit alarm* occurs whenever an invalid entry is attempted on a numerical entry screen. The invalid entry alarm sounds a brief tone with an advisory message onscreen.                                                   |
| Neglected pump     | The *Neglected Pump alarm* is a medium priority alarm. It is simply reminding you to finish what you started. Once you begin programming any infusion delivery setting, the pump expects you to continue until setup is complete.  
                      If you leave the pump paused too long (>30 seconds) on a data entry screen, then the pump sounds a medium priority alarm tone with the yellow indicator flashing. |}

Note: The Neglected Pump alarm, the Periodic Callback alarm, the Improper Shutdown alarm, the Check Syringe Barrel Clamp alarm, and all Limit Priority alarms are not recorded in the pump's alarm history record.
## Troubleshooting

### Alarm messages & priorities

The following table defines alarm message, alarm priority, and cause for each alarm condition:

<table>
<thead>
<tr>
<th>Alarm message</th>
<th>Alarm priority</th>
<th>Cause or corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Battery Communication Timeout (System Advisory)</strong></td>
<td>Low</td>
<td>Pump has sensed battery current present, but the battery gauge on the battery pack is not communicating. Check connections from main board, to interconnect, to battery pack.</td>
</tr>
<tr>
<td><strong>Battery Not Charging (System Advisory)</strong></td>
<td>Low</td>
<td>Pump has sensed AC or DC external power is present, but the battery is not charging. Use Biomed &gt; Diagnostics and run Monitor Battery Status to review battery function. Check battery connections and battery charge circuit on the interconnect board.</td>
</tr>
<tr>
<td><strong>Battery Not Working (System Advisory)</strong></td>
<td>Medium</td>
<td>Pump has found no battery present – no charge current and no battery gage communication. Battery may be unplugged.</td>
</tr>
<tr>
<td><strong>Calculated Rate Out of Range</strong></td>
<td>High</td>
<td>The calculated rate is not valid. Verify that all infusion parameters have been entered correctly.</td>
</tr>
<tr>
<td><strong>Check Clutch / Plunger Lever</strong></td>
<td>–</td>
<td>Normal alarm message. Software uses position potentiometer to monitor motion of the plunger driver during delivery. If the motion is not correct this alarm is generated. May be caused because pump was not primed and clutches took too long to engage, or may occur when user squeezes the plunger lever and moves plunger head. May also occur if position pot is not calibrated or is contaminated – use Biomed &gt; Utilities and run View Alarm History to check if failure occurs at same position reading.</td>
</tr>
<tr>
<td><strong>Check Syringe Barrel Clamp</strong></td>
<td>Medium</td>
<td>Certain syringe brands and sizes may cause the barrel clamp sensor to have difficulty in verifying the clamp is in position. Use Biomed &gt; Diagnostics and run Monitor Digital Sensors to check function of barrel sensor.</td>
</tr>
<tr>
<td><strong>Check Syringe Flange Sensor</strong></td>
<td>High</td>
<td>At power-up, software has sensed the flange is loaded when no syringe is loaded in the pump (as sensed by the barrel clamp size sensor). Use Biomed &gt; Diagnostics and run Monitor Digital Sensors to check function of flange sensor.</td>
</tr>
<tr>
<td>Alarm message</td>
<td>Alarm priority</td>
<td>Cause or corrective action</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>----------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Check Syringe Plunger Sensor</strong></td>
<td>High</td>
<td>At power-up, software has sensed the plunger is loaded when no syringe is loaded in the pump (as sensed by the barrel clamp size sensor). Use <strong>Biomed &gt; Diagnostics</strong> and run <strong>Monitor Digital Sensors</strong> to check function of both plunger sensors.</td>
</tr>
<tr>
<td><strong>Clear TVD to Start Infusion</strong></td>
<td>Limit</td>
<td>Normal advisory message. Total volume delivered (TVD) or total dose delivered (TDD) needs to be cleared to start an infusion when TVD/TDD exceeds the volume limit setting.</td>
</tr>
<tr>
<td><strong>Completing System Initialization</strong></td>
<td>Limit</td>
<td>Normal advisory message. At power-up, if all settings are entered by the user and <strong>Start</strong> is pressed before background self-tests are completed, then this message appears. Wait a few seconds until self-testing is completed and then press <strong>Start</strong> to begin infusion.</td>
</tr>
<tr>
<td><strong>Data Does Not Match Previous Entry</strong></td>
<td>Limit</td>
<td>Normal advisory message. In cases where confirmation of user entered data is required, the confirmation value did not match. Re-enter the value.</td>
</tr>
<tr>
<td><strong>Depleted Battery (System Failure)</strong></td>
<td>High</td>
<td>Normal alarm message. Battery voltage measured by the gauge on the battery pack is too low. Software then stops delivery and allows watchdog to generate alarm. Plug pump into AC power, cycle power on the pump, then use <strong>Recall Last Settings</strong> to recall delivery settings and resume delivery. If problem is chronic, check battery pack function or perform battery calibration.</td>
</tr>
<tr>
<td><strong>Force Sensor Bgnd Test</strong></td>
<td>High</td>
<td>Normal alarm message. Press <strong>Start</strong> to turn the pump off. Background self-test has found the force sensor signal out-of-range or the force sensor signal did not change when bridge-test signal was asserted. Use <strong>Biomed &gt; Diagnostics &gt; Monitor Analog Sensors</strong> to check operation of plunger force sensor. Open plunger head and check plunger cable and force sensor cable on the plunger board. Replace plunger board, plunger cable or force sensor.</td>
</tr>
<tr>
<td><strong>Infusion Complete</strong></td>
<td>–</td>
<td>Normal alarm message. Infusion has reached the set volume limit and delivery has stopped.</td>
</tr>
<tr>
<td><strong>Input Out of Range - Greater Than Max Value</strong></td>
<td>Limit</td>
<td>Normal advisory message. User attempted to enter a number greater than the maximum value allowed. (See also “maximum rate” in general problems below). Try a lower value.</td>
</tr>
<tr>
<td>Alarm message</td>
<td>Alarm priority</td>
<td>Cause or corrective action</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td><strong>INPUT OUT OF RANGE - LESS THAN MIN VALUE</strong></td>
<td>Limit</td>
<td>Normal Advisory Message. User attempted to enter a number less than the minimum value allowed. Try a higher value.</td>
</tr>
<tr>
<td><strong>INVALID INFUSION PARAMETER COMBINATION</strong></td>
<td>Low</td>
<td>Normal advisory message. The user has attempted to set a combination of infusion values that does not allow a valid flow rate to be calculated. Press BACK and enter a different set of values.</td>
</tr>
<tr>
<td><strong>INVALID LIBRARY ENTRY</strong></td>
<td>Limit</td>
<td>Normal advisory message. The library entry was not defined correctly when it was created. Review the library entry using the PharmGuard® Toolbox and correct the problem.</td>
</tr>
<tr>
<td><strong>INVALID SYRINGE SIZE</strong></td>
<td>High</td>
<td>Syringe size (barrel clamp potentiometer sensor) does not match selected manufacturer or when barrel clamp is lifted during delivery, this alarm occurs. If there is any question about this sensor’s function perform PM check of barrel clamp calibration.</td>
</tr>
<tr>
<td><strong>INVALID RATE FOR SYRINGE SIZE (V3 pumps only)</strong></td>
<td>High</td>
<td>Normal advisory message. When using E-plates library entries, the library stores syringe size. Changing this size may cause this message to appear (refer to the Operation Manual for syringe size/rate tables).</td>
</tr>
<tr>
<td><strong>KVO IN PROGRESS</strong></td>
<td>–</td>
<td>Normal alarm message. Infusion has reached the set volume limit and delivery changed to KVO rate.</td>
</tr>
<tr>
<td><strong>LIMITS ADJUSTED - CANNOT DELIVERY ALL DOSES</strong></td>
<td>Limit</td>
<td>Normal alarm message. The limits on the parameter to be entered were adjusted to keep the resulting rate inside allowable limits.</td>
</tr>
<tr>
<td><strong>LOW BATTERY (each 1% drop in capacity following initial signal if power cord is not plugged in)</strong></td>
<td>Low</td>
<td>Normal advisory message. Battery gauge has measured the capacity of the battery is less than 10%. The infusion rate will determine the run time remaining on the battery.</td>
</tr>
<tr>
<td><strong>LOW BATTERY (initial signal)</strong></td>
<td>Medium</td>
<td>Normal advisory message. Plug in the power cord and run the pump on AC Mains while recharging battery.</td>
</tr>
<tr>
<td><strong>MOTOR RATE ERROR</strong></td>
<td>High</td>
<td>Normal advisory message. The stepper motor moving at the wrong speed. Clear any obstructions to proper motor operation. If the message reoccurs, you may need to replace the motor.</td>
</tr>
<tr>
<td>Alarm message</td>
<td>Alarm priority</td>
<td>Cause or corrective action</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>----------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>OCLUSION - CHECK INFUSION LINE</td>
<td>– High</td>
<td>Normal alarm message. The force sensor in the plunger driver has sensed occlusion of the infusion line when the force value exceeds the set limit. If this is a chronic problem review: (a) the configured occlusion limit – the setting appears on graph on delivery screen as VL, L, N, H - <strong>pumps with v3 software</strong>: use Configuration Manual to change settings; <strong>pumps with v4 software</strong>: use the PharmGuard® Software to change settings or (b) change the infusion set up (high rates through micro-bore tubing can cause high backpressures).</td>
</tr>
<tr>
<td>OUTSIDE RANGE LIMIT - SILENCE ALARM TO CONTINUE</td>
<td>Medium -</td>
<td>Normal alarm message. The user entered a rate which is outside of the library limits. The user has the option to override the limit and use the questioned value or press <strong>BACK</strong> and change values so that the infusion stays inside the established limits.</td>
</tr>
<tr>
<td>PERIODIC CALLBACK - SILENCE ALARM TO CONTINUE</td>
<td>– Medium</td>
<td>Normal alarm message. User programmed callback alarm - no remedy required.</td>
</tr>
<tr>
<td>PHARMGUARD DATA TRANSFER IS RECOMMENDED</td>
<td>Medium Medium</td>
<td>Normal alarm message. PharmGuard® Safety Data on the pump is nearly full, and continued use may result in lost PharmGuard® event data. Use the PharmGuard® software to download the event data to computer. This alarm can be enabled or disabled using the PharmGuard® Toolbox.</td>
</tr>
<tr>
<td>PRESSURE INCREASING - CHECK INFUSION LINE</td>
<td>– Medium</td>
<td>Normal alarm message. Backpressure in the infusion line is increasing. User should attempt to clear blockage in infusion line. If blockage is not cleared occlusion alarm will result.</td>
</tr>
<tr>
<td>PROFILE DOES NOT MATCH LAST SETTINGS PROFILE</td>
<td>Limit –</td>
<td>Normal alarm message. The “Recall Last Settings” feature only works for the profile under which the settings were programmed. Change the profile and try again.</td>
</tr>
<tr>
<td>PUMP IS LOCKED</td>
<td>– Limit</td>
<td>Normal advisory message. Press <strong>Unlock</strong> before changing settings during delivery.</td>
</tr>
<tr>
<td>RATE BELOW RECOMMENDED MIN FOR SYRINGE SIZE</td>
<td>Limit –</td>
<td>Normal advisory message. Reminds user that the programmed rate is below that recommended for the syringe size. No remedy required.</td>
</tr>
<tr>
<td>RESTRICTED FLOW - BOLUS CANCELLED</td>
<td>– Medium</td>
<td>Normal alarm message. During bolus rate reduction, the rate fell below the main infusion rate or the time was extended past the maximum bolus time of 59 minutes. The bolus dose has been cancelled.</td>
</tr>
<tr>
<td>Alarm message</td>
<td>Alarm priority programming</td>
<td>Alarm priority infusing</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>----------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Restricted Flow - Loading Cancelled</td>
<td>–</td>
<td>Medium</td>
</tr>
<tr>
<td>Restricted Flow - Rate Reduced</td>
<td>–</td>
<td>Medium</td>
</tr>
<tr>
<td>Set Volume Limit Before KVO</td>
<td>Limit</td>
<td>–</td>
</tr>
<tr>
<td>Syringe Does Not Match Library Entry</td>
<td>Limit</td>
<td>–</td>
</tr>
<tr>
<td>Syringe Empty</td>
<td>–</td>
<td>High</td>
</tr>
<tr>
<td>Syringe Empty - Manual</td>
<td>–</td>
<td>High</td>
</tr>
<tr>
<td>Syringe Flange Not in Place</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Syringe Near Empty</td>
<td>–</td>
<td>Medium or Low*</td>
</tr>
</tbody>
</table>
### Troubleshooting

<table>
<thead>
<tr>
<th>Alarm message</th>
<th>Alarm priority</th>
<th>Cause or corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syringe Plunger Not in Place</td>
<td>High</td>
<td>Pump has sensed the plunger is not loaded when syringe is loaded in the pump (as sensed by the barrel clamp size sensor). User may not have loaded syringe correctly. If necessary, use Biomed &gt; Diagnostics and run Monitor Digital Sensors to check function of both plunger sensors.</td>
</tr>
<tr>
<td>System Advisory – “Description”</td>
<td>Low</td>
<td>See detailed descriptions in section below.</td>
</tr>
<tr>
<td>System Failure – “Description”</td>
<td>High</td>
<td>See detailed descriptions in section below.</td>
</tr>
<tr>
<td>Neglected Pump (User Call-back)</td>
<td>Medium</td>
<td>If pump is left in a user input screen (e.g. set rate or titrate rate) for more than 30 seconds the pump alarms. Go to pause screen or main screen to get longer alarm silence intervals.</td>
</tr>
</tbody>
</table>
## Troubleshooting

### System Advisory Alarms

This section explains the system advisory alarms in the Medfusion® 3000 Series pump, and suggests possible causes and remedies for these alarms.

<table>
<thead>
<tr>
<th>System advisory alarm</th>
<th>Cause or remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BACKUP CRITICAL DATA CORRUPTED</strong></td>
<td>Configuration and library settings are stored redundantly in non-volatile serial EEPROM on the main board. This message will occur if backup data was lost, and primary data was used to restore backup values. No action is required.</td>
</tr>
<tr>
<td><strong>DEFAULT CONFIGURATION RESTORED</strong></td>
<td>Configuration settings are stored redundantly in non-volatile serial EEPROM on the main board. If both primary and backup are lost, the configuration is defaulted. Use pump <strong>CUSTOM PROGRAM &gt; TEACH/LEARN</strong> to copy configuration from a known good pump to restore settings. If problem persists, there may be a problem with the main board. This message may appear when a new main board is installed.</td>
</tr>
<tr>
<td><strong>HISTORY DATA CORRUPTED</strong></td>
<td>Infusion history log is stored in non-volatile serial EEPROM on the main board. This message will occur if this data is lost. No action is required.</td>
</tr>
<tr>
<td><strong>IMPROPER SHUTDOWN</strong></td>
<td>This alarm is recorded to history when the pump is turned on if the last power-down did not occur through pressing the power key. Check for possible causes for a pump power failure.</td>
</tr>
<tr>
<td><strong>INVALID INTERRUPT &amp; SYSTEM ADVISORY: IMPROPER SHUTDOWN</strong></td>
<td>Replace the Main PCB.</td>
</tr>
<tr>
<td><strong>NON CRITICAL DATA CORRUPTED</strong></td>
<td>Other settings are stored in non-volatile serial EEPROM on the main board. This message will occur if this data was lost. No action is required.</td>
</tr>
<tr>
<td><strong>PHARMGUARD DATA CORRUPTED</strong></td>
<td>The PharmGuard® Safety Data is stored in non-volatile serial EEPROM on the main board. This message will occur if this data is lost. No action is required.</td>
</tr>
<tr>
<td><strong>PRIMARY CRITICAL DATA CORRUPTED</strong></td>
<td>Configuration and library settings are stored redundantly in non-volatile serial EEPROM on the main board. This message will occur if primary data was lost, and backup data was used to restore primary values. No action is required.</td>
</tr>
<tr>
<td><strong>SET TIME AND DATE</strong></td>
<td>Advisory message that real time clock has reset on the pump. This may occur if the battery is depleted and the main board supply totally discharged – the super-capacitor on main board should keep up the clock for many days after a depleted battery is reached. Use <strong>BIOMED &gt; UTILITIES</strong> and run <strong>SET TIME/DATE</strong> to restore date and time settings. No functionality of pump is affected by date/time setting.</td>
</tr>
<tr>
<td><strong>MAINTENANCE IS RECOMMENDED</strong></td>
<td>This is a reminder to the user to conduct the Annual Maintenance Testing (section 1, page 19). To clear this alarm, reset the PM Maintenance date (see section 5, Quick Maintenance Check-out Test and follow the instructions).</td>
</tr>
</tbody>
</table>


**System Failure Alarms**

This section discusses the diagnosis of system failure alarms in the Medfusion® 3000 Series pump, and suggests possible causes and remedies for these alarms.

<table>
<thead>
<tr>
<th>System failure alarm</th>
<th>Cause or remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A2D Reference Voltage BGND Test</strong></td>
<td>Background self-test measured an invalid range on analog-to-digital converter reference voltage. Use <strong>BIOMED &gt; DIAGNOSTICS</strong> to check the voltage. Replace the main board if invalid voltage found.</td>
</tr>
<tr>
<td><strong>ACU Power Strobe Failure</strong></td>
<td>Self-test has found that the ACU processor is not maintaining its power strobe. If this failure repeats, then try full reset of main board – disconnect AC power, open pump, disconnect battery, short super-cap through ~100 ohm load; then reassemble pump and retest. Replace main board if problem persists.</td>
</tr>
<tr>
<td><strong>ACU Watchdog Failure</strong></td>
<td>Self-test has found that the ACU watchdog alarm signal active. This alarm may occur if processor failed to pet watchdog within allotted time (e.g. a software failure occurred). If problem recurs, replace the main board.</td>
</tr>
<tr>
<td><strong>Analog Supply BGND Test</strong></td>
<td>Background self-test measured an invalid range on analog supply voltage. Use <strong>BIOMED &gt; DIAGNOSTICS</strong> to check the voltage. Replace the main board if invalid voltage found.</td>
</tr>
<tr>
<td><strong>Aux Controller Unit POST</strong></td>
<td>Power-up self-test has found that the ACU processor failed to shut down motor current during the watchdog alarm test. If problem recurs, replace the main board.</td>
</tr>
<tr>
<td><strong>Background CRC Test Timeout</strong></td>
<td>Software timing failure. A transient failure may have occurred in the software; if problem recurs, replace the main board.</td>
</tr>
<tr>
<td><strong>Background Self Test Timeout</strong></td>
<td>Software timing failure. A transient failure may have occurred in the software; if problem recurs, replace the main board.</td>
</tr>
<tr>
<td><strong>Backup Audible Alarm POST</strong></td>
<td>Power-up self-testing has found that the backup audible alarm (controlled by ACU) is not working at correct power (current) or frequency. Replace the alarm buzzer on the main board or replace the main board.</td>
</tr>
<tr>
<td><strong>Calibration Required</strong></td>
<td>Calibration values stored in non-volatile serial EEPROM memory are invalid. This message appears whenever a new main board is installed. Calibrate all the sensors in the pump.</td>
</tr>
<tr>
<td><strong>Control Key Switch BGND Test</strong></td>
<td>Key on keypad was found stuck on during continuous background self-test. Use <strong>BIOMED &gt; DIAGNOSTICS</strong> to determine which key is stuck. If stuck key is found, replace keypad.</td>
</tr>
<tr>
<td><strong>Control Key Switch POST</strong></td>
<td>Key on keypad was found stuck on during power-on self-test. Use <strong>BIOMED &gt; DIAGNOSTICS</strong> to determine which key is stuck. If stuck key is found, replace keypad.</td>
</tr>
<tr>
<td><strong>Critical Data Block BGND Test</strong></td>
<td>Delivery settings are stored in a critical data block of RAM on the main board. This message will occur if background self-test showed the critical data block was corrupted (i.e. a RAM cyclic redundancy test failed). Run power-on self test which executes extensive RAM testing – if problem recurs, replace the main board.</td>
</tr>
<tr>
<td><strong>System failure alarm</strong></td>
<td><strong>Cause or remedy</strong></td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td><strong>Critical Data Block Post</strong></td>
<td>Configuration and library settings are stored redundantly in non-volatile serial EEPROM on the main board. This message will occur if backup data and primary data are both good, but fail to agree. Use pump Custom Program &gt; Teach/Learn to copy configuration from a known good pump to restore settings. Replace main board if serial EEPROM has failed.</td>
</tr>
<tr>
<td><strong>Critical Data Failure</strong></td>
<td>After settings are programmed into the pump, the pump performs a reverse calculation to ensure all settings are correct. Using incompatible ranges of settings may cause this alarm (e.g. using concentration of 1000 mg/ml and trying to set a rate of 0.1 microgram/hour). Review pump settings. Alternatively, this alarm may indicate a software data failure where critical flags are found invalid. If problem recurs, replace the main board.</td>
</tr>
<tr>
<td><strong>D2A Offset Voltage BGND Test</strong></td>
<td>Background self-test found failure in force sensor offset signal. Probably a failure in the main board digital-to-analog converter or a failure in the plunger cable/board. Use Biomed &gt; Diagnostics to check force sensor voltage readings.</td>
</tr>
<tr>
<td><strong>Depleted Battery</strong></td>
<td>Battery is fully discharged below low voltage threshold. Plug in the pump to AC power or external DC power to recharge the battery.</td>
</tr>
<tr>
<td><strong>Display Controller Post</strong></td>
<td>Failure detected in testing the LCD display. Check cabling between main board and display. Replace LCD display.</td>
</tr>
<tr>
<td><strong>External COM Task Timeout</strong></td>
<td>External computer or device connected to the pump is sending too many commands too quickly, or sending too many invalid commands and this causes the software to timeout. Remove the Medfusion® 3000 Series external RS232 adapter and observe if the problem is corrected.</td>
</tr>
<tr>
<td><strong>Flash Memory BGND Test</strong></td>
<td>CRC failure found in program memory during background self-tests. Failure may occur during external re-programming of the pump software. Otherwise failure is in flash memory of the main board, and main board should be replaced.</td>
</tr>
<tr>
<td><strong>Flash Memory Post</strong></td>
<td>CRC failure found in program memory during power-up self-tests. Failure may occur during external re-programming of the pump software. Otherwise failure is in flash memory of the main board, and main board should be replaced.</td>
</tr>
<tr>
<td><strong>Force Sensor BGND Test</strong></td>
<td>Background self-test has found the force sensor signal out-of-range or the force sensor did not change when the bridge-test signal was asserted. Use Biomed Diagnostics monitor analog sensors to check operation of plunger force sensor. Open plunger head and check plunger cable and force sensor cable on the plunger board. Replace plunger board, plunger cable, or force sensor.</td>
</tr>
<tr>
<td><strong>Force Sensor Bridge Test</strong></td>
<td>Software sensed no voltage change when sensor test signal was asserted. The force sensor bridge (strain gage) may be unplugged or have an open connection. Use Biomed &gt; Diagnostics &gt; Monitor Analog Sensors to check operation of plunger force sensor. Open plunger head and check plunger cable and force sensor cable on the plunger board. Replace plunger board, plunger cable, or force sensor.</td>
</tr>
<tr>
<td>System failure alarm</td>
<td>Cause or remedy</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>FORCE SENSOR TEST</strong></td>
<td>Power-up self test found that the force sensor output did not change when the DAC offset voltage was changed. May be problem on main board offset circuit, plunger board, plunger cable, or force sensor. Check cabling first.</td>
</tr>
<tr>
<td><strong>INPUT TASK TIMEOUT</strong></td>
<td>Software timing failure. A transient failure may have occurred in the software; if problem recurs, replace the main board.</td>
</tr>
<tr>
<td><strong>INTERNAL A2D FAILURE</strong></td>
<td>Software self-test identified a failure in the 10-bit analog to digital converter. Use <strong>BIOMED &gt; Diagnostics &gt; Check Analog Sensor</strong> readings. If they are abnormal, replace the main board.</td>
</tr>
<tr>
<td><strong>INVALID INTERRUPT</strong></td>
<td>Software/hardware failure. Software attempted to execute invalid interrupt, may be caused by main processor hardware failure, bus failure, or software flash memory failure.</td>
</tr>
<tr>
<td><strong>LED TASK TIMEOUT</strong></td>
<td>Software timing failure. A transient failure may have occurred in the software; if problem recurs, replace the main board.</td>
</tr>
<tr>
<td><strong>LOGIC SUPPLY VOLTAGE BGND TEST</strong></td>
<td>Background self-test measured an invalid range on logic supply voltage. Use <strong>BIOMED &gt; Diagnostics</strong> to check the voltage. Replace the main board if invalid voltage found.</td>
</tr>
<tr>
<td><strong>MCU POWER STROBE FAILURE</strong></td>
<td>Failure in self-test of power strobe (output port) signal from the main processor. Replace the main board if problem recurs.</td>
</tr>
<tr>
<td><strong>MONITOR TASK TIMEOUT</strong></td>
<td>Software timing failure. A transient failure may have occurred in the software; if problem recurs, replace the main board.</td>
</tr>
<tr>
<td><strong>MOTOR FAILED TO STOP ERROR</strong></td>
<td>Software sensed motor rotation after stop pump motor was executed. This could be caused by failing motor rotation (photo-reflective) sensor on the back of the main board. Use <strong>BIOMED &gt; Diagnostics</strong> to run motor drive test (set motor step period to ~100 msec) then use monitor digital sensors to check motor rate sensor. Stop motor and rate sensor should stop changing. Replace the main board if sensor has failed.</td>
</tr>
<tr>
<td><strong>MOTOR NOT RUNNING ERROR</strong></td>
<td>Motor sensor did not detect any rotation of the stepper motor. Sensor (on main board) may have failed, or worm/gear/leadscrew may be jammed.</td>
</tr>
<tr>
<td><strong>MOTOR RATE ERROR</strong></td>
<td>Motor sensor did not measure the correct rotation rate for the stepper motor. Sensor (on main board) may have failed, or the force sensor may be inoperative and the stepper motor stalled when an occlusion occurred.</td>
</tr>
<tr>
<td><strong>MOTOR SUPPLY VOLTAGE BGND TEST</strong></td>
<td>Background self-test measured an invalid range on motor supply voltage. Use <strong>BIOMED &gt; Diagnostics</strong> to check the voltage. Replace the main board if invalid voltage found.</td>
</tr>
<tr>
<td><strong>MOTOR VOLUME LIMIT ERROR</strong></td>
<td>The motor has run more steps than should have been required to deliver the set volume limit.</td>
</tr>
<tr>
<td><strong>PLUNGER SENSOR FAILURE</strong></td>
<td>Software sensed plunger sensor voltage out of range. The plunger position sensor (potentiometer) may be unplugged or have an open connection. Use <strong>BIOMED &gt; Diagnostics &gt; Monitor Analog Sensors</strong> to check operation of plunger position sensor. Open pump case and check connections to plunger sensor. Replace plunger position sensor.</td>
</tr>
<tr>
<td><strong>POSITIVE SUPPLY BGND TEST</strong></td>
<td>The power supply has malfunctioned. Check the outputs of the supply.</td>
</tr>
<tr>
<td>System failure alarm</td>
<td>Cause or remedy</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>PRIMARY AUDIBLE ALARM BGND TEST</strong></td>
<td>Background self-test sensed no current flowing in the primary speaker. Speaker may be unplugged or wire came loose from connector. Check connections from main board to interconnect and from interconnect board to speaker. Replace speaker if wiring is intact.</td>
</tr>
<tr>
<td><strong>PRIMARY AUDIBLE ALARM POST</strong></td>
<td>Power-up self-test sensed no current flowing in the primary speaker. Speaker may be unplugged or wire came loose from connector. Check connections from main board to interconnect and from interconnect board to speaker. Replace speaker if wiring is intact.</td>
</tr>
<tr>
<td><strong>PUMP MOTOR DRIVE OFF POST</strong></td>
<td>Power-up self-test sensed no current in the stepper motor. Motor supply or motor driver circuit may have failed. Verify motor connections are correct, then use <strong>BIOMED &gt; DIAGNOSTICS &gt; MOTOR DRIVE TEST</strong> to check motor operation. If motor does not run replace the motor or the main board.</td>
</tr>
<tr>
<td><strong>PUMP MOTOR DRIVE PHASE A POST</strong></td>
<td>Power-up self-test found the stepper motor winding open. Motor may be unplugged or wire came loose from winding. Replace motor if wiring is intact.</td>
</tr>
<tr>
<td><strong>PUMP MOTOR DRIVE PHASE B POST</strong></td>
<td>Power-up self-test found the stepper motor winding open. Motor may be unplugged or wire came loose from winding. Replace motor if wiring is intact.</td>
</tr>
<tr>
<td><strong>RAM BGND TEST</strong></td>
<td>Software test showed failure of a RAM on the main board. Cycle power and run rerun power-up self test which executes more extensive RAM test. If failure recurs, then check the main board to ensure no cable or contamination is shorting the board, then replace the main board.</td>
</tr>
<tr>
<td><strong>SERIAL EEPROM TIMEOUT</strong></td>
<td>Software test showed failure of a serial EEPROM on the main board. Check the main board to ensure no cable or contamination is shorting the board, then replace the main board.</td>
</tr>
<tr>
<td><strong>SPI BUS TIMEOUT</strong></td>
<td>Software test showed failure of some component on the SPI bus. Check the main board to ensure no cable or contamination is shorting the board, then replace the main board.</td>
</tr>
<tr>
<td><strong>SUPERCAP POST</strong></td>
<td>Power-up self-test sensed insufficient charge in the super-capacitor. This problem can occur with a new main board or when a pump battery is totally dead. Plug pump into AC power for at least two minutes then cycle power. If problem is not corrected, then replace the main board.</td>
</tr>
<tr>
<td><strong>SYRINGE FLANGE SENSOR FAILURE</strong></td>
<td>Software sensed syringe sensor voltage out of range. The sensor (potentiometer) may be unplugged or have an open connection. Use <strong>BIOMED &gt; DIAGNOSTICS &gt; MONITOR ANALOG SENSORS</strong> to check operation of syringe sensor. Open pump case and check connections to syringe sensor. Replace syringe sensor.</td>
</tr>
<tr>
<td><strong>TIME BASE BGND TEST</strong></td>
<td>Background self-test found the system (MCU) time base did not agree with the time of day clock tick. Problem with oscillator for MCO or oscillatory for real time clock. If problem recurs, replace main board.</td>
</tr>
<tr>
<td><strong>TIME OF DAY CLOCK POST</strong></td>
<td>Power-up self-test found the system (MCU) time base did not agree with the time of day clock tick. Problem with oscillator for MCO or oscillatory for real time clock. If problem recurs, replace main board.</td>
</tr>
<tr>
<td><strong>TIME OF DAY CLOCK TIMEOUT</strong></td>
<td>Time of day clock failed to communicate. If problem recurs, replace main board.</td>
</tr>
</tbody>
</table>
## General troubleshooting

This section discusses some potential problems which may be encountered with the Medfusion® 3000 Series pump, and suggests remedies for those problems.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Remedy or solution</th>
</tr>
</thead>
</table>
| Alarms do not sound (either loudly or at all) | a) If the alarms sound faintly, they may have been configured to their lowest level. Use **Custom Program** to change the audio alarm volume to a higher level.  
  
b) Use **Biomed > Diagnostics** and run the **Audio Test** on Speaker and Alarm Style. Replace speaker if audio alarm does not work correctly. |
| **Problem:** No charge light | a) Connect to AC power. Turn on pump and allow to complete startup self-testing. If both AC indicator and charge lights are off then see “Indicators Do Not Flash” below.  
  
b) Use **Biomed > Diagnostics** and run the **Monitor Battery Status** test. Determine whether battery is charging at 50 MA or greater. |
| Battery Problem: Battery not working message | a) Open the battery door in the case bottom and check the connection of the battery ribbon cable to the interconnect board.  
  
b) Use **Biomed > Diagnostics** and run the **Monitor Battery Status** test. If no information appears then replace the battery pack. |
| Battery Problem: Battery does not hold charge | a) Open the battery door in the case bottom and check the connection of the battery ribbon cable to the interconnect board.  
  
b) Connect to AC power. Turn on pump and allow to complete startup self-testing. Use **Biomed > Diagnostics** and run the **Monitor Battery Status** test. Check whether battery is charging at least +50 MA (wait at least 1 minute from power-on for charge current reading to stabilize).  
  - Unplug AC power if pump immediately shuts down then replace battery pack.  
  - If pump continues to operate and gauge shows normal discharge current -100 to -200 ma, then perform a battery calibration. |
| Indicator lights do not flash | If the indicator lights do not flash during startup, or along with their appropriate function or alarm, then:  
  - Open the case and check the keypad connection to the Main Board. If any connections are loose, reconnect and re-test.  
  - Otherwise, replace keypad. |
| Keyclick (Beep) is faint or not present | If the keyclicks (beeps) sound faintly, or not at all, they may have been configured to their lowest level or turned off.  
  
Use **Custom Program** to reset the audio to a higher level. |
| Keypad button does not work | Use **Biomed > Diagnostics** and run the **Keypad Test**. If any keys do not pass this test, open the case and check connections for the keypad. |
| Liquid Crystal Display (LCD) has poor contrast | Use **Biomed > Calibration** and run the **Adjust Contrast**.  
  
If the LCD contrast cannot be adjusted, then check LCD negative supply, and consider replacing display or main board. |
<table>
<thead>
<tr>
<th>Problem</th>
<th>Remedy or solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Libraries not available</td>
<td>Libraries may have been turned off or cleared in pump configuration. Use <strong>CUSTOM PROGRAM, TEACH</strong> mode or <strong>LEARN</strong> mode to copy the Libraries from a correctly configured pump. See <strong>Configuration Manual</strong>.</td>
</tr>
<tr>
<td>Maximum rate not available</td>
<td>Maximum rate may be set low in pump configuration. Use <strong>CUSTOM PROGRAM, SET MAX FLOW RATE</strong> to configure the pump’s maximum flow rate. See <strong>Configuration Manual</strong>.</td>
</tr>
<tr>
<td>Occlusion alarms occur frequently</td>
<td>Occlusion alarm limit may be set too low in pump configuration. Use <strong>CUSTOM PROGRAM, SET OCCLUSION LIMIT</strong> to configure the pump’s occlusion alarm level. See <strong>Configuration Manual</strong>.</td>
</tr>
<tr>
<td>Pump won’t turn on</td>
<td>Plug into AC power (pump will not turn on with a dead battery) then push and hold power key to turn on. Otherwise, open case and check:</td>
</tr>
<tr>
<td></td>
<td>• Connections of main to interconnect ribbon cable</td>
</tr>
<tr>
<td></td>
<td>• AC power connections.</td>
</tr>
<tr>
<td></td>
<td>• Battery connections.</td>
</tr>
<tr>
<td></td>
<td>• Keypad cable connections.</td>
</tr>
<tr>
<td>Syringe Manufacturer not available</td>
<td>Syringe manufacturer may have been turned off or cleared in pump configuration. See <strong>Configuration Manual</strong> (if available) or <strong>Operations Manual</strong>.</td>
</tr>
</tbody>
</table>
Smiths Medical service and support

Using Smiths Medical service assistance

Use the following steps to make use of Smiths Medical technical service assistance:

1. Contact Smiths Medical Technical Service Department at one of the following telephone numbers:

<table>
<thead>
<tr>
<th>Toll-free in the United States</th>
<th>1 800.258.5361</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside the continental United States</td>
<td>1 214.618.0218</td>
</tr>
<tr>
<td>In Europe, Contact:</td>
<td>Your local distributor or: Smiths Medical International Ltd. +44 (0)1923 246434</td>
</tr>
</tbody>
</table>

2. When calling any of these numbers, please have the following ready:
   - Model name / number of pump
   - Pump serial number
   - Purchase date if pump is within warranty period
   - Description of problem in as much detail as possible

3. The service representative will give suggestions in an attempt to help solve the problem.

Returning a pump for repair

When a pump problem cannot be solved, it becomes necessary to return the infusion pump for service.

Note: The following instructions apply primarily to product within the United States. If you are outside the United States, contact your local distributor for specific instructions. If you are unsure of who your local distributor is, contact Smiths Medical International Ltd. at the address and/or phone number listed below.

1. If the problem cannot be resolved through the assistance of the Technical Service Department, then you will be assigned a Return Authorization (RA) number.

2. Clean and decontaminate the pump and accessories prior to returning items to Smiths Medical. This is required before shipment according to United States Occupational Safety & Health Administration (OSHA) regulations.

3. Remove the power cord and poleclamp assembly before shipping the pump. Return ONLY the pump, not the accessories. Smiths Medical will not be responsible for lost poleclamp parts or power cords.

4. Package the infusion pump carefully for shipment.

5. Smiths Medical will not accept returns for service without the assigned RA number clearly printed on the shipping package. Mark the Return Authorization (RA) number clearly on the outside of the shipping package used to return the pump.

6. The shipment method must meet the environmental conditions of:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Shipping</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>–40° to 60° C</td>
<td>–40° to 140° F</td>
<td>–20° to 50° C</td>
</tr>
<tr>
<td>(–4° to 140° F)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relative humidity</th>
<th>5 to 95% non-condensing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric pressure</td>
<td>50 to 108 kPa</td>
</tr>
<tr>
<td>(7.3 to 15.4 psia)</td>
<td></td>
</tr>
</tbody>
</table>

6. Ship the carefully packaged infusion pump to either of the addresses listed below:

**United States Service**
Smiths Medical ASD, Inc.
1265 Grey Fox Road
St. Paul, Minnesota 55112
1 800.258.5361
www.smiths-medical.com

**European Service**
Your local distributor or:
Smiths Medical International Ltd.
WD24 4LG UK
+44 (0)1923 246434
Using Biomed for troubleshooting

The primary tools for troubleshooting the Medfusion® 3000 Series pumps are available through the Biomed menu which contains Diagnostics, Calibration, Utilities and for all version below 4.1.x, Update Firmware features. All version of the Medfusion® 3500 pump also contains Set Language, which allows you the ability to change the displayed language.

Two features within Utilities are very useful for investigating user complaints on the pump: View Infusion History and View Alarm History. View Infusion History allows review of infusion pump settings, delivery information, and alarms with each entry date and time stamped. View Alarm History allows review of pump alarms (together with sensor data) with each entry date and time stamped.

There are many features under Diagnostics which allow the examination of various sensors and components within the pump. The speaker, motor, keypad, indicators and display may be tested individually through this program. The battery gauge status information and charging/discharging current may be viewed. Numerous digital and analog inputs may also be viewed.

Accessing Biomed

Note: The following screens are slightly different depending on the version you have. For this reason, version 3-type screens are shown first, followed by version 4-type screen (if they are different). Also, depending on the personalization performed on your pump, the items listed in some of the menus may be different than those shown.

1. Turn the pump on and allow the power-on, self-testing to complete. (If there is a system failure detected in power-on testing, then the pump will directly go to Enter Biomed Passcode screen - see item 4.)

2. Press More until the Biomed appears onscreen. (If E-Plates/Libraries are enabled, you will have to press Main Menu before using More to locate Biomed.) (For v4 software, if Profiles are displayed you must select a profile then choose Biomed - you may need to press More to find it.)

3. Use the number button to choose Biomed.

4. Use the number buttons to enter the Biomed Passcode (2580) then press Enter.

Now you may select:

- Calibration to check calibration values, re-calibrate sensors or set display contrast.
- Diagnostics to examine analog and digital signal readings, or test the speaker, motor or display function.
• **Utilities** to review alarm history, to review infusion history, to set time and date, to update periodic maintenance timestamp.

• **Update Firmware** to reprogram the pump’s software version through the serial interface (only available with service upgrade software diskette and instructions). [Not available on Medfusion® 3500 pumps version 4.1 and above.]

• **Set Language** to change the national language displayed. [Available on Medfusion® 3500 pumps.]

**Biomed > Calibration**

Within **Biomed > Calibration** the following selections are available. See the Calibration section of this manual for further details.

<table>
<thead>
<tr>
<th>PRESS THE NUMBER TO SELECT THE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CAL SIZE AND POSITION</td>
</tr>
<tr>
<td>2. CAL FORCE SENSOR</td>
</tr>
<tr>
<td>3. CAL PRESSURE SENSOR</td>
</tr>
<tr>
<td>4. CAL PLUNGER POSITION</td>
</tr>
<tr>
<td>5. CAL SYRINGE SIZE SENSOR</td>
</tr>
<tr>
<td>6. ADJUST CONTRAST</td>
</tr>
<tr>
<td>7. VIEW CALIBRATION DATA</td>
</tr>
<tr>
<td>8. SAVE CHANGES AND EXIT</td>
</tr>
</tbody>
</table>

**Biomed > Diagnostics (screen 1 of 2)**

Within **Biomed > Diagnostics** the following selections are available (one of two screens). Use the number buttons to select the test.

<table>
<thead>
<tr>
<th>PRESS THE NUMBER TO SELECT THE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. AUDIO TEST</td>
</tr>
<tr>
<td>2. DISPLAY TEST</td>
</tr>
<tr>
<td>3. INDICATOR TEST</td>
</tr>
<tr>
<td>4. KEYPAD TEST</td>
</tr>
<tr>
<td>5. MONITOR ANALOG SENSORS</td>
</tr>
<tr>
<td>6. MONITOR DIGITAL SENSORS</td>
</tr>
<tr>
<td>7. MONITOR BATTERY STATUS</td>
</tr>
<tr>
<td>8. DRIVE TRAIN TEST</td>
</tr>
</tbody>
</table>

**Audio Test**

Use the number buttons to select the test. **Set Alarm Style** allows testing of the various alarm tones. **Test Speaker** is a factory/engineering test.

<table>
<thead>
<tr>
<th>PRESS THE NUMBER TO SELECT THE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SET ALARM STYLE</td>
</tr>
<tr>
<td>2. TEST SPEAKER</td>
</tr>
</tbody>
</table>

**Display Test**

**Display Test** repeats blank, all pixels on, vertical lines, horizontal lines, and checkerboard patterns across the LCD display. This test may only be exited by use of the Stop button.

| STARTING THE DISPLAY TEST            |
| PRESS <STOP> TO EXIT                 |

**Indicator Test**

The **Indicator Test** allows the individual control and testing of each indicator on the front panel (except battery and AC). Use the number button for the indicator to toggle on or off.

<table>
<thead>
<tr>
<th>PRESS THE NUMBER TO CHANGE LED STATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. RED ALARM OFF</td>
</tr>
<tr>
<td>2. YELLOW ALARM OFF</td>
</tr>
<tr>
<td>3. PRESSURE CELL OFF</td>
</tr>
<tr>
<td>4. LEFT INFUSE OFF</td>
</tr>
<tr>
<td>5. MID INFUSE OFF</td>
</tr>
<tr>
<td>6. RIGHT INFUSE OFF</td>
</tr>
<tr>
<td>7. LOCK OFF</td>
</tr>
</tbody>
</table>
**Troubleshooting**

**Keypad Test**
The Keypad Test allows each key to be tested (except \(\text{Exit} \); pressing \(\text{Exit} \) turns the pump off) to be tested. The only exit from this test is to press Exit.

<table>
<thead>
<tr>
<th>Keypad Test</th>
<th>Keypad Test</th>
<th>Keypad Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Monitor Analog Sensors**
Monitor Analog Sensors allows viewing the high resolution analog signals in the pump. These are force, pressure (future option), plunger position, and syringe size. The first data column is analog to digital converter counts (0 to 1023), the second column is the voltage equivalent to counts, and the third column is the reading with calibration values applied.

<table>
<thead>
<tr>
<th>Force</th>
<th>Pressure</th>
<th>Plunger Pos</th>
<th>Syringe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>64 CNTS</td>
<td>0.256V</td>
<td>0.50LBS</td>
<td></td>
</tr>
<tr>
<td>0 CNTS</td>
<td>0.0000V</td>
<td>1.898IN</td>
<td></td>
</tr>
<tr>
<td>375 CNTS</td>
<td>1.500V</td>
<td>0.853IN</td>
<td></td>
</tr>
<tr>
<td>632 CNTS</td>
<td>2.528V</td>
<td>0.853IN</td>
<td></td>
</tr>
</tbody>
</table>

**Monitor Digital Sensors**
Monitor Digital Sensors allows viewing the state of the digital sensors in the pump. Syringe plunger sensor is the state of the flippers on the plunger head where open is true. Syringe ear (flange) sensor indicates true when the ear clip (flange) is pulled out. Pressure cell is future option. The motor rate sensor with show true or false depending upon the position of the reflective surface on the end of the motor/worm shaft.

<table>
<thead>
<tr>
<th>Force</th>
<th>Plunger Pos</th>
<th>Syringe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUNT: 957</td>
<td>5.002IN</td>
<td></td>
</tr>
<tr>
<td>COUNT: 902</td>
<td>1.167IN</td>
<td></td>
</tr>
</tbody>
</table>

**Monitor Battery Status**
Monitor Battery Status shows the information from the battery gauge. It may take up to 1 minute for current readings to stabilize when changing from charge to discharge or visa versa. If current is positive the battery is charging; thus negative is discharging. See schedule maintenance for discussion of battery gauge.

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Current</th>
<th>Pressure Cell</th>
<th>Motor Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8 MA-HOURS</td>
<td>0 MA</td>
<td>FALSE</td>
<td></td>
</tr>
<tr>
<td>1600.0 MA-HOURS</td>
<td>0 MA-HOURS</td>
<td>FALSE</td>
<td></td>
</tr>
</tbody>
</table>

**Drive Train Test**
This feature is for factory/engineering use.

**Biomed > Diagnostics (screen 2 of 2)**
Within Biomed Diagnostics the following selections are available (second of two screens). Use the number buttons to select the test.

<table>
<thead>
<tr>
<th>Press the Number to Select</th>
<th>Press the Number to Select</th>
<th>Press the Number to Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MOTOR DRIVE TEST</td>
<td>2 MONITOR A2D SELT TEST</td>
<td>3 MONITOR 6811 A2D GRP1</td>
</tr>
<tr>
<td>4 MONITOR 6811 A2D GRP2</td>
<td>BEGINNING</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Press the Number to Select</th>
<th>Press the Number to Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MOTOR DRIVE TEST</td>
<td>MONITOR A2D SELT TEST</td>
</tr>
<tr>
<td>4 MONITOR 6811 A2D GRP2</td>
<td>BEGINNING</td>
</tr>
</tbody>
</table>
**Troubleshooting**

**Motor Drive Test**
The Motor Drive Test allows running the motor without any alarms (position, rotation, etc.) being active. Only use the Set Motor Step Period feature. Enter a motor step period where 2 milliseconds is the fastest rate and 1000 milliseconds is the slowest rate, then press SET to start the motor and STOP to stop. All other features are for factory/engineering use.

<table>
<thead>
<tr>
<th>PRESS THE NUMBER TO SELECT THE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SET MOTOR STEP PERIOD 5. REVERSE MOTOR</td>
</tr>
<tr>
<td>2. SET MOTOR MAX CURRENT 6. SET MOTOR MAX RUN TIME</td>
</tr>
<tr>
<td>3. REVERSE MOTOR STEPS 7. VIEW SOFTWARE VERSIONS</td>
</tr>
</tbody>
</table>

**Monitor A2D Selftest**
These are self-test values within the high-resolution analog to digital converter. This feature is for factory/engineering use. The normal readings are full scale equals 1023, midrange equals 512, and zero equals 0.

**Monitor 6811 A2D Group 2**
This Monitor Analog Sensors allows viewing the low resolution analog signals in the pump. These are supercap detect, speaker detect, power strobe, and force offset. The first data column is analog to digital converter counts (0 to 255), the second column is the “normalized” voltage equivalent to counts multiplied by the resistor divider feeding that channel. See Main Board theory of operation for definition of signals and values.

<table>
<thead>
<tr>
<th>PRESS &lt; BACK &gt; TO STOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPERCAP DETECT 0 CNTS 0.000V</td>
</tr>
<tr>
<td>SPEAKER DETECT 0 CNTS 0.000V</td>
</tr>
<tr>
<td>POWER STROBE 0 CNTS 0.000V</td>
</tr>
<tr>
<td>FORCE OFFSET 0 CNTS 0.000V</td>
</tr>
</tbody>
</table>

**Biomed > Utilities**
Within Biomed > Utilities the following selections are available. Use the number buttons for selection.

<table>
<thead>
<tr>
<th>PRESS THE NUMBER TO SELECT THE MODE</th>
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</thead>
<tbody>
<tr>
<td>1. SET/VIEW LAST PM DATE 5. VIEW SOFTWARE CRCS</td>
</tr>
<tr>
<td>2. SET TIME/DATE 6. VIEW SOFTWARE VERSIONS</td>
</tr>
<tr>
<td>3. VIEW ALARM HISTORY 7. VIEW SERVICE DATA</td>
</tr>
<tr>
<td>4. VIEW INFUSION HISTORY 8. VIEW EEPROM SIZE</td>
</tr>
</tbody>
</table>

**Set/View Last [Next] PM Date**
Depending on your pump version, this feature will either be Set/View Last PM Date or Set/View Next PM Date (Medfusion® 3500 software version 4 and above). This feature should be used every time that Periodic Maintenance is performed on the pump. Use the number keys to enter the date of the current or next maintenance date into the pump, then this value is stored in non-volatile memory. When two years elapse from this date, or when it reaches this date, an advisory message (low priority alarm) appears on-screen for annual maintenance to be performed.

<table>
<thead>
<tr>
<th>PRESS &lt; BACK &gt; TO STOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANALOG SUPPLY 68 CNTS 2.176V</td>
</tr>
<tr>
<td>POS SUPPLY 0 CNTS 0.000V</td>
</tr>
<tr>
<td>MOTOR SUPPLY 152 CNTS 38.912V</td>
</tr>
<tr>
<td>A2D REFERENCE 125 CNTS 4.000V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRESS &lt; BACK &gt; TO STOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANALOG SUPPLY COUNT: 156 4.992V</td>
</tr>
<tr>
<td>POS SUPPLY COUNT: 148 9.472V</td>
</tr>
<tr>
<td>MOTOR SUPPLY COUNT: 68 17.408V</td>
</tr>
<tr>
<td>A2D REFERENCE COUNT: 127 4.064V</td>
</tr>
</tbody>
</table>
Troubleshooting

[Note: ensure current date and time are correct in Set Time/Date.]

**Set Time/Date (Current)**

This feature allows setting the current date and time. This setting is stored in a clock/calendar chip on the main board. [Note: if all power is removed from the main board and the super-capacitor is drained, the clock will be reset to 1998 and PM advisory message may appear until the clock is set.]

**View Alarm History**

This feature allows review from the most recent alarm backwards in time. Each alarm is date and time stamped. [Note: see latest power-on record in view infusion history to check current clock/calendar settings.]

**View Infusion History**

This feature allows the review of infusion history from the most recent time backwards. Each entry is date and time stamped. The infusion history is “event” driven with entries made for start infusion, stop infusion, change rate, alarms, etc. Depending upon complexity of infusions, the infusion history stores approximately 8 or more complete infusions. Press Prev Entry to step backwards one event at a time, or press Prev Prog to step back one infusion at a time. Here, Next Entry and Next Prog step forwards in time one event or one infusion respectively.

**View Software CRCs & View Software Versions**

These features are for factory/engineering use.

**View Service Data**

This feature is for factory service allows the service department to review the data on pump usage.

**View EEPROM Size [available only on Medfusion® 3500 pumps version 4 and higher]**

This feature allows you to view the size (in kilobytes) of the EEPROM installed on the pump.
**Troubleshooting**

**BIOMED > UPDATE FIRMWARE [not available on Medfusion® 3500 pumps, version 4 and higher]**

Do Not Use this feature unless specifically authorized by Smiths Medical to update the software of the pump. Review the documentation provided with the software update. Follow the instructions provided with the software update and ensure the update is compatible with the pump model before performing a software update.

![ENTER FIRMWARE UPDATE MODE?](image)

[Note: pressing Yes does not erase any software in the pump. The pump must be connected to a host personal computer running a Medfusion® 3000 Series download program and a download must be initiated on the PC in order to update the pump’s software.]

**Set Language [Not available on Medfusion® 3010 and 3010a]**

Selecting this option permits changing the displayed language on the pump. All messages are displayed using the new language.

![PRESS THE NUMBER TO SELECT THE MODE](image)

To select a language, press the number button corresponding to the language, and press Enter. The display will immediately change to the selected language. Some pumps may not have all languages implemented; selecting an unimplemented language will result in English being selected.

**Note:** Do not select a language unless you know how to read and understand that language.
Section 4: Parts Replacement provides procedures for disassembly, parts replacement & re-assembly of the pump.

Maintenance warnings/cautions

Observe the following warnings and cautions while disassembling, replacing parts, and reassembling any Medfusion® 3000 Series pump.

After reassembling pump, use Retest Guidelines listed in the Calibration and Adjustment section to find any re-calibration or re-testing required before returning pump to use.

Service warnings

- **AC Power**: The only means of removing AC power is to disconnect the AC power cord. While the AC power cord is attached to the pump and plugged into an AC outlet, live mains voltage is present inside the pump.

- **Battery Replacement**: For continued protection against fire hazard, always replace battery pack with same type and model of battery specified in the labeling on the pump.

- **Clean the Pump**: Always clean the pump thoroughly before performing maintenance on it. This is recommended by the United States Occupational Safety & Health Administration (OSHA) as a protection from potential biohazard.

- **Pump Maintenance**: Only trained biomedical service personnel may repair, calibrate, and maintain this pump.

- **Follow Manufacturer’s Maintenance Procedures**: Always repair and maintain this pump following the manufacturer’s recommended instructions in this Service Manual.

- **Repair Pump in ESD Controlled Work Area**: The pump case should only be opened at a workstation with Electrostatic controls, including a grounded mat and wrist-strap.

- **External DC Power**: Any power source connected to the external DC jack must be IEC 60601-1 certified for medical equipment: Type CF, Safety Class II. Connecting external power to the pump creates a medical system; therefore, the user is responsible for compliance with IEC 60601-1 standards. Refer all questions to Smiths Medical Technical Service department.

  - **Collect Separately**. There are potential health hazards associated with improper disposal of batteries, electronics, and contaminated (used) infusion sets and syringes. Dispose of used batteries, infusion sets, syringes, and other used accessories, or a pump that has reached the end of its useful life, in an environmentally safe manner, and according to any regulations that may apply.

Service cautions

- **Disconnect AC Mains & External DC Power**: Always disconnect the pump from AC Mains and from External DC power before disassembling the pump for maintenance.

- **Handle Batteries with Care**: Always handle the pump’s battery pack with care.

- **Don’t Over-tighten Screws**: Never over-tighten any screws in the pump. Unless otherwise specified, you should torque all screws to 60 in-oz (0.42 Nm).

- **Battery Disposal**: Always dispose of exhausted NiMH batteries in compliance with all pertinent local, state, national, and international regulations. If unsure of correct methods for compliance, you may return battery packs to Smiths Medical for recycling.
Opening & closing the pump housing

Tools needed
For this disassembly procedure you will need:

- Torque screwdriver with a #1 Phillips head

Always work at an electrostatic-controlled work station when disassembling the pump.

Opening the pump housing
1. Unplug the AC power cord (also disconnect any external DC power, if in use).
2. If the poleclamp is attached to the pump, you must remove it before disassembling the pump. Remove the 2 flat head screws attaching the poleclamp bracket to bottom housing of the pump.
3. Remove the 2 flat head screws from the battery compartment cover, and then remove the cover.
4. Carefully remove battery pack from its compartment, and disconnect its cable from the interconnect board.
5. Remove the 2 pan head screws from the bottom housing of the pump.
6. Carefully separate the two halves of the pump housing (there are three snap tabs across the back).
7. Unplug the ribbon cable from J9 on the main board (in most cases the other end of this ribbon cable is glued or soldered into the interconnect board).

Closing the pump housing
1. Before closing the pump housing, be sure the AC and external DC power are disconnected, and the battery pack is removed.
2. Reconnect the ribbon cable joining the interconnect board and the main board at J9.
3. Be sure all wires are clear of pinch points when rejoining the housing halves.
4. There are 3 snap fit tabs and slots along the backside of the housing. Align them and close the top & bottom housings together.
5. Screw in the 2 pan head screws which connect the top & bottom housings. Torque these screws to 60 in oz (0.42 Nm).
6. Orient the battery pack with the circuit board and cable facing the rectangular cutout in the battery compartment.
7. Connect battery cable to the interconnect board. Slide the battery into the compartment.
8. Replace battery cover and secure it with 2 flathead screws. Torque these screws to 60 in oz (0.42 Nm).
9. If using the pole clamp, reattach it to the pump with the 2 flathead screws. Torque these screws to 160 in oz (1.13 Nm).

Follow retest guidelines listed in the Calibration and Adjustment section to verify pump functionality before returning it to use.
Battery pack
This section defines the steps for removing and replacing the battery pack for the Medfusion® 3000 Series pump.

Tools needed
For this disassembly procedure you will need:
• Torque screwdriver with a Phillips head
Always work at an electrostatic-controlled work station when disassembling the pump.

Removing the battery pack
1. Before removing the battery pack, be sure the AC mains and external DC power are disconnected.
2. Remove the 2 flat head screws from the battery compartment cover, and then remove the cover.
3. Carefully remove battery pack from the compartment, and gently disconnect (pull) its ribbon cable from the interconnect board.

Replacing the battery pack
1. Unpack and carefully inspect the battery pack for physical damage.
2. Orient the battery pack with the circuit board and cable facing the rectangular cutout in the battery compartment.
3. Connect battery cable into the interconnect board. Slide the battery into the compartment.
4. Replace battery cover and secure it with 2 flathead screws. Torque these screws to 60 in oz (0.42 Nm).

Verifying battery function after new battery replacement
Before returning the Medfusion® 3000 Series pump to service, you must verify the new battery is functioning nominally.
1. Connect the pump to AC power and verify the battery charge indicator is on.
2. Turn ON the pump. From the Main screen, select Biomed program Diagnostics and go to Monitor Battery Status.
3. Wait several minutes from power-on for readings to stabilize and then verify battery charge current is greater than 160 ma (if battery charge reading is greater than 95%, then charge current is reduced to 50 ma or greater).
4. If < 0 ma, then check connections to AC power. [Note: negative current means the battery is discharging.]
5. If there is no battery information on the Monitor Battery Status screen, then check battery connection on battery pack, or connection on the interconnect board.
6. Turn off the pump, but leave it connected to AC power. Allow pump to recharge battery for at least 10 hours.

Follow retest guidelines listed in the Calibration and Adjustment section to verify pump functionality before returning it to use.
Parts Replacement

Interconnect board
This section defines the steps for removing and replac-ing the interconnect board for the Medfusion® 3000 Series infusion pump.

Tools needed
For this disassembly procedure you will need:
- Torque screwdriver with a Phillips head

Always work at an electrostatic-controlled work sta-tion when disassembling the pump.

Removing the interconnect board
1. Disconnect the pump from AC power source.
2. Open the pump housing, remove battery pack, and separate the top and bottom halves.
3. Unplug the ribbon cable from J9 on the main board (in most cases the other end of this ribbon cable is glued or soldered directly into the interconnect board).
4. Disconnect the speaker cable from the intercon-nect board at J2.
5. Disconnect power supply cable from interconnect board at J3.
6. Remove the 2 pan head screws holding the board, and carefully remove the interconnect board from housing.

Replacing the interconnect board
[Torque all screws to 60 in oz (0.42 Nm).]
1. Align the interconnect board with the threaded bosses, and press firmly into place.
2. Secure it with the 2 pan head screws.
3. Attach the speaker cable to connector J2, and the power supply cable to connector J3.
4. Close the housing and secure with 2 pan head screws.
5. Replace the battery pack, battery cover, and secure with 2 flat head screws.

Verify interconnect board function
Follow retest guidelines listed in the Calibration and Adjustment section to verify pump functionality before returning it to use.

Speaker
This section defines the steps for removing and replac-ing the speaker for the Medfusion® 3000 Series pump.

Tools Needed
For this disassembly procedure you will need:
- Torque screwdriver with a Phillips head

Always work at an electrostatic-controlled work sta-tion when disassembling the pump.

Speaker removal
1. Disconnect the pump from AC power source.
2. Open the pump housing, remove battery pack, and separate the top and bottom halves.
3. Disconnect the speaker cable from the intercon-nect board at J2.
4. Remove the 2 pan head screws & shoulder (or flat) washers holding the speaker to the case, and remove the speaker from housing.

Speaker replacement
[Torque all screws to 60 in oz (0.42 Nm).]
1. Align the speaker on the round holder, and orient the cable to run toward the interconnect board.
2. Insert the 2 pan head screws & shoulder (or flat) washers and secure the speaker to the housing.
3. Close the housing and secure with 2 pan head screws.
4. Replace the battery pack, battery cover, and secure with 2 flat head screws.

Verifying speaker function
After installing the new speaker, you only need to execute power-up testing to verify speaker function.
1. Connect the pump to AC power.
2. Turn ON the pump.
3. Listen for power-on tones. Allow power-on self-tests to complete. If no system failure messages appear, then the speaker is good.

Follow retest guidelines listed in the Calibration and Adjustment section to verify pump functionality before returning it to use.
AC power supply
This section defines the steps for removing and replacing the AC Power Supply for the Medfusion® 3000 Series infusion pump.

Tools needed
For this disassembly procedure you will need:
- Torque screwdriver with a Phillips head & small flat blade
- 5mm open end wrench
- ¼” nut driver
Always work at an electrostatic-controlled work station when disassembling the pump.

Removing AC power supply
1. Disconnect the pump from AC power source.
2. Open the pump housing, remove battery pack, and separate the top and bottom halves.
3. Remove the power supply shield.
4. Disconnect the interconnect board cable from power supply board at J2.
5. Use small flat blade screwdriver to loosen the terminals on the AC input wires, and disconnect the AC input wires from the power supply board at J1.
6. Remove the 2 pan head screws securing board to bottom housing, and remove AC Power Supply Board.

Replacing the AC power supply
1. Align the AC Power Supply Board over the threaded bosses, with J1 in line with the AC input cable.
2. Secure the board with 2 pan head screws. Medfusion® 3500BC: The earth wire from the AC inlet is to be secured at the AC supply mounting post furthest from the AC inlet. Torque to 60 in oz (0.42 Nm).
3. Connect the AC Input Wires to J1 and tighten the 2 terminal screws. Torque to 32 in oz (0.23 Nm).
4. Reconnect the interconnect board cable to J2.
5. Reinstall the Power Supply Shield by sliding it into the notched tabs.
6. Close the housing and secure with 2 pan head screws. Torque to 60 in oz (0.42 Nm).

AC input assembly
This section defines the steps for removing and replacing the AC Input Assembly.

Tools Needed
For this disassembly procedure you will need:
- ¼” open end wrench
- Torque screwdriver with a Phillips head & small flat blade
Always work at an electrostatic-controlled work station when disassembling the pump.

Removing AC input module assembly
1. Disconnect the pump from AC power source.
2. Open the pump housing, remove battery pack, and separate the top and bottom halves.
3. Remove power supply shield.
4. Use small flat blade screwdriver to loosen the 2 screws on the Terminal Block of the power supply.
5. With screwdriver & open end wrench, remove the 2 flathead screws & Nylock nuts. Medfusion® 3500BC: Remove screw holding earth ground connection.
6. Slide the AC Input Module Assembly from the case.

Replacing AC input module assembly
1. Install AC Input Module Assembly with 2 power
wires oriented toward the bottom of the housing. 

Medfusion® 3500BC: Install AC Input Module Assembly with 3 wires, mains wires oriented toward the bottom of the housing, earth wire oriented toward the top.

2. Insert the 2 wires into the Terminal block on the power supply.
3. Tighten the 2 screws of the Terminal block.
   Torque to 32 in oz (0.23 Nm).
4. Secure with the 2 flathead screws & Nylock nuts. 
   Medfusion® 3500BC: Reinstall the earth wire from the A/C inlet to the A/C supply mounting post furthest from the A/C inlet. Torque to 60 in oz (0.42 Nm).
5. Reinstall the Power Supply Shield by sliding it into the notched tabs.
6. Close the housing and secure with 2 pan head screws. Torque to 60 in oz (0.42 Nm).
7. Replace the battery pack, battery cover, and secure with 2 flat head screws. Torque to 60 in oz (0.42 Nm).

Verifying AC input assembly module function
1. After you replace or repair the AC Input Assembly Module, you must verify its nominal function with the following steps:
   2. Plug the pump into AC power.
   3. Verify the AC power indicator lights.
Follow retest guidelines listed in the Calibration and Adjustment section to verify pump functionality before returning it to use.

Bottom housing plastic

Tools Needed
For this disassembly procedure you will need:
- ¼” open end wrench
- Torque screwdriver with a Phillips head and small flat blade

Always work at an electrostatic-controlled workstation when disassembling the pump.

Removing the bottom housing
1. Disconnect the pump from AC power source.
2. Open the pump housing, remove battery pack, and separate the top and bottom halves.
3. Unplug the ribbon cable from J9 on the main board (in most cases the other end of this ribbon cable is glued or soldered directly into the interconnect board).
4. Remove the Interconnect Board, the speaker, the Power Supply Shield, the AC Power Supply, and the AC Input Assembly using the procedures listed above.

Replacing the bottom housing
1. The new case bottom should have rubber feet, and IR lens already installed; however, new labels (included) need to be applied.
2. Record the serial number from the old case bottom. Take the new serial number label and type the serial number into the blank field on this label. Take the overlay supplied with the label, remove the backing and apply this overlay to cover/protect the typed serial number label.
3. Remove the backing on the typed serial number label, and apply this to the new case bottom.
4. Attach all new labels to the new case bottom, use the old bottom as a guide for label application.
5. Install the AC Power Supply, the AC Input Assembly, the Power Supply Shield, the speaker, and the Interconnect Board into the replacement housing using the procedures listed above.
6. Reconnect the ribbon cable to J9 on the main board in the top housing.
7. Close and secure the two halves of the housing.
and reinstall the battery pack.
Follow retest guidelines listed in the Calibration and Adjustment section to verify pump functionality before returning it to use.

**Main board**

This section defines the steps for removing and replacing the Main Board for the Medfusion® 3000 Series pump.

**Tools needed**
For this disassembly procedure you will need:

- Torque screwdriver with Phillips head & small flat head

*Always work at an electrostatic-controlled work station* when disassembling the pump.

**Removing the main board**

1. Disconnect the pump from AC power source.
2. Open the pump housing, remove battery pack, and separate the top and bottom halves.
3. Disconnect the interconnect ribbon cable from the main board at J9.
4. Loosen the 2 terminal block screws connecting the fiber optic back light to the main board, then pull the fiber cable assembly from the terminal block.
5. Disconnect all cable connections on the main board. These include:
   - Keypad ribbon cables at J10.
   - Motor cable at J3.
   - Position pot cable at J6.
   - Display cable at J12.
   - Ear clip sensor cable at J2.
   - Barrel clamp flex circuit at J4.
   - Plunger cable at J11 and unscrew the cable clamp.
6. If present, clip the wire tie securing the 2nd backlight cable.
7. Remove the 2 pan head screws securing main board, and carefully remove the main board from housing.

**Replacing the main board**

1. Place the new main board into the housing. It should rest in the slot on the extrusion, and align the mounting holes with the 2 stand-offs.
2. Secure the main board with the 2 pan head screws. Torque to 60 in oz (0.42 Nm).
3. Reconnect all cable and wire connections on the main board. These include:
   - Keypad ribbon cables at J10.
   - Motor cable at J3.
   - Position pot cable at J6.
   - Display cable at J12.
   - Ear clip sensor cable at J2.
   - Barrel clamp flex circuit at J4.
   - Plunger cable at J11. Install the cable clamp over the exposed braid of the plunger cable and secure with small pan head screw. Torque screw to 16 in oz (0.12 Nm).

4. If a 2nd fiber optic tail is present on the backlight, connect its cable to J8 on the main board. If you are replacing an older main board (with a black connector at J8), you can discard the backlight adapter cable. After completing the next step, anchor both fiber optic tails to the main board with a wire tie.

5. Insert the backlight wires into the main board terminal block. Screw the terminal connector onto the leads with the flat edge of the LED lens toward the outside edge of the board. Torque terminal block screws to 32 in oz (0.23 Nm).

   **Note:** If you reverse the leads during installation, the backlight will not turn on. You may wish to loosely reassemble the case halves, plug in the battery, and power up pump to check the backlight.

6. Close and secure the two halves of the housing and reinstall the battery pack.

7. Complete recalibration and reconfiguration is required when replacing main board. Follow retest guidelines listed in the Calibration and Adjustment section to verify pump functionality before returning it to use.

### Drive train assembly

**Tools Needed**

For this disassembly procedure you will need:

- Torque screwdriver with a Phillips head & ¼” nut drive
- ¼” wrench
- .002” (.051mm) shim

**Always work at an electrostatic-controlled work station** when disassembling the pump.

**Motor unit (motor, worm, worm gear)**

**Removal**

1. Open pump housing per pump housing section above, and set up the case top section with the handle down and main board facing up.
2. Remove the main board per section above.
3. Squeeze the plunger lever and fully extend the plunger head away from the case.
4. Remove pan head screws and standoffs holding the extrusion (drive train assembly). Remove pan head screws and Nylock nuts holding barrel clamp assembly to extrusion.
5. Partially slide extrusion out of case until motor mount screws are accessible.

**Disassemble motor unit as required:**

1. For motor or worm, remove two pan head screws and Nylock nuts holding the motor. Remove motor and worm. Worm pulls straight off of motor shaft.
2. For worm gear (plastic gear on leadscrew), remove e-clip. Pull gear straight off of leadscrew shaft.

**Replacement**

**Reassemble motor unit**

1. For motor/worm, slide worm onto motor shaft. Rotate motor to align mounting holes with holes in motor plate. Ensure the motor is positioned for the wires to properly reach the main board. Secure motor with two pan head screws and Nylock nuts. Torque to 100 in oz (0.71 Nm).
2. For worm gear, align “D” with shaft and press onto leadscrew until centered over worm. Attach e-clip.
3. Carefully slide the extrusion (drive train assembly) back into case.
4. Ensure right end plate on extrusion does not damage ear clip sensor.
5. Ensure plunger cable comes out between middle boss and boss by the motor.
6. Slide keypad ground tab (black side toward extrusion) between boss by the motor and extrusion.
7. Secure extrusion with 3 standoffs and 3 pan head screws. Torque to 100 in oz (0.71 Nm).
8. Secure the barrel clamp assembly to the extrusion with 2 pan head screws and Nylock nuts. Torque to 100 in oz (0.71 Nm).
9. Reinstall main board per main board section above.
10. Close pump housing per housing section above.

Position potentiometer

Removal

1. Open pump housing per pump housing section above, and setup the case top section with the handle down and main board facing up.
2. Remove the main board per section above.
3. Squeeze the plunger lever and fully extend the plunger head away from the case.
4. Remove pan head screws and standoffs holding the extrusion (drive train assembly). Remove pan head screws and Nylock nuts holding barrel clamp assembly to extrusion.
5. Partially slide extrusion out of case until flat head screw in right end plate is accessible.
6. Remove small flat head screw holding position potentiometer (pot).
7. On the carriage remove pan head screw, washer, and Nylock nut holding the post of the pot. (It may be necessary to reposition carriage by moving the plunger head.)
8. Remove three flat head screws holding motor assembly on extrusion and rotate out of way.
9. Slide position pot out of the extrusion.

Replacement

1. Slide new position pot into extrusion.
2. Clean small flat head screw (or use a new screw), apply Loctite 242 (mild thread-locking adhesive) to screw, and secure pot to right end plate of extrusion assembly. Torque only to 16 in oz (0.12 Nm).
3. Secure motor assembly on extrusion with three flat head screws. Torque to 100 in oz (0.71 Nm).
4. Slide post of position pot up to carriage. Insert pan head screw through hole in carriage arm, then through washer. Start the Nylock nut onto the screw. Insert 0.002” shim between pot's post and the washer, then tighten the nut until slack is removed. Do not over-tighten nut. Remove shim and check if flat washer can move (spin) freely, if not loosen nut slightly.
5. Carefully slide the extrusion (drive train assembly) back into case.
6. Ensure right end plate on extrusion does not damage ear clip sensor.
7. Ensure plunger cable comes out between middle boss and boss by the motor.
8. Slide keypad ground tab (black side toward extrusion) between boss by the motor and extrusion.
9. Secure extrusion with 3 standoffs and 3 pan head screws. Torque to 100 in oz (0.71 Nm).
10. Secure the barrel clamp assembly to the extrusion with 2 pan head screws and Nylock nuts. Torque to 100 in oz (0.71 Nm).
11. Reinstall main board per main board section above.
12. Close pump housing per housing section above.
Clutch assembly

Tools needed
For this disassembly procedure you will need:

- Torque screwdriver with a Phillips head & ¼” nut drive
- ¼” wrench
- .002” (.051mm) shim

Always work at an electrostatic-controlled work station when disassembling the pump.

Leadscrew

Removal
1. Open pump housing per pump housing section above, and setup the case top section with the handle down and main board facing up.
2. Remove the main board per section above.
3. Squeeze the plunger lever and fully extend the plunger head away from the case.
4. Remove pan head screws and standoffs holding the extrusion (drive train assembly). Remove pan head screws and Nylock nuts holding barrel clamp assembly to extrusion.
5. Partially slide extrusion out of case until Nylock nut holding leadscrew on right end plate is accessible.
6. Pull the plastic worm gear off the end of leadscrew near motor.
7. Remove three flat head screws holding motor assembly on extrusion, and pull off motor assembly.
8. Slide carriage rod out of the carriage.
9. Move the plunger head/carriage in about 1” (2.5cm) from the right end plate. Hold onto the “D” side of the leadscrew and use ¼” wrench to remove Nylock nut holding leadscrew and the flat brass washer.
10. Slide extrusion in slightly until leadscrew clears right end plate, then pull off the thrust bearings.
11. Squeeze the plunger lever to open clutch and pull leadscrew out of carriage.

Replacement
1. Apply light coating of STP poly-plus (lithium) grease to leadscrew. Squeeze plunger lever to open clutch and insert leadscrew until it sticks slightly through the carriage.
2. Install thrust bearing assembly (flat washer, bearings, flat washer) onto end of leadscrew and pull on plunger head to feed leadscrew through the right end plate. Ensure nylon shoulder washer is still in place on right end plate.
3. Place brass washer over the leadscrew and start Nylock nut. Insert .002” shim between the brass washer and shoulder washer and tighten the nut. Do not over-tighten nut. Remove shim and check if brass washer can move (spin) freely, if not loosen nut slightly.
4. Slide carriage rod through carriage and seat into hole in right end plate.
5. Slide motor assembly over leadscrew and align carriage rod with motor assembly bracket. Secure motor assembly on extrusion with three flat head screws. Torque to 100 in oz (0.71 Nm).
6. Align “D” of worm gear with leadscrew shaft and press onto leadscrew until gear is centered over the motor worm.
7. Carefully slide the extrusion (drive train assembly) back into case.
8. Ensure right end plate on extrusion does not damage ear clip sensor.
9. Ensure plunger cable comes out between middle boss and boss by the motor.
10. Slide keypad ground tab (black side toward extrusion) between boss by the motor and extrusion.
11. Secure extrusion with 3 standoffs and 3 pan head screws. Torque to 100 in oz (0.71 Nm).
12. Secure the barrel clamp assembly to the extrusion with 2 pan head screws and Nylock nuts. Torque to 100 in oz (0.71 Nm).
13. Reinstall main board per main board section above.
14. Close pump housing per housing section above.

Clutch or clutch cam

Tools needed
For this disassembly procedure you will need:

- Safety glasses
• Needle nose pliers

**Removal**

1. Remove leadscrew per procedure above.
2. Use needle nose pliers (or hemostats) to remove e-ring from cam in carriage plate.
3. Using ¼” open end wrench and Phillips screwdriver, remove three pan head screws with Nylock nuts holding the carriage plate.
4. Use needle nose pliers to remove either:
   - the clutches, use caution in separating clutches because of spring.
   - the cam, pull straight out and separate from square shaft.

**Replacement**

1. For replacement of:
   - the cam, first ensure the shaft is seated to the plunger lever, then press the cam gear on the shaft.
   - the clutches, put the clutch halves together (closed) and press the spring into place, then slide the clutch halves into the carriage.
2. Feed the pan head screws through the carriage then the carriage plate, then secure with nylon nuts. Nuts should be on top of the carriage plate not the carriage. Torque to 100 in oz (0.71 Nm).
3. Snap e-ring over cam sticking through carriage plate.
4. Replace leadscrew per procedure above.

**Plunger cable**

**Removal**

1. Remove leadscrew per procedure above.
2. Using ¼” open end wrench and Phillips screwdriver, remove three pan head screws with Nylock nuts holding the carriage plate. Pull plate with cam and square shaft attached.
3. Open plunger case right per procedure below.
4. Unplug the plunger cable from plunger board and pull cable out of slot in force mount and plunger tube.
5. At the carriage, turn plunger cable connector in line with the cable, and pull cable out through plunger head.

**Replacement**

1. Take the new plunger cable, with the smaller exposed braid area towards the carriage, turn connector in line with the cable, then thread the cable through the plunger tube.
2. Plug the cable into the plunger board, then press the braided portion into the slot of the force mount and plunger tube. This should leave about 2” (5cm) of cable sticking out the notched end of the plunger tube.
3. Press the square shaft on the cam, the cam through the carriage plate (check orientation of plate) and snap the e-ring on the cam.
4. Slide carriage plate with clutch cam and shaft into plunger tube.
5. Feed the pan head screws though the carriage then the carriage plate, then secure with nylon nuts. Nuts should be on top of the carriage plate not the carriage. Torque to 100 in oz (0.71 Nm).
6. Close plunger case per procedure below.
7. Replace lead screw per procedure above.
Parts Replacement

LCD and backlight

This section defines the steps for removing and replacing the LCD Display and Backlight for the Medfusion® 3000 Series pump.

Tools Needed

For this disassembly procedure you will need:

- ¼” open end wrench
- Torque screwdriver with Phillips head & small flat head

Always work at an electrostatic-controlled work station when disassembling the pump.

Removing LCD and/or backlight assembly

1. Disconnect the pump from AC power source.
2. Open the pump housing, remove battery pack, and separate the top and bottom halves.
3. Disconnect the display cable from the main board at J12.
4. Use small flat blade screwdriver to loosen the 2 screws connecting the fiber optic back light to the main board. Then pull the fiber optic cable assembly from the terminal block.
5. If the back light has a 2nd fiber optic tail, cut the wire tie anchoring its connecting cable and separate the 2nd tail from the connecting cable.
6. With ¼” open end wrench, remove the 2 Nylock nuts securing the display.
7. Carefully lift the display assembly from the top housing.
8. Slide the back light and spacer from the display assembly.

Replacing the LCD and/or backlight assembly

1. Remove the protective plastic film from the new display’s glass.
2. Remove the tape which holds the plastic spacer inside the new display, and slide out the spacer. Discard the white plastic spacer.
3. If the backlight has one fiber optic tail, then you will use two clear plastic spacers in the next step.
4. Place the clear plastic spacer(s) on top of the backlight with the white side of the back light facing up and the silver side down.
5. Gently slide the back light and spacer together into the display with the clear plastic spacer toward the display glass.
6. Orient the display with the back light tail on the side with the keypad cables. Verify there is not lint or dirt on the display.
7. Slide the display onto the ribs in the top of the top housing and over the spacers/studs. Secure the display assembly with the 2 Nylock nuts and tighten with ¼” wrench.
8. Reconnect the display cable to the main board at J12.
9. If a 2nd fiber optic tail is present on the backlight, clip the lead on the LED of the shorter fiber optic tail to match the length of the shorter tail’s LED on the removed backlight. Note: the longer fiber optic tail’s LED requires longer leads. Connect the shorter fiber optic tail to the round connector on the cable. Be sure to orient the lead closest to the flat edge of the LED into the terminal touching the MELF resistor embedded in the round connector. After completing the next step, anchor both fiber optic tails to the main board with a wire tie.
10. Insert the back light wires into the main board terminal block. (When replacing the back light, trim the LED leads to about ½” in length.) Screw the terminal connector onto the leads with the flat edge of the LED lens toward the outside edge of the board. Torque terminal block screws to 32 in oz (0.23 Nm).

Note: If you reverse the leads during installation, the backlight will not turn on. You may wish to loosely reassemble the case halves, plug in the battery, and power up pump to check the backlight.

11. Close and secure the two halves of the housing and reinstall the battery pack.
Verify LCD & backlight assembly function

1. Plug the pump into AC power and turn it ON.
2. Watch the screen during startup and self-testing. [Note: you may wish to adjust the display contrast, see chapter on calibration and adjustment.]
3. After self-testing completes, set the pump in a darkened area and verify the backlight is functioning.

Follow retest guidelines listed in the Calibration and Adjustment section to verify pump functionality before returning it to use.

Keypad

This section defines the steps for removing and replacing the Keypad.

Tools needed

For this disassembly procedure you will need:

- ¼” open end wrench
- Torque screwdriver with a Phillips head & small flat blade

Always work at an electrostatic-controlled work station when disassembling the pump.

Removing the keypad

1. Disconnect the pump from AC power source.
2. Open the pump housing, remove battery pack, and separate the top and bottom halves.
3. Disconnect the interconnect ribbon cable from J9 on the main board.
4. Loosen the 2 terminal block screws connecting the fiber-optic backlight to the main board. Then, carefully pull the leads from the connector. If a 2nd backlight LED is present, disconnect its cable at the main board and clip the wire tie securing it to the main board.
5. Disconnect the keypad cables at J10 on the main board.
6. Disconnect the display cable at J12 on the main board.
7. Remove the 2 pan head screws securing the main board, and then loosen the main board. It is not necessary to remove the main board, or disconnect all cables from it, to access the keypad.
8. With ¼” open end wrench, remove the 2 Nylock nuts securing the display board, and remove the display from the top housing.
9. With ¼” open end wrench, remove one hex head standoff nearest to the motor, and carefully slide out the keypad ground tab from between the top housing boss and the extrusion.
10. Press on inside of clear lens (window) to loosen keypad and peel keypad from top housing.
Replacing the keypad

**CAUTION: Keypad is NOT Flexible:** Whenever handling the keypad, always ensure it remains flat. Bending the keypad can damage keys or break LED contacts.

1. Clean the clear lens with a soft cloth. Ensure there is no lint or fingerprints on the lens.
2. Ensure inside of new keypad window is clear of lint or fingerprints.
3. Remove backing from the keypad. Feed the 3 keypad cables through the housing window. Slide the clear lens into the cutout of the case top.
4. Align the keypad and carefully press into recess in the case top. Keep the keypad as flat as possible.
5. Slide the keypad ground tab between the extrusion and the top housing boss. Be sure the black side of the tab faces toward the extrusion. Replace the hex head standoff into the extrusion securing the ground tab. Torque to 100 in oz (0.71 Nm).
6. Slide the display assembly into the ribs on the top housing, and secure it with 2 Nylock nuts.
7. Reposition the main board and secure with 2 pan head screws. Torque to 60 in oz (0.42 Nm).
8. Reconnect display cable to J12, keypad cables to J10.
9. Insert the back light wires into the main board terminal block. (When replacing the back light, trim the LED leads to about ½” in length.) Screw the terminal connector onto the leads with the flat edge of the LED lens toward the outside edge of the board. Torque terminal block screws to 32 in oz (0.23 Nm). If present, connect the 2nd backlight LED’s cable to J8.

**Note:** If you reverse the leads during installation, the backlight will not turn on. You may wish to loosely reassemble the case halves, plug in the battery, and power up pump to check the backlight.

10. If a 2nd backlight LED is present, secure the fiber optic cable to the main board with a wire tie.
11. Close the pump case and reinstall the battery pack. Follow retest guidelines listed in the Calibration and Adjustment section to verify pump functionality before returning it to use.

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Syringe barrel clamp assembly

**Tools Needed**
For this disassembly procedure you will need:
- Torque screwdriver with a Phillips head & 1/16” hex head
- ¼” wrench
- Small vise-grip pliers

*Always work at an electrostatic-controlled work station* when disassembling the pump.

**Barrel clamp head**

**Removal**

1. Lift barrel clamp head until screw is accessible then use vise grips to clamp near base of barrel clamp rod to hold it in place.
2. Using a 1/16” hex wrench, remove hex head screw from barrel clamp head.
3. Pull barrel clamp head off of the barrel clamp rod.

**Replacement**

1. Align the hole in the barrel clamp rod with the barrel clamp head, and press the head onto the rod.
2. Secure the barrel clamp head with the 1/16” hex head screw. Torque to 60 in oz (0.42 Nm)

**Verify Function**

1. Verify barrel clamp head moves up and down, and will rotate when fully extended.

Follow retest guidelines listed in the Calibration and Adjustment section to verify pump functionality before returning it to use.

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**Barrel clamp body assembly**

**Removal**

1. Remove barrel clamp head per above.
2. Open pump housing per pump housing section above.
3. Using a ¼” wrench and Phillips screwdriver, remove two pan head screws with Nylock nuts which hold the barrel clamp assembly. These
screws are located on the right end plate of the drive train assembly.

4. Unplug the barrel clamp flex circuit from J4 of the main board.

5. Gently slide barrel clamp assembly out of the case avoiding the fingers extending from the right end plate around the plunger tube.

6. Remove small screw holding the pot to the barrel clamp assembly.

7. Carefully lift pot up off alignment bosses and out of fingers on the slide.

**Replacement**

1. Align new pot into fingers of slide on the barrel clamp assembly and press onto bosses.

2. Secure pot with small screw. Tighten until screw is flush with pot. [Do not over-tighten.]

3. Carefully slide barrel clamp body assembly into case. Push the rod through the hole in top of the case.

4. Secure barrel clamp assembly with two pan head screws with Nylock nuts. Torque to 100 in oz (0.71 Nm).

5. Plug barrel clamp flex circuit into J4 of the main board.

6. Close pump housing per housing section above.

7. Replace barrel clamp head and verify function per above.

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**Ear clip, handle & guide**

**Tools Needed**

For this disassembly procedure you will need:

- Torque screwdriver with a Phillips head & ¼” nut drive
- Needle nose pliers (two pairs)

*Always work at an electrostatic-controlled work station* when disassembling the pump.

**Ear clip**

**Removal**

1. Open pump housing per pump housing section above, and setup the case top section with the handle down and main board facing up.

2. Use one pair of needle nose pliers to press the ear clip sleeve towards the case wall, then use a second set of pliers (or hemostats) to pull the e-ring off of the ear clip. [Note, on older pumps sleeve is not present, so use 1st set of pliers to pull spring towards the case wall.]

3. Slide the ear clip out of the top housing assembly.

**Replacement**

1. Partially insert new ear clip through side of case, then slide the spring onto shaft of ear clip.

2. Slide sleeve over ear clip with hollow end of sleeve towards the spring.

3. Ensure the ear clip faces the “V” groove in the case top, then press the ear clip into the case. Use one pair of needle nose pliers to compress the sleeve (and/or spring) and use a second set of needle nose (or hemostats) to snap e-ring into groove on the ear clip.

4. Pull on the ear clip and release it. Verify that the ear clip moves smoothly out and is pulled back flush to the case by the spring when released.

5. Close pump housing per housing section above.

**Ear clip optical sensor**

**Removal**

1. Open pump housing per pump housing section above, and setup the case top section with the
handle down and main board facing up.
2. Remove the main board per section above.
3. Squeeze the plunger lever and fully extend the plunger head away from the case.
4. Remove pan head screws and standoffs holding the extrusion (drive train assembly). Remove pan head screws and Nylock nuts holding barrel clamp assembly to extrusion.
5. Partially slide extrusion out of case until ear clip sensor is visible.
6. Remove pan head screw holding sensor and remove the ear clip optical sensor.

**Replacement**

1. On the new ear clip sensor, look at the old sensor then use wire cutters to carefully cut a portion of the plastic tab/mounting hole to allow clearance for the display connector.
2. Slide ear clip sensor onto post in case top, with grey side of sensor away from the display.
3. Secure the sensor with the pan head screw. Torque to 100 in oz (0.71 Nm).
4. Carefully slide the extrusion (drive train assembly) back into case.
5. Ensure right end plate on extrusion does not damage ear clip sensor.
6. Ensure plunger cable comes out between middle boss and boss by the motor.
7. Slide keypad ground tab (black side toward extrusion) between boss by the motor and extrusion.
8. Secure extrusion with 3 standoffs and 3 pan head screws. Torque to 100 in oz (0.71 Nm).
9. Secure the barrel clamp assembly to the extrusion with 2 pan head screws and Nylock nuts. Torque to 100 in oz (0.71 Nm).
10. Reinstall main board per main board section above.
11. Close pump housing per housing section above.

**Handle**

**Removal**

1. Open pump housing per pump housing section above, and setup the case top section with the handle down and main board facing up.
2. Remove the main board per section above.
3. Squeeze the plunger lever and fully extend the plunger head away from the case.
4. Remove pan head screws and standoffs holding the extrusion (drive train assembly). Remove pan head screws and Nylock nuts holding barrel clamp assembly to extrusion.
5. Partially slide extrusion out of case until two handle screws are visible.
6. Remove two pan head screw holding handle and remove the handle.

**Replacement**

1. Place new handle on case top and secure with two pan screws with washers through the inside of case.
2. Carefully slide the extrusion with plunger tube back into the case.
3. Carefully slide the extrusion (drive train assembly) back into case.
4. Ensure right end plate on extrusion does not damage ear clip sensor.
5. Ensure plunger cable comes out between middle boss and boss by the motor.
6. Slide keypad ground tab (black side toward extrusion) between boss by the motor and extrusion.
7. Secure extrusion with 3 standoffs and 3 pan head screws. Torque to 100 in oz (0.71 Nm).
8. Secure the barrel clamp assembly to the extrusion with 2 pan head screws and Nylock nuts. Torque to 100 in oz (0.71 Nm).
9. Reinstall main board per main board section above.
10. Close pump housing per housing section above.

**Tubing guide**

**Removal**

1. Open pump housing per pump housing section above, and setup the case top section with the handle down and main board facing up.
2. Remove the main board per section above.
3. Squeeze the plunger lever and fully extend the plunger head away from the case.
4. Remove pan head screws and standoffs holding the extrusion (drive train assembly). Remove pan head screws and Nylock nuts holding barrel clamp assembly to extrusion.
5. Partially slide extrusion out of case until three tubing guide screws are visible.
6. Remove pan head screw holding tubing guides and remove the tubing guides. Note orientation of each tubing guide.

Replacement

1. Place each tubing guide onto case top and secure with a pan head screw and nylon washer. The bumps on the case top help ensure correct orientation of each guide. Torque to 60 in oz (0.42 Nm).
2. Carefully slide the extrusion (drive train assembly) back into case.
3. Ensure right end plate on extrusion does not damage ear clip sensor.
4. Ensure plunger cable comes out between middle boss and boss by the motor.
5. Slide keypad ground tab (black side toward extrusion) between boss by the motor and extrusion.
6. Secure extrusion with 3 standoffs and 3 pan head screws. Torque to 100 in oz (0.71 Nm).
7. Secure the barrel clamp assembly to the extrusion with 2 pan head screws and Nylock nuts. Torque to 100 in oz (0.71 Nm).
8. Reinstall main board per main board section above.
9. Close pump housing per housing section above.

Plunger case assembly

Tools needed

For this disassembly procedure you will need:
- Torque screwdriver with a Phillips head & 2.5mm hex head
- Needle nose pliers
- Safety glasses

Always work at an electrostatic-controlled work station when disassembling the pump.

Plunger lever

Removal

1. Remove pan head screw from lever.
2. Pull plunger lever off the lever gear.

Replacement

1. Position new plunger lever onto lever gear and secure with pan head screw. Torque to 60 in oz (0.42 Nm).

Plunger case disassembly

WARNING: While servicing the Medfusion® 3000 Series infusion pump you should wear safety glasses as it contains springs and other small parts which may be a hazard.

Disassembly

1. Stand the pump up on its left side so that the plunger assembly points vertically up. Squeeze the plunger lever and position the plunger driver for disassembly.
2. Remove three pan head screws holding the plunger case halves together (do not remove screw on lever).
3. Remove the plunger case right and remove the plunger case seal. The lever gear will be attached to the plunger case right. The square shaft may come out with plunger case right; if so, pull the shaft out of the lever gear and slide the shaft down the plunger tube into gently press into the cam.

Reassembly

1. Remove any slack in movement of square shaft by
turning counter-clockwise. With plunger lever positioned up against long rib on plunger case right, join the two case halves together pressing the lever gear over the square shaft.

2. Start the three pan head screws into the plunger case halves, with the long screw into the tall rib of the case.

3. Before tightening, press the plunger case seal into the gaps between the case halves. Ensure the seal is positioned properly between the halves then tighten the plunger case screws. Torque to 60 in oz (0.42 Nm).

Follow retest guidelines listed in the Calibration and Adjustment section to verify pump functionality before returning it to use.

**Cam gear and timing plate**

**WARNING:** While servicing the Medfusion® 3000 Series infusion pump you should wear safety glasses as it contains springs and other small parts which may be a hazard.

**Removal**

1. Open the plunger case halves per above.
2. Lift cam gear off of pin.
3. Remove push block.
4. Press timing plate upward and lift carefully to remove timing plate spring and timing plate. Note, the timing plates are asymmetrical (left and right handed).

**Replacement**

1. Rotate the right flipper until it stops against the “V” groove on the plunger case.
2. Insert the spring into the timing plate right. Slide spring over the post in the side wall of the plunger case.
3. Slowly lower timing plate into the plunger case slot – as far down the slot as possible toward the optical sensor on the plunger board – while lining up the gears.
4. Repeat this process for the left flipper and left timing gear.
5. Place the push block on top of the timing plate
6. Place cam gear over pin (check assembly drawing for orientation) and up against push block.
7. Close plunger case halves per above.

**Flipper and flipper gear**

**Removal**

1. Disassemble plunger case and remove timing plates per above.
2. Use the needle nose pliers to compress the flipper shaft inside the flipper gear. Gently pull on the flipper while compressing the shaft.
3. Slide the O-ring seal off of the flipper. (Inspect the O-ring replace if damaged; otherwise, clean with soap and water.)

**Replacement**

1. Slide O-ring seal over new flipper.
2. Insert flipper through the plunger case and snap onto the flipper gear. (Ensure gear recess faces out from case – if gear is installed incorrectly then flipper will not snap in place. If flipper gear is damaged replace flipper gear.)
3. Install timing plates per above and reassemble plunger case halves.

**Plunger board**

*Note: Ensure plunger head is fully extended away from pump housing before starting.*

**Additional tools needed**

For this disassembly procedure you may also need:
- .002” (.051mm) shim

**Removal**

1. Disassemble plunger case and remove timing plates per above.
2. Gently pull on the plunger cable unplugging it from connector J2. Unplug force sensor cable from J1 on plunger board.
3. Using a Phillips screwdriver, remove pan head screw with washer from the force mount assembly.
4. On newer assemblies it is not necessary to remove float plate seal and float plate. Gently try to pull plunger case left towards the pump. If it comes apart skip to step 7 below, otherwise remove float plate seal and float plate.
5. Grab float plate seal with pliers (or hemostats) and pull off from plunger case left. (Float plate seal is glued in place and may be damaged in removal.)
6. Using a metric 2.5mm hex wrench, remove the screw holding the float plate.
7. Slide plunger case left toward pump until plunger board is accessible, then remove plunger board.

Replacement
1. Insert new plunger board into plunger case left. (Ensure board sits on two guide pins and does not interfere with flipper gears.)
2. Slide the plunger case left up and over the force mount assembly. Secure in place with the flat washer and pan head screw. Torque to 100 in oz (0.71 Nm).
3. Connect force sensor cable to the plunger board at connector J1 and press excess cable flat against board.
4. Connect plunger cable to plunger board connector J2, and check to ensure cable remains in slot through force mount and plunger tube.
5. If you did not remove float plate/seal skip to step 7; otherwise, place float plate into opening in plunger case left and start 2.5mm hex screw into this assembly. Slide a .002” shim between float plate and the wall of the plunger case. Tighten screw and torque to 100 in oz (0.71 Nm), then remove shim.
6. Use sharp tool or knife to clean slot for seal. If seal was damaged, replace with a new seal. Place small drops of Loctite 454 (cyanoacrylate adhesive) at four points in the slot and then press the seal into place.
7. Install timing plates and reassemble plunger case per above.

Force sensor
Note: Ensure plunger head is fully extended away from pump housing before starting.

Additional tools needed
For this disassembly procedure you will also need:
- .002” (.051mm) shim

Removal
1. Disassemble plunger case and remove timing plates per above.
2. Gently pull on the plunger cable unplugging it from connector J2. Unplug force sensor cable from J1 on plunger board.
3. Using a Phillips screwdriver, remove pan head screw with washer from the force mount assembly.
4. On newer assemblies it is not necessary to remove float plate seal. Gently try to pull plunger case left towards the pump. If it comes apart skip to step 6 below, otherwise remove float plate seal.
5. Grab float plate seal with pliers or hemostats and pull off from plunger case left. (Float plate seal is glued in place and may be damaged in removal.)
6. Using a metric 2.5mm hex wrench, remove the screw holding the float plate.
7. Slide plunger case left toward pump until the hex head screw is accessible on the force mount assembly.
8. Using a metric 2.5mm hex wrench, remove the screw holding the force sensor onto the force mount. Note the orientation of the cable on the force mount.

Replacement
1. Install the new force sensor onto the force mount bracket with the 2.5mm hex screw. (Ensure the cable of the force sensor faces towards the plunger PCB and connector J1.) Torque to 100 in oz (0.71 Nm).
2. Slide the plunger case left up and over the force mount assembly. Secure in place with the flat washer and pan head screw. Torque to 100 in oz (0.71 Nm).
3. Connect force sensor cable to the plunger board at connector J1 and press excess cable flat against board.
4. Connect plunger cable to plunger board connector J2, and check to ensure cable remains in slot through force mount and plunger tube.
5. If you did not remove float plate seal skip to step 7; otherwise, use sharp tool or knife to clean slot for seal. Place the float plate into opening in plunger case left and start 2.5mm hex screw into this as-
asmble. Slide a .002” shim between float plate and the wall of the plunger case. Tighten screw and torque to 100 in oz (0.71 Nm), then remove shim.

6. If seal was damaged, replace with a new seal. Place small drops of Loctite 454 (cyanoacrylate adhesive) at four points in the slot and then press the seal into place.

7. Install timing plates and reassemble plunger case per above.

Left plunger case

Note: Ensure plunger head is fully extended away from pump housing before starting.

Additional tools needed

For this disassembly procedure you will also need:

- .002” (.051mm) shim

Removal

1. Disassemble plunger case and remove timing plates per above.

2. Remove plunger flippers and gears per above.

3. Gently pull on the plunger cable unplugging it from connector J2. Unplug force sensor cable from J1 on plunger board.

4. Using a Phillips screwdriver, remove pan head screw with washer from the force mount assembly.

5. On newer assemblies it is not necessary to remove float plate seal. Gently try to pull plunger case left towards the pump. If it comes apart skip to step 8 below, otherwise remove float plate seal.

6. Grab float plate seal with pliers or hemostats and pull off from plunger case left. (Float plate seal is glued in place and may be damaged in removal.)

7. Using a metric 2.5mm hex wrench, remove the screw holding the float plate.

8. Slide plunger case left toward pump until the two small flat head screws are accessible on the force mount. Unscrew two flat head screws on force mount. Pull plunger cable out of slot on force mount bracket and plunger tube. Slide off the force mount assembly from the plunger tube.

9. Slide plunger case left off of plunger tube.

Replacement

1. Install flippers and flipper gears per above into new plunger case left.

2. Transfer plunger board into new plunger case.

3. Slide new plunger case left onto plunger tube. (Ensure case is correctly oriented.)

4. Thread plunger cable through force mount assembly and slide assembly onto plunger tube align screw holes and cable slot. Apply (mild thread-locking adhesive) Loctite 242 to flat head screws and secure the force mount to the plunger tube. Torque to 100 in oz (0.71 Nm). [Be careful not to cross-thread screws.]

5. Slide the plunger case left up and over the force mount assembly. Secure in place with the flat washer and pan head screw. Torque to 100 in oz (0.71 Nm).

6. Connect force sensor cable to the plunger board at connector J1 and press excess cable flat against board.

7. Press plunger cable into slot though plunger tube, force mount, and plunger case left. Ensure exposed braid of cable touches metal on force mount or plunger tube.

8. Connect plunger cable to plunger board connector J2, and check to ensure cable remains in slot through force mount and plunger tube.

9. If you did not remove the float plate seal, skip to step 11. Place the float plate into opening in plunger case left and start 2.5mm hex screw into this assembly. Slide a .002” shim between float plate and the wall of the plunger case. Tighten screw and torque to 100 in oz (0.71 Nm), then remove shim.

10. Use a new seal. Place small drops of Loctite 454 (cyanoacrylate adhesive) at four points in the slot and then press the seal into place.

11. Install timing plates and reassemble plunger case per above.
Using **Biomed > Calibration**

This section explains the use of Biomed Calibration for the calibration of internal sensors of the Medfusion® 3000 Series pumps.

**Biomed > Calibration**

In order to complete the calibration of the Medfusion® 3000 Series infusion pumps, you need the *Smiths Medical Medfusion® 3000 Series Calibration Kit*. This kit contains one (each) of the following:

- Small Calibration Slug
- Large Calibration Slug
- Force Gauge

**Note:** The equipment supplied in the Calibration Kit should be added to your annual calibration and maintenance schedule.

To access **Biomed > Calibration**, from the Main menu use the **number** buttons to choose Biomed (you may need to press **More** to find it; if libraries are enabled you may need to press **Main Menu**, then **More**). Enter the Passcode (**2580**) then press Enter.

To select Calibration:

1. **Press the number to select the mode**
   1. Calibration
   2. Diagnostics
   3. Utilities
   4. Update Firmware

2. **Press the number to select**
   1. Calibration
   2. Diagnostics
   3. Utilities
   4. Set Language

Use the **number** buttons to select **Calibration**.

To select Calibration options:

1. **Press the number to select the mode**
   1. Cal Size and Position
   2. Cal Force Sensor
   3. Cal Pressure Sensor
   4. Cal Plunger Position
   5. Cal Syringe Size Sensor
   6. Adjust Contrast
   7. View Calibration Data
   8. Save Changes and Exit

2. **Press the number to select**
   1. Cal Size and Position
   2. Cal Force Sensor
   3. Cal Pressure Sensor
   4. Cal Plunger Position
   5. Cal Syringe Size Sensor
   6. Adjust Contrast
   7. View Calibration Data
   8. Save Changes and Exit
Below is table which summarizes the options available for calibration.

<table>
<thead>
<tr>
<th>Calibration Option</th>
<th>What it Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibrate (Syringe) Size and Position</td>
<td>Performs concurrent adjustment of syringe size &amp; position sensors settings. This requires Smiths Medical “calibration slugs”.</td>
</tr>
<tr>
<td>Calibrate Force Sensor</td>
<td>Performs adjustment of force sensor settings.</td>
</tr>
<tr>
<td>Calibrate Pressure Sensor</td>
<td>This is a future option of the Medfusion® 3000 Series pumps.</td>
</tr>
<tr>
<td>Calibrate Plunger Position Sensor</td>
<td>Performs adjustment of plunger position sensor settings.</td>
</tr>
<tr>
<td>Calibrate Syringe Size Sensor</td>
<td>Performs adjustment of syringe size sensor setting.</td>
</tr>
<tr>
<td>Adjust Contrast</td>
<td>Varies the onscreen contrast of the LCD. The pump is shipped with a “factory average” default. You may set it above or below for “comfortable” viewing.</td>
</tr>
<tr>
<td>View Calibration Data</td>
<td>Displays the “current” calibration data settings.</td>
</tr>
<tr>
<td>Save Changes and Exit</td>
<td>Saves the new calibration settings and then returns to the main Biomed menu.</td>
</tr>
</tbody>
</table>
Calibrate (Syringe) size and position

This procedure calibrates both the syringe size sensor and the syringe position sensor. The syringe size sensor is part of the barrel clamp assembly and measures the syringe barrel external diameter allowing the software to determine the syringe size loaded onto the pump. The syringe position sensor is part of the drive train assembly and measures the plunger head position allowing the software to determine the empty position and plunger head travel.

Performing both size & position calibration

1. From the Calibration Menu, use the number buttons to choose Cal Size and Position.

2. Load the small calibration slug into the barrel clamp. Keeping the barrel clamp perpendicular to the slug, move the clamp slightly back and forth to find the lowest size reading, then press Continue to calibrate the small size.

| MAX VALUE | DATA: 175 COUNTS |
| SYRINGE SIZE | DATA: 125 COUNTS |
| MIN VALUE | DATA: 75 COUNTS |

| MAX VALUE | DATA: 175 COUNTS |
| SYRINGE SIZE | DATA: 902 COUNTS |
| MIN VALUE | DATA: 75 COUNTS |

Press the number to select the mode

1. CAL SIZE AND POSITION 5. CAL SYRINGE SIZE SENSOR
2. CAL FORCE SENSOR 6. ADJUST CONTRAST
3. CAL PRESSURE SENSOR 7. VIEW CALIBRATION DATA
4. CAL PLUNGER POSITION 8. SAVE CHANGES AND EXIT
3. Squeeze the plunger lever to hold the flippers open, move the plunger head against the small slug, and press **Continue** to calibrate the low position.

```
<table>
<thead>
<tr>
<th>SETUP LOW STANDARD - PRESS CONTINUE WHEN READY</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX VALUE DATA: 200 COUNTS</td>
</tr>
<tr>
<td>PLUNGER POS DATA: 151 COUNTS</td>
</tr>
<tr>
<td>MIN VALUE DATA: 100 COUNTS</td>
</tr>
<tr>
<td>CONTINUE</td>
</tr>
</tbody>
</table>
```

4. Load the large calibration slug into barrel clamp. Keeping the barrel clamp perpendicular to the slug, move the clamp slightly back and forth to find the lowest size reading, then press **Continue** to calibrate large size.

```
<table>
<thead>
<tr>
<th>SETUP HIGH STANDARD - PRESS &lt; CONTINUE &gt; WHEN READY</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX VALUE DATA: 1024 COUNTS</td>
</tr>
<tr>
<td>SYRINGE SIZE DATA: 975 COUNTS</td>
</tr>
<tr>
<td>MIN VALUE DATA: 925 COUNTS</td>
</tr>
<tr>
<td>CONTINUE</td>
</tr>
</tbody>
</table>
```

5. Load the large calibration slug into barrel clamp. Squeeze the plunger lever to hold the flippers open, move the plunger head against the large slug, and press **Continue** to calibrate high position.

```
<table>
<thead>
<tr>
<th>SETUP HIGH STANDARD - PRESS &lt; CONTINUE &gt; WHEN READY</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX VALUE DATA: 175 COUNTS</td>
</tr>
<tr>
<td>PLUNGER POS DATA: 125 COUNTS</td>
</tr>
<tr>
<td>MIN VALUE DATA: 75 COUNTS</td>
</tr>
<tr>
<td>CONTINUE</td>
</tr>
</tbody>
</table>
```
6. You return to the **CALIBRATION** menu. You may calibrate another mode, choose **SAVE CHANGES AND EXIT** to exit calibration, or press **BACK** to return to the **BIOMED** menu.
Calibrate force sensor

1. From the Calibration menu, choose Cal Force Sensor.

2. Ensure nothing is loaded in the plunger head, press Continue and wait until force sensor zero is finished.

3. The pump then auto-zeroes the force sensor’s offset (this takes about 40 seconds). [Do not use arrow keys.]

4. Press Enter when zeroing is complete.
5. Press the zero button on the force gauge. Load the force gauge under the barrel clamp resting flush on the case top. Ensure the flippers are below (closed) the force gage head, and use the thumbscrew to adjust the gauge to 10 lbs. ±0.2, then press **Continue**. The force calibration is complete.

6. You return to the **Calibration** menu. You may calibrate another mode, choose **Save Changes and Exit** to exit calibration, or press **BACK** to return to the **Biomed** menu.
Calibrate pressure sensor
(future option)

Do not use, this is a “future option” of the Medfusion® 3000 Series.

Calibrate plunger position

1. From the Calibration menu, choose Cal Plunger Position.

2. Load the small calibration slug into the barrel clamp. Squeeze the plunger lever to hold the flippers open, move the plunger head against the small slug, and press Continue to calibrate the low position.

3. Load the large calibration slug into barrel clamp. Squeeze the plunger lever to hold the flippers open, move the plunger head against the large slug, and press Continue to calibrate the high position.
4. You return to the **CALIBRATION** menu. You may calibrate another mode, choose **SAVE CHANGES AND EXIT** to exit calibration, or press **BACK** to return to the **BIOMED** menu.
Calibrate syringe size sensor

1. From the **Calibration** menu, choose **Cal Syringe Size Sensor**.

2. Load the small calibration slug into the barrel clamp. Keeping the barrel clamp perpendicular to the slug, move the clamp slightly back and forth to find the lowest size reading, then press **Continue**.

3. Load the large calibration slug into barrel clamp. Keeping the barrel clamp perpendicular to the slug, move the clamp slightly back and forth to find the lowest size reading, then press **Continue** to calibrate large size.

4. You return to the **Calibration** menu. You may calibrate another mode, choose **Save Changes and Exit** to exit calibration, or press **Back** to return to the **Biomed** menu.
Adjust contrast (voltage) setting

The factory default contrast voltage setting is 00BF (however this value may vary for different LCD display manufactures). This is the nominal setting for most lighting conditions and may be adjusted higher or lower.

1. From the Calibration menu, choose Adjust Contrast.

```
1. CAL SIZE AND POSITION
2. CAL FORCE SENSOR
3. CAL PRESSURE SENSOR
4. CAL PLUNGER POSITION
5. CAL SYRINGE SIZE SENSOR
6. ADJUST CONTRAST
7. VIEW CALIBRATION DATA
8. SAVE CHANGES AND EXIT
```

2. Use the “↑” and “↓” keys to setup the contrast voltage. “↑” increases contrast.

```
ADJUST CONTRAST - PRESS ENTER TO CONTINUE

CONTRAST VOLTAGE: 00B6
↑ ↓ ENTER
```

```
ADJUST CONTRAST - PRESS < ENTER > TO CONTINUE

CONTRAST VOLTAGE: 00B6
↑ ↓ ENTER
```

3. When ready, press Enter to accept the new contrast voltage setting and return to the Calibration menu. You may calibrate another mode, choose Save Changes and Exit to exit calibration, or press BACK to return to the Biomed menu.
View calibration data

This feature allows you to display the pump’s calibration data onscreen. This screen is generally used in factory service or for troubleshooting.

1. From the **Calibration** menu, choose **View Calibration Data**.

<table>
<thead>
<tr>
<th>PRESS THE NUMBER TO SELECT THE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CAL SIZE AND POSITION</td>
</tr>
<tr>
<td>2. CAL FORCE SENSOR</td>
</tr>
<tr>
<td>3. CAL PRESSURE SENSOR</td>
</tr>
<tr>
<td>4. CAL PLUNGER POSITION</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRESS THE NUMBER TO SELECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CAL SIZE AND POSITION</td>
</tr>
<tr>
<td>2. CAL FORCE SENSOR</td>
</tr>
<tr>
<td>4. CAL PLUNGER POSITION</td>
</tr>
</tbody>
</table>

2. When ready, press **Continue** to return to the **Calibration** menu. You may calibrate another mode, choose **Save Changes and Exit** to exit calibration, or press **(BACK)** to return to the **Biomed** menu.

<table>
<thead>
<tr>
<th>PRESS CONTINUE WHEN READY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORCE</td>
</tr>
<tr>
<td>PLUNGER POS</td>
</tr>
<tr>
<td>PRESSURE</td>
</tr>
<tr>
<td>SYRINGE SIZE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRESS &lt; CONTINUE &gt; WHEN READY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORCE</td>
</tr>
<tr>
<td>PLUNGER POS</td>
</tr>
<tr>
<td>SYRINGE SIZE</td>
</tr>
</tbody>
</table>
Save changes and exit

This feature is the normal path to save the new calibration values when exiting Biomed > Calibration. If a mistake occurred in the calibration process press (BACK) to exit Biomed > Calibration without saving any new calibration values.

1. From the Calibration menu, choose Save Changes and Exit.

2. Press (BACK) to exit Biomed and return to the main menu.

Exit calibration without saving changes

You may exit the Calibration menu at any time – without saving your changes – by pressing Back.

1. To exit without saving changes, press (BACK) to exit and the following screen appears.

2. Press No to exit without saving new calibration values.
## Retest guidelines

The following are minimum guidelines for re-calibration and re-testing after repair.

<table>
<thead>
<tr>
<th>Repair Type</th>
<th>From Biomed &gt; Calibration, perform:</th>
<th>From Periodic Maintenance, perform:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Opened</td>
<td>None</td>
<td>Quick Check-out</td>
</tr>
<tr>
<td><strong>Repair drive-train</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace motor</td>
<td>None</td>
<td>Complete Mandatory Annual Maintenance Testing</td>
</tr>
<tr>
<td>Replace clutches, square rod, lead-screw, or plunger cable</td>
<td>Recalibrate position &amp; size</td>
<td>Complete Mandatory Annual Maintenance Testing</td>
</tr>
<tr>
<td><strong>Repair sensors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace ear clip or ear clip sensor</td>
<td>Recalibrate size</td>
<td>Quick Check-out &amp; Calibration Verification</td>
</tr>
<tr>
<td>Replace barrel clamp assy or size pot.</td>
<td>Recalibrate size</td>
<td>Quick Check-out &amp; Calibration Verification</td>
</tr>
<tr>
<td>Replace force sensor</td>
<td>Recalibrate force</td>
<td>Quick Check-out &amp; Calibration Verification</td>
</tr>
<tr>
<td>Replace position pot</td>
<td>Recalibrate position &amp; size</td>
<td>Quick Check-out &amp; Calibration Verification &amp; Plunger Travel Test</td>
</tr>
<tr>
<td><strong>Repair electronics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace speaker</td>
<td>None</td>
<td>Quick Check-out</td>
</tr>
<tr>
<td>Replace interconnect cable</td>
<td>None</td>
<td>Quick Check-out</td>
</tr>
<tr>
<td>Replace AC supply</td>
<td>None</td>
<td>Quick Check-out</td>
</tr>
<tr>
<td>Replace battery</td>
<td>None</td>
<td>Quick Check-out &amp; after AC charging run Power-up Tests</td>
</tr>
<tr>
<td>Replace interconnect board</td>
<td>None</td>
<td>Quick Check-out</td>
</tr>
<tr>
<td>Replace keypad, display or backlight</td>
<td>None</td>
<td>Quick Check-out &amp; Calibration Verification</td>
</tr>
<tr>
<td>Replace main board/ component</td>
<td>Recalibrate all sensors</td>
<td>Complete Mandatory Annual Maintenance Testing</td>
</tr>
<tr>
<td>Replace plunger board/ component</td>
<td>Recalibrate force</td>
<td>Quick Check-out &amp; Calibration Verification</td>
</tr>
<tr>
<td><strong>Software Updates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reprogramming</td>
<td>See update instructions</td>
<td>See update instructions</td>
</tr>
<tr>
<td><strong>Repair case or case parts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace case bottom</td>
<td>None</td>
<td>Quick Check-out</td>
</tr>
<tr>
<td>Item</td>
<td>Action</td>
<td>Additional Action</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>-------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Replace case top</td>
<td>Recalibrate all sensors</td>
<td>Complete Mandatory Annual Maintenance Testing</td>
</tr>
<tr>
<td>Replace case handle</td>
<td>Recalibrate position &amp; size</td>
<td>Quick Check-out &amp; Calibration Verification</td>
</tr>
<tr>
<td>Replace plunger head, or flippers</td>
<td>Recalibrate force</td>
<td>Quick Check-out &amp; Calibration Verification</td>
</tr>
<tr>
<td>Replace IR lens</td>
<td>None</td>
<td>Quick Check-out</td>
</tr>
<tr>
<td>Replace plunger lever</td>
<td>None</td>
<td>Quick Check-out</td>
</tr>
<tr>
<td>Replace pump labels</td>
<td>None</td>
<td>Quick Check-out</td>
</tr>
<tr>
<td>Replace feet</td>
<td>None</td>
<td>Quick Check-out</td>
</tr>
<tr>
<td>Replace tubing holders</td>
<td>Recalibrate size</td>
<td>Quick Check-out &amp; Calibration Verification</td>
</tr>
</tbody>
</table>
System layout
Main board schematics

The following are the main board schematics if the Medfusion® 3000 Series pump.

Main board / logic kernel
Main Board / Logic Kernel -- Continued
Main Board / Logic Kernel -- Continued
Main Board / Power Control Logic Core
Main Board / Keypad Interface
Main Board / Graphic Display Interface
Main Board / Pressure Sensing
Main Board / Speaker Drive
# Main Board Assembly – Parts list

<table>
<thead>
<tr>
<th>#</th>
<th>QTY</th>
<th>REF. Designator</th>
<th>Package</th>
<th>Value</th>
<th>Part Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36</td>
<td>C1, C9, C16, C19, C24, C39, C41, C56, C57, C73, C77, C78, C80, C81, C84, C87, C89, C95, C96, C97, C98, C99, C104, C106, C108, C109, C110, C114, C115, C117, C118, C120, C122, C130, C160, C161</td>
<td>1206W</td>
<td>0.1UF</td>
<td>CAPACITOR, 50V, X7R, 10%, 1206; GMC31X7R104K50NT, CAL-CHIP 12065C104KAT2A AVX</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>C2, C29, C31, C35, C36, C46, C55, C83</td>
<td>0805W</td>
<td>.047UF</td>
<td>CAPACITOR, 50V, X7R, 10%, 0805; GMC21X7R473K50NT, CAL-CHIP</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
<td>C3, C33, C68, C71, C74, C82, C85, C93, C100, C101, C111</td>
<td>1206W</td>
<td>0.22UF</td>
<td>CAPACITOR, 25V, X7R, 10%, 1206; GMC31X7R224K25NE, CAL-CHIP 12063C224KAT2A AVX</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>C4, C59</td>
<td>TANT_D</td>
<td>100UF</td>
<td>CAPACITOR, 10V, TANT, 10%, SMT_D; TPSD107K010R0100, AVX; T495D107K010AS, KEMET</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
<td>C5, C6, C8, C10, C14, C17, C20, C22, C23, C27, C40, C42, C47, C48, C52, C54, C61, C63, C64, C65, C66, C67, C72, C75, C76, C79, C90, C94, C107, C112, C116, C119, C121, C123, C124, C125, C126, C128, C129, C151, C152, C153</td>
<td>0805W</td>
<td>.01UF</td>
<td>CAPACITOR, 50V, X7R, 10%, 0805; GMC21X7R103K50NT, CAL-CHIP</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>C7</td>
<td>0805W</td>
<td>10PF</td>
<td>CAPACITOR, 50V, NPO, 5%, 0805; GMC21CG100J50NT, CAL-CHIP</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>C11</td>
<td>SUPERCAP</td>
<td>1F</td>
<td>CAPACITOR, 5.5V, ELECT, 20%, RADIAL; FYD0H105Z; TOKIN</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>C12, C127</td>
<td>0805W</td>
<td>27PF</td>
<td>CAPACITOR, 50V, NPO, 5%, 0805; GMC21CG270J50NT, CAL-CHIP</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>C13, C15, C18, C25, C26, C30, C34, C43, C69</td>
<td>TANT_B</td>
<td>10UF</td>
<td>CAPACITOR, 10V, TANT, 20%, SMT_B; TCMIA106BT, CAL-CHIP; TAJB106M010R, AVX; T491B106M010AS, KEMET</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>C21</td>
<td>0805W</td>
<td>18PF</td>
<td>CAPACITOR, 50V, NPO, 5%, 0805; GMC21CG180J50NT, CAL-CHIP</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>C28, C50</td>
<td>0805W</td>
<td>.0047UF</td>
<td>CAPACITOR, 50V, X7R, 10%, 0805; GMC21X7R472K50NT, CAL-CHIP</td>
</tr>
<tr>
<td>12</td>
<td>2</td>
<td>C32, C88</td>
<td>TANT_A</td>
<td>1UF</td>
<td>CAPACITOR, 16V, TANT, 20%, SMT_A; TCMIC105AT, CAL-CHIP; TAJA105M016R, AVX</td>
</tr>
<tr>
<td>13</td>
<td>4</td>
<td>C37, C38, C44, C60</td>
<td>TANT_D</td>
<td>22UF</td>
<td>CAPACITOR, 25V, TANT, 10%, SMT_D; TPSD226M025R0200, AVX; T495DD26M025AS, KEMET</td>
</tr>
<tr>
<td>14</td>
<td>2</td>
<td>C45, C49</td>
<td>SMT_8X10_8</td>
<td>220UF</td>
<td>CAPACITOR, 35V, ELECT, 20%, RADIAl; NACZ221M35V8X10.8TR13, NIC, 35VCV220GX, SURGE COMPONENTS</td>
</tr>
<tr>
<td>#</td>
<td>QTY</td>
<td>REF. Designator</td>
<td>Package</td>
<td>Value</td>
<td>Part Spec</td>
</tr>
<tr>
<td>----</td>
<td>-----</td>
<td>----------------</td>
<td>---------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>C51, C53</td>
<td>TANT_D</td>
<td>100UF</td>
<td>CAPACITOR, 10V, TANT, 20%, SMT_D; TCMIA107DT, CAL-CHIP; TAJD107M010R, AVX; T491D107M010AS, KEMET</td>
</tr>
<tr>
<td>16</td>
<td>13</td>
<td>C58, C62, C86, C103, C105, C113, C155, C156, C157, C158, C159, C162, C163</td>
<td>0805W</td>
<td>1000PF</td>
<td>CAPACITOR, 50V, NPO, 5%, 0805; GMC21CG102J50NT, CAL-CHIP</td>
</tr>
<tr>
<td>17</td>
<td>1</td>
<td>C70</td>
<td>CAP_200MIL</td>
<td>1UF</td>
<td>CERAMIC, 100V, X7R, 10%, LEADED; SR401C105KAA, AVX; RPE114X7R105K100V, MURATA ERIE</td>
</tr>
<tr>
<td>18</td>
<td>2</td>
<td>C91, C92</td>
<td>0805W</td>
<td>100PF</td>
<td>CAPACITOR, 50V, NPO, 5%, 0805; GMC21CG101J50NT, CAL-CHIP</td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>C102</td>
<td>SMT_10X10_8</td>
<td>330UF</td>
<td>CAPACITOR, 35V, ELECT, 20%, RADIAL; NACZ331M35V10X10.8TRHL, NIC</td>
</tr>
<tr>
<td>20</td>
<td>21</td>
<td>C131, C132, C133, C134, C135, C136, C137, C138, C140, C141, C142, C143, C144, C145, C146, C147, C148, C149, C150, C154</td>
<td>0805W</td>
<td>1000PF</td>
<td>CAPACITOR, 50V, NPO, 5%, 0805; GMC21CG102J50NT, CAL-CHIP</td>
</tr>
<tr>
<td>21</td>
<td>2</td>
<td>D1,D23</td>
<td>SMC</td>
<td></td>
<td>CMSH3-60, CENTRAL SEMI; 30BQ600, INTERN. RECTIFIER</td>
</tr>
<tr>
<td>22</td>
<td>18</td>
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<td>CRCW08051371F50 Vishay, RK-73GC2ATTD1371F KOA</td>
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<td>4.7KOHM</td>
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Plunger Board Schematic

Plunger Board / Force Preamplifier
Plunger Board Assembly Drawing

Top Side:

Bottom Side:
## Plunger Board Assembly – Parts list

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<th>#</th>
<th>QTY</th>
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<th>Package</th>
<th>Value</th>
<th>Part Spec</th>
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<td>470PF</td>
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<td>MMBT2222ALT1, ON SEMICONDUCTOR; CMPT 2222ATR or TR13 CENTRAL SEMICONDUCTOR</td>
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Interconnect Board Schematic

Interconnect Board / Power Control
Interconnect Board / Battery Management
Interconnect Board / Infrared Serial Communications
Interconnect Board Assembly Drawing

Top Side:

Bottom Side:
## Interconnect board assembly – parts list

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<th>#</th>
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<th>Value</th>
<th>Part Spec</th>
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<td>DO_204AC</td>
<td></td>
<td>SA13CA, On Semiconductor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SA13CA Vishay Semiconductor</td>
</tr>
<tr>
<td>47</td>
<td>2</td>
<td>TVS2, TVS3</td>
<td>1206W</td>
<td></td>
<td>VC120614D300D, AVX</td>
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<tr>
<td>48</td>
<td>1</td>
<td>TVS4</td>
<td>0805W</td>
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<td>VC080505A150, AVX</td>
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<tr>
<td>49</td>
<td>1</td>
<td>U1</td>
<td>LEADED_IR</td>
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<td>PS5042, STANLEY</td>
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<td>50</td>
<td>1</td>
<td>U2</td>
<td>SOT23-5</td>
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<td>LMC7111BM5, NATION-AL SEMICONDUCTOR; MIC7111BM5, MICREL</td>
</tr>
<tr>
<td>51</td>
<td>1</td>
<td>U3</td>
<td>SOT23</td>
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<td>MAX809LEURT, MAXIM; ADM-809LART, ANALOG DEVICES</td>
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<tr>
<td>52</td>
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<tr>
<td>53</td>
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<td>U5</td>
<td>SO8</td>
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<td>LT1512CS8, LINEAR TECH</td>
</tr>
<tr>
<td>54</td>
<td>1</td>
<td>PCB</td>
<td>N/A</td>
<td></td>
<td>INTERCONNECT PCB RAW, Medfusion® 3000 Series</td>
</tr>
</tbody>
</table>
Assembly drawings

The following section provides assembly drawings – exploded views, and detailed parts lists including Smiths Medical part numbers.

Always follow the procedures (including warnings/cautions) in “Parts Replacement” section of this manual while disassembling, replacing parts, and reassembling any Medfusion® 3000 Series pump.

Note: Part numbers and pricing are subject to change without notice. See the website at www.smiths-medical.com.
Medfusion® 3000 series main pump assembly

See Note 1
# Medfusion® 3000 series main pump assembly – parts list

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>See following drawing</td>
<td>Assembly Case Bottom</td>
<td>1 ea.</td>
</tr>
<tr>
<td>2</td>
<td>G6000059</td>
<td>Screw, 4-40 × .62 PH Phillips</td>
<td>2 ea.</td>
</tr>
<tr>
<td>3</td>
<td>No longer required</td>
<td>Label, Device Tracking</td>
<td>1 ea.</td>
</tr>
<tr>
<td>4</td>
<td>G6000775</td>
<td>Label, Warning</td>
<td>1 ea.</td>
</tr>
<tr>
<td></td>
<td>G6000763</td>
<td>Label, Warning, CE Mark</td>
<td>1 ea.</td>
</tr>
<tr>
<td></td>
<td>G6000354</td>
<td>Label, Warning, German</td>
<td>1 ea.</td>
</tr>
<tr>
<td>5</td>
<td>G6000112</td>
<td>Door, Battery Bay</td>
<td>1 ea.</td>
</tr>
<tr>
<td>6</td>
<td>G6002083</td>
<td>Label, Serial Number (Blank)</td>
<td>1 ea.</td>
</tr>
<tr>
<td>7</td>
<td>G6000117</td>
<td>Screw 4-40 × .31 FH SS</td>
<td>2 ea.</td>
</tr>
<tr>
<td>8</td>
<td>G6001392</td>
<td>Battery Assy, 3000</td>
<td>1 ea.</td>
</tr>
<tr>
<td>10</td>
<td>See following drawing</td>
<td>Assembly Case Top w/Plunger Head</td>
<td>1 ea.</td>
</tr>
<tr>
<td>12</td>
<td>G6000979</td>
<td>Label, Battery Warning</td>
<td>1 ea.</td>
</tr>
<tr>
<td>16</td>
<td>See note 2</td>
<td>Label, Date of Manufacture</td>
<td>1 ea.</td>
</tr>
<tr>
<td>17</td>
<td>G6000418</td>
<td>Label, MRI Warning</td>
<td>1 ea.</td>
</tr>
<tr>
<td></td>
<td>G6000623</td>
<td>Label, MRI Warning, German</td>
<td>1 ea.</td>
</tr>
<tr>
<td></td>
<td>G6000631</td>
<td>Label, MRI Warning, Spanish</td>
<td>1 ea.</td>
</tr>
<tr>
<td>18</td>
<td>G6000142</td>
<td>Label, Protege Logo</td>
<td>1 ea.</td>
</tr>
<tr>
<td></td>
<td>G6000541</td>
<td>Label, Medfusion® 3010A Logo</td>
<td>1 ea.</td>
</tr>
<tr>
<td></td>
<td>G6000605</td>
<td>Label, Medfusion® 3500 Logo</td>
<td>1 ea.</td>
</tr>
</tbody>
</table>

**Notes:**

1. Older model pumps may have this connector cable. In current pumps this cable is connected to the interconnect PCB.
2. This label changes yearly. Please specify the manufacturing year shown on your pump when communicating with the Service Center.
Case bottom assembly
Case bottom assembly – parts list

See also case bottom service assembly, note 4 below.

To obtain replacement labels with the CE mark and national language, international customers must order the International Case Bottom Assy. See note 4 below.

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G6000094</td>
<td>Case Bottom - No Feet (See note 4)</td>
<td>1 ea.</td>
</tr>
<tr>
<td></td>
<td>G6000754</td>
<td>Case Bottom - With Feet (See note 4)</td>
<td>1 ea.</td>
</tr>
<tr>
<td>3</td>
<td>G6000014</td>
<td>Speaker Assembly</td>
<td>1 ea.</td>
</tr>
<tr>
<td>4</td>
<td>G6000312</td>
<td>PCB Assembly, Interconnect (see note 6)</td>
<td>1 ea.</td>
</tr>
<tr>
<td>5</td>
<td>G6000773</td>
<td>Power Supply, Conformal Coated</td>
<td>1 ea.</td>
</tr>
<tr>
<td>6</td>
<td>G6000016</td>
<td>Shield, Power Supply</td>
<td>1 ea.</td>
</tr>
<tr>
<td>7</td>
<td>G6000017</td>
<td>Lens, IR Window</td>
<td>1 ea.</td>
</tr>
<tr>
<td>8</td>
<td>G6000276</td>
<td>Cable, AC Power</td>
<td>1 ea.</td>
</tr>
<tr>
<td></td>
<td>G6000102</td>
<td>Cable, AC Power, Medfusion® 3500E</td>
<td>1 ea.</td>
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<tr>
<td></td>
<td>G6000695</td>
<td>Cable, AC Power, Medfusion® 3500BC (See note 9)</td>
<td>1 ea.</td>
</tr>
<tr>
<td>9</td>
<td>G6000693</td>
<td>Screw, 4-40 × .31 PH Phillips</td>
<td>6 ea.</td>
</tr>
<tr>
<td>10</td>
<td>G6000220</td>
<td>Clamp, Cord Retainer</td>
<td>1 ea.</td>
</tr>
<tr>
<td>11</td>
<td>G6000192</td>
<td>Locknut, 6BA Nylock</td>
<td>2 ea.</td>
</tr>
<tr>
<td>12</td>
<td>G6000410</td>
<td>Washer, Shoulder, Nylon</td>
<td>2 ea.</td>
</tr>
<tr>
<td>13</td>
<td>G6000118</td>
<td>Pad, Battery Bay</td>
<td>1 ea.</td>
</tr>
<tr>
<td>14</td>
<td>G6000012</td>
<td>Cable, DC Power</td>
<td>1 ea.</td>
</tr>
<tr>
<td>15</td>
<td>G6000387</td>
<td>Cable</td>
<td>1 ea.</td>
</tr>
<tr>
<td>16</td>
<td>0340IF1400</td>
<td>Solder</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>G6000706</td>
<td>Feet, Rubber (glue type) (See note 5) (See note 7)</td>
<td>4 ea.</td>
</tr>
<tr>
<td>18</td>
<td>G6000694</td>
<td>Label, Functional Ground (See note 8)</td>
<td>1 ea.</td>
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</tbody>
</table>

Notes:
1. In newer assemblies, the interconnect PCB assembly (item 4) P/N G6000312 has superseded the older assembly P/N G6000234.
2. In older assemblies, items 10 & 11 are Screw, 4-40 × .38 FH SS (G6000127) and Nut, 4-40 Nylock (G6000043).
3. In newer assemblies, the shoulder washer (item 12) has superseded the flat washer, Smiths Medical P/N G6000058.
4. Items 1, 17 (four pieces), 7, 13 and labels are available as a service subassembly part number:
   English: G6000438, Case Bottom Assembly – Service (USA)
   International: G6000622, Case Bottom Assy German – Service
5. Use with Loctite® 401, part number 036LT40100.

Notes (continued):
6. Board comes with cable (#G6000387) attached.
7. Older models use Enlarged rubber foot (#G6000287).
8. Item 18 is adhered to the top of the AC power cable.
9. Item 8 ring terminal is secured at secondary-side mounting post of power supply.
Case top assembly w/plunger
# Case top assembly w/plunger – parts list

See also plunger case left service assembly, note 1 below.

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G6000067</td>
<td>Mount, Plunger Head</td>
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<tr>
<td>2</td>
<td>G6000068</td>
<td>Force Sensor</td>
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<tr>
<td>3</td>
<td>G6000069</td>
<td>Plate, Plunger Float</td>
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<tr>
<td>4</td>
<td>G6000755</td>
<td>Case Left, Plunger (See note 1)</td>
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</tr>
<tr>
<td>5</td>
<td>G6000071</td>
<td>Cam Gear, Plunger</td>
<td>1 ea.</td>
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<tr>
<td>6</td>
<td>G6000725</td>
<td>Flipper, Plunger</td>
<td>2 ea.</td>
</tr>
<tr>
<td>7</td>
<td>G6000074</td>
<td>Case Right Plunger</td>
<td>1 ea.</td>
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<tr>
<td>8</td>
<td>G600180</td>
<td>Assy PCB Plunger, Tested Service</td>
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<tr>
<td>9</td>
<td>G6000925</td>
<td>Timing Plate Left</td>
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</tr>
<tr>
<td>10</td>
<td>G6000926</td>
<td>Push Block</td>
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<td>G6000085</td>
<td>Screw, M4 × 12, Button Head</td>
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</tr>
<tr>
<td>12</td>
<td>G6000086</td>
<td>Spring, .21 OD × 1.5</td>
<td>2 ea.</td>
</tr>
<tr>
<td>13</td>
<td>G6000669</td>
<td>Lever, Plunger</td>
<td>1 ea.</td>
</tr>
<tr>
<td>14</td>
<td>G6000089</td>
<td>Gear, Plunger Flipper</td>
<td>2 ea.</td>
</tr>
<tr>
<td>15</td>
<td>G6000087</td>
<td>Gear, Plunger Lever</td>
<td>1 ea.</td>
</tr>
<tr>
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<td>G6000082</td>
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<td>2 ea.</td>
</tr>
<tr>
<td>17</td>
<td>G6000927</td>
<td>Timing Plate Right</td>
<td>1 ea.</td>
</tr>
<tr>
<td>18</td>
<td>G6000083</td>
<td>Seal, Lever</td>
<td>1 ea.</td>
</tr>
<tr>
<td>19</td>
<td>G6000103</td>
<td>Screw 4-40 × 7/8 Pan Phil SS</td>
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<td>20</td>
<td>G6000110</td>
<td>Pin, Dowel</td>
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<tr>
<td>21</td>
<td>G6000105</td>
<td>Screw, 4-40 × 7/16 Pan Phil SS</td>
<td>2 ea.</td>
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<tr>
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<td>G6000749</td>
<td>Screw, 4-40 × .18 FH SS</td>
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<tr>
<td>23</td>
<td>G6000090</td>
<td>Seal, Plunger Case</td>
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<tr>
<td>24</td>
<td>G6000474</td>
<td>Washer, Flat #4, SS</td>
<td>1 ea.</td>
</tr>
<tr>
<td>25</td>
<td>G6000693</td>
<td>Screw, Pan Phil, 4-40 1/4 SS</td>
<td>2 Ea.</td>
</tr>
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<td>26</td>
<td>G232100076</td>
<td>Loctite Black Max</td>
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<td>27</td>
<td>G6000544</td>
<td>Screw, 6-19 × 1/2 (See note 3)</td>
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<tr>
<td>28</td>
<td></td>
<td>See following drawing</td>
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<td>29</td>
<td></td>
<td>Assy, Case Top w/o Plunger</td>
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</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
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<tr>
<td>31</td>
<td>G6001656</td>
<td>O-ring (See note 2)</td>
<td>1 ea.</td>
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</table>

**Notes:**

1. Items 3, 4, 6 (two pieces), 14 (two pieces), and 17 (two pieces), and 31 (two pieces) are available as a service subassembly part number **G6000439, Plunger Case Left Assembly - Service**.
2. New style plunger case requires o-ring (older models do not require this part).
3. Use with Loctite® Black Max, part number G232100076 (Item 32).
Case top assembly without plunger
# Case top assembly without plunger – parts list

See also case top service assembly, note 2 below.

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>See note 2.</td>
<td>Case Top, With Tubing Holders</td>
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<tr>
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<td>See note 4.</td>
<td>Keypad 3000</td>
<td>1 ea.</td>
</tr>
<tr>
<td>3</td>
<td>G6000021</td>
<td>Stud Self Clench 4-40 × 625</td>
<td>2 ea.</td>
</tr>
<tr>
<td>4</td>
<td>G6000022</td>
<td>Spacer, .25 OD × .31, Nylon</td>
<td>2 ea.</td>
</tr>
<tr>
<td>5</td>
<td>G6001457L</td>
<td>Display, Liquid Crystal</td>
<td>1 ea.</td>
</tr>
<tr>
<td>6</td>
<td>G6000023</td>
<td>Ear Clip</td>
<td>1 ea.</td>
</tr>
<tr>
<td>7</td>
<td>See following drawing</td>
<td>Assembly Barrel Clamp</td>
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</tr>
<tr>
<td>8</td>
<td>G6000034</td>
<td>E-Ring</td>
<td>1 ea.</td>
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<tr>
<td>9</td>
<td>See following drawing</td>
<td>Assembly Drive Train</td>
<td>1 ea.</td>
</tr>
<tr>
<td>10</td>
<td>See note 3.</td>
<td>Assy 3000 Main PCB</td>
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<tr>
<td>11</td>
<td>G6000010</td>
<td>Optocoupler Assembly</td>
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</tr>
<tr>
<td>12</td>
<td>G6000692</td>
<td>Screw 4-40 × .31 Phillips</td>
<td>10 ea.</td>
</tr>
<tr>
<td>13</td>
<td>G6001999</td>
<td>Case Handle</td>
<td>1 ea.</td>
</tr>
<tr>
<td>14</td>
<td>G6000101</td>
<td>Backlight Fiber Optic (Medfusion® 3010A Series)</td>
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</tr>
<tr>
<td></td>
<td>G6000582</td>
<td>Backlight Fiber Optic Dual LED (Medfusion® 3500 Series)</td>
<td>1 ea.</td>
</tr>
<tr>
<td>15</td>
<td>G6000064</td>
<td>Standoff Hex 4-40 × .38</td>
<td>3 ea.</td>
</tr>
<tr>
<td>16</td>
<td>G6000043</td>
<td>Nut 4-40 Nylock</td>
<td>4 ea.</td>
</tr>
<tr>
<td>18</td>
<td>G6000122</td>
<td>Seal, Barrel Clamp/Ear Clip</td>
<td>2 ea.</td>
</tr>
<tr>
<td>19</td>
<td>G6000077</td>
<td>Tube Seal</td>
<td>1 ea.</td>
</tr>
<tr>
<td>21</td>
<td>G6000474</td>
<td>Washer, #4 Flat</td>
<td>2 ea.</td>
</tr>
<tr>
<td>22</td>
<td>G6000715</td>
<td>Barrel Clamp Head</td>
<td>1 ea.</td>
</tr>
<tr>
<td>23</td>
<td>G6000802</td>
<td>Screw 4-40 × .25 BH Black</td>
<td>1 ea.</td>
</tr>
<tr>
<td>27</td>
<td>G6000257</td>
<td>Clamp, Stainless Steel</td>
<td>1 ea.</td>
</tr>
<tr>
<td>28</td>
<td>G6000903</td>
<td>Screw, Pan Phil 2-56 3/16 SS Nylock</td>
<td>1 ea.</td>
</tr>
<tr>
<td>32</td>
<td>0382000000</td>
<td>Grease, Silicone 111</td>
<td>0.1 oz.</td>
</tr>
<tr>
<td>33</td>
<td>G6000339</td>
<td>Lens, Keypad Support</td>
<td>1 ea.</td>
</tr>
<tr>
<td>35</td>
<td>G6000393</td>
<td>Sleeve, Ear Clip</td>
<td>1 ea.</td>
</tr>
<tr>
<td>36</td>
<td>G6000397</td>
<td>Spring, Ear Clip</td>
<td>1 ea.</td>
</tr>
<tr>
<td>37</td>
<td>G6000583</td>
<td>Spacer, LCD, Backlight (see note 5)</td>
<td>1-2 ea.</td>
</tr>
<tr>
<td>38</td>
<td>039TT10200</td>
<td>Wire Tie (Medfusion® 3500 Series)</td>
<td>1 ea.</td>
</tr>
<tr>
<td>39</td>
<td>G6000585</td>
<td>Cable, Backlight Dual LED (Medfusion® 3500 Series)</td>
<td>1 ea.</td>
</tr>
<tr>
<td>40</td>
<td>G6000692</td>
<td>Nylok Screw</td>
<td>3 ea.</td>
</tr>
<tr>
<td>41</td>
<td>G6000238</td>
<td>Tube Holder</td>
<td>3 ea.</td>
</tr>
</tbody>
</table>
Notes:

1: Item 35 does not appear in older pumps.

2: Items 1, 2, 3 (two pieces), 13, 18, 19 and 33 are available as a service subassembly part number:

   **For Medfusion® 3010 and 3010a:**
   - G6000437, Case Top Protege Assembly - Service (old style barrel clamp head and no keyway)
   - G6000736, Case Top Protege Assembly - Service (new style barrel clamp with keyway)

   **For Medfusion® 3500 (English):**
   - G6000610, Case Top 3500 – Service (old style barrel clamp head and no keyway)
   - G6000737, Case Top 3500 - Service (new style barrel clamp with keyway)

   **For Medfusion® 3500 (International):** G6000624, 3500 International Case Top - Service

   **English:** G6000438, Case Bottom Assembly – Service

   **International:** G6000622, Case Bottom Assy International – Service

3: Items 10 is available as service subassembly part numbers:

   - G6000435, 3010 Main PCB Assembly – Software Version 2.0.6 - Service
   - G6000361, 3500 Main PCB Assembly – Software Version 3.0.6 - Service
   - G6001260, 3500 Main PCB Assembly – Software Version 4.0.2 - Service
   - G6001560, 3500 Main PCB Assembly – Software Version 4.1.5 - Service
   - G6001561, 3500 Main PCB Assembly – Software Version 3.0.9 - Service
   - G6001562, 3500 Main PCB Assembly - Software Version 4.1.4 -Service

   Check with the Smiths Medical service department for other software versions.

4: Item 2, for Medfusion® 3010 English Text Keypad use G6000005. For Medfusion® 3500 English Text keypad use G6000607. For Medfusion® 3500 International Keypad use G6000912.

5: Early Medfusion® 3010 pumps have no spacer, later Medfusion® 3010 pumps have 2 spacers. All Medfusion® 3500 and later pumps have 1 spacer.
Barrel clamp assembly

1. Grease
2. Silicone III
3. Solder
4. No Clean
## Barrel clamp assembly – parts list

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G6000716</td>
<td>Guide Barrel Clamp</td>
<td>1 ea.</td>
</tr>
<tr>
<td>2</td>
<td>G6000904</td>
<td>Rod Barrel Clamp</td>
<td>1 ea.</td>
</tr>
<tr>
<td>4</td>
<td>G6000031</td>
<td>Barrel Clamp Slide</td>
<td>1 ea.</td>
</tr>
<tr>
<td>5</td>
<td>G6000032</td>
<td>Spring, Barrel Clamp</td>
<td>1 ea.</td>
</tr>
<tr>
<td>6</td>
<td>G6000024</td>
<td>Spring .265 ID × .5</td>
<td>1 ea.</td>
</tr>
<tr>
<td>7</td>
<td>G6000186 - See note 1</td>
<td>Pot Size Sensor, 10K</td>
<td>1 ea.</td>
</tr>
<tr>
<td>8</td>
<td>G6000096 - See note 1</td>
<td>Flex Cable Size Pot</td>
<td>1 ea.</td>
</tr>
<tr>
<td>9</td>
<td>G6000121</td>
<td>Screw #2 × .18 Plastite</td>
<td>1 ea.</td>
</tr>
<tr>
<td>11</td>
<td>0340IF1400 - See note 1</td>
<td>.030 DIA, Spool Solder</td>
<td>0.01 oz.</td>
</tr>
<tr>
<td>12</td>
<td>0382000000</td>
<td>Grease, Silicon 111</td>
<td>0.1 oz.</td>
</tr>
<tr>
<td>13</td>
<td>G6000906</td>
<td>Screw, 6-32 ¼” Truss Nylock</td>
<td>1 ea.</td>
</tr>
</tbody>
</table>

**Notes:**

1: These items 7, 8 and 9 are available as a service subassembly part number G6000436, Size Sensor Pot Assembly - Service.
Drive train assembly

Assembly Drawings & Parts Lists

SEE NOTE 2

LEFT SIDE VIEW

RIGHT SIDE VIEW

111 GREASE
RED GREASE
Drive train assembly – parts list

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>See following drawing</td>
<td>Assembly Clutch</td>
<td>1 ea.</td>
</tr>
<tr>
<td>2</td>
<td>G6000931</td>
<td>Extrusion Main</td>
<td>1 ea.</td>
</tr>
<tr>
<td>3</td>
<td>G6000717</td>
<td>Assy Right End Plate</td>
<td>1 ea.</td>
</tr>
<tr>
<td>4</td>
<td>G6000049</td>
<td>Plate Motor Mount</td>
<td>1 ea.</td>
</tr>
<tr>
<td>5</td>
<td>See note 2</td>
<td>Motor Stepper 7.5 Degree</td>
<td>1 ea.</td>
</tr>
<tr>
<td>7</td>
<td>G6000053</td>
<td>Bushing .19 ID × .25 Delron</td>
<td>2 ea.</td>
</tr>
<tr>
<td>8</td>
<td>G6000055</td>
<td>Rod, Guide, Precision</td>
<td>1 ea.</td>
</tr>
<tr>
<td>9</td>
<td>G6000056</td>
<td>Thrust Bearing</td>
<td>1 ea.</td>
</tr>
<tr>
<td>10</td>
<td>G6000058</td>
<td>Washer Steel .438 × .125 × .031</td>
<td>1 ea.</td>
</tr>
<tr>
<td>11</td>
<td>G6000059</td>
<td>Screw 4-40 × .62 PH Phillips</td>
<td>1 ea.</td>
</tr>
<tr>
<td>12</td>
<td>G6000043</td>
<td>Nut 4-40 Nylock</td>
<td>4 ea.</td>
</tr>
<tr>
<td>13</td>
<td>See note 1</td>
<td>Worm</td>
<td>1 ea.</td>
</tr>
<tr>
<td>14</td>
<td>G6001459</td>
<td>Leadscrew</td>
<td>1 ea.</td>
</tr>
<tr>
<td>15</td>
<td>G6000051</td>
<td>Gear, Worm</td>
<td>1 ea.</td>
</tr>
<tr>
<td>16</td>
<td>G6000057</td>
<td>Bushing, Leadscrew, Right</td>
<td>1 ea.</td>
</tr>
<tr>
<td>17</td>
<td>G6000075</td>
<td>Screw 6-20 × .5 FH Thread Form</td>
<td>7 ea.</td>
</tr>
<tr>
<td>18</td>
<td>G6000902</td>
<td>Screw, 2-56 × .19 FH SS</td>
<td>1 ea.</td>
</tr>
<tr>
<td>19</td>
<td>G6000072</td>
<td>Washer Brass .340 × .117 × .050</td>
<td>1 ea.</td>
</tr>
<tr>
<td>20</td>
<td>See note 2</td>
<td>Washer, Teflon®, .312 × .093 × .010</td>
<td>1 ea.</td>
</tr>
<tr>
<td>21</td>
<td>G6000063</td>
<td>Screw, 4-40 × .31 PH Phillips</td>
<td>2 ea.</td>
</tr>
<tr>
<td>22</td>
<td>See note 2</td>
<td>Shaft Driver</td>
<td>1 ea.</td>
</tr>
<tr>
<td>23</td>
<td>07020STP00</td>
<td>Grease, STP</td>
<td>0.1 oz.</td>
</tr>
<tr>
<td>24</td>
<td>G6000791</td>
<td>Washer, Wave Spring, .490 × .326 × .010</td>
<td>1 ea.</td>
</tr>
<tr>
<td>26</td>
<td>036LT24200</td>
<td>Loctite® 242</td>
<td>0.01 oz.</td>
</tr>
<tr>
<td>27</td>
<td>See note 1</td>
<td>Coupling, Worm</td>
<td>1 ea.</td>
</tr>
<tr>
<td>28</td>
<td>0391331800</td>
<td>E-Clip</td>
<td>1 ea.</td>
</tr>
<tr>
<td>30</td>
<td>G60001223</td>
<td>Washer, Teflon®</td>
<td>A/R</td>
</tr>
</tbody>
</table>

**Notes:**

1: Items 13 and 27 are bonded together to form a worm assembly, in older pumps these may appear as a single machined part. These items are available as a service subassembly part number G6001480, Worm/Coupling Assembly - Service.

2: Items 22, 20, and 5 are available as a service subassembly part number G6000431, Motor Service Assembly - Service.
**Clutch assembly**

Clutch assembly – parts list

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G6000099</td>
<td>Carriage</td>
<td>1 ea.</td>
</tr>
<tr>
<td>2</td>
<td>G6000928</td>
<td>Clutch, Left</td>
<td>1 ea.</td>
</tr>
<tr>
<td>3</td>
<td>G6000929</td>
<td>Clutch, Right</td>
<td>1 ea.</td>
</tr>
<tr>
<td>4</td>
<td>G6000924</td>
<td>Cam, Clutch</td>
<td>1 ea.</td>
</tr>
<tr>
<td>5</td>
<td>G6000905</td>
<td>Plate, Carriage</td>
<td>1 ea.</td>
</tr>
<tr>
<td>6</td>
<td>G6000044</td>
<td>Spring, Clutch</td>
<td>1 ea.</td>
</tr>
<tr>
<td>7</td>
<td>G6000045</td>
<td>Tube Plunger</td>
<td>1 ea.</td>
</tr>
<tr>
<td></td>
<td>G6000738</td>
<td>Insulated Tube</td>
<td>1 ea.</td>
</tr>
<tr>
<td>8</td>
<td>0391331800</td>
<td>E-Clip</td>
<td>1 ea.</td>
</tr>
<tr>
<td>9</td>
<td>G6000378</td>
<td>Square Shaft (See note below)</td>
<td>1 ea.</td>
</tr>
<tr>
<td>10</td>
<td>G6000063</td>
<td>Screw 4-40 × .31 PH Phillips</td>
<td>3 ea.</td>
</tr>
<tr>
<td>11</td>
<td>G6000310</td>
<td>Nut, Nylock, 4-40, SS, Small</td>
<td>3 ea.</td>
</tr>
<tr>
<td>12</td>
<td>G6000749</td>
<td>Screw 4-40 × .18 FH SS</td>
<td>2 ea.</td>
</tr>
<tr>
<td>13</td>
<td>G6000159</td>
<td>Assembly, Plunger Cable</td>
<td>1 ea.</td>
</tr>
<tr>
<td>15</td>
<td>07020STP00</td>
<td>Grease, STP</td>
<td>0.1 oz.</td>
</tr>
</tbody>
</table>

**Notes:** In newer pumps, square shaft (item 9) is being superseded by SS Square Shaft, P/N G6000378.
Accessories – parts list
Poleclamp assembly
## Poleclamp parts
(Catalog number 3000PC)

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>G6000284</td>
<td>Poleclamp “C” Bracket</td>
<td>1 ea.</td>
</tr>
<tr>
<td>11</td>
<td>G6000286</td>
<td>Poleclamp “L” Bracket</td>
<td>1 ea.</td>
</tr>
<tr>
<td>13</td>
<td>G6000774</td>
<td>Screw, #8-32 × 5/16”, Pan Head with Washer, Stainless</td>
<td>4 ea.</td>
</tr>
<tr>
<td>16</td>
<td>G6001456</td>
<td>Knob, ½-13 × 2”, Stainless</td>
<td>1 ea.</td>
</tr>
<tr>
<td>18</td>
<td>G6000345</td>
<td>Screw, #4-40 × 5/16”, Flat Head, Stainless</td>
<td>4 ea.</td>
</tr>
</tbody>
</table>

## Rotating poleclamp parts
(Catalog number 3000RPC)

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G6000496</td>
<td>Mount, Rotor Rotating</td>
<td>1 ea.</td>
</tr>
<tr>
<td>2</td>
<td>0502003100</td>
<td>Shoulder Bushing</td>
<td>1 ea.</td>
</tr>
<tr>
<td>3</td>
<td>G6000284</td>
<td>Poleclamp “C” Bracket</td>
<td>1 ea.</td>
</tr>
<tr>
<td>4</td>
<td>G6000499</td>
<td>Screw, #8-32 × 7/16 Flat</td>
<td>4 ea.</td>
</tr>
<tr>
<td>5</td>
<td>0482004400</td>
<td>Index Cam</td>
<td>2 ea.</td>
</tr>
<tr>
<td>6</td>
<td>0502002400</td>
<td>Compression Spring</td>
<td>4 ea.</td>
</tr>
<tr>
<td>7</td>
<td>G6000497</td>
<td>Rotor Base</td>
<td>1 ea.</td>
</tr>
<tr>
<td>8</td>
<td>046L050200</td>
<td>¼-20 × .5 Button Head Hex</td>
<td>1 ea.</td>
</tr>
<tr>
<td>9</td>
<td>G6000505</td>
<td>Indexing Plunger ⅝-24 Thread</td>
<td>1 ea.</td>
</tr>
<tr>
<td>10</td>
<td>G6000538</td>
<td>Assy, Plate Back</td>
<td>1 ea.</td>
</tr>
<tr>
<td>11</td>
<td>G6000286</td>
<td>Poleclamp “L” Bracket</td>
<td>1 ea.</td>
</tr>
<tr>
<td>13</td>
<td>G6000774</td>
<td>Screw, #8-32 × 5/16 PAN Head Phillips w/Washer Nylock SS</td>
<td>4 ea.</td>
</tr>
<tr>
<td>14</td>
<td>G6000551</td>
<td>Bracket, Poleclamp Stop</td>
<td>2 ea.</td>
</tr>
<tr>
<td>15</td>
<td>G6000104</td>
<td>Screw 4-40 × .25 BH Black</td>
<td>4 ea.</td>
</tr>
<tr>
<td>16</td>
<td>G6001456</td>
<td>Knob, ½-13 × 2”, Stainless</td>
<td>1 ea.</td>
</tr>
<tr>
<td>17</td>
<td>G6000288</td>
<td>#4 External Conical Tooth Lockwasher</td>
<td>2 ea.</td>
</tr>
<tr>
<td>18</td>
<td>G6000345</td>
<td>Screw, #4-40 × 5/16, FH, Locking, SS</td>
<td>2 ea.</td>
</tr>
</tbody>
</table>

## Miscellaneous parts

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>G6000329</td>
<td>AC Line Cord, North American, Class II</td>
<td>1 ea.</td>
</tr>
<tr>
<td>G6000330</td>
<td>AC Line Cord, United Kingdom, Class II</td>
<td>1 ea.</td>
</tr>
<tr>
<td>G6000331</td>
<td>AC Line Cord, Continental European, Class II</td>
<td>1 ea.</td>
</tr>
</tbody>
</table>
Calibration & repair – parts list

Medfusion® 3000 series calibration kit

The Biomed Medfusion® 3000 Series Calibration Kit contains the tools necessary for performing the periodic maintenance and calibration of the Medfusion® 3000 Series pumps.

Order kit number 3000CAL.

This kit contains the following items:

- 1 ea. – Small Calibration Slug, G6000216
- 1 ea. – Large Calibration Slug, G6000215
- 1 ea. – Analog Force Gauge, G6000294

Other tools & equipment required to service Medfusion® 3000 series pumps

The following tools are necessary for performing the maintenance, parts replacement, and diagnosis of the Medfusion® 3000 Series pumps.

- 1 ea. – 50 or 60cc syringe (see Operations Manual for list of acceptable types)
- 1 ea. – Medium bore tubing set, Smiths Medical 53-60-225 or equivalent
- 1 ea. – 3 Way Stopcock
- 1 ea. – Torque Screwdriver with #1 Phillips bit, #0 Flat bit, & 2.5mm Hex bit
- 1 ea. – 3/16” nut driver
- 1 ea. – ¼” open end wrench or nut driver
- 1 ea. – .002” shim or feeler gauge
- 1 ea. – Pliers, standard & needle nose
- 1 ea. - Calipers
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