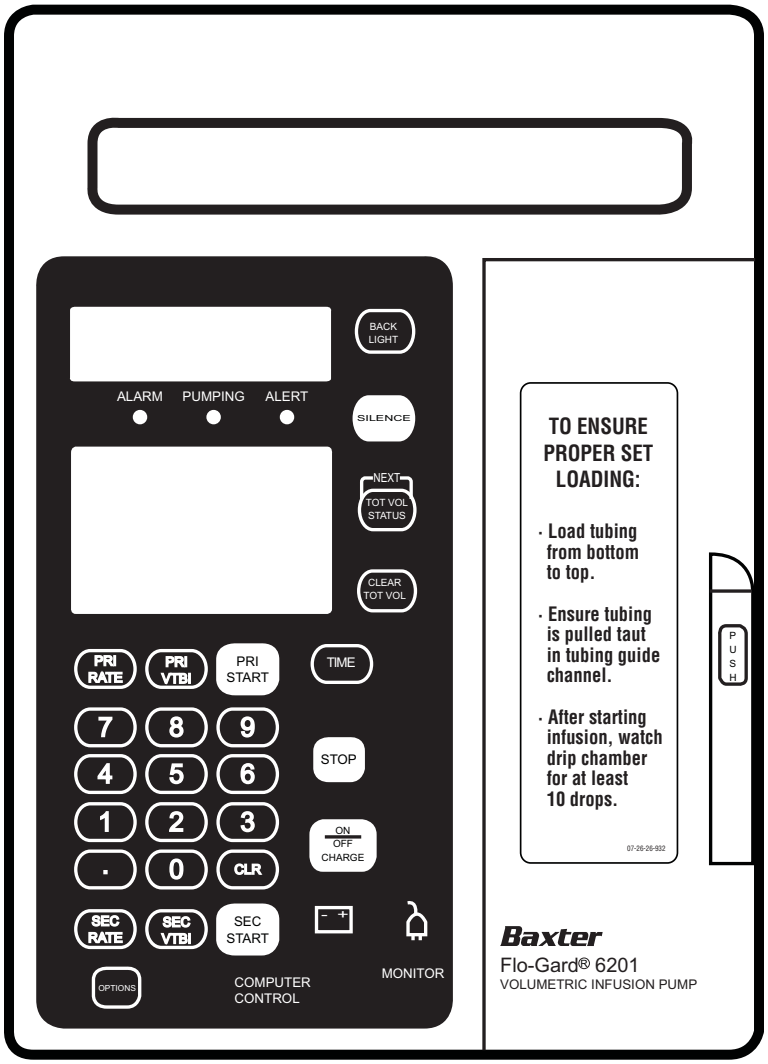
Service Manual

Flo-Gard 6201

Volumetric Infusion Pump

Product Code: 2M8063



Baxter

Prior to servicing these pumps, read this manual and the pump's Operator's Manual carefully to fully understand the pump's functionality and to ensure safe and proper servicing.

07-19-B1-688

Warning

There are risks associated with using anything other than the recommended sets with this device. Sets designated for use with this device are identified in the Operator's Manual. See "Warranty Information" on page 1-4 for full information of Baxter's warranty on this device.

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Documentation Copyrights

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Year 2000 Compliance

This product is Year 2000 Compliant and will function as designed through 2035 without interruption or failure by the occurrence of dates prior to, during or after year 2000.

Patent Information

This device is protected under one or more of the following U.S. patents: 4,981,467; 5,068,586; 5,276,610; 5,290,239; 5,300,044; and 5,343,734.

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Chapter 1

Introduction

Overview

This manual provides service information for the FLO-GARD 6201 Single Channel Volumetric Infusion Pump (product code 2M8063) for qualified hospital biomedical engineers and service personnel. It is strongly recommended that you read the pump's Operator's Manual (part number 07-19-x1-602) for detailed operating instructions and operator oriented information, warnings, and cautions.

This chapter contains the following information:

The FLO-GARD 6201 Single Channel Volumetric Infusion Pump is an electromechanical pump used for the intravenous infusion of fluids at user-selected rates. The pump contains a linear peristaltic pump head which is programmable and permits infusion of primary and secondary medication programs. The secondary program automatically switches over to the primary program when secondary infusion is complete (automatic piggybacking).

The pump operates on standard 115 VAC 60 Hz electrical power, or on its self-contained rechargeable battery. It is portable and has a panel lock-out feature to prevent tampering. It is designed for use with Baxter's standard administration sets that contain an "s" as the last character of the code number, for example, 2C5537s. When infusing solutions through a central line catheter, sets with a Luer lock adapter should be used. Sets with a Flashball device are not recommended in these applications.

The primary rate of infusion is selectable from 1 to 1999 mL in 1 mL/hr increments and 1 to 99.9 mL/hr in 0.1 mL/hr increments. The secondary rate is selectable from 1 to 999 mL in 1 mL/hr increments and 1 to 99.9 mL/hr in 0.1 mL/hr increments. The volume to be infused (VTBI) is also selectable from 1 to 9999 mL in 1 mL increments and 1 to 99.9 mL in 0.1 mL increments.

The total volumes infused from primary and secondary programs are added together and accumulated and can be displayed on demand. The primary and secondary VTBIs are independently decremented and displayed. Upon completion of the primary VTBI, the pump automatically switches to a keep vein open (KVO) rate. When the pump is started on a secondary rate and VTBI, the pump changes to the primary rate when the secondary program is completed. The pump may be stopped at any time by pressing the **STOP** key unless the pump is in the lockout mode.

The Programmed Delivery Profile (PDP) enables manual programming or ramped calculation (available only on pumps running software versions 1.09 or later) of up to 10 sequential infusion programs for situations where multiple flow rates are indicated. See the appropriate Operator's Manual for additional information.

Safety Summary

General precautions to observe while servicing the pump are shown below. Warnings and cautions related to personal safety are summarized in this section.

! WARNING ! **This device should be repaired only by Baxter authorized service personnel or Baxter-trained hospital biomedical engineering personnel.**

! WARNING ! **If the pump has been dropped or appears to be damaged, it should be taken out of service and carefully inspected.**

! WARNING ! **Use only Baxter replacement/service parts. Installation of parts other than those available from Baxter may affect product performance. The use, by any party, of non-Baxter parts in the repair, renovation, repackaging or restoration of a Baxter device means that person or entity is the manufacturer of that device. Any liability arising from the use of non-Baxter parts is assumed by the entity performing such work. Baxter's warranty is immediately null and void where non-Baxter parts are used to repair Baxter devices.**

! WARNING ! **Batteries are intended to be used as a back-up power source ONLY when AC power is not available. The pump should be plugged in to AC power to maintain battery charge during storage whenever possible.**

! WARNING ! **If the charging state of the batteries is unknown or the pump has not been plugged in to AC power for at least 16 uninterrupted hours then the pump must be charged for at least 16 uninterrupted hours of charging prior to releasing it for use.**

! WARNING ! **Whenever the pump is in for service the battery's capacity should be evaluated because battery performance degrades through its life.**

! WARNING ! **Ensure that the pump is powered off and unplugged from the AC receptacle before performing maintenance procedures unless directed otherwise by the procedure in this manual.**

! WARNING ! **To avoid the possibility of electric shock, use caution when the power supply is connected to the AC input during calibration. Power supply line input is energized whenever the pump is connected to an AC outlet.**

! WARNING ! **Shock hazard: Do not wear a grounded wrist strap while the pump is open and connected to AC power.**

! WARNING ! **The pins of the connectors should not be touched. The connectors should not have objects inserted into them other than the mating connector. ESD precautionary procedures should be used when inserting the mating connectors into the connectors.**

CAUTION **The power cord must be connected to a 100-120 VAC 50/60 Hz properly grounded 3-wire receptacle. Do not allow the use of three prong adapters because this may not provide a reliable earth ground.**

CAUTION **To avoid possible damage to the pump, make Nurse Call connections only as outlined in "Nurse Call" on page 4-1.**

CAUTION **Failure to power off the pump when finished with testing can result in battery depletion and damage if the pump is operating on battery power, because a Battery Low alarm will not occur when the pumps are in Configuration/Service mode.**

CAUTION **Follow the cleaning schedule and methods described in Chapter 6 to ensure proper maintenance of the device.**

CAUTION **Do not submerge the pump into liquids of any kind.**

CAUTION **Do not clean, disinfect, or sterilize any part of the pump by autoclaving or with ethylene oxide gas. Doing so may damage the pump and void the warranty. Only external parts of the pump should be disinfected.**

CAUTION **Do not use hard instruments for cleaning. Do not spray cleaners directly into any openings or gaps in the pump housing.**

CAUTION **Do not use the following chemicals on the pump, as they will damage the front panel: acetoaldehyde, acetone, ammonia, benzene, hydroxytoluene, methylene chloride, and ozone. Do not use cleaners containing n-alkyl dimethyl ethyl benzyl ammonium chloride.**

CAUTION **Work only at a properly installed electrostatic discharge (ESD) workstation. Wear a grounding wrist strap, when not connected to AC power, while servicing the pump.**

CAUTION **Do not lay the pump face down on components or tools which could scratch or damage the keypad. Do not lay the pump face down with door assembly open.**

CAUTION **Ensure that wires are not pinched or overstressed.**

CAUTION **When troubleshooting the pump, do not inject or apply signals unless the procedures herein specifically instruct you to do so. Damage to the pump or its subassemblies could result.**

CAUTION **Tighten fasteners to the torque values specified in the procedures. Do not overtighten any fastener.**

CAUTION **Ensure that connectors are mated and observe the correct orientation.**

CAUTION **Where connectors are identified as "locking," unlock the connectors before removing cables.**

CAUTION **Note the routing of the wires before removing them.**

CAUTION **Fully unlock flat ribbon cable connector flange before removing cable. Attempting to remove the cable while locked can damage the cable and connector.**

CAUTION **Ensure that the door assembly is properly latched prior to transport or storage.**

Warranty Information

Baxter Healthcare Corporation ("Baxter") warrants that the equipment shall be free from defects in material and workmanship when delivered to the original purchaser. Baxter's sole obligation shall be limited to repair or replacement, at Baxter's option and expense, of the defective part or unit, excluding batteries, for a period of one year following the date of initial delivery. The warranty for batteries is limited to a period of six months following the date of initial delivery.

The warranty extends only to the original purchaser and is not assignable or transferable, and shall not apply to auxiliary equipment or disposable accessories.

THERE ARE NO OTHER WARRANTIES INCLUDING ANY IMPLIED WARRANTY AND ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WHICH EXTEND BEYOND THE DESCRIPTION OF THE PRODUCT AND THOSE EXPRESSLY SET FORTH IN ITS LABELING. UNLESS USED ACCORDING TO THE DIRECTIONS ACCOMPANYING THE PRODUCT, ALL WARRANTIES ARE SPECIFICALLY EXCLUDED. In no event shall Baxter be responsible for incidental, consequential or exemplary damages. Modification, alteration, recalibration, abuse, or service by other than a Baxter authorized representative may void this warranty.

Service Information

While under Baxter Healthcare Corporation Warranty, Service Agreement (optional), or lease agreement, the instrument must not be opened by unauthorized personnel.

Call 1-(800) -THE-PUMP for service and repair information for all instruments.

Shipping costs for all units returned to Baxter shall be paid by the customer. The unit must be packed in its original container or in another Baxter approved container that provides adequate protection during shipment. Before shipping any unit for repair, call 1-(800)-THE-PUMP and notify a customer service representative to ensure prompt return of your device. When calling Product Service, please be prepared to provide code number and serial number of the unit. A brief written description of the problem should be attached to the instrument when it is returned for service.

Baxter Healthcare Corporation is not responsible for unauthorized returns or for units damaged in shipment due to improper packing.

General Information

Baxter Healthcare Corporation reserves the right to change the design without notice.

Chapter 2

Description

Overview

This chapter provides an overview of the pump controls and features. This chapter contains the following information:

- "Technical Specifications," 2-1
- "Controls and Indicators," 2-3

For detailed instructions on using the pump, refer to the pump's Operator's Manual.

Technical Specifications

Item	Characteristic
Catalog Code Number	2M8063
Description	Single channel linear peristaltic volumetric infusion pump
Administration Set	Baxter's standard administration set with "s" suffix
Keep Vein Open (KVO) rate	5 mL/hr or programmed rate, whichever is less
Battery	12 Volt, 2.0 Ah sealed lead acid
Battery Life	Approximately 6 hours with pump running at rates from 1 to 1400 mL/hr
Battery Recharge	8 hours for 80% recharge 16 to 72 hours for full charge, depending upon battery condition
AC Power Requirements	110/120V, 60 Hz
Power Cord	2.9 m (9.5 ft.) long, with hospital grade plug

Item	Characteristic
Leakage Current	Typically less than 50 µA (using UL-544 specified test methods)
Power Consumption	30 W
Weight	5.3 kg (11.6 lbs)
Dimensions	20 cm W x 13 cm D x 29 cm H (7.9" W x 5.1" D x 11.4" H)
Flow Rate Range	Primary program: 1 - 1999 mL/hr in 1 mL/hr increments and 1 - 99.9 mL/hr in 0.1 mL/hr increments. Upper limit can be reduced by authorized service personnel. Secondary program: 1 - 999 mL/hr in 1 mL/hr increments and 1 - 99.9 mL/hr in 0.1 mL/hr increments.
VTBI Range	1 - 9999 mL in 1 mL increments and 1 - 99.9 in 0.1 mL increments for both primary and secondary. Upper limit can be reduced by authorized service personnel.

Ramp PDP Parameter Ranges (available only on pumps running software versions 1.09 or later)	• Total VTBI: 100 - 9,999 in 1 mL increments. Upper limit can be reduced by authorized service personnel.
	• Delay Time: 00:00 - 08:00 hours in minute increments.
	• Run Time:
	  • *01:00 - 16:00 hours in minute increments.*
	  • *01:00 - 24:00 hours in minute increments (software versions 1.14 and later).*
	• Ramp Up: 00:00 to 45% of the Run Time minus Ramp Up, in minutes.
	• Ramp Down: 00:00 to the Run Time minus Ramp Up, in minutes.

Air-in-Line Detection	Factory set to NORM which causes the device to alarm on air bubbles approximately 75 µL or larger. The MIN setting causes the device to alarm on bubbles approximately 50 µL or larger.
Fuse	0.5 A Slo-Blo
Nurse Call	9-pin D connector, Pin 1: N/O, Pin 4: N/C, Pin 9: Common Contact rating: 0.4A at 30 VAC, 2A at 30 VDC resistive load (internal activation required)

Controls and Indicators

All controls and indicators are described in the following sections and are shown in Figure 2-1, Figure 2-2, and Figure 2-3. Service personnel should be familiar with the pump's features and operation before servicing the pump. The pump's serial number is recorded on a label on the back of the pump.

Front Controls and Indicators

See Figure 2-1 for the locations of the controls and indicators described below.

Item	Function
1. Message Display	Shows all messages.
2. **BACKLIGHT** key	Provides backlighting of the displays when the pump is used in darkened areas. The key toggles the backlighting on and off. When the pump is operating on battery power, the backlight remains on for 60 seconds and turns off automatically to conserve battery power.
3. **SILENCE** Key	Temporarily silences an audible alarm or alert for two minutes. All visual alarm or alert information remains displayed.
4. NEXT Legend	When the NEXT legend is lit, the **TOT VOL/STATUS** key functions as a scrolling key to advance to the next step of a programmed delivery profile (PDP) or configuration option. See Chapter 5, "Configuration Option Feature".
5. **TOT VOL/STATUS** Key	Dual-function key. During operation, this key causes total volume delivered and current settings to display when pressed. It is also used to select a next step in Review Configuration, Modify Configuration and Programmed Delivery Profile modes. The word "NEXT" above the key is illuminated when the key is functioning as a **NEXT** key.
6. **CLEAR TOT VOL** Key	Resets the total volume delivered to zero when the pump is stopped.
7. **TIME** Key	Enters desired time interval for an infusion during Volume-Time or Rate-Time programming.
8. **STOP** Key	Stops the pump. The STOPPED message appears when the key is pressed. An alert sounds when the pump is stopped for more than two minutes. Clears all programming alerts while pump is running.
9. Door Latch	Opens and closes pump door.
10. **ON-OFF/CHARGE** Key	Turns the pump on and off. The internal battery charger remains on regardless of the **ON-OFF/CHARGE** key as long as the pump is plugged in.
11. Battery Icon	Yellow LED, always lit while the pump is operating on battery power.
12. Plug Icon	Green LED, always lit while the pump is plugged in and the battery is charging.

Item	Function
13. MONITOR Legend	Lights for at least 2 seconds each time the host computer communicates with the pump when the pump is in monitor mode.
14. COMPUTER CONTROL Legend	Flashes when the pump is initiating communications with a host computer to enter the computer control mode. It is constantly illuminated when the pump is in computer control mode.
15. **SEC START** Key	Starts the delivery of the secondary solution.
16. **SEC VTBI** Key	Allows programming of the secondary VTBI.
17. **OPTIONS** Key/Legend	Allows the pump to operate in special modes, when enabled. The OPTIONS legend lights when the key is enabled.
18. **SEC RATE** Key	Allows programming of the secondary infusion rate.
19. **CLR** Key	Clears any locked in values and programming values currently being entered.
20. Numerical Keypad	The numerical values for rate, VTBI, and time are entered with these keys.
21. **PRI VTBI** Key	Allows programming of the primary VTBI.
22. **PRI RATE** Key	Allows programming of the primary infusion rate.
23. **PRI START** Key	Starts the primary infusion.
24. Main Display	Shows rate, volume to be infused (VTBI), and total volume infused for primary and secondary infusion programs.
25. ALARM LED	Red LED that blinks on and off during an alarm, accompanied by a visual message display and a repeated sequence of three beeps. An alarm indicates that the pump requires immediate attention.
26. PUMPING LED	Green LED which is constantly lit while pump is running.
27. ALERT LED	Yellow LED which lights during alerts, accompanied by a message display and a repeated single beep. An alert indicates that the pump needs timely attention.

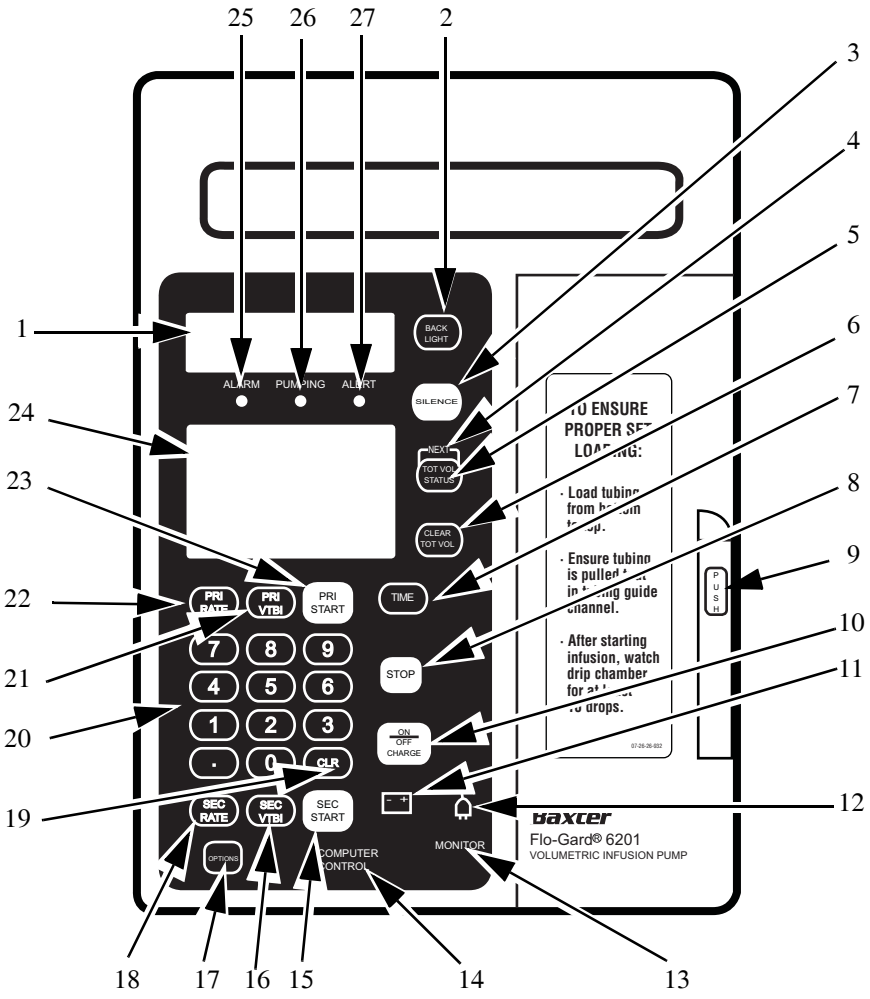


Figure 2-1 Front View of Pump

Interior Controls and Indicators

See Figure 2-2 for the location of the items described below.

Item	Function
1. Upstream Occlusion Sensor	Detects a complete tubing restriction upstream of the pump.
2. Pump Mechanism	Linear peristaltic pump mechanism.
3. Tube Misloading Sensor	Detects misloaded tubing out of the channel guide slots.
4. Downstream Occlusion Sensor	Detects a complete tubing restriction downstream of the pump.
5. Air Sensor	Detects air bubbles in the IV set.
6. Safety Clamp	Prevents accidental fluid flow when the IV set is properly loaded and the pump door is opened.
7. Slide Clamp Feature	Provides an additional means of preventing accidental gravity fluid flow by occluding the tubing in the administration set with the slide clamp before the set can be removed from the pump. The use of this feature is optional; when used, the slide clamp must be loaded in the slide clamp slot. The feature is selectable through the pump's configuration options. When alert mode is enabled, the pump operates without the slide clamp inserted and the INSERT SLIDECLAMP message is displayed. An alert tone sounds to notify the user that the slide clamp should be inserted. When the alarm mode is enabled (software versions 1.09 or later), the pump does not start and an alarm tone sounds when the slide clamp is not loaded.
8. Spring Retainer Insert	The pump is shipped from the factory with this plastic insert in the slide clamp slot. It prevents damage to the mechanism during shipment and maintains the proper spring tension. If your hospital does not plan on using the slide clamp feature, Baxter recommends that this plastic insert remain in place during use. See "Spring Retainer Removal" on page 8-21.
9. Channel Guide Ridges	Function as a guide to keep the tubing properly aligned over the pumping fingers.

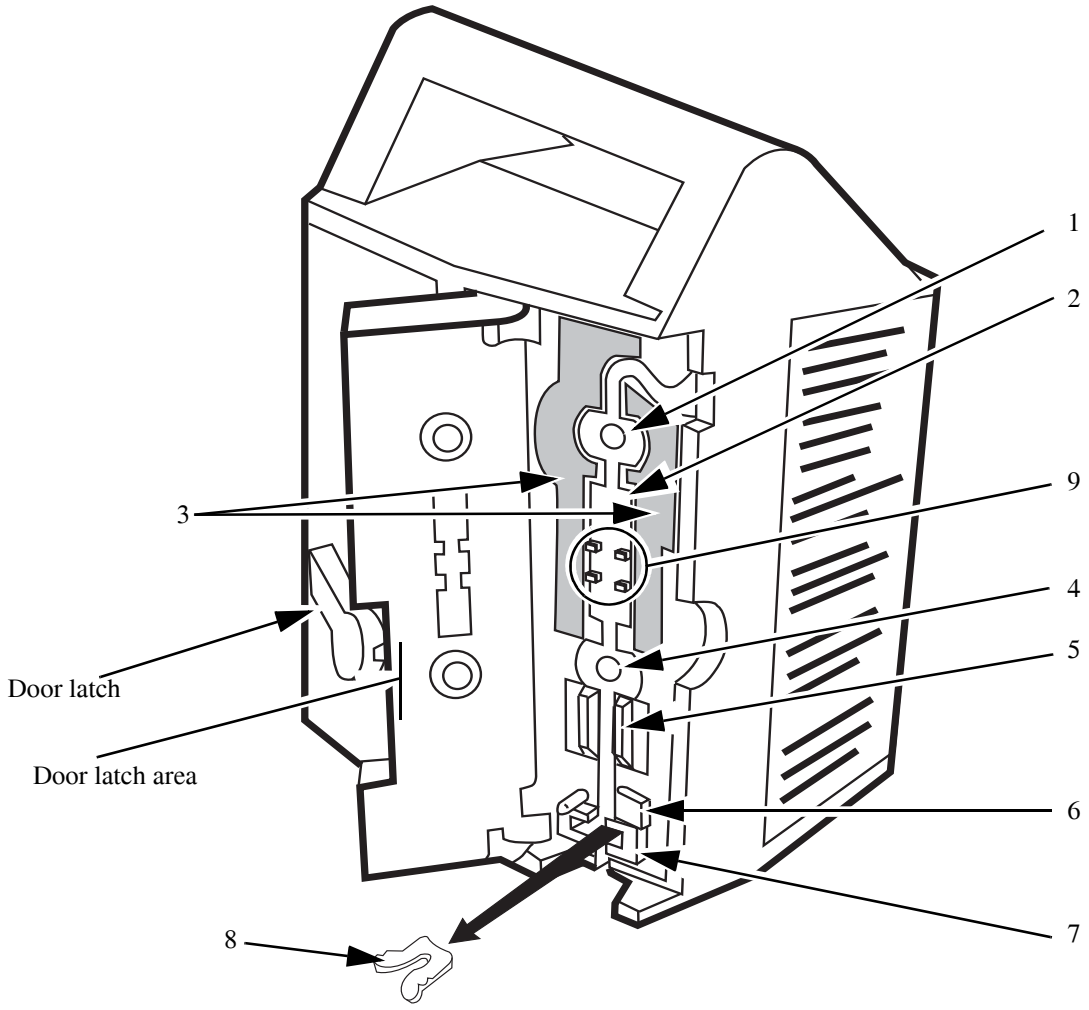


Figure 2-2 Pump With Door Open

Rear Controls and Indicators

The following items are located on the rear of the pump and are shown in Figure 2-3.

Item	Function
1. IV Pole Clamp	Secures the pump to the IV pole.
2. Power Cord Strap	Stores power cord during battery operation and pump storage.
3. Audio Speakers	For generation of audible alarm and alert tones.
4. Battery Compartment	Allows authorized service personnel easy access to the battery, EPROMS, and battery fuse.
5. VOLUME Knob	Adjusts loudness of audible alarm and alert tones. The audible alarm cannot be turned completely off.
6. PANEL LOCK Switch	Disables all front panel keys, except **BACKLIGHT** and **TOT VOL/STATUS**, while the pump is running without alerts.
7. Power Cord	Removable only by authorized service personnel.
8. Fuse Compartment	The power cord cover must be removed to access the fuses.
9. COMMUNICATIONS PORT	The communications port contains wiring for a nurse call jack as well as RS-232 serial communications. See “Technical Specifications,” 2-1 for more information.

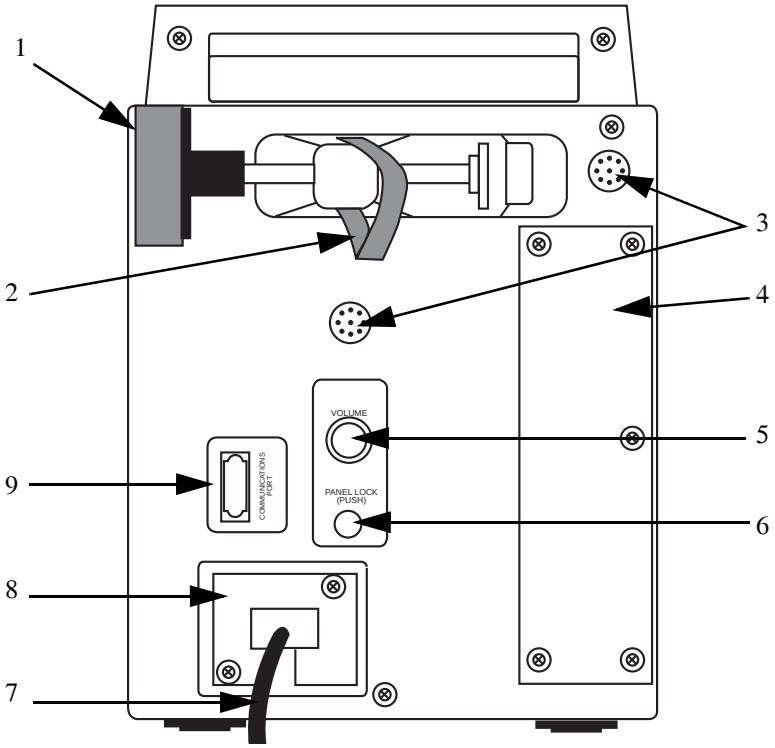


Figure 2-3 Rear View of Pump

Chapter 3

Preparation for Use

Overview

This chapter provides information about putting pumps into service.

Unpacking Instructions

Open the shipping carton. Take the pump out of the box and remove the plastic bag. Keep the packaging materials to re-use if the pump has to be shipped. To order additional packaging materials, see Chapter 11 for part number information.

The Operator's Manual (and any Operator's Manual addenda included with the pump) should be forwarded to the appropriate care area where the pump is to be used.

Inspect the pump for signs of damage incurred during shipment. If you find any damage, notify the shipping company immediately.

Factory Testing

The tests listed below were performed at the factory.

- Functional Inspection 1
  - LCD/LED Inspection
  - Main and backup lithium battery current
  - Battery low (alarm/alert)
  - Voltage
  - Internal inspection
  - Set time and date

- Functional Test 1
  - Keypad test and Panel Lock switch test
  - Nurse call test
  - DC voltage measurement test
  - Main speaker test
  - Back-up beeper test
  - Calibration constants checked
- Final Accuracy Test
  - Pump was tested at 125 mL/hr and 10 mL/hr
  - KVO test
- Upstream/Downstream Pressure and Air in Line Test
  - Downstream occlusion
  - Upstream occlusion
  - Air alarm inspection
  - AIL sensor value with empty tube
  - AIL sensor value with primed tube
  - AIL with back pressure service code check
  - Air alarm test
- Functional Test 2
  - Free flow prevention
  - Door open/closed inspection
  - FSR and air sensor inspection
  - Drive defect inspection
  - Electrical safety tests
  - Factory setting verification
- Final Run-In Test
  - Pump runs at 500 mL/hr for 6 hours and 999 mL/hr for 6 hours

Charging the Batteries

! WARNING ! **If the charging state of the batteries is unknown or the pump has not been plugged in to AC power for at least 16 uninterrupted hours then the pump must be charged for at least 16 uninterrupted hours of charging prior to releasing it for use.**

To charge the batteries, plug the pump into a hospital-grade AC outlet. Verify that the Plug icon lights.

Testing New and Recently Serviced Pumps

Before placing new and recently serviced pumps into service at your facility, perform the following tests:

Note: Allow the pump to stabilize at operating temperature (15° – 38° C (59° – 100° F)), and perform the initial battery charge before performing the self-test.

Note: Adjust the volume control (located on the rear of the pump) to its highest setting.

1. "Self Test" on page 10-3
2. "Free Flow Prevention Test" on page 10-11
3. "Electrical Safety Tests" on page 10-11
4. Perform one of the following tests, at your discretion:
   - "Measurement by volume per time" on page 10-12
   - "Measurement incorporating VTBI option" on page 10-12

If the pump fails to pass any of the tests, contact your Baxter customer representative.

If you want to perform additional testing before placing pumps into service, refer to the complete Operational Checkout provided in Chapter 10, "Operational Checkout".

Nurse Call

The optional nurse call feature enables a user to connect the pump to a nurse call system at a care area. To connect the pump to your facility's Nurse Call system authorized service personnel must:

- Install a jumper as described in "Nurse Call" on page 4-1.
- Construct or purchase a cable as shown in "Nurse Call" on page 4-1.
- Connect the cable to the pump's communications port and the facility's system.

Note: Ensure that the connector locking screws are tightened before use.

A manual explaining the computer monitoring feature is available from Baxter upon request.

Administration Sets

The FLO-GARD 6201 Single Channel Volumetric Infusion Pump is designed for use with Baxter's standard administration sets that contain an "s" as the last character of the code number, for example, 2C5537s.

Chapter 4

Accessories and Options

Nurse Call

The Nurse Call feature requires that a jumper wire be installed to the terminal printed circuit board (Figure 13-26) at the location labeled R421 (trace only) on the board. When the jumper is connected, the Nurse Call relay is energized only during an alarm condition and when the ALARM LED is lit. To connect the pump's Communications Port to your Nurse Call system build a cable as shown in either Figure 4-1.

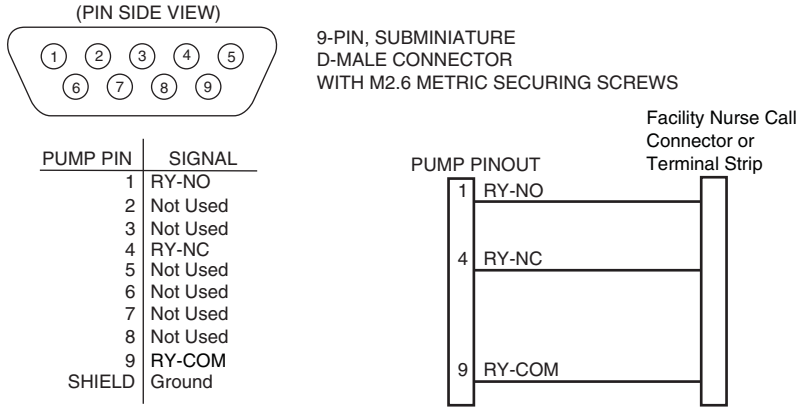


Figure 4-1 Nurse Call Cable Wiring

Chapter 5

Configuration Option Feature

Overview

This section describes the configuration option feature of the pump, which allows qualified personnel to inspect and/or modify certain pump operating parameters to suit customer requirements.

These parameters and their setting options are shown in Table 5-1. The factory settings made at the time of manufacture are also shown in the table.

Note: Although the configuration option data is stored in battery backed-up RAM, it may be lost when the main battery connector (CN302) is disconnected from the CPU board without turning off the pump. The configuration option data is also lost when the lithium backup battery connector (CN304) is disconnected while the main battery is disconnected. Therefore, we advise that the configuration options be recorded before beginning repair procedures and reset when repairs are complete.

Appendix C,"Configuration Options Data Sheet" is a data sheet which may be reproduced and used to record the pump's configuration settings.

Reviewing the Configuration Option Settings

To review the configuration option settings, the pump must be powered on and stopped. Press **TIME** and **TOT VOL/STATUS** simultaneously for one second. The message REVIEW CONFIG is displayed in the Message Display. The option description is displayed in the first line of the Message Display when the **NEXT** or **SEC START** key is pressed, beginning with OCCLUSION. The current setting is displayed on the second line.

To view the next setting, press the **NEXT** or **SEC START** key. Each press of the **NEXT** or **SEC START** key causes the pump to advance to the next setting, in the order shown in Table 5-1, starting with Occlusion Alarm Level. To exit the inspection mode, press the **STOP** key or press **TIME** and **TOT VOL/STATUS** simultaneously.

Modifying the Configuration Option Settings

1. Turn off the pump.

2. While pressing the **STOP** key and PANEL LOCK switch, press the **ON-OFF/CHARGE** key. The following occurs:

   2.1 The MODIFY CONFIG message appears in the Message Display.

Note: When the message LOCKED OUT is displayed, the configuration option settings can be changed only via computer control. See the Programmer's Manual for additional information.

   2.2 The parameter descriptor appears in the first line of the Message Display when the **NEXT** or **SEC START** key is pressed.

   2.3 The current parameter setting appears in the second line of the Message Display.

   2.4 The programming display is blank.

3. Press the **NEXT** or **SEC START** key to advance to the desired parameter. The parameters appear in the order shown in Table 5-1.

4. To change the settings, enter the desired value on the front panel. The selected numeric value is displayed in the Primary Rate display until the value is locked in by the **PRI START** key, or the next parameter is displayed by pressing the **NEXT** or **SEC START** key.

Note: The alarm log for the pump can be cleared via the configuration option. See Table 5-1.

5. To lock in the selected value, press the **PRI START** key. The selected value is then displayed in the Message Display. To move on to the next parameter, press the **NEXT** key or **SEC START** key.

6. To exit, press the **ON-OFF/CHARGE** key.

Table 5-1 Configurable Settings

Parameter Description	Setting Options	Factory Settings
1. Alarm Log: Clear alarm/failure codes of the pump. Select 1 to clear the pump's alarm log.	N/A	N/A

Table 5-1 Configurable Settings — continued

Parameter Description	Setting Options	Factory Settings
2. Occlusion Alarm Level: The increase in pressure required to trigger a downstream occlusion alarm.	1: LEVEL 1 (3.0 to 13.0 psi, nominal 7 psi) 2: LEVEL 2 (8.0 to 18.0 psi, nominal 12 psi) 3: LEVEL 3 (13.0 to 23.0 psi, nominal 17 psi)	LEVEL 1
3. Audible Switchover Determines whether or not an audible alert tone is generated when the pump switches from the secondary program to the primary program.	1: OFF 2: ON	OFF
4. Number of Automatic Restarts: Determines whether or not the pump automatically restarts after a downstream occlusion, and if so, how many restarts can occur before the pump remains in alarm. When this parameter is set to anything other than 0, it is enabled. The selected number corresponds to the number of automatic restarts. When set to 0, the feature is disabled.	0 - 9	3
5. Door Open Required: Determines when the pump door must be opened after a downstream occlusion alarm. When the door is not opened and the pump is started within two minutes of the alarm, the pump uses the pressure at which the alarm occurred as the baseline for the next alarm. You may wish to set this option to force the user to open the pump door. This action resets the baseline and encourages the user to relieve the downstream pressure, thereby lowering the alarm threshold. **Example**: Suppose the initial pressure is approximately 1 psi and the occlusion alarm is set to LEVEL 1 or approximately 7 psi. The first alarm occurs at approximately 1+7 or 8 psi. This value represents the baseline pressure that is used to calculate the next alarm unless the door is opened, the downstream pressure is relieved, and a new baseline is set.	1: OFF 2: ON	OFF
6. Air Bubble Alarm Size: Determines the air bubble size that causes an AIR alarm.	1: MIN (average 50 µL) 2: NORM (average 75 µL)	NORM
7. Alarm Off Interval: Selected setting is equivalent to the number of seconds between each occurrence of the three-beep alarm tone.	1 - 7	1
8. Alert Off Interval: Selected setting is equivalent to the number of seconds between each occurrence of the one-beep alert tone.	1 - 7	7
9. Maximum Rate of Infusion: Sets the maximum programmable primary infusion rate of the pump. When the maximum primary rate is 999 or higher, the maximum secondary rate is 999. At values below 999, the maximum secondary rate matches the value of the maximum primary rate.	1 - 1999 mL/hr	1999 mL/hr
10. Maximum VTBI: The maximum volume that the pump can be programmed to infuse.	1 - 9999 mL	9999 mL

Table 5-1 Configurable Settings — continued

Parameter Description	Setting Options	Factory Settings
11. Flow Check: Determines whether the flow check display appears during pump operation, or only when the decimal point key and **TOT VOL/STATUS** keys are pressed simultaneously.	1: OFF 2: ON	OFF
12. Baud Rate: Determines the baud rate for normal communications between the pump and a computer. The baud rate is 9600 when the pump is in modify configuration mode.	1: 300 2: 1200 3: 2400 4: 4800 5: 9600	9600
13. Computer Control: Determines the type of computer control option available at power up.	1: Disabled 2: Off with Alarm. The pump drops out of remote control when an alarm occurs. 3: On with Alarm. The pump remains in remote control when an alarm occurs. See the Programmer's Manual 2M8963C for additional information.	Disabled
14. Hospital Area Designator: Determines the hospital area designator to be displayed upon power ON for 3 seconds. These messages can be redefined using the computer communications feature.	0: no message 1: NICU 2: PICU 3: MED/SURGICAL 4: TRAUMA/BURN UNIT 5: OPER ROOM 6: CARDIAC/ICU 7: SURGICAL/ICU 8: ICU 9: ONCOLOGY	0
15. Close Clamp: Determines whether or not the CLOSE CLAMP message appears with the DOOR OPEN message.	1: OFF 2: ON	ON
16. Insert Clamp: Determines whether or not the slide clamp loading feature is enabled. The spring retainer must be removed when this feature is enabled. See "Spring Retainer Removal" on page 8-21 and "Spring Retainer Installation" on page 8-21. **Note:** The alert or alarm option is available only on pumps running software versions 1.09 or later.	1: OFF (The spring retainer should be installed.) 2: ON for software versions earlier than 1.09 or ALERT for software versions 1.09 or later (An audible alert occurs and the message INSERT SLIDECLAMP is displayed. The pump continues pumping. 3: ALARM (An audible alarm occurs and the message INSERT SLIDECLAMP is displayed. The pump does not operate.)	ALARM

Table 5-1 Configurable Settings — continued

Parameter Description	Setting Options	Factory Settings
17. Programmed Delivery Profile: Determines the memory to store the programmed delivery profile. **Note:** Ramp PDP option is available only on pumps running software versions 1.09 or later.	1: Disabled 2: 5 hour memory 3: Semi-permanent memory 4: Permanent memory 5: Ramp PDP (Profile is saved in permanent memory. When a new PDP is entered, the pump reverts to the PDP in permanent memory once the cycle has been completed.)	Disabled
18. Time Setting: Set the real time clock in hours and minutes. (military time 00:00 - 23:59)	——	Central Standard Time-CST
19. Date Setting: Set the date using the Month/Day/Year format.	——	Current date-CST

Chapter 6

Routine Maintenance

Overview

This chapter contains a table describing preventive maintenance which should be performed on the FLO-GARD 6201 Single Channel Volumetric Infusion Pump. The maintenance procedures outlined in this section may be performed in the hospital. When an abnormal condition occurs which is not correctable by performing the following procedures, remove the pump from service and troubleshoot it in accordance with Chapter 7, “Troubleshooting”, or return it to Baxter for repair.

! WARNING ! **If the pump has been dropped or appears to be damaged, it should be taken out of service and carefully inspected.**

Cleaning

The pump should be cleaned as soon as possible after each use to minimize the accumulation and hardening of spilled solutions. The case and front panel may be cleaned with a soft cloth or cotton swabs dampened with a properly diluted cleaning agent listed in Table 6-1.

Be sure to follow the manufacturer’s dilution instructions for concentrated cleaners where applicable. Do not spray cleaning agents directly onto the inside of the pump door, the pump mechanism, and the front panel film. When these areas require cleaning, wipe carefully with a soft cloth, sparingly dampened with a cleaning agent listed in Table 6-1. When solution spillage onto the pumping mechanism or front panel occurs, it must be cleaned immediately. If necessary, contact Product Service at 1-(800)-THE-PUMP.

CAUTION **Do not submerge the pump into liquids of any kind.**

CAUTION **Do not clean, disinfect, or sterilize any part of the pump by autoclaving or with ethylene oxide gas. Doing so may damage the pump and void the warranty. Only external parts of the pump should be disinfected.**

CAUTION **Do not use hard instruments for cleaning. Do not spray cleaners directly into any openings or gaps in the pump housing.**

CAUTION **Do not use the following chemicals on the pump, as they will damage the front panel: acetoaldehyde, acetone, ammonia, benzene, hydroxytoluene, methylene chloride, and ozone. Do not use cleaners containing n-alkyl dimethyl ethyl benzyl ammonium chloride.**

Table 6-1 Recommended Cleaning Solutions

Cleaner
Septisol
Super Edisonite
Bafix
Tor
Hi-Tor Plus
10% bleach and water
Soapy water
Isopropyl alcohol (up to 95%)

For a pump that has been in an Isolation Area, select those agents from Table 6-1 that both clean and disinfect. Only external parts of the pump should be disinfected. The following are procedures for cleaning accessible areas of the pump. Do not use hard instruments for cleaning.

1. Lift the door latch to the open position. Open the door and press the safety clamp latch until it locks in the open position.

2. Using a cotton swab dampened with one of the agents listed in Table 6-1, clean all tubing guides and tubing channels from the top of the pump to the exit point below the safety clamp.

3. Clean all surfaces in the pump head which may contact the tubing.

4. Clean all surfaces of the air sensor located just above the safety clamp. This area must be completely dry and free of foreign matter prior to reuse.

Battery Charging

The battery is recharged whenever the pump is plugged in regardless of whether the pump is on or off. However, for optimal charging, turn the pump off. The Plug Icon is illuminated whenever the battery is charging. The battery must be stored in a charged condition and, if stored for prolonged periods, should be recharged at least every three months for 48 hours. To charge the battery, simply plug the pump into a 115 VAC outlet.

! WARNING ! **Whenever the pump is in for service the battery's capacity should be evaluated because battery performance degrades through its life.**

Preventive Maintenance

Table 6-2 lists preventive maintenance for the pump, which should be performed at the intervals shown.

Table 6-2 Preventive Maintenance Procedures

Check	Action
Schedule: As required, but recommended after every use.	
Pump mechanism	Clean with an agent listed in Table 6-1.
Case	Clean with an agent listed in Table 6-1.
Rear Panel Connector (comm port)	Clean with an agent listed in Table 6-1. Replace the connector when its shell is damaged. Check that plastic cover is in place.
Loose or missing hardware (for example, door latch, pole clamp, etc.)	Replace in accordance with Chapter 8, "Removal/Replacement Procedures".
Main Battery	Recharge by plugging into a 115 VAC outlet for at least 16 hours. Check that the Plug Icon is illuminated during this time.

Table 6-2 Preventive Maintenance Procedures — continued

Check	Action
Schedule: Every 12 months or as required	
Back plate and safety clamp	When the safety clamp or back plate does not operate smoothly, clean or replace in accordance with "Replacement of Safety/Slide Clamp Assembly" on page 8-19 or "Replacement of Back Plate" on page 8-22.
Door latch area	Remove pump head door cover in accordance with "Replacement of Pump Head Door Cover" on page 8-9. If Latch is cracked or loose replace in accordance with "Replacement of Pump Door Latch" on page 8-10. If door is cracked in Latch area replace in accordance with "Replacement of the Pump Door or Pump Door Assembly" on page 8-11.
Pole clamp	When operation is not smooth, apply one drop of high grade general purpose machine oil to the screw threads. Ensure that the disk and cushion are installed correctly. Replace if the disk or cushion are missing or are damaged If required, apply Loctite 242 to the disk screw.
Power cord	Replace power cord when the pins are bent or the insulation is damaged.
Preventive maintenance tests	Perform the tests detailed in Chapter 10, "Operational Checkout". Perform the calibration verifications described in "Automatic Test Mode 1: Calibration Mode 1" on page 9-14 and "Automatic Test Mode 2: Calibration Mode 2" on page 9-15.
Schedule: Every 6 months or as required	
Battery check	Perform the Battery Check described in Chapter 10, "Operational Checkout" every 6 months after the first year following battery installation/ replacement.

Chapter 7

Troubleshooting

Overview

This chapter describes how to find the cause of pump malfunctions. The section consists of the following:

- A description of the pump's alarm and alert messages.
- A description of the pump's Failure Identification Codes.
- A description of the pump's automatic test modes.
- A table which lists each failure code, its cause, and ways of correcting it.
- A table which describes how to correct problems not represented by failure codes.

Once the cause of a failure has been determined, perform the corrective action given in the table. All disassembly/reassembly and calibration procedures for the pump are in Chapter 8, "Removal/Replacement Procedures" and Chapter 9, "Calibration". To verify the effectiveness of repairs after they are completed, perform the Operational Checkout procedures given in Chapter 10, "Operational Checkout".

! WARNING ! **Whenever the pump is in for service the battery's capacity should be evaluated because battery performance degrades through its life.**

CAUTION **When troubleshooting the pump, do not inject or apply signals unless the procedures herein specifically instruct you to do so. Damage to the pump or its subassemblies could result.**

Maintenance Flowchart

Figure 7-1 is a flowchart illustrating the maintenance procedures for this pump. The appropriate sections of the operational checkout should be performed after any repairs are performed on the pump. Any problems discovered while performing the operational checkout should be corrected using the troubleshooting procedures discussed in this chapter. Once a problem has been isolated to a single assembly, the assembly must be replaced in accordance with the disassembly procedures provided in Chapter 8, “Removal/Replacement Procedures”. The pump should then be calibrated as described in Chapter 9, “Calibration”. After all maintenance procedures are complete, perform the operational checkout in Chapter 10, “Operational Checkout”.

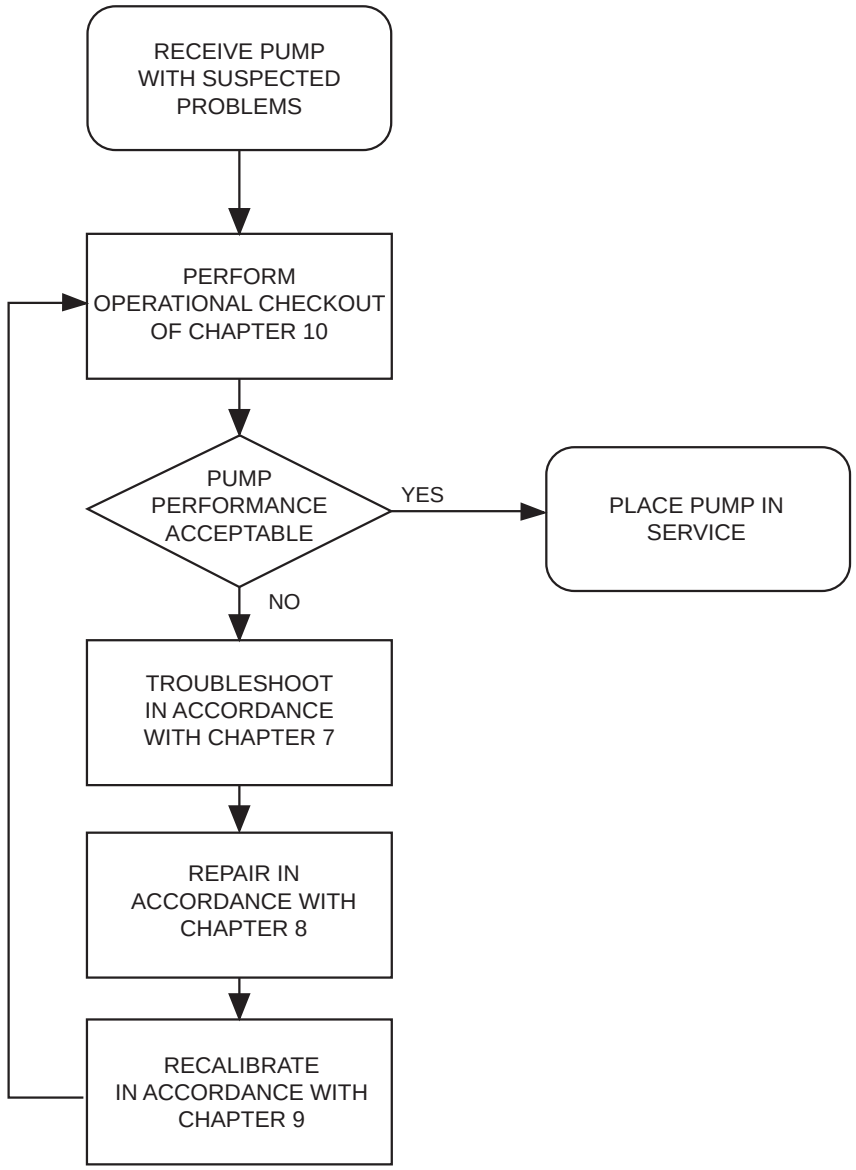


Figure 7-1 Maintenance Flowchart

Determing the Software Version

In order to troubleshoot the pump you must know the pump's installed software version. Perform the following to detemine the pump's software version:

1. Turn the pump off.
2. Press and hold the **SILENCE** key, then press the **ON-OFF/CHARGE** key.
3. Record the software version displayed in the Main Display.

Alarms

The pump has a number of built-in safety features. Should a situation occur which requires operator attention or intervention, the pump stops infusing and sounds an audible alarm. The following are brief descriptions of these alarms.

AIR: An ultrasonic sensor in the pump head detects air in the administration set. Detection of an air bubble stops the infusion and illuminates the red ALARM LED. AIR is displayed in the Message Display and the audible alarm is activated.

OCCLUSION: The downstream occlusion sensor senses an increase in back-pressure between the patient and the pump, indicating an occlusion or closed clamp. When an occlusion is sensed, the pump stops, OCCLUSION is displayed in the Message Display, the red ALARM LED is illuminated and the audible alarm is activated.

UPSTREAM OCCLUSION: The upstream occlusion sensor senses a closed clamp or complete blockage upstream of the pump. When sensed, the pump stops, UPSTREAM OCCLUSION is displayed in the Message Display, the red ALARM LED is illuminated, and the audible alarm is activated.

BATTERY LOW: When approximately 15 minutes of running time remain during battery operation, BATTERY LOW is displayed in the Message Display, the yellow ALERT LED is illuminated, and the audible alert is activated. After approximately 15 minutes, the pump stops, BATTERY LOW is displayed on the Message Display, the red ALARM LED is illuminated, and the audible alarm is activated.

Table 7-1 lists the alarms and the possible causes of each. In all cases, fluid infusion is halted. Appropriate troubleshooting is discussed throughout the rest of this chapter.

Table 7-1 Alarm Messages

Alarm Message	Possible Cause
AIR	a. Air bubble at sensor. b. Empty fluid container. c. Improper set loading. d. The **START** key was pressed with no set in pump.
OCCLUSION	a. Closed distal clamp, stopcock, clogged filter, kinked tubing or other blockage downstream of the pump. b. Ambient and/or solution temperature is too low.
UPSTREAM OCCLUSION	a. Closed clamp or other blockage upstream of the pump. b. Pinched or kinked tube loaded in the pump. c. Improper set loading.
DOOR OPEN	Door must be fully closed with tubing properly loaded for the pump to operate. Door not fully closed or possible missing magnet in door latch. The door latch must be pushed down completely.
FAILURE with code number	Turn the pump off and back on to reset. When FAILURE does not clear, the microprocessor has detected a pump malfunction. After recording the code number, remove the pump from use and have it serviced. See “Failure Identification Code Troubleshooting Table” on page 7-11 for more detailed service instructions.
BATTERY LOW with rapid three-beep alarm tone	Battery power has been exhausted. Plug pump into AC outlet immediately to restore operation.
CHECK SET/LOADING	The tubing is pinched between the pump head door and base plate. Load set properly in the IV set loading path.
COM TIMEOUT	There has been no communication between the pump and the computer for the specified time period. Check for a disconnected cable or computer problem. To clear this alarm, press the **OPTIONS** key to return the pump to computer control, or press **SILENCE** to use the pump without the computer.
EXT COMM ERROR	The controlling computer is sending multiple queries or commands to the pump without waiting for the pump’s replies. The condition has been caused by the computer, not the pump. To clear the alarm, press the **OPTIONS** key to return the pump to computer control, or press **SILENCE** to control the pump manually. Notify the technical personnel responsible for the computer. When the alarm recurs, disconnect the cable from the communications port. Reprogram the pump for manual operation.
INSERT SLIDECLAMP **Note:** This alarm option is available only on pumps running software versions 1.09 or later.	The slide clamp loading option is enabled and the slide clamp is not loaded in the slide clamp slot. To clear this alarm, open the pump door and insert the slide clamp into the slot. Close the door.

Alerts

Alert messages call attention to a condition that require operator intervention in the near future, or indicate that a procedure has been initiated which requires that the operator complete a sequence of keystrokes. These alerts are generally cleared by the operator taking the appropriate action.

Table 7-2 lists the various alerts and possible causes.

Table 7-2 Alert Messages

Alert Message	LED	Flow Status	Key Pressed	Alert Condition
STOPPED	Yellow	No flow	None	The pump has been left in the STOPPED mode for more than two minutes.
KVO PRI VTBI = 0	Green, Yellow	KVO rate	None	Primary VTBI has been delivered and the pump has switched to 5 mL/hr KVO rate (or programmed rate, whichever is lower).
NEW RATE	Green, Yellow	No change until procedure is completed	**PRI** or **SEC RATE**	Primary or Secondary flow rate is being changed while pump is running. Pump does not exit this alert condition until the appropriate **START** key is pressed.
PRI RATE = 0	Yellow	No flow	**PRI** or **SEC START**	The pump cannot be started without entering a primary flow rate.
BATTERY LOW with audible alert	Green, Yellow	No change	None	Battery needs recharging. The pump stops operating in approximately fifteen minutes or longer unless it is plugged into an AC source.
SEC PROGRAM	Green, Yellow	No change	**SEC RATE** or **SEC VTBI**	Secondary (piggyback) information is being programmed into the pump while it is running in primary mode. Pump does not exit this alert condition until **SEC START** is pressed.
SEC RATE = 0	Yellow	No flow	**SEC START**	A secondary (piggyback) infusion cannot be started unless a secondary flow rate is input.
SEC VTBI = 0	Yellow	No flow	**SEC START**	A secondary (piggyback) infusion cannot be started unless a secondary volume to be infused has been input.
SEC COMPLETE	Yellow	No change	None	The pump has completed infusing the secondary VTBI and has switched over to the primary infusion settings. Pump does not exit this alert condition until any enabled key is pressed.
FLOW RATE	Yellow	No flow	**PRI** or **SEC START**	Enter a rate within the range selected through the configuration option. The pump cannot be started when Hi or Lo is displayed in a rate display.

Table 7-2 Alert Messages — continued

Alert Message	LED	Flow Status	Key Pressed	Alert Condition
CHECK VTBI	Yellow	No flow	**PRI** or **SEC START**	Enter a VTBI within the range selected through the configuration option. The pump cannot be started when Hi is displayed in a VTBI display.
INSERT SLIDECLAMP	Yellow	No flow or flow if started	Closed door, **PRI** or **SEC START**	Slide clamp is not loaded into the slide clamp slot although the set is loaded into the pump.
COM TIME OUT	Yellow	No change or no flow	None	Communication timeout period has elapsed. No communication has occurred between the pump and the host computer during the power-up default time period (60 seconds) or during the time period most recently specified by the host computer (1-300 seconds). The computer and the pump must maintain periodic and successful communication in order to avoid this timeout alert. See the Programmer's Manual for further information.
EXT COMM ERROR	Yellow	No change	None	The controlling or monitoring computer is sending multiple queries or commands to the pump without waiting for the pump's replies. The condition has been caused by the computer or the pump CPU board. To clear the alert, press **OPTIONS** to return the pump to computer control (if appropriate), or press **SILENCE**. Notify the technical personnel responsible for the computer. When the alert occurs, disconnect the cable from the communications port. Reprogram the pump(s) for manual operation.
PGM DELIV ENTER PGM	Yellow	No flow	**PRI** or **SEC START**	An attempt was made to start the PDP before a program was entered. Enter a program or press **OPTIONS** to leave the PDP mode.
PGM DELIV REVIEW PGM	Yellow	No flow	**PRI** or **SEC START**	An attempt was made to start a PDP profile prior to reviewing all the programmed steps. Press **NEXT** until the first step is again displayed or press **OPTIONS** to leave the PDP mode.
PGM DELIV CLEAR ALL?	Yellow	No flow	**CLR**	The **CLR** key was pressed after entering the PDP mode to clear all steps. Do one of the following: press **CLR** to erase the profile; press **NEXT** to review the rest of the profile; press **PRI RATE** or **PRI VTBI** to modify this step; press **OPTIONS** to leave the PDP mode.

Table 7-2 Alert Messages — continued

Alert Message	LED	Flow Status	Key Pressed	Alert Condition
RAMP PDP ENTER DATA **Note:** Alert message or Ramp PDP can only appear on pumps running software versions 1.09 or higher.	Yellow	No flow	None	The pump is waiting for Ramp PDP data to be entered. Either enter the data (as described in the Operator's Manual), or press the **OPTIONS** key to leave the PDP mode.
RAMP PDP RATES HIGH **Note:** Alert message or Ramp PDP can only appear on pumps running software versions 1.09 or higher.	Yellow	No flow	None	The Programmed Ramp PDP parameters have resulted in a calculated flow rate that exceeds the pump's capabilities. To correct this alert, either reduce the volume for total VTBI or increase the Run Time.
RESUME PDP Ramp Profile Phase **Note:** Alert message or Ramp PDP can only appear on pumps running software versions 1.09 or higher.	Yellow	No flow	**PRI START** or **STOP**	The pump is asking if it should resume the Ramp PDP where it was interrupted. Do one of the following: Press **PRI START** to start fluid delivery or press **STOP** to cancel the alert.

Failure Identification Codes

Specific errors which may occur during pump operation are represented by Failure Identification Codes. When the alarm message FAILURE occurs, it is accompanied by a two-digit code number. This code is the Failure Identification Code. The last 10 Failure Identification Codes (including alarm codes except DOOR OPEN and AIR alarms occurring in the stopped mode) are stored in the pump's memory, along with the date and time at which the alarm occurred. The Failure Identification Codes can be used to determine the nature of a pump failure and to troubleshoot its cause.

To view the stored Failure Identification Codes, press the **STOP** key. Press and hold the **SILENCE** and **TOT VOL/STATUS** keys. The most recent Failure Identification Code is displayed in the lower right corner of the Main Display. The time at which the failure occurred is displayed in the upper right corner of the Main Display. The date when the failure occurred is displayed in the Message Display for as long as the keys are held, plus one second. To exit from the Failure Identification Code viewing mode, release the **SILENCE** and **TOT VOL/STATUS** keys. One second later, the display of the RATE(s) and VTBI(s) data resumes. To scroll back through the previous nine codes that occurred, press the **CLEAR TOT VOL** key before the one second period elapses. Each failure code, along with the time and date, is displayed for one second with a one second off interval after each code. After the last failure code has been displayed for 1 second, the display returns to normal. To exit, press the **STOP** key.

See Table 7-3 for descriptions of all Failure Identification Codes and instructions on how to correct each failure. Disassembly/reassembly and calibration procedures are located in Chapter 8, “Removal/Replacement Procedures”.

During operation, a pump failure is indicated by the message FAILURE and the failure code number (in the format, F_nn) in the Message and Main Displays.

Automatic Test Modes

! WARNING ! **The automatic test modes are for servicing the pump only, and must not be used while the pump is connected to a patient.**

The pump has ten automatic test modes to aid in troubleshooting and manufacturing. Modes 1 and 2 are described in Chapter 9, “Calibration” (sections “Automatic Test Mode 1: Calibration Mode 1” on page 9-14 and “Automatic Test Mode 2: Calibration Mode 2” on page 9-15, respectively). Modes 3 through 10 are described briefly in the following paragraphs. The procedure to access any of the automatic test modes is as follows:

1. Turn the pump off.
2. Press and hold the **CLEAR TOT VOL** key and while pressing the numeric key corresponding to the automatic test mode you wish to enter (1 through 0).
3. While performing step 2, press the **ON-OFF/CHARGE** key.
4. To exit any automatic test mode, press the **ON-OFF/CHARGE** key.

Automatic Test Mode 3: Manufacturing Test Mode

! WARNING ! **This is an automatic test mode for testing the pump during manufacturing only. This mode must not be used on patients because the downstream occlusion, upstream occlusion and air sensors are disabled.**

The initial display in this automatic mode is for a PRI RATE of 1999 mL/hr, PRI VTBI of 3998 mL, SEC RATE of 500 mL/hr, and SEC VTBI of 100 mL. Pressing the **TIME** key changes the primary settings as follows:

PRI RATE	PRI VTBI	SEC RATE	SEC VTBI
999	1998	500	100
499	998	500	100
250	500	500	100
125	250	500	100
10	20	500	100

In each combination, the primary and secondary rates and VTBI can be manually altered.

The pump stops automatically one hour after the **PRI START** key was pressed. While the pump is running, the air sensor and the upstream and downstream occlusion sensors are disabled.

Automatic Test Mode 4: Aging Mode

! WARNING ! **This is an Automatic Test Mode for testing the pump during manufacturing only. This mode must not be used on patients because the rates and VTBI settings cannot be altered.**

While the pump is stopped, pressing any numbered key (0 - 6) programs a preset rate/VTBI combination as follows:

Key Number	PRI RATE	PRI VTBI	SEC RATE	SEC VTBI
0	500	3000	999	6000
1	499	0	999	1

Key Number	PRI RATE	PRI VTBI	SEC RATE	SEC VTBI
2	3	0	0	0
3	250	0	0	0
4	499	100	0	0
5	1401	100	0	0
6	1999	100	0	0

The **RATE/VTBI** keys and number keys **7**, **8**, and **9** are not accepted. Other specifications are the same as during normal operation.

Automatic Test Mode 5: Display Check Mode

All the LCD segments, LEDs and icons turn on sequentially for a visual check each time the **STOP** key is pressed. At any point in the sequence the **SEC START** key may be pressed to return to the beginning of the sequence.

Automatic Test Mode 6: Time Information Display Mode

In this test mode, the cumulative time values are displayed sequentially each time the **SEC RATE** key is pressed. The test mode first displays the cumulative Power On time, then the time on battery and finally, the time that the pump was actually pumping. It should be noted that the first six digits from the left are the time in hours and the two digits on the right are the time in minutes. Therefore, the display 0001 02:21 represents 102 hours and 21 minutes.

Automatic Test Mode 7: Pumping Sensor Monitoring Mode

! WARNING ! **This is an automatic test mode for testing the device during manufacturing only. This mode must not be used on patients.**

In this test mode, the motor current and occlusion sensors may be monitored during pumping. During pumping, the motor current is displayed in the PRI VTBI location, the upstream occlusion detector reading in the SEC RATE location, and the downstream occlusion sensor reading in the SEC VTBI location. When the pump is stopped, all of the displayed values return to normal.

Automatic Test Mode 8: Air Sensor Test Mode

Upon entering this mode, the PRI RATE is set to 30, PRI VTBI = 100, SEC RATE = 600, and SEC VTBI = 100. Pressing the **TIME** key selects the pump's air sensor sensitivity (MIN or NORM) without using the configuration option. The air sensor selection is displayed in the message display when the pump is started. All other keys function normally except for the **TIME** key. Rate and VTBI information for both primary and secondary mode may be changed.

Automatic Test Mode 9: Elapsed Time Test Mode

The elapsed pumping time is displayed in the first line of the message display in this test mode. Momentarily pressing the **TIME** key selects two pre-programmed primary mode test conditions. The first is a PRI RATE of 125 mL/hr with a VTBI of 100 mL. The second is a PRI RATE of 499 mL/hr with a VTBI of 100 mL. The elapsed time counts only when the pump is running. Stopping the pump and then restarting it resets the timer to zero. All other keys function normally except for the **TIME** key. When the VTBI has been delivered, the pump enters KVO mode.

Automatic Test Mode 0: Downstream Occlusion Test Mode

In this mode, pressing the **TIME** key allows you to select the pump's downstream occlusion level sensitivity without entering the configuration mode. The selected occlusion sensor level (1, 2, or 3) is momentarily shown in the second line of the message display until the test mode is exited. After exiting test mode, the downstream occlusion sensor level reverts to the original configuration setting. Rate and VTBI information may be programmed manually.

Failure Identification Code Troubleshooting Table

Use Table 7-3 to determine the corrective action necessary to resolve failure codes. The causes of each failure code are listed in the order in which they are most likely to occur. Perform the corrective action items in the order in which they are listed and retest the pump after each action. All replacement procedures are contained in Chapter 8, "Removal/Replacement Procedures".

There are two types of Failure Identification Codes: Alarm (codes 1-19) and Failure (codes 20 and above). Alarm codes report malfunctions generally correctable by the operator. Failure codes may require servicing of the pump. A code of 0 indicates that less than 10 alarms/failures have occurred since the log was cleared. The time and date are also 0.

Table 7-3 Failure Identification Codes

Code	Cause	Checks	Corrective Action
0	No alarms or failures.	No action necessary.	
1	Air bubble detected in a Run mode.	Check for air in tubing. Ensure set is correct type and is properly loaded. Ensure set tubing is not scratched or deformed.	Expel air in tubing. Replace or reposition set when tubing is flattened or scratched. Clean air sensor in accordance with Chapter 6, "Routine Maintenance" when dirty.
		Perform "Automatic Test Mode 2: Calibration Mode 2" on page 9-15 steps 2 through 6.	When values are not within specification, recalibrate or replace the air sensor.
2 3	Downstream occlusion was detected.	Check for scratched or deformed tubing. Verify that ambient temperatures are between 60° and 100° F (15.5° and 37.7° C). Ensure set is correct type and is properly loaded. Check for spilled solution in sensor region.	Remove downstream occlusion and reposition the tubing. Clean occlusion sensors in accordance with "Cleaning" on page 6-1 when dirty. Raise or lower temperatures if necessary.
		Perform "Automatic Test Mode 1: Calibration Mode 1" on page 9-14, steps 1 through 9.	Perform "Safety Slide Clamp Mechanical Calibration" on page 9-4.
4 5	Upstream occlusion was detected.	Check for spilled solution in sensor region. Ensure set is proper type and is properly loaded.	Remove upstream occlusion and reposition tubing. Clean the sensor with cotton swabs dampened with one of the agents listed in Table 6-1. Remove fibers or foreign particles. Do not use hard instruments for cleaning.
		Ensure ambient and solution temperatures are between 60° and 100° F (15.5° and 37.7° C).	Raise or lower temperatures.
		Perform the appropriate steps from "Automatic Test Mode 1: Calibration Mode 1" on page 9-14 related to upstream occlusion.	Reading displayed in pump's PRI RATE window must be within 3242 and 3314. If not, recalibrate or replace the sensor.
		Check for damage to door latch and hinges.	Replace any damaged parts.

Table 7-3 Failure Identification Codes — continued

Code	Cause	Checks	Corrective Action
6	Low battery voltage (10.4 V or less) was detected.	When BATTERY LOW alarm is on and CHARGING LED is off, check:	
		a. Tightness of AC plug	a. Plug in firmly.
		b. AC voltage source	b. When AC voltage is below 105 VAC, connect pump to a correct voltage source.
		c. Power fuse	c. Replace when it has failed.
		d. Battery fuse	d. Replace when it has failed.
		Turn pump off and recharge for 16 hours.	When alarm recurs after recharging, check and repair loose connections at battery terminals. If problem persists, replace battery.
7	Communication alarm was detected: A framing error, overrun error or parity error occurs during the communication with an external computer.	Check that the pump is in computer control mode. Check for the loss of the communications link. Verify that computer software is correctly loaded onto PC.	Place pump into computer control mode. Ensure communication cable is plugged in and/or the cable is wired correctly. Correct problems with PC software.
8	Communication time out alarm was detected: No communication between the pump and an external PC for a given period	See Failure Identification Code 7.	Place pump into computer control mode. Ensure communication cable is plugged in and/or the cable is wired correctly. Correct problems with PC software.
9	Slide Clamp Alarm (software versions 1.09 or later).	Slide clamp is not inserted or is improperly inserted in the slide clamp slot. Ensure that the slide clamp sensor is clean. Check calibration. Check connectors.	Insert slide clamp properly. Clean the slide clamp sensor with a cotton tipped swab dampened with water. When alarm recurs after cleaning the sensor, perform the slide clamp test in Chapter 10, “Operational Checkout”. Perform “Slide Clamp Sensor Calibration” on page 9-11. Replace sensor board. Replace safety/slide clamp assembly.
10	Misloaded tubing was detected.	Check set loading in the pump mechanism. Check any damage on the tube misloading sensors.	Load the tubing in the guides and channels correctly. Repair or replace the FSR(s).

Table 7-3 Failure Identification Codes — continued

Code	Cause	Checks	Corrective Action
12	Upstream occlusion was detected in Revolution Counter Interrupt.	See Failure Identification Code 4.	
20	Malfunction in Door Open detection circuitry: P54 of the Master CPU remains low.	Check that magnet in pump door latch is present.	Replace pump door latch when magnet is missing. Repair or replace CPU board.
21	Malfunction in frequency converter circuitry for occlusion detection: P20 of master CPU remains high or low.	Check connectors CN851 and CNBUS1/CNBUS2 for proper connection and continuity.	Repair or replace connectors as necessary. Replace CPU board. Replace Sensor board.
22	Malfunction in frequency converter circuitry for occlusion detection: P20 of master CPU remains high or low.	See Failure Identification Code 21. Verify low resistance (<30 Ω) between CN851-1 and CN851-2 (upstream occlusion coil) and CN851-3 and CN851-2 (downstream occlusion coil)	See Corrective Action for Failure Identification Code 21 Replace the failed coil as indicated by the high resistance reading. Also, replace the core and actuator of the applicable occlusion sensor and recalibrate.
23	P50 (IRQ interrupt port) remains high.	Check U101 pin 10 for a high (+5 VDC) signal.	Replace CPU board.
24	UP and DOWN occlusion values agree.	Check connector CNBUS1/ CNBUS2 for proper connection and continuity.	Repair or replace CNBUS1/ CNBUS2 if necessary. Replace CPU board. Replace Sensor board.
25	Failure in occlusion circuit	None	Replace CPU board.
27	Malfunction in slide clamp detection circuit.	Check battery voltage in accordance with "Automatic Test Mode 1: Calibration Mode 1" on page 9-14. Check connector CN803 for proper connection.	Clean contacts. Charge or replace the battery. Repair CN803 if necessary. Replace safety/slide clamp assembly.
28	Two air sensor outputs (NORM and MIN) cannot be selected.	Check connectors CN811 and CNBUS1/CNBUS2 for proper connection and continuity.	Repair or replace CN811 or CNBUS1/CNBUS2 if necessary. Replace CPU board. Replace Sensor board.
29	Two occlusion sensors (UP and DOWN) cannot be selected.	Check tightness of connectors CN851 and CNBUS1/CNBUS2 for proper connection and continuity.	Repair or replace CN851 or CNBUS1/CNBUS2 if necessary. Replace CPU board. Replace Sensor board.

Table 7-3 Failure Identification Codes — continued

Code	Cause	Checks	Corrective Action
30	Malfunction in A/D converter circuitry for air detection: A/D conversion did not complete in 50 mS.	Turn pump off and back on.	If failure recurs, replace CPU board.
31	Malfunction in air MIN detection circuitry: Input to A/D converter remains high.	Turn pump off and back on.	If failure recurs, replace CPU board. Replace Sensor board.
32	Malfunction in air NORM detection circuitry: Input to A/D converter remains high.	Turn pump off and back on.	If failure recurs, replace CPU board. Replace Sensor board.
33	Malfunction in air MIN detection circuitry: Input to A/D converter is not 0 V although the MIN air transducer is not oscillating.	Check tightness of connectors on the CPU board.	Replace CPU board. Replace Sensor board.
34	Malfunction in air NORM detection circuitry: Input to A/D converter is not 0 V although the NORM air transducer is not oscillating.	Check tightness of connectors on the CPU board.	Replace CPU board. Replace Sensor board.
35	Front panel key was pressed for more than 40 seconds.	Check that key was not inadvertently pressed for 40 seconds. Check that front panel is not damaged.	Turn the pump off and back on. If failure code recurs, replace front panel.
36	Master CPU received an abnormal power ON/OFF signal	Check CPU board for proper function.	Replace CPU board.
37	**ON-OFF/CHARGE** key was pressed for more than 5 seconds when pump power was off.	Check that the key was not inadvertently pressed for 5 seconds. Check that key is not damaged.	Replace front panel if necessary.
38	Malfunction in tube misloading detection circuitry.	Check connector CN803 and wiring for proper connection.	Clean contacts on male connector. Repair CN803 if necessary. Replace tube misload detector harness, QCNW1097.A. Replace the FSRs as a pair.
41	Abnormal operation of master CPU.	Turn pump off and back on.	If failure recurs, replace CPU board.
42	Malfunction in alarm control circuit.	Turn pump off and back on.	If failure recurs, replace CPU board.
46	The PWRON1 signal is held low.	Turn pump off and back on.	If failure recurs, replace CPU board.

Table 7-3 Failure Identification Codes — continued

Code	Cause	Checks	Corrective Action
47	The PWRON1 signal is held high.	Turn pump off and back on.	If failure recurs, replace CPU board.
48	Malfunction in real time clock: RTC does not count time correctly.	Turn pump off and back on.	Replace CPU board.
49	Malfunction in real time clock: Abnormal RTC data.	Turn pump off and back on. Check backup battery voltage in "Automatic Test Mode 1: Calibration Mode 1" on page 9-14. Reset all configuration option settings in "Modifying the Configuration Option Settings" on page 5-2	If failure recurs, charge or replace the battery. Replace CPU board.
50	Master CPU received a TRAP interrupt.	Turn pump off and back on.	If failure recurs, replace the software (EPROMs). Replace CPU board.
51	Master CPU received a CMI interrupt.	Turn pump off and back on.	If failure recurs, replace CPU board.
52	Master CPU received a SWI interrupt.	Turn pump off and back on.	If failure recurs, replace CPU board.
53	Master CPU received a NMI interrupt.	Turn pump off and back on.	If failure recurs, replace CPU board.
54	Master CPU received an OCI interrupt.	Turn pump off and back on.	If failure recurs, replace CPU board.
55	Master CPU received an IRQ2 interrupt.	Turn pump off and back on.	If failure recurs, replace CPU board.
58	Master CPU's TIMER 1 interrupt does not occur.	Turn pump off and back on.	If failure recurs, replace CPU board.
59	Program stuck in block 1 routine.	Turn pump off and back on. Check connections on CPU board.	Plug connectors in firmly. If failure recurs, replace CPU board.
60	Malfunction in battery voltage detection circuitry: Input to A/D converter remains high.	Turn pump off and back on.	If failure recurs, replace CPU board.
61	Malfunction in battery voltage detection circuitry: Input to A/D converter remains low.	Turn pump off and back on.	If failure recurs, replace CPU board.
62	Malfunction in memory back up battery voltage detection circuitry: Input to A/D converter remains high.	Turn pump off and back on.	If failure recurs, replace CPU board. Replace Sensor board.

Table 7-3 Failure Identification Codes — continued

Code	Cause	Checks	Corrective Action
63	Lithium backup battery voltage is too low to back up the memories.	Check connector CN304 for proper connection and continuity.	Plug CN304 in firmly. Replace lithium backup battery. Replace CPU board. Replace Sensor board.
64	Malfunction in A/D converter circuitry. A/D conversion for 0 through 3 channels did not complete in 144 mS.	Turn pump off and back on.	If failure recurs, replace CPU board. Replace Sensor board.
65	Malfunction in A/D converter circuitry. A/D conversion for 4 through 7 channels did not complete in 144 mS.	Turn pump off and back on.	If failure recurs, replace CPU board. Replace Sensor board.
66	Supply voltage of CPU circuitry is too high.	Turn pump off and back on.	If failure recurs, replace Sensor board.
67	Supply voltage of CPU circuitry is too low.	Turn pump off and back on.	If failure recurs, replace Sensor board.
68	Malfunction in A/D converter circuitry. A/D conversion for channels 8 and 9 did not complete in 72 mS.	Turn pump off and back on.	If failure recurs, replace CPU board. Replace Sensor board.
69	Abnormal battery recharging voltage.	Check calibration of DC Power Supply board.	Recalibrate the board. If failure recurs, replace CPU board.
70	Data in duplicate memory areas does not agree.	Turn pump off and back on. Check connections on CPU board.	If failure recurs, replace CPU board.
71	Slave CPU received no data from Master CPU.	Turn pump off and back on. Check connections on CPU board.	If failure recurs, replace CPU board.
72	Slave CPU received undefined data 4 times from Master CPU.	Turn pump off and back on. Check connections on CPU board.	If failure recurs, replace CPU board.
73	Overcurrent to motor. Motor current exceeds 1 A.	Check for loose motor coupler. Check that connector CN201 is seated firmly. Check for loose encoder wheel. Check for blown fuse F201 and F202.	Apply a trace of Loctite 211 or 222 to coupling set screws and tighten them to 5 kgf-cm (4.3 in-lb). Secure encoder wheel. Plug CN201 firmly. Replace fuse if necessary. Replace Sensor board. Replace CPU board.

Table 7-3 Failure Identification Codes — continued

Code	Cause	Checks	Corrective Action
74	Motor slipped even though at maximum current to motor.	Check that connector CN201 is seated firmly. Check for blown fuse F201 and F202. Check for loose encoder wheel.	Secure encoder wheel. Plug CN201 in firmly. Replace fuse if necessary. Replace Sensor board. Replace CPU board.
77	Slave CPU received no revolution interrupt while motor was rotating.	Turn pump off and back on. Ensure that the encoder wheel is properly secured. Check photointerrupter outputs for proper function.	Secure encoder wheel. Replace photointerrupters if necessary. Replace Sensor board. Replace CPU board.
78	Drive defect - overinfusion. High motor rotation against the number of revolution counter interrupts.	See Failure Identification Code 77.	
79	Drive defect - underinfusion. Low motor rotation against the number of revolution counter interrupts.	Ensure that pump head is clean and rotates freely. Check coupling between pump mechanism and motor. Check encoder wheel for secure mounting.	Apply a trace of Loctite 211 or 222 to coupling set screws and tighten. Secure encoder wheel. Replace Sensor board. Replace CPU board.
82	No acknowledgment message from Slave CPU for three communication trials.	Turn pump off and back on.	If failure recurs, replace CPU board.
83	Undefined message type received from Slave CPU.	Turn pump off and back on.	If failure recurs, replace CPU board.
86	LVDT reading of downstream occlusion sensor is too low.	Check calibration of downstream occlusion sensors.	See Failure Identification Code 2.
87	LVDT reading of downstream occlusion sensor is too high.	Check calibration of upstream occlusion sensors.	See Failure Identification Code 4.
89	Bank switching control circuit failure	Turn pump off and back on.	If failure recurs, replace CPU board.
90	RATE, VTBI and VI data checksum is not 0.	Turn pump off and back on.	If failure recurs, replace CPU board.
91	Checksum error of Programmed Delivery Profile stored data.	Reset all of PDP.	If failure recurs, replace CPU board.
92	Checksum error of Programmed Delivery Profile working data.	Reset all of PDP.	If failure recurs, replace CPU board.

Table 7-3 Failure Identification Codes — continued

Code	Cause	Checks	Corrective Action
93	Write data and read data of M5M5165 do not agree.	Turn pump off and back on.	If failure recurs, replace CPU board.
94	Configuration option settings checksum is not 0.	Reset all of the configuration option settings in accordance with "Modifying the Configuration Option Settings" on page 5-2. Turn pump off and back on. Check battery voltage in accordance with "Automatic Test Mode 1: Calibration Mode 1" on page 9-14.	If failure recurs, charge or replace the battery. Replace CPU board.
95	Checksum error of alarm log data.	Turn pump off and back on. Clear the alarm log via the modify configuration mode.	If failure recurs, replace CPU board.
96	Checksum error of ROM code.	Turn pump off and back on.	If failure recurs, replace CPU board.
99	Undefined failure code received from Slave CPU.	Turn pump off and back on.	If failure recurs, replace CPU board.

Troubleshooting Chart

Table 7-4 identifies specific failures by symptoms rather than Failure Identification Codes.

Table 7-4 Troubleshooting Chart

Symptom	Checks	Corrective Action
Power Issues		
The pump cannot be turned on.	Check backup battery voltage in accordance with "Automatic Test Mode 1: Calibration Mode 1" on page 9-14. Check front panel cables for short circuits and proper connection. Check CNBUS1/CNBUS2, CN601 and CN602 for proper connection and continuity.	Sometimes this condition is followed by a F49 and/or F94 code. Charge or replace the battery to clear the condition. Repair if necessary.

Table 7-4 Troubleshooting Chart — continued

Symptom	Checks	Corrective Action
The pump cannot be turned off.	Check backup battery voltage in accordance with "Automatic Test Mode 1: Calibration Mode 1" on page 9-14. Check front panel cables for short circuits. Check CNBUS1/CNBUS2, CN601 and CN602 for proper connection and continuity. Check if all 3 LEDs are on and the constant alarm is on.	Sometimes this condition is followed by a F49 and/or F94 code. Recharge or replace the battery to clear the condition. The battery compartment may need to be opened and the battery momentarily disconnected to turn off the pump. Disconnect then reconnect lithium battery. Replace front panel film. Replace CPU board. Replace Sensor board.
Battery does not provide rated backup power when AC power is not available.	Perform "Battery Check" on page 10-10.	Recharge or replace battery as required.
Pressing the **START** key causes a BATTERY LOW alarm.	Power the pump off and on again.	If the problem persists, recharge the battery. Repair as required. If the problem persists, replace the battery.
The pump fails to run on the internal battery (no LCD displays appear).	After recharging the battery for 12 hours with the pump turned off, check the battery charging voltage, MB, per "Automatic Test Mode 1: Calibration Mode 1" on page 9-14.	When the battery charge voltage is normal and the problem still persists, replace the battery. See "Replacement of Battery" on page 8-23.
The pump stops with BATTERY LOW alarm.	No check required.	Recharge the battery.
The pump does not run on AC but runs on internal battery.	Check that the AC power cord is firmly connected. Check AC fuses. Check power supply for proper voltage per "Automatic Test Mode 1: Calibration Mode 1" on page 9-14. Check CN301 and CNBUS1/ CNBUS2 for proper connection and continuity.	Repair or replace power cord. Replace AC fuses. Replace Power Supply board. Repair or replace the connectors. Replace CPU board. Replace Sensor board.

Table 7-4 Troubleshooting Chart — continued

Symptom	Checks	Corrective Action
The Battery Icon is lit while pump is running on AC.	Check the tightness of the power plug into the AC outlet. Check the rear power fuses under the power cord cover. Check the AC outlet for proper voltage. Check the line cord for continuity. Check power supply for proper voltage per "Automatic Test Mode 1: Calibration Mode 1" on page 9-14. Check connectors CNAC, CN301 and CNBUS1/CNBUS2 for proper connection and continuity.	Press the power plug firmly into the grounded AC outlet. Replace the fuse(s) when it has failed and recharge the battery. When the voltage is below 105 VAC, connect the pump to the correct supply voltage. Connect the power terminals of the power plug to an ohmmeter. The ohmmeter should indicate continuity. Replace Power Supply board. Replace CPU board. Replace Sensor board.
The Plug Icon is not lit when the pump is plugged in to AC power	Check the tightness of the power plug into the AC outlet. Check the rear power fuses under the power cord cover. Check the AC outlet for proper voltage. Check the line cord for continuity.	Press the power plug firmly into the grounded AC outlet. Replace the fuse(s) when it has failed and recharge the battery. When the voltage is below 105 VAC, connect the pump to the correct supply voltage. Connect the power terminals of the power plug to an ohmmeter. The ohmmeter should indicate continuity.
The Battery Icon is off while pump is running on internal battery.	Turn pump off and back on.	If failure recurs, replace Display board. Replace CPU board.
The backlight is off when the pump is running on internal battery power.	N/A	Press the **BACKLIGHT** key as long as required to view the pump settings.
ALARM and ALERT LEDs are lit but the pump does not operate.	Check backup battery voltage in accordance with "Automatic Test Mode 1: Calibration Mode 1" on page 9-14.	Sometimes this condition is followed by a F49 and/or F94 code. Recharge or replace the battery to clear the condition.
Electrical Issues		
The LCDs are blank, indicate irrational display or have missing segments.	Check ICP301 and CNDISP for proper connection and continuity using Test Mode 5 ("Automatic Test Mode 5: Display Check Mode" on page 7-10).	Install LCD Cushions, if necessary. See "LCD Cushion Installation" on page 8-30. Replace CPU board. Replace Sensor board. Replace Display board.
The backlight does not light.	N/A	Replace Display board.

Table 7-4 Troubleshooting Chart — continued

Symptom	Checks	Corrective Action
The backlight cannot be turned off.	N/A	Replace Sensor board. Replace Display board.
The pump turns off or stops with audible alarm for no apparent reason.	Check ICP301. Check CNBUS1/CNBUS2 for proper connection and continuity. Check front panel cables for short circuits.	Repair or replace CNBUS1/CNBUS2 Replace front panel film. Replace Sensor board. Replace Display board.
ALARM LED is always lit.	Turn pump off and back on.	If problem recurs, charge or replace battery. Replace CPU board. Replace Display board.
ALARM LED does not light.	Check CNDISP and CNBUS1/ CNBUS2 for proper connection and continuity.	Replace CPU board. Replace Display board.
ALERT LED is always lit.	Turn pump off and back on. Check CNBUS1/CNBUS2 for proper connection and continuity.	If problem recurs, charge or replace battery. Replace CPU board. Replace Display board.
ALERT LED does not light.	Check CNDISP for proper connection and continuity.	Replace CPU board. Replace Display board.
PUMPING LED is always lit.	Check CNDISP for proper connection and continuity.	Replace Sensor board. Replace Display board.
PUMPING LED does not light.	Check CNDISP for proper connection and continuity.	Replace Sensor board. Replace Display board.
The audible alarm volume is not loud enough.	N/A	Turn the VOLUME knob on the rear of the pump clockwise until the desired volume is obtained.
Audible alarm is always on.	Momentarily disconnect and reconnect battery. Check F302 or ICP301. Check CNBUS1/CNBUS2, CN302, CN701, CN751, and CNI/F for proper connection and continuity.	Charge or replace battery. Replace Sensor board. Replace CPU board.
Audible alarm does not sound.	Turn pump off and back on.	If problem recurs, replace CPU board. Replace Sensor board. Replace speaker.

Table 7-4 Troubleshooting Chart — continued

Symptom	Checks	Corrective Action
Beep does not sound when a key other than BACKLIGHT or **SILENCE** is pressed when the pump is stopped.	Turn pump off and back on. Check CN751, CN701, CNI/F1, and CNBUS1/CNBUS2 for proper connection and continuity.	Repair or replace the connectors. Replace speaker. If problem recurs, replace CPU board. Replace Sensor board.
Optional nurse call is always on.	Check CN401, CNI/F2 and CNBUS1/ CNBUS2 for proper connection and continuity.	Replace CPU board. Replace Sensor board.
Optional nurse call is always off.	Verify that the Nurse Call feature has been enabled via the addition of a jumper (R421) on the terminal PCB. Check CN401, CNI/F2 and CNBUS1/ CNBUS2 for proper connection and continuity.	Replace CPU board. Replace Sensor board.
Configuration option cannot be set via the remote computer. **Note:** Computer monitoring and remote control are available only when used with user-generated software applications. See the FLO-GARD 6201 Programmer's Manual for details.	Check the cable connections between the computer and the pump. Check that the user-generated software is properly loaded onto the computer. Check CN401, CNI/F2 and CNBUS1/ CNBUS2 for proper connection and continuity.	Repair connections between computer and pump. Restart the program. Repair or replace connectors as required. Replace CPU board. Replace Sensor board.
Backup buzzer does not activate during self test.	Check that the buzzer wiring is connected. Check for an open fuse on the battery wire harness.	Plug in connector. Replace fuse. Replace backup buzzer.

Table 7-4 Troubleshooting Chart — continued

Symptom	Checks	Corrective Action
Mechanical Issues		
The pump door does not open or close smoothly.	Check the positioning and seating of the administration set tubing and the slide clamp.	Position the tubing and the slide clamp properly and make certain they are seated in the guides.
	Check the administration set for type and code.	Replace with a Baxter "s" suffix administration set if required.
	Check for solution spills (liquids or residue).	Clean all accessible areas with cotton swabs dampened with one of the cleaners listed in Table 6-1. Remove fibers or foreign particles. Do not use hard instruments for cleaning.
	Check that the door latch roller pin turns smoothly.	Clean the roller with an approved cleaner.
	Remove pump head door cover in accordance with "Replacement of Pump Head Door Cover" on page 8-9, steps 1 and 2. Check for possible damage to the door latch, latch pin roller, or door hinge.	See "Replacement of Pump Door Latch" on page 8-10 for instructions on replacing the door latch and "Replacement of Door Latch Pin" on page 8-11 for replacing the latch pin.
		Replace door as described in "Replacement of the Pump Door or Pump Door Assembly" on page 8-11.
A CHECK SET/LOADING alarm occurs when the pump door is closed.	Open the door and check the position of the tubing in the guide channel.	Load the set properly in the guide channel.
An AIR alarm occurs with no air in the tubing or with the pump door closed and the **START** key pressed.	Check the positioning and seating of the tubing.	Position the tubing fully into the air sensor.
	Check the tubing for surface scratches and for tube roundness.	Replace or reposition the tubing when surface scratches are significant or when the tubing has become flattened or oval in shape.
	Check the administration set for type and code.	Replace with Baxter's "s" suffix administration set.
	Check for solution spills (liquids or residue).	Clean the sensor with cotton swabs dampened with one of the agents listed in Table 6-1. Remove fibers or foreign particles. Do not use hard instruments for cleaning.

Table 7-4 Troubleshooting Chart — continued

Symptom	Checks	Corrective Action
An OCCLUSION alarm or an UPSTREAM OCCLUSION alarm occurs with the pump door closed and the **START** key pressed.	Check the positioning and seating of the tubing.	Position the tubing properly into the sensor and safety clamp. Correct any pinched or kinked tubing in the pump.
	Check that there are no obstructions upstream or downstream of the pump.	Remove obstructions and/or open the roller clamp.
	Check the administration set for type and code.	Replace with Baxter's "s" suffix administration set if required.
	Check that ambient and solution temperatures are above 60° F.	Raise ambient and/or solution temperatures.
	Check for solution spills (liquids or residue) on the inside of the door and/or on the baseplate.	Clean all accessible areas with cotton swabs dampened with one of the cleaning agents listed in Table 6-1. Remove fibers or foreign particles. Do not use hard instruments for cleaning.
	Check for damage to door latch and hinges.	Replace any damaged parts.
	Perform "Automatic Test Mode 1: Calibration Mode 1" on page 9-14, steps 1 through 6.	Perform "Safety Slide Clamp Mechanical Calibration" on page 9-4.
PANEL LOCK switch is not accepted.	Check the operation of the switch.	Replace PANEL LOCK switch.
	Check CN701, CNI/F2 and CNBUS1/CNBUS2 for proper connection and continuity.	Replace Sensor board.
DOOR OPEN alarm occurs while door is closed, or does not occur when door is opened.	Check magnet on door latch.	Replace door latch when magnet is missing.
	Check CN851.	Replace CPU board.
Pump operation is louder than normal.	Check administration set for proper type and code.	Replace with Baxter's "s" suffix standard administration set, if required.
	Check for solution spills on the pumping fingers and around the back plate.	Clean in accordance with Chapter 6, "Routine Maintenance".
	Check the tightness of the motor mounting bracket screws.	Tighten as required.
	Check for a PC board or other assembly vibrating against the inside of the case.	Ensure all internal assemblies are securely fastened.
The rear clamp fails to hold the pump on the IV pole.	Check for worn or missing friction pad.	Replace worn or defective parts on the clamp as necessary.
	Check the clamp for worn threads and other worn or defective parts.	

Table 7-4 Troubleshooting Chart — continued

Symptom	Checks	Corrective Action
The safety clamp does not latch open.	Check the positioning and seating of the slide clamp in the slide clamp slot. Check if the administration set is equipped with the slide clamp designed for use with this pump. See the instructions accompanying the administration set. Make sure the safety clamp arm cover is in the full open position. Check for solution spills (liquids or residue).	Push the slide clamp all the way into the slide clamp slot. If not, use an administration set which has the compatible slide clamp. Insert the slide clamp into the slide clamp slot before closing the pump door. Exercise the safety clamp by opening and closing it several times. Clean with cotton swabs dampened with one of the cleaning agents listed in Table 6-1. Remove fibers or foreign particles. Do not use hard instruments for cleaning.
Free flow occurs when the door is closed.	Check administration set for proper type and code. Check position and seating of the tubing. Check that ambient and solution temperatures are between 60° and 100° F (15.5°and 37.7° C). Check for cracks in the door hinges. Check for deformation of the coil springs of the back plate. Press back plate in and out and ensure range of motion. Check for worn cams and pumping fingers. Remove front cover. Check for damaged or deformed door latch or damaged latch area.	Replace with Baxter's "s" suffix standard administration set if required. Position tubing properly, without stretching or slack. Raise or lower the temperatures. Replace the pump head in accordance with "Replacement of Pump Head Assembly" on page 8-12. Replace the springs if required. Replace worn parts as required. Replace door latch in accordance with "Replacement of Pump Door Latch" on page 8-10. Replace door in accordance with "Replacement of the Pump Door or Pump Door Assembly" on page 8-11.
Free flow occurs when the door is opened.	Check administration set for proper type and code. Check for solution spills on and around safety clamp. Check position and seating of tubing in safety clamp. Check that ambient and solution temperatures are between 60° and 100°F (15.5° and 37.7°C). Check for broken safety clamp spring and/or broken safety clamp.	Replace with Baxter's "s" suffix standard administration set if required. Clean in accordance with Chapter 6, "Routine Maintenance". Position tubing properly and make certain it is seated in guides and channels. Raise or lower the temperatures. Replace broken parts if required.

Table 7-4 Troubleshooting Chart — continued

Symptom	Checks	Corrective Action
INSERT SLIDECLAMP alert or alarm is constantly on. **Note:** The alarm option is available only on pumps running software versions 1.09 or later.	Ensure that the slide clamp sensor is clean. Check connections. Check calibration and operation.	Clean the slide clamp sensor. Disconnect and reconnect. Perform steps in "Slide Clamp Sensor Calibration" on page 9-11. Replace sensor board. Replace the safety/slide clamp assembly.
An INSERT SLIDECLAMP alert or alarm occurs when the pump door is closed. **Note:** The alarm option is available only on pumps running software versions 1.09 or later.	Check that the slide clamp is in the slide clamp slot. Check for solution spills (liquids or residue) on the slide clamp or safety/ slide clamp assembly. Check if the administration set is equipped with the slide clamp designed for use with this pump. See the instructions accompanying the administration set.	Push the slide clamp all the way into the slide clamp slot. Clean the safety/slide clamp assembly. If not, use an administration set which has the proper slide clamp for use with the pump. Insert the slide clamp into the slide clamp slot before closing the pump door.
AIR alarm is continuously on	Check for air in tubing. Ensure set is correct type and is properly loaded. Ensure set tubing is not scratched or deformed. Perform "Automatic Test Mode 2: Calibration Mode 2" on page 9-15 steps 2 through 9.	Expel air in tubing. Replace or reposition set when tubing is flattened or scratched. Recalibrate the air sensor in accordance with "Air Sensor Calibration" on page 9-6. Clean air sensor in accordance with Chapter 6, "Routine Maintenance" when dirty. When values are not within specification, recalibrate or replace the air sensor. Verify air sensor calibration in accordance with "Automatic Test Mode 2: Calibration Mode 2" on page 9-15 steps 2 through 9. Repair or replace the occlusion sensor.

Table 7-4 Troubleshooting Chart — continued

Symptom	Checks	Corrective Action
Inaccurate delivery: Accuracy	Check administration set for proper type and code. Check position and seating of the tubing. Check that ambient and solution temperatures are between 60° and 100° F (15.5°and 37.7° C). Check for cracks in the door hinges. Check for deformation of the coil springs of the back plate. Press back plate in and out and ensure range of motion. Check for worn cams and pumping fingers. Remove front cover. Check for damaged or deformed door latch or damaged latch area.	Replace with Baxter "s" suffix standard administration set if required. Position tubing properly, without stretching or slack. Raise or lower the temperatures. Replace the pump head in accordance with “Replacement of Pump Head Assembly” on page 8-12. Replace the springs if required. Replace worn parts as required. Replace door latch in accordance with “Replacement of Pump Door Latch” on page 8-10. Replace door in accordance with “Replacement of the Pump Door or Pump Door Assembly” on page 8-11.
Operational Issues		
A FLOW RATE or CHECK VTBI alarm occurs when a **START** key is pressed.	Check that the rate or VTBI are within the limits set by the configuration option.	Change the maximum rate and/or maximum VTBI setting through the configuration option.
All front panel keys other than **BACKLIGHT** and **TOT VOL/ STATUS** are disabled.	Does Loc appear in the Main Display?	Press and release PANEL LOCK switch on the rear panel. Loc in the Main Display should disappear.
One or more front panel keys are not accepted.	Check if the front panel is locked (Loc appears in Main Display). Turn pump off and back on and try the key again. Check front panel ribbon cable for proper connection and continuity.	Press the PANEL LOCK switch to remove the panel lock. Replace front panel film. Replace Sensor board. Replace Display board.
The interval between audible alarm tones is too long.	N/A	Change the interval for alert and/or alarm tones to the desired value through the configuration option.

Chapter 8

Removal/Replacement Procedures

Overview

This section of the manual includes a list of tools and test equipment required for performing maintenance, procedures for removing and replacing subassemblies once the cause of a malfunction has been determined, and procedures for calibration after component or circuit board replacement. Detailed exploded views of the pump are provided in Chapter 11, “Illustrated Parts Breakdown”.

Preparation for Maintenance

! WARNING ! **This device should be repaired only by Baxter authorized service personnel or Baxter-trained hospital biomedical engineering personnel.**

! WARNING ! **Use only Baxter replacement/service parts. Installation of parts other than those available from Baxter may affect product performance. The use, by any party, of non-Baxter parts in the repair, renovation, repackaging or restoration of a Baxter device means that person or entity is the manufacturer of that device. Any liability arising from the use of non-Baxter parts is assumed by the entity performing such work. Baxter’s warranty is immediately null and void where non-Baxter parts are used to repair Baxter devices.**

Tools and Test Equipment

The following tools and test equipment are required to perform the procedures contained in this section. Since all fasteners on this pump are metric, ensure that all tools used are for metric fasteners. Tightening torques on certain screws are specified in kgf-cm and in-lb for your convenience. The values in in-lb are approximate.

Note: Reset the configuration options in accordance with "Modifying the Configuration Option Settings" on page 5-2 after performing any repairs. This is especially important after replacing the EPROMs, and after the occurrence of failure codes 49 or 94.

Test Equipment	Tools
• Digital Voltmeter • DC Ammeter • 10Ω, 10W resistor with variable load • Thickness gauge, part number UKOG1013.B • 0.3 mm, flat- feeler gauge • Grounded wrist strap • Anti-static mat or other anti-static work surface • Calibration tubing, part no. 3-2-92-479 • Precision 250 µL gas tight syringe. part no. Hamilton #1725 (or equivalent) • Oscilloscope (dual trace)	• Razor blade • Metric Phillips-head screwdriver, #0 • Metric Phillips-head screwdriver, #1 • Metric Phillips-head screwdriver, #2 • UPP extractor, part no. UKOG1020.A • Wire harness connector extractor, part no. UKOG1021.A • Torque screwdriver, 0-15 kgf-cm or 0-20 in-lb • Metric ball point Allen wrench, 1.5 mm • Slide Clamp Resetting Tool, part no. 020416132 • Soldering Iron, temperature-regulated, 600° - 700°F, 20 - 48 Watts, 1/32" tip • Yellow paint pen

Recording the Configuration Option Settings

It is necessary to record the configuration option settings and the alarm log data before beginning maintenance procedures so that the pump can be reconfigured properly when maintenance is completed. See "Reviewing the Configuration Option Settings" on page 5-1 for more information.

Note: When the battery, EPROMs or a circuit board is disconnected or replaced, or a calibration is performed, all the configuration options must be reset. See "Modifying the Configuration Option Settings" on page 5-2.

1. Turn on the pump. Enter the configuration review mode by pressing the **TIME** and **TOT VOL/STATUS** keys simultaneously. Hold the keys for 1 second.

2. Press the **NEXT** or **SEC START** key to access each parameter sequentially. Record the configuration settings.

3. Exit the configuration inspection mode by pressing **TIME** and **TOT VOL/STATUS** again or press the **STOP** key.

4. Record the contents of the alarm log by pressing the **SILENCE** and **TOT VOL/STATUS** keys simultaneously then, within one second, press the **CLEAR TOT VOL** key to display the rest of the failure codes.

Torque Specifications

The following table provides torque values for the hardware that requires them.

Table 8-1 Torque Specifications

Component Secured	Item No. in Figure	Torque Specification
Rear housing to front housing, body	Item 26 in Figure 11-4	9 kgf-cm (7.8 in-lbs)
Rear housing to front housing, handle	Item 37 in Figure 11-4	9 kgf-cm (7.8 in-lbs)
PCBs/hardware to front housing	Item 17 in Figure 11-2	7 kgf-cm (6.1 in-lbs)
Front panel film ground screw	Item 13 in Figure 11-2	3 kgf-cm (2.6 in-lbs)
Door cover to pump head assembly	Item 28 in Figure 11-5	4 kgf-cm (3.5 in-lbs)
Pump head assembly	Item 4 in Figure 11-1 Item 6 in Figure 11-1	9 kgf-cm (7.8 in-lbs) 9 kgf-cm (7.8 in-lbs)
Upstream occlusion sensor	Item 16 in Figure 11-7 Item 6 in Figure 11-7	3 kgf-cm (2.6 in-lbs) 1.5 kgf-cm (1.3 in-lbs)
Downstream occlusion sensor	Item 16 in Figure 11-7 Item 6 in Figure 11-7	3 kgf-cm (2.6 in-lbs) 1.5 kgf-cm (1.3 in-lbs)
Air sensor	Item 16 in Figure 11-7 Item 14 in Figure 11-2	2 kgf-cm (1.7 in-lbs) 7 kgf-cm (6.1 in-lbs)
Door latch pin	Item 15 in Figure 11-6	7 kgf-cm (6.1 in-lbs)
Pump motor	Item 22 in Figure 11-8 Item 27 in Figure 11-8 Item 30 in Figure 11-9	6 kgf-cm (5.2 in-lbs) 5 kgf-cm (4.3 in-lbs) 6 kgf-cm (5.2 in-lbs)
Safety slide clamp assembly	Items 28 and 40 in Figure 11-8 Item 35 in Figure 11-9 Item 2 in Figure 11-7	6 kgf-cm (5.2 in-lbs) 3 kgf-cm (2.6 in-lbs) 1 kgf-cm (0.9 in-lbs)
Back plate	Items 26 and 27 in Figure 11-5	6 kgf-cm (5.2 in-lbs)
Main battery	Item 19 in Figure 11-4	9 kgf-cm (7.8 in-lbs)
DC power supply	Item 17 in Figure 11-3	7 kgf-cm (6.1 in-lbs)

Table 8-1 Torque Specifications — continued

Component Secured	Item No. in Figure	Torque Specification
Main buzzer PCB assembly	Item 22 in Figure 11-3	7 kgf-cm (6.1 in-lbs)
Backup audible alarm PCB assembly	Item 22 in Figure 11-3	7 kgf-cm (6.1 in-lbs)
Terminal PCB assembly	Item 22 in Figure 11-3	7 kgf-cm (6.1 in-lbs)
117V, 60 Hz AC transformer	Items 21 and 24 in Figure 11-3 Item 20 in Figure 11-3	9 kgf-cm (7.8 in-lbs) 5 kgf-cm (4.3 in-lbs)
Pole clamp	Item 21 in Figure 11-4	9 kgf-cm (7.8 in-lbs)

Disassembly/Reassembly

Disassembly of the FLO-GARD 6201 Single Channel Volumetric Infusion Pump is limited to the mechanical components and printed circuit boards (PCBs). It is recommended that electrical problems be corrected by replacing entire PCBs unless circumstances warrant component repair. Use only approved replacement parts provided by Baxter Healthcare Corporation and listed in Chapter 11, “Illustrated Parts Breakdown”.

Please read all steps in the procedure before beginning. The procedures are given in order of disassembly. Disassemble the pump only as far as required to complete repair. All fastening components such as screws, washers and nuts used in the pump are metric. Be sure to use metric tools and replace only with metric components.

! WARNING ! **Ensure that the pump is powered off and unplugged from the AC receptacle before performing maintenance procedures unless directed otherwise by the procedure in this manual.**

CAUTION **Tighten fasteners to the torque values specified in the procedures. Do not overtighten any fastener.**

CAUTION **Work only at a properly installed electrostatic discharge (ESD) workstation. Wear a grounding wrist strap, when not connected to AC power, while servicing the pump.**

CAUTION **Do not lay the pump face down on components or tools which could scratch or damage the keypad. Do not lay the pump face down with door assembly open.**

CAUTION **Where connectors are identified as “locking,” unlock the connectors before removing cables.**

CAUTION **Note the routing of the wires before removing them.**

CAUTION **Fully unlock flat ribbon cable connector flange before removing cable. Attempting to remove the cable while locked can damage the cable and connector.**

CAUTION **Ensure that connectors are mated and observe the correct orientation.**

CAUTION **Ensure that wires are not pinched or overstressed.**

Separation of Front and Rear Housings

1. Turn the pump off and place it face down on an anti-static mat or work surface. Take care not to lay the pump face down on components (such as screws) which could damage the front panel.

2. Remove 8 screws that secure the rear housing to the front housing. (Figure 11-4 , items 26 and 37.)

CAUTION **Avoid stressing the pump's internal cabling when separating the front and rear housings.**

3. Stand the pump upright and separate the front and rear housings by slowly pulling the front half forward.

4. While the pump is standing, disconnect the following connectors in order:

   4.1 Transformer connector, CN1, from the power supply board (Figure 11-2 , item 12) located in the front half of the pump.

   4.2 Battery connector, CN302, from the sensor board (Figure 11-2 , item 3) located in the front half of the pump.

Note: The backup audible alarm may be activated. Continue with step 4.3 to disable the alarm.

   4.3 Battery connector, CN751, from the backup audible alarm board (Figure 11-3 , item 1) located in the rear half of the pump.

Note: Unlock the flat cable connector flange before disconnecting the cable.

   4.4 Disconnect the flat cable connector from the back case half by first pulling the flange forward about 2 mm (5/64"). (CN-IF2)

Note: Later versions of the pump may have the ribbon cable tacked to the side of the case half.

5. Lay the front case half down on its front surface. Position it immediately in front of the rear half.

6. Separate the two housings by disconnecting the ground wire from the main ground plate (Figure 11-3 , item 6) from the back case half.

7. Reassemble the housings in the following order:

   7.1 Replace the ground wire.

   7.2 Stand the front housing up. Make sure that the connector flange is unlocked and reconnect the ribbon cable connector. Push in the flange to hold the cable in place. Use double sided tape as necessary.

   7.3 Reconnect CN1, CN751 and CN302 in that order.

   7.4 Route the following wires between the front and rear housings so that they are not pinched by internal components when the housings are closed:

   - Ground wire
   - Battery harness
   - Pump head harness
   - Ribbon cable

   7.5 Route the battery harness so that it is located over the battery compartment and through the cut portion of the CPU and Power Supply PCBs (Figure 11-2 , items 2 and 12).

CAUTION **The CPU board (item 2) must be placed in the space between the battery compartment and the power transformer mounting bracket. Do not hit the EPROMs on the board against the battery compartment.**

   7.6 Close the two housings by slightly lifting and moving the rear housing slowly toward the front housing.

Note: Tilting the case halves apart or rocking them back and forth to align the cases when the pump is standing up should be avoided. This action can cause the corner of the transformer to snag the keypad ribbon. Figure 8-1 shows the transformer and keypad ribbon.

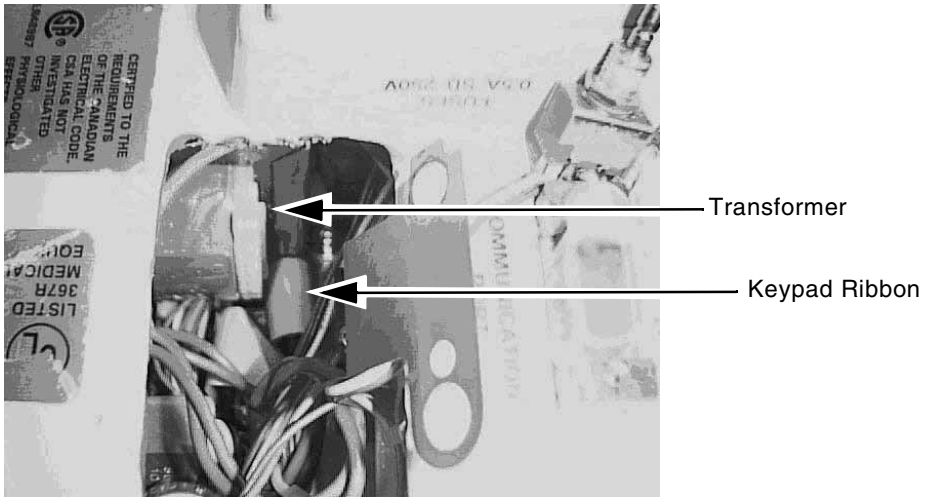


Figure 8-1 Transformer and Keypad Ribbon Location

7.7 Plug power cord into an AC outlet and check that the Plug Icon is lit. If not, check for proper connection of CN1.

7.8 Press the **ON-OFF/CHARGE** key and check that the self test is performed correctly.

7.9 Be sure the front and rear housing surfaces are flush before tightening. Replace 6 screws (Figure 11-4 , item 26) and tighten them to 9 kgf-cm (7.8 in-lb) with a torque screwdriver.

7.10 Replace 2 screws (Figure 11-4 , item 37) at handle. Tighten them to 9 kgf-cm (7.8 in-lb) with a torque screwdriver.

7.11 If no other repairs are performed, perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Separation of Printed Circuit Boards

1. Separate the front and rear housings completely ("Separation of Front and Rear Housings" on page 8-5).
2. Disconnect the two connectors (CN601 and CN602) of the front panel film from the sensor board.
3. Disconnect four pump head connectors, CN201, CN851, CN803 and CN811, from the sensor board (Figure 11-2 , item 3) with the wire harness connector extractor, part no. UKOG1021.A.
4. Remove the outermost four screws affixing the sensor board to the front housing. They are marked by arrows. Remove the ground wire screw (Figure 11-2 , item 14) beside motor only.
5. Hold both top corners of the CPU board (Figure 11-2 , item 2) and lift it until the sensor board (item 3) engages with the ground tab of the pump head mounting bracket.
6. Incline the boards toward the pump head assembly and slide the boards out of the side of the front half.
7. Place the printed circuit boards with the LCD display face down on a dust free flat surface. Be careful not to touch or damage the LCD display surface. Keep them away from dust. Take care not to place the LCD display on components (such as screws) which could damage the LCD display.
8. Reassemble in reverse order.
   - Be sure to remove any dirt or dust on the LCD or its windows on the front housing before tightening the sensor board to the front housing.
   - Be sure to reconnect all the removed connectors (refer to "Routing of Internal Wiring" on page 8-33).

9. Tighten the four screws (item 17) securing the sensor board to 7 kgf-cm (6.1 in-lb).

Note: The function of the four printed circuit boards can be checked outside of the front housing as long as all the connectors are properly connected.

10. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Replacement of Front Panel Film

1. Separate the front and rear housings completely ("Separation of Front and Rear Housings" on page 8-5).

2. Separate the printed circuit boards. ("Separation of Printed Circuit Boards" on page 8-7).

3. Remove one screw (Figure 11-2 , item 13) that grounds the front panel film.

CAUTION **Do not damage the front housing or the EMI plating with the tool. Do not reuse the removed front panel.**

4. Remove the front panel film and the silicon rubber around the panel from the front housing with a razor blade or similar tool.

5. Reassemble in reverse order.

6. Tighten the front panel film ground screw (item 13) to 3 kgf-cm (2.6 in-lb).

7. Remove the adhesive backing from the new front panel film edges and press firmly around front panel film edges and ensure that film is securely attached to the pump with no gaps.

8. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

9. Seal the edges of the new front panel as follows:

   9.1 Place the pump on its back and apply a strip of masking tape along the four edges and corners of the front panel, approximately 0.38 to 0.64 mm (0.015 to 0.025") from the edges and corners of the panel.

   9.2 Using a dispenser with a small-diameter tip, apply a bead of Toray Dow Corning Silicone SE 9189 L (part no. UPAS0002.A) along the edges and corners of the panel. Apply the bead uniformly, within 40 to 50 seconds per edge.

9.3 Remove the masking tape before the silicone starts to form a skin.

9.4 Keep the pump on its back for 30 – 45 minutes.

Replacement of Pump Head Door Cover

1. Open the pump head door.
2. Remove five screws that secure the pump head door cover to the pump head door. (Figure 11-5 , item 28) Do not remove the screw affixing the metal plate in the recess at the bottom of the door (Figure 11-5 , item 27).
3. If clicking is heard during pump operation and is irritating, you may be able to stop this by following the procedure below, otherwise proceed to the next step:

3.1 Remove the seven screws (item 26 in Figure 11-5) from the outside of the door.

3.2 Remove one screw (item 27 in Figure 11-5) from the inside of the door.

CAUTION **Perform this step carefully so as to avoid losing the springs held in place by the screws you just removed.**

3.3 Note how the springs are currently installed to ensure they are installed correctly later.

3.4 Remove the five springs (item 18 in Figure 11-5) and the back plate (item 17 in Figure 11-5).

3.5 Apply a very small quantity of silicone grease (part no. G-501) to the four blue pads (item 20 of Figure 11-5) located inside the back plate slot with a brush.

3.6 Ensure that the back plate is clean.

3.7 Ensure that the five springs are installed correctly.

3.8 Ensure that the safety clamp plate (item 15 in Figure 11-5) and any spacers are in place.

3.9 Align the notch in the back plate with the tongue in the door and secure the back plate in place with the 8 screws (items 26 and 27 in Figure 11-5) removed previously. Torque to 6 kg-cm (5.2 lbs.-in.)

3.10 Proceed to the next step.

Note: If this does not stop the clicking you need to check for the source in other areas such as a loose motor coupling or a misaligned motor.

4. Reassemble the cover in reverse order. Tighten each of the five screws to 4 kgf-cm (3.5 in-lb) with a torque screwdriver.

5. Apply the Front Door Information Label (p/n 07-26-26-932) to the outside of the door (see Figure 8-2).

Figure 8-2 Door Information Label Location

6. Perform the procedure in "Safety Slide Clamp Mechanical Calibration" on page 9-4.

7. Perform the procedure in "Free Flow Prevention Test" on page 10-11.

8. Perform an accuracy test as specified in the Operational Checkout procedures of Chapter 10, "Operational Checkout".

Replacement of Pump Door Latch

1. Remove the pump door cover in accordance with "Replacement of Pump Head Door Cover" on page 8-9.

2. Close the pump door.

3. Remove the E-ring (Figure 11-5 , item 5) that secures the door latch.

4. Lift the door latch and carefully pull it out of the pump door. Use caution to avoid losing the associated parts on the door latch pin.

5. To replace the latch, lay the pump on its back.

6. Place one thin washer (Figure 11-5 , item 8), the spring (item 6), and the other thin washer (item 8) on the door latch pin.

7. Insert the pin into the hole in the pump door.

8. Open the pump door slightly.

9. Press the door latch in toward the pump door so that the spring is compressed.

10. Install 4 mm washer (item 7) onto the pin.

11. Install the E-ring (item 5) onto the pin.

12. Calibrate in accordance with "Air Sensor Calibration" on page 9-6 through "Upstream Occlusion Sensor Calibration" on page 9-10.

13. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Replacement of the Pump Door or Pump Door Assembly

1. Remove the pump door cover in accordance with "Replacement of Pump Head Door Cover" on page 8-9.

2. Remove the two set screws (Figure 11-5 , item 29)

3. Slide the hinge pins (Figure 11-5 , item 14) toward each other and remove the door.

4. Install the replacement door or door assembly in reverse order. Note the alignment of the hinge pins and make sure that the tapered ends are pointed toward each other.

5. Install door hinge pin set screws (Figure 11-5 , item 29).

6. Calibrate in accordance with "DC Line Voltage Calibration" on page 9-1 through "Upstream Occlusion Sensor Calibration" on page 9-10.

7. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Replacement of Door Latch Pin

1. Remove one screw (Figure 11-6 , item 15) that secures the latch pin mounting block to the pump head base plate.

2. Install replacement door latch pin and secure with 1 screw. Tightening torque is 7 kgf-cm (6.1 in-lb).

3. Calibrate in accordance with "DC Line Voltage Calibration" on page 9-1 through "Upstream Occlusion Sensor Calibration" on page 9-10.

4. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Replacement of Pump Head Assembly

1. Separate the front and rear housings (“Separation of Front and Rear Housings” on page 8-5).
2. Disconnect four pump head connectors, CN201, CN851, CN803 and CN811, from the sensor board (Figure 11-2 , item 3) with the wire harness connector extractor, part no. UKOG1021.A.
3. Remove the screw that secures the pump head ground wire to the pump head mounting plate (Figure 11-2 , item 14, top ground wire only).
4. Remove the pump door cover (“Replacement of Pump Head Door Cover” on page 8-9).
5. Open the pump door and remove one black flathead screw and Phillips screw at the top and bottom right of pump head assembly. (Figure 11-1 , items 4 and 6).
6. Close the door and remove two black flat head screws (Figure 11-1 , item 4) on the door hinge side that secure the pump head assembly to the front housing. These screws are accessible only when the door is closed. Do not open the door before completely removing the two screws from the pump head assembly.
7. Push the pump head assembly from the back and take it out of the front housing.

CAUTION **Do not pull out the two flexible cables (Figure 11-6 , items 10 and 11) from their associated connector housings. This action could open the circuit.**

CAUTION **Do not remove the gasket (Figure 11-1 item 3) from the front case.**

CAUTION **When resistance is felt, check any pinched wires between the pump head assembly and the mounting plate or remove tangled wiring harness. Do not force the assembly out. Insulation of pump head wire harness can be damaged.**

8. Reassemble the pump head assembly in reverse order (refer to “Routing of Internal Wiring” on page 8-33).

CAUTION **Be sure not to pinch wires and gasket between the front housing and the pump head assembly when reinstalling the pump head assembly.**

CAUTION **The three black screws (Figure 11-1 , item 4) and one Phillips screw (item 6) must be torqued to 9 kgf-cm (7.8 in-lb). The screw (Figure 11-2 , item14) for the pump head ground wire must be torqued to 7 kgf-cm (6.1 in-lb).**

CAUTION **Route the pump head wiring harnesses as close to the side of the pump head assembly as possible so that the wires are not pinched or damaged by internal components when the housings are closed.**

9. Calibrate in accordance with "DC Line Voltage Calibration" on page 9-1 through "Upstream Occlusion Sensor Calibration" on page 9-10.

10. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Replacement of Upstream Occlusion Sensor

1. Remove two Phillips screws (Figure 11-7 , item 16) which secure the sensor (item 9) to the pump head base plate.

2. Pull and rotate the sensor 45° clockwise and carefully remove it from the pump head base plate.

CAUTION **Maintain an appropriate soldering pencil tip temperature to avoid damaging insulation.**

3. Desolder black and white wires from sensor. Use caution to avoid contacting any plastic parts with the soldering iron.

4. Remove the screw (Figure 11-7 , item 6) securing grounding plate (item 11), ground wire and star washer (item 8). Do not lose the plate, washer and screw.

5. Install replacement sensor and reassemble in reverse order. Take care not to damage the FSR flex cable while inserting the upstream occlusion sensor housing. Be sure to attach the ground wire and plate to the sensor, see Figure 11-7 . Tightening torque for item 16 is 3 kgf-cm (2.6 in-lb). Tightening torque for item 6 is 1.5 kgf-cm (1.3 in-lb).

6. Calibrate in accordance with "DC Line Voltage Calibration" on page 9-1 and "Upstream Occlusion Sensor Calibration" on page 9-10.

7. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Replacement of Downstream Occlusion Sensor Assembly

1. Remove two Phillips screws (Figure 11-7 , item 16) which secure the sensor to the pump head base plate.

2. Pull and rotate the sensor 45° clockwise and carefully remove it from the pump head base plate.

CAUTION **Maintain an appropriate soldering pencil tip temperature to avoid damaging insulation.**

3. Desolder black and white wires from sensor. Use caution to avoid contacting any plastic parts with the soldering iron.

4. Remove the screw (Figure 11-7 , item 6), ground wire and star washer (item 8). Do not lose the washer and screw.

5. Install replacement sensor and reassemble in reverse order. Tightening torque for item 16 is 3 kgf-cm (2.6 in-lb). Tightening torque for item 6 is 1.5 kgf-cm (1.3 in-lb).

6. Calibrate in accordance with “DC Line Voltage Calibration” on page 9-1 and “Downstream Occlusion Sensor Calibration” on page 9-8.

7. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Air Sensor Assembly Replacement

1. Separate the front and rear housings per “Separation of Front and Rear Housings” on page 8-5, steps 1 through 3.

2. Separate connector CN811 (lower left corner of the circuit board as viewed from the rear).

Note: Note the location of the wire ties restraining the cable leading to CN811 (for later replacement) and carefully cut and remove them.

Be sure not to cut or nick any other wires during this process. Removing two cable ties usually frees the cable but, in some instances, more need to be removed. They are replaced with new cable ties upon completion of these steps.

When the ground wire from the pump head mounting plate (Figure 11-2 , item 14) prevents separation of CN811, loosen the ground wire screw and reposition the ground wire to gain access to the connector.

3. Disconnect air sensor connector CN811 from the sensor board. Remove the two screws (Figure 11-7 , item 16) that secure the air sensor (item 14) to the pump head and carefully pull out the air sensor assembly.

CAUTION **Maintain an appropriate soldering pencil tip temperature to avoid damaging insulation.**

4. Desolder the green ground wire from the back of the air sensor. If it is present, desolder and discard the green ground wire from the back of the replacement air sensor assembly (Item 14 in Figure 11-7).

Be careful not to disconnect the ribbon cable of the slide clamp mechanism during this step.

5. Insert the replacement air sensor connector through the air sensor opening on the pump head and pull the wires all the way through.

6. Solder the ground wire to the new air sensor.

7. Secure the replacement air sensor to the pump head (tightening torque of 2 kgf-cm or 1.7 in-lbs) and reconnect CN811.

8. Route the wires to their original location and replace any cable ties that were removed in step 2. The number of ties and their locations should approximate the original configuration (refer to "Routing of Internal Wiring" on page 8-33).

9. Trim the ends of all newly added cable ties so that they are flush with the cable tie buckles. If the ground wire screw was loosened in step 2, tighten the ground wire screw to 7 kgf-cm (6.1 in-lb).

10. Perform the calibration in "DC Line Voltage Calibration" on page 9-1 and "Air Sensor Calibration" on page 9-6.

11. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Replacement of Force Sensing Resistor[1] (FSR) Devices for Tube Misloading Sensors

Note: When the repair requires replacement of the FSR, replace the pair of FSRs.

1. Remove pump door cover in accordance with "Replacement of Pump Head Door Cover" on page 8-9.

2. Separate the front and rear housings ("Separation of Front and Rear Housings" on page 8-5).

3. Disconnect the tube misloading sensors (Figure 11-6 , items 10 and 11) from the connector at rear top of the pump head assembly by pulling their connector housings. Do not remove them by pulling the film portion.

4. Open the pump door.

5. Remove two Phillips screws (Figure 11-7 , item 16) which secure the upstream occlusion sensor (Figure 11-7 , item 9) to the pump head base plate.

CAUTION **Do not scratch the ribbon connectors located above the sensors. Scratches can damage the connectors.**

6. Pull and rotate the sensor 45° clockwise and carefully remove it from the pump head base plate.

7. Remove the mounting block for the latch pin (Figure 11-6 , item 1).

CAUTION **Do not damage the base plate or the surface of the other tube misloading sensor with the tool. Do not reuse the removed tube misloading sensor.**

1. Interlink Electronics

8. Remove the tube misloading sensors from the pump base plate with a razor blade or similar tool.

Note: All adhesive residues must be removed from the surface to ensure the successful attachment of FSRs.

9. Completely remove any adhesive residue from the base plate and clean the surface with an alcohol-soaked cloth.

10. Using a digital multimeter, check that the resistance of the new tube misloading sensor at no load is between 140 KΩ and 210 KΩ . If not, do not use it.

11. Carefully insert the FSR flex cable through the opening for the upstream occlusion sensor to avoid damage to the electrical traces on the FSR flex cable. Loosely attach a new tube misloading sensor to the pump base plate. Ensure that it fits within its recess and does not override the pump head area. Do not attach the sensor firmly to the pump base plate yet.

12. Check that the resistance of the tube misloading sensor at no load is within 140 KΩ and 210 KΩ .
    - If not, repeat steps 10 through 12.
    - If so, peel the backing off the adhesive, press the tube misloading sensor firmly, and ensure that it is securely attached to the pump base plate with no gaps.

13. Connect both sensors to the connectors at top rear of the pump base plate through the hole for the upstream occlusion sensor. (See Figure 11-6).

14. Replace the upstream occlusion sensor to the pump base plate. Take care not to damage the FSR flex cable while inserting the upstream occlusion sensor housing. Calibrate in accordance with “DC Line Voltage Calibration” on page 9-1 and “Upstream Occlusion Sensor Calibration” on page 9-10.

15. Install the mounting block for the latch pin (Figure 11-6 , item 1) if it was removed. Tightening torque is 6 kgf-cm (5.2 in-lb).

16. Reassemble the case halves.

17. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Replacement of Pump Motor

1. Remove pump door cover in accordance with “Replacement of Pump Head Door Cover” on page 8-9.

2. Separate the front and rear housings (“Separation of Front and Rear Housings” on page 8-5).

3. Remove pump head assembly in accordance with “Replacement of Pump Head Assembly” on page 8-12.

4. Close the pump door.

5. Carefully place the pump head assembly face down on the work surface.

Note: Perform the following step carefully to avoid losing springs.

6. Carefully remove the two springs (Figure 11-8 , item 9) above the motor coupling.

7. Remove two screws (Figure 11-9 , item 30) that secure the motor holding plate to the safety/slide clamp assembly.

8. Remove two screws, washers and spring washers (Figure 11-8 , items 22, 14 and 25) securing the encoder cover (Figure 11-8 , item 16) and finger box cover to the finger box. Do not lose the short nut bar (Figure 11-8 , item 31).

9. Remove two screws, washers and spring washers (Figure 11-8 , items 22, 14 and 25) securing the finger box cover to the finger box (item 15) above the motor coupling. Do not lose the long nut bar (Figure 11-8 , item 32).

10. Remove the finger box cover.

Note: Slide the encoder cover toward the encoder to prevent it from sticking to the encoder screw head.

11. Carefully lift the motor and remove motor and its associated assembly from the pump head base plate. Take care not to deform the encoder or damage the fingers. Keep the finger box and the fingers away from dirt or dust.

12. Remove the motor holding plate (Figure 11-9 , item 8) from the motor shaft bottom and carefully place on the work surface.

13. Remove two set screws (Figure 11-8 , item 27) closest to the motor.

14. To install the motor, push motor shaft into motor coupling (item 8).

15. Install set screws (item 27). Do not tighten them at this time.

16. Attach the spring retainer (item 2) to the replacement motor, as necessary.

17. Place the motor holding plate (Figure 11-9 , item 8) onto the motor shaft bottom such that the plate sticks out of the motor housing on the side with the motor wires (Figure 11-8).

18. Install the motor and its associated assembly into the pump head base plate with the following cautions:

    18.1 The motor must be positioned such that the wires go out the rear of the base plate (Figure 11-8).

    18.2 Be sure that the fingers are in the finger box and the motor holding plate is properly installed in the groove of the safety/ slide clamp assembly (Figure 11-8 , item 1).

19. Check that the bearings (Figure 11-8 , item 10) are properly seated on the finger box and install the finger box cover using the four screws, washers and spring washers (Figure 11-8 , items 22, 14 and 25). Before tightening these screws, rotate the motor coupling by hand to ensure smooth rotation of the motor shaft and the encoder.

20. Tighten the screws to 6 kgf-cm (5.2 in-lb).

21. Install the motor holding plate onto the safety/slide clamp assembly. Tighten the two screws (Figure 11-9 , item 30) to 6 kgf-cm (5.2 in-lb).

22. Apply a trace of Red Glpt Insulation Varnish to the set screws (Figure 11-8 , item 27).

23. Place a 0.3 mm, flat-feeler gauge between the motor bottom surface and the motor end plate.

    - If the flat-feeler gauge can be inserted and the gap is not wider than 0.3mm, proceed to the next step.
    - If the flat-feeler gauge cannot be inserted or the gap is wider than 0.3mm, loosen the set screws (Figure 11-8 , item 27) to move the motor. Ensure that the edge of the flat-feeler gauge is touching the side of the motor shaft. Press the motor against the plate and tighten the set screws to 5 kgf-cm (4.3 in-lbs).

Note: When the set screws have been properly tightened, the screw heads are recessed in the motor coupling and the screw ends are in contact with the flat surfaces of the finger shaft.

24. Install the springs removed in step 6, and remove the flat-feeler gauge.

25. Install pump head assembly into case in accordance with “Replacement of Pump Head Assembly” on page 8-12.

26. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Replacement of Safety/Slide Clamp Assembly

1. Remove pump door cover in accordance with “Replacement of the Pump Door or Pump Door Assembly” on page 8-11.
2. Separate the front and rear housings in accordance with “Separation of Front and Rear Housings” on page 8-5.
3. Remove the pump head in accordance with “Replacement of Pump Head Assembly” on page 8-12.
4. Press the safety clamp pin (Figure 11-9 , item 6) to close the safety clamp.
5. Remove the screw (Figure 11-7 , item 2) on the right side of the safety clamp arm cover (Figure 11-7 , item 10) and remove the arm cover.
6. Close the pump door.
7. Place the pump head face down and remove the two screws (Figure 11-9 , item 35) to remove the sensor assembly.
8. Remove the two screws (Figure 11-9 , item 30) on the bottom of the safety/slide clamp assembly to release the motor holding plate (Figure 11-9 , item 8).
9. Remove the six screws (Figure 11-6 , item 19) on the finger box and lift the finger and motor assembly off of the base plate.
10. Remove the flexible cable at the back of the slide clamp assembly (Figure 11-9 , item 29) from the connector on the terminal board. Be sure to pull the reinforced part so as not to damage the flexible cable.
11. Remove four screws (Figure 11-8 , items 28 and 40) securing the safety/slide clamp assembly and remove it from the pump head base plate.
12. Press the safety clamp pin (Figure 11-9 , item 6) on the replacement assembly to close the safety clamp, with the safety clamp seal dangling, install the replacement safety/slide clamp assembly into rear of the pump head base plate and secure with four screws (Figure 11-8 , items 28 and 40). Make sure safety clamp seal (Figure 11-9 , item 25) is in place and moves freely side to side with the safety clamp arm. Tightening torque for the four screws is 6 kgf-cm (5.2 in-lb).
13. Inspect for a white or yellow dot on the side of the slide clamp assembly (nearest the middle of the device) and on the FPC terminal PCB (see Figure 8-3 for location). If a dot is present, proceed to step 14.

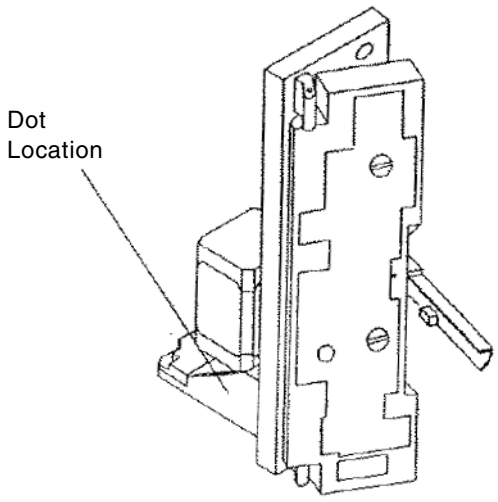


Figure 8-3 Location of Yellow or White Dot

Note: If there is a white dot, the connector is gold. A yellow dot indicates that Nyogel 759G has already been applied to the ribbon foil.

If no dot is present, complete the following steps:

13.1 Carefully disconnect the slide clamp sensor foil ribbon from the FPC connector (located between the motor and the base plate). Use a right angled needle nose plier with the tips covered with electrical tape or heat shrink tubing. DO NOT WIGGLE THE RIBBON FOIL DURING REMOVAL.

13.2 Apply a thin coat of Nyogel 759G on the contacts of the ribbon foil to protect them from oxidation and carefully reinsert it using the angled needle nose pliers into the connector. DO NOT WIGGLE THE RIBBON FOIL DURING INSTALLATION.

13.3 Using a yellow paint pen, mark a yellow dot on the side (nearest the middle of the device, see Figure 8-3) of the slide clamp assembly. Proceed to step 14.

14. Connect the flexible cable (Figure 11-9 , item 29) to the connector on the terminal board.

15. Place the motor holding plate (Figure 11-9 , item 8) on the motor shaft and slide it in the safety/slide clamp assembly while replacing the finger and motor assembly. Install the six screws (Figure 11-6 , item 19). Tightening torque is 6 kgf-cm (5.2 in-lb).

16. Install the two motor holding plate screws (Figure 11-9 , item 30). Tightening torque is 6 kgf-cm (5.2 in-lb).

17. Place a 0.3mm, flat-feeler gauge between the motor bottom surface and the motor end plate. When the flat-feeler gauge cannot be inserted, or the gap is wider than 0.3mm, loosen the set screws (Figure 11-8 , item 27) to move the motor. Ensure that the edge of the flat-feeler gauge is touching the side of the motor shaft. Press the motor against the plate and tighten the set screws to 5kgf-cm (4.3 in-lb).

18. Install the sensor 2 assembly using the two screws (Figure 11-9 , item 35). Tightening torque is 3 kgf-cm (2.6 in-lb).

19. Install safety clamp arm cover. Tightening torque for the arm cover securing screw (Figure 11-7 , item 2) is 1 kgf-cm (0.9 in-lb). Remove the flat-feeler gauge.

20. Install pump head assembly into case in accordance with “Replacement of Pump Head Assembly” on page 8-12.

21. Install pump door cover in accordance with “Replacement of Pump Head Door Cover” on page 8-9.

22. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Spring Retainer Removal

The spring retainer is installed into the slide clamp slot at the factory to maintain proper tension on the springs within the assembly. It must be removed prior to use if the Insert Slide Clamp option is enabled.

1. Open the pump door. See Figure 2-2 for the location of the spring retainer.

2. Press the safety clamp arm cover in until the safety clamp latches open.

3. Using E-ring pliers, insert the tips into the holes in the spring retainer.

4. Gently remove the spring retainer. Keep the removed spring retainer in case it is needed in the future.

Spring Retainer Installation

The spring retainer is installed into the slide clamp slot at the factory to maintain proper tension on the springs within the assembly. If the Insert Slide Clamp option is not going to be used, the spring retainer should remain in the assembly during pump use to maintain proper spring tension as well as to help prevent the ingress of fluids into the mechanism. Instructions for installing the spring retainer are provided below.

1. Open the pump door and insert the Slide Clamp Resetting Tool into the slide clamp mechanism until it stops (this tool cannot be pushed in fully).
2. Press the safety clamp pin to release the slide mechanism. This pushes out the tool slightly.
3. Carefully remove the tool. When the slide clamp mechanism is activated properly, the ridges on both sides of the tool should rub against the claws of the mechanism.
4. Insert the spring retainer until it locks in place.

Replacement of Back Plate

1. Remove the pump door cover in accordance with "Replacement of Pump Head Door Cover" on page 8-9.
2. Remove the back plate cover (Figure 11-5 , item 16) by removing the screw inside the door (item 27).

Note: Perform the following step carefully to avoid losing springs (Figure 11-5 , item 18).

3. Remove the 7 screws (item 26) from the outside of the door.
4. Remove the 5 springs (item 18) and the back plate (item 17).
5. Install the replacement back plate.
   - Ensure that the back plate is clean and not worn.
   - Ensure that the notch in the back plate aligns with the tongue in the door.
   - Ensure that all 5 springs (item 18) are in place and perpendicular to the back plate cover.
6. Install the back plate cover (item 16) in reverse order.
7. Apply pressure to the back plate cover and install the screws (items 26 and 27) working from the outside edges to the center. That is, install the top and bottom corner screws first, followed by the screws in the center of the back plate cover.
8. Press the back plate a few times from the inside of the door to ensure smooth operation and then tighten these screws to 6 kgf-cm (5.2 in-lb).
9. Replace pump door cover in accordance with "Replacement of Pump Head Door Cover" on page 8-9.
10. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Replacement of Battery

1. Turn off and unplug the pump.
2. Remove the 4 screws (Figure 11-4 , item 19) on the battery compartment cover.
3. Slide the battery out of the rear housing.

Note: Lead batteries must be recycled or disposed of properly. Contact Federal or State environmental agencies for information on recycling and disposal options.

4. Disconnect the two female connectors from the battery terminals.
5. Reassemble the battery into the pump in reverse order. Tightening torque for the four screws is 9 kgf-cm (7.8 in-lb).

CAUTION **Be sure to match the polarities of the female connectors.**

CAUTION **Red wires (+) must be connected to red marked (+) battery terminal. See the battery label on the underside of the battery cover. The battery must be placed with its connectors up. (See Figure 11-4). The wires must be routed in the battery compartment so that they run between the battery and the boss for the housing screw.**

CAUTION **Be sure to place the cushion (Figure 11-4 , item 10) around the boss such that its surface becomes flush with the boss.**

CAUTION **Be careful not to pinch wires between the front housing and battery compartment cover.**

6. Perform the Self Test (“Self Test” on page 10-3) and Battery Check (“Battery Check” on page 10-10).

Replacement of Main Power Fuse

1. Plug the pump into an AC power outlet.
2. Check if the Plug Icon is illuminated. If it is not, replace the fuse.
3. Remove the power plug from the AC power outlet.
4. Remove the power cord cover on the back of the pump and unscrew the fuse caps with a small screwdriver.
5. Remove the fuses and check them for electrical continuity with an ohmmeter. If necessary, replace with a new fuse of the same value, type and voltage.

6. Replace and tighten the fuse caps with a screwdriver. Over tightening the fuse caps may cause the fuse holders to break.

7. Replace the power cord cover.

8. Perform the Electrical Safety Test to verify proper grounding impedance. See “Electrical Safety Tests” on page 10-11.

Replacement of Power Supply Board

1. Turn off and unplug the pump.

2. Separate front and rear housings completely in accordance with “Separation of Front and Rear Housings” on page 8-5.

3. Separate the boards in accordance with “Separation of Printed Circuit Boards” on page 8-7.

4. Unplug CN301 from the sensor board (Figure 11-2 , item 3).

5. Stand the boards upright and remove the screws (Figure 11-2 , item 17) securing the lower corners of the power supply board.

6. Squeeze the board spacer (Figure 11-2 , item 10) tops with needle nose pliers to release the power supply board from the spacers.

7. Install the power supply board. Tightening torque for the two screws (item 17) securing the board is 7 kgf-cm (6.1 in-lb).

8. Reassemble in reverse order. Be sure to remove any dirt or dust on the LCD windows before tightening the sensor board to the front housing. Be sure to reconnect all the removed connectors (refer to “Routing of Internal Wiring” on page 8-33).

9. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Replacement of CPU Board

1. Separate front and rear housings in accordance with “Separation of Front and Rear Housings” on page 8-5.

2. Separate boards in accordance with “Separation of Printed Circuit Boards” on page 8-7.

3. Remove the power supply board in accordance with “Replacement of Power Supply Board” on page 8-24.

4. Stand the boards upright and remove the three screws (Figure 11-2 , item 17) securing the lower edges of the CPU board to the PCB spacer.

5. Unplug CNBUS1 connector from the CNBUS2 connector on the sensor board by carefully pulling the CPU board perpendicularly to the sensor board.

CAUTION **Be sure to place the CPU board on an insulated surface. Shorting the wires from the lithium battery may result in a fire hazard.**

6. Install the CPU board. Tightening torque for the three screws (Figure 11-2 , item 17) securing the board is 7 kgf-cm (6.1 in-lb).

7. Reassemble in reverse order. Be sure to remove any dirt or dust on the LCD windows before tightening the sensor board to the front housing. Be sure to reconnect all the removed connectors.

8. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Replacement of Display Board

1. Separate front and rear housings in accordance with “Separation of Front and Rear Housings” on page 8-5.

2. Separate circuit boards in accordance with “Separation of Printed Circuit Boards” on page 8-7.

3. Stand the printed circuit cards upright and remove the five screws (Figure 11-2 , items 15) securing the corners and right center of the display board.

4. Carefully disconnect connector CNDISP and remove the display board from the sensor board.

5. Install the display board. Tightening torque for the five screws (Figure 11-2 , item 15) securing the board is 1.5 kgf-cm (1.3 in-lb).

6. Reassemble in reverse order. Be sure to remove any dirt or dust on the LCD windows before tightening the sensor board to the front housing. Be sure to reconnect all the removed connectors (refer to “Routing of Internal Wiring” on page 8-33).

7. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Replacement of Sensor Board

1. Separate front and rear housings in accordance with “Separation of Front and Rear Housings” on page 8-5.

2. Separate printed circuit boards in accordance with “Separation of Printed Circuit Boards” on page 8-7.

3. Separate display board in accordance with “Replacement of Display Board” on page 8-25.
4. Unplug CN301 from the sensor board (Figure 11-2 , item 3).
5. Remove the three screws (item 17) securing the center of the sensor board.
6. Carefully disconnect connector CNDISP and remove the sensor board from the display board.
7. Install the sensor board. Tightening torque for the three screws (Figure 11-2 , item 17) securing the board is 7 kgf-cm (6.1 in-lb). Be sure to insert the standoffs of the spacers into the holes of the sensor board.
8. Reassemble in reverse order. Be sure to remove any dirt or dust on the LCD windows before tightening the sensor board to the front housing. Be sure to reconnect all the removed connectors (refer to “Routing of Internal Wiring” on page 8-33).
9. Calibrate in accordance with “DC Line Voltage Calibration” on page 9-1 through “A/D Converter Reference Voltage Calibration” on page 9-18.
10. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Replacement of Audible Alarm/Alert Board

1. Separate the front and rear housings in accordance with “Separation of Front and Rear Housings” on page 8-5.
2. Remove one screw (Figure 11-3 , item 22) securing the audible alarm/alert board (item 3) to the rear housing.
3. Remove the board and unplug connector CN751.
4. Reassemble in reverse order. Tightening torque for item 22 is 7 kgf-cm (6.1 in-lb).
5. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Replacement of Backup Audible Alarm/Alert Board

1. Separate the front and rear housings in accordance with “Separation of Front and Rear Housings” on page 8-5.
2. Unplug connectors CN751 and CN752.

3. Remove one screw (Figure 11-3 , item 22) securing the backup audible alarm/alert board (item 2) to the rear housing.

4. Remove the board.

5. Reassemble in reverse order. Tightening torque for item 22 is 7 kgf-cm (6.1 in-lb).

6. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Replacement of Terminal Board

1. Separate the front and rear housings in accordance with "Separation of Front and Rear Housings" on page 8-5.

Note: Be sure to unlock the connector flange before disconnecting the cable.

2. Unplug connectors CN401, CN701, and ribbon cable connector CNI/F2.

3. Remove three screws (Figure 11-3 , item 22) securing the terminal board (item 1) to the rear housing.

4. Remove the board.

Note: Be sure to unlock the connector flange before connecting the cable and then push it in to lock.

5. Reassemble in reverse order. Tightening torque for item 22 is 7 kgf-cm (6.1 in-lb).

6. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Replacement of Power Transformer

1. Separate the front and rear housings completely in accordance with "Separation of Front and Rear Housings" on page 8-5.

2. Disconnect the 2-pin CNAC connector from the power supply board (Figure 11-2 , item 12).

CAUTION **Maintain an appropriate soldering pencil tip temperature to avoid damaging insulation.**

3. Desolder the black and white wires from the transformer at the AC receptacle (Figure 11-4 , item 15).

4. Remove the transformer mounting bracket by removing four securing screws (Figure 11-3 , items 20 and 23).

5. Remove the transformer by removing two securing screws (Figure 11-3 , item 21).

6. Reassemble in reverse order. Tightening torque for items 21 and 23 is 9 kgf-cm (7.8 in-lb) and for item 20 is 5 kgf-cm (4.3 in-lb).

Note: Be sure to match the color of the wire when resoldering the black and white wires to the fuse holders.

7. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Replacement of PANEL LOCK Switch

1. Separate front and rear housings in accordance with “Separation of Front and Rear Housings” on page 8-5.

2. Pull out black pushbutton (Figure 11-4 , item 6) on rear of pump while holding the rear housing.

CAUTION **Maintain an appropriate soldering pencil tip temperature to avoid damaging insulation.**

3. Desolder pink and brown wires from switch.

4. Remove hex nut and lockwasher securing the switch and remove it.

5. Reassemble in reverse order.

6. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Replacement of Lithium Backup Battery

The lithium backup battery provides backup voltage to the pump’s memory when the main battery is disconnected. To avoid loss of configuration option settings, record the settings and ensure that the main battery is connected before beginning this procedure.

1. Separate front and rear housings in accordance with “Separation of Front and Rear Housings” on page 8-5.

2. Cut the tie wrap holding the lithium battery on the CPU board (Figure 11-2 , item 2).

3. Disconnect connector CN304 and remove the lithium battery.

4. Install replacement battery in reverse order.

5. Verify that the configuration option is set as desired and modify if necessary (see "Modifying the Configuration Option Settings" on page 5-2).

6. Check the backup battery voltage reading per "Automatic Test Mode 1: Calibration Mode 1" on page 9-14, step 10.

7. Perform the Operational Checkout in Chapter 10, "Operational Checkout".

Tube Guide Shim Installation

Required Parts:

- Air Sensor Tubing guide shim (part no. 722003396)
- Loctite Prism 454 adhesive (part no. 722003397)
- Cellophane tape

Note: Open the pump head door and check for a white tubing guide shim or a letter "A" on the door, opposite the air sensor. When the shim or letter "A" is present, it is NOT necessary to perform this procedure.

! WARNING ! **Make sure the pump is not plugged into AC power.**

1. Clean the tube guide area on the door with a small paint brush soaked in a solution of dishwashing detergent and rinse with clean water. Use an air source that is free of oil to dry the tube guide or allow it to air dry.

2. Lay the pump on its side opposite the pump head. Place the tube guide shim on the tube guide and note the surfaces making contact with the tubing guide for adhesive application. To handle the shim, press a 3-inch piece of cellophane tape onto the shim lengthwise. Use the tape to lift the shim from the door. Save the tape and shim combination.

3. Use the applicator on the tube to apply a thin, uniform layer of Loctite Prism 454 adhesive to the tube guide surfaces to which the shim is to be bonded. To achieve a good bond you must apply adhesive to all of the shaded areas (See Figure 8-4).

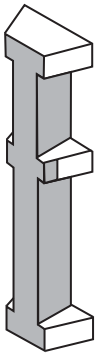


Figure 8-4 Adhesive Application

4. Immediately place the shim back onto the tube guide using the tape as a handling aid. Apply finger pressure to the corner of the shim at a 45° angle as indicated in Figure 8-5. Apply pressure at the ends, as well as, at the middle of the shim. The tape acts as a barrier preventing adhesive from contacting the fingers.

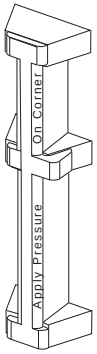


Figure 8-5 Pressure Application Points

5. Hold the shim motionless for 60 seconds while continuing to apply pressure.

6. Remove the tape and visually inspect the shim for excess adhesive. Remove excess adhesive using a dry cotton swab.

7. Ensure that the shim is properly bonded to the door by verifying that there are no gaps between the shim and the tubing guide. Use a fingernail to attempt to lift each end and the middle section of the shim to verify that the bond is secure.

8. Perform the calibration in “Air Sensor Calibration” on page 9-6.

LCD Cushion Installation

Note: These instruction are for devices that exhibit blanking displays. Cushions are installed on the inside of the case to keep the case interior from touching the LCD.

Equipment:

- #2 Phillips Screwdriver or power screwdriver
- Indelible ink (permanent marker)

Parts:

- 1 ea. LCD cushion (part no. PCUSU101.A)
- 1 ea. Upgrade Label (part no. 072601047)

1. Turn off the pump and make sure it is disconnected from AC power.
2. Separate the front and rear housings ("Separation of Front and Rear Housings" on page 8-5).
3. Remove the CPU and Display board assembly ("Separation of Printed Circuit Boards" on page 8-7).

Note: CNI/F, CN601, and CN602 are the only connectors that have to be disconnected before the four screws shown with arrows are removed. The CPU/Display board assembly can be placed on top of the pump assembly.

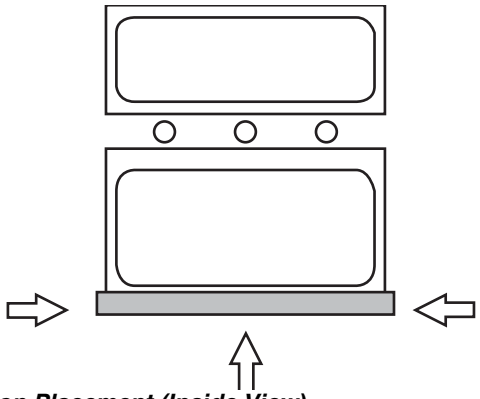


Figure 8-6 LCD Cushion Placement (Inside View)

Note: The LCD cushion is installed on the inside of the case housing not on the LCD.

4. Peel off the adhesive backing and install the LCD cushion across the bottom edge of the inset (recessed area for the LCD). See Figure 8-6. When properly positioned, you should be able to feel a ridge (the inset edge) in the center of the LCD cushion. The cushion should also be centered from left to right. Ensure that the cushion is not visible in the display window when looking at the outside of the case.
5. Remove the adhesive backing from the upgrade label (Part no. 072601047) and install it between the feet on the front case half. Use indelible ink (permanent marker) and mark box number 1.

6. Assemble the pump by performing applicable previous steps in reverse order.

7. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Software Installation

Equipment:

- #2 Phillips Screwdriver
- IC Removal Tool
- IC Insertion Tool

Parts:

- 1 EPROM with master software (-MAS - as necessary)
- 1 EPROM with slave software (-SLV - as necessary)

Note: There are two EPROMs available for replacement/upgrade in this device. Although these ICs are the same, the software stored in each is different. Therefore, ensure that the correct part is installed into the correct location.

Note: This device contains CMOS circuitry. Adequate steps to prevent damage cause by electrostatic discharge should be taken such as ground straps and grounded work surfaces.

EPROM Installation

1. With the pump powered off, press and hold the **SILENCE** key then press the **ON-OFF/CHARGE** key. Record the software version number shown on the lower right corner of the main display.

2. Turn off the pump and disconnect it from AC power.

3. Remove the battery from the pump (“Replacement of Battery” on page 8-23).

4. Remove the screw (Figure 11-4 , item 22) from the EPROM access cover (Figure 11-4 , item 3) located inside the battery compartment, and remove the cover.

5. Remove the EPROM(s) using an IC removal tool.

Note: The Master EPROM is located above the Slave EPROM (designated on the board). Also, note that the orientation of both EPROMs is with the notch toward the bottom of the PC board.

6. Install the new version EPROM(s) in its (their) socket(s). Make sure that all of the pins are seated in the socket correctly, and that the notched end(s) of the EPROM(s) is/are toward the bottom of the PC board. An IC insertion tool makes this step much easier.

7. Replace the EPROM access cover along with the cover screw.

8. Replace the battery ("Replacement of Battery" on page 8-23). Connect the battery wires to the battery (check polarity) and carefully slide the battery into the battery compartment.

Note: When the secondary alarm is activated, press the **ON-OFF/CHARGE** key to stop the alarm. If a failure code appears, perform steps 1-5 of "Modifying the Configuration Option Settings" on page 5-2.

9. Set the configuration to its original settings per "Modifying the Configuration Option Settings" on page 5-2.

10. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Routing of Internal Wiring

1. Form the wires leading from CN803 and CN811 such that they run close as possible to the surface of the sensor board up between the power supply and the CNI/F connector. See Figure 8-7.

2. There should be no wires routed underneath, in between, or directly over the ribbons near the CN601 and CNI/F connectors.

3. Route the power supply earth wire straight down from the supply around CN811 and up between CN811 and CN803 keeping it close as possible to the sensor board.

4. Use cable ties as needed to neatly bundle the wiring in place.

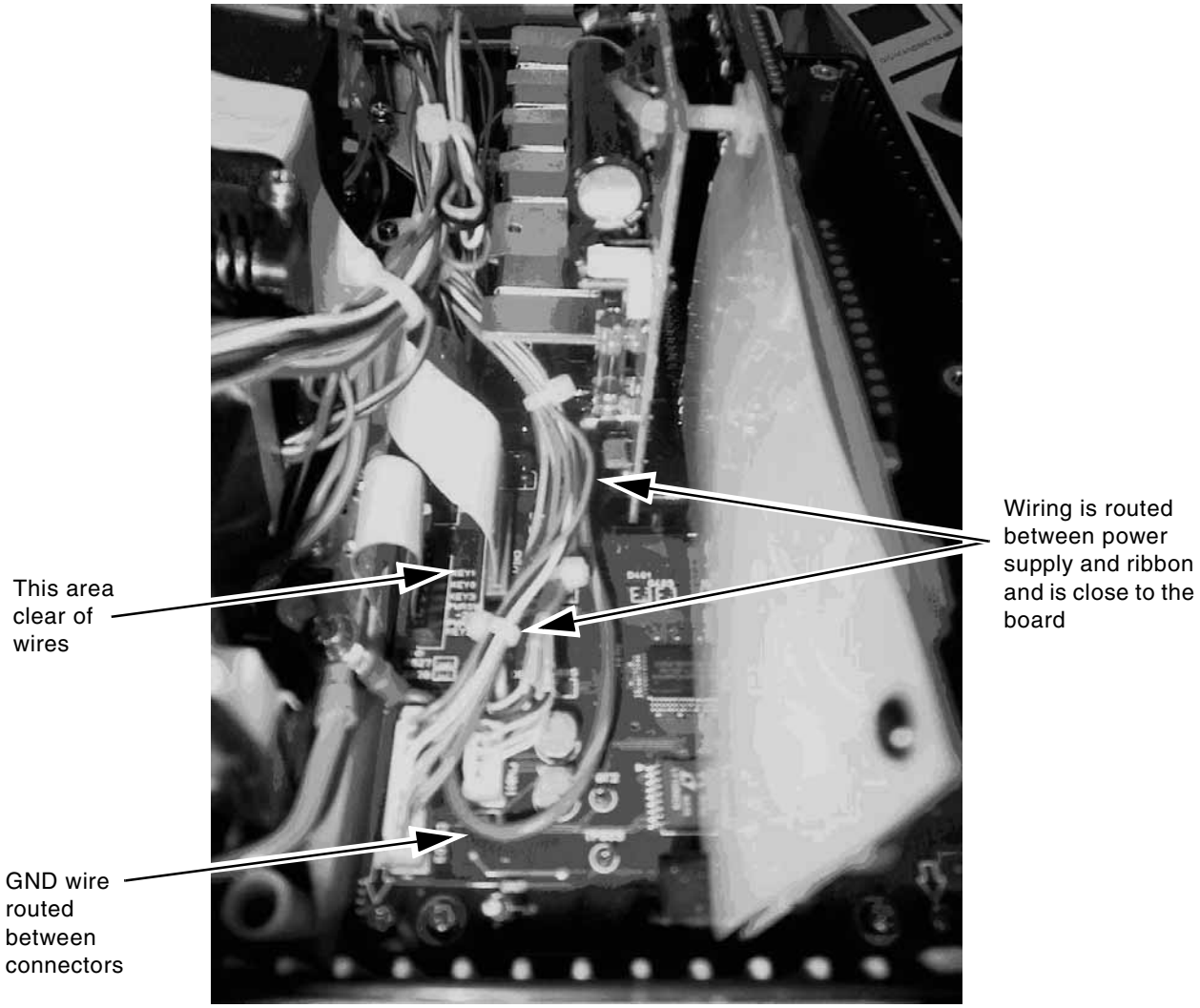


Figure 8-7 Wiring Routing

Pole Clamp Tightening Instructions

Note: These instructions must be performed during any service involving the IV pole clamp assembly.

Note: When servicing the pump ensure the pole clamp body is secured to the rear housing. In addition, all pumps being serviced must meet the requirements listed below. An upgrade label with box number 2 marked indicates these requirements have already been met.

1. Refer to Figure 11-4 "Rear Housing Assembly, External" to view the attachment of the pole clamp body to the rear housing.

    a. The recessed area in the housing for the pole clamp body must be clean.

b. The three mounting screw holes in the housing must not show signs of cracking.

c. The ground wire must be attached to the center screw.

d. The screws must be M4x10, with captive washers.

e. Loctite 425 threadlocker must be applied to each of the three screws.

f. Torque the screws to 9 kgf-cm (7.8 in-lb).

2. If not already present, apply an upgrade label (Part no. 072601047) between the feet on the front case half. Use indelible ink (permanent marker) and mark box number 2.

3. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Chapter 9

Calibration

Overview

This chapter includes a list of tools and test equipment required for performing calibration after component or circuit board replacement. Detailed exploded views of the pump are provided in Chapter 11, “Illustrated Parts Breakdown”.

Read all sections in this chapter prior to calibration of the pump. Be sure that all of the necessary equipment is available before beginning calibration procedures. During calibration it is important to keep the connectors clean.

The pump should be powered off for at least two hours before attempting to perform calibration. All calibration procedures should be performed in ambient and solution temperatures of 72°F to 82°F (22°C to 28°C).

DC Line Voltage Calibration

Verify DC line voltages prior to performing other calibrations.

The following section may be used to verify various voltages and signals without disassembling the pump. Measurements should be made with the pump on AC power.

1. Remove the battery access cover (“Replacement of Battery” on page 8-23).
2. Remove the EPROM access cover by removing 1 securing screw.
3. Locate the CNTEST connector beneath the EPROM access cover.

Note: Connections called out in the following steps refer to the CNTEST connector. Pin 8 of the CNTEST connector is always used as signal ground.

4. Connect a voltmeter to Vmain (pin 6). With the pump powered off, the reading should be 13.65 ±0.15 VDC.
   - The ripple voltage should be measured using an oscilloscope or using a 0.1 mF capacitor with the lead connected in series and the voltmeter set to AC.
   - The ripple voltage should be ≤100 mVp-p at 105 VAC.
5. Connect the voltmeter to Vref (pin 1). Power up the pump. While in STOP mode, the voltage should be 5.000 ±0.050 VDC.
6. Measure the Vcpu voltage at pin 3. The voltage should be 5.00 ±0.30 VDC.
7. Measure the Voth voltage at pin 4. The voltage should be 12.90 to 13.90 VDC.
8. Measure the Vkey voltage at pin 5. The voltage should be 5.00 ±0.30 VDC.
9. Measure the lithium backup battery voltage at pin 7. It should be 3.0 to 3.4 VDC.
10. Press the **ON-OFF/CHARGE** key to turn off the pump. Disconnect all test equipment.
11. Replace the EPROM cover and the battery (“Replacement of Battery” on page 8-23).
12. Calibration is not required when Vcpu voltage is within specifications.
    - If the values are within specification, proceed to the next step.
    - If the values are out of specification, calibrate the voltages using the following procedure.

      12.1 Connect the calibration circuit shown in Figure 9-1.

      - Variable transformer; 100 - 135 VAC, minimum 50 VA.
      - Digital voltmeter: 4.5 digits with ±0.1% accuracy at 20 VDC range and ±3% accuracy at 100 - 135 VAC range.
      - DC ammeter: 1 ADC in 0.01 A increments.
      - External circuit consisting of a 10Ω, 10 watt resistor in series with a 10Ω, 10 watt potentiometer (see Figure 9-1).

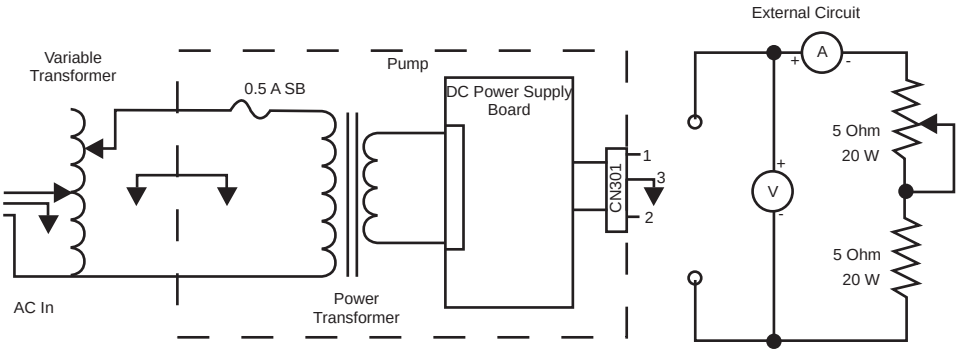


Figure 9-1 Calibration Equipment Setup

12.2 Separate the front and rear housings completely in accordance with "Separation of Front and Rear Housings" on page 8-5.

12.3 Disconnect the power supply connector (CN301) from the sensor board (Figure 11-2 , item 3) and connect it to the external circuit.

12.4 Connect the external circuit as illustrated in Figure 9-1 with the positive lead connected to pin 2 and the negative lead connected to pin 3.

12.5 Plug all calibration equipment into a 115 ± 5.0 VAC, 60 Hz power source.

- Variable transformer: 0 V or minimum setting
- Minimum current setting: constant current mode

12.6 Turn potentiometers VR1 on the DC power supply board fully counterclockwise and VR2 fully clockwise.

12.7 Set the DC ammeter to the appropriate range and the DC voltmeter to 20 VDC range. Do not use autorange.

Calibration of Output Current Limit by VR2

12.8 Ensure the AC power plug of the pump is connected to the variable transformer.

12.9 Adjust the variable transformer output to 120 VAC. The voltage may be checked with an ordinary tester with ±3% accuracy.

12.10 Adjust the potentiometer until the output current is 0.85 A.

12.11 Slowly turn VR2 counterclockwise until the voltage between pin 2 (+, red) and pin 3 (–, black) of CN301 is 13.65 ±0.05 V. It may be necessary to readjust the potentiometer of the external circuit during this step.

12.12 Check that the voltage between pin 1 (+, yellow) and pin 3 (–, black) of CN301 is between 13.8 and 14.5 V.

12.13 Disconnect the resistive load and check that the voltage between pins 2 and 3 at no load is 13.7 ±0.1 V.

Calibration of Output Current Limit by VR1

12.1 Adjust the variable transformer output to 100 VAC and adjust the external circuit for an output current of 0.9 A.

12.2 Slowly turn VR1 clockwise so that the voltage between pin 2 (+, red) and pin 3 (–, black) of CN301 is 11.5 ±0.5 V.

12.3 Adjust the variable transformer output to 135 VAC and check that the voltage between pin 2 (+, red) and pin 3 (–, black) of CN301 is 13.65 ±0.1 V.

12.4 Turn off the pump and disconnect the external circuit.

13. Reassemble the pump.

14. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout” if any calibration was performed.

Safety Slide Clamp Mechanical Calibration

1. Lay the pump on its back with the door open.

2. Push the red safety clamp and make sure it latches open.

3. Lay the 0.045 in. (1.15 mm) pin gage in the section of the pump head as shown below. Make sure that the end of the pin gage extends about 1/4” from the bottom of the pump head.

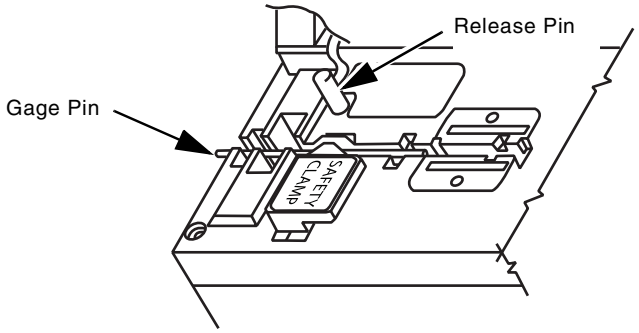


Figure 9-2 Safety Slide Clamp Adjustment

4. Slowly close the safety clamp button by holding it with one hand while pressing the release pin with the other. Let the safety clamp slowly rest over the pin gage.

CAUTION **Do not let the safety clamp snap closed by itself. This could damage the clamp or the pin gage.**

5. Close the pump door. Without touching the pump door, lift the pump upright about 1 foot above the work surface.
   - If the 0.045 in. (1.15 mm) pin gage falls out of the safety clamp, proceed to step 6.
   - If the 0.045 in. (1.15 mm) pin gage stays in the safety clamp, proceed with the following procedure to shim the safety clamp plate:

     5.1 Lay the pump on its back.

     5.2 Remove the safety clamp plate and screw. See Figure 11-5 , items 27 and 15.

     5.3 Place one polyester film spacer (part no. S050109) between the safety clamp plate and the door.

     5.4 Install the screw and torque to 6 kgf-cm (5.2 in-lb).

     5.5 Retest starting at step 3.

6. Repeat steps 3 through 5 with the 0.063 in. (1.60 mm) pin gage.
   - If the 0.063 in (1.60 mm) pin gage falls out of the safety clamp, the gap is too large. Proceed to step 7.
   - If the 0.063 in (1.60 mm) pin gage stays in the safety clamp, you are done with the adjustment.

7. Remove the safety clamp plate and inspect for excess shims or damage.
   - If no excess shims or damage are noticed, replace the safety clamp plate with a thinner plate (part no. S054643) and retest.
   - If excess shims are installed, remove one and retest.

- If damage to the slide clamp mechanism or door assembly is seen, replace as required and retest.
- If the safety clamp gap cannot be calibrated, replace the slide clamp mechanism or the door assembly as required.

Air Sensor Calibration

Note: This section must be performed when the pump head, sensor board, air sensor, door/door assembly, door latch, or latch pin is replaced.

1. Verify if a modification to the pump head door is necessary to complete this calibration procedure. Open the door and check for a white tubing guide shim or a letter "A" on the door, opposite the air sensor.
   - If the shim or letter "A" is present, the modification was already performed. Proceed to step 2 below.
   - If the white tubing guide shim or letter "A" is not present, go to "Tube Guide Shim Installation" on page 8-29 to install the tubing guide shim. For FLO-GARD 6201 pumps with serial numbers less than 83030018 but not ending in FA, a modification to the air sensor assembly is also necessary. Replace the existing air sensor assembly with a new assembly, part no. F049120023.
2. Modify an administration set by cutting the tubing about 6 inches below the first Y-site and splicing in a piece of calibration tubing (part no. 3-2-92-479) using tubing connectors. Fully prime the set with distilled water.

Note: This fluid filled tube, along with a dry calibration tubing segment, is used to calibrate the pump. These sections of tubing should only be used to calibrate 5 pumps with the tubing moved to an unused section for each pump tested. After the calibration of the fifth pump, discard the segments and replace them with new ones.

3. Place the pump upright. If the case is not already opened, separate the front and rear housings (see "Separation of Front and Rear Housings" on page 8-5), but do NOT remove any connectors. Plug the pump into AC power.

! WARNING ! **When working on an open pump, an electrical hazard exists when the pump is plugged into AC power.**

4. Set the pump to Test Mode 2:

4.1 Press and hold the **CLEAR TOT VOL** and **2** keys, then press the **ON-OFF/CHARGE** key.

4.2 Release the **ON-OFF/CHARGE** key without releasing the **CLEAR TOT VOL** and **2** keys for at least three seconds.

- The pump is in Test Mode 2 if NORM and MIN are displayed on the left hand side of the message (upper) display.
- If the pump is not in Test Mode 2, turn off the pump and repeat this step.

5. Using the set created in step 2, load the fluid filled calibration tubing segment, into the pump head and close the pump door. Open and close the pump door two more times and wait 2 minutes.

6. Adjust the NORM value (PRI RATE window) and the MIN value (PRI VTBI window) using VR801. Take the greater of the NORM and MIN values and calibrate to 450 ±20 (430 - 470).

- If the lesser value is less than 410, adjust it up so that it is just above 410. Recheck that the greater of the NORM and MIN values is still within 430 - 470.
- If both the NORM and MIN air sensor values are within the specified ranges, continue to the next step.
- If these ranges cannot be achieved, replace the air sensor per "Air Sensor Assembly Replacement" on page 8-14. After the air sensor is replaced, return to step 3 above.

7. Remove the fluid filled tubing from the pump head.

8. Load an air filled piece of calibration tubing into the pump head and close the pump door.

9. Open and close the pump door two more times and wait 2 minutes.

- If the values are 5 or less proceed to the next step.
- If the values are greater than 5 perform the following procedure:

9.1 adjust VR801 so that the higher of the NORM or MIN values is 4 ±1.

9.2 load the fluid filled piece of calibration tubing into the pump head and close the pump door.

9.3 Open and close the pump door two more times and wait 2 minutes.

9.4 Verify that both NORM and MIN values are within the range of 410 and 470.

Note: Apply Red Glpt to VR801.

10. Exit Test Mode 2 by pressing the **ON-OFF/CHARGE** key.

11. Prime and load a Baxter "s" suffix standard administration set. See "Administration Set Preparation" on page 10-2, steps 1 through 6.

12. Using the precision syringe, introduce an air bubble (25 mL for MIN setting, or 50 mL for NORM setting) into tubing just above the pump head door.

13. Press and hold the safety clamp arm cover slightly and allow the air bubble to travel to just above the air sensor.

14. Release the safety clamp arm cover.

15. Close the pump door.

16. Turn on the pump.

17. Set the Primary Rate to 125 mL/hr and Primary VTBI to 1000 mL.

18. Start the pump.

19. Ensure that this bubble is allowed to pass with no alarm.
    - If the air bubble is detected, repeat the calibration procedure.
    - If the air sensor cannot be calibrated:

      19.1 Turn off the pump.

      19.2 Replace the sensor in accordance with "Air Sensor Assembly Replacement" on page 8-14.

20. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

21. Perform the Air Alarm Test ("Air Alarm Test" on page 10-7) prior to the other tests.

Downstream Occlusion Sensor Calibration

1. Check calibration as described in "Automatic Test Mode 1: Calibration Mode 1" on page 9-14, steps 1 through 9.
    - If the value is within specification, proceed to the next step.
    - If the value is out of specification, calibrate the sensor as follows:

1.1 Remove the pump head door cover, see “Replacement of Pump Head Door Cover” on page 8-9.

1.2 Loosen and remove the occlusion detector stop (Figure 11-5 , item 19).

Note: If the stop is stuck, apply a small amount of isopropyl alcohol to the threads to free them and then wipe the threads clean.

1.3 Apply Loctite 211 or 222 to the screw threads of the stop.

1.4 Repeat “Automatic Test Mode 1: Calibration Mode 1” on page 9-14, steps 1 through 4.

1.5 Reassemble the stop into the pump head door and slowly turn it with a screwdriver until the value displayed in the PRI VTBI window of the Main Display is between 2998 and 3002.

1.6 Knock on the center of the door and check that the reading does not change more than 2 counts.

1.7 Allow the Loctite 211 or 222 to set.

1.8 Remove the thickness gauge and place the pump upright.

1.9 Turn off the pump.

2. The following procedure confirms that the calibration is correct.

2.1 Load a Baxter “s” suffix standard administration set, prime it with fluid and close the pump head door. Ambient and liquid temperatures must be between 72° and 82° F (22°and 28°C).

2.2 Occlude the tubing downstream of the pump.

2.3 Turn the pump on and set the Primary Rate to 125 mL/hr and Primary VTBI to 50 mL.

2.4 Start the pump and ensure that a downstream occlusion alarm occurs.

2.5 Press and hold the **SILENCE** and **TOT VOL STATUS** keys until a Failure Identification Code appears in the lower right corner of the Main Display. The Failure Identification Code should be 2 or 3.

3. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Upstream Occlusion Sensor Calibration

1. Connect the AC plug of the pump to a 115 ±5.0 VAC 60 Hz power source.

2. Enter Automatic Test Mode 1 and check the calibration as described in "Automatic Test Mode 1: Calibration Mode 1" on page 9-14, steps 7 through 5.
   - If the value is within specification, proceed to the following step.
   - If the value is out of specification, calibrate the sensor using the following procedure.

   2.1 Remove the pump head door cover. See "Replacement of Pump Head Door Cover" on page 8-9.

   2.2 Loosen and remove the stop (Figure 11-5 , item 19).

Note: If it is stuck, apply a small amount of isopropyl alcohol to the threads. Wipe the threads clean.

   2.3 Lay the pump on its back and place the thickness gauge on the upstream occlusion sensor, then close the pump door.

   2.4 Apply Loctite 211 or 222 to the threads of the occlusion stop and reassemble the stop in the door.

   2.5 Slowly turn the occlusion stop with a screwdriver until the value in the PRI RATE window of the Main Display is between 3273 and 3277.

   2.6 Knock on the center of the door by the back of fingers and check that the reading does not change more than 2 counts.

   2.7 Allow the Loctite 211 or 222 to set.

   2.8 Remove the thickness gauge and stand the pump upright.

   2.9 Install the pump head door cover, see "Replacement of Pump Head Door Cover" on page 8-9.

   2.10 Turn off the pump.

3. The following procedure confirms that the calibration is correct.

   3.1 Load a Baxter "s" suffix standard administration set.

   3.2 Prime it with fluid.

   3.3 Close the pump head door. Ambient and liquid temperatures must be between 72° and 82° F (22° and 28° C).

3.4 Occlude the tubing upstream of the pump.

3.5 Turn the pump on.

3.6 Set the Primary Rate to 125 mL/hr and the Primary VTBI to 50 mL.

3.7 Start the pump and ensure that an upstream occlusion alarm occurs.

3.8 Press and hold the **SILENCE** and **TOT VOL STATUS** keys until a Failure Identification code appears in the lower right corner of the Main Display. The Failure Identification code should be 4, 5 or 12.

4. Turn off the pump and reassemble the pump head door cover.

5. Perform the Operational Checkout procedures in Chapter 10, “Operational Checkout”.

Slide Clamp Sensor Calibration

Equipment required:

- DC Voltmeter
- Slide Clamp (part no. 030801011)
- Screwdriver with flat tip (2.5 to 3 mm width) for potentiometer calibration. Ceramic or insulated type is preferred.
- E-ring pliers
- Cotton-tipped swabs

1. Turn off the pump.

2. Press the safety clamp arm cover in until the safety clamp latches open.

3. Use a C or E-ring tool to remove the spring retainer from the slide clamp slot if one is present.

4. Use a cotton-tipped swab dampened with water to clean the safety clamp sensor. This sensor is located approximately 1/4” in at the upper left of the slide clamp slot. Repeat with a second dampened swab.

5. Separate the front and rear housings in accordance with “Separation of Front and Rear Housings” on page 8-5.

6. Connect the device to a 115 VAC, 60 Hz AC power source.

7. Disconnect and reconnect the slide clamp sensor connector CN803.

8. To calibrate the pump, connect a voltmeter to TP802 and GND on the sensor PCB.

9. Enter Automatic Test Mode 1 by pressing and holding the **CLEAR TOT VOL** and **1** keys while pressing the **ON-OFF/CHARGE** key.

Note: If the potentiometer in the following step cannot be easily moved from its present setting, it has been sealed with Loctite 211 or 222 or Red Glpt Varnish. To loosen the adhesive, apply one or two drops of isopropyl alcohol to the affected potentiometer and wait one minute before trying to move it again.

10. Insert the slide clamp (part no. 030801011) and close the door. Verify that the voltage at the appropriate test point is 0.25 V or less.
    - If the voltage is less than or equal to 0.25 V then proceed to the next step.
    - If the voltage is greater than 0.25 V, attempt to adjust the voltage by turning the potentiometer VR802 fully counterclockwise. Replace the safety/slide clamp assembly when it cannot be calibrated ("Replacement of Safety/Slide Clamp Assembly" on page 8-19).

11. Without the slide clamp inserted and the door closed, verify that the voltage at TP802 is 4.2 V or greater.

12. Replace the safety/slide clamp assembly when it cannot be calibrated ("Replacement of Safety/Slide Clamp Assembly" on page 8-19).

13. Apply a thin film of Red Glpt to VR802 to lock it in position.

14. Perform the Operational Checkout procedures in Chapter 10, "Operational Checkout".

Verifying Calibration Values

Follow the instructions described in "Automatic Test Mode 1: Calibration Mode 1" on page 9-14 and "Automatic Test Mode 2: Calibration Mode 2" on page 9-15 for verification of pump calibration for isolation of failures or as part of the annual preventive maintenance plan for the pump. Table 9-1 provides a list of the acceptable calibration ranges for each test mode. Appendix B, "Calibration Verification Data Sheet" contains a blank data sheet for recording the results from the calibration verification procedures described below.

Table 9-1 Acceptable Calibration Ranges

Function	Acceptable Range
Calibration Verification (Verification in Automatic Test Mode 1)	
Upstream Occlusion Calibration Value	3242-3314
Downstream Occlusion Calibration Value	2967-3039
Main Battery Calibration Value	688-714
Backup Battery Calibration Value	574-737
Calibration Verification (Verification in Automatic Test Mode 2)	
NORM and MIN Air Sensor Calibration with Primed Tubing	
NORM	330-565
MIN	
NORM and MIN Air Sensor Calibration with Air Filled Tubing	
NORM	< 11
MIN	
NORM and MIN Air Sensor Calibration with No Tube	
NORM	< 40
MIN	
FSR Verification with Pump Door Open	
RIGHT	500-820
LEFT	
FSR Verification with Pump Door Closed	
RIGHT	500-820
LEFT	

Table 9-1 Acceptable Calibration Ranges — continued

Function	Acceptable Range
FSR Verification with Tubing Misloaded	
RIGHT	450 or less
LEFT	
Vcpu	472-579

Automatic Test Mode 1: Calibration Mode 1

The purpose of this calibration mode is to check the calibration of the upstream and downstream occlusion sensors, and to check the pump's internal DC voltages from the power supply.

1. Place the pump on its back. Enter Automatic Test Mode 1:

   1.1 Press and hold **CLEAR TOT VOL** and **1** keys, then press the **ON-OFF/CHARGE** key.

   1.2 Release the **ON-OFF/CHARGE** key without releasing the **CLEAR TOT VOL** and **1** keys for at least three seconds.

   - The pump is in Test Mode 1 if UP and DOWN are displayed on the left hand side of the message (upper) display.
   - If the pump is not in Test Mode 1, turn off the pump and repeat this step.

2. Place the thickness gauge (part no. UKOG1013.B) onto the upstream occlusion sensor.

3. Close the pump head door.

4. Plug the pump into a 115 ±5.0 VAC, 60 Hz power source.

5. Check that the value displayed in the PRI RATE window of the Main Display is between 3242 and 3314.

6. Remove the thickness gauge, close the door, and check that the value is 3080 or less.

   ■ If the value is within specification, proceed to the next step.

   ■ If the value is out of specification, perform "Upstream Occlusion Sensor Calibration" on page 9-10, steps 2 and 3.

7. Place the thickness gauge used in step 2 onto the downstream occlusion sensor.

8. Close the pump door.

9. Check that the value displayed in the PRI VTBI window of the Main Display is between 2967 and 3039.
   - If the value is within specification, no calibration is required. Proceed to the next step.
   - If the value is out of specification, perform "Downstream Occlusion Sensor Calibration" on page 9-8, steps 1 and 2.

10. Check that the voltage readings in the SEC RATE and SEC VTBI windows are within specification:

Note: The pump must be plugged in to obtain voltage readings within the specifications below.

Descriptor	Window Displayed	Specification
Vmain = MB	SEC RATE	688 - 714 (a)
Vmem = BB	SEC VTBI	574 - 737 (b)
(a) Actual voltage = Displayed data x 0.01953 (b) Actual voltage = Displayed data x 0.00488		

If the BB display is out of specification, replace the lithium backup battery per "Replacement of Lithium Backup Battery" on page 8-28.

11. MB is a value relating to the voltage of the charging circuit.
   - If the MB display is within specification, you have completed the procedure.
   - When the MB display is out of specification, turn the pump off and charge it for 16 hours. Repeat steps 1 and 10. If the MB display is still out of specification, perform the following step.

12. Remove the battery cover by removing 4 screws (Figure 11-4 item 4) on the battery cover located on the back of the pump. Disconnect the main battery at the battery terminals and perform steps 1 and 10.
   - If the MB display is out of specification, the DC power supply must be calibrated per "DC Line Voltage Calibration" on page 9-1.
   - If the MB display is within specification as described in step 10, the main battery should be replaced per "Replacement of Battery" on page 8-23.

Automatic Test Mode 2: Calibration Mode 2

The purpose of this Automatic Test Mode is to check the calibration of the air sensor and to check the tube misloading sensor outputs.

1. Open the door and check for a white tubing guide shim or the letter "A" on the door opposite the air sensor.
   - If the shim or "A" is present, use the air sensor calibration values of 330 - 565.
   - If the shim or "A" is NOT present, perform tube guide installation per "Tube Guide Shim Installation" on page 8-29.
2. Plug the pump into a 115 ±5.0 VAC, 60 Hz power source. Enter Automatic Test Mode 2:
   - 2.1 Press and hold the **CLEAR TOT VOL** and **2** keys, then press the **ON-OFF/CHARGE** key.
   - 2.2 Release the **ON-OFF/CHARGE** key without releasing the **CLEAR TOT VOL** and **2** keys for at least three seconds.
     - The pump is in Test Mode 2 if NORM and MIN are displayed on the left hand side of the message (upper) display.
     - If the pump is not in Test Mode 2, turn off the pump and repeat this step.
3. Load a Baxter "s" suffix standard administration set and prime it with fluid. Close the pump door. Ambient and solution temperatures must be between 72° and 82° F (22° and 28° C).
4. Open and close the pump door two more times and wait 2 minutes.
5. Check the NORM value (at PRI RATE window) and the MIN value (at PRI VTBI window). Both values should display between 330 and 565 or 400 and 650 (Check above for the proper values).
6. Remove the primed tubing and load an unprimed calibration tubing segment and close the door.
7. Open and close the door two more times and wait 2 minutes.
8. View the NORM value displayed in the PRI RATE location at the upper left of the main display.
9. View the MIN value displayed in the PRI VTBI location at the lower left of the main display. Both values must be less than 11.
   - If they are within specification, proceed to the next step.
   - If they are out of specification, perform the procedure in "Air Sensor Calibration" on page 9-6.
10. Remove the empty tubing segment and close the door.
11. View the NORM value displayed in the PRI RATE location at the upper left of the main display.

12. View the MIN value displayed in the PRI VTBI location at the lower left of the main display. Both values must be less than 40.
    - If they are within specification, proceed to the next step.
    - If they are out of specification, perform the procedure in "Air Sensor Calibration" on page 9-6.
13. Follow steps 14 through 18 to check that the tube misloading sensor outputs in SEC RATE and SEC VTBI windows are within specification.
14. Load a Baxter "s" suffix standard administration set and prime it with fluid.
15. With the pump door open, check the FSRR value (at SEC RATE window) and the FSRL value (at SEC VTBI window). Both values should display between 500 and 820.
16. Repeat above step with the pump door closed. Both values should display between 500 and 820.
17. Open the door and intentionally load the tubing over the tube misloading sensor 2L (Figure 11-6 , item 10).
18. Close the door. Do not load hard components on the administration set between the door and the base plate. The FSRL value (at SEC VTBI window) should display 450 or less.
19. Repeat above step on the tube misloading sensor 2R (Figure 11-6 , item 11). The FSRR value (at SEC RATE window) should display 450 or less.

Note: The sensors are normal when the values in steps 15 through 18 are within specification. When any of these values are out of specification, replace the tube misloading sensor per "Replacement of Force Sensing Resistor (FSR) Devices for Tube Misloading Sensors" on page 8-15.

20. Press the **TIME** key and check that the voltage Vcpu reading in the SEC RATE window of the display is within 472 - 579. Actual voltage = displayed data x 0.00976.

Slide Shaft Sensor Calibration

Note: Early production units may contain the potentiometer VR803 instead of a jumper wire soldered across the holes. If your unit contains the VR803 potentiometer you must perform this calibration procedure, otherwise, skip this procedure.

Note: This calibration must be done after the slide clamp sensor has been calibrated.

1. Connect the pump to a 115 ±5.0 VAC 60 Hz power source. Enter Automatic Test Mode 1.
2. Connect a DC voltmeter between TP803 and GND on the sensor PCB.
3. Insert the slide clamp and keep the pump door opened.
4. Turn potentiometer VR803 fully counterclockwise and check that the voltage reading is 0.2 V or less.
5. Close the door and check that the voltage reading is 4.2 V or more.
6. Open the pump door and push the slide clamp fully into the slide clamp slot. Check that the voltage reading is 0.2 V or less with the door opened.
7. Repeat steps 4 through 6 two times.

Note: Apply a thin film of Red Glpt to the potentiometer to prevent the calibration from being changed.

A/D Converter Reference Voltage Calibration

1. Separate the front and rear housings in accordance with “Separation of Front and Rear Housings” on page 8-5. Do not disconnect any of the cable connectors.
2. Remove the battery per “Replacement of Battery” on page 8-23.
3. Remove the EPROM cover by removing 1 securing screw.
4. Connect a digital voltmeter between pin 1 (+) and pin 8 (–) of the CNTEST connector.
5. Connect the AC plug of the pump to a 115 ±5.0 VAC 60 Hz power source.
6. Turn the pump on and adjust potentiometer VR501 until the meter reading is 5.000V ±0.010 V.
7. Disconnect all test equipment. Install the EPROM cover and battery, see “Replacement of Battery” on page 8-23.

Chapter 10

Operational Checkout

Overview

The operational checkout procedures in this chapter determine that the pump operates properly after it has been repaired or as preventive maintenance. When the pump fails any part of the operational checkout, the fault must be corrected prior to placing the pump in service. Please become familiar with all the checkout procedures before beginning.

As part of a thorough checkout, verify the calibration values as indicated in Chapter 9, “Calibration”.

The following test equipment is required to perform the operational checkout procedures:

- Baxter Continu-Flo “s” suffix administration set with at least one Y-site
- Solution containers (such as distilled/sterile water)
- Precision gas-tight 250 µL syringe (Hamilton #1725 or equivalent)
- Thickness gauge (part no. UKOG1013.B)
- Tape measure or yardstick
- Calibrated scale with 0.1 g resolution or better
- ASTM class A graduated cylinder, 25 mL or larger, depending on test (optional)
- Calibrated pipetter, 1000 µL (optional)
- Calibrated safety analyzer, Dale Technology LT544D or equivalent

Appendix A, “Operational Checkout Data Sheet” is a data sheet which may be reproduced and used to record the results of the Operational Checkout. Use Appendix C, “Configuration Options Data Sheet” to record the pump’s configuration settings.

Note: Prior to beginning these tests, please become familiar with the pump operating procedures in the Operator’s Manual.

! WARNING ! **If the pump fails to perform as described or stops with a failure code alarm during any of the tests herein, troubleshoot it in accordance with Chapter 7, "Troubleshooting" and repair in accordance with Chapter 8, "Removal/ Replacement Procedures" before placing the pump in service.**

Exterior Inspection

1. Inspect the exterior of the pump.
   - Verify that the pump is clean and free from physical damage.
   - Check the gray RTV surrounding the front keypad. Ensure an intact, uniform bead of sealant is present. Perform touch up as required and allow to cure.
2. Check the mounting clamp.
   - Verify the clamp screw rotates smoothly without binding.
   - Verify that the disc and cushion are intact and secure.
3. Check the power cord.
   - Verify that there are no cuts or breaks that would expose an electrical shock hazard.
   - Check the strain relief and plug. Verify these are intact and secure.

Administration Set Preparation

To avoid the possibility of fluids contacting the air sensor and pump mechanism, the solution container should be spiked and the set primed before opening a pump door. The container should also be placed low enough to permit a loop in the tubing to the side of the pump. Position the container so that accidental spillage onto the pump is minimized. Do not stretch the set when removing it from the packaging.

1. Using a solution filled container (distilled/sterile water, etc.) and a Baxter Continu-Flo administration set with at least one Y-site, prepare the administration set according to instructions accompanying the set.
2. Splice a tubing segment (part no. 03-02-92-479) into the middle of the administration set.
3. Spike the solution container and fully prime the set.

4. Remove all trapped air bubbles from all set components.

5. Hang the solution container such that the fluid level is a minimum of 27" above midpoint of the pump.
   - Ensure that the tubing is clean and dry before placing it in the pump.
   - Ensure that the tubing is placed and seated properly in the guide channel, pump mechanism, sensors and safety clamp.
   - Ensure that there is no slack in the tubing and that it is not kinked or pinched before closing the pump door.

6. Place the distal end of the administration set in a container or sink to dispose of pumped solution.

Self Test

1. With the device disconnected from AC power and the powered OFF, press and hold the **SILENCE** key and then press the **ON-OFF/CHARGE** key to power it ON. Do not release the **SILENCE** key until instructed in step 3.

2. Check the software version on the Main Display. The word SOFT displays, followed by the version number. Record the software version number on the data sheet.

3. Release the **SILENCE** key and allow the self test to complete. Verify the following occurs:

Note: If you miss any of the indications listed below during the self test, repeat the self test as many times as required to observe the indications. To repeat the self test turn the device off then back on.

- BEGINNING OF SELF TEST:
  - All LEDs turn on.
  - All segments of the Message display and all segments of the Main display turn on.
  - All backlit icons are turned on except for the plug icon.
  - The main buzzer will turn on and change tone while all segments of the displays are on.
  - The backup buzzer will turn on after the main buzzer turns off.
  - When the backup buzzer turns off, all LEDs will turn off.

■ DURING SELF TEST:

- The Main display turns off until the end of self test.
- The Message display sequence is as follows:
  - Hospital Area Designator (active if the pump is configured with options 1-9)
  - OCCLUSION LEVEL 1, 2, or 3
  - AUDIBLE SWITCHOVER if configured ON
  - AUTO RESTART (active if the pump is configured with options 1-9 and flow check is configured ON)

Note: If the INSERT SLIDECLAMP message appears, it means that one or more sensors indicate that a tube is present and the on/off slide clamp is not. Stop testing and verify the following:

- No tube is in the pump.
- The upstream occlusion sensor button is not siezed or sticking.
- The upstream occlusion calibration in Test Mode 1 is within specification.
- The air sensor "no tube" readings are within specification.

■ AT THE END OF SELF TEST:

- The Main display should show the following:

PRI RATE (ML/HR)
0

PRI VOLUME (ML)
TO BE INFUSED
0

Note: Non-zero PRI and/or SEC rates and VTBIs may appear if still retained in the five hour memory.

- The Message display should show the following:

STOPPED

- BATTERY LOW alarm must not be activated.
- The battery icon must be lit.

4. Reconnect the device to AC power. Verify that the plug icon is lit and that the battery icon is OFF.

Door Open Alarm Test

1. Load the administration set into the pump head and close the door.
2. Program a primary rate of 100 mL/hr and a primary VTBI of 10 mL.
3. Press the **PRI START** key.
4. Open the pump door. The following should occur:
   - DOOR OPEN is displayed in the Message Display. (CLOSECLAMP may also appear depending on the configuration.)
   - The red ALARM LED flashes.
   - The audible alarm is activated.
5. Rotate the volume knob through its entire travel. Verify the alarm volume increases with clockwise rotation, and that the alarm remains audible at all settings. Leave the volume set to maximum.

Slide Clamp Mechanism Test

The slide clamp feature is an alert or alarm (software versions 1.09 or later) option enabled through the configuration utility. When this option is enabled, the slide clamp on the administration set must be loaded into the slide clamp slot. When the infusion is complete, the administration set cannot be easily removed from the pump without first pushing the slide clamp all the way into the slide clamp slot, thus occluding the tubing in the slide clamp. This test verifies that the slide clamp feature is functioning properly.

Note: An administration set with the dark blue slide clamp (part no. 030801011) compatible with the slide clamp mechanism must be used for this test.

Note: If the slide clamp feature is enabled, the administration set slide clamp must be loaded into the assembly. In the alert mode, the pump operates with an alert if the slide clamp is not loaded. In the alarm mode (software versions 1.09 or later), the pump does not start and an alarm tone sounds if the slide clamp is not loaded. Use of the slide clamp feature is selected as part of the configuration option before the pump is placed into service.

Note: This test is to be performed with the SLIDE CLAMP configuration set to option 2 (ON or ALERT) or 3 (ALARM). If necessary, remove the spring retainer and enter the modify configuration mode to configure INS CLAMP to option 2 (ON or ALERT) or 3 (ALARM).

Note: A spring retainer is loaded into the slide clamp slot at the factory to prevent damage during shipment. The spring retainer must be removed before operating the pump with the slide clamp feature enabled. If the feature is not going to be used by your hospital, it is recommended that the spring retainer remain in the slot to help prevent spilled solutions from entering the slide clamp slot. Contact Product Service at 1–800–THE–PUMP for additional spring retainers.

1. If your hospital does not have the slide clamp feature enabled, ensure that the spring retainer occupies the slide clamp slot and proceed directly to "Electrical Safety Tests" on page 10-11.

2. With the device ON, open the door and fully insert the slide clamp of a primed Baxter "s" suffix standard administration set into the slide clamp slot.

3. Press the red safety clamp arm until it locks open, and load the set into the pump mechanism.

4. Close and latch the pump door.

Note: If INSERT SLIDECLAMP appears on the display, clean the slide clamp sensor with a cotton-tipped swab dipped in water and check the calibration. If INSERT SLIDECLAMP still appears on the display, replace the safety/slide clamp assembly including the entire wiring assembly in accordance with Chapter 8, "Removal/Replacement Procedures".

! WARNING ! **If the pump does not respond as described for steps 5, 6, and 7 below, replace the safety/slide clamp assembly including the entire wiring assembly in accordance with Chapter 8, "Removal/Replacement Procedures".**

5. Open the door. Press the red safety clamp arm with moderate force (approximately 15 lb. [6.5 kg]) and verify that the latch does not lock in the open position.

6. Using one hand, pull on the slide clamp with moderate force (approximately 8 lb. [3.6kg]) perpendicular to the pump face. Verify that the slide clamp cannot be removed.

7. Push the slide clamp in fully. Verify that the red safety clamp arm can be latched in the open position, and verify that the slide clamp and tubing can be removed.

8. Load the primed set again but do not insert the slide clamp into the mechanism.

9. Close the pump door. Verify that INSERT SLIDECLAMP appears on the display with the ALERT LED constantly on, and the audible tone alternates on and off.

Note: If INSERT SLIDECLAMP does not appear on the display, clean the slide clamp sensor with a cotton-tipped swab dipped in water and check the calibration. If INSERT SLIDECLAMP still does not appear, replace the safety/slide clamp assembly including the entire wiring assembly in accordance with Chapter 8, “Removal/Replacement Procedures”.

10. Insert the slide clamp approximately one third of the way into the mechanism.

11. Close the pump door. Verify that INSERT SLIDECLAMP appears on the display.

Note: If INSERT SLIDECLAMP appears on the display, clean the slide clamp sensor with a cotton-tipped swab dipped in water and check the calibration. If INSERT SLIDECLAMP still appears on the display, replace the safety/slide clamp assembly including the entire wiring assembly in accordance with Chapter 8, “Removal/Replacement Procedures”.

12. Open the pump door and remove the tubing from the pump.

Air Alarm Test

The air bubble size for air detection is selectable through the configuration option and is factory set to NORM. See Chapter 5, “Configuration Option Feature” for an explanation of the configuration option. If the pump fails to detect air or if air detection is too sensitive, remove the pump from service and troubleshoot it in accordance with Chapter 7, “Troubleshooting”. Repair and recalibrate in accordance with Chapter 8, “Removal/Replacement Procedures”. Perform this test to verify air detection.

1. Prime and load a Baxter “s” suffix standard administration set with one Y-site above the pump. Follow “Administration Set Preparation” on page 10-2, steps 1 through 6.

2. Using a precision gas-tight syringe, introduce an air bubble into the administration set through the Y-site above the pump. Verify that the pump detects air bubbles properly, depending on the bubble volume as shown in the table below:

Air Sensor Configuration	Test Air Bubble Volume (microliters)		Recommended Syringe (or equivalent)
	No Alarm	Alarm	
NORM	50	110	Hamilton #1725
MIN	25	85	

3. Open the pump door and slightly press the safety clamp to position the air bubble below the pump fingers and above the air sensor.

4. Close the door and start the pump. When the intact air bubble reaches the air sensor the following should occur when an alarm is expected:
   - AIR is displayed in the Message Display.
   - The red ALARM LED flashes.
   - The audible alarm is activated.
   - The pump stops.

   ■ If the pump does not alarm as required, verify that the bubble did not break up before reaching the sensor by observing the bubble downstream from the sensor. Either repeat the test or recheck and adjust the sensor calibration.

   ■ If the pump alarms with the 25 or 50 microliter bubbles, recheck and adjust the air sensor calibration.

5. Test both MIN and NORM options and all four air bubble volumes. Upon completion, return the pump to the correct air sensor configuration.

FSR Check

1. Note the left and right FSR values displayed while the pump is on.

2. Note the left and right FSR values displayed while the pump is unplugged.

3. Note the difference between the two values from steps 1 and 2.

4. Wait for one minute and plug the pump back into AC power.

5. Note the left and right FSR values displayed when the pump is plugged in:

   ■ If the values are within 10 counts in the readings, proceed to the next step.

   ■ If there is a jump of more than 10 counts in the readings:

   5.1 Clean the FSR connectors with a non lubricating contact cleaner. Access the connectors after opening the pump as outlined in “Separation of Front and Rear Housings” on page 8-5.

   5.2 Perform this procedure again to verify FSR operation. If they fail again, replace the FSR pair in accordance with “Replacement of Force Sensing Resistor (FSR) Devices for Tube Misloading Sensors” on page 8-15.

6. Open the pump's door and misload the tubing over the left FSR.
7. Close the door.
8. Verify that the message display shows CHECK SET LOADING, the ALARM LED blinks on and off, and the audible alarm tone is sounding.
9. Record the result on the data sheet.
10. Open pump's door and misload the tubing over the right FSR.
11. Close the door.
12. Verify that the message display shows CHECK SET LOADING, the ALARM LED blinks on and off, and the audible alarm tone is sounding.
13. Record the result on the data sheet.

Downstream Occlusion Testing

Perform the following steps at room temperature to ensure proper operation of the downstream occlusion sensor.

1. Prime and load a Baxter "s" suffix standard administration set. See "Administration Set Preparation" on page 10-2, steps 1 through 6.
2. Start the pump at a rate of 200 mL/hr with a VTBI of 20 mL. Allow the pump to deliver at least 5 mL.
3. Fold and completely pinch the tubing just below the pump. OCCLUSION should be displayed in the Message Display, the red ALARM LED should flash, the audible alarm should sound, and the pump should stop.
4. Turn the pump off and remove the tubing.

Upstream Occlusion Testing

Perform the following steps to ensure the performance of the upstream occlusion sensor.

1. Prime and load a Baxter "s" suffix standard administration set. See "Administration Set Preparation" on page 10-2, steps 1 through 6.
2. Pinch off the tubing with a set clamp or hemostat 12 to 16 inches above the pump head.
3. Set a rate of 200 mL/hr with a VTBI of 20 mL and start the pump.

4. Within three minutes of starting, the following should occur:
    - The pump stops.
    - The red ALARM LED flashes.
    - UPSTREAM OCCLUSION is displayed in the Message Display.
    - The audible alarm is activated.

5. Turn the pump off and remove the tubing.

Battery Check

1. Verify battery charging and capacity.

2. Plug the battery into AC power for at least 16 uninterrupted hours before proceeding to the next step.

3. Load a primed Baxter “s” suffix standard administration set into the pump. Set the pump’s PRI RATE to 1901 mL/hr and PRI VTBI to 4800 mL and start the pump.

4. Unplug the device while it is running. Verify that the battery icon is lit and that no change in pumping occurs.

5. Operate the device on battery power for 2.5 hours. Make sure that the device does not initiate a LOW BATTERY alert before the KVO alert occurs.
    - If the unit fails this test, change the battery per “Replacement of Battery” on page 8-23.
    - If the device operates satisfactorily on battery power, plug it back in. Recharge the battery by allowing the device to remain connected to AC power for a minimum of 16 hours.

Panel Lock Test

1. With the pump running without an alert, press the PANEL LOCK pushbutton on the rear of the pump.

2. Verify that the word Loc is displayed in the Main Display.

3. Verify that the input from front panel keys is not accepted except from **BACKLIGHT** and **TOT VOL/STATUS**.

4. Press PANEL LOCK again. The Loc message should disappear, and input from all front panel keys should be accepted.

Free Flow Prevention Test

1. Prime and load a Baxter "s" suffix standard administration set.
2. Place the distal end of the set into a container of known weight. Open the roller clamp and close the pump door and observe the distal end of the set for 60 seconds after closing the door.
3. Verify that no more than 0.5 mL of fluid is allowed to flow in the first 60 seconds, and that no gravity flow occurs after 60 seconds. Measure the fluid gravimetrically with a scale, by collecting the fluid with a pipettor (recommended size 1000 μL), or by counting drops in the administration set drip chamber:
   - For a drip chamber with 10 drops/mL, ≤ 0.5 mL ≤ 5 drops
   - For a drip chamber with 60 drops/mL, ≤ 0.5 mL ≤ 30 drops

Electrical Safety Tests

Ground Impedance

1. Using an equivalent NFPA-99 tester, measure the resistance between one of more accessible dead metal parts such as the communication port or the mounting nut of the PANEL LOCK switch and the ground pin of the attachment plug.
2. Flex the cord at the strain relief at each end of the cord during the test. The resistance must not exceed 0.5 Ω.

Current Leakage

1. Measure the current leakage at the communication port of the mounting nut of the PANEL LOCK switch. Perform all four leakage current test modes per UL 544 (Normal Polarity/Normal Ground, Normal Polarity/ Open Ground, Reverse Polarity/Normal Ground, Reverse Polarity/Open Ground).
2. Record the highest reading. The leakage current must not exceed 50 μA in any mode.

Accuracy Tests

Any one of the tests described in this section can be used to test the accuracy of the pump. You can perform just the One-Hour Accuracy Test (page 10-13), or one of the shorter tests ("Measurement by volume per time" on page 10-12 or "Measurement incorporating VTBI option" on page 10-12). The One-Hour Accuracy Test should be performed if either of the shorter tests fail.

1. Before proceeding with the selected test, perform steps 1 through 6 of "Administration Set Preparation" on page 10-2.

Note: An unused section of a Baxter "s" suffix standard administration set or calibration tubing (part no. 03-02-92-479) can also be used for these tests.

2. Mark the section of the tubing in the pump to indicate that the segment has been used.

Note: Do NOT reuse a tubing segment that has already been used to conduct an accuracy test.

Note: The accuracy specifications included in these tests account for an extensive list of variables over a short duration test cycle. A more precise measurement of flow rate requires longer test times, including statistical trials. However, this is not necessary to demonstrate proper function of the pump.

Measurement by volume per time

1. Program a PRI VTBI of 20 mL and start the pump at 200 mL/hr.

2. Collect the solution in an ASTM Class A 25 mL graduated cylinder, with a resolution of 0.2 mL or better, for 6 minutes ±3 seconds or until the pump switches to the KVO mode.

Note: Stop the pump within 10 seconds after the KVO alert, because fluid delivered after the KVO alert adds to the test error.

3. The solution collected should be between 18.6 mL and 21.4 mL.

Measurement incorporating VTBI option

1. Program a PRI RATE of 200 mL/hr. and PRI VTBI of 35 mL.

2. Start the pump and collect the solution in a container of known weight. When the pump goes into KVO alert mode, stop the pump within 20 seconds.

Note: Stop the pump within 20 seconds after the KVO alert, since fluid delivered after the KVO alert adds to the test error.

3. Use a calibrated scale with a resolution of 0.1 grams or better to weigh the container and solution. Then, divide the solution weight by the specific gravity of the solution (water's specific gravity is 1 g/mL).

4. The solution collected should be between 32.5 mL and 37.5 mL.

One-Hour Accuracy Test

Note: Perform this test if the pump fails tests "Measurement by volume per time" on page 10-12 or "Measurement incorporating VTBI option" on page 10-12.

Note: Do NOT reuse a tubing segment that has already been used to conduct an accuracy test.

1. Connect the device to AC power and power it on.

2. Program a PRI RATE of 125 mL/hr with a PRI VTBI of 1000 mL.

3. Place the distal end of the infusion set into a container of known weight.

4. Simultaneously, start a timer and press the **START** key.

5. Stop the pump 1 hour ±20 seconds later. Use a calibrated scale with a resolution of 0.1 grams or better to weigh the container and solution. Then, divide the solution weight by the specific gravity of the solution (water's specific gravity is 1 g/mL).

6. The collected solution should be between 116.25 and 133.75 mL.

7. If the volume of the collected solution is not between 116.25 and 133.75 mL, verify proper test technique. Refer to the information on Inaccurate Delivery: Accuracy in Table 7-4.

Important: Do not run this test again to improve results unless there is reason to believe that the test technique was in error. Replace any pump head that fails this test and be sure to clearly identify it as having failed the One-Hour Accuracy Test.

Chapter 11

Illustrated Parts Breakdown

Overview

This section includes illustrations and parts lists required to identify any replaceable part in the FLO-GARD 6201 Volumetric Infusion Pump. Each illustration is keyed to a parts list, which lists each component shown in the figure by part number and description. The quantity per assembly is also shown. To obtain replacement parts, contact product service. The first column shows the figure and item number of each part. The second column is the Product Service part number. The third column is the manufacturer's part number, and the last column is the quantity per assembly.

Table 11-1 Parts List - Front Housing Assembly (F049990010)

Item	Svc. Part #	Mfg. Part #	Description	Qty
1	F049120022	F049120022S	PUMP, HEAD ASSY	1
2	HPNL1025.A	5003474001	PANEL, Front	1
3	PGUMM103.K	F044630004	SEAL, Rubber	1
4	XBSUF40P.A	4009310015	SCREW, Flat Head, M4X18	3
5	LRTNP100.A	F044620002	SPRING RETAINER	1
6	XBPUF30P.A	4009310009	SCREW, Pan Head, M3X20	1

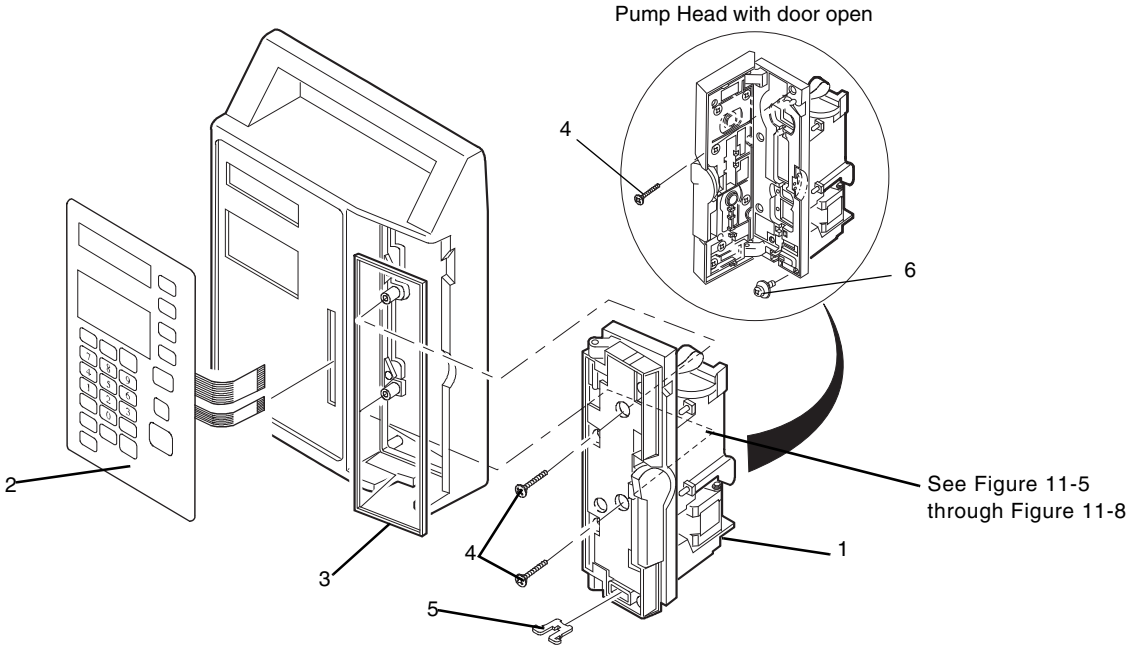


Figure 11-1 Front Housing Assembly (F049990010) - Front View

Table 11-2 Parts List - Front Housing Assembly (F049990010)

Item	Svc. Part #	Mfg. Part #	Description	Qty
1	CPWBN104.A	F042130005	Display PCB Assembly	1
2	CPWBX104.A	F042130006	CPU PCB Assembly	1
3	CPWBX104.B	F041130007	Sensor PCB Assembly	1
4	GCABA104.A	F041624001	Front Housing	1
5	GLEGG100.D	F044630001	FOOT, Rubber	2
6	LANGT103.B	F042220001	BRACKET, MOUNTING-Pump Head	1
7	LDAi1008.A	F044620014	SPACER, PCB	3
8	PGUMM103.J	F044630002	SEAL, Rubber, Housing	1
9	PSPAF103.A	F044230001	SPACER, Pump Head	1
10	PSPAN103.A	F049620013	SPACER, Double Locking, PCB	2
11	PSPAB103.A	4009320001	SPACER, Large PCB 7M	5
12	RDENC100.D	F049130002S	DC Power Supply, 105-130V	1
13	XBPBN30P.A	4009310001	SCREW, Pan Head, M3 x 6 w/ washer assy	1
14	XBPBN40P.E	4009310004	SCREW, Pan Head, M4X10	2
15	XBPSD30P.D	4009310005	SCREW, Pan Head, M4X6	10
16	XBPSD30P.G	4009310038	Screw, Pan Head, M3X6	1
17	XUPSD30P.B	4009310020	SCREW, Pan Hd-Tapping, M3X8	15
18	XWHSD300.C	4009330001	WASHER, Rubber Foot, M3	4
19	07-26-01-081	07-26-01-081	LABEL, Directions for Use	1
20	XEPSD30P.A	4009310018	SCREW, Pan Hd-Tapping, M3X8	4
21	PZETL100.A	F044610001	Cover, LCD Insulation	1
22	PSEL1007.A	3004090001	SEAL, DUST, LCD	1
23	UBATL100.A	5009480002	Lithium Battery	1

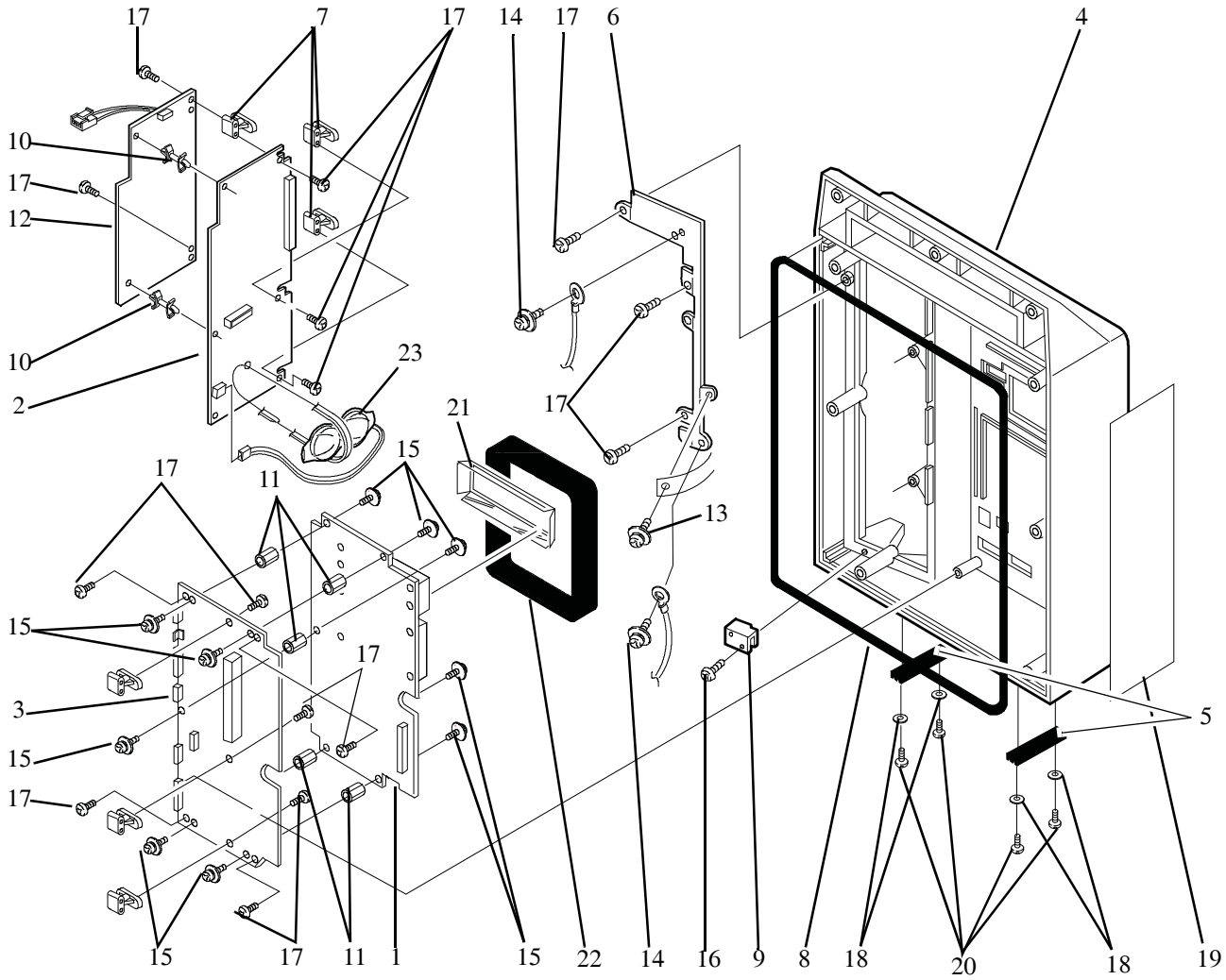


Figure 11-2 Front Housing Assembly (F049990010) - Rear View

Table 11-3 Parts List - Rear Housing Assembly

Item	Svc. Part #	Mfg. Part #	Description	Qty
1	CPWBN104.B	F043130001	PCB, ASSEMBLY-Terminal	1
2	CPWBN104.C	F049130012	PCB, ASSEMBLY-Backkup Aud Alrm	1
3	CPWBN105.A	F043130004	PCB, ASSEMBLY-Audible Alarm	1
4	GCABB104.C	F044624006	Rear Housing	1
5	GLEGG100.D	F044630001	FOOT, Rubber	2
6	LANGQ103.A	F044211001	Main Ground Plate	1
7	LANGQ103.B	F044220003	Vol/lock Ground Plate	1
8	LANGT102.B	F044220005	BRACKET, XFORMER	1
9	PGUMM103.D	F044620003	BOOT, Rubber-Main Buzzer	1
10	PGUMM103.E	F044620004	BOOT, Rubber-Backup Buzzer	1
11	QCNW1043.B	F044140001	GND WIRE, Front Housing	1
12	QCNW1052.B	F044140003	GND WIRE, XFORMER	1
13	QCNW1058.A	F044140002	Gnd Wire, Pwr Receptacle	1
14	QCNW1093.A	F042140005	Buzzer Harness,	1
15	QCNW1095.A	F044140007	GND WIRE, Pole Clamp	1
16	QCNW1117.A	5003415001	Flat Ribbon Cable	1
17	QSWP1008.A	5009470002	Switch, Panel Lock	1
18	RTRNP100.E	5009462001	AC Transformer 117V, 60Hz	1
19	RVRC1350.A	2501003200	POT, Volume Control	1
20	XBPBN30P.C	4009310029	Screw, Pan Head-M3X8 with brass washer assy	2
21	XBPBN40P.E	4009310003	SCREW, Pan Head-M4X8 w/washer assy	7
22	XUPSD30P.B	4009310020	SCREW, Pan Hd-Tapping M3X8	5
23	XUPSD40P.A	4009310021	SCREW, Pan Hd-Tapping M4X8	2
24	PZETL102.D	3004010007	FILM, Batt. Compartment Insulation	1
25	XWHSD300.C	4009330001	WASHER, Rubber Foot-M3	4
26	PZETV102.A	3004010008	FILM, Power Trans Insulation	1
27	XEPSD30P.A	4009310018	SCREW, Pan Hd-Tapping M3X8	4

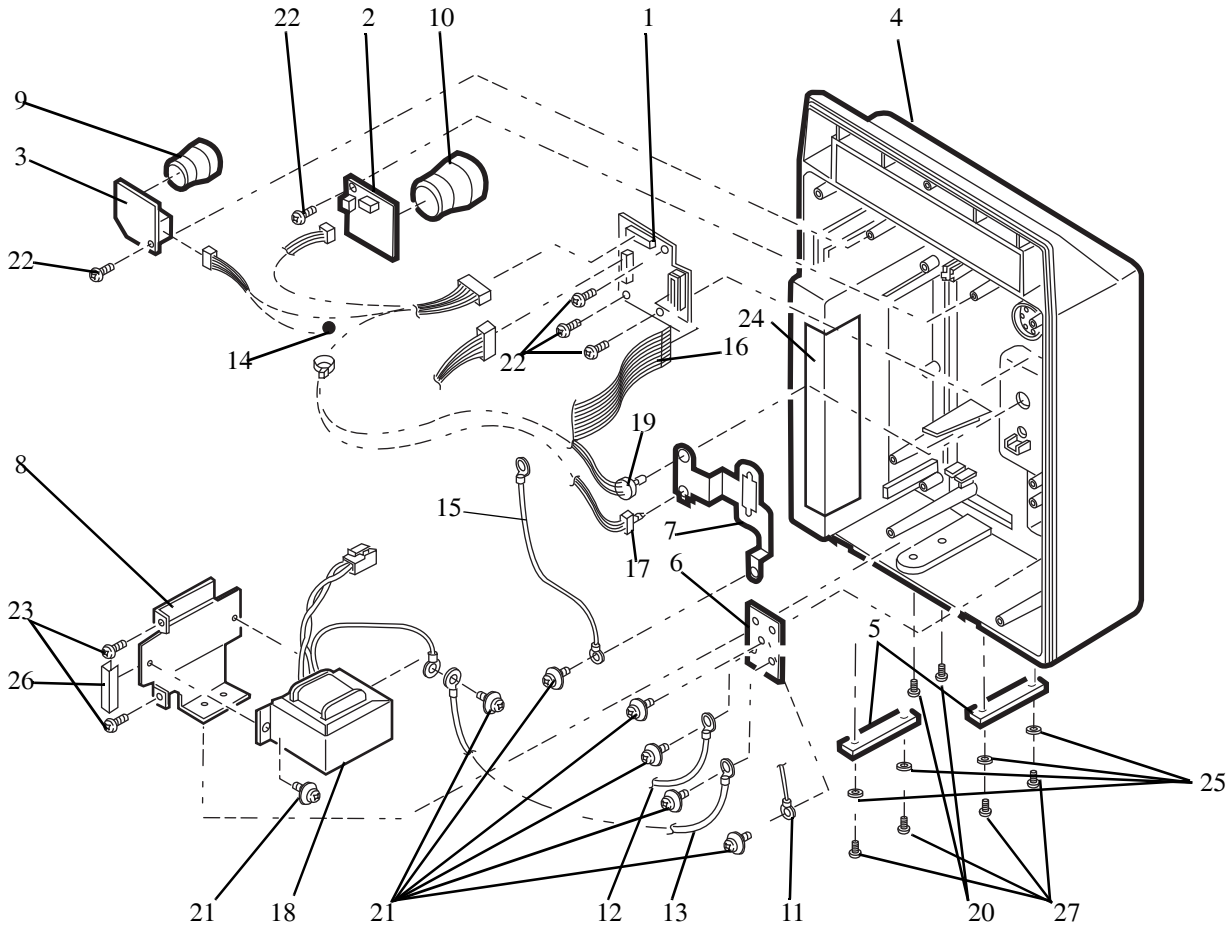


Figure 11-3 Rear Housing Assembly, Internal

Table 11-4 Parts List - Rear Housing Assembly

Item	Svc. Part #	Mfg. Part #	Description	Qty
1	F049120008	F049120008	Pole Clamp Assembly	1
2	4009390001	4009390001	COVER, Comm. Port	1
3	GCOVH101.A	F044624005	COVER, EPROM Access	1
4	GFTAB101.A	F042624004	Battery Compartment Cover	1
5	JKNBZ100.C	F049620011	KNOB, Volume Control	1
6	JKNBZ101.C	6009590024	KNOB, Panel Lock Sw.	1
7	F049211002	F049211002	NUT, Comm. Port	2
8	PCUSS102.A	F044630003	CUSHION, Battery	1
9	PGUMM103.C	F044630005	SEAL, Batt. Comprtmnt	1
10	PGUMM103.F	F044620005	CUSHION, Batt. Comprtmnt	1
11	QCNW1092.A	F043140004	HARNESS, Comm. Port	1
12	QCNW1094.A	F042140006	Battery Harness	1
13	QFSB1221.A	5009425001	FUSE, Main, 0.5A, 250V, Slow Blow	2
14	QFSB4451.A	5009425002	FUSE, Battery, 2A, 125V	1
15	QSOCA101.A	5009410002	AC Receptacle	1
16	F044810003	F044810003	LABEL, Panel Lock & Alarm Volume	1
17	07-26-B1-087	07-26-B1-087	LABEL, Battery	1
18	UBAT1010.A	5009480001	Battery, Lead-Acid, NP2-12	1
19	XBBSD40P.D	4009310012	SCREW, Binder Head, M4X10	4
20	4009310006	4009310006	SCREW, Pan Head, M2.6X8	2
21	XBPBN40P.B	4009310004	SCREW, Pan Head, M4X10	3
22	XBPSD30P.L	4009310007	SCREW, Pan Head, M3X8	1
23	XBSBN30P.A	4009310013	SCREW, Flat Head, M3X10	2
24	PZETL102.G	3004010004	FILM, EPROM Access Cov. Insulation	1
25	GCOVH101.B	F043624003	COVER, Power Cord	1
26	LXBZ1004.A	4004310023	SCREW, Pan Head, M4X63	6
27	5009410001	5009410001	AC Power Cord	1

Table 11-4 Parts List - Rear Housing Assembly

Item	Svc. Part #	Mfg. Part #	Description	Qty
28	07-26-E1-082	07-26-E1-082	LABEL, Caution, Japan	1
28a	0726C1212	07-26-C1-212	LABEL, Caution, Sing.	1
29	QFSH5100.A	5009425014	Fuse, 0.1A, 250V	1
30	Not available		Label, UL	1
31	Not available		Label, CSA	1
32	Not available		Plate, Serial Number, Aluminum	1
32a	Not available		Serial Number Label	1
32b	Not available		Film, Overlay-serial Number	1
33	TLABZ106.C	07-27-B1-018	Label, 24 Hour Service, Rev. A	1
34	07-26-01-089	07-26-01-089	Fuse Label FG6201	1
35	07-26-01-086	07-26-01-086	Comm Port Label	1
36	XBBSD30P.B	4009310010	SCREW, Binder Head, M3X12	2
37	XBBSD30P.C	4009310011	SCREW, Binder Head, M3X16	2
38	GCAS101.A	F042624007	Pole Clamp Body	1
39	JKNBZ101.B	F044620012	Pole Clamp Knob	1
40	LFiX1010.A	F044220004	Pole Clamp Disk	1
41	LPLTZ107.A	F044630006	Pole Clamp Rubber Cushion	1
42	LXBZ1019.A	4009310024	Screw With Snap, ISO 4X8	1
43	LXWZ1007.A	4004330003	Cord Wrap Washer, M4-Rozet	1
44	NSFTT102.A	F044211003	Pole Clamp Shaft	1
45	UBNDA100.A	F042615001	Power Cord Strap	1
46	XBPSD30P.V	4009310008	SCREW, Pan Head, M3X14 w/washer assy.	1
47	XBSUW40P.A	4009310016	SCREW, Flat Head, M4X8	1
48	XBTSN30P.A	4009310017	SCREW, Truss, M3X8	1
49	XWHUZ400.A	4009330013	WASHER, Pole Clamp Shaft, M4	1
50	XXHUW40L.A	4009310022	SCREW, Allen, M4X8	1

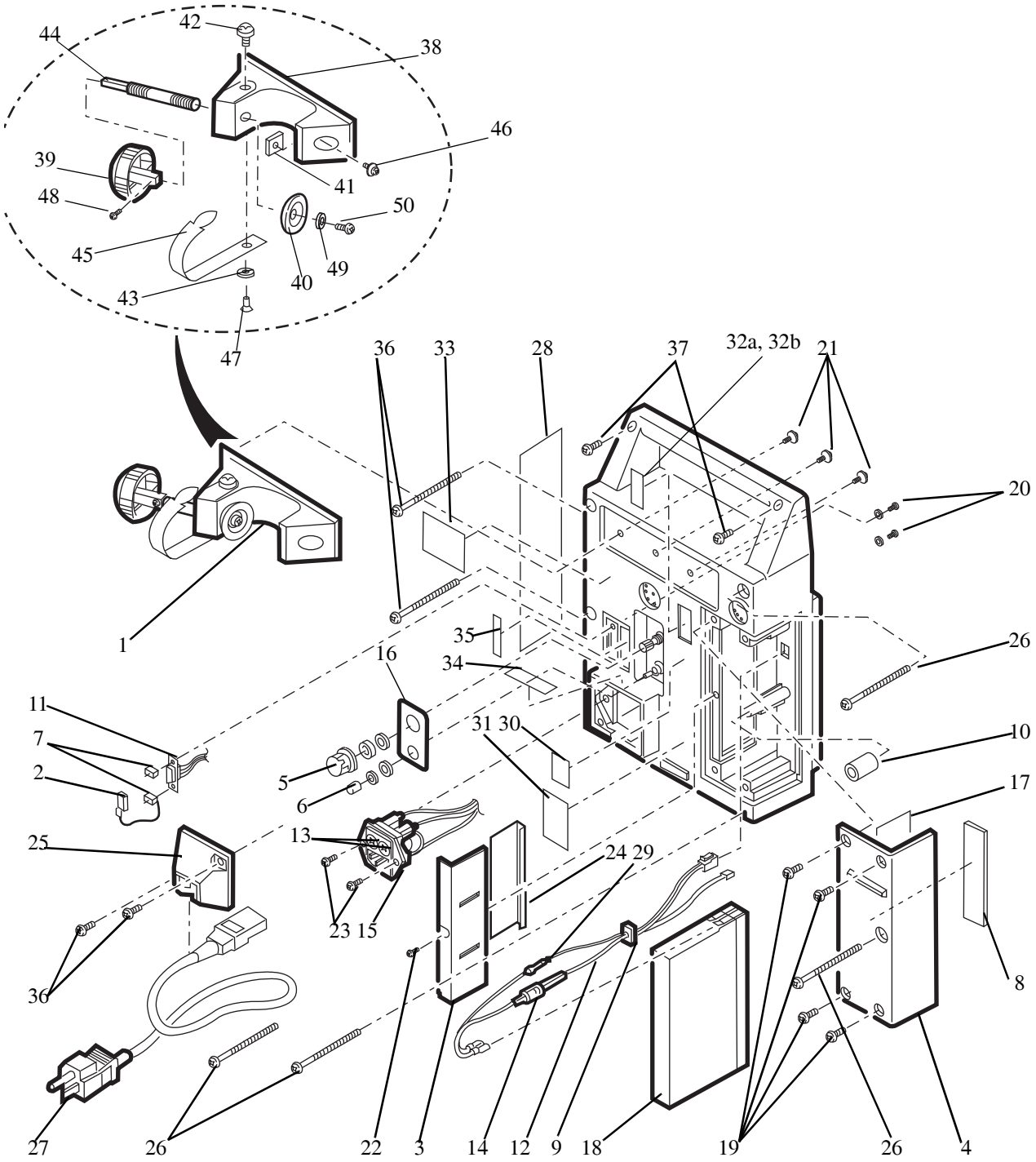


Figure 11-4 Rear Housing Assembly, External

Table 11-5 Parts List - Pump Head Door Assembly (F049120021)

Item	Svc. Part #	Mfg. Part #	Description	Qty
1	F049120021	F049120021	Pump Head Door Assy	1
2	CHNDP100.F	S047944	LATCH, Door Assembly	1
3	JHNDP100.B	S048021	LATCH, Door	1
4	LPLTP106.A	S048440	PLATE, Door Latch Label	1
5	LXRZ1003.A	S048882	E-RING, Door Latch	1
6	MSPRC101.D	S048500	Spring, Door Latch	1
7	OiCMP32T.H	S048896	Washer, M4, 0.8T	1
8	OiCMP32T.L	S048897	WASHER, M4.2, 0.1T	2
9	PMAGT100.B	S048498	MAGNET, Door Latch	1
10	TLABH109.A	07-26-01-179	Label, Push	1
11	S050051	S050051	DOOR, Pump Head	1
12	LBSHZ101.A	S048489	Bumper, Door	2
13	LBSHZ101.C	S048502	BUSHING, Door Latch	1
14	LPiNS101.C	S047417	PIN, Door Hinge	2
15	LPLTM106.A	S048445	Plate Safety Clamp, 1.2 mm Thickness	1
16	LPLTM106.B	S048441	Cover, Back Plate	1
17	S048493	S048493	PLATE, BACK	1
18	MSPRC101.C	S048499	SPRING, Back Plate	5
19	PAJS1002.A	S048494	STOP, Occlusion Detector	2
20	PCUSG101.A	S048504	Door Bumper	4
21	PZETE100.C	S048506	Film, Plate Insulation	1
22	072626930	072626930	Warning Label FG6X01 Pump	1
23	TLABZ110.B	S047929	LABEL, Tube Loading A	1
24	TLABZ110.C	S047930	LABEL, Tube Loading B	1
25	XBPSD20P.C	S048933	SCREW, Pan Head, M2X8 w/ washer assy	2
26	XBSUZ30P.A	S048987	SCREW, Flat Head, M3X6	7
27	XBSUZ30P.F	S048966	SCREW, Flat Head, M3X10	1

Table 11-5 Parts List - Pump Head Door Assembly (F049120021) — continued

Item	Svc. Part #	Mfg. Part #	Description	Qty
28	XBSUF30P.A	4009310014	SCREW, Flat Head, M3X12	5
29	XXXSP30L.B	S048890	SCREW, Set, M3X4	2
30	GCOVA101.A	F043624002	Front Cover	1
31	S050109	S050109	Safety Clamp Shim (See Note below)	1
32	S054643	S054643	PLATE, Safety Clamp, 1.0 mm Thickness (See Note below)	1
33	072626931	072626931	Inside Door Information Label	1
34	072626932	072626932	Front Door Information Label	1

Note: See “Safety Slide Clamp Mechanical Calibration” on page 9-4.

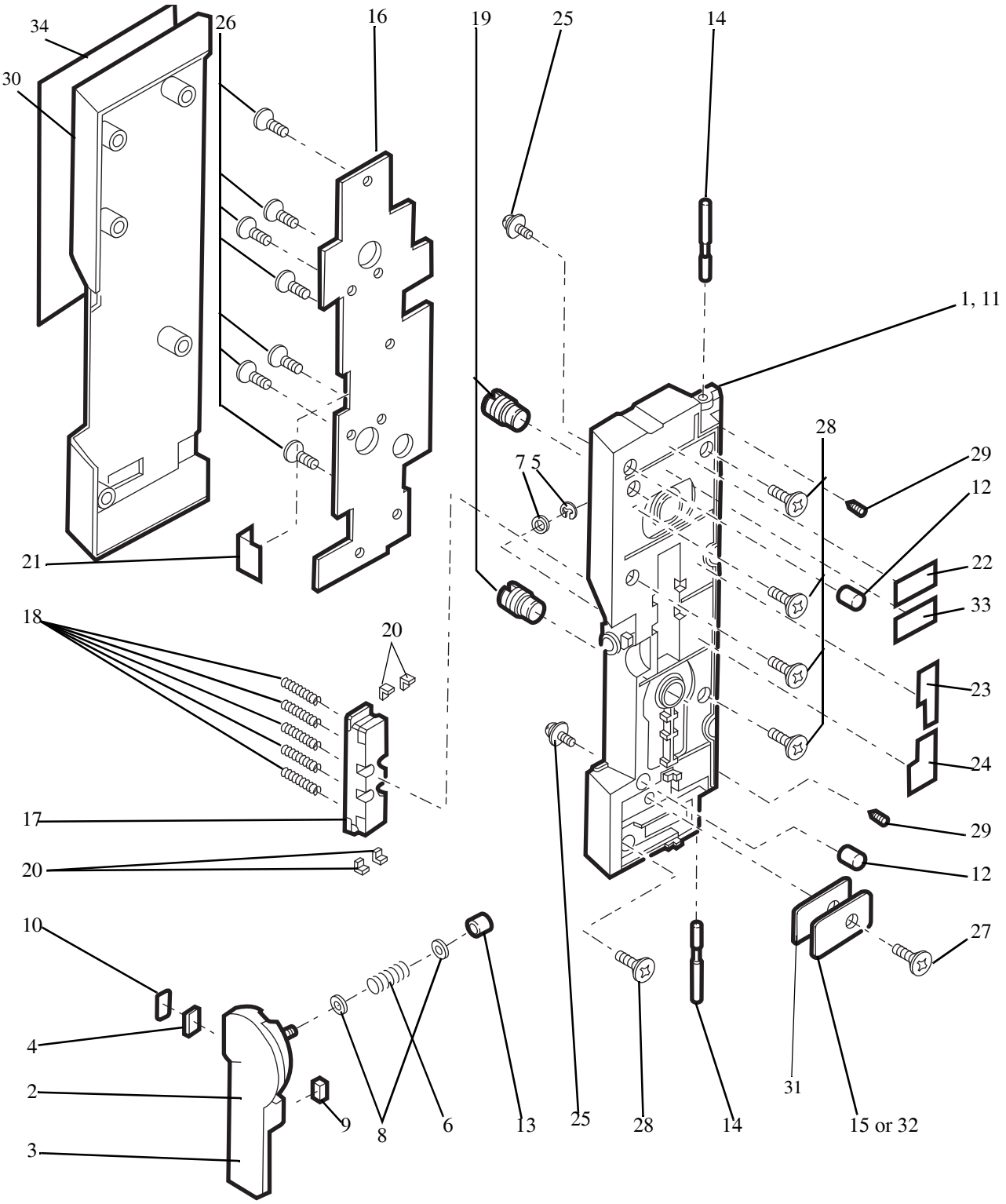


Figure 11-5 Pump Head Door Assembly (F049120021)

Table 11-6 Parts List - Pump Base Plate Assembly

Item	Svc. Part #	Mfg. Part #	Description	Qty
1	LBRC1008.A	S048018	BLOCK, Mounting Latch Pin	1
2	LBSHZ101.B	S048501	BUSHING, Door Hinge	4
3	LPiNS101.A	S048447	PIN, Latch	1
4	LPiNS101.E	S048453	PIN, Latch Mounting Block	2
5	LPLTC106.A	S048017	PLATE, Base	1
6	LXWZ1006.A	S048522	WASHER, Latch Roller	1
7	NROLP100.A	S048455	ROLLER, Latch	1
8	PGiDM100.D	S048486	GUIDE, Tubing, Lower Channel	2
9	PGiDM100.E	S048487	GUIDE, Tubing, Upper Channel	3
10	QSWZ1011.A	S047933	SENSOR, Tube Misload L	1
11	QSWZ1012.A	S047934	SENSOR, Tube Misload R	1
12	S055623	S055623	DECAL, Channel Right	1
13	F049810000	F049810000	Slide Clamp Slot Label	1
14	XBSSF20P.B	4009310081	SCREW, Flat Head, M2X5	2
15	XBSUF30P.C	S048963	SCREW, Flat Head, M3X8	1
16	PZETL102.B	S050045	TAPE, Conductive Finger	2
17	PBOX1004.A	S048432	Finger Box	1
18	OiCMP32T.G	S048895	Washer, M3	6
19	XBPSD30P.K	S048940	Screw, Pan Head, M3x8 with Spring Washer	6
20	BLBRCASSY1	S047945	Mounting Block Assembly	1

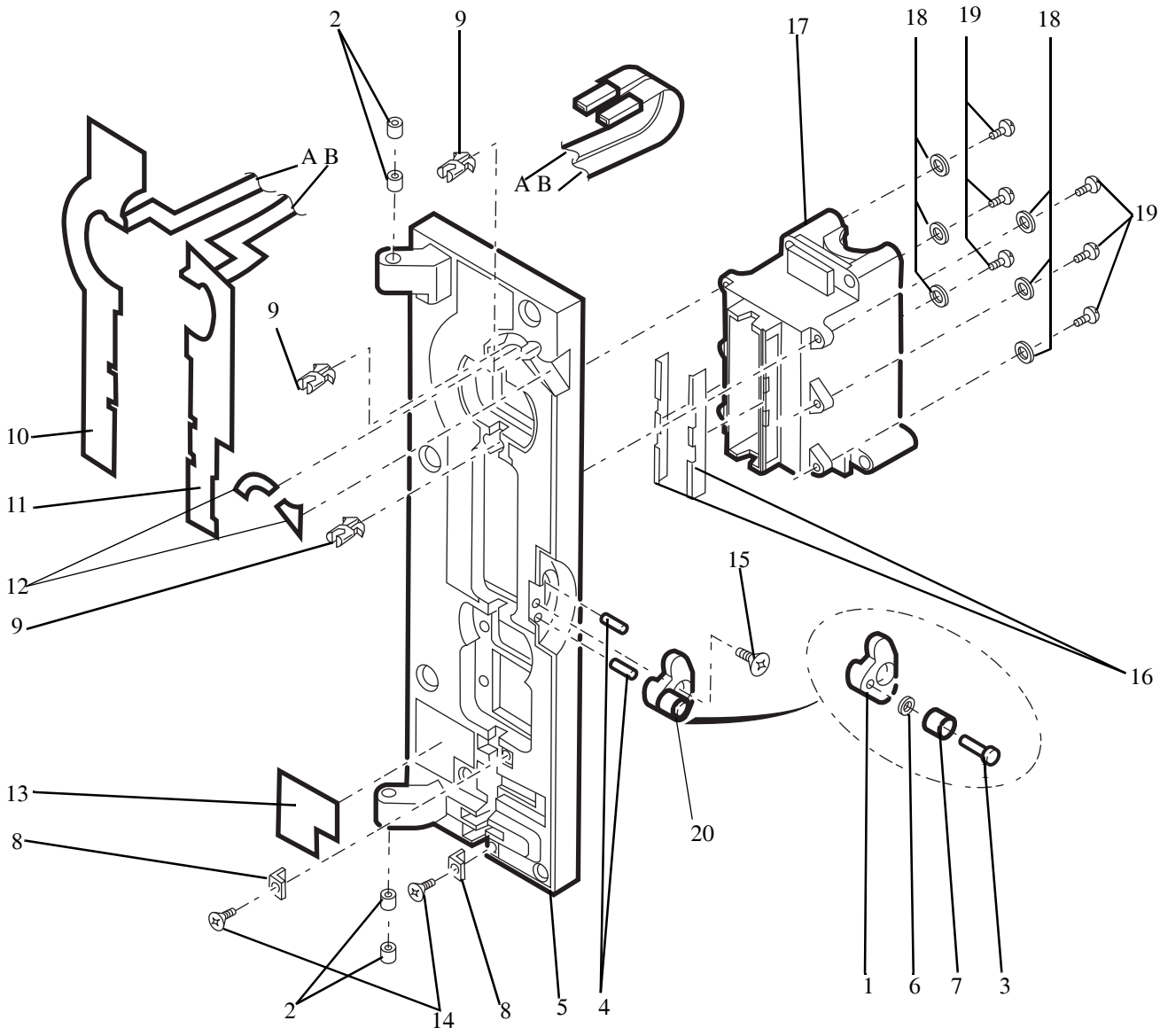


Figure 11-6 Pump Base Plate Assembly

Table 11-7 Parts List - Pump Base Plate Assembly

Item	Svc. Part #	Mfg. Part #	Description	Qty
1	LPLTC106.A	S048017	PLATE, Base	1
2	LXBZ1020.A	S048918	SCREW, Flat Head, MM1.7X6	1
3	MSPR1001.C	S048015	SPRING, Downstream Occl. Sensor	1
4	MSPR1002.B	S048014	SPRING, Upstream Occl. Sensor	1
5	NSFTZ102.A	S048012	ACTUATOR, Occl. Sensor	2
6	OiCMP32T.A	S048928	Screw, Pan Head, M1.7x4.5	4
7	OiCMP32T.E	S048893	Washer, M1.7	2
8	OiCMP32T.J	S048901	Washer, M2	2
9	PCASD100.B	S048022	HOUSING, Occl. Sensor	2
10	PCOVP101.C	S048436	COVER, Safety Clamp Arm	1
11	PZETL102.E	S048508	PLATE, Ground Upstrm Occl. Sensor	1
12	CCiLZ100.A	S048011	COIL, Occl. Sensor Assy	2
13	RCORF100.D	S048013	Core, Occl. Sensor	2
14	F049120023	F049120023	SENSOR, AIR ASSEMBLY	1
15	TLABH109.B	S048468	LABEL, Safety Clamp	1
16	XBSUF20P.A	S048962	SCREW, Flat Head, M2X10	6

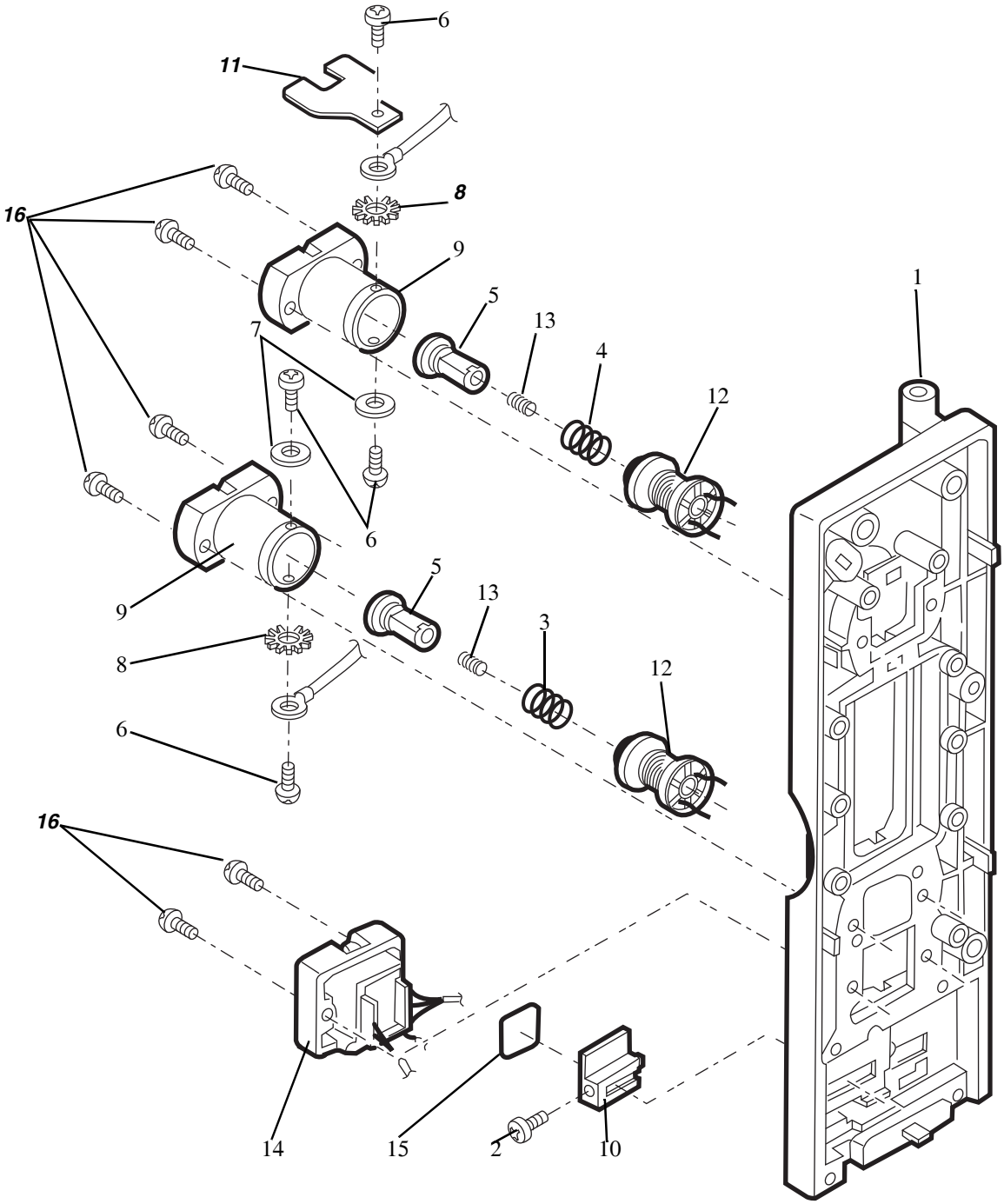


Figure 11-7 Pump Base Plate Assembly

Table 11-8 Parts List - Pump Base Plate Assembly with Pump Mechanism

Item	Svc. Part #	Mfg. Part #	Description	Qty
1	CCRA1006.A	S047875	CLAMP, SAFETY/SLIDE ASSEMBLY	1
2	LBRC1006.A	S048426	RETAINER, Motor Spring	1
3	LBSHZ101.D	S048497	STOPPER, Cam	1
4	LPLTM104.D	S048488	WHEEL, Encoder	1
5	LPLTP104.A	S048484	FINGER, #1,2,7,8	4
6	LPLTP104.B	S048485	FINGER, #3,4,5,6	4
7	MCAMP100.A	S048483	ECCENTRIC CAM	8
8	MJNTM100.B	S048454	COUPLING, Motor	1
9	MSPRD102.A	S048471	SPRING, Motor	2
10	NBRGY100.B	S048511	BEARING, Pumping Finger	9
11	NBRGY100.C	S048512	BEARING, Finger Box	1
12	NSFTD103.A	S048433	SHAFT, Finger	1
13	OiCMP32T.F	S048894	WASHER, Optocoplr PCB	2
14	OiCMP32T.G	S048895	WASHER, M3	4
15	PBOX1005.A	S048431	COVER, Finger Box	1
16	PCOVP101.B	S048427	COVER, Encoder Wheel	1
17	PSPAB102.A	S048496	SPACER, Encoder Wheel	1
18	CPWBN105.B	S047876	PCB, ASSEMBLY-Optocoupler	1
19	VHPGP3S2.A	S048016	OPTOCOUPLR	1
20	RMOTP100.B	S048510	STEPPING MOTOR	1
21	XBPSD30P.D	4009310005	SCREW, Pan Head, M3X6	1
22	XBPSD30P.U	S048947	SCREW, Pan Head, M3X55	4
23	XJPSF20P.A	S048955	SCREW, Pan Head, M2X6	2
24	XWSSD200.A	S048879	WASHER, Spring, Optocoupler PCB	2
25	XWSSD300.B	S048899	WASHER, M3	4
26	XXXSP30L.A	S048876	SCREW, Set, M3X3	2
27	XXXSP30L.B	S048890	SCREW, Set, M3X4	4

Table 11-8 Parts List - Pump Base Plate Assembly with Pump Mechanism — continued

Item	Svc. Part #	Mfg. Part #	Description	Qty
28	XBPSD30P.W	4009310042	Screw, Pan Head, M3X10 w/ Washer Assy	2
29	LANGT103.A	S048446	BRACKET, Fixing, Door Sw PCB	1
30	LFiX1011.A	S048443	Nut Bar, Finger Box Top	1
31	LFiX1012.A	S048444	Nut Bar, Finger Box Bottom	1
32	PSPA1020.A	S048746	Spacer, Door Sw PCB	1
33	PSPAZ101.A	S048490	Retainer, Rubber, Bottom Bearing	1
34	PSPAZ101.B	S048491	RETAINER, Rubber, Top Bearing	1
35	PZETL101.A	S048462	Film, Door Switch PCB Insulation	1
36	QPWBN103.B	S048492	PCB, Door Open Sw	1
37	QPWBN105.A	S048459	PCB, Tube Misload Terminal	1
38	CPWBN105.F	S047877	PCB, Flexible Prntd Crkt Terminal	1
39	VRDRV2EY.A	S048521	Resistor, 100 Ohms	1
40	XBBSD30P.D	4009310075	SCREW, Binder Head, M3X8	2
41	XBPBN30P.C	S048929	Screw, Pan Head, M3x8 W/ Washer Assy	3
42	XBPBN40P.F	4009310080	SCREW, Pan Head, M4X6	1
43	XBPSD20P.A	S048923	Screw, Pan Head, M2x5	2
44	XBPSD26P.B	S048933	SCREW, Pan Head, M2.5X8	1
45	XWHSD200.A	S048891	Washer, Door Open Sw PCB Bracket	2
46	XBPSD30P.i	S048939	Screw, Pan Head M3x8	2
The following wire harnesses are not shown.				
	QCNW1097.A	S048473	Harness, Tube Misload Detector	1
	QCNW1098.A	S048474	Harness, Slide Clamp Sensor 1 & 2	1
	QCNW1099.A	S048475	Harness, Slide Clamp Sensor 1 & 2 Ext.	1
	QCNW1100.A	S048476	Harness, Optocoupler PCB	1
	QCNW1101.A	S048477	Harness, Door Open Sw PCB	1
	QCNW1102.A	S048478	Wire Harness CVOT	1
	QCNW1103.A	S048479	Harness, Downstream Occlusion Sensor	1
	QCNW1104.A	S048480	Harness, Air Detector Input	1
	QCNW1105.A	S048481	Harness, Air Detector Output	1

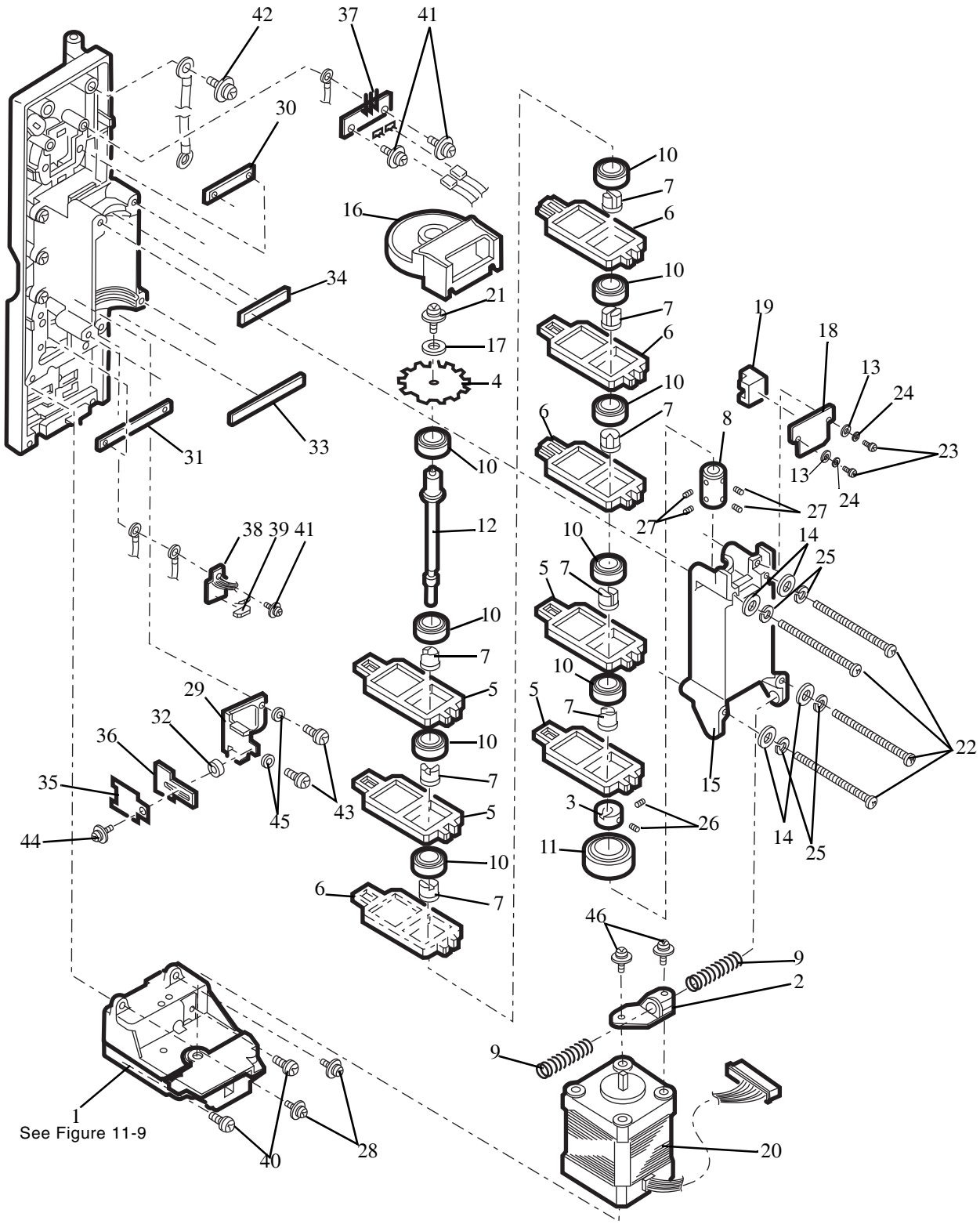


Figure 11-8 Pump Base Plate Assembly

Table 11-9 Parts List - Safety/Slide Clamp Assembly

Item	Svc. Part #	Mfg. Part #	Description	Qty
1	LCHSM100.A	S048428	Upper Housing	1
2	LCHSM100.B	S048429	Lower Housing	1
3	LCHSM100.C	S048438	Sensor Housing, SCSI	1
4	LCHSM100.D	S048439	Sensor Housing, SCS2	1
5	LCRA1006.A	S048430	Safety Clamp	1
6	LPiNS101.B	S048448	Pin, Release	1
7	LPiNS101.F	S048986	Pin, Dowel, Slide A	1
8	LPLTP107.A	S048434	Motor Holding Plate	1
9	LXRZ1002.A	S048881	E-ring, Shaft	3
10	MARMP100.B	S048970	Retainer Arm R2, Left	1
11	MARMP100.A	S048023	Retainer Arm R1, Right	1
12	MARMP100.C	S048437	Arm, Release	1
13	MCAMP100.B	S048435	Safety Latch, P2	1
14	MSLiZ100.A	S048425	Slide A	1
15	MSLiZ100.B	S048424	Slide Latch	1
16	MSPRC101.D	S048500	Spring, Door Latch	1
17	MSPRD102.B	S048470	Spring, Retainer Arms	2
18	MSPRD102.C	S048472	Spring, Slide Shaft	1
19	MSPRD102.D	S048469	Spring, Safety Clamp	1
20	MSPRP102.A	S048642	Spring, Flat, Slide Shaft	1
21	NSFTD103.B	S048449	Shaft, Slide	1
22	LPiNS101.D	S048450	Pin, Release Pin	1
23	NSFTD103.C	S048451	Shaft, Safety Latch	1
24	NSFTD103.D	S048452	Shaft, Safety Clamp	1
25	PSLDP100.B	S048456	Seal, Safety Clamp	1
26	PZETL101.B	S048464	Film, Insulation, PCB	1
27	PZETL101.C	S048463	Film, FPC Insulation	1

Table 11-9 Parts List - Safety/Slide Clamp Assembly — continued

Item	Svc. Part #	Mfg. Part #	Description	Qty
28	CPWBN105.C	S050046	Slide Clamp Sensor PCB,P2	1
29	QPWBN105.C	S048461	FPC, P2	1
30	XBPSD30P.i	S048939	Screw, Pan Head, M3x8 W/ Washer Assy	2
31	XBSSD30P.B	S048960	Screw, Flat Head, M3x10	2
32	XBSUF20P.C	S048967	Screw, Flat Head, M2x6	1
33	XJPSD30P.A	S048953	Screw, Pan Hd-tapping, M3x6	1
34	XJPSF20P.B	S048954	Screw, Pan Head, M2x4	2
35	XJPSF20P.A	S048955	Screw, Pan Head, M2x6	2
36	Not Available		Sensor, 1	1
37	Not Available		Sensor, 2	1

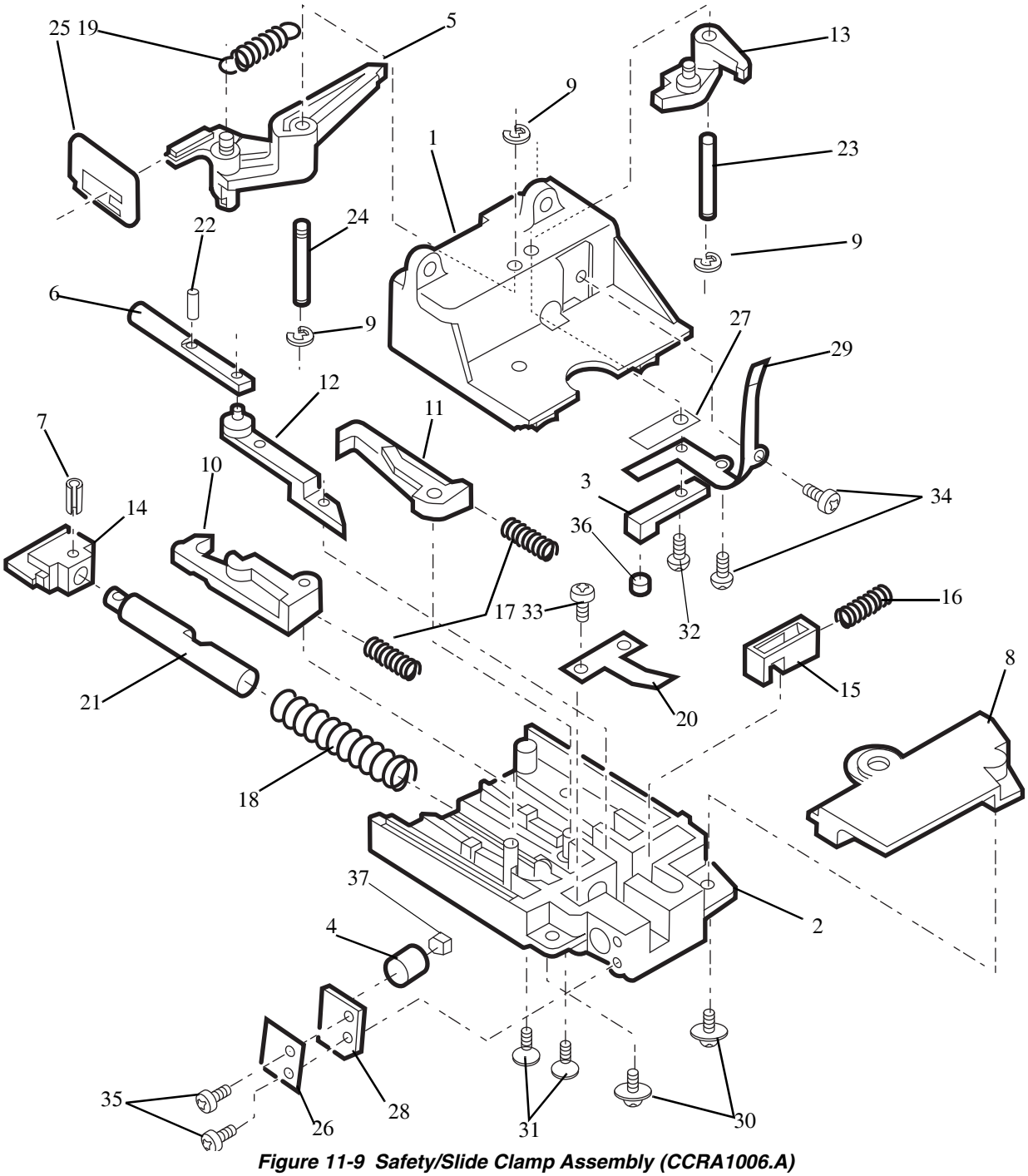


Figure 11-9 Safety/Slide Clamp Assembly (CCRA1006.A)

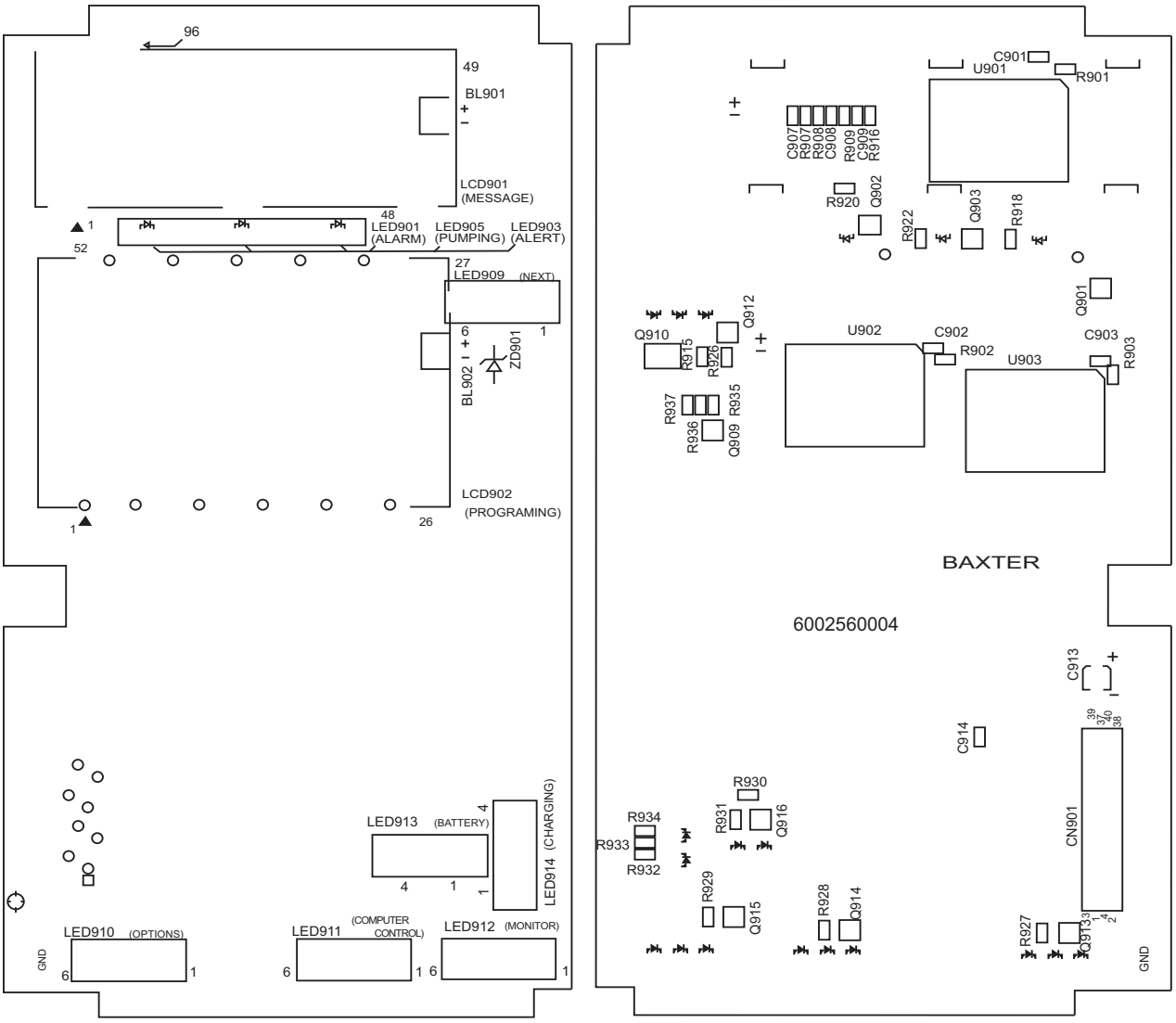


Figure 11-10 Display PCB (CPWBN104.A)

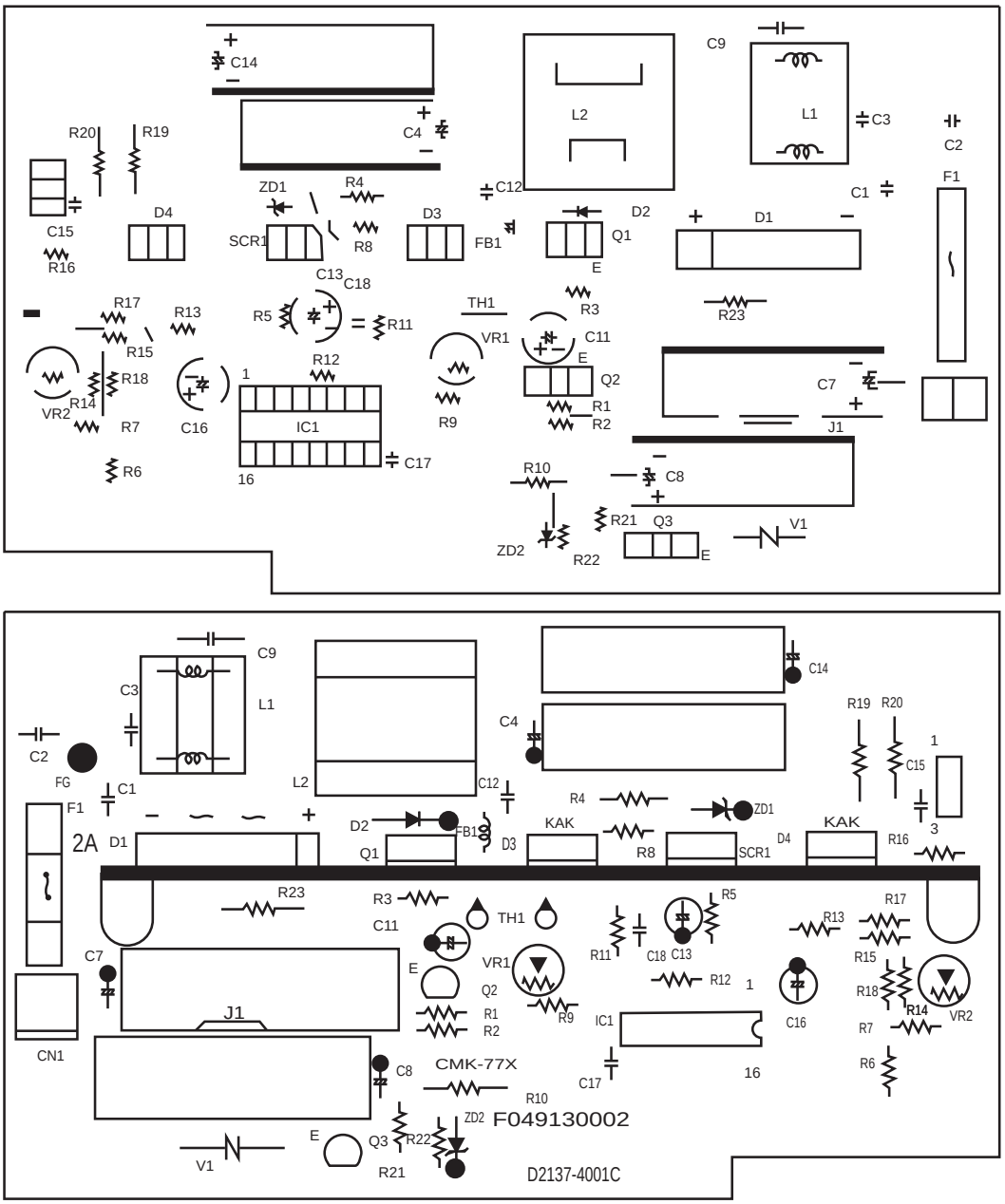


Figure 11-11 Power Supply PCB (RDENC100.D)

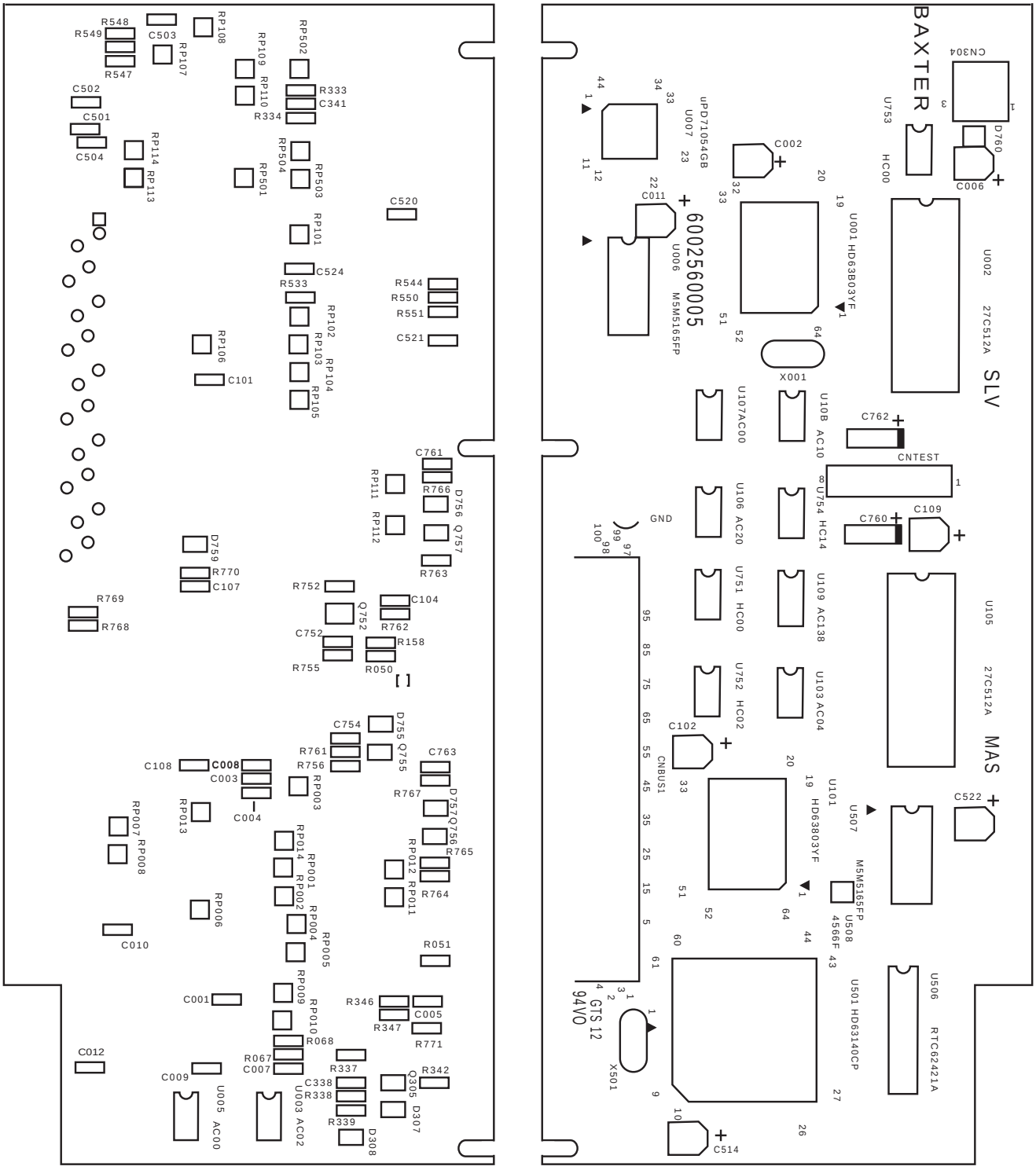


Figure 11-12 CPU PCB (CPWBX104.A)

Table 11-10 Sensor PCB

Item	Svc. Part #	Mfg. Part #	Description	Qty
1	QFSH4330.A	5009425004	F201 Fuse, 1.5A, 125V, NTI-AX	1
2	QFSH8300.A	5009425005	F302 Fuse, 1A, 125V, SSFR	1
3	VHViCPF1.A	6009590001	F15 IC Protector, ICP-F15	1

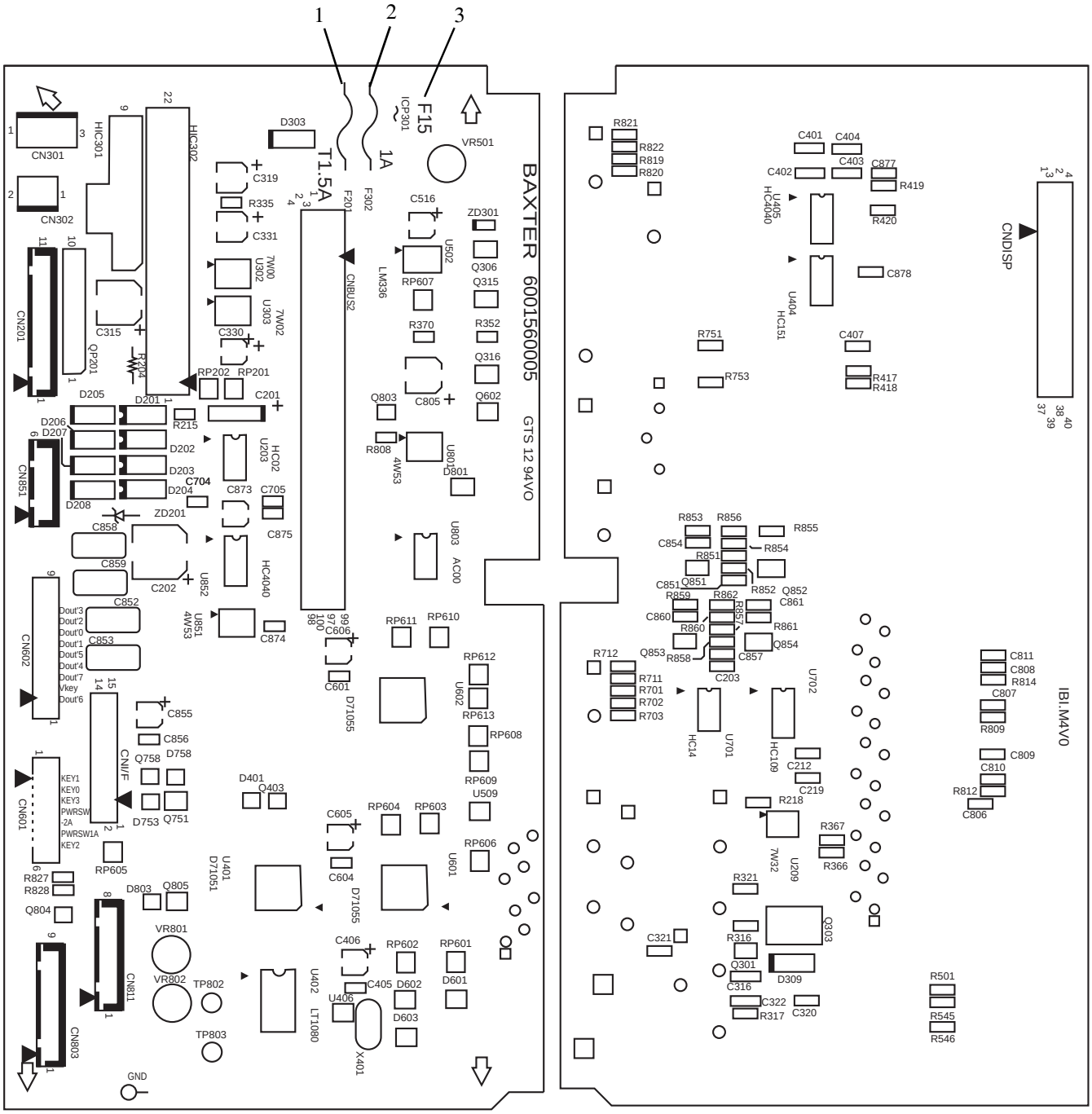


Figure 11-13 Sensor PCB (CPWBX104.B)

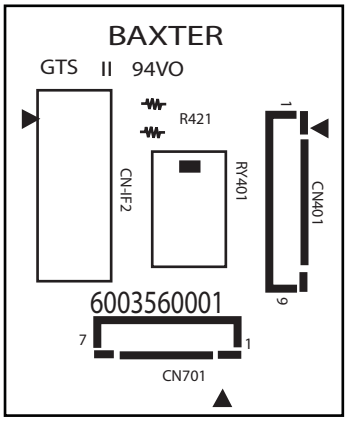


Figure 11-14 Terminal PCB (CPWBN104.B)

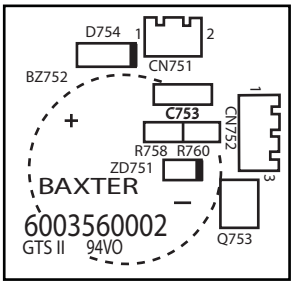


Figure 11-15 Backup Audible Alarm PCB Assembly (CPWBN104.C)

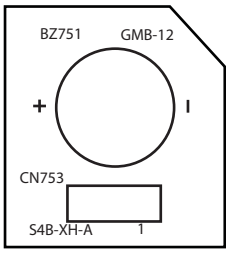


Figure 11-16 Audible Alarm PCB Assembly (CPWBN105.A)

Table 11-11 Parts List for Accessories and Options

Svc. Part #	Mfg. Part #	Description	Qty
UKOG1013.B	F049230002	Thickness Gauge	1
UKOG1020.A	3009090008	UPP Extractor	1
UKOG1021.A	3009090007	Extractor, Wire Harness Connector	1
722003396	72-20-03-396	Door Shim, FG6X	1
722003397	72-20-03-397	Adhesive, Loctite Prism 454	1
3009035001	3009035001	Cable Tie, PLT1M	1
072601228	07-26-01-228	Lead Bat Disposable Label	1

Table 11-12 Parts List for Packaging Materials

Svc. Part #	Mfg. Part #	Description	Qty
07-19-D1-602	07-19-C1-602	Manual, Operator's	1
SSAKA124.A	3004035002	Manual Polyethylene Bag	1
TTAG1003.A	07-26-06-30	Tag, Batt. Recharge	1
0705C1529	07-05-B1-529	Carton, Individual, Japan	1
0705D1625	07-05-D1-615	Carton, Individual, Singapore	1
SPAKA128.A	F041720001	Soft, Protect. Buffers (U)	1
SPAKA129.A	F042720002	Soft, Protect. Buffers (L)	1
3004035003	3004035003	Housing Vinyl Bag	1

Chapter 12

Theory of Operation

Overview

This section covers the operating principles of the pump. The theory of operation does not cover the specific circuitry in great detail, but provides general information needed to perform fault isolation. Active-low signals on all schematic diagrams in Chapter 13,“Diagrams” are denoted by an exclamation point (!) preceding the signal name.

CPU System

CPUs

See Figure 13-6 and Figure 13-7. The pump uses two identical CPUs, U101 and U001. Normally, U101 and U001 act as master and slave, respectively.

The master CPU controls all pump functions except motor control, which is handled by the slave CPU. The master CPU sends rate information and motor start/stop messages to the slave CPU and also monitors the motor control by the slave CPU.

The master CPU gathers data from and/or controls the interlock switch, the power control circuit, the communication controller, two I/O controllers, the occlusion detection multiplexer, the RAM, the real time clock, the air sensor, the universal pulse processor and the alarm control circuit.

The master CPU also handles RS-232 serial communication with an external computer through the communication controller.

The slave CPU controls the pump motor via the motor control circuit in three ways:

- Generates pulses to rotate the motor.

- Monitors motor skip step by checking the signal from the motor rotation detector.
- Controls the motor current while minimizing current draw from the battery. It also controls the alarm control circuit.

The slave CPU outputs an interrupt signal to the master CPU through the universal pulse processor after every one-eighth of the liveband period to provide air bubble detection timing to the master CPU.

Both CPUs handle the watchdog function, which is the periodic communication between the CPUs through two serial communication lines at 15,625 baud.

The CPUs, in conjunction with the two 64K x 8 EPROMs, utilize 16 address lines and eight data lines.

The master CPU addresses an EPROM, RAM, Real Time Clock, universal pulse processor, two I/O controllers and the communication controller. The slave CPU addresses an EPROM, RAM and programmable timer module. The software in the EPROMs for master and slave CPUs is different.

Programmable Timer Module (PTM)

See Figure 13-10. The programmable timer module (PTM) divides the 8 MHz system clock into 500 kHz for the oscillation of the air sensor and also generates a signal for pulse width modulation control of the motor driver.

The slave CPU calculates and outputs motor drive signals based on the rate information from the master CPU. It also sets a motor current level in the PTM from a reference table.

Watchdog Function

The watchdog function is performed in two ways:

Both CPUs monitor each other's status. The purpose of this watchdog is to detect a malfunction of either microprocessor and stop the pump with an alarm. See Figure 13-7 and Figure 13-9. Both CPUs communicate through the two serial communication lines, Tx and Rx. Each CPU has a communication counter, which is initialized to a predetermined value by a signal from the other CPU. The counter is then decremented by one count every 32.768 mS. The counters are normally initialized again by the signal from the other CPU before they decrement to zero. When a counter reaches zero, it indicates that the watchdog signal from the other CPU was never received. This indicates a problem with the other CPU. The remaining functional CPU then stops the pump with visual and audible alarms.

When communication between the CPUs cannot occur, both CPUs stop the pump with visual and audible alarms.

Should both CPUs fail at the same time, this watchdog function does not work. The alarm control circuit is provided as a backup watchdog function. See Figure 13-9. Signals from each CPU are the inputs to the alarm control circuit.

When both CPUs are functioning normally, the signals change their state periodically. The software to control the signals is divided into several parts and located in different portions of the main program. The state changes of the signals are considered normal only when all the individual parts of the program are executed according to an expected sequence.

When either or both signals fail, the alarm control circuit is triggered and stops the pump with visual and audible alarms.

The accompanying audible tone whenever either watchdog function is activated is continuous rather than intermittent.

I/O Controllers

See Figure 13-16 and Figure 13-17. The I/O controller U601 performs the following functions: activating backlight, addressing the keyboard and scanning the **ON-OFF/CHARGE** key, **PANEL LOCK** switch and LCD drivers, and writing display data from the master CPU into the display drivers.

The other I/O controller, U602, performs the following functions: controlling the air and occlusion sensors, and activating all LEDs and icons except ALARM and OPTIONS LEDs and key beep. It also transfers the slide clamp sensor signals to the master CPU.

Multiplexer

See Figure 13-14. The multiplexer, U851, selects one of the two occlusion sensor outputs in accordance with the address signals from an I/O controller, and sends it to the master CPU.

Universal Pulse Processor

See Figure 13-8. The universal pulse processor (UPP) is controlled by the master CPU and converts the following analog signals into digital signals: air sensor outputs, tube misloading sensor outputs, battery voltages, motor currents and the voltage of the CPUs. The digital signals are periodically read by the master CPU.

The UPP generates 2 kHz and 4 kHz signals for the audible alarm and key beep and a 17 kHz signal for the door open sensor, and the signal for backlight dimming.

The UPP also interrupts the master CPU each time a pulse is received from the motor rotation detector, when an interrupt signal from slave CPU is received or when the pump communicates with an external PC.

The UPP is used to select the baud rate for external communications. The baud rate is set at power-up according to the configuration setting.

Communication Controller

See Figure 13-11 and Figure 13-18. The communication controller allows the pump to communicate with an external computer through an RS-232C interface. The baud rate is selectable and controlled by the universal pulse processor.

Air Sensor Circuit

See Figure 13-14 and Figure 13-28. The circuit consists of an ultrasonic transmitter and receiver mounted on opposite sides of the tubing path. The transmitter consists of a 500 kHz oscillator and a selector that transfers the oscillator output to two of three transducers. The transducers are selected by the air bubble alarm size setting in the configuration option. The receiver contains a selector that transfers the transducer outputs to the UPP through an amplifier.

The transducers operate on the principle that air in the tubing transmits ultrasonic energy much less effectively than fluid. This energy is amplified, rectified, applied to the UPP and then converted into a digital signal. The master CPU monitors the signal and activates an AIR alarm when it detects the absence of a precise level of energy.

Occlusion Sensors

Downstream Occlusion Sensor

See Figure 13-14 and Figure 13-28. The downstream occlusion sensor consists of a moving ferrite core inside a mechanically fixed oscillator coil. The moving ferrite core is spring loaded against the administration set. When pressure downstream of the pump increases, the core moves from its original position, which in turn changes the frequency of the oscillator.

The downstream occlusion sensor output is selected by the multiplexer, applied to the master CPU and compared to the occlusion level selected in the configuration option. When the occlusion is sufficient to cause a specific frequency change, the CPU activates an alarm. There is a maximum expansion of the tubing beyond which the pump no longer permits operation.

The downstream occlusion sensor operates in a frequency range of 1.3 MHz to 1.45 MHz.

Upstream Occlusion Sensor

See Figure 13-14 and Figure 13-28. The upstream occlusion sensor is similar to the downstream occlusion sensor (except for the spring) but is not tuned to the same frequency and is controlled by different software.

The upstream occlusion sensor output is selected by the multiplexer and applied to the master CPU. Because the tubing collapses somewhat during normal operation, the software looks for a collapse that is faster and/or farther than expected. When the rate of collapse is too fast or too far, the pump alarms. There is a maximum tubing collapse beyond which the pump no longer permits operation.

The upstream occlusion sensor operates in a frequency range of 1.2 MHz to 1.35 MHz.

Tube Misloading Detector

See Figure 13-8 and Figure 13-28. The pump head has a Force Sensing Resistor[1] device (FSR) attached to each side of the tube loading channel. When the tube is misloaded over the FSR, its resistance decreases. The two FSR output voltages are converted into digital signals by the UPP and monitored by the master CPU. The CPU activates an alarm when the resistance decreases below a specified level.

Slide Clamp Detector

See Figure 13-17 and Figure 13-28. The slide clamp sensor consists of two opto-interrupters contained in the safety/slide clamp assembly. When the slide clamp option is selected via the configuration option settings, the administration set slide clamp should be loaded into the slide clamp slot in order to avoid an alert or alarm condition. When the slide clamp is not loaded into the slide clamp slot, or is loaded improperly, the opto-interrupters do not receive reflection signals. The interrupter output voltages are read and monitored by the master CPU via the I/O controller. The CPU activates an alert or an alarm (software versions 1.09 or later) when the slide clamp is not loaded and the option has been selected.

1. Interlink Electronics

Battery Low Alert/Alarm Detector

See Figure 13-8. The battery voltage is converted into a digital signal by the UPP and monitored by the master CPU. The CPU activates the alert or alarm when the battery charge state falls too low.

The BATTERY LOW alert is triggered when the battery voltage drops below 11.4 V, which permits approximately 15 minutes of operation. The BATTERY LOW alarm is triggered when battery voltage drops below 10.4 VDC, which stops the pump with an alarm to prevent the battery from being damaged.

Interlock Switch

See Figure 13-28. The interlock switch is a reed type, activated by a magnet attached to pump door latch. The switch opens the circuit when the pump door is opened. The master CPU monitors the interlock switch, activates the DOOR OPEN alarm and stops the pump when the door is opened.

Panel Lock Circuit

See Figure 13-16. The panel lock circuit is initiated by the **PANEL LOCK** pushbutton switch located on the rear of the pump. The switch is connected to an I/O controller. The purpose of this circuit is to prevent patient tampering. After the **PANEL LOCK** switch has been pressed, the message Loc is displayed in the unused rate window and no keys except **TOT VOL/STATUS** and **BACKLIGHT** are accepted. The panel lock out is released by pressing the **PANEL LOCK** switch again. The switch is enabled only when the pump is infusing without an alert.

Keypad

See Figure 13-29. The keypad is a multiplexed 8 x 4 array that is scanned by an I/O controller. One of eight select lines determine which four keys are read. All normal keypad depressions are decoded by this matrix except the **ON-OFF/CHARGE** key, which has special input to the power control circuit.

Displays

See Figure 13-21 and Figure 13-22. The LCD displays are multiplexed by display drivers, which apply a DC biased free-running frequency AC voltage to the segments of the displays when in the ON state, and no DC biased AC voltage when in the OFF state. The display drivers are addressed by the master CPU through an I/O controller. The data is sent on the data bus and is coded to update the display periodically. Once addressed, the display driver retains the data until addressed again. The entire display is updated every 128 msec.

The display backlight is toggled on or off by the BACKLIGHT key. When the pump is running on AC power, the backlight stays on continuously. When the pump is running on the battery, the backlight shuts off after 60 seconds to conserve battery life.

Motor Driver

See Figure 13-15. The motor driver receives four separate motor drive signals from the slave CPU, which are effectively ANDed with a pulse width modulation (PWM) signal from the programmable timer module. The PWM signal controls the current level required for proper motor operation. The motor current level is converted into digital signal by the UPP and monitored by the master CPU, which activates an alarm and stops the pump when motor overcurrent is detected. The user-defined rate is saved in two different memory locations which are compared against each other and the feedback from the motor rotation detector to guard against any non-programmed rate changes.

Snubbing diodes have been added to increase motor efficiency. The motor is shut down when an alarm or a failure occurs. The motor speed range permits infusions from 1 mL/hr to 1999 mL/hr.

Motor Rotation Detectors

See Figure 13-8 and Figure 13-28. The motor rotation detector assures that pump drive rotation occurs or the motor shuts down. The motor rotation signal is read by the master CPU via the UPP and slave CPU. The sector signal is read by the slave CPU and utilized for controlling motor current.

DC Power Supply and Power Control Circuit

See Figure 13-30. The DC power supply circuit is a switching type, which provides a regulated 13.65 V output at 0.85A maximum. The circuit charges the battery as long as the pump is connected to a specified AC outlet. The design continues to supply useful output down to a 105.0 VAC input. Two 500 mA slow blow replacement fuses are required for AC. A 2.0A fuse is required in the battery circuit. Whenever the supply is activated by AC voltage, the Plug Icon on the front panel is lit. The DC power supply has over-voltage and over-current protection.

The power supply circuit on the CPU board (Figure 13-13) generates several DC sources from the 13.65 V output of the DC power supply board, (when the pump is plugged into a specified AC source) or from the internal battery. The +5 VDC lines are shown below. See “DC Line Voltage Calibration” on page 9-1 for voltage specification limits.

- Vcpu: This line is the output of a DC to DC convertor, HIC301, and is switched by the master CPU. Vcpu is the main DC source voltage of the pump. Motor current does not flow while Vcpu is off.
- Vref: This is the reference voltage regulated by a filter and a reference diode (U502: LM336M-5.0) for the A/D convertor in the UPP. This voltage is generated from Voth, which is switched by the master CPU.
- Vkey: This is generated either from the output of the DC power supply board, or from the internal battery voltage and is used for monitoring the **ON-OFF/CHARGE** key. This is the unswitched power source.

Other DC voltages used in the pump are as follows:

- Vmtr: This is the DC source for the motor. It comes either from the DC power supply output or the internal battery voltage. This is the unswitched power source.
- Voth: This is used for backlights, icons and optional nurse call feature. The voltage comes from the DC power supply output and is switched by the master CPU.
- Vmem: This is the output of the lithium backup battery for the backup memory in the RAM (U507) and for maintaining the time in real time clock (U506). This is the unswitched power source.

All the voltages except unswitched power sources are turned on when the **ON-OFF/CHARGE** key is pressed while the pump is off. However, turning these voltages off can only be accomplished by the master CPU through the power control circuit.

The master CPU saves necessary data in the backup memory in the RAM (U507) and turns off the Vcpu, Vref and Voth voltages when the pump is turned off.

The power control circuit is contained in a hybrid chip, HIC302, which also includes a circuit to activate the backup audible alarm when the pump is shut down by a failure. The RAM (U006) for the slave CPU is not backed up.

Chapter 13

Diagrams

Overview

This section contains all of the schematic and wiring diagrams for the FLO-GARD 6201 Volumetric Infusion Pump. These diagrams are intended only to assist the reader in understanding the theory of operation.

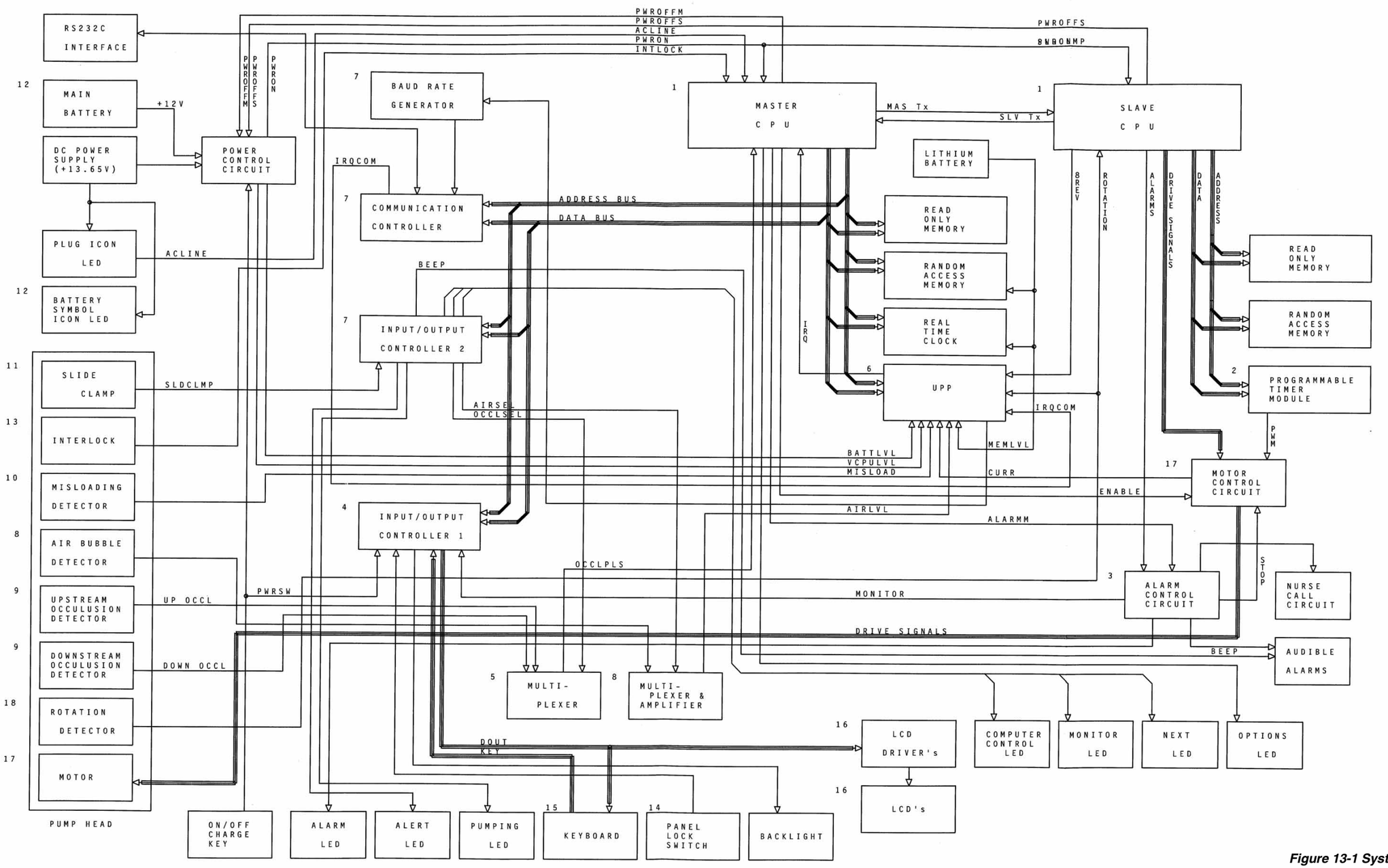


Figure 13-1 System Block Diagram

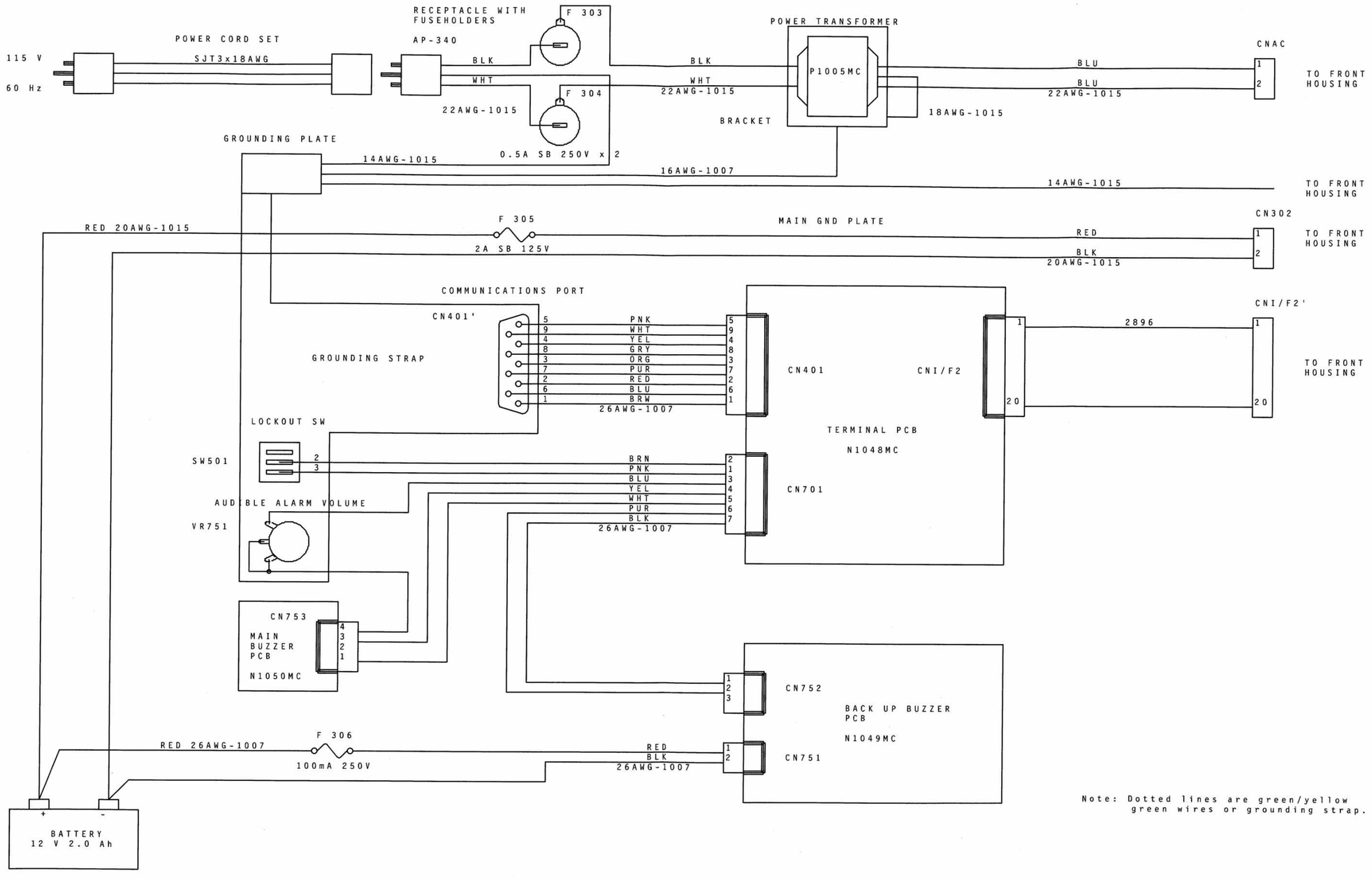
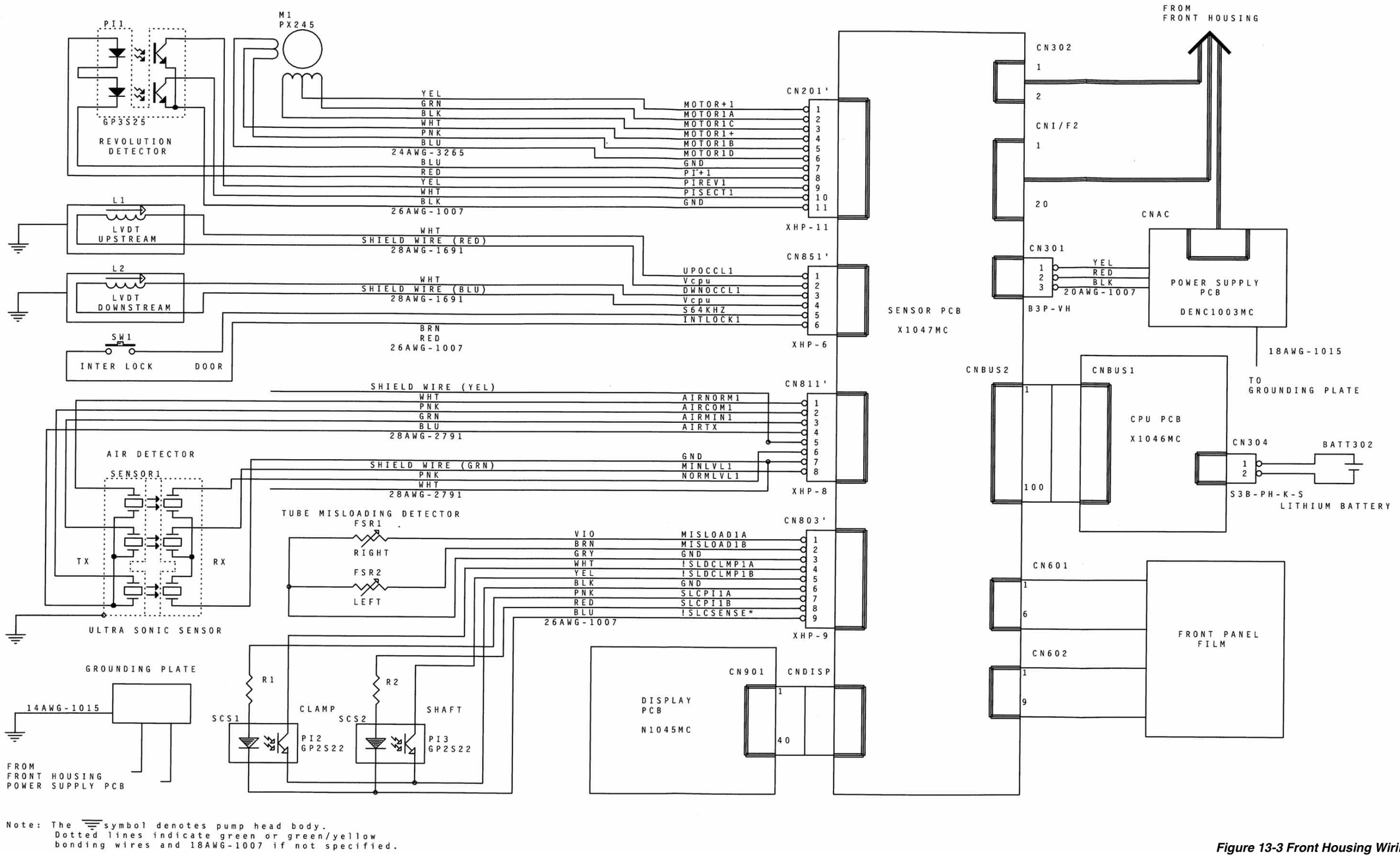


Figure 13-2 Rear Housing Wiring Diagram



Note: The ⏚ symbol denotes pump head body.
Dotted lines indicate green or green/yellow bonding wires and 18AWG-1007 if not specified.

Figure 13-3 Front Housing Wiring Diagram

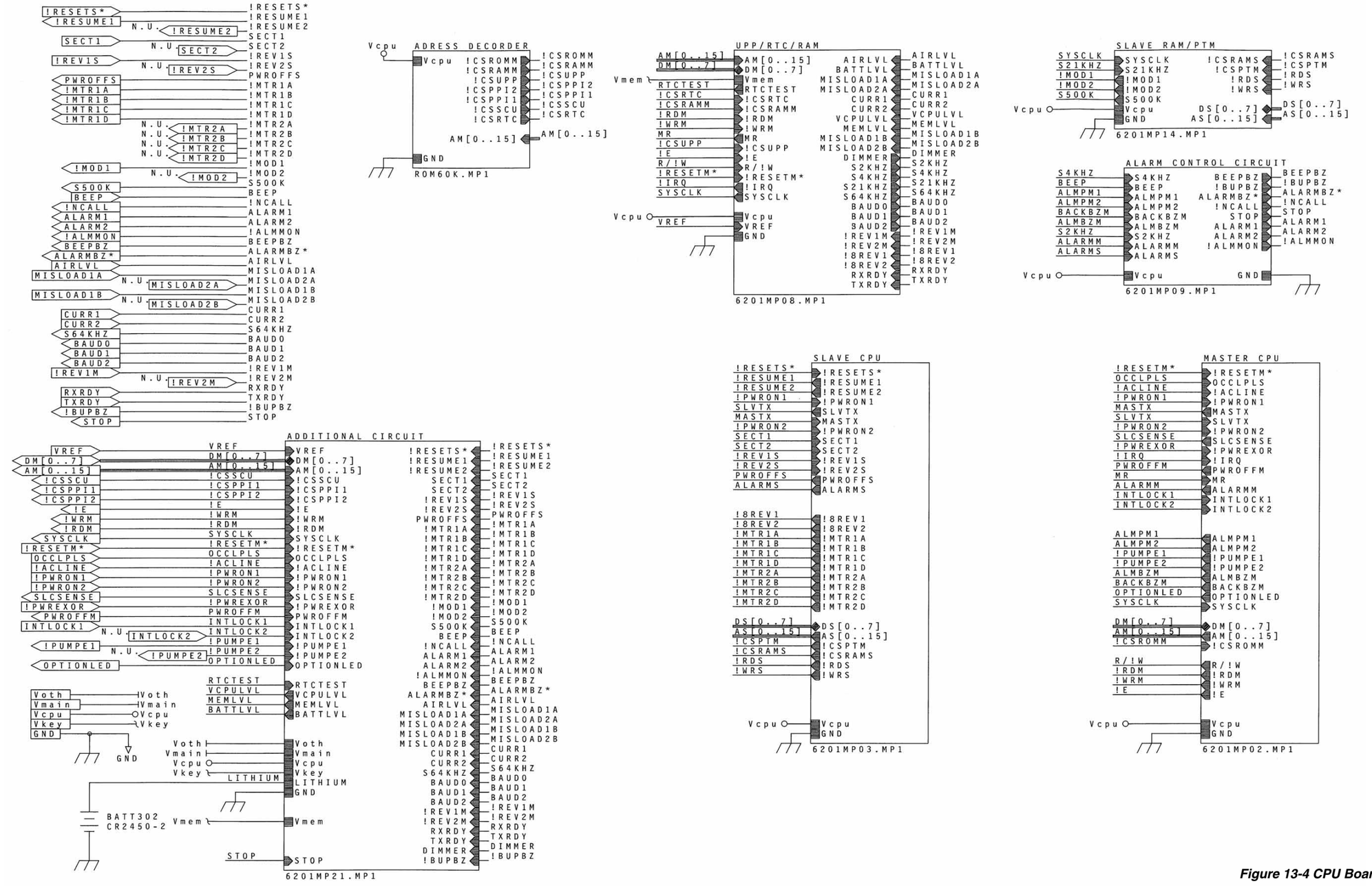


Figure 13-4 CPU Board Block Diagram

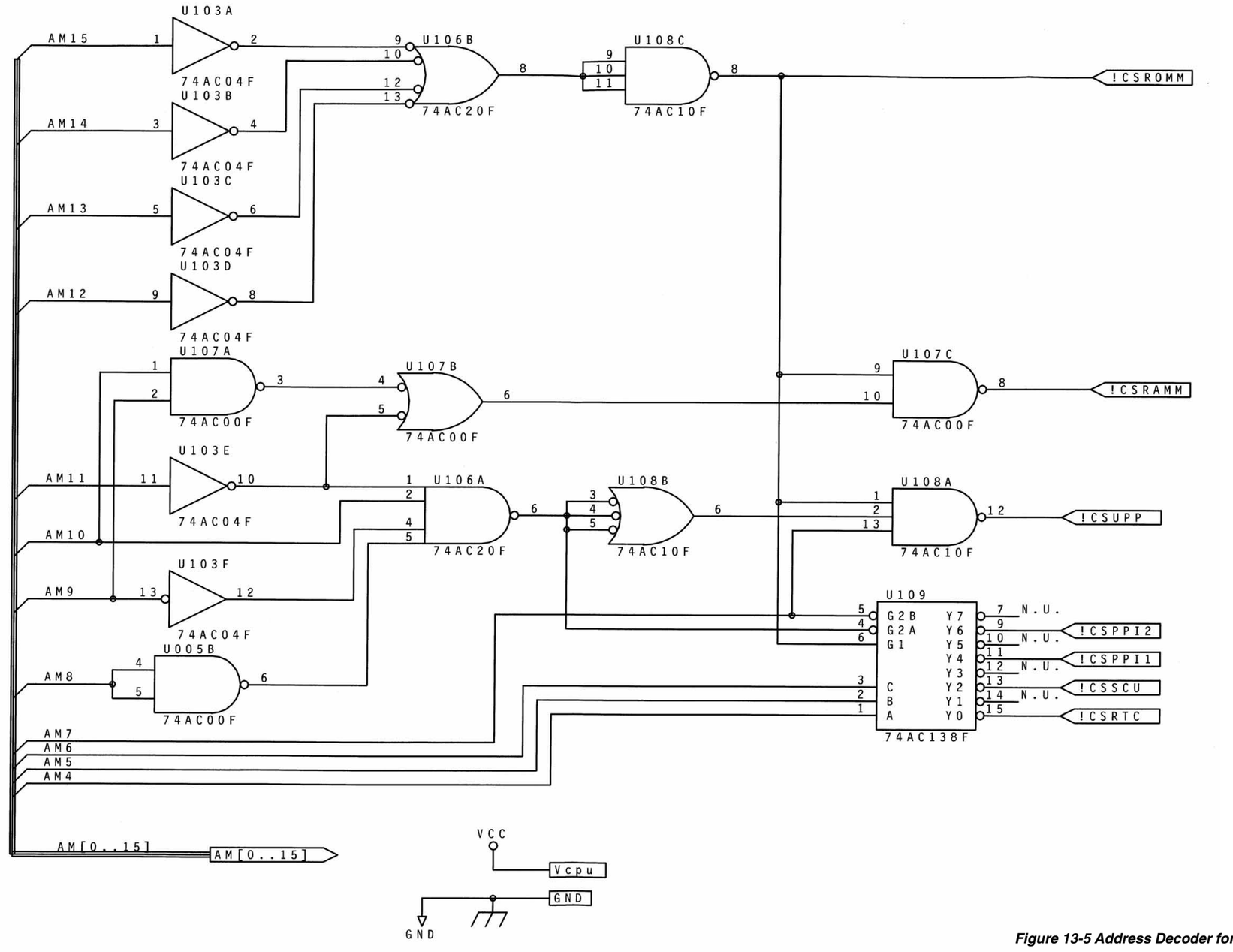


Figure 13-5 Address Decoder for 60K ROM Area (part of CPU Board)

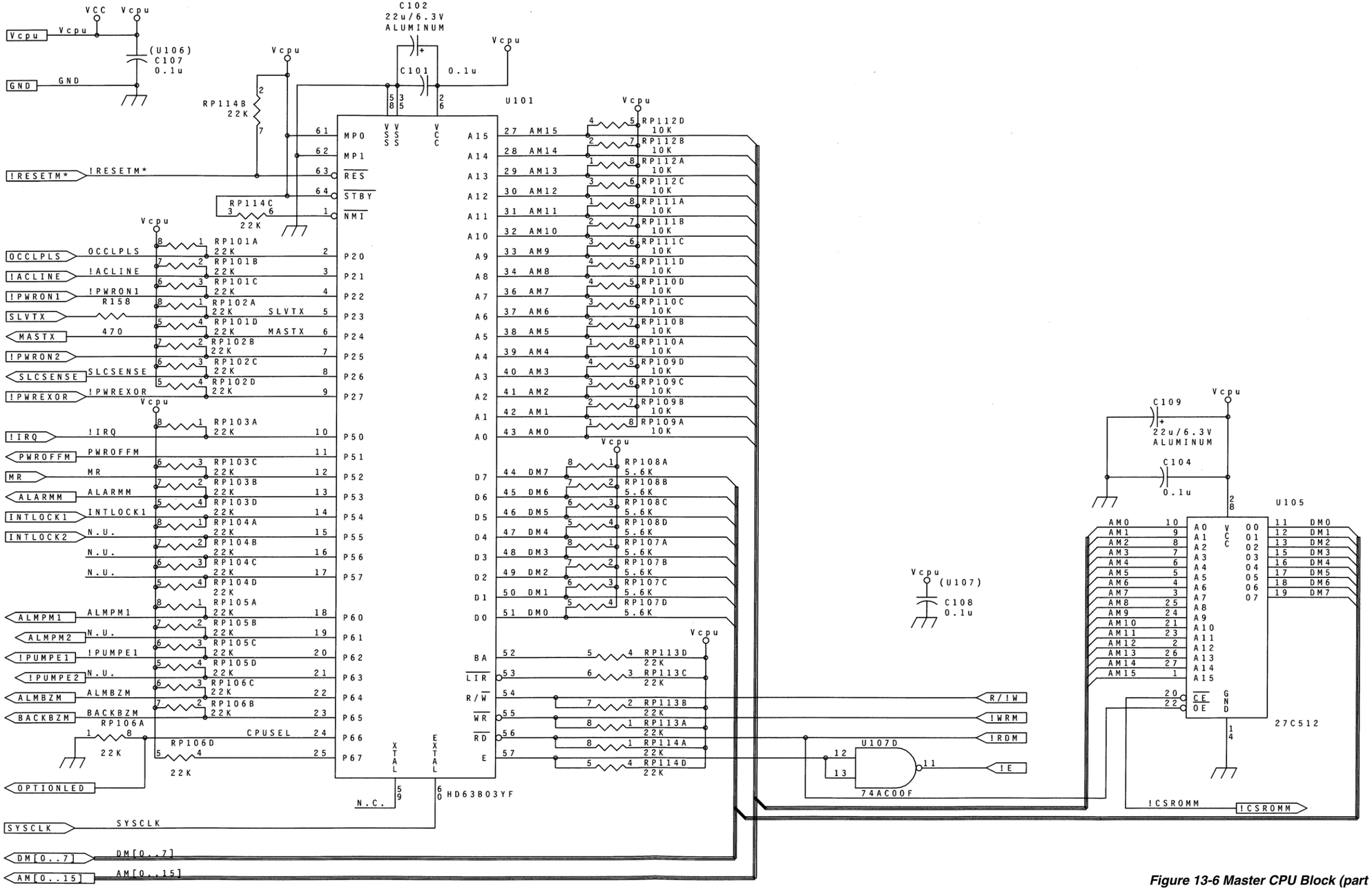


Figure 13-6 Master CPU Block (part of CPU Board)

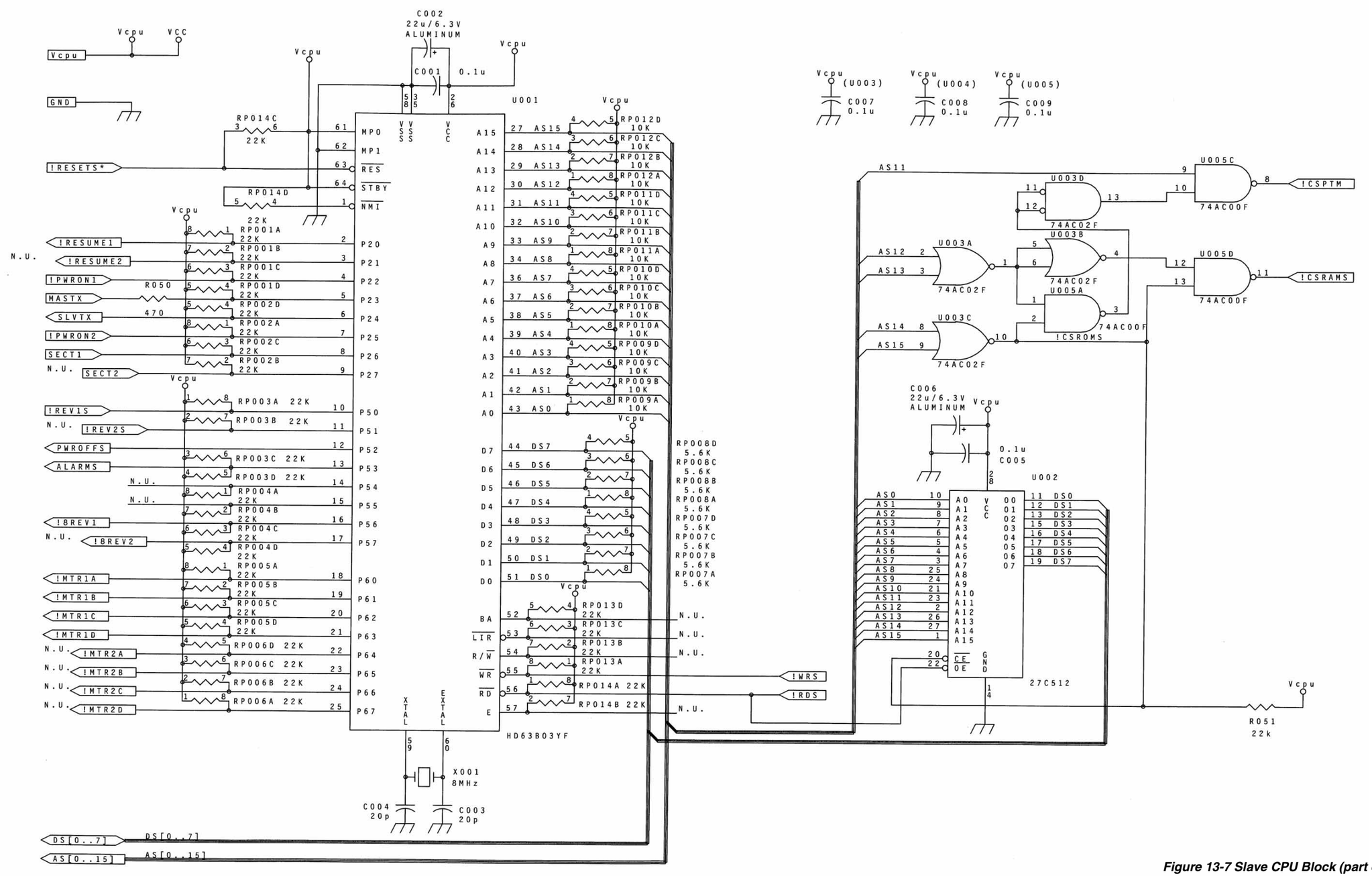


Figure 13-7 Slave CPU Block (part of CPU Board)

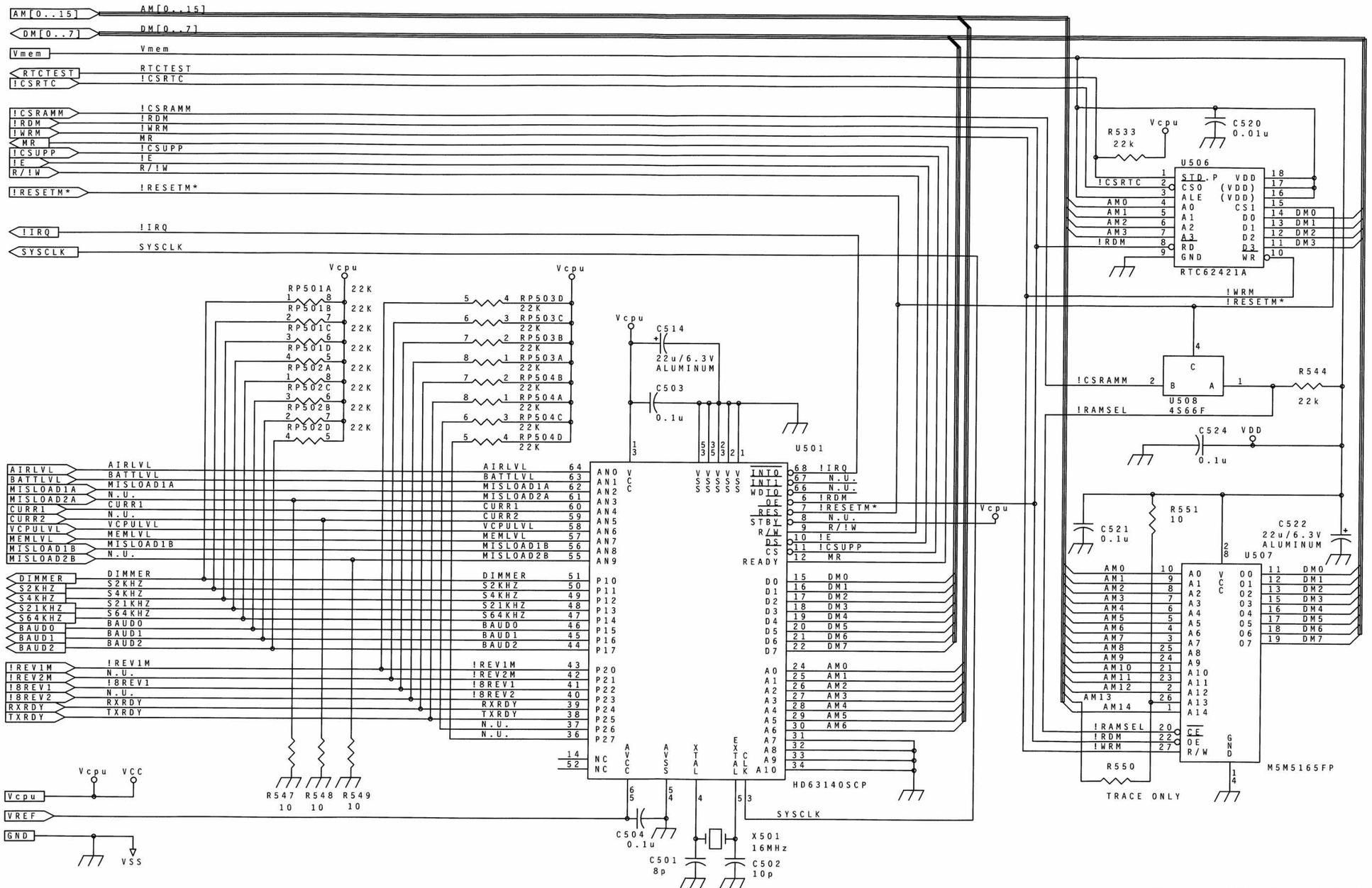


Figure 13-8 UPP, RTC, and SRAM Block (part of CPU Board)

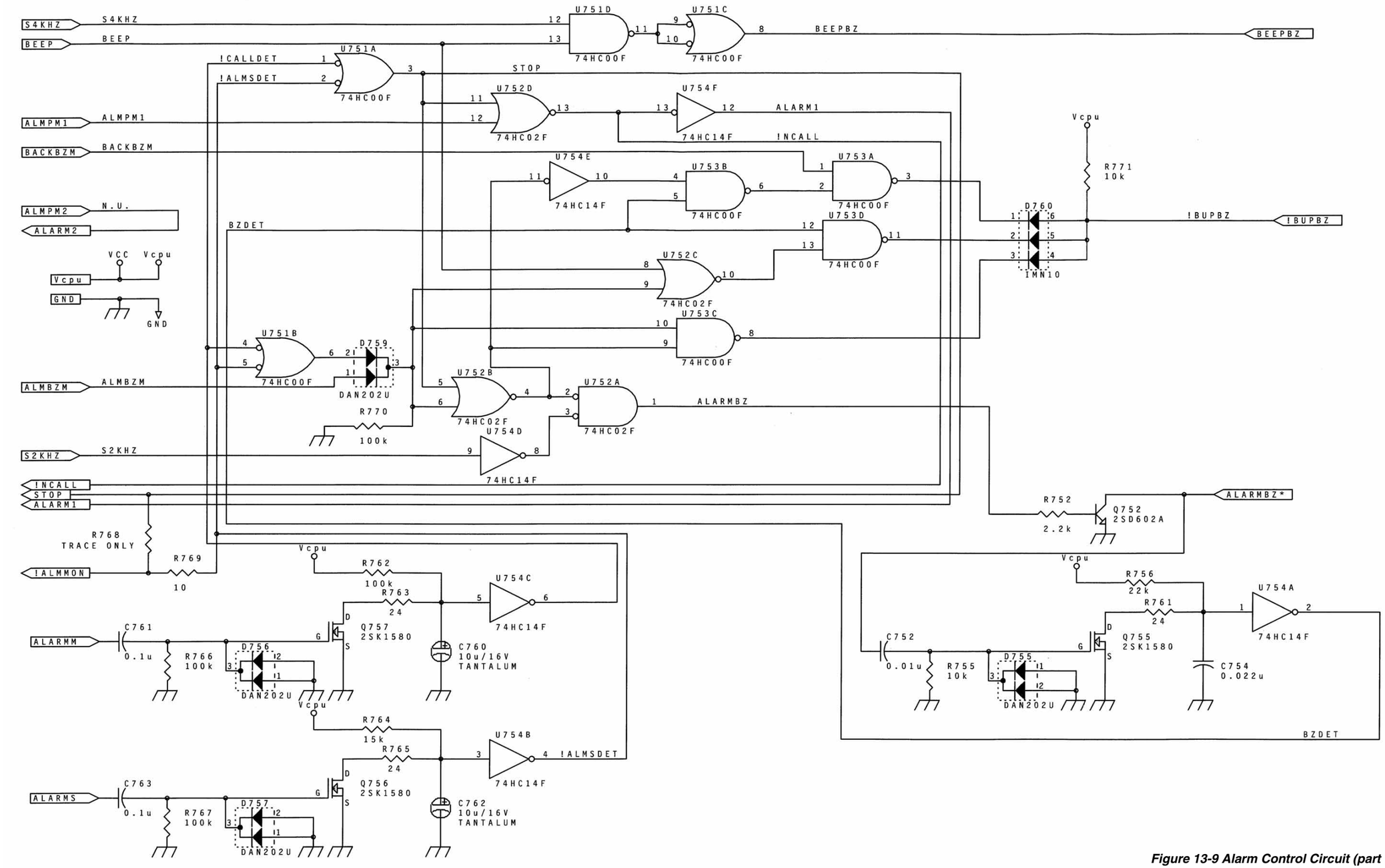


Figure 13-9 Alarm Control Circuit (part of CPU Board)

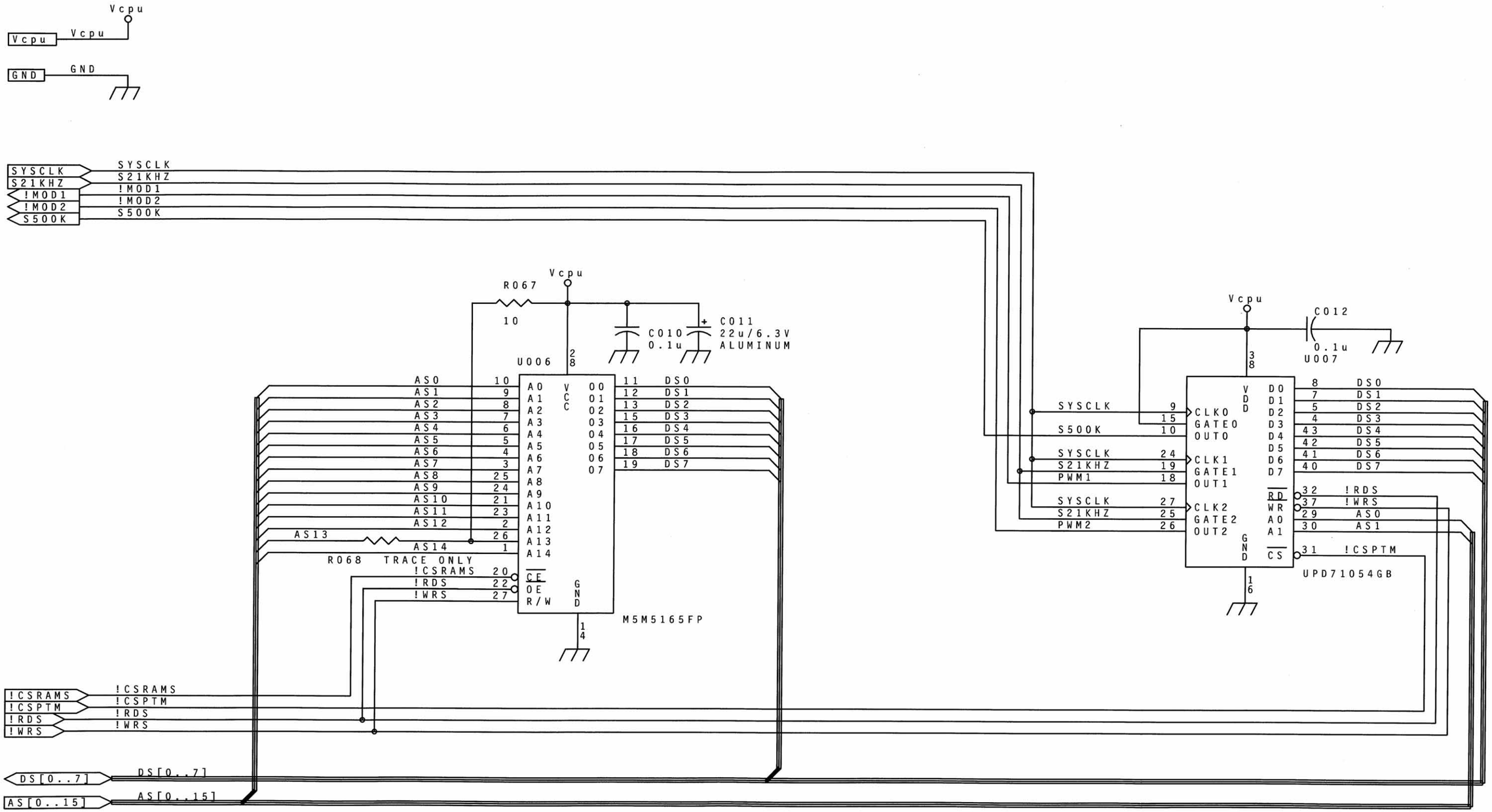


Figure 13-10 Slave RAM and PTM (part of CPU Board)

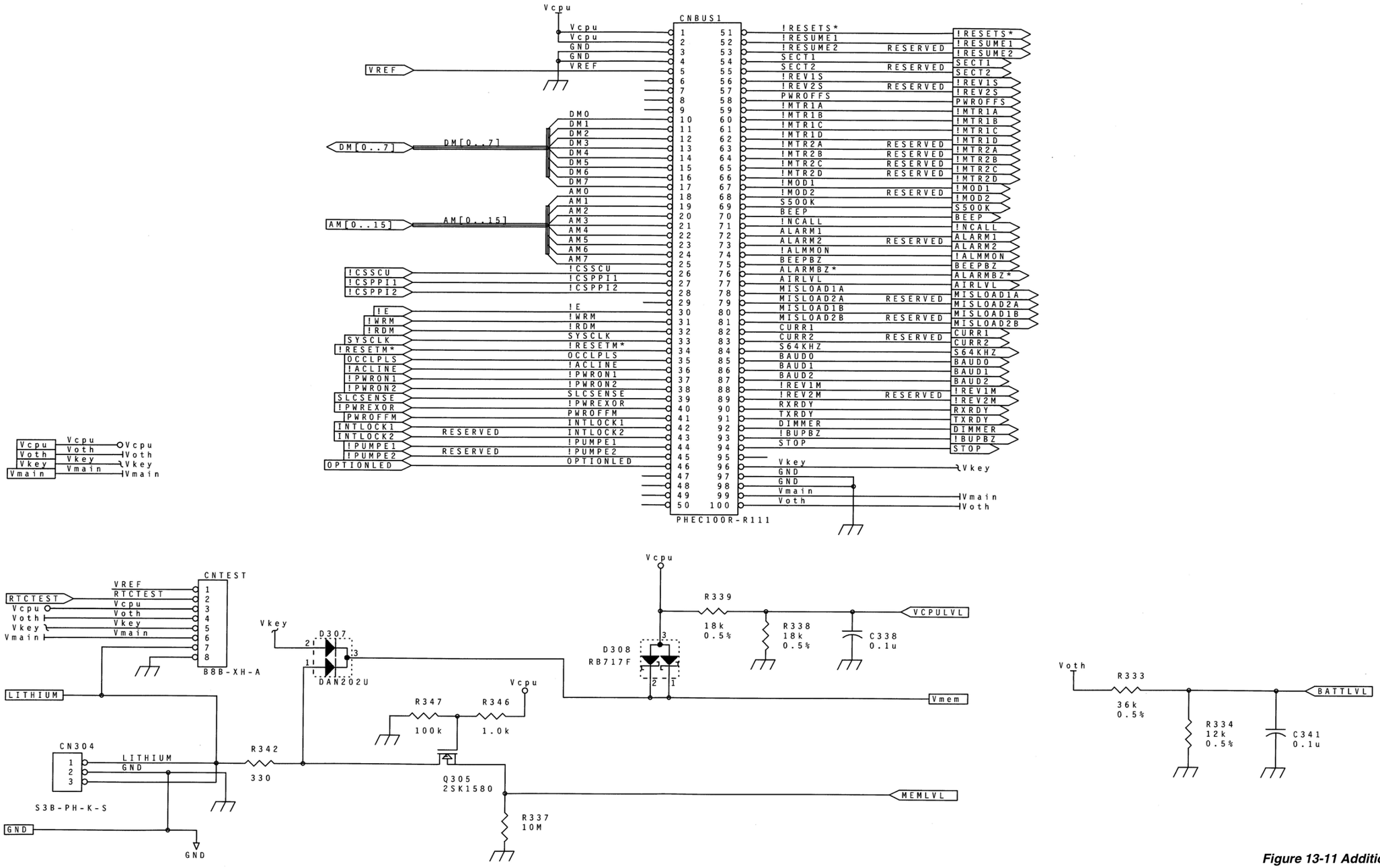


Figure 13-11 Additional CPU Circuitry

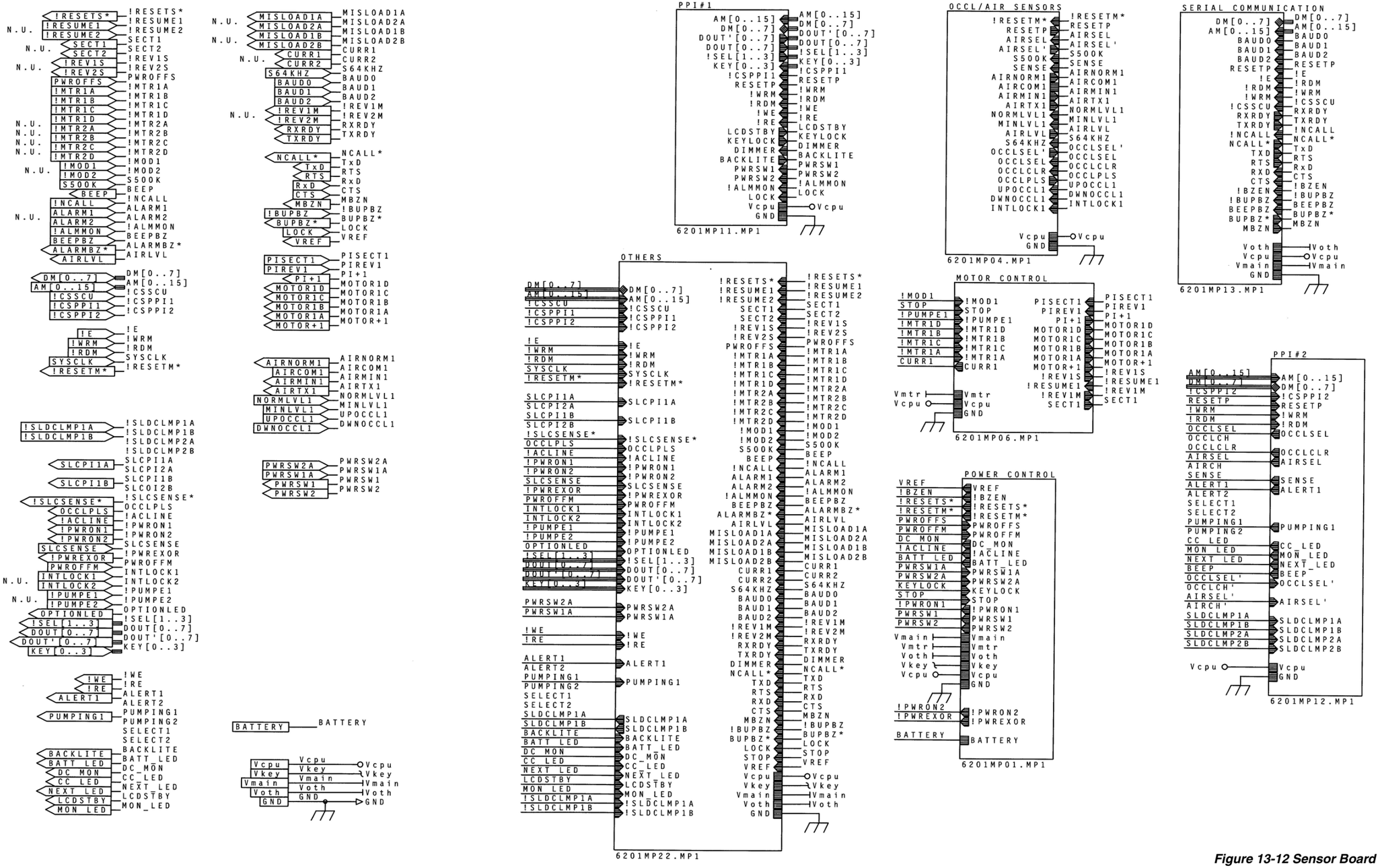


Figure 13-12 Sensor Board Block Diagram

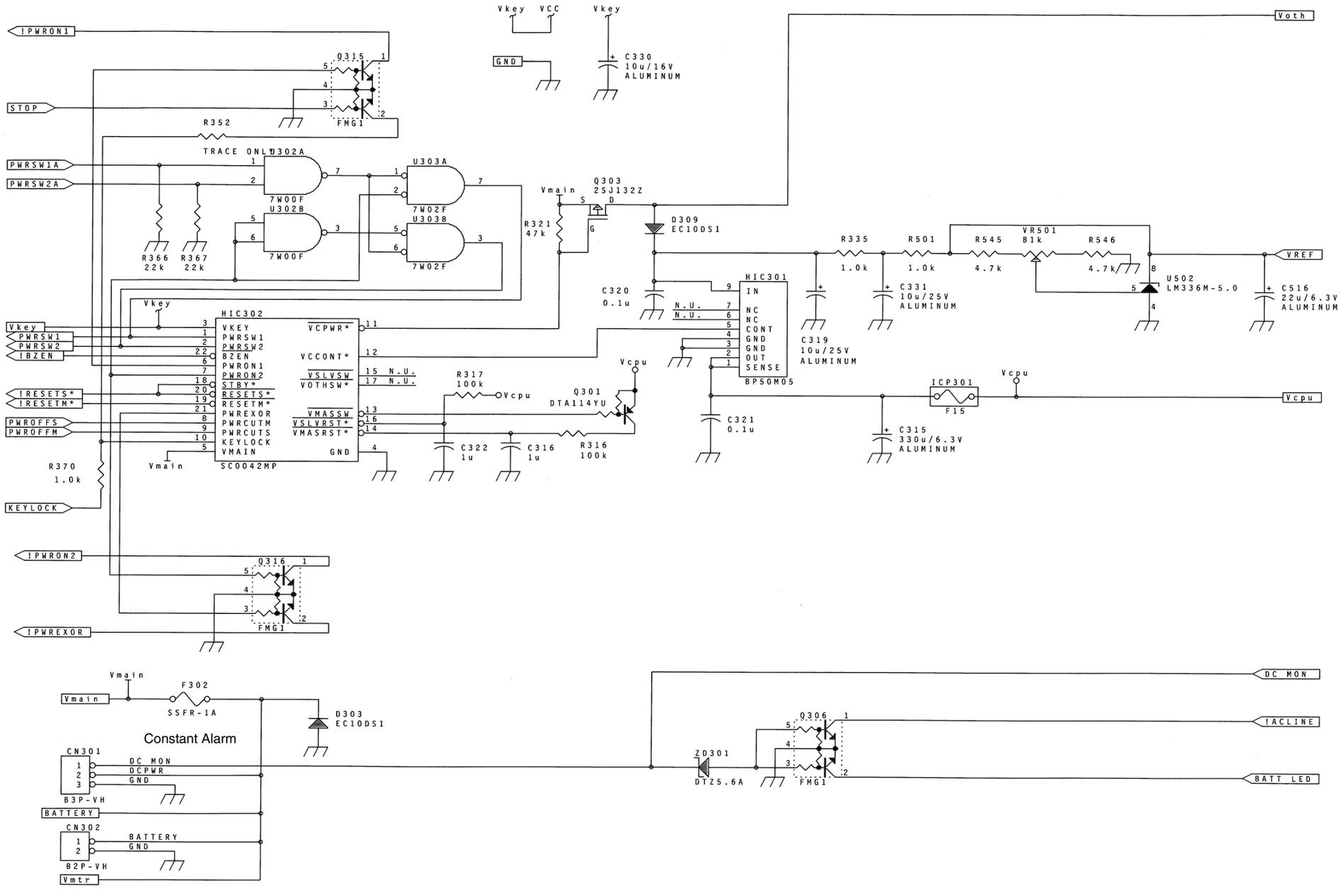


Figure 13-13 Power Supply Control Block (part of Sensor Board)

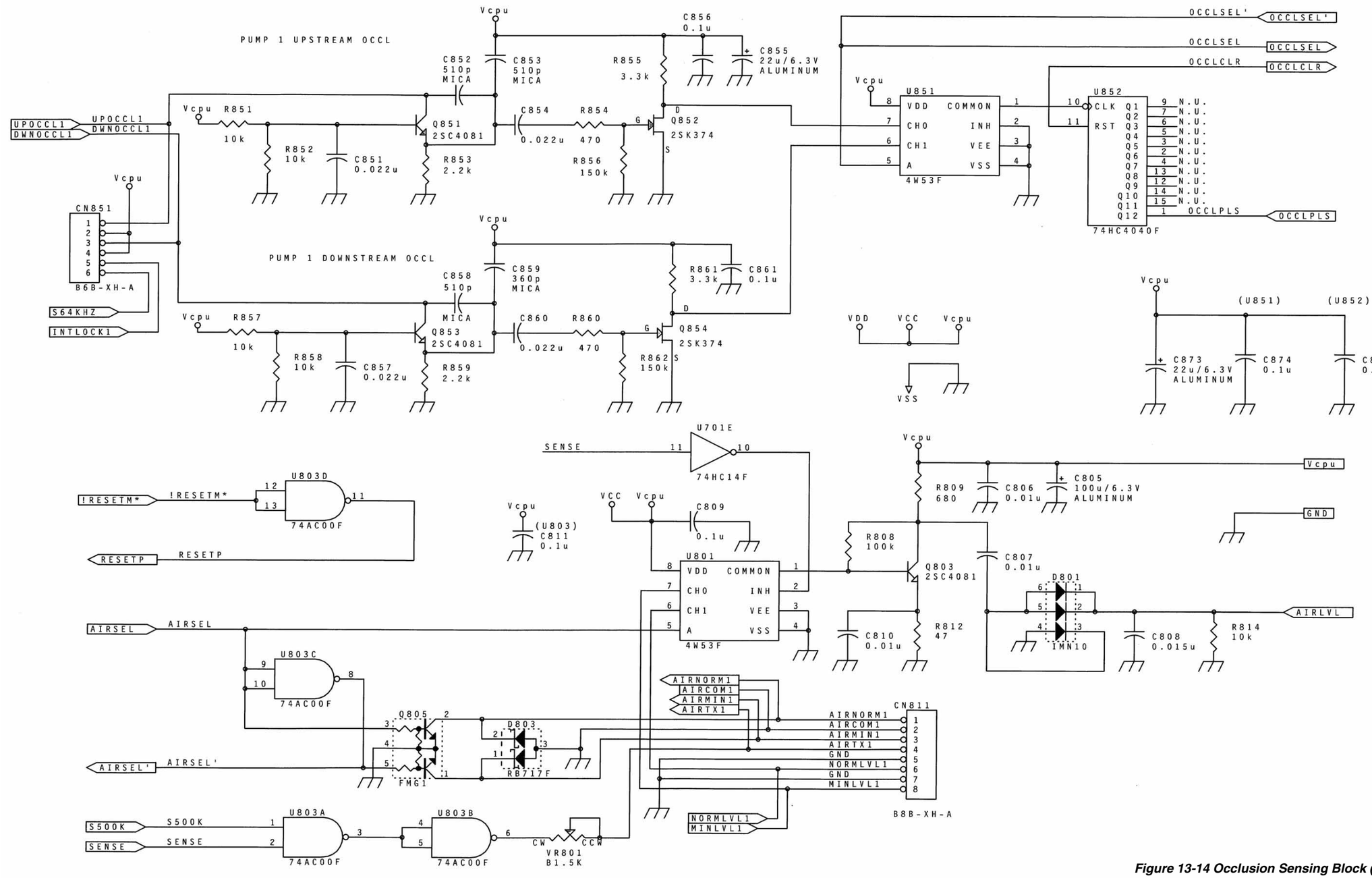


Figure 13-14 Occlusion Sensing Block (part of Sensor Board)

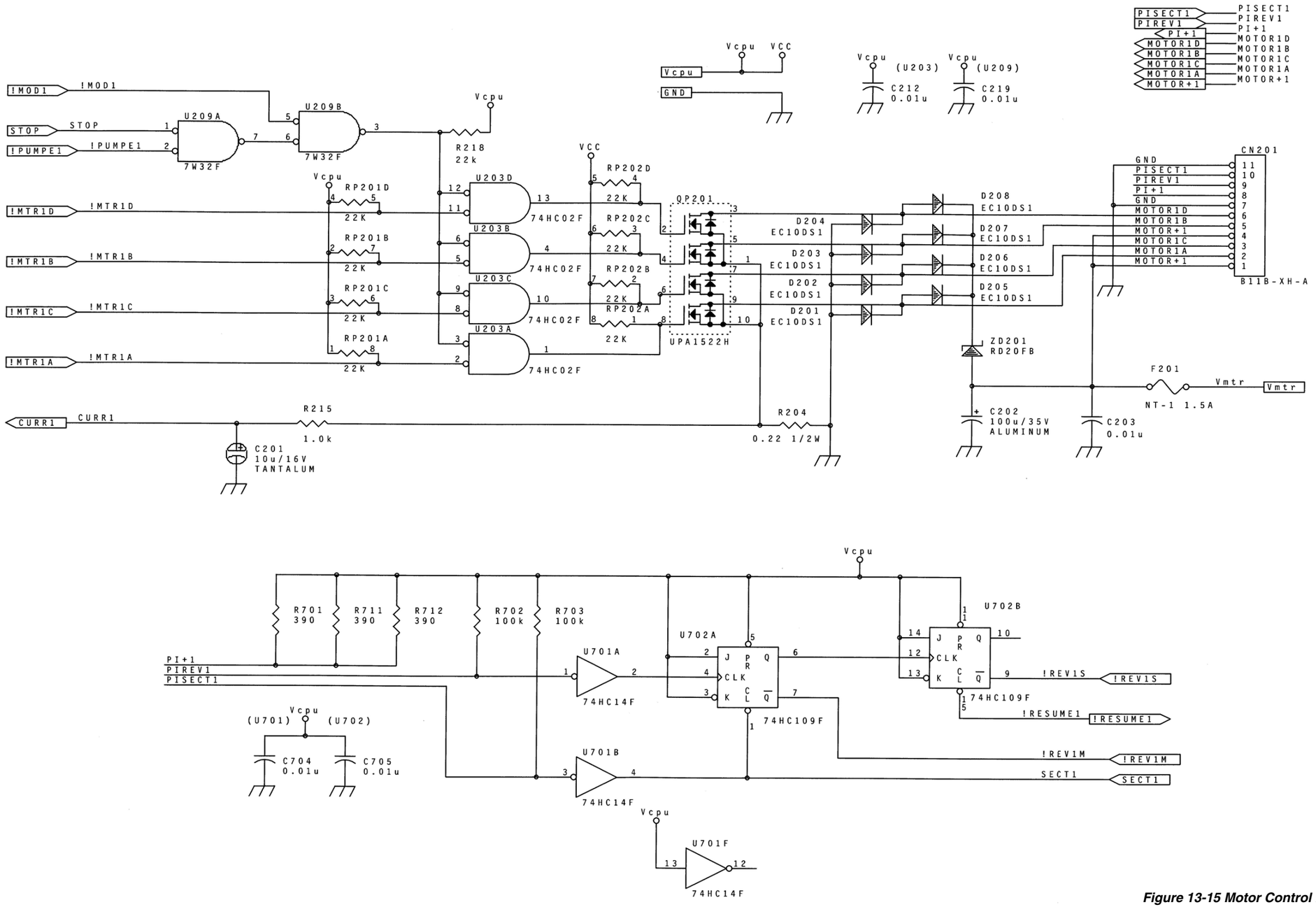


Figure 13-15 Motor Control Block (part of Sensor Board)

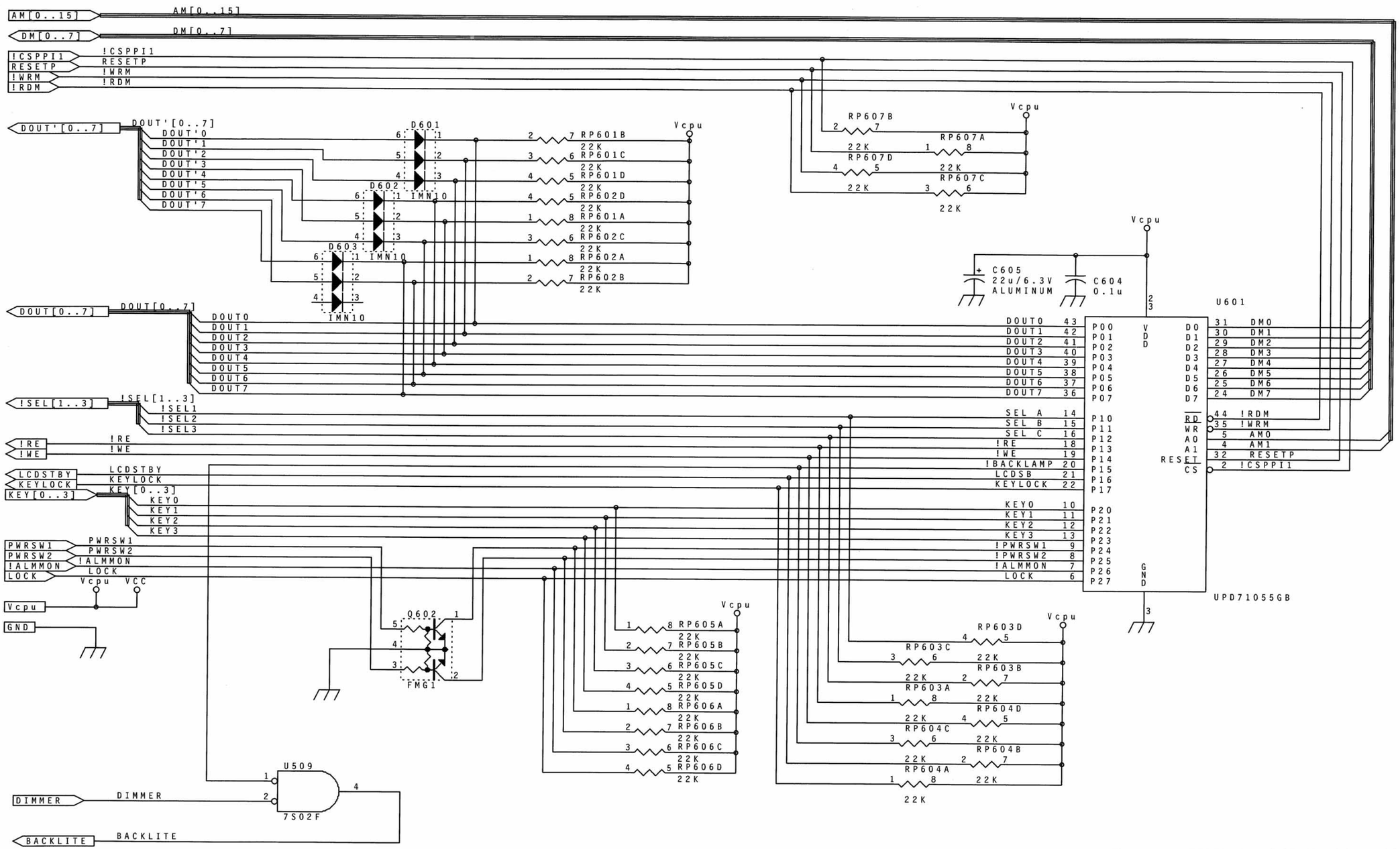


Figure 13-16 PPI Block #1 (LCD, Keys) (part of Sensor Board)

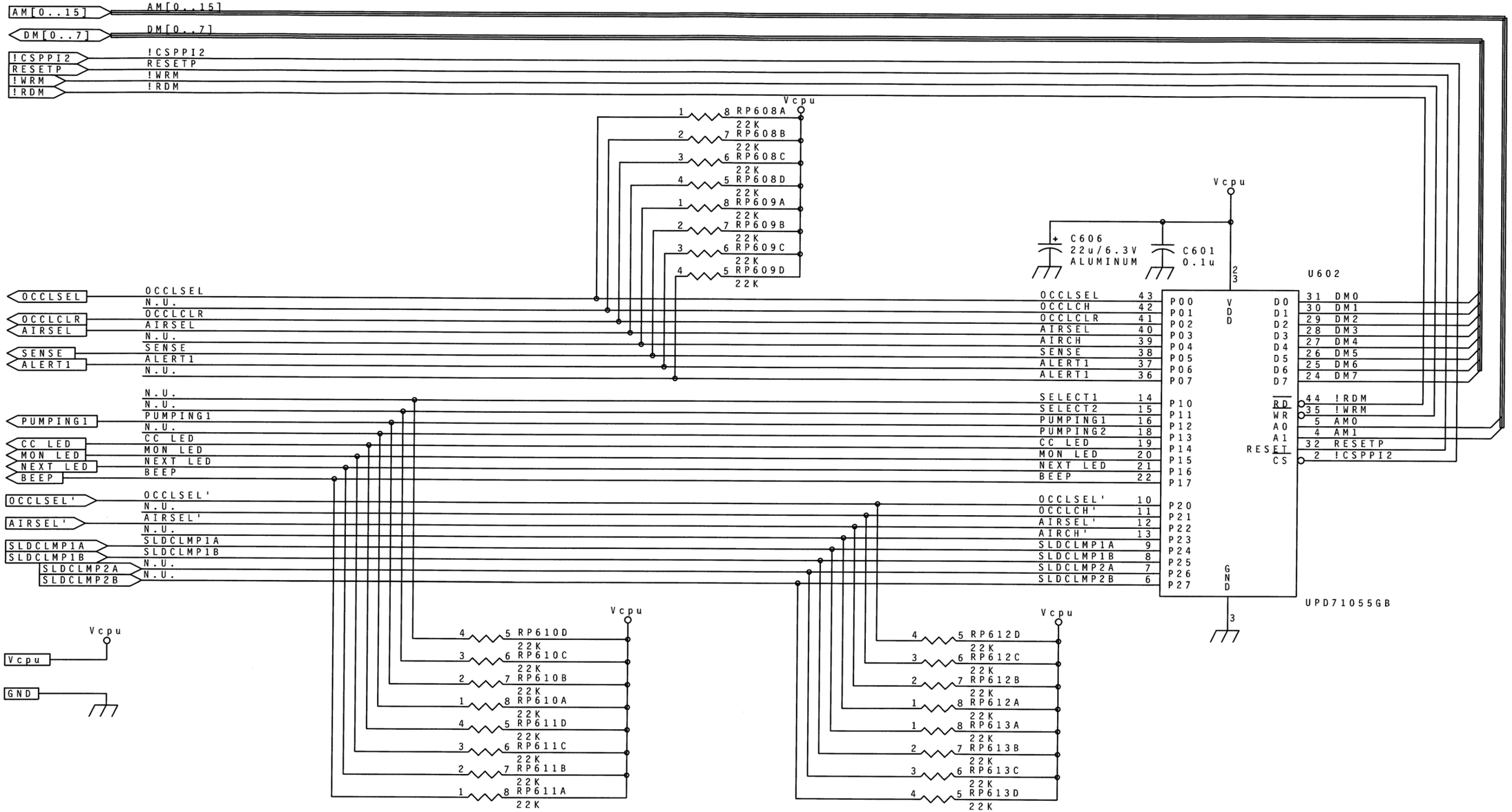


Figure 13-17 PPI Block #2 (part of Sensor Board)

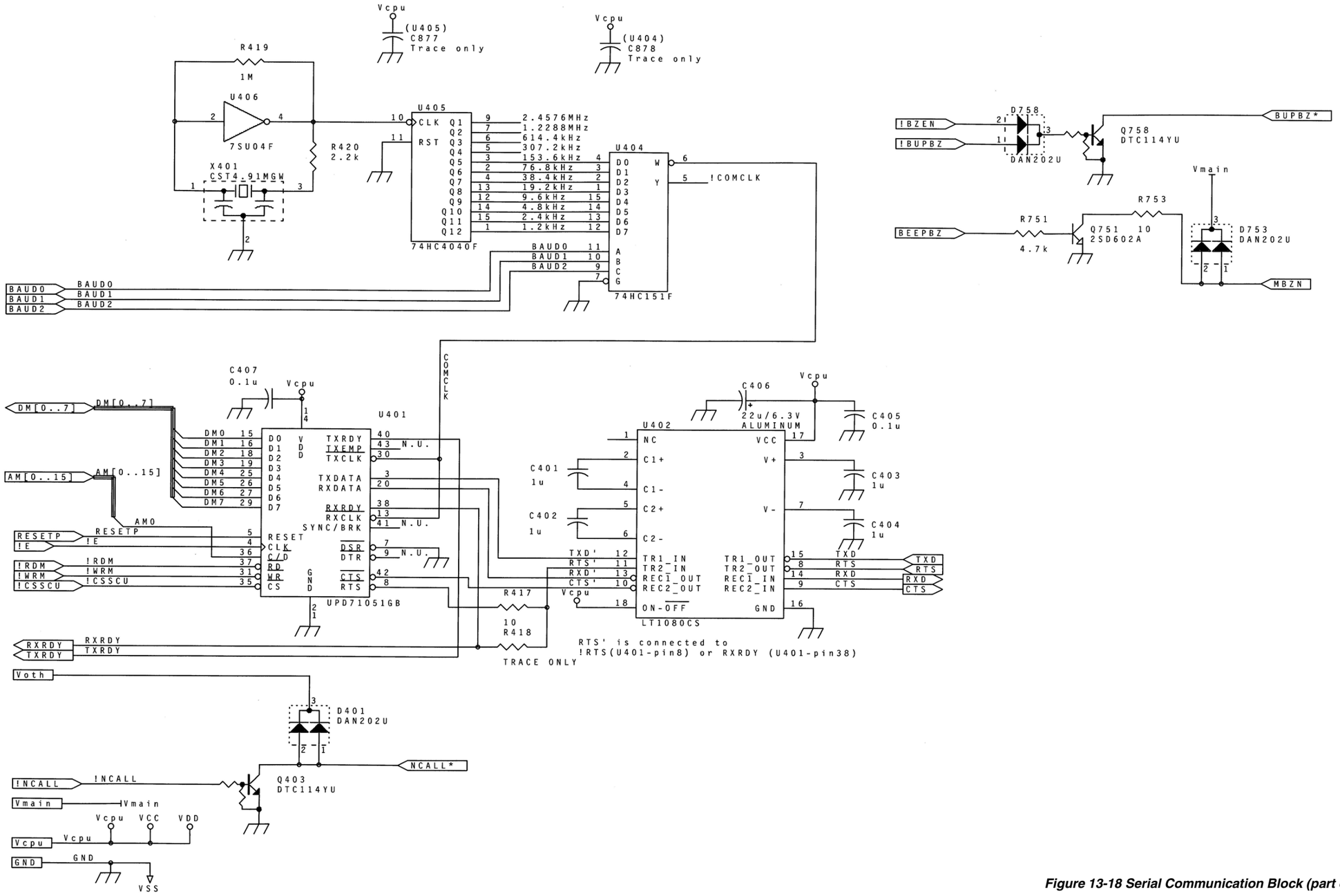


Figure 13-18 Serial Communication Block (part of Sensor Board)

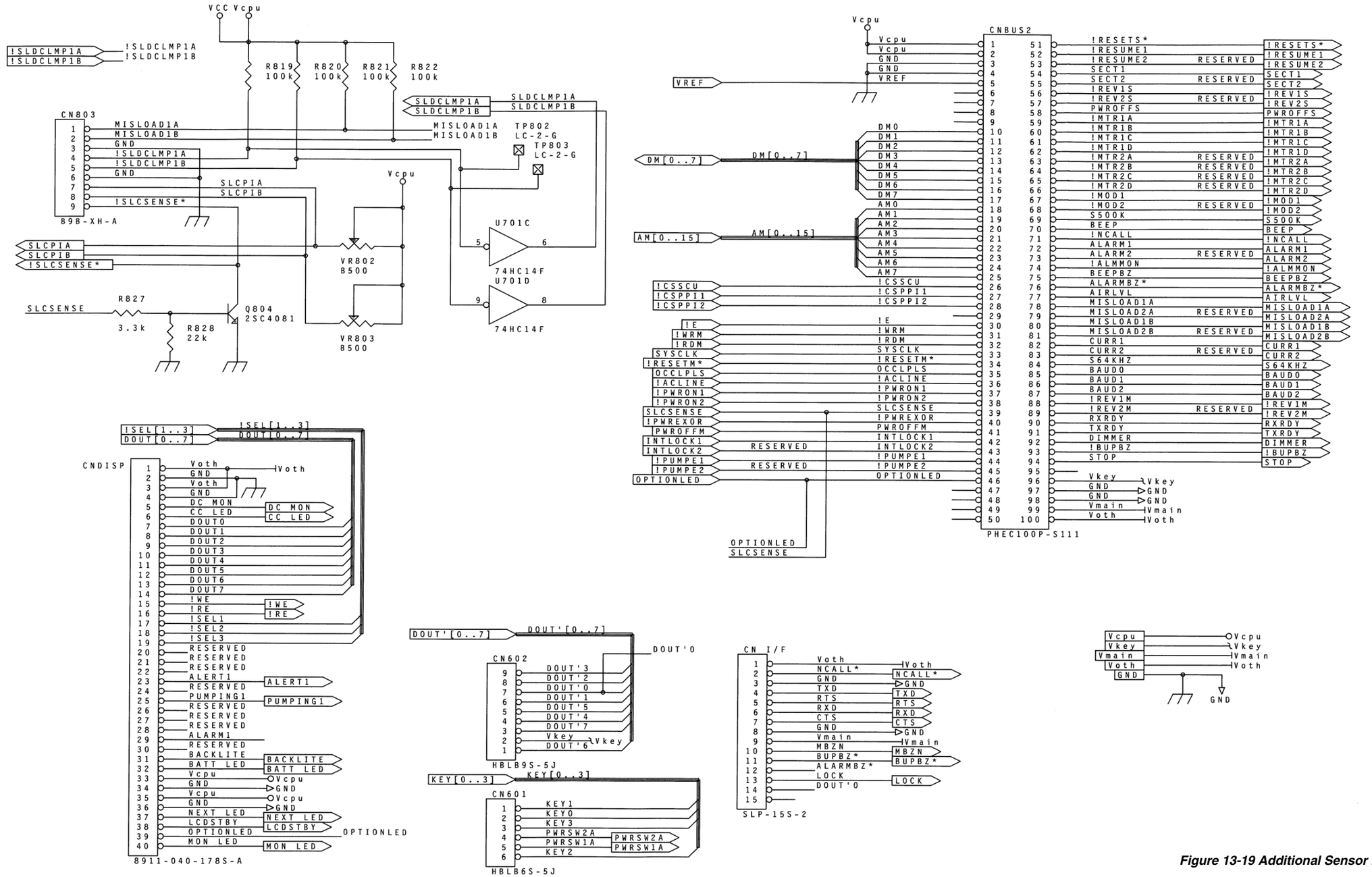


Figure 13-19 Additional Sensor Board Circuitry

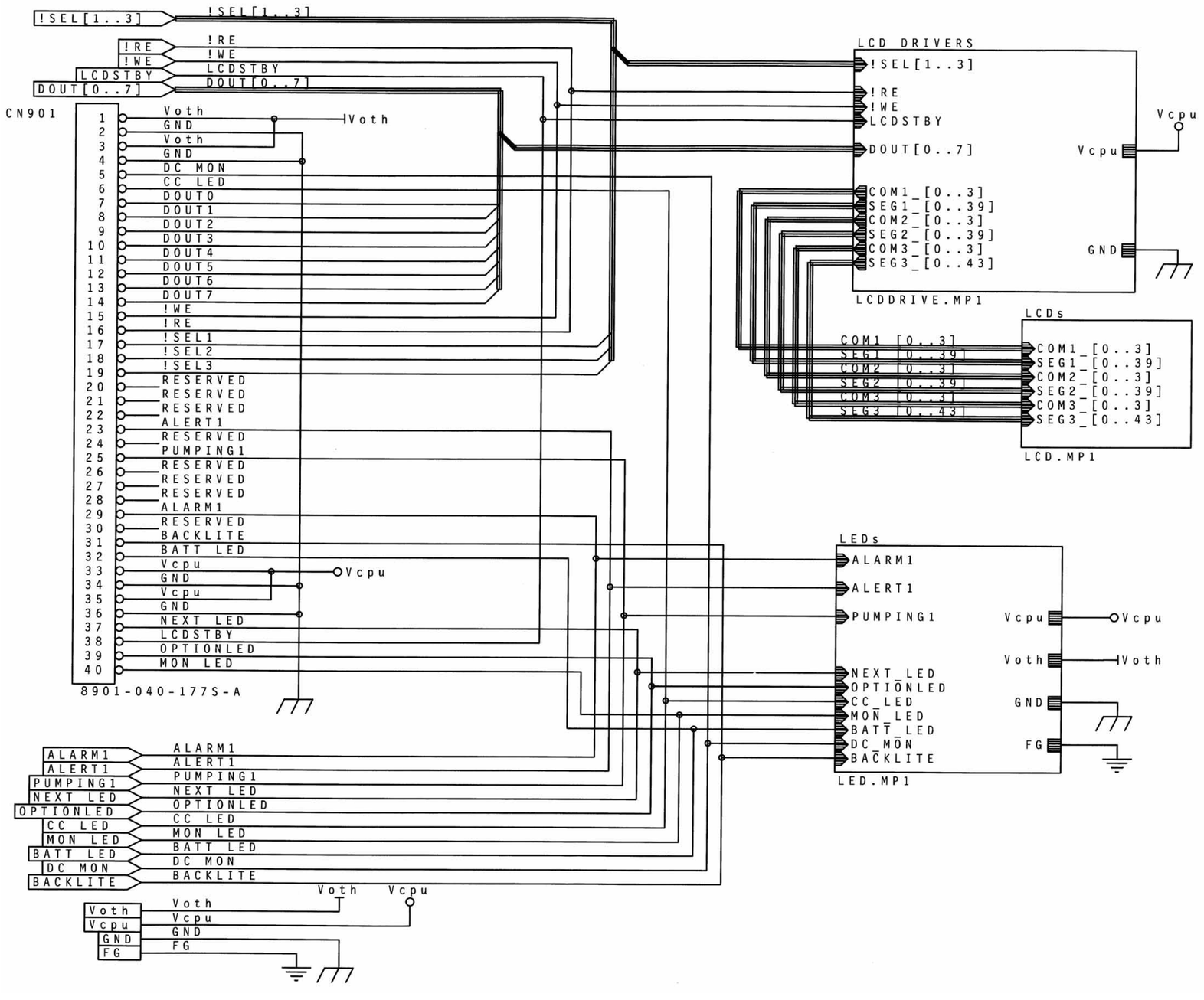


Figure 13-20 Display Board

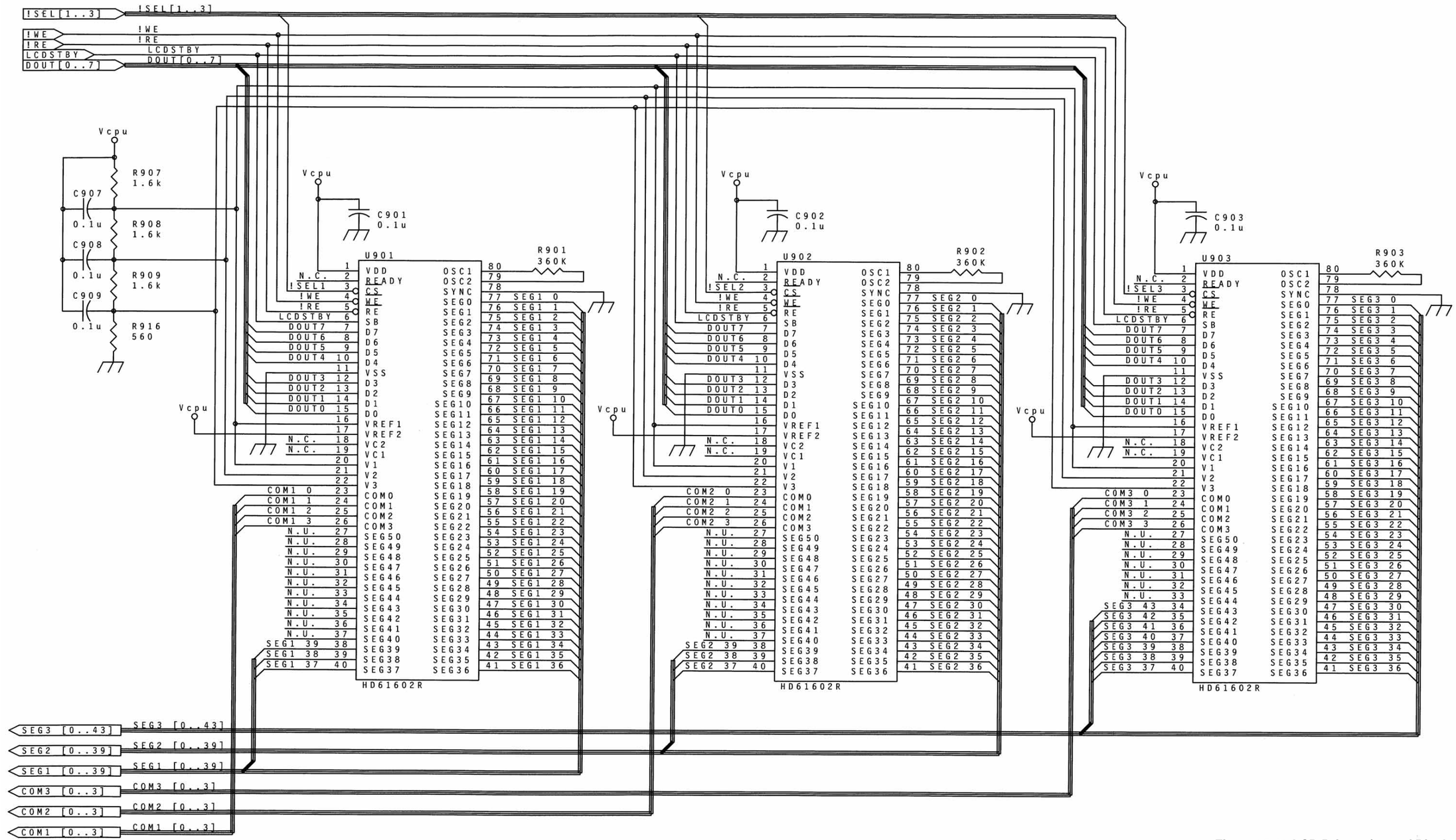


Figure 13-21 LCD Drivers (part of Display Board)

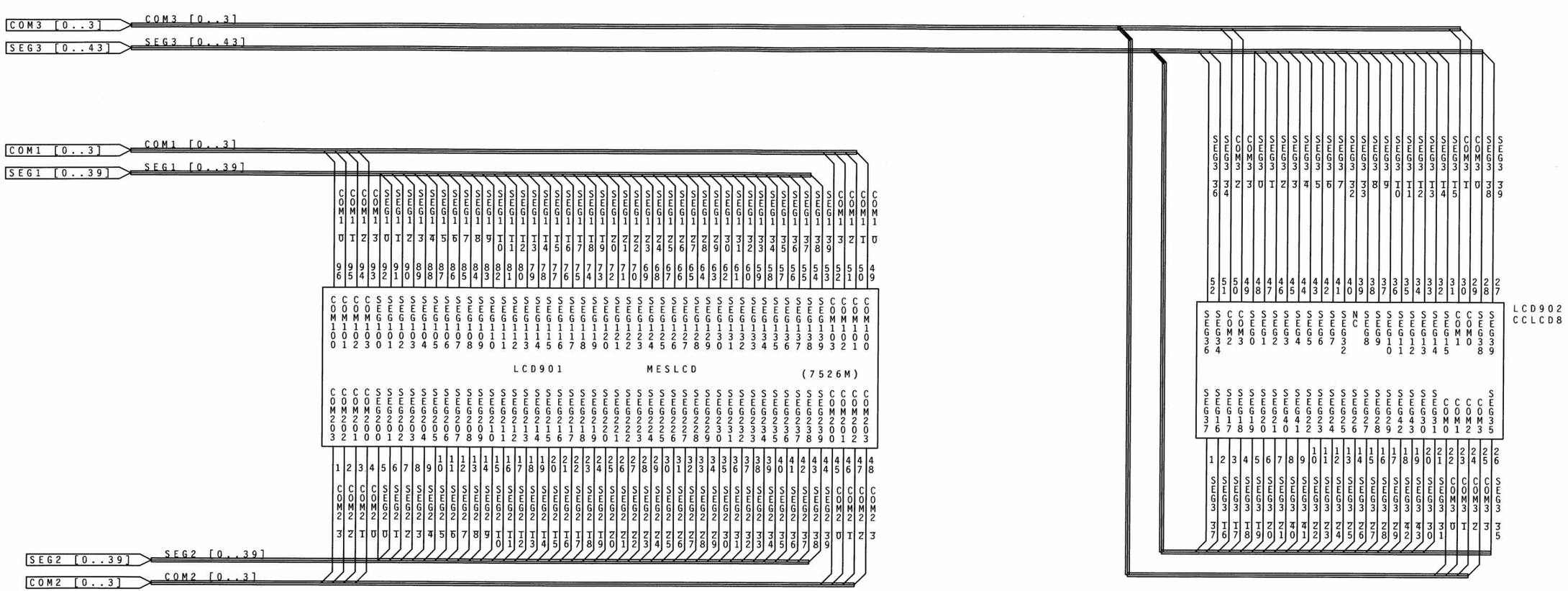
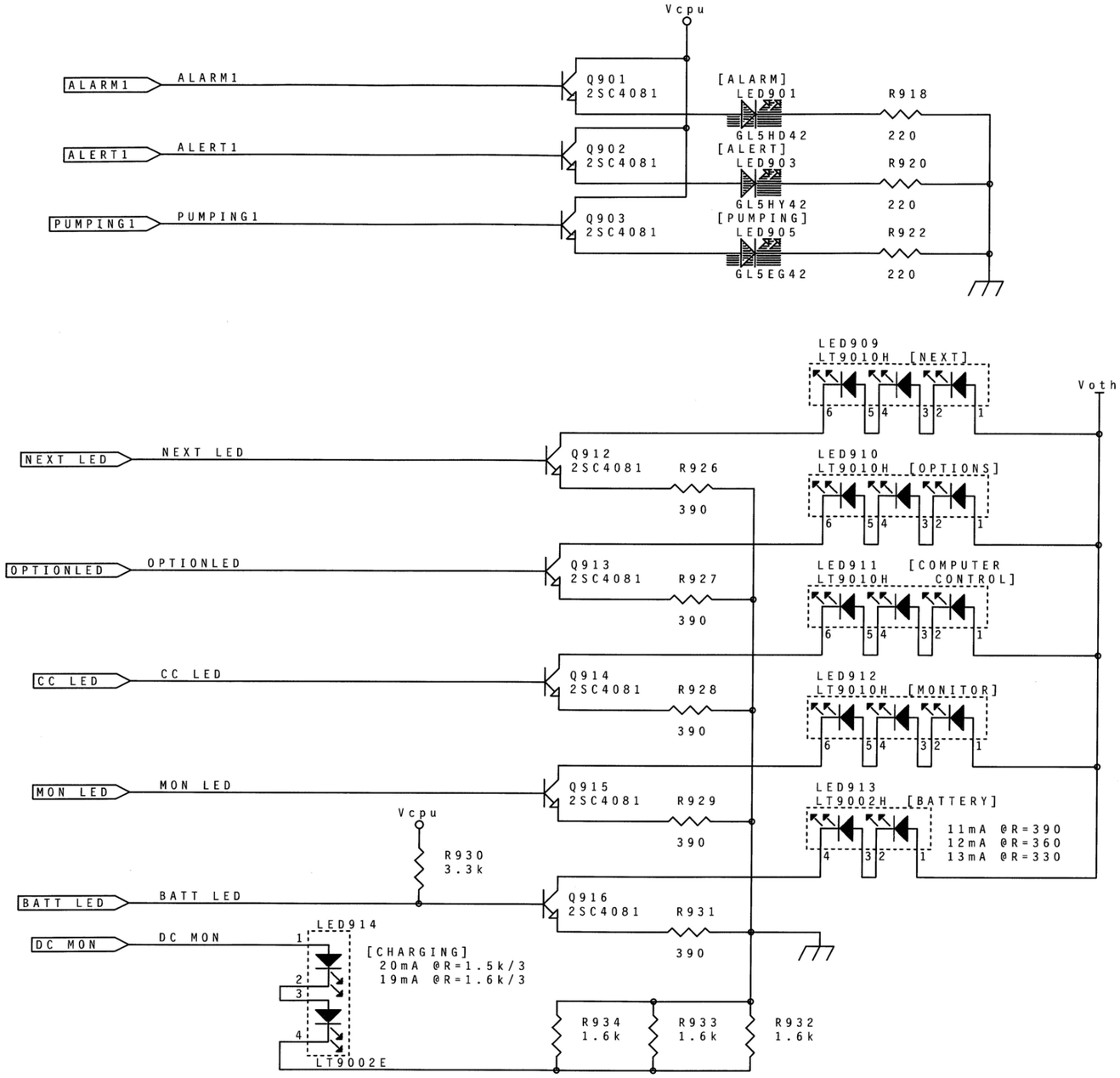


Figure 13-22 Liquid Crystal Displays (part of Display Board)



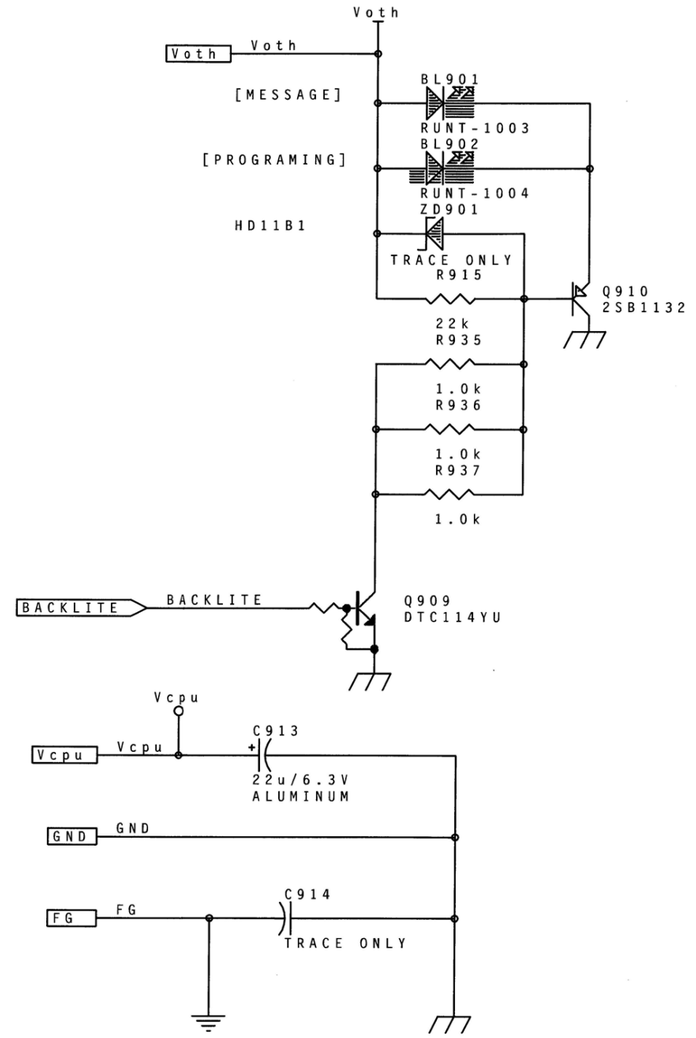


Figure 13-23 LED Lamps (part of Display Board)

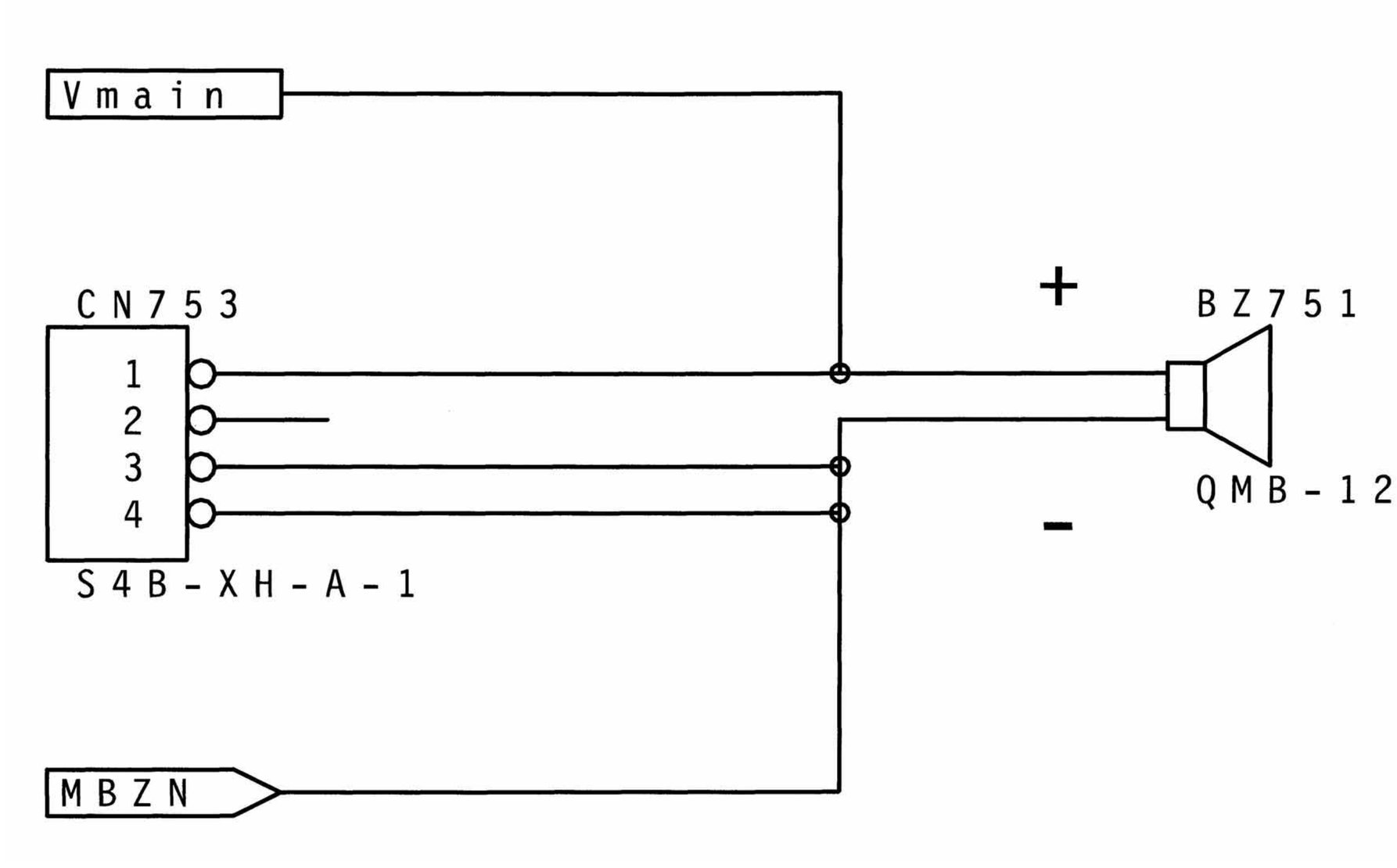


Figure 13-24 Audible Alarm Board

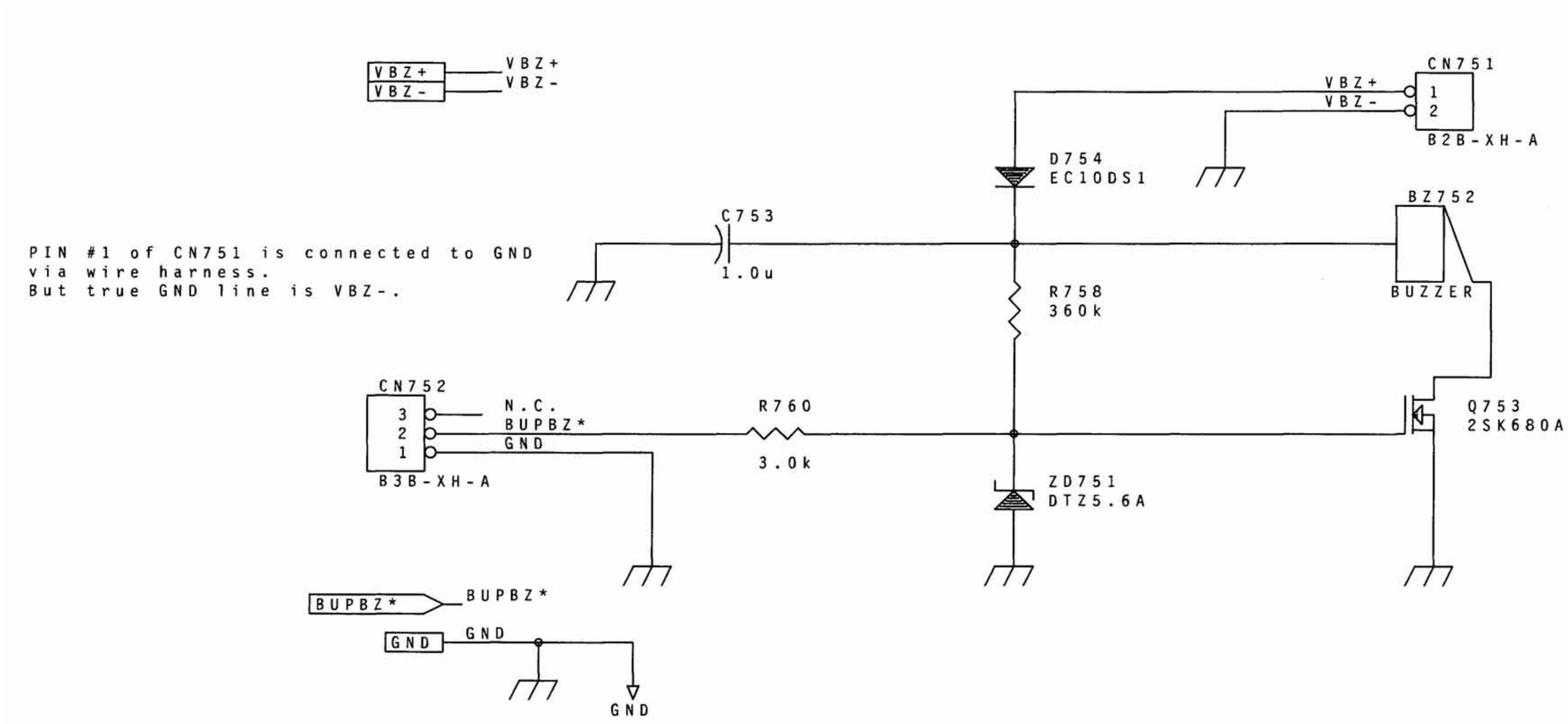


Figure 13-25 Backup Buzzer Board

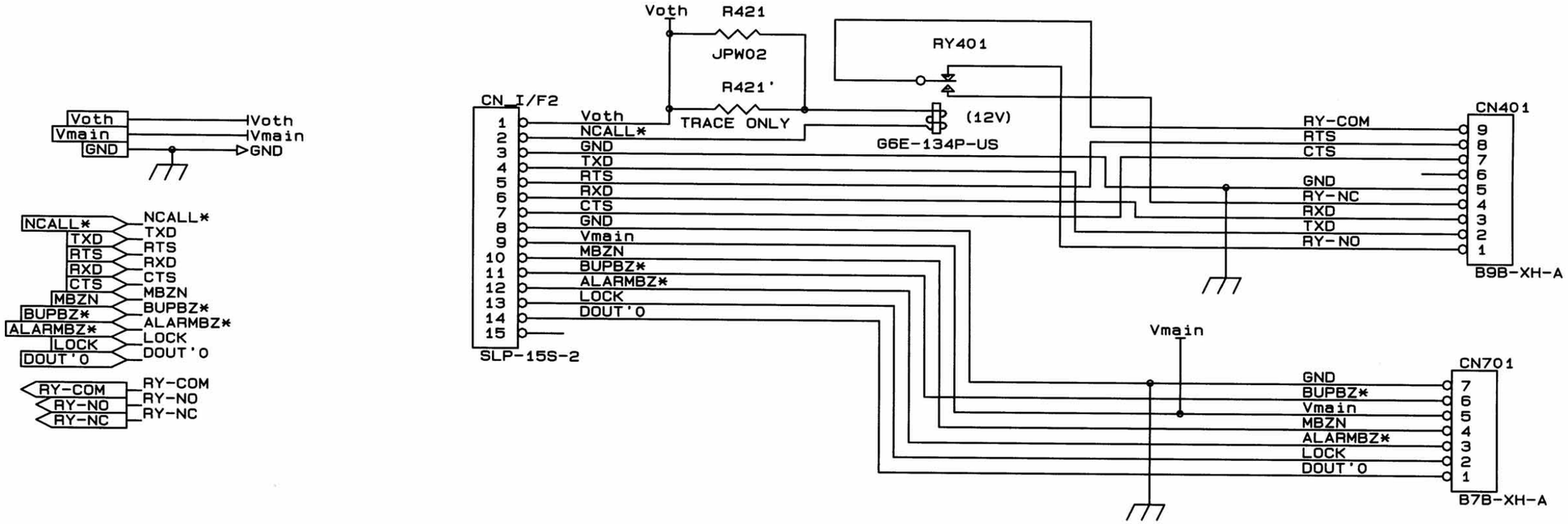


Figure 13-26 Terminal Board

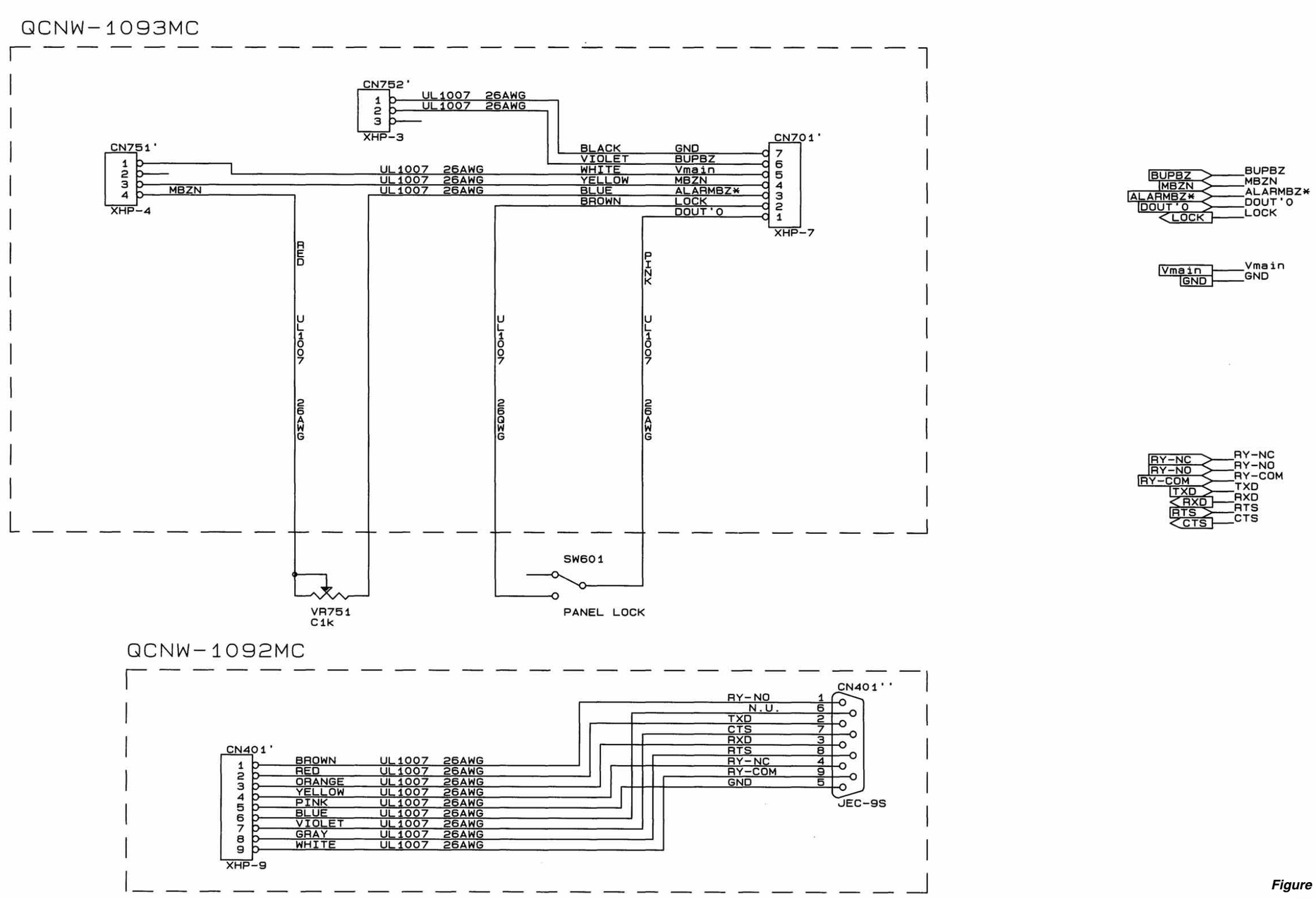


Figure 13-27 Accessories

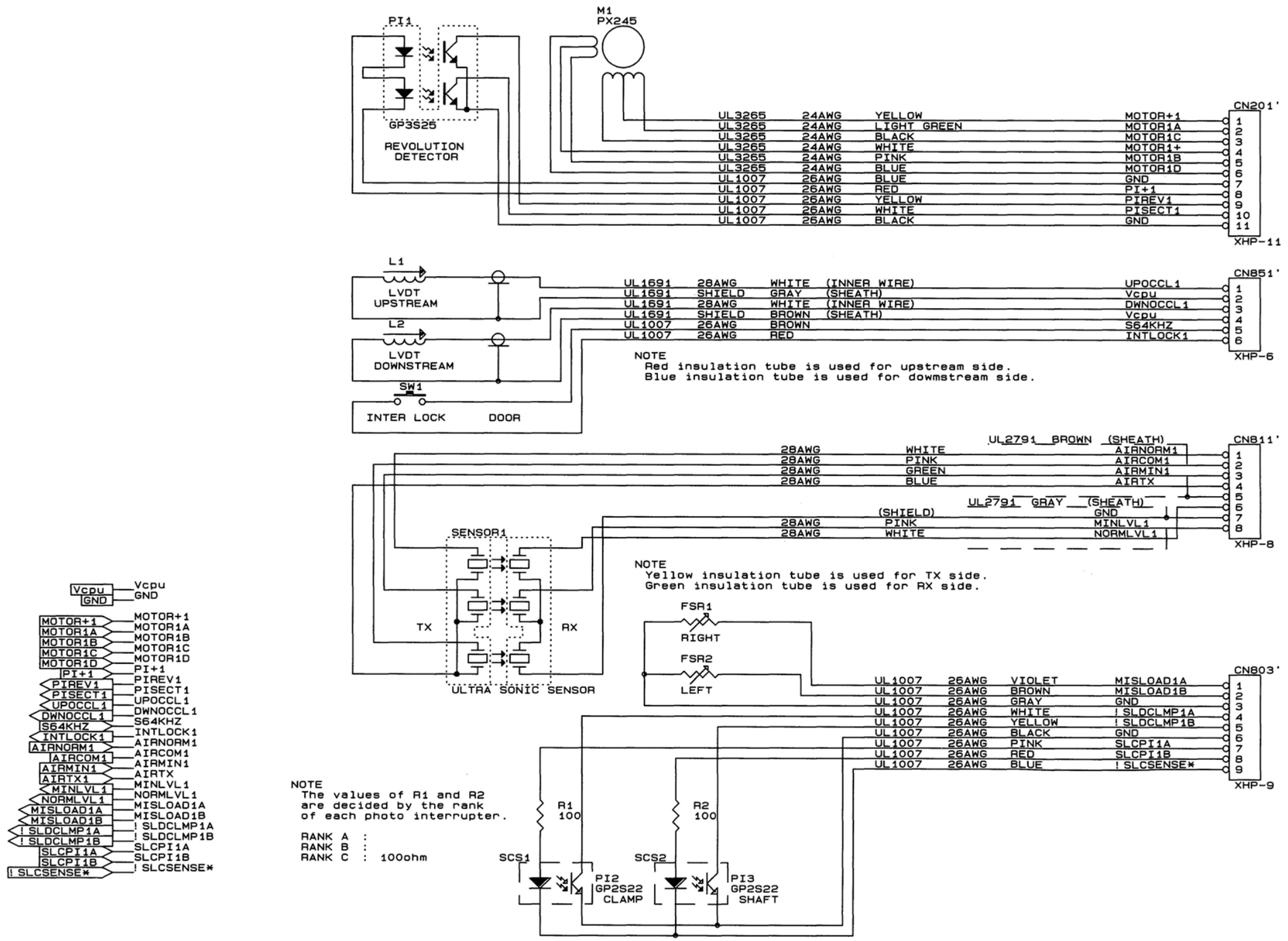


Figure 13-28 Pumphead Sensors

	DOUT7	DOUT6	DOUT5	DOUT4	DOUT3	DOUT2	DOUT1	DOUT0
KEY3							STOP	
KEY2	. (DOT)	SEC START	SEC VTBI	SEC RATE	OPTIONS	PRI START	PRI VTBI	PRI RATE
KEY1	8	9	TIME	CLEAR	BACK LIGHT	SILENCE	CLEAR TOT VOL	TOT VOL STATUS
KEY0	0	1	2	3	4	5	6	7

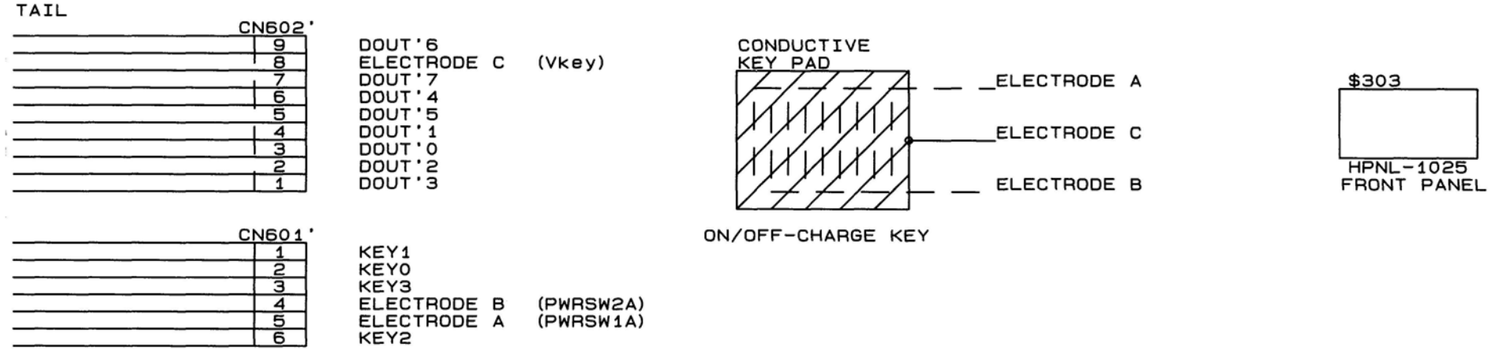


Figure 13-29 Front Panel Key Assignments

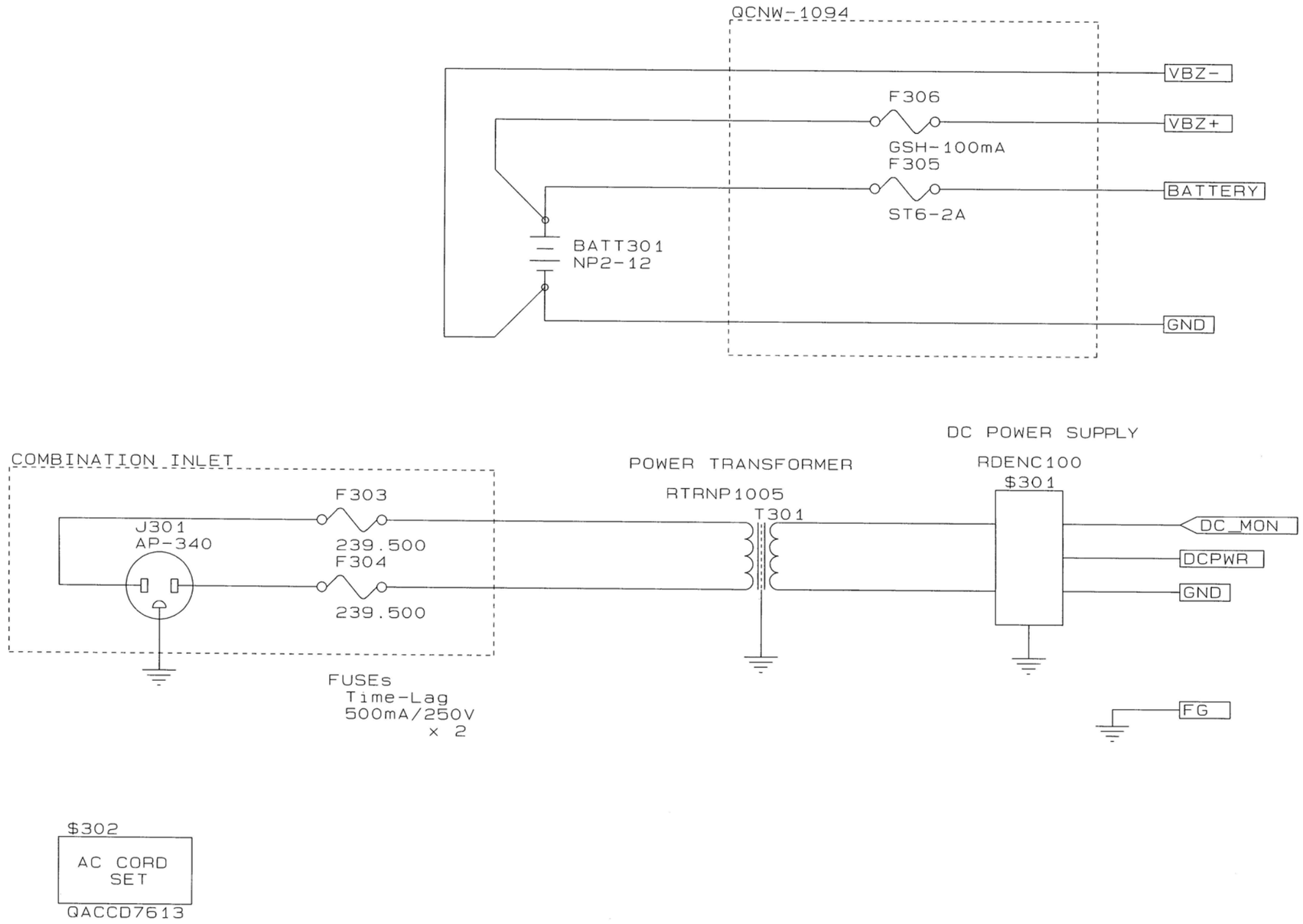


Figure 13-30 Power Supply

Appendix A

Operational Checkout Data Sheet

Pump Serial Number: _____

	Printed Name	Signature	Date
Tester:	_____	_____	_____
Reviewer (optional):	_____	_____	_____

This section contains a blank data sheet for recording the test results from the Operational Checkout tests described in Chapter 10, “Operational Checkout”. Reproduce one copy of the complete data sheet for each pump you test.

Exterior Inspections			
Exterior Inspection: Pump is clean and undamaged		**Fail** ❑	**Pass** ❑
RTV Seal Check: RTV seal is present and evenly applied		**Fail** ❑	
Mounting Clamp Check	Mounting clamp moves freely	**Fail** ❑	
	Disc and cushion are installed correctly		
Power cord is secure, undamaged, and is a Baxter-approved part		**Fail** ❑	

Self Test		
Power Up Self-Test completed successfully	**No** ❑	**Yes** ❑
Software Check		
Master Version Number:		

Door Open and Alarm Volume Test		
"DOOR OPEN" message displays Alarm LED flashes Audible alarm sounds	**No** ❑	**Yes** ❑

Pump Serial Number: _____

	Printed Name	Signature	Date
Tester:	_____	_____	_____
Reviewer (optional):	_____	_____	_____

N/A _____

Slide Clamp Mechanism Test		
"INSERT SLIDECLAMP" message displays	**No ❑**	**Yes ❑**

Calibrated Syringe Due Date/ID: _____

Air Alarm Test			
NORM	(50µL) No air detected	**Fail ❑**	**Pass ❑**
	(110µL) Air detected	**Fail ❑**	**Pass ❑**
MIN	(25µL) No air detected	**Fail ❑**	**Pass ❑**
	(85µL) Air detected	**Fail ❑**	**Pass ❑**

FSR Test			
LEFT	"CHECK SET LOADING" message displays Alarm LED flashes Audible alarm sounds	**Fail ❑**	**Pass ❑**
RIGHT			

Downstream Occlusion Test		
"DOWNSTREAM OCCLUSION" message displays Alarm LED flashes Audible alarm sounds	**Fail ❑**	**Pass ❑**

Stopwatch or Timer Calibration Due Date/ID: _____

Operational Checkout Data Sheet

Pump Serial Number: _____

	Printed Name	Signature	Date
Tester:	_____	_____	_____
Reviewer (optional):	_____	_____	_____

Upstream Occlusion Test		
Pump stops "UPSTREAM OCCLUSION" message displays Alarm LED flashes Audible alarm sounds	Time to Alarm < 3 Minutes	Time to Alarm:

Battery Check	
Pump Runs 2.5 hrs. Without Battery Low Alert	Record Run Time:

Panel Lock Test		
"Loc" displays, front panel keys (except **BACKLIGHT** and **TOT/VOL/STATUS**) do not accept input	**Fail ❑**	**Pass ❑**

Free Flow Prevention Test		
Pump Prevents Fee Flow of Fluid	< 0.5 mL	mL

Pump Serial Number: _____

	Printed Name	Signature	Date
Tester:	_____	_____	_____
Reviewer (optional):	_____	_____	_____

Multimeter Calibration Due Date/ID: _____

Electrical Safety Tester Calibration Due Date/ID: _____

Electrical Safety Tests		
Ground Impedance		
Ground Impedance	< 0.5 Ω	Ω
Leakage Current		
Earth Leakage Current	< 50 µA	µA

Scale Calibration Due Date/ID: _____

Graduated Cylinder Calibration Due Date/ID: _____

Accuracy Tests **Note:** Perform either Volume Measurement with VTBI or Measurement by Volume per Time.			
Measurement by Volume per Time			N/A _____
PRI Rate 200mL/VTBI 20mL	18.6mL-21.4mL	mL	
Volume Measurement with VTBI			N/A _____
PRI Rate 200mL/ VTBI 35mL	32.5mL-37.5mL	mL	
1 Hour Accuracy Test **Note:** Perform only if pump failed Volume Measurement w/VTBI or Measurement by Volume per Time			N/A _____
PRI Rate 125mL/ VTBI 1000mL	116.25mL-133.75mL	mL	

Appendix B

Calibration Verification Data Sheet

Pump Serial Number: _____

	Printed Name	Signature	Date
Tester:	_____	_____	_____
Reviewer (optional):	_____	_____	_____

This section contains a blank data sheet for recording the results from the calibration verification procedures described in "Verifying Calibration Values" on page 9-13. Reproduce one copy of the complete data sheet for each pump you test.

Calibration Verification (Verification in Mode 1)	
Upstream Occlusion Calibration Verification	
3242-3314	Value:
Downstream Occlusion Calibration Verification	
2967-3039	Value:
Main Battery Calibration Verification	
688-714	Value:
Backup Battery Calibration Verification	
574-737	Value:

Pump Serial Number: _____

	Printed Name	Signature	Date
Tester:	_____	_____	_____
Reviewer (optional):	_____	_____	_____

Calibration Verification (Verification in Mode 2)		
NORM and MIN Air Sensor Calibration with Primed Tubing		
NORM	330-565	Value:
MIN		Value:
NORM and MIN Air Sensor Calibration with Air Filled Tubing		
NORM	< 11	Value:
MIN		Value:
NORM and MIN Air Sensor Calibration with No Tube		
NORM	< 40	Value:
MIN		Value:
FSR Verification with Pump Door Open		
RIGHT	500-820	Value:
LEFT		Value:
FSR Verification with Pump Door Closed		
RIGHT	500-820	Value:
LEFT		Value:
FSR Verification with Tubing Misloaded		
RIGHT	450 or less	Value:
LEFT		Value:
Vcpu	472-579	Value:

Appendix C

Configuration Options Data Sheet

Use the data sheet pages herein to record the Configuration Option settings described in Chapter 5, “Configuration Option Feature”.

Note: Not all of the options below are available in all software versions. Factory defaults may not match pump defaults.

Serial Number:		**Date:**
Configuration Options	**Factory Default Values**	**Current Settings**
Occlusion Alarm Level	Level 1	❑ Level 1 ❑ Level 2 ❑ Level 3
Audible Switchover	Off	❑ Off ❑ On
Number of Automatic Restarts	3	Range 0-9, record value:
Door Open Required	Off	❑ Off ❑ On
Air Bubble Alarm Size	Norm	❑ Norm (avg. 75 µL) ❑ Min (avg. 50 µL)
Alarm Off Interval	1	Range 1-7, record value:
Alert Off Interval	7	Range 1-7, record value:
Maximum Rate of Infusion	1999 mL/hr	Range 1- 1999 mL/hr, record value:
Maximum VTBI	9999 mL	Range 1- 9999 mL, record value:
Flow Check Display	Off	❑ Off ❑ On
Baud Rate	9600	❑ 300 ❑ 1200 ❑ 2400 ❑ 4800 ❑ 9600
Computer Control	Disabled	❑ Disabled ❑ Off w/Alarm ❑ On w/Alarm

Serial Number:		**Date:**
Configuration Options	**Factory Default Values**	**Current Settings**
Hospital Area Designator	No Message	❑ NO MESSAGE ❑ NICU ❑ PICU ❑ MED/SURGICAL ❑ TRAUMA ❑ BURN UNIT ❑ OPER ROOM ❑ CARDIAC/ICU ❑ SURGICAL/ICU ❑ ICU ❑ ONCOLOGY
Close Clamp	On	❑ Off ❑ On
Insert Clamp	Off	❑ Off (Spring Retainer Should Be Installed) ❑ On (Software versions earlier than V1.09) ❑ Alert (V1.09 Software or later) ❑ Alarm
Programmed Delivery Profile	Disabled	❑ Disabled ❑ 5 Hour Memory ❑ Semi-permanent memory ❑ Ramp PDP
Time Setting	Military Time	record value:
Date Setting	00/00/00 (mm/dd/yy)	record value:

Appendix D

Multiple Key Combinations

The following multiple key combinations can be used to initiate sequences on the pump. See the appropriate sections for details regarding the proper use of these combinations. An example of the standard convention used in this table is given below.

Key combination: **LOCK** + **STOP** + **ON-OFF/CHARGE**

Action: Press and hold the **LOCK** key, while simultaneously pressing the **STOP** and **ON-OFF/CHARGE** key, then release all of the keys.

Table D-1 Multiple Key Combinations

Sequence	Key Combination	Section
Alarm Log (Failure identification codes)	**SILENCE** + **TOT VOL STATUS** Press **CLR TOT VOL** within 3 seconds. The display scrolls backwards through the alarm codes and automatically exit at the end.	"Failure Identification Codes" on page 7-7.
Flow Check	"." + **TOT VOL STATUS** When the keys are released, the display disappears 10 seconds later.	Table 5-1
Modify Configuration	**LOCK** + **STOP** + **ON-OFF/CHARGE**	"Modifying the Configuration Option Settings" on page 5-2
View Configuration	**TIME** + **TOT VOL STATUS**	"Reviewing the Configuration Option Settings" on page 5-1
Software Version	**SILENCE** + **ON-OFF/CHARGE**	"Determing the Software Version" on page 7-3
Calibration Test Mode 1	**CLR/TOT VOL** + **1** + **ON-OFF/CHARGE**	"Automatic Test Mode 1: Calibration Mode 1" on page 9-14
Calibration Test Mode 2	**CLR/TOT VOL** + **2** + **ON-OFF/CHARGE**	"Automatic Test Mode 2: Calibration Mode 2" on page 9-15

Table D-1 Multiple Key Combinations — continued

Sequence	Key Combination	Section
Mfg Test Mode 3	**CLR/TOT VOL** + **3** + **ON-OFF/CHARGE**	"Automatic Test Mode 3: Manufacturing Test Mode" on page 7-9
Aging Test Mode 4	**CLR/TOT VOL** + **4** + **ON-OFF/CHARGE**	"Automatic Test Mode 4: Aging Mode" on page 7-9
Display Check Test Mode 5	**CLR/TOT VOL** + **5** + **ON-OFF/CHARGE**	"Automatic Test Mode 5: Display Check Mode" on page 7-10
Time Information Test Mode 6	**CLR/TOT VOL** + **6** + **ON-OFF/CHARGE**	"Automatic Test Mode 6: Time Information Display Mode" on page 7-10
Pumping Sensor Monitoring Mode 7	**CLR/TOT VOL** + **7** + **ON-OFF/CHARGE**	"Automatic Test Mode 7: Pumping Sensor Monitoring Mode" on page 7-10
Air Sensor Test Mode 8	**CLR/TOT VOL** + **8** + **ON-OFF/CHARGE**	"Automatic Test Mode 8: Air Sensor Test Mode" on page 7-11
Elapsed Time Test Mode 9	**CLR/TOT VOL** + **9** + **ON-OFF/CHARGE**	"Automatic Test Mode 9: Elapsed Time Test Mode" on page 7-11
Downstream Occlusion Test Mode 0	**CLR/TOT VOL** + **0** + **ON-OFF/CHARGE**	"Automatic Test Mode 0: Downstream Occlusion Test Mode" on page 7-11

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