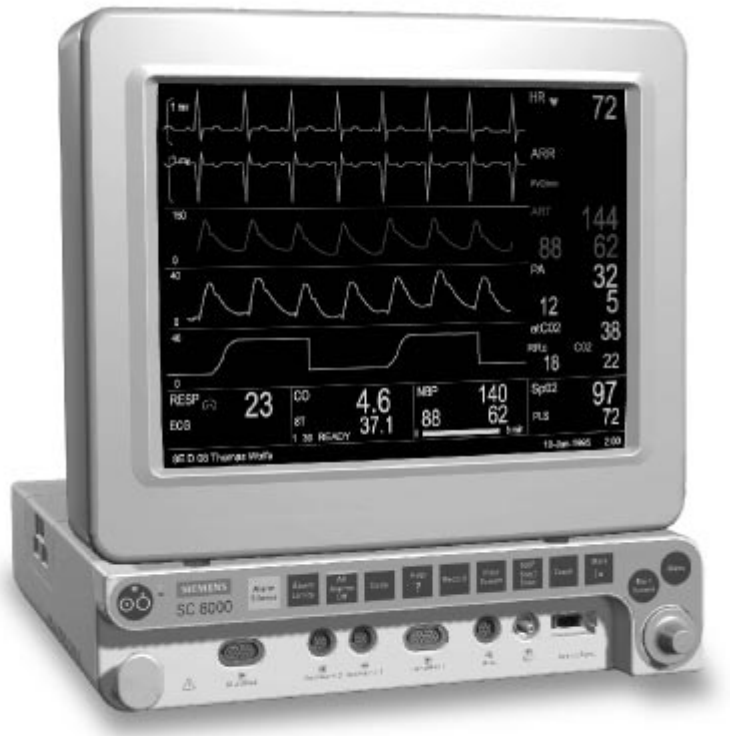
SIEMENS

SC 8000 Patient Monitor
Service Manual



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ADVISORY

Siemens is liable for the safety of its equipment only if maintenance, repair, and modifications are performed by authorized personnel, and if components affecting the equipment's safety are replaced with Siemens spare parts.

Any modification or repair not done by Siemens personnel must be documented. Such documentation must:

- be signed and dated
- contain the name of the company performing the work
- describe the changes made
- describe any equipment performance changes.

It is the responsibility of the user to contact Siemens to determine warranty status and/or liabilities if other than an authorized Siemens technician repairs or makes modifications to medical devices.

Table of Contents

Chapter 1: General Information

1 Overview

Although similar to an SC 7000 or SC 9000XL monitor in user interface and monitoring capabilities, the SC 8000 has been designed to support applications that require a larger screen display in place of “pick-and-go” functionality. It also differs in several other significant ways —

- It has no integral display but instead provides an output connector for a separate VGA Display.
- It is AC powered and has a built-in power supply.
- An internal battery maintains monitoring functions for up to 20 minutes in the event of temporary AC power loss. The battery does not, however, provide power to the VGA display.
- It is fan cooled instead of convection cooled.
- It has no etCO_2 module capability, but instead uses an etCO_2 pod.
- When equipped with Advanced Communication Option, it provides MGM and MIB support as well as up to 5 user-defined setups.

2 Introduction

This Manual is intended to serve as a source of technical information for qualified personnel to use in servicing SC 8000 Monitors and associated peripheral devices. In light of the state-of-the-art technology used in the manufacture of Siemens' equipment, proprietary nature of the software, and specialized equipment required for replacement of most individual parts, Siemens policy is for SC 8000 monitors, and peripheral modules specifically related to the SC 8000, to be serviced to only the field-replaceable subassembly level. Replacement of components other than those listed in “Appendix A: Replacement Parts”, should be performed only at Siemens service depots.

3 Related Documentation

- User Guide for the installed software version
- Hardware and Software Installation instructions
- Service Setup Instructions

4 Cleaning

Contact with chlorine bleach, Cidex, or body fluids does not damage or cause discoloration of an SC 8000. Clean Base Unit, pods, and cables using a 95% solution of isopropyl alcohol.

Note: Bac solution mars the finish of the monitor case.

5 Technical Data

A complete set of technical data is given in the Operating Instructions (User Guide) for the installed software version.

6 Brief Operating Instructions

This section provides a brief overview of SC 8000 monitor controls to assist technical personnel in servicing and testing procedures. For detailed operating instructions and additional information, consult the monitor’s User Guide and supplements for the installed software version.

6.1 SC 8000 Monitor Controls

Control of all SC 8000 functions is via fixed keys that have tactile feedback, and a rotary knob for selecting from on-screen menus that appear on the separate VGA Display. Turning the rotary knob locates different menu items, and pressing the knob in selects the item. Depending on the item selected, pressing the knob in may either bring up another menu or initiate an action. “Ghosted” items cannot be selected.

7 Peripheral Device Controls

Individual cartridges, pods, and peripheral devices (such as the R50 recorder) also have fixed keys that control specific aspects of their operation. Refer to the monitor's User Guide for specific key functions.

8 Passwords

SC 8000 monitors have two kinds of basic password protection -- clinical password, and service password. Clinical and service passwords are entered via selections on a keypad that appears whenever a password-protected function is selected. To enter a password, turn the rotary knob to highlight a number and then press in on the knob to enter the number. When all numbers of the password have been entered, turn the knob to highlight "Accept," and press in on the knob.

8.1 Clinical Password

The clinical password is available to authorized supervisory personnel at the clinical site as well as to service personnel.

8.2 Service Password

The service password is available to only authorized service personnel.

9 Menus

9.1 Main Menu

The Main Menu uses a three column layout for menu navigation: Level 1 = main selection list, Level 2 = workspace A, and Level 3 = workspace B. Selecting any function category on Level 1 of the Main Menu brings up a list of selectable related functions and menus in Level 2. Selecting a function in Level 2 produces a similar result in Level 3.

Press MENU fixed-key to display *MAIN* screen with overlay of Main Menu.

9.2 Service Menu

The Service Menu is accessed via the Monitor Options selection under the Monitor Setup function on the Main Menu. To access the Service menu and related functions, do the following:

1) Select Monitor Setup on Level 1, then select Biomed on Level 2, and then select Service on Level 3.
2) Input the service password (**4712**).

   Note: In general, the Service Menu provides access to the following (may vary with software version):

   - Language selection
   - Regulation
   - Alarm Sounds
   - Network control
   - Network Configuration
   - Line frequency setting
   - Restore factory defaults
   - Copy setups to card
   - Copy setups to monitor
   - Install Software
   - Locked Options
   - Waveform Simulator

9.3 Install Monitoring Software

Software and languages for SC 8000 Monitors are installed from a memory card via the monitor's memory card reader. If the software loading process fails to complete properly, and/or the monitor sounds a steady tone (other than the Piezo), repeat the procedure. If the process fails a second time, either the card or the Monitor is defective. Troubleshoot and repair or replace as necessary.

1) With Monitor switched off, insert and firmly seat PCMCIA card into memory card slot. Do NOT remove PCMCIA card until instructed to do so.

   Note: The card can be seated in only one orientation because of keyed channels on the end of the card. If the card can not be easily seated, remove card, turn card over, reinsert, and firmly seat. Do NOT attempt to forceably seat the card.

2) Power Monitor ON to initiate download process.

   Note: During the download process, the pick and go icon (running man) and the SIEMENS logo appear on the screen. The icon initially displays as green and changes to white. The logo toggles between green and white,and finally displays as green on a white background. The newly installed software version appears under the logo.

3) After a single alert tone sounds and a message regarding patient data loss appears, select “Continue” and then select YES for new patient.

4) Access Bedside Setup, and verify that settings of Language, Regulation, Alarm Sounds, Transport Brightness, and Line Frequency are approrpriate for customer site. Also, assure that Waveform Simulator is set to OFF.

5) Remove PCMCIA card.

6) For an initial installation of monitor into an INFINITY NETWORK, refer to procedure in Software Installation Instructions or Service Setup Instructions to set Network Mode and configure monitor. Then go to step 9. Otherwise, continue.

7) Affix new software version label (supplied) over existing software version label near right-hand bottom of memory card slot on rear panel.

8) Verify that monitor returns to MAIN screen, after timeout.

9) Recycle PCMCIA card when it is of no further use.

9.4 Configuration Download Procedure

The configuration download procedure should not to be confused with the monitor configuration procedure required for DirectNet functioning (see “Appendix E: Service Setup Instructions”). In general, the procedure is to completely set up one monitor and then transfer the setup to a Data Card. The configuration stored in the Data Card can then be used to setup other monitors.

1) With no Data Card inserted, adjust settings for monitor exactly as required by customer.

2) Review configuration with appropriate customer personnel before proceeding.

3) Press Menu key, and select Save/Restore → Save Setup.

4) Enter clinical password, **375**, and select Accept.

5) Wait for message “New Setup Saved.”

6) Repeat steps 1 through 5 for optional setups as required, and select Rename Setup in Biomed menu to name each setup in accordance with site requirements.

7) With *MAIN* screen displayed on monitor, insert and firmly seat Data Card into memory slot.

Note: The card can be fully inserted in only one orientation, because of keyed channels on the end of the card, and can be damaged if forced into the slot. Insert the card firmly, but **do NOT attempt to force the card.** Be sure that Write Protect on the card is OFF.

8) Press Menu key, and select Monitor Setup → Biomed → Service.

9) Enter Service password, **4712**, and select Accept.

10) Select More → "Copy Setups to Card."

11) Select "Copy All."

12) Wait for message "Memory Card Tansfer Complete." Then press Main Screen key and remove Data Card from monitor.

13) Insert card into next monitor to be identically configured.

14) Press Menu key, and select Monitor Setup → Biomed → Service

15) Enter Service password, 4712, and select Accept.

16) Select More → "Copy Setups to Monitor."

17) Wait for message "Memory Card Tansfer Complete." Then press Main Screen key and remove Data Card from monitor.

18) Press Menu key, and select Save/Restore → Restore Setup.

19) Select "Default" → "Patient and Monitor Settings."

20) Repeat steps 13 through 19 until all monitors to be identically configured have been set up.

9.5 Diagnostic Log Upload Procedure

The monitor is constantly checking its performance during monitoring. If errors occur, they are logged in the unit and stored in non-volatile memory. The logs are useful in diagnosing problems remotely at the factory. The following procedure can upload the diagnostic logs from approximately 10 to 16 monitors to a Data Card, depending on the size of the individual logs. Assure that Write/Protect switch on Data Card is set to Write position.

1) With *MAIN* screen displayed on monitor, insert and firmly seat Data Card into memory slot.

2) Press Menu key, and select Monitor Setup → Biomed → Logs

3) Select "Copy All Logs."

4) Remove Data Card from monitor, and repeat steps 1, 2 and 3 for next monitor from which logs are to be uploaded.

5) After all required diagnostic logs have been uploaded to the Data Card, send the Card (in its preaddressed return case when possible) to:

Siemens Medical Systems, Inc.
EM-PCS
16 Electronics Avenue
Danvers, MA 01923 U.S.A.
Att: SC 8000 Project Manager

Note: The battery in the Data Card must be recharged for a period of 12 hours approximately every six months. Any SC 8000 or SC 7000/ 9000XL Monitor powered by a CPS, IDS, or PSL can be used to recharge the Data Card. Insert the card into the Monitor, and allow it to remain in the monitor for 12 hours.

Chapter 2: Theory of Operation

1 Introduction

The SC 8000 is a high-end single-board patient monitor. The board provides the following parameters; 6 lead ECG, Respiration, two Temperatures, SpO_2, NBP, four IBPs, Cardiac Output, and two onboard 5 watt patient isolated ports for additional parameters. It has connectors for external CRT, user interface, audio, NBP pneumatic assembly, chart recorder, analog out, defib sync, memory card, and Uarts. The board also contains the patient isolated front ends.

2 Computer Archictecture

Hardware architecture of the monitors is based on a dual processor design using two Motorola MPC860s with onboard cache. The main processor is responsible for graphics and communications, while the second processor is dedicated to data acquisition and algorithm processing. A DSP subsystem preprocesses the front end data.

There are three major bus structures within the system; MAIN processor bus, FRONT END bus, and REMOTE COMM bus (see Figure 2-1). The buses operate at different speeds and efficiency. The FRONT END bus and REMOTE COMM bus have multiple bus masters and common memory to allow exchange between I/O devices.

The REMOTE COMM bus interfaces to the Advanced Comm Option. This option includes the main circuit board from the IDS.

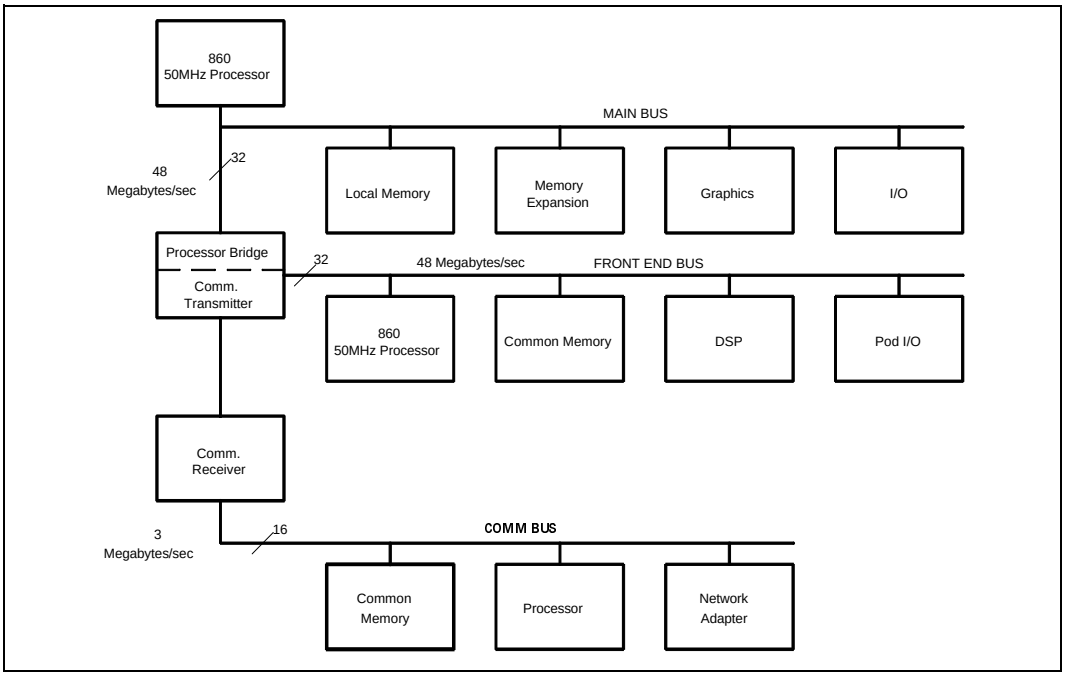


Figure 2-1 SC 8000 Bus Structure

2.1 Main Processor Bus

The Main processor bus is a 32 bit data bus connecting the MPC860 to its main bank of 16 meg DRAM memory. The Program for the monitor is stored in 8 meg Flash memory and uploaded to DRAM during initialization. The DRAM is optimized for multiple word transfers allowing efficient cache fills. This bus has an optional daughter card connector allowing expansion of the main memory space. The graphics controller is connected to this bus to allow high bandwidth access to video memory. The bus has a max bandwidth of 40 megbytes/sec.

This bus also has an I/O space implemented in an FPGA. These functions include audio, chart recorder interface, keypad and rotary knob interface, and EEPROM. The EEPROM contains serial #'s, calibration constants and configurations. The I/O space also includes the Bridge to the FRONT END bus and a port to the REMOTE COMM bus. The Bridge to the FRONT END bus is unidirectional. This means that the Main processor may read and write to the FRONT END bus, but the Front end processor can not access the MAIN bus.

2.2 Front End Bus

The Front End bus is a 32 bit data bus connecting the second MPC860 to its main bank of 4 meg DRAM memory. The program for this processor is downloaded from the main processor during initialization. The DRAM is optimized for multiple word transfers allowing efficient cache fills. Both processors contain 512K of battery-backed SRAM for trend and other patient data storage. Data is exchanged through the common memory. This bus has multiple bus masters that include the following:

- Front End 860
- Main 860
- DSP DMA
- POD Comm DMA (a POD is a configured front end)
- DRAM Refresh

2.3 COMM Bus

The COMM bus interfaces to a network controller and other local serial buses including MIB, IGraphics, Gas Monitoring, and other peripherals. The host is stalled until completion of all read operations, but is released after a write is latched to be serialized.

2.4 Error Handling

The hardware provides several circuits for error detection, error recovery, and safety. The main processor bus, front end processor bus, and COMM bus both have timeouts implemented with the arbiter to prevent a lock up of the system. The main 860 and the Front End 860 are both protected with watchdog timers. If a timer expires, the system initiates a reset and restarts the monitor.

The power supply is also monitored with a piezo alarm that sounds during power up (for test) and power down. This is to alert the user that the monitor has turned off. The piezo is also sounded continuously if the monitor does not reset properly after a watchdog timer has expired and the computer has halted.

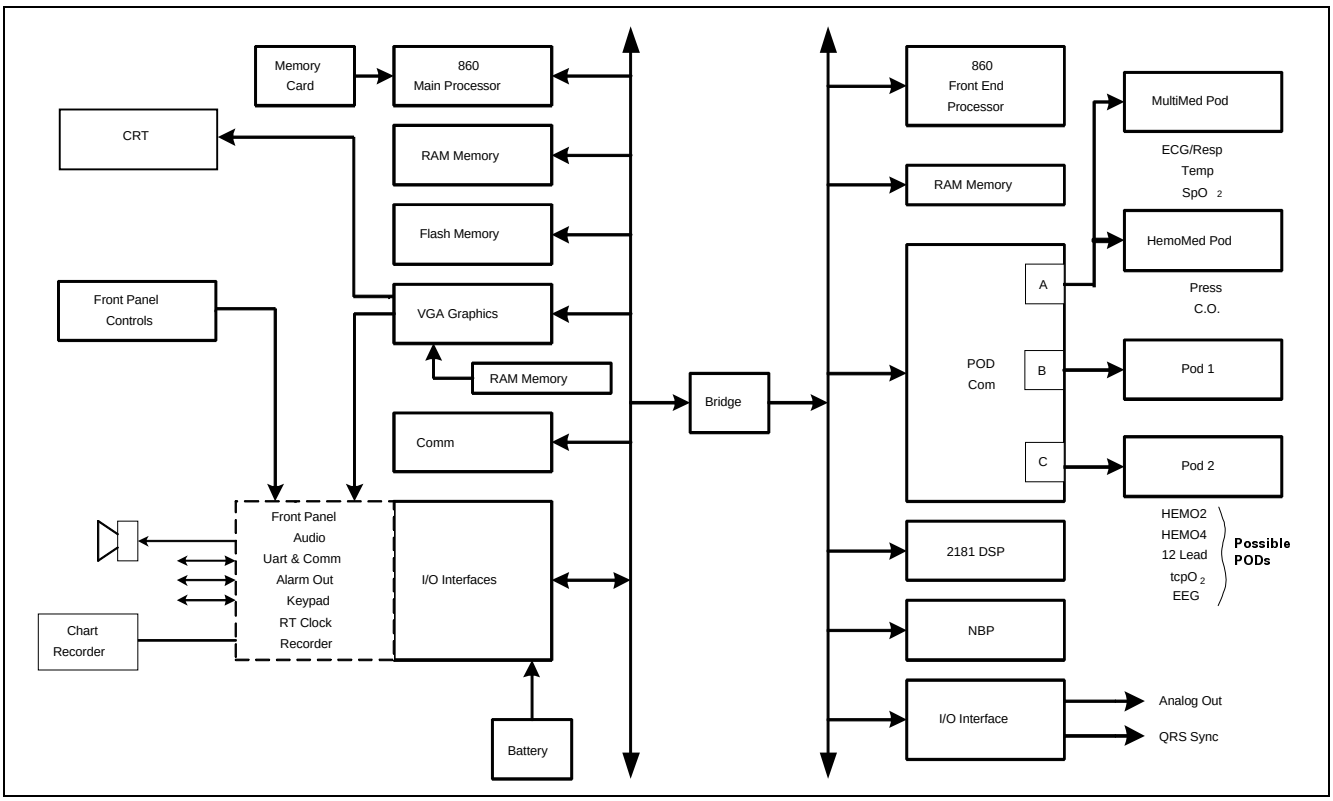


Figure 2-2 SC 8000 Block Diagram

3 Main Unit

The main unit has been designed as a single board computer used in the SC7000. In addition to the main board there is a connector board that adds the functionality of the SC8000 which is different from the SC7000. These functions include Analog Out buffering, Sync buffering, power for the ISD, fan control, and circuitry to convert the cartridge connector of the SC7000 to a pod connector. The other functions of this board are identical to the SC7000 connector board which include EEProm and a cable harness. The main board has three main sections (see Figure 2-2) -- processor, power conversion, and front end. Each section is shielded from the others.

Processor Section

The processor section contains all computer functions of the monitor. It contains two MPC 860 processors, a VGA graphics controller, and a 2181 DSP. All of these devices communicate using one large FPGA (field programmable gate array) that is downloaded at initialization. The FPGA contains all custom circuitry used in the computer, including the processor bridge, comm transmitter, pod com DMA, DSP interface, NBP interface, and I/O interfaces for both processors. Configuration of the FPGA may be updated with the Software through the memory card adapter.

Power Conversion Section

The power conversion section operates on a DC input from +11 to +15 volts. It switches between the power supply and the internal battery for the proper power source, and generates all necessary dc voltages for the unit. It charges and maintains the internal battery. This section also contains the patient isolation for the two internal front ends as well as two general pod comm ports. It also has the power control for the NBP pneumatics.

Front End Section

The front end contains MultiMed and HemoMed circuitry. The MutiMed front end provides the following parameters; 6-lead ECG, Respiration, Pulse Oximetry, and Temperature. The NBP pressure transducer is also

contained in this front end. The front end is based on a single 16 bit oversampling converter. Oversampling allows for a reduction in anti-aliasing analog circuitry while maintaining superior noise rejection. The HemoMed front end provides four invasive pressures and Thermal Dilution Cardiac Output.

3.1 Cooling System

The cooling system for the main monitor uses a fan mounted on the rear of the chassis. If the internal temperature of the circuit board exceeds 80° C the monitor shuts down to prevent damage to the electronics. The monitor does not restart until the temperature is below the shut off value.

3.2 Real Time Clock

The Real Time Clock function is implemented with the EPSON-SEIKO RTC4513 device, and is synchronized by the Central Station.

3.3 Non-volatile Memory Battery Backup and Power Reset

The shared RAM and real time clock are provided with a lithium battery backup circuit to prevent corruption of this non-volatile memory during a power loss condition (both primary and battery power are lost). Note that the battery used for non-volatile memory backup should not be confused with the internal and external batteries used to provide power to the monitor base unit when primary power is lost. Non-volatile memory lithium battery backup is controlled by a power supervisory device that provides a power reset during a power loss condition.

Note: No provisions have been made to recharge non-volatile memory backup battery. Eventually (≈10 years), battery must be replaced.

3.4 MPC 860 Communication Channels

MPC 860 has an embedded communications processor capable of executing several protocols such as UART or Ethernet. The 860 communications channels are used as follows:

Main Processor	SCC1	Ethernet	10 Mbits/sec (future option)
	SCC2	SC 9015 UART	selectable baud
	SCC3	MVP-1 UART	selectable baud
	SCC4	MVP-2 UART	selectable baud
	SMC1	main diag UART	19.2 Kbaud
	SPI	a/d (power monitor)	
Front End Processor	SCC3	serial pod data	
	SCC4	serial pod data	
	SMC1	front end diag UART	

An additional UART implemented in the FPGA contains a large FIFO and interfaces to the chart recorder.

3.5 Interfaces

3.5.1 Local Fixed Keys Interface

The monitor base unit has twelve fixed function keys and a fixed key dedicated as a power on/off switch. The power on/off switch is unique in that it is not directly available via a status read command, but rather is input to the power supply subsystem interface, where the switch state is detected and processed. Detection of a power off condition causes an interrupt to the host processor.

3.5.2 Rotary Knob Interface

The rotary knob is a 16 detent rotary knob. Each detent position indicates a "click" clockwise or counter-clockwise. The change in detent position is detected via a 2 bit quadrature code that changes value every time the rotary knob is moved into a detent position. Also included in the rotary knob is a push button switch that is operated by a press/release action. This switch is used to select menu items on the screen.

3.5.3 Fast Analog Output

The ANALOG OUT interface consists of two identical channels. Each ANALOG OUT channel provides a 12 bit D/A function. The design uses a dual DAC to produce the D/A conversion. The sampled analog data is then passed through a 2 pole low pass filter. The analog output has a maximum delay of 20ms, and can be used for a defibrillator or balloon pump.

Separate Pacer Spike generation circuits for analog outputs 1 and 2 are provided.

3.5.4 HiFi Audible Alarm Interface

The Audible alarm interface consists of an FM synthesis and Audio DAC chip set. There is also power amplifier drive circuitry for the two speaker interfaces: the internal speaker located in the base unit and the speaker located in the remote CRT. Circuitry has been included to provide a mechanism for automatically generating an error tone when a watchdog failure occurs via the piezo alarm Section 7.1.8).

The chip is loaded with tone frequency, pitch, harmonics, and volume information by the host processor, which controls the duration of the tone. The audio DAC converts the received sampled tone data and produces a sampled analog representation of the tone data.

The local speaker interface (also designated as main speaker interface) is designed for an 8 ohm speaker load. This local speaker interface produces 1 watt of power into an 8 ohm load, and has thermal shutdown capability.

The remote speaker interface is designed to produce a 1Vrms maximum signal into a 1 kohm load, and provides an ac coupled output.

3.5.5 LED/Status Interface

Five LEDs provide information in the present SC 8000 configuration. Two are dedicated to the front end processor, to the DSP, and two to the main processor.

3.5.6 QRS Sync Out Interface

A QRS sync output is provided. The QRS SYNC OUTPUT is an open collector type output driver that is pulled up to +12 volts (active HIGH). The output is initialized to Gnd on reset or power on.

This QRS signal is available via an external connector mounted on the main PC board. High level = +6V min (10KΩ load), +12.6V (no load); Low level (no QRS) = 1V @ 5ma.

3.5.7 Local Alarm Out Interface

A Local Alarm output is provided. This Local Alarm Output is an open collector type output driver that is pulled up to +12 volts. The output is initialized to ground (0 volts) on reset or power on (active HIGH).

Loopback status is available via a status read command.

The Local Alarm Out signal is available via an external connector mounted on the main PC board.

3.6 Recorder Interface

The recorder interface provides all of the necessary control, data and power supply signals required to drive an external recorder. The interface consists of current limited DC power and a UART with handshake signals. The UART is implemented in the main processor FPGA to allow for an extended FIFO.

3.7 Serial EEPROMS

Four serial EEPROM devices, which contain the Monitor serial number, Ethernet address, NBP pneumatic characterization and calibration constants, and monitor setups, are located on the connector I/O board. If the main processor board is replaced the monitor will keep its set ups from these serial EEPROMs.

Two EEPROMs can be written only at the factory, and contain the Monitor serial number and Ethernet ID address. The other devices are writable by the main processor and are changed during service menu setups. These devices are used for the monitor as well as network setups, device compatibility, and software feature locks.

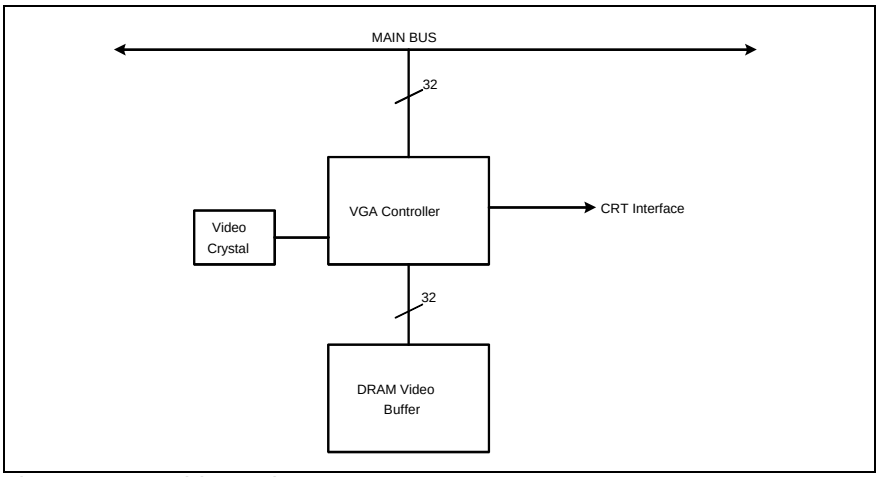


Figure 2-3Graphics Subsystem

4 Graphics Subsystem

4.1 Overview

The Graphics Subsystem is based on a commercial VGA controller (see Figure 2-3), and drives a CRT display from a local memory used to refresh the screen. It uses a special video crystal which enables it to synchronize to most video standards. The graphics chip is capable of running resolutions such as 800 x 600, when these displays are added to the monitor. The standard resolution is set to 640 X 480.

4.2 Functional Description

The VGA subsystem is designed to optimize the Bitblit operation, which allows for quick updates of the screen. This is accomplished by writing images to non-viewable areas of video memory before they are needed and copying them to the screen on demand. The copy function is performed by the VGA controller.

4.3 Video Output

The Graphics Subsystem provides output to a standard VGA monitor. The CRT interface uses three 8 bit DACs for its three color outputs. The front bezel interface is digital and contains 6 bits for each color.

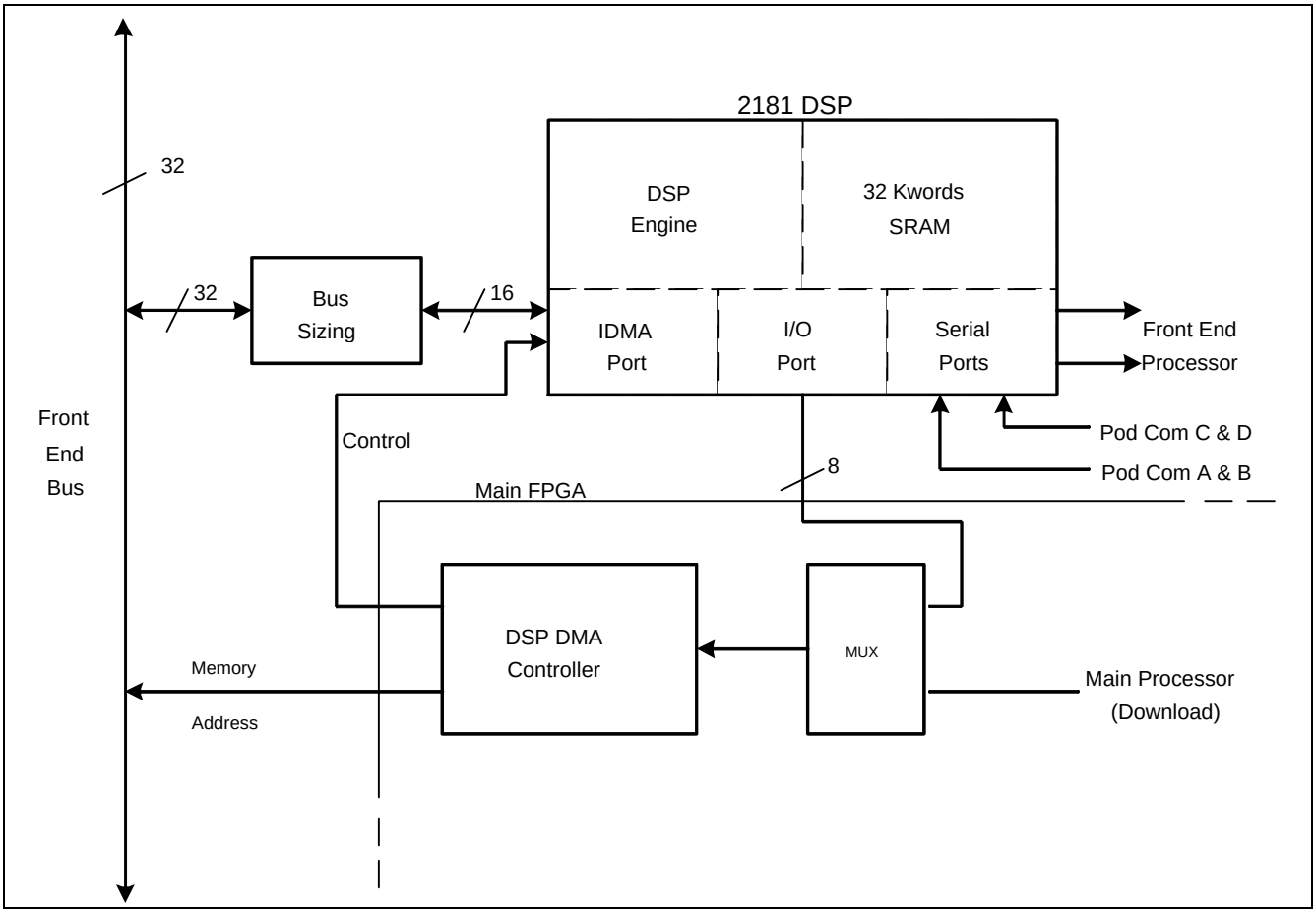


Figure 2-4 DSP Subsystem

5 DSP Subsystem

The monitor uses a DSP for preprocessing of oversampled data (see Figure 2-4). The DSP is a specialized microprocessor that executes high speed repetitive functions such as digital filters. The DSP acquires data from the incoming serial pod comm data streams. The data sent to the DSP is selected by the control words in the pod com memory buffer. Typically only high acquisition rate data is sent to the DSP.

The DSP has two other communication ports both of which can access the internal 32Kword memory. The IDMA port is used to DMA data to and from the common memory. Bus sizing logic converts the DSP 16 bit port to the 32 bit FRONT END bus. During initialization this path is used to download code to the DSP. The main processor takes control of the DMA port during this time. Once the system is operational the DSP takes control of the DMA controller by using its I/O port. The I/O port is a dedicated 8 bit path into the main FPGA, which allows the DSP access to the DSP DMA controller as well as other internal FPGA registers, including analog out and QRS sync.

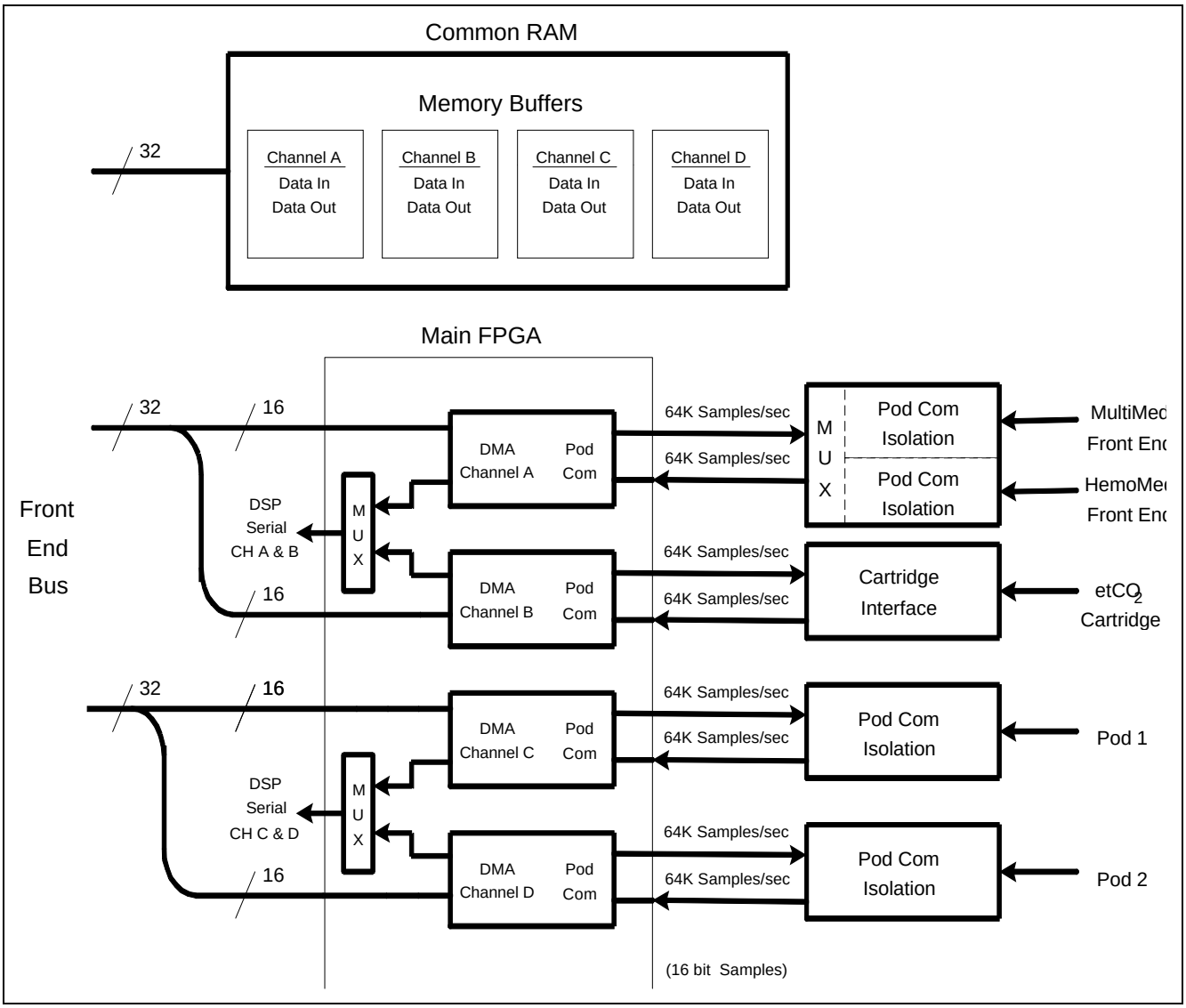


Figure 2-5 POD Communications

6 POD COM Subsystem

A pod is a front end device that acquires data for a particular set of parameters. A pod may contain a processor and return preprocessed data or it may provide raw A/D samples.

Refer to Figure 2-5.

6.1 Overview

Data acquisition of the monitor is controlled by several DMA controllers that operate on circular buffers residing in common memory on the FRONT END bus. There are four channels, each allocated a 16 bit transmit buffer and a 16 bit receive buffer. It takes four 32 bit transfers to update one location in every buffer, since each access consists of high and low data from different channels. The transmit buffer tells the pod either what sample to take or to change a control setting. The receive buffer contains a/d samples and status information from the pod. A control register in the FPGA sets a mux to the DSP's communication port and connects the selected pod com channel.

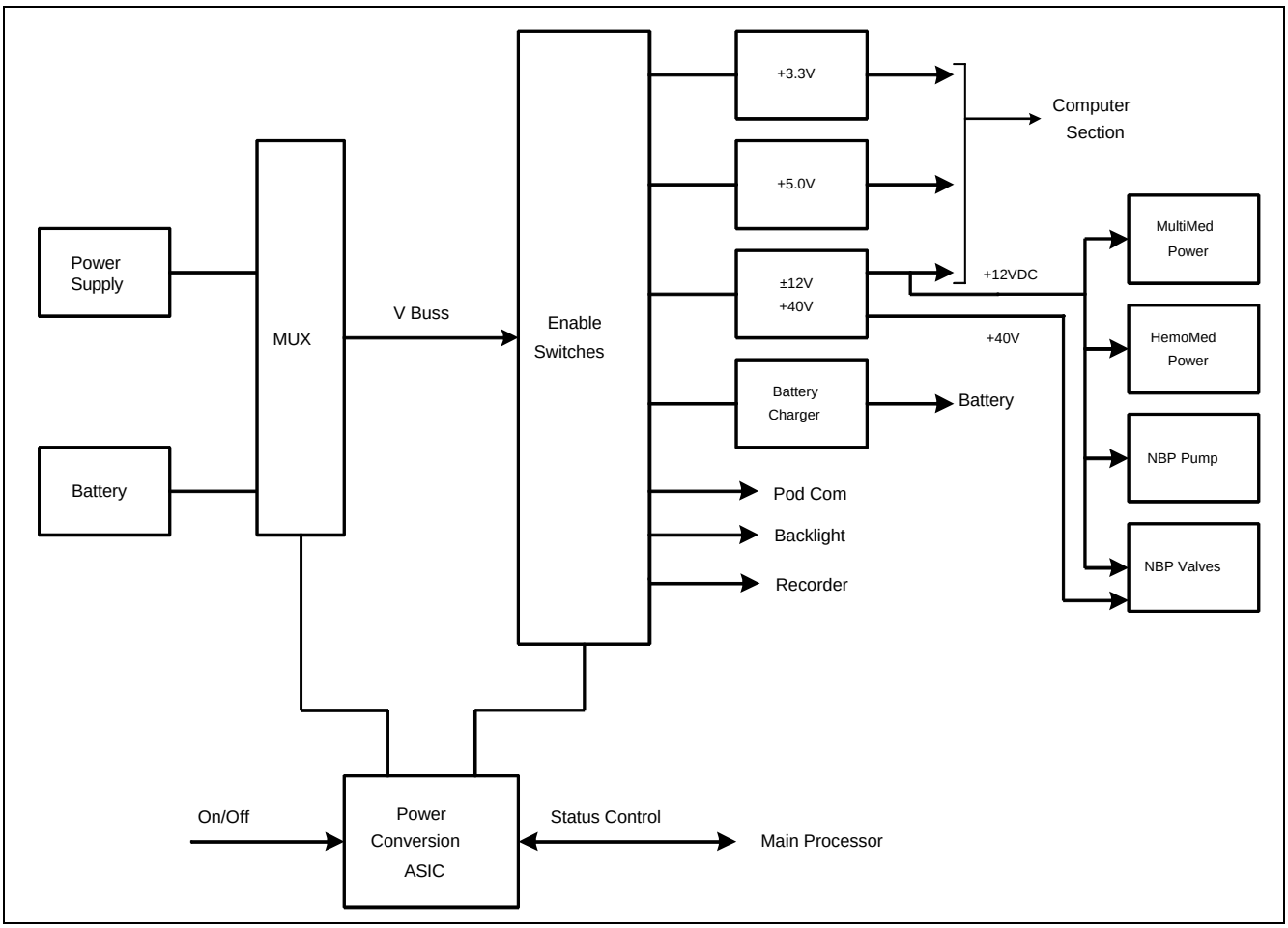


Figure 2-6 Power Conversion

6.2 Outputs

The pod com subsystem has four channels. Channel 1 is dedicated to the two internal front ends; the MultiMed and HemoMed. Channel 2 is dedicated to the slot on front for $etCO_2$. This connector does not require patient isolation and has higher power than the pod com connectors. Channels 3 and 4 are both used to communicate with external pods. They have full patient isolation for both power and data.

6.3 Error Handling

The pod com channels provide error detection by performing CRC checks on data in both directions. CRC errors are reported to the front end processor through interrupts.

7 Power Conversion

Refer to Figure 2-6.

7.1 Power Control

7.1.1 Power Buss

Most monitor loads are powered from a DC power buss, called VBUSS, within the monitor. VBUSS powers the +3.3VDC, +5.0VDC, ±12VDC, +40VDC and charger power converters. VBUSS also powers the external pods, cartridge, strip recorder and backlight. The NBP pump and valves as well as the internal multimed and hemomed front ends are powered from the regulated +12V supply.

7.1.2 Control and Load Sequencing

The switching of the VBUSS power inputs and the power converters is managed by the power supply gate array. This gate array controls the power on and power off of the monitor, and the battery charging process. It

also provides a safety timer for the NBP pneumatics, which are controlled by the main processor FPGA.

Logic circuits on the main gate array sequence the power to the Pods, Cartridges, and Recorder to reduce power on load transients.

7.1.3 Power On / Off

The monitor is normally switched on by the user pushing the On/Off button for at least 1 second. (The monitor may switch on when the switch is pushed for as short a time as 50 msec.)

The power down sequence may be initiated either by the user pushing the on/off switch for at least 1 second or when the batteries are depleted. When the power down sequence is initiated, the power conversion board control logic generates an interrupt for the processor. 100 ms later, the power supply shuts down. An immediate shutdown is initiated if a power fault occurs (such as overvoltage).

7.1.4 Power Source Control

Power for the monitor is provided by the internal power supply or internal battery.

This input is monitored by a voltage comparator to determine that adequate voltage is present for internal power supply operation. The main battery also has a voltage comparator indicating that its voltage is high enough to provide power.

Based on the information provided by the comparators, a power source is connected to VBUSS in the priority of main power supply and then battery.

7.1.5 Battery charging

The battery charger is a two-level constant voltage charger with a fixed current limit and temperature compensated voltage levels. When the main power comes on, the battery is fast charged at the high voltage until the current drops below a specific threshold. Then the charger voltage drops to the lower “float” voltage.

7.1.6 Indicator LEDs

Two green LED indicators on the front bezel of the monitor indicate power and charger status, as given in Table 2-1.

Table 2-1 Power and Charger LED Indicators

LED	CONDITION	LED STATE
Power	Processor power on	on
	processor power off	off
Charger	Main power on	on
	Main power off	off
	*Battery or power fault	off
* The charger LED is off if the battery temperature is excessive or if there is a power fault.		

7.1.7 Power Mode Indication

The source of power is indicated to the processor via the power mode bits, as given in Table 2-2.

Table 2-2 Power Mode Table

MODE1	MODE0	INDICATION
1	X	operating on main power
0	1	operating on battery

7.1.8 Piezo Alarm

The piezo alarm activates at power up, power down, and if a software watchdog is activated. At turn on, the software shuts the piezo off after two seconds. The piezo functions are as indicated in Table 2-3.

Table 2-3 Piezo Alarm

Cause	Duration
Turn on	2 seconds
Turn off	>4 seconds, <10 seconds
Processor watchdog	Continous (until sucessful reboot)
+5V Undervoltage	>4 seconds, <10 seconds
+3.3V Undervoltage	>4 seconds, < 10 seconds

7.1.9 Fault Protection

Reverse polarity protection for the battery and the main power input are provided by shunt diodes and fuses on the connector board. There is also a fuse in series with the battery harness. +5V, +3.3V, and +12V supplies are provided with overvoltage protection.

The battery has a temperature sensor on the Connector I/O PC board that is used to disable charge or discharge of the battery if the temperature is excessive.

A temperature sensor in the power supply section of the main board shuts down the power system if the board temperature is excessive.

All power converters are fused to limit fault currents.

7.1.10 External Pod Overload Protection

External pod current limit circuits are implemented as follows:

When an overload occurs, the load is switched off after the 0.2 second overload timeout. A retry occurs after 5 seconds.

7.2 Electrical Specifications

The following specifications indicate the design limits of the power system and do not relate to a present design configuration of the SC 8000.

7.2.1 Power Supply

Power Supply Input

100 Vac @ 2.5A; 240 Vac @ 1.3A; 50/60 Hz

Power Supply Output

11.0 to 15 volts DC @ 6.0 Amps Max.

Buss Fault Detection <8.97 V±1%

Battery Source: 12V Lead Acid, 9.8 to 15 VDC @ 6.0 Amps Max.

7.2.2 Battery Specifications

Voltage 12V

Discharge Time 20 minutes

8 Front Bezel

8.1 Introduction

The Front Bezel provides an interface to the various operator related functions. The interface consists of circuitry and connectors that allow the main processor to access all of the operator related functions.

8.2 Functional Description

The front panel interface section of the Connector I/O PC board provides an interface between the main board and the front bezel components. It is a cable harness for these components and is unique in its construction. The board provides for unit rotary knob input and keypad interface.

8.3 Local Rotary Knob/ fixed Keys Interface

The SC 8000 base unit has twelve fixed keys. An additional key is dedicated as the power on/standby switch. The rotary knob interface provides a 2-bit encoder output and also a rotary knob push button signal output. All of the key/rotary knob signals are filtered. All of the keypad switches have pulldowns except the power on/standby switch. Thus, the power switch signal output from the front bezel is pulled up by the power switch interface located in the power supply section.

8.4 Battery/power LED Interface

The battery LED is turned on or off via the associated LED control signal from the main board. The power LED is connected to +5V. Both the battery and power led's are green when turned on. The power and battery LED's have been integrated into the membrane switch interface used for the fixed key and power on/standby switch. The LED on/off control signals are provided by the power supply.

9 MultiMed Front End

The MutiMed front end section of the main board combines 6-lead ECG, 2-lead respiration, temperature, and saturated oxygen data gathered by the MultiMed Pod from transducers at the patient and converts them to digital form for transmission through isolators to the computer section of the main board. This section also houses the NBP pressure transducer which uses the same acquisition system. See Figure 2-7 on page 17.

The hardware design uses a single oversampling 16 bit converter to measure all of the parameters. This allows bulky analog filters to be replaced by software filters. Careful shielding and filters protect against very high frequency interference from upsetting measurements.

9.1 Safety

- Patient isolation withstands 5kV during defib.
- Leakage currents are limited to safe values normally and during single fault conditions.
- Patient is protected against electrosurgical burns at the electrodes.
- Defibrillation protection does not drain excessive current away from the patient.

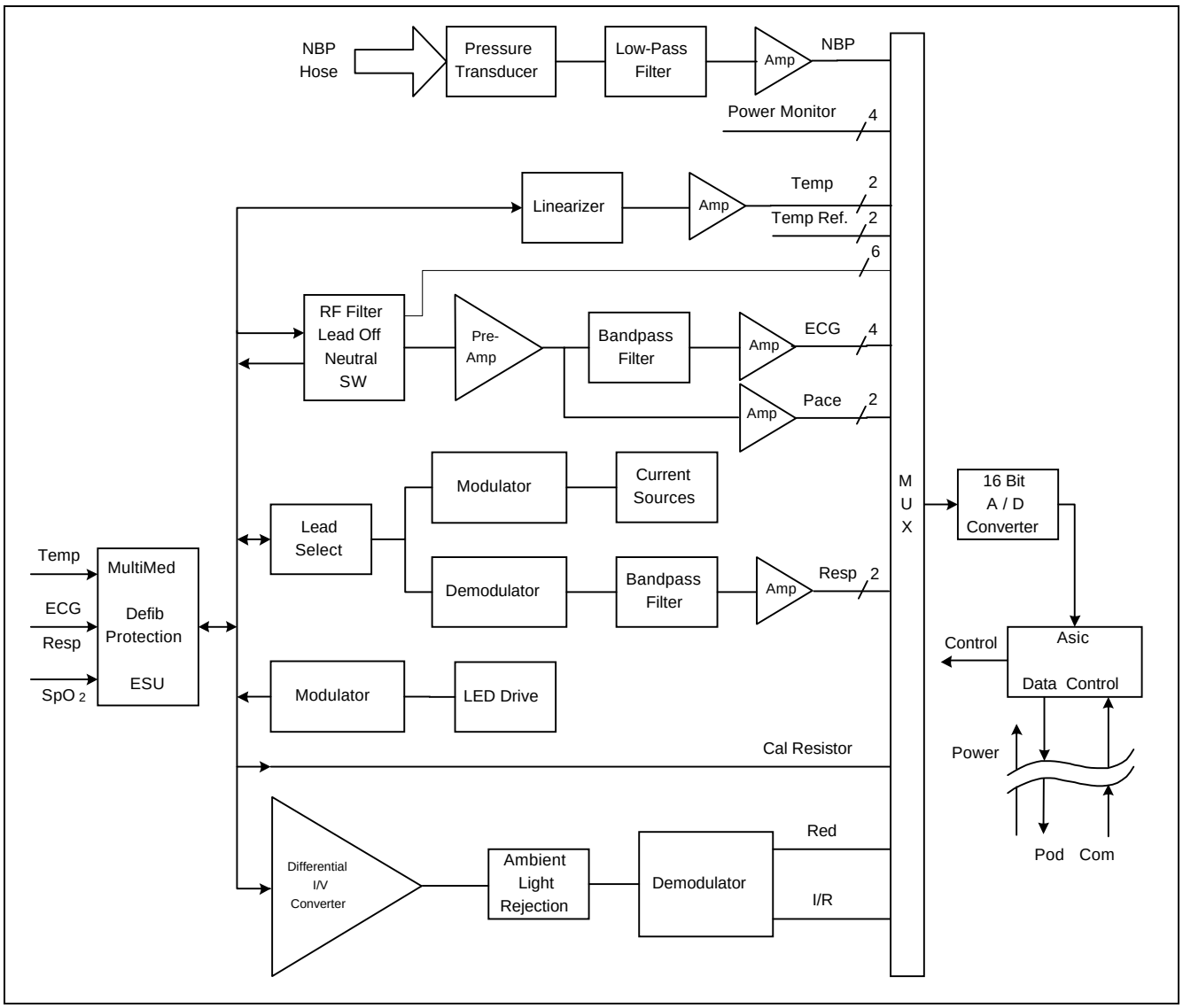


Figure 2-7 MultiMed Front End

- Specially shielded connectors and cables are used to provide excellent immunity up to 1000MHz and can not be touched by patient even when disconnected.
- Single cable from MultiMed Pod to SC8000 reduces clutter between bed and monitor.

9.2 Functional Description

Transducers gather physiological data at the patient and feed them into the small MultiMed Pod at the bed. The MultiMed Pod in turn is connected via a 3-meter cable to the MultiMed front end in the main unit where analog ECG, Respiration, Temperature, and SpO_2 signals are converted to digital form and sent through isolators for processing.

9.2.1 ECG/Resp

The MultiMed Pod located close to the patient accepts a set of 3, 5 or 6 shielded ECG electrode leads, an SpO_2 (Nellcor) cable adapter, and a temperature sensor. The ECG section contains RF filters, and overvoltage clamps that include 1k series resistors to limit shunting of defibrillator current. The SpO_2 and temperature sections also contain RF filters. Impedance respiration is sensed through the ECG electodes. Void-free

potting and internal shielding enable compact containment of high voltage defibrillator and electrosurgery pulses. The small interconnecting cable to the main assembly is captive at the MultiMed POD but plugs into the MultiMed front end via a specially shielded connector.

The front end accepts physiological signals from the MultiMed POD connector and feeds temperature, respiration, and ECG signals via RF filters, configuration multiplexers, and pre-amplifiers to a high-speed multiplexer driving a 16-bit analog-to-digital (A/D) converter. The data stream is sent to the Main Processor board via an opto-isolator. Control commands from the Processor are sent out to the front end on a similar isolating link. Isolated DC power is also provided.

The ECG signals are conductively coupled to the isolated circuits via current-limiting series resistors, whereas the SpO_2 signals are optically isolated at the transducer. Temperature signals are doubly insulated at the patient by disposable boots on the sensors. AC (40kHz) excitation currents for respiration monotoring are dc-isolated by high-voltage ceramic capacitors.

The A/D samples the following parameters:

Table 2-4 Parameter Sampling Table

Parameter	# of Channels
ECG	4
Pace	2
SpO_2 Red	1
SpO_2 IR	1
NBP	1
Resp	1
Temp	2

The pace signal samples are used directly by the DSP to detect pace pulses. All other signals are decimated and filtered using digital signal processing to the above specifications. Additional filtering is user selectable and invokes additional digital signal processing in the computer section of the board. The high oversampling rate is required to minimize the requirements (and size) of the analog anti alias filters. Superior rejection to ESU and other types of interference is achieved with this type of design.

ECG

- Pacer pulses may be detectable by software on two lead-pairs.
- Bandwidth is set flexibly by software filters.
- Reconfigurable neutral selector can drive any electrode.
- Lead-on detection functions with even poor electrodes.
- Calibration voltages can be superimposed on patient wave-forms or onto flat baselines.

See Figure 2-8. Composite electrocardiographic (ECG) signals generated by the heart and by a pacemaker are filtered to reduce RF interference from impedance respiration and electrosurgery and then injected with dc lead-off detection currents. Over-voltage clamps protect the semiconductors from the surges passing the sparkgaps in the MultiMed Pod and also reduce the dc current applied to the patient due to a component fault.

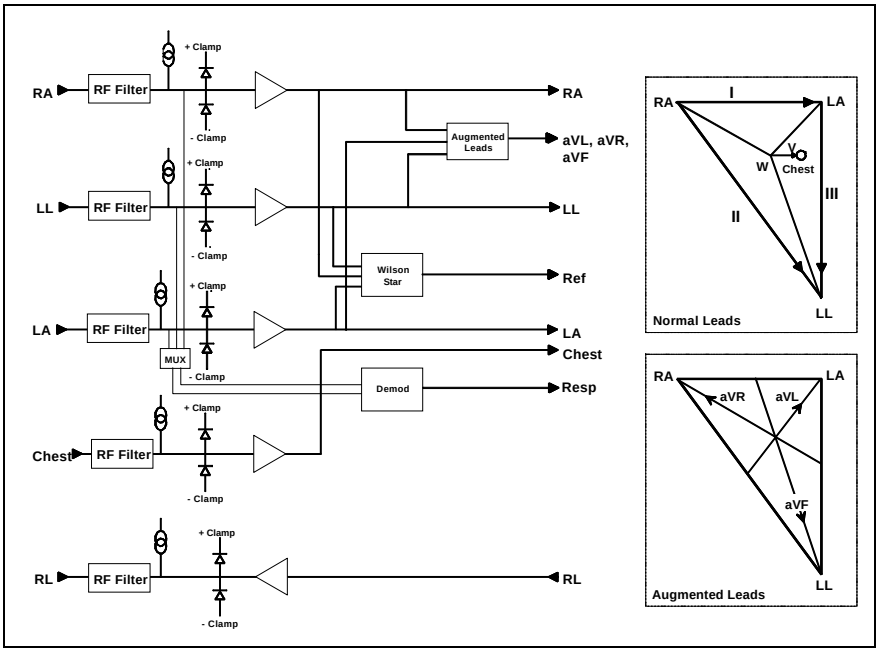


Figure 2-8 Lead Forming Network

The Wilson point, "W", the average of the LA, RA, and LL electrode potentials, serves as the negative reference potential for the V and V' lead-pairs and is also used as a measure of the common-mode potential of the patient Figure 2-8. By driving the isolated common of the front end at the same potential as the Wilson point, the common-mode voltage across the electrodes is reduced nearly to zero and the effective common-mode rejection is improved. As most of the common-mode current is now forced through the neutral electrode, it becomes noisier and hence is not used as part of another signal path. Switches are provided to select other electrodes to be neutral if the RL electrode is off or missing. If the V' electrode is present, then it can be selected to be neutral so that the three Einthoven and the V lead pairs can still be used. However, the V' lead-pair will be corrupted due to neutral current noise. Similarly the V electrode can be selected to be neutral. Now that the RL is disconnected from the neutral driver, its potential can be monitored to determine whether it has been reconnected to the patient and thus is able to be reselected to be neutral.

If only the three Einthoven (LA, RA, and LL) electrodes are connected, one is selected as neutral leaving the remaining two electrodes to form one valid lead-pair. The "W" now contains the neutral drive signal which bypasses the neutral electrode and reduces the gain of the neutral driver amplifier. To improve the resulting poor common-mode rejection, a Wilson Grounding "WG" switch is activated to selectively disable the offending input to the "W".

Respiration

Refer to Figure 2-9.

- Respiration is both ac- and dc-coupled in hardware. DC is used for high Z sensing; ac is used for signal acquisition.
- Respiration may be monitored on leads I and II.
- Detection sensitivity has low dependence on base resistance or electrode unbalance.

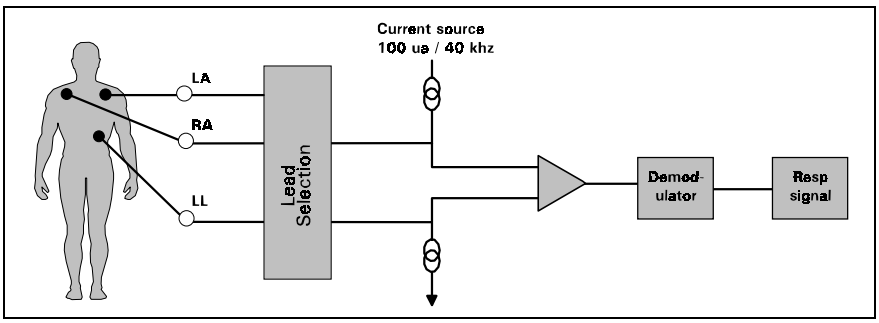


Figure 2-9 Respiration Functional Block Diagram

Impedance respiration is monitored by injecting a nominally 40kHz square wave of current into one ECG electrode and removing it at another ECG electrode. The resulting 40kHz voltage drop across those electrodes is proportional to the impedance. Specially balanced true current sources do not load the ECG electrodes or distort the ECG morphology. The waveform of the current is preemphasized to reduce bypassing effects of cable capacitance. The returning 40kHz differential voltage is amplified, synchronously demodulated, and low-pass filtered. The resulting dc-coupled waveform is converted to single-ended form, further low-pass filtered, and passed to the A/D multiplexer. An ac-coupled stage with an "autobloc" dc-restorer feeding a separate input to the A/D multiplexer also provides additional gain.

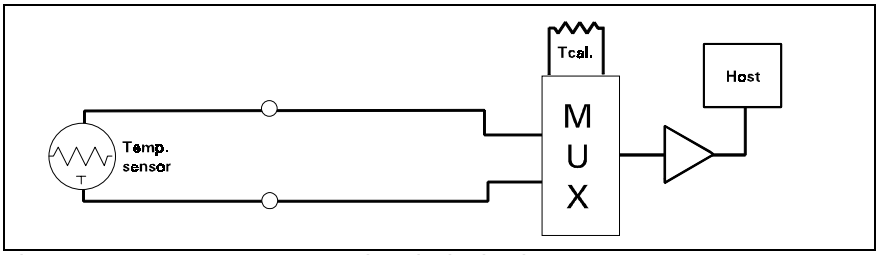


Figure 2-10Temperature Functional Block Diagram

9.2.2 Temperature

Refer to Figure 2-10.

- Designed to meet the stringent German PTB requirements including detection of marginal accuracy due to degradation of a single component.
- A second temperature channel is also available.

Temperature is sensed at the patient by a non-linear negative-temperature-coefficient thermistor. This is linearized with a precision resistor network and excited by the same reference as the A/D converter to a produce ratiometric digital output. An input multiplexer (MUX) selects among the external signal and internal reference dividers simulating -5 and +50°C. The dc amplifier matches the dynamic range of the A/D by combining, amplifying, and precisely offsetting the small signal from the multiplexer. Power supplies whose failure would invalidate temperature measurements are also monitored and compared against the A/D reference.

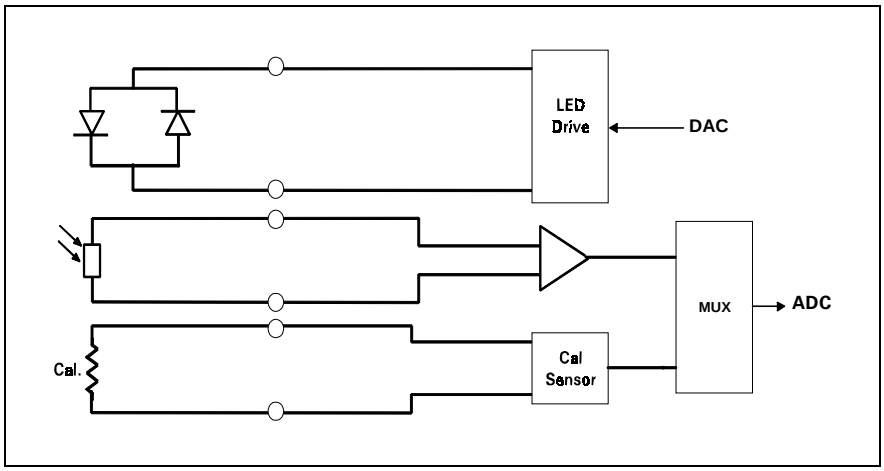


Figure 2-11SpO_2 Functional Block Diagram

9.2.3 SpO_2

Determination of the concentration of oxygen in the blood depends on the principle that the absorption of red (R) light depends on the degree of oxygenation of the blood, whereas the absorption of infrared (IR) radiation is independent of oxygenation and causes only constant attenuation. Refer to Figure 2-11. In the SpO_2 sensor, R and IR emitting leds are alternately pulsed on at a 25% duty cycle. The intensity of light (including ambient) transmitted through or scattered by the blood is converted to a current by a photodiode in the sensor. The current that appears when both leds are off depends mainly on the ambient light. This ambient contribution is later subtracted to leave only the R or IR signal levels. The large dynamic range of the light intensities requires constant automatic monitoring and adjustment.

The intensities of the R and IR sources are independently controlled by two digital-analog converters attenuating the 2.5V reference.

Attenuated radiation falling on the photodiode in the sensor is converted to a current which passes through an RF filter balun in the HVPOD and enters the current-to-voltage converters in the MultiMed front end. The resulting unipolar stream of pulses is then ac-coupled to a controllable-gain differential amplifier. The signal is then synchronously demodulated into Red and IRed signals with ambient light subtracted. Additional gain control, filtering, and signal offset are provided for each signal prior to A/D conversion.

The calibration of each sensor is coded into the value of a precision resistor built into the sensor. The value of this resistor is sensed by forming a voltage divider. The value of the resistor ratio is read by a separate A/D input, and out of range values are interpreted as “sensor unplugged.”

Communications

The multiplexers and A/D are controlled by the Main Processor via a Manchester-encoded serial communications channel (Pod Com) optically coupled to the isolated front end. Most of the digital logic is contained in the MultiMed FPGA. Outputs from the A/D are Manchester-encoded in the MultiMed FPGA and fed to the opto-coupled data flow to the Main Processor.

A power-on monitor resets the FPGA until both ±5V have risen to normal range. The isolated dc-dc converters are synchronized to the data acquisition sequence via the Main Processor FPGA. The A/D converter is automatically calibrated after the power-on reset is cleared.

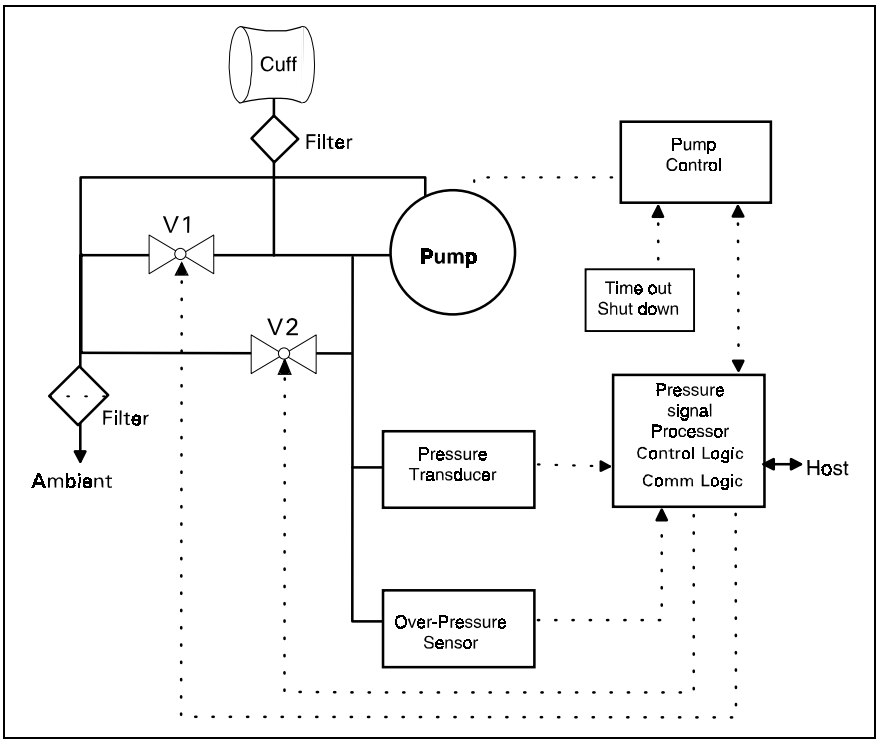


Figure 2-12NBP Functional Block Diagram

10 NBP

Refer to Figure 2-12.

10.1 Introduction

The NBP design measures blood pressure non-invasively using an inflatable cuff and the oscillometric method. The NBP algorithms are performed in the front end processor. The NBP circuit contains two pressure transducers which measure the hose pressure. The second redundant pressure sensor is used to measure overpressure for safety. This pressure transducer is mounted in the power section while the other pressure transducer is mounted in the MultiMed front end. A plastic manifold connects the two transducers together and to the pneumatic assembly in the rear case. The MultiMed front end A/D samples the pressure transducer.

10.2 Pneumatic Subassembly

The pneumatic subassembly consists of two modulating solenoid valves (V1, V2), a pump (P1), a filter, and a manifold. The manifold provides the interconnection of the air passages between the individual components and provides for their mechanical mounting. It also provides an acoustic attenuation of the valve and pump noise. The filters prevent contamination from entering the pneumatic system from the cuff hose or ambient air.

P1 provides the pressurized air to inflate the blood pressure cuff. V1 and V2 are used to control the air flow during the de-flation phase of a blood pressure measurement. V1 is a normally closed exhaust valve with a relatively small orifice. V2 is a normally open exhaust valve with a comparatively large orifice.

When a blood pressure measurement is initiated V2 is closed, P1 is turned on and the rising cuff pressure is monitored via pressure transducers. When the pressure has reached the target inflation pressure, P1 is turned off. Neonate inflation cycles are identical except that a speed control circuit is used to reduce the pump output to approximately 15% of the adult mode.

After the inflation, there is a short delay after the pump stops to allow thermal transients to settle. Either V1 or V2 is now modulated to control the deflation rate. The choice of V1 or V2 and the initial pulse width is made based on the inflation cycle. The chosen valve is modulated and the pulse width (open time) is continuously adjusted to provide a constant deflation rate. If initial deflation was started with V1 the software may determine that it needs to switch to V2 to maintain proper deflation. In any case when the measurement cycle is complete, V2 is opened fully (de-energized) to allow for rapid deflation.

10.3 Transducers

The measurement pressure transducer is DC coupled to a 16 bit A/D converter so that cuff pressure is measured with adequate resolution to detect blood pressure pulses.

The overpressure transducer has two threshold settings. The adult setting is 300 ±30 mmHg and the nominal neonatal setting is 158 ±7 mmHg. Both transducers share a common manifold and are mounted on the main PC board.

10.4 Pneumatic Controls

The P1 control provides 3 functions.

- It limits current to the pump when the pump starts to prevent power supply overload.
- It rapidly decelerates the pump when the pump is shut off, by applying a low resistance across the motor.
- It provides a closed loop speed control for low speed neonatal operation.

A relatively high pulse voltage is used to drive V1 and V2 to get quick response. This pulse lasts for approximately 2 milliseconds after which time the valve voltage is lowered to a holding value. At the end of the valve "on" time period, the valve voltage is allowed to reverse and the energy stored in the solenoid inductance is rapidly released into a relatively high voltage clamp circuit.

P1 and V2 are supplied by a redundant power switch so that, under fault conditions, they can be de-energized.

10.5 Safety timer

The software limits measurement time to 119 secs for adult mode, 89 secs for neonatal mode and 59 secs for French neonatal mode. A safety timer circuit monitors current in P1 and V2, and if due to some failure (hardware or software), P1 or V2 remain activated for more than 120±1 seconds in adult mode, 90±1 seconds for neonatal mode or 60±1 seconds in French neonatal mode, the circuit latches on, causing the redundant power switch to P1 and V2 to switch off. When the safety timer latch has been set, V1 is opened as an additional safety feature. Only recycling the monitor resets the safety timer latch. The safety timer circuit is functionally independent of the logic gate array.

When the unit is powered up, the safety timer is de-activated until the pump is started the first time. This feature allows service calibration without triggering the safety timer. Once the pump has been activated the timer circuit becomes functional.

10.6 Logic gate array

The main FPGA provides the following control functions for the pneumatics and the communications.

- Clock generation for safety timer
- 12 bit 20 Hz PWM and pulse control for V1 and V2

- Pump control
- Neonatal mode switching of pump and overpressure
- Safety logic

10.7 Non-volatile memory

A EEPROM stores pneumatic component flow factors. During calibration at production system test and in the field, a 0.5 liter canister is connected to the NBP input on the monitor. The monitor automatically measures the pump and valve flow rates and determines their flow factors for the use in the flow control algorithm.

10.8 Hose detection

An electromagnetic coil located at the hose connector detects the metal in the hose connector when the connector is present.

10.9 Watchdog Timer

A watchdog timer is implemented in the power conversion FPGA to monitor the safety timer clock input from the main FPGA in case the main FPGA or its crystal become damaged.

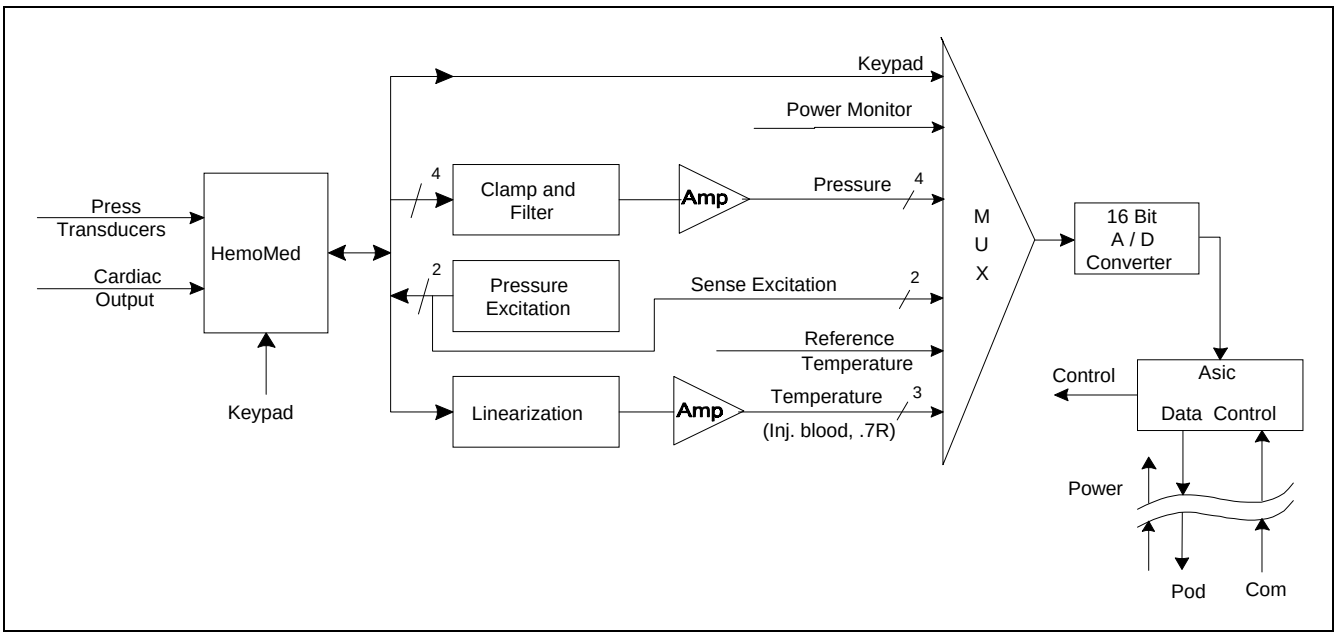


Figure 2-13HemoMed Front End

11 HemoMed Front End

11.1 Introduction

Refer to Figure 2-13. The HemoMed front end section of the monitor's main board takes invasive blood pressure, and thermal dilution cardiac output data gathered by the HemoMed Pod from transducers at the patient and converts them to digital form for transmission through isolators to the computer section of the main board. The HemoMed front end may also be used with a single or dual pressure cable instead of using the HemoMed.

11.2 Pressure

The pressure data acquisition front end is designed to operate with resistive strain gage pressure transducers having an output impedance of less than 3000 Ohms and an input impedance between 3000 and 200 Ohms. Excitation voltage is applied in pairs. Press 1 and 3 share a driver as well as Press 2 and 4. The output signals generated from the pressure sensors are passed through filter and clamp networks which limit and filter RF noise. The pressure excitations are monitored for fault detection.

11.3 Cardiac Output

The two thermistor signals are connected to a precision resistor network to linearize voltage vs temp curve of the thermistor. The thermistor signals are filtered and clamped before amplification. Two calibration voltages are also sampled by the A/D converter to correct amplifier offset and gain errors. The catheter also has a reference resistor which is read for calibration.

The front bezel switches on the HemoMed are converted to unique voltages when pressed, allowing a voltage to be sent to the A/D converter, which can be decoded by the front end processor into the corresponding switch closure.

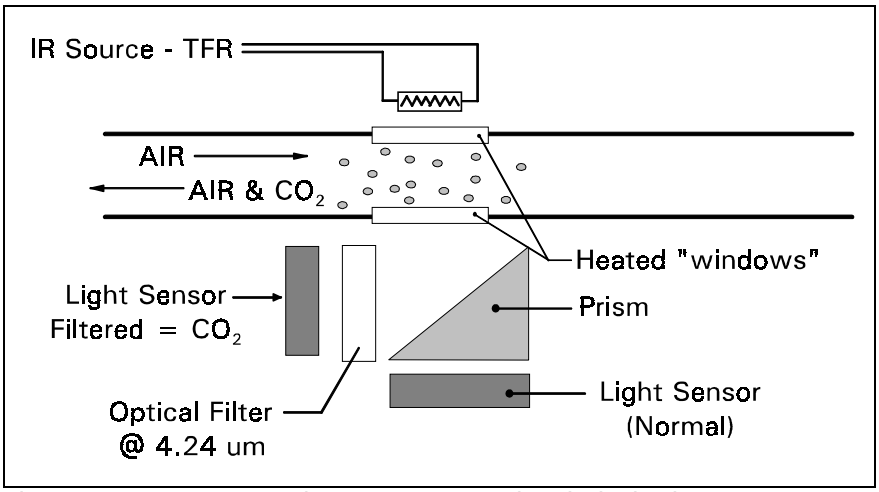


Figure 2-14 $etCO_2$ Sensing Process Functional Block Diagram

12 $etCO_2$ Pod

The $etCO_2$ pod non-invasively monitors end-tidal CO_2 using a technique that relies on the selective absorption properties of the CO_2 to specific frequencies of infra-red radiation. See Figure 2-14.

In the sensor a thick film infra-red source is pulsed at a rate of approximately 87 Hz, generating a broad- band spectrum of IR. Selective filtering separates this into two narrow regions, one inside and one outside the band of CO_2 absorption. The detector associated with the filter outside the band of CO_2 absorption records the maximum level of the source energy since the signal it receives is not affected by CO_2. It provides a baseline which serves as a Reference for the level of CO_2 in the airway. The other detector senses a filtered energy level modified by the presence of CO_2. As the level of CO_2 increases, the CO_2 gas molecules in the airway absorb more of the light energy and less signal reaches the detector. This signal, converted by the detector, is referred to as the Data signal. Current through the thick-film source is bidirectional to offset the tendency of particles within the source to migrate when exposed to a strong unidirectional electric field caused by current flow only in one direction. This keeps the structure of the source uniform and enhances system integrity and life of the product.

To acquire a precise level of CO_2, both channels are simultaneously sampled and the level of CO_2 is determined from the ratio of the Data and the Reference channels. The ratio is compared to a look-up table in memory to establish the correct value in units of mmHg.

The pod then sends the results to the host system for further processing and display.

12.1 System Memory

The system has three types of memory:

- PROM Programmable Read Only Memory
- SRAM Static Random Access Memory
- EEPROM Electrically Erasable Read Only Memory

PROM stores the pod's program. Its contents remain intact even when power is removed from the pod. It has been socketed to allow for future program updates, if required. Besides containing the pod's program, it also contains various look-up tables for calculating CO_2 parameters and the Interrupt Vector Table.

The system's Static RAM functions as a scratch pad to temporarily hold various system variables until they are either no longer needed by the system and are overwritten with new information, or power is removed from the pod and the RAM contents are lost.

The EEPROM holds system parameter information that must be retained when power is removed, but must also be modifiable by the processor. The device contains multiple copies of system information such as calibration factors, sensor serial number, and span cell number, to ensure data integrity.

A Supervisor chip performs various monitoring tasks to ensure that the microprocessor and system run properly.

12.2 User Interface

The user interface provides capability for airway and adapter calibration, and also compensation for effects of N_2O and O_2. When calibrating the accessory assembly, switches inside the sensor, one for the Zero Cell and one for the Span Cell, tell the processor when the assembly has been placed on the proper cell for system calibration.

13 HEMO 2/4 POD

13.1 Functional Description

HEMO 2/4 PODs have provisions for monitoring either 2 or 4 invasive blood pressures, 2 temperatures and cardiac output. See Figure 2-15

13.2 Pressure

The pressure data acquisition front end is designed to operate with resistive strain gage pressure transducers having an output impedance of less than 3000 Ohms and an input impedance between 3000 and 200 Ohms (see Figure 2-16). Excitation voltage is applied, one at a time, to each resistive strain gauge pressure transducers by a single, current limited voltage reference circuit which is time-multiplexed across four pressure sensors. The differential output signals generated by the pressure sensors are passed through filter and clamp networks which limit the differential and common mode voltage swings and filter out RF noise.

Next, the signals enter a functional block that converts the differential signals into single ended signals which are then presented one at a time in a time-multiplexed fashion to a fixed gain single ended amplifier. Calibration voltages for zero and 200 mmHg are periodically switched into the amplifier input to correct errors in amplifier offset and gain respectively.

An A/D converter samples the resulting output voltage. Timing is coordinated by the logic gate array.

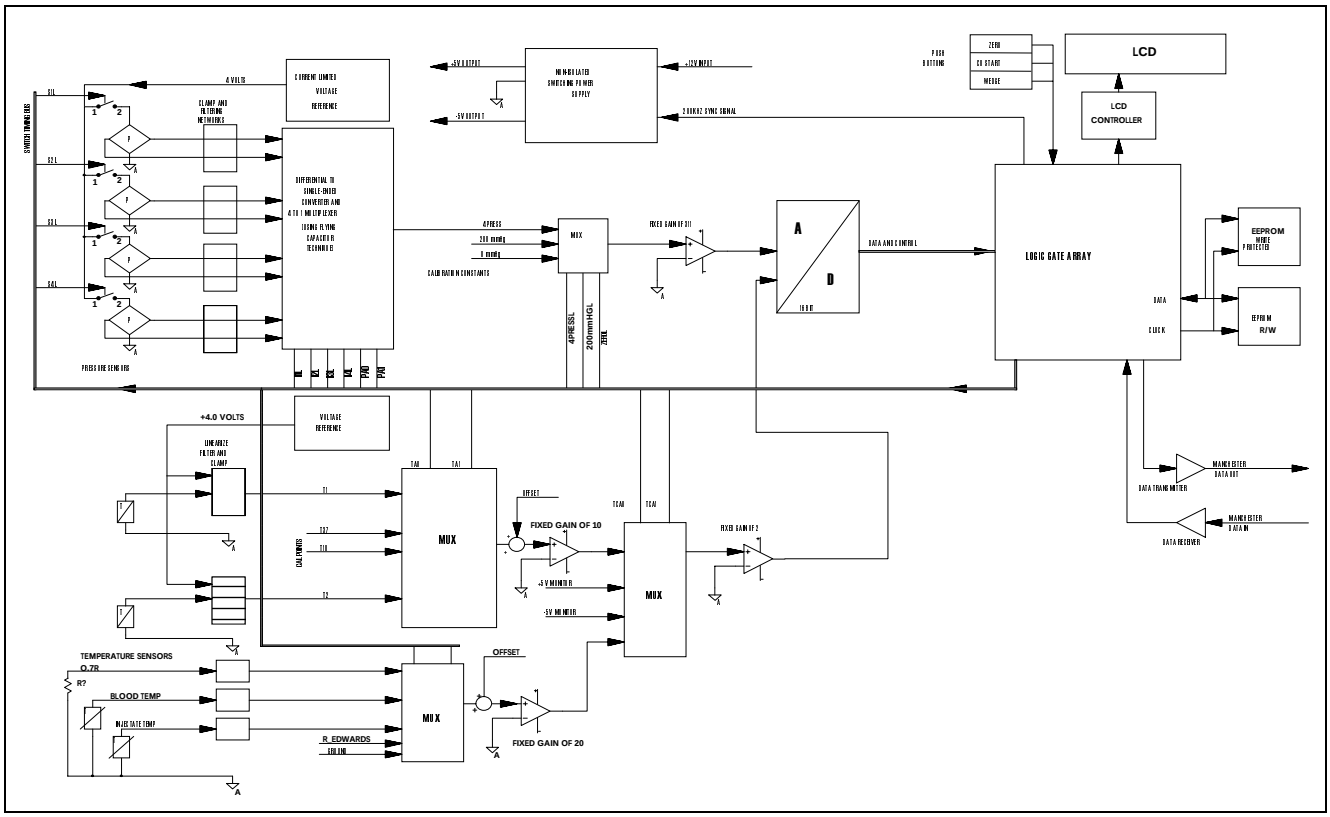


Figure 2-15HEMO 2/4 POD Functional Block Diagram

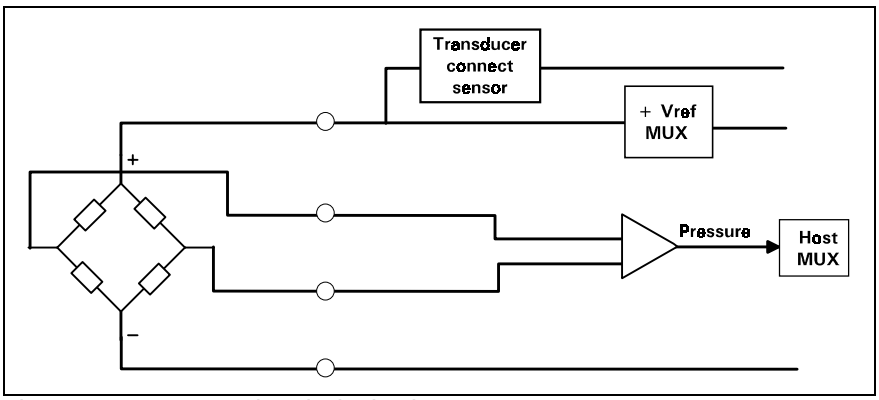


Figure 2-16IBP Functional Block Diagram

13.2.1 Temperature

Each of two thermistors is connected to a functional block that consists of a precision resistor network to partially linearize the voltage verses temperature transfer curve of the thermistor. This functional block also consists of means for filtering RF noise and limiting the voltage swing. A 4.5 Volt reference is connected to power each linearization network.

A multiplexer selects one of the two temperatures or one of the two calibration points and connects the voltage to the input of a fixed gain amplifier. The two calibration points are used to correct gain and offset errors in the amplifier circuits.

An offset is added to center the signal within the dynamic range of the A/D converter. The signal is then further multiplexed with two power supply

voltage monitors and Cardiac Output. A fixed gain of two is finally applied to match the signal range to the full scale range of the A/D converter.

13.2.2 Cardiac Output

Cardiac output operates in much the same way as temperature. The thermistor signals are filtered and clamped then multiplexed to the input of a fixed gain amplifier. Two calibration voltages are also multiplexed in to correct amplifier offset and gain errors.

Next, an offset is added to the signal to center it to the dynamic range of the A/D converter. The amplified signal is then multiplexed with temperature, then through a fixed gain of two and finally to the A/D converter.

13.2.3 EEPROM Storage

Two EEPROM's are used for non-volatile information storage. One EEPROM is used for reading and writing data that changes during the operation of the POD, such as pressure offsets, the other stores more permanent information such as POD serial number and is therefore write protected. A state machine inside the logic gate array supports communications between the Host and the two EEPROM's. A mechanism is provided which allows service personnel to disable the write protection of the otherwise write protected EEPROM.

13.2.4 LCD and Push Buttons

A total of 16 LCD characters are provided for use as pressure labels. Each pressure channel is allocated 4 LCD characters. The Logic Gate Array supports communication of controll between the Host and the LCD's.

Up to three push buttons are provided for user interface. There is one for pressure zero, one for Cardiac Output Start and one spare. The interface of the buttons to the Host is handled by the gate array.

13.2.5 Current Limiting the Voltage Reference

In the event a defective pressure sensor presents a short circuit to the excitation voltage source, the voltage source goes into current limit during the bad transducer's time slot.

14 Advanced Comm Option

The SC 8000 has been designed to function in standalone mode or in an INFINITY NETWORK. It is not compatible with SIRENET.

The Comm Option PC board supplies power and communications interface for peripheral devices associated with the monitor.

14.1 Comm Option Board Hardware

The major circuits include a high speed serial link to the Patient Monitor, control and status registers to the 68302 processor, and miscellaneous functions. The serial link functions as a bus master on the local bus. The 68302 performs bus arbitration. The registers and miscellaneous functions are slave devices on the bus and completely accessible to the 68302.

14.2 EEPROMs

The Comm Option PC board contains SERIAL EEPROMs which are programmed in the factory with various configuration parameters. One contains factory-programmed field service data and is read-only in the field. A second EEPROM is field-programmable and contains various configuration parameters.

Chapter 3: Repair

1 Introduction

The following procedures are applicable to the SC 8000 Patient Monitor as of the date of publication of this Manual. Subsequent changes may be published as a supplement and/or posted on the Siemens TD Intranet site, http://www-td.med.siemens.de/, under EM Product Information.

Before attempting to open the monitor, always do the following:

- Unplug all cables from connectors on the back and front of the monitor.
- Remove monitor cover and unplug main cable from battery.

Caution

Assure that both you and the work area are properly protected against static-electricity discharge.

2 Replaceable Items

Refer to Figure 3-1 and Figure 3-6. The following items are available for replacement in the field. Refer to Appendix A for part numbers.

1) Front Bezel Subassembly
2) Front Bezel Language Label
3) Main Processor PCB Subassembly
4) Power Supply (OEM)
5) Optical Encoder
6) Rotary Knob
7) NBP Pump Subassembly (also see Figure 3-2 on page 34)
8) Battery
9) Speaker Subassembly (also see Figure 3-2 on page 34)
10) Connector I/O PCB (also see Figure 3-2 on page 34)
11) External Fan
12) Rear Panel w/o Adv Comm Option
13) Rear Panel w/ Adv Comm Option (See Figure 3-6 on page 40)
14) Adv Comm Option (See Figure 3-6 on page 40)
15) MIB 1&2 Option (See Figure 3-6 on page 40)

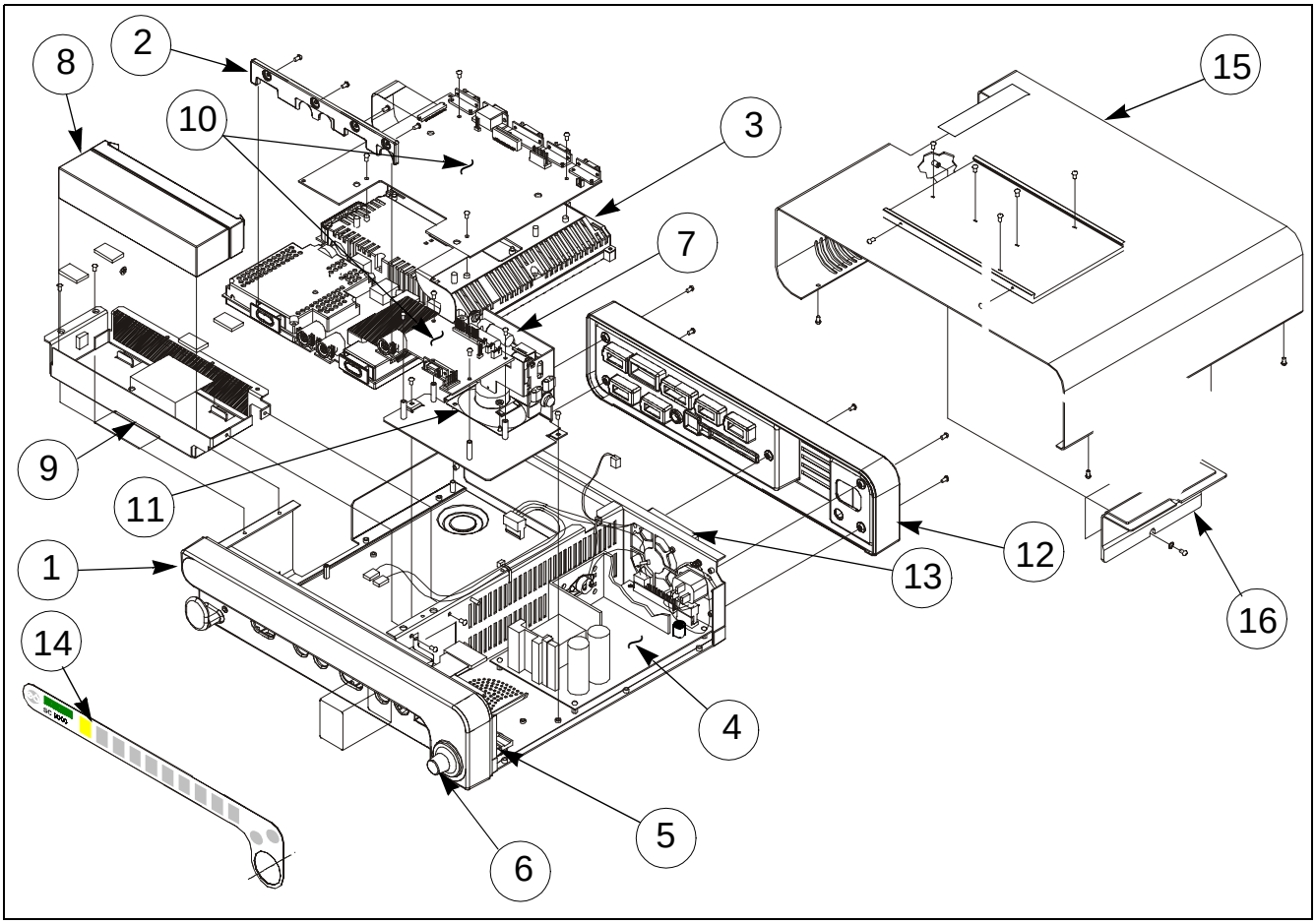


Figure 3-1 Basic SC 8000 Patient Monitor (shown w/o Adv. Comm. and MIB 1&2 Options - see Figure 3-6)

① Front Bezel Subassembly
② Channel Guide
③ Main Processor PCB Subassembly
④ Power Supply Subassembly
⑤ Optical Encoder Subassembly
⑥ Rotary Knob
⑦ NBP Pump Subassembly (also Figure 3-2 on page 34)
⑧ Battery
⑨ Battery Tray
⑩ Connector I/O PCB Subassembly (2 boards connected by flex cable)
⑪ Speaker Subassembly (also Figure 3-2 on page 34)
⑫ Rear Panel (w/o installed Adv. Comm and MIB 1&2 Options)
⑬ Fan
⑭ Language Label
⑮ Top Cover
⑯ Blank Cover (if Adv. Comm and MIB 1&2 Options not installed)

Warning

After monitor has been opened and then reassembled, always functionally verify proper operation of monitor functions as detailed in Chap. 4, before returning monitor to clinical service.

2.1 Rotary Knob

The rotary knob is press fitted onto the metal shaft of the optical encoder subassembly, and is the only component on the SC 8000 monitor that can be replaced without removing any other components of the monitor. It must be removed very carefully if it is to be reinstalled.

1) To remove the knob, grip it **very** firmly with vise-grips or a similar tool, and pull it straight out and off of the metal shaft. Avoid turning knob.

   Note: Placing a piece of cloth around the knob should prevent scratching by the jaws of the tool, and allow the knob to be reused.

2) To install or reinstall a knob, align and firmly press knob onto shaft.

2.2 Replacing Fan

Fan (⑭ in Figure 3-1) is located behind back panel beside AC power connector, and can be replaced without removing outer case of monitor.

2.2.1 Removing Fan

1) With monitor on a clean flat surface, unplug external power cable and disconnect all signal cables from the monitor.
2) Remove and save five Phillips-head screws that secure back panel to monitor chassis.
3) Remove back panel.

   Note: Required direction of fan rotation is indicated on side of fan housing.

4) **Carefully** unplug fan cable connector from connector on fan housing.

Caution

If the connector gets damaged, the monitor will need to be opened and the complete fan subassembly replaced.

5) Slide cable through slots in fan housing to free cable from housing.
6) Remove and save two screws that secure fan to back of chassis, and remove fan.

2.2.2 Installing Fan

Reverse steps of Section 2.2.1 to install fan. Observe proper orientation of fan housing as noted in step 3.

2.3 Opening Monitor

Except for Fan and Rotary Knob replacement, open monitor to access replaceable components and subassemblies. Use following procedure.

Caution

Assure that both you and the work area are properly protected against static-electricity discharge.

1) Place monitor on clean flat surface, unplug external power cable and disconnect all signal cables from monitor.
2) Remove five screws that secure Display mount to top of monitor. Set mount and screws aside for use in reassembly.
3) Remove and save five Phillips-head screws that secure back panel to monitor chassis.

   Note: In SC 8000 monitors equipped with Adv Comm Option, the screw that holds the network connector bracket is a different size from the other four securing screws. Be sure to note difference when saving screws for use in reassembly.
4) Remove network connector bracket (if present) and back panel.
5) Turn monitor topside down and remove six Phillips-head screws that secure top cover to chassis along outside edges.
6) Turn monitor topside up with back of monitor facing you and slide top cover toward you to remove cover.

2.4 Battery and Tray

Battery (⑨ in Figure 3-1 on page 30 and in Figure 3-6 on page 40) is located in tray (⑩ in Figure 3-1) behind front panel on left side above Main PCB Subassembly.

2.4.1 Removing Battery

1) Open monitor. Refer to Section 2.3.
2) Using long nose pliers or similar tool, unplug two battery connectors from main battery terminals. **Note orientation of battery in tray, and routing and polarity of battery cable wires!** (See illustration at left.)
3) Lift battery out of tray.

2.4.2 Removing Tray

4) If necessary to remove tray, remove and save two screws that secure tray to left side of chassis and two screws that secure tray to bulkhead.

   Note: Be careful to not damage grounding strap from front panel membrane switch subassembly, secured to the bulkhead by one of the tray securing screws.

2.4.3 Installing Battery and Tray

If tray was removed, be sure to reinstall grounding strap from front panel membrane switch subassembly when reinstalling tray. Reverse steps of removal procedure to install battery and tray.

2.5 Power Supply

Power supply (④ in Figure 3-1 on page 30) is located in back right-hand corner of chassis, and is secured to chassis by four screws through corners of power supply PC board into standoffs on bottom of chassis and bracket on bulkhead. Use following procedure to replace Power Supply.

2.5.1 Removing Power Supply

1) Open monitor. Refer to Section 2.3.
2) Unplug power input connector from P1 on power supply PC board.
3) Unplug Connector I/O PCB power input connector from P2 on power supply PC board.
4) Remove and save screws and nuts securing thermal sensor to power supply heat sink.
5) Remove and save Adv Comm Option Subassembly (if installed, see Section 2.13 on page 39) to access securing screw on bulkhead bracket.
6) Remove and save four screws, one in each corner of power supply PC board, securing board to standoffs on chassis.

7) Lift Power Supply out of monitor chassis.

2.5.2 Installing Power Supply

Reverse steps of removal procedure, Section 2.5.1, to install Power Supply. Refer to Section 2.14 to close monitor.

2.6 Connector I/O PC Board

The Connector I/O PCB Subassembly (⑪ in Figure 3-1 on page 30) is comprised of two sections permanently connected to each other by flex cable. The rear panel interface section, mounted on standoffs on the Main Processor PCB subassembly heat sink, is the larger of the two PC boards and contains connectors accessible from the back panel. The front panel interface section (also see ⑪ in Figure 3-2 on page 34), is the smaller of the two and contains connectors accessible from the front panel as well as circuitry for the user interface. Each section is individually secured in the monitor chassis, and may be temporarily freed up from the chassis in order to facilitate access to other components.

Note: If monitor equipped with Adv Comm Option Subassembly, remove Subassembly to access rear panel interface section. See Section 2.13 on page 39.

Do either a or b as appropriate.

a If removing Connector I/O PCB subassembly or attempting to access Main Processor PCB subassembly, continue to Section 2.6.1.

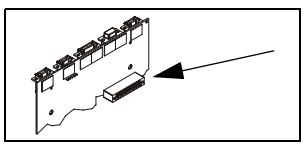
b If attempting to access Speaker subassembly or NBP subassembly, go to Section 2.6.2.

2.6.1 Freeing Rear Panel Interface Board

1) Open monitor. Refer to Section 2.3.
2) Remove battery and battery tray. Refer to Section 2.4.
3) Remove Adv Comm Option subassembly, if installed. See Section 2.13.
4) Unplug ribbon cable from X3 of PC board.

   Note: Carefully slide ribbon lock back off of PCB connector along ribbon to release lock, and then slide ribbon out of connector.

5) Unplug Battery connector from X14 near rear right hand corner of PCB.
6) Unplug fan connector from X8 at rear right hand corner of PC board.
7) Remove and save four Phillips-head screws securing board to standoffs on Main Processor PCB subassembly heat sink.



8) Carefully lift PC board on outer side, to unplug 48-pin interface connector on bottom of board (see arrow in illustration at left), and unplug docking connector on side of board to separate board from Main PCB subassembly.
9) Do either a or b, as appropriate.

   a If removing Connector I/O PCB, leave rear panel interface board resting on Main Processor PCB subassembly and continue to section 2.6.2

   b If removing Main Processor PCB subassembly, go to Section 2.7.

2.6.2 Freeing Front Panel Interface Board

1) With monitor open (refer to Section 2.3 to open monitor), and battery and battery tray removed, unplug front panel membrane keys ribbon connector from X13 on front panel interface board (smaller board) of Connector I/O PCB subassembly.

2) Carefully remove pneumatic tubing from cuff connector on front panel.

3) Note dress of cables, and unplug following connectors from front panel interface board of Connector I/O PCB subassembly (see Figure 3-2).

   - Rotary switch connector from X15
   - Speaker connector from X16
   - Cuff sensor connector from X10
   - Pump connector from X11
   - Pump valves connector from X12

4) Remove four screws securing plastic channel guide (② in Figure 3-1 on page 30) to front of chassis.

5) Carefully pry channel guide up, and remove guide from monitor. Set guide aside for reinstallation.

   Note: The guide also anchors the front panel connectors of the Main Processor PCB to the chassis.

6) Remove four Phillips-head screws that secure front panel interface board in monitor, two to chassis and two to NBP mounting bracket.

7) Slide smaller board through bulkhead to provide access to one of two screws that secure NBP mounting bracket to chassis (on some hardware revisions) or if removing Connector I/O PCB subassembly.

   Note: Be observant that NBP sensor cable doesn't snag on board.

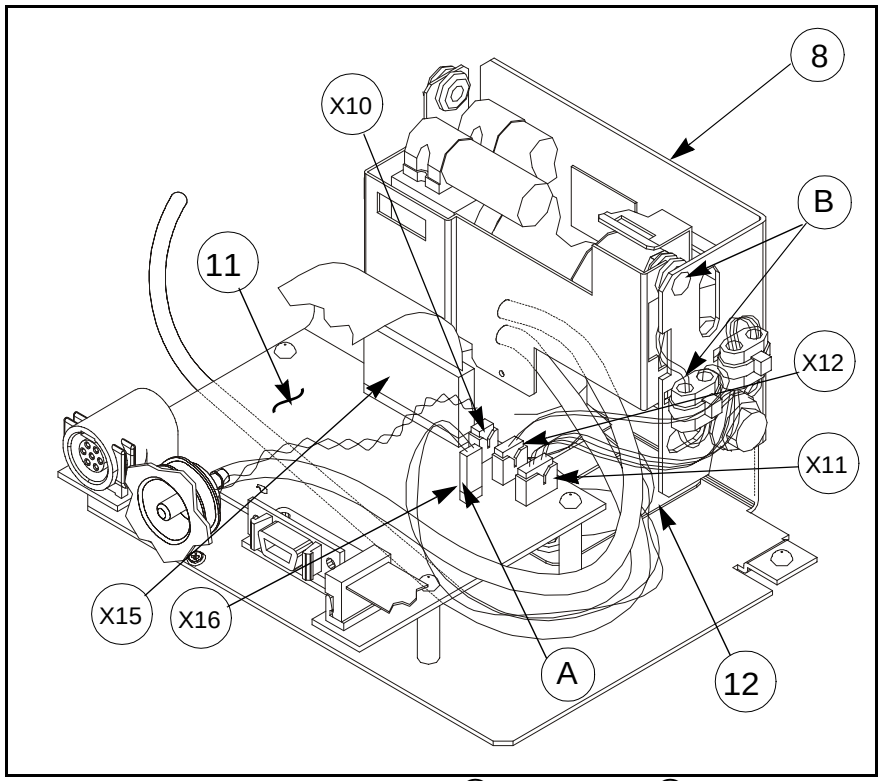


Figure 3-2 NBP Pump Subassembly ⑧ and Speaker ⑫ with front panel interface board of Connector I/O PCB Subassembly ⑪

2.6.3 Reinstalling Connector I/O PCB Subassembly

Reverse procedures of Section(s) 2.6.1 and/or 2.6.2, as applicable, to reinstall Connector I/O PCB Subassembly.

2.7 Main Processor PCB Subassembly

Main Processor PCB Subassembly (③ in Figure 3-1 on page 30) is located under larger PC board of Connector I/O PCB subassembly. It is secured in monitor by four screws into mounting posts on bottom of chassis and by channel guide on front panel. Use following procedure to replace Main Processor PCB subassembly (③ in Figure 3-1).

2.7.1 Removing Main PCB subassembly

1) If not already done, unfasten larger PC board of Connector PCB subassembly. Refer to sections 2.6 and 2.6.1.
2) Remove and save four screws securing channel guide to front panel.
3) Carefully pry channel guide up, and remove guide from monitor. Set guide aside for reinstallation.

   Note: The guide also anchors front panel connectors to front panel.
4) Turn board over and rest board on right-hand side of chassis to permit access to Main PCB securing screws.
5) Remove four screws that secure Main PCB to mounting posts on bottom of chassis. Note lengths of screws so that proper screws can be reinstalled during reassembly.
6) Lift back of board sufficiently to access NBP transducer pneumatic tubing.
7) Using smooth-jaw (unserrated) needle-nose pliers or similar tool, carefully pull pneumatic tubing off of NBP transducer.

> **Caution**
>
> Be careful that pliers or tweezers do NOT damage the tubing.

8) Lift back of Main Processor PCB subassembly sufficiently to clear back of chassis, and remove subassembly from monitor. Take due notice of how the flex cable is dressed and routed, so that it can be reinstalled in exactly the same manner during reassembly.

> **Caution**
>
> Use extreme care to avoid damaging the ribbon cable or pulling the ribbon cable out of its connector on the Main Processor PCB. If either occurs, the Main Processor PCB subassembly will need to be replaced.

2.7.2 Installing Main Processor PCB Subassembly.

1) Slide pneumatic tubing from NBP pump manifold onto transducer post.
2) Angle Main Processor PCB subassembly front side down into position in chassis and seat on mounting posts. See **Caution** in step 8 of section 2.7.1 above.
3) Install screws removed in step 5 of section 2.7.1above.
4) Slide channel guide onto connectors on front of Main PCB, and secure to front of chassis.

5) Reverse procedures of Section(s) 2.6.1 and/or 2.6.2, as applicable, to reinstall Connector I/O PCB Subassembly.

2.8 Speaker Subassembly

Speaker subassembly is located under NBP pump subassembly on NBP Subassembly bracket (see ⑫ in Figure 3-1 on page 30 and also in Figure 3-2 on page 34), and is secured to bracket by lip on bracket and two threaded studs protruding from bracket under pump subassembly. Use following procedure to replace speaker subassembly.

2.8.1 Removing Speaker

1) Remove top cover from monitor.
2) Carefully remove pneumatic tubing from cuff connector on front panel.
3) Using long-nose pliers, unplug speaker cable (A in Figure 3-2) from X16 on front panel interface board of Connector I/O PCB subassembly.

   Note: Note orientation of speaker connector on X16 and cable dress.
4) Cut ty-wrap bundling speaker cable to NBP pump cables.
5) Remove four screws securing plastic channel guide to front of chassis to free connector on Front Panel Interface board.

   Note: The guide also anchors the front panel connectors of the Main Processor PCB to the chassis.
6) Carefully pry channel guide up, and remove guide from monitor. Set guide aside for reinstallation.
7) Remove four Phillips-head screws that secure front panel interface PC board in monitor, two to chassis and two to NBP mounting bracket standoffs.
8) Lift inner edge of front panel interface board, and use a 5mm nut driver to remove nuts securing speaker housing to studs on NBP mounting bracket.
9) Slide speaker out from under NBP pump subassembly.

2.8.2 Installing Speaker

Reverse removal procedure to install speaker subassembly. Be sure to rebundle and dress cables as noted in step 3 of Section 2.8.1.

2.9 NBP Subassembly

The NBP Pump Subassembly is housed on a mounting bracket in front of the power supply. See ⑧ in Figure 3-1 on page 30 and in Figure 3-2 on page 34.

2.9.1 Removing NBP Subassembly

1) Open monitor, and free front panel interface board from chassis. See Section 2.6.2.
2) Cut ty-wrap loops that bundle NBP and speaker cables, and secure ferrite filters to NBP mounting bracket.
3) Remove and save two Phillips-head screws (B in Figure 3-2 on page 34) that secure NBP Pump Subassembly in mounting bracket.
4) Remove spacers between pump subassembly and mounting bracket, and pull pump subassembly away from bulkhead to free from positioning post on bulkhead.

   Note: Be careful to not pull pneumatic tubing out from under Main Processor PCB Subassembly on other side of bulkhead.
5) Turn pump subassembly on right side to facilitate access, and using long-nose pliers or tweezers carefully pull NBP transducer pneumatic tubing (tubing that goes to Main Procesor PCB on other side of bulkhead) off of manifold on NBP pump.

Caution

Be careful that the pliers or tweezers do NOT damage the tubing. Also, do NOT put any tension on the other end of the tubing, routed under Main Processor PCB Subassembly.

6) Remove NBP Pump Subassembly from bracket.

2.9.2 Installing NBP Subassembly

1) Slide NBP transducer pneumatic tubing (tubing to Main Processor PCB Subassembly on other side of bulkhead) onto manifold on pump.

   Note: Be careful to not pull pneumatic tubing out from under Main Processor PCB.

2) Position spacers between pump subassembly and side of mounting bracket, and secure pump subassembly to bracket using mounting screws removed in step 3 of Section 2.9.1 above.

3) Reinstall front panel interface board. Perform steps of Section 2.6.2 in reverse.

4) Close monitor (see Section 2.14) and perform an NBP calibration check (and calibration, if required). See Chapter 4.

5) Perform an NBP characterization. Use procedure in Section 10.4 in “Chapter 4: Functional Verification and Calibration” .

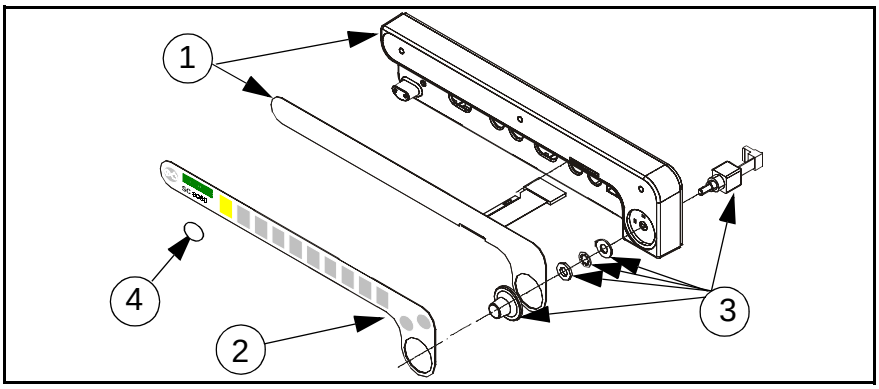


Figure 3-3 Front Bezel Subassembly (incl. Membrane Keypad) ① w/ Language Label ②, Optical Encoder Subassembly ③, and R393 Access Port Cover ④

2.10 Front Bezel Subassembly

On most chassis, the Front Bezel Subassembly is secured to the chassis by five screws -- three near the top edge, accessible after the battery and tray have been removed, and two along the bottom edge, accessible from the bottom side of the monitor. See ① in Figure 3-1 on page 30. On some chassis, the two bottom screws are installed through the front of the chassis from inside the monitor.

2.10.1 Removing Front Bezel Subassembly

1) Open monitor and remove battery and tray.

   Note: If bottom securing screws for the Front Panel Subassembly are through the front of the chassis from inside the monitor, also remove Connector I/O PCB subassembly and Main Processor PCB subassembly to access the screws.

2) Unplug front panel membrane keypad ribbon connector from X13 on front panel interface PC board.

3) Carefully remove pneumatic tubing from cuff connector on front panel.
4) Unplug rotary switch connector from X15.
5) Remove four screws securing plastic channel guide to chassis front.
6) Carefully pry channel guide up, and remove guide from monitor. Set guide aside for reinstallation.

   Note: The guide also anchors the front panel connectors of the Main Processor PCB to the chassis.

7) Remove five Phillips-head screws that secure Front Bezel Subassembly to chassis, and remove subassembly.

2.10.2 Installing Front Bezel Subassembly

Reverse steps of Section 2.10.1 to install Front Bezel Subassembly, and then close monitor. See Section 2.14.

Note: Install new R393 Access Port Cover if Front Bezel Slubassembly has been replaced. See ④ in Figure 3-3 on page 37.

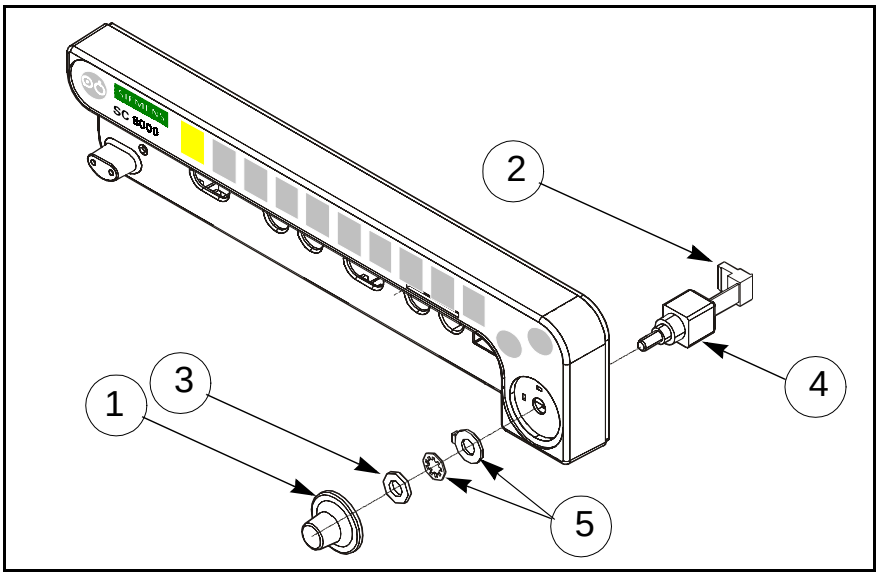


Figure 3-4 Optical Encoder Subassembly Removal/Replacement

2.11 Replacing Optical Encoder Subassembly

1) Remove rotary knob (① in Figure 3-4).

   Note: The rotary knob is press fitted onto the metal shaft of the optical encoder subassembly. It must be removed very carefully if it is to be reinstalled. To remove knob, grip it **very** firmly with vise-grips or a similar tool, and pull it straight out and off of the metal shaft. Avoid turning knob. Placing a piece of cloth around knob should prevent scratching by the vise-grips, and allow knob to be reused.

2) Open monitor, and disconnect battery cable from battery terminals.
3) Unplug optical encoder ribbon cable connector (② in Figure 3-4) from front panel interface board of Connector I/O PCB subassembly.
4) Unscrew nut ③securing optical encoder shaft in position in front bezel, and remove optical encoder subassembly ④ through back of panel. Save nut, and lock washer / positioning washer combination ⑤ for use in reassembly.

Reverse steps 1 through 4 to install Optical Encoder Subassembly.

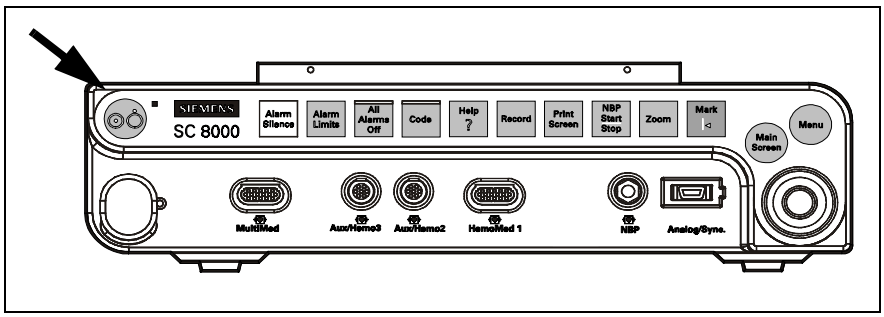


Figure 3-5 Removing Front Bezel Language Label

2.12 Removing/ Installing Language Label

The Language Label kit ships with a set of language labels to facilitate customizing the front bezel to the language requirement of a specific customer site, if the original label becomes damaged or the bezel is replaced.

2.12.1 Removing Existing Label

To remove an existing label, carefully pry up one corner of label (see arrow in Figure 3-5) and peel label off of membrane keypad towards opposite corner.

> **Caution**
>
> Use extreme care to not damage underlying membrane keypad when replacing Language Label. If membrane keypad is damaged the Front Bezel/Lens Subassembly must be replaced.

2.12.2 Installing Language Label

1) Peel protective covering from section of new label under function keys.
2) Position label along top of membrane keypad so that it fits squarely in label depression allowance on front bezel, and using a sweeping or rolling motion to prevent air bubbles from becoming trapped under label, press on label to secure it to membrane keypad.
3) Remove protective covering from remainder of language label, and with a similar motion affix label along right-hand side of bezel near rotary knob.

2.13 MIB 1&2 Option and Adv Comm Option Subassemblies

In the SC 8000 Patient Monitor, the MIB 1&2 Option PC board resides in the Adv Comm Option Subassembly. See ⑰ in Figure 3-6 on page 40. Both MIB 1&2 Option and Adv Comm Option subassemblies must be removed to access and service Comm Connector PCB and Main PCB Subassemblies.

2.13.1 Opening Adv Comm Option Subassembly

1) Open monitor and remove battery. Refer to Sections 2.3 and 2.4.
2) Carefullly observe how tape (① in Figure 3-7 on page 40) has been applied to outside back corner of Adv Comm Option subassembly chassis, so that the tape can be reapplied in **exactly** same manner. Then remove and save tape.
3) Remove and save five screws (② in Figure 3-7) that secure Adv Comm Option subassembly cover to chassis.
4) Slide tongue of cover (③ in Figure 3-7) out from under lip at back of chassis (④ in Figure 3-7).
5) Lift cover off, and do either a or b below as appropriate.

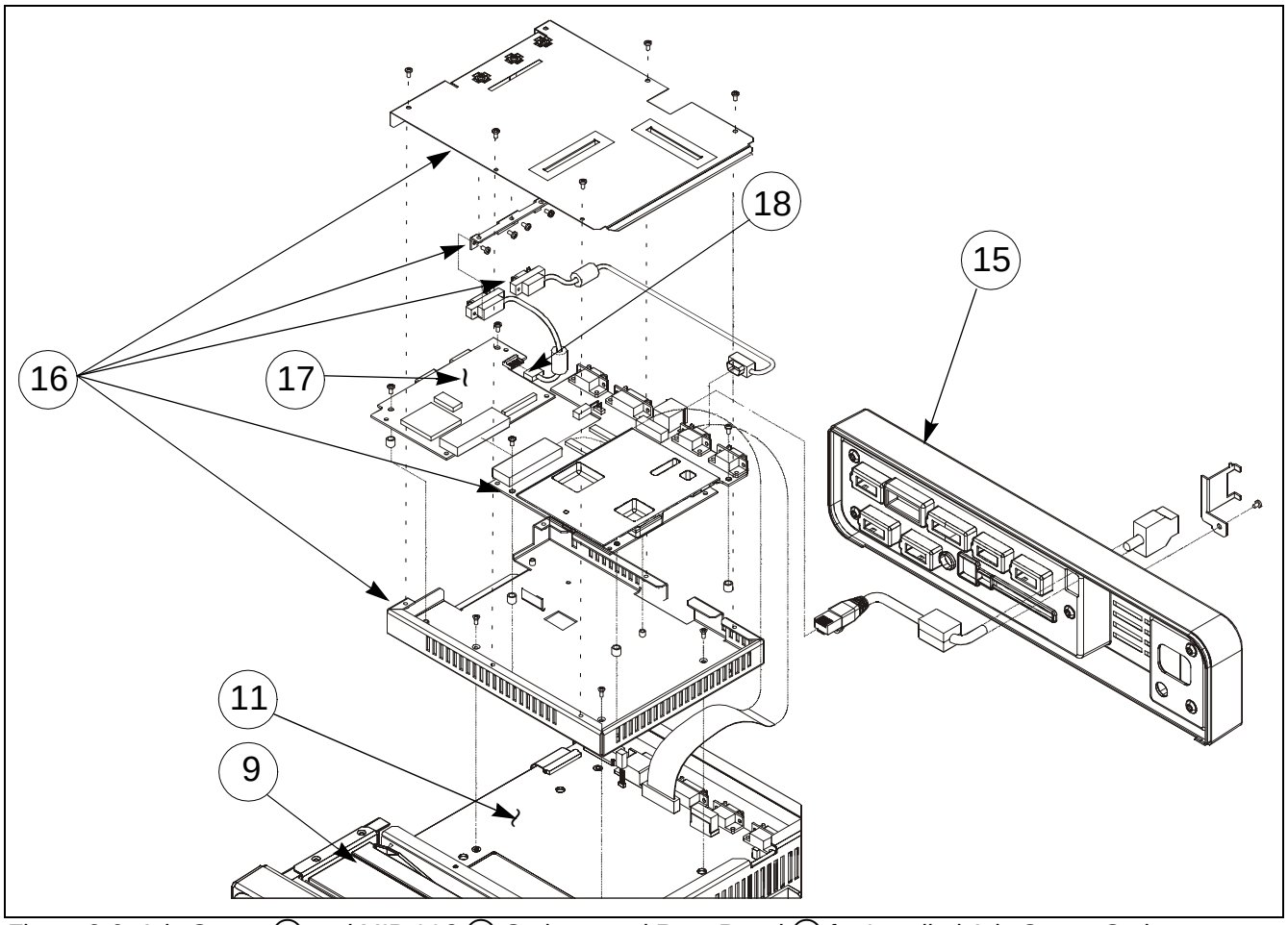


Figure 3-6 Adv Comm ⑯ and MIB 1&2 ⑰ Options, and Rear Panel ⑮ for Installed Adv Comm Option

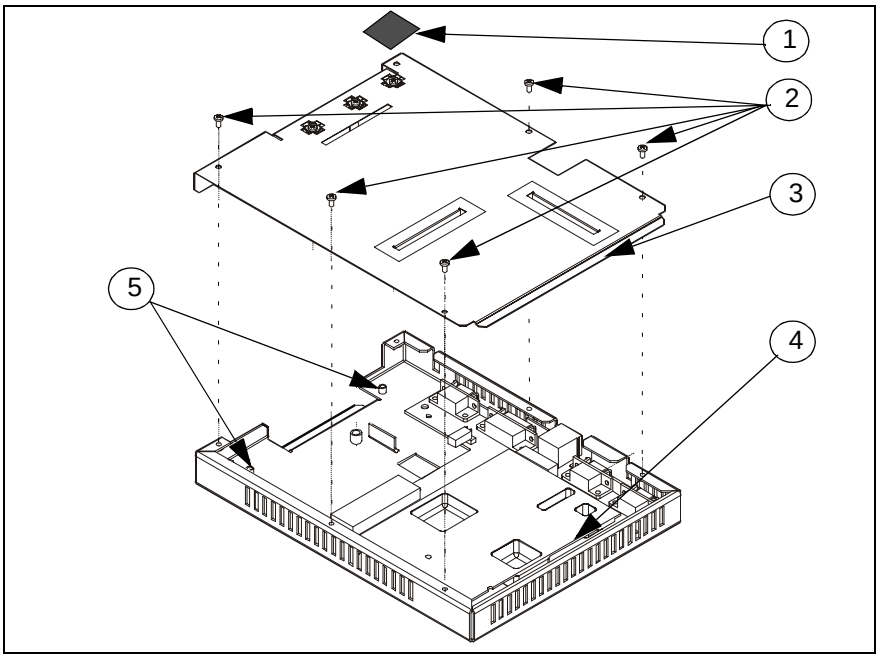


Figure 3-7 Comm Option Subassembly Cover Removal/Installation; Location of MIB 1&2 Mounting Posts ⑤

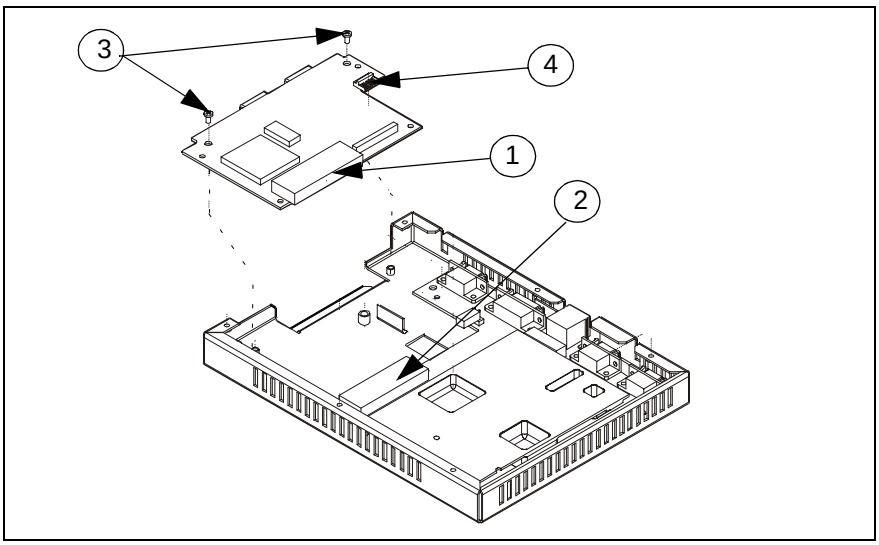


Figure 3-8 Removing/Installing MIB 1&2 Option PC board

a) If MIB 1&2 Option installed, unplug CAN cable connector (⑱ in Figure 3-6 on page 40) from MIB 1&2 Option PC board connector (④ in Figure 3-8). Set cover unside down beside monitor chassis and continue to step 1 of Section 2.13.2.

b) Otherwise, if MIB 1&2 Option NOT installed, unfasten loose end of CAN cable from bottom of Adv Comm Option subassembly chassis. Set cover upside down beside monitor chassis and go directly to step 1 in Section 2.13.3.

2.13.2 Removing MIB 1&2 Option

1) Remove mounting screws (③ in Figure 3-8) that secure MIB Option PCB to Adv. Comm Option chassis.

2) Unplug MIB 1&2 Option PC board (① in Figure 3-8) from Adv. Comm Option PC board (② in Figure 3-8), and set aside in static-protected environment if PC board is not being replaced and is to be reinstalled.

3) Reinstall screws removed in step 1 onto threaded mounting posts to safely store screws (③ in Figure 3-8) and 1/4”dia. x 3/16” (6mm dia. x 4.5mm) spacers (⑤ in Figure 3-7) for use in reassembly.

4) Do either a or b as appropriate.

a) If replacing only MIB 1&2 Option, go to Section 2.13.5 on page 44.

b) Otherwise, if removing Adv. Comm Option Subassembly, continue to step 1 in Section 2.13.3.

2.13.3 Removing Adv. Comm Option Subassembly

1) Note polarity of 2-wire (red/black) Adv. Comm Option power cable plugged into X17 (behind VGA connector) on rear panel interface PC board, and unplug cable.

2) Unplug network cable connector from network connector (X6) on Adv Comm Option PC board in Adv Comm Option subassembly.

Note: It may be easier to access release tab on network connector if you temporarily unplug 4-wire power cable connector from connector on rear panel interface board (X14).

3) Lift flex cable lock on each side of connector X7 (behind Recorder connector on rear panel interface board) and extract cable out of connector. (Note dress of flex cable so that cable can be reinstalled in exactly same manner during reassembly.

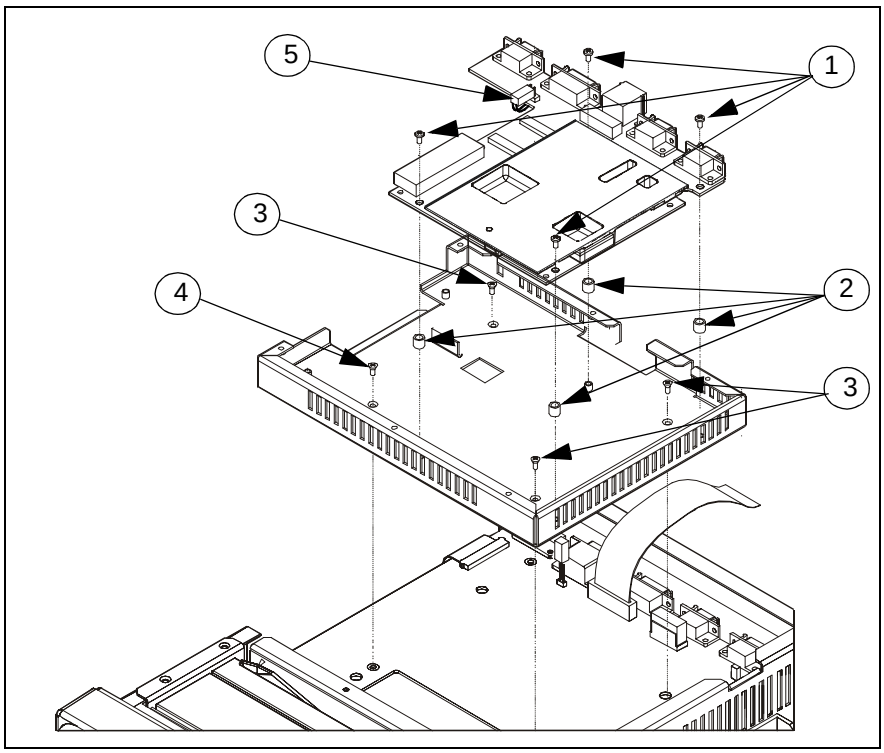


Figure 3-9 Removing/Installing Adv. Comm Option PC board

4) Remove and save four screws (① in Figure 3-9) that secure Adv Comm Option PC board to chassis.

5) Lift side of Adv Comm Option PC board and unplug comm cable connector from COMM 1 (X4) connector on board.

6) Carefully lift Adv Comm Option PC board out of subassembly, sliding flex and power cables out of slot in side of chassis as you lift board.

   Note: Be carefull to NOT remove insulating material, that adheres to slot and protects flex cable from abrasion.

7) Do either a or b as appropriate.

   a) If replacing Adv Comm Option PC board, omit remaining steps in this section and go to step 5 in Section 2.13.4 on page 43.

   b) Otherwise, set Adv. Comm Option PC board aside in static-protected environment and continue to step 8.

8) Reinstall screws removed in step 4, to safely store screws and 1/4”dia. x 3/16” (6mm dia. x 4.5mm) spacers (② in Figure 3-9) on threaded mounting posts for use in reassembly.

9) Remove and save four screws (③ and ④ in Figure 3-9) that secure Adv. Comm Option subassembly chassis to threaded mounting posts on Main PC Board heat sink.

   Note: Note difference between screws ③ and screw ④ in Figure 3-9. Screw ④ was selected to prevent possible interference with installation of MIB 1&2 Option and must be used in mounting post indicated.

10) Lift Adv. Comm Option chassis out of SC 8000 monitor, and set aside for use in reassembly.

11) Reinsert screws ③ and ④ into proper locations in threaded mounting posts on Main PCB heat sink to safely store them for use in reassembly, and then go to Section 2.6.1 on page 33 if removing Connector I/O PC board or to Section 2.5 on page 33 if removing Power Supply.

2.13.4 Installing Adv Comm Option Subassembly

1) Remove screws from threaded mounting posts on Main PCB heat sink. Note type of screw in each mounting post. See note in step 9 of Section 2.13.3 above.

2) Align holes in bottom of Adv Comm Option chassis with threaded mounting posts on Main PCB heat sink, and secure to posts using screws removed in step 1.

3) Remove four screws that secure 1/4”dia. x 3/16” (6mm dia. x 4.5mm) spacers (② in Figure 3-9) on threaded mounting posts in bottom of Adv Comm Option chassis. Do NOT remove spacers.

4) Do either a or b as appropriate.

   a) If reinstalling Adv Comm Option PC board, go to step 10.

   b) If installing replacement Adv Comm Option PC board, go on to step 5.

5) Note polarity of power cable (⑤ in Figure 3-9) plugged into X8 on top side of previously installed Adv Comm Option PC board, and unplug cable.

6) Plug cable into replacement board connector X8 with polarity as noted in step 5 (red wire to pin 1).

7) Lift flex cable lock on each side of connector X10 on back of previously installed Adv Comm Option PC board, and extract flex cable out of connector.

   Note: Note that flex cable has a front and back side. The front of the cable has identifying labeling and is against the bottom of the PC board (labeling not visible) when properly installed.

8) Slide flex cable into X10 of replacement Adv Comm Option PC board, oriented as noted in step 7, and set lock to secure flex cable in connector.

9) Plug cable connector of cable secured to comm connector on top cover of Adv Comm Option chassis into COMM 1 (X4) on Adv Comm Option PC board.

10) Carefully slide power and flex cables under insulation on slot in side of chassis as you orient Adv Comm Option PC board so that mounting holes align with four mounting posts in bottom of Adv Comm Option subassembly chassis. Refer to Figure 3-9 on page 42.

11) Secure Adv Comm Option PC board to chassis using four screws removed in step 3.

12) Plug power cable into connector X17, observing polarity noted in step 1 of Section 2.13.3 on page 41 (red wire to pin 1).

13) Seat flex cable into flex connector X7 on rear panel interface PC board and set lock to secure flex cable in connector.

14) Do either a or b as appropriate.

   a) If installing MIB 1&2 Option, continue to step 1 of Section 2.13.5.

b) Otherwise, if NOT installing MIB 1&2 Option, go to step 1 of Section 2.13.6.

2.13.5 Installing MIB 1&2 Option

1) Remove screws reinstalled in step 3 of Section 2.13.2 on page 41.
2) Slide MIB 1&2 Option PC Board connector (① in Figure 3-9) into connector on Comm Option PC Board (② in Figure 3-9) and seat board in Comm Option chassis.
3 Insert any MIB - External Vendor Device cable into MIB connector, to assist in proper MIB PC board alignment.
4 Insert and tighten mounting screws (③ in Figure 3-9) to secure MIB Option PCB to Comm Option chassis.
5 Remove MIB - External Vendor Device cable inserted in step 3.
6 Plug CAN cable connector (formerly taped to bottom of comm option chassis or plugged into X5 on MIB 1&2 Option PC board) into connector on MIB 1&2 Option PC board (④ in Figure 3-9).
7 Remove labels covering MIB 1&2 Option ports on side of SC 8000 top cover, if installed.

2.13.6 Closing Adv Comm Option Subassembly

1) Dress cable from Comm 1 connector on Adv Comm Option PC board so that it exits chassis via slot in side of chassis beside connector, routes along top of rear panel interface board behind Recorder connector (X5) and VGA connector (X4), and reenters Adv Comm Option chassis via slot in side of chassis near corner. Locate ferrite shield outside chassis near slot where cable reenters chassis.
2) Do either a or b, as appropriate.
   a) If MIB 1&2 Option installed, dress cable from CAN connector so that ferrite filter is positioned so as to not interfere or damage any components when top cover of Adv Comm Option subassembly is secured in place.
   b) If MIB 1&2 Option not installed, resecure loose end of CAN connector cable to bottom of Adv Comm Option chassis.
3) Slide top cover of Adv Comm Option subassembly onto chassis so that mounting holes in cover align with threaded holes in lip of chassis, making sure tongue on back of cover slides under lip of chassis.
4 Insert and tighten five flat-head screws removed in step 3 of Section 2.13.1 on page 39 to secure cover to chassis.
5 Reapply protective tape onto back corner of Adv Comm Option chassis as noted in step 2 of Section 2.13.1 on page 39.
6) Plug network cable connector into network connector on Adv Comm Option subassembly.

   Note: Replug 4-wire power cable connector back into rear panel interface PC board power connector (X14), if disconnected.

7 Close Monitor. Refer to Section 2.14.

2.14 Closing Monitor

1) Reinstall battery tray (if removed) and battery. See Section 2.4.3.
2) With monitor positioned topside up and back of monitor facing you, slide top cover onto monitor.
3) Turn monitor topside down, on a clean flat surface, and install six Phillips-head screws along outside edges to secure top cover to chassis.

4) Turn monitor topside up with back of monitor facing you and set back panel into position on chassis.

5) Install five Phillips-head screws to secure back panel to chassis.

   Note: If Adv Comm Option installed, be sure correct screw is used to secure network cable bracket to back panel and chassis.

6) Plug external power cable and, except for network cable, reconnect all signal cables to monitor.

7) If Connector I/O PCB subassembly or NBP Pump subassembly has been replaced, perform an NBP characterization before continuing to step 8. See Section 10.4 in “Chapter 4: Functional Verification and Calibration”. Otherwise, continue.

8) Functionally verify proper operation of monitor before returning monitor to clinical service.

   Note: Be sure that reassembled monitor passes all leakage tests. Refer to procedures in Section 20 of “Chapter 4: Functional Verification and Calibration”.

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Chapter 4: Functional Verification and Calibration

1 Introduction

Calibration required for proper operation of SC 8000 Patient Monitors has been programmed into the software for the monitor. An adjustment potentiometer, however, permits calibration of the NBP transducer in the field, if required following a calibration check. Specific calibration and adjustment procedures needed in routine operations of the monitor are detailed in the User Guide for the installed software version, and are required to be performed only when directed to do so by a message in the message field on the monitor display.

If specific reading of a patient parameter is suspect, Siemens recommends functional verification for that function. Siemens recommends a full functional verification for all patient parameters, including an NBP calibration check, a pneumatic leakage check, a Temperature calibration check and a leakage current check be performed in accordance with local regulations or at least annually. In addition, re-characterization should be performed at least every two years. Refer to Section 10.4.

> Note: Re-characterization and calibration checks for NBP and Temperature should be performed by only qualified personnel with the necessary equipment. **Regulations in some national jurisdictions may place specific requirements on who may perform these functions**

This chapter describes functional verification procedures, calibration check procedures, and NBP calibration procedures for monitors in the field. The procedures assure proper operation of the monitor, using industry-standard patient simulators and test equipment, to verify that the monitor properly processes and reports patient physiological parameter signal inputs. Record results of functional verification testing in a copy of “Appendix D: Functional Verification Checklist” on page 111.

Software and certain of the monitor’s hardware components are continually checked, first during power-up and later during on-line self-tests. All monitor functions that are tested are performing in accordance with design specifications if no error messages exhibit.

Perform all functional verification and calibration procedures with the monitor off-line. Disconnect all patient parameter signal inputs from the monitor, and plug in signal inputs from patient simulators and industry-standard test equipment only as instructed to do so. **To assure that the monitor is off-line, unplug network cable from monitor.**

If the monitor fails to perform as indicated for any specific function during functional verification procedures, troubleshoot the monitor using procedures in “Chapter 5: Troubleshooting” of this Manual and remedy the malfunction before attempting to complete functional verification.

2 Recommended Tools and Test Equipment

Use specified recommended tools and test equipment given in Table 4-1 below, or a known equivalent, when performing functional verification tests. Substitutions are approved only if an equivalent is listed. Use of other test equipment and/or accessories could result in inconclusive tests or damage to system components.

Table 4-1Recommended Tools and Test Equipment

Tools & Test Equipment			Description
ECG/Resp:			
Patient ECG/Resp simulator			DNI Medsim 300B or equivalent
Leads:	Three-lead grabber set, or	IEC color code 1	Art. No. 33 75 230 E530U
		IEC color code 2	Art. No. 33 75 248 E530U
	Five-lead grabber set	IEC color code 1	Art. No. 33 75 255 E530U
		IEC color code 2	Art. No. 33 75 263 E530U
SpO_2			
Patient SpO_2 simulator, or			Nellcor® PT2500 or equivalent
Reusable SpO_2 sensor:	Durasensor	Adult	Art. No. 45 34 475 EH50U
Non-Invasive Blood Pressure:			
*NBP simulator (calibrated) or			Dynatech CuffLink®, or Veri-Cal® Pressure Transducer Tester, or equivalent
*Mercury manometer with hand bulb			Baumanometer®, 0-300 mmHg
NBP Calibration Assembly			Art. No. 28 77 855 EE54U
NBP connection hose, 3.7 m			Art. No. 12 75 275 EH40U
$etCO_2$			
5.00 ±0.03% CO_2, balance N_2, Calibration Gas Cylinder			Art. No. 28 68 532 EE54U
Calibration Gas Regulator, with elbow fitting			Art. No. 28 68 540 EE54U
Mercury barometer with mm grade			
Invasive blood pressure:			
IBP simulator w/ test cable			DNI Medsim 300B or equivalent
Cardiac Output			
SHP ACC C.O. INTERMEDIATE CABEL			Art. No. 33 68 458 E530U
Temperature			
Temperature simulator w/ test cable (2 cables req'd)			DNI Medsim 300B or equivalent
Temperature Y Cable			Art. No. 55 92 154 E530U
SHP ACC TEMP ADPT CBL 1/4" JACK (2 req'd)			Art. No. 51 98 333 E530U
Leakage			
Leakage Tester			Bender µP-Safety Tester 601/751, or equivalent
Output Cables:			
Recorder ÷ Interface Plate or CPS/IDS			Art. No. 47 21 770 E530U
IDS (or equivalent CPS), unless Monitor used only in DirectNet mode			Art. No. 52 60 110 E5460
*For functional verification and calibration check. For calibration, Paroscientific Pressure Meter, Model 740-12D, or equivalent, is recommended. An equivalent must be accurate to ±0.3 mmHg from 0 to 330 mmHg.			

3 Power Circuits and Start-up

The following procedures check the monitor's power circuits, power-up sequence, and power off indicator. Begin this procedure with the monitor turned off and plugged into a hospital-grade power source.

3.1 Power ON/OFF

1) Press ON/OFF switch on front panel and verify that power LED in ON/OFF key turns on.
2) Press and hold ON/OFF key for approximately two seconds.
3) Verify that high pitched piezo tone sounds briefly and power LED in ON/OFF key turns off.

3.2 Power-Up Sequence

Press ON/OFF key and verify following sequence of events:

- Power LED in ON/OFF key turns on.
- Display illuminates briefly, monitor beeps, high-pitched piezo tone sounds briefly, and Battery charger LED illuminates briefly.
- After a few moments, during which display is NOT illuminated, monitor sounds a chime.
- After a few more moments, New Patient prompt displays.
- Select NO, and press rotary knob in to clear prompt.

  Note: With all patient inputs removed from the monitor, only "adult" and "ALL Alarms OFF" appear on *MAIN* screen.
- Battery charge level bar graph, date and time report in message area at bottom of display.

4 Rotary Knob

The Rotary Knob in the lower right corner of the front panel controls an optical encoder for pointing to and selecting display fields and functions.

1) Press Menu key, and verify that selected menu item changes for each detent as knob is rotated one complete revolution in either direction.
2) Rotate knob until [←] in upper left corner of Main Menu is selected.
3) Press knob in and verify that *MAIN* screen displays.

5 LCD Display

The display is composed of an active-matrix LCD screen with backlight. Test the LCD display as follows:

1) With *MAIN* Screen displayed, verify that ≤17 Pixels are inoperative ("stuck" ON).
2) Press Menu key and select Monitor Setup → Display Options.
3) Select Brightness
4) Change setting of rotary knob and observe that brightness of display screen varies accordingly. (monitor must be on battery power)
5) Set brightness for AUTO.
6) Verify that backlite provides sufficient and uniform background illumination for LCD, while connected to external power source (CPS, IDS, PSL).
7) Verify intensity change with change in ambient light.
8) Press Main Screen key to return to *MAIN* screen.

6 Fixed Keys

The following tests verify that membrane switches on the front panel are functioning properly, and that the signal from the key is processed by the

Front Panel Control PCB. Functions controlled by the fixed keys are individually verified elsewhere in this Chapter as required.

Note: Before beginning Key tests access Main menu. Select Monitor Setup → Monitor Options → Speaker Volumes, and assure that Attention Tone Volume is set to other than OFF.

6.1 ON/OFF Key

The ON/OFF key initiates the power-on sequence if the monitor is powered off, and powers-off the monitor, initiating a brief power-off piezo alarm, if the monitor is powered-on.

Note: This test can be omitted if the procedure of section 3.1 has already been performed.

1) Press and momentarily hold ON/OFF key.
2) Verify that powered state of monitor changes.
3) Set monitor to powered-on state, if monitor powered off.

6.2 Main Screen Key

The Main Screen key sets the display to the *MAIN* screen.

1) Press Menu key to display Main menu.
2) Press Main Screen key, and verify that Main menu extinguishes, and display returns to *MAIN* screen.

6.3 Alarm Silence Key

The Alarm Silence key silences an alarm tone for one minute.

1) Assure that HR alarm is enabled, and without any input applied to MultiMed POD, plug MultiMed or MultiMed 12 cable into monitor. Monitor should Alarm.
2) Press Alarm Silence key and verify that alarm ceases.
3) Turn off HR alarm in Alarm Limits Table before proceeding. See section 6.4.

6.4 Alarm Limits Key

The Alarm Limits fixed key calls up a setup table on which upper and lower alarm limits for physiologic parameters can be assigned, and alarms and alarm recordings can be enabled or disabled.

1) With *MAIN* screen displayed, press Alarm Limits fixed key.
2) Verify that Alarms Setup Table displays.

6.5 All Alarms Off Key

The All Alarms Off key silences all alarms for a period of 2 minutes.

1) Press All Alarms Off key.
2) Verify that 2 minute countdown field appears at top center of display.

6.6 Code Key

The Code key can perform any of several functions, depending on other parameter settings entered into the monitor. Refer to operating instructions in the User Guide for more detailed information. The following procedure verifies only that the monitor responds to a key press.

1) Press the key and verify that a change occurs in the display.
2) Double-click key to return display to former status.

6.7 Record Key

The Record key starts and stops a recording of limited duration when the monitor is mounted on an IDS (or CPS).

1) With monitor mounted on IDS (or CPS) press Record key.
2) Verify that message “Recording Not Accepted” appears in message field at bottom right-hand side of display.

6.8 Print Screen Key

Print Screen key initiates printing a copy of the display, on network printer.

1) Press Print Screen key twice.
2) Verify that message “Printer Unavailable, Waiting” appears in message field at bottom right-hand side of display.

6.9 NBP Start/Stop Key

The NBP Start/Stop key initiates or terminates the inflation cycle for the non-invasive blood pressure monitor function.

1) Press Menu key. Access Monitor Setup → Monitor Options → Speaker Volumes, and set Attention Tone Volume to 50%.
2) Press NBP Start/Stop key.
3) Verify that monitor sounds a tone. (Cuff must not be plugged into cuff connector.)

6.10 Zoom Key

When a patient is being monitored, the Zoom key calls up a 1-hour trend display for a quick overview of patient status.

1) Press Zoom key, and verify that “Fast Access Menu” displays.
2) Press Main Screen key to return.

6.11 Help Key

1) Press Help key and observe that Main Help Menu appears on display.
2) Press Main Screen key to clear display.

6.12 Mark Key

The Mark key inserts parameter values with time and date stamp in the tabular trends. Verify that Mark membrane switch is functional as follows:

1) Press Menu key and select Review → Trend Table.
2) Press Mark key and observe that time stamp on HR readout changes from white to green and Mark symbol appears above stamp.

7 ECG/RESP Functions

With the cable plugged into the monitor connect either a 3-lead, 5-lead, or 6-lead ECG cable from the Patient Simulator into the MultiMed POD.

7.1 ECG/RESP Test Setup

1) Select HR parameter box and press rotary knob in to bring up ECG menu.
   - Set all ECG Lead settings at default values and remaining parameters as follows:
     - ARR Monitoring Basic
     - RESP Monitoring ON
     - Pacer Detection ON
   - QRS Sync MarkerON
   - Pulse Tone SourceECG
   - Pulse Tone Volume10%
2) Set simulator as follows:
   - ECG = Normal Sinus
   - HR = 80 beats per minute (bpm)
   - amplitude = 1.0 mV
   - RESPIRATION = Normal Rest.
   - rate = 20 breaths per minute (BPM)

- ohms = 1.0
- LEAD SELECT = II/RA-LL
- BASELINE IMPEDANCE = 500

7.2 Waveforms/Digital Readouts/Tones

1) Verify the following:
   - Waveform and HR correspond to data provided by simulator.
   - Heart symbol (♥) blinks and pulse tone sounds for each QRS complex.
   - White spike present at each QRS complex.
   - RESP and HR digital readout correspond to settings of simulator.
2) Vary Tone Volume setting and verify that pulse tone volume changes.
3) Set Tone Volume to OFF, and verify that pulse tone stops.

7.3 Pacer Detection

1) Apply paced signal from simulator.
2) Verify that small “P” accompanies heart symbol (^{P}♥) for every detected, paced beat, blue spike appears for each paced signal, and HR digital value agrees with pacer bpm setting.
3) Generate asystole condition in simulator, with pacer output still active.
4) Verify that ASY appears in ARR parameter box, an asystole alarm sounds, and waveform is flatline with pacer pulses.
5) Disable pacer signal, and return simulator to setup above (section 7.1).

7.4 Lead-Off Indicators

1) One at a time, disconnect each ECG lead from simulator.
2) • For LL and RA electrodes, verify “Lead-Off” and “ECG Leads Invalid” messages appear in message area, pulse tone ceases, *** replaces digital heart rate in HR field.
   - For V and RL electrodes, verify “Lead-Off” message, loss of V trace.
   - For LA electrode, verify “Lead-Off” message only.
3) Reconnect all leads to simulator.

7.5 Alarm Function

This procedure also tests that the alarm function of the monitor, as applicable to all other patient parameters, is operational in the monitor.

1) In Alarm Limits Table, set HR alarm parameters as follows:
   - Upper limit = 110 bpm
   - Lower limit = 40 bpm
   - Alarm = ON
2) Set emulator to HR = 120 bpm.
3) Verify that monitor responds with following Serious Alarm indications:
   - HR in parameter field = 120
   - HR parameter field blinks and color changes.
   - Serious Alarm tone sounds.
   - Message HR > 110 appears in message area at bottom of display.
4) Reset simulator to HR = 80 bpm.

5) Verify the following:
   - HR parameter field returns to normal color
   - HR returns to 80
   - Message area continues to report most recent alarm, HR >110.
6) Press Alarm Silence fixed key.
7) Verify that “HR > 110” ceases to be reported.

7.6 Asystole

Switch power to simulator OFF. Verify that HR parameter field reports ASY, “Asystole” appears in message area at bottom of display, and monitor responds with Life-Threatening alarm.

Switch power to simulator ON.

8 SpO_2 Function

The SC 8000 monitors oxygen saturation (SpO_2) and pulse rate using the spectrophotometric method. SpO_2 software is checked on monitor power-up and also periodically while the monitor is in operation.

8.1 SpO_2 Test Setup

The SpO_2 parameter box appears when an SpO_2 input is applied to the monitor through the MultiMed POD.

1) Access SpO_2 parameter box menu. Set parameters as follows:
   - Pulse Tone Source - SpO_2
   - Pulse Tone Volume -10%
   - Waveform Size - 10%
   - Averaging - Normal
2) Do either of the following as appropriate:
   a If using a variable SpO_2 simulator, set SpO_2 level to 98% and pulse rate to 70 bpm, and plug simulator into SpO_2 input adapter cable to MultiMed POD.
   b If using a Nellcor PT-2500 pocket tester or equivalent, plug tester into SpO_2 input adapter cable to MultiMed POD.

8.2 Waveforms/Digital Readouts/Tones

1) Verify the following:
   - Simulated SpO_2 waveform appears, and digital SpO_2 and pulse rate (PLS) values correspond to simulator settings.
   - ♥ symbol blinks in SpO_2 field, and pulse tone sounds synchronous with appearance of ♥ symbol.

8.3 Pulse Tone Generator

1) Select Pulse Tone Volume in SpO_2 menu.
2) Vary volume setting and verify that pulse tone volume changes.
3) Set Pulse Tone Volume to OFF, and verify that tone stops. Then reset pulse tone to ON.
4) Do either of the following as appropriate:
   a If using variable simulator, change oxygen saturation value and verify that pulse tone frequency (pitch) increases as SpO_2 level increases, and decreases as SpO_2 level decreases.
   b If using pocket tester or equivalent, replace tester with adult finger sensor and place sensor on your finger. Your SpO2 reading should

be > reading obtained from tester, and frequency (pitch) of pulse tone should increase.

8.4 SpO_2 Limits Alarms

1) In Alarm Limits Table, set SpO_2 upper limit to 100%, lower limit to 80%, and assure that alarm is ON.
2) Set simulator to an SpO_2 value outside of set limits.
3) Verify that monitor responds with serious Alarm indication.
4) Reset simulator to value within alarm range. Verify that alarm ceases

9 Temperature Function

9.1 Temperature Test Setup

Using the Temperature Y Cable input to the MultiMed Pod, set up the patient simulator to supply a temperature input to Temp A.

Set the simulator for a standard 37°C.

9.2 Digital Readout

1) Verify that monitor indicates temperature of 37±0.1°C.
2) Change simulator to temperature above and then below 37°C.
3) Verify that monitor readout agrees with simulator settings ±0.1°C.
4) Repeat procedure for Temp B input to Temperature Y Cable.

9.3 Temperature Calibration Check

Use the following procedure to check temperature calibration. Record and retain results in a copy of Table 4-2. Also record results in Appendix D. Monitor must be returned to Siemens for repair if calibration check fails.

Table 4-2 Resistance Value vs Temperature

Resistance Setting	Set Temperature	Reading On Monitor	Tolerance	Pass/ Fail
9045	-4.0		-4.1 to -3.9	
3539	15.0		14.9 to 15.1	
1355	37.0		36.9 to 37.1	
843.2	49.0		48.9 to 49.1	

9.3.1 Recommended Equipment

Decade Resistor, ±0.1% accuracy (or fixed resistors with same accuracy)

Siemens Temp Adapter Cable, Art. No. 51 98 333 E530U (Optional)

Siemens “Y” Adapter, Art. No. 55 92 154 E530U

9.3.2 Procedure

1) Connect MultiMed cable to input of patient monitor.
2) Connect temp “Y” cable to temp input of MultiMed Pod.
3) Connect decade resistor to Temp A temperature input.
4) For each resistance value in Table 4-2, verify that monitor reports “Set Temperature” value ±0.1°C.
5) Repeat procedure for Temp B input to Temperature Y Cable.

10 Non-Invasive Blood Pressure Function

The SC 8000 measures non-invasive blood pressure (NBP) according to the oscillometric method. Perform NBP characterization after replacing the NBP Subassembly and also after replacing the Rear Housing Subassembly (which includes the Connector I/O PCB). Use tools listed in Table 4-1 on page 48 to check calibration of the pressure transducer. Note pressure indicator required for NBP calibration.

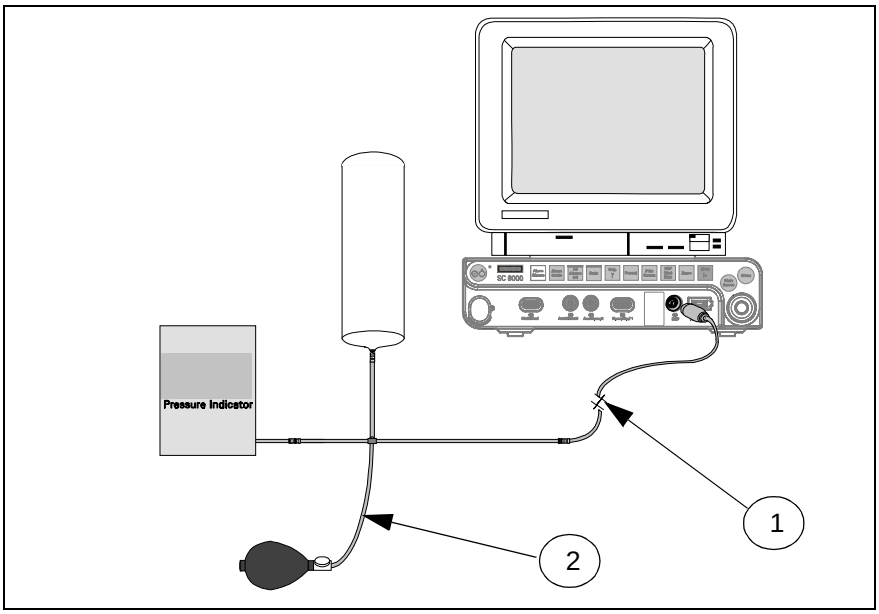


Figure 4-1 NBP Calibration Check / Calibration Test Setup

10.1 System Setup and Pneumatics Leakage Test

Set up the NBP Calibration assembly (Art. No. 28 77 855 EE54U) as illustated in Figure 4-1. Assure that pneumatic leakage is within specifications before continuing to Section 10.2, Calibration Check.

1) Assure that patient category is set to Adult.
2) Set following in NBP parameter field menu:
   - Interval Time - OFF
   - Continuous Mode - OFF
   - Calibrate Mode - ON. (Observe “NBP Cal. = 0 mmHg” appears.)
3) Clamp pneumatic hose (with hemostat or clamp) between T-connector and monitor (① in Figure 4-1), and using pressure bulb, increase pressure to 250 ±5 mmHg. Then clamp hose at inflation bulb (② in Figure 4-1),and let pressure stabilize for 1 minute. *Do NOT run pump.*
4) Observe pressure drop for an additional 5 minutes. Drop should be <2 mmHg in 5 minutes. If not, tighten all connections and fittings and retest equipment for leakage. When leakage test OK, go on to step 5.
5) With both clamps removed, reinflate to 250±5 mmHg, if necessary, and then reclamp hose at inflation bulb.
6) Observe pressure drop for 1 minute. Drop should be <4 mmHg. If not, service monitor’s internal pneumatics system and retest system for leakage. When leakage test OK, remove clamp at inflation bulb and go on to Section 10.2.

10.2 Calibration Check

Note: You may have only 2 min. to perform this test if the pump has run since the monitor was powered on, before the H/W deflation error initiates. If this happens, you will need to reset the monitor. If the pump has not run, however, there is no time limit.

1) Return to Main menu. Using hand bulb, increase pressure to 250 ±5 mmHg, if necessary, and allow it to stabilize for 1 minute.
2) Verify that pressure values displayed on monitor and pressure indicator are within ±3 mmHg of each other.

3) Slowly release pressure in 50 mmHg increments. At pressures of 200, 150, 100, and 50 mmHg, verify that pressure values on monitor and pressure indicator are within ±3 mmHg of each other at each level.

4) If NBP function fails calibration check, continue to Section 10.3. If calibration check OK, go on to Section 10.5, Hardware Overpressure.

10.3 NBP Calibration Procedure

Note: For NBP calibration, the Pressure Indicator must be accurate to ±0.3 mmHg from 0.0 mmHg to 330.0 mmHg, and must be calibrated. The calibration must be traceable to National Standards.

1) With NBP Calibrate Mode in monitor set to ON, using inflation bulb, increase pressure to 250 ±5 mmHg.

2) Clamp pneumatic hose (with hemostat or clamp) at inflation bulb.

3) Remove R393 port cover (if installed, see ⑨ in Figure A-1 on page 80), and adjust R393 for monitor pressure indication that matches reading on pressure indicator ±1mmHg.

Note: R393 is accessible through hole in left side of front bezel beside cable dress post. Replace covering on hole after adjustment.

4) Remove clamp and release pressure from system.

5) Perform an NBP characterization. Use procedure in Section 10.4.

10.4 NBP Characterization

Note: Always perform NBP calibration check before attempting characterization. Perform NBP calibration if required.

1) Using adult hose, connect .5l pressure canister of NBP Calibration assembly directly to monitor cuff connector.

2) Press Main Menu key, and select Monitor Setup → Biomed → Service.

3) Enter service password (4712) and select Accept.

4) Select Characterization → NBP Char.

5) Verify that “NBP Characterizing” displays in message field. When message blanks, process has completed.

Note: If characterization fails, see “NBP Troubleshooting” in Chapter 5.

6) Return to Section 10.2, Calibration Check.

10.5 Hardware Overpressure

1) With monitor still in calibration mode, slowly increase pressure. while observing pressure rise on monitor’s screen.

Note: Pressure indicator accuracy of ±0.3 mmHg is not required for hardware overpressure and subsequent NBP tests.

2) Verify that pressure suddenly drops at 300 ±30 mmHg.

3) Release all remaining pressure before proceeding.

4) Set patient category to neonatal and repeat steps 1 through 3, using pressure limit of 157±8 mmHg for step 2.

10.6 Pump

1) Set Calibrate Mode in NBP parameter field menu to OFF.

2) Press NBP Start/Stop key.

3) Verify the following:

- Pressure increases and then decreases.
- Inflation and deflation pressures reported in message field.

- Message “NBP No Pulsation” exhibits at end of deflation phase.
- All digital readouts in NBP field are ***.

10.7 Interval Mode

1) With NBP Calibrate Mode set to OFF, set Interval Time to 1 min.
2) Verify the following:
   - One-minute countdown bar graph appears at bottom of NBP parameter box.
   - NBP pump starts immediately when rotary switch is pressed in.
   - NBP sequences through an inflation/deflation cycle and produces “NBP No Pulsation” message at bottom of display.
   - NBP pump starts again when one-minute countdown bar resets to initiate another cycle.
3) Press NBP Start/Stop key to stop cycle, and reset Interval Time to OFF.

10.8 Safety Timer

1) Assure that NBP Calibrate Mode is set to OFF.
2) Press NBP Start/Stop fixed key to start pump.
3) Press same key again to stop measurement.
4) Set NBP Calibrate Mode to ON, and press MAIN SCREEN key.
5) Press CODE key to start screen stopwatch. Observe monitor screen.
6) Press CODE key again to stop watch when “NBP Cuff Deflation Error” message displays, indicating that safety timer has activated.
7) Verify that elapsed time is as follows:
   - Adult 120 ±5 seconds.
   - Neonatal 90 ±5 seconds
   - French Homologation 60 ±5 seconds
8) Press NBP Start/Stop fixed key.
9) Verify that tone sounds and pump fails to start.
10) Power-cycle monitor to clear fault condition.

11 $etCO_2$ Function

With ≥VE0 software installed in the SC 8000, the $etCO_2$ Pod enables the SC 8000 to non-invasively monitor end-tidal CO_2 ($etCO_2$) using a technique that relies on the selective absorption properties of CO_2 to specific frequencies of infrared radiation. The pod automatically compensates for variations in ambient barometric pressure if Monitor set to automatic mode. Before beginning this procedure, use a mercury column barometer or equivalent other device to determine local atmospheric pressure. Record this value.

1) Plug $etCO_2$ Pod into Aux. connector (between Hemo Med 1 connector and NBP port) on front of Monitor .

   Note: Observe that the parameter box appears on the monitor display screen, and that “etCO2 Sensor Warming Up” followed by “etCO2 Place Sensor on Zero Cell” appears in the message field.
2) While sensor is warming up, select etCO2 parameter box.
3) Assure that Atmospheric Pressure is set to “Manual”, and is set to value indicated by mercury column barometer.

4) Place sensor on Zero Cell.
5) Note that “etCO2 Calibrating Sensor” appears in message field, followed by “etCO2 Place Sensor on Ref Cell”.
6) Place sensor on Reference Cell.
7) Verify that”etCO2 Verifying Sensor Cal” followed by “etCO2 Sensor Cal Verified” appears in message area, and reading in etCO2 parameter box = 38 ±2mmHg.
8) Attach adult airway adapter to calibration gas cylinder. Do NOT open valve on cylinder.

   Note: As CO_2 is heavier than room air, set up the airway adapter such that the point where the gas exits from the adapter is higher in elevation than the point where it enters.
9) Place sensor on adult airway adapter and note reading = 0 ±1 mmHg.
10) Turn valve on the cylinder until it is fully open.
11) Wait for 30 seconds and record displayed value.
12) Close valve and remove sensor from airway.
13) Verify that measured value is in range (0.05 x local pressure) ±3, rounded to nearest integer.
14) Select $etCO_2$ parameter box and set Atmospheric Pressure to AUTO.
15) Repeat steps 4 through 12.
16) Verify that measured value = previously measured value ±3, rounded to nearest integer.

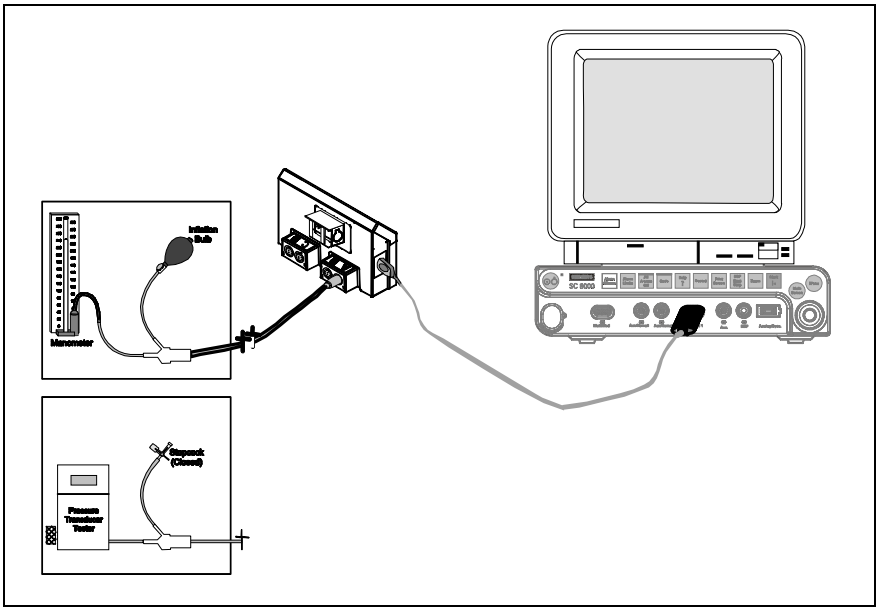


Figure 4-2 IBP Functional Verification Test Setup for HemoMed Pod

12 HemoMed Pod

Refer to Figure 4-2 for test setup. Invasive blood pressure and cardiac output functions of HEMO2/4 PODs are incorporated in the HemoMed Pod. A single cable connects the Pod to the HemoMed 1input on the front of the SC 8000. Pressure labels for HemoMed Pod channels are set in the monitor.

12.1 IBP Function

12.1.1 IBP Test setup

1) With MultiMed cable and all other patient inputs unplugged from monitor, power-cycle monitor. Select NO to clear display.
2) Plug cable from HemoMed Pod output into HemoMed 1 connector on front of Monitor. See Figure 4-2.

12.1.2 Channel A

3) With *MAIN* screen displayed, connect BP output from simulator to first input, channel A, on HEMO POD adapter.
4) Set IBP simulator for a static pressure = 0 mmHg.

   Note: "Zero Required" message, appears on display.

Monitor Zero Function

5) Press Zero All key on HemoMed Pod.

   Note: All four pressures are zeroed simultaneously in the monitor, even if only channels A and B are to be used in the HemoMed Pod.
6) Verify that a "Zero Accepted" message that changes to "Static Pressure" appear in the message field.
7) Select a pulsatile pressure on patient simulator.
8) Assure that Cal Factor and Manometer Cal are set to 100.
9) Verify that pressure reading on monitor agrees with values generated by pressure signal from simulator.

If verifying only SC 8000, omit remaining steps in this section and go to section 12.2. If also verifying HEMO POD, go on to step 10.

12.1.3 Channel B

10) Unplug BP adapter cable from channel A on HEMO POD and plug it into channel B.
11) Verify that pressure reading on monitor agrees with values generated by pressure signal from simulator.
12) Do either step a or step b as appropriate.
    a If HemoMed Pod has four channels, unplug the BP adapter cable from channel B and plug it into channel C. then go on to step 13.
    b If HemoMed Pod has only two channels, bypass remaining steps of this section and go to section 12.2.

12.1.4 Channel C

13) Unplug BP adapter cable from channel B on HemoMed Pod and plug it into channel C.
14) Verify that pressure reading on monitor agrees with values generated by pressure signal from simulator.

12.1.5 Channel D

15) Unplug BP adapter cable from channel C on HemoMed Pod and plug it into channel D.
16) Verify that pressure reading on monitor agrees with values generated by pressure signal from simulator.
17) Unplug simulator input adapter cable from HemoMed Pod, and go on to section 12.2.

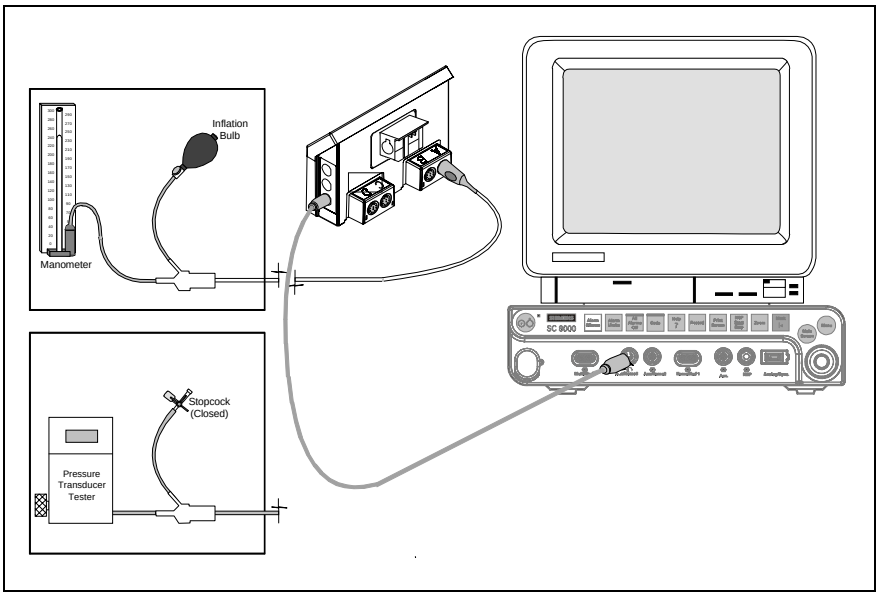


Figure 4-3 IBP Functional Verification Test Setup for HEMO2/4 PODs

12.2 Cardiac Output Function

1) Plug C.O. output from simulator into C.O. test adapter cable, and plug adapter cable into C.O input on HemoMed Pod.
2) When READY appears in CO parameter field verify that blood temperature indication is 37±0.15°C.
3) Press C.O. START key on simulator, and verify an Injectate Temperature indication of 1±0.2°C.

13 HEMO POD2/4

Refer to Figure 4-3 for test setup.

13.1 IBP Function

IBP parameter boxes for up to two pressures for HEMO 2 POD or up to four pressures for HEMO 4 POD display automatically when IBP signal from POD is plugged into monitor, when Display Mode is set to automatic.

If verifying proper IVP functioning of only the Monitor, do sections 13.1.1 and 13.1.2, and then go on to section 13.2. If functionally verifying the HEMO POD also complete sections 13.1.3, 13.1.4, and 13.1.5.

13.1.1 IBP Test setup

1) With MultiMed cable and all other patient inputs unplugged from monitor, power-cycle monitor. Select NO to clear display.
2) Plug cable from HEMO POD IBP SC 9000 output into Aux./Hemo3 input on front of SC 8000 monitor.

13.1.2 HEMO2/4 POD Channel A

3) With *MAIN* screen displayed, connect BP output from simulator to first input, channel A, on HEMO POD adapter.
4) Set IBP simulator for a static pressure = 0 mmHg.

   Note: "Zero Required" message, identified by same pressure label is shown in LCD window for channel A on front of HEMO POD appears on display.

Monitor Zero Function

5) Press Zero All key on HEMO POD.
6) Verify that a "Zero Accepted" message that changes to "Static Pressure", both identified by the same pressure label, appear in the message field.
7) Select a pulsatile pressure on patient simulator.

8) Assure that Cal Factor and Manometer Cal are set to 100.

9) Verify that pressure reading on monitor is in agreement with values generated by pressure signal from simulator.

10) Plug cable from HEMO POD IBP SC 9000 output into Aux./Hemo2 input and repeat steps 3 through 9. Otherwise, continue.

11) If functionally verifying only the SC 8000, omit the remaining steps in this section and go to section 13.2. If also functionally verifying HEMO POD, go on to step 12.

13.1.3 HEMO2/4 POD Channel B

12) Unplug BP adapter cable from channel A on HEMO POD and plug it into channel B.

13) Observe that pressure label changes to same pressure label as is shown in LCD window for channel B on front of HEMO POD.

14) Verify that pressure reading on monitor is in agreement with values generated by pressure signal from simulator.

15) Do either step a or step b as appropriate.

a If the HEMO POD has four channels, unplug the BP adapter cable from channel B and plug it into channel C. then go on to step 16.

b If the HEMO POD has only two channels, bypass remaining steps of this section and go to section 13.2.

13.1.4 HEMO4 POD Channel C

16) Unplug BP adapter cable from channel B on HEMO POD and plug it into channel C.

17) Observe that pressure label changes to same pressure label as is shown in LCD window for channel C on front of HEMO POD.

18) Verify that pressure reading on monitor is in agreement with values generated by pressure signal from simulator.

13.1.5 HEMO4 POD Channel D

19) Unplug BP adapter cable from channel C on HEMO POD and plug it into channel D.

20) Observe that pressure label changes to same pressure label as is shown in LCD window for channel D on front of HEMO POD.

21) Verify that pressure reading on monitor is in agreement with values generated by pressure signal from simulator.

22) Unplug simulator input adapter cable from HEMO POD, and go on to section 13.2.

13.2 Temperature Function

To perform a temperature calibration check, refer to the procedure of Section 9.3 on page 54. Connect the decade resistor directly across the temp input to the Hemo 2/4 Pod instead of using the Y cable.

1) Plug fixed temperature (37°C) output from simulator into TEMP A connector HEMO POD.

2) Plug selectable temperature output from simulator into TEMP B connector HEMO POD, and set temperature for other than 37°C.

3) Verify the following:

- T field appears on *MAIN* screen
- T1a temperature = 37 ±0.1°C
- T1b temperature = simulator setting ±0.1°C.

4) Select Temperature field, and access TEMP1 menu.
5) Select TEMP Display and then select $\Delta T1$.
6) Verify that T1b changes to $\Delta T1$ and reports temperature difference between T1a and T1b ±0.2°C.
7) Reset TEMP Display in TEMP1 menu to T1b.
8) Press Main Screen key to clear table and return to *MAIN* Screen.

13.3 Cardiac Output Function

1) Plug C.O. output from simulator into C.O. test adapter cable, and plug adapter cable into C.O./Temp B input on HEMO POD.
2) When READY appears in CO parameter field verify that blood temperature indication is 37±0.15°C.
3) Press C.O. START key on simulator, and verify an Injectate Temperature indication of 1±0.2°C.

14 Memory Backup

The monitor retains patient-related data, such as alarm limits, trends, and stored alarm recordings when it is powered off.

1) With monitor powered-up and no patient inputs applied, press Alarms Limits fixed key and change limit for any parameter.

   Note: Note time on Real Time Clock.
2) Power monitor off for approximately 2 minutes, and then power it back on again.
3) After *MAIN* screen displays, press Alarm Limits fixed key to call up Alarm Limits Table.
4) Verify that new limit(s) you set in Step 1 have been retained, and that clock has advanced the proper amount of time.

15 MIB 1&2 and CAN Options (if installed)

Omit steps 1 and 2 if MGM not used with this monitor.

1) With MAIN screen displayed on the SC 8000, connect MGM to Comm connector input on SC 8000 and to a hospital-grade power source.
2) Switch MGM power on, and verify that Agent parameter box displays on SC 8000 screen.
3) Plug MIB - External Vendor Device cable into any MIB input and into External Vendor Device port as given in Table 2 of Software Compatibility Chart, T855-xx-7600, for installed monitor software.
4) Refer to Operating Instructions for External Vendor Device to set up device as required in Table 2 of the Software Compatibility Chart.
5) Power External Vendor Device ON, and verify that vendor parameters appear on Monitor Display in accordance with MIB User Guide.

   Note: If test mode not possible on External Vendor Device, only parameter and waveform templates may display on Patient Monitor. Refer to User Guide for installed softrware version for instructions on using MIB option.

16 Adv Comm Option (if installed)

Functional verification of proper operation of the Adv Comm Option has been programmed into the software. To verify proper operation, connect an SDC (Surgical Display Controller) to the Adv Comm connector. The Monitor automatically performs a functional verification and reports successful completion on the Display.

17 Configuration

This checks for proper configuration and for monitor communication via the INFINITY NETWORK.

1) Connect monitor to INFINITY NETWORK using ethernet connector on back of monitor.
2) Setup monitor for simulated patient using external patient simulator.
3) Verify that waveforms display on MVWS.

   Note: If INFINITY NETWORK not equipped with MVWS, use remote view function of another monitor on network to view waveforms. Then skip step 4 and go on to Section 18.

4) Access **netInfo** on MVWS and verify that monitor labels are unique.

18 Battery Charger Circuit

1) With partially discharged battery installed in monitor and monitor unplugged from AC source, bring up *MAIN* screen.
2) Plug monitor into AC power source and assure that Battery charger LED is illuminated.
3) After 1 hr., unplug monitor and verify that charge level on main battery has increased.

19 Recorder Function

The R50 Recorder connects to the SC 8000 monitor through X13 on back of the monitor. The following procedure verifies that the monitor is communicating with the Recorder.

1) Connect known good R50 Recorder to monitor.
2) Press Menu key, and access Monitor Setup → Biomed → Service.
3) Enter Service password (**4712**) and select Accept.
4) Select Bedside Setup, and set Waveform Simulator to ON.
5) After monitor cycles, bring up *MAIN* screen.
6) Press Record fixed key.
7) Verify that recorder begins to dispense waveform printout.
8) Press Stop key on recorder to stop paper flow.
9) Press Menu key, and access Monitor Setup → Biomed → Service.
10) Enter Service password (**4712**) and select Accept.
11) Select Bedside Setup, and set Waveform Simulator to OFF.

20 LeakageTests

SC 8000 monitors are AC voltage operated devices. Leakage tests assure that under both normal and fault conditions, any leakage current does not exceed values given in Section 20.2.

20.1 Resistance Test

1) Using DMM (Fluke, model 8050A or equivalent) measure resistance between ground stud on rear panel and earth pin on the AC inlet (i.e. where the cord plugs in).

   Note: Since the value of resistance is very small, you are reminded that it is necessary to account for lead resistance in the measurement. Prior to measuring the resistance between the ground stud on the rear panel and the earth pin on the AC inlet, connect both meter leads to the ground stud and measure the meter lead resistance. Subtract this lead resistance value from the DVM reading obtained in the ground stud / earth pin resistance measurement.

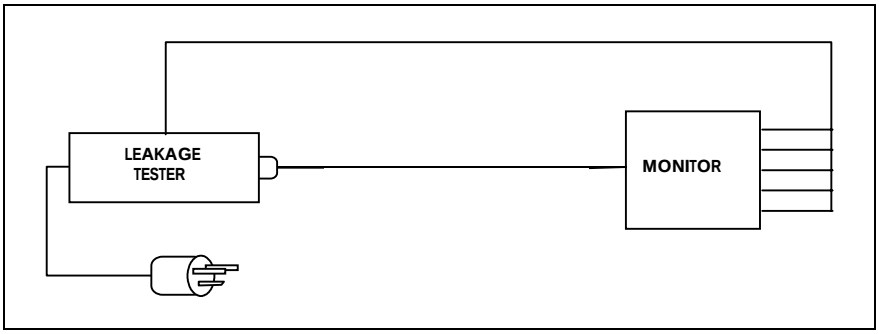


Figure 4-4 Leakage Current Test Setups

2) Verify that resistance between ground stud and earth pin <0.5Ω. Record reading in space provided on functional verification checklist.

20.2 Leakage Current Tests

1) Perform leakage current tests with monitor plugged into leakage tester. See Figure 4-4.

2) Follow leakage tester manufacturer's instructions to measure each of leakage currents given below:

Enclosure (Case) Leakage Current:

Normal:	Limit	<10 µa
Open Ground:	Limit	<500 µa at 240 vac
	or	<300 µa at 120 vac

Open Ground and Reverse Mains:

	Limit	<500 µa at 240 vac
	or	<300 µa at 120 vac

Patient Combined Leakage Current:

Normal:	Limit	<10 µa
Open Ground:	Limit	<50 µa

Leakage with Mains on Patient Leads:

	Limit	<50 µa

3) Record all values in copy of monitor's functional verification checklist in Appendix D.

Chapter 5: Troubleshooting

1 Introduction

Troubleshooting SC 8000 monitors is either a two- step or three-step process.

Step 1) Determine whether the trouble is external, such as a malfunctioning pod, connector, or cable, or internal.

Step 2) Do either a or b as appropriate.

a If external, replace malfunctioning item.

b If internal, go on to step 3.

Step 3) Usual remedial action is to replace malfunctioning component or subassembly. See "Appendix A: Replacement Parts" for complete listing of replaceable system components and subassemblies. After replacing an internal subassembly, functionally verify all monitor functions before returning monitor to clinical service.

SC 8000 monitoring system devices consist of the Base Unit, and peripheral devices including the R50 Recorder, etCO_2 Pod, MultiMed or MultiMed 12 Pod, HEMO or HemoMed Pod, and VGA Display.

2 Recommended Tools and Test Equipment

Use the specified, recommended tools and test equipment, or a known equivalent, when troubleshooting SC 8000 monitors and peripheral equipment. Substitutions are approved only if an equivalent is listed. Use of other test equipment and/or accessories could result in inconclusive tests or damage to system components.

Table 5-1 Recommended Tools and Test Equipment

Tools & Test Equipment			Description
Digital Multimeter (DMM), 4.5 digit			Fluke, model 8050A (or equiv.)
Patient ECG/RESP, Temp, IBP simulator			DNI Medsim 300B or equivalent
Leads:	Three-lead grabber set, or	IEC color code 1	Art. No. 33 75 230 E530U
		IEC color code 2	Art. No. 33 75 248 E530U
	Five-lead grabber set	IEC color code 1	Art. No. 33 75 255 E530U
		IEC color code 2	Art. No. 33 75 263 E530U
Patient SpO_2 simulator, or			Nellcor® PT2500 or equivalent
Reusable SpO_2 sensor:	Durasensor, Adult		Art. No. 45 34 475 EH50U
NBP simulator (calibrated) or			DNI CuffLink®
Mercury manometer with hand bulb, or			Baumanometer®, 0-300 mmHg
Electronic pressure indicator with handbulb			Veri-Cal® Pressure Transducer Tester, or equivalent
NBP Calibration Assembly			Art. No. 28 77 855 EE54U
NBP connection hose	3.7 m		Art. No. 12 75 275 EH40U

3 Power Problems

Before troubleshooting power problems, keep in mind that fuses are used to protect delicate circuits from potentially harmful currents. Replacement of a fuse may provide only a temporary solution and may not remove the source of the fault. Never replace a fuse with other than what is specified.

3.1 Power Problems

3.1.1 No Response When POWER ON/OFF Key Pressed

Table 5-1 Power-On Problems

Conditions	Possible Cause(s)	Troubleshooting and Remedial Action
Monitor plugged into clinical site power source. AC power LED not illuminated.	Clinical site power source not active, or defective power cable. Defective power supply or power harness Connector I/O PCB malfunction	1. Assure that clinical site power source is active, and known-good power cable is plugged into SC 8000 power supply. 2. If problem persists, check for +12Vdc across red and black wires at output connector of power supply. If voltage not OK, replace power supply. 3. If voltage OK, replace power cable. 4. If problem persists, replace Connector I/O PCB. 5. If problem persists, contact TSS in Solna or Danvers.
Monitor plugged into clinical site power source. AC power LED illuminated.	Power Supply Connector I/O PCB malfunction Main Processor PCB malfunction	1. Check for +12Vdc across red and black wires at output connector of power supply. If voltage not OK, replace power supply. 2. If problem persists, replace Connector I/O PCB. 3. If problem persists, replace Main Processor PCB Subassembly. 4. If problem persists, contact TSS in Solna or Danvers.

3.1.2 Power On/Off Piezo Tone Fails to Sound.

Table 5-2 Power-off Alarm Malfunction

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
Piezo tone fails to sound when monitor powered on, monitor loses power, or on power-off.	Main Processor PCB malfunction	1. Replace Main Processor PCB Subassembly. 2. If problem persists, contact TSS in Solna or Danvers.

3.1.3 Power-Up Sequence Fails to Complete Properly

Table 5-3 Power-up Process Malfunction

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
Monitor fails to complete power-up sequence, e.g., powers itself down before *MAIN* screen displays, sounds continuous tone, repeatedly resets.	Software program corrupted Main Processor PCB malfunction	1. If power ON LED illuminates but monitor fails to complete power-up sequence, software may have become corrupted. Try reinstalling software. 2. If problem persists, replace Main Processor PCB Subassembly. 3. If problem persists, contact TSS in Solna or Danvers.

3.1.4 Monitor fails to operate on battery power

Table 5-4 Power-up Process Malfunction

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
Battery fails to maintain operation of monitor during power failure, for time duration specified in User guide.	Battery malfunction Battery charger malfunction	1. Check that battery properly connected to power harness. If connected, continue. 2. If monitor powered from clinical site for ≥3.5 hours but fails to maintain operation for time duration specified in User guide when power removed, replace battery. 3. If problem persists, replace Main Processor PCB Subassembly. 4. If problem persists, contact TSS in Solna or Danvers.

4 Rotary Knob Malfunction.

Table 5-5 Rotary Knob Malfunction

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
Rotary knob fails to properly select fields, or pressing the knob in fails to activate a menu or select a default.	Rotary knob subassembly malfunction Connector I/O PCB malfunction Main Processor PCB malfunction	1. If problem persists, replace rotary knob subassembly. 2. Replace Connector I/O PCB. 3. If problem persists, replace Main Processor PCB Subassembly. 4. If problem persists, contact TSS in Solna or Danvers.

5 Fan Malfunction.

Table 5-6 Fan Malfunction

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
Monitor completes normal power-up sequence but fan fails to start.	Fan or temp sensor malfunction Connector I/O PCB malfunction	1. Replace Fan subassembly. 2. If problem persists, replace Connector I/O PCB. 3. If problem persists, contact TSS in Solna or Danvers.

6 VGA Display Malfunction.

Table 5-7 VGA Display Malfunction

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
Display powers on, but waveforms fail to appear on screen	VGA cable malfunction Display malfunction Connector I/O PCB malfunction Main Processor PCB malfunction	1. Replace VGA cable with known-good cable. 2. If problem persists, replace VGA Display with known-good Display. 3. If problem persists, replace Connector I/O PCB. 4. If problem persists, replace Main Processor PCB Subassembly. 5. If problem persists, contact TSS in Solna or Danvers.
Areas of display missing or color contaminated	Connector I/O PCB malfunction Graphics Processor on Main Processor PCB malfunction	1. Replace Connector I/O PCB. 2. If problem persists, replace Main Processor PCB Subassembly. 3. If problem persists, contact TSS in Solna or Danvers.

7 Fixed Key Fails to Function.

Table 5-8 Fixed Key Malfunction

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
A Fixed Key fails to initiate change	Front Bezel malfunction Connector I/O PCB malfunction Main Processor PCB malfunction	1. Replace Front Bezel Subassembly. 2. Replace Connector I/O PCB. 3. If problem persists, replace Main Processor PCB Subassembly. 4. If problem persists, contact TSS in Solna or Danvers.

8 Isolating Cable Malfunctions

In general, the troubleshooting and repair approach for cable malfunctions is to use a known input signal for any given parameter, and then replace a cable or sensor found to be malfunctioning. Cable malfunctions, including those associated with connectors on the cables, generally fall into one of three cagegories -- Open circuits, Short circuits, and Intermittent conditions

Open circuits and short circuits manifest themselves as a loss of signal. Software in the Monitor senses the loss, and generates an error message such as “ECG Leads Off” and “SpO2 Transparent.” Typically, short circuits result in software resets.

An intermittent condition manifests itself as noise on the signal. The source of the noise can often be isolated by removing the signal and shorting the input(s) to the cable. Then flex along the cable, particularly at connectors, while watching for noise indications on the monitor display.

9 Visible or Audible Alarm Reporting Failure.

Table 5-9 Alarm Malfunctions

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
Audible Alarm O.K., but Visible Alarm Fails.	Software problem	1. Try reinstalling software. 2. If problem persists, contact TSS in Solna or Danvers.
Visible Alarm O.K., but Audible Alarm Fails.	Speaker malfunction Connector I/O PCB malfunction Main Processor PCB malfunction	1. Power-cycle monitor and listen for tone after icon appears on power-up screen (not the piezo, which sounds before the icon appears). 2. If tone fails to sound, replace Speaker Subassembly. 3. If problem persists, replace Connector I/O PCB. 4. If problem persists, replace Main Processor PCB Subassembly. 5. If problem persists, contact TSS in Solna or Danvers.

10 MultiMed POD - Parameter Signal Problems

Table 5-10 Parameter Signal Problems

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
Failure to report lead-off condition	MultiMed POD malfunction Main Processor PCB malfunction	1. Check MultiMed Pod contadct for possible contamina-tion. Clean if required. If problem persists, replace Pod. 2. If problem persists, replace Main Processor PCB Subassembly. 3. If problem persists, contact TSS in Solna or Danvers.
ECG/Resp waveform noise	Incorrect setting of line frequency for customer site Poor connection or intermittent break MultiMed POD malfunction Main Processor PCB malfunction	1. Access the Service Menu under Monitor Setup → Biomed → Service in the Main menu. 2. Assure that the setting is proper for the frequency of the power source at the customer site. 3. If problem persists, check cables, connections, and MultiMed POD for intermittent breaks. 4. Connect grabber connectors of an ECG lead set to a common conductor, such as the shank of a screwdriver blade, to produce a flatline ECG waveform. 5. Watch for a distinct change in noise level, indicating the source of the problem, as you flex each lead and cable (particularly at connectors). 6. Replace a defective ECG lead, cable, or MultiMed POD 7. If no cable, connector, or POD problem, replace Main Processor PCB Subassembly. 8. If problem persists, contact TSS in Solna or Danvers.
SpO_2 parameter box fails to appear when sensor plugged into MultiMed POD, or SpO_2 readings missing	Sensor malfunction Open cable or connector MultiMed POD malfunction Main Processor PCB malfunction	1. Check illumination of red LED in the sensor. 2. • If LED not illuminated, replace sensor and continue to step 3. • If LED illuminated, place sensor on your finger and go on to step 3. 3. If problem persists, replace intermediate cable between sensor and MultiMed POD. 4. If problem persists, replace MultiMed POD. 5. If problem persists, replace Main Processor PCB Subassembly. 6. If problem persists, contact TSS in Solna or Danvers.

Table 5-10 Parameter Signal Problems (Continued)

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
SpO_2 waveform noise	Poor connection or intermittent break in cable MultiMed POD malfunction Main Processor PCB malfunction	1. With the SpO_2 sensor on your finger, observe the waveform while you flex the lead and cable, particularly at the sensor, at connectors, and at the MultiMed POD. 2. Watch for a distinct change in the waveform (distinctly different from artifact) as you flex along the length of the cables as well as at the sensor and connectors. 3. Replace a defective sensor, cable or MultiMed POD. 4. If no cable, connector, or POD problem, replace Main Processor PCB Subassembly. 5. If problem persists, contact TSS in Solna or Danvers.
Temp parameter box fails to appear when sensor plugged into MultiMed POD, Temp readings missing or inaccurate	Sensor malfunction Open cable or connector POD malfunction Main Processor Board malfunction	1. Replace sensor 2. If problem persists, replace MultiMed POD. 3. If problem persists, replace Main Processor PCB Subassembly. 4. If problem persists, contact TSS in Solna or Danvers.

11 NBP

11.1 NBP Error Messages

NBP Open Line — Results if the NBP measurement circuit does not sense pressure changes after initiating inflation. Possible causes include an open line out to the patient, an open or occluded line on the pressure measurement line running between the NBP assembly and the pressure transducer on the main processor board, a leaky cuff or cuff connector, or a defective valve on the NBP pump assembly.

NBP Blocked Line — Result of the NBP measurement circuit detecting an occlusion on the line to the patient, or a neonatal cuff with monitor in adult mode.

NBP Overpressure — Result attributable to hardware or software detecting overpressure.

NBP Cuff Deflation Error — Result of the two minute NBP measurement timer expiring. It is typically triggered when an NBP measurement had been taken prior to placing the unit in calibration mode. (When calibrating, power-cycle monitor and then don't run pump until after calibration.)

NBP Artifact — Result of erratic pressure values being sensed and could be related to an application problem or could caused by an intermittent connection to the sense line.

11.2 NBP Troubleshooting

Before attempting to troubleshoot NBP malfunctions, do the following:

1) Set up NBP Calibration assembly.
2) Perform leakage test on fixed volume and hose, and on system. Refer to Section 10.1 in Chapter 4.
3) Check calibration. Refer to Section 10.2 in Chapter 4.
4) If problem persists, continue with troubleshooting procedures.

Table 5-11NBP Malfunctions

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
NBP fails to zero properly, fails characterization, or fails calibration check	NBP pneumatic system malfunction Main Processor PCB malfunction	1. If monitor fails calibration, perform characterization procedure. Refer to Section 10.4 in Chapter 4. 2. If monitor fails characterization or problem persists, open monitor and assure NBP transducer tubing properly routed and unobstructed. 3. If problem persists, replace NBP Subassembly. 4. If problem persists, replace Main Processor PCB Subassembly. 5. If problem persists, contact TSS in Solna or Danvers.
NBP pump fails to start/stop when NBP key on front panel is pressed	Front Bezel malfunction Connector I/O PCB malfunction NBP pump subassembly malfunction Main Processor PCB malfunction	1. If pump fails to start and no error message displays, replace Front Bezel Subassembly. 2. If monitor reporting NBP in fault mode, or error message displays, power-cycle monitor. 3. If problem persists, replace Connector I/O PCB. 4. If problem persists, replace Main Processor PCB Subassembly. 5. If problem persists, contact TSS in Solna or Danvers.
NBP pump starts, but cuff fails to inflate/ deflate properly	Cuff assembly malfunction NBP pneumatic system malfunction	1. Recheck cuff assembly and installation, and replace cuff assembly if defective. 2. If problem persists, open monitor and check that pneumatic tubing to NBP transducer properly routed and not obstructed. 3. If problem persists, replace NBP Subassembly. 4. If problem persists, contact TSS in Solna or Danvers.
NBP parameter box fails to appear when cuff hose plugged into NBP module	MAIN screen display mode set for Manual Cuff sensor defective or not plugged into Connector I/O PC Board. Main Processor PCB malfunction	1. Assure *MAIN* screen display mode set to automatic. 2. If parameter box fails to appear, remove monitor cover and check that cuff sensor cable is plugged into X8 on Connector I/O PC Board. 3. • If sensor unplugged, plug sensor into X8 on Connector I/O PC Board, and reinstall monitor cover. • If sensor plugged in, unplug sensor and check for continuity across pins of sensor cable connector. If continuity O.K. (≈ 1.5 Ω), replace Connector I/O PC Board. 4. If problem persists, replace Main Processor PCB Subassembly. 5. If problem persists, contact TSS in Solna or Danvers.

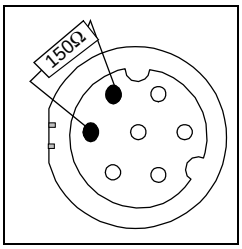
12 $etCO_2$ Malfunction.

Table 5-12 $etCO_2$ Malfunctions

Symptom(s)	Possible Cause(s)	Troubleshooting and Remedial Action
Parameter box fails to appear when sensor plugged into pod	Sensor or cable malfunction $etCO_2$ pod malfunction Main Processor PCB malfunction	1. Be sure $etCO_2$ cable plugged into AUX connector on front of SC 8000. If problem persists, continue. 2. Clean calibration windows. 3. Replace $etCO_2$ Sensor. 4. If problem persists, replace $etCO_2$ pod. 5. If problem persists, replace Main Processor PCB Subassembly. 6. If problem persists, contact TSS in Solna or Danvers.
Sensor fails calibration	Sensor or cable malfunction $etCO_2$ pod malfunction Main Processor PCB malfunction	1. Replace $etCO_2$ Sensor. 2. If problem persists, replace $etCO_2$ pod. 3. If problem persists, replace Main Processor PCB Subassembly. 4. If problem persists, contact TSS in Solna or Danvers.
Persistent Adapter Failure message	Airway adapter or sensor window occluded Airway adapter malfunction Sensor malfunction	1. If adapter or sensor window occluded, clean window. 2. If problem persists, replace airway adapter. 3. If problem persists, replace sensor. 4. If problem persists, replace $etCO_2$ pod.

13 HEMO2/4 Pod / HemoMed Pod

13.1 Readings Missing or Inaccurate



Aux/Hemo2
or
Aux/Hemo3

Disruption in communications to an external pod is caused by the pod itself, by a cable problem, or by a communication problem on the main processor board. Power for an external pod is supplied from the main processor board **when the board senses that a load is present**. If the monitor is not reporting connection of a Hemo2/4 pod, 12-lead pod or tcpO2/CO2 pod, use the following test to determine first whether or not the pod is being detected.

Note: Only the Hemo2/4 pod “communicates” with the monitor. The Hemo2/4 Pod is a digital device; the HemoMed Pod is analog.

Connect a 150Ω ¼W resistor between pins 1 and 3 on the suspect port (see illustration at left), and check monitor display for a pod connection error “DEVICE FAILURE ON HEMO CONNECTOR x.”

- If no error message displays, the problem is on the main processor board. Replace the Main Processor PCB Subassembly.
- If error message displays, problem may be in cable, pod, or main processor board. Replace defective component as required.

If only one input or output on a HEMO2/4 or HemoMed Pod fails to function, try replacing the sensor or cable. If problem persists, replace the Pod.

13.2 IBP Malfunctions.

Table 5-13IBP Malfunctions

Conditions	Possible Cause(s)	Troubleshooting and Remedial Action
Zero All key, C.O.Start key or Wedge key on Pod fails to initiate function	Pod malfunction Cable malfunction Main Processor PCB malfunction	1. Try replacing Pod / monitor cable. 2. If problem persists, replace Pod. 3. If problem persists, replace Main Processor PCB Subassembly. 4. If problem persists, contact TSS in Solna or Danvers.
IBP fails to zero properly or fails calibration check	Cable malfunction Pod malfunction Main Processor PCB malfunction	1. Unplug all patient parameter inputs to the monitor. 2. Set Patient simulator for an IBP static pressure = 0 mmHg, and plug simulator into Pod. 3. Plug Pod output cable into monitor. 4. Check that “Zero Required” appears in message field and that IBP parameter box appears on display. 5. If either message or parameter box fails to appear, replace Pod and cable with known-good Pod and cable. 6. If problem persists, replace Main Processor PCB Subassembly. Otherwise, continue. 7. Select IBP parameter field on *MAIN* screen, and assure that Cal Factor is set to 100. 8. Select Zero in menu, and press in on rotary knob. 9. • If “Zero Accepted” appears in message field, continue. • If “--- Did Not Zero” appears in message field, replace Main Processor PCB Subassembly, if not already replaced in step 6. If Main Processor PCB Subassembly already replaced, return monitor to Siemens for repair or exchange. 10.Increase simulator pressure to 100 mmHg. 11. • If monitor reading = 100 ±1 mmHg, return monitor to clinical service. • If monitor reading ≠ 100 ±1 mmHg, replace Main Processor PCB Subassembly, if not already replaced in step 6 or step 9. If Main Processor PCB Subassembly already replaced, contact TSS in Solna or Danvers.

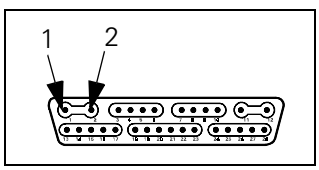
Table 5-13IBP Malfunctions (Continued)

Conditions	Possible Cause(s)	Troubleshooting and Remedial Action
IBP or Temp (HEMO2/ 4 Pod only) parameter box fails to appear when sensor plugged into Pod	Defective sensor or cable Pod malfunction Pod / Monitor cable malfunction Main Processor PCB malfunction	1. Replace sensor and cable with known-good sensor and cable. If problem persists, continue. 2. • With HEMO2/4 connected to the monitor, assure that parameter labels are visible in LED windows on HEMO Pod. • If HemoMed Pod, go on to step 4. 3. • If labels are visible, replace sensor. If problem persists, go on to step 4. • If labels NOT visible, try replacing HEMO POD / Monitor interconnecting cable. If problem persists, continue. 4. Replace Pod. 5. If problem persists, replace Main Processor PCB Subassembly. 6. If problem persists, contact TSS in Solna or Danvers.

13.3 No Printout from Recorder.

Table 5-14Recorder Problems

Conditions	Possible Cause(s)	Troubleshooting and Remedial Action
Recorder connected directly to Monitor Power LED on Recorder NOT illuminated	Recorder malfunction Cabling malfunction Interface Plate (if installed) malfunction Connector I/O PCB malfunction Main Processor PCB malfunction	1. Detach Interface Plate from Recorder and check voltage between pins 1 and 2 on Interface Plate docking connector. See illustration below. 2. If voltage OK, replace Recorder. 3. If voltage OK, check for +12VDC between pins 2 and 15 of X13 on monitor. • If voltage OK replace cable. • If voltage not OK replace Connector I/O PCB. 4. If problem persists, replace Main Processor PCB Subassembly. 5. If problem persists, contact TSS in Solna or Danvers.



Interface Plate Docking Connector

Table 5-14 Recorder Problems (Continued)

Conditions	Possible Cause(s)	Troubleshooting and Remedial Action
Recorder connected directly to Monitor Recorder power LED illuminated	Recorder malfunction Interconnecting cable or connection malfunction Connector I/O PCB malfunction Main Processor PCB malfunction	1. With an ECG waveform on Monitor display, provided by patient simulator, press Record key. 2. • If "Recorder Not Connected" message appears in the message field, go to step 3. • Press Zoom key and select Event Recall. After ≈20 sec, BED TIMED strip should appear on display. If BED TIMED strip fails to appear, replace Connector I/O PCB and go to step 7. Otherwise, continue. 3. If problem persists, and Recorder Cable Art. No. 4318130E530U is installed, replace Recorder cable and go to step 5. 4. If problem persists, replace Recorder Interface Plate. 5. If problem persists, replace Recorder. 6. If problem persists, replace Connector I/O PCB. 7. If problem persists, replace Main Processor PCB Subassembly. 8. If problem persists, contact TSS in Solna or Danvers.

14 Patient-Related Data Not Retained, or Monitor Fails to Compute Trends

1) Replace Main Processor PCB Subassembly.
2) If problem persists, contact TSS in Solna or in Danvers.

15 Software Loading Problems

For problems concerning software downloads, refer to software installation instructions for version of software you are attempting to install.

16 Difficulty acquiring export protocol data

This problem is usually caused by an incorrect connection or communications protocol. Refer to INFINITY RS-232 Export Protocol Reference Booklet, Art. No. 64 93 212 E315U.

17 Total or partial loss of network communications

Temporary network communication losses are caused by either an interruption with the Ethernet port on the main processor or in the network line.

1) Verify that network configuration data in monitor are correct. See Section 3 "Configuration Parameters" and Section 4 "Configuring Monitor" in "Appendix E: Service Setup Instructions".
2) Replace Main Processor PCB Subassembly if problem isolated to monitor.

Problem Report

SC Series Patient Monitoring

Enter all applicable data in the spaces provided, and include a copy of this form when faxing a request for technical assistance.

Name of contact

Telephone

Fax

Email Address (If available)

Monitoring Site: Country:

Region / State / Province:

Hospital or Clinical Site:

Device Type:

Device Serial Number:

Device Operating Software:

Care Unit Type:

Parameters being monitored at time of fault:

Network / Stand-alone Use

Brief Description of Fault:

_____

_____

_____

_____

Can the problem be reproduced or is the problem intermittent?

Has TSS been previously contacted concerning this problem?

Has a customer complaint on this product been filed?

Complaint Reference Number (If applicable)

Fax inquiry to:

TSS SOLNA	46-8-98-66-62
TSS DANVERS	978-907-7546

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Appendix A: Replacement Parts

Refer to the Figures and corresponding Tables in this appendix for a listing of replacement subassemblies and components. The lists contain all information available as of the publication date of this Manual. Field experience and technological development, however, may require future modifications. Subsequent changes may be published as a supplement, as well as posted on the Siemens Intranet Med UPTIME Services Online Service Support, http://www-td.med.siemens.de/, under Product Information, EM Systems, PCS.

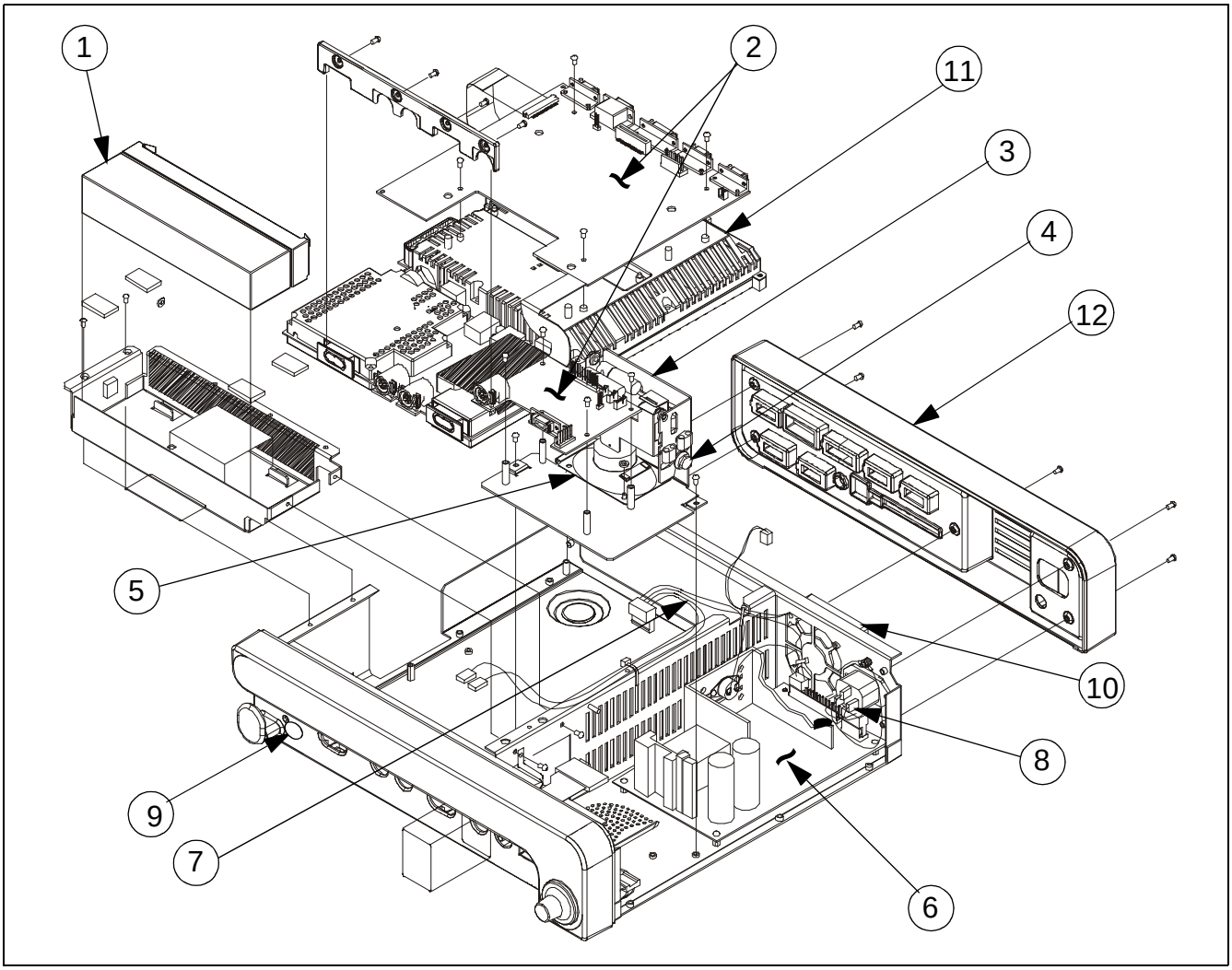

Figure A-1 Basic SC 8000 Monitor (Top Cover Removed)

Table A-1 Basic SC 8000 Monitor - Replaceable Parts/Subassemblies

Item No.	Description	Siemens Article Number
1	Battery	59 43 563 E549U
2	Connector I/O PCB	57 37 577 E549U
3	NBP Pump Subassembly	59 43 571 E549U
4	NBP Air Intake Filter	28 66 726 E516U
5	Speaker Subassembly	51 94 365 E522U
6	Power Supply	57 38 450 B3305
7	Power Supply Harness	57 38 013 E549U
8	Power Supply Entry Module / Harness	57 38 468 E549U
9	R393 Access Port Cover	59 56 979 E549U
10	Fan	57 40 936 E549U
11	Main Processor PCB Subassembly	57 40 050 E549U
12	Rear Bezel w/o installed Adv. Comm Option	57 36 470 E549U
13	Top Cover	57 36 397 E549U

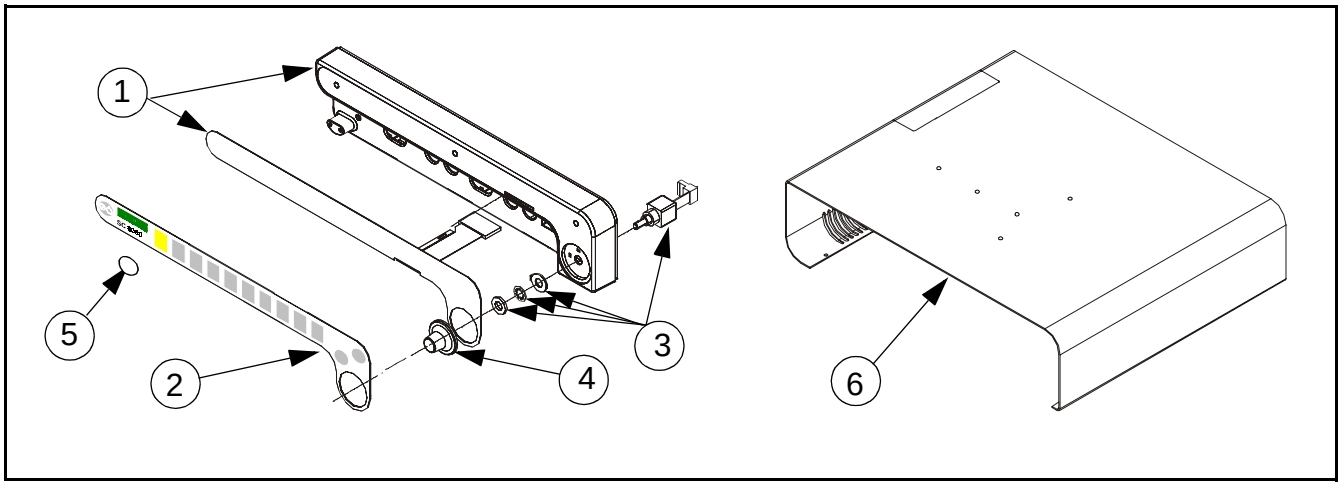

Figure A-2 Front Bezel Subassembly and Top Cover

Table A-2 Front Bezel Subassembly and Top Cover - Replaceable Parts/Subassemblies

Item No.	Description	Siemens Article Number
1	Front Bezel Subassembly	59 43 597 E549U
2	Label Kit for Front Panel	59 43 589 E549U
3	Optical Encoder Subassembly	43 11 622 E533U
4	Rotary Knob	43 16 662 E533U
5	R393 Access Port Cover	59 56 979 E549U
6	Top Cover	57 36 397 E549U

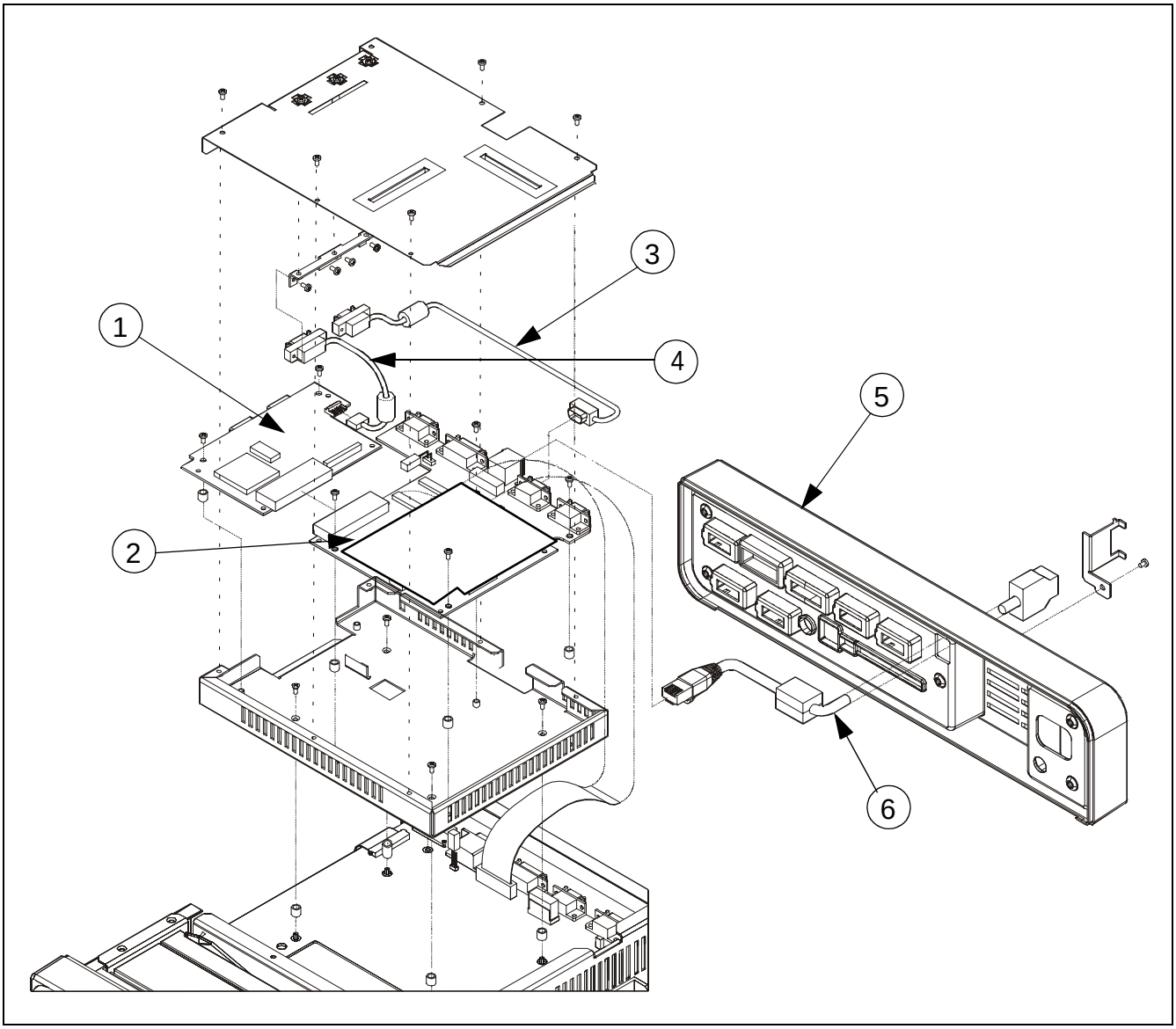

Figure A-3 Adv Comm and MIB 1&2 Options

Table A-3 Adv Comm and MIB 1&2 Options - Replaceable Parts/Subassemblies

Item No.	Description	Siemens Article Number
1	MIB 1&2 PCB	50 90 794 E530U
2	IDS Adv Comm PCB	59 48 356 E549U
3	14-P USD Adv Comm Cable Asy	59 49 693 E549U
4	CAN Adv Com Cable Asy	59 49 685 E549U
5	Rear Bezel w/ Adv Comm Option	59 47 630 E549U
6	Ethernet Interconnect Cable	57 40 985 E549U

Appendix B: Connector / Cable Pinouts

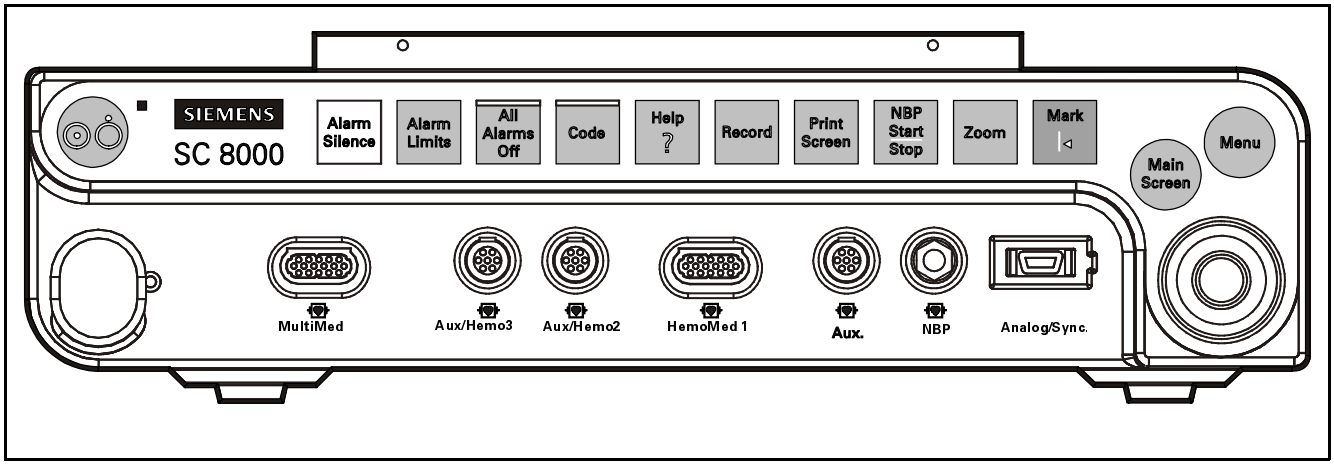

Figure B-1 Front Panel Connectors (shown for Monitor w/ ≥VE0 software installed)

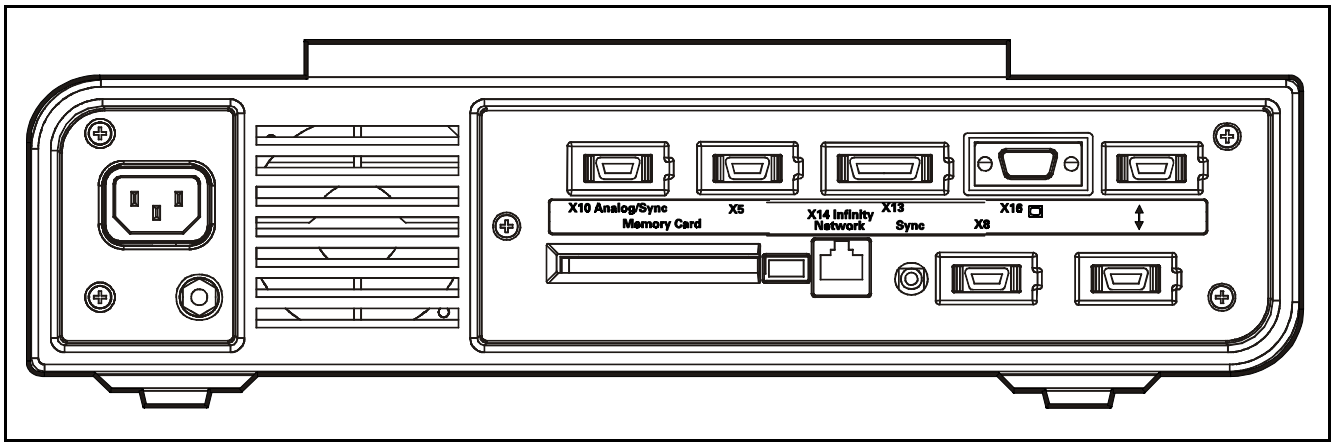

Figure B-2 Rear Panel Connectors (shown for Monitor without Adv. Comm. Option installed)

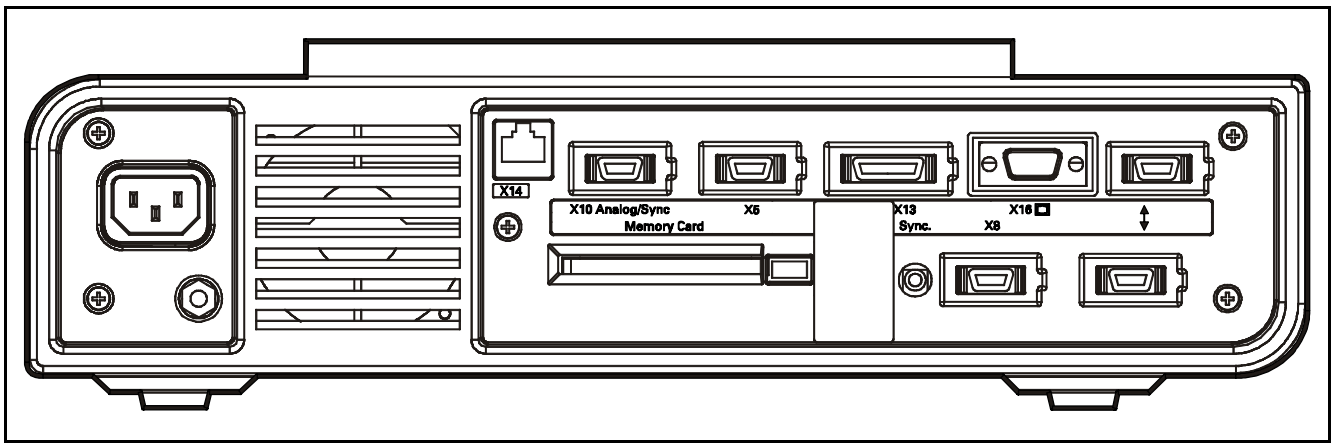

Figure B-3 Rear Panel Connectors (shown for Monitor with Adv. Comm. Option Installed)

1 MultiMed Pod Cable Connector on SC 8000

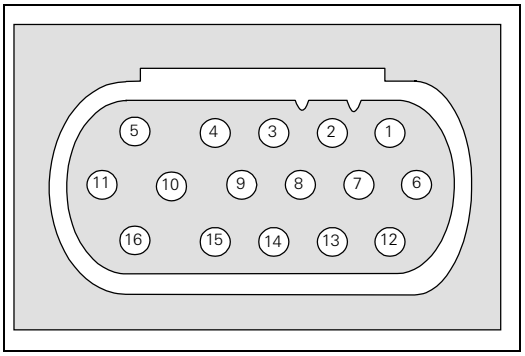

Figure B-1 MultiMed Pod Cable Connector

Table B-1MultiMed Pod Cable Connector Pinouts

MultiMed Pod Cable Connector	
Pin No.	Signal
1	RCALIB
2	REDK
3	HVPODIDR
4	VEE_1
5	LFT_LEG
6	DET_A
7	DET_K
8	TB
9	TCOM
10	RT_LEG
11	LFT_ARM
12	(RCALRTN)
13	IRK
14	TA
15	VEE_2
16	RT_ARM

2 HemoMed Pod Cable Connector on SC 8000

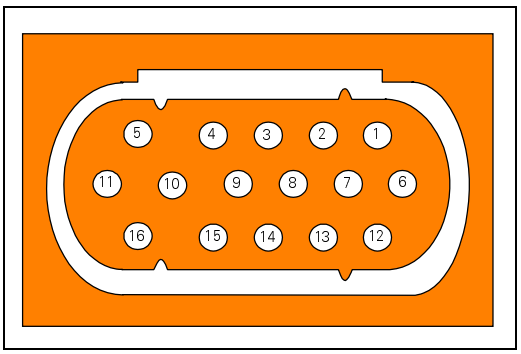

Figure B-2 HemoMed Pod Cable Connector

Table B-2 HemoMed Pod Cable Connector Pinouts

HemoMed Pod Cable Connector	
Pin No.	Signal
1	-IBP1
2	-IBP2
3	-IBP3
4	-IBP4
5	P1SWITCHES
6	+IBP1
7	+IBP2
8	+IBP3
9	+IBP4
10	TINJ
11	CO_SW_RET
12	PRES_RET
13	PRES1_3+
14	PRES2_4+
15	7R37
16	TBLD

3 Aux Connector on SC 8000

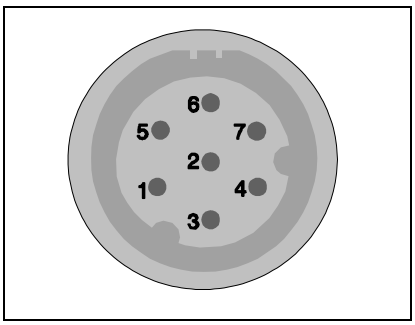

Figure B-3 Aux1, Aux2 and Aux 3 Connectors (refer to Table B-3)

Table B-3 Aux Connectors, Pinouts

Aux.	
Pin No.	Signal
1	TX+
2	
3	TX-
4	RX+
5	Gnd
6	PWR
7	RX-

4 SC 8000 Network Connector

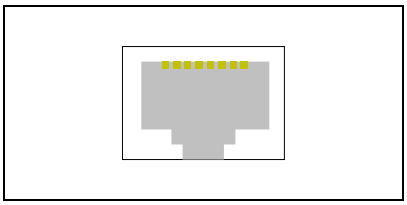

Figure B-4 Network Connector

Table B-4 Network Connector Pinouts

Network	
Pin No.	Signal
1	TxD+
2	TxD-
3	RxD+
4	RxD-

5 SC 8000 Analog Output Connector

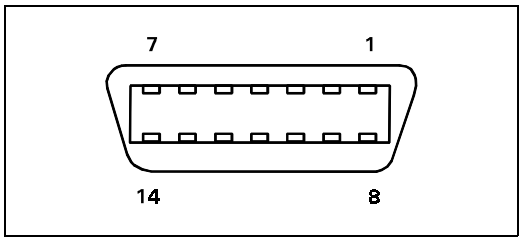

Figure B-5 Analog Output Connectors, Front/Rear (refer to Table B-5)

Table B-5 Analog Output Connectors Pinouts

Analog-Out	
Pin No.	Signal
1	GND
2	Hd Audio Out
3	Hd Audio Rtn
4	NC
5	Diag TxD
6	Chan2 Rtn
7	Chan2 Analg
8	Hd Audio Det
9	AGND
10	AGND
11	
12	Chan1 Anlg
13	Chan1 Rtn
14	Diag RxD

6 MultiMed 12 Pod

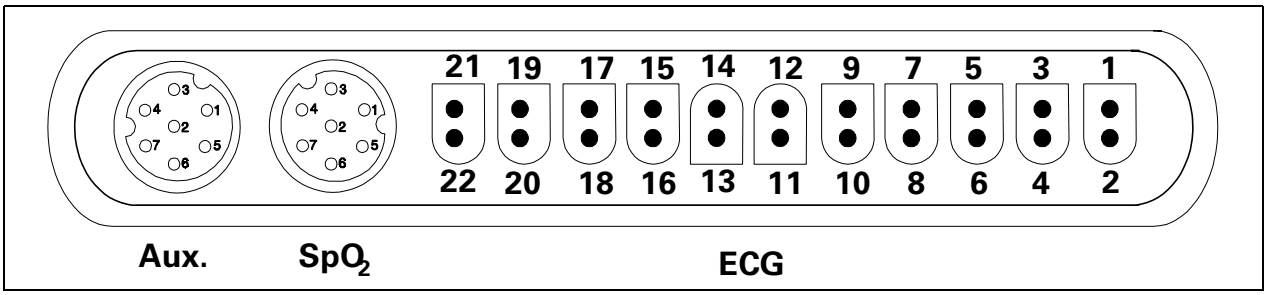

Figure B-6 MultiMed 12 Pod (Refer to Table B-6.)

Table B-6 MultiMed 12 Pod Connector Pinouts

Aux.		SPO2		ECG					
Pin No.	Signal	Pin No.	Signal	Pins 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21 = SHGND					
1		1	DETA	Pin No.	IEC-1/IEC/2 Signals		Pin.No.	IEC-1/IEC-2 Signals	
2		2	DETK SH	2	L	LA	14	C6	V6
3		3	NC	4	F	LL	16	C5	V5
4		4	REDK	6	R	RA	18	C4	V4
5		5	RCALRTN	8	C/C1	VC/V1	20	C3	V3
6		6	RCALIB	10	N	RL	22	C2	V2
7		7	IRK	12	C+	V+			

7 SC 8000 RS-232, Keypad Input, Alarm Out Connector

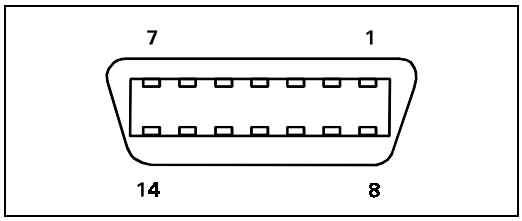

Figure B-7 RS-232, Keypad Input, Alarm Out Connector (see Table B-7)

Table B-7 RS-232, Keypad Input, Alarm Out Connector Pinouts

RS-232, Keypad Input, Alarm Out			
Pin No.	Signal	Pin No.	Signal
1	GND	8	COM 1 RXD
2	COM 1 TXD	9	ALRM OUT L
3	REM PWR	10	GND
4	MC800TL	11	COM2 RXD
5	COM2 TXD	12	SER. D IN
6	SER. D OUT	13	SER. CLK
7	SER. FSL	14	GND

8 Remote Alarm Cable

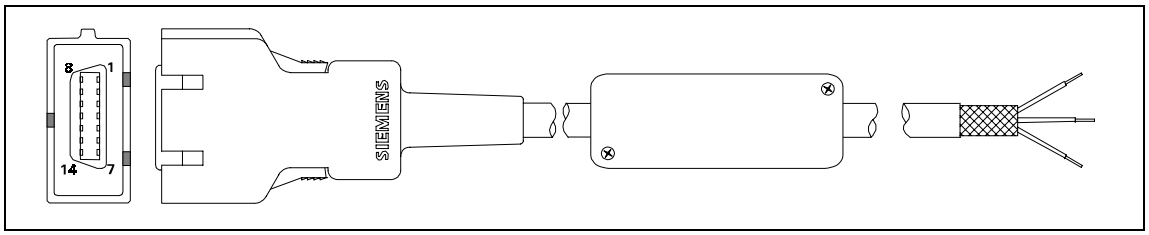

Figure B-8 Remote Alarm Cable - Unterminated (Refer toTable B-8)

Table B-8 Remote Alarm Cable Connector Pinouts and Wire Color Code

Color Code			
Connector Pin No.	Relay Input Wire Color	SPDT Relay Output	Circuit Status
1	TAN	Brown	RTN
2 - 8, 10 - 14	NC	Green	Inactive Open
9	ORANGE	White	Inactive Closed

9 Analog Cable

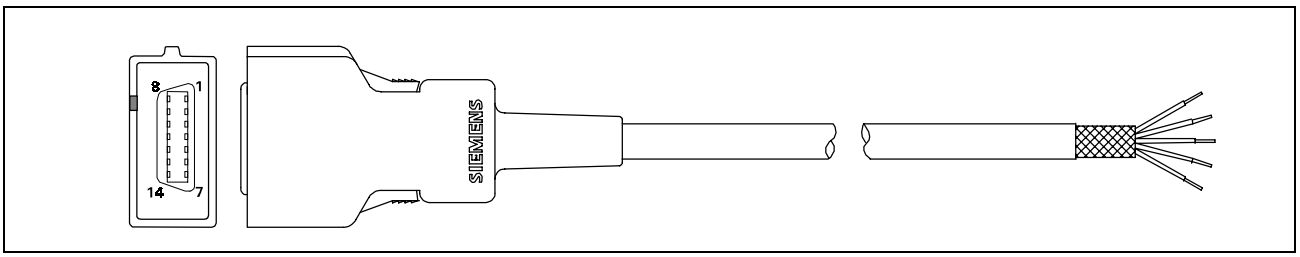

Figure B-9 Analog Cable (Unterminated - Refer to Table B-9.)

Table B-9 Analog Cable Color Code

Color Code		
Connector Pin No.	Wire Color	Function
1	TAN	NC
2	WHITE	NC
3	BLACK	NC
4	RED	NC
5	GREEN	NC
6	YELLOW	CHAN 2 RTN
7	BLUE	CHAN 2 ANLG
8	BROWN	NC
9	ORANGE	NC
10	GREY	NC
11	VIOLET	NC
12	PINK	CHAN 1 ANLG
13	LT BLUE	CHAN 1 RTN
14	LT GREEN	NC

10 Cardiac Output Intermediate Cable Wiring Diagram

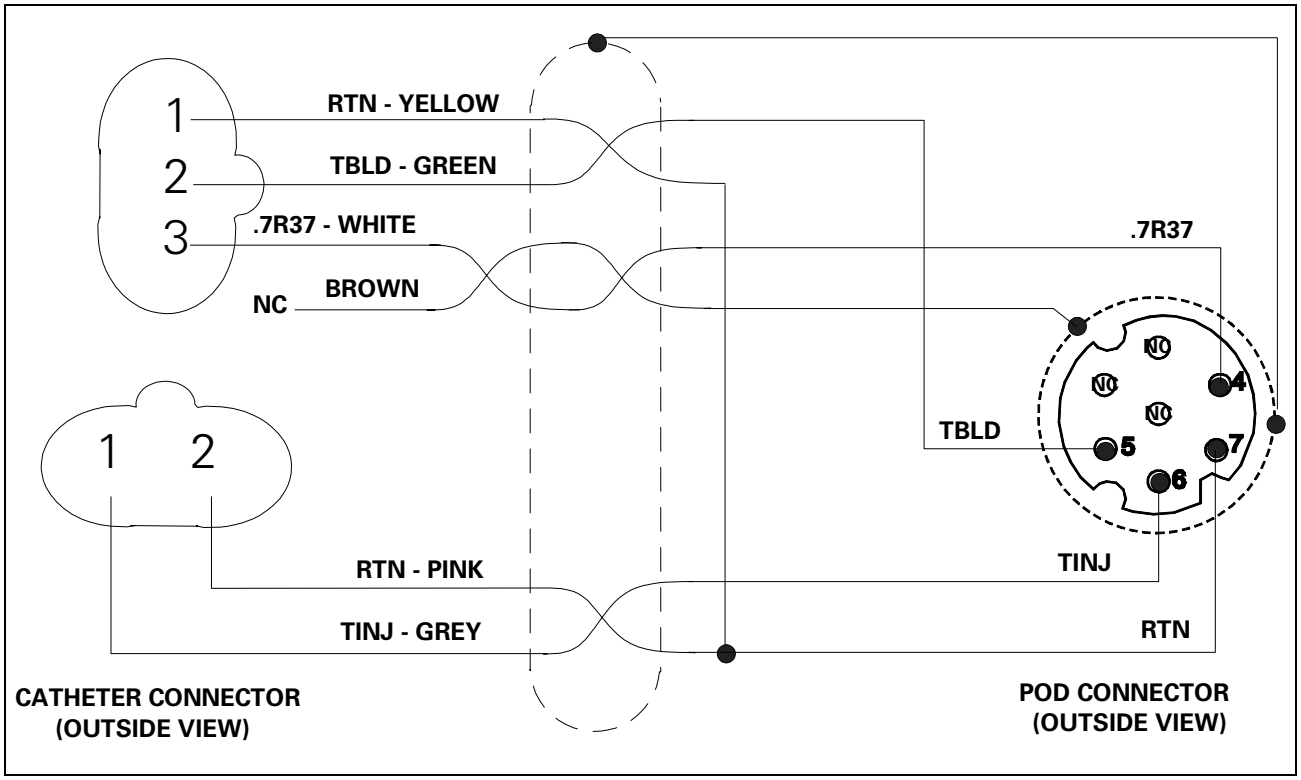

Figure B-10 Cardiac Output Intermediate Cable Wiring Diagram

11 Input Connector on etCO2 Pod

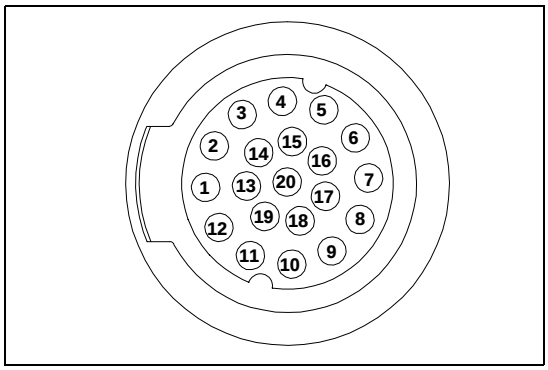

Figure B-11 Input Connector on etCO2 Pod (Refer to Table B-10.)

Table B-10 $etCO_2$ Pod Input Connector Pins

Pin No.	Signal
1	SRC-
2	SRC+
3	EE CS
4	REF IN
5	CASE HTR
6	DATA IN
7	EE SK
8	HTR RTN
9	EE DOUT
10	+5V
11	EE DIN
12	SPAN SW
13	SRC SHLD
14	ZERO SW
15	CASE THRM
16	DET HTR
17	DET THRM
18	-12V
19	+12V
20	AGND

12 HEMO Pod

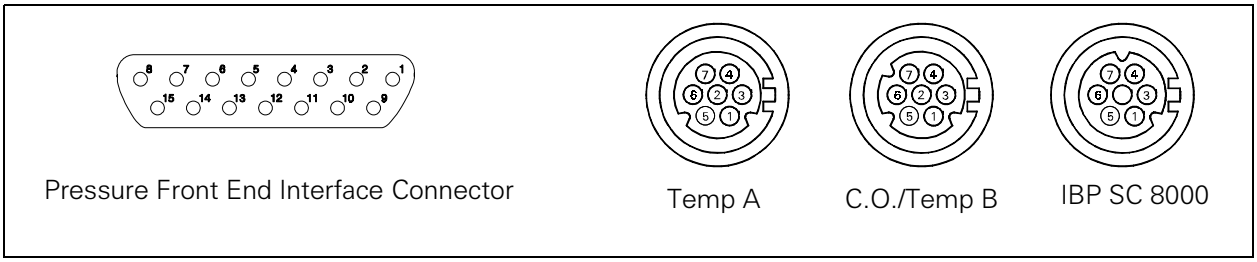

Figure B-12HEMO Pod Connectors (Refer to Table B-11.)

Table B-11 HEMO Pod Connector Signals

Pin No.	PRESSURE FRONT END INTERFACE	Temp A	C.O./Temp B	IBP SC 8000
1	+SIG (P1)	TEMP 1	TEMP 2	CNTRLH
2	GND	GND		
3	GND	GND	GND	CNTRLL
4	+EXCIT (P1)	GND	.7R37	DATH
5	+EXCIT (P2)	GND	TBLD	VDCRTN
6	GND	GND	TINJ	VDC
7	GND	GND	GND	DATL
8	+SIG (P2)			
9	-SIG (P1)			
10	GND			
11	-EXCIT (P1)			
12	GND			
13	-EXCIT (P2)			
14	GND			
15	-SIG (P2)			

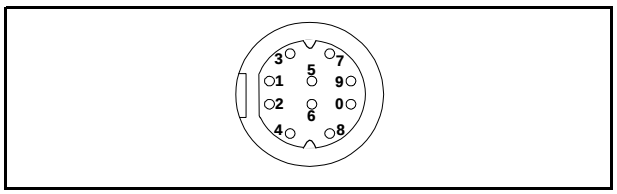

Figure B-13 Press Adapter Input (Refer to Table B-12.)

Table B-12 PRESS Input Connector

Pin No.	A, B, C, D	Pin No.	A, B, C, D
1	+EXCIT	6	+SIGNAL
2		7	
3	-EXCIT	8	GND
4	Cable In	9	
5	-SIGNAL	0	

Appendix C: Diagnostic/Error Messages

1 Overview of Diagnostic Messages

The diagnostic codes given in C-1 may appear in an SC 8000 Diagnostic Log, and help in troubleshooting a malfunctioning Monitor. Both possible cause and suggested remedial action are listed for the field-significant codes.

Only codes for field-related procedures are given in the Table. There are also a number of other diagnostic codes, not listed in the Table, that have significance for engineering in helping to improve product performance. **If observed, report these codes to the factory**. Refer to Chapter 1, Section 9.5, for the procedure to download the Diagnostic Log to a DataCard.

To access the Diagnostic Log, on the Main Menu select BIOMED, then DIAG. LOG.

Diagnostic messages caused by an error condition can be generated by four sources:

- Replaceable hardware malfunction, such as an etCO2 or HEMO Pod
- Software error
- Intermittent condition
- Hardware error

Notes for Table C-1:

1) When action says replace..., do so only if problem can be reproduced.
2) Convention of A, B, C etc. in the messages given in the Description column is an abbreviation of actual messages, which will have numbers in place of the A, B, C, etc., that help engineers uncover the actual cause.
3) When action says “upgrade to Vxx”, problem can also be solved by upgrading to any SW version released after Vxx.

Table C-1Diagnostic Log Codes

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
80007xxx 80008xxx 80009xxx 8000axxx			Try upgrading SW to currently released version. If error persists, replace Main Processor Board Subassembly.
8000bxxx 8000cxxx		Software did not allocate enough memory for user’s current setup.	Try disabling items connected or disabling Auto Dual View. If error persists, replace Main Processor Board Subassembly.
800c9009	atten OOR = A cal factor = B	Speaker too quiet	Replace speaker
800c9022	cal factor=A max_sample_value=B	Speaker broken	Replace speaker

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
800cd007	Loopback Active = A Expect Active =B	Hardware malfuction in “nurse call” circuit.	Check “Nurse Call” circuit.
800d3xxx 800d4xxx 800d5xxx 800d6xxx	Cardiac Output-related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
800d7xxx 800d8xxx	Temperature - related (MultiMed Pod)		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
800d9xxx 800daxxx		Pod communications problem. Pod cable, Pod, or CPU board failed	Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
800dbxxx 800dcxxx	etCO2 Pod - related		Try swapping out airway adaptor with known-good components. Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
800ddxxx 800dexxx	HEMOPOD / HEMOMED - related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
800dfxxx 800e0xxx		Pod communications problem. Pod cable, Pod, or CPU board failed	Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
800e1xxx 800e2xxx	NIBP - related		Try disconnecting/ reconnecting pneumatic tubing. If problem persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
800e5xxx 800e6xxx	RESP-related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly
800e7xxx	SPO2 - related		Try disconnecting/ reconnecting cable. If problem persists, try replacing sensor. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
800e9xxx 800eaxxx	Temperature - related (MultiMed Pod)		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
800f1xxx 800f2xxx	Temperature - related (MultiMed Pod)		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
800f5xxx 800f6xxx	HEMOPOD / HEMOMED - related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
800fbxxx 800fcxxx	NIBP - related		Try disconnecting/ reconnecting pneumatic tubing. If problem persists, replace Main Processor Board Subassembly.
80101xxx 80102xxx	Analog Out		Replace Main Processor Board Subassembly.
80107xxx 80108xxx	RESP-related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
8010dxxx 8010exxx	SPO2 - related		Try disconnecting/ reconnecting cable. If problem persists, try replacing sensor. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
80117xxx 80118xxx	Serial Interface to Remote Keypad - related		Try disconnecting/ reconnecting keypad. If problem persists, swap cable with known-good keypad. If problem persists, replace Main Processor Board Subassembly.
80119xxx 8011axxx	Temperature - related (MultiMed Pod)		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
80127xxx 80128xxx	bkg_operational determined MONITORING SW is corrupt.	Background entity determined that the Main Software was corrupted (BAD CRC)	Try upgrading SW to currently released version. If error persists, replace Main Processor Board Subassembly.
8012901e	boot_validate_download_card could not open/close one of the boot files.	Software memory card may have been removed during a download or the card may have become corrupted	Re-download monitor software. If problem persists, replace memory card.
8014bxxx 8014cxxx	RECORDINGS - related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping Recorder. If problem persists, replace Main Processor Board Subassembly.
8016a00a	Image checksum test failed due to TAXI error!	Bad memory/access/ fetch	Restart monitor. If error persists replace monitor.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
80179xxx 8017axxx		Pod communications problem. Pod cable, Pod, or CPU board failed	Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly
8017fxxx 80180xxx	Temperature -related (MultiMed Pod)		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly
80187020	Error Log was cleared!	Manual clear of error log via system console menu	None
8018bxxx 8018cxxx	etCO2 Pod - related		Try swapping out airway adaptor with known-good components. Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
8018d005	sn A, status B	$etCO_2$ Hardware Fail	Replace $etCO_2$ Pod.
8018fxxx 80190xxx			Try upgrading SW to currently released version. If error persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
80196006	Chip timed out at: A wrote: B, read: C	Flash memory failed tests when doing a download. Bit one is always on.	Re-download software. If problem persists then replace Main Processor Board Subassembly .
8019601d	Flash program write verify failed at A. wrote: B, read: C	Monitor flash failed tests when doing a download	Re-download software. If problem persists, replace Main Processor Board Subassembly.
8019700c	time=A	Heart blip not showing; most likely due to rapid screen re-draws	Ignore
80199xxx 8019axxx	PCMCIA Interface - related		Retry download. If error persists, return card.
801ac00b	Pod Type A Conn B, S/N=C, event D state E	Pod would not power on or off. Connector number in description string are: 1,2,3-hemo pod 4-reserved 5-etCO_2	Check/replace in this order pod/cartrige, cable, Main Processor Board Subassembly.
801ac00c	Pod Type A, Conn B, S/N=C, event D state E	Comm error, CRC error	If problem persists, check connector or replace pod
801adxxx 801aexxx			Try upgrading SW to currently released version. If error persists, replace Main Processor Board Subassembly.
801b7000	ERROR: load_34010	34010 Failure	Replace Main Processor Board Subassembly
801b7001	ERROR: load_34010	34010 Failure	Replace Main Processor Board Subassembly.
801c9xxx 801caxxx	RECORDINGS - related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping Recorder. If problem persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
801e1xxx 801e2xxx	HEMOPOD / HEMOMED - related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
801e7xxx 801e8xxx			Try upgrading SW to currently released version. If error persists, replace Main Processor Board Subassembly.
8020fxxx 80210xxx		Software did not allocate enough memory for user's current setup.	Try disabling items connected or disabling Auto Dual View. If error persists, try upgrading SW to currently released version. If error persists, replace Main Processor Board Subassembly.
80231005	LCOM_BAD_SWITCH_COUNT_ERROR	Comm error	This indicates a SW error and should be reported to Customer service via DataCard.
8023100a	LCOM_CHECKSUM_DIAG_ERROR	Comm error	This indicates a SW error and should be reported to Customer service via DataCard.
8023102b	LCOM_RAM_DIAG_ERROR	Net comm failure	This indicates a SW error and should be reported to Customer service via DataCard.
8023102c	LCOM_ROM_DIAG_ERROR	Net comm failure	This indicates a SW error and should be reported to Customer service via DataCard.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
8023102e	LCOM_SHRAM_CHECKSUM_ERROR	Net comm failure	This indicates a SW error and should be reported to Customer service via DataCard.
80231030	LCOM_SHRAM_DIAG_ERROR	Net comm failure	This indicates a SW error and should be reported to Customer service via DataCard.
80231031	LCOM_SHRAM_PACKET_ERROR	Net comm failure	This indicates a SW error and should be reported to Customer service via DataCard.
80231032	LCOM_SHRAM_PRL_ERROR	net comm failure	This indicates a SW error and should be reported to Customer service via DataCard.
8023dxxx 8023exxx 80249xxx 8024axxx	PCMCIA Interface - related		Retry download. If error persists, return card.
80255xxx 80256xxx			Try upgrading SW to currently released version. If error persists, replace Main Processor Board Subassembly.
8025bxxx 8025cxxx 80263xxx 80264xxx	RS-232 Output - related		Ignore. If problem persists, replace Main Processor Board Subassembly.
80264001	Invalid status after RX_RESET! rx_data=A	Recorder ASIC failed hardware test	Power cycle unit. If error persists, replace Main Processor Board Subassembly.
80264002	TX Empty should be set after TX_RESET! tx_data=A	Recorder ASIC failed cold start test	Power cycle unit. If error persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
8026dxxx 8026exxx	Network Communications - related		Try disconnecting/ reconnecting cable between Monitor and network wallbox. Verify proper SW version(s) installed in all related devices, in accordance with SW compatibility chart for Monitor SW. If problem persists, replace Main Processor Board Subassembly.
80271xxx 80272xxx	Network Communications - related		Try disconnecting/ reconnecting cable between Monitor and network wallbox. Verify proper SW version(s) installed in all related devices, in accordance with SW compatibility chart for Monitor SW. If problem persists, replace Main Processor Board Subassembly.
80273xxx 80274xxx	NIBP - related		Try disconnecting/ reconnecting pneumatic tubing. If problem persists, replace Main Processor Board Subassembly.
8027dxxx 8027exxx	Network Communications - related		Try disconnecting/ reconnecting cable between Monitor and network wallbox. Verify proper SW version(s) installed in all related devices, in accordance with SW compatibility chart for Monitor SW. If problem persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
8027fxxx 80280xxx		Software did not allocate enough memory for user's current setup.	Try disabling items connected or disabling Auto Dual View. If error persists, replace Main Processor Board Subassembly.
80281xxx 80282xxx 80283xxx 80284xxx	HEMOPOD / HEMOMED - related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
80289xxx 8028axxx 80291xxx 80292xxx		Pod communications problem. Pod cable, Pod, or CPU board failed	Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
8029fxxx 802a0xxx 802a1xxx 802a2xxx	Power -related		Replace Battery Replace Main Processor Board Subassembly.
802a3xxx 802a4xxx	QRS Sync pulse - related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
802abxxx 802acxxx 802adxxx 802aexxx	RECORDINGS - related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping Recorder. If problem persists, replace Main Processor Board Subassembly.
802b9xxx 802baxxx	RESP-related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly
802bbxxx 802bcxxx			Try upgrading SW to currently released version. If error persists, replace Main Processor Board Subassembly.
802bf008	memory partition 2 is 91 percent used.	Memory utilization note	Ignore
802d4002	shutdown not due to user. Could be low battery.	Monitor was shut down without using the user's front panel switch. Usually this means that the monitor was running on internal batteries and ran out of power.	If runing monitor on internal battery, ignore this message. Otherwise report condition to customer service

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
802dfxxx 802e0xxx	SPO2 - related		Try disconnecting/ reconnecting cable. If problem persists, try replacing sensor. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
802e701c	Powering up the System...	Power was turned on.	Ignore
802e701d		Indicates that new software was installed	No action nessessary
802ef011	trends completely cleared, new sofware loaded	Software warning	Ignore
802f1xxx 802f2xxx	Network Communications - related		Try disconnecting/ reconnecting cable between Monitor and network wallbox. Verify proper SW version(s) installed in all related devices, in accordance with SW compatibility chart for Monitor SW. If problem persists, replace Main Processor Board Subassembly.
8030500d	b A a=B w=C d=D 0 e=E 0 s=F rx=G ok=H flags=I df=J,K	SW error	Replace Main Processor Board Subassembly.
80309xxx 8030axxx			Try upgrading SW to currently released version. If error persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
80311xxx 80312xxx	Network Communications - related		Try disconnecting/ reconnecting cable between Monitor and network wallbox. Verify proper SW version(s) installed in all related devices, in accordance with SW compatibility chart for Monitor SW. If problem persists, replace Main Processor Board Subassembly.
80325001	Speaker Out of Range value: A	Failed speaker, CPU board or front panel board	If sound is heard replace Connector I/O Board. Otherwise, replace Main Processor Board Subassembly
80359xxx 8035axxx	Network Communications - related		Try disconnecting/ reconnecting cable between Monitor and network wallbox. Verify proper SW version(s) installed in all related devices, in accordance with SW compatibility chart for Monitor SW. If problem persists, replace Main Processor Board Subassembly.
8035bxxx 8035cxxx	Serial Interface to Remote Keypad - related		Try disconnecting/ reconnecting keypad. If problem persists, swap cable with known-good keypad. If problem persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
8035dxxx 8035exxx 8036fxxx 80370xxx	Network Communications - related		Try disconnecting/ reconnecting cable between Monitor and network wallbox. Verify proper SW version(s) installed in all related devices, in accordance with SW compatibility chart for Monitor SW. If problem persists, replace Main Processor Board Subassembly.
80371xxx 80372xxx	MGM - related		Verify proper SW version(s) installed in all related devices, in accordance with SW compatibility chart for Monitor SW. If problem persists, try disconnecting/reconnecting cable(s) between Monitor and MGM. If problem persists,try replacing cable(s) between Monitor and MGM. If problem persists, try swapping MGM with known-good device. If problem persists try replacing MIB 1&2 Option. If problem persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
80373xxx 80374xxx	MIB - related		Verify proper SW version(s) installed in all related devices, in accordance with SW compatibility chart for Monitor SW. If problem persists, try disconnecting/reconnecting cable(s) between Monitor and MIB converter. If problem persists,try replacing cable(s) between Monitor and MIB converter. If problem persists, try swapping MIB converter with known-good device. If problem persists, try replacing MIB 1&2 Option. If problem persists, replace Main Processor Board Subassembly.
80375xxx 80376xxx	ISD (SDC) - related		Verify proper SW version(s) installed in all related devices, in accordance with SW compatibility chart for Monitor SW. If problem persists, try disconnecting/reconnecting cable(s) between Monitor and ISD (SDC). If problem persists,try replacing cable(s) between Monitor and ISD (SDC). If problem persists, try swapping ISD (SDC) with known-good device. If problem persists, try replacing Adv. Comm Option Subassembly. If problem persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
803a1xxx 803a2xxx	12 LEAD POD - related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
803a3xxx 803a4xxx	Serial Interface to Remote Keypad - related		Try disconnecting/ reconnecting keypad. If problem persists, swap cable with known-good keypad. If problem persists, replace Main Processor Board Subassembly.
803e5xxx 803e6xxx 803e7xxx 803e8xxx	SPO2 - related		Try disconnecting/ reconnecting cable. If problem persists, try replacing sensor. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
80361xxx 80362xxx	12 LEAD POD - related		Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.

Table C-1Diagnostic Log Codes (Continued)

Code xxx = any alphanumeric characters	**Description**	**Cause**	**Action**
803f1xxx 803f2xxx 803f3xxx 803f4xxx	etCO2 Pod - related		Try swapping out airway adaptor with known-good components. Try disconnecting/ reconnecting cable. If problem persists, swap cable with known-good cable. If problem persists try swapping pod. If problem persists, replace Main Processor Board Subassembly.
ffffffff	boot_program_images failed with status: A on image: B	Flash programming error when performing a download	Retry download. If problem persists replace Main Processor PC Board Subassembly.

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Appendix D: Functional Verification Checklist

Section Reference in "Chapter 4: Functional Verification and Calibration" **✔ = Test Passed**

3 Power Circuits and Start-up (page 49) _____

3.1 Power ON/OFF key _____

- Power LED _____
- Piezo tone _____

3.2 Power-Up Sequence _____

3.3 Monitor Powered By External Source _____

4 Rotary Knob (page 49) _____

- Pointing Function _____
- Selecting Function _____

5 LCD Display (page 49) _____

- Inoperative pixels within spec _____
- Brightness control _____
- Backlite illumination _____

6 Fixed Keys (page 49) _____

6.1 ON/OFF _____

6.2 Main Screen _____

6.3 Alarm Silence _____

6.4 Alarm Limits _____

6.5 All Alarms Off _____

6.6 Code _____

6.7 Record _____

6.8 Print Screen _____

6.9 NBP Start/Stop _____

6.10 Zoom _____

6.11 Help _____

6.12 Mark _____

7 ECG/RESP Functions (page 51) _____

7.2 Waveforms/Digital Readouts/Tones _____

7.3 Pacer Detection _____

7.4 Lead-Off Indicators _____

7.5 Alarm Function _____

7.6 Asystole _____

8 SpO2 Function (page 53) _____

8.2 Waveforms/Digital Readouts/Tones _____
8.3 Pulse Tone Generator _____
8.4 Limits Alarm _____

9 Temperature Function (page 54) (MultiMed POD) _____

9.2 Digital Readout Temp A _____
Temp B _____
9.3 Temperature Calibration _____

10 Non-Invasive Blood Pressure Function (page 54) _____

10.2 (or 10.3) Calibration OK _____
10.4 Hardware Overpressure _____
10.5 Pump _____
10.6 Interval Mode _____
10.7 Safety Timer _____

11 etCO2 Function (page 57) _____

- Sensor Cal. _____
- Sensor Zero _____
- Measured Value w/ Manual Atm. Press. _____
- Measured Value w/ AUTO Atm. Press. _____

12 HemoMed Pod (page 58) _____

12.1 Invasive Blood Pressure Function _____

12.1.2 HEMO Channel A (Aux./Hemo3 input)

- Monitor Zero Function _____
- Monitor Pressure Reading _____

12.1.2 HEMO Channel A (Aux./Hemo2 input)

- Monitor Zero Function _____
- Monitor Pressure Reading _____

12.1.2 HEMO POD Channel B _____
12.1.2 HEMO POD Channel C _____
12.1.2 HEMO POD Channel D _____

12.2 Cardiac Output Function _____

- Blood temperature _____
- Injectate temp _____

13 HEMO POD2/4 (page 60) _____

13.1 Invasive Blood Pressure Function _____

13.1.2 HEMO Channel A (Aux./Hemo3 input)

- Monitor Zero Function _____
- Monitor Pressure Reading _____

13.1.2 HEMO Channel A (Aux./Hemo2 input)

- Monitor Zero Function _____
- Monitor Pressure Reading _____

13.1.2 HEMO POD Channel B _____

13.1.2 HEMO POD Channel C _____

13.1.2 HEMO POD Channel D _____

13.2 Temperature Function _____

- T1a _____
- T1b _____
- ΔT1 _____

13.3 Cardiac Output Function _____

- Blood temperature _____
- Injectate temp _____

14 Memory Backup (page 62) _____

15 MIB 1&2 and CAN Options (if installed) (page 62) _____

- CAN Option _____
- MIB 1&2 Option _____

16 Adv Comm Option (if installed) (page 62) _____

17 Configuration (page 63) _____

18 Battery Charger Circuit (page 63) _____

19 Recorder Function (page 63) _____

20 LeakageTests (page 63) _____

20.1 Resistance Test

Resistance Reading (Ω _____

20.2 Leakage Current Tests

Enclosure (Case) Leakage Current:

Normal: _____

Open Ground:

@ 240 vac _____

or @ 120 vac _____

Open Ground and Reverse Mains:

@ 240 vac _____

or @ 120 vac _____

Patient Combined Leakage Current:

Normal: _____

Open Ground: _____

Leakage with Mains on Patient Leads: _____

Clinical Site Report

Clinical Site Name: _____ Date: _____

Address: _____

_____Clinical Site Facility Manager: _____

_____Clinical Site Contact Person: _____

Tel. No: _____ _____ _____ FAX No. _____
Int'l Code Number Ext:

Monitoring Unit _____

Care Unit _____

Monitor Serial No. _____

Monitor has passed all required tests.

Siemens Service Representative:

_____ _____ _____
Name (Print) Signature Date

Clinical Site Representative:

_____ _____ _____
Name (Print) Signature Date

Appendix E: Service Setup Instructions

1 Introduction

SC 8000 Monitors are shipped with software installed. Certain service password-protected functions in the monitor, however, need to be set for the specific customer site. Also, if the monitor is to be used in an INFINITY NETWORK environment, the monitor needs to be configured to communicate properly in the network.

2 Initial Setup

Note: Turn the rotary knob to select a field or menu item, or to change the default for a selected item. Press in on the knob to access a menu or menu item, or to set the new default for a selected item.

1. Firmly press ON/OFF key in left corner of front panel.
2. After the monitor has completed power-up sequence, as indicated by illumination of "New Patient?" prompt, press rotary knob to select "Yes" and bring up *MAIN* screen.
3. Select Monitor Setup → Monitor Options → Date & Time.
4. Set Time and Date as appropriate for customer site.
5. Press Menu key to return to Main menu.
6. Select Monitor Setup → Unit Manager.
7. Enter Clinical password (**375**), and then select Menu Setup on Unit Manager menu.
8. Set Menu Time Limit to OFF.
9. Press Menu key to return to Main menu.

Accessing Service Menu

10. Select Monitor Setup → Biomed → Service.
11. Enter Biomed password (**4712**).
12. Select Bedside Setup, and verify the following or set as required.
    - Language setting is appropriate for customer site.
    - Regulation is appropriate for customer site.
    - Alarm Sounds set to either Default or Sirecust 900/1200, as preferred.
    - Line Frequency is appropriate for customer site.
    - Waveform Simulator is set OFF, for clinical use of Monitor.
13. Select ← in upper left hand corner to return to previous menu.
14. Select Network Date and Time, and set Current Date and Current Time as appropriate for customer site.
15. Select ← to return to previous menu.
16. Select Network Setup, and set the following as required.
    - If SC 8000 to be used only in Standalone mode, set Network Control to OFF and power-cycle monitor. Verify that *MAIN* screen displays after completion of power-up sequence. Monitor setup is complete.
    - If SC 8000 is to be connected to an INFINITY NETWORK, set Network Control to ON, and continue.
    - "Printer Address" displays the fourth octet of the IP address of the network printer (if any) that prints out Monitor Setup → Biomed → Logs → Print Log requests. Enter network printer number to set or change address. Otherwise, continue.

17. Select Network Config.
18. Do either a or b as required.

    Note: For first-time data entry, if parameters in Network Config menu cannot be selected plug network cable into port on back panel. Power-cycle monitor. Then disconnect network cable.

    a) If Adv Comm Option is NOT installed, set Network Mode to DirectNet and select Save ALL before continuing.

    b) If Adv Comm Option is installed, set Network Mode to CPS/IDS. (The Adv Comm Option PCB performs some functions of an IDS.)
19. Enter configuration data into Table 1 in Section 3, Configuration Parameters, and then follow procedure in Section 4 to configure monitor.

    Note: Section 3 includes an explanation of each parameter in Table 1.

3 Configuration Parameters

Configuring is the process of assigning a unique electronic address and various alphanumeric addresses (labels) that identify the monitor and enable it to communicate with other devices in an INFINITY NETWORK. Table 1 is a replication of the Network Config menu for data entry in the monitor. Where applicable, the table lists default value (or most likely value). DO NOT use leading zeros for numbers 1- 99.

1. Network Mode: set as in step 18 above. (Always select "Save ALL" before continuing, if changing Network Mode setting.)
2. Bed: a user-defined 7-character alphanumeric field for naming a bed (e.g. ICBED12, BED1). Label appears in lower left hand corner of *MAIN* screen, and on MULTIVIEW WORKSTATION display and recordings. (Must be unique in Monitoring Unit)
3. CPS/IDS: a user-defined 7-character alphanumeric field for naming monitor (e.g. SC7k01). Label appears on MULTIVIEW WORKSTATION display in SHOW DEVICE screen. (Must be different from Bed label, and unique in Monitoring Unit.)
4. Care Unit: label of Care Unit to which monitor is assigned.
5. Monitoring Unit: label of Monitoring Unit to which monitor is assigned.
6. Hospital: label for clinical site to which monitor is assigned.
7. Recorder 1, Recorder 2, and Recorder Use: Not configurable in this software version.
8. Host ID: a number from 1 to 239 (not already used for Host ID of another device in same Monitoring Unit to which monitor is assigned)
9. Monitoring Unit ID: number of Monitoring Unit to which monitor is assigned
10. IP address: This field uses 191.1 for first two bytes, Monitoring Unit ID for third byte, and Host ID for fourth byte. **Be sure Monitoring Unit ID is set to the same number as in step 9.**
11. Subnet mask: Use default unless hospital requires a different value.
12. Default router: Use default unless hospital requires different value.
13. Remote Silence: type in **y** or **n**. "y" means the MULTIVIEW WORKSTATION can silence the bedside alarm. "n" means that alarm cannot be remotely silenced.

14. Remote control enabled: type in **y** or **n**. "y" means monitor allows MULTIVIEW WORKSTATION to change alarms, setup, and demographics in monitor. "n" means monitor cannot be remotely controlled through MVWS.
15. Alarm group: 0-255: An alarm group is a group of beds that monitor each other. Think of this as bed-to-bed communication (as opposed to bed-to-MULTIVIEW WORKSTATION communication). Being part of the same alarm group allows you to see the alarm messages for all beds in same alarm group.
16. Central Station enabled: yes or no: If you choose yes, the bedside monitor expects an alarm acknowledgment from MULTI-VIEW WORKSTATION. If it doesn't get one, it goes to its highest alarm volume and indicates an off-line condition.
    - If you choose no, the bedside monitor does not expect an acknowledgment from MULTIVIEW WORKSTATION and will not go to its highest alarm volume.
    - If there is no MULTIVIEW WORKSTATION on this INFINITY NETWORK, or this bed is NOT to be centrally monitored, choose "NO."

Table 4: Monitor Configuration Parameters

←	Network Config	
Network Mode	**Host ID**	z
Bed	**Monitoring Unit ID**	y
CPS/IDS	**IP Address**	191.1.*y* .*z*
Care Unit	**Subnet Mask**	255.255.0.0
Monitoring Unit	**Default Route**	0.0.0.0
Hospital	**Remote Silence**	
Recorder 1	**Remote Control**	
Recorder 2	**Alarm Group**	
Recorder Use	**Central Station**	
Save ALL		

4 Configuring Monitor

1. On Main menu, access Monitor Setup → Unit Manager, and enter Clinical password (**375**).
2. Select Menu Setup, and set Menu Time Limit to OFF.
3. On Main menu, access Monitor Setup → Biomed → Service, and enter Biomed password (**4712**).
4. On Service menu, select Network Config.
5. For each parameter, enter data from Table 1 and select "Accept".

   Note: For numerical fields, rotary knob increments and decrements numbers in the field as well as enters the data.
6. After all data has been entered, recheck data and then select Save ALL.

Note: Monitor saves all entries, and then power-cycles if any IP address parameters or Network Mode were changed. Menu Time Limit automatically resets to ON if monitor power-cycles.

7. Power-cycle monitor, unless monitor power-cycled in step 6.
8. Connect monitor to network, and verify on MVWS that monitor communicates with MVWS and configuration contains no duplicate names.
9. This completes monitor setup.

If procedures in this Manual are performed by other than Siemens service personnel, for more information contact your local Siemens service representative. Technical support for Siemens service personnel is available as follows:

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