Service Manual

Accutorr® V

mindray

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Accutorr® is a registered trademark of Mindray DS USA, Inc.

Masimo SET® is a U.S. registered trademark of Masimo Corp.

Mindray® is a trademark or a registered trademark of Shenzhen Mindray Bio-Medical Electronics Co., Ltd.

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Preface

This manual provides detailed information about the assembling, disassembling, testing, and troubleshooting of the equipment to support effective troubleshooting and repair. It is not intended to be a comprehensive, in-depth explanation of the product architecture or technical implementation. Observance of the manual is a prerequisite for proper equipment maintenance and prevents equipment damage and personnel injury.

Refer to the Accutorr V Operating Instructions: P/N 0070-00-0699-XX for information for operating this instrument.

This manual is based on the maximum configuration. Therefore, some contents may not be applicable. For questions, contact Service.

This manual is for biomedical engineers, authorized technicians, or service representatives responsible for troubleshooting, repairing, and maintaining the monitors.

Contents of this manual are subject to change without prior notice.

A password is required to access the service mode. The service password is 321.

The Accutorr V configurations are:

- **Accutorr V with Nellcor® Pulse Oximetry**—
  includes NIBP, Nellcor SpO_2, a Trend Display, and Recorder
- **Accutorr V with Nellcor® Pulse Oximetry and SmarTemp™**—
  includes NIBP, Nellcor SpO_2, SmarTemp, a Trend Display, and Recorder
- **Accutorr V with Masimo SET® Pulse Oximetry**—
  includes NIBP, Masimo SpO_2, a Trend Display, and Recorder
- **Accutorr V with Masimo SET® Pulse Oximetry and SmarTemp™**—
  includes NIBP, Masimo SpO_2, SmarTemp, a LCD, and Recorder
- **Accutorr V with DPM Pulse Oximetry**—
  includes NIBP, DPM SpO_2, a Liquid Crystal Display (LCD), and Recorder
- **Accutorr V with DPM Pulse Oximetry and SmarTemp™**—
  includes NIBP, DPM SpO_2, SmarTemp, a Liquid Crystal Display (LCD), and Recorder
- **Accutorr V with DPM NIBP and SmarTemp™**—
  includes NIBP, SmarTemp, a Trend Display, and Recorder
- **Accutorr V with DPM NIBP only**—
  includes NIBP, a LCD, and Recorder

All Accutorr V configurations can be upgraded with a barcode scanner.

Masimo Patents: This device (MASIMO SpO_2 Module) is covered under one or more of the following U.S. Patents 5,758,644, 5,823,950, 6,011,986, 6,157,850, 6,263,222, 6,501,975, and other applicable patents listed at: www.masimo.com/patents.htm. Possession or purchase of this device does not convey any express or implied license to use the device with replacement parts which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

Nellcor Patents: This device (Nellcor SpO_2 Module) is covered under one or more of the following U.S. Patents Patent No. 5,485,847, 5,676,141, 5,743,263, 6,035,223, 6,226,539, 6,411,833, 6,463,310, 6,591,123, 6,708,049, 7,016,715, 7,039,538, 7,120,479, 7,120,480, 7,142,142, 7,162,288, 7,190,985, 7,194,293, 7,209,774, 7,400,919, and 7,212,847. Possession or purchase of this device does not convey any express or implied license to use the device with replacement parts which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

Warnings, Cautions, and Notes

Read and adhere to all of the warnings and cautions listed throughout this manual.

A **WARNING** is provided to alert the user to potentially serious outcomes (death, injury or serious adverse events) to the patient or the user.

A **CAUTION** is provided to alert the user that special care should be taken for the safe and effective use of the device. They will include actions to be taken to avoid effects on patients or users that will not be potentially life threatening or result in serious injury, but about which the user should be aware.

A **NOTE** is provided when additional general information is available.

Warnings

WARNING: Internal Electrical Shock Hazard - This unit does not contain any user-serviceable parts. Do not remove instrument covers. Refer servicing to qualified personnel. When the integrity of the protective earth conductor, in the installation or its arrangement, is in doubt, the equipment should be operated from its internal battery. Observe all CAUTION and WARNING labels on the unit.

WARNING: Possible explosion hazard. Do not operate machine near flammable anesthetic agents or other flammable substances. Do not use flammable anesthetic agents (i.e., ether or cyclopropane.)

WARNING: Always place the unit on a flat, rigid surface or onto a Mindray approved stable mounting bracket.

WARNING: To ensure proper performance and safety and to prevent the voiding of the warranty, only use authorized parts and accessories with the Accutorr V. Use of unauthorized accessories may result in erroneous readings.

WARNING: Use only cuffs with approved quick connect type connectors.

WARNING: The Accutorr V is not intended for use in a magnetic resonance imaging (MRI) environment and may interfere with MRI procedures.

WARNING: Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturers instructions and local regulations. Batteries used in this device may present a risk of fire or chemical burn if mistreated. Do not incinerate battery, possible explosion may occur.

WARNING: Do not use a damaged or broken unit or accessory.

WARNING: Operation of the Accutorr V below the minimum amplitude or value of patient physiological signal may cause inaccurate results.

WARNING: Use of accessories, transducers, and cables other than those specified in the manual may result in increased Electromagnetic Emissions or decreased Electromagnetic Immunity of the Accutorr V. It can also cause delayed recovery after the discharge of a cardiac defibrillator.

WARNING: Perform the decontamination or cleaning process with the unit powered down and power cord removed.

WARNING: Electrical safety tests are a proven means of verifying the electrical safety of the monitor. They are intended for determining potential electrical hazards. Failure to identify these hazards in a timely manner may cause personnel injury.

WARNING: Commercially available test equipment such as a safety analyzer can be used for electrical safety tests. Verify that the test equipment can be safely and reliably used with the monitor before use. The service personnel should acquaint themselves with the use of the test equipment.

WARNING: Electrical safety tests should meet the requirements of the latest editions of EN 60601-1 and UL 60601.

WARNING: These electrical safety tests do not supersede local requirements.

WARNING: All devices using the AC mains and connected to medical equipment within patient environments must meet the requirements of the IEC 60601-1-1 medical electrical systems standard and should be put under electrical safety tests at the frequency recommended for the monitor.

Cautions

CAUTION: Observe extreme caution when a defibrillator is in use. Do not touch any part of the patient, table, or monitor when a defibrillator is in use. The Accutorr V should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the Accutorr V should be observed to verify normal operation in the configuration in which it will be used.

CAUTION: The unit should be checked periodically for obstructed vents. If an obstruction is found, refer the unit to qualified service personnel.

CAUTION: At the end of their life, dispose of the Accutorr V, accessories, and single use supplies in accordance with local regulations. Dispose of packaging waste in accordance with local regulations.

CAUTION: When equipped with Nellcor® SpO_2, use only Nellcor® oxygen transducers including Nellcor® Oxisensor® patient dedicated adhesive sensors. Use of other oxygen transducers may cause improper oximeter performance.

CAUTION: When equipped with MASIMO® SpO_2, use only MASIMO® oxygen transducers including MASIMO LNOP® and MASIMO LNCS® patient dedicated adhesive sensors and MASIMO PC Series Patient Cable. Use of other oxygen transducers may cause improper Oximetry performance.

CAUTION: **Inaccurate readings may be caused by incorrect sensor application or use; significant levels of dysfunctional hemoglobins (i.e. carbohemoglobins or methemoglobin); or intra-vascular dyes such as indocyanine green or methylene blue; exposure to excessive illumination, such as surgical lamps (especially ones with a Xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps, or direct sunlight; excessive patient movement; venous pulsations; electro-surgical interference; and placement of a sensor on an extremity that has a blood pressure cuff, arterial catheter, or intra-vascular line.**

CAUTION: **Route cables neatly. Ensure cables, hoses, and wires are kept away from patient's neck to avoid strangulation. Keep floors and walkways free of cables to reduce risk to hospital personnel, patients, and visitors. If the sensor or patient cable is damaged in any way, discontinue use immediately.**

CAUTION: **When cleaning sensors, do not use excessive amounts of liquid. Wipe the sensor surface with a soft cloth, dampened with the cleaning solution. To prevent damage, do not soak or immerse the sensor in any liquid solution. DO NOT ATTEMPT TO STERILIZE.**

CAUTION: **Recharge the Lithium ion battery while in the unit at room temperature. If using the Accutorr V in a hot environment, the Lithium ion battery may not charge when the unit is connected to the AC mains.**

CAUTION: **Remove the battery if the Accutorr V is not used for an extended period of time.**

CAUTION: **The Communications Connectors on the Accutorr V are only for use with IEC 60601-1-1 compliant equipment.**

CAUTION: **Never place fluids on top of this monitor. If fluid spills on the unit, wipe clean immediately and refer the unit to qualified service personnel.**

CAUTION: **Before disassembling the monitor, eliminate static charges. When disassembling the parts labeled with static-sensitive symbols, wear electrostatic discharge protection such as antistatic wristband or gloves. Follow the correct sequence to disassemble the monitor. Otherwise, the monitor may be damaged permanently. Disconnect all the cables before disassembling any parts. Take care not to damage any cables or connectors.**

CAUTION: **Properly connect the cables or wires when reassembling the monitor to avoid short circuit. When assembling the monitor, select proper screws. If the wrong size screw is tightened by force, the monitor may be damaged and the screw or the part may not function as expected.**

CAUTION: **All tests should be performed by qualified personnel only.**

CAUTION: **Disconnect the monitor from the patient and make sure that important data is saved before upgrading the monitor.**

CAUTION: **Do not shut down or power off the equipment when upgrading the bootstrap program. Otherwise, it may cause the equipment to break down.**

CAUTION: Program upgrades should be performed by qualified service personnel only.

Notes

NOTE: The Accutorr V should be operated only by trained and qualified personnel.

NOTE: Use disposable and single use accessories only once.

NOTE: Place the equipment in a location where the screen can easily be seen and the operating controls can easily be accessed.

NOTE: The instructions in this manual are based on the maximum configuration.

NOTE: The optional Temperature module kit must be installed only by trained personnel, and proper ESD prevention methods must be followed.

NOTE: Only devices specified by Mindray DS USA, Inc./Shenzhen Mindray Bio-Medical Electronics Co. , Ltd shall be connected the RS-232 port.

NOTE: When the RS-232 connector is used for DIAP, barcode power must be set to OFF.

NOTE: Disconnect the Accutorr V from the mains to isolate it from the mains power during an emergency.

Safety Designations

Safety designations per IEC 60601-1 Standard:

Type of protection against electric shock	Class 1 with internal electric power source. Where the integrity of the external protective earth (ground) in the installation or its conductors is in doubt, the equipment shall be operated from its internal electric power source.
Degree of protection against electric shock	Monitor - Type B applied part. NIBP - Type BF defibrillation protected applied part. SpO_2 - Type BF protected applied part. Temp - Type BF protected applied part.
Supply Connection	100 – 240 VAC 50/60 Hz 0.85 – 0.5 A
Mode of Operation	Continuous
Protection Against Hazard of Explosion	Not Protected (Ordinary)
Protection Against Ingress of Liquids	IPX1
Degree of Electrical Connection Between Equipment and Patient	Equipment designed for direct electrical and non-electrical connection to the patient.
Degree of Mobility	Portable

Product Limitations

Non-invasive blood pressure (NIBP) accuracy depends on the application of the proper cuff size. See Chapter 3.0 of the Operating Instructions for detailed information.

The Accutorr V will not operate effectively on patients who are experiencing convulsions or tremors.

The Accutorr V is a portable device intended for intra-hospital use.

If the pressure cuff is not placed at the patient's heart level, the NIBP measurement may be subject to error, due to the hydrostatic effect.

The pulse rate data displayed on the Accutorr V is computed from the measurement of peripheral pulses (peripheral pulses taken only during a measurement cycle). The rate measured by the Accutorr V may differ from the rate of an ECG monitor. This is because the ECG is an electrical signal that may not always result in a peripheral pulse.

Administration of certain vasoconstrictor drugs (for example, norepinephrine), may reduce peripheral perfusion to a level that prevents the Accutorr V from taking pulse rate measurements.

Arterial compression, tricuspid regurgitation, or other conditions may reduce perfusion to a level that prevents the Accutorr V from taking pulse rate measurements.

The presence of arrhythmias may increase the time required to complete a measurement and may extend this time so that a measurement cannot complete.

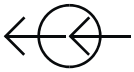
The Accutorr V is not intended for use during CPR. The monitor uses an oscillometric technique based on normal peripheral circulation to compute blood pressure.

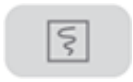
Unpacking

Remove the instrument from the shipping carton and examine it for signs of shipping damage. Save all packing materials, invoice, and bill of lading. These may be required to process a claim with the carrier. Check all materials against the packing list. Contact the Customer Service Department (800) 288-2121 or (201) 265-8800 for prompt assistance in resolving shipping problems.

NOTE: **The Accutorr V should only be shipped in its original packing materials to avoid shipping damage.**

Symbols and Descriptions

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	Attention, Consult Accompanying Documents / Refer to Manual		Type BF Equipment
	Equipotentiality Equipotential grounding		Defibrillator-proof Type BF Equipment
	Alternating Current (AC)		Adult
T1	Predictive Thermometer Connector		Pediatric/Child
SpO_2	SpO_2 Connector		Neonate
	Electrical connectors		Operating on battery power
	Battery		Manufacturer
	Connected to AC mains		NIBP Connector
	Power On/Off – Standby		Recycle
SN	Serial number		Up key

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
REF	Part Number	OK	Confirm key
	Patient Information key		Down key
	Main menu key		Deflate Cuff key
	Set alarms key		Patient Size key
	Start NIBP key		Alarm Silence key
	Display Tabular Trends/Pleth Wave	**NC1**	Nurse Call connector
	NIBP interval key	**SP1**	RS-232 connector (Serial Port 1)
	Print key (front panel)	**CS1**	Network connector
	Print key (recorder)		Alarm Disabled indicator on LCD display
	Alarm Silenced indicator on LCD display		Audio Alarm Off indicator on LCD display
	Classified by Underwriters Laboratories Inc. with respect to electric shock, fire and mechanical hazards, only in accordance with UL 60601-1, CAN/CSA C22.2 NO.601-1, IEC 60601-1-1, IEC 60601-2-30, IEC 60601-2-49.		

1.0 *Theory of Operation*

1.1 Introduction

The Accutorr V monitors the following patient vital signs: non-invasive blood pressure (NIBP), pulse oxygen saturation (SpO_2), pulse rate (PR), and temperature (Temp) for a single adult, pediatric, or neonatal patient. Temperature is measured using the optional Temperature Module.

1.2 Controls and Indicators

For information on controls, connectors, and indicators, refer to the Accutorr V Operating Instructions, Part Number 0070-10-0699-02.

1.3 System Overview

FIGURE 1-1 shows the relationship of the Accutorr V monitoring system's mechanical, hardware, and software components.

FIGURE 1-2 shows the Accutorr V monitoring system's PC board connections.

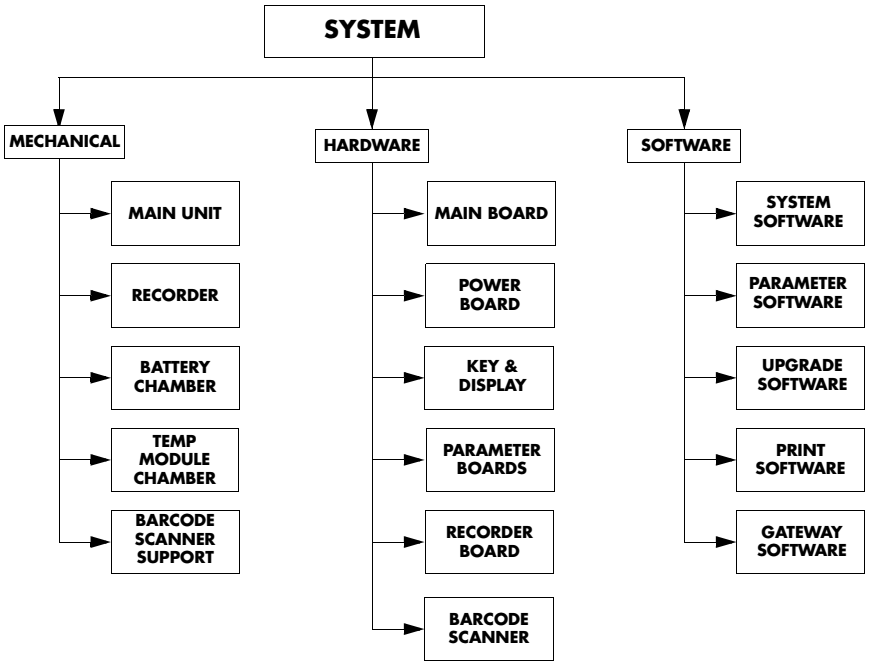


FIGURE 1-1 System Mechanical, Hardware, and Software Overview

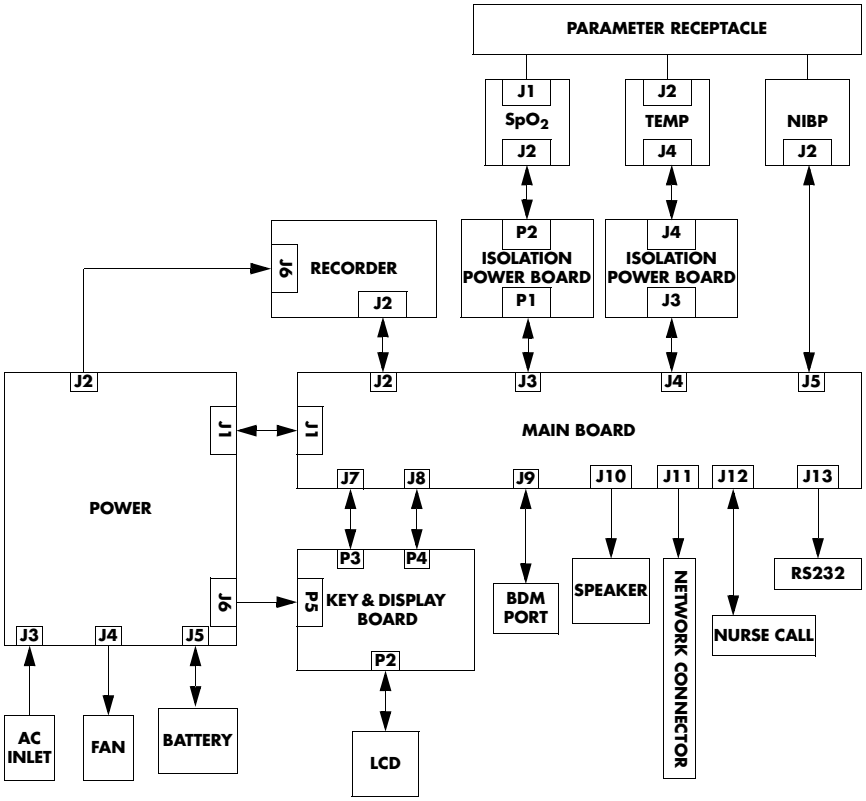


FIGURE 1-2 The System PCBA Connections

1.4 Hardware Structure

FIGURE 1-3 shows the Accutorr V's Hardware Structure. The core of the system is the main board, which supplies power for all parameter modules. The parameter modules directly communicate with the main board. The the main board processes measurements and the status of all modules, and displays them through the key and display board.

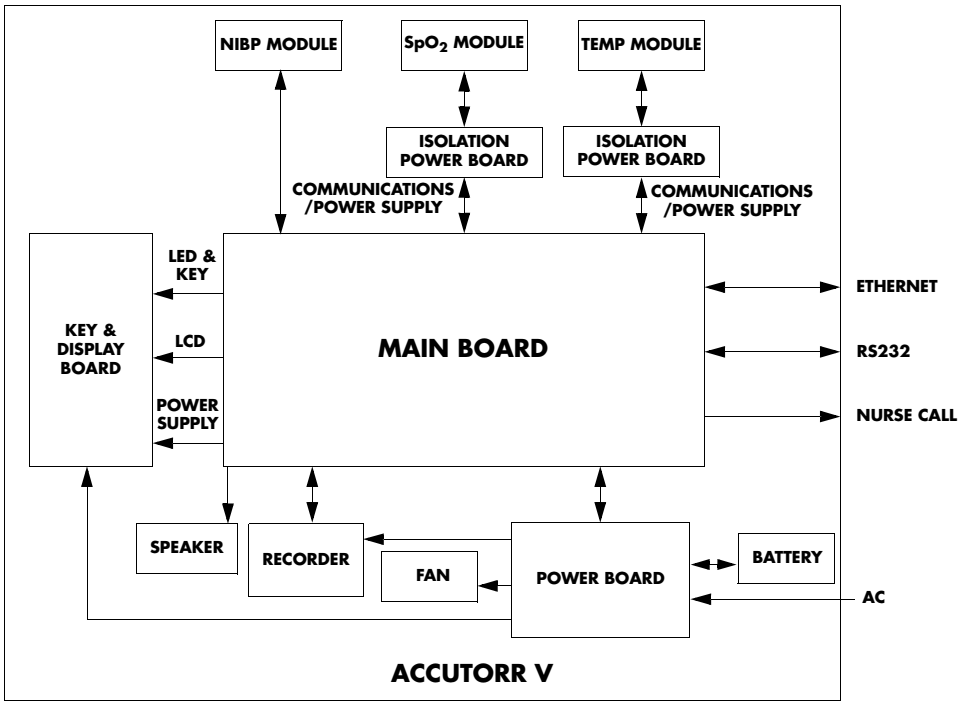


FIGURE 1-3 The Accutorr V's Hardware Structure

NOTE: The SpO_2 isolation power board does not apply to models with DPM Pulse Oximetry.

1.4.1 Main Board

FIGURE 1-4 shows the main board, which provides resources and support for the overall system. It controls the LCD, LED, keyboard, speaker, and recorder. It also communicates with parameter modules and connectors. The main board also controls communication with the speaker, the recorder, and all external connectors.

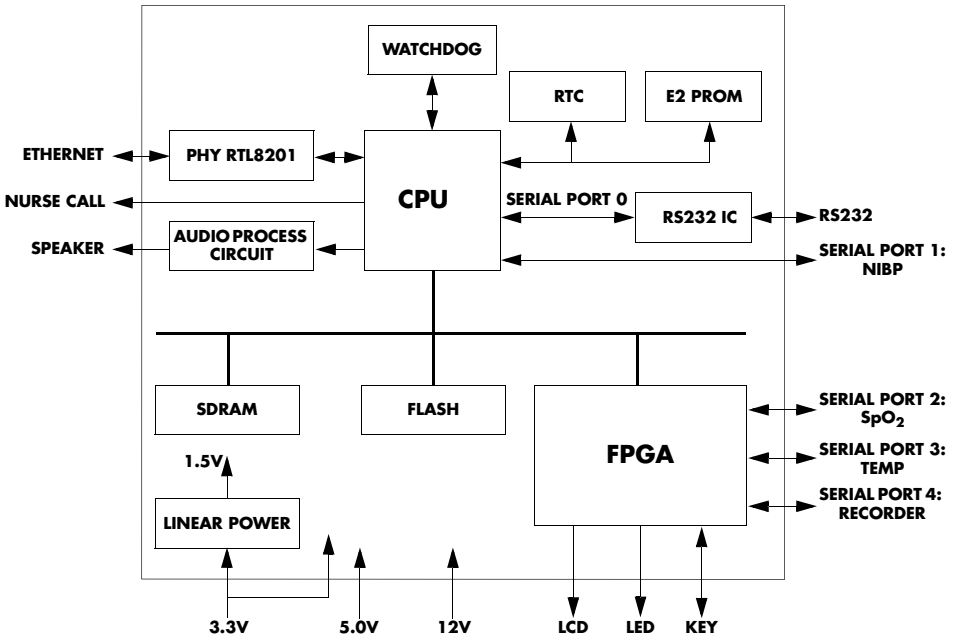


FIGURE 1-4 Main Board Principle Diagram

The main board communicates with all parameter modules and the recorder through an FPGA extended serial port.

The main board supplies information using FPGA to the key and display board. It drives the display, detects the keys, and implements the user interface.

The main board controls the alarm indicator using FPGA.

The main board controls the speaker to give audible alarms, key tones, and Pitch Tone.

The main board provides the nurse call connection, network connection, and R232 connection.

The real-time clock is implemented by the RTC chip. The RT clock is powered by the AC mains, battery, or button cell on the main board. The button cell ensures the continuous working of the clock in the event that the AC mains and batteries are not available.

SDRAM stores running program instructions and data temporarily. The system memory and trend data memory is flashed. The device configuration memory is EEPROM.

1.4.2 Power Board

The power board, shown in FIGURE 1-5, converts the input power (AC mains or battery) to different working voltages for other boards. It also charges the battery.

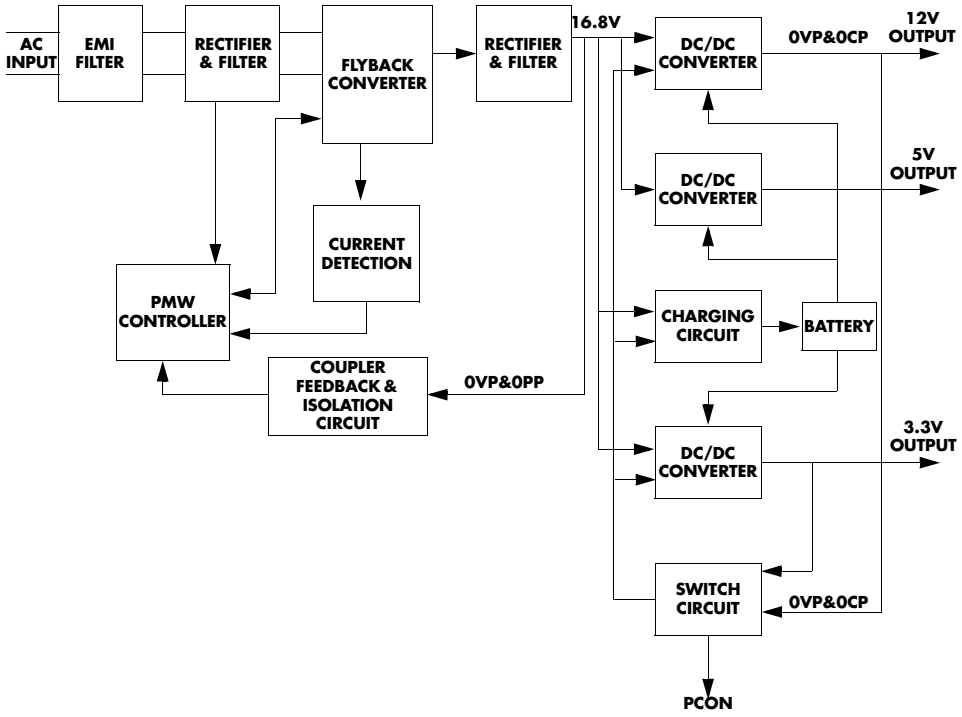


FIGURE 1-5 Power Board Principle Diagram

The AC flows through the EMI filter and the rectifier and filter. The rectifier and filter converts the AC to 16.8V DC voltage by the Flyback converter. The 16.8V DC voltage is the main input to the DC/DC converters and charging circuit. The DC/DC converters convert 16.8V DC to 12V, 5V, and 3.3V DC. The charging circuit charges the lithium battery. When the Accutorr V is not connected to the AC mains, the battery supplies power to the DC/DC converters.

The 16.8V DC output is protected against over-voltage and over-power. The 12V, 5V, and 3.3V DC outputs are protected against over-voltage, short-circuit, and over–current.

1.4.3 Key and Displays Board

The key and displays board, shown in FIGURE 1-6, provides the user interface. The board contains the LCD module, 7-segment digital display, LED indication lamp, and keys.

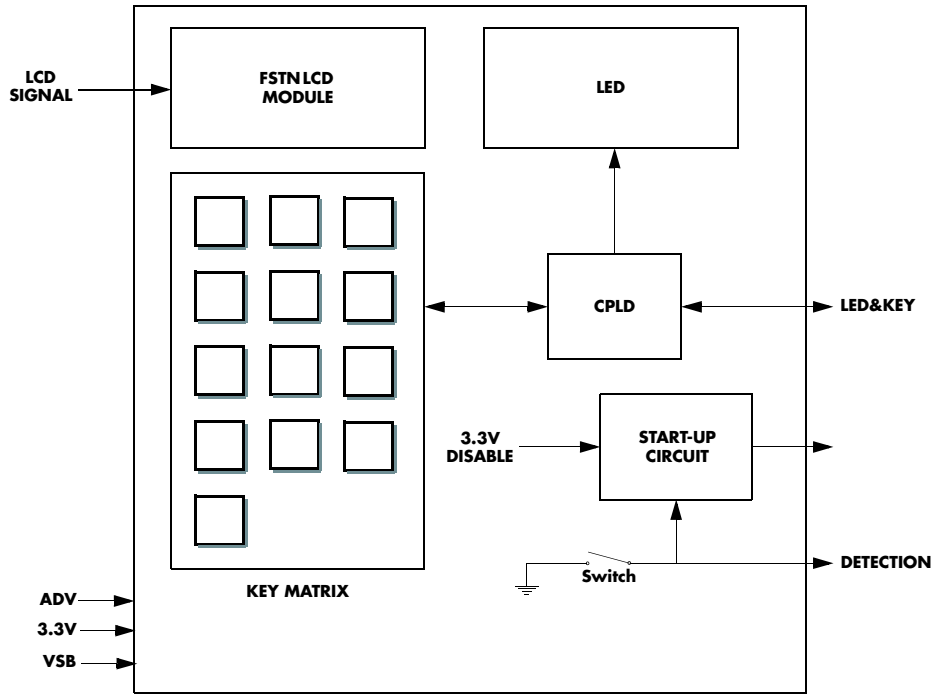


FIGURE 1-6 Key and displays Board Principle Diagram

The LCD module adjusts brightness and contrast (only for black-and-white LCD display).

NOTE: The monitor with color LCD does not have "Contrast " setting item in the common setup menu.

The 7-segment digit units display parameter data.

The AC indicator is driven by the ADV output from the power board, and the working status indicator (built in the Power On/Off key) is driven by 3.3V voltage. The battery indicator is jointly controlled by the flash control signal, ADV signal, and VBC signal.

The keypad contains the power ON/OFF key and the other 13 function keys.

1.4.4 Parameter Boards

1.4.4.1 SpO_2 Module

FIGURE 1-7 shows the SpO_2 module parameter board diagram.

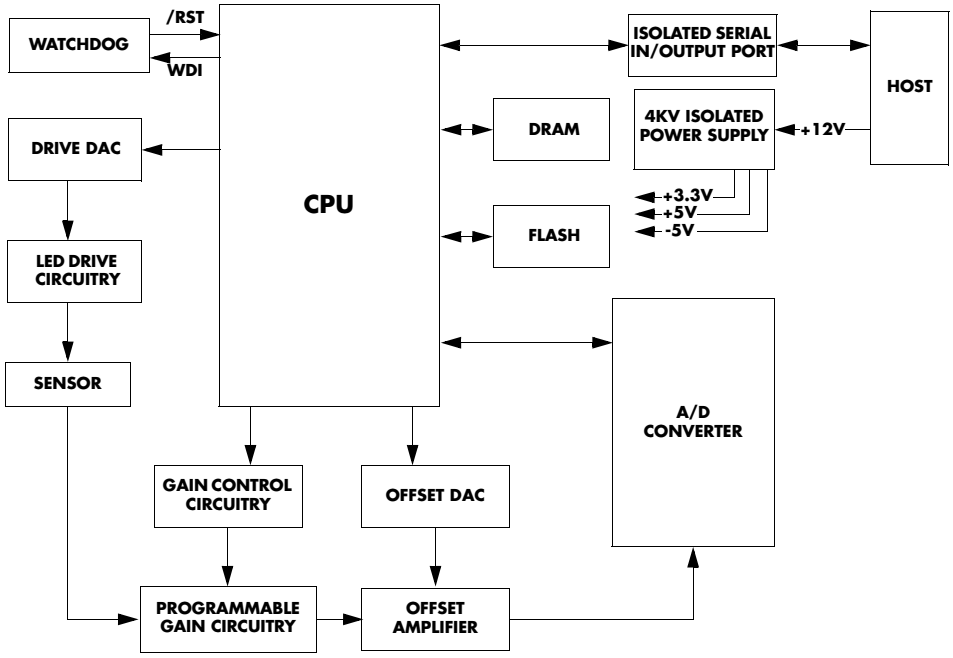


FIGURE 1-7 SpO_2 Module Principle Diagram

The SpO_2 sensor collects the pulsing red and infrared light signals transmitting through the finger or toe, and processes the collected signals to create the measured result. The SpO_2 module controls the LED drive circuit and the amplifying circuit gain corresponding to the finger or toe perfusions and transmittances.

1.4.4.2 NIBP Module

FIGURE 1-8 shows the NIBP module parameter board diagram.

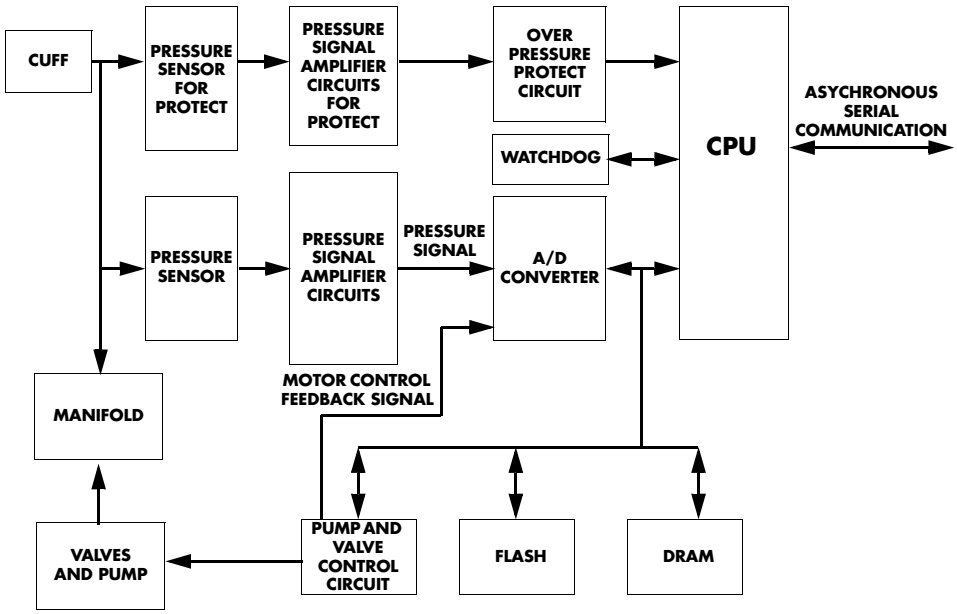


FIGURE 1-8 NIBP Module Principle Diagram

The Accutorr V calculates NIBP values using the oscillometric method of noninvasive blood pressure measurement. These measurements correspond to comparisons with auscultatory values, measured using the fifth Korotkoff sound within ANSI/AAMI SP10 standards for accuracy.

1.4.4.3 Optional Temperature Module

FIGURE 1-9 shows the Temperature module parameter board diagram.

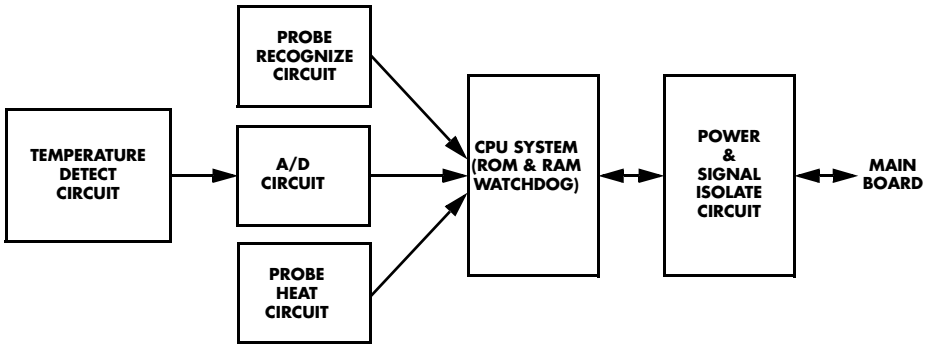


FIGURE 1-9 Optional Temperature Module Principle Diagram

The Temperature Module uses a thermistor as a sensor for measuring temperature. The resistance of a given thermistor is nonlinearly relative to the temperature. The Temperature Module measures the resistance of the thermistor and converts it into temperature.

1.4.5 Recorder

The recorder receives data from the main board and sends it to the thermal printhead for printing. It has a button to start or stop printing and a green LED to indicate the presence or absence of paper.

1.4.6 Bar Code Scanner

The bar code scanner reads one-dimensional and two-dimensional bar codes to simplify admitting a patient. The bar code scanner communicates with the monitor. The serial port supplies it with power. The scanner's serial port is defined in the following table:

PIN	DEFINITION
2	Barcode_RX
3	Barcode_TX
5	GND
9	VCC5VDC

The monitor's serial port is defined in the following table:

PIN	DEFINITION
2	Monitor_TX
3	Monitor_RX
5	GND
9	VCC5VDC

Basic settings of the bar code scanner are listed in the following table:

HOST PARAMETERS	BAR CODE SCANNER	FACTORY DEFAULT
Baud Rate	9600	9600
Data Bits	8	8
Stop Bits	1	1
Calibration bit	0	0
Handshaking	None	None

USER PARAMETERS	BAR CODE SCANNER	FACTORY DEFAULT
Beeper Tone	Medium	Medium
Beeper Volume	Medium	High
Trigger Mode	Level	Auto Aim
Parameter Scanning	Disable	Enable

DATA FORMAT	BAR CODE SCANNER	FACTORY DEFAULT
Prefix Value	7013 <CR><LF>	7013 <CR><LF>
Suffix 1 Value Suffix 2 Value	7013 <CR><LF>	7013 <CR><LF>
Scan Data Transmission Format	<PREFIX><DATA><SUFFIX 1><SUFFIX 2>	Data only

To change parameter settings, scan the following bar codes in sequence.

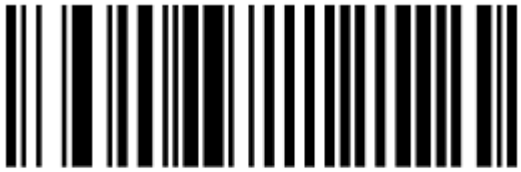
1. Set parameter defaults:

*Set All Defaults

2. Set beeper volume:

Medium Volume
(01h)

3. Set trigger mode:



Level
(00h)

4. Set scan data transmission format:

<PREFIX> <DATA> <SUFFIX 1> <SUFFIX 2>
(07h)

5. Disable parameter scanning:

Disable Parameter Scanning
(00h)

2.0 Specifications

2.1 Introduction

The Accutorr V monitors patient vital signs (including non-invasive blood pressure (NIBP), pulse oxygen saturation (SpO_2), and pulse rate (PR)) for a single adult, pediatric, or neonatal patient. It also monitors oral or rectal mode temperature (Temp) for a single adult or pediatric patient; or axillary mode temperature for a single neonate, adult, or pediatric patient using the optional Temperature Module.

2.2 NIBP Measurement

The NIBP module is used to measure the systolic pressure, diastolic pressure, and mean pressure in the neonatal, pediatric, and adult modes. The Accutorr V calculates NIBP values using the oscillometric method of noninvasive blood pressure measurement. These measurements correspond to comparisons with auscultatory values, measured using the fifth Korotkoff sound within ANSI/AAMI SP10 standards for accuracy.

2.2.1 Blood Pressure

PARAMETER	PATIENT SIZE	RANGE
Systolic pressure measurement	Adult	55 – 235 mmHg
	Pediatric	55 – 160 mmHg
	Neonate	45 – 120 mmHg
Diastolic pressure measurement	Adult	30 – 200 mmHg
	Pediatric	30 – 150 mmHg
	Neonate	20 – 100 mmHg
Mean pressure measurement	Adult	30 – 235 mmHg
	Pediatric	30 – 160 mmHg
	Neonate	20 – 120 mmHg
Measurement accuracy	Mean error: <±5 mmHg Standard deviation: <±8 mmHg	

Measurements outside of the stated ranges are not guaranteed to be accurate.

2.2.2 Static Accuracy

Measurement range:	0 – 300 mmHg
Static pressure measurement accuracy:	±3 mmHg

2.2.3 Maximum Cuff Pressure

Normal Use Over Pressure Protection

In normal use, the over-pressure detection is controlled by software. Once the cuff pressure exceeds the threshold, the software enables the system to deflate the cuff.

Adult	300 mmHg
Pediatric	200 mmHg
Neonate	150 mmHg

Single Fault Over-pressure protection

In single fault conditions, the hardware controls the cuff deflation to prevent the cuff pressure from exceeding the following ranges:

Adult	330 mmHg
Pediatric	220 mmHg
Neonate	165 mmHg

2.2.4 Cuff Inflation

The Non-Invasive Blood Pressure inflation source brings a volume of 200 ccs to a pressure of 300 mmHg in less than or equal to 10 seconds

2.2.5 Maximum Leakage

The Non-Invasive Blood Pressure Cuff driver allows a pressure drop to be, at most, 1 mmHg in 10 seconds as measured with a 200 cc volume at differential pressures of 250 mmHg, 150 mmHg, and 50 mmHg.

2.2.6 Deflation Rate

The Non-Invasive Blood Pressure Cuff venting mechanism in adult mode vents a volume of 500 cc, reduced from a pressure of 260 mmHg to a pressure of 15 mmHg in a maximum of 10 seconds.

The Non-Invasive Blood Pressure Cuff venting mechanism in neonatal mode vents a volume of 500 cc, reduced from a pressure of 150 mmHg to a pressure of 5 mmHg in a maximum of 5 seconds.

2.2.7 Update Period

The Non-Invasive Blood Pressure Parameter has an update period of one (1) second.

2.2.8 Initial NIBP Pressure Setup and Range

The initial pressure is adjustable, and should be set to the following default values:

PATIENT TYPE	DEFAULT INITIAL PRESSURE	ADJUST RANGE
Adult	180 mmHg	100 – 280 mmHg
Pediatric	140 mmHg	60 – 180 mmHg
Neonate	100 mmHg	40 – 120 mmHg

Manual pressure changes in increments of 5 mmHg.

2.3 NIBP Measurement Cycle

There are two different modes of measurement operation: manual and interval modes. The manual mode requires the operator to initiate the measurement cycle.

The interval mode follows a configured plan of automatically initiated measurement cycles, using the follow selections:

OFF (manual), STAT, or 1, 2, 3, 5, 10, 15, 20, 30, 60, 120, 240 minutes

NOTE: When the NIBP STAT interval is selected, the Accutorr V takes back to back (one right after the other) blood pressure readings. As a safety precaution, there is a five minute or 10 measurement limit for continuous NIBP measurements. After 5 minutes or 10 measurements, the NIBP module automatically switches to the mode in use before NIBP STAT was selected. This reduces the chance of surface vessel rupture (petechia).

The maximum adult and pediatric measurement cycle is 180 seconds.

The maximum neonatal measurement cycle is 90 seconds.

The NIBP module adjusts the inflation pressure automatically according to the systolic pressure of the last measurement. If the first measurement is unsuccessful, the subsequent inflation pressures change to 50 mmHg higher than the previous systolic pressure in adult or pediatric mode, and 40 mmHg higher than the previous systolic pressure in neonate mode. (The subsequent inflation pressure should be greater than the systolic pressure in the previous measurement).

2.3.1 Cuff Inflation Time

If the cuff pressure does not attain 15 mmHg within 20 seconds for adult and pediatric patients, or 15 mmHg within 10 seconds for neonate patients from the start of inflation, the Accutorr V retries measuring up to three times. If the target pressure is not reached after three retries, the cuff is deflated, and a status code displays.

2.3.1.1 Cuff Pressure Automatic Check Algorithm

If the monitor cannot inflate the cuff to the Pressure Threshold within the expected time period, the monitor deflates the cuff, cancels the measurement, shuts off the pump, and displays the message “Unable to Measure”. The cancellation occurs based on the following tables.

OPERATING MODE	PRESSURE THRESHOLD	DURATION	NUMBER OF RETRIES
Adult and Pediatric	15 mmHg	20 sec.	3
Neonate	15 mmHg	10 sec.	3

OPERATING MODE	TARGET INFLATION PRESSURE	NUMBER OF RETRIES
Adult, Pediatric, Neonate	60 mmHg	3

2.3.2 Automatically Adjusted Inflation Value after First Measurement

In the Interval and Stat modes, the inflation value of the next measurement will be automatically adjusted by the NIBP module based on the systolic value of the previous reading. After the first unsuccessful measurement, the subsequent inflation value will be the previous systolic pressure reading plus P2:

Adult Mode:	P2 = 50 ±10 mmHg
Pediatric Mode:	P2 = 50 ±10 mmHg
Neonate Mode:	P2 = 40 ±10 mmHg

2.3.3 Pulse Rate

Accuracy: ±3 BPM or ±3%, whichever is greater.

Resolution: 1 BPM

PATIENT TYPE	PULSE RANGE
Adult	35 – 245 BPM
Pediatric	35 – 245 BPM
Neonate	70 – 245 BPM

Measurements outside of the stated ranges are not guaranteed to be accurate.

2.4 SpO_2 Measurement

When configured with the DPM SpO_2 module, NELLCOR NELL-3 SpO_2 module, or MASIMO MS-2013 SpO_2 module, the Accutorr V can perform SpO_2 measurements.

The SpO_2 measurement function complies with the requirements of ISO9919.

2.4.1 DPM SpO_2 Module Performance

The DPM SpO_2 accuracy has been validated in human studies against arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurements are statistically distributed, and only about two-thirds of the measurements can be expected to fall within the specified accuracy compared to CO-oximeter measurements.

2.4.1.1 SpO_2

Range: ..... 0 – 100%

Resolution: 1%

Accuracy in the static condition:

	SPO_2 RANGE	
PATIENT TYPE	**70% TO 100%**	**0 – 69%**
Adult or pediatric	±2 digits	Undefined
Neonate	±3 digits	Undefined

2.4.1.2 Pulse Rate

Range: ..... 20 – 254 BPM

Resolution: ..... 1 bpm

Accuracy in the static condition:

PATIENT TYPE	**PR RANGE**	**ACCURACY**
Adult / Pediatric / Neonate	20 – 254 bpm	± 3 digits

2.4.1.3 Alarm setting range

SPO_2 MODULE	**SPO_2**	**PR**
DPM SpO_2 module	50 – 100%	0 – 254 bpm

2.4.2 Masimo MS-2013 SpO_2 Performance

This section details the performance measurements of the Masimo MS-2013, which is designed in accordance with the requirements of the interface of the Masimo MS-2013 board. The Accutorr V interface complies with the requirements of the Masimo MS-2013 board communication protocol.

2.4.2.1 SpO_2

Compatible Sensors:

See Section 6.6 for a list of compatible sensors.

Measurement range: 1 – 100%

Resolution: 1%

Accuracy no motion conditions:

PATIENT TYPE	SPO_2 RANGE: 70% – 100%	SPO_2 RANGE: 1% – 69%
Adult	±2 digits	Undefined
Pediatric	±2 digits	Undefined
Neonate	±3 digits	Undefined

Accuracy During motion conditions:

PATIENT TYPE	SPO_2 RANGE: 70% – 100%	SPO_2 RANGE: 1% – 69%
Adult	±3%	Undefined
Pediatric	±3%	Undefined
Neonate	±3%	Undefined

SpO_2 response time:

Under the condition that the PR is 75 BPM and the averaging is 8 seconds, the maximum response time for the SpO_2 value to increase from 60% to 95% is 20 seconds.

Low Perfusion Performance:

LOW PERFUSION CONDITION			
PULSE AMPLITUDE	% LIGHT TRANSMISSIBILITY	SPO_2 ACCURACY	PR ACCURACY
> 0.02%	> 5%	± 2 digits	± 3 digits

2.4.2.2 Pulse Rate

Resolution: 1 BPM

Update frequency: 1 Hz

Range and Accuracy:

PATIENT TYPE	PR RANGE	ACCURACY IN STATIC CONDITION[1]	ACCURACY IN MOTION CONDITION[2,3,4]
Adult/Pediatric/Neonate	25 – 240 BPM	± 3 digits	± 5 digits

1 The Masimo MS-2013 pulse oximeter with an LNOP- Adt sensor was validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

2 The Masimo MS-2013 pulse oximeter with LNOP- Adt sensor has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz. At an amplitude of 1 to 2 cm and non-repetitive motion between 1 to 5 Hz at an amplitude of 2 to 3cm in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

3 The Masimo MS-2013 pulse oximeter with LNOP-Neo and Neo Pt sensors has been validated for neonatal motion accuracy in human blood studies on neonates while moving the neonate's foot at 2 to 4 Hz at an amplitude of 1 to 2 cm against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

4 The Masimo MS-2013 pulse oximeter has been validated for low perfusion accuracy in bench top testing against a Biotek Index 2 simulator and Masimo's simulator with signal strengths of greater then 0.02% and transmission of greater than 5% for saturations ranging from 70 to 100%. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

2.4.2.3 Alarm Setting Range

SPO_2 MODULE	SPO_2	PR
MS-2013 SpO_2 module	50 – 100	20 – 250 bpm

2.4.3 Nellcor NELL-3 SpO_2 Performance

This section details the performance measurements of the NELL-3 pulse oximeter (integrated OxiMax measurement technique), which is designed in accordance with the requirement of the interface of the Nellcor NELL-3 board. The SHIP (Standard Host Interface Protocol) mode is used.

2.4.3.1 SpO_2

Compatible Sensors:

See Section 6.6 for a list of compatible sensors

Measurement Range and Accuracy:

	ACCURACY[1,2]	
SENSOR	**70% – 100%**	**0% – 69%**
MAX-A, MAX-P, and MAX-I	± 2%	Undefined
OxiCliq A, OxiCliq N, OxiCliq P and OxiCliq I	±2.5%	Undefined
D-YS, DS-100A, OXI-A/N and OXI-P/I	± 3%	Undefined
MAX-R, D-YSE and D-YSPD	± 3.5%	Undefined

1 When sensors are used on neonatal subjects as recommended, the specified accuracy range increases by ± 1 digit, to account for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood.

2 Neonatal accuracy specifications are based upon testing neonatal sensors on healthy adult volunteers in induced hypoxia studies, in the range of 70-100% SpO_2. The specified accuracy also takes into account published literature which predicts that there may be a small difference in % SpO_2 reported by the oximeter when measurements from adult and fetal blood with 100% fetal hemoglobin are compared. Fetal hemoglobin is present in concentrations varying from 10% to 90% in neonatal blood, and this percentage declines over time. As the percentage of fetal hemoglobin in neonatal blood declines, the theoretical effect on accuracy due to this source is reduced

2.4.3.2 Pulse Rate

MEASUREMENT RANGE	ACCURACY
20 – 250 BPM	±3 BPM
251 – 300 BPM	Undefined

2.4.3.3 Alarm Setting Range

SPO_2 MODULE	SPO_2	PULSE RATE
Nell-3 SpO_2 module	50 – 100	20 – 250 bpm

2.5 Temperature

MODE	MEASUREMENT RANGE	ACCURACY		TYPICAL MEASUREMENT TIME
monitor	25° C – 44° C (77° F – 111.2° F)	25° C (77° F) – 32° C (89.6° F), not including 32° C (89.6° F)	±0.2° C (±0.4 °F)	<60 s
		32° C (89.6° F) – 44° C (111.2° F), including 32° C (89.6° F)	±0.1° C (±0.2° F)	
predict	35° C – 43° C (95° F – 109.4° F)	Not defined		typically 10 s – 12 s from the moment when temperature "—" displays dynamically

2.6 Display Area, Indicator, and Controller

On the front panel of the Accutorr V, there are a panel display area, a red/yellow LED group (on the top of the device), a set of buttons, and patient cable connectors. Refer to Chapter 2 of the Accutorr V Operating Instructions (P/N 0070-10-0699-XX).

2.6.1 Display Area

The display area includes 1 LCD, 7 groups of 7-segment digit display, and 7 groups of monochrome LED indicators.

2.6.1.1 LCD

LCD type	SIZE AND RESOLUTION	DISPLAYED CONTENTS	NOTE
Monochrome FSTN	Matrix: 320×160 dot pitch: 0.24×0.24	Startup screen, menus/ dialogs, time and date, prompt messages, patient ID, patient size, trend data (including scroll bar), SpO_2 waveform, and time to the next NIBP measurement	The brightness and contrast of the LCD are adjustable.
Color TFT	Matrix: 480×272 dot pitch: 0.16125×0.16125	Startup screen, menus/ dialogs, time and date, prompt messages, patient ID, patient size, trend data (including scroll bar), SpO_2 waveform, and time to the next NIBP measurement	Only brightness of LCD is adjustable.

2.6.1.2 7-Segment Digit Display

Seven groups of 7-segment digit displays display the systolic pressure (red LED), diastolic pressure (red LED), mean pressure/cuff pressure (red LED), SpO_2 (green LED), PR (red LED), temperature (red LED), and NIBP interval (red LED).

2.6.1.3 Monochrome LED Indicator

Seven groups of monochrome LED indicators display or indicate the pulse strength (green LED), ADULT–PEDIATRIC–NEO (patient type)–(green LED), Pulse Rate Source (SpO_2 or NIBP)–(green LED), F/C (unit of temperature)–(red LED), silence function (yellow LED), NIBP measurement status (green LED), and temperature measurement type (red LED).

2.6.1.4 Power Indicator

AC power indicator	**Green LED**
	Illuminates when the Accutorr V is connected to the AC mains.
Battery indicator	**Green LED**
	Illuminates when the unit is on and the battery is inserted.
	Flashes when the battery voltage is too low.
On/Standby indicator	**Green LED**
	Illuminates when the device is powered on or in standby mode.
	Darkens when the device is shut down.

2.6.2 Overlay and labeling

- The front panel overlays are displayed in English and extended to other languages.
- The labeling is displayed only in English.
- Startup screen, menu fonts, and LCD prompting characters can be changed through a software upgrade. The default start logo is Accutorr V.
- The format of the date can be set in the maintenance mode: Chinese style (year - month - day), European style (day - month - year), American style (year - day - month).
- Display of NIBP data:
  - The LCD display order is: systolic pressure data, diastolic pressure data, and mean pressure data. For legibility, a "/" separates the data of the three pressures.
  - Data displayed by LED digit displays: The systolic pressure data and diastolic pressure data (in the same fonts) are displayed in parallel. The font of the mean pressure data is smaller than the systolic pressure data and diastolic pressure data, and displays next to them.

2.6.3 Alarm Lamp

- The monitor provides 2 alarm priority levels: high level alarms or low level alarms.
- The Alarm lamp is on the front panel of the monitor. It is a group of (red/yellow) LED indicators.
- During a high alarm, the red LED, of which the duty cycle is 50%, flashes at a frequency of 1.4 – 2.8 Hz (84 times per minute).
- During a low alarm, the yellow LED illuminates continuously.
- In case a high alarm and a low alarm occur simultaneously, only the red LED flashes.

NOTE: The audio alarm indication complies with EN60601-1-8.

2.6.4 Keys

There are 14 keys on the front panel of the monitor.

KEYS	DESCRIPTION
On/Standby indicator	Turn the monitor on, off, or switch to standby. In the operating state, press and hold for less than 1 second to switch the device to the standby or press and hold for 2s to turn the device off.
Start NIBP	Press to start an NIBP measurement.
Deflate	During an NIBP measurement, stops the measurement. Also, suspends interval mode until the next time NIBP Start is pressed.
Print	Start recording trend data/real-time waveform. Press again to stop recording. When recording trend data, press and hold for less than 1 second to record the current data displaying on the LCD, or press and hold for 2 seconds to record all data of the current patient.
Silence	This button has dual functions: Press and hold for less than 1 second to pause an audio alarm (parameters in alarm continue to flash). Press and hold for 2 seconds to silence an alarm.
Set Alarms	Sets alarm parameters.
Interval	Sets the measurement mode and time interval. Option: STAT mode, Off, and interval mode (options: 1, 2, 3, 5,10, 15, 20, 30, 60, 120, and 240 minute intervals). In the Off mode, perform measurement manually.
Menu	Press to view the menu options.
Display	Press to switch between the normal views, PLETH waveform.
Patient Info	Press to automatically create a patient ID.
Patient Size	Press to change patient size
Up Arrow	Press to perform menu operations on the LCD.
OK	
Down Arrow	

2.6.5 Patient Cable Connectors

The patient cable connectors include the NIBP connector, SpO_2 connector, and the optional thermometer connector.

CABLE CONNECTOR	DESCRIPTION
NIBP Cuff	The NIBP cuff connector label is  .
SpO_2	The SpO_2 connector label is **SpO_2**. • Connects the DPM, Masimo, or Nellcor cable. The Label is SpO_2 with the manufacturer name. • Apply standard round DPM 6 pin connector (same as used on Trio) to the monitor configured with the DPM SpO_2 board. • Apply the Masimo connector to the monitor configured with the MS-2013 SpO_2 board. • The monitor configured with the Masimo SpO_2 board must be labeled with the Masimo SET registered trademark. • Apply the Nellcor connector to the monitor configured with the Nell-3 SpO_2 board. • The monitor configured with the Nellcor SpO_2 board must be labeled with the Nellcor mark.
Temperature probe	The Temperature probe connector label is **T1**. • Uses optional Mindray Smartemp predictive temperature module. • The connector of temperature probe (oral/axillary or rectal) is labeled "T1". • The oral/axillary probe is blue, and the rectal probe is red.

2.7 Audio Indicator

A built-in speaker sounds audio alarms, button tones, and pulse tones.

The Accutorr V supports pitch tone and multiple-level volume.

2.7.1 Pulse Tone Function

The pitch of the pulse tone is modulated according to the SpO_2 value, and the frequency increases as the SpO_2 value increases.

The monitor can perform automatic 22-level modulation of the pulse tone's pitch.

2.7.2 Multiple-Level Volume

There are 11 alarm levels. The alarm may be disabled or set to a level between 1 and 10.

2.8 Real-time Clock

Range	0:0:0, 2001 – 23:59:59, 2099
Accuracy	At 21 ±3° C, ±1 min/month
Resolution	1 second

The real-time clock is powered by an independent battery and functions when the device is powered off.

2.9 Standby Mode

- To enter the standby mode, the monitor must be disconnected from the patient and receive no physiological signals from a patient with no low-battery alarm.
- To enter the standby mode, press  and confirm the operation in the pop-up dialog.
- After the monitor enters the standby mode:
  - The LCD and the LEDs no longer display data.
  - The SYS. LEDs Display flashes — — —.
  - The current monitoring configuration and history data are saved.
  - All current alarms are cleared.
  - The NURSE CALL function is disabled. The NURSE CALL function is re-enabled when the monitor resumes in normal mode.
  - The connection with the central monitoring system stays the same as before entering the standby mode.
- To resume normal mode:

  1. Press any key on the front panel.

  2. Confirm the resume operation at the confirm dialog. After confirming the resume operation, the monitor exits the standby mode and enters the normal mode. If the operation is not confirmed within 30 seconds, the system automatically selects Cancel, and the monitor stays in the standby mode.
- In the following conditions, the monitor exits the standby mode and enters the normal mode:
  - The monitor receives SpO_2 physiological signals for 5 seconds.
  - The predictive temperature sensor is removed from its sheath.
  - The monitor is powered by battery, and a low-battery alarm occurs.
- Once the monitor enters the normal mode:
  - The alarm function is re-enabled.
  - The history data, patient information, and other settings from before the monitor entered the standby mode are restored.
  - Data communication is restored.
  - The LCD displays.
  - The LEDs display parameter data.
  - Saving trend data starts.

2.10 Alarm Information

2.10.1 Basics

- There are two types of alarms:
  - **Physiological alarms:** The physiological parameters of the monitored patient exceed the specified ranges, or the physiological exceptions of the patient cannot be judged according to a single physiological parameter.
  - **Technical alarms:** The patient cannot be monitored normally and accurately due to faults in manual operation, technical faults, or faults in the monitor.
- The high priority alarm indicates only physiological alarms and a low battery alarm.
- The low priority alarm indicates only technical alarms, other than low battery.
- The Accutorr V provides functionality for selecting the upper limit and lower limit of each physiological alarm.

2.10.2 Alarm Notification

1. When an alarm occurs, the system notifies the user through the speaker, alarm indicator, relevant 7-segment LED digit displays, and LCD status bar.
2. When alarms of multiple levels occur simultaneously, the system notifies the user of the alarm with the highest level through the speaker and alarm indicator.
3. If the hospital Nurse Call system is available and connected to the monitor, the user can be notified of relevant alarms through the Nurse Call system.

2.10.3 Audio Alarm Pause, Audio Alarm Off, and Audio Alarm Silencing

The monitor provides functionality for pausing (disabling) an audio alarm for 120 seconds. After 120 seconds, the audio alarm notification functionality resumes. The user can resume the audio alarm notification at any time. An alarm causes the monitor to terminate the paused state.

- The monitor provides the ability to turn the audio alarm off globally. During audio alarm off, a remind signal reminds the user every minute.
- The monitor provides the ability to silence an alarm. The monitor automatically exits the alarm silenced status if a new technical or physiological alarm occurs.

2.11 Configuration management

The monitor provides a factory configuration and a user configuration. The monitor loads the selected configuration when it is switched on. If no user configuration exists, the factory configuration is automatically loaded.

2.12 Barcode scanner

The monitor can admit a patient using the barcode scanner.

3.0 *Troubleshooting*

3.1 Introduction

This chapter details potential monitor issues with possible causes and corrective actions. For additional information on troubleshooting, contact service.

3.2 Part Replacement

Printed circuit boards (PCBs), major parts, and components in the monitor are replaceable. Isolate a PCB suspected to be defective, follow the instruction to replace it, and retest. If the trouble remains, exchange the replacement PCB with the original suspicious PCB and continue troubleshooting as directed in this chapter.

3.3 Monitor Status Check

Some troubleshooting tasks may require identifying the hardware version and status of the monitor.

To view the system software version and FPGA version:

1. Press .to display the SYSTEM SETUP dialog as shown in FIGURE 3-1.
2. Press or to highlight **MAINTENANCE**.

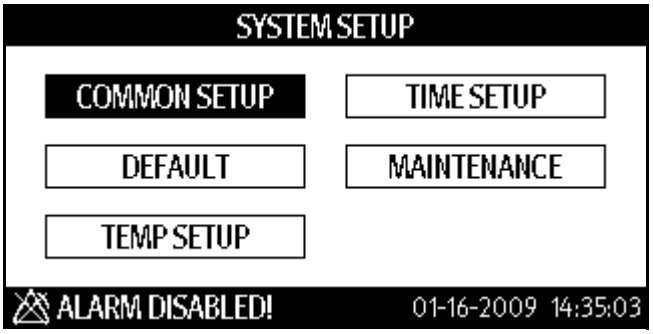


FIGURE 3-1 SYSTEM SETUP Dialog

3. Once **MAINTENANCE** is highlighted, press OK to display the MAINTENANCE dialog as shown in FIGURE 3-2.

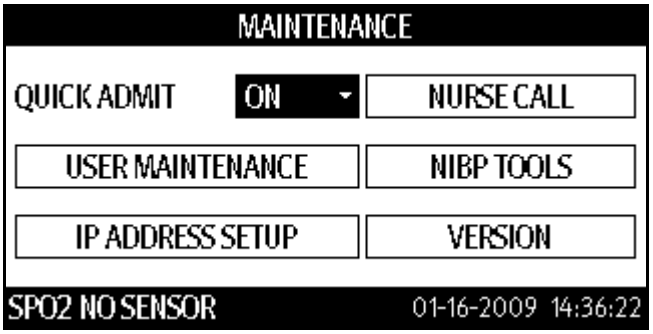


FIGURE 3-2 MAINTENANCE dialog

4. Press or to highlight **VERSION**.

5. Once **VERSION** is highlighted, press OK to display the VERSION dialog as shown in FIGURE 3-3.

FIGURE 3-3 Example VERSION dialog

6. Press ▲ or ▼ to highlight **TOTAL RUN TIME** or **MODULE VERSION**.

7. Once the selection is highlighted, press OK to display the data.

8. Press ▭ to exit to the MAINTENANCE dialog.

3.4 Technical Alarm Check

If a technical alarm message displays on the LCD, eliminate the technical alarm first, then troubleshoot according to the following instructions. For additional information on technical alarm messages, possible causes, and corrective actions, refer to the Accutorr V Operating Instructions.

3.5 Troubleshooting Guide

3.5.1 Power On/Off Failures

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTIONS
The monitor fails to start. AC LED or battery LED does not light	AC mains not connected or battery too low	Confirm that the AC mains is properly connected and that the battery capacity is sufficient.
	Power supply protection	Refer to Power Supply Failures.
	Cables defective or poorly connected	• Confirm that the cables from the power switch and the LED board to the keyboard, keyboard to the main board, and the power module to the main board are correctly connected. • Confirm that the cables and connectors are not damaged.
	Power switch and LED board defective	Replace the power switch and LED board.
	Power module defective	Replace the power module.
	Main board Defective	Replace the main board.

3.5.2 Display Failure

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTIONS
The display is black or blank, but the monitor still works correctly.	Cables defective or poorly connected	• Confirm that the cables from the display to the main board are correctly connected. • Confirm that the cables and connectors are not damaged.
	Backlight defective	Replace the LCD.
	LCD defective	Replace the LCD.
Images overlapped or distorted	FPGA error	Update or upgrade FPGA.
	Cables defective or poorly connected	• Confirm that the cable from the display to the main board is correctly connected. • Confirm that the cables and connectors are not damaged.

3.5.3 LED Digital Display and Indication Lamp Failure

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTIONS
LED digital display or indication lamp display abnormally.	Signal wires damaged	• Confirm that the LED signal wires are correctly connected. • Confirm that the cables and connectors are not damaged.
	LED digital display or indication lamp damaged	Replace the LED digital display or indication lamp.

3.5.4 Alarm Problems

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTIONS
The alarm lamp does not light or is extinguished, but alarm sounds	Cables defective or poorly connected	• Confirm that the cables from alarm LED board to keyboard and keyboard to main board are properly connected. • Confirm that the connecting cables and connectors are not damaged.
	Key and display board failure	Replace the key and display board.
	Main board failure	Replace the main board.
Alarm does not sound, but alarm lamp lights properly	Audio alarm disabled	**1.** Press [▭] to display the SYSTEM SETUP dialog as shown in FIGURE 3-1. **2.** Press [▲] or [▼] to highlight MAINTENANCE. **3.** Once MAINTENANCE is highlighted, press [OK] to display the MAINTENANCE dialog as shown in FIGURE 3-2. **4.** Press [▲] or [▼] to select USER MAINTENANCE. **5.** Once USER MAINTENANCE is highlighted, press [OK] to display the USER MAINTENANCE dialog. **6.** Enter the required password. **7.** In the pop-up menu, set the [MIN ALARM VOL] to a value other than zero.
	Cable defective or poorly connected	• Confirm that the cable between speaker and main board is properly connected. • Confirm that the connecting cables and connectors are not damaged.
	Audio program error identified in the system program	Upgrade system programs.
	Speaker failure	Replace the speaker.
	Main board failure	Replace the main board,

3.5.5 Key Failure

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTIONS
Keys do not work	Cables defective or poorly connected	• Confirm that the cable between keyboard and main board is properly connected. • Confirm that the connecting cables and connectors are not damaged.
	Keyboard failure	Replace keyboard.

3.5.6 Recorder Failures

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
No printout	Recorder module disabled	• Confirm that the recorder status LED is on. • If yes, reset the recorder. If no, check for other possible causes.
	Paper reversely installed	Re-install the paper roll.
	Cable defective or poorly connected	• Confirm that the cable between recorder and main board is appropriately connected. • Confirm that the connecting cables and connectors are not damaged.
	Recorder power supply failure	Confirm that the power module outputs 5V DC and 16.8V DC correctly.
	Recorder failure	Replace the recorder.
Poor print quality or paper not feeding properly	Paper roll not properly installed	Stop the recorder and re-install the paper roll.
	Dirty thermal print head	• Confirm that the thermal print head and the paper roller do not contain foreign matter. • Clean the thermal print head with an appropriate detergent.
	Recorder failure	Replace the recorder.

3.5.7 Interface Failures

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
No nurse call signals are issued	Incorrect function settings	**1.** Press [▭] to display the SYSTEM SETUP dialog as shown in FIGURE 3-1. **2.** Press [▲] or [▼] to highlight MAINTENANCE. **3.** Once MAINTENANCE is highlighted, press [OK] to display the MAINTENANCE dialog as shown in FIGURE 3-2. **4.** Press [▲] or [▼] to select NURSE CALL. **5.** Once NURSE CALL is highlighted, press [OK] to display the NURSE CALL dialog. **6.** Select desired nurse call output.
	Main board failure	Replace the main board.
Bar code scanner unable to be used	Bar code scanner failure	Refer to Bar Code Scanner Failures.
	Serial port failure	Replace the main board.

3.5.8 Power Supply Failures

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
Fluctuating battery voltage	Battery failure	Replace battery.
	Cable defective or poorly connected	• Confirm that the cable between battery interface board and power module is correctly connected. • Confirm that the cables and connectors are not damaged.
	Power board failure	Replace the power board.

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
Battery fails to be fully charged	Battery failure	Replace battery.
	Cable defective or poorly connected	• Confirm that the cable between battery interface board and the power module is properly connected. • Confirm that the connecting cables and connectors are not damaged.
	Power board failure	Replace the power board.
Battery unable to be recharged	Battery damaged	Replace battery and recharge the replacement battery. If the replacement battery can be recharged, the original one fails.
	Cable defective or poorly connected	• Confirm that the cable between battery interface board and the power module is properly connected. • Confirm that the connecting cables and connectors are not damaged.
	Power board failure	Replace the power board.
No +3.3 V output No +5.0 V output No +12 V output	• Power supply protection • Power board failure	• Turn off the monitor then restart it. • If the problem remains, disconnect the AC mains for 5 seconds and reconnect it, then restart the monitor. • If the problem still remains, replace power board.

NOTE: If the power module fails, it may damage other components (e.g. the monitor suddenly shuts down during the start-up). In this case, troubleshoot the power module using the procedure described in the previous table.

NOTE: If the parameter module, recorder, or bar code scanner malfunctions, check if the operating voltage is correct.

3.5.9 Network Related Problems

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTIONS
The monitor can not connect to the CMS.	No connection to LAN	• Confirm that the cables and connectors are in good condition and that the monitor is connected to the network. • Confirm that the hub and switch facilities are correctly configured.
Frequent dropouts and network disconnections	Improper LAN cable connection	Confirm that the LAN cable is connected. The LAN cable must not be longer than 50 m.
	Incorrect IP address configuration	Check for IP address conflict. Reconfigure IP address.

3.5.10 Software Upgrade Problems

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTIONS
Bootstrap upgrade fails	Power failure or unintended power off during bootstrap upgrade	Return the main board to the factory for repair.
Program upgrade fails	Incorrect network connection	• Confirm that the monitor is connected to the network. • Confirm that the hub or the switcher is functioning. • Confirm that the net cables are of the right type and have been connected correctly.
	Wrong upgrade package has been downloaded	Incorrect upgrade package .mup files were used. Select package according to the program to upgrade.
	Incorrect IP address configuration	Configure a fixed IP address in range as specified for the monitor. Do not upgrade a program while the monitor is connected to a network.

3.5.11 Bar Code Scanner Failures

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTIONS
Bar code scanner does not work	Bar code scanner not powered on	**1.** Press [▭] to display the SYSTEM SETUP dialog as shown in FIGURE 3-1. **2.** Press [▲] or [▼] to highlight MAINTENANCE. **3.** Once MAINTENANCE is highlighted, press [OK] to display the MAINTENANCE dialog as shown in FIGURE 3-2. **4.** Press [▲] or [▼] to select USER MAINTENANCE. **5.** Once USER MAINTENANCE is highlighted, press [OK] to display the USER MAINTENANCE dialog. **6.** Enter the required password. **7.** Set [**BARCODE POWER**] to [**ON**] in the menu to switch on the bar code scanner.
	Incorrect interface cables used	Replace interface cables.
	Loose Interface cables	Confirm that the interface cables are attached securely.
Bar code scanner cannot decode the target bar codes	Bar code scanner not programmed correctly.	Re-program the bar code scanner to decode the specified bar codes.
	Unreadable bar code	Check if bar codes of the same type can be decoded.
	Scanner and bar code at improper distance and angle	Aim the scanner at the bar code and adjust the distance between the scanner and the bar code.
Scanned characters incorrectly displayed on the monitor	The monitor's bar code recognition configuration does not meet the format of the target bar code.	Download the correct bar code recognition configuration for the monitor.
	Scanner serial port output incorrectly set	Configure the scanner's serial port output according to the host serial port settings.

3.5.12 NIBP Measurement Failures

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTIONS
Unable to start NIBP measurement	Cables detective	Confirm that the cables between NIBP module and the main board are in good condition.
	Main board failure	Replace the main board.
Cuff inflation/deflation failure	Pump or valve damaged	Replace the NIBP module.
	Air tubing occluded	Replace the air tubing.

3.5.13 SpO_2 Measurement Failure

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTIONS
Unable to measure SpO_2	SpO_2 sensor failure	Replace the SpO_2 sensor.
	Cables defective	Confirm that the cable between the SpO_2 module and the main board is in good condition.
	SpO_2 module failure	Replace the SpO_2 module.
	Main board failure	Replace the main board.

3.5.14 Temperature Measurement Failures

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTIONS
Unable to measure patient temperature	Temperature probe damaged	Replace the Temperature probe.
	Cables detective	Confirm that the cable between the Temperature module and the main board is in good condition.
	Main board failure	Replace the main board.

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4.0 Repair and Disassembly

4.1 Tools

During disassembly and replacement, the following tools may be required:

- Phillips screwdrivers
- Wire cutters
- Sharp nose pliers
- Metric wrenches
- Metric nut drivers

4.2 Preparation for Disassembly

Before disassembling the monitor: stop monitoring patients, turn off the monitor, disconnect all the accessories and peripheral devices, remove the battery, and disconnect the monitor from the mains power supply.

CAUTION: Before disassembling the monitor, eliminate static charges. When disassembling the parts labeled with static-sensitive symbols, wear electrostatic discharge protection such as antistatic wristband or gloves. Follow the correct sequence to disassemble the monitor. Otherwise, the monitor may be damaged permanently. Disconnect all the cables before disassembling any parts. Take care not to damage any cables or connectors.

CAUTION: Properly connect the cables or wires when reassembling the monitor to avoid short circuits. When assembling the monitor, select proper screws. If the wrong size screw is tightened by force, the monitor may be damaged and the screw or the part may not function as expected.

4.3 Disassembly

4.3.1 Separating the Front and Rear Halves of the Monitor

1. If the monitor is not configured with an Optional Temperature module, proceed to step 2. If the monitor is configured with an Optional Temperature module:

a. Remove the two (2) M3×6 cross-head screws (as shown in Figure 4-1).

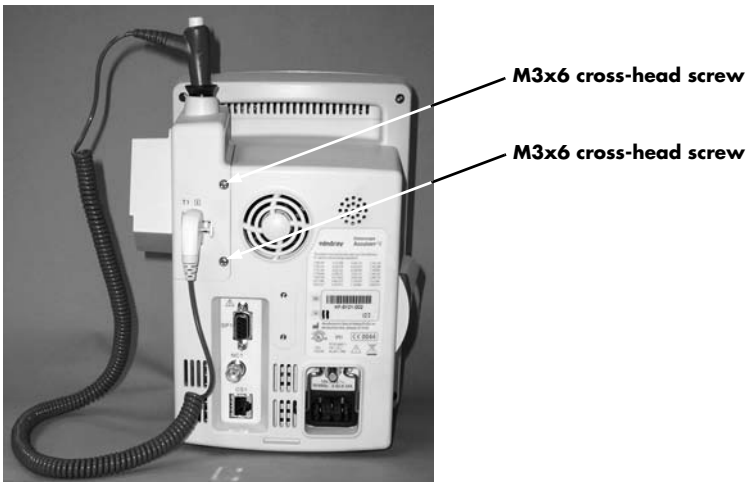


FIGURE 4-1 Remove two (2) M3x6 cross-head screws.

b. Disconnect the Temp cable connector from the PCBA as shown in Figure 4-2.

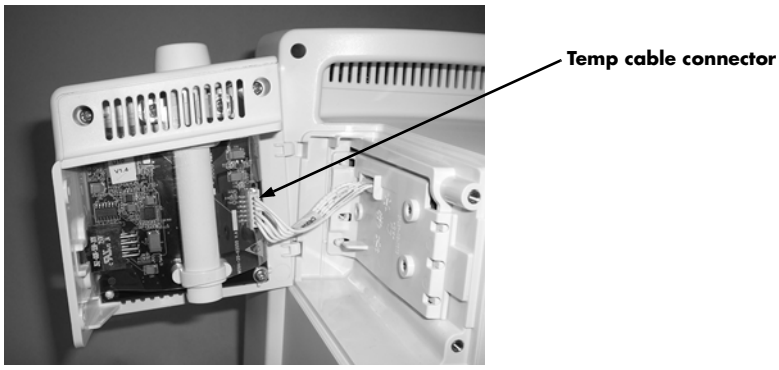


FIGURE 4-2 Disconnect the Temp cable connector.

2. Remove the four (4) M3×8 cross-head screws (as shown in Figure 4-3).

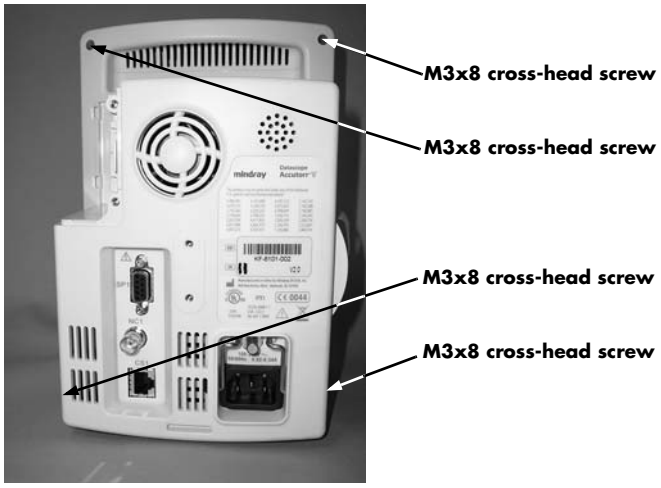


FIGURE 4-3 Remove four (4) M3x8 cross-head screws.

3. Release the clips (as shown in Figure 4-4) on the front and rear housings.

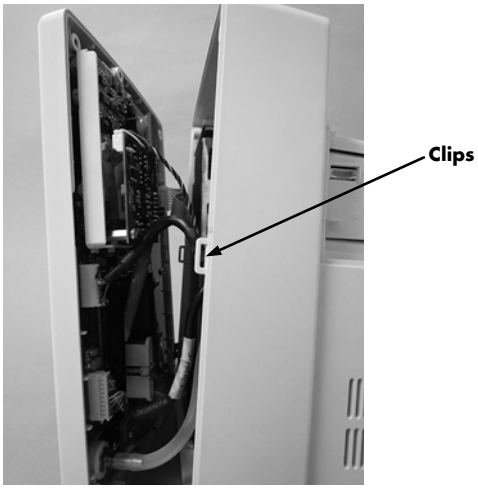


FIGURE 4-4 Release the clips.

4. Disconnect the cables and air tubing connecting the front and the rear housings.

5. Separate the front and the rear housings (Figure 4-5).

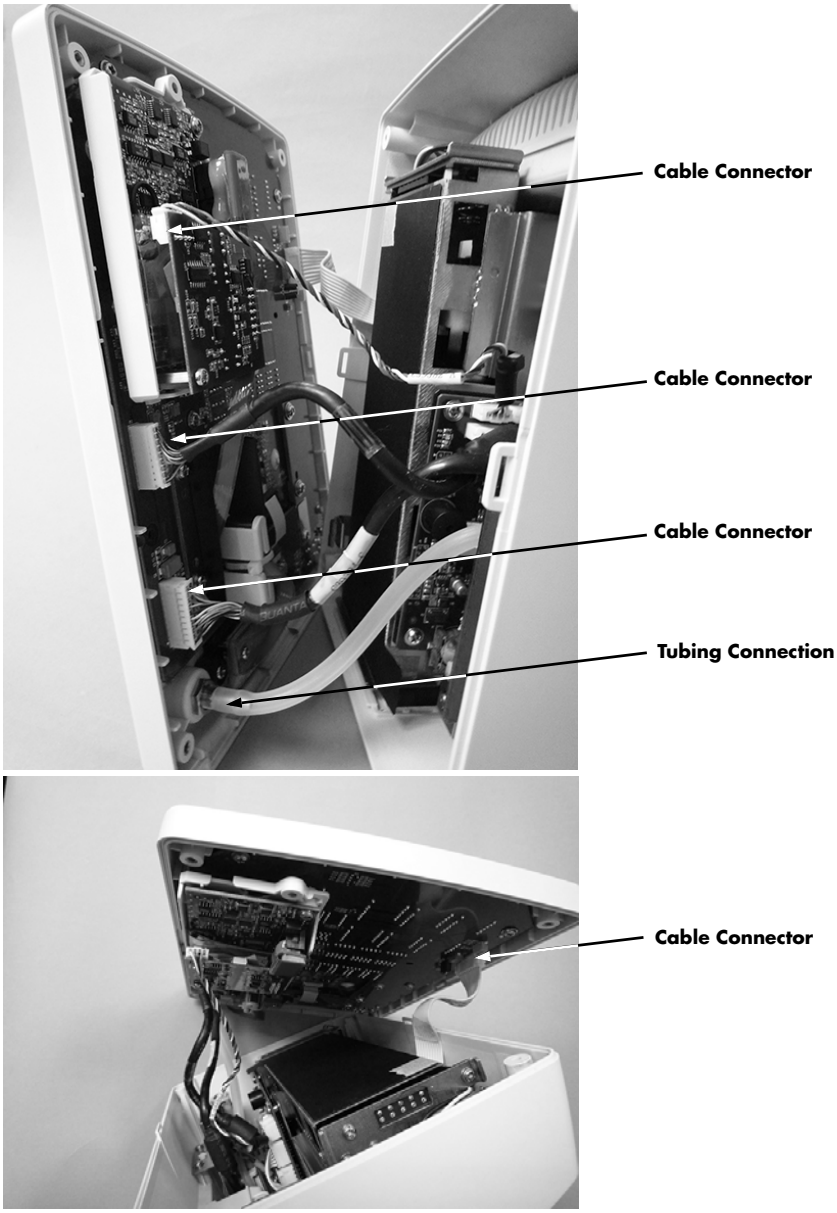
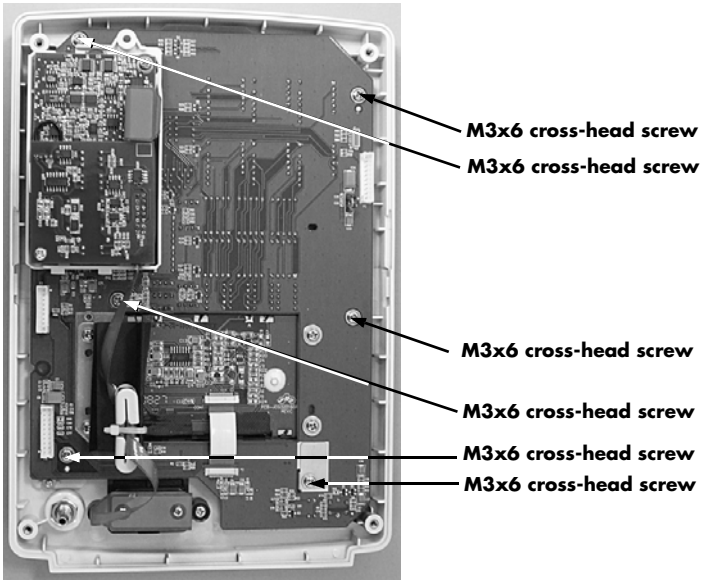


FIGURE 4-5 Separate the front and rear housings.

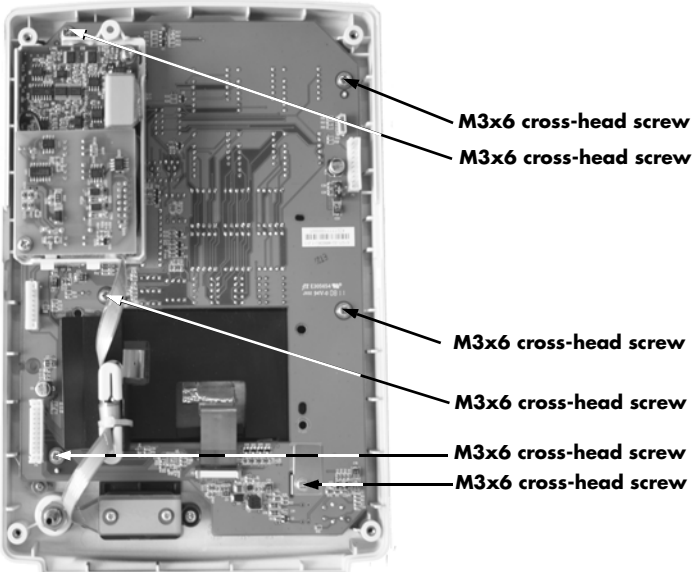
NOTE: **Exercise care when separating the front and the rear housings. Be sure not to damage the cables and connectors.**

4.3.2 Disassembling the Front Housing Assembly

1. Remove the six (6) M3×6 cross-head screws (as shown in Figure 4-6), and remove the key board.



Black-and-White LCD Front Housing Assembly



Color LCD Front Housing Assembly

FIGURE 4-6 Remove six (6) M3x6 cross-head screws.

2. Remove the four (4) M3×8 cross-head screws (as shown in Figure 4-7).The monitor with color LCD does not need this step.

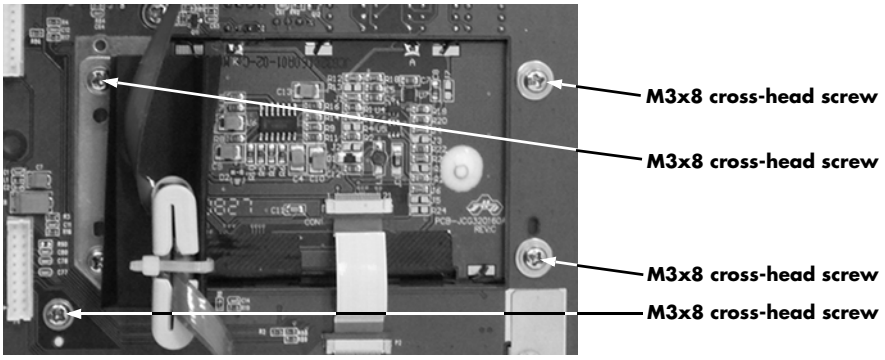


FIGURE 4-7 Remove four (4) M3x8 cross-head screws.

3. Disconnect the flexible cables on the button board.

4. Remove the LCD.

5. Remove the two (2) M3×6 cross-head screws (as shown in FIGURE 4-8), and take out the SpO_2 rack.

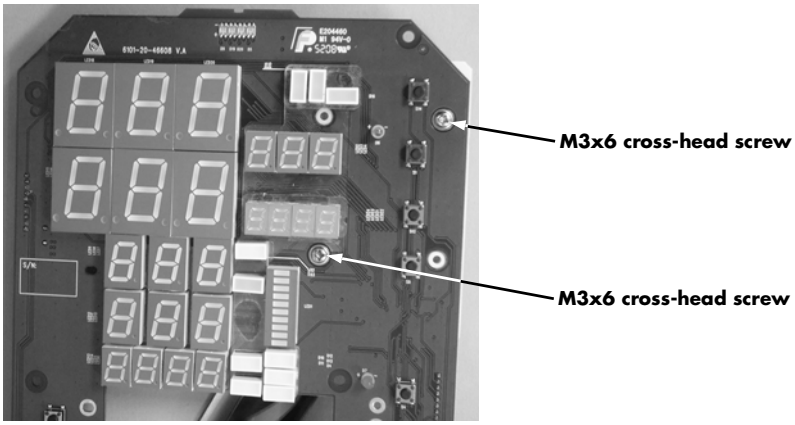


FIGURE 4-8 Remove two (2) M3x6 cross-head screws.

6. Remove the screw (as shown in FIGURE 4-9) to remove the SpO_2 module from the SpO_2 rack.

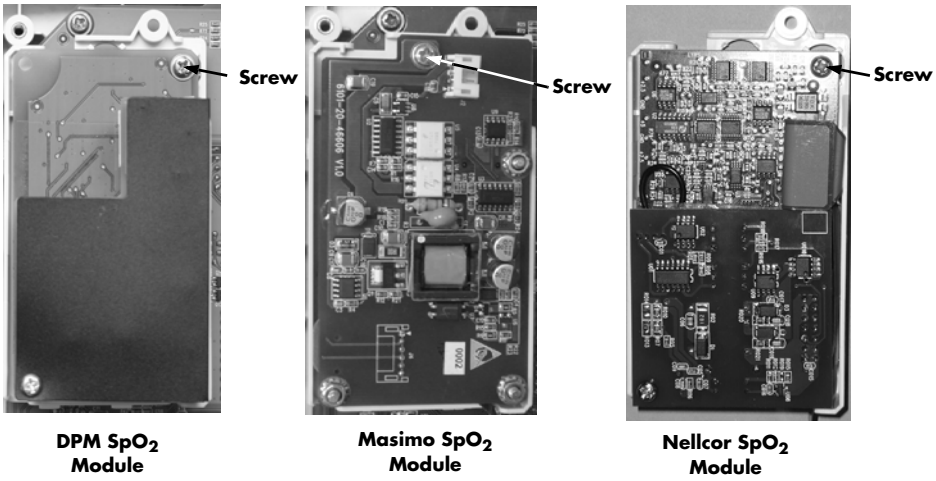


FIGURE 4-9 Remove the screw.

7. Remove the two (2) screws for the SpO_2 signal cable (as shown in Figure 4-10).

8. Take out the SpO_2 signal cable.

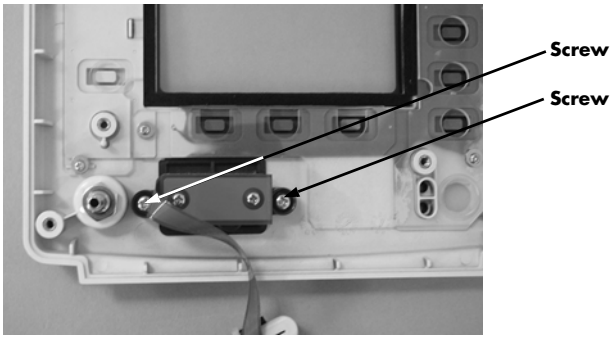


FIGURE 4-10 Remove two (2) screws.

9. For DPM SpO_2 only, unscrew the plastic nut for the DPM SpO_2 signal cable (as shown in Figure 4-11).

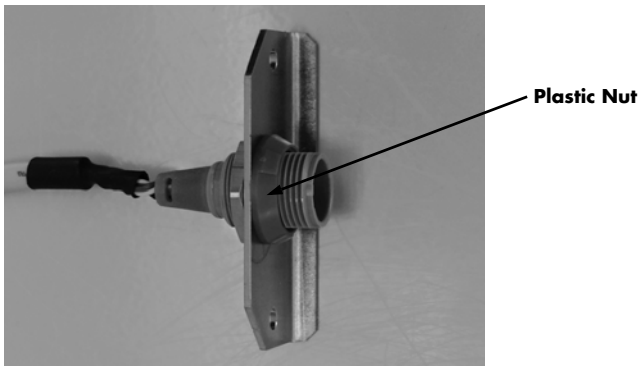


FIGURE 4-11 For DPM SpO_2 only, unscrew the plastic nut.

4.3.3 Removing the Main Rack Assembly

1. Remove the two (2) M3×6 cross-head screws (as shown in Figure 4-12).

2. Take out the recorder by pushing the clips inward.

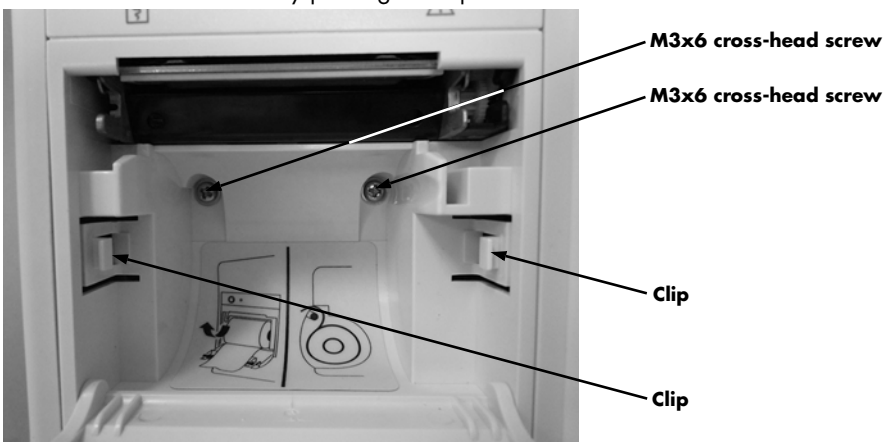


FIGURE 4-12 Remove two (2) M3x6 cross-head screws.

3. Unplug the two (2) cable connectors (as shown in Figure 4-13) from the recorder.

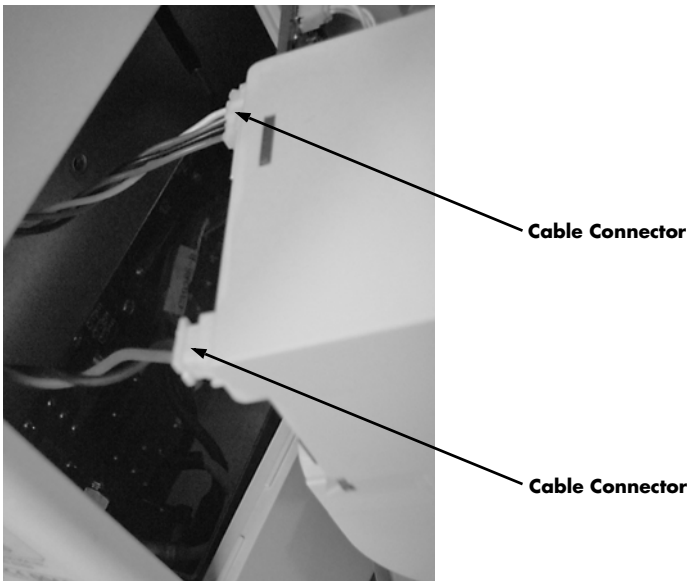


FIGURE 4-13 Unplug two (2) cable connectors.

4. If the device is not configured with an optional Temperature module, skip to Step 6.

5. If the device is configured with an optional Temperature module, remove the Temperature module board.

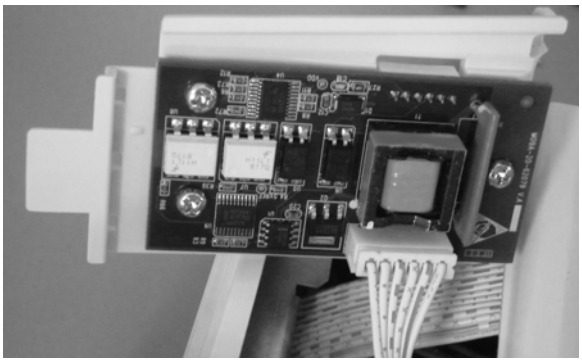


FIGURE 4-14 Remove optional temperature module board.

6. Remove the six (6) M3×6 cross-head screws (as shown in Figure 4-15).

7. Take out the main rack assembly.

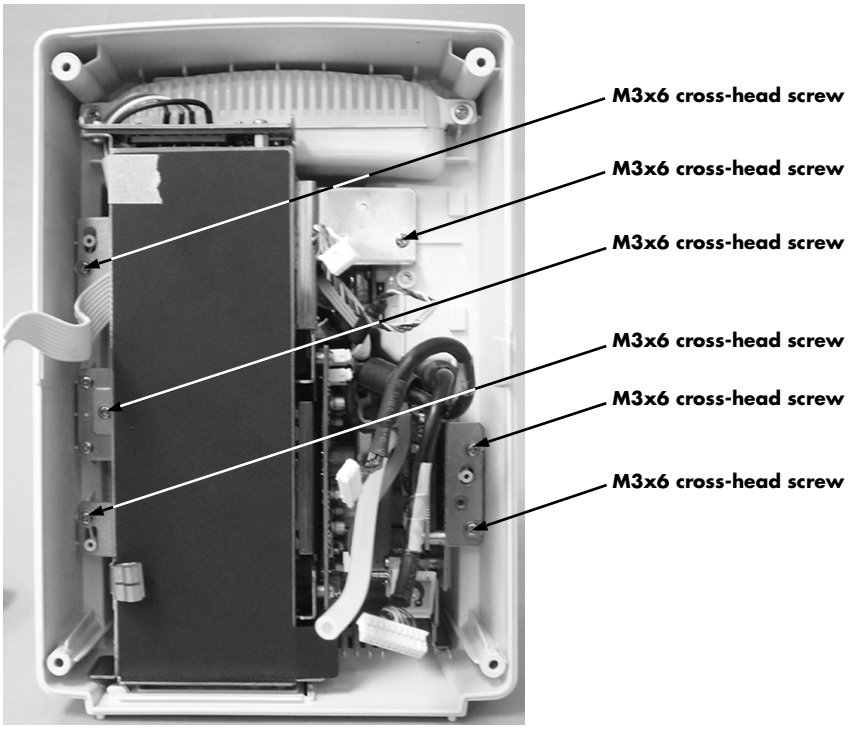


FIGURE 4-15 Remove six (6) M3x6 cross-head screws.

4.3.4 Removing NIBP Module

1. Unplug the NIBP module from the CPU Board (as shown in Figure 4-16).

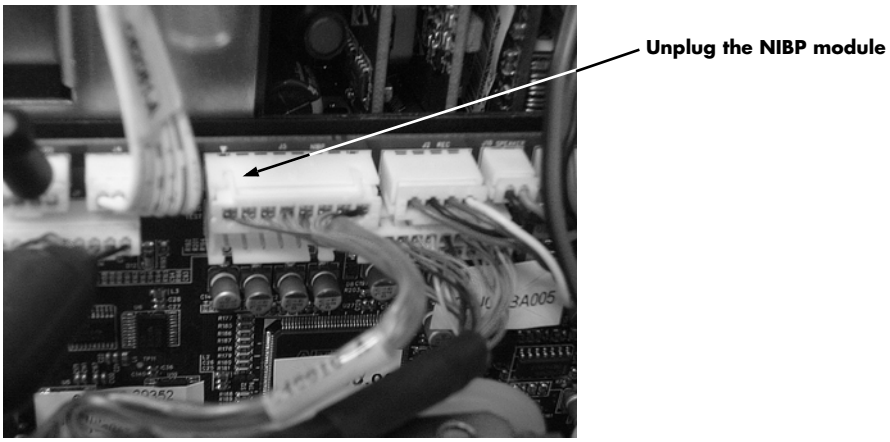


FIGURE 4-16 Unplug the NIBP module.

2. Remove the three (3) M3×6 cross-head screws (as shown in Figure 4-17).

3. Take out the NIBP rack.

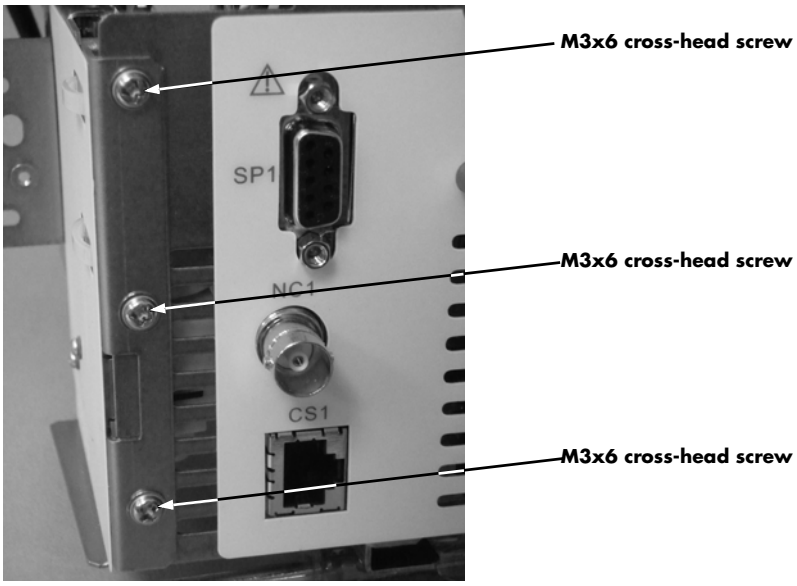


FIGURE 4-17 Remove three (3) M3x6 cross-head screws.

4.3.5 Removing the Main (CPU) Board

1. Unplug the Main board power cable from the power supply as shown in FIGURE 4-18.
2. Cut the tie wrap to the speaker as shown in FIGURE 4-18.

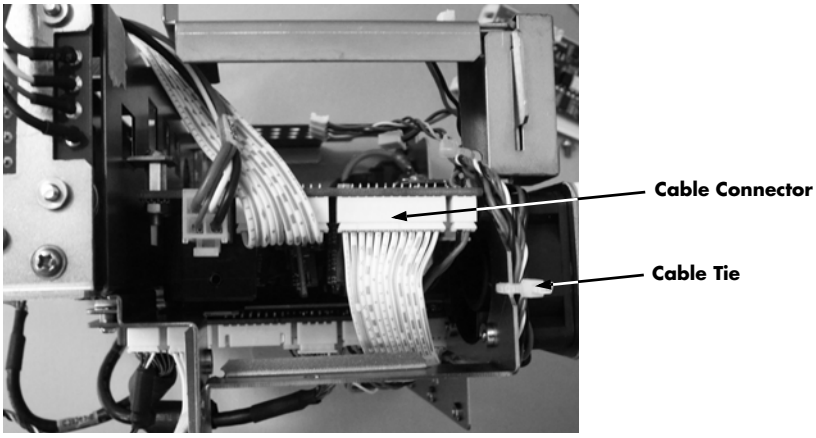


FIGURE 4-18 Unplug the Main board cable connector and cut one (1) tie wrap.

3. Unplug the speaker cable (J10) from the Main board (see FIGURE 4-19).
4. Unplug the recorder cable (J8) from the Main board (see FIGURE 4-19).
5. Take out the main board by removing the four (4) M3×6 cross-head screws (as shown in FIGURE 4-19).

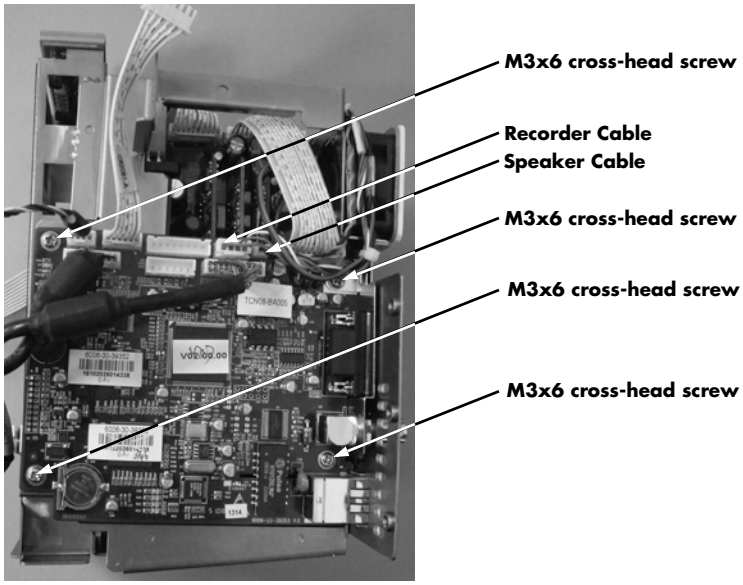


FIGURE 4-19 Unplug (2) two cable connectors and remove four (4) M3x6 cross-head screws.

4.3.6 Removing the Power Board

1. Unplug the battery connector cable.
2. Remove the power board by removing the three (3) M3×6 cross-head screws (as shown in Figure 4-20).
3. Unplug the remaining cable connectors (fan, AC mains connector, and Main (CPU) board) from the Power board.

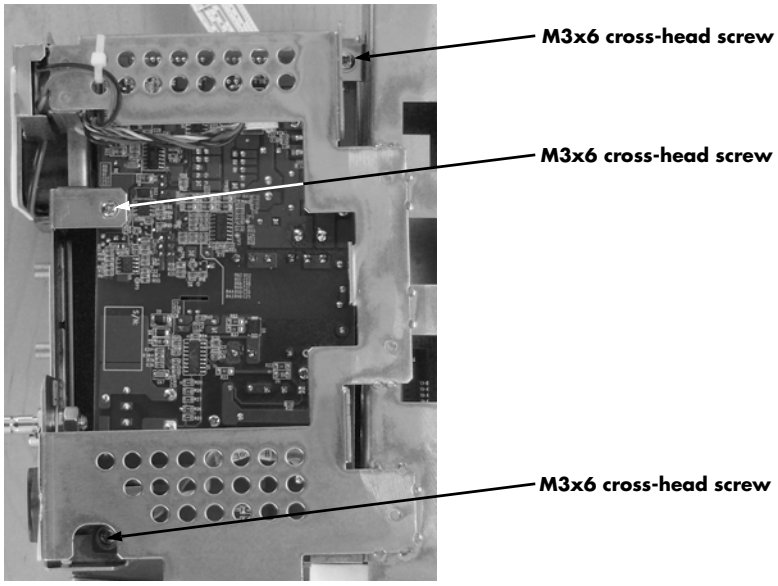


FIGURE 4-20 Remove three (3) M3x6 cross-head screws.

4.3.7 Removing the Battery Connector Assembly

Remove the three (3) M3×6 cross-head screws (as shown in Figure 4-21).

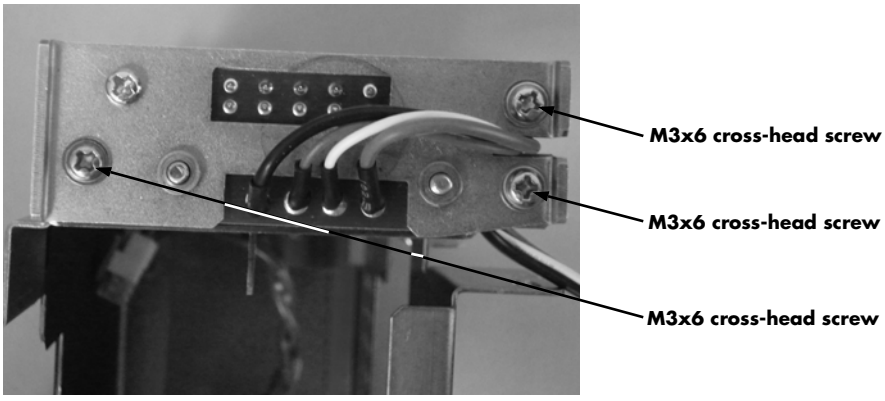


FIGURE 4-21 Remove three (3) M3x6 cross-head screws.

4.3.8 Removing the Fan and Speaker

1. Cut the cable ties on the fan, speaker, and the main rack.

2. Remove the fan cushion (as shown in Figure 4-22).

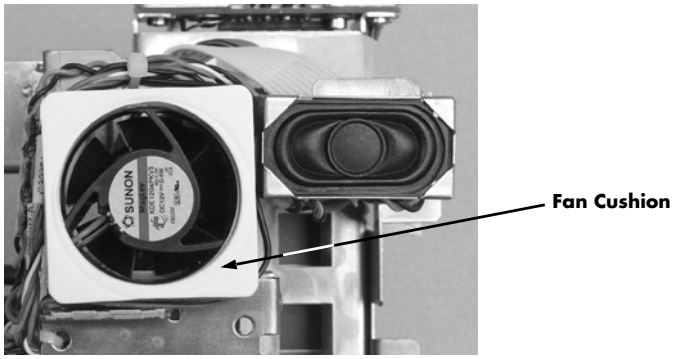


FIGURE 4-22 Remove the Fan Cushion.

3. Remove the three (3) M3×25 cross-head screws (as shown in Figure 4-23).

4. Remove the fan.

5. Remove the speaker from the main rack.

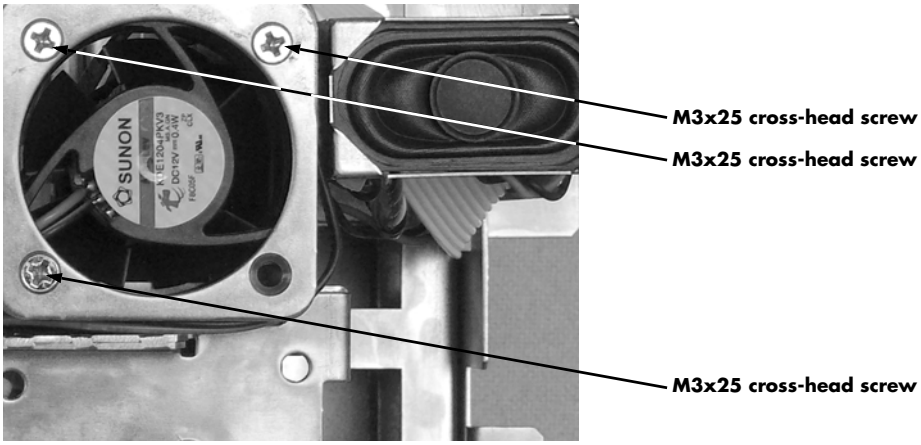


FIGURE 4-23 Remove Three (3) M3x25 cross-head screws.

4.3.9 Removing the Power Socket

1. Remove the retaining nut securing the grounding post (as shown in Figure 4-24).
2. Remove the grounding terminal.

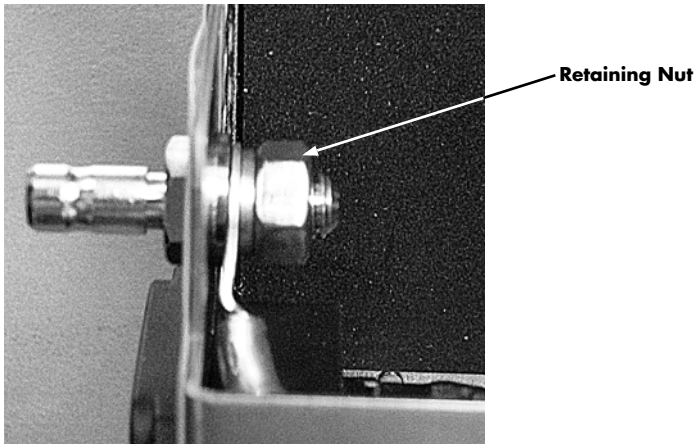


FIGURE 4-24 Remove the retaining nut.

3. Remove the two (2) M3×8 cross-head screws (as shown in Figure 4-25).
4. Remove the power socket.

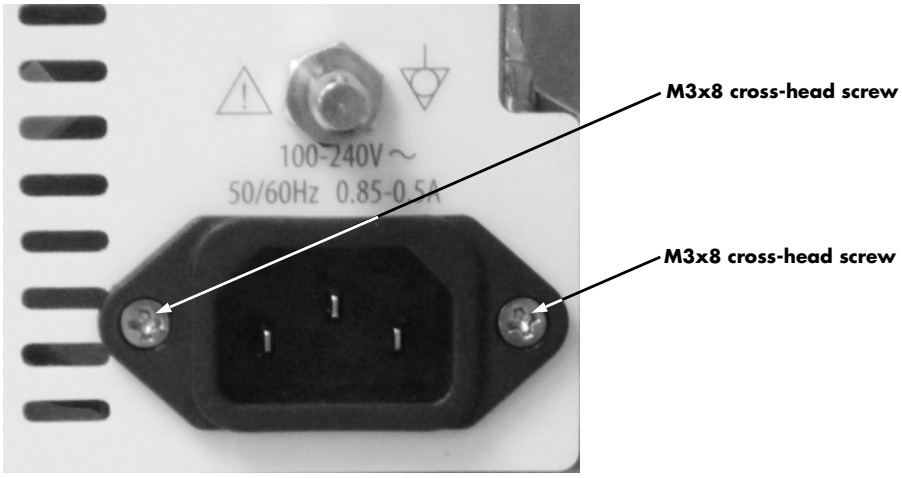


FIGURE 4-25 Remove Two (2) M3x8 cross-head screws.

4.3.10 Disassembling the Temperature Module

1. Remove the two (2) M3x6 cross-head screws (as shown in Figure 4-26).
2. Take the cover plate off.

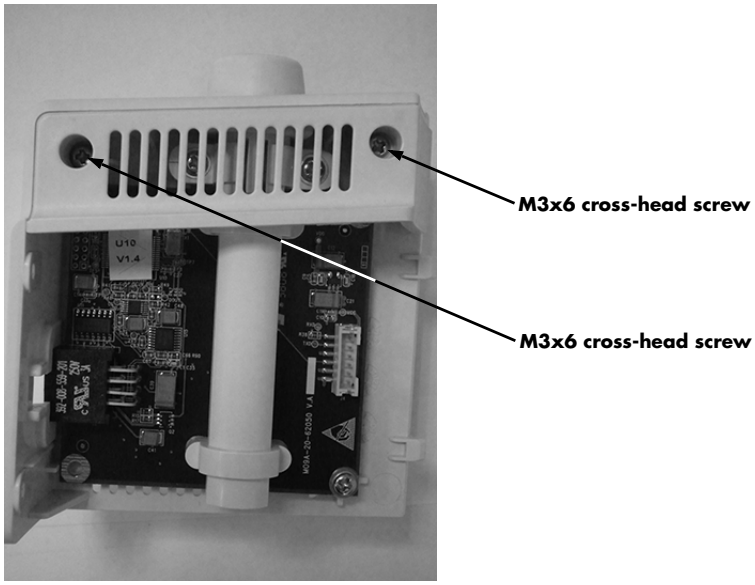


FIGURE 4-26 Remove Two (2) M3x6 cross-head screws

3. Remove the three (3) M3x6 cross-head screws (as shown in Figure 4-27).
4. Remove the Temperature module board.
5. Remove the mylar sleeve.

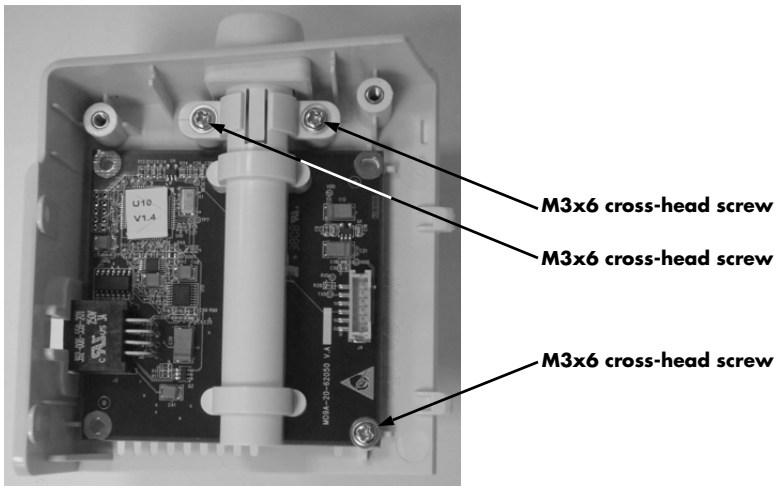


FIGURE 4-27 Remove three (3) M3x6 cross-head screws.

4.3.11 Disassembling SpO_2 Modules

4.3.11.1 Disassembling a DPM SpO_2 module

1. Remove the M3×6 cross-head screw (as shown in FIGURE 4-28).

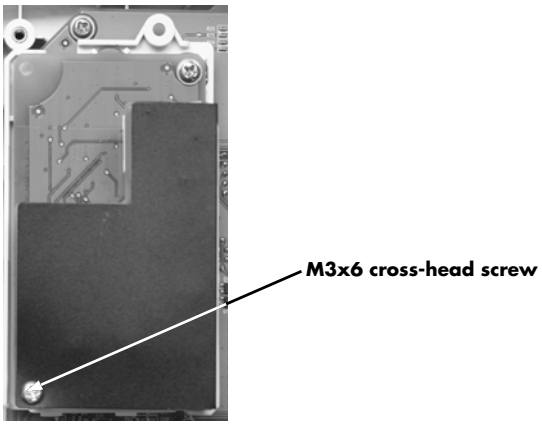


FIGURE 4-28 Remove one M3 X 6 cross-head screw

2. Remove the SpO_2 board. (as shown in FIGURE 4-29)

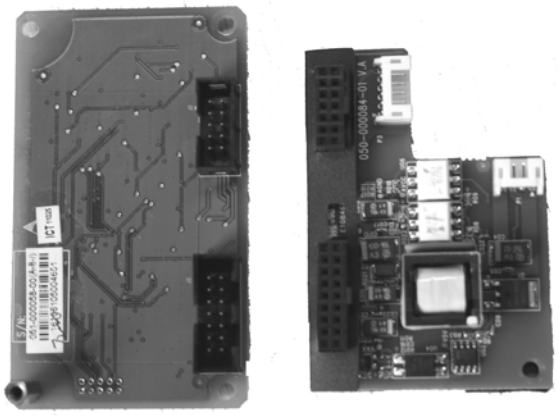


FIGURE 4-29 DPM SpO_2 board and isolated power supply.

4.3.11.2 Disassembling a Masimo SpO_2 module

1. Remove the isolation power board by removing the three (3) M3 nuts (as shown in Figure 4-30).
2. Remove the three (3) M3×6 cross-head screws.

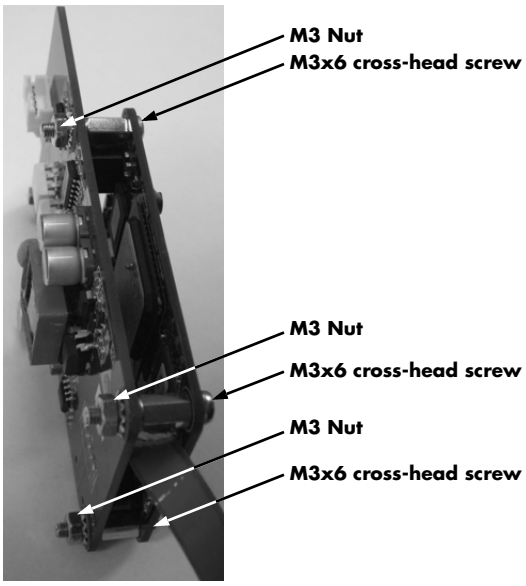


FIGURE 4-30 Remove three (3) M3 nuts, and three (3) M3x6 cross-head screws.

3. Remove the SpO_2 board.

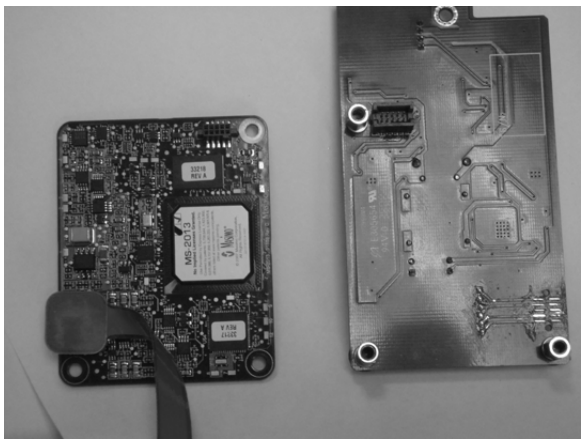


FIGURE 4-31 Masimo SpO_2 board and isolated power supply.

FIGURE 4-32 Masimo isolated power supply.

4.3.11.3 Disassembling a Nellcor SpO_2 module

1. Remove the M3×6 cross-head screw (as shown in FIGURE 4-33) to separate the SpO_2 module from its isolated power supply (as shown in FIGURE 4-34).

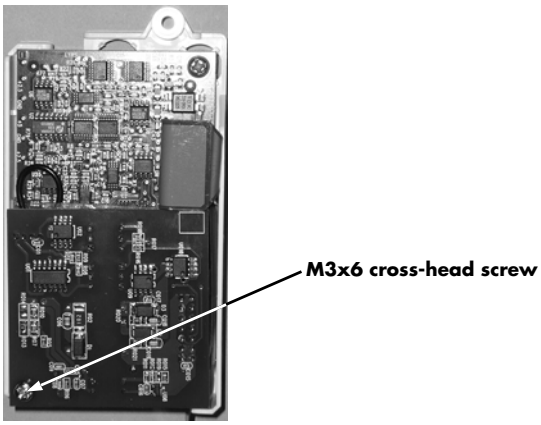


FIGURE 4-33 Remove one (1) M3x6 cross-head screw.

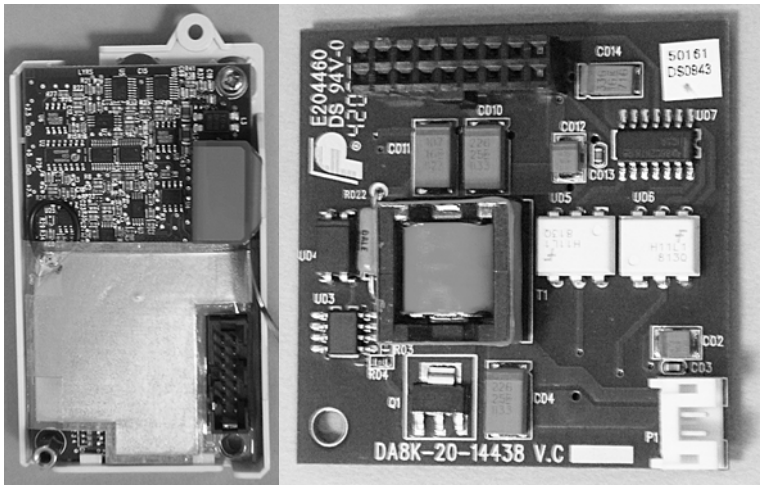


FIGURE 4-34 Nellcor SpO_2 board and isolated power supply.

4.3.12 Disassembling the NIBP Module

4.3.12.1 Removing the NIBP Pump

1. Unplug the pump cable connector from the NIBP board.
2. Disconnect the tubing.
3. Cut the two tie wraps holding the NIBP pump as shown in FIGURE 4-35.
4. Remove the pump.

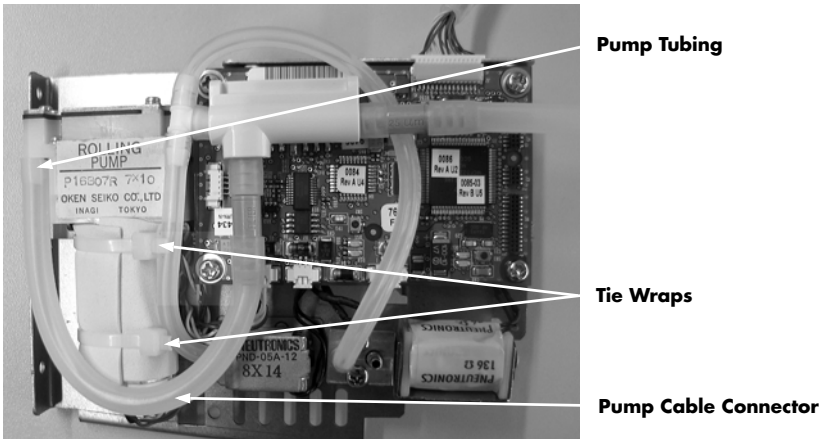


FIGURE 4-35 Cut two (2) tie wraps.

4.3.12.2 Removing the NIBP Dump Valve

1. Unplug the dump valve cable connector from the NIBP board.
2. Disconnect the tubing.
3. Remove the two (2) screws on the bottom of the NIBP rack as shown in FIGURE 4-36.
4. Remove the dump valve.

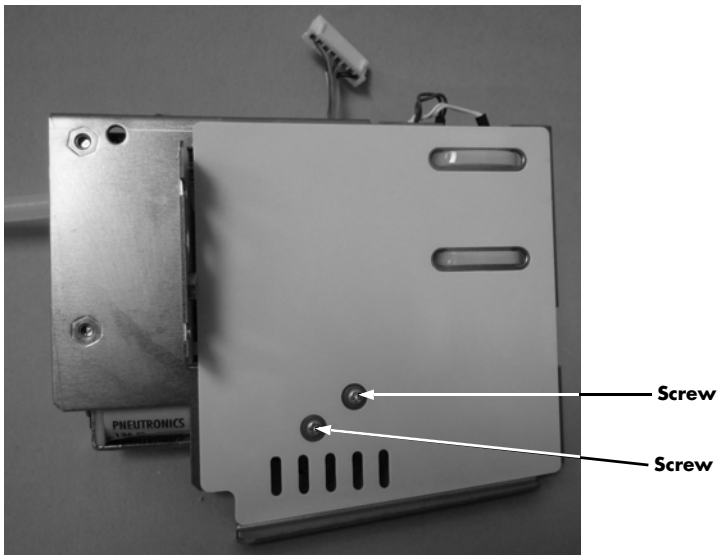


FIGURE 4-36 Remove two (2) screws.

4.3.12.3 Removing the NIBP Bleed Valve

1. Unplug the bleed valve cable connector from the NIBP board.
2. Disconnect the tubing.
3. Remove the two (2) screws as shown in FIGURE 4-37.
4. Remove the bleed valve.

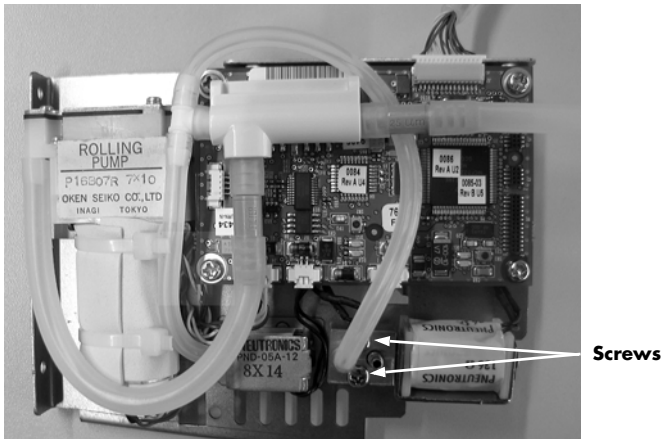


FIGURE 4-37 Remove two (2) screws.

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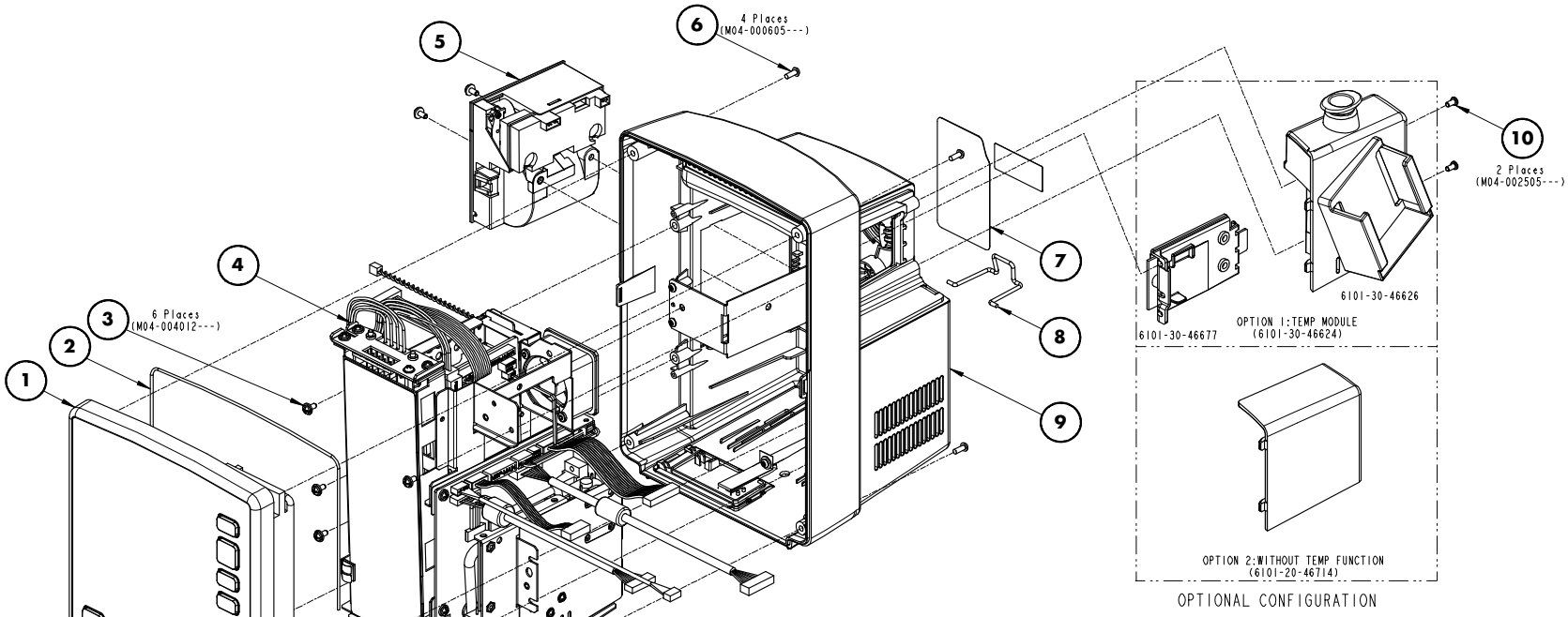
5.0 Parts

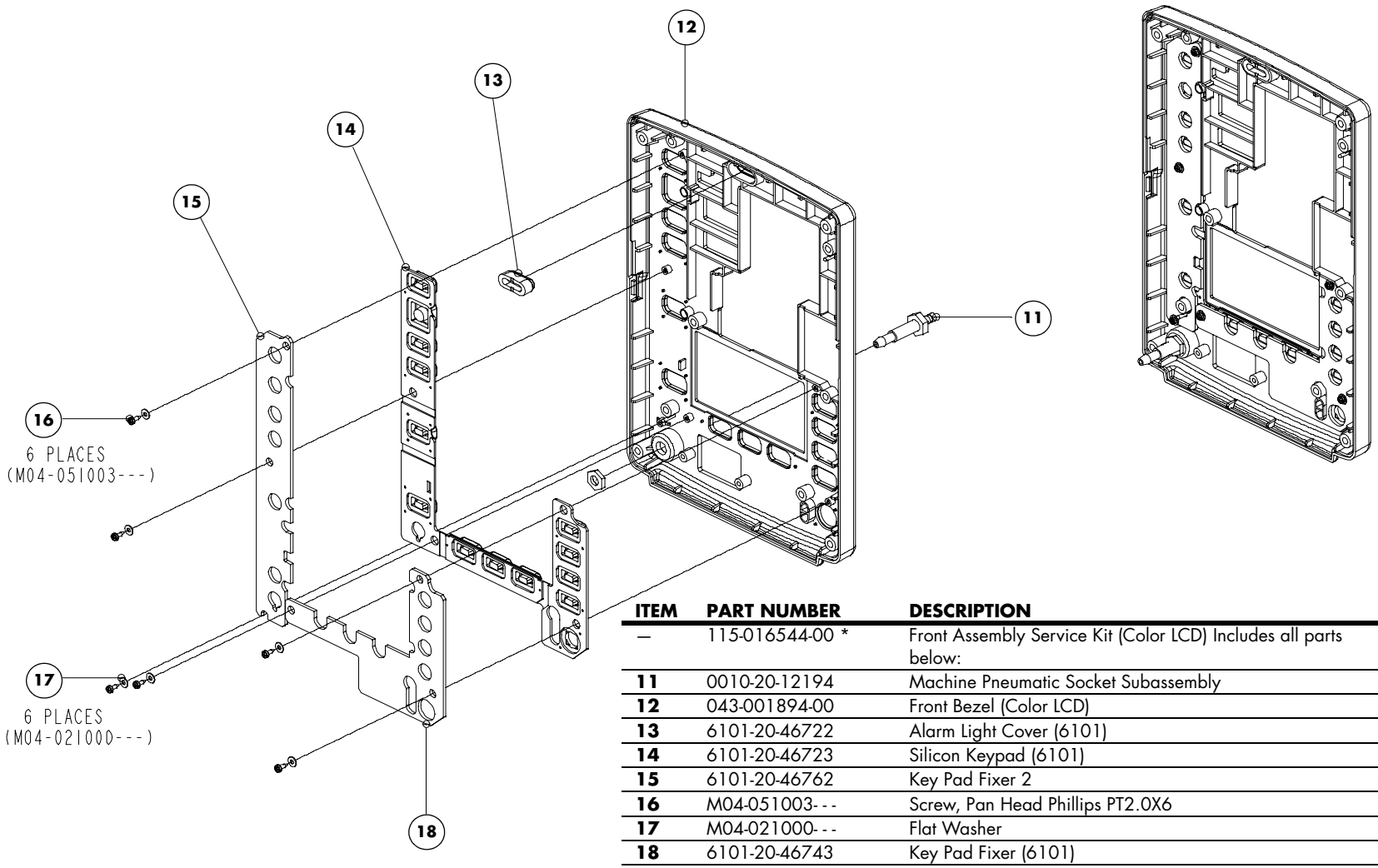
5.1 Main Assembly



ITEM	PART NUMBER	DESCRIPTION
1	801-6101-00003-00	Front Shell Assembly (B&W)
	801-6101-00023-00	Front Shell Assembly (Color)
2	M6G-020015- - -	Hose Silicone,1.6mmODX0.8mmID 10m/per
3	M04-004012- - -	Screw, Crosshead M3×6
4	6101-30-46616	Main Bracket Assembly
5	801-6101-00011-00	Recorder module package
6	M04-000605- - -	Screw, Pan Head Phillips M3X8
7	6101-20-46742	Rear Overlay (6101)
8	9211-20-87369	AC Inlet Retainer Clip
9	801-6101-00010-00	Rear Housing Assembly
10	M04-002505- - -	Screw M3×6

FIGURE 5-1 Main Assembly

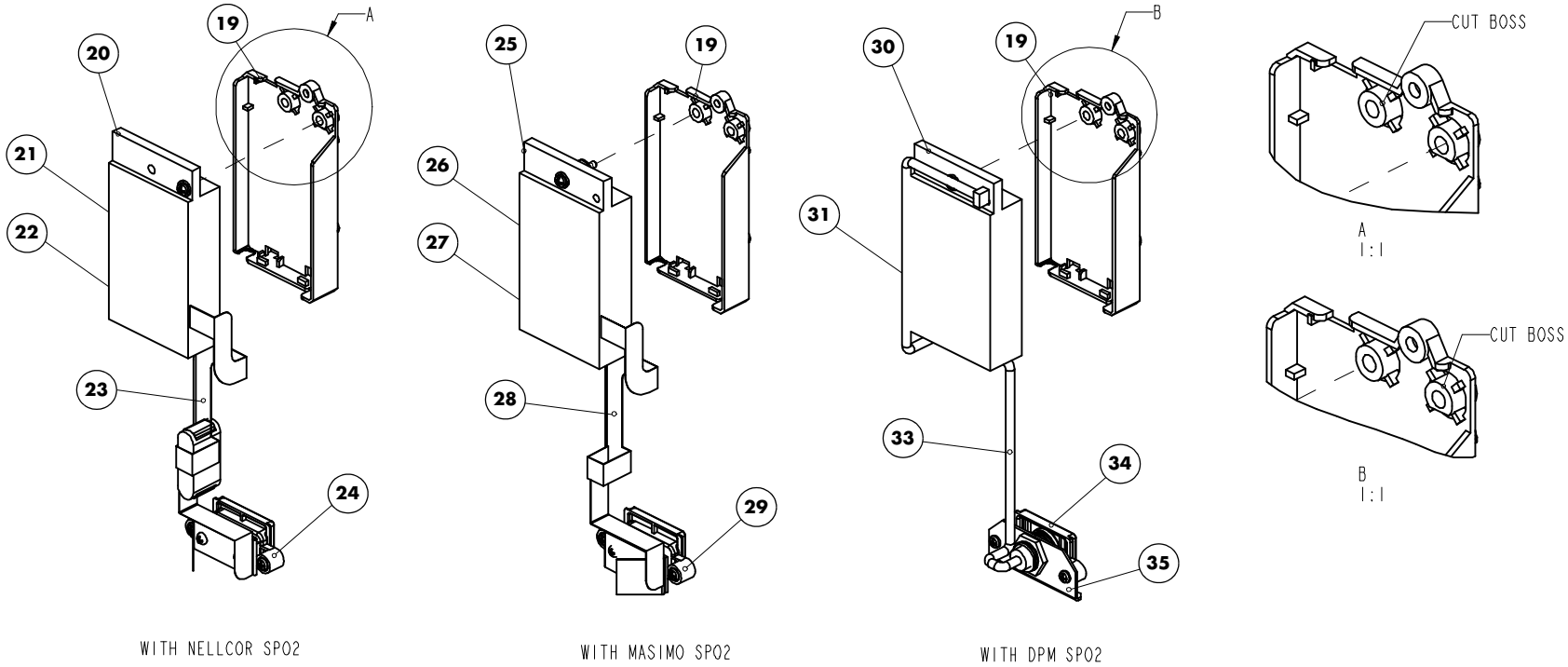
5.2 Front Assembly (Color LCD)



ITEM	PART NUMBER	DESCRIPTION
—	115-016544-00 *	Front Assembly Service Kit (Color LCD) Includes all parts below:
11	0010-20-12194	Machine Pneumatic Socket Subassembly
12	043-001894-00	Front Bezel (Color LCD)
13	6101-20-46722	Alarm Light Cover (6101)
14	6101-20-46723	Silicon Keypad (6101)
15	6101-20-46762	Key Pad Fixer 2
16	M04-051003---	Screw, Pan Head Phillips PT2.0X6
17	M04-021000---	Flat Washer
18	6101-20-46743	Key Pad Fixer (6101)

FIGURE 5-2 Front Bezel Assembly

NOTE: *** To upgrade the Black & White LCD requires FRU# 801-6101-00023-00. Included in this FRU are: FRU# 801-6101-000211-00 (Main board), 009-002037-00 (LCD signal cable), 042-004637-00 (Ferrite Fixer Plate), 051-000875-00 (Display and Key panel), 049-000280-00 (Color LCD Rubber), 021-000056-00 (LCD) for the new assembly, and 115-016544-00. Please refer to the figures 5 -2, 5-4, 5-5 and 5-12.**

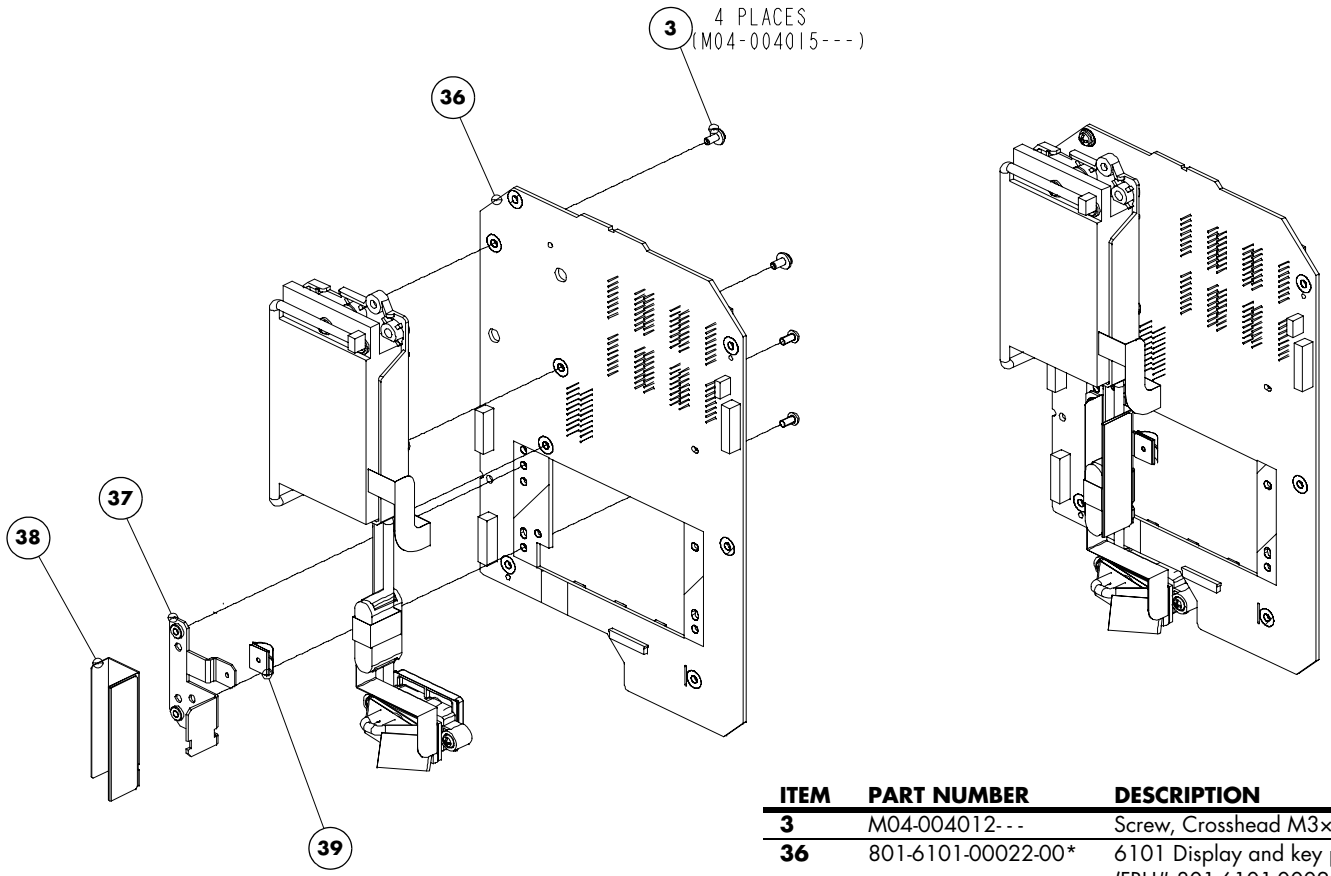


ITEM	PART NUMBER	DESCRIPTION
19	6101-20-46734	SpO2 Mounting Bracket (6101)
20	6101-30-46622	Nellcor SpO2 module package
21	801-0010-00002-00	Nellcor SpO2 Board
22	801-6101-00017-00	Nellcor Power Isolation Board
23	801-0010-00018-00	Nellcor SpO2 Flex Cable
24	6101-20-46719-51	Nellcor SpO2 Interface Bracket
25	6101-30-46621	Masimo SpO2 Module Package
26	801-6101-00016-00	Masimo SpO2 Board
27	801-6101-00015-00	Masimo Power Isolation Board PCBA
28	801-0010-00019-00	Masimo SpO2 Flex Cable
29	6101-20-46720-51	Masimo SpO2 Interface Bracket

ITEM	PART NUMBER	DESCRIPTION
30	6101-30-46620	DPM SpO2 Module Package
31	801-9211-00108-00*	DPM SpO2 Isolation Board*
32	801-9211-00107-00*	DPM SpO2 Board*
33	801-6006-00029-00	DPM SpO2 Signal Cable
34	6101-20-46718-51	DPM SpO2 Interface Bracket
35	6101-20-46733	DPM SpO2 Interface Bracket Plate

* Upgrading the 9006 SpO2 module to the 9008 SpO2 module requires FRU# 801-9211-00107-00, 801-9211-00108-00, 6101-20-46734.

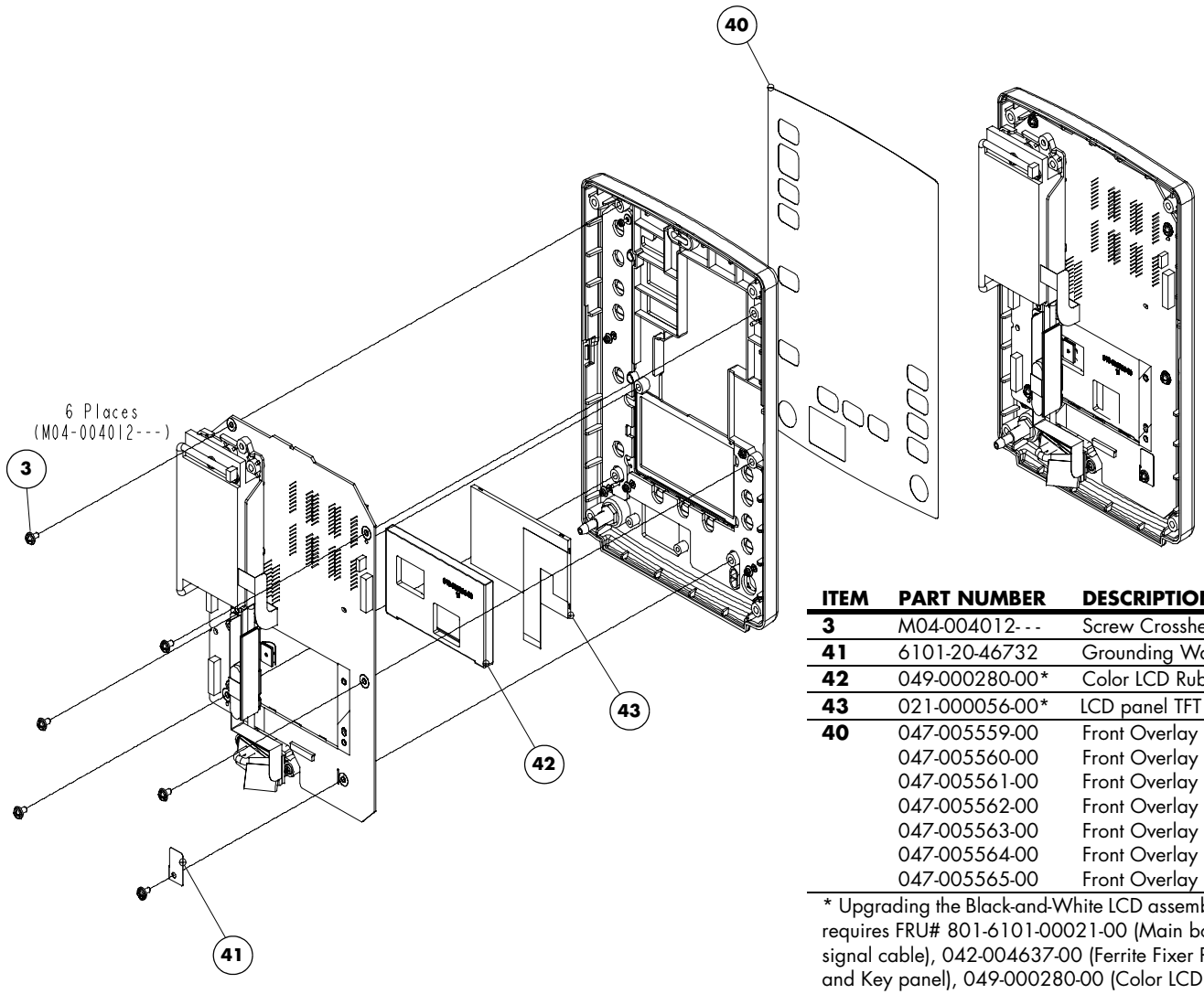
FIGURE 5-3 SpO_2 Assembly



ITEM	PART NUMBER	DESCRIPTION
3	M04-004012---	Screw, Crosshead M3×6
36	801-6101-00022-00*	6101 Display and key panel PCBA (Color)* (FRU# 801-6101-00023-00 contains these parts.)
37	6101-20-46763	Ferrite Fixer Plate Isolation Sheet
38	042-004637-00*	Ferrite Fixer Plate (Color LCD)* (FRU# 801-6101-00023-00 contains these parts.)
39	0000-10-10996	Spring Strip

* Upgrading the Black-and-White LCD assembly to the new Color LCD assembly requires FRU# 801-6101-00021-00(Main board),009-002037-00(LCDsignal cable), 042-004637-00(Ferrite Fixer Plate), 051-000875-00(Display and Key panel), 049-000280-00(Color LCD Rubber), 021-000056-00(LCD) for the new assembly. Please refer to the figures 5 -2, 5-4, 5-5 and 5-12.

FIGURE 5-4 Display/Keyboard Assembly

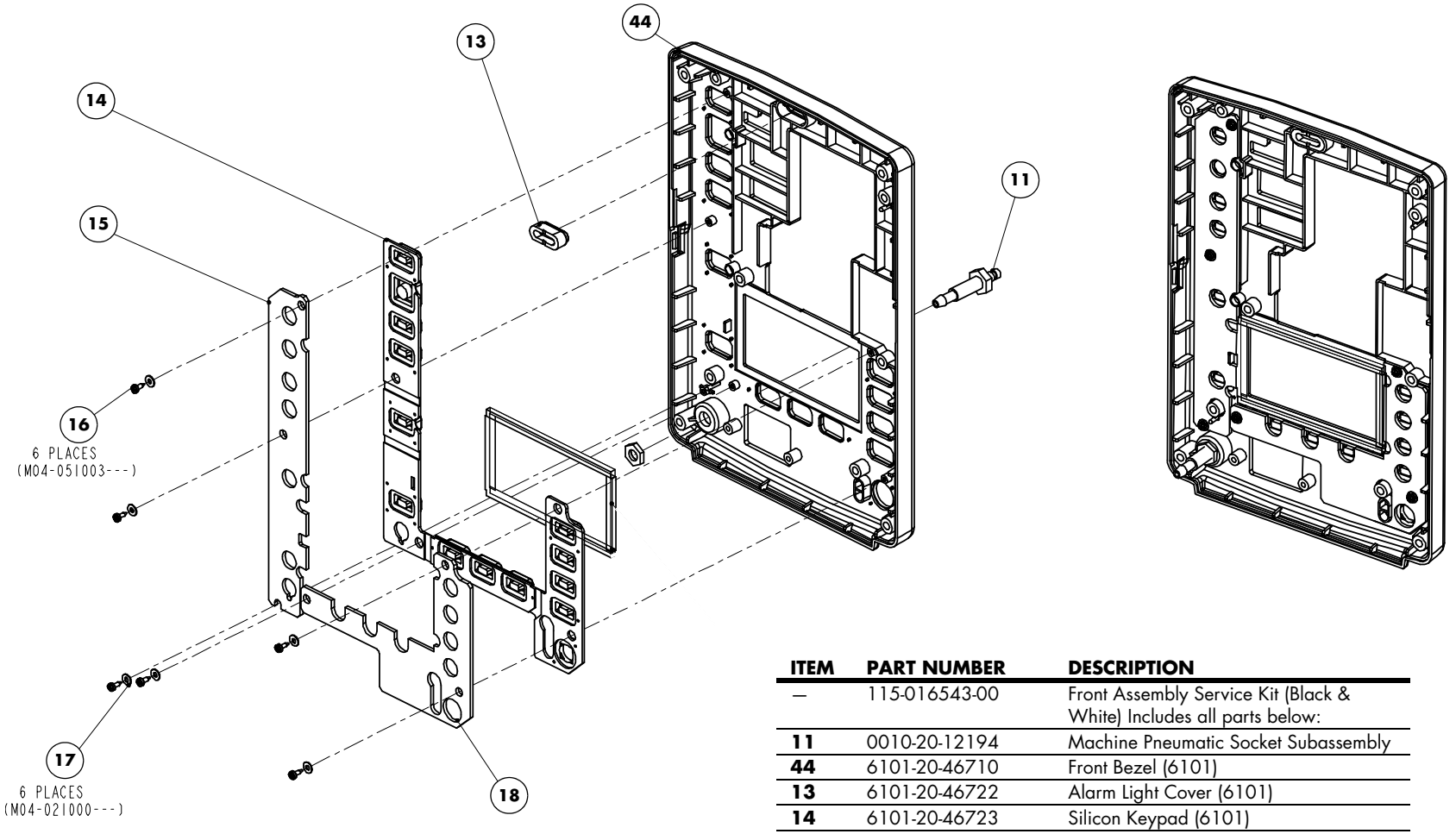


ITEM	PART NUMBER	DESCRIPTION
3	M04-004012- - -	Screw Crosshead M3×6
41	6101-20-46732	Grounding Washer (6101)
42	049-000280-00*	Color LCD Rubber*
43	021-000056-00*	LCD panel TFT 3.5inch 272*480 3.3V*
40	047-005559-00	Front Overlay (6101), English
	047-005560-00	Front Overlay (6101), Italy
	047-005561-00	Front Overlay (6101), French
	047-005562-00	Front Overlay (6101), German
	047-005563-00	Front Overlay (6101), Spanish
	047-005564-00	Front Overlay (6101), Portuguese
	047-005565-00	Front Overlay (6101), Dutch

* Upgrading the Black-and-White LCD assembly to the new Color LCD assembly requires FRU# 801-6101-00021-00 (Main board), 009-002037-00 (LCD signal cable), 042-004637-00 (Ferrite Fixer Plate), 051-000875-00 (Display and Key panel), 049-000280-00 (Color LCD Rubber), 021-000056-00 (LCD) for the new assembly. Please refer to the figures 5 -2, 5-4, 5-5 and 5-12.

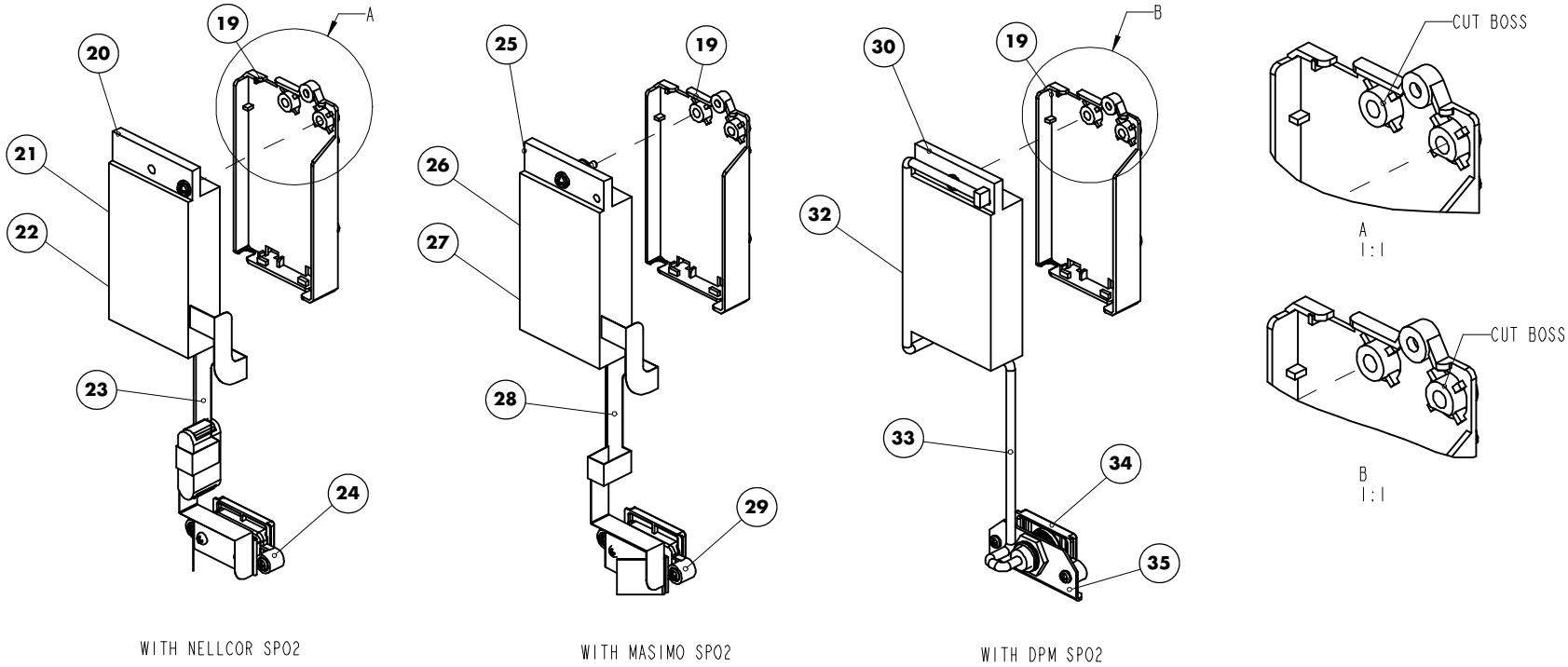
FIGURE 5-5 Front Shell Assembly

5.3 Front Assembly (Black and White LCD)



ITEM	PART NUMBER	DESCRIPTION
—	115-016543-00	Front Assembly Service Kit (Black & White) Includes all parts below:
11	0010-20-12194	Machine Pneumatic Socket Subassembly
44	6101-20-46710	Front Bezel (6101)
13	6101-20-46722	Alarm Light Cover (6101)
14	6101-20-46723	Silicon Keypad (6101)
15	6101-20-46762	Key Pad Fixer 2
16	M04-051003- - -	Screw, Pan Head Phillips PT2.0X6
17	M04-021000- - -	Flat Washer
18	6101-20-46743	Key Pad Fixer (6101)

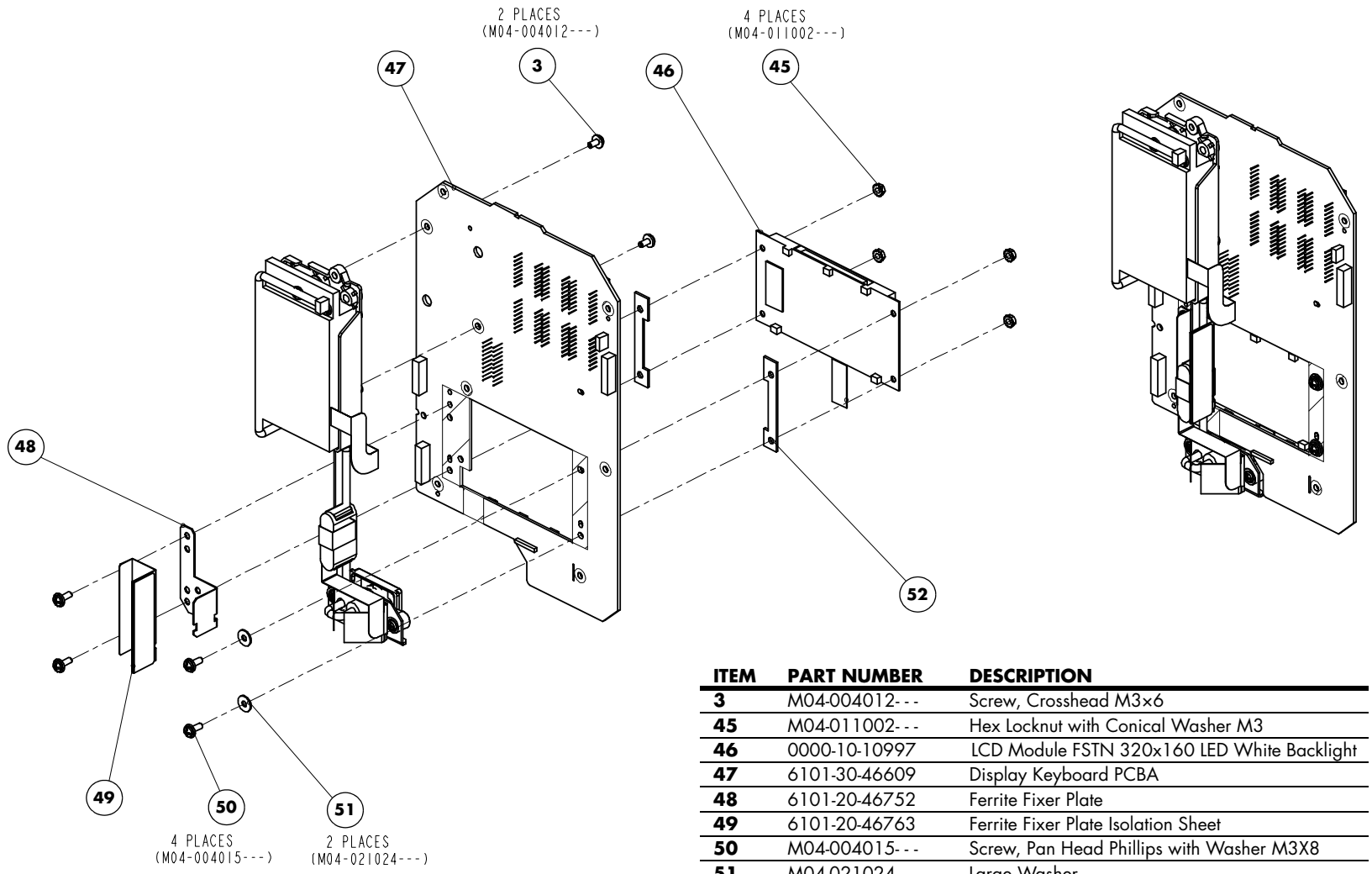
FIGURE 5-6 Front Bezel Assembly



ITEM	PART NUMBER	DESCRIPTION
19	6101-20-46734	SpO_2 Mounting Bracket (6101)
20	6101-30-46622	Nellcor SpO_2 module package
21	801-0010-00002-00	Nellcor SpO_2 Board
22	801-6101-00017-00	Nellcor Power Isolation Board
23	801-0010-00018-00	Nellcor SpO_2 Flex Cable
24	6101-20-46719-51	Nellcor SpO_2 Interface Bracket
25	6101-30-46621	Masimo SpO_2 Module Package
26	801-6101-00016-00	Masimo SpO_2 Board

ITEM	PART NUMBER	DESCRIPTION
27	801-6101-00015-00	Masimo Power Isolation Board PCBA
28	801-0010-00019-00	Masimo SpO_2 Flex Cable
29	6101-20-46720-51	Masimo SpO_2 Interface Bracket
30	6101-30-46620	DPM SpO_2 Module Package
32	801-9006-00001-00	DPM SpO_2 Board
33	801-6006-00029-00	DPM SpO_2 Signal Cable
34	6101-20-46718-51	DPM SpO_2 Interface Bracket
35	6101-20-46733	DPM SpO_2 Interface Bracket Plate

FIGURE 5-7 SpO_2 Assembly



ITEM	PART NUMBER	DESCRIPTION
3	M04-004012- - -	Screw, Crosshead M3x6
45	M04-011002- - -	Hex Locknut with Conical Washer M3
46	0000-10-10997	LCD Module FSTN 320x160 LED White Backlight
47	6101-30-46609	Display Keyboard PCBA
48	6101-20-46752	Ferrite Fixer Plate
49	6101-20-46763	Ferrite Fixer Plate Isolation Sheet
50	M04-004015- - -	Screw, Pan Head Phillips with Washer M3X8
51	M04-021024- - -	Large Washer
52	6006-20-39502	LCD Display Back Plate

FIGURE 5-8 Display/Keyboard Assembly

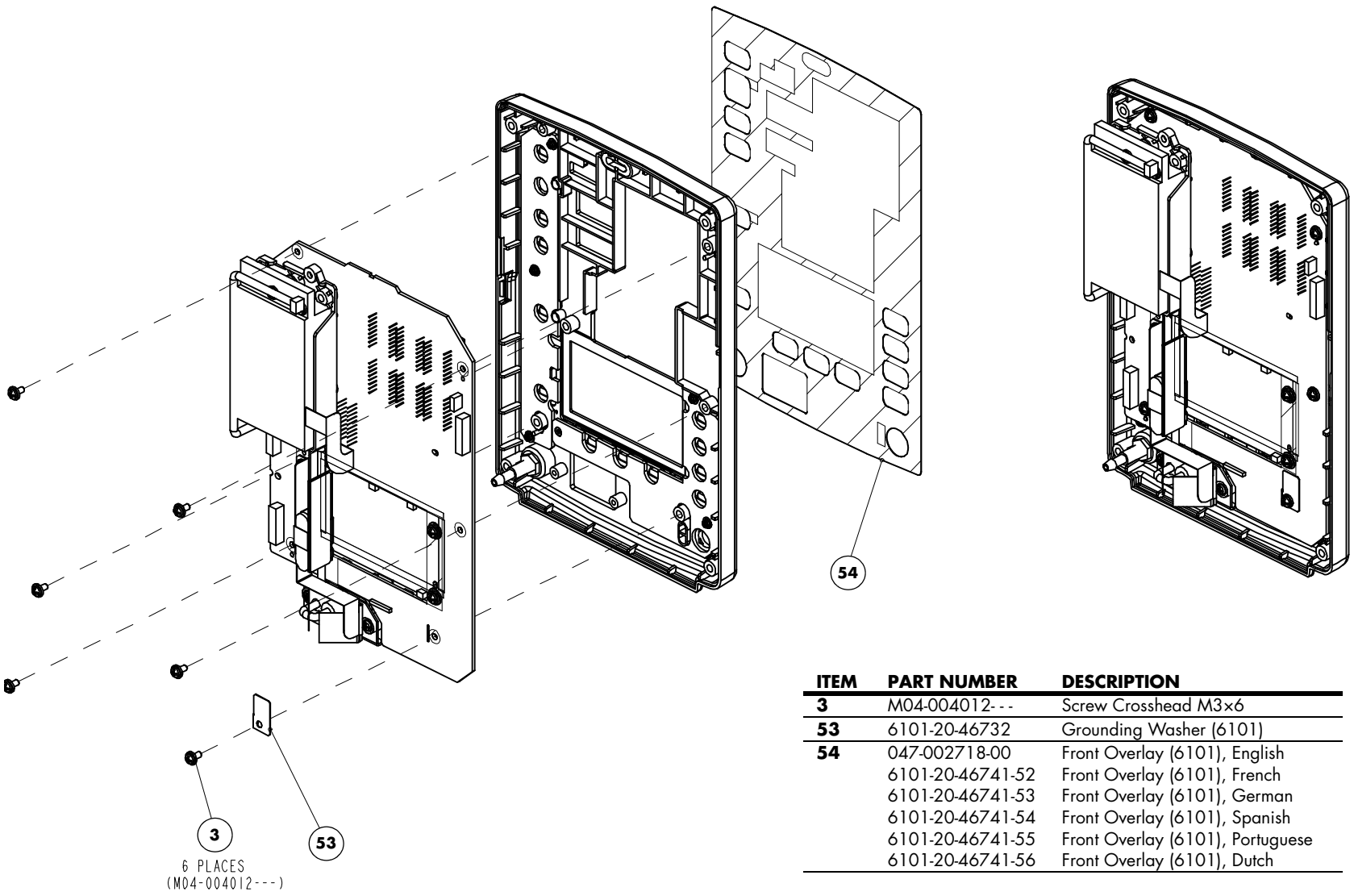
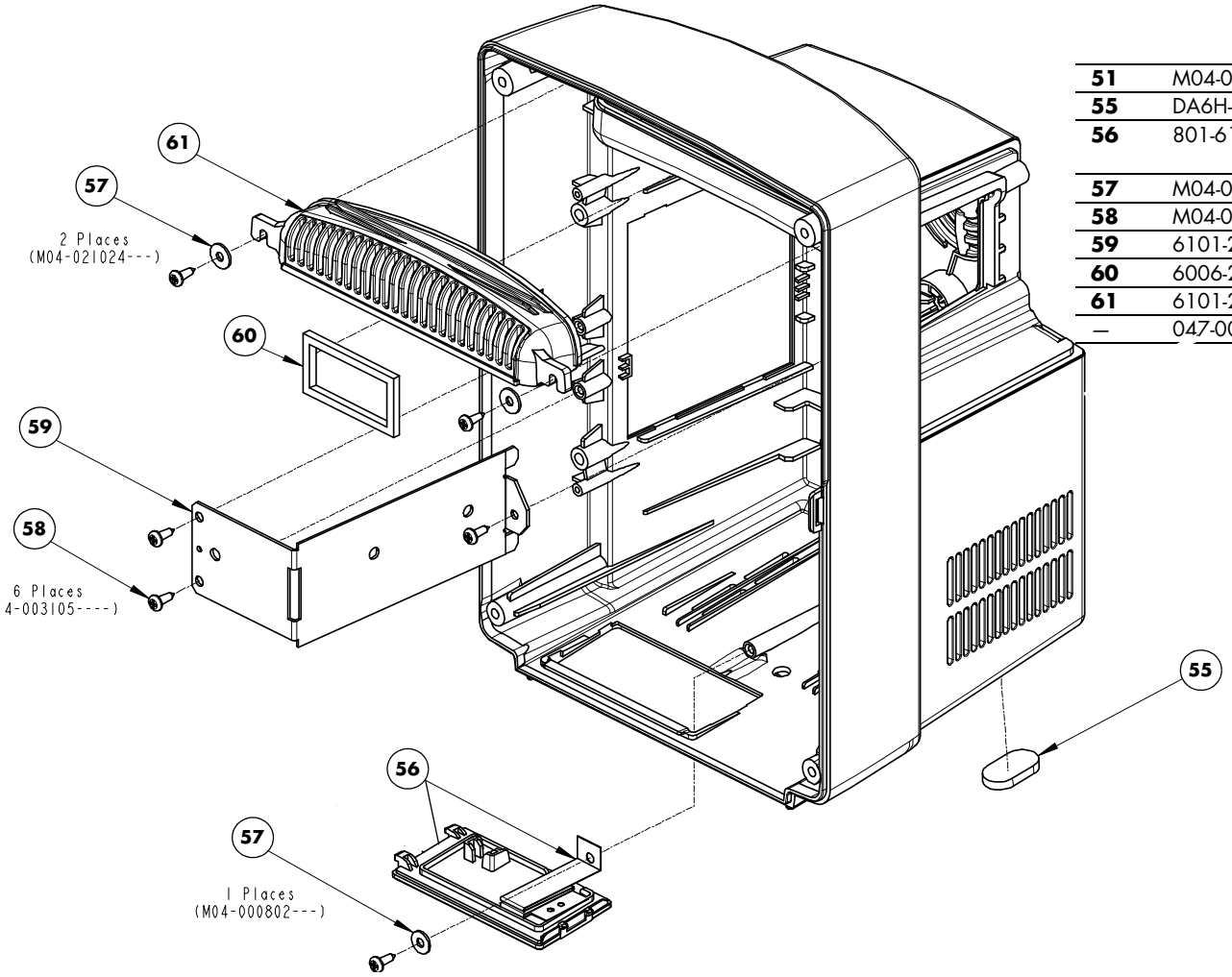


FIGURE 5-9 Front Shell Assembly

ITEM	PART NUMBER	DESCRIPTION
3	M04-004012---	Screw Crosshead M3×6
53	6101-20-46732	Grounding Washer (6101)
54	047-002718-00	Front Overlay (6101), English
	6101-20-46741-52	Front Overlay (6101), French
	6101-20-46741-53	Front Overlay (6101), German
	6101-20-46741-54	Front Overlay (6101), Spanish
	6101-20-46741-55	Front Overlay (6101), Portuguese
	6101-20-46741-56	Front Overlay (6101), Dutch

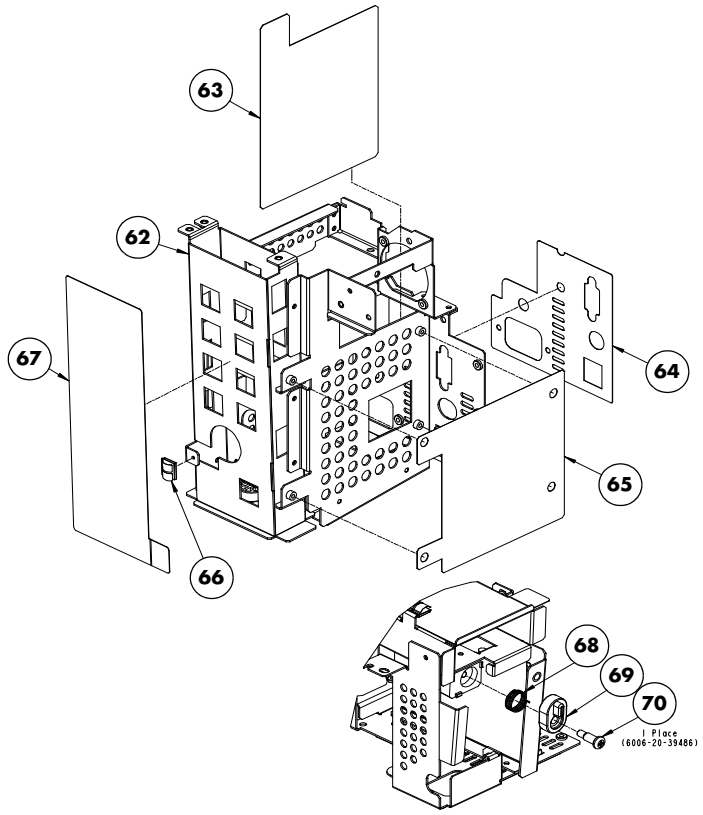
5.4 Rear Housing Assembly

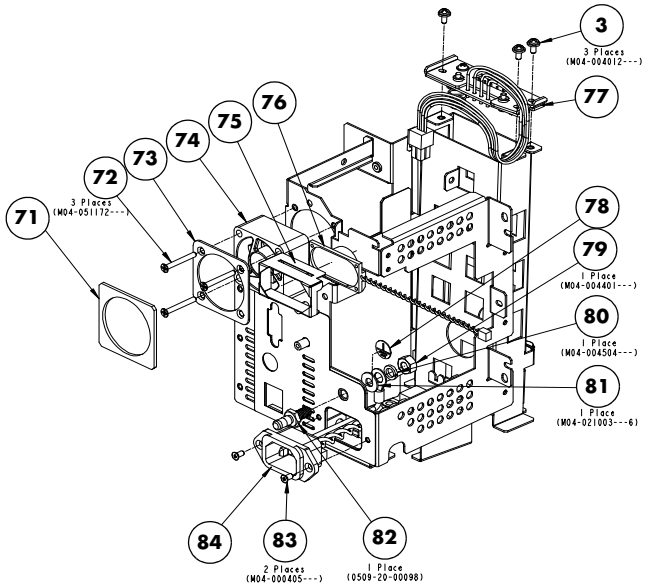


ITEM	PART NUMBER	DESCRIPTION
—	801-6101-00010-00	Complete Rear Cover Service Kit. Includes all parts below, except 801-6101-00009-00.
51	M04-021024- - -	Large Washer
55	DA6H-20-22831	Foot Cushion
56	801-6101-00009-00	Battery Door (6101) and Battery Door Link
57	M04-000802- - -	Flat Washer
58	M04-003105- - -	Tapping Screw PT3×8
59	6101-20-46751	Recorder Bracket (6101)
60	6006-20-39418	Speaker Spacer
61	6101-20-46713	Handle Cover (6101)
—	047-002714-00	Rear Label

FIGURE 5-10 Rear Housing Assembly

5.5 Main Bracket Assembly

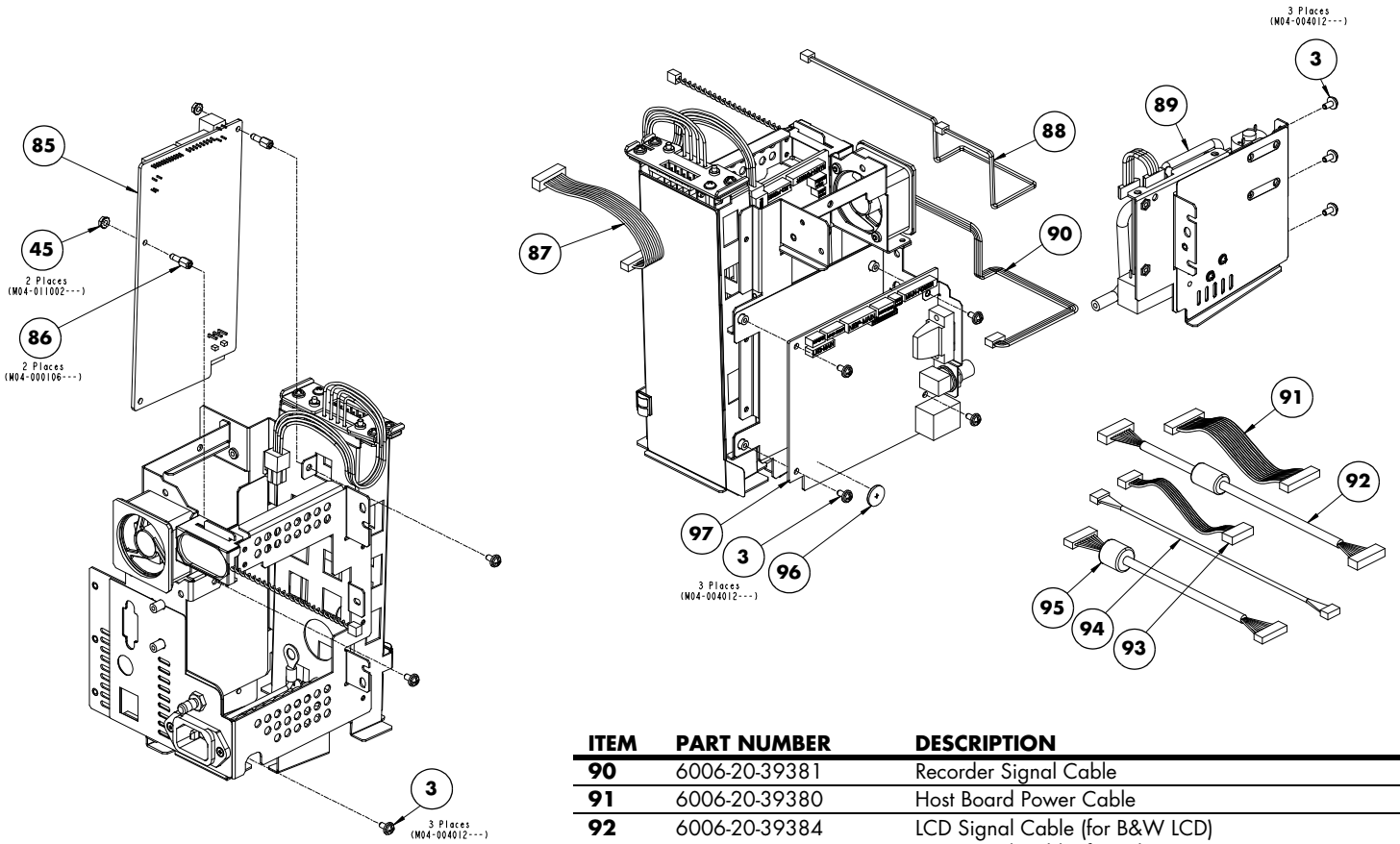




ITEM	PART NUMBER	DESCRIPTION
3	M04-004012- - -	Screw, Crosshead M3×6
62	6101-20-46725	Main Bracket (6101)
63	6101-20-46736	Power Supply Board Isolation Sheet (6101)
64	6101-20-46735-51	I/O Overlay (6101)
65	6006-20-39451	Main Board Insulating Plate
66	0000-10-10996	Spring Strip
67	6101-20-46738	Battery Box Isolation Sheet (6101)
68	6101-20-46753	Battery Hook Torsion Spring

ITEM	PART NUMBER	DESCRIPTION
69	7000-20-24365	Torsion Spring
70	6006-20-39486	Battery Bar Setscrew
71	6101-20-46739	Fan Gasket (6101)
72	M04-051172- - -	Screw, Flat Head Phillips M3X25
73	6101-20-46731	Fan Binder Plate (6101)
74	801-9201-00001-00	Fan (KDE1204PKV3)
75	6006-20-39379	Speaker Spacer
76	801-6006-00048-00	Speaker and Cables
77	801-6006-00019-00	Lithium Battery Connector Assembly
78	2102-20-17166	Protective Ground Label
79	M04-004401- - -	Hex Nut, M6
80	M04-004504- - -	Spring Washer
81	M04-021003- - -	Flat Washer
82	0509-20-00098	Grounding Terminal
83	M04-000405- - -	Screw, Crosshead M3×8
84	6006-21-39386	Power Board AC Input cable

FIGURE 5-11 Main Bracket Assembly



ITEM	PART NUMBER	DESCRIPTION
3	M04-004012- - -	Screw, Crosshead M3×6
45	M04-011002- - -	Nut, M3 with Spring Washer
85	6101-30-46601	AC-DC Power Supply PCBA
86	M04-000106- - -	Bolt, M3×7
87	6101-20-46611	Keyboard Power Cable
88	6006-20-39492	Recorder Power Cable
89	6101-30-46618	NIBP Assembly

ITEM	PART NUMBER	DESCRIPTION
90	6006-20-39381	Recorder Signal Cable
91	6006-20-39380	Host Board Power Cable
92	6006-20-39384 009-002037-00*	LCD Signal Cable (for B&W LCD) LCD Signal Cable (for color LCD) *
93	M09A-20-62081	Communication Cable from Host Board to Isolation Board
94	6006-20-39382	SpO_2 Module Cable
95	6006-20-39383	Keyboard Signal Cable
96	M05-010R03- - -	Button Battery Lithium 3V35mAh D12.5x2.0
97**	801-6101-00001-00 801-6101-00021-00*	Main Board (for B&W LCD) Main Board (for color LCD)*

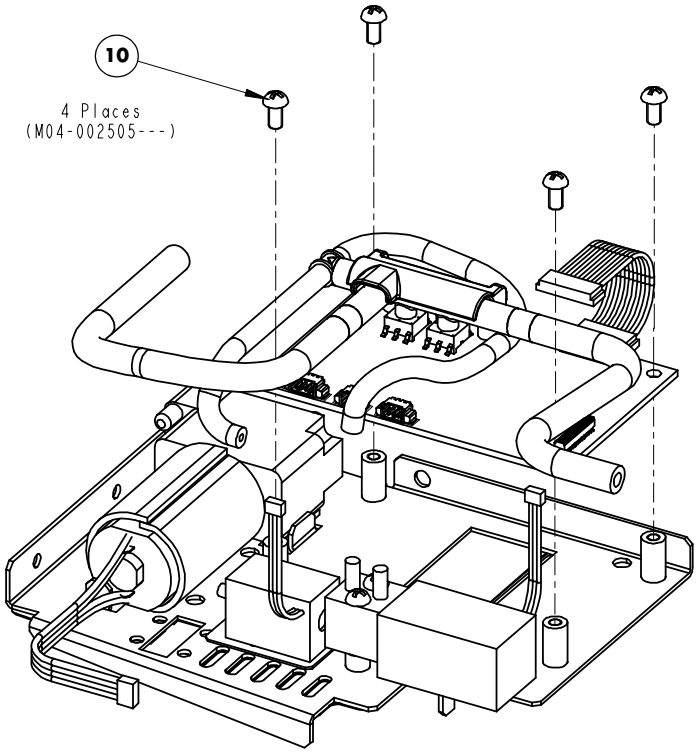
* Upgrading the Black-and-White LCD assembly to the new Color LCD assembly requires FRU# 801-6101-00021-00 (Main board),009-002037-00 (LCD signal cable), 042-004637-00 (Ferrite Fixer Plate), 051-000875-00 (Display and Key panel), 049-000280-00 (Color LCD Rubber), 021-000056-00 (LCD) for the new assembly. Please refer to the figures 5 -2, 5-4, 5-5 and 5-12.

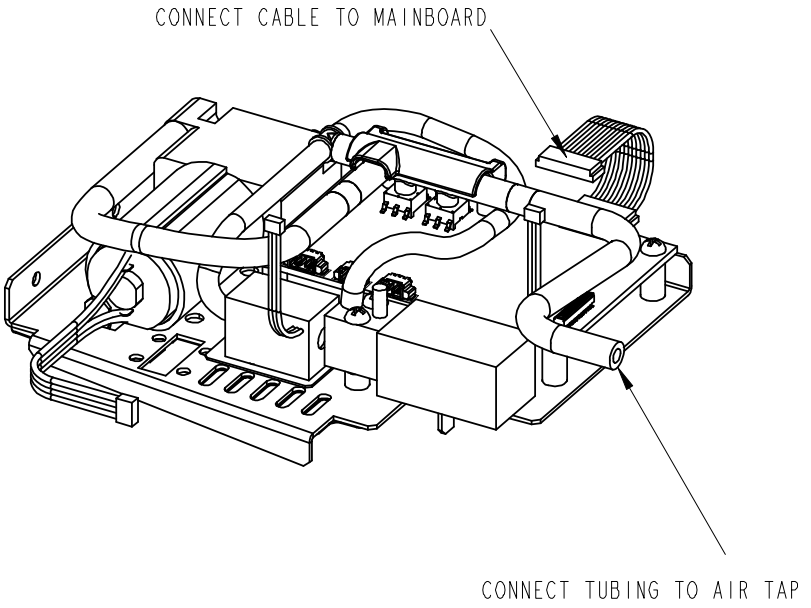
FIGURE 5-12 Main Bracket Assembly

NOTE: ****After replacing the Main Board, a System Reconfiguration should be performed by following this procedure:**
While the monitor is powered on, press and hold the MENU key for two seconds. While the MENU key is still depressed, press and hold the power ON/OFF key. Verify that the message "Clear system config and restarting" appears. Release the MENU and ON/OFF keys. The monitor will shutdown and restart. Then the message "Checking system config..." appears. After the monitor is successfully configured, the message "System configure succeed. Restarting..." is displayed and the monitor shuts down and restarts automatically.

5.6 NIBP Assembly (Pump M6Q-100003- - -)

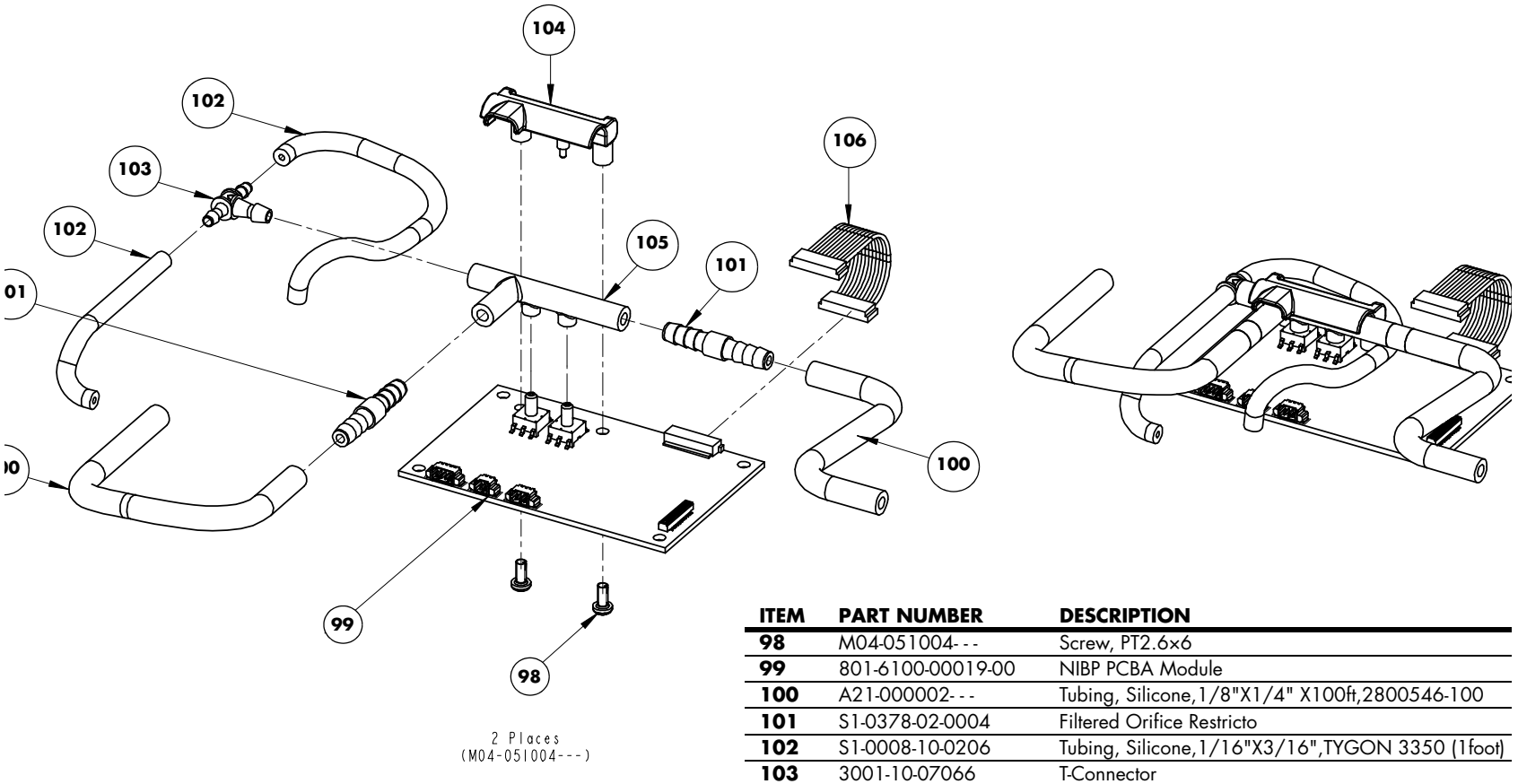
Accutorr V models with serial numbers lower than S/N A7503017K9 are configured with the old NIBP pump (083-000056-00).





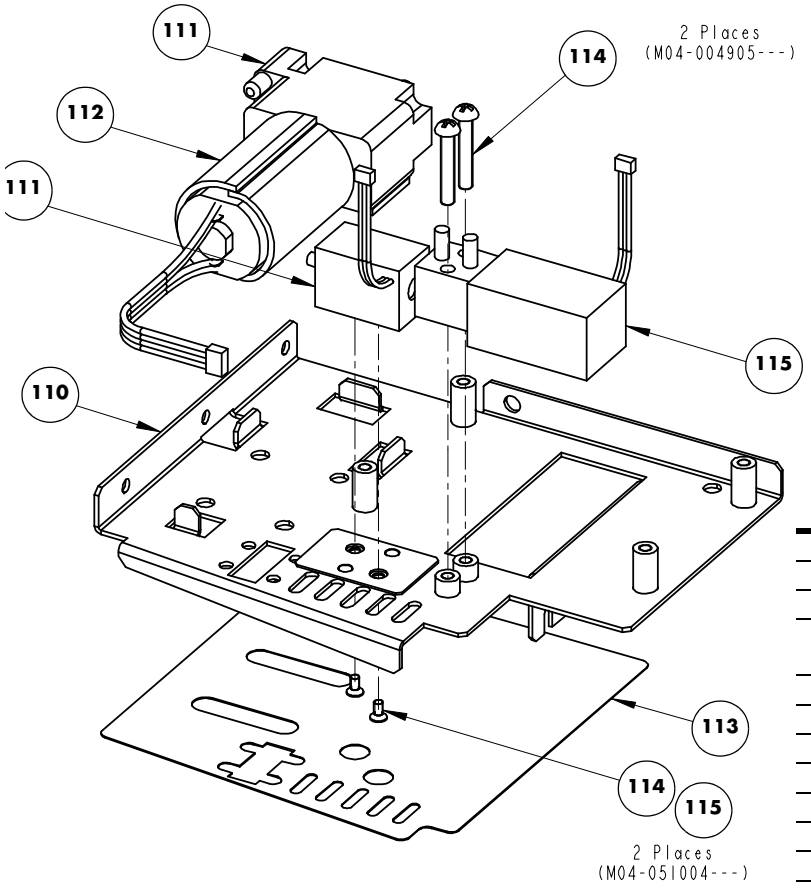
ITEM	PART NUMBER	DESCRIPTION
10	M04-002505---	Screw, M3×6

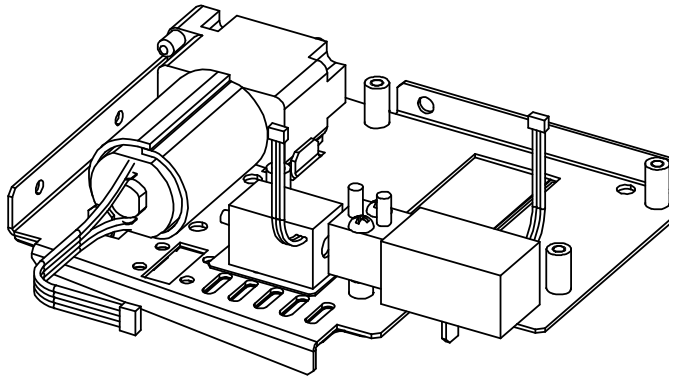
FIGURE 5-13 NIBP Assembly (Pump M6Q-100003- - -)



ITEM	PART NUMBER	DESCRIPTION
98	M04-051004- - -	Screw, PT2.6x6
99	801-6100-00019-00	NIBP PCBA Module
100	A21-000002- - -	Tubing, Silicone,1/8"X1/4" X100ft,2800546-100
101	S1-0378-02-0004	Filtered Orifice Restricto
102	S1-0008-10-0206	Tubing, Silicone,1/16"X3/16",TYGON 3350 (1foot)
103	3001-10-07066	T-Connector
104	6101-20-46756	NIBP Bracket Manifold
105	6101-20-46755	NIBP Manifold
106	6101-20-46610	Cable, Main Board to NIBP Module Board

FIGURE 5-14 NIBP Pneumatics (Pump M6Q-100003- - -)



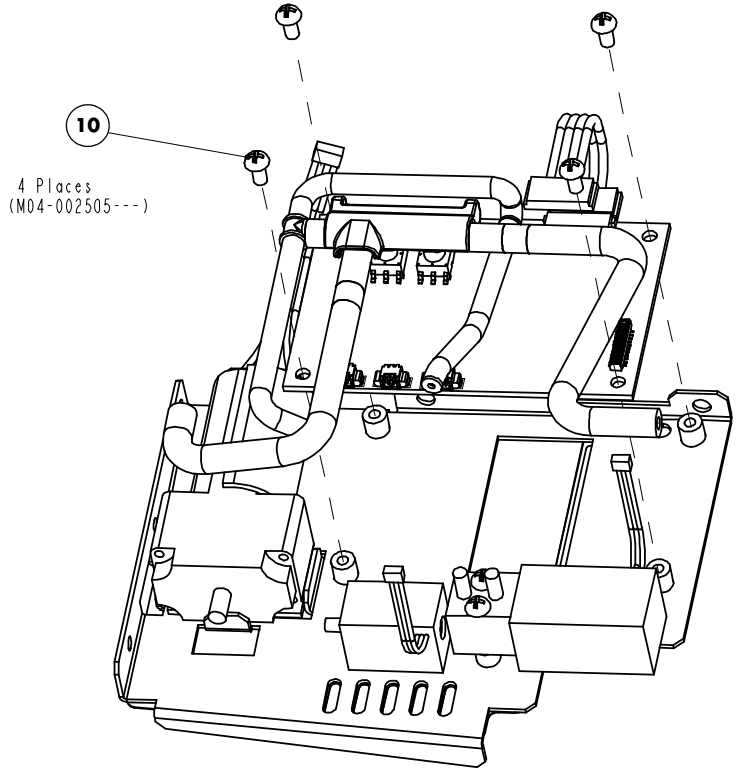


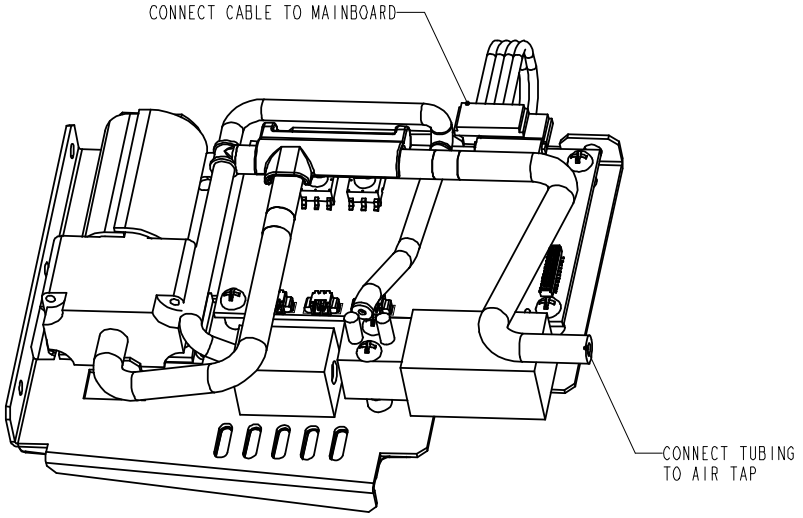
ITEM	PART NUMBER	DESCRIPTION
107	047-001582-00*	NIBP Bracket Label*
108	M04-051137-- -	Screw, M2×4
109	M90-000002-00	Insulation Washer F2
110	042-001417-00*	NIBP Bracket* (FRU# 801-6101-00018-00 contains these parts.*)
111	M6Q-100003-- -	Rolling Pump
112	6101-20-46761	Pump Cushion
113	082-000057-00	Valve Solenoid
114	M04-004905-- -	Screw, M3×18
115	082-000058-00	Valve
—	009-000588-00	Pump connection cable
—	A90-000031-- -	Cable Tie CHS-4x150mm

* Upgrading the old pump (082-000056-00) to the new rolling pump (M6Q-100003- - -) requi
FRU# 801-6101-00018-00 (pump kit), 047-001582-00 (label), and 042-001417-00 (bracke
See section 5.7 (pg. 5-19) ''NIBP Assembly (Pump 082-000056-00)'' for the old pump assem

FIGURE 5-15 NIBP Mechanical (Pump 082-000056-00)

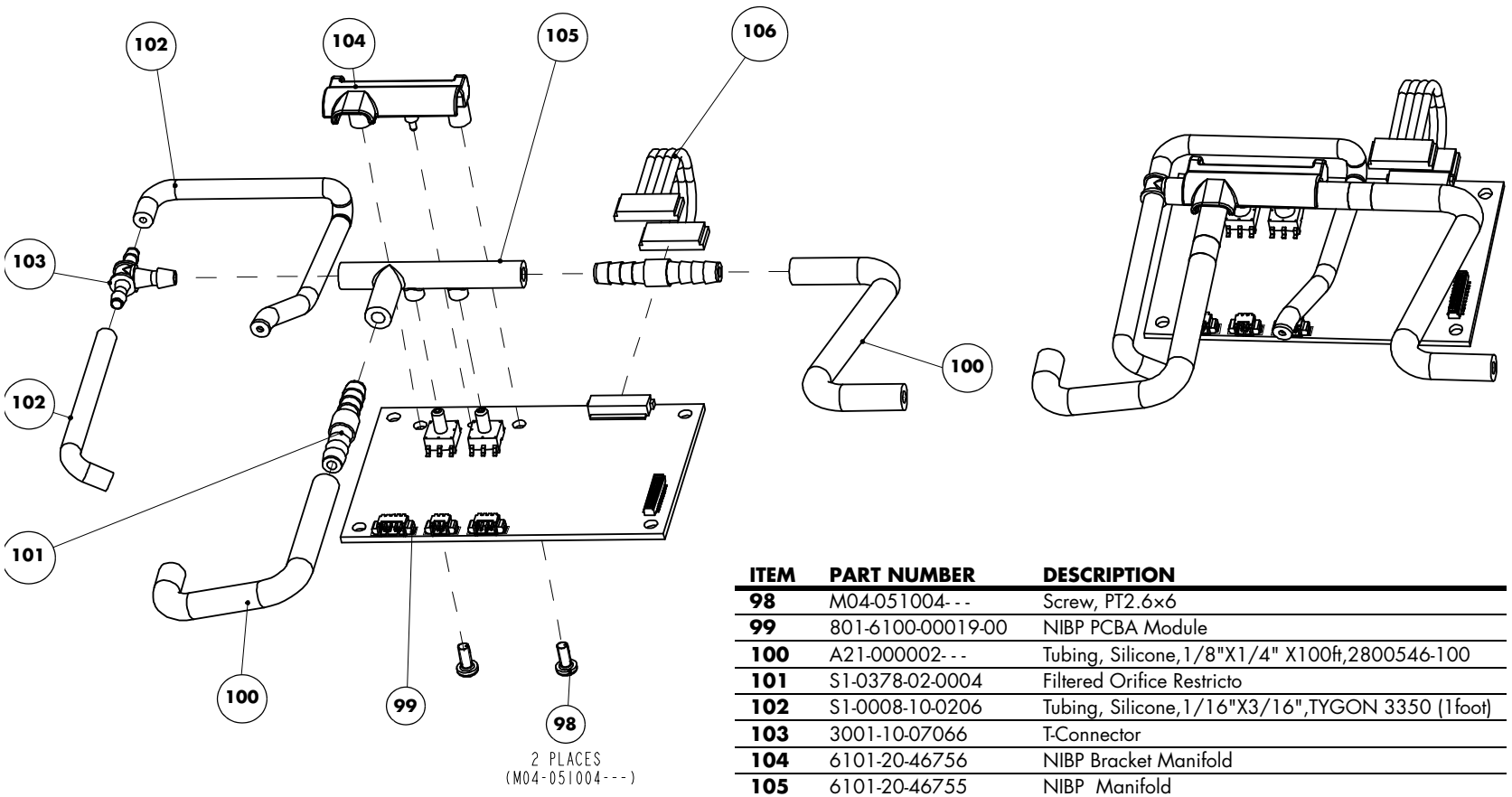
5.7 NIBP Assembly (Pump 082-000056-00)





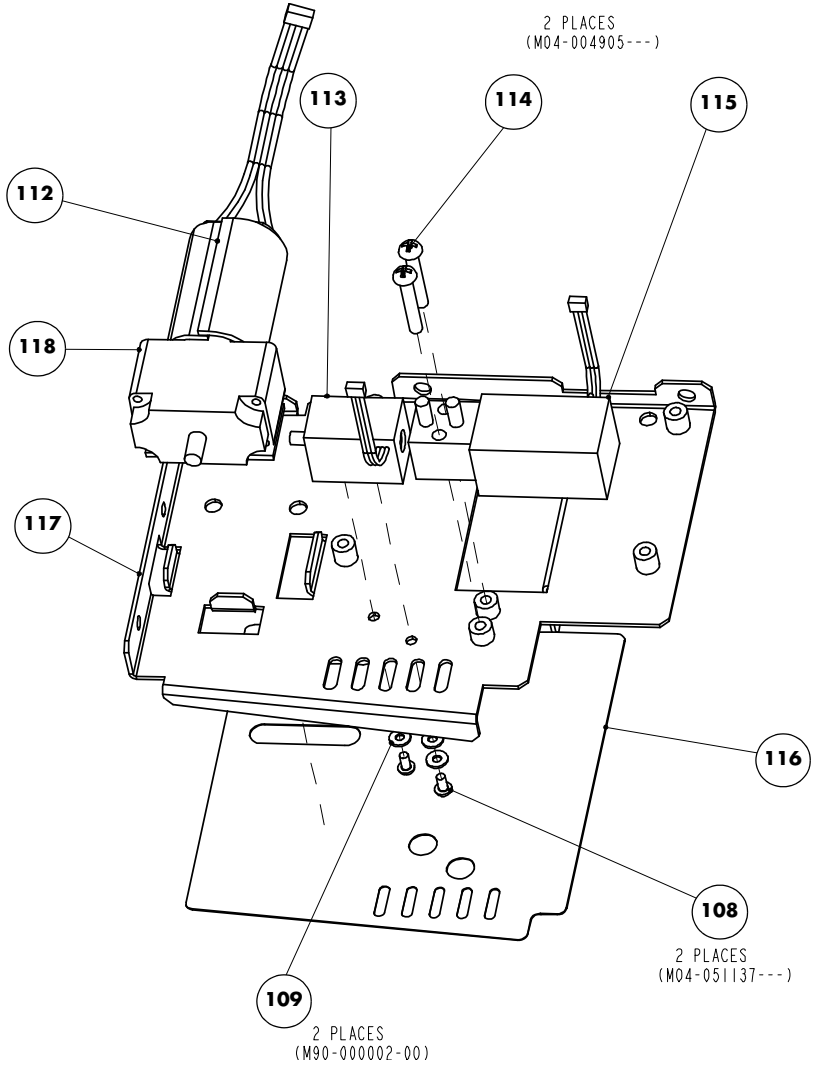
ITEM	PART NUMBER	DESCRIPTION
10	M04-002505---	Screw, M3×6

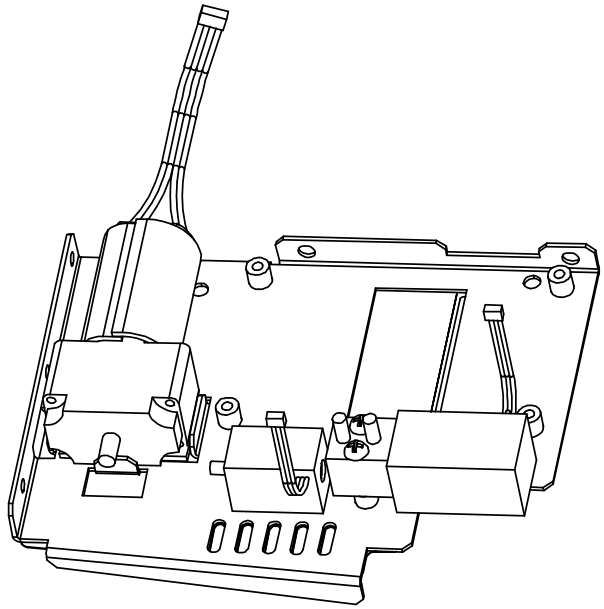
FIGURE 5-16 NIBP Assembly (Pump 082-000056-00)



ITEM	PART NUMBER	DESCRIPTION
98	M04-051004- - -	Screw, PT2.6x6
99	801-6100-00019-00	NIBP PCBA Module
100	A21-000002- - -	Tubing, Silicone,1/8"X1/4" X100ft,2800546-100
101	S1-0378-02-0004	Filtered Orifice Restricto
102	S1-0008-10-0206	Tubing, Silicone,1/16"X3/16",TYGON 3350 (1foot)
103	3001-10-07066	T-Connector
104	6101-20-46756	NIBP Bracket Manifold
105	6101-20-46755	NIBP Manifold
106	6101-20-46610	Cable, Main Board to NIBP Module Board

FIGURE 5-17 NIBP Pneumatics (Pump 082-000056-00)



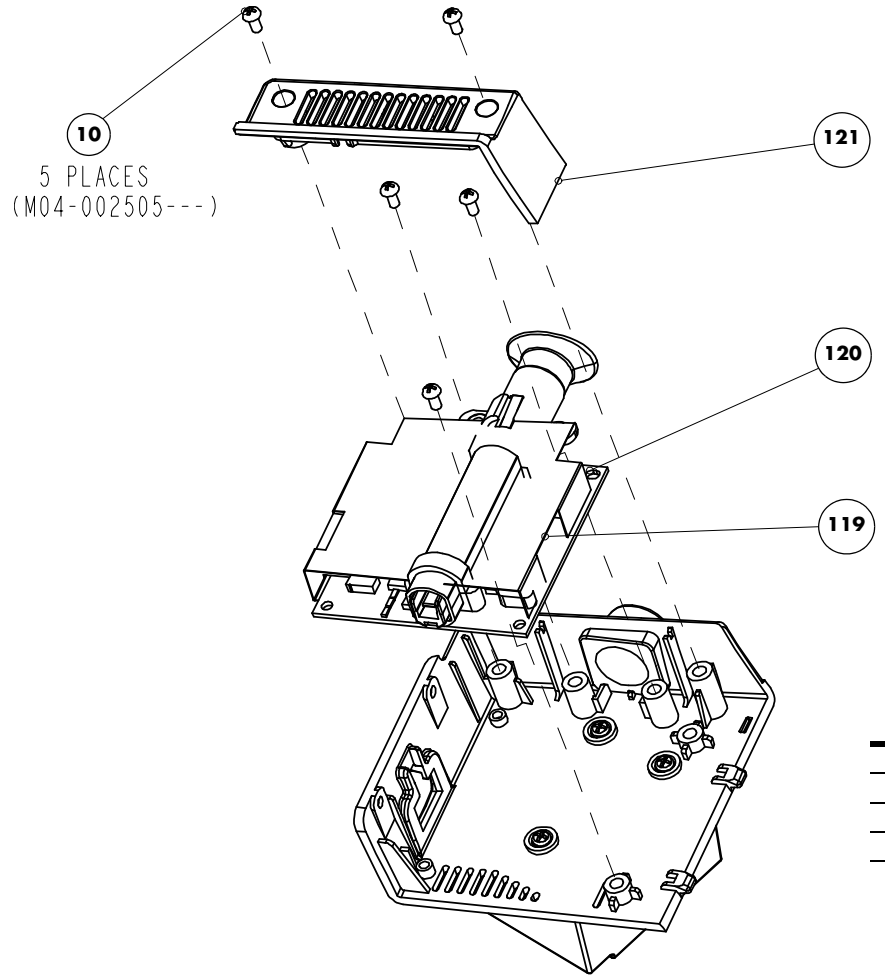


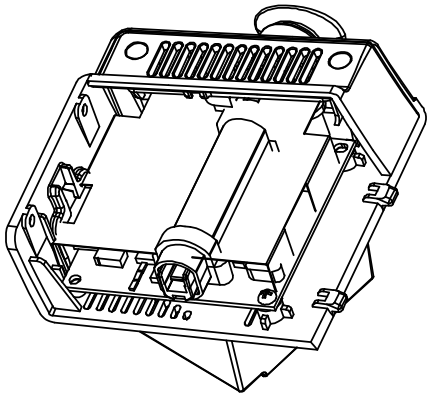
ITEM	PART NUMBER	DESCRIPTION
116	6101-20-46737	NIBP Fram Overlay (6101)
108	M04-051137---	Screw, M2×4
109	M90-000002-00	Insulation Washer F2
117	6101-20-46730	NIBP Bracket (6101)
118	082-000056-00*	Pump*
112	6101-20-46761	Pump Cushion
—	801-6101-00002-00	Pump Kit (includes pump 082-000056-00 and cushion 6101-20-46761)
113	082-000057-00	Valve Solenoid
114	M04-004905---	Screw, M3×18
115	082-000058-00	Valve

* Upgrading the old pump (082-000056-00) to the new rolling pump (M6Q-100003- - -) requires FRU# 801-6101-00018-00 (pump kit), 047-001582-00 (label), and 042-001417-00 (bracket). See section 5.6 (pg. 5-16) ''NIBP Assembly (Pump M6Q-100003- - -)'' for the new rolling pump assembly.

FIGURE 5-18 NIBP Mechanical (Pump 082-000056-00)

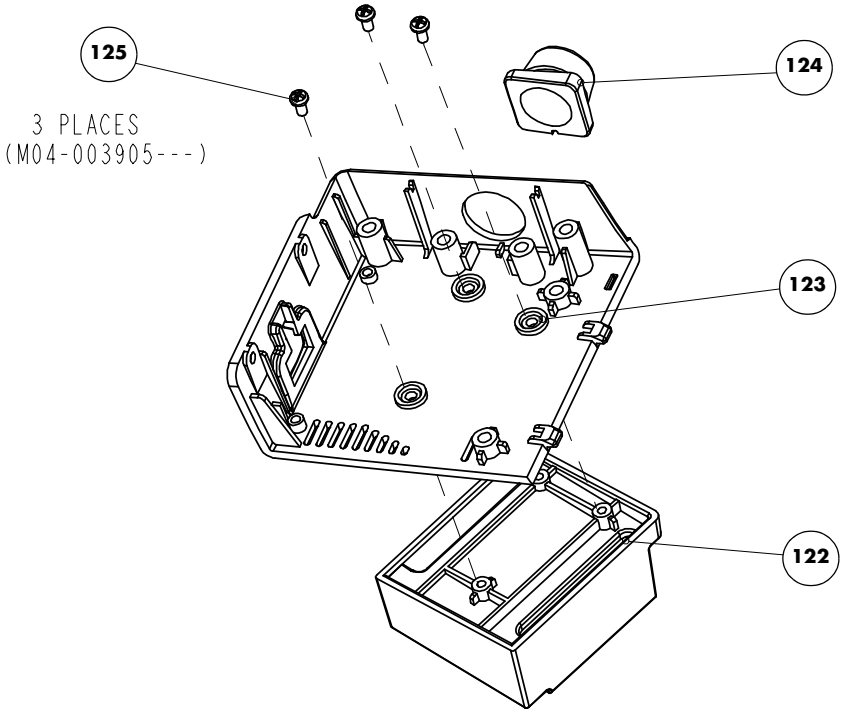
5.8 Temperature Module Subassembly

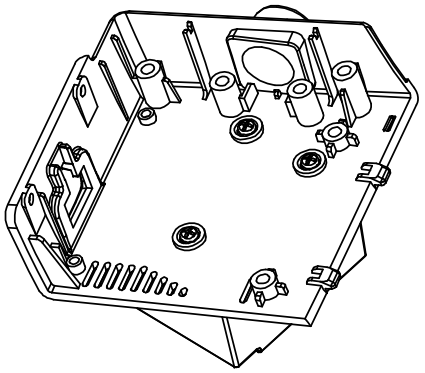




ITEM	PART NUMBER	DESCRIPTION
10	M04-002505- - -	Screw, M3×6
119	6101-20-46759	Temp Module Water Ingress Blocker
120	801-6006-00044-00	Temp Measurement Board Subassembly
121	6101-20-46716	Temp Module Inner Cover

FIGURE 5-19 Temperature Module Subassembly

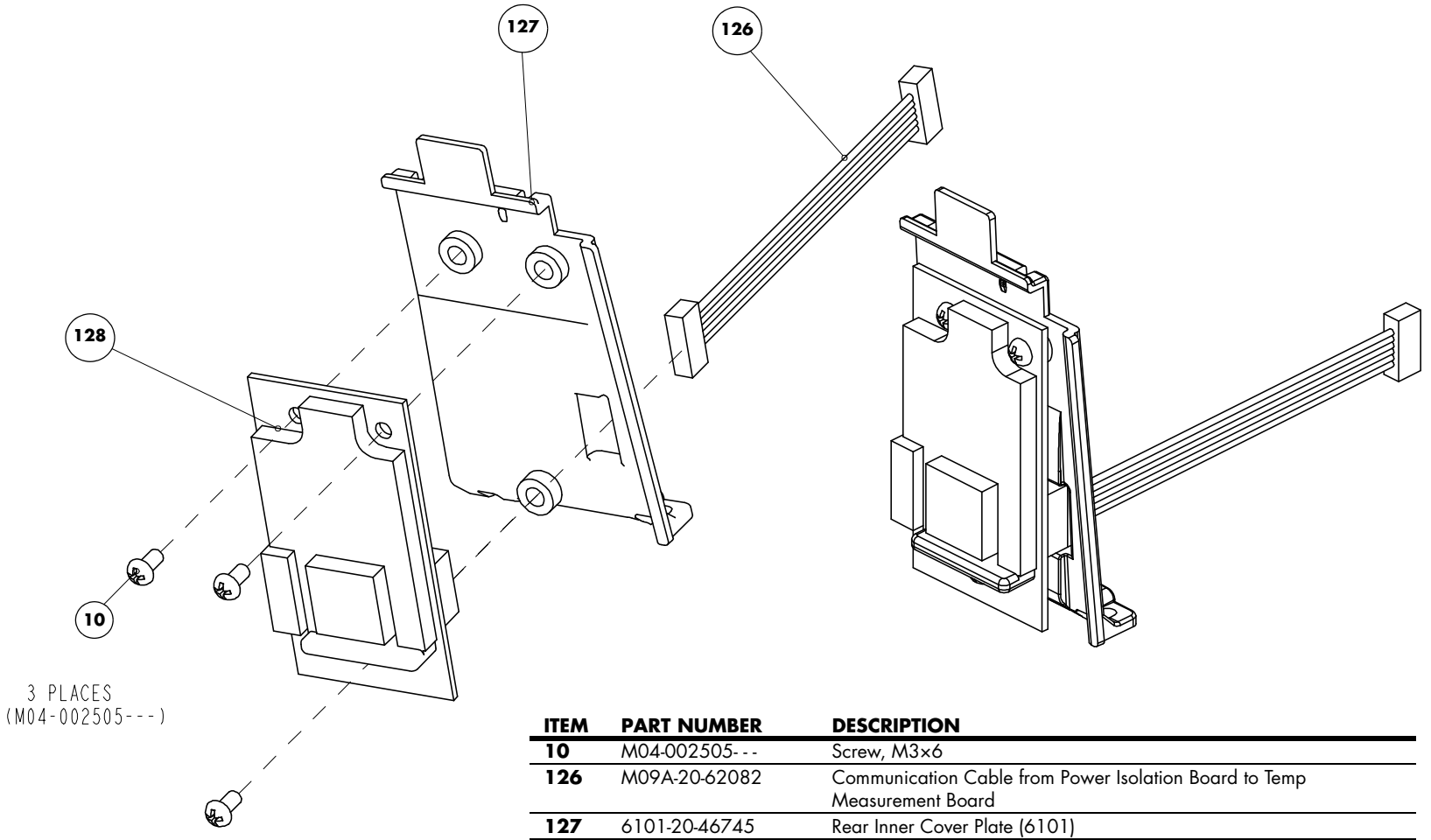




ITEM	PART NUMBER	DESCRIPTION
122	6101-20-46717	Temp Probe Cover Holder
123	6101-20-46715	Temp Module External Cover
124	6101-20-46724	Temperature Probe Holder Ring (6101)
125	M04-003905- - -	Screw, Phillips PT3×6

FIGURE 5-20 Temperature Module Subassembly

5.9 Temperature Power Module Subassembly



ITEM	PART NUMBER	DESCRIPTION
10	M04-002505- - -	Screw, M3×6
126	M09A-20-62082	Communication Cable from Power Isolation Board to Temp Measurement Board
127	6101-20-46745	Rear Inner Cover Plate (6101)
128	801-6006-00043-00	Temp Module Power Supply Board PCBA

FIGURE 5-21 Temperature Power Module Subassembly

6.0 Test and Calibration

6.1 Introduction

To ensure the monitor always functions properly, qualified personnel should perform regular inspections, maintenance, and testing. This chapter provides the test procedures for the monitor and includes recommended test equipment and frequency. Qualified personnel should perform the testing and maintenance procedures as required and use appropriate test equipment.

The testing procedures provided in this chapter are intended to verify that the monitor meets the performance specifications. If the monitor or a module fails to perform as specified in any test, repair or replacement is required to correct the problem. If the problem persists, contact service.

CAUTION: All tests should be performed by qualified personnel only.

NOTE: Qualified personnel should acquaint themselves with the test tools and confirm that test tools and cables are applicable.

NOTE: When fields or buttons in a dialog have a line through them, they are not available for selection or modification.

6.1.1 Test Report

After completing the tests, service personnel should record test results in this table and retain them for hospital records.

TEST EQUIPMENT

Name	Model/PN	Next Calibration Due Date

TEST RECORD

No.	Test Item	Test Site	Test Results
1			
2			

CONCLUSION

Pass/Fail:	Tested by:	Date:

6.1.2 Recommended Frequency

CHECK/MAINTENANCE ITEM		FREQUENCY
Visual test		When first installing or after reinstalling.
Power on test		1. When first installing or after reinstalling. 2. Following any maintenance or replacement of any main unit parts.
NIBP tests	Accuracy test	1. If the user suspects that the measurement is incorrect. 2. Following any repairs or replacement of the NIBP module. 3. At least once every two years.
	Leakage test	
	Calibration	
SpO_2 test		
Temperature test		

Bar code scanner test		If the user suspects that bar code scan is incorrect.
Electrical safety tests	Enclosure leakage current test	1. Following any repair or replacement of the power module. 2. At least once every two years.
	Earth leakage current test	
	Patient leakage current test	
	Patient auxiliary current test	
Recorder check		Following any repair or replacement of the recorder.

6.2 Visual Test

Inspect the equipment for obvious signs of damage. Follow these guidelines when inspecting the equipment:

- Carefully inspect the case, the display screen, and the buttons for physical damage.
- Inspect all external connections for loose connectors, bent pins, or frayed cables.
- Inspect all connectors on the equipment for loose connectors or bent pins.
- Make sure that the labels on the equipment are clearly legible.

6.3 Power-on Test

Verify that the monitor can power up correctly by following this procedure:

1. Insert the lithium battery in the battery compartment and connect the monitor to the AC mains. The AC mains LED and battery LED light.
2. Press the Power On/Off button to turn on the monitor.
   - The operating status LED built into the Power On/Off button illuminates.
   - The system beeps to indicate it has passed the alarm sounds self test.
   - All the LEDs on the front panel illuminate.
   - The technical alarm lamp illuminates yellow, then red, and then turns off to indicate it has passed the alarm lamp self test.
   - The start-up screen clears, and the monitor enters the main screen, indicating start-up is complete.

6.4 NIBP Calibration

Required Tools:

- One (1) T-Connector
- Three (3) pieces of Tubing
- One (1) Metal Vessel with volume of 500 ±25 ml
- One (1) Reference manometer with accuracy of 1 mmHg

To calibrate NIBP:

1. Attach the calibration vessel and reference manometer as shown in FIGURE 6-1.

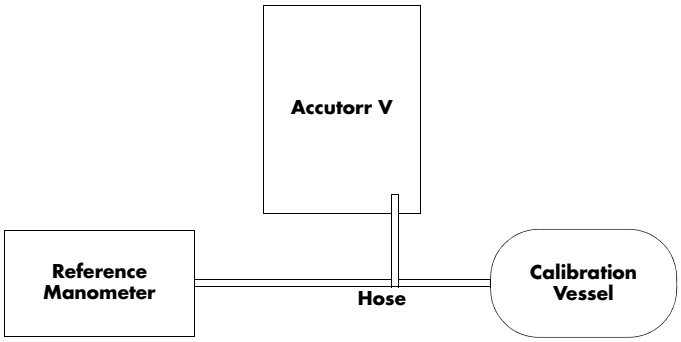


FIGURE 6-1 NIBP calibration configuration

2. If needed, press (11) to display the Normal Screen.

3. Press (12) to display the **SYSTEM SETUP** dialog.

4. Press (16) or (19) to highlight **MAINTENANCE**.

5. Once **MAINTENANCE** is highlighted, press OK (18) to display the **MAINTENANCE** dialog as shown in FIGURE 6-2.

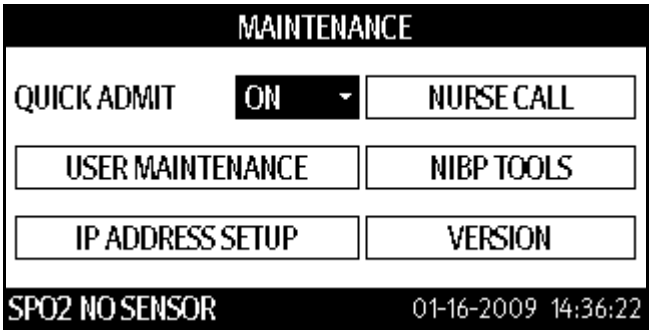


FIGURE 6-2 MAINTENANCE dialog

6. Press (16) or (19) to highlight **NIBP TOOLS**.

7. Once **NIBP TOOLS** is highlighted, press OK (18) to display the **NIBP TOOLS** dialog.

8. Press (16) or (19) to highlight **CALIBRATION**, as shown in FIGURE 6-3.

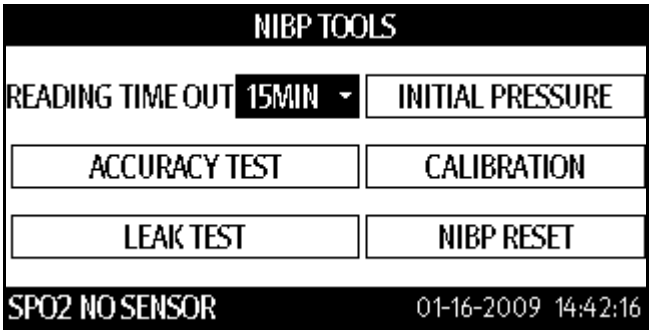


FIGURE 6-3 NIBP TOOLS dialog

9. Once **CALIBRATION** is highlighted, press OK (18) to display the Enter Password dialog, as shown in FIGURE 6-4.

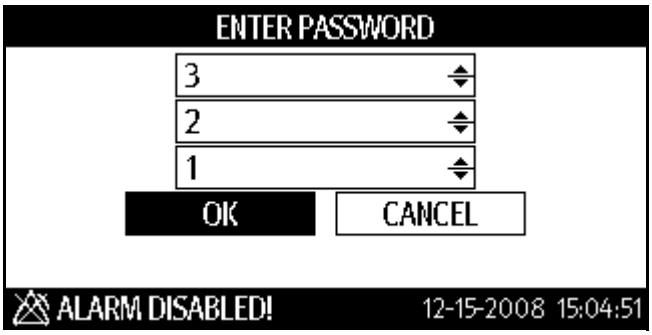


FIGURE 6-4 ENTER PASSWORD dialog

10. In the Enter Password dialog, press OK (18). See FIGURE 6-4.

11. Press ▲ (16) or ▼ (19) to set the first password digit to 3.

12. Press OK (18).

13. Press ▲ (16) or ▼ (19) to highlight the second password digit.

14. Press OK (18).

15. Press ▲ (16) or ▼ (19) to set the second password digit to 2.

16. Press OK (18).

17. Press ▲ (16) or ▼ (19) to highlight the third password digit.

18. Press OK (18).

19. Press ▲ (16) or ▼ (19) to set the third password digit to 1.

20. Press OK (18).

21. Press ▲ (16) or ▼ (19) to highlight **OK**.

22. Press OK (18).

NOTE: **When the NIBP CALIBRATION dialog is first displayed, INFLATE is highlighted, as shown in FIGURE 6-5.**

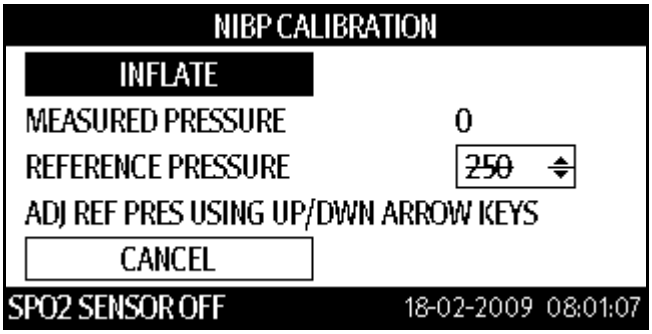


FIGURE 6-5 NIBP CALIBRATION dialog with **INFLATE** highlighted

23. Press OK (18) to start pressurizing the calibration vessel.

NOTE: **Use ▲ (16) or ▼ (19) to highlight CANCEL, then press OK (18) to cancel the calibration.**

NOTE: **After the calibration vessel is pressurized, the reference pressure field is highlighted, as shown in FIGURE 6-6.**

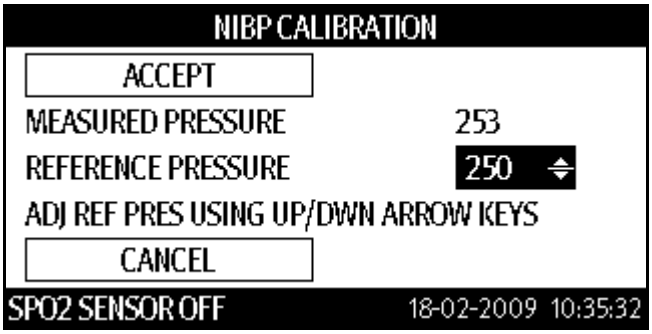


FIGURE 6-6 NIBP CALIBRATION dialog with the reference pressure field highlighted

24. Press the ▲ (16) or ▼ (19) to adjust the reference pressure value in 1 mm increments until it matches the **MEASURED PRESSURE** value.

25. Press OK (18) to set the reference pressure value. After the reference pressure value is set, **ACCEPT** is highlighted, as shown in FIGURE 6-6.

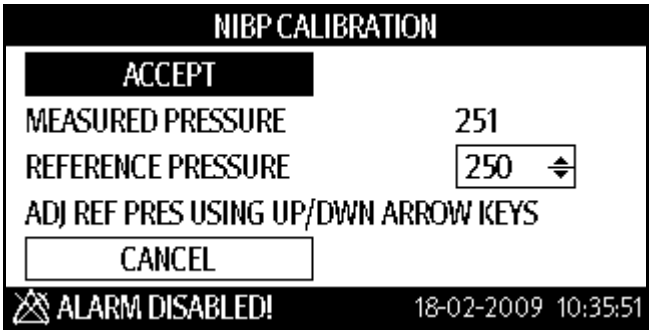


FIGURE 6-7 NIBP CALIBRATION dialog with **ACCEPT** highlighted

26. Press the ▲ (16) or ▼ (19) to select **ACCEPT**.

27. Press OK (18) to accept the calibration.

NOTE: Use ▲ (16) or ▼ (19) to highlight CANCEL, then press OK (18) to cancel the calibration.

The Accutorr V uses the new calibration factor until another calibration sequence is performed.

6.5 NIBP Accuracy Test

Required Tools:

- Two (2) T-Connectors
- Five (5) pieces of tubing
- One (1) Metal Vessel with volume of 500 ±25 ml
- One (1) Reference manometer with accuracy of 1 mmHg
- One (1) Ball Pump

To calibrate NIBP:

1. Attach the calibration vessel, ball pump, and reference manometer as shown in FIGURE 6-8.

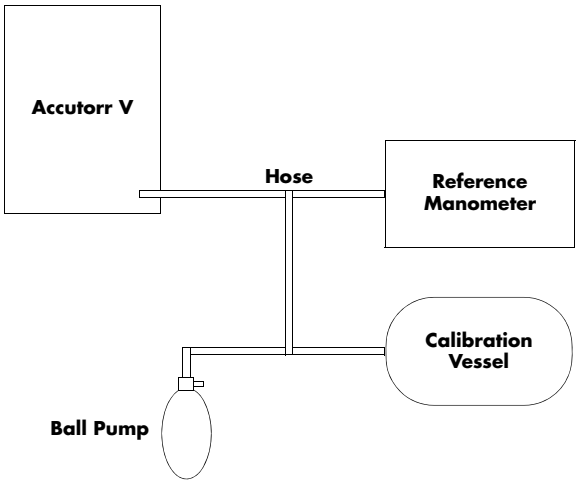


FIGURE 6-8 NIBP accuracy test configuration

2. If needed, press to display the Normal Screen.

3. Press to display the **SYSTEM SETUP** dialog.

4. Press or to highlight **MAINTENANCE**.

5. Once **MAINTENANCE** is highlighted, press OK to display the **MAINTENANCE** dialog.

6. Press or to highlight **NIBP TOOLS**.

7. Once **NIBP TOOLS** is highlighted, press OK to display the **NIBP TOOLS** dialog as shown in FIGURE 6-3.

8. Press or to highlight **ACCURACY TEST**.

9. Once **ACCURACY TEST** is highlighted, press OK to start the **ACCURACY TEST** as shown in FIGURE 6-9.

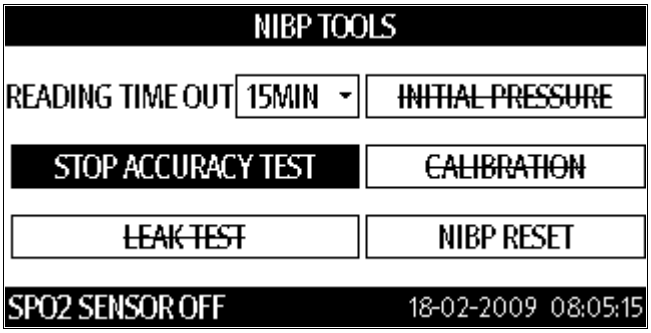


FIGURE 6-9 NIBP TOOLS dialog running the accuracy test

NOTE: **The ACCURACY TEST button changes to STOP ACCURACY TEST. Use ▲ or ▼ to highlight STOP ACCURACY TEST, then press OK to cancel the accuracy test.**

10. Use the ball pump to pressurize the vessel to each of the three different ranges shown in following table.

RANGE	ACCURACY
Low approximately 50 mmHg	±3 mmHg
Medium approximately 150 mmHg	±3 mmHg
High approximately 250 mmHg	±3 mmHg

The pressure value in the **MAP LED** display should match the value shown on the reference manometer within the accuracy for each test range as shown in the table.

11. Use ▲ or ▼ to highlight **STOP ACCURACY TEST**, then press OK to end the accuracy test.

If the accuracy test failed, send the Accutorr V to service for repair.

6.5.1 NIBP Leakage Test

Required Tools:

- One (1) piece of tubing
- One (1) Cylinder
- One (1) Metal Vessel with volume of 500 ±25 ml

To perform the NIBP leakage test:

1. Set Patient size to adult by pressing until Adult is selected. The patient size changes with each key press.

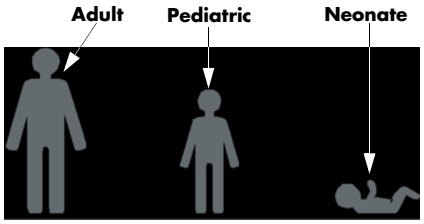


FIGURE 6-10 Patient size graphics and indicators

The Patient size indicator illuminates to indicate the selected size as shown in FIGURE 6-10. The factory default setting for the Patient size is Adult.

2. Connect the metal vessel with the NIBP connector on the Accutorr V monitor.

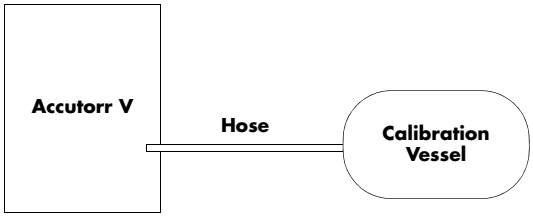


FIGURE 6-11 Leakage test configuration

3. If needed, press [%] to display the Normal Screen.

4. Press [ ] to display the **SYSTEM SETUP** dialog.

5. Press [▲] or [▼] to highlight **MAINTENANCE**.

6. Once **MAINTENANCE** is highlighted, press [OK] to display the **MAINTENANCE** dialog.

7. Press [▲] or [▼] to highlight **NIBP TOOLS**.

8. Once **NIBP TOOLS** is highlighted, press [OK] to display the **NIBP TOOLS** dialog as shown in FIGURE 6-3.

9. Press [▲] or [▼] to highlight **LEAK TEST**.

10. Once **LEAK TEST** is highlighted, press [OK] to start the leak test. The Accutorr V automatically deflates in approximately 60s, and the NIBP leakage test is complete.

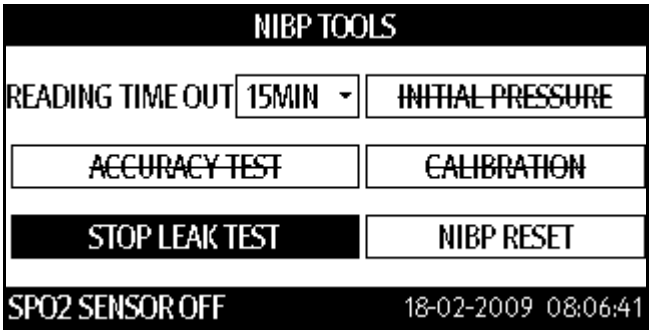


FIGURE 6-12 NIBP TOOLS dialog running the leak test

NOTE: **The LEAK TEST button changes to STOP LEAK TEST. Use ▲ or ▼ to highlight STOP LEAK TEST, then press OK to cancel the leak test.**

11. If the system leaks, the message **PNEUMATIC LEAK** will be displayed in the technical alarm area/prompt area. In this case, check for a loose connection and perform the test again.

NOTE: **If the system does not leak, the Accutorr V does not display a message.**

6.6 SpO_2 Test

NOTE: A functional tester cannot be used to assess the accuracy of a pulse oximeter probe or a pulse oximeter monitor.

Required Tool: SpO_2 simulator.

- For the monitor equipped with DPM SpO_2 module, BIO-TEK Index-2 SpO_2 simulator is recommended.
- For the monitor equipped with Nellcor SpO_2 module, an SRC-MAX SpO_2 simulator is recommended.
- For the monitor equipped with Masimo SpO_2 module, a BIO-TEK Index-2 SpO_2 simulator is recommended.

6.6.1 SpO_2 Test Under Normal Conditions

1. Connect the SpO_2 simulator to the SpO_2 sensor.
2. Select the model and the manufacturer of the SpO_2 module under test, and then configure the SpO_2 simulator as follows: SpO_2 96%; PR 80 bpm.
3. The displayed SpO_2 and PR values should be within the ranges listed below.

6.6.2 SpO_2 Test in Motion Mode

1. Connect the SpO_2 simulator to the SpO_2 sensor.
2. Select the model and the manufacturer of the SpO_2 module under test; take measurement in the motion mode preset by the SpO_2 simulator.
3. The displayed SpO_2 and PR values should be within the ranges listed below.

MANUFACTURER	SPO_2 SENSOR	SPO_2	PR (BPM)
DPM Compatible Sensors	512E, 512G, 512F, 512H, 518B, 520A, 520P, 520I	96%±2%	80±3
	520N	96%±3%	
Masimo Compatible Sensors	LNCS-NeoPt-L, LNCS Neo-L, LNOP DCI, LNOP DCIP, LNOP TCI, LNOP YI-Multisite, LNOP DCSC, LNOP Adt, LNOP Pdt, LNOP II Inf-L, LNOP II Neo-Neonatal L, LNOP NeoPt Preterm Neonatal Y, LNOP II NeoPt Preterm Neonatal Y	96%±3% (without motion) 96%±3% (with motion)	80±3 bpm (without motion) 80±5 bpm (with motion)
	LNCS Inf-L, LNCS-Pdtx, LNCS-Adtx, LNCS DC-I,LNCS DC-I Pt, TC-I	96%±2% (without motion) 96%±3% (with motion)	
Nellcor Compatible Sensors	MAX-A, MAX-P, MAX-I,	96%±2%	80±3 bpm
	DS-100A, OXI-A/N (Adult), OXI-P/I, MAX-N	96%±3%	
	OXI-A/N (Neonate)	96%±4%	

NOTE: **The SpO_2 simulator can only be used to verify that the pulse oximeter operates properly. It cannot be used to verify the accuracy of the pulse oximeter or the SpO_2 sensor. To verify the accuracy, clinical tests are required.**

Contact Technical Support if the SpO_2 test fails.

6.6.3 Summary of Test Methods

6.6.3.1 DPM SpO_2

Measurement validation: The DPM SpO_2 module accuracy has been validated in human studies against arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurements are statistically distributed, and about two-thirds of the measurements can be expected to fall within the specified accuracy compared to CO-oximeter measurements.

6.6.3.2 Nellcor SpO_2

The Nellcor SpO_2 module was tested for accuracy using a simulator.

6.6.3.3 Masimo SpO_2

The Masimo SpO_2 module was tested by Masimo to verify accuracy.

6.7 Testing the Optional Temperature Module

Required Tool: Thermostatic oil tank, HART 7102 recommended

1. Set the temperature of the oil tank to 37° C and conduct the test after the temperature stabilizes.
2. Press ▭ to display the **SYSTEM SETUP** dialog as shown in FIGURE 6-13.

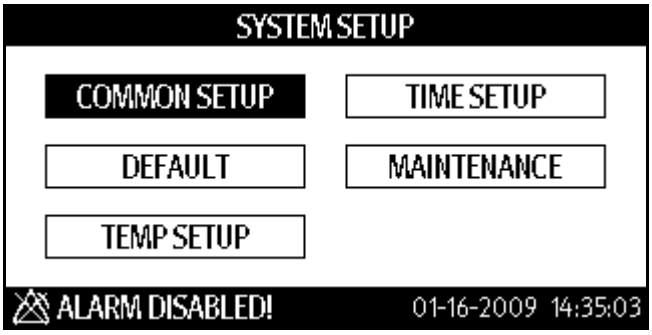


FIGURE 6-13 SYSTEM SETUP dialog

3. Press ▲ or ▼ to highlight **TEMP SETUP**.
4. Once **TEMP SETUP** is highlighted, press OK to display the **TEMP SETUP** dialog as shown in FIGURE 6-14.

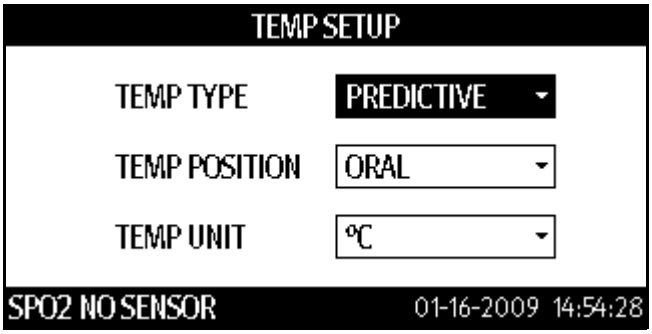


FIGURE 6-14 Example **TEMP SETUP** dialog

5. Press ▲ or ▼ to highlight the **TEMP TYPE** pull-down list.
6. Once the pull-down list is highlighted, press OK to view the selections.
7. Press ▲ or ▼ to change the selection to **MONITOR**.
8. Once MONITOR is highlighted, press OK to set it.
9. Press ▲ or ▼ to highlight the **TEMP UNIT** pull-down list.
10. Once the pull-down list is highlighted, press OK to view the selections.

NOTE: For this test, the monitor and test tank temperature units are in Celsius.

11. Press ▲ or ▼ to change the selection to °C.

12. Once °C is highlighted, press OK to set it.

13. Once the choices are set, press ⎋ to exit the **TEMP SETUP** dialog.

14. Remove the Temperature probe from the probe sheath, insert a probe cover, and place the probe into the oil tank.

15. Wait till the Temp value displayed on the monitor stabilizes. Verify that the displayed value is 37±0.1° C.

Contact Technical Support if the temperature test fails.

6.8 Nurse Call Performance Test

Required Tool: Multimeter

1. Connect the nurse call cable to the analog output connector.
2. If needed, press [ ] to display the Normal Screen.
3. Press [ ] to display the **SYSTEM SETUP** dialog.
4. Press [▲] or [▼] to highlight **MAINTENANCE**.
5. Once **MAINTENANCE** is highlighted, press [OK] to display the **MAINTENANCE** dialog shown in FIGURE 6-2.
6. Press [▲] or [▼] to highlight **NURSE CALL**.
7. Once **NURSE CALL** is highlighted, press [OK] to display the **NURSE CALL SETUP** dialog shown in FIGURE 6-15.

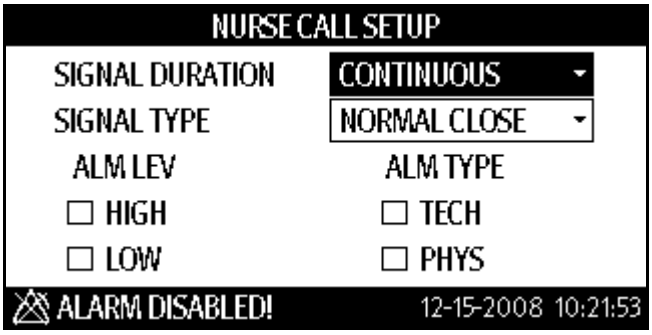


FIGURE 6-15 NURSE CALL SETUP dialog

8. Press [▲] or [▼] to highlight the **SIGNAL DURATION** pull-down list.
9. Once the **SIGNAL DURATION** pull-down list is highlighted, press [OK] to select it.
10. Press [▲] or [▼] to highlight the **PULSE**.
11. Once the **PULSE** is highlighted, press [OK] to select it.
12. Press [▲] or [▼] to highlight the **SIGNAL TYPE** pull-down list.
13. Once the **SIGNAL TYPE** pull-down list is highlighted, press [OK] to select it.
14. Press [▲] or [▼] to highlight the **NORMAL OPEN**.
15. Once the **NORMAL OPEN** is highlighted, press [OK] to select it.
16. Press [▲] or [▼] to highlight either **HIGH** or **LOW** for **ALM LEV**.
17. Once an **ALM LEV** is highlighted, press [OK] to select it.
18. Press [▲] or [▼] to highlight either **TECH** or **PHYS** for **ALM TYPE**.
19. Once an **ALM TYPE** is highlighted, press [OK] to select it.
20. Trigger an alarm and measure the contact output with the multimeter. The output should be square waves with an interval of 1s.

21. Press ▲ or ▼ to highlight the **SIGNAL DURATION** pull-down list.

22. Once the **SIGNAL DURATION** pull-down list is highlighted, press OK to select it.

23. Press ▲ or ▼ to highlight the **CONTINUOUS**.

24. Once the **CONTINUOUS** is highlighted, press OK to select it.

25. In the **NURSE CALL SETUP** dialog, set **SIGNAL TYPE** to **NORMAL OPEN**. Trigger an alarm and measure the contact output with the multimeter. The output should be continuous high level.

Contact Technical Support if the nurse call test fails.

6.9 Bar Code Scanner Test

Required Tool: None

1. Connect the barcode reader to the RS-232 connector on the back of the Accutorr V.
2. Press [ ] to display the **SYSTEM SETUP** dialog FIGURE 6-13.
3. Press [▲] or [▼] to select **MAINTENANCE**.
4. Once **MAINTENANCE** is highlighted, press [OK] to display the **MAINTENANCE** dialog as shown in FIGURE 6-16.

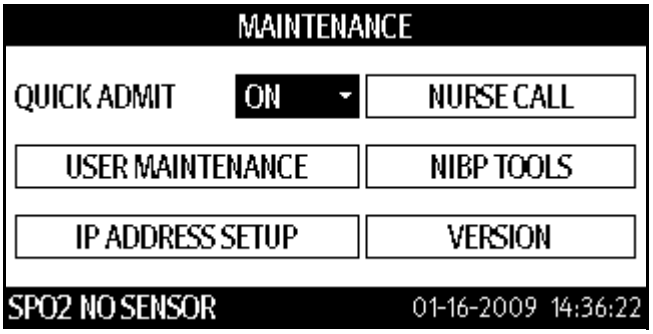


FIGURE 6-16 MAINTENANCE dialog

5. Press [▲] or [▼] to select **USER MAINTENANCE**.
6. Once **USER MAINTENANCE** is highlighted, press [OK] to display the Enter Password dialog, as shown in FIGURE 6-17.

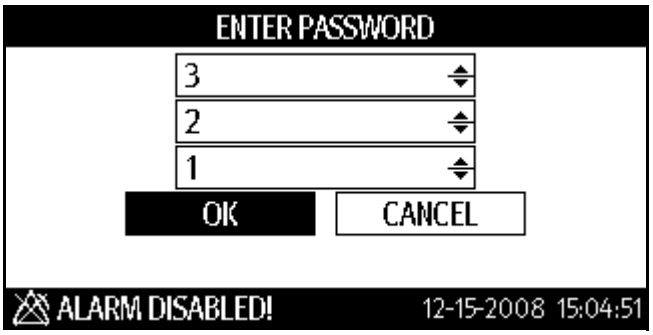


FIGURE 6-17 ENTER PASSWORD dialog

7. In the Enter Password dialog, press [OK].
8. Enter the password 321 to display the **USER MAINTENANCE** dialog as shown in FIGURE 6-18. See Section 6.4, steps 10 – 22 for the password procedure.

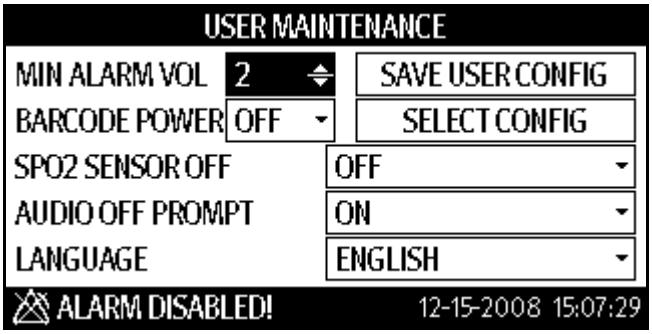


FIGURE 6-18 Example **USER MAINTENANCE** dialog

9. Press ▲ or ▼ to highlight the **BARCODE POWER** selection field.

10. Once the selection field is highlighted, press OK select it.

11. Press ▲ or ▼ to select **ON**.

12. Once the selection is highlighted, press OK select it.

NOTE: **When the RS-232 connector is used for DIAP, barcode power must be set to OFF.**

13. Aim the bar code scanner at the target bar code. Adjust the field of view to capture the bar code.

14. Hold the trigger until the bar code scanner beeps, indicating the bar code is successfully decoded. The indication lamp turns green and scanned characters are displayed on the monitor.

Contact Technical Support if the bar code scanner does not work as described.

6.10 Electrical Safety Tests

WARNING: Electrical safety tests are a proven means of verifying the electrical safety of the monitor. They are intended for determining potential electrical hazards. Failure to identify these hazards in a timely manner may cause personnel injury.

WARNING: Commercially available test equipment such as a safety analyzer can be used for electrical safety tests. Verify that the test equipment can be safely and reliably used with the monitor before use. The service personnel should acquaint themselves with the use of the test equipment.

WARNING: Electrical safety tests should meet the requirements of the latest editions of EN 60601-1 and UL 60601.

WARNING: These electrical safety tests do not supersede local requirements.

WARNING: All devices using the AC mains and connected to medical equipment within patient environments must meet the requirements of the IEC 60601-1-1 medical electrical systems standard and should be put under electrical safety tests at the frequency recommended for the monitor.

Electrical safety tests are intended to check the potential electrical hazards to the patient, operator, or service personnel. Electrical safety tests should be performed under normal ambient conditions of temperature, humidity, and atmospheric pressure.

The electrical safety test plan described here uses the 601 safety analyzer. Different safety analyzers may be used. Choose an applicable safety analyzer and test plan.

6.10.1 Enclosure Leakage Current Test

1. Connect the 601 safety analyzer to an AC power supply.
2. Connect SUM terminal of the applied part connection apparatus to RA input terminal of 601 safety analyzer, another terminal to the applied part of EUT.
3. Connect the EUT to the 601 analyzer's auxiliary output connector by using a power cord.
4. Attach on end of the red lead to the red input terminal of the analyzer, and the other end to tinsel over the enclosure of the EUT.
5. Power on the 601 safety analyzer and then press the "5-Enclosure leakage" button on the analyzer's panel to enter the enclosure leakage test screen.
   - Under normal condition, the enclosure leakage current should be no greater than 100μA.
   - Under single fault condition, the leakage current should be no greater than 300μA.

6.10.2 Earth Leakage Current Test

1. Connect the 601 safety analyzer to an AC power supply.
2. Connect the SUM terminal of the applied part connection apparatus to RA input terminal of 601 safety analyzer, another terminal to the applied part of EUT.

3. Connect the EUT to the 601 analyzer's auxiliary output connector by using a power cord.
4. Power on the 601 safety analyzer and then press the "4-Earth leakage" button on the analyzer's panel to enter the earth leakage test screen.
   - Under normal condition, the earth leakage current should be no greater than 300μA.
   - Under single fault condition, the leakage current should be no greater than 1000 μA.

6.10.3 Patient Leakage Current Test

1. Connect the 601 safety analyzer to an AC source.
2. Connect the SUM terminal of the applied part connection apparatus to RA input terminal of 601 safety analyzer, another terminal to the applied part of EUT.
3. Connect the EUT to the 601 analyzer's auxiliary output connector by using a power cord.
4. Power on the 601 safety analyzer and then press the "6-Patient leakage" on the 601 analyzer's panel.
5. Repeatedly press the "APPLIED PART" button to measure AC and DC leakage alternatively. DC leakage reading is followed by "DC".
   - Under normal status, the patient leakage current should be no greater than 100μA AC, 10μA DC.
   - Under single fault condition, the leakage current should be no greater than 500μA AC, 50μA DC.

6.10.4 Patient Auxiliary Leakage Current Test

1. Connect the 601 safety analyzer to an AC source.
2. Connect the equipment under test (EUT) to the analyzer's auxiliary output connector by using a power cord.
3. Connect the sensors of the applied part to the applied part connection apparatus, whose RA-P terminal is connected to 601 safety analyzer's RA terminal and SUM terminal to 601 safety analyzer's LA terminal. RA terminal is switched on.
4. Power on the 601 safety analyzer and then press the "8-Patient Auxiliary Current Test" button on the analyzer's panel to enter the patient auxiliary current test screen.
5. Repeatedly press the "APPLIED PART" button to measure AC and DC leakage alternatively. DC leakage reading is followed by "DC".
   - Under normal status, the patient leakage current should be no greater than 100μA AC, 10μA DC.
   - Under single fault condition, the leakage current should be no greater than 500μA AC, 50μA DC.

Contact Technical Support if the electrical safety test fails.

6.11 Recorder Check

1. Print SpO_2 Pleth waveforms. The recorder should print correctly and printout should be clear.
2. Open the recorder door and verify the monitor gives the proper message. Close recorder door before proceeding to the next step.
3. Set the recorder to print trend data. Check that the recorder prints accordingly.

Contact Technical Support if the recorder test fails.

6.12 Software upgrade

CAUTION: Disconnect the monitor from the patient and make sure that important data is saved before upgrading the monitor.

CAUTION: Do not shut down or power off the equipment when upgrading the bootstrap program. Otherwise, it may cause the equipment to break down.

CAUTION: Program upgrades should be performed by qualified service personnel only.

NOTE: After upgrading the boot program, re-upgrade the system program and other programs to ensure compatibility.

NOTE: Make sure the version of the upgrade package is the correct one. To obtain the latest upgrade package, contact Service.

The following is a list of upgrade programs:

- Bootstrap program
- System program
- Bar code recognition configuration
- Multilingual library
- General configurations (including passwords, company logo)
- System functional configuration
- FPGA program
- Parameter module programs: SpO_2 module (DPM), NIBP module and optional Temperature module.

1. In the **MAINTENANCE** dialog (see FIGURE 6-19), check the installed software version and compare it with the currently released version to determine if an upgrade is needed.

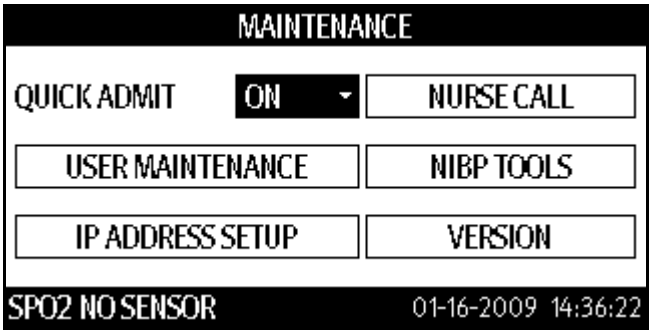


FIGURE 6-19 MAINTENANCE dialog

2. Download the upgrade software through a network to a portable PC or desktop PC. Connect the PC to the monitor using a cable plugged into the network connectors.

3. Run the upgrade software.

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