EAGLE 4000
patient monitor

FIELD SERVICE MANUAL

marquette
Medical Systems

NOTE
The procedures in this manual reflect software version 6.

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HOW TO REACH US ...

TELEPHONE NUMBERS AND ADDRESSES

The following are telephone numbers and addresses for contacting various Marquette Electronics Service and Supplies Division departments.

ORDERING SUPPLY ITEMS

Supply items are generally items used during normal operation of a product. Leadwires, electrode paste, patient cables, and printer paper are examples of supply items.

Make telephone inquiries about supply items at:

1-800-558-5102 (U.S. only),

1-407-575-5000 (outside the U.S.), or

1-407-575-5050 (fax).

Address orders or inquiries to:

Attn: Supplies Department
Marquette Electronics Service & Supplies Division
P.O. Box 9100
100 Marquette Drive
Jupiter, FL 33468-9100

ORDERING SERVICE PARTS

Service parts are items that are not expended in the normal operation of the product. They are generally replacements for defective or malfunctioning items inside the product. Service parts include PCB assemblies, electronic components, internal cables and harnesses, software or firmware, and operator and service manuals. When ordering additional operator manuals, remember to notate the software version from the start-up screen.

A part number for the item to be replaced is necessary for ordering a service part. If the part number for the desired item is unobtainable, the following will be necessary to order the item:

- model and serial number of the equipment,
- part number/name of the assembly where the item is used,
- item name, and
- where applicable, reference designation (ex., R3, S1, U32).

SERVICE CALLS

To open a service call with Marquette Electronics Service Department, contact Service Dispatch at:

1-800-558-7044 (U.S. only), or

1-407-575-5000 (outside the U.S.).

SERVICE MAINTENANCE AGREEMENTS

For questions regarding service maintenance agreements, contact the service and supplies division at:

1-800-552-3248, or

1-407-575-5000 ext. 4206.

HOW TO REACH US ... (CONT)

TECHNICAL SUPPORT

Technical Support has the most current information about your equipment and can provide assistance with any technical questions or problems.

For All Hardware

For technical advice concerning any equipment in your Marquette Electronics monitoring system, contact Tech Support—Monitoring Hardware at:

1-800-558-7822, or

(407) 575-5000 ext. 4216.

Telemetry

For technical advice concerning your Telemetry system, contact Tech Support—Telemetry at:

1-800-552-3243, or

(407) 575-5000 ext. 4202.

Series 7000/7010

For technical advice concerning Series 3000, 7000/7010 patient monitoring equipment, contact Tech Support:

1-800-443-0980, or

(407) 575-5000 ext. 4217.

48-Hour Turnaround Repair

Some Marquette products (Input Modules, Tram modules, Series 7700 ECG Telemetry Transmitters, and CD Telemetry Transmitters) are repaired on a 48-hour turnaround basis.

To inquire about status of 48-hour turnaround repair items, or if you have questions before shipping an assembly to be repaired, call:

1-800-552-3243, or

(407) 575-5000.

Service Address

Send items for 48-hour repair and all monitoring repair items to:

Attn: Monitoring Repair
Marquette Electronics Service and Supplies
P.O. Box 9100
100 Marquette Drive
Jupiter, FL 33468-9100

MAIN SWITCHBOARD

The main switchboard operator will direct your call to the person most able to assist you. For any other questions or problems, contact the main switchboard operator at:

1-800-558-5120, or

(407) 575-5000.

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1 EQUIPMENT OVERVIEW

PRODUCT DESCRIPTION

ABOUT THE MONITOR

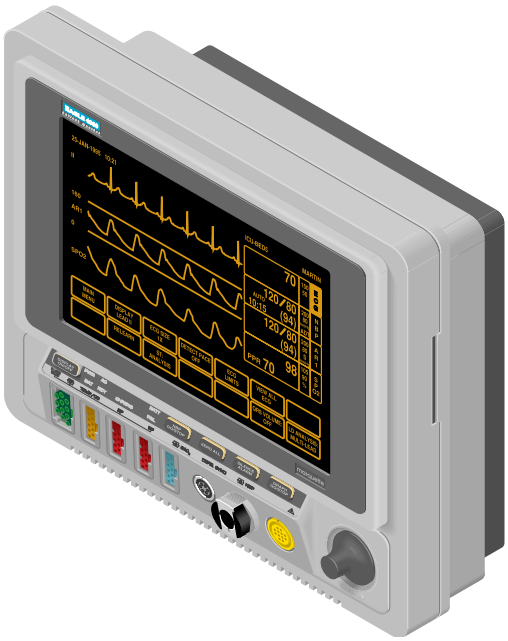
The monitor is a compact, self-contained patient monitor incorporating many advanced features previously found only in complete modular systems.

Compact design

Measuring a compact 12.8 x 12.5 x 5.6 inches, and weighing just under 18 pounds, the monitor is thin and unobtrusive enough for locations previously considered impractical. The display is an impressive 10.4 inches with exceptional visibility.

Multi-lead ST and arrhythmia monitoring

This full-featured vital signs monitor offers various software and hardware options which allow it to be configured to meet the needs of specific care units. The basic monitor includes multi-lead ECG, respiration, two temperatures (or cardiac output), two invasive blood pressures and pulse oximetry.



The monitor meets the needs of a variety of care areas from subacute to acute incorporating additional monitoring features such as: simultaneous multi-lead arrhythmia analysis, multi-lead arrhythmia event recall, enhanced multi-lead ST segment measurement capabilities, thermodilution cardiac output determination with cardiac indices calculation, pulmonary and dosage calculations, non-invasive blood pressure, end-tidal carbon dioxide and more.

Network compatible

The monitor can be part of a patient monitoring network, an open architecture, systems integration platform designed to improve the efficiency and effectiveness of health care delivery, permitting viewing of remote bed information and much more.

Easy to use

From software designed for specific care areas to the monitor's unique Trim Knob® control, the monitor was designed to be as easy to use as it is comprehensive. The Mentor™ user support system provides on-screen prompts and instructions as well as answers to operational questions to assist novice users.

MARQUETTE UNITY NETWORK

MONITOR APPLICATION

The Marquette Unity Network (hereafter referred to as the network) provides a method for standardized communication with various Marquette medical systems devices. This versatile monitor can operate both as a fully functional stand-alone device and as a component on the network, depending upon the application.

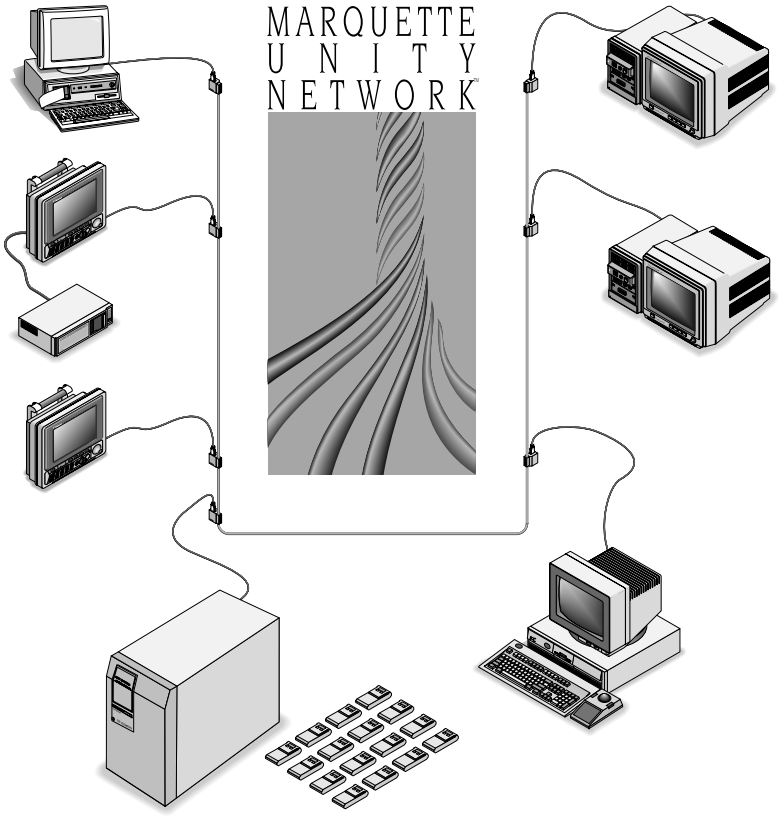
PATIENT MONITORING SYSTEM APPLICATION

When connected to the network, the monitor provides access to other devices for many purposes. Marquette patient monitoring equipment such as Centralscope central station monitor; Series 7200/7260 direct digital writer; CDT-LAN patient telemetry system; ADU/Pager-LAN; and, Solar or other Eagle patient monitors are examples of devices that can be used in conjunction with the monitor when connected to the network.

HOSPITAL-WIDE NETWORK APPLICATION

There are various types of information management and data base systems devices which may also be integrated with the monitor via connection to the network. Marquette medical systems equipment such as MUSE cardiology management system; MARS UNITY workstation; MARS 24 clinical review station; MRT II automated vital sign and arrhythmia data collection system; MAC-Lab cardiac catheterization system; QMI patient data management system; and, MUSE HIS interface are examples of systems and data bases which can be integrated with the monitor on the network.

Patient monitoring system application

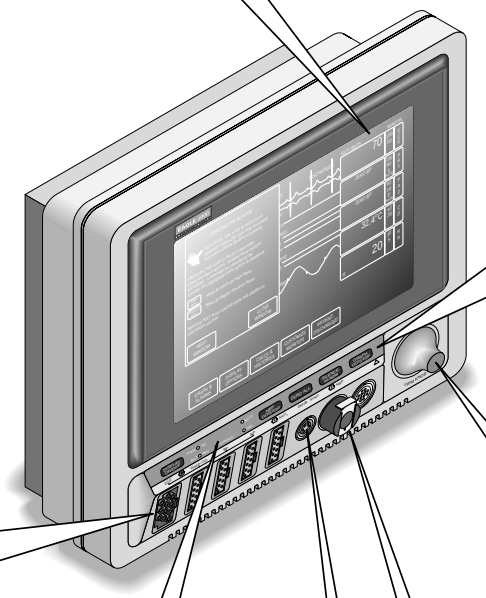


FRONT PANEL CONTROLS/CONNECTORS

NOTE

To insure patient safety, use only parts and accessories manufactured or recommended by the manufacturer. Parts and accessories used must meet the requirements of the applicable IEC 601 series safety standards, and/or the system configuration must meet the requirements of the IEC 601-1-1 medical electrical systems standard.

Display: Two types are available:
Monochrome —
Hi-bright electroluminescent (EL) display panel.
Color —
Active matrix thin film transistor (TFT) LCD panel.
Screen size —
10.4-inch diagonal
Resolution —
640 x 480 pixels



Front Panel Controls: Five backlit pushbutton operator controls provide the following functions:

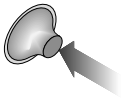
- **DISPLAY ON/OFF** — When operating on ac power, controls only display power. When operating on battery power, controls overall monitor power.
- **NBP GO/STOP** — Manually starts or stops the noninvasive blood pressure function.
- **ZERO ALL** — Sets zero references for all invasive blood pressure functions.
- **SILENCE ALARM** — Controls patient alarm silencing functions.
- **GRAPH GO/STOP** — Manually starts or stops graphs to selected writers. Manually stops alarm graphs.

Patient Input Connectors: Used to attach patient cables for various electrodes, sensors and transducers used in patient signal acquisition

Trim Knob Control: This is the control that is used most often to choose menu items and enter data.

Rotate the Trim Knob control to highlight an item on the display.

Press the Trim Knob control to select the highlighted item.



NBP Connector: A pneumatic connector for attaching a noninvasive blood pressure cuff to the monitor.

Indicators: Five LED's indicate the following power related conditions of the monitor:

PWR-AC: Monitor is operating on ac power

PWR-BATT: Monitor is operating on battery power

BATT-RDY: The battery is fully charged — monitor is ready for battery powered use

BATT-CHRGNG: The battery is charging — the monitor is not ready for battery powered use

BATT-FAIL: The battery has failed and requires maintenance

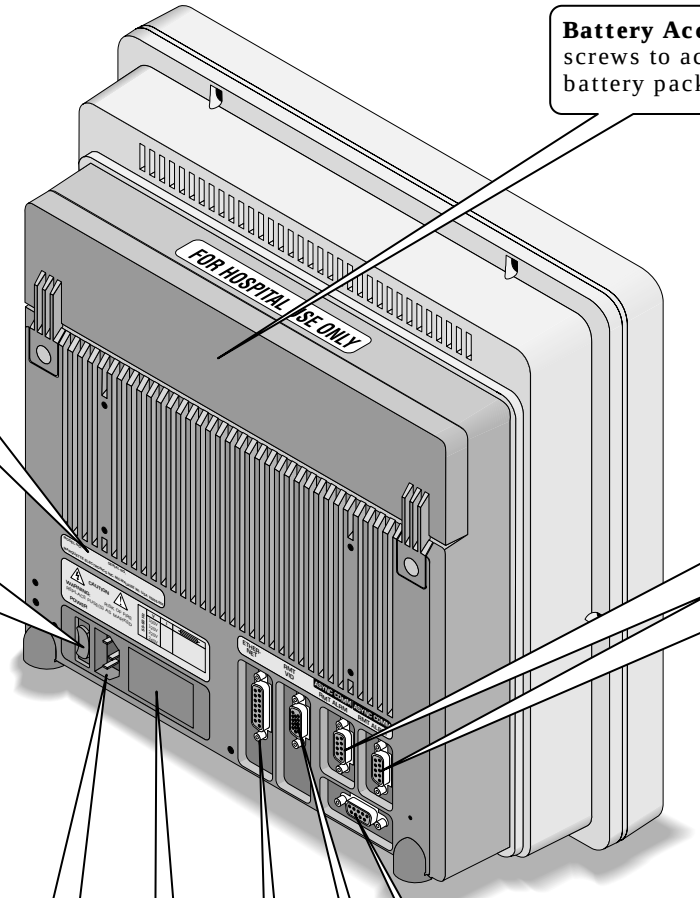
DEFIB SYNC: This front panel jack provides a direct interface between the monitor and a defibrillator for synchonization of the two devices during emergency defibrillation or for synchronized cardioversion. The signals available through this connector are:
Outputs —
- Defib sync pulse
- Analog ECG signal
- Analog invasive BP signal

Input —
- Defibrillator triggered marker pulse

REAR PANEL CONTROLS/CONNECTORS

NOTE

The use of ACCESSORY equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system. Consideration relating to the choice shall include: use of the accessory in the PATIENT VICINITY; and evidence that the safety certification of the ACCESSORY has been performed in accordance to the appropriate IEC 601-1 and/or IEC 601-1-1 harmonized national standard.



Battery Access Cover: Remove two screws to access the optional Ni-Cad battery pack located under this cover.

Serial Number Label: Describes the type of equipment, date and sequence of product manufacture for each monitor.

Main Power Switch: Selects ac or battery power. When in the on (I) position, the monitor operates on ac power and battery charging is enabled. When in the off (0) position, the monitor operates on battery power controlled by the DISPLAY ON/OFF pushbutton switch located on the front panel.

ASYNC COMM Connectors (2): These ports can be used for interconnection to remote controls, direct digital writers and other devices

Main Power: A power cord connected between this port and a wall receptacle is used for ac main power operation of the monitor.

Fuse/Voltage Selector Cover: Main power fuses and the voltage selector for the monitor are located behind this cover. The label above the cover shows the correct ratings for replacement fuses.

REMOTE ALARM Connector: This 9-pin "D" connector provides interconnection to the Marquette/Hellige Isolation Relay for a nurse-call light system. The following alarms will trigger these outputs:

- CRISIS Patient Status Alarms, and
- WARNING System Status Alarms.

ETHERNET Connector: An IEEE 802.3 AUI cable and transceiver can be connected to this port for monitors used in patient monitoring network configurations.

RMT VID (remote video) Connector: *For monitors with color displays only*, an external display monitor can be connected to this port for viewing patient information from a remote location.

REAR PANEL CONTROLS/CONNECTORS (CONT)

ABOUT THE REMOTE ALARM CONNECTOR

The remote alarm connector (REMOTE ALARM) is for use with the Marquette/Hellige Isolation Relay, pn 303 444 77 (non-U.S.) and pn 303 445 50 (U.S.). This accessory provides a relay closure when either of the following alarms occur:

- CRISIS (Patient Status Alarm), and/or
- WARNING (System Status Alarm).

How the system works

The signals from the REMOTE ALARM connector activate and deactivate the isolation relay. When the monitor is initially powered up or rebooted, the relay remains deactivated until the monitor completes its power-up or reboot sequence. Once the monitor successfully completes this sequence, the relay is then activated.

If either of the above listed alarms occurs, the relay is deactivated by the monitor. This causes the nurse call system to notify personnel that an alarm situation exists at the monitor. When the alarm has been cleared, the relay is activated. This causes the nurse call system to notify personnel the alarm situation has been cleared.

The relay is deactivated when AC power is removed from the monitor.

PERFORMANCE SPECIFICATIONS

DISPLAY

Size:	10.4-inch diagonal
Type:	
Monochrome:	Hi-Bright Electroluminescent (EL)
Color:	Thin-Film Transistor (TFT) Liquid Crystal Display (LCD)
Resolution:	640 by 480 pixels
Number of traces:	6
Number of seconds/trace:	6.0 at 25 mm/sec
Sweep speed:	
All waveforms except $EtCO_2$:	25 mm/sec (with erase bar)
$EtCO_2$:	6.25, 12.5 or 25 mm/sec (with erase bar)
Waveform display options:	Full or individual
Information window:	Displays non-real-time information without obstructing the display of real-time information
Display organization:	Prioritized by parameter

CONTROLS

Standard:	Trim Knob control plus 4 hard keys: Silence Alarm, Graph Go/Stop, Zero All, and Display On/Off

PROCESSING

Main processor:	MC68332 32-bit integrated microcontroller (19.968 MHz)
Data acquisition processor:	MC68332 32-bit integrated microcontroller (15.72 MHz)
Graphics processor:	TMS34010 32-bit graphics system processor (50 MHz)
Program storage:	4-MB flash memory
Data storage:	2-MB RAM (battery backed-up)

ALARMS

Classification:	4 levels — Crisis, Warning, Advisory, and Message
Notification:	Audible and visual
Setting:	Default and individual
Silencing:	1 minute, current alarm only
Volume:	Default 70%, 70 dB measured at 1 meter

PERFORMANCE SPECIFICATIONS (CONT)

ECG

Standard leads available:	I, II, III, V, aVR, aVL, and aVF
(Optional) 12SL leads available:	V2, V3, V4, V5 and V6
Leads analyzed simultaneously:	I, II, III, and V (multi-lead mode)
Lead fail:	Identifies failed lead
Alarms:	User selectable upper and lower heart rate limits

Input specifications:

Voltage range:	±0.5 mV to ±5 mV
Signal width:	40 ms to 120 ms (Q to S)
Heart rate range:	30 to 300 BPM
Input impedance:	
Common mode:	>10 MΩ at 50/60 Hz
Differential:	>2.5 MΩ from dc to 60 Hz

Output specifications:

Frequency response:	
Display:	
Diagnostic:	0.05 to 120 Hz
Monitoring:	0.05 to 40 Hz
Moderate:	0.05 to 25 Hz
Maximum:	5 to 25 Hz
DDW:	
Diagnostic:	0.05 to 120 Hz
Monitoring:	0.05 to 40 Hz
Moderate:	0.05 to 25 Hz
Maximum:	0.05 to 25 Hz
Common mode rejection:	90 dB minimum at 50 Hz or 60 Hz
Gain:	1000 ±3%
Linearity deviation:	±3%
Noise:	<30 µV RTI (referred to input)

Pacemaker detection/rejection:

Input voltage range:	±2 mV to ±700 mV
Input pulse width:	0.1 ms to 2 ms
Rise time:	10 µs to 100 µs
Over/under shoot:	2 mV (max)
Baseline drift:	<0.5 mV/hour with a ±700-mV, 2-ms pacemaker pulse applied

RESPIRATION

Measurement technique:	Impedance variation detection
Range:	
Respiration rate:	1 - 200 breaths per minute
Base impedance:	100 - 1000 Ω at 52.6 kHz excitation frequency
Detection sensitivity:	0.4 to 10 Ω variation
Waveform display bandwidth:	0.1 to 1.8 Hz (–3 dB)

Alarms: User-selectable upper and lower respiration rate limits, and user-selectable apnea limit

PERFORMANCE SPECIFICATIONS (CONT)

TEMPERATURE (TEMP)

Number of channels: 2

Input specifications:
- Probe type: YSI Series 400 or 700 thermistor (determined by input cable)
- Temperature range: 0°C to 45°C (32°F to 113°F)
- Resolution: ±0.1°C

Output specifications:
- Parameters displayed: T1, T2
- Gain: 121.95 ±1%
- Linearity: <1% from 30°C to 42°C
- dc drift: <1 mV/°C
- Error: (independent of source) ±0.1°C for YSI series 400 probes; ±0.3°C for YSI series 700 probes
- Noise: <20 mV from dc to 100 Hz
- Alarms: User-selectable upper and lower limits for T1, T2

CARDIAC OUTPUT (CO)

Availability: Included in 7020, 7025, and 7030 software packages. Not available in 7015 software package.

Input specifications:
- Probe type: In-line or bath probe
- Catheter size: 5F, 6F, 7F, 7.5F, and 8F
- Injectate volume: 3, 5, or 10 cc

Output specifications:
- Parameters displayed: Cardiac output, blood temperature, injectate temperature, trial number
- Range:
  - Cardiac output: 0.2 - 15 liters per minute
  - Blood temperature: 30 - 42°C
  - Injectate temperature: 0 - 30°C
- Noise: <20 mV from dc to 100 Hz

Accuracy:
- Cardiac output: ±5% (liters of blood/min)
- Blood temperature: ±0.2°C
- Injectate temperature: ±0.3°C

Frequency response: dc to 15 Hz ±2 Hz
- Noise: <20 mV from dc to 100 Hz

PERFORMANCE SPECIFICATIONS (CONT)

INVASIVE BLOOD PRESSURE (BP)

Number of channels:	2
Transducer sites:	Arterial (ART), femoral artery (FEM), pulmonary artery (PA), central venous (CVP), right atrial (RA), left atrial (LA), intracranial (ICP), and special (SP)
Transducer requirements:	
Excitation voltage:	±2.5 V_{dc} ±0.1%
Transducer output:	50 µV/V/cm Hg
Input specifications:	
Range:	–25 mmHg to 300 mmHg
Offset:	±150 mmHg
Input impedance:	
Common mode:	>100 kΩ at 50/60 Hz
Differential:	>100 kΩ from dc to 60 Hz
Output specifications:	
Gain:	976 ±1%
Frequency response:	dc to 50 Hz (+0/-3 dB)
Gain stability:	< ±0.1%/°C, and < ±0.1% over any 24 hour period
Zero balance range:	±150 mmHg
Zero balance accuracy:	±1 mmHg
Zero balance drift:	±1 mmHg over 24 hours
Common mode rejection:	>60 dB at 60 Hz
Noise:	<5 mV_{p-p} from dc to 30 Hz
Accuracy:	±2% or ±1 mmHg, whichever is greater (exclusive of transducer)
Alarms:	User-selectable upper and lower limits for systolic, diastolic, and mean pressures

PULSE OXIMETRY (SpO_2)

Parameters monitored:	Arterial oxygen saturation (SpO_2) and peripheral pulse rate (PPR)
SpO_2 range:	50 - 100%
PPR range:	20 - 250 beats per minute (±3 beats per minute)
Accuracy	Actual accuracy depends on probe. Please reference manufacturer's specifications.
SpO_2:	± 2% (70 - 100% SpO_2) ±1 standard deviation ± 3% (50 - 69% SpO_2) ±1 standard deviation
PPR	± 3 beats per minute
Alarms:	User-selectable upper and lower limits for SpO_2 and PPR

PERFORMANCE SPECIFICATIONS (CONT)

NON-INVASIVE BLOOD PRESSURE (NBP)

Measurement technique:	Oscillometric
Displayed parameters:	Systolic, diastolic, and mean pressures, pulse rate, time of last measurement
Measurement modes:	Manual, auto, and stat
Heart rate detection:	30 to 300 beats per minute
Total cycle time:	20 to 40 seconds typical (dependent on heart rate and motion artifact)
Automatic cycle times:	0 to 24 hours
Auto zero:	Zero pressure reference prior to each cuff inflation
Tubing length:	
Adult:	12 feet
Neonatal:	8 feet
Automatic cuff deflation:	Cycle time exceeding 3 minutes (90 seconds neonatal), power off, or cuff pressure exceeds 300 mmHg (+10%) adult, 150 mmHg (+10%) neonatal
Cuff sizes:	
Disposable:	Large adult, adult, small adult, pediatric, small pediatric, and infant
Reusable:	Thigh, large adult, adult, child, and infant
Alarms:	User-selectable upper and lower limits for systolic, diastolic, and mean pressures

PERFORMANCE SPECIFICATIONS (CONT)

END-TIDAL CARBON DIOXIDE ($ETCO_2$)

Information displayed:	Inspired and expired carbon dioxide measurement, respiration rate measurement.
Measurement technique:	Non-dispersive infrared absorption, dual wavelength ratiometric.
Sensor type:	Novametrix Medical Systems' Capnostat III
Patient interface:	Compatible with Novametrix Medical Systems' Capnogard monitoring product.

Airway adaptor specifications:

Airway adaptor types:	Adult reusable (standard), adult disposable, neonatal
Airway adaptor dead space/chamber volumes:	
Adult reusable:	<5 cc
Adult disposable:	<5 cc
Neonatal:	<0.5 cc

CO_2 measurement specifications:

Measurement range:	
Pi CO2/Fi CO2:	0 to 100 Torr/0 to 13%
Pe CO2/Fe CO2:	0 to 100 Torr/0 to 13%
RR:	0 to 120 breaths/min
Accuracy:	±2 mmHg or 5%, whichever is greater.
Display update interval:	2 sec
CO_2 averaging:	Selectable from single breath, 10 seconds, or 20 seconds.
CO_2 measurement stability:	Accuracy maintained over 8 hours.
Resolution:	1 mmHg
Noise:	0.5 mmHg or 2% (maximum), whichever is greater, measured over a 10 second period.
Repeatability:	±1 mmHg or ±2.5% (maximum), whichever is greater.
Step response time:	
Mainstream adult:	<60 ms (10-90%)
Mainstream neonate	<50 ms (10-90%)
Interference:	
N_2O gas:	±2 mmHg or ±5% (maximum), whichever is greater, with N_2O compensation enabled.
O_2 gas:	±2 mmHg or ±5% (maximum), whichever is greater, with O_2 compensation enabled.
Barometric pressure:	±2 mmHg (maximum) from 500 to 800 mmHg, with barometric pressure compensation enabled.
Water vapor:	±0.5 mmHg or 1.5% (maximum), whichever is greater.
Anesthetic agent:	±0.5 mmHg (maximum) for concentration of no more than 5% of halogenated agents.
Airway adaptor variability:	±1.5 mmHg or 3% (maximum), whichever is greater, with same or different adaptor; not applicable after adaptor zero.
Warm-up time:	Less than 15 seconds to initial CO_2 indication, full specification within 120 seconds; waveform immediate upon power up.
Calibration:	
Factory settings:	Factory calibration settings stored in nonvolatile memory within the sensor; 15 second adaptor calibration when switching airway types.
Verification:	Zero and span performance check with on-cable verifier.
CO_2 sweep speed:	Selectable 6.25, 12.5, or 25 mm/sec

PERFORMANCE SPECIFICATIONS (CONT)

Respiration rate specifications:

Range (for 5% step size):	0-120 breaths per minute
Accuracy:	±1 breath per minute
Resolution:	±1 breath per minute

Barometric pressure sensor specifications:

Range:	530-785 mmHg
Accuracy:	±7 mmHg
Calibration:	Calibrated at factory; user calibration in service menu.

Capnostat III sensor specifications:

Operating temperature:	10° to 40° C (50° to 104° F)
Storage temperature:	-30° to 65° C (-22° to 149° F)
Humidity:	5 to 95%, relative humidity, non-condensing.
Barometric pressure:	500 to 800 mmHg
Shock resistance:	Able to withstand 6 ft. drop to tile floor.
Moisture resistance:	Splash resistant sealed transducer

Cleaning and sterilization:

Sensor:	Transducer, cable and verifier may be wiped with cold chemical disinfectant; no steam sterilization or EtO gas permitted; fluid immersion not recommended.
Adult reusable airway adaptor:	Disinfect with buffered glutaraldehyde, EtO gas, isopropyl alcohol, household bleach; also steam sterilizable and pasteurizable.
ESD susceptibility:	No damage to the sensor from electrostatic discharge of 0.01 J at up to 15 kV, applied to sensor connector pins.
60 Hz interference:	<0.5 mmHg at 38 mmHg
Alarms:	Selectable upper and lower limits for CO_2 and RR.

PERFORMANCE SPECIFICATIONS (CONT)

ANALOG OUTPUT

ECG:

Gain:	1 V/mV ±10%
DC offset:	±100 mV (max)
Noise:	<5 mV_{p-p} (0-300 Hz)
Frequency response:	0.05 Hz to 100 Hz +7/–0 Hz

Blood pressure:

Gain:	10 mV/mmHg ±2%
DC offset:	±20 mV (max)
Noise:	<5 mV_{p-p} (0-300 Hz)
Frequency response:	dc to 50 Hz +2/–0 Hz

DEFIBRILLATOR SYNCHRONIZATION PULSE

Marker out:

Time delay:	35 ms (maximum), R-wave peak to leading edge of pulse.
Amplitude (selectable via internal DIP switch):	
+5 V selection:	3.5 V (min) at 1 mA sourcing; 0.5 V (max) at 5 mA sinking.
+12 V selection:	11.0 V (min) at 1 mA sourcing; 0.75 V (max) at 5 mA sinking.
Pulse width:	10 ms ±10% or 100 ms ±10% in service menu (selectable via internal DIP switch).
Output impedance:	50 Ω nominal
Current limit:	15 mA nominal, both sourcing and sinking.

Marker in:

Input threshold:	VIH = ±2.5 V (min); VIL - ±1.5 V (max)
Input hysteresis:	650 mV typical
Maximum input voltage:	±30 V (with respect to ground on pin 2)
Input impedance:	10 kΩ (min) for -25 V < V_{in} < 25 V
Pulse width:	1.0 ms (min), V_{in} > 2.5 V

PERFORMANCE SPECIFICATIONS (CONT)

ENVIRONMENTAL SPECIFICATIONS

Power requirements:	
AC voltage selections:	
100 V_{ac} ±10%	1.5 A
120 V_{ac} ±10%	1.4 A
220 - 230 V_{ac} ±10%	800 mA
240 V_{ac} ±10%	700 mA
Power consumption:	<50 watts
Cooling:	Convection
Heat dissipation:	240 BTu/hr
Battery:	Optional, nickel-cadmium (Ni-Cad), 12V, 1.8 ampere hour
Fuses:	
100 V_{ac}:	T2.5A, 250 VAC, 5 x 20 mm
120 V_{ac}:	2.5 A, SB, 250 VAC
220 – 230 V_{ac}:	T1.25A, 250 VAC, 5 x 20 mm
240 V_{ac}:	T1.25A, 250 VAC, 5 x 20 mm
Design (general):	Continuous, not protected against ingress of liquids
Battery operation time:	
General:	Battery age will affect operating time. Not recommended for transport. Serves as backup power source in the event of short-term power loss. SpO_2, $EtCO_2$ and NBP monitoring, as well as battery age, reduce operating time.
Monochrome EL display:	Typical operation time while monitoring ECG is 45 to 55 minutes from a new, fully-charged battery.
TFT Color LCD display:	Typical operation time while monitoring ECG is 15 to 30 minutes from a new, fully-charged battery.
Operating conditions:	
Ambient temperature:	10 to 35°C (50 to 95°F)
Relative humidity:	30 - 70%
Storage conditions:	
Maximum:	50°C (122°F) at 50% relative humidity, or 70°C (158°F) at 15% relative humidity
Minimum:	–25°C (–13°F)

PHYSICAL SPECIFICATIONS

Height:	32.6 cm (12.8 inches)
Width:	32 cm (12.5 inches)
Depth:	14.1 cm (5.6 inches)
Weight (optional battery pack installed):	
With color display:	17.9 lb
With monochrome display:	17.5 lb

CERTIFICATION

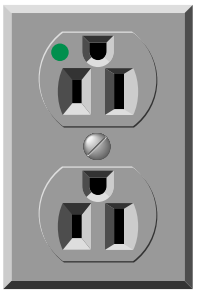
UL:	UL 2601-1 Listed. C22.2 No. 601.1-M90
IEC:	IEC 601-1 Certified.

WARRANTY

Standard:	One year
Optional:	Other options are available. Contact the manufacturer sales representative for more information.

PREPARATION FOR USE

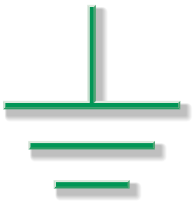
POWER REQUIREMENTS



At least one grounded duplex wall receptacle should be provided for each monitor. The wall receptacle should be hospital grade and installed in a suitable junction box. Power should be provided by a power line dedicated solely to equipment requiring emergency power.

WARNING
Loss of power to the monitor results in the loss of all monitoring functions.

EQUIPMENT GROUND REQUIREMENTS



The ground pin of the wall receptacles and all exposed metal parts (beds, radiators, water pipes, etc.) in the patient area should be connected together and tied to the nearest equipotential ground point through a bonded grounding system, or with a 10-AWG stranded copper grounding cable. This equipotential ground point should be as close to earth ground as possible. Use only three-prong, polarized, hospital-grade wall receptacles to accept the three-wire, polarized plug on the power cord of the monitor.

If a bonded grounding unit is not available, interconnect the ground pins of all wall receptacles in the patient and monitor areas with 10-AWG (or larger) stranded copper cables. This copper cable must connect to the central grounding point. Do not jumper from ground pin to ground pin, then to the central grounding point. The ground cabling must not carry current, such as a grounded neutral, since the current flow will produce differences in potential along the ground. These potential differences are the main source for shock hazards to the users and patients.

Do not rely on conduit as a ground conductor. Plastic (PVC) pipes or fittings used as conduit break up the ground path, which can present potential shock hazards. The electrical ground system must be connected to actual earth ground. If this is not possible, then a good reference ground such as a metal cold water pipe or an electrically conductive building component should be used. It is more important that all grounded objects in the patient area are at the same potential than at true earth potential.

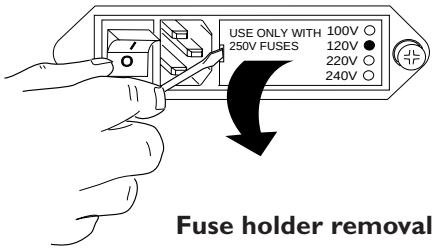
PREPARATION FOR USE (CONT)

FUSE AND VOLTAGE SETUP

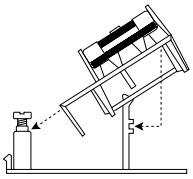
To change the fuse arrangement and operating voltage setup of the monitor, the settings on the power input module (located on the rear panel of the monitor) must be configured properly.

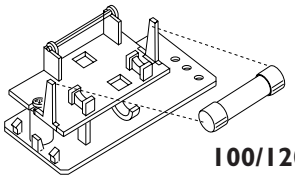
First, change the fuse arrangement. Follow these steps:

1. Using a flat blade screwdriver, remove the fuse holder from the power input module.
2. Remove the fuse block from the fuse holder by loosening the Phillips-head screw 2 full turns counterclockwise.
3. Separate the fuse block from the fuse holder by tilting it up and away from the mount.
4. Arrange fuses as required for proper monitor operating voltage.

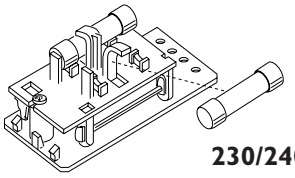


Fuse holder removal





100/120 Vac setup



230/240 Vac setup

NOTE

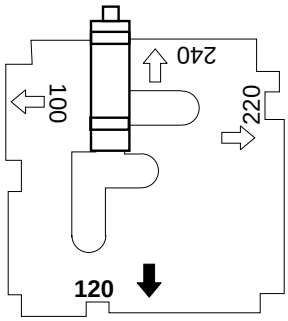
Two fuses are required for 230/240 Vac operation. A dummy fuse may be used in the neutral (lower) holder. Fuse(s) inserted into the power input module first, are the active set.

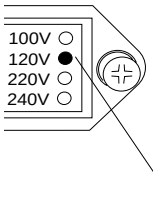
5. To change fuse arrangement, invert the fuse holder and reassemble it to the fuse block in the reverse order of steps 2 and 3.

VOLTAGE SELECTOR CARD SETUP

Next, change the voltage selector for the correct operating voltage of the monitor. Continue with these steps:

1. With the fuse holder remaining out of the power input module, remove the voltage selector card from the power input module as well by pulling it straight out.
2. Holding the indicator pin in the upright position, rotate the selector card so the desired voltage is readable at the bottom.
3. Insert the voltage selector card into the power input module such that the voltage lettering imprinted on the card is facing the power on/off switch.
4. Replace the fuse holder into the power input module and verify the desired voltage is indicated, when viewed from the rear panel.



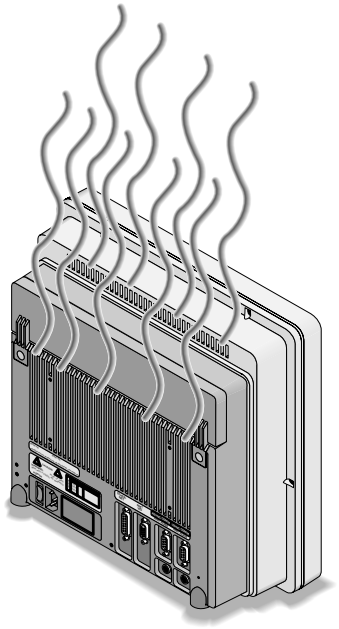


Selected voltage

PREPARATION FOR USE (CONT)

MONITOR VENTILATION REQUIREMENTS

The monitor is capable of producing as much as 170 BTu per hour of heat load. This is equivalent to approximately 50 watts of energy.



WARNING

Failure to properly ventilate the monitor may cause equipment failure or improper monitoring conditions which may endanger the patient being monitored.

CAUTION

Do not locate the monitor in an enclosed area that may restrict the heat dissipated by it. Any restriction in air flow causes a rise in internal temperature which may result in equipment failure.

CAUTION

The monitor must be located no closer than 4 inches (10 cm) from any partition or wall. The monitor can be no closer than 12 inches (30 cm) from any overhead partition or the ceiling.

MOUNTING RECOMMENDATIONS

Tram Critical Care Monitoring System Reference Guide:

- pn. 403799-010
- Manufacturer recommended methods of mounting the monitor to various locations.

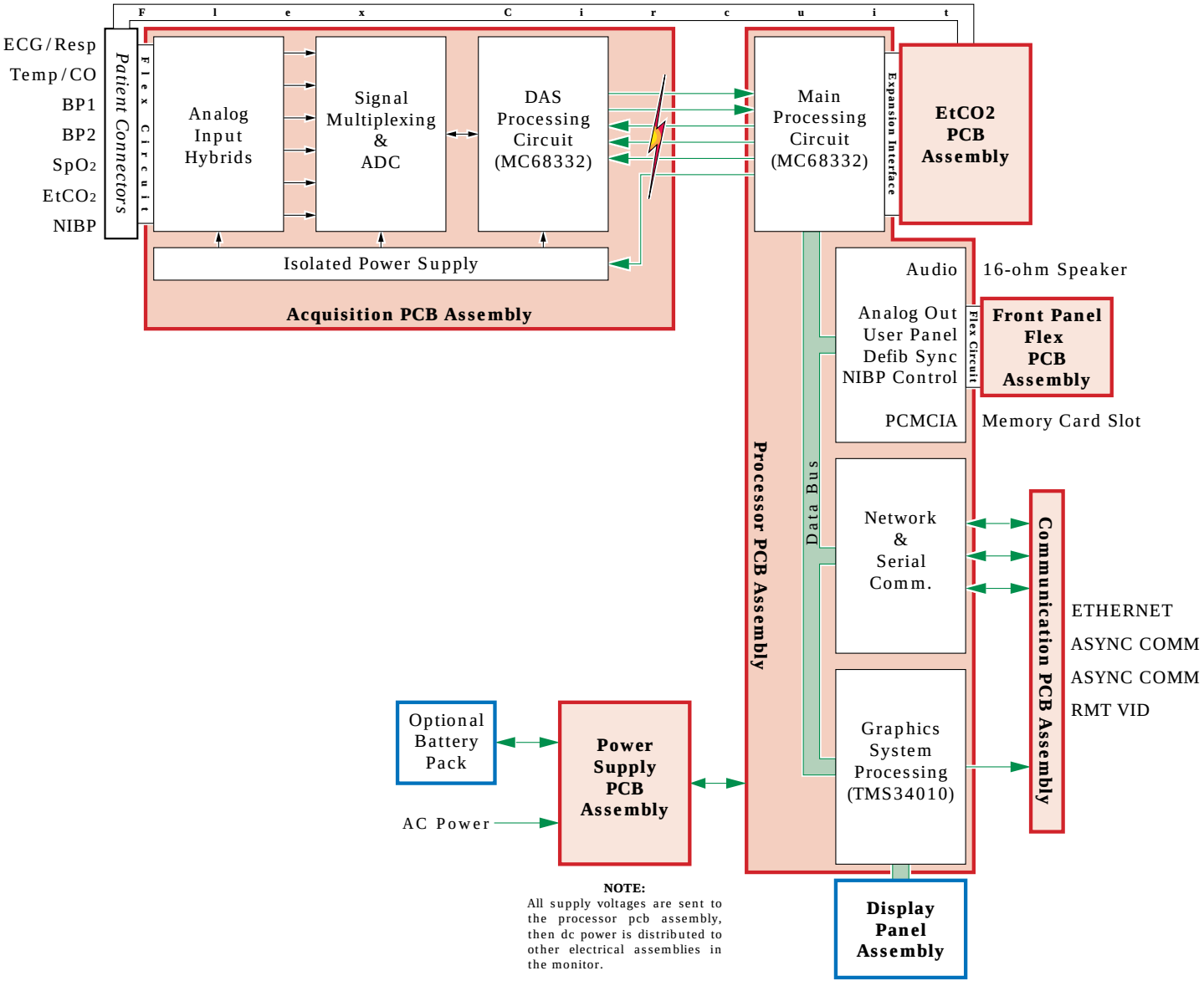
SOFTWARE SETUP

Section 6: Configuration

- Information regarding connection of the monitor to peripherals

THEORY OF OPERATION

OVERALL BLOCK DIAGRAM



NOTE:
All supply voltages are sent to the processor pcb assembly, then dc power is distributed to other electrical assemblies in the monitor.

THEORY OF OPERATION (CONT)

OVERALL BLOCK THEORY

The block level theory of operation, as covered in this section, is intended for service technicians and provides a general overview of the monitor and its main electrical assemblies. An understanding of the block level theory of operation is essential for effectively installing, maintaining or troubleshooting the monitor.

Power supply PCB assembly

The power supply PCB mounts internally to the monitor rear casting assembly. The board accepts both low voltage AC power from the main step down isolation transformer or 12 V_{dc} from the optional battery pack. Both the step down transformer and the battery pack are located off of the power supply PCB, mounting into the rear casting assembly. The power supply PCB provides four independent output voltages and appropriate power control and status input/output (I/O) signals required by the monitor electronic assemblies.

Acquisition PCB assembly

The acquisition PCB provides an electrically isolated patient data acquisition system (DAS) to acquire real time patient data for the monitor. Analog sensor/electrode patient input signals are amplified and conditioned, then converted to digital data. The digital patient data is transferred across an optically coupled isolation barrier to the processor PCB for analysis and display.

The DAS consists of an isolated and non-isolated section which are separated by a coupled inductor power supply and optical-isolation for signals crossing the barrier.

Processor PCB assembly

The processor PCB provides signal processing, system control, user interface, and communications functions for the monitor, both TFT color LCD and High-Bright EL display versions. It receives and processes digitized patient data from the isolated DAS assembly (acquisition PCB), text and waveform information for the video display, interfaces with the operator via the front panel switches and Trim Knob control, and communicates with other products on the Ethernet network. Additional capabilities include support for an external color CRT slave display (functional only in color or "normal scan" mode) and a pair of asynchronous communications ports for devices like a DDW and/or remote control.

Communication PCB assembly

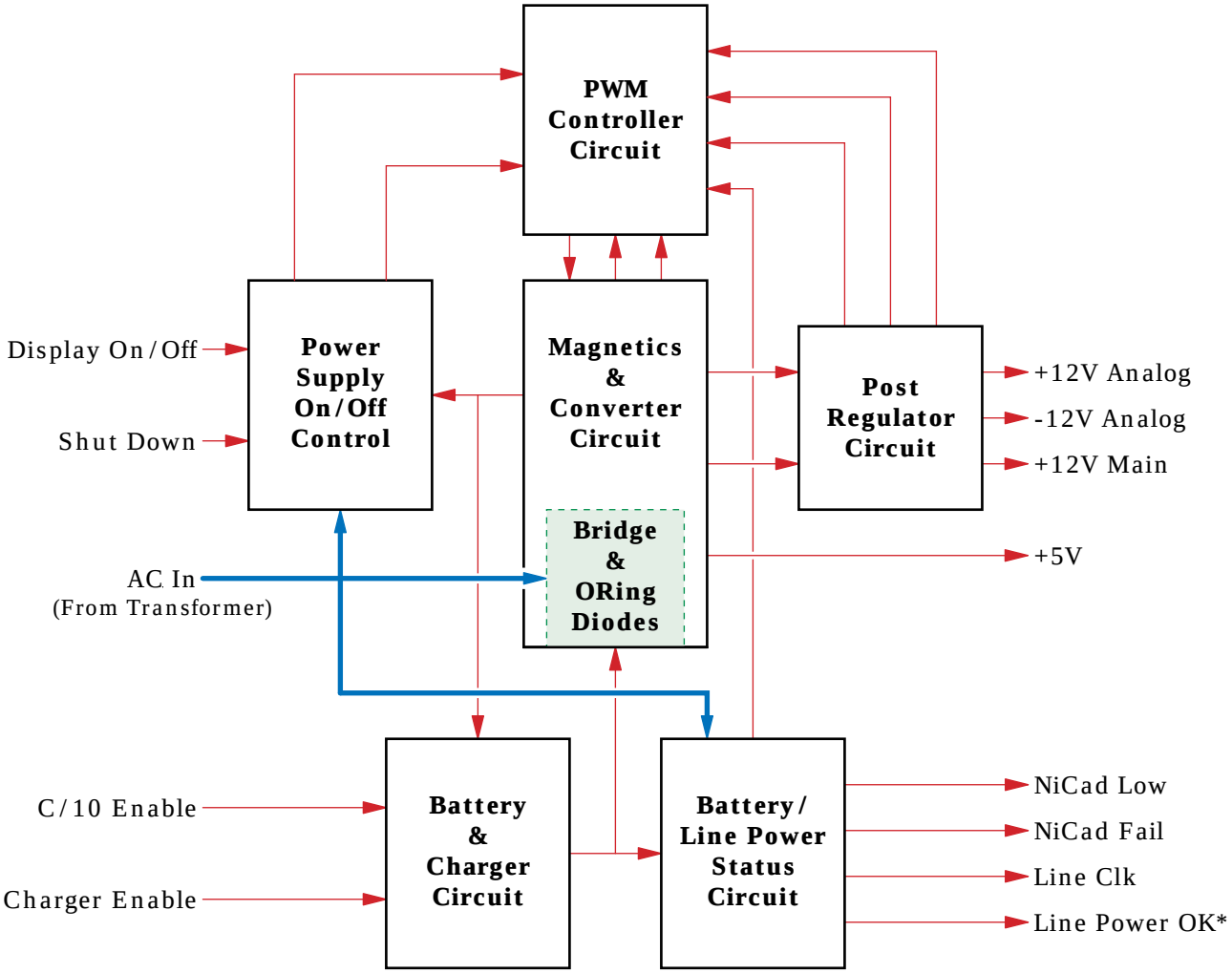
The communication PCB is responsible for the dispersion of signals between the processor PCB and the monitor rear panel connectors. Ethernet, remote video, asynchronous communication, remote alarms and static protection are the primary functions of the board.

(Optional) End-tidal CO_2 PCB assembly

The optional end-tidal CO_2 PCB is designed to plug directly into the expansion interface connector on the processor PCB assembly. The main microcontroller on the processor PCB controls the $EtCO_2$ PCB assembly. This optional board provides patient interface, signal acquisition and processing for all carbon dioxide monitoring functions. The CO_2 patient signals are processed and stored by an on-board microcontroller. The acquired CO_2 data is then sent to the processor PCB for display, communication and long-term patient data storage purposes.

THEORY OF OPERATION (CONT)

POWER SUPPLY PCB BLOCK DIAGRAM



THEORY OF OPERATION (CONT)

POWER SUPPLY PCB BLOCK THEORY

The power supply PCB mounts internally to the monitor rear casting assembly. The board accepts both low voltage AC power from the main step down isolation transformer or 12 V_{dc} from the optional battery pack. Both the step down transformer and the battery pack are located off of the power supply PCB, mounting into the rear casting assembly. The power supply PCB provides four independent output voltages and appropriate power control and status input/output (I/O) signals required by the monitor electronic assemblies.

Power supply PCB functional circuits

Functional circuits on the power supply PCB include:

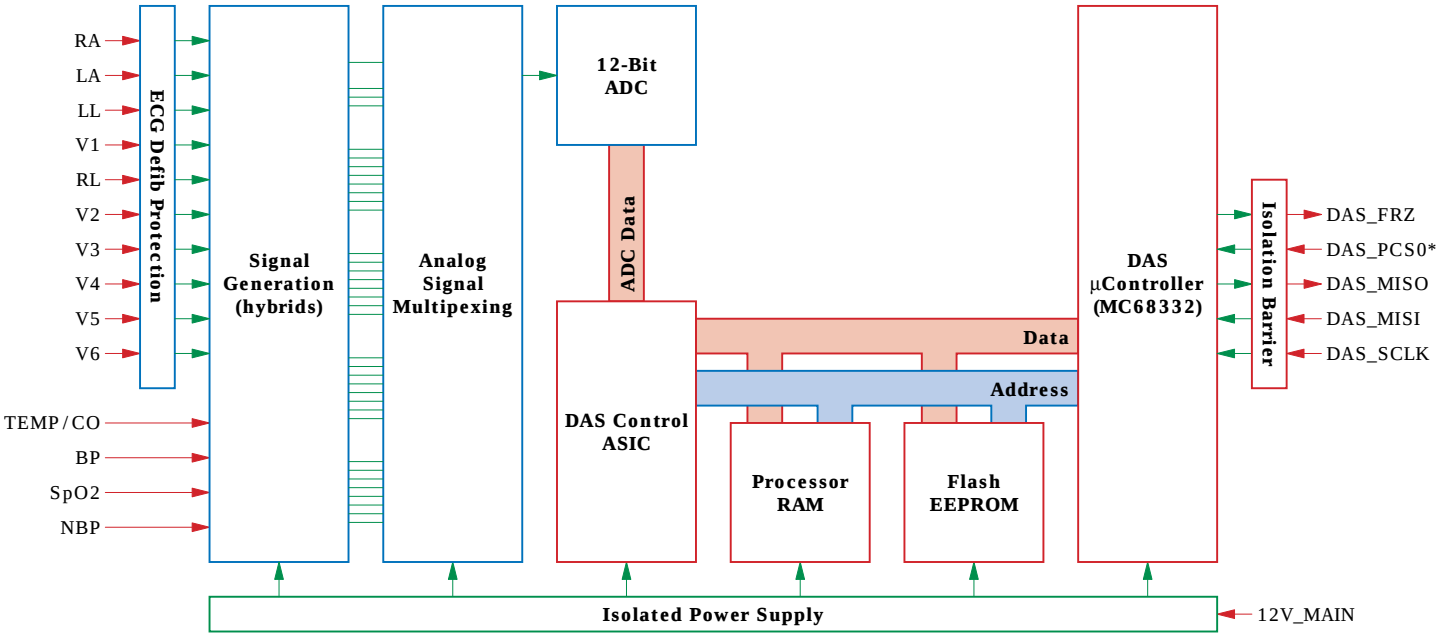
- Power on/off control, and
- Power forward converter/magnetics,
- Pulse width modulation (PWM) controller,
- Post regulator,
- Battery and charger, and
- Battery/line power status.

Calibration

The calibration procedure for this assembly is found in the section titled *Calibration* in this manual.

THEORY OF OPERATION (CONT)

ACQUISITION PCB BLOCK DIAGRAM



THEORY OF OPERATION (CONT)

ACQUISITION PCB BLOCK THEORY

The acquisition PCB, or data acquisition system (DAS), located in the monitor, is responsible for the acquisition of all vital-sign patient data. Analog sensor/electrode input signals are amplified and conditioned by hybrid assemblies, then converted to digital data. The digital patient data is transferred across an isolation barrier via high-speed opto-couplers to the processor PCB for analysis and display.

The DAS consists of an isolated and non-isolated section which are separated by a barrier that is capable of withstanding up to 6000 Vdc with respect to earth ground. Isolation is accomplished by using a coupled inductor power supply and opto-isolation for signals crossing the barrier.

Functional circuits

Functional circuits on the acquisition PCB include:

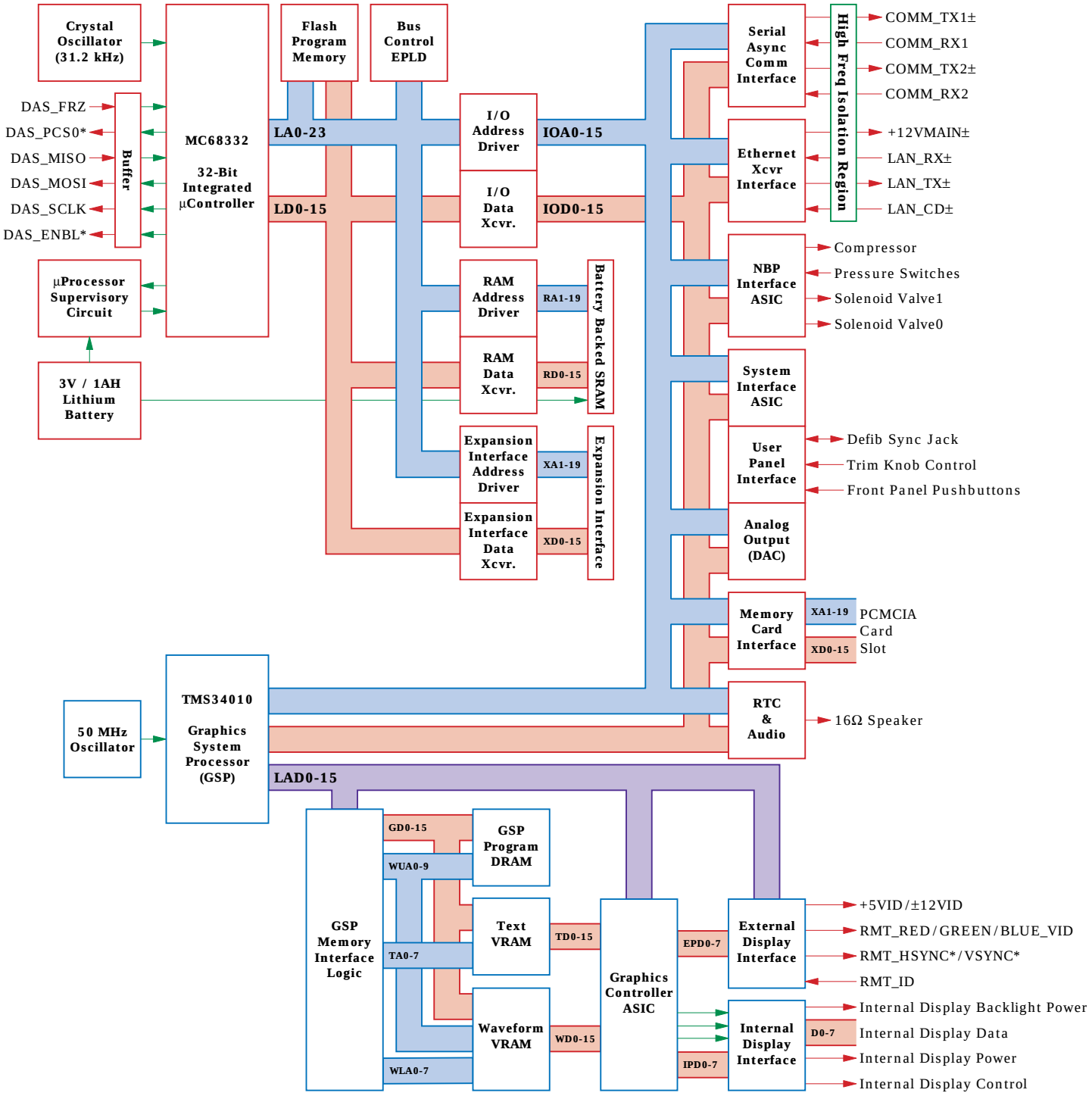
- Isolated power supplies generation,
- Patient input connector interface,
- ECG defibrillator protection,
- Patient signal generation (hybrids interface),
- Analog-to-digital conversion (patient signals),
- DAS microcontroller and processing, and
- DAS communication interface (isolation barrier).

Calibration

The calibration procedure for this assembly is found in the section titled *Calibration* in this manual.

THEORY OF OPERATION (CONT)

PROCESSOR PCB BLOCK DIAGRAM



THEORY OF OPERATION (CONT)

PROCESSOR PCB BLOCK THEORY

The processor PCB provides signal processing, system control, user interface, and communications functions for the monitor, both TFT color LCD and High-Bright EL display versions. It receives and processes digitized patient data from the isolated DAS assembly (acquisition PCB), text and waveform information for the video display, interfaces with the operator via the front panel switches and Trim Knob, and communicates with other products on the network using a built-in Ethernet interface. Additional capabilities include support for an external color CRT slave display (functional only in color or "normal scan" mode) and a pair of asynchronous communications ports for devices like a DDW and/or remote control.

Functional circuits

As a result of the complexity of this board, there are many functional circuits. The functional circuits on the processor PCB include:

- Main processing circuit:
  - » Motorola MC68332 32-bit integrated microcontroller (19.968 MHz internally),
  - » Clock - 31.2 kHz crystal oscillator,
  - » Bus control EPLD,
  - » Microprocessor support circuit (watchdog) and 3 volt lithium battery,
  - » Flash EEPROM (4 megabytes),
  - » Static RAM (2 megabytes),
  - » System interface ASIC.
- Serial asynchronous serial communications interface DUART (ASYNC COMM ports),
- Serial network interface controller (ETHERNET port),
- Non-invasive blood pressure (NBP) interface ASIC,
- Analog output 12-bit DAC (ECG and blood pressure),
- Real-time clock/calendar and audio generation,
- User panel interface (Trim Knob control/push-buttons),
- Memory card (PCMCIA) interface,
- Video processing circuit (waveforms and text for display):
  - » Texas Instruments TMS34010 graphics co-processor (50 MHz),
  - » Clock - 50 MHz CMOS/TTL oscillator,
  - » Video control LCA,
  - » Graphics system processor memory interface LCA,
  - » Graphics system processor program memory - DRAM (512 kilobytes),
  - » Waveform display memory - VRAM (256 kilobytes),
  - » Text display memory - VRAM (256 kilobytes),
  - » Display driver circuit,
  - » Remote display video interface (RMT VID port).
- DAS interface and power supply interface.

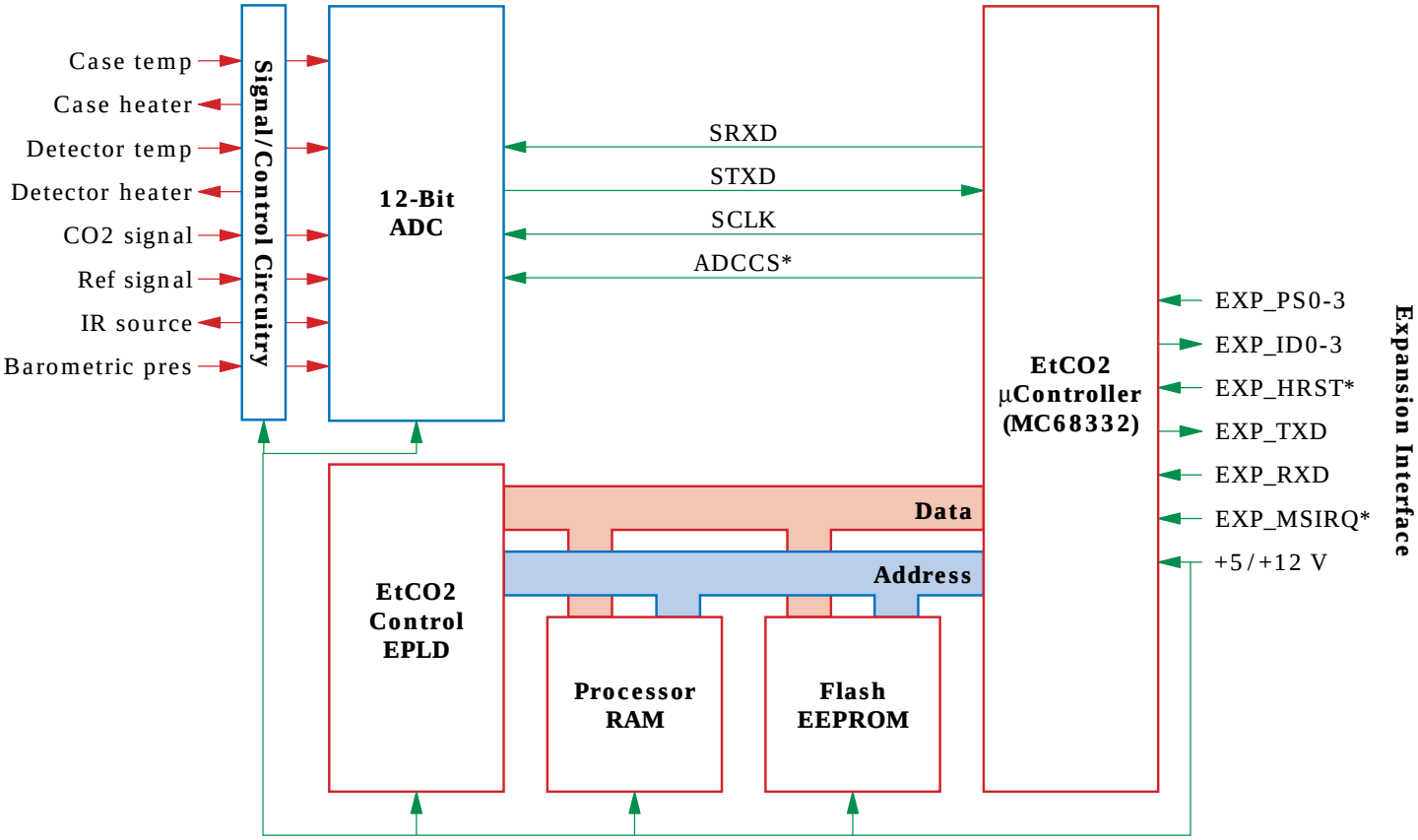
Calibration

The calibration procedure for this assembly is found in the section titled *Calibration* in this manual.

THEORY OF OPERATION (CONT)

(OPTIONAL) $EtCO_2$ PCB

BLOCK DIAGRAM

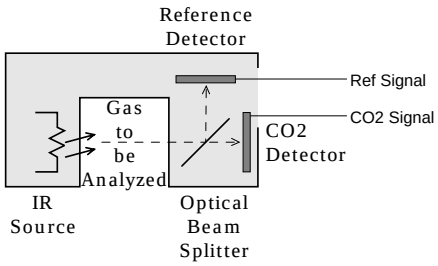


THEORY OF OPERATION (CONT)

(OPTIONAL) ETCO$_2$ PCB

BLOCK THEORY

The Eagle Capnostat CO_2 System (ECCS) is a self-contained printed circuit assembly that interfaces Novametrix Capnostat 3 sensors to the Eagle 4000 Patient Monitor. The ECCS has the necessary circuitry to interface to the Capnostat 3. It acquires raw signals from the Capnostat 3, processes these signals to produce CO_2 waveform data and respiration parameters. These parameters are sent to the host system via an asynchronous serial communication link.



EtCO$_2$ Transducer Head

The Mainstream Capnometer measures End-tidal Carbon Dioxide using a non-invasive technique that relies on the selective absorption properties of CO_2 to specific frequencies of infrared radiation. In the transducer head, a thick film infrared source is pulsed at a rate of approximately 87 Hz, generating a broad - band spectrum of IR. Selective filtering separates this into two narrow regions, one inside the band of CO_2 absorption, the other outside the region of CO_2 absorption. Behind each filter is a detector which produces an electrical signal proportional to the amount of light energy it receives. The detector associated with the filter outside the band of CO_2 absorption always records the maximum level of the source energy since the signal it receives is not affected by CO_2. As the level of CO_2 increases, more of the light energy is absorbed by the CO_2 gas molecules in the airway and less signal reaches the detector. This signal, inverted by the detector is referred to as the CO_2 Input signal. To acquire a precise level of CO_2, both channels are sampled simultaneously and the level of CO_2 in the sampling chamber is determined from the ratio of CO_2 Input and Reference channels. The ratio is compared to a lookup table in memory to establish the correct value in units of mmHg (which can be converted to units of kPa or %).

Functional circuits

The functional circuits on the EtCO$_2$ PCB include:

- Signal/control circuitry
  - » Power Converter Circuit
  - » Source Pulser
  - » Heater Circuits
  - » Pump circuitry
  - » Barometric pressure measurement
- Analog to digital conversion circuit.
- EtCO$_2$ microcontroller circuit,
  - » Motorola MC68332 32-bit integrated microcontroller running at the clock rate of 15.9744 MHz from the crystal frequency of 31.2 kHz
  - » Time processing unit (TPU) channels
  - » Memory,

    Flash EEPROM; 128 kB; 80 ns,

    SRAM; 128 kB; 80 ns,

    Serial EEPROM.
- EtCO$_2$ control EPLD,

THEORY OF OPERATION (CONT)

Calibration The calibration procedure for the $EtCO_2$ PCB assembly is found in the section titled *Calibration* in this manual.

For your notes.

2 MAINTENANCE

MAINTENANCE SCHEDULE

MANUFACTURER RECOMMENDATION

To make sure the monitor remains in proper operational and functional order, a good maintenance schedule must be adhered to. The manufacturer's recommendations in this regard is as follows:

- **Inspection:** Operators should perform this prior to admitting each patient to the monitor. Service personnel should perform this prior to servicing the monitor.
- **General Cleaning:** Operators should perform this prior to admitting each patient to the monitor. Service personnel should perform this after servicing the monitor.
- **Checkout Procedures:** These should be performed by qualified service personnel upon receipt of the equipment, one time per year thereafter, and each time the monitor is serviced.
- **Leakage Current Tests:** These should be performed by qualified service personnel upon receipt of the equipment, one time per year thereafter, and each time the monitor is serviced.
- **Hi-Pot Tests:** High-potential tests should be performed by qualified service personnel whenever a circuit board is removed, repaired or replaced in the monitor. These tests should also be performed if any component or assembly effecting patient isolation is removed, repaired or replaced in the monitor.

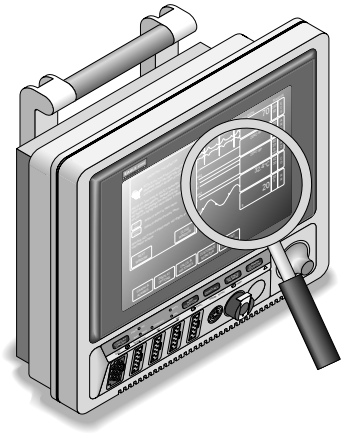
NOTE
The Hi-Pot Tests provide a means of checking the patient isolation circuitry such that a patient receiving defibrillation, while attached or admitted to the monitor, will receive the full energy of each shock and that the monitor will not absorb the energy, when delivered.

MANUFACTURER RESPONSIBILITY

Failure on the part of all responsible individuals, hospitals or institutions, employing the use of this monitor, to implement the recommended maintenance schedule may cause equipment failure and potential operator and patient health hazards. The manufacturer does not in any manner, unless an Equipment Maintenance Agreement exists, assume the responsibility for performing the recommended maintenance schedule. The sole responsibility rests with all individuals, hospitals, or institutions utilizing the monitor.

VISUAL INSPECTION

INSPECTING THE MONITOR



The monitor should be carefully inspected prior to each patient being admitted to the monitoring system. Follow these guidelines when inspecting the equipment:

- Carefully inspect the monitor for obvious physical damage to the outer case, display screen and controls. Do not use the monitor if physical damage is determined. Refer damaged equipment to qualified service personnel for repair before using the monitor on a patient.
- Inspect all front and rear panel external connectors for damaged pins, prongs and connector housings. Refer damaged equipment to qualified service personnel for repair before using the monitor on a patient.
- Inspect all cables, insulation, strain-reliefs and connectors for damage, cracks or degradation. Refer damaged equipment to qualified service personnel for repair before using the monitor on a patient.

CLEANING THE MONITOR

CLEANING THE DISPLAY

To clean the display on the monitor, use a soft, clean , lint-free cloth dampened with a glass cleaner similar to Windex, or a 1:1 mixture of isopropyl alcohol and water.

WARNING
Do not spray glass cleaner or general cleaning solutions directly onto the display. Do not use hospital disinfectants, like Cidex, on the display.

Filter lens characteristics

The monitor display uses a circular-polarized filter with anti-reflective (AR) coating, which is the exposed external surface. This type of filter increases the display contrast while, at the same time, reducing glare from ambient light sources. Upon close inspection of this filter lens while the display is turned off, milky-white streaks may be noticed. Visible streaks do not indicate that the display needs to be cleaned. This phenomena is inherent of displays incorporating this technology.

CLEANING THE EXTERNAL SURFACES

Clean the external surfaces of the monitor before each time a patient is admitted to the system. The exterior surfaces may be cleaned with a lint-free cloth dampened with one of these approved solutions:

ammonia (diluted),

Cidex,

mild soap (dissolved), or

sodium hypochlorite bleach (diluted).

MANUFACTURER RECOMMENDATION

The manufacturer recommends the following guidelines to avoid damaging the monitor:

- Dilute all cleaning solutions according to respective manufacturer recommendations.
- Use a clean, dry, lint-free cloth to wipe off excess cleaning solution after each application.
- Do not pour water or cleaning solutions directly onto the monitor. Do not allow fluids to run into crevices, connectors or cooling vents on the monitor.
- Never use these cleaning agents:

  abrasive cleaners or solvents of any kind,

  alcohol-based cleaning agents,

  wax containing a cleaning substance,

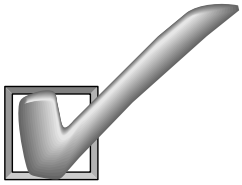
  acetone, or

  betadine.

CAUTION
Follow these cleaning instructions exactly. Failure to follow the instructions may melt, distort, or dull the finish of the case, blur lettering on the labels, or cause equipment failures.

CHECKOUT PROCEDURES

ABOUT THE CHECKOUT PROCEDURES



This part of the section contains all of the checkout procedures for the monitor. The checkout procedures provide service personnel with a method of verifying operational and functional performance of the monitor without having to disassemble the unit. Failure to attain the prescribed results indicates a need for calibration or potential malfunction of the monitor.

Perform the checkout procedures upon receipt of the monitor, every year thereafter, and each time a circuit board is removed or replaced.

The checkout procedures are based on the assumption that the monitor being tested is used with known, good cables and test equipment. It also requires that the user be somewhat familiar with the operation of the monitor and all test equipment used for the checkout procedures. For more information concerning the operation of these components, refer to the respective operator manual.

MANUFACTURER RECOMMENDED TEST EQUIPMENT

The following table lists the manufacturer's recommended test equipment, adaptors, and cables necessary to successfully complete the checkout procedures. The checkout procedures were written for the test equipment in the following table. If test equipment other than the manufacturer's recommendation is used, it may be necessary to slightly modify some test steps.

Description	Part Number	Qty
Multifunction Microsimulator	MARQ1	1
Multi-Link ECG cable, 5-Lead, AHA	412931-001	1
Multi-Link ECG cable, 12-Lead, AHA	416035-001	1
Multi-Link Leadwire Set, 5-Lead, AHA	414556-001	1
Multi-Link Leadwire Set, V-Leads, AHA	415467-003	1
BP Adapter	700095-001	2
Temperature Adaptor	402015-004	1
TEMP-to-Simulator Cable	6770031	1
Cardiac Output Simulator II	900028-001	1
CO Adaptor	700092-001	1
Mercury manometer	SenSym 1200	1
SpO_2 Simulator	408610-001	1
SpO_2 Simulator Cable, Nellcor	700232-004	1
Capnostat (CO_2) Sensor Cable	412340-001	1

CHECKOUT PROCEDURES (CONT)

POWER-UP SELF-TEST

The following steps are used to run the monitor power-up self tests.

1. Turn the monitor rear panel power switch to the off (0) position.
2. If the display is on, press the DISPLAY ON/OFF key to turn it off.
3. Connect a power cord between a properly wired wall receptacle and the monitor power connector.
4. Turn the monitor rear panel power switch to the on (1) position.
5. Verify all of the front panel indicators illuminate for a second or two.

6. Verify the PWR-AC indicator stays illuminated.
7. For monitors with the optional battery installed, verify one of the BATT indicators stays illuminated.

- If the RDY indicator is on, continue with the tests.
- If the CHRGNG indicator is on, wait for the battery to fully charge and the RDY indicator to illuminate.
- If the FAIL indicator is on, replace the battery as described in the Battery Failure portion of Section 4: Troubleshooting.

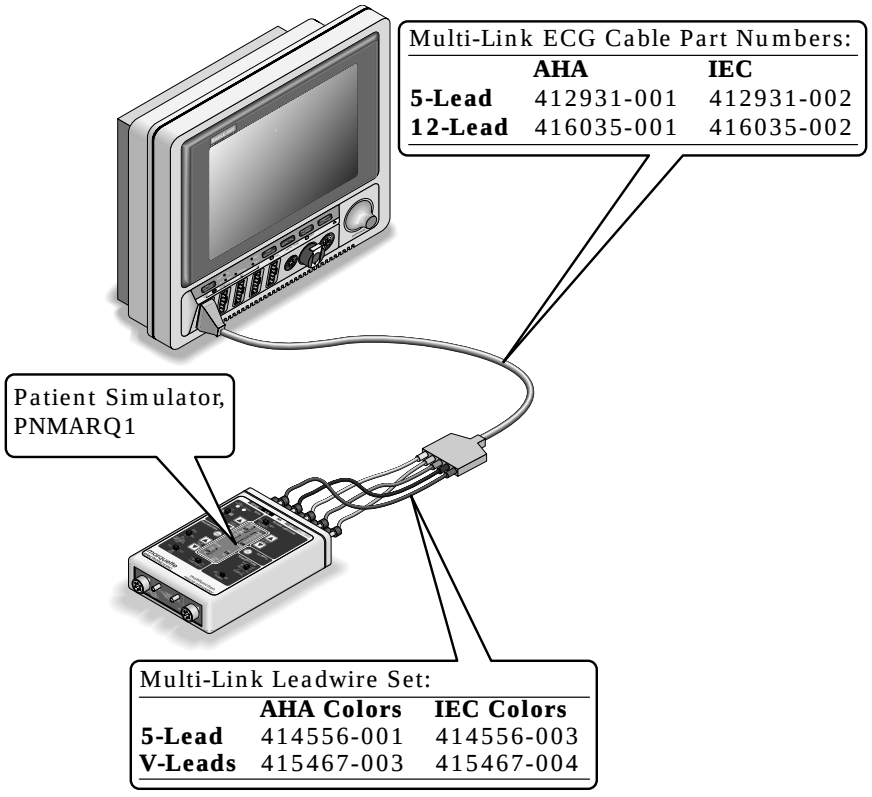
CHECKOUT PROCEDURES (CONT)

ECG TESTS

Follow these steps to perform the ECG tests.

1. Set up the patient simulator as follows:
   - Heart rate - 80 BPM,
   - Heart rate amplitude - 1.0 mV,
   - 5-Lead ECG patient cable properly attached.
2. Attach the ECG patient cable and ECG leadwire set to the ECG/RESP connector on the monitor and the leadwire connectors on the top of the patient simulator.

ECG test setup



ECG waveform, heart rate and QRS tones

3. Admit the patient simulator to the monitor.
4. Observe the following:
   - ECG lead II is displayed and is noise-free,
   - Heart rate of 80 ±1 BPM is displayed,
   - With QRS tones enabled, an audible tone sounds with each R-Wave (QRS complex).
5. Verify all seven ECG leads are available for viewing and are noise-free.

CHECKOUT PROCEDURES (CONT)

Pacemaker detection test setup

6. Select DETECT PACE and set to NORMAL.
7. Select the VP2 pacemaker pulse on the simulator.
8. Observe the following while viewing ECG leads II, III, aVR, aVF, and V:
   - a **P** appears above the PVC count indicating pacemaker pulse detection is enabled, and
   - the heart rate still reads 80 ±1 BPM.

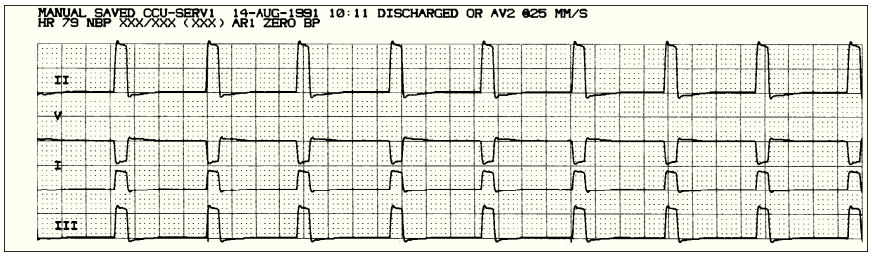
Lead-fail detection test setup

9. Disable pacemaker pulse detection on the monitor and return the simulator to these conditions:
   - Heart rate - 80 BPM,
   - Heart rate amplitude - 1.0 mV,
   - 5-Lead ECG patient cable properly attached.
10. Select ECG lead II for viewing in the top trace position on the monitor display.
11. Disconnect the RA leadwire from the patient simulator.
12. Observe following:
    - a RA FAIL message appears on the display, and
    - lead III automatically displays in place of lead II in the top trace position.

Calibration pulse test setup

13. Reconnect the RA leadwire to the patient simulator.
14. Inject a 1 mV calibration signal using the patient simulator and start a manual graph.
15. Observe that the calibration pulse is properly displayed and graphed (see figure below).

Graphed cal pulses



ECG test completion

16. This completes the ECG tests. Continue to the next steps of these checkout procedures.

CHECKOUT PROCEDURES (CONT)

12SL ECG TESTS

Follow these steps to perform the 12SL ECG tests.

1. Set up the patient simulator as follows:
   - Heart rate - 80 BPM,
   - Heart rate amplitude - 1.0 mV,
   - 12-Lead ECG patient cables properly attached.
2. Attach the ECG patient cable and ECG leadwire sets to the ECG/RESP connector on the monitor and the leadwire connectors on the top of the patient simulator.
3. Admit the patient (simulator) to the monitor.
4. From the Main Menu of the monitor, rotate the Trim Knob to highlight the **ECG** parameter box then press the Trim Knob to select it.
5. Select **12 LEAD ECG ANALYSIS** from the ECG parameter menu option items.
6. Observe the 12 ECG traces are noise-free and properly displayed,

CHECKOUT PROCEDURES (CONT)

RESPIRATION TESTS

Using the same test setup as used for the ECG tests, follow these steps to perform the respiration tests.

Respiration tests setup

1. With the ECG patient cable attached to the ECG/RESP connector of the monitor, setup the patient simulator as follows:
   - Respiration (RESP) baseline impedance - 750Ω,
   - RESP ΔR - 0.5Ω,
   - RESP lead select - I & II,
   - RESP rate (respirations per minute) - 30.

ECG lead II respiration test

2. Set up the monitor as follows:
   - RESP waveform - on,
   - RESP waveform lead select - lead II (RESP waveform derived from ECG lead II).
3. Observe the following:
   - RESP parameter window appears on the monitor with a reading of 30 ±2 (respirations per minute),
   - RESP waveform appears distortion-free on the monitor.

ECG lead I respiration test

4. Change the RESP waveform lead select of the monitor to lead I (RESP waveform derived from ECG lead I).
5. Observe the following:
   - RESP parameter window appears on the monitor with a reading of 30 ±2 (respirations per minute),
   - RESP waveform appears distortion-free on the monitor.

Respiration tests completion

6. Disconnect the ECG patient cable from the ECG/RESP connector of the monitor. Proceed to the next steps in these checkout procedures.

CHECKOUT PROCEDURES (CONT)

TEMPERATURE TESTS

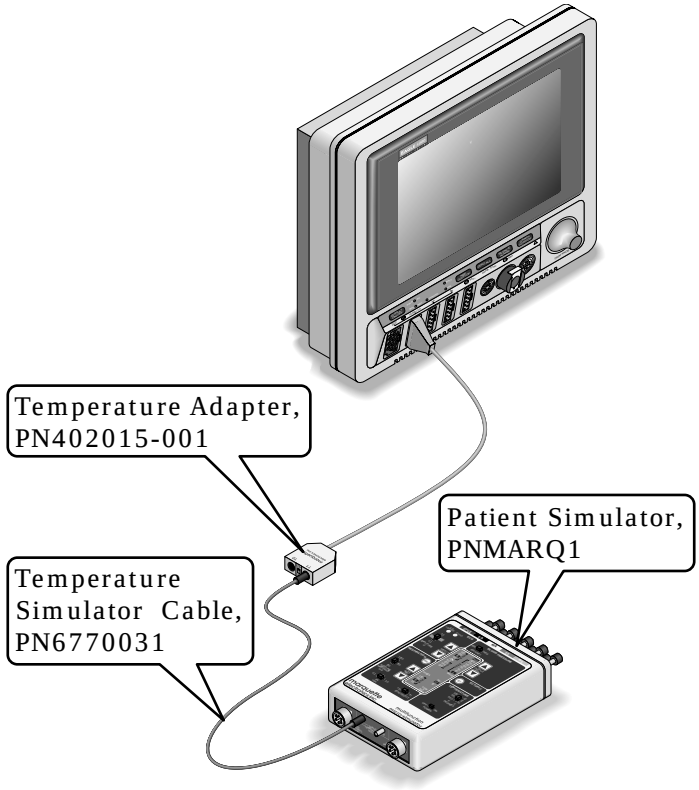
Follow these steps to perform the temperature tests.

1. Set up the patient simulator for a temperature output of 37°C.

T1 temperature setup

2. Attach the temperature adaptor cable to the TEMP/CO connector of the monitor (see figure below).
3. Set the switch on the temperature adaptor to the 400 position.
4. Attach the temperature simulator cable from the SERIES 400 TEMPERATURE OUTPUT connector of the patient simulator to the T1 connector of the temperature adaptor.

Temperature tests setup



5. Verify a TEMP parameter window appears on the monitor display with a T1 reading of 37.0° ±0.4° C.

T2 temperature setup

6. Move the temperature simulator cable from the T1 connector of the temperature adaptor to the T2 connector of the temperature adaptor.
7. Verify a T2 reading of 37.0° ±0.4° C in the TEMP parameter window on the monitor display.

Temperature tests completion

8. Remove the temperature adaptor and temperature simulator cable from the monitor and patient simulator.

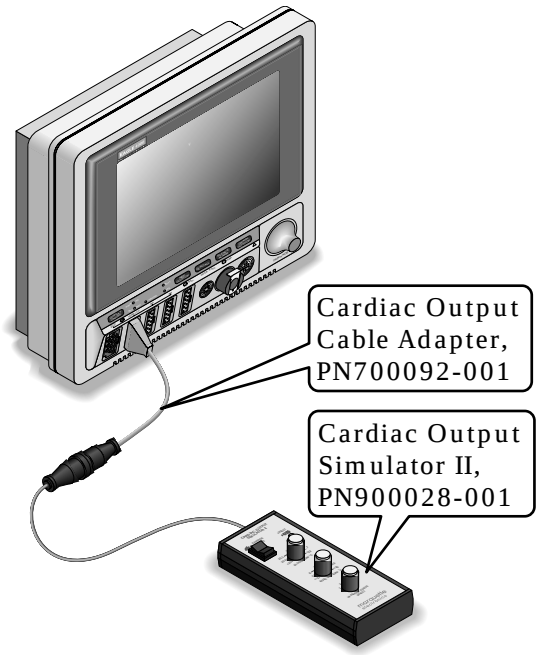
CHECKOUT PROCEDURES (CONT)

CARDIAC OUTPUT TESTS

Follow these steps to perform the cardiac output tests.

1. Connect the cardiac output (CO) cable adaptor to the TEMP/CO connector of the monitor.
2. Connect a simulator cable between the CO cable adaptor and the CO simulator.

CO test setup



Blood temperature test

3. Set the CO simulator to output blood temperature (BT) readings. Verify a CO parameter window appears on the monitor display with BT readings in the ranges as shown in the table below:

Simulator BT Setting	Monitor BT Reading Range
30.3°C	30.1 – 30.5
35.1°C	34.9 – 35.3
36.0°C	35.8 – 36.2
37.0°C	36.8 – 37.2
41.7°C	41.5 – 41.9

Injectate temperature test

4. Set the CO simulator to output injectate temperature (IT) readings. Verify a CO parameter window appears on the monitor display with IT readings in the ranges as shown in the table below:

Simulator IT Setting	Monitor IT Reading Range
0.0°C	–0.3 – +0.3
8.0°C	7.7 – 8.3
15.0°C	14.7 – 15.3
24.0°C	23.7 – 24.3
29.6°C	29.3 – 29.9

CO test completion

5. Disconnect the CO cable adaptor from the TEMP/CO connector of the monitor. This completes the CO tests.

CHECKOUT PROCEDURES (CONT)

INVASIVE BLOOD PRESSURE TESTS

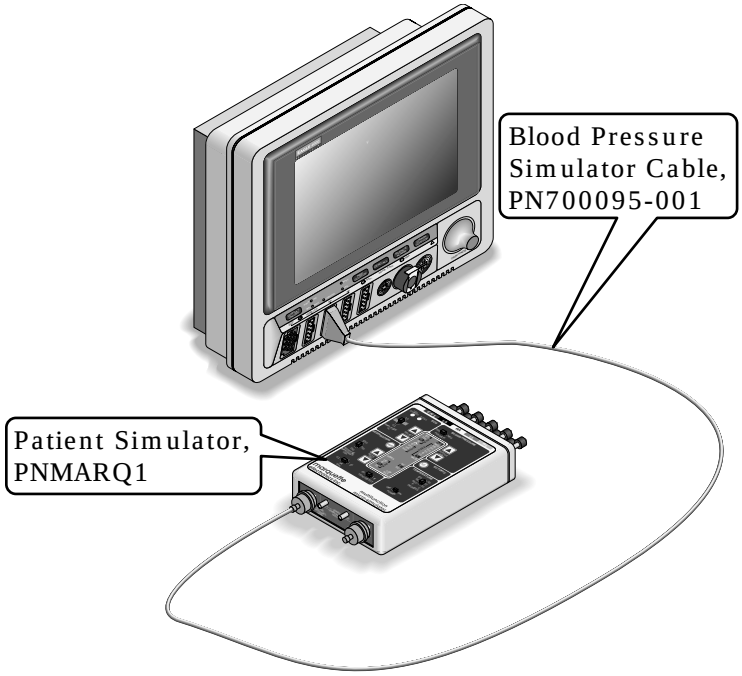
The invasive blood pressure (BP) tests provide a method of verification for both BP connectors (BP1 and BP2) of a monitor equipped with this optional function. Follow these steps:

1. Set up the patient simulator as follows:
   - Blood pressure (BP) polarity - POS,
   - BP output - 0 mmHg.

BP1 connector (AR1) tests

2. Connect the BP simulator cable from the BLOOD PRESSURE 1 - 120/80 connector of the patient simulator to the BP1 (left-most BP) connector of the monitor.

BP test setup



3. Verify the AR1 parameter window, waveform label, corresponding graticules, and waveform appear on the monitor display, along with a BP waveform requiring zero reference.

Zero-reference AR1

4. Press the ZERO ALL push-button on the front panel of the monitor to zero-reference the AR1 BP waveform.

Static pressure verification

5. Change the patient simulator BP output to 200 mmHg.
6. Observe a reading of 200/200 (200) ± 4 mmHg in the AR1 parameter window on the monitor display.

Dynamic pressure verification

7. Change the patient simulator BP output to WAVE (simulated BP waveform).
8. Set the AR1 BP waveform gain on the monitor to auto.
9. Observe a distortion-free AR1 BP waveform and a reading of approximately 120/80 (93) in the AR1 parameter window on the monitor display.

BP1 test completion

10. Disconnect the BP simulator cable from the BP1 connector of the monitor. Continue to the next step for the BP2 test.

CHECKOUT PROCEDURES (CONT)

BP2 connector (PA2) tests

11. Set up the patient simulator as follows:
    - BP polarity - POS,
    - BP output - 0 mmHg.
12. Connect the BP simulator cable to the BP2 (right-most BP) connector of the monitor.
13. Verify a PA2 parameter window, waveform label and corresponding graticules appear on the monitor display, along with a PA2 BP waveform requiring zero reference.

Zero-reference PA2

14. Press the ZERO ALL push-button on the front panel of the monitor to zero reference the PA2 BP waveform.

Static pressure verification

15. Change the patient simulator BP output to 200 mmHg.
16. Observe a reading of 200/200 (200) ± 4 mmHg in the PA2 parameter window on the monitor display.

Dynamic pressure verification

17. Change the patient simulator BP output to WAVE (simulated BP waveform).
18. Set the PA2 BP waveform gain on the monitor to auto.
19. Observe a distortion-free PA2 BP waveform and a reading of approximately 120/80 (93) in the PA2 parameter window on the monitor display.

Invasive BP test completion

20. Remove the BP simulator cable from the BP2 connector of the monitor. This completes the BP tests.

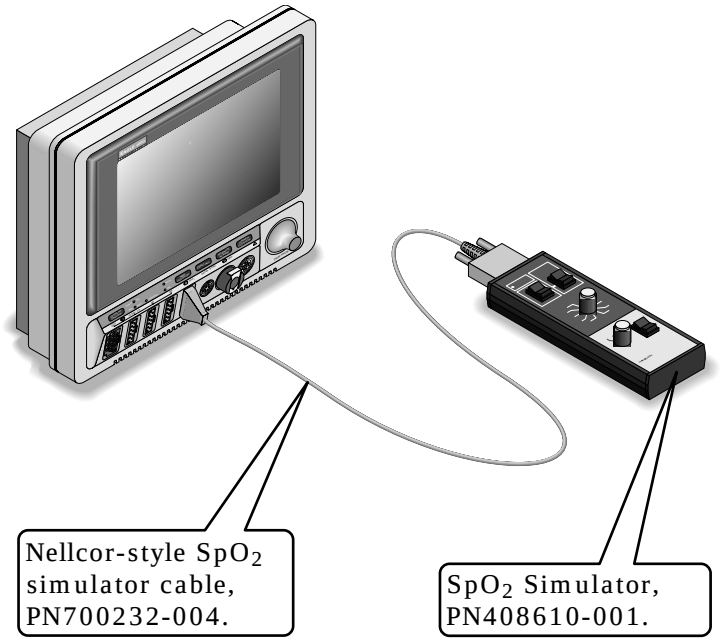
CHECKOUT PROCEDURES (CONT)

PULSE OXIMETRY TESTS

Follow these steps to perform the pulse oximetry (SpO_2) tests.

1. Set the SpO_2 simulator power switch to the off position.
2. Connect the Nellcor-style SpO_2 simulator cable between the SpO_2 connector of the monitor and the SpO_2 simulator as shown below.

SpO_2 test setup



SpO_2 percentage accuracy verification

3. Set up the SpO_2 simulator as follows:
   - SpO2 - 99% (using the white NELLCOR values),
   - PULSE RATE - 100 B/M (beats per minute),
   - MODE - NELLCOR,
   - Power switch - on.
4. Verify a SpO2 parameter window, waveform label and corresponding graticules appear on the monitor display.
5. Verify the following appear on the monitor display:
   - Sinusoidal SpO_2 waveform,
   - SPO2% parameter reading of 97-102 (%),
   - PPR parameter reading of 97-103 (beats per minute).
6. Verify accuracy of the SPO2% values (these are the white NELLCOR values shown on the SpO_2 simulator) on the monitor display using the SpO_2 simulator settings from the following table:

SpO_2 Simulator Setting	Displayed SPO2% Value
99%	97 – 102
85.5%	83 – 88
68.4%	66 – 71

CHECKOUT PROCEDURES (CONT)

Peripheral pulse rate accuracy verification

7. Verify accuracy of the PPR values on the monitor display using the SpO_2 simulator pulse rates from the following table:

Simulator PULSE RATE	Displayed PPR Value
70 B/M	68 – 72
100 B/M	97 – 103
160 B/M	156 – 164

Interference detection test

8. Press the INTERFERENCE TEST button on the SpO_2 simulator for 30 seconds.
9. Verify the displayed SPO2% value remains 97-102%, or an interference detection message is displayed and XX is displayed in the SpO_2 parameter window in place of an SPO2% value.

SpO_2 tests completion

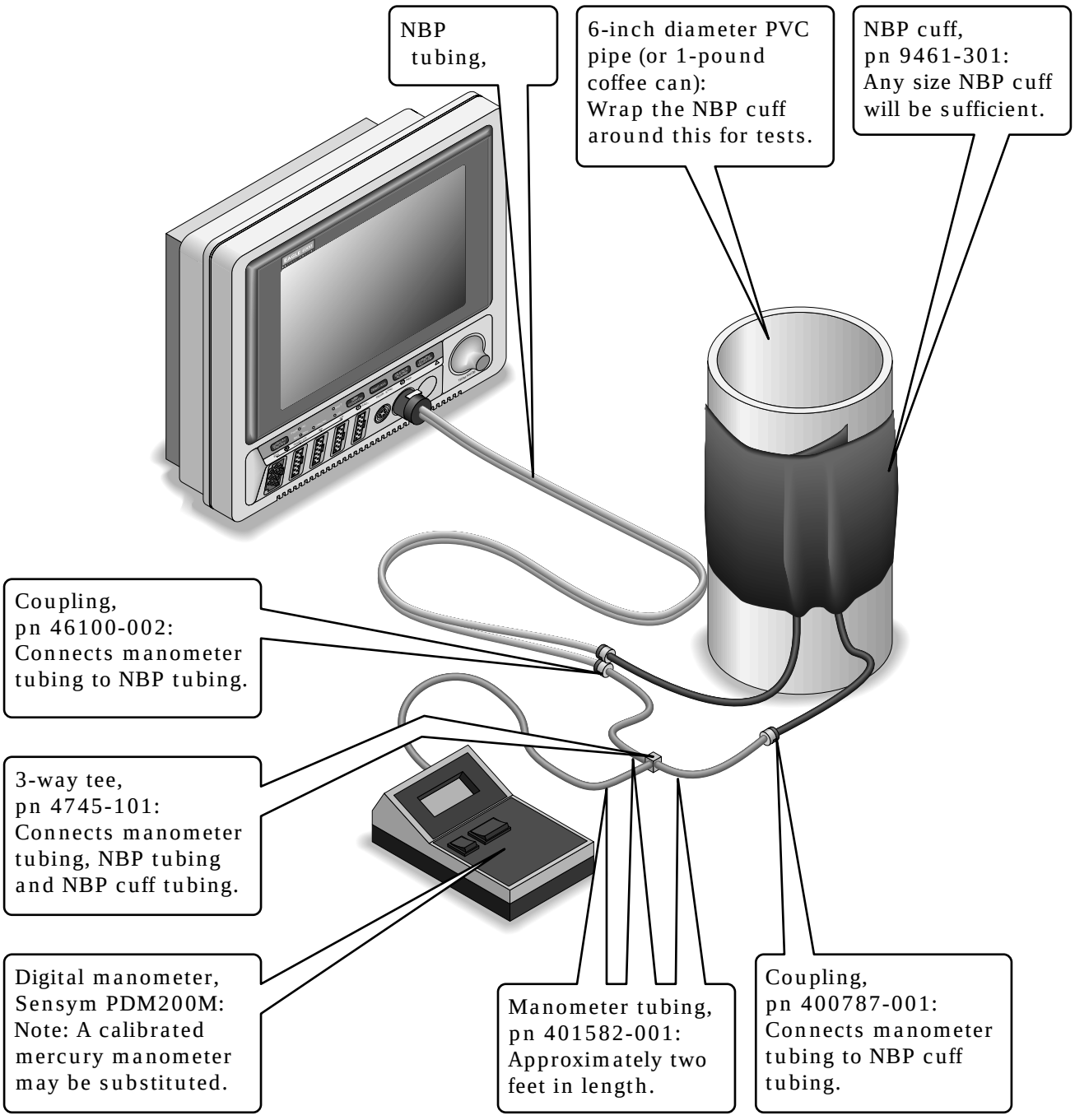
10. Set the SpO_2 simulator power switch to the off position.
11. Disconnect the Nellcor-style SpO_2 simulator cable from the monitor SpO_2 connector. This completes the SpO_2 tests.

CHECKOUT PROCEDURES (CONT)

NON-INVASIVE BLOOD PRESSURE TESTS

Follow these steps to setup for the non-invasive blood pressure (NBP) tests.

1. Attach the digital manometer, NBP cuff, pneumatic plumbing tees and tubing to the NBP connector on the monitor front panel (see figure below).



NBP test setup

2. Set the digital manometer power switch to the on position.
3. Set the digital manometer range switch to 1000mmHg.

CHECKOUT PROCEDURES (CONT)

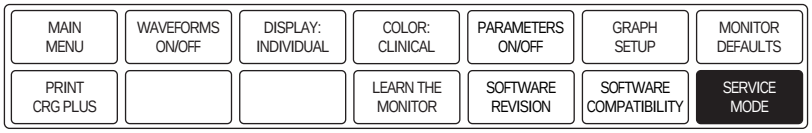
NBP tests

Follow these steps to perform the NBP tests (menu option items for version 5 software are shown in these steps).

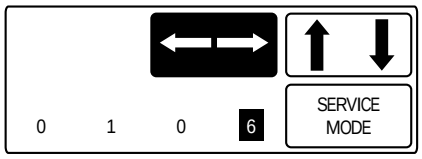
1. From the main menu of the monitor, rotate the Trim Knob control to highlight MONITOR SETUP and press the Trim Knob control to select it.

Enter the monitor service mode menu

2. Rotate the Trim Knob control to highlight SERVICE MODE, and press the Trim Knob control to select it.



Enter the service mode password



3. A service menu password window will appear on the monitor display. A password is required to prevent non-service personnel from accessing the service menus. The password is four numbers that represent the date that currently resides in a memory circuit within the monitor (please note that this may or may not be the correct date). In the password, the first two numbers, starting from the left, represent the day and the second two numbers represent the month of whatever date that currently resides in the memory circuits of the monitor. For example, the seventh day of the third month (March 7th) would be represented in the password as 0703 (ddmm). Note the date that is currently on the monitor display and follow these steps to enter the password;

   - Rotate the Trim Knob control to highlight the password number that you would like to change.
   - To change the highlighted number. Press the Trim Knob control.
   - Rotate the Trim Knob control until the correct number is displayed in the selected field.
   - To enter the number, press the Trim Knob control.
   - Repeat these steps until all password numbers are correctly displayed.
   - Once you have entered the correct password numbers, rotate the Trim Knob control to highlight SERVICE MODE in the enter password window.
   - Press the Trim Knob control one more time to enter the password and access the service menus of the monitor.

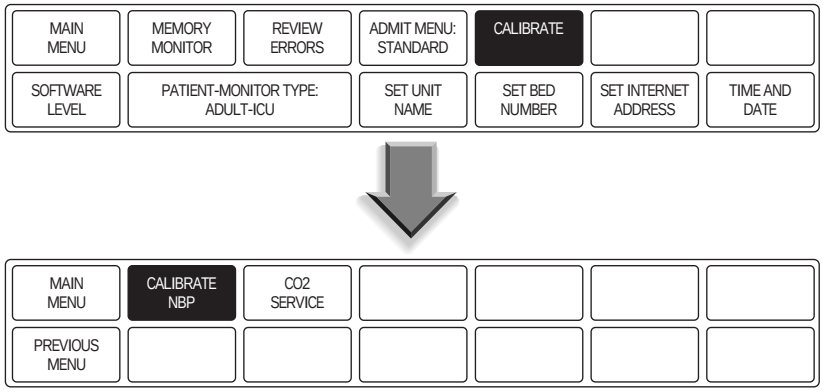
CHECKOUT PROCEDURES (CONT)

NBP calibration verification

From the service mode menu, follow these steps for testing NBP calibration. If desired test results are not obtained, NBP calibration will be required.

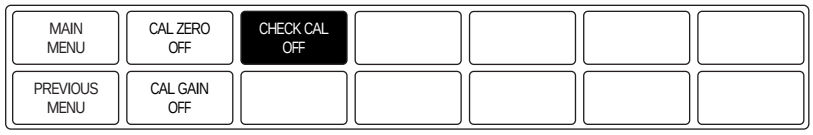
Enter the NBP calibration service menu

4. Rotate the Trim Knob control to highlight CALIBRATE and press the Trim Knob control to select it. Next, rotate the Trim Knob control to highlight CALIBRATE NBP and press the Trim Knob control to select it.

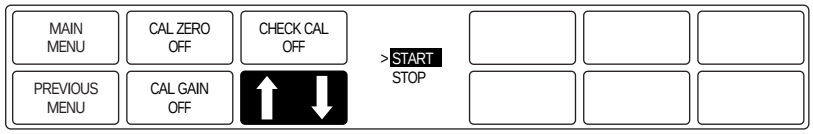


Start the NBP calibration test

5. Rotate the Trim Knob control to highlight CHECK CAL OFF and press the Trim Knob control to select it.



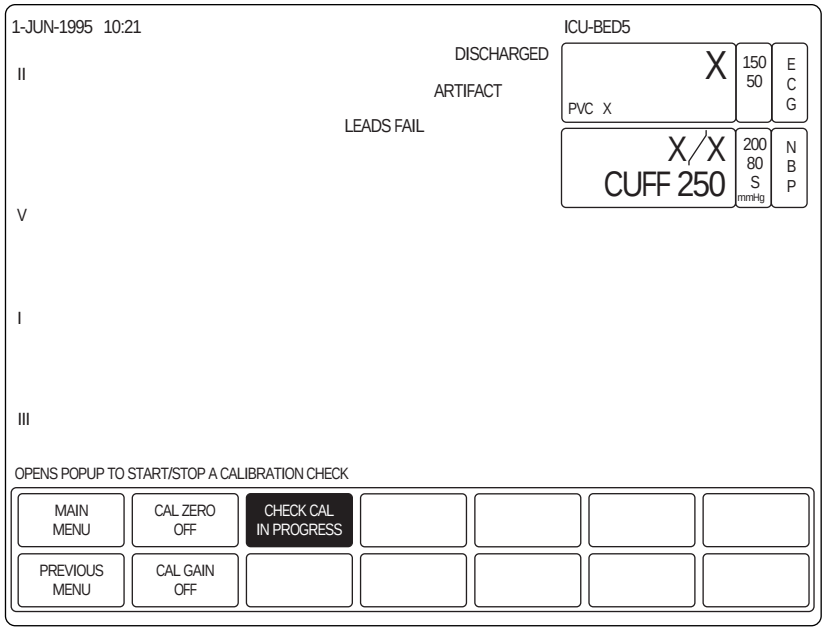
6. Rotate the Trim Knob control to highlight START and press the Trim Knob control to select it.



CHECKOUT PROCEDURES (CONT)

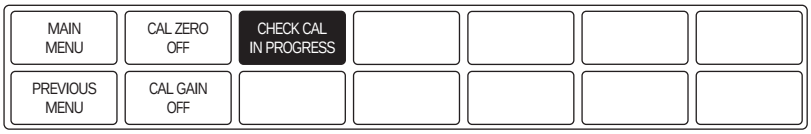
Verify NBP calibration

7. The text on the menu item will change from CHECK CAL OFF to CHECK CAL IN PROGRESS. Verify the readings in the NBP parameter window on the monitor display and readings on the digital manometer are equal (± 1 mmHg) for at least one full minute. If the readings are not equal for at least one full minute, the NBP circuit requires calibration.



Stop the NBP cal test

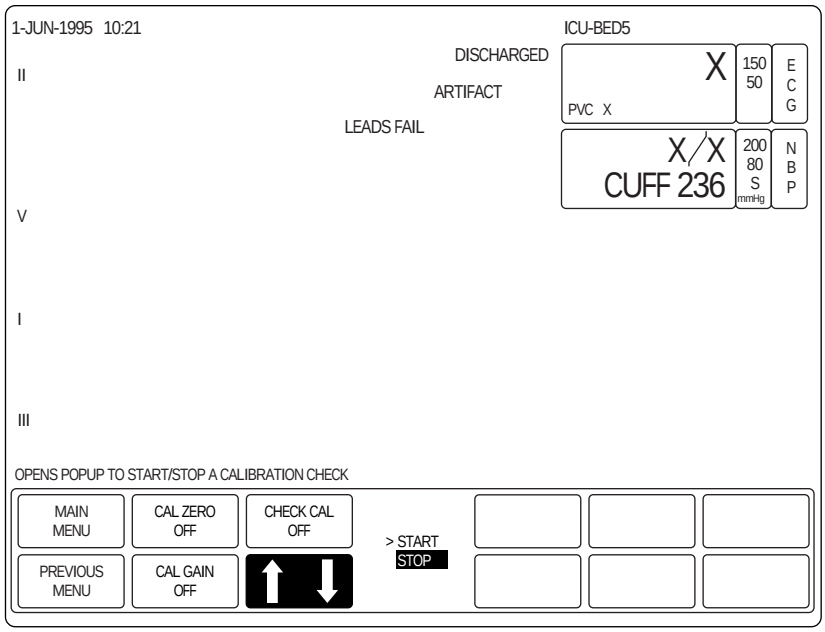
8. Rotate the Trim Knob control to highlight CHECK CAL IN PROGRESS and press the Trim Knob control to select it.



CHECKOUT PROCEDURES (CONT)

Select STOP from the NBP cal menu

9. Rotate the Trim Knob control to highlight STOP and press the Trim Knob control to select it. The pneumatic control circuit of the monitor will vent air pressure in the pneumatic circuit of the monitor to atmosphere, causing the NBP cuff to deflate.



NBP test completion

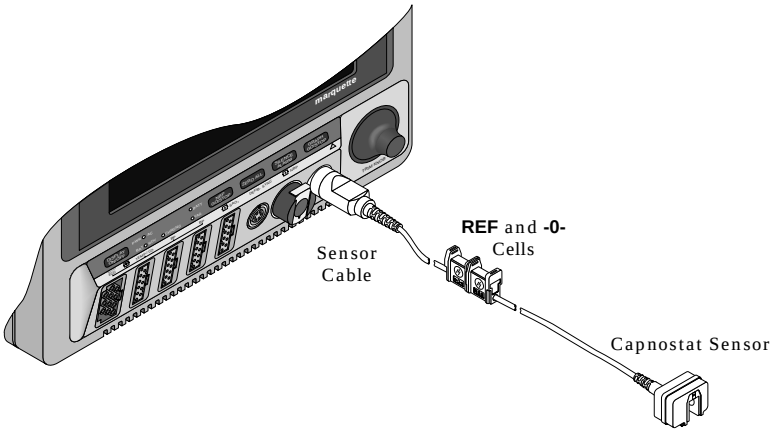
10. Remove the NBP test setup apparatus from the monitor. The NBP tests are complete.

CHECKOUT PROCEDURES (CONT)

END-TIDAL CARBON DIOXIDE TESTS

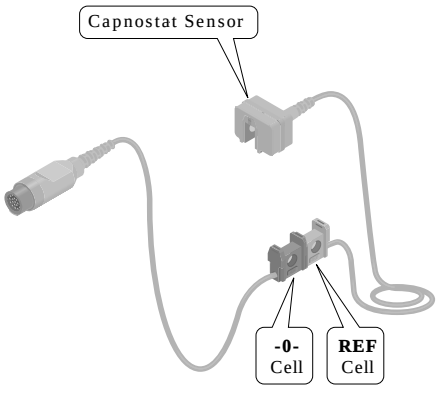
Follow these steps to test the end-tidal carbon dioxide ($EtCO_2$) functions of the monitor.

1. Connect the Capnostat Sensor Cable, pn 412340-001, into the $EtCO_2$ patient input connector on the front of the monitor (see below). The **CO2** parameter window will appear on the monitor display.



NOTE
When the Capnostat sensor cable is first connected to the monitor, there is warm-up period of approximately two minutes. The message WARMING UP is displayed in the CO2 parameter window.

When the Capnostat sensor is finished warming up, the message CAL SENSOR TO ZERO CELL will appear in the CO2 parameter window.



Capnostat Sensor Cable

The Capnostat sensor cable is equipped with two cells (see figure at left). The **-0-** cell is used to zero calibrate the sensor and the **REF** cell is used for verifying the accuracy of the Capnostat Sensor.

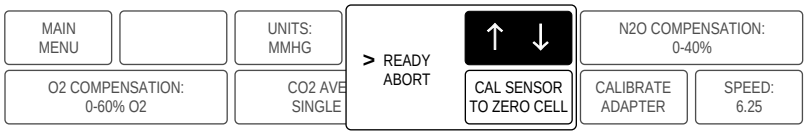
WARNING
The Capnostat Sensor should not be used in the presence of strong electromagnetic fields such as radio station transmitters, citizen's band radios, cellular phones, etc.

2. Place the sensor on the **-0-** cell.

CHECKOUT PROCEDURES (CONT)

End-tidal carbon dioxide tests (Cont)

3. Select CAL SENSOR TO ZERO CELL option from the CO2 Menu. A pop-up menu with READY and ABORT choices is displayed.

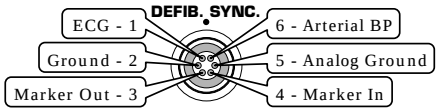


CAL SENSOR TO ZERO CELL Pop-up Menu

4. Select READY. The message CALIBRATING is displayed in the CO2 parameter window. When calibration is complete, the pop-up menu clears and an EXP value of 0 is displayed in place of the message.
5. Remove the sensor from the **-0-** cell and place it on the **REF** cell.
6. Observe an EXP value of 38 mmHg (±2 mmHg) is displayed. If the value is not within this range, contact Monitoring Technical Support.

CHECKOUT PROCEDURES (CONT)

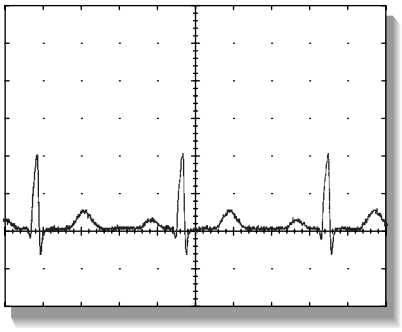
DEFIB SYNCH TESTS



To perform the defibrillator synchronization (DEFIB. SYNC.) tests, check the ECG, Arterial BP and Marker Out signals from the DEFIB SYNC front panel connector of the monitor (reference figure at left). The signals displayed on the oscilloscope should closely resemble the waveforms shown in the figures below. There are two Marker Out figures shown below. The uppermost figure references the *frequency* characteristics of the Marker Out signal and the bottom figure references the *pulse width* characteristics of that signal.

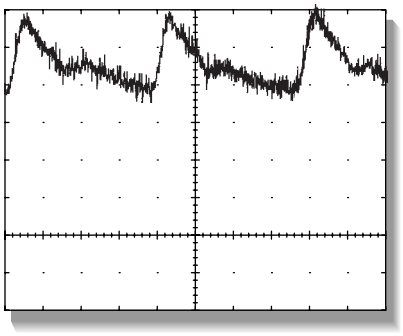
DEFIB SYNC connector: ECG

Signal Pin: 1
Ground Pin: 5
Probe Type: x10
Time/Division: 0.2S
Volts/Division: 0.5V



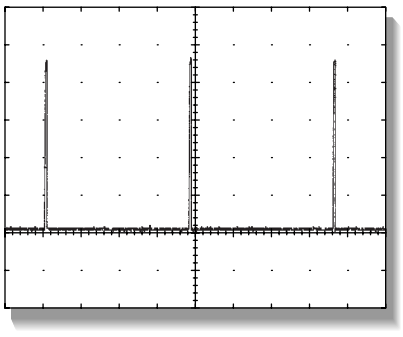
DEFIB SYNC connector: Arterial BP

Signal Pin: 6
Ground Pin: 5
Probe Type: x10
Time/Division: 0.2S
Volts/Division: 0.2V



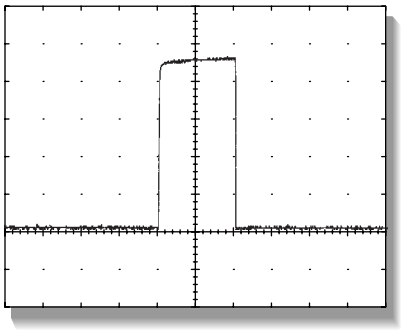
DEFIB SYNC connector: Marker Out (frequency)

Signal Pin: 3
Ground Pin: 2
Probe Type: x10
Time/Division: 0.2S
Volts/Division: 1V



DEFIB SYNC connector: Marker Out (pulse width)

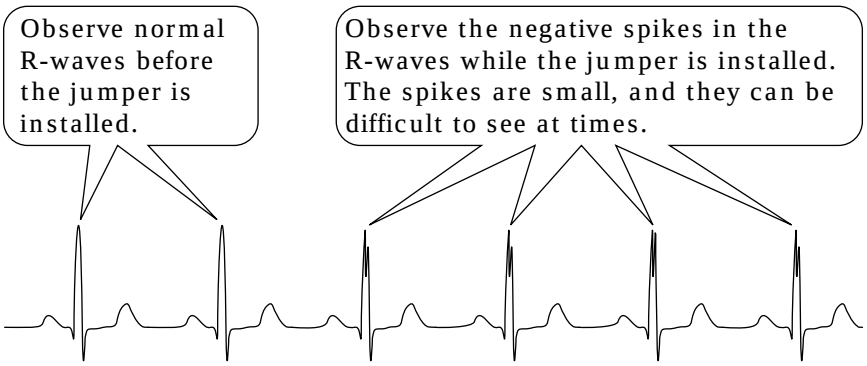
Signal Pin: 3
Ground Pin: 2
Probe Type: x10
Time/Division: 5mS
Volts/Division: 1V



CHECKOUT PROCEDURES (CONT)

Defib synch marker verification

3. Attach a jumper wire between pin 3 (Marker Out) and pin 4 (Marker In) of the DEFIB SYNC connector located on the front of the monitor. Verify negative spikes in each of the QRS Complex (ECG waveform) R-Waves on the monitor display, similar to those shown in the illustration below.



Defib synch test completion

4. Remove the jumper wire installed in the previous step, from the DEFIB SYNC connector. This completes the defibrillator synchronization tests.

CHECKOUT PROCEDURES (CONT)

BATTERY TESTS

Follow these steps to perform the battery tests.

1. Turn the monitor rear panel power switch to the off (0) position and disconnect the power cord plug from the wall receptacle.

Verify battery operation

2. Verify the PWR-BATT front panel indicator illuminates (see figure below). This indicates operation from monitor battery power.

3. Setup the patient simulator as follows:
   - ECG heart rate - 80 BPM,
   - ECG amplitude - 1.0 mV,
   - 5-lead patient cable attached.
4. Observe the following:
   - ECG Lead II is displayed and is noise-free,
   - Heart rate of 80 ±1 BPM is displayed,
   - With QRS TONES enabled, an audible tone sounds with each R-Wave.
5. Verify all seven ECG leads are selectable for display on the monitor.

Verify AC operation

6. Connect the power cord plug to the wall receptacle and turn the monitor rear panel power switch to the on (1) position.
7. Verify the PWR-AC front panel indicator illuminates (see figures below). This indicates the monitor is operating from wall receptacle (AC) power.

Verify battery charging circuit operation

8. Verify the BATT-CHRGNG front panel indicator illuminates for a few minutes. This indicates the monitor battery is charging.

9. Verify the BATT-RDY front panel indicator illuminates after a few minutes. This indicates the monitor battery has fully charged.

CHECKOUT PROCEDURES (CONT)

SPEAKER TESTS

Follow these steps to perform the speaker tests.

1. Change the alarm volume of the monitor to 100%.
2. Verify the speaker volume of the monitor changes accordingly.
3. Return the volume of the monitor to the level it was previously set to, before you changed it for this test.

CHECKOUT PROCEDURE COMPLETION

Upon completing all tests described in these checkout procedures, disconnect the monitor from the test equipment in the following manner:

1. Set all test equipment power switches to the off position.
2. Set the monitor rear panel power switch to the off (0) position.
3. Remove all test equipment from the monitor.

ELECTRICAL SAFETY TESTS

CURRENT LEAKAGE TESTS

Leakage current tests provide a method of determining potential electrical health hazard to the patient exist in the monitor. These tests generally are required by the National Fire Protection Agency (NFPA) as a part of National Electrical Code (NEC) guidelines for medical device electrical safety.

Manufacturer recommendation

It is recommended that these tests be performed upon receipt of the equipment, once per year thereafter, and each time the main enclosure is disassembled or a circuit board is removed, tested, repaired, or replaced.

WARNING

Failure to perform leakage current tests may cause undue equipment failure and potential health hazards to patients connected to the monitor. The manufacturer does not in any manner, unless an Equipment Maintenance Agreement exists, assume the responsibility for performing the leakage current tests. The sole responsibility rests with the individual or institution using the equipment. Manufacturer service representatives may, at their discretion, use this procedure as a helpful guide during visits to the equipment site.

Test conditions

Leakage current tests may be performed under normal ambient conditions of temperature, humidity, and pressure.

Test equipment

The Manufacturer recommended test equipment required to perform leakage current tests is listed below. Equivalent equipment may be substituted as necessary.

Name	Manufacturer	Part Number
Digital Multimeter	Fluke	8060A
Leakage Tester - 115V/60Hz	MEI	MT-1216-01
ECG test body	MEI	MT-3387

ELECTRICAL SAFETY TESTS (CONT)

WALL RECEPTACLE TESTS

Before starting the tests, the wall receptacle from which the monitor will get electrical power must be checked. This test checks the condition of the wall receptacle to ensure correct results from leakage tests.

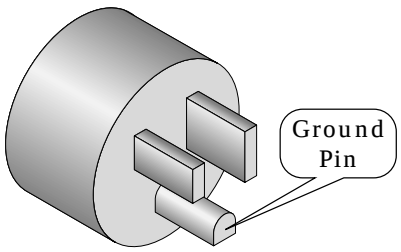
Connect the leakage tester to the wall receptacle. Observe the 0, K, and R lamps with the GND switch in the down position. For safe conditions, the lamps should reflect normal polarity and ground as shown below.

0	K	R	Condition
On	On	Off	Normal polarity and ground
Off	On	On	Reverse polarity
Off	On	Off	No ground
On	Off	Off	No neutral
Off	Off	On	No neutral/reverse polarity
Off	Off	Off	No power

If other than normal polarity and ground is indicated

If other than normal polarity and ground is indicated, corrective action must be taken before proceeding to the following steps. The results of the following steps will be meaningless unless a properly wired wall receptacle is used.

SURFACE CONTINUITY TESTS



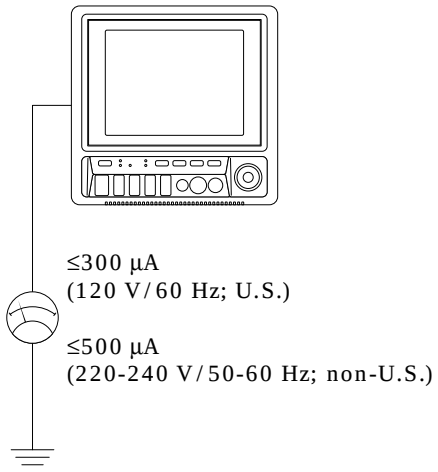
Power cord plug (120 V_{ac})

The surface continuity test provides a method of checking the integrity of the monitor relative to proper internal and external electrical ground. This test determines whether the monitor has a power ground fault.

1. Disconnect the monitor (unit under test) from any wall receptacle.
2. Connect the negative lead of a digital multimeter (DMM) to the ground pin of the unit under test's power cord plug. The figure to the left shows the location of the ground pin on a 120 V_{ac} power cord plug used in the United States. If your monitor uses a different voltage, or you live in a different country, your outlet will look different.
3. Set the DMM to the milliohms (mΩ) range.
4. Connect the positive lead of the DMM to any exposed metal surface on the unit under test.
5. Read the resistance displayed on the DMM. If the resistance is higher than 100 mΩ, the unit under test fails this test and should be repaired and tested again.

ELECTRICAL SAFETY TESTS (CONT)

GROUND WIRE TO GROUND TESTS



Perform this test to measure leakage current through the ground wire of the monitor during normal operation.

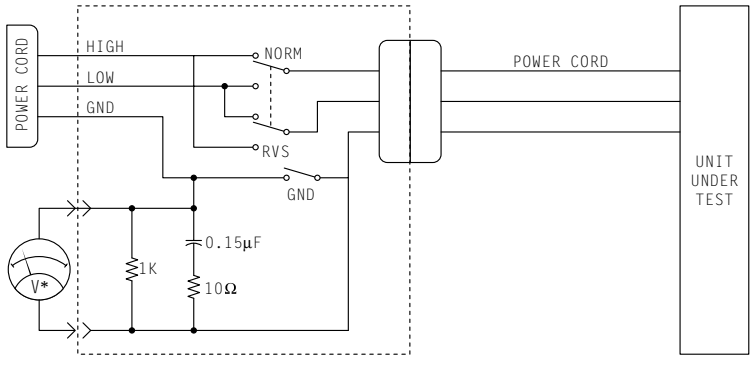
1. Set the leakage tester switches as follows:
   - Selector knob - 1,
   - GND switch - OPEN,
   - Polarity switch - NORM,
   - Power switch - OFF.
2. Connect the DMM to the METER jacks on the leakage tester. Set the DMM to measure AC millivolts.
3. Connect the power cord of the monitor to the power receptacle on the rear of the leakage tester.
4. Set the leakage tester power switch to ON.
5. Set the rear panel power switch of the monitor to ON.
6. Read leakage current indicated on DMM. If the reading is greater than:
   - 300 microamperes (µA, read as 0.3 volts on the DMM), and the monitor is operating at 120 V/60 Hz (U.S.); or
   - 500 µA (0.5 volts on the DMM), and the monitor is operating at 220-240 V/50-60 Hz (non-U.S.);

   the unit under test fails this test and should be repaired and tested again.
7. Set the polarity switch on the leakage tester to RVS (reverse).
8. Read the leakage current indicated on the DMM. If the reading is greater than:
   - 300 µA, (0.3 volts on the DMM), and the monitor is operating at 120 V/60 Hz (U.S.); or
   - 500 µA (0.5 volts on the DMM), and the monitor is operating at 220-240 V/50-60 Hz (non-U.S.);

   the unit under test fails this test and should be repaired and tested again.
9. Set the leakage tester power switch to OFF.

Electrical diagram: ground wire to ground tests

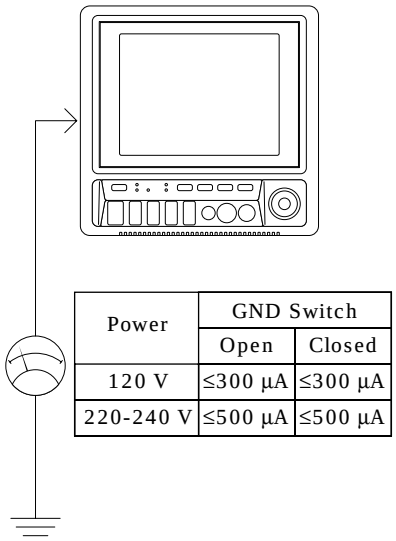
Leakage Tester



*Meter reading: 1 mV = 1 µA (leakage current)

ELECTRICAL SAFETY TESTS (CONT)

CHASSIS TO GROUND TESTS



Power	GND Switch	
	Open	Closed
120 V	≤300 µA	≤300 µA
220-240 V	≤500 µA	≤500 µA

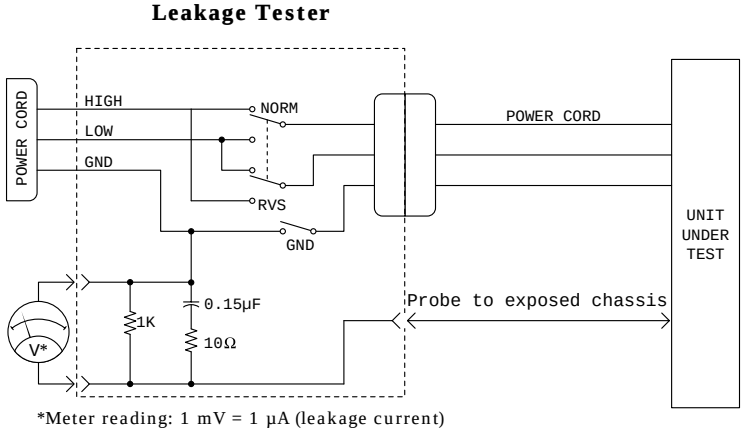
Perform this test to measure leakage current through exposed conductive surfaces on the monitor during normal operation.

1. Set the leakage tester switches as follows:
   - Selector knob - 2,
   - GND switch - OPEN,
   - Polarity switch - NORM.
2. Connect a meter lead between the CHAS connector on the rear of the leakage tester and an unpainted, non-anodized chassis ground on the unit under test.
3. Set the leakage tester power switch to ON.
4. Read the leakage current indicated on the DMM. If the reading is greater than:
   - 300 µA, (0.3 volts on the DMM), and the monitor is operating at 120 V/60 Hz (U.S.); or
   - 500 µA (0.5 volts on the DMM), and the monitor is operating at 220-240 V/50-60 Hz (non-U.S.);

   the unit under test fails this test and should be repaired and tested again.
5. Set the polarity switch to RVS and observe the same meter readings as in the previous step.
6. Set the GND switch on the leakage tester to CLOSED.
7. Read the leakage current indicated on the DMM. If the reading is greater than:
   - 300 µA, (0.3 volts on the DMM), and the monitor is operating at 120 V/60 Hz (U.S.); or
   - 500 µA (0.5 volts on the DMM), and the monitor is operating at 220-240 V/50-60 Hz (non-U.S.);

   the unit under test fails this test and should be repaired and tested again.
8. Set the polarity switch to RVS and observe the same meter readings as in the previous step.
9. Set the leakage tester power switch to OFF and remove the meter lead connected in step 2.

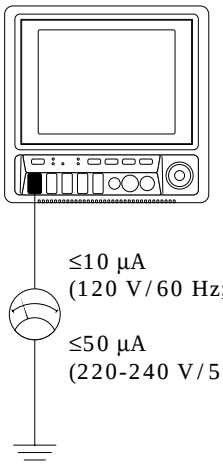
Electrical diagram: chassis to ground tests



*Meter reading: 1 mV = 1 µA (leakage current)

ELECTRICAL SAFETY TESTS (CONT)

PATIENT SOURCE TESTS



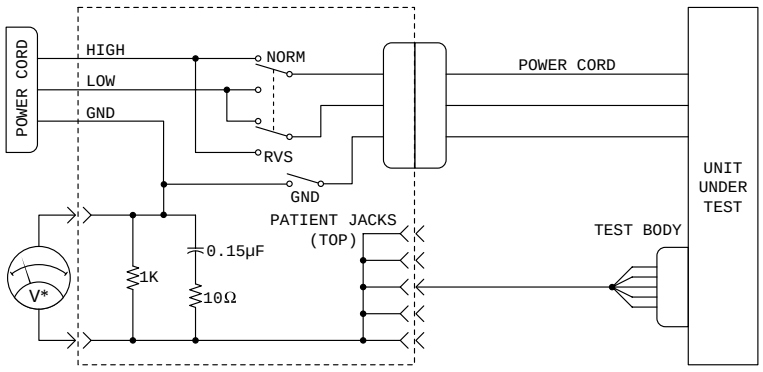
This test checks leakage current from the ECG/RESP connector of the monitor relative to ground.

1. Set leakage tester switches as follows:
   - Selector knob - 3,
   - GND switch - GND OPEN,
   - Polarity switch - NORM,
   - Power switch - OFF.
2. Connect an ECG test body to the ECG/RESP connector of the monitor.
3. Connect a short length of cable between the ECG test body installed in the last step and the jacks on the top of the leakage tester.
4. Set the leakage tester power switch to ON.
5. Set the rear panel power switch of the monitor to ON.
6. Read the leakage current indicated on the DMM.

   If the reading is greater than 10 µA (10 mV on the DMM), the unit under test fails this test and should be repaired and tested again.
7. Change the leakage tester polarity switch to the RVS position.
8. Read the leakage current indicated on the DMM.
   - 10 µA, (0.01 volts on the DMM), and the monitor is operating at 120 V/60 Hz (U.S.); or
   - 50 µA (0.05 volts on the DMM), and the monitor is operating at 220-240 V/50-60 Hz (non-U.S.);
9. Change the GND switch to the CLOSED position.

Electrical diagram: patient source tests

Leakage Tester



*Meter reading: 1 mV = 1 µA (leakage current)

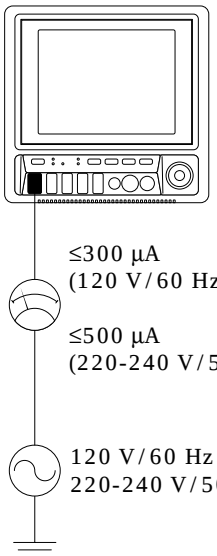
ELECTRICAL SAFETY TESTS (CONT)

Patient source tests (Cont)

10. Read the leakage current indicated on the DMM.
    - 10 µA, (0.01 volts on the DMM), and the monitor is operating at 120 V/60 Hz (U.S.); or
    - 50 µA (0.05 volts on the DMM), and the monitor is operating at 220-240 V/50-60 Hz (non-U.S.);
11. Change the leakage tester polarity switch to the RVS position.
12. Read the leakage current indicated on the DMM.
    - 10 µA, (0.01 volts on the DMM), and the monitor is operating at 120 V/60 Hz (U.S.); or
    - 50 µA (0.05 volts on the DMM), and the monitor is operating at 220-240 V/50-60 Hz (non-U.S.);
13. Set the power switch of the leakage tester to OFF.

ELECTRICAL SAFETY TESTS (CONT)

PATIENT SINK TESTS



This tests ECG connector leakage current from a 115 or 220 V_{ac} source into the ECG/RESP connector of the monitor.

1. Set the leakage tester switches as follows:
   - Selector knob - 5,
   - GND switch - CLOSED,
   - Polarity switch - NORM.
2. Disconnect the test cable from the leakage tester PATIENT JACKS (TOP) and reconnect it to the PATN JACK connector on the front panel of the leakage tester.

WARNING
The following step will cause high voltage (120 V_{ac} to 240 V_{ac}) to appear at the PATN JACK on the leakage tester. Do not touch the PATN JACK posts or ECG lead clips during this test as an electrical shock will occur.

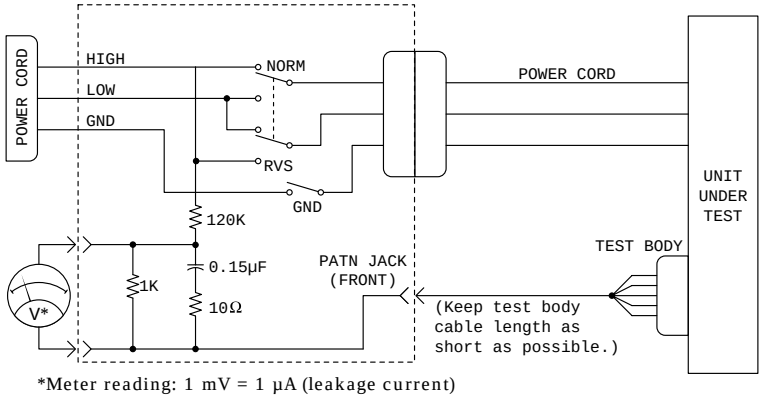
3. Set power switch on the leakage tester to ON.
4. Read leakage current indicated on DMM.

   If the reading is greater than:
   - 10 µA, (0.01 volts on the DMM), and the monitor is operating at 120 V/60 Hz (U.S.); or
   - 50 µA (0.05 volts on the DMM), and the monitor is operating at 220-240 V/50-60 Hz (non-U.S.);

   the unit under test fails this test and should be repaired and tested again.

Electrical diagram: patient sink tests

Leakage Tester



*Meter reading: 1 mV = 1 µA (leakage current)

ELECTRICAL SAFETY TESTS (CONT)

Patient sink tests (Cont)

5. Change the leakage tester polarity switch to the RVS position.
6. Read the leakage current indicated on the DMM.

   If the reading is greater than:

   - 10 µA, (0.01 volts on the DMM), and the monitor is operating at 120 V/60 Hz (U.S.); or
   - 50 µA (0.05 volts on the DMM), and the monitor is operating at 220-240 V/50-60 Hz (non-U.S.);

   the unit under test fails this test and should be repaired and tested again.

Patient sink tests completion

7. Set the power switch on the leakage tester to OFF.

TEST COMPLETION

Disconnect all test equipment from the monitor. Disconnect the monitor power cord plug from the leakage tester power receptacle. Disconnect the leakage tester from the wall receptacle.

ELECTRICAL SAFETY TESTS (CONT)

HI-POT (DIELECTRIC WITHSTAND) TESTS

The high potential (Hi-Pot) tests provide a method of checking patient isolation circuits and protect patients connected to the monitor from potential electrical health hazards. These tests are recommended for direct patient-connected medical devices to check the integrity of the patient isolation circuitry after any isolated component in the device has been repaired.

Manufacturer recommendation

The manufacturer recommends that hi-pot tests be performed whenever a circuit board in the patient-isolated portion of the monitor is removed, repaired, or replaced. Examples of patient-isolated components include, but are not limited to, the front panel patient cable connectors, the isolated power supply, or any patient data acquisition assemblies.

WARNING

Failure to perform hi-pot tests may cause undue equipment failure and possible health hazards. The manufacturer does not in any manner, unless an Equipment Maintenance Agreement exists, assume the responsibility for performing these recommended hi-pot tests. The sole responsibility rests with the individuals, hospitals or institutions utilizing this equipment. Manufacturer service representatives may, at their discretion, use this procedure as a helpful guide during visits to the equipment site.

Test conditions

These tests may be performed under normal ambient conditions of temperature, humidity, and pressure.

Test equipment

Equipment required to perform these tests is listed below. Equivalent equipment may be substituted as necessary.

Name	Manufacturer	Part Number
AC/DC Hi-Pot Generator	Hipotronics	AD125
ECG Test Body	MEI	MT-3387

Pretest preparation

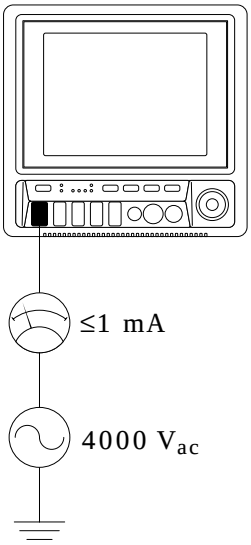
Follow these steps in the same order in which they are listed.

1. Set up the AC/DC Hi-Pot Generator in the following manner:
   - Power switch - ON,
   - VOLTAGE RANGE selector - MEDIUM (10 kVA),
   - RAISE VOLTAGE selector - 0 volts,
   - OUTPUT & CURRENT selector - 1 mA range, and
   - Allow the tester to warm up for 15 minutes before continuing with this test.
2. Connect the ground pin on the power cord connector of the monitor to the ground of the AC/DC Hi-Pot Generator.

ELECTRICAL SAFETY TESTS (CONT)

High Potential Tests (Cont)

Perform the AC hi-pot tests *only* on the ECG/RESP front panel connector of the monitor.



CAUTION
Never attempt to perform this test on any of the other front panel connectors of the monitor. Damage to the monitor may occur if this test is performed on any of the other front panel connectors.

1. Install the ECG test body in the ECG/RESP front panel connector of the monitor.
2. Connect one end of a high voltage lead to the exposed lead of the test body.
3. Connect the other end of the high voltage lead to the AC OUT connector of the AC/DC Hi-Pot Generator.

WARNING
The following step will cause high voltage (4000 V_{ac}) to appear at the test body.

4. Set the HIGH VOLTAGE switch to ON. The high voltage indicator should illuminate with this action.

NOTE
During this test, watch the analog meter to ensure the current level never exceeds 1mA. If it does, the unit has failed the test and must be repaired then tested again.

5. Slowly turn the RAISE VOLTAGE selector to 4000 volts.
6. Wait for 60 seconds. If the breakdown warning lamp illuminates or the buzzer activates before the time expires, then the unit has failed the test and should be repaired then tested again.
7. Slowly turn the RAISE VOLTAGE selector to 0 volts.
8. Set the HIGH VOLTAGE switch to OFF. The high voltage indicator should turn off.
9. If the unit under test fails, repairs must be made and the unit must be tested again.

AC hi-pot tests completion

10. This completes the AC hi-pot test. Next, perform the dc hi-pot test.

For your notes.

3 CALIBRATION

ADJUSTMENTS / JUMPERS / SWITCHES

HARDWARE CALIBRATION

The following table summarizes the hardware adjustments, switches, and jumpers on the monitor. The hardware adjustments are only necessary if a circuit board is repaired or replaced.

Leakage current tests, checkout procedures and hi-pot tests are recommended by the manufacturer if a circuit board has been repaired or replaced in the monitor. The tests and procedures for these can be found in the section titled *Maintenance* in this manual.

	Reference Designation	Description
Processor PCB	R1	Blood pressure analog output zero offset adjustment
	R2	Blood pressure analog output gain adjustment
	R6	Low battery voltage threshold adjustment
	SW1	Multipurpose, 8-station DIP switch
	W1	Battery backup enable jumper
Acquisition PCB	R33	Isolated +5-volt supply level adjustment
Power Supply PCB	R38	+12-volt main adjustment
	R43	+5-volt output adjustment
	R50	Frequency adjustment

SOFTWARE CALIBRATION

Non-invasive blood pressure (NBP) is the only function requiring software calibration. The manufacturer recommends performing this calibrations upon receipt of the monitor initially, and once each year thereafter. The calibration should also be performed whenever the monitor is opened for service purposes. This will ensure the pneumatic circuit plumbing has not developed any air leaks as a result of disassembly.

PROCESSOR PCB

ABOUT THE PROCEDURE

The processor PCB has three potentiometers, a bank of DIP switches, and one jumper on it. Each monitor is calibrated before it is shipped. Replacement assemblies are calibrated before being shipped as well. Calibration of this PCB includes blood pressure analog output null/gain and low-battery threshold. These adjustments are only required if components on the board have been replaced.

TEST EQUIPMENT

The following items are required to perform the adjustment:

- Variable DC power supply capable of generating 0.0-3.0 V_{dc}.
- Voltmeter accurate to 1.0 mV.
- Software update memory (PCMCIA) card. Because updating software is not actually required, any version software update memory card will work.

Maintain the latest software version in the monitor

NOTE

Software updates occur as necessary, either for improvement of existing software or for additional features for the monitor. Contact Technical Support for latest software information. It is recommended that the monitor have the latest revision of software installed for best overall performance.

The following pages describe the adjustments as well as how to set jumpers and switches if the processor PCB is replaced in the monitor.

CALIBRATION PROCEDURE

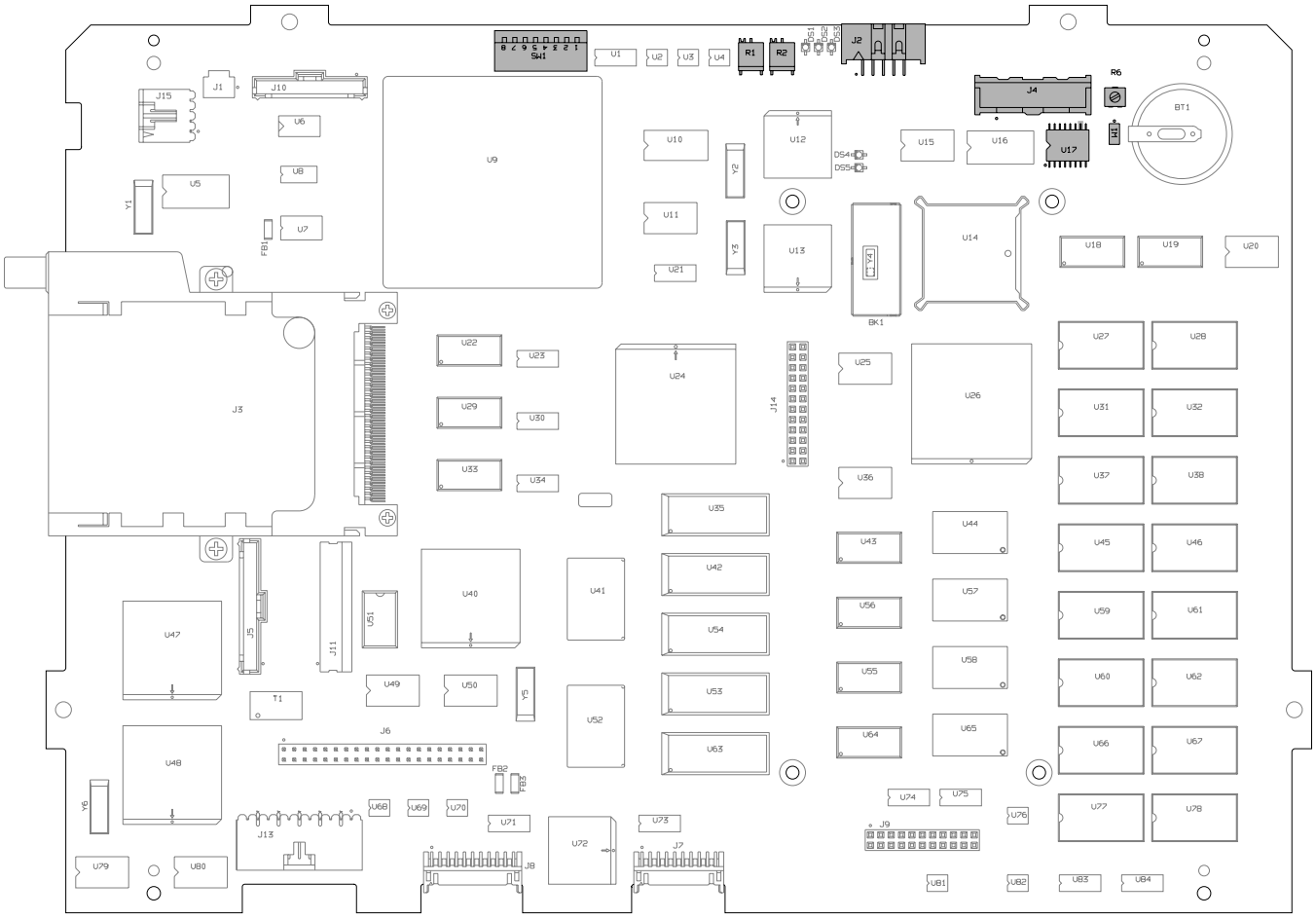
It is only necessary to make adjustments after repair or replacement of the processor PCB. Assuming a replacement processor PCB is yet to be installed, follow these steps:

1. Disassemble and install the replacement processor PCB into the monitor. Connect all cables associated with the processor PCB and other assemblies of the monitor.
2. Partially reassemble the monitor, leaving only the rear housing disassembled, allowing access to adjustments, switches, and the one jumper.
3. Insert a software update memory card into the PCMCIA card slot located on the right side of the monitor.
4. Connect a power cord to the rear panel power connector on the monitor, plug it into a working wall receptacle and toggle the rear panel main power switch to the on (1) position.

PROCESSOR PCB (CONT)

Processor PCB parts location diagram

Below is the parts location diagram for the processor PCB assembly. Reference this diagram for the location of components (highlighted) relative to calibration of this assembly.



Processor PCB Assembly (pn 800704-004)

SWITCH (SW1) SETTINGS - COLOR DISPLAY

POS.	FUNCTION	ON (CLOSE)	OFF (OPEN)
1.	PROGRAM MEMORY UPDATE	DISABLE	ENABLE
2.	BOOT FROM MEMORY CARD	ENABLE	DISABLE
3.	50/60 HZ	50 Hz	60 Hz
4.	NOT USED	N/A	N/A
5.	DISPLAY SCAN MODE	NORMAL	SPLIT
6.	PROBE TYPE	N/A	NORMAL
7.	DEFIB SYNC PULSEWIDTH	100 mS	10 mS
8.	DEFIB SYNC PULSE AMPLTD.	12 V	5 V

NORMAL SWITCH SETTINGS:
SWITCHES 1-4 & 6-8 OFF (OPEN)
SWITCH 5 ON (CLOSED)

SWITCH (SW1) SETTINGS - MONO DISPLAY

POS.	FUNCTION	ON (CLOSE)	OFF (OPEN)
1.	PROGRAM MEMORY UPDATE	DISABLE	ENABLE
2.	BOOT FROM MEMORY CARD	ENABLE	DISABLE
3.	50/60 HZ	50 Hz	60 Hz
4.	NOT USED	N/A	N/A
5.	DISPLAY SCAN MODE	NORMAL	SPLIT
6.	PROBE TYPE	N/A	NORMAL
7.	DEFIB SYNC PULSEWIDTH	100 mS	10 mS
8.	DEFIB SYNC PULSE AMPLTD.	12 V	5 V

NORMAL SWITCH SETTINGS:
ALL SWITCHES OFF (OPEN)

PROCESSOR PCB (CONT)

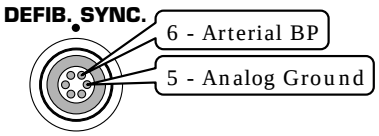
BP ANALOG OUTPUT NULL AND GAIN CALIBRATION

Use potentiometers R1 and R2 to adjust the BP analog output null (zero offset) and gain, respectively.

Start the boot loader program

1. Start the monitor Boot Loader program:
   - Press and hold the NBP GO/STOP and ZERO ALL front panel controls on the monitor,
   - Press and release the Trim Knob front panel control on the monitor,
   - Continue holding the NBP GO/STOP and ZERO ALL front panel controls until the EAGLE BOOT LOADER MENU appears on the monitor display.

Connect a voltmeter to the Defib sync jack



2. Connect a voltmeter to the Arterial BP pins of the DEFIB SYNC front panel connector (refer to the figure at left) on the monitor:
   - Connect the positive test lead of the voltmeter to pin 6, Arterial BP, of the Defib Sync jack.
   - Connect the negative test lead of the voltmeter to pin 5, Analog Ground, of the Defib Sync jack.

Calibrate BP analog output null (zero offset)

3. Dedicated circuitry on the processor PCB writes a static blood pressure value to a DAC. That value is shown on the bottom of the monitor display in both hexadecimal and decimal form. Rotate the Trim Knob control until the hexadecimal value displayed is 0x800 (the decimal value will be 2048).
4. Adjust potentiometer R1 until the voltmeter reads precisely 0.0 V_{dc}. Turning R1 clockwise increases the voltage reading on the meter and turning R1 counterclockwise decreases it.

Calibrate BP analog output gain

5. Rotate the Trim Knob control until the hexadecimal value shown at the bottom of the monitor display is 0xFFF (the decimal value will be 4095).
6. Adjust potentiometer R2 until the voltmeter reads precisely 9.995 V_{dc}. Turning R2 clockwise increases the voltage reading on the meter and turning R1 counterclockwise decreases it.

Completion of this adjustment

Each adjustment affects the other, therefore steps 8 through 11 must be repeated until accurate results are achieved. When finished with this process, press and release the Trim Knob control to exit the calibration mode.

PROCESSOR PCB (CONT)

LOW BATTERY VOLTAGE THRESHOLD CALIBRATION

A 3-volt lithium battery on the processor PCB provides backup power for memory circuits used for retaining data when the monitor is powered off. When the battery voltage diminishes to 2.1 volts, reliable memory data retention is jeopardized. The low battery voltage threshold adjustment controls the point at which the monitor posts a call service message on the display if, in fact, the battery reaches or falls below the 2.1-volt threshold level. Follow these steps to make this calibration:

Remove jumper W1

1. Carefully remove jumper W1 to disable battery power from the memory circuits. Do not loose the jumper, it is quite small and can easily be misplaced.

Adjust R6 fully cw

2. Turn potentiometer R6 fully clockwise.

Turn the monitor on and jumper J2, pins 5 & 7

3. Power the monitor up using AC power from the wall receptacle. Place a jumper wire across connector J2, pin-5 and pin-7. This holds the processor PCB in a constant reset state.

Connect the power supply, turn it on and adjust it to 3-volts

4. Follow these steps to apply 3.0 V_{dc} from an adjustable DC power supply to the processor PCB:
   - Connect the positive test lead of the adjustable DC power supply to the pin on jumper W1 that is closest to connector J4.
   - Connect the negative test lead of the adjustable DC power supply to a ground point on the processor PCB. Connector J2, pin-3 or pin-5 are probably the most convenient ground points for this.

   Turn on the adjustable DC power supply and set the output to 3.0 V_{dc}.

> **NOTE**
> If current draw from the adjustable DC power supply reads greater than 25.0 µA, replacement of the processor PCB is required

Verify U17, pin-10 is logic high

5. Using an oscilloscope or a voltmeter, verify pin 10 on microprocessor support circuit U17 is a logic high.

Adjust the power supply down to 2.1 volts

6. Slowly and evenly adjust the DC power supply down to exactly 2.1 volts. It is extremely important not to undershoot this 2.1-volt level.

Adjust R6 ccw to set the trip point of the threshold

7. While continuously observing the logic level of pin 10 on microprocessor support circuit U17, slowly and evenly adjust potentiometer R6 counterclockwise to set the trip point of the threshold. When pin 10 of U17 toggles to a logic low, the threshold has been set.

Check calibration

8. Check the calibration by varying the adjustable DC power supply from 3.0 volts down to 2.1 volts once again while observing the logic level of pin 10 on microprocessor support circuit U17. Pin 10 of U17 must switch from a logic high to a logic low state between 2.05 V_{dc} and 2.15 V_{dc}.

Replace jumper W1

9. Remove AC power from the monitor and replace jumper W1 to enable battery backup to the memory circuits.

PROCESSOR PCB (CONT)

SWITCH SETTINGS

The processor PCB has one switch, SW1, which is a 8-station DIP switch. Station 1 is the left-most station of the DIP switch. The switches are open when in the upward-most position (away from the circuit board). Each of the eight stations has a different function, as described in the following:

Station 1: Software update disable

With this switch in the closed position, software updating and NBP calibration are disabled. This switch is set to the open position for all monitors, except those located in Germany.

Station 2: Boot/Service Mode

With this switch in the closed position, two functions are set: the watchdog timer is disabled; and, the monitor is enabled to run from code stored in a memory (PCMCIA) card. This switch is set to the open position for all monitors. This switch is closed for manufacturing purposes only.

Station 3: Power Filter Frequency

With this switch in the closed position, AC power with 50 Hz line frequency can be used with the monitor. With this switch in the open position, AC power with 60 Hz line frequency can be used with the monitor.

Station 4:

This switch is not used.

Station 5: Display Type

This switch is set to the closed position for monitors with a TFT color display. Conversely, this switch is set to the open position for monitors with an EL monochrome display.

Station 6: Probe Type

This switch can only be set to the open position. Do not change the factory setting.

Station 7: Defib Sync Pulse Width

This switch determines the pulse-width of the Defib Sync output signal. When this switch is closed, the pulse-width is 100 mS. When this switch is open, the pulse-width is 10 mS. This switch is set to the open position by the manufacturer.

Station 8: Defib Sync Level

This switch determines the amplitude of the Defib sync output signal. When this switch is closed, the amplitude is 12 volts. When the switch is open, the amplitude is 5 volts. This switch is set to the open position by the manufacturer.

PROCESSOR PCB (CONT)

JUMPER SETTING

Jumper W1 is the only jumper located on the processor PCB. Jumper W1, when installed, enables memory circuit battery backup. Jumper W1 is used during the low battery voltage threshold adjustment calibration, mentioned earlier in this section. Jumper W1 is installed by the manufacturer and must remain installed on the processor PCB for proper operation of the monitor during normal use.

If removal of this jumper is necessary, be careful not to lose it or drop it into the monitor as it is quite small.

Completion

Upon completion of the processor PCB calibration, follow these steps:

1. Turn the monitor rear panel main power switch to the off (0) position. Unplug the monitor power cord from the AC power wall receptacle.
2. Remove the software update memory card from the card (PCMCIA) slot located on the right side of the monitor.
3. Power down and disconnect all test equipment and test leads from the processor PCB.
4. Finish the reassembly process by securing the rear housing to the monitor using associated hardware.
5. Perform the checkout procedures and leakage current tests as described in the section of this manual titled *Maintenance*.

ACQUISITION PCB

ABOUT THE PROCEDURE

The acquisition PCB requires calibration after a repair to ensure the accuracy of the isolated power supply voltages.

The following procedure describes calibration for the acquisition PCB +5-volt isolated power supply voltage. Potentiometers for adjusting null (zero offset) and gain of analog-to-digital converter (ADC) U32 are also located on the acquisition PCB. The ADC calibration cannot be made in the field and, therefore, no procedure for this is included in this section.

Calibration of the acquisition PCB in the field is required only after repair. Every acquisition PCB is calibrated by the manufacturer initially and after manufacturer repair. Replacement acquisition PCB's do not require calibration as a result.

TEST EQUIPMENT

A digital multimeter (DMM) accurate to 0.01-volt is required to successfully perform the calibration.

CALIBRATION PROCEDURE

To calibrate the +5-volt isolated power supply voltage, follow these steps:

1. Install the acquisition PCB into the monitor. Connect all of the cables, but do not install the RFI shield that covers the acquisition PCB.

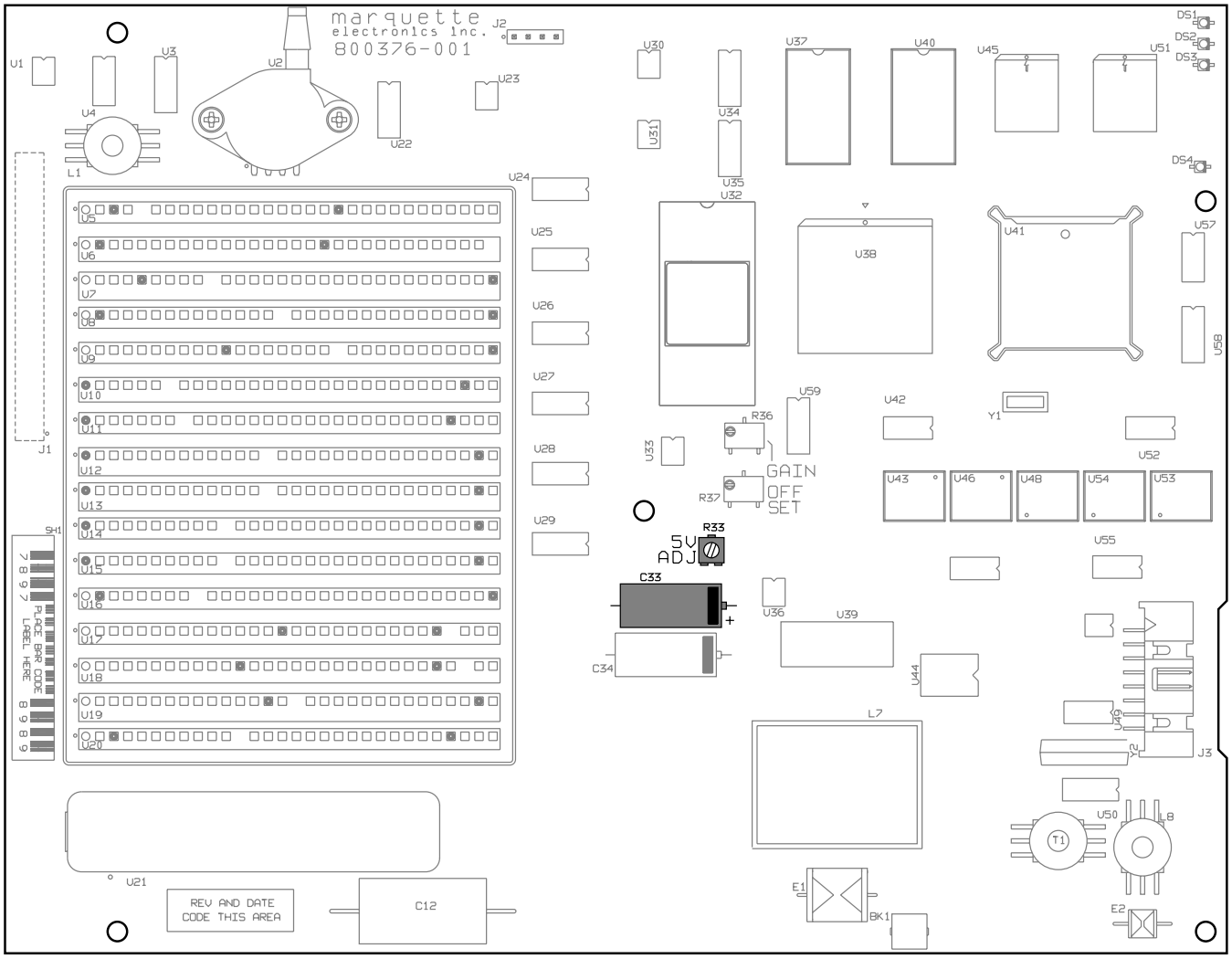
WARNING
In the following step, line voltage appears at the power inlet module. Be very careful not to touch the power inlet module during the following steps.

2. Plug the monitor power cord into an AC power wall receptacle and turn the rear panel main power switch to the on (1) position.
3. Connect a DMM across capacitor C33 and measure the +5-volt isolated supply voltage.
4. Adjust potentiometer R33 until the DMM reads +5.0 V_{dc} (±0.01V).
5. Turn the monitor rear panel main power switch to the off (0) position and unplug the power cord from the wall receptacle .
6. Reassemble the monitor with the associated hardware.
7. Perform the checkout procedures, leakage current tests, and hi-pot tests as described in the section of this manual titled *Maintenance*.

ACQUISITION PCB (CONT)

Acquisition PCB parts location diagram

Below is the parts location diagram for the acquisition PCB assembly. Reference this diagram for the location of components (highlighted) relative to calibration of this assembly.



Acquisition PCB Assembly (pn 800376-002)

POWER SUPPLY PCB

ABOUT THE PROCEDURE

It is important to calibrate your power supply PCB assembly if you ever repair it. When you calibrate the power supply, you'll make sure the +5-volt and +12-volt main output voltages are at the proper levels. You'll also make sure that the pulse width modulation controller on the circuit board is operating at the correct frequency.

You only need to calibrate the power supply PCB assembly if you repair or replace it.

TEST EQUIPMENT

The following test equipment is required to successfully complete the calibration:

- Oscilloscope (a digital voltmeter and frequency counter may be substituted)
- 5Ω/5W load resistor

CALIBRATION PROCEDURE

To complete the power supply PCB calibration, follow these steps:

1. Disconnect all cables from the power supply PCB assembly.

CAUTION
The following step is very important. If power is applied to the power supply PCB without first connecting a load resistor to the +5-volt output, damage to the circuit board may occur, and voltage readings may be incorrect.

2. Connect a 5Ω / 5W load resistor across connector J4, pin-7 and pin-8.
3. Connect cable harness plug P1 from the power transformer located in the rear housing (casting) of the monitor, to connector J2 on the power supply PCB.
4. Verify the voltage selector on the power inlet module located on the rear panel on the monitor, is in the appropriate position for the AC power being applied to the monitor.
5. Plug the power cord of the monitor into an AC power wall receptacle.

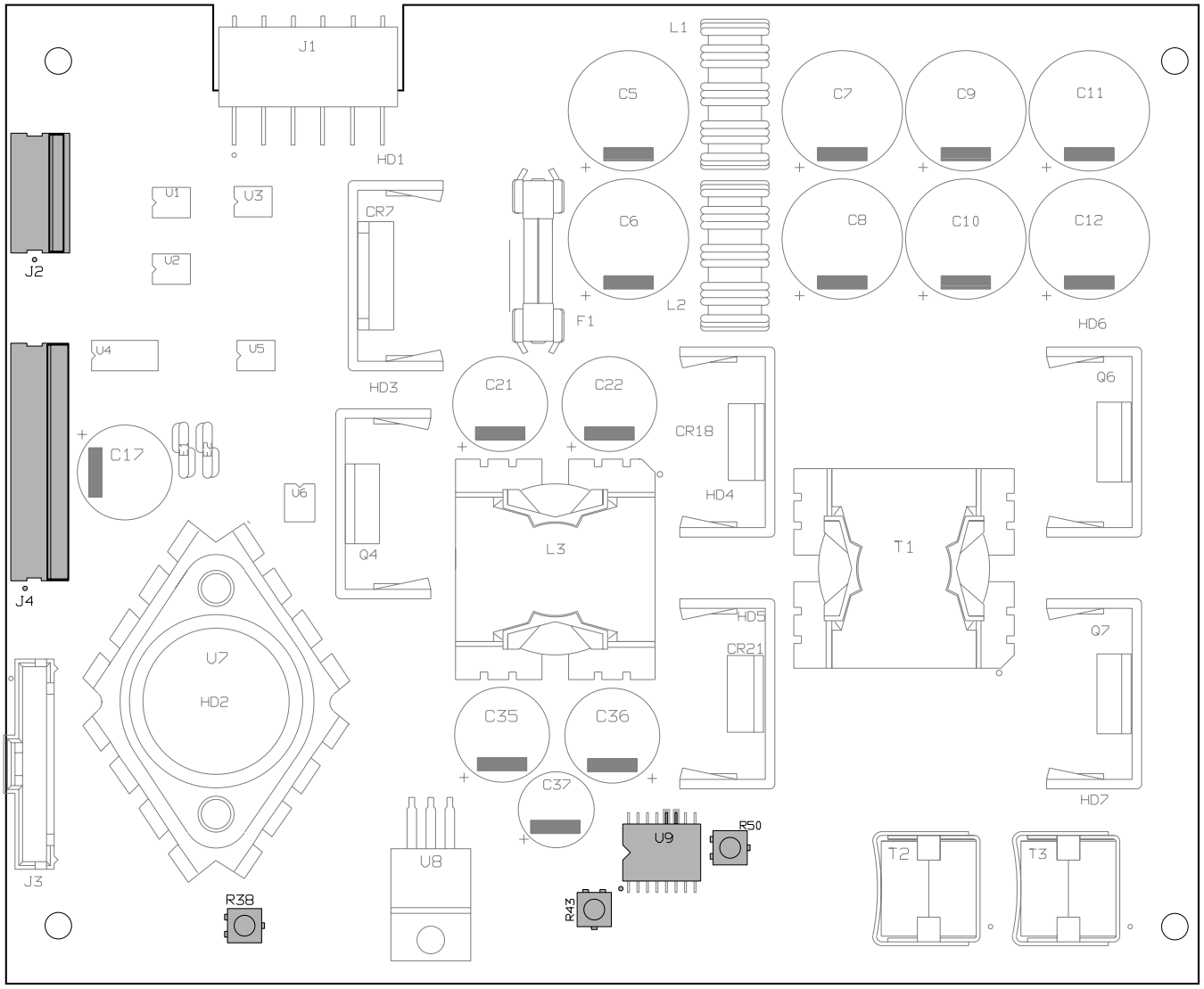
WARNING
In the following step, line voltage appears at the power inlet module. Be very careful not to touch the power inlet module during the following steps.

6. Turn the monitor rear panel main power switch to the on (1) position.

POWER SUPPLY PCB (CONT)

Power supply PCB parts location diagram

Below is the parts location diagram for the power supply PCB assembly. Reference this diagram for the location of components (highlighted) relative to calibration of this assembly.



Power Supply PCB Assembly (pn 800378-002)

POWER SUPPLY PCB (CONT)

Frequency calibration

7. Wait at least 2 minutes for the power supply PCB to warm up and stabilize sufficiently before proceeding to the next steps.
8. Connect the oscilloscope (or frequency counter) to the output of controller U9.
   - Connect the positive test lead to controller U9, pin 11,
   - Connect the negative test lead to controller U9, pin 12.
9. Adjust potentiometer R50 until the oscilloscope measures (or the frequency counter reads) 112 ±0.25 kHz.

+5 V_{dc} calibration

10. Connect the DMM (or oscilloscope) to the +5 V_{dc} output:
    - Connect the positive test lead to connector J4, pin-8,
    - Connect the negative test lead to connector J4, pin-6.
11. Adjust potentiometer R43 until the DMM reads (or the oscilloscope measures) +5 ±0.01 V_{dc}.

+12 V_{dc} main calibration

12. Connect the DMM (or oscilloscope) to the +12 V_{dc} (12V_MN) output:
    - Connect the positive test lead to connector J4, pin-4.
    - Connect the negative test lead to connector J4, pin-6.
13. Adjust potentiometer R38 until the DMM reads (or the oscilloscope measures) 12 ±0.02 V_{dc}.

Completion

14. Turn the monitor rear panel main power switch to the off (0) position and unplug the power cord from the wall receptacle.
15. Power down all test equipment and disconnect all test leads from the power supply PCB.
16. Disconnect the 5Ω 5W load resistor from connector J4.
17. Completely reassemble the monitor.
18. Perform the checkout procedures and leakage current tests as described in the section of this manual titled *Maintenance*.

NON-INVASIVE BLOOD PRESSURE

ABOUT THE PROCEDURE

The overall accuracy of non-invasive blood pressure (NBP) readings by the monitor depend on the following:

- the zero pressure reading, and
- the voltage span of the NBP sensor in the monitor.

This procedure provides a method of verifying these items are accurate and also checks the NBP pneumatic circuit plumbing for leaks.

MANUFACTURER RECOMMENDATION

The manufacturer recommends performing this procedure upon initially receiving the monitor, before it is used on a patient, and once each year thereafter. Also, perform the procedure each time the monitor is opened for service or repair, simply to verify the NBP pneumatic circuit plumbing did not develop inadvertent air leaks.

TEST EQUIPMENT

The following items are required to successfully complete the NBP calibration procedure:

- Manometer (Sensym PDM200M or mercury manometer),
- NBP tube, pn. 9461-203,
- NBP cuff, pn. 9461-301 (any size will work),
- Something to wrap the NBP cuff around (PVC pipe or coffee can),
- The table below lists items for connecting the NBP tube between the manometer and NBP cuff:

Description	Part Number	Qty
NBP cuff coupling	400787-001	1
NBP hose coupling	46100-002	1
NBP tee	4745-101	1
NBP tubing	401582-001	2

WARNING
When the NBP cuff is used in this procedure, it must be tightly wrapped around a rigid cylinder or pipe. Do not put the NBP cuff around a human arm during the calibration procedures due to the potential for injury.

NON-INVASIVE BLOOD PRESSURE (CONT)

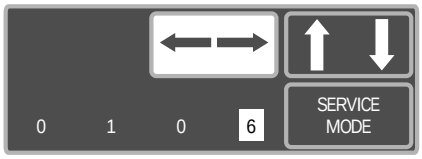
CALIBRATION PROCEDURE

Follow these steps to calibrate the NBP functions of the monitor.

1. Remove all cables except for the power cord from the monitor.
2. Apply power to the monitor.
   - Plug the power cord into a working AC power wall receptacle and turn the monitor rear panel main power switch to the on (1) position,
   - Press the DISPLAY ON/OFF front panel control on the monitor. The display should be on.
3. Use the Trim Knob control to scroll to MONITOR SETUP in the monitor main menu and press the Trim Knob control to select it.

4. Use the Trim Knob control to scroll to SERVICE MODE in the monitor setup menu and press the Trim Knob control to select it.

Enter the proper password to access the service menu



5. A service menu password window will appear on the monitor display, as shown in the figure at the left. A password is required to prevent non-service personnel from accessing the service menus. The password is four numbers that represent the date that currently resides in a memory circuit within the monitor (please note that this may or may not be the correct date). In the password, the first two numbers, starting from the left, represent the day and the second two numbers represent the month of whatever date that currently resides in the memory circuits of the monitor. For example, the seventh day of the third month (March 7th) would be represented in the password as 0703 (ddmm). Note the date that is currently on the monitor display and follow these steps to enter the password;
   - Rotate the Trim Knob control to highlight the password number that you would like to change.
   - To change the highlighted number, press the Trim Knob control.
   - Rotate the Trim Knob control until the correct number is displayed in the selected field.
   - To enter the number, press the Trim Knob control.
   - Repeat these steps until all password numbers are correctly displayed.
   - Once you have entered the correct password numbers, rotate the Trim Knob control to highlight SERVICE MODE in the enter password window.
   - Press the Trim Knob control one more time to enter the password and access the service menus of the monitor.

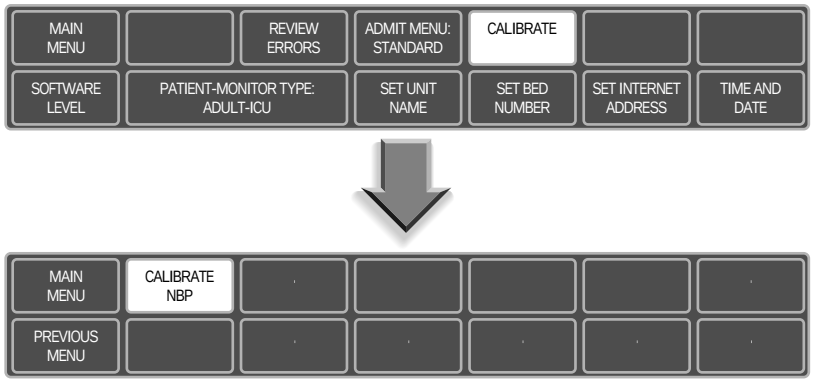
NON-INVASIVE BLOOD PRESSURE (CONT)

Service menus

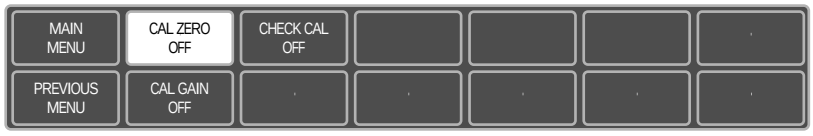
The service menus should appear on the monitor display. These next steps guide you through the service menus associated with checking NBP calibration. If desired test results are not obtained, NBP calibration will be necessary.

Enter the NBP calibration menus

6. Rotate the Trim Knob control to highlight CALIBRATE and press the Trim Knob control to select it. Next, rotate the Trim Knob control to highlight CALIBRATE NBP and press the Trim Knob control to select it.

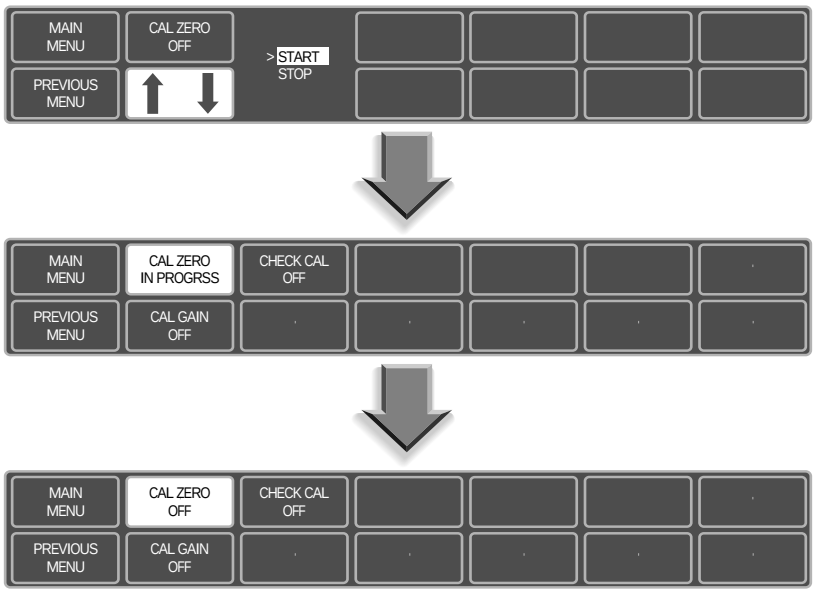


7. Rotate the Trim Knob control to highlight CAL ZERO OFF, and then press the Trim Knob control to select it.



NBP zero calibration

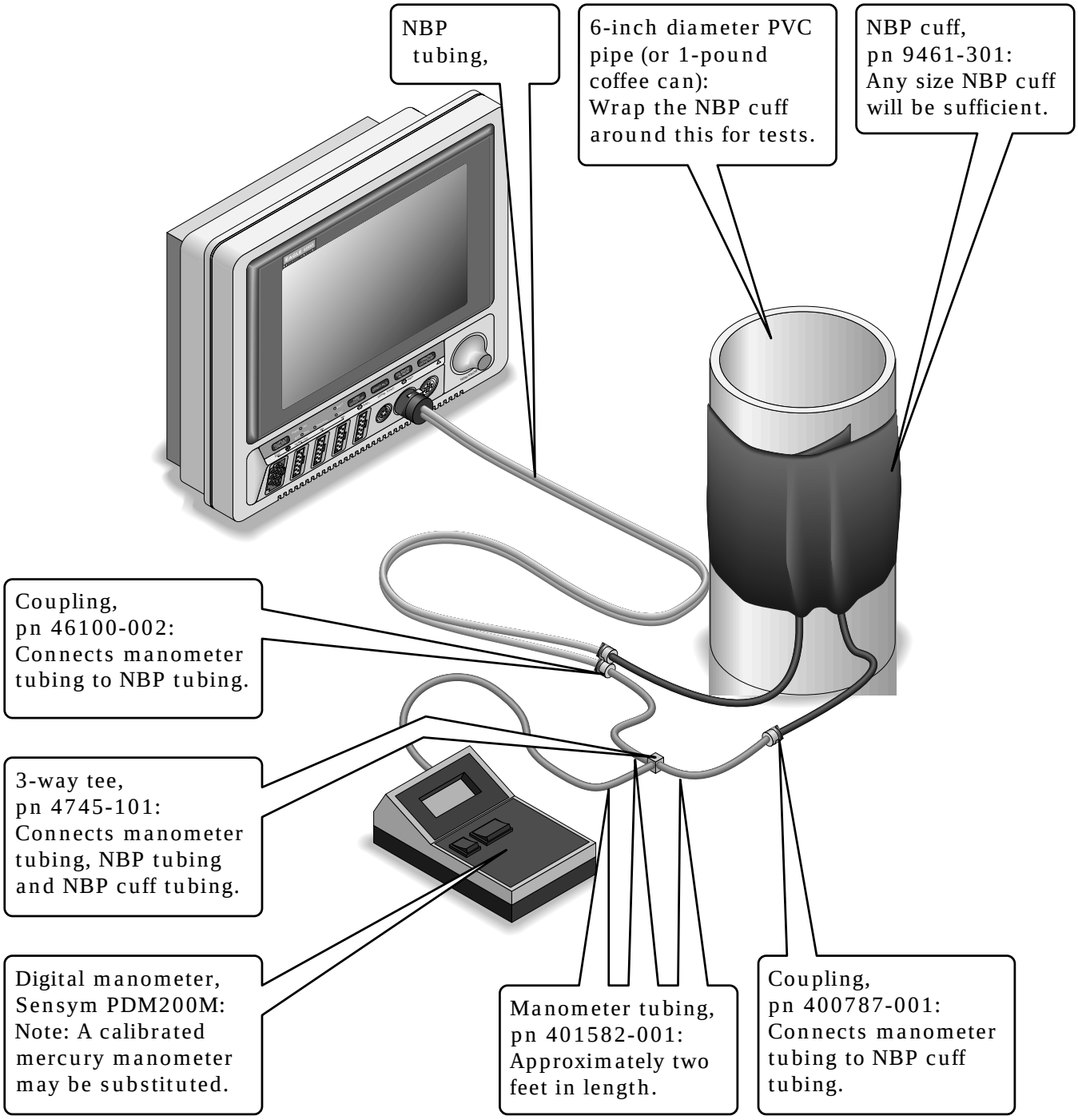
8. Rotate the Trim Knob control to highlight START, and then press the Trim Knob control to select it. The CAL ZERO menu item will show that it's IN PROGRESS, and when it's done it will show that it's OFF again.



NON-INVASIVE BLOOD PRESSURE (CONT)

NBP calibration setup

9. Connect a cuff and manometer to the monitor as shown below.



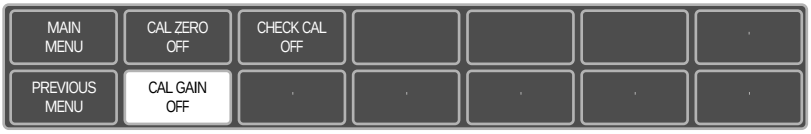
Set up the manometer

10. Turn the manometer on and adjust the range switch to the 1000mmHg setting.

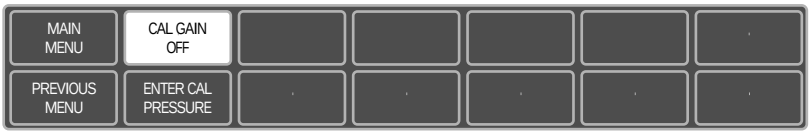
NON-INVASIVE BLOOD PRESSURE (CONT)

Start the gain calibration test

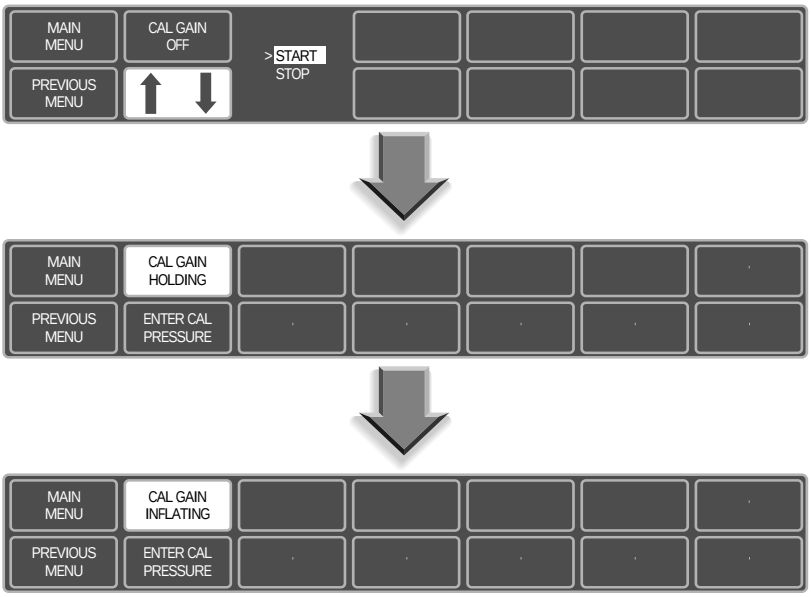
11. Rotate the Trim Knob control to highlight CAL GAIN OFF, and then press the Trim Knob control to select it.



12. Rotate the Trim Knob control to highlight CAL GAIN OFF, and then press the Trim Knob control to select it.



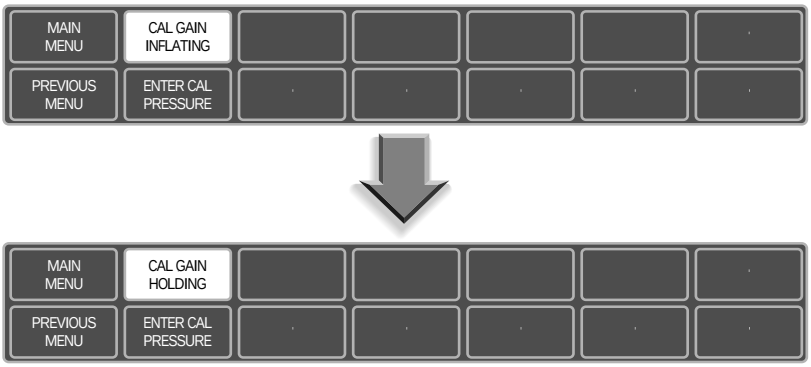
13. Rotate the Trim Knob control to highlight START, and then press the Trim Knob control to select it. The second line of text on the CAL GAIN menu item changes from HOLDING to INFLATING. Then, the monitor starts pumping up the pressure bulb or cuff—the audible whirring sound of the NBP pump motors will occur and an increase in displayed pressures on both the monitor and the manometer will be observed.



NON-INVASIVE BLOOD PRESSURE (CONT)

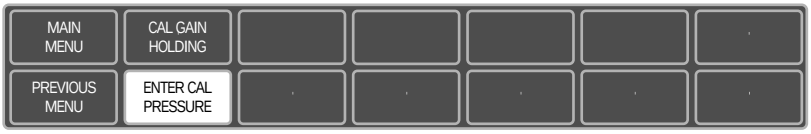
Verify the pneumatic circuit plumbing does not have air leaks

14. The pump shuts off at about 250 mmHg, and the pressure drops slowly to about 240 mmHg before stabilizing. The second line of text on the CAL GAIN menu item changes from INFLATING back to HOLDING. If the pressure continues to drop at a rate of 1 mmHg or more for every five seconds, there is a leak in the NBP plumbing. If there is a leak in the NBP plumbing, repair it and restart this calibration procedure.

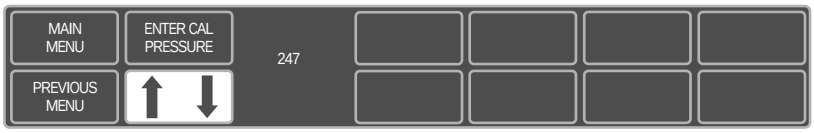


Perform the software calibration of the monitor

15. Rotate the Trim Knob control to highlight ENTER CAL PRESSURE and press the Trim Knob control to select it.



16. An ENTER CAL PRESSURE pop-up window will appear. Use the Trim Knob control to select a pressure value that is 1 mmHg lower than the current manometer reading.

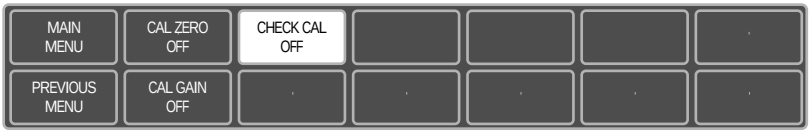


17. When the manometer falls to exactly the value that you selected in the pop-up window, press the Trim Knob control to enter the value.

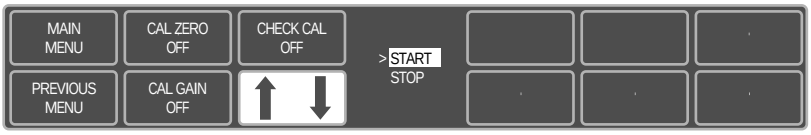
NON-INVASIVE BLOOD PRESSURE (CONT)

Start the cal check

18. Rotate the Trim Knob control to highlight CHECK CAL OFF, and then press the Trim Knob control to select it.

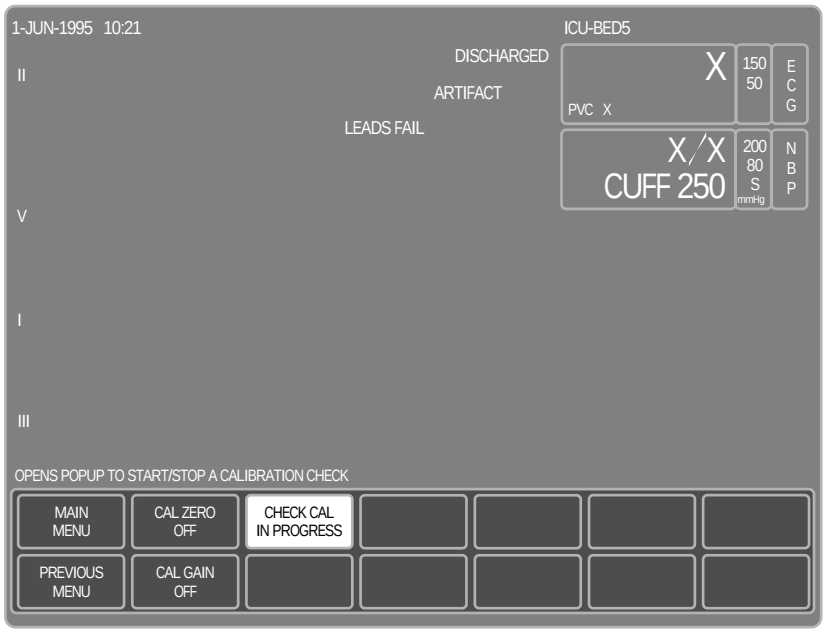


19. Rotate the Trim Knob control to highlight START and press the Trim Knob control to select it.



Verify pressure readings are accurate

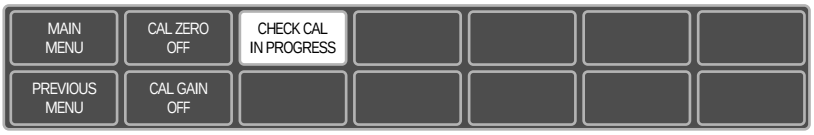
20. The text on the menu item will change from CHECK CAL OFF to CHECK CAL IN PROGRESS. Verify the pressure readings (shown as CUFF in the NBP parameter box) on the monitor and manometer are equal (±1 mmHg) for at least one full minute.



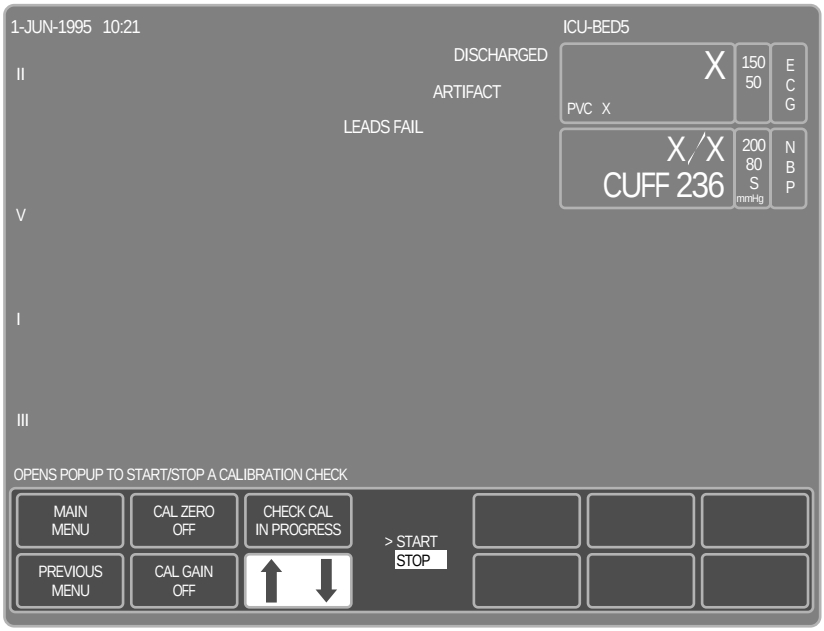
NON-INVASIVE BLOOD PRESSURE (CONT)

Stop the cal check

21. Rotate the Trim Knob control to highlight CHECK CAL IN PROGRESS and press the Trim Knob control to select it.



22. Rotate the Trim Knob control to highlight STOP and press the Trim Knob control to select it. The monitor automatically releases pneumatic pressure in the entire plumbing circuit.



Calibration procedure completion

23. Turn the monitor rear panel main power switch to the off (0) position, turn the manometer off and remove the test apparatus from the monitor.

END-TIDAL CO_2

ABOUT THE PROCEDURE

The overall accuracy of end-tidal CO_2 ($EtCO_2$) readings by the monitor depend on the following:

- the barometric pressure calibration, and
- the null and gain of the CO_2 sensor in the monitor.

This procedure provides a method of verifying these items are accurate.

TEST EQUIPMENT

The following items are required to successfully complete the $EtCO_2$ calibration procedure:

- Mercury manometer (SenSym PDM200M or laboratory grade mercury manometer),
- Two 12-inch lengths of silicone tubing (1/8" ID x 1/4" OD),
- Tubing tee fitting (3-way, 1/8"), and
- 10 cc syringe (any size will work).

PRETEST SETUP

The following steps describe the test setup for calibrating the end-tidal CO_2 functions of the monitor.

1. Remove the 4 screws on the back of the monitor.
2. Remove the front and rear housings from the monitor.
3. Unsnap the processor PCB to gain access to the $EtCO_2$ calibration tube located in the recess behind the processor PCB.
4. Connect the 3-way tee fitting to the $EtCO_2$ calibration tube affixed to the mounting frame.
5. Connect one length of silicone tubing between one of the unused tee fittings and the mercury manometer.
6. Connect the other length of silicone tubing between the remaining unused tee fitting and the 10 cc syringe.

END-TIDAL CO_2 (CONT)

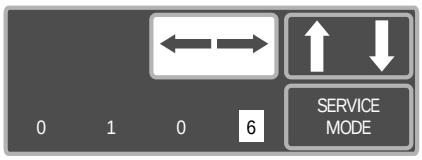
CALIBRATION PROCEDURE

Follow these steps to calibrate the $EtCO_2$ function of the monitor.

1. Turn the manometer on and adjust the range switch to the 200mmHg setting. Remove all cables from the monitor except for the AC power cord and the $EtCO_2$ sensor.
2. Apply power to the monitor.
   - Plug the power cord into a working AC power wall receptacle and turn the monitor rear panel main power switch to the on (1) position,
   - Press the DISPLAY ON/OFF front panel control on the monitor. The display should be on.
3. Use the Trim Knob control to scroll to MONITOR SETUP in the monitor main menu and press the Trim Knob control to select it.

4. Use the Trim Knob control to scroll to SERVICE MODE in the monitor setup menu and press the Trim Knob control to select it.

Enter the proper password to access the service menu



5. A service menu password window will appear on the monitor display, as shown in the figure at the left. A password is required to prevent non-service personnel from accessing the service menus. The password is four numbers that represent the date that currently resides in a memory circuit within the monitor (please note that this may or may not be the correct date). In the password, the first two numbers, starting from the left, represent the day and the second two numbers represent the month of whatever date that currently resides in the memory circuits of the monitor. For example, the seventh day of the third month (March 7th) would be represented in the password as 0703 (ddmm). Note the date that is currently on the monitor display and follow these steps to enter the password;
   - Rotate the Trim Knob control to highlight the password number that you would like to change.
   - To change the highlighted number, press the Trim Knob control.
   - Rotate the Trim Knob control until the correct number is displayed in the selected field.
   - To enter the number, press the Trim Knob control.
   - Repeat these steps until all password numbers are correctly displayed.
   - Once you have entered the correct password numbers, rotate the Trim Knob control to highlight SERVICE MODE in the enter password window.
   - Press the Trim Knob control one more time to enter the password and access the service menus of the monitor.

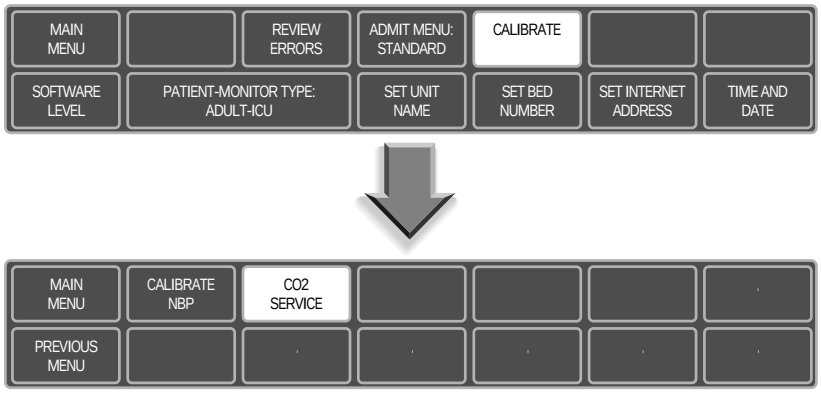
END-TIDAL CO_2 (CONT)

Service menus

The service mode menu should appear on the monitor display. These next steps guide you through the service menus associated with checking CO_2 calibration. If desired test results are not obtained, CO_2 calibration will be necessary.

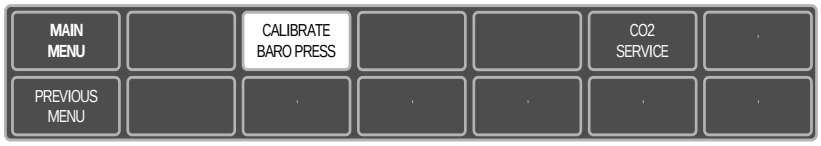
Enter the CO_2 service menu

6. Rotate the Trim Knob control to highlight CALIBRATE and press the Trim Knob control to select it. Next, rotate the Trim Knob control to highlight CO2 SERVICE and press the Trim Knob control to select it.



Enter the barometric pressure calibration menu

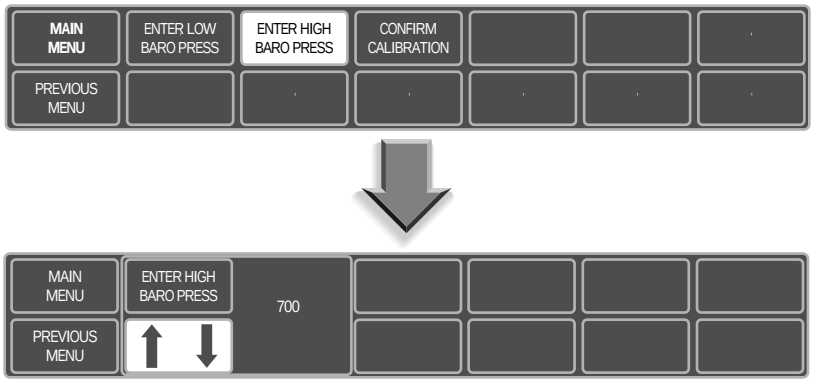
7. Rotate the Trim Knob control to highlight CALIBRATE BARO PRESS, and press the Trim Knob control to select it.



High barometric pressure calibration

8. Use the 10 cc syringe to create a 35 ±1 mmHg reading on the manometer.

9. Rotate the Trim Knob control to highlight ENTER HIGH BARO PRESS, and press the Trim Knob control to select it. The ENTER HIGH BARO PRESS pop-up window will appear on the display.



END-TIDAL CO_2 (CONT)

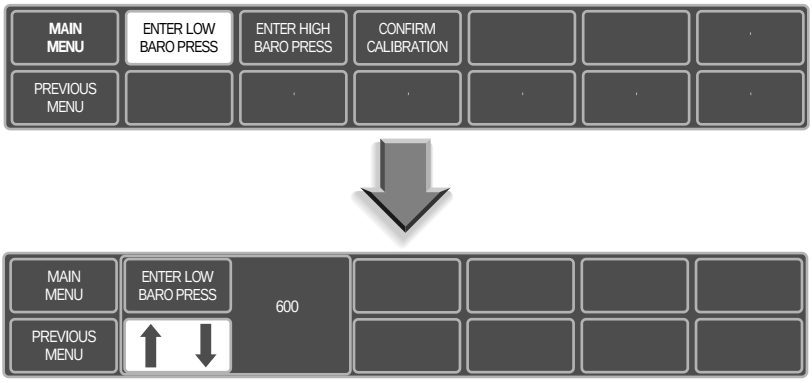
Enter the high barometric pressure value into the monitor

9. Take the current atmospheric barometer reading (local weather service can provide this data if a laboratory grade barometer is not available) and add 35 mmHg. Rotate the Trim Knob control until the correct number (mmHg) is displayed and press the Trim Knob control to enter the value into the monitor.

NOTE
785 mmHg is the maximum barometric pressure value which can be entered into the monitor.

Low barometric pressure calibration

10. Use the 10 cc syringe to create a -100 ±1 mmHg reading on the manometer.
11. Rotate the Trim Knob control to highlight ENTER LOW BARO PRESS, and press the Trim Knob control to select it. The ENTER LOW BARO PRESS pop-up window will appear on the display.



Enter the low barometric pressure value into the monitor

12. Take the current atmospheric barometer reading (local weather service can provide this data if a laboratory grade barometer is not available) and subtract 100 mmHg. Rotate the Trim Knob control until the correct number (mmHg) is displayed and press the Trim Knob control to enter the value into the monitor.

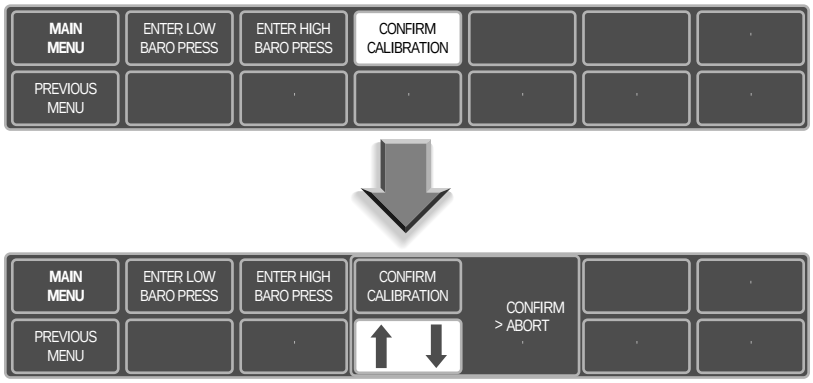
NOTE
530 mmHg is the minimum barometric pressure value which can be entered into the monitor.

CAUTION
The high and low barometric pressures must have a 100 mmHg differential minimum for calibration to be successfully confirmed.

END-TIDAL CO_2 (CONT)

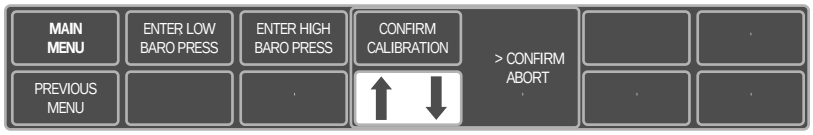
Confirm the pressure calibration

13. Rotate the Trim Knob control to highlight CONFIRM CALIBRATION, and then press the Trim Knob control to select it.

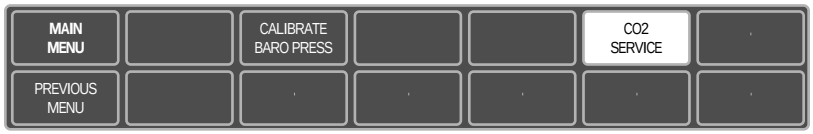


Select confirm from the pop-up menu

14. Rotate the Trim Knob control to move the cursor so it points at CONFIRM in the pop-up window, and press the Trim Knob control to confirm the calibration.



15. Rotate the Trim Knob control to highlight PREVIOUS MENU, and press the Trim Knob to move to the CO2 SERVICE menu.
16. Remove the 10 cc syringe from the test setup.
17. Rotate the Trim Knob control to highlight CO2 SERVICE, and press the Trim Knob to select it.



18. Verify the displayed barometric pressure listed in the pop-up window on the monitor is the same as the current atmospheric barometric pressure reading ±5 mmHg.

END-TIDAL CO_2 (CONT)

Verify calibration using the Capnostat sensor

19. Return to the main menu of the monitor.
20. With the Capnostat sensor attached to the front panel connector of the monitor, put the sensor into the zero reference (→ 0 ←) cell mode.
21. Use the Trim Knob control to select the CO_2 parameter menu. Rotate the Trim Knob control to highlight CAL SENSOR TO ZERO CELL, and press the Trim Knob to select it. A CALIBRATING message will appear in the CO_2 parameter box.
22. After zero calibration is complete, put the sensor into the reference (REF) cell mode.
23. Verify the reading in the CO_2 parameter box displays 38 ±2 mmHg.

For your notes.

4 CONFIGURATION

MONITOR CONFIGURATIONS

SETUP FOR USE

The last part of this section is devoted to setup or configuration of the monitor. Also refer to the **Marquette Unity Network User's Manual** (pn 403799-023), for information relative to setup or configuration of other patient monitoring system components.

STAND-ALONE

The monitor is fully functional with respect to patient monitoring capabilities when operating without connection to a network or any other devices for that matter.

Refer to the Eagle 4000 Monitor Operator's Manual, pn 407300-145 (version 5 software), for more information regarding all patient monitoring functions of the monitor.

NETWORK INTERFACE

The monitor can be connected to many peripheral devices, other patient monitoring devices, diagnostic devices, as well as other hospital-wide network systems by direct connection to The Marquette Unity Network.

INSTALLING SOFTWARE

METHODS FOR DOWNLOADING SOFTWARE

This part of the section describes three procedures for downloading software to the monitor flash memory circuits. Following is a brief description of each procedure:

Update from network

- Update from Network — One procedure is for downloading software to the monitor from a Centralscope Central Station in networked patient monitoring system configurations. Using floppy disks, software is loaded to a central station hard disk drive. The central station then acts as a file server for downloading software over the network to each monitor. This procedure is only for monitors networked with a Centralscope Central Station;

Update from memory cards

- Update from Memory Cards — This procedure is for downloading software to the monitor from a memory card plugged directly into the PCMCIA card slot on the side of the monitor. This is for monitors that operate in one of the following patient monitoring system configurations:
  - Stand-alone monitors *not* connected to a networked patient monitoring system, or
  - Monitors connected to a networked patient monitoring system *without* Centralscope Central Station monitors.

  In either case, a memory card is plugged into the PCMCIA memory card slot and software is download directly to permanent memory circuits in the monitor;

Update from diskettes using a PC

- Update from Diskette — In this procedure the monitor is connected directly to a personal computer (PC) or PC laptop. This is for monitors that operate in one of the following patient monitoring system configurations:
  - Stand-alone monitors *not* connected to a networked patient monitoring system, or
  - Monitors connected to a networked patient monitoring system *without* Centralscope Central Station monitors.

NOTE

The monitor being updated must already be running software version 6a or later in order to update from diskettes. Refer to the Update from Diskette section later in these instructions.

In either case, the Update Program is run off the update disketes and the software is downloaded to the monitor via serial communication.

INSTALLING SOFTWARE (CONT)

Follow the correct procedure

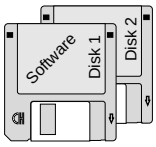
Follow the procedure best suited for each application of the monitor. The manufacturer recommends completely reading all of these instructions prior to any attempt to load or update software. This is particularly important if this is a first attempt to load or update software in the monitor.

INTENDED USE

This document is prepared for the purpose of loading manufacturer software into the monitor initially, reloading software when the possibility of corrupted software exists, or updating software in the event of a release of a new software revision.

AVAILABLE SOFTWARE

The following types of software media are available from the manufacturer for downloading software to the monitor:



- 3.5-inch floppy diskettes are available from the manufacturer to download software to the monitor if:
  - the monitor and at least one Centralscope Central Station monitor are interconnected in a networked patient monitoring system configuration, or
  - the monitor and a PC or PC laptop are interconnected via serial communication and the monitor is already running software version 6a or later.

- Memory cards are available from the manufacturer to download software to the monitor if:
  - the monitor is stand-alone, or
  - a Centralscope central station is not connected or available to the monitor in a networked patient monitoring system configuration, or
  - a PC or PC laptop is not connected or available to the monitor via serial communication.

INSTALLING SOFTWARE (CONT)

SUMMARIZED DOWNLOAD PROCEDURES

The following summary is for service personnel already experienced in downloading software to the monitor.

NOTE
The serial download option using a PC is only available for updating monitors already running software version 6a or later. Refer to the section Update Software from Diskette later in these instructions for more information on the serial download process.

1. Disconnect any DDW cables or remote controls from the monitor. If using the memory card to download software to the monitor, disconnect the attachment unit interface (AUI) cable from the ETHERNET rear panel connector on the monitor.
2. Verify that the monitor has AC power.
3. If using a central station monitor to download software to the monitor, load the software from the diskettes onto a central station first. If using a memory card to download software to the monitor, insert it into the PCMCIA card slot on the right side of the monitor.
4. Start the monitor boot loader. Select the appropriate option (the care unit name of the central station, **Memory Card**, or **localHost**) from the file server selection menu.
5. If you are updating from software version 5c or earlier, a conversion procedure must be done before updating the software:
   - Select **/update.net/eagle** from the mount pt selection menu.
   - Select **tool.scr** from the script name selection menu.
   - Select YES when prompted LOAD THESE tool.scr PARTS?.
   - When the conversion process is complete, the screen will return to the file server selection menu. Continue with step 6.
6. If you have already loaded the conversion tool, continue by loading the boot code (boot.scr) from the script name selection menu. If you are updating a monitor already running software version 6a or later, you do not need to load the boot code. Continue with step 7.
7. Load the acquisition processor code (das.scr) from the script selection menu.
8. If the monitor being updated is equipped with option CO2, load the CO2 main code (co2main.scr) from the script selection menu.
9. Load the main code (main.scr) from the script selection menu.

INSTALLING SOFTWARE (CONT)

SUMMARIZED DOWNLOAD PROCEDURES (CONT)

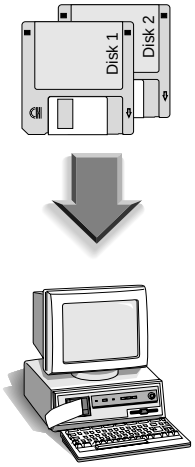
10. Set up a graph location for each of the three types of graphs in the GRAPH LOCATION MENU, accessed from the monitor setup menu.
11. Verify that the software was downloaded to the monitor successfully by viewing the SOFTWARE REVISION pop-up window from the monitor setup menu.
12. Perform the procedures described in “Setup for Use” in the configuration section of the service manual.
13. If software was downloaded for the purpose of updating the monitor to a new version of software, documentation will be supplied by the manufacturer in a software update kit. Completely fill out all documentation as required by the manufacturer.

LOAD SOFTWARE FOR UPDATE

USE THE CORRECT LOADING PROCEDURE

To update software *from a Centralscope Central Station*, follow the procedure described below. If you are updating software from memory cards, see page 10 for instructions on loading software from memory cards. If you are updating software from a PC using diskettes, refer to the section "Update Software From Diskette" later in these instructions.

LOAD SOFTWARE ONTO A CENTRAL STATION



Load software from disk #1 onto a central station

This procedure assumes that the Centralscope Central Station is currently running version 8 (or later) software. If the central station has an earlier version of software, it must be updated to the current version before proceeding. Refer to the Centralscope Central Station Update Instructions for more information. Contact your regional sales representative for the latest revision level and part numbers. Refer to the addendum at the beginning of these instructions for current Eagle 4000 revision levels and part numbers.

1. Insert Diskette #1 into the floppy disk drive on the front panel of the central station monitor.

CAUTION
This installation requires all diskettes to be available for successful downloading of software to the central station monitor internal hard disk drive.

2. Press the MAIN MENU front panel control on the Centralscope central station.
3. Rotate the Trim Knob control until CENTRAL SETUP from the main menu of the central station is highlighted and press the Trim Knob control to make the selection.
4. Rotate the Trim Knob control until SERVICE from the central setup menu is highlighted and press the Trim Knob control to make the selection.
5. The central station service menu requires a password for entry. Type **mei cs 123** (note the spaces between each part of the password; the password is not upper/lower case sensitive) and press the ENTER key on the central station keyboard to enter the password.
6. Rotate the Trim Knob control until LOAD SOFTWARE from the service menu is highlighted and press the Trim Knob control to make the selection.
7. Wait for approximately ten seconds.

LOAD SOFTWARE FOR UPDATE (CONT)

8. Rotate the Trim Knob control until FLOPPY appears in the load software pop-up window and press the Trim Knob control to make the selection. The central station monitor will display a LOADING FROM...FLOPPY message in the upper-left corner of the display. The message is soon replaced by LOADING DISK EAGLE E4_6X #1 OF 3... . Diskette #1 will take approximately 10 minutes to load completely.

NOTE
The central station monitor may display status messages other than those described in these instructions. If, after waiting at least 20 minutes, the floppy drive ejects diskette #1 and diskette #2 is requested to be inserted, continue with the next step. Otherwise, you will have to reboot the central station monitor and start over from step 1, an error occurred and the download automatically aborted.

Load software from disk #2 onto a central station

9. When disk #1 is finished loading, the central station will automatically eject the disk and display the message: INSERT DISK EAGLE E4_6X #2 OF 3... . Insert Disk #2 into the floppy disk drive on the front panel of the central station monitor.

NOTE
A message is displayed in the upper left corner of the central station display: LOADING DISK EAGLE E4_6X #2 OF 3... . Diskette #2 will take approximately 5–10 minutes to download.

Load software from disk #3 onto a central station

10. When diskette #2 is finished loading, the central station will automatically eject the disk and display the message: INSERT DISK EAGLE E4_6X #3 OF 3... . Insert Disk #3 into the floppy disk drive on the front panel of the central station monitor.

NOTE
A message is displayed in the upper left corner of the central station display: LOADING DISK EAGLE E4_6X #3 OF 3... . Diskette #3 will take approximately 5–10 minutes to download. When downloading of diskette #3 is complete, the central station floppy disk drive will automatically eject the diskette and display the message: LOAD FROM FLOPPY COMPLETE.

LOAD SOFTWARE FOR UPDATE (CONT)

NOTE
For Centralscope Central Stations that have version 9A (or later) software installed, skip Step 11 and proceed to Step 12.

If the central station has never been used to load software to a monitor before, it must "learn" how to make the software available to the monitor via the network

11. The central station (with version 8E or earlier software installed) has now downloaded the monitor software onto its internal hard disk drive. If the central station has never been used to download software to a monitor before, it must be taught how to make the software available to the monitor via the network. To do this, simultaneously press the Ctrl, Alt, and Delete (backspace) keys on the keyboard to reboot the central station.

CAUTION
Central station monitoring functions will be disrupted for approximately 90 seconds while the device reboots.

If it is possible to reboot the central station without interrupting patient monitoring, by moving monitored patients to another central station for instance, do that before proceeding.

If a monitor has never downloaded software from a central station via the network before, and the central station is busy monitoring patients, follow these steps:

- Rotate the Trim Knob control until SERVICE MONITOR from the service menu is highlighted and press the Trim Knob control to make the selection. The right side of the central station display will turn into an area for command entry with a prompt at the bottom of that part of the display screen; it appears very similar to a DOS-prompt on a PC display screen.
- Type: **ps eaglefs** (note the space between the command parts; this command is upper/lower case sensitive) and press the Enter key on the keyboard to enter the command into the central station. The central station responds in one of two ways:

a. If the central station is not running eaglefs, it responds with an invalid process id or name message. If this is the case, start eaglefs to teach the central station how to download software to the monitor.

b. If the central station lists eaglefs as a running process, you can just press the MAIN MENU key on the front panel to exit the service mode and proceed to step 12.

LOAD SOFTWARE FOR UPDATE (CONT)

Step 11 (Cont)

- If the central station isn't running eaglefs, type: **run eaglefs HDØ** (note the spaces between the command parts; this command is upper/lower case sensitive) and press the Enter key on the keyboard to enter the command into the central station.
- Press the MAIN MENU key on the front panel of the central station to exit the service mode and return the central station main menu and display.

DOWNLOAD FROM A CENTRAL STATION TO THE MONITOR

When the diskettes have finished loading onto the central station, complete the remaining steps.

12. If a memory card is installed in the monitor, remove it.
13. If there are any remote controls or DDWs connected to the monitor, disconnect them.
14. Apply AC power to the monitor.
15. Turn the rear panel power switch to the on (1) position and make sure that the PWR AC indicator on the front panel lights up.

Start the monitor boot loader program

16. To start the monitor Boot Loader program:
    - Hold down the NBP GO/STOP and ZERO ALL front panel controls on the monitor,
    - Press and release the Trim Knob control.
    - Continue to hold the NBP GO/STOP and ZERO ALL front panel controls until the Eagle Boot Loader menu appears on the monitor display.

Select the central station to load software from

17. Observe the monitor display. In less than ten seconds a FILE SERVER SELECTION menu appears on the display. At the FILE SERVER SELECTION menu:
    - Find the care unit name of the appropriate central station (the one that has the monitor software on its internal hard disk drive) in the file server selection menu,

> **NOTE**
> If the care unit name of the central station you are using doesn't appear in the file server selection menu, use the Search for fileserver option to look for the appropriate care unit name again.

    - Rotate the Trim Knob control until the correct number of the appropriate central station is displayed in the file server selection menu, and
    - Press and release the Trim Knob control to make the selection.

    A network communication path between the monitor and the central station is established. The central station is acting as a file server for downloading software from its hard disk drive to the monitor via the established network communication path.
18. Continue the update process by following the "Load the version 6 conversion tool" procedure described on page 11.

LOAD SOFTWARE FOR UPDATE (CONT)

USE THE CORRECT LOADING PROCEDURE

To update software *using memory cards*, follow the procedure described below. If you are updating software from a Centralscope Central Station, see page 6 for instructions on loading software from the central station. If you are updating software from a PC using diskettes, refer to the section "Update Software From Diskettes Usinbg A PC" later in these instructions.

DOWNLOAD FROM MEMORY CARD TO THE MONITOR

Follow these steps to download software from the memory cards to the monitor. Refer to the addendum at the beginning of these instructions for current Eagle 4000 revision levels and part numbers.

Start the monitor boot loader program

1. If a memory card is installed in the monitor, remove it by pushing in the black button above the PCMCIA card slot on the right side of the monitor.
2. If there are any remote controls or DDWs connected to the monitor, disconnect them. If the monitor is connected to the network, disconnect the AUI cable from the monitor rear panel (ETHERNET) connector.
3. Apply AC power to the monitor.
4. Turn the rear panel power switch to the on (1) position and make sure that the PWR AC indicator on the front panel lights up.
5. Start the monitor Boot Loader program:
   - Hold down the NBP GO/STOP and ZERO ALL front panel controls on the monitor,
   - Press and release the Trim Knob control,
   - Continue to hold the NBP GO/STOP and ZERO ALL front panel controls until the Eagle Boot Loader menu appears on the monitor display.

Insert the memory card into the monitor card slot

6. Insert the first memory card into the PCMCIA card slot on the right side of the monitor. The side of the memory card with the purple stripe and the word "Flash" should face the rear of the monitor and Marquette's label should face the front of the monitor. Insert the edge of the memory card with the connector interface into the PCMCIA card slot first.
7. Observe the monitor display. In less than ten seconds a FILE SERVER SELECTION menu appears on the display. If the FILE SERVER SELECTION menu does not appear after 10 seconds, use the Search for Fileserver option to look for it again. At the FILE SERVER SELECTION menu:
   - Find the **localHost** or **Memory Card** option in the file server selection menu,
   - Rotate the Trim Knob control until the number corresponding to the **localHost** or **Memory Card** menu item is displayed, and
   - Press and release the Trim Knob control to make the selection.
8. Continue the update process by following the "Load the version 6 conversion tool" procedure described on the next page.

LOAD THE VERSION 6 CONVERSION TOOL

DOWNLOAD THE VERSION 6 CONVERSION TOOL

Monitors running software version 5C or earlier must have a special software conversion tool loaded in order to update the software to version 6a or later. The procedure below describes how to load this conversion tool.

NOTE

If the monitor being updated is already running software version 6a or later, you do not need to load the conversion tool. Proceed to the Download the Software Components section on page 14.

Load update.net/eagle

1. When the MOUNT PT SELECTION menu appears on the monitor display:
   - Find the **/update.net/eagle** option in the mount pt selection menu,
   - Rotate the Trim Knob control until the number corresponding to the **/update.net/eagle** menu item is displayed, and
   - Press and release the Trim Knob control to make the selection.

Load tool.scr

2. When the SCRIPT NAME SELECTION menu appears on the monitor display:
   - Find the **tool.scr** option in the script name selection menu,
   - Rotate the Trim Knob control until the number corresponding to the **tool.scr** menu item is displayed, and
   - Press and release the Trim Knob control to make the selection.

Reply YES to the prompt

3. The monitor then displays the part number, version, and date of the conversion tool about to be installed. A prompt appears on the monitor display requiring verification of the software about to be installed. This prompt allows the user to either continue with the download or abort. Rotate the Trim Knob control until YES appears, and press and release the Trim Knob control to make the selection.

LOAD THE VERSION 6 CONVERSION TOOL (CONT)

The conversion tool is downloaded to the monitor

4. Various messages appear on the monitor display. These messages indicate how the download is going. Be patient during this part of the procedure — it can take a couple of minutes.

CAUTION
Do not reboot or power down the monitor unless the download is successfully completed, or the monitor shows no indication of download activity for over 5 full minutes.

DOWNLOAD THE BOOT CODE SOFTWARE

Once the conversion tool (tool.scr) has been loaded, download the monitor boot code (boot.scr) using the following procedure. Do NOT reboot the monitor in between the two procedures.

1. At the FILE SERVER SELECTION menu, choose one of the following:

   - If you are downloading the software from a Centralscope central station, find the care unit name of the appropriate central station (the one that has the monitor software on its internal hard disk drive) in the file server selection menu. Rotate the Trim Knob control until the number of the appropriate central station is displayed in the file server selection menu, then press and release the Trim Knob control to make the selection.

NOTE
If the care unit name of the central station you are using doesn't appear in the file server selection menu, use the Search for fileserver option to look for the appropriate care unit name again. Occasionally, the monitor must search the network more than once before it "finds" all the care units on the network.

   - If you are downloading the software from memory cards, find the **Memory Card** option in the file server selection menu. Rotate the Trim Knob control until the number corresponding to the **Memory Card** menu item is displayed, then press and release the Trim Knob control to make the selection.

LOAD THE VERSION 6 CONVERSION TOOL (CONT)

Load boot.scr

2. When the SCRIPT NAME SELECTION menu appears on the monitor display:
   - Find the **boot.scr** option in the script name selection menu,
   - Rotate the Trim Knob control until the number corresponding to the **boot.scr** menu item is displayed, and
   - Press and release the Trim Knob control to make the selection.

Reply YES to the prompt

3. The monitor then displays the part number, version, and date of the boot code about to be installed. A prompt appears on the monitor display requiring verification of the software about to be installed. This prompt allows the user to either continue with the download or abort. Rotate the Trim Knob control until YES appears, and press and release the Trim Knob control to make the selection.

The boot code is downloaded to the monitor

4. Various messages appear on the monitor display. These messages indicate how the download is going. Be patient during this part of the procedure — it can take a couple of minutes.

CAUTION
Do not reboot or power down the monitor unless the download is successfully completed, or the monitor shows no indication of download activity for over 5 full minutes.

Continue downloading the other software update components

5. When the conversion tool and the boot code have been successfully loaded, proceed to the Download the Software Components section for instructions on how to download the other software components needed for this update.

DOWNLOAD THE SOFTWARE COMPONENTS

DOWNLOAD MONITOR SOFTWARE COMPONENTS

The monitor requires certain software to make it operational as a fully capable patient monitor. The procedure below describes how to load this software.

Software components must be updated in order

There are four different software components that may need to be updated. The components must be downloaded in the following order:

- Boot code (**boot.scr**)

> **NOTE**
> If the conversion tool for updates from pre-version 6 software has been downloaded, it is not necessary to download the boot code. Begin the software component download with the acquisition processor code.

- Acquisition processor code (**das.scr**)
- CO2 main code (**co2main.scr**)

> **NOTE**
> CO2 is an optional feature. If the monitor being updated is not equipped with the CO2 feature, the CO2 main code cannot be updated.

- Main processor code (**main.scr**)

Download procedures are the same for each software component

The procedure for downloading the software components is the same for each component.

Follow the directions below for each component that needs to be updated.

Start the monitor boot loader program

1. To start the monitor Boot Loader program:
   - Hold down the NBP GO/STOP and ZERO ALL front panel control keys on the monitor,
   - Press and release the Trim Knob control, and
   - Continue to hold the NBP GO/STOP and ZERO ALL front panel control keys until the Eagle Boot Loader menu appears on the monitor display.

DOWNLOAD THE SOFTWARE COMPONENTS (CONT)

Select the source to load the software from

2. Observe the monitor display. In less than ten seconds a FILE SERVER SELECTION menu appears on the display. At the FILE SERVER SELECTION menu, choose one of the following:

- If you are downloading the software from a Centralscope central station, find the care unit name of the appropriate central station (the one that has the monitor software on its internal hard disk drive) in the file server selection menu. Rotate the Trim Knob control until the number of the appropriate central station is displayed in the file server selection menu, then press and release the Trim Knob control to make the selection.

NOTE
If the care unit name of the central station you are using doesn't appear in the file server selection menu, use the Search for fileserver option to look for the appropriate care unit name again. Occasionally, the monitor must search the network more than once before it "finds" all the care units on the network.

- If you are downloading the software from memory cards, find the **Memory Card** option in the file server selection menu. Rotate the Trim Knob control until the number corresponding to the **Memory Card** menu item is displayed, then press and release the Trim Knob control to make the selection.

NOTE
When updating the main processor code (**main.scr**), you must remove memory card #1 and insert memory card #2 at this point. For instructions on inserting or removing the memory card, refer to page 10.

Load /update.net/egl4000/6x

3. When the DIRECTORY SELECTION menu appears on the monitor display:

- Find the **/update.net/egl4000/6X** option in the directory selection menu,
- Rotate the Trim Knob control until the number corresponding to the **/update.net/egl4000/6X** menu item is displayed, and
- Press and release the Trim Knob control to make the selection.

DOWNLOAD THE SOFTWARE COMPONENTS (CONT)

Load the appropriate option

4. When the SCRIPT NAME SELECTION menu appears on the monitor display:
   - Find the appropriate option (**boot.scr**, **das.scr**, **co2main.scr**, or **main.scr**) in the script name selection menu,
   - Rotate the Trim Knob control until the number corresponding to the appropriate menu item is displayed, and
   - Press and release the Trim Knob control to make the selection.

Reply YES to the prompt

5. The monitor then displays the part number, version, and date of the software components that are about to be installed. A prompt appears on the monitor display requiring verification of the software about to be installed. This prompt allows the user to either continue with the download or abort. Rotate the Trim Knob control until YES appears, and press and release the Trim Knob control to make the selection.

The software is downloaded to the monitor

6. Various messages appear on the monitor display. These messages indicate how the download is going. First, the program erases flash memory. Then it downloads each software component to the monitor flash memory circuits. Be patient during this part of the procedure — it can take a couple of minutes.

CAUTION
Do not reboot or power down the monitor unless the download is successfully completed, or the monitor shows no indication of download activity for over 5 full minutes.

Errors may occur during download. For most errors, try starting the procedure over again. If you continue to experience problems, contact Marquette Service (refer to *How to Reach Us...* at the beginning of this manual).

7. Repeat steps 2 through 6 for each additional software component that needs to be updated. Keep the following in mind as you update:
   - The software components must be updated in order. See page 14 for the update order.
   - The boot code (**boot.scr**) does not need to be loaded if the conversion tool (**tool.scr**) has been downloaded. It is loaded as part of the conversion tool.
   - CO2 is optional, so **co2main.scr** does not need to be loaded if the monitor being updated is not equipped with CO2.
   - To load the main processor code (**main.scr**) from memory cards, the second memory card must be inserted. Refer to Step 2 for more details.

DOWNLOAD THE SOFTWARE COMPONENTS (CONT)

COMPLETING THE PROCEDURE

Verify that the downloading of software into the monitor was successful. The following steps must be completed for each monitor.

Perform the Checkout Procedures

8. Before putting the monitor into normal service, perform the procedures described in "Setup for Use" in the configuration section of the service manual to verify proper operation. The monitor battery should be fully charged before starting these procedures.

Set up graph locations

9. To set up proper graph locations for the monitor, connect the monitor to the network, then from the monitor main menu:
   - Scroll to the MONITOR SETUP menu selection and select it by pressing and releasing the Trim Knob control,
   - In the monitor setup menu, scroll to the GRAPH SETUP menu selection and select it by pressing and releasing the Trim Knob control,
   - In the graph setup menu, scroll to the GRAPH LOCATION menu selection and select it by pressing and releasing the Trim Knob control.

Select a writer for each of the three possible locations

10. From the graph location menu option items, use the Trim Knob to scroll to and select:
   - The MANUAL GRAPH LOCATION option item (the monitor may take up to a minute to poll the network for available writers), then choose one of the manual graph locations from that list of writers; then
   - The ALARM GRAPH LOCATION option item, then choose one of the alarm graph locations from that list of writers; and finally,
   - The PRINT WINDOW LOCATION option item, then choose one of the print window locations from that list of writers.

Test the monitor

11. Connect a patient simulator to the monitor. Admit and generate patient waveforms at the monitor with the simulator powered up. Perform the following steps to test the communication paths between the monitor and each selected writer.
   - Press the GRAPH GO/STOP button on the monitor front panel and verify the graph output arrives at the selected manual graph location. Press the GRAPH GO/STOP again to stop the manual graph.
   - Cause a CRISIS alarm by switching the simulator power off and verify the graph output arrives at the selected alarm graph location.
   - Bring up a non-real-time window on the monitor display and print the window. Verify the print output arrives at the selected print window location.

DOWNLOAD THE SOFTWARE COMPONENTS (CONT)

Verify that the software is loaded into monitor memory

12. Verify that the software was downloaded to the monitor properly. From the monitor main menu:
    - Rotate the Trim Knob control until the MONITOR SETUP menu selection is highlighted,
    - Press and release the Trim Knob control to make the selection,
    - Rotate the Trim Knob control until the SOFTWARE REVISION menu selection is highlighted,
    - A list of the installed software components, their part numbers, versions, and dates will appear on the monitor display. Verify that these match the revisions shown on the addendum at the beginning of these instructions.
    - Press the Trim Knob control to exit the software revision pop-up window on the monitor display.

Documentation requirements

13. If software was downloaded for the purpose of updating the monitor to a new version of software, documentation will be supplied by the manufacturer in a software update kit. Completely fill out all documentation as required by the manufacturer.

Repeat the procedure for each monitor

14. Go to each monitor in the system that requires software downloading and repeat the entire procedure, beginning with the *Load Software for Update* section.

UPDATE SOFTWARE FROM DISKETTES USING A PC

ABOUT THE PROCEDURE

This procedure describes how to update software in the monitor from a PC or PC laptop floppy disk drive using update diskettes provided in the Software Update Kits. Refer to the addendum included with each set of update instructions for current monitor software revision levels and associated part numbers.

NOTE
This procedure can only be used if the monitor being updated is already running software version 6a or later. It is recommended that either the network or memory card method be used when possible for all software boot code update procedures, since these methods are more reliable. Refer to the Load Software for Update section in the procedures for more information.

This update procedure requires the following:

1. PC or PC laptop, to download software, with the following minimum requirements:
   - MS-DOS compatible,
   - 1.4M, 3.5-inch floppy disk drive, and
   - RS-232C serial port.
2. Download kit including:
   - RS-232C to RS-422 converter,
   - monitor cable assembly, and
   - PC cable assembly.

NOTE
Contact your regional Marquette sales representative for the download kit part numbers.

3. Manufacturer software update diskettes.

CONNECT THE PC TO THE MONITOR

Connect the PC to the monitor by following these steps:

1. Attach the monitor cable assembly to the 9-pin D-type connector labeled Async Comm (the connector closest to the Ethernet connector) on the monitor rear panel.
2. Connect the other end of the monitor cable assembly to the RS-232C to RS-422 converter. Note the RS-232C to RS-422 converter is powered by the monitor and does not require a separate power source.
3. Connect the PC cable assembly from the RS-232C to RS-422 converter to the D-type connector labeled COMMS or COMM 1 at the rear of the PC.

UPDATE SOFTWARE FROM DISKETTE (CONT)

UPDATE PROGRAM START-UP

Start the update download program from an update diskette to begin loading software into the monitor by following these steps:

Boot up the PC to a DOS operating system

4. Apply power to the PC and wait for the C:\> prompt to appear on the PC display.

CAUTION

The manufacturer recommends operating the PC (or PC laptop) on AC power for the duration of the update process. This will prevent inadvertent power interruptions to the PC or PC laptop. Interruption of power will cause the update process to fail. While downloading the boot code components, interruptions in the update process may result in monitor malfunction or being rendered completely useless. The monitor may require factory service as a result.

NOTE

If the PC being used for this procedure automatically launches any version of Windows, perform the necessary steps to quit Windows and return to DOS.

Insert diskette #4

5. Insert diskette #4 into the PC floppy disk drive.

Run the update program from the PC

6. Type **a:** at the c:\> prompt and press the ENTER key on the PC keyboard to change directories to the floppy drive. Then type **update** at the a:\> prompt and press the ENTER key on the PC keyboard to launch the update program. The UPDATE UTILITIES menu will appear on the PC display.

Select the update bedside utility

7. Select UPDATE BEDSIDE from the update utilities menu by pressing the F2 key on the PC keyboard. The UPDATE BEDSIDE utilities menu will appear on the PC display.

UPDATE SOFTWARE FROM DISKETTE (CONT)

DOWNLOAD FROM THE PC TO THE MONITOR

The PC and the monitor are serially linked, communication-wise. The following steps describe how to download a specific file into monitor memory. In order to proceed, the monitor must be enabled to receive update files. Follow these steps to enable the monitor for download, then select and load a specific file to the monitor.

8. If a memory card is installed in the monitor, remove it.
9. If there are any remote controls or DDW's connected to the monitor, disconnect them.
10. Apply AC power to the monitor.
11. Turn the rear panel power switch to the on (1) position and make sure that the PWR AC indicator on the front panel lights up.

Start the monitor boot loader program

12. To start the monitor Boot Loader program, follow these steps:
    - Hold down the NBP GO/STOP and ZERO ALL keys,
    - Press and release the Trim Knob control,
    - Continue holding the NBP GO/STOP and ZERO ALL keys until the Boot Loader menu appears on the monitor display.

Bring up the service menu on the monitor display

13. At this point, one of two situations will be present:
    - For a monitor *not connected* to a patient monitoring network, the Boot Loader will take approximately 30 seconds to activate and the Service Menu will appear on the monitor display. If this is the case, proceed to the next step.
    - For a monitor *connected* to a patient monitoring network, the File Server Selection menu will appear in approximately 10 seconds. Use the Trim Knob to scroll to and select the number corresponding to **Service Menu** from the file server selection menu list. The service menu will then appear on the monitor display.

Select the code to be downloaded

14. Select the code to be updated. Refer to the addendum at the beginning of these instructions to identify which components need to be updated. The code must be updated in the following order:
    - Acquisition processor code (**DAS**)
    - Boot code (**Boot**)
    - CO2 main code (**CO2 Main**)

NOTE
CO2 is an optional feature. If the monitor being updated is not equipped with this feature, the CO2 main code cannot be updated.

    - Main processor code (**Main**)

UPDATE SOFTWARE FROM DISKETTE (CONT)

Select the appropriate serial download routine

15. Use the Trim Knob to scroll to and select the number corresponding to the **Serial Download** routine for each file requiring update. Be sure to update files in the order listed in Step 14.

> **NOTE**
> A warning message and prompt will appear on the monitor display. Use the Trim Knob to scroll to and select YES to proceed with the download only if the selected code that currently resides in the monitor is an earlier version as compared to the software contained on the update diskettes.

DOWNLOAD FILES TO THE MONITOR

At this point, the monitor is ready to start accepting download files and the PC has been set up to provide the files for download. Follow the next steps once the PC and monitor have been set up for download.

Select the file for download from the PC

16. Moving back to the PC, find and select (highlight) the file requiring download from the UPDATE BEDSIDE utility menu list of files. If the list does not include the necessary file, eject the diskette from the floppy drive and insert the correct diskette. Press the HOME key on the PC keyboard to refresh the UPDATE BEDSIDE utility menu list.

    Use the up/down arrow keys on the PC keyboard to scroll through the list of files contained on the update diskettes.

Download the selected file

17. To begin the process of downloading the selected file, simply press the ENTER key on the PC keyboard.

> **CAUTION**
> In the process of loading update software into the monitor, the update download program first erases all of the memory locations associated with each file. Problems in the download process may cause the monitor to be rendered useless. Do not interrupt the download process once it has begun. If problems are encountered, rendering the monitor useless, contact the appropriate technical support group listed in the beginning of this document.

UPDATE SOFTWARE FROM DISKETTE (CONT)

If incorrect files are chosen, a prompt appears on the monitor display

The monitor will indicate a warning if the file name from the PC does not match the file name residing in monitor memory.

NOTE
The main processor code is on two diskettes. When downloading the main processor code, the PC will prompt you to insert the second diskette at the proper time.

CAUTION
Do not reboot or power down the monitor while downloading boot code files. The monitor will be rendered useless and require factory service.

Verify PC-to-monitor communication

Messages will appear on the monitor and PC displays indicating how the update is going. Verify that the Received bytes advance. When the selected file has finished downloading, the monitor will return to the Boot Loader program and display the Service Menu, and the PC will give an audible indication (a "beep") as well as indicate a completed download process on the PC display. The monitor automatically restarts itself after any main processor code (MAIN or BOOT) is finished loading.

Errors may occur during the download process

For most errors, simply press the RETURN key on the PC or repeat the download procedure. If the byte numbers stop advancing for more than two minutes, contact the appropriate technical support group listed in the beginning of this document.

Repeat these steps for each file requiring update

18. Perform steps 12 through 17 for each file that requires updating before proceeding to the next steps. When all code has been loaded, turn monitor power off, then on.

UPDATE SOFTWARE FROM DISKETTE (CONT)

COMPLETING THE PROCEDURE

Verify that the downloading of software from the PC into the monitor was successful. The following steps must be completed for each monitor.

Perform the Checkout Procedures

19. Before putting the monitor into normal service, perform the procedures described in "Setup for Use" in the configuration section of the service manual to verify proper operation. The monitor battery should be fully charged before starting these procedures.

Set up graph locations

20. To set up proper graph locations for the monitor, connect the monitor to the network, then from the monitor main menu:
    - Scroll to the MONITOR SETUP menu selection and select it by pressing and releasing the Trim Knob control,
    - In the monitor setup menu, scroll to the GRAPH SETUP menu selection and select it by pressing and releasing the Trim Knob control,
    - In the graph setup menu, scroll to the GRAPH LOCATION menu selection and select it by pressing and releasing the Trim Knob control.

Select a writer for each of the three possible locations

21. From the graph location menu option items, use the Trim Knob to scroll to and select:
    - The MANUAL GRAPH LOCATION option item (the monitor may take up to a minute to poll the network for available writers), then choose one of the manual graph locations from that list of writers; then
    - The ALARM GRAPH LOCATION option item, then choose one of the alarm graph locations from that list of writers; and finally,
    - The PRINT WINDOW LOCATION option item, then choose one of the print window locations from that list of writers.

Test the monitor

22. Connect a patient simulator to the monitor. Admit and generate patient waveforms at the monitor with the simulator powered up. Perform the following steps to test the communication paths between the monitor and each selected writer.
    - Press the GRAPH GO/STOP button on the monitor front panel and verify the graph output arrives at the selected manual graph location. Press the GRAPH GO/STOP again to stop the manual graph.
    - Cause a CRISIS alarm by switching the simulator power off and verify the graph output arrives at the selected alarm graph location.
    - Bring up a non-real-time window on the monitor display and print the window. Verify the print output arrives at the selected print window location.

UPDATE SOFTWARE FROM DISKETTE (CONT)

Verify that the software is loaded into monitor memory

23. Verify that the software was downloaded to the monitor properly. From the monitor main menu:
    - Rotate the Trim Knob control until the MONITOR SETUP menu selection is highlighted,
    - Press and release the Trim Knob control to make the selection,
    - Rotate the Trim Knob control until the SOFTWARE REVISION menu selection is highlighted,
    - A list of the installed software components, their part numbers, versions, and dates will appear on the monitor display. Verify that these match the revisions shown on the addendum at the beginning of these instructions.
    - Press the Trim Knob control to exit the software revision pop-up window on the monitor display.

Documentation requirements

24. If software was downloaded for the purpose of updating the monitor to a new version of software, documentation will be supplied by the manufacturer in a software update kit. Completely fill out all documentation as required by the manufacturer.

Repeat the procedure for each monitor

25. Go to each monitor in the system that requires software downloading and repeat the entire procedure, beginning with the *Load Software for Update* section.

SET FRENCH OR GERMAN DEFAULTS

DEFAULTS FOR FRENCH OR GERMAN MONITORS

There are various operating software defaults contained in the main code of the monitor software that was just downloaded. If the monitor is to be used in France or Germany, follow this procedure to set the respective software defaults. If the monitor is to be used anywhere *other* than France or Germany, you do not need to complete this procedure.

Start the monitor boot loader program

1. To enable either French or German software defaults, you will have to start the boot loader program again:
   - Hold down the NBP GO/STOP and ZERO ALL front panel controls on the monitor,
   - Press and release the Trim Knob control.
   - Continue to hold the NBP GO/STOP and ZERO ALL front panel controls until the Eagle Boot Loader menu appears on the monitor display.

Access the service menu

2. Observe the monitor display. The FILE SERVER SELECTION menu appears on the display. At the FILE SERVER SELECTION menu:
   - Find the **Service Menu** option in the file server selection menu,
   - Rotate the Trim Knob control until the correct number of the **Service Menu** selection is displayed in the file server selection menu, and
   - Press and release the Trim Knob control to select the **Service Menu**.

Select the set configuration option

3. When the service menu appears on the monitor display:
   - Find the **Set Configuration** option in the service menu,
   - Rotate the Trim Knob control until the number corresponding to the **Set Configuration** menu item is displayed, and
   - Press and release the Trim Knob control to make the selection.

Select the country selection option

4. When the Configuration Menu appears on the monitor display:
   - Find the **Country Selection** option in the set configuration menu,
   - Rotate the Trim Knob control until the number corresponding to the **Country Selection** menu item is displayed, and
   - Press and release the Trim Knob control to make the selection.

SET FRENCH OR GERMAN DEFAULTS (CONT)

Select the country that the monitor software defaults are to be set for

5. When the Select Country menu appears:
   - Find the country option in the select country menu that corresponds to the appropriate country (if the monitor is not German or French, use the **DEFAULT** option),
   - Rotate the Trim Knob control until the number corresponding to the appropriate country (or Default) is displayed, and
   - Press and release the Trim Knob control to make the selection.

Save changes and exit

6. When the Select Country menu reappears:
   - Find the **Save Changes and Exit** item in the select country menu,
   - Rotate the Trim Knob control until the number corresponding to the **Save Changes and Exit** menu item is displayed, and
   - Press and release the Trim Knob control to make the selection.
7. When the Service Menu appears:
   - Find the **Exit** item in the service menu,
   - Rotate the Trim Knob control until the number corresponding to the **Exit** menu item is displayed, and
   - Press and release the Trim Knob control to make the selection.

Reboot into normal monitoring mode

8. When the File Server Selection menu appears:
   - Find the **Goto Main Flash** item in the menu,
   - Rotate the Trim Knob control until the number of the **Goto Main Flash** menu item is displayed, and
   - Press and release the Trim Knob control.

   When this step is complete, the screen will flash and the monitor will reboot into normal monitoring mode.

ENABLE (VERSION 6) SOFTWARE FEATURES

PROCEDURE

The monitor has optional patient monitoring features that are enabled through the use of passwords. The passwords are derived from the Ethernet address and stored in memory on the comm/processor PCB flex assembly. Passwords are provided from the factory and are unique for each of the features which require them. If the comm/processor PCB flex assembly is replaced or software features need to be changed, it will be necessary to enable/disable features in the monitor. Follow this procedure to setup features in the monitor.

Ethernet address: _____

Serial number: _____

Follow these instructions to enable features in the monitor:

Start the boot loader program

1. Start the **Eagle 4000 Boot Loader** program. To do this, press and hold the NBP GO/STOP and ZERO ALL front panel control keys. Press and release the Trim Knob control while continuing to hold the NBP GO/STOP and ZERO ALL keys until the Eagle 4000 Boot Loader menu appears on the monitor display.

Open the Options Menu

2. Within approximately 30 seconds, one of the two following menus will be displayed:
   - the SERVICE MENU, or
   - the FILE SERVER SELECTION menu (if this menu appears, rotate and press the Trim Knob to select SERVICE MENU at the prompt).

   From the SERVICE MENU, rotate and press the Trim Knob to select the number corresponding to the **Options Menu** item from the SERVICE MENU list.

Enabling features

3. Use the Trim Knob to select one of the features from the Options Menu list.

NOTE

Individual passwords are required for each optional feature. Have the Ethernet address, serial number and software revision available for each monitor when requesting passwords from the manufacturer.

ENABLING SOFTWARE FEATURES (CONT)

Entering passwords

4. An **Enter password:** prompt will appear on the display. Enter the password(s) provided. To do this, rotate the Trim Knob until the desired character appears, then press the Trim Knob to select the desired character. Upon selecting the desired character, the cursor will advance to the next character field.

NOTE
Select the < character to erase or change the previous character, if an error is made.

Repeat this procedure until the correct characters for the password have been selected, then select the ^ character. Selecting the ^ character serves as a carriage return and terminates the password entry sequence.

Features, brief explanations and passwords

Following is the list and brief explanation of each feature:

Display Type: Select either standard or enhanced.

Password: _____

NIBP: Enabled or disabled as required.

Password: _____

Respiration: Requires password to enable.

Password: _____

Invasive BP's: Requires password to enable. This option can be enabled on monitors with BP (red) patient connectors only.

Password: _____

Hires Trends: If enabled, this feature also requires a memory card to be inserted into the slot on the side of the monitor.

Password: _____

12 Lead ST: Disabled (this feature is only shown for monitors running Version 6A software and does not appear in subsequent software versions).

Password: _____

12SL Analysis: Enabled or disabled as required (see note below).

Password: _____

NOTE
Processor PCB assembly, pn 800704-003 (or later), and DAS PCB assembly, pn 800376-002 (or later), are required as a minimum configuration to enable 12SL Analysis.

ENABLING SOFTWARE FEATURES (CONT)

Features, brief explanations and passwords (Cont)

Set options in hexadecimal form (xx) Do not alter.

Password: _____

Change Software Level: Requires password to enable. Select the software feature level (7015, 7020 or 7025/30) to enable operating features that correspond to those purchased for the monitor.

Password: _____

WARNING

Select and enable only the software level that operators have been trained for. The 7025 software feature level replaces the 7030 software feature level that was available in early production units.

Program Genesis Card Used for manufacturing/service purposes (do not alter).

Change Ethernet Address Select this to configure the network address in the monitor.

Password: _____

Clear Configuration Memory Select this to clear the erasable memory in the monitor.

Password: _____

Enable Trial Options Select this to temporarily configure all of the features for demonstration purposes only. After 5 days, the monitor will default to the previous configuration.

Password: _____

Save Changes and Exit Select this to make the feature settings permanent and exit the Options Menu.

Enabling selected features

5. When the Options Menu has been properly configured, select Exit to return to the SERVICE MENU. Restart the monitor to enable the selected features.
6. If any labels are included in the service kit, apply them to the appropriate location on the monitor.

COMPLETION

After the software feature level has been changed, it may be necessary to configure the monitor for the feature that was selected.

SETUP FOR USE

ABOUT SETUP

This part of the section contains the procedure for initial setup or configuration of the monitor. The procedure addresses use in both types of patient monitoring system configurations:

- Stand-alone patient monitor: The monitor is not interconnected to other patient monitoring system devices, and
- Networked patient monitor: The monitor is interconnected to other patient monitoring system devices for the sake of sharing patient data.

Monitor setup parameters

Both configurations require some initial setup before the monitor can be used to full potential on patients. The following is a description of each area requiring setup or configuration:

Unit name

- UNIT NAME: This a general identification parameter (seven characters in length) for the monitor to establish communication links between other devices on the network. The *unit name* acts as a means of separating groups of patient monitoring devices on the network.

Bed number

- BED NUMBER: This is also an identification parameter (five characters in length) for the monitor to establish communication links between other devices on the network. The *bed number* acts as a means of separating each monitor within groups of patient monitoring devices on the network.

Graph locations

- GRAPH LOCATION: This is a setup parameter for the monitor to establish communication links between graph devices directly connected to the monitor or those located on the network. The *graph location* must be setup or configured for each of the following types of graphs:
- MANUAL GRAPH LOCATION: Where the manual graph will print,
- ALARM GRAPH LOCATION: Where the alarm graph will print, and
- PRINT WINDOW LOCATION: Where windows (displayed by the operator for various purposes) will print.

Although information in this part of the section relates to a specific version of software, the process generally remains similar from version to version of software.

PROCEDURE SUMMARY

Below is a summary of the procedure to setup the monitor for normal operation:

1. Determine the current monitor software revision level.
2. Setup the monitor care UNIT NAME.
3. Setup the monitor BED NUMBER.
4. Configure graph locations for:
   - Select MANUAL GRAPH LOCATION;
   - Select ALARM GRAPH LOCATION; and,
   6. Select PRINT WINDOW LOCATION.
5. Verify setup or configuration of the above items.

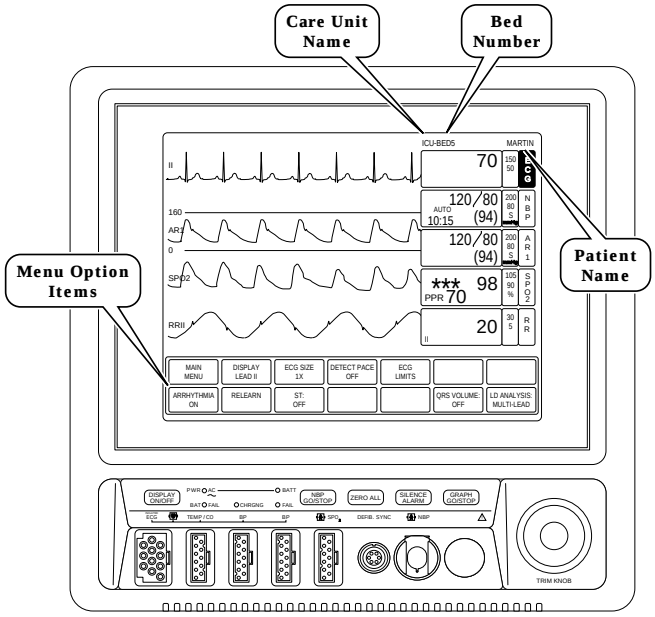
SETUP FOR USE (CONT)

DISPLAY FEATURES

The monitor display shows features that are mentioned in this part of the section. Use the figure below to locate these three features.

1. Along the top of the display are two text fields.
   - The first text field consists of a care UNIT NAME followed by a BED NUMBER. These both must be setup or configured on the monitor before initial use.
   - The second text field is the PATIENT NAME. This may be entered by the user (optionally) each time a patient is admitted to the monitor.
2. The center part of the display shows each of the monitored patient parameters in both a graphic and text format.
3. Along the bottom of the display (shown below is an ECG Menu) are menu option items.

Display feature locations



The main menu of the monitor

The topmost level (master directory) of the monitor operating system software is the **main menu**; the menu that normally remains displayed when there is no operator intervention on the monitor. The main menu includes a normal patient monitoring display plus five menu option items.

Menu option items of the monitor

In lower levels (sub-directories) of monitor operating system software are **menu option items**. These are used for further navigation through monitor operating system software for purposes that are specific to previous menu selections. Note that these may sometimes be referred to as menu "buttons."

More about the menus

When most groups of menu option items are displayed on the monitor, an option item labeled MAIN MENU allows the user to immediately step back to the main menu, or topmost menu, on the monitor display. The only Main Menu option item discussed in this section is MONITOR SETUP.

SETUP FOR USE (CONT)

SOFTWARE REVISION MENU

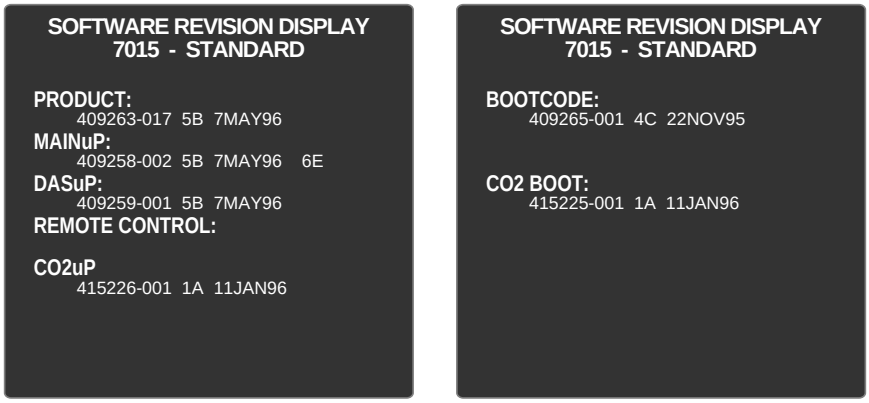
To determine the software revision under which the monitor is currently operating, follow these steps:

1. Use the Trim Knob control to scroll to and select MONITOR SETUP from main menu on the monitor display.

2. Scroll to and select SOFTWARE REVISION from the monitor setup menu.

About the software revision pop-up window

The software revisions of the monitor, in general, as well as the software revisions of each processing circuit within the monitor are displayed in a pop-up window similar to the one shown below.



The PRODUCT software revision is the first item listed in the pop-up window. This is the overall software revision level of the monitor. The various processing circuits listed below PRODUCT, each may have different revision levels.

A part number for the software (409263-018), the version of the software (5B), and the software release date (22MAY96) immediately follow each item in the list.

SETUP FOR USE (CONT)

ENTER INTO THE SERVICE MODE MENU

Begin setup by entering into the service mode menu of the monitor. Follow these steps:

1. Make sure all cables are properly connected to the monitor.
2. Apply AC power to the monitor.
   - Plug the power cord into a working AC power wall receptacle and turn the monitor rear panel main power switch to the on (1) position,
   - Press the DISPLAY ON/OFF front panel control on the monitor. The display should be on.

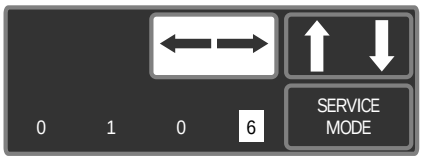
Select monitor setup from the main menu

3. Use the Trim Knob control to scroll to MONITOR SETUP in the monitor main menu and press the Trim Knob control to select it.

Select service mode from the monitor setup menu

4. Use the Trim Knob control to scroll to SERVICE MODE in the monitor setup menu and press the Trim Knob control to select it.

Enter the service menu password



5. A service menu password window will appear on the monitor display, as shown in the figure at the left. A password is required to prevent non-service personnel from accessing the service menus. The password is four numbers that represent the date that currently resides in a memory circuit within the monitor (please note that this may or may not be the correct date). In the password, the first two numbers, starting from the left, represent the day and the second two numbers represent the month of whatever date that currently resides in the memory circuits of the monitor. For example, the seventh day of the third month (March 7th) would be represented in the password as 0703 (ddmm). Note the date that is currently on the monitor display and follow these steps to enter the password;
   - Rotate the Trim Knob control to highlight the password number that you would like to change.
   - To change the highlighted number, press the Trim Knob control.
   - Rotate the Trim Knob control until the correct number is displayed in the selected field.
   - To enter the number, press the Trim Knob control.
   - Repeat these steps until all password numbers are correctly displayed.
   - Once you have entered the correct password numbers, rotate the Trim Knob control to highlight SERVICE MODE in the enter password window.
   - Press the Trim Knob control one more time to enter the password and access the service menus of the monitor.

SETUP FOR USE (CONT)

UNIT NAME

From the service mode menu option items which appear on the monitor display, follow the next steps of the procedure to setup or configure the UNIT NAME of the monitor.

About the monitor unit name

The monitor UNIT NAME provides a means of differentiating groups of devices on the network. Groups of devices with similar care unit names auto-segment themselves from other groups of devices with different care unit names on the network. The care UNIT NAME is part of a software address that is integrated into electronic packets of information which are transmitted or received to or from the network. The UNIT NAME is programmable and therefore allows users to define groups of devices on the network.

Setup the unit name of the monitor

Setup or configure the UNIT NAME of the monitor by following these steps:

1. Use the Trim Knob control on the front panel of the monitor to scroll to and select SET UNIT NAME from the service mode menu option items.

2. The SET UNIT NAME pop-up window appears on the monitor display as shown below.

The UNIT NAME pop-up window displays either the current care UNIT NAME or is completely blank. The software supports up to seven alphanumeric characters to be used in the UNIT NAME field.

NOTE

It is important that the correct UNIT NAME be entered with regard to spelling, spaces and special characters programmed into the field. If a mistake is made in programming the UNIT NAME field, the monitor will not be available on the network for display at central stations within the same care unit.

WARNING

Never use the word "*none*" as a care UNIT NAME. This name can be very confusing to users and make network troubleshooting extremely difficult.

SETUP FOR USE (CONT)

Setup the unit name of the monitor (Cont)

CAUTION
It is very difficult to visually detect spaces ("spaces" are characters) when programmed into the UNIT NAME. The manufacturer recommends avoiding the use of spaces in the UNIT NAME.

3. Two sets of arrow icons appear in the UNIT NAME pop-up window.
   - The horizontal (left/right) arrow icons, when highlighted, allow the user to select a specific character for change by rotating the Trim Knob control. Press and release of the Trim Knob while a specific character is highlighted, enables that specified character for change.
   - The vertical (up/down) arrow icons, when highlighted, allow the user to scroll through all of the alphanumerics available for each character. Rotating the Trim Knob control at this point allows the user to select a specific alphanumeric to be entered into the specified character position within this field. To enter the chosen character into memory, press and release the Trim Knob control one more time.
4. Repeat step 3 for each character to be entered as part of the UNIT NAME. Up to seven characters may be setup or configured. The manufacturer recommends UNIT NAME fields that are less than seven characters to be left-justified, leaving unused character positions (immediately to the right of the user-entered unit name) blank.
5. When finished making each character entry, use the Trim Knob control to select the SET UNIT NAME menu option item. Press the Trim Knob control. This programs the newly entered UNIT NAME into the monitor memory and closes the pop-up window.

SETUP FOR USE (CONT)

BED NUMBER

From the service mode menu option items which appear on the monitor display, follow the next steps of the procedure to setup or configure the BED NUMBER of the monitor.

About the monitor bed number

The monitor BED NUMBER is manually programmed into monitor. The monitor has flash memory which stores the user programmed BED NUMBER. This acts as a software identification code for the following applications:

- For networked monitors, the BED NUMBER provides unique network identification for each monitor from groups of devices sharing the same unit name on the network. The monitor BED NUMBER software is integrated into electronic packets of information which are either sent to or received from other devices on the network.
- General identification: The BED NUMBER also is used for annotation purposes on all graphs generated by the monitor.

Setup the bed number of the monitor

Setup or configure the BED NUMBER of the monitor by following these steps:

1. Use the Trim Knob control on the front panel of the monitor to scroll to and select SET BED NUMBER from the service mode menu option items.

2. The SET BED NUMBER pop-up window appears on the monitor display as shown below.

The SET BED NUMBER pop-up window displays either the current BED NUMBER or is completely blank. The software supports up to five alphanumeric characters to be used in the BED NUMBER field.

NOTE

It is important that the correct BED NUMBER be entered with regard to other monitors within the same care unit. If a mistake is made in programming the BED NUMBER field, the worse-case being a duplicate BED NUMBER on two different monitors within the same care unit, the monitor will not communicate properly on the network and will present problems when the monitor is setup or configured for display at central stations.

SETUP FOR USE (CONT)

Setup the bed number of the monitor (Cont)

WARNING
Never use the word "none" as a BED NUMBER. This name can be very confusing to users and make network troubleshooting extremely difficult.

CAUTION
It is very difficult to visually detect spaces ("spaces" are characters) when programmed into the BED NUMBER. The manufacturer recommends avoiding the use of spaces in the BED NUMBER.

Use the Trim Knob to initially setup or change the monitor bed number

3. Two sets of arrow icons appear in the BED NUMBER pop-up window. Rotate the Trim Knob to highlight one of the sets of arrows and press it to enable each function:
   - The horizontal (left/right) arrows, when highlighted and enabled, allow the user to select a specific character for change by rotating the Trim Knob control. A press and release of the Trim Knob while a specific character is highlighted, enables that specified character for change.
   - The vertical (up/down) arrows, when highlighted, allow the user to scroll through all of the alphanumerics available for each character in the BED NUMBER. Rotating the Trim Knob control at this point allows the user to select a specific alphanumeric to be entered into the specified character position within this field. To enter the chosen character into memory, press and release the Trim Knob control one more time.

There are five characters in the monitor bed number

4. Repeat step 3 for each character to be entered as part of the BED NUMBER. Up to five characters may be setup or configured. The manufacturer recommends that user-defined BED NUMBER consisting of less than five characters, be left-justified and leave unused character positions (those to the right of the user-defined bed number) blank.
5. When finished making each character entry, use the Trim Knob control to select the SET BED NUMBER menu option item. Press the Trim Knob control. This programs the newly entered BED NUMBER into the monitor memory and closes the pop-up window.

SETUP FOR USE (CONT)

GRAPH LOCATIONS

One area of monitor setup or configuration that most often is overlooked, is the setup or configuration of each GRAPH LOCATION for the monitor. Three types of graphs can be generated by the monitor: manual, alarm and print windows.

Monitor application determines which writer/printer may be selected

The application of the monitor plays an important role in the selection of GRAPH LOCATIONS. The following describes each application:

- For a networked monitor, each type of graph is setup or configured individually and can be directed to various writer/printer locations on the network. Each type of graph can be sent to a writer/printer on the network, or to an external writer directly connected to the ASYNC rear panel connector on the monitor. Each type of graph can be setup or configured on the monitor to print at one of the following destinations:

  Centralscope Central Station (with internal or external writer),

  Solar Patient Monitor (with external writer),

  Eagle Patient Monitor (with external writer), and/or

  Network laser printer.

- For a stand-alone monitor, each type of graph is setup or configured individually and can be directed *only* to an external writer (optional) directly connected to the ASYNC rear panel connector on the monitor.

Three graph locations can be setup on the monitor

Three separate graph locations can be setup or configured in the monitor. The following describes each GRAPH LOCATION:

- MANUAL GRAPH LOCATION: The graph device that prints patient waveforms and annotation. Manual graphs are generated by the monitor whenever the GRAPH GO/STOP front panel control on the monitor is pressed.
- ALARM GRAPH LOCATION: The graph device that prints patient waveforms and annotation. Alarm graphs are automatically generated by the monitor whenever a Crisis Alarm or Warning Alarm is sensed.
- PRINT WINDOW LOCATION: The graph device that prints patient information displayed in various types of screens on the monitor. Print windows are generated by the monitor whenever a menu option item for each specific function is displayed and selected by an operator.

NOTE
Graphs can be sent to locations other than the writer directly connected to the monitor.

SETUP FOR USE (CONT)

Setup the graph locations of the monitor

Setup or configure the GRAPH LOCATIONS of the monitor by following these steps:

Select monitor setup

1. Use the Trim Knob control on the front panel of the monitor to scroll to and select MONITOR SETUP from the main menu option items.

Select graph setup

2. Use the Trim Knob control on the front panel of the monitor to scroll to and select GRAPH SETUP from the monitor setup menu option items.

Select graph location

3. Use the Trim Knob control on the front panel of the monitor to scroll to and select GRAPH LOCATION from the graph setup menu option items.

Setup each graph or print window location

4. Use the Trim Knob control on the front panel of the monitor to scroll to and select either MANUAL GRAPH LOCATION, MANUAL GRAPH LOCATION, or PRINT WINDOW LOCATION from the graph location menu option items.

NOTE

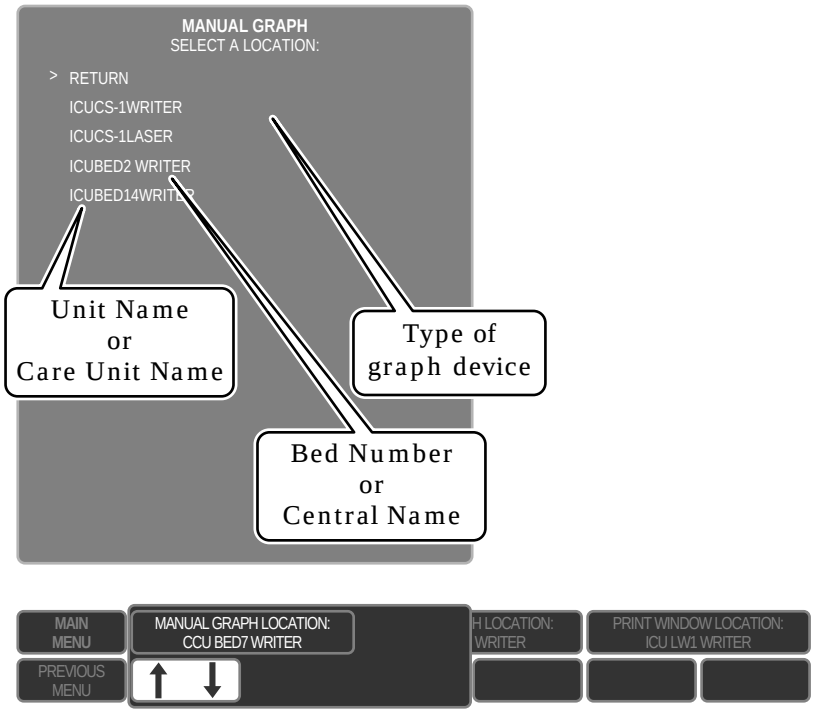
The graph location menu has menu option items for programming the manual graph location, the alarm graph location and the print window location. All three must be setup and configured individually for full functional use of the monitor.

Select one of the graph location menu option items on the monitor to display a pop-up list of all available writers.

SETUP FOR USE (CONT)

Select a writer from the pop-up list on the monitor display

The graph location pop-up list appears in the upper left portion of the monitor display.



The pop-up list includes the unit name (or care unit name), the bed number (or central name), as well as the type of graph device for:

- The writer (DDW's) connected directly to the monitor itself, and/or
- Writers connected to devices that have an identical care UNIT NAME on the network.

6. Rotate the Trim Knob control to scroll (move the cursor) to a desired graph location and press the Trim Knob control to program the selected writer graph location into the monitor flash memory. The graph location menu option item will change to show the selected graph location and the pop-up list will close.

7. When finished making each graph location selection, use the Trim Knob control to scroll to MAIN MENU from the graph location menu option items. Press the Trim Knob control to exit all of the menus and return to the main menu.

SETUP FOR USE (CONT)

TIME AND DATE SETUP

The TIME AND DATE function of the monitor provides a means for the real time clock circuit to be setup correctly or changed by the user. The TIME AND DATE setup or configuration of the monitor is used mainly for the purpose of documentation of patient events and history files stored in the monitor each time a patient is admitted. Therefore, it is important that the correct time and date be entered into the monitor.

Leap years and daylight savings time

The internal real time clock circuit of the monitor will automatically compensate for leap years, but will not automatically compensate for daylight savings time changes. The latter requires manual setup or configuration of the monitor TIME AND DATE field each spring and fall.

CAUTION

For networked monitors, changing the TIME AND DATE field on the monitor causes the new time and date to be broadcast over the network. All other devices on the network will change the time and data to match the newly entered TIME AND DATE on the monitor. This may cause other monitors on the network to change time-dated patient data stored in each monitor.

Procedure for time/date setup

Follow these steps to setup or configure the TIME AND DATE of the monitor:

From the service mode menu, select time and date

1. From the service mode menu, use the Trim Knob control to scroll to and select the TIME AND DATE menu option item.

Select set time or set date

2. Use the Trim Knob control to scroll to and select one of the time and date menu option items.

WARNING

TIME AND DATE parameters are actively enabled for change each time the SET TIME or SET DATE menu option items are selected. If time and date information on the monitor is correct, do not select these menu option items. For monitors connected to the network, changing time and date parameters will cause this information to change on all monitors and central stations connected to the same network.

SETUP FOR USE (CONT)

Select set time/date

3. To enter or change time on the monitor, select SET TIME from the time and date menu option items. To enter or change the date on the monitor, select SET DATE from the time and date menu option items.

Enter or change the desired time/ date parameter

4. To enter or change a SET TIME or SET DATE parameter, rotate the Trim Knob control to select a parameter for change. Press the Trim Knob control to enable the selected parameter for change.

Use the Trim Knob to scroll and select

5. Rotate the Trim Knob control to enter or change the selected time or date parameter. Press the Trim Knob control to enter new time or date parameters into temporary memory in the monitor.

NOTE
Changes are written to memory in the monitor when SET TIME or SET DATE is selected and set.

Enter the changes into the monitor

6. When each desired time or date entry has been made, immediately rotate the Trim Knob control to select SET TIME or SET DATE in the time and date menu on the monitor. Press the Trim Knob control to enter the new time or date into the monitor.

5 TROUBLESHOOTING

BATTERY FAILURE

THE BATT FAIL INDICATOR

While the monitor is running on power from the wall receptacle, the battery is being continuously charged. The monitor internally checks the battery voltage at 30-second intervals. After the monitor attempts to charge the battery for 30 minutes, the battery voltage must reach a minimum of 11.7 volts or the monitor determines the battery has failed. When this occurs, the BATT FAIL indicator will illuminate.

When the BATT FAIL indicator illuminates, immediately remove the monitor from service and replace the battery. The BATT FAIL indicator, when illuminated, indicates the battery will not reliably power the monitor during patient transport , emergency power testing, or AC power failure.

WARNING
Attempting to use a monitor for patient transport while the BATT FAIL indicator is illuminated, will result in complete loss of all monitoring functions. Use during emergency power testing or during AC power failure with this pending condition , will also result in complete loss of all monitoring functions for as long as AC power is removed.

BATTERY REPLACEMENT

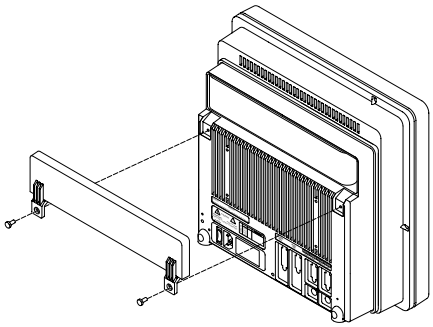
Follow this procedure to replace a defective battery pack in the monitor.

1. Apply AC power to the monitor. This is necessary due to the fact that the main processor PCB only senses the presence of a battery while the monitor is powered on.

NOTE
If you insert a replacement battery while it is turned off, the monitor will assume the failed battery is still installed, and will not charge the replacement battery properly. This situation is rectified with a cold start after you install the replacement battery, but all memory used for storing trends, histories and settings in the monitor, will be erased.

To perform a cold start, simply press and hold the GRAPH GO/STOP front panel control while turning the monitor on, using the rear panel main power control switch.

2. Turn the rear panel power switch on. The PWR—AC indicator will illuminate.
3. Remove the two screws which secure the battery cover.

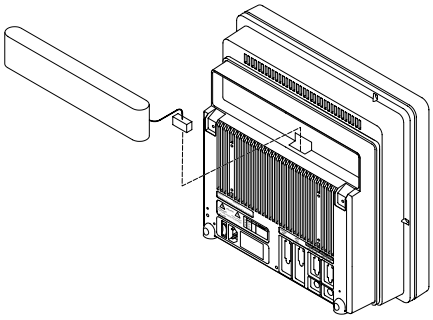


WARNING
Do not insert these screws without the battery cover. The screws are long enough to potentially cause damage to the PCB located nearest the rear of the monitor if inserted without the battery cover.

4. Remove the battery cover.

BATTERY FAILURE (CONT)

Remove the battery cover and disconnect the failed battery



5. Locate and pay special attention to exactly how the battery connector is attached before disconnecting it from the power supply PCB in the monitor. Remove the battery from the battery compartment.

6. Observe the front panel indicators on the monitor. Do not proceed until all three BATT indicators, RDY, CHRGNG and FAIL, are no longer illuminated.

> **NOTE**
> It is necessary to wait for the above condition because the main processor PCB in the monitor only checks for battery presence at 30-second intervals. Because battery voltage does not change rapidly, microcomputer circuitry on the main processor performs many other tasks before returning to test the battery voltage level. If a replacement battery is installed while one of the BATT indicators is still illuminated, the main processor PCB will assume the failed battery is still installed, and the replacement battery will not be properly charged.

Connect the replacement battery to the power supply PCB

7. Carefully mate the connector of the replacement battery with the connector on the power supply PCB. Depending on the voltage level of the battery, a small spark may occur when the connectors are mated together. Do not be alarmed by this.

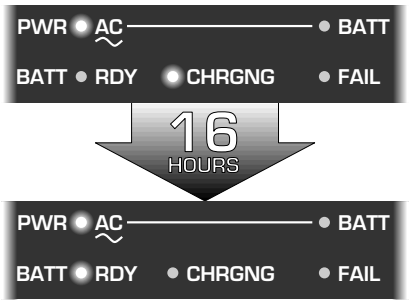
Install the replacement battery

8. Install the replacement battery into the battery compartment, folding the cable harness so that it will not be crimped by the battery cover or associated screws.

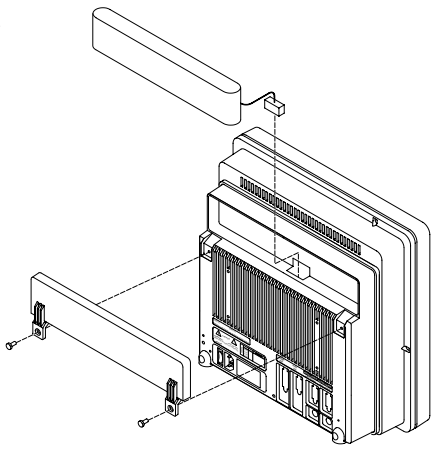
Install the battery cover

9. Attach the battery cover to the rear housing of the monitor with the screws that were removed in step 3 (see WARNING after step 3).

Allow the replacement battery to fully charge before use



After you install the replacement battery, the BATT CHRGNG indicator will illuminate. This may take as long as 30 seconds, for reasons explained in previous steps. The BATT CHRGNG indicator will remain illuminated for a duration of time necessary to fully charge the replacement battery (approximately 12-16 hours) before the BATT RDY indicator illuminates. Do not use the monitor on a patient with or without AC power until the BATT RDY indicator illuminates.



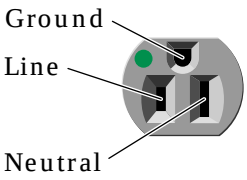
POWER SOURCE TESTS

WALL RECEPTACLE

Use this procedure to confirm AC power from the wall receptacle which the monitor is plugged into.

Use a digital multimeter (DMM) to verify the wall receptacle is wired correctly. This is accomplished by performing a:

- voltage measurement between all three connections of the wall receptacle;
- ground-to-neutral loop resistance measurement.



Wall receptacles consist of three connections: line, neutral and ground. The figure at left indicates the location of each on a 120 V_{ac} hospital grade wall receptacle commonly used in the United States. The location and shape of pins may be different on wall receptacles used in countries other than the United States.

Perform the following tests:

Voltage tests

1. Use a DMM to measure the voltage between the three connections.
   - Select the AC voltage scale on the DMM.
   - Measure the voltage from line to neutral, line to ground, and neutral to ground and make sure these are correct. With a correctly wired wall receptacle used in the United States, the following readings should be obtained:

     Line to neutral: 120 V_{ac}
     Line to ground: 120 V_{ac}
     Neutral to ground: < 3 V_{ac}

   Readings other than these indicate improper wiring. Have the wall receptacle checked by an electrician.

Ground to neutral loop resistance

2. Use a DMM to measure the ground-to-neutral loop resistance.

CAUTION
Do not check the ground to neutral loop resistance if the wall receptacle is wired improperly.

   - Select the milliohms (mΩ) scale on the DMM.
   - Measure resistance across the power cord ground and neutral.
   - Measure from the ground lug on the rear power connector to any exposed metal of the monitor. The resistance between the ground and neutral connections, after the ohmmeter is nulled, must be less than 100 mΩ. If not, have the wall receptacle checked by an electrician.

POWER SOURCE TESTS (CONT)

POWER CORD AND PLUG

Verify the power cord being used with the monitor is good. The following are a couple of things to check for in this regard:

- Failure of the power cord strain relief is very common. Often times users of the equipment will pull on the power cord itself, rather than the power cord plug, to unplug the monitor from a wall receptacle. If in doubt, test for continuity through each conductor of the power cord connector and plug.
- Verify line, neutral, and ground conductors are properly connected to the power cord plug and are not short-circuited. Rewire and tighten these, or replace the power cord, as necessary.

MAIN POWER AND DISPLAY POWER CONTROL

Turn the rear panel main power switch of the monitor to the on (1) position. During normal operation, the main power switch is typically left in the on position. The DISPLAY ON/OFF front panel control on the monitor is used for turning the display on or off, depending on whether a patient is admitted to the monitor or not.

The position of the main power switch determines if battery power or AC power from the wall receptacle is the monitor power source. The following describes the main power switch functions:

- In the on (1) position, the main power switch enables AC power from a wall receptacle. If, for whatever reason, AC power is not available from the wall receptacle, the monitor will automatically sense this condition and enable battery power.
- In the off (0) position, the main power switch enables battery power when the DISPLAY ON/OFF switch is on.

NOTE

The battery does not charge when the main power switch on the rear panel of the monitor is in the off (0) position. Because of this, the manufacturer recommends use of the DISPLAY ON/OFF front panel control for turning the monitor off and on during normal use. This will allow the battery to remain fully charged for continued patient monitoring during transport or any AC power loss.

DATA ACQUISITION TESTS

ECG FUNCTIONAL TESTS

Follow these steps to test all ECG functions of the monitor.

1. Connect the MEI Multifunction Microsimulator, pn MARQ1, and appropriate patient cables, to the ECG connector of the monitor. Turn the monitor and the patient simulator on.
2. Set the monitor to display leads I, II, III, and V simultaneously:
   - From the main menu, select DISPLAY OPTIONS.
   - Make sure the DISPLAY menu item shows INDIVIDUAL. If it shows FULL, change it to INDIVIDUAL.
   - Select WAVEFORMS ON/OFF from the menu.
   - Set the displayed waveforms for the following ECG leads:

     ECG 1: LEAD II

     WAVEFORM 2: LEAD V

     WAVEFORM 3: LEAD I

     WAVEFORM 4: LEAD III
3. Set the patient simulator to output calibration (cal) pulses at 1.0 mV.
4. Measure the cal pulse (⎍) amplitude. These should be:

   0.5 mV: Lead I

   1 mV: Lead II

   0.5 mV: Lead III

   –0.5 mV: Lead V
5. It may be necessary to run a graph to accurately measure the cal pulses. Perform these steps to graph all four waveforms.
   - From the main menu, select GRAPH & ALARMS.
   - Select GRAPH CONTROL from the menu.
   - Set the graphed waveforms for the following ECG leads:

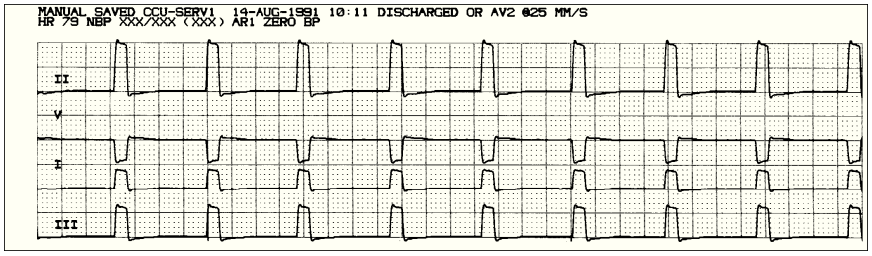
     ECG 1: LEAD II

     WAVEFORM 2: LEAD V

     WAVEFORM 3: LEAD I

     WAVEFORM 4: LEAD III
   - Press the GRAPH GO/STOP front panel control on the monitor to start and stop a manual graph.
   - Compare the printed graph with the sample shown below.

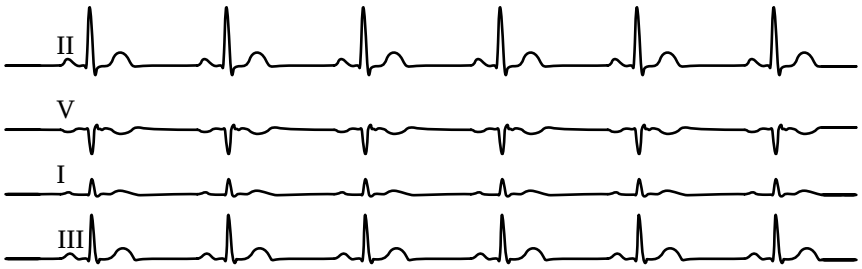
Cal pulse graphed waveforms



DATA ACQUISITION TESTS (CONT)

ECG functional tests (Cont)

6. Change the patient simulator output from cal pulses to an 80-BPM ECG waveform.
   - The displayed ECG waveforms should be similar to those shown in the figure below.
   - If this is the case, the ECG functions of the acquisition PCB, as well as communication between the acquisition and processor PCB's are functioning as designed.



ECG TEST FAILURE SOLUTIONS

Following are symptoms and solutions for ECG functional test failures.

ECG waveforms displayed incorrectly

1. If the calibration pulses were not correct, test the patient simulator using a working monitor. If the patient simulator is functioning as designed, calibration of the acquisition PCB may be necessary. Refer to Chapter 5: Calibration information in this regard.
2. If displayed ECG waveforms contain a significant amount of noise (see figure at left), check the ECG patient cables.
3. Test the patient simulator and ECG patient cables on a working monitor to verify the ECG signal.
4. If the ECG signal, patient simulator and ECG patient cables are good, the acquisition PCB is suspect. Swap a working acquisition PCB into the monitor to verify the malfunction.

ECG waveforms not displayed

1. Test the ECG patient cables on a working monitor.
2. Test the patient simulator on a working monitor.
3. Swap the acquisition PCB into a working monitor. If the symptoms follow the PCB into the working monitor, replace the acquisition PCB.
4. If these three steps do not provide positive results, the processor and/or power supply PCB are suspect. Swap a working processor and/or power supply PCB into the monitor to verify the malfunction.

DATA ACQUISITION TESTS (CONT)

LEAD FAIL FUNCTIONAL TESTS

Follow these steps to test lead fail detection functions of the monitor.

1. With the monitor displaying ECG Lead I, Lead II, Lead III, and V-Lead (from the patient simulator), remove the RA leadwire from the patient simulator terminal.
2. The monitor should display a RA FAIL alarm message and automatically switch to monitoring only ECG Lead III. Lead fail detection is functioning properly if this is the case.
3. Reattach the RA leadwire to the patient simulator. The monitor should automatically switch back to the lead selections displayed previous to the removal of the RA leadwire from the patient simulator.

LEAD FAIL TEST FAILURE SOLUTIONS

Lead fail detection is not functioning properly if the criteria above is not successfully achieved. The acquisition PCB is the most likely suspect component. Swap a working acquisition PCB into the monitor to verify the malfunction.

DATA ACQUISITION TESTS (CONT)

PACEMAKER PULSE DETECTION FUNCTIONAL TESTS

Follow these steps to test the pacemaker pulse detection functions of the monitor.

1. With the monitor configured to display ECG Leads I, II, III, and V, set the patient simulator to output a VP1 (ventricular pacemaker simulation #1) waveform.
2. Enable the pacemaker detection function of the monitor:
   - select ECG from the display main menu,
   - select DETECT PACE and set to PACE 1.
3. Verify the heart rate remains at approximately 80 BPM.
4. Select the VP2 output (ventricular pacemaker simulation #2) on the patient simulator. The heart rate number may disappear from the display for a few seconds and return to the screen shortly thereafter. Verify the heart rate is at approximately 80 BPM. Verify the pacemaker spikes display at the same amplitude.
5. Disable the pacemaker detection function of the monitor. Verify the displayed pacemaker spikes have a different amplitude than in the previous step.
6. Select the AVS output (A/V sequential pacemaker simulation) on the patient simulator. Again, verify the displayed pacemaker spikes are at different amplitudes.
7. Enable the pacemaker detection function of the monitor once again.
8. Verify a stable heart rate display of approximately 80 BPM. Verify the pacemaker spikes are again at the same amplitude.
9. Disable the pacemaker detection function of the monitor.

PACE DETECT TEST FAILURE SOLUTIONS

If the pacemaker detection test results are incorrect as described above, follow these steps to determine the problem.

1. Verify the patient simulator is functioning properly by performing the above tests on a working monitor,
2. If the patient simulator is determined to be operating correctly, the acquisition PCB is most likely suspect component to have failed. Swap a working acquisition PCB into the monitor to verify the malfunction.

DATA ACQUISITION TESTS (CONT)

INVASIVE BP FUNCTIONAL TESTS

The following invasive blood pressure (BP) functional tests require the use of a MEI Multifunction Microsimulator, pn. MARQ1. If a different patient simulator is used, adjust the following steps and readings as necessary.

Setup BP1

1. Connect the BLOOD PRESSURE 1 output of the patient simulator to the P1 patient connector on the front panel of the monitor.

Setup BP2

2. Connect the BLOOD PRESSURE 2 output of the patient simulator to the P2 patient connector on the front panel of the monitor.

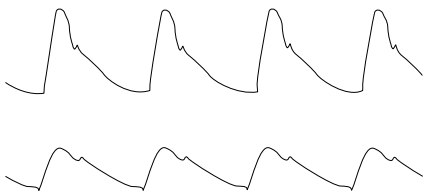
Zero-reference both BP's

3. Properly zero-reference each BP input:
   - Set the patient simulator BP output to 0 mmHg
   - Press the ZERO ALL front panel control on the monitor.

Generate dynamic BP waveforms

4. Set the patient simulator BP output to WAVE.
5. Setup the BP scales on the monitor for auto gain:
   - Select AR1 from the main menu of the monitor
   - Select ART SCALES from the AR1 menu
   - Select AUTO gain from the ART SCALES menu
   - Return to the main menu of the monitor and setup auto gain for the PA2 waveform as you did for AR1.

Verify dynamic BP results



6. Once the BP waveforms are setup as described above verify the following:
   - Both the AR1 and PA2 BP waveforms are noise-free, as shown in the figure at the left.
   - BP displayed parameters are within tolerance as indicated here:

BP Parameter:	AR1	PA2
Systolic (mmHg):	116 – 124	28 – 32
Diastolic (mmHg):	78 – 82	9 – 11

NOTE

These tests are designed for use with a MEI Multifunction Microsimulator, pn. MARQ1. Accuracy specifications of the patient simulator in combination with the monitor (±2% or 1 mmHg, whichever is greater) is how the parameter values listed above, were derived. Use of any other manufacturer patient simulator and associated specifications, will potentially change these test results.

Generate static BP waveforms

7. Set the patient simulator BP output to 200 mmHg, static pressure.

Verify static BP results

8. Verify the BP channels are working correctly if systolic, diastolic, and mean pressure values for both AR1 and PA2 are displaying parameter readings between 194 and 206 mmHg.

DATA ACQUISITION TESTS (CONT)

BP TEST FAILURE SOLUTIONS

Perform the following if any part of the previously described invasive BP functional test has failed to yield the desired results.

BP waveforms do not appear correctly on the display

Follow these steps if the BP waveforms displayed on the monitor appear noisy or distorted (example shown on the left).

1. Test the Patient simulator and simulator test cables and on a working monitor to determine the source of the problem.
2. If the static pressure test results were inaccurate, test the Patient simulator and simulator test cables and on a working monitor to determine the source of the problem.
3. If the patient simulator and associated test cables are determined to be functioning correctly, the acquisition PCB is suspect. Swap the acquisition PCB into a working monitor to determine if replacement is necessary.

BP waveforms do not appear on the display at all

Follow these steps if the AR1 or PA2 parameter labels, readings and associated waveforms do not display on the monitor at all.

1. Verify the patient simulator and associated test cables on a working monitor.
2. Inspect the BP front panel connectors on the monitor for bent or broken pins.
3. Perform continuity tests between the front panel connectors of the monitor, front panel flex circuit assembly located behind the front panel connectors and connection to the acquisition PCB.
4. If the patient simulator and associated test cables are determined to be functioning correctly and the continuity tests yield no malfunction, the acquisition PCB is suspect. Swap the acquisition PCB into a working monitor to determine if replacement is necessary.

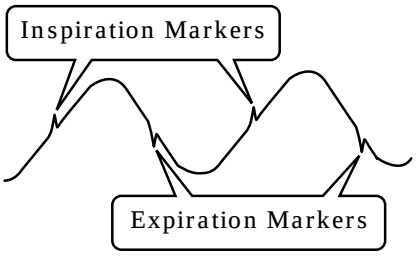
DATA ACQUISITION TESTS (CONT)

RESPIRATION FUNCTIONAL TESTS

Follow these steps to test respiration monitoring functions.

1. Connect the MEI Multifunction Microsimulator, pn. MARQ1, and appropriate patient cables to the ECG/RESP front panel connector on the monitor.
2. Adjust the patient simulator to output a respiration waveform using the following settings:
   - Rate BPM - 30
   - Baseline Impedance Ohms - 750,
   - ΔR Ohms - 2.0.
3. Enable the respiration function of the monitor:
   - Select MONITOR SETUP from the main menu display on the monitor,
   - Select PARAMETERS ON/OFF from the monitor setup menu.

   Next, turn and push the Trim Knob to:
   - scroll to and select RR in the parameters on/off pop-up window.
   - toggle and select ON in the RR line of the parameters on/off pop-up window.



4. Verify the following:
   - Respiration rate is displayed and accurate.
   - Respiration waveform is displayed and noise-free.
   - Markers appear in the displayed respiration waveform (refer to figure at left). These indicate the points at which the monitor senses inspiration and expiration for determination of the respiration rate.

DATA ACQUISITION TESTS (CONT)

RESPIRATION TEST FAILURE SOLUTIONS

Perform the following if any part of the previously described respiration functional test has failed to yield the desired results.

No respiration waveform or rate appear on the display

If the respiration waveform or rate does not appear on the monitor display, perform the following steps to isolate the problem:

1. Vary the baseline impedance on the patient simulator
2. Vary the ΔR on the patient simulator.
3. Test the patient simulator and appropriate patient cables on a working monitor to determine the source of the problem.
4. If none of the previous recommendations corrects the problem, the acquisition PCB is suspect. Swap the PCB into a working monitor to determine the source of the problem and replace as necessary.

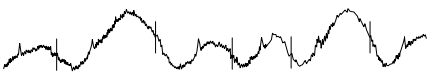
Markers do not appear on the respiration waveform; respiration rate is inaccurate

If the markers on the respiration waveform do not appear on the display or the respiration rate count is inaccurate, try changing the respiration sensitivity level on the monitor. To do this, use the Trim Knob on the monitor to:

1. Scroll to and select RR (respiration parameter) from the monitor main menu,
2. Scroll to and select SENSITIVITY from the respiration parameter menu, and
3. Scroll to and select a different sensitivity percentage (%) from the sensitivity menu

NOTE
Usually, a lower respiration sensitivity % level rectifies this problem.

Respiration functions work properly when using a patient simulator but not on an actual patient



Refer to the Operator's Manual for detailed information regarding patient preparation relative to respiration monitoring functions. Achieving optimum results for respiration waveforms and accurate respiration rate detection by the monitor, requires proper preparation for ECG electrode placement on the patient. An example of a noisy respiration waveform, usually due to bad patient preparation, is shown at the left.

NOTE
With patients that exhibit excessively high baseline chest impedance, proper respiration monitoring will be extremely difficult, if not impossible.

DATA ACQUISITION TESTS (CONT)

NBP FUNCTIONAL TESTS AND TEST FAILURE SOLUTIONS

Perform the non-invasive blood pressure (NBP) Checkout Procedure found in Section 3: Maintenance. This procedure will determine whether the NBP functions of the monitor are working as designed or whether the monitor requires NBP calibration.

If, after performing the prescribed checkout procedure, it is determined that there are potential problems that NBP calibration does not cure, try the following:

1. If calibration is unsuccessful and cannot be properly performed, there could be leaks in the pneumatic circuit plumbing. The following steps will assist you in determining this:
   - The NBP cuff and tubing is the easiest area to inspect for leaks and is also the most likely area for failure in this regard. Closely inspect these items for cracks or leaks. Test the NBP cuff and tubing on a working monitor to determine the source of the problem.
   - If the NBP cuff and tubing are determined to be good after testing them on a working monitor, the leaks are probably internal to the monitor. Disassemble the monitor and check inspect all internal tubing and connections in the pneumatic circuit plumbing.
2. If no leaks are found after performing the previous step, the NBP pump assembly is suspect. Swap the NBP pump assembly with one from a working monitor and/or replace as necessary.

NBP alarms occur continuously

Cannot get NBP readings from a patient in under 3 minutes

NBP displayed readings are inaccurate

If the monitor is not configured properly, a variety of NBP problems may occur. To determine monitor configuration, rotate then push the Trim Knob to:

- Scroll to and select CUSTOMIZE MONITOR from the main menu of the monitor,
- Scroll to and select PATIENT-MONITOR TYPE from the customize monitor menu of the monitor.

Verify the configured monitor type matches the environment in which the monitor is being used. If it is set to a neonatal ICU when the monitor is used for the adult ICU application or vice versa, problems listed to the left may occur.

SERVICE MODE MENU

ABOUT THE SERVICE MODE MENU

The SERVICE MODE menu option items provide the user access to several general and technical built-in software functions of the monitor. Only persons responsible for configuring and maintaining the monitor should access the service mode menu option items.

WARNING
The Service Mode menu is intended for use only by qualified service technicians. Experimentation with service mode menu option items can be detrimental to the monitor. Lost patient data, damaged operating system software for the monitor, even network related problems are but a few examples of problems that can be induced as the result of tampering with service mode menu option items.

Service mode menu option items

Access to the service mode menu option items is necessary for the following functions of the monitor:

- REVIEW ERRORS - Troubleshooting difficult equipment problems or network problems on a software engineering level,
- ADMIT MENU - Setup or configuration of the monitor to admit a patient with one of the following network configuration features enabled:
  - » Standard,
  - » Rover,
  - » Combo, or
  - » Rover Combo.
- CALIBRATE - Checkout or calibration of the non-invasive blood pressure and end-tidal CO_2 functions of the monitor,
- SOFTWARE LEVEL - For setup or configuration of one of four monitor operating system software feature levels. The three feature levels of the monitor are:
  - » 7015,
  - » 7020, or
  - » 7025,
- PATIENT - MONITOR TYPE - Setup or configuration of one of three monitor operating modes. The three modes of operation for the monitor are:
  - » Adult ICU,
  - » Neonatal ICU, or
  - » Operating Room.
- SET UNIT NAME - Setup or configuration of the monitor care unit name,
- SET BED NUMBER - Setup or configuration of the monitor bed number or bed name,
- SET INTERNET ADDRESS - Setup or configuration of the monitor Internet address for the network,
- TIME AND DATE - Set or change time and date information in the monitor.

SERVICE MODE MENU (CONT)

ACCESS TO THE SERVICE MODE MENU

Begin setup by entering into the service mode menu of the monitor. Follow these steps:

1. Make sure all cables are properly connected to the monitor.
2. Apply AC power to the monitor.
   - Plug the power cord into a working AC power wall receptacle and turn the monitor rear panel main power switch to the on (1) position,
   - Press the DISPLAY ON/OFF front panel control on the monitor. The display should be on.

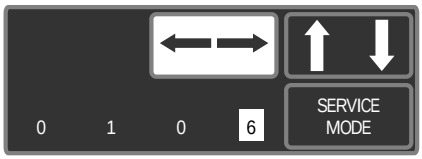
Select monitor setup from the main menu

3. Use the Trim Knob control to scroll to MONITOR SETUP in the monitor main menu and press the Trim Knob control to select it.

Select service mode from the monitor setup menu

4. Use the Trim Knob control to scroll to SERVICE MODE in the monitor setup menu and press the Trim Knob control to select it.

Enter the service menu password



5. A service menu password window will appear on the monitor display, as shown in the figure at the left. A password is required to prevent non-service personnel from accessing the service menus. The password is four numbers that represent the date that currently resides in a memory circuit within the monitor (please note that this may or may not be the correct date). In the password, the first two numbers, starting from the left, represent the day and the second two numbers represent the month of whatever date that currently resides in the memory circuits of the monitor. For example, the seventh day of the third month (March 7th) would be represented in the password as 0703 (ddmm). Note the date that is currently on the monitor display and follow these steps to enter the password;
   - Rotate the Trim Knob control to highlight the password number that you would like to change.
   - To change the highlighted number, press the Trim Knob control.
   - Rotate the Trim Knob control until the correct number is displayed in the selected field.
   - To enter the number, press the Trim Knob control.
   - Repeat these steps until all password numbers are correctly displayed.
   - Once you have entered the correct password numbers, rotate the Trim Knob control to highlight SERVICE MODE in the enter password window.
   - Press the Trim Knob control one more time to enter the password and access the service menus of the monitor.

SERVICE MODE MENU (CONT)

ABOUT SERVICE MODE MENU OPTION ITEMS

Service mode menu option items are used for many purposes in the monitor. The majority of the functions of these menu option items are for initial setup and configuration. Some of the functions are for troubleshooting as well. Caution should always be exercised when using any of these password-protected functions.

Service mode menu option items are used by service technicians to: relay software information to design engineers; calibrate and troubleshoot NBP functions of the monitor; set admit menu options, software feature levels and operating mode of the monitor; configure the monitor unit name, bed number and Internet address for use on the network; and enter or change the time and date on the monitor. None of these options should be used unless specifically instructed to do so.

WARNING

Some of the service mode menu option items are to be used only by qualified service technicians and others are for general use. Because of this, unnecessary tampering with service mode menu option items for experimentation purposes is not recommended by the manufacturer and may cause a malfunction of the monitor.

SERVICE MODE MENU (CONT)

REVIEW ERRORS

The REVIEW ERRORS menu option item is mostly used as an advanced troubleshooting technique by manufacturer engineering personnel. Some of the information recorded in the monitor error log can be useful for field service troubleshooting.

About the monitor error log

Details included in this part of the section will provide an introduction to error log usage and meaning. Because the information contained in the error log is engineering-oriented, the intent of the manual is to simply provide a general understanding of this monitor function.

Downloading the error log

A method for downloading error log data over the network to a central station is included in this part of the section. Once downloaded to a central station, the error log data can be loaded onto floppy diskettes, or reviewed on the central station.

Accessing the review errors menu option item

To access the error log and learn more about the REVIEW ERRORS menu option item, follow these steps:

1. Rotate and press the Trim Knob control to scroll to and select REVIEW ERRORS from the service mode menu option items.

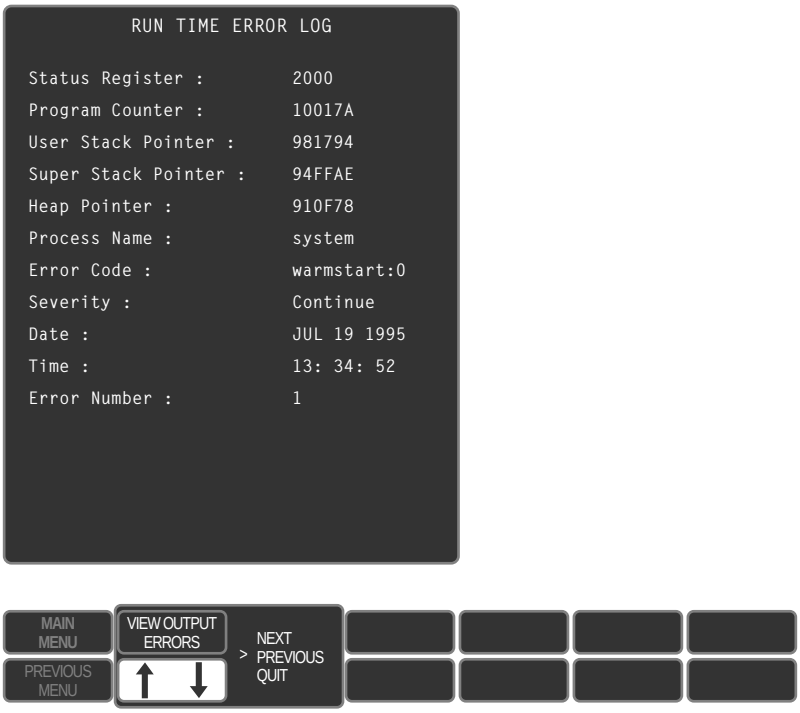
Viewing output errors

2. The review errors menu option items include four possible selections; one each for viewing output or input errors along with one each for clearing output or input errors. Rotate and press the Trim Knob control to scroll to and select VIEW OUTPUT ERRORS from the review errors menu option items.

SERVICE MODE MENU (CONT)

Run time error log pop-up window

3. The RUN TIME ERROR LOG pop-up window appears on the left side of the monitor display. One time-dated output software error appears in the pop-up window at a time.



Use the Trim Knob to navigate through the error log

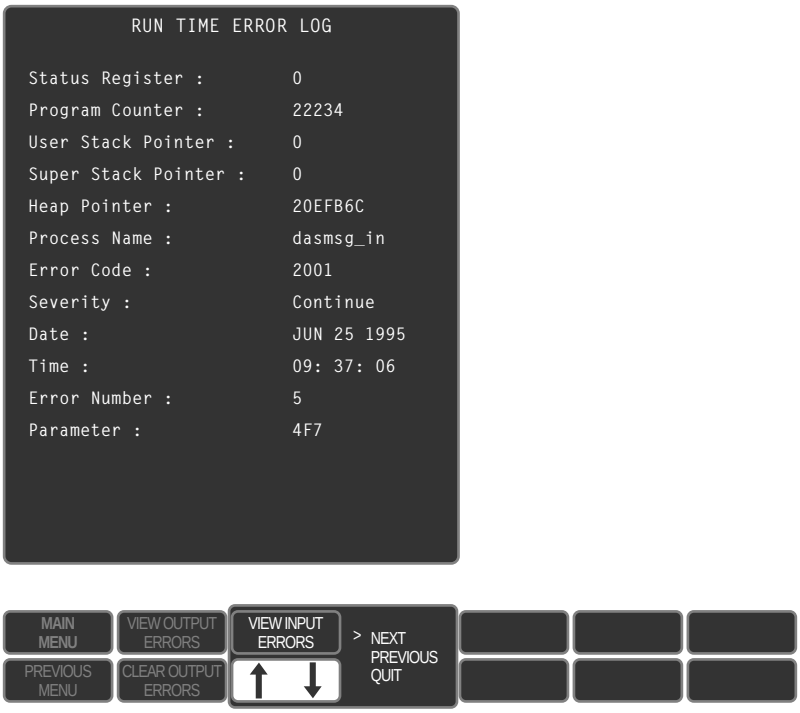
The Trim Knob control can be used to scroll through each logged error, perusing all of the parameters associated with each output software error. Rotate the Trim Knob control to move the cursor (>) to a position for viewing the NEXT or PREVIOUS error as well as the position that allows the user to QUIT viewing output errors.

SERVICE MODE MENU (CONT)

View input errors

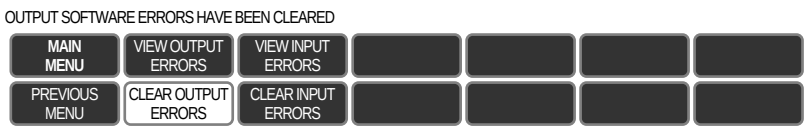
Selecting QUIT closes the run time error log pop-up window and returns to the review errors menu option items.

4. The VIEW INPUT ERRORS menu option item, when selected using the Trim Knob, causes a RUN TIME ERROR LOG pop-up window to appear on the monitor display. The pop-up window now displays input software errors and provides basically the same information as the VIEW OUTPUT ERRORS pop-up window provided. The appearance of both pop-up windows are similar, the difference being errors that are logged as input versus output to/from the monitor.



Clearing the error log

5. To clear out the stored run time error logs, use the Trim Knob to scroll to and select the CLEAR OUTPUT ERRORS or CLEAR INPUT ERRORS menu option item, respectively.



Immediately following the assertion of the Trim Knob to clear one of the error logs, a message appears directly above the menu option items, on the right side of the display. The message verifies the actuation of the Trim Knob for this function.

SERVICE MODE MENU (CONT)

MORE ABOUT REVIEW ERRORS

This part of the section describes in greater detail what information the error log contains and what can be learned from error logs.

How much data actually is in the error log

An error log in the monitor is constructed as a circular file (not referring to a wastepaper basket). This circular file can hold up to 50 events. As an event occurs, error information is stored in the log. Subsequent events are stored sequentially as they occur. When the 50-event limit is reached, the next error (the 51st error) is written over the first event that was logged, erasing that event and replacing it with the latest event. The 52nd event is written over the second event, and so on. If errors occur infrequently the error log could span a period of weeks and months, maybe even years. For example; if a problem with the network begins, repeating frequently, the error log might consist only of errors from the last few hours. In any case the error log will contain the most recent 50 errors that were detected and recorded.

Using information in the error log

A sample of the monitor error log pop-up window appears at the left. If using the error log to troubleshoot a potential problem with the monitor, the parameters from the pop-up window which are of greatest interest are listed in the following table.

```
          RUN TIME ERROR LOG

Status Register :         2000
Program Counter :         10017A
User Stack Pointer :      981794
Super Stack Pointer :     94FFAE
Heap Pointer :            910F78
Process Name :            system
Error Code :              warmstart:0
Severity :                Continue
Date :                    JUL 19 1995
Time :                    13: 34: 52
Error Number :            1
```

Process Name:	The task that was operating when the event or problem occurred,
Error Code:	A software code for the type of event or problem that occurred,
Severity:	Indicates the level of impact of the event or problem on the system,
Date:	The date the event or problem occurred,
Time:	The time the event or problem occurred, and
Error number:	A sequential number (0-50) used to identify each event or problem.

How network errors are logged

If certain types of network errors or problems occur, two additional parameters are added to the error log pop-up window. The table below lists the additional parameters.

Network Error:	Identifies a network error or problem occurred,
Channel Number:	Identifies the network channel exhibiting the error

SERVICE MODE MENU (CONT)

ERROR LOGS

Something to remember about the error log is that it contains more than just operating system errors. Many events that occur that might have an impact upon the system are entered into the log. The 700-series of error codes include many such events.

Error code descriptions

Some of the event/error codes you might find useful are described in the following table:

Error Code	Description
400-4FF	Network errors were detected.
703	Diagnostics test were completed.
70B	Internet address was changed (network address for the monitor was changed; network address changes should only be done by qualified service personnel only).
70E	Time was changed from this monitor (helps determine how the system-wide time may have been altered).
70F	Date was changed from this monitor (helps determine how system-wide time was altered).

Severity of the error

Severity of errors is an indication of how the event (error) affected the system. There are three levels of severity. The following table provides a list of the levels including a description of each:

CONTINUE	The event or error was logged, the task may or may not have completed, but the system was able to continue operating. Most error log entries will have this severity level.
FATAL	The event or error was logged, the task did not complete, and the system was unable to continue operating as recovery was not possible. This level of severity in an event or error is always followed by an automatic warm start.
FORCED RESTART	The operating system restarted normally after a known condition, such as an Internet address change, patient discharge, etc.

SERVICE TIPS

FAULT/SYMPTOM ANALYSIS

This information is provided for the benefit of service technicians responsible for the maintenance and repair of the monitor. The symptoms covered in this part of the Troubleshooting section represent only a select number of faults that you may encounter and by no means are intended to cover every possible failure that may occur.

A systematic approach to the diagnosis of problems as well as a general understanding of the architecture, both hardware and software, of the monitor are essential to ensure successful troubleshooting of this device. The manufacturer recommends formal service training before repairs are attempted on the monitor. The Service Tips listed below combined with formal training should provide the service technician with skills necessary to service and repair a monitor, in the event of a malfunction.

The power LED on the front panel flashes every 2 seconds

Reason: The +5 Vdc supply voltage is in an over-current condition.

- Replace the processor PCB assembly. This is the only board that uses the +5 Vdc supply voltage. The power supply PCB assembly is working properly by the fact that it is restarting after detection of the over-current condition, thus causing the front panel LED to flash at a regular interval.
- Check the power supply PCB assembly. This board can be bench-tested as per the Calibration section of this manual.

The LED's on the front panel continually flash and the monitor never boots-up

Reason: The monitor is stuck in its boot-up sequence due to the lack of processor-to-processor communication.

- Replace the acquisition PCB. Typically, with a fault of this type, the processor PCB has successfully booted-up but is unable to boot-up the acquisition PCB assembly. This fault is verified if the display flashes the monitor main menu intermittently during the boot-up process.
- Replace the processor PCB if replacing the acquisition PCB does not fix the problem.

Video problem - the patient waveforms are displayed correctly but the alphanumerics are displayed improperly or are not displayed at all or vice-versa

Reason: The graphics processing (video) circuitry on the processor PCB has problems attempting to "clock-out" the text information data that is stored in video memory circuits (VRAM).

- Replace the processor PCB. This is the only area of the monitor where text (alphanumerics) information and graphics (patient waveforms) information is processed separately.

SERVICE TIPS (CONT)

Video problem - there are bars/ strips of pixels missing on the display in rows/columns. Or only one row/column of pixels on the display is missing or never turned on. The remaining portion of the display functions properly.

Reason: The active matrix display has a defective row or column driver. If the entire driver has failed, the display will have a whole missing *strip* of display area. If just a part of the driver has failed, the display will have only a single missing line of display area.

- Replace the display assembly. This will be either a TFT (thin-film transistor) color display assembly or an EL (electroluminescent) monochrome display assembly depending on the monitor. Both displays have specific drivers for rows and columns integrated into the display assembly and, therefore, cannot be repaired.

ACQUISITION PCB SYMPTOMS

Symptoms relative to patient signal acquisition such as missing parameter text and waveform(s) may be associated with acquisition PCB assembly failure. It is important that you are able to distinguish the difference between the general format of the display, which is generated by the processor PCB assembly, versus the patient signals and data that is associated with these patient signals, a function of data acquisition, which is generated by the acquisition PCB assembly.

PROCESSOR PCB SYMPTOMS

Symptoms with network communications, asynchronous communications, NBP control, PCMCIA communications, analog output, audio/sound generation, and remote video signals/ communications as well as other display-related problems all may be associated with processor PCB assembly failure. All of these are functions controlled by microcontroller or graphics processing circuitry located on the processor PCB assembly.

SERVICE TIPS (CONT)

POWER SUPPLY PCB SYMPTOMS AND APPLICATIONS

The power supply PCB assembly provides power that is used throughout the Eagle monitor. All of the supply voltages are distributed to the processor PCB assembly for various application. Below is a list of the supply voltages and where and how these voltages are applied. Problems in any of the following areas may be associated with power supply PCB assembly failure.

Following is the list of applications for each supply voltage generated by the power supply PCB:

+12 V_{dc} (+12 MAIN) supply applications

- Acquisition PCB - main power source
- Ethernet transceiver - power source
- Display assembly - backlight power source
- Expansion interface - flash memory programming power source
- Memory card (PCMCIA) slot - programming power source
- Defib marker out - power source for Defib Sync jack
- Audio amplifier - power source (speaker)
- NBP compressor (pump assembly) and solenoid valves - power source
- Main memory - flash memory programming power source

+5 V_{dc} (+5) supply applications

- Processor PCB - logic power source
- Display assembly - logic power source
- Expansion interface - logic power source
- Memory card (PCMCIA) slot - logic power source
- Remote display - logic power source

±12 V_{dc} (±12 ANALOG) supply applications

- Remote display - analog signal power source
- Expansion interface - analog power source
- Analog ECG/blood pressure - signal generation for Defib Sync jack

SERVICE TIPS (CONT)

END-TIDAL CO_2 MESSAGES

Following is a list of messages that may appear on the monitor when monitoring $EtCO_2$. The message should clear when normal operating criteria are met or a solution is found. If a message persists, call Monitoring Technical Support.

CAL SENSOR TO ZERO CELL

Cause: A new sensor was introduced into the system or possible signal drift in sensor electronics.

Solution: Zero CO2 sensor.

CANNOT CALIBRATE

Cause: Message appears when attempting calibration in an unstable condition such as sensor still warming up, or other error condition.

Solution: Calibrate sensor when no error condition exists.

CHANGE AIRWAY ADAPTER

Cause: Sensor signal is out of tolerance.

Solution: Check for obstructions in airway adapter or other defects.

CHECK ADAPTER / ADAPTER CAL

Cause: Adapter is not attached to sensor, adapter is obstructed, or adapter used is of a different type than the one last calibrated to sensor.

Solution: Check connections. Check for possible obstructions in the adapter. Calibrate adapter.

INCOMPATIBLE SENSOR

Cause: Capnostat sensor is of older type and not supported by monitor software.

Solution: Use only a Mainstream Capnostat III CO2 sensor.

NO BREATH DETECTED

Cause: No breath detected or sensor is disconnected from patient airway.

Solution: Check the patient and all patient connections.

NOT CALIBRATED

Cause: Sensor signal is out of tolerance.

Solution: Calibrate the sensor on the Zero cell and then on the Reference cell to double check.

SERVICE CO2 SENSOR

Cause: CO2 sensor feature failure.

Solution: Call Marquette for service.

SERVICE CO2 SENSOR-SENSOR TEMP

Cause: CO2 sensor is too warm.

Solution: Remove sensor from external heat source. If message persists, call Marquette for service.

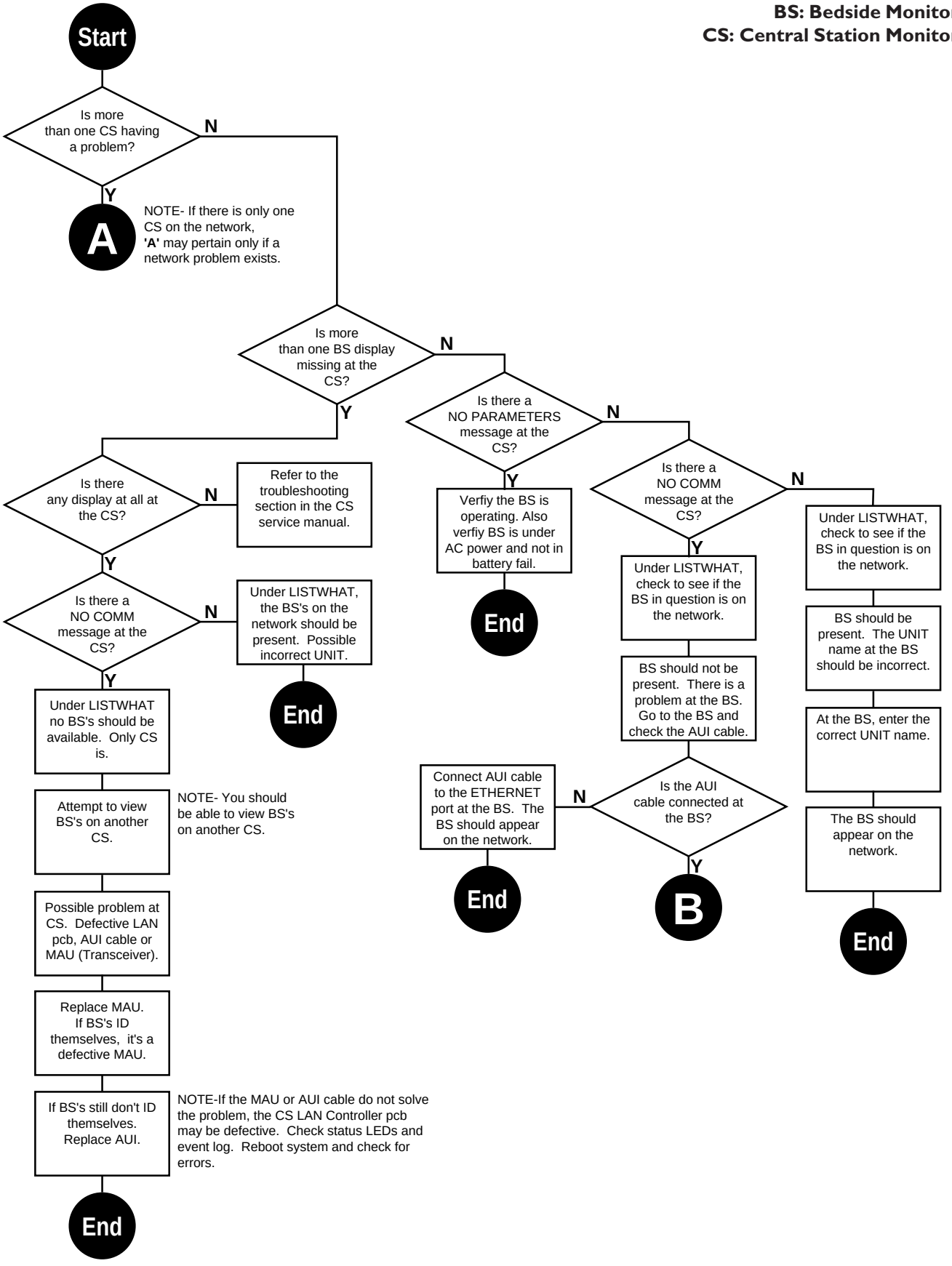
WARMING UP

Cause: Appears whenever a sensor is first plugged in and when a sensor is first powered on.

Solution: Message will clear when warmed up. If it persists beyond 4 minutes, call Marquette service.

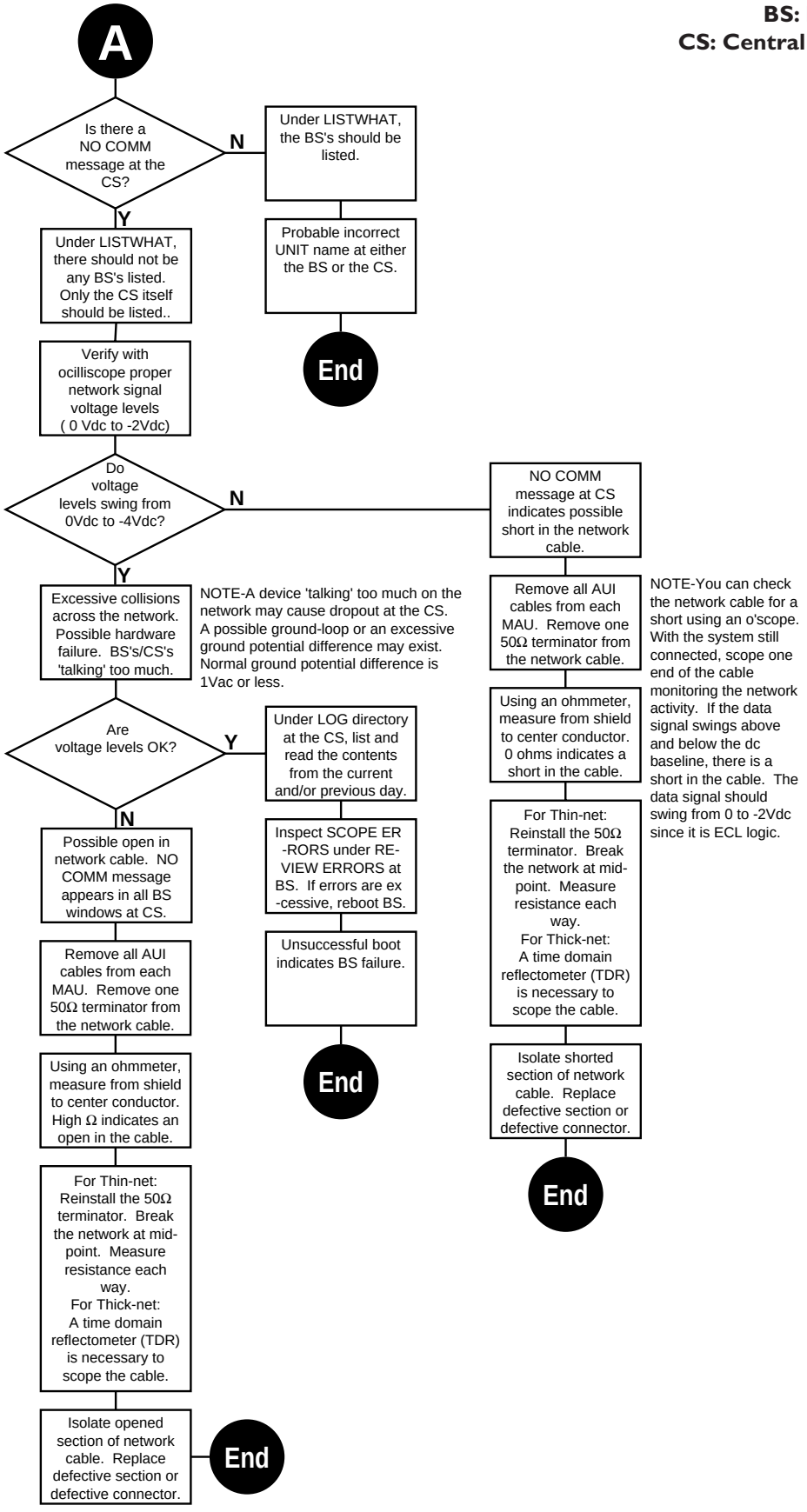
NETWORK TROUBLESHOOTING

BS: Bedside Monitor
CS: Central Station Monitor



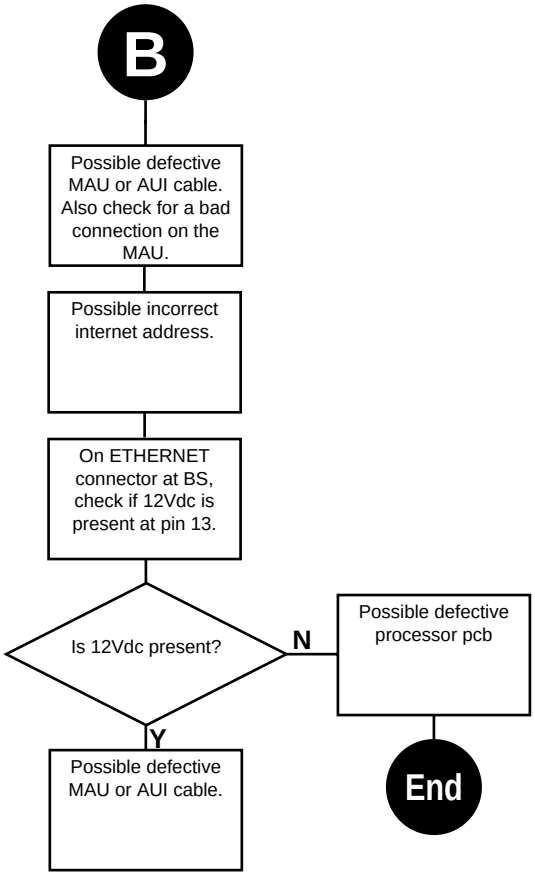
NETWORK TROUBLESHOOTING (CONT)

BS: Bedside Monitor
CS: Central Station Monitor



NETWORK TROUBLESHOOTING (CONT)

BS: Bedside Monitor
CS: Central Station Monitor



NOTE-There is a possibility that the MAU is defective. On a busy network, it may be difficult to determine whether the MAU is detecting carriers properly. The MAU may be continually detecting carriers and will not allow the BS to transmit.

For your notes.

6 ASSEMBLY DRAWINGS

ASSEMBLY DRAWINGS

ABOUT THIS SECTION

Included in this section is a complete set of engineering assembly drawings. These drawings provide reference for components of the monitor in the form of mechanical and electrical diagrams.

Two sets of drawings

There are two complete sets of assembly drawings (6 individual drawings per set) included in this section. The two sets include assembly drawings for the following:

- Monitors with a TFT color display, and
- Monitors with a monochrome EL display (standard and/or non-invasive configurations).

ABOUT THE ASSEMBLY DRAWINGS

The assembly drawings for all of the monitors configurations are broken down as follows:

- Packing materials: These diagrams provide reference to the manufacturer shipping container used for the monitors.
- Electrical diagrams: These diagrams provide a reference to electrical assemblies in the monitors.
- Interconnect diagrams: These diagrams provide a reference to electrical signals used for all of the assemblies in the monitor. The diagrams show connector to connector pin designations for each wiring harness, cable and flex circuit.
- Exploded views: These diagrams provide an exploded view of the monitor with itemized reference to the parts lists.
- Parts Lists: These lists provide part numbers and descriptive cross-reference to parts and subassemblies found in the exploded views.

PN D412186E - COLOR

ABOUT THE ASSEMBLY DRAWINGS

The TFT color monitor assembly drawings provide reference for components of the monitor in the form of mechanical and electrical diagrams.

The following assembly drawings for monitors with TFT color displays can be found in this part of the section:

Packing materials: This diagram provides a reference to the manufacturer packing materials used for shipping the monitor from the factory.

Exploded views: These diagrams provide reference to the individual parts and assemblies used in the monitor.

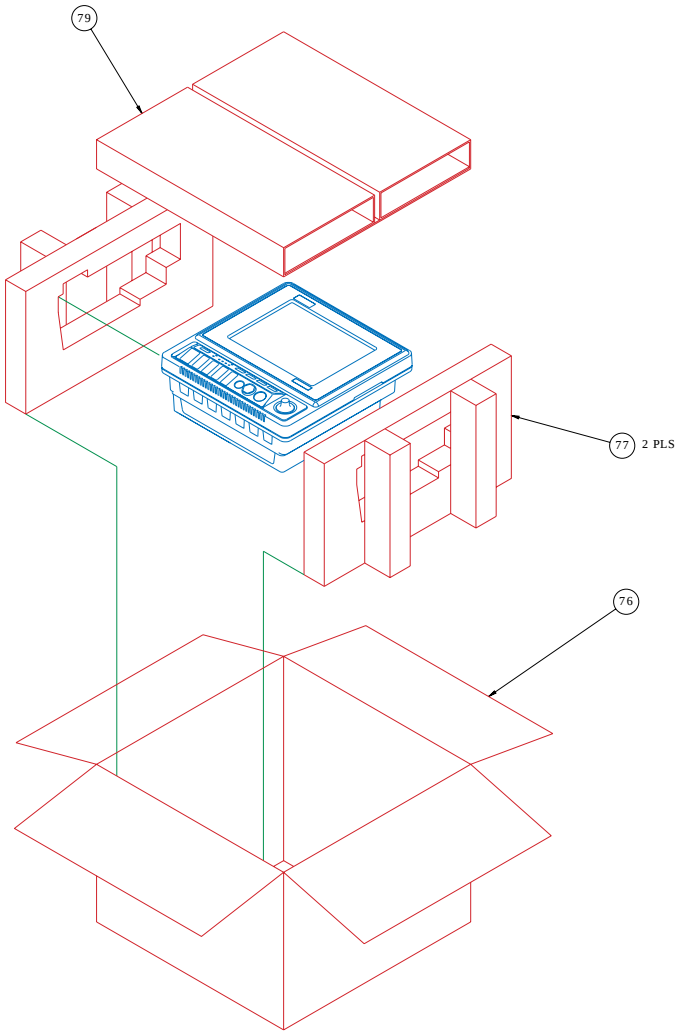
Electrical connectors: This diagram provides a reference to electrical signals for each cable or wiring harness used for interconnection of electrical assemblies in the monitor.

Electrical diagram: This diagram provides a reference for the electrical assemblies in the monitor and respective interconnections.

Parts List: This list provides part numbers and a descriptive cross-reference to parts and subassemblies found in each of the drawings.

PN D412186E - COLOR (CONT)

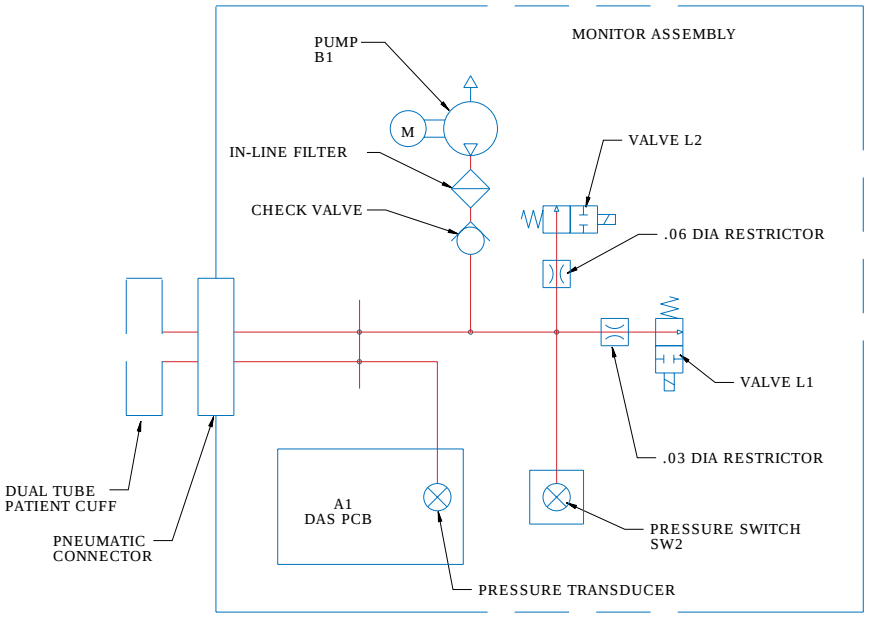
PACKING MATERIALS



NOTES:
1. PLACE INSTRUCTION CARD, ITEM 84 AND CONNECTOR COVERS, ITEM 81, IN BAG, ITEM 91, FOR SHIPPING.
2. PLACE INSTRUCTION CARD, ITEM 92, IN BAG, ITEM 93, FOR SHIPPING.
3. LOOSE ITEMS MAY BE SHIPPED WITH THE UNIT IF SPACE PERMITS OR PACKAGED AND SHIPPED SEPARATELY.
4. -010 & -021 ASSEMBLIES: PLACE INSTRUCTION SHEET, ITEM 130, AND ASSEMBLED PNEUMATIC CIRCUIT IN BAG, ITEM 93, FOR SHIPPING.

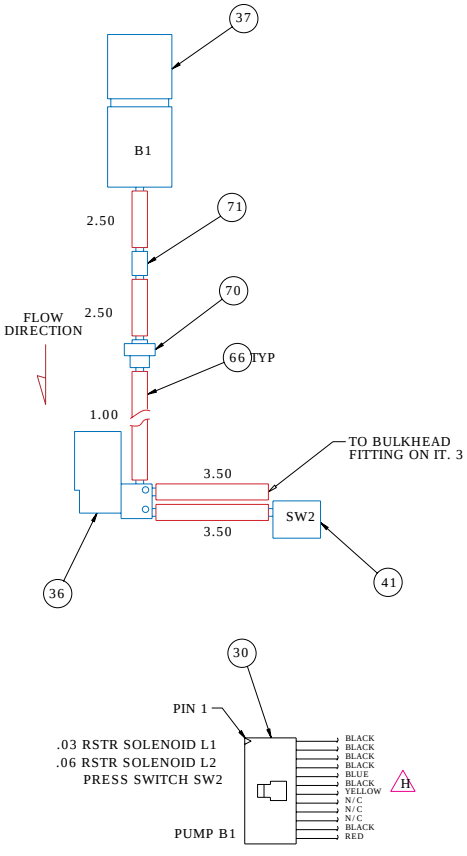
PN D412186E - COLOR (CONT)

NBP PNEUMATIC CIRCUIT DIAGRAM



PNEUMATIC SCHEMATIC

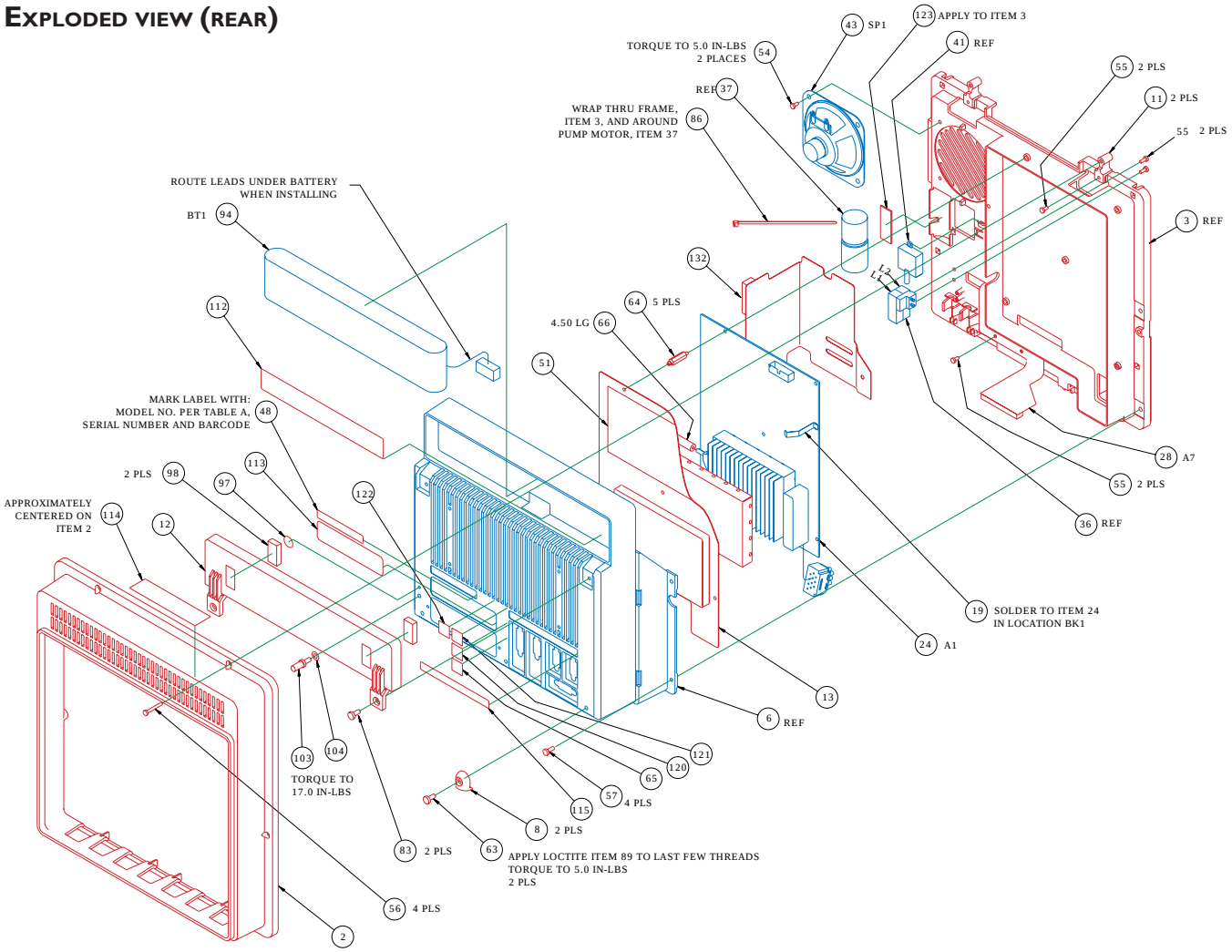
EXPLODED VIEW (DETAIL G)



DETAIL G
NBP PLUMBING ASSEMBLY

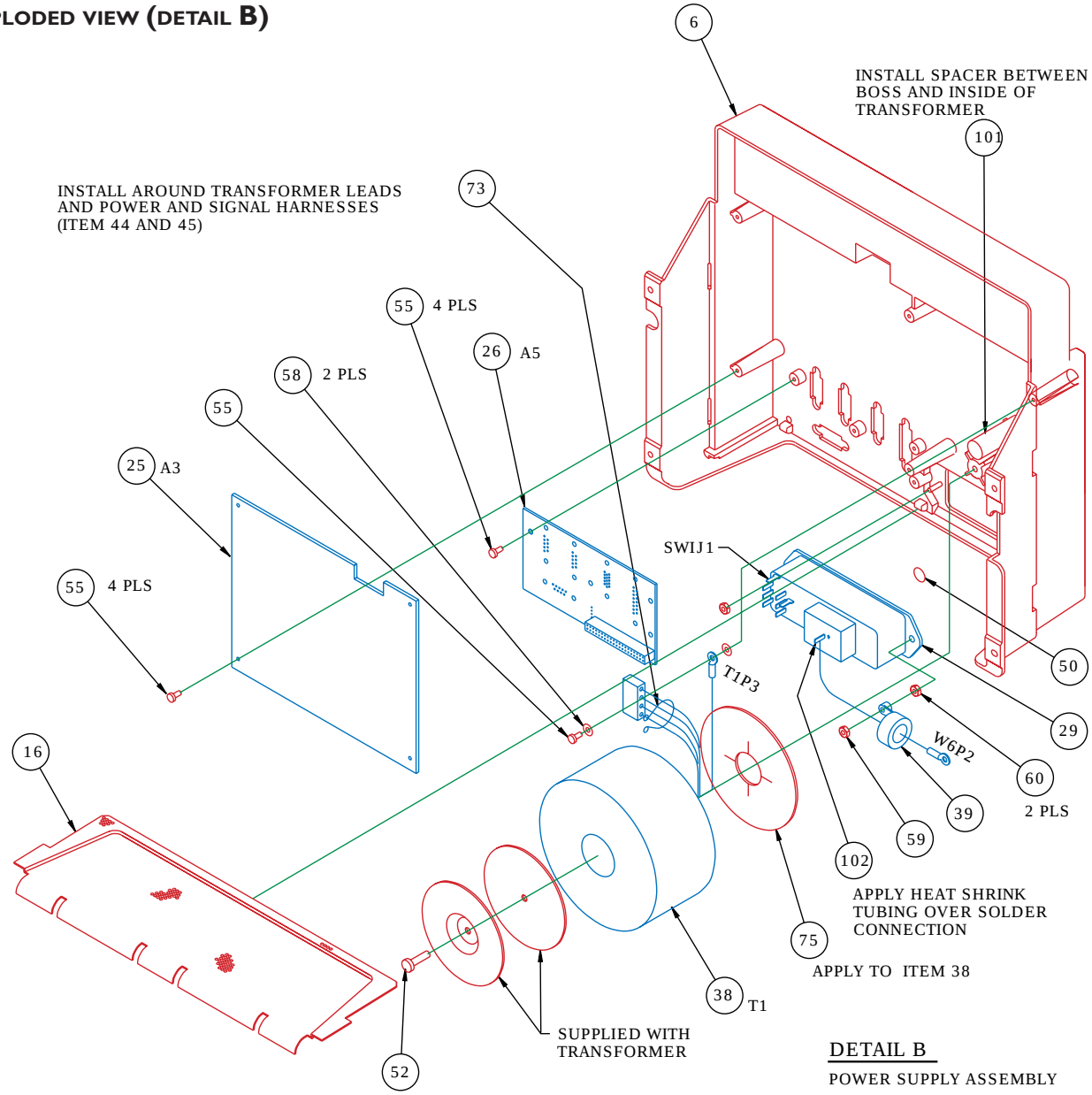
PN D412186E - COLOR (CONT)

EXPLODED VIEW (REAR)



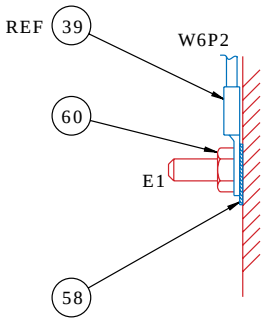
PN D412186E - COLOR (CONT)

EXPLODED VIEW (DETAIL B)



DETAIL B

POWER SUPPLY ASSEMBLY

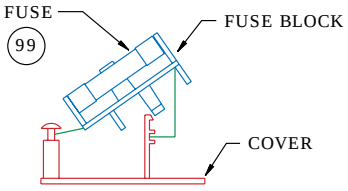


CHASSIS GROUND DETAIL

GROUND STUD IN CASTING, ITEM 6

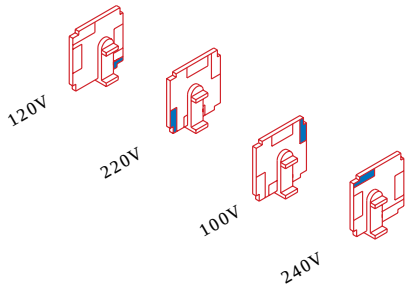
PN D412186E - COLOR (CONT)

FUSE REPLACEMENT/VOLTAGE SETTINGS



FUSE BLOCK/COVER ASSY

TO CHANGE TO 5 X 20 MM FUSES REMOVE FUSE BLOCK BY LOOSENING SCREW AND INVERT BLOCK. INSTALL FUSES AND REPLACE INTO HOUSING. NOTE:THE FUSE(S)THAT GO INTO HOUSING FIRST ARE THE ACTIVE FUSE(S).



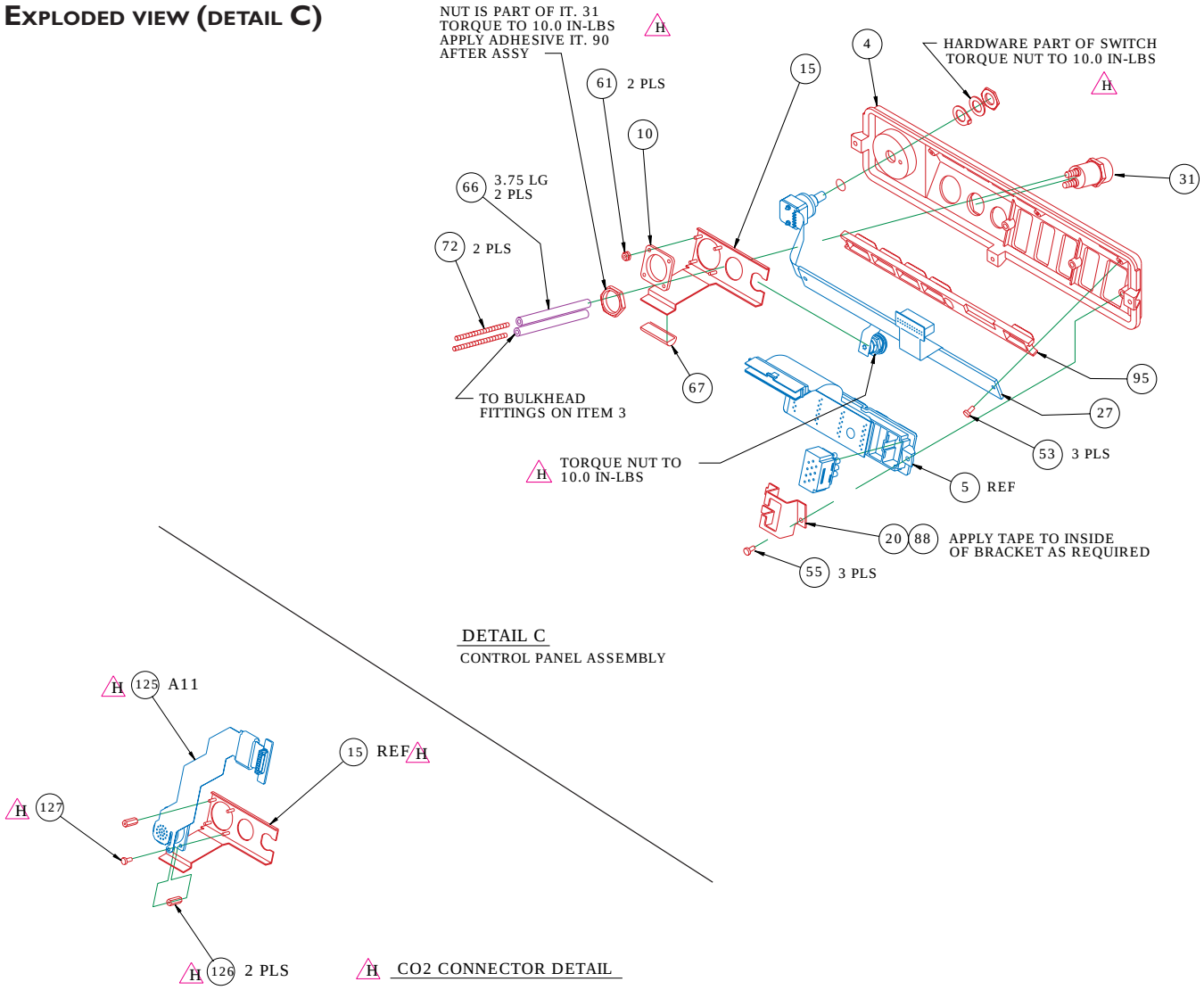
VOLTAGE SELECTOR CARD ORIENTATION:

ROTATE WHITE KEYING PIN TO POSITION SHOWN. FOR CORRESPONDING VOLTAGE INSTALL WITH PRINTED SIDE FACING IEC CONNECTOR (AS SHOWN)

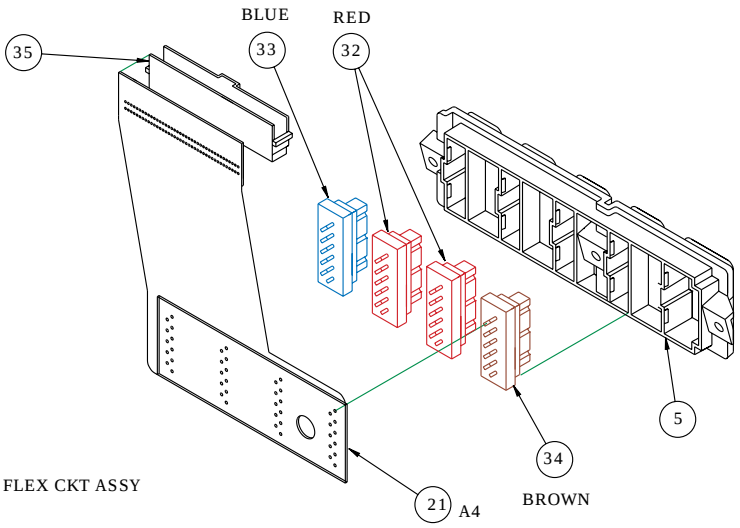
FUSE/VOLTAGE SETTING
SCALE 1:1

PN D412186E - COLOR (CONT)

EXPLODED VIEW (DETAIL C)

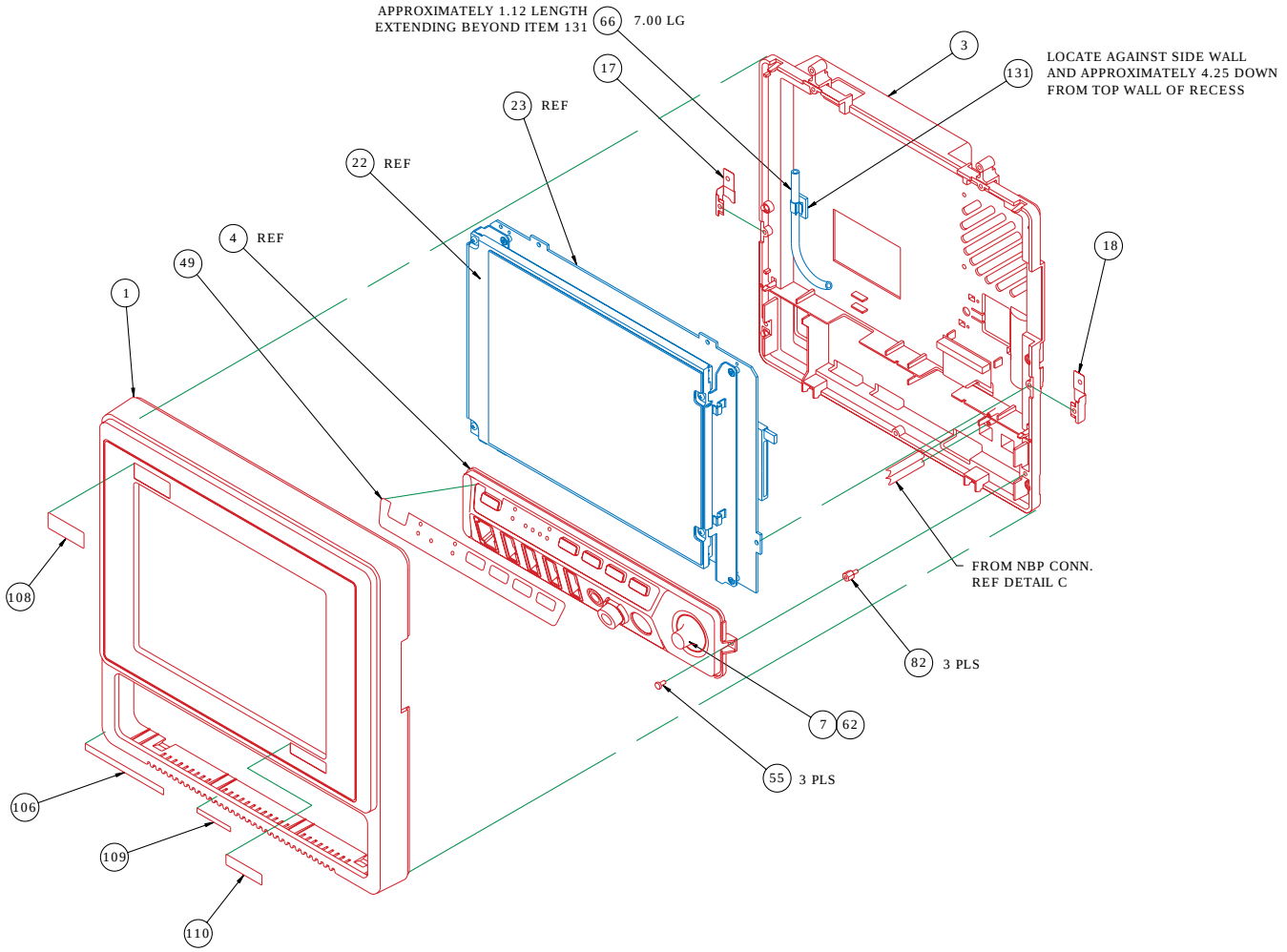


EXPLODED VIEW (DETAIL F)



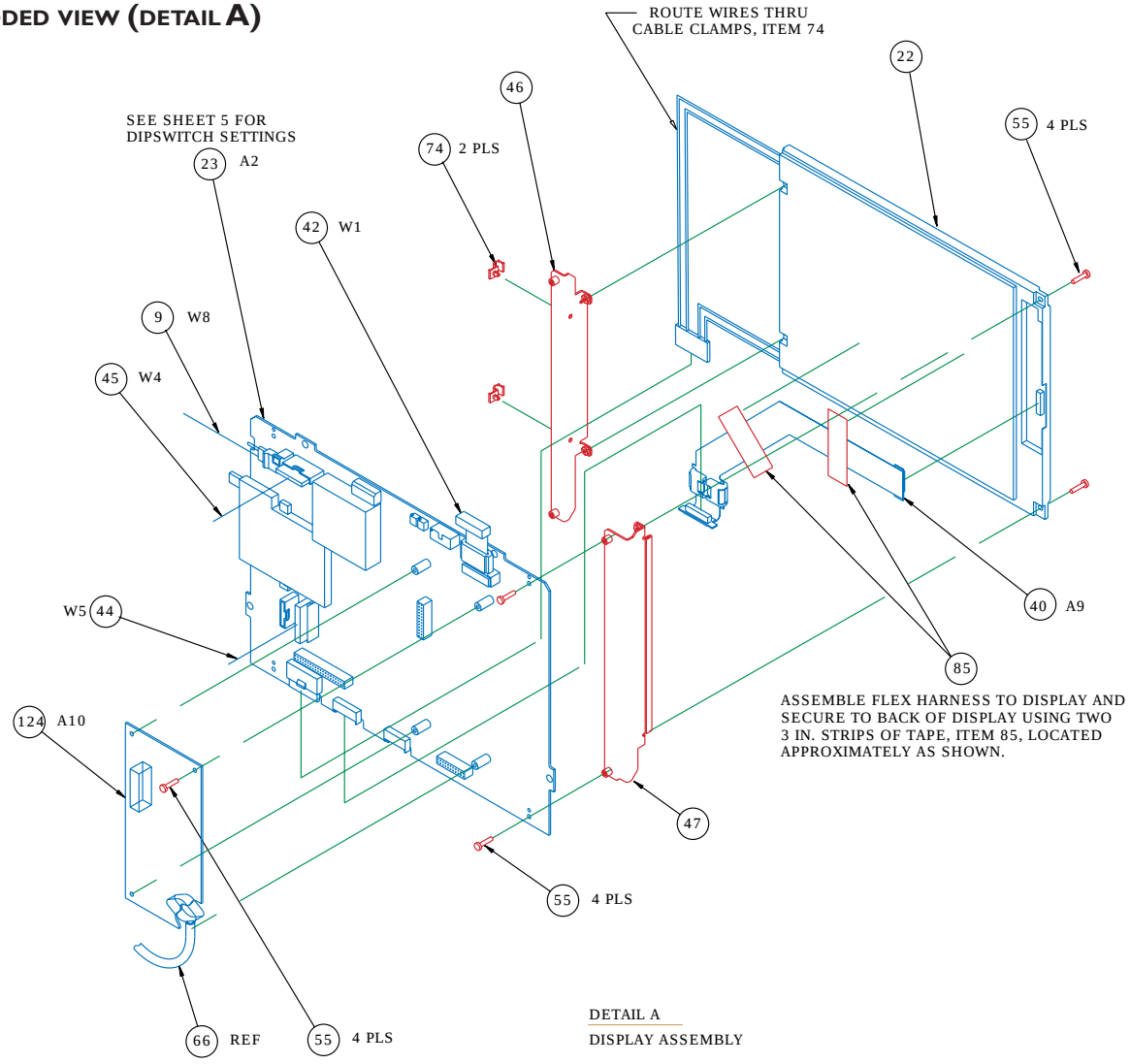
PN D412186E - COLOR (CONT)

EXPLODED VIEW (FRONT)



PN D412186E - COLOR (CONT)

EXPLODED VIEW (DETAIL A)



DETAIL A

DISPLAY ASSEMBLY

PROCESSOR PCB DIP SWITCH SETTINGS

H

PROCESSOR BRD DIP SWITCH SETTINGS (A2SW1)

POS.	FUNCTION	ON (Closed)	OFF (Open)
1.	PROGRAM MEMORY UPDATE	DISABLE	ENABLE
2.	BOOT FROM MEMORY CARD	ENABLE	DISABLE
3.	50/60 Hz	50 Hz	60 Hz
4.	ENGLISH/SI UNITS	SI	ENGLISH
5.	DISPLAY SCAN MODE	NORMAL	SPLIT
6.	PULSE OXIMETRY MODE	Not Used	NELLCOR
7.	DEFIB SYNC PULSEWIDTH	100 mS	10 mS
8.	DEFIB SYNC PULSE AMPLTD.	12 V	5 V

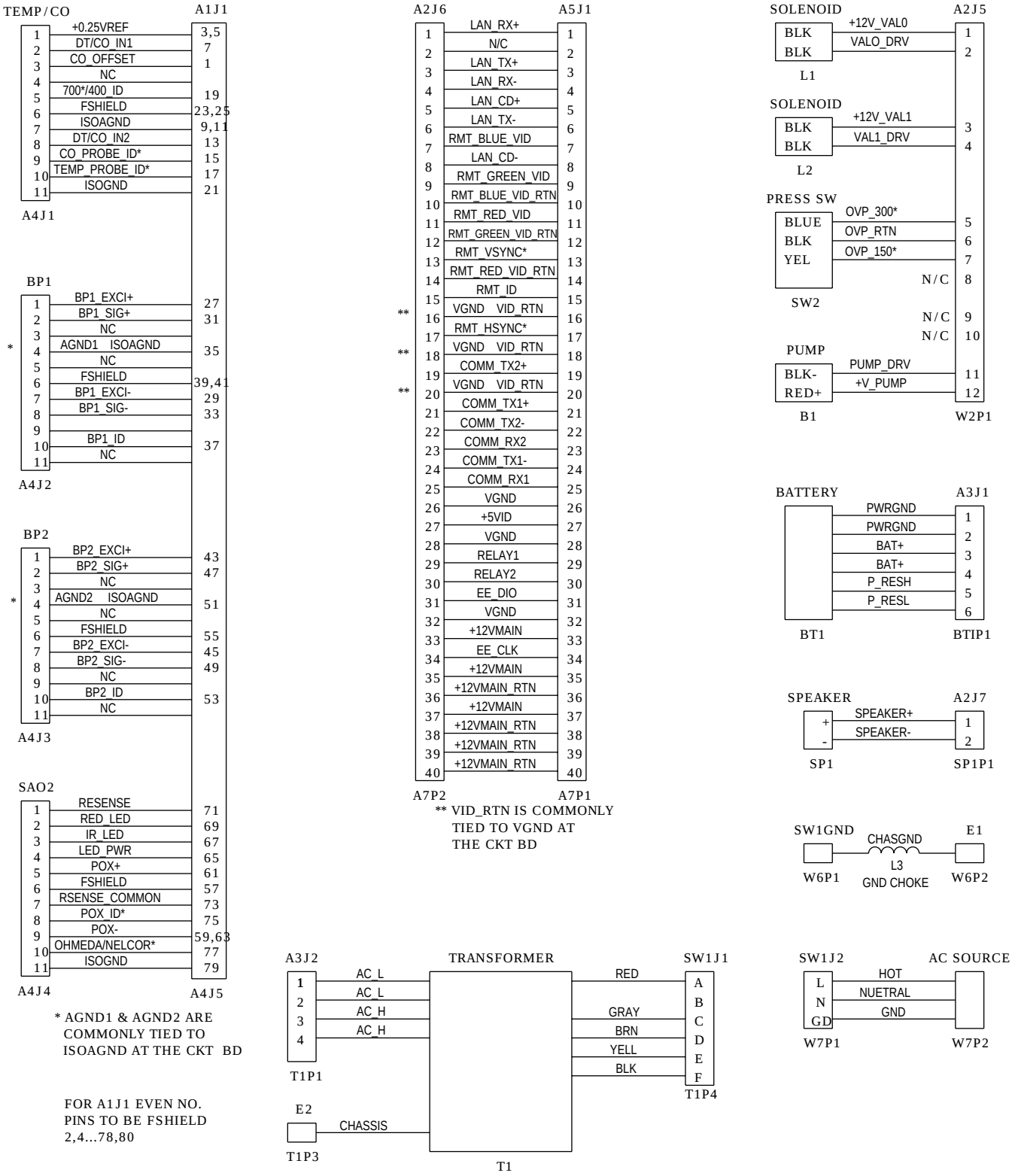
NORMAL SWITCH SETTINGS:

SWITCHES 1-4 & 6-8 OFF (Open)

SWITCH 5 ON (Closed)

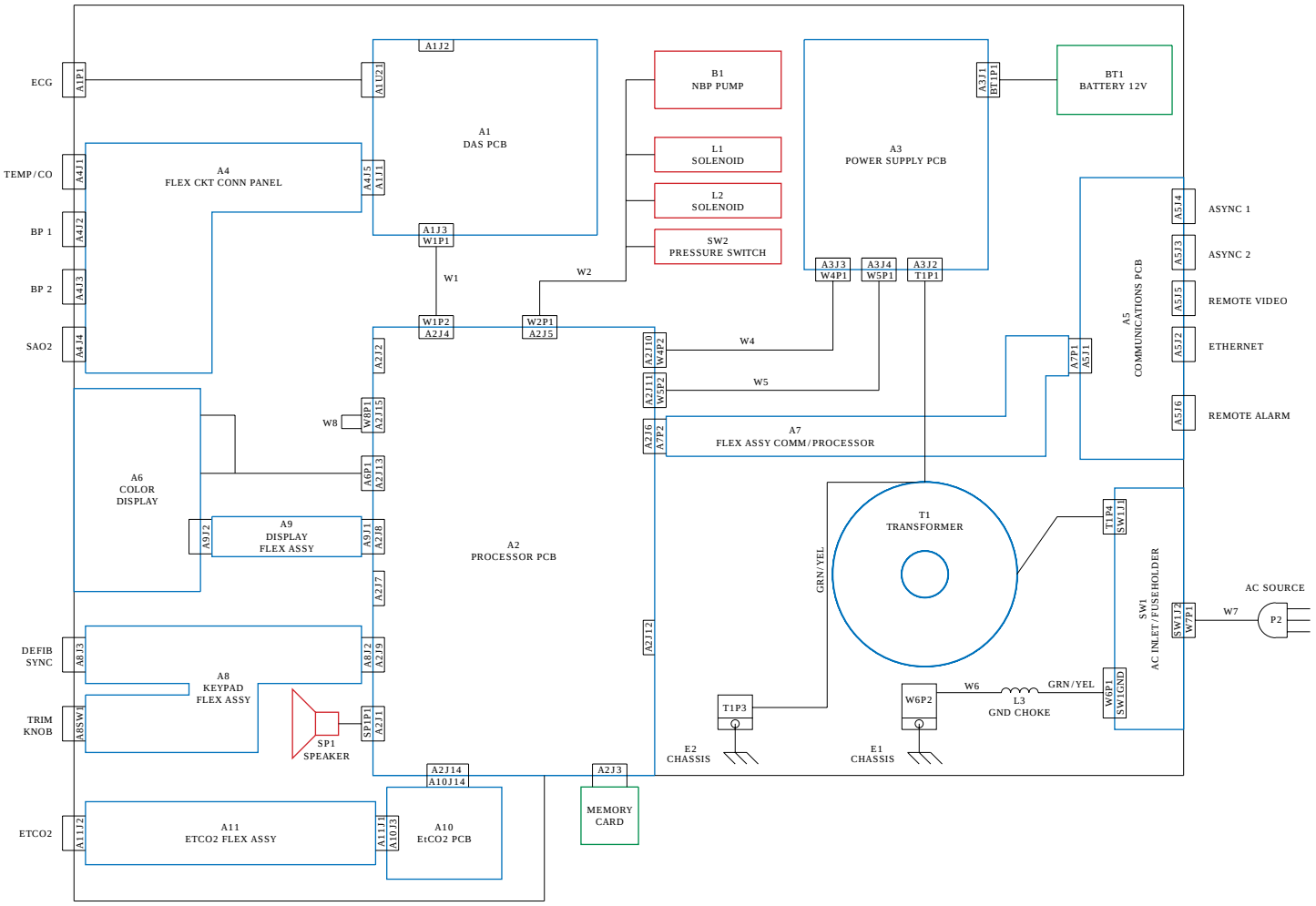
PN D412186E - COLOR (CONT)

ELECTRICAL CONNECTORS



PN D412186E - COLOR (CONT)

ELECTRICAL DIAGRAM



PN. 412186-023E/-024E PARTS LIST - COLOR

REFERENCE ASSEMBLY DRAWING PN D412186E

Item	Qty.	Part Number	Description
1	1.00	405747-008	FRONT HOUSING EAGLE 4000
2	1.00	405748-003	REAR HOUSING EAGLE HB/COLOR
3	1.00	409109-002	MOUNTING FRAME SERIES 2 EAGLE
4	1.00	405751-004	CONTROL PANEL SERIES 2 EAGLE
5	1.00	405753-001	CONNECTOR FRAME EAGLE
6	1.00	405755-004	CASTING POWER SUPPLY EAGLE
7	1.00	406080-001	TRIM KNOB EAGLE
8	2.00	406464-001	REAR FOOT EAGLE
9	1.00	413346-001	GASKET ADHESIVE DISPLAY FILTER
11	2.00	412086-001	SPACER HOUSING EAGLE HB/COLOR
12	1.00	408640-001	BATTERY COVER EAGLE
13	1.00	408989-002	COVER DAS BOARD
15	1.00	406130-004	PLATE CONN MTG ETCO2 EAGLE
16	1.00	406394-001	BOTTOM COVER CASTING
17	1.00	413536-001	CLIP GROUNDING PROC PCB LEFT
18	1.00	413536-002	CLIP GROUNDING PROC PCB RIGHT
19	1.00	408984-002	CLIP GROUNDING DAS BRD
20	1.00	409472-001	BRACKET ECG CONN
21	1.00	406324-002	FLEX CKT CONNECTOR PANEL; A4
22	1.00	417851-001	LCD ASSY TFT D344 W/HARNESS
23	1.00	800704-004	PCB EAGLE 4000 CPU 20MHZ; A2
24	1.00	800376-002	PCB EAGLE DAS 12SL; A1
25	1.00	800378-002	PCB EAGLE POWER SUPPLY; A3
26	1.00	801316-001	PCB EAGLE COMMUNICATION; A5
27	1.00	800760-001	PCB FLEX SERIES 2 KEYPAD; A8
28	1.00	800400-001	FLEX PCB COMM/PROCESSOR; A7
29	1.00	17033-007	CONN FUSE HLDR SW VOL FILTER
30	1.00	17043-112	CONN RCPT LOCKING 12P
31	1.00	401184-001	COUPLING TWIN BODY 1/8 ID
32	2.00	401762-004	11P SKT 1.0MM KEY4 BP
33	1.00	401762-008	11P SKT 1.0MM KEY8 PULSE OX
34	1.00	401762-021	11P SKT 1.0MM KEY21 CO
35	1.00	408820-001	CONN RA 050C 80P
36	1.00	416153-002	ASSY VALVE/MANIFOLD EAGLE; L1,L2
37	1.00	406693-003	ASSY NBP PUMP; B1
38	1.00	410168-001	TRANSFORMER ISO STEPDOWN EAGLE; T1
39	1.00	411810-001	ASSY CHOKE GROUND WIRE
40	1.00	417768-001	FLEX PWB ASSY W/SPLIT CORE; A9
41	1.00	408800-002	ASSY PRESS SENSOR 150/300 MMHG; SW2
42	1.00	415682-001	CABLE ASSY RBN 16P DAS/CPU; W1
43	1.00	408884-001	ASSY SPEAKER HARNESS; SP1
44	1.00	409060-001	ASSY HARNESS POWER; W5
45	1.00	409155-001	ASSY HARNESS SIGNAL; W4
46	2.00	417847-001	BRACKET LCD MTG E-4000 LEFT
47	2.00	417849-001	BRACKET LCD MTG E-4000 RIGHT
48	1.00	404525-006	LABEL BLANK 2.6IN X.4IN
49	1.00	415372-001	LABEL EAGLE CONTROL PANEL ENG
49	1.00	415372-003	LABEL EAGLE CONTROL PANEL FRE
49	1.00	415372-004	LABEL EAGLE CONTROL PANEL SWE

PN. 412186-023E/-024E PARTS LIST - COLOR (CONT)

REFERENCE ASSEMBLY DRAWING PN D412186E

Item	Qty.	Part Number	Description
49	1.00	415372-005	LABEL EAGLE CONTROL PANEL SPA
49	1.00	415372-006	LABEL EAGLE CONTROL PANEL ITA
49	1.00	415372-007	LABEL EAGLE CONTROL PANEL DUT
49	1.00	415372-008	LABEL EAGLE FRT PNL GER NO PTB
49	1.00	416802-001	LBL EAGLE FRONT PANEL CO2 ENG
49	1.00	416802-002	LBL EAGLE FRONT PANEL CO2 GER
49	1.00	416802-003	LBL EAGLE FRONT PANEL CO2 FRE
49	1.00	416802-004	LBL EAGLE FRONT PANEL CO2 SWE
49	1.00	416802-005	LBL EAGLE FRONT PANEL CO2 SPA
49	1.00	416802-006	LBL EAGLE FRONT PANEL CO2 ITA
49	1.00	416802-007	LBL EAGLE FRONT PANEL CO2 DUT
50	1.00	415511-001	LABEL SYMBOL GROUND
51	1.00	415509-001	LABEL PATIENT ISO CAUTION
52	1.00	45000-810	SCREW SEMS PH 8-32X5/8
53	3.00	45074-418	SCREW BDGH 4-40 X .312L
54	2.00	45040-604	SCREW TT PH 6-32X1/4
55	33.00	45074-408	SCREW BDGH 4-40 X 1/4
56	4.00	45074-432	SCREW BDGH 4-40X1.00
57	4.00	45074-612	SCREW BDGH 6-32X3/8
58	3.00	4520-304	WASHER LOCK EXT #4
59	1.00	4521-304	NUT ESNA 4-40
60	3.00	4521-704	NUT HEX KEPS 4-40
62	1.00	4556-001	SPRING CLIP D TYPE .250 DIA
63	2.00	4502-812	SCREW PH 8-32 X 3/8
64	5.00	409764-001	STANDOFF 4-40 THD W/SNAP .75L
65	1.00	408230-002	LABEL UL LISTED MEDICAL
66	2.08	401582-001	TUBING SILICONE 1/8ID X 1/4OD
67	0.09	403741-001	SPRING CHASSIS GRD TRAM REAR
70	1.00	404675-001	CHECK VALVE 1/8 I.D.
71	1.00	404679-001	FILTER IN-LINE 1/8ID 43 MICRON
72	2.00	404855-001	SPRING COMPRESSION .112 DIA
73	1.00	406447-002	TIE WRAP KURLY-LOK .45 DIA BDL
74	2.00	408381-001	CLIP .25 DIA HOLD DOWN
75	1.00	416760-001	GASKET TRANSFORMER EAGLE 4000
76	1.00	407396-004	CARTON SHIPPING EAGLE 4000
77	2.00	407397-002	FOAM INSERT EAGLE 2
79	1.00	407399-002	INSERT SPACER EAGLE 2
81	2.00	408557-001	COVER PATIENT CONNECTORS
82	3.00	4656-404	SPCR M/F 4-40 X .25
83	2.00	4502-808	SCREW PH 8-32 X /14
84	1.00	409326-001	INSTRUCTION CARD CONN COVER
85	2.00	412635-001	GROUND CLIP COLOR DISPLAY
86	1.00	4535-002	TIE WRAP 8.00LG X .187W
88	0.01	4814-002	TAPE DS BK .03X1.0
89	0.01	4851-003	CEMENT LOCTITE 242
90	0.01	4851-071	ADHESIVE LOCTITE PRISM 460
91	1.00	9956-002	4X6IN ANTI-STATIC ZIPLOCK BAG

PN. 412186-023E/-024E PARTS LIST - COLOR (CONT)

REFERENCE ASSEMBLY DRAWING PN D412186E

Item	Qty.	Part Number	Description
92	1.00	407300-054	INST EAGLE DISPLAY CLEANING
93	1.00	9976-008	BAG ANTI-STATIC 8.00W X 10.00L
94	1.00	406679-003	BATTERY PACK EAGLE
95	1.00	407175-001	BACKLIGHT KEYPAD EAGLE
95	1.00	407175-002	BACKLIGHT KEYPAD SWEDISH
95	1.00	407175-003	BACKLIGHT KEYPAD FRENCH
95	1.00	407175-004	BACKLIGHT KEYPAD GERMAN
95	1.00	407175-005	BACKLIGHT KEYPAD ITALIAN
95	1.00	407175-007	BACKLIGHT KEYPAD DUTCH
95	1.00	407175-008	BACKLIGHT KEYPAD SPANISH
96	0.25	407300-123	MNL EAGLE 4000 FIELD SERVICE
97	1.00	415511-002	LABEL EQUIPOTENTIALITY SYMBOL
98	2.00	4819-101	TAPE FOAM .5WX1.0L
99	2.00	1908-503	FUSE METRIC 1.25A SLO-BLO
99	2.00	1908-505	FUSE METRIC 2.5A SLO-BLO
99	1.00	1910-212	FUSE 3AG 2 1/2A SB
101	1.00	410491-001	SPACER .5 DIA RUBBER
102	0.04	4882-105	TUBING FIT 3/16 BLK
103	1.00	400040-001	PLUG MC EQUIPOTENTIAL
104	1.00	400041-001	WASHER LOCK SERRATED F/M-6
106	1.00	415512-001	LABEL LEADWIRE WARNING EAGLE
108	1.00	415379-001	LABEL PRODUCT MARK EAGLE 4000
108	1.00	415379-002	LABEL PRODUCT MARK EAGLE 4000N
109	1.00	415377-001	LABEL NELLCOR SENSOR
110	1.00	414908-001	LABEL MARQUETTE .39 X 1.59
110	1.00	414908-002	LABEL COROMETRICS .39 X 1.59
110	1.00	414908-005	LABEL MARQ HELLIGE .39 X 1.59
112	1.00	415374-001	LABEL EAGLE BATTERY CALLOUT
113	1.00	415375-001	LABEL EAGLE FUSE RATINGS DOM
113	1.00	415375-002	LABEL EAGLE FUSE RATINGS INTL
114	1.00	415376-001	LABEL EAGLE WARNING/HOSP USE
115	1.00	415373-001	LABEL EAGLE CONNECTORS BACK
120	1.00	408230-008	LABEL CE MARK
121	1.00	408230-011	LABEL UL LISTED MEDICAL C
122	1.00	416094-001	LABEL RISK CLASS 3
123	1.00	416761-001	GASKET NBP PUMP EAGLE 4000
124	1.00	800862-002	PCB CAPNOSTAT CO2 SUBSYSTEM;A10
125	1.00	800894-001	FLEX ASSY EAGLE C02 CONN;A11
126	2.00	413324-002	SPCR.188 HX 2-56X.562LG
127	1.00	45074-206	SCR BDGH 2-56 X .188L
128	1.00	416749-001	BRKT GND CLR DSPL EAGLE LEFT
129	1.00	416749-002	BRKT GND CLR DSPL EAGLE RIGHT
131	1.00	405558-001	CLIP CABLE HIGH TEMP .188 DIA

PN 412185M - MONOCHROME/NON-INVASIVE

ABOUT THE ASSEMBLY DRAWINGS

The monochrome EL/non-invasive monitor assembly drawings provide reference for components of the monitor in the form of mechanical and electrical diagrams.

The following assembly drawings for monitors with monochrome EL displays, including non-invasive monitors, can be found in this part of the section:

Packing materials: This diagram provides a reference to the manufacturer packing materials used for shipping the monitor from the factory.

Exploded views: These diagrams provide reference to the individual parts and assemblies used in the monitor.

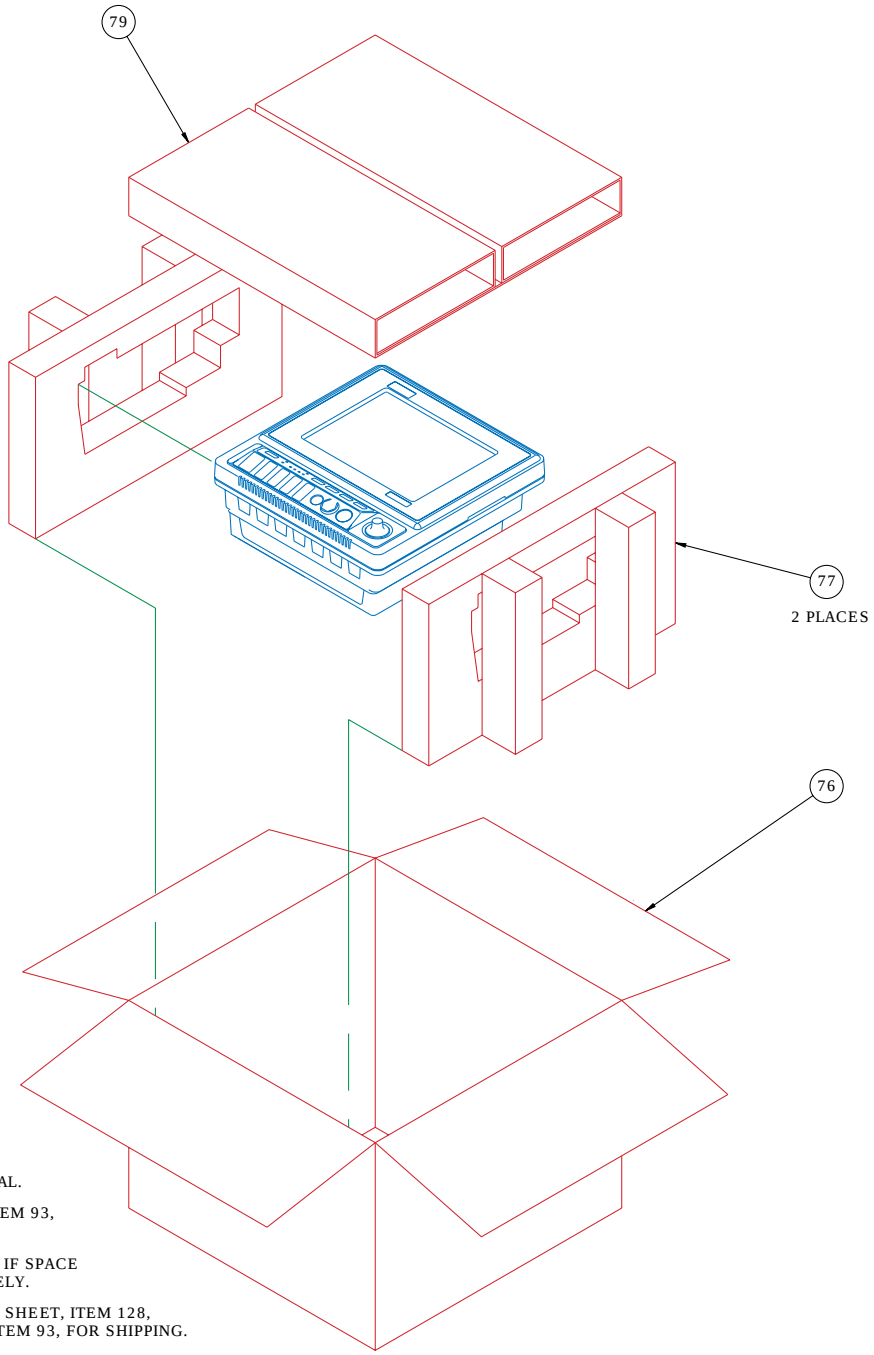
Electrical connectors: This diagram provides a reference to electrical signals for each cable or wiring harness used for interconnection of electrical assemblies in the monitor.

Electrical diagram: This diagram provides a reference for the electrical assemblies in the monitor and respective interconnections.

Parts List: This list provides part numbers and a descriptive cross-reference to parts and subassemblies found in each of the drawings.

PN 412185M - MONOCHROME/NON-INVASIVE (CONT)

PACKING MATERIALS



NOTES:

1. -001, -021 & -022 ASSEMBLIES:
   PLACE ITEMS 84 AND 81 INTO ITEM 91 AND SEAL.

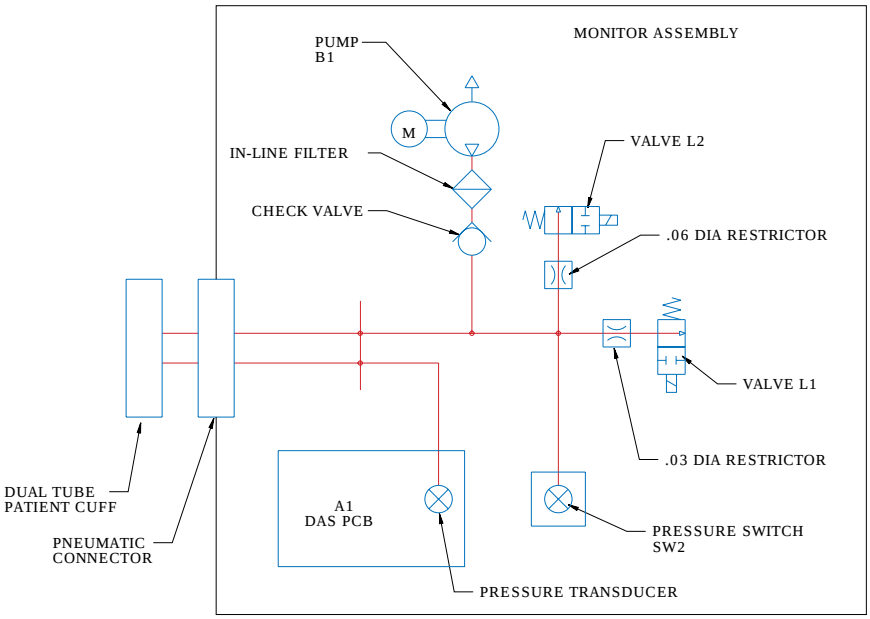
2. PLACE INSTRUCTION CARD, ITEM 92, IN BAG, ITEM 93, FOR SHIPPING.

3. LOOSE ITEMS MAY BE SHIPPED WITH THE UNIT IF SPACE PERMITS OR PACKAGED AND SHIPPED SEPARATELY.

4. -010 & -038 ASSEMBLIES: PLACE INSTRUCTION SHEET, ITEM 128, AND ASSEMBLED PNEUMATIC CIRCUIT IN BAG, ITEM 93, FOR SHIPPING.

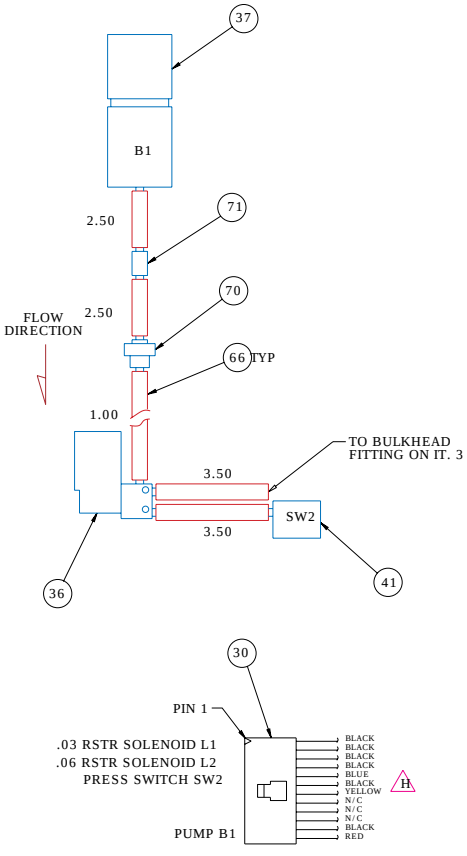
PN 412185M - MONOCHROME/NON-INVASIVE (CONT)

NBP PNEUMATIC CIRCUIT DIAGRAM



PNEUMATIC SCHEMATIC

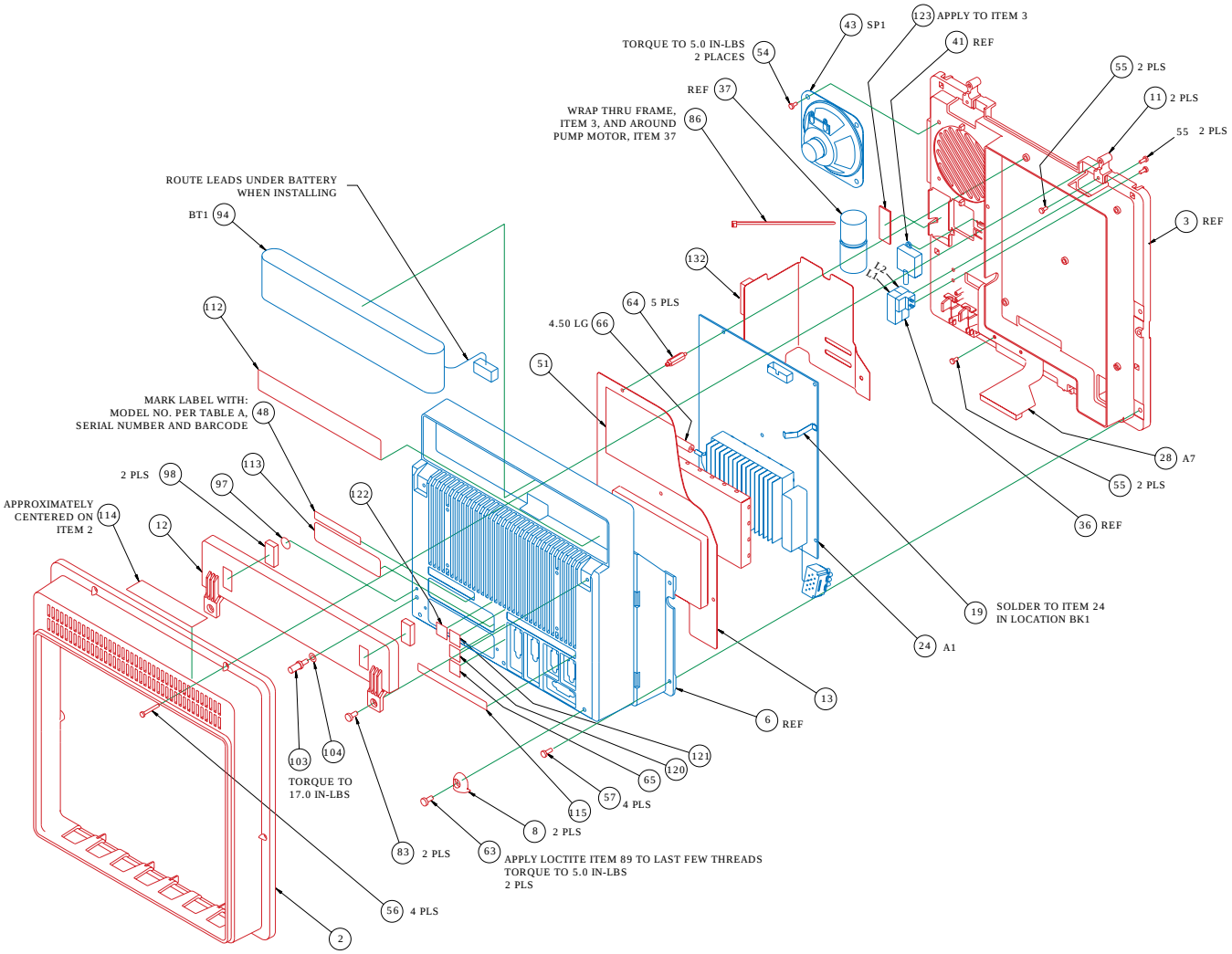
EXPLODED VIEW (DETAIL G)



DETAIL G
NBP PLUMBING ASSEMBLY

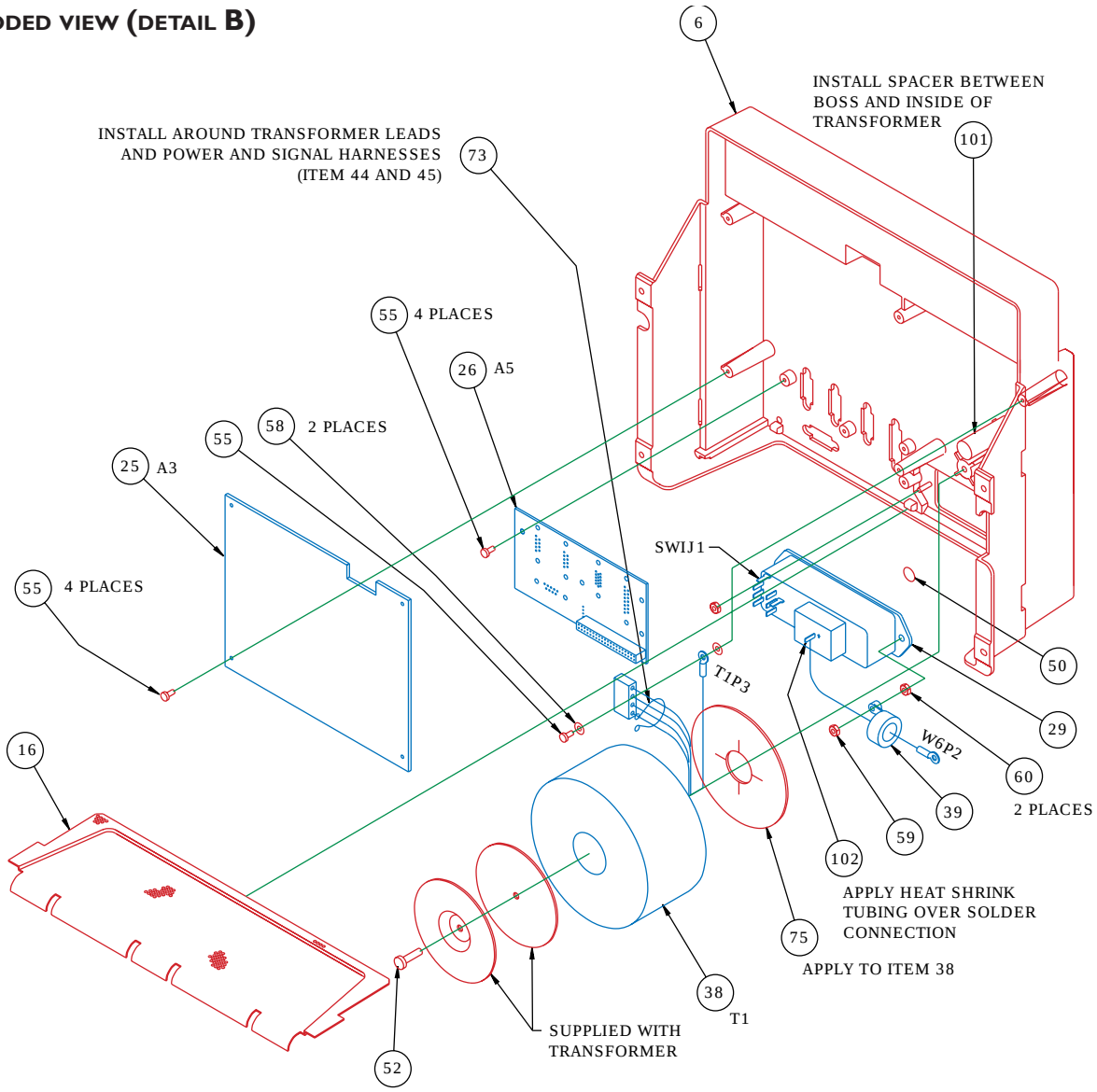
PN 412185M - MONOCHROME/NON-INVASIVE (CONT)

EXPLODED VIEW (REAR)



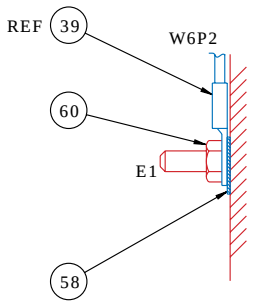
PN 412185M - MONOCHROME/NON-INVASIVE (CONT)

EXPLODED VIEW (DETAIL B)



DETAIL B

POWER SUPPLY ASSEMBLY

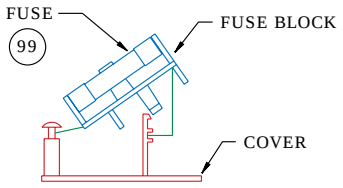


CHASSIS GROUND DETAIL

GROUND STUD IN CASTING, ITEM 6

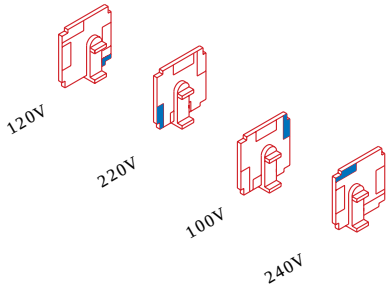
PN 412185M - MONOCHROME/NON-INVASIVE (CONT)

FUSE REPLACEMENT/VOLTAGE SETTINGS



FUSE BLOCK/COVER ASSY

TO CHANGE TO 5 X 20 MM FUSES REMOVE FUSE BLOCK BY LOOSENING SCREW AND INVERT BLOCK. INSTALL FUSES AND REPLACE INTO HOUSING. NOTE:THE FUSE(S)THAT GO INTO HOUSING FIRST ARE THE ACTIVE FUSE(S)



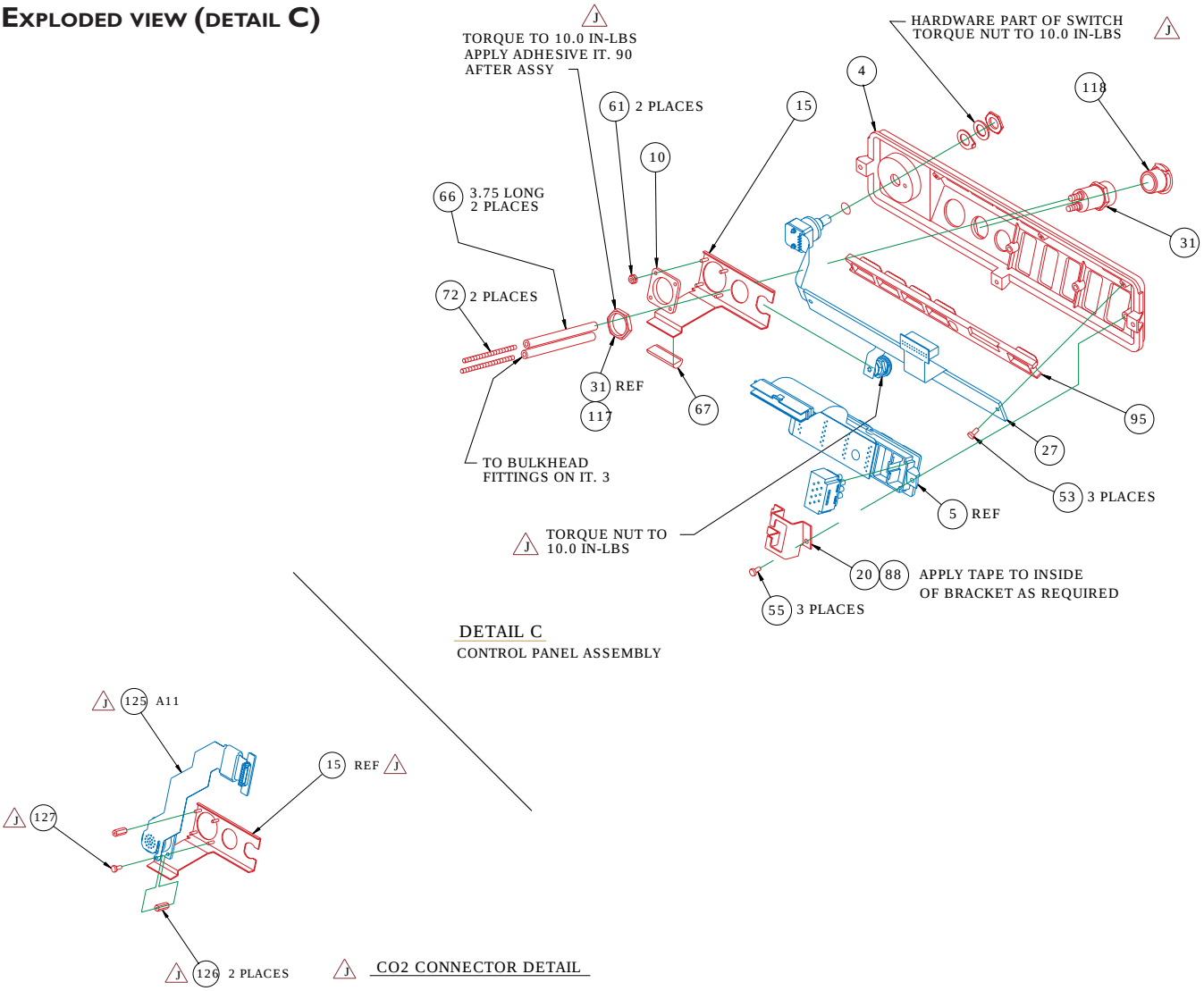
VOLTAGE SELECTOR CARD ORIENTATION:

ROTATE WHITE KEYING PIN TO POSITION SHOWN FOR CORRESPONDING VOLTAGE. INSTALL WITH PRINTED SIDE FACING IEC CONNECTOR (AS SHOWN).

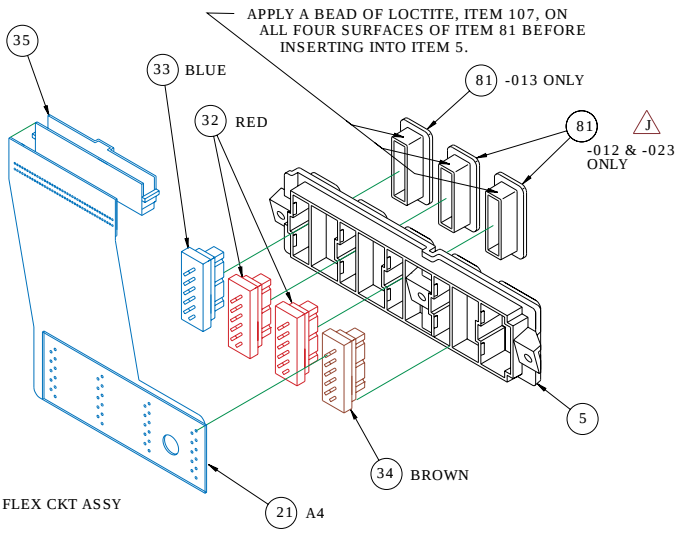
FUSE/VOLTAGE SETTING

PN 412185M - MONOCHROME/NON-INVASIVE (CONT)

EXPLODED VIEW (DETAIL C)

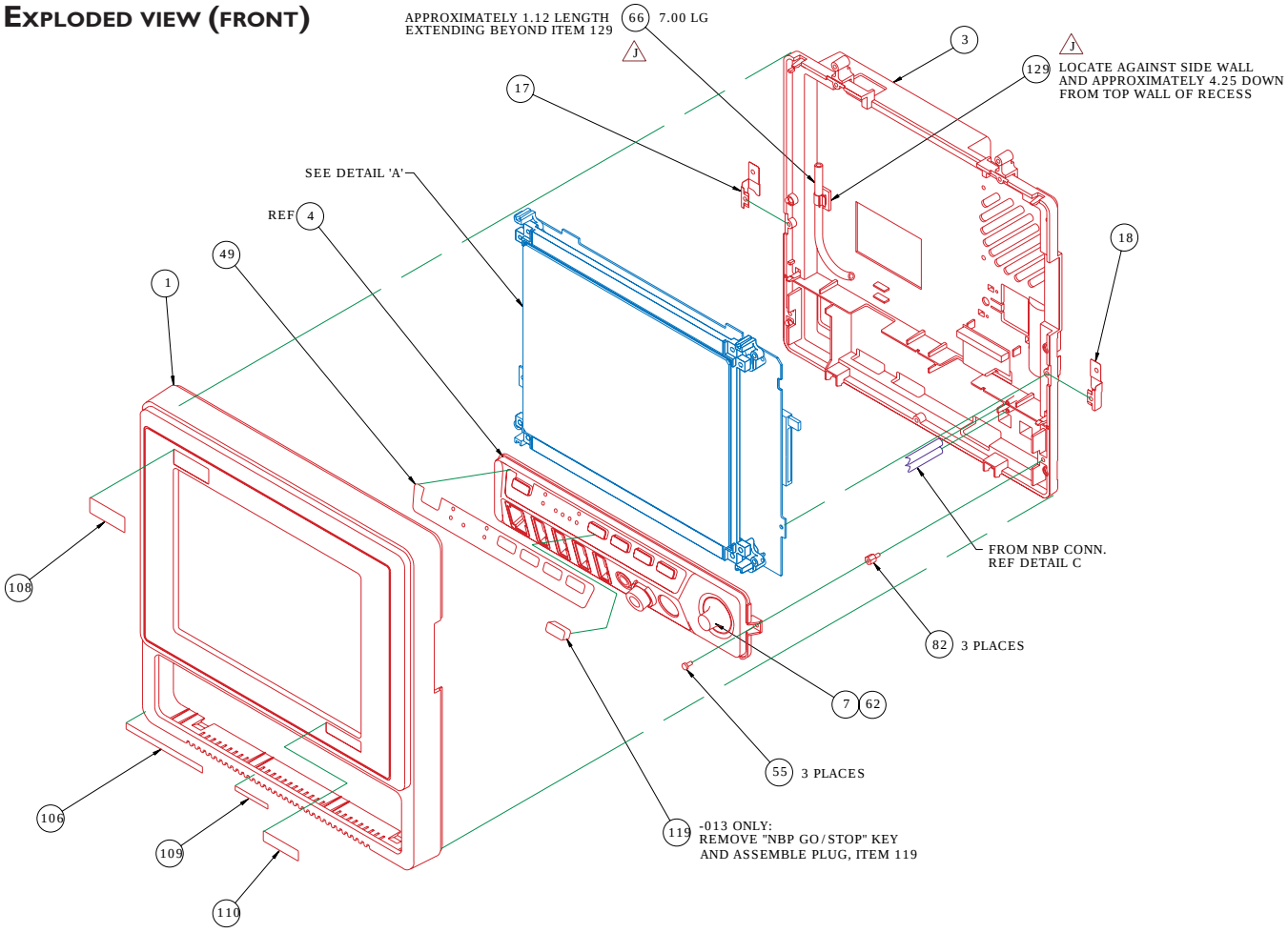


EXPLODED VIEW (DETAIL F)



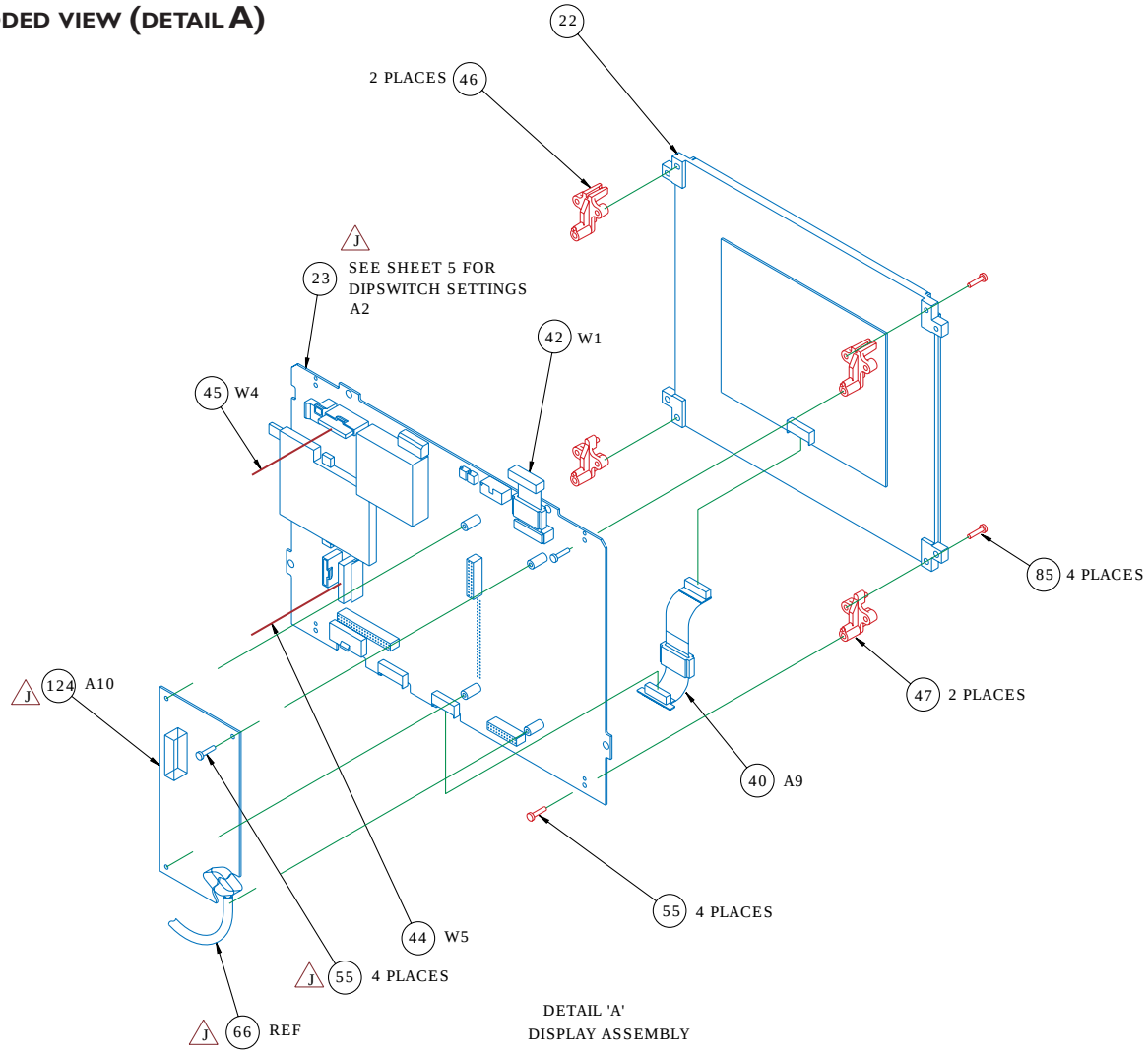
PN 412185M - MONOCHROME/NON-INVASIVE (CONT)

EXPLODED VIEW (FRONT)



PN 412185M - MONOCHROME/NON-INVASIVE (CONT)

EXPLODED VIEW (DETAIL A)



PROCESSOR PCB DIP SWITCH SETTINGS

J

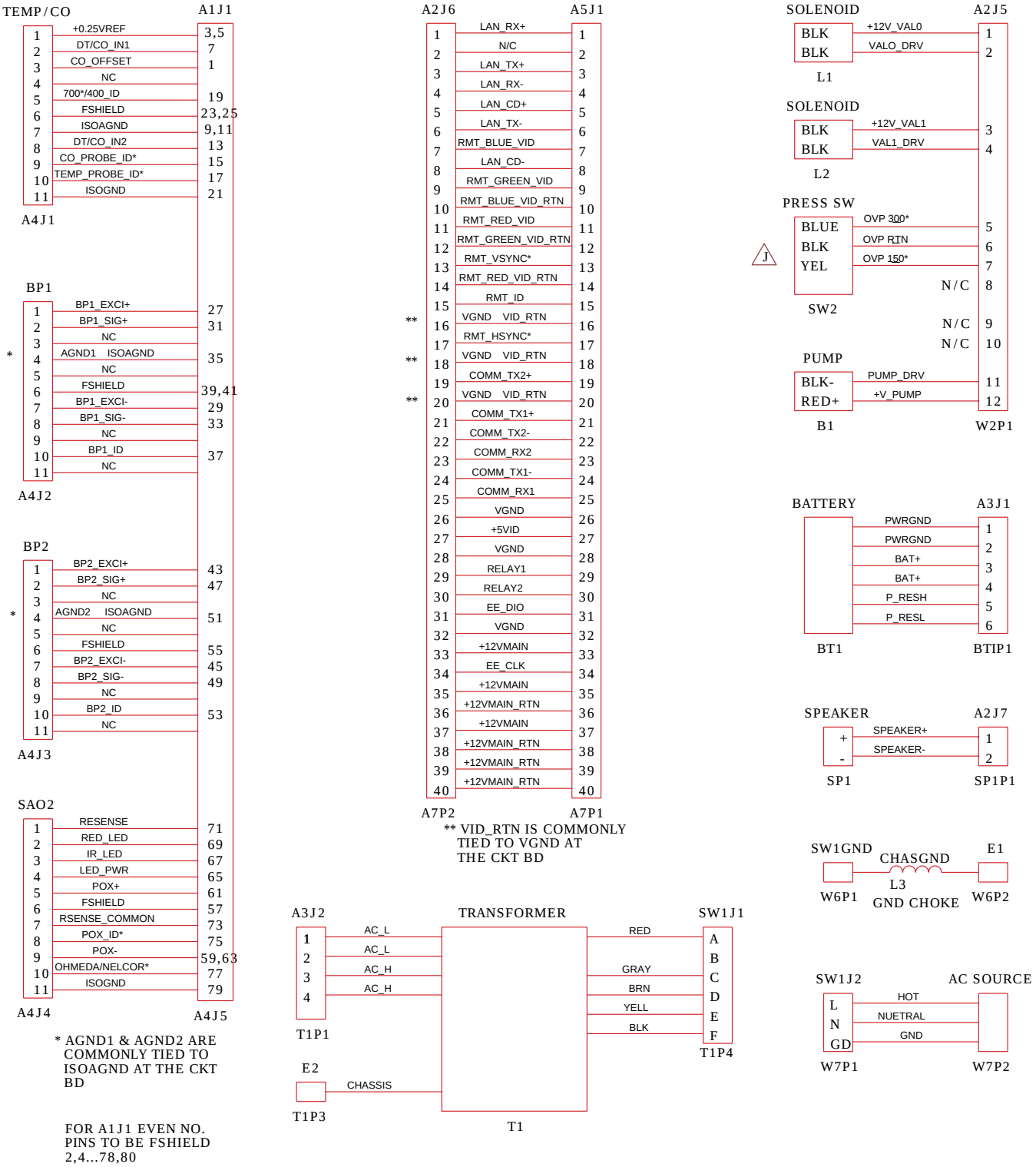
PROCESSOR BRD DIP SWITCH SETTINGS (A2SW1)

POS.	FUNCTION	ON (CLOSED)	OFF (OPEN)
1.	PROGRAM MEMORY UPDATE	DISABLE	ENABLE
2.	BOOT FROM MEMORY CARD	ENABLE	DISABLE
3.	50/60 Hz	50 Hz	60 Hz
4.	ENGLISH/SI UNITS	SI	ENGLISH
5.	DISPLAY SCAN MODE	NORMAL	SPLIT
6.	PULSE OXIMETRY MODE	Not Used	NELLCOR
7.	DEFIB SYNC PULSEWIDTH	100 mS	10 mS
8.	DEFIB SYNC PULSE AMPLTD.	12 V	5 V

NORMAL SWITCH SETTINGS: ALL SWITCHES OFF (OPEN)

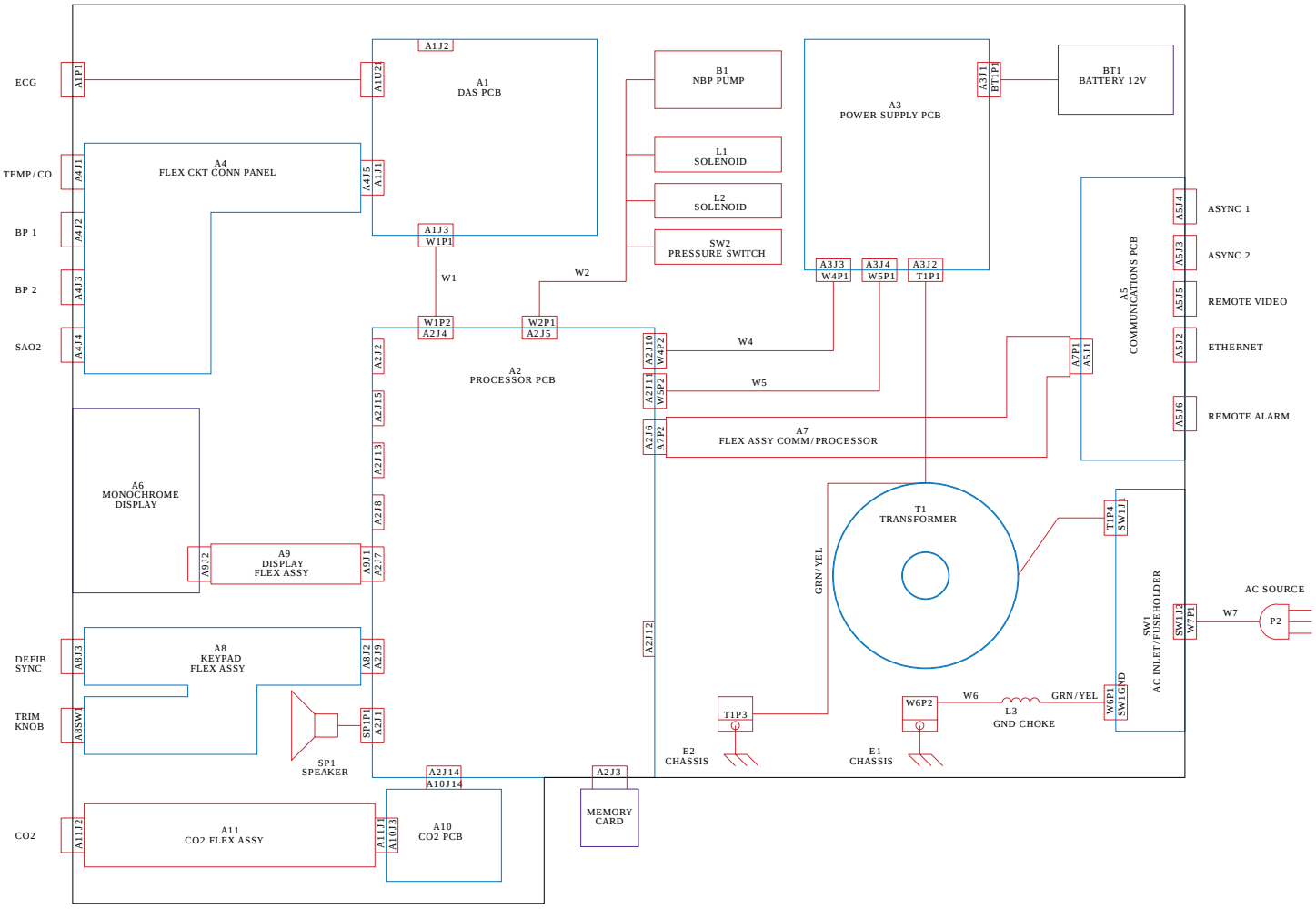
PN 412185M - MONOCHROME/NON-INVASIVE (CONT)

ELECTRICAL CONNECTORS



PN 412185M - MONOCHROME/NON-INVASIVE (CONT)

ELECTRICAL DIAGRAM



PN 412185-021L/-022E PARTS LIST - MONOCHROME

REFERENCE ASSEMBLY DRAWING PN 412185M

Item	Qty.	Part Number	Description
1	1.00	405747-008	FRONT HOUSING EAGLE 4000
2	1.00	405748-003	REAR HOUSING EAGLE HB/COLOR
3	1.00	409109-002	MOUNTING FRAME SERIES 2 EAGLE
4	1.00	405751-004	CONTROL PANEL SERIES 2 EAGLE
5	1.00	405753-001	CONNECTOR FRAME EAGLE
6	1.00	405755-004	CASTING POWER SUPPLY EAGLE
7	1.00	406080-001	TRIM KNOB EAGLE
8	2.00	406464-001	REAR FOOT EAGLE
11	2.00	412086-001	SPACER HOUSING EAGLE HB/COLOR
12	1.00	408640-001	BATTERY COVER EAGLE
13	1.00	408989-002	COVER DAS BOARD
15	1.00	406130-004	PLATE CONN MTG ETCO2 EAGLE
16	1.00	406394-001	BOTTOM COVER CASTING
17	1.00	413536-001	CLIP GROUNDING PROC PCB LEFT
18	1.00	413536-002	CLIP GROUNDING PROC PCB RIGHT
19	1.00	408984-002	CLIP GROUNDING DAS BRD
20	1.00	409472-001	BRACKET ECG CONN
21	1.00	406324-002	FLEX CKT CONNECTOR PANEL;A4
22	1.00	415703-001	DSPL MONO EL 640X480 W/FILTER;A6
23	1.00	800704-004	PCB EAGLE 4000 CPU 20HZ;A2
24	1.00	800376-002	PCB EAGLE DAS 12SL;A1
25	1.00	800378-002	PCB EAGLE POWER SUPPLY;A3
26	1.00	801316-001	PCB EAGLE COMMUNICATION;A5
27	1.00	800760-001	PCB FLEX SERIES 2 KEYPAD;A8
28	1.00	800400-001	FLEX PCB COMM/PROCESSOR;A7
29	1.00	17033-007	CONN FUSE HLDR SW VOL FILTER
30	1.00	17043-112	CONN RCPT LOCKING 12P
31	1.00	401184-001	COUPLING TWIN BODY 1/8 ID
32	2.00	401762-004	11P SKT 1.0MM KEY4 BP
33	1.00	401762-008	11P SKT 1.0MM KEY8 PULSE OX
34	1.00	401762-021	11P SKT 1.0MM KEY21 CO
35	1.00	408820-001	CONN RA 050C 80P
36	1.00	416153-002	ASSY VALVE/MANIFOLD EAGLE;L1,L2
37	1.00	406693-003	ASSY NBP PUMP;B1
38	1.00	410168-001	TRANSFORMER ISO STEPDOWN EAGLE;T1
39	1.00	411810-001	ASSY CHOKE GROUND WIRE
40	1.00	800742-001	PCB FLEX EAGLE 2 MONO EL;A9
41	1.00	408800-002	ASSY PRESS SENSOR 150/300 MMHG;SW2
42	1.00	415682-001	CABLE ASSY RBN 16P DAS/CPU;W1
43	1.00	408884-001	ASSY SPEAKER HARNESS;SP1
44	1.00	409060-001	ASSY HARNESS POWER;W5
45	1.00	409155-001	ASSY HARNESS SIGNAL;W4
46	2.00	412361-001	ADAPTER MONO EL DISPLAY TOP
47	2.00	412361-002	ADAPTER MONO EL DISPLAY BOTTOM
48	1.00	404525-006	LABEL BLANK 2.6IN X.4IN

PN 412185-021L/-022E PARTS LIST - MONOCHROME (CONT)

REFERENCE ASSEMBLY DRAWING PN 412185M

Item	Qty.	Part Number	Description
49	1.00	415372-001	LABEL EAGLE CONTROL PANEL ENG
49	1.00	415372-003	LABEL EAGLE CONTROL PANEL FRE
49	1.00	415372-004	LABEL EAGLE CONTROL PANEL SWE
49	1.00	415372-005	LABEL EAGLE CONTROL PANEL SPA
49	1.00	415372-006	LABEL EAGLE CONTROL PANEL ITA
49	1.00	415372-007	LABEL EAGLE CONTROL PANEL DUT
49	1.00	415372-008	LABEL EAGLE FRT PNL GER NO PTB
49	1.00	416802-001	LBL EAGLE FRONT PANEL CO2 ENG
49	1.00	416802-002	LBL EAGLE FRONT PANEL CO2 GER
49	1.00	416802-003	LBL EAGLE FRONT PANEL CO2 FRE
49	1.00	416802-004	LBL EAGLE FRONT PANEL CO2 SWE
49	1.00	416802-005	LBL EAGLE FRONT PANEL CO2 SPA
49	1.00	416802-006	LBL EAGLE FRONT PANEL CO2 ITA
49	1.00	416802-007	LBL EAGLE FRONT PANEL CO2 DUT
50	1.00	415511-001	LABEL SYMBOL GROUND
51	1.00	415509-001	LABEL PATIENT ISO CAUTION
52	1.00	45000-810	SCREW SEMS PH 8-32X5/8
53	3.00	45074-418	SCREW BDGH 4-40 X .312L
54	2.00	45040-604	SCREW TT PH 6-32X1/4
55	29.00	45074-408	SCREW BDGH 4-40 X 1/4
56	4.00	45074-432	SCREW BDGH 4-40X1.00
57	4.00	45074-612	SCREW BDGH 6-32X3/8
58	3.00	4520-304	WASHER LOCK EXT #4
59	1.00	4521-304	NUT ESNA 4-40
60	3.00	4521-704	NUT HEX KEPS 4-40
62	1.00	4556-001	SPRING CLIP D TYPE .250 DIA
63	2.00	4502-812	SCREW PH 8-32 X 3/8
64	5.00	409764-001	STANDOFF 4-40 THD W/SNAP .75L
65	1.00	408230-002	LABEL UL LISTED MEDICAL
66	2.67	401582-001	TUBING SILICONE 1/8ID X 1/4OD
67	0.09	403741-001	SPRING CHASSIS GRD TRAM REAR
70	1.00	404675-001	CHECK VALVE 1/8 I.D.
71	1.00	404679-001	FILTER IN-LINE 1/8ID 43 MICRON
72	2.00	404855-001	SPRING COMPRESSION .112 DIA
73	1.00	406447-002	TIE WRAP KURLY-LOK .45 DIA BDL
75	1.00	416760-001	GASKET TRANSFORMER EAGLE 4000
76	1.00	407396-004	CARTON SHIPPING EAGLE 4000
77	2.00	407397-002	FOAM INSERT EAGLE 2
79	1.00	407399-002	INSERT SPACER EAGLE 2
81	2.00	408557-001	COVER PATIENT CONNECTORS
82	3.00	4656-404	SPCR M/F 4-40 X .25
83	2.00	4502-808	SCREW PH 8-32 X /14
84	1.00	409326-001	INSTRUCTION CARD CONN COVER
85	4.00	45074-412	SCREW BDGH 4-40X3/8
86	1.00	4535-002	TIE WRAP 8.00LG X .187W
88	0.01	4814-002	TAPE DS BK .03X1.0
89	0.01	4851-003	CEMENT LOCTITE 242

PN 412185-021L/-022E PARTS LIST - MONOCHROME (CONT)

REFERENCE ASSEMBLY DRAWING PN 412185M

Item	Qty.	Part Number	Description
90	0.01	4851-071	ADHESIVE LOCTITE PRISM 460
91	1.00	9956-002	4X6IN ANTI-STATIC ZIPLOCK BAG
92	1.00	407300-054	INST EAGLE DISPLAY CLEANING
93	1.00	9976-008	BAG ANTI-STATIC 8.00W X 10.00L
94	1.00	406679-003	BATTERY PACK EAGLE
95	1.00	407175-001	BACKLIGHT KEYPAD EAGLE
95	1.00	407175-002	BACKLIGHT KEYPAD SWEDISH
95	1.00	407175-003	BACKLIGHT KEYPAD FRENCH
95	1.00	407175-004	BACKLIGHT KEYPAD GERMAN
95	1.00	407175-005	BACKLIGHT KEYPAD ITALIAN
95	1.00	407175-007	BACKLIGHT KEYPAD DUTCH
95	1.00	407175-008	BACKLIGHT KEYPAD SPANISH
96	0.25	407300-123	MNL EAGLE 4000 FIELD SERVICE
97	1.00	415511-002	LABEL EQUIPOTENTIALITY SYMBOL
98	2.00	4819-101	TAPE FOAM .5WX1.0L
99	2.00	1908-503	FUSE METRIC 1.25A SLO-BLO
99	2.00	1908-505	FUSE METRIC 2.5A SLO-BLO
99	1.00	1910-212	FUSE 3AG 2 1/2A SB
101	1.00	410491-001	SPACER .5 DIA RUBBER
102	0.04	4882-105	TUBING FIT 3/16 BLK
103	1.00	400040-001	PLUG MC EQUIPOTENTIAL
104	1.00	400041-001	WASHER LOCK SERRATED F/M-6
106	1.00	415512-001	LABEL LEADWIRE WARNING EAGLE
108	1.00	415379-001	LABEL PRODUCT MARK EAGLE 4000
108	1.00	415379-002	LABEL PRODUCT MARK EAGLE 4000N
109	1.00	415377-001	LABEL NELLCOR SENSOR
110	1.00	414908-001	LABEL MARQUETTE .39 X 1.59
110	1.00	414908-002	LABEL COROMETRICS .39 X 1.59
110	1.00	414908-005	LABEL MARQ HELLIGE .39 X 1.59
112	1.00	415374-001	LABEL EAGLE BATTERY CALLOUT
113	1.00	415375-001	LABEL EAGLE FUSE RATINGS DOM
113	1.00	415375-002	LABEL EAGLE FUSE RATINGS INTL
114	1.00	415376-001	LABEL EAGLE WARNING/HOSP USE
115	1.00	415373-001	LABEL EAGLE CONNECTORS BACK
120	1.00	408230-008	LABEL CE MARK
121	1.00	408230-011	LABEL UL LISTED MEDICAL C
122	1.00	416094-001	LABEL RISK CLASS 3
123	1.00	416761-001	GASKET NBP PUMP EAGLE 4000
124	1.00	800862-002	PCB CAPNOSTAT CO2 SUBSYSTEM;A10
125	1.00	800894-001	FLEX ASSY EAGLE C02 CONN;A11
126	2.00	413324-002	SPCR.188 HX 2-56X.562LG
127	1.00	45074-206	SCR BDGH 2-56 X .188L
129	1.00	405558-001	CLIP CABLE HIGH TEMP .188 DIA

PN. 412185-012L/-023E PARTS LIST - NON-INVASIVE

REFERENCE ASSEMBLY DRAWING PN 412185J

Item	Qty.	Part Number	Description
1	1.00	405747-008	FRONT HOUSING EAGLE 4000
2	1.00	405748-003	REAR HOUSING EAGLE HB/COLOR
3	1.00	409109-002	MOUNTING FRAME SERIES 2 EAGLE
4	1.00	405751-004	CONTROL PANEL SERIES 2 EAGLE
5	1.00	405753-001	CONNECTOR FRAME EAGLE
6	1.00	405755-004	CASTING POWER SUPPLY EAGLE
7	1.00	406080-001	TRIM KNOB EAGLE
8	2.00	406464-001	REAR FOOT EAGLE
11	2.00	412086-001	SPACER HOUSING EAGLE HB/COLOR
12	1.00	408640-001	BATTERY COVER EAGLE
13	1.00	408989-002	COVER DAS BOARD
15	1.00	406130-004	PLATE CONN MTG ETCO2 EAGLE
16	1.00	406394-001	BOTTOM COVER CASTING
17	1.00	413536-001	CLIP GROUNDING PROC PCB LEFT
18	1.00	413536-002	CLIP GROUNDING PROC PCB RIGHT
19	1.00	408984-002	CLIP GROUNDING DAS BRD
20	1.00	409472-001	BRACKET ECG CONN
21	1.00	406324-002	FLEX CKT CONNECTOR PANEL;A4
22	1.00	415703-001	DSPL MONO EL 640X480 W/FILTER;A6
23	1.00	800704-004	PCB EAGLE 4000 CPU 20HZ;A2
24	1.00	800376-002	PCB EAGLE DAS 12SL;A1
25	1.00	800378-002	PCB EAGLE POWER SUPPLY;A3
26	1.00	801316-001	PCB EAGLE COMMUNICATION;A5
27	1.00	800760-001	PCB FLEX SERIES 2 KEYPAD;A8
28	1.00	800400-001	FLEX PCB COMM/PROCESSOR;A7
29	1.00	17033-007	CONN FUSE HLDR SW VOL FILTER
30	1.00	17043-112	CONN RCPT LOCKING 12P
31	1.00	401184-001	COUPLING TWIN BODY 1/8 ID
33	1.00	401762-008	11P SKT 1.0MM KEY8 PULSE OX
34	1.00	401762-021	11P SKT 1.0MM KEY21 CO
35	1.00	408820-001	CONN RA 050C 80P
36	1.00	416153-002	ASSY VALVE/MANIFOLD EAGLE;L1,L2
37	1.00	406693-003	ASSY NBP PUMP;B1
38	1.00	410168-001	TRANSFORMER ISO STEPDOWN EAGLE;T1
39	1.00	411810-001	ASSY CHOKE GROUND WIRE
40	1.00	800742-001	PCB FLEX EAGLE 2 MONO EL;A9
41	1.00	408800-002	ASSY PRESS SENSOR 150/300 MMHG;SW2
42	1.00	415682-001	CABLE ASSY RBN 16P DAS/CPU;W1
43	1.00	408884-001	ASSY SPEAKER HARNESS;SP1
44	1.00	409060-001	ASSY HARNESS POWER;W5
45	1.00	409155-001	ASSY HARNESS SIGNAL;W4
46	2.00	412361-001	ADAPTER MONO EL DISPLAY TOP
47	2.00	412361-002	ADAPTER MONO EL DISPLAY BOTTOM
48	1.00	404525-006	LABEL BLANK 2.6IN X.4IN

Pn. 412185-012L/-023E Parts List - Non-Invasive (Cont)

Reference assembly drawing pn 412185M

Item	Qty.	Part Number	Description
49	1.00	415530-001	LABEL EAGLE CNTRL PANEL NI ENG
49	1.00	415530-003	LABEL EAGLE CNTRL PANEL NI FRE
49	1.00	415530-004	LABEL EAGLE CNTRL PANEL NI SWE
49	1.00	415530-005	LABEL EAGLE CNTRL PANEL NI SPA
49	1.00	415530-006	LABEL EAGLE CNTRL PANEL NI ITA
49	1.00	415530-007	LABEL EAGLE CNTRL PANEL NI DUT
49	1.00	415530-008	LBL EAGLE FRT PNL NI GER NOPTB
49	1.00	416809-001	LBL EAGLE FRONT PNL NI CO2 ENG
49	1.00	416809-002	LBL EAGLE FRONT PNL NI CO2 GER
49	1.00	416809-003	LBL EAGLE FRONT PNL NI CO2 FRE
49	1.00	416809-004	LBL EAGLE FRONT PNL NI CO2 SWE
49	1.00	416809-005	LBL EAGLE FRONT PNL NI CO2 SPA
49	1.00	416809-006	LBL EAGLE FRONT PNL NI CO2 ITA
49	1.00	416809-007	LBL EAGLE FRONT PNL NI CO2 DUT
50	1.00	415511-001	LABEL SYMBOL GROUND
51	1.00	415509-001	LABEL PATIENT ISO CAUTION
52	1.00	45000-810	SCREW SEMS PH 8-32X5/8
53	3.00	45074-418	SCREW BDGH 4-40 X .312L
54	2.00	45040-604	SCREW TT PH 6-32X1/4
55	29.00	45074-408	SCREW BDGH 4-40 X 1/4
56	4.00	45074-432	SCREW BDGH 4-40X1.00
57	4.00	45074-612	SCREW BDGH 6-32X3/8
58	3.00	4520-304	WASHER LOCK EXT #4
59	1.00	4521-304	NUT ESNA 4-40
60	3.00	4521-704	NUT HEX KEPS 4-40
62	1.00	4556-001	SPRING CLIP D TYPE .250 DIA
63	2.00	4502-812	SCREW PH 8-32 X 3/8
64	5.00	409764-001	STANDOFF 4-40 THD W/SNAP .75L
65	1.00	408230-002	LABEL UL LISTED MEDICAL
66	2.67	401582-001	TUBING SILICONE 1/8ID X 1/4OD
67	0.09	403741-001	SPRING CHASSIS GRD TRAM REAR
70	1.00	404675-001	CHECK VALVE 1/8 I.D.
71	1.00	404679-001	FILTER IN-LINE 1/8ID 43 MICRON
72	2.00	404855-001	SPRING COMPRESSION .112 DIA
73	1.00	406447-002	TIE WRAP KURLY-LOK .45 DIA BDL
75	1.00	416760-001	GASKET TRANSFORMER EAGLE 4000
76	1.00	407396-004	CARTON SHIPPING EAGLE 4000
77	2.00	407397-002	FOAM INSERT EAGLE 2
79	1.00	407399-002	INSERT SPACER EAGLE 2
81	2.00	408557-001	COVER PATIENT CONNECTORS
82	3.00	4656-404	SPCR M/F 4-40 X .25
83	2.00	4502-808	SCREW PH 8-32 X /14
85	4.00	45074-412	SCREW BDGH 4-40X3/8
86	1.00	4535-002	TIE WRAP 8.00LG X .187W
88	0.01	4814-002	TAPE DS BK .03X1.0

PN. 412185-012L/-023E PARTS LIST - NON-INVASIVE (CONT)

REFERENCE ASSEMBLY DRAWING PN 412185M

Item	Qty.	Part Number	Description
89	0.01	4851-003	CEMENT LOCTITE 242
90	0.01	4851-071	ADHESIVE LOCTITE PRISM 460
92	1.00	407300-054	INST EAGLE DISPLAY CLEANING
93	1.00	9976-008	BAG ANTI-STATIC 8.00W X 10.00L
94	1.00	406679-003	BATTERY PACK EAGLE
95	1.00	407175-001	BACKLIGHT KEYPAD EAGLE
95	1.00	407175-002	BACKLIGHT KEYPAD SWEDISH
95	1.00	407175-003	BACKLIGHT KEYPAD FRENCH
95	1.00	407175-004	BACKLIGHT KEYPAD GERMAN
95	1.00	407175-005	BACKLIGHT KEYPAD ITALIAN
95	1.00	407175-007	BACKLIGHT KEYPAD DUTCH
95	1.00	407175-008	BACKLIGHT KEYPAD SPANISH
96	0.25	407300-123	MNL EAGLE 4000 FIELD SERVICE
97	1.00	415511-002	LABEL EQUIPOTENTIALITY SYMBOL
98	2.00	4819-101	TAPE FOAM .5WX1.0L
99	2.00	1908-503	FUSE METRIC 1.25A SLO-BLO
99	2.00	1908-505	FUSE METRIC 2.5A SLO-BLO
99	1.00	1910-212	FUSE 3AG 2 1/2A SB
101	1.00	410491-001	SPACER .5 DIA RUBBER
102	0.04	4882-105	TUBING FIT 3/16 BLK
103	1.00	400040-001	PLUG MC EQUIPOTENTIAL
104	1.00	400041-001	WASHER LOCK SERRATED F/M-6
106	1.00	415512-001	LABEL LEADWIRE WARNING EAGLE
107	0.01	4851-082	CEMENT LOCTITE PRISM 411
108	1.00	415379-001	LABEL PRODUCT MARK EAGLE 4000
108	1.00	415379-002	LABEL PRODUCT MARK EAGLE 4000N
109	1.00	415377-001	LABEL NELLCOR SENSOR
110	1.00	414908-001	LABEL MARQUETTE .39 X 1.59
110	1.00	414908-002	LABEL COROMETRICS .39 X 1.59
110	1.00	414908-005	LABEL MARQ HELLIGE .39 X 1.59
112	1.00	415374-001	LABEL EAGLE BATTERY CALLOUT
113	1.00	415375-001	LABEL EAGLE FUSE RATINGS DOM
113	1.00	415375-002	LABEL EAGLE FUSE RATINGS INTL
114	1.00	415376-001	LABEL EAGLE WARNING/HOSP USE
115	1.00	415373-001	LABEL EAGLE CONNECTORS BACK
120	1.00	408230-008	LABEL CE MARK
121	1.00	408230-011	LABEL UL LISTED MEDICAL C
122	1.00	416094-001	LABEL RISK CLASS 3
123	1.00	416761-001	GASKET NBP PUMP EAGLE 4000
124	1.00	800862-002	PCB CAPNOSTAT CO2 SUBSYSTEM;A10
125	1.00	800894-001	FLEX ASSY EAGLE C02 CONN;A11
126	2.00	413324-002	SPCR.188 HX 2-56X.562LG
127	1.00	45074-206	SCR BDGH 2-56 X .188L
129	1.00	405558-001	CLIP CABLE HIGH TEMP .188 DIA

For your notes.

7 ABOUT THIS MANUAL

FIELD SERVICE MANUAL

INTENDED USE

This field service manual has been prepared by the Media Technologies staff at Marquette Medical Systems. It is intended for use by biomedical electronic technicians or other qualified service personnel responsible for installation, maintenance or repair of the Eagle 4000 Patient Monitor (hereafter referred to as the monitor).

SCOPE OF THE MANUAL

The content of this field service manual is aimed primarily at biomedical equipment technicians and field service personnel. The user of this field service manual is expected to have a solid background in electronics, including strong backgrounds in analog and digital electronics, as well as microcomputer technology familiarity.

MANUAL CONTENT

The field service manual is organized into sections, as follows:

Section 1: Equipment Overview

- Section one describes the product, the Marquette Unity Network, performance specifications, preparation for use, product part numbers and block level theory of operation.

Section 2: Maintenance

- Section two describes the maintenance schedule, visual inspection, cleaning the monitor, checkout procedures, and electrical safety tests.

Section 3: Calibration

- Section three describes adjustments/jumpers/switches, processor PCB calibration, acquisition PCB calibration, power supply PCB calibration, non-invasive blood pressure calibration and end-tidal CO_2 calibration.

Section 4: Configuration

- Section four describes monitor configurations, installing software, loading software using floppy diskettes, loading software using a memory card, loading software using a personal computer and setup for use.

Section 5: Troubleshooting

- Section five describes battery failure, power source tests, data acquisition tests, service tips, a network related troubleshooting flow chart and the service mode menu.

Section 6: Assembly Drawings

- Section six provides assembly drawings for all configurations of the monitor. These include electrical and connector diagrams, pneumatic schematics, NBP plumbing detail and exploded views.

Section 7: About the Manual

- Section seven describes the field service manual, manual page layout, related documentation, manufacturer responsibility, part numbers and revisions, notes/cautions/warnings, parts lists, abbreviations and change pages.

PAGE LAYOUT

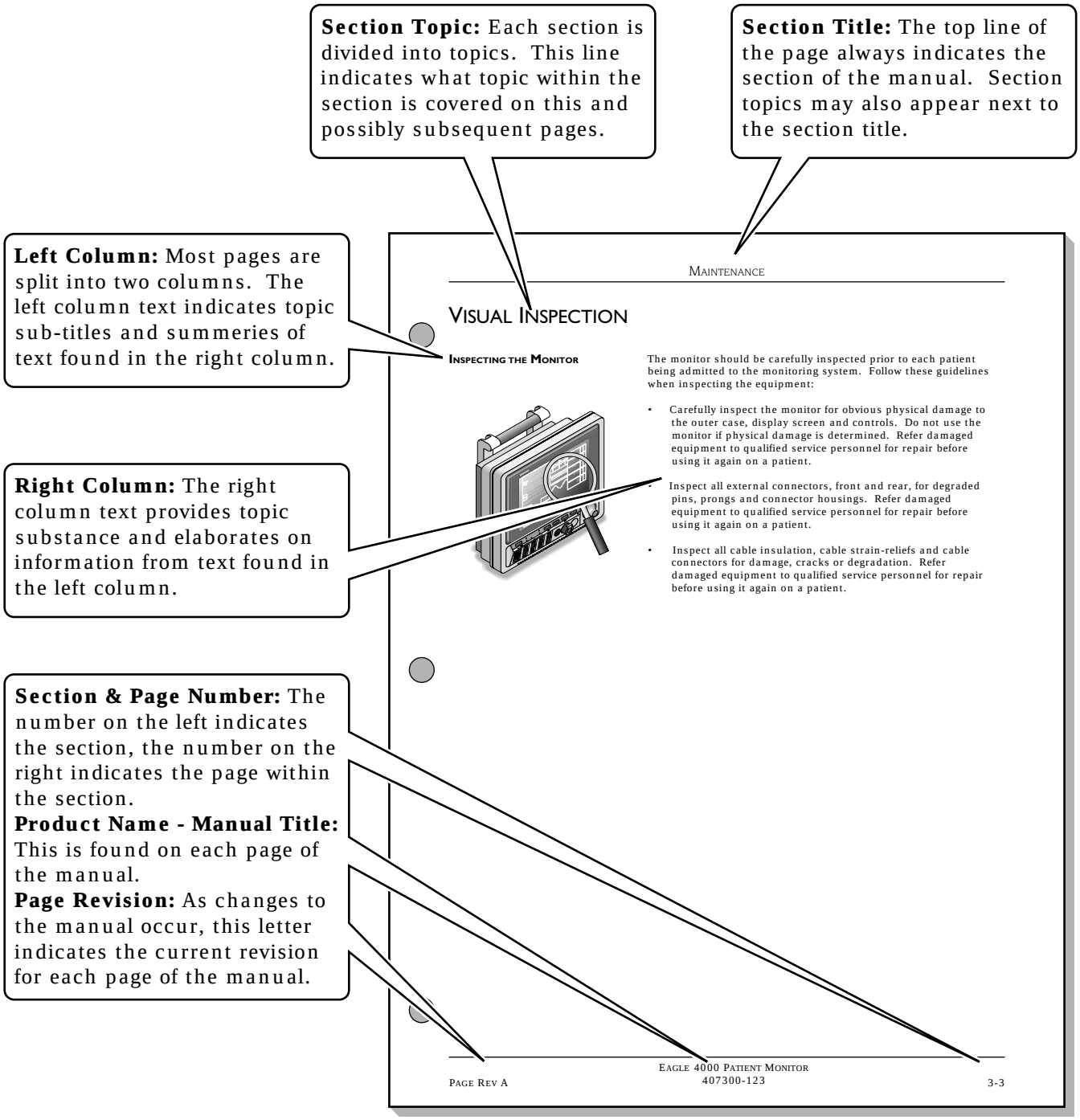
Section Topic: Each section is divided into topics. This line indicates what topic within the section is covered on this and possibly subsequent pages.

Section Title: The top line of the page always indicates the section of the manual. Section topics may also appear next to the section title.

Left Column: Most pages are split into two columns. The left column text indicates topic sub-titles and summeries of text found in the right column.

Right Column: The right column text provides topic substance and elaborates on information from text found in the left column.

Section & Page Number: The number on the left indicates the section, the number on the right indicates the page within the section.
Product Name - Manual Title: This is found on each page of the manual.
Page Revision: As changes to the manual occur, this letter indicates the current revision for each page of the manual.



MAINTENANCE

VISUAL INSPECTION

INSPECTING THE MONITOR

The monitor should be carefully inspected prior to each patient being admitted to the monitoring system. Follow these guidelines when inspecting the equipment:

- Carefully inspect the monitor for obvious physical damage to the outer case, display screen and controls. Do not use the monitor if physical damage is determined. Refer damaged equipment to qualified service personnel for repair before using it again on a patient.
- Inspect all external connectors, front and rear, for degraded pins, prongs and connector housings. Refer damaged equipment to qualified service personnel for repair before using it again on a patient.
- Inspect all cable insulation, cable strain-reliefs and cable connectors for damage, cracks or degradation. Refer damaged equipment to qualified service personnel for repair before using it again on a patient.

EAGLE 4000 PATIENT MONITOR
407300-123
PAGE REV A
3-3

RELATED DOCUMENTATION

OPERATOR INFORMATION

Eagle 4000 Patient Monitor Operator's Manual

- Part number: 407300-163
- Describes complete operation for monitors with version 6 software installed

Cleaning Your Eagle Monitor's Display

- Part number: 407300-054
- Describes manufacturer recommendation for cleaning a monochrome EL monitor display screen

Charging Your Eagle Monitor Battery Pack

- Part number: 407300-064
- Describes monitor battery management procedures.

SERVICE INFORMATION

Tram X00 Modules/Eagle Monitor Termination Instructions for BP, CO, and TEMP Cables

- Part number: 403799-016
- Describes how to properly terminate the listed patient cable connectors.

Eagle 4000 Patient Monitor - Version 6 Update Instructions

- Part number - 407300-170
- Describes the procedure for updating software in the monitor.

Marquette Unity Network User's Manual

- Part number - 403799-023
- Describes configuration and network related service information for all products on the network.

MANUFACTURER RESPONSIBILITY

LIABILITY DISCLAIMER

The manufacturer is responsible for the effects on safety, reliability, and performance of the monitor only if:

- installation, maintenance, extensions, calibration, modification, repair and any other general service requirements of the monitor are conducted by manufacturer field service engineers, certified biomedical equipment technicians (CBET) or other qualified service personnel formally trained by the manufacturer;
- the electrical installation, relevant to main AC power from the wall receptacle for the monitor, complies with all associated regulations; and
- the monitor is used in accordance with the manufacturer's recommended operational instructions.

NOTES, CAUTIONS, AND WARNINGS

WHAT THESE INDICATE

Notes, cautions, and warnings all appear in a similar fashion throughout the manual. These are designed to draw special attention to particular relevant points of interest.

NOTE
A note conveys special instructions to highlight an operating procedure, practice, etc. Notes may precede or follow the applicable text, depending on the material to be highlighted.

CAUTION
The purpose of a caution is to inform users of this manual of operating procedures, practices, etc., which if not strictly observed, could result in possible damage to the equipment.

WARNING
A warning provides instructions to users of the manual that operating procedures, practices, etc., if not followed, may result in personal injury.

PARTS LISTS

DIMENSION SPECIFICATIONS

Hardware dimensions in parts lists use either metric or American standards.

- Metric standards are indicated as items that include the letter *M* as a prefix (example: Screw, M 2.0 x 4)
- American standards are indicated as items without a letter as a prefix (example: Screw, 4-40 x 5/16)

ABBREVIATIONS

A

AAMI: Association for the Advancement of Medical Instrumentation
AC: alternating current
ADC: analog-to-digital converter
Adj: adjustable
Al: aluminum
Ampl: amplifier
ANSI: American National Standards Institute, Inc.
ASIC: application specific integrated circuit
ASYNC COMM: asynchronous communication
AUI: attachment unit interface
Ave: Avenue
AWG: American Wire Gage

B

B/M: beats per minute
BDGH: binding head
BP: blood pressure
bpm: beats per minute
BT: blood temperature

C

Cap: capacitor
cc: cubic centimeter
Cer: ceramic
CMOS: complimentary metal-oxide semiconductor
CO: cardiac output
CSA: Canadian Standards Association

D

DAC: digital-to-analog converter
dB: decibel
dc: direct current
DDW: Direct Digital Writer
DEFIB SYNC: defibrillator synchronization
DMM: digital multimeter

E

ECG: electrocardiogram, electrocardiograph
EEPROM: electronically erasable programmable read only memory
ESD: electrostatic discharge

F

FCC: Federal Communication Commission
FDA: Food and Drug Administration
FET: field-effect transistor
FL: Florida

G

GND: ground

H

hi-pot: high potential
Hz: Hertz

I

ID: inside diameter
IEC: International Electrotechnical Commission
IEEE: Institute of Electrical and Electronic Engineers
in: inch

J

IT: injectate temperature
JFET: junction field effect transistor

K

kg: kilogram
kHz: kilohertz
kV: kilovolt

L

LAN: local area network
lb: pound
LCA: logic cell array

M

M: mega, megohm
mA: milliampere
MHz: megahertz
mm: millimeter
mmHg: millimeter of mercury
MOSFET: metal-oxide semiconductor field-effect transistor
MPP: metallized polypropylene
MRT: Monitoring Review Terminal
mV: millivolt

ABBREVIATIONS (CONT)

N
NBP: non-invasive blood pressure
No: number
nS: nanosecond
Ntwk: network

O, P
PC: printed circuit, personal computer
PCB: printed circuit board
pF: picoFarad
PLCC: plastic leaded chip carrier
PLL: phase locked loop
pn: part number
PNH: pan head
Pos: position
PPR: peripheral pulse rate
PVC: premature ventricular contraction

Q, R
RAM: random access memory
Res: resistor
RESP: respiration
Rgltr: regulator

S
SM: surface mount
SPDT: single-pole, double-throw
SpO_2: pulse oximetry (arterial oxygen saturation)
SPST: single-pole, single-throw
SST: stainless steel

T
Tant: tantalum
TEMP: temperature
TPU: time processing unit
Tram: Transport Remote Acquisition Module
TTl: transistor-transistor logic

U
UART: universal asynchronous receiver/ transmitter
UL: Underwriters Laboratories, Inc.

V
V: volt, voltage
Var: variable
VDE: Verband Deutscher Electrotechniker
Volt: voltage

W
W: watt, West
w/: with
WI: Wisconsin
WW: wire wound

X, Y, Z
YSI: Yellow Springs Instrument

Other
(Cont): continued
˚C: degrees Celsius
˚F: degrees Fahrenheit
Δz: impedance variation
µ: micro
µA: microampere
µF: microfarad
µV: microvolt
Ω: ohm
ΔT: temperature difference
%: percent

PAGE CHANGES

LIST OF PAGE CHANGES

Following is a list of page changes, page revision and document date. The list provides a reference of changes to the manual. This page is updated as page changes are updated in the manual.

Page Changes	Page Rev	Document Date
Initial release.	A	22 November 1995
All pages.	B	21 August 1996
Title/T-2, ix, x, 1-9, Section 7.	C	13 November 1996
All pages.	D	20 December 1996
All pages.	E	9 May 1997

For your notes.

marquette
Medical Systems

8200 West Tower Avenue • Milwaukee, WI 53223 USA • (414) 355-5000 • FAX (414) 355-3790