EAGLE 3000
patient monitor

FIELD SERVICE MANUAL

marquette
Medical Systems

Specifications are subject to change

Due to continual product innovation, specifications in this manual are subject to change.

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About this manual

This manual reflects Eagle 3000 software version 3 type.

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1 ABOUT THIS MANUAL

FIELD SERVICE MANUAL

ABOUT THE MANUAL

This field service manual has been prepared by the technical publications staff at Marquette Medical Systems, Inc. It is intended for use by biomedical electronic technicians or other qualified service personnel responsible for installation, maintenance or repair of the Eagle 3000 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: Introduction
- Section one describes the field service manual, manual page layout, related documentation, manufacturer responsibility, notes/cautions/warnings, and abbreviation.

Section 2: Equipment Overview
- Section two describes the product, the Marquette Unity Network, technical specifications, preparation for use, product part numbers and theory of operation.

Section 3: Maintenance
- Section three describes the maintenance schedule, visual inspection, cleaning the monitor, checkout procedures, leakage current tests and hi-pot tests.

Section 4: Troubleshooting
- Section four describes electrostatic discharge, special components, power source tests, data acquisition tests, service tips, the service mode menu and a network related troubleshooting flow chart.

Section 5: Calibration
- Section five describes adjustments and non-invasive blood pressure calibration.

Section 6: Configuration
- Section six describes monitor configurations, installing software, loading software from diskettes, loading software over the network and setup for use.

Section 7: Assembly Drawings
- Section seven provides assembly drawings of the monitor. These include electrical diagrams, schematics, and exploded views.

PAGE LAYOUT

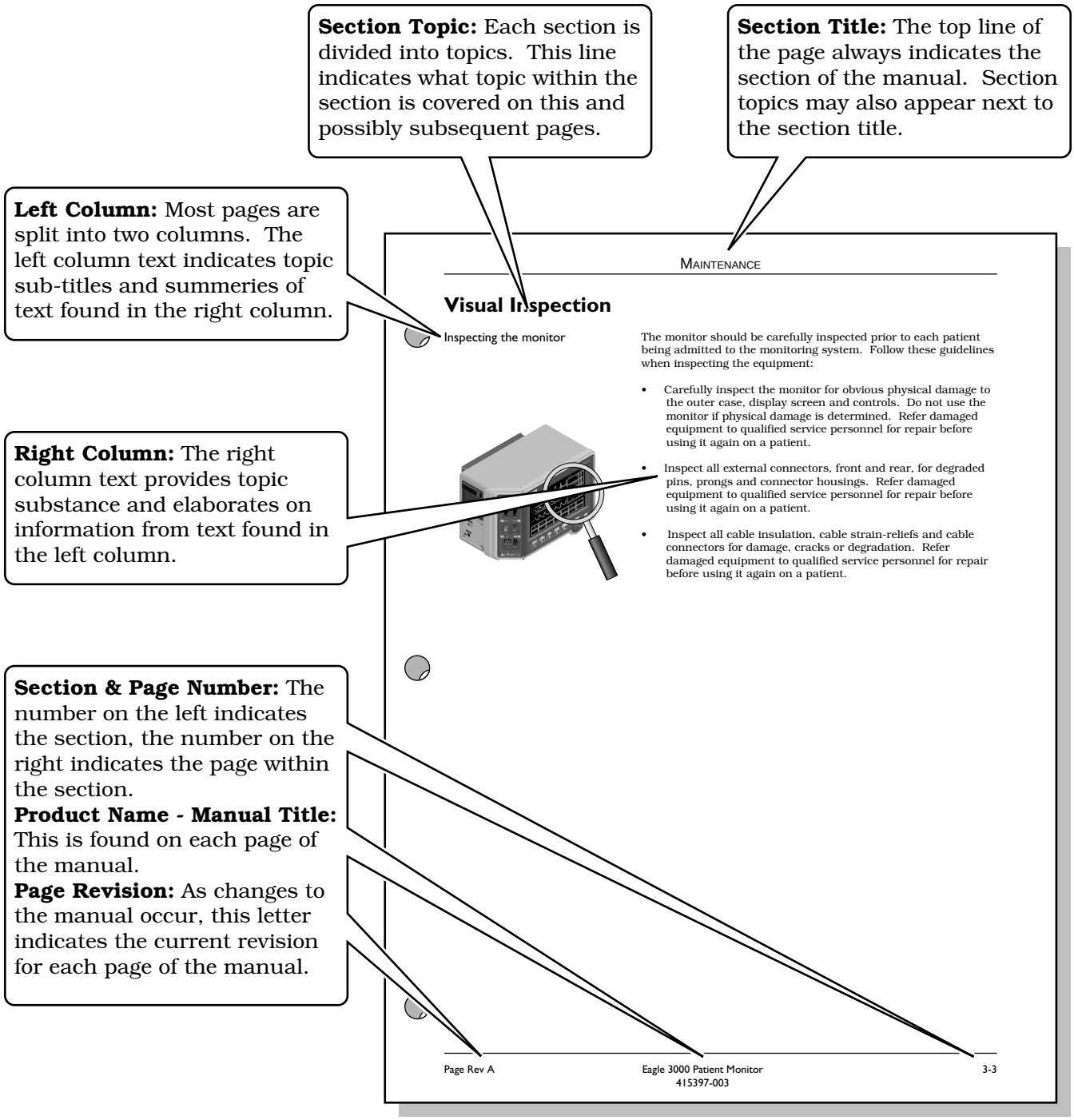
Section Topic: Each section is divided into topics. This line indicates what topic within the section is covered on this and possibly subsequent pages.

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.



MANUAL REVISIONS

The following list gives the revision of each release of this manual. As changes to the manual occur, the following list will provide a reference to these changes.

Revision	A	25 January, 1996	Initial release
Revision	B	18 February, 1997	
Revision	C	18 April, 1997	New RMT ALM connector info.

RELATED DOCUMENTATION

OPERATOR INFORMATION

Eagle 3000 Monitor Operator's Manual

- Part number: 415397-020 software version 2.
- Part number: 415397-042 software version 3.

Eagle 3000 Monitor Instruction Sheet

- Part number: 415397-023 software version 2.
- Part number: 415397-043 software version 3.

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 3000 Patient Monitor - Version 3B Update Instructions

- Part number - 415397-060
- Describes methods for updating software in the monitor:

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)

MANUFACTURER RESPONSIBILITY

Marquette Medical Systems is responsible for the effects on safety, reliability, and performance only if:

- assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by Marquette Medical Systems;
- the electrical installation of the relevant room complies with the requirements of the appropriate regulations; and,
- the patient monitor is used in accordance with the instructions for use.

EQUIPMENT SYMBOLS

Following are descriptions of the symbols used to identify various safety concerns for patient monitoring equipment.

NOTE
Some symbols may not appear on all equipment.

ATTENTION: Consult accompanying documents

CAUTION: To reduce the risk of electric shock, do NOT remove cover. Refer servicing to qualified service personnel.

Defibrillator-proof type CF equipment: type CF equipment is specifically designed for applications where a conductive connection directly to the heart is established. The paddles indicate the equipment is defibrillator proof.

Defibrillator-proof type BF equipment: type BF equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application. Type BF equipment is type B equipment with an F-type isolated (floating) part. The paddles indicate the equipment is defibrillator proof.

Fuse

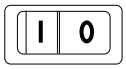
Equipotentiality

Alternating current (AC)

EQUIPMENT SYMBOLS (CONT)

EQUIPMENT RATINGS FOR PATIENT APPLIED PARTS

The following describes the symbols for patient applied parts of patient monitoring equipment.



Power: **I** = On; **O** = Off

Indicates where to press to open the door on the 7160 DDW.

ECG and Respiration
Temperature (TEMP)
Invasive Blood Pressure (BP)

Pulse Oximetry (SPO2)
Non-invasive BP (NBP)

End-tidal CO2 (CO2)

NOTE
The rating of protection against electrical shock (indicated by symbol for Type B, BF or CF) is achieved only when used with patient applied parts listed for use in the *Supplies* section of the Operator's Manual. Do not test the dielectric strength directly at the CO2 connector.

HOW TO REACH US...

The following are telephone numbers and addresses for contacting various Marquette Medical Systems Service and Supplies Division personnel.

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.)

- Address orders or inquiries to:

  Marquette Medical Systems Service and Supplies
  P.O. Box 9100
  100 Marquette Drive
  Jupiter, FL 33468-9100
  Attn: Supplies

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 (eg, R13, S12, U32).

Service Calls

To open a service call with Marquette Medical Systems Service, contact a Service Dispatcher at:

1-800-558-7044 (U.S. only)
1-407-575-5000 (outside the U.S.)

Service Contracts

For any questions about Service Contracts, contact the service contract operator at:

1-800-552-3248 (U.S. only)
1-407-575-5000 (outside the U.S.)

HOW TO REACH US... (CONT)

Technical Support

Monitoring Technical Support has a broad base of information regarding Marquette patient monitoring equipment and provides assistance with technical questions and concerns.

For All Hardware

For technical information regarding Marquette patient monitoring equipment, contact Monitoring Technical Support at:

1-800-558-7822 (U.S. only)
1-407-575-5000 (outside the U.S.)

Telemetry

For technical information regarding Marquette telemetry patient monitoring equipment, contact Monitoring Technical Support — Telemetry Products at:

1-800-552-3243 (U.S. only)
1-407-575-5000 (outside the U.S.)

Series 7000/7010

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

1-800-443-0980 (U.S. only)
1-407-575-5000 (outside the U.S.)

48-Hour Turnaround Repair

Some Marquette patient monitoring products or components such as Series 7000 Input Modules, Tram Modules, Series 7700 ECG Telemetry Transmitters, and CD Telemetry Transmitters are repaired on a 48-hour turnaround basis.

For information regarding 48-hour repair items, contact Monitoring Technical Support — 48-Hour Repair at:

1-800-552-3243 (U.S. only)
1-407-575-5000 (outside the U.S.)

Service Address

Send all patient monitoring repair items to:

Marquette Medical Systems Service and Supplies
P.O. Box 9100
100 Marquette Drive
Jupiter, FL 33468-9100
Attn: Monitoring Technical Support — Repair

For Additional Information

The service telephone operator can direct calls to personnel most able to assist with information. For other Monitoring Technical Support information, contact the service telephone operator at:

1-800-558-5120 (U.S. only)
1-407-575-5000 (outside the U.S.)

Abbreviations

A

AAMI: Association for the Advancement of Medical Instrumentation

AC,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, 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

IT: injectate temperature

J

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

N

NBP: non-invasive blood pressure

No: number

nS: nanosecond

Ntwk: network

ABBREVIATIONS (CONT)

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

For your notes

2 EQUIPMENT OVERVIEW

PRODUCT DESCRIPTION

ABOUT THE MONITOR

The monitor provides the parameters needed in a single, inexpensive, easy-to-use device. Its compact size and innovative package allow it to fit in small, tight places making it an ideal choice for patient monitoring in an operating room, recovery room, emergency care area as well as outpatient care areas.

Cost-effective design

Designed to provide high reliability, long operational life, minimal downtime, and low maintenance cost, the monitor is a cost-effective solution to general purpose patient monitoring needs. Monitor configurations include simultaneous multi-lead ECG, non-invasive blood pressure, dual temperature, pulse oximetry monitoring. Optional features that can be added to all monitors include an integral two-channel two inch thermal writer, two invasive blood pressures and end-tidal CO_2.

Standard monitoring configuration ...

... with options available

"Value-added" features

The monitor is equipped with a 9" diagonal high-contrast electroluminescent (EL) display capable of showing four waveforms and full digital data for all monitored parameters. The Trim Knob control and a clinically logical software menu structure assure ease-of-use and reduced inservice time. Multi-lead ST-segment monitoring, high quality graphic and tabular trends, and sophisticated algorithms (which may assist to reduce false alarms and provide more accurate data) are "value-added" features. In addition, the monitor is a member of a complete family of critical care products from the manufacturer, and is fully compatible with interconnection to the patient monitoring network.

Network compatibility

PRODUCT DESCRIPTION (CONT)

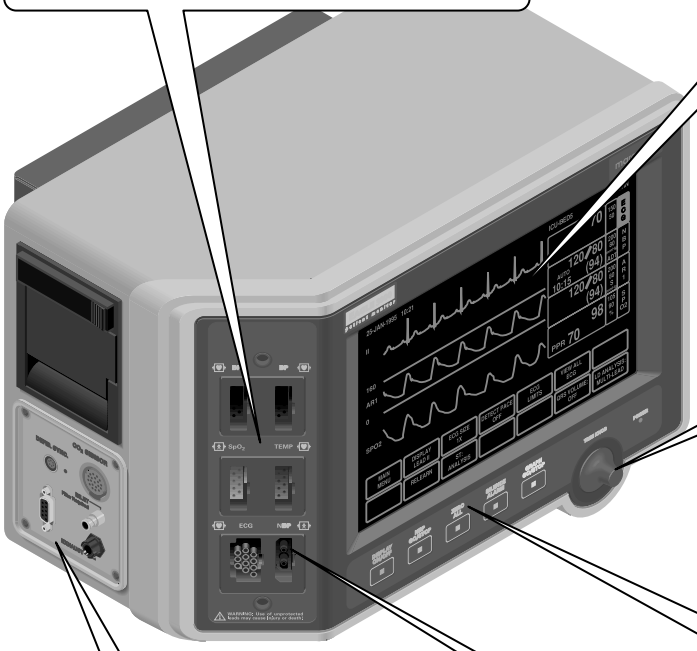
FRONT PANEL DESCRIPTION

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.

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

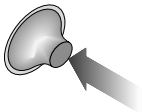
Display:
Monochrome electroluminescent (EL) display panel.
Screen size: 9-inch diagonal
Resolution: 640 x 400 pixels



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.



DEFIB SYNC (option): This side 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

RMT ALM (option): This side panel connector provides interconnection through the Marquette/Hellige Isolation Relay to a nurse-call light system.

CO2 Sensor (option): These side panel connectors provide a direct interface between the monitor and an End-tidal CO2 monitoring kit.

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

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

Controls power to the display without disrupting monitor main power.

Manually starts or stops the noninvasive blood pressure function.

Sets zero references for all invasive blood pressure functions.

Controls patient alarm silencing functions.

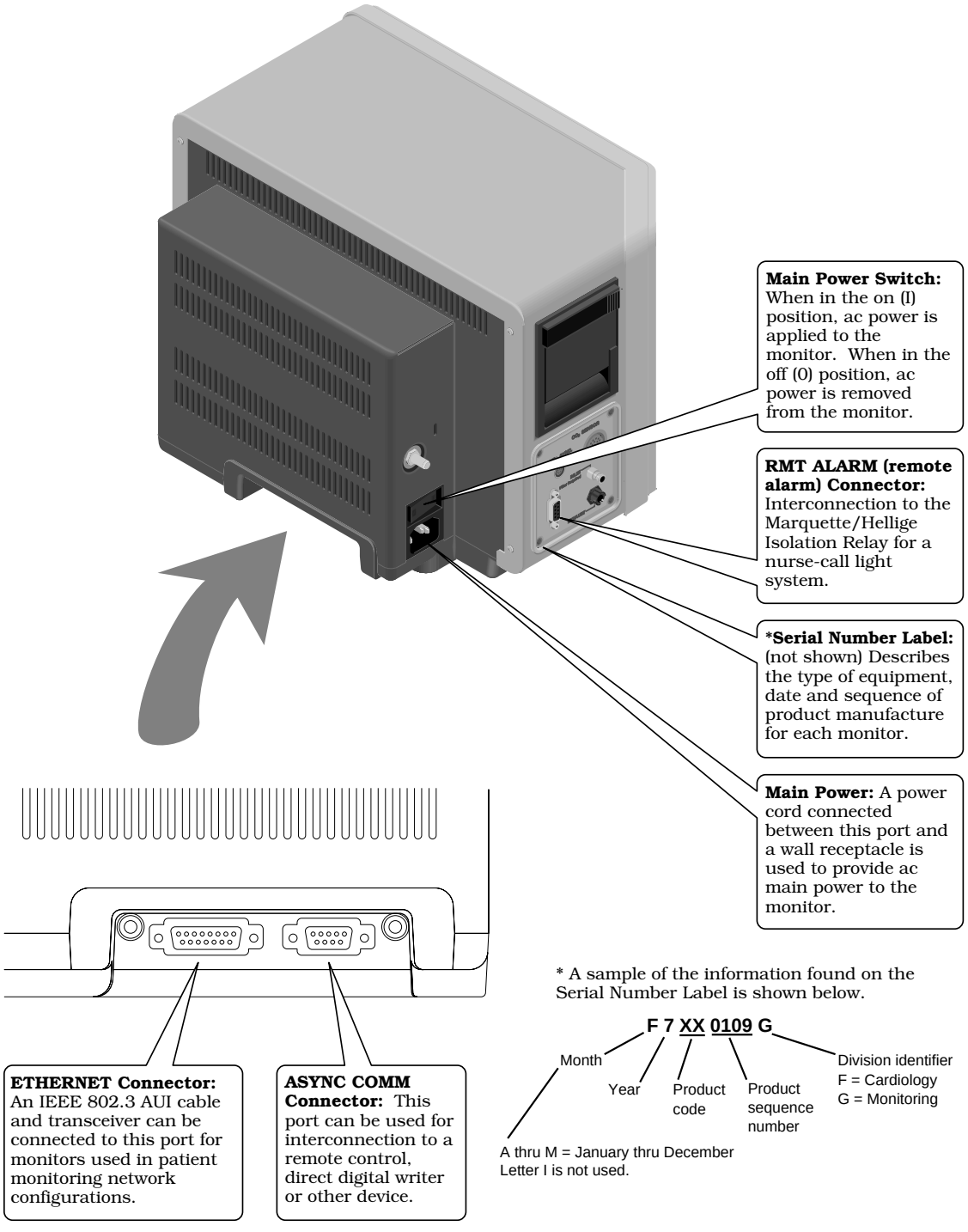
Manually starts or stops graphs to selected writers.

PRODUCT DESCRIPTION (CONT)

REAR PANEL DESCRIPTION

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.



PRODUCT DESCRIPTION (CONT)

ABOUT THE REMOTE ALARM CONNECTOR

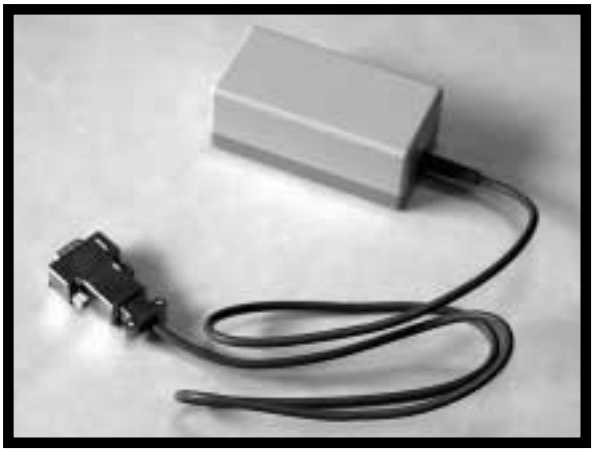
The remote alarm (RMT ALRM) connector is for use with a Marquette/Hellige Isolation Relay (pn 303 555 77) which provides a relay closure during the following alarms:

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

The signals provided at the RMT ALRM connector activate and deactivate the Marquette/Hellige Isolation Relay (shown below). When the monitor is powered up initially or rebooted, the relay remains turned off until the monitor is finished with its power up or reboot sequence. Once the monitor finishes powering up or rebooting, the relay is then energized.

When a CRISIS Patient Status Alarm or a WARNING System Status Alarm is detected, the relay is turned off by a signal from the monitor. When the alarm has been cleared, the relay is turned on once again.

The relay is turned off when AC power is removed from the monitor.



• Marquette/Hellige Isolation Relay •

NOTE:
Refer to the Installation Instructions that come with the Marquette/Hellige Isolation Relay for proper connection to your Nurse Call system.

FOR YOUR NOTES

MONITOR APPLICATIONS

STAND-ALONE MONITOR APPLICATION

The Marquette Unity Network (hereafter referred to as the network) provides a method for standardized communication with various Marquette medical system 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.

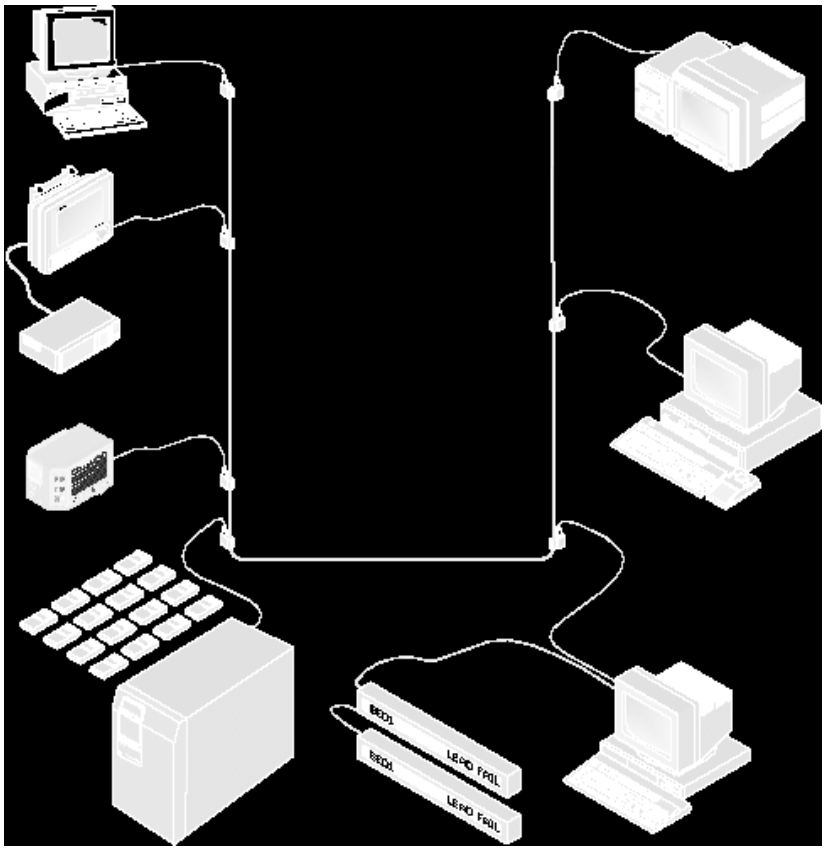
PATIENT MONITORING SYSTEM APPLICATION

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-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



PERFORMANCE SPECIFICATIONS

Display

Size:	9-inch diagonal
Type:	Monochrome, electroluminescent, flat panel
Resolution:	640 by 400 pixels
Number of waveform traces:	4
Length of trace:	5.7 seconds
Sweep speed:	22.9 mm/s (with erase bar), all waveforms except CO2
Waveform display options:	Full or individual
Information window:	Displays all non-real-time information without obstructing the display of real-time information
Display organization:	Prioritized by parameter

Processing

Main processor:	MC68EN360 (32-bit microprocessor), 23.4936 MHz clock frequency
Data acquisition processor:	MC68332 (32-bit microprocessor), 15.7248 MHz clock frequency
Program memory:	2MB flash EEPROM
Data memory:	2MB RAM

Alarms

Classification:	4 levels (Crisis, Warning, Advisory, Message)
Notification:	Audible and visual
Setting:	Default and individual
Silencing:	1 minute, current alarm only
Pause	
Adult mode:	5 minutes
Neonatal ICU mode:	3 minutes
OR mode	5 minute, 15 minute, or permanent
Volume:	Default 70%, 70 dB measured at 1 meter

User Interface:

Trim Knob control:	Provides access to all menu-based operations
Hard keys	
Silence Alarm:	Controls alarm silencing
Graph Go/Stop:	Start and stop manual graph operation
NBP Go/Stop:	Start and stop non-invasive blood pressure measurement
Zero All:	Zero BP transducers
Display On/Off:	Blanks the display and disables alarms, for use as screen saver

PERFORMANCE SPECIFICATIONS (CONT)

ECG

Standard leads available:	I, II, III, V, aVR, aVL, and aVF
Leads analyzed simultaneously:	I, II, III, and V (multi-lead mode)
Lead fail:	Identifies failed electrodes
Lead fail sensing current	
Active electrodes:	<25 nA each
Reference electrode:	<100 nA
Waveform display aspect ratio:	0.34 s/mV
Input specifications	
Voltage range:	±0.5 mV to ±5 mV
Signal width:	40 ms to 120 ms (Q to S)
Input impedance	
Common mode:	>10 MΩ at 50/60 Hz
Differential:	>2.5 MΩ from dc to 60 Hz
Output specifications	
Display frequency response	
Adult ICU mode:	0.05 to 40 Hz
Neonatal Mode:	0.5 to 40 Hz
OR Mode:	0.05 to 25 Hz
Paper Recorder frequency response	
Standard Mode:	0.05 to 100 Hz
Neonatal:	0.5 to 40 Hz
OR Mode:	0.05 to 25 Hz
Common mode rejection:	90 dB minimum at 60 Hz
Gain:	1000 ±3%
Linearity deviation:	±3% (maximum)
Noise:	<30 µV (referred to input)
Heart Rate	
Heart rate range:	30 to 300 beats per minute
Heart rate averaging:	8 beats
Display update interval:	2 seconds
Response time:	<6 seconds (per AAMI EC13)
Limit alarm display:	<10 seconds after alarm condition exceeded
ST Segment analysis	
Measurement description:	ST segment deviation measured and displayed for all acquired leads, and averaged for anterior, lateral and inferior lead groups
ST display:	Three 30-minute trends, or ECG complexes for leads I, II, and V, and a summation trend
Measurement point:	Measures at 60 ms following the J point
Measurement range	
Adult:	-12.0 mm to + 12.0 mm
Neonatal:	-10.0 mm to + 10.0 mm
Display resolution:	0.1 mm
ST measurement averaging:	16 beats
Display update interval:	2 seconds
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 (maximum)
Baseline drift:	<0.5 V with a ±700-mV, 2-ms pacemaker pulse applied
Arrhythmia detection	
Adult mode:	Asystole, ventricular fibrillation/tachycardia, ventricular tachycardia
Neonatal mode:	Asystole, ventricular fibrillation/tachycardia, ventricular bradycardia
Alarms:	Selectable upper and lower heart rate limits, arrhythmia detection; lead-failure

PERFORMANCE SPECIFICATIONS (CONT)

Invasive Blood Pressure (optional)

Number of channels:	2
Transducer sites:	Arterial, pulmonary arterial, central venous, left atrial, intracranial, and special
Transducer requirements	
Excitation voltage:	±2.5 V dc ±0.1%
Transducer output:	50 µV/V/cm Hg
Pressure measurement specifications	
Range:	-25 mmHg to 300 mmHg
Accuracy:	±2% or ±1 mmHg, whichever is greater (independent of transducer)
Drift:	< ±0.1%/°C, and < ±0.1% over and 24-hour period
Zero balance range:	±150 mmHg
Zero balance accuracy:	±1 mmHg
Zero balance drift:	±1 mmHg over 24 hours
Frequency response:	dc to 50 Hz (-3 dB)
Input impedance	
Common mode:	100 KΩ (minimum) at 50/60 Hz
Differential:	100 KΩ (minimum) from dc to 60 Hz
Common mode rejection:	60 dB (minimum) at 60 Hz
Noise:	5 mV peak to peak (maximum) from dc to 30 Hz
Averaging:	4 seconds
Display update interval:	2 seconds
Alarms:	Selectable upper and lower limits for systolic, diastolic, and mean pressures; sensor failure

Non-invasive Blood Pressure

Measurement technique:	Oscillometric
Displayed parameters:	Systolic, diastolic, and mean pressures, pulse rate, time of last measurement
Measurement modes:	Manual, auto, and stat
Systolic pressure range:	30 to 275 mmHg
Diastolic pressure range:	15 to 250 mmHg
Heart rate range:	30 to 300 beats per minute
Total cycle time:	20 to 40 seconds typical (dependent on heart rate and motion artifact)
Maximum inflation pressure	
Adult:	300 mmHg
Pediatric	250 mmHg
Neonatal:	150 mmHg
Overpressure safety valve:	Activates when cuff pressure exceeds:
Adult mode:	300 mmHg (+30/-0 mmHg) cuff pressure
Neonatal mode:	150 mmHg (+15/-0 mmHg) cuff pressure
Maximum pressure leakage:	4 mmHg per minute
Automatic cycle times:	0 to 24 hours
Auto zero:	Zero pressure reference prior to each cuff inflation
Tubing length:	12 feet adult, 8 feet neonatal
Automatic cuff deflation:	Occurs when power is off or the following limits are exceeded:
Adult mode:	300 mmHg (± 3 mmHg) cuff pressure or 3 minutes cycle time
Neonatal mode:	150 mmHg (± 2 mmHg) cuff pressure or 90 seconds cycle time
Cuff sizes:	
Disposable:	Large adult, adult, small adult, pediatric, small pediatric, and infant
Reusable:	Thigh, large adult, adult, child, and infant
Alarms:	Selectable upper and lower limits for systolic, diastolic, and mean pressures

PERFORMANCE SPECIFICATIONS (CONT)

Pulse Oximetry

Parameters monitored:	Arterial oxygen saturation (SpO2) and peripheral pulse rate (PPR)
Probe types:	Marquette, Nellcor
Oxygen saturation measurement specifications	
SpO2 range:	50–100%
Accuracy:	Actual accuracy depends on probe. Please reference manufacturer's specifications.
SpO2:	±2% (70–100% SpO2) ±3% (50–60% SpO2)
SpO2 resolution:	1%
Averaging	
Adult:	6 seconds
Neonatal:	12 seconds
Display update interval:	2 seconds
Peripheral pulse rate measurement specifications	
PPR range:	20–250 beats per minute
PPR accuracy:	±3 beats per minute
PPR resolution:	1 beat per minute
Averaging:	10 seconds
Display update interval:	2 seconds
Alarms:	Selectable upper and lower limits for SpO2 and PPR

Temperature

Number of channels:	2
Input specifications	
Probe type:	YSI Series 400 or 700 (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
Linearity deviation:	± 1% (maximum)
DC drift:	±1 mV/˚C (maximum)
Error:	(independent of source) ±0.1˚C for YSI series 400 probes ±0.3˚C for YSI series 700 probes
Noise:	20 mV (maximum) from dc to 100 Hz
Alarms:	Selectable upper and lower limits for T1, T2

Respiration (optional)

Measurement technique:	Impedance variation detection
Respiration rate measurement specification	
Range:	0 to 200 breaths per minute (for variation of 1.0 to 10Ω)
Accuracy:	± 1 breath per minute
Base impedance:	100 to 1000Ω
Detection sensitivity:	0.4 to 10 Ω variation (for 0 to 120 breaths per minute)
Excitation current:	250 μA_{RMS} at 52.6 kHz
Averaging:	8 breaths
Display update interval:	2 seconds
Waveform display bandwidth:	0.1 to 1.8 Hz (-3 dB)
Lead fail:	Indicated when base impedance exceeds 1750 ± 250Ω
Apnea detection:	Indicated when impedance variation is less than selected sensitivity or 0.2Ω, whichever is greater
Alarms:	Selectable upper and lower respiration rate limits, and user selectable apnea limit

PERFORMANCE SPECIFICATIONS (CONT)

End-tidal CO_2 (optional)

Monitoring functions:	Inspired and expired CO2 measurements, respiration rate measurement
Measurement technique:	Non-dispersive infrared absorption, dual wavelength ratiometric
Airway adapter specifications	
Airway adapter dead space/chamber volume	
Adult reusable:	<5 cc
Adult disposable:	<5 cc
Neonatal:	<0.5 cc
Sampling:	<0.2 cc
CO2 measurement specifications	
Range:	0 to 100 mmHg
Accuracy	
Mainstream:	±2 mmHg or 5%, whichever is greater
Sidestream mode:	±3 mmHg or 8%, whichever is greater
Display update interval:	2 seconds
CO2 averaging:	Selectable from single breath, 10 seconds, or 20 seconds
Resolution:	1 mmHg
Response time (for 5% step size)	
Mainstream adult:	<60ms (10 to 90%)
Mainstream neonate:	<50 ms (10 to 90%)
Sidestream (with filter):	<600ms (10% to 90%) at 180 cc/min
Interference	
N2O gas:	±2 mmHg or 5%, whichever is greater, with N2O compensation enabled
O2 gas:	±2 mmHg or 5%, whichever is greater, with O2 compensation enabled
Barometric pressure:	±2 mmHg (maximum) from 500 to 800
Water vapor:	±0.5 mmHg or 1.5% (maximum), whichever is greater
Anesthetic agent:	±0.5 mmHg (maximum), for concentrations of no more than 5% of halogenated agents
Warm-up time:	Less than 15 seconds to initial CO2 indication, full specification within 60 seconds
Calibration	
Factory setting:	Factory calibration settings stored in nonvolatile memory within the sensor. 15 second adapter calibration when switching airway types
Verification:	Zero and reference performance check with on-cable verifier
CO2 Waveform sweep speed:	Selectable one-fourth, one-half, and full speed
Respiration rate specifications	
Range: (for 5% step size)	
Mainstream mode:	0 to 120 breaths per minute
Sidestream mode:	0 to 50 breaths per minute
Accuracy:	±1 breath per minute
Resolution:	±1 breath per minute
Sidestream pump specifications	
Flow rate:	190 ±10 cc/min
Capnostat III sensor specifications	
Operating temperature:	10 to 40°C
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, no ETO gas permitted, do not immerse in fluid
Reusable airway adapters:	Disinfect with buffered glutaraldehyde, ETO gas, isopropyl alcohol, household bleach; also steam sterilization and pasteurizable
Alarms:	Selectable upper and lower limits for CO2 and respiration rate

PERFORMANCE SPECIFICATIONS (CONT)

STAR Recorder (optional)

Method:	Thermal dot array
Horizontal resolution:	800 dots/in at 1, 5, 10, 12.5, 25 mm/sec; 400 dots/in at 50 mm/sec
Vertical resolution:	200 dots/in
Number of waveform channels:	2
Paper width:	50 mm (1.97 in)
Paper speed:	1, 5, 10, 12.5, 25, 50 mm/sec
Paper speed accuracy:	±5% at 1 and 5 mm/sec; ±2% at 10 mm/sec or faster
Frequency response:	Determined by acquisition system

Direct Digital Writer (optional)

Method:	Thermal, fixed head
Horizontal resolution:	480 dots/in at 25 mm/sec;
Vertical Resolution:	200 dots/in
Number of Waveform Channels:	4
Paper width:	
7100:	108 mm (4.3 in)
7160:	50 mm (1.97 in)
Paper length:	
7100:	46 m (150 ft)
7160:	25 m (95 ft)
Paper speed:	1, 5, 10, 12.5, 25, 50 mm/sec
Paper speed accuracy:	±5% at 1 and 5 mm/sec; ±2% at 10 mm/sec or faster
Frequency response:	determined by acquisition system

Analog Output (optional)

ECG	
Gain:	1 V/mV ±10%
DC offset:	±100 mV (maximum)
Noise:	5 mV peak to peak (maximum) 0 to 300 Hz
Frequency response:	0.05 Hz to 100 Hz –0/+7 Hz
Blood pressure	
Gain:	10 mV/mmHg ±2%
DC offset:	±20 mV (maximum)
Noise:	5 mV peak to peak (maximum) 0 to 300 Hz
Frequency response:	dc to 50 Hz -0/+2 Hz

Defibrillation Synchronization Pulse (optional)

Marker out	
Time delay (R wave peak to leading edge of pulse):	35 ms (maximum)
Amplitude	
+5 V selection:	3.5V (min) at 1 mA sourcing: 0.5V (max) at 5 mA sinking
+12 V selection:	11.0V (min) at 1 mA sourcing: 0.75V (max) at 5 mA sinking
Pulse width:	Selectable 10 ms ± 10% or 100 ms ± 10% in service menu
Output impedance:	50Ω nominal
Current limit:	15 mA nominal, both sourcing and sinking
Marker in	
Input threshold:	V_{IH} =±2.5V (min), V_{IL} =±1.5V (max)
Input hysteresis	650 mV typical
Maximum input voltage:	±30 V (with respect to ground on pin 2)
Input impedance:	10kΩ (min) for -25V <V_{IN} <25V
Pulse width:	1.0 ms (min), $V_{IN} \geq 2.5V$

PERFORMANCE SPECIFICATIONS (CONT)

Environmental Specifications

Power Requirements:	90–132 VAC 50/60 Hz 190–264 VAC 50/60 Hz
Power consumption: (maximum)	90–132 VAC 2A 190–264 VAC 50/60 1A
Heat dissipation:	500 Btu/hr
Cooling:	Convection
Operating Conditions:	
Ambient temperature:	10 to 40˚C (50 to 104˚F)
Relative humidity:	30 - 70%
Storage Conditions:	Do not exceed: Maximum: 50°C (122°F) at 50% relative humidity 70°C (158°F) at 15% relative humidity Minimum: –25°C (–13°F)

Physical Specifications

Height:	24.13 cm (9.5 inches)
Width:	31.11 cm (12.25 inches)
Depth:	21.59 cm (8.5 inches)
Weight:	7.3 kg (16 lb)

Certification

UL:	UL2601-1 Listed
CSA:	C22.2 No. 601.1-M90
IEC:	IEC 601-1 Certified

Electromagnetic Compatibility

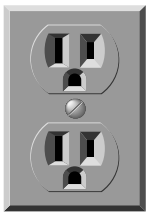
CISPR Publication 11	Class B Radiated, Class B Conducted

Classifications The Eagle 3000 Patient Monitor is classified, according to IEC 601-1.

Type of protection against electrical shock:	Class 1 Equipment
Degree of protection against electrical shock:	ECG, Respiration, and Invasive Blood Pressure are type CF equipment. Non-Invasive blood pressure, SpO2, and CO2 are type BF equipment.
Degree of protection against harmful ingress of water:	Ordinary Equipment (enclosed equipment without protection against ingress of water)
Degree of safety of application in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide:	Equipment not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.
Method(s) of sterilization or disinfection recommended by the manufacturer:	Not applicable
Mode of operation:	Continuous operation

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.

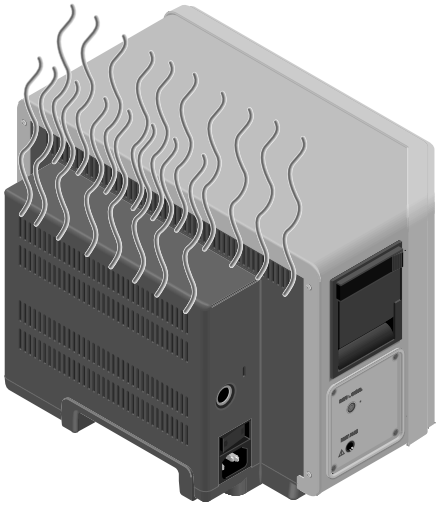
If a bonded grounding unit is not available, interconnect the ground pins of all wall receptacles in the patient and monitor areas with 10-AWG (or larger) stranded copper cables. This copper cable must connect to the central grounding point. Do not jumper from ground pin to ground pin, then to the central 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)

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 should be approximately 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

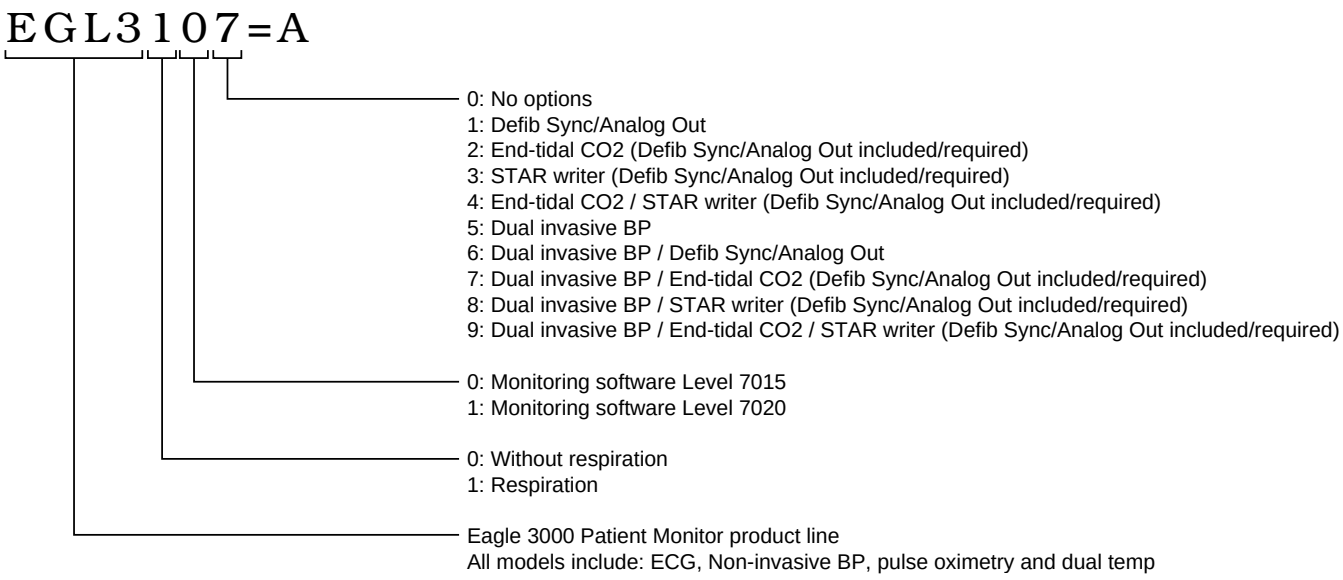
Section 6: Configuration

- Information regarding connection of the monitor to peripherals

ORDERING INFORMATION

PART NUMBERS AND DESCRIPTIONS

Below is a breakdown of the product part number used for ordering the monitor.



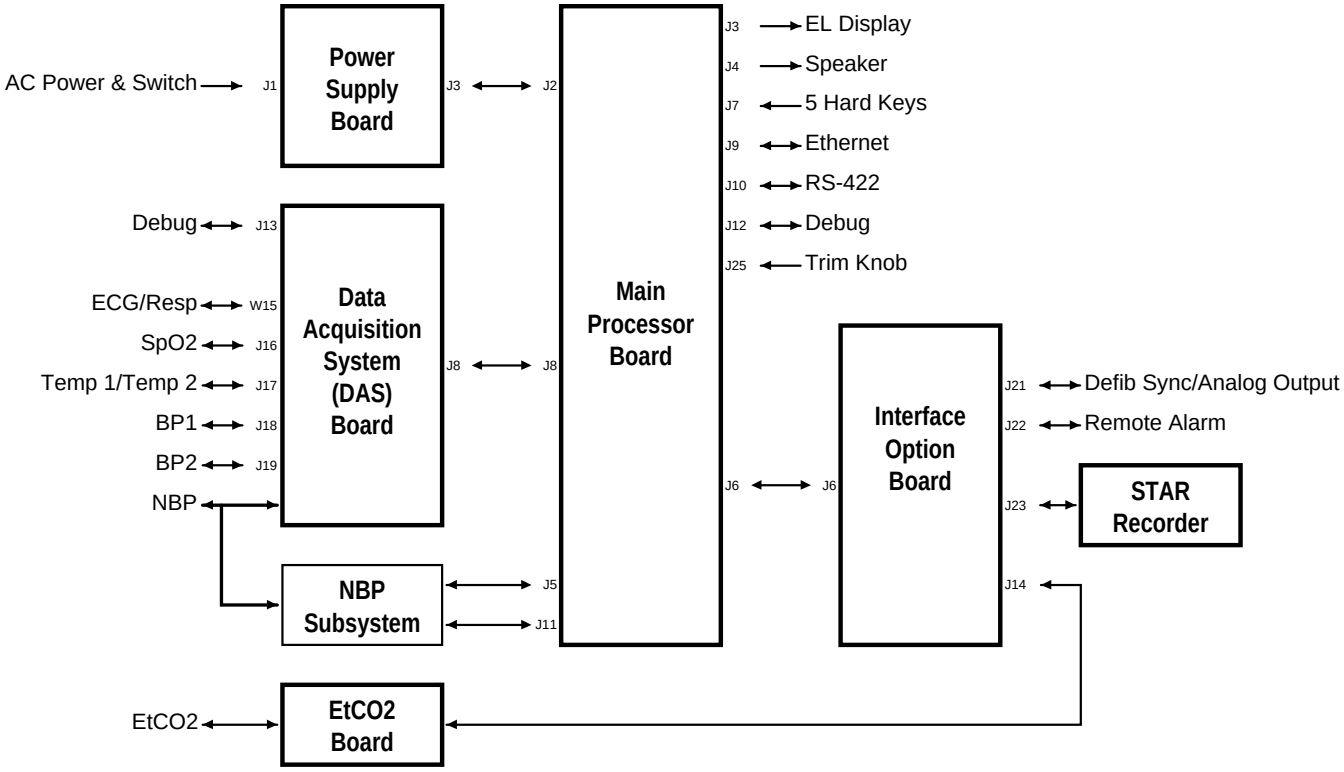
How the order numbers are broken down

Using the sample product order number provided (EGL3107=A), the following information regarding the monitor configuration can be determined:

- The “1” in the numeric portion of the order number (3**1**07) indicates that the monitor includes respiration along with all of the standard vital sign monitoring functions included with all monitors: ECG, non-invasive blood pressure, pulse oximetry and dual temperature.
- The “0” in the numeric portion of the order number (31**0**7) indicates the monitor is configured with Level 7015 operating software enabled. Level 7015 operating software includes only basic monitoring functions. Level 7020 operating software includes lethal ECG arrhythmia detection (V-Fib and V-Tach) along with basic monitor operating functions.
- The “7” in the numeric portion of the order number (310**7**) indicates the monitor also is configured with the following optional vital sign monitoring functions:
  - » two invasive blood pressure ports, and
  - » end-tidal CO_2 monitoring which requires the use of an option interface board. The option interface board also provides defibrillator synchronization and analog output jacks.

THEORY OF OPERATION

OVERALL MONITOR BLOCK DIAGRAM



GENERAL MONITOR BLOCK THEORY

The theory of operation for the monitor, as covered in this part of the section, is intended to provide an overall block level overview of the monitor for service technicians. A general understanding of the theory of operation is required to effectively install, maintain or repair the monitor.

Detailed circuit theory

More detailed theory of operation can be obtained by attending manufacturer formal technical training classes. Regularly scheduled technical training classes are held throughout the year at the manufacturer training facility located in Jupiter, Florida. If warranted, technical training classes may be scheduled at customer sites or other locations in the field as well.

THEORY OF OPERATION (CONT)

About the power supply board

The power supply is an off-line forward converter topology with a two input range voltage rectifier/doubler scheme. The converter uses current mode control for best overall performance and fault tolerance. A two-transistor power switch approach was used to provide maximum ruggedness against input voltage transients and low conducted/radiated EMI.

Two individual output voltages are provided with complete overload/fault protection. The supply has six unique functional sections:

1. Input voltage rectifier/doubler section
2. Power forward converter/magnetics section
3. PWM controller section
4. Fault management section
5. +12V overvoltage protection section
6. Post regulator section

About the DAS board

The data acquisition system (DAS) board, 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.

About the main processor board

The processor pcb provides signal processing, system control, user interface, and communications functions for the monitor. It receives and processes digitized patient data from the isolated DAS board, text and waveform information for the 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 an asynchronous communications port for devices like a DDW or remote control.

About the interface option board

The development of the interface option board allows the cost of the main processing board to be reduced by incurring the cost of additional circuitry and connectors not required in many monitoring applications. This board provides the electrical hardware required to interface and control optional monitoring features. The options available include analog output, defibrillator synchronization, remote nurse alarm control, an integrated thermal recorder and an end-tidal CO_2 subsystem.

About the $EtCO_2$ option board

The $EtCO_2$ subsystem connects electrically and mechanically to the interface option board. An asynchronous communications port is used to communicate to the main processor board.

For your notes

3 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 are 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, every 12 months thereafter, and each time the monitor is serviced.
- **Leakage Current Tests:** These should be performed by qualified service personnel upon receipt of the equipment, every 12 months thereafter, and each time the monitor is serviced.
- **Hi-Pot Tests:** High-potential tests should be performed by qualified service personnel whenever any component of the isolated data acquisition system (DAS) 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.

- **Non-invasive Blood Pressure (NBP) Calibration:** NBP calibration should be performed by qualified service personnel upon receipt of the equipment and once each year, thereafter. Refer to Section 5: Calibration, for this information.

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 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.

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.

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

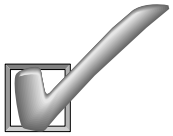
The manufacturer recommends the following guidelines to avoid damaging the monitor:

- 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



The following pages contain the checkout procedures for the monitor. The purpose of the checkout procedures is to provide service personnel with a method which can be used to verify operational and functional performance of the monitor. Failure to attain any of the listed results indicates a potential malfunction of the monitor.

Perform the checkout procedures upon receipt of the monitor, every 12 months 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 all test equipment required 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 Micro-simulator	MARQ1	1
Multi-link ECG cable, 5-Leadwire, AHA	412931-001	1
Multi-link Leadwire Set, Individually Replaceable, 5-Leadwire, AHA	411200-001	1
BP Adapter	700095-001	2
Temperature Adaptor	402015-004	1
TEMP-to-Simulator Cable	6770031	1
Digital manometer	Sensym PDM200M	1
NBP Cuff	9461-301	1
NBP Tubing	414873-001	1
Manometer Tubing	401582-001	2 ft
Coupling	46100-002	1
Coupling	400787-001	1
3-Way Tee	4745-101	1
SpO_2 Simulator	408610-001	1
SpO_2 Simulator Cable, Nellcor	700232-004	1
CO_2 Simulator	Novametrix TB1265	1

CHECKOUT PROCEDURES (CONT)

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.
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.
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.
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 the following:
    - a RA FAIL message appears on the display, and
    - lead III automatically displays in place of lead II in the top trace position.
13. Reconnect the RA leadwire to the patient simulator.
14. Inject a 1-millivolt calibration signal using the patient simulator and start a manual graph.
15. Observe that the calibration pulse is properly displayed and graphed.
16. This completes the ECG tests. Continue to the next steps of these checkout procedures.

CHECKOUT PROCEDURES (CONT)

RESPIRATION TESTS (OPTIONAL)

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

1. Set up the patient simulator for a temperature output of 37°C.
2. Attach the temperature adaptor cable to the TEMP connector of the monitor.
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.
5. Verify a TEMP parameter window appears on the monitor display with a T1 reading of 37.0° ±0.4° C.
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)

INVASIVE BLOOD PRESSURE (OPTIONAL) 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.
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.
4. Press the ZERO ALL push-button on the front panel of the monitor to zero-reference the AR1 BP waveform.
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.
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.
11. Again, set up the patient simulator as follows:
    - BP polarity - POS,
    - BP output - 0 mmHg.

BP2 connector (PA2) tests

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

1. Set the pulse oximetry (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.
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

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

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.
10. Set the SpO_2 simulator power switch to the off position.

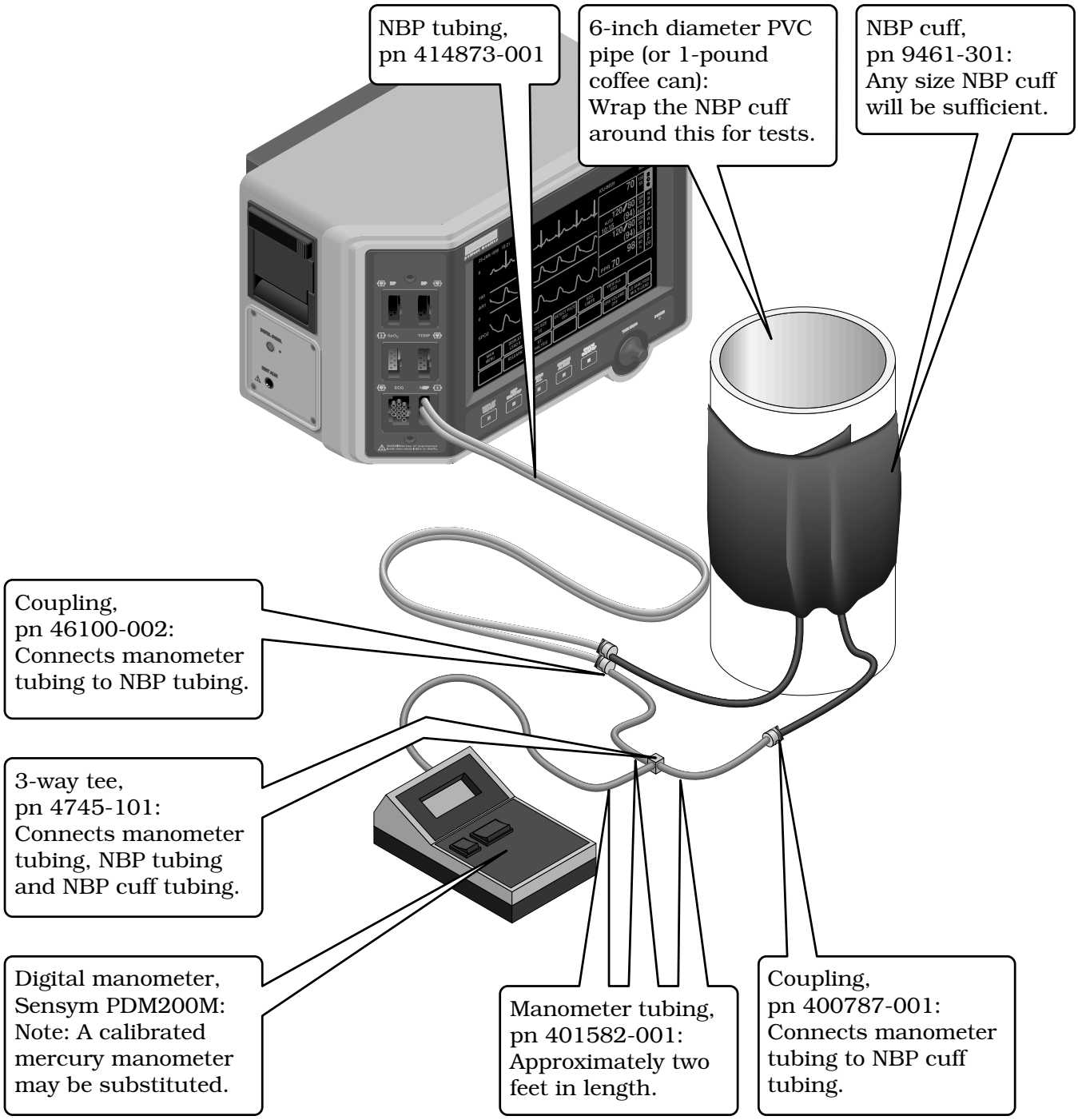
Pulse oximetry tests completion

11. Disconnect the Nellcor-style SpO_2 simulator cable from the monitor SpO_2 connector. This completes the SpO_2 tests.

CHECKOUT PROCEDURES (CONT)

NONINVASIVE BLOOD PRESSURE TESTS: PRE-TEST SETUP

1. Attach the digital manometer, noninvasive blood pressure (NBP) cuff, tees and tubing, as shown below, to the NBP connector of the monitor.



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

CHECKOUT PROCEDURES (CONT)

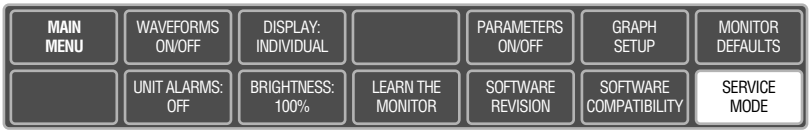
NONINVASIVE BLOOD PRESSURE TESTS

To perform the noninvasive blood pressure (NBP) tests, current software is assumed to be installed in the monitor.

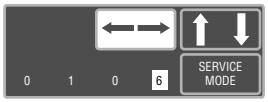
1. From the main menu of the monitor, rotate the Trim Knob control to highlight MONITOR SETUP and press the Trim Knob control to select it.

Enter the service menus of the monitor

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



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 (June 1st) would be represented in the password as 0106 (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.

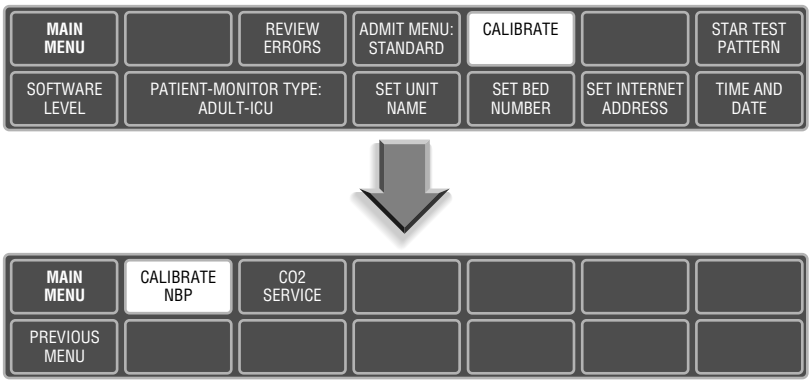


CHECKOUT PROCEDURES (CONT)

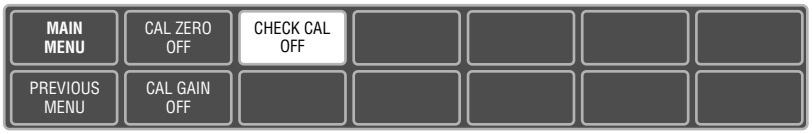
NBP calibration menu of the monitor

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.

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.

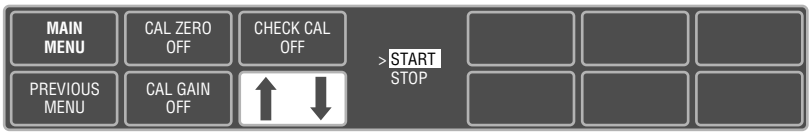


5. Rotate the Trim Knob control to highlight CHECK CAL OFF and press the Trim Knob control to select it.



Start the NBP calibration test

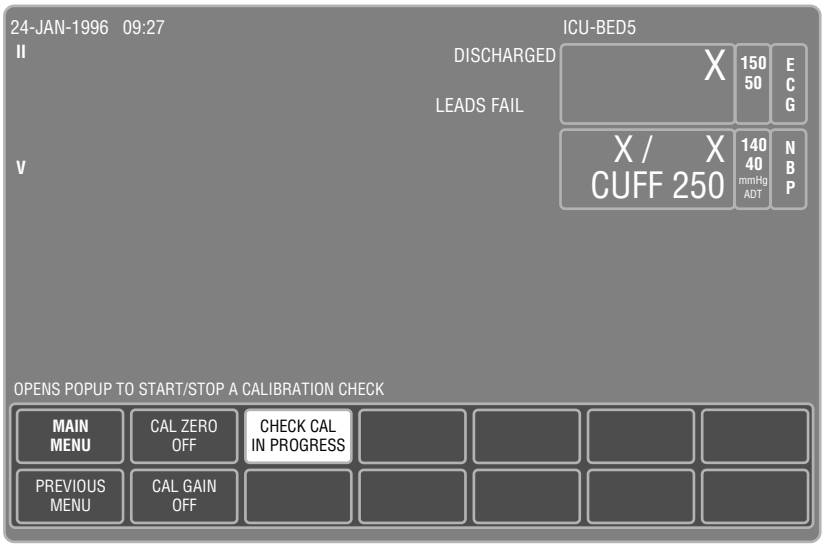
6. Rotate the Trim Knob control to highlight START and press the Trim Knob control to select it.



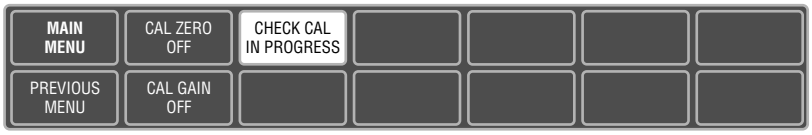
CHECKOUT PROCEDURES (CONT)

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 dispaly 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.



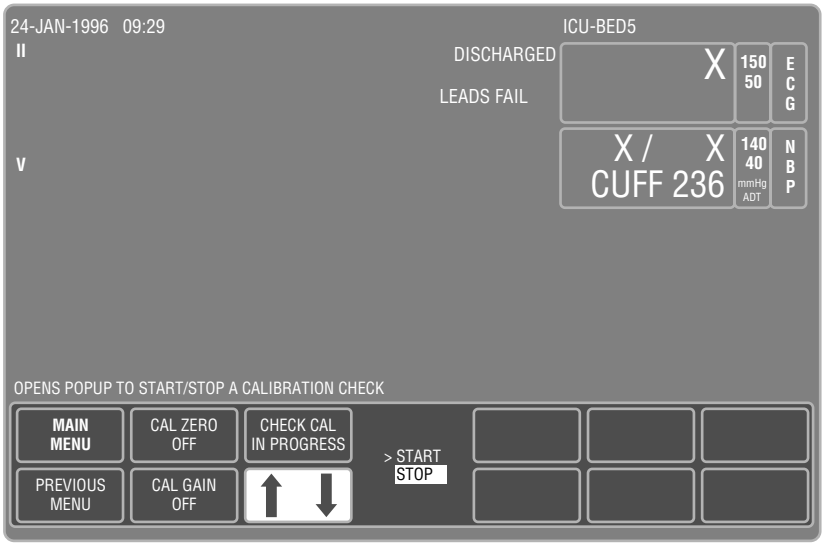
8. Rotate the Trim Knob control to highlight CHECK CAL IN PROGRESS and press the Trim Knob control to select it.



CHECKOUT PROCEDURES (CONT)

Stop the NBP calibration test

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.



Noninvasive blood pressure tests completion

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

CHECKOUT PROCEDURES (CONT)

END-TIDAL CO_2 TESTS

1. Return to the main menu of the monitor.

2. With the Capnostat sensor attached to the front panel connector of the monitor, put the sensor on the zero reference (→ 0 ←) cell.

3. 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. Select READY and press the Trim Knob.

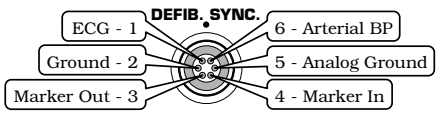
   A CALIBRATING message will appear in the CO_2 parameter box.

4. After zero calibration is complete, put the sensor on the reference (REF) cell.

5. Verify the reading in the CO_2 parameter box displays 38 ±2 mmHg.

CHECKOUT PROCEDURES (CONT)

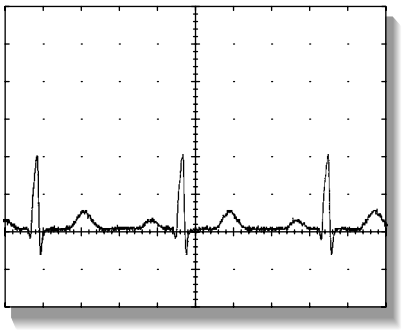
DEFIBRILLATOR SYNCHRONIZATION TESTS



1. Use the figure at the left as a reference for connecting the oscilloscope to the DEFIB SYNC connector, located on the front panel of the monitor, for performing these tests.
2. Test the ECG, Arterial BP and Marker Out signals from the DEFIB SYNC connector. They should closely resemble the waveforms in the figures below. Note that there are two Marker Out traces shown below. The upper Marker Out figure references the frequency aspects of the signal. The lower Marker Out figure references the pulse width aspects of the signal.

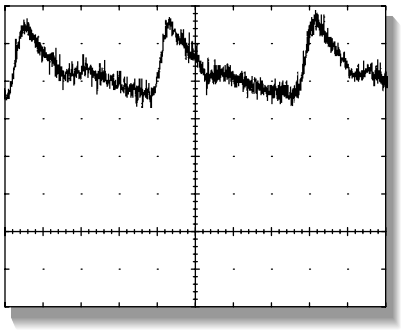
DEFIB SYNC connector: ECG

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



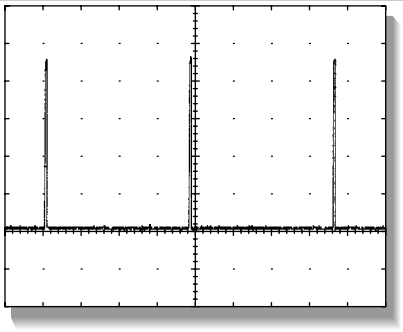
DEFIB SYNC connector: Arterial BP

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



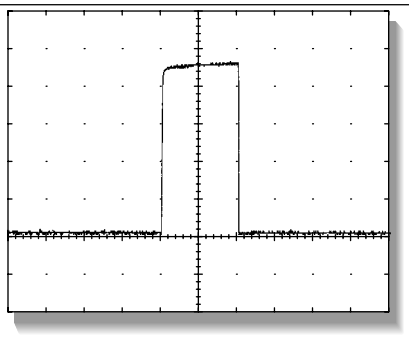
DEFIB SYNC connector: Marker Out (frequency)

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



DEFIB SYNC connector: Marker Out (pulse width)

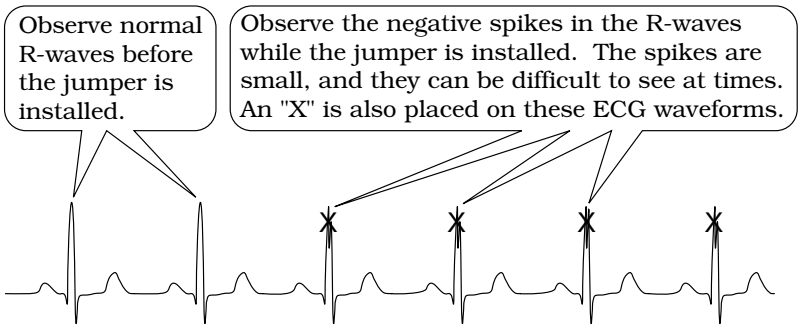
Signal Pin: 3
Ground Pin: 2
Probe Type: x10
Time/Division: 5mS
Volts/Division: 1V



CHECKOUT PROCEDURES (CONT)

Verify defib sync markers

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.



Defibrillator synchronization tests 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)

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 tests completion

This completes all tests associated with the checkout procedures. Disconnect the monitor from all 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 if potential electrical health hazards 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.

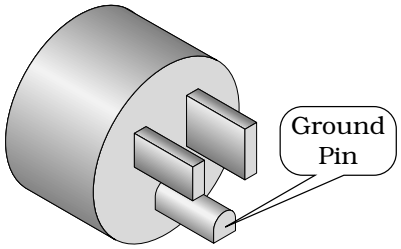
Connect the leakage tester to the wall receptacle. Observe the 0, K, and R lamps with the GND switch in the down position. For safe conditions, the lamps should reflect normal polarity and ground as shown below.

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.

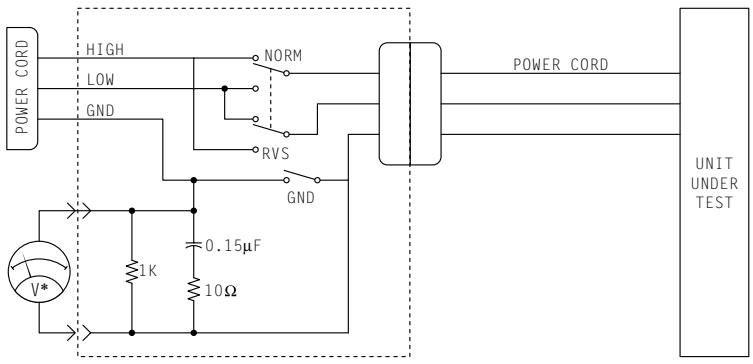
1. Set the leakage tester switches as follows:
   - Selector knob - 1,
   - GND switch - OPEN,
   - Polarity switch - NORM,
   - Power switch - OFF.
2. Connect the DMM to the METER jacks on the leakage tester. Set the DMM to measure AC millivolts.
3. Connect the power cord of the monitor to the power 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

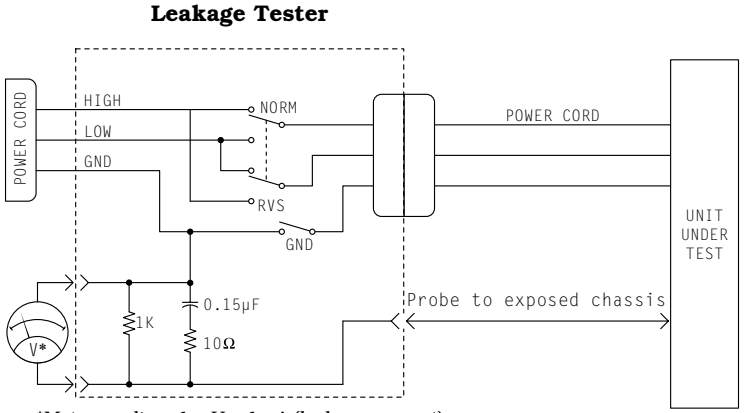
Perform this test to measure leakage current through exposed conductive surfaces on the monitor during normal operation.

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

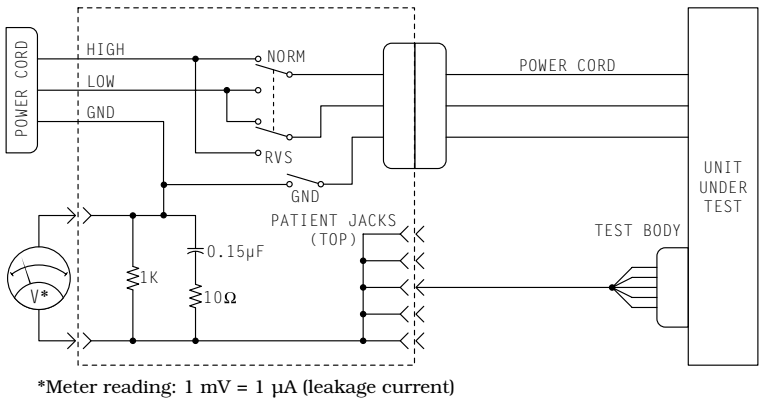
This test checks leakage current from the ECG/RESP connector of the monitor relative to ground.

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.

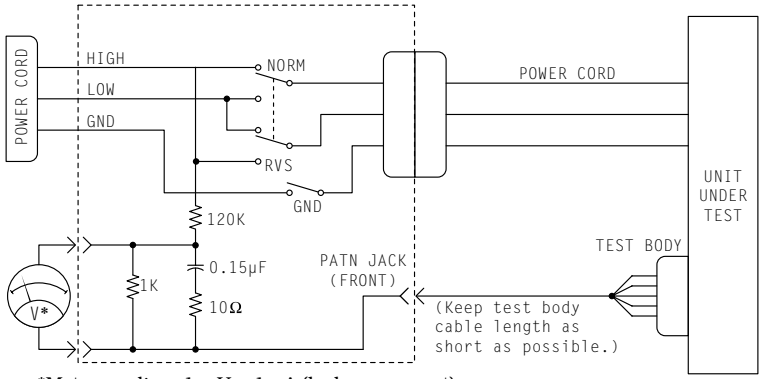
3. Set power switch on the leakage tester to ON.
4. Read leakage current indicated on DMM.

   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 1 mA. 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.
10. This completes the AC hi-pot test.

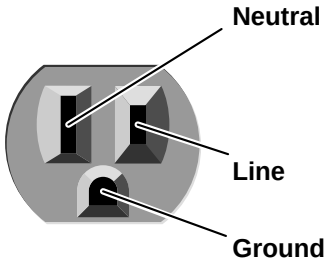
FOR YOUR NOTES

4 TROUBLESHOOTING

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.

A standard wall receptacle consists of three connections: line, neutral and ground. The figure at left indicates the location of each on a 120 V_{ac} 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 resistance test

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

CAUTION
Do not check the ground-neutral loop resistance unless the wall receptacle is correctly wired.

   - 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.

DATA ACQUISITION TESTS

ECG FUNCTIONS

1. Connect the Marquette 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 MONITOR SETUP.
   - 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:
   - Lead I: 0.5 mV
   - Lead II: 1 mV
   - Lead III: 0.5 mV
   - Lead V: –0.5 mV
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:

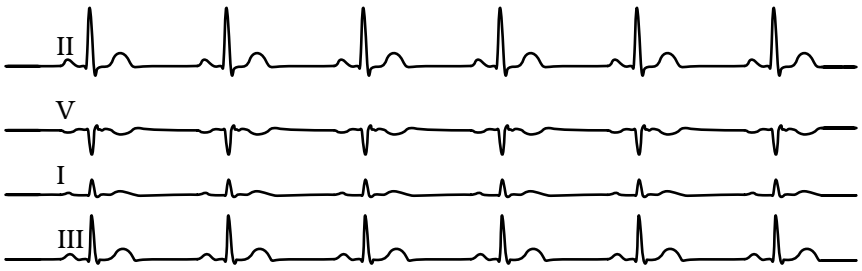
     ECG 1: LEAD II

     WAVEFORM 2: LEAD V
   - Press the GRAPH GO/STOP front panel control on the monitor to start and stop a manual graph.
   - Verify the printed graph shows proper cal pulses.

DATA ACQUISITION TESTS (CONT)

ECG functions (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 WAVEFORMS ARE DISPLAYED INCORRECTLY

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 Section 5: Calibration information in this regard.

1. If displayed ECG waveforms contain a significant amount of noise (see figure at left), check the ECG patient cables.
2. Test the patient simulator and ECG patient cables on a working monitor to verify the ECG signal.
3. If the ECG signal, patient simulator and ECG patient cables are good, the acquisition pcb is suspect and may need to be replaced.

ECG waveforms are not displayed at all

4. Test the ECG patient cables on a working monitor.
5. Test the patient simulator on a working monitor.
6. Swap the acquisition pcb into a working monitor. If the symptoms follow the pcb into the working monitor, replace the acquisition pcb.
7. If none of these first three steps provide any results, swap the processor pcb and/or power supply pcb into a working monitor.

Lead fail functions

Perform the following steps to test lead fail detection function:

1. With the monitor displaying leads I, II, III, and V from the patient simulator, remove the RA leadwire from the patient simulator.
2. The monitor should display a RA FAIL message. Lead fail detection is functioning properly if this is the case. Lead fail detection is not functioning, if this is not the case. The acquisition pcb is suspect. Swap the pcb with a working monitor to verify the malfunction.
3. Reattach the RA leadwire to the patient simulator.

DATA ACQUISITION TESTS (CONT)

PACE DETECT FUNCTIONS

1. With the monitor displaying 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 functions are not working properly

If the pacemaker detection test results are not correct, as described above:

- Verify the patient simulator is functioning correctly by testing it on a working monitor,
- The acquisition pcb is suspect. Swap a working acquisition pcb into the monitor and perform these test to verify correct operation.

DATA ACQUISITION TESTS (CONT)

INVASIVE BLOOD PRESSURE FUNCTIONS

The invasive blood pressure (BP) test procedure requires the use of the following patient simulator: Marquette Multifunction Microsimulator, pn. MARQ1. If use of a different patient simulator is necessary, adjust the procedure steps/readings accordingly.

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.

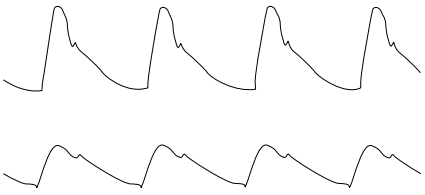
Zero-reference both BP's

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



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 in the following list:

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 Multi-function 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

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

Verify static BP results

7. 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 WAVEFORMS DO NOT APPEAR CORRECTLY ON THE DISPLAY

If the BP waveforms displayed on the monitor appear noisy or distorted (example shown on the left), test the Patient simulator and simulator test cables and on a working monitor to determine the source of the problem.

1. 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.
2. 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

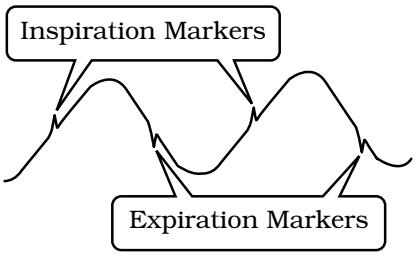
3. If the AR1 or PA2 parameter labels, readings and associated waveforms do not display on the monitor, verify the patient simulator and associated test cables on a working monitor.
4. Inspect the BP front panel connectors on the monitor for bent or broken pins.
5. Perform continuity tests between the front panel connectors of the monitor, front panel flex circuit assembly located behind the front panel connectors and connection to the acquisition pcb.
6. 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 FUNCTIONS (OPTIONAL)

1. Connect the Marquette 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.



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.

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:

- Vary the baseline impedance on the patient simulator
- Vary the ΔR on the patient simulator.
- Test the patient simulator and appropriate patient cables on a working monitor to determine the source of the problem.
- 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.

DATA ACQUISITION TESTS (CONT)

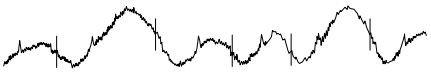
Markers do not appear on the respiration waveform; respiration rate is inaccurate

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:

- Scroll to and select RR (respiration parameter) from the monitor main menu,
- Scroll to and select SENSITIVITY from the respiration parameter menu, and
- 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)

NON-INVASIVE BLOOD PRESSURE FUNCTIONS

Perform the non-invasive blood pressure (NBP) Checkout Procedure found in Section 3: Maintenance. This procedure will determine whether or not 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 MONITOR SETUP from the main menu of the monitor,
- Scroll to and select SERVICE MODE from the monitor setup menu of the monitor and enter the two-digit numeric day and month shown in the upper-left corner of the monitor display,
- Scroll to and select PATIENT-MONITOR TYPE from the service mode 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 service-related functions of the monitor:

- REVIEW ERRORS - For troubleshooting difficult equipment problems or network problems on a software engineering level,
- ADMIT MENU - For setup or configuration of the monitor to admit a patient with one of the following network configuration features enabled:
  - » Standard, or
  - » Rover.
- CALIBRATE - For checkout or calibration of the non-invasive blood pressure and CO_2 functions of the monitor,
- STAR TEST PATTERN - Generates a print test for an optional built-in thermal array printer,
- SOFTWARE LEVEL - If enabled for 7020 feature, the menu allows you to select 7020 or 7015.
- PATIENT - MONITOR TYPE - For 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 - For setup or configuration of the monitor care unit name,
- SET BED NUMBER - For setup or configuration of the monitor bed number or bed name,
- SET INTERNET ADDRESS - For setup or configuration of the monitor Internet address for the network,
- TIME AND DATE - For entering or changing the monitor time and date.

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.

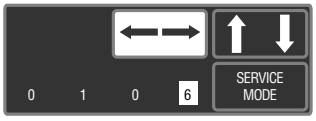
Select monitor setup from the main menu

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 (June 1st) would be represented in the password as 0106 (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.

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.

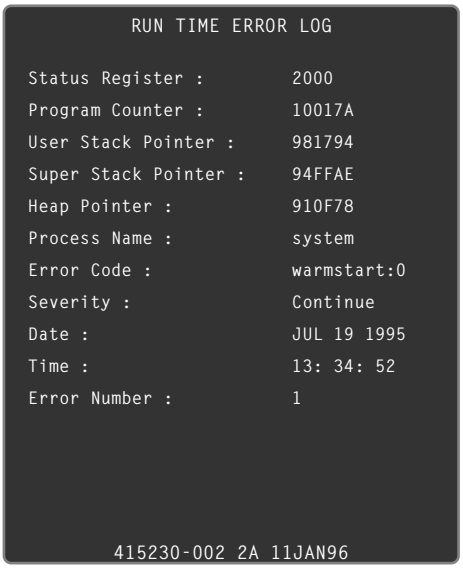
SERVICE MODE MENU (CONT)

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.

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

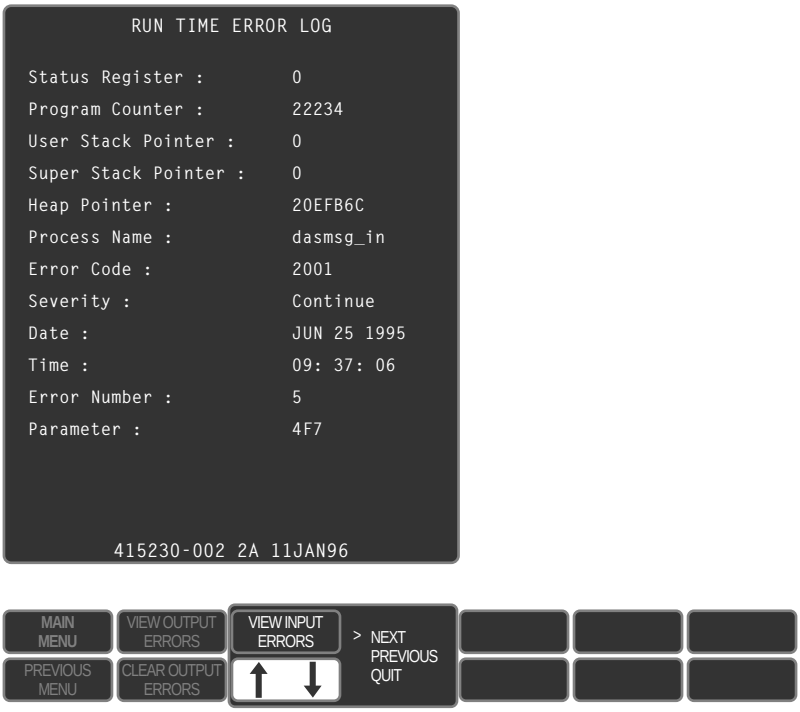
The Trim Knob control can be used to scroll through each logged error, perusing all of the parameters associated with each output software error. Rotate the Trim Knob control to move the cursor (>) to a position for viewing the NEXT or PREVIOUS error as well as the position that allows the user to QUIT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

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

SERVICE MODE MENU (CONT)

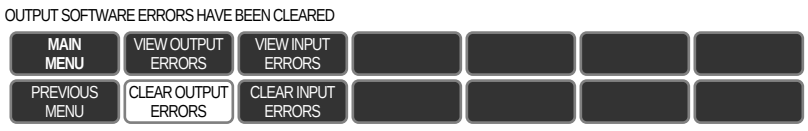
View input errors

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

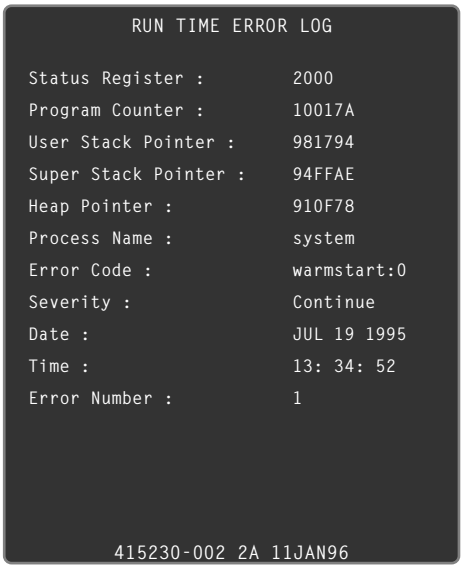
This part of the section describes in greater detail what information the error log contains and what can be learned from error logs.

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 as follows:



Error log categories of greatest interest for troubleshooting purposes

When using the error log to troubleshoot a problem with the monitor, the following parameters from the pop-up window that are of greatest interest are:

- 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.

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
1A00-1AFF	Network errors were detected.
703	Diagnostics test were completed.
70B	Internet address was changed. The network address for the monitor was changed. Any network address changes should only be done by qualified service personnel.
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 the system-wide time may have been altered.

Severity of the error

Severity is a measure of how the event/error affected the system. There are three levels of severity. The following is a list of these levels accompanied by a brief 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 main processor board. 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 board. This board can be bench-tested as per the Calibration section of this manual.

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 main processor board. This is the only area of the monitor where text (alphanumerics) information and graphics (patient waveforms) information is processed separately.

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 is an EL (electroluminescent) monochrome display assembly. This type of display has specific drivers for rows and columns integrated into the display assembly and, therefore, cannot be repaired.

SERVICE TIPS (CONT)

DAS BOARD 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.

MAIN PROCESSOR BOARD SYMPTOMS

Symptoms with network communications, asynchronous communications, NBP control, analog output, audio/sound generation, and 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.

POWER SUPPLY BOARD SYMPTOMS

The power supply pcb assembly provides power that is used throughout the 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 a list of functions for each of the supply voltages generated on the power supply pcb:

+12 V_{dc} (+12 MAIN) supply applications

- DAS board - main power source
- Ethernet transceiver - power source
- Display assembly - 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

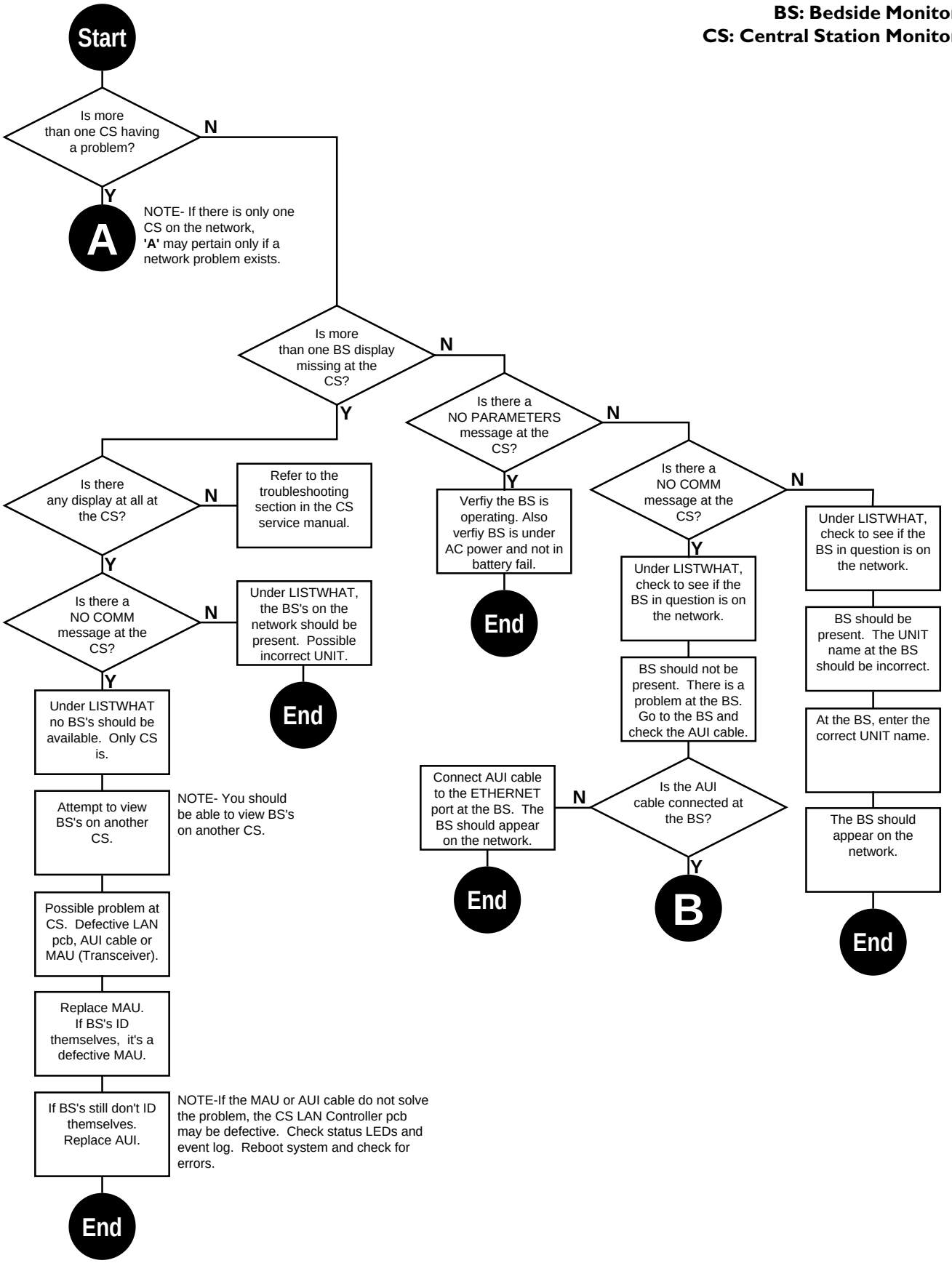
- Main processor board - logic power source
- Display assembly - logic power source

±12 V_{dc} (±12 ANALOG) supply applications

- Analog ECG/blood pressure - signal generation for defib sync jack

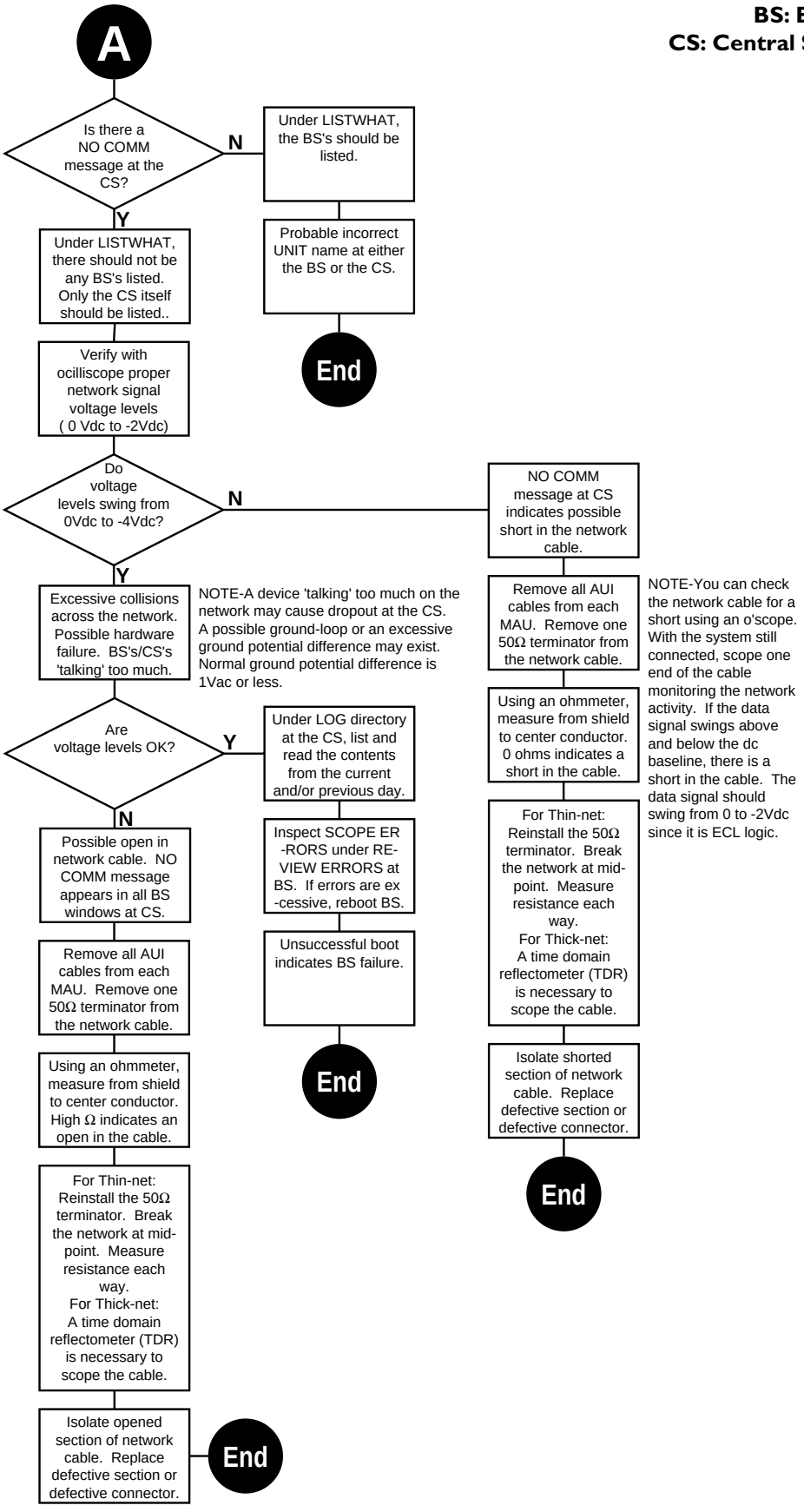
ISOLATING PROBLEMS ON A NETWORK

BS: Bedside Monitor
CS: Central Station Monitor



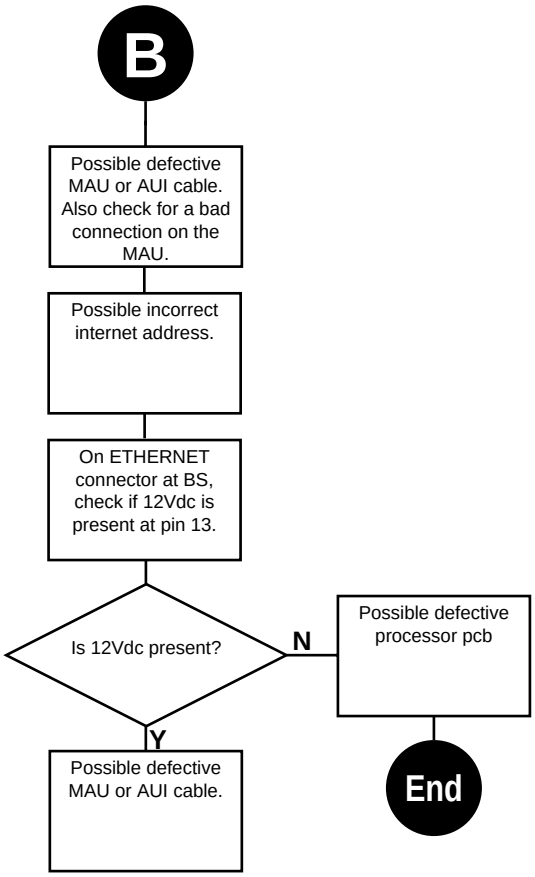
ISOLATING PROBLEMS ON A NETWORK (CONT)

BS: Bedside Monitor
CS: Central Station Monitor



ISOLATING PROBLEMS ON A NETWORK (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

5 CALIBRATION

ADJUSTMENTS

ABOUT CALIBRATION

This section summarizes the calibration for the monitor. Noninvasive blood pressure (NBP) is the only function that requires software calibration. The manufacturer recommends performing the NBP software calibration upon receipt of the monitor initially, and once each year thereafter. The NBP software 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.

Safety tests

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. These can be found in Section 3: 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. 414873-001,
- 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
Manometer tubing	401582-001	2ft

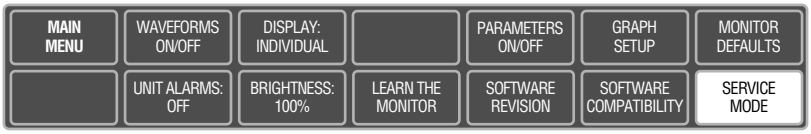
WARNING
When the NBP cuff is used in this procedure, it must be tightly wrapped around a rigid cylinder or pipe. Do not put the NBP cuff around a human arm during the calibration procedures due to the potential for injury.

NON-INVASIVE BLOOD PRESSURE (CONT)

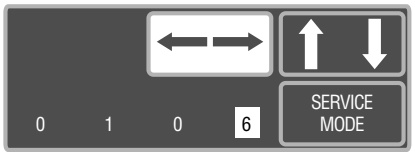
CALIBRATION PROCEDURE

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 (June 1st) would be represented in the password as 0106 (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.

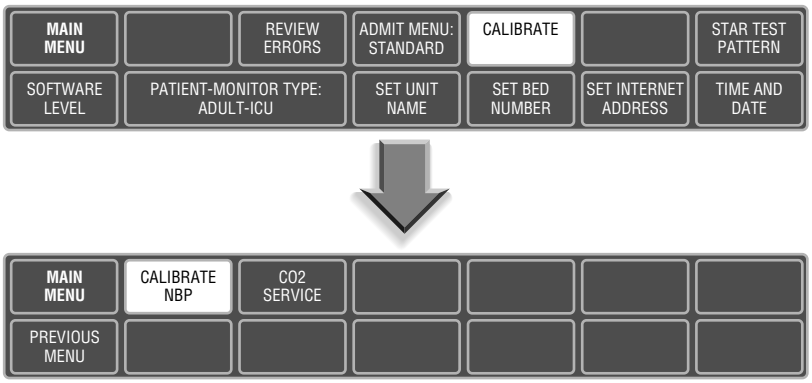
NON-INVASIVE BLOOD PRESSURE (CONT)

Service menus

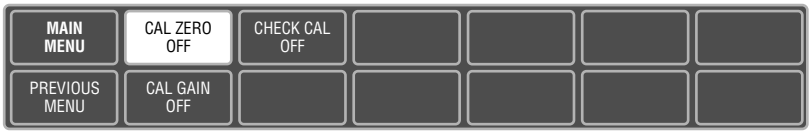
The service menus should appear on the monitor display. These next steps guide you through the service menus associated with checking NBP calibration. If desired test results are not obtained, NBP calibration will be necessary.

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.

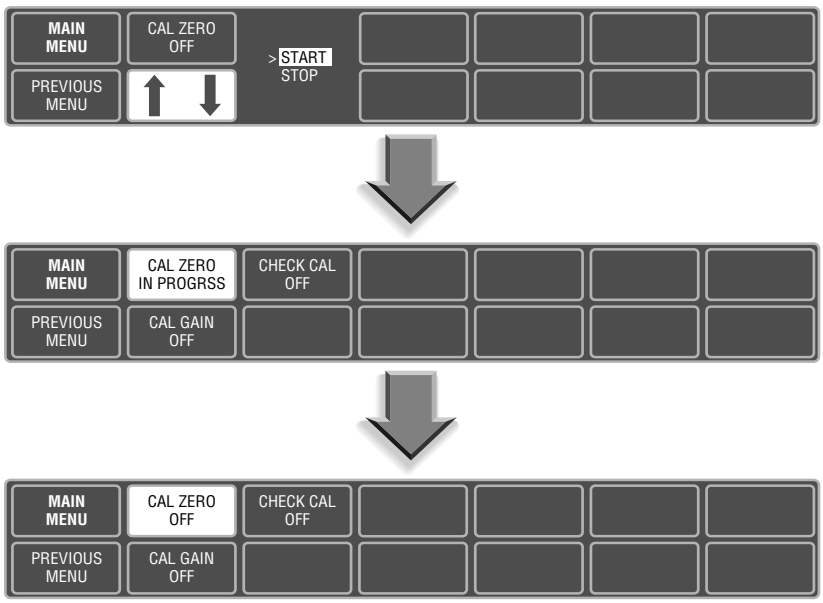


7. Rotate the Trim Knob control to highlight CAL ZERO OFF, and then press the Trim Knob control to select it.



NBP zero calibration

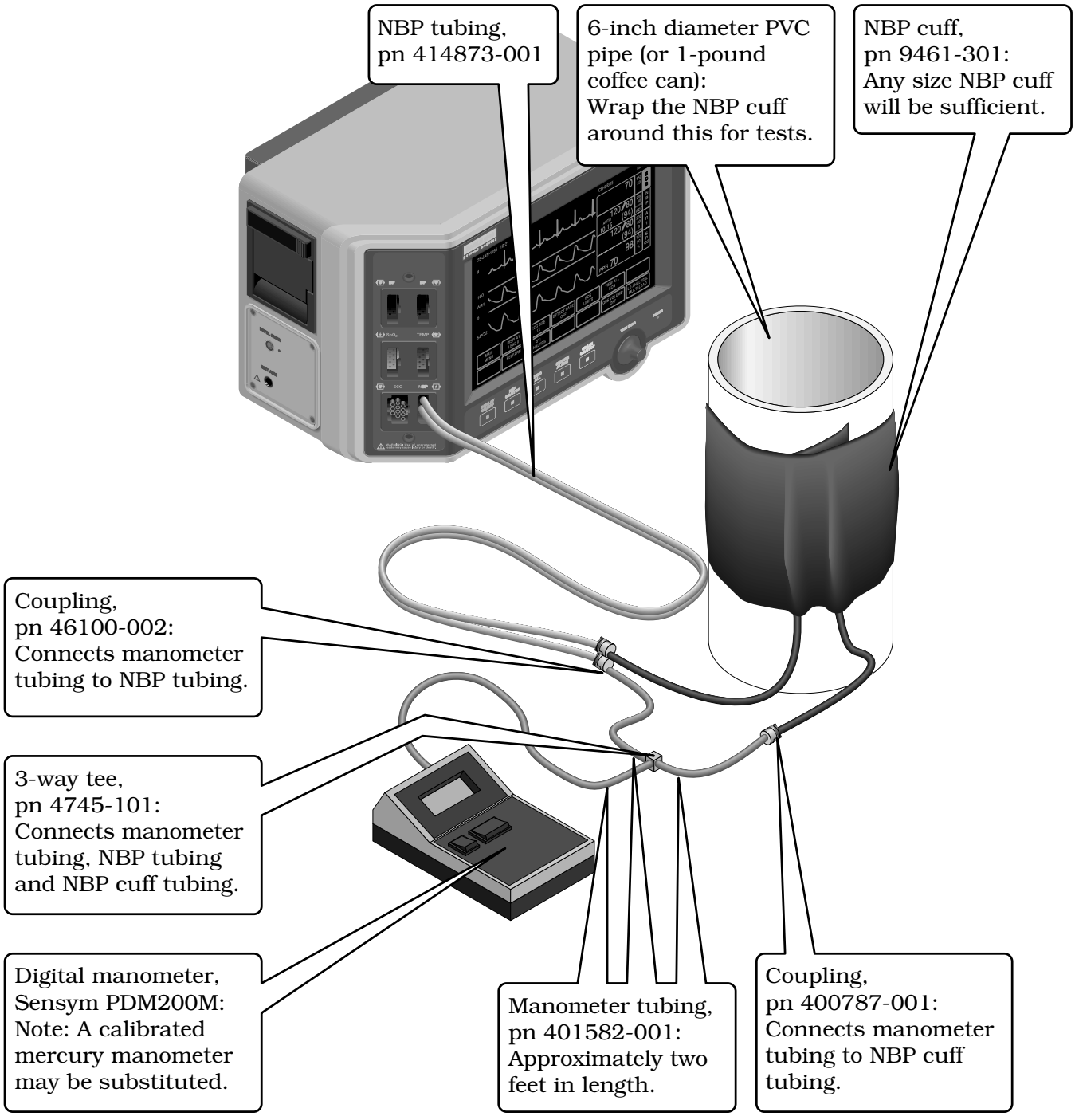
8. Rotate the Trim Knob control to highlight START, and then press the Trim Knob control to select it. The CAL ZERO menu item will show that it's IN PROGRESS, and when it's done it will show that it's OFF again.



NON-INVASIVE BLOOD PRESSURE (CONT)

NBP calibration setup

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



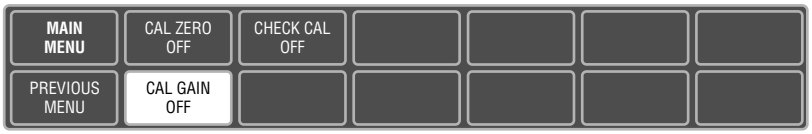
Set up the manometer

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

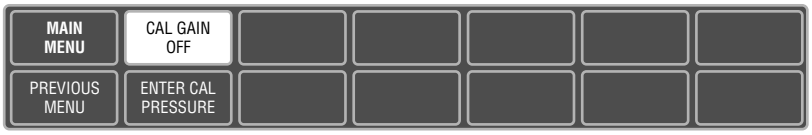
NON-INVASIVE BLOOD PRESSURE (CONT)

Start the gain calibration test

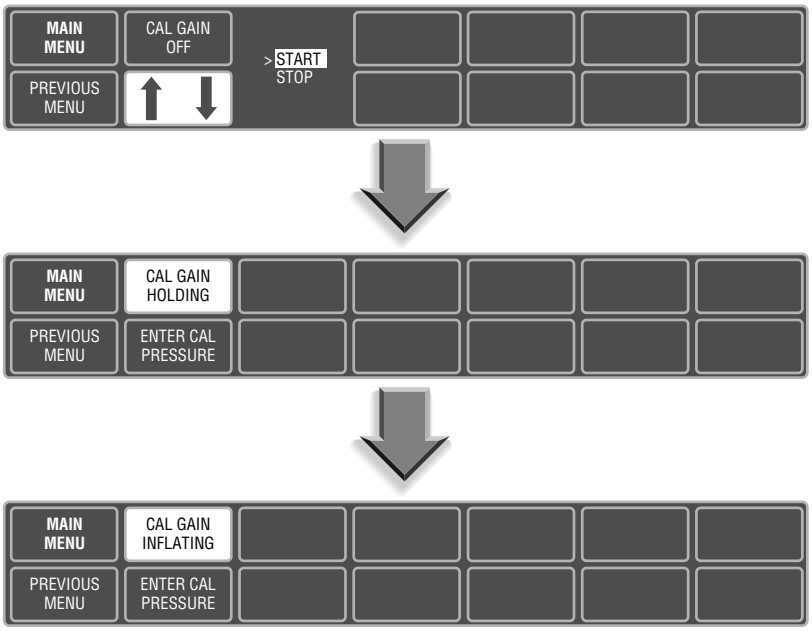
11. Rotate the Trim Knob control to highlight CAL GAIN OFF, and then press the Trim Knob control to select it.



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



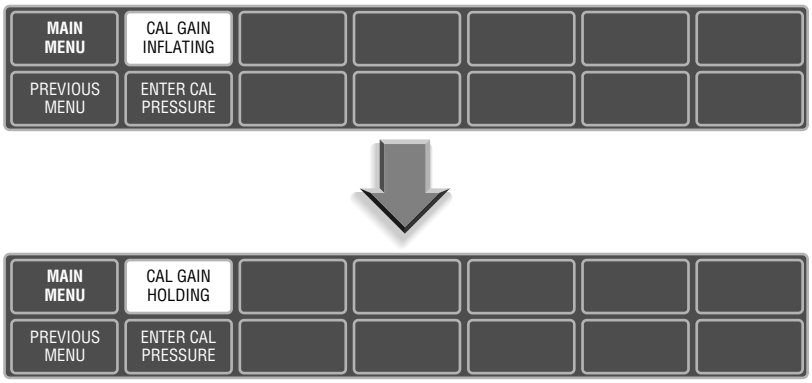
13. Rotate the Trim Knob control to highlight START, and then press the Trim Knob control to select it. The second line of text on the CAL GAIN menu item changes from HOLDING to INFLATING. Then, the monitor starts pumping up the pressure bulb or cuff—the audible whirring sound of the NBP pump motors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



NON-INVASIVE BLOOD PRESSURE (CONT)

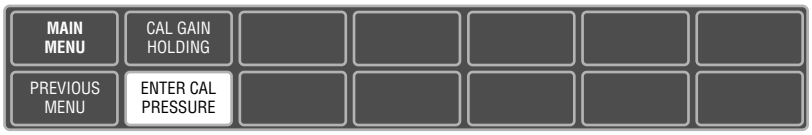
Verify the pneumatic circuit plumbing does not have air leaks

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.

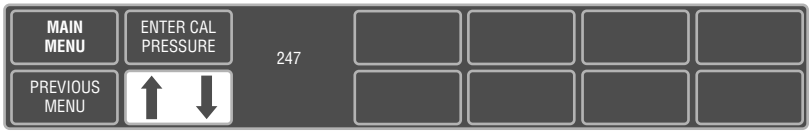


Perform the software calibration of the monitor

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.

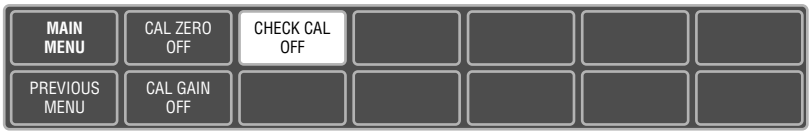


17. When the manometer falls to exactly the value that you selected in the pop-up window, press the Trim Knob control to enter the value.

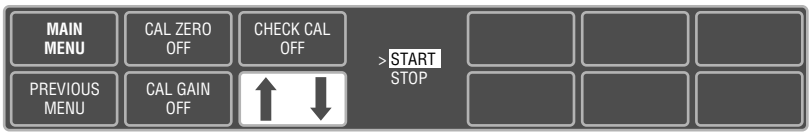
NON-INVASIVE BLOOD PRESSURE (CONT)

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.

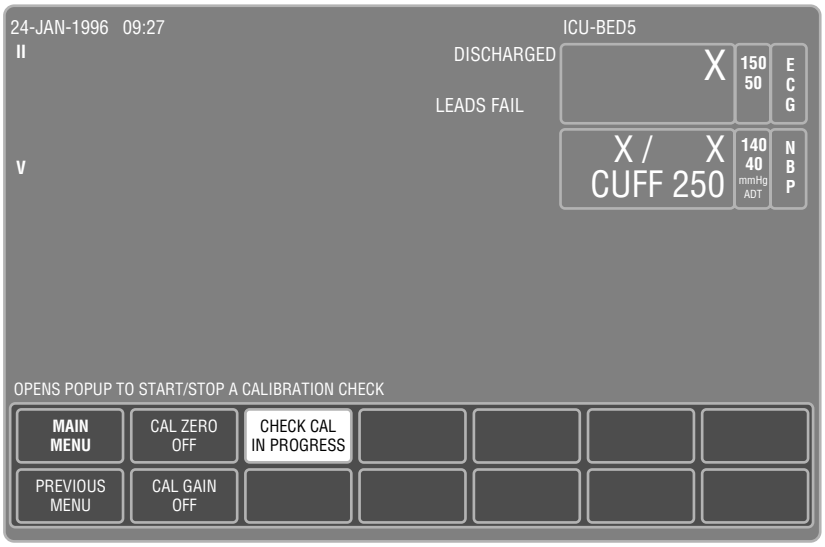


19. Rotate the Trim Knob control to highlight START and press the Trim Knob control to select it.



Verify pressure readings are accurate

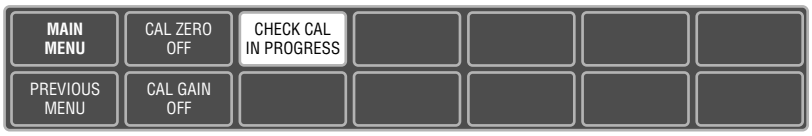
20. The text on the menu item will change from CHECK CAL OFF to CHECK CAL IN PROGRESS. Verify the pressure readings (shown as CUFF in the NBP parameter box) on the monitor and manometer are equal (± 1 mmHg) for at least one full minute.



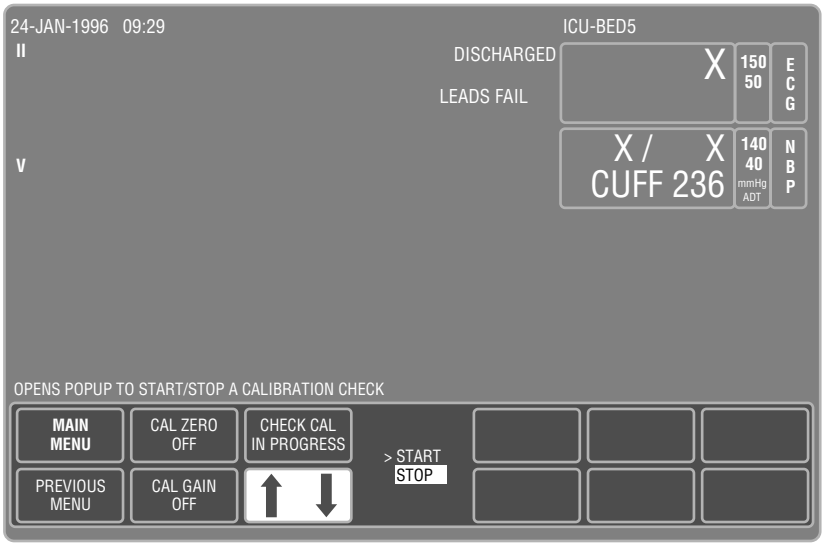
NON-INVASIVE BLOOD PRESSURE (CONT)

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 sidestream end-tidal CO_2 ($EtCO_2$) readings by the monitor depend on the following:

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

FLOW CALIBRATION

This procedure provides a method of doing a Flow calibration.

MANUFACTURER RECOMMENDATION

The manufacturer recommends performing this procedure once each year and each time the $EtCO_2$ assembly is opened for service or repair.

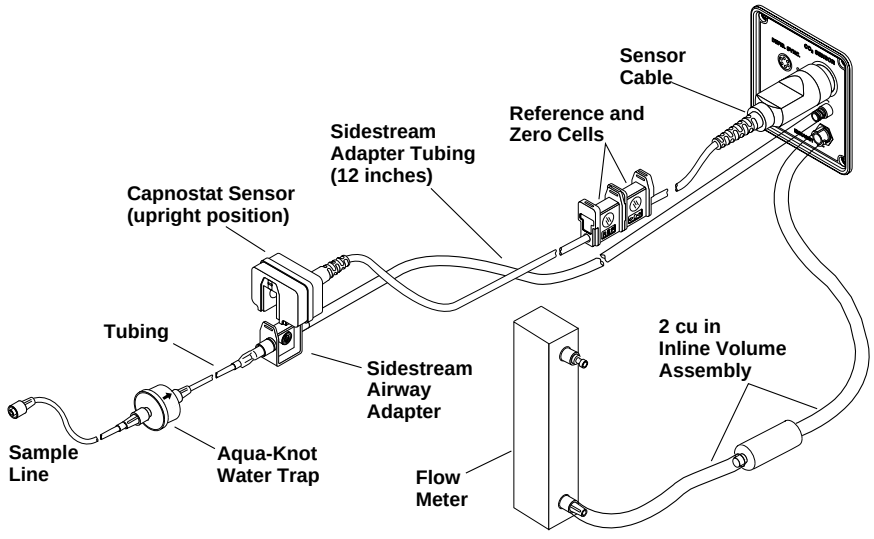
FLOW CALIBRATION TEST EQUIPMENT

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

Name	Description	Quantity	Part Number
Flowmeter	Porter Instruments (requires NIST certification)	1	150AO - B 125-20-C
Inline Volume Assy	2.0 cu in Clippard Minimatic	1	MT-4763
Male Adapter	Bulkhead, Tube Adapter	1	12900
Female Luer	Tube Fitting	1	12901
Sidestream Adapter	Tubing, 12"	1	412343-002
Adapter	Tubing 6"	1	S509-106-001
Aqua-Knot II	Water Trap	1	415201-002
Sample Line	B-Line	1	401015-001

PRETEST SETUP

Connect tubing as shown and follow the steps for calibrating the flow of the end-tidal CO_2 functions of the monitor.

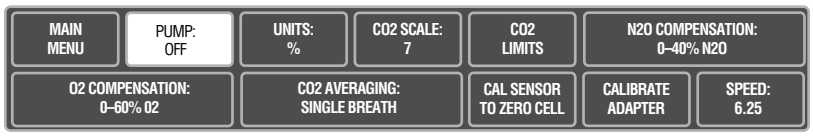


END-TIDAL CO_2 (CONT)

CALIBRATION PROCEDURE

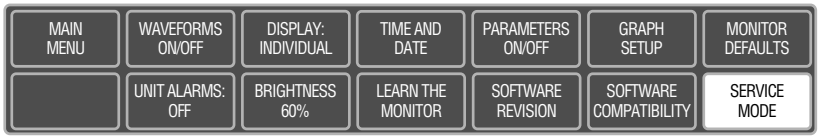
Follow these steps to calibrate the flow function of the monitor.

1. 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,
2. With the monitor main menu displayed, select the CO2 parameter label and press the Trim Knob control to display the CO2 main menu.

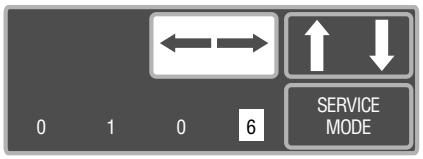


3. If PUMP OFF is displayed, press the Trim Knob control to turn the PUMP ON.
4. Block the sample line and observe that the Flowmeter goes to zero. If the Flowmeter fails to go to zero, check tubing connections for leaks and retest.
5. With pump still on, return to the Main Menu and select MONITOR SETUP.

6. 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



7. 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 first day of the sixth month (June 1st) would be represented in the password as 0106 (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.

END-TIDAL CO_2 (CONT)

- 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.

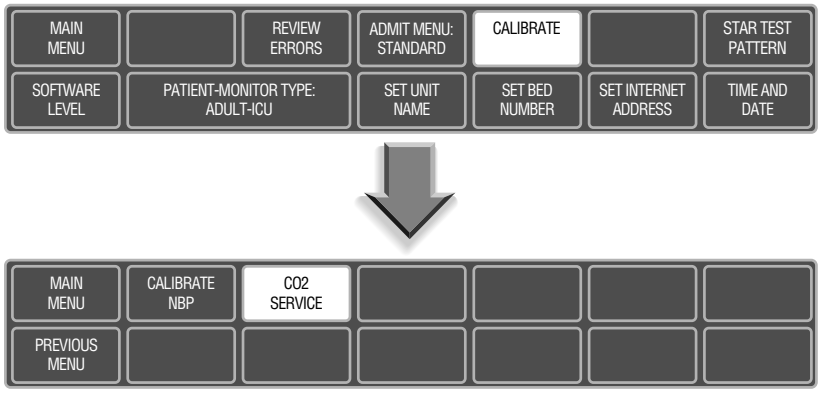
Service menus

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.

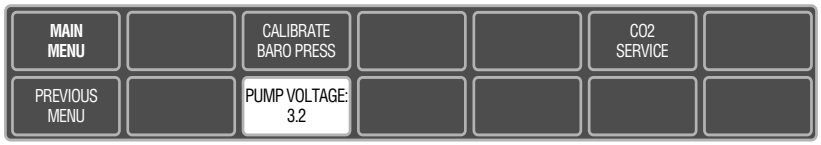
Enter the CO_2 service menu

8. 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.

CO_2 service calibration



9. Rotate the Trim Knob control to highlight PUMP VOLTAGE:, and press the Trim Knob control to select it.



Pump Voltage (Flow) calibration

10. Observe the reading of the Flowmeter is 190 ml ±10 ml. If necessary rotate the Trim Knob control to adjust the PUMP VOLTAGE, and press the Trim Knob control to select it.

NOTE:
The PUMP VOLTAGE and flow will not change until the Trim Knob control is pressed.

END-TIDAL CO_2 (CONT)

Enter the Pump Voltage value into the monitor

11. When the PUMP VOLTAGE (Flow) has been adjusted and set, return to the Main Menu.

12. Disconnect Flow Cal test equipment and proceed to barometric pressure and sensor calibration.

END-TIDAL CO_2

BAROMETRIC PRESSURE / CO_2 SENSOR CALIBRATION

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

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.

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).

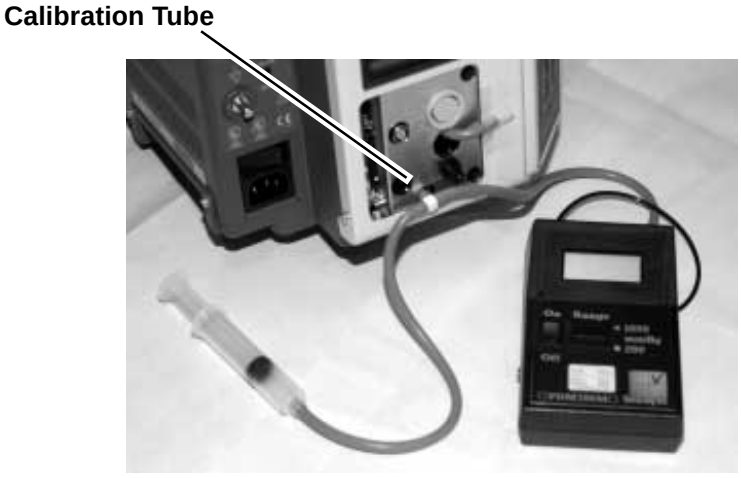
PRETEST SETUP

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

NOTE
Connector panel was removed for clarity of illustration. You may find it not necessary to completely remove the side connector panel to do this calibration.

1. Remove the 4 screws on the side connector panel of the monitor to gain access to the $EtCO_2$ calibration tube located behind the panel.
2. Connect the 3-way tee fitting to the $EtCO_2$ calibration tube.

   See picture below.
3. Connect one length of silicone tubing between one of the unused tee fittings and the mercury manometer.
4. Connect the other length of silicone tubing between the remaining unused tee fitting and the 10 cc syringe.



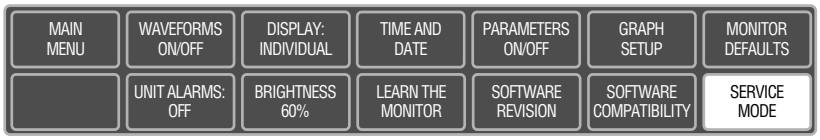
END-TIDAL CO_2 (CONT)

CALIBRATION PROCEDURE

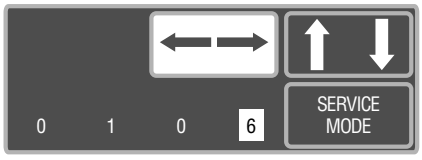
Follow these steps to calibrate the $EtCO_2$ function of the monitor.

1. Turn the manometer on and adjust the range switch to the 200 mmHg 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 recep tacle 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 (June 1st) would be repre sented in the password as 0106 (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 cor rectly displayed.

END-TIDAL CO_2 (CONT)

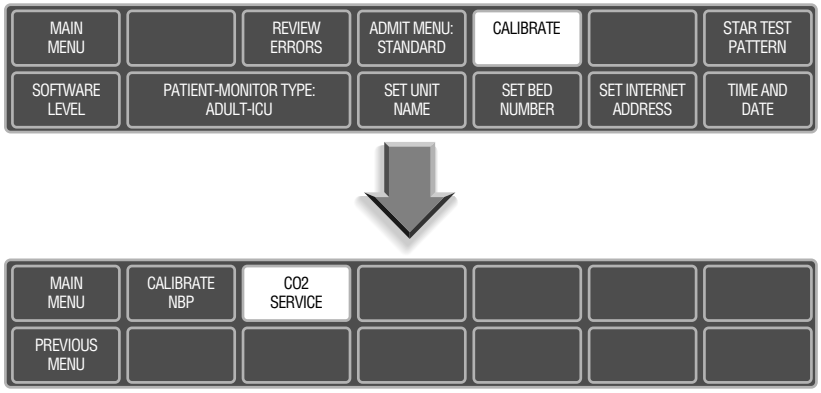
Service menus

- 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.

Enter the CO_2 service menu

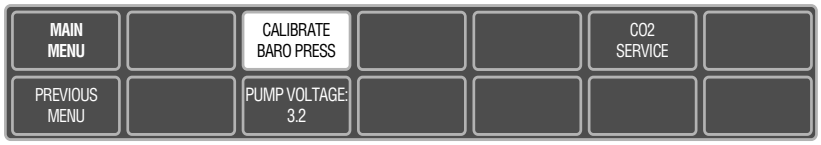
The service mode menu should appear on the monitor display. These next steps guide you through the service menus associated with checking CO_2 calibration. If desired test results are not obtained, CO_2 calibration will be necessary.

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.



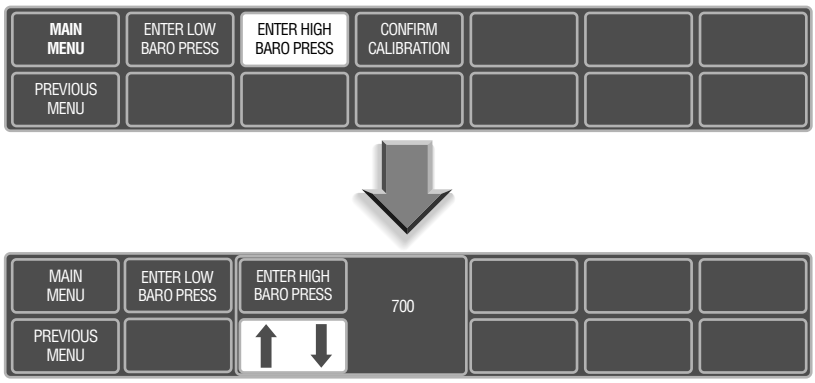
8. Use the 10 cc syringe to create a 35 ±1 mmHg reading on the manometer.

High barometric pressure calibration

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



Low barometric pressure calibration

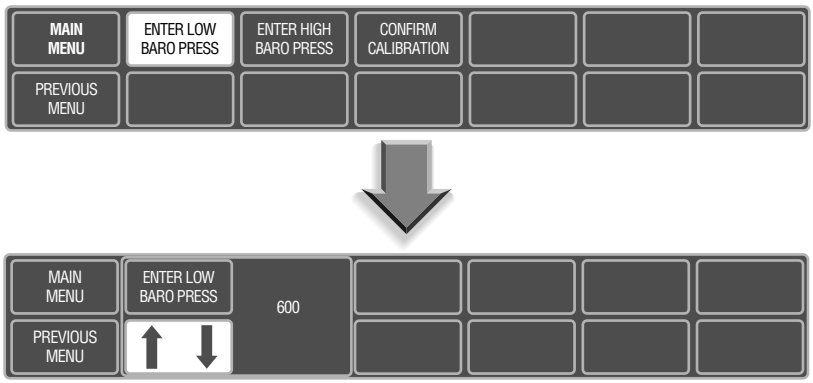
10. Take the current atmospheric barometer reading (local weather service can provide this data if a laboratory grade barometer is not available) and add 35 mmHg. Rotate the Trim Knob control until the correct number (mmHg) is displayed and press the Trim Knob control to enter the value into the monitor.

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

11. Use the 10 cc syringe to create a -100 ±1 mmHg reading on the manometer.

Enter the low barometric pressure value into the monitor

12. 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.



END-TIDAL CO_2 (CONT)

Confirm the pressure calibration

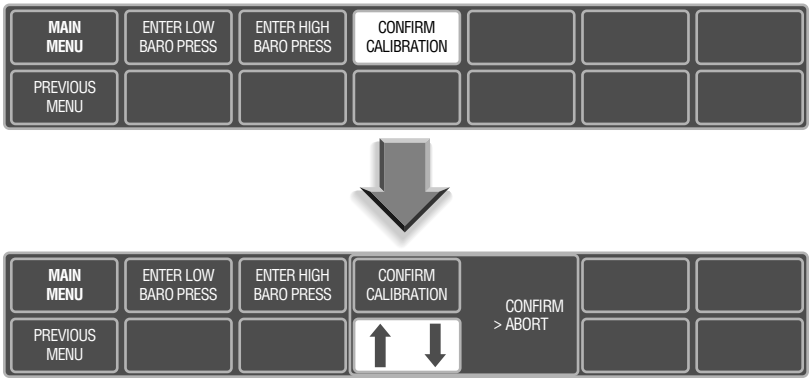
13. Take the current atmospheric barometer reading (local weather service can provide this data if a laboratory grade barometer is not available) and subtract 100 mmHg. Rotate the Trim Knob control until the correct number (mmHg) is displayed and press the Trim Knob control to enter the value into the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

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

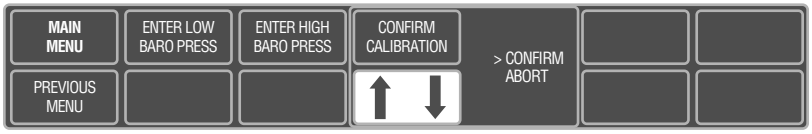
CAUTION
The high and low barometric pressures must have a 100 mmHg differential minimum for calibration to be successfully confirmed.

Select confirm from the pop-up menu

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



15. 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.



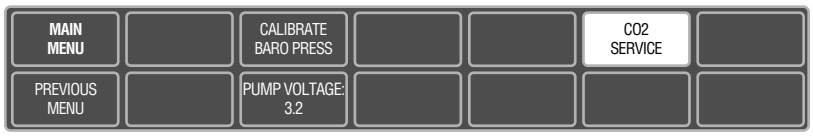
END-TIDAL CO_2 (CONT)

Verify calibration using the Capnostat sensor

16. Rotate the Trim Knob control to highlight PREVIOUS MENU, and press the Trim Knob to move to the CO2 SERVICE menu.

17. Remove the 10 cc syringe from the test setup.

18. Rotate the Trim Knob control to highlight CO2 SERVICE, and press the Trim Knob to select it.



19. 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.

20. Return to the main menu of the monitor.

21. With the Capnostat sensor attached to the front panel connector of the monitor, put the sensor into the zero reference (→ 0 ←) cell mode.

22. 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. Select READY and press the Trim Knob.

    A CALIBRATING message will appear in the CO_2 parameter box.

23. After zero calibration is complete, put the sensor into the reference (REF) cell mode.

24. Verify the reading in the CO_2 parameter box displays 38 ±2 mmHg.

6 CONFIGURATION

MONITOR CONFIGURATIONS

SETUP FOR USE

The last part of this section is devoted to setup or configuration of the monitor.

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 3000 Monitor Operator's Manual for more information regarding all patient monitoring functions of the monitor.

NETWORK INTERFACE

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

LOADING SOFTWARE

METHODS FOR LOADING OR UPDATING SOFTWARE

The process of loading or updating software in the monitor is described in this part of the section. Manufacturer software can be loaded into the monitor using these methods:

Load from diskette

- Load Software From Diskette — The monitor is connected directly to a personal computer (PC) or PC laptop. The Update Program is run off of the update diskettes and the software is downloaded to the monitor via serial communication.

Load over the network

- Load Software Over The Network — For the monitor connected to a patient monitoring network, the software is loaded from the update diskettes onto a Centralscope central station (hereafter referred to as "the central station"). The central station then acts as a network file server and software is downloaded to the monitor over the network.

Read these instructions over completely before attempting to load software

Each method of downloading software to the monitor is distinctly different. The manufacturer recommends completely reading all of this part of the section 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 part of the section is 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.

NOTE
The current version of software may vary from that version referred to in the text of this section.
Example: This section refers to software version 2A while you may actually have 3B. In this case substitute 3B wherever 2A is referred to in the text.

LOADING SOFTWARE (CONT)

SOFTWARE COMPATIBILITY

Write down or print out software code part numbers from the SOFTWARE REVISION window for each monitor in the system. To print the SOFTWARE REVISION table from each monitor, use the Trim Knob to scroll to and select the following menu option items from the monitor main menu display:

- MONITOR SETUP,
- SOFTWARE REVISION,
- press the GRAPH GO/STOP key.
- NEXT, then
- press the GRAPH GO/STOP key.

If there is a previous revision of software residing in monitor memory, update the monitor as necessary (see software compatibility chart below). Keeping the monitor at current levels of manufacturer software will maintain proper network communication and provide the user with all of the latest operational features that the manufacturer offers.

The boot codes (main boot, DAS boot, etc.), which reside in various monitor memory locations, play a minor role with regard to actual patient monitoring functions. These boot codes are designed to be updated very infrequently — if ever.

NOTE
Boot code components of the monitor software should be updated only when absolutely necessary.

CAUTION
If a failure occurs in the update process while loading one of the boot code components, full or partial patient monitoring capability *will* be lost. The monitor will be rendered useless and will require service by a manufacturer technical support engineer.

Software compatibility chart

Below is the software compatibility chart for current revisions.

Product	1A (8 June 95)	2A (11 Jan 96)	3A (5 Sep 96)	3B (18 Feb 97)
MAINuP:	1A	2A	3A	3B
DASuP:	1A	2A	3A	3B
STARS:	1A or later	1A or later	1A or later	1A or later
REMOTE CONTROL:	1A or later	1A or later	1A or later	1A or later
CO2uP:	n/a	1A	1C	1E
BOOTCODE:	1A	1A or 2A	3A	3A
DAS BOOT:	1A	1A or 2A	2A	2A
CO2 BOOT:	n/a	1A	1A	1A

LOADING SOFTWARE (CONT)

MONITOR SOFTWARE FILES

All software files for the monitor are contained on 4 diskettes included with a manufacturer software update kit. The functional characteristic of files that can be updated is listed below (in the order by which these must be downloaded to the monitor) along with the respective representation from the monitor SOFTWARE REVISION table:

- Main processor operational code (MAINuP):
- Acquisition processor operational code (DASuP):
- End-tidal CO_2 operational code (CO2uP):
- Main processor boot code (BOOTCODE):
- Acquisition processor boot code (DAS BOOT):
- End-tidal CO_2 boot code (CO2 BOOT):

MAINTAIN PATIENT MONITORING

The monitor is not capable of downloading code while connected to a patient. Inform medical staff responsible for patients connected to the monitor that the equipment is going to be updated so they may take appropriate actions.

WARNING
There will be a temporary loss of monitoring functions throughout various parts of the patient monitoring system until the update is complete on each monitor in the system. Medical staff should be prepared to cover patients in need during these periods of lost monitoring functions.

To transfer a patient from one bed to another, have the medical staff transfer the patient to a spare monitor while loading or updating software.

PROBLEMS WHILE LOADING SOFTWARE

If problems result while loading software into the monitor:

- Restart the procedure from the beginning, or
- Contact manufacturer technical support at one of the following telephone numbers:

  1-800-558-7044 — within the United States, or

  1-407-575-5000 — outside of the United States.

LOAD SOFTWARE FROM DISKETTE

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 manufacturer software update kits.

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, pn 404307-001, including:
   - RS-232C to RS-422 converter, pn 404308-001,
   - monitor cable assembly, pn 5516-206, and
   - PC cable assembly, pn 405159-001.
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 (RS-422) 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 connection to a 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.

SOFTWARE DISKETTES

The software media consists of four 3.5-inch high density (HD) floppy diskettes.

Diskettes 1 and 2 contain programs and files for downloading software to the monitor over the network. Refer to *Load Software Over The Network* for that procedure.

Diskette 3, used for this procedure, contains the update program utility along with update files for:

- Main processor boot code,
- Acquisition processor boot and operational code, and
- End-tidal CO_2 boot and operational code.

Diskette 4, also used for this procedure, contains the update program utility along with the update file for:

- Main processor operational code. This part of the update software includes monitor software in various languages.

LOAD 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

1. 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.

Update operational code that is outdated; boot code components do not require updating for this revision

2. Compare the SOFTWARE REVISIONS window, printed previously in this procedure (see *Introduction*), with the file names from the table below. Only load the files that currently reflect earlier revisions, as compared with the SOFTWARE REVISIONS printout, into the monitor. Generally, the main processor operational code (MAINuP), acquisition processor operational code (DASuP) or end-tidal CO_2 operational code (CO2uP) will need to be updated. Depending on the vintage of the monitor, boot code may need to be updated as well but this is generally not the case.

Files must be updated in a certain order

3. Following is the order in which the update files are to be downloaded (reference the compatibility chart on page 3 for more information):
   - Main processor op-code (MAINuP),
   - Acquisition processor op-code (DASuP), and
   - *End-tidal CO_2 op-code (CO2uP).

   Then, *only if necessary*:
   - Main processor boot code (BOOTCODE), and
   - Acquisition processor boot code (DAS BOOT), and
   - *End-tidal CO_2 boot code (CO2 BOOT).

   *Only used for monitors with this option

LOAD SOFTWARE FROM DISKETTE (CONT)

Files on diskette 3

Below is the list of update files typically found on Diskette 3 (examples are for an English version 2A software update).

— Diskette 3 —		
File Name	**Bytes Used**	**Description**
41495800.2A1	122284	BOOTCODE
41495900.2A1	46652	DASuP
41510500.2A1	5492	DAS BOOT
41522500.2A1	5804	CO2 BOOT
41522600.2A1	72140	CO2uP

Files on diskette 4

Below is a list with the update file typically found on Diskette 4.

— Diskette 4 —		
File Name	**Bytes Used**	**Description**
41495700.2A1	1277544	MAINµP (English)

NOTE
The update file included on diskette 4 for other language update kits will reflect a different file name than that shown in the list for each language of update kit ordered.

Insert the diskette containing the file which requires update

4. Insert the diskette containing the specific software to be loaded or updated in the monitor into the PC floppy disk drive.

Run the update program from the PC

5. 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

6. 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.

LOAD SOFTWARE FROM DISKETTE (CONT)

SETUP THE MONITOR TO ACCEPT DOWNLOAD FILES

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.

Start-up the monitor boot loader program

7. At the monitor, activate the BOOT LOADER program by following 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

8. In this step, 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, 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 appear on the monitor display.

Select and download code to the monitor

9. Decide which code is to be downloaded to the monitor based on software revision comparisons made earlier in the procedure. Use the Trim Knob to scroll to and select the number corresponding to the SERIAL DOWNLOAD routine for the file requiring update.

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.

CAUTION
Do not update any of the boot code components unless absolutely necessary.

LOAD SOFTWARE FROM DISKETTE (CONT)

DOWNLOAD FILES TO THE MONITOR

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

Select the file for download from the PC

10. 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 (see lists on pages 6-8). 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

11. 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.

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.

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 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 (MAINuP or BOOTCODE) 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, refer to "Problems while loading software," found in the *Introduction* section of this procedure.

Repeat these steps for each file requiring update

12. Perform steps 7 through 12 for each file that requires updating before proceeding to the next steps. When all code has been loaded, turn monitor power off, then on.

LOAD SOFTWARE FROM DISKETTE (CONT)

COMPLETION

To configure (setup) proper graph locations for a monitor that has a stand-alone writer attached to it, connect the monitor to the network then follow these steps:

Setup graph locations

13. Use the Trim Knob to scroll to and select the following menu options selection sequence. Beginning at the monitor main menu options, scroll to and select:
    - MONITOR SETUP
    - GRAPH SETUP
    - GRAPH LOCATION

Select a writer for each of the three possible locations

14. 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

15. 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 fatal 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.

Verify software update

16. Verify software was downloaded successfully. Execute the following menu option selection sequence, beginning at the monitor main menu:
    - MONITOR SETUP
    - SOFTWARE REVISION
    - Press the GRAPH GO/STOP KEY

    Compare displayed monitor software revisions with the those previously printed or written down. Repeat the entire procedure if software revisions are not properly updated.

Update all monitors

17. Load or update software for each monitor as required. Update software to current revisions in all monitors for best monitor performance and operation.

LOAD SOFTWARE OVER THE NETWORK

ABOUT THE PROCEDURE

This part of the section provides instructions to load the contents of software update diskettes 1 and 2 to the central station hard disk drive, initiate the central station as a file server from the monitor, and download software to the monitor over the patient monitoring network.

This method can only be used for loading software in monitors that are connected to a patient monitoring network. If the monitor requiring update is not connected to the network or is connected to a network without central stations, this procedure cannot be used for updating the monitor. Refer to *Load Software From Diskette* for an alternate procedure.

SOFTWARE MEDIA

The manufacturer software media consists of four 3.5-inch high density (HD) floppy diskettes.

Diskettes 1 and 2, used for this procedure, contain the update program utility along with update files for (listed in order by which these files must be downloaded to the monitor):

- Main processor operational code (MAIN.SCR) —this part of the update software includes monitor software in various languages, when available—,
- Acquisition processor operational code (DASMAIN.SCR),
- End-tidal CO_2 operational code (CO2MAIN.SCR),
- Main processor boot code (BOOT.SCR),
- Acquisition processor boot code (DASBOOT.SCR), and
- End-tidal CO_2 boot code (CO2BOOT.SCR).

Diskettes 3 and 4 contain code and programs and files for downloading software to the monitor from a PC or PC laptop floppy disk drive. Refer to *Load Software From Diskette* for that procedure.

LOAD SOFTWARE OVER THE NETWORK (CONT)

COPY UPDATE FILES ONTO A CENTRAL STATION

The following steps describe how to copy files from update diskettes 1 and 2 onto the central station hard disk drive. The central station will act as a file server for downloading update files to the monitor over the patient monitoring network.

Insert diskette 1 into the floppy drive

1. Insert diskette 1 (usually found in a software update kit) into the central station floppy disk drive.

Copy diskette 1 files onto the central station hard drive

2. At the central station, execute the following menu option item selection sequence. Beginning from the MAIN MENU of the central station display, use the Trim Knob to scroll to and select:
   - CENTRAL SETUP,
   - SERVICE ,
   - using the central station keyboard, type the service menu PASSWORD (mei cs 123),
   - LOAD SOFTWARE (Wait 10 seconds), and
   - FLOPPY.

   Observe status messages in the upper left corner of the central station display. Verify the following messages:

   LOADING FROM...FLOPPY, (then)

   LOADING 2A DISK #01 OF 02.

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

Insert diskette 2 into the floppy drive and load its contents onto the hard drive as well

3. When loading of diskette 1 is complete, the central station will automatically eject the diskette and display the message:

   INSERT DISK MONITOR 2A DISK#02 OF 02.

4. Insert diskette 2 (from the software update kit). Diskette 2 will take approximately 5 minutes to copy onto the central station hard drive. Once again, observe status messages in the upper left corner of the central station display. Verify the following messages appear:

   LOADING FROM...FLOPPY, (then)

   LOADING 2A DISK #02 OF 02.

5. When loading of diskette 2 is complete, the central station will automatically eject the diskette and display the message:

   LOAD FROM FLOPPY COMPLETE.

6. Once the process of loading update files onto the central station is complete, it is important to note (write down if necessary) the central station CARE UNIT NAME and CENTRAL NUMBER of that particular central station for use later in this procedure.

LOAD SOFTWARE OVER THE NETWORK (CONT)

DOWNLOAD FILES TO THE MONITOR

After copying the contents of update diskettes 1 and 2 onto the central station hard drive, download the files from the central station, which will now act as a file server, to the monitor over the network. Verify the monitor is on the network by selecting LIST NETWORK from the SERVICE MONITOR menu of the central station.

Start the monitor boot loader program

7. At the monitor, start the BOOT LOADER program by following these steps:
   - Hold down the NBP GO/STOP and ZERO ALL keys,
   - Press and release the Trim Knob control, and
   - Continue holding the NBP GO/STOP and ZERO ALL keys until the BOOT LOADER menu appears on the monitor display.

Select the file server (central station where the update files have been stored) for the monitor

8. Use the Trim Knob to scroll to and select the following at the FILE SERVER SELECTION menu:
   - In the menu list, identify and scroll to the central station which has the update files stored on it, this should have been noted or written down earlier in the procedure. This central station, upon being selected, will act as a file server to download files to the monitor over the network.
   - Select the number corresponding to the central station containing the update files.

Select the update file directory on the file server

9. Use the Trim Knob to scroll to and select the number from the MOUNT PT SELECTION menu corresponding to:

   /update.net/egl3000/2a

Determine which files need to be updated in the monitor

10. Using the compatibility chart on page 3, compare the revision of the file to be updated with the software revision of the corresponding area of the monitor. Perform the following steps only if a file existing in the monitor is an earlier version as compared to the update files just copied onto the central station hard drive.

Select and download files to the monitor as necessary

11. From the SCRIPT NAME SELECTION menu list, use the Trim Knob to scroll to and select the number corresponding to the file (script) requiring update. Following is a list of files that appear in the SCRIPT NAME SELECTION menu (listed in sequential order for each script to be loaded):
    - *MAIN.SCR,
    - DASMAIN.SCR,
    - CO2MAIN.SCR (optional),
    - *BOOT.SCR,
    - DASBOOT.SCR, and
    - CO2BOOT.SCR (optional).

    *Monitor reboots when loading these scripts.

    Download only the files that require update based on comparison of file revisions made previously. Once a file has been selected, the monitor will begin the download process.

LOAD SOFTWARE OVER THE NETWORK (CONT)

Verify the files selected for download

12. The monitor will display the part number, version, and date of the file to be downloaded.

> **NOTE**
> A warning message and prompt will appear on the monitor display. Use the Trim Knob to scroll to and select YES if the file selected for download is correct.

Files must be updated in proper order

13. The order in which the files are updated in the monitor is important (see Step 11). If update of the main processor operational code (MAIN.SCR) or main processor boot code (BOOT.SCR) components is required, the monitor will reboot automatically upon completion of each of those updates.

> **CAUTION**
> Do not reboot or power down the monitor while downloading boot code components (BOOT.SCR, DASBOOT.SCR, etc.). The monitor *will* be rendered useless and manufacturer factory service will be required.

Messages will appear on the display to indicate how the update is going. Upon completion of the main code (MAIN.SCR) update, the screen flashes and the monitor reboots into normal monitoring mode.

For most errors, simply repeat the previous steps. If the byte numbers stop advancing for more than two minutes, refer to *Problems while loading software* in the *Loading Software* part of this section.

Repeat the steps for each file requiring update

14. Perform the previous steps for each software file requiring update in the monitor. This should be based on comparison of revisions made earlier in this procedure.

After all of the files have been successfully loaded, turn the monitor power switch to off (0) then on (1) to operate the monitor with the newly loaded software.

Configure the monitor graph locations

15. Properly setup the graph locations for the monitor. The procedure for this is found on the following page.

LOAD SOFTWARE OVER THE NETWORK (CONT)

COMPLETION

To configure (setup) proper graph locations for a monitor that has a stand-alone writer attached to it, connect the monitor to the network then follow these steps:

Setup graph locations

1. Use the Trim Knob to scroll to and select the following menu options selection sequence. Beginning at the monitor main menu options, scroll to and select:
   - MONITOR SETUP
   - GRAPH SETUP
   - GRAPH LOCATION

Select a writer for each of the three possible locations

2. 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

3. 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 fatal 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.

Verify software update

4. Verify software was downloaded successfully. Execute the following menu option selection sequence, beginning at the monitor main menu:
   - MONITOR SETUP
   - SOFTWARE REVISION
   - Press the GRAPH GO/STOP KEY

   Compare displayed monitor software revisions with the those previously printed or written down. Repeat the entire procedure if software revisions are not properly updated.

Update all monitors

5. Load or update software for each monitor as required. Update software to current revisions in all monitors for best monitor performance and operation.

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. Setup a MANUAL GRAPH LOCATION for the monitor.
5. Setup an ALARM GRAPH LOCATION for the monitor.
6. Setup a PRINT WINDOW LOCATION for the monitor.
7. Verify setup or configuration of the above items.

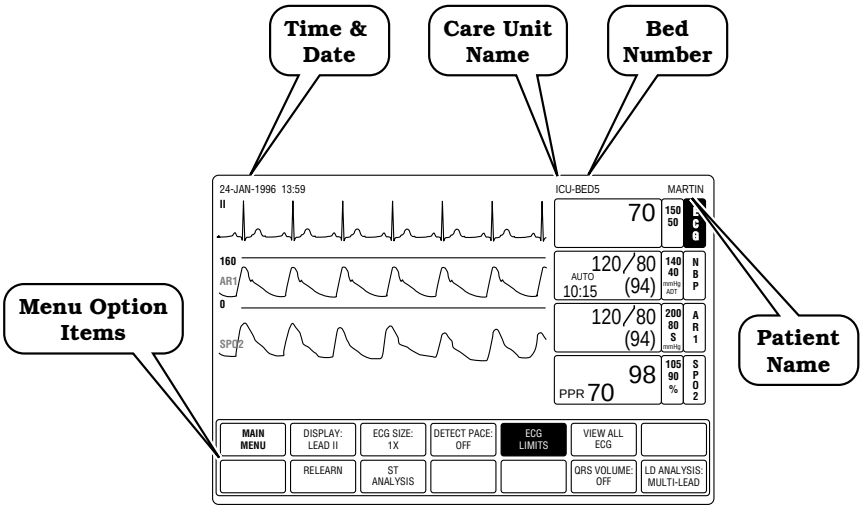
SETUP FOR USE (CONT)

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 three text fields.
   - The first text field is the TIME AND DATE. These both must be setup correctly on the monitor before initial use.
   - The second 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 third 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 four 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 part of this section is MONITOR SETUP.

SETUP FOR USE (CONT)

SOFTWARE REVISION MENU

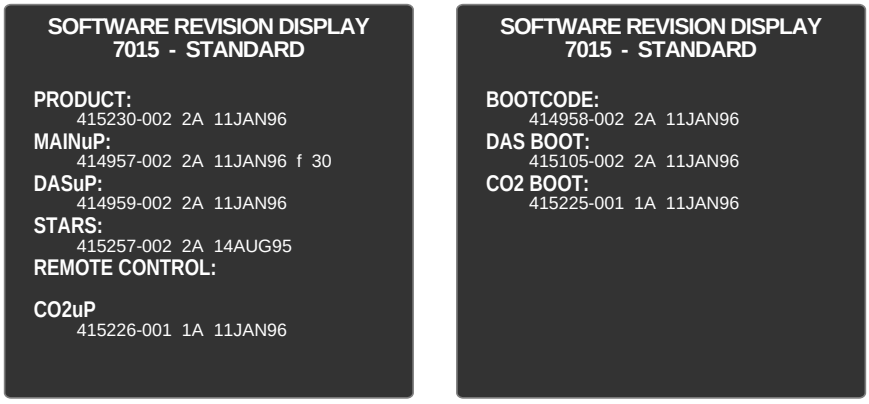
To determine the software revision under which the monitor is currently operating, follow these steps:

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 two pop-up windows similar to those 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 (415230-002), the version of the software (2A), and the software release date (11JAN96) 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.

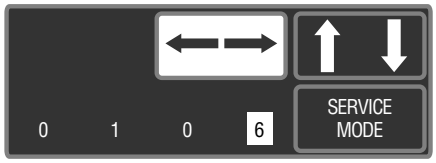
Select monitor setup from the main menu

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 (June 1st) would be represented in the password as 0106 (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. Using the word "*none*" as a care UNIT NAME will cause the monitor's alarms and patient information not to appear at the Central Station. This name can also be very confusing to users and make network troubleshooting extremely difficult.

SETUP FOR USE (CONT)

Setup the unit name of the monitor (Cont)

WARNING
The manufacturer recommends avoiding the use of spaces in the UNIT NAME. It is very difficult to visually detect spaces ("spaces" are read as characters) when programmed into the UNIT NAME. Using spaces in the UNIT NAME will cause the monitor's alarms and patient information not to appear at the Central Station.

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)

Bed number (Cont)

WARNING
Never use the word "*none*" as a BED NUMBER. Using the word "*none*" as a BED NUMBER will cause the monitor's alarms and patient information not to appear at the Central Station. This name can also be very confusing to users and make network troubleshooting extremely difficult.

WARNING
The manufacturer recommends avoiding the use of spaces in the BED NUMBER. It is very difficult to visually detect spaces ("spaces" are read as characters) when programmed into the BED NUMBER. Using spaces in the BED NUMBER will cause the monitor's alarms and patient information not to appear at the Central Station.

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 stand-alone printer, an internal (built-in) writer, or an external writer directly connected to the ASYNC rear panel connector of a monitor or central station. Each type of graph can be setup or configured on the monitor to print at one of the following destinations:
  1. Centralscope Central Station with internal or external writer,
  2. Solar 7000/8000 Patient Monitor with external writer,
  3. Eagle 4000 Patient Monitor with external writer,
  4. Eagle 3000 Patient Monitor with internal or external writer, and/or
  5. Network laser printer.
- For a stand-alone monitor, each type of graph is setup or configured individually and can be directed to an internal writer (optional) or external writer (also optional) directly connected to the ASYNC rear panel connector on the monitor.

Three graph locations must be setup on the monitor

Three separate graph locations must 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, ALARM GRAPH LOCATION, or PRINT WINDOW LOCATION from the graph location menu option items.

NOTE

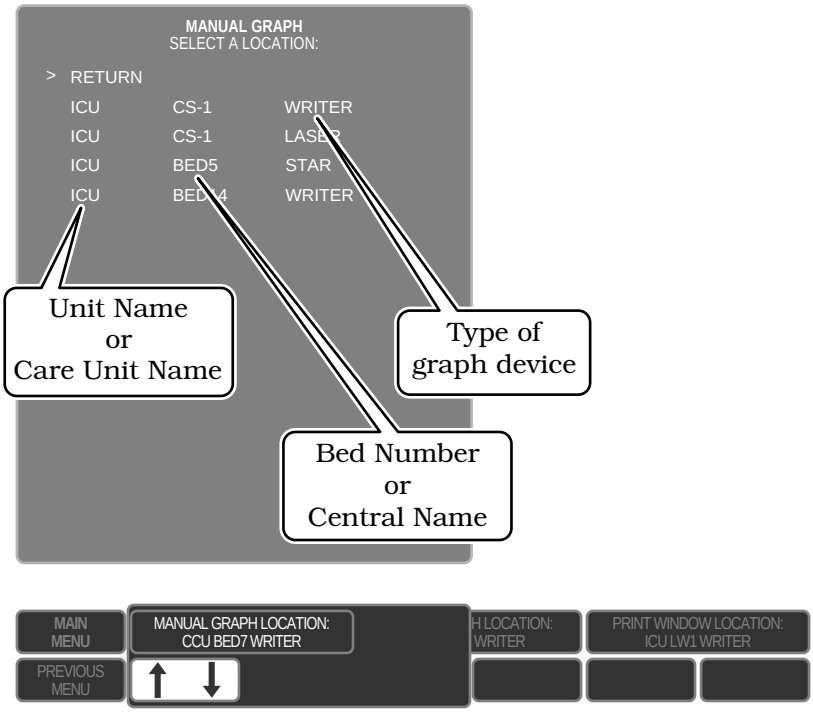
The graph location menu has menu option items for programming the manual graph location, the alarm graph location and the print window location. All three must be setup and configured individually for full functional use of the monitor.

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 internal writer of the monitor or a writer connected to the monitor ASYNC port, and/or
- Writers connected to or part of devices that have an identical care UNIT NAME on the network.

5. 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.

6. 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 date 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:

1. Use the Trim Knob control to scroll to and select the TIME AND DATE menu option item.

For a monitor connected to the network...

- For monitors connected to the network, select the menu option from the SERVICE MODE menu.

For a stand-alone monitor...

- For a stand-alone monitor (not connected to the network), select the menu option from the MONITOR SETUP menu.

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.

CAUTION
TIME AND DATE parameters are actively enabled for change each time the SET TIME or SET DATE menu option items are selected.

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 the real time clock IC in the monitor when SET TIME or SET DATE is selected and set.

Enter the changes into the real time clock IC

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 program the new time or date into the real time clock IC in the monitor.

FOR YOUR NOTES

7 ASSEMBLY DRAWINGS

ENGINEERING 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.

The assembly drawings for all monitor configuratons are broken down as follows:

Packing materials: This diagram provides a reference to the manufacturer packing materials used for shipping the monitor from the factory.

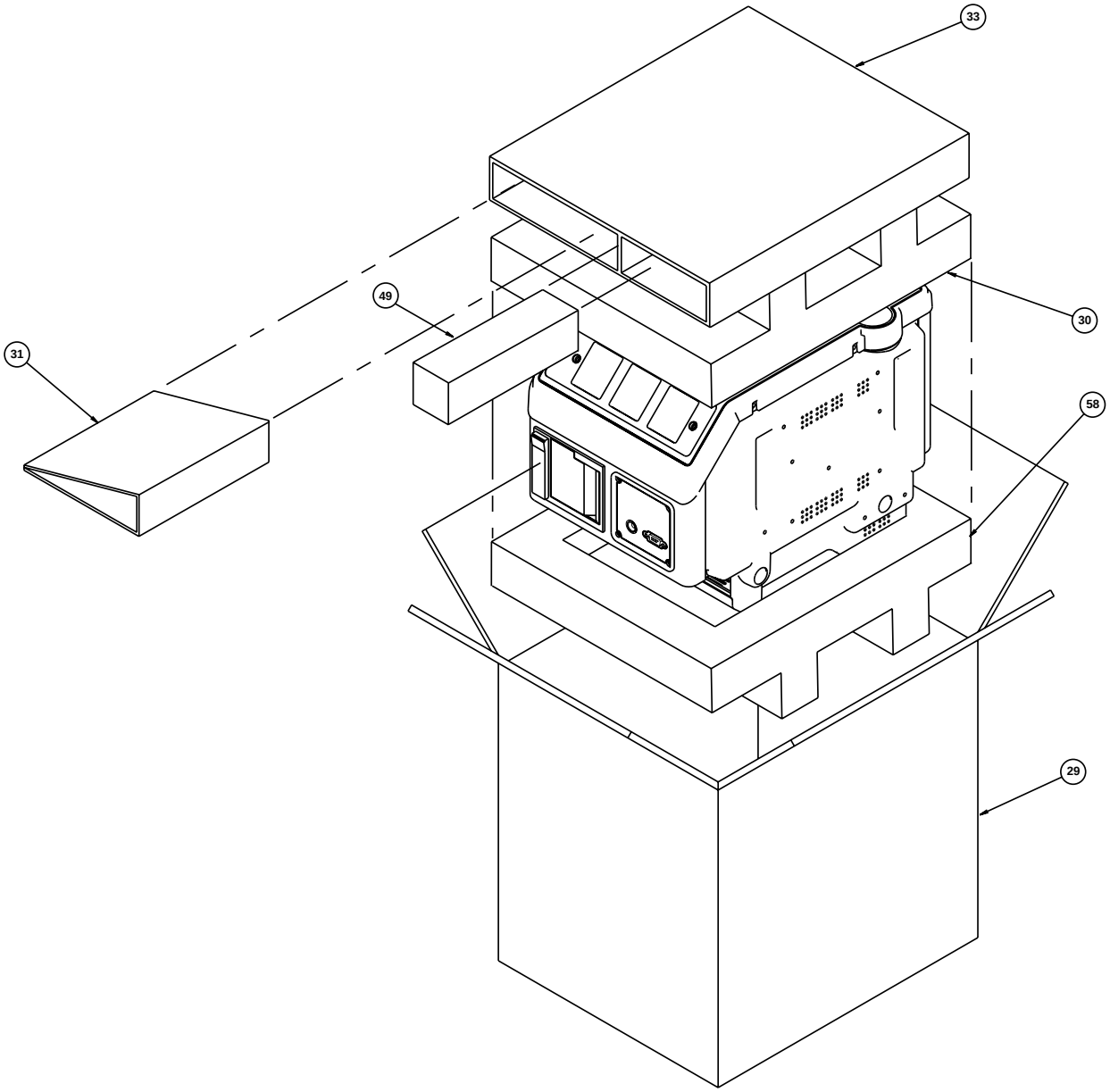
Exploded views: These diagrams provide reference to the individual parts and assemblies used in the monitor.

Electrical 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.

ENGINEERING ASSEMBLY DRAWINGS (CONT)

PACKING MATERIALS



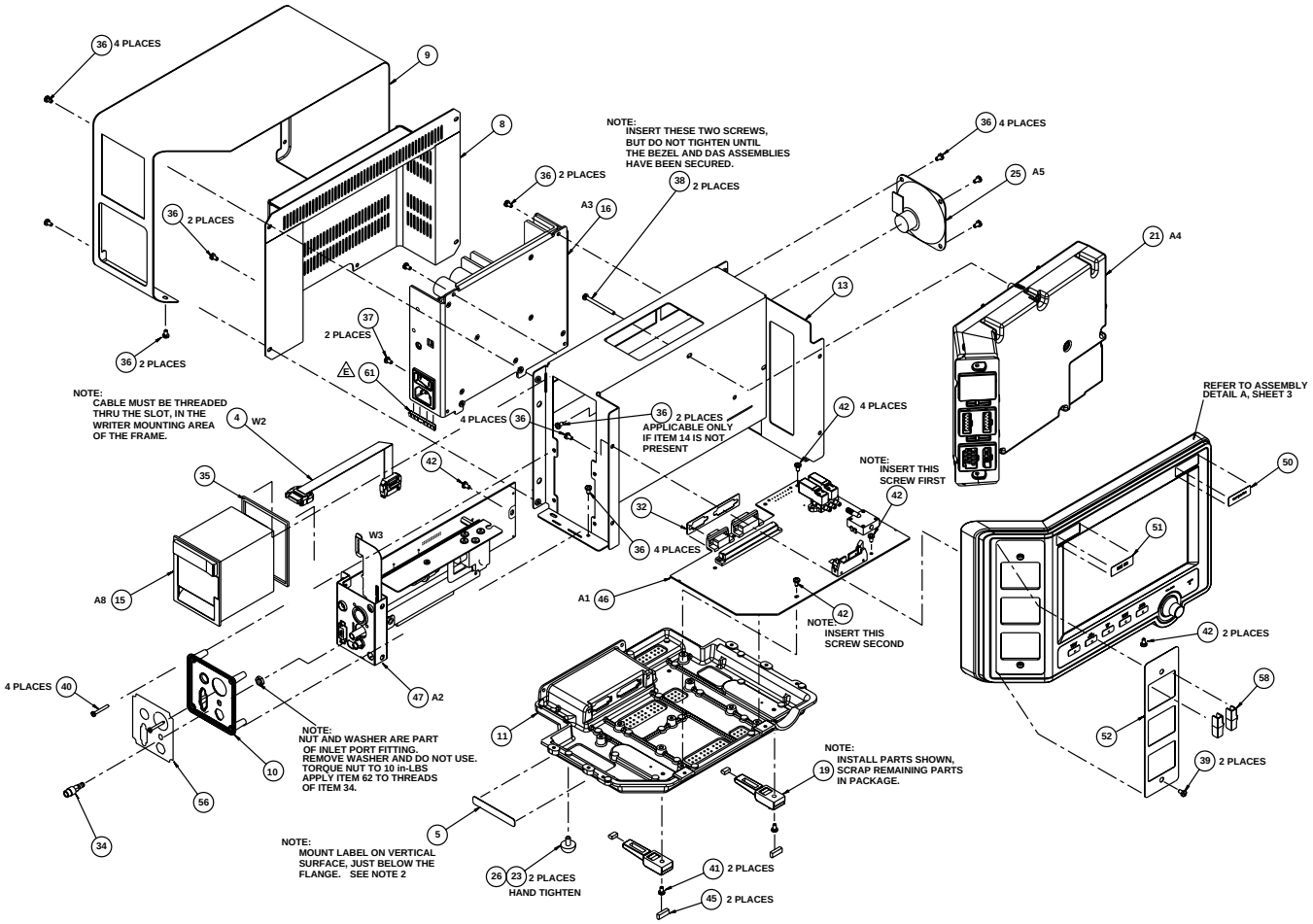
NOTES:

1) LOOSE ITEMS MAY BE SHIPPED WITH THE UNIT IF SPACE PERMITS OR PACKAGED SEPERATELY.

2) MARK LABEL WITH THE FOLLOWING; "MODEL NAME", SERIAL NUMBER AND APPROPRIATE BARCODE.

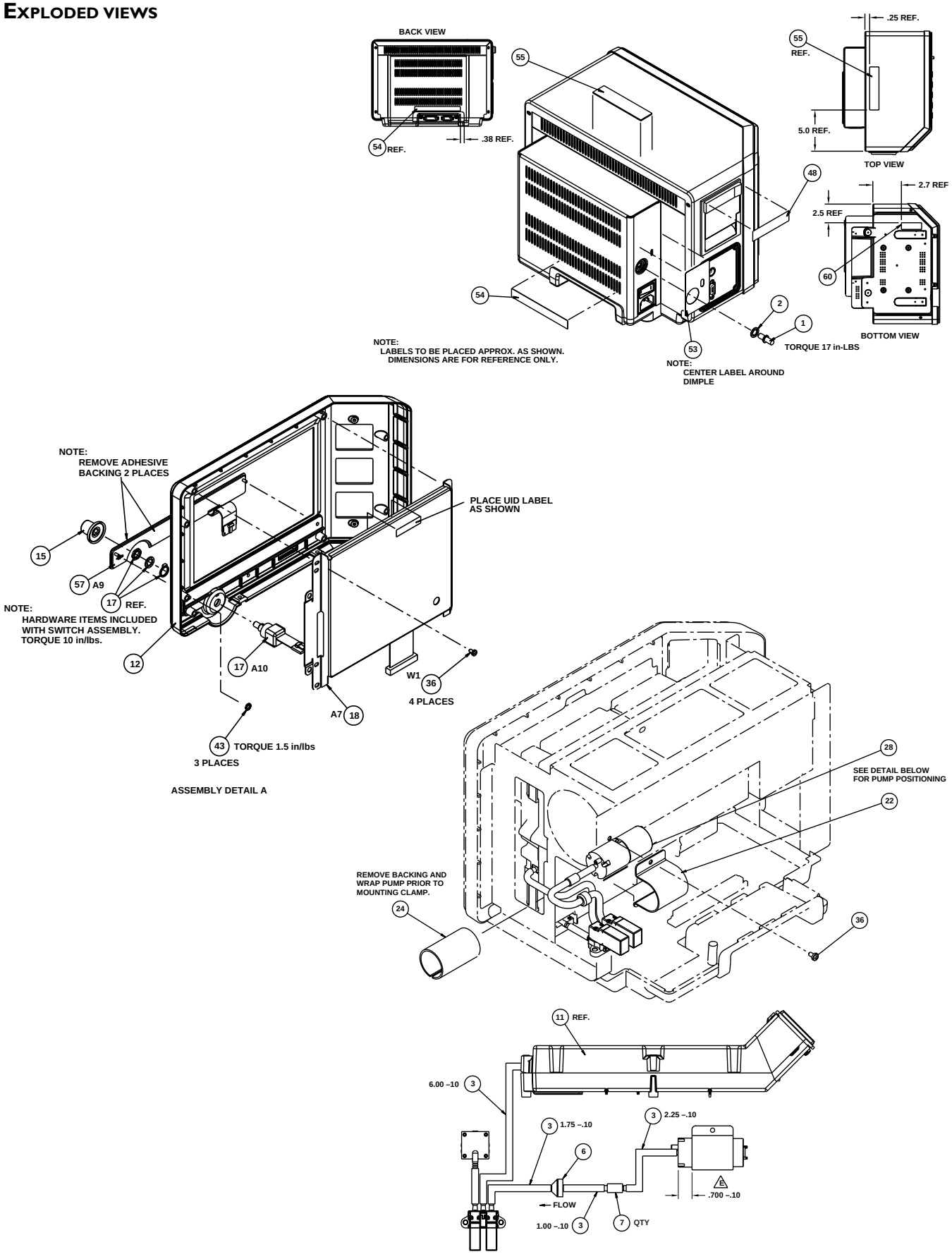
ENGINEERING ASSEMBLY DRAWINGS (CONT)

EXPLODED VIEWS



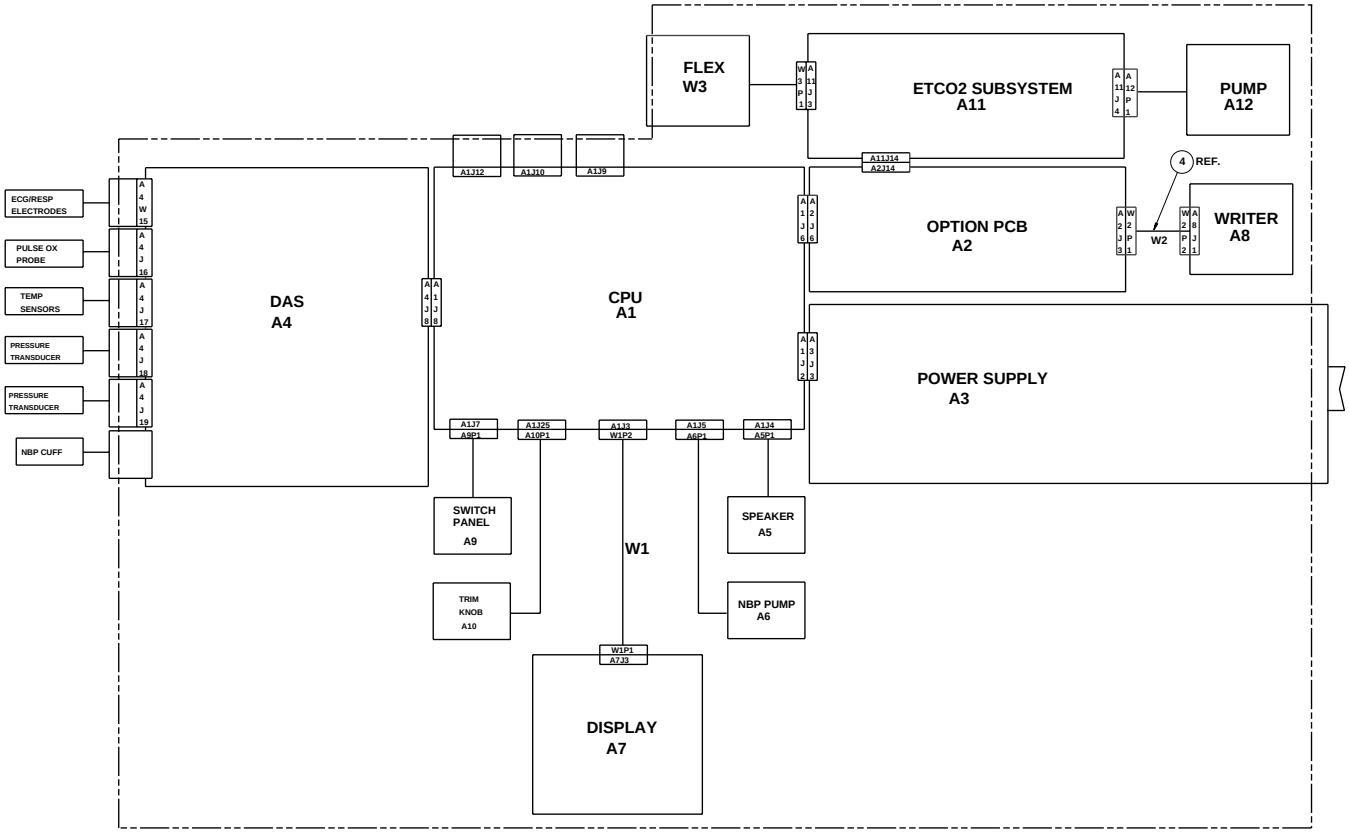
ENGINEERING ASSEMBLY DRAWINGS (CONT)

EXPLODED VIEWS



ENGINEERING ASSEMBLY DRAWINGS (CONT)

ELECTRICAL DIAGRAM



PARTS LIST 414888-005H

ITEM	REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	QTY
1		Plug, MC, Equipotential	400040-001	1
2		Washer, Lock, Serrated, Male/Female, No 6	400041-001	1
3		Tubing, Silastic	401582-001	AR
4	W2	Harness Assembly, Writer Data	402642-007	1
5		Label, Model/Serial Number	404525-006	1
6		Check Valve, 1/8 ID	418437-001	1
7		Filter, 43 Micron	404679-001	1
8		Rear Cover	412847-001	1
9		Top Cover (For 414888-004 and -005 Only)	412848-001	1
10		Side Connector Cover, ETCO2 (For 414888-003 and -005 Only)	412849-005	1
11		Base, Diecast	412857-002	1
12		Bezel, Monitor	412858-001	1
13		Chassis Frame	412868-003	1
14	A8	Thermal Writer Assembly, 2-inch, STAR	413568-001	1
15		Knob, Trim Knob, Soft	414622-001	1
16	A3	Power Supply Assembly, 5/12 Volt	414641-001	1
17	A10	Switch Assembly, Rotary	414642-001	1
18	A7	Display Processor PCB Assembly	414704-002	1
19		Foot, Two-Position	414793-001	1
21		Data Acquisition PCB Assembly	414887-001	1
22		Clamp, NBP Pump	414992-002	1
23		Foot, Rubber, 0.62 diameter	415054-002	2
24		Foam Pump Mount	415081-001	1
25	A5	Speaker Assembly	415091-001	1
26		Cement, Loctite	4851-003	AR
28	A6	NBP Pump Assembly	415321-001	1
29		Carton, Shipping, Eagle 3000	415337-001	1
30		Insert, Foam, Glued, Top Section	415338-001	1
31		Eagle 3000 Field Service Manual	415397-003	
32		Gasket, EMI Shield	415478-002	1
33		Insert Spacer, Packaging	415582-001	1
34		Connector, Luer, Female, 1/8 Barb	416229-001	1
35		Gasket, Writer	415650-001	1
36		Screw, PNH, Phillips, 6-32 x 1/4	45000-604	27
37		Screw, PNH, Phillips, 6-32 x 3/8	45000-606	2
38		Screw, PNH, Phillips, 6-32 x 1-1/2	45000-817	2
39		Screw, PNH, Phillips, SST, 4-40 x 3/8	4502-412	2
40		Screw, PNH, Phillips, SST, 4-40 x 15/16	4502-430	4
41		Screw, BDGH, Phillips, 6-32 x 3/16	45074-606	2
42		Screw, BDGH, Phillips, 6-32 x 1/4	45074-608	9
43		Nut, Hex, 4-40	4521-304	3
45		Tape, Double-Sided (White)	4813-100	AR
46	A1	Main Processor PCB Assembly	800772-002	1
47	A2	Assembly, Eagle 3000 Options	418394-001	1
59		Insert, Foam, Glued, Bottom Section	415338-002	1
61		Clip, EMI	416053-002	1
62		Adhesive, Permabond 910FS (For 414888-003 and -005 Only)	4851-074 416021-001	AR 1

For Your Notes