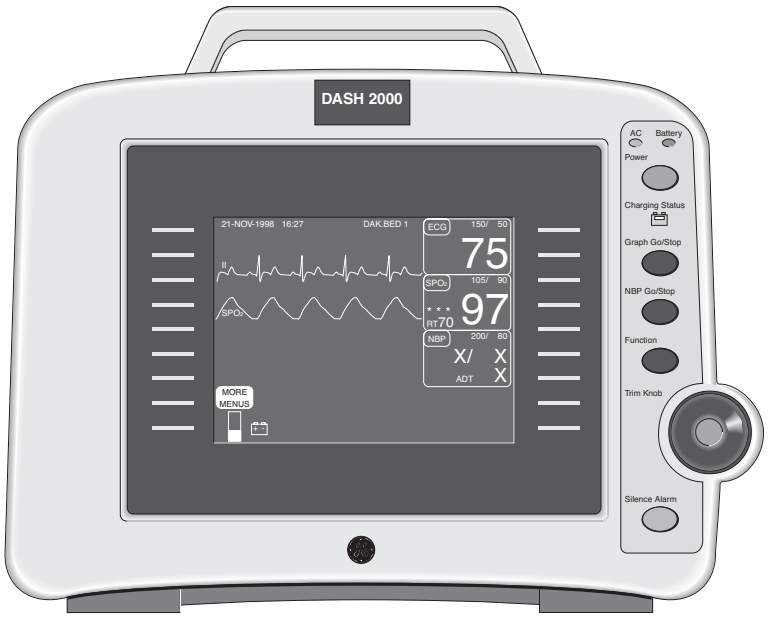
Dash 2000
Patient Monitor Version 3
Service Manual

2005873-010 Revision D



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Information Technologies

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1 INTRODUCTION

Contents

Manual Information

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.

Revision History

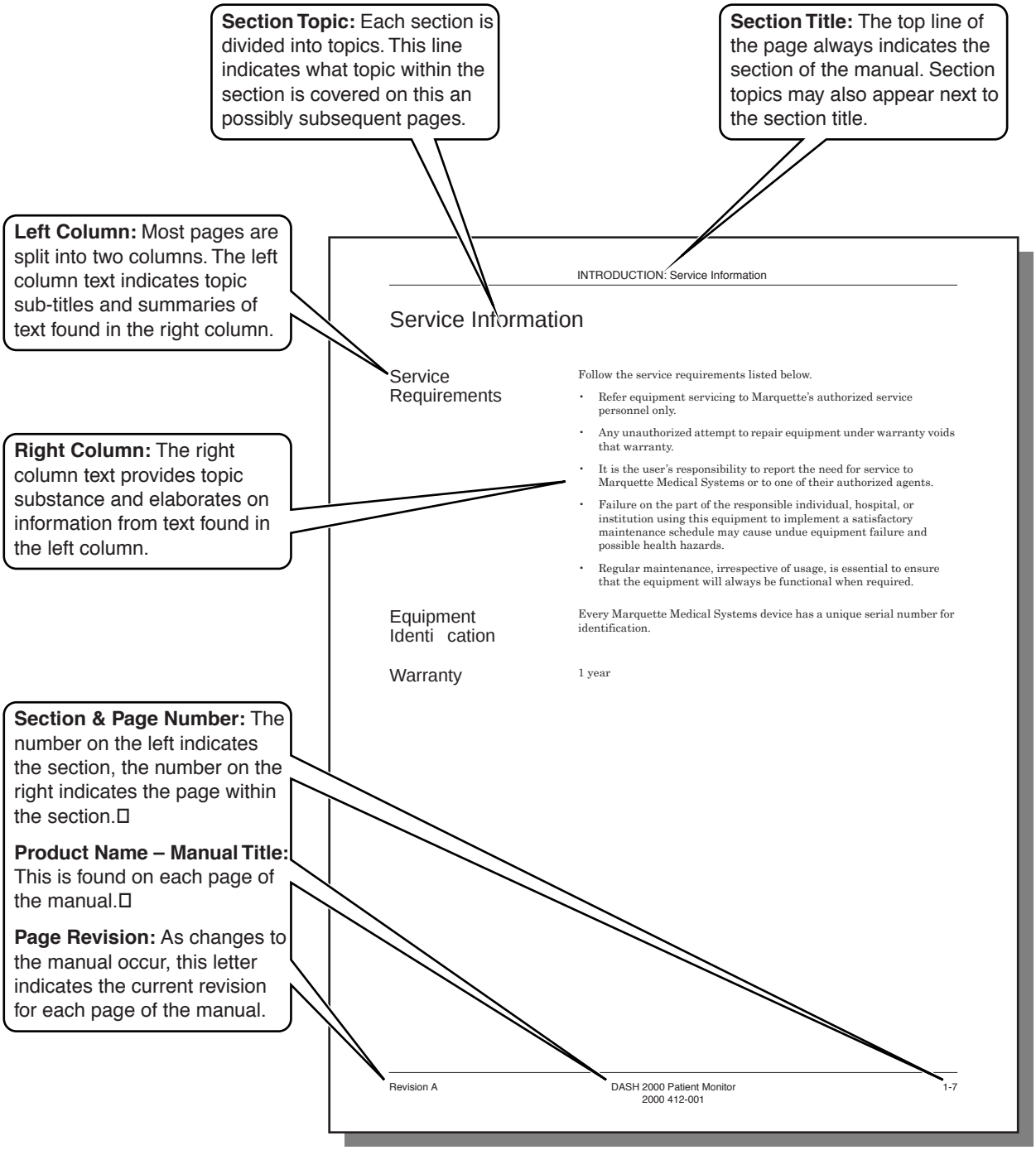
Each page of this manual has a revision letter located at the bottom of the page. It identifies the revision level of the entire manual. This may be important if you have different manuals and you don't know which is the most current.

For the initial release, all pages have the revision letter A. For the second update, all pages receive the revision letter B. The latest letter of the alphabet added to the table below corresponds to the most current revision.

Revision History

Revision	Date	Comment
A	1 April 2001	Initial release of this manual.
B	13 Juli 2001	ECO 067 421
C	1 January 2002	ECO 068 878
D	03-Sept-2004	ECO 078588

Page Layout


Section Topic: Each section is divided into topics. This line indicates what topic within the section is covered on this an 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 summaries 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.
INTRODUCTION: Service Information
Service Information
Service Requirements
Follow the service requirements listed below.
• Refer equipment servicing to Marquette's authorized service personnel only.
• Any unauthorized attempt to repair equipment under warranty voids that warranty.
• It is the user's responsibility to report the need for service to Marquette Medical Systems or to one of their authorized agents.
• Failure on the part of the responsible individual, hospital, or institution using this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.
• Regular maintenance, irrespective of usage, is essential to ensure that the equipment will always be functional when required.
Equipment Identi cation
Every Marquette Medical Systems device has a unique serial number for identification.
Warranty
1 year
Revision A
DASH 2000 Patient Monitor
2000 412-001
1-7

Safety Information

Responsibility of the Manufacturer

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

- Assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by Marquette.
- The electrical installation of the relevant room complies with the requirements of the appropriate regulations.
- The equipment is used in accordance with the instructions for use.

Intended Use

This device is intended for use under the direct supervision of a licensed health care practitioner.

To ensure patient safety, use only parts and accessories manufactured or recommended by Marquette Medical Systems.

Contact Marquette Medical Systems for information before connecting any devices to this equipment that are not recommended in this manual.

Equipment Symbols

The following symbols appear on the equipment.

NOTE

Some symbols may not appear on all equipment.

ATTENTION: Consult accompanying documents before using the equipment.

In Europe, this symbol means dangerous or high voltage. In the United States, this symbol represents the caution notice below:

CAUTION

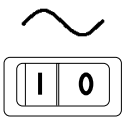
To reduce the risk of electric shock, **do not** remove the cover (or back). Refer servicing to qualified personnel.

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.

Type B equipment; type B equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application.

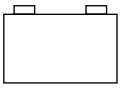
Equipotentiality



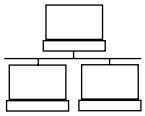
Alternating current (AC)

Power; **I** = ON; **O** = OFF

Fuse



Battery



Indicates the Ethernet connection for the monitor.

Indicates where to press to open the door on the Series 7160 Direct Digital Writer.

Classified by Underwriters Laboratories Inc. with respect to electric shock, fire, mechanical and other specified hazards, only in accordance with UL 2601-1, CAN/CSA C22.2 No. 601.1, IEC 60601-1, and, if required, IEC 60601-2-27, IEC 60601-2-30, IEC 60601-2-34, IEC 60601-1-1.

Notes, Cautions, and Warnings

The safety statements presented in this section apply to the components of the DASH 2000 Patient Monitor. Look for additional safety information throughout the rest of this manual.

The order in which safety statements are presented in no way implies order of importance.

The terms **WARNING**, **CAUTION**, and **NOTE** are used throughout this manual to point out hazards and to designate a degree or level or seriousness. Familiarize yourself with their definitions and significance.

Hazard is defined as a source of potential injury to a person.

WARNING

indicates a potential hazard or unsafe practice which, if not avoided, could result in death or serious injury.

CAUTION

indicates a potential hazard or unsafe practice which, if not avoided, could result in minor personal injury or product/property damage.

NOTE

provides application tips or other useful information to assure that you get the most from your equipment.

Service Information

Service Requirements

Follow the service requirements listed below.

- Refer equipment servicing to Marquette's authorized service personnel only.
- Any unauthorized attempt to repair equipment under warranty voids that warranty.
- It is the user's responsibility to report the need for service to Marquette Medical Systems or to one of their authorized agents.
- Failure on the part of the responsible individual, hospital, or institution using this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.
- Regular maintenance, irrespective of usage, is essential to ensure that the equipment will always be functional when required.

Equipment Identification

Version 3 (and later) of the Dash 2000 can easily be identified by the Peripheral Expansion Interface Connector PCB at the bottom of the monitor.

Version 2 monitors are not provided with this PCB.

Abbreviations

A

AAMI Association for the Advancement of Medical Instrumentation
ac alternating current
ADC analog-to-digital converter
Adj adjustable
Al aluminum
Ampl amplifier
ANSI American National Standards Institute, Inc.
ASIC application specific integrated circuit
ASYNC COMM asynchronous communication
AUI attachment unit interface
Ave Avenue
AWG American Wire Gage

B

B/M beats per minute
BDGH binding head
BP blood pressure
bpm beats per minute
BT blood temperature

C

Cap capacitor
cc cubic centimeter
Cer ceramic
CMOS complimentary metal-oxide semiconductor
CO cardiac output
CSA Canadian Standards Association

D

DAC digital-to-analog converter
dB decibel
dc direct current
DDW Direct Digital Writer
DEFIB SYNC defibrillator synchronization
DMM digital multimeter
DRST Dash Responder Service Tool

E

ECG electrocardiogram, electrocardiograph
EEPROM electronically erasable programmable read only memory
ESD electro static 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

P

PC printed circuit, personal computer

PCB printed circuit board

PCMCIA Personal Computer Memory Card International Association

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

R

RAB Remote Alarm Box

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

Y

YSI Yellow Springs Instrument

Other

(Cont) continued

°C degrees Celsius

°F degrees Fahrenheit

ýz impedance variation

µ micro

µA microampere

µF microfarad

µV microvolt

Ω ohm

***y*T** temperature difference

% percent

How to Reach Us

Service Calls and Product Support

To open a service call or obtain product support call the numbers below:

800. 558. 7044 (US & Canada)
561.575. 5000 (outside US)

or contact your representative or distributor

For other product information please contact one of the offices listed on the next page.

Ordering Supplies & Service Parts

Order supplies (leadwires, electrode paste, thermal paper, etc.) or service parts (manuals, circuit boards, cables, software, etc.) from:

Accessories

GE Medical Systems Accessories and Supplies
2607 North Grandview Blvd.
Mail Code: SN- 471
Waukesha, WI 53188

Telephone: 800. 558.5102 (US only)
262. 521.6856 (outside U. S.)
Fax: 800. 232.2599 (US only)
262. 521.6855 (outside US)

Service Parts

GE Clinical Services
P. O. Box 9100, 100 Marquette Drive
Jupiter, FL 33468- 9100

Telephone: 800.558. 7044 (US only)
561.575. 5000 (outside US)
Fax: 800.421. 6841 (US only)
561.575. 5050 (outside US)

Have the following information available before calling:

- part number of the defective part, or
- 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 (e.g., R13, S12).

Ordering Manuals

When ordering additional operator manuals, be sure to include the software version of the product.

2 EQUIPMENT OVERVIEW

Contents

Product Description

About the Monitor

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

Compact Design

Measuring a compact 27 cm (10.5 inches) wide, 22 cm (8.5 inches) tall, and 20 cm (8 inches) deep, and weighing just 5.1 kg (13 pounds), the monitor is thin and unobtrusive enough for locations previously considered impractical. The display size is 5.8 inches.

Network Compatible

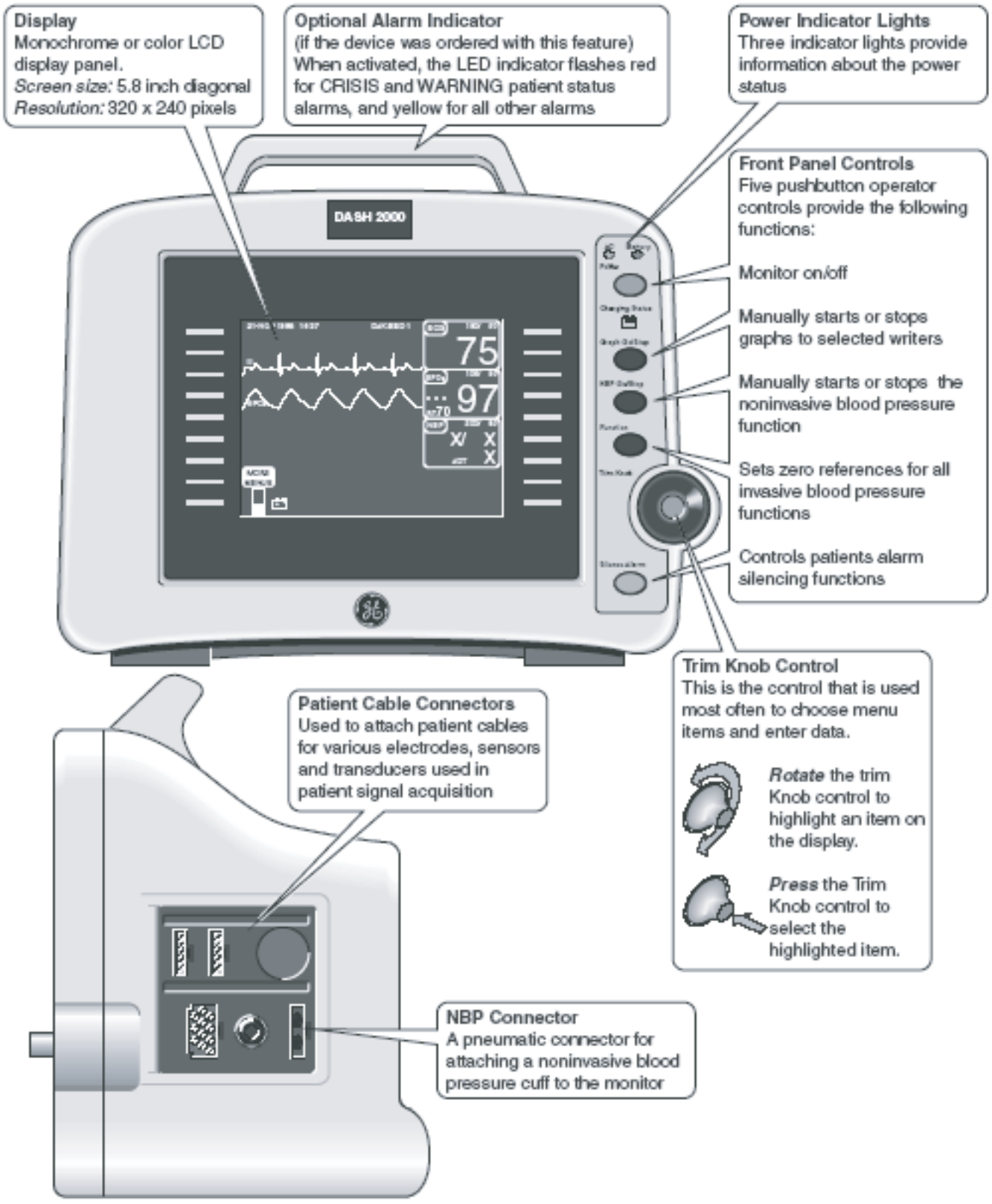
The monitor can be part of a patient monitoring network, an open architecture, systems integration platform designed to improve the efficiency and effectiveness of healthcare delivery.

Easy to use

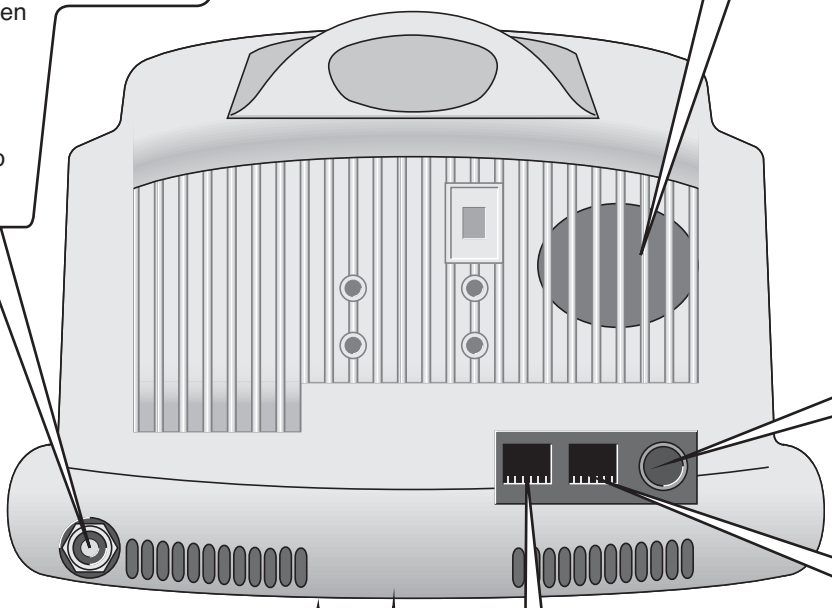
From software designed for specific care areas to the monitor's unique Trim Knob® control, the monitor was designed to be as easy to use as it is comprehensive.

Components

Front Panel Description



Rear Panel Description



Equipotential Terminal
For measurements in or near the heart, we recommend connecting the monitor to the potential equilization system. Use the green and yellow potential equilization cable an connect it to this pin.

Audible Alarm Annunciator
The internal speaker provides sound for audible alarms. For better sound quality do not block speaker.

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

Input
- Defibrillator triggered marker pulse

Aux Port
This port can be used for interconnection to other devices (e.g. RAB*, Polled Parameter Server*, software updates). This port is inactive if the monitor is connected to the Dash Port docking station.

Serial Number Label
(not shown)
Describes the type of equipment, date and sequence of product manufacturer for each monitor

AC Power

Peripheral Expansion Port*
This port can be used for interconnection to the Dash Port docking station or the Dash Responder defibrillator

Network Connector
An IEEE 802.3 twisted pair cat 5 cable can be connected to this port for monitors used in patient monitoring network configurations.
This port is inactive if the monitor is connected to the Dash Port docking station.

* Note: These features are only available with version 3

Optional Remote Alarm Box

For connecting of the monitor to a nurse-call system, a separation line according to IEC 60601 (4 kV voltage isolation) is required. Use Remote Alarm Box (RAB), part number 2005693-001.

Optional Dash Responder Defibrillator and Pacer

The Dash Responder® defibrillator (with optional integrated pacer) also connects to the Dash 2000 Patient Monitor, version 3.

Refer to the Dash Responder Operator's Manual for instructions on operation.

WARNING

Arrhythmia processing is suspended during external pacing with the Dash Responder

Refer to the ECG chapter in this manual for notes on influences of the Dash Responder defibrillator and pacer.

NOTE

Only version 3 and higher of the Dash 2000 Patient Monitor are capable of communicating with the Dash Responder.

Optional Dash Port Docking Station

Via the Dash Port Docking Station, the Dash 2000 Patient Monitor, version 3, can also be powered, connected to the Ethernet and to the AUX Port.

Refer to the Dash Port Docking Station Operator's Manual for instructions on operation.

NOTE

The Dash 2000 Patient Monitor can only be connected either to the Dash Responder or to the Dash Docking Station at a time.

Only version 3 and higher of the Dash 2000 Patient Monitor are compatible with the Dash Responder

Device Compatibility

The tables in this section are current as of the publication date of this manual and are subject to change. For current information, cintact your Service or Sales Representative.

Unity Network Devices

The Dash 2000 Patient Monitor is compatible with the following Unity Network devices.

Product	Software
ADU/Pager LAN	3G, 3H
CDT-LAN	5H, 6A
Centralscope: CS 12	10A, 10B, 10C, 10D
CIC	1.5
Dash 3000/4000	1A, 2B
Eagle 3000	3A, 3B, 4A
Eagle 4000	5B, 6A, 6C, 6D, 6F
Impact Pager	V2.53
QS	5.03.0
Solar 7000/8000	3C, 4B, 4C (Special), 5B, 5D, 5E, 6A
Solar 8000M	1A, 1B, 1C
Solar 9500	1A, 2A, 2B

Peripheral Devices

The Dash 2000 Patient Monitor is compatible with the following peripheral devices.

Product	Software	Interface
Polled Data Services	1A	AUX
Serial download		AUX
RAB	1A	AUX
Dash Responder	1A	Periph. Exp.
Dash Port Docking Station	1A	Periph. Exp.

Technical Specifications

Due to continual product innovation, specifications are subject to change without notice. The following specifications are accurate as of the date of this publication, and pertain to the Dash 2000 Patient Monitor, version 3.

Performance Specifications

The Dash 2000 Patient Monitor consists of a self-contained monitor. The Dash 2000 can also operate on battery (DC) power for use as a transport monitor.

Display

Size:	5.8-inch diagonal
Type:	
Monochrome:	Hi-Bright Liquid Crystal Display (LCD)
Color:	Liquid Crystal Display (LCD)
Resolution:	320 by 240 pixels
Number of traces:	3
Number of seconds/trace:	3.8 at 25 mm/sec (Chinese Version: 3.1 at 25 mm/sec)
Sweep speed:	
All waveforms:	25 mm/sec -20% (with erase bar) Chinese Version: 25 mm/sec ±10% (with erase bar)
Waveform display:	Individual
Information window:	Display of non-real-time information without obstructing the display of real-time information
Display organization:	Prioritized by parameter

Controls

Standard:	Trim Knob control plus 5 hard keys: Silence Alarm, NBP Go/Stop, Graph Go/Stop, Function, and Power

Processing

Main processor:	MPC 821 32-bit integrated microcontroller (24 MHz)
Data acquisition processor:	MC68332 32-bit integrated microcontroller (15.72 MHz)
Program storage:	4-MB flash memory
Data storage:	512 kB (battery backed-up), 4-MB DRAM

Alarms

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

Location	Bedside and central station, if applicable
Visual color/modulation	Red, flashing
Pause	5 minutes (adult); 3 minutes (neonatal); 5, 15 minutes, permanent (OR mode)

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 lead
Alarms:	User selectable upper and lower heart rate limits
Input specifications:	
Voltage range:	±0.5 mV to ±5 mV with size 2x or 4x below 1 mV and with QRS width Adult ICU 70 to 120 ms Neonatal ICU 40 to 80 ms
Signal width:	40 ms to 120 ms (Q to S)
Heart rate range:	30 to 300 BPM
Accuracy:	±1 BPM or 1%, whichever is greater
Response time to change in heart rate:	12 s ±2 s (HR averaging)
Heart rate update:	2 s
Input impedance:	
Common mode:	>10 MOhms at 50/60 Hz
Differential	>2.5 MOhms from dc to 60 Hz
Tall T-wave rejection amplitude:	1.2 mV max.
Output specifications:	
Frequency response:	
Display:	
Diagnostic:	0.05 to 120 Hz
Monitoring:	0.05 to 40 Hz
Moderate:	0.05 to 25 Hz
Maximum:	5 to 25 Hz
DDW (Direct Digital Writer)	
Diagnostic:	0.05 to 120 Hz
Monitoring:	0.05 to 40 Hz
Moderate:	0.05 to 25 Hz
Maximum:	5 to 25 Hz
Common mode rejection:	90 dB minimum at 50 Hz or 60 Hz
Linearity deviation:	±3%
Noise:	<30 µV RTI (referred to input)
Leads off sensing:	For each electrode 1.25 V/62 MOhms referred to RL
Pacemaker detection/rejection:	
Input voltage range:	±2 mV to ±700 mV
Input pulse width:	0.1 to to 2 ms
Rise time:	10 ms to 100 µs
Over/under shoot:	2 mV (max.) with Diagnostic or Monitor filter setting and size 1x or 0.5x
Baseline drift:	<0.5 mV/hour with a ±700-mV, 2-ms pacemaker pulse applied

Time to alarm:	
for tachycardia:	12 s ±2 s (Chinese Version: 10 s ±2 s)
for cardiac standstill:	7 s ± 1 s (acoustic alarm)
Response to irregular rhythm	EK PRO used for optimized results, with learning function

Respiration

Measurement technique:	Impedance variation detection
Range:	±14 Vpk /(330 pF + 20 kOhm) per electrode excitation voltage/impedance
Respiration rate:	1 – 200 breaths per minute
Base impedance:	100 to 1000 Ohms at 52.5 kHz excitation frequency
Detection sensitivity:	0.4 to 10 Ohms variation
Waveform display bandwidth:	0.1 to 1.8 Hz (-3 dB)
Alarms:	User-selectable upper and lower respiration rate limits, and user-selectable apnea limit

Temperature (TEMP)

Number of channels:	1
Input specifications:	
Probe type:	YSI Series 400
Temperature range:	0 °C to 45 °C (32 °F to 113 °F)
Resolution:	±0.1 °C
Output specifications:	
Parameter displayed:	TP
Linearity:	<1 % from 30 °C to 42 °C
Error:	(independent of source) ±0.1 °C for YSI series 400 probes
Alarms:	User-selectable upper and lower limits for TP

Invasive Blood Pressure (BP)

Number of channels:	1
Transducer sites:	Arterial (ART), femoral artery (FEM), pulmonary artery (PA), central venous (CVP), right atrial (RA), left atrial (LA), intracranial (ICP), and special (SP)
Transducer requirements:	
Excitation voltage:	±2.5 Vdc ±0.1 %
Transducer output:	50 µV/V/cmHg
Input specifications:	
Range:	-25 mmHg to 300 mmHg
Offset:	±150 mmHg
Input impedance:	
Common mode:	>100 k at 50/50 Hz
Differential:	>100 k from dc to 60 Hz
Output specifications:	
Gain:	976 ±1 %
Frequency response:	dc to 50 Hz (+0/-3 dB)
Gain stability:	<±0.1%/°C, and <±0.1% over any 24 hour period
Zero balance range:	±150 mmHg

Zero balance accuracy:	±1 mmHg
Zero balance drift:	±1 mmHg over 24 hours
Common mode rejection:	>60 dB at 60 Hz
Noise:	<5 mVp-p from dc to 30 Hz
Accuracy:	±2% or ±1 mmHg, whichever is greater (exclusive of transducer)
Alarms:	User-selectable upper and lower limits for systolic, diastolic, and mean pressures

Pulse Oximetry (SpO2)

Parameters monitored:	Arterial oxygen saturation (SpO2) and peripheral pulse rate (PPR)
SpO2 range:	
calibrated:	50 – 100%
total:	0 – 100%
PPR range:	25 – 250 beats per minute (±3 beats per minute)
Accuracy:	Actual accuracy depends on probe. Please reference manufacturer's specifications.
SpO2:	±2% (70 – 100% SpO2) ±1 standard deviation ±3% (50 – 69% SpO2) ±1 standard deviation
PPR	±3 beats per minute
Alarms:	User-selectable upper and lower limits for SpO2 and PPR

Non-invasive Blood Pressure (NBP)

Measurement technique:	Oscillometric
Displayed parameters:	Systolic, diastolic, and mean pressures, pulse rate, time of last measurement
Measurement modes:	Manual, auto, and stat in adult and OR mode; manual and auto in neonatal mode
NBP pressure range:	
Systolic pressure range	
Adult:	30 to 275 mmHg
Pediatric:	30 to 235 mmHg
Neonatal:	30 to 135 mmHg
Diastolic pressure range	
Adult:	10 to 220 mmHg
Pediatric:	10 to 220 mmHg
Neonatal:	10 to 110 mmHg
Mean pressure range	
Adult:	20 to 260 mmHg
Pediatric:	20 to 260 mmHg
Neonatal:	20 to 125 mmHg
Cuff pressure range	
Adult:	0 to 275 mmHg
Pediatric:	0 to 235 mmHg
Neonatal:	0 to 135 mmHg
Heart rate detection:	30 to 200 beats per minute

Total cycle time:	20 to 40 seconds typical (dependent on heart rate and motion artifact)
Automatic cycle times:	0 to 8 hours
Auto zero:	Zero pressure reference prior to each cuff inflation
Tubing length:	
Adult:	12 feet (3.6 m)
Neonatal:	8 feet (2.4 m)
Automatic cuff deflation:	Cycle time exceeding 3 minutes (90 seconds neonatal), power off, or cuff pressure exceeds 300 mmHg (+10%) adult, 150 mmHg (+10%) neonatal
Cuff sizes:	
Disposable:	Large adult, adult, small adult, pediatric, small pediatric, and infant
Reusable:	Thigh, large adult, adult, child, and infant
Alarms:	User-selectable upper and lower limits for systolic, diastolic, and mean pressures
Accuracy:	
Static:	±2% or ±3 mmHg whichever is greater
Clinical:	±5 mmHg average error 8 mmHg standard deviation

Analog Output

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

Defibrillator Synchronization Pulse

(not for Dash Responder)

Marker out:	
Time delay:	35 ms (max), R-wave peak to leading edge of pulse.
Amplitude selectable in Service Menu	
+5 V selection:	3.5 V (min) at 1 mA sourcing; 0.5 V (max) at 5 mA sinking.
+12 V selection:	11.0 V (max) at 1 mA sourcing; 0.75 V (max) at 5 mA sinking.
Pulse width:	10 ms ±10% or 100 ms ±10% in Service Menu
Output impedance:	50 Ohms nominal
Current limit:	15 mA nominal, both sourcing and sinking.
Marker in:	
Input threshold:	VIH = +2.5 V (min); VIL = +1.5 V (max)
Input hysteresis:	650 mV typical
Maximum input voltage:	±30 V (with respect to ground on pin 2)

Input impedance:	10 k (min) for –25 V < Vin < 25 V
Pulse width:	1.0 ms (min), Vin < 2.5 V

Environmental Specifications

Power requirements:	
AC voltage:	100 – 240 VAC ±10%
Power consumption:	16 W normal use, 45 W fast charge, 23 W with Dash Responder
Cooling:	Convection
Heat dissipation:	240 BTU/hr
Battery:	nickel-cadmium (NiCd), 12 V, 2.0 ampere hours
Fuses:	100 – 240 VAC: T2.0A, 250 VAC, 5 x 20 mm
Design (general):	Continuous operation, not protected against ingress of liquids
Battery operation time:	
General:	Battery age will affect operating time. SpO2 and NBP monitoring, as well as battery age, reduce operating time.
Monochrome LCD display:	Typical operation time while monitoring ECG is 3.5 hours from a new, fully-charged battery.
Color LCD display:	Typical operation time while monitoring ECG is 3 hours from a new, fully-charged battery.
Min. battery operating time:	1.5 hours
Battery charge time to 90%:	1 hour to 3 hours
Operating conditions:	
Ambient temperature:	10 to 40 °C (50 to 104 °F)
Relative humidty:	5 to 95% at 40 °C (104 °F)
Atmospheric pressure:	700 to 1060 hPa
Storage conditions:	
Maximum:	50 °C (122 °F) at 50% relative humidity, or 70 °C (158 °F) at 15% relative humidity
Minimum:	-25 °C (-13 °F)
Atmospheric pressure:	500 to 1060 hPa
Duration:	without battery recharge: 2 months at 30 °C (86 °F) 1 month at 40 °C (104 °F) 2 weeks at 50 °C (122 °F) 1 week at 60 °C (140 °F) 4 days at 70 °C (158 °F)

Physical Specifications

Height:	21.5 mm (8.5 inches)
Width:	26.0 cm (10.2 inches)
Depth:	20.0 cm (7.9 inches)
Weight (with battery pack and recorder):	
with color/monochrome display:	11.5 lb (5.2 kg)

Certification

IEC:	IEC 60601-1 certified CE Marking for the 93/42/EEC Medical Device Directive
UL:	UL 2601-1 classified UL classified for CAN/CSA C22.2 No. 601.1

Warranty

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

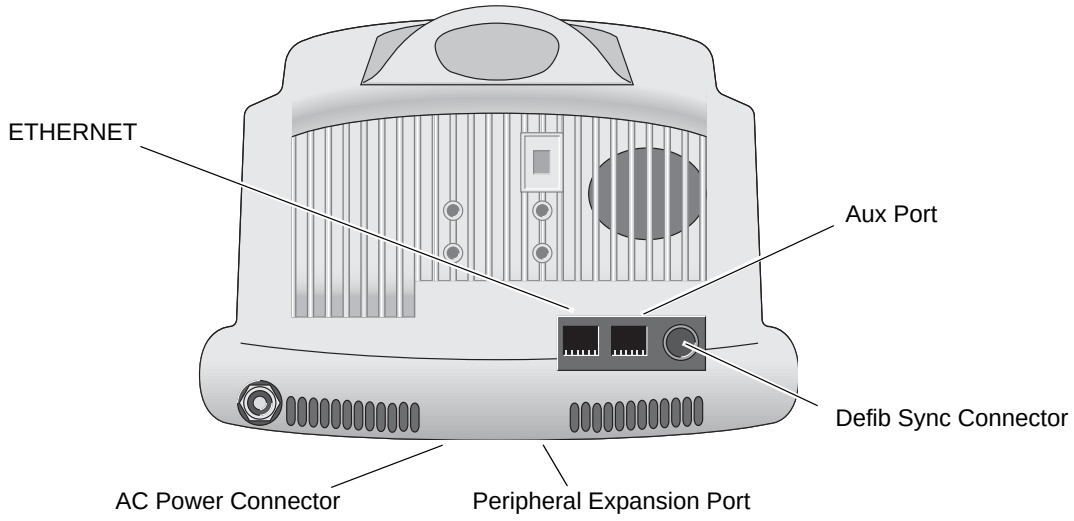
3 INSTALLATION

Contents

Connections

Back Panel Connections

On the back of the monitor you will find all connectors for equipment and network.



ETHERNET

The **ETHERNET** connector provides an ANSI/IEEE 802.3 10BaseT Ethernet standard interface to the Unity Network.

NOTE

This port is inactive if the monitor is connected to the Dash Port docking station. Use the corresponding port of the Dash Port docking station.

Defib Sync

The connector provides ECG analog output signals to user-supplied equipment.

CAUTION

Equipment damage. Connect all peripheral equipment before plugging the power cord into an AC outlet. Otherwise, connectors may be damaged.

AC Power

Use this connector to apply power to the monitor. The monitor will be powered at all times when using AC power (there is no AC power switch). Refer to the label on the back of the unit for the voltage and current requirements.

Aux Port

Use this port to connect either

- Remote Alarm Box (RAB) or
- Polled Parameter Server
  (via PC Interface 420915-013 connected with category 5 cable and RJ 45 connector, straight through, with max. length of 50 ft) or
- PC for software download
  (via Download Kit 2000453-001)

NOTE

This port is inactive if the monitor is connected to the Dash Port docking station. Use the corresponding port of the Dash Port docking station.

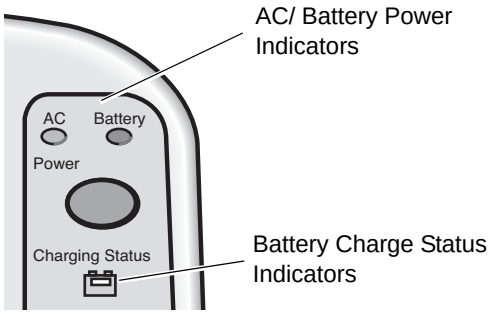
Peripheral Expansion Interface

This port is used to attach either

- the Dash Port docking station or
- the Dash Responder defibrillator and pacer

Front Panel Indicators

Power and battery indicators are located on the front panel of the monitor.



Dash 2000 Monitor's Front Panel

AC Power Indicator

The indicator illuminates green when AC power is applied to the monitor. The indicator is not illuminated when the monitor is not powered.

Battery Power Indicator

The indicator illuminates yellow when the monitor is battery powered. The indicator is not illuminated when the monitor is not powered or when AC power is applied.

Battery Charging/Ready Indicators

An icon for the battery indicates its charging status. The battery icon illuminates yellow when the battery is being charged. The battery icon illuminates green when the battery is fully charged.

When the monitor is operating under battery power the battery icon will not be illuminated. The icon is also not illuminated when the battery is either not being charged or has failed.

NOTE

No specific information is given to distinguish a failed battery pack condition from a condition where the battery is not being charged.

Power Up

After making all connections, plug the power cord into an AC wall outlet.

When all cables are properly connected, press the power button to turn the monitor on. All four front panel indicators will illuminate until the power-up sequence is complete. After approximately 10 seconds you should see a display on the screen.

Ethernet Communication

Overview

Ethernet is a local area network used as the main link of the GE Medical Systems *Information Technologies*' Unity network, a comprehensive information communication system. The Unity network offers the high rate of communication of 10 megabits per second. The Ethernet connector connects to an Ethernet transceiver directly or via a transceiver cable. This local area network links all patient monitors, central stations, and other GE Medical Systems *Information Technologies*' equipment throughout the hospital. Depending on the construction of the hospital, thick-net, thin-net, or twisted pair cabling is used.

Twisted Pair

Twisted pair is the most popular cabling because it is easy to install and flexible to work with. It uses the star topology with a concentrator as the hub of the segment. Each of the network devices is connected directly to the concentrator so longer lengths of cable are required. A maximum of 100 meters or 328 feet is the longest length of twisted pair cable used. The number of devices is limited to the amount of connectors at the concentrator.

Concentrator

The concentrator is simply a transceiver that passes all network data between any two branches in the LAN. Note that the concentrator passes all network data between the two branches, regardless of whether or not one node is sending data to another node on the same branch.

To implement the star topology, each network device is connected to a concentrator. The concentrator functions as a central hub and simply passes all network data between each network device in the star segment. Typically, the concentrator supports 8 to 12 network devices and may be linked to other concentrators to form larger networks.

Node

Each network device or node is assigned an address number and requires a transceiver to interface between the network device and the network. For thick-net and thin-net cabling a transceiver and a serial drop cable connects to the main trunk. The serial drop cable is sometimes referred to as an AUI (attachment unit interface) transceiver cable. For twisted pair cabling, the transceiver to connected directly to the network device.

Segment and Branch

Some Ethernet systems are comprised of smaller, stand-alone Ethernet systems (called branches or segments) that are connected by bridges, concentrators, or repeaters. Many nodes on the Ethernet network may be serviced by one segment or branch. Each segment may support many patient monitors, central stations, and auxiliary devices.

For example, one segment may connect all the patient monitors and central stations in the ICU (Intensive Care Unit) and another may connect the monitoring system in the CCU (Critical Care Unit). Each segment could be a fully-functioning stand-alone system if they were not connected to each other. However, with a bridge or repeater to connect the ICU (one segment) with the CCU (the other segment), information can pass between any of the nodes (patient monitors and central stations) on either branch similar to a patient transfer from one unit to another.

A section is a single length of twisted pair cable with a RJ-45 connector on each end. A section goes from one twisted pair transceiver to the concentrator. A segment is comprised of all the sections of twisted pair cable connected in a star formation to one concentrator.

Repeater

A repeater is used to extend the length of cabling when the distance required exceeds the length of the cable specifications. It is simply a transceiver that passes all network data between any two segments. Note that the repeater passes all network data between the two segments, regardless of whether or not the one node is sending data to another node on the same segment.

Bridge

A bridge is more selective than a repeater with the data that it passes between segments. It also acts as a transceiver between two segments, but it only passes signals if a node on one of the segments is attempting to communicate with a node on the other segment. Since the majority of communication on the network occurs within a single segment, the bridge does not pass all of the data from one segment to the other. This lowers the amount of data traffic passing between segments, and makes the network more efficient than a system that is connected with repeaters.

Twisted Pair Cabling (10BaseT)

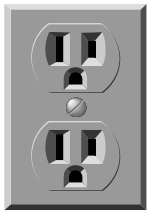
Twisted pair is an IEEE 802.3 local area network that uses flat and small diameter cable containing four pairs of twisted wires to connect devices. Twisted pair operates at the same speed as thin-net and thick-net (10 megabits/second), but the cable distances extended up to 100 meters (328 feet).

A twisted pair transceiver passes data back and forth between the network device and the LAN. It is attached directly to the network device at the at the 15-pin D-type connector. The twisted pair cable is connected from the RJ-45 connector at the transceiver and the RJ-45 connector at the concentrator.

NOTE: Some devices (like Octacomm/Solar 8000M/Dash patient monitor) have 10BaseT standard meaning that the RJ-45 connector is part of the product and the twisted pair transceiver is not required.

Preparation for Use

Power Requirements

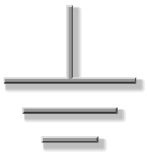


At least one grounded duplex wall receptacle should be provided for each monitor. The wall receptacle should be hospital grade and installed in a suitable junction box. Power should be provided by a power line dedicated solely to equipment requiring emergency power.

WARNING

Depending on battery charge, 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.

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

Marquette Monitoring System Mounting Reference Guide:

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

Software Setup

Section 7: Configuration

- Information regarding connection of the monitor to peripherals

4 MAINTENANCE

Contents

Maintenance Schedule

Manufacturer Recommendations

WARNING

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

To ensure the monitor is always functional when required, qualified service personnel should perform the following regular maintenance.

- **Visual Inspection:** Perform a visual inspection upon receipt of the equipment, every 12 months thereafter, and prior to servicing the unit.
- **Cleaning:** Clean the unit upon receipt of the equipment, every 12 months thereafter, and each time the unit is serviced.
- **Conditioning the Batteries:** Condition the batteries once every three months or as needed.
- **Electrical Safety Tests:** Perform safety tests upon receipt of the equipment, every 12 months thereafter, and each time the unit is serviced.
- **Checkout Procedures:** Perform the checkout procedures upon receipt of the equipment, every 12 months thereafter, and each time the unit is serviced.
- **Clearing the Stored Patient Data Memory:** Admit and discharge a test patient every 12 months to clear the monitor's stored patient data memory.

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.

PM Form

For the latest PM forms regarding this product, contact GEMS IT Service. Make a copy of the DASH 2000 Patient Monitor PM form and use this copy to help guide you as you go through this chapter of the manual. The PM form may then be archived for reference after completion of all the steps required to test the equipment.

If, for any reason, any of the procedures or tests are not met to standards indicated, contact GEMS IT Technical Support.

Repair Log

For your convenience, a repair log is provided at the end of this chapter for you to record the repair history of this product.

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.
- Safety labels and inscriptions on the device are clearly legible.

Cleaning

Cleaning Precautions

Use one of the following approved solutions:

- Cidex solution, or
- Sodium hypochlorite bleach (diluted), or
- Mild soap (diluted)
- Lint-free cloth
- Dust Remover (compressed air)

To avoid damage to the equipment surfaces, *never* use the following cleaning agents:

- organic solvents,
- ammonia based solutions,
- acetone solution,
- alcohol based cleaning agents,
- Betadine solution,
- a wax containing a cleaning substance, or
- abrasive cleaning agents.

Cleaning the Display

To clean the display use a soft, clean, lint-free cloth dampened with a glass cleaner.

CAUTION

To avoid getting liquid into connector openings, do not spray glass cleaning or general cleaning solutions directly onto the product's surface.

Exterior Cleaning

Clean the exterior surfaces with a clean, lint-free cloth and one of the cleaning solutions listed in the table above.

- Wring the excess solution from the cloth. Do not drip any liquid into open vents, switches, plugs, or connectors.
- Dry the surfaces with a clean cloth or paper towel.

Cleaning the Print Head

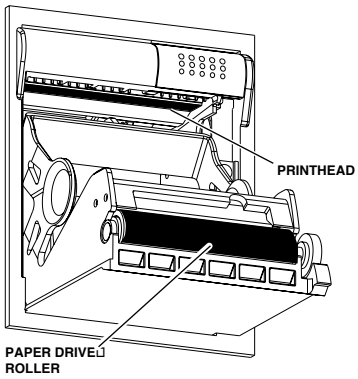
Heavy usage causes debris to build up on the print head. This build can cause the printed images to appear distorted. It is recommended that this procedure be performed when necessary, depending on usage.

Materials Required

A nonabrasive material/cloth and isopropyl alcohol are all that are necessary to perform this procedure.

This procedure should be performed in the order listed.

Procedure



1. Disconnect the power cord from the mains source.
2. Open the writer door to expose the print head.
3. Remove paper roll.
4. Locate print head shown in figure at left. A flashlight may help illuminate the print head for closer examination.
5. Wipe print head with alcohol and a nonabrasive material/cotton swab in an side to side motion. Continue wiping until the cloth/swab wipes clean.
6. Wipe paper drive roller clean of any bits of paper and debris with alcohol and a nonabrasive material.

Battery Maintenance

Charging

The battery is charged whenever the monitor is connected to AC power, regardless whether the monitor is turned on or turned off.

Conditioning the Batteries

To obtain the greatest possible battery performance and to keep the fuel gauge up to date, the battery needs to be conditioned every 3 months or after 250 discharge cycles.

There are three battery conditioning modes: automatic, user-controlled, and manual.

- Automatic mode: Conditioning starts automatically when the time limit (3 months) or the discharge limit (250 cycles) is reached. The automatic start time for the conditioning cycle is defined with the softkey AUTO START AT. (Should there be a loss of AC power, all the user has to do is plug in the power cord.)
- User-controlled mode: If the time limit or discharge limit is reached, the monitor displays the status message “BATTERY NEEDS COND”. It is up to the user to start the conditioning as a result of this message.
- Manual mode: In this mode the user is required to manually start the conditioning process. The time limit or discharge limit is not observed and has no effect. The conditioning process is started from the service menu.
- In the user-controlled and manual modes, conditioning is started using this menu sequence:
  MONITOR SETUP -> SERVICE MODE -> BATTERY SERVICE -> START CONDITION (notify service!).

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 twelve 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
Patient cable, 5-leadwire, AHA or	412931-001	1
Patient cable, 5-leadwire, IEC	412931-002	1
Leadwireset, 5-leadwire, AHA or	414556-001	1
Leadwireset, 5-leadwire, IEC	414556-003	1
BP to Simulator cable	700095-001	1
Temp to Simulator cable	6770031	1
NIBP tubing and fittings according drawing		
Digital Manometer	Sensym PDM2OOM	1
SpO_2 Simulator	408610-001	1
SpO_2 Simulator cable, Nellcor	700232-004	1
RAB	2005693-001	1
Data Service Kit	412637-003	1
Download Kit	2000453-001	1
DRST Dash Responder Service Tool	2006861-001	1*

* **Note**: When the monitor is connected to a docking station, use the docking station's power cable instead of the monitors power cable.

Monitor Power and Battery Tests

1. Connect a power cord between a properly wired wall receptacle and the monitor power connector.
2. If the unit is not turned off; press the power button to switch it off.
3. Verify that the AC power indicator stays illuminated.
   Verify that the CHARGING STATUS indicator stays illuminated according the following list:

   yellow battery is being charged but not full

   green battery is fully charged

   NOTE

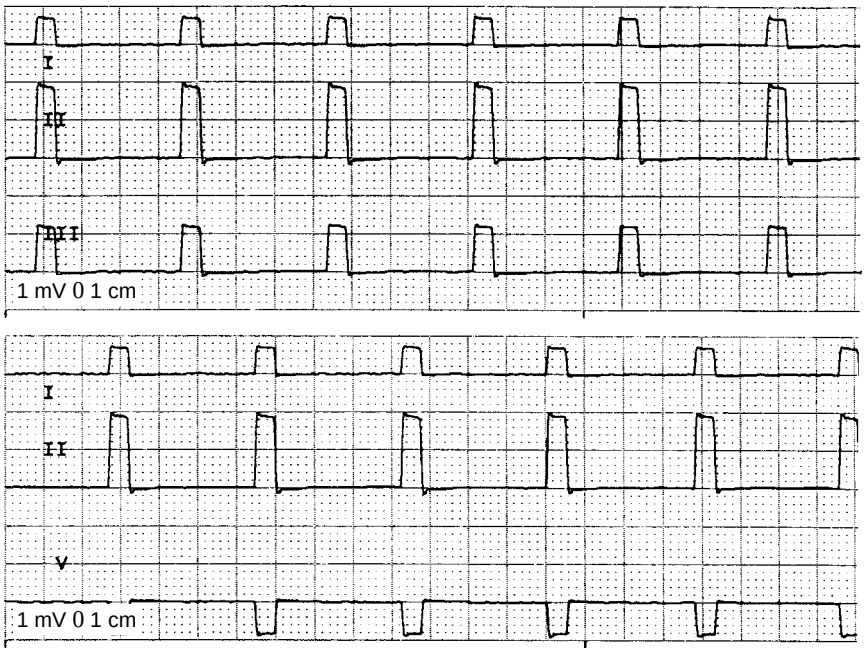
   If indicator blinks yellow, then there is a malfunction in the power management system. The unit needs to be repaired.

4. Switch the unit on and disconnect the the power cord. Verify that the BATTERY indicator stays illuminated, AC power indicator and CHARGING STATUS indicator go off.
5. Connect the power cord back to the unit (or to the docking station). Before continuing the test procedures the battery condition has to be checked.
   Starting from the screen showing the softbutton MORE MENUS, select the following menus in sequence:
   MORE MENUS, MONITOR SETUP, SERVICE MODE (actual date as password), BATTERY SERVICE.
   If the entry for last conditioning is older then 3 months, start a condition cycle (takes hours). If the entry is within 3 months, check if the FULL/NEW entry is below 40%, if it is below, exchange the battery.
6. Run the unit under battery power and perform the ECG Test step 1. to 4. as described later.
7. Connect the unit back to AC and perform the following tests.

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 ±2 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 ANALYSIS SETTING, DETECT PACE and set to PACE2.
7. Set ECG amplitude on simulator to 2 mV. 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, a star is blinking at each Pacemaker Pulse
   - if necessary press “Silence alarms”.
9. Disable pacemaker pulse detection on the monitor and return the simulator to these conditions:
   - Heart rate – 80 bpm,
   - Heart rate amplitude – 1.0 mV,
   - 5-lead ECG patient cable properly attached.
10. Select ECG lead II for viewing in the top trace position on the monitor display.
11. Disconnect the RA leadwire from the patient simulator.
12. Observe following:
    - a RA FAIL message appears on the display, and
    - lead III automatically displays in place of lead II in the top trace position.
13. Reconnect the RA leadwire to the patient simulator.
14. Setup the graph curve selection according to the figure below. 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. If others than the recommended simulators are used, the calibration pulses may be different (see figure below).
16. This completes the ECG tests. Continue to the next steps of these checkout procedures.



Respiration Tests

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 – 750 ¾,
   - RESP ýR – 0.5 ¾,
   - RESP lead select – I & II,
   - RESP rate (respirations per minute) – 30.
2. Set up the monitor as follows:
   - RESP parameter – on
   - 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.
6. Disconnect the ECG patient cable from the ECG/RESP connector of the monitor. Proceed to the next steps in these checkout procedures.

Temperature Tests

1. Set up the patient simulator for a temperature output of 37 °C.
2. Attach the temperature simulator from the series 400 TEMPERATURE OUTPUT connector of the patient simulator to the TEMP input of the monitor.
3. Verify a TEMP parameter window appears on the monitor display with a temperature reading of 37.0 °C ±0.4 °C.
4. Remove the temperature adaptor and temperature simulator cable from the monitor and patient simulator.

Invasive Blood Pressure Tests

The invasive blood pressure (BP) tests provide a method of verification for the BP connector 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.
2. Connect the BP simulator cable from the BLOOD PRESSURE 1 - 120/80 connector of the patient simulator to the BP connector of the monitor.
3. Select ART as pressure site. Verify the ART parameter window, waveform label, corresponding graticules, and waveform appear on the monitor display, along with a BP waveform requiring zero reference. If waveform does not appear select waveform display ART.
4. Press the FUNCTION push-button on the front panel of the monitor to zero-reference the ART BP waveform.
5. Change the patient simulator BP output to 200 mmHg.
6. Observe a reading of 200/200 (200) ± 6 mmHg in the ART parameter window on the monitor display.
7. Change the patient simulator BP output to WAVE (simulated BP waveform).
8. Set the ART BP waveform gain on the monitor to auto.
9. Observe a distortion-free ART BP waveform and a reading of approximately 120/80 (93) in the ART parameter window on the monitor display.
10. Disconnect the BP simulator cable from the BP connector of the monitor. This completes the BP test.

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 – 95.5% (using the white NELLCOR values),
   - PULSE RATE – 100 B/M (beats per minute),
   - MODE – NELLCOR,
   - Power switch – on.
4. Verify a SPO_2 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,
   - SPO_2% parameter reading of 92 – 99(%),
   - PPR parameter reading of 96 – 104 (beats per minute).
6. Verify accuracy of the SPO_2% 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 SPO_2% Value**
95.5%	92 – 99
85.5%	82 – 89
68.4%	65 – 72

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	66 – 74
100 B/M	96 – 104
160 B/M	155 – 165

8. Press the INTERFERENCE TEST button on the SpO_2 simulator for 30 seconds.
9. Verify the displayed SPO_2% value remains 92 – 99%, or an interference detection message is displayed and XX is displayed in the SpO_2 parameter window in place of an SPO_2% value.
10. Set the SpO_2 simulator power switch to the off position.
11. Disconnect the Nellcor-style SpO_2 simulator cable from the monitor SpO_2 connector. This completes the SpO_2 tests.

Noninvasive Blood Pressure Test

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

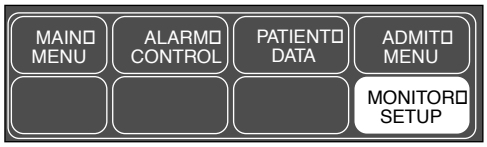
- the zero pressure reading, and
- the voltage span of the NBP sensor in the monitor.

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

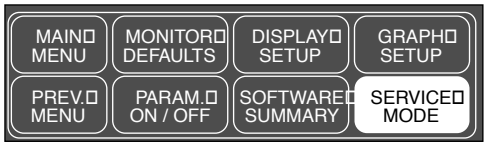
WARNING

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.

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 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.



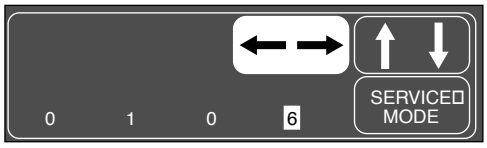
4. Use the Trim Knob control to scroll to SERVICE MODE in the monitor setup menu and press the Trim Knob control to select it.



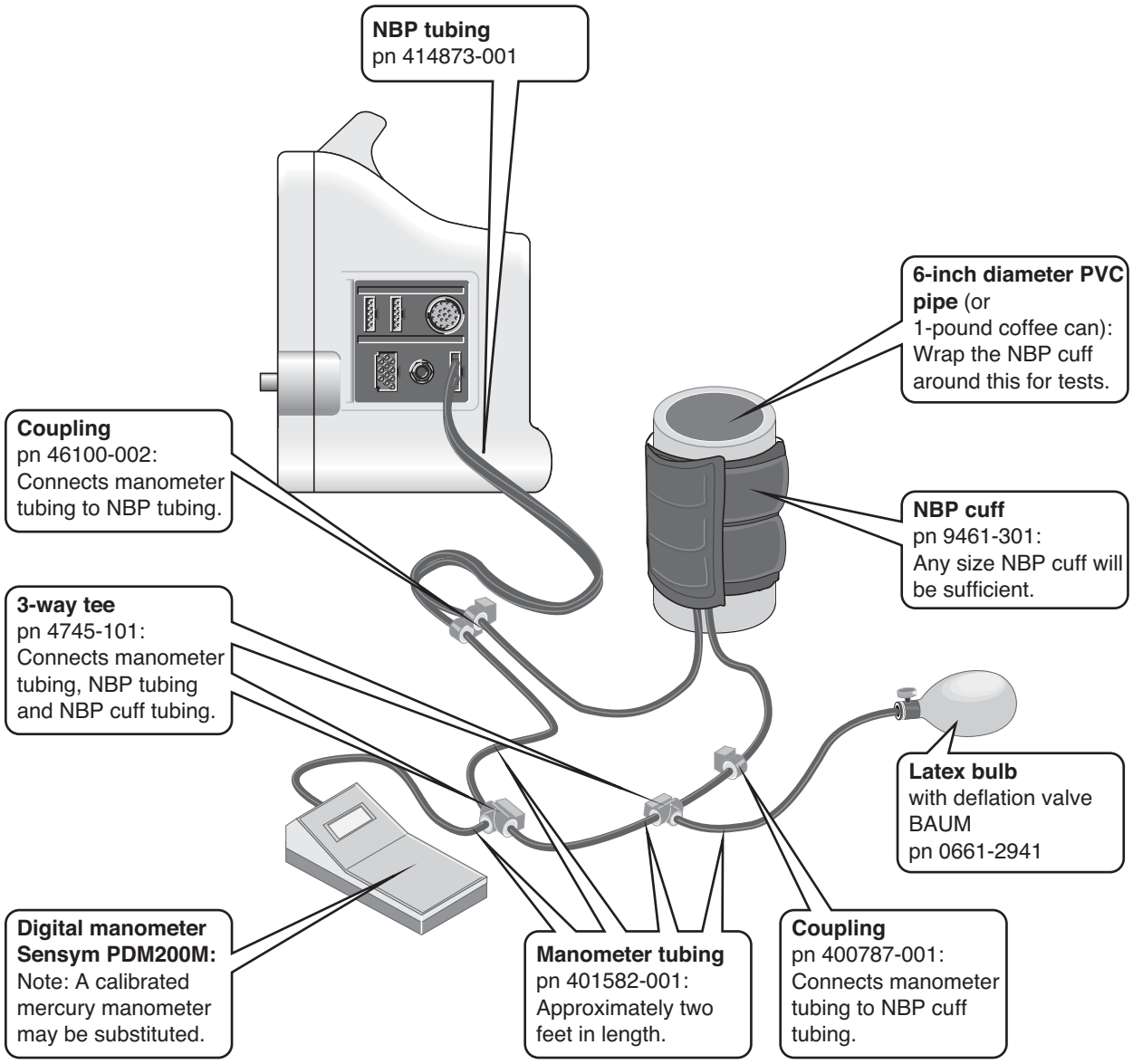
5. A service menu password window appears on the monitor display, as shown in the figure at the left. A password is required to prevent non-service personnel from accessing the service menus. The password is four numbers that represent the date that currently resides in a memory circuit within the monitor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

monitor display and follow these steps to enter the password:

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

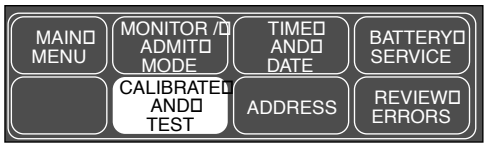


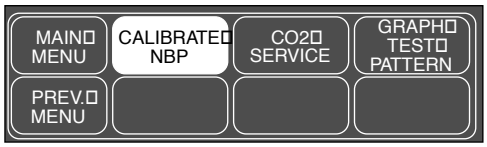
6. Connect a cuff and manometer to the monitor as shown below.



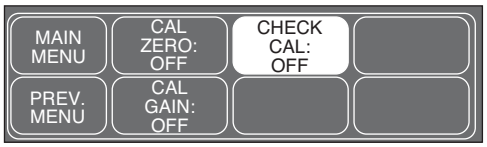
7. The service menus should appear on the monitor display. These next steps guide you through the service menus associated with checking NBP calibration and checking for leaks. If desired test results are not obtained, NBP calibration is necessary.

8. Rotate the Trim Knob control to highlight CALIBRATE AND TEST 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.





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



10. Rotate the Trim Knob control to highlight START, and then press the Trim Knob control to select it.

11. Leakage Test
    The Dash pumps up to 250 mmHg and then holds the pressure. Wait about 30 s until the pressure has stabilized to approximately 240 mmHg. From now on the dropdown-rate of the pressure must be less then 4 mmHg/min.

12. Measurement Accuracy
    By means of the latex bulb adjust the following pressures and check that the tolerance limits are not exceeded.

250 mmHg	±5 mmHg
200 mmHg	±4 mmHg
150 mmHg	±3 mmHg
100 mmHg	±3 mmHg
50 mmHg	±3 mmHg

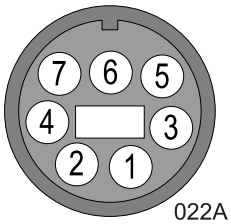
13. Deflation Pressure Threshold Test
    Increase the pressure, the cuff must be deflated automatically between 300 mmHg and 330 mmHg.

    Leave the service mode by pressing MAIN MENU:
    In NIBP menu, select neonate cuff size. Now start NIBP measurement. The system pumps up to appr. 120 mmHg. Now increase the pressure with the bulb, the cuff must be deflated automatically between 150 mmHg and 165 mmHg.

14. Active Test
    Apply a cuff and measure the blood pressure. Asses that the SYS, MAP and DIA parameter readings are plausible.

Defibrillator Synchronization Tests
(not for Dash Responder)

1. Use the figure at the left as a reference for connecting the oscilloscope to the DEFIB SYNC connector, located on the back panel of the monitor, for performing these tests.
2. Test the ECG 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.



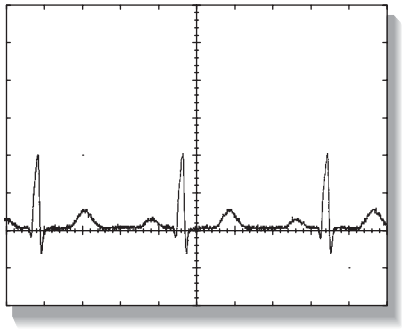
PIN	Signal Name	I/O	Signal Description
1	MARKER_OUT	O	Digital defibrillator output synchronization signal
2	MARKER_IN	I	Digital defibrillator input signal
3	ANALOG_GND	–	Analog return
4	DIGITAL_GND	–	Digital return
5	NC		
6	NC		
7	ECG_OUT	O	Analog ECG output signal

Patient Simulator Setup: HR – 80 bpm
HR amplitude – 1,0 mV

Display Setup: Channel I – Lead II

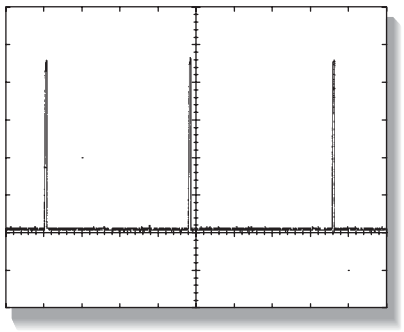
DEFIB SYNC connector: ECG

Signal Pin: 7
Ground Pin: 3
Time/Division: 0.2 s
Volts/Division: 0.5 V



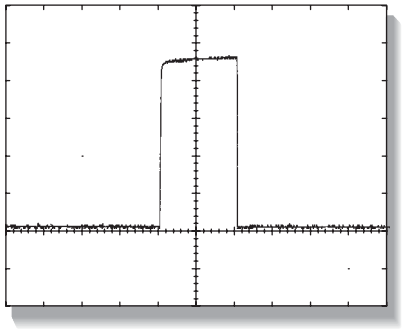
DEFIB SYNC connector: Marker Out (frequency)

Signal Pin: 1
Ground Pin: 4
Time/Division: 0.2 s
Volts/Division: 1 V, when Defi Sync output configured for 5 V



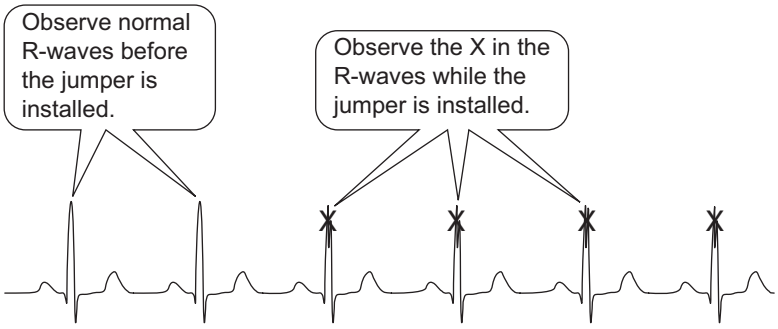
DEFIB SYNC connector: Marker Out (pulse width)

Signal Pin: 1
Ground Pin: 4
Time/Division: 5 ms
Volts/Division: 1 V, when Defi Sync output configured for 5 V and 10 ms



Verify defib sync markers

3. Attach a jumper wire between pin-1 (Marker Out) and pin-2 (Marker In) of the DEFIB SYNC connector located on the front of the monitor. Verify an X is displayed 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.

Display Test

1. Hold the **NBP GO/STOP** and the **FUNCTION** keys and press the Trim Knob control *at the same time.*
2. Release the Trim Knob control immediately.
3. Continue holding the **NBP GO/STOP** and the **FUNCTION** keys.
4. Select "Video Test Screens."
5. Inspect the WHITE SCREEN for defect cells.

Speaker Tests

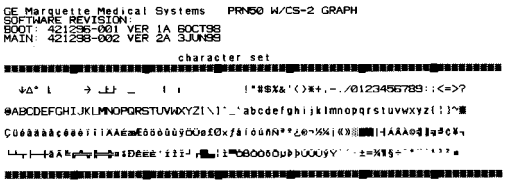
1. Enable an alarm of level WARNING.
2. Select *MORE MENUS -> ALARM CONTROL -> ALARM VOL*:
3. Change the alarm volume of the monitor to 100%.
4. Verify the speaker volume of the monitor changes accordingly.
5. Return the volume of the monitor to the level it was previously set to, before you changed it for this test.

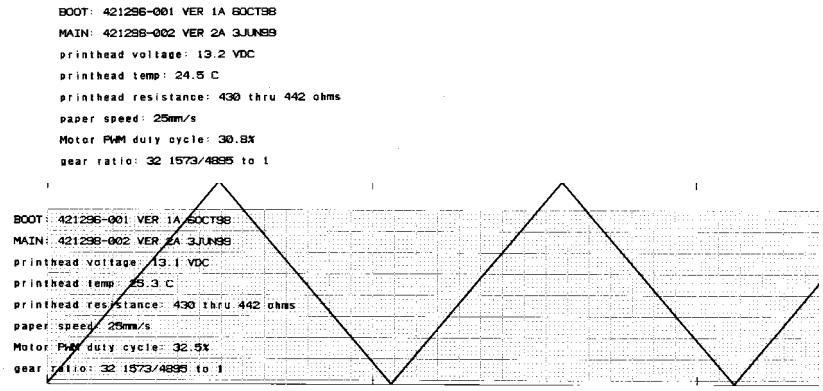
Graph Test

(with optional recorder built in)

Using the Trim Knob control, access the *SERVICE MODE* menu starting from the MAIN menu.

1. Select *MORE MENUS -> MONITOR SETUP -> SERVICE MODE ->*
2. Enter password using the Trim Knob control to select the day and month from monitor screen with leading zeros. (e.g. July 4 = 0407).
3. Select *CALIBRATE AND TEST -> GRAPH TEST PATTERN -> START ->*.
4. Verify the following:
   - Fonts.
   - Shading.
   - Triangle Pattern.
   - No missing dots.





5. Select *GRAPH TEST PATTERN-> STOP->*.

Graph Speed Test (with optional recorder built in)

Using the Trim Knob control, access the *GRAPH SETUP* menu starting from the MAIN menu.

1. Select *MORE MENUS -> MONITOR SETUP -> GRAPH TIME / SPEED -> GRAPH SETUP ->*
2. Select *SPEED:25* (default).
3. Verify that all eight speeds work.

Dash Port Docking Station Test

(with optional Dash Port Docking Station)

Electrical Safety Tests

When the monitor is connected to the docking station, perform ALL the tests described in "Electrical Safety Tests", starting on page 4-24.

Operation

Complete the "Checkout Procedures" located in the "Dash Port Docking Station Service Manual."

For the test of the Aux port, follow the Polled Parameter Interface check as described later.

LAN Network Check

Do the following to check the monitoring network:

Check if the ECG and parameter values are displayed correctly on a Centraloscope or CIC.

Remote Alarm Box Check

1. Connect the monitor to a RAB.
2. Verify all LEDs are flashing once.
3. Verify one of the LEDs A, B or C on (D may be on)
4. Provide a patient crisis alarm and verify LED E is on (and relay switches)

Peripheral Expansion Interface Check

If the monitor is used with the Dash Port Docking Station, perform the "Checkout Procedures" according to the "Dash Port Docking Station Service Manual". If it is used with the Dash Responder, perform the following steps.

Use the Dash Responder Service Tool Kit (DRST, pn 2006861-001) including:

1. software diskette
2. DRST-Box (pn 2005378-001) for adaption,
3. DC power supply (pn 2000300-001),
4. PC cable assembly (pn 223 362 03).

Additionally you need

- PC or laptop with
- Microsoft Windows 95 / 98 / NT / Windows 2000 or Windows Millenium.

- RS-232C serial port (COM)
- 3.5-inch floppy drive
- power cord for the power supply

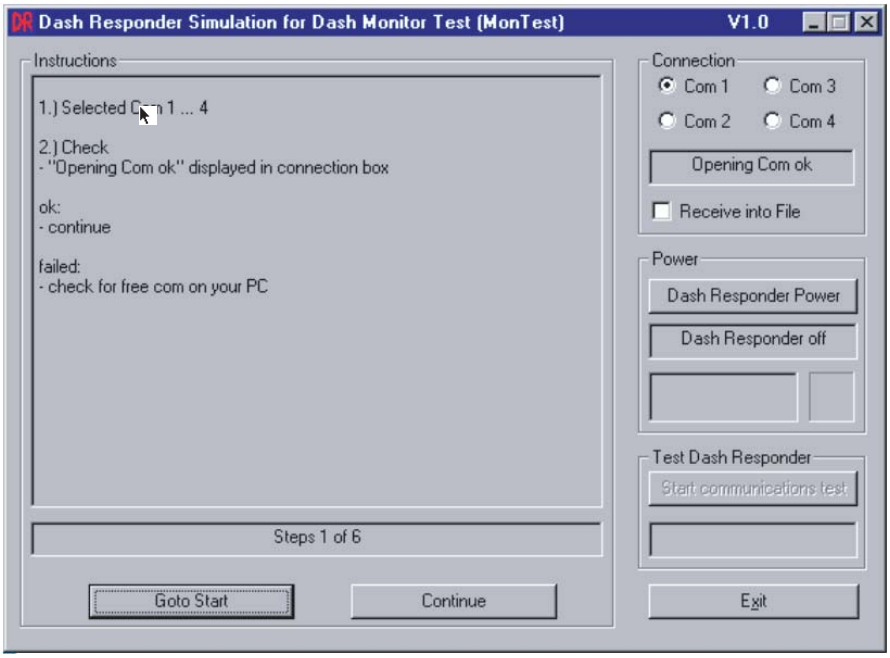
Installation

1. Create a directory on your hard disk (e.g., stools) and copy the service program MONTEST.EXE into this directory .
2. Attach the DRST-Box to the Dash Monitor instead of a Dash Responder.
3. Connect the power supply and the serial cable to the DRST-Box. The other end of the serial cable should fit into a free COM-port of your PC. You may need a standard 9pin/25pin adapter if the PC has a 25-pin socket COM

Interface Check

Start the test by executing MONTEST.EXE.

1. Follow the steps in the instruction window.



NOTE

The pushbuttons “Dash Responder Power” and “Test Dash Responder” are on the right side of the window.

2. After step 6, apply an ECG to the ECG input connector and check the DRST box's Sync LED blicking according the ECG heart rate.
3. To check the pacer blank function, press the Pacer Blank key on the DRST box several times and verify that the ECG waveform on the display is blanked each time.

Polled Parameter Interface Check

1. Connect the Monitor via the Download Kit 2000453-001 to the Serial Port of a PC or Notebook.
2. Connect an ECG simulator to the ECG input and set the simulator to a static heart rate.
3. Put the Data Services Demo Diskette 412637-003 in drive **a:** of your PC.
4. From directory **a:**\ASYNC start PDMS.EXE.
5. Now type **vp** and press ENTER.
6. Verify that the heart rate displayed on the monitor is the same as the heart rate displayed on the PC.
7. Now type **ex** and ENTER to quit the program.

Checkout Procedures Completion

This completes all tests associated with the checkout procedures.

1. Discharge the test patient admitted during the "ECG Tests" on page 4-10.
2. Set all test equipment power switches to the off position.
3. Unplug the monitor (or docking station) from AC power.
4. Remove all test equipment from the monitor (or docking station).

PM Form

Due to continuing product innovation and because specifications in this manual are subject to change without notice, a PM form is not included with this manual. For the latest PM form regarding this product, contact GE Medical Systems *Information Technologies* Service.

If repairs/adjustments were made or any parts replaced, describe this in the area provided on the PM form.

Also include comments regarding any unusual environmental conditions that may affect the operation or reliability of the equipment in the area provided on the PM form.

On the following pages a repair log is included for your convenience to record the repair history of this product.

Electrical Safety Tests

General

Electrical safety tests provide a method of determining if potential electrical health hazards to the patient or operator of the device exist.

Recommendations

To help you establish a systematic maintenance routine, Marquette recommends that you perform all safety tests presented in this chapter

- upon receipt of the device,
- every twelve months thereafter,
- each time the main enclosure is disassembled or a circuit board is removed, tested, repaired, or replaced, and
- record the date and results on the "Maintenance/Repair Log" included at the end of this chapter.

WARNING

Failure to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards. Unless you have an Equipment Maintenance Contract, Marquette Medical Systems does not in any manner assume the responsibility for performing the recommended maintenance procedures. The sole responsibility rests with the individual or institution using the equipment. Marquette service personnel may, at their discretion, follow the procedures provided in this manual as a guide during visits to the equipment site.

Test Conditions

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

Test Equipment

The manufacturer recommended test equipment required to perform electrical safety tests is **listed** below. Equivalent equipment may be substituted as necessary.

Required Tools/Special Equipment	
Item	**Part Number**
Leakage Current Tester	Equivalent to the circuits shown below
Multimeter	0 – 1000 mV AC eff.
ECG test body SpO_2 test body	MT 3387 MT4366

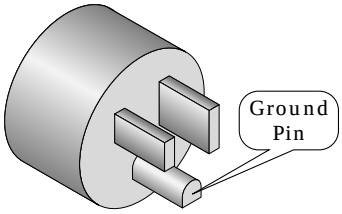
Wall Receptacle Test

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

For international wall receptacles, refer to the internal standards agencies of that particular country. Use a digital multimeter to ensure the wall receptacle is wired properly.

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

Ground (Earth) Integrity



Listed below are two methods for checking the ground (earth) integrity, “Ground Continuity Test” and “Impedance of Protective Earth Connection.” These tests determine whether the device's exposed metal and power inlet's earth (ground) connection has a power ground fault condition.

Perform the test method below that is required by your Country/Local governing safety organization.

Ground Continuity Test

Completion of this test is checked by the following steps:

1. Disconnect the DUT (device under test) from the wall receptacle.
2. Connect the negative(-) lead of the ohm meter to the protective earth terminal (ground pin in power in-let connector) or the protective earth pin in the MAINS PLUG (ground pin in power cord). Refer to the US 120Vac power cord figure on the left.
3. Set the Ohm meter to the milliohm (mΩ) range.
4. Connect the positive (+) lead of the Ohm meter to all exposed metal surfaces on the DUT. If the metal surfaces are anodized or painted scrape off a small area in a inconspicuous area for the probe to make contact with the metal.
5. Resistance should read to pass:
   - 0.1 ohm or less without power cord
   - 0.2 ohms or less with power cord

Impedance of Protective Earth Connection

This test unlike a ground continuity test will also stress the ground system by using special ground bond testers.

This test normally is only required as a manufacturing production test to receive safety agency compliance (i.e. IEC601-1).

Some country agency's do require this test after field equipment repairs (i.e. Germany's DIN VDE 0751 standards).

Consult your country/local safety agency if in question.

Compliance is checked by the following steps:

1. A current not less than 10A and not exceeding 25 A from a current source with a frequency of 50 or 60 Hz with a no-load voltage not exceeding 6 V is passed for at least 5 s through the PROTECTIVE EARTH TERMINAL or the protective earth pin in the MAINS PLUG and each ACCESSIBLE METAL PART which could become LIVE in case of failure in BASIC INSULATION.
2. The voltage drop between the parts described is measured and the impedance determined from the current and voltage drop. It shall not exceed the values indicated.

For EQUIPMENT without a POWER SUPPLY CORD the impedance between the PROTECTIVE EARTH TERMINAL and any ACCESSIBLE METAL PART which is PROTECTIVELY EARTHED shall not exceed 0.1 ohms

For EQUIPMENT with a POWER SUPPLY CORD the impedance between the protective earth pin in the MAINS PLUG and any ACCESSIBLE METAL PART which is PROTECTIVELY EARTHED shall not exceed 0.2 ohms.

When taking this measurement move the customer's power cord around, no fluctuations in resistance should be observed.

Ground (Earth) Wire Leakage Current Tests

Perform this test to measure current leakage through the ground (earth) wire of the equipment during normal operation.

1. Set the leakage tester switches as follows:
   - GND switch – OPEN,
   - Polarity switch – NORM and RVS,
   - 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 device under test to the power receptacle on the rear of the leakage tester.

NOTE

The device under test is to be tested at its normal operating voltage.

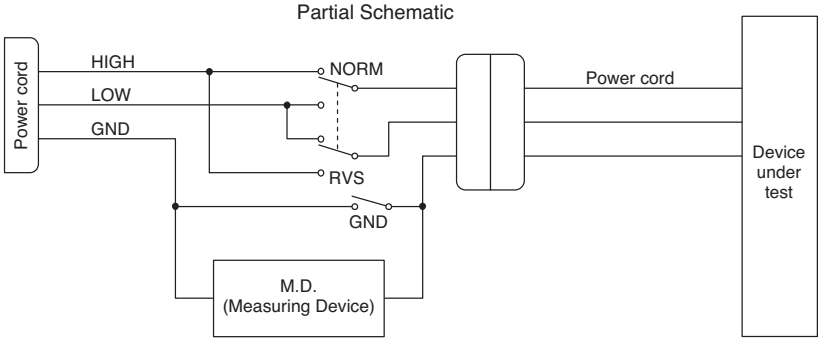
4. Set the leakage tester power switch to ON.
5. Set the power switch of the device under test to ON.
6. Read the current leakage indicated on DMM. If the reading is greater than the appropriate specification below, the device under test fails and should be repaired and tested again.
   - 300 microamperes (0.3 volts on the DMM), and the device under test is powered from 100 – 120 V / 50 – 60 Hz
   - 300 µA (0.3 volts on the DMM), and the device under test is powered from a centered-tapped 200 – 240 V / 50 – 60 Hz, single-phase circuit
   - 500 µA (0.5 volts on the DMM), and the device under test is powered from a non-center-tapped, 200 – 240 V / 50 – 60 Hz, single-phase circuit

NOTE

Center-tapped and non-center-tapped circuits produce different leakage currents and the UL and IEC limits are different.

7. Set the leakage tester power switch to OFF.

Leakage Tester
Partial Schematic



NOTES

The MD (measuring device) is the circuitry defined by the appropriate standard for measuring leakage current.

The measuring devices, defined by various standard organizations (IEC, UL, etc.), produce almost identical test measurement results.

Enclosure Leakage Current Test

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

1. Set the leakage tester switches as follows:
   - GND switch – OPEN,
   - Polarity switch – NORM.
2. Connect a meter lead between the GND of the tester according to the circuit and the 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 current leakage indicated on DMM. If the reading is greater than the appropriate specification below, the device under test fails and should be repaired and tested again.
   - 300 microamperes (0.3 volts on the DMM), and the device under test is powered from 100 – 120 V / 50 – 60 Hz
   - 300 µA (0.3 volts on the DMM), and the device under test is powered from a centered-tapped 200 – 240 V / 50 – 60 Hz, single phase circuit
   - 500 µA (0.5 volts on the DMM), and the device under test is powered from a non-center-tapped, 200 – 240 V / 50 – 60 Hz, single-phase circuit

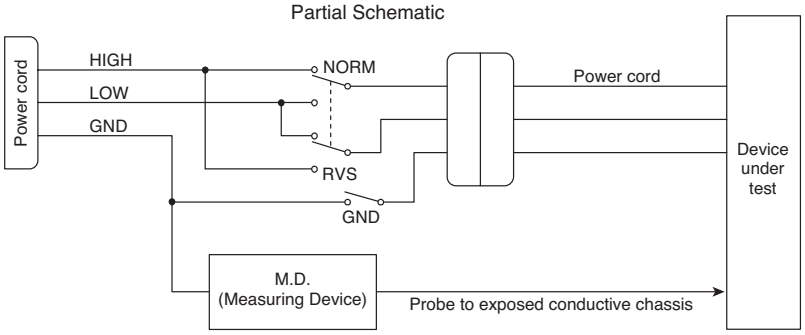
   NOTE

   Center-tapped and non-center-tapped circuits produce different leakage currents and the UL and IEC limits are different.

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 current leakage indicated on DMM. If the reading is greater than the appropriate specification below, and the device under test is powered from 100-240 V/50-60 Hz, the device under test fails and should be repaired and tested again.
   - 100 microamperes (0.1 volts on the DMM), and the device under test is powered from 100-240 V/50-60 Hz
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.

Leakage Tester
Partial Schematic



Test Completion

Disconnect all test equipment from the device. Disconnect the device power cord plug from the leakage tester power receptable. Disconnect the leakage tester from the wall receptable.

Patient (Source) Leakage Current Test

This procedure only applies to Class I (grounded/earthed) equipment, and measures the leakage current from the ECG/RESP connector of the device to ground.

1. Set leakage tester switches as follows:
   - GND switch – GND OPEN,
   - Polarity switch – NORM,
   - Power switch – OFF.
2. Connect a patient cable or ECG test body to the ECG/RESP connector of the DUT.
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. Read the leakage current indicated on the DMM.

   If the reading is greater than 50 µA (0.05 volts on the DMM), the device under test fails this test and should be repaired and tested again.

   NOTE

   The AAMI and IEC single fault condition (ground open) is 50 µA, whereas the normal condition (ground closed) is less.

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

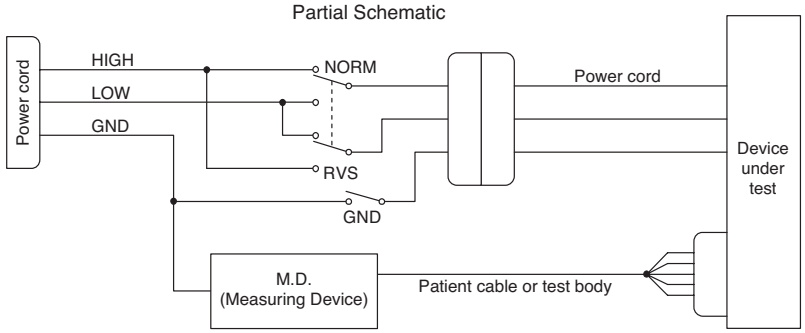
   If the reading is greater than 50 µA (0.05 volts on the DMM), the device under test fails this test and should be repaired and tested again.

   NOTE

   The AAMI and IEC single fault condition (ground open) is 50 µA, whereas the normal condition (ground closed) is less.

8. Change the GND switch to the CLOSED position.

Leakage Tester
Partial Schematic



9. Read the leakage current indicated on the DMM.

   If the reading is greater than 10 µA (0.01 volts on the DMM), the device under test fails this test and should be repaired and tested again.

10. Change the leakage current switch to the RVS position.

11. Read the leakage current indicated on the DMM.

    If the reading is greater than 10 µA (0.01 volts on the DMM), the device under test fails this test and should be repaired and tested again.

12. Set the power switch of the leakage tester to OFF.

Patient (Source) Leakage Current Test

This procedure only applies to Class I (grounded/earthed) equipment, and measures the leakage current from the SpO_2 connector of the device to ground.

1. Set leakage tester switches as follows:
   - GND switch – GND OPEN,
   - Polarity switch – NORM,
   - Power switch – OFF.
2. Connect a SpO_2 test body to the SpO_2 connector of the DUT.
3. Connect a short length of cable between the SpO_2 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. Read the leakage current indicated on the DMM.

   If the reading is greater than 50 µA (0.05 volts on the DMM), the device under test fails this test and should be repaired and tested again.

   NOTE

   The AAMI and IEC single fault condition (ground open) is 50 µA, whereas the normal condition (ground closed) is less.

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

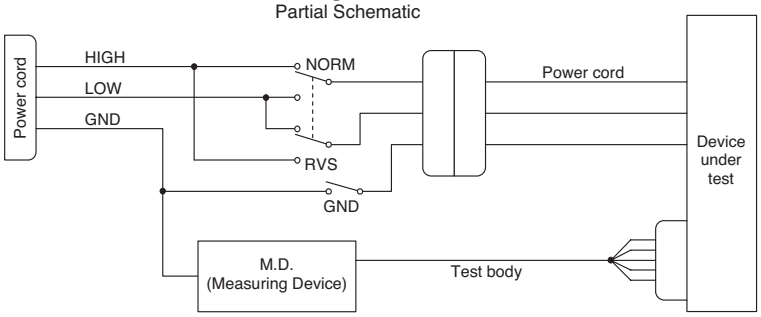
   If the reading is greater than 50 µA (0.05 volts on the DMM), the device under test fails this test and should be repaired and tested again.

   NOTE

   The AAMI and IEC single fault condition (ground open) is 50 µA, whereas the normal condition (ground closed) is less.

8. Change the GND switch to the CLOSED position.

Leakage Tester
Partial Schematic



9. Read the leakage current indicated on the DMM.

   If the reading is greater than 10 µA (0.01 volts on the DMM), the device under test fails this test and should be repaired and tested again.

10. Change the leakage current switch to the RVS position.

11. Read the leakage current indicated on the DMM.

    If the reading is greater than 10 µA (0.01 volts on the DMM), the device under test fails this test and should be repaired and tested again.

12. Set the power switch of the leakage tester to OFF.

Patient (Sink) Leakage Current Test (Mains Voltage on the Applied Part)

This procedure only applies to Class I (grounded/earthed) equipment, and measures the leakage current from a mains voltage source into the ECG/RESP connector.

1. Set the leakage tester switches as follows:
   - GND switch – CLOSED,
   - Polarity switch – NORM and RVS.
2. Configure the leakage tester like the circuit shown below.

WARNING

The following step will cause high voltage (120 VAC to 240 VAC) to appear on the leakage tester. Do not touch the 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 the appropriate specification below, the device under test fails this test and should be repaired and tested again.

   - 10 µA, (0.01 volts on the DMM) at 120 VAC w/o the patient cable.
   - 20 µA (0.02 volts on the DMM) at 240 VAC w/o the patient cable.

NOTE

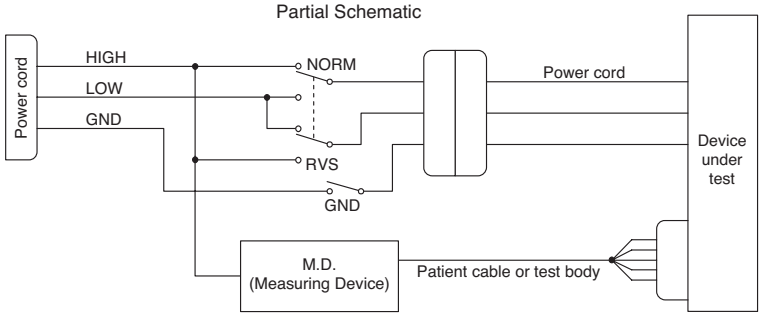
10 and 20 µA limits are based on internal design standards.

   - 50 µA (0.05 volts on the DMM) at 120 – 240 VAC with the patient cable.

NOTE

The 50 µA limit is common to all standards. AAMI ES-1 standard requires using the patient cable.

Leakage Tester
Partial Schematic



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

Patient (Sink) Leakage Current Test (Mains Voltage on the Applied Part)

This procedure only applies to Class I (grounded/earthed) equipment, and measures the leakage current from a mains voltage source into the SpO_2 connector.

1. Set the leakage tester switches as follows:
   - GND switch – CLOSED,
   - Polarity switch – NORM and RVS.
2. Configure the leakage tester like the circuit shown below.

WARNING

The following step will cause high voltage (120 VAC to 240 VAC) to appear on the leakage tester. Do not touch the SPO2 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 the appropriate specification below, the device under test fails this test and should be repaired and tested again.

   - 10 µA, (0.01 volts on the DMM) at 120 VAC w/o the patient cable.
   - 20 µA (0.02 volts on the DMM) at 240 VAC w/o the patient cable.

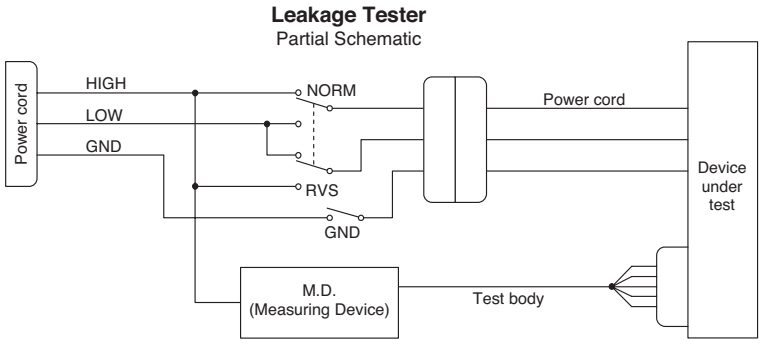
NOTE

The 10 and 20 µA limit are based on internal design standards.

   - 50 µA (0.05 volts on the DMM) at 120 – 240 VAC.

NOTE

The 50 µA limit is common to all standards.



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

Test Completion

Disconnect all test equipment from the device. Disconnect the device power cord plug from the leakage tester power receptable. Disconnect the leakage tester from the wall receptable.

Repair Log

A repair log is included for your convenience to record the repair history of this product.

Unit Serial Number:

Institution Name:

Date	Maintenance / Repair	Technician

5 TROUBLESHOOTING

Contents

Electrostatic Discharge (ESD)

CMOS Components

The monitor makes extensive use of CMOS components because they are more immune to noise and consume less power than standard TTL or NMOS components. However, CMOS components are inherently more susceptible to electrostatic discharge (ESD) damage than other types of semiconductor materials. ESD damage, causing a weakening or complete breakdown of p-n junctions within multilayer semiconductor substrates, can range from slight degradation to catastrophic failure. Slight degradation usually results in intermittent failure of the affected component catastrophic failure results in rendering the affected component permanently unusable. Although CMOS components may be more sensitive to ESD, all semiconductor devices are susceptible to ESD damage.

All external connector inputs and outputs of the monitor are designed with protection from ESD damage. However, if the monitor requires service, exposed components and assemblies contained within are susceptible to ESD damage. This includes human hands, non-ESD protected work stations and/or improperly grounded test equipment.

The following guidelines help make a service workstation more resistant to the ESD damage:

- Discharge any static charge you may have built up before handling semiconductors or assemblies containing semiconductors.
- A grounded, antistatic wristband (3M part number 2046 or equivalent) or heel strap should be worn *at all times* while handling or repairing assemblies containing semiconductors.
- Use properly grounded soldering and test equipment.
- Use a static-free work surface (3M part number 8210 or equivalent) while handling or working on assemblies containing semiconductors.
- **Do not** remove semiconductors or assemblies containing semiconductors from antistatic containers (Velo-stat bags) until absolutely necessary.
- Make sure power to an assembly is turned off before removing or inserting a semiconductor.
- **Do not** slide semiconductors or electrical/electronic assemblies across any surface.
- **Do not** touch semiconductor leads unless absolutely necessary.
- Semiconductors and electrical/electronic assemblies should be stored only in antistatic bags or boxes.

These guidelines may not guaranty a 100% static-free workstation, but can greatly reduce the potential for failure of any electrical/electronic assemblies being serviced.

Special Components

Surface Mounted Devices

Surface mounted devices are used to aid in miniaturizing the electrical/ electronic assemblies within the monitor.

Surface mounted integrated circuits have legs that are soldered to rectangular pads on the surface of the printed circuit board (PCB), versus pin-through devices having legs that are made to be inserted into solder fillets protruding completely through a PCB. Surface mounted integrated circuits (ICs, SMD, PLCC) may have legs on either two or four sides of the IC. Another surface mounted technology are Ball Grid Array ICs (BGA) using soldering balls as electrical connections on the bottom of the components.

Surface mounted resistors, capacitors, and diodes have conductive parts acting as legs that are directly soldered to the PCB.

WARNING

Surface mounted components were **not** designed to be removed or replaced using standard soldering equipment. Removal of surface mounted components using a conventional soldering iron can potentially destroy the PCB. Only soldering workstations specifically designed for surface mount technology may be used to remove and replace these type of components.

Battery Failure

Defective Battery/ Battery System

The BATTERY DEFECTIVE message is displayed in the STATUS MESSAGE line when errors have occurred within the battery management system or the battery. The reason of the battery system error can be found in the error log-book (MONITOR SETUP –> SERVICE MENU –> REVIEW ERRORS –> VIEW OUTPUT ERRORS). Check for PROCESS NAME: power_battm in the log-book.

The following error entries could be produced by the battery system:

0x717	No communication between PIC and PPC (12C-Error)
0x718	PIC loses communication to benchmark chip
0x719	Battery defective or disconnected or battery fuse blown

Blinking Charging Status

When the BATTERY DEFECTIVE error 0x719 occurs then additionally the CHARGING STATUS LED is blinking yellow.

Battery Replacement

A replacement of the battery is absolutely necessary when the battery reaches 40% full rated capacity of the 100% design capacity of the battery pack. Then the system message REPLACE BATTERY is displayed in the STATUS MESSAGE line. The Battery Service Information Window in the Battery Service Menu shows the actual FULL/NEW ratio in percent. If the usage of the Dash 2000 requires a replacement because the FULL/ NEW ratio of 40% is not acceptable then it is up to the user to replace the battery earlier.

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

Preparations to Open the Device

Before any service interventions, turn off the device and disconnect the device from the power line. Take ESD protection precautions as described in "Safety Information for Disassembly". Put the device on a clean, level surface (ESD pad) which is placed on a soft material to avoid scratches on the front panel.

Opening the Device and Battery Replacement

1. Disassemble the **DASH 2000 Assembly** as described in "Disassembly Procedure".
2. Disconnect battery connector and remove the 2 screws from the battery bracket.
3. Remove old battery and insert the new battery.
4. Assembly the device by reversing the above operating steps.

Due to replacement of the battery during which the battery management system was without current the fuel gauge no longer reflects the current battery status. The system indicates BATTERY LOW.

Everytime, after the battery was disconnected from the circuit board drain the battery by operating the device on battery power until it switches off. Then connect the device to the power line and start a conditioning cycle.

NOTE

Disposal Notice: Should this product (battery) become damaged beyond repair, or for some reason its useful life is considered to be at an end, please observe all local, state, and federal regulation that relate to the disposal of products that contain lead, batteries, plastics, etc.

Power Source Tests

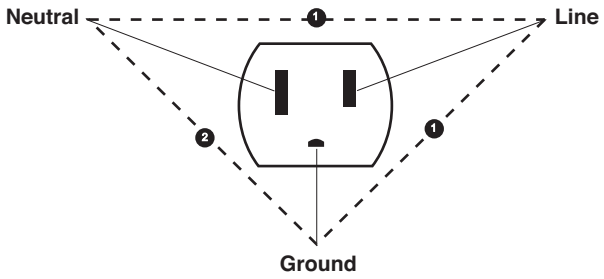
AC Line Voltage Test

This test verifies that the domestic wall outlet supplying power to the equipment is properly wired For international wiring tests, refer to the internal standards agencies of that particular country.

120 VAC, 50/60 Hz

Use a digital voltmeter to check the voltages of the 120-volt AC wall outlet (dedicated circuit recommended). If the measurements are significantly out of range, have a qualified electrician repair the outlet. The voltage measurements should be as follows:

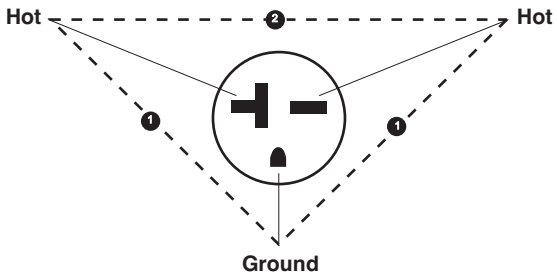
1. 120 VAC (±10 VAC) between the line contact and neutral and between the line contact and ground.
2. Less than 3 VAC between neutral and ground.



240 VAC, 50/60 Hz

Use a digital voltmeter, set to measure at least 300 VAC, to check the voltages of the NEMA 6-20R, AC wall outlet (dedicated circuit recommended). If the measurements are significantly out of range, have a qualified electrician repair the outlet. The voltage measurements should be as follows:

1. 120 VAC (±10 VAC) between either “hot” contact and ground.
2. 210 to 230 VAC between the two “hot” contacts.



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 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.

Ground Continuity and Impedance of Protective Earth Connection

- Verify correct Ground Continuity and Impedance of Protective Earth Connection as described under “Preventive Maintenance”.

Data Acquisition Tests

ECG Functions

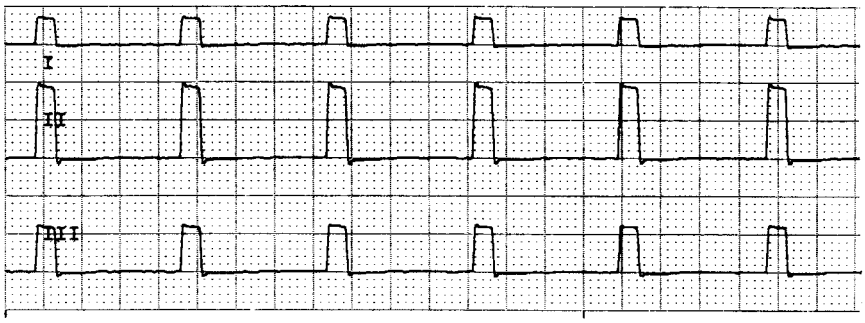
1. Connect the MEI Multifunction Microsimulator, pn MARQ1, and appropriate patient cables, to the ECG connector of the monitor. Turn the monitor and the patient simulator on.
2. Set the monitor to display leads I, II, and III and a second time to I, II and V:
   - Select WAVEFORMS ON/OFF from the menu.
   - Set the displayed waveforms for the following ECG leads:

	ECG 1	WAVEFORM 2	WAVEFORM 3
1.	LEAD I	LEAD II	LEAD III
2.	LEAD I	LEAD II	LEAD V

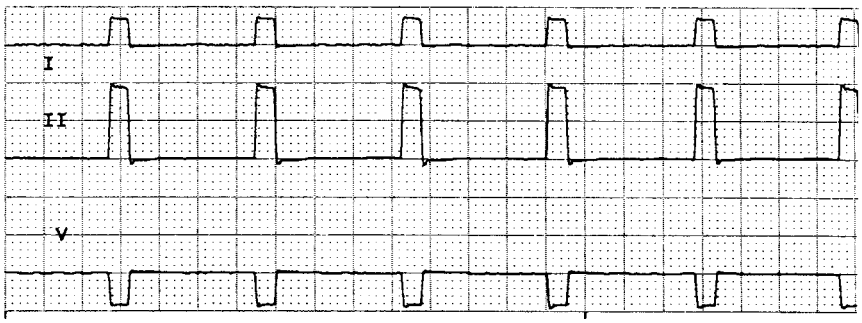
3. Set the patient simulator to output calibration (cal) pulses at 1.0 mV.
4. Check the cal pulse () amplitude. These should be according to the printed graph below.
5. It may be necessary to run a graph to accurately measure the cal pulses. Perform these steps to graph all four waveforms.
   - From the main menu, select GRAPH & ALARMS.
   - Select GRAPH CONTROL from the menu.
   - Set the graphed waveforms for the following ECG leads:

	ECG 1	WAVEFORM 2	WAVEFORM 3
1.	LEAD I	LEAD II	LEAD III
2.	LEAD I	LEAD II	LEAD V

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

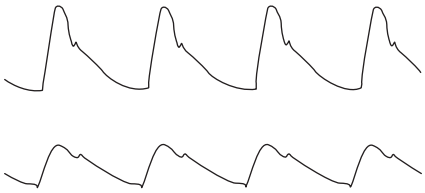


1 mV 0 1 cm



1 mV 0 1 cm

ECG Waveforms Display Incorrectly



1. If the calibration pulses were not correct, test the patient simulator using a working monitor. If the patient simulator is functioning as designed, you may need to replace the acquisition PCB.
2. If displayed ECG waveforms contain a significant amount of noise (see figure at left), check the ECG patient cables.
3. Test the patient simulator and ECG patient cables on a working monitor to verify the ECG signal.
4. If the ECG signal, patient simulator and ECG patient cables are good, the acquisition PCB is suspect and may need to be replaced.

ECG Waveforms Do Not Display At All

1. Test the ECG patient cables on a working monitor.
2. Test the patient simulator on a working monitor.
3. Swap the acquisition PCB into a working monitor. If the symptoms follow the PCB into the working monitor, replace the acquisition PCB.
4. If 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

1. With the monitor displaying leads I, II, 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.

Pace Detect Functions

(not for Dash Responder)

1. With the patient simulator set to HR 80, amplitude 2 mV and with the monitor displaying leads II, I, and V set the patient simulator to output a VP2 waveform.
2. Enable the pacemaker detection function of the monitor:
   - select ECG from the display main menu,
   - select DETECT PACE and set to PACE 2.
3. Verify the heart rate remains at approximately 80 bpm.
4. Disable the pacemaker detection function of the monitor.

Pace Detect Functions Do Not Work 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.

Invasive Blood Pressure Functions

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

Setup BP

Connect the BLOOD PRESSURE output of the patient simulator to the patient connector on the monitor.

Zero-Reference

Properly zero-reference the BP input:

- Set the patient simulator BP output to 0 mmHg
- Press the ZERO ART softkey in the BP menu.

Generate Dynamic BP Waveforms

Set the patient simulator BP output to WAVE.

Setup the BP scale on the monitor for auto gain:

- Select ART from the main menu of the monitor
- Select ART SCALE from the ART menu
- Select AUTO gain from the ART SCALE menu

Verify Dynamic BP Results

Once the BP waveforms are setup as described above verify the following:

- The ART BP waveform is noise-free.
- BP displayed parameter is within tolerance as indicated in the following list:

BP Parameter:	ART
Systolic (mmHg):	116 – 124
Diastolic (mmHg):	78 – 82

NOTE

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

Generate Static BP Waveform

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

- Verify the BP channel is working correctly if systolic, diastolic, and mean pressure values for ART are displayed between 194 and 206 mmHg.

BP Waveform Does Not Appear Correctly On The Display

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

BP Waveform Does Not Appear On The Display At All

1. If the ART parameter label, reading and associated waveform do not display on the monitor, verify the patient simulator and associated test cables on a working monitor.
2. Inspect the BP front panel connector on the monitor for bent or broken pins.
3. Perform continuity tests between the front panel connector of the monitor, front panel circuit assembly located behind the front panel connector and connection to the acquisition PCB.
4. If the patient simulator and associated test cables are determined to be functioning correctly and the continuity tests yield no malfunction, the acquisition PCB is suspect. Swap the acquisition PCB into a working monitor to determine if replacement is necessary.

Respiration Functions

1. Connect the MEI Multifunction Microsimulator, pn. MARQ1, and appropriate patient cables to the ECG/RESP front panel connector on the monitor.
2. Adjust the patient simulator to output a respiration waveform using the following settings:
   - Rate BPM – 30
   - Baseline Impedance Ohms – 750,
   - ýR 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 ýR 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.

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:

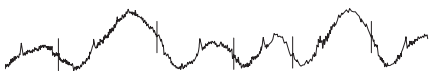
- Scroll to and select RR (respiration parameter) from the monitor main menu,
- Scroll to and select SENSITIVITY from the respiration parameter menu, and
- Scroll to and select a different sensitivity percentage (%) from the sensitivity menu

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 can be extremely difficult, if not impossible.

Noninvasive Blood Pressure Functions

Perform the noninvasive blood pressure (NBP) Checkout Procedure found in Chapter 4, “Maintenance”. This procedure determines 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 and enter the two-digit numeric day and month shown in the upper-left corner of the monitor display.
- Scroll to and select MONITOR/ADMIT 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.

Remote Alarm Box

Refer to Service Manual Remote Alarm Box.

Peripheral Expansion Interface

To check the Peripheral Expansion Interface, perform the interface check as described in section “Checkout Procedures” found in Chapter 4, “Maintenance”.

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.

Fault / Problem	Reason	Solution
The string "SERVICE MONITOR" is displayed on the screen	• Communication problems between DAS Acquisition board and PCB Mainboard • Calibration problems on DAS Acquisition	• Check connection between DAS and PCB Mainboard. • Replace DAS Acquisition board.
The Charging Status LED is blinking yellow	The battery is defective, disconnected or the battery fuse SI1 is defective	• Check the possible reasons and try to solve them. Change battery or replace PCB Mainboard.
Network communication problems	• PCB Main Connector defective • Ethernet Connector problems	• Check the possible reasons and try to solve them.
The LED 4 on the PCB Mainboard is not flashing continuously after 20 seconds startup time	The monitor is stuck somewhere in its startup sequence due to a malfunction on the PCB Mainboard.	• Replace the PCB Mainboard
Video problem – the LCD display is always dark	The LCD display, the backlight converter, the PCB Mainboard or Connector to LCD display has a malfunction	• Check the possible reasons and try to solve them • Replace the devices
General Problems		
The unit is plugged in, but it does not switch to AC from Battery power.	• The output voltage of the power supply is inadequate for the processor PCB to recognize.	• Replace the power supply. • Replace the processor/power management assembly.

Fault / Problem	Reason	Solution
Audio Problems		
Audio does not sound. **Go to MORE MENUS -> ALARM CONTROL -> ALARM VOL, change the volume and listen.**	• The speaker cable is loose or disconnected. • The speaker failed. • The audio circuit on the processor PCB failed.	• Restore the cable connections. • Replace the speaker. • Replace the processor/power management assembly.
Optional Writer Problems		
No paper comes out, even though "Graphing" is displayed.	• Graph locations are set incorrectly.	• With the Trim Knob control, select MONITOR SETUP -> GRAPH SETUP -> GRAPH LOCATION. Verify that MANUAL, ALARM, and PRINT locations are set properly.
Paper comes out, but no graph data is shown.	• The paper may be loaded incorrectly. • Print head may be dirty or defective.	• See the *Operator Manual* for correct paper installation. • Clean the printhead (refer to the maintenance chapter of this manual). • Perform a graph test. If problem persists, replace the writer assembly.
Saving Message.	• Writer is busy. • Writer is no longer available.	• When the graph is complete, the saved graph prints out. • Check the graph locations. Set the correct graph locations if necessary.
Missing segments in the graph data.	• Print head may be dirty or defective.	• Clean the printhead (refer to the maintenance chapter of this manual). • Perform a graph test. If problem persists, replace the writer assembly.
Optional Alarm Light		
The red or yellow lights do not light on boot up of the monitor.	• Cable may be loose or disconnected. • LEDs are burned out.	• Restore the connection. • Replace the alarm light assembly or PCB.

Fault / Problem	Reason	Solution
Video Display Problems		
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.	• Possible burned-out pixels.	• Run the display tests in the boot loader. • Replace the display assembly.
No display	• Display may be in standby mode. • Backlight inverted may be defective.	• Press the Power button. If display still does not appear within 10 seconds, replace the display assembly. • Replace back light inverter.

Acquisition PCB Symptoms

Symptoms relative to patient signal acquisition such as missing parameter text and waveform(s) may be associated with acquisition PCB 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, 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.

Processor PCB Symptoms

Symptoms with network communications, asynchronous communications, NBP control, analog output, audio/sound generation, and remote video signals/communications as well as other display-related problems all may be associated with processor PCB failure. All of these are functions controlled by microcontroller or graphics processing circuitry located on the processor PCB.

Power Supply PCB Symptoms

The power supply provides power that is used throughout the DASH monitor. The supply voltages are generated for various applications on the PCB Mainboard out of the +9 to +18 regulated VDC voltage. 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 failure.

+9 to +18 VDC Supply Applications

- Voltage Converters (+12 VDC, -12 VDC, +5 VDC, +3.3 VDC, +26 VDC, -23 VDC)
- Acquisition PCB
- Expansion Interface
- Writer Interface
- On/Off Interface

+12 VDC Supply Applications

- Defib marker out – power source for defib sync jack
- Audio amplifier – power source (speaker)
- NBP compressor (pump assembly) and solenoid valves – power source

+3.3 VDC Supply Applications

- Main processor PCB – logic power source

+5 VDC Supply Applications

- Main processor PCB – logic power source
- Display assembly – logic power source and backlight power source
- Ethernet transceiver
- Expansion Interface – logic power source
- Remote display – logic power source
- Main memory – flash memory programming power source

+26 VDC Supply Applications

- Color LCD voltage

-23 VDC Supply Applications

- Monochrome LCD voltage

Power Supply Fuses

The power supply has two 2-Ah fuses (slow-blow) on the primary side. If these fuses fail, the power supply must be replaced, not the fuses. For the secondary side, there is a 4-Ah fuse (slow-blow) on the PCB Mainboard. If this fuse blows, the entire PCB Mainboard has to be replaced, because the fuse is soldered onto the board.

Troubleshooting Software Updates – Problems and Solutions

The following is a list of problems commonly encountered during a software update with their solutions.

Problem	Possible Reason/Solution
Centralscope central station contains the software, but the monitor cannot find it.	The Centralscope central station has loaded the monitor software onto its hard drive, but the monitor does not see the central station on the network. There are two ways to get the central station to broadcast across the network. ■ If patient monitoring may be interrupted, press the CTRL, ALT, and DELETE (backspace) keys simultaneously to reboot the central station. ■ If the central station is monitoring patients, do the following: 1. At the central station, starting from the MAIN menu select *CENTRAL SETUP -> SERVICE ->* 2. Enter Password **MEI CS 123**. 3. Select *SERVICE MONITOR*. 4. Type ***ps eaglefs*** (case sensitive) and press **ENTER**. Enabling the EAGLEFS program that teaches your central station how to broadcast the software on the network. The central station will respond in one of two ways: ■ If the central station is not running EAGLEFS, it will respond with: *INVALID PROCESS ID OR NAME*. Type ***run eaglefs HDØ*** (case sensitive) and press **ENTER**. ■ If the central station lists EAGLEFS as a running process, go to the next step. 5. Press **MAIN MENU** on the front panel to exit the *SERVICE MONITOR* and go back to the monitor to download the software.
Monitor appears 'locked up' during a network download.	**CAUTION** Do not power cycle or reboot the monitor if downloading the Boot Code is proceeding normally. The monitor will be rendered useless. If the packet or byte numbers stop advancing for at least two minutes, do the following: 1. Check that all cables are properly connected. 2. At the patient monitor: ■ Hold down **NBP Go/Stop** and **Function**. ■ Press and release the Trim Knob control. ■ Keep holding **NBP Go/Stop** and **Function** until the Boot Code information appears on the display. 3. Repeat the software update procedure for the aborted file from the beginning.

Problem	Possible Reason/Solution
A:/> prompt does not appear at the PC	Select the correct disk drive on the PC to get the **A:/>** prompt. Many laptop PCs have a switch that allows a single disk drive to emulate two disk drives. Set the drive switch to A and then press the **CTRL**, **ALT**, and **DELETE** keys simultaneously to reboot the PC.
Monitor appears 'locked up' during a PC download	**CAUTION** Do not power cycle or reboot the monitor if downloading the Boot Code is proceeding normally. The monitor will be rendered useless. If the packet or byte numbers stop advancing for at least two minutes, do the following: 1. Check that all cables are properly connected. 2. Press the **ESC** key on the PC and the update will continue. 3. Select *ABORT* on the monitor or power cycle the monitor. 4. Repeat the software update procedure for the aborted file from the beginning.
Software revision window does not list part numbers.	If the part numbers are not listed for the monitor interfaces in the software revision window, the software update has not been activated. power cycle the monitor and view the software revisions window again. If the part numbers are still missing, repeat the update procedure for each missing file.
Waveforms do not appear at the central station.	If communication is corrupted, do the following: 1. Check all cables for a good connection. 2. Ensure that the central station software is correct. 3. Ensure Ethernet addresses have been programed correctly. Refer to the appropriate service manual. 4. Ensure the Ethernet address has been programmed correctly at the patient monitor: ■ Hold down **NBP Go/Stop** and **Function**. ■ Press and release the Trim Knob control. ■ Keep holding **NBP Go/Stop** and **Function** until the Boot Code information appears on the display. ■ The Ethernet address displays in the Boot Code banner information. 5. If the Ethernet address needs to be changed in Boot Code, a unique password is required to access *Change Ethernet Address* in the *Options Menu*. Fax a password request to GE Medical Systems *Information Technologies*' Software Upgrade Coordinator at (414) 362-3250 to obtain a password. You will need to provide your product serial number and Ethernet address. (The Ethernet address displays in the Boot Code banner information.)

6 CALIBRATION

Contents

Adjustments and Switches

Hardware Calibration

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

Reference Designation	Description
Main Processor PCB:	
S1	2-station DIP switch, LCD Type and Watchdog
R526	"Contrast" Potentiometer for display contrast adjustment. **Note**: Do not use this switch, see below.
Main Connector PCB:	
None	None
Acquisition PCB:	
None	None
Power Supply PCB:	
None	None

Software Calibration

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 if the maintenance test failed. The NBP software calibration should also be performed whenever the monitor is opened for service purposes. This ensures the pneumatic circuit plumbing has not developed any air leaks as a result of disassembly.

Display Calibration

Because of different displays used in the field, the display contrast is adjustable

- through the SERVICE MENU (bootloader) and
- a potentiometer (R526) at the PCB Mainboard.

To adjust the contrast, the following procedure has to be performed.

NOTE

The display should operate appr. 10 minutes before adjustment.

Display adjustment procedure

Disconnect the Dash monitor from Unity Network.

1. Activate the BOOT LOADER menu by the following steps:
   a. Hold down the NBP GO/STOP and FUNCTION keys
   b. Press and release the Trim Knob
   c. Do not release the NBP GO/STOP and FUNCTION until the BOOT LOADER menu appears on the display
   d. Wait until the SERVICE MENU is displayed
2. Select the VIDEO TEST SCREENS (11) by the Trim Knob
3. Select the CONTRAST (6) by the Trim Knob

Color Display

4. Select the middle value (corresponding to 60% in the MAIN MENU) by the Trim Knob, until there is a good contrast between red and orange and the different gray scales.
5. Select the minimum value (corresponding to 10% in the MAIN MENU) until the darkest bars are just distinguishable.
6. Select the maximum value (corresponding to 100% in the MAIN MENU) until the darkest bar changes to grey.

NOTE

If the maximum or minimum value is not adjustable, repeat the step 4, but select the default value and adjust the potentiometer R526. Then proceed with steps 5 and 6.

7. Exit the Video Test Screen Menu

Monochrome Display

4. Select the middle value (corresponding to 60% in the MAIN MENU) by the Trim Knob, until there is a good contrast between all gray bars.
5. Select the minimum value (corresponding to 10% in the MAIN MENU) until the dark bars are well distinguishable.
6. Select the maximum value (corresponding to 100% in the MAIN MENU) until the darkest bar changes to grey.

NOTE

If the maximum or minimum value is not adjustable, repeat the step 4, but select the default value and adjust the potentiometer R526. Then proceed with steps 5 and 6.

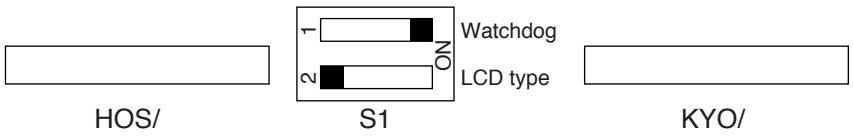
7. Exit the Video Test Screen Menu

Main Processor PCB

The main processor PCB has a 2-station DIP switch. This switch is used to configure the LCD display type color or monochrome and the watchdog ON or OFF.

Switch S1 Settings

As you can see in the picture below the 2-station DIP switch S1 can be found on the PCB Mainboard between the LCD connector HOS for the monochrome LCD display and the KYO connector for the color display. The switches are switched to ON state on the right site of S1. The above switch is switch 1 and the below switch is switch 2. Switch 1 is the watchdog ON/OFF switch. Switch 2 is the LCD type switch for monochrome or color display. Switch 2 has to be in position ON for a color display, in OFF position the monochrome display is selected. The watchdog needs to be enabled for normal application. If a board is configured as shown in the picture below the watchdog is configured ON and the LCD type is configured as monochrome type.



PCB Mainboard

Noninvasive Blood Pressure

The overall accuracy of noninvasive 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 the "noninvasive blood pressure test" upon initially receiving the monitor, before it is used on a patient, and once each year thereafter. Also, perform that procedure each time the monitor is opened for service or repair. If this test fails, the following has to be performed.

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:

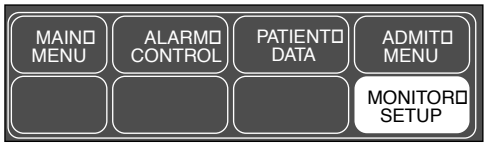
Description	Part Number	Qty
NBP cuff coupling	400787-001	1
NBP hose coupling	46100-002	1
NBP tee	4745-101	1
NBP tubing	401582-001	2

WARNING

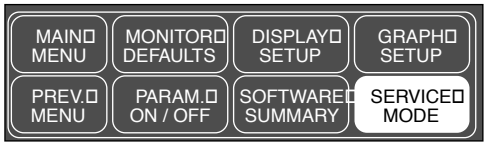
When the NBP cuff is used in this procedure, it must be tightly wrapped around a rigid cylinder or pipe. **Do not** put the NBP cuff around a human arm during the calibration procedures due to the potential for injury.

Calibration Procedure

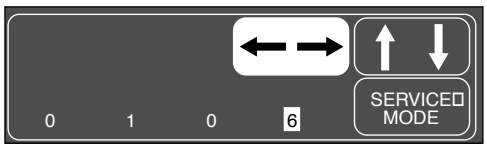
1. Remove all cables except for the power cord from the monitor.
2. Apply power to the monitor.
   - Plug the power cord into a working ac power wall receptacle and turn the monitor on.
3. Use the Trim Knob control to scroll to MONITOR SETUP in the monitor main menu and press the Trim Knob control to 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.



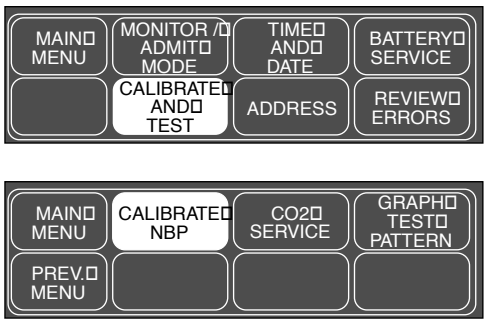
5. A service menu password window appears on the monitor display, as shown in the figure at the left. A password is required to prevent non-service personnel from accessing the service menus. The password is four numbers that represent the date that currently resides in a memory circuit within the monitor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



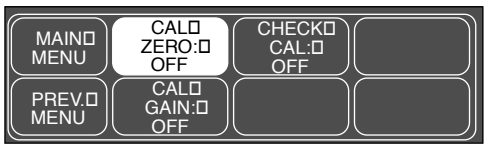
Service Menus

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 is necessary.

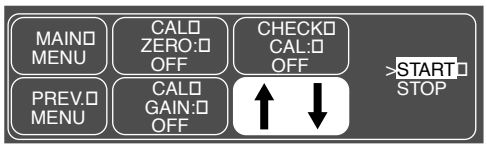
1. Rotate the Trim Knob control to highlight CALIBRATE AND TEST and press the Trim Knob control to select it. Next, rotate the Trim Knob control to highlight CALIBRATE NBP and press the Trim Knob control to select it.

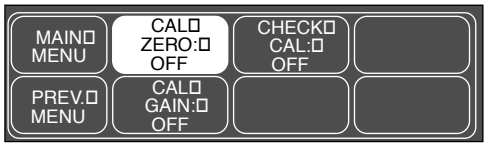


2. Rotate the Trim Knob control to highlight CAL ZERO OFF, and then press the Trim Knob control to select it.

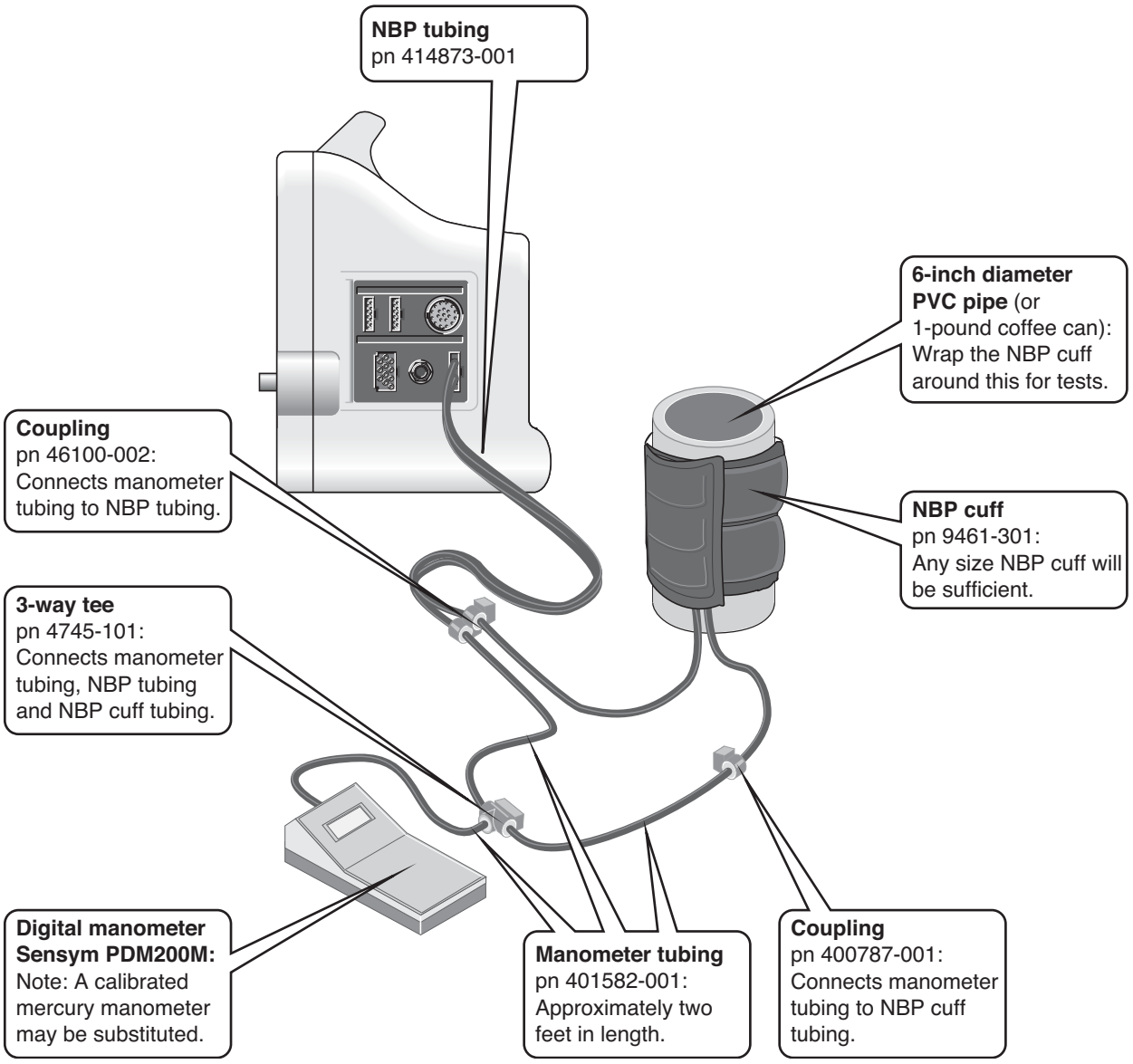


3. Rotate the Trim Knob control to highlight START, and then press the Trim Knob control to select it. The CAL ZERO menu item shows that it's IN PROGRESS, and when it's done it shows that it's OFF again.





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

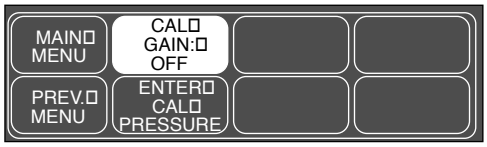


5. Turn the manometer on and adjust the range switch to the 1000þmmHg setting.

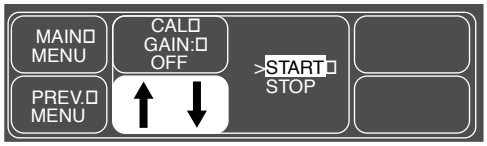
Start the Gain Calibration Test

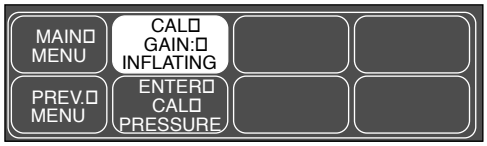
1. Rotate the Trim Knob control to highlight CAL GAIN OFF, and then press the Trim Knob control to select it.

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

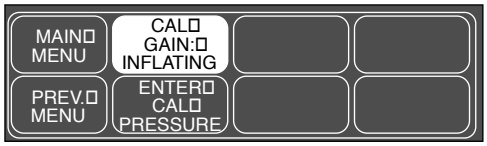


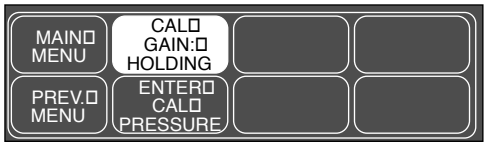
3. Rotate the Trim Knob control to highlight START, and then press the Trim Knob control to select it. The second line of text on the CAL GAIN menu item changes from OFF to INFLATING. Then, the monitor starts pumping up the pressure bulb or cuff – the audible whirring sound of the NBP pump motors occurs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



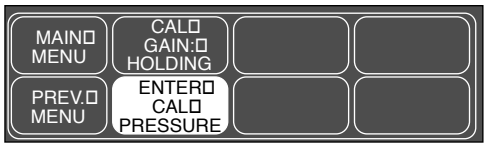


4. The pump shuts off at about 250 mmHg, and the pressure drops slowly to about 240 mmHg before stabilizing. The second line of text on the CAL GAIN menu item changes from INFLATING back to HOLDING. If the pressure continues to drop at a rate of 4 mmHg/min or more, there is a leak in the NBP plumbing. If there is a leak in the NBP plumbing, repair it and restart this calibration procedure.

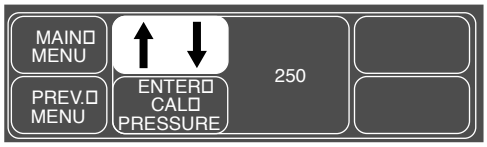




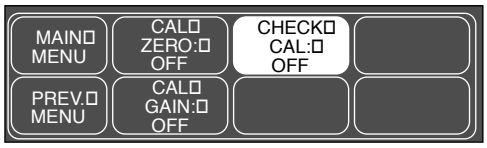
5. Rotate the Trim Knob control to highlight ENTER CAL PRESSURE and press the Trim Knob control to select it.



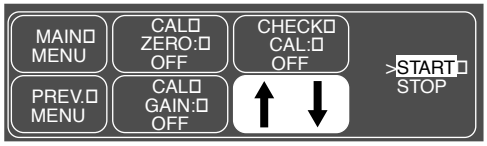
6. An ENTER CAL PRESSURE pop-up window will appear. Use the Trim Knob control to select a pressure value that is 1 mmHg lower than the current manometer reading.



7. 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.
8. Rotate the Trim Knob control PREV. MENU to highlight CHECK CAL OFF, and then press the Trim Knob control to select it.

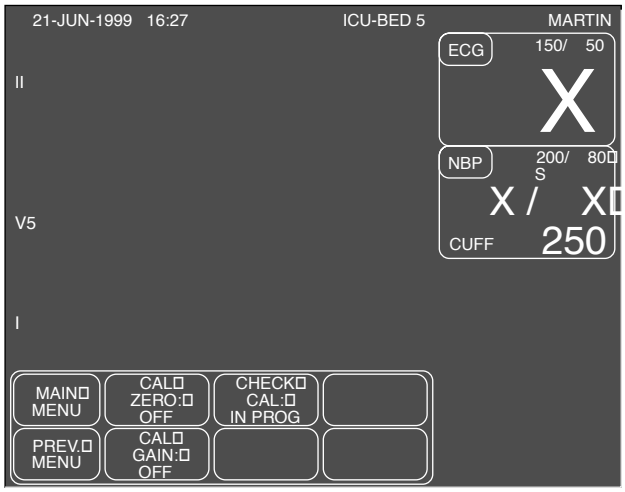


9. Rotate the Trim Knob control to highlight START and press the Trim Knob control to select it.



10. The text on the menu item changes 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.



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

12. 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.

13. Turn the monitor off, turn the manometer off and remove the test apparatus from the monitor.

7 CONFIGURATION

Contents

Monitor Configurations

Setup For Use

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

Stand-alone

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

Refer to the *DASH 2000 Patient Monitor Operator's Manual* for more information regarding all patient monitoring functions of the monitor.

Network Interface

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

Loading Software

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.

Software Loading/ Updating Methods

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:

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. Over the Network

NOTE

You must use the cables included in the download kit. See "Load Software From Diskette" on page 7-7.

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 or a Clinical Information Center (CIC). The central station or CIC then acts as a network file server and software is downloaded to the monitor over the network.

NOTE

It is recommended that you use AC power during the software download. If you use battery power, you cannot complete the download procedure and may need to return the monitor to the manufacturer for service.

Each method of downloading software to the monitor is distinctly different. Completely read 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.

Software Compatibility

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

MONITOR SETUP,
SOFTWARE SUMMARY, then
press the GRAPH GO/STOP key.

To print the software revision of the writer, use the Trim Knob to scroll to and select the following menu option items from the monitor main menu display:

MONITOR SETUP (1),
SERVICE MODE (2),
enter password (3)
(The password is the current date shown in the upper left corner of the display. The expected format is: DDMM.)
CALIBRATE AND TEST (4),
GRAPH TEST PATTERN (5), then
select START (6)

To stop test pattern, follow step (1) to (5), then select STOP.

If there is a previous revision of software residing in the monitor memory, update the monitor as necessary. Keep the monitor at current levels of manufacturer software to maintain the proper network communication and to 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.

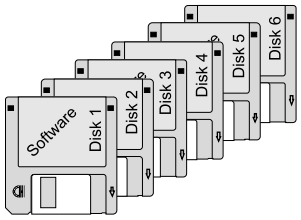
NOTE

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 is lost. The monitor is rendered useless and requires service by a manufacturer technical support engineer.

Monitor Software Files



All software files for the monitor are contained on six 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 SUMMARY table:

- Main processor operational code (MAIN),
- Acquisition processor operational code (DAS),
- Main processor boot code (MAIN BOOT), and
- Acquisition processor boot code (DAS BOOT)

To update the internal writer in the Dash 2000, you need to order the writer update kit. Contact your GE Marquette representative for further information.

NOTE

Do not start the download of the writer software without having the software available. The writer will get useless.

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 is 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, refer to the "How To..." chapter of the *Marquette Unity Network User's Manual*, pn 403799-023. If one is available, have the medical staff transfer the patient to a spare monitor while loading or updating software.

CAUTION

Patient Histories, Trends and Vitals are lost after the upgrade. Notify hospital staff to print out data before you start the upgrade.

Problems While Loading Software

If problems result while loading software into the monitor:

- Restart the procedure from the beginning,
- For monitors connected to patient monitoring network, refer to the

Marquette Unity Network User's Manual, pn 403799-023, 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.

Record Defaults

Print or record the monitor defaults before you upgrade the software and re-enter the monitor defaults when you finish the upgrade. This data may be lost during the software upgrade.

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 manufacturers 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 2000453-001, including:
   - Monitor cable assembly, pn 418335-002, and
   - PC cable assembly, pn 420915-013.
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 8-pin D-type connector labeled AUX (RS-232) on the monitor rear panel.
2. Connect the PC cable assembly from the RS-232C to the D-type connector labeled AUX at the rear of the PC.

Software Diskettes

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

Diskettes 1, 2, and 3 contain programs and files for downloading software to the monitor over the network. Refer to “Load Software Over The Network” for that procedure.

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

- Main processor boot code, and
- DAS processor boot code.

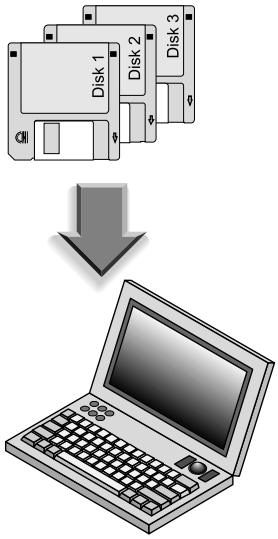
Diskette 5, also used for this procedure, contains the update program utility along with the update file for:

- Main processor operational code (part 1). This part of the update software includes monitor software in various languages.
- DAS operational code.

Diskette 6, also used for this procedure, contains the update program utility along with the update file for:

- Main processor operational code (part 2). This part of the update software includes monitor software in various languages.

Update Program Start-up



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

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 prevents inadvertent power interruptions to the PC or PC laptop. Interruptions of power 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.

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

   - Upgrade does not perform correctly under the simulated MS-DOS. Exit out of Windows to a DOS prompt.
   - Do not use Windows NT, since it does not allow an option to exit to DOS.

3. Compare the SOFTWARE SUMMARY window with the file names from the tables on the next page. Only load the files that currently reflect earlier revisions, as compared with the SOFTWARE SUMMARY printout, into the monitor. Generally, the main processor operational code (MAIN) or acquisition processor operational code (DAS) 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.

4. Following is the order in which the update files are to be downloaded:

   - Main processor op-code (MAIN), and
   - Acquisition processor op-code (DAS).

Then, only if necessary:

- Main processor boot code (MAIN BOOT), and
- Acquisition processor boot code (DAS BOOT).

Files on Diskette 4

Below is the list of update files typically found on Diskette 4.

Diskette 4 Files	
File Name	**Description**
45668900.*xxx*	MAIN BOOT
41510500.*xxx*	DAS BOOT

Files on Diskette 5

Below is the list of update files typically found on Diskette 5.

Diskette 5 Files	
File Name	**Description**
45669000.*xxx*	MAIN (1)
41495900.*xxx*	DAS

Files on Diskette 6

Below is a list with the update files typically found on Diskette 6.

Diskette 6 Files	
File Name	**Description**
45669000.*xxx*	MAIN (2)

5. Insert the diskette containing the specific software to be loaded or updated in the monitor into the PC floppy disk drive.
6. Type **a:** at the **c:**\> prompt and press ENTER on the PC keyboard to change directories to the floppy drive. Then type **update** at the **a:**\> prompt and press ENTER on the PC keyboard to launch the update program. The UPDATE UTILITIES menu appears on the PC display.

NOTE

Some computers may have a RETURN key rather than an ENTER key.

7. Press F2 on the PC keyboard to select UPDATE BEDSIDE from the update utilities menu. The UPDATE BEDSIDE utilities menu appears on the PC display.

NOTE

The update file included on diskettes 5 and 6 for other language update kits reflects a different file name than that shown in the list for each language of update kit ordered.

Setup 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.

1. At the monitor, activate the BOOT LOADER program by following these steps:
   - Hold down the NBP GO/STOP and FUNCTION keys,
   - Press and release the Trim Knob control,
   - Hold down the NBP GO/STOP and FUNCTION keys until the BOOT LOADER menu appears on the monitor display.
2. In this step, one of two situations is present:
   - For a monitor **not connected** to a patient monitoring network, the BOOT LOADER takes approximately 30 seconds to activate and the SERVICE MENU appears 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 appears on the monitor display.
3. Decide which code to download to the monitor based on software revision comparisons made earlier in the procedure. Use the Trim Knob to select the number corresponding to the SERIAL DOWNLOAD routine for the file requiring update.

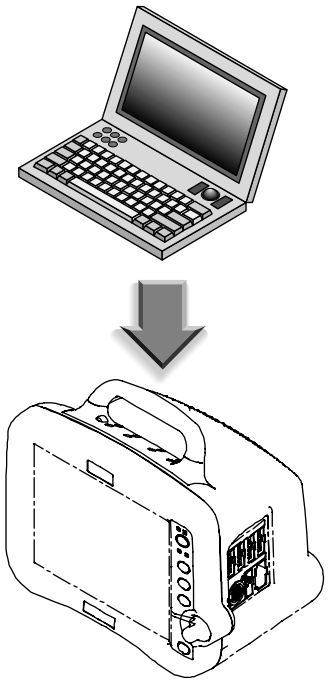
NOTE

A warning message and prompt appears on the monitor display. Use the Trim Knob to 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.

Download Files to the Monitor



At this point, the monitor is ready to accept download files and the PC is setup to provide the files for download. Follow the next steps once the PC and monitor are setup for download.

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

2. To begin the process of downloading the selected file, press ENTER 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 render the monitor useless. **Do not** interrupt the download process once it has begun. If you encounter problems that render the monitor useless, contact the appropriate technical support group listed in the beginning of this document.

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

NOTE

If you need to load MAIN code for a language other than already resides in the monitor ignore the warning and proceed to download software.

CAUTION

Do not reboot or power down the monitor while you download boot code files. This renders the monitor useless and requires factory service.

Verify PC-to-Monitor Communication

Messages 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 returns to the BOOT LOADER program and displays the SERVICE MENU, and the PC sounds an audible indication (a “beep”) and indicates a completed download process on the PC display. The monitor automatically restarts itself after any main processor code (MAIN or MAIN BOOT) is finished loading.

Errors During Download Process

For most errors, simply press RETURN 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 Steps For Each File Requiring Update

Perform steps in “Setup Monitor to Accept Download Files” and “Download Files to the Monitor” for each file that requires updating before proceeding to the next steps. When all code is loaded, turn monitor power off, then on.

Load Software Over The Network

About the Procedure

This section of the procedure provides instructions to load the contents of update diskettes 1, 2, and 3 to a Centralscope central station or Clinical Information Center (CIC) system 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.

NOTE

This method can only be used to update monitors 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, you cannot use this procedure to update the monitor. Refer to "Load Software From Diskette" for an alternate procedure.

Network Update Diskettes

Diskettes 1, 2, and 3, are used for this procedure and 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),
- Main processor boot code (BOOT.SCR), and
- Acquisition processor boot code (DASBOOT.SCR).

Copy Files

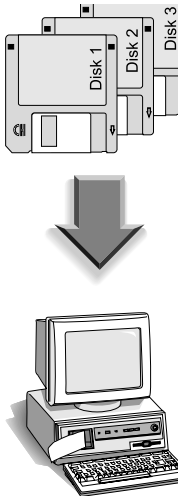
The following steps describe how to copy files from update diskettes 1, 2, and 3 onto the Centralscope central station or CIC system hard disk drive. The Centralscope central station or CIC system acts as a file server for downloading update files to the monitor over the patient monitoring network.

1. Write down the Centralscope central station or CIC CARE UNIT NAME and CENTRAL NUMBER of that particular central station for use later in this procedure.
2. Insert diskette 1 from the Update Kit into the Centralscope central station or CIC floppy disk drive.

Choose Procedure

Perform the procedure for your application ("Centralscope Central Station" or "Clinical Information Center (CIC)"). After you have copied the diskettes to your system, go to "Download Files to the Monitor."

Centralscope Central Station



1. At the Centralscope central station, execute the following menu sequence, starting from the MAIN menu:

   CENTRAL SETUP,
   SERVICE,
   PASSWORD (MEI CS 123),
   LOAD SOFTWARE (Wait 10 seconds), and
   FLOPPY.

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

   LOADING FROM...FLOPPY, (then)
   LOADING DISK D2<version> # 1 OF 3…

NOTE

The Centralscope central station may display status messages other than those described in these instructions. If, after 20 minutes, diskette 1 does not eject from the floppy drive, reboot the central station and start over.

---

3. When diskette 1 is completely loaded, the Centralscope central station automatically ejects the diskette and displays the message:

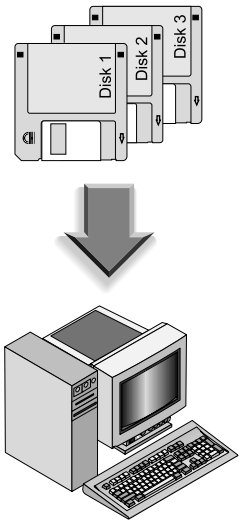
   INSERT DISK D2<version> #2 OF 3…

4. Follow the instructions on the screen to exchange diskettes in the hard drive as each one is loaded on the Centralscope central station hard drive.

5. When loading of diskette 3 is complete, the Centralscope central station automatically ejects the diskette and displays the message:

   LOAD FROM FLOPPY COMPLETE.

Clinical Information Center (CIC)



1. At the Clinical Information Center, execute the following menu sequence, starting from the MAIN menu:

   SETUP CIC,
   then, select the SERVICE PASSWORD tab,
   Type password: mms_com (lowercase with underscore)
   RETURN

2. At the **c:** prompt message, type:

   a: cinstall *xx*

   Where *xx* is the software version you are installing.

NOTE

If you insert the wrong diskette, or type in the wrong version number, the screen displays an “Incorrect Disk” error message. Press [CONTROL] [C] to restart the procedure.

---

3. Follow the instructions on the screen to exchange diskettes in the hard drive as each one is loaded on the Clinical Information Center hard drive.
4. When loading of diskette 3 is complete, the Clinical Information Center displays the message:

   INSTALL COMPLETE.

5. Click on the "X" in the upper right hand corner of each screen to close out the download screen and the main screen.

Download Files to the Monitor

The following steps describe how to download files from the network to the monitor.

NOTE

Verify the monitor is on the network by selecting LIST NETWORK from the SERVICE MONITOR menu of the central station or CURRENT TELEMETRY LISTINGS from the SERVICE menu of the CIC system

1. At the monitor, start the BOOT LOADER program by following these steps:
   - Hold down the NBP GO/STOP and FUNCTION keys,
   - Press and release the Trim Knob control, and
   - Hold the NBP GO/STOP and FUNCTION keys until the BOOT LOADER menu appears on the monitor display.
2. Use the Trim Knob to 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 acts as a file server to download files to the monitor over the network.
   - Select the number corresponding to the central station that contains the update files.
3. Use the Trim Knob to scroll to and select the number from the DIRECTORY SELECTION menu corresponding to:

   /update.net/dash2000/<version>

4. 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 older than the update files just copied onto the central station hard drive.

5. 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,
   *BOOT.SCR,
   DASMAIN.SCR, and
   DASBOOT.SCR.
   *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.

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

   NOTE

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

   CAUTION

   Do not reboot or power down the monitor while downloading boot code components (BOOT.SCR, DASBOOT.SCR, etc.). This renders the monitor useless and manufacturer factory service is required.

7. The order in which the files are updated in the monitor is important (see “Network Download Procedure”). If an update of the main processor operational code (MAIN.SCR) or main processor boot code (BOOT.SCR) components is required, the monitor reboots automatically upon completion of each of those updates.
8. Messages appear on the display to indicate how the update is going.
9. For most errors, simply repeat the previous steps. If the byte numbers stop advancing for more than two minutes, start the procedure over or call technical support.
10. Perform the previous steps for each software file as required. This should be based on comparison of revisions made earlier in this procedure.
11. When the update is complete, use the Trim Knob to select START PATIENT MONITORING.

Complete the Software Download

Activate Software

1. After all of the files have been successfully loaded, press the monitor power switch to OFF then ON to operate the monitor with the newly loaded software.
2. Re-enter the monitor defaults that you wrote down or recorded at the beginning of this procedure. If you need any assistance, see the Operator's Manual.

Completion

Setup Graph Locations

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

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

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 key on the monitor front panel. Verify the graph output arrives at the selected manual graph location. Press the GRAPH GO/STOP key again to stop the manual graph.
- Switch the simulator power off to cause a fatal alarm by. Verify the graph output arrives at the selected alarm graph location.
- Bring up a non-real-time window on the monitor display. Print the window. Verify the print output arrives at the selected print window location.

Verify Software Update

Verify the software downloaded successfully. Execute the following menu option selection sequence, beginning at the monitor main menu:

MONITOR SETUP
SOFTWARE SUMMARY
Press the GRAPH GO/STOP key

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

Update All Monitors

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

Configuring a Monitor

This section explains how to configure a patient 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.

The following procedure explains how to configure a patient monitor on the Unity Network. The monitor communicates with central stations, and other related equipment over the Unity Network. This network is essentially an Ethernet implementation.

General

Use this procedure if you are:

- experiencing communication problems on the Unity Network, or
- adding a new monitor to the Unity Network.

Gather Information

To configure a new monitor, you must first:

- know that the new monitor's software revision is compatible with the other monitors connected to the Unity Network.
- write down the exact care unit name from the upper left hand corner of the central station.
- write down the bed name for the new monitor.
- know if the monitor will be used for either stationary or ambulatory (telemetry) monitoring or both.
- know if the monitor will be moved from one Ethernet connection to another.

Select Procedures

Choose and program the procedures listed below in the order presented. Each procedure is described on the next pages.

Main Menu Selections

- Set Unit Name
- Set Bed Number
- Patient-Monitor Type
- Set Graph Locations
- Admit Menu

Boot Code Selections

- Defib Sync Voltage
- Defib Sync Pulse Width
- Line Frequency
- TC Pace Blank Length

After completing all necessary procedures, perform the “Checkout Procedures” found in Chapter 4, “Maintenance”.

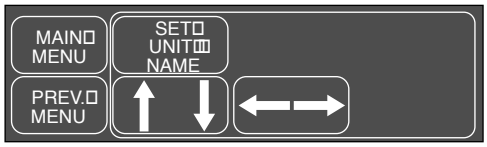
Main Menu Selections

Set Unit Name

Up to seven characters are used to identify the care unit. These characters display at the top right of the screen immediately preceding the bed number.

Access *SET UNIT NAME* option, starting from the Main Menu.

1. Select *MORE MENUS -> MONITOR SETUP -> SERVICE MODE.*
2. Enter password using the Trim Knob control to select the day and month from monitor screen with leading zeros. (e.g. July 4 = 0407)
3. Select *ADDRESS -> SET UNIT NAME.*



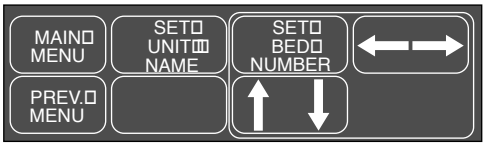
4. Use the Trim Knob control to select and change each character. Up to seven characters may be entered.
5. Select *SET UNIT NAME* and press the Trim Knob control to exit.

Set Bed Number

The bed number identifies a particular patient bed. Up to five characters are used to identify bed number. This number displays at the top right of the screen.

Access *SET BED NUMBER* option, starting from the Main Menu.

1. Select *MORE MENUS -> MONITOR SETUP -> SERVICE MODE.*
2. Enter password using the Trim Knob control to select the day and month from monitor screen with leading zeros. (e.g. July 4 = 0407)
3. Select *ADDRESS -> SET BED NUMBER.*



4. Use the Trim Knob control to select and change each character. Up to five characters may be entered.
5. Select *SET BED NUMBER* and press the Trim Knob control to exit.

Patient-Monitor Type

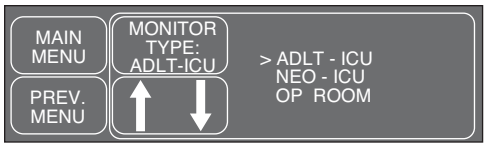
The *MONITOR TYPE* selection determines the type of monitor desired, i.e adult, neonatal or operating room. Different alarms and parameters are activated for each selection. This menu item is part of the *SERVICE MODE* menu.

CAUTION

Each time the patient-monitor type is changed, the *ADMIT MENU* function defaults to STANDARD configuration. Be aware that some alarms and parameters may be changed.

Access *MONITOR TYPE* option, starting from the Main Menu.

1. Select *MORE MENUS -> MONITOR SETUP -> SERVICE MODE.*
2. Enter password using the Trim Knob control to select the day and month from monitor screen with leading zeros. (e.g. July 4 = 0407)
3. Select *MONITOR/ADMIT TYPE -> MONITOR TYPE.* Be sure to read the information in the ATTENTION box before changing anything.



4. Rotate Trim Knob control to select the type of environment the monitor will be used in.
5. Press Trim Knob control to exit. Your selection displays at the top of the screen after the time.

Set Graph Locations

Access *MANUAL GRAPH LOCATION* option, starting from the Main Menu.

1. Select *MORE MENUS -> MONITOR SETUP -> GRAPH SETUP -> GRAPH LOCATION -> MANUAL GRAPH LOCATION*.
2. Using the Trim Knob control, choose the manual graph location from the list.
3. Select *ALARM GRAPH LOCATION*.
4. Using the Trim Knob control, choose the alarm graph location from the list.
5. Select *PRINT WINDOW LOCATION*.
6. Using the Trim Knob control, choose the print window location from the list.

Communication Confirmation

Confirm communication across the network.

1. Admit and generate a waveform at the monitor with a simulator.
2. Press **Graph Go/stop** and observe graph output at chosen locations.

Problems?

If the writer or printer does not graph:

- Ensure the writer or printer is turned ON.
- Check all cables for a good connection.
- Check programmed alarms and manual graph locations at the monitor.

If you do not have a waveform at the central station:

- Ensure the central station software is compatible.
- Check all cables for a good connection.
- Check the programmed alarms and manual graph locations at the monitor.
- Ensure the care unit name is the same in the monitor and in the central station.
- Ensure the central station serial number and LAN address are programmed correctly.

Admit Menu

The *ADMIT MENU* selection determines the function of the monitor. This menu item is part of the *SERVICE MODE* menu.

Before programming the *ADMIT MENU*, you must know if the monitor will be used for standard adult, neonatal, or operating room monitoring, and if the monitor will be moved from room to room. All combinations are explained below.

- STANDARD configures the monitor to stay in one room for stationary monitoring only. Monitors not connected to the Unity Network (Ethernet connection) must use STANDARD configuration only.
- ROVER configures the monitor to move from room to room for stationary monitoring only.
- COMBO configures the monitor to stay in one room for both stationary and ambulatory (telemetry) monitoring. This monitor displays all Tram module data combined with ECG data for ambulatory patients.
- ROVER COMBO configures the monitor to move from room to room for both stationary and ambulatory (telemetry) monitoring.

1. Access *ADMIT MENU* option, starting from the Main Menu. Select *MORE MENUS -> MONITOR SETUP -> SERVICE MODE*.
2. Enter password using the Trim Knob control to select the day and month from monitor screen with leading zeros. (e.g. July 4 = 0407)
3. Select *MONITOR/ADMIT TYPE -> ADMIT MENU*.

4. Use the Trim Knob control to select the function of the monitor.
5. Press Trim Knob control to exit.

Boot Code Selections

To access the Boot Code selections, you need to start the boot loader program and enter either the CONFIGURATION menu or the OPTIONS menu according to the following instructions.

CAUTION

Disconnect the patient from all patient cables before starting this process.

Start the boot loader program

1. Press and hold the **NBP Go/Stop** and **Function** keys on the keypad.
2. Press and release the Trim Knob control while continuing to hold the **NBP Go/Stop** and **Function** keys on the keypad until the boot loader menu appears on the monitor display.

Open the Option Menu

1. Within approximately 30 seconds, one of the two following menus will be displayed:
   - the SERVICE MENU, or
   - the FILE SERVER SELECTION menu (if this menu appears, rotate and press the Trim Knob control to select SERVICE MENU at the prompt).
2. From the SERVICE MENU, rotate and press the Trim Knob control to select the number corresponding to the OPTIONS MENU feature. Following is a list and a brief explanation of each feature.

1 Change Ethernet Address	For factory use only; don't change
2 Clear Configuration Memory	For factory use only
3 Set options in hex form (XX)	For factory use only
4 Invasive BP: enabled	Enables or disables Invasive BP option
5 Enable Trial Options	Time limited enabling of options
6 Exit	Return to the Service Menu

The option are stored on the main board. If exchanging a main board, check if the options match the status before exchange. If not, the options have to be activated by password:

Enter password

3. After selecting a feature, an "Enter password" prompt will appear on the display. Enter the password(s) provided. To do this, rotate the Trim Knob control until the desired character appears, then press the Trim Knob control to select the desired character. Upon the selected character, the cursor will advance to the next character

field.

NOTE

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

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

Exit the program

4. When the OPTIONS MENU has been properly configured, select Exit to return to the SERVICE MENU. Restart the monitor to enable the selected features.

Open the Configuration Menu

1. Within approximately 30 seconds, one of the two following menus will be displayed:
   - the SERVICE MENU, or
   - the FILE SERVER SELECTION menu (if this menu appears, rotate and press the Trim Knob control to select SERVICE MENU at the prompt).
2. From the SERVICE MENU, rotate and press the Trim Knob control to select the number corresponding to the SET CONFIGURATION feature. Following is a list and a brief explanation of each feature.

1 Defib Synch Voltage: …	Choose 5 V or 12 V amplitude. Default is 5 V.
2 Defib Synch Pulse Width: …	Choose 10 ms or 100 ms for pulse duration. Default is 10 ms.
3 Line Frequency: …	Choose 50 Hz or 60 Hz. Default is 60 Hz.
4 TC pace blank length (x * 8,33 ms): …	This menu option refers to the Dash Responder pacer detection. If the pacer provides a pulse, the ECG acquisition is suspended for a certain period of time. The length of this period, the Transcutaneous Pace Blank Length, is determined by a configurable value (range 3 to 10) multiplied by 8.33 milliseconds. Default value is 3.
5 Country Selection: …	Select DEFAULT or FRANCE to choose a particular set of factory defaults. Even though a GERMANY selection is offered, it has no different effect than using DEFAULT.
6 Exit	Return to the Service Menu

Advanced User Procedures

The following procedures are for advanced users only. These procedures should rarely be used, and only experienced technicians should proceed.

Procedures

The following procedures are discussed later in this chapter.

- Set Time and Date
- Change Ethernet Address
- Set Internet Address
- Reviewing Error Logs
- Transferring Error Logs
- Reviewing Event Logs

After completing any of the procedures, it is recommended to perform the "Checkout Procedure" found in Chapter 3, Maintenance.

Set Time and Date

Change the time only when the system is switched to or from daylight savings time.

NOTE: When a monitor is first connected to the Unity Network, the time and date is automatically updated from the network time.

WARNING

Loss of patient data history. Changing the time or date settings may result in the loss of patient data history. If one monitor's time or date is changed, all monitors on the network 'listen' and follow suit within 3-5 seconds. Changing the time base of one monitor may cause some loss of patient data history for all the monitors on the network.

The following procedure explains how to use the *TIME AND DATE* option in the monitor *SERVICE MODE* menu.

1. Access the *TIME AND DATE* menu starting from the Main Menu. Select *MORE MENUS -> MONITOR SETUP -> SERVICE MODE.*
2. Enter password using the Trim Knob control to select the day and month from monitor screen with leading zeros. (e.g. July 4 = 0407)
3. Select *TIME AND DATE -> SET TIME* and use the Trim Knob control to change the time. The time displays as a 24-hour military clock.
4. Select *TIME AND DATE -> SET DATE* and use the Trim Knob control to change the date.

Change Ethernet Address

The Ethernet address is an identification number assigned to each device on the Unity Network. It must be done in Boot Code using a unique password only if it has been corrupted. Contact your sales/service representative and provide them with the serial number and Ethernet address of the unit to obtain a password.

WARNING

Lost Data. Duplication of an Ethernet address on a network will cause lost data. If you change the factory assigned Ethernet address, you must first record all *other* Ethernet addresses used on your network to avoid duplication.

Activate the Boot Code program as follows:

1. Hold down **NBP Go/Stop** and **Function** on the front panel.
2. Press and release the Trim Knob control.
3. Keep holding **NBP Go/Stop** and **Function** until the Boot Code information appears on the display.
4. Select *Service Menu -> Option Menu -> Change Ethernet Address*.

Review Errors

This procedure describes how to review the error logs of a monitor. The error logs may also be transferred over the network to a central station and copied onto diskette for further review or sent to GE Medical Systems *Information Technologies*' personnel for review. The transferring procedure "Copying Error Log Files" is described later in this chapter.

WARNING

This procedure is intended for use by service personnel with advanced troubleshooting skills.

Some of the information recorded in the error logs is useful for field troubleshooting. The details included here serve as an introduction to the error logs and provide basic information about what you can learn from them.

1. Access *REVIEW ERRORS* starting from the Main Menu. Select *MORE MENUS -> MONITOR SETUP -> SERVICE MODE*.
2. Enter password using the Trim Knob control to select the day and month from monitor screen with leading zeros. (e.g. July 4 = 0407)
3. Select *REVIEW ERRORS*.

The menu provides four error log choices, two for viewing error logs and two for clearing the error logs.

View Output/Input Errors

1. Select *VIEW OUTPUT ERRORS* or *VIEW OUTPUT ERRORS* to view one error in the log of errors.

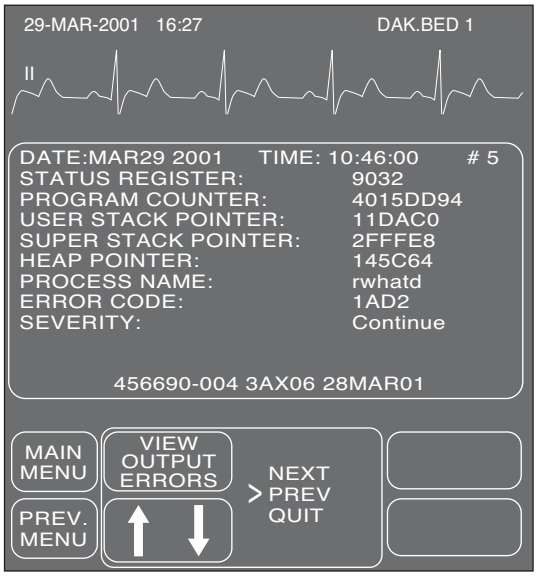
   The error log in a monitor holds 50 errors that can be accessed with the *NEXT* or *PREVIOUS* command. The errors display one error at a time in the upper right corner of the screen. Watch the error number category to keep track of which error you are viewing.

   The *VIEW OUTPUT ERRORS* provides a list of output software errors; the *VIEW INPUT ERRORS* provides a list of input software errors.

2. To clear all the errors in the error log, select *CLEAR OUTPUT ERRORS* or *CLEAR INPUT ERRORS* menu option. Be aware that once the clear menu option is executed, all selected errors in memory are erased.

Useful Error Data

Below is sample error log followed by a description of parameters found in the error log.



Process Name

The name of the software task that was operating when the event/ problem occurred.

Error Code

The error log contains more than just operating system errors. Many events that have an impact upon the system are also entered into the log. The 700-series of error codes are really system initiated events. Listed below are some of the event/error codes you might find useful.

Definition of Error Codes	
Error Code	**Description**
400-4FF	Network errors were detected.
703	Diagnostic tests were completed.
70B	Internet address was changed. The network address for the monitor was changed. This should only be done by qualified service personnel.
70C	Video test was completed. This test should only be performed by qualified service personnel.
70E	Time was changed from this monitor. This helps determine how the system-wide time may have been altered.
70F	Date was changed from this monitor. This helps determine how the system-wide date was altered.
710	Incompatible software was detected. If the main processor software finds that the software operating on the communication software incompatible, it turns off the communication (network) controller and enters this data into the error log. When the monitor won't "talk" to the network, looking for this entry in the error log is one part of the troubleshooting process.

NOTE: The monitor may be referred to as a display or scope in the error code descriptions.

Severity

Severity is a measure of how the event/error affected the system. There are three levels of severity.

CONTINUE—the event/error was logged, the task may have or may not have been finished, but the system was able to go on. Most log entries will have a severity of *CONTINUE.*

FATAL—the event/error was such that the task is not able to go on. Recovery was not possible. This always is followed by a WARM START.

FORCED RESTART—the system was restarted by a known condition (internet address change, video test, etc).

Date and Time

The date and time the event/problem occurred.

Error Number

A sequential number that is used to identify each event/problem.

Transferring Error Logs

General

The following procedure describes how to copy the patient monitor and parameter module error logs and then transfer them to a diskette at the Centralscope central station. To transfer error files from a Clinical Information Center (CIC), refer to the GE Medical Systems *Information Technologies*' Prism Information Field Service Manual.

A Centralscope or CIC central station can perform normal patient data display tasks and act as a remote terminal. The remote terminal function is useful for retrieving, viewing, and saving error logs from any GE Medical Systems *Information Technologies*' patient monitoring equipment communicating on the Unity Network. Through a series of menus, a device such as a monitor, another central station, or parameter module, can be selected in any Care Unit. Then a device error log for a particular day may be chosen.

Once the desired error log is selected it can be copied over the network to a floppy diskette in the central station's floppy diskette drive. Since the error logs are text files they can be read into other computers and using most text editors or word processing applications.

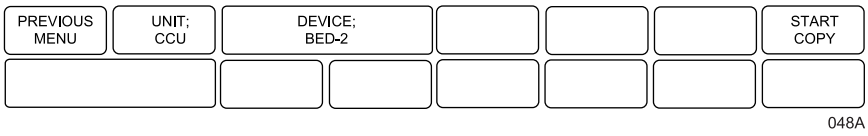
Use the following procedure to transfer error files from a Centralscope central station.

CAUTION

This procedure is intended for use by service personnel with advanced troubleshooting skills. Do not "experiment" with these commands! The consequences of misuse include loss of patient data, corruption of the central station operating software, or disruption of the entire Unity Network.

Access the *COPY LOGS* Menu

1. Beginning with the Centralscope central station Main Menu select *CENTRAL SETUP -> SERVICE*.
2. Enter password: **MEI CS 123**
3. Select *COPY LOGS*. The *COPY LOGS* menu displays.



048A

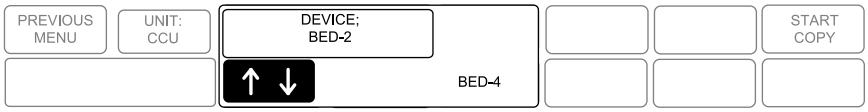
Select the Care Unit

1. Select *UNIT:*
2. Using the Trim Knob control, change the displayed Care Unit name. When the desired Care Unit name displays, press the Trim Knob control.

044A

Select the Monitoring Device

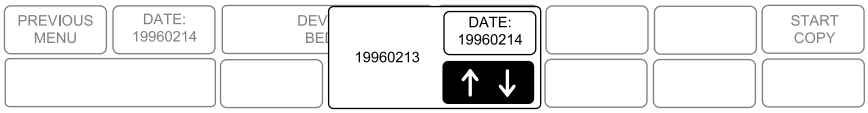
1. Select *DEVICE:*
2. Using the Trim Knob control, change the displayed device name. Note that only monitoring devices within the previously selected Care Unit show. When the desired monitoring device name displays, press the Trim Knob control.



045A

Select the Error Log Date

1. Select *DATE:*
2. Using the Trim Knob control, change the error log date. Note that one of the selections is ALL, which retrieves all stored error logs from the specified device. When the desired date displays, press the Trim Knob control.



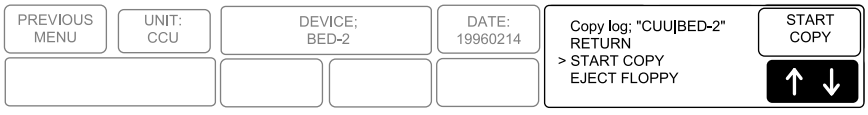
046A

Copy Error Logs

Once the Care Unit, device, and date have been specified the final step is to begin copying the error logs to the floppy diskette.

1. Insert a PC-formatted, high-density floppy diskette into the floppy diskette drive of the central station.
2. Select *START COPY*. A new display appears that confirms the file source device.

Using the Trim Knob control, select the desired function. Press the Trim Knob control to start.



047A

Once the copy function begins the START COPY button changes to show the function: “copying.”

Eject Floppy

Select this option to eject the floppy diskette from the central station’s disk drive.

8 UPPER LEVEL ASSEMBLY

Contents

Safety Information for Disassembly

Please observe the following safety information when disassembling the monitor.

ESD Protection

All PCBs contain semiconductor which must be protected from electrostatic discharge. When working on open montiors and when handling PCBs, it is important to observe ESD safety precautions. Please read also the paragraph "ESD Discharge" in this chapter. It is especially important that service technicians always establish contact between the PCB and ground before touching a component.

ESD Protection Guidlines

Use the following ESD protection guidlines when working on an open monitor or when handling PCBs.

- Use an ESD protective underlay connected to a non-fused earth conductor potential.
- Connect yourself to the ESD protective underlay via an armband.
- Use an ESD protective travel bag to transport PCBs.

Suggested Tools/ Equipment

The following tools may be required for disassembling the unit.

Goosenecked tweezers

Posidrive screwdriver

Type "Posidrive", sizes 0 , 1 and 2

Slotted head screw screwdriver 6mm for battery screws

Connector wrench 5.5 mm for hexagonal spacers

ESD packaging for PCBs

ESD underlay with ESD armband

Disassembly Procedure

Preparations before Opening the monitor

Before any service interventions, turn off the device and disconnect the device from power line.

Opening Unit

To open the unit, do the following.

1. Lay the monitor with the front panel face down on a clean, level surface (ESD pad) which is placed on a soft material to avoid scratches on the front panel.
2. Undo the 6 screws on the rear to remove the front panel frame and open the device.
3. Fold the front panel frame down and disconnect the keypad connector.

Display

To remove the display, do the following.

1. Open the unit as described in **Opening Unit**.
2. Remove the 2-pole converter plug and the flat cable connector for the display from the PCB Mainboard.
3. Undo the screws which hold the converter.
4. Undo the 4 screws which hold the display and remove it.

DAS PCB

To remove the DAS PCB, do the following.

1. Open the unit as described in **Opening Unit**.
2. Remove the 2-pole converter plug and the flat cable connector for the display from the PCB Mainboard.
3. Tilt the display frame with the DAS board towards the front.
4. Disconnect the DAS flat cable connector.
5. Remove NIBP tubing from DAS PCB.
6. Undo the 4 screws which hold the DAS PCB and remove it.

DAS Input Assembly

To remove the DAS Input Assembly, do the following.

1. Open the unit as described in **Opening Unit**.
2. Remove the 2-pole converter plug and the flat cable connector for the display from the PCB Mainboard.
3. Tilt the display frame with the DAS board towards the front.
4. Loosen the DAS input assembly and remove it
5. Remove NIBP tubing from DAS input assembly.

DASH 2000 Assembly

1. Open the unit as described in **Opening Unit**.
2. Remove the 2-pole converter plug and the flat cable connector for the display from the PCB Mainboard.
3. Tilt the display frame with the DAS board towards the front.
4. Disconnect the DAS flat cable connector.
5. Loosen the DAS input assembly.
6. Remove NIBP tubing from DAS input.
7. Remove Alarm Light cable from PCB Main Connector

For devices equipped with writer:

8. Open writer and remove paper.
9. Loosen the 2 screws in the writer housing and carefully pull out the writer.
10. Remove writer cable which is attached to the PCB Mainboard by means of a screw.
11. Loosen writer bracket and carefully pull it out towards the inside.
12. Remove speaker from PCB Mainboard.
13. Remove 4 screws at the rear panel.
14. Remove 4 screws at the foot pad.
15. Remove 2 screws at the bottom of the enclosure.
16. Remove ground wire from enclosure.
17. Carefully pull the DASH2000 assembly from the enclosure

PCB Main Connector

1. Disassemble the **DASH 2000 Assembly** as described above.
2. Undo the 3 screws from PCB Main Connector and remove it.

PCB NIBP

1. Disassemble the **DASH 2000 Assembly** as described above.
2. Disconnect battery connector and remove the 2 screws from the battery bracket.
3. Disconnect the NIBP connector from the Mainboard.
4. Undo the 3 screws which hold the NIBP board on the battery bracket.
5. Remove NIBP tubing from the pump.
6. Disconnect NIBP Pump connector and remove NIBP board.

PCB Mainboard

1. Disassemble the **DASH 2000 Assembly** as described above.
2. Disconnect battery connector and remove the 2 screws from the battery bracket.
3. Disconnect the NIBP connector from the Mainboard and remove the battery bracket with NIBP board.
4. Remove the battery and the battery pad.

5. Undo the 3 screws which hold the PCB Mainconnector and remove it.
6. Disconnect DAS flat cable from PCB Mainboard.
7. Remove ground wire from PCB Mainboard.
8. Undo the 2 hexagonal spacers and the 3 screws which hold the PCB Mainboard.
9. Pull the PCB Mainboard from the Power Supply Connector.

Power Supply PCB

1. Disassemble the **PCB Mainboard** as described above.
2. Disconnect the AC-Line Connector from the Power Supply PCB
3. Undo the 4 screws which hold the Power Supply PCB and remove it.

NOTE

When reassembling the Power Supply PCB on the frame be sure the ferrite ring is on the upper left distance bolt and the shield carton is under the Power Supply PCB.

Assembly Note

NOTE

When reassembling the PCBs or the DASH 2000 use the above described disassembly instructions in reverse order.

If the battery was disconnected from the mainboard, drain the battery by operating the devices on battery power until it switches off. Then connect the device to the power line and start a conditioning cycle.

Spare Parts List

Printed circuit boards and assemblies*

Part	Part Description	Part Number
Pcb. Main Board V3	Pcb. Mainboard with latest software in english language	2006798-001 S
Pcb. Main Connector	Pcb. Main Connector (high pot tested)	303 44809
DAS Ass. V3	DAS Assembly (high pot tested) with latest software	2006799-001 S
Pcb.Dash2000 Expansion PT	Pcb. Expansion Board for connection of Docking Station	801550-001
Pcb.Converter DC-AC	Pcb. Converter DC-AC for monochrome display	93011708
Pcb. Converter DC-AC	Pcb. Converter DC-AC for color display	93011863
Pcb. NIBP	Pcb. NIBP incl. Valve and Pressure Sensor	388 032 78
Pcb. Power Supply	Pcb. Power Supply	93011859
Pcb. DAS Input	DAS Input Assembly with ECG, IBP, TEMP, NIBP and SpO2 connectors. Labels (language dependent) have to be ordered seperately.	38803277
Thermal Printer	Thermal Printer 50mm (CS2) loaded with latest software.	419743-002 S

* Boards and Assemblies signed with S are loaded with latest software and may be overloaded in the field. We support to deliver these boards completely configured and loaded with the desired software. This has to be mentioned in the order with the following added information: S/N of Dash, language, P/N of Dash and Software Version.

Mechanical Parts

Part	Part Description	Part Number
Front Bezel	Front Bezel incl. Filter. Labels (language dependent) have to be ordered seperately.	2000347-001
Chassis	Housing rear (metal) not for field replacement	419030-004
Bracket Writer MTG	Bracket as housing for the recorder.	421263-001
Cover Side wo/writer	Cover Side for Dash 2000 without printer	419378-001
Plug Holder	Plug Holder for mains plug and docking connector	43252584
Bracket for Inverter	Bracket DC-AC converter for monochrome display	43252577
Pump Bracket	Pump Bracket (rubber)	43252580
Battery Socket	Battery Socket	43252551
Plastik Cover	Plastic Cover to close blood pressure connector	43252618
Foot Pad	Foot Pad (plastic)	421877-001
Plate Mount GCX	Plate Mount GCX (metal socket for GCX bracket)	420001-001
Handle Half Front	Handle Half Front Dash (part of the complete handle)	419998-001
Handle Half Rear	Handle Half Rear Dash (part of the complete handle)	419998-002
Alarm Light Dash	Alarm Light Insert Dash Handle (part of the complete handle)	422309-001
Blank Insert Dash Handle	Blank Insert Dash Handle (part of the complete handle)	422296-002

Switch Assemblies/Cables/Connectors

Part	Part Description	Part Number
Keypad Assembly	Keypad Assembly incl. Trim Knob potentiometer	418957-001
Flex Recorder Connector	Flex cable for Recorder connection	38803300
Flex Cable	Flex Cable to keypad assembly	91920394
Cable Dash Alarm Light	Cable from Dash Alarm Light to Mainboard	422647-001
Flat Cable 15 pin	Flat Cable 15 pin for Color Display	91920395

Labels

All the labels for one specific language for Dash 2000 are on one label set

Part	Part Description	Part Number
Label Kit English	Label Kit with labels for Dash 2000 in English language	422691-001
Label Kit German	Label Kit with labels for Dash 2000 in German language	422691-002
Label Kit French	Label Kit with labels for Dash 2000 in French language	422691-003
Label Kit Spanish	Label Kit with labels for Dash 2000 in Spanish language	422691-005
Label Kit Italian	Label Kit with labels for Dash 2000 in Italian language	422691-006
Label Kit Japanese	Label Kit with labels for Dash 2000 in Japanese language	422691-010
Label Kit Chinese	Label Kit with labels for Dash 2000 in Chinese language	422691-013

Displays

Part	Part Description	Part Number
LCD Module Monochrome	LCD-Module Grafik 320 x 240 Backlight (HLM 8619-010200)	93011717
LCD Module Color	LCD-Modul Grafik 320 x 240 Color (KCS 057 QV1AA-A07)	93011862
LCD Module Color	LCD-Modul Grafik 320 x 240 Color (KCS 057 QV1AJ-623) for Dash 2000 with S/N 101 038 770 and higher	2003170-001

Miscellaneous

Part	Part Description	Part Number
Battery NC	Battery rechargeable, NC, 12 V 2,0 Ah	92916781
Pump Assembly	Pump Assembly (pump incl. Wiring)	2000355-001
Manifold Valve	Manifold Valve	414621-001
Speaker	Speaker 66 mm SQ water rsstnts	419482-001
Trim Knob	Trim Knob	92607501
Filter	Filter 1/8 for NIBP	92916708
Check Valve	Check Valve for NIBP	91920320
NIBP Connector	NIBP Connector insert	43252398
Power Receptacle	Power Receptacle	91541520
Pot.Equalization Connector	Pot. Equalization Connector	91541408
Cable Assy. Sync. Responder 1100	Defi Sync. Cable completely assembled for Dash 2000/3000/ 4000 to Responder 1100, lenght appr. 2.8 m	22342805

Miscellaneous

Part	Part Description	Part Number
Cable Assy. Cinch MDC 7P15	Defi Sync. Cable for 7 pole DIN connectore Dash 2000/ Dash 3000 with one open end (3 m)	2000633-001
Power Cord	Power Cord right angle 1,8 m (US)	80274-103
Power Cord	Power Cord right angle 1,8 m (Europe)	422845-001
Power Cord	Power Cord right angle 1,8 m (British)	422845-002
Power Cord	Power Cord right angle 1,8 m (Italian)	422845-003
Power Cord	Power Cord right angle 1,8 m (Swiss)	422845-004
Power Cord	Power Cord right angle 1,8 m (Indian)	422845-005
Power Cord	Power Cord right angle 1,8 m (Australian)	422845-006

9 ASSEMBLY DRAWINGS

Contents

Introduction

Included in this section is a complete set of mechanical diagrams, reference diagrams, schematic diagrams and parts lists.

Mechanical diagrams — These diagrams show the mechanical assembly of the Dash 2000 monitor.

Reference diagrams — These diagrams provide a reference and view of the used components in the schematic.

Schematic diagrams — These diagrams show the electrical wired connections between the used analog and digital electronics components.

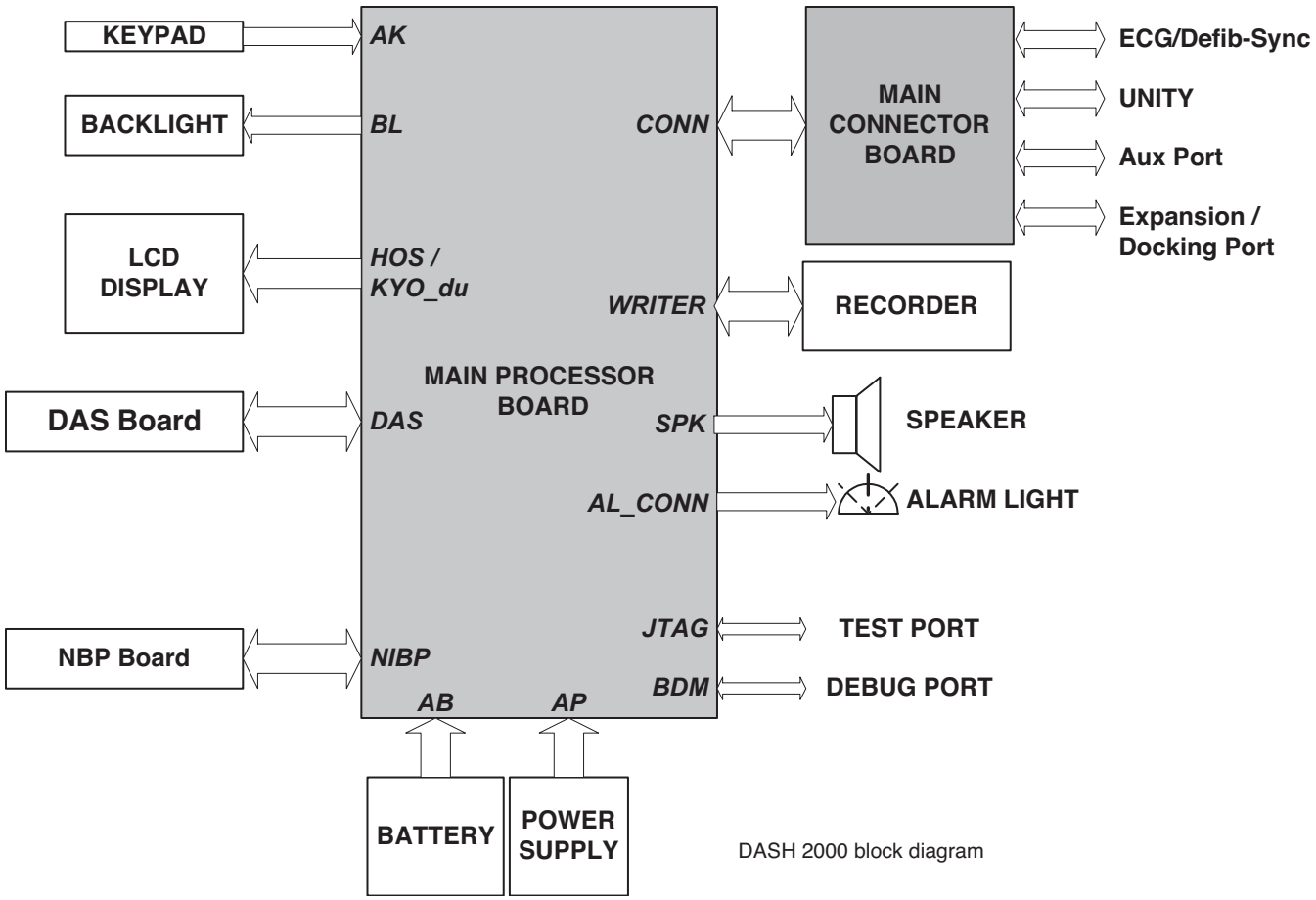
Theory of Operation

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.

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, or in Freiburg for Europe. If warranted, technical training classes may be scheduled at customer sites or other locations in the field as well.

Overall Monitor Block Diagram



DASH 2000 block diagram

Components

Power Supply PCB

The power supply PCB mounts internally to the monitor rear casting assembly. It's a 40 Watts controllable single output, universal input switching power supply, which has been designed to meet the safety ground leakage current requirements laid down by IEC 60601 and UL 544.

Battery Pack

The Battery Pack is composed of ten nickel cadmium batteries with nominal 2000 mAh Capacity, with a build in temperature sensor and over temperature switch.

Acquisition PCB

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

The DAS consists of two isolated and one non-isolated sections 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.

Main Processor PCB

The main processor PCB provides signal processing, system control, user interface, and communications functions for the monitor, both color LCD and monochrome LCD display versions. It receives and processes digitized patient data from the isolated DAS assembly (acquisition PCB), text and waveform information for the video display, interfaces with the operator via the front panel switches and Trim Knob, and communicates with other products on the network using a built-in Ethernet interface.

The Battery Management control the charging and discharging of the battery and the ON OFF Interface.

Main Connector PCB

The main connector PCB is connected to the main processor board and is responsible for the dispersion of signals between the processor PCB and the monitor rear panel connectors. Ethernet, AutoPort communication, ECG/Defib syn and the docking station are the primary functions of the board.

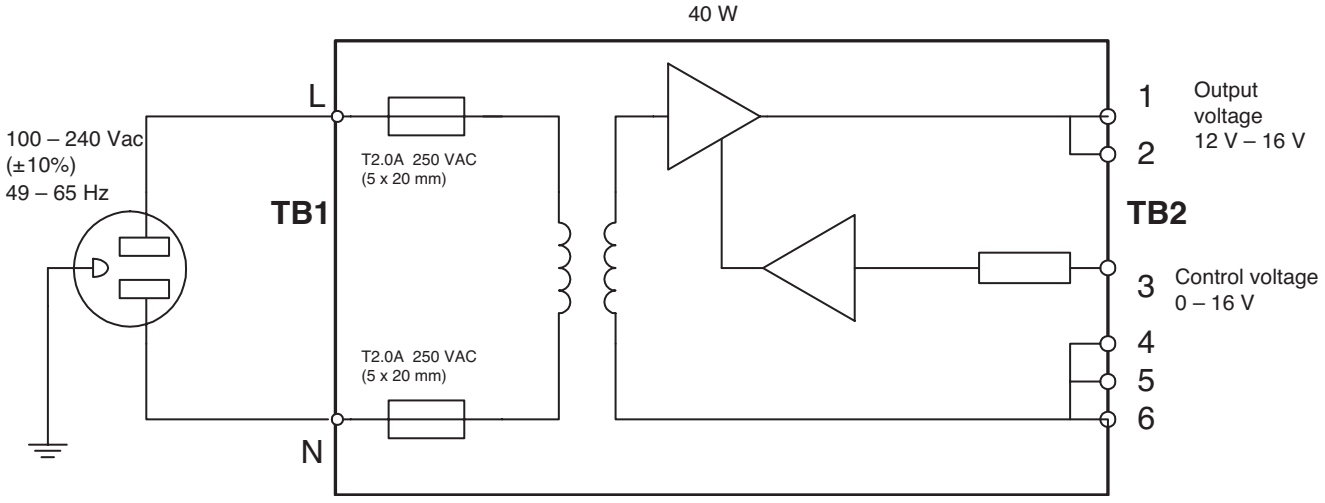
Power Supply PCB Theory

The power supply PCB mounts internally to the monitor rear casting assembly. The input voltage is between 85–264 V AC / 49–64 Hz. The power supply PCB provides a controllable output voltage between 12–16 V.

PCB Functions

The power supply PCB is a 40 W controllable single output, universal input switching converter. The output voltage is controlled via control voltage input (TB2, Pin 3).
The output voltage range is between 12–16 V, the control voltage range is 0–16 V.
The output voltage with open control input is 15.5 V ± 100 mV.

PCB Block Diagram



Acquisition PCB Theory

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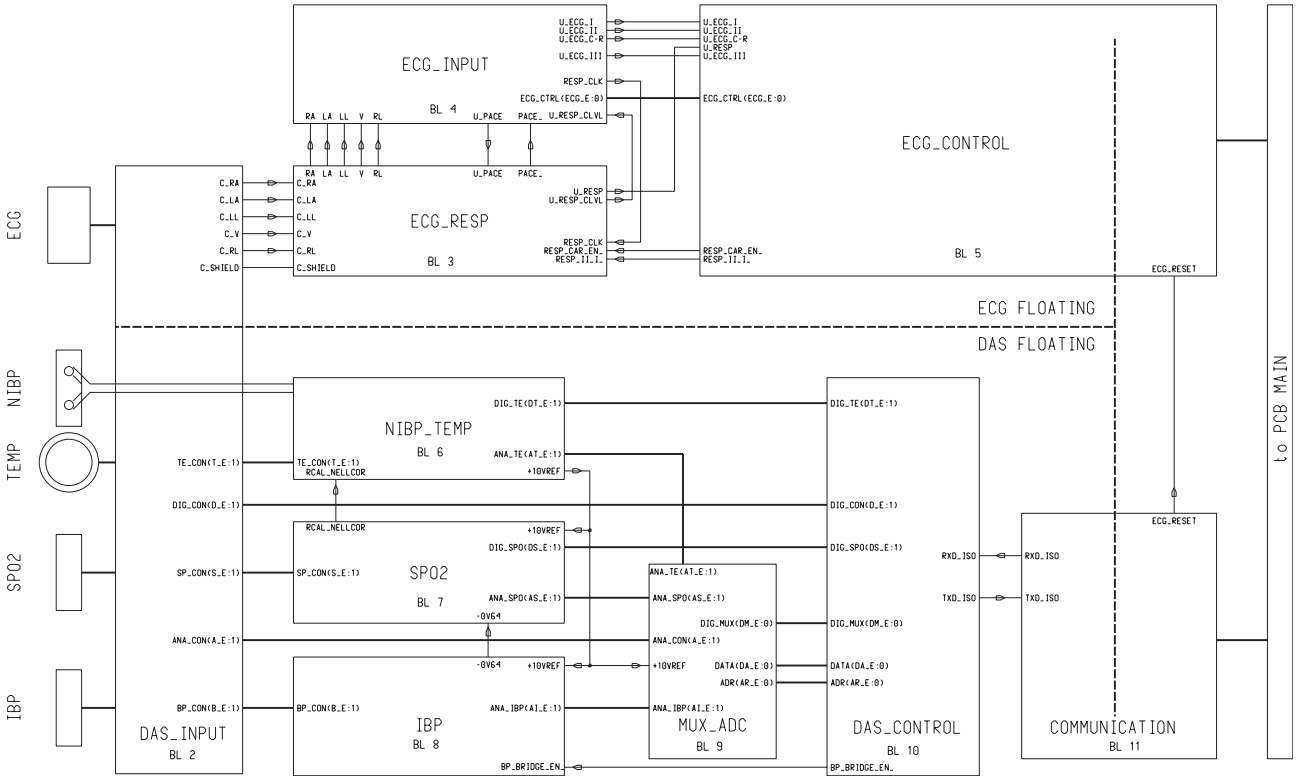
The DAS consists of two isolated (ECG/RESP and NBP, SPO2, TEMP, IBP) and one non-isolated sections which are separated by a barrier that is capable of withstanding up to 6000 VDC with respect to earth ground. Isolation is accomplished by using a coupled inductor power supply and opto-isolation for signals crossing the barrier.

PCB Block Diagram



Functional Circuits

Functional circuits on the acquisition PCB include:

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

PCB Functions

The acquisition PCB is a microprocessor based data acquisition system with patient isolated power supply included. The DAS can be divided into four main sections:

1. Input sensor/electrode signal conditioning,
2. Analog to digital conversion,
3. Microprocessor/digital interface, and
4. Isolated power supply.

The input sensor/electrode conditioning for NBP, SPO2, TEMP and IBP is accomplished by the Analog input hybrids and the ECG/RESP section is accomplished by the HECTOR chip set with its own SPI interface to the main processor board. Input signals are received from the DAS input connector board. The NBP pressure hose is connected to a pressure transducer which develops the pressure equivalent electrical signal. The signals are then routed to the appropriate hybrid for amplification and filtering. All input signals are clamped for static protection either on the hybrids or on the circuit board.

Analog to Digital Conversion (NBP, SPO2, TEMP, IBP)

Output signals from the hybrids are coupled to a series of analog multiplexers. Outputs from the multiplexers are then applied via a summing multiplexer to an analog to digital (A/D) buffer. The high slew rate A/D buffer drives the 20-volt input of the analog to digital converter (ADC). Under microprocessor control, the channels are individually selected and sampled at a rate determined by the frequency content of the signal.

The ADC is a complete 12-bit successive-approximation device with tri-state output buffers for direct interface to the microprocessor bus. The data is read in two steps, first the 8 most significant bits then the 4 least significant bits.

Microprocessor/Digital Interface

The MC68332 is a 32-bit microcontroller which is upward compatible with the M68000 family. It provides 24 address lines and has a 16-bit data bus. It controls data acquisition, digital control and serial communication across the isolation barrier.

The system clock is generated by an on-chip PLL circuit and voltage controlled oscillator (VCO) which uses a low frequency external crystal (31.2 kHz) and an internal frequency synthesizer to step up the frequency to 15.7248 MHz (504 *x* 31.2 kHz). The frequency was selected for timing synchronization, to be an exact multiple of 60 Hz (60 Hz *x* 266,240).

The MC 68332 contains intelligent peripheral modules such as the TPU, the Queued Serial Module (QSM), the Test Submodule, the System Protection as well as 2 kilobytes of fast static RAM and twelve independent programmable chip selects.

The TPU provides 16 microcoded channels for performing time related activities. It is used to control the timing critical portion of the Pulse Oximetry function. The rest of the TPU is used for input/output (I/O) control signals.

The Queued Serial Peripheral Interface (QSPI) synchronous serial link is used to communicate with the MC68332 on the processor PCB via opto-

isolators and associated circuitry. The programmable queue allows the QSPI to perform up to sixteen (bytes) serial transfers without CPU intervention.

The MC68332 QSPI is designed to be used in a multiprocessor environment where one processor is the master and the other processors are slaves. A signal generated from the master processor selects the QSPI slave mode for the DAS processor which enables communications.

During normal operation, the DAS processor is a slave to the MPC821 host processor on the main processor PCB. Upon power up or reset, the DAS processor is designed to come up in the Background Debug Mode (BDM) since no boot code resides on the DAS. Direct communication with BDM allows the master to execute a number of commands including loading boot code into the memory if the DAS has never been programmed. Logic then disconnects the BDM communication link so the SPI link is connected directly between the host processor and the DAS processor. The host processor can then download the executable program into the FLASH memory.

The memory configuration is two 128K *x* 8 FLASH chips and direct addressing of two 128K *x* 8 static RAM chips. The RAM is expandable by moving zero-ohm jumpers if using higher density RAM chips.

The CMOS FLASH memory uses a high-integration block architecture. Programming of one block does not affect data stored in another block, allowing maximum flexibility.

The DAS control ASIC is a multifunction digital interface which provides logic interface support for the MC68332 processor. The ASIC provides the following functions:

- A latched buffer for analog to digital conversion,
- Provides logic to enable processor BDM upon power up or reset; connects serial communications to the processor debug module,
- The communication interface and control to the pulse oximetry function, and
- Identification for the ASIC and circuit board.

Isolated Power Supply

The voltage monitor for both isolated sections is an under-voltage sensing circuit which generates a reset to the processor if the 5-volt isolated supply voltage drops below 4.6 VDC.

The isolated power supply for both isolated sections is a current mode control flyback converter providing a main +5-volt regulated output (digital supply), a ±5 volts, as well as a ±12 volt winding cross regulated output (analog supplies). To achieve UL 544 patient connected hi-pot and leakage requirements, a specially designed potted coupled inductor and optical isolation are used. The supply uses feedback loss time-out for overload protection.

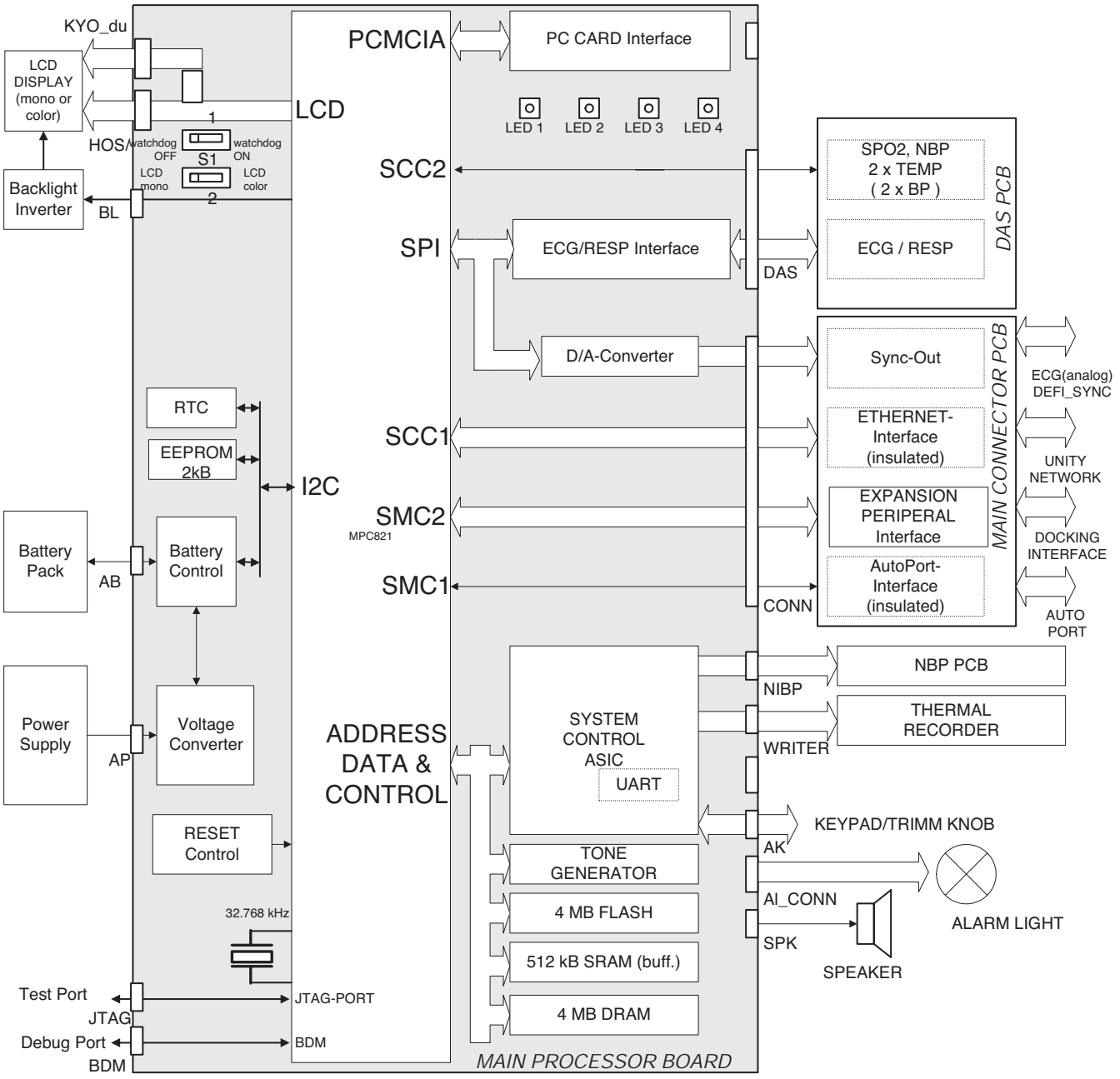
Calibration

The calibration procedure for the this assembly is found in Chapter 6, “Calibration”.

Main Processor PCB Theory

The main processor PCB provides signal processing, system control, user interface, and communications functions for the monitor, both color LCD and monochrome LCD display versions. It receives and processes digitized patient data from the isolated DAS assembly (acquisition PCB), text and waveform information for the video display, interfaces with the operator via the front panel switches and Trim Knob, and communicates with other products on the network using a built-in Ethernet interface.

PCB Block Diagram



Functional Circuits

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

- Host processing circuit (monitor main processing unit):
  - Motorola MPC821 32-bit integrated microcontroller (25 MHz),
  - Clock – 32.7 kHz crystal oscillator,
  - Microprocessor support circuit (Reset Control),
  - Flash Memory (4 megabytes),
  - DRAM (4 megabytes)
  - Static RAM (512 Kbytes, buffered),
  - System Control ASIC.
- Real-time clock/calendar (RTC),
- Asynchronous serial communications interface UART (SCC/SMC ports),
- Ethernet SCC 1 (ETHERNET port),
- Noninvasive blood pressure interface,
- Alarm Light interface
- Analog output 10-bit DAC (ECG),
- Stereo sound generator, audio amplifier and speaker interface,
- Key pad (TRIM KNOB and push-buttons) interface,
- Integrated video processing circuit which develops waveform and text data for display,
- High frequency isolation region, DAS interface and power supply interface.

Battery Management with:

- Power Controller PIC 16C73 to control battery charging
- Gas GAUGE BQ2014 to measure the charge and discharge current
- Power REGULATOR to control the charge current together with the Power Supply PCB output voltage
- ON OFF Interface to switch the Main Processing System on or off

PCB Functions

The main processor PCB is essentially a self-contained, single-board computer. It includes a Motorola MPC821 microcontroller functioning as the host processor. The MPC821 has an integrated graphics system controller handling the video interface. The system application code is stored in electrically erasable FLASH memory for easy software updates. Data memory is implemented with static RAM (SRAM), all of which is backed with a gold capacitor.

Because of the large number of memory and peripheral devices which are interfaced to the MPC821, a multiple bus structure is employed. This approach limits the number of devices sharing a given bus and results in increased reliability and lower system noise. It allows most devices to operate at (or near) full speed because the capacitance each device I/O sees is typically no more than 100 pF.

To keep the overall size of the board to a minimum, the design utilizes a high-density Field Programmable Gate Array device (FPGAs). One of the outstanding features of this board is the almost total lack of Small Scale Integration (SSI) logic devices (gates, counters, etc.). Functions which required SSI devices in the past are now implemented in the FPGAs. These devices, which we referr to as ASICs (Application Specific Integrated Circuits) in this theory of operation, handle such functions as main system control, bus interface, NBP interface and the writer, and keypad interface. The ASIC is implemented using Altera Flex 6000 devices which must be loaded with a logic program each time the system powers up.

MPC821 High Integration Microcontroller

The Motorola MPC821 microcontroller was chosen as the main (host) processor for the monitor. This chip allows it to run existing Tram and Solar software, along with numerous on-chip peripherals such as a Universal Asynchronous Receiver Transmitter (SCC/SMC) and Serial Peripheral Interface (SPI). It also incorporates a very sophisticated Time Processing Unit (TPU) which is only utilized to a very small extent on the processor PCB. A special feature is the integrated graphic system controller which handles the complete video interface. An additional support feature of the MPC821 is the Background Debug Mode (BDM) which allows testing of the board (a special connector is incorporated on the edge of the board to access this mode).

The monitor actually utilizes a 821 on the main board and a 68332 on the acquisition PCB (DAS). The two processors communicate over the isolation barrier using the on-chip SPI. This interface operates at up to 4 megabits per second, transfers packets of up to 256 bits without CPU intervention, and requires very little external interface hardware. The Main (host) Processor functions as the SPI master in this design.

Basic Initialization Requirements

Because of the numerous on-chip peripheral registers, the 821 requires many configuration steps before it becomes fully operational in the system. In addition, certain basic steps are required by the hardware design and must be performed immediately upon power-up.

Main Memory Configuration

The main memory consists of 4 megabytes of electrically erasable FLASH memory and 512 Kbyte backed static RAM. All main memory runs at full speed with one wait-states being inserted. The FLASH memory is sector erasable so no separate boot memories are provided (i.e., the main code sectors may be erased without erasing the boot sectors).

Program Memory (FLASH)

The electrically erasable FLASH memory allows the monitor to receive software updates either from a AutoPort or from the network. The FLASH devices used on this board are state-of-the-art components which store 16 megabit per device. Considerable board area is saved by using these devices since only two are required. Physically, the devices reside directly on the local bus of the 821.

Data Memory (SRAM)

Data memory consists of 512 Kbyte of static RAM (SRAM) operating with three wait states. All SRAM is backed up using a gold capacitor. Check of the buffered voltage is performed upon power-up.

LEDs

The LED 1 to 3 are used as operating status indicator. LED 4 is only used as reference element.

Power Control

The Power Supply / Battery Managment is controlled by a microcontroller named Power Controller PIC 16C73.

The circuit GAS GAUGE BQ2014 measures the battery charging and discharging current.

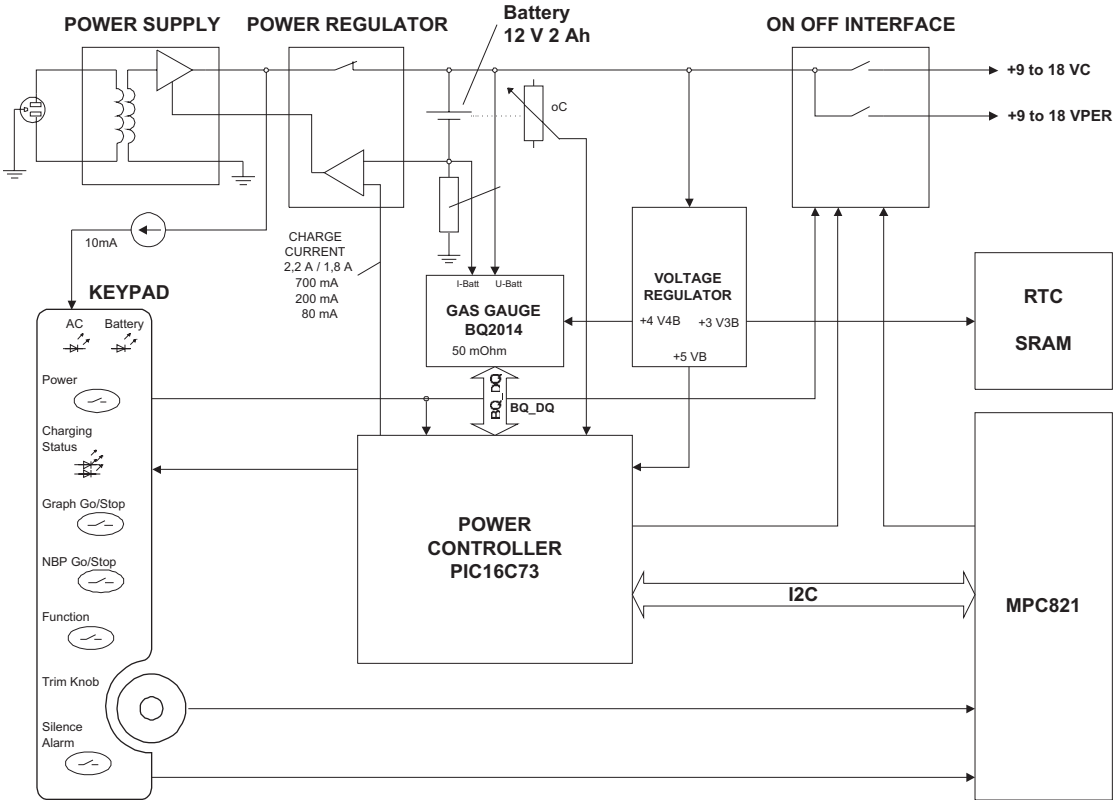
The POWER CONTROLLER provides a control-voltage for the POWER REGULATOR, that resembles the actual charging current on 50 mOhm.

The POWER REGULATOR regulates the output voltage of the POWER SUPPLY to achive the chosen charging current. This circuit supersedes an additional battery-charging circuit with the power devices and the decoupling diodes that would separate the battery from the main circuit during charging.

The ON OFF INTERFACE supplies the battery voltage to the device electronics.

The CONTROLLER and the GAS GAUGE IC are constantly connected to the supply voltage.

POWER CONTROL Block Diagram



STAND-BY MODE

As long as the monitor is switched off and not connected to mains voltage the PIC rests in sleep mode. The current consumption of the complete circuit is less than 1 mA (typical 0,3 mA). Considering a self-discharge of the battery of about 1% per day at 30 °C a fully charged battery will be depleted in 60 days. The self-discharge rate doubles every 10 °C.

POWER ON-MONITOR OFF-MODE

As soon as a switched-off monitor is connected to mains power, the green AC LED is solid on and the PIC leaves the sleep mode. A fully depleted battery will then be charged within one hour by a quick-charge current of 2,2 A. During this process the yellow charging-status LED will be solid on. If a Dash Responder is connected to the monitor the quick-charging current is reduced to 1,8 A. After the GAS GAUGE IC detected the charging status 'BATTERY FULL', the charging process continues for one hours with a charging-current of about 200 mA, meanwhile the green charging status LED is solid on. Afterwards the battery is permanently being charged by a trickle-charge current of about 80 mA. During the charging process the battery temperature is monitored. On temperatures above 50 °C the charging current is incremental reduced.

POWER ON-MONITOR ON-MODE

On switching the ON/OFF-key the charging current is reduced to 700 mA (independent from Dash Responder). A fully depleted battery will be charged in about 3 hours. Afterwards the charging process proceeds as mentioned above.

Additionally the monitor supply will be switched on by the ON OFF INTERFACE.

MONITOR ON-POWER OFF-MODE

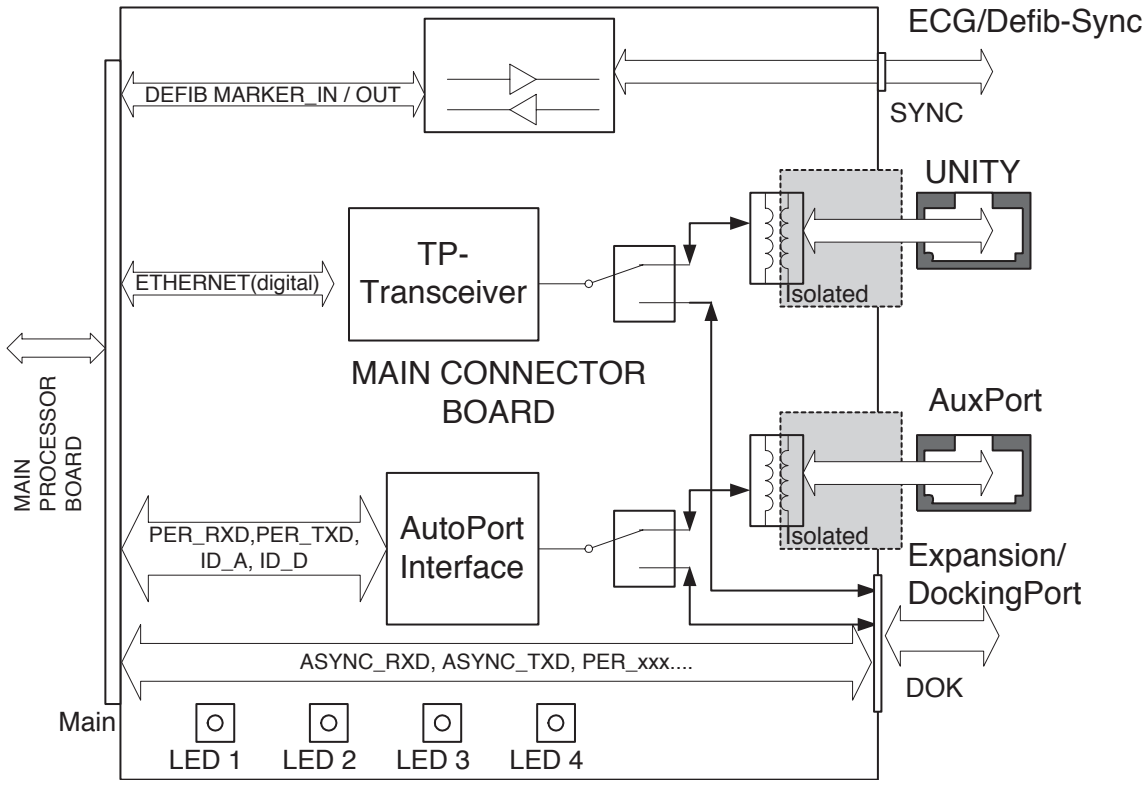
If the monitor is powered by battery the yellow Battery LED is solid on. When the battery gets depleted to a level from which the monitor can only be powered for less than 10 minutes a battery alarm is set. To prevent a deep-discharge when the battery voltage lowers to 10 V, the POWER CONTROL switches the monitor automatically off after an acknowledging signal form the main processor MPC821. No power is provided to the Dash Responder in this case

Main Connector PCB Theory

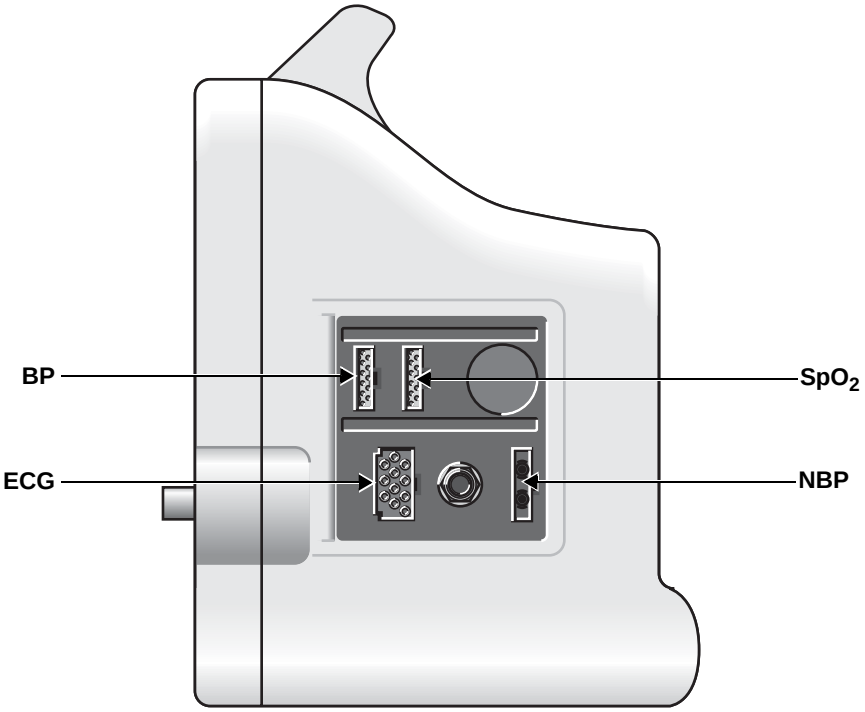
The main connector PCB is connected to the Main Processor Board and is responsible for the dispersion of signals between the processor PCB and the monitor rear panel connectors. Ethernet, AutoPort communication, and the docking station are the primary functions of the board.

If the monitor is connected to the docking station, the UNITY and also the AutoPort signals are automatically switched from the rear connectors to the docking station connector.

The four LEDs indicate the following UNITY functions:
LED 1: Collision indicator
LED 2: Link test (on if test is running)
LED 3: Receive indicator
LED 4: Transmit indicator

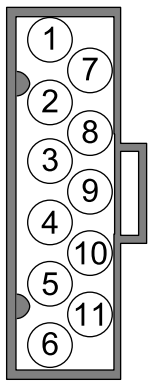


Port Connections



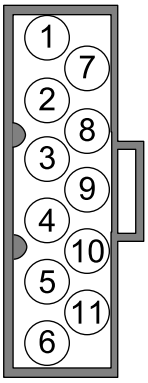
Invasive Blood Pressure Cable Connector

Two invasive blood pressure channels are provided; each channel uses a separate 11-pin, female connector. The pinout is as follows:

PIN	SIGNAL NAME	I/O	SIGNAL DESCRIPTION	DIAGRAM
1	BP_+VREF	O	BP transducer excitation voltage	
2	BP SIG+	I	BP transducer signal positive (+)	
3	NC	–	No connection	
4	AGND	O	Analog ground	
5	NC	–	No connection	
6	SHIELD	O	BP cable shield	
7	AGRND	O	Analog ground	
8	BP SIG1	I	BP transducer signal negative (–)	
9	NC	–	No connection	
10	BP1_ID	I	BP1 probe identification signal	
11	NC	–	No connection	

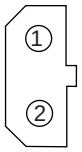
Pulse Oximetry (SpO_2) Cable Connector

The pulse oximetry function uses an 11-pin, female connector. The pinout is as follows:

PIN	SIGNAL NAME	I/O	DESCRIPTION	DIAGRAM
1	NELLCOR_RCAL	O	Nellcor probe characteristics ID resistor	
2	IR/RED*	O	Anti-parallel LED drive (low=RED, high=IR)	
3	RED/IR*	O	Anti-parallel LED drive (low=IR, high=RED)	
4	NC	–	Not connected	
5	POX+	I	Photo detector anode	
6	SHIELD	–	Cable shield	
7	NELLCOR_RCAL_RETURN	I	Return for probe characteristics ID resistor	
8	MARQUETTE_PROBE*	I	Marquette probe select	
9	POX–	I	Photo detector cathode	
10	NELLCOR_PROBE*	I	Nellcor probe select	
11	GND	–	Ground reference for pins 8 and 10	

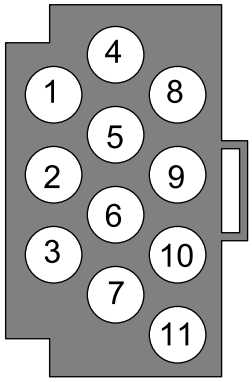
NBP Connector

A pneumatic connector is used for the patient interface.

PIN	SIGNAL NAME	I/O	DESCRIPTION	DIAGRAM
1		I	Sensing Side (to pressure sensor)	
2		I	Pressure Side (pump, valves, overpressure sensor)	

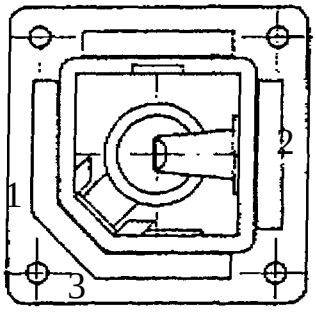
ECG Cable Connector

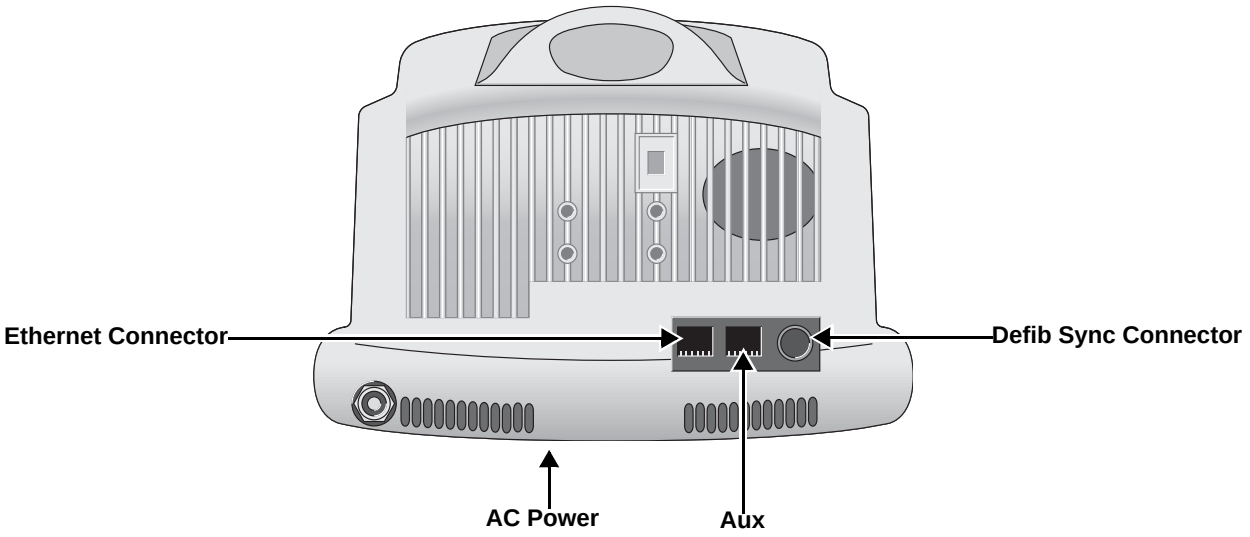
The ECG/Respiration function uses a recessed, 11-pin, female, ECG connector. The pinout is as follows:

PIN	SIGNAL NAME	I/O	DESCRIPTION	DIAGRAM
1	RA	I	Right arm electrode	
4	LA	I	Left arm electrode	
5	RL	O	Right leg (reference) electrode	
6	V/V1	I	Chest electrode V1	
8	LL	I	Left leg electrode	
11	SHIELD	–	Cable shield - connected to ECG shield plane and electrostatic cover	

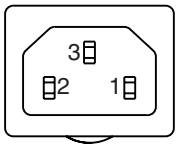
Temperature Cable Connector

The Temperature function uses YSI series 400 temperature probes only (do not use YSI 700 probes). The pinout is as follows:

PIN	SIGNAL NAME	I/O	DESCRIPTION	DIAGRAM
1	CP_+0V25REF (red)	O	Reference voltage	
2	CP_TEMP1 (brown)	I	Temperature Input	
3	CP_U_CONTACT (green)	I	Plug-in contact detection by break contact jack	

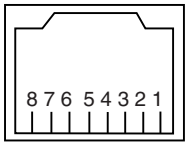


Input Power Requirements

PIN	SIGNAL NAME	I/O	SIGNAL DESCRIPTION	DIAGRAM
1	NEUTRAL	I	AC Mains Power	
2	LINE	–	Pin Not Inserted	
3	GROUND	–	AC Mains Power	

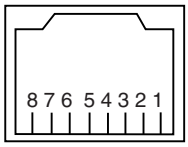
Network Interface

An 8-pin RJ-45 connector containing two isolated, differential pairs is provided to connect the monitor to a network hub.

PIN	SIGNAL NAME	I/O	SIGNAL DESCRIPTION	DIAGRAM
1	LAN _TX+	O	LAN transmit +	
2	LAN_TX-	O	LAN transmit –	
3	LAN _RX+	O	LAN receive +	
4	NC	–	No connection	
5	NC	–	No connection	
6	LAN _RX-	O	LAN receive –	
7	NC	–	No connection	
8	NC	–	No connection	

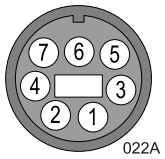
Auxiliary Communication

Auxiliary communication communicates with peripherals such as a remote control, data logger, or external thermal recorder. The UART channel is only capable of communicating with external devices having the same transmit and receive baud rates. Power available to peripheral devices is current limited to 100 mA.

PIN	SIGNAL NAME	I/O	SIGNAL DESCRIPTION	DIAGRAM
1	AUTOPORT_+5V	O	Isolated +5V	
2	SPARE	I	Spare	
3	AUTOPORT_232_RX	I	RS-232 receive signal	
4	AUTOPORT_GND	–	Power return	
5	AUTOPORT_ID	I/O	Device identification signal - host side	
6	AUTOPORT_232_TX	O	RS-232 transmit signal	
7	AUTOPORT_+10V_RTS	O	RS-232 request-to-send signal (remote alarm control signal)	
8	AUTOPORT_+10V_DSR	O	RS-232 data-terminal-ready signal	

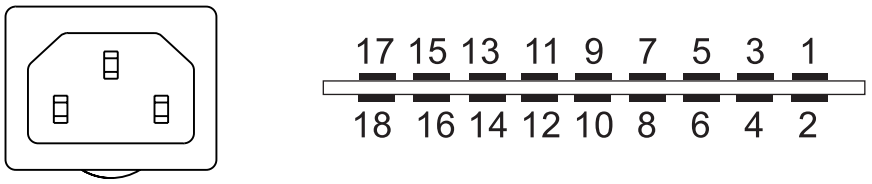
Defib Sync

Analog outputs consisting of ECG waveforms including the pace pulse and the BP out are available through the 7- pin mini-DIN connector. The two analog outputs are calibrated by monitoring the outputs with a precision voltmeter while trimming the offset and gain adjustments with the Trim Knob.

PIN	SIGNAL NAME	I/O	SIGNAL DESCRIPTION	DIAGRAM
1	MARKER_OUT	O	Digital defibrillator output synchronization signal	
2	MARKER_IN	I	Digital defibrillator input signal	
3	GND	–	Common return	
4	GND	–	Common return	
5	RESERVED	–	Reserved	
7	ECG_OUT	O	Analog ECG output signal	

Peripheral Expansion Interface

An 18-pin peripheral expansion interface is provided to support future use. An active low peripheral present signal may be polled by software to identify when a peripheral is attached to the Dash monitor. Asynchronous, Aux, and a switched Ethernet serial communication channels are supported as well as switched +9-18V and +5V power.



Bottom View of the Monitor

PIN	SIGNAL NAME	I/O	SIGNAL DESCRIPTION
1	RETURN	–	Common power return
2	+9-18V	O	+9-18V power
3	PER_MARKER_OUT	O	Marker out
4	PER_ENET_PRESENT*	I	Signal to request switched Ethernet to peripheral
5	PER_ENET_TXD–	O	Transmit data + to peripheral
6	PER_ENET_RXD–	O	Transmit data – to peripheral
7	PER_ENET_TXD+	I	Receive data + from peripheral
8	PER_ENET_RXD+	I	Receive data – from peripheral
9	PER_AUTOPORT_ID_RXD	I	AutoPort ID RXD
10	PER_PRESENT*	I	Asserted by the installed peripheral device once powered
11	PER_ASYNC_RXD	I	Serial asynchronous data input from peripheral
12	PER_ASYNC_TXD	O	Serial asynchronous data output to peripheral
13	TC_PACER_BLANK*	O	Pacer blanking pulse from defibrillator
14	PER_AUTOPORT_ID_TXD	O	AutoPort ID TXD
15	PER_AUTOPORT_RXD	O	AutoPort RXD
16	PER_AUTOPORT_TXD	I	AutoPort TXD
17	+5V	O	+5V power
18	RETURN	–	Common power return

Appendix A – Electromagnetic Compatibility

Electromagnetic Compatibility (EMC)

Changes or modification to this system not expressly approved by GE Medical System could cause EMC issues with this or other equipment. This system is designed and tested to comply with applicable regulation regarding EMC and needs to be installed and put into service according to the EMC information stated as follows.

WARNING
Use of portable phones or other radio frequency (RF) emitting equipment near the system may cause unexpected or adverse operation.

WARNING
The equipment or system should not be used adjacent to, or stacked with, other equipment. If adjacent or stacked use is necessary, the equipment or system should be tested to verify normal operation in the configuration in which it is being used.

Guidance and Manufacturer's Declaration – Electromagnetic Emissions

The DASH® 2000 Monitor is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or user to ensure that the DASH 2000 Monitor is used in such an environment.

Emissions Test	Compliance	Electromagnetic Environment – Guidance
RF emissions EN 55011	Group 1	The equipment uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions EN 55011	Class A	The equipment is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions EN 61000-3-2	Class A	
Voltage fluctuations/ Flicker emissions EN 61000-3-3	Complies	

Guidance and Manufacturer's Declaration – Electromagnetic Immunity

The DASH 2000 Monitor is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or user to ensure that the DASH 2000 Monitor is used in such an environment.

Immunity Test	EN 60601 Test Level	Compliance Level	Electromagnetic Environment – Guidance
Electrostatic discharge (ESD) EN 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst EN 61000-4-4	± 2 kV for power supply lines ±1 kV for input/output lines	± 2 kV for power supply lines ±1 kV for input/output lines	Mains power should be that of a typical commercial or hospital environment.
Surge EN 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines EN 61000-4-11	<5% U_t (>95% dip in U_t) for 0.5 cycles <40% U_t (>60% dip in U_t) for 5 cycles <70% U_t (>30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5 s	<5% U_t (>95% dip in U_t) for 0.5 cycles <40% U_t (>60% dip in U_t) for 5 cycles <70% U_t (>30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5 s	Mains power should be that of a typical commercial or hospital environment. If the user of the DASH 2000 Monitor requires continued operation during power mains interruptions, it is recommended that the Dash 2000 Monitor be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field EN 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristics of a typical location in a typical commercial or hospital environment.

NOTE:

U_t is the AC mains voltage prior to application of the test level.

Guidance and Manufacturer's Declaration – Electromagnetic Immunity

The DASH 2000 Monitor is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or use to assure that the DASH 2000 Monitor is used in such an environment.

Immunity Test	EN 60601 Test level	Compliance level	Electromagnetic environment – guidance
			Portable and mobile RF communications equipment should be used on closer to any part of the equipment, including cables, than the recommended separation distance calculated fro the equation applicable to the frequency of the transmitter. **Recommended separation distance**
Conducted RF EN 61000-4-6	3 Vrms 150 KHz to 80 MHz	3 V rms	$d = 1.2\sqrt{P}$
Radiated RF EN 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and *d* is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a], should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 

NOTE 1: At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by reflection from structures, objects, and people.

a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, and electromagnetic site survey should be considered. If the measured field strength in the location in which the equipment is used exceeds the applicable RF compliance level above, the equipment should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the equipment.

b Over the frequency range 150 KHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended Separation Distances

The table below provides the recommended separation distances (in meters) between portable and mobile RF communication equipment and the DASH 2000 Monitor.

The DASH 2000 Monitor is intended for use in the electromagnetic environment on which radiated RF disturbances are controlled. The customer or the user of the DASH 2000 Monitor can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the DASH 2000 Monitor as recommended below, according to the maximum output power of the communications equipment.

	Separation Distance in Meters (m) According to Frequency of Transmitter		
Rated Maximum Output Power of Transmitter in Watts	**150 kHz to 80 MHz** [C] $d = 1.2\sqrt{P}$	**80 MHz to 800 MHz** [C] $d = 1.2\sqrt{P}$	**800 MHz to 2.5 GHz** [C] $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

[C] At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

For transmitters rated at a maximum output power not listed above, the recommended separation distance [*d*] in meters (m) can estimated using the equitation applicable to the frequency of the transmitter, where *P* is the maximum output power rating of the transmitter in watts (w) according to the transmitter manufacturer.

NOTE:

These guidelines may not apply in all instances. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people

WARNING
The use of accessories, transducers and cables other than those specified may result in increased emissions or decreased immunity performance of the equipment or system.

Compliant Cables and Accessories

The table below lists cables, transducers, and other applicable accessories with which GE Medical Systems claims EMC compliance.

NOTE: Any supplied accessories that do not affect EMC compliance are not included.

Part No	Description	Maximum Lengths
ECG Cables		
416035-00X	Multi-Link 12-Ld ECG Standard Cable	3.6 m /12 ft
412931-00X	Multi-Link 5-Ld ECG Standard Cable	6 m /20 ft
412944-00X	Multi-Link 3-Ld ECG Neonatal Cable	3.6 m /12 ft
2001292-00X	Multi-Link 3-Ld ECG Cable w/Grabber	3.6 m /12 ft
411910-00X	Multi-Link 5-Ld ECG ESU	3.6 m /12 ft
2017003-00X	Multi-Link, 3/5-Ld ECG Cable	3.6 m / 12 ft
2017004-00X	Multi-Link 3-Ld Neonatal ECG Cable	3.6 m / 12 ft
2021141-00X	Multi-Link 3-Ld ECG Cable w/Grabber	3.6 m / 12 ft
2017005-00X	Multi-Link 6-Ld ECG Cable	3.6 m / 12 ft
M1020453 / M1020454	Multi-Link to 300 Series 3-Ld Trunk Cable	3 m / 10 ft
M1020541 / M1020546	Multi-Link to 300 Series 5-Ld Trunk Cable	3 m / 10 ft
2017006-00X	Multi-Link 12 SL ECG Cable	3.6 m / 12 ft
2017007-00X	Multi-Link 3/5/6 Adapter	N/A
ECG Multi-Link Lead wires		
412681-00X	Multi-Link lead wire Set-Group, 5-Ld, Grabber	130 cm / 51 in
412682-00X	Multi-Link lead wire Set-Group, 3-Ld, Grabber	130 cm / 51 in
414556-00X	Multi-Link lead wire set, 5-Ld, Grabber	130 cm / 51 in
41646X-00X	Multi-Link lead wire set, 5-Ld, Grabber V2-V6	130 cm / 51 in
2014811-00X	Multi-Link lead wire set, 3-Ld, MiniGrab AHA Ld I	74 cm / 29 in
2014813-00X	Multi-Link lead wire set, 3-Ld, MiniGrab IEC Ld I	74 cm / 29 in
2014816-00X	Multi-Link lead wire set, 3-Ld, Adult Graber AHA LD II	74 cm / 29 in
2014817-00X	Multi-Link lead wire set, 3-Ld, Adult Grabber IEC LD II	74 cm / 29 in

Part No	Description	Maximum Lengths
411202-00X	Multi-Link Ldwr Set-Group, 5-Ld, Snap	130 cm / 51 in
545315 / 545317	300-Series 3-Ld Set w/clips	75 cm / 30 in
8001958 / 80019560	300-Series 3-Ld Set w/clips	1.5 m / 60 in
545327	300-Series 3-Ld Set w/snaps	75 cm / 30 in
545316 / 535318	300-Series 5-Ld set w clips	125 cm /49 in
8001959 / 8001961	300-Series 5-Ld set w/clips	1.5 m / 60 in
545328	300-Series 5-Ld set w/snaps	125 cm / 49 in
54534X	300-Series replacement clip lead	125 cm / 49 in
800327X	300-Series replacement clip lead	1.5 m / 60 in
545358 / 545359	300-Series replacement clip lead	75 cm / 30 in
54535X	300-Series replacement snap lead	125 cm / 49 in
411203-00X	Multi-Link Ldwr Set-Group, 3-Ld, Snap	130 cm / 51 in
900716-001	Multi-Link Ldwr Set, Mini-Clip/DIN, Neonatal	60 cm / 24 in
411200-00X	Multi-Link Ldwr Set, 5-Ld, Snap	130 cm / 51 in
403751-0XX	Multi-Link Ldwr Set, Radiotranslucent Grabber	1.6 m / 60 in
42193X-00X	Multi-Link Ldwr Set, 6-Ld, Snap	130 cm / 51 in
412680-00X	Multi-Link Ldwr Set, Individual, Grabber	130 cm / 51 in
412596-00X	Multi-Link Ldwr Set, Individual, Snap	130 cm / 51 in
416447-0XX	Multi-Link Ldwr Set, Individual, Grabber, V2-V6	130 cm / 51 in
Invasive BP Cable and Transducers		
700078-001	Utah Transducer Adapter Cable	3.6 m / 12 ft
700077-001	Spectramed Transducer Adapter Cable	3.6 m / 12 ft
2005772-001	Dual BP adapter	30 cm / 12 in
2016997-00X	Utah Transducer Adapter Cable	3.6 m / 12 ft
2016996-00X	Abbott Transpac-III Adapter Cable	3.6 m / 12 ft
2021196-00X	Abbott Transpac-IV Adapter Cable	3.6 m / 12 ft
2021197-00X	Edwards Truwave Adapter Cable	3.6 m / 12 ft
2016995-00X	Spectramed Transducer Adapter Cable	3.6 m / 12 ft
N/A	Utah Disposable Transducers (DPT, DP2,DP3)	N/A
N/A	Spectramed Transducers (TC-MQ)	N/A
N/A	Abbott Transpac-III Transducers	N/A
N/A	Abbott Transpac-IV Transducers	N/A
N/A	Edwards Truwave Transducers (PX)	N/A

Cardiac Output Cables and Probe		
700148--00X	Cardiac Output Cable	3.6 m / 12 ft
9446-9XX	Cardiac Output Probe	2.4 m / 8 ft
Temperature Cables and Probes		
217 294 0X	Temp Probe, Rectal, 4.5mm diameter	3.6 m / 12 ft
217 300 0X	Temp Probe, Rectal and esophageal, calibrated, 3.8mm diameter, autoclavable	3.6 m / 12 ft
217 331 01	Temp Probe, aural measurement, highly flexible, 2mm diameter	3.6 m / 12 ft
217 335 01	Temp Probe, Neonate, highly flexible, 2mm diameter	3.6 m / 12 ft

Part No	Description	Maximum Lengths
Pulse Oximetry Cables and Sensors		
2006644-001	Nellcor RECAL Interface Cable	3.6 m / 12 ft
2002592-00X	Masimo Set Interface Cable	3.6 m / 12 ft
2017002-00X	Masimo Set Interface Cable	3.6 m / 12 ft
2017001-00X	Nellcor RCAL Interface Cable	3.6 m / 12 ft
2021406-00X	Nellcor OxiMax Interface Cable	3 m / 10 ft
2002799-001	Masimo Finger Sensor, Pediatric	N/A
2002800-001	Masimo Finger Sensor, Adult	N/A
407705-00X	Nellcor Sensor Finger Probe	N/A
Accessories		
N/A	RJ45 series Category 5 cable	N/A
223 225 01	Power Cord, US, Hospital Grade	3 m / 10 ft
919 200 37	Potential Equalization cable	3 m / 10 ft
403939-001	Defib Sync Cable	3 m / 10 ft