CardioLab®/Mac-Lab® 2000/4000/7000

System Service Manual

2002937-003   Revision C

GE Medical Systems

Information Technologies

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1   Introduction

For your notes

Revision History

Each page of the document has the document part number and revision letter at the bottom of the page. The revision letter identifies the document's update level.

The revision history of this document is summarized in the table below.

Table 1. Revision History PN 2002937-003		
A	June 15, 2000	Initial release of this manual.
B	March 19, 2001	Initial release of this manual.
C	May 21, 2002	Release C with editorial changes to incorporate 5.1D.

Manual Purpose

This manual contains the instructions necessary to operate and service the CardioLab/Mac-Lab system safely in accordance with its function and intended use. These instructions include but are not limited to:

- Describing fundamental controls and indicators.
- Operating procedures.
- Connecting and disconnecting detachable parts and accessories.
- Troubleshooting and service procedures.

Intended Audience

This manual is intended for the person who maintains and troubleshoots this equipment.

Statement of Indications for Use

Mac-Lab System

The Mac-Lab system is intended for use under the direct supervision of a licensed healthcare practitioner to monitor, calculate, or record cardiovascular data from patients as they undergo cardiac catheterization. Cardiovascular data may be manually entered or acquired via interfaced GE Medical Systems *Information Technologies* TRAM modules (k921669), MUSE cardiovascular system, and other interfaced information systems. Data includes: ECG waveforms, heart rate, pulse oximetry (SpO2), respiration rate, valve gradients and areas, cardiac output, hemodynamic measurements, invasive and non-invasive blood pressure, procedural information, and optional intracardiac electrocardiogram (IECG).

This is applicable to pediatric and adult patients requiring cardiac/circulatory system catheterization. This is intended for use in catheterization and related cardiovascular specialty laboratories.

CardioLab System

The intended use of the CardioLab system is to acquire, filter, digitize, amplify, display, and record electrical signals obtained during electrophysiological studies and related procedures conducted in an electrophysiological laboratory. Signal types acquired include ECG signals, direct cardiac signals, and pressure recordings. Physiological parameters such as diastolic, systolic, and mean blood pressure, heart rate, and cycle length may be derived from the signal data, displayed and recorded. The system allows the user to monitor the acquisition of data, review the data, store the data, perform elementary caliper-type measurements of the data, and generate reports on the data. Additionally, the system may acquire, amplify, display, and record data received from other medical devices typically used during these procedures, such as imaging devices and RF generators.

The CardioLab EP system does not control the delivery of energy, administer drugs, perform any life-supporting or life-sustaining functions, or analyze physiological data or other data acquired during an EP procedure. It does not transmit alarms or arrhythmias and does not have arrhythmia detection capabilities.

Chapter Content

This manual is organized into chapters and appendices.

1 Introduction

This chapter describes the field service manual and chapter contents. Provides general information on safety, service requirements, equipment symbols, and serial number identification.

2 Equipment Overview

This chapter describes the equipment and its technical characteristics, connector locations, and preparation for use.

3 System Components

This chapter contains the system components for the CathLab/Mac-Lab system.

4 Maintenance

This chapter contains a preventive maintenance schedule, illustrated instructions for opening the unit, and cleaning guidelines. Instructions for performing electrical safety (leakage) tests are also included.

5 Troubleshooting

This chapter provides overall and specific troubleshooting help, and directions for performing functional tests.

6 Drawings and Parts Lists

This chapter contains upper-level parts lists, photos, and illustrations for reference in repairing the unit at the assembly level.

Appendix A - Technical Specifications

This appendix lists the technical descriptions and specifications for the CardioLab/Mac-Lab system.

Index

The Index lists the terms used in the document.

Safety Information

Follow all of the instructions and warnings marked included in this manual, save these instructions for later use. However, these instructions in no way supersede current medical practices regarding patient care and safety.

Electromagnetic Compatibility and Interference

This catheterization system meets the requirements of the European Medical Device Directive, and by reference, the requirements for electromagnetic compatibility specified by EN 60601-1-2. This equipment is not likely to interfere with other equipment, except with certain types of rate adaptive pacemakers that rely on bioelectric impedance measurement (BIM) technology. Also, interference with the operation of this equipment is not likely to result from proximity to general equipment.

This equipment meets or exceeds Class A immunity levels. However, avoid the use of strong intentional radio transmitters in the immediate vicinity, including cellular telephones. The use of strong unintentional radiators, such as electrosurgical equipment, may cause some level of interference. GE Medical Systems *Information Technologies* offers optional ECG patient cables with electrosurgical noise filtering, which reduces the level of interference on ECG traces.

If using electrosurgical or RF ablation equipment in conjunction with this equipment, select an ESU filtered cable. For more information about management of the equipment in the clinical environment (from an electromagnetic compatibility perspective) consult the Association for the Advancement of Medical Instrumentation's technical information report *Guidance on Electromagnetic Compatibility of Medical Devices for Clinical/Biomedical Engineers*.

Responsibility of the Manufacturer

GE Medical Systems *Information Technologies* is responsible for the effects of safety, reliability, and performance only if:

- Installation operations, extensions, readjustments, modifications, or repairs are performed by persons authorized by GE Medical Systems *Information Technologies*.
- The equipment is used in accordance with the instructions provided.
- The user attaches only accessory equipment recommended for interaction with the amplifier.

General

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

The CardioLab/Mac-Lab system maintains leakage currents below medical limits with an isolation transformer which is incorporated into the design of the integrated electronics box (IEB). The system power is supplied by a dedicated power supply on an isolated circuit for proper behavior of the system.

To ensure patient safety, use only parts and accessories manufactured or recommended by GE Medical Systems *Information Technologies*. Parts and accessories used must meet the requiremetns for the applicable IEC 601 series safety standards, and the system configuration must meet the requirements of the IEC 601-1-1 medical electrical systems standard. Contact GE Medical Systems *Information Technologies* before connecting any device to this system that is not recommended for use in this manual.

If the equipment is installed in the USA and uses 240V rather than 120V, the source must be a center-tapped, 240V single-phase circuit.

To ensure patient safety, use only parts and accessories manufactured or recommended by GE Medical Systems *Information Technologies*.

This equipment should only be connected as specified by GE Medical Systems *Information Technologies*. Installation of the equipment should only be performed by qualified GE Medical Systems *Information Technologies* service representatives. Connection of the system to the equipment is not recommended in this manual.

Contact GE Medical Systems *Information Technologies* for information before connecting any device to this equipment that is not recommended in this manual. Only cables and accessory equipment purchased form GE Medical Systems *Information Technologies* should be used in conjunction with the system.

It is important that all of the instructions in this manual be followed. However, these instructions in no way supersede current medical practices regarding patient care and safety.
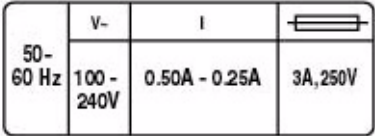
Refer servicing of the equipment to GE Medical Systems *Information Technologies* authorized service personnel. Any attempt to repair equipment under warranty will void that warranty.

Failure on the part of responsible individuals or institutions to implement a satisfactory equipment maintenance schedule may lead to undue equipment failure and possible health hazards.

The use of ACCESSORY equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system. Consideration relating to the choice includes:

■ Use of the accessory in the PATIENT VICINITY.

■ Evidence that the safety certification of the ACCESSORY is performed in accordance with the appropriate IEC 601-1 and IEC 601-1 harmonized national standard.

Equipment Symbols

Table 2. Equipment Symbols	
Equipment Symbols	**Descriptions**
[UL CLASSIFIED symbol: c(UL)us 4P41 MEDICAL EQUIPMENT JL 2601-1 AND CAN/CSA 601.1]	**Underwriters Laboratories, Inc.** 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.
[CE 0459 symbol]	**CE Marking**
[Power ratings label: 50-60 Hz, V~ 100-240V, I 0.50A - 0.25A, Fuse 3A, 250V]	**Power Ratings Chart:** V~ = Voltage I = Current Fuse = *[fuse symbol]*
[Equipotentiality symbol]	**Equipotentiality** A nonessential electrical connection which may be used to connect the chassis to other equipment to achieve the same potential.
[Heart with box and paddles symbol]	**Type CF Equipment that is Defibrillator Proof** Type CF Applied Part: Isolated (floating) applied part suitable for intentional external and internal application to the patient excluding direct cardiac application. The "paddles" outside the box indicate that the part is defibrillator proof. (Medical Standard Definition:) F-Type applied part (floating/isolated) complying with the specified requirements of IEC 60601-1/UL 2601-1/CSA 601.1 Medical Standards provide a higher degree of protection against electric shock than that provided by Type B applied parts.
[Heart with box symbol]	**Type CF Equipment** Type CF Applied Part: Isolated (floating) applied part suitable for intentional external and internal application to the patient excluding direct cardiac application. (Medical Standard Definition:) F-Type applied part (floating/isolated) complying with the specified requirements of IEC 60601-1/UL 2601-1/CSA 601.1 Medical Standards provide a higher degree of protection against electric shock than that provided by Type B applied parts.
[Attention triangle symbol]	**Attention** Pay attention to the documents delivered with the equipment.
[Input symbol]	**Input Symbol**

Conventions

These are the conventions used in this manual.

Safety Messages

DANGER safety messages indicate an imminently hazardous situation, which if not avoided, WILL result in death or serious injury.

WARNING safety messages indicate a potentially hazardous situation, which if not avoided, COULD result in death or serious injury.

CAUTION safety messages indicate a potentially hazardous situation, which, if not avoided may result in minor or moderate injury.

NOTE messages provide additional user information.

Danger, Warnings, and Cautions

DANGER
EXPLOSION HAZARD

Do not use in the presence of flammable anesthetics or other flammable gases.

WARNINGS
ACCESSORIES

Only connect UL 544 or UL 2601-1 listed or IEC certified medical equipment.

ACCIDENTAL SPILLS

If fluid of any kind should leak into the system, discontinue use of the equipment and contact GE Medical Systems *Information Technologies* immediately.

DO NOT allow hydraulic fluid from any device to contact any conductive surface. Hydraulic fluid is electrically conductive.

ACCURACY

The system may report erroneous heart rate values when pacemaker spikes or arrhythmias are present. Reported values should be verified by a qualified physician.

CONDUCTION HAZARD

Keep the conductive parts of lead electrodes and associated parts away from other conducting parts, including earth.

DEFIBRILLATOR PRECAUTIONS

DO NOT contact the amplifier or patient during defibrillation.

Standby defibrillation equipment is required in the event that the patient needs to be cardioverted or defibrillated.

Disconnect leadwires from patient before defibrillating. Otherwise, serious injury, death, or damage to the equipment could result.

IEC

All equipment not complying with IEC 601-1 should be placed outside the patient environment.

WARNINGS

INTERPRETATION HAZARD

A qualified physician must overread all computer-generated measurements and tracings. Computerized interpretation is only significant when used in conjunction with clinical findings.

Signal quality should be checked only by a licensed health care practitioner.

All computer assisted measurement functions must be verified by a licensed health care practitioner.

LEAKAGE CURRENT TEST

The system should be tested yearly for adequate grounding on patient leakage current.

Keep leakage current within acceptable limits when connecting auxiliary equipment to the system.

When more than two electrical devices are interconnected, the summation of leakage currents must be checked yearly.

MAINTENANCE/SERVICE

High voltages exist in the unit. Use insulated tools. Remove jewelry and use only one hand when possible.

Always disconnect power from the equipment before attempting service.

PINCH POINT HAZARD

Keep hands, hair, jewelry and loose clothing away from moving parts. Otherwise, serious injury could result.

POWER SUPPLY

Total system earth leakage current must not exceed 500 microamperes.

Voltages between the three power outlet connections must be accurate BEFORE measuring power outlet ground-to-neutral loop resistance.

Electrostatic discharge (ESD) can damage electronic components. Be sure you are properly grounded when using or servicing the system.

To reduce the risk of electric shock or damage to the equipment, do not disable the power cord grounding feature. This equipment is designed for connection to a grounded (earthed) power outlet.

WARNINGS

The supply line must be fused and capable of delivering 16A.

Route the AC power cable away from moving parts.

Connect only to a properly earth grounded outlet.

REPLACEMENTS

Replace only with the same type and rating of fuse.

SHOCK HAZARD

Electrical shock hazard between chassis ground and isolated (floating) ground when power is applied. Unplug the unit from the power source before proceeding.

To reduce the risk of electric shock or damage to your equipment, do not disable the power cord grounding feature. This equipment is designed for connection to a grounded (earthed) power outlet. The grounding plug is an important safety feature.

SUPERVISED USE

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

CAUTIONS

Federal (USA) law restricts this device to sale by or on the order of a physician.

ACCURACY

DO NOT display any channels which are based on unused catheter input modules. Otherwise, erroneous values may occur.

ECG signal quality should only be checked by qualified medical personnel.

CABLING

Route optical cables thorough conduit in the ceiling or floor to avoid damage to the cables of cable connectors.

DEVICES

DO NOT reuse single use devices.

CAUTIONS
EMC

No known electromagnetic or other interference between the system exists. However, precautions should be taken to avoid the use of cellular telephones, pagers, or other transmitters.

OPTICAL DISK

Exit the software application properly before turning off the system. Failure to do so may damage the optical disk.

Remove the optical disk before moving the system. Failure to do so may result in damage to the drive or the disk.

TRANSDUCER

Remove air that is trapped in the transducer or associated tubing by flushing the system according to Cath lab procedures.

REMOTE MONITOR

Always power the system through separate isolation transformers which are independently connected to a wall outlet. You can power the laser printer through the IEB/Workstation power supply. Otherwise, the printer may draw enough current away from the system and cause it to reboot.

SOFTWARE

DO NOT add unauthorized software to the CardioLab/ Mac-Lab system. Doing so may make the CardioLab/ Mac-Lab software unstable.

Service Information

Service Requirements

Follow the service requirements listed below:

- Equipment servicing should be performed by GE Medical Systems *Information Technologies* 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 GE Medical Systems *Information Technologies* or 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 system is always functional when required.

Equipment Identification

Every GE Medical Systems *Information Technologies* device has a unique serial number for identification. The serial number appears on the back of the CardioLab II Plus Amplifier.
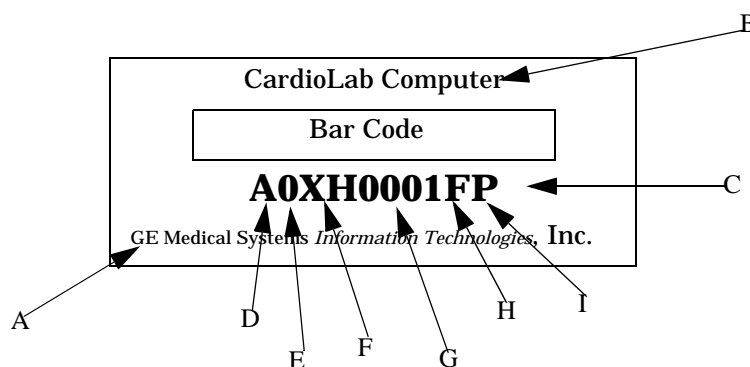
PK1

Equipment Identifications Table

Table 3. Equipment Identifications		
Item	**Name**	**Description**
A	Manufacturer	GE Medical Systems *Information Technologies*
B	Name of device	CardioLab computer
C	Serial number	Unique identifier
D	Month manufactured	A = January, B = February, C = March, D = April, E = May, F = June, G = July, H = August, J = September, K = October, L = November, M = December
E	Year manufactured	9 = 1999, 0= 2000, 1= 2001, (and so on)
F	Product code	Two-character product descriptor XH= CardioLab computer
G	Product sequence number	Four-character manufacturing number (of total units manufactured)
H	Plant designator	F = Cardiology G = Monitoring
I	Device characteristics	One or two characters that further describe the unit, for example: P = prototype not conforming to marketing specification; R = refurbished equipment; S = special product documented under Specials part numbers; U = upgraded unit

Required Tools and Supplies

The following is a list of tools needed to service the CardioLab/Mac-Lab system:

- Adjustable wrench with a 1-inch capacity
- Phillips screwdriver
- Needle nose pliers
- Pliers
- Socket wrench (3/16 inch to 1 inch size bits)
- Phillips head screwdriver (small and large sizes)
- Flat head screwdriver (small and large sizes)
- Cutting pliers
- Power outlet ground tester
- Grounding strap
- Signal generator with ECG, pressure, cardiac output, and temperature outputs.
- Cables to connect simulator to ECG inputs of amplifier and TRAM
- Cables to connect the simulator to the catheter input modules (2 mm shielded)
- Adapter cable to connect the simulator to the amplifier and TRAM pressure inputs
- Cables to connect the simulator to the TRAM, cardiac output, and temperature inputs

Power Input Requirements

If the equipment is installed in the USA and uses 240V rather than 120V, the source must be a center-tapped, 240V single-phase circuit (120V, 20A; 240V, 10A).

For your notes

2 Equipment Overview

For your notes

Acquisition Computer with Workstation

Central Processing Unit (CPU)

The CardioLab/Mac-Lab products are diagnostic systems used for the assessment of the cardiac electrophysiologic (CardioLab) and hemodynamic (Mac-Lab) condition of patients.

The computer hardware consists of a PC motherboard, expansion cards for added functionality, and a SCSI drive system.

See Chapter 6, Drawings and Parts List for diagrams of the computer.

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General Description

Standard Equipment

Table 1. Standard Equipment	
Description	**Part Number**
Barcode Scanner	2003417-001
Laser Printer (4050 and 2100M)	2000902-001 & 2000902-001

Monitors: 21"
            18"
            17"
	21" 2001732-001
	18" 2004130-001
	17" 408057-004

Keyboard: Mac-Lab (English)
            CardioLab (English)
            CardioLab/Mac-Lab (English)
	2003809-001
	2003809-002
	2003809-003

Mouse (PS2)	403590-199
TRAM Modules (Mac-Lab 7000/Combination systems only) (400SL or 450 SL)	450SL-412654-001 400SL-411161-001
Remote Acquisition Unit (RAU) Mac-Lab 7000/Combination systems only) (400SL or 450 SL)	415540-001
CardioLab II Plus Amplifier (CardioLab/Mac-Lab/Combination systems only)	2003232-001 (032) 2003232-002 (064) 2003232-003 (096) 2003232-004 (128)
Acquisition Computer	2006834-001 2006834-002 2006834-003 2006834-004 2006834-005 2006834-007 2006834-008
TRAM-Net RAC 4A (Mac-Lab/Combo System only)	900031-006

Additional Systems

Table 2. CardioLink Clients	
Description	
Nurses Station/Pre-Post Op Station/Review Station	2006834-006

Optional Equipment

<table>
<tr><td colspan="2" align="center">Table 3. Optional Equipment</td></tr>
<tr><td align="center">Description</td><td align="center">Part Number</td></tr>
<tr><td>Strip Chart Recorder (Thermal Writer)</td><td>2002480-001</td></tr>
<tr><td>Analog Output Box</td><td>2003443-001</td></tr>
<tr><td>Video Printer</td><td>2004142-001</td></tr>
</table>

CardioLink Server

<table>
<tr><td colspan="2" align="center">Table 4. Server</td></tr>
<tr><td align="center">Description</td><td align="center">Part Number</td></tr>
<tr><td>High-End Server
Mid-Level Server
Local Server</td><td>2009350-001
2009350-002
2009350-003</td></tr>
<tr><td>Network Switch 10/100 Base-TX</td><td>2001084-001</td></tr>
<tr><td>Rack-Mounted UPS</td><td>2006397-001</td></tr>
<tr><td>Rack</td><td>2006483-001</td></tr>
</table>

Software

Operating System

The computer uses the Windows NT 4.0 Operating System.

Application

The CardioLab and Mac-Lab system is a single, custom application which has an EP and a CathLab mode. The Combination system includes both CardioLab and Mac-lab.

Accessory Software

In addition to the CardioLab/Mac-Lab system, the computer has the following accessory software installed:

- Microsoft Office (for generating procedure reports)
- PC Anywhere 32 (for remote support via modem)
- Microsoft Database Engine (MSDE) for database communication

MotherBoard

The motherboard is a server and has the following features:

- Pentium III processor support
- Integrated 10/100 Network card
- Integrated SCSI controller

Component Boards

The following expansion cards may be added to the computer for additional functionality.

Video PCI Expansion Cards (2003236-001)

The video subsystem utilizes a PCI video card. This card supports the high resolutions used for the application (up to 1600 by 1280 per monitor).

- The computer can be configured with one or two video cards, depending on the configuration purchased.
- The use of the extra video card allows the desktop display to be shown across two monitors instead of one.
- The board in the slot labeled Video 1 drives the real-time signal display of the system, as well as non-real-time display elements.
- The optional board in the slot labeled Video 2 displays only non-real-time display elements.
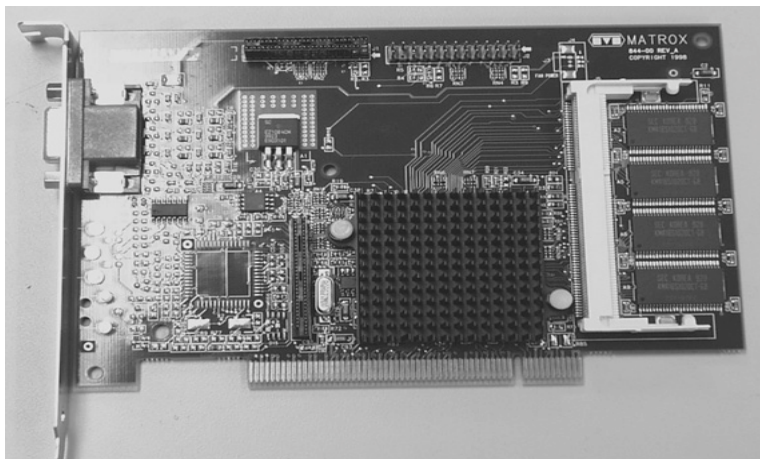
PK2

RS422 PCI Expansion Card (2003245-001)

- The computer can be configured with an optional RS422 expansion card.
- This card allows the computer to communicate with the TRAM RAU module.
- This card has two independent RS422 DB9 connectors, allowing it to communicate with two TRAM RAUs simultaneously.
- Note that the DB9 connectors on the board do not connect directly to the TRAM, but connect instead to the IEB. The IEB routes the dual RS422 connections to a single DB15 connector, which connect to the TRAM RAU cable.
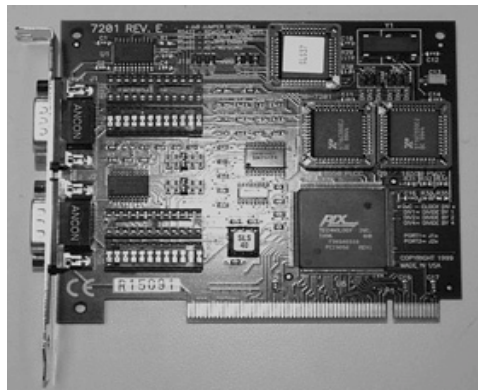
PK3

Imaging PCI Expansion Card (2003243-001) - Optional

- The computer can be configured with an optional Imaging expansion card.
- This card allows the computer to acquire and display analog video input, such as images from an X-ray system.
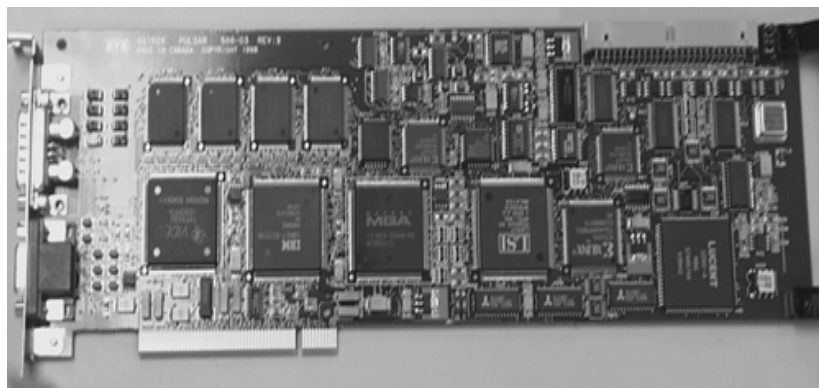
PK4

COMMS ISA Expansion Card (2002886-003)

The computer is configured with a COMMS expansion card. The purpose of this card is to:

- Communicate with the CardioLab II/II Plus amplifier (via 2 ST connectors on the bracket).

- Output of analog signals for use by other equipment (output via the DB 44 connector on the bracket).

- Input of analog signals from other equipment (input via the DB 44 connector on the bracket).

- Provide additional serial ports (COM 5,6,7,8,9,10). Input/Output via the internal 40 pin header for COM 5,6,7,8,9 and internal 10 pin header for COM 10.

- Output a video switching signal to toggle the video display of the Switched Video output on the system VID/MUX (video distribution/ amplifier board in the IEB) (output via the DB 44 connector on the bracket).
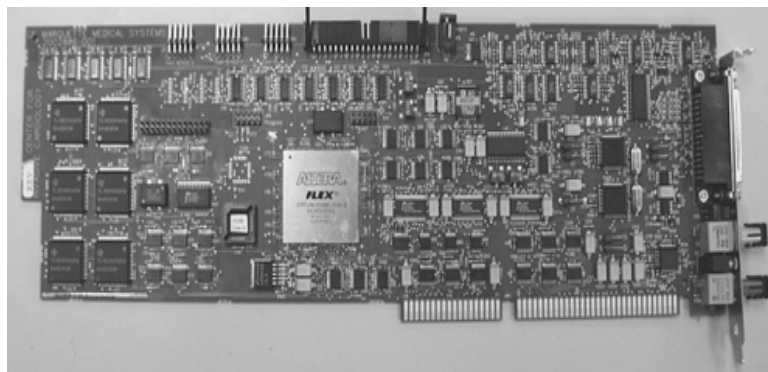
PK5

SCSI PCI Expansion Card (2003338-001) Optional

- The computer can be configured with an optional SCSI expansion card.

- This card allows the computer to review old patient studies from the previous DOS CardioLab EP version of the CardioLab product.

SCSI Drive Subsystem

The computer is configured with an Ultrawide II SCSI interface. A SCSI interface is used to increase performance of the data read/write that is achieved with the SCSI.

The SCSI drives used in the system are:

- Hard drive used for the operating system, application software, and accessory software.

- CD ROM drive used for loading software as needed.

- Optical drive used for recording system studies to portable optical media.

USB Port (part of IEB Box)

The computer is configured with two USB ports:

- The USB port communicates with or prints to the optional Thermal Writer. Only one port is needed for the writer.
- The second port is an active port which can be used in the event of a problem with the first port.

Optical Drive 2.6G (2003240-001)

The optical drive used for recording system studies to portable optical media.

Type IV (High-end option):

5 1/4 inch Optical Drive (2003240-001)

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Optical Drive 320MB (2003241-001)

The optical drive used for recording system studies to portable optical media.

Type III (low-end option):

3 1/2 inch Optical Drive (2003241-001)

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TRAM-net to Ethernet conversion board (2009937-001)

Converts signals from the TRAM-net RAC to Ethernet. Allows Mac-Lab communications with the TRAM-net RAC.

Integrated Electronics Box (IEB)

Introduction

The IEB serves as the power conditioner/distribution device for the CardioLab/Mac-Lab/Combination workstations. The power supplied by the IEB supports all specified equipment that is needed for system operation.The IEB is designed to provide power to the following equipment:

- NT Computer
- 3, 21-inch Cathode Ray Tube (CRT) monitors
- Uninterruptible Power Supply (UPS) (Internal)
- Laser printer
- Video Multiplexer (VID/MUX) amplifier (Internal)
- Modem (Internal)
- Thermal Writer
- Two TRAM modules

There are three different versions of the IEB. They are:

- IEB 100V, 50/60 Hz
- IEB 120V, 50/60 Hz
- IEB 240V, 50/60 Hz

Refer to Chapter 6 for IEB part numbers for 2003153-001 and 2003696-001.

Isolation Transformer (part of IEB Box)

The isolation transformer is used to provide isolation as required by IEC601-1. The transformer is a 2.5kVA medical grade high isolation transformer. It has the appropriate primary and secondary taps to achieve 1:1 ratings for 100V, 120V, and 240V.

Uninterruptible Power Supply (UPS) (2003262-001)

There are three different versions of the UPS:

- One for each rated voltage version of the IEB. The UPS is only required to power the computer (no monitors) to prevent momentary loss of power.
- The UPS is powered directly from the unswitched power on the secondary of the transformer. This prevents the UPS from detecting a power fault condition when the power is switched off to other components.
- The computer is turned off using the power switch on either the UPS or the computer.
- The UPS is mounted on the upper internal shelf and is fastened in place using the UPS Hold Bracket.
- The front panel of the UPS is visible through the opening in the front panel of the IEB. This is needed for user access to the UPS power switch.

PK8

Modem (2002241-001)

The universal modem is used for remote dialing to the system for service.

■ The IEB is supplied with an internal modem that is connected to the computer.

■ There are two versions of modems. One for use in the 120V IEB and one that is used in the 100V and 220V versions. Each version of modem is supplied with a power supply.

PK9

Modem Power Supply (part of IEB Box)

■ The IEB is supplied with an internal modem that is connected to the computer.

■ There are two versions of modems. One for use in the 120V IEB and one that is used in the 100V and 220V versions. Each version of modem is supplied with a power supply.

■ The modem is attached to the lower internal shelf and the power is connected to the appropriate AC outlet on the same shelf. The modem is secured with Velcro. The serial interface to the computer is

connected through the DB Connect Circuit Board. The phone line in and out is connected through the DB Connect Panel.

PK10

Video Multiplexer (VID/MUX) for IEB (2003681-001)

The VID/MUX is a video board that is capable of the following functions:

- Accepts three video inputs
- Two buffered outputs for each input (one for a local monitor and one for remote)
- One buffered output that is software selectable to view input 1 or 2
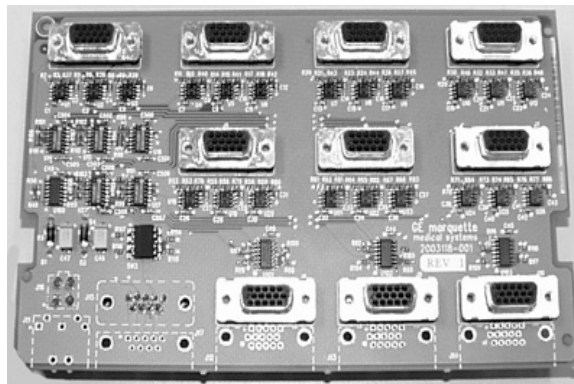
PK11

VID/MUX Power Supply (part of IEB Box)

The VID/MUX board requires ±5V @ 1.25A each. The power supply for the VID/MUX board is mounted in the lower power compartment of the IEB. Switched AC power is delivered by the power supply.

DB Connect Circuit Board (2003680-001)

The DB Connect Panel has the following I/O connections.

- Analog IN and OUT from computer on DB44

   The DB44 is the new connector on the COMMS board. It combines the functions of Analog In and Analog OUT.

- Analog OUT to breakout box on DB37

   This connection routes the Analog OUT from the DB44 to the DB37. This allows for interface to the current analog output breakout cable.

- Analog OUT Channel 1-2 on BNC
- These connections are individual channel outputs from the DB44 connector.
- Analog IN CH 1-4 on BNC

   These connections are analog inputs that connect to the DB44.

- Digital IN on 1/4 inch phone jack.

   These connections are digital inputs that connect to the DB44.

- Modem Line IN on pass through RJ12.

   Connects modem to the phone line.

- Modem Phone OUT on pass through RJ12.

   Port allows for the connection of the external phone to the phone line.

- Serial IN for the modem.
- Serial connection for the internal modem.
- RS422 from the computer on 2 DB9.

   There are two RS422 ports from the computer for interface to 2 TRAM modules

- RS422 to TRAM on DB15 (DB9 shell).

   This connector has integrated the two RS422 ports and power for the TRAM. This connects to an RAU.

- Power from TRAM power supply for TRAM (solder side connector).

PK12

Thermal Overcurrent Circuit Breaker (2003578-001)

The device is mounted on the lower half of the rear panel. It has two functions:

- Main Power Switch

  This switch controls power to all internal components and all external components that are connected to the system.

- Overcurrent Protection

  This is an overcurrent condition to trip the breaker. Once the overcurrent condition is removed, the breaker can be turned on.

ON/Standby Switch (2003334-001)

This switch controls power to all components connected to the 4 inch 1 outlets on the rear of the unit. It does not switch power to the single unswitched outlet on the rear of the unit. The main purpose for this switch is to allow for power control of all the components except the UPS that delivers power to the computer.

Fan (2003360-001)

There are two types of fans that are used, a 115VAC and a 230VAC version.

Rack-Mounted UPS (2006397-001) for CardioLink Server

The UPS features a maximum of 2700 Watts of true power. This new rack-space saving design allows more support for critical rack mountable equipment.

LED and switch menbrane integrated into the front panel with four button controls (three buttons for UPS power control and one button under the front bezel for configuration).

For your notes

3   Installation

For your notes

Installation

CardioLab 2000/4000/7000

Components

The components may vary depending on the options in use. These variations are covered in instructions that are provided with each option.

Catheterization Procedure Room

The components that are found in the catheterization procedure room are:

- Patient leads, ECG cable
- Catheter input
- Analog output cable
- Analog input cable
- Remote monitors
- Video cables
- Video power cables
- Amplifier
- Stim input cables
- Fiber optic cable
- Amplifier power cable
- RF generator
- Stimulator
- Integrated Electronics Box (IEB) power cable
- Radio Frequency (RF) cable
- IEB
- Computer
- Workstation
- Printer
- Barcode scanner
- Network cable (with Network option)
- Mouse
- Keyboard
- Image input cable (with Image option)
- Analog phone line

Reviewing the Assembly

Before beginning to service the system, review the existing assembly to ensure that it is correctly installed and connected. This should be done prior to turning on the system.

- Ensure that the power is off.
- Ensure that the components are conveniently positioned in the room and have adequate room for access and ventilation.
- Have the monitors been mounted properly?
- Use a line analyzer to check the wall outlets for power and ground. Is the wall outlet in both the control room and procedure room a duplex 20 Amplifier circuit on the hospital emergency power?
- Is the conduit sized correctly and correctly installed?
- Make sure that all connections are complete and secure.
- If a line conditioner is to be used, make sure that it is connected now.
- Route all cables so that they will not be walked on, tripped over, or rolled on.
- Ensure that Network cables are correctly installed (Network option).
- Ensure that the floppy disk drive is empty.
- Turn on the power to the system at the IEB.
- Check the screen adjustments on each monitor. Is the picture centered, shaped properly, sized correctly, and the right color? Is there any color distortion indicating a need for degaussing the monitor? Moving the monitor may cause color distortion.

Mac-Lab 2000/4000/7000

Connecting System Components

For complete information on planning for and assembling the system, mounting brackets, and options, see the following manual:

■ MAC-LAB System EX RAU Mounting Kits Installation Manual (PN: 422024-008)

This chapter is limited to an overview of the assembly/disassembly as it pertains to the repair of a unit already in the field.

Components

The components may vary depending on the options in use. These variations are covered in instructions that are provided with each option.

Catheterization Procedure Room

The components that are found in the catheterization procedure room are:

■ Remote Acquisition Unit (RAU) or TRAM-net RAC 4a
■ TRAM
■ RAU mounting bracket
■ Patient leads
■ BP cuff SPO$_2$ probe
■ Analog output cable
■ Analog input cable
■ RAU data acquisition/power cable (from RA unit DB-15 to buffer plate DB-15 connection)
■ Remote monitors
■ Video cable
■ Video power cable

Control Room

The components that are found in the control room are:

■ IEB power cable
■ Video power cables to IEB
■ Video cables
■ IEB
■ Computer
■ Workstation
■ Printer
■ Thermal Writer
■ Image input cable (with Image option)
■ Barcode scanner
■ Network cable (with Network option)
■ Local system monitors

- Mouse
- Keyboard
- Analog phone line

Reviewing the Assembly

Before beginning to service the system, review the existing assembly to ensure that it is correctly installed and connected. This should be done prior to turning on the system.

- Ensure that the power is off.
- Ensure that the components are conveniently positioned in the room and have adequate room for access and ventilation.
- Is the RA unit positioned so that the TRAM opening is not facing the ceiling or floor?
- Have the monitors been mounted properly?
- Use a line analyzer to check the wall outlets for power and ground. Is the wall outlet in both the control room and procedure room a duplex 20 Amp circuit on the hospital emergency power?
- Is the conduit sized correctly and correctly installed?
- Make sure that all connections are complete and secure.
- If a line conditioner is to be used, make sure that it is connected now.
- Route all cables so that they will not be walked on, tripped over, or rolled on.
- Ensure that Network cables are correctly installed (Network option).
- Ensure that the floppy disk drive is empty.
- Turn on the power to the system at the IEB.
- Check the screen adjustments on each monitor. Is the picture centered, shaped properly, sized correctly, and the right color? Is there any color distortion indicating a need for degaussing the monitor? Moving the monitor may cause color distortion.

PROCEDURE ROOM

MAC-LAB 7000

21" Monitor — Real Time
21" Monitor — Review
17" OR 21" Monitor — Cimage

Keyboard

Mouse
Printer
Power
IEB
Computer
Monitor

Thermal Writer

Modem Connection To Wall
Imaging Input

Workstation 60"

MONITOR MOUNTING PLATE

21" Monitor
Power

21" Monitor
Power

BOOM
ISOLATION TRANSFORMER
Power

Bed

TRAM

Tram Cable

3' Conduit

3' Conduit

Ceiling

Video Cables

3' Conduit

3' Conduit

*NOTE: ALL ITEMS MAY NOT BE IN THE PROPER PLACE, OR BE REPRESENTED WITH PROPER PICTURE.

PK2

Combination 2000/4000/7000

Connecting System Components

For complete information on planning for and assembling the system, mounting brackets, and options, see the following manual:

- MAC-LAB System EX RAU Mounting Kits Installation Manual (PN: 422024-008)

This chapter is limited to an overview of the assembly/disassembly as it pertains to the repair of a unit already in the field.

Components

The components may vary depending on the options in use. These variations are covered in instructions that are provided with each option.
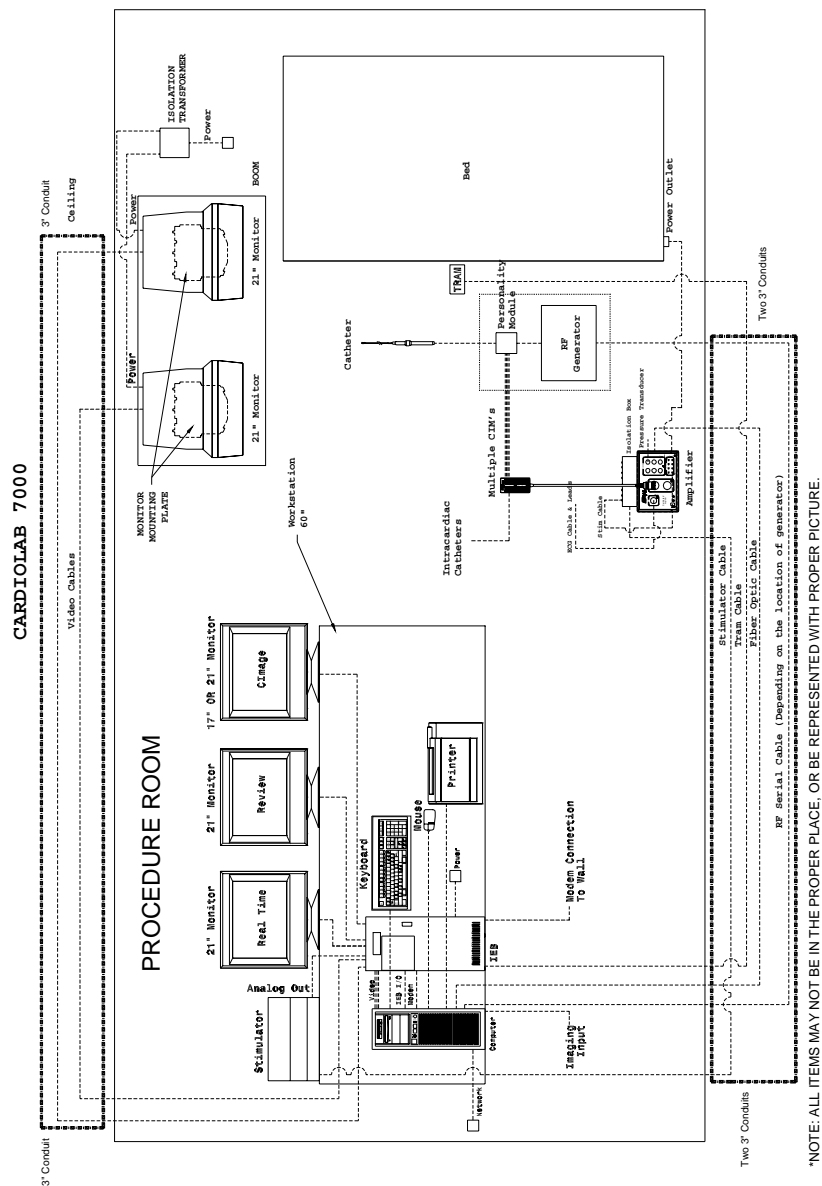
Catheterization Procedure Room

The components that are found in the catheterization procedure room are:

- RAU or TRAM-net RAC 4A
- TRAM
- RAU mounting bracket
- Patient leads
- BP cuff SPO_2 probe
- ECG cable
- Catheter input modules,
- Analog output cable, and
- Analog input cable.
- Simulator and cables
- RAU data acquisition/power cable (from RA unit DB-15 to buffer Plate DB-15 connection)
- Remote monitors
- Video cables
- Video power cables
- Amplifier
- IEB
- Workstation
- RF generator
- Fiber optic cable
- Amplifier power cable
- Computer
- Thermal Writer
- IEB power cable
- Printer
- Barcode scanner
- Network cable (with Network option)

- Analog phone line
- Mouse
- Keyboard
- Image input cable (with Image option)
- RF cable

Reviewing the Assembly

Before beginning to service the system, review the existing assembly to ensure that it is correctly installed and connected. This should be done prior to turning on the system.

- Ensure that the power is off.
- Ensure that the components are conveniently positioned in the room and have adequate room for access and ventilation.
- Ensure that the RA unit is positioned so that the TRAM opening is not facing the ceiling or floor.
- Ensure that the monitors are mounted properly.
- Use a line analyzer to check the wall outlets for power and ground. Is the wall outlet in both the control room and procedure room a duplex 20 Amp circuit on the hospital emergency power?
- Is the conduit sized correctly and correctly installed?
- Make sure that all connections are complete and secure.
- Ensure that the line conditioner being used is connected.
- Route all cables so that they will not be walked on, tripped over, or rolled on.
- Ensure that LAN cables are correctly installed (LAN option).
- Ensure that the floppy disk drive is empty.
- Turn on the power to the system at the IEB.
- Check the screen adjustments on each monitor. Is the picture centered, shaped properly, sized correctly, and the right color? Is there any color distortion indicating a need for degaussing the monitor? Moving the monitor may cause color distortion.
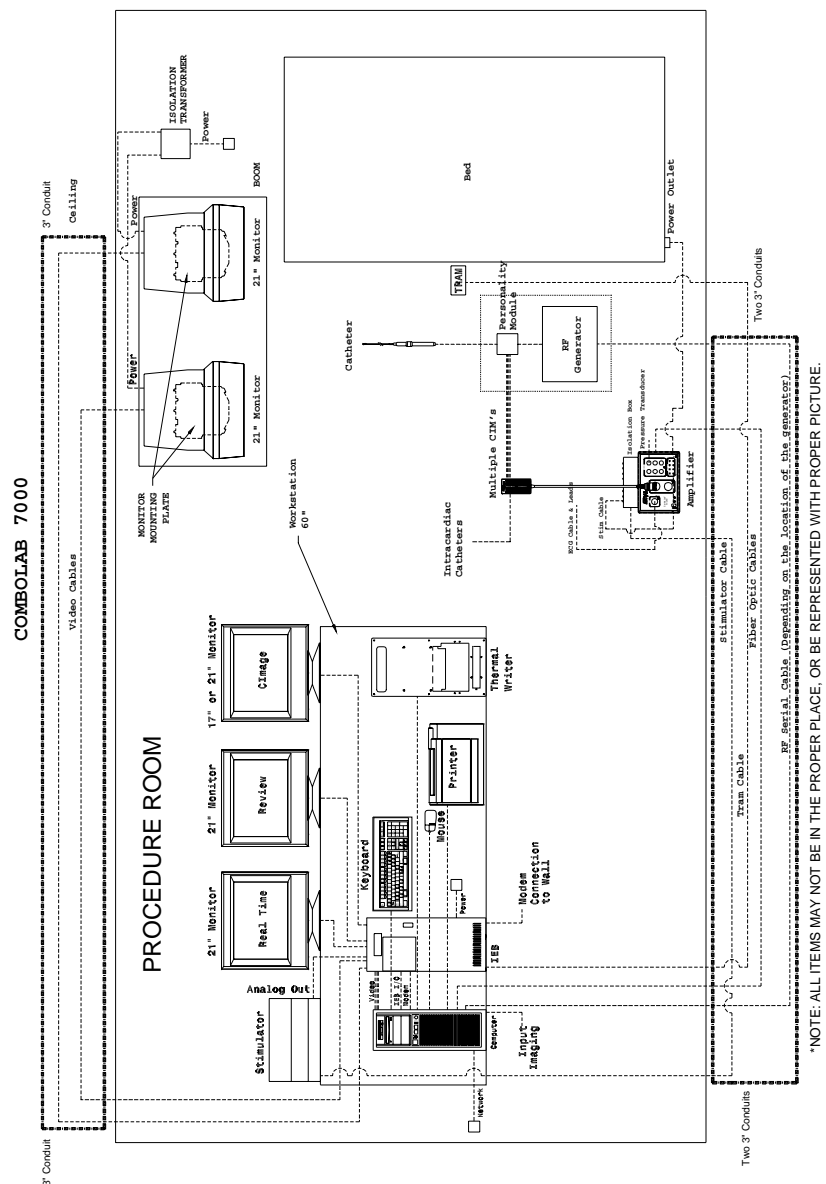
Integrated Electronics Box
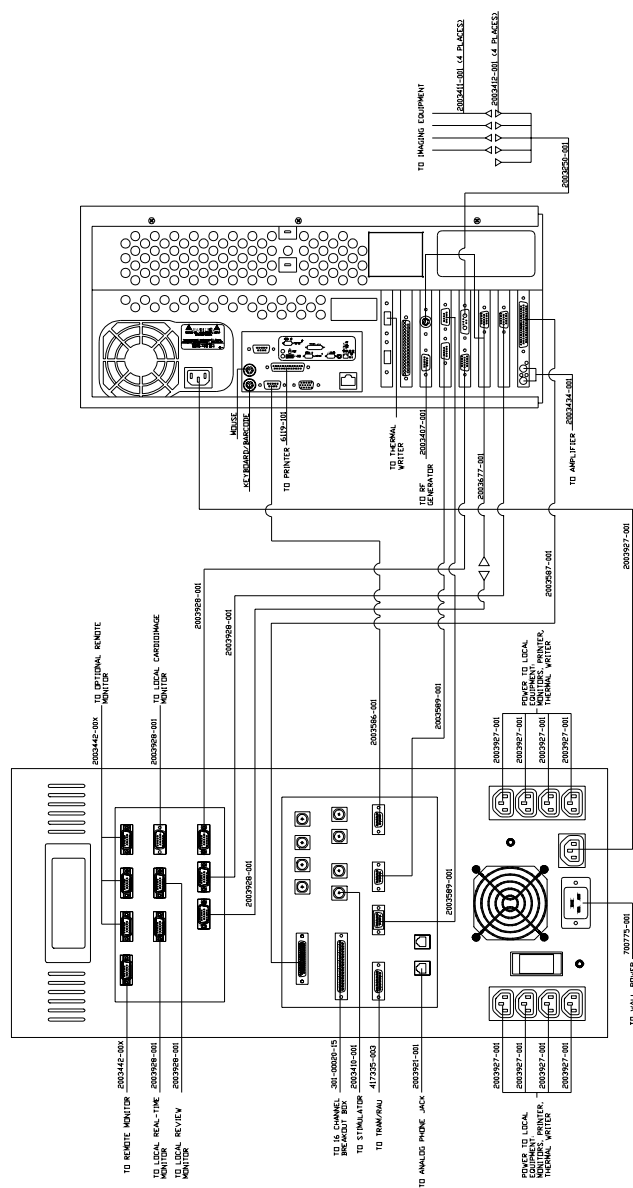
PK4

CardioLink Diagram
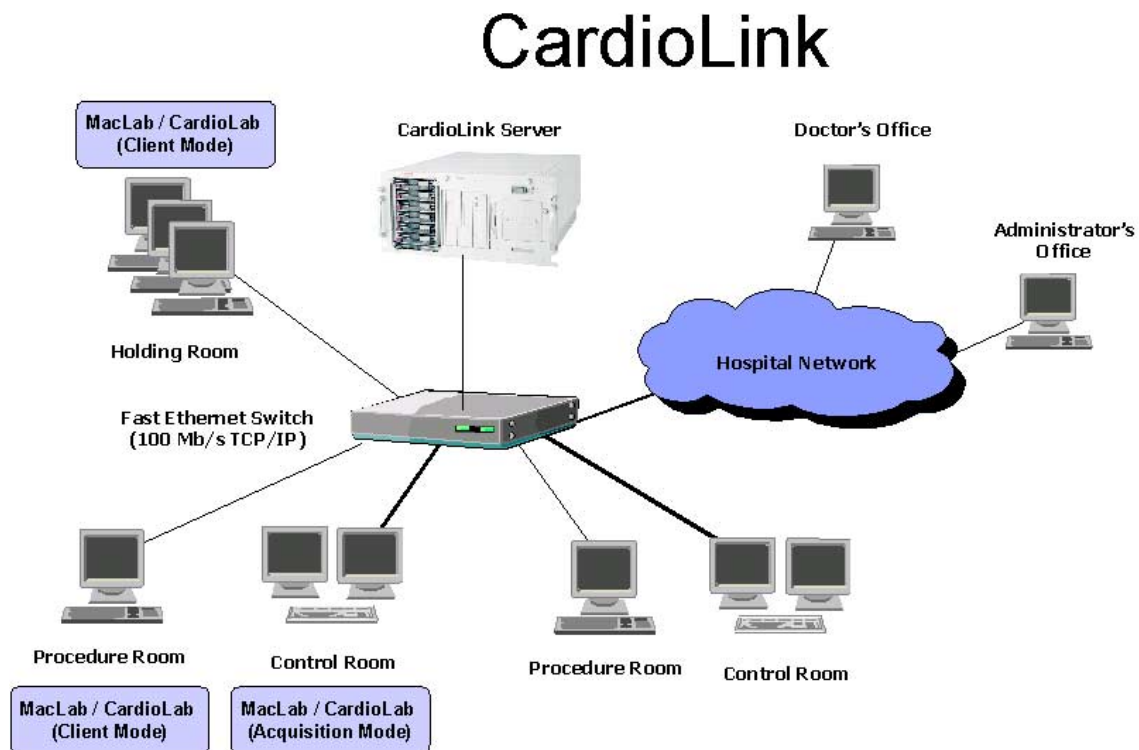
Thermal Writer Paper Installation

1. Open the thermal writer.
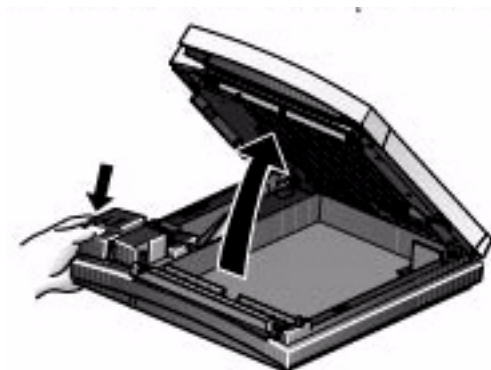
2. Slide a stack of paper into the writer compartment with the paper cue toward the internal access button.

3. Pull out the top sheet of paper from the stack. The holes in the paper should be on the same side as the opener lever.
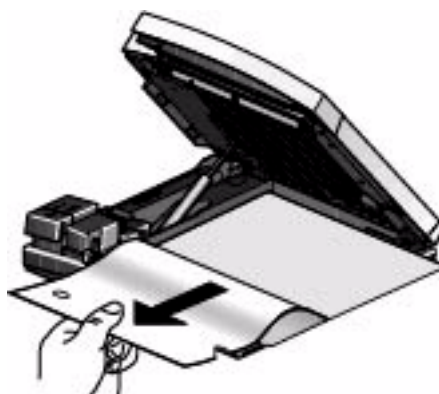
4. Close the unit.

5. Use the slider under the lid to adapt the paper compartment to different formats: A4 or standard as shown in the example.

6. Install the paper try on the side of the thermal writer.
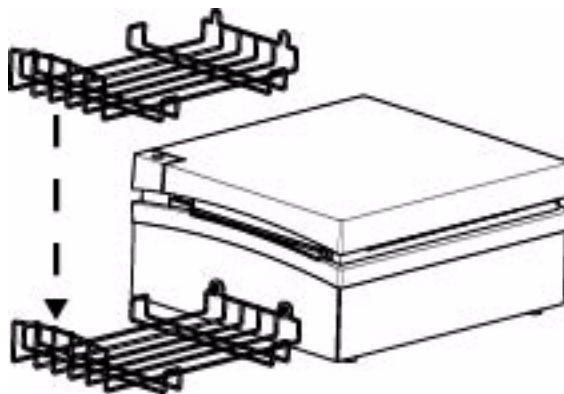
For your notes

4   Maintenance

For your notes

Introduction

Recommended Maintenance

This chapter provides preventive maintenance instructions for the system and its equipment and supplies. These maintenance guidelines are followed to prevent unnecessary equipment and supply failure and possible health hazards.

This chapter contains instructions for the following recommended maintenance:

- Inspecting and cleaning the unit
- AC line voltage tests to verify that the power outlet is properly wired
- Leakage tests to verify that the equipment does not pose a microshock hazard
- Ground continuity test to verify that all exposed metal is properly grounded

Operator's Maintenance Schedule

This chapter contains maintenance schedules for users. The CathLab supervisor and assigned operators should perform the maintenance described.

Pre-service Procedures

Before you open the unit for maintenance or service, perform these required preparations:

- Turn OFF the system at the console and at the IEB, and unplug the IEB before servicing the equipment.
- Check the power cord, but do not remove it if you will be doing anything that requires a ground. The power cord should be removed for cleaning purposes.
- Verify that the line, neutral, and ground wires are all connected firmly to the plug and that they are not shorted together.

Environmental Protection

Although the system operates in many different environments, some precautions are observed.

- Take care to avoid extremes of temperature, moisture, and humidity. The system components are not waterproof.
- Protect the various system components from spills or other debris. Eating, drinking and smoking should not be permitted near the system during a study or during maintenance procedures.

Inspection and Cleaning

Precautions

- Turn off the Integrated Electronics Box (IEB) and remove the power cord from the wall outlet before inspecting or cleaning.
- Wear latex surgical gloves and follow hospital regulations when cleaning equipment that has been exposed to bodily fluids.
- Do not immerse any part of the equipment in water.
- Do not use organic solvents, strong ammonia-based solutions, or abrasive cleaning agents which may damage equipment surfaces.
- Do not use a cleaning solution or solvent on the diskettes or disk drives. Doing so can cause loss of data or damage to the data and/or drive.
- Do not use metal articles to clean the disk drives.
- Do not allow any magnetic material near the system unit.

Daily Visual Inspection

Operators should perform a general overall inspection daily.
- Turn off the console and the IEB, and remove the power cord from the wall outlet before making an inspection or cleaning the unit.
- Check the case and display screens for cracks or other damage.
- Regularly inspect all cords and cables for fraying or other damage.
- Inspect all plugs, cables, and connectors for bent prongs or pins.
- Verify that all cords, socketed components, and connectors are securely seated.
- Inspect keys and controls for proper operation.

   Toggle keys should not stick in one position.

   Diskette drives should be fully functional.

Perform a visual exterior and interior inspection during preventive maintenance checks.

- Inspect interior for debris, oil, and moisture (liquid or condensation). Determine the source of the contamination and correct both the source and resulting problems.
- Inspect for missing hardware. Be sure that all components are present and intact. Socketed components should be firmly seated in their respective sockets. Check that all board components are properly attached, especially soldered components added as part of a repair or modification.
- Check for burn damage from overheated components. The familiar smell of burned components indicates that something has failed, even when there is no discoloration or disformation.
- Check that all printed circuit boards are seated properly if mounted in a card cage or connected to any type of edge connector. Make sure that all ground straps are connected.

- Check that all power cords and interface cables are firmly connected, with no sign of excessive wear or excessive tension.
- Check that screws and other hardware connectors are in place and properly installed. Check the security of the Remote Acquisition Unit (RAU) mounting bracket. The knobs holding the RAU to the bracket should be tight. However, be careful not to strip the threads.
- Verify that the remote video monitors are properly secured to the mounting plates. Verify that the mounting plates are properly secured.
- Verify that the local monitors are properly placed or secured.

General Maintenance

This section contains preventive maintenance instructions for the system and its equipment and supplies. These maintenance guidelines should be followed by the operator to prevent unnecessary equipment failure or possible health hazards. Before starting any maintenance, turn the system power off.

Cleaning the Exterior

Clean the exterior of the system on a regular basis with a clean, soft cloth and a solution consisting of mild detergent diluted in water. However, avoid coming in contact with open vents, plugs and connectors of any kind, the keyboard, mouse, and the thermal printer. Thoroughly wipe the exterior of the unit with a lint-free cloth dampened with one of the following approved solutions, then dry it with a clean, soft cloth or paper towel. The cleaning agents include:

- Ammonia (diluted to 10% strength)
- Cidex
- Mild soap
- Sodium hypochlorite bleach (diluted to 10% strength)

To avoid damage to the equipment, follow these rules:

- Wring the excess cleaning solution from the cloth.
- If exterior surface is swabbed with bleach or 10% ammonia solution, follow by swabbing with water.
- Always immediately wipe off all of the cleaning solution with a dry cloth or paper towel after cleaning.
- Never pour water or any cleaning solution on the equipment or permit fluids to run into the Thermal Writer, Console, AC Distribution Unit, RAU, monitors, connectors, or ventilation openings in the equipment.
- Never use these cleaning agents:

    Abrasive cleaners or solvents of any kind

    Alcohol-based cleaning agents

    Wax containing a cleaning substance

    Acetone

    Betadine

Failure to follow these guidelines may melt, distort, or dull the finish of the case, blur lettering on the labels, or cause equipment failures.

Cleaning the Monitor Screens

Clean the monitor's screen using a gentle commercial glass cleaner. Apply a small amount of cleaner to a clean, soft, anti-static, lint-free cloth, then use on screen. This method prevents excess cleaner from running inside of the monitor.

- Use a gentle commercial cleaner.
- Follow directions for use on product.
- Do not spray directly on the glass.
- Use a clean, non-abrasive, soft, anti-static, lint-free cloth.
- Wipe glass carefully and allow to dry.

Cleaning EP Cables

GE's electrophysiology cables are typically used outside the sterile zone and therefore are not routinely sterilized. The cables may, however, be cleaned using one of the following solutions:

- Ammonia (diluted to 10% strength)
- Cidex
- Sodium hypochlorite bleach (diluted to 10% strength)
- Mild soap
- Isopropyl alcohol

Monthly Maintenance

Perform the following preventive maintenance on a monthly basis. Before starting any maintenance, turn off the system.

Cleaning the Print Head

Clean the thermal print head using isopropyl alcohol and a clean, soft cloth. Non-abrasive alcohol wipes may also be used. To access the print head, open the writer door and wipe the print head where it makes contact with the capstan roller. Clean the roller when necessary with a small amount of alcohol. Excessive use of alcohol over time may cause the roller to crack.
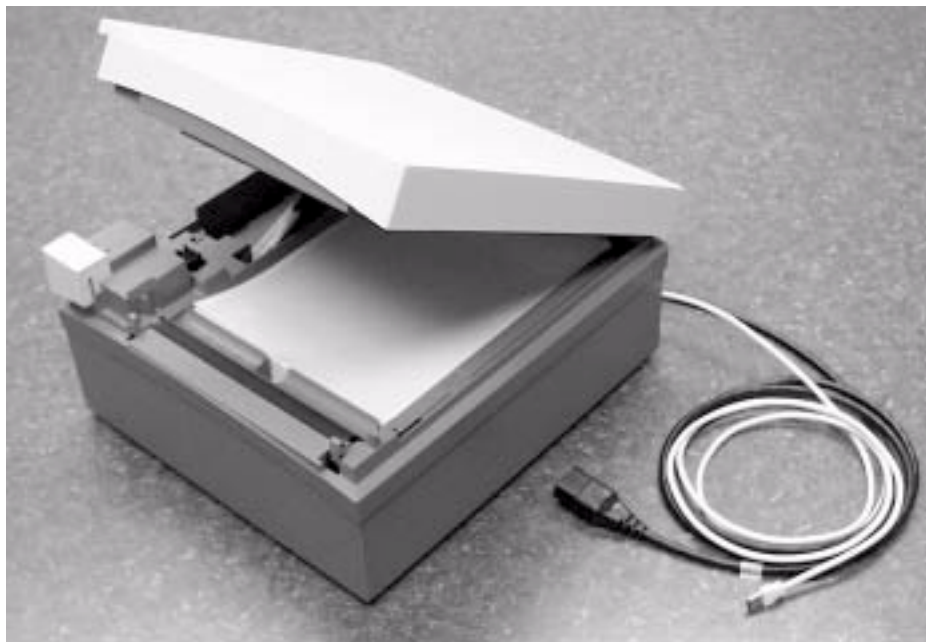
PK1

Annual Maintenance

Perform the following preventive maintenance on an annual basis. Before starting any maintenance, turn off the Console and AC Distribution Unit, and remove the power cord from the wall outlet.

Cleaning the Interior

Generally, it is not necessary to clean the interior of the system; however, if dust is an environmental problem, use a commercially available, electronically-safe, dust remover (compressed air, difluoroethane, or other). Follow the manufacturer's directions for use. Note cautions about flammability, the possibility of ignition, and the possibility of causing frostbite. Be sure to clear the nozzle before use, hold the can upright, and do not allow liquid propellant to contact skin or electronics. Be careful not to drive dust into connections or disk drives.

Whenever an exterior spill occurs, you should completely turn off the IEB and remove power from the wall outlet. Clean up the spill, and check to be sure the spill has not penetrated the CPU, Thermal Writer, RAU, or IEB. If it has, carefully blot and dry the affected area. Do not reconnect power or turn the system on until you are sure no moisture remains.

Inspect All Cables, Plugs, and Connectors

Inspect all cords for fraying or other damage. Inspect all plugs and connectors for bent prongs or pins. Verify that all cords and connectors are securely seated. Repair or replacement must be performed by qualified service personnel.

Cleaning the RAU and TRAM

Check the RAU and TRAM modules for buildup of moisture, fluids, or dust. Clean the units in the same way as the exterior of the console, being careful not to allow any moisture into the unit.

Preventative Maintenance

Perform the following general preventative maintenance.

- Make a backup copy of the hard drive onto a blank optical disk. This way, if any files ever become corrupt, a backup copy will exist to replace them.
- Test the integrity of the disk using scandisk or a similar utility found at the local computer store. DO NOT ATTEMPT TO REPAIR ANY PROBLEMS FOUND. Only diagnose the errors. If errors are found, contact technical support for assistance.
- Scan the hard disk for viruses using anti-virus software. This can be found at your local computer store.
- Remove the fiber optic cable from the amplifier and computer and clean the contacts with rubbing alcohol and a clean, lint-free cloth. When finished, verify that you have connected the cables back correctly by acquiring a test patient in the software.
- Remove any dust or lint from inside the computer and IEB using electronics-safe compressed air. Do not use compressed air to clean the inside of the optical drive.
- Ensure that all cables connected to the monitors, IEB and computer are securely fastened.
- The standard life of the UPS ranges from 3 to 6 years. Test the UPS by turning the main power switch on, letting the computer boot completely and then unplugging the IEB from the wall. The computer should maintain power and the UPS will beep to indicate that power was lost to the system. If computer maintains power, the UPS is functioning normally.

Domestic Electrical Safety 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:

■ 120 VAC (± 10%) (108 to 132 VAC) between the line contact and neutral and between the line contact and ground.

■ Less than 3 VAC between neutral and ground.
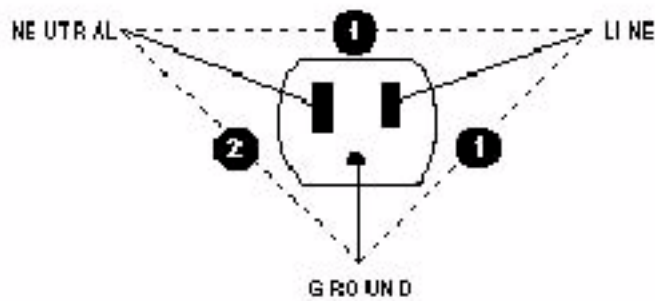
PK2

240 VAC, 50/60 Hz

Use a digital voltmeter, set to measure at least 300 VAC, to check the voltages of the 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:

■ 240 VAC (± 10%) (216 to 264 VAC) between either "hot" contact and ground.

■ 216 to 264 VAC between the two "hot" contacts.

HOT ⟵⋯⋯⋯⋯ **2** ⋯⋯⋯⋯⟶ HOT

1   **1**

GROUND
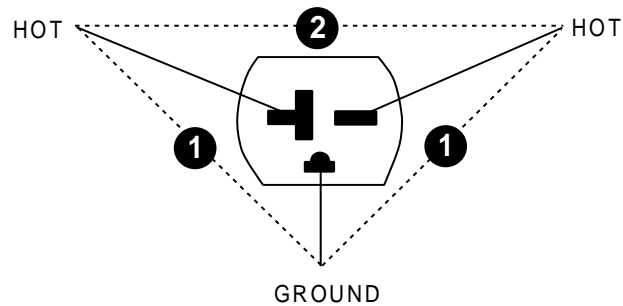
PK3

Leakage Current Tests

The leakage tests are safety tests to ensure that the equipment poses no electrical microshock hazards. The specific leakage current tests and the frequency at which they should be performed should be determined by your facility.

Use the table below to determine which tests apply to the unit under test and the maximum allowable leakage currents. For international leakage limits, refer to the internal standards agencies of that particular country.

If the unit under test fails the leakage tests, do not allow the customer to use the equipment. Call Tech Support for assistance. (See the "How to Reach Us" page in the front of the manual.)

GE Medical Systems recommends that you perform these tests:
■ Before applying power for the first time
■ Every year as part of routine maintenance
■ Whenever internal assemblies are serviced

You need a leakage tester to perform the leakage tests.

NOTE:

The accuracy of the leakage tests depends on a properly wired wall outlet. Do not proceed until you verify the integrity of the power source.

Leakage Current Tests Table

Table 5. Leakage Current Tests and Maximum Allowable Limits		
Test	**Maximum Current (microamps) 120 V source voltage**	**Maximum Current (microamps) 253 V source voltage**
Enclosure (chassis) leakage current	142	300
Patient Leakage Source	24	50
Patient Leakage Sink Current (mains voltage on applied part)	24	50

Special Test Considerations

■ The official leakage current limits per the standard are those in the third column of the Leakage table. The most correct method to measure the leakage currents are with an unbalanced mains supply and at 253 V. Since U.S. domestic supplies are typically 120 V, the second column is provided to check leakage currents where it is inconvenient to use a 253 V unbalanced supply. The limits of the second column are proportional and provide a test which is equivalent to the official limits with a 253 V supply.

■ When patient sink current is measured, it may be necessary to manipulate the patient cable to avoid excessive stray capacitance to ground, which may result in artificially high measurements.

Ground Continuity

This test verifies that there is continuity (less than 100 mΩ resistance) between all the exposed metal surfaces on the console that have the potential to become energized, and the ground prong on the Mains AC power cord.

■ Measure the resistance between the equipotential lug on the back of the console and the ground pin on the AC inlet of the AC Distribution Unit. Repeat between the shell of the I/O port on the Thermal Writer and the ground pin on the AC inlet of the AC Distribution Unit.

■ If the measurements are significantly out of range, check for breaks in the power cord or in the internal connections within the unit.

Special Considerations

■ To perform this test accurately, it is necessary to use a special ground impedance measuring device that can accurately measure low resistances while providing a significant amount of current (10 to 30 A). This test cannot be performed accurately with a typical volt ohm meter.

■ Because of the resistance in the power cables between the console or writer and the AC Distribution Unit, it is essential that special care is taken to obtain precise measurements. Resistance in test leads must be subtracted from an overall reading to accurately isolate the resistance in the equipment under test.

■ For a cursory field service check, a volt ohm meter may be used to verify continuity and that resistance is reasonable low (less than 0.3 to 0.4 ohms, including test leads).

Maintenance/Repair Log

The Maintenance/Repair Log is included in this manual to aid in keeping a record of the work performed on the system.

NOTE: Unless you have an Equipment Maintenance Contract, GE Medical Systems does not in any manner assume the responsibility for performing the recommended maintenance procedures. The sole responsibility rests wit the individual or institution using the equipment. GE Medical Systems service personnel may, at their discretion, follow the procedures provided in this manual as a guide during visits to the equipment site.

Maintenance/Repair Log Table

Unit Serial Number:		
Institution Name:		

Date	Maintenance/Repair	Technician

Unit Serial Number:

Institution Name:

Date	Maintenance/Repair	Technician

5   Troubleshooting

For your notes

Introduction

This chapter includes the following sections:

- General Troubleshooting for the system
- Troubleshooting the Remote Acquisition Unit (RAU)
- Troubleshooting the Video Processing
- Troubleshooting the Thermal Writer

First Things to Check

The following are the most common causes for system failure:

- Ensure that the IEB, CPU, RAU, monitors, keyboard, and optional LAN are properly connected. If not, power down the system, connect the cables properly, and turn on the IEB.
- Ensure that the wall outlet is live. With a line analyzer, check the outlet for both power and ground.
- Ensure that a disk is not in the floppy disk drive. No disk should be present.
- Ensure that the IEB turned on.
- Ensure that the monitors turned on.
- Ensure that the CPU turned on.
- Ensure that nothing (other than a patient lead on the TRAM) is connected or disconnected while the system is under power. If so, turn off the IEB, reconnect the cables, and then turn the IEB on again.

Visual Inspection

A thorough visual inspection of the equipment can save time. Small things — disconnected cables, foreign debris on circuit boards, missing hardware, loose components — can frequently cause symptoms and equipment failures that may appear to be unrelated and which are difficult to track.

General Troubleshooting for the System

Problems

No Boot Up

If the computer does not boot:

- Verify that the power cable from the workstation is plugged into the wall.
- Verify that the power cable is secure in the back of the IEB.
- Check the power cable from the IEB to the computer to verify that it is secure on both ends.
- With the IEB power switch turned on, try pressing the power switch on the CPU. This can be accessed by opening the right front panel on the workstation.
- Replace the power cables.

System Does Not Boot Disk in Disk Drive

- Check to see if you left a disk in the floppy disk drive. If you did, remove the disk. Turn the system off and wait 10 seconds before turning the system on again.
- Check the IEB and then the other hardware.

System Locked Up

The system locked up and there is a patient on the table.

- If you are still able to monitor the patient, continue, but get assistance from Technical Support. See the How to Reach Us insert at the front of the manual.
- If you are not able to monitor the patient, recycle power on the system. Have hospital ready to put patient on standby equipment. Get assistance from Technical Support.

If there is no patient on the table when the system locks up:

- Turn the system off, wait ten seconds, then turn the system on again.
- If the system still does not work correctly, get assistance from technical support.

Multiple Monitors Change Colors

If more than one monitor changed colors, there is a possible VID/MUX problem. Get assistance from Technical Support. See the How to Reach Us insert at the front of the manual.

Monitor Went Black (No Signal)

One Monitor Went Black (No Signal)

- If only one monitor went black, check to see if the power light is on.
- If the power light is not on, check power to the monitor.
- If the power is OK, the fuses are OK, and the power light is still off, the monitor needs to be replaced.
- If the power light is on, hook the monitor up to another monitor signal cable.
- If the monitor still does not work with a good known signal, the monitor must be replaced.

Multiple Monitors Went Black (No Signal)

If more than one monitor goes black, there is a possible VID/MUX problem. Get assistance from Technical Support.See the How to Reach Us insert at the front of the manual.

Take the time to make all the recommended visual checks (refer to the visual inspection chart on the next page) before starting any detailed troubleshooting procedures

Inspection List

Table 1. Visual Inspection List (Continued)	
Area	**Look for the following problems**
I/O Connectors and Cables	■ Fraying or other damage ■ Bent prongs or pins ■ Damaged housing ■ Loose screws in plugs
Fuses	■ Type and rating. Replace as necessary.
Interface Cables	■ Excessive tension or wear ■ Loose connection ■ Strain reliefs out of place
Circuit Boards	■ Moisture, dust, or debris (top and bottom) ■ Loose or missing components ■ Burn damage or smell of over-heated components ■ Socketed components not firmly seated ■ PCB not seated properly in edge connectors ■ Solder problems: cracks, splashes on board, incomplete feedthrough, prior modifications or repairs
Ground Wires/Wiring	■ Loose wires or ground strap connections ■ Faulty wiring ■ Wires pinched or in vulnerable position
Mounting Hardware	■ Loose or missing screws or other hardware, especially fasteners used as connections to ground panes on PCBs
IEB	■ IEB not plugged in to working wall outlet. ■ CPU or peripheral device not properly connected to AC Distribution Unit.
Power Source	■ Faulty wiring, especially AC outlet ■ Circuit not dedicated to system ■ Power source problems cause static discharge, resetting problems, and noise.

Power On Failure Modes

No display, system appears not to initialize

■ Most errors will be displayed on the window. The following are additional things to check.

■ Can you hear the floppy disk drive being accessed several seconds after Power On? The "in use" LED will come on at the same time. The keyboard LEDs will turn on at Power On and turn off just prior to the floppy disk drive's LED turning on. These LEDs indicate that the PC/AT system (EPC-9) is functioning properly.

■ Is the floppy disk drive active?

■ If you do not hear the floppy disk drive, check the fuses and power.

■ Several different failures modes may exist. If the floppy drive LED is never active and there is brief activity on the hard disk drive (listen for the drive activity or watch for the hard disk drive light), the problem is probably the floppy disk drive, and vice versa.

If the two drives appear inactive at initialization, there is probably a controller failure.

■ Is the Hard Disk Drive Active?

If the system appears to initialize, but there is still no display, listen for the hard drive or watch the hard drive light to see if the hard disk drive is active several seconds after turning the system on. This activation should occur shortly after you hear the floppy disk drive spin up.

If the hard disk drive is not active, communication between the disk drive and the control board does not exist, and the software is not being loaded into the system from the drive. The hard disk drive should be active for about 17 seconds, indicating that it is loading software for the entire system. If it is on for only about 2 to 3 seconds, then it is not loading the software.

■ Is the COMMS board active? Check for the green LED on the COMMS board.

If the system appears inactive, observe the LEDs on the COMMS board. After Power On, the green LED should be on.

■ Is the software present?

Functional Checkout Procedure

Introduction

As part of the system checkout procedure, hook up a simulator to the TRAM module) in the RAU or the CardioLab II Plus Amplifier located in the procedure area.

- If a GE or Bio-Tek simulator is being used, connect the P1 output to the P1 input of the TRAM module in the slot A position.
- Connect the P2 output to the P2 input of the same TRAM module.
- Define the pressures to be Arterial and Venous. These two pressure simulations provide a realistic representation of pressure monitoring waveforms.
- Also connect the ECG leadwires.

See the *TRAM 100-600 A and SL Modules Service Manual* (P/N 404422-065) for additional information.

System Initialization

After you are sure that the system is properly connected, the peripherals are turned on, and there is no disk in the floppy disk drive, you can Power On the system.

- Turn on the IEB and CPU power switches.
- Verify that the image fills the entire window and that the colors are correct. If there appear to be video problems, refer to the Video Processing section. If the system does not successfully initialize, refer to the *Troubleshooting section*.

Front End Data Acquisition

- Adjust the simulator so that the BP waveforms are zero.
- Readjust the simulator so that it is simulating BP waveforms. If you have hooked up the simulator as recommended, you should see pressures in the window.
- Verify that the correct ECG waveforms are present at the top of the window.
- Verify that intracardiac inputs are present. Hook simulator ECG outputs to catheter input modules.

Troubleshooting the RAU

RAU Description

This chapter is designed to clarify operation and troubleshooting of the RAU and its interfacing with the Cardiolab/Mac-Lab system. The RAU is also called the "Front End. Introductory material on the system configuration is followed by specific symptom-dependent troubleshooting techniques. Front end data, ECG, and invasive blood pressures, are acquired by using a TRAM module installed in an RAU.

Each system is shipped with either one or two TRAM modules capable of providing up to 12 ECG waveforms and up to 4 pressure waveforms. Note that the system RAUs for earlier MAC-LAB units are different from the Prucka Cardiolab/Mac-Lab system RAU. They cannot be interchanged. Older RAUs have room for three TRAMs (one was not functional).

The system RAUs have room for only two. The system RAU receives its power and data via a single cable rather than via separate power and data cables. The system RAU does not have an on/off switch.

TRAM modules in the RAU

The TRAM modules are installed in the RAU that is mounted in the procedure area. Power for the RAU comes from the Console.

RAU Interconnection

The TRAM series of modules, used with the system RAU, has only one indicator, the power-on indicator.

If the system is operating with one TRAM module, it must be in the slot A position (top slot) in the RAU. Otherwise, there are no ECG waveforms.

The RAU receives its power from the IEB.

Data Transmission

The serial data from and to the TRAM module is communicated via a DB-15 connector on the rear DB connect board on the IEB. The cable also carries power for the RAU. The data is then communicated to the COMMS board.

The COMMS board must be working in order for the system to initialize. The error message "No TRAM module" appears on the review monitor window if communication with the TRAM fails.

RS-422 serial communication at a rate of 115 K baud is used between the RAU and the COMMS board.

Pressure Waveforms

Individual waveforms may be removed from the monitor window by selecting that pressure and turning off the pressure. This removes the trace.

Channel is labeled, but no pressure values are listed:

If there is a label, but no pressure numbers, and a transducer is connected, a zeroing procedure may be required.

Channel is labeled, but no pressure values or waveforms:

If a pressure site label is present, but there are no pressure numbers, a waveform may or may not be present. Check the pressure gain of the system.

Troubleshooting the Video Processing

General Information

The system video consists of one or more color monitors. For most configurations, two are mounted on the workstation and at least one is mounted in the catheterization procedure lab. At the desk are the real-time and review monitors. In the catheterization procedure lab is a remote monitor, which is a slave of the other monitors.

The review monitor displays waveforms and system-related information and allows the technician to operate the system via the menu bar at the top of the window.

The real-time monitor displays real-time data, such as ECG and blood pressure waveforms. The monitor in the catheterization procedure lab can display either workstation monitor signal, allowing the doctor to track monitoring and measurement functions.

POWER SWITCH

POWER INDICATOR

+ BUTTON (Next Choice)

- BUTTON (Previous Choice)

MENU (also ACCEPT)

D-SUB Mini 15 Pin Connector

Red

Green/Sync

Blue

H/HV

V

AC IN Connector
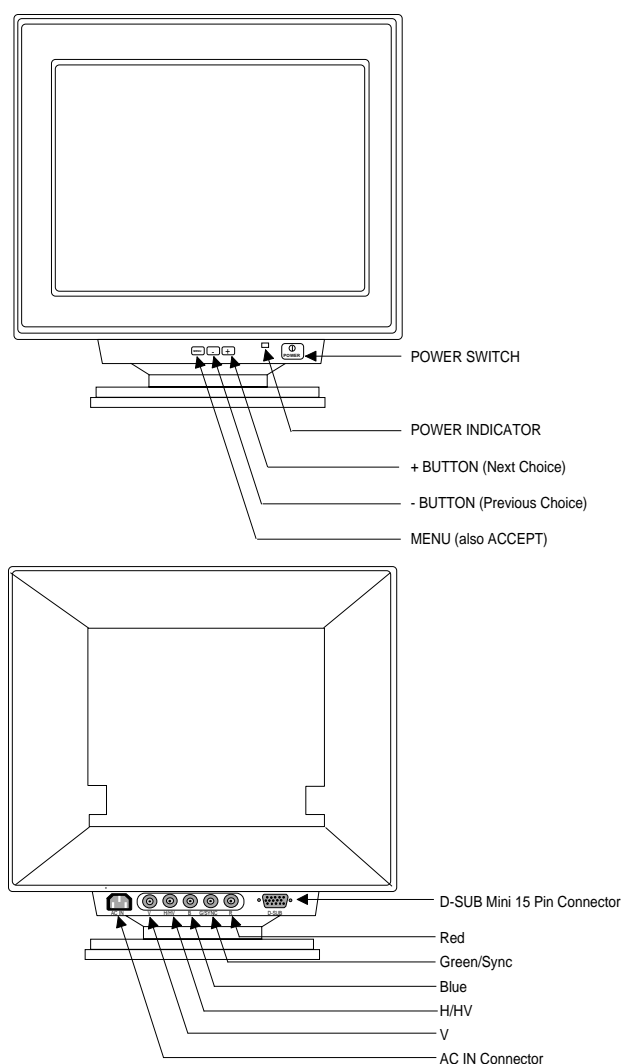
PK1

Monitor Description

All monitors are color monitors that are controlled by the video boards in the computer. The monitors themselves are not serviced by GE Field Service Engineers, but are sent back to the manufacturer for repairs. However, there is a window calibration procedure that includes brightness and position of the tracings. Several brands of monitors have been used. All are essentially the same, but have different controls.

Installation Checklist

- Be sure that the ventilation openings are not blocked or covered.
- Do not place the monitor near a heating appliance or in direct sunlight.
- Do not expose the monitor to moisture of any kind, as this may result in electrical shock or fire hazard.
- Route the power cord and cables so that they will not be walked on, tripped on, or rolled over. The monitors should be powered via the AC outlets in the lab or should be connected to one of the outlets on the IEB.
- Never use a monitor if the power cord has been damaged.
- Unplug the monitor and clean the window as needed with a small amount of a mild glass cleaner sprayed on a soft cloth. Never spray cleaner directly on the window as it may penetrate the monitor enclosure.
- Never open the enclosure. There are no user-serviceable parts inside. Risk of serious shock hazard! Refer all monitor problems to GE Service personnel.

Video Failure Modes

Color distortion

Demagnetize the monitor window by pressing the **degauss** switch, which generally is located just below the monitor window or can be found by pressing the **MENU** button.

One or more colors are missing on monitor

- Confirm that cabling for all three colors is connected to the monitor and that the cabling is properly connected to the rear interconnection panel and to the Video/Writer board in the console.
- If the problem moves to the other monitor, then replace the defective board.
- Otherwise, replace the monitor.

If the video signal on one monitor is distorted or missing:

- If video signals are not present, verify that monitor is receiving power.
- Take the video cable from the back of the working monitor and plug it into the monitor with the bad signal. This will verify that the monitor works.
- If the step above produces a good image, try replacing the video cable from the VIDMUX to the monitor.
- If problem continues, replace cable from the associated video signal input on the VIDMUX to correct video board the computer.
- If the problem persists, the problem may be with the system hardware.

Thermal Writer Problems

Thermal Writer Starts to Print, then Stops on its Own

Check and clean dust from the paper sensor by using canned air. Paper sensor is located on the left side of the top of the paper slot. If the thermal writer still fails to work properly, get assistance from Technical Support.

Thermal Writer Outputs Blank Sheets of Paper

Check and clean dust from the paper sensor by using canned air. Paper sensor is located on the left side of the top of the paper slot. If the thermal writer still fails to work properly, get assistance from Technical Support.

Thermal Writer Does Not Print (Blank Sheets Only)

If the thermal writer prints only blank sheets of paper, the paper may be installed upside down. Try flipping paper end for end. The top side of the paper should mark easily if scratched. Verify that the correct paper is being used. If the thermal writer still does not work correctly, get assistance from Technical Support.

Paper Jams During Printing

Verify that correct paper is being used. If the thermal writer still does not work correctly, get assistance from Technical Support.

Thermal Writer Does Not Print, Makes Machine Gun Noise

A machine gun noise indicates a possible hardware problem. Get assistance from Technical Support. Replace the thermal writer.

Troubleshooting the Thermal Writer

Thermal Writer Description

The system uses a direct digital writer with an 8.5-inch thermal print head. The paper is a plain, fan-fold style with no pre-printed grid. The system prints the necessary grid at the same time as it prints the waveforms and text. The thermal writer can run at four speeds: 5, 25, 50, and 100 mm/sec. Paper is stored in a slot backed by a paper strap that slides in and out for ease of replacement.

The thermal writer release button, which disengages the print head and opens the door, must be pressed before closing the door as well. When the door is open the 26.5 volt power is removed from the printhead, but not from the thermal writer control board. The 5 volt power is still on the print head. The print head assembly is located inside and above the door. This allows easy access for cleaning and replacement.

Repairing the Thermal Writer

Generally, the only in-field repair of the thermal writer is to replace the print head or anti-static brush. Replacing the printer engine in its bracket requires the use of a fixture, and so is performed only at the factory. Likewise, the electrical adjustment is only done at the factory. This is different from older MAC-LAB procedures.

Thermal Writer Failure Modes

Chart paper will not queue. Thermal writer runs extra sheets of blank paper.

- The queuing sensor could be dirty. Clean the queuing sensor by blowing air across it.

Erratic or no chart paper drive

- If the paper does not advance, or it advances erratically and there is no error message, check the fixed and movable cables that connect along the side of the writer drawer. Confirm that there is a solid connection.
- Verify that all required conditions are met to enable the thermal writer.

Printing too light or too dark

If the thermal print head voltage is too low, the printing may be too light, and the traces may fade prematurely. If the voltage is too high, the printing may be too dark and the life of the print head will be shortened. Voltage adjustments must be performed at the factory.

■ Check the thermal paper quality. Some non-GE thermal papers are more heat-sensitive than others.

■ Check print head voltage to ensure that it is in range: 24V to 27V.

■ If there is no other reason, replace the Thermal Writer.

White line running across the printing

■ Clean the print head and the print roller. If the lines still occur and they are obscuring the tracings, replace the print head.

RAU Failure Modes

ECG labeled, but no ECG data

These symptoms indicate no communications with the TRAM modules. Confirm that each TRAM module is installed and that the RAU is plugged in.

Check that the cable is connected on the back of the RAU (DB-15 connector) and is connected on the rear DB connect board on the IEB (DB-15 connector).

Is the power-on LED on the TRAM module illuminated? Try switching the position of the TRAM modules.

BP sites are labeled, but no pressure numbers or waveforms

This condition indicates that a transducer needs to be zeroed or replaced. Rezero this BP by selecting the correct channel and pressing the **Zero** button. This could also be a TRAM module problem.

BP waveforms are present, but no ECG waveforms

Some patients require skin preparation, including abrasion, depending on their skin type.

If the BP waveforms are present, and the ECG cable is properly connected, ensure that the ECG waveforms have not been turned off.

If the ECG waveforms are selected, are not turned off, and still are not present, suspect a TRAM module failure.

ECG waveform is present, but one or both BPs are missing

Has the BP trace been turned off at the keyboard? Try rezeroing and replacing the corresponding transducer. This situation also could be a TRAM module failure.

Server UPS Troubleshooting

The following tables provide troubleshooting information for the Tower UPS. For more detailed information, see the OEM manuals included with the UPS.

For troubleshooting recommendations for the rack-mount server UPS, see the OEM manuals.

During Start

Symptom	Possible Cause	Suggested Action
UPS will not start	No Utility Power	Check Power at the Utility power receptacle or contact a qualified electrician.
	UPS Power cord disconnected	Connect the power cord.
	UPS input circuit breaker open	Press the circuit breaker button to reset. If the breaker trips repeatedly, contact an authorized service provider (high models only).
LED 5 is red (Site wiring fault)	Utility power receptacle ungrounded or no ground wire in UPS power cord	Contact a qualified electrician.
	Line and neutral wires reversed in utility power receptacle or in UPS power cord	For units factory-configured for 208V, the Site Wiring Fault function has been disabled. If reconfiguring a 230V unit to operate at 208V, the Site Wiring Fault function must be manually disabled (high models only).
LED 10 is red (Battery Service)	Battery voltage is low because the UPS has been out of service for a long period	Allow the UPS to charge the batteries for 24 hours. Initiate a self-test: if LED 10 does not turn off, replace batteries.
	The UPS was powered on with the Sleep mode disabled, draining the batteries	Utility voltage has returned to the voltage range for which the UPS has been configured. The UPS is supplying utility power. The audio alarm should be reset.

After Start

Symptom	Possible Cause	Suggested Action
Audio Alarm	Alarm condition exists	Identify the red LED associated with this alarm condition. Check this troubleshooting guide to determine the cause of the alarm.
LED 1 is red (Input power)	Utility voltage is too high	The utility voltage is higher than the UPS operating range. The UPS switches to battery power. If this happens repeatedly, update the configuration.
LED 1 is flashing red	Alarm may need to be reset	The utility voltage has returned within the UPS operating range. Press the TEST/ALARM RESET button.
LED 4 is red (Input power)	Utility voltage is too low	The utility voltage is lower than the UPS operating range. The UPS switches to battery power. If this happens repeatedly, update the configuration. Contact a qualified electrician to make sure that utility power is suitable for the UPS.
LED 4 is flashing red	Alarm may need to be reset	The utility voltage has returned within the UPS operating range. Press the TEST/ALARM RESET button.
UPS frequently switches between utility and battery power	Utility power variations	The utility voltage is frequently outside the UPS operating range. Update the configuration. Contact a qualified electrician to make sure that utility power is suitable for the UPS.
LED 11 is red	Protected devices are exceeding the UPS power rating	Remove one or more devices to reduce the power requirements.
	(UPS may switch from utility to battery power)	Make sure that the devices are not defective.
LED 9 is red (Battery Charge)	Low battery voltage	If the UPS is supplying battery power, save current work and shut down the system. Allow the batteries to charge. If the UPS is supplying utility power, no user intervention is required. Allow the batteries to charge.
Insufficient warning of low batteries	Battery service required	Allow batteries to charge for 24 hours, then initiate self-test. If LED 10 is red, replace batteries.
	Shutdown Delay configuration inappropriate	Update the Shutdown Delay from 5-seconds to 3-minutes. Use Compaq Power Management Software to specify a suitable delay.

Symptom	Possible Cause	Suggested Action
LED 10 is red (Battery Service)	Potential battery failure detected	Allow batteries to charge for 24 hours, then initiate self-test. If LED 10 is red, replace batteries.
	New batteries improperly connected	Check connections.
LED 10 is flashing red; audio alarm cannot be silenced	Internal UPS over-voltage condition exists	Shut down the UPS. Contact an authorized service provider.

UPS Alarm Conditions

Alarm Condition	LED Activity	Can be disabled?
Utility power failure	LED 1 or LED 4 red	Yes
Site wiring faulty	LED 5 on red	Yes
Battery service	LED 10 on red	Yes
Internal UPS over voltage	LED 10 flashing red	No

Silencing an Audio Alarm

To silence the alarm, press the TEST/ALARM RESET button.

◆ Even though an audio alarm may be silenced, the condition that caused the alarm may still exist. For information on procedures to follow if the UPS detects an alarm condition, see the Troubleshooting chapter or the UPS manual.

◆ If a utility power failure caused the alarm (AC Input LED 1 or LED 4 red), the alarm will be silenced after utility power is restored.

Tram-rac 4A LED Troubleshooting Chart

Use the following chart to determine if the Tram-rac 4A is functioning properly. This chart refers to LEDs on the Processor Acquisition PCB. For problems, refer to the appropriate manual for more information about troubleshooting a patient monitor and Tram-rac housing together.

Processor Acquisition PCB Indicators			
LED/Color	**Signal Name**	**Function**	**Condition**
DS6/Green	Power Indicator	Proper Operation ■ Visible on Tram-rac 4A front bezel (lower left)	■ On Continuous: normal operation ■ Flashing Quickly (2Hz): ADC Error ■ Flashing Slowly (0.5Hz): watchdog time-outs ■ LED Off: power off, supply fault, RAC FPGA configuration fault
DS5/Red	Network Activity	I hear talking on TRAM-net	■ On mostly steady: TRAM-RAC connected ■ Flickers low: TRAM-net not connected (I hear myself talk)
DS4/Green	Transmit Enable	I am talking on TRAM-net	■ Flickers occasionally: when talking ■ On continuous: while graphing
DS3/Yellow	Error Detect	I detect an error on this PCB	■ Off: normal operation
DS2/Red	RAC COMM 80C152	COMM Processor is OK	■ Flashes with DS1 (twice per second): normal operation
DS1/Red	RAC DAS 80C31	DAS Processor is OK	■ Flashes with DS2 (twice per second): normal operation

NOTE

"I hear talking on my TRAM-net" LED flashes:

◆ with the "I am talking on TRAM-net" LED and

◆ alone when someone else is talking.

CardioLink Server Disaster Recovery

This section is divided into two sections, Re-imaging the Server for Disaster Recovery and Restoring Data from Backup. The re-image procedure should be used in the event of catastrophic server failure to restore the server to its state previous to problems occurring. The Restoring Data from Backup section should be used when there is a need to only restore the database or patient data in the event of data corruption or suspected data corruption.

Before re-imaging, please note whether Lab Management Tools (LMT) is installed on the server. If LMT is installed, it will need to be re-installed after the server is imaged.

Re-Imaging the CardioLink Server

This procedure is intended to be used in the event of a catastrophic software failure of the server or during server replacement. The following steps will restore the server with all patient data contained in the backup file as long as the backup data has not been compromised.

Steps 1 through 6 assume that the server operating system is accessible. If the server cannot be booted completely, skip to step 7.

1. Verify all acquisition systems and review systems are running and have exited from the CardioLab/Mac-Lab application to the desktop.

2. Verify all acquisition and review systems are visible on the server from the network.

3. Disable Data Replication on server.

   ◆ Go to *Start -> Microsoft SQL Server 7.0 ->Enterprise Manager.*
   ◆ Navigate to the CardioLink server under SQL Server Group
   ◆ Highlight the <SERVER_NAME> and from the menu select
       Tools->Replication->Diable Publishing

The following screen will appear.
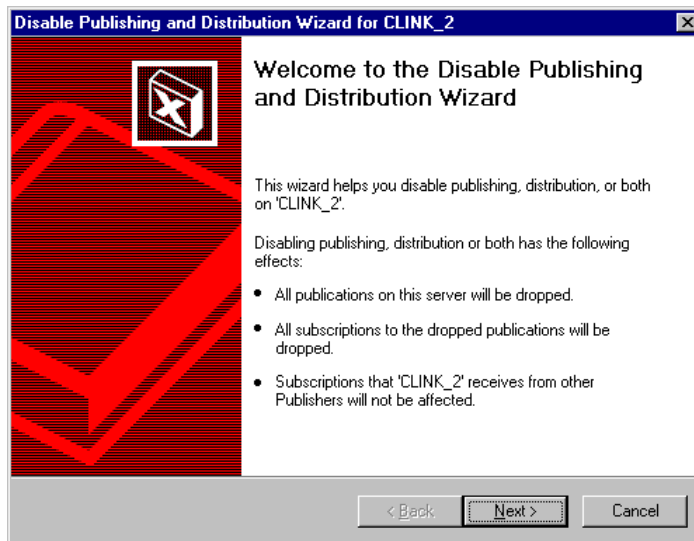
Select *Next* to continue and the following screen will appear.
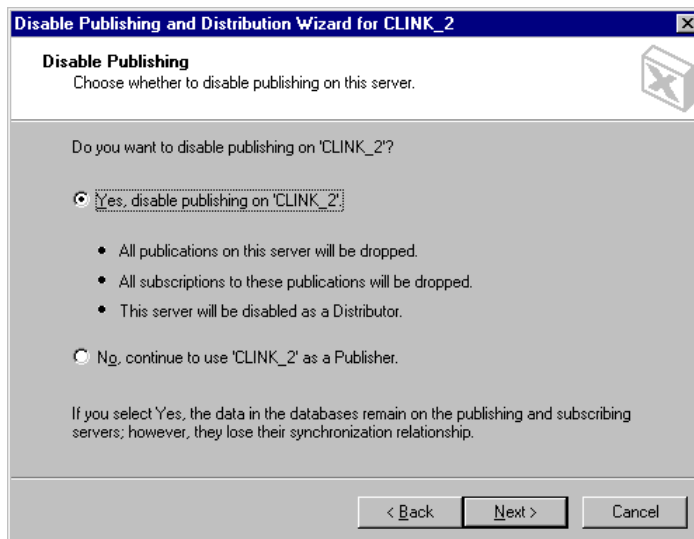
The default selection is *No*, select *Yes* to change selection. Select *Next.*

The next screen is for information only and looks like the following:
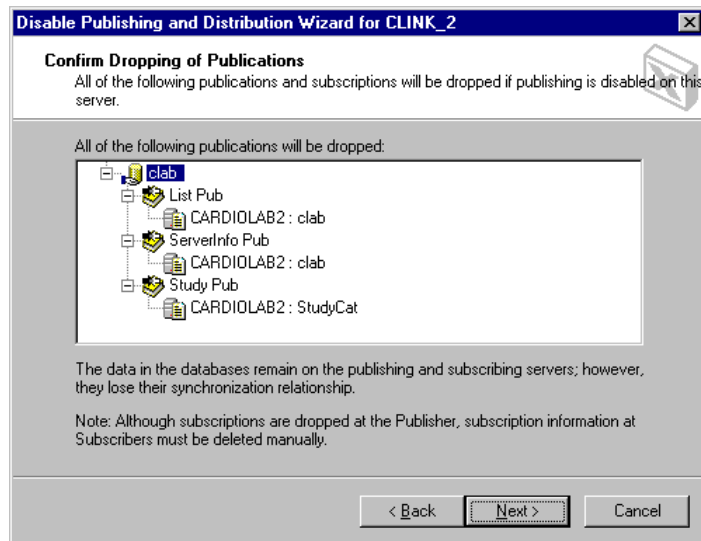
Select *Next* to continue and the following screen appears.
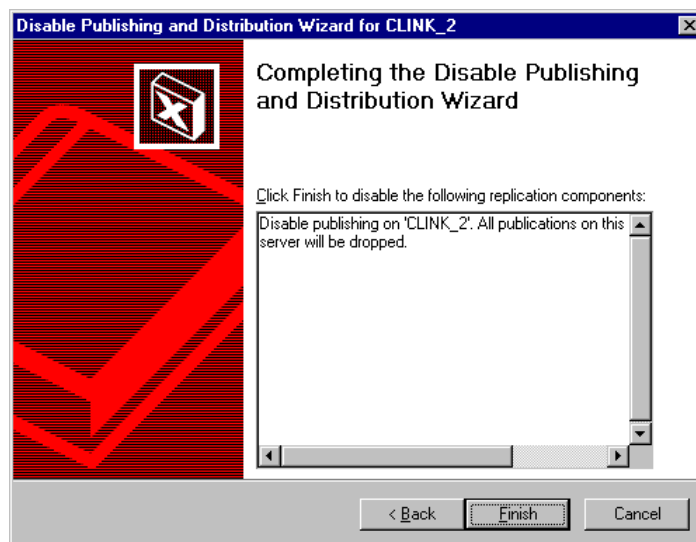
Select *Finish* to complete the task.

NOTE

Sometimes Enterprise Manager will show an error when attempting to disable data replication. If this occurs, re-run Step 3 starting with selecting the menu option *Tools->Replication->Disable Publishing*.

4. Verify Data Replication is *Disabled*. Right click on the server in *Enterprise Manager* and select *Refresh*. Now open the Server by

double clicking on it. Verify that the Replication Monitor is not visible. If the monitor appears as below, data replication is active.
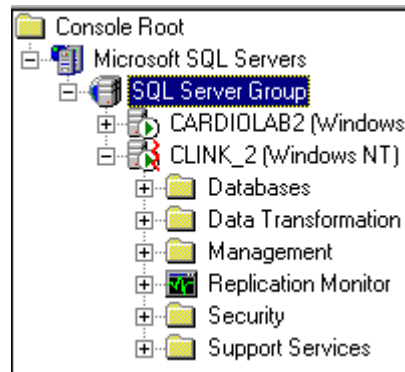
5. Do not allow Cardiolab to run on either the acquisition or review systems during any part of this process.

6. Configure the server to accept the Image.

NOTE

If the logical drive array is still intact (i.e. the multiple drives in the array are seen as one drive), then skip to step 7. If the logical drive information has been lost, perform the following steps:

a. Insert the *Compaq SmartStart CD* shipped with the server.

b. Re-boot the system with the Compaq SmartStart CD inserted. Once in the utility screen, select the icon for *Run System Utility Erase*r then select *OK.*

c. At the warning prompt, select *Yes.*

d. At the *System has been erased. Cycle system power now* screen, cycle the server power with the CD still in the drive.

e. At the language screen, select *English*.

f. At the Regional Settings screen, select the following:

◆ Country - United States

◆ Keyboard - United States

◆ Date - Enter Current Date

◆ Time - Enter Current Time

g. Select *Next* and verify the summary page, then *Continue*.

h. In the *License Agreement* screen, read/verify the agreement then select the *I agree* box. Select *OK.*

i. In the *Desired SmartStart path*, select *manual configuration* and then select *Begin*.

j. In the *Operating System* screen, open the folder for Microsoft and put an **X** in the box for Microsoft Windows NT Server version 4.0 English, then select *Next*.

k. Select *Continue* at the confirmation screen.

l. At the *Hardware SmartStart for Compaq Server* screen, use the keyboard to select *Continue with SmartStart* and select **Enter**.

m. At the *Hardware SmartStart Reboot* screen, select **Enter**.

n. At the *Unconfigured Controller Welcome* screen, select *Next*.

o. At the *Select a Configuration* screen, select *Raid 5 distributed data guarding* then pick *next*.

p. At the *Configuration Preview* screen, select *Next*.

q. At the *Configuration Wizard Finished* screen, select *Done.*

r. In the *Compaq Array Configuration Utility*, browse through the top pull down menu to *Controller>Save Configuration.*

s. In the *Compaq Array Configuration Utility*, browse through the top pull down menu to *Controller>Exit.*

t. The system will now reboot a few times for the SmartStart CD to discover hardware and prepare the drive array for operating system installation.

u. In the *Disk Builder* screen, select *Next.*

v. In the *Manual Path* screen, read the on-screen instructions to remove the SmartStart CD then select *continue*. (The server will reboot. Insert the image boot disk before the system reboots.)

7. Re-Image the Server.

   a. Insert the *ImageCast Boot Floppy* and *Image Disk* and reboot the server.

   ◆ High End Server Image CD (PN: 2007006-002)
   ◆ Mid Level Server Image CD (PN: 2007005-002)
   ◆ Low End Server Image CD (PN: 2007004-002)

   b. After Image Cast wizard comes up, select *Image file to Disk*.

   c. After *Select Image Type* screen, select *Restore Entire Image*.

   d. At the *Selected Image Type* screen, select the *Browse* button. Select the C: drive and then select the *IMC file* for system being configured. Select *OK*.

   e. At the *Selecting File* screen, confirm the IMC file selection. Select *Next*.

   f. At the *Select Post Configuration File* screen, verify that nothing is selected. Select *Next*.

   g. At the *Select Destination* screen, select *Drive Array 1.* Select *Next*.

   h. At the *Select Advanced Options* screen, select *Automatically Resize Partition*. Select *Next*.

   i. At the *Ready to Begin* screen, select *Image*. Select *Continue* in the warning screen.

   j. When the image process begins, eject the boot disk from the floppy drive and allow the server to reboot twice.

   k. After the system reboots, login as **Administrator**; password: **changeme.** Verify that the image was transferred to the server.

8. Follow all Server System Setup portions of the CardioLink Installation Instructions from start up and stop just before running the PEICreate_Replica.exe. At that point, continue with these instructions.

NOTE

In order to successfully restore the disk to its latest state, remember to restore the most recent normal (weekly) backup first and then each successive incremental (daily) backup.

For example: If a system failure occurs on Thursday, in order to restore the system to its most recent state, one must first restore the last normal backup from the previous Friday and then restore each incremental backup from Monday, Tuesday and Wednesday.

Restoring Data from Tape

1. Launch the Backup Utility from *Start>Programs>Administrative Tools>Backup.*

2. Insert the data cartridge you desire to restore.

3. Open the tapes screen by selecting the *Tape* button.

4. From the tapes screen, double click on the *Tape* icon. The following dialog box should appear:
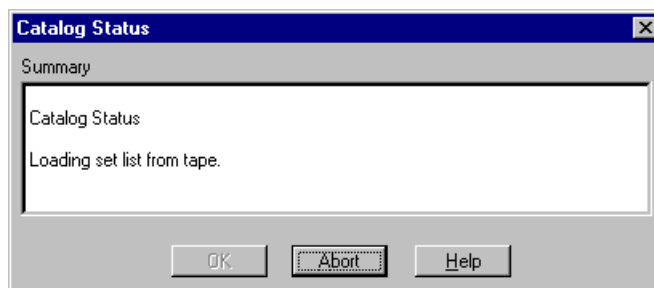
PK 3

5. After the catalog is loaded, the tapes screen should display the contents of the tape.

6. From the tape screen, select the items by checking the checkboxes next to "D:\" to restore all data (by description & set number) from the Drive D:.

7. Select the appropriate set.

8. After selecting the folders from tape, select on the *Restore* button. The Restore Information screen appears.
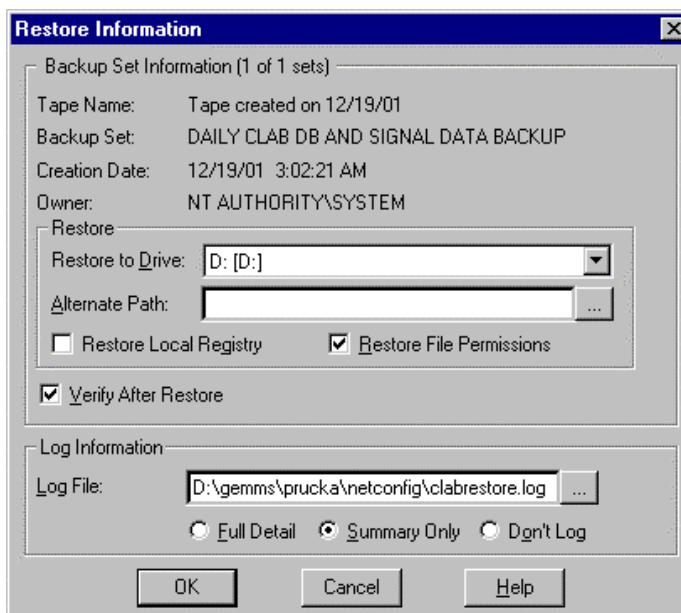
9. Specify restore settings as follows:

    a. Select *Restore File Permissions.*

    b. Select *Verify After Restore.*

    c. Type the path and filename to specify the log file as *d:\gemms\prucka\netconfig\clabrestore.log.*

    d. Select the option *Summary Only.*

10. Select *OK* to begin Restore Process.

NOTE

If the message *Confirm File Replace* appears, select *Yes to All* to continue. This message will only appear during the restore of the daily tape backups.

11. Verify that the restoration is complete by viewing the Restore Status screen.
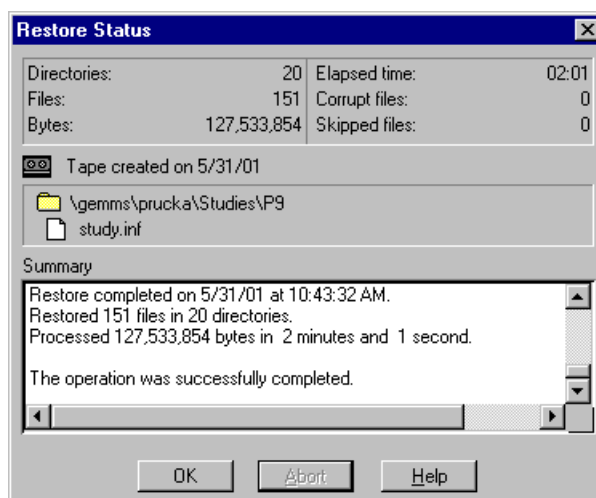
PK 5

12. Select *OK* on Restore Status screen.

NOTE

Repeat steps 12 - 22 for each data cartridge to restore.

13. Exit the backup utility after restoring the desired data cartridges.

Restoring from a Veritas Backup

NOTE:

Before attempting to restore server data using Veritas, the Veritas Remote Agent must be installed on the CardioLink server. See the CardioLink Operator's Manual for detailed instructions on installing the agent.

◆ Both the Daily and Weekly Restore sets will include the user databases files from D:\GEMMS\Prucka\Database\Maintenance\Backup and the patient studies folder from the path D:\GEMMS\Prucka\Studies as per the figure below.
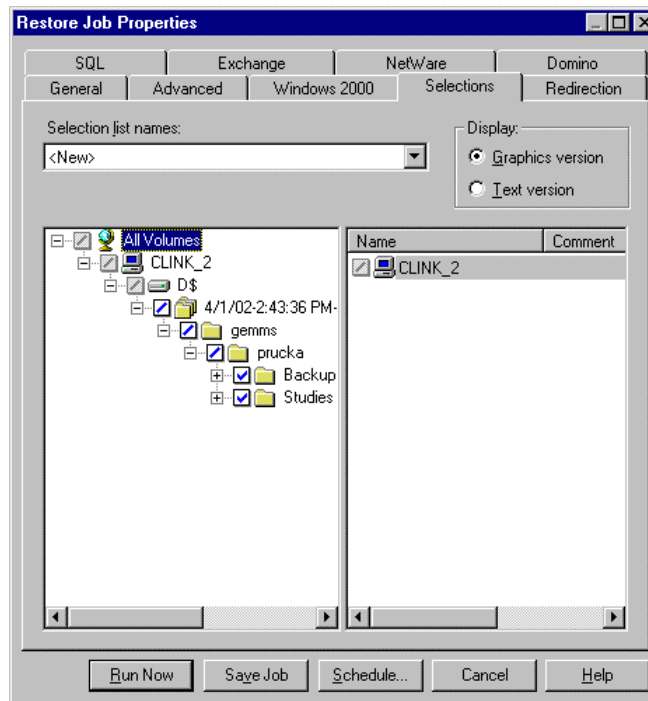
◆ Daily Restore Selection

Select the D:\GEMMS\Prucka\Database\Maintenance\Backup D:\GEMMS\Prucka\Studies

◆ Weekly Restore Selection

Select the D:\GEMMS\Prucka\Database\Maintenance\Backup D:\GEMMS\Prucka\Studies

Restoring from a ArcServe Backup

NOTE:

Before attempting to restore server data using ArcServe, the ArcServer Remote Agent must be installed on the CardioLink server. See the CardioLink Operator's Manual for detailed instructions on installing the agent.

◆ Both the Daily and Weekly Restore sets will include the user databases files from D:\GEMMS\Prucka\Database\Maintenance\Backup and the patient studies folder from the path D:\GEMMS\Prucka\Studies as per the figure below.
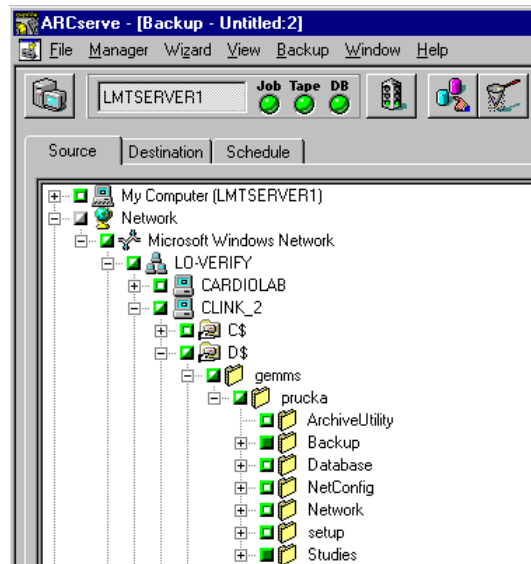
◆ Daily Restore Selection

Select the
D:\GEMMS\Prucka\Database\Maintenance\Backup
D:\GEMMS\Prucka\Studies

◆ Weekly Restore Selection

Select the
D:\GEMMS\Prucka\Database\Maintenance\Backup
D:\GEMMS\Prucka\Studies

14. Copy the clabbackup.bak file from the folder D:\GEMMS\Prucka\Database\Maintenance\Backup to C:\.

NOTE

If the message *Confirm File Replace* appears, select *Yes* to continue.

15. Execute the db restore utility *D:\gemms\prucka\netconfig\RestoreClab.exe.*

16. Select *OK* to message *Copy the backup files to the location c:\clabbackup.bak.*

17. Select *OK* to message *C:\clabbackup.bak backup file has been restored.*

18. **Reboot server to restart process.**

19. Navigate to *Start > Microsoft SQL Server 7.0 >Enterprise Manager >*

    a. In Enterprise manager, navigate to:

    Clink_2->Databases>Clab>Tables>DetailVersion

    b. Right Click on *Detail Version table*, select *Open Table->Return All Rows from the menu.*

    c. From the newly opened Data, Set the NetVersion and MachineDBVersion fields to 0.

    d. Exit from Enterprise manager.

20. Run the file E*:\Utilities\stoprepl.bat* from the CardioLink CD (PN: 2006556-00X) on the server.

21. Run the CardioLink installation from the CD (PN: 2006556-00X).

The setup files are located on your CD. Use the following setup steps.

22. Insert the *CardioLink CD* into the CD-ROM drive.

23. In Windows NT Explorer, locate the CD-ROM drive.

24. Double click the *Setup.exe* file.

25. If CardioLink is already installed, use the following steps. If you have never installed CardioLink, proceed to the Welcome screen.

    ◆ Select the *Update Application* radio button.

    ◆ Select *Next* to continue.
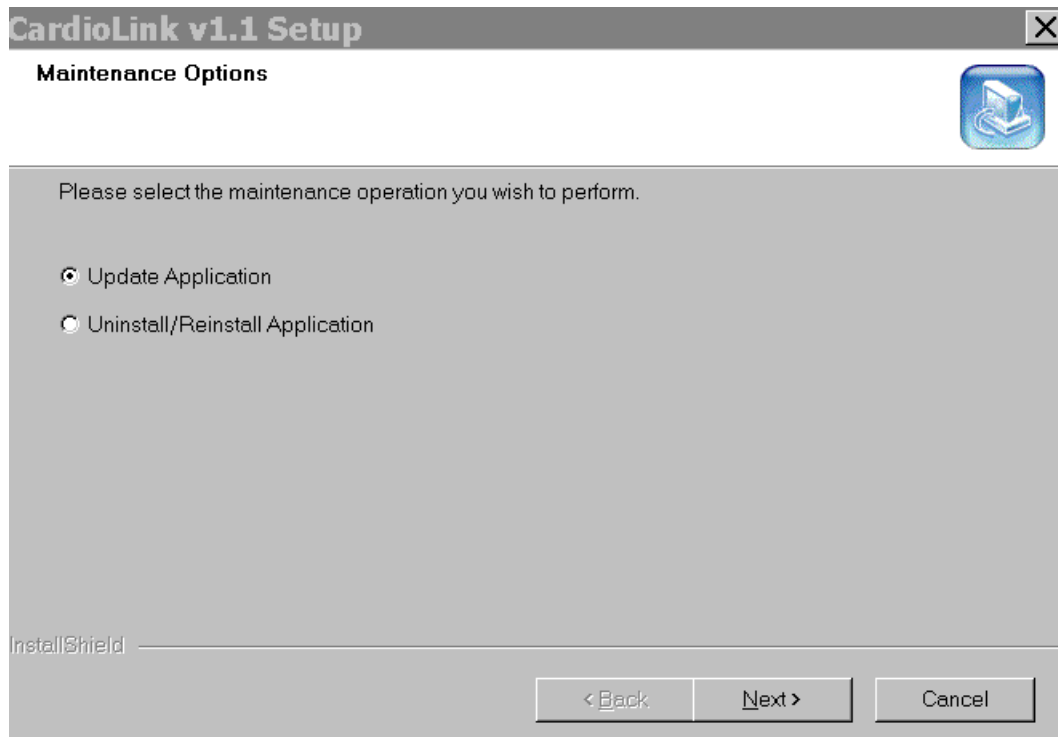
When you start the Setup.exe file, the following screen appears.
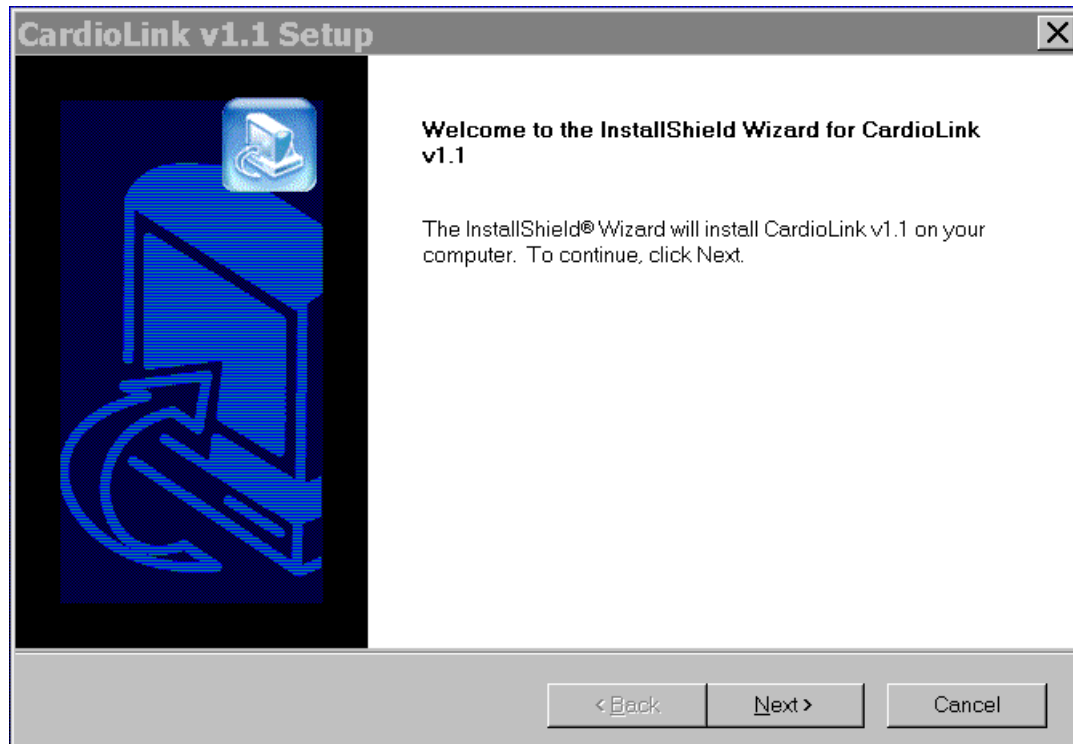
26. Select *Next* to continue.

27. After you select *Next* at the Welcome screen, the following screen appears. Select the *CardioLink Server* radio button for the server setup type.

28. Select *Next.*
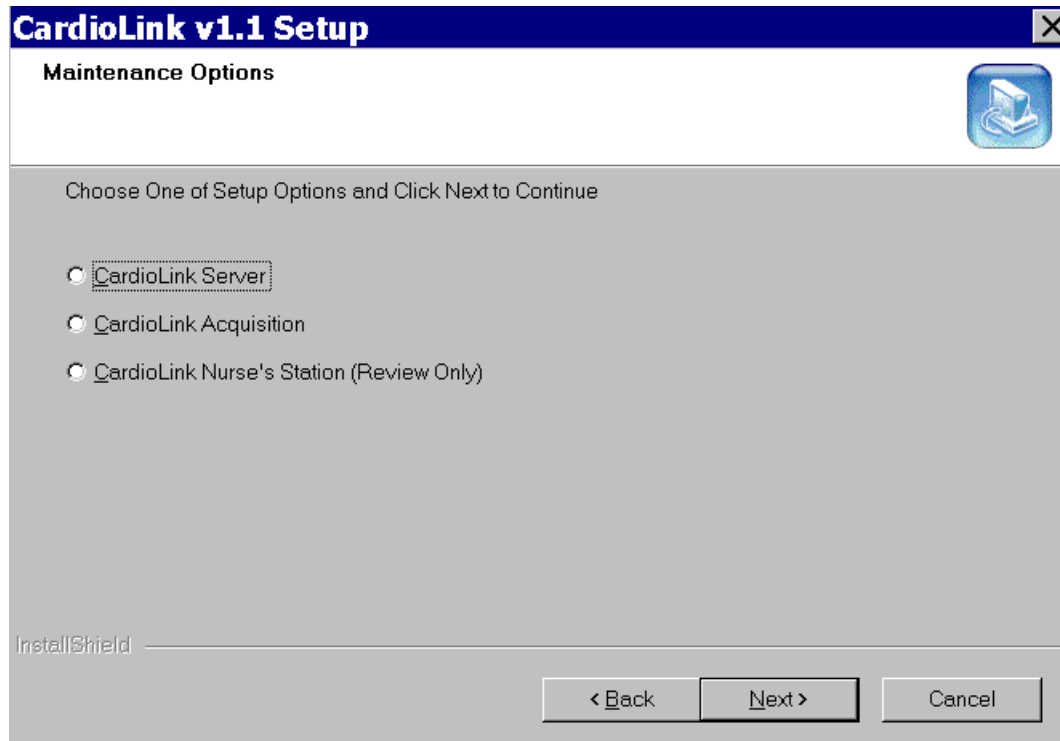
PK2

29. Leave the sa password as blank, and select *Next.*

30. If a read-only file detected box appears, select *Yes.*

    The installation takes approximately 10 minutes to run. Ignore any error messages that may be displayed in the MS-DOS screen.

The following screen indicates that the software was successfully installed. You must restart your computer to finish installing the software.
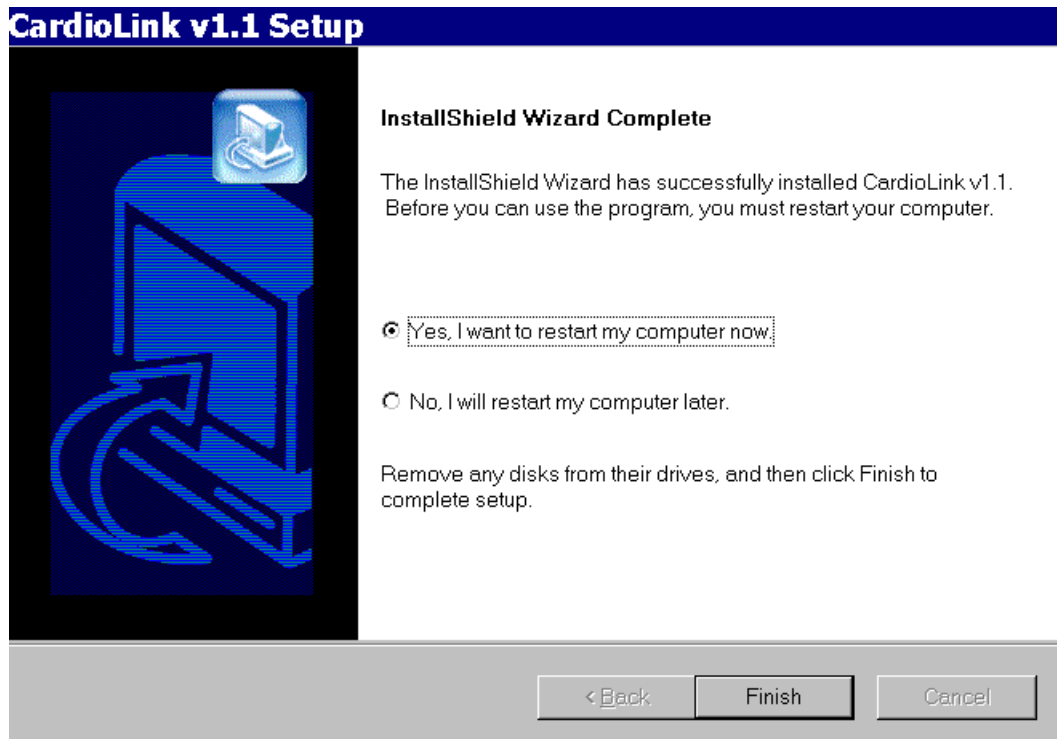
PK3

31. To restart your computer, check the first radio button. A reboot is necessary for the changes to take effect.

32. Select *Finish*.

33. After the system reboots, login as **Administrator**; password: **cardiolab!**

Restoring the GEMS Registry Key

NOTE:

This step should be performed after the installation or re-installation of the GEMS application. The registry restore function only over-writes existing registry entries and does not create new entries.

◆ Select *Start\Run* and type **D:\GEMMS\Prucka\database\maintenance\gems_regres .cmd**. Select *OK*.

◆ At the screen prompt, *Are you sure you want to replace Software\GEMS (Y, N)*, type **Y** and hit the **Enter** key.

◆ Select *OK* to the message *GEMS Application Settings Restored*.

34. Run the Replication Utility.

a. Select the path *D:\Gemms\Prucka\Netconfig*, and double click on the *PEICreate_Replica.exe file*. The logging dialog box launches.

b. Type in:

   User Name: **clabsys**

   Password: **clab.admin** (case-sensitive).

c. Select OK.

d. Wait for the processes to stop running.

e. In the Select *System for Replication* dialog box:

   From the System list, select: <LOCAL-SERVER-NAME>.

      Select the *Add* button.

      Ensure the server is selected for the type of system Select *OK*.

      The <LOCAL-SERVER-NAME> appears in the Network list.

      From the System list, select each <ACQUISITIONSYSTEM NAME>.

      Select the *Add* button.

      Ensure the acquisition system is selected as the type of system.

      Select *OK*.

      The <ACQUISITION-SYSTEM-NAME> appears in the Network list.

f. Repeat for all the Acquisition computers being added to the network and after adding all acquisition computers, select *OK*.

g. Select *Yes* at the message: P*lease ensure you have created a master list*.

h. Wait for the processes to stop running.

i. The following messages will appear for each acquisition system added: *Do you want to move existing studies from the acquisition system: <ACQUISITION-SYSTEM-NAME> to the server?*

Select *No* to consolidation

Select *Yes* if asked if you still wish to continue

j. Select *OK* on the Replication Started message window.

NOTE

Any studies done on the acquisition systems when not connected to the CardioLink server may be added to the network by reviewing each study from the optical disk.

35. If not already installed, perform the following steps, install the modem, and configure the driver.

a. Select *Start/Settings/Control Panel/Modems.*

b. Check the box: *Don't detect my modem*, and select *Next.*

c. Select *Have Disk.*

d. Insert the CardioLink CD, and browse to the *\Modem Driver directory.*

e. Select the *Multitech Systems MT5634ZBA* modem from the list.

f. Select the *Com 2 port.* Select *Next* and *Finish/Close.*

36. Configuring PC Anywhere Host - If not already installed, you must configure PC Anywhere.

Use the following steps to configure PC Anywhere to be in host mode when the server boots and to create a short cut to a host connection named GE Host.

a. Launch the PC Anywhere application. (If there is no icon for PC Anywhere, select *C:\ProgramFiles\Symantec\pcanywhere\winaw32.exe* and create a shortcut on the desktop.)

b. Select on *Be a Host PC.*

c. Double click on *Add a New Host PC* Item.

d. In the wizard window, name the item "GE HOST', select *Next.*

e. Select the *Multitech Systems MT5634ZBA* modem as the connection device, then select *Next.*

f. Select *Use PCAnywhere caller security*, select *Next.*

g. Uncheck A*utomatically launch this host upon wizard completion* and then Select *Finish.*

h. Right click on the *GE Host item* and select *Properties.*

i. Under the settings tab, select *Launch with Windows.*

j. Select the *Callers* tab.

k. Select *Use PCAnywhere authentication with PCAnywhere privileges.*

    l.   Double click on *Add Caller.*

    m.   Name the caller **GEMMS**, select *Next.*

    n.   Set the password to **gemms.com**.

    o.   Confirm the password and select *Next.*

    p.   Select *Finish.*

    q.   Select the *Protect Item* tab.

    r.   Set the password to **gemms.com** and confirm the password.

    s.   Select *Apply* then select *OK.*

    t.   Make a copy of the "GE Host" connection and place it on the desktop.

    u.   Reboot the server and ensure that the PCAnywhere icon appears in the system tray by the clock.

37. Test the modem connection using PCAnywhere and an analog phone line.

    a.   Identify the phone number for the server analog line.

    b.   Launch *PCAnywhere*, and begin the host operation through the modem.

    c.   Use technical support or clinical applications to modem into the server.

Restoring CardioLink Server Data from Backup

CAUTION

If the user needs to restore the backed up server data from a tape or Enterprise network, the existing data on the server must be backed up before restoring the data Restoring will overwrite the existing database on the server.

NOTE

In order to successfully restore the disk to its latest state, remember to restore the most recent normal (weekly) backup first and then each successive incremental (daily) backup.

For example: If a system failure occurs on Thursday, in order to restore the system to its most recent state, one must first restore the last normal backup from the previous Friday and then restore each incremental backup from Monday thru Wednesday.

Server Configuration

Prior to restoring database and patient signal data, verify that the server is properly configured as per CardioLink Installation Instructions (PN: 2008069-001).

Restoring Database and Study Data from Tape

Before restoring study data from tape backup, replication must be disabled as follows:

1. Select *Start>Programs>Microsoft SQL Server 7.0>Enterprise Manager*.

2. Enterprise Manager launches. Expand the *SQL Server Group*.

3. Highlight *<Clink_2>* or the *<Server_Name>*.

4. Select *Tools>Replication>Disable* publishing.

5. Select *Next* in the Disable Publishing and Distribution Wizard window.

6. Select *Yes* to disable publishing on <Server_Name>, and select *Next*.

7. At *Confirm Dropping of Publications* window, select *Next* and then select *Finish*.

8. In the *SQL Server Enterprise Manager successfully disable* window, select *OK*.

9. Delete the file *history.log* from *D:\Gemms\Prucka\Netconfig* folder.

10. Select the *<Ctrl + ALT + Delete>* keys.

11. Select the *Task Manager* button.

12. Select the *Processes* tab.

13. Select the process *NetMsgSender.ex.*

14. Select the *End Process* Button.

15. Select *Yes* to the Task Manager Warning message.

NOTE

Make sure you have a backup of the existing studies before continuing.

16. Delete all items under the *D:\Gemms\Prucka\Studies* folder.

17. Launch the *Backup Utility* from *Start>Programs>Administrative Tools>Backup*.

18. Insert the data cartridge you desire to restore.

19. Select the *Tape* button to open the tapes window.

20. From the tapes window, double click on the *Tape* icon. The following dialog box should appear:
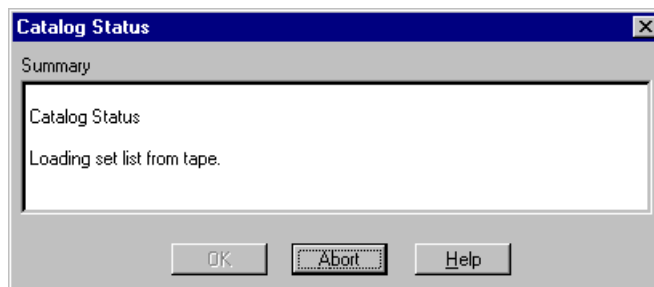
PK 3

21. After the catalog is loaded, the tapes window should display the contents of the tape.

22. From the tape window, select the items by checking the checkboxes next to *D:* to restore all data (by description and set number) from the Drive D:

23. Select the appropriate set.

24. After selecting the folders from tape, select the *Restore* button.
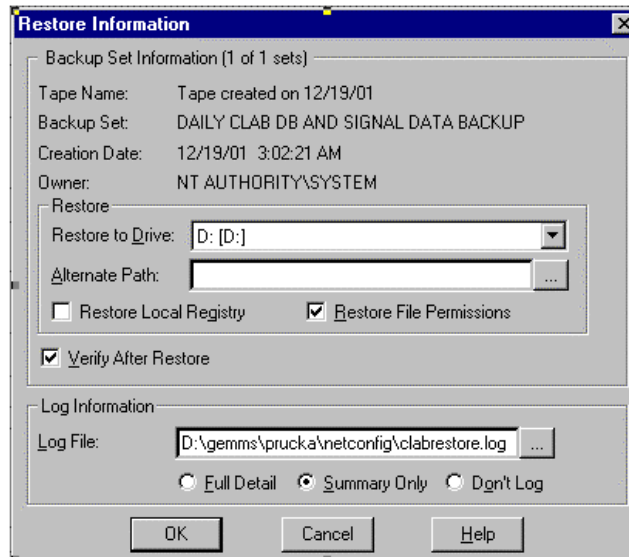
PK 4

25. The Restore Information window appears.

26. Specify restore settings as follows:

   a.   Select *Restore File Permissions.*

   b.   Select *Verify After Restore.*

   c.   Select the log file as
        d:\gemms\prucka\netconfig\clabrestore.log.

   d.   Select the option *Summary Only.*

27. Select *OK* to begin Restore Process.

NOTE

If the message *Confirm File Replace* appears, select *Yes to All* to continue. This message will only appear during the restore of the daily tape backups.

28. Verify that Restore is complete by viewing the *Restore Status* window.
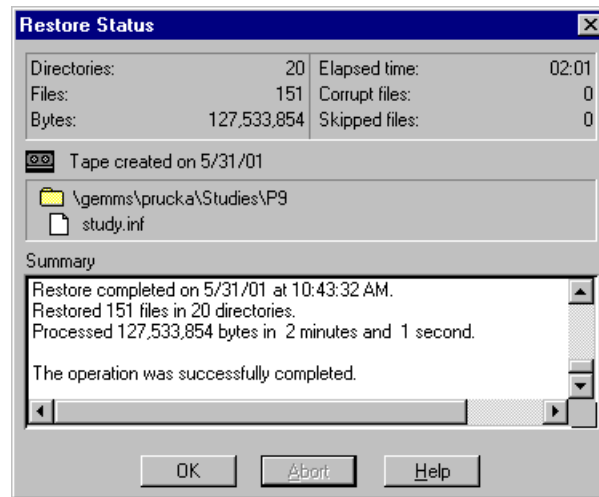
PK 5

29. Select *OK* on Restore Status window.

NOTE

Repeat steps 2 thru 12 for each data cartridge to restore.

30. Exit the backup utility after restoring the desired data cartridges.

31. Copy the *clabbackup.bak* file from the folder D:\GEMMS\Prucka\Database\Maintenance\Backup.

32. Execute the db restore utility *D:\gemms\prucka\netconfig\RestoreClab.exe.*

33. Select *OK* to message *Copy the backup files to the location c:\clabbackup.bak.*

34. Select *OK* to message *C:\clabbackup.bak backup file has been restored.*

35. Run the file E*:\Utilities\stoprepl.bat* from the CardioLink 1.1D CD-Rom.

36. Reboot Server to restart process.

37. Restart replication by running the replication utility. On the server, select *D:\Gemms\Prucka\Netconfig,* and double click on the *PEICreate_Replica.exe* file. The log-in dialog box launches.

38. Type in:

    User Name: **clabsys**

    Password: **clab.admin** (case-sensitive).

39. Select *OK*.

40. In the Select System for Replication dialog box:

    From the System list, select: *<LOCAL-SERVER-NAME>*.

    a. Select the *Add* button.

    b. Make sure the server is selected for the type of system.

    c. The <LOCAL-SERVER-NAME> appears in the Network list.

    From the System list, select each <ACQUISITION-SYSTEM-NAME>.

    a. Select the *Add* button.

    b. Make sure acquisition system is selected as the type of system.

    c. The <ACQUISITION-SYSTEM-NAME> appears in the Network list.

41. Select *OK*.

42. Select *Yes* to the message: *Please make sure you have created a master list.*

43. Wait for the processes to stop running.

44. The message appears: *Do you want to move existing studies form the acquisition system: <CUSTOMER-ACQUISITION-SYSTEM-NAME> to the server?*

    Select *Yes* if any of the following conditions are true:

    - If you are adding a single acquisition system to the network environment for the first time.

    - If there are studies on the system that need to be moved to the server.

    - If this system has been removed from the network and studies were performed.

    - If this system has been removed from the network and lists were edited.

NOTE

If Yes is selected and a message appears warning *All Lists will be Deleted,* DO NOT CONTINUE. Select *No* to consolidate.

Select *No* if any of the following conditions are true:

- If the acquisition system is currently on the network.

- If the acquisition system was removed from the network and no studies or list modifications were performed. A message will appear to warn of duplicate lists. If it is certain that no list modifications have been made, select *Yes* to continue, otherwise do not continue and select *Yes* to Consolidate.

45. Select *OK* on the Replication Started message window.

46. Run the batch file *D:\Gemms\Prucka\Netconfig\Synclist.bat*. This will synchronize the server database with the new acquisition system.

NOTE

After the replication is re-started at the end of restore process, the user will be able to locate the patient studies that were restored from tape on the Network catalog on acquisition machines and will be able to review or continue the studies.

Restoring Database and Study Data from the Enterprise Network

Before restoring study data from tape backup, replication must be disabled as follows:

1. Select *Start>Programs>Microsoft SQL Server 7.0>Enterprise Manager*.

2. Enterprise Manager launches. Expand the *SQL Server Group*.

3. Highlight *<Clink_2>* or the *<Server_Name>*.

4. Select *Tools>Replication>Disable* publishing.

5. Select *Next* in the Disable Publishing and Distribution Wizard window.

6. Select *Yes* to disable publishing on <Server_Name>, and select *Next*.

7. At *Confirm Dropping of Publications* window, select *Next* and then select *Finish*.

8. In the *SQL Server Enterprise Manager successfully disable* window, select *OK*.

9. Delete the file *history.log* from *D:\Gemms\Prucka\Netconfig* folder.

10. Select the *<Ctrl + ALT + Delete>* keys.

11. Select the *Task Manager* button.

12. Select the *Processes* tab.

13. Select the process *NetMsgSender.ex*.

14. Select the *End Process* Button.

15. Select *Yes* to the Task Manager Warning message.

NOTE

Make sure you have a backup of the existing studies before continuing.

16. Delete all items under the *D:\Gemms\Prucka\Studies* folder.

17. Copy the *clabbackup.bak* file from the folder *D:\GEMMS\Prucka\Database\Maintenance\Backup*.

18. Execute the db restore utility *D:\gemms\prucka\netconfig\RestoreClab.exe*.

19. Select *OK* to message *Copy the backup files to the location c:\clabbackup.bak*.

20. Select *OK* to message *C:\clabbackup.bak backup file has been restored*.

21. Run the file *D:\GEMMS\Prucka\Netconfig\Stoprepl.bat*.

22. Reboot Server to restart process.

23. **Restart replication by running the replication utility. On the server, select** *D:\Gemms\Prucka\Netconfig,* **and double click on the** *PEICreate_Replica.exe* **file. The log-in dialog box launches.**

24. Type in:

   User Name: **clabsys**

   Password: **clab.admin** (case-sensitive).

25. Select *OK*.

26. In the Select System for Replication dialog box:

   From the System list, select: *<LOCAL-SERVER-NAME>.*

   a. Select the *Add* button.

   b. Make sure the server is selected for the type of system.

   c. The <LOCAL-SERVER-NAME> appears in the Network list.

   From the System list, select each <ACQUISITION-SYSTEM-NAME>.

   a. Select the *Add* button.

   b. Make sure acquisition system is selected as the type of system.

   c. The <ACQUISITION-SYSTEM-NAME> appears in the Network list.

27. Select *OK*.

28. Select *Yes* to the message: *Please make sure you have created a master list.*

29. Wait for the processes to stop running.

30. The message appears: *Do you want to move existing studies form the acquisition system: <CUSTOMER-ACQUISITION-SYSTEM-NAME> to the server?*

   Select *Yes* if any of the following conditions are true:

   ■ If you are adding a single acquisition system to the network environment for the first time.

   ■ If there are studies on the system that need to be moved to the server.

   ■ If this system has been removed from the network and studies were performed.

   ■ If this system has been removed from the network and lists were edited.

NOTE

If Yes is selected and a message appears warning *All Lists will be Deleted,* DO NOT CONTINUE. Select *No* to consolidate.

Select *No* if any of the following conditions are true:

- If the acquisition system is currently on the network.

- If the acquisition system was removed from the network and no studies or list modifications were performed. A message will appear to warn of duplicate lists. If it is certain that no list modifications have been made, select *Yes* to continue, otherwise do not continue and select *Yes* to Consolidate.

31. Select *OK* on the Replication Started message window.

32. Run the batch file *D:\Gemms\Prucka\Netconfig\Synclist.bat*. This will synchronize the server database with the new acquisition system.

NOTE

After the replication is re-started at the end of restore process, the user will be able to locate the patient studies that were restored from tape on the Network catalog on acquisition machines and will be able to review or continue the studies.

Using Veritas Backup Exec Remote Agent for Windows NT

Restoring from a Veritas Backup

◆ Both the Daily and Weekly Restore sets will include the user databases files from D:\GEMMS\Prucka\Database\Maintenance\Backup and the patient studies folder from the path D:\GEMMS\Prucka\Studies as per the figure below.
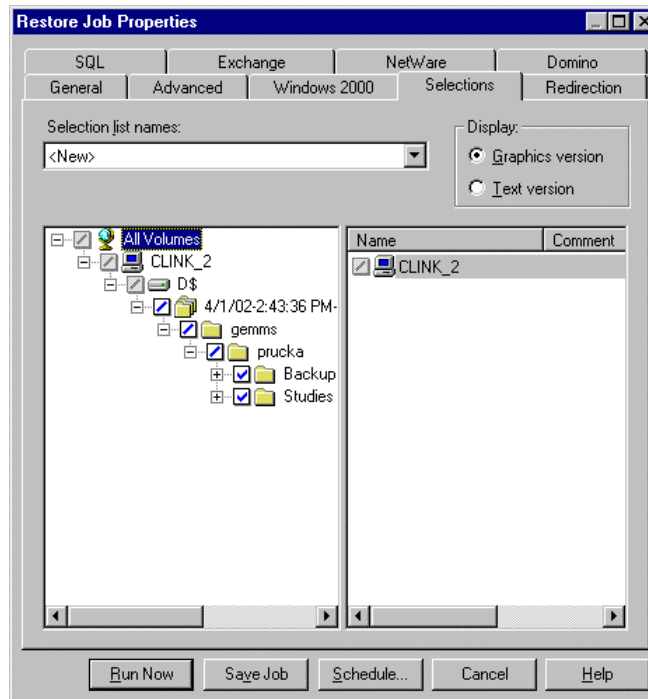
◆ **Daily Restore Selection**

Select the
D:\GEMMS\Prucka\Database\Maintenance\Backup
D:\GEMMS\Prucka\Studies

◆ **Weekly Restore Selection**

Select the
D:\GEMMS\Prucka\Database\Maintenance\Backup
D:\GEMMS\Prucka\Studies

Using ArcServe Windows NT Enterprise ED. v6.5 Bld 600

Restoring from a ArcServer Backup

◆ **Both the Daily and Weekly Restore sets will include the user databases files from D:\GEMMS\Prucka\Database\Maintenance\Backup and the patient studies folder from the path D:\GEMMS\Prucka\Studies as per the figure below.**
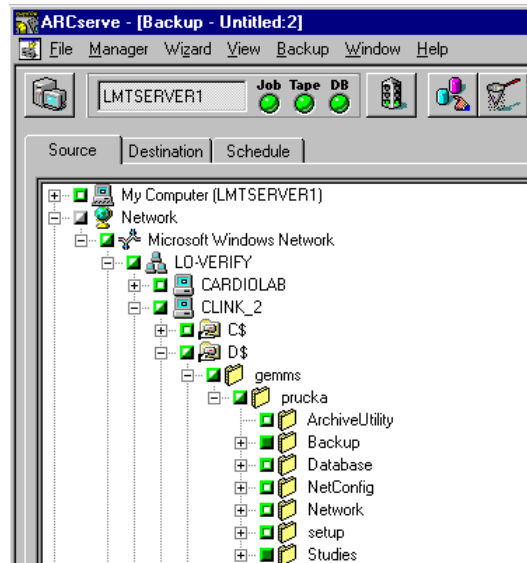
◆ **Daily Restore Selection**

Select the
D:\GEMMS\Prucka\Database\Maintenance\Backup
D:\GEMMS\Prucka\Studies

◆ **Weekly Restore Selection**

Select the
D:\GEMMS\Prucka\Database\Maintenance\Backup
D:\GEMMS\Prucka\Studies

6   Drawings and Parts List

For your notes

Diagrams/Drawings/Illustrations

Chassis Front View (2003235-0010)

3 1/2"Optical Drive

5 1/4" Optical Drive

CD ROM Drive

Power Switch

Reset Switch

Floppy Drive
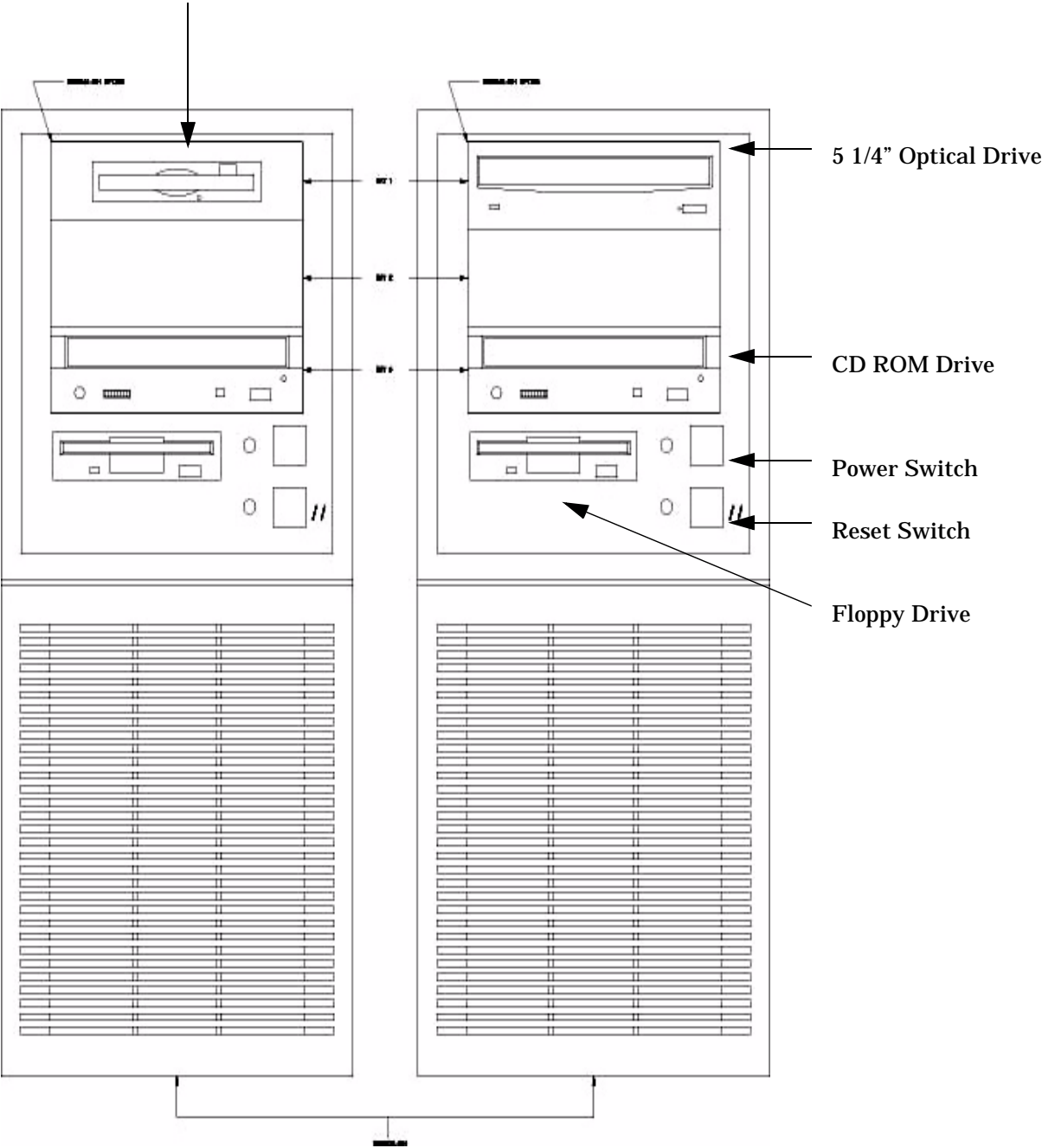
PK1

Chassis Back View CD-ROM Drive (2003235-001)
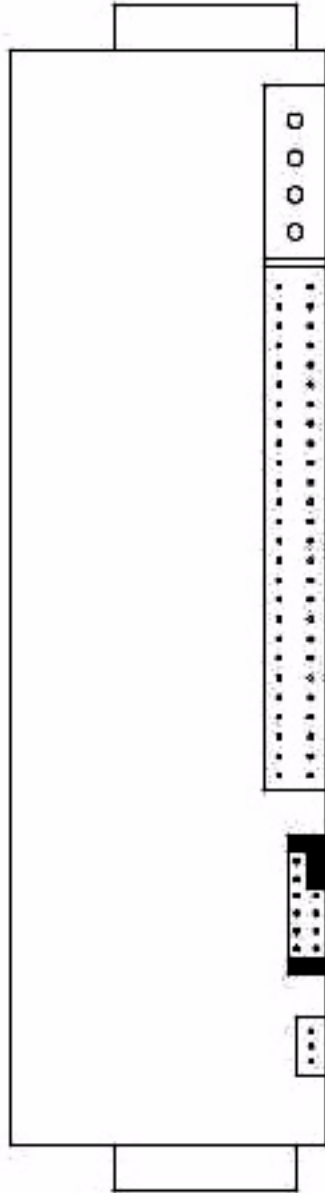
PK2

Optical Drive - 3 1/2 (2003341-001)

BOTTOM VIEW

BACK VIEW
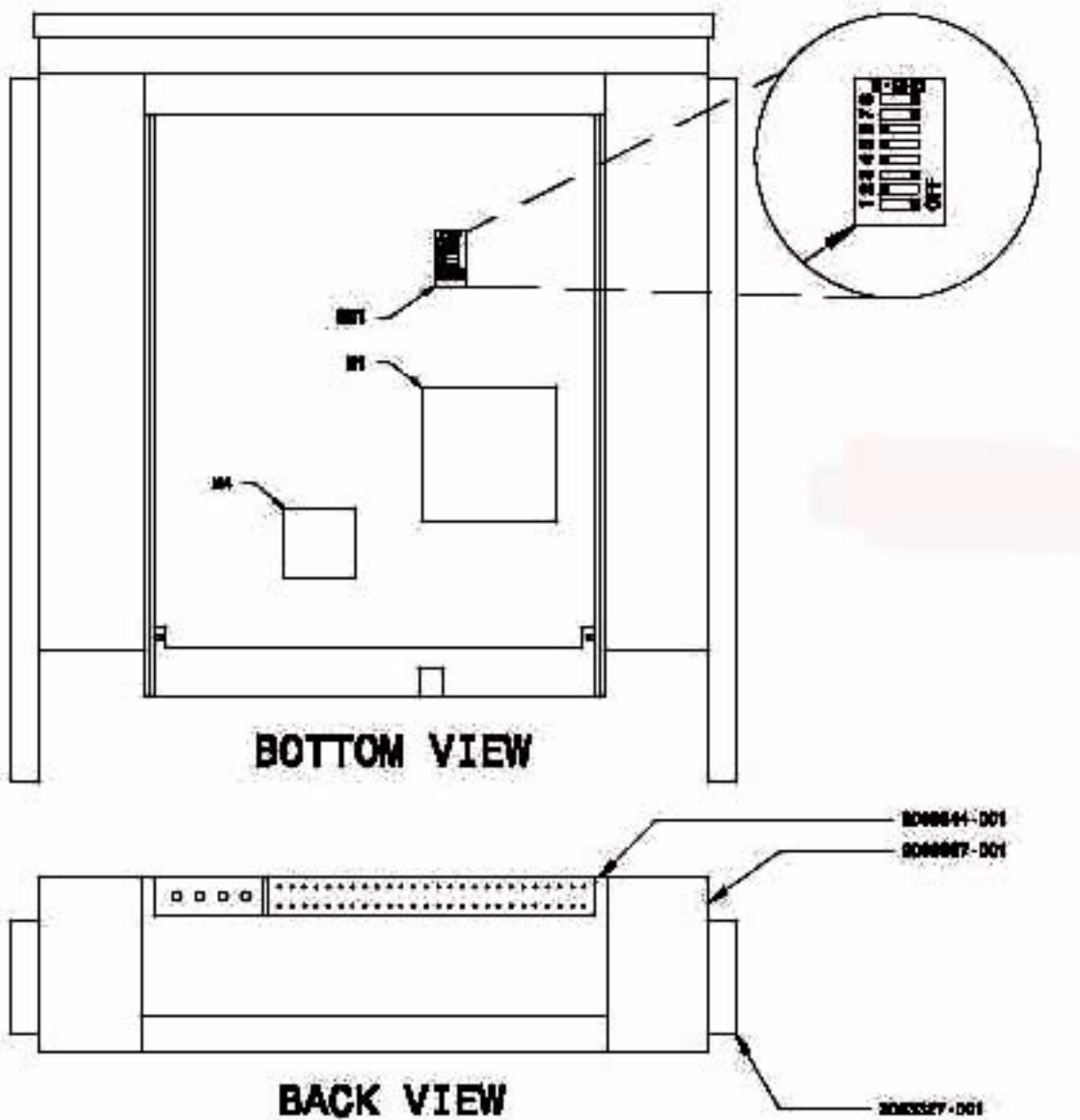
PK3

RS422 PCI Card (2003245-001)
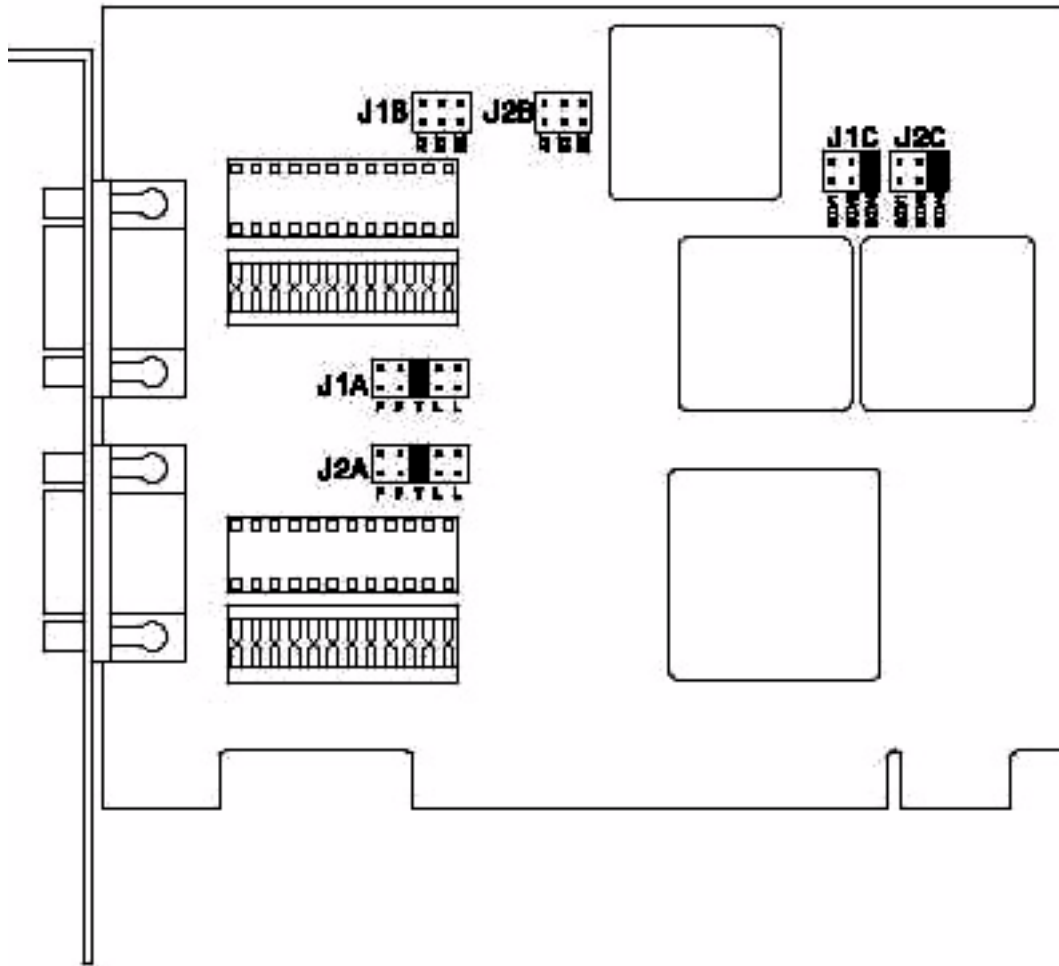
PK4

Optical Drive - 5 1/4 (2003340-001)
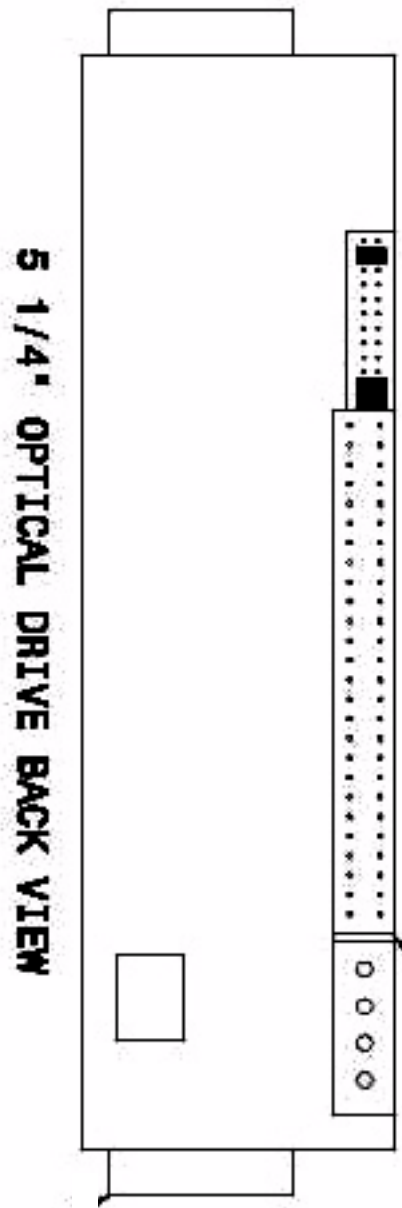
Back Panel Showing Slots for CardioLab/Mac-Lab Computers (2003806-001, 2003806-002, 2003806-003)
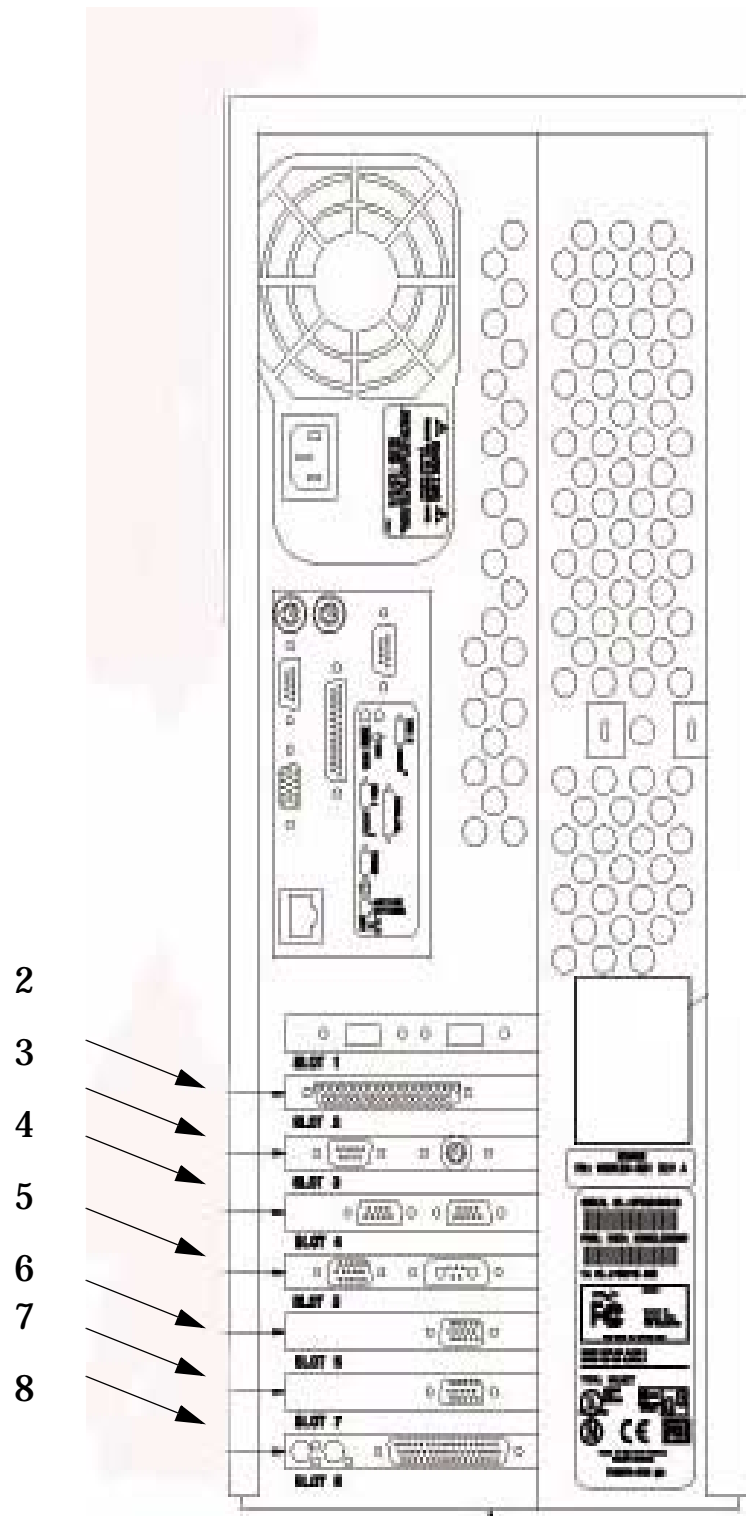
PK11

Slots for CardioLab/Mac-Lab Computer with RS422 or TRAM-net Card

Table 1. Slot Descriptions with RS422 Card

Slot	Reference	Description	Part Number
Slot 2	Reference 2	Digital Input	2003238-001
Slot 3	Reference 3	COM 10/V-Synch	2003240-001
Slot 4	Reference 4	PCI Card, RS422 or TRAM-net	2003245-001 or 2009937-001
Slot 5	Reference 5	Image Card	2003243-001
Slot 6:	Reference 6	Video Card 1 (Real-Time)	2003236-001
Slot 7	Reference 7	Video Card 2	2003236-001
Slot 8	Reference 8	Acquisition COMMS	2002886-001

Back Panel Showing Slots for CardioLab/Mac-Lab Computers (2003806-001, 2003806-001, 2003806-001)
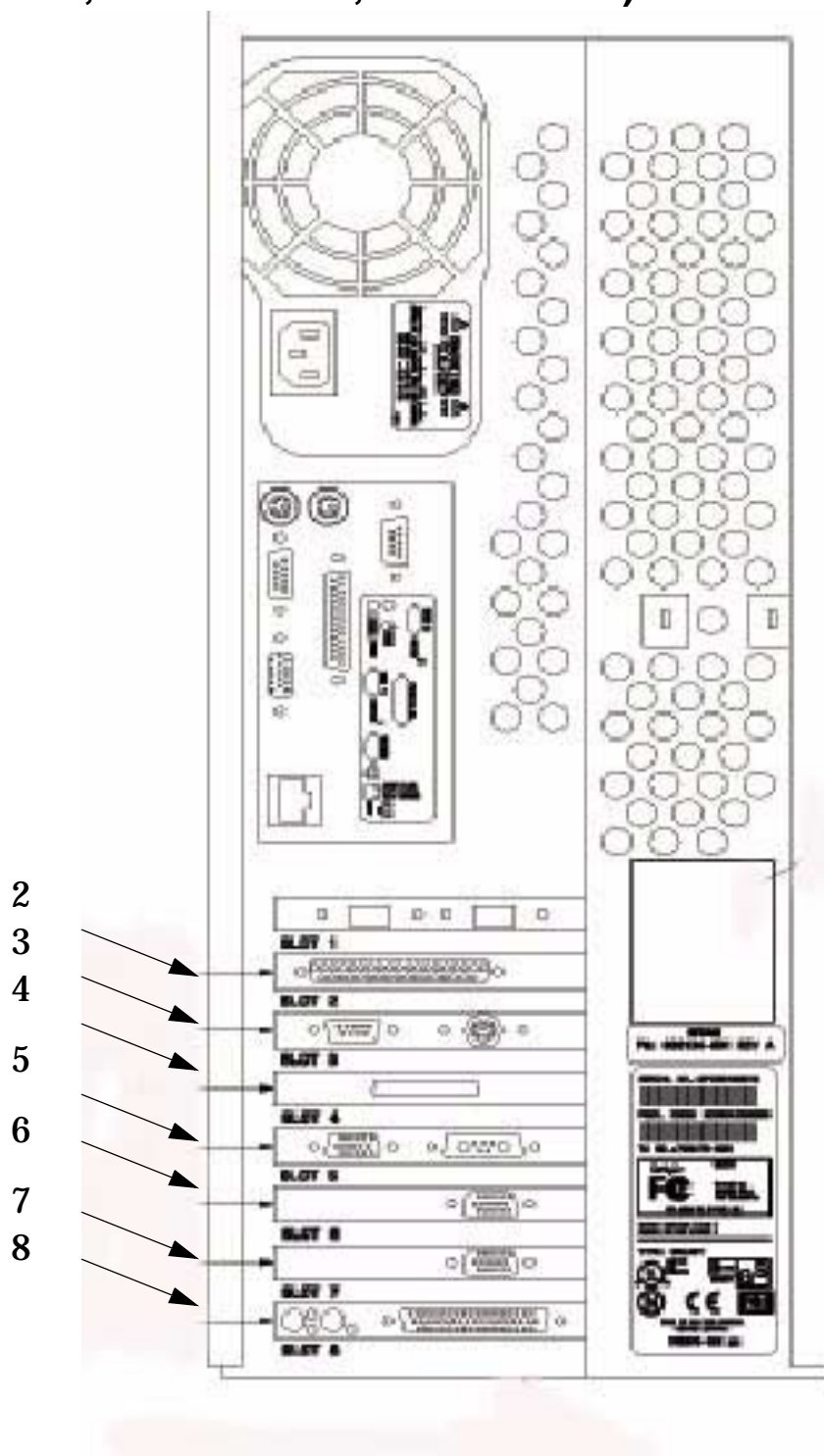
PK7

Slots for CardioLab/Mac-Lab Computer with PSI Card

Table 2. Slot Descriptions with PSI Card

Slot	Reference	Description	Part Number
Slot 2	Reference 2	Digital Input	2003238-001
Slot 3	Reference 3	COM 10/V-Synch	2003240-001
Slot 4	Reference 4	PSI SCSI Controller Card	2003338-001
Slot 5	Reference 5	Image Card	2003243-001
Slot 6:	Reference 6	Video Card 1 (Real-Time)	2003236-001
Slot 7	Reference 7	Video Card 2	2003236-001
Slot 8	Reference 8	Acquisition COMMS	2002886-001

Thermal Writer (415241-001)
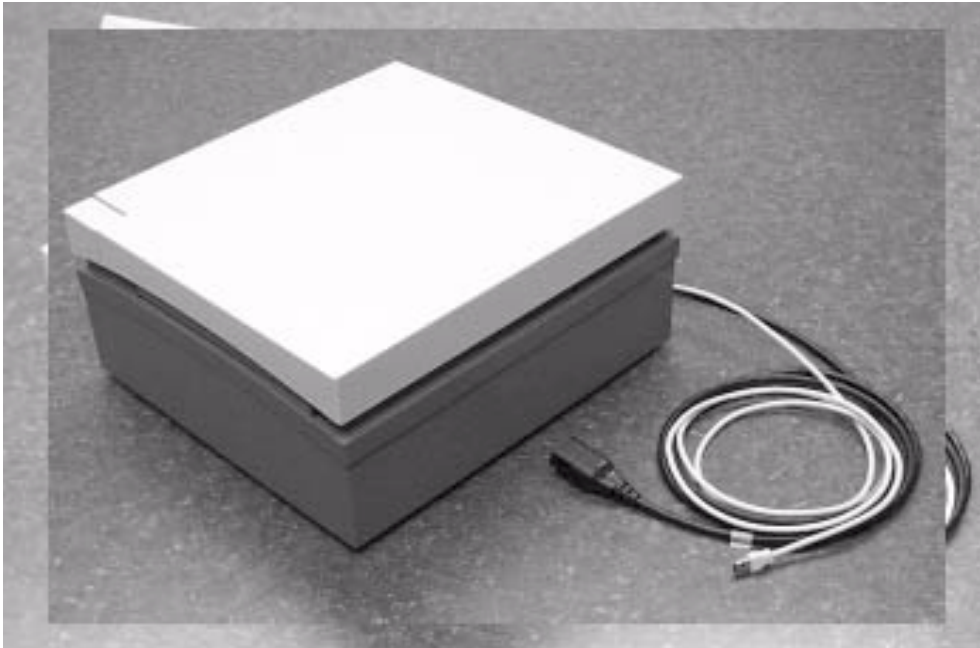
PK8

PK9

Remote Acquisition Unit (RAU) with TRAM (415540-001)

A

B
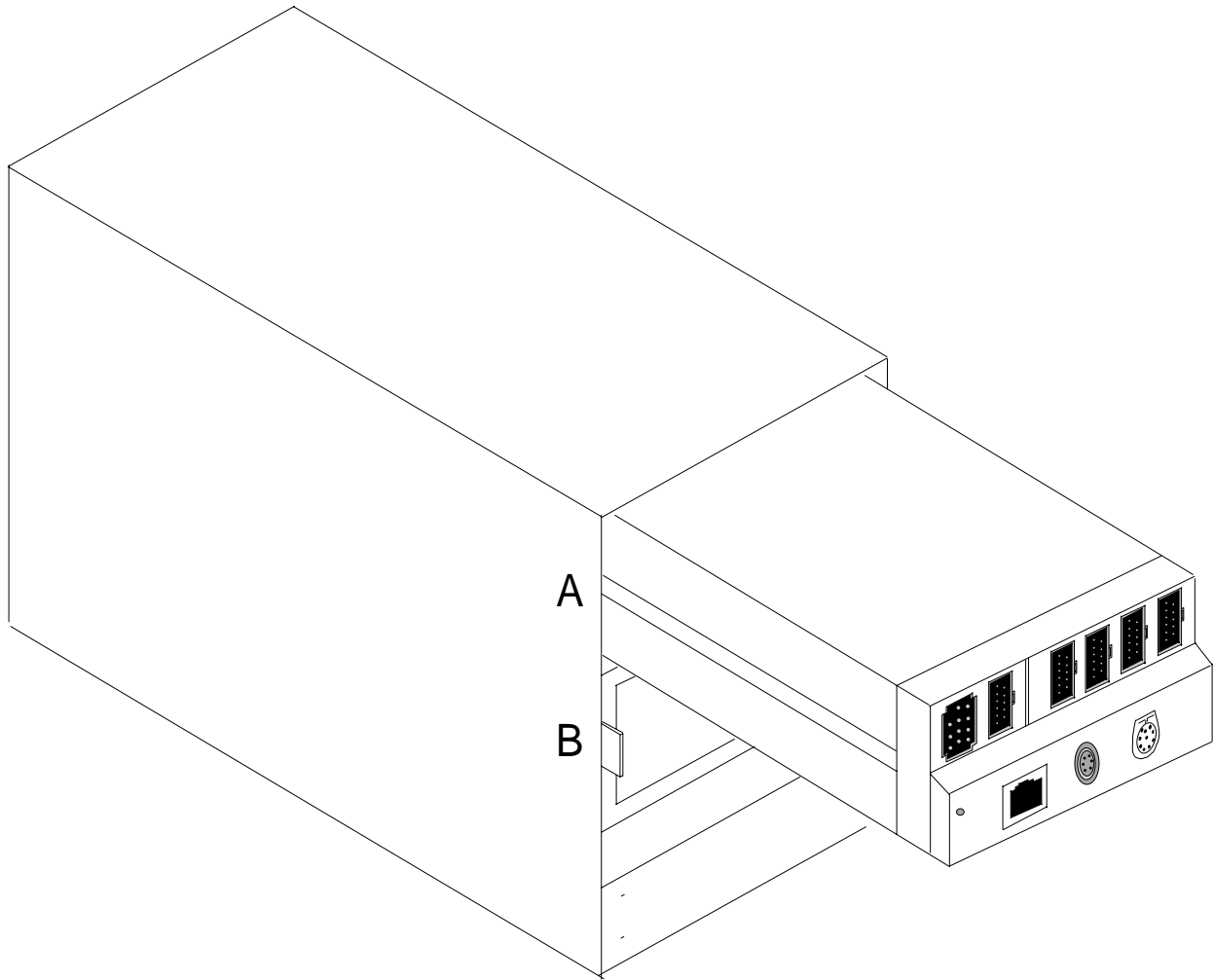
PK10

RAU Rear Panel (415540-001)

ANALOG
OUTPUT

RS-422
PORT

EXTERNAL
POWER
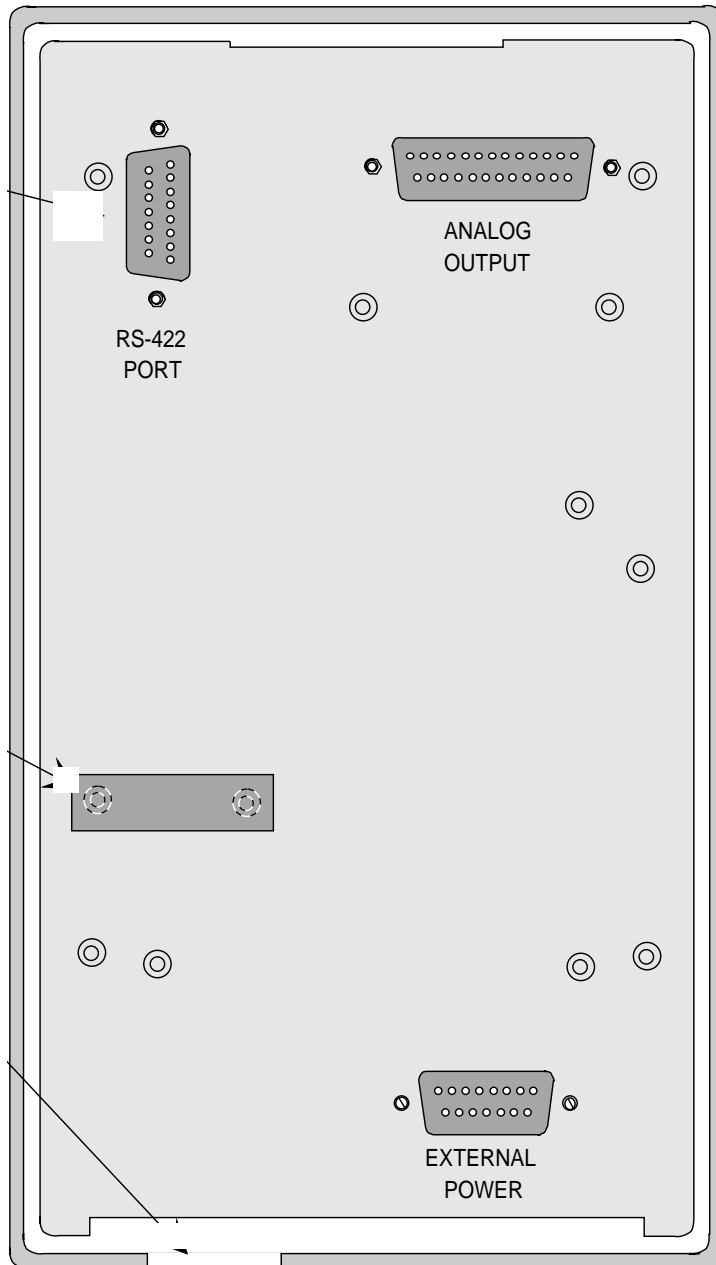
PK11
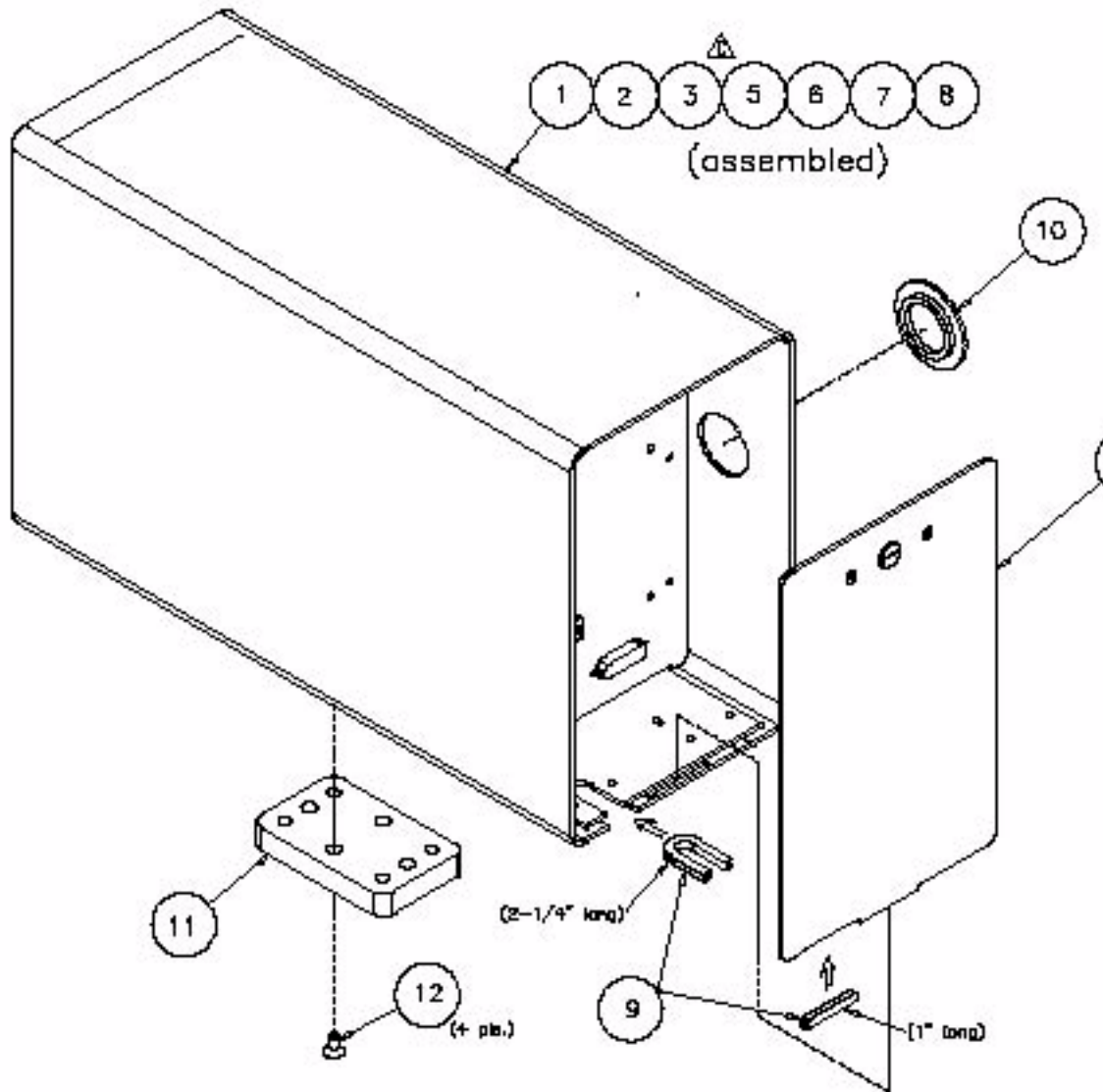
RAU (415540-001)

RAU (415540-001)
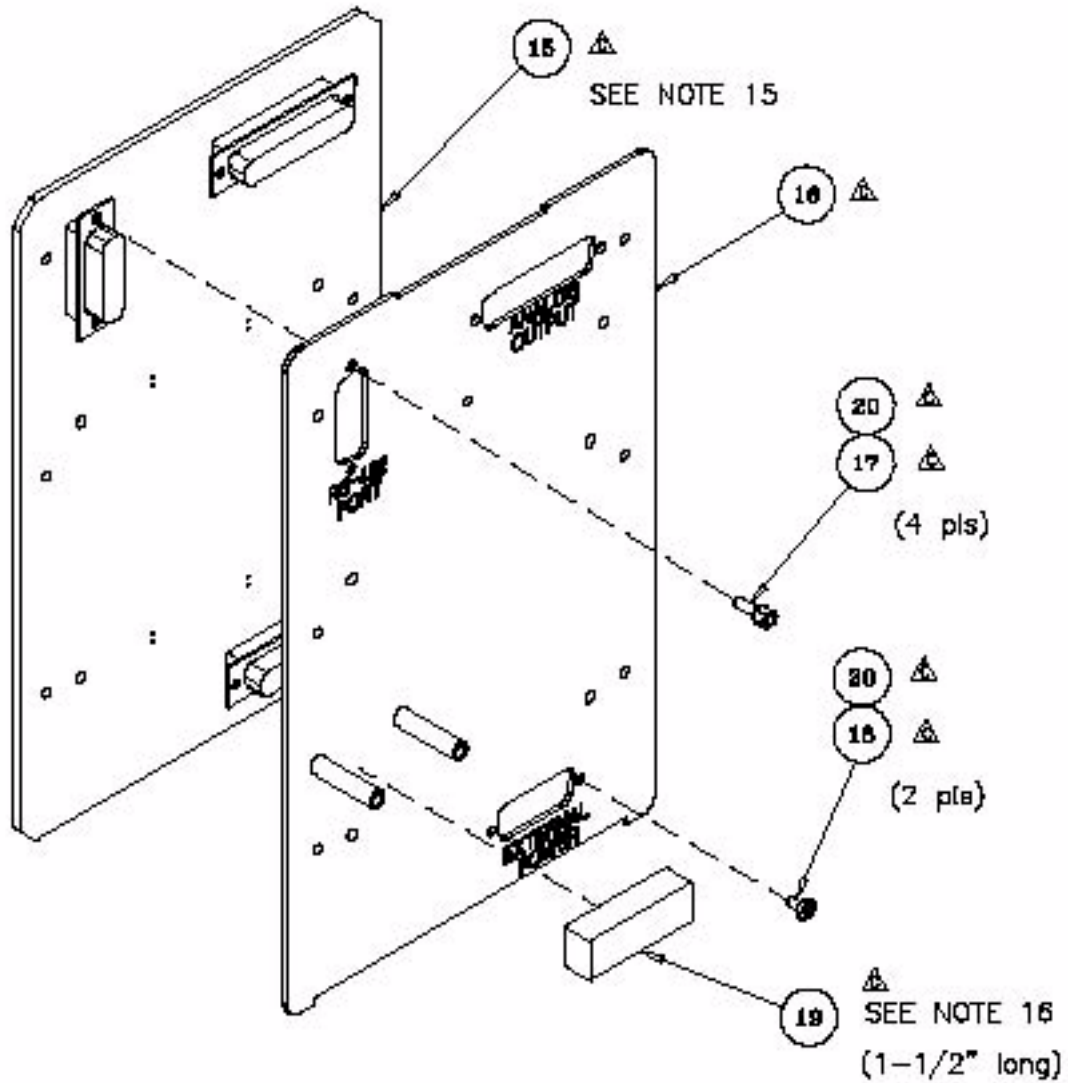
PK13

Connections for the NT CardioLab/Mac-Lab Computer

This diagram shows the connections between the following components: the NT CardioLab/Mac-Lab computer, the COMMS Interface box, the Analog Output Breakout box, and the External VIDMUX box
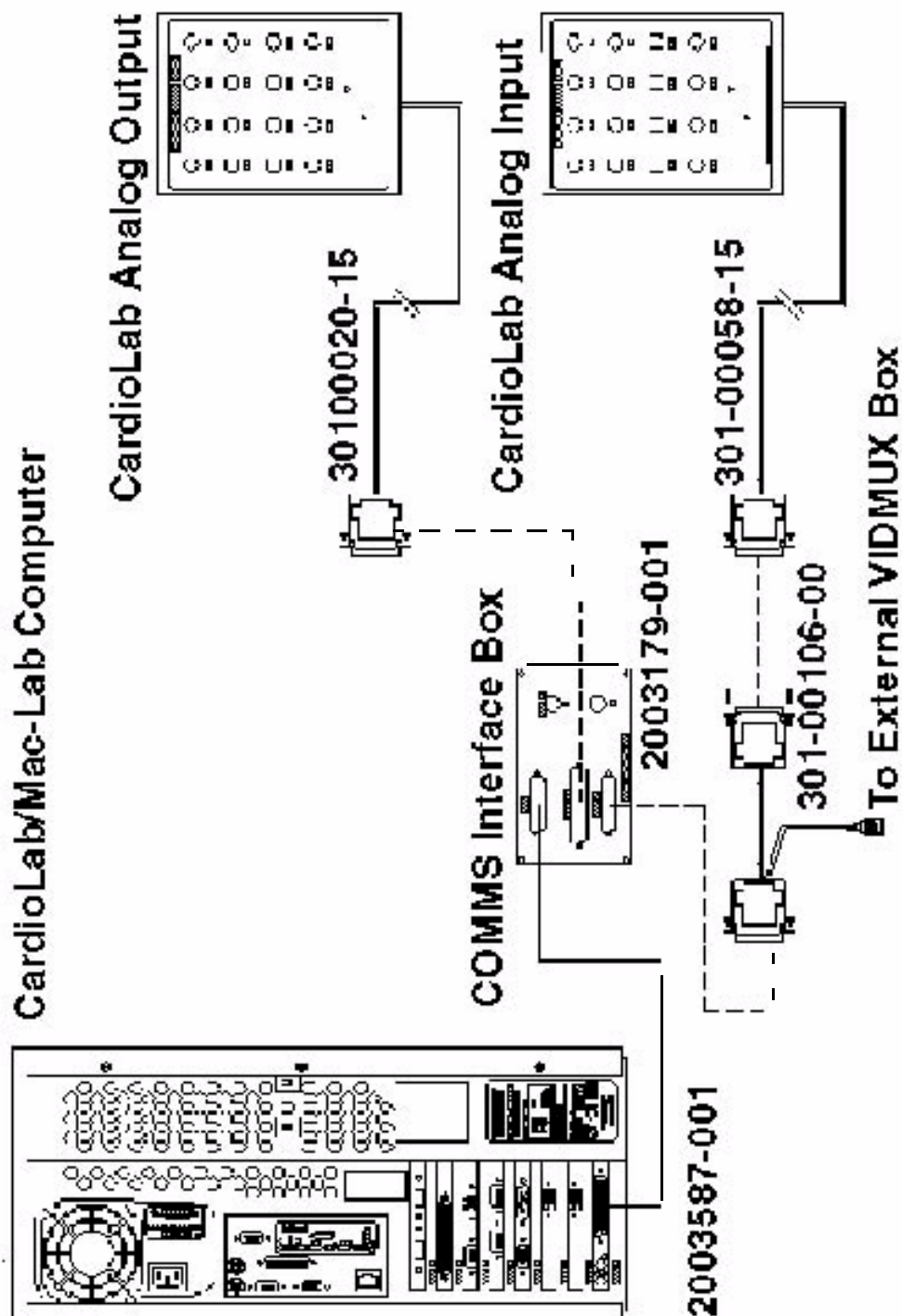
PK14

This diagram shows the connections between the following components: the NT CardioLab/Mac-Lab computer, the COMMS Interface box, and the back panel of the DOS Cardiolab workstation
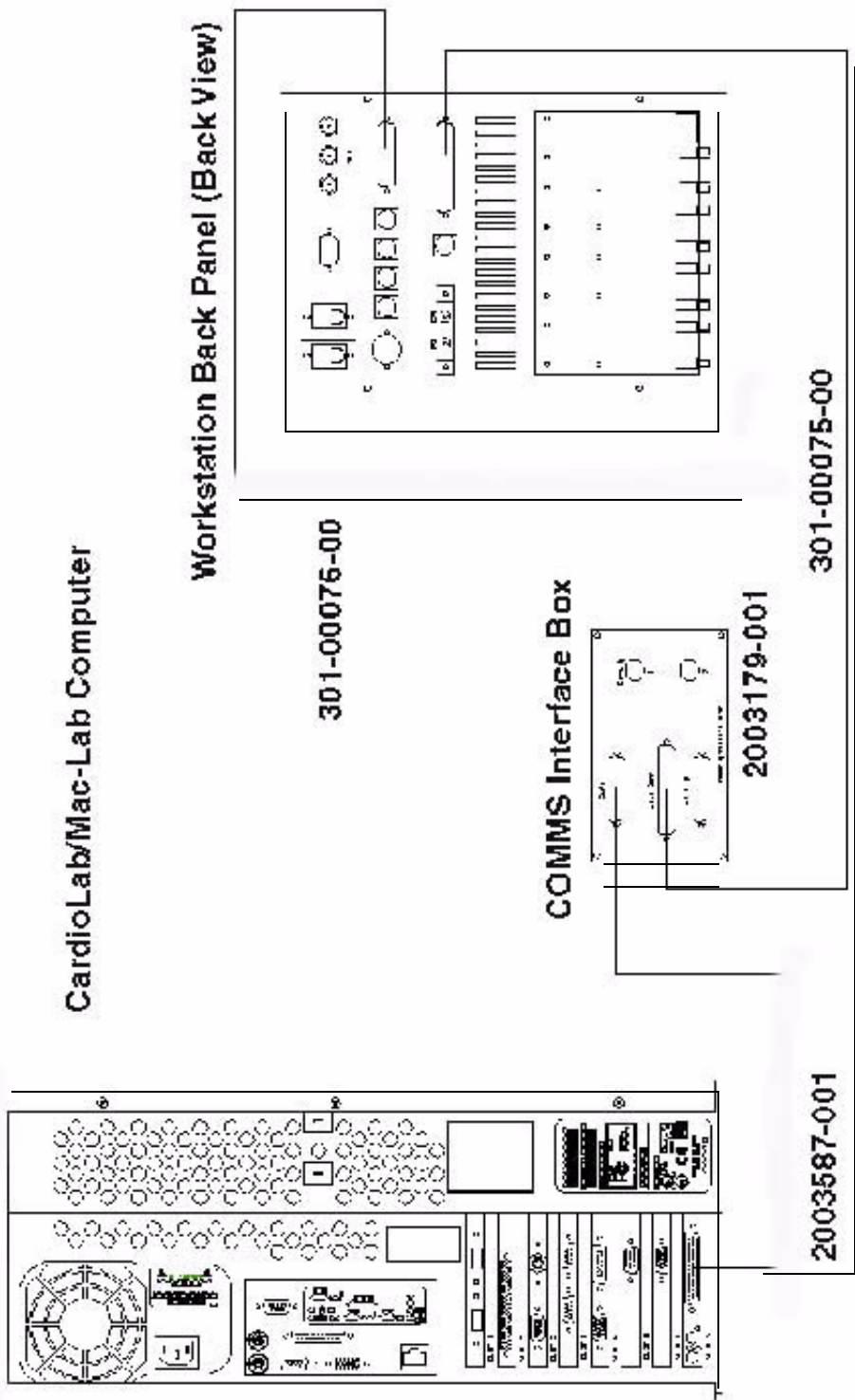
PK15

CardioLink Server Airflow Requirements

Compaq rack-mountable servers draw cool air in through the front door and exhaust warm air out the rear door of the server. Therefore, the front door of the rack must be adequately ventilated to allow ambient room air to enter the cabinet and the rear door must be adequately ventilated to allow the warm air to escape from the cabinet. Do not block the ventilation apertures. Leave at least 2 to 3 feet in front and behind the server for ventilation.

NOTE:

If all of the vertical space in the rack is not filled by components, the gaps that are left cause a change in airflow through the rack and across the components. These gaps should be covered with blanking panels.

Rack-Mount Server Front View
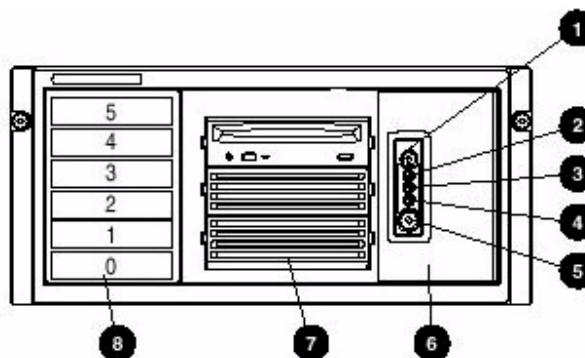
Item	Name
1	UID switch and LED
2	Internal system health LED
3	External system health LED
4	Network LED
5	Power button/LED assembly
6	Diskette Drive (behind media door)
7	Removable media area
8	Hot-plug SCSI hard drive bays (SCSI IDs o through 5)

Rack-Mount Server Back View
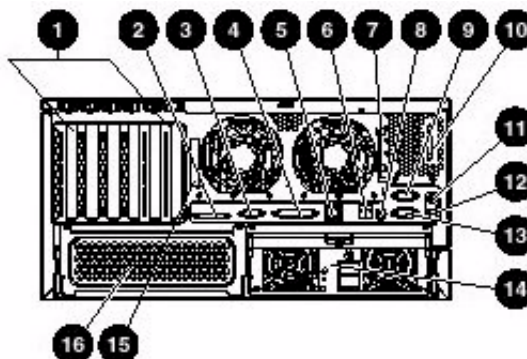
Item	Name
1	PCI expansion slots
2	VHDCI SCSI connector
3	Video connector
4	Parallel connector
5	RJ-45 connector
6	USB connectors
7	Torx T-15 too
8	UID switch and LED
9	Serial connector B
10	Auxillary VDHCI SCSI blank
11	Mouse connector
12	Keyboard connector
13	Serial connector A
14	Primary hot-plug power supply
15	Serial number
16	Secondary hot-plug power supply bay

Rack-Mount Server UPS

The rack-mount server uses an R3000 XR universal power supply.

I

Item	Name
1	Battery compartment
2	Control Buttons
3	LED display

Rack Mount Server UPS Rear View

Item	Name
1	REPO port
2	ERM connector
3	Communications port/open slot
4	Load segment 1
5	Load segment 2
6	Load segment 3
7	Load segment circuit protectors
8	Compaq PDU output (L5-30) receptable (Load segment 1)
9	Cord retention clip attachment locations
10	Ground bonding screw
11	Power cord with L5-30 plug

Tram-net Communication

Tram-net communication permits connection to the Tram-rac housing and other bedside peripherals. The Tram-net communication is one form of local area network that provides a data and power link from the monitor to peripheral devices. The connector makes a communication processor available for the peripheral devices. The Tram-net controller processor is built into the communication PCB assembly which frees up the main processor in the monitor.

To avoid confusion, consider Tram-net communication as a small area network (SAN) contained in one room or at the patient bedside. For more details about communication networks, refer to the appropriate monitor service manual.

Tram-rac 4A Housing

Shown below is a Tram-rac 4A housing with a Tram module and one BP and one BP/Dual Temperature module inserted.
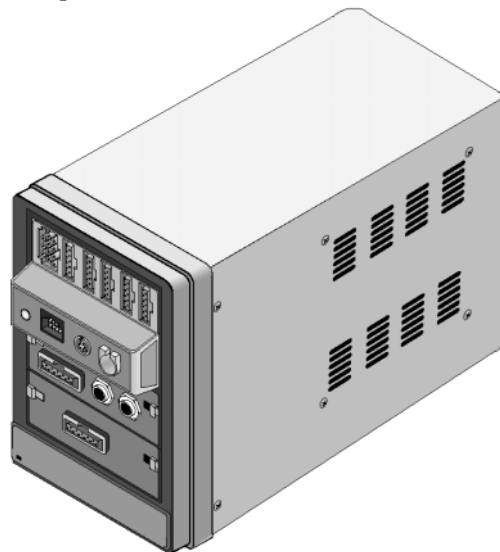
The Tram-rac 4A housing has three communication connectors:
- The 15-pin yellow color-coded connector is used for analog output,
- The two 9-pin blue color-coded connectors are for:
  - Tram-net communication with a patient monitor,
  - Tram-net hub,
  - remote control, or
  - an additional Tram-rac housing.

The number of peripheral devices is dependent upon the software version of the host monitor. When you use an optional power supply, there is an additional hidden connector on the back panel for the power supply connection.

Below are examples of the rear label of the Tram-rac 4A housing with and without a power supply. Further explanation about connection and labeling of the male and female Tram-net connectors is found on the following pages.
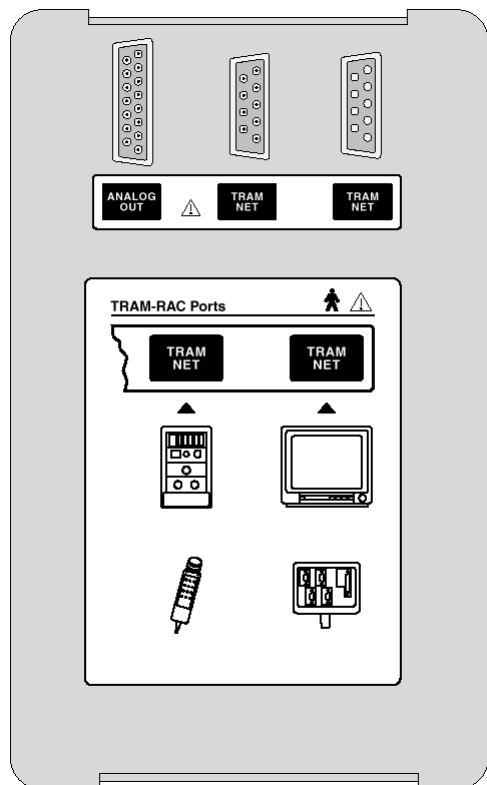
Tram-rac without Power Supply
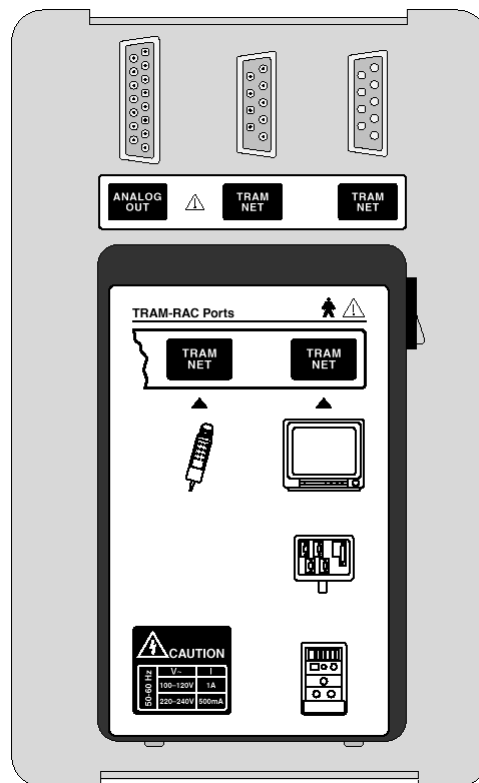
Tram-rac with Power Supply

Analog Output Connection

The analog out connector is provided for customized uses for other peripheral devices. The yellow color-coded 15-pin connector provides an analog output waveform signal.
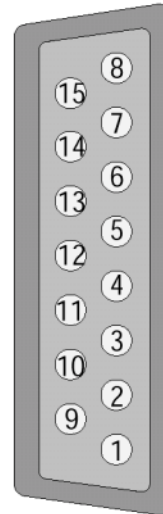
Note the parameter numbers indicated on the front of the Tram-rac 4A housing.
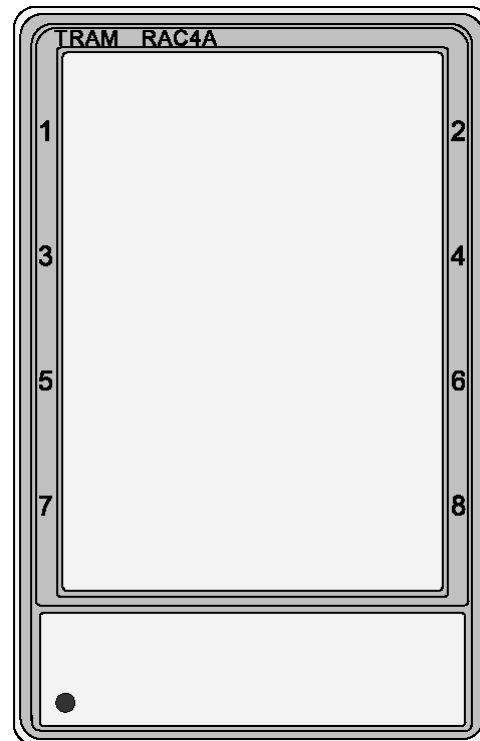
When a Tram or discrete parameter module is inserted into the housing, the slot number of the parameter and its analog output waveform is available at a designated pin of the analog out connector. Refer to the list below

NOTE

The Tram module must be in the top slot in order to receive the Tram signals listed below.

Table 1. Analog Output Signals		
Analog Output Pin	**Signal Name**	**Bezel Number For BP**
Pin 1	Signal Ground for Tram Waveforms	–
Pin 2	Trace 1	Tram[1]
Pin 3	Tram BP3 or SPO$_2$ Value	Tram[1]
Pin 4	Slot 1 Discrete Module Waveform A	1
Pin 5	Tram ART 1 or BP1	Tram
Pin 6	Slot 3 Discrete Module Waveform A	6
Pin 7	Slot 4 Discrete Module Waveform A	8
Pin 8	Signal Ground for Discrete Module Waveforms	
Pin 9	Tram ECG II	Tram[1]
Pin 10	Tram ECG V	Tram[1]
Pin 11	Tram BP4 or RESP	Tram[1]
Pin 12	Slot 1 Discrete Module Waveform B	2
Pin 13	Tram BP2 or SPO$_2$ Waveform	Tram
Pin 14	Slot 3 Discrete Module Waveform B	5
Pin 15	Slot 4 Discrete Module Waveform B	7

NOTE

The superscript number 1 indicates that this signal remains unchanged after entering the Tram-rac 4A housing and is controlled by Tram module software. All other signals are generated by the DAC (digital-to-analog converter) on the Tram-rac 4 interface PCB assembly.

Ordering Parts

Introduction

The parts lists and assembly drawings in this chapter supply enough detail for you to order parts for the assemblies that are considered field serviceable. If you require additional information, schematic diagrams, or troubleshooting assistance, contact technical support.

Orders for new installations should be made using the system Site Survey and Price List.

To order parts, contact Service Parts at the address or telephone number on the "How to Reach Us" insert provided at the beginning of this manual.

Computer

Item	Description	2006834-/2011646-								
		001	002	003	004	005	006	007	008	009
	SW MLAB/CLAB BCM SYSTEM 900MHz	1	1	1	1	1	1			
	SW MLAB/CLAB BCM SYSTEM 1 GHz							1	1	1
403590-199	MICROSOFT MOUSE	1	1	1	1	1	1	1	1	1
421572-028	CABLE ETHERNET	1	1	1	1	1	1	1	1	1
422310-001	MOUSEPAD GE	1	1	1	1	1	1	1	1	1
2003587-001	CABLE MUTICONDUCTOR DB44 M-M 2.5FT	1	1	1	1	1		1	1	1
2003677-001	CABLE ASSY HD DB15F TO HD DB15M AND PS2	1	1	1	1	1		1	1	1
9956-001	BAG ANTI-STATIS 12SQ 4MIL	1	1	1	1	1		1	1	1
2003856-026	DISK MLAB/CLAB DATA EXTRACTION V1A		1	1	1	1			1	1
2003856-028	DISK MLAB/CLAB X DATA EXTRACTION V1A		1	1	1	1			1	1
2003856-030	DISK MLAB/CLAB HOLTER WINDOW V1A		1	1	1	1			1	1
2003856-032	DISK MLAB/CLAB X HOLTER WINDOW V1A		1	1	1	1			1	1
2003888-001	DISK OPTICL FAT 16FMT DRV4 MLAB 2.6GB V1A		1	1	1	1			1	1
2003339-001	KIT, IMAGE CABLE ACCESSORIES			1	1					1
2003887-001	DISK OPTICL FAT 16FMT DRV3 MLAB 230MB V1A	1						1		
2003236-001	CARD, VIDEO, MATROX, 6200 PCI, 8MB RAM	1	1	1	1	1	1	1	1	1
2003971-001	LABEL PRUCKA CPU IDENTITY	1	1	1	1	1	1	1	1	1
2006785-002	CMPTR BCM CLAB/MLAB	1	1	1	1	1	1			
2006785-XX?	CMPTR BCM CLAB/MLAB 1.0g							1	1	1
404525-001	LABEL BLANK 2 X 3/4	1	1	1	1	1	1	1	1	1
404525-008	LABEL BLANK 1.2IN X 6IN.	1	1	1	1	1	1	1	1	1

408230-008	LABEL CE MARK	1	1	1	1	1	1	1	1	1
2002886-003	PCB COMM	1	1	1	1	1		1	1	1
2003238-001	CABLE ASSY, 27PIN RIBBON W/ 2X20 TO DB37	1	1	1	1	1		1	1	1
2003240-001	CABLE ASSY, 9PIN RIBBON W/2X5 TO DB9M	1	1	1	1	1		1	1	1
2003340-001	DISK DRIVE OPT 5 1/4 SONY SMO-F551SD	1	1	1	1	1		1	1	1
2006827-001	LABEL CL/ML BCM COMPUTER W/ RS-422 CARD		1	1	1	1			1	1
2011482-001	LABEL CL/ML BCM COMPUTER W/ TRAMNET CARD							1	1	1
2003245-001	CARD PCI, RS422 - ICS MODEL UC232PCI/2-55	1	1	1						
2003243-001	CARD MATROX PULSAR IMAGE CARD, PCI BOARD			1	1					
2003338-001	CARD PSI SCSI CONTROLLER PCI2000A				1	1				
2006826-001	LABEL CL/ML BCM COMPUTER W/ PSI CARD				1	1				
2003371-001	DISK DRIVE MO 3.5″, 640MB INTERNAL	1						1		
2009937-001	PCB TRAMNET TO ETHERNET ADAPTER							1	1	1
2011111-001	HARD SPKR JUMPER							1	1	1
4535-001	TIE WRAP 4IN							1	1	1
2011129-001	CABLE ETHERNET PATCH - 1FT							1	1	1

Workstations

Monitor Cart-32 inch

(32w x 32.5h x 30d - w/casters; 32w x 32.5h x 30d - w/feet installed by service/installation person)

Item	Item Number	Description	QTY
1	2002459-004	CART ACCESSORY	1

Workstation-32 inch

(32w x 32.5h x 30d - w/casters; w/feet installed by service/installation person) 250 pounds

Item	Item Number	Description	QTY
1	2002459-001	SMALL ASSEMBLY WORKSTATION	1

Workstation-40 inch

(40w x 32.5h x 30d - w/casters; w/feet installed by service/installation person) 265 pounds

Item	Item Number	Description	QTY
1	2002459-002	MEDIUM WORKSTATION	1

Workstation-60 inch

(60w x 32.5h x 30d - w/casters; w/feet installed by service/installation person) 340 pounds

Item	Item Number	Description	QTY
1	2002459-003	LARGE WORKSTATION	1

Printers

Printer - High End

Item	Item Number	Description	QTY
1	2002245-002	PRINTER	1

Printer - Low End

Item	Item Number	Description	QTY
1	2002245-001	PRINTER	1

Printer Cable - 12 ft.

Item	Item Number	Description	QTY
1	6119-101	PARALLEL CABLE	1

Printer Paper

Item	Item Number	Description	QTY
1	2003403-001	PAPER WHITE, REAM	1

Printer Paper/ 81/2 by 11

Item	Item Number	Description	QTY
1	9242-101	PAPER BOND	1

Image Printer/Digital

Item	Item Number	Description	QTY
1	2004142-001	IMAGE PRINTER	1

Image Printer/Switch Box

Item	Item Number	Description	QTY
1	2004192-001	PARALLEL SWITCHBOX	1

Image Printer/A6 Paper

Item	Item Number	Description	QTY
1	2004194-001	A6 SIZE TONER/PAPER PRINT PACK FOR UPD-2500/2	1

Image Printer Cable

Item	Item Number	Description	QTY
1	2004193-001	PARALLEL SWITCHBOX TO CPU CABLE	1

Monitors

Monitor

Item	Item Number	Description	QTY
1	2004130-001	MONITOR, 18"	1

System Monitors/17 in.

Item	Item Number	Description	QTY
1	408057-009	MONITOR 17"	1

System Monitors/21 in.

Item	Item Number	Description	QTY
1	2001732-001	21" COLOR MONITOR	1

Video Cable

Item	Item Number	Description	QTY
1	2003442-001	CABLE VIDEO, DB15MHD-DB15MHD, 100FT	1
2	2003442-002	CABLE VIDEO, DB15MHD-DB15MHD, 75FT	1

Hardware Options

Analog Out Standard Kit

Item	Item Number	Description	QTY
1	2007557-002	ASSY 16CHANNEL ANALOG OUT W/BREAKOUT BOX	1

RF Option/5 ft. Cable

Item	Item Number	Description	QTY
1	2003406-001	CABLE	1

RF Option/25 ft. Cable

Item	Item Number	Description	QTY
1	2003407-001	CABLE	1

RF Option/50 ft. Cable

Item	Item Number	Description	QTY
1	2003408-001	CABLE	1

CardioImage/Image Cable

Item	Item Number	Description	QTY
1	2003250-001	CABLE, 50FT COAX BNC-BNC	1
2	2003412-001	CONNECTOR, BNC-BNC	1
3	2003250-001	CABLE, IMAGE ACQUISITION (TO COMPUTER)	1

Accessories/Mouse

Item	Item Number	Description	QTY
1	403590-199	MOUSE	1

Accessories/Mouse Pad

Item	Item Number	Description	QTY
1	422310-001	MOUSEPAD GE	1

Accessories/Barcode Scanner

Item	Item Number	Description	QTY
1	2003417-001	EQPMT, BARCODE SCANNER	1

Video Card 2003236-001

Item	Item Number	Description	QTY
1	2003236-001	CARD, VIDEO	1

Image Card 2003243-001

Item	Item Number	Description	QTY
1	2003243-001	IMAGE CARD, PCI BOARD	1

Drive 2003340-001

Item	Item Number	Description	QTY
1	2003340-001	DISK DRIVE OPT 5 1/4	1

Drive 2003341-001

Item	Item Number	Description	QTY
1	2003341-001	DISK DRIVE OPT 3.5"	1

RS422 Card 2003245-001

Item	Item Number	Description	QTY
1	2003245-001	CARD PCI,RS422	1

TRAM-net to Ethernet card 2009937-001

Item	Item Number	Description	QTY
1	2009937-001	TRAM-net to Ethernet card	1

External Speakers 2001323-001

Item	Item Number	Description	QTY
1	2001323-001	External speakers	1

SCSI Controller 2003238-001

Item	Item Number	Description	QTY
1	2003238-001	CABLE ASSEMBLY	1

Server Parts G1

Item	Item Number	Description	QTY
1	2006397-001	PWR COND TNR CPQ UPS 3KVA RACK MNT 2U	1
1	2002241-001	MODEM MULTITECH ANALOG 56K GLOBAL 220V	1
1	408997-001	CBL 10BASE-T UTP 15FT	1
1	2005992-001	MEMORY DIMM SDRAM PC133 128MB ECC ML370	1
1	2005992-002	MEMORY DIMM SDRAM PC133 256MB ECC ML370	1
1	2005165-001	KIT OPTION SMART ARRAY CONTROLER MOD	1
1	2002664-005	HD HOT PLUG 36.4 GB WIDE ULTRA3 SCSI	1
1	2002664-006	HD HOT PLUG 18.6 GB WIDE SCSI	1
1	413627-005	TAPE DRIVE DAT DDS3 GRAY	1
1	413629-001	MOUNTING KIT DDS-2 DAT	1
1	421572-012	KEYBOARD W/ TRACKBALL	1
Rack			
1	2001400-003	RACK 22U, 4FT, CPQ	1
1	2006548-001	PANEL BLANKING OPAL FOR 22U RACK	1
1	2001400-001	SHELF KEYBOARD DRAWER FOR RACK, CPQ	1
1	2006549-001	SHELF MONITOR/UTILITY FOR 22 U RACK	1

Item	Item Number	Description	QTY
Network Switch			
1	**2001084-001**	**NTWK SWITCH 800 10/100 TX**	1
Isolation Transformer			
1	2005051-001	XFMR ISOLATION 100-240V 50/60HZ	1
Client Computer Parts			
1	2003236-001	CARD, VIDEO, MATROX, G200 PCI, 8MB RAM	1
1	403590-199	MICROSOFT MOUSE	1
Monitors			
1	2001131-002	MONITOR 15" CPD-E100	1
1	900103-001	MACLAB 17" MONITOR	1

Compaq ML370 G2 File Server

Description	Compaq Spare Part #	Service Part #	Additional Notes
System Board	230998-001	C230998-001-1	
Redundant Power Supply, 500W	230993-001	C230993-001-1	2008887-003 (Milw #)
Redundant Fan Kit	231213-001	C231213-001	2008887-004 (Milw #)
3.3 V Lithium Battery	179322-001	C179322-001	
Processor w/heatsink PIII 1.26Ghz	230991-001	C230991-001-1	2004348-008 (Milw #) 2 in rack server
Processor Power Module	228506-001	C228506-001	
Smart Array 5i Controller	233609-001	C233609-001-1	2005165-002 (Milw #)
Diskette Drive 1.44MB	233409-001	C233408-001	
CD-ROM Drive IDE 40X	233408-001	C233408-001	
Tape Drive AIT 50GB		2005996-001	Connected to on-board SCSI
128Mb 133Mhz Memory	164278-001	C164278-001-1	Rack (2x128Mb Standard)
1 GB 133Mhz Memory	163902-001	C163902-001-1	Added to Rack (2x1Gb - 2Gb)
PC133 1Gb Ecc mem		2005992-008	2 added to Rack/ 1 added to Tower
DigiBoard		412946-006	Standard on Rack and Tower
DigiBoard cable		4141961-003	Cable 8 port
Compaq 5304 Array Controller	129803-B21	2005994-001	Rack - used for drive array
Adaptec 2944 SCSI Controller		2002752-001	Rack - used for tape library (always present)
MultiTech ZBA Modem		2002242-001	
Modem Cable		421572-029	
Hard Drive - 36Gb Wide SCSI		2002664-005	
Pwr Condtnr CPQ UPS 3KVA Rack Mnt 2U	192186-001	2006397-001	Used in Rack
Ethernet NC3123 10/100		414582-003	Quantity 2 (Redundant)
Trackball Keyboard		2007827-001	Used on Rack
Mouse, scroll 2 button, carbon		420403-002	Used on Tower

Appendix A – Technical Specifications

For your notes

Specifications

Special Instructions for Using Equipment

The remote monitor is powered through a separate isolation transformer, which is independently connected to a wall outlet to maintain leakage currents at medical grade levels. The laser printer is powered through the IEB/Workstation power supply.

Table 1. Electrical Specifications	
Item	**Description**
Equipment Class	Class I
Degree of Protection Against Ingress of Water	Ordinary
Mode of Operation	Continuous
Power	
Frequency	50/60 Hz
Maximum Current Draw	9.6/4.8 Amps at 115 Volts; 4.8 Amps at 230 Volts (945 Kcal/hr)
Chassis Leakage Current	< 100 µA
Maximum Cumulative Load for AC Distribution Subsystem	1100VA
Fuse	
Thermal Writer	3.15A, fast blow 5 x 20 mm
Specified ECG signal amplitude accuracy	+/-5%
Specified ECG time base accuracy	+/-5%

Table 2. Equipment Type	
Item	**Description**
CardioLab/Mac/Lab System Console	Type B
CardioLab II Plus Amplifier	Class I, Type CF
Display Monitors	Type B
Tram Module Surface ECG	Defibrillator-proof Type CF
Tram Module Internal ECG	Defibrillator-proof Type CF
Tram Module Noninvasive Blood Pressure	Defibrillator-proof Type CF
Tram Module Invasive Blood Pressure	Defibrillator-proof Type CF

Tram Module Temperature/Cardiac Output	Defibrillator-proof Type CF
Tram Module Oxygen Saturation	Type B or defibrillator-proof Type BF

Table 3. Thermal Writer	
Technology	Instant load thermal array printer. User selectable: A4 and STD (8.5x11) paper
Paper Type	Thermal, perforated, fan fold, 300 sheets per pack
Paper Size	A size 215 mm (8.5 in) x 280 mm(11 in) A4 size 210 mm (8.27 in) x 297.5 mm (11.7 in)
Resolution	200 dpi (vertical) x 1000 lines/sec; (horizontal) dedicated local printing 200 x 200 dpi generic printing
Channels	3, 6, or 12 channels
Frequency Response (-3 dB point)	HPF: 0.01 (or 0.05 Hz.) LPF: 150, 100, 40, or 20 Hz. User Selectable
Line Filter	50.0 or 60.0 Hz Notch filter. User Selectable.
Baseline Roll Filter	Cubic Spline
Noise/Artifact filter	Finite Residual Filter (FRF)
Sensitivity	2.5, 5, 10, or 20 mm/mV (+/- 5%). User selectable.
Speeds	5, 12.5, 25, and 50 mm/sec (+/- 2%). User selectable.

Table 4. Display Monitors (Real-Time, Review, Local or Remote)	
Item	**Description**
Quantity	Real-Time - up to 2 Review - up to 2 Image - up to 2 Switched Video - 1
Size	17-inch 18-inch 21 inch
Type	Up to 1600 x 1280 (CRT monitors) Up to 1280 x 1024 (led monitors)
Sweep speed	5 - 400 mm/s (Real-Time monitor) 5 - 1600 mm/s (Review monitor)
Sweep Speed Accuracy	10%
Frequency Response	0 to 40 Hz

Table 5. Safety	
Item	**Description**
Handling of Disposable Supplies and Other Consumables	Use only parts and accessories manufactured or recommended by GE. Follow manufacturer's instructions for use for disposable/ consumable product. Follow local environmental guidelines concerning the disposal of hazardous materials.
Maintenance Frequency	Recommended user daily visual inspection and cleaning as necessary. Recommended monthly and annual maintenance by qualified technical personnel. See maintenance section of this manual for details.
Repair Guidelines	Calibration instructions, equipment descriptions, and all other service information to repair those parts of the equipment designated as field repairable by qualified technical personnel is available in the MAC-LAB system for Cardiac Catheterization Service manual. Upon request, GE will provide circuit diagrams and component parts lists for printed circuit boards deemed repairable by qualified technical personnel.

Environmental

Table 6. Transport and Storage Conditions	
Item	**Description**
Temperature	-40^0 C to +60^0 C
Relative Humidity	10% to 100% non-condensing
Pressure	500 hPA (mbar) to 1060 hPA (mbar)

Table 7. Operating Conditions	
Item	**Description**
Temperature	+15^0 C to +30^0 C
Relative Humidity	95% non-condensing
Pressure	700 hPA to 1060 hPA

Classifications/Standards

■ Classified by Underwriters Laboratories, Inc., with respect to electric shock, fire and mechanical hazards only in accordance with UL 2601-1

■ Meets or exceeds CAN/CSA C22.2 No 601-1-M90

■ Meets or exceeds IEC 601-1

■ Meets or exceeds Japanese Safety and Performance Standards

■ European Union Medical Device Directive (CE Mark)

NOTE: For detailed information about the TRAM modules, see the TRAM 100-850 A and SL Service Manual (p/n 404422-065).

NOTE: hPa is a measure of atmospheric pressure. One hPa (hectopascal) is equivalent to one millibar. At sea level the standard atmospheric pressure is 1013.25 hPa or millibars, and is equal to 29.92 inches or 760 mmHg (millimeters of Mercury).

Table 8. Equipment Type				
Equipment Type	**Height/Length**	**Width**	**Depth**	**Weight**
TRAM (all models)	3.2 inches 8.1 cm	4.5 inches 11.4 cm	11.6 inches 29.5 cm Need 5″ (12.7 cm) front clearance for cables	4.7 lbs 2.1 kg
CardioLab II Plus Amplifier 32/64 channel 96/128 channel	9.5 inches 14.0 inches	14.0 inches 14.0 inches	14.0 inches 14.0 inches	22 lbs 25 lbs
CPU	18.9/47.3 in/cm	8.3/20.8 lbs/kg	18/45 in/cm	43/20 in/cm
IEB	24.5/61.3 in/cm	11/27.5 lbs/kg	21/53 in/cm	75/34 in/cm

Table 9. Remote Acquisition Unit (RAU)	
Item	**Description**
RAU Cabinet	Accommodates one or two TRAM modules With Table Mount or Floor Mount

Table 10. Processing	
Item	**Description**
ECG	12-lead with ST analysis (Mac-Lab only)
Respiration	Impedance method (1 — 200 breaths per minute range)
Cardiac Output	Thermal Dilution, Calculated, and Estimated Fick (Mac-Lab only)
Invasive Pressure	4 channels with means (-98 to 350 mmHg range)
Non-invasive Pressure	Automatic and Manual modes (Oscillometric)
Pulse Oximetry	Saturation range 0 — 100% (accuracy 90 — 100%; ±1.5%)
IECG	8 channels, 16 inputs (6000 Hz per channel) (CardioLab only) 32 channel (Clab II Plus), 16 channels, 32 inputs (1000Hz per channel) 64 channel (Clab II Plus), 48 channels, 96 inputs (1000Hz per channel)

Table 11. Analog Output Cable for TRAMs (Defib Sync Cable)				
The Analog Output cable interfaces to the 6-pin LEMO connector on the front panel of the 200, 500, and 600 TRAM modules. The cable is 15' long and is terminated for the TRAM connection only.				
Pin No.	**Wire Color**	**Signal Name**	**INput OUTput**	**Volts/Units**
1	White	Software Selectable	OUT	1V/mV
2	Black	Signal Ground		
3	Red	Digital Sync Pulse (Factory Set)	OUT	
4	Green	Return Marker Pulse In	IN	
5	Yellow	Analog Ground		

Table 12. Analog Input Cable for TRAMs (External Analog Signal)				
The Analog Input cable is designed to interface an external analog signal to one of the BP inputs on the TRAM module. This enables the MAC-LAB system to display that signal on the BP channel to which it is connected. The cable is 15' long and is terminated for the TAM connection only.				
Pin No.	**Wire Color**	**Signal Name**	**INput OUTput**	**Volts/Units**
1	Red	Analog Signal	IN	1 V/100 mmHg
2	Black	Signal Ground		

Table 13. Analog Output Connector J4 (RAU)	
Pin No.	**Sign Al**
1	MOD B BP 4
2	MOD B BP 2
3	GND
4	GND
5	GND
6	GND
7	GND
8	GND
9	GND
10	MOD B ART BP
11	MOD B RESP/ECGV

Table 14. Analog Output Connector J4 (RAU)	
Pin No.	**Sign AI**
12	MOD B TRC2/ECG1
13	MOD B TRC1/ECG2
14	MOD B SYNC ECG
15	MOD A BP 4
16	MOD A BP 3
17	MOD A BP 2
18	MOD A ART BP
19	MOD A RESP/ECGV
20	MOD A TRC2/ECG1
21	MOD A TRC1/ECG2
22	MOD A SYNC ECG
23	B SYNCECGRTN
24	A SYNCECGRTN
25	MOD B BP 3

Table 15. CardioLink Archive Waveform Server			
Hardware Option	Low-End 2006433-003	Mid-End 2006433-002	High-End 2006433-001
Processor	933 MHz	933 MHz	933 MHz
Memory	256 MB	512 MB	512 MB
Added Controller	N/A	Integrated Smart Array	Integrated Smart Array
RAID	N/A	RAID 5	RAID 5
Storage Capacity	One 18.2 GB Hot Pluggable Ultra 3 SCSI	Three 36.4 GB Hot Pluggable Ultra 3 SCSI	Six 36.4 GB Hot Pluggable Ultra 3 SCSI
Tape Drive	12/24GB DDS-s DAT Drive	12/24GB DDS-s DAT Drive	12/24GB DDS-s DAT Drive
CD-ROM	High Speed IDE CD-ROM	High Speed IDE CD-ROM	High Speed IDE CD-ROM

Table 16. SCSI Drive Locations			
SCSI ID and Bay location.	2006433-001	2006433-002	2006433-003
SCSI ID 0 (this is the bottom bay in the Drive array cage)	36.4 GIG hot swappable drive.	36.4 GIG hot swappable drive.	18.2 GIG hot swappable drive.
SCSI ID 1	36.4 GIG hot swappable drive.	36.4 GIG hot swappable drive	
SCSI ID 2	36.4 GIG hot swappable drive.	36.4 GIG hot swappable drive	
SCSI ID 3	36.4 GIG hot swappable drive		
SCSI ID 4	36.4 GIG hot swappable drive		
SCSI ID 5	36.4 GIG hot swappable drive.		

CardioLink Server G1

Table 17. CardioLink Server	
CardioLink Server	
Dimensions	
Height	8.67 in. / 22.02 cm
Depth	22.75 in / 57.78 cm
Width	19.0 in / 48.26 cm
Weight	
No drives installed	50.0 lb / 22.68 kg
Input Requirements	
Rated input voltage	100 to 240 VAC
Rated input frequency	50 to 60 Hz
Rated input current	6A (110V) to 3A (220V)
Rated input power	550W
BTUs per hour	1880
Power Supply Output Power	
Rated steady-state power	325W
Maximum peak power	350 W
Temperature Range	
Operating	50°F to 95°F / 10°C to 35° C
Shipping	-22°F to 122°F / -30°C to 50°C
Relative Humidity (noncondensing)	
Operating	8% to 90%
Nonoperating	5% to 95%
Wet Bulb Temperature	
Maximum	101.7°F / 38.7°C
Connector Interfaces	
Integrated Dual Channel Wide Ultra2 SCSI Controller on Port 1 (internal and external) and Port 2 (internal only)	
Hot-plug keyboard	
Mouse	
Serial 2	
Parallel	
IDE Interface for CD-ROM drive	

Table 17. CardioLink Server (Continued)	
NC31163 Fast Ethernet NIC Embedded 10/100 WOL with RJ-45 Interface	
Video	
Operating Voltage Settings (Low-Voltage Models)	120V (User selectable for 100, 110, 120, 127 V via front panel)
Power Out (VA/Watts)	2880 / 2700
Input Connection	NEMA L5-30P
Output Connection	(1)L5-30R; (6)5-15R
UPS R3000 XR	
Unit Dimensions	3.50 x 19.0 x 24.5in / 89 x 483 x 622 mm
Shipping Dimensions	14 x 32 x 38.5 in / 356 x 813 x 978 mm
Unit Weight	82 lb / 37 kg
Shipping Weight:	105 lb / 48 kg
Electrical. Input	
Voltage Range	100, 110, 120, and 127V selectable via front panel
Frequency	50/60 Hz
Online Efficiency	96%
Surge Suppression	High Energy 6500A peak
REPO:	Remote Emergency Power-Off disables AC power to load
Electrical Output	
Online Regulation	-10% to +6% of nominal voltage
On battery Regulation	$\pm$5% of nominal voltage
Voltage Wave Form	Sine wave
Output Protection	Re-set table circuit protectors
Environmental and Safety	
Operating Temperature	50× F to 104× F / 10× C to 40× C
Transit Temperature	-13× F to 131× F / -25× C to 55× C
Storage Temperature	32× F to 77× F / 0× C to 25× C
Humidity (Operation)	20% to 80% (non-condensing)
Humidity (Non-Operating)	5% to 95%
Operating Altitude	Up to 6,562 ft / 2000 m above sea level
Transit Altitude	49,212 ft / 15,000 m above sea level
Safety Markings	FCS, UL, CSA, VDE, NEMKO, FIMKO, DEMKO, SEMKO, NOM
Safety Certifications	UL1778; CSA22.2 No.107.1, No.107.2, No.950; CB Bulletin No.86AI; EN50091-1; EN60950; EMKO-TSE207/95; NOM-019-SCFI-1993
EMC Markings	FCC; CISPR; VCCI; CE

Table 17. CardioLink Server (Continued)	
Emissions	FCC CFR 47, Part 15 Class A, EN50091-2
Immunity	IEC 801-2, IEC 801-3, IEC 801-4, IEC 801-5
Surge Suppression	Conforms to IEEE 587B and ANSI C62.41
REPO Port	Meets NEC code 645-11 intent and UL requirements
Network Switch	2001084-001
Eight 10/100 Base-Tx Autosensing Ports	
Auto-Negotiating Full and Half Duplex	
Store-and Forward Switching	
Connectors	8 RJ-45 Ports ((MDI/MDUX Selectable on Prot 8)
Dimensions	
Width	220 mm (8.7 in.
Height	54.6 mm (2.1 in.)
Depth	185.4 mm (7.3 in)
Power	16.6 VA
Standards	
Functional/EMC	ISO 8802; IEEE 802.3; EMC; EN 55022-1;FCC PART 15 CLASS B; ICES-003 CLASS B; CSA C108.8 CLASS B; VCCI CLASS B; AS/NZS 3548 CLASS B
Safety	UL 1950; 60950 CSA 22.2 #950

Rack for CardioLink Server

Table 18. Rack for CardioLink Server	
Dimensions (H x D x W)	
Total Cabinet Area	49.5 x 33.25 x 23.25 in / 1257.3 x 844.55 x 590.55 mm
Shipping	56.63 x 48 x 32 in / 1438.4 x 1219.2 x 812 mm
Weight	
Operating	176 lb / 79.89 kg
Shipping	225 lb / 102.13 kg
Color	
Opal	Beach Gray

CardioLink **Server 2**

System Specifications

The CardioLink rack-mount server is a Compaq ProLiant ML370 Generation 2 (G2) server.

ProcessorsTwo 1.26 GHz

Item	Description
Processors	Two 1.26 GHz
System Memory	2 GB
Expansion Slots	Eight I/O expansion slots
Media Bays	IDE CD-ROM drive 3 1/2″, 1.44 MB diskette drive DLT Tape Drive
Keyboard	The keyboard connector is hot-pluggable. Any standard keyboard can be plugged in without powering down the system or causing keyboard errors.
Mouse	The keyboard uses an integral trackball that is plugged into the standard mouse port on the rear of the CPU.
Video	Integrated ATI Rage XL PCI Video Controller with 8MB
High-Availability Features	Hot-Plug Redundant Power supplies Redundant fans RAID support with Smart Array Family controllers
System Management	Integrated Management Log (IML) provides a detailed log of key system events. This log is accessible through Compaq Insight Manager.
Fans	Three redundant hot-swappable fans.
Power Supply	Redundant power supply: 500-W at 110V, 700-W at 220V

Additional information, updates and the most current information on Compaq hardware is available at http://www.compaq.com.

Compaq Server Standard Features (Rack)	
Feature	**Specification**
Model Number	Compaq Proliant ML370 Generation 2 (G2)
System Memory	2 GB
Hard drive capacity	■ 100 GB Tower / 300GB Rack ■ 300 GB (11 x 36.4 RAID 5 with Hot Spare)
Processor	1.26 GHz
Cache Memory	512 KB second level ECC cache (full speed)
Video/Graphics	Integrated ATI Rage XL Video Controller with 8mb SDRAM Video memory
Network Controller	(2) Compaq NC 3123 Fast Ethernet NIC
Diskette Drive	1.44 MB
CD ROM	40x IDE
Power supply	500 Watt Redundant Dual
Interfaces	Parallel 1, Serial 2, Pointing Device (Mouse) 1, Graphics 1, Keyboard 1, External SCSI (for tape only) 1, Network RJ-45 2, USB Ports 2
Tape Drive	DLT, DDS-3
Storage Controller	Integrated Dual Channel Wide Ultra3 SCSI Adapter and Compaq Smart Array 5i Controller Option Kit.

Rack Server Specifications		
Feature	**Metric Units**	**English Units**
Dimensions		
Height	22.07 cm	8.69 in
Depth	65.41 cm	25.75 in
Width	48.26	19.0
Weight		
No drives installed	23.05 kg	50.8 lb
Power supply input		
Rated input voltage		90 to 264 VAC
Rated input frequency		47 to 63 Hz
Rated input current		7.3 A (110v) / 3.6 A (220v)
Rated input power		800W
BTU's per hour		2732
Power supply output		
Rated steady-state power		500 W
Maximum peak power		550 W for up to two minutes
Rated output voltages		+5., +3.3, +12 (VDC)
Rated auxiliary voltage		+5 VDC
Temperature range		
Operating	5 to 35 degrees C	41 to 95 degrees F
Shipping	-40 to 50 degrees C	-40 to 185 degrees F
Relative humidity (noncondensing)		
Operating	5% to 95%	5% to 95%
Non-operating	5% to 95%	5% to 95%
Maximum wet bulb temperature	38.7 degrees C	101.7 degrees F

LaserJet 4050 Printer

Table 19. HP LaserJet 4050 Printer	
GEMMS PN	2001162-005
Manufacturer/Model	Hewlett Packard / C4251A
Description	HP Laserjet 4050N Printer, 16 MB RAM PostScript Level 2, HP PCL 6, 120V Included: Toner cartridge, 500-sheet paper tray, power cord, drivers, and documentation.
Speed	17 pages per minute (ppm) 133 MHz RISC microprocessor First page out = 15 seconds "RIP ONCE" capability with 16 MB or hard disk option.
Resolution	600 dpi Level 2 emulation (PS) HP FastRes 1200 (PCL6, PS) HP ProRes 1200 at engine speed (17 ppm) (PCL6, PS)
Typefaces	100 Scalable TrueType (80 built-in, 30 via HP FontSmart) Euro symbol
Memory Options	8 MB RAM standard
Optional Memory	4, 8, 16, MB EDO DIMMs 4, 8, 16, 32, 64 MB SDRAM DIMM
Mass Storage Options	2 and 4 MB Flash DIMMs Greater than 1GB hard disk
Expansion Slots	3 100-pin DIMM slots 2 enhanced I/O (EIO) slots
Interface	Bidirectional IEEE 1284-compliant parallel RS232 9-pin serial Paper Handling Connector (PHC)
Optional Networking	10Base-T and 10Base-2 100Base-TX Token Ring LocalTalk
Paper Trays	100-sheet Tray 1 Size: 76 x 127 mm to 2 16 x 356 mm (3 x 5 inches to legal) 500-sheet Tray 2 Size: letter, legal, A4
Paper Path	Straight through from Tray 1 to Rear Output Bin or to Top Output Bin
Output Capacity	250-sheet Top Output Bin 50-sheet Rear Output Bin
Paper Handling Options	Duplexer, Envelope Feeder, Optional 500-sheet Universal Tray Assembly

Table 19. HP LaserJet 4050 Printer (Continued)	
Physical Specifications	
Height	343 mm (13.5 inches)
Width	390 mm (15.4 inches)
Depth	493 mm (19.4 inches)
Depth (trays/rear output bin open)	100.76 cm (39.67 inches) 100.76 cm (39.67 inches)
Weight (without toner cartridge)	17 kg (37.5 lb)
Electrical specifications	

Printer State
    Printing
    Standby
    PowerSave (default activation
    time, 30 minutes)
    Off
	Power Consumption (average, in watts)
	    317 watts
	    21 watts
	
	    16 watts

Minimum recommended circuit capacity	

Voltage
    100-127 Volts
    220-240 Volts
	Amps
	    8 amps
	    4 amps

Power requirements (acceptable line voltage)	100-127 Volts; (±10% 50-60 Hz, (+/-2 Hz)
Environmental specifications	

Condition
    Operating Temperature
 	
    Relative Humidity
	Specification
	    10 to 32 degrees C (50 to 91 degrees F)
	
	    20% to 80% RH

Acoustic emissions (per ISO 9296)	

Condition
 	
    Printing, 17 ppm
    Printing, 8 ppm
    PowerSave
	Specification
	
	    Lwad = 6.6 bels (A)
	    Lwad = 6.2 bels (A)
	     Lwad = 0 bels (A)

Safety certifications	
Safety	IEC 950:1991+A1+A2+A3 / EN 60950:1992+A1+A2+A3+A4+A11 IEC 825-1:1993 / EN 60825-1:1994 Class 1 (Laser/LED)

Table 19. HP LaserJet 4050 Printer (Continued)	
EMC	CISPR 22:1993+A1 / EN 55022:1994 Class B (1) EN 50082-1:1992 4 kV CD, 8 kV IEC 801-2:1991 / prEN AD 55024-2:1992 - 4 V/m IEC 801-3:1984 / prEN 0.5 kV Signal 55024-3:1991 - Lines IEC 801-4:1988 / prEN 1.0 kV Power 55024-4:1992 - Lines IEC 1000-3-2:1995 / EN61000-3-2:1995 IEC 1000-3-3:1994 / EN61000-3.3:1995 FCC Title 47 CFR, Part 15 Class B (2)) / ICES-003, Issue 2 / VCCI-2 (1)) AS / NZS 3548:1992 / CISPR 22:1993 Class B (1))
Supplementary Information:	The product herewith complies with the requirements of the following Directives and carries the CE-marking accordingly: the EMC directive 89/336/EEC the Low-Voltage Directive 73/23/EEC [1] The product was tested in a typical configuration with Hewlett-Packard Personal Computer Systems. [2] This Device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: This device may not cause harmful interference, and this device must accept any interference received, including interference that may cause undesired operation.

Compaq Server Standard Features (Rack)	
Feature	**Specification**
Model Number	Compaq Proliant ML370 Generation 2 (G2)
System Memory	2 GB
Hard drive capacity	■ 100 GB Tower / 300GB Rack ■ 300 GB (11 x 36.4 RAID 5 with Hot Spare)
Processor	1.26 GHz
Cache Memory	512 KB second level ECC cache (full speed)
Video/Graphics	Integrated ATI Rage XL Video Controller with 8mb SDRAM Video memory
Network Controller	(2) Compaq NC 3123 Fast Ethernet NIC
Diskette Drive	1.44 MB

Compaq Server Standard Features (Rack)	
Feature	**Specification**
CD ROM	40x IDE
Power supply	500 Watt Redundant Dual
Interfaces	Parallel 1, Serial 2, Pointing Device (Mouse) 1, Graphics 1, Keyboard 1, External SCSI (for tape only) 1, Network RJ-45 2, USB Ports 2
Tape Drive	DLT, DDS-3
Storage Controller	Integrated Dual Channel Wide Ultra3 SCSI Adapter and Compaq Smart Array 5i Controller Option Kit.

HP 2100

Table 20. HP LaserJet 2100 Printer	
GEMMS PN	2002245-001
Manufacturer/Model	Hewlett Packard 2100
Description	HP Laserjet 2100Printe; 5,000-page toner cartridge capacity.
Speed	10 pages per minute (ppm) 60 MHz Intel 80960JD processor First page out = 17 seconds
Resolution	1200 x 1200 dpi with PCL6/HP's PostScript; Level 2 emulation (PS); 600 dpi with PCL6/PS
Typefaces	HP PCL 6; 45 scalable typefaces built-in, additional 65 on CD-ROM for Microsoft Windows HP PostScript Level II emulaltion: 35 scalable typefaces built-in, additional 75 on CD-ROM for Windows; HP FontSmart for Windows provides font management;Euro Symbol built-in. Note: Font Smart provides a total of 145 fonts; standard is 45 device fonts, 110 extro fonts via FontSmart. With PostScript, 80 device fonts with 65 extra TrueType fonts.
Memory Options	HP LaserJet 2100; 4 MB standard; u to 52 MB with 100 Pin EDO DIMM's
Optional Memory	66 MHz processor and 4 to 8 MB memory.
Media Handling and Weights	Tray 1: up to 100 sheets paper of 20 lb.; 16 to 43 lb. Tray 2/3 up to 250-sheets paper of 20 lb.; 16-28 lb.
Media Size	Tray 1: minimum 3 x 5 in.; Tray 2/3: Paper: letter, legal, executive.
Interface	1 bi-directional parallel port (IEEE 1284 ECP-compliant, B-size); 1 fast infrared port (IrDA compliant); 1 LocalTalk port of r Macintosh and 1 Enhanced Input Output) EIO) slot; HP JetSend enabled (Ir and EIO only)
Physical Specifications	
Width and Depth	15.9 x 16.5 x 9 in.
Power	110 V. = 100/127 V; AC 50/60 Hz
Weight	25 lb (11.5kg)

Table 21. IEB Dimensions	
Dimensions: Power	100 V, 50/60 Hz; 120 V, 50/60 Hz; 240 V, 50/60 Hz
Height	24.5 in
Width	11 in
Depth	21 in

Table 22. CPU Dimensions	
Dimensions: Power	Auto Switching:100-120 4.6A, 60 Hz; 200-240 2.3A, 50 Hz
Height	19 in
Width	8.5 in
Depth	18 in

HP LaserJet 4100N Printer	
GEMMS PN	2001162-005
Manufacturer/Model	Hewlett Packard / C4253A
Description	HP Laserjet 4100N Printer; 16MB RAM, Ethernet (BNC, 10BASET). Parallel and RS-232 9PIN serial interfaces, PostScript Level 2, HP PCL 6, 120V Included: Toner cartridge, 500 sheet paper tray, power cord, drivers and documentation.
Speed	17 pages per minute (ppm) 133 MHz RISC microprocessor First page out = 15 seconds "RIP ONCE" capability with 16 MB or hard disk option
Resolution	300 dpi with PCL5e/HP's Post Script Level 2 emulation (PS) 600 dpi with PCL5e/PS HP FastRes 1200 (PCL6, PS) HP Prores 1200 at engine speed (17 ppm) (PCL6, PS)
Typefaces	100 Scalable True Type (80 built-in, 30via HP FontSmart) Euro symbol
Memory Options	8 MB RAM standard (4050/4050 T) 16 MB RAM standard (4050N/ 4050 TN)
Optional Memory	4, 8, 16 MB EDO DIMMs 4, 8, 16, 32, 64 MB SDRAM DIMM
Mass Storage Options	2 and 4 MB Flash DIMMs Greater than 1GB hard disk
Expansion Slots	3 100-pin DIMM slot 2 enhanced I/O (EIO) slots
Interface	Bidirectional IEEE 1284 compliant parallel CJ3113A - 10/100 Base-TX (bundled with 4050N/4050 TN) Hp Fast InfraRed Receiver (FIR) RS232 9-pin serial Paper Handling Connector (PHC)
Optional Networking	10Base-T and 10Base-2 10/100 Base-TX Token Ring LocalTalk
Paper Trays	100-sheet Tray 1 Size: 76 x 127 mm to 2 16 x 356 mm (3 x 5 inches to legal) 500-sheet Tray 2 Size: letter, legal, A4
Paper Path	Straight through from Tray 1 to Rear Output Bin or to Top Output Bin
Output Capacity	250-sheet Top Output Bin 50-sheet Rear Output Bin

HP LaserJet 4100N Printer (Continued)	
Paper Handling Options	Duplexer, Envelope Feeder, Optional 500-sheet Universal Tray Assembly
Physical Specifications	
Height	34.3 cm (13.3 inches) 38.5 mm (15.5 inches)
Width	39 cm (15.4 inches) 39 cm (15.4 inches)
Depth	61.64 cm (24.27 inches) 61.64 cm (24.27 inches)
Depth (trays/rear output bin open)	100.76 cm (39.67 inches) 100.76 cm (39.67 inches)
Weight	17.85 kg (39.27 obs.) 20.71 kg (45.66 lbs.)
Electrical Specifications	
Printer State Printing Standby PowerSave (default activation time, 30 minutes) Off	Power Consumption (average, in watts) 330 watts 22 watts 20 watts
Minimum Recommended Circuit Capacity	
Voltage 100-127 Volts 220-240 Volts	Amps 8 amps 4 amps
Power requirements (acceptable line voltage)	Voltage 100-127 Volts 220-240 Volts HZ 50-60 Hz 50-60 Hz
Environmental Specifications	
Condition Operating Temperature Relative Humidity	Specification 10 to 32 degrees C (50 to 90 degrees F) 20% to 80%
Acoustic Emissions (per ISO 9296)	
Condition Printing, 17ppm Printing, 8 ppm PowerSave	Specification Lwad = 6.6 bels (A) Lwad = 6.2 bels (A) Lwad = 0 bels (A)

HP LaserJet 4100N Printer (Continued)

Safety Certifications	
Safety	IEC 950:1991+A1+A2+A3 / EN 60950:1992+A1+A2+A3+A4+A11 IEC 825-1:1993 / EN 60825-1:1994 Class 1 (Laser/LED)
Supplementary Information:	The product herewith complies with the requirements of the following Directives and carries the CE marking accordingly.: The EMC directive 89/336/EEC The low voltage directive 72/23/EEC [1] The product was tested in a typical configuration with Hewlett-Packard Personal Computer Systems. [2] This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: This device may not cause harmful interference, and this device must accept any interference received, including interference that may cause undesired operation.

Multi-Modem	
Feature	**Specification**
GE Medical Systems *Information Technologies* Part Number	2002242-001
Multi Tech Systems Part Number	MT5600ZBA
Client-to-Server	K56flex speeds when accessing an ISP type
Data Rates	K56flex server (actual speed depends on server capabilities and line conditions)
Client-to-Client	33,600, 31,200, 28,800, 26, 400, 21,600
Data Rates	19,200, 16,800, 14,400, 12,000, 9600, 7200, 4800, 2400, 1200, 0-300 bps
Fax Data Rates	14,400, 9600, 7200, 4800, 2400, 300 bps
Data Format	Serial, binary asynchronous
Modem Compatibility	K56flex; ITU-T V.34 enhanced, V.34, V.32terbo, V.32bis, V.32, V.22bis, V.22; Bell 212A and 103/113; ITU-T V.29, V.42, V.42bis; ITU-T V.21 & V.23 in international versions
Fax Compatibility	ITU-T Group 3, Class 1 and 2, T.4, T.30, V.21, V.27ter, V.29, V.17 and TIA/EIA TR29.2
Voice Compatibility	TIA/EIA IS-101 (MT5634ZBAV only)
Video Compatibility	ITU-T V.80 fro H.324 video conferencing
Error Correction	ITU-T V.42 (LAP-M or MNP 3-4)
Data Compression	ITU-T V.42bis (4:1 throughput), MNP 5 (2:1 throughput)
Speed Conversion	Serial port data rates adjustable to 300, 1200, 2400, 4800, 9600, 19,200, 38,400, 57,600, 115,200, and 230,400 bps

HP LaserJet 4100N Printer (Continued)	
Mode of Operation	Mode of Operation Fax online modes; full duplex over dial-up lines; AT and AT+V command modes supporting answering machine and voice mail functions (MT5634ZBAV only)
Flow Control	XON/XOFF (software), RTS/CTS (hardware)
Intelligent Features	Plug and play; fully AT command compatible; autodial, redial, repeat dial; pulse or tone dial; dial pauses; auto answer; caller ID; EIA ex-tended automode; adaptive line probing; automatic symbol and carrier frequency during start-up, retrain, and rate renegotiation; DTMF detection; call status display, auto-parity and data rate selections; keyboard-controlled modem options; non-volatile memory; on-screen displays for modem option parameters; command lines of up to 40 characters each; help menus; remote configuration; DTR dialing; callback security; 11-bit support.
Command Buffer	40 characters
Data Modulation	FSK at 300 bps, PSK at 1200 bps, QAM at 2400, 4800, and 9600 bps (non-trellis), QAM with trellis-coded modulation (TCM) at 9600, 12,000, 14,400, 16,800, 19,200, 21,600, 24,000, 26,400, 28,800, 31,200, 33,600, and 56,000 bps
Fax Modulation	V.21 CH2 FSK at 300 bps (half duplex) V.27ter DPSK at 4800 and 2400 bps V.29 QAM at 9600 and 7200 bps V.17TCM at 14400, 12000, 9600, and 7200 bps
Carrier Frequencies ITU-T V.341	600, 1646, 1680, 1800, 1829, 1867, 1920, 1959, 2000 Hz

Carrier Frequencies
    AT&T V.32 terbo/
    ITU-T V.32bis/V.32
	1800 Hz

Carrier Frequencies
    V.22bis/V.22 or
    Bell 212A Standard
    (2400 & 1200 bps)
	Transmit originate:1200 Hz
	Transmit answer: 2400 Hz
	Receive originate: 2400 Hz
	Receive answer: 1200 Hz

Carrier Frequencies
    ITU-T V.23
    (1200 bps)
	Transmit originate:
	    390 Hz mark
	    450 Hz space
	Receive originate:
	    1300 Hz mark
	    2100 Hz space
	Transmit answer:
	    1300 Hz mark
	    2100 Hz space
	Receive answer:
	    90 Hz mark
	    450 Hz space

HP LaserJet 4100N Printer (Continued)	

Carrier Frequencies
  ITU-T V.21
  (0ñ300 bps)
	Transmit originate:
	     980 Hz mark
	     1180 Hz space
	Receive originate:
	     1650 Hz mark
	     1850 Hz space
	Transmit answer:
	     1650 Hz mark
	     1850 Hz space
	Receive answer:
	     980 Hz mark
	     1180 Hz space

Carrier Frequencies
  Bell 103/113
  (0ñ300 bps)
	Transmit originate:
	     1270 Hz mark
	     1070 Hz space
	Receive originate:
	     2225 Hz mark
	     2025 Hz space
	Transmit answer:
	     2225 Hz mark
	     2025 Hz space
	Receive answer:
	     1270 Hz mark
	     1070 Hz space

Fax Carrier Frequencies	V.21 Ch2 (half duplex): 1650 Hz mark, 1850 HZ space for transmit originate 1650 HZ mark, 1850 Hz space for transmit answer V.27ter: 1800 Hz originate/answer V.29 QAM: 1800 Hz originate/answer V.17 TCM: 1800 Hz originate/answer
Voice Compressionand Sampling RateMT5634ZBAV only)	PCM 128, 8000 Hz, or IMA ADPCM, 8000 Hz, (selectable via +V commands). Note that your computer system should have a processing speed of at least 75 MHz to take full advantage of the telephony features of this product.
Transmit Level	11 dBm (dial-up)
Frequency Stability	±0.01%
Receiver Sensitivity	43 dBm under worst-case conditions
AGC Dynamic Range	43 dB
Interface	EIA RS-232C/ITU-T V.24/V.28
Connectors	DB25 RS-232C connector; two RJ-11 phone jacks (one RJ-11 jack on UK and international modems), power jack; 1/8-inch stereo speaker jack and microphone jack on ZBAV model.
Cables	One 14-foot RJ-11 phone cable (USA); countryñspecific cord for UK and International models; external power transformer and cord Note: Any cables connected to the computer should be shielded to reduce interference.
Diagnostics	Power-on self test, local analog loop, local digital loop, remote digital loop.

HP LaserJet 4100N Printer (Continued)	
Indicators	LEDs for Transmit Data, Receive Data, Carrier Detect, 56K bps, 33.6K bps, 14.4K bps, Off Hook, Terminal Ready, Error Correction, Fax.
Speaker	Command-controlled 2-inch speaker for call progress monitoring.
Manual Control	ON/OFF power switch
Environmental	Temperature range0×ñ50×C (32×ñ120×F); humidity range20ñ90% (non-condensing)
Power Requirements	100ñ130VAC, 50/60 Hz, 5 W; two-prong outlet-mounted transformer (included); 230V/50 Hz optional (international)
Power Consumption	9 VDC, 300mA maximum transformer output
Dimensions1	10.8 cm wide x 14.8 cm long x 2.9 cm high
Weight	224 g (8 oz)
Limited Warranty	10 years in the U.S.A., U.K., Canada, and Mexico; 5 years elsewhere

For your notes

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