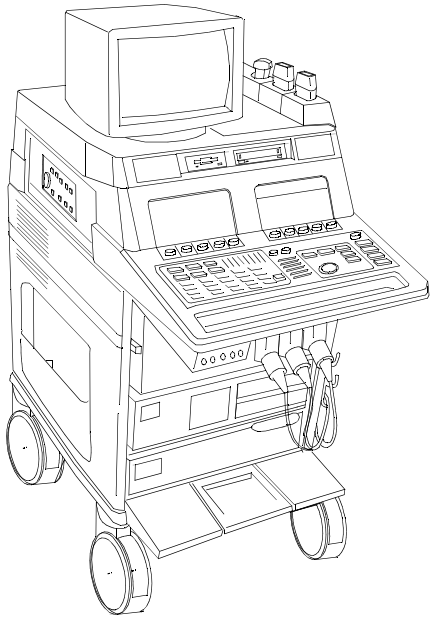
M2424A
SONOS 4500/5500
Ultrasound Imaging System

Service Manual



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SONOS M2424A
Ultrasound Imaging System
Service Manual

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1 Introduction

2 Specifications

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Service Manual

SONOS M2424A
Ultrasound Imaging System

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WARNING

Electrical Shock Hazard

Do not remove system covers. To avoid electrical shock, use only supplied power cords and connect only to properly grounded (3-hole) wall outlets.

Explosion Hazard

Do not operate the system in the presence of flammable anesthetics.

Safety Information

Before you use a specialty transducer for the first time, be sure to read the "Description and Use" section of the chapter that is applicable to your transducer. Also, for TEE and intraoperative transducers, review the "Electrical Safety" sections in those chapters.

Pay special attention to the "Warnings" and "Cautions".

The warnings explain the dangers of electrical shock and explosion hazard, the safety of ultrasound, applications, guidelines for fetal use, and guidelines for setting controls that affect acoustic output and accuracy of clinical measurements.

Warning Symbol used in the Text:

WARNING

The cautions explain potential damage to equipment.

Caution Symbol used in the Text:

CAUTION

Warning Symbols used on the System:

Instruction manual symbol: the product is marked with this symbol when it is necessary for the user to refer to the User's Guide.

Dangerous voltage symbol: the product is marked with this symbol to indicate potential for electrical shock.

Monitor Radiation++

The monitor used in this system complies with the FDA regulations that were applicable at the date of manufacture (21 CFR Subcategory J).

Prescription Device

The United States Food and Drug Administration requires the following labeling statement:

Caution - Federal Law restricts this device to use by or on the order of a physician.

Important

CE 0123 marking is for Council Directive 93/42/EEC.

This system complies with the Medical Device Directive.

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1 Introduction and General Information

About This Manual

This manual is intended to provide a level of information sufficient to troubleshoot and service the M2424A (M2425A upgrade) line of Phased Array Ultrasound Systems.

Product Overview

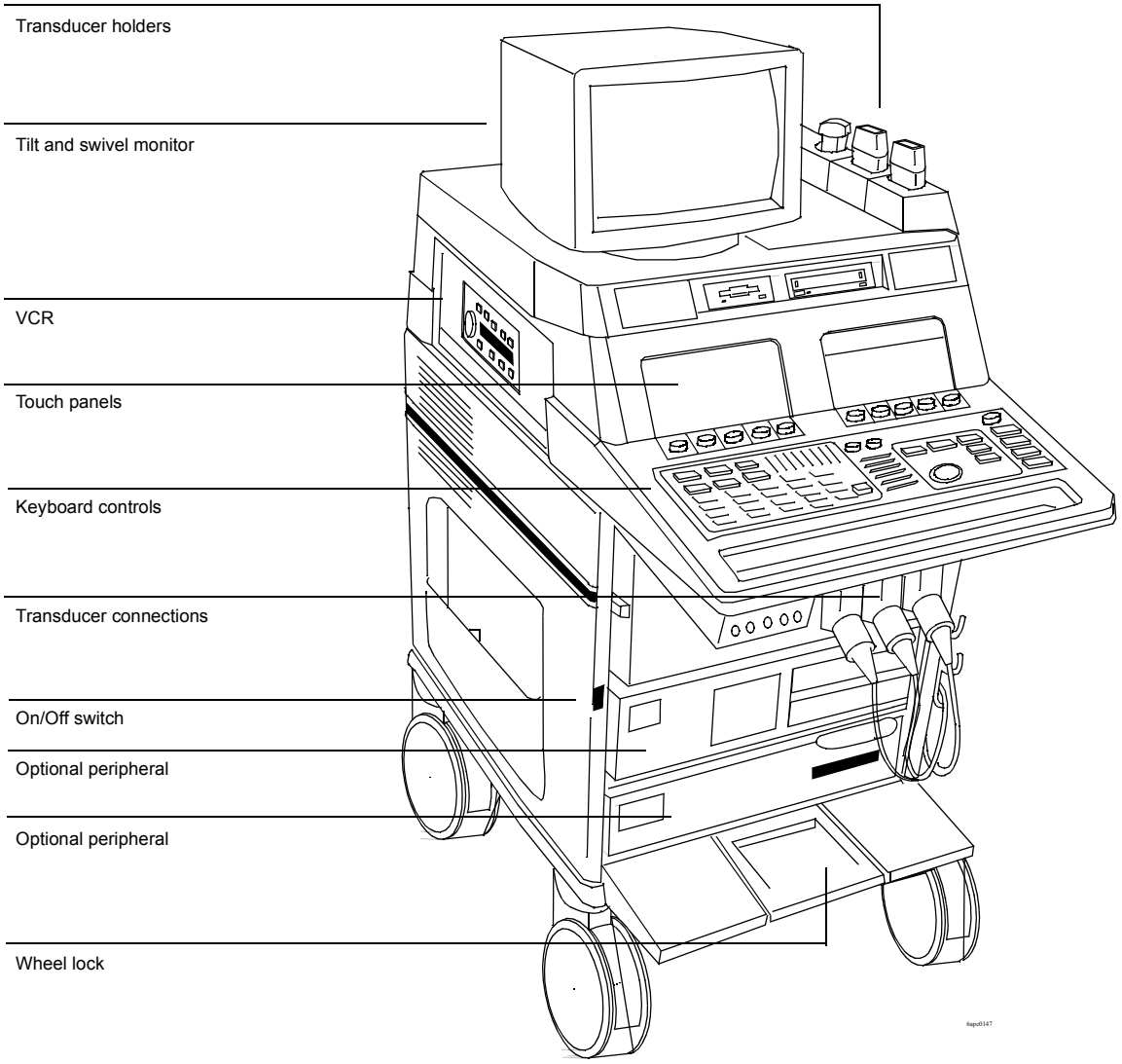
The Model M2424A Phased Array Ultrasound system, shown in Figure 1-1, with designed mechanical and electronic system components and combined with an updated software architecture, provides a flexible platform that is able to support a wide range of product offerings.

The advantages of previous Phased Array Systems have been maintained while state of the art components have been added to improve the performance of the system.

Some of the outstanding features and benefits are listed below:

- 15-inch monitor to improve screen quality of imaging
- Swivel/lock wheels allow for improved maneuverability and locking while stationary
- Service floppy disk drive allows for easier software upgrades, system service and saving system presets
- Easier access to Digital Storage and Retrieval (DSR) system
- Digital front end interface
- Harmonics Imaging capability
- Color Angio imaging mode
- Adaptive Color Flow for improved color presentation
- Transthoraxic 3D acquisitions
- Improved audio system for clearer audio capabilities

Figure 1-1 M2424A System Configuration with Optional OEM Peripherals



System Description

The M2424A includes the following hardware components.

Cart

The cart base is manufactured from folded sheet steel parts and provides the main support structure to which the wheels are attached. Major AC components, like the isolation transformer, are enclosed within the base and are attached in a fixed position towards the front of the base. DC components are housed in a separate chassis that can be pulled out for service or replacement.

Stem mounted swivel wheels (6-inch) are located on the front and rear. Front wheels may be locked providing an added measure of convenience and safety during system operation. The front wheel casters contain hardware allowing the operator to swivel lock the wheels in a straight ahead position and brake lock them using a foot lever in the middle of the front footrest. Swivel casters allow 0.5 inch vertical wheel travel to allow for surface irregularities. All wheels have integrated sealed bearings for maintenance free operation. The base includes a structural footrest and brake lock.

The cart top housing is cast of aluminum and incorporates the handle, control panel, and VCR housing. Integral hinges are located along the rear so that the top housing can be lifted for service access. Latch supports in front lock the top housing to the main cart during use. Special gas filled struts (one on each side) provide the necessary counter force when raising and lowering the main top housing.

Power Supply

The main power supply consists of a switching mode supply. It resides in the lower rear section of the cart and delivers all working DC levels to the main E-Box via a cable harness and three large cables. These cables are routed directly to the E-Box. Necessary DC power for the Keyprocessor Electronics section is routed from the power supply via an additional cable from the I/O panel.

OEM peripherals associated with the system, including the main display monitor, have integral power supplies which run on isolated AC provided by a 120V power strip mounted inside the right-rear corner of the cart. Peripherals requiring 220/230/240V run off another power strip mounted inside the right-rear corner of the cart (this strip is provided as an option when required). The additional power strip is

mounted next to the 120V strip. Both power strips receive AC voltage from the isolation transformer mounted in the base of the cart.

Testing of the power supply is possible by monitoring the LEDS and test point outputs made available on the rear panel of the supply. For more information, see Chapter 3, “Service Data.”

System Monitor

The monitor at the top of the cart is a 15-inch color display mounted on a “twivel” assembly. The twivel allows tilt/swivel positioning of the display for ease of viewing.

WARNING **Before transporting the system or raising the top housing for service, always check that the monitor is securely mounted in position.**

Electronic Box (E-Box)

The Electronics Box, referred to as E-Box in this manual, is located immediately below the hinged control/cart top housing. The E-Box combines several functions in one enclosure and is the heart of the system. The E-Box enclosure is divided into two distinct sections; i.e. the *Scanner* section and the *Scan Converter* section. The number of PC boards included in each of these sections will vary depending on installed system options. The E-Box design accommodates new front-end digital circuitry.

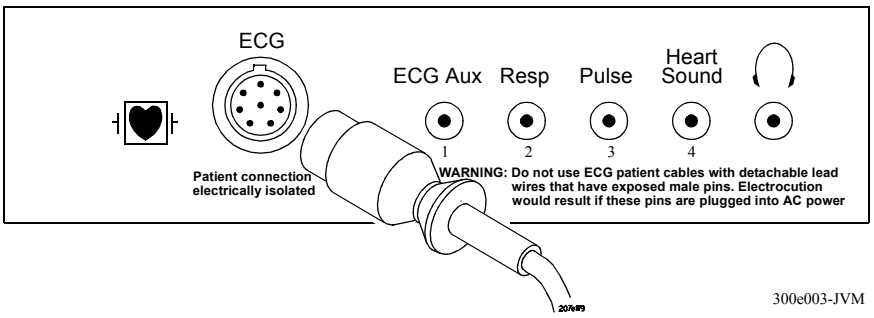
The Scanner section directly interfaces the transducers to the system and provides digital signal processing for all modes including 2D, Color Flow, M-Mode and Doppler. The Scanner section is physically divided into two sections by a septum. This septum divides the Scanner into an analog half and a digital half. The Scan Converter section is directly responsible for all digital processing for all modes.

Physio Amplifier

The Physio Amplifier is shown in Figure 1-2 on page 1-5. In addition to a standard ECG module, other signals are available and may include heartsound, respiration, and Pulse. A headphone output is available for real-time or pre-recorded audio. All physio waveforms are routed to overlay the M-Mode or spectral data but may be positioned on a reserved area above this data. In the 2D mode, ECG is displayed in the lower part of the screen and may be summed with the heartsound signal.

Up to four externally generated Physio signals may be substituted by appropriate connections to the front panel via standard 1/4-inch phone jacks. It is also possible to input an auxiliary ECG waveform from an external patient monitor and display it in all modes while using the R-wave as a time reference for the system. Trigger levels (high or low) are preset via the physio setup screen. For details, see the SONOS 4500/5500 *Reference Manual: System Basics*.

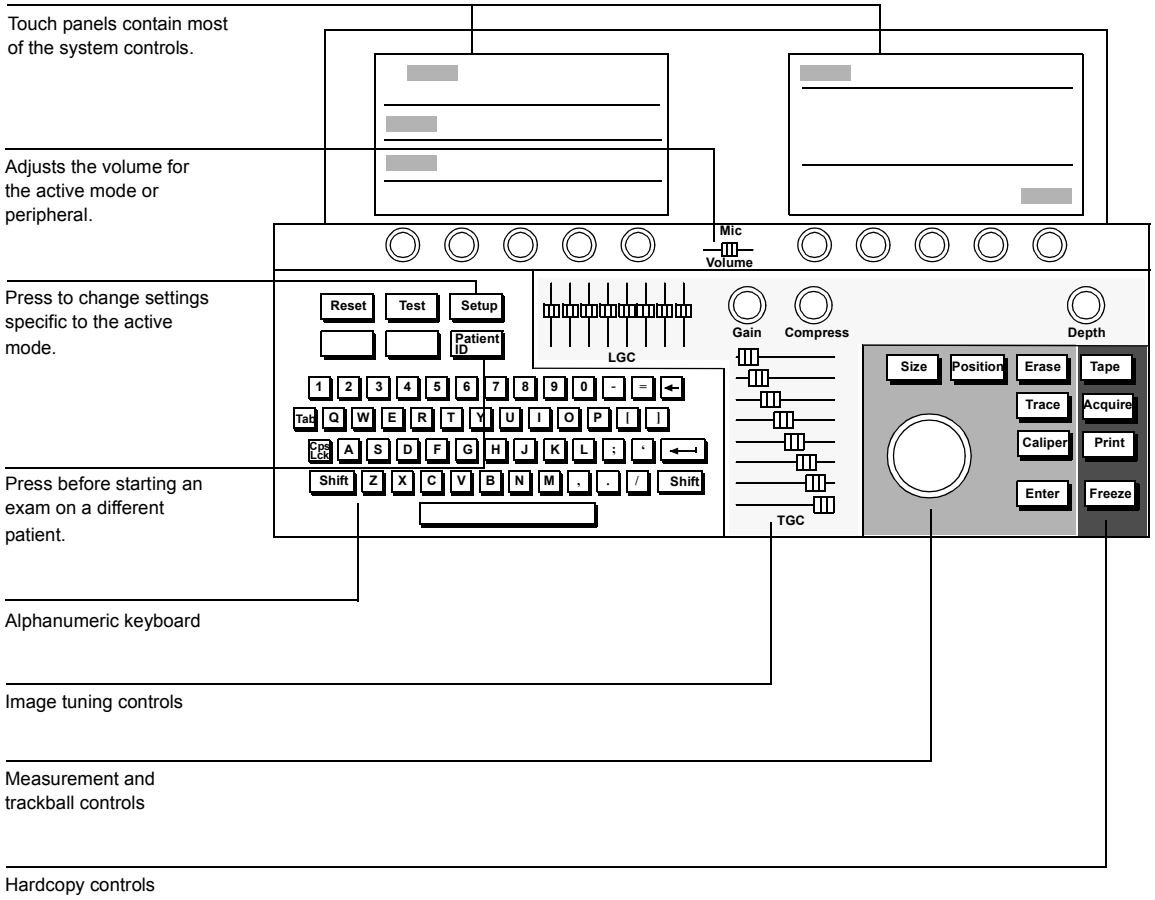
Figure 1-2 Physio Amplifier



Keyprocessor Electronics (Control Panel)

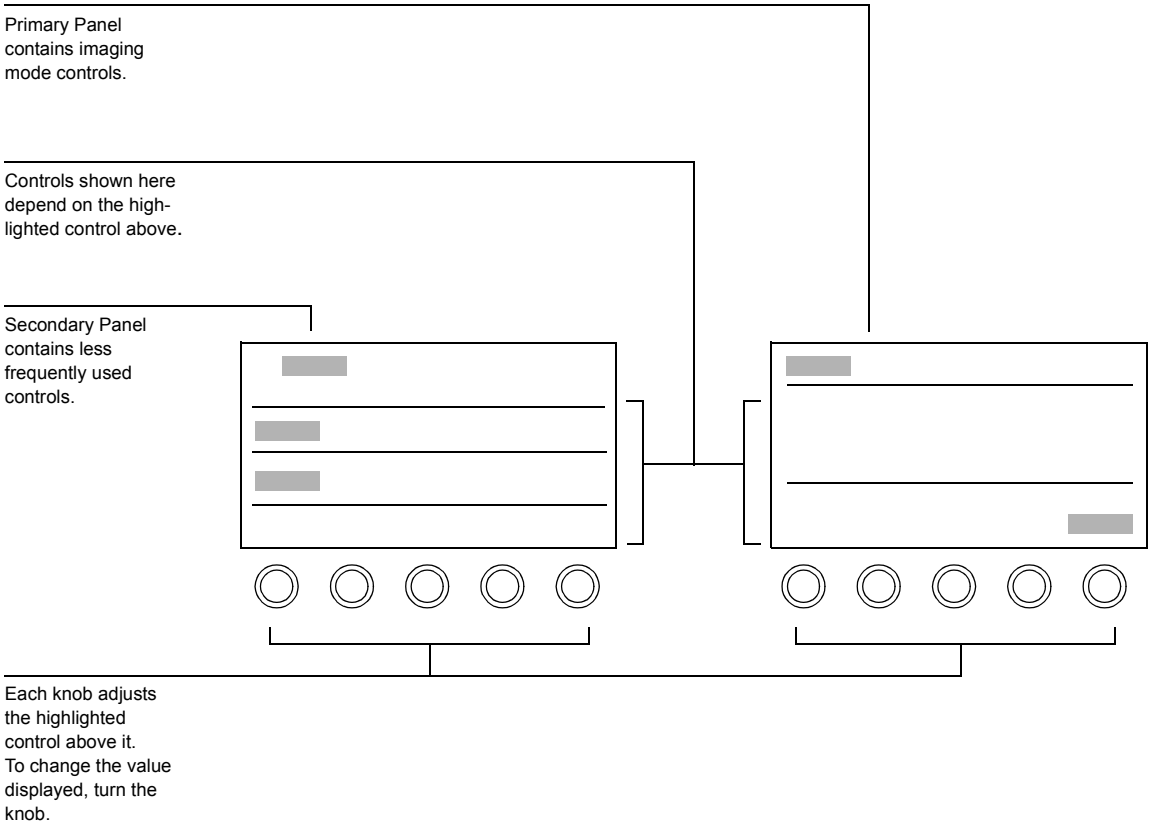
The Keyprocessor Electronics section (Figure 1-3 on page 1-6) at the top-front of the cart houses the operator control panel, consisting of a backlighted computer keyboard with function keys, slide pots, and rotary controls which provide operator interface to the system. In addition to the keyboard controls, the Keyprocessor Electronics section also includes two Electroluminescent (EL) touch sensitive screens (Figure 1-4 on page 1-7), which add a programmable user interface to the system. Operating software defines appropriate system response to a touch at any given EL screen location.

Figure 1-3 Keyprocessor Electronics (Control Panel) Layout



Below the EL touch screens are the image tuning controls, keyboard and hardcopy controls. Function keys, such as **Setup**, **Position** and **Freeze**, are active when their lights are on. Pressing one of these keys turns the light and the function on or off.

Figure 1-4 EL Touch Screen Panels



Backlighting and EL panel intensity can be set through the user interface to accommodate unique lighting environments. Five rotary encoders positioned below each EL touch screen allow for many functional controls.

Additional System Components

In addition to the primary system modules, the following are also available.

Table 1-1 Peripherals Supported

Model	Application	Standard	Optional	Notes
M2424A	4X DSR—4X Optical Drive, 2.2 GB	X	X	5500—Standard 4500—Optional Ship on systems with serial number US97806099 or less.
M2424A	8X DSR—8X Optical Drive, 5.2 GB	X	X	5500—Standard 4500—Optional Ship on systems with serial number US97806100 or greater.
77470A	Digital Network Interface		X	HP D3962A (Rev A.X only)
77471A	Integrated Digital Interface		X	Rev. B.0
77471B	Integrated Digital Interface		X	Rev. B.1
77510A	Strip Chart-B&W		Upgrade	Kowa TLR-111
77530/5A	Printer, Color-NTSC/PAL		Upgrade	Sony UP3000MD/ UP3000P
77530/5B	Printer, Color-NTSC/PAL		Upgrade	Sony UP1850MD-NTSC/ UP1850EPM-PAL
77530D	Printer, Color-NTSC/PAL		X	Sony UP2950MD
77550B	Printer, Color-NTSC		Upgrade	Sony UP5200MD
77550/5C	Printer, Color-NTSC/PAL		X	Sony UP5600MD/ UP5600MDP
77550D	Printer, color-NTSC		X	Sony UP51MDU Replaces 77550B
77560/5A	Printer, B&W-NTSC/PAL		Upgrade	Sony UP 870MD/UP 860LF, Small format

Table 1-1 Peripherals Supported *(Continued)*

Model	Application	Standard	Optional	Notes
77560B	Printer, B&W-PAL/NTSC		X	Sony UP 890MD
77580/5A	Printer, B&W-NTSC/PAL		X	Sony UP 910/UP 910/P - Large format
77580B	Printer, B&W-NTSC/PAL		X	Sony UP 960MD
77613/23A	VCR, SVHS-NTSC/PAL		Upgrade	Panasonic-7350/7350P
77615/25A	VCR, SVHS-NTSC/PAL	X		Panasonic-AG-MD830
77617/27A	VCR, SVHS-NTSC/PAL	X		Panasonic MD835P

Preset Functionality

Presets provide the capability to automatically adjust system variables (including acoustic power) to pre-set values that have proven to provide the best imaging results for a particular mode in the judgment of the operator. This repeatability of settings can reduce the time to complete an exam. In addition to default presets, there are up to 12 user-determined presets in Rev. A and up to 29 in Rev. B and C that can be retained by the system at one time.

A key on the top row of the left touch panel is dedicated to the preset function.

For information regarding the use of presets or other mode/features of this system, please refer to the SONOS 4500/5500 *Reference Manual: System Basics*.

Safety Considerations

Transmit Power (Acoustical)

Acoustic output expressed as an *Index* is displayed on the screen to allow the best possible diagnostic image with a minimal power output setting. In order to accomplish this display in a meaningful way, a *display standard* is adopted using one of the following four power Indexes:

- Mechanical Index (MI).
- Thermal Index for Soft Tissue (TIS).
- Thermal Index for Bone (TIB).
- Thermal Index for Cranial Bone (TIC). Index values are displayed on screen in the form **TIC: X.X** in increments of 0.1.

The type of power *Index* is displayed on screen depends on *the preset type, the imaging mode, and the setting of the Index control (Power)*. For more information about transmit power, see the *Output Display Standards and ODS Acoustic Tables Reference Guide* (M2424-96605-06).

Explosive Hazards

WARNING

Do not operate the system in the presence of flammable anesthetics. Doing so could lead to an explosion.

Moving the Ultrasound System

CAUTION

Be careful to *never* push the system from the rear. Always push from the front where you have more control over steering.

Although the system is designed to be mobile, remember that it weighs approximately 500 pounds (234 kg.).

WARNING

Never move your system with the peripheral shelves extended forward.

System Tilting

The system has been tested for stability using the IEC 601-1 test protocol. With the peripheral shelves retracted, the system will not tip over on an incline of up to 10 degrees in any direction. The system becomes unstable with the peripheral shelves extended.

When this amount of incline is exceeded, as is the case when the system is moved over a roadside curb or some other small but steep incline, there exists the potential for the system to tip over. Use care when moving the system on any incline.

Ramps

Use two people to transport the ultrasound system when moving it up and down ramps longer than 20 feet or steeper than 5 degrees. (Wheelchair ramps are usually less than 5 degrees.) Avoid ramps that are steeper than 10 degrees to eliminate the potential danger of the system tipping over. For more information, see the SONOS 4500/5500 *Reference Guide: Safety and Standards*.

Transducers

Before transporting the system in a vehicle, remove all transducers from the holders and receptacles. For safekeeping, place them in a packing box.

Transporting Vehicle/Lift Weight-Handling Considerations

Be sure that the load capacity of a transporting vehicle or lift device can handle the combined weight of the system(s) and passengers. A minimum capacity of 750 pounds is recommended.

Loading and Unloading

Load and unload the ultrasound system when the transporting vehicle is parked on a level surface. The weight of the system on the extended lift may cause the transporting vehicle to tilt, which could cause personal injury or system damage. Always use the swivel wheel lock during transport.

Always secure the ultrasound system while it is on the loading lift so that it cannot roll. Engage the two front wheel locks and use either wood chocks, restraining straps, or other similar types of constraints as an added measure of safety. Do not attempt to hold it in place yourself.

WARNING **Never ride on a loading lift with the system. Your weight coupled with the system's weight may exceed the lift's load capacity.**

Acoustic Exposure

Although no harmful effects have been demonstrated for any of the ultrasound frequencies, intensities, and exposure times used in examinations with ultrasound systems, Philips recommends that you select the lowest ultrasound exposure that will produce diagnostically acceptable information.

- Use diagnostic ultrasound only when there is a good medical reason.
- Reset controls at the start of every examination.
- Reduce exposure time, independent of acoustic index value.
- Use techniques that enable you to collect clinical data quickly and end the examination promptly.
- Select a probe that provides good resolution and focal depth for the region of interest. Then use the imaging controls to fine-tune image resolution.

For more detailed information on acoustic exposure, please refer to the *Output Display Standards and ODS Acoustic Tables Reference Guide* (M2424-96605-06).

AIUM/NEMA Output Display Standard (ODS)

In compliance with the Output Display Standard jointly proposed by the American Institute of Ultrasound in Medicine and the National Electrical Manufacturers Association, the Philips ultrasound system displays power output indices related to the potential for bioeffects.

The real-time information related to the power output is displayed on the imaging monitor, indicating the type of index displayed and the value of that index for the acoustic output currently being used. For example, if the output corresponds to a Mechanical Index of 0.8, the following would be displayed:

```
MI: 0.8
```

The Index displayed is one of four types: MI, TIS, TIB, or TIC. These ultrasound abbreviations conform to the AIUM/NEMA Output Display Standard. MI refers to the Mechanical Index. *TIS* and I are thermal indices for soft tissue and bone, respectively. *TIC* is a thermal index used for cranial applications, and appears only in the transcranial preset.

The soft tissue thermal index (TIS) is used in cardiac, fetal, or abdominal scanning. For example, the thermal index for bone (TIB) would be used for second or third trimester fetal scanning or neonatal cephalic (through the fontanelle) scanning.

NOTE

The power index displayed on the screen depends on the preset type, the active probe type, the imaging mode, and the user-selectable Power Index. It is possible to select any of the four power indices for display at any time using the Power Index control in the System Setup menu, provided that the index type is supported by the probe in use.

For automatic selection of Power Index based on system mode, the user can select Default with the Power Index control in the System Setup menu. The default index is MI in B-mode, and TIS for other modes outside of the transcranial preset. Default is the setting defined in all Presets.

If the user selects an ODS setting other than Default, then that will be the preferred acoustic power display format as long as that index is supported by the current probe and preset. If it is not supported, the Default index will be displayed.

The displayed index value does not provide an exact value of the potential for adverse bioeffects in the patient. However, for any patient, the higher the value, the higher the potential for adverse bioeffects will be. The user can minimize the potential for bioeffects by keeping the index value as low as possible. This is done by their choice of probes and adjustments. Minimizing bioeffects is also accomplished by minimizing examination time.

NOTE

The ODS power index formulas were defined for reasonable worst case patient conditions. It is likely that a particular patient's actual conditions will be better than indicated by the index. The operator should be aware of patient conditions that mitigate the actual exposure.

Electrical Warnings

WARNING

Failure to follow these warnings can affect both patient and operator safety.

- System covers (trim and access panels) should be removed only by qualified service personnel. Accidental contact with electrical circuits inside the system could cause serious injury.
- To avoid electrical shock, use only the power cords supplied with the system, and connect them only to properly grounded (three-hole/mains) electrical outlets.

WARNING

Life support devices should not be connected to the same circuit used for the imaging system.

Peripheral Connections

WARNING

This system has been investigated to the requirements of IEC 601-1, with peripherals that are powered by the built-in isolation transformer. Anyone who uses the system with peripherals that are powered from a separate wall receptacle is considered to be configuring a medical system, and is therefore responsible that the system complies with the requirements of the IEC 601-1-1. If you have questions, contact your Philips representative.

Glutaraldehyde Exposure

The United States Occupational Safety and Health Administration (OSHA) has issued a regulation dealing with levels of acceptable glutaraldehyde exposure in the working environment. Philips does not sell glutaraldehyde-based disinfectants for the SONOS products. This type of disinfectant is, however, recommended for disinfection of transesophageal (TEE) or endocavity probes.

To minimize exposure to glutaraldehyde fumes, make sure the area is well ventilated and use appropriate eye and skin protection.

For additional information, see the SONOS 4500/5500 *Reference Guide: Transducer Reference*.

Electromagnetic Compatibility

The testing for electromagnetic compatibility (EMC) of this system has been performed according to the international standard for EMC with medical devices, as determined by the International Electrotechnical Commission (IEC 601-1-2). This IEC standard has been adopted in Europe as the European Norm (EN 60601-1-2).

Avoiding Electromagnetic Interference

A medical device can generate or receive electromagnetic interference. The EMC standards describe tests for both emitted and received interference. Emission tests deal with interference generated by the device being tested. The ultrasound system does not generate interference based on the tests described in the referenced standards.

An ultrasound system is designed to receive radio frequency (RF) energy and is therefore susceptible to interference generated by other RF energy sources.

Examples of other sources of interference are medical devices, information technology products, or radio/television transmission towers. Tracing down the source of radiated interference can be a difficult task.

Customers should consider the following issues to locate the source of the interference:

- Is the interference intermittent or constant?
- Does the interference appear with only one transducer or with several transducers?
- Do two different transducers operating at the same frequency have the same problem?
- Is the interference present if the system is moved to a different location in the facility?
- Can the EMC coupling path be attenuated?

  For example, probe placement close to an ECG cable can increase electromagnetic interference. Moving the ECG cable or other medical equipment away from the probe can result in reduced interference.

Only a physician can determine if an artifact caused by radiated interference will negatively impact image quality and the subsequent diagnosis.

Answers to these questions will help determine whether the problem resides with the system or with the scanning environment. Contact your local service representative with a full description and your observations.

Restrictions for Use

Immunity Level Test Results

The EMC standards state that manufacturers of patient-coupled equipment must specify immunity levels for their systems. It is recognized that this type of device is designed to receive and amplify low level signals in the same bandwidth as the interference it is susceptible to.

Immunity is defined in the standard as the ability of a system to perform without degradation in the presence of an electromagnetic disturbance. Degradation in image quality is a qualitative assessment which can be subjective. The simplest way to assess degradation is to note when the first sign of an artifact is seen. This method has two advantages. It removes the issue of subjective decision making and provides the most stringent test results.

Caution should therefore be taken in comparing immunity levels of different ultrasound systems. The criteria used for measuring degradation is not specified by the standard and may vary with the manufacturer.

Testing has been performed on each class of transducer for every operating mode (B-mode, PW Doppler, CW Doppler, and Color Flow) over a wide range of frequencies. This testing showed PW Doppler to be the most susceptible to radio frequency interference.

Electrostatic Discharge Immunity

Electrostatic discharges may cause the ECG heart rate display to increase by 10 to 15% for a few seconds after the discharge. However, the ECG heart rate display will return to normal within four seconds.

Please see the Declaration of Conformity shipped with your system for additional information about compliance with EMC standards.

Electrosurgical Units

Electrosurgical units (ESUs) and other devices intentionally introduce radio frequency electromagnetic fields or currents into patients. Because imaging ultrasound frequencies are coincidentally in the radio frequency range, ultrasound transducer circuits are susceptible to radio frequency interference. While an ESU is in use, the noise generated severely interferes with the black and white image and completely obliterates the color image.

2 System Specifications

Detailed Specifications

Table 2-1 Power and Weight

Nomenclature	Specification
AC Input	89–100V/120–127V/220V/230V/240 Vac, +/-10%, 50/60 Hz. (Selected by jumpers on Isolation Transformer)
AC Internal	Isolated 120 Vac. Source all peripherals and DC switcher via single NEMA strip. Typical draw: 11.5A at 120 Vac. 240 Vac Countries: reverse IEC strip on right-hand side. Isolated 240V
Load	1440 VA
Heat Output	5000 BTUs/hour, excluding external instruments
Earth (3rd Wire) Leakage	50 microamps at 240 Vac typical
Environmental	Temp range 0 to 55° C at 80% RH (All peripherals limited to 35° C)
Dimensions	Depth 42.5 in., width 25.2 in., height (top of monitor) 60.3 in., top of controller upper section with monitor removed for transport 45.8 in.
Weight	460 lbs. (209 Kg) approximately, fully loaded (VCR, Optical Drive, IDI, UP5600).

Table 2-2 Main Display

Nomenclature	Specification
Screen Size	15-inch Diagonal, RGB Color Display
Raster Format US	60 Hz, Non-Interlaced, 512 X 480 pixel resolution 30 Hz, Interlaced, 512 X 480 pixel resolution NTSC Color for VCR recording
Raster Format European	50 Hz, Non-Interlaced, 512 X 512 pixel resolution 25 Hz, Interlaced, 512 X 512 pixel resolution PAL Color for VCR recording
Features	Tilt +/-10 degrees, Swivel +/-120 degrees

Table 2-3 Imaging Transducers

Model No.	Label	2D Frequency Range	Notes
21253B	C3540	Fusion 2–6 MHz	Requires xducer adapter
21255B	L5040	Fusion 3–7 MHz	Requires xducer adapter
21258B	L7540	Fusion 4–10 MHz	Requires xducer adapter
21273A	C5040	Fusion 3–7 MHz	Requires xducer adapter
21311A	s3	Fusion 1–3 MHz	
21321A	c3540	Fusion 2–5 MHz	
21330A	s4	Fusion 2–4 MHz	
21336A	E6509	Fusion 4–7 MHz	
21350A	s8	Fusion 3–8 MHz	
21353B	C3540	Fusion 2–6 MHz	
21355B	L5040	Fusion 3–7 MHz	
21356A	11-3L	Fusion 3–11 MHz	
21358B	L7540	Fusion 4–10 MHz	
21373A	C5040	Fusion 3–7 MHz	
21380A	s12	Fusion 5–12 MHz	
21390A	15-6L	Fusion 7–15 MHz	

Table 2-4 Separate Probe Doppler Transducers

Model No.	Label	Description	Notes
21221A	D1914C	1.9 MHz CW	CW only
21221B	D1914C	1.9 MHz CW/PW	CW and PW
21223A	D5014V	5.0 MHz CW/PW	CW and PW
21223B	D5014V	5.0 MHz CW/PW	CW and PW
21224A	D1009V	10 MHz CW	CW

Table 2-4 Separate Probe Doppler Transducers *(Continued)*

Model No.	Label	Description	Notes
21228A	D1914V	1.9 MHz PW	PW only
21228B	D1914V	1.9 MHz PW	PW only

Table 2-5 Transesophageal (TEE) and Transthoracic Omniplane Transducers

Model No.	Label	2D Frequency Range	Notes
21349A	R5012	Fusion 4–6 MHz	
21364A	T5012	Fusion 3–6 MHz	Requires xducer adapter
21366A	T7506B	Fusion 5–9 MHz	Requires 2 xducer adapters
21367A	T6210	Fusion 4–7 MHz	Requires xducer adapter
21369A	T6210	Fusion 4–7 MHz	
21381A	T6207	Fusion 4–7 MHz	

Table 2-6 System Rear I/O Ports

Description	Specification
RGB/Sync	BNC connectors, switchable to sync on green
Color Aux.	BNC connector, NTSC or PAL compatible
B/W Aux.	BNC connector, Composite Video, RS-170/CCIR 472-1
S-Video Aux.	NTSC or PAL Compatible, 4 pin mini circular DIN connector
Print	BNC connector, trigger for external peripherals. Contact closure to ground.
Stereo Audio Aux.	Spare stereo audio out, line level, L and R on phono jacks
ECG/R Wave	Selected through user set-up, 3.5 mm jack
Footswitch	In parallel with control panel, Freeze - Print - Tape
J1	RS-232C 25-pin “D” female connector for serial output
Strip chart (optional)	Strip chart recorder output port

Table 2-6 System Rear I/O Ports *(Continued)*

Description	Specification
AQ Wave	Analog output of AQ waveforms
LAN	Connection port for network

Table 2-7 Physios

Description	Specification
ECG	3 lead monitoring quality ECG with R-wave detection Bandwidth 0.35–30 Hz +/-20% Gain up to 4500 +/-20% Common mode rejection >90 db, defib protected Respiration through ECG leads available
ECG Aux	Bandwidth DC to 1.8 KHz +/-20% Gain up to 9.6 +/-10% at maximum control setting
Resp	-2.6V +/-20% per 1 Ohm change at maximum control setting, measured at 1 Hz
Pulse	Bandwidth 0.15 to 150 Hz +/-20% Gain up to 1367 +/-10% at maximum control setting
Heart Sound	Filters 25/50/100/200/400/800 Hz
Aux 1	Bandwidth DC to 1800 Hz +/-20% Gain up to 9.6 +/-10% at maximum control setting
Aux 2	Bandwidth DC to 1800 Hz +/-20% Gain up to 9.3 +/-10% at maximum control setting
Aux 3	Bandwidth DC to 1800 Hz +/-20% Gain up to 20.5 +/-10% at maximum control setting
Aux 4	Bandwidth DC to 1800 Hz +/-20% Gain up to 20.5 +/-10% at maximum control setting

Table 2-8 Audio

Description	Specification
Speakers	Stereo—VCR, Doppler, Physio output on both channels Doppler Spectrum toward Xdcr—left speakers Doppler Spectrum away from Xdcr—right speakers Max power input: 15 Watts. Impedance: 8 Ohms. Base and midrange speakers (2 of each) Base < 800 Hz Midrange > 800 Hz
Frequency Response	60 Hz–15 KHz
Microphone	Omni-directional sens. 10 Hz–20 KHz condenser type.
Headphone Jack	Standard Phone Jack on Physio amp. Minimum load resistance is 8 Ohms. Shuts off speaker when headphone plug (1/4" phone jack) is inserted.

Table 2-9 Video

Description	Specification
B&W Aux out	RS170 (US), CCIR 472-1 (Europe) 1.0V p to p +/- 5% into 75 Ohms. Rear BNC
Color Aux out	NTSC 3.58 Compatible (US), PAL 4.43 Compatible (Europe) 1.0V p to p +/-5% into 75 Ohms. Rear BNC
RGB and Sync out	Four BNCs, 0.7 or 1.0V p to p into 75 Ohms Sync: TTL (Behind 75 Ohms) Negative true
S-Video Aux out	4 pin mini-DIN NTSC or PAL Compatible Luma level: 1.0 V p to p +/- 5% into 75 Ohms Chroma level: 0.286 V p to p +/- 5% into 75 Ohms (NTSC) 0.300V p to p +/- 5% into 75 Ohms (PAL)

Table 2-10 AQ Ports

Nomenclature	Specification
AQ Out (wave)	Analog, +/- 1Vpp, DC, 1KHz

Table 2-11 Peripheral Control

Nomenclature	Specification
Footswitch	Rear Panel Connector for remote operation of Freeze, Print, and Tape. For stress option: foot switch is labeled Acquire, Accept, Border. Each signal is a contact closure to ground, TTL compatible, active low.

Table 2-12 Power Supply

Nomenclature	Specification
Input Voltage	120V (Connected to output of Isolation Transformer)
Line Frequency	50 or 60 Hz
DC Outputs	10 regulated (+/-3% of nominal)
Ripple	On any reg. output: 50mv p to p or 0.5% of nominal voltage, whichever is greater (for static load)

Table 2-13 Regulatory Compliance

Item	Specification
Regulatory Approvals	FDA, JTA, MDD (CE mark), GOST, CCIB
System Software Languages	English, French, German, Italian, Spanish
Standards	UL-2601-1-94, CAN/CSA-C22.2 No. 601.1-1M90 & No. 601.1S-94, IEC 60601-1:1995, IEC 60601-1-2:1993, AIUM/NEMA Output Display Standard:1998, JIS T 1001:1992, JIS T 1002:1992, JIS T 1501;version 84, ACR/NEMA DICOM 3.0:1996

Table 2-14 Safety Limits

Test	Notes
Ground Wire Leakage	See "Ground Wire Leakage Current" on page 6-12.
Acoustic Power	Consult the *Reference Manual: Safety and Standards Guide* shipped with each system.

Video Timing Specifications

Video Output

The video output is RGB standard RS-170 (525 lines, interlaced/60Hz) or CCIR 472-1(625 lines, interlaced/50Hz); 0.7 volt (switchable to 1.0 volt if necessary) peak-to-peak into 75 Ohms with external sync. The table below defines the exact video characteristics. These numbers supersede RS-170 or CCIR 472-1 specifications wherever differences occur.

Table 2-15 Video Output Characteristics

Description	Interlaced		Non-Interlaced	
	60 Hz Format	50 Hz Format	60 Hz Format	50 Hz Format
Horizontal Timing				
Horizontal Rate	15734 Hz	15625 Hz	31468 Hz	31250 Hz
Horizontal Time	63.56 µs	64 µs	31.78 µs	32 µs
Sync Pulse	4.89 µs (48p[a])	4.92 µs (48p)	2.44 µs (48p)	2.46 µs (48p)
Front Porch	1.53 µs (15p)	1.54 µs (15p)	1.32 µs (26p)	1.33 µs (26p)
Back Porch	4.99 µs (49p)	5.03 µs (49p)	1.93 µs (38p)	1.95 µs (38p)
Total Blanking	11.41 µs	11.49 µs	5.70 µs	5.74 µs

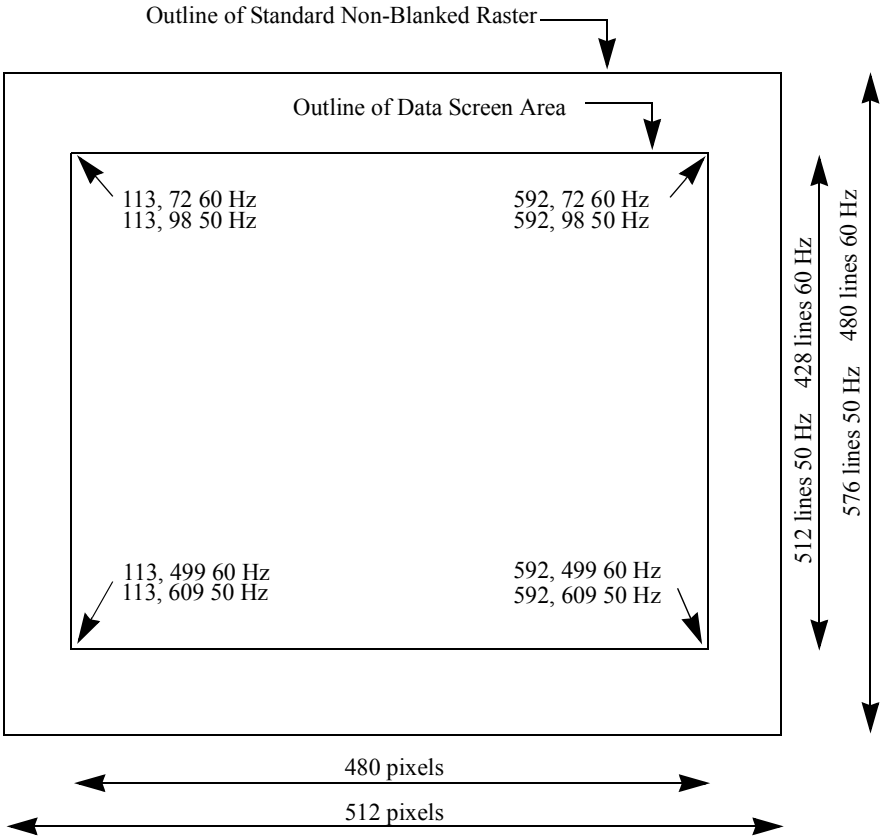
Table 2-15 Video Output Characteristics *(Continued)*

Description	Interlaced		Non-Interlaced	
	60 Hz Format	50 Hz Format	60 Hz Format	50 Hz Format
Data Time	48.89 µs	49.23 µs	24.44 µs	24.62 µs
Total Active Time	52.15 µs	52.51 µs	26.07 µs	26.26 µs
Pixel Clock	9.818 MHz (101.9 ns)	9.750 MHz (102.6 ns)	19.636 MHz (50.9 ns)	19.5 MHz (51.3 ns)
Total Active Pixels	512	512	512	512
Vertical Timing				
Interlace	2:1	2:1	N/A	N/A
Frame Rate	29.97 Hz	25 Hz	59.94 Hz	50 Hz
Field Rate	59.94 Hz	50 Hz		
Equalization Pulse Duration	2.44 µs	2.46 µs	N/A	N/A
Number of Equalization Pulses Leading	6	5	N/A	N/A
Number of Equalization Pulses Trailing	6	5	N/A	N/A
Serrated Pulse Duration	27.7 µs	27.9 µs	27.5 µs	27.6 µs
Number of Serrated Vertical Pulses	6	5	2	2
Vertical Pulse Duration	190.7 µs (6 half-lines)	160 µs (5 half-lines)	63.56 µs (2 lines)	64 µs (2 lines)
Vertical Blanking Time	1.430 ms (22 1/2 lines)	1.568 ms (24 1/2 lines)	1.557ms/1.589 ms[b] (49/50 lines[b])	1.568 ms/1.600 ms[b] (49/50 lines[b])
Active Lines (Unblanked)	480 lines	576 lines	476/475 lines[b]	576 lines
Data Lines (useful Info)	428 lines	512 lines	428 lines	512 lines
Total Lines	525 lines	625 lines	525 lines	625 lines

a. p = Pixel

b. Alternating

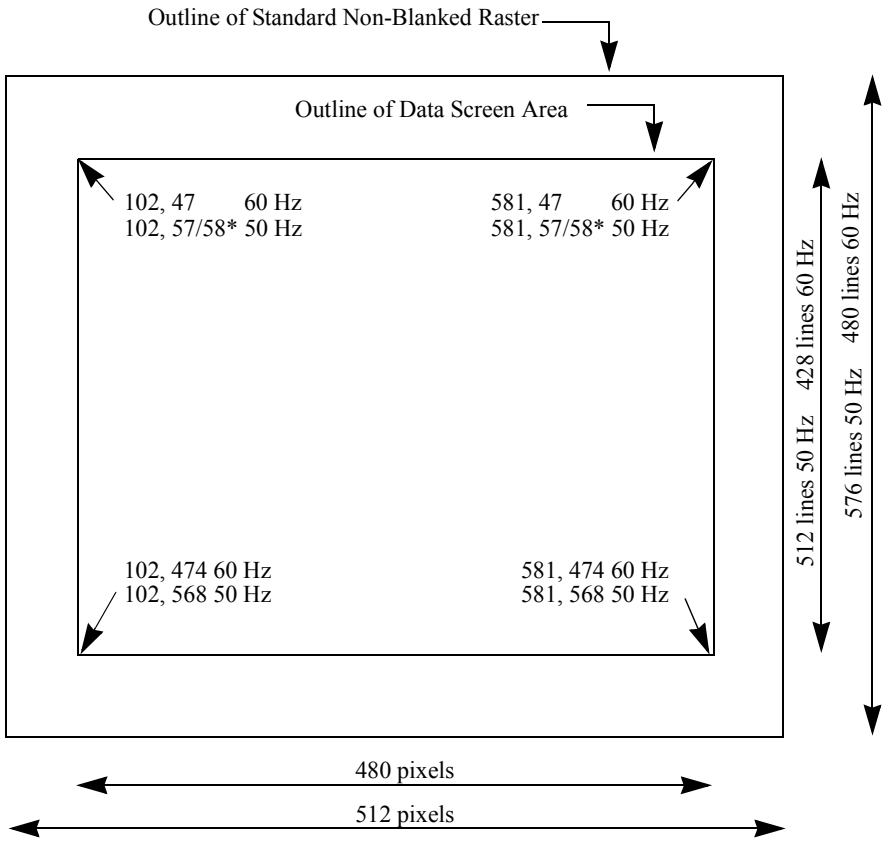
Figure 2-1 Video Raster Organization (Interlaced Video)



Nomenclature on corners in diagram:

X, Y: where X = horizontal pixel number
Y = vertical line number

Figure 2-2 Video Raster Organization (Non-Interlaced Video)



Note* Alternating: line #57, then line#58.

Nomenclature on corners in diagram:

X, Y: where X = horizontal pixel number
Y = vertical line number

Figure 2-3 Horizontal Line Timing (Interlaced and Non-Interlaced)

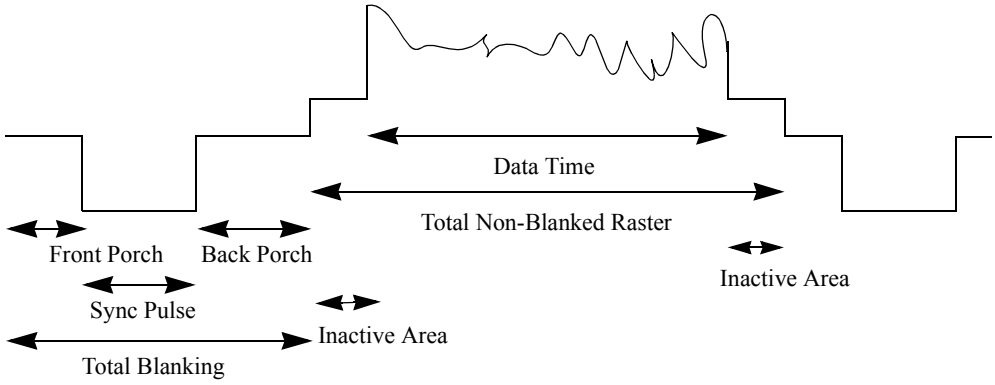
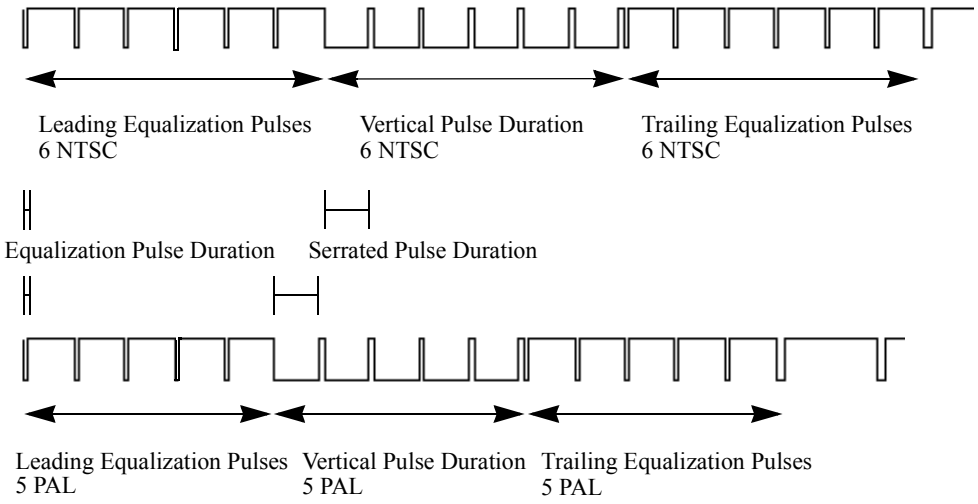


Figure 2-4 Vertical Line Timing (Interlaced Only)



3 Service Data

About This Section

This section contains practical data that may be useful when troubleshooting the M2424A. Reference data, such as power supply test points and DIP switch configuration settings have been grouped together in an effort to localize information that is used often. Disassembly procedures for removal and replacement of system modules is also included in this Section.

NOTE

For Resident Self Test (RST) troubleshooting procedures, see Chapter 4, "Resident Self Test."

Repair Philosophy

The approach to repairing this system is dictated by the complexity of the electronics and the surface mount technology used in the manufacture of individual circuit boards.

Experience indicates that modular system design, with complete interchangeability of circuit boards and other modules (without the need for even trivial adjustments), provides the most cost-effective and practical means of field repair. This modular field-exchange repair method minimizes system down time and maintains the high standards of performance.

PC Board Exchange

The more complex PC boards in the system are typically field-exchanged from a pool of lower-cost *Exchange* units that are compatible boards that have been refurbished and are readily available from the factory. For Exchange unit part numbers, see Chapter 8, "Parts Lists and Exploded Views." Maintaining a readily available inventory of Exchange units for the less complex PC boards loses its price advantage, so Exchange units are not available for the less complex PC boards—those boards have to be purchased new.

OEM Instrument Exchange

OEM instruments such as VCRs and Printers can also be field-exchanged from an available pool of factory refurbished *Exchange* units. All OEM Exchange units are refurbished and tested to meet manufacturers specifications.

Transducer Exchange

Most transducers in the system are typically field-exchanged from a pool of lower-cost *Exchange* units—transducers that have been refurbished and are readily available from the factory. For Exchange unit part numbers, see "Transducer Exchange" on page 8-5. Some transducers, such as non-imaging transducers are not available as exchange units and need to be purchased new. For part numbers, see Table 8-3 on page 8-5.

Service Tools

In addition to a set of basic hand tools, the following are recommended and should be available when troubleshooting or servicing the M2424A:

CAUTION

Most hardware throughout the system has been transitioned to metric standards, however where the fastener depends on OEM components (example: the trackball), hardware is SAE (English dimensioned thread). All Torx hardware is metric.

Required Tools

- Long (10 to 12 in) Pozi drive screwdriver
- Torx screwdriver set: # 10, 15, and 25
- Long T15 driver (minimum eight inches)
- Phillips screwdriver
- Long screw/nut grabber or magnetic holder
- Rachet wrench with 10mm/13mm sockets; plus 6 inch extension
- Voltmeter (accuracy 1% or better)
- Safety Analyzer
- Anti-static wipe pad (for cleaning EL touch screen panels)

Supplementary Accessories

These additional items are often helpful when servicing the M2424A:

- Spare System Cables
- Full complement of substituting boards
- Computer keyboard, monitor, and mouse for optional Digital Network Interface or Integrated Digital Interface. For more information, see the DNI and IDI Service Manuals.
- Ultrasound Phantom, ATS Model 539 or equivalent. The ATS Model 539 Phantom is particularly suited to field use because of its tolerance to low temperatures. The manufacturer's specification is > -40° C. The unit is supplied in a travel case.

Service Access

General accessibility to various areas within the system cart are described in the following paragraphs. For the location of each item, see Figure 3-1 on page 3-6. For more detailed views of each item, see to Chapter 8, "Parts Lists and Exploded Views."

Service Precautions

Observe the following precautions to prevent damaging the M2424A during service procedures.

CAUTION

All M3 (T10 drive) & M4 (T15 drive) screws require a torque setting of 10 in-lbs (1.2 N-m). Overtightening these screws during servicing could result in damaged screw-threads in the cart chassis casting.

CAUTION

NEVER raise the cart top for access to the E-Box while a transducer is still plugged-in at the front of the system. To do so may cause the transducer cord to become caught on one of the modular components at the front of the cart, resulting in unwanted strain or stress on the transducer cord as the cart top is being lifted.

CAUTION

NEVER raise the cart top for access to the E-Box until you have checked that the system monitor is securely mounted on its twivel base.

Air Filter Access

Two filters that filter dust from the cooling air intakes at the bottom of the cart are removable for cleaning. The filters slide into position on the left and right sides of the cart base.

Both filters can be removed by sliding them forward, toward the front of the cart. The filters can be rinsed clean with warm water and replaced by sliding them back into their mounts *after they are dry.*

Cart Side Panel Trim

The plastic side panel trim can be removed from each side of the cart by raising the cart top assembly. Press the two recessed latches, one on each side of the cart just below the Keyprocessor Electronics, and raise the cart top assembly on its two rear corner hinges. You can then remove the four screws (two at the bottom and two at the top) and screw inserts that hold each side panel in place. Once the four screws are removed from either panel, the panel will fall away from the cart. It may be helpful to place a small flat blade screwdriver between each screw head and its associated screw insert, and gently lift the screw while removing it from its insert.

E-Box and PCB Access

The E-Box and its complement of PC cards are accessible by raising the cart top assembly. Press the two recessed latches, one on each side of the cart just below the Keyprocessor Electronics, and raise the cart top assembly on its two rear corner hinges. You can then remove the five Torx 15 screws that hold the top cover on the E-Box, to access the system Printed Circuit boards (PCBs) that are shown in Figure 3-2. When you replace the E-Box top cover, gently tap it down to assure that it is flush against the E-Box chassis before tightening the five screws that hold it in place.

Keyprocessor Electronics (Operator Control Panel)

Using a large flat blade screwdriver, loosen the two captured screws on the underside of the front handle (one under each corner). From the front of the system, lift the Keyprocessor Electronics control panel upward while pivoting the top of it toward you. Pull the panel toward you until the slide hinges inside the bottom two corners of the panel are fully extended.

Hold the control panel in this fully extended position and lift the service arm out of its two holding brackets inside the rear wall of the key processor area. Swing the service arm out and insert its free end into the hole provided behind the lower left corner of the left EL panel. All control panel components can be accessed while the system is energized. Plastic inserts like the keyboard buttons may be pried up and lifted for easy cleaning.

Speakers

Access to the four system speakers requires removal of the cart top cover. For details, see “Cart Top Assembly” on page 3-33.

Power Supply

The power supply is mounted inside the left rear corner at the back of the cart, and consists of two modules: the Power Factor Corrector (PFC) Module and the DC to DC Converter Module. An air duct cover fitted between both of these modules assures adequate air flow passage in both. The air duct cover must be in place whenever the power supply is operating, to prevent overheating of either power module.

To access the power supply, use a large flat blade screwdriver to turn the “lock” at the top of the cart rear door counter-clockwise and remove the door from the cart. See “Power Supply Removal/Replacement” on page 3-18 for more information.

Figure 3-1 M2424A Ultrasound System

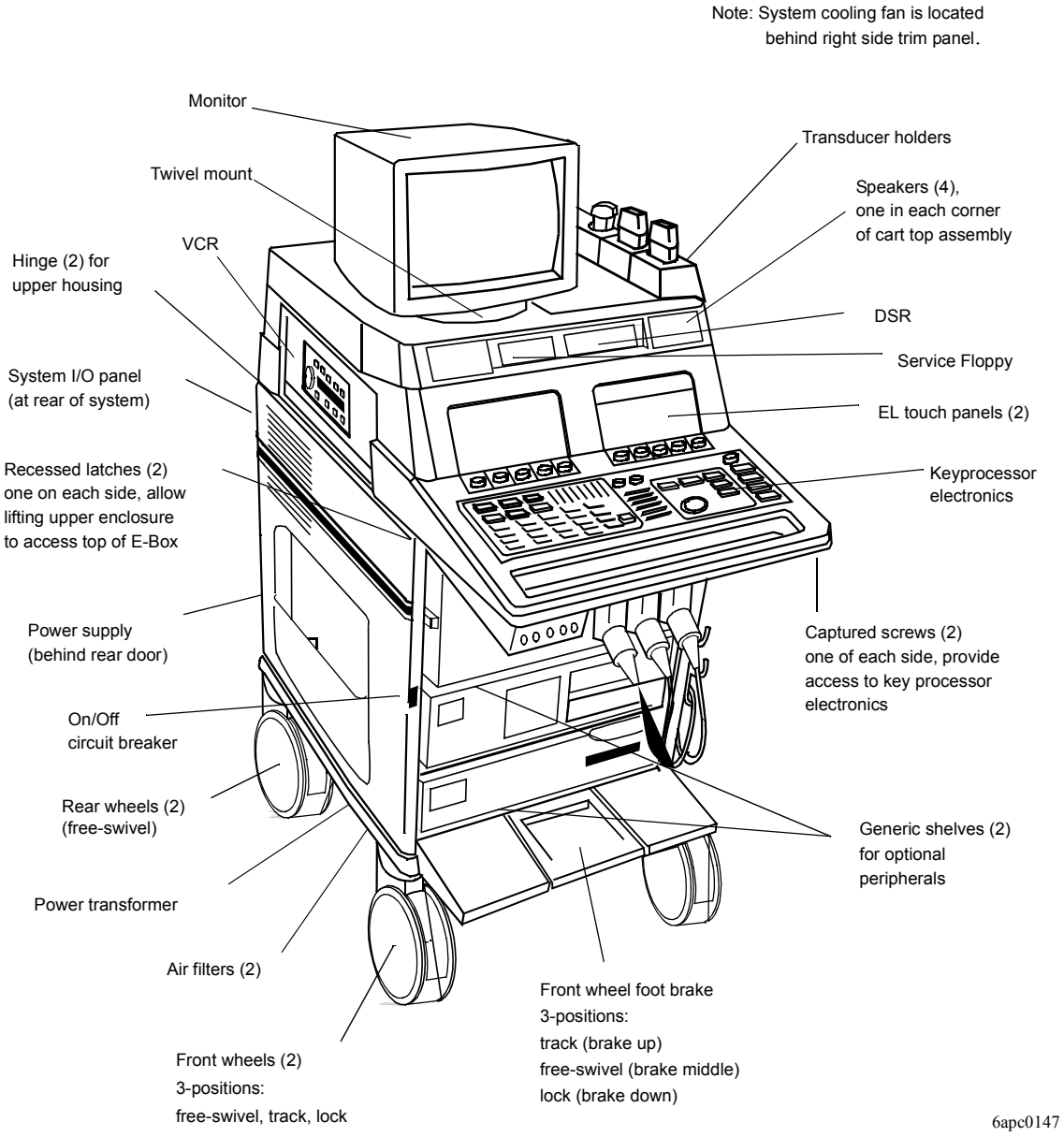
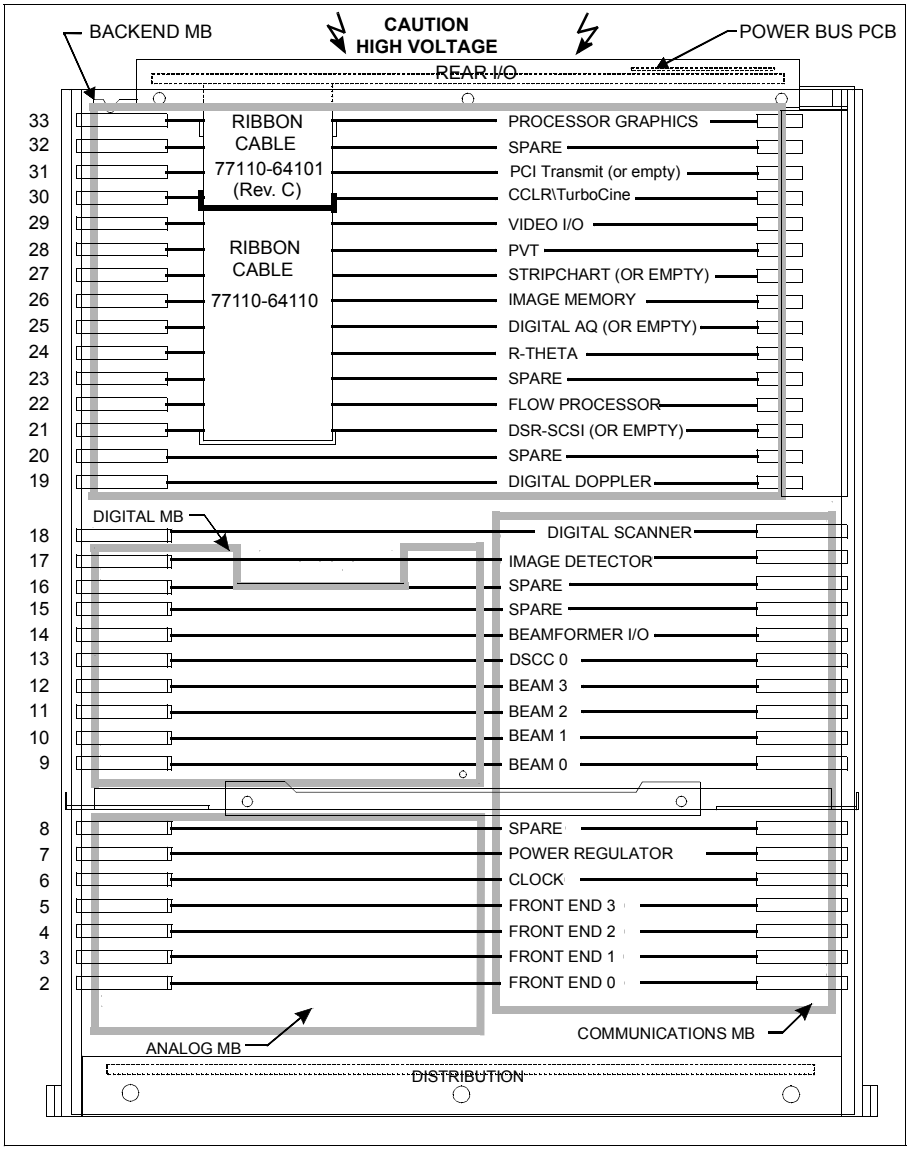


Figure 3-2 E-Box PCB Allocation



Power Distribution

See Figure 3-3 on page 3-10.

AC Power Distribution

AC power from the primary source enters the M2424A via the system power cord, and passes through the On/Off circuit breaker switch. This AC power then becomes isolated by the isolation transformer located in the bottom of the system cart.

The isolation transformer supplies AC power to the cart's power outlet strips, which in turn provides AC power to all system peripherals, the system monitor, and the system power supply.

DC Power Distribution

All DC voltages originate at the system power supply and are delivered to the E-Box through the Rear I/O panel. The following DC voltages are generated:

- +3.3V
- +5VD (Digital)
- +5VA (Analog)
- +12V
- -12V
- +170V
- -170V
- +24V
- +85V
- -5V

+3.3V, +5VD, +5VA Voltages

The +3.3V, +5VD and +5VA pass through the Rear I/O Panel over three large black cables that are bolted to three bus bars. The bus bars pass below the Rear I/O, and through a small circuit board called the Power Bus Bar PCB; this small circuit board has no active components, however its multiple layers act as a large capacitor which filters RF noise that may try to enter or leave the E-Box by way of the bus bars. The bus bars also pass beneath the Back End Motherboard and Communications Motherboard, and are bolted to both of them.

The 3.3V supply is used by several boards which have low voltage ASICs (Application Specific Integrated Circuits). The +5VA (Analog) provides power to the analog boards in the Scanner section, while the +5VD (Digital) provides power to the remaining boards in the E-Box. These two +5V voltage supplies are separated from each other in an effort to reduce the introduction of noise from digital circuitry into the sensitive analog circuits.

+12V, -12V, +5V, -5V, +24V, +170V, -170V Voltages

All DC voltages other than the 3.3V, +5VD and +5VA are routed to the E-Box through a cable harness that connects to a “D” connector on the Rear I/O Panel. These voltages pass through the Back End Motherboard, the Scanner I/O PCB and the Communications Motherboard, which distribute power to numerous other locations throughout the E-Box.

Additionally, the +12V -12V, and +5V are routed up to the Crossover Filter board in the Keyprocessor, and then on to the Keyscanner Main I/O board for use throughout the Keyprocessor circuitry.

Power Distribution to Circuit Boards

Table 3-1 through Table 3-3 list DC voltages distributed to each board in the M2424A.

Figure 3-3 Power Distribution Block Diagram

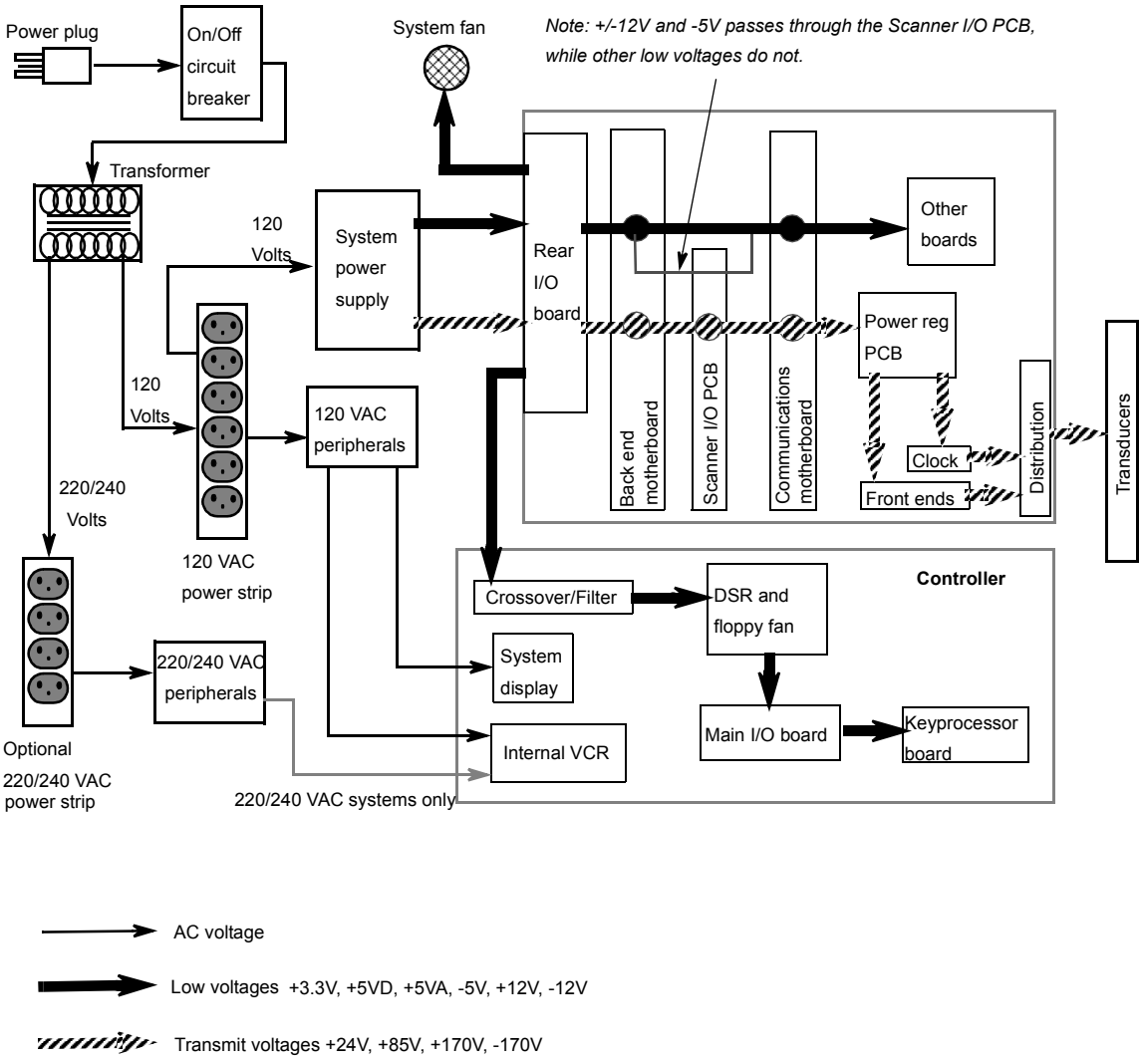


Table 3-1 DC Voltage Distribution, Scanner Section

Board	+5A	+5D	+3.3	-5	+12	-12	+24	+85	+170	-170
Distribution	X				X	X				
Front End	X			X	X	X				
Clock	X				X	X				
Power Regulator	X			X	X	X	X	X	X	X
Beam	X		X	X	X					
DSCC		X								
Beamformer I/O		X			X	X				
Image Detector		X	X							
Analog Motherboard	X			X	X	X	X	X	X	X
Digital Motherboard										
Comm. Motherboard	X	X	X	X	X	X	X	X	X	X

Table 3-2 DC Voltage Distribution, Scan Converter Section

Board	+5A	+5D	+3.3	-5	+12	-12	+24	+85	+170	-170	V Batt
Rear I/O		X			X	X					
Processor Graphics		X			X						S/X 3.5V
CCLR/TurboCine		X			X	X					
Video I/O		X		X	X	X					
PVT		X		X	X	X					
Stripchart				X	X	X	X				
Image Memory		X									
Digital AQ		X									

Table 3-2 DC Voltage Distribution, Scan Converter Section

Board	+5A	+5D	+3.3	-5	+12	-12	+24	+85	+170	-170	V Batt
R-Theta-AC		X									
Flow Processor		X									
DSR-SCSI		X									
Digital Doppler		X		X	X	X					
Digital Scanner I/O	X	X		X	X	X					
Backend Motherboard	X	X	X	X	X	X	X	X	X	X	
Cart Fan					X	X					

Table 3-3 DC Voltage Distribution, Keyscanner Section

Board	+5	-12	+12
Filter/Crossover	X	X	X
Function	X	X	X
EL Panels	X		X
Keyscanner/Audio	X	X	X
Physio I/O	X	X	X
Physio	X	X	X
QWERTY	X	X	X
DSR Drive	X		X
Floppy Drive	X		
DSR/Floppy Fan			X

E-Box Power

Power enters the E-Box by two different means. First, the three high current supplies (3.3V, +5VD, and +5VA) enter through the three heavy black power cables bolted to the bus bars which emerge from the E-Box Rear I/O. Second, the lower current supplies (+/-12V, -5V, +24V, +85V and +/-170V) enter by way of the 25-pin D connector labeled “E-Box Power”.

The three lower voltages that pass through the bus bars are routed through a board called the Power Bus Bar PCB. This board acts as a RF filter which keeps RF from either entering or leaving the E-Box. This board has no active components. The bus bars pass under the Back End Motherboard and the Communications board. They are bolted to each of these boards and provide power to all of the E-Box circuit boards. See Table 3-1 on page 3-11 through Table 3-3 on page 3-12. The +5VA (analog) and +5VD (digital) are separated from each other in an effort to keep digital “noise” from contaminating the sensitive analog circuitry.

The higher voltages that pass through the D connector are routed from the Rear I/O directly to the Back End Motherboard. From there they pass through the Scanner I/O board and onto the Communications Motherboard.

Power Regulator Board

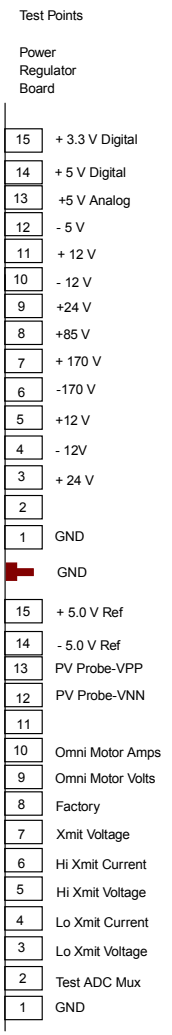
The best place to measure all of the various power supplies is on the two Molex test connectors located on the top edge of the Power Regulator PCB (see Figure 3-4 on page 3-14). In general, the voltages measured on these test points are approximately 300 mV less (due to line losses) than measuring the same supply on the back of the power supply itself.

The Power Regulator PCB has the capacity to limit the HV from the system power supply (i.e. a fault condition would limit the current and generate an error message). If any of the four transmit voltages were to become short circuited, all four supplies would be latched Off. (If any power supply output is shorted, that module would be latched Off.) Once the short circuit has been discovered and removed, the power from the system power supply will recover and begin normal operation when the AC power is re-applied. There are no fuses on the power Regulator PCB or on the other boards through which these supplies pass.

NOTE

Voltage test points are also provided on the DC to DC Converter Module (see Figure 3-5 on page 3-17).

Figure 3-4 Power Regulator Board Voltage Test Points



Voltage Testing Notes:

+ 3.3 V Digital (Main power bus. Measure +/- 0.1V)
+ 5 V Digital (Main power bus to digital circuitry. Measure +/- .15 V)
- 5 V Analog (Main power bus to analog front end circuits. Measure +/- 0.15V)

- 5 V (Measure +/- 0.5V)
+ 12 V (Measure 11.5 V to 12.8 V)
- 12 V (Measure - 11.5V to -12.8 V)

+ 24 V (one of 4 Hi voltage supplies for Xmit circuits. Measure +/- 0.7 V)
+ 85 V (One of 4 Hi voltage supplies for Xmit circuits. Measure +/- 5.1 V)
+170 V (One of 4 Hi voltage supplies for Xmit circuits. Measure +/- 5.1 V)
- 170 V (One of 4 Hi voltage supplies for Xmit circuits. Meausre +/- 5.1 V)

+12/-12 & +24 V Filtered(Same as + 12/-12/+24 Above, except that it has gone thru additional filtering on the Power Regulator PCB. Filtering reduces above voltages by approximately 300 mV.

+ 5.00 V. Reference Voltage used by P.R. PCB to do self testing. Measure +/- 50 mV)
- 5.00 V. Reference Voltage used by P.R. PCB to do self testing. Measure +/- 50 mV)
PV Probe VPP (PV Probe positive bias supply) Measure a range of +45 V, +/- 7 volts, with PV probe activated. Does not vary with gain.

PV Probe VNN (PV Probe negative bias supply) Measure a range of -110V, +/- 7 volts, with PV probe activated. Does not vary with gain.

Omni Probe Motor Current (Factory use).
Omni Probe Motor Voltage (Voltage that drives the Omni Probe. Probe motor must be moving. Polatity changes. Measure a range of 3.7 V to - 3.7 volts)
Factory (only used for factory testing)

All of the following voltages vary according to GAIN (for 2D) and XMIT POWER (for Doppler) The voltages shown apply to a 21330A Probe, You must be in the MODE indicated:

Transmit Voltage (Range: 3 to 130 Volts. Mode = 2D)
High Voltage Xmit Supply Output Current (Factory use)
Hi Voltage Xmit Supply Output Voltage (Range: 3 to 130 volts. Mode = 2D)
Lo Voltage Xmit Supply Output Current (Factory use)
Lo Voltage Xmit Supply Output Voltage (Range: 0.8 to 8 volts. Mode = CW Doppler)
Test ADC MUX Output (Factory use)
GND==Testing Reference Point

CAUTION: This board has high voltages with significant current capacity !

Power Supply Servicing

The M2424A power supply consists of two modules:

- Power Factor Corrector (PFC) Module
- DC to DC Converter Module.

The PFC Module is located at the bottom of the system cart, below the DC to DC Converter. An air duct cover installed between the two modules assures adequate air flow passage in both. The air duct cover must be in place whenever the power supply is operating, to prevent overheating of either power module. For detailed assembly drawings, see Figure 8-10 on page 8-38.

PFC Module

WARNING

DO NOT attempt to open the PFC for troubleshooting or repair. There are no replaceable parts within the PFC and internal voltages could present dangerous electrical shock hazards.

The PFC is powered from the 120V power strip, which supplies *isolated* power from the system transformer. The PFC has three functions:

- It converts AC input power to a high current DC supply (215V)
- It acts as a power conditioner by keeping the current levels in phase with the AC supply voltage (unity power factor)
- It provides a small housekeeping supply voltage; this voltage is used by both the PFC and DC to DC Converter circuits and powers the internal fans

The 215V and small housekeeping voltages are sent from the PFC to the DC to DC Converter through a cable and Molex connector that is located between the two sections (behind the air duct). If the PFC circuits are functioning properly, the 215V LED on the bottom right of the DC to DC Converter (see Figure 3-5 on page 3-17) will be On. If the PFC has a problem, the 215V LED and all of the other LEDs on the DC to DC Converter will be Off.

DC to DC Converter Module

The DC to DC Converter section of the Main Power Supply receives 215 volts from the PFC and, using seven separate converters, creates the +5VA, +3.3V, +5VD, +12V, -12V, HV, and -5V supplies. The HV operates as a single unit, even though it consists of four different high transmit voltages (+24V, +85V, +170V, and -170V). These four HV supplies are sent to the Power Regulator board where they are used to transmit pulses to the transducers.

Power Supply Troubleshooting Hints

There are no replaceable parts or fuses in the PFC, nor in the DC to DC Converter except for the fan assembly. Therefore, the power supply is repaired by module exchange. If you suspect a power supply problem, use the following information to help confirm your observations.

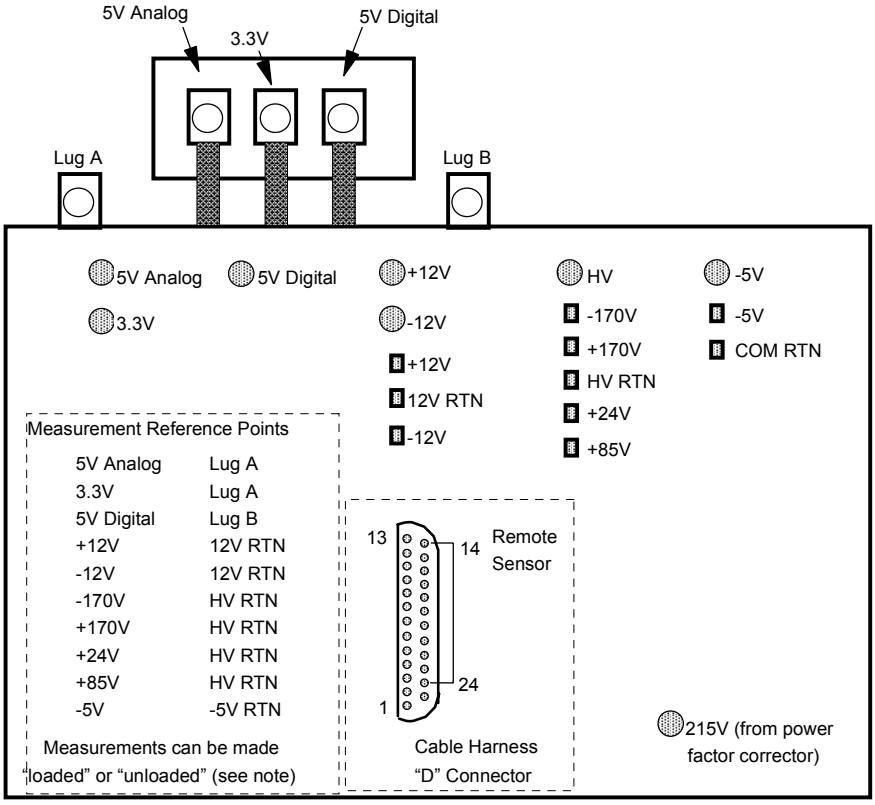
If any one of the four HV supplies from the DC to DC Converter Module becomes shorted, all four will shut down.

If the PFC and all DC to DC voltage converters are working properly, all LEDs on the back of the DC to DC Converter Module (see Figure 3-5 on page 3-17) will be On. Should any given voltage converter LED encounter an overcurrent or overvoltage condition within the power supply itself or externally, its associated LED will latch Off. All of the DC to DC Converter (but not the PFC) LEDs will also turn Off if the power supply does not receive a signal from the “remote sensor”; i.e. pin 14 of the power supply harness “D” connector. The remote sensor is connected to the heat sensor on the Rear I/O board. If the E-Box overheats, this thermistor will disconnect the signal to the power supply and the system will shut down. When troubleshooting the power supply, disconnect the “D” connector from the back of the E-Box, then short pin 14 (the sensor) to pin 24 (-5V ground). This will isolate the power supply from the E-Box and simulate a *normal* remote sensor signal.

The transmit HV voltages (+24V, +85V, +170V, and -170V) act as a single unit and will all latch Off if any one of them encounters an abnormal condition. Correction of the problem and recycling system AC power is necessary to restore their operation.

All low voltages, including the large low voltage busses (+5VD, +5VA and +3.3V) cannot be damaged by a short circuit. If they are shorted, they will be latched Off. Recycling AC power is necessary to restore operation.

Figure 3-5 Power Supply Rear Panel LEDs and Test Points



Voltage Tolerances (under load)

Description	Variance	Description	Variance	Description	Variance
+5V Analog	+/- 0.15V	-12V	+/- 0.36V	-5V Analog	+/- 0.15V
		12V RTN	Reference	COM RTN	Reference
+5V Digital	+/- 0.15V	+12V	+/- 0.36V		
		-170V	+10V		
+3.3V	+/- 0.1V	+170V	+10V		
		+24V	+2V		
		+85V	+5V		

Note: Jumper pins #14 and #24 to disable the E-Box sensing circuit and operate the Power Supply with the 25-pin "D" connector removed from the E-Box. Unloaded voltages may be slightly higher than shown above.

Power Supply Voltage Test Points

All power supply voltages can be measured by means of test points on the rear of the DC to DC Converter. Figure 3-4 on page 3-14 shows the locations for these test points and lists the expected voltage variations for each supply under load conditions. It is possible to measure voltages with the supplies disconnected from the E-Box, but expect the voltages to read a little higher than shown in the tolerance chart. If you suspect that the supply might be disabled due to a problem inside the E-Box, check this by disconnecting the power harness cable from the E-Box and shorting pins 14 and 24 in the cable harness "D'" connector as discussed in "Power Supply Troubleshooting Hints" on page 3-16.

NOTE

Voltage test points are also provided on the Power Regulator board (see Figure 3-4 on page 3-14).

Power Supply Removal/Replacement

For detailed assembly drawings, see Chapter 8, "Parts Lists and Exploded Views."

Begin by removing the DC to DC Converter Module:

1 Turn off the system power and unplug the system power cable from the wall outlet.

2 Remove the system cart rear door.

3 Remove the four screws that hold the cart's lower rear panel in place (the panel through which the power cord passes).

4 Remove the four screws that hold the air duct in place. Pull the air duct straight back to remove it from the system.

5 Disconnect the power harness "D" connector at the Rear I/O Panel connector labeled E-BOX POWER.

6 Using a socket wrench with 6-inch extension and 10 mm socket, remove the three nuts that hold the three low voltage power cables to the back of the E-Box. The three cables are labeled for ease of reinstallation.

7 Disconnect the molex cable connector below the DC to DC Converter that connects the PFC.

8 Remove the two nuts (10mm) on the bottom lip of the DC to DC Converter chassis.

9 Remove the three nuts (10mm) on the top lip of the DC to DC Converter chassis, where it attaches to the rear of the E-Box.

NOTE At this point the DC to DC Converter is free from the cart, but is held in place by a bracket on the cart chassis.

10 Slide the peripheral cables out of the way and pull the DC to DC Converter backwards and out of the cart. The PFC will remain inside the cart.

CAUTION **DO NOT** position the DC to DC Converter upright after it is removed from the cart! Instead, lie it on its side. The converter is not balanced and could fall over and become damaged.

11 Unplug the PFC from the 110 Vac power outlet strip.

12 Pull the PFC toward the rear of the cart and out of the system.

13 To reinstall the power supply modules, perform all of the above steps in reverse order.

NOTE Make sure you hold the nut behind the power lug to prevent the voltage from shorting out on the Bus Bar Board.

CAUTION When reinstalling the power supply, be sure to position the lower mounting lip of the DC to DC Converter behind the upper mounting lip of the PFC or the rear door of the system will not close properly.

CAUTION **NEVER** operate the power supply for more than one minute without the air duct in place. If the air duct is improperly installed, the power supply will overheat and shut off!

Power Supply Internal Fan Assembly Removal/Replacement

The two fans internal to the power supply are part of an assembly that can be removed from the DC to DC Converter Module as follows:

1. Remove the Power Supply DC to DC Converter Module from the cart as described in "Power Supply Removal/Replacement" on page 3-18.

2. Remove the six screws that hold the fan assembly inside the DC to DC Module:
   a. Four screws on the bottom edges (two at each side).
   b. One screw is in the center of the back (near the bottom edge).
   c. One screw is in the center of the front (near the bottom edge).

3. Insert a flat blade screw driver between the fan assembly face plate and the power supply case (at the point on the center/front of the power supply where the screw was removed in step 2c above). The fan assembly will slide out of the power supply case.

4. Disconnect the fan's power wires from the board on which it is connected inside the power supply.

5. Replace the entire fan assembly. Reinstall the new fan assembly by reversing the above procedure.

Power On/Off Circuit Breaker

The circuit breaker on the front-left corner post of the cart provides protection between the primary electrical source voltage and the system power supply. The circuit breaker also is used to turn the M2424A On and Off.

Circuit Breaker Removal/Replacement

Perform the following procedure to remove or replace the M2424A On/Off circuit breaker switch. For detailed assembly drawings, see Figure 8-11 on page 8-40.

WARNING **Be sure to unplug the system power cord from the primary source voltage before performing the following procedure. Otherwise, internal voltages present at the circuit breaker could present dangerous electrical shock hazards.**

1 Turn the circuit breaker Off (down) and unplug the system power cord from the primary voltage supply source.

2 Remove the left side plastic trim panel from the cart.

3 Remove the cover (two Torx 10 screws) that surrounds the rear of the circuit breaker.

4 Remove the two Torx 10 screws that hold the circuit breaker in place. Pull the circuit breaker out from behind its mounting location and remove the insulator that is surrounding the breaker.

5 Mark the four wires that connect to the rear of the circuit breaker, so that they can be replaced on the same terminals. Label them top left/right and bottom left/right *as viewed from the rear of the breaker.*

6 To replace the breaker, perform the above steps in reverse order. **Be sure to replace the insulator and** to reinstall the breaker with proper On/Off orientation. Switch label “1” must be facing up and “0” facing down.

7 Perform system electrical safety checks as defined in “Electrical Safety Test Procedures” on page 6-10.

Power Transformer

The power transformer is located beneath the cart. It accepts power from the system power cord and supplies the necessary primary voltages throughout the system power supply.

Power Transformer Removal/Replacement

Perform the following procedure to remove or replace the M2424A power transformer. For a detailed assembly drawing, see Figure 8-14 on page 8-46.

WARNING **Be sure to unplug the system power cord from the primary source voltage before performing the following procedure. Otherwise, internal voltages present at the power transformer could present dangerous electrical shock hazards.**

CAUTION The power transformer is very heavy. It weighs more than 50 pounds. Be sure to grasp it securely when sliding it out of the cart.

1 Fully extend both peripheral shelves by sliding them out at the front of the cart.

2 Unplug the rear panel cables at the peripheral rear panels, and unplug the peripheral power cords from the internal power strip at the rear of the cart.

3 Remove both peripheral shelves from the cart by pressing the "spring tab" within the outer channel of the left and right sliding rails. Pressing this tab allows the *inner* slide rail sections to be pulled further out of the cart, until they disengage from their outer slide rail sections. You do not need to unstrap the peripherals from the shelves.

4 Remove the screws that secure the cover plate from the floor of the cart, beneath the bottom peripheral shelf, and remove the cover plate to obtain access to the top of the power transformer.

5 Disconnect the cord from the *primary* terminals on the power transformer. Be sure to mark which two primary terminals the power cord is being disconnected from, so that the cord may be properly replaced.

6 Disconnect the system power wires connected to the *secondary* terminals on the power transformer. Be sure to mark the wires being disconnected, so that they may be properly replaced.

7 At the bottom of the cart, remove the two bolts that secure the power transformer in place at the bottom of the cart.

8 Lift the transformer out from the front of the cart.

9 To replace the transformer:

a. Unplug all power cords from the internal power outlet strips at the rear of the cart (to prevent accidental damage to peripherals).

b. Perform the above steps in reverse order, then check the voltage at each outlet in the power outlet strip(s).

c. If voltages measure correctly at the power outlet strips, plug-in the power cord for each peripheral.

d. Perform system "Electrical Safety Test Procedures" on page 6-10.

Power Line Voltage Conversion

If it becomes necessary to power the system from a different source voltage than setup at the factory, you have to:

1 Check the source voltage jumper configuration at the primary terminals on the system power transformer.

2 Change the system power cord connections at the primary side of the power transformer.

3 Install the optional 240V power outlet strip at the rear of the cart, if it is not already installed.

4 Connect the cable for the above 240V power outlet strip at the secondary side of the power transformer.

NOTE

The optional power terminal outlet strip is factory-installed only in systems manufactured for 220/240 VAC operation. This 220/240VAC power outlet strip must be added to the inside of the right rear cart post, as viewed from the rear of the cart, whenever a 110/120 VAC system is field-upgraded to operate from a 220/240 VAC source.

Proceed as follows (see Table 3-7 on page 3-67).

1 Remove the peripheral shelves from the front of the cart, and remove the cover plate from the floor of the cart. For details, see "Power Transformer Removal/ Replacement" on page 3-21.

2 Check the jumpers at the ***PRIMARY*** terminals of the power transformer. (The *primary* terminals on the transformer have six available screw connections, while the secondary terminals have only five.)

a. For 100 VAC or 120-127 VAC source voltage, jumpers should be positioned between ***PRIMARY*** terminals 1-2, and 3-4 as shown in Figure 3-6 on page 3-26 (count terminals from right to left).

b. For 220 VAC, 230 VAC or 240 VAC source voltage, jumpers should be positioned between ***PRIMARY*** terminals 2-3 as shown in Figure 3-6 on page 3-26 (count terminals from right to left).

NOTE

Jumpers for the transformer terminals are metal clips that fit beneath the screw on each terminal, thereby connecting two terminal contacts together.

3 Connect the system power cord to the ***PRIMARY*** terminals on the transformer as follows. Be sure to count terminals *starting at the right side* of the terminal strip. Also note that the domestic standard *white (common) wire is blue on international power cords*, and the domestic standard *black (+) wire is brown on international power cords*.

a. For 100 VAC source voltage, connect the power cord white (common) wire to primary terminal number 1 and the black (+) wire to primary terminal number 6.

b. For 120 VAC source voltage, connect the power cord white (common) wire to primary terminal number 1 and the black (+) wire to primary terminal number 4.

c. For 220 VAC source voltage, connect the power cord white (common) wire to primary terminal number 1 and the black (+) wire to primary terminal number 6.

d. For 230 VAC source voltage, connect the power cord white (common) wire to primary terminal number 1 and the black (+) wire to primary terminal number 5.

e. For 240 VAC source voltage, connect the power cord white (common) wire to primary terminal number 1 and the black (+) wire to primary terminal number 4.

4 Perform this step only if setting up the cart to operate from a 240V AC source, and the optional factory installed 240V terminal strip *is not present:*

a. Mount the 240V terminal strip next to the 120V terminal strip, inside the right corner post of the cart (as viewed from the rear). Use the pre-drilled and tapped holes provided for the optional terminal strip in the cart.

b. Route the loose ends of the 240V power transformer cord, P/N 77921-64320, (the other end of this cord plugs into the optional 240V power strip) through the one-inch hole provided in the rear of the cart floor. Note there are five access holes; use the one on the right as viewed from the rear of the cart.

c. Connect the loose ends of the 240V power transformer cord to the ***SECONDARY*** terminals on the transformer. The ***SECONDARY*** terminals are the lower set of *five* terminals at the transformer. The brown wire connects to ***SECONDARY*** terminal number 1, and the Blue wire connects to terminal number 2 (see the 240 Volt wiring configuration in "Power Transformer Primary and Secondary Terminals" on page 3-26).

d. Ground the Green/Yellow common wire by fastening it to the cart chassis at the lower left front corner of the cart.

e. Plug the other end of the 240V transformer cord into the male connector on the 240V outlet strip.

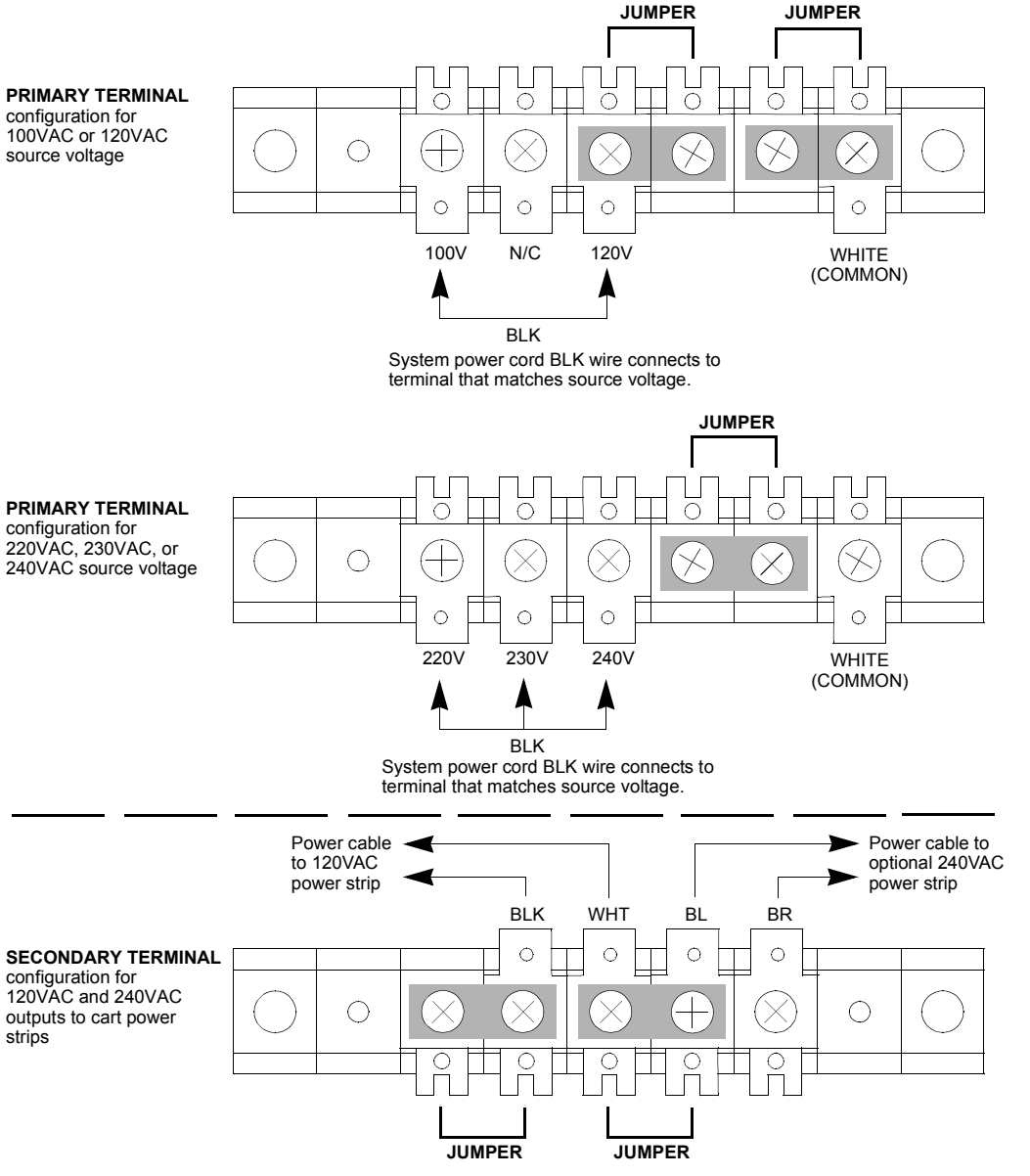
NOTE

The 240V outlet strip has a 4-ampere fuse located behind a small plastic cover below its 3-prong male connector. Use a small flat blade screwdriver to remove the cover if access to the fuse becomes necessary.

5 Perform system "Electrical Safety Test Procedures" on page 6-10.

6 Replace the cover plate in the floor of the cart and replace the peripheral shelves by performing the above steps in reverse order.

Figure 3-6 Power Transformer Primary and Secondary Terminals



System Cooling Fan

The system cooling fan is a large fan assembly mounted within the right side wall of the cart. It supplies cooling for the E-Box and system Printed Circuit boards.

NOTE

There are two other fan assemblies mounted in the M2424A: one in the Floppy Drive/DSR chassis at the top of the cart, and another in the DC to DC Converter chassis of the system power supply. For more information, see "Power Supply Servicing" on page 3-15 and "Cart Top Assembly" on page 3-33.

System Cooling Fan Removal/Replacement

Perform the following procedure to remove or replace the M2424A system cooling fan. See Figure 8-15 on page 8-48 for a detailed assembly drawing.

1. Remove the right side plastic trim panel from the cart.
2. Unplug the system fan cable from the FAN connector at the E-Box Rear I/O Panel and feed the cable through the cutout at the right side of the cart.
3. Remove the fan mounting plate (eight Torx 15 screws) from the side of the cart. Be sure to hold onto the mounting plate while removing the screws so that it doesn't fall.
4. Remove the cooling fan assembly and cable from its mounting plate (four Torx 15 screws).
5. To replace the cooling fan, perform the above steps in reverse order.

System Monitor

The Color Monitor is a critical component of the system which requires precise video adjustments before being shipped from the factory. These video adjustments cannot be duplicated in the field and therefore field service procedures are very limited in scope. In most cases, the preferred service method is exchange.

NOTE

Confirm the part number of the monitor before servicing it. The non-interlaced monitor has no internal serviceable parts or user adjustments.

Monitor Removal/Replacement

Refer to Figure 3-7 when performing these procedures.

1 Remove the power connector clamp at the rear of the monitor, then unplug the power cord and video cables from the rear of the monitor.

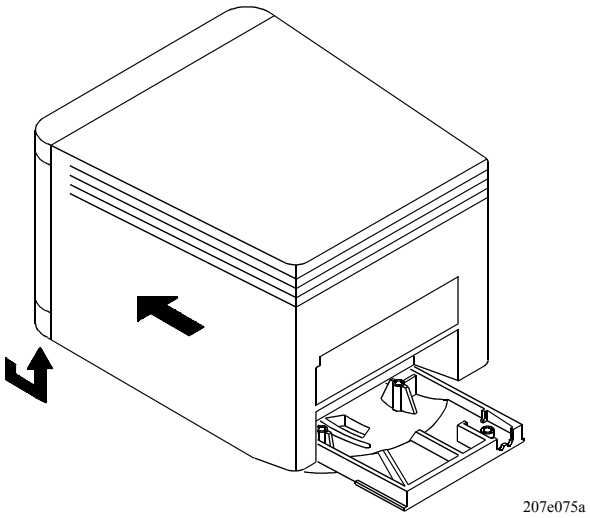
2 Slide the monitor off the twivel base:

a. locate the release bar beneath the center of the screen.

b. Push the release bar upward to unlock the monitor base and then slide the monitor forward and upward until it lifts off the twivel mount. BE CAREFUL, THE MONITOR IS HEAVY!

3 To replace the monitor, slide the rear of the monitor base backward onto the front of the twivel mount; slide the monitor back until you hear its base “snap” into its locked position on the twivel. Then plug in the video cables and power cord.

Figure 3-7 Removing Color Monitor from Twivel Base



Monitor Disassembly/Reassembly

NEVER disassemble the monitor further than described below. See Figure 8-17 on page 8-53 for reference.

1 Make note of the monitor brightness and contrast control knob numerical settings beneath the “detent” line that is printed below each knob on the front bezel. This will help you reset the knobs to the customer’s settings when the monitor is reassembled.

2 Remove the monitor from the system as described earlier in this section. Place it face down on a soft surface to prevent scratching or damaging the monitor glass.

3 Using a long #1 Phillips screwdriver, loosen the four screws at the back of the monitor that secure the plastic case to the front bezel. Lift off the plastic case and turn it upside down to let the 4 screws fall out of their respective holes.

4 Unscrew the 4 bezel clamp screws that secure the front bezel to the monitor. (Loosen these screws until the clamps release from their white shock mounts.)

5 Remove the 4 bezel clamps and lift the monitor assembly off its front bezel. If replacing the bezel, remove the 4 white bezel shock mounts from the old bezel and install them on the new bezel.

6 To reassemble the monitor, reverse the above procedures. Be sure to set the brightness and contrast knobs to the customer's original detent position. Also be sure that the color temperature switch on the back of the monitor is set to position #1.

Monitor Knob Replacement

To replace the Brightness and Contrast knobs, disassemble the monitor as described above. After the front bezel is removed, you can pull the knobs from their shafts. The knobs are not keyed, however proper knob alignment is important; therefore follow the steps below to replace/align the knobs:

1 Turn the knob shaft fully counterclockwise.

2 Align the replacement knob so that the "0" on the knob is facing in the six o'clock position—the "0" is at the very lowest position possible.

3 Push the knob onto the shaft as far as possible, then reassemble the monitor as described above.

Monitor Image Centering Adjustment (Interlaced Monitor)

The image displayed by the Color Monitor can be adjusted to center it in the screen. Before attempting this image centering adjustment, make note of the following:

- It is not necessary to remove the monitor from the system to perform this adjustment. Leave the monitor in its operating position.
- Limit your adjustment to the controls described below; DO NOT attempt to adjust any other monitor controls in the field!
- Always use an insulated screwdriver or tuning tool.
- Warm up the monitor for a minimum of 30 minutes before starting the adjustment.

WARNING

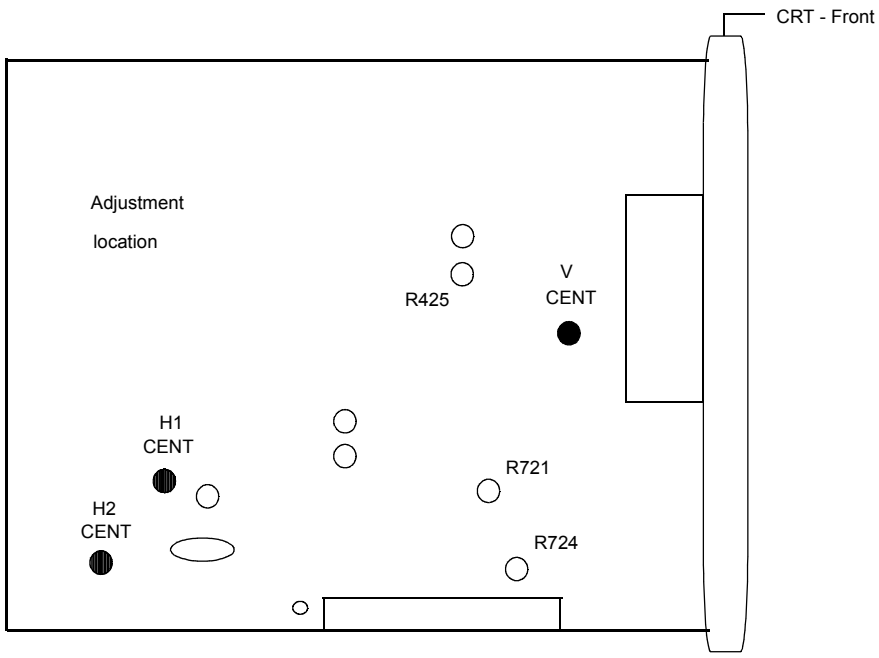
HIGH VOLTAGE! When the system is powered-up, 500–800 VDC are present at exposed heat sinks and at a test point on the main PCB in the Data Ray monitor (the PCB mounted on the left side when looking at the screen where the adjustments are located).

Image Centering Adjustment Procedure

1. Remove the cover from the monitor as described earlier in this section.
2. Power-up the system, press and hold the **Shift** key and press the **TEST** button on the system control panel. Display the "White Rectangle" test pattern by choosing the following selections from the test menus that are subsequently displayed:
   a. Other Tests & Utilities
   b. Test Patterns
   c. White Re*ctangle*
3. Adjust the V CENT (VERTICAL CENTERING) and H1 CENT (HORIZONTAL PHASE 1 CENTERING) control knobs shown in Figure 3-8 on page 3-31. Adjust until the displayed test pattern is centered inside the bezel when viewed from a height even with the top of the monitor at a distance of 3 feet.

NOTE For 50 HZ systems, use H2 CENT (HORIZONTAL PHASE 2) instead of H1 CENT.

Figure 3-8 Color Monitor Image Centering Adjustments (Interlaced Monitor)


CRT - Front
Adjustment
location
R425
V
CENT
H1
CENT
H2
CENT
R721
R724

Cart Top Assembly

The cart top assembly consists of the housing which contains the following subassemblies:

- Monitor Twivel Base and Twivel Mounting Hardware
- Floppy Drive/DSR Chassis
- System Speakers (4)

Removal/replacement procedures for all subassemblies in the cart top are provided in the following procedures.

Cart Top Removal/Replacement

Perform the following procedure to remove or replace the cart top assembly. See Figure 8-15 on page 8-48 and Figure 8-16 on page 8-51 for detailed assembly drawings.

1 Remove the monitor from the system. For details, see "Monitor Removal/ Replacement" on page 3-28.

2 Remove the monitor twivel base (see Figure 3-9 on page 3-34):

a. Cut the cable tie (if present) that ties the monitor power cord and video cables together within the twivel base.

b. Using a Torx 15 screwdriver, remove the cable strain relief clamp from the rear of the twivel base.

c. Using a Torx 10 screwdriver, remove the cable clamps that secure the monitor power and video cables within the twivel base.

d. Unhook the tension spring from the spring holder stud at the front of the twivel base, then remove the two Torx 15 screws from the twivel washer. Remove the spring, spring clamp, and washer from the twivel.

e. Feed the monitor cables down through the holes in the bottom of the twivel base and lift the twivel base off the cart top assembly.

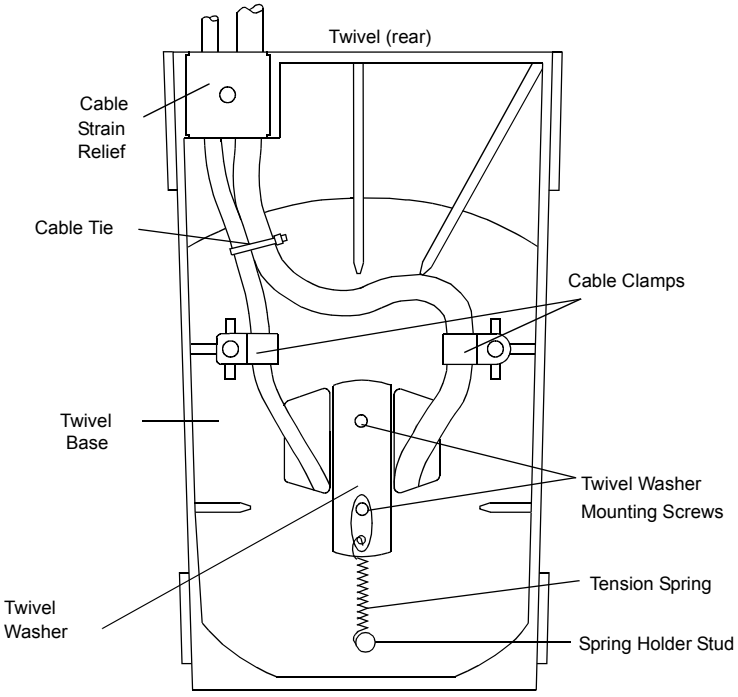
3 Open the Keyprocessor Electronics panel at the front of the cart. For details, see "Keyprocessor Electronics (Operator Control Panel)" on page 3-4.

4 Using a Torx 25 screwdriver, remove the two screws that secure the back of the cart top assembly to the cart (these two screws are located just above the cart's rear handle brackets).

5 Gently push the cart top assembly toward the rear of the system until it disengages from the cart, then lift the rear of the cart top slightly so that you can unplug the speaker wire connector. Feed the monitor cables down through the swivel mounting hardware and remove the cart top from the system.

6 To replace the cart top assembly, perform the above steps in reverse order. After the twivel base is replaced, be sure to perform the twivel friction adjustment which follows.

Figure 3-9 Twivel Base



Top View

Twivel Friction Adjustment

Perform the following friction adjustment after the twivel is reassembled, or when twivel movement is unsatisfactory.

Remove the color monitor from the system. Loosen both mounting screws that hold the Twivel Washer in place within the Twivel Base. Re-tighten each Twivel Washer screw a little at a time, until the twivel base can move back and forth freely but with some friction when slight pressure is applied.

Twivel Mounting Hardware Removal/Replacement

1 Remove the cart top assembly and twivel base from the system. For details, see "Cart Top Removal/Replacement" on page 3-33.

2 Remove the 2 screws (one at each end) that secure the twivel top retainer plate to the twivel bottom retainer plate within the cart top (see Figure 3-10 on page 3-36).

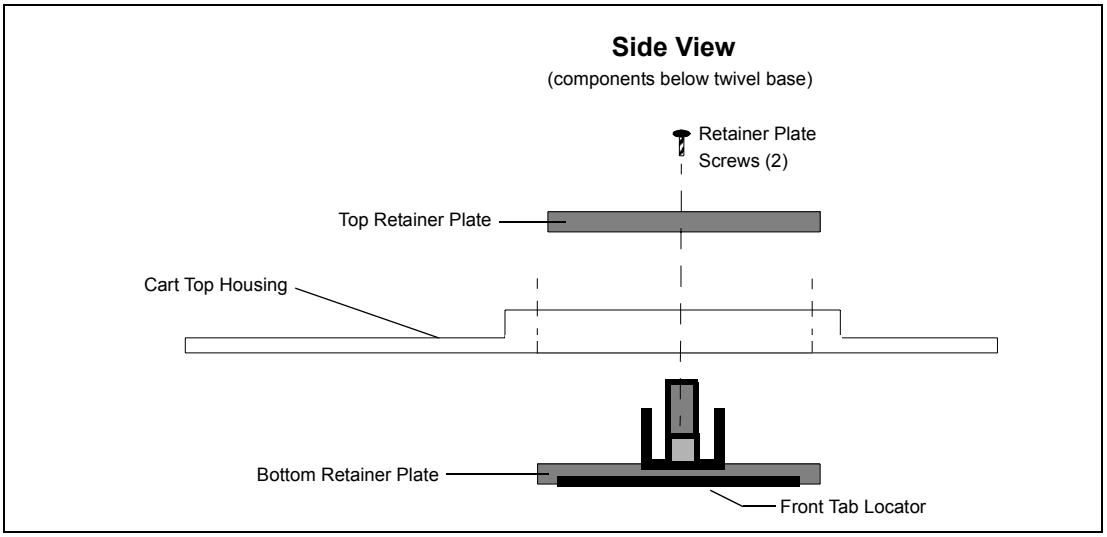
3 Remove the top retainer plate and bottom retainer plate from the cart top assembly.

4 To reassemble the twivel mounting hardware, perform the above procedure in reverse order.

NOTE

WHEN REASSEMBLING THE TWIVEL:
The bottom retainer plate (step 3 above) MUST be installed with its extended locator tab positioned toward the front of the cart.

Figure 3-10 Twivel Mounting Hardware



Floppy Drive/DSR Chassis Removal/Replacement

1 Open the Keyprocessor Electronics (control panel) section as described under *Service Access* at the beginning of this chapter.

2 Slide the Floppy Drive/DSR chassis toward the front of the cart, so that the "tail" extending from the rear of the chassis releases to allow the chassis to be removed from the cart.

3 Unplug the two connectors at the rear of the Floppy Drive/DSR chassis: one 9-pin connector and one SCSI connector. (Note that if the ultrasound system includes the optional Digital Network Interface or Integrated Digital Interface unit, two SCSI cables will be present at the rear of the Floppy Drive/DSR chassis.)

4 Using a Torx 15 screwdriver, remove the ground wire connected to the Floppy Drive/DSR chassis.

5 To replace the chassis, perform the above steps in reverse order.

Floppy Drive or DSR Drive Removal/Replacement

1 Remove the Floppy Drive/DSR Chassis from the cart as described above.

2 Using a Torx 15 screwdriver, remove the three screws that secure the chassis top cover and remove the cover.

3 Unplug the SCSI ribbon cable from the rear of the floppy or DSR. (Note: when replacing these cables, be sure that the red stripe faces toward the left side of the connector(s) as viewed from the rear.)

CAUTION

When performing the next step be very careful; the power connectors are difficult to unplug, and the wires going into these connectors can be easily pulled from the connectors and damaged.

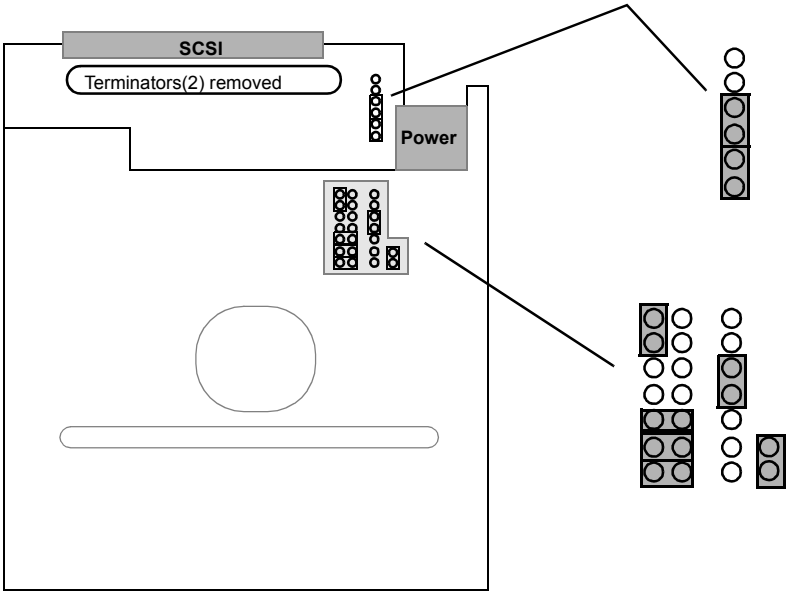
4 Unplug the power connector from the floppy or DSR.

5 Remove the four screws holding the floppy or DSR drive to the chassis and lift out the drive.

6 Replace either drive by performing the above steps in reverse order. Be sure to verify that the jumpers and switch settings on the replacement drives are set properly as defined below.

7 Set all jumpers as shown in Figure 3-11 on page 3-38.

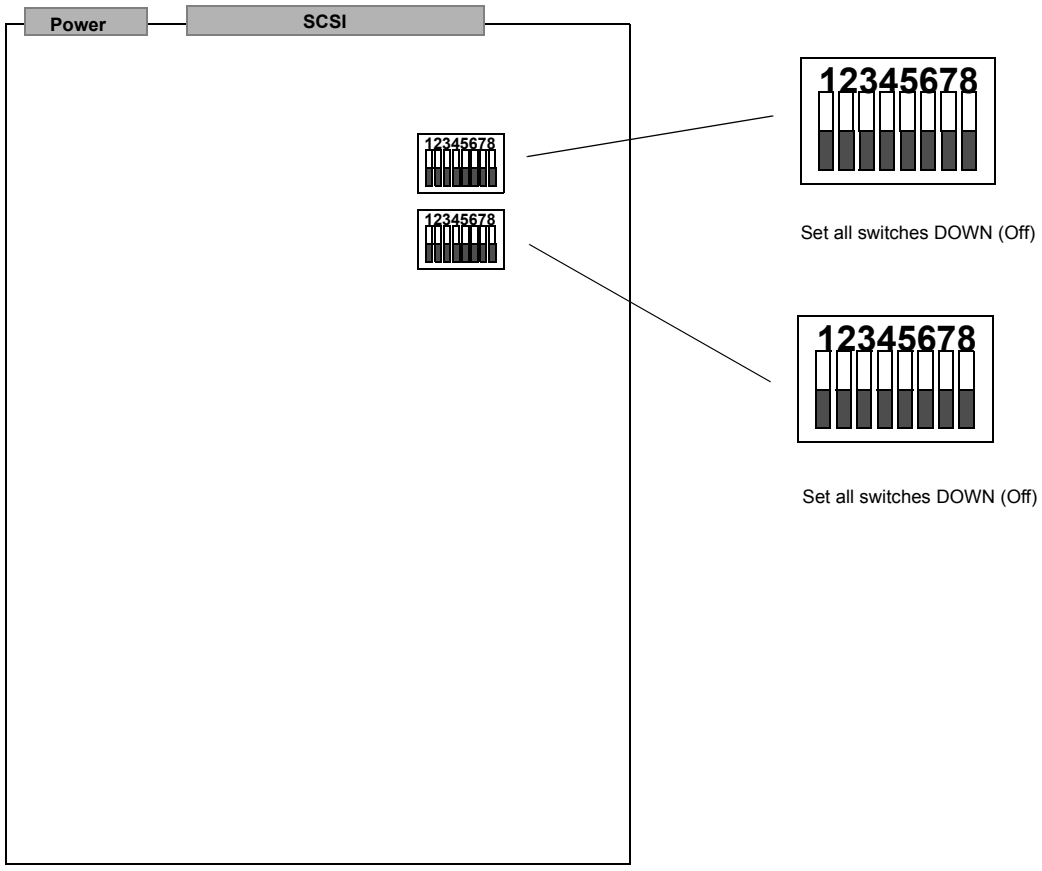
Figure 3-11 Floppy Disk Drive Jumper Settings



Floppy Drive (front)

All switches should be down (Off) as shown in Figure 3-12.

Figure 3-12 DSR Drive Switch Settings (4X, 8X)



NOTE

If the optional 77470A Digital Storage and Retrieval or 77471A/B Integrated Digital Interface instrument is NOT installed on a shelf at the front of the cart, then a terminator (p/n 1252-3251) should be connected to the unused SCSI connector at the rear of the Floppy Drive/DSR module.

Jumper Settings for DNI SCSI Drive (77470A)

There are two possible jumper settings to verify. Open up the DNI to access the drives. Inspect the label on the SCSI (D) drive to determine the revision:

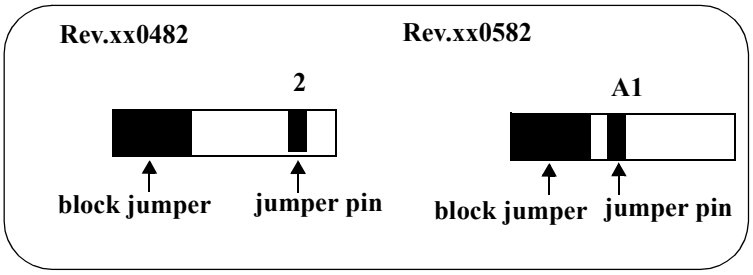
- xx0**482** - metal case
- xx0**582** - black case

NOTE When inspecting the label, only the bold numbers are important - the xx digits do not matter.

To locate the D drive, please refer to the *DNI Service Manual* (77470A).

Set the jumpers as shown in Figure 3-13.

Figure 3-13 DNI SCSI Drive Jumper Settings



Jumper is on the second set of pins from the right

Jumper is on the second set of pins from the left

Floppy Drive/DSR Chassis Internal Cooling Fan Removal/Replacement

Perform the following procedure to remove the cooling fan assembly from the Floppy Drive/DSR Chassis.

1 Remove the Floppy Drive/DSR Chassis from the cart as described earlier in this section.

2 Using a Torx 15 screwdriver, remove the three screws that secure the Floppy Drive/DSR chassis top cover and remove the cover.

CAUTION When performing the next step be very careful; the power connectors are difficult to unplug, and the wires going into these connectors can be easily pulled from the connectors and damaged.

3 Unplug the power connectors from both the floppy drive and DSR drive.

4 Using a small nut driver, remove the two screw posts that secure the 9-pin connector to the Floppy Drive/DSR Chassis rear panel.

NOTE When performing the next step, observe the placement and the direction of the fan, and that air flow is towards the Floppy/DSR Chassis.

5 Remove four rivets that secure the cooling fan assembly to the Floppy/DSR Chassis cover.

6 To replace the fan assembly, perform the above steps in reverse order. When replacing the fan, mount it so that the air will be pulled into the Floppy/DSR Chassis when operational.

7 Secure cover and reinstall enclosure into the system.

NOTE If your system serial number is less than US97805948, order the Fan Assembly Upgrade kit listed in Table 8-8 on page 8-19.

E-Box Removal/Replacement

The E-Box contains the majority of the system Printed Circuit boards. These PC boards plug into four separate Motherboards which receive power from the system power supply.

Perform the following procedure to remove or replace the E-Box assembly. For a detailed assembly drawing, see Figure 8-8 on page 8-34.

WARNING

The E-Box weighs approximately 70 pounds, therefore use caution when removing this assembly. Assistance may be needed.

1. Using a large flat blade screwdriver, turn the cart rear door lock counterclockwise and remove the rear door. Unplug all cable connectors at the Rear I/O Panel (the I/O panel is the rear panel of the E-Box chassis).

2. Using a 10mm socket and 6-inch extension, remove the three low voltage (+5A, +3VA, +5VDC) power cables from the Rear I/O Panel. Note that these cables are labeled for re-connection when the E-Box is reinstalled.

3. Using the same socket and extension as above, remove the three 10mm mounting nuts that secure the top of the DC to DC Converter (power supply) to the bottom of the E-Box rear panel. Be careful not to damage the wiring/connectors at the top of the power supply.

4. Press the two recessed latches, one on each side of the cart just below the Keyprocessor Electronics, and raise the cart top assembly on its two rear hinges.

5. Remove the three Torx 15 screws from underneath the cart's front plastic trim panel, and lift the trim panel off of the three "tabs" that hold the top of it in place at the front of the E-Box.

6. Remove the four Torx 15 screws from the E-Box left and right front mount flanges.

7. The E-Box can now be removed by sliding it out from the front of the cart.

Keyprocessor Electronics (Control Panel)

The Keyprocessor Electronics assembly includes all of the operator controls for the system. For information on accessing the assembly, see "Service Access" on page 3-3.

Touch Screens Removal/Replacement

The touch screens in front of the EL panels are exposed to mechanical damage like scratches etc. due to their location within the system. If it becomes necessary to replace the screens, follow the procedure and guidelines below (see Figure 3-14 on page 3-45).

CAUTION

Whenever the EL panels or touch screens are disassembled, extreme care must be taken to wipe the entire inside mating surfaces of both the touch screen and EL panel with an ANTI-STATIC wipe pad, or a staticide dampened lint-free cloth. Failure to properly perform this anti-static cleaning requirement may leave an electrostatic charge between the panel and screen surfaces, causing the display to emit a high-pitched whine.

NOTE

External surfaces of the touch screens (the surface used by customers) can be cleaned with a water moistened cloth or an isopropyl alcohol solution.

1. Remove power from the system.
2. Loosen the two captured screws beneath the cart handle and lift the keyboard assembly so that the rear of the EL panels are facing up. Make use of the service arm stored in the main top housing to keep the keyboard panel in the open service position.
3. Remove the four screws holding the panel. There is no need to disconnect it, but it may be easier to remove if you disconnect the two ribbon cables at the EL panel PC Board. Set the panel aside.
4. **With care**, disconnect the four conductor flexible ribbon that is integrated to the touch panel. **PROCEED WITH CAUTION - A KINK IN THIS RIBBON CABLE MAY DESTROY IT!**

5 Now you may lift the touch panel from the locating pins. Make sure to clean the area around where the panel meets the housing.

6 Reassemble the unit being sure to wipe clean the mating surfaces of the panel and screen as instructed in the ***CAUTION*** above. Allow the mating surfaces to air dry; do not wipe dry, as this may build a charge on the surfaces. After the surfaces are completely dry, assemble the panel and screen with as little sliding motion as possible.

Trackball Removal/Replacement

The trackball on the operator control panel can be removed and replaced as follows:

1 Remove power from the system.

2 Loosen the two captured screws beneath the cart handle and lift the keyboard assembly so that the rear of the EL panels are facing up. Make use of the service arm stored in the main top housing to keep the keyboard panel in the open service position.

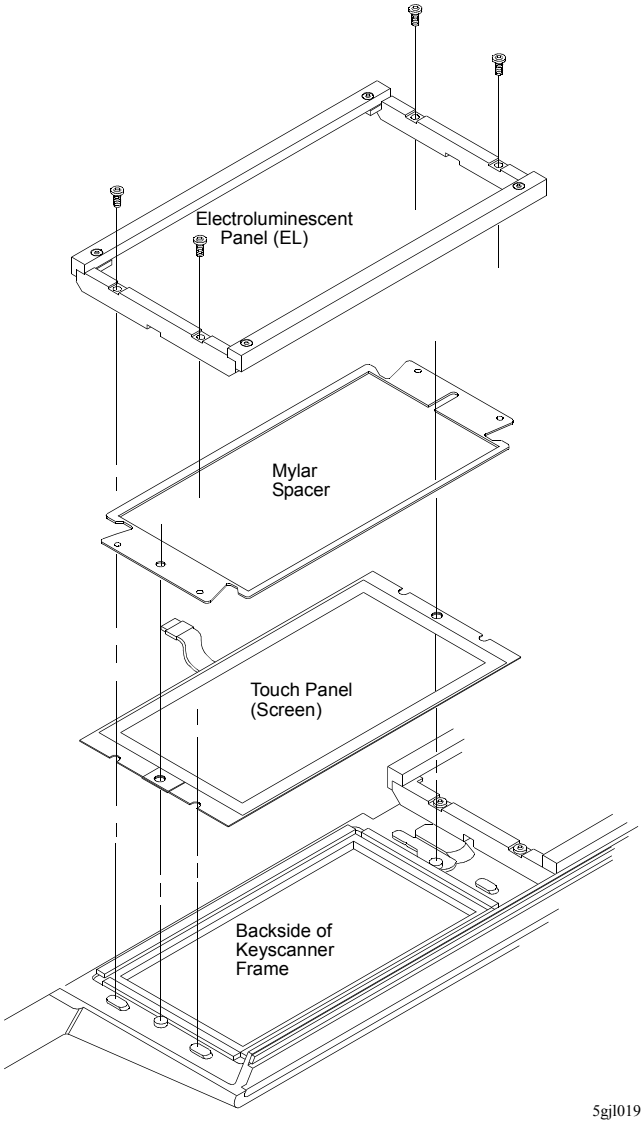
3 On the underside of the control panel:

a. Unplug the cable from the top of the trackball module.
b. Remove the four Torx 15 screws that secure the trackball module to the control panel casting.

4 Lift the trackball from beneath the control panel and remove it from the system.

5 To replace the trackball, perform the above steps in reverse order. (Be sure to reinstall the trackball module with its wiring connector facing up.)

Figure 3-14 Touch Screens Replacement



Cart Wheel Assemblies

The two rear wheels on the cart are different assemblies than the two front wheels. The rear wheels are fully free-wheeling and will roll and swivel whenever the cart is being moved. The front wheels may be set to one of three positions dependent on the position of the front foot pedal:

- When the foot pedal is in its fully raised position, both front wheels are set to their "tracking" position and the two front wheels are set in a straight line with the sides of the cart.
- When the foot pedal is in its middle (half-way up/down) position, both front wheels are set to their "free-swivel" position and the two front wheels are free to swivel in any direction dependent on the direction in which the cart is being maneuvered.
- When the foot pedal is in its fully lowered position, both front wheels are locked in a "brake" position and the two front wheels are locked and will not swivel nor roll (prevents the cart from moving).

Foot Brake Removal/Replacement

Perform the following procedure to remove or replace the front foot brake assembly. For detailed assembly drawings, see Chapter 8, "Parts Lists and Exploded Views."

To remove the brake pedal:

1 Swivel both front wheels so that they are locked *beneath* the cart and locked in their "tracking" position; the foot brake should be in its fully raised position.

2 Using a 10mm socket wrench, remove the two nuts at the bottom of the brake pedal.

3 Pull the brake pedal off the cart. Slight pressure may be needed to pull the pedal from its spring mounts that fit into indents at both sides of the pedal.

To remove the wheel locking shafts:

4 Slide both shafts the brake pedal are mounted on inward toward the center of the cart and remove them. (The opposite end of these shafts fit into an access hole within the cart's front wheels.)

To remove the brake pedal spring mounts:

5 Using a flat blade screwdriver, pry the metal spring mounts that fit into the indents at each side of the brake pedal out of their rubber grommets.

6 Pry the rubber grommets that hold the metal spring mounts out of the holes in the cart base.

To reassemble the foot brake:

7 Perform all of the above steps in reverse order to reassemble the foot brake. Be sure to swivel the front wheels beneath the cart in their "tracking" position when sliding the wheel locking shafts into position.

Front Wheel Removal/Replacement

Perform the following procedure to remove or replace either front wheel assembly. For detailed assembly drawings, see Figure 8-11 on page 8-40.

1 Remove the plastic side panel trim from the same side of the cart that the front wheel is being removed.

CAUTION After removing the cart's side trim panel, be sure to lower the cart top. Otherwise the system may become top heavy and fall over during the remainder of this procedure.

2 Remove the foot brake assembly as described in the previous procedure. Be sure the front wheels are swiveled "beneath" the cart and locked in their tracking position (foot brake positioned fully up) before removing the brake assembly.

3 Position wheel chocks in the front and rear of both wheels that are on the opposite side of the cart from where the wheel is being removed.

4 Lift the side of the cart where the wheel is being replaced approximately 2.5 inches off the floor. The best way to do this is with a small pneumatic jack positioned beneath the side of the cart. If a jack is not available, lift the cart and position a block beneath the side.

5 Using a 13mm socket wrench and extension, remove the bolt from behind the cart corner post that secures the wheel shaft to the cart bottom. The wheel should drop out of its mounting location when the bolt is fully removed.

6 To replace the front wheel, perform the above procedure in reverse order.

Rear Wheel Removal/Replacement

To remove either rear wheel from the cart, perform all of the above steps provided for front wheel replacement except for step 2 (the rear wheels are free-wheeling and are not controlled by the foot brake).

System Programming and Customer Presets

This section describes the numerous software paths, locations and functions for the system operating software that controls all system functions. In addition to the operating software, the user can also store patient information (*patient data*) and system *presets* in various locations. This section discusses the various software storage locations, methods of loading and down-loading operating software and customer presets. Figure 3-14 shows a block diagram of the software locations and software flow paths.

Service Floppy Disk Drive

The Service Floppy Disk Drive serves as the primary tool to load operating systems, customer preset back-ups, system options, software upgrades, and software fixes. System software can easily be loaded by booting from the software floppy diskettes. When loaded, the new software will overwrite the existing system software and provide the latest functionality to the system. In most cases, the system software will be contained in a “set” of diskettes. The Boot Block software must already be present on each of the processor circuit boards before system software can be loaded using the Service Floppy Disk drive.

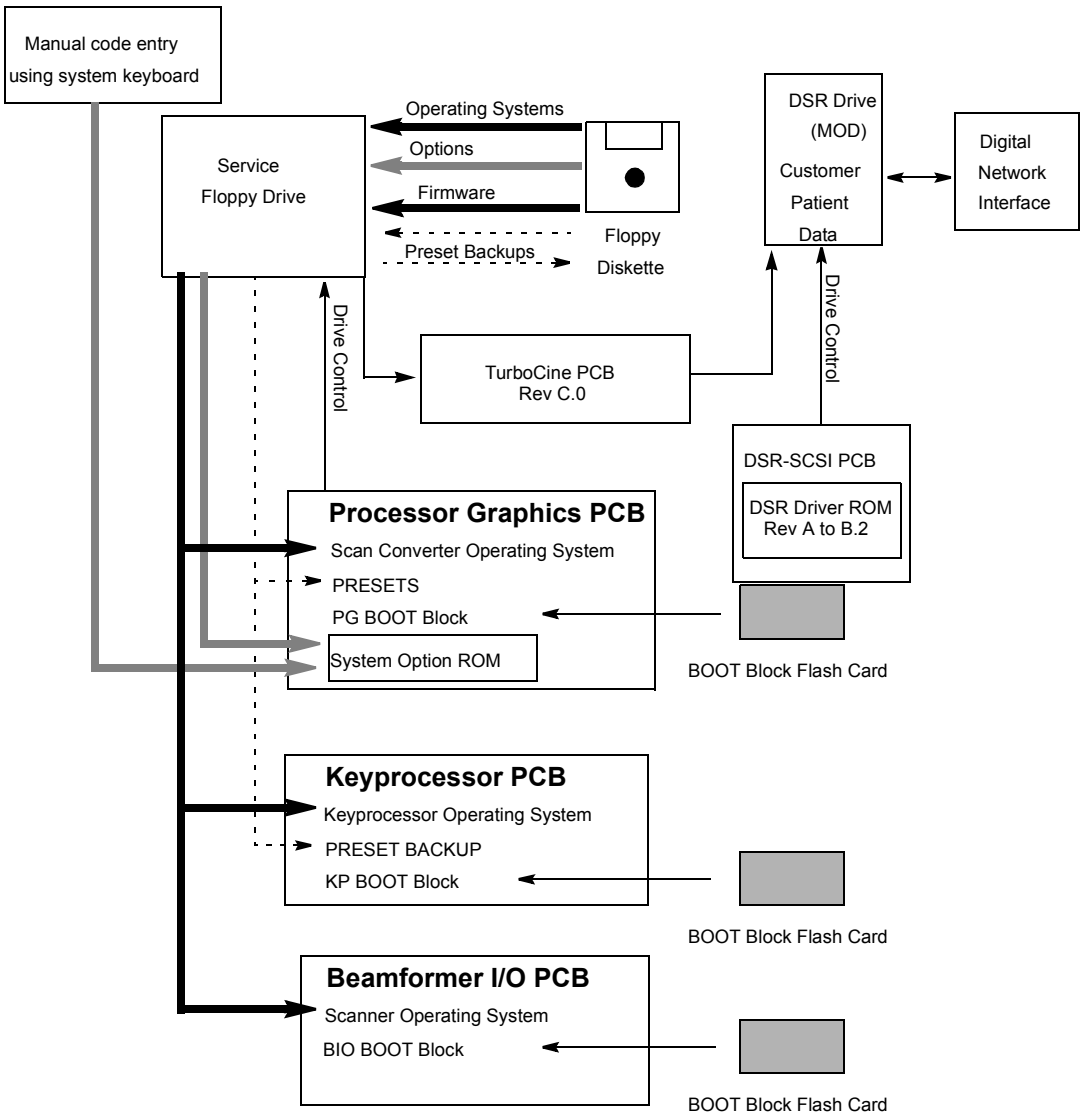
NOTE

It is recommended to unplug all transducers from the system before programming the system to prevent the loading process from having any effect on transducer EPROMs.

The Service Floppy drive, which is located in the Keyprocessor Section, can be used for loading system software, saving presets, and loading system options. If a customer has a Digital Network Interface (DNI) or an Integrated Digital Interface (IDI) installed, there will be another floppy drive on the system. The floppy drive located in the DNI/IDI is only for loading software related to the DNI/IDI itself.

Before any software upgrade, a backup of the customer configured software (institution name, and customer presets) should be made to the customer backup disk. The customer configured software should be restored from the backup disk following installation of new or replacement system software. Backup and restore procedures are described in Customer Presets later in this section.

Figure 3-15 System Software Block Diagram



Floppy Disk System Programming Procedure 1

To install system software, perform either this procedure or the following procedure (Procedure 2):

1. Turn system power Off. Insert system software disk number 1 then turn On the power.
2. After approximately 30 seconds, a message displays to indicate the revision level of the software that is about to be loaded, and instructions on how to continue.
3. Follow the on-screen instructions. Insert each subsequent upgrade disk and press **ENTER** when prompted.
4. When the software is completely loaded as indicated by the display, turn system power Off and remove the last upgrade disk from the disk drive.
5. Perform the Clear Bat-Backed RAM procedure on page 3-56.
6. Then power up the system and restore all user configured software from the customer's backup disk.

NOTE

Upon power up, the system will display three error messages. Disregard these messages that merely signify that new software has been loaded (the messages will not appear again)

7. Follow the instructions in "Restore Operation" on page 3-58 to restore all user configured software from the backup disk.

Floppy Disk System Programming Procedure 2

To install system software, perform either this procedure or the previous procedure (Procedure 1):

1 Turn system power On. Press Setup.

2 Press Service Floppy on the right touch panel.

3 Press Upgrade Software on the right touch panel.

4 Press **Okay**.

5 Follow the on-screen instructions. Insert each subsequent upgrade disk and press **ENTER** when prompted.

6 When the software is completely loaded as indicated by the display, turn system power Off and remove the last upgrade disk from the disk drive.

7 Perform the Clear Bat-Backed RAM procedure on page 3-56.

8 Then power up the system and restore all user configured software from the customer's backup disk.

9 Follow instructions in "Restore Operation" on page 3-58 to restore all user configured software from the backup disk.

TurboCine Firmware Downloading Procedure

To install the TurboCine firmware in C.0 systems:

1 Turn the system power Off.

2 Insert the TurboCine firmware diskette into the floppy drive.

3 Turn the system power On.
The floppy drive light is on while the firmware downloads.

4 When prompted, press **Enter**.

5 When a message appears that the download was successful, remove the diskette from the floppy drive and turn the system power off.

6 Turn the system power On.

Flash Card Programming Procedure

Some of the PC boards in the system have flash card connectors, providing the capability to temporarily insert plug-in flash cards that are designed to reprogram the system. Flash cards provide a quick and convenient means for entering the *boot block* software that is needed to load the system's operating system. As shown in Figure 3-15 on page 3-50, there is *boot block* software in each of the system's three processor circuit boards (the Processor Graphics, the Keyscanner, and the Beamformer I/O). Once this *boot block* software is loaded into each of these boards, it will allow each board to download its respective operating system from the Service Floppy Disk drive.

The *boot block* flash card consists of 3 boot programs, one for each of the system's processors. While the primary purpose of flash cards is to load the *boot block* software, flash cards can also be used to load the system's operating system, software fixes, software changes, and software upgrades. Use of flash cards to load the other non-Boot Block software would only be done in unusual circumstances (e.g. if the Service Floppy drive were not operational).

Flash card programming should be performed on only one section of the system at a time:

- Keyprocessor Electronics—program via the Keyscanner/Audio PCB
- Scanner section—program via the Beamformer I/O PCB
- Scan Converter section—program via the Processor Graphics PCB

1 Plug the flash card into the flash card connector on the PCB you want to program:

   a. Beamformer I/O PCB (see Figure 3-16 on page 3-61)
   b. Processor Graphics PCB (see Figure 3-19 and Figure 3-20 on page 3-70)
   c. Keyscanner/Audio PCB (see Figure 3-22 on page 3-73)

2 Set the flash programming DIP switch(es) *only on the board being programmed:*

   a. Beamformer I/O PCB—SW4 and SW5 are CLOSED.
   b. Processor Graphics PCB—SW7 in the *left* bank of switches is Up.
   c. Keyscanner/Audio PCB—SW3 in the small bank of 4 switches is On.

3 Power-up the system and/or press **RESET** at the system control panel. This initiates automatic programming on the board that has been setup in steps 1 and 2 above. During programming, the 4-digit LED display on the board provides specific indications as described in the following paragraphs. After the LED display verifies that programming was completed successfully, remove the flash card from the board.

Flash Card Programming Visual Indications

After initiating flash programming of any PCB, the following four-stage process occurs automatically:

Stage 1, Erase PCB Memory

First, on-board memory is erased. The 4-digit LED display on the PC board being programmed displays '**ERAS'** while the erase operation is underway.

Stage 2, Program PCB Memory

Next, on-board memory is programmed. The 4-digit LED display on the PC board being programmed displays '**PROG'** while the programming operation is underway. This is the longest stage of the three-stage procedure, depending on the type of software being loaded (loading Boot software is extremely fast).

Stage 3, Verify Programming

Last, on-board flash memory is compared word-for-word with the flash card's load data. The 4-digit LED display on the PC board being compared displays '**VERI**' while the comparison operation is underway.

Stage 4, Indicate Success/Failure

After the comparison of programmed PCB memory to flash cards load data is completed, the 4-digit LED display displays '**OK**!!' indicating that the procedure was successful. If programming was not successful, one of the error messages described in the Figure 3-15 on page 3-55 will be displayed by the LEDs.

Flash Programming Error Codes

The OK!! or error indication displayed by the LEDs remains present until the system is RESET. This allows the programmer to keep important information available until the programming procedure is completed.

Table 3-4 lists error messages that might be displayed by the 4-digit LEDs on the PCB during stage 4 of the flash programming procedure, if programming was not completed successfully.

Table 3-4 Flash Card Programming Error Codes

Displayed Code	Description
-VFY	The verify test failed. Check flash card or PCB that flash card is plugged into.
-ETO	The erase operation timed out. Check flash card or PCB that flash card is plugged into.
-VPP	The voltage was too low for successful programming. Check flash card or PCB that flash card is plugged into.
-SEQ	A sequence error occurred during the attempted erase. Check flash card or PCB that flash card is plugged into.
-ERA	The flash memory failed to erase. Check flash card or PCB that flash card is plugged into.
-WTO	The write (programming) operation timed out. Check flash card or PCB that flash card is plugged into.
-WRI	The write (programming) operation failed. Check flash card or PCB that flash card is plugged into.
-SIZ	Either the code size to be programmed exceeds the size of the on-board flash memory, or the flash card is plugged into a subsystem for which it has not load to program. Check flash card or PCB that flash card is plugged into.
-SWC	Switch settings are incorrect for the attempted flash update. Check the switch settings as defined in step 2 of the "Flash Card Programming Procedure" on page 3-53.
-CRD	The wrong flash card was used to program this circuit board.

Battery-Backed RAM

CAUTION

Before initiating the clear Bat-Backed RAM operation, always obtain pre-approval from the customer. The operation resets all of the customer configured presets, in addition to erasing the system error logs!

The battery-backed RAM on the Processor Graphics board is a nonvolatile memory that stores system error logs, as well as all operational presets configured into the system by the customer. The life expectancy of the battery on the Processor Graphics board is many years, ensuring that the contents of this memory is maintained. Provision has been made for a capacitor to hold CMOS voltage for several minutes so that the battery can be replaced without losing data stored in the RAM.

Clear Bat-Backed RAM:

Occasionally it may be desirable to reset the nonvolatile system memory, to clear the error logs and correct problems that may be caused by erroneous values in the memory region. You can erase the memory by executing the *Clear Bat-Backed RAM* operation as follows:

1. Press the **TEST** button on the operator control panel. After about 30 seconds the main Test menu will appear on the screen.
2. Select **OTHER TEST AND UTILITIES** from the menu
3. Select **MORE**
4. Select **CLEAR BATTERY BACKED RAM** and then acknowledge **OKAY** when prompted. Memory is now erased.

Another method of erasing the RAM is by means of the CLR jumper or the RESET push button on the Processor Graphics PCB (see Figure 3-19 and Figure 3-20 on page 3-70). ***Either*** move the jumper from pins 1 and 2 to pins 2 and 3, or press RESET. The CMOS memory will instantly be cleared. If the jumper was moved, be sure to return it to pins 1 and 2.

NOTE

The Backup/Restore procedures discussed in the Customer Presets section that follows allow you to backup customer configured Presets to floppy disk. The Presets can then be restored from disk at a later time.

Customer Presets

Customer presets are initially stored by the customer on the Processor Graphics PCB. Maintaining these presets requires that the battery on the Processor Graphics PCB is maintained at a minimum level of at least 3.0V. If the Processor board is changed, or the battery dies, customer presets could be lost. To avoid this possibility, the customer or Service Engineer can save these presets to the Keyprocessor or a Floppy disk. The procedure for saving to the Keyprocessor or to the Floppy Disk drive is as follows.

Saving Presets to the Keyprocessor

1 Push the **TEST** button on the operator control panel and wait for the main Test menu to appear on the screen.

2 Select **OTHER TESTS AND UTILITIES**.

3 Select **PRESET BACKUP**.

4 Select **BACKUP PRESETS TO KP** and acknowledge with **OKAY** when prompted.

Saving Presets to Floppy Disk

The backup procedure copies all of the contents of the battery back RAM to disk including the institution name that appears on the main screen, as well as the custom configured Presets. Perform the following procedure to back up all user configurable data.

1 Push the **SETUP** key from the operator control panel.

2 On the right-hand Touch Panel, push the **SERVICE FLOPPY** key.

3 Select **BACKUP PRESETS**.

4 Follow on-screen instructions as they appear:

a. Insert a blank formatted disk into the system's Service Floppy disk drive (see note below).

b. Select **OKAY** and press **ENTER**.

c. A message will appear indicating the backup is in progress. The information will be copied to the backup disk, and after a short time you will be asked to press **ENTER** (OKAY) to complete the procedure.

5 Remove the backup diskette from the disk drive and store it in a safe place where it can be used if restoration becomes necessary.

NOTE

You can format the disk if necessary by canceling the Backup Setup operation, and selecting the Service Floppy—Format Diskette selections that appear under the SETUP menu. Follow the instructions displayed for the disk formatting operation. Also, only the presets from one system can be saved on a diskette. Do not put the presets from two different systems on the same diskette unless both sets of presets are identical.

Restore Operation

The restore operation overwrites all customer configured information in the system's battery-backed RAM, with information from the customer backup disk. A restore is recommended following execution of the *Clear Bat-Backed RAM* operation, or after a software upgrade has been installed on the system.

NOTE

All presets may not be restored when upgrading to a later software revision. The system makes a “best attempt” at copying all presets. However, depending on specific preset configurations and previous software upgrades, some may not be copied. The system will only reject a former preset if it is incompatible with the software upgrade. The customer should be reassured that all compatible presets will be restored and that those that aren't, are incompatible.

Perform the following procedure to restore all user configurable data from the customer backup disk.

1 Press the **SETUP** button on the operator control panel.

2 Select **SERVICE FLOPPY** on the right-hand touch screen.

3 Select **RESTORE PRESETS** and then follow the on-screen instructions.

4 Remove the customer backup diskette from the disk drive and store it in a safe place where it can be used if restoration again becomes necessary.

NOTE

The restore operation overwrites and erases all current customized presets stored in the system.

Service Related PCB Components: Switches, Jumpers, LEDs, Fuses, Flash Card Connectors, and Battery

Several Printed Circuit boards throughout the system contain switches that determine video format, options present or absent, factory/field tests and other service related functions. Some of these boards also contain LEDs that provide visual indication of board operation, and connectors for flash card programming.

Information in this section describes all of these service related components: the switch/jumper settings, normal LED indications, and locations of fuse, battery and flash card connectors.

The following system PC boards have one or more of these service related components:

- Clock PCB (E-Box slot 6)
- Power Regulator PCB (E-Box slot 7)
- DSCC PCB (E-Box slot 13)
- Beamformer I/O PCB (E-Box slot 14)
- Digital Scanner I/O PCB (E-Box slot 18)
- Digital Doppler PCB (E-Box slot 19)
- DSR-SCSI (E-Box slot 21)
- Video I/O PCB (E-Box slot 29)
- CCLR PCB (E-Box slot 30)
- Processor Graphics PCB (E-Box slot 33)
- Keyprocessor Main I/O PCB (Keyprocessor section)
- Keyscanner/Audio PCB (Keyprocessor section)

Clock PCB - Toggle Switch

The toggle switch located near the left edge of the component side of the board defines whether the system is operating as NTSC or PAL format. Set this switch to the left for NTSC or to the right for PAL.

Power Regulator PCB - LEDs

Three green LEDs located at the upper left corner on the solder side of the Power Regulator board indicate board and power supply operation. These LEDs should always be On. Any of these three LEDs Off indicates that either the Power Regulator PCB or the system power supply is not functioning properly.

DSCC PCB - LEDs

The two red LEDs located near the top edge on the component side of the DSCC board typically blink at a 1Hz rate. If the LEDs are Off, or are blinking at a faster rate, it is an indication that the DSCC PCB may have a problem.

Beamformer I/O PCB - Switches LEDs and Flash Connector

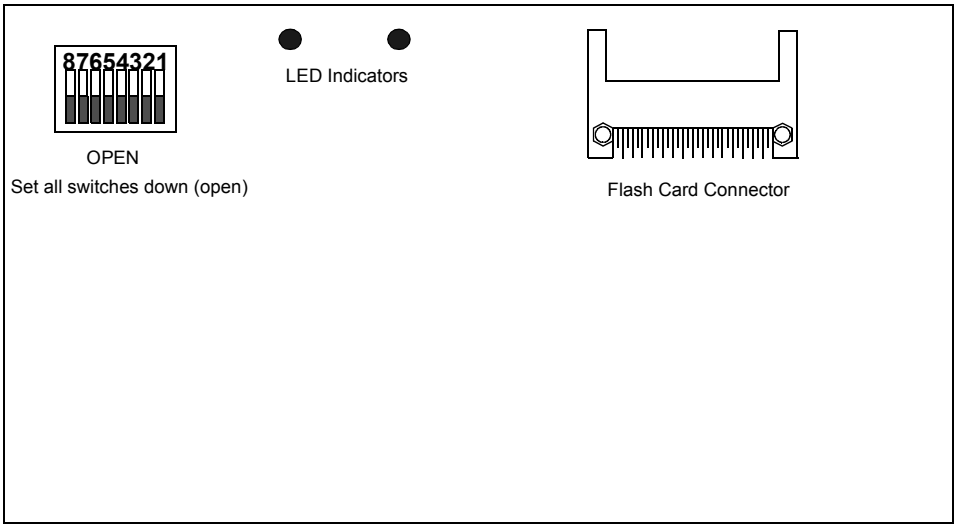
All eight DIP switches located near the upper left corner on the component side of the Beamformer I/O board (see Figure 3-16 on page 3-61) should be set to OPEN (down) positions.

The two red LEDs located to the right of the DIP switches are typically blinking. One of these LEDs always On indicates that the board is not functioning properly.

Digital Scanner I/O PCB - Toggle Switch

The toggle switch located near the left edge of the component side of the Digital Scanner I/O board selects the Clock function. The switch is normally set to the left (FE/60 MHz) position. Setting the switch to the right sets the board to operate from the Local/60 MHz position (useful for debugging the Scan Converter without the Scanner.

Figure 3-16 Beamformer I/O PCB—Switches, LEDs and Flash Connector



Digital Doppler PCB - LEDs

Two red LEDs are located near the top center-edge of the component side of the Digital Doppler board. *When in Doppler mode,* these LEDs will remain Off (no LED activity). During any other mode the LEDs should blink at a 1 Hz rate. No LED activity or a blinking rate greater than 1 Hz when NOT in Doppler mode could be an indication of a problem with this board.

DSR-SCSI PCB - LEDs

Two red LEDs are located near the top edge of the component side of the DSR-SCSI board. Typically the left LED blinks while the right LED remains Off. Any other LED indications could be an indication of a problem with the board.

Video I/O PCB - Switches

All eight DIP switches located near the upper right corner on the component side of the Video I/O board are normally set to their CLOSED (up) positions. For more information, see Table 3-5 on page 3-62.

Table 3-5 Video I/O Board Switches

Switch #	Function	Default position	Comments
1	Background level on video tape	CLOSED (up)	OPEN increases playback video background level (equivalent to selecting ‘grey’ under the IMAGE menu on the left touch panel).
2	Loopback mode	CLOSED (up)	Field/Factory loopback test
3	Color burst	OPEN (down)	
4	BW/Color camera port	CLOSED (up)	OPEN for B/W printers
5	RGB aux changed to BETACAM	CLOSED (up)	
6	RGB aux changed to Sync on green	CLOSED (up)	
7	RGBaux port changed to SMPTE std.	CLOSED (up)	1V p-p Vs. 0.7V p-p. 1V p-p = Closed; 0.7V p-p = Open Required for some peripherals. i.e: Freeland.
8	RGB int port changed to SMPTE std	CLOSED (up)	

TurboCine PCB - Memory Modules

With Rev. C.0, the TurboCine board replaces the CCLR and DSR boards. The TurboCine board increases Cine Loop memory and the speed of data transfer. With the use of 512 MB SODIMM memory modules, the memory can be increased up to 2 GB. The are no switch settings.

Installing and Removing Memory Modules

The TurboCine board is populated beginning with Slot 0. Increase the memory size by adding the modules incrementally from 0 through 3. Table 3-6 shows the allowable configurations.

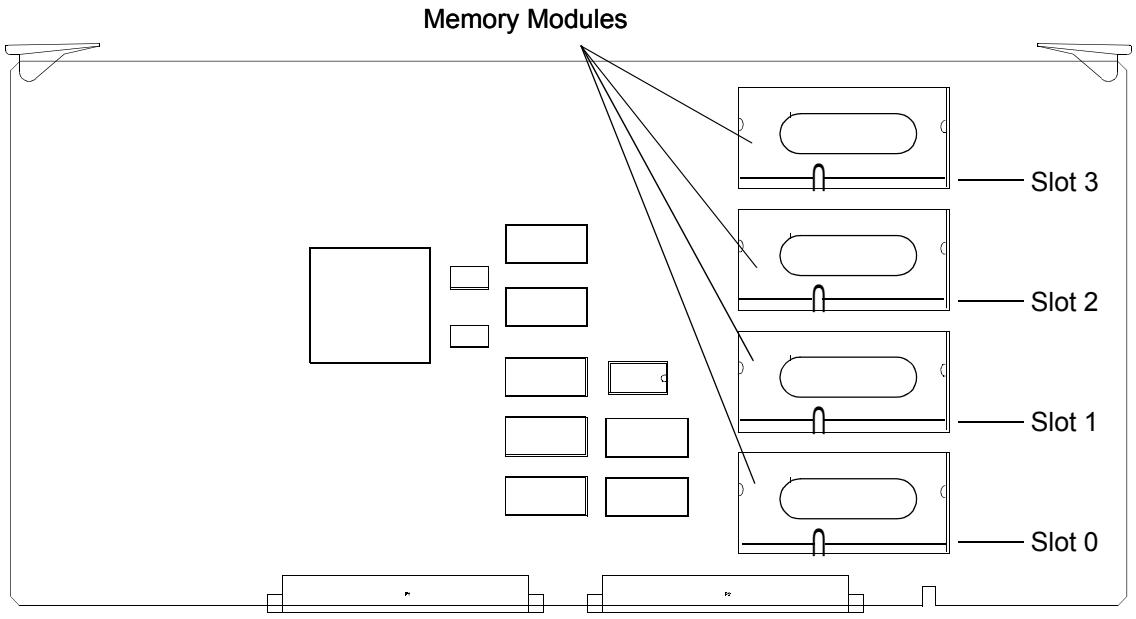
Table 3-6 TurboCine Memory Module Configuration

Placement	Memory Total
Slot 0	Use only if Slot 1 will be populated also
Slot 1	1 GB
Slot 2	Use only if Slot 3 will be populated also
Slot 3	2 GB

512 MB and 1.5 GB configurations are not allowed.

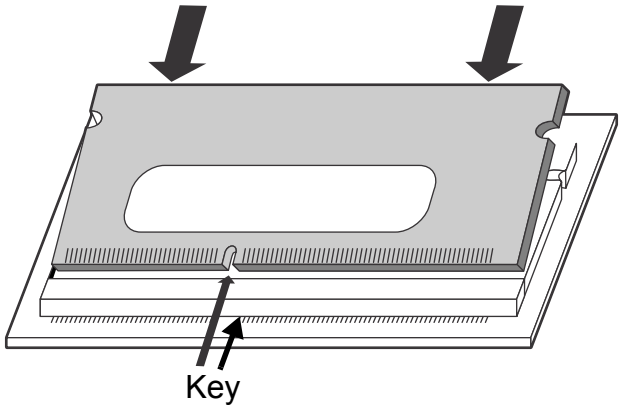
Figure 3-17 shows the location of the memory modules on the TurboCine board.

Figure 3-17 TurboCine Board Memory Modules

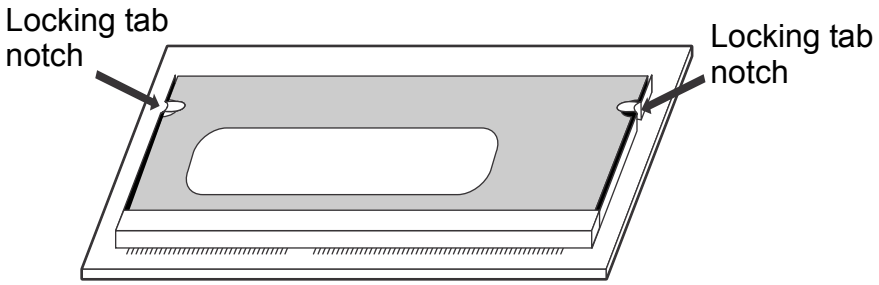


To install the SODIMM modules:

1 Push the module into the slot at a 25º angle using the base of the connector for support. Align the keys.

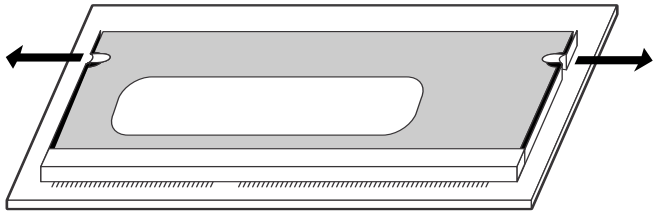


2 Ensure that the locking tabs are centered in the memory module's notches.

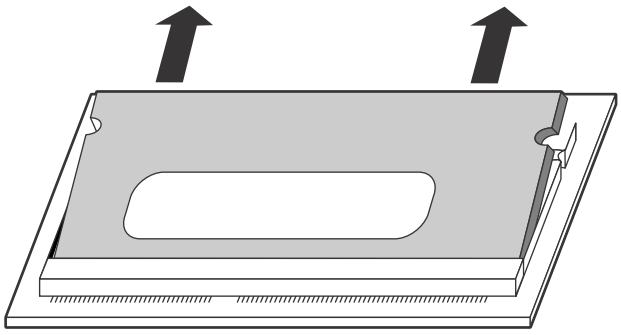


To remove the memory modules:

1 Pull the tabs outward. The module pops up at a 45º angle.



2 Push the module up and out of the slot.



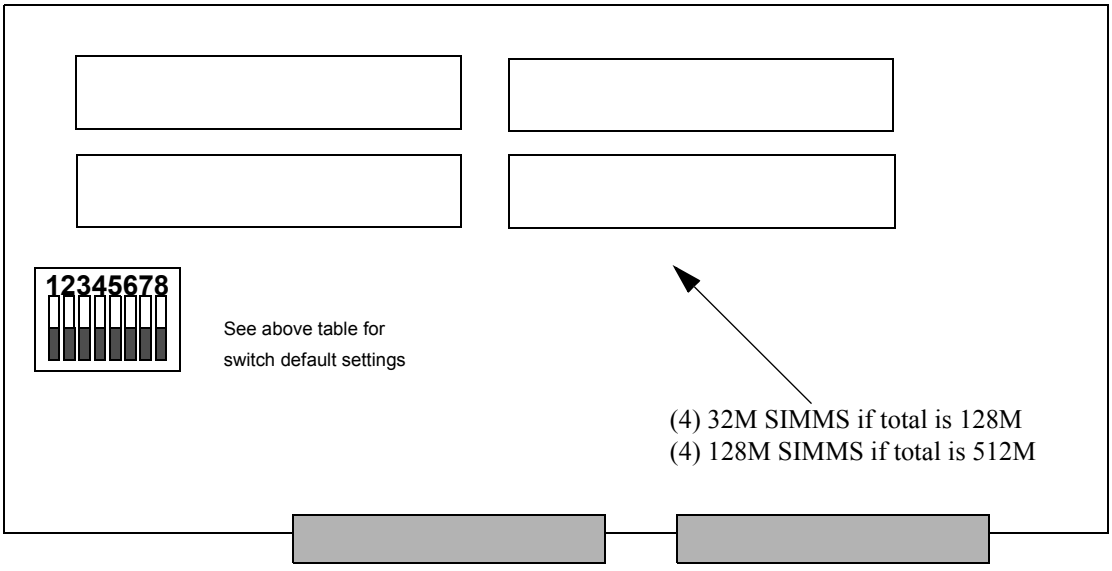
CCLR PCB— Switches and SIMMs

All eight DIP switches located near the left edge on the component side of the CCLR board are normally set as shown in Figure 3-18 on page 3-67. For standard versus optional SIMMS allocation see Figure 3-19 on page 3-69 and Figure 3-20 on page 3-70.

Table 3-7 CCLR Board Switch Settings

MB	Switch Settings
128	XX000111
512	XX010111

Figure 3-18 CCLR PCB—Switches and SIMM Allocation



Processor Graphics Switches, Jumpers, Fuses, Battery and Flash Card Connector

The Processor Graphics PCB (see Figure 3-19 on page 3-69 and Figure 3-20 on page 3-70) contains a RESET button that can be used to clear CMOS memory. This board also contains a battery, fuses, and a pair of 8-bank DIP switches. Refer to Table 3-8 for default DIP switch settings.

Table 3-8 Processor Graphics Board -Switch Banks 1 & 2

Switch #	Function	Default position	Comments
1	US/EUR Format	ON for PAL (EUR) OFF for NTSC.	TV Standards
2	Kernel/Normal	OFF	Factory test
3-5	Not Used	NA	NA
6	Reserved, error DDOBD if set to on	OFF	Factory test
7	Reserved, flash programing from external card.	OFF	Factory mode/field mode Used to reprogram flash memory
8	Emulation	OFF	Operates board out of emulation (factory only).
9	Not Used	NA	NA
10	Cache	OFF (normal, Cache enabled)	Disables/Enables Caching (factory only)
11-16	Not Used	N/A	

Figure 3-19 Processor Graphics (77100-66290): Switches, Jumpers, Fuses, Battery, Flash Connector

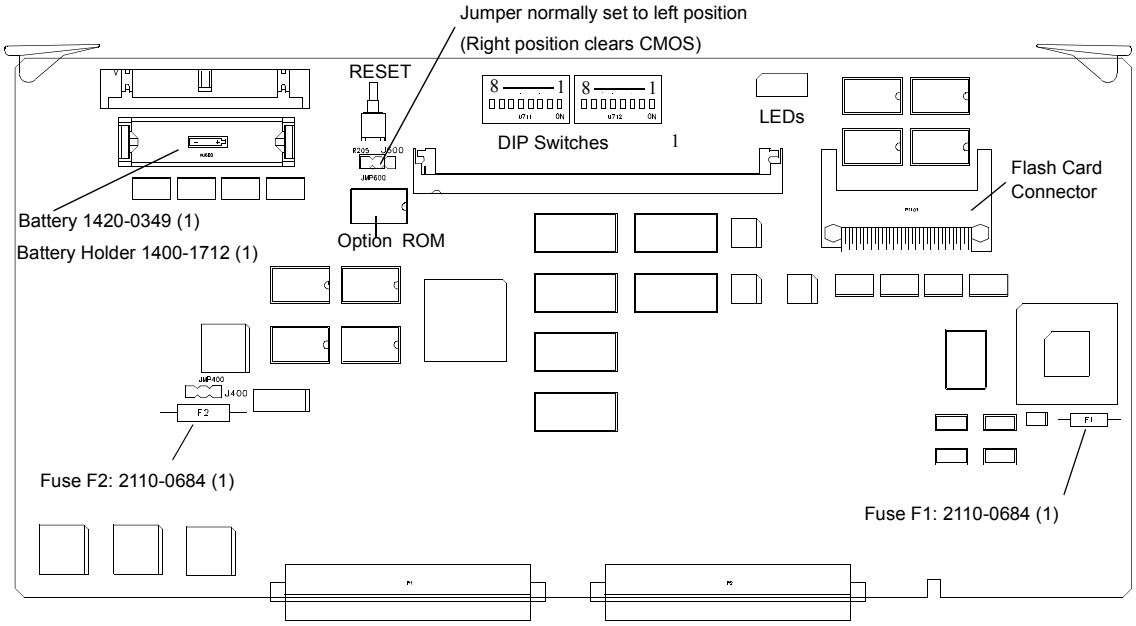
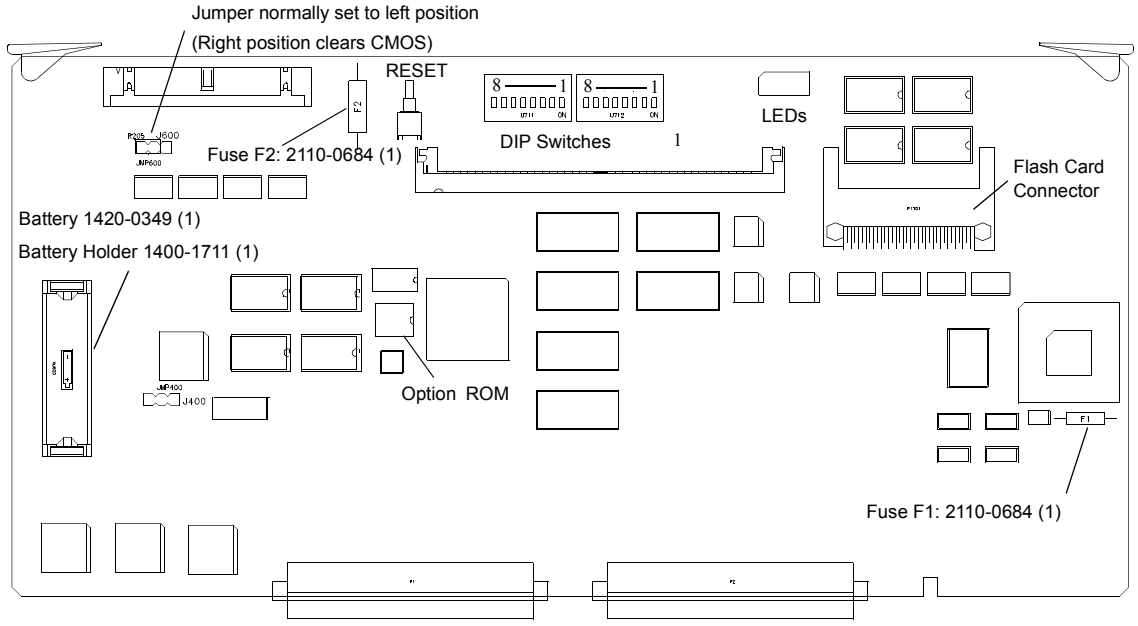


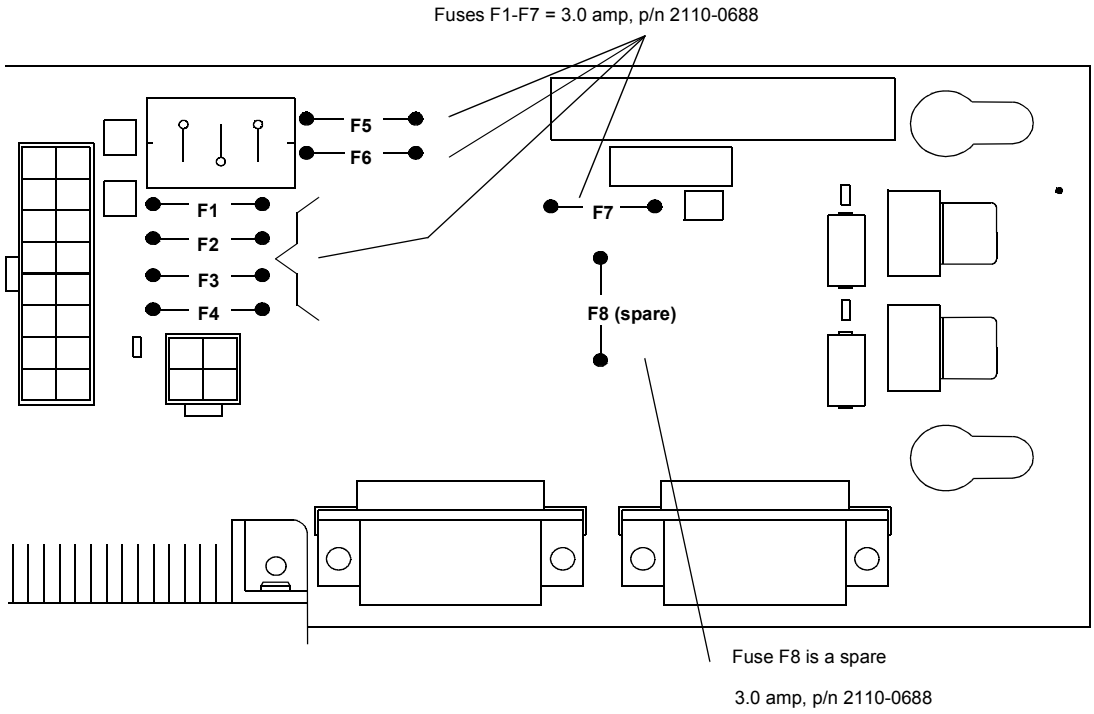
Figure 3-20 Processor Graphics (77100-66300): Switches, Jumpers, Fuses, Battery, Flash Connector



Keyprocessor Main I/O—Fuses

The Keyprocessor Main I/O PCB, located beneath the operator control panel, contains the fuses shown in Figure 3-21 on page 3-71.

Figure 3-21 Keyprocessor Main I/O—Fuses



Keyscanner/Audio PCB - Switches and Flash Connector

The Keyscanner/Audio PCB contains a bank of 4-position DIP switches and a bank of 8-position DIP switches as shown in Figure 3-22 on page 3-73. Default positions for these switches are listed in Table 3-9 and Table 3-10.

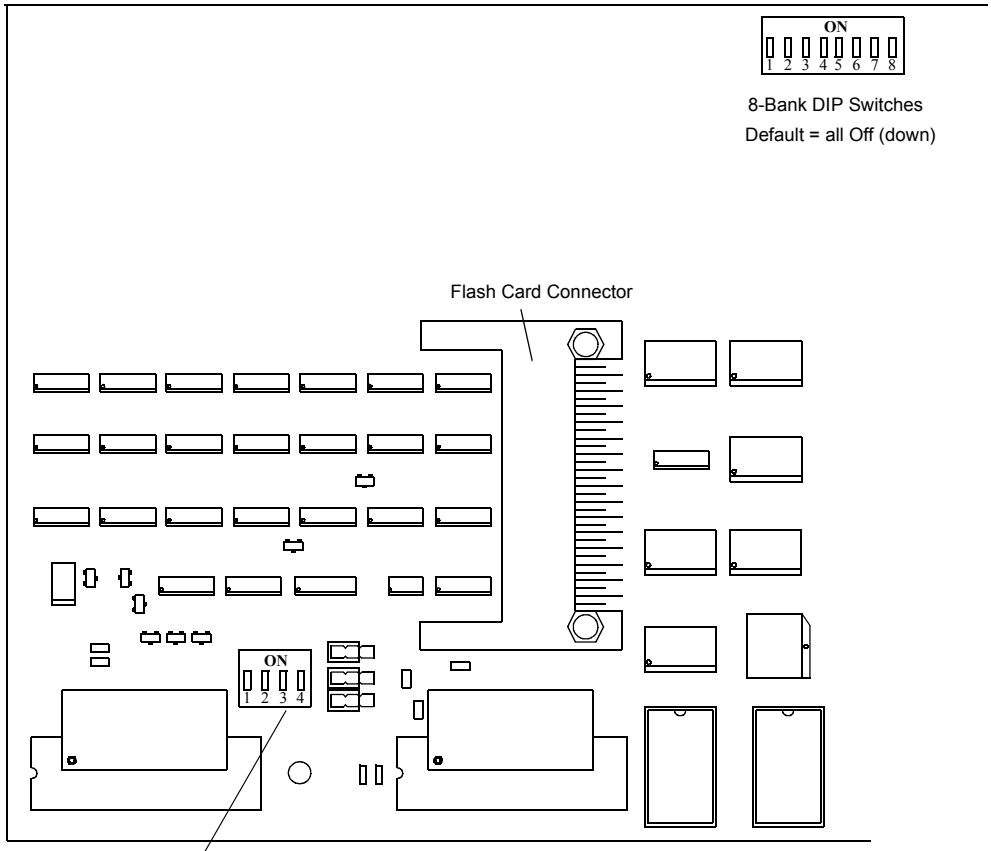
Table 3-9 Keyscanner PCB, 4-Bank DIP Switch Settings

Switch #	Function	Default Position	Comments
1	Reset	OFF	ON=Reset
2	Kernal test	OFF	Factory only
3	Remap	OFF	Program Flash Memory (see "Flash Card Programming Procedure" on page 3-53.)
4	Clock disable	OFF	Shuts off clock source on board, Factory use only

Table 3-10 Keyscanner PCB, 8-Bank DIP Switch Settings

Switch #	Function	Default Position	Comments
1	Unused	OFF	NA
2-3	Factory Only	OFF	Must be OFF
4	EL Frame Rate	OFF	OFF=70Hz,ON=60Hz
5	Data Line	OFF	1 Data Line
6	Factory Mode	OFF	ON=Factory Mode
7-8	Unused	OFF	Unused

Figure 3-22 Keyscanner Audio PCB—Switches and Flash Connector



TEE Probes—Thermistor Measurement Checks

The function of the thermistor, located at the distal tip of the transesophageal transducer, is to monitor the temperature rise at the site where power is dissipated and where a potential for burning the patient exists. Since the thermistor has a negative temperature coefficient; as the temperature increases the resistance measured across the thermistor decreases. Should the thermistor temperature threshold be reached, the Scanner will stop delivering power to the transducer, thereby preventing a possible burn.

There are two different procedures for measuring TEE probe thermistor resistance, depending on the type of TEE probe. Both procedures are provided in the following pages:

- 21364A/21366A/21367A TEE Probe Thermistor Measurement
- 21369A/21381A TEE Probe Thermistor Measurement

21364A/21366A/21367A TEE Probe Measurement

For each of the 21364A/21366A/21367A TEE probes, thermistor measurements are made between pins 1 and 2, 1 and 18, or both sets of pins depending on the transducer (see list in Table 3-11 on page 3-75). Measurements are made at room temperature in air as shown in Figure 3-23 on page 3-76.

Please note that these are *approximate* values since room temperature will vary. In general, regardless of transducer, the room temperature range of values should be between 2.6K and 3.4K Ohms. Defective thermistors will typically be considerably out of that range.

Table 3-11 21364A/21366A/21367A TEE Probe Thermistor

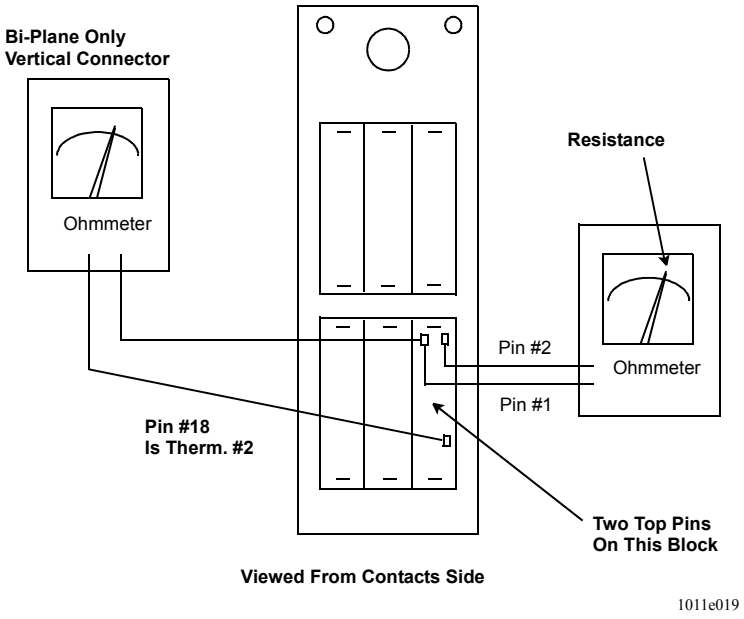
Transducer Model	Connector Pin #		Resistance (K Ohms)
21364A		1 - 2	2.9 - 3.4
		1 - 18	2.2 (Fixed)
21366A	Horizontal:*	1 - 2	2.4 - 3.6
		1 - 18	OPEN
	Vertical:	1 - 2	OPEN
		1 - 18	2.4 - 3.6
21367A		1 - 2	2.4 - 2.8
		1 - 18	2.2 (Fixed)

Measurement

NOTE

*Measurements between pins 1 & 18 on bi-plane transducers are made on the “vertical” connector. Measurements between pins 1 & 2 are made on the “horizontal” connector. All measurements are made in Kilo-ohms.

Figure 3-23 21364A/21366A/21367A TEE Probe Thermistor Measurement



NOTE

When measuring the thermistor resistance, allow the tip of the transducer to hang freely away from any temperature absorbing material such as a desk or bench top.

The Bi-Plane Transducer has two thermistor elements. Pins 1 and 2 in the figure above are thermistor #1 (Horizontal connector). Pins 1 and 18 of the vertical connector correspond to thermistor #2.

21369A/21381A TEE Probe Thermistor Measurement

For the 21369A and 21381A TEE probe, the thermistor resistance measurements are made between pins H1-H2 and H2-J1 on the plug at the end of the transducer cable (see Figure 3-24 on page 3-78). The measured resistance should be equivalent to the measurements listed in Table 3-12.

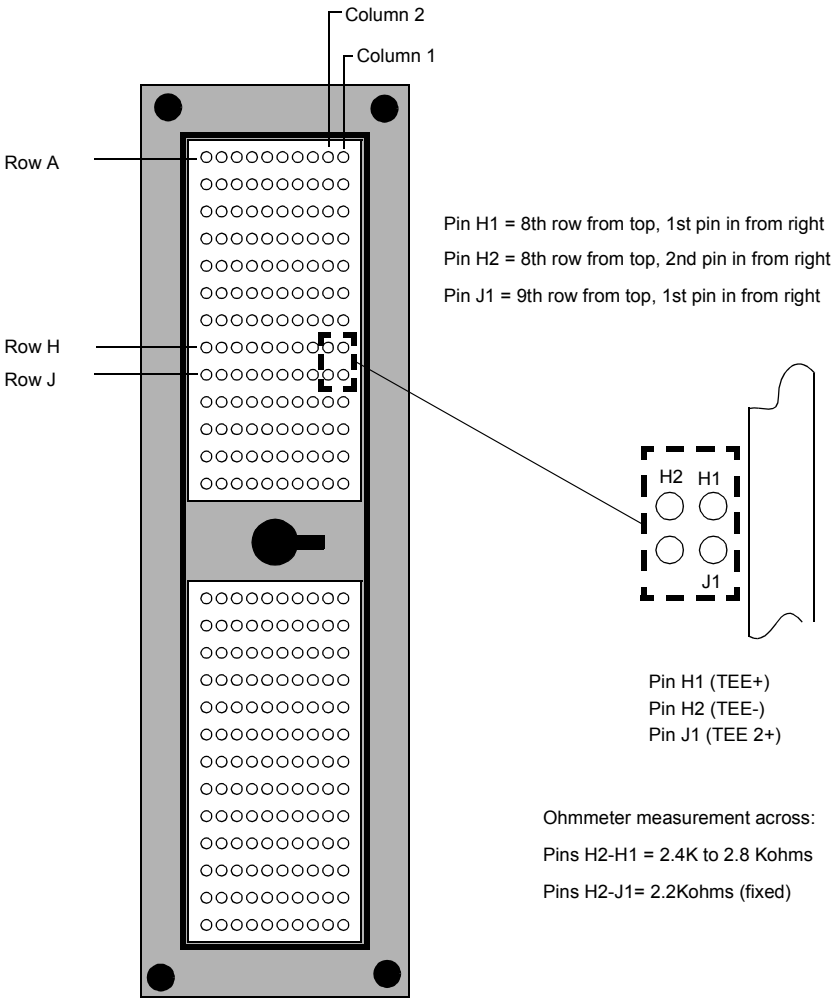
When measuring the thermistor resistance, allow the top of the transducer to hang freely away from any temperature absorbing material such as a desk or bench top. Defective thermistors will typically have resistance values considerably different than the indicated range.

Table 3-12 21369A TEE Probe Thermistor Measurement

Probe Connector Pins	Thermistor Resistance (approximate)	Comments
H2-H1	2.4 to 2.8 Kohms	Resistance values represent measurements made at room temperature, in air.
H2-J1	2.2 Kohms (fixed)	

NOTE Thermistor resistance values shown above are approximate. They will vary as room temperature changes.

Figure 3-24 21369A/21381A TEE Probe Thermistor Measurement



End View of Plug on
21369A/21381A Transducer Cable

System Peripherals

This section provides service-related information for the system peripherals as they relate to the ultrasound system. System Peripherals include the system VCR, the optional printers (color, B&W, strip-chart), and the optional Digital Network Interface or Integrated Digital Interface. Information such as instrument removal and replacement, and instrument switch settings are supplied. Refer to the *Peripherals Service Manual* (Part No. 77030-90700) for more detailed information. Repair information for system peripherals is not provided in this manual, because the recommended method of peripheral repair is instrument exchange.

NOTE

For a complete listing of peripherals that are supported by the ultrasound system, Chapter 1, "Introduction and General Information."

Peripheral Mounting Locations

All available peripherals except the VCR and side-mounted printers reside on either of the two shelves at the front of the cart. Both shelves are generic—any front-mounted peripheral can reside on either shelf, after being secured to the shelf with a strap (see Figure 3-25 on page 3-81). The strap surrounds the bottom of the shelf and the peripheral, securing the peripheral in place.

The VCR is mounted in an area at the left side of the cart, above the E-Box. This area is commonly referred to as the VCR "garage".

Peripheral Shelves

The two shelves at the front of the cart can be pulled out from the front of the cart to gain access to the mounted peripherals. The shelves slide out on slide-rails, allowing access to the peripheral rear panels and connectors. A locking-lever positioned at the right front edge of each shelf must be pushed to the left to unlock the shelf and allow it to be pulled out from the cart. The locking-levers provide sufficient safety to prevent the shelves from inadvertently sliding forward on their own while the cart is being maneuvered.

When either shelf is locked in its fully extended position, you must depress "spring tabs" built into the outside of each rail in order to push the shelf back into the cart.

NOTE

It is sometimes necessary to apply moderate pressure to the front edge of the shelf when sliding it in or out of the cart.

CAUTION NEVER move the system until both front shelves are locked fully inward.

Securing Peripherals with Straps/Buckles

Proceed as follows (see Figure 3-25 on page 3-81).

1. Pull shelf outwards as far as it will slide. Slide locking lever to left and hold while pulling shelf outwards.

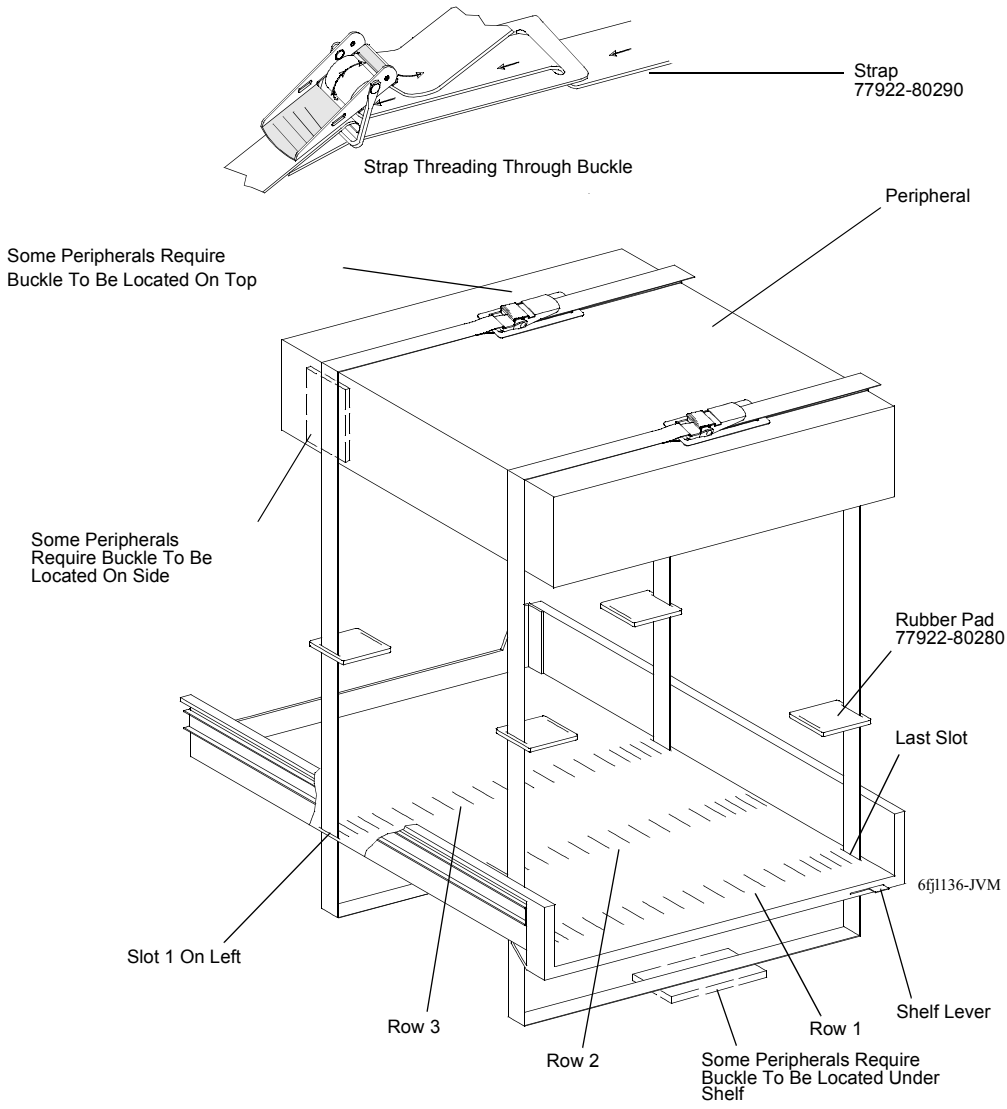
2. If straps are not connected to shelf, thread straps through slotted openings and rubber pads on shelf as follows:
   a. Place rubber pads on top of the proper slots on the shelf.
   b. Thread straps through rubber pads and slots in shelf. Use the appropriate slots in the shelf that will allow straps to fit securely against sides of peripheral chassis. *Note that Buckles at end of strap must be positioned on top, side or bottom of peripheral, depending on peripheral being installed. Position the buckle at the position that will allow the shelf to move freely in and out of the cart without obstruction*.

3. Place the peripheral on the shelf and connect cables to peripheral. For peripheral cabling diagrams, see Chapter 7, "Wiring and Cabling."

4. Secure straps to peripheral:
   a. Place strap buckle in the open position as shown in Figure 3-25 on page 3-81.
   b. With other end of strap around peripheral, thread end of strap through slot in plastic protector.
   c. Continue to thread strap through ring of buckle and up through slot in center of lever arm of buckle. Then thread strap down through other slot in lever arm.
   d. Pull end of strap to take up slack around peripheral.
   e. Pull lever arm forward and press to flat (closed) position.
   f. If too much force is required to close lever arm, slacken strap slightly.
   g. To release strap, pull up on end of strap, lifting lever arm to open buckle.

NOTE If the peripheral being mounted has a door which hits the bottom of the shelf, move the peripheral forward to eliminate shelf interference with the open door.

Figure 3-25 Peripheral Shelf Strap and Buckle Assemblies



VCR Removal/Replacement

The system VCR supplied with all systems resides in a "garage" at the left side of the cart. To remove and replace the VCR, proceed as follows.

1 Raise the cart top assembly.

2 Using a Phillips screwdriver, remove the screws from the underside of the cart top assembly that secure the VCR to the floor of its garage.

3 Using a flat blade screwdriver, turn the two captured screws that secure the panel surrounding the VCR front panel to the side of the cart.

4 Pull the VCR out of its garage until you can unplug all of its rear panel cables, then remove the VCR from the cart.

5 To replace the VCR, perform the above procedure in reverse order.

Using the Remote Service Feature

The Remote Service feature, which is available in Revision B.1.x or greater, provides access to the system via a modem through the J1 port on the system rear I/O panel (cable not supplied). This feature allows Response Center Engineers to remotely connect to a Sonos 4500/5500 system to view system information like serial number, error codes, software, and board revisions. Response Center Engineers can execute different resident self tests and view error logs while remotely connected to the system.

WARNING

Do not use the Sonos 4500/5500 system on a patient while the system is connected to phone lines, because the connection is not electrically isolated. After remote service support is complete, be sure to disconnect the system from phone lines prior to returning it to service.

The following sections describe how to configure and use the Remote Service feature:

- Configuring for Remote Service mode
- Connecting the modem to the system
- Selecting Remote Service mode
- Exiting Remote Service mode

WARNING

Users must disconnect the cable and the modem from the system before performing any imaging.

Configuring for Remote Service Mode

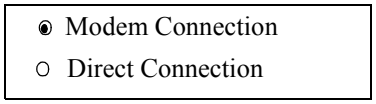
For details on how to use the modem, refer to the manufacturer's documentation.

1 Press the **Test** button to access the Test Menu.

2 From the Test Menu, select the Other Tests & Utilities option.

3 From the Other Tests & Utilities menu, select the Equipment Service option.

4 From the Equipment Service menu, select the Modem Connection or the Direct Connection option.



5 Exit from the previous menus.

Connecting the Ultrasound System to a Modem

1 Disconnect all transducers and other external peripherals if necessary.

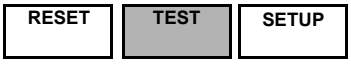
2 Connect the modem to the RS-232C 25-pin female connector port located on the back of the ultrasound system rear I/O panel (J1).

3 Connect the modem to a fax line, or to a dedicated analog phone line.

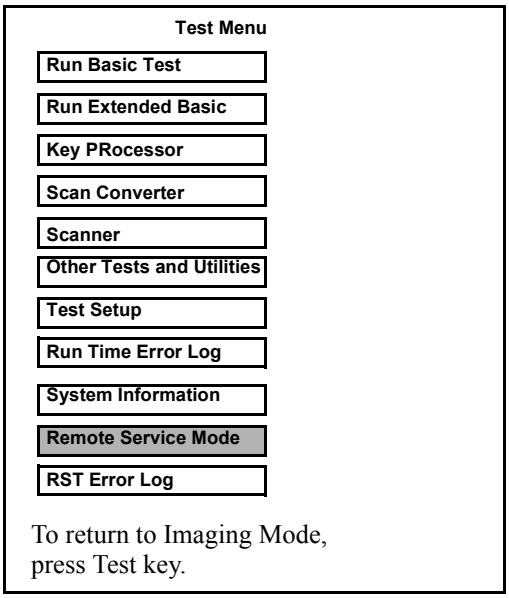
4 Turn on the modem. The system is now ready for Remote Service Mode.

Selecting Remote Service Mode

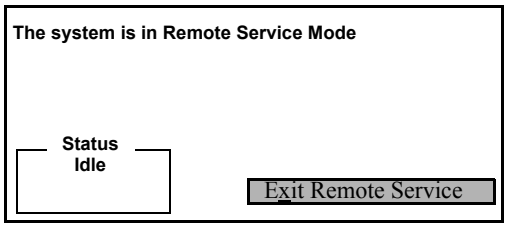
1 To access the Test Menu, press Test.



2 Use the trackball to select **Remote Service Mode** and press **Enter**.



3 After a short delay, the system displays a message indicating it's ready to accept a call from the local Philips Service Center.



Note: If your modem is not responding, a warning message appears. Make sure that your modem is on, and that your modem and power cables are connected.

While the system is being worked on, the Status box is updated:

Note that the information in the Status box is not an indicator that the Philips Representative is done working on the system.

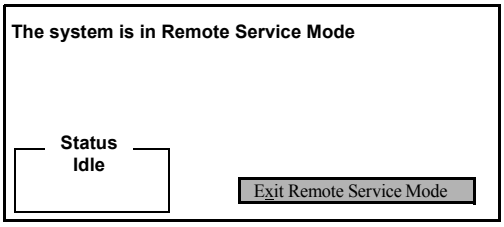
Idle	Indicates the system is not logged on to remote service.
Remote User Connected	Indicates the Service Center is connected to the system.
Working	Indicates the system is logged on to remote service, and is being worked on.

Exiting Remote Service Mode

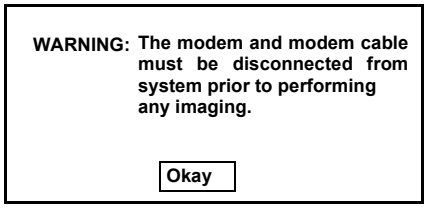
Note that if the Status box reads either **Remote user logged on**, or **Working**, and you disconnect the modem, delays in servicing the system can occur.

After your lab is notified by the local Service Center that the ultrasound system is ready to be used for imaging, follow these steps to return to live imaging.

1 Use the trackball to select **Exit Remote Service Mode**, and press **Enter**.



2 Select **Okay** with the trackball, and press **Enter** after the system warning message appears.



3 At the Test Menu screen or after you exit from Test mode, disconnect the modem from the ultrasound system rear I/O panel (J1 port).

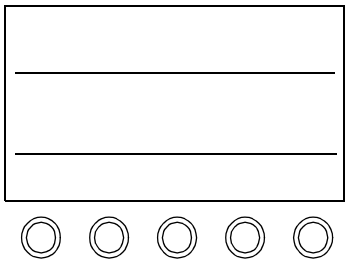
Configuring the RS232 Interface

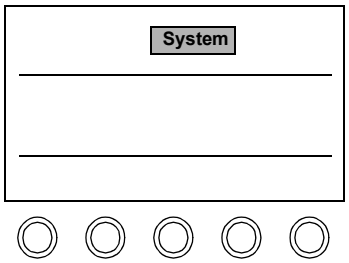
You can configure the RS-232 interface, which is available in Revision B.1.x or greater, for sending analysis reports to either an external printer or a PC. The RS-232 interface is a 25-pin connector port located on the back of the ultrasound system (J1). This cable is not provided.

NOTE

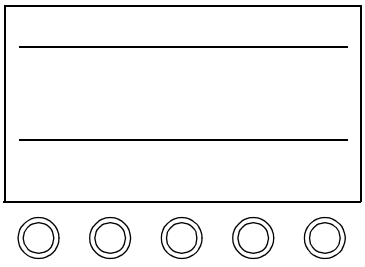
The RS232 port is only for outgoing signals, and does not allow two-way communication. You must set the external printer for no initial communication (no "handshaking").

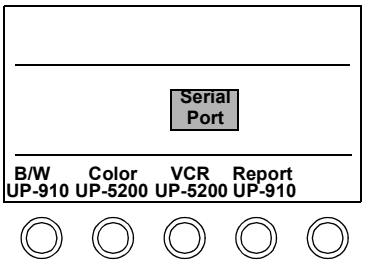
1 Press **Setup**, and touch **System**.



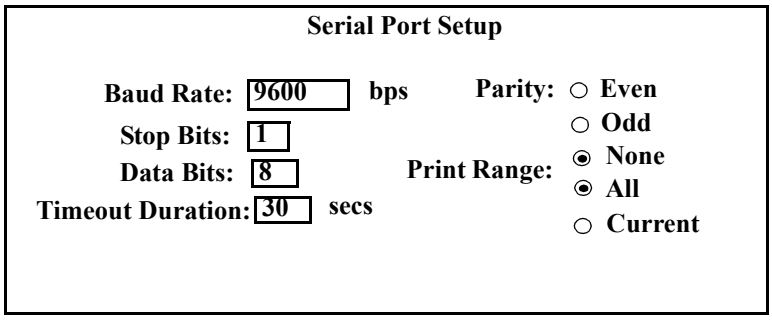


2 Touch **Serial Port**.





3 Use the trackball to highlight, and make your selections by typing in the information. On the Serial Port Setup screen, enter the data such as baud rate, stop and data bits, and select parity and print range according to the external printer device that is connected.

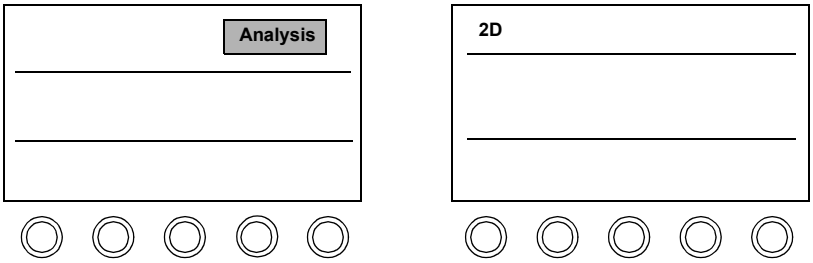


4 Press **Setup** to finish and exit this function.

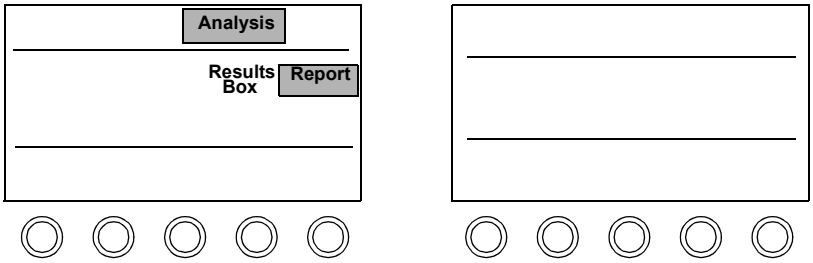
Printing an Analysis Report

After you complete configuring the RS232 interface, you can send analysis reports to an external printer or to a PC.

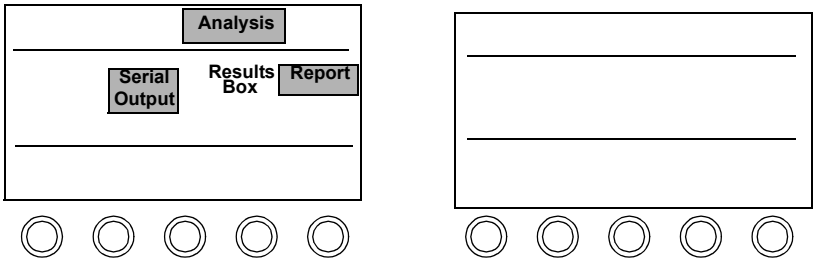
1 Touch **Analysis**.



2 Touch **Report**.



3 Touch **Serial Output**. After you complete the setup and selection of the **Serial Port** for the analysis report print, the system redirects the output of the analysis report to the serial port when you press the **Print** control.



4 Press Print on the keyboard.

Peripheral Switch Settings

Some peripherals for the ultrasound system have external switches that define the peripheral's operational mode. These switches are set to their default positions at the factory, prior to ultrasound system shipment. Refer to the following pages for a description of these peripheral switches and their default settings. For additional information, see the *Peripherals Service Manual*, (P/N 77030-90700).

VCR (Model 77615A/77625A and 77617A/77627A) Switches

Table 3-12 lists front panel "function" switches and their default settings for the Models 77615A/77617A (NTSC format) and 77625A/77627A (PAL format) VCRs. These switches are located behind the small access door at the lower right of the VCR front panel.

Note that each switch has small push-in rubber stops which fit into the switch handle openings and help lock each switch into its appropriate position. Any of the switch stops may be removed in the event that an alternate switch setting is needed for a special application.

Table 3-13 VCR (77615A/77625A and 77617A/77627A) Switches

Switch Name	Positions	Default Setting	Comments
AUDIO OUT	CH1 MIX CH2	MIX	CH1 and CH2 mixed to MON OUT
AUDIO OUT	Hi-Fi NORM	NORM	Normal audio to AUDIO OUT
INPUT	S-VIDEO LINE	S-VIDEO	
S-VHS	AUTO OFF	AUTO	Off = VHS recorded on S-VHS tape
MENU	SET OFF	OFF	On screen menu disabled
MODE LOCK	ON OFF	OFF	Front panel controls enabled

VCR Function Display

In addition to the front panel switches, the Model 77615A/77625A and 77617A/77627A VCR also have internal function settings that should appear as shown in Table 3-14. These settings can be verified through the system monitor, or via the VCR tape counter values that are displayed when the MENU switch is in the SET position.

To view or change the VCR function settings listed in Table 3-14, perform the following procedure.

1 Set the VCR to the STOP mode.

2 To view the menu on the system monitor press SETUP, MORE, SHIFT-TEST on the operator control panel. Select *Other Tests and Utilities*, then select *Video Display Path Test*. (VCR internal function codes will appear in the tape counter display in addition to being displayed on the monitor).

3 Move the MENU switch behind the access door on the VCR front panel to SET.

4 Press the FF button (subtitled Shift V) at the VCR front panel to select the function (item) to be set.

5 Press the VCR STOP/REW buttons (subtitled (Data +/-) to toggle between settings.

6 Press the VCR REC button (subtitled Page +) to select the second page of menu choices.

7 Select the factory default settings shown in Table 3-14.

8 Terminate the process by resetting the MENU switch back to OFF, then press the RESET button on the operator control panel.

Table 3-14 VCR (77615A/77625A and 77617A/77627A) Default Function Display

Function	Default Setting	Tape Counter Display (xx xx:xx) (function: setting)
VISS	REC	10 01:01
TAPE SELECT	--T120 (77615a) --E180 (77625a)	10 02:00 10 02:00
AUTO BACK	ON	10 03:01
TAPE IN MODE	STOP	10 04:00
TAPE END MODE	STOP	10 05:00
REC TAPE END	STOP	10 06:00
STBY OFF TIME	(30 MIN)	10 07:02
HI-FI REC	OFF	10 08:00
AUDIO DUB	CH2	10 09:02
EDIT	OFF	10 10:00
YC FILTER (NOTCH)	OFF	10 11:00

VCR Error Codes

The following error messages are displayed on the tape counter if a problem occurs:

Table 3-15 VCR Error Codes

Error Code	Problem	Action
E - 2	Problem in elevator section	Video cassette may not be loaded properly. Try switching the power off and on.
E - 3	Problem in loading section	
E - 4	Problem in cylinder section	Video cassette may have a problem. Try switching the power off and on. Also, try replacing the video cassette.
E - 5	Problem in reel section	
E - 6	Incorrect tape tension	
E - 7	Problem in solenoid	Try switching the power off and on.
d	Dew Indicator	Allow VCR to dry out.

Strip Chart Recorder (Model 77510A) Error Displays

The Model 77510A Strip Chart Recorder has an error display that can display one of the following indications whenever an error occurs. To read the display, hold down the period key while powering up the recorder.

- H:Indicates thermal head is overheated.
- PS:Indicates system speed is set to 10mm/second.
- E:Indicates test switch is set to T (test position) on back of recorder.
- J:Indicates paper is jammed.
- UP:Indicates thermal head is positioned incorrectly.

Color Printer UP3000/UP3000P (Model 77530A/77535A) Switches

The Models 77530A (NTSC format) and 77535A (PAL format) Color Printers have a bank of 8 DIP switches mounted at the printer rear panel. All of these switches except SW4-6 should be Down (Off). Set SW 4-6 up (On).

- brightness = center position

Color Printer UP1850MD-NTSC/UP1850EPM-PAL (Model 77530B/77535B) Switches

The Models 77530B (NTSC format) and 77535B (PAL format) Color Printers have a 75-Ohm slide switch and a bank of 8 DIP switches mounted at the printer rear panel. The factory default setting for the 75-Ohm slide switch is ON (up). All dip switches except SW 3-6 should be down (Off). Set SW 3-6 up (On).

- Set Gain = +2

Sony Color Printer UP2950 (Model 77530D) Switches

- 75 Ohms (Termination): ON
- NTSC/PAL: set to match system
- Gain = 0
- AGC: OFF

Sony Color Printer UP5200 (Model 77550B)

- 75 Ohms (Input): ON
- Gain = +.5
- AGC: OFF

Sony Color Printer UP5600MD/UP5600MDP (Model 77550C/ 77555C)

- 75 Ohms (Input): ON (Both Switches)

B/W Printer UP870/UP860 (Model 77560A/77565A) Switches

The Models 77560A (NTSC format) and 77565A (PAL format) B/W Printers have a bank of 8 DIP switches mounted at the printer rear panel. All of these switches except SW1 should be down (On). Set SW1 up (Off).

- Gamma = Middle
- Dadj (NTSC) or Densite (PAL) = Middle

B/W Printer UP890 (Model 77560B) Switches

The Model 77560B (NTSC/PAL format) B/W printer rear panel has two 3-position slide switches which define the paper being used, and a bank of 12 DIP switches which configure printer functions. Set switches as noted below:

- Back panel controls: All DIP switches down
- Front panel controls

Contr & Brt = Detent

Direction = Standard

Size = Normal

B/W Printer UP910/UP910P (Model 77580A/77585A) Switches

The Models 77580A (NTSC format) and 77585A (PAL format) B/W Printers have a bank of 8 DIP switches mounted at the printer rear panel. All of these switches should be Off. Set the 75 Ohm switch On.

B/W Printer UP960 (Model 77580B) Switches

The Model 77580B (NTSC format and PAL format) B/W Printer has one bank of 8 DIP switches mounted at the printer front door, and one bank of 10 DIP switches mounted at the printer rear panel.

At the front door, set all 8 DIP switches to On, except for DIP Switch Number 1 (AGC). Set DIP Switch Number 1 to Off.

At the rear panel, set all 10 DIP switches to On, except for DIP Switch Number 8 (INTERRUPT). Set DIP Switch Number 8 to Off.

4 Resident Self Test

Overview

The Model M2424A Ultrasound System includes built-in troubleshooting tests that are designed around the architecture of system hardware and software. Hardware hooks throughout the digital electronics provide specific reference signals for the Resident Self Test (RST) diagnostic software.

All system testing follows the *Inverted Pyramid* principle—the most fundamental portions of the system are tested first. After those tests are passed, testing continues along a hierarchy of a pre-established priorities.

The RST procedures are accessible through a menu driven user interface. The test menus are organized in a hierarchical structure with a single root menu located on the Main Test Menu, and lower level menus available on a series of second level RST screens. The more sophisticated features of the system require traversing to the lower level screens.

RST Menu Hierarchy

- Figure 4-1 provides a sample display of the menu hierarchy.
- Figure 4-2 through Figure 4-4 list a sample submodule hierarchy test for the Keyboard Processor, Scan Converter, and Scanner.

NOTE

Information provided in Figure 4-1 through Figure 4-4 is subject to change. Module and submodule tests can be added or removed without notice. The RST user interface will present the current set of module and submodule tests.

RST Menu Hierarchy

Figure 4-1 RST Menu Flow Diagram

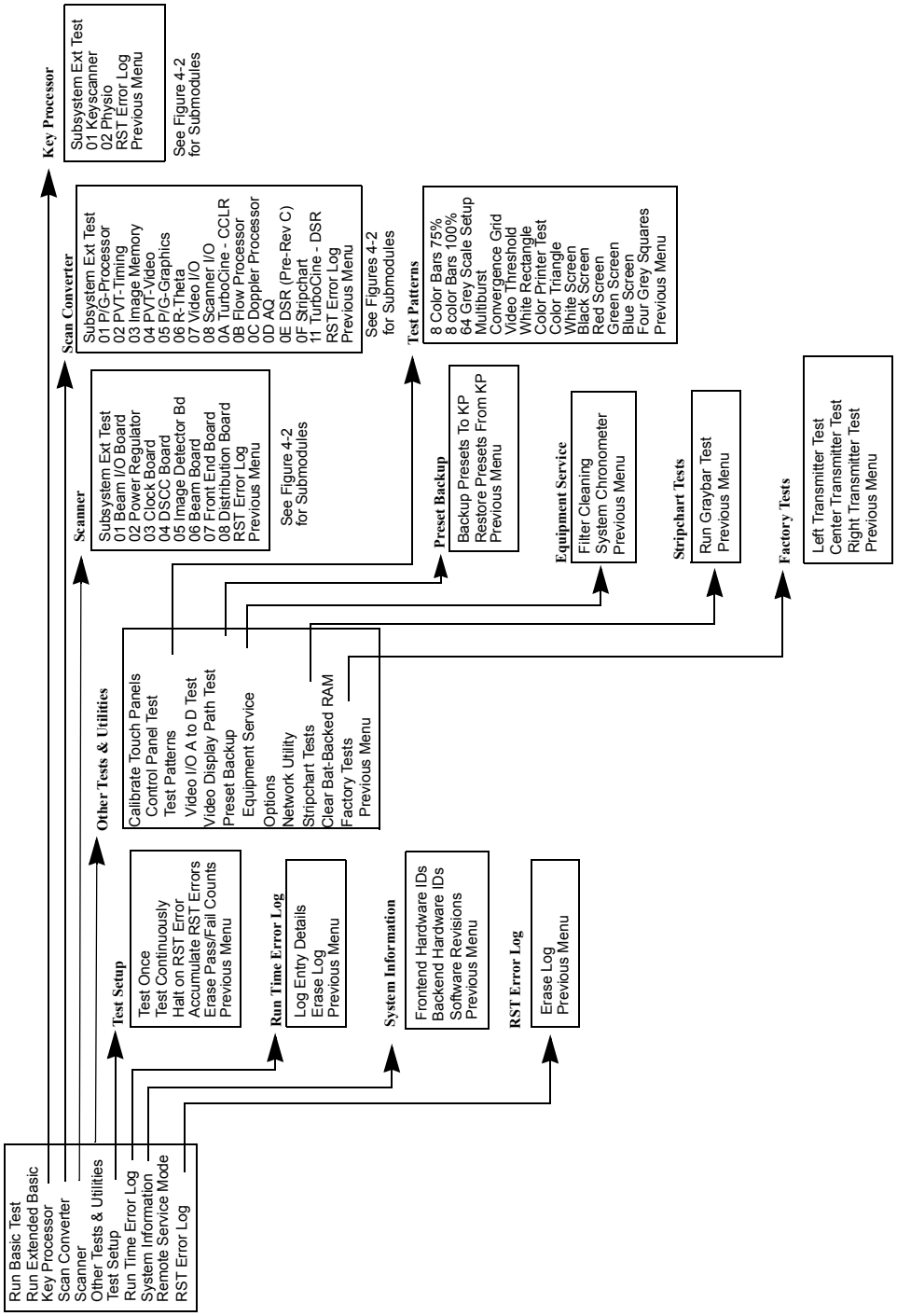
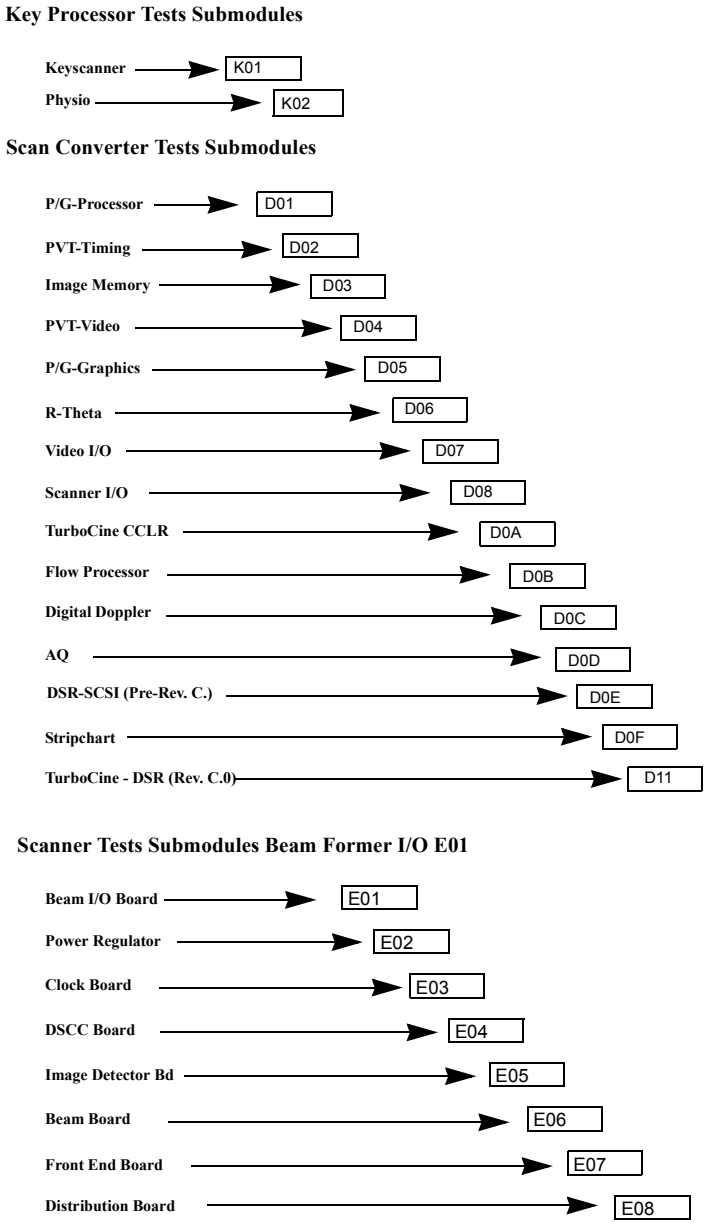


Figure 4-2 Submodule Test Hierarchy



RST Definitions and Acronyms

Basic Test

A *non-exhaustive* test of hardware along our *imaging and video data paths*. Basic test executes submodule tests in multiple subsystems and has a total execution duration goal of less than 10 minutes.

Basic test verifies correct overall instrument operation. Errors can be non-specific, indicating a problem with the instrument, while not identifying a specific PC board.

Basic test includes optional boards that are part of the imaging and video paths such as CLR and AQ if present, but does not include peripherals such as the DSR and Stripchart boards.

Extended

An *exhaustive* test of all testable hardware: imaging and video paths, RAM, ROM, optional boards and peripheral interface boards. Extended test executes submodule tests in multiple subsystems and has a total execution duration goal of less than 20 minutes.

Extended test verifies detailed instrument operation. Failures must be identified to the failed PC board.

Factory Basic

This executes the Extended Basic test with slightly different control semantics: run continuously and collect all errors. It is used as an endurance test during manufacturing and environmental factory testing.

Module

Corresponds generally to a PC board, but it can refer to two or more PC boards or a major function of one PC board.

Module Test

A collection of submodule tests to examine the overall operation of the module.

RST Errors

Deficiencies found during the execution of submodule tests.

Run Time Errors

Errors detected by application software during its normal execution.

Submodule Test

A single function testing the correct operation of a submodule.

Subsystem

One of the components of the system: Keyprocessor Electronics, Scan Converter, and Scanner.

Interface Components

Each screen of the interface contains one or more of the following components:

- Menus
- List boxes
- Option buttons
- Progress boxes
- Static screens

Menus Definition

A menu is a collection of selectable items, from which the user can select one at a time. Each item in a menu causes the system either to execute a particular test or display another screen. Menu items can be selected by using the trackball and Enter key combination, or with a hotkey. The designated letter appears in red and is underlined in the menu title to indicate a "***hotkey***". When a menu item is selected, the menu item's label is briefly displayed in inverse video prior to its associated action being invoked.

Figure 4-3 Sample of Main Menu RST Screen

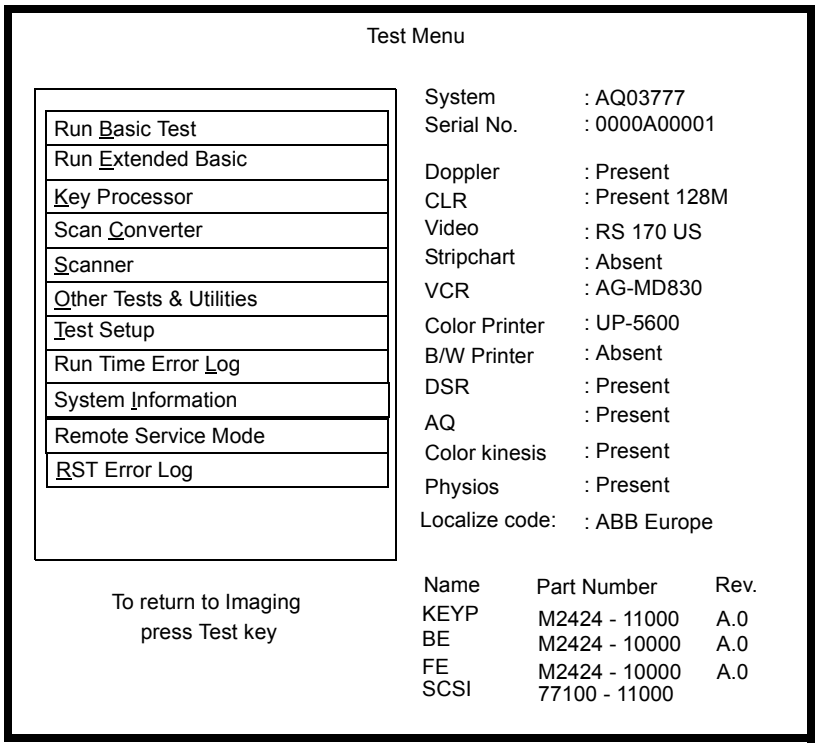
NOTE:

An asterisk by the Run Time or RST Error Log menu entry signifies that error codes have been generated and are stored in the log.

NOTE:

The serial number format of instruments has changed effective 01 Nov 1998 for Test Menu/INT screens.

Format = ddddcssss
where:
Date Code = dddd or YYMM
Unique serial number = ssss
Country of manufacture = c.



List Boxes

List boxes are, as the name implies, boxes surrounding lists. They allow the user to select multiple items from a master list. **NEXT** and **PREV** fields are provided in the list border so the user can page through the list. These fields are activated using the trackball to place the arrow on top of your selection, then pressing **ENTER**. For an example of list boxes, see Figure 4-5 on page 4-18.

Option Buttons

Option buttons are displayed as small circles on the screen with adjacent descriptive text. The button next to the currently selected option is solid (filled), while the other buttons are outlined (empty). When a new option is selected, its button becomes solid and the previously selected button becomes empty.

Option buttons allow the user to select from one of several mutually exclusive choices. These items differ from menu choices in that the item selected modifies the future behavior of the system, but does not cause the system to transition to a new screen or mode. Option buttons are not highlighted like menu items, but can be selected using hotkeys or using the trackball and pressing the Enter key.

Command Buttons

Command buttons allow the user to acknowledge or cancel an operation before the operation is executed. Command buttons appear in message boxes displayed in the center of the display. The two command buttons are **Okay** and **Cancel**.

Progress Boxes

Progress boxes identify the subsystem, module, and submodule of the currently executing submodule test, and indicate whether RST errors have been detected during the test. Progress boxes are especially helpful during long tests that do not otherwise modify the display when underway. Dependent on which tests are being executed, progress boxes may or may not appear on the monitor or EL panel.

Test Modes Description

Interactive RST

The operator places the system into interactive RST by pressing **Test** while in imaging mode. The system responds by resetting, clearing the touch panel displays, and displaying the ***Main Test Menu***.

The operator exits interactive RST by again pressing the Test key. The system responds by resetting and returning to imaging mode, using the set of presets that were loaded at the time interactive RST was entered. If the system is reset while in interactive RST, the system returns to interactive RST, clearing the touch panel displays and displaying the ***Main Test Menu***.

Hardware problems can prevent the system from initializing into imaging mode. The Service Engineer can debug such conditions by forcing the system to initialize into interactive RST. To accomplish that, depress the Test key, and keep it depressed while you reset the system. When the system detects the forced transition into RST, the Test key LED will light. Release the Test key at this time and the Main Test Menu of Interactive RST will be displayed.

NOTE

Some resident tests require the operator to take action to exit them. Most pattern tests and all of the system summary screens are exited by the operator pressing the Enter key. The control panel test, the Video Display Path Test, and Video I/O A to D Test require the system to be reset to exit them.

Factory Basic

Factory Basic is a collection of submodules spanning all three subsystems. Each submodule is executed in turn, one at a time. *When all submodules have been executed, Factory Basic repeats*. Resetting the system or cycling power returns the system to Factory Basic.

Factory Basic is not affected by test setup.

The operator places the system into Factory Basic by pressing the Shift-Test key combination from either imaging mode or interactive RST. The system responds by resetting, displaying the message ***"Beginning Factory Basic Test"*** and executing the submodules that are part of Factory Basic.

During execution of Factory Basic, a progress box and the message, ***"System is in Factory Basic test mode; press Test key to return to normal mode."*** are displayed on the touch panel display for tests executing on the Scan Converter and on the CRT display for tests executing on either the Keyboard Processor or the Scanner. The progress box and message must move from one display to the other in order to provide a constant display of these screen components during test execution.

The operator exits Factory Basic by pressing the Test key. The system responds by resetting and entering the previous mode of operation: either the imaging mode or interactive RST.

If Factory Basic cannot be executed, the system will display a message in the middle of the CRT describing the reason the test cannot be run.

(Example: ***"Remove transducers"***)

When this message is acknowledged, the system again attempts to execute Factory Basic.

Stand Alone Basic

The operator places a subsystem into Stand Alone Basic (SAB) by disconnecting cables providing communication between the subsystems or pulling boards to below the minimum configuration required to execute interactive RST, and powering the system on. When a subsystem initializes without the ability to communicate with the other subsystems, it executes Stand Alone Basic on its own, collects RST Errors as they occur, and displays the results on the four digit LED located on the processor boards. The Scan Converter will require the switch on the Scanner I/O board set to use the local (or left position) clock (this results in error code DD090).

Stand Alone basic is not affected by test configuration. The scanner will require switch 5 set to the open (On) position to allow use of the Beamformer I/O board's four character LED. The scanner might not execute properly after power is cycled. If the scanner does not enter SAB, toggle switch 8 on the Beamformer I/O board. This will send a reset signal to the Beamformer I/O board processor and begin correct initialization.

For more details, see "Processor Board LEDs" on page 4-13.

Basic and Extended Basic

Basic and Extended Basic are entered from the **Main Test Menu**:

- The system responds to entering Basic by displaying the message ***"Beginning Basic Test"*** in the center of the CRT, it then begins executing the submodules that are part of Basic.
- The system responds to entering Extended Basic by displaying the message ***"Beginning Extended Basic Test"*** in the center of the CRT. It then begins executing the submodules that are part of Extended Basic.

Basic and Extended basic are not affected by test configuration.

Basic and Extended Basic, like Factory Basic, execute a collection of submodules spanning all of the subsystems. Unlike Factory Basic, these tests will execute all appropriate submodules on each subsystem only once. RST errors detected during execution will be recorded in the RST Error Log.

Test Configuration

Tests may be configured through the Test Setup Screen available from the ***Main Menu.***

The operator can configure tests to run one time or continuously and to halt when an RST Error is detected or to accumulate errors in the RST Error Log. The configuration applies globally to all configured tests. The default behavior is to run once and accumulate errors.

The tests which are affected by these option settings are:

- Subsystem Extended Basic Tests
- Module Tests
- Submodule Group Tests

Specifically excluded from configuration are the Basic, Extended Basic, and Factory Basic tests.

Subsystem Extended Basic

The operator enters Subsystem Extended Basic tests from any of the subsystem screens via the ***Main Menu***.

Subsystem Extended Basic executes Extended Basic tests on the selected subsystem. The system responds to entering Subsystem Extended Basic by executing each submodule on the specified subsystem.

During Subsystem Extended Basic, the system updates the pass/fail counts of the subsystem and each module.

Module and Submodule Group

Module tests and submodule group tests are both selected through subsystem screens. A pair of option buttons in the lower right corner of each subsystem screen determines which test mode will be in effect.

When either Modules (the default) or Submodules mode is selected for any subsystem, that mode is assumed for **all** subsystems. The selected mode will be maintained, through system reset and cycles of power until it is explicitly set to the other mode.

Module

The operator may enter a Module test from any of the subsystem screens.

The operator first selects the Modules option (the default) from the option buttons in the lower right corner of the subsystem screen. The operator then selects the module to be executed.

During the module test, the Pass/Fail counts for the specified module test will be updated.

Submodule Group

The operator enters a submodule group test from any of the subsystem screens.

The operator first selects the Submodules option from the lower right corner of the subsystem screen. The operator then selects the module and submodules to be run.

User-Dependent Tests

The following sections describe tests which require user intervention to decide if each test passes or fails.

Control Panel

The operator enters the control panel test from the ***Other Tests & Utilities Screen:***

The control panel test exercises the components of the control panel: keyboard, hard keys, trackball, TGCs, LGCs, pots, and rotary knobs. The test displays a depiction of the control panel on the touch panel display, and each time a component is pressed, moved, or turned, the resulting action is mimicked in the depiction.

The control panel test is exited by resetting the system. After reset, the system will return to the Main Test Menu. A prompt appears on the CRT display during test execution:

“To exit the control panel test, press RESET”

Processor Board LEDs

This section discusses the interactive test behavior of the four digit LED displays located on the processor boards of each subsystem.

NOTE

This information becomes particularly important in the event that troubleshooting must be done when the main display is not operational.

As a first step, place the subsystem in question into ***Stand Alone Basic Mode*** by following the steps listed below.

- For the Keyprocessor, disconnect the RS-232 cable that runs from the rear of the E-Box to the Main I/O board on the keyboard area. Cable part #77921-64060.
- For the Scanconverter, switch the clock switch on the Digital Scanner I/O to the "Local" (or left) position.
- For the Scanner, set switch 5 on the Beamformer I/O to the Open position.

When Stand Alone Basic begins, the LEDs read "***SAB***" for two seconds prior to executing the submodule tests. During the test, the module and submodule number of each test will be displayed on the LEDs.

Each RST error consists of two parts: the first four digits represent the module and submodule of the failed test. The last four digits contain additional information for factory use.

When errors are found, ***XX ERRORS FOUND*** followed by ***ERROR CODES: XXXX XXXX, XXXX XXXX ...*** will be scrolled repeatedly until the system resets or the power is cycled. If no errors are found, ***NO ERRORS FOUND*** is scrolled repeatedly until the system is reset or the power cycled.

If Stand Alone Basic or Power-Up Self Test does not detect any RST Errors, the Processor Graphics board display blinks ***"...."*** until the system is reset or power is cycled.

NOTE

During RST execution, if no submodule test is executing, each four digit LED display blinks the following pattern "....". When a resident test comprised of submodule tests is invoked on a subsystem, the module number and submodule number of each submodule test is displayed on the LED prior to the submodule test's execution. For instance, if module 4 submodule 3 is executing on the Scanner, the Scanner I/O board LED display reads "0403". When all of the submodules comprising the resident test module 04 completes, the display returns to blinking the pattern "....".

Test Patterns

Stimulus Loops / Patterns

The service engineer may access test patterns through the Test Patterns Screen which is a sub-set of the **Other Tests & Utilities** available from the **Main Menu.**

Test Patterns is a category of interactive testing that leaves the system in a certain state for an indefinite amount of time. This allows for a test pattern to be left on the screen as long as desired. See Table 4-1 for definitions of each test pattern.

To exit a selected test pattern, press **ENTER**; the system returns to the Test Pattern Menu Screen.

Table 4-1 Test Pattern Definitions

Test Pattern Description	Typical Use
8 Color Bars 75%	Encoder test, color guns
8 Color Bars 100%	Encoder test, color guns
64 Grey Scale Setup	Dynamic range
Multiburst	Resolution
Convergence Grid	Linearity/Convergence
Video Threshold	Merging of B/W with color
White Rectangle	Monitor adjustment
Color Printer Test	Adjustment of color printer
Color Triangle	Color dynamic range
White Screen	High level background tint
Black Screen	Low level background tint
Red Screen	Color purity
Green Screen	Color purity
Blue Screen	Color purity
Four Grey Squares	Dynamic Range

Hardcopy

The hardcopy device controlled by the Print hard key is available during RST execution. The print key is controlled by the B/W image print device of the last preset that was used.

In addition to the Print key, each device is available during RST execution through its own front panel.

Some submodule tests exercise the interface to hardcopy devices, thereby temporarily disabling the hardcopy device.

The hardcopy device will become available as soon as the test completes.

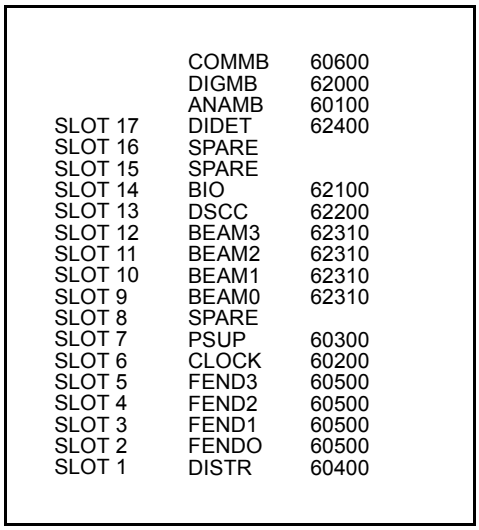
System Information

The System Information Screen available from the Main Menu allows you to access software or hardware information.

The operator exits each of the system information screens by pressing the Enter key. The display returns to the Main System Information Screen.

An example of this feature is the hardware information screen sample that follows.

Figure 4-4 Sample Hardware ID Screen (FrontEnd)



Logs

This section discusses the RST Error Log and Run Time Error Log. These logs are independent and are maintained over system resets and cycling of power.

An asterisk by the error log name in the Main Menu means that the log contains error codes.

RST Error Log

The operator accesses the RST Error Log through the Main Menu or through any menu which detects RST errors. (Figures 4-1 through 4-4 provide an overview of the menu hierarchy).

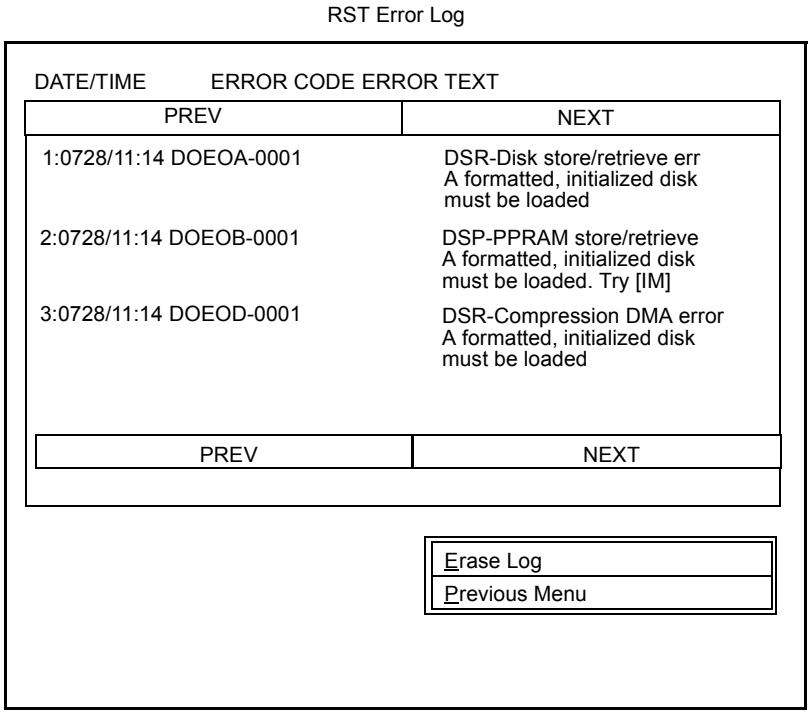
All RST errors detected during test execution are logged. The RST Error Log presents a time-sorted display of the last 64 RST errors detected during test execution. Duplicate errors detected at different times are listed separately. The errors detected by the most recent test set appear at the top of the log, separated from the older errors by a banner (a series of asterisks "*"). Each time a resident test capable of detecting RST errors is executed, a banner is added to the top of the RST Error Log. If no RST errors are detected, the banner remains at the top of the log. At most, one banner can appear at the top of a log. If a Resident Test is executed and a banner already exists at the top of the log, a second banner is not added. The banner separates only groups of errors detected during resident tests.

The operator erases the contents of the log by selecting **Erase Log** from the RST Error Log Menu, and confirms the operation with the Erase Log Confirmation Message.

NOTE When the error log is full, new errors will no longer be accumulated.

For a list of on board abbreviations, refer to "Board Abbreviations" on page 5-1.

Figure 4-5 Sample RST Error Log Screen



Run Time Error Log

The operator accesses the Run Time Error Log through the Main menu. Run time errors are presented in a time-sorted display with the most recent 20 run time errors appearing at the top of the log. The list box in which the log is displayed provides the ability to page through the log. See page 4-8 for a discussion of list box use.

Log Entry Details

The screen shown in Figure 4-6 provides additional information beyond what is displayed in the run time error log. The screen can be entered by:

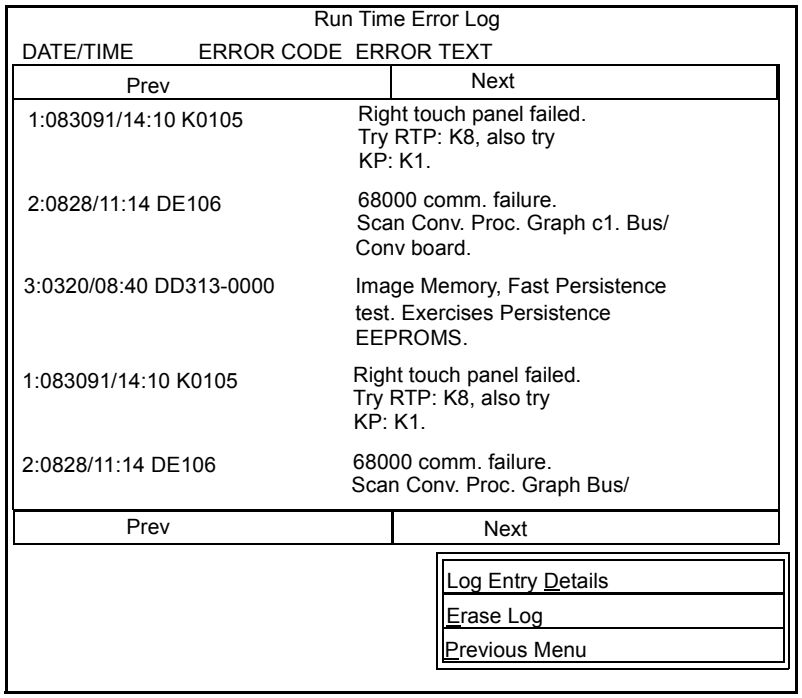
1 Moving the cursor to the error and pressing ENTER,

2 Selecting Log Entry Details.

The operator erases the contents of the log by selecting Erase Log from the Run Time Error Log Menu, and confirms the operation with the Erase Log Confirmation Message.

NOTE When the Run Time Error Log is full, new errors will no longer be accumulated.

Figure 4-6 Sample Run Time Error Log Screen



CMOS RAM (Presets)

The operator resets custom presets and error logs to their factory values and stores and restores custom presets and error logs to the Keyboard Processor through the PRESETS backup option. Customer presets can also be restored from the service floppy (see "Customer Presets" on page 3-57).

The options are:

- Erase PRESETS
- Backup PRESETS to KP
- Restore PRESETS from KP

The erase PRESETS operation resets the non-volatile system memory, thereby providing a mechanism to correct problems caused by erroneous values in this memory region.

NOTE

After erasing PRESETS, the current date and time defaults to 00:00:00 1 January 1994. You also must recalibrate the touch panel displays.

Erase PRESETS operation must be confirmed before it is executed.

The Backup PRESETS to KP and Restore PRESETS from KP operations provide for easier service related functions by allowing the removal/replacement of the Processor Graphics board without totally erasing presets and other information that would otherwise need to be entered manually after the service is completed.

Touch Panel Calibration

The operator invokes the touch panel calibration function through the **Other Tests & Utilities Screen**.

This function prompts the operator to touch locations on each touch panel. The system uses these locations to calibrate each touch panel display and stores the calibration values in battery-backed RAM (CMOS).

If CMOS is cleared, the touch panels need to be recalibrated.

Video Tests

Video Path

This test is invoked through the **Other Tests & Utilities Screen** allowing an external video source, such as the VCR, to feed a signal through to the CRT.

Video I/O A to D test

This function digitizes the output of the VCR and prepares it as it would for a signal to be printed on the stripchart. This test is used to debug stripchart printing problems.

Stripchart Tests

The operator invokes Stripchart Tests through the **Other Tests & Utilities Screen**.

The Stripchart Test is the Grey Bar test. This test is used to calibrate the stripchart printer. It writes a grey scale pattern on the stripchart allowing the operator to adjust the printer controls. Three printer speeds are supported: 25, 50, and 100 mm/s.

Equipment Service

This feature provides the operator or Service Engineer access to utilities related to system servicing

The ***Filter Cleaning utility*** provides for setting the frequency at which the power-on filter cleaning message shall be displayed. This setting is normally based on the number of hours since the filters were last observed to need cleaning.

The ***System Chronometer utility*** provides for reviewing and setting the following:

- The date the system was installed at the customer site.
- The number of hours the system has been operating since installation.

NOTE

Filter Cleaning and ***System Chronometer*** settings are reset when CMOS is erased, and must be configured by the operator or the Service Engineer.

Network Utility

You access the **Network Utility** screen from the **Other Tests & Utilities** option on the Main RST Menu screen.

The Network Utility screen allows the operator or Service Engineer to obtain information about the current Network Interface (DNI or IDI) settings and to customize Network Interface operation. The screen is always available, but only functional if the Network Interface option is installed.

The main Network Utility screen contains a list of the utilities and shows a summary of the current configuration settings on DNI or IDI.

You can use Help to view additional information about the following options:

- Autodelete
- Beeps
- Help
- Network
- Registry
- Server
- Summary

To access Help:

1 In the Network Utility, select Help or type Help in the text box and press Enter.

The network Help Utility Screen appears.

2 Type H, space, and the first letter of the command for which you want to view Help, and then press Return.

3 Press Exit to return to the Other Tests & Utilities screen.

5 Error Codes

Board Abbreviations

Scanner Section

Abbreviation	Actual Name
Distr	Distribution
Fend0	Front End 0 (slot #2)
Fend1	Front End 1 (slot #3)
Fend2	Front End 2 (slot #4)
Fend3	Front End 3 (slot #5)
CLK	Clock
PREG	Power Regulator
Beam0	Beam 0 (slot #9)
Beam1	Beam 1 (slot #10)
Beam2	Beam 2 (slot #11)
Beam3	Beam 3 (slot #12)
DSCC	DSCC
BIO	Beamformer I/0
ID	Digital Image Detector

Scan Converter Section

Abbreviation	Actual Name
SIO	Digital Scanner I/O
DD	Digital Doppler
DSR	DSR-SCSI
FP	Flow Processor
RT	R-Theta-AC
AQ	Digital AQ
IM	Image Memory
SC	Stripchart
PVT	Physio Video Timing
VIO	Video I/O
CCLR	Combined CLR
TCINE	TurboCine
PG	Processor Graphics

Keyprocessor Section

Actual Name	Abbreviation
K	Keyscanner / Audio
RTP	Right Touch Panel
LTP	Left Touch Panel
PHY	Physio

Error Types

Error codes are divided into two broad categories:

- Run Time Errors
- Resident Self Test Errors (RST)

Run Time Errors, by definition, are errors detected by the application software during the normal operation of the system. In the event that an error is detected while the system is in normal operation, it will be displayed on the screen with an appropriate message, as well as recorded in the Runtime Error Log.

A source of Run Time Errors may be power line glitches or other momentary disruptions, for which there may not be an immediate solution or fix. Nevertheless, a log is kept of these errors that may be used as a troubleshooting reference. The log may be examined as often as required by invoking the Run Time Error Log from the main test menu.

The best course of action when noting these errors is to notify the factory, so that corrective action can be taken.

Resident Self Test Errors represent deficiencies that may be present in the hardware or software. These may be detected and pinpointed by running submodule tests individually, or as a group. The message represented by the error code will often help in diagnosing the failure.

RST is a tool accessed from the main test menu.

During normal operation, error codes and their corresponding messages will appear on the screen. The error numbers are preceded by a letter that identifies the subsystem, as follows:

K = Keyprocessor Electronics

E = Scanner

D = Scan Converter

NOTE

In the event of video failure, the Service Engineer may obtain valuable failure data by resorting to information extracted from the four digit LEDs incorporated in each subsystem. The messages associated with each error code are listed on the following pages. Codes displayed on the LEDs of the subsystem omit the letters K, E, or D.

To use the LEDs on the Beamformer I/O (Scanner), switch 5 on the same board must be set OFF or OPEN. The Scan Converter will require that the switch on the Scanner I/O board be set to use the local clock during Stand Alone Basic testing.

Error Code Table

Table ID	Error Type	Subsystem	Page #
5KRST	Resident Test	Keyprocessor Electronics	5-7
5DRST	Resident Test	Scan Converter	5-65
5ERST	Resident Test	Scanner	5-77
5KRST	Resident	Keyscanner	5-125

Errors on LEDs During Stand Alone Basic Testing

When the tests are complete, the message XX ERRORS FOUND or NO ERRORS FOUND will be scrolled on the LEDs. For example, if four errors are found, the following string will be displayed: 04 ERRORS FOUND. If no errors are found, then the message NO ERRORS FOUND will scroll repeatedly until the system is reset, or the power is cycled.

The message announcing the number of errors will be followed by the display of each error code in two parts: four hexadecimal characters for the error code, and four hexadecimal characters for the error data.

NOTE

The error data (the second set of 4 characters) is intended for factory use. Unless a specific value is assigned, for example: 0003, errors listed as XXXX, 0000, or nnnn, mean that any value applies.

Error code example:

ERROR CODES: 0201 XXXX; 0302 00F4; ...

In these examples, the LEDs being observed are on the Beamformer I/O board of the Scanner. The first two digits, 02, indicate that the failure is in modules 02. If you refer to the beginning of Chapter 4, you will see that module 02 corresponds to the Power Supply board.

In the second example, module 03 refers to the Clock board.

The second set of two digits, 01 and 02 respectively in these example, denotes the submodule that has failed. This information is rarely of practical value in the field because it indicates a group of components or cluster within a module that may not be repaired in the field. The list of submodule numbers associated with a module may be found on Figures 4-2 through 4-4 of Chapter 4.

5 Run Time Error Codes

Board Abbreviations

Keyprocessor Section

Actual Name	Abbreviation
KP	Keyscanner / Audio
RTP	Right Touch Panel
LTP	Left Touch Panel
PHY	Physio

Run Time Errors

Whenever a Run Time Error is detected while the system is in normal operation, the error will be displayed: (1) on the screen with a message, (2) on a subsystem LED and (3) in the Run Time Error Log.

The Run Time Error code consists of five characters. Sometimes a second set of four characters is displayed to give additional meaning to the error.

Run Time Error Code Example: EDEC4 0001

The first character of the code identifies the subsystem. In this example, **E** identifies the Scanner subsystem.

K = Keyprocessor
E = Scanner
D = Scan Converter

The second character of the code identifies the type of failure. In this example, **D** identifies that the error is recoverable.

D = Recoverable
E = Conditional
F = Non-recoverable

The next three characters identify the **error code**. Also, if a second set of four characters appear after the error code, it becomes part of the error code. In this example, **EC4 0001** identifies the error as "Missing Autocool option." Use the table that follows to identify the error code.

Core Test Errors

The following errors could appear during the core test that takes place during power-on or during a system reset. These errors indicate a problem with one of the system's three processor boards. These errors will only be reported on the 4-digit LED of the processor which had experienced the error. These errors are always non-recoverable (code F).

NOTE

Remember that the LED display on the Beamformer I/O is not normally on. Move switch #5 to the down (closed) position to turn on the LED display.

xFD27-xxxxxxxx Indicates that the processor RAM failed core test. Eight digits of additional information indicates the address that failed.

xFD28-xxxx Indicates that the processor ROM failed core test. Four digits of additional information indicates the ROM that failed.

xFD29-xxxx Indicates that a particular integrated circuit failed core test. Four digits of additional information indicates the U number of the failing part.

Where the leading "x" can be either a K (Keyprocessor), D (Scan Converter), or E (Scanner), representing the keyprocessor that has failed.

Run Time Error Codes

Error Code	Failure Data
000	RS-232 Scanner to Scan Converter communications failure.
001	RS-232 Scanner to Scan Converter communications failure.
002	Control pressed not functional with Color. Pressed a key not functional with color.
004	Control pressed not functional with loop.
006	Control pressed not functional with Full Screen Report.
015	Tape is rewinding. Stop tape and try again.
034	Incorrect DP version installed. [DP].
065	Undo key is held down.
066	Measurement buffer is full.
069	Undo key has been inhibited.
06A	Software or Hardware error (CMOS pointer out of range).
06B	CMOS memory initialized to default values. Check battery or [PG].

Error Code	Failure Data
06C	CMOS error. Check battery or [PG].
06D	Hardware configuration has been changed. Restore original hardware configuration or clear and restore CMOS.
06E	CMOS battery backed memory checksum error. Check battery or [PG].
06F	Analysis CMOS checksum error. Check battery or [PG].
073	Invalid control was pressed.
074	Invalid control was pressed.
075	Invalid control was pressed.
076	Maximum number of trace dots reached. Press Enter to complete trace, or Erase to remove dots.
077	VCR Measurement calibration in progress.
07A	Software or Hardware error (Bad column number).
07B	Software or Hardware error (Bad text entry control code).
07C	CMOS recovery failed; bad Processor Graphics board suspected.
080	Volume measurement incomplete.Press Enter to complete trace, and press Store EF Vol. Pressed STORE EF VOL without completing the volume measurement.
082	Cannot make measurements in this mode.
083	Annotation text too long. Perform a Move or Delete function.
085	Annotation not allowed.
087	Printing. Please wait.... While the printer was printing, the user tried to configure the printer or make another print.
090	[SIO] Clock toggle switch set to internal clock. Change to external clock.
091	System not communicating with printer. Turn printer on and press Reset. Communication with the Sony printer has failed. Check RS-232 cable. Check power. Reset system.

Error Code	Failure Data
092	System not communicating with printer. Turn printer on and press Reset. Communication with the Sony printer has failed. Check RS-232 cable. Check power. Reset system.
093	Unexpected response from the Sony printer. Try resetting system.
094	Sony printer communications. failure. Try resetting system. Check power.
095	Unable to print. Check paper tray and ribbon cassette.
096	Unable to print. Check paper tray and ribbon cassette. Sony printer communications failure. Try resetting system. Check power.
097	Software or Hardware error (Scanio gaincal fifo error).
098	Unable to print. Check paper tray and ribbon cassette. Sony printer error.
099	Control pressed not allowed in quick review.
09A	Software error.
09B	System not communicating with printer. Turn printer on and press Reset.
09C	Some receive data from Sony printer was lost. Reset system.
09D	Sony and system think different number of quad prints have been captured. Reset system.
0BD	Backdoor enabled. To disable backdoor set PG switch 6 off (down).
0BE	Factory mode enabled. Cannot continue scanning. Contact your Philips service representative.
0BF	Cache disabled. To enable cache, set PG switch 10 off (switch 2 on second bank down).
0C0	Software or Hardware error (Bad word received).
0E9	RS-232 Error (RS-232 relay out of free nodes).
100	[VIO] Incorrect video format for system (NTSC versus PAL).
101	Control pressed is not allowed during loop Compare.
102	Trace is frozen, can’t chart.
104	Image currently printing. Pressed CHART key during FRAME record.

Error Code	Failure Data
105	Image currently printing. Trying to use CHART footswitch during FRAME record.
107	Paper speed 10 mm/s prohibited.
109	Strip chart recorder currently printing.
10A	Strip chart recorder currently printing.
10B	Cannot use strip chart in Color mode.
111	Software error or [PG] Unexpected DUART 2 interrupt received.
117	Software or Hardware error (Divide by zero in calibration cvt factor).
130	Software or Hardware error (DSR incorrectly called Cine).
131	Software or Hardware error (Bad DSR storage algorithm).
133	Software or Hardware error (Invalid loop ID).
134	Software or Hardware error (Feature not implemented).
135	Software or Hardware error (Smart store failure).
136	Software or Hardware error (Cine bad smart store mode).
137	Software or Hardware error (Cine bad smart store percentages).
138	Software or Hardware error (Cine smart store range).
139	Software or Hardware error (Cine bad parameter).
13A	Software or Hardware error (Cine should not have reached this point).
13B	Software or Hardware error (No ABD loops stored in Cine).
13C	Software or Hardware error Cine illegal state.
13D	Software or Hardware error (Cine control region enter).
13E	Software or Hardware error (Cine SCSI error.)
13F	Software or Hardware error (Cine CPU bin overflow).
140 0001	Cannot edit an empty loop.
140 0002	End point cannot precede start point.

Error Code	Failure Data
140 0003	End point of loop reached.
140 0004	Start point cannot exceed end point.
140 0005	Multiple loops required.
140 0006	Cannot edit multiple loops.
140 0007	Start point of loop reached.
140 0008	Loop is being retrieved. Please wait...
140 0009	Must finish processing Loop before exiting. Please wait...
140 000A	No frames available for quick review.
140 000B	Cannot scroll further in this direction.
140 000C	Cannot scroll further in this direction.
140 000D	Quick review available in full screen format only.
140 000E	Loop memory full.
140 000F	Quick review not supported for VCR data.
140 0010	Text entry not allowed.
151	Software or Hardware error (Requested dialog box too wide).
152	Software or Hardware error (Analysis requested invalid mod conversion).
153	Software or Hardware error (A regular expression may only have 31 terminal symbols. Terminal symbols are character classes and normal literals.)
180	System/Disk error occurred. Press Reset.
181	System/Disk error occurred. Press Reset.
181 300C	Disk not responding. Please try again, or contact your Philips service representative.
181 3018	Disk not responding. Please try again, or contact your Philips service representative.
181 3134	Network Interface error. Reset recommended.
183	System/Disk error occurred. Please try again.

Error Code	Failure Data
183 2005	Maximum number of files stored. Delete file(s) or change sides/disk.
183 2007	File does not exist. Press Disk. Select Rebuild Database. Choose the Reconcile option.
183 200A	Disk is full. Delete unwanted file(s) and try again.
183 2010	Disk not properly inserted. Check disk and try again.
183 2011	Disk is damaged. Format Disk recommended.
183 2015	Disk is write-protected.
183 2039	Unrecognizable disk format. Initialize Disk recommended.
183 203B	Unrecognizable disk format. Initialize Disk recommended.
183 203D	File damaged. Cannot perform requested operation.
183 2052	The Network Interface is powering up. This normally takes several minutes. Please wait and try again.
183 2054	The Network Interface is powering up. This normally takes several minutes. Please wait and try again.
183 2056	A Format Disk has been done. The system must be powered off and powered back on before using Disk operations.
183 2100	Disk and/or loop busy. Wait until function finishes and try again.
183 2104	Disk is full. Delete unwanted file(s) and try again.
183 2105	File damaged. Cannot perform requested operation.
183 2108	Incompatible loop format. Change loop format setting and try again.
183 210D	File damaged. Cannot perform requested operation.
183 210E	Inconsistencies in database. Rebuild Database recommended.
183 2117	Incompatible video format. Cannot retrieve file.
183 2118	Incompatible file format. Cannot retrieve file.
183 2119	Disk not ready. Please try again.
183 2200	Incompatible loop format. Change loop format setting and try again.

Error Code	Failure Data
183 2201	Loop memory full. Delete unwanted loop(s) and try again.
183 2202	Disk and/or loop busy. Wait until function finishes and try again.
183 2203	Loop too long for quad screen format. Use Format Full, Format Split or Format Cropped.
183 2204	Unable to resume protocol. The Stress protocol on disk is complete or does not match the currently active protocol.
183 2208	Loop too long to retrieve.
183 2300	No files found on disk.
183 2305	Cannot store still frame during Loop Acquire or VCR play.
183 2306	Cannot retrieve still frame while in VCR Play.
183 2308	Multiple loops selected. Select one loop.
183 230A	No Acoustic Densitometry files found.
183 230B	No files found for this application.
183 230C	Study is empty.
183 230D	Too many loops selected to retrieve with the current CLR loop format.
183 230E	Too many or no items selected. Select one item only.
183 230F	List Contents requires selecting a Study.
183 2312	Insufficient CLR memory to retrieve remainder of study.
183 2313	No items selected. Select an item and try again, or press Cancel.
183 2314	Too many still frames selected.
183 2315	Select CLR protocol to retrieve individual loops.
183 2317	Please enter a Stress protocol prior to retrieving a Stress study.
183 2318	No Stress studies which may be resumed were found.
184	Omni TEE transducer calibration failed. Straighten transducer, and lift and lower locking bail. Contact your Philips service representative.
185 010B	Inconsistencies in database. Rebuild Database recommended.

Error Code	Failure Data
185 1104	Disk is full. Delete unwanted file(s) and try again.
185 110B	Inconsistencies in database. Rebuild Database recommended.
186	Network Interface error during study creation. Study has been saved on the hard disk, but will not transfer over the network.
187	Network Interface error during study transfer. Study file(s) have been saved on the hard disk, but will not transfer over the network.
188	Network Interface error during End Study. Study was saved to hard disk, but the fact that a study ended may not have been communicated over the network.
189	Network Interface error during copy to optical. File(s) did not copy.
190	Software or Hardware error (Line # not in range).
191	Software or Hardware error (Depth not in range).
192	Software or Hardware error (Doppler angle not in range).
193	Software or Hardware error (Invalid command in DO command).
194	Software or Hardware error (Line angle not in range).
195	Software or Hardware error (Gain not in range).
196	System overheated. Turn system off and clean all air filters. System overheated. Clean filters.
197	System temperature near upper limit. Clean all air filters as soon as possible. System temperature near upper limit. Clean filters.
198	Another user on the network is accessing the hard disk. Study has been saved on the hard disk, but will not transfer over the network. (Another user on the network is accessing the hard disk. Study was saved on the hard disk, but did not transfer to EIMS.)
18A	DSR/DICOM network mismatch between SONOS and IDI. Network transfers will fail.
18B	This control may not be used while a study is in progress. Try again after End Study has been pressed.
18C	Software or Hardware error. (SCSI bus timed out.)

Error Code	Failure Data
18D	The server has not responded yet. Consider using manual entry or trying again in a few moments.
18F	Software or Hardware error. (Unable to write the analysis database to the hard disk.
18E	Software or Hardware error. (Unexpected DUNE state table stimulus.)
198	Another user on the network is accessing the hard disk. Study has been saved on the hard disk, but will not transfer over the network.
19A	Software or Hardware error (Wall filter not in range).
19B	Software or Hardware error (Bad application number).
19C	Software or Hardware error (Bad application number in kscom).
19D	Software or Hardware error (Bad event number from resource manager).
19E	Software or Hardware error (Bad resource number from resource manager).
19F	Software or Hardware error (Bad tee status value from controller).
200	Software error (Back End: Generic DSS error).
201 0001	Software or Hardware error (Txgrmgr, max. string length exceeded).
201 0002	Software or Hardware error (Txgrmgr, null string).
201 0003	Software or Hardware error (Txgrmgr, max. length exceeded).
201 0004	Software or Hardware error (Txgrmgr, updated string too long).
202	Software or Hardware error (Bad type value in text package).
203	Software or Hardware error (Text package unable to read marker).
207	Software or Hardware error (Bad coordinates to Text area).
208	Software or Hardware error (Too many text WM blocks).
209	Software or Hardware error (Text manager error).
20A	Software or Hardware error (Invalid argument to MeasDisp update).
20B	Software or Hardware error (Invalid ID to MeasDisp).
20C	Software or Hardware error (Invalid mode to MeasDisp).

Error Code	Failure Data
20D	Software or Hardware error (Invalid mask).
20E	Software or Hardware error (Invalid type/scrnarea).
20F	Software or Hardware error (Bad wave argument to MeasDisp).
211	Software or Hardware error. (Error in generic calibration object.)
212	Software or Hardware error. (Too many regions found when measurements queried generic calibration.)
213 0001	Software or Hardware error. Bad parameters passed to delete all routine.
213 0002	Software or Hardware error. Bad parameters passed to delete call.
213 0003	Software or Hardware error. Bad parameters passed to create call.
213 0004	Software or Hardware error. Bad parameters passed to copy call.
213 0005	Software or Hardware error. No image ids left.
213 0006	Software or Hardware error.Attempted to delete an image which was never created. Bad image ID.
213 0007	Software or Hardware error. Bad parameters passed to read call.
213 0008	Software or Hardware error. Bad parameters passed to count call.
214	Network interface error during a study rescue. File (s) did not transfer.
254	Software or Hardware error (Bad field value).
255	Bad character entered.
256	Software or Hardware error (Higher application in progress).
258	Unable to respond to controls pressed. If problem persists, contact your Philips service representative.
259	Analysis not available in this mode.
260	Measurements not allowed in this area.
261	Trace not entered. Press Enter to approve trace.
262	One point measurements not allowed in this area.
263	Control changes have been made. Measurements invalid in this area.

Error Code	Failure Data
264	Angle should be greater than 30 and less than 70 degrees.
265	Scan vessels larger than 3mm for better accuracy.
266	Use greater zoom for better accuracy.
267	Focus at vessel depth for better accuracy.
268	Position scanline in center of image for better accuracy.
269	CVI Software Sampling Error.
26A	CVI Software generating too few samples.
26B	Software or Hardware error (DFBACK DSS invalid command received.)
26C	Software or Hardware error (DFBACK DSS routines table size mismatch.)
26D	Software or Hardware error (DFBACK DSS routines table out of sequence.)
26E	Software or Hardware error (CRT dip text ROM table size mismatch.)
26F	Software or Hardware error (CRT dip text ROM table out of sequence.)
270	Insufficient doppler spectral data since last control change
271	Software or Hardware error (No MEAS_BASE_... for the given prim or calc bit mask.)
272	Software or Hardware error (Invalid unit parameter requested.)
273 0001	Software or Hardware error (Meas Output Error: Too many meas objects attached to image. Does not match the constant governing the max number.)
273 0002	Software or Hardware error (Meas Output Error: Too many components for this measurement collection, must bump up constant.)
273 0003	Software or Hardware error (Meas Output Error: The number of measurements and calcs which can be displayed for a given graphic has exceeded the constant.)
274	Software or Hardware error (Unknown measurement type)
275	Software or Hardware error (Can’t do measurement on this application. Only realtime, CLR and VCR allowed.)

Error Code	Failure Data
276	Control pressed only valid in text entry.
280	[CCLR]: Requested more cine memory than is available; also check SIMMS or SIMMS switches.
281	Printer does not support this depth.
282	Printer not responding. Press reset.
283	(The data segment allocated for ifd entries has overflown. Must bump up IFD_DATA_BUFF_SIZE in scsi_hdw.c.)
284	(The data segment allocated for ifd entries has overflown. Must bump up IFD_DATA_BUFF_SIZE in scsi_hdw.c.)
286	Trigger delay is greater than the R-R interval. Forcing a trigger on the R-wave.
287	Software or Hardware error (Call to UI DIP that has not been activated.)
288	Unexpected Acquisition 3D condition encountered
289	Spectral data out of calibration
28A	Doppler Detector Board firmware download error
28B	Hardware error: Clock Power Regulator or Doppler Detector Board hardware general error.
28B-0003	Most probable cause is the Clock Board or the Pencil Probe.
28C	Doppler Detector Board processor not responding
28D	Timeout or Local Processor Communications error
28E	General Local Processor Communications Error; see extra data
28F	Qualification mode enabled. Contact your Philips service representative.
290	Pvt slave processor failed to respond
291	Programable chip is unprogrammed
292	Storing more memory in SCSI parameter buffer than can be transferred to Dunebox
293	Titan I/O chips did not program

Error Code	Failure Data
296	Software queue error
297‘	Software queue error
298	Software queue error
299	Software queue error
29A	Measurement not allowed - endpoints in areas with different calibration.
29B	Unexpected Option Configuration. Please review your option settings.
29D	Software error (Invalid index to Eprom application bit vector).
29E	DSR firmware detected error
2A3	Acoustic cine to CCLR transfer is in an invalid state
300	Software error (R Theta received invalid request)
305	R Theta Software error
306	R Theta Software error
307	R Theta Software error
308	R Theta Software error
309	R Theta Software error
30A	R Theta Software error
30B	R Theta Software error
30C	R Theta Software error
30D	(Software error or try in order [SIO], [FP], [RT]).
30E	(Software error or try in order [SIO], [FP], [RT]).
30F	(Software error or try in order [SIO], [FP], [RT]).
310	Factory switch setting is incorrect
311	R Theta Hardware error
312	R Theta Hardware error
313	R Theta Hardware error

Error Code	Failure Data
314	Software error (R Theta couldn't idle).
315	[RT]: R Theta uneven cine acquisition.
316	Software error (R Theta can't stop looping)
317	Software or Hardware error ((R Theta frame count mismatch).
330	Control pressed invalid in Annotation.
339	AQ processor communications failure. Check [AQ].
340	DSS processor communications failure. Check [PG].
342	Software or Hardware error (Illegal ack).
343	AQ processor not responding. Check [AQ].
346	Illegal AQ region of Interest key
347	Software or Hardware error (Unmatched ROI start).
348	Software or Hardware error (AQ ROI slope divide by zero).
356	AQ text label specified is unknown. Check label.
359	Software or Hardware error (AQ processor message specifying data type).
364	Software or Hardware error (Border or image width/position message).
365	Software or Hardware error (Screen, scales or minimum message).
366	Software or Hardware error (AQ On message).
367	Software or Hardware error (Waves On message).
368	Software or Hardware error (Volume data message).
369	Software or Hardware error (Resolution message).
370	Software or Hardware error (Sector depth message).
371	Software or Hardware error (Number of samples on line message).
372	Software or Hardware error (VSR message).
373	Software or Hardware error (ROI data message).
374	AQ software error

Error Code	Failure Data
391	Software or Hardware error (Data message).
393	Software or Hardware error (AQ measurement error.)
394	Software or Hardware error (AQ bad ROI.)
395	ECG must be connected in this mode.
396	
400	Software or Hardware error (Generic keyp).
401	Software or Hardware error (IPC problems in send dip).
402	Software or Hardware error (Exceeded max. number of unique IDs).
403	Software or Hardware error (Interpret stim xchg is not alive).
404	Software or Hardware error (Can't disable scan controls).
410	Software or Hardware error (IPC problems in send dip).
411	Software or Hardware error (DFBACK invalid command received).
412	Software or Hardware error (DFBACK routines table size mismatch).
413	Software or Hardware error (DFBACK routines table out of sequence).
420	Software or Hardware error (EL dip operations table size mismatch).
421	Software or Hardware error (EL dip operations table out of sequence).
422	Software or Hardware error (EL dip text rom table mismatch).
423	Software or Hardware error (EL dip text ROM table out of sequence).
424	Software or Hardware error (EL dip text index array table mismatch).
425	Software or Hardware error (EL dip text index array ROM table out of sequence).
426	Software or Hardware error (EL dip TU add failed).
427	Software or Hardware error (EL dip text ID mismatch).
428	Software or Hardware error (EL text ID out of sequence).
430	Touch panel calibration failed. Previous data will be used until next calibration.

Error Code	Failure Data
431	Touch calibration CMOS data invalid - recalibrate.
432	[PG]: Option Eprom missing or broken.
433	Option ROM not programmed for that system.
434	Physio board is incompatible with 3D option. Needs to be 77921-60620 or 77921-60630.
500	Scanner software error.
510	Software or Hardware error (Reformat list is full).
512	Power supply out of regulation. Adjust gain pot. Check transmit power supply and overheated thermistor on Power Regulator board.
515	Software or Hardware error (Aperture control value invalid).
516	Software or Hardware error (Access frame table while scanning).
517	Software or Hardware error (Options not valid).
518	Software or Hardware error (Incorrect parameters for the backdoor).
519	Software or Hardware error (Illegal parameters passed into the routine).
51A	Software or Hardware error (Illegal addressing in timer table).
51B	Software or Hardware error (Illegal size in generic command).
51C 0001	Software or Hardware error (Could not allocate timer).
51C 0002	Software or Hardware error (Illegal time ID or not allocated).
51C 0003	Software or Hardware error (Time manager hung or not started).
51D	Software or Hardware error (Transducer capability parameter missing).
51E	Software or Hardware error (Coefficients not valid).
520	Reconnect the transducer, then press Reset. If problem persists, contact your Philips service representative.
520	Thermistors in TEE transducer open. Check for bent pins on the connector.
521	Cannot have two TEE transducers connected at the same time.

Error Code	Failure Data
522	One of the Biplane TEE transducer connectors not properly inserted.
523	Reconnect the transducer, then press Reset. If problem persists, contact your Philips sevice representative
523	TEE thermistor circuitry or [XPS] failure. Check for bent pins on the connector.
524	TEE thermistor failure. First check transducer connector and adapter. Check for bent pins on the connector.
525	Bad TEE thermistor type selected.
530	Check CDs for proper types, quantities and locations.
535	Transducer not supported.
536	Software or Hardware error (Invalid power data).
537	Transducer is incompatible with the System Hardware.
537 0001	This transducer not supported.
537 0002	
537 0010	This transducer not supported. A 128 channel system is needed to support this transducer.
537 0020	Vascular option required to support this transducer.
537 0030	Pediatrics option required to support this transducer.
537 0040	Curved linear option required to support this transducer.
537 0050	Transcranial Doppler option required to support this transducer.
538 0001	Transducer EEPROM checksum invalid. Also try [DC] and [DB].
53A	This system supports only TEE transducers and IJV locator transducer (21211B).
53B	Software or Hardware error (Transducer inconsistent with reformat).
53C	Software or Hardware error (Table in software is not correct).
53D	Omni TEE transducer calibration failed. Straighten transducer. Contact your Philips service representative.

Error Code	Failure Data
53D	Omni TEE transducer calibration failed. Straighten transducer. Also check connector.
53E	This transducer not supported. Transducer has been obsoleted.
551	Software or Hardware error (Unexpected frame interrupt).
552	Software or Hardware error (Frame error).
553	Software or Hardware error (No interrupt, but RS-232 invoked).
554	Software or Hardware error (RS-232 break too long or short).
555	Software or Hardware error (No nodes available in RS-232 fifo).
556	Software or Hardware error RS-232 error.
557	Software or Hardware error RS-232 error.
558	Software or Hardware error RS-232 error.
559	Software or Hardware error RS-232 never came up.
55A	Invalid power supply tap voltages. Check two plug-in fuses (green) on [XPS] Also try [FEs, ID, TGC].
55B	Software or Hardware error (Error allocating RAM).
560	Software or Hardware error (Bad functional test number passed).
561	The LED switch on the DC card is in the wrong position. Contact your Philips service representative.
562	Software error (Dot matrix LED driver process could not start).
563	Software error (Unable to activate dot matrix LED process).
564	This transducer not supported. This transducer is unsupported by this hardware configuration or option configuration.
566	Software or Hardware error Bad data read from PV card Check PV power supply [PV:A9].
567	Illegal Doppler gate placement.
569	Cannot have two Omni transducers connected at the same time.
56A	Software or Hardware error (Invalid harmonic requested).

Error Code	Failure Data
56B	Software or Hardware error (Invalid number of line spacings).
56C	Receive frequency is larger than expected.
56D	Software or Hardware error (Illegal thermistor data in probe).
56E	Omni transducer calibration failed. Reconnect the transducer. If problem persists, contact your Philips service representative.
581	Too many Graphics windows.
582	Graphics window is not allocated.
590	Software or Hardware error (File already open).
591	Software or Hardware error (File is not open).
592	Cannot read request when in write mode.
593	Cannot write request when in read mode.
594	Software or Hardware error (Invalid filename format).
595	Software error (String too long).
596	Software error (No pending file writes to be processed).
597	Software error (File processing error).
598	Software error (File processing error).
599	Software error (File processing error).
59A	Software error (File processing error).
59B	Cannot write request with write pending.
59C	Cannot read request with read pending.
59D	Write buffer is not empty.
59E	Software error (Write block could not be packetized).
5E0	Fine Delays are missing.
5E1	Invalid test signal from DC. Try [DC].
5E2	Bad test RF signal. Try [DB, ID, CLK].

Error Code	Failure Data
5E5	CDs are not properly recognized. Check CDs.
5E6	Too many flat tap CDs installed.
5E7	Color flow failure. Try [DD].
5E8	Image detector calibration has failed. Exit resolve mode and run resident test. Possibly beam board error.
5F0	Software or Hardware error (Time out waiting for run loop).
5F3	Software or Hardware error (Unable to create a global exchange).
5F4	Software or Hardware error (Unable to create a global semaphore).
5F5	Software or Hardware error (Unable to create a global process).
5F6	Software or Hardware error (SHARK startup error).
5F7	Software or Hardware error (Info size check error - enter SIZECHECK backdoor to display inconsistent tables).
5F8	2.5V reference voltage out of specification. Try [XPS:A8].
5F9 0A13	Vascular option requires image detector. [ID:A13].
5FB	Software error (Invalid parallel 2D lines).
5FC	Software error (Invalid coefficients).
600	Software or Hardware error (Generic shcore error).
601	Check for software mismatch or communications problem between subsystems. (Subgroup lost).
602	Software or Hardware error (Severity of event exceeds max).
603	Software or Hardware error (Can’t send subgroup with no events).
604	Check for software mismatch or communications problem between subsystems. (Max. number of subgroups exceeded).
605	Software or Hardware error (Synchronize Imager undefined event).
606	Check for software mismatch or communications problem between subsystems.(Unrecognized message type in Interpret stimulus).
607	Software or Hardware error (Variable size agent not expected).

Error Code	Failure Data
608	Software or Hardware error (Long agent not expected).
609	Software or Hardware error (Short agent not expected).
60A	Software or Hardware error (Variable size agent expected).
60B	Check for software mismatch or communications problem between subsystems. (Imager stimulus must be A-Z only).
60C	Software or Hardware error (Garbled imager stimulus message).
60D	Software or Hardware error (Invalid imager stimulus message).
60E	Software or Hardware error (Uninitialized interpret stimulus agent).
60F	Software or Hardware error (Max. number of imager stimuli exceeded).
610	Software or Hardware error (Max. number of internal agents exceeded).
611	Software or Hardware error (Agent size disagrees with table).
612	Software or Hardware error (Agent max. size 254 bytes).
613	Software or Hardware error (Attribute table entry missing).
614	Software or Hardware error (Number of entries in attribute table wrong).
615	Software or Hardware error (Too many interpret stimulus internal agents).
616	Software or Hardware error (Bad ID passed to interpret stimulus).
617	Software or Hardware error (Uninitialized array agent).
618	Software or Hardware error (Given array agent element size is too large).
619	Software or Hardware error (Given array agent index too large).
61A	Software or Hardware error (Enumeration of inhibit lists bad).
61B	Software or Hardware error (Too many inhibits).
61C	Check for software mismatch or communications problem between subsystems. (Key ID is out of range in dymap).
61D	Check for software mismatch or communications problem between subsystems. (Key type is undefined in dymap).
61E	Software or Hardware error (Inhibit list array mismatch).

Error Code	Failure Data
61F	Software or Hardware error (Vk attributes mismatch).
620	Software or Hardware error (Dynamic mapping table received upstroke before downstroke).
621	Software or Hardware error (Max. vk functions exceeded).
622	Software or Hardware error (Layouts mismatch).
623	Software or Hardware error (Bad dymap inhibit list ID).
624	Unable to respond to controls pressed. If problem persists, contact your Philips service representative.
625	Check for software mismatch or communications problem between subsystems. (Imager stimulus not declared in Interpret stimulus).
626	Software or Hardware error (Internal table is too small).
627	Software or Hardware error (Feedback message bigger than limit).
627	Software or Hardware error (Feedback message bigger than limit).
628	Software or Hardware error (Key feedback out of room in the auto-on list).
628	KEY FDBK OUT OF ROOM IN AUTO_ON_LIST.
62B	Software or Hardware error (Empty event group).
62C	Software or Hardware error (TU linked list size needs to be increased).
62D	Software or Hardware error (Too many key messages).
62E	Software error (Invalid number of TGC_CONTROLS).
62F	Processor Graphics waiting for signal from Keyprocessor. (Either board could be faulty).
630	Software or Hardware error (Text_id passed into key feedback object is out of range).
631	Software error (Too many events in one event group).
632	Software error (Key assign list contains an index which is too large).
633	Software error, menu/dialog box (Invalid text ID detected).

Error Code	Failure Data
634	Software error, menu/dialog box (Invalid menu ID detected).
635	Software error, menu/dialog box (Invalid menu template detected).
636	Software error, user interface (Invalid key ID detected).
637	Software error, user interface (Size of text ROM table does not equal size of FDIP_TEXT_ID TYPE).
638	Software error, user interface (Key already has a different menu assigned to it).
639	Software error, user interface (Form already has a different level assigned to it).
63A	Software error, user interface (No free form information structure exists to assign form to).
63B	Software error, user interface (Too many menus active at the same time).
63C	Software error, user interface (Tried to move cursor to a key that was not displayed, not mapped, or disabled).
63D	Software error, user interface (Text string assigned to a text ID was longer than allowed).
63E	Software error, user interface (Menu's parent text ID is not linked to a key).
63F	Software error, user interface (Form does not have either a title or parent text ID).
640	Software error, user interface (SHCORE DFB routines table size and enumerated type mismatch).
641	Software error, user interface (SHCORE DFB routines table out of sequence).
642	Software error, user interface (SHCORE DFB invalid command).
643	Software error, user interface (Key function form not found in cache).
644	Software error, user interface (Key function overlay not found in cache).
645	Software error, menu/dialog box (Invalid form ID detected).
646	Software error, menu/dialog box (Menu doesn't exist).

Error Code	Failure Data
647	Software or Hardware error, menu/dialog box (Invalid field ID detected).
648	Software error, user interface (Invalid or non-existent field information table detected).
649	Software error, user interface (Invalid attribute).
64A	Software error, user interface (Invalid template).
64B	Software error, user interface (Memory allocation error, menus).
64C	Software error, user interface (Required form parameter was not given).
64D	Software error, user interface (Bad command found in parameter section of menu template).
64E	Software error, user interface (Bad command found in definition section of menu template).
64F	Software error, user interface (Too many groups/field levels in menu template).
650	Software error, user interface (Too many fields found in a menu template).
651	Software error, user interface (No parent menu or field for pop-up submenu).
652	Software error, user interface (Tried to activate a menu that was not displayed).
656	User Interface Software Error
657	User Interface Software Error
658	User Interface Software Error
707	Software or Hardware error (Bad number of ROM presets).
708	Inconsistency in CMOS memory. Erase and Restore memory.
709	Software or Hardware error (ROM preset ID).
70A	Software or Hardware error (Wrong preset size).
70B	Software or Hardware error (Preset redefined).
70C	Imaging is frozen. Unfreeze image and try again.

Error Code	Failure Data
70D	Software or Hardware error (Preset type mismatch).
70E	Loop memory full. Delete unwanted loop(s) and try again.
70F	Software or Hardware error (Unspecified parameter in vk function).
710	Software or Hardware error (Bad transducer connector idx).
711	Software or Hardware error (Bad transducer number of depths).
712	Software or Hardware error (Bad transducer number of frequencies).
713	Software or Hardware error (Bad transducer number of foci).
714	Software or Hardware error (Bad transducer number line to line times).
715	Unrecognized transducer type.
716	Software or Hardware error (Can’t start fzacq when entering playthrough).
717	Software or Hardware error (Request agent isn’t part of preset).
718	Software or Hardware error (Wrong preset query routine).
719	Software or Hardware error (Wrong preset query routine).
71A	Software or Hardware error (Bad Doppler line angle).
71B	Software or Hardware error (Last transducer cutoff depth).
71C	Software or Hardware error (Null address in txtutil stack).
71D	Software or Hardware error (Txtutil stack is full).
71E	CMOS initialized because bad checksum.
71F	Loop memory full. Delete unwanted loop(s) and try again.
720	Printer not installed or not selected in Setup.
721	Software or Hardware error (Stimulus to DSR state machine unexpected).
722	Multiple loop selected. Select one loop and try again.
723	Multiple loops required.
724	Touch Loop Display to exit.
726	Must complete AQ ROI edit before changing imaging controls.

Error Code	Failure Data
727	Software or Hardware error (Colmap not found in list).
728	Cannot perform this action while Trace mode is active.
729	Cannot acquire while dual image is active.
72A	Cannot acquire while Trigger mode is active.
72B	Image must be frozen. Press Freeze.
72C	Cannot perform this action while VCR play is active.
72D	Cannot perform this action while in a Full Screen report.
72E	There is no tape in the VCR.
72F	This tape is write-protected.
730	Cannot record until the VCR tape is stopped.
731	The printer is busy, turned off, or out of paper. Please check printer status.
732	The VCR is not responding. Make sure the VCR is turned on.
733	Cannot perform this action while CW mode is active.
734	Software or Hardware error (Lateral Averaging Array incorrect - bad end condition or too many elements).
735	Software or Hardware error (Lateral Averaging Array incorrect - may not start with depth 0).
736	Software or Hardware error (Wrong number of elements in the 'BID_TYPE' enum or wrong order in write_rtn[ ]).
737	Software or Hardware error (Bad state/event in cmosbu_state()).
738 0001	To limit acoustic exposure to the eye, use a TCD-TO preset.
739	Select another preset. Preset not valid for non-imaging transducer.
73A	Change to a live imaging mode before pressing PATIENT ID.
73B	Software or Hardware error (Old backup format detected. Upgrade to A.1 first.)
73C	Software or Hardware error (Patient ID's ROM table and the preset's enums are mismatched.)

Error Code	Failure Data
73D	Enter a valid Date of Birth Example: 01/12/1960
73E	Patient Height must be blank or between 15 and 204 cm.
73F	Patient Height must be blank or between 6 and 80 inches.
740	Patient Weight must be blank or between 0.5 and 160 Kg.
741	Patient Weight must be blank or between 1.1 and 352 lbs.
742	Please enter a valid LMP date. Example: 03/08/1998
743	Please enter an LMP date within 45 weeks of today's date.
744	Please enter a valid Prev Exam date. Example: 08/09/1998
745	Please enter a valid Prev GA age. Example: 12W6D
746	Please enter a valid Expected GA age. Example: 12W6D
747	Please enter a valid Expected Ovul date. Example: 07/08/1996
748	Please enter a valid Gravida number. Example: 1
749	Please enter a valid Para number. Example: 1
74A	Please enter a valid Aborta number. Example: 0
74B	Please enter a valid Ectopic number. Example: 0
74C	A new dialog box is not allowed here until the existing one is dismissed.
74D	Cannot perform this action while Hold is active.
74E	Software or Hardware error. (Analysis ROM table and the preset's enums are mismatched.)
750	Please enter a valid date. Example: 08/10/1998
751	Please enter a valid year (1996 through 2069).
752	Please enter a valid time. Example: 23:59
753	Exit Dual mode to change this control.
755	Support floppy device busy
756	Support floppy disk activity not completed

Error Code	Failure Data
757	File not found
758	Please enter an EDC (Exp GA) within 40 weeks of today's date.
759	CW Doppler is not allowed with the current transducer.
75A	Please enter a number between -60 and 1000.
760	Software or Hardware error (Bad state/event in floppy_control ( ))
761	Erase measurement before scrolling.
762	Press Display to view loop.
763	Cannot scroll triggered dual images.
764	This key is not operational unless Stress or DSR Option is installed.
765	VCR selection not compatible with camera selection.
766	Erase protocol measurements before scrolling.
767	Please enter a name for this equation.
768	Missing coefficient or biometry.
769	Min not less than max.
76A	More than 4 biometries selected.
76B	Need to edit biometry limits.
76C	There are no biometries selected.
76D	No terms - equation deleted.
76E	GA at upper limit greater than 44 weeks or less than 0 weeks.
76F	Standard deviation at upper limit greater than 44 weeks or less than 0 weeks.
770	This equation may generate an unreasonable fetal weight.
771	Software or Hardware error (Stimulus to Stress state machine unexpected.)
772	Software or Hardware error (Cine alloc failed unexpectedly.)

Error Code	Failure Data
773	Software or Hardware error (Lato linked list utility call failed unexpectedly.
774	Unable to pause the protocol. Cannot reserve enough memory for a stress multicycle acquisition.
775	Software or Hardware error (Islm called with null index.)
776	Wait until disk storage is complete before acquiring or displaying loops.
778	VCR acquisitions in stress are only allowed during single acquisition stages
779	Please wait a moment and then try to store tis loop again
77A	Must complete cardiac phase edit before making measurements.
77B	Deferred Selection is not allowed when Complete Heart Cycle is active.
77C	Can’t have Angio and Color together.
77D	Illegal option values. Using default options. Contact your Philips service representative.
77E	Software or Hardware error (Cine page assignment error)
780	Cannot acquire with the View control in the Off position.
781	Cannot acquire a loop in this imaging mode.
782	This imaging mode is inconsistent with previously acquired images. Please use the same imaging mode with which the previous images were acquired.
783	Cannot change imaging modes during an acquisition.
784	This control is not valid when Setup is active. Exit Setup and try again.
785	Delete loops to start a new study.
786	This control is not valid while selecting loops. Finish selecting loops and try again.
788	This control is not available while a study is in progress.
789	ECG must be connected in this mode.

Error Code	Failure Data
78A	This control is not valid while there are unselected loops. Turn on Loop Display to finish selection.
78B	This color map is inconsistent with the previously acquired images. Please use the same color map type (turbulent or non-turbulent) with which the previous images were acquired.
78C	A duplicate stage name has been entered.
78D	A duplicate view name has been entered.
78E	There are no view names defined.
78F	Too few stages defined.
790	Clipped voltage at dissipation limit.
791	Power supply A/D converter calibration failed: offset.
792	Power supply shut down by hardware.
793	Reconnect the transducer, then press Reset. If problem persists, contact your Philips service representative.
794	Reconnect the transducer, then press Reset. If problem persists, contact your Philips service representative.
795	Reconnect the transducer, then press Reset. If problem persists, contact your Philips service representative.
796	Reconnect the transducer, then press Reset. If problem persists, contact your Philips service representative.
797	Power supply A/D converter measurement check failed.
798	Raw power supply failure.
799 000	Power Supply test failed high voltage portion.
799 0001	
79A 0000	Power Supply test failed low voltage portion.
79A 0001	
79B	Power supply target voltage too high.

Error Code	Failure Data
79C	Reconnect the transducer, then press Reset. If problem persists, contact your Philips service representative.
79D	Power supply failed to convert ADC.
79E	Most probable cause is the Distribution Board or the Transducer.
79E 0000	PV MUX bias voltages are out of regulation. Mux'd probes can't be used.
79E 0001	
79F	Power supply high voltage out of regulation.
7A0	Power supply low voltage out of regulation
7A1	Front end discharge by Power Supply timed out.
7A2	Beam PCB, A/D out of range.
7A3	Beam PCB, A/D noisy.
7A4	Beam PCB, A/D out of range.
7A5	Beam PCB, A/D noisy.
7A6	Software or Hardware error (Scan start request timeout).
7A7	Software or Hardware error (Scan stop request timeout).
7A8	Software or Hardware error (Scan active unexpectedly).
7AA	Software or Hardware error (Scan inactive unexpectedly).
7AB	Software or Hardware error (Scan target line not reached).
7AD	Illegal transmit delay.
7B0	EEPROM write/erase timeout.
7B1 0000	Probe selection relay caps not charged in time.
7B1 0001	
7B2	Distribution relays not initialized.
7C0	Clockboard ASIC timeout.
7C1	Software or Hardware error (Interrupts enabled unexpectedly).

Error Code	Failure Data
7CC	Download optimization failure.
7CD	Line to line time too short for parallel 2D.
7D0	Software error (Front End: No data packet in stream: packet #).
7D1	Software error (Front End: Bad line group for treading transmit event).
7D2	Invalid frequency for Front End filters.
7E0	Digital Image detector error.
7F0	Hardware error (DSCC 0 Digital Signal Processor is not responding).
7F1	Hardware error (DSCC 1 Digital Signal Processor is not responding).
810	RST Class Error.
811	RT Load is not installed.
812	Insufficient board configuration for running resident self tests. Check hardware ID screen.
813	Undefined system mode.
814	Front End has detected missing or defective boards required for imaging; entering resident self test. Check hardware ID screen.
815	Back End has detected missing or defective boards required for imaging; entering resident self test. Check hardware ID screen.
816	Front End is not responding, entering resident self test.
817	Software error (Invalid command to display gain during Transducer dot test).
818	Illegal combination of flags set in this submodule test.
819	Software error (No return from routine).
850	RAPTOR error: A non-specific RAPTOR error has occurred. RAPTOR error: A non-specific RAPTOR error has occurred.
851	RAPTOR error: Empty Action List received. RAPTOR error: Empty Action List received.

Error Code	Failure Data
852	RAPTOR error: Unexpected Action List received while another list is currently running. RAPTOR error: Unexpected Action List received while another list is currently running.
853	RAPTOR error: Unable to allocate memory for Action List (malloc error). RAPTOR error: Unable to allocate memory for Action List (malloc error).
854	RAPTOR error: Illegal CMD_ID received from PC. CMD_ID in extra bits. RAPTOR error: Illegal CMD_ID received from PC. CMD_ID in extra bits.
855	RAPTOR error: Cannot reset status while executing an Action List. RAPTOR error: Cannot reset status while executing an Action List.
856	RAPTOR error: Unknown CMD_ID detected in Action List. RAPTOR error: Unknown CMD_ID detected in Action List.
857	RAPTOR error: Illegal Application Manager Command detected. RAPTOR error: Illegal Application Manager Command detected.
858	RAPTOR error: The Command Level Interface (CLI) is unable to retrieve its capabilities. RAPTOR error: The Command Level Interface (CLI) is unable to retrieve its capabilities.
859	RAPTOR error: Illegal number of functional commands found in Action List. RAPTOR error: Illegal number of functional commands found in Action List.
860	RAPTOR error: There are no functional commands in this List Item. RAPTOR error: There are no functional commands in this List Item.
861	RAPTOR error: An error has occurred which invoked the Ack Cancel handler in the CLI. RAPTOR error: An error has occurred which invoked the Ack Cancel handler in the CLI.
862	RAPTOR error: A registry error has occurred. RAPTOR error: A registry error has occurred.
863	RAPTOR error: Unable to execute command. Illegal load specified. RAPTOR error: Unable to execute command. Illegal load specified.
863	RAPTOR error: An illegal application ID has been encountered. RAPTOR error: An illegal application ID has been encountered.
864	RAPTOR error: The CLC has encountered an illegal command. RAPTOR error: The CLC has encountered an illegal command.

Error Code	Failure Data
866	RAPTOR error: An error has been encountered while trying to create a capability list. RAPTOR error: An error has been encountered while trying to create a capability list.
8D0	Software or Hardware error (Front End Serial Interface write timeout).
8D1	Software or Hardware error (Front End Serial Interface read timeout).
8D2	Software or Hardware error (Front End Serial Interface test failed at power supply).
8D3	Software or Hardware error (Front End Serial Interface test failed at Clock Board). Try Front End or Clock board.
8D4	Front End Serial Interface test failed at Distribution Board.
8D8	Software or Hardware error (Coefficient delays not measured).
8D9	Software or Hardware error (Coefficient calculations not supported).
8DA	Line type frequency unspecified.
8DB	Incorrect line number: line #
8DC	Scanner Software error.
8DD	Insufficient Hardware delay for coefficient.
982	Beam I/O Local Processor Communication error.
984	Beam I/O Local Processor Communication error (Timeout of Unknown hardware source).
9A2	Cannot have parameters either overflow or underflow their registers.
9A3	[DET]: Cannot calibrate 2D DAC on detector board.
9A6	[PREG]: Power supply bad filter drop.
9AA	Clock board gain calibration error.
9AB	Clock board gain calculation error.
A00	Software or Hardware error (invalid type of data to display).
A01	Software or Hardware error (float conv. width too wide/narrow).
A02	Software or Hardware error (invalid type of data to conv).

Error Code	Failure Data
A03	Software or Hardware error (invalid demographic data encoding)
A04	Software or Hardware error (invalid system data encoding)
A05	Software or Hardware error (too many report items. Increase size of RAM tables)
A06	Software or Hardware error (field width is not allowed)
A10	Software or Hardware error (Can't edit Fixed/System field)
A11	Software or Hardware error (Can't find row # for field)
A12	Software or Hardware error (Unexpected data type)
A13	Software or Hardware error (No editable field exists)
A14	Software or Hardware error (Data type storage unallowed)
A15	Software or Hardware error (Unexpected data type)
A16	Software or Hardware error (Unexpected data type)
A17	Software or Hardware error (Unexpected data type)
A18	Software or Hardware error (Bad Edit Report resource)
A19	Software or Hardware error (Bad Edit Report event)
A1A	Software or Hardware error (Unable to find an editable fld).
A1B	Software or Hardware error (invalid dep. data for blanking)
A30	Software or Hardware error (No reports are configured, can't build report menu)
A31	Software or Hardware error (No groups are configured, can't build report menu)
A32	Software or Hardware error (No group id is present when one is required)
A33	Software or Hardware error (An invalid package pointer was used)
A34	Software or Hardware error (AnalMakeCfgItemstring received a type other than package, group, meas, or calc).
A35	Software or Hardware error (The AnalKeyEvents () routine received a resource it didn't request)

Error Code	Failure Data
A36	Software or Hardware error (number of calc menus exceeds the limit ANAL_MAX_CALC_MENUS)
A37	Software or Hardware error (ANAL_MAX_STUDY_PACKAGES has exceeded max # of packages)
A38	DSR Software error.
A40	Software or Hardware error (Invalid menu type found)
A41	Software or Hardware error (Invalid anal state change attempted)
A42	Software or Hardware error (can't choose meas and non-meas from menu at same time)
A43	Software or Hardware error (attempt was made to get calc input which was not a meas, demo, or system data)
A44	Software or Hardware error (An expected calc_ptr was not a calc_ptr)
A45	Software or Hardware error (System data input is not ready for a calculation)
A46	Software or Hardware error (menu entry not found for given meas. or calc. data pointer)
A47	Software or Hardware error (must be in Anal Editing Report state to process Approve key input)
A48	Software or Hardware error (must be in Anal Editing Report state to process Menu key input)
A49	Software or Hardware error (expected menu or approve key return but got preempt, reactivate or another key instead)
A4A	Software or Hardware error (too many calc dependencies to fit in calcs_tocompute array in module AnalBldCalcComputeList)
A4B	Software or Hardware error (too many measurements are being requested of AnalMeasProcess)
A4C	Software or Hardware error (no measurements are being requested of AnalMeasProcess)
A4D	Software or Hardware error (Meas package returned an invalid measurement to analysis)

Error Code	Failure Data
A51	Software or Hardware error (AnalProcToggleItem received a type other than package, group, meas, or calc).
A52	Software or Hardware error (AnalSetForcedBits expects all items to be calc_ptrs or meas_ptrs in list)
A53	Software or Hardware error (Auto meas entries meta-meas entries require a meas char id. (get_meas.c))
A54	Software or Hardware error (Only MEASUREMENT_DATA & DEMOGRAPHIC_DATA are exceptable to AnalStoreMeasData (anal_meas.c))
A55	Software or Hardware error (Can not enter measurement's during config, code shouldn't get to here... (enter_meas.c))
A56	Software or Hardware error (The number of elements that came in to the routine does not equal the number at the end of the routine)
A60	Software or Hardware error (_HEADER_ ptr is nil)
A61	Software or Hardware error (unexpected header data type)
A62	Software or Hardware error (match(): syntax error)
A63	Software or Hardware error (group(): syntax error)
A64	Software or Hardware error (parser(): bad token found)
A65	Software or Hardware error (parser(): Too many '(')
A66	Software or Hardware error (Unexpected header data type)
A67	Software or Hardware error (undefined table #)
A68	Software or Hardware error (table not large enough)
A69	Software or Hardware error (NUMBER stack overflow)
A6A	Software or Hardware error (NUMBER stack underflow)
A6B	Software or Hardware error (xeq_math: unexpected token)
A6C	Software or Hardware error (unconsumed NUMBER left on stack)
A6D	Software or Hardware error (Analysis: Too many definitions for averages)

Error Code	Failure Data
A70	Software or Hardware error (Analysis: Perform calcs is active, can't update events)
A71	Software or Hardware error (Analysis: Data entry is active, can't update events)
A72	Software or Hardware error (Analysis: Unbalanced update event region)
A73	Software or Hardware error (Analysis: Data entry is active, can't enter perform calcs).
A74	Software or Hardware error (Analysis: Update events is active, can't enter perform calcs).
A75	Software or Hardware error (Analysis: Unbalanced perform calc region)
A76	Software or Hardware error Analysis: Perform calcs is active, can't enter data)
A77	Software or Hardware error (Analysis: Update events is active, can't enter data)
A78	Software or Hardware error (Analysis: Unbalanced data entry region)
A80	Software or Hardware error (idw window number too big)
A81	Software or Hardware error (too many lines in IDW)
A82	Software or Hardware error (A call to sprintf generated a string that was too long for the space allocated to it)
A83	Software or Hardware error (AnalGet_ received resource it never requested)
A84	Software or Hardware error (A measurement which was in the meas primitive list is no longer there)
A85	Software or Hardware error (Input is not usable from the AnalGet_ object)
A86	Software or Hardware error (Input to AnalPrimitiveReturned is invalid)
A87	Software or Hardware error (Input to AnalDoneMeasGetInput is invalid)
A88	Software or Hardware error (There isn't any routine to call once AnalGet_ has an APRROVED string)

Error Code	Failure Data
A89	Software or Hardware error (AnalGet can only handle one request at a time)
AA0	Software or Hardware error (All Sail CMOS initialization routine's should call back... see sailcmos.c)
AA1	Software or Hardware error (The ptr for reading or writing was out of Sail CMOS range)
AA2	Software or Hardware error (The ptr for reading or writing was out of Sail CMOS range)
AA3	Software or Hardware error (A Sail CMOS initialization routine was called from outside sailcmos.c)
AA4	Software or Hardware error (Bad CMOS checksum)
AA5	Software or Hardware error (Analysis: no more BBM; the attempted malloc failed.)
AA6	Software or Hardware error (Analysis: BBM data is larger than destination array
AB0	Software or Hardware error (a function has been attempted on a class, where it is not allowed)
AB1	Software or Hardware error (Invalid Object number)
AB2	Software or Hardware error (Invalid component ID number)
AB3	Software or Hardware error (Component's data structure not defined)
AB7	Software or Hardware error Analysis: List of inputs is too big)
AB8	Software or Hardware error (Analysis: Size mismatch of inputs list)
AB9	Software or Hardware error (Analysis: Dependencies list is too big)
ABA	Software or Hardware error (Analysis: Caller's dependency list is too small)
ABB	Software or Hardware error (Analysis: Too many dependencies)
AD0	Software or Hardware error (Wrong meas primitive made)
ABC	Analysis memory full. Please erase unnecessary dat from analysis report and continue.

Error Code	Failure Data
AC2	Software or Hardware error (Wrong meas primitive made)
AC2 0000	Make an acceleration/deceleration measurement.
AC2 0001	Make an area measurement.
AC2 0002	Make a circumference measurement.
AC2 0003	Make a Doppler frequency/velocity measurement.
AC2 0004	Measure a distance.
AC2 0005	Trace the Doppler spectrum.
AC2 0006	Measure a distance.
AC2 0007	Measure a distance.
AC2 0008	Make a mean velocity trace.
AC2 0009	Make a pressure gradient trace.
AC2 000A	Measure the time from onset to cessation of flow velocity.
AC2 000B	Measure the time from onset to peak velocity.
AC2 000C	Measure the time from peak to cessation of flow velocity.
AC2 000D	Measure an M-mode slope.
AC2 000E	Measure a time interval.
AC2 000F	Measure a Doppler velocity.
AC2 0010	Measure a volume.
AC3	Data not logged. Please make an automatic Doppler Trace measurement.
AC5	Software or Hardware error (erase_hotcalcs( ): measurements list overflow)
AC6	Software or Hardware error (AL_EraseComponentsIds( ): measurements list overflow)
AD0 0000	Make an acceleration/ deceleration measurement.
AD0 0001	Make an area measurement.

Error Code	Failure Data
AD0 0002	Make a circumference measurement.
AD0 0003	Make a Doppler frequency/ velocity measurement.
AD0 0004	Measure an M-mode height.
AD0 0005	Trace the Doppler spectrum.
AD0 0006	Measure a 2-D length.
AD0 0007	Measure a 2-D length or M-mode height.
AD0 0008	Make a mean velocity trace.
AD0 0009	Make a pressure gradient trace.
AD0 000A	Measure the time from onset to cessation of flow velocity.
AD0 000B	Measure the time from onset to peak velocity.
AD0 000C	Measure the time from peak to cessation of flow velocity.
AD0 000D	Measure an M-mode slope.
AD0 000E	Measure a time interval.
AD0 000F	Measure a Doppler velocity.
AD0 0010	Measure a 2-D volume.
B01	Software or Hardware error (Null update loc. not allowed).
B02	Software or Hardware error (Malloc failed).
B03	Software or Hardware error (User data required for this resource).
B04	Software or Hardware error (No menu key user).
B05	Software or Hardware error (No approve key user).
B06	Software or Hardware error (No text key user).
B07	Software or Hardware error (No trackball user).
B08	Software or Hardware error (Zero scale factor not allowed).
B09	Software or Hardware error (Al least one resource required).
B0A	Software or Hardware error (Can’t open message exchange).

Error Code	Failure Data
B0B	Software or Hardware error (PSOS send_x failed).
B0C	Software or Hardware error (PSOS req_x failed).
B0D	Software or Hardware error (Bad RM operation).
B0E	Software or Hardware error (Invalid resource).
B0F	Software or Hardware error (No erase key user).
B10	Software or Hardware error (No point key user).
B11	Software or Hardware error (No trace key user).
B12	Software or Hardware error (No undo key user).
B13	Software or Hardware error (Bad trackball update type).
B14	Software or Hardware error (RM application already active).
B15	Software or Hardware error (No clear key user).
B16	Software or Hardware error (Too many RM events generated).
B20	Software or Hardware error (Soft reformat table mismatch).
B21	Software or Hardware error (Bad soft reformat type).
B22	Software or Hardware error (Multiple soft reformats requested).
B23	Software or Hardware error (Severity does not indicate soft reformat).
B24	Software or Hardware error (Missing soft reformat designation).
B25	Software or Hardware error (Bad event list).
B26	Software or Hardware error (Unbalanced com table).
B27	Software or Hardware error (Map between events and COMs is corrupt).
B28	Software or Hardware error (Mismatch in com table).
B29	Software or Hardware error (No event data).
B2A	Software or Hardware error (Invalid level ID).
B2B	Software or Hardware error (Event size changed).
B2C	Software or Hardware error (Insufficient buffer space).

Error Code	Failure Data
B2D	Software or Hardware error (Bad stimulus send).
B30	Software or Hardware error (Invalid window type).
B31	Software or Hardware error (Negative priority).
B32	Software or Hardware error (Malloc failed).
B33	Software or Hardware error (Window not found).
B34	Software or Hardware error (Invalid update operation).
B35	Software or Hardware error (Unexpected WM event type).
B36	Software or Hardware error (IDW too big).
B37	Software or Hardware error (Raster string size does not match).
B80	Software or Hardware error (Indicated window not created).
B81	Software or Hardware error (Bad status from get-overlap-case).
B82	Software or Hardware error (Rectangle list too small to add to).
B83	Software or Hardware error (No graphics allowed in unmapped or uncreated).
B84	Software or Hardware error (Size of list of wids too small to add to).
B85	Software or Hardware error (Can’t remove wid from empty list).
B86	Software or Hardware error (Can’t find wid in list).
B87	Software or Hardware error (Resize rect must overlap itself).
B88	Software or Hardware error (Event location can’t be NULL).
B89	Software or Hardware error (Need attribute structure from Wm_CreateWindow).
B8A	Software or Hardware error (GetIntersect rect must return intersection).
B8B	Software or Hardware error (Can’t create window, max. number reached).
B8C	Software or Hardware error (Resize can’t generate more than 2 rects).
B8D	Software or Hardware error (Window must be unmapped for this operation).

Error Code	Failure Data
B90	Software or Hardware error (The user attempted to exit the dialog box with an invalid number of items selected from the list box, either too few or too many, and no custom application error was given. Please specify an application user error for this condition - DB_ERROR_CODE attribute.)
B91	Software or Hardware error (String given for text input box too many chars or lines)
B92	Too many items selected.
B93	Software or Hardware error (An attribute is being changed which cannot be changed while the dialog is displayed)
B94	Software or Hardware error (This dialog has a parent dialog which is not displayed)
B95	Software or Hardware error (An attempt was made to shutdown a widget that is not a WINDOW)
B96	Software or Hardware error (String given for text input box too many chars or lines).
B97	Software or Hardware error (An application must give the display procedure the ID of a WINDOW widget)
B98	Software or Hardware error (An attempt was made to shutdown a window that wasn't displayed)
B99	Software or Hardware error (The resize attribute is not set and the widget size is not large enough)
B9A	Software or Hardware error (The parent of an option button must be of GROUP class)
B9B	Software or Hardware error (An EXPOSE event came in for a non displayed window)
B9C	Invalid control was pressed.
B9D	Software or Hardware error (User entered a string which does not match the regular expression specified and no custom application error was given. Please specify an application user error for this condition - DB_ERROR_Code attribute.)

Error Code	Failure Data
B9E	Software or Hardware error (The regular expression given to the dialog box manager as the DB_INPUTTXT_REG_EXPR is an invalid expression. See documentation for correct syntax.)
BB1	Software or Hardware error (Null update loc. not allowed).
BB2	Software or Hardware error (Malloc failed).
BB3	Software or Hardware error (User data required for this resource).
BB4	Software or Hardware error (No menu key user).
BB5	Software or Hardware error (No approve key user).
BB6	Software or Hardware error (No text keys user).
BB7	Software or Hardware error (Bad user ID).
BB8	Software or Hardware error (Instance structure not valid).
BB9	Software or Hardware error (At least one resource required).
BBA	Software or Hardware error (Can't open message exchange).
BBB	Software or Hardware error (PSOS send_x failed).
BBC	Software or Hardware error (PSOS req_x failed).
BBD	Software or Hardware error (Bad RR operation).
BBE	Software or Hardware error (Invalid resource).
BBF	Software or Hardware error (No resource passed in).
BC0	Software or Hardware error (Too many resources passed in).
BC1	Software or Hardware error (No user of resource).
BC2	Software or Hardware error (No undo key user).
BC3	Software or Hardware error (Bad trackball update type).
BC4	Software or Hardware error (RR application already active).
BC5	Software or Hardware error (No clear key user).
BC6	Software or Hardware error (Too many RR events generated).

Error Code	Failure Data
BD0	Software or Hardware error No more fields available for Calib_get_entry call. Must either raise CAL_MAX_FIELDS or free other text field before making this call.
BD1	Software or Hardware error The textfield pointer given to Text_free_entry is not a valid member of the calib_fields structure.
BE0	Software or Hardware error (Float conv. width too wide/narrow).
BE1	Software or Hardware error (Delete or map on uncreated dialog).
BE2	Software or Hardware error (Delete on displayed dialog).
BE3	Software or Hardware error (Shutdown on undisplayed dialog).
BF0	Set CLR Loop for FULL screen display
BF1	Data Acquisition is complete.
BF2	DSR file-format is incompatible.
BF3	AD cannot analyze this data.
BF4	This Dataset already contains data.
BF5	AD protocol is active. Touch AQ.
BF6	DSR file does not match AD Studytype.
BF7	Real-time datasets are not recorded when loop is stored to disk.
C02	Software error (Invalid CCLR loop value).
C03	Software or Hardware error (Declared # of CCLR ranges exceeds maximum allowed).
C04	Software or Hardware error (A CCLR Page needs loop(s)).
C05	Software or Hardware error (Too many loops or loops overlap on a page).
C06	Software error (Quarter Field List is too large).
C07	Software or Hardware error (Entering display requires having a page).
C08	Software error (Embedded Graphics operation not found in loop).
C0A	Software error (Invalid disk storage algorithm requested).

Error Code	Failure Data
C0B	Software error (Invalid disk retrieve algorithm requested).
C0C	Software error (Disk storage algorithm found an unexpected null frame).
C0D	Software error (Number of Quarter Fields requested must be multiple of 4).
C0E	Software error (CCLR loop not found in display table).
C0F	Software error (Insufficient number of Quarter Fields to retrieve CCLR loop).
C10	Software error (CCLR quick review requires full screen loop on current page).
C12	Software error (ECG length can't be zero here).
C13	Software error (CCLR constant mismatched with system constant).
C14	Software error (CCLR error - attempting to draw more ECG pixels than can fit).
C15	Software error (Can't do operation with null CCLR loop).
C16	Software error (CCLR page has a loop included multiple times).
C17	Software error (Multi-cycle CCLR acquire was attempted twice with no end acquire).
C18	Software or Hardware error (Ran out of loop memory during multi-cycle).
C19	Software or Hardware error (Can't acquire loop with null CCLR list).
C1A	Software or Hardware error (Can't retrieve loop with null CCLR frame list).
C1B	Software or Hardware error (Can't do operation with null CCLR loop ID).
C1C	Software error (Can't acquire into a loop with no Quarter Fields).
C1D	Software error (Can't retrieve into a loop with no Quarter Fields).
C1E	Software error (Destination Quarter Field list too small for Quarter Field extract operation).
C1F	Software error (First Quarter Field missing from list during extract).
C20	Software error (Last Quarter Field missing from list during extract).

Error Code	Failure Data
C21	Software error (Can't free unused Quarter Fields of loop with this status).
C22	Software error (Destination Quarter Field list too small for copy).
C23	Software error (Contents of CCLR page invalid).
C24	DSR board installed with TurboCine. Please remove DSR board.
D00	Software or Hardware error (Global).
D01	Software or Hardware error (Creating global exchange).
D02	Software or Hardware error (Creating global semaphore).
D03	Software or Hardware error (Creating global process).
D04	Software or Hardware error (Routine queue).
D05	Software or Hardware error (Routine queue parameter).
D06	Software or Hardware error (Routine queue parameter).
D07	Software or Hardware error (Option information).
D08	Software or Hardware error (Linked list default).
D09	Software or Hardware error (Replace operation overwrote data).
D0A	Processor sent unexpected interrupt.
D0B	Software or Hardware error (pSOS error).
D0C	Software or Hardware error (Bad case in switch statement).
D0D	Software or Hardware error (Unexpected value).
D0E	Software or Hardware error (IPC call failed).
D0F	Software or Hardware error (IPC call failed).
D10	Software or Hardware error (IPC call failed).
D11	Software or Hardware error (IPC call failed).
D12	Software or Hardware error (IPC call failed).
D13	Software or Hardware error (Ident_p call failed).
D14	Software or Hardware error (IPC call returned an error).

Error Code	Failure Data
D15	Software or Hardware error (IPC call returned an error).
D16 0XXX	Unsupported hardware in slot indicated by extra data bits.
D17 0XXX	Illegal hardware in slot indicated by extra data bits.
D18 0XXX	Unknown hardware in slot indicated by extra data bits.
D19	Software or Hardware error (Alloc_seg call failed).
D1A	Software or Hardware error (Assign_seg call failed).
D1B	Failure erasing Flash memory. Check flash card, [PG]
D1C	Flash programming voltage (+12V) too low.
D1D	Failure programming Flash memory. Check flash card, [PG]
D1E	Software or Hardware error (Error in CMOS back-up/restore)
D1F	Invalid Backup data. Make valid backup before attempting to Restore.
D20	Software error (System queued higher routine out of order).
D21	Software error (Software Revision Information invalid string size).
D22	Option ROM request not initialized.
D24	Data transmission error.
D25	Receive timeout exceeded.
D26	Transmit timeout exceeded.
D27	RAM failed core test addl=MSaddr,LSaddr
D28	ROM failed core test add1=00|set|byte
D29	IC failed core test add1=U number of IC
D2A	Raptor Comm Module Error.
D30	The calendar/clock has not been set. Date related calculations may be blank. Go to System Setup to enter data.
E00	Software or Hardware error Can’t send error tp exchange.
E01	Software or Hardware error Can’t get error message.

Error Code	Failure Data
E02	Software or Hardware error Can't find error exchange.
E03	Software or Hardware error Can't create error exchange.
E04	Software or Hardware error Can't add to error log.
E05	Software or Hardware error Can't return error message.
E06	Software or Hardware error Can't return error message.
E07	Software or Hardware error Non-zero length, null ptr.
E08	Software or Hardware error Cannot identify sem.
E10	RS-232 communications failure.
E11	RS-232 communications failure.
E12	RS-232 communications failure.
E20	Software or Hardware error (Internal Processing Communication buffer size mismatch).
E21	Software or Hardware error (Internal Processing Communication out of buffers).
E22	Software or Hardware error (Internal Processing Communication fhdr size mismatch).
E23	Software or Hardware error (Internal Processing Communication out of fhdrs).
E24	Software or Hardware error (Internal Processing Communication unknown function type).
E25	Software or Hardware error (Internal Processing Communication unknown message type).
E26	Software or Hardware error (Internal Processing Communication create error).
E27	Software or Hardware error (Internal Processing Communication remote create error).
E28	Software or Hardware error (Internal Processing Communication power-on synch error).

Error Code	Failure Data
E29	Software or Hardware error (Internal Processing Communication could not send packet).
E2A	Software or Hardware error (Internal Processing Communication could not start system).
E2B	Software or Hardware error (Internal Processing Communication could not find the object).
E2C	Software or Hardware error (Internal Processing Communication could not signal process).
E2D	Software or Hardware error (Internal Processing Communication buffer error).
E2E	Software or Hardware error (Internal Processing Communication op performed on an invalid ID).
E2F	Software or Hardware error (Internal Processing Communication unknown message type returned).
E30	NO KEY PANEL. Check key processor [KP]
E31	Software or Hardware error (Internal Processing Communication no response from DSS node).
E32	Software or Hardware error Communication with the Front End has failed. Turn on the LED switch on the DC card. (Internal Processing Communication no response from scan node).
E33	Software or Hardware error (Internal Processing Communication buffer pool error).
E34	Software or Hardware error (Internal Processing Communication error reassembling message).
E35	Software or Hardware error (Internal Processing Communication error getting static buffers).
E40	Software or Hardware error (Event stream garbled).
E41	Software or Hardware error (Can only specify one subsystem).
E42	Software or Hardware error (PID not found in reply data table).
E43	Software or Hardware error (Multiply specified reply data).
E44	Software or Hardware error (Reply data is missing).

Error Code	Failure Data
E45	Software or Hardware error (Insufficient reply space).
E46	Software or Hardware error (Invalid event ID; must be A-Z only).
E47	Software or Hardware error (Max. allowed event size exceeded).
E48	Software or Hardware error (Unexpected mnemonic).
E49	Check for a mismatch of software revisions in the subsystems.
E4A	Software or Hardware error (Max. number of events exceeded).
E4B	No ECG trigger detected. Please check Delay 1 value. 3D Acquisition Ended.
E4C	No R-wave detected. 3D Acquisition Ended.
E4D	Please select an Omni transducer and Acquire again.
E4E	Software error (Insufficient memory for 3D CCLR).
E50	Generic VCR error. Check VCR
E51	Software or Hardware error (Invalid VCR request).
E52	Omni positioning error. 3D Acquisition Ended.
E53	Omni controlled automatically. User request ignored.
E54	Omni failed calibration. 3D Acquisition Ended.
E55	Delay 1 and Delay 2 must be further apart. 3D Acquisition Ended.
E56	Software or Hardware error (Disqualified VCR software state).
E57	Software or Hardware error (Bad VCR transition level).
E58	Software or Hardware error (VCR system Q overflow).
E60	Generic VCR error. Check VCR.
E61	Software or Hardware error (Invalid VCR request).
E62	Software or Hardware error (VCR cancel widget not found).
E63	Software or Hardware error (Invalid VCR aux command).
E64	Software or Hardware error (VCR Q overflow).

Error Code	Failure Data
E65	Software or Hardware error (Bad level 2 state).
E66	Software or Hardware error (Disqualified VCR software state).
E67	Software or Hardware error (Bad VCR transition level).
E68	Software or Hardware error (VCR system Q overflow).
E70	Software or Hardware error (VCR free text widget not found).
E71	Software or Hardware error (VCR OK, widget not found).
E72	Software or Hardware error (VCR cancel widget not found).
E73	Software or Hardware error (VCR input widget not found).
E74	Software or Hardware error (VCR dialog box ID not found).
E75	Software or Hardware error (Can't attach VCRX).
E76	Software or Hardware error (Can't identify VCR).
E80	Software or Hardware error (Can't create VCRX).
E81	Software or Hardware error (Can't get VCR message).
E82	Software or Hardware error (Can't return VCR message).
E83	Software or Hardware error (Can't send VCR message).
E84	Software or Hardware error (Can't get VCR IPC message).
E85	Software or Hardware error (Can't attach VCRX).
E86	Software or Hardware error (Can't identify VCR).
E87	No video input detected. Insert a tape into the VCR, press Play on the VCR, and then press Tape again.
E88	VCR Serial Communications error.
E89	Software or Hardware error (VCR error table mismatch).
E8A	VCR controls pressed too quickly or Tape in VCR is write-protected
E8B	Software or Hardware error (VCR Invalid Error Type).
E8C	Software or Hardware error (VCR Data Format Error).

Error Code	Failure Data
EC0	Software or Hardware error (Bad node ID providing options).
EC1	Software or Hardware error (Unexpected size of option data).
EC2	[KP]. Timed out waiting for Key Processor.
EC3	Timed out waiting for Scanner.
EC4 0001	Missing Autocool option. [XPS].
EC4 0002	[PVPS] in 64 channel system.
EC4 0003	Neither Cardiac nor Linear options installed. Check options.
EC5	PAL/NTSC configuration for front end and back end disagree.
EC6	Doppler hardware mismatch. [DP] present, but no [DD].
EC7	DSR hardware installed without CLR hardware. DSR disabled. Check CLR boards. [C CLR] [B&W CLR]
EC8	Pediatrics option installed without cardiac application.
EC9	Color Flow hardware mismatch. [FP] present, but no [DD].
ECA	Single CVI Card in wrong slot. Single CVI must be in [CVM].
ECB	Software or Hardware error (Too many options have been defined).
EE0	Software or Hardware error (Option ID is not declared).
EE1	Software or Hardware error (Suboption ID is not declared).
F00	Software or Hardware error (Exception error).
F08 0000	Processor bus error.
F0C 0000	Processor address error.
F10	Processor illegal instruction.
F14	Processor zero divide exception
F18	Processor CHK instruction error.
F1C	Processor TRAPV instruction error.
F20	Processor privilege violation.

Error Code	Failure Data
F24	Software or Hardware error (Trace error).
F28	Software or Hardware error (EM1010 error).
F2C	Software or Hardware error (EM1111 error).
F60	Software or Hardware error (Spur error).
F64	Software or Hardware error (Level 1 error).
F68	Software or Hardware error (Level 2 error).
F6C	Software or Hardware error (Level 3 error).
F70	Software or Hardware error (Level 4 error).
F74	Software or Hardware error (Level 5 error).
F78	Software or Hardware error (Level 6 error).
F7C	Software or Hardware error (Level 7 error).
FC0	Branch/Set Unordered Condition.
FC4	Software error (Inexact Result; Floating Point Coprocessor).
FC8	Software error (Divide by Zero; Floating Point Coprocessor).
FCC	Software error (Underflow; Floating Point Coprocessor).
FD0	Software error (Operand Error; Floating Point Coprocessor).
FD4	Software error (Overflow; Floating Point Coprocessor).
FD8	Software error (Not a Number; Floating Point Coprocessor).
FF0	Software or Hardware error (Floating point error).

5 Scan Converter Error Codes

Board Abbreviations

Abbreviation	Actual Name
SIO	Digital Scanner I/O
DD	Digital Doppler
DSR	DSR-SCSI
FP	Flow Processor
RT	R-Theta-AC
AQ	Digital AQ
IM	Image Memory
SC	Stripchart
PVT	Physio Video Timing
VIO	Video I/O
CCLR	Combined CLR
TCINE	TurboCine
PG	Processor Graphics

NOTE

While not yet implemented, in the future we may provide the TurboCine PCB as a service replacement for older CCLR and DSR boards. If you run the CCLR or DSR RST tests on a pre-rev C.0 system with a TurboCine board (which takes the place of both the CCLR and DSR boards), the error code messages could be somewhat confusing. If the TurboCine board is defective the error message may say “CCLR-error message” or “DSR-xxxx”. Interpret these error messages to mean that the problem is on the TurboCine board. The testing process works as intended and error codes indicate real problems. However, the error code wording may not identify the hardware that is installed.

Error Codes

Error Code	Failure Data	Additional Information
D0101 0xxx	PG-Static RAM failure.	
D0104 0xxx	PG-DUART communication failure.	
D0105 0xxx	PG-DUART communication failure.	
D0106 0xxx	PG-Bus communication error.	Check all Scan Converter boards.
D0107 0xxx	PG-Real time clock failure.	Also check battery.
D0108 0xxx	PG-SRAM RAM failure. CMOS excluded.	
D0109 0xxx	PG-CMOS failure.	Also check battery.
D010A 0xxx	PG-DUART communication failure.	
D0111 0xxx	PG-LED display failure.	
D0112 0xxx	PG-RS232 Loopback failure	For factory test use only; needs adapter.
D0201 0xxx	PVT-Video timing failure.	
D0301 0xxx	IM:Post-processing lookup table failure.	
D0302 0xxx	IM:Persistence lookup table failure.	
D0303 0xxx	IM:Image plane data failure	
D0304 0xxx	IM:Image plane adr failure.	
D0305 0xxx	IM:Image plane mask failure.	
D0306 0xxx	IM:XFER or Bus Grab error.	
D0307 0xxx	IM:Persistence Buffer error.	
D0401 0xxx	PVT-B&W memory failure.	
D0402 0xxx	PVT-Color memory failure	

Error Code	Failure Data	Additional Information
D0403 0xxx	PVT-Physio memory failure.	
D0404 0xxx	PVT-Mmode/Doppler post-processing failure.	
D0405 0xxx	PVT-Communications failure.	
D0406 0xxx	PVT-Post-processing failure.	Factory Mode text: Local CPU accessing Post Proc RAM and system CPU accessing shared memory
D0407 0xxx	PVT-Autovector failure.	Factory Mode text: Failure detected using chksum Image Memory grab
D0409 0xxx	PVT-A/D converter failure.	
D0410 0xxx	PVT-Local CPU Interrupt failure.	
D0411 0xxx	PVT-PVT interrupt failure.	
D0412 0xxx	PVT-Video bus failure.	Tests physio overlay, border and M-Mode window.
D0413 0xxx	PVT-Autovector failure.	Factory Mode text: Failure detected via chksum Image Memory bus grab
D0414 0xxx	PVT-Mmode/Dop input failure.	Factory Mode text: State machine failure
D0415 0xxx	PVT-ROM checksum failure.	Verify correct part numbers.
D0501 0xxx	PG-Video or priority interface failure.	
D0503 0xxx	PG-Video processor failure.	Factory Mode text: No communication with VSC chip
D0504 0xxx	PG-Graphics video failure.	Factory Mode text: Improper communication to VRAMs
D0505 0xxx	PG-Graphics display output failure.	Factory Mode text: Priority RAM failure

Error Code	Failure Data	Additional Information
D0506 0xxx	PG-Video path failure.	Also try [IM,PVT]
D0601 0xxx	RT-2D Flow, or Mask/Turb Sequence Table failure.	
D0602 0xxx	RT-Splice, Adapt, Persist, or Arctangent Table failure.	
D0603 0xxx	RT-Acoustic Buffer failure.	
D0604 0xxx	RT-Data Paths or Format PALS failure.	
D0605 0xxx	RT-Splice failure.	
D0606 0xxx	RT-Adaptive Persistence failure.	
D0607 0xxx	RT-Lateral Average failure.	
D0608 0xxx	RT-HARRIER Internal Registers failure.	
D0609 0xxx	RT-CRAM failure.	
D060A 0xxx	RT-HARRIER Internal RAM failure.	
D060B 0xxx	RT-HARRIER Internal RAM failure.	
D060C 0xxx	RT-HARRIER Shadow RAM or Working Registers failure.	
D060D 0xxx	RT-MFlip State Machine failure.	
D060E 0xxx	RT-Sector Patterns CRC failure.	Also try [IM].
D060F 0xxx	RT-Reduced Sector Patterns CRC failure.	Also try [IM].
D0610 0xxx	RT-Color Persistence failure.	
D0611 0xxx	RT - Pepper filter error.	
D0612 0xxx	RT - Acoustic Cine RAM error.	
D0701 0xxx	VIO-System CPU access failure.	
D0702 0xxx	VIO-Red B&W lookup table failure.	
D0703 0xxx	VIO-Green B&W lookup table failure.	
D0704 0xxx	VIO-Blue B&W lookup table failure.	

Error Code	Failure Data	Additional Information
D0705 0xxx	VIO-Red color lookup table failure.	
D0706 0xxx	VIO-Green color lookup table failure.	
D0707 0xxx	VIO-Blue color lookup table failure.	
D0708 0xxx	VIO-Threshold map data failure.	
D0709 0xxx	VIO-Adder and carry bit failure.	
D070A 0xxx	VIO-D/A converter error.	
D070B 0xxx	VIO-Red RAM border value failure.	
D070C 0xxx	VIO-Phase lock loop failure.	Also try [PVT].
D0730 0xxx	VIO-PAL/NTSC mismatch.	
D0731 0xxx	VIO-Green video level failure.	
D0732 0xxx	VIO-Blue video level failure.	
D0733 0xxx	VIO-Red video level failure.	
D0734 0xxx	VIO-Aux composite failure.	
D0735 0xxx	VIO-SVHS Luma signal failure.	
D0736 0xxx	VIO-SVHS Chroma signal failure.	
D0737 0xxx	VIO-STD VHS composite signal failure.	
D0738 0xxx	VIO-VTR Playback failure.	
D0739 0xxx	VIO-Loss of color on playback failure.	
D073A 0xxx	VIO-Loss of color on record failure.	
D0801 0xxx	SIO-Initialization error.	
D0802 0xxx	SIO-Gain CAL memory error.	
D0803 0xxx	SIO-2D Compression RAM error.	
D0804 0xxx	SIO-Sampling Error.	
D0805 0xxx	SIO-2D Data path error.	
D0806 0xxx	SIO-2D Data path error.	

Error Code	Failure Data	Additional Information
D0807 0xxx	SIO-2D Data path error.	
D0808 0xxx	SIO-Color data path error.	
D0809 0xxx	SIO-Color data path error.	
D080A 0xxx	SIO-MMode path error.	
D080B 0xxx	SIO-2D gain CAL error.	
D080C 0xxx	SIO-Interface error.	Also check RT
D080D 0xxx	SIO-Depth compression error.	
D080E 0xxx	SIO-MMode line decimation error.	
D080F 0xxx	SIO-Color packetizer interleave error.	
D0810 0xxx	SIO-AQ data path failure.	
D0A01 0xxx	CCLR or TCINE-Register test failure.	See Note, page 5-65.
D0A02 0xxx	CCLR or TCINE-VSXX or VCXX Bus Error.	See Note, page 5-65.
D0A03 0xxx	CCLR or TCINE-VCR analog failure.	See Note, page 5-65.
D0A04 0xxx	CCLR or TCINE-Look up Table error.	See Note, page 5-65.
D0A05 0xxx	CCLR or TCINE-DRAM Memory error.	See Note, page 5-65.
D0A06 0xxx	CCLR or TCINE-GREEN ROM error.	See Note, page 5-65.
DOB01 0xxx	FP-MAC Multiplier or Compression ROM failure.	
D0B02 0xxx	FP-MAC Accumulator or Compression ROM failure.	
D0B03 0xxx	FP-Compression ROM failure.	
D0B04 0xxx	FP-Mag. normalizer shifter failure.	
D0B05 0xxx	FP-Mag. ROM failure.	
D0B06 0xxx	FP-Weighting ROM failure.	

Error Code	Failure Data	Additional Information
D0B07 0xxx	FP-Max Mag Accum or compression failure.	
D0B08 0xxx	FP-Packet velocity ROM failure.	
D0B09 0xxx	FP-Packet velocity or subtracter failure.	
D0B0A 0xxx	FP-Zero Turbulence failure.	
D0B0C 0xxx	FP-Velocity theta filter failure.	Factory Mode text: negative velocities
D0B0D 0xxx	FP-Velocity theta filter failure.	Factory Mode text: positive velocities
DOBOF 0xxx	FP-Turb. Theta Filter failure	
D0B11	FP-Lateral theta Detection filter failure	
D0B12 0xxx	FP-Timing generator failure.	
D0B13 0xxx	FP-Turbulence failure.	Factory Mode text: y component=0 x component<=MAXMAG
D0B14 0xxx	FP-Normalizer mag failure.	Factory Mode text: I=Q
D0B15 0xxx	FP-Theta shifter failure.	Also try [RT,IM].
D0B16 0xxx	FP-Theta ROM failure.	Also try [RT,IM].
D0B17 0xxx	FP-Velocity ROM failure.	Also try [RT,IM].
D0B18 0xxx	FP-Turbulence radial filter error.	Also try [RT,IM].
D0B19 0xxx	FP-Velocity radial filter error.	Also try [RT,IM].
D0B1A 0xxx	FP-Reject failure.	Also try [RT,IM].
D0B1C 0xxx	FP-Theta Normalizer failure.	Also try [RT,IM].
D0B1D 0xxx	FP-SABLE failure.	Also try [RT,IM]. Factory Mode text: 16 Line packets using 1 pole filter.

Error Code	Failure Data	Additional Information
D0B1E 0xxx	FP-SABLE failure.	Also try [RT,IM]. Factory Mode text: 16 Line packets using averaging filter.
D0B1F 0xxx	FP-SABLE failure.	Also try [RT,IM]. Factory Mode text: 16 Line packets using PV filter.
D0B20 0xxx	FP-SABLE failure.	Also try [RT,IM]. Factory Mode text: 12 Line packets using PV filter.
D0B21 0xxx	FP-SABLE failure.	Also try [RT,IM]. Factory Mode text: 8 Line packets using PV filter.
D0B23 0xxx	FP-Flash reject failure.	Also try [RT,IM].
D0B24 0xxx	FP-Adaptive flash rejection error.	Also try [RT,IM].
D0C01 0xxx	DD-Board ID invalid.	
D0C02 0xxx	DD-Processor to RAM error.	
D0C03 0xxx	DD-Processor to RAM error.	
D0C04 0xxx	DD-Processor to RAM error.	
D0C05 0xxx	DD-DSP Download failure.	Also try [PG]
D0C06 0xxx	DD-On board RAM error.	
D0C07 0xxx	DD-On board RAM error.	
D0C08 0xxx	DD-On board RAM error.	
D0C09 0xxx	DD-On board RAM error.	
D0C0A 0xxx	DD-Doppler data path error.	
D0C0B 0xxx	DD-Doppler data path error.	
D0C0C 0xxx	DD-Doppler data path error.	
D0C0D 0xxx	DD-Stripchart signal failure.	

Error Code	Failure Data	Additional Information
D0D01 0xxx	AQ-Timing ram failure.	
D0D02 0xxx	AQ-Grey scale ram failure.	
D0D03 0xxx	AQ-Splice ram failure.	
D0D04 0xxx	AQ-Threshold ram failure.	
D0D05 0xxx	AQ-ROI ram failure.	
D0D06 0xxx	AQ-Input ram failure.	
D0D07 0xxx	AQ-Signal processing Loop failure.	
D0D08 0xxx	AQ-ROI failure.	
D0D09 0xxx	AQ-Blood decision failure	
D0D0A 0xxx	AQ-Interrupt timer failure	
D0D0B 0xxx	AQ-2D bus I/O failure	
DOE01 0xxx	DSR or TCINE-SCSI Processor communications failure.	See Note, page 5-65.
D0E02 0xxx	DSR or TCINE-Interrupt failure.	See Note, page 5-65. DSR: Factory Mode text: NPGINT, DMAINT, SCSIINT
D0E03 0xxx	DSR or TCINE-Mbox RAM failure.	See Note, page 5-65.
D0E04 0xxx	DSR or TCINE-SW RAM failure.	See Note, page 5-65.
D0E05 0xxx	DSR or TCINE-Hardware file control buffer failure.	See Note, page 5-65.
D0E06 0xxx	DSR or TCINE-Backplane direct memory access failure.	See Not,e page 5-65. DSR: Also try [IM]
D0E07 0xxx	DSR or TCINE-Compression failure.	See Note, page 5-65.
D0E08 0xxx	DSR or TCINE-Expansion buffer error.	See Note, page 5-65.
D0E09 0xxx	DSR or TCINE-Compression DMA failure.	See Note, page 5-65.

Error Code	Failure Data	Additional Information
D0E0A 0xxx	DSR or TCINE-Disk store/retrieve error.	See Note page 5-65. A formatted, initialized disk must be loaded.
D0E0B 0xxx	DSR or TCINE-PPRAM store/retrieve.	See Note, page 5-65. A formatted, initialized disk must be loaded. Also try [IM].
D0E0C 0xxx	DSR or TCINE-Checksum failure.	See Note, page 5-65. DSR: Also check DSR cabling.
D0E0D 0xxx	DSR or TCINE-Compression DMA failure.	See Note, page 5-65. DSR: A formatted, initialized disk must be loaded.
D0E0E 0xxx	DSR or TCINE-Store error.	See Note, page 5-65. DSR: A formatted, initialized disk must be loaded. Also try [B&W CLR] Factory Mode text: Buffer overflow test
D0E0F 0xxx	DSR or TCINE-Mailbox failure.	See Note, page 5-65.
D0E10 0xxx	DSR or TCINE-Expansion DMA failure.	See Note, page 5-65. DSR: Uncompressed data. A formatted, initialized disk is required.
D0E11 0xxx	DSR or TCINE-Expansion DMA failure.	See Note, page 5-65. DSR: Compressed data. A formatted, initialized disk is required.
D0E12 0xxx	DSR or TCINE-Fast Retrieve/Store error.	See Note, page 5-65. DSR: A formatted, initialized disk must be loaded. Try [BW CLR] Factory Mode text: Buffer overflow test
D0E13 0xxx	DSR or TCINE-Mailbox failure.	See Note, page 5-65.

Error Code	Failure Data	Additional Information
D0E14 0xxx	DSR or TCINE-Software file control buffer failure.	See Note, page 5-65.
D0E15 0xxx	DSR or TCINE-Hardware FCB RAM failure.	See Note, page 5-65.
D0F01 0xxx	SC-Processor Core failure.	
D0F02 0xxx	SC-Interrupt circuit failure.	
D0F03 0xxx	SC-RAM failure.	
D0F04 0xxx	SC-Character RAM failure.	
D0F05 0xxx	SC-Mark RAM failure.	
D0F06 0xxx	SC-Greyscale RAM failure.	
D0F07 0xxx	SC-Timing RAM failure.	
D0F08 0xxx	SC-Trident circuit failure.	
D0F09 0xxx	SC-DAC circuit failure.	
D0F0A 0xxx	SC-Paper speed circuit failure.	KOWA must be connected.
D0F0B 0xxx	SC-Sweep ramp failure.	
D0F0C 0xxx	SC-Shared RAM Extended Test failure.	
D0F0D 0xxx	SC-Character RAM Extended Test failure.	
D0F0E 0xxx	SC-Graphics RAM Extended Test failure.	
D0F0F 0xxx	SC-Greyscale RAM Extended Test failure.	
D0F10 0xxx	SC-Timing RAM failure.	
D0F11 0xxx	SC-Extended trident data bus test.	
D1101 0xxx	TCINE_FPGA Mailbox Memory. Error from PG-side.	
D1102 0xxx	TCINE_FPGA Mailbox Memory. Error from Coldfire-side.	
D1103 0xxx	TCINE-DIMM Type Mismatch.	

Error Code	Failure Data	Additional Information
D1104 0xxx	TCINE-Coldfire DMA Fails.	
D1105 0xxx	TCINE-SCSI Chip R/W Failure.	
D1106 0xxx	TCINE-DIMM #O Read/Write Fails.	
D1107 0xxx	TCINE-DIMM #1 Read/Write Fails.	
D1108 0xxx	TCINE-DIMM #2 Read/Write Fails.	
D1109 0xxx	TCINE-DIMM #3 Read/Write Fails.	
D110A 0xxx	TCINE-SCSI MO R/W Failure. A formatted initialized disk required.	
D110B 0xxx	TCINE-FullDataPathTest Failure. A formatted initialized disk required.	

5 Scanner Error Codes

Board Abbreviations

Abbreviation	Actual Name
Distr	Distribution
Fend0	Front End 0 (slot #2)
Fend1	Front End 1 (slot #3)
Fend2	Front End 2 (slot #4)
Fend3	Front End 3 (slot #5)
CLK	Clock
PREG	Power Regulator
Beam0	Beam 0 (slot #9)
Beam1	Beam 1 (slot #10)
Beam2	Beam 2 (slot #11)
Beam3	Beam 3 (slot #12)
DSCC	DSCC
BIO	Beamformer I/0
ID	Digital Image Detector

Scanner Error Codes

Error Code	Description	Additional Information
E0000 0000	RST Scanner Error	
E0101 1000	[BIO] Frame Table RAM error	
E0101 2000	[BIO] Frame Table RAM error	
E0101 3000	[BIO] Frame Table RAM error	
E0101 4000	[BIO] Frame Table RAM error	
E0102 1000	[BIO] Frame Table RAM error	
E0102 2000	[BIO] Frame Table RAM error	
E0103 1000	[BIO] Frame Table Test error	
E0103 2000	[BIO] Scanner start error	
E0103 3000	[BIO] Frame Table Test error	
E0103 4000	[BIO] Scanner stop error	
E0103 5000	[BIO] Frame Table Test error	
E0103 6000	[BIO] Frame Table Test error	
E0103 7000	[BIO] Frame Table Test error	
E0104 1000	[BIO] Frame Table Test error	
E0104 2000	[BIO] DUART Line test error	
E0104 3000	[BIO] DUART Line test error	
E0104 4000	[BIO] Frame Table Test error	
E0104 5000	[BIO] Frame Table Test error	
E0105 1000	[BIO] Scanner start error	

Error Code	Description	Additional Information
E0105 2000	[BIO] Scanner stop error	
E0105 3000	[BIO] Frame Table Test error	
E0105 4000	[BIO] Frame Table Test error	
E0105 5000	[BIO] Frame Table Test error	
E0106 1000	[BIO] Scanner start error	
E0106 2000	[BIO] Frame Table Test error	
E0106 3000	[BIO] Scanner stop error	
E0106 4000	[BIO] Frame Table Test error	
E0106 5000	[BIO] Frame Table Test error	
E0107 1000	[BIO] Scanner start error	
E0107 2000	[BIO] Frame Table Test error	
E0107 3000	[BIO] Scanner stop error	
E0108 1000	[BIO] Scanner start error	
E0108 2000	[BIO] Scanner stop error	
E0108 3000	[BIO] Repeat line error	
E0109 1000	[BIO] Scanner start error	
E0109 2000	[BIO] Scanner stop error	
E0109 3000	[BIO] Frame Table Test error	
E0109 4000	[BIO] Frame Table Test error	
E010A 1000	[BIO] Timer RAM error	
E010A 2000	[BIO] Timer RAM error	
E010A 3000	[BIO] Timer RAM error	
E010A 4000	[BIO] Timer RAM error	
E010B 1000	[BIO] Timer Register error	

Error Code	Description	Additional Information
E010B 2000	[BIO] Timer Register error	
E010B 3000	[BIO] Timer Register error	
E010B 4000	[BIO] Timer Register error	
E010B 5000	[BIO] Timer Register error	
E010B 6000	[BIO] Timer Register error	
E010B 7000	[BIO] Timer Register error	
E010B 8000	[BIO] Timer Register error	
E010C 1000	[BIO] Scanner start error	
E010C 2000	[BIO] Line timer error	
E010D 1000	[BIO] Scanner start error	
E010D 2000	[BIO] Scanner stop error	
E010D 3000	[BIO] Line timer error	
E010E 1000	[BIO] Scanner start error	
E010E 2000	[BIO] Line timer error	
E010E 3000	[BIO] Scanner stop error	
E010F 1000	[BIO] Scanner start error	
E010F 2000	[BIO] Scanner stop error	
E010F 3000	[BIO] Line timer error	
E010F 4000	[BIO] Line timer error	
E0110 1000	[BIO] Line timer error	
E0110 2000	[BIO] Line timer error	
E0111 1000	[BIO] Array Position error	
E0111 2000	[BIO] Array Position error	
E0111 3000	[BIO] Array Position error	

Error Code	Description	Additional Information
E0112 1000	[BIO] FESI Bus error	
E0112 2000	[BIO] FESI Bus error	
E0112 3000	[BIO] FESI Bus error	
E0112 4000	[BIO] FESI Bus error	
E0112 5000	[BIO] FESI Bus error	
E0113 1000	[BIO] Clock Interface error	
E0113 2000	[BIO] Clock Interface error	
E0114 1000	[BIO] Xmit RAM error	
E0114 2000	[BIO] Xmit RAM error	
E0114 3000	[BIO] Xmit RAM error	
E0114 4000	[BIO] Xmit RAM error	
E0115 1000	[BIO] Xmit Coef Download error	
E0115 2000	[BIO] Xmit Coef Download error	
E0115 3000	[BIO] Xmit Coef Download error	
E0115 4000	[BIO] Xmit Coef Download error	
E0115 5000	[BIO] Xmit Coef Download error	
E0115 6000	[BIO] Xmit Coef Download error	
E0115 7000	[BIO] Xmit Coef Download error	
E0115 8000	[BIO] Xmit Coef Download error	
E0116 1000	[BIO] Xmit Coef Download error	
E0116 2000	[BIO] Xmit Coef Download error	
E0116 3000	[BIO] Xmit Coef Download error	
E0116 4000	[BIO] Xmit Coef Download error	
E0117 1000	[BIO] Xmit Coef Download error	

Error Code	Description	Additional Information
E0117 2000	[BIO] Xmit Coef Download error	
E0117 3000	[BIO] Xmit Coef Download error	
E0117 4000	[BIO] Xmit Coef Download error	
E0118 1000	[BIO] Xmit Coef Download error	
E0118 2000	[BIO] Xmit Coef Download error	
E0118 3000	[BIO] Xmit Coef Download error	
E0118 4000	[BIO] Xmit Coef Download error	
E0119 1000	[BIO] Xmit Coef Download error	
E0119 2000	[BIO] Xmit Coef Download error	
E0119 3000	[BIO] Xmit Coef Download error	
E0119 4000	[BIO] Xmit Coef Download error	
E0201 1000	[PREG] F.E. control bus failure	
E0201 2000	[PREG] F.E. control bus failure	
E0202 1000	[PREG] F.E. control bus failure	
E0202 2000	[PREG] F.E. control bus failure	
E0203 1000	[PREG] Neg 12V supply error	
E0203 2000	[PREG] PReg Test error	
E0204 1000	[PREG] Neg 5 V supply error	
E0204 2000	[PREG] PReg Test error	
E0205 1000	[PREG] Pos 12V supply error	
E0205 2000	[PREG] PReg Test error	
E0206 1000	[PREG] Pos 5V supply error	
E0206 2000	[PREG] PReg Test error	
E0207 1000	[PREG] Pos Ref V error	

Error Code	Description	Additional Information
E0207 2000	[PREG] PReg Test error	
E0208 1000	[PREG] Neg Ref V error	
E0208 2000	[PREG] PReg Test error	
E0209 1000	[PREG] Low V Ref error	
E0209 2000	[PREG] PReg Test error	
E020A 1000	[PREG] Low V supply error	
E020A 2000	[PREG] PReg Test error	
E020B 1000	[PREG] Low V supply error	
E020B 2000	[PREG] PReg Test error	
E020C 1000	[PREG] Hi V Ref error	
E020C 2000	[PREG] PReg Test error	
E020D 1000	[PREG] Hi V Ref error	
E020D 2000	[PREG] PReg Test error	
E020E 1000	[PREG] HV supply 24V rail error	
E020E 2000	[PREG] PReg Test error	
E020F 1000	[PREG] HV supply 85V rail error	
E020F 2000	[PREG] PReg Test error	
E0210 1000	[PREG] HV supply 170V rail error	
E0210 2000	[PREG] PReg Test error	
E0211 1000	[PREG] Omni motor voltage error	
E0211 2000	[PREG] PReg Test error	
E0212 1000	[PREG] Omni Ref V error	
E0212 2000	[PREG] PReg Test error	
E0213 1000	[PREG] TEE thermister error	

Error Code	Description	Additional Information
E0213 2000	[PREG] PReg Test error	
E0213 3000	[PREG] TEE thermister error	
E0214 1000	[PREG] Omni position error	
E0215 1000	[PREG] PV bias Voltage error VPP	
E0215 2000	[PREG] PReg Test error	
E0215 3000	[PREG] PV bias Voltage error VPP	
E0215 4000	[PREG] PV bias Voltage error VPP	
E0215 5000	[PREG] PV bias Voltage error VPP	
E0216 1000	[PREG] PV bias Voltage error VNN	
E0216 2000	[PREG] PReg Test error	
E0216 3000	[PREG] PV bias Voltage error VNN	
E0216 4000	[PREG] PV bias Voltage error VNN	
E0216 5000	[PREG] PV bias Voltage error VNN	
E0217 1000	[PREG] HV pulser error	
E0218 1000	[PREG] FE interrupt error	
E0218 2000	[PREG] FE interrupt error	
E0218 3000	[PREG] FE interrupt error	
E0218 4000	[PREG] FE interrupt error	
E0219 1000	[PREG] HV Xmit V out of regulation	
E0219 2000	[PREG] HV Xmit V out of regulation	
E0219 3000	[PREG] HV Xmit V out of regulation	
E0219 4000	[PREG] HV Xmit V out of regulation	

Error Code	Description	Additional Information
E0219 5000	[PREG] HV Xmit V out of regulation	
E0219 6000	[PREG] HV Xmit V out of regulation	
E021A 1000	[PREG] LV Xmit V out of regulation	
E021A 2000	[PREG] LV Xmit V out of regulation	
E021A 3000	[PREG] LV Xmit V out of regulation	
E021A 4000	[PREG] LV Xmit V out of regulation	
E021A 5000	[PREG] LV Xmit V out of regulation	
E021A 6000	[PREG] LV Xmit V out of regulation	
E021B 1000	[PREG] System supply interrupt	
E021B 2000	[PREG] System supply interrupt	
E021B 3000	[PREG] System supply interrupt	
E021B 4000	[PREG] System supply interrupt	
E021B 5000	[PREG] System supply interrupt	
E021C 1000	[PREG] Pencil probe interrupt	
E021C 2000	[PREG] Pencil probe interrupt	
E021C 3000	[PREG] Pencil probe interrupt	
E021C 4000	[PREG] Pencil probe interrupt	
E021D 1000	[PREG] TEE thermister error	
E021D 2000	[PREG] TEE thermister error	
E021D 3000	[PREG] TEE thermister error	

Error Code	Description	Additional Information
E021D 4000	[PREG] TEE thermister error	
E021D 5000	[PREG] TEE thermister error	
E021E 1000	[PREG] TEE thermister error	
E021E 2000	[PREG] TEE thermister error	
E021E 3000	[PREG] TEE thermister error	
E021E 4000	[PREG] TEE thermister error	
E021E 5000	[PREG] TEE thermister error	
E021F 1000	[PREG] PV Probe MUX error	
E021F 2000	[PREG] PV Probe MUX error	
E0220 1000	[PREG] PV Probe MUX error	
E0221 1000	Do Not Execute - Factory Test Only	
E0222 1000	Do Not Execute - Factory Test Only	
E0301 1000	[CLK] FESI bus error	Also Check BIO/PREG
E0301 2000	[CLK] FESI bus error	Also Check BIO/PREG
E0302 1000	[CLK] Mixer amplitude error	
E0302 2000	[CLK] Mixer amplitude error	
E0302 3000	[CLK] Mixer amplitude error	
E0302 4000	[CLK] Mixer amplitude error	
E0302 5000	[CLK] Mixer amplitude error	
E0302 6000	[CLK] Mixer amplitude error	
E0302 7000	[CLK] Mixer amplitude error	
E0302 8000	[CLK] Mixer amplitude error	
E0302 F000	[PREG] PReg test error	
E0303 1000	[CLK] Mixer amplitude error	

Error Code	Description	Additional Information
E0303 2000	[CLK] Mixer amplitude error	
E0303 3000	[CLK] Mixer amplitude error	
E0303 4000	[CLK] Mixer amplitude error	
E0303 5000	[CLK] Mixer amplitude error	
E0303 6000	[CLK] Mixer amplitude error	
E0303 7000	[CLK] Mixer amplitude error	
E0303 8000	[CLK] Mixer amplitude error	
E0303 F000	[PREG] PReg test error	
E0304 1000	[CLK] Mixer amplitude error	
E0304 2000	[CLK] Mixer amplitude error	
E0304 3000	[CLK] Mixer amplitude error	
E0304 4000	[CLK] Mixer amplitude error	
E0304 5000	[CLK] Mixer amplitude error	
E0304 6000	[CLK] Mixer amplitude error	
E0304 7000	[CLK] Mixer amplitude error	
E0304 8000	[CLK] Mixer amplitude error	
E0304 F000	[PREG] PReg test error	
E0305 1000	[CLK] Mixer amplitude error	
E0305 2000	[CLK] Mixer amplitude error	
E0305 3000	[CLK] Mixer amplitude error	
E0305 4000	[CLK] Mixer amplitude error	
E0305 5000	[CLK] Mixer amplitude error	
E0305 6000	[CLK] Mixer amplitude error	
E0305 7000	[CLK] Mixer amplitude error	

Error Code	Description	Additional Information
E0305 8000	[CLK] Mixer amplitude error	
E0305 F000	[PREG] PReg test error	
E0306 1000	[PREG] PReg test error	
E0306 2000	[CLK] Mixer Filter error	
E0306 3000	[CLK] Mixer Filter error	
E0307 1000	[PREG] PReg test error	
E0307 2000	[CLK] Mixer Filter error	
E0307 3000	[CLK] Mixer Filter error	
E0308 1000	[PREG] PReg test error	
E0308 2000	[CLK] Mixer Filter error	
E0308 3000	[CLK] Mixer Filter error	
E0309 1000	[PREG] PReg test error	
E0309 2000	[CLK] Mixer Filter error	
E0309 3000	[CLK] Mixer Filter error	
E030A 1000	[CLK] Doppler Gain test error	
E030A 2000	[CLK] Doppler Gain test error	
E030A 3000	[CLK] Doppler Gain test error	
E030A 4000	[CLK] Doppler Gain test error	
E030A 5000	[CLK] Doppler Gain test error	
E030A 6000	[CLK] Doppler Gain test error	
E030A 7000	[CLK] Doppler Gain test error	
E030A 8000	[CLK] Doppler Gain test error	
E030A 9000	[CLK] Doppler Gain test error	
E030A A000	[CLK] Doppler Gain test error	

Error Code	Description	Additional Information
E030A B000	[CLK] Doppler Gain test error	
E030A C000	[CLK] Doppler Gain test error	
E030A D000	[CLK] Doppler Gain test error	
E030A E000	[CLK] Doppler Gain test error	
E030A F000	[PREG] PReg test error	
E030B 1000	[CLK] Doppler Gain test error	
E030B 2000	[CLK] Doppler Gain test error	
E030B 3000	[CLK] Doppler Gain test error	
E030B 4000	[CLK] Doppler Gain test error	
E030B 5000	[CLK] Doppler Gain test error	
E030B 6000	[CLK] Doppler Gain test error	
E030B 7000	[CLK] Doppler Gain test error	
E030B 8000	[CLK] Doppler Gain test error	
E030B 9000	[CLK] Doppler Gain test error	
E030B A000	[CLK] Doppler Gain test error	
E030B B000	[CLK] Doppler Gain test error	
E030B C000	[CLK] Doppler Gain test error	
E030B D000	[CLK] Doppler Gain test error	
E030B E000	[CLK] Doppler Gain test error	
E030B F000	[PREG] PReg test error	
E030C 1000	[CLK] Doppler Gain test error	
E030C 2000	[CLK] Doppler Gain test error	
E030C 3000	[CLK] Doppler Gain test error	
E030C 4000	[CLK] Doppler Gain test error	

Error Code	Description	Additional Information
E030C 5000	[CLK] Doppler Gain test error	
E030C 6000	[CLK] Doppler Gain test error	
E030C 7000	[CLK] Doppler Gain test error	
E030C 8000	[CLK] Doppler Gain test error	
E030C 9000	[CLK] Doppler Gain test error	
E030C A000	[CLK] Doppler Gain test error	
E030C B000	[CLK] Doppler Gain test error	
E030C C000	[CLK] Doppler Gain test error	
E030C D000	[CLK] Doppler Gain test error	
E030C E000	[CLK] Doppler Gain test error	
E030C F000	[PREG] PReg test error	
E030D 1000	[CLK] Doppler Gain test error	
E030D 2000	[CLK] Doppler Gain test error	
E030D 3000	[CLK] Doppler Gain test error	
E030D 4000	[CLK] Doppler Gain test error	
E030D 5000	[CLK] Doppler Gain test error	
E030D 6000	[CLK] Doppler Gain test error	
E030D 7000	[CLK] Doppler Gain test error	
E030D 8000	[CLK] Doppler Gain test error	
E030D 9000	[CLK] Doppler Gain test error	
E030D A000	[CLK] Doppler Gain test error	
E030D B000	[CLK] Doppler Gain test error	
E030D C000	[CLK] Doppler Gain test error	
E030D D000	[CLK] Doppler Gain test error	

Error Code	Description	Additional Information
E030D E000	[CLK] Doppler Gain test error	
E030D F000	[PREG] PReg test error	
E030F 1000	[CLK] Dop Gain test error	
E030F 2000	[CLK] Dop Gain test error	
E030F 3000	[CLK] Dop Gain test error	
E030F 4000	[CLK] Dop Gain test error	
E030F 5000	[CLK] Dop Gain test error	
E030F 6000	[CLK] Dop Gain test error	
E030F 7000	[CLK] Dop Gain test error	
E030F 8000	[CLK] Dop Gain test error	
E030F 9000	[CLK] Dop Gain test error	
E030F A000	[CLK] Dop Gain test error	
E030F B000	[CLK] Dop Gain test error	
E030F C000	[CLK] Dop Gain test error	
E030F D000	[CLK] Dop Gain test error	
E030F E000	[CLK] Dop Gain test error	
E030F F000	[PREG] PReg test error	
E0310 1000	[CLK] Doppler Gain test error	
E0310 2000	[CLK] Doppler Gain test error	
E0310 3000	[CLK] Doppler Gain test error	
E0310 4000	[CLK] Doppler Gain test error	
E0310 5000	[CLK] Doppler Gain test error	
E0310 6000	[CLK] Doppler Gain test error	
E0310 7000	[CLK] Doppler Gain test error	

Error Code	Description	Additional Information
E0310 8000	[CLK] Doppler Gain test error	
E0310 9000	[CLK] Doppler Gain test error	
E0310 A000	[CLK] Doppler Gain test error	
E0310 B000	[CLK] Doppler Gain test error	
E0310 C000	[CLK] Doppler Gain test error	
E0310 D000	[CLK] Doppler Gain test error	
E0310 E000	[CLK] Doppler Gain test error	
E0310 F000	[PREG] PReg test error	
E0311 1000	[CLK] Doppler Blanking error	
E0311 2000	[CLK] Doppler Blanking error	
E0311 F000	[PREG] PReg test error	
E0312 1000	[CLK] DAC Bias error	
E0313 1000	[CLK] TGC test error	
E0313 2000	[CLK] TGC test error	
E0313 3000	[CLK] TGC test error	
E0313 4000	[CLK] TGC test error	
E0313 5000	[CLK] TGC test error	
E0313 6000	[CLK] TGC test error	
E0314 1000	[PREG] PReg test error	
E0314 2000	[CLK] TGC test error	
E0314 3000	[CLK] TGC test error	
E0315 1000	[CLK] TGC test error	
E0315 2000	[CLK] TGC test error	
E0315 3000	[CLK] TGC test error	

Error Code	Description	Additional Information
E0315 4000	[CLK] TGC test error	
E0316 1000	[BIO] Scanner start error	
E0316 2000	[BIO] Scanner timeout error	
E0316 3000	[BIO] Scanner stop error	
E0316 4000	[CLK] Wall filter test error	
E0316 5000	[CLK] Wall filter mtest error	
E0317 1000	[BIO] Scanner start error	
E0317 2000	[BIO] Scanner timeout error	
E0317 3000	[BIO] Scanner stop error	
E0317 4000	[CLK] Wall filter test error	
E0317 5000	[CLK] Wall filter test error	
E0318 1000	[BIO] Scanner start error	
E0318 2000	[BIO] Scanner timeout error	
E0318 3000	[BIO] Scanner stop error	
E0318 4000	[CLK] Wall filter test error	
E0318 5000	[CLK] Wall filter test error	
E0319 1000	[BIO] Scanner start error	
E0319 2000	[BIO] Scanner timeout error	
E0319 3000	[BIO] Scanner stop error	
E0319 4000	[CLK] Wall filter test error	
E0319 5000	[CLK] Wall filter test error	
E031A 1000	[BIO] Scanner start error	
E031A 2000	[BIO] Scanner timeout error	
E031A 3000	[BIO] Scanner stop error	

Error Code	Description	Additional Information
E031A 4000	[CLK] Wall filter test error	
E031A 5000	[CLK] Wall filter test error	
E0401 1000	[DSCC] On Board RAM error	Also check BIO
E0401 2000	[DSCC] On Board RAM error	Also check BIO
E0401 3000	[DSCC] On Board RAM error	Also check BIO
E0401 4000	[DSCC] On Board RAM error	Also check BIO
E0402 1000	[DSCC] On Board RAM error	Also check BIO
E0402 2000	[DSCC] On Board RAM error	Also check BIO
E0402 3000	[DSCC] On Board RAM error	Also check BIO
E0402 4000	[DSCC] On Board RAM error	Also check BIO
E0403 1000	[DSCC] On Board RAM error	Also check BIO
E0403 2000	[DSCC] On Board RAM error	Also check BIO
E0403 3000	[DSCC] On Board RAM error	Also check BIO
E0403 4000	[DSCC] On Board RAM error	Also check BIO
E0404 1000	[DSCC] On Board RAM error	Also check BIO
E0404 2000	[DSCC] On Board RAM error	Also check BIO
E0404 3000	[DSCC] On Board RAM error	Also check BIO
E0404 4000	[DSCC] On Board RAM error	Also check BIO
E0405 1000	[DSCC] On Board RAM error	Also Check BIO
E0405 2000	[DSCC] On Board RAM error	Also Check BIO
E0406 1000	[DSCC] On Board RAM error	Also Check BIO
E0406 2000	[DSCC] On Board RAM error	Also Check BIO
E0407 1000	[DSCC] On Board RAM error	Also Check BIO
E0407 2000	[DSCC] Test Timeout Error	

Error Code	Description	Additional Information
E0407 5000	[DSCC] Download error	Also Check BIO
E0408 1000	[DSCC] On Board RAM error	Also check BIO
E0408 2000	[DSCC] Test timeout error	
E0408 5000	[DSCC] Download error	Also Check BIO
E0409 1000	[DSCC] Coefficient RAM error	
E0409 2000	[DSCC] Coefficient timeout error	
E0409 5000	[DSCC] Download error	Also Check BIO
E040A 1000	[DSCC] Coefficient RAM error	
E040A 2000	[DSCC] Coefficient timeout error	
E040A 5000	[DSCC] Download error	Also check BIO
E040B 1000	[DSCC] Coefficient RAM error	
E040B 2000	[DSCC] Coefficient timeout error	
E040B 5000	[DSCC] Download error	Also check BIO
E040C 1000	[DSCC] Coefficient RAM error	
E040C 2000	[DSCC] Coefficient timeout error	
E040C 5000	[DSCC] Download error	Also check BIO
E040D 1000	[DSCC] Coefficient RAM decode error	
E040D 2000	[DSCC] Coefficient timeout error	
E040D 5000	[DSCC] Download error	Also check BIO
E040E 1000	[DSCC] Coefficient RAM decode error	
E040E 2000	[DSCC] Coefficient timeout error	
E040E 5000	[DSCC] Download error	Also check BIO
E040F 1000	[DSCC] Coefficient Readbackerror	

Error Code	Description	Additional Information
E040F 2000	[DSCC] Coefficient timeout error	
E040F 4000	[BIO] Line timer timeout error	
E040F 5000	[DSCC] Download error	Also check BIO
E0410 1000	[DSCC] Coefficient Readback error	
E0410 2000	[DSCC] Coefficient timeout error	
E0410 4000	[BIO] Line timer timeout error	
E0410 5000	[DSCC] Download error	Also check BIO
E0411 1000	[DSCC] Coefficient MUX error	
E0411 2000	[DSCC] Coefficient timeout error	
E0411 4000	[BIO] Line Timer timeout error	
E0411 5000	[DSCC] Download error	Also check BIO
E0412 1000	[DSCC] Coefficient MUX error	
E0412 2000	[DSCC] Coefficient timeout error	
E0412 4000	[BIO] Line Timer timeout error	
E0412 5000	[DSCC] Download error	Also check BIO
E0413 1000	[DSCC] Coefficient MUX error	
E0413 2000	[DSCC] Coefficient timeout error	
E0413 4000	[BIO] Line timer timeout error	
E0413 5000	[DSCC] Download error	Also check BIO
E0414 1000	[DSCC] Coefficient MUX error	
E0414 2000	[DSCC] Coefficient timeout error	
E0414 4000	[BIO] Line timer timeout error	
E0414 5000	[DSCC] Download error	Also check BIO
E0415 1000	[DSCC] Coefficient sequence error	

Error Code	Description	Additional Information
E0415 2000	[DSCC] Coefficient timeout error	
E0415 4000	[BIO] Line timer timeout error	
E0415 5000	[DSCC] Download error	Also check BIO
E0416 1000	[DSCC] Coefficient sequence error	
E0416 2000	[DSCC] Coefficient timeout error	
E0416 4000	[BIO] Line timer timeout error	
E0416 5000	[DSCC] Download error	Also check BIO
E0417 1000	[DSCC] Coefficient Line error	
E0417 2000	[DSCC] Coefficient timeout error	
E0417 4000	[BIO] Line timer timeout error	
E0417 5000	[DSCC] Download error	Also check BIO
E0418 1000	[DSCC] Coefficient Line error	
E0418 2000	[DSCC] Coefficient timeout error	
E0418 4000	[BIO] Line timer timeout error	
E0418 5000	[DSCC] Download error	Also check BIO
E0419 1000	[[DSCC] Coefficient Line error	
E0419 2000	[DSCC] Coefficient timeout error	
E0419 4000	[BIO] Line timer timeout error	
E0419 5000	[DSCC] Download error	Also check BIO
E041A 1000	[DSCC] Coefficient Line error	
E041A 2000	[DSCC] Coefficient timeout error	
E041A 4000	[BIO] Line timer timeout error	
E041A 5000	[DSCC] Download error	Also check BIO
E0501 3000	[ID] 2D FPGA error	

Error Code	Description	Additional Information
E0501 5000	[ID] TGC FPGA error	
E0501 6000	[ID] Doppler FPGA error	
E0501 7000	[ID] Data path FPGA error	
E0502 1000	[ID] Data path RAM error	
E0502 2000	[ID] Data path RAM error	
E0502 3000	[ID] Data path RAM error	
E0502 4000	[ID] Data path RAM error	
E0503 1000	[ID] Data path RAM error	
E0503 2000	[ID] Data path RAM error	
E0503 3000	[ID] Data path RAM error	
E0503 4000	[ID] Data path RAM error	
E0504 1000	[ID] Data path RAM error	
E0504 2000	[ID] Data path RAM error	
E0504 3000	[ID] Data path RAM error	
E0504 4000	[ID] Data path RAM error	
E0505 1000	[ID] Data path RAM error	
E0505 2000	[ID] Data path RAM error	
E0505 3000	[ID] Data path RAM error	
E0505 4000	[ID] Data path RAM error	
E0506 1000	[ID] Data path RAM error	
E0506 2000	[ID] Data path RAM error	
E0506 3000	[ID] Data path RAM error	
E0506 4000	[ID] Data path RAM error	
E0507 1000	[ID] Mixer Filter RAM error	

Error Code	Description	Additional Information
E0507 2000	[ID] Mixer Filter RAM error	
E0507 3000	[ID] Mixer Filter RAM error	
E0507 4000	[ID] Mixer Filter RAM error	
E0508 1000	[ID] TGC map RAM error	
E0508 2000	[ID] TGC map RAM error	
E0508 3000	[ID] TGC map RAM error	
E0508 4000	[ID] TGC map RAM error	
E0509 1000	[ID] DS Mode RAM error	
E0509 2000	[ID] DS Mode RAM error	
E0509 3000	[ID] DS Mode RAM error	
E0509 4000	[ID] DS Mode RAM error	
E050A 1000	[ID] TGC RAM error	
E050A 2000	[ID] TGC RAM error	
E050A 3000	[ID] TGC RAM error	
E050A 4000	[ID] TGC RAM error	
E050B 1000	[ID] TGC RAM error	
E050B 2000	[ID] TGC RAM error	
E050B 3000	[ID] TGC RAM error	
E050B 4000	[ID] TGC RAM error	
E050C 1000	[PREG] PReg test error	
E050C 2000	[ID] TGC RAM error	
E050C 5000	[ID] TGC RAM error	
E050D 1000	[PREG] Power Regulator test error	
E050D 2000	[ID] TGC RAM error	

Error Code	Description	Additional Information
E050D 5000	[ID] TGC RAM error	
E050E 1000	[BIO] Scanner start error	
E050E 2000	[BIO] Scanner stop error	
E050E 3000	[ID] 2D FPGA error	
E050E 4000	[ID] Data path error	
E050E 5000	[ID] TGC FPGA error	
E050E 6000	[ID] Doppler FPGA error	
E050E 7000	[ID] Data path FPGA error	
E050F 1000	[BIO] Scanner Start error	
E050F 2000	[BIO] Scanner Stop error	
E050F 3000	[ID] 2D FPGA error	
E050F 5000	[ID] TGC FPGA error	
E050F 6000	[ID] Doppler FPGA error	
E050F 7000	[ID] Data path FPGA error	
E050F 8000	[ID] Data path error	
E0510 1000	[BIO] Scanner start error	
E0510 2000	[BIO] Scanner stop error	
E0510 3000	[ID] 2D FPGA error	
E0510 4000	[ID] Data path error	
E0510 5000	[ID] TGC FPGA error	
E0510 6000	[ID] Doppler FPGA error	
E0510 7000	[ID] Data path FPGA error	
E0511 1000	[BIO] Scanner start error	
E0511 2000	[BIO] Scanner stop error	

Error Code	Description	Additional Information
E0511 3000	[ID] 2D FPGA error	
E0511 4000	[ID] Data path error	
E0511 5000	[ID] TGC FPGA error	
E0511 6000	[ID] Doppler FPGA error	
E0511 7000	[ID] Data path FPGA error	
E0512 1000	[BIO] Scanner start error	
E0512 2000	[BIO] Scanner stop error	
E0512 3000	[ID] 2D FPGA error	
E0512 5000	[ID] TGC FPGA error	
E0512 6000	[ID] Doppler FPGA error	
E0512 7000	[ID] Data path FPGA error	
E0512 C000	[ID] Data path error	
E0513 1000	[BIO] Scanner start error	
E0513 2000	[BIO] Scanner stop error	
E0513 3000	[ID] 2D FPGA error	
E0513 5000	[ID] TGC FPGA error	
E0513 6000	[ID] Doppler FPGA error	
E0513 7000	[ID] Data path FPGA error	
E0513 C000	[ID] Data path error	
E0514 1000	[BIO] Scanner start error	
E0514 2000	[BIO] Scanner stop error	
E0514 3000	[ID] 2D FPGA error	
E0514 4000	[ID] Data path error	
E0514 5000	[ID] TGC FPGA error	

Error Code	Description	Additional Information
E0514 6000	[ID] Doppler FPGA error	
E0514 7000	[ID] Data path FPGA error	
E0514 8000	[ID] Data path error	
E0514 C000	[ID] Data path error	
E0515 1000	[BIO] Scanner start error	
E0515 2000	[BIO] Scanner stop error	
E0515 3000	[ID] 2D FPGA error	
E0515 4000	[ID] Data path error	
E0515 5000	[ID] TGC FPGA error	
E0515 6000	[ID] Doppler FPGA error	
E0515 7000	[ID] Data path FPGA error	
E0515 8000	[ID] Data path error	
E0515 C000	[ID] Data path error	
E0516 1000	[BIO] Scanner start error	
E0516 2000	[BIO] Scanner stop error	
E0516 3000	[ID] 2D FPGA error	
E0516 4000	[ID] Data path error	
E0516 5000	[ID] TGC FPGA error	
E0516 6000	[ID] Doppler FPGA error	
E0516 7000	[ID] Data path FPGA error	
E0517 1000	[BIO] Scanner start error	
E0517 2000	[BIO] Scanner stop error	
E0517 3000	[ID] 2D FPGA error	
E0517 5000	[ID] TGC FPGA error	

Error Code	Description	Additional Information
E0517 6000	[ID] Doppler FPGA error	
E0517 7000	[ID] Data path FPGA error	
E0517 8000	[ID] Data path error	
E0518 1000	[BIO] Scanner start error	
E0518 2000	[BIO] Scanner stop error	
E0518 3000	[ID] 2D FPGA error	
E0518 4000	[ID] Data path error	
E0518 5000	[ID] TGC FPGA error	
E0518 6000	[ID] Doppler FPGA error	
E0518 7000	[ID] Data path FPGA error	
E0519 1000	[BIO] Scanner start error	
E0519 2000	[BIO] Scanner stop error	
E0519 3000	[ID] 2D FPGA error	
E0519 4000	[ID] Data path error	
E0519 5000	[ID] TGC FPGA error	
E0519 6000	[ID] Doppler FPGA error	
E0519 7000	[ID] Data path FPGA error	
E051A 1000	[BIO] Scanner start error	
E051A 2000	[BIO] Scanner stop error	
E051A 3000	[ID] 2D FPGA error	
E051A 5000	[ID] TGC FPGA error	
E051A 6000	[ID] Doppler FPGA error	
E051A 7000	[ID] Data path FPGA error	
E051A 8000	[ID] Data path error	

Error Code	Description	Additional Information
E051B 1000	[BIO] Scanner start error	
E051B 2000	[BIO] Scanner stop error	
E051B 3000	[ID] 2D FPGA error	
E051B 5000	[ID] TGC FPGA error	
E051B 6000	[ID] Doppler FPGA error	
E051B 7000	[ID] Data path FPGA error	
E051B 8000	[ID] Data path error	
E051C 1000	[BIO] Scanner start error	
E051C 2000	[BIO] Scanner stop error	
E051C 3000	[ID] 2D FPGA error	
E051C 5000	[ID] TGC FPGA error	
E051C 6000	[ID] Doppler FPGA error	
E051C 7000	[ID] Data path FPGA error	
E051C 8000	[ID] Post Log Filter error	
E051D 1000	[BIO] Scanner start error	
E051D 2000	[BIO] Scanner stop error	
E051D 3000	[ID] 2D FPGA error	
E051D 4000	[ID] Data path error	
E051D 5000	[ID] TGC FPGA error	
E051D 6000	[ID] Doppler FPGA error	
E051D 7000	[ID] Data path FPGA error	
E051D 8000	[ID] Data path error	
E051D C000	[ID] Data path error	
E051E 2000	[ID] Data path RAM error	

Error Code	Description	Additional Information
E051E 3000	[ID] Data path RAM error	
E051E 4000	[ID] Data path RAM error	
E051E 5000	[ID] Data path RAM error	
E051E 6000	[ID] Data path RAM error	
E051E 7000	[ID] Data path RAM error	
E051E 8000	[ID] Data path RAM error	
E051E 9000	[ID] Data path RAM error	
E051E A000	[ID] Data path RAM error	
E051E B000	[ID] Data path RAM error	
E051E F000	[ID] Invalid board ID	
E051F 1000	[BIO] Scanner start error	
E051F 2000	[BIO] Scanner stop error	
E051F 3000	[ID] Data path error	
E051F 4000	[ID] Data path error	
E051F 5000	[ID] Data path error	
E051F 6000	[ID] Data path error	
E051F 7000	[ID] Data path error	
E051F 8000	[Beam3] Invalid X pipe output	Also Check ID
E051F F000	[ID] Invalid board ID	
E0520 1000	[BIO] Scanner start error	
E0520 2000	[BIO] Scanner stop error	
E0520 3000	[ID] Data path error	
E0520 4000	[ID] Data path error	
E0520 5000	[ID] Data path error	

Error Code	Description	Additional Information
E0520 6000	[ID] Data path error	
E0520 7000	[ID] Data path error	
E0520 8000	[Beam3] Invalid Y pipe output	Also Check ID
E0520 F000	[ID] Invalid board ID	
E0601 1000	[Beam0] Pos 5V error	
E0601 2000	[PREG] Power Regulator test error	
E0601 3000	[Beam0] Pos 3V error	
E0602 1000	[Beam1] Pos 5 V error	
E0602 2000	[PREG] Power Regulator test error	
E0602 3000	[Beam1] Pos 3V error	
E0603 1000	[Beam2] Pos 5V error	
E0603 2000	[PREG] Power Regulator test error	
E0603 3000	[Beam2] Pos 3V error	
E0604 1000	[Beam3] Pos 5V error	
E0604 2000	[PREG] Power Regulator test error	
E0604 3000	[Beam3] Pos 3V error	
E0605 1000	[Beam0] Pos Reference V error	
E0605 2000	[PREG] Power Regulator test error	
E0605 3000	[Beam0] Neg Reference V error	
E0606 1000	[Beam1] Pos Reference V error	
E0606 2000	[PREG] Power Regulator test error	
E0606 3000	[Beam1] Neg Reference V error	
E0607 1000	[Beam2] Pos Reference V error	
E0607 2000	[PREG] Power Regulator test error	

Error Code	Description	Additional Information
E0607 3000	[Beam2] Neg Reference V error	
E0608 1000	[Beam3] Pos Reference V error	
E0608 2000	[PREG] Power Regulator test error	
E0608 3000	[Beam3] Neg Reference V error	
E0609 1000	[Beam0] ADC input error	
E0609 2000	[PREG] Power Regulator test error	
E0609 3000	[Beam0] ADC input error	
E0609 4000	[Beam0] ADC input error	
E060A 1000	[Beam1] ADC input error	
E060A 2000	[PREG] Power Regulator test error	
E060A 3000	[Beam1] ADC input error	
E060A 4000	[Beam1] ADC input error	
E060B 1000	[Beam2] ADC input error	
E060B 2000	[PREG] Power Regulator test error	
E060B 3000	[Beam2] ADC input error	
E060B 4000	[Beam2] ADC input error	
E060C 1000	[Beam3] ADC input error	
E060C 2000	[PREG] Power Regulator test error	
E060C 3000	[Beam3] ADC input error	
E060C 4000	[Beam3] ADC input error	
E060D 1000	[Beam0] Delay element error	
E060D F000	[ID] Invalid board ID	
E060E 1000	[Beam1] Delay element error	
E060E F000	[ID] Invalid board ID	

Error Code	Description	Additional Information
E060F 1000	[Beam2] Delay element error	
E060F F000	[ID] Invalid board ID	
E0610 1000	[Beam3] Delay element error	
E0610 F000	[ID] Invalid board ID	
E0611 1000	[Beam0] X signal path error	
E0611 F000	[ID] Invalid board ID	
E0612 1000	[Beam1] X signal path error	
E0612 F000	[ID] Invalid board ID	
E0613 1000	[Beam2] X signal path error	
E0613 F000	[ID] Invalid board ID	
E0614 1000	[Beam3] X signal path error	
E0614 F000	[ID] Invalid board ID	
E0615 1000	[Beam0] Y signal path error	
E0615 F000	[ID] Invalid board ID	
E0616 1000	[Beam1] Y signal path error	
E0616 F000	[ID] Invalid board ID	
E0617 1000	[Beam2] Y signal path error	
E0617 F000	[ID] Invalid board ID	
E0618 1000	[Beam3] Y signal path error	
E0618 F000	[ID] Invalid board ID	
E0619 1000	[Beam0] X signal path error	
E0619 F000	[ID] Invalid board ID	
E061A 1000	[Beam1] X signal path error	
E061A F000	[ID] Invalid board ID	

Error Code	Description	Additional Information
E061B 1000	[Beam2] X signal path error	
E061B F000	[ID] Invalid board ID	
E061C 1000	[Beam3] X signal path error	
E061C F000	[ID] Invalid board ID	
E061D 1000	[Beam0] Y signal path error	
E061D F000	[ID] Invalid board ID	
E061E 1000	[Beam1] Y signal path error	
E061E F000	[ID] Invalid board ID	
E061F 1000	[Beam2] Y signal path error	
E061F F000	[ID] Invalid board ID	
E0620 1000	[Beam3] Y signal path error	
E0620 F000	[ID] Invalid board ID	
E0621 1000	[Beam0] X signal path error	
E0621 F000	[ID] Invalid board ID	
E0622 1000	[Beam1] X signal path error	
E0622 F000	[ID] Invalid board ID	
E0623 1000	[Beam2] X signal path error	
E0623 F000	[ID] Invalid board ID	
E0624 1000	[Beam3] X signal path error	
E0624 F000	[ID] Invalid board ID	
E0625 1000	[Beam0] Y signal path error	
E0625 F000	[ID] Invalid board ID	
E0626 1000	[Beam1] Y signal path error	
E0626 F000	[ID] Invalid board ID	

Error Code	Description	Additional Information
E0627 1000	[Beam2] Y signal path error	
E0627 F000	[ID] Invalid board ID	
E0628 1000	[Beam3] Y signal path error	
E0628 F000	[ID] Invalid board ID	
E0629 1000	[Beam0] ADC sample error	
E0629 F000	[ID] Invalid board ID	
E062A 1000	[Beam1] ADC sample error	
E062A F000	[ID] Invalid board ID	
E062B 1000	[Beam2] ADC sample error	
E062B F000	[ID] Invalid board ID	
E062C 1000	[Beam3] ADC sample error	
E062C F000	[ID] Invalid board ID	
E062D 1000	[BeamX] X signal path error	
E062D F000	[ID] Invalid board ID	
E062E 1000	[BeamX] Y signal path error	
E062E F000	[ID] Invalid board ID	
E0701 1000	[Fend0] Control signal error	Also check PREG
E0701 2000	[Fend0] Control signal error	Also check PREG/Distr
E0701 3000	[Fend0] Control signal error	Also check PREG
E0701 4000	[Fend0] Control signal error	Also check PREG
E0701 5000	[Fend0] Control signal error	Also check PREG
E0701 6000	[Fend0] Control signal error	Also check PREG
E0701 7000	[Fend0] Control signal error	Also check PREG
E0701 8000	[Fend0] Control signal error	Also check PREG

Error Code	Description	Additional Information
E0702 1000	[Fend1] Control signal error	Also check PREG
E0702 2000	[Fend1] Control signal error	Also check PREG
E0702 3000	[Fend1] Control signal error	Also check PREG/Distr
E0702 4000	[Fend1] Control signal error	Also check PREG
E0702 5000	[Fend1] Control signal error	Also check PREG
E0702 6000	[Fend1] Control signal error	Also check PREG
E0702 7000	[Fend1] Control signal error	Also check PREG
E0702 8000	[Fend1] Control signal error	Also check PREG
E0703 1000	[Fend2] Control signal error	Also check PREG
E0703 2000	[Fend2] Control signal error	Also check PREG
E0703 3000	[Fend2] Control signal error	Also check PREG/Distr
E0703 4000	[Fend2] Control signal error	Also check PREG
E0703 5000	[Fend2] Control signal error	Also check PREG
E0703 6000	[Fend2] Control signal error	Also check PREG
E0703 7000	[Fend2] Control signal error	Also check PREG
E0703 8000	[Fend2] Control signal error	Also check PREG
E0704 1000	[Fend3] Control signal error	Also check PREG
E0704 2000	[Fend3] Control signal error	Also check PREG
E0704 3000	[Fend3] Control signal error	Also check PREG/Distr
E0704 4000	[Fend3] Control signal error	Also check PREG
E0704 5000	[Fend3] Control signal error	Also check PREG
E0704 6000	[Fend3] Control signal error	Also check PREG
E0704 7000	[Fend3] Control signal error	Also check PREG
E0704 8000	[Fend3] Control signal error	Also check PREG

Error Code	Description	Additional Information
E0705 1000	[PREG] Xmit supply error	Also check Fend0
E0705 2000	[PREG] Xmit enable error	Also check Fend0/Distr
E0705 3000	[Fend0] Xmit test circuit error	Also check CLK
E0705 4000	[Fend0] Xmit enable error	
E0705 5000	[Fend0] Pulse parameter error	Also check Distr/A.MB
E0705 6000	[Fend0] Pulse parameter error	Also check Distr/A.MB
E0705 7000	[Fend0] Pulse parameter error	Also check Distr/A.MB
E0705 8000	[Fend0] Pulse parameter error	Also check Distr/A.MB
E0705 9000	[Fend0] Pulse parameter error	Also check Distr/A.MB
E0705 A000	[Fend0] Pulse parameter error	Also check Distr/A.MB
E0705 B000	[Fend0] Pulse parameter error	Also check Distr/A.MB
E0705 C000	[Fend0] Pulse parameter error	Also check Distr/A.MB
E0705 D000	[Fend0] Pulse parameter error	Also check Distr/A.MB
E0705 E000	[Fend0] Pulse parameter error	Also check Distr/A.MB
E0705 F000	[Fend0] Pulse parameter error	Also check Distr/A.MB
E0706 1000	[PREG] Xmit supply error	Also check Fend1
E0706 2000	[PREG] Xmit enable error	Also check Fend1/Distr
E0706 3000	[Fend1] Xmit test circuit error	Also check CLK
E0706 4000	[Fend1] Xmit noise error	
E0706 5000	[Fend1] Pulse parameter error	Also check Distr/A.MB
E0706 6000	[Fend1] Pulse parameter error	Also check Distr/A.MB
E0706 7000	[Fend1] Pulse parameter error	Also check Distr/A.MB
E0706 8000	[Fend1] Pulse parameter error	Also check Distr/A.MB
E0706 9000	[Fend1] Pulse parameter error	Also check Distr/A.MB

Error Code	Description	Additional Information
E0706 A000	[Fend1] Pulse parameter error	Also check Distr/A.MB
E0706 B000	[Fend1] Pulse parameter error	Also check Distr/A.MB
E0706 C000	[Fend1] Pulse parameter error	Also check Distr/A.MB
E0706 D000	[Fend1] Pulse parameter error	Also check Distr/A.MB
E0706 E000	[Fend1] Pulse parameter error	Also check Distr/A.MB
E0706 F000	[Fend1] Pulse parameter error	Also check Distr/A.MB
E0707 1000	[PREG] Xmit supply error	Also check Fend2
E0707 2000	[PREG] Xmit enable error	Also check Fend2 /Distr
E0707 3000	[Fend2] Xmit test circuit error	Also check CLK
E0707 4000	[Fend2] Xmit noise error	
E0707 5000	[Fend2] Pulse parameter error	Also check Distr/A.MB
E0707 6000	[Fend2] Pulse parameter error	Also check Distr/A.MB
E0707 7000	[Fend2] Pulse parameter error	Also check Distr/A.MB
E0707 8000	[Fend2] Pulse parameter error	Also check Distr/A.MB
E0707 9000	[Fend2] Pulse parameter error	Also check Distr/A.MB
E0707 A000	[Fend2] Pulse parameter error	Also check Distr/A.MB
E0707 B000	[Fend2] Pulse parameter error	Also check Distr/A.MB
E0707 C000	[Fend2] Pulse parameter error	Also check Distr/A.MB
E0707 D000	[Fend2] Pulse parameter error	Also check Distr/A.MB
E0707 E000	[Fend2] Pulse parameter error	Also check Distr/A.MB
E0707 F000	[Fend2] Pulse parameter error	Also check Distr/A.MB
E0708 1000	[PREG] Xmit supply error	Also check Fend3
E0708 2000	[PREG] Xmit enable error	Also check Fend3/ Distr
E0708 3000	[Fend3] Xmit test circuit error	Also check CLK

Error Code	Description	Additional Information
E0708 4000	[Fend3] Xmit error	
E0708 5000	[Fend3] Pulse parameter error	Also check Distr/A.MB
E0708 6000	[Fend3] Pulse parameter error	Also check Distr/A.MB
E0708 7000	[Fend3] Pulse parameter error	Also check Distr/A.MB
E0708 8000	[Fend3] Pulse parameter error	Also check Distr/A.MB
E0708 9000	[Fend3] Pulse parameter error	Also check Distr/A.MB
E0708 A000	[Fend3] Pulse parameter error	Also check Distr/A.MB
E0708 B000	[Fend3] Pulse parameter error	Also check Distr/A.MB
E0708 C000	[Fend3] Pulse parameter error	Also check Distr/A.MB
E0708 D000	[Fend3] Pulse parameter error	Also check Distr/A.MB
E0708 E000	[Fend3] Pulse parameter error	Also check Distr/A.MB
E0708 F000	[Fend3] Pulse parameter error	Also check Distr/A.MB
E0709 1000	[Fend0] Rcv 2D Filter error	Also check Beam0/CLK
E0709 F000	[ID] Invalid board ID	
E070A 1000	[Fend1] Rcv 2D Filter error	Also check Beam1/CLK
E070A F000	[ID] Invalid board ID	
E070B 1000	[Fend2] Rcv 2D Filter error	Also check Beam2/CLK
E070B F000	[ID] Invalid board ID	
E070C 1000	[Fend3] Rcv 2D Filter error	Also check Beam3/CLK
E070C F000	[ID] Invalid board ID	
E070D 1000	[Fend0] Rcv 2nd Harmonic error	Also check Beam0/CLK
E070D F000	[ID] Invalid board ID	
E070E 1000	[Fend1] Rcv 2nd Harmonic error	Also check Beam1/CLK
E070E F000	[ID] Invalid board ID	

Error Code	Description	Additional Information
E070F 1000	[Fend2] Rcv 2nd Harmonic error	Also check Beam2/CLK
E070F F000	[ID] Invalid board ID	
E0710 1000	[Fend3] Rcv 2nd Harmonic error	Also check Beam3/CLK
E0710 F000	[ID] Invalid board ID	
E0711 1000	[Fend0] Rcv Clipper error	Also check Beam0/CLK
E0711 F000	[ID] Invalid board ID	
E0712 1000	[Fend1]Rcv Clipper error	Also check Beam1/CLK
E0712 F000	[ID] Invalid board ID	
E0713 1000	[Fend2] Rcv Clipper error	Also check Beam2/CLK
E0713 F000	[ID] Invalid board ID	
E0714 1000	[Fend3] Rcv Clipper error	Also check Beam3/CLK
E0714 F000	[ID] Invalid board ID	
E0715 1000	[Fend0] Rcv CW error	Also check CLK
E0715 2000	[Fend0] Rcv CW error	
E0715 3000	[Fend0] Rcv CW error	
E0715 4000	[Fend0] Rcv CW error	
E0715 5000	[Fend0] Rcv CW error	
E0715 6000	[Fend0] Rcv CW error	
E0715 7000	[Fend0] Rcv CW error	
E0715 8000	[Fend0] Rcv CW error	
E0715 9000	[Fend0] Rcv CW error	
E0715 A000	[Fend0] Rcv CW error	
E0715 B000	[Fend0] Rcv CW error	
E0715 C000	[Fend0] Rcv CW error	

Error Code	Description	Additional Information
E0715 D000	[Fend0] Rcv CW error	
E0715 E000	[Fend0] Rcv CW error	
E0715 F000	[Fend0] Rcv CW error	
E0716 1000	[Fend1] Rcv CW error	Also check CLK
E0716 2000	[Fend1] Rcv CW error	
E0716 3000	[Fend1] Rcv CW error	
E0716 4000	[Fend1] Rcv CW error	
E0716 5000	[Fend1] Rcv CW error	
E0716 6000	[Fend1] Rcv CW error	
E0716 7000	[Fend1] Rcv CW error	
E0716 8000	[Fend1] Rcv CW error	
E0716 9000	[Fend1] Rcv CW error	
E0716 A000	[Fend1] Rcv CW error	
E0716 B000	[Fend1] Rcv CW error	
E0716 C000	[Fend1] Rcv CW error	
E0716 D000	[Fend1] Rcv CW error	
E0716 E000	[Fend1] Rcv CW error	
E0716 F000	[Fend1] Rcv CW error	
E0717 1000	[Fend2] Rcv CW error	Also check CLK
E0717 2000	[Fend2] Rcv CW error	
E0717 3000	[Fend2] Rcv CW error	
E0717 4000	[Fend2] Rcv CW error	
E0717 5000	[Fend2] Rcv CW error	
E0717 6000	[Fend2] Rcv CW error	

Error Code	Description	Additional Information
E0717 7000	[Fend2] Rcv CW error	
E0717 8000	[Fend2] Rcv CW error	
E0717 9000	[Fend2] Rcv CW error	
E0717 A000	[Fend2] Rcv CW error	
E0717 B000	[Fend2] Rcv CW error	
E0717 C000	[Fend2] Rcv CW error	
E0717 D000	[Fend2] Rcv CW error	
E0717 E000	[Fend2] Rcv CW error	
E0717 F000	[Fend2] Rcv CW error	
E0718 1000	[Fend3] Rcv CW error	Also check CLK
E0718 2000	[Fend3] Rcv CW error	
E0718 3000	[Fend3] Rcv CW error	
E0718 4000	[Fend3] Rcv CW error	
E0718 5000	[Fend3] Rcv CW error	
E0718 6000	[Fend3] Rcv CW error	
E0718 7000	[Fend3] Rcv CW error	
E0718 8000	[Fend3] Rcv CW error	
E0718 9000	[Fend3] Rcv CW error	
E0718 A000	[Fend3] Rcv CW error	
E0718 B000	[Fend3] Rcv CW error	
E0718 C000	[Fend3] Rcv CW error	
E0718 D000	[Fend3] Rcv CW error	
E0718 E000	[Fend3] Rcv CW error	
E0718 F000	[Fend3] Rcv CW error	

Error Code	Description	Additional Information
E0719 1000	[Fend0] TGC error	Also check CLK
E0719 2000	[Fend0] TGC error	Also check CLK
E0719 3000	[Fend0] TGC error	Also check CLK
E0719 4000	[Fend0] TGC error	Also check CLK
E0719 5000	[Fend0] TGC error	Also check CLK
E0719 6000	[Fend0] TGC error	Also check CLK
E0719 7000	[Fend0] TGC error	Also check CLK
E0719 8000	[Fend0] TGC error	Also check CLK
E0719 9000	[Fend0] TGC error	Also check CLK
E0719 A000	[Fend0] TGC error	Also check CLK
E0719 B000	[Fend0] TGC error	Also check CLK
E0719 C000	[Fend0] TGC error	Also check CLK
E0719 D000	[Fend0] TGC error	Also check CLK
E0719 F000	[ID] Invalid board ID	
E071A 1000	[Fend1] TGC error	Also check CLK
E071A 2000	[Fend1] TGC error	Also check CLK
E071A 3000	[Fend1] TGC error	Also check CLK
E071A 4000	[Fend1] TGC error	Also check CLK
E071A 5000	[Fend1] TGC error	Also check CLK
E071A 6000	[Fend1] TGC error	Also check CLK
E071A 7000	[Fend1] TGC error	Also check CLK
E071A 8000	[Fend1] TGC error	Also check CLK
E071A 9000	[Fend1] TGC error	Also check CLK
E071A A000	[Fend1] TGC error	Also check CLK

Error Code	Description	Additional Information
E071A B000	[Fend1] TGC error	Also check CLK
E071A C000	[Fend1] TGC error	Also check CLK
E071A D000	[Fend1] TGC error	Also check CLK
E071A 1000	[ID] Invalid board ID	
E071B 1000	[Fend2] TGC error	Also check CLK
E071B 2000	[Fend2] TGC error	Also check CLK
E071B 3000	[Fend2] TGC error	Also check CLK
E071B 4000	[Fend2] TGC error	Also check CLK
E071B 5000	[Fend2] TGC error	Also check CLK
E071B 6000	[Fend2] TGC error	Also check CLK
E071B 7000	[Fend2] TGC error	Also check CLK
E071B 8000	[Fend2] TGC error	Also check CLK
E071B 9000	[Fend2] TGC error	Also check CLK
E071B A000	[Fend2] TGC error	Also check CLK
E071B B000	[Fend2] TGC error	Also check CLK
E071B C000	[Fend2] TGC error	Also check CLK
E071B D000	[Fend2] TGC error	Also check CLK
E071B F000	[ID] Invalid board ID	
E071C 1000	[Fend3] TGC error	Also check CLK
E071C 2000	[Fend3] TGC error	Also check CLK
E071C 3000	[Fend3] TGC error	Also check CLK
E071C 4000	[Fend3] TGC error	Also check CLK
E071C 5000	[Fend3] TGC error	Also check CLK
E071C 6000	[Fend3] TGC error	Also check CLK

Error Code	Description	Additional Information
E071C 7000	[Fend3] TGC error	Also check CLK
E071C 8000	[Fend3] TGC error	Also check CLK
E071C 9000	[Fend3] TGC error	Also check CLK
E071C A000	[Fend3] TGC error	Also check CLK
E071C B000	[Fend3] TGC error	Also check CLK
E071C C000	[Fend3] TGC error	Also check CLK
E071C D000	[Fend3] TGC error	Also check CLK
E071C F000	[ID] Invalid board ID	
E071D	Do Not Execute - Factory test only	
E0801 1000	[Distr] Communication error	Also check BIO
E0801 2000	[Distr] Communication error	
E0801 3000	[Distr] Communication error	
E0802 1000	[PREG] PReg test error	
E0802 2000	[Distr] Probe VPP error	Also check P.S./PREG
E0802 3000	[Distr] Probe VPP error	Also check P.S./PREG
E0802 4000	[Distr] Probe VPP error	Also check P.S./PREG
E0802 5000	[Distr] Probe VNN error	Also check P.S./PREG
E0802 6000	[Distr] Probe VNN error	Also check P.S./PREG
E0802 7000	[Distr] Probe VNN error	Also check P.S./PREG
E0802 8000	[Distr] Probe VDD error	Also check P.S./PREG
E0802 9000	[Distr] Probe VDD error	Also check P.S./PREG
E0802 A000	[Distr] Probe VDD error	Also check P.S./PREG
E0802 B000	[Distr] Probe VCC error	Also check P.S./PREG
E0802 C000	[Distr] EPROM power error	Also check P.S./PREG

Error Code	Description	Additional Information
E0803 1000	[PREG] Power Regulator test error	
E0803 2000	[Distr] HV isolation error	Also check FE./PREG
E0803 3000	[Distr] HV isolation error	Also check FE./PREG
E0803 4000	[Distr] HV isolation error	Also check FE./PREG
E0803 5000	[Distr] HV isolation error	Also check FE./PREG
E0804 1000	[Distr] EPROM error	
E0804 2000	[Distr] EPROM error	
E0804 3000	[Distr] EPROM error	
E0805 1000	[Distr] xducer sense error	
E0805 2000	[Distr] xducer sense error	
E0805 3000	[Distr] xducer sense error	
E0806 1000	[Distr] Interrupt request error	
E0806 2000	[Distr] Interrupt request error	
E0806 3000	[Distr] Interrupt request error	
E0806 4000	[Distr] Interrupt request error	
E0807 1000	[Distr] Shutoff sense error	
E0807 2000	[Distr] Shutoff sense error	
E0807 3000	[Distr] Shutoff sense error	
E0808 1000	[PREG] HV supply error	
E0808 2000	[Distr] Pulser enable error	Also check Fend /PREG
E0808 3000	[BIO] Scanner Start error	
E0808 4000	[PREG] Power Regulator test error	
E0808 5000	[BIO] Scanner stop error	
E0808 6000	[Distr] Xmit channel error	Also check Fend0

Error Code	Description	Additional Information
E0808 7000	[Distr] Xmit channel error	Also check Fend0
E0808 8000	[Distr] Xmit channel error	Also check Fend0
E0809 1000	[PREG] HV supply error	
E0809 2000	[Distr] Pulser enable error	Also check Fend /PREG
E0809 3000	[BIO] Scanner start error	
E0809 4000	[PREG] Power regulator test error	
E0809 5000	[BIO] Scanner stop error	
E0809 6000	[Distr] Xmit channel error	Also check Fend1
E0809 7000	[Distr] Xmit channel error	Also check Fend1
E0909 8000	[Distr] Xmit channel error	Also check Fend1
E080A 1000	[PREG] HV supply error	
E080A 2000	[Distr] Pulser enable error	Also check Fend/PREG
E080A 3000	[BIO] Scanner start error	
E080A 4000	[PREG] Power Regulator test error	
E080A 5000	[BIO] Scanner stop error	
E080A 6000	[Distr] Xmit channel error	Also check Fend2
E080A 7000	[Distr] Xmit channel error	Also check Fend2
E080A 8000	[Distr] Xmit channel error	Also check Fend2
E080B 1000	[PREG] HV supply error	
E080B 2000	[Distr] Pulser enable error	Also check Fend/PREG
E080B 3000	[BIO] Scanner start error	
E080B 4000	[PREG] Power Regulator test error	
E080B 5000	[BIO] Scanner stop error	
E080B 6000	[Distr] Xmit channel error	Also check Fend3

Error Code	Description	Additional Information
E080B 7000	[Distr] Xmit channel error	Also check Fend3
E080B 8000	[Distr] Xmit channel error	Also check Fend3
E080C 1000	[Distr] PV MUX data error	Connector 1
E080C 2000	[Distr] PV MUX data error	Connector 1
E080C 3000	[Distr] PV MUX data error	Connector 1
E080D 1000	[Distr] PV MUX data error	Connector 2
E080D 2000	[Distr] PV MUX data error	Connector 2
E080D 3000	[Distr] PV MUX data error	Connector 2
E080E 1000	[Distr] PV MUX data error	Connector 3
E080E 2000	[Distr] PV MUX data error	Connector 3
E080E 3000	[Distr] PV MUX data error	Connector 3

Scanner Error Codes

5 Keyscanner Codes

Board Abbreviations

Actual Name	Abbreviation
KP	Keyscanner/Audio
RTP	Right Touch Panel
LTP	Left Touch Panel
PHY	Physio

Resident Test

Error Code	Failure Data	Additional Information
K0101	[KP:K1] Test A/D reference.	
K0101 0000	[KP] A/D high reference failure.	
K0101 0001	[KP] A/D low reference failure.	
K0102	[KP:K1] Video RAM failure.	
K0102 0001	[KP] video RAM failure.	
K0103 0000	[KP:K1] right display & driver failure.	
K0103 0001	[KP] right display & driver failure.	
K0103 0002	[KP] right display & driver failure.	
K0103 1000	[KP:K1] left display & driver failure.	
K0103 1001	[KP] left display & driver failure.	
K0103 1002	[KP] left display & driver failure.	
K0104	[KP:K1] Reset flag failure.	
K0104 0000	[KP] reset flag failure.	
K0104 0001	[KP] reset flag failure.	

Error Code	Failure Data	Additional Information
K0105 0000	[RTP:K8] right touch panel failure.	Also try KP:K1
K0105 0001	[RTP] right touch panel failure.	Also try KP
K0105 0002	[RTP] right touch panel failure.	Also try KP
K0105 0003	[RTP] right touch panel failure.	Also try KP
K0105 0004	[RTP] right touch panel failure.	Also try KP
K0105 0005	[RTP] right touch panel failure.	Also try KP
K0105 0006	[RTP] right touch panel failure.	Also try KP
K0105 0007	[RTP] right touch panel failure.	Also try KP
K0105 0008	[RTP] right touch panel failure.	Also try KP
K0105 0009	[RTP] right touch panel failure.	Also try KP
K0105 000A	[RTP] right touch panel failure.	Also try KP
K0105 000B	[RTP] right touch panel failure.	Also try KP
K0105 000C	[RTP] right touch panel failure.	Also try KP
K0105 000D	[RTP] right touch panel failure.	Also try KP
K0105 1000	[LTP:K8] left touch panel failure.	Also try KP:K1
K0105 1001	[LTP] left touch panel failure.	Also try KP
K0105 1002	[LTP] left touch panel failure.	Also try KP
K0105 1003	[LTP] left touch panel failure.	Also try KP
K0105 1004	[LTP] left touch panel failure.	Also try KP
K0105 1005	[LTP] left touch panel failure.	Also try KP
K0105 1006	[LTP] left touch panel failure.	Also try KP
K0105 1007	[LTP] left touch panel failure.	Also try KP
K0105 1008	[LTP] left touch panel failure.	Also try KP
K0105 1009	[LTP] left touch panel failure.	Also try KP

Error Code	Failure Data	Additional Information
K0105 100A	[LTP] left touch panel failure.	Also try KP
K0105 100B	[LTP] left touch panel failure.	Also try KP
K0105 100C	[LTP] left touch panel failure.	Also try KP
K0105 100D	[LTP] left touch panel failure.	Also try KP
K0106	[KP:K1] Duart #1 readback reg.	
K0106 0002	[KP] readback register failure.	Duart # 1 failed.
K0107	[KP:K1] Duart #2 readback reg.	
K0107 0001	[KP] readback register failure.	Duart # 2 failed.
K0107 0002	[KP] readback register failure.	Duart # 2 failed.
K0108	[KP:K1] Duart #3 readback reg.	
K0108 0001	[KP] readback register failure.	Duart # 3 failed.
K0108 0002	[KP] readback register failure.	Duart # 3 failed.
K0109	[KP:K1] vcr frame counter failure.	
K0109 0001	[KP] vcr frame counter failure.	
K0109 0002	[KP] vcr frame counter failure.	
K0109 0004	[KP] vcr frame counter decrement failure.	
K010A 0000	[KP:K1] color D/A error.	
K010A 0001	[KP] color D/A signal error.	
K010A 1000	[KP:K1] Hue D/A error.	
K010A 1001	[KP] Hue D/A signal error.	
K010A 2000	[KP:K1] right EL panel brightness D/A.	
K010A 2001	[KP] right EL panel brightness failure.	
K010A 3000	[KP:K1] left EL panel brightness D/A.	
K010A 3001	[KP] left EL panel brightness failure.	

Error Code	Failure Data	Additional Information
K010B 0001	[KP] audio gain failure.	
K010B 0002	[KP] audio gain failure.	
K010B 0004	[KP] audio gain failure.	
K010B 0008	[KP] audio gain failure.	
K010B 0010	[KP] audio offset failure.	
K010B 0020	[KP] audio offset failure.	
K010B 0040	[KP] audio offset failure.	
K010B 0080	[KP] audio offset failure.	
K010C 0001	[KP] switch matrix failure.	
K010C 0002	[KP] switch matrix failure.	
K010C 0004	[KP] switch matrix failure.	
K0201	[PH:K2] data bus failure.	
K0201 0000	[PH] data bus failure.	
K0201 0001	[PH] data bus failure.	
K0202 0000	[PH:K2] ECG circuitry.	
K0202 0001	[PH] ecg positive offset failure.	
K0202 0002	[PH] ecg negative offset failure.	
K0202 0003	[PH] ecg zero signal level failure.	
K0202 0004	[PH] ecg positive gain failure.	
K0202 0005	[PH] ecg negative gain failure.	
K0202 1000	[PH:K2] ECG R-wave circuitry	
K0202 1001	[PH] ecg r-wave high level failure.	
K0202 1002	[PH] ecg r-wave reset zero level failure.	
K0203	[PH:K2] Respiration circuitry.	

Error Code	Failure Data	Additional Information
K0203 0000	[PH] respiration zero offset failure.	
K0203 0001	[PH] respiration positive offset failure.	
K0203 0002	[PH] respiration negative offset failure.	
K0203 0003	[PH] respiration zero signal level failure.	
K0203 0004	[PH] respiration positive gain failure.	
K0203 0005	[PH] respiration negative gain failure.	
K0204	[PH:K2] Pulse circuitry.	
K0204 0000	[PH] pulse zero offset failure.	
K0204 0001	[PH] pulse positive offset failure.	
K0204 0002	[PH] pulse negative offset failure.	
K0205	[PH:K2] Heartsound circuitry.	
K0205 0000	[PH] heartsound zero offset failure.	
K0205 0001	[PH] heartsound positive offset failure.	
K0205 0002	[PH] heartsound negative offset failure.	
K0205 0003	[PH] heartsound zero signal level failure.	

6 Preventive Maintenance

Introduction

The maintenance recommendations described in this chapter are designed to minimize the possibility of unexpected system failure. Preventive Maintenance (PM) procedures call for thorough system cleaning. This is particularly true of the OEM peripheral equipment, because the peripherals contain electromechanical components which, if exposed to constant or excessive environmental dust and humidity, may degrade in performance and reliability.

System Preventive Maintenance

Basic PM procedures for the main system consist of:

- Periodically and consistently cleaning the two air filters beneath the front of the cart.
- Maintaining an accurate record of electrical safety checks
- Performing visual checks for liquid spills and other signs of potential problems

When a Philips or Philips-qualified service provider performs Preventive Maintenance, the M2424A System Test and Inspection Matrix must be used.

Peripherals Preventive Maintenance

Basic PM procedures for system compatible OEM peripherals are offered in this manual mostly as a reminder. More complete procedures for each peripheral are available in the *Peripherals Service Manual* (77030-90700) and individual OEM peripheral service manuals.

Safety Tests

Safety tests the and recommended frequency of tests are described in detail within this chapter.

NOTE

For more details on transducers, see the SONOS 4500/5500 *Reference Guide:* “Transducer Reference”

Recommended Frequency of Maintenance Procedures

The frequency of preventive maintenance performed on the system plays a key role on extending or eliminating downtime due to poor performance or unexpected breakdown. The table below offers recommendations that must be weighed by factors like frequency of use and environmental conditions. In every case, a frequent check of the safety related items is highly recommended.

Table 6-1 Maintenance Tasks

Frequency Interval	Test/Clean
Before each use—Steering, Visual test	TEE Probes
Three months or sooner—Clean or replace	Air Filters—All
Six months—Check for cracks and bent pins	Transducers
Six months—Ground Impedance/Leakage test	Safety
Six months—Clean Video Heads/ Tape path	VCR
Six months (or sooner)—Clean printhead, rollers, and sensor	Video Printers
Six months—Check for good air flow without excessive noise	Fans
Six months—Follow recommendations in this chapter	Preventive Maintenance
As necessary—Clean cart. Wheels have sealed bearings; no lubrication is required.	Cart

Total Quality Preventive Maintenance

Table 6-2 Preventive Maintenance Checklist

Done	N/A	Activities
		Determined any existing problems or issues with system.
		Inserted initialized disk in DSR.
		Checked error log, cleared log, ran Extended Test, logged errors.
		Inspected system controls, power cord and cables for cracks, cuts, wear.
		Inspected probes for bent pins, cracks, cuts, swelling, worn latches, or other physical damage.
		Performed system electrical safety checks (see "Electrical Safety Test Procedures" on page 6-10).
		Performed transducer electrical safety checks (see "Electrical Safety Test Procedures" on page 6-10 and Table 6-3, page 6-4).
		Cleaned transducers with water dampened cloth. TEEs, intraoperative, and endocavity transducers should already have been cleaned and disinfected by hospital clinical staff.
		Cleaned hardcopy devices (see *Peripherals Service Manual,* P/N 77030-90700).
		Cleaned VCR (see "Cleaning the VCR" on page 6-6).
		Verified performance of imaging and non-imaging transducers.
		Verified/replaced battery (see "Checking the Battery" on page 6-7).
		Cleaned all external surfaces.
		Replaced/cleaned all filters.
		Checked system fans for noise, vibration, air flow.
		Checked power supply fan for noise, vibration, air flow.
		Cleaned CRT and verified CRT performance (see "Checking CRT Performance" on page 6-7).
		Cleaned and inspected keyboard, trackball, and imager box.
		Performed keyboard/control test (see Chapter 4 "Resident Self Test" control panel test).
		Executed final Extended Test (Chapter 4 "Resident Self Test").

Table 6-2 Preventive Maintenance Checklist *(Continued)*

Done	N/A	Activities
		Verified complete system operation (see "Verifying Complete System Operation" on page 6-8).

Table 6-3 TEE Transducer Performance and Safety Check

Yes/Passed	No/Failed	Checklist
		Visual inspection of probe for perforations, sheath swelling & twisting, acoustic lens cuts or chips, loose or missing control handle screws.
		Transducer Control: tip deflection (up, down), reflection (left, right).
		Excessive freeplay: adjustment necessary?
		Electrical leakage current: Less than 80% of chassis leakage.
		Cable shielding check (noise produced while in CW Doppler mode).
		Verify proper storage of TEE transducer.
		Review customer training/education.
		Use of proper disinfecting agents.

Transducer Maintenance

All transducers are exposed to many potentially damaging situations during use and cleaning. Periodically check them for the following signs of damage:

- Cracks on the handle
- Cracks on the nose piece
- Cuts or gouges on the lens material
- Swelling of the lens material
- Cracks or other signs of damage to the connector
- Bent or damaged pins

- Integrity and flexibility of the cable

NOTE

Transducers with cracks in the handle should be replaced. Although no lethal voltages are present during normal use, it is possible for a tingle to be felt by the operator that could result in a nervous reaction and potential injury. Cracks will also interfere with standard cleaning procedures.

System Maintenance

NOTE

It is imperative that service and maintenance procedures be preceded by adequate Electrical Static Discharge (ESD) safeguards.

Follow ESD guidelines to avoid the possibility of inadvertent deterioration or destruction of sensitive electronic components. General guidelines include:

- Avoid working in carpeted areas.
- If a vacuum cleaner is used to clean the interior of any part of the system sensitive to static electricity, take the necessary ESD precautions to avoid static buildup and discharge.
- Use wrist-grounding strap, properly grounded.
- Use a grounding mat for assembly work on sensitive areas.

The keyboard panels and other surfaces may be affected by accidental liquid spills and other materials including excessive amounts of gel. The protective membrane beneath the keyboard keys offers protection against these accidental occurrences, but spilled materials may seep into electrical components beneath the panel and cause intermittent failures. During maintenance, look for such potential problems, loose knobs, and worn TGC/LGC controls.

Keep the following of good practice points in mind:

- Turn OFF the system when not in use.
- Do not remove or install boards or cables with system power on.
- When system is on but not in use, leave the Gain control in the minimal position.

Power Supply

All power for the cart's electronics is provided by the power supply box located at the rear of the cart. An important required maintenance is to insure good air flow to the power supply by:

- Making sure power supply LEDs are working.
- Examining the power supply connectors and cables for tight bends and insulation damage.

NOTE

It is most important to assure that terminal strip screws for all power connections (isolation transformer strips) are tight. Factory specification for these critical screws is a torque setting of 10 inch/Lbs. To insure that this setting is correct, a torque screwdriver is required.

Cleaning the Trackball

1. Remove the 3 allen screws holding the rings around the trackball.
2. Remove the metal and plastic rings, noting their positions.
3. Clean the plastic ring with water.
4. Clean the trackball with an alcohol-dampened pad while spinning the ball.
5. If the trackball is loose, invert white plastic ring from its original position.
6. Reinstall both rings.
7. Replace and tighten the 3 screws.

Cleaning the VCR

1. Verify that the VCR lamps are lit.
2. Clean video heads:
   a. Remove the VCR’s top cover, exposing the tape transport mechanism and video heads assembly.
   b. Dampen the head cleaning stick with video head cleaning solution.
   c. Gently position head cleaning stick against entire upper cylinder, while slowly rotating counterclockwise. Do not rub vertically. Do not apply excessive pressure to remove contaminants, but continue to rotate gently, allowing time to dissolve the contaminants.
3. Clean the video tape path using the same cleaning solution and tool as in step 2. Clean the entire tape path so that contaminants will not be transported to the video heads.

4 Before reinstalling the VCR cover, ensure all connectors are properly seated.

5 Verify the position of the front and rear switches. For details, see Chapter 3, "Service Data."

Cleaning and Inspecting System Modules

1 Remove the keyboard panels and wash them under a faucet.

2 Inspect the exposed membrane and then clean it with a lint-free cloth, dampened with soapy water.

3 **Thoroughly dry the keyboard panels before reinstalling!**

4 Reinstall the keyboard panels.

5 Inspect the interior for dust and vacuum as necessary. **Use proper ESD precautions** for the vacuum itself and when removing PCBs for vacuuming.

CAUTION

Because the PC boards are two-sided (surface mount components on both sides of the board), special caution must be taken when removing boards from the system. Be sure the board lies flat on an ESD protected surface. All service and maintenance procedures must be preceded by adequate ESD safeguards. Follow ESD guidelines to avoid the possibility of inadvertent deterioration or destruction of sensitive electronic components.

Checking the Battery

1 Back up the presets to a floppy disk or to the Keyprocessor using the procedures described in Chapter 3, "Service Data".

2 Access the imager box and test the voltage between test points VBB+ and VBB- on the Processor Graphics board with the system powered down.

3 Replace the battery if the voltage is less than 3.0V.

Checking CRT Performance

Ask the customer whether there are any problems with CRT performance, and if not, clean the CRT face with a water dampened cloth.

If the customer has had CRT performance problems, follow the procedures described in Chapter 3, "Service Data".

Verifying Complete System Operation

1 2-D

a. Enter Imaging modality.
b. Vary Compress, Gain, and all TGCs while observing result on display.

2 M-Mode

a. Enter M-Mode modality.
b. Position TGCs at 75%, Compress and Gain at maximum.
c. Check format on screen and vary depth setting.
d. Observe response to settings in M-Mode grey scale.

3 Color

a. Enter Color modality.
b. Position color Gain to maximum.
c. Put gel on transducer.
d. Place your finger on the gel and move your finger up and down.
e. Verify mosaic color of flow alternating between forward and reverse flow.

4 Color Angio

a. Enter Angio modality.
b. Position color Gain to maximum.
c. Set Persistence to 1.
d. Put gel on transducer.
e. Place your finger on the gel and move your finger up and down, varying the velocity.
f. Observe different color hues corresponding to the “flow amplitude” of your finger’s velocity.

5 PW Doppler Mode

a. Enter PW Doppler modality.
b. Select spectral modality.
c. Put gel on transducer.
d. Place your finger on the gel and move your finger up and down.
e. Verify signal on spectrum, alternating between forward and reverse flow.
f. Change wall filters and verify change in audio.

6 CW Doppler Mode

a. Enter CW Doppler modality.
b. Put gel on the transducer.

c. Place your finger on the gel and move your finger up and down.
d. Verify the signal on the spectrum is alternating between forward and reverse flow.
e. Change the wall filters and verify the change in audio.

7 CLR Operation

a. Enter M-Mode modality.
b. Press Freeze.
c. Use the trackball to scroll backward and forward.
d. Select Loop on the Right Touch Panel.
e. Select REDUCED format.
f. Acquire four loops.
g. Display four quadrants.

8 Physio Operation

- Obtain an ECG waveform to check size and position controls.

9 Hardcopy Operation

- Obtain a Color and/or Black & White print.

10 VCR Operation

a. Record a B/W and a Color signal.
b. Record voice by activating the microphone.
c. Play back and check for solid performance.

11 Network Interface (DNI or IDI) Operation

a. Store a frame and loop to the network interface.
b. Retrieve and verify that what was stored is the same as what was retrieved.
c. If a network is available, store the frame to the network and verify that the stored image was obtained on the other end of the network (EnConcert or DICOM server).

12 Floppy Operation

a. Enter system Setup.
b. Select Service Floppy on the right touch panel.
c. Insert a floppy disk.
d. Backup and restore Presets.

Electrical Safety Test Procedures

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator.

The safety tests consist of:

- Chassis to Ground Resistance and Ground Wire Leakage Current tests—for the ultrasound system as a whole.
- ECG Leads Leakage Current Source and Sink tests—for ECG leads connected to the ultrasound system.
- Transducer Leakage Current Source and Sink, tests—for transducers connected to the ultrasound system.

All tests can be performed using commercially available safety analyzer test equipment. Basic measurements may be performed with widely available multifunction instruments like the HP 3469A multimeter or equivalent.

NOTE

These procedures assume the use of a Dynatech Nevada, Inc. (DNI) 232D or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe such as Rigel, Metron, or Gerb may require modifications to the procedure. Follow the instructions of the analyzer manufacturer.

The consistent use of a safety analyzer as a routine step in closing a repair or upgrade is emphasized as a mandatory step if an approved agency status is to be maintained. The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

The limits referenced in these tests are those prescribed by UL, CSA, and IEC. Additional tests may be required according to local regulations.

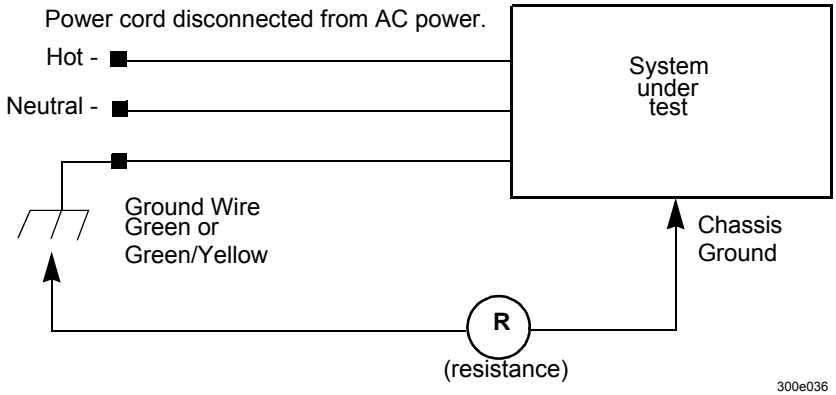
Chassis to Ground Resistance

Figure 6-1 shows the basic electrical concept of the Ground Resistance test. Use a safety analyzer to perform the following procedure.

WARNING

Some users may routinely perform a safety earth or ground bonding test at currents in excess of 10 amps. Please note that exposed metal on the transducer assembly, including the connector are for RFI and not safety grounds. Test currents in excess of 1 amp will likely fail the impedance limit specification and may also damage the RFI protection finger contacts.

Figure 6-1 Chassis to Ground Resistance Test Diagram



LIMIT: UL, CSA & IEC: **R** = 200 MilliOhms maximum

Chassis to Ground Resistance Test Procedure

1. Inspect the power cord to ensure it is free of cracks and wear.
2. Set the analyzer mode to **Power Cord Resistance**, and set the **TEST RECEPTACLE POLARITY** switch to the center position (**OFF**).
3. Plug the analyzer into an AC wall outlet. Plug the ultrasound system power plug into the test receptacle on the analyzer.
4. Connect Kelvin Cable dual banana plugs to **+External Meter** and **+Current Source** (red) jacks on the back of the analyzer and clamp the other end to the Ground lug on the ultrasound system near the power cord input. The *Current Source* LED lights up.
5. Read the chassis ground resistance in mΩ. Flex the ultrasound power cord during the test to detect intermittent changes in the resistance value.

6 Record the highest resistance value measured in step 5. Check that the highest resistance value is within the limit specified in Figure 6-1.

CAUTION If the resistance value exceeds the specified limit, check the power cord and associated primary wiring.

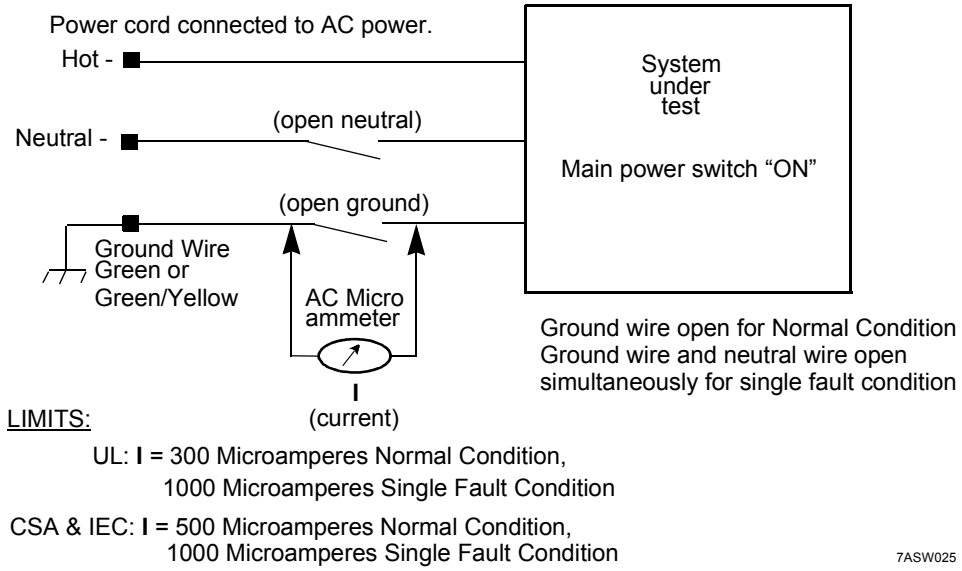
A comprehensive Ground Impedance measurement may be performed using the safety analyzer. The impedance test drives a load current through the ground wire while measuring the AC voltage drop across the entire length of the power cord and to the system chassis. The reading will be directly in mΩ.

Ground Wire Leakage Current

Figure 6-2 shows the electrical concept of the Ground Wire Leakage Current test. Use a safety analyzer to perform the following the procedure.

CAUTION If the safety analyzer is used for an extended length of time, it could be damaged by the high current draw of the system.

Figure 6-2 Ground Wire Leakage Current Test Diagram



Ground Wire Leakage Current Test Procedure

1 Set the analyzer mode to **CASE LEAKAGE, GROUND CONDUCTOR**.

2 Plug the analyzer into an AC wall outlet. Plug the ultrasound system power plug into the Test Receptacle on the analyzer. Turn the ultrasound system's power switch **ON**.

3 Take ground wire leakage current measurements:

   a. Set the **POLARITY** switch to **NORMAL**, and press the **OPEN GROUND** button, and then read the ground wire leakage current in microamperes.

   b. Move the **POLARITY** switch to **REVERSE**, press the **OPEN GROUND** button again, and then read the current.

      Record the highest value. Check that the highest value is within the limit specified for Normal Condition in Figure 6-2.

   c. Set the **POLARITY** switch to **NORMAL**, press and hold the **OPEN GROUND** button. While holding, press the **OPEN NEUTRAL** button and read the ground wire leakage current in microamperes.

   d. Move the **POLARITY** switch to **REVERSE**, press and hold the **OPEN GROUND** button and while holding press the **OPEN NEUTRAL** button again and read the current.

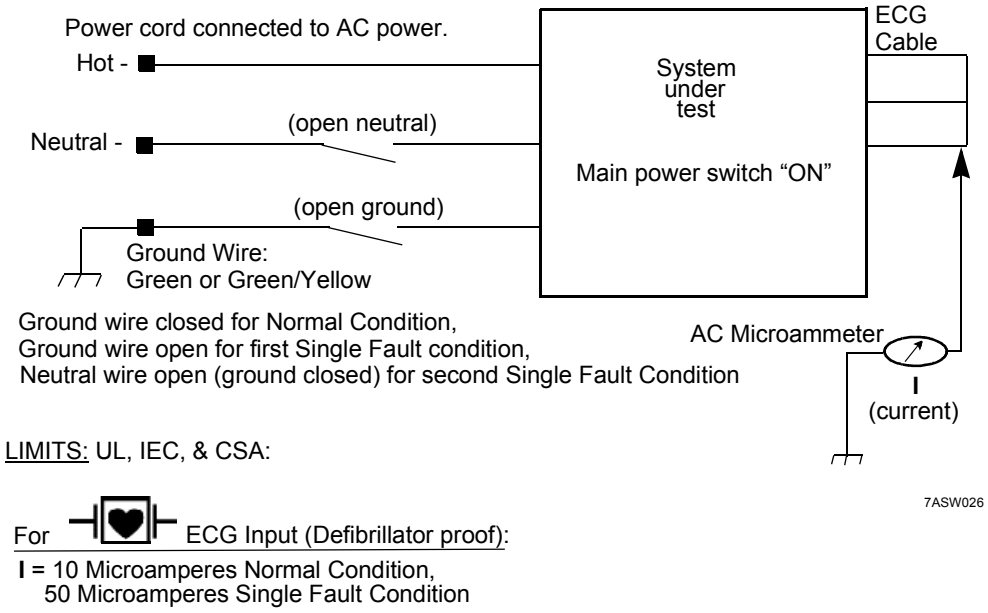
      Record the highest value. Check that the highest value is within the limit specified for Single Fault Condition in Figure 6-2.

A reading higher than acceptable limits may indicate a problem with the power cord, its associated connections, or with the power transformer.

ECG Lead Leakage Current (Source)

Figure 6-3 shows the electrical concept of the ECG Lead Leakage Current test. Use a safety analyzer to perform the following procedure.

Figure 6-3 ECG Lead Leakage Current Test Diagram



ECG Lead Leakage Current Test Procedure

1. Set the analyzer mode to **ECG**, and set the **LEADS** selector to **ALL**.
2. Plug the analyzer into an AC wall outlet. Plug the ultrasound system power plug into the **TEST RECEPTACLE** on the analyzer. Turn the ultrasound system's power switch **ON**. Connect all ECG leads to the ultrasound system and to the **LEADS** jacks on the analyzer.
3. Take ECG lead leakage current measurements:
   a. Set the **POLARITY** switch to the **NORMAL** position. Read lead leakage current in microamperes.
   b. Move the **POLARITY** switch to **REVERSE** and read current again. Record the highest value. Check that the highest value is within the limit specified for Normal Condition in Figure 6-3.

c. Set the **POLARITY** switch to the **NORMAL** position. Press the **OPEN GROUND** button and read the lead leakage current in microamperes.

d. Move the **POLARITY** switch to **REVERSE**, press the **OPEN GROUND** button again, and then read the current. Write down the highest value. This is the value for the first single fault condition.

e. Set the **POLARITY** switch to the **NORMAL** position. Press the **OPEN NEUTRAL** button and read the lead leakage current in microamperes.

f. Move the **POLARITY** switch to **REVERSE**, press the **OPEN NEUTRAL** button again, and then read the current. Write down the highest value. This is the value for the second single fault condition.

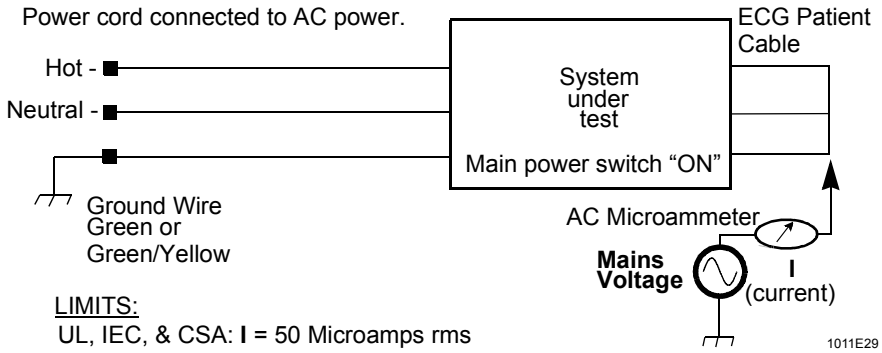
g. Record the highest current value measured in step 3d and step 3f. Check that the highest value is within the limit specified for Single Fault Condition in Figure 6-3.

Failure to meet the specified limits may point to a fault with the isolation of the ECG amplifier's front end.

ECG Lead Isolation Leakage Current Test (Sink-with Mains Voltage Applied)

Figure 6-4 shows the electrical concept of the ECG Lead Isolation Leakage Current test. Use a safety analyzer to perform the following procedure.

Figure 6-4 ECG Lead Isolation Leakage Current Test Diagram



WARNING

This test is hazardous. It applies line voltage to the ECG leads. Avoid accidental contact with the line voltage. Do not touch the chassis or ECG cable while performing the test. Additionally, place the ECG cable at least 20 cm from any grounded or conductive surfaces.

NOTE

During the isolation test, select only **NORMAL POLARITY**.
DO NOT press **OPEN GROUND** or **OPEN NEUTRAL**.

ECG Lead Isolation Leakage Current Test Procedure

1. Set the analyzer mode to **ECG**.
2. Plug the analyzer into an available AC wall outlet. Plug the ultrasound system power plug into the **TEST RECEPTACLE** on the analyzer. Turn the ultrasound system's power switch **ON**. Connect ECG leads to the ultrasound system, but DO NOT connect the ECG leads to the analyzer at this time.
3. Set the **LEADS** selector to **ISOLATION TEST**.
4. Set the **POLARITY** switch to the **NORMAL** position. Press the red **ISO TEST** button to take a reading in microamperes. This is a correction factor to be subtracted from the final reading.
5. Connect all ECG leads to the **LEADS** jacks on the analyzer and press the red **ISO TEST** button again to take a reading in microamperes. Subtract the correction factor measured in step 4 to get an accurate isolation leakage measurement and record this value. Check that the value is within the limit specified in Figure 6-4.

Transducer Tests

This section contains leakage current test procedures for transducers. Following these procedures, the Setup and Theory section provides supporting information for the transducer tests. This is supplemental information, and is not required to complete the tests.

Every transducer has a symbol indicating its type. This symbol, usually located on the transducer connector or cable, is referenced in the safety tests with different test limits for each.

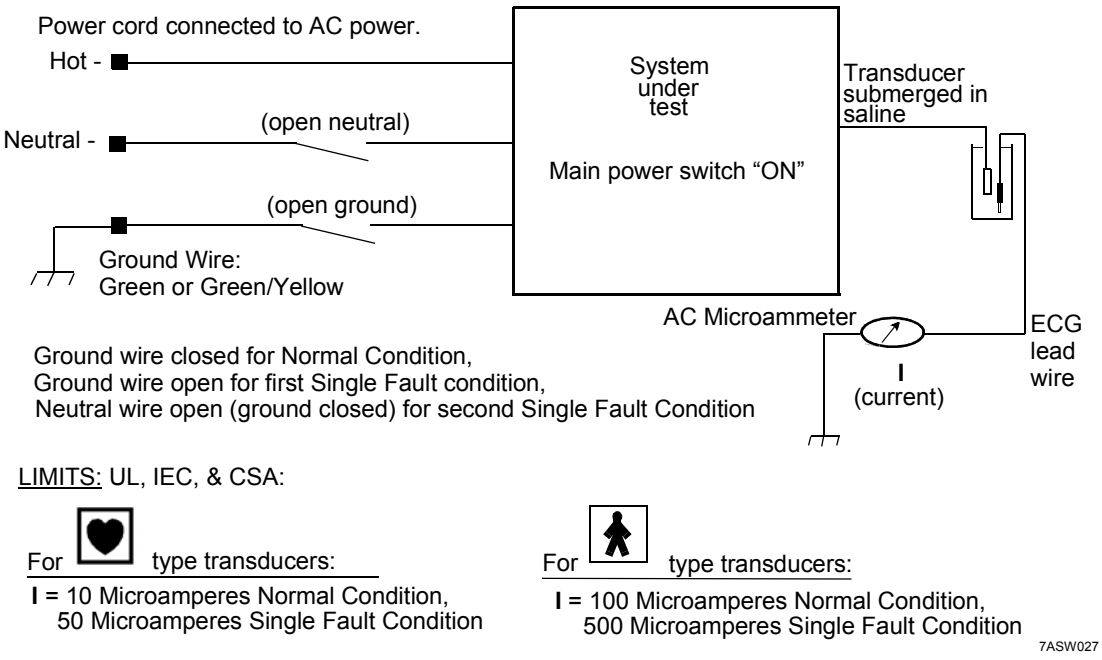
Before proceeding with any transducer test, perform a thorough visual inspection of the transducer. If the transducer is a TEE, check that its deflection (steering) controls are working properly.

In order to insure patient safety, it is very important to verify the integrity of the insulating layers of all transducers. This is accomplished by immersing the transducer and cable into saline solution. The saline will find its way into any cracks in the plastic outer sheath, providing an electrical path for fault detection.

Transducer Leakage Current Test (Source)

Figure 6-5 shows the electrical concept of the Transducer Leakage Current test. Use a safety analyzer to perform the following procedure. For supporting information, see "Transducer Safety Testing: Test Setup and Theory" on page 6-22.

Figure 6-5 Transducer Leakage Current Test Diagram



Transducer Leakage Current Test Procedure

1 Set the analyzer mode to **ECG** and set the **LEADS** selector to **RL**.

2 Plug the analyzer into an AC wall outlet. Plug the ultrasound system power plug into the **TEST RECEPTACLE** on the analyzer. Turn the ultrasound system's power switch **ON**. Plug the transducer to be tested into the ultrasound system. Connect an ECG lead wire to the **RL LEAD** jack on the analyzer.

3 Prepare a test container filled with enough saline to completely cover the appropriate parts of the transducer. Insert the exposed end of the ECG lead into the saline, then carefully insert the transducer:

- For Transthoracic and Endocavity transducers, submerge the head and 5 cm of the cable. Do not submerge the connector.
- For TEE transducers, submerge all of the flexible shaft that would normally enter the patient: 100 cm for Adult TEE, 60 cm for Pediatric TEE.

CAUTION

When submerging a TEE probe, be careful to not submerge or allow saline to contact its control handle. Liquid inside the control handle causes corrosion and failure.

4 Take the transducer leakage current measurements:

a. Set the **POLARITY** switch to the **NORMAL** position. Read the leakage current in microamperes.
b. Move the **POLARITY** switch to **REVERSE** and read the current again.
c. Record the highest value. Check that the highest value is within the limit specified for Normal Condition. Match the transducer type symbol on the transducer connector or cable with the symbol in Figure 6-5.
d. Set the **POLARITY** switch to the **NORMAL** position. Press the **OPEN GROUND** button and read the leakage current in microamperes.
e. Move the **POLARITY** switch to **REVERSE**, press the **OPEN GROUND** button again, and then read the current.
f. Write down the highest value. This is the value for the first single fault condition.
g. Set the **POLARITY** switch to the **NORMAL** position. Press the **OPEN NEUTRAL** button and read the leakage current in microamperes.
h. Move the **POLARITY** switch to **REVERSE**, press the **OPEN NEUTRAL** button again, and then read the current.
i. Write down the highest value. This is the value for the second single fault condition.
j. Record the highest current value measured in steps step 4c and step 4i. Check that the highest value is within the limit specified for Single Fault Condition in Figure 6-5.

Failure to meet the specified limits may point to a fault in the transducer housing or cabling sheath. If this is the case, identify the precise location of the fault by repeating the measurement while slowly inserting the transducer into the saline. When the aberrant reading appears, the fault in the cable has just entered the saline.

5 For TEE and Endocavity transducers only:

The TEE and Endocavity transducers have a grounded cabling jacket just beneath the outer plastic skin of the cable. They can have leakage currents within the specified limits yet still have a break or fault in the outer plastic skin. Comparing the transducer leakage to the chassis leakage of the ultrasound system gives an indication of such a fault.

Compare transducer leakage to ground wire leakage:

a. Set the mode to **CASE LEAKAGE, GROUND CONDUCTOR**, and set the **POLARITY** switch to the **NORMAL** position.

b. Press the **OPEN GROUND** button and read ground wire leakage in microamperes.

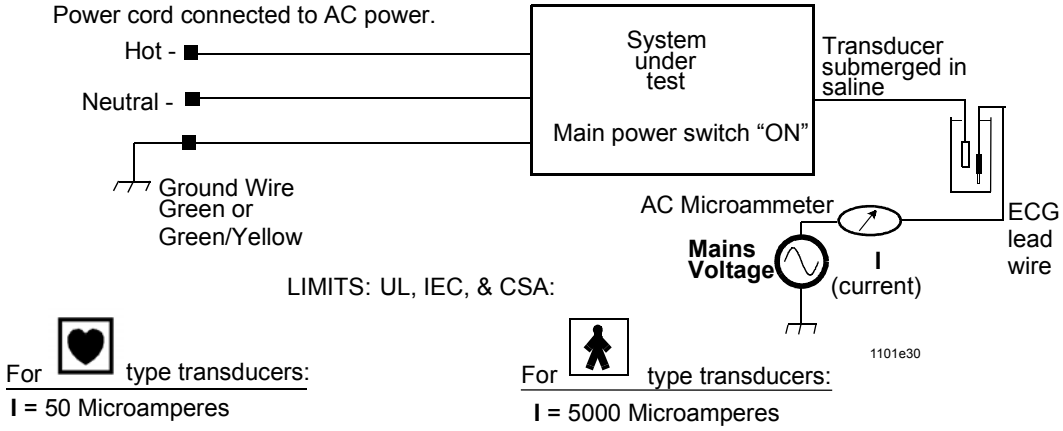
c. Compare this value to the highest value for transducer leakage current, Single Fault Condition obtained in step 4. If the transducer leakage is greater than 80% of the chassis leakage, the test has failed and there is a fault in the transducer.

   To identify the fault, repeat the measurement while slowly inserting the transducer into the saline. When the aberrant reading appears, the fault in the cable has just entered the saline.

Transducer Isolation Leakage Current Test (Sink-with Mains Voltage Applied)

Figure 6-6 shows the electrical concept of the Transducer Isolation Leakage Current test. Use a safety analyzer to perform the following procedure.

Figure 6-6 Transducer Isolation Leakage Current Test Diagram



WARNING

This test is hazardous. It applies line voltage to the ECG and transducer cables. Avoid accidental contact with the line voltage. Do not touch the chassis, ECG, or transducer cables while performing the test. Additionally, place the ECG and transducer cables at least 20 cm from any grounded or conductive surfaces.

NOTE

During the isolation test, select only **NORMAL POLARITY**. DO NOT press **OPEN GROUND** or **OPEN NEUTRAL**.

Transducer Isolation Leakage Current Test Procedure

1 Set the mode on the analyzer to **ECG**.

2 Plug the analyzer into an AC wall outlet. Plug the ultrasound system power plug into the **TEST RECEPTACLE** on the analyzer. Turn the ultrasound system's power switch **ON**. Plug the transducer to be tested into the ultrasound system.

3 Prepare a test container filled with enough saline to completely cover the appropriate parts of the transducer. Insert the exposed end of the ECG lead wire into the saline, and then carefully insert the transducer.

- For Transthoracic and Endocavity transducers, submerge the head and 5 cm of the cable, being careful to not submerge the connector.
- For TEE transducers, submerge all of the flexible shaft that would normally enter the patient: 100 cm for Adult TEE, 60 cm for Pediatric TEE.

NOTE

When submerging a TEE probe, be careful to not submerge or allow saline to contact its control handle. Liquid inside the control handle causes corrosion and failure.

4 Set the **LEADS** selector to **ISOLATION TEST**.

5 Take transducer isolation leakage current measurements:

a. Set the **POLARITY** switch to the **NORMAL** position. Press the red **ISO TEST** button; read leakage current in microamperes. This is a correction factor to be subtracted from the final reading.

b. Connect the ECG lead to the **RL** jack on the analyzer and press the red **ISO TEST** button again and read the current. Subtract the correction factor measured in step 5a to get an accurate transducer isolation leakage measurement. Record this value. Check that the value is within the limit specified in Figure 6-6.

Transducer Safety Testing: Test Setup and Theory

This section provides background and supporting information for the transducer leakage tests. This information helps understanding of concepts, but is not required to perform the tests.

Test Setup

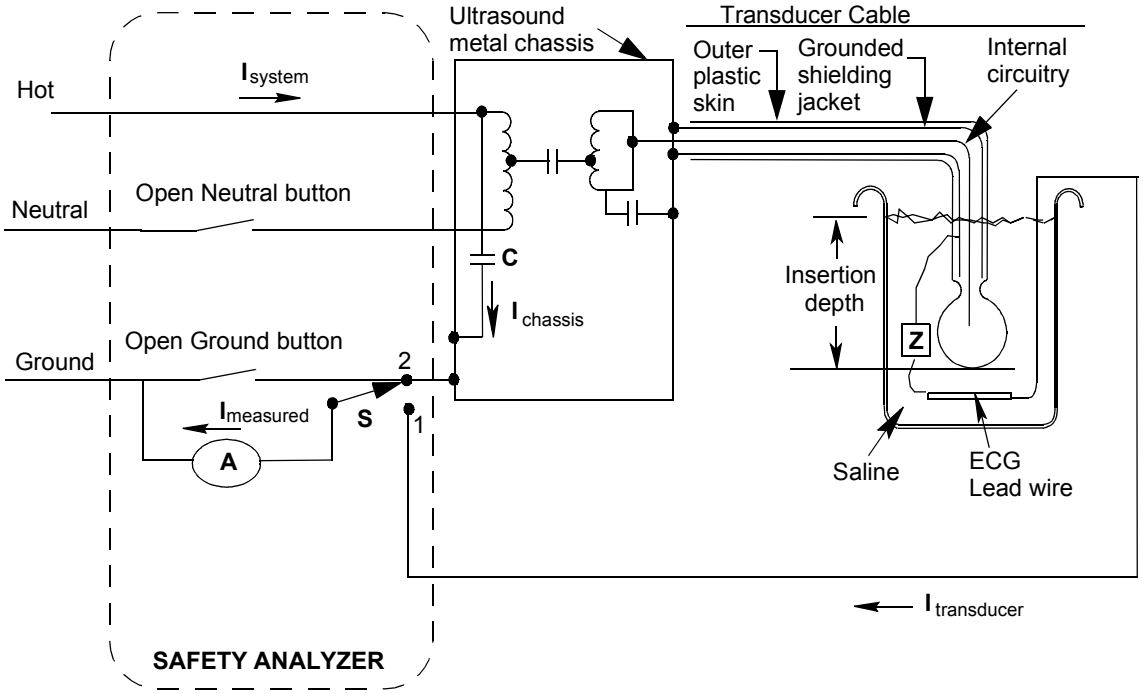
Tools required:

- Safety analyzer
- Saline holder
- ECG lead wire
- Saline solution. If saline is not available, mix 27 grams of table salt in 3 liters of tap water.

When performing the safety tests, a container filled with saline solution is required as a conductive medium (see Figure 6-7 on page 6-23). The solution will penetrate any cracks or holes in the transducer insulation and provide an electrical path between the submerged lead wire and the inner transducer shield (grounded via the system connector).

The test for Transthoracic and Endocavity transducers differs from the test for TEE transducers only in the extent that they are submerged in the test solution.

Figure 6-7 Transducer Leakage Current Test Setup and Theory Diagram



Open Neutral button:
closed for normal condition
closed for 1st single fault condition
open for 2nd single fault condition

Open Ground button:
closed for normal condition
open for 1st single fault condition
closed for 2nd single fault condition

Switch **S** (mode selector on safety analyzer):
Position 1 (ECG) for transducer leakage test
Position 2 (Case Leakage, Ground Conductor) for ground wire leakage test

7ASW030-1

Key:

A = Microammeter inside safety analyzer

$I_{measured}$ = Leakage Current

S = Switch connecting the ammeter directly to the chassis or through the ECG lead wire. (This is the mode selector on the safety analyzer: **ECG** for transducer leakage, **CASE LEAKAGE, GROUND CONDUCTOR** for chassis leakage.)

C= Stray capacitance from the system's power wiring to chassis.

Z = Impedance between the transducer's metal parts and the test electrode:
= ~850 KOhm if sheath is intact
= ~500 Ohm if sheath is compromised

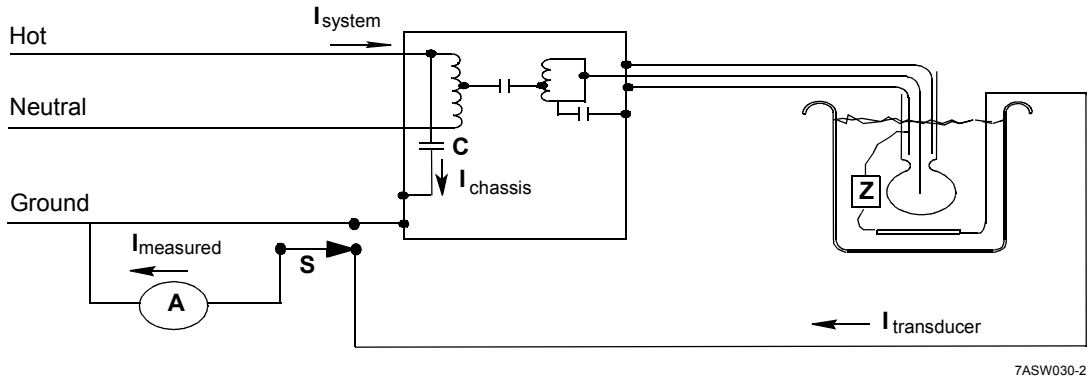
Insertion depth:

- For Transthoracic and Endocavity transducers, submerge the head and 5 cm of the cable, being careful to not submerge the connector.
- For TEE transducers, submerge all of the flexible shaft that would normally enter the patient: 100 cm for Adult TEE, 60 cm for Pediatric TEE.

Theory of the Transducer Leakage Current Test

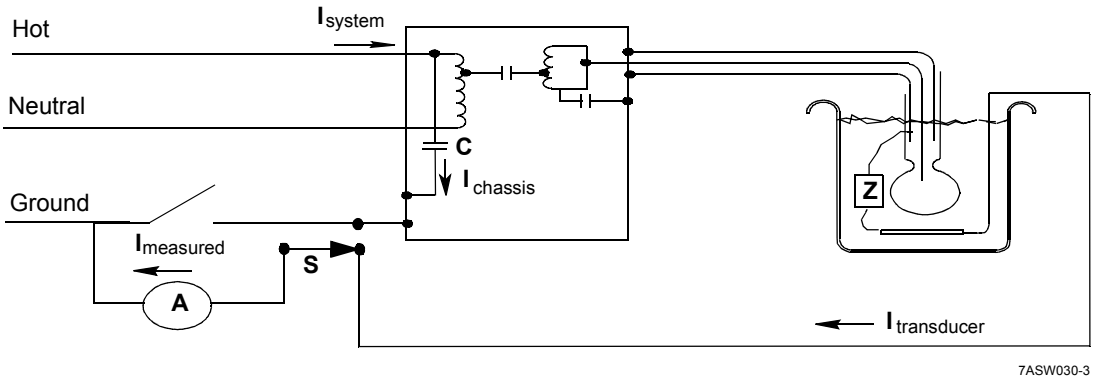
Leakage current $\mathbf{I}_{chassis}$, driven by the line supply, flows through the stray capacitance **C** between the primary wiring and the system's metal chassis.

Figure 6-8 Transducer Leakage Current Test Diagram for Normal Condition



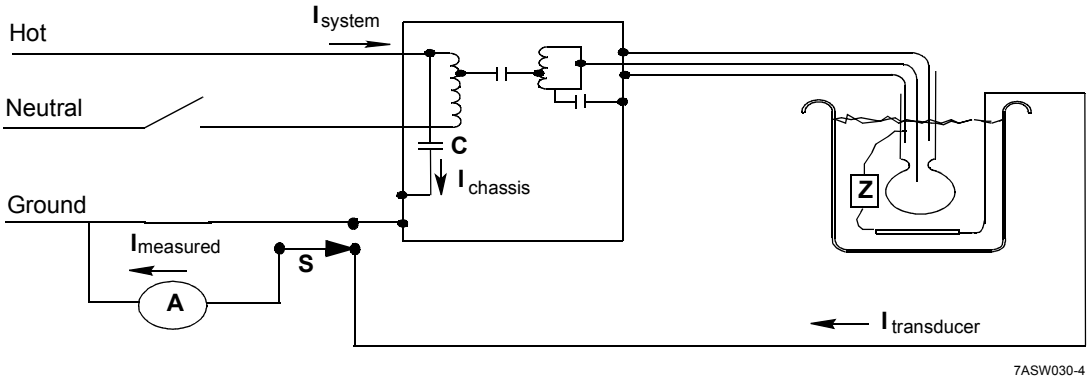
Ordinarily, the leakage current then flows from the chassis safely out through the ground wire. If there is a fault or break in the transducer insulation, some of the current will flow through this path and be measured by the analyzer. This $\mathbf{I}_{transducer}$ will still be fairly low unless the chassis is not properly grounded.

Figure 6-9 Transducer Leakage Current Test Diagram for 1st Single Fault Condition



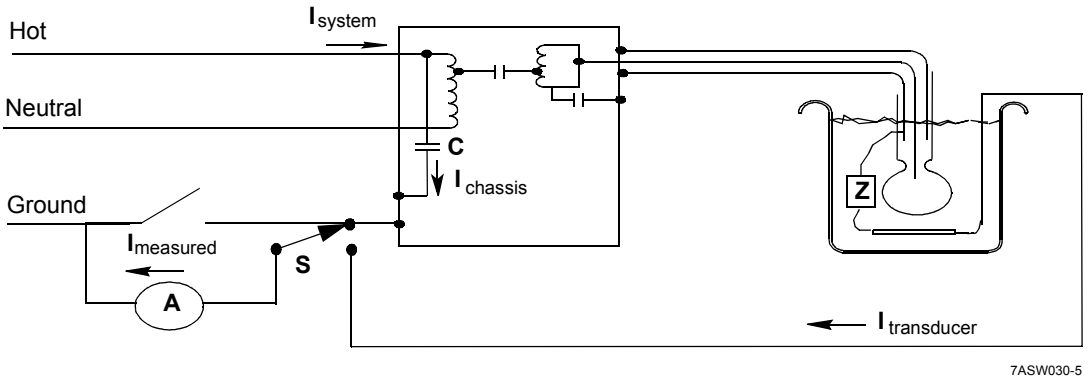
When the **OPEN GROUND** button is pressed, all $I_{chassis}$ is forced through the transducer. This $I_{transducer}$ will still be fairly low unless its sheath is compromised.

Figure 6-10 Transducer Leakage Current Test Diagram for 2nd Single Fault Condition



Pressing the **OPEN NEUTRAL** button prevents all system current from flowing. This creates a higher potential for leakage current $I_{chassis}$. Most will flow safely through the ground wire and some will flow through the transducer. This $I_{transducer}$ will still be fairly low unless the chassis is not properly grounded.

Figure 6-11 Ground Wire Leakage Test Diagram (for comparison with 1st Single Fault Condition)



With the transducer circuit disconnected, all of the leakage current $I_{chassis}$ flows through the analyzer by way of the ground wire. In the transducer leakage test, 1st single fault condition (Figure 6-9), all the leakage current $I_{chassis}$ flows through the analyzer by way of the transducer. The only difference is the resistance or impedance of the respective paths. If the transducer sheath is intact, its resistance is high and therefore $I_{measured}$ in the transducer leakage test is low when compared with $I_{measured}$ in the ground wire leakage test. If the transducer sheath is compromised, its resistance will be close to that of the ground wire. Transducer leakage current equaling 80% or more of ground wire leakage current indicates a fault or break in the transducer insulation. Sheath integrity is tested in this way because there could be a break in the transducer sheath causing significant $I_{transducer}$, yet that leakage current could still be within acceptable limits. Comparison to the ground wire leakage current is the only way to ensure sheath integrity.

7 Wiring and Cabling

System Cabling

This chapter provides reference information for M2424A system cabling. Information is supplied for cables that interconnect externally between system I/O panels and for cables that interconnect internally between system PC boards.

Information provided in this chapter is *not duplicated* in Chapter 8, “Parts Lists and Exploded Views.”

Internal E-Box Cables

SCSI Ribbon Cable, P/N 77110-64110, from the Processor Graphics Board to the DSR-SCSI Board, is the only cable internal to the E-Box. At Rev. C.0, SCSI cable, P/N 77110-64101, goes from the Processor Graphics board to the TurboCine board.

E-Box Rear I/O Cabling

Table 7-1 provides a “from-to” list of external cables that interconnect from the rear of the E-Box to other M2424A subsystems and peripherals. Some of the listed cables interface to the E-Box Rear I/O panel; the remaining cables interface to System I/O panel connectors. All of the listed E-Box cables are referenced in Figure 7-1 on page 7-4.

Keyscanner Cabling

Table 7-2 provides a “from-to” list of internal cables that interconnect from several PCBs in the Keyprocessor Electronics section of the system. All of the listed cables are referenced in Figure 7-2.

System Rear I/O Cabling

External cables that interconnect from the system rear I/O panel to other devices are not provided and should be purchased locally.

Table 7-1 E-Box Rear I/O Cabling (See Figure 7-1)

Cable Ref #	Cable Name	Cable Part #	Cable Connections	
			From	To
W1	VCR Video Cable	77922-64080	Rear I/O Panel, SVHS OUT	Internal VCR, SVHS OUT
W2	VCR Video Cable	77922-64080	Rear I/O Panel, SVHS IN	Internal VCR, SVHA IN
W3	Keyprocessor Power Cable	77922-64120	Rear I/O Panel, KP Power	Keyprocessor Main I/O PCB, J9
W4	Keyprocessor Serial Data Cable	77921-64060	Rear I/O Panel, KP Serial	Keyprocessor Main I/O PCB, RS232
W5	Physio	77921-64080	Rear I/O Panel, Physio	Keyprocessor Main I/O PCB, Physio
W6	Serial and Serial AUX	77960-64070	Rear I/O Panel, Serial AUX	System Rear I/O Panel, J1 and Main I/O of Keyprocessor
W7	E-Box Power	77101-60230	Rear I/O Panel E-Box Power	Power Supply (Cable comes with power supply.)
W8	B/W Printer Video Cable	8120-1840P	Rear I/O Panel COMP VIDEO	B/W Printer, VIDEO IN
W9	B/W Printer Trigger Cable 1250-0080 (BNC-BNC Adapter) 77530-64010 (Remote Ctrl. Cable)	8120-1840P	Rear I/O Panel TRIGGER 2	B/W Printer, REMOTE
W10	SCSI Cable	77922-64190	Rear I/O Panel SCSI	DSR & Floppy Drives
W11	LAN RJ45	77470-60030	Network Interface (DNI or IDI)	System Rear I/O Panel, LAN
W12	AQ WAVE AUX Cable	8120-1840P	Rear I/O Panel, AQ	System Rear I/O Panel, AQ

Table 7-1 E-Box Rear I/O Cabling (See Figure 7-1) *(Continued)*

Cable Ref #	Cable Name	Cable Part #	Cable Connections	
			From	To
W13	SVHS AUX Cable	77922-64020	Rear I/O Panel, SVHS AUX	System Rear I/O Panel, SVHS
W14	Printer AUX Cable	8120-1840P	Rear I/O Panel, Trigger AUX	System Rear I/O Panel, Print
W15	B/W AUX Video Cable	8120-1840P	Rear I/O Panel, B/W VIDEO AUX	System Rear I/O, B/W VIDEO
W16	RGB Monitor Cable	77922-64010	Rear I/O Panel, RGB MONITOR	System Monitor
W17	Color Printer, RS232 Cable (Optional)	77922-64180	Rear I/O Panel, RS232 PRINTER	Internal Color Printer
W18	RGB Internal to Color Printer	77922-64010	Rear I/O Panel, RGB INTERNAL	Internal Color Printer
W19	Stripchart Cable	77922-64010	Rear I/O Panel, Strip Chart	KOWA Strip Recorder
W20	Stripchart Run Ctrl Cable	77922-64060	Rear I/O Panel, STRIP RN CTRL	KOWA Strip Recorder RN CTRL
W21	SCSI	8120-5159CP	DSR/Floppy Drive Chassis	Network Interface (DNI or IDI)
W22	RGB AUX	77922-64000	Rear I/O Panel, RGB AUX	System I/O, RGB AUX
W23	Stripchart AUX (Optional)	77922-64090	Rear I/O Panel, Strip Chart	System I/O, Strip Chart
W24	VCR Control	77921-64040	VCR	Main I/O

Figure 7-1 E-Box Rear I/O Cabling

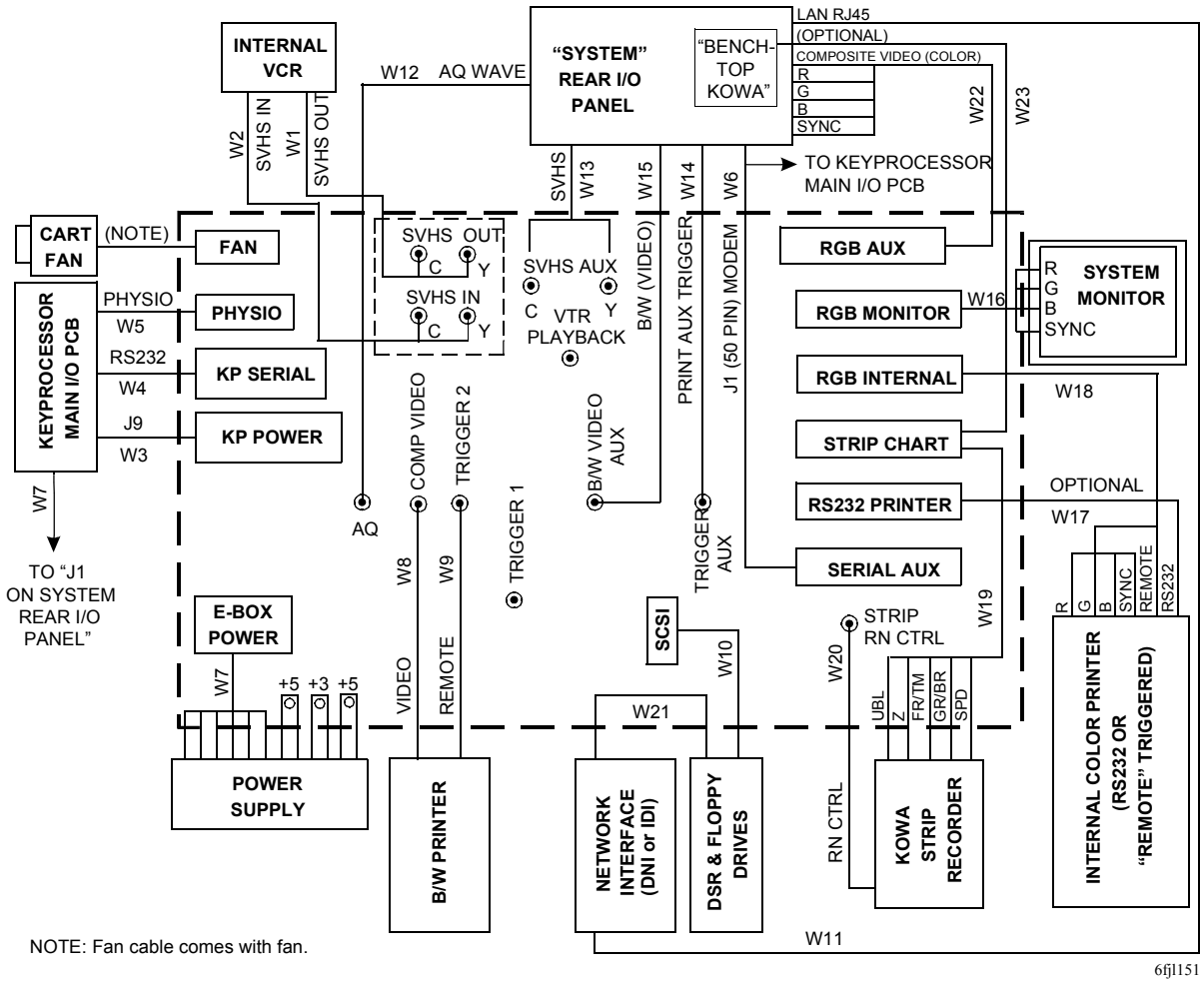


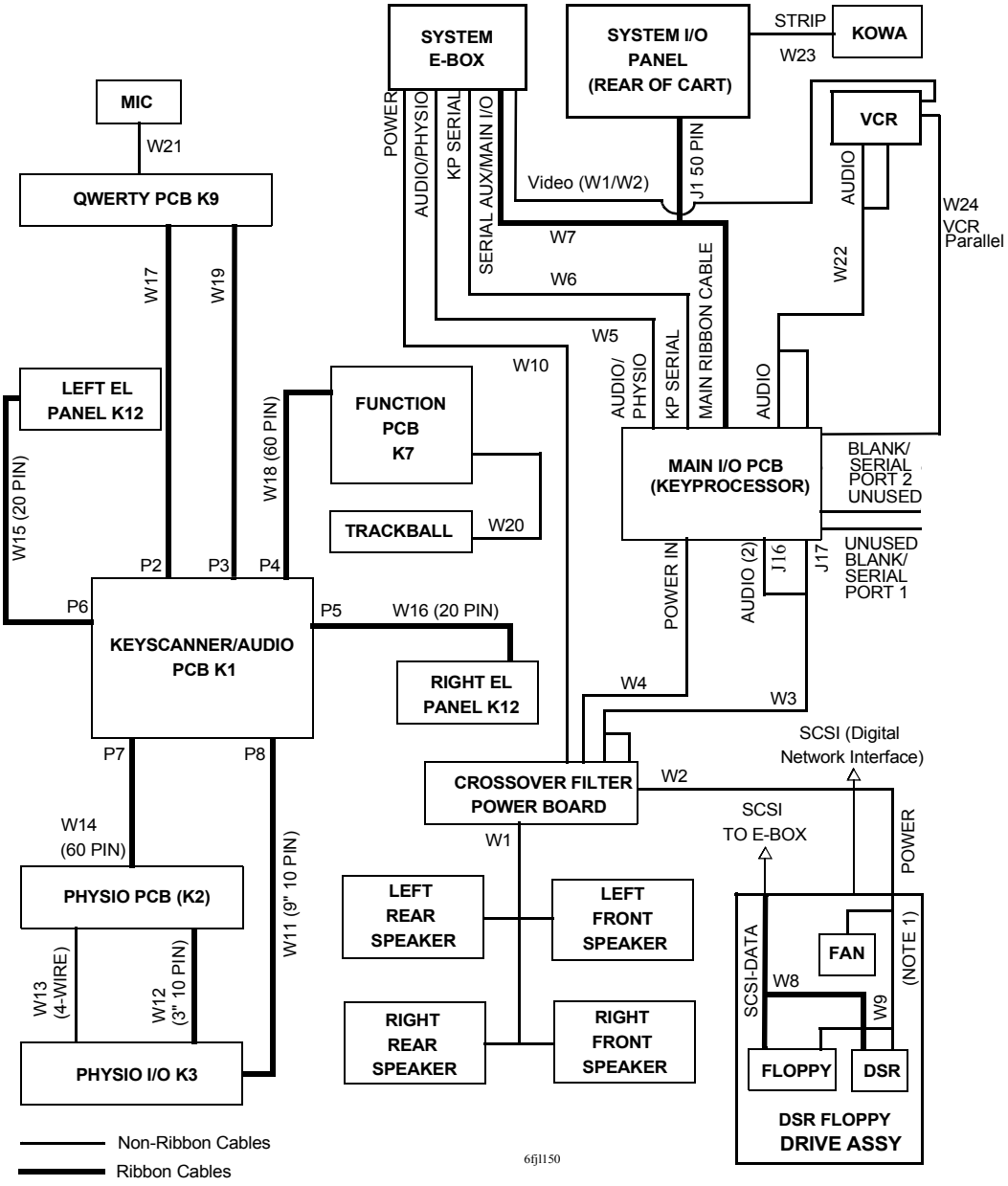
Table 7-2 Keyscanner Cabling (See Figure 7-2)

Cable Ref #	Cable Name	Cable Part #	Cable Connections	
			From	To
W1	Speaker Cable	77922-64070	Crossover Filter Power Board (K6)	Speakers, Left & Right, Front & Rear
W2	DSR Power External Cable	77922-64130	Crossover Filter Power Board (K6)	DSR /Floppy Drive Assy
W3	Main I/O Audio to Filter Board	77922-64100	Crossover Filter Board (K6)	Main I/O (K5) PCB (Keyprocessor), J16, J17
W4	Keyprocessor Power	77922-64110	Crossover Filter Board (K6)	Main I/O (K5) PCB (Keyprocessor), POWER IN
W5	Physio Cable	77921-64080	E-Box Rear I/O, AUDIO/PHYSIO	Main I/O (K5) PCB (Keyprocessor), AUDIO/PHYSIO
W6	KP Serial Cable	77921-64060	E-Box Rear I/O, KP SERIAL	Main I/O (K5) PCB (Keyprocessor), KP SERIAL
W7	System Split Cable Serial AUX	77960-64070	E-Box Rear I/O, SERIAL AUX	Main I/O (K5) PCB (Keyprocessor) and System I/O, J1
W8	DSR Ribbon Cable	77922-64040	Floppy and DSR Drives	DSR Floppy Drive Assy Rear Chassis Connector
W9	Fan Power Cable	77922-64050 (Cable is supplied **with** Fan Assy)	Fan	Chassis Connector, DSR, and Floppy Drives
W10	Keyprocessor Power Cable	77922-64120	System E-Box, POWER	Crossover Filter Board (K6)
W11	10-pin Physio, 9 inches	77921-64182	Physio I/O (K3) PCB	Keyscanner (K1) PCB, P8
W12	10-pin Physio, 3 inches	77921-64181	Physio I/O (K3) PCB Middle Connector	Physio (K2) PCB

Table 7-2 Keyscanner Cabling (See Figure 7-2) *(Continued)*

Cable Ref #	Cable Name	Cable Part #	Cable Connections	
			From	To
W13	Physio to I/O	77921-64190	Physio I/O (K3) PCB	Physio (K2) PCB
W14	60-pin Physio	77921-64300	Keyscanner (K1) PCB, P7	Physio (K2) PCB
W15	EL Ribbon	77921-64140	Keyscanner (K1) PCB, P6	Left Touch Screen (K11)
W16	EL Ribbon	77921-64140	Keyscanner (K1) PCB, P5	Right Touch Screen (K12)
W17	60-pin Keyscanner	77921-64310	Keyscanner (K1) PCB, P2	Qwerty (K9) PCB
W18	60-pin Keyscanner	77921-64310	Keyscanner (K1) PCB, P4	Function (K7) PCB
W19	Control Cable	77921-64150	Keyscanner (K1) PCB, P3	Qwerty (K9) PCB
W20	Trackball Control	77120-65660	Function	Trackball
W21	Mic Control	77921-64130	Qwerty	Mic
W22	VCR Audio	77000-60580	KP Main I/O	VCR Audio
W23	Strip Chart	77500-61130 Benchtop, optional	System I/O	Benchtop Strip Chart Recorder
W24	VCR Control	77921-64040	KP Main I/O	VCR

Figure 7-2 Keyscanner Cabling



Note 1: Fan, DSR, Floppy power cable is part of fan assembly.

Primary Cart Wiring

A double pole circuit breaker connects the line to the load via isolation transformer T1.

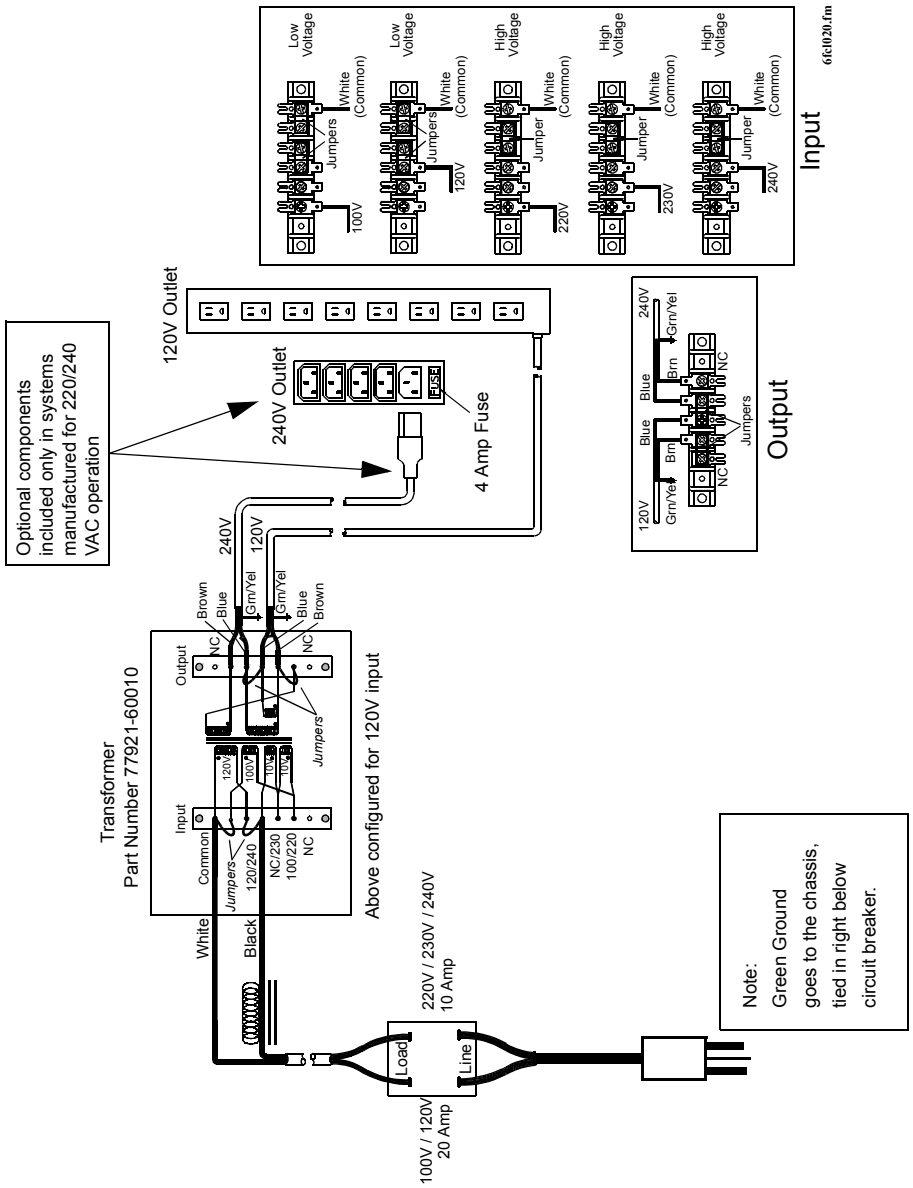
The input side of the isolation transformer may be wired to accept a number of different line voltages. Figure 7-3 shows jumper location and wiring data.

The secondary of the transformer is wired to always deliver 120 VAC and 240 VAC (optional) to the cart mounted outlets.

CAUTION

Assure that all terminal strip screws for power connections, including the transformer mounted terminal strips, are tight. A setting of 10 inch/Lbs is factory set and specified as the recommended torque. The use of a torque screwdriver is strongly recommended.

Figure 7-3 Primary Line Wiring Diagram



8 Parts Lists and Exploded Views

Introduction

This chapter lists available supplies, accessories, and replacement parts for the Model M2424A Ultrasound Imaging System. Where required for reference, exploded view diagrams that support many of the parts listings are included.

The content of this chapter is based on latest information available at the time of issue and is subject to change. Updated information may be issued periodically. The issue date at the front of this manual provides a reference point for the information provided.

Parts Ordering

Address all parts orders or inquiries to your local Philips Sales/Service Office. Always specify the correct part number or exchange number for the sub-assembly or component being ordered, as well as the serial and revision numbers of the system in which the assembly is being installed or replaced.

NOTE

Because some M2424A parts are shared parts used by Hewlett Packard Company, the letter “C” may be required after the existing part number. For example, you may need to order part number 92279T as part number 92279TC. Some parts are shared by Agilent Technologies and the letter “P” may be required after the existing part number.

- **New Parts**

  Be sure to specify the correct sub-assembly or component part number, as listed throughout this chapter.

- **Exchange Parts**

  Certain PC boards, transducers, and OEM peripherals are available as an exchange item (i.e. a repaired or refurbished item), providing significant cost savings. Exchange item part numbers are different than original equipment part numbers, as referenced in appropriate tables throughout this chapter.

- **System Serial Number and Revision Level**

  When ordering any new or exchange part, be sure to include the system serial number and revision prefix. These can be found on the system ID label, located inside the left rear corner post of the cart. The ID label also identifies installed system options.

Supplies & Accessories

Table 8-1 lists M2424A supplies and accessories that are available from the Philips Medical Supply Center. To order items from within the U.S.A., call Medical Supplies at 1-800-225-0230. From other countries, contact your local Philips representative or sales office.

Table 8-1 Supplies and Accessories/Medical Supply Center

Description	Part Number	Comments
Physio		
Patient Cable-Lead Set-USA	M1603A	3 leads-30 inch-Grabbers
Patient Cable-Lead Set-EUR	M1613A	3 leads-30 inch-Grabbers
Patient Cable-Trunk-USA	M1580A	3 lead
Patient Cable-Trunk-EUR	M1590A	3 lead
Patient Cable-Lead Set-USA	M1605A	3 leads-30 inch-Snaps
Patient Cable-Lead Set-EUR	M1615A	3 leads-30 inch-Snaps
Patient Cable-Lead Set	M1619A	IEC Pediatric Lead Set
Patient Cable-Lead Set	M1609A	USA Pediatric Lead Set
Foam Electrodes, Pre-Gelled	40420A	100 pack
Foam Electrodes, Pre-Gelled	40493E	30 pouch
Cloth Electrodes, Pre-Gelled	13941E	10 pouch
Cloth Electrodes, Pre-Gelled	13944B	3 pack—recommended substitute for 40420A
Transducer Ergonomic Grip	M2421-60000	For s4 (21330A) and s8 (21350A) transducers, s3 (21311A)

Table 8-1 Supplies and Accessories/Medical Supply Center

Description	Part Number	Comments
Printer Paper		
77530A/77535A Color Thermal paper	SNY3010	5 packs per box / 80 prints, 400 total
77530B/77535B Printer, Color-PAL/NTSC	SNY1010	5 packs per box / 100 Prints, 500 total
77530D Color Thermal Paper	SNY2010	1000 Color Prints
77550B Printer, Color - NTSC	SNY5010A	Box, 500 sheets, Color Prints
77550C/77555C Color Thermal paper	SNY5510-001	Box, 200 sheets, Color Prints
77550C/77555C Color Thermal paper	SNY5510-005	Case of 5 boxes, Color Prints, 1000 total
77550D Color Thermal paper	SNY510-001	Box, 200 sheets, Color Prints
77550D Color Thermal paper	SNY510-005	Case of 4 boxes, Color Prints, 800 total
Strip Chart Paper		
77510A Kowa Thermal paper	40479A	Box of 4 rolls, 131 foot (40m) per roll.
B&W Printer Paper		
77550B (NTSC)	SNY5020A	Box, 500 sheets, B/W Prints
77560A/77560B/77565A (NTSC/PAL Small)	SNY110HA/ SNY110HD	5 rolls per box
77580A/77585A (NTSC/PAL Large)	SNY216HD SNY210HD	5 rolls per box
77580B(NTSC/PAL Large)	SNY210HD	5 rolls per box
Ultrasound Gel		
Aquasonic Gel	40483A	8.5 Oz. bottle (12 ea.).
Aquasonic Gel	40483B	5 liter bottle (1 ea. to refill 40483A)
Video Tape		
SVHS Tape-SQ-T120	13921B	1/2 inch, case of 10 tapes
VHS Tape-SQ-T120	13920B	1/2 inch, case of 10 tapes

Table 8-1 Supplies and Accessories/Medical Supply Center

Description	Part Number	Comments
Philips recommends use of SVHS tape to maximize playback image quality.		
Other Supplies		
TEE Sheath Kits	40487A	10 Latex Sheaths and Tubes, 10 Syringes, Sterile Gel Pockets, 2 Applicators
TEE Tip Protector	M2243A	Omni I, Box 24
TEE Tip Protector	M2273A	Omni II, Box 24

Table 8-2 lists supplies and accessories available from the Philips Global Trade and Logistics Solutions (GTLS) organization. To order items from within the U.S.A., call 1-877-447-7278. From other countries, contact your local Philips representative or sales office.

Table 8-2 Supplies and Accessories/GTLS

Description	Part Number	Comments
Magneto Optical Disks		
2X 1.2 GB capacity	92279TC (1 disk)	For DSR or Digital Network Interface option
4X 2.3 GB capacity	92279FC (1 disk)	For DSR or Digital Network Interface option
8X 4.8 GB capacity	88143JC (1 disk)	For DSR or Digital Network Interface option *NOTE: This part is available only from HP. Call 1-800-227-8164 to order.*

Parts and Accessories

All parts and accessories listed in the remainder of this chapter are available from Philips Global Trade and Logistics Solutions (GTLS) organization. To order items from within the U.S.A., call 1-877-447-7278. From other countries, contact your local Philips representative or sales office.

Transducer Exchange

Table 8-3 lists M2424A compatible transducers, along with their exchange part numbers. For a complete list of transducers that support this product, see the *Reference Guide:* "Transducer Reference".

In the following table:

- C = Curvilinear
- S = Sector
- E = Endocavity
- L = Linear

Table 8-3 Transducer Exchange Part Numbers

Model No.	Label	2D Frequency Range	Exchange Part #
Transthoracic Transducers			
21253B	C3540	Fusion 2-6 MHz	21253-68100
21255B	L5040	Fusion 3-7 MHz	21255-68100
21258B	L7540	Fusion 4-10 MHz	21258-68100
21273A	C5040	Fusion 3-7 MHz	21273-68000
21311A	s3	Fusion 1-3 MHz	21311-68000
21321A	c3540	Fusion 2-5 MHz	21321-68000
21330A	s4	Fusion 2-4 MHz	21330-68000
21336A	E6509	Fusion 4-7 MHz	21336-68000

Table 8-3 Transducer Exchange Part Numbers *(Continued)*

Model No.	Label	2D Frequency Range	Exchange Part #
21350A	s8	Fusion 3-8 MHz	21350-68000
21353B	C3540	Fusion 2-6 MHz	21353-68300
21355B	L5040	Fusion 3-7 MHz	21355-68100
21356A	11-3L	Fusion 3-11 MHz	21356-68000
21358B	L7540	Fusion 4-10 MHz	21358-68100
21373A	C5040	Fusion 3-7 MHz	21373-68100
21380A	s12	Fusion 5-12 MHz	21380-68000
21390A	15-6L	Fusion 7-15 MHz	21390-68000
Transesophageal (TEE) and Transthoracic Omniplane Transducers			
21349A	R5012	Fusion 4-6 MHz	21349-68000
21364A	T5012	Fusion 3-6 MHz	21364-68000
21366A	T7506B	Fusion 5-9 MHz	21366-68000
21367A	T6210	Fusion 4-7 MHz	21367-68000
21369A	T6210	Fusion 4-7 MHz	21369-68000
21381A	T6207	Fusion 4-7 MHz	21381-68000
Transducer Adapter			
21292A	Transducer Adapter		21292-68000

Model No.	Label	Description	Exchange Part #
Separate Doppler Transducers			
21221A	D1914C	1.9 MHz CW	Exchange not avail. Order 21221-60061
21221B	D1914C	1.9 MHz CW/PW	Exchange not avail. Order 21221-60062

Table 8-3 Transducer Exchange Part Numbers *(Continued)*

Model No.	Label	2D Frequency Range	Exchange Part #
21223A	D5014C	5.0 MHz CW/PW	Exchange not avail. Order 21223-60060
21223B	D5014C	5.0 MHz CW/PW	Exchange not avail. Order 21223-60061
21224A	D1009V	10 MHz CW	Exchange not avail. Order 21224-60060
21228A	D1914V	1.9 MHz PW	Exchange not avail. Order 21228-60060
21228B	D1914V	1.9 MHz PW	Exchange not avail. Order 21228-60061

Transducer Parts/Accessories

In addition to stocking transducers on exchange, Philips also stocks the replaceable transducer parts and accessories listed in Table 8-4.

Table 8-4 Transducer Parts/Accessories

Description	Part Number	Comments
Accessories		
TEE Care Booklet	21364-99740	For ALL languages
TEE Care Video Tape	21364-99790 21364-99780 21364-99791 21364-99795 21364-99781 21364-99782 21364-99784 21364-99785	English/NTSC English/PAL French/NTSC Spanish/NTSC French/PAL German/PAL Italian/PAL Spanish/PAL
Foam, Insert	21349-80070	For 21349A
Case, Carrying	21349-80080	For 21349A
Tag, ID	21349-80090	For 21349A
Label connector	21349-80100	For 21349A
Foam insert, Omni I Suitcase	21364-80050	For Hard suitcase
Soft-sided Suitcase	21364-80080	Omni I & II, & Pedi TEE
Tag, Omni I	21364-80090	Use w/soft case
Tag, Omni II	21367-80090	Use w/soft case
Tag, PTEE	21366-80090	Use w/soft case
Omni I TEE Foam Bottom	21364-80070	For soft suitcase
Omni II TEE Foam Bottom	21367-80070	For soft suitcase
Omni I TEE Tip Protectors	M2243A	21364A only/Box 24
PTEE Foam Insert	21366-80070	Bottom, for soft case
PTEE Tip Protector	21366-80150	

Table 8-4 Transducer Parts/Accessories *(Continued)*

Description	Part Number	Comments
PTEE Cable Ring Clamp	21366-24280	
TEE Disinfection Basin TEE Basin base TEE Basin lid Small connector insert	21110A 21110-40010 21110-40020 21110-40030	All TEE probes
Transducer Repair Parts/Tools		
"CF" Rating Sticker	21200-80130	Epiaortic transducers
Transducer Label	21364-00270	"Do not Submerse"
Omni Large Knob	21364-83080	
Omni Small Knob	21364-83090	
Ellipse Ring	21364-63070	For Omni I (order next part too)
Ellipse Ring's Hook	21364-24235	For Omni I (order prev. part too)
Connector housing	21246-40010 (right) 21363-40020 (left)	
Serial label	21363-80110	
Ellipse Ring	21367-63070	For Omni II (21367A)
Ellipse Ring's Hook	21367-24235	For Omni II (21367A)
Connector housing	21215-40010 (right) 21215-40020 (left)	
Label Mounting Kit	21246-60500	
Top RFI Connector-Latch Side.	21246-00020	Plate, signal / ground, (front).
Bottom RFI Connector-Non Latch	21246-00130	Plate, signal / ground, (rear).
Transducer Connector Cover Kit (Amp)	21364-65500	Fits all transducers with Amp Connectors

Table 8-4 Transducer Parts/Accessories *(Continued)*

Description	Part Number	Comments
Transducer Connector Cover Kit (Cannon)	21369-65500	Fits all transducers with Cannon connectors
Transducer Housing Connector Cover (Amp)	21246-60310	Gray covers left and right; includes Screws (2) 0624-0716, Screws (3) 0624-0717
Transducer Blank Label	21200-80110	For all 212XX series Xducers
Transducer Latch	1252-4254	AMP connectors only
Latch Removal Tool	21246-62010	AMP connectors only
Serial Label, blank	21215-80110	For 21367A
Connector Housing, Left	21215-40010	For 21367A
Connector Housing, Right	21215-40020	For 21367A
Knob latch	21369-40030	Cannon connector only. 21349A (Trans-thoracic Omni) 21369A (Omni II) 21390A (Intraoperative) These may have either type of knob latch.
Knob latch (All other transducers)	21300-40040	Cannon connectors only. 21311A (s3) 21330A (s4) 21350A (s8) 21380A (s12)
Screw (For both Knob latch types)	21300-80030	Cannon connectors only.
Actuator, black switch cover, rubber	21364-40100	21364A
Actuator, black switch cover, rubber	21367-40100	21367A/21369A

To order individual Biopsy parts, please contact your CIVCO representative.

OEM Instrument Exchange

Table 8-5 lists M2424A compatible OEM instruments and their exchange part numbers.

Philips CEs should refer to the *Peripheral Service Manual* for more information.

Table 8-5 OEM Peripheral Exchange Part Numbers

Model #	Application	Notes	Exchange Part #
77470A	Digital Network Interface (For Rev A Only)	HP D3962A	N/A
77471A	Integrated Digital Interface	Net PC Hard Drive	77471-60000 77471-60500
77471B	Integrated Digital Interface	Net PC Hard Drive	77471-68010 77471-60510
77510A	Strip Chart-B&W	Kowa TLR-111	N/A
77530A	Printer-Color-NTSC	Sony UP-3000	77530-68000
77535A	Printer-Color PAL	Sony UP-3000P	77535-68000
77530B	Printer-Color-NTSC	Sony-UP-1850MD-NTSC	77530-68100
77535B	Printer-Color-PAL	Sony-UP-1850EPM-PAL	77535-68100
77530D	Printer-Color-NTSC/ PAL	Sony UP-2950D	77530-68300
77550B	Printer-Color-NTSC	Sony UP5200MD	77550-68001
77550C	Printer-Color-NTSC	Sony-UP-5600MD	77550-68200
77550D	Printer-Color-NTSC	Sony-UP-51MDU	77550-68300
77555C	Printer-Color-PAL	Sony-UP-5600MDP	77555-68200
77560A	Printer-B&W-NTSC	Sony UP 870-Small	77560-68000
77565A	Printer-B&W-PAL	Sony UP 860-Small	77565-68000
77560B	Printer-B&W-PAL & NTSC	Sony UP 890	77560-68200

Table 8-5 OEM Peripheral Exchange Part Numbers *(Continued)*

Model #	Application	Notes	Exchange Part #
77560C	Printer-B&W-PAL & NTSC	Sony UP 895	77560-68300
77580A	Printer-B&W-NTSC	Sony UP 910-Large	77580-68000
77585A	Printer-B&W-PAL	Sony UP 910/P-Large	77585-68000
77580B	Printer-B&W - NTSC&PAL	Sony UP 960- Large	77580-68100
77613A	VCR-SVHS-NTSC	Panasonic-AG-7350	77613-68000
77623A	VCR-SVHS-PAL	Panasonic-AG-7350E	77623-68000
77615A	VCR-SVHS-NTSC	Panasonic-AG-MD830P	77615-68000
77617A	VCR-SVHS-NTSC	Panasonic-MD835P	77617-68000
77625A	VCR-SVHS-PAL	Panasonic-AGMD830E	77625-68000
77627A	VCR-SVHS-PAL	Panasonic-MD835E	77627-68000

In addition to stocking OEM instruments on exchange, Philips stocks some replaceable parts for these instruments. These parts are stocked and identified using the OEM part number, as listed in the OEM manufacturer's service manual, with the first three letters of the manufacturer added as a suffix.

For example:

VXA4504-PAN refers to a Panasonic part.

A8261-099-A-SON refers to a Sony part.

When ordering an OEM part from Philips, obtain the correct part number from the OEM manufacturer's service manual and add the appropriate suffix. Or, if the manufacturer does not list the part in their service manual, provide the following information to your Philips parts supplier:

- Instrument model number and serial number
- Description of the part including its function and location
- Product Line-76
- Supplying Division-2900

OEM Instrument Manuals

Philips no longer stocks OEM service manuals for the M2424A. These manuals should be ordered directly from the OEM vendor within your respective countries.

Printed Circuit Board (PCB) Allocation and Exchange

Table 8-6 lists the M2424A PCBs and their part numbers. For each board available on exchange, an exchange part number is provided.

Exchange PCBs:

In the table, exchange part numbers are the same as the new part number for each board, except that the last digit changes to 8. For example, if you order the Distribution board - Slot 1 (Table 8-6), the installed part number (unless it was previously replaced) is 77110-68000. The Exchange Part number for the same PCB is 77110-68008. Thus, if you replace a PCB with the number 8 as the last digit in the part number, you know that PCB was previously replaced.

NOTE

Refer to Figure 8-1 for PCB allocation within the system.

Table 8-6 PCB Listing with Exchange Part Numbers

Slot Location #	Part #	Description	Exchange Part #
E-Box PCBs (Figure 8-1)			
1	77110-68000/20	Distribution PCB Assembly	77110-68008/28
2	77110-60500/40	Front End 0 PCB	77110-60508/48
3	77110-60500/40	Front End 1 PCB	77110-60508/48
4	77110-60500/40	Front End 2 PCB	77110-60508/48
5	77110-60500/40	Front End 3 PCB	77110-60508/48
6	77110-60200	Clock PCB	77110-60208
7	77110-60300	Power Regulator PCB	77110-60308
8		Spare	

Table 8-6 PCB Listing with Exchange Part Numbers *(Continued)*

Slot Location #	Part #	Description	Exchange Part #
9	77110-62310/20	Beam 0 PCB	77110-62318/28
10	77110-62310/20	Beam 1 PCB	77110-62318/28
11	77110-62310/20	Beam 2 PCB	77110-62318/28
12	77110-62310/20	Beam 3 PCB	77110-62318/28
13	77110-62200	DSCC PCB	77110-62208
14	77110-62100	Beamformer I/O PCB	77110-62108
15		Spare	
16		Spare	
17	77110-62400/20	Digital Image Detector PCB	77110-62408/28
18	77110-65100	Digital Scanner I/O PCB	77110-65108
19	77110-65200	Digital Doppler PCB	77110-65208
20		Spare	
21	77100-65310	DSR-SCSI PCB	77100-65318
22	77100-65450/60	Flow Processor PCB	77100-65458/68
23		Spare	
24	77100-65550	R-Theta-AC PCB	77100-65558
25	77110-66200	Digital AQ PCB	77110-66208
26	77160-65630	Image Memory PCB	77160-65638
27	77100-66310	Stripchart PCB	77100-66318
28	77160-65720	Physio Video Timing (PVT) PCB	77160-65728

Table 8-6 PCB Listing with Exchange Part Numbers *(Continued)*

Slot Location #	Part #	Description	Exchange Part #
29 or 29	77100-66010 77100-66020	Video I/O PCB (NTSC) (interlaced) Video I/O PCB (PAL) (interlaced)	77100-66018 77100-66028
29 or 29	77100-66030 77100-66040	Video I/O PCB (non-interlaced NTSC) Video I/O PCB (non-interlaced PAL)	77100-66038 77100-66048
30	77100-65810	Combined CLR PCB For SIMMS, see Table 8-8	77100-65818
30	77100-65860	TurboCine PCB For SODIMMS, see Table 8-8	77100-65868
31		Spare	
32		Spare	
33	77100-66290/300	Processor Graphics PCB	77100-66298/308
N/A	77110-68010	Rear I/O PCB Assembly (interlaced)	77110-68018
N/A	77110-68030	Rear I/O PCB Assembly (non-interlaced)	NA
N/A	77110-67200	Power Bus Bar PCB	NA
N/A	77110-63000	Back End Motherboard	NA
N/A	77110-62000	Digital Motherboard	NA
N/A	77110-60100	Analog Motherboard	NA
	77110-60600	Communications Motherboard	NA

Figure 8-1 PC Board Allocation, E-Box Electronics

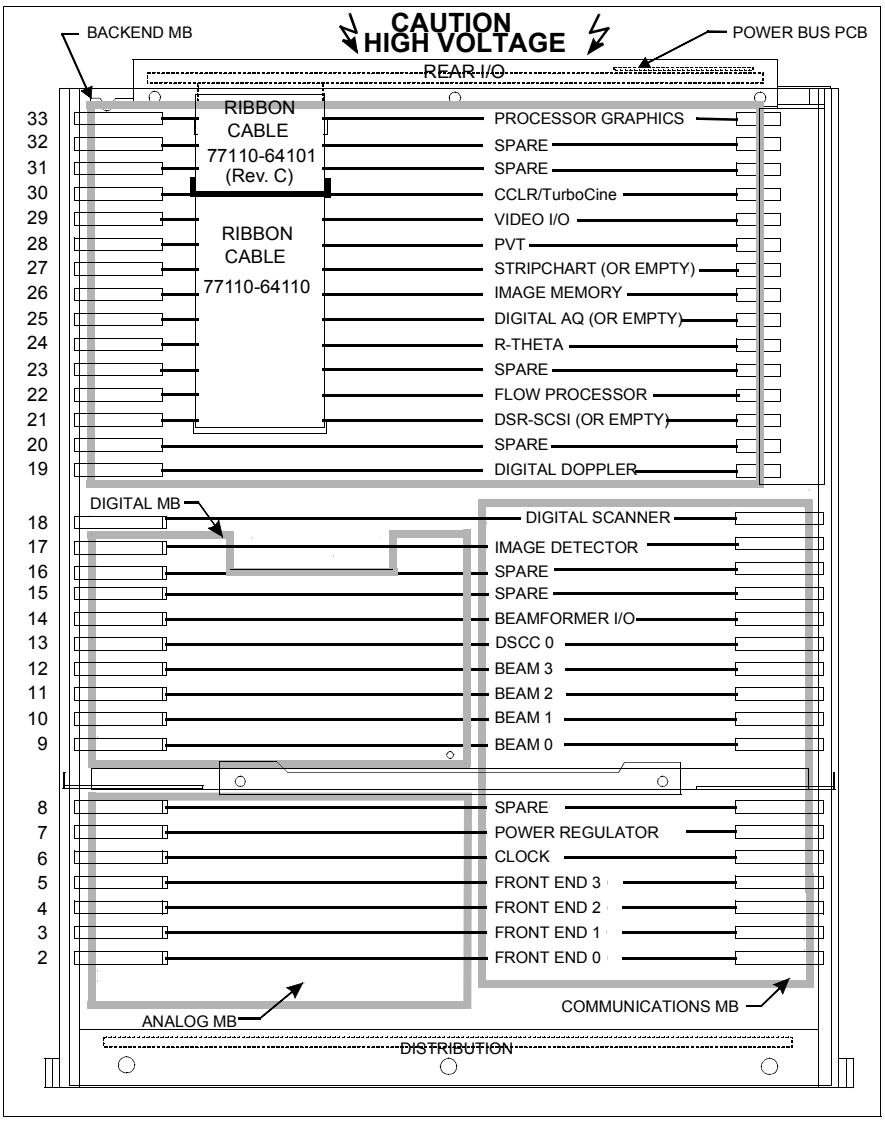
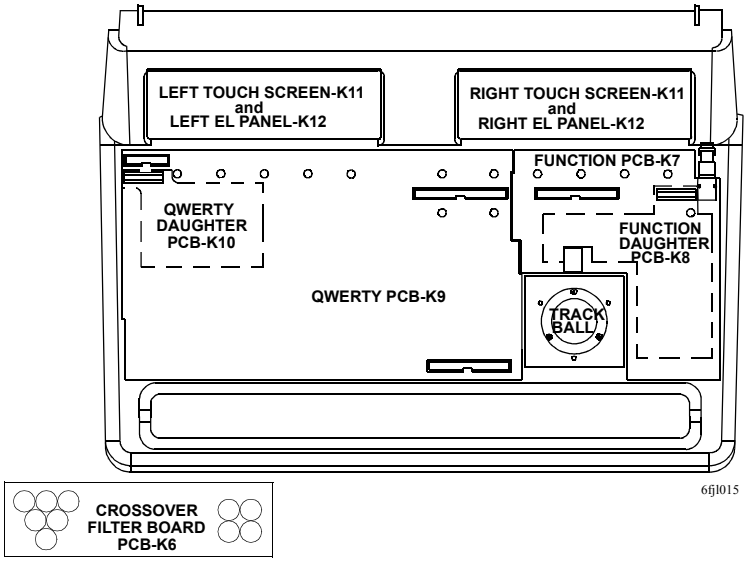


Table 8-7 Keyprocessor Electronics PCBs

ID	Part #	Description	Exchange Part #
Keyprocessor Electronics PCBs (see Figure 8-2 & Figure 8-7)			
K1	77921-60100 or 77921-60110	Keyscanner/Audio Keyscanner/Audio	77921-60108 77921-60118
K2	77921-60620	Physio, Extended	N/A
K3	77921-60300	Physio I/O	N/A
K4	77921-60400	System I/O (Not shown, located at rear of system.)	N/A
K5	77921-60200	Main I/O	N/A
K6	77922-60200	Crossover Filter	N/A
K7	77921-61400 or 77921-61410	Function Function	N/A N/A
K8	77921-61800	Function LED Daughterboard	N/A
K9	77921-61300 or 77921-61310	Qwerty or Qwerty	77921-61308 77921-61318
K10	77921-61700	Qwerty LED Daughterboard	N/A
K11	77921-80030	Touch Screens (Left or Right)	N/A
K12	2090-0330	EL Panels (Left or Right)	77921-62698

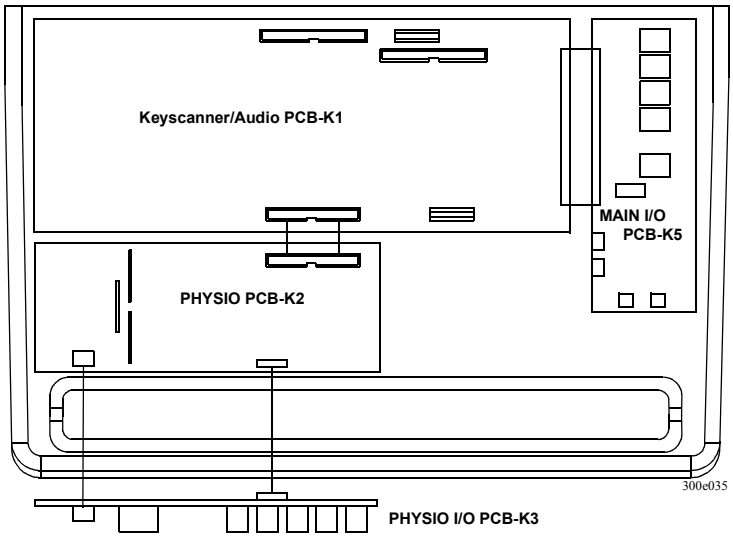
Figure 8-2 Keyprocessor Electronics-K0, Exploded View Diagram



Note: SYSTEM I/O PCB-K4 at rear of Cart Top assembly, not shown.

See Figure 8-16.

NOTE: Located on rear cart wall above the keyscanner PCB



Miscellaneous Parts

Table 8-8 lists miscellaneous orderable parts.

Remove fuses by pulling them out of their terminals. Replace removed fuses with fuses of the same value.

Table 8-8 PCB Fuses, Battery, and Other Miscellaneous Parts

Misc. Part Location	Part(s) Description	Part #	Reference
System Fuses			
K5 PCB Main I/O	Fuse (8), 3.0 amp *Note: Fuse F8 is a spare.*	2110-0688	See Figure 8-3
A33 PCB Processor-Graphics	Fuse (1) 2.0 amp	2110-0684	See Figure 8-5
System Battery			
A33 PCB Processor-Graphics	Battery, 3.6V Battery Cover	1420-0349 1400-1712	See Figure 8-4
N/A	Battery Box	1400-1711	
Miscellaneous			
Motherboards	Screws (11) Scanner, Screws (9) Scan Converter	2360-0115	NA
N/A	Static Wipes	9300-1741	NA
N/A	Footswitch with label	77921-62470	
N/A	Physio Interface Cable Kit	77921-62480	NA
ECG Interface cable (TEE)	Round ECG connector to 1/4-inch phone plug	77020-60300	
ECG Modification Kit	Kit to modify 77020-60300. (Includes 1/4-inch phone plug and instructions.)	77020-60315	

Table 8-8 PCB Fuses, Battery, and Other Miscellaneous Parts *(Continued)*

Misc. Part Location	Part(s) Description	Part #	Reference
Fan assembly in the DSR/ Floppy assembly	Fan Assembly Kit for M2424A systems less than serial number US978005948. Includes new top cover with insulating washers attached; adhesive backup cable clamp; 5 push pivots (1 extra).	77922-60365	
Wheel Kit Assembly	Kit contains 4 wheels, 4 hub caps, 2 extra screws, and drawing/procedure.	77922-68010 (for REAR) 77922-63010 (for FRONT)	
VCR Memory Button	MEMO Button Cover	77615-40020	
Interface cable	37 pin “D” connector one end, no connector on other end. Use with 77020-60315 above. Takes analog output from Merlin monitor.	M1181-61651	
Static Wipes	EL Touch Screen cleaner	9300-1741	
Shipping material	System Cover	77921-80130	N/A
Shipping material	Keyboard Protect. Cover	77921-81061	N/A
Shipping material	Lock Foot Bar Protector	77921-81065	N/A
N/A	Torque screwdriver 1/4“preset to 10 inch/lbs	02-0068-IRP	N/A
Keyprocessor	Clamp, cable, KP	1400-1196	N/A
N/A	Tie wrap, reusable	1400-2222	
KPE Aluminum Casing	Touch-up Paint, Glacier Gray	77921-87610	
Cart Base	Touch-up Paint, Titanium Gray	77921-87600	
N/A	Package of Blank Floppy Diskettes (2)	M2424-12007	
E-box (CCLR PCB)	128 MB SIMMS (4/system) 32 MB SIMMS (4/system)	1818-7785 1818-5622	512 MB 128 MB
E-box (TurboCine PCB)	512 MB SODIMM	1818-8687	2 GB

Figure 8-3 Keyprocessor Electronics Main I/O

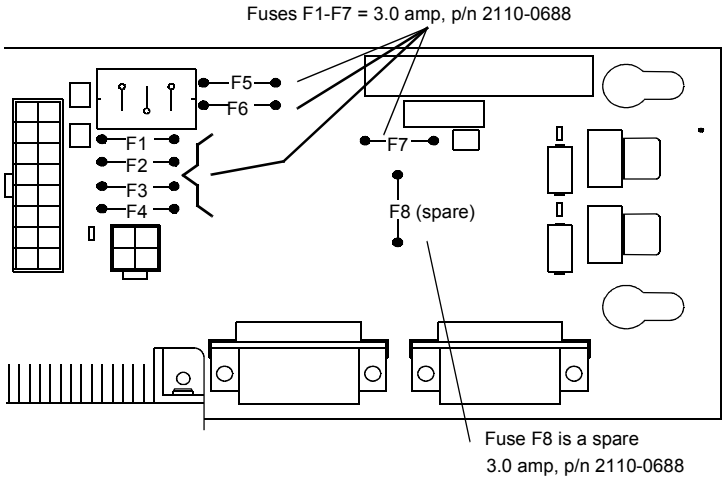


Figure 8-4 Processor-Graphics Board (C1) (77100-66290)—Fuse, Battery, and Flash Connector

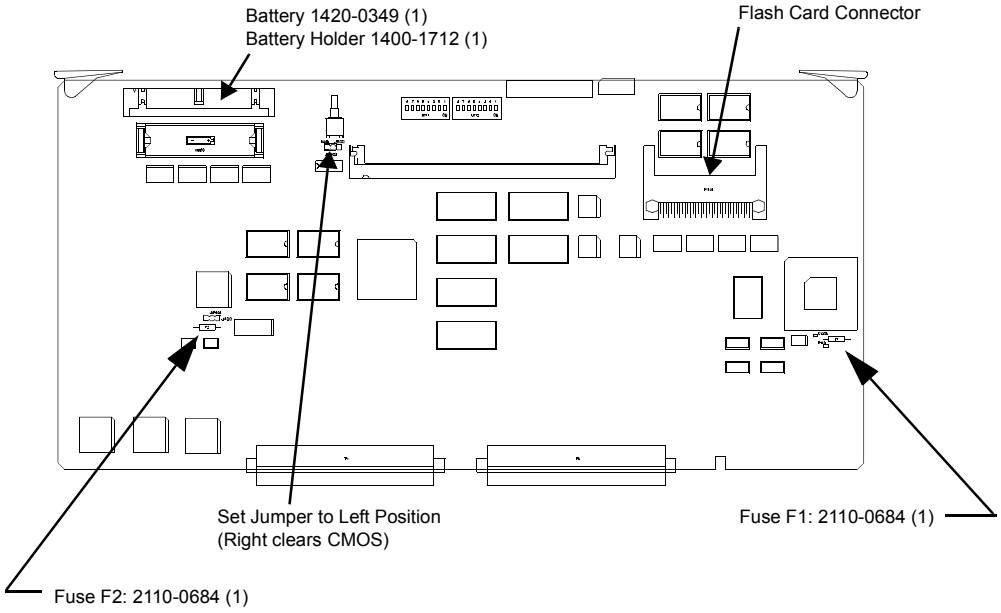
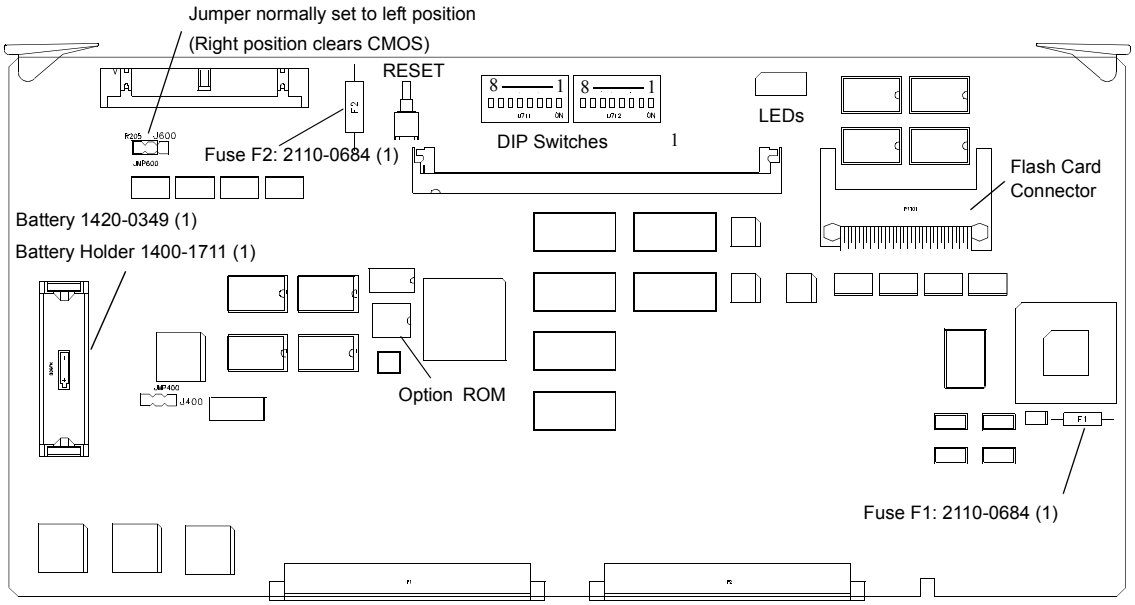


Figure 8-5 Processor Graphics (77100-66300): Switches, Jumpers, Fuses, Battery, Flash Connector



I/O Panel/Keyprocessor Electronics Language Options

Table 8-10 lists part numbers for all I/O panels and Keyprocessor Electronics controls. These components are available in English, as well as four foreign languages. Notice that part numbers for similar panels/controls are the same for each language, except for the last digit, which defines specific language labeling (Table 8-9).

Table 8-9 Part Number Last Digit Change Per Language

Labeling language	Last digit in the part number is always changes to…
English	0
French	1
German	2
Italian	4
French	5

Table 8-10 I/O Panels and Keyprocessor Language Options

English	French	German	Italian	Spanish	Swedish
Physio I/O Front Panels, Extended					
77921-62640	77921-62641	77921-62642	77921-62644	77921-62645	N/A
77922-80335 Physio Panel Label, generic					
System I/O Rear Panels					
77922-00900	77922-00801	77922-00900	77922-00900	77922-00900	77922-00900
Qwerty Keyboard					
77921-62300	77921-62301	77921-62302	77921-62304	77921-62305	77921-62313
Function Keyboard					
77922-63050	77922-63051	77922-63052	77922-63054	77922-63055	N/A
T-Panel Label Set					

Table 8-10 I/O Panels and Keyprocessor Language Options

English	French	German	Italian	Spanish	Swedish
77922-80240	77922-80241	77922-80242	77922-80244	77922-80245	N/A
Mic Label 77921-80160	77921-80160	77921-80162	77921-80160	77921-80160	77921-80160
Volume Label 77921-80170	77921-80170	77921-80172	77921-80170	77921-80175	77921-80170

Power Cord and Line Voltage/Circuit Breaker Options

Table 8-11 lists part numbers for system power cords and circuit breakers. These items are optional, based on country requirements for cords and line voltage.

Table 8-11 Power Cord and Line Voltage/Circuit Breaker Options

Option #	Description	Part Number	Comments
Power Cords			
900 (UK)	Cable, cart #16.	77922-64160	Requires United Kingdom power connector 1251-4209.
901 (AUS)/ (AR)	Cable, cart #16.	77922-64200	Includes Australia or Argentina power connector, which is molded on.
902 (EURP)	Cable, cart	77922-64150	Includes Europe power connector.
903 (USA/ JAPAN)	Cable, AC Power	77922-64140	Includes connector (88030270).
906 (SWISS)	Cable,cart #16.	77922-64160	Requires Swiss connector 1251-4896.
912(DENMK)	Cable,cart #16.	77922-64160	Requires Danish connector 1251-6189.
917 (S AFR)	Cable,cart #16.	77922-64160	Requires South Africa connector 1252-1173.
922 (CHINA)	Power cord	77922-64210	Includes power connector.
NA	Monitor power cord	8120-4456	Use clamp 77000-05700.
NA	Power cord tie wrap	1400-0399	
Line Voltages/Circuit Breakers			
Z02	100 V	3105-0258, (20A)	
Z03	120 V	3105-0258, (20A)	
Z04 Z05 Z06	220 V 230 V 240 V	3105-0302, (10A)	Includes 240V power strip 77921-64320, IEC bracket 77922-00840, expander strip 1252-5497.

Replacement Parts and Exploded View Diagrams

The following pages provide listings of replaceable M2424A sub-assemblies and parts, keyed to exploded view diagrams. Only primary sub-assemblies and parts that can be ordered from the factory are shown in the exploded view diagram for each major assembly. Related hardware such as screws, washers, etc. that can be ordered for each sub-assembly are called out in the comments section of the associated parts tables.

Exploded view diagrams and associated parts list tables appear on the pages shown in Table 8-12.

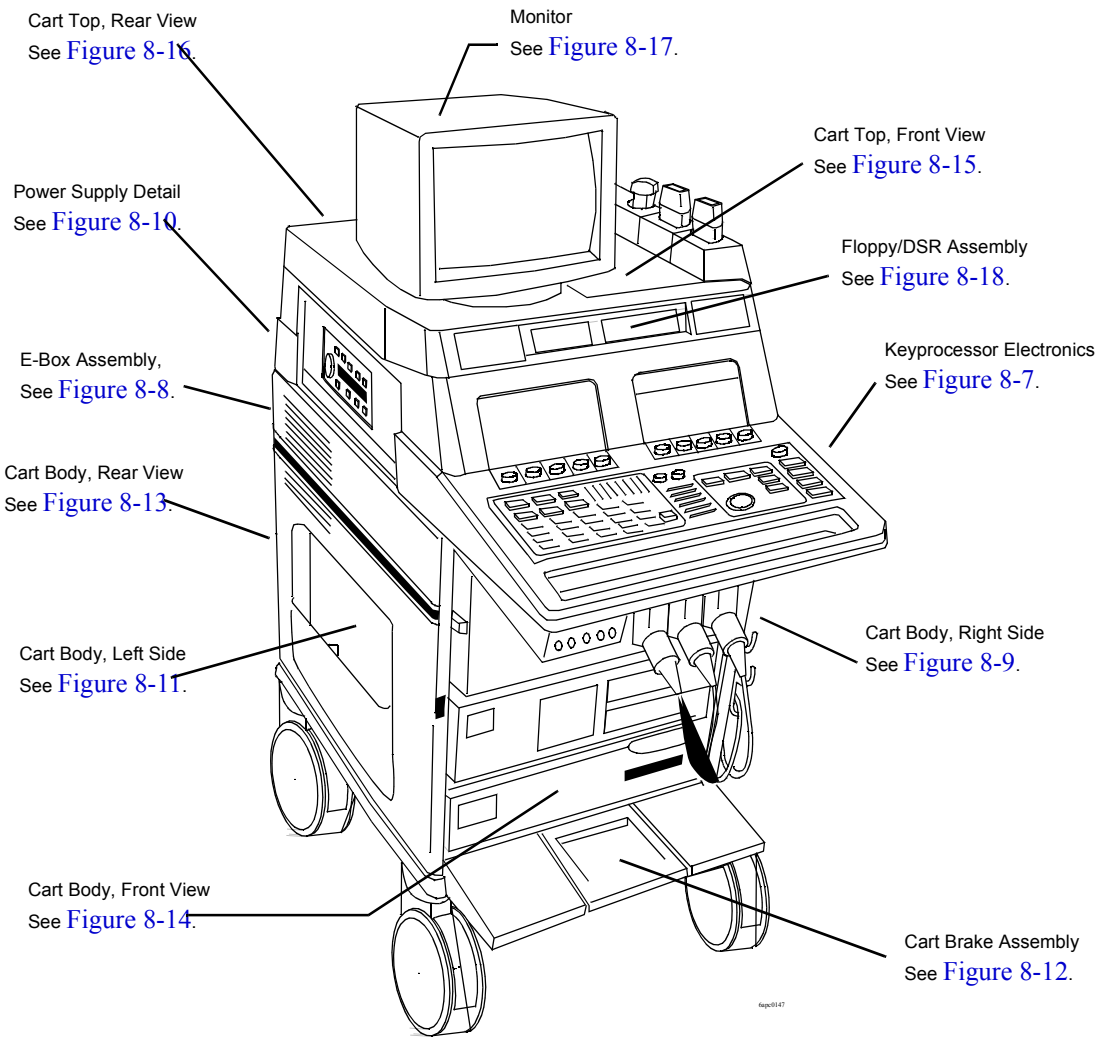
Table 8-12 Parts Lists and Exploded View Diagrams

Part	Parts List	Diagram
Keyprocessor Electronics (K0)	Table 8-13, page 8-31	Figure 8-7 on page 8-30
E-Box Assembly (E0)	Table 8-14, page 8-35	Figure 8-8 on page 8-34
Cart Body, Right Side, Rear View (C0)	Table 8-15, page 8-37	Figure 8-9 on page 8-36
Power Supply Detail (P0)	Table 8-16, page 8-39	Figure 8-10 on page 8-38
Cart Body, Left Side, Front View (C1)	Table 8-17, page 8-41	Figure 8-11 on page 8-40
Cart Brake Assembly Detail (B0)	Table 8-18, page 8-43	Figure 8-12 on page 8-42
Cart Body, Rear (C2)	Table 8-19, page 8-45	Figure 8-13 on page 8-44
Cart Body, Front (C3)	Table 8-20, page 8-47	Figure 8-14 on page 8-46
Cart Top, Front View (T0)	Table 8-21, page 8-49	Figure 8-15 on page 8-48

Table 8-12 Parts Lists and Exploded View Diagrams

Part	Parts List	Diagram
Cart Top, Rear View (T1)	Table 8-22, page 8-52	Figure 8-16 on page 8-51
Monitor (M0)	Table 8-23, page 8-54	Figure 8-17 on page 8-53
Floppy/DSR Assembly (F0)	Table 8-25, page 8-57	Figure 8-18 on page 8-55

Figure 8-6 Main Assembly Locator Drawing



Parts Locator Reference Numbers

Note that each major assembly is referenced by a letter and a number.

For example:

E0 = E-Box

Sub-assemblies for each major assembly have a dash-number following the assembly number.

For example:

E0-2 = Distribution Board Assembly

The sub-assembly dash-numbers in each parts listing will appear in the associated exploded view diagram.

NOTE

These **Assembly** and **Sub-Assembly** numbers are used for parts locator reference purposes only. They cannot be used to order parts; to order a part you must supply the associated part number listed in the parts tables.

When using reference numbers to locate parts remember the following:

1 *Assembly Reference Numbers:*
Referenced by a letter and a number. Items are normally not ordered at this level. In cases where a major assembly can be ordered, a part number will be listed. The same letter may be followed by a different number to indicate a different level of the same major assembly. The first number used is always 0.

2 *Sub-Assembly Reference Numbers:*
Referenced by a dash-number. All parts referenced by a dash-number may be ordered by supplying the associated part number.

3 *Secondary Hardware:*
Secondary parts and hardware such as washers, screws, etc. are sometimes listed in the ***comments*** column of the listings-along with appropriate part numbers-if the factory estimates that the part will be required as a standard service item. When listed, these items may also be ordered; otherwise, re-use the hardware that was removed with the old part when installing the new item.

Figure 8-7 Keyprocessor Electronics-K0 Exploded View Diagram

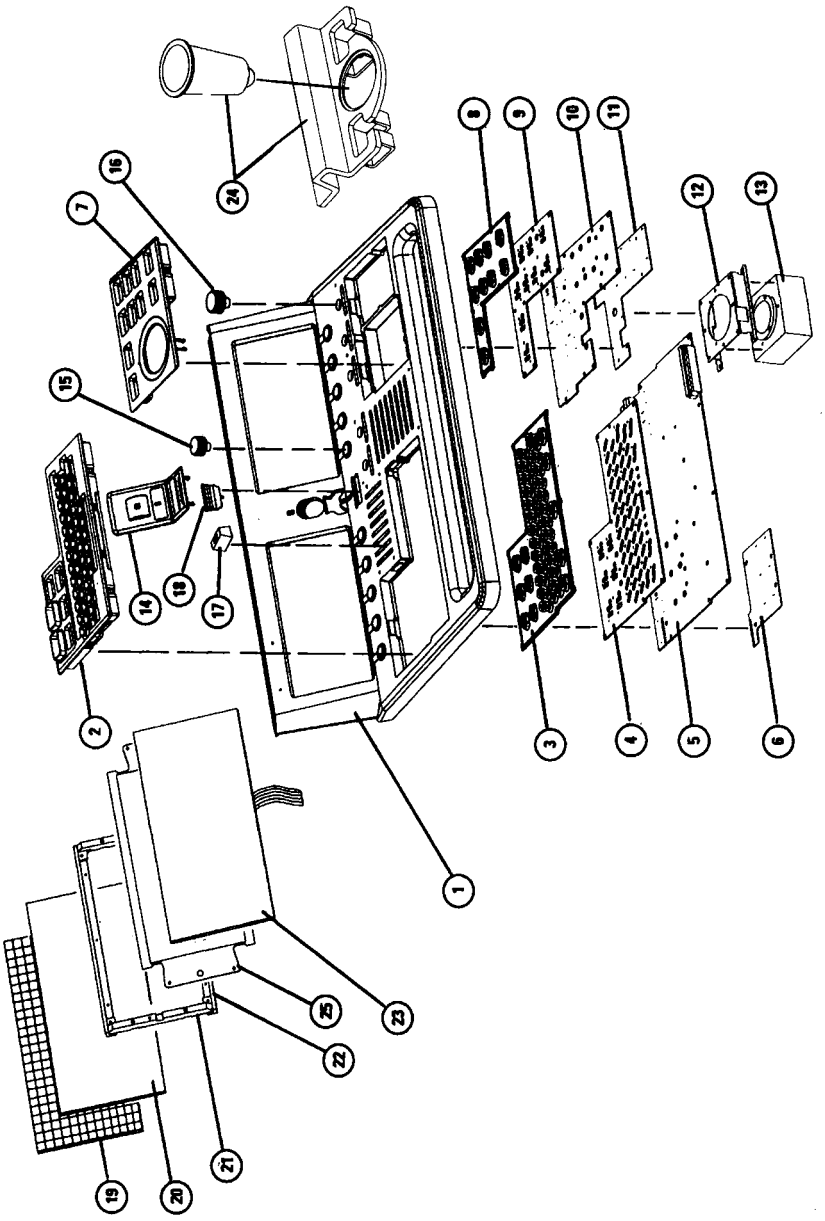


Table 8-13 Keyprocessor Electronics-K0, Replaceable Parts

ID	Description	Part Number	Comments
K0	***Keyprocessor Electronics*** *(See* Figure 8-7.*)*		
K0-1	Control Panel Casting	77921-20022	Glacier Grey
*	Name Plate	77922-80337	SONOS 4500 Agilent
*	Name Plate	77922-80141	SONOS 5500 Agilent
*	Name Plate	77922-80301	SONOS 4500/5500 Philips
	Medallion	77922-80300	
	T-Panel Label Set	77922-80240	See LANGUAGE options Table 8-10, page 8-23.
*	T-Panel	77921-40122	
	Retainer, Push on clips	77901-00671	Quantity - 9.
K0-2	Qwerty Keyboard/Buttons	77921-62300	English. See LANGUAGE options Table 8-10, page 8-23.
K0-3	Qwerty Keyboard Membrane	77921-40530	
K0-4	Qwerty Keyboard Spacer	77921-20170	
K0-5	Qwerty PCB	77921-61300/8	Screw (14), 0515-2392, Screw (13) 77921-22430, Screw (4) 0515-0430.
KO-5	Qwerty PCB	77921-61310/8	
K0-6	Qwerty LED Daughterboard	77921-61700	Standoff (4) 0380-1887. Screw (4) 0515-0430. LED 1990-1682.
K0-7	Function Keyboard/Buttons	77922-63050	English. See LANGUAGE options Table 8-10, page 8-23.
K0-8	Function Keyboard Membrane	77921-40540	
K0-9	Function Keyboard Spacer	77921-20180	
K0-10	Function PCB	77921-61400	Screw (9), 77921-22430
K0-10	Function PCB	77921-61410	

Table 8-13 Keyprocessor Electronics-K0, Replaceable Parts *(Continued)*

ID	Description	Part Number	Comments
K0-11	Function LED Daughterboard	77921-61800	Screw (4) 0515-0430 LED 1990-1682
K0-12	Trackball Bracket	77921-00510	Screw (4) 0515-2245.
K0-13	Trackball	0950-1759	Cable 77120-65660. Screw (3), 3030-0494, (1/16 Allen®).
K0-14	Microphone Bezel	77921-42382	Cable 77921-64130. Mic LED 1990-0487, Mic Label, Volume Label, See LANGUAGE options Table 8-10, page 8-23.
*	Retainer, Push on (Black)	0510-1403	
K0-15	Knob-small round	77921-40323	(10) below touch screen panel.
K0-16	Knob-large round	77921-40443	(3) Gain, Focus, Depth Labels. See LANGUAGE options Table 8-10, page 8-23.
K0-17	Knob-slide pot	77921-40332	(18) LGC & TGC, Volume. [TGC LED AY4553K]
K0-18	Light Pipe (for Gain, Focus, Depth knobs)	77921-40230	4 each (plug-in beneath knob labels)
K0-19	EL Panel Rear Shield (Grid)	77921-02060	1 per panel. Screw (8) 0515-2145. Screw (1) 0515-1194.
K0-20	EL Panel PCB	77921-62690/8	1 per Panel. Screw (4) 0515-2245.
K0-21	EL Panel Vertical Mount Bracket	77921-22370	2 per Panel. Screw (2) 0515-0664.
K0-22	EL Panel Horizontal Stiffener	77921-22340	2 per Panel. Screw (2) 0515-0664.
K0-23	EL Panel (Touch Screen)	77921-80030	1 per Panel.

Table 8-13 Keyprocessor Electronics-K0, Replaceable Parts *(Continued)*

ID	Description	Part Number	Comments
K0-24	Storage Caddy Assembly	77922-64250	Includes Caution Label 77921-84240 & Regulatory Label 77921-87230
*	Variable Resistor	2100-4322	LGC & Volume
*	Variable Resistor	2100-4323	TGC
*	Rotary Variable Pot	0960-0760	For Soft & Hard Keys
K0-25	Mylar spacer	77921-80460	

* Not Shown

Figure 8-8 E-Box Assembly-E0 Exploded View Diagram

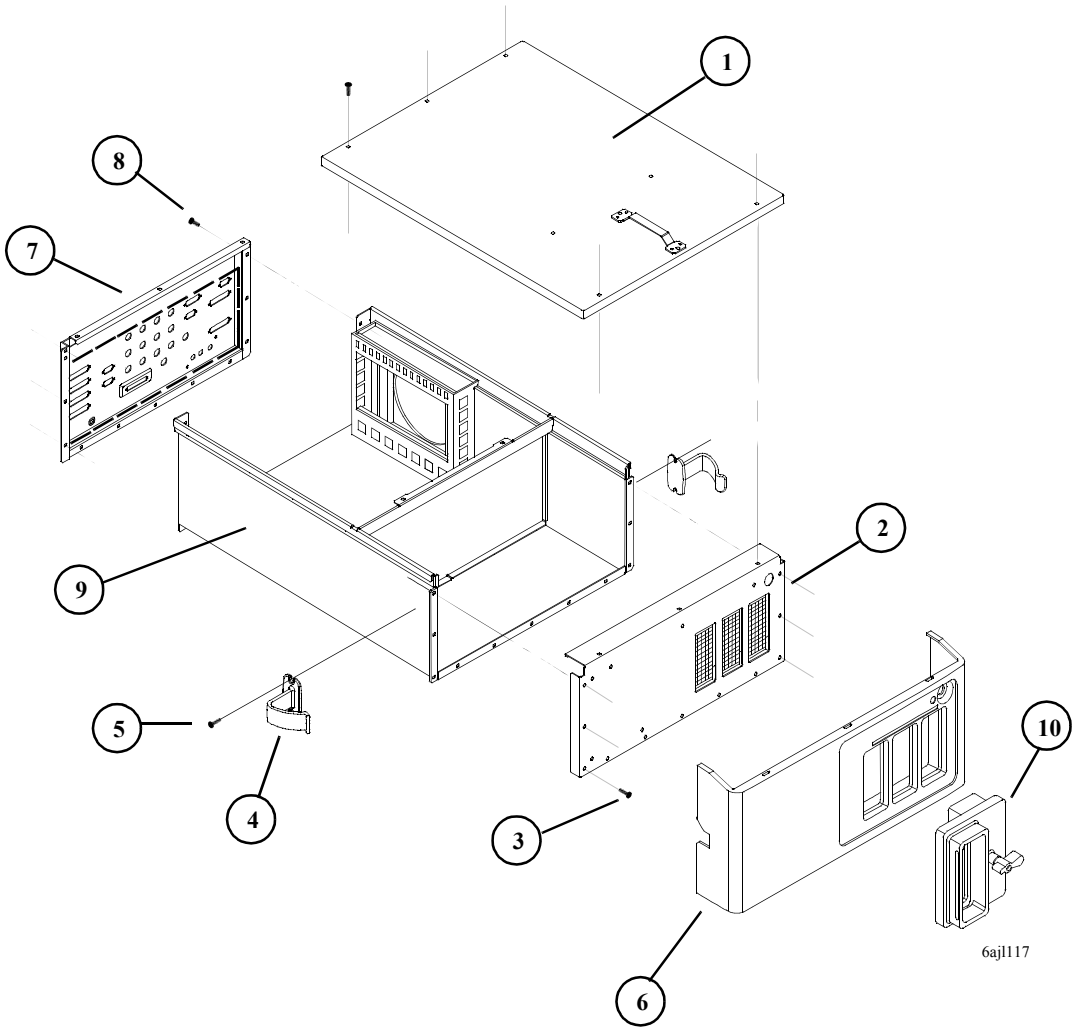


Table 8-14 E-Box-E0, Replaceable Parts

ID	Description	Part Number	Comments
E0	***E-Box*** *(See* Figure 8-8.*)*		
E0-1	Cover, E-box	77110-69050 0515-0380	Label, 77110-80110. Screws, 4.0 x 10
E0-2	Distribution board assembly	77110-68000	Includes front panel hardware. 77110-68008 exchange
E0-2	Distribution board assembly	77110-68020	77110-68028 exchange
E0-3	Screws, distribution board	0515-0380	19 ea.
E0-4	Holder, cable	77922-40050	Plastic, 2 ea.
E0-5	Screws, cable holder	0515-0380	
E0-6	Cover, plastic	77922-40010	Glacier gray
E0-7	Rear I/O assembly	77110-68030	With board, panel, and connectors.
E0-8	Screw, I/O assembly	0515-0380	6 ea. per assembly
*	Nuts, bus bar and I/O panel	0535-0171	21 ea.
E0-9	Box, E-chassis	77110-69000	With cover, chassis, front, card guides, and rear panels.
E0-10	Adaptor, transducer	21292A	21292-68000, exchange.

Figure 8-9 Cart Body, Right Side, Rear View-C0 Exploded View Diagram

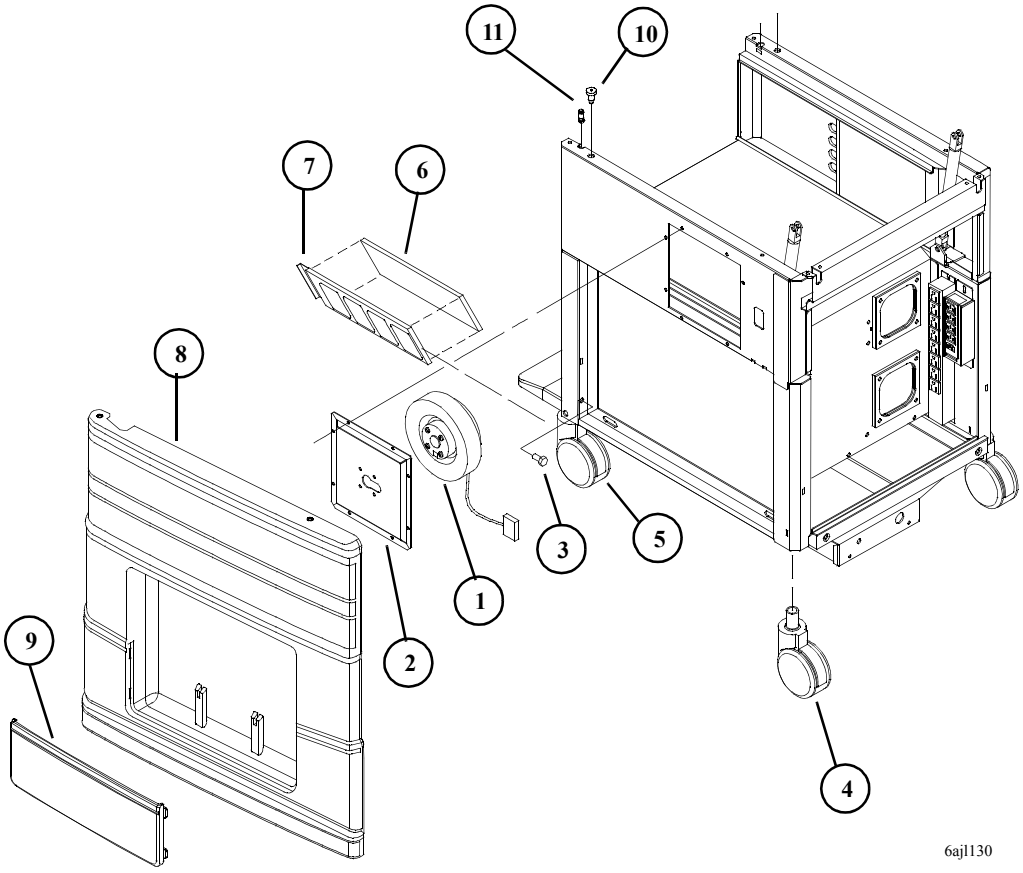


Table 8-15 Cart Body, Right Side, Rear View-C0, Replaceable Parts

ID	Description	Part Number	Comments
C0	**Cart Body, Right Side, Rear View** *(See Figure 8-9.)*		
C0-1	Fan assembly	77110-80040	With attached cable
*		0515-0380	Fan assembly mounting screws, 4 ea.
C0-2	Cover, fan	77922-00300	
*		0515-0380	Fan cover mounting screws, 6 ea.
C0-3	Bolt, caster assembly	0515-2466	
C0-4	Caster, rear	77922-63020	
C0-5	Caster, front	77922-63010	
C0-6	Filter, air	77922-80120	
C0-7	Holder, filter	77922-00770	
C0-8	Panel assembly, right side	77922-69440	Includes pocket. (Order labels also. See Table 8-17, page 8-41.)
C0-9	Pocket, right side	77922-69420	Includes divider
C0-10	Bumper, rubber	0403-0792	
C0-11	Pin, cart top latch	77922-20000	
*		0515-0380	Latch pin screw.

* Not Shown

Figure 8-10 Power Supply Detail-P0 Exploded View Diagram

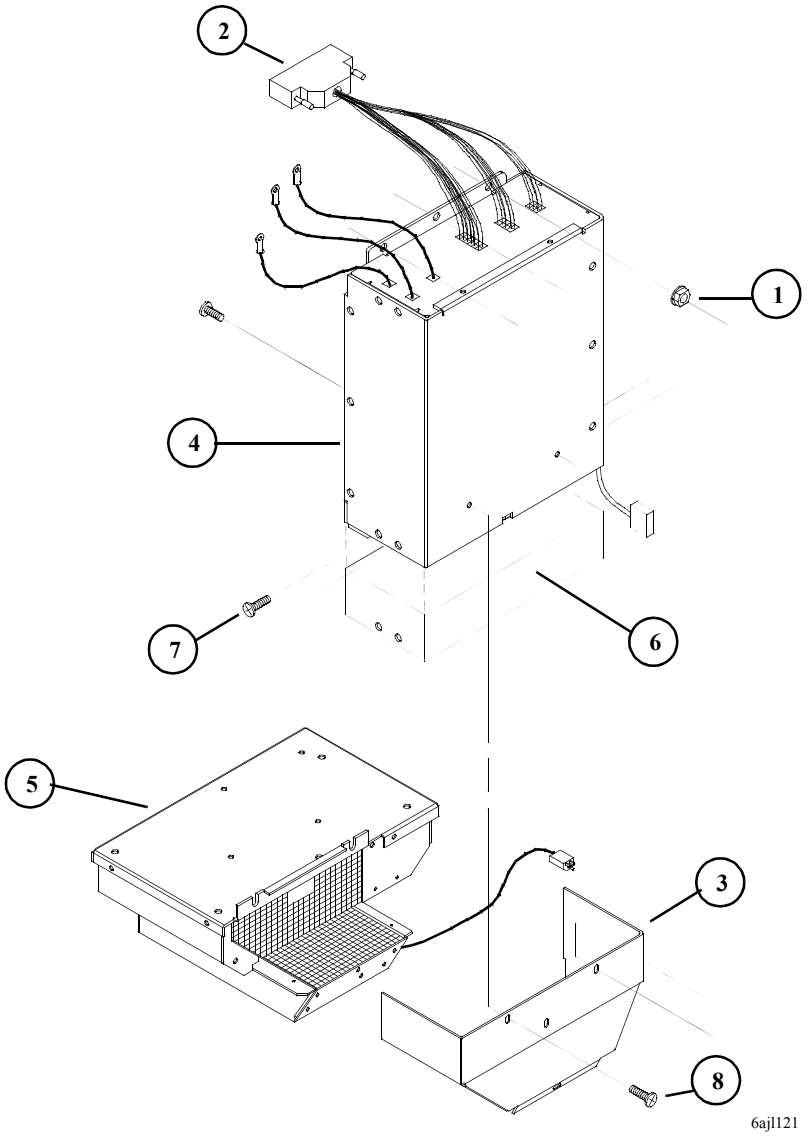


Table 8-16 Power Supply Detail-P0, Replaceable Parts

ID	Description	Part Number	Comments
P0	***Power Supply Detail*** *(See* Figure 8-10*.)*		
P0-1	Nuts, mounting	0535-0171	5 ea., 10 mm
P0-2	Power cable, E-Box	77101-60230	Comes with DC converter
P0-3	Cover, air duct	77101-60250	Does **NOT** come with exchange power supplies
P0-4	DC converter assembly	77101-60210	Comes with E-box cable (77101-60218 exchange)
P0-5	Power factor corrector assembly	77101-60220	77101-60228 exchange
P0-6	Fan assembly	77101-60240	2 fans and mounting hardware
P0-7	Screws, fan assembly	0515-0380	6 ea.
P0-8	Screws, air duct	0515-0380	4 ea.

Figure 8-11 Cart Body, Left Side, Front View-C1 Exploded View Diagram

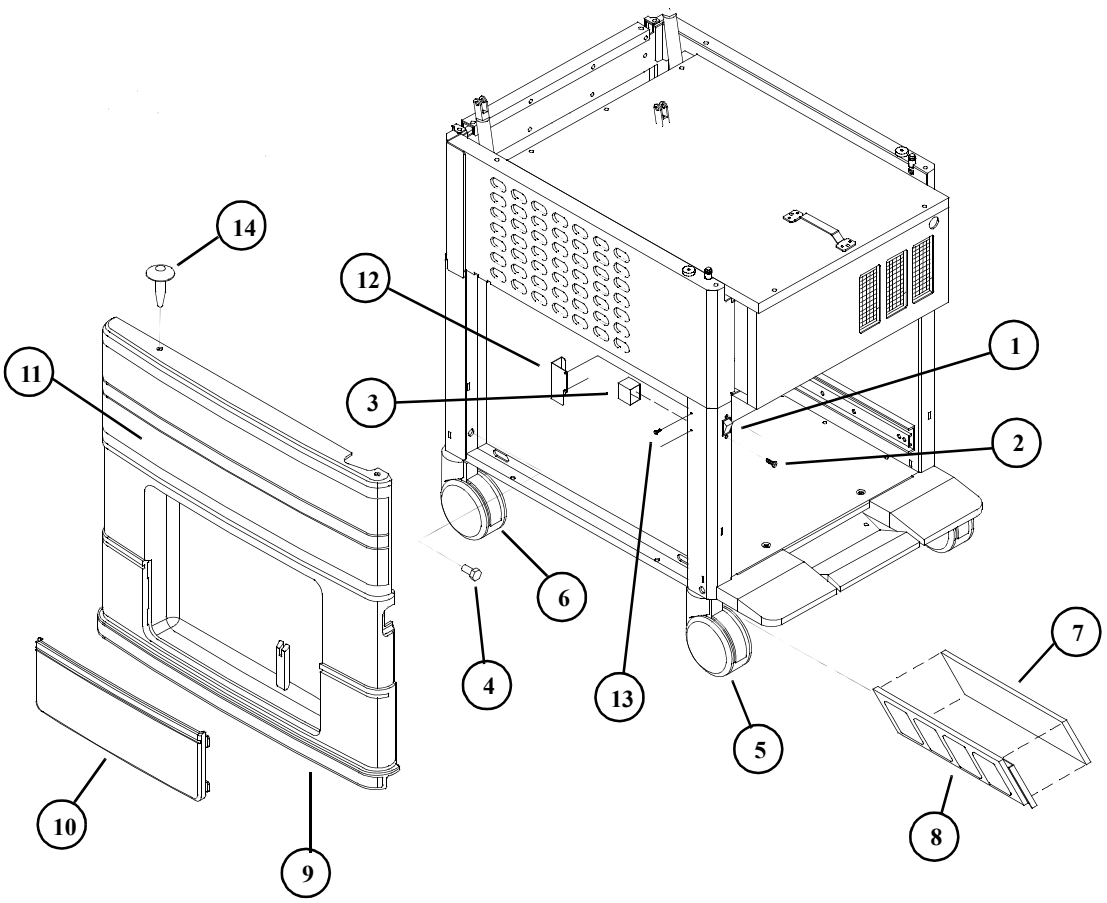


Table 8-17 Cart Body, Left Side, Front View-C1, Replaceable Parts

ID	Description	Part Number	Comments
C1	***Cart Body, Left Side, Front View*** *(See* Figure 8-11*.)*		
C1-1	Switch, breaker	3105-0258 3105-0302	110V 220V
*	Cable, power interconnect	77921-64210	Breaker switch to transformer.
*	Clamp, power interconnect cable	1400-1174	
C1-2	Screws, breaker switch	0515-1102	2 ea.
C1-3	Cover, breaker switch (paper)	77922-80320	
C1-4	Bolt, caster assembly	0515-2466	13 mm, Hex
C1-5	Caster, front (right or left)	77922-63010	
C1-6	Caster, rear (right or left)	77922-63020	
*	Wheel Repair Kit	77922-68010	4 wheels, 4 hub caps, 2 extra screws, instructions
C1-7	Filter, air	77922-80120	
C1-8	Filter holder, air	77922-00770	
C1-9	Panel, left side	77922-69430	Includes side pocket. Order label set also.
C1-10	Panel pocket, left side	77922-69410	Includes dividers
C1-11	Label set, side panel, SONOS 5500	77922-80210	Kit includes 2 large blue stripes and four copper stripes
	Label set, side panel, SONOS 5500	77922-80260	Kit includes 2 large copper stripes and four blue stripes
	Label set, side panel, SONOS 4500	77922-80331	
C1-12	Cover, breaker switch (metal)	77922-00320	
C1-13	Screws, breaker cover	0515-1102	
C1-14	Insert	0361-1603	Includes screw

* Not Shown

Figure 8-12 Cart Brake Assembly Detail-B0 Exploded View Diagram

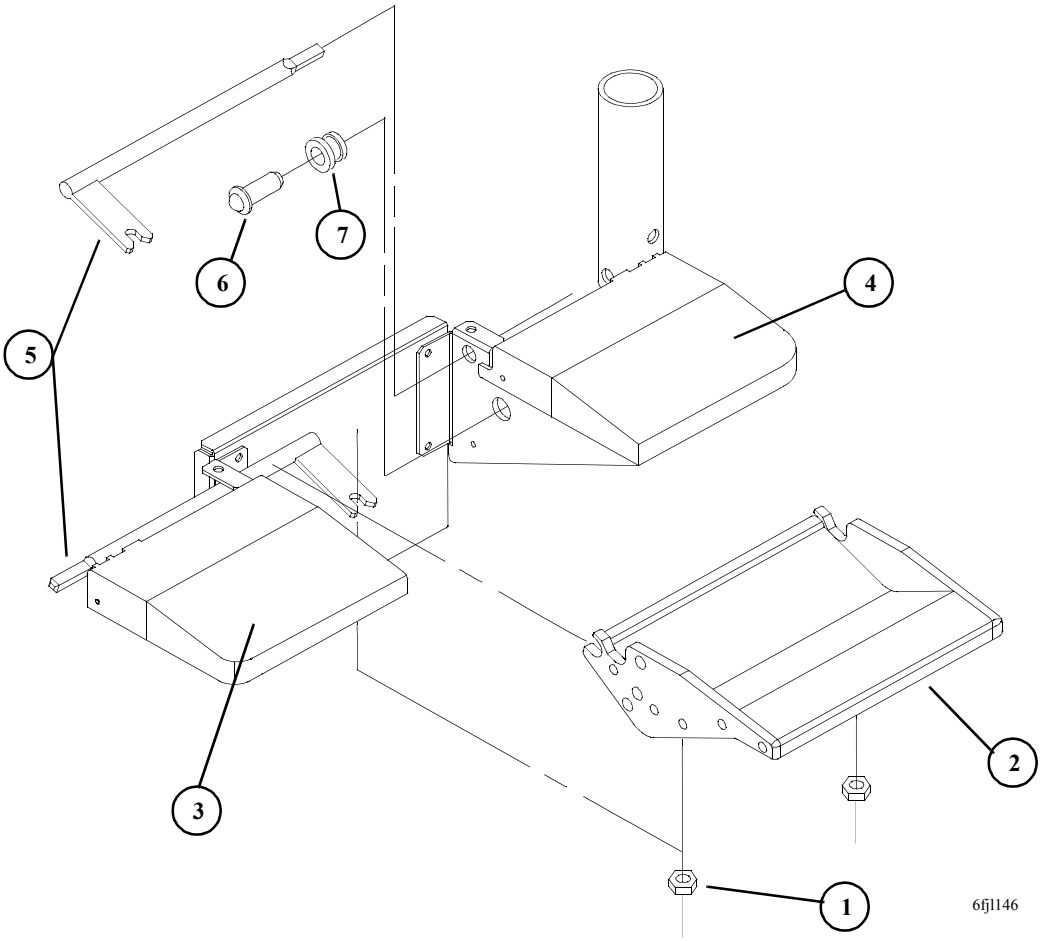


Table 8-18 Cart Brake Assembly Detail-B0, Replaceable Parts

ID	Description	Part Number	Comments
B0	***Cart Brake Assembly Detail*** *(See* Figure 8-12*.)*		
B0-1	Nut, brake assembly	0535-0171	
B0-2	Pedal, brake	77922-69400	
B0-3	Foot rest, left	77922-69120	
B0-4	Foot rest, right	77922-69130	
B0-5	Shaft, brake	77922-20080	
B0-6	Plunger, ball	77922-20120	2 Required
B0-7	Grommet, rubber	0400-0906	

Figure 8-13 Cart Body, Rear View—C2 Exploded View Diagram

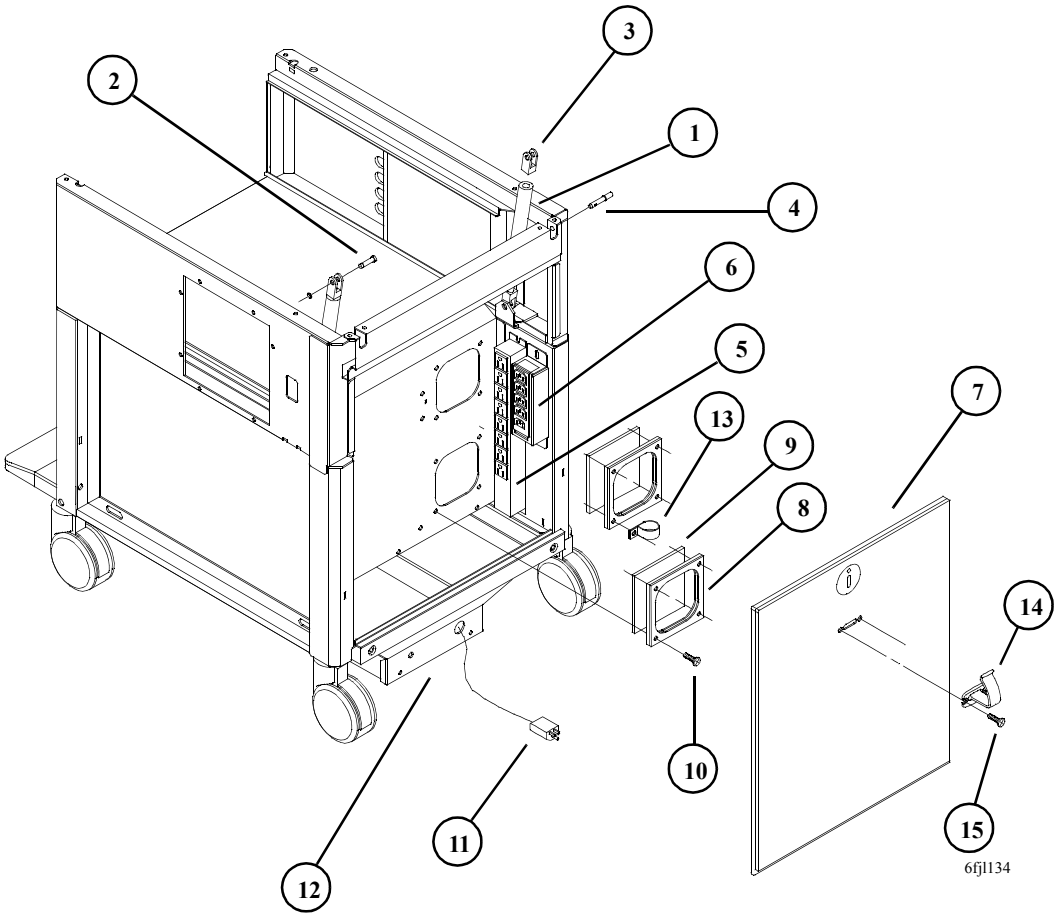


Table 8-19 Cart Body, Rear View-C2, Replaceable Parts

ID	Description	Part Number	Comments
C2	***Cart Body, Rear View*** *(See* Figure 8-13*.)*		
C2-1	Strut, gas	77922-80000	Without pins and fittings.
C2-2	Pin, strut hinge	1480-1042	Includes “C” clip for both top and bottom of the strut.
C2-3	Fitting, strut end	77922-20010	
C2-4	Pin, gas strut	1480-1050	4 ea.
C2-5	Power strip, 110 volts	77922-63000	
C2-6	Power strip, 220 volts	1252-5497	
C2-7	Assembly, cart rear door	77922-69150	Does not include cable holder.
C2-8	Filter cover, internal	77922-00500	Top and bottom are the same.
C2-9	Filter, internal	77922-80130	4.75 x 4.75 inches.
C2-10	Screws, filter cover	0515-0380	4 ea.
C2-11	Cord assembly, power		See Table 8-11, page 8-25.
C2-12	Panel, cart rear, lower	77922-00570	
*	Label, power	77922-80170	
C2-13	Clamp, cable	1400-0036	
C2-14	Holder, cable	77922-40050	
C2-15	Screw, cable holder	0515-0380	

* Not Shown

Figure 8-14 Cart Body, Front—C3 Exploded View Diagram

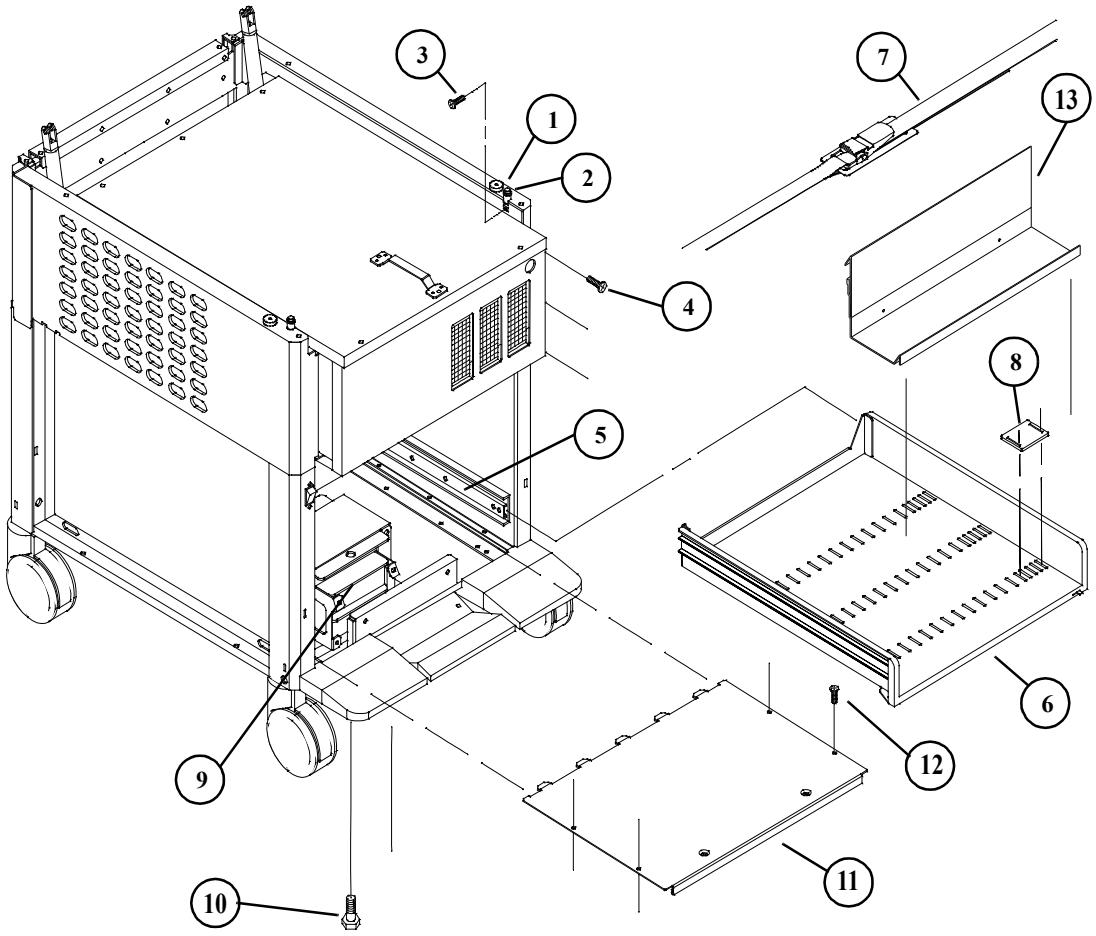


Table 8-20 Cart Body, Front-C3, Replaceable Parts

ID	Description	Part Number	Comments
C3	***Cart Body, Front*** *(See* Figure 8-14*.)*		
C3-1	Bumper, rubber	0403-0792	
C3-2	Latch pin, cart top	77922-20000	
C3-3	Screw, latch pin	0515-0380	
C3-4	Screw, E-box mounting	0515-0380	
C3-5	Rails, shelf	NA	Rails come with peripheral shelf.
C3-6	Shelf, peripheral	77922-69050	Comes with rails
C3-7	Strap, peripheral shelf	77922-80290	
C3-8	Rubber foot, peripheral	77922-80280	Goes under all peripherals.
*	Screw, ground wire	0515-0380	
C3-9	Transformer	77921-60010	
C3-10	Bolt, transformer	0515-2466	
C3-11	Cart cover, bottom	77922-00590	
C3-12	Screw, cart cover bottom	0515-0380	
C3-13	Assembly, bin	77922-61100	

* Not shown.

Figure 8-15 Cart Top Assembly, Front View—T0 Exploded View Diagram

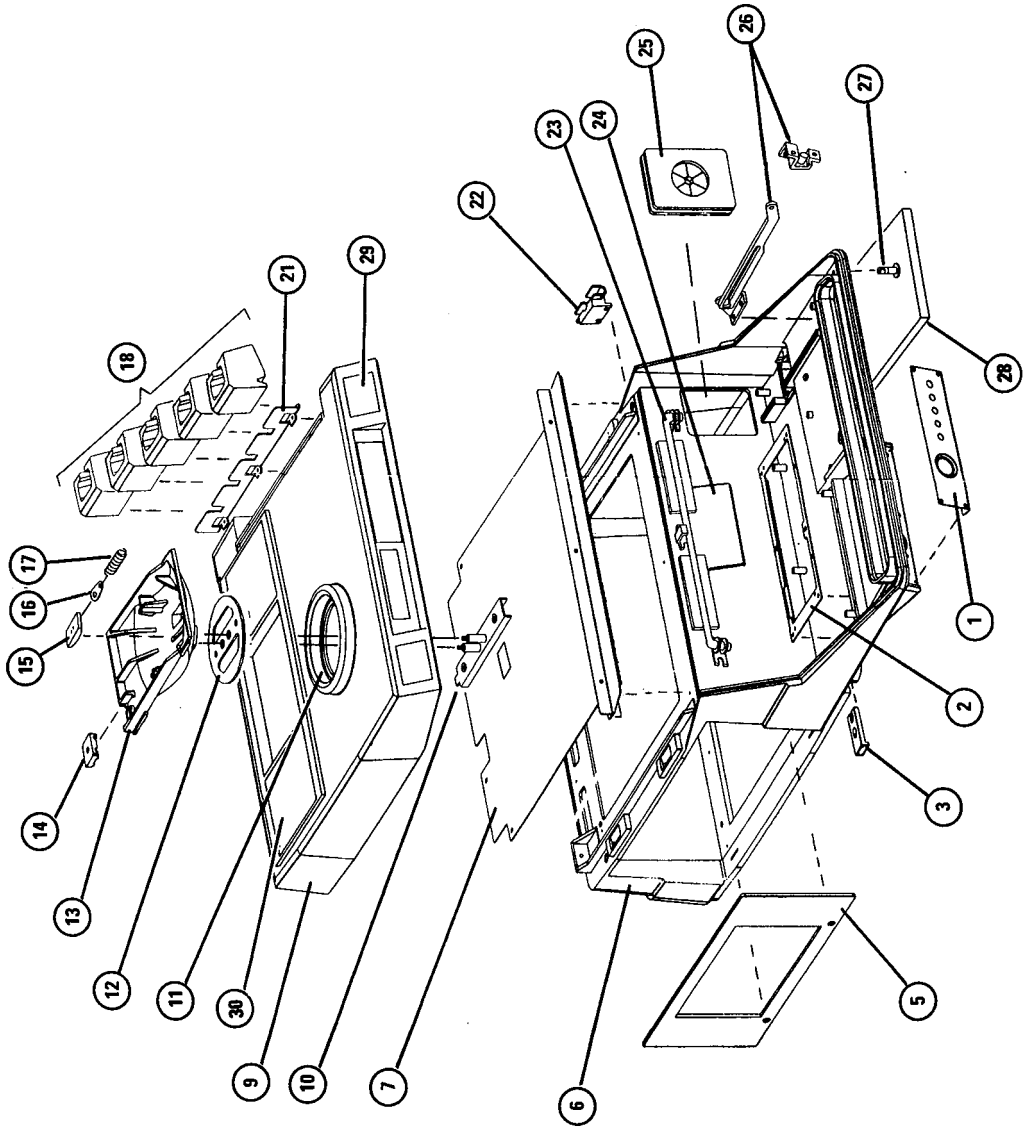


Table 8-21 Cart Top Assembly, Front View-T0, Replaceable Parts

ID	Description	Part Number	Comments
T0	***Cart Top Assembly, Front View*** *(See Figure 8-15.)*		
T0-1	Physio Front Panel for Options L10-L15 (ECG Extended)	77921-62640	Screw (4) 0515-1102. English. See LANGUAGE options Table 8-10, page 8-23. See Board Listing and Exchange No.s in Table 8-7, page 8-17 for Physio PCB P/N.
T0-2	Physio Bottom Bracket	77921-00480	
T0-3	Latch	77921-22040	Screws 0515-2043
T0-4	Deleted		
T0-5	Front Panel	See comments.	P/N dependent on peripheral options. Refer to OEM installation information.
T0-6	Cart Top Base	77921-20012	Glacier Grey
T0-7	Base plate top cover	77922-69160	
T0-8	Deleted		
T0-9	DSR Garage	77922-20110	Glacier gray
T0-10	Stop Bar, Twivel	NA	See T0-12
T0-11	Liner Bearing, Twivel	77921-40240	Plastic insert
T0-12	Retainer Ring, Twivel Kit	77922-69070	Includes stop bar (T0-10)
T0-13	Twivel Pad Base Assy	77921-87482	
T0-14	Cable Strain Relief	77921-40172	Screw 0515-2392 Cable clamp (large) 1400-0018 Cable clamp (small) 1400-0017
T0-15	Washer, Twivel	77921-22310	
T0-16	Spring Clamp	0360-1362	
T0-17	Tension Spring	1460-2386	

Table 8-21 Cart Top Assembly, Front View-T0, Replaceable Parts *(Continued)*

ID	Description	Part Number	Comments
T0-18	Transducer Holder	77921-40415	Use with all probes except endocavity probe (21336A).
	Transducer Holder Adapter	21390-40415	Use with 21390A
	Endocavity Transducer Holder	77922-40170	21336A
T0-20	Deleted		
T0-21	Transducer Holder Support Rack	77921-01190	Screw 0515-1269.
T0-22	CW Holder	77921-42392	Screw 77921-22422.
T0-23	Service Support Arm/Bracket Assy	77921-67400	Screw (6) 0515-0380.
T0-24	PCB, Crossover filter	77922-60200	
T0-25	Thermal Plug Grommet	77921-80520	Foam-like material.
T0-26	Keyprocessor Electronics Hinge/Mntg Bracket Assembly	77921-87470	Screw (4) 0515-2043.
T0-27	1/4 Turn Screw	1390-1036	2 (new style) 0510-1636 screw keeper
TO-28	Shelf assembly, writing	77922-69060	
*	Bracket	77922-00630	
*	Transducer Cable Manager—Extra	77922-40050 77922-00890 0515-0380 0515-1269	For Cable hook, glacier For Mount, cable hook For 2 Screws, M4 10mm pan For 1 Screw, M4 10mm fl
TO-29	Speakers, front (Left & Right)	9164-0730	Screws, 0515-0380 Grill, 77922-80150
TO-30	Speakers, rear (Left & Right)	9164-0729	Screws, 0515-2245 Grill, 77922-80160
*	Latch Kit	77921-87475	
*	Cable hook, auxiliary, Glacier	77922-40050	Cable hook mount 77922-00890 Screw 0515-0380 Screw 0515-1269

*Not shown.

Figure 8-16 Cart Top Assembly, Rear View—T1 Exploded View Diagram

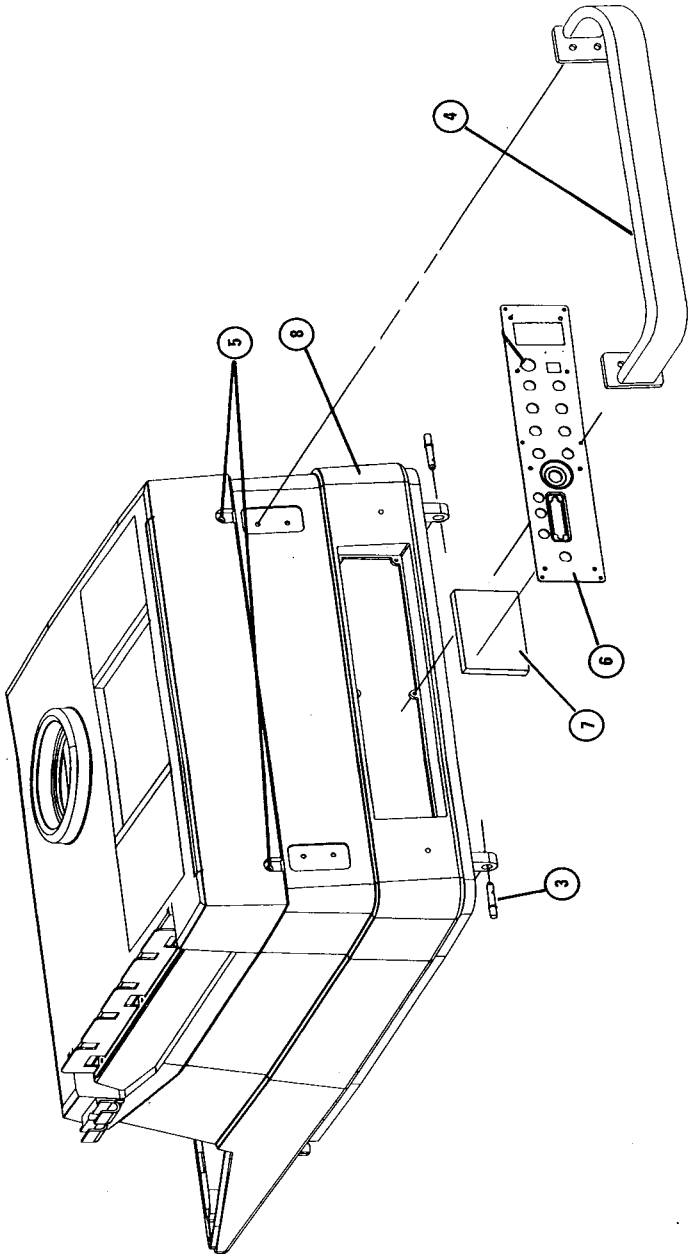


Table 8-22 Cart Top Assembly, Rear View-T1, Replaceable Parts

ID	Description	Part Number	Comments
T1	***Cart Top Assembly, Rear View*** *(See* Table 8-18*.)*		
T1-1	Deleted		
T1-2	Deleted		
T1-3	Pin, Hinge Cart Top	1480-1050	2 ea.
T1-4	Rear Handle, Cart Top	77921-64502	Screw (4) 77921-22422
T1-5	Rear Screw, Top Cover	77921-22422	
T1-6	System I/O Panel	77922-00900	Universal for languages. May require LAN connector 1252-6178. BNC Coax adapter (7) 1250-0583.
	System I/O Panel with AQ Dataport	77921-01450	'Print' BNC right angle (1) 1250-0076.
T1-7	System I/O PCB	77921-60400	
T1-8	DSR Garage	77922-20110	Glacier Grey

Figure 8-17 15-Inch Color Monitor—M0 Exploded View Diagram

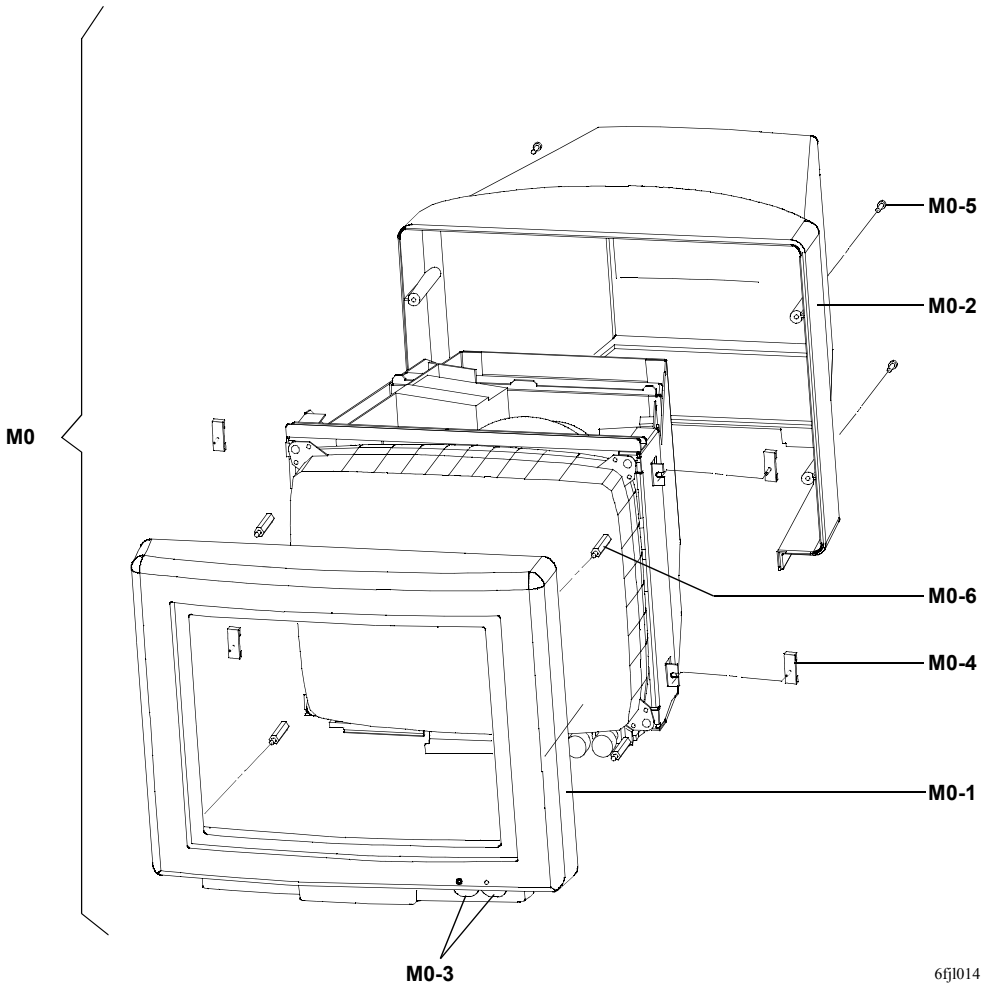


Table 8-23 15-inch Interlaced Color Monitor-M0, Replaceable Parts

ID	Description	Part Number	Comments
M0	Monitor,15-inch interlaced (See Figure 8-17.)	2090-0542	Exchange part # M2409-68000 monitor assembly includes all parts listed below.
M0-1	Bezel, glacier gray	77921-42602	
M0-2	Housing, glacier gray	77921-72612	
M0-3	Knobs (brightness/contrast)	77921-40182	
M0-4	Bezel shock mounts (4)	77921-22440	
M0-5	Housing screws (4)	0515-2876	
M0-6	Locknuts (4)	77921-22460	
*	Housing rear label New Monitor Base 12 mm screws (4) Tie Wraps (4)	77921-80392 77921-42622 0515-0382 1400-0249	

* Not shown.

Table 8-24 15-inch Color Non-Interlaced Monitor-M0, Replaceable Parts

ID	Description	Part Number	Comments
M0-1	Monitor,15-inch color (non-interlaced)	2090-0355	Exchange part # M2409-68100

Figure 8-18 Floppy/DSR-J0 Exploded View Diagram (Earlier version)

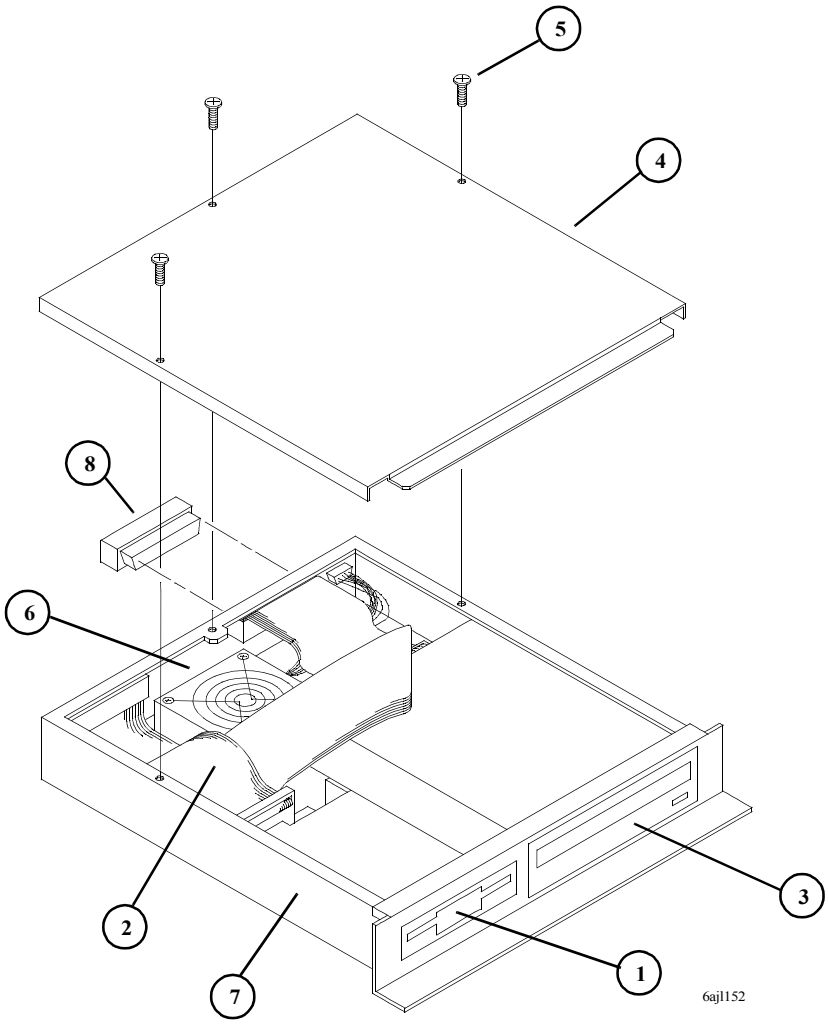


Figure 8-19 Floppy/DSR Housing-J0 Exploded View Diagram (Later version)

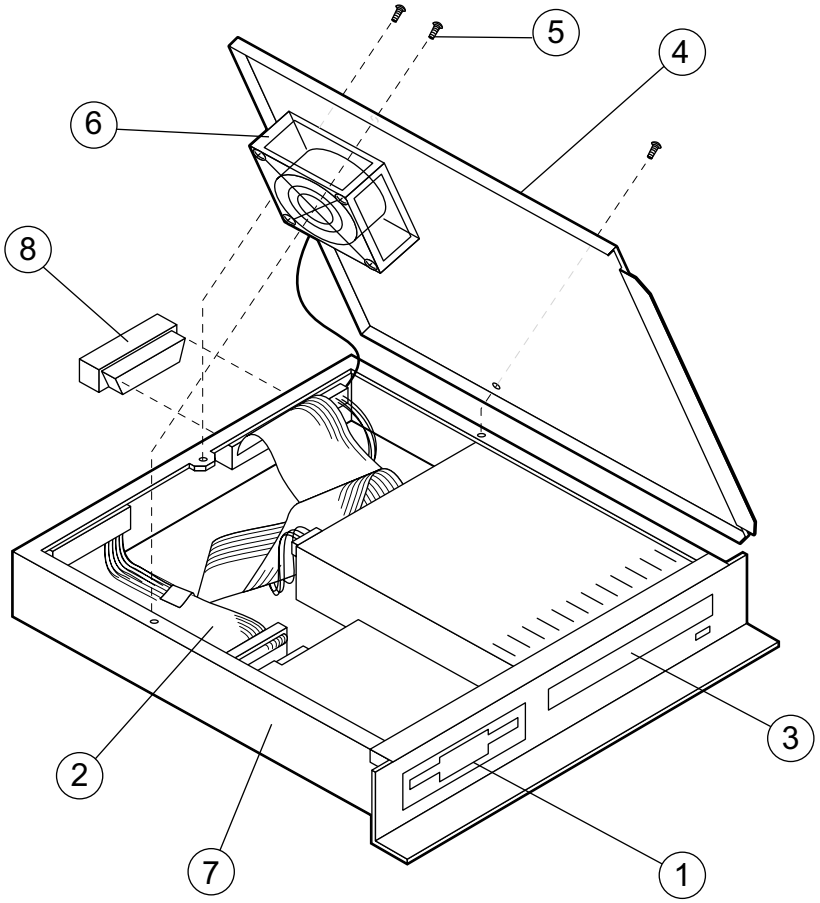
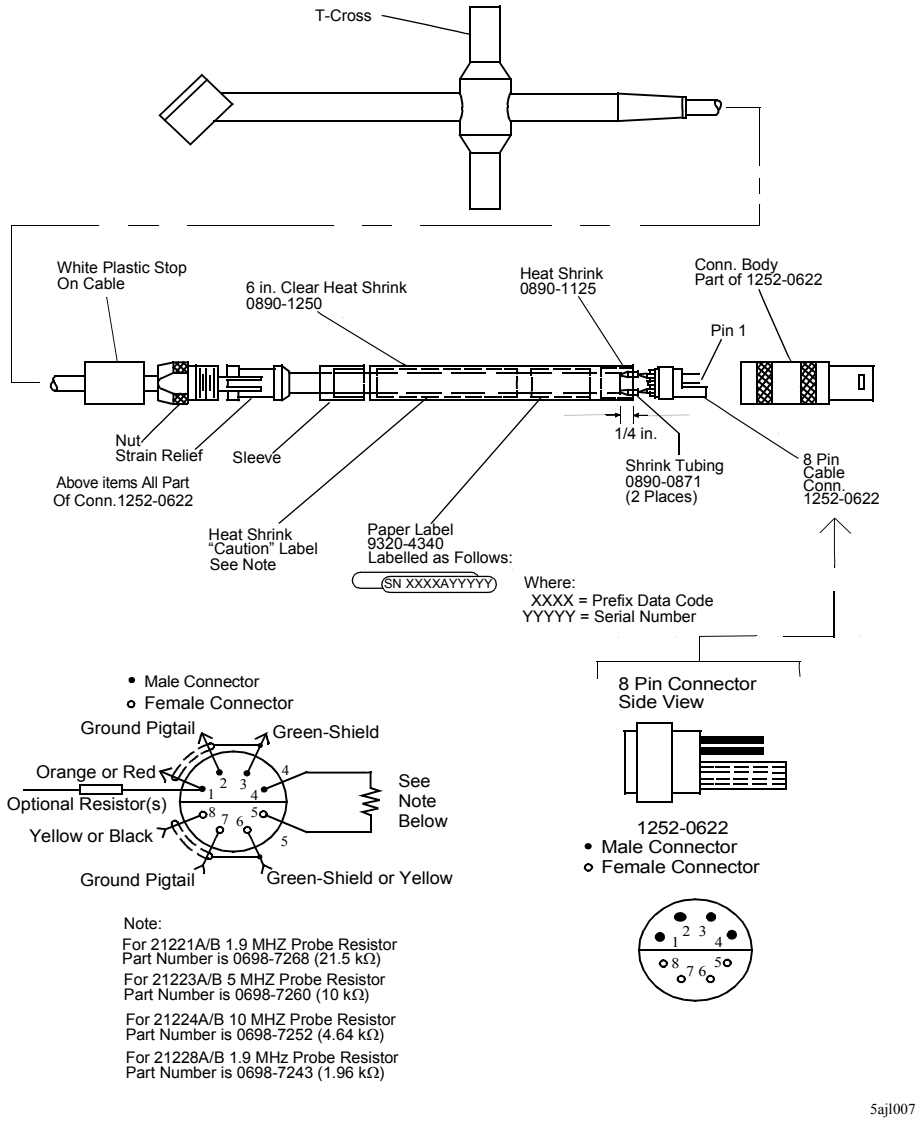


Table 8-25 Floppy/DSR Housing-J0, Replaceable Parts

ID	Description	Part Number	Comments
J0	***Floppy/DSR Housing*** *(See* Figure 8-18 *and* Figure 8-19*.)*		
J0-1	Drive, floppy	0950-9074	
J0-2	Cable, SCSI	77922-64040	Includes rear I/O connector.
J0-3	Drive, DSR 4X	0950-3033	77450-68300 (Exchange) Front Panel: 4040-2330 4X label: 77450-80200. Blank DSR panel: 77922-00870 Blank panel: 77922-00880 Blank panel screws (2 required): 0515-2858
	Drive, DSR 8X	0950-2866	77450-68400 (Exchange) 5.2 GByte Optical Drive Repair Parts: 8X Optical Drive: 77450-68400 8X DSR Label part: 77450-80201 Plastic bezel part: 4040-2330
J0-4	Top Cover	77922-00360	For systems without DSR.
J0-5	Screws, top cover	0515-0380	
J0-6	Fan	77922-64050	Includes power cable.
J0-6a	Fan Assembly Upgrade	77922-60365	To improve air circulation. New top cover included.
J0-7	Chassis, drive assembly	77922-69040	Includes front panel, rear mounting bracket, chassis, and top cover.
J0-8	Resistor, terminator	1252-3251	
	Storage Caddy	77922-62450	
*	Strap, DSR ground	77922-64170	
*	Top Cover kit	77922-60365	Includes cover, clamp, rivets

* Not shown.

Figure 8-20 Model 2122XA/B Probe Wiring Exploded View Diagram



9 Theory of Operation

Introduction

This chapter provides the reader with a basic understanding of system architecture, and an overview of the basic functions for each of the circuit boards. For convenience and clarity, the system is divided into the following two sections:

- **The Keyscanner Control Electronics**—All keyboard controls, electroluminescent displays and touch panels, Physios, Audio, and I/O interface.
- **The Main E-Box Electronics**—Transducer interface, Scanner, Scan Converter, and I/O interface.

The RGB color monitor and the main power supply are serviced by exchange, so they are not covered in detail. For troubleshooting information for these components, see Chapter 3, “Service Data.” For power distribution information, see Chapter 7, “Wiring and Cabling.”

NOTE Block diagrams are located at the end of this chapter. They can be used as a general troubleshooting tool, in addition to aiding in understanding the theory of each board.

Section 1: Keyscanner Control Electronics

The *Keyscanner* is a broad term which consists of all of those circuit boards and associated hardware located above the E-Box in the top 1/3 of the system. These circuits act as the interface between the ultrasound system and the operator. In addition to acting as the user interface, the Keyscanner also acts as the interface to other peripheral devices located exterior to the ultrasound system (such as external printers, VCRs, LAN, etc.).

The following section describes the details of the circuitry located in the Keyscanner section of the Sonos 4500/5500.

User Interface

The user interface consists of the panels and controls that allow the user to interact with the ultrasound machine (see area included in the dotted line box on Figure 9-1 on page 9-22).

The user interface includes the following boards and assemblies:

- 2 electroluminescent (EL) displays and resistive touch screens
- 2 Main PC boards (Function and QWERTY keyboard)
- 2 Daughterboards (these plug into the Function and QWERTY keyboards)
- A Trackball
- A microphone and LED status indicators

All of these components interface directly to the Keyscanner/Audio board, which constantly scans the user interface for user input. Two EL panels are used to display soft keys, which change depending on the application selected. Resistive touch screens overlay the EL panels to allow selection of a function in a particular illuminated area on the EL panel.

The touch screen consists of two transparent sheets with a transparent conductive coating on the sides facing each other. There is a grid of miniature separator dots between the two sheets, to keep them from touching without external stimulus. Finger pressure causes the outer sheet to contact the inner sheet at the position of touch. The connector and ribbon cable is delicate and should not be bent with a radium smaller than 1/4 inch.

The keyboard is a standard “QWERTY” configuration; the keys are in a standard keyboard layout with the top row beginning with these keys: Q W E R T Y.

DSR & Service Floppy Drives

The DSR (Digital Storage & Review) drive and the Service floppy disk drive are both located in the Keyscanner section of the ultrasound system. The DSR drive is controlled by the DSR-SCSI (the TurboCine board at Rev. C.0) board located in the E-Box. The SCSI cable is connected directly to the E-Box and not to any other Keyscanner circuitry. The power for both the DSR drive and the floppy disk drive comes from the Crossover Filter Board, which is located on the rear interior wall of the Keyscanner section. The floppy disk drive is controlled by the Processor Graphics board, and communicates through the SCSI cable.

System I/O Board

The System I/O board is located at the rear of the system, mounted to the System I/O panel, and interfaces to the Main I/O board. This board is primarily responsible for allowing the system to communicate with other devices not contained on the ultrasound system.

Several auxiliary signals for connection to remote devices are provided through this board. These include (see Figure 9-1 on page 9-22):

- External audio output connectors (left & right)
- Footswitch interface
- Physio output
- Serial output

In addition to the signals that originate from the Controller's Main I/O board, numerous signals also originate from the E-Box I/O, and exit the system through the System I/O. These additional signals include:

- LAN connection (for Digital Network Interface/Integrated Digital Interface)
- Stripchart output (optional internal cable required)
- SVHS video output
- B/W video output
- Composite video output
- RGB sync. output
- AQ wave output
- Print trigger

Keyscanner/Audio Board

The main function of the Keyscanner/Audio board is to read inputs from the control panel or alternative control source (such as audio inputs or peripherals), and send the commands to the E-Box via RS-232C.

The Keyscanner board acts as the central processor for the Controller section. It contains its own operating software, which can be loaded by means of the Service floppy disk drive, or in an emergency situation, by using a flash card (via on-board PCMCIA slot). A four digit LED display is provided on this board for error codes. The LED display is self-scanned independent of the on board processor. This allows the last error code to remain visible in the event of a software crash.

The following distinct functions are performed on this board:

- Audio processing
- Video control to the EL panels
- VCR interface
- Input conditioning for rotary encoders
- Scanning of front panel keys
- Decoding of LED drivers
- Board contains the removable system option ROM

Physio Board

The functions of the Physio board include:

- Detection of an ECG waveform through three electrodes, and processing to obtain three waveforms (Sector ECG, Doppler/MMode ECG, and an R-wave pulse). Signals are routed to the PVT board in the E-Box.
- Detection of a respiration waveform through the RA/LA ECG electrodes, and processing to obtain a waveform for the E-Box PVT board.
- Heartsound amplification and filtering from a Heartsound Transducer to obtain an audio output and a waveform to the E-Box PVT board.
- Pulse waveform processing from a pulse transducer to obtain a waveform for the E-Box PVT board.

The following sections provide specific details related to Physio signals generated.

ECG

ECG patient signals are derived from three leads: RA (right arm), LA (left arm) and RL (right leg). These leads are housed in a shielded cable whose shield is at a floating ground potential. From the patient cable, signals are processed through high voltage protection circuitry which resides on the Physio I/O board. The board contains current limiting carbon resistors and voltage limiting neon lamps to discharge differential static or common mode ESD or defibrillation events. It also contains an 800 volt spark gap device between the floating ground and instrument ground.

Respiration Waveform

The principle of respiration measurement is as follows:

A carrier signal of known frequency is applied across the patient via the RA and LA ECG electrodes. Breathing changes the effective impedance across the thorax which causes the carrier to be modulated, creating a signal made up of a large static component that reflects the respiration. This small signal is coupled via a optoisolator, amplified and filtered to a final bandwidth of 8Hz.

Heartsound

The Heartsound signal processor amplifies and filters heartsound audio signals in the range of 25 to 1800 Hz, received for the Heartsound Microphone.

It consists of a low noise high gain input amplifier. The output is AC-coupled to remove the offset created by the input amplifier. It is then low pass filtered by two second order stages which create a cutoff at 2 kHz with 24dB/octave rolloff.

Pulse

The Pulse signal processor amplifies and filters Pulsation signals in the range of 0.15 to 150 Hz, received from the Pulse Microphone.

It consists of a simple high gain non-inverting amplifier input stage, which AC-couples (corner frequency = 0.5 Hz) into a unity gain buffer amplifier and filter (corner frequency of 100 Hz.). It is then followed by two gain stages.

Physio I/O Board

The Physio I/O board contains the input connectors to which the physio transducers (or auxiliary inputs) are connected. It also contains the ECG input connector, ECG

high voltage protection circuitry, and the headphone port. All connectors are PC mounted and grounded to the chassis. The headphones are connected via resistors to match the drive level to speakers.

Contacts in the headphone jack disconnect the cart speakers when the headphones are plugged in. When the headphones are plugged into the Physio I/O board, the speakers will be disabled.

Physio Control

The setup menu allows the user to select which Physio inputs appear on the primary display. In addition, it provides access to controls which vary the ***position*** and ***gain*** of each channel, ***invert*** a waveform, and control the application of an internal ***test signal***.

Main I/O Board

The Main I/O board performs the task of interfacing the Keyscanner/audio and Physio boards to the many functional components of the system:

- The E-Box via RS-232
- The VCR via a 34-pin parallel or RS-232 interface
- The speakers
- The DC power supply
- Various signals to/from the system I/O board
- Stereo audio to/from the VCR
- Audio/Physio signals to/from the E-Box
- Two spare serial ports for future use

Crossover/Filter Board

The Crossover/Filter board has two functions. The crossover circuitry buffers and splits the left and right speaker drive outputs from the Main I/O board in order to drive four speakers. The filter circuit isolates +/-12V to the crossover circuit mentioned above, +12V to the EL panels, and +12V to the DSR/floppy drive and DSR fan, from the dynamic currents created by these loads. The object is to prevent these circuits from causing voltage variations in the power to the Front End boards which could result in spurious Doppler tones. The Crossover board accomplishes this by maintaining a constant “load” on the system’s power supply.

Section 2: E-Box Electronics

Scanner Section

The Scanner (also called the Front End) subsystem is responsible for transmitting and receiving acoustic signals to and from a target via a transducer. The acoustic information is then processed to extract the Doppler, Color flow, M-Mode, and 2-D signals, which are then sent to the Back End sub-system to be further processed. For a block diagram of the Scanner sub-section, see Figure 9-2 on page 9-23.

The Scanner section of the E-Box is divided into two sections that are separated by a metal septum. The side of the septum closest to the front of the E-Box is the analog section that consists of:

- The Distribution board
- Four Front End boards
- A Clock board
- The Power Regulator board

These boards are physically separated (by the septum) in order to reduce noise which could be injected into them from the digital circuits. The rear half of the Front End section is digital and consists of:

- The four Beam boards
- A DSCC (Digital Scanner Coefficient Computer) board
- The Beamformer I/O board
- The Digital Image Detector

Following are functional descriptions of the Scanner circuit boards.

Distribution Board

The Distribution board has no signal processing capability. It acts as a conduit and switch through which transmit and receive signals pass between the E-Box and one of the four transducer connectors (three imaging transducer connectors and one pencil probe connector).

The board has two basic functions:

1 **EPROM interface**—transducer identification information is transmitted from the circuitry inside the transducer connector to the Beamformer I/O (via the FEPI and FESI buses) so that the system will know what kind of transducer it is interfacing with.

2 Electro-mechanical relay switches on the Distribution board select which transducer is to be selected and also turns power on and off to each transducer. Power will be turned off to any given connector if there is no probe attached. In an effort to reduce noise and reduce the possibility of "naughty neighbor" problems, mechanical relays (versus diodes) are used to switch each of the 128 channels on and off. The board "senses" the insertion or removal of a probe and will cut off power to the connectors during transition periods, or when no probe is present.

This board receives signals from the Clock board, the Power Regulator board, and the four Front End boards.

Front End Boards (4)

The Front End board provides two primary functions: it transmits signals and it receives signals. The transmit drivers provide transmit pulses for the transducer elements. There are 32 channels of drivers on each board. Transmit voltages are provided by the Power Regulator board. Small reflected signals are returned to the system and received by the Front End boards where each channel is buffered, amplified (TGC/Time Gain Compensation), and filtered. The only transmit and receive signals that do not pass through these boards are the signals to the stand-alone CW/PW pencil probes.

The Distribution board and four Front End boards form the "analog" RF signal path for the Scanner. The Receive RF signals are sent on from the Front End boards to the Beam boards where they are digitized. The CW Doppler signal (from non-pencil probes) path is separated from the Receive RF signals in the Front End boards and sent to the Digital Doppler board by way of the Clock board (see Figure 9-2 on page 9-23).

Clock Board

As the name implies, the primary purpose of the Clock board is to provide clocks to all circuit boards in the E-Box (some boards generate their own clocks, but they use clocks from the Clock board as their primary generator source). The Clock board sits in the analog section of the Scanner.

Other features of this board include:

- Provides a number of different clocks (40 MHz, 80 MHz, 60 MHz, 20 MHz, etc.) to be used throughout the Scanner.

NOTE

The Back-end of the E-Box can operate without this board by switching the toggle switch on the Digital Scanner I/O board to the "local" position. In this position, the Scanner I/O generates its own clock.

- Supplies the transmit and receive functions for the stand-alone CW/PW probes. Power for these probes comes from the Power Regulator board. These signals are sent “directly” to the Distribution board’s Lima connector. The Clock board filters and mixes the return signals into two identical analog CW/PW signals (I & Q) which are 90 degrees out of phase from one another.
- Contains a toggle switch that switches the system from NTSC to PAL (video standard) operation.

Power Regulator Board

The primary purpose of the Power Regulator board is to provide regulated transmit voltages to the Front End boards. These voltages include: +170V, + 85V, and +24V. Other features of this board include:

- A temperature sensor on the board’s heat sink which will shut transmit power down if the heat sink becomes too hot.
- Safety circuitry for the TEE probes. It monitors the probe’s thermistors and will shut off power if probe temperature exceeds established limits. Temperatures are read back to the Beamformer I/O board where the decision is made whether or not the Power Regulator should shut down power to the probes.
- Controls and provides voltages for the motors inside the Omni TEE probes and the Transthoracic Omni probe.
- The digital logic needed to program the active multiplexers in the linear array transducers. A ROM-based sequencer is used to set each multiplexer so that the proper transducer elements are connected to the receive channels before each line is transmitted and received.
- Control signals from the Beamformer I/O board are passed through this board and on to the Front End boards (by way of FESI and FEPI buses). See Figure 9-2 on page 9-23
- The Power Regulator board must be operating in the Scanner in order for minimum Scanner functions to take place because this board provides the power necessary to operate the Clock board.

Beam Boards (4)

The primary purpose of the four Beam boards is to convert the RF Receive signals into a digital format by means of A to D (analog to digital) converters. Each of the four boards can convert 32 analog channels coming from the Front End boards. These four Beam boards are “daisy-chained” together. Signals are sent from the first Beam board to the second where these signals are “summed” together. They are then sent to the third and fourth Beam boards where they are summed again and again until there are two beamformed (summed) signals containing all 128 channels of information. These two summed signals are called the X and Y signals and they are identical. They constitute an identical parallel data path. This parallel data path gives the system additional capability to provide improved image quality. Additional features of this board are:

- The parallel X and Y signals are sent to the Digital Image Detector.
- These boards perform coarse delay and fine delay (which allows for steering the beam) and filtering and digitizing functions on the incoming analog signals.

DSCC Board

The primary function of the DSCC (Digital Scanner Coefficient Computer) board is to calculate and distribute the Receive Coefficients for use by the four Beam boards as they perform beamforming. The DSCC board is primarily just a slave processor with a large amount of RAM (random access memory) to hold the coefficients until they are ready to be sent to the Beam boards. The DSCC is controlled by the Beamformer I/O board (via the Processor Bus) which is the primary processor of the Front End section.

Beamformer I/O Board

The Beamformer I/O board is the central processor for the Scanner section of the E-Box. It utilizes a 32 bit microprocessor and co-processor. This board communicates to the other boards in the Scanner by way of the Processor Bus. Functions of this board include:

- Contains the software needed to operate the Scanner. Software can be loaded onto this board by means of a the Service Floppy Drive, or in an emergency situation, by using a Flash card in the PCMCIA slot of this board. The board contains a large amount of RAM to store control instructions. The board can also be programmed by using the Service Floppy disk drive (assuming that the entire system is operational).
- Provides the frame timing (or scan sequencing) for the Front End boards.

- Provides Transmit Coefficients for the Front End boards.
- Acts as a “control” connection between the Back End of the E-Box and the Front End of the E-Box by way of the RS-232 bus (see Figure 9-2 on page 9-23).

Digital Image Detector

The Digital Image Detector receives parallel data from the Beam boards on the X and Y data buses. When it receives these data signals, it performs filtering, mixing, and detection on the 2D, Color Flow, M-Mode, and Doppler (PW only) data. It then sends the data “over-the-wall” to the Back End section of the E-Box. More specific functions on this board include:

- Sends signals to the Front End boards to control the way that these boards perform the front TGC (Time Gain Compensation) function. (TGC is performed in two places, once in the Front Ends, and again in the Digital Image Detector).
- Performs rear TGC functions and RF filtering. TGCs increase or decrease signal gain for a given amount of time.
- Using the X & Y buses, this board performs all functions in a parallel manner to increase image quality.
- The Digital Image Detector can operate in any one of 16 different operating “modes” depending on the type of signal it is processing (Color Flow, 2D, etc.). The Mode Control signal is sent to the Back End along with data signals so that the Back End knows what kind of data signal it is receiving and thereby process it correctly (see Figure 9-2 on page 9-23).
- A portion of the Edge Enhancement function takes place on this board (part is also done on the Digital Scanner I/O).
- 2D, M-Mode, and Color Flow data is sent on to the Digital Scanner I/O in the Back End section for further processing.
- PW Doppler data is send to the Digital Doppler board in the Back End section for further processing.

Analog Motherboard

The Analog Motherboard resides in the very front end portion of the Scanner and provides the interconnects for the analog boards in the Scanner (see Figure 9-4 on page 9-25). It is physically separated from the digital portion of the Scanner to reduce noise that might be introduced into the analog data signals. The daughter boards that plug into this board are the Distribution board, four Front End boards,

the Clock board, and the Power Regulator board. Signals that pass through this board are (see Figure 9-2 on page 9-23):

- FESI Bus (Front End Serial Interface)
- Transmit Coefficients (from Power Regulator)
- Analog Transmit and Receive Signals

There are no active components on this board.

Digital Motherboard

The Digital Motherboard provides the interconnect paths for the digital buses which run through the Scanner sub-system. The daughter boards that plug into the Digital Motherboard (see Figure 9-4 on page 9-25) include:

- 4 Beam boards
- DSCC board
- Digital Image Detector
- Beamformer I/O
- The Digital Scanner I/O

Signals that are found on this board include:

- Receive Coefficients Bus
- Processor Bus
- Y & X Sum Buses
- 2D, M-Mode, and Color Flow Data signals (to Digital Scanner I/O)

There are no active components on this board.

Communications Motherboard

The Communications Motherboard provides the interconnect paths for processor communications and power distribution to all of the daughterboards of the Scanner section. There is a “porch” extension on the board to act as a bridge to route the high voltage supplies from the Back End section to the Scanner section of the E-Box. Some of the power supply filtering needed by the Scanner is located on this board along with the power bus bar connections for the high current supplies (3.3V, + 5V Digital, and + 5V Analog). Note that the Analog 5V power is separated from the Digital 5V supply in an effort to reduce noise and because they have different current requirements.

Signals or voltages on this board include:

- +/- 12 Volts
- +/- 170 Volts
- + 85 Volts
- + 24 Volts
- - 5 Volts
- Transmit Coefficient Bus
- Receive RF Signal (to Beam boards)
- FESI Bus (Front End Serial Interface)
- Clocks from the Clock Board
- + 5 Volts Digital (via bus bars)
- + 5 Volts Analog (via bus bars)
- + 3.3 Volts (via bus bars)

Scan Converter Section

The primary function of the Scan Converter is to convert a frame of acoustic data from its native coordinate system, draw it into an X-Y organized frame buffer and make it available for display on the system's video monitor. The Scan Converter parameters are configured to compensate for input data sample density and line density, to set the size of the image on the screen, to magnify a particular region of interest, and to adjust the image's aspect ratio for NTSC or PAL video systems. For a block diagram of the data flow for this section, see Figure 9-3 on page 9-24.

The Back End (Scan Converter) sub-system receives signals from the Front End (Scanner) and further processes these signals. Signals are processed and quantized to present information to the clinicians in a usable format. This information can take the form of audio data, video data, or measurements.

Processor/Graphics Board

The Processor Graphics board consists of a main processor section and a graphics-generating section:

- **Processor**—The Processor Graphics board contains the main processor and its associated software for operating the Scan Converter boards via the back-plane processor bus. The processor is clocked by the 10 MHz clock used for the non-video portion of the Scan Converter.

- **Graphics**—The graphics section contains eight graphics planes of bit maps. The Processor Graphics board generates graphics information which is stored in RAM as a single bit for each screen pixel for each plane. A video system controller chip controls the graphics dynamic memory and updates to the video bus.
- **Battery**—The Processor Graphics board uses a non-charging, lithium battery (3.6V nominal). It supplies the battery-backed RAM and is located in a socket on this board.
- This board contains operating code in flash ROM which controls the Scan Converter section. The software can be loaded onto this board using a flash card (via on-board PMCMIA card slot) or by using a Floppy disk.
- The board contains a four digit LED which will give software loading information and also error codes.
- The Processor Graphics board is also responsible for controlling the data transfer that occurs on the SCSI cable to and from the support floppy disk drive, and the DSR circuit board.

Digital Scanner I/O

The Digital Scanner I/O board acts as the interface between the Back End and the Scanner section. Signals, both data and control, use this board to bridge the gap from the Communications Motherboard to the Backend Motherboard. It also serves as the bridge from Back End to Front End for the high voltage power supplies. This board receives digital signal data (2D, Color Flow and M-Mode) from the Front End and performs some processing of these signals. It then separates these signals depending on the line type as defined by the Mode Control signal, and sends the appropriate signal to other Back End boards for further processing (see Figure 9-3 on page 9-24).

More specific functions of this board include:

- It re-samples the digitized, log-detected image and baseband I & Q flow signals from the Scanner. It performs some simple signal processing on the data: gray scale compression mapping, and M-Mode edge enhancement filtering.
- The Digital Scanner I/O temporarily stores the processed data, and then sends it out to the Flow Processor, AQ, R-Theta-AC (Acoustic Cine), and Stripchart back-end boards whether rearranged, or just delayed, as required. Data is dispersed to other boards as follows:

a. **2D**—2D detected data is resampled and applied to the compression ROMs for grayscale mapping. The data is then sent to the R-Theta-AC board along with output timing signals.

b. **M-Mode**—The M-Mode data is resampled by the same A/D converter as 2D and also passes through the same compression ROMs. Once it has been processed, it passes from the Digital Scanner I/O board to both the PVT board and to the Stripchart board.

c. **Color Flow**—The Color Flow baseband I and Q components are digitally resampled. Color data is then buffered while one full color packet is acquired; then, the flow data is read out to the Flow Processor board.

d. **AQ—**2D detected data is resampled. The data is then sent to the AQ board along with output timing signals. It is labeled as 2D because it is the same as the 2D signal except that it does not contain compression.

- The Scanner I/O board contains its own internal clock. In the “Local” position it provides the 10 MHz clock needed to operate all of the Back End section of the E-Box without needing the Clock board. In the “60” position, the Scanner I/O is using the 60 MHz clock from the Clock board to generate clock signals that it passes on to the other boards in the Back End.
- The Digital Scanner I/O board passes control signals to the Front End of the E-Box by way of the RS-232 control bus.

Digital Doppler

The primary function of the Digital Doppler board is to process Doppler signals. To accomplish this, the Digital Doppler board communicates with six other boards in the E-Box:

- The Processor Graphics board controls the Digital Doppler board through the Processor Bus
- The Image Detector supplies range gated data in PW mode
- The Digital Scanner I/O supplies the clocks
- The Clock board supplies the analog baseband I and Q signals in CW mode (non-pencil probe) and for the separate CW probe
- The Digital Doppler provides spectrum data to the PVT board and Stripchart board

The Controller section of the system receives data for audio signals. The audio and spectral paths of this board are further defined as follows:

- **Audio Path**—The audio path contains wall filters, a lowpass noise filter, and a rotational filter which develops the left and right audio channels. It determines left and right audio by determining the phase of the signal.
- **Spectral Path**—The spectral path contains user selectable wall filters and a low pass filter. Data from the spectral path is digitized and sent to the digital signal processor. The Processor Graphics board downloads operating software to RAM on this board. This programs the digital signal processor to perform FFT calculations on the I and Q signals and thus produce Doppler spectral data. Spectral data is sent to the screen via the PVT board. Also, a D/A converter converts the spectrum to analog form for routing to the Stripchart board.

Nyquist filtering is also performed on this board.

Digital AQ Board

The Digital AQ board provides the hardware and firmware associated with the AQ (Acoustic Quantification) and CK (Color Kinesis) features of the system. The Digital AQ board receives logged, detected, and packetized 2D data from the Digital Scanner I/O board. Once it receives the 2D data, it threshold detects it to determine if each pixel is blood or tissue.

In addition to this primary function, this board also has these additional tasks:

- Outputs data to the R-Theta-AC board for further scan conversion.
- Outputs to the PVT board which then draws waveforms on the screen.
- Calculates the area and volume waveforms.
- Sends data to the AQ Wave output on the Rear I/O panel (analog data).
- Creates the integrated backscatter signal used in AD (Acoustic Densitometry).
- Performs the Color Kinesis algorithms.

E-Box Rear I/O

The E-Box Rear I/O board acts as the point of connection for sub-system interconnects, peripheral interconnects, and E-Box power connections. In addition this board has these additional functions:

- Contains the circuitry that senses the system temperature and controls the system fan. There is a thermal cutout switch on this board which will shut down the system's power supply if the sensor reaches 75° C. The switch will reset itself when the temperature drops down to 50° C.
- The Rear I/O board contains filters that filter the power supply to the fan. If these filters were to malfunction, it could result in noisy Doppler signals.

Power Bus Board

The system E-Box has three high current power supply connections: 5V digital, 5V analog, and 3.3V. Heavy wires from the power supply bolt to threaded rods that pass through holes in the E-Box and attach to bus bars. Potentially, this connection through the E-Box shield radiates RF energy out of the E-Box. This board clamps between nuts on the threaded rods and the sheet metal adjacent to the three holes. This is a 16 layer board with interleaved power and ground layers and only 2 mil thick insulation. The board acts as a capacitor between each rod and ground and thus dissipates the RF energy. This board has no active components.

Back End Motherboard

The Back End Motherboard provides the interconnects between all of the Back End daughter boards (see Figure 9-4 on page 9-25). A "porch" that extends into the Scanner section is provided to allow the Digital Image Detector to drive the 40 MHz Scanner output data bus, the 60 MHz clock, and the various line time hand-shaking signals into the Back End brother board. This feature of the board eliminates the need for the "over-the-top" ribbon cables used on older model E-Boxes for Scanner

to Back End communications. Finally, all voltages (except +3.3, +5V A, +5V D) pass through this board to the Scanner I/O board, and into the Front End of the E-Box.

Flow Processor

The Flow Processor board receives digitized color flow I and Q data from the Digital Scanner I/O board. One complete color packet is read out to the Flow Processor. A control bit indicates if the data is 2D or M-Mode. The Color Flow I and Q data is filtered by the color process selection and is used to reduce low velocity wall artifacts. Mean flow velocity and turbulence calculations are then performed. Finally, the resulting velocity data is spatially filtered according to the smoothing configuration setting selected by the user.

DSR - SCSI Board

The SCSI (Small Computer System Interface) board adds the capability for storing and retrieving digital data to an optical disk media (DSR) and to the Network Interface (DNI or IDI). Control of the support floppy disk drive is done by the Processor Graphics board.

The following are the main circuit components of this board:

- The board contains a local microprocessor. It performs all board controls with low level, disk oriented commands received by way of the mailbox from the main 68020 chip located on the Processor Graphics board. Special DMA (Direct Memory Access) circuitry allows high speed memory transfer over the processor data bus of the Scan Converter.

NOTE

At Rev. C.0, primary transfer is on the TurboCine board.

- The industry standard, Small Computer System Interface or SCSI is used as the interface to the disk drive.

NOTE

Beginning at Rev. C.0, the DSR functionality is located on the TurboCine board.

R-Theta-AC

The R-Theta-AC board (AC stands for Acoustic Cine) scan converts 2D black and white and 2D color flow data from sector or linear format to X-Y rectangular coordinates. These data are written to X-Y addresses, one frame at a time, in the Image Memory. Each image is drawn as a series of slices, where a slice is the area of video pixels lying between two acoustic lines.

The R-Theta-AC board now contains an Acoustic Cine (AC) function that provides storage for multiple frames of 2D, Color Flow, and Mask/Turbulence acoustic data. It is implemented as three independent blocks of DRAM, each with its own control logic.

More specific functions of this board include:

- The R-Theta-AC board is responsible for providing the double-buffered acoustic input memories, the control and address-generation associated with the input buffers, the data interpolation block and the coordinate transform input and output address generation logic.
- It also provides several processing functions on the incoming acoustic data. Frames of acoustic data are collected from the Digital Scanner I/O, Flow Processor and AQ boards. Input signal processing blocks are present on the 2D data input path to perform line splicing, adaptive frame persistence, lateral line averaging, and filtering to remove dropout.
- Color persistence is also performed on this board.

Image Memory

The Image Memory board holds the memory for sector and linear images, both black and white and Color Flow. This board is also responsible for the insertion of a gray scale bar which is provided as a means for calibration reference. Finally, the Image Memory board sends these images to the Video I/O for display.

Stripchart Board

The primary function of the Stripchart recorder board is to provide hard copy data from the Image Memory board as a “frame dump” output directly to a video chart printer.

In addition, the board will process strip information on Doppler and M-Mode signals and physiological signals. A D/A converter outputs the signals directly to the strip chart recorder.

Physio/Video/Timing (PVT) Board

The Physio/Video/Timing board (PVT) performs three main functions:

- Video display—The video display system generates the sync and timing signals for the monitor and for digital video sources such as the Image Memory, Processor Graphics, CCLR, TurboCine, and the memory portion of the PVT itself. The PVT board distributes the video clock (real-time or playback) to the other Scan Converter boards. This portion of the PVT is controlled by the main processor on the Processor Graphics board.
- M-Mode/spectral memory—This part of the PVT board contains the memory for M-Mode and Doppler spectral data.
- Physio memory—There is a separate memory for physio and other wave form data. Signals from the Physio amplifier are filtered and digitized by an A/D converter on the PVT. The Physio memory acts as a graphics overlay which can be configured on or off.

Video I/O Board

The Video I/O board translates digital image data and graphics into video signals. Data in memory on the Image Memory, PVT, Processor Graphics, TurboCine, or CCLR boards is read out pixel-by-pixel onto the digital video buses and mapped to RGB signals. RGB video is also converted to composite video and S-video for peripheral devices. The Video I/O outputs drive the main video display, cameras, and printers, VCRs, auxiliary video outputs, TurboCine, and the CCLR and Image Memory boards in VCR playback. All output signals are routed via the Imager's Rear I/O panel except playback video to the CCLR, TurboCine, and Image memory boards which passes through the Scan Converter Motherboard.

Combined Continuous Loop Review (CCLR) Board

The Combined Continuous Loop Review board (CCLR) contains additional memory. Data sources for this board include the system color video bus, color components of the VCR playback signal, and black and white data during non-color modes. Color VCR playback components are digitized on the CCLR prior to storing in memory. Cine Loops acquired to the CCLR board are played back directly to the Video I/O board. Also, DSR playback goes directly to the Video I/O through the CCLR. The CCLR board contains socketed expandable memory that can be configured for either 16 MB, 128 MB, or 512 MB.

TurboCine Board

The TurboCine board combines the functionality of the CCLR and DSR boards into one board. For more details, see “Combined Continuous Loop Review (CCLR) Board” on page 9-20 and “DSR - SCSI Board” on page 9-18. The only new functionality is that the TurboCine board uses flash memory instead of the removable DSR ROMs found on the DSR board. Also, the TurboCine uses expandable memory that can be configured for 512 MB, 1 GB, or 2 GB.

Figure 9-1. Keyscanner Block Diagram

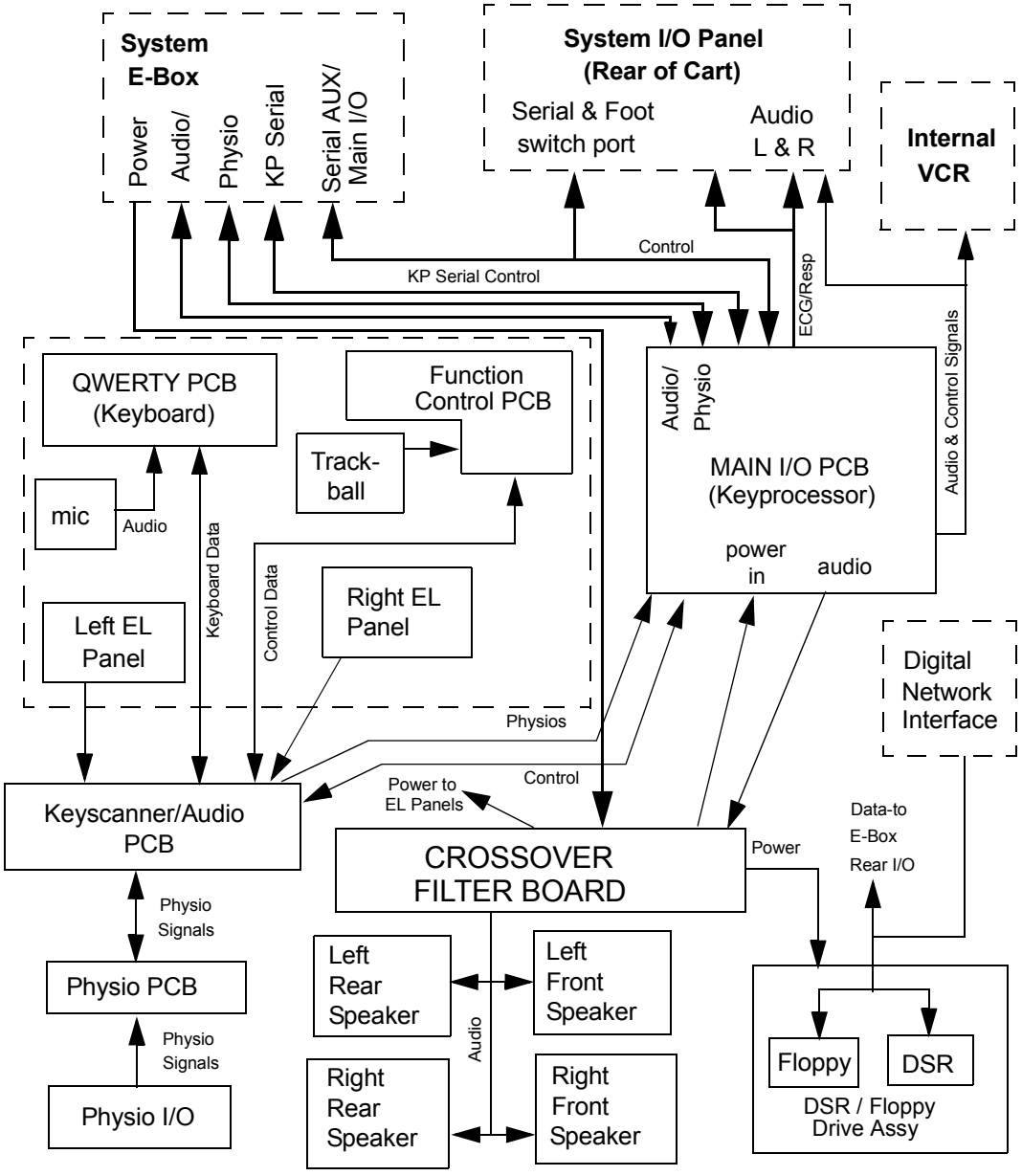


Figure 9-2. Scanner 77110A

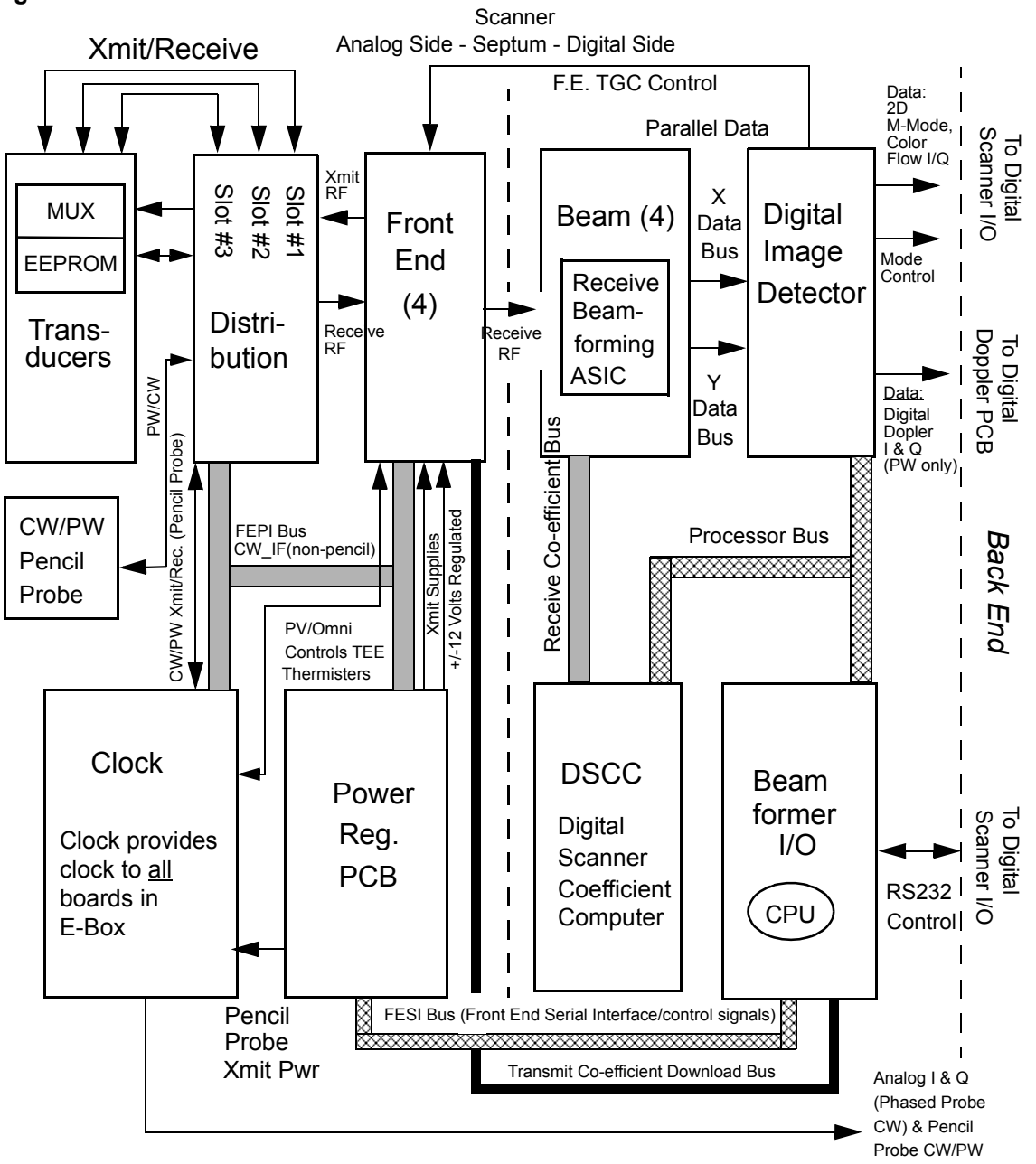


Figure 9-3. Scan Converter 7710A Block Diagram

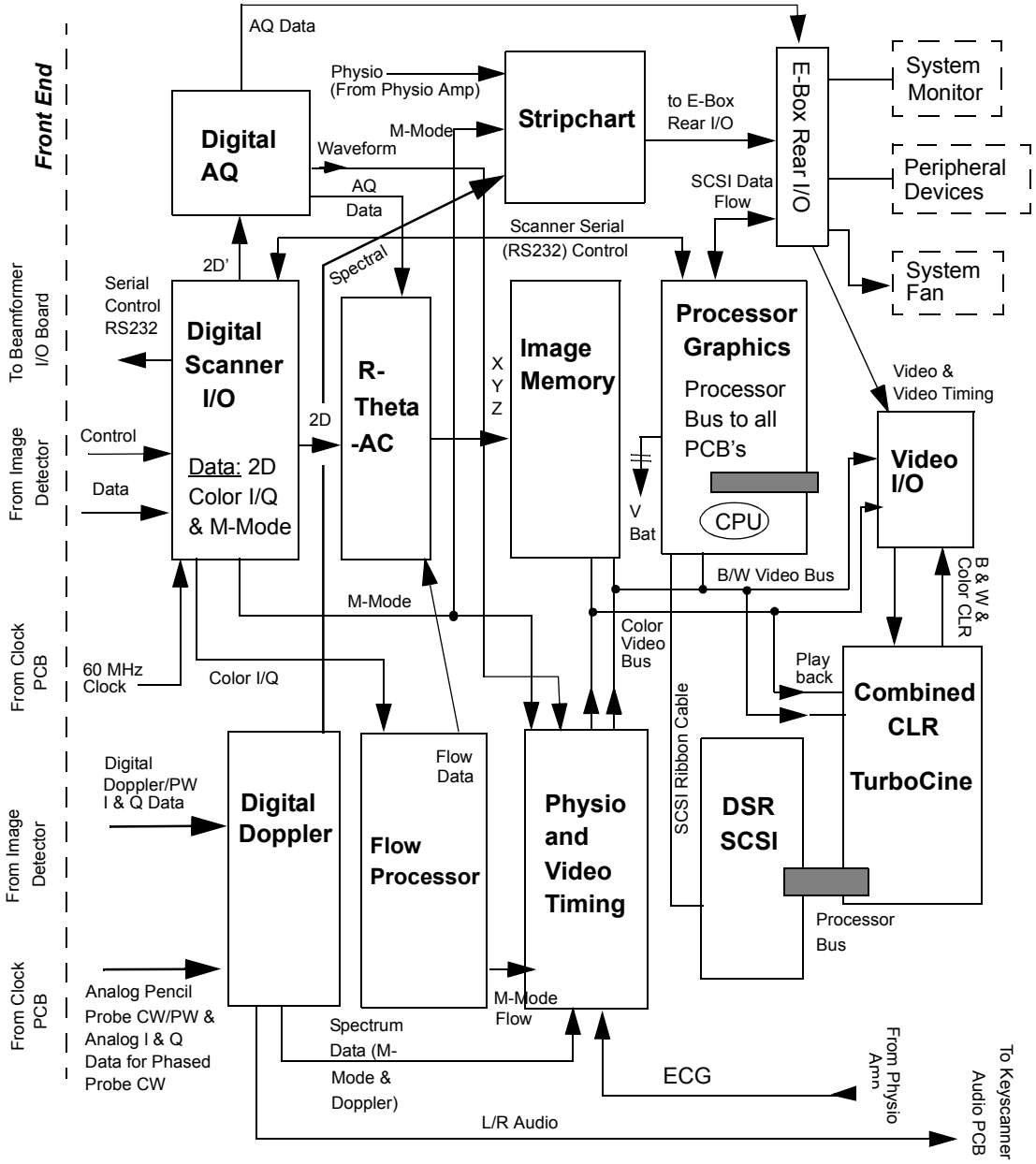
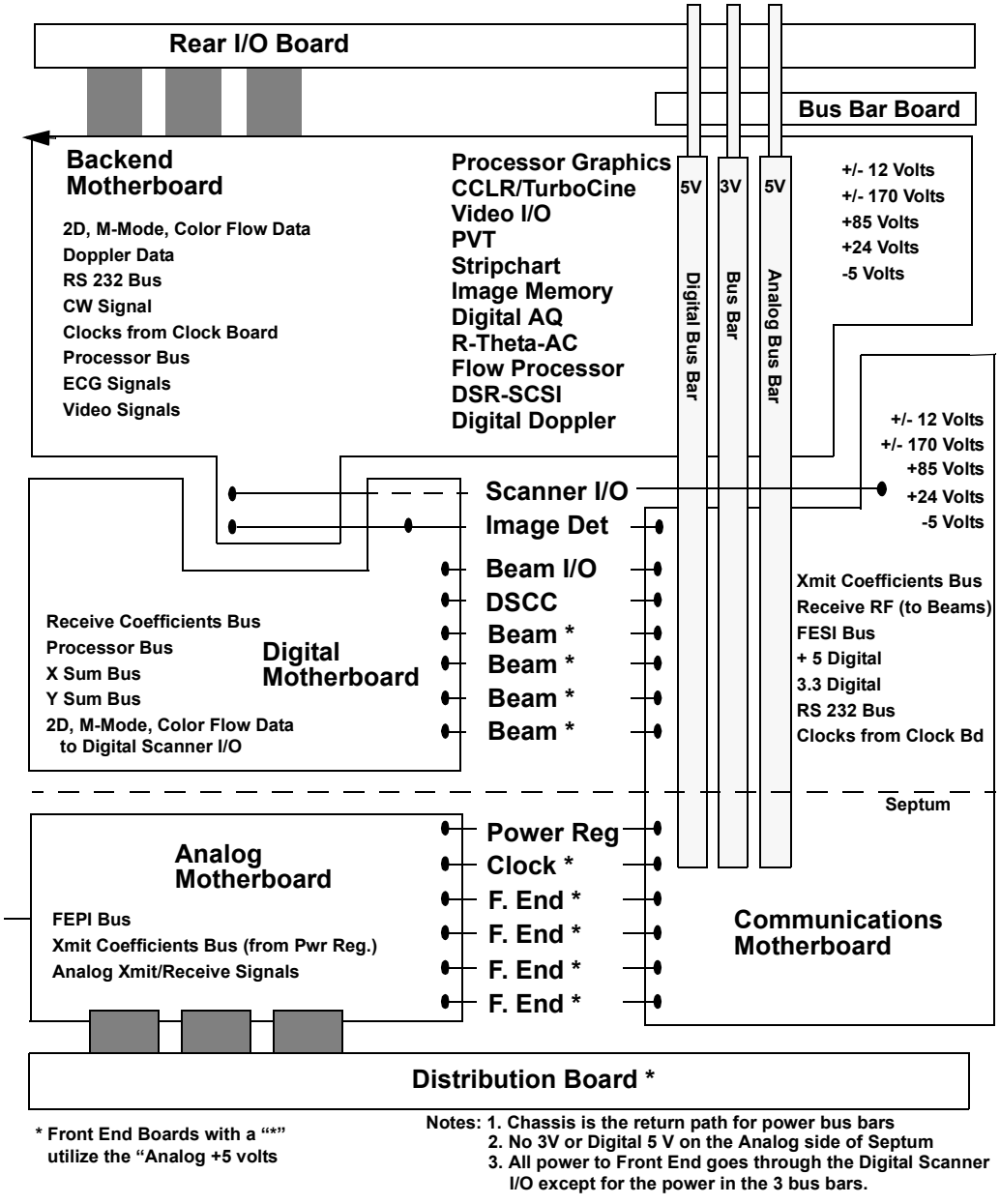


Figure 9-4. Motherboard Interconnection Diagram 77110A



* Front End Boards with a "*" utilize the "Analog +5 volts

Notes: 1. Chassis is the return path for power bus bars
2. No 3V or Digital 5 V on the Analog side of Septum
3. All power to Front End goes through the Digital Scanner I/O except for the power in the 3 bus bars.

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