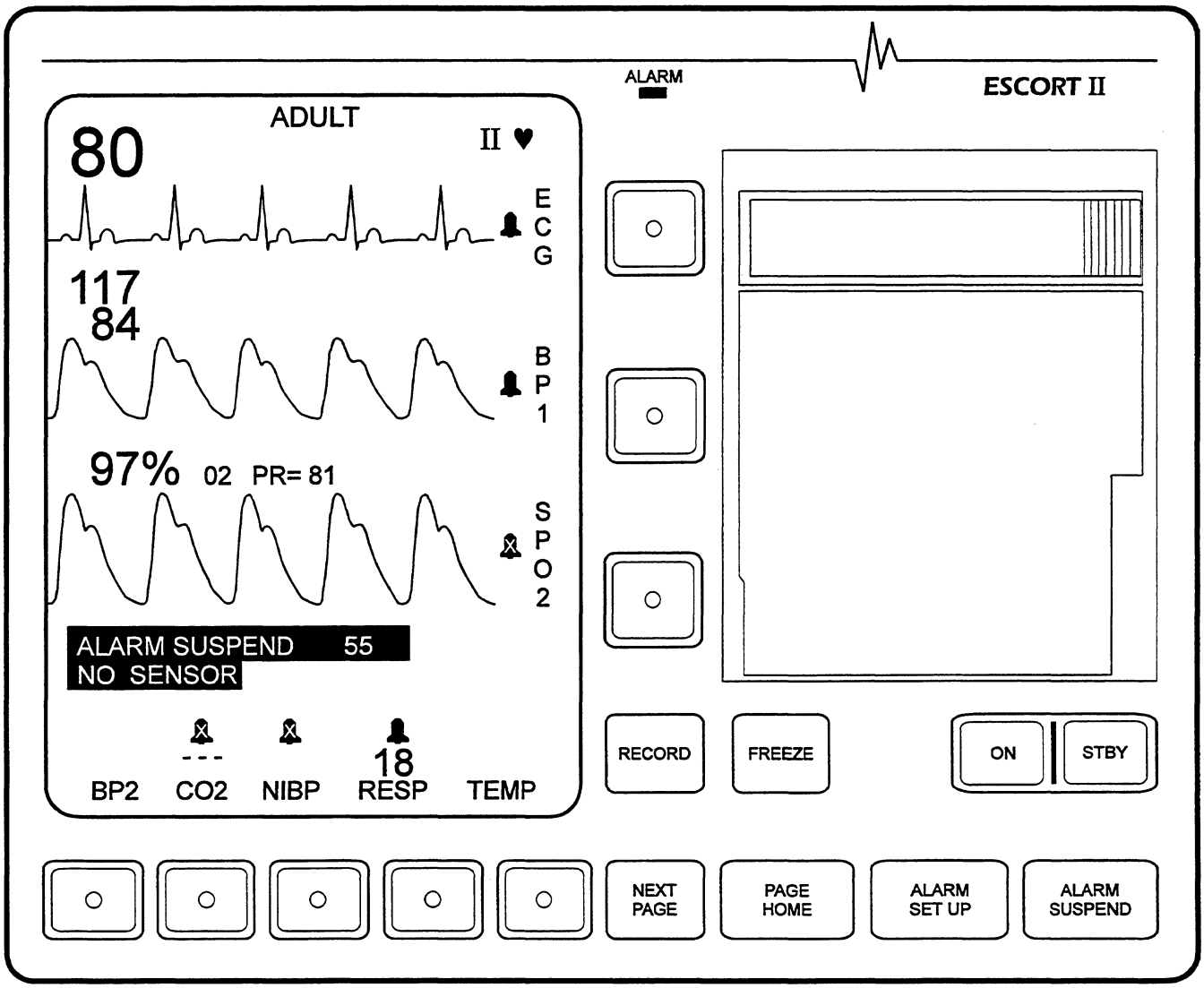
ESCORT® II
MODEL 20100
3 TRACE PATIENT MONITOR
SERVICE MANUAL



MDE

MDE P/N E9040-50
Revision - B
August 1995

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PATENT INFORMATION

MDE US Patents: 4,757,520; 4,922,918

Nellcor US Patents: 4,621,643; 4,830,014; 4,700,708; 4,770,179; 4,869,254; 4,685,464; 4,802,486

CERTIFICATIONS

The ESCORT II 100 has received the following certifications:

AGENCY	STANDARDS
ETL Testing Laboratories, Inc.	UL 544
Canadian Standards Association	CAN/CSA-22.2 No. 601.1 / IEC 601-1: 1988
Compatible Electronics, Inc.	IEC 601-1-2

WARRANTY

The ESCORT II Model 20100 Monitor is warranted against defects in materials and workmanship for a period of twelve (12) months from the date of shipment to the original purchaser. Batteries, cables, cuffs, and sensors are warranted ninety (90) days from date of shipment. Warranty is valid only to the original buyer. Defective equipment should be returned freight prepaid to Medical Data Electronics. Equipment returned with defective parts and assemblies will be either repaired or replaced. This warranty is not applicable if repair has been attempted, if the instrument has been damaged due to operation outside the environmental and power specifications for the product, or due to improper handling or use.

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1 Introduction

1 INTRODUCTION

1.1 General Description

The ***ESCORT II 100*** Series monitor is a modular patient monitor capable of keeping track of as many as nine (9) parameters simultaneously, including dual vector ECG, Respiration, SpO_2, Noninvasive Blood Pressure, one or two Invasive Blood Pressures, Temperature, Mainstream/Sidestream $ETCO_2$, and Cardiac Output. The ***ESCORT II 100*** monitor features several modular components that are interchangeable with other ***ESCORT II 100*** and ***300*** Series modular monitors.

The ***ESCORT II 100*** monitor has a high-resolution CRT display screen, capable of displaying as many as three waveform traces simultaneously. This CRT display accurately reproduces physiological waveform abnormalities, providing the detail needed to make clinical decisions.

The ***ESCORT II 100*** monitor is equipped with AC, battery (optional), and external DC power capability. Optional battery operation is provided by three modular batteries, with operating time ranging from 1.75 to 2.5 hours, depending upon configuration.

The ***ESCORT II 100*** can monitor adult, pediatric, and neonatal patients. The appropriate monitoring mode for each patient, ADULT, PED, or NEO, is selectable. Changing from one mode to another automatically changes all appropriate algorithms, alarm limits, and any applicable parameter defaults.

The ***ESCORT II 100*** monitor minimizes the number of function keys at any given time. Some keys, fixed function keys, are labeled on the front panel and always retain the same function. Other keys, softkeys, are not labeled and vary in function according to the labels displayed adjacent to them on the monitor's screen. There are eight softkeys, five located at the bottom of the front panel, and three located on the right side of the front panel. For more information on the monitor keys and their functions, see Chapter 2, "Controls & Indicators."

Factory defaults have been established and installed for all system and physiological monitoring issues (i.e., alarm settings, default ECG lead, etc.). These values may be easily reconfigured to meet specific needs.

This service manual provides readily available documentation to troubleshoot, repair, and maintain the ESCORT II 100 monitor. It outlines functional block diagrams, board layouts, schematic diagrams, and parts listings for each of the hardware modules of the ESCORT II 100 for use by technical service personnel. Also included is a performance check section, as well as a section on care and cleaning. Following these procedures will help to keep your ESCORT II 100 monitor(s) working efficiently and reliably for many years to come.

1.2 System Configuration & Options

The vital sign parameters for the ESCORT II 100 monitor are factory configured in a Multiparameter Module. The Multiparameter Module is removable, allowing the user to move it from one monitor to another as necessary. The Multiparameter Module includes dual vector ECG and can be equipped with as many as nine parameters.

The ESCORT II 100 monitor can be equipped with several additional options, including a bedside recorder module and a wireless central station transceiver module. Table 1-1 lists all the available options.

Table 1-1: ESCORT II 100 Options

Model Number	Description
20100	**ESCORT II 100 Series Modular Patient Monitor with High Resolution 3-Trace CRT Display**
Option 15	Modular Batteries
Option 37	Add Graphic Trends
20001	**Multiparameter Module (includes dual vector ECG)**
Option 27	Add Respiration
Option 28	Add Noninvasive Blood Pressure
Option 29	Add Noninvasive Blood Pressure and Temperature
Option 30	Add SpO2
Option 31	Add Invasive Blood Pressure
Option 32	Add Invasive Blood Pressure and Temperature
Option 33	Add (2) Invasive Blood Pressures
Option 34	Add (2) Invasive Blood Pressures and Temperature
Option 35	Add Temperature
Option 36	Add ETCO2 (Note: Requires Model 20020 or Model 20021 ETCO2 sensor, sold separately)
Option 38	Add Hewlett-Packard Merlin ECG & Invasive Blood Pressure Connectors
Option 39	Add Cardiac Output
20002	**Multichannel Thermal Array Recorder Module**
20011	**E3200B LINK Transceiver Module**
20012	**UHF Telemetry Receiver Module 430 - 470 MHz**
1200LR-01	**Single Vector UHF Long Range Transmitter 450 - 470 MHz**
20013	**Dual Vector UHF Long Range Transmitter 450 - 470 MHz**
20014	**Dual Vector UHF Long Range Transmitter 430 - 450 MHz**
20015	**E3200A UHF LINK Transceiver Module**
20018	**Serial I/O Module**
20020	**Mainstream ETCO2 Sensor**
20021	**Sidestream ETCO2 Sensor**
20025	**Programmable Remote Display**

1.3 Safety Considerations

Read the following sections before using the ESCORT II 100 monitor. Several warnings are presented to both increase patient safety and prevent damage to the monitor. Rear panel symbols are displayed and defined in section 1.3.2.

1.3.1 Warnings

Warnings are included throughout the manual. All warnings are presented in the following format.

WARNING: Read this service manual in its entirety prior to attempting any service or repair.

WARNING: ONLY qualified technicians possessing specific experience and expertise in the servicing of biomedical equipment should attempt servicing the ESCORT II monitor.

WARNING: HIGH VOLTAGES are present within the ESCORT II monitor. Use caution when servicing.

WARNING: Always use an ESD (Electro-Static Discharge) grounding wrist or ankle strap that is properly grounded. Always perform service in an ESD safe environment.

WARNING: The ESCORT II 100 is intended only as an adjunct in patient assessment. It cannot replace skilled nursing care and proper surveillance. Keep high risk patients under close surveillance.

WARNING: Carefully read the ESCORT II 100 Operator's Manual, all directions for use of monitor accessories, and all precautionary information before attempting clinical use of the ESCORT II.

WARNING: When operating the ESCORT II from an AC power source, the wall receptacle must be a three-wire, grounded, hospital grade outlet. Use only ESCORT II's original hospital grade AC power plug and cord, or an equivalent hospital grade plug and cord. If in doubt about the integrity of the grounding of the main supply connection, the unit must be operated by battery power.

WARNING: DO NOT plug unit into multiple outlet power strip to avoid summation of leakage currents.

WARNING: Explosion hazard. Do not use the ESCORT II in the presence of flammable anesthetics.

WARNING: In the event of an adverse patient condition, the audio alarm will not sound if it has been temporarily silenced or disabled.

WARNING: For pacemaker patients, the HR may continue to count the pacemaker artifact during cardiac arrest or other arrhythmias. Keep pacemaker patients under close surveillance.

WARNING: Do not use in ambient temperatures above 40° C or below 5° C.

WARNING: For protection against fire, replace fuses only with those of the same type and rating.

WARNING: The alarms for some parameters are factory set to default to the OFF setting. This may not be consistent with the policies of your institution or the type of patients being monitored by the ESCORT II monitors.

1.3.2 Symbols

The following are cautionary symbols that appear on the ESCORT II 100 monitor and their definitions. You should familiarize yourself with these symbols and their meaning before using the ESCORT II 100 monitor.

Type CF Defibrillation Protected Equipment: Isolated patient connections comply with the allowable leakage current limits for direct cardiac application and are protected against the effects of defibrillation.

Attention: Consult accompanying documents.

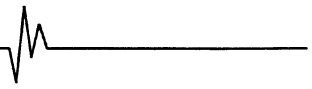
Replace Fuses as Marked: For protection against fire, replace only with fuses of the same type and rating.

Caution: Dangerous voltage.

Alternating Current: 115 V @ 60 Hz, or 220-240 V @ 50 Hz.

Equipotential Connection: When external DC power is used, the equipotential connection must be used as a protective ground terminal.

Fuse: Voltage and current ratings appear adjacent to symbol.

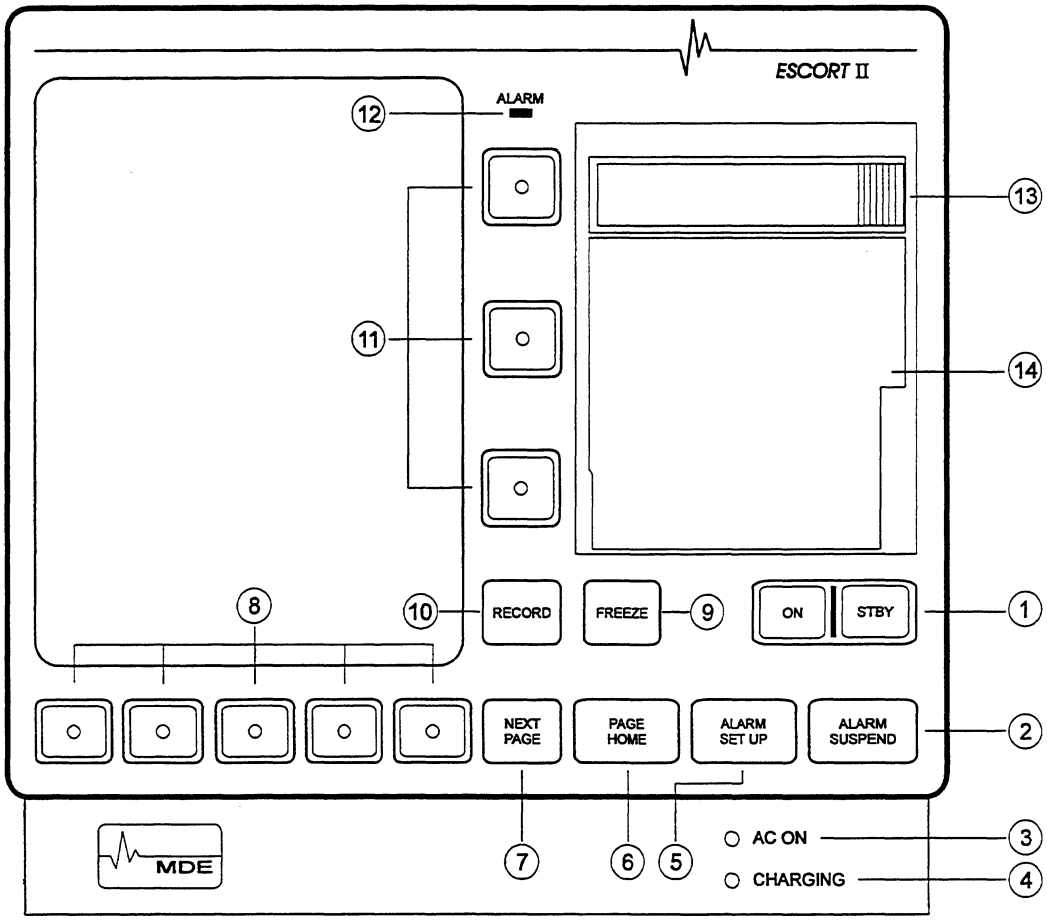


2 Controls and Indicators

2 CONTROLS and INDICATORS

2.1 Front Panel

A summary of the ESCORT II 100 front panel keys and indicators is provided in the figure below and on the following pages. Fixed functions keys, softkeys, and indicators are each discussed individually.



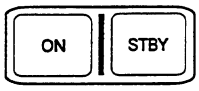
1. Monitor On/Standby Keys
2. Temporary Alarm Suspend
3. AC Power Indicator
4. Battery Charging Indicator
5. Alarm Setup Key
6. Return to Home Page
7. Display Next Page of Softkey Menus
8. Parameter/System Softkeys
9. Freeze/Unfreeze All Waveform Traces
10. Start/Stop Manual Recordings
11. Parameter Softkeys
12. Alarm Indicator Light
13. Recorder Door Release
14. Multichannel Thermal Recorder

Figure 2-1: ESCORT II 100 Front Panel Detail

Fixed Function Keys

The ESCORT II 100 includes the following seven (7) fixed functions keys: ON/STBY, ALARM SUSPEND, ALARM SET UP, PAGE HOME, NEXT PAGE, RECORD, and FREEZE. Each of these keys, as the name implies, is fixed and performs its intended function regardless of the monitoring scenario. A brief description of each is provided below.

ON/STBY



Turns the display on and initializes the ESCORT II when ON is pressed. The ESCORT II is returned to standby status by pressing STBY. When in STBY, the batteries continue to be charged if the ESCORT II is connected to AC power, but no monitoring or storing of data occurs.

ALARM SUSPEND

Temporarily suspends alarm tones. The factory defaults for alarm suspend intervals are 180 seconds in adult mode, 90 seconds in pediatric mode, and 60 seconds in neonatal mode. If an alarm limit is violated, pressing ALARM SUSPEND will silence the alarm tone. Pressing the key again before the suspend time period has elapsed will reactivate the audible alarm tones if the alarm condition still exists. While alarms are suspended, the following message will appear on the ESCORT II screen:

ALARM SUSPEND *XXX*

The ***XXX*** will be replaced with the number of seconds remaining until the alarm suspend condition is removed.

ALARM SET UP

Displays the alarm status for all vital sign parameters. Alarm ON/OFF status, high and low limits, and recording type for each active parameter are displayed. A 🔔 to the right of the listed parameter indicates that one or more alarms for that parameter is ON. An X is displayed when all alarms for the associated parameter are OFF.

PAGE HOME

Returns the ESCORT II display to the HOME PAGE screen (i.e., the screen normally displayed during patient monitoring).

NEXT PAGE

Scrolls through softkey options. Up to five selections may be displayed at the bottom of the ESCORT II screen just above a row of five softkeys. To access additional softkey selections, press the NEXT PAGE key.

RECORD

Initiates a 16-second recording of any one or two parameter waveforms. To stop a recording in process, press RECORD prior to completion of a manual or alarm recording. To specify the parameters to be recorded, press the softkey(s) of the desired parameter(s) within two seconds after pressing the RECORD key. If no parameters are selected after pressing record, a 16-second strip of ECG waveform will be recorded.

Note: ***Active waveforms (i.e., parameters currently being monitored) do not need to be displayed in order to acquire a recorded waveform.***

FREEZE

Freezes all displayed waveforms for evaluation purposes. Pressing FREEZE again releases waveforms.

Note: ***Waveforms cannot be frozen during recording. Initiating a recording will also release the frozen waveforms.***

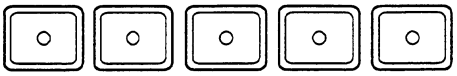
Softkeys

The ESCORT II 100 monitor is equipped with eight (8) softkeys. Softkey operation changes depending upon the monitoring mode, parameter, or configuration options being accessed. Three parameter softkeys are located to the right of the display screen. Five parameter/system softkeys are located below the display screen.

PARAMETER SOFTKEYS

These three softkeys, located on the right side of the front panel, provide access to the function keys of the parameters displayed in the waveform display zone. ECG is always assigned to the top waveform trace, and as many as two additional parameters, when available (i.e., installed), can be assigned to trace 2 and trace 3.

PARAMETER/SYSTEM SOFTKEYS



The function of these five softkeys, located directly below the display screen, depends on the label or function key displayed directly above the softkey. In the HOME PAGE state, parameter labels and associated numeric values may be displayed directly above one or more of the softkeys. To access the function keys for any of these parameters, press the softkey under the parameter label and a page of function keys that relates specifically to that parameter will be displayed.

Indicators

The ESCORT II 100 includes up to three indicators which illuminate to notify the operator of a specific activity or situation. Two of the indicators, AC ON and CHARGING are only present when the ESCORT II battery option is included with the monitor. An ALARM indicator is present on all ESCORT II 100 monitors.

ALARM INDICATOR ALARM

The red ALARM LED (Light Emitting Diode) illuminates and flashes when a parameter alarm limit is violated. The light stops flashing when the alarm violation is corrected, or when the operator turns the alarm off. The ALARM LED will continue to flash when the ALARM SUSPEND key has been pressed and the alarm violation is still present.

AC ON INDICATOR ● AC ON

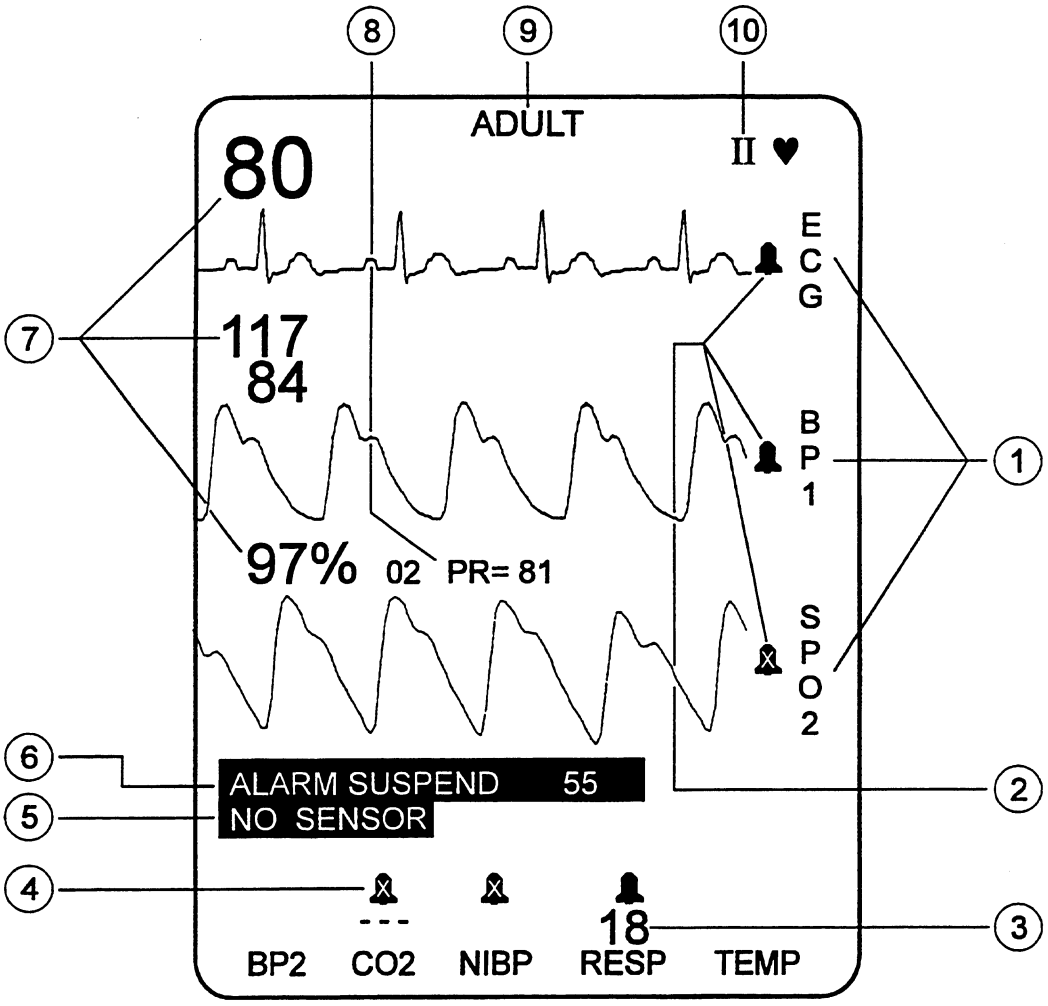
The green AC ON LED illuminates when the ESCORT II is connected to AC power.

BATTERY CHARGING INDICATOR ● CHARGING

The yellow CHARGING LED illuminates when the ESCORT II's optional batteries are charging. The CHARGING LED will not be illuminated when the batteries are fully charged, or when the monitor is not connected to AC power.

2.2 Display Screen

The following is a brief description of the information and format presented on the ESCORT II 100 display screen.



1. Softkey Labels for Parameters Displayed in the Waveform Display Zone (WDZ)
2. Alarm Status for Parameters in the WDZ
3. Numeric-Only Display Zone (NODZ)
4. Alarm Status for Parameters in the NODZ
5. Message Line for Parameters in the NODZ
6. System Message Line
7. WDZ with Associated Numerics
8. Message Line for Parameters in the WDZ
9. Current Monitoring Mode
10. ECG Lead in Use

Figure 2-2: ESCORT II 100 Display Screen

Softkey Labels for Parameters Displayed in the Waveform Display Zone (WDZ)

The labels displayed adjacent to the parameter softkeys specify the parameters displayed in the WDZ.

Alarm Status for Parameters in the Waveform Display Zone

Each bell displayed in the WDZ indicates the alarm ON/OFF status for the parameter adjacent to it.

If a solid bell is displayed, one or more alarm for the associated parameter is ON.

If the bell is displayed with an X through it, the alarms for the associated parameter are OFF.

Numeric-Only Display Zone (NODZ)

The parameter labels displayed above the softkeys at the bottom of the front panel specify the parameters associated with each softkey. The numeric data associated with the parameters are displayed above the parameter labels in the Numeric-Only Display Zone.

Note: ***In the HOME PAGE state, the parameter labels and numeric data are displayed directly above the softkeys. When a parameter or system setup page is displayed above the softkeys, the Numeric-Only parameter labels and associated data are displayed slightly above the setup page.***

Alarm Status for Parameters in the NODZ

Each bell displayed in the Numeric-Only Display Zone indicates the alarm ON/OFF status for the parameter listed below it.

If a solid bell is displayed, one or more alarm for the associated parameter is ON.

If the bell is displayed with an X through it, the alarms for the associated parameter are OFF.

Message Line for Parameters in the NODZ

Messages concerning parameters in the NODZ will be displayed in a reverse-video box on the left side of the screen, just above the NODZ. Message display is temporarily obscured when a parameter or system setup page is displayed. In the HOME PAGE state, the message continues to be displayed as long as the message condition exists.

System Message Line

A message that is not specific to a single parameter, such as "ALARM SUSPEND 180," is displayed in a reverse-video box on the left side of the screen, just below the WDZ. Message display is temporarily obscured when a parameter or system setup page is displayed. In the HOME PAGE state, the message continues to be displayed as long as the message condition exists.

Waveform Display Zone with Associated Numerics

The Waveform Display Zone displays waveform traces and associated numeric data for as many as three different parameters. The top waveform trace is reserved for the ECG waveform; however, you can assign different parameters to the other two waveform traces.

Message Line for Parameters in the WDZ

Messages concerning parameters displayed in the WDZ will be displayed in a reverse-video box to the right of the numeric data for the corresponding waveform parameters. The message is displayed as long as the message condition exists.

Current Monitoring Mode

The current monitoring mode is displayed at the top of the screen — ADULT, PED, or NEO. The monitoring mode can be changed through the system function key ADULT/PED/NEO.

ECG Lead in Use

Indicates the ECG lead displayed in the top trace of the WDZ. Choices include lead I, II, III, or V LD (for "chest lead" in a 5-lead configuration). If heart rate is being derived from SpO_2 or Invasive Blood Pressure instead of ECG, *PULSE* is displayed.

2.3 Side Panel

Figure 2-3 displays the right side of the ESCORT II 100 monitor. The Multiparameter Module and the Recorder Module Release may each be accessed from this side of the monitor.

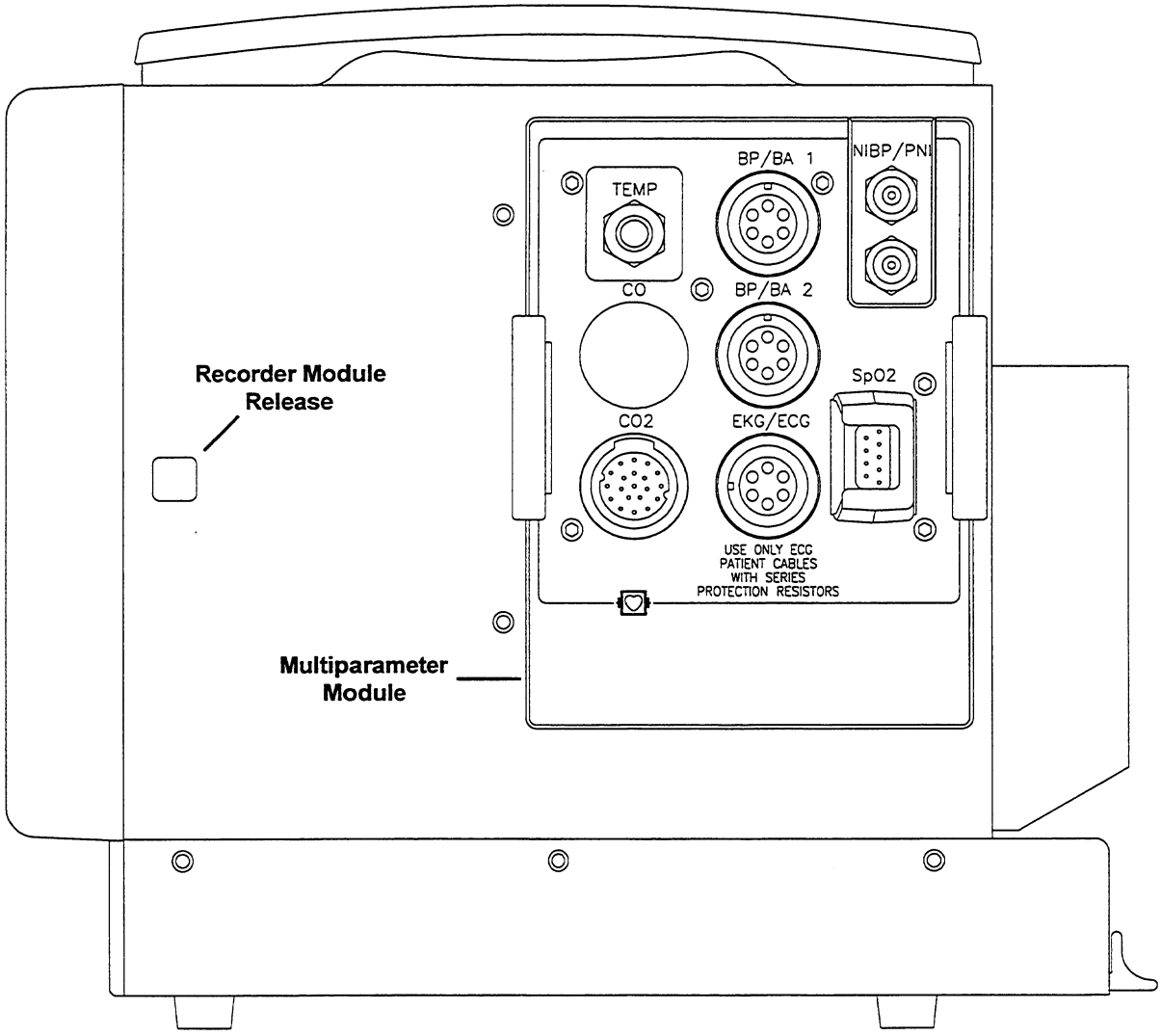


Figure 2-3: ESCORT II 100 Side Panel

Multiparameter Module

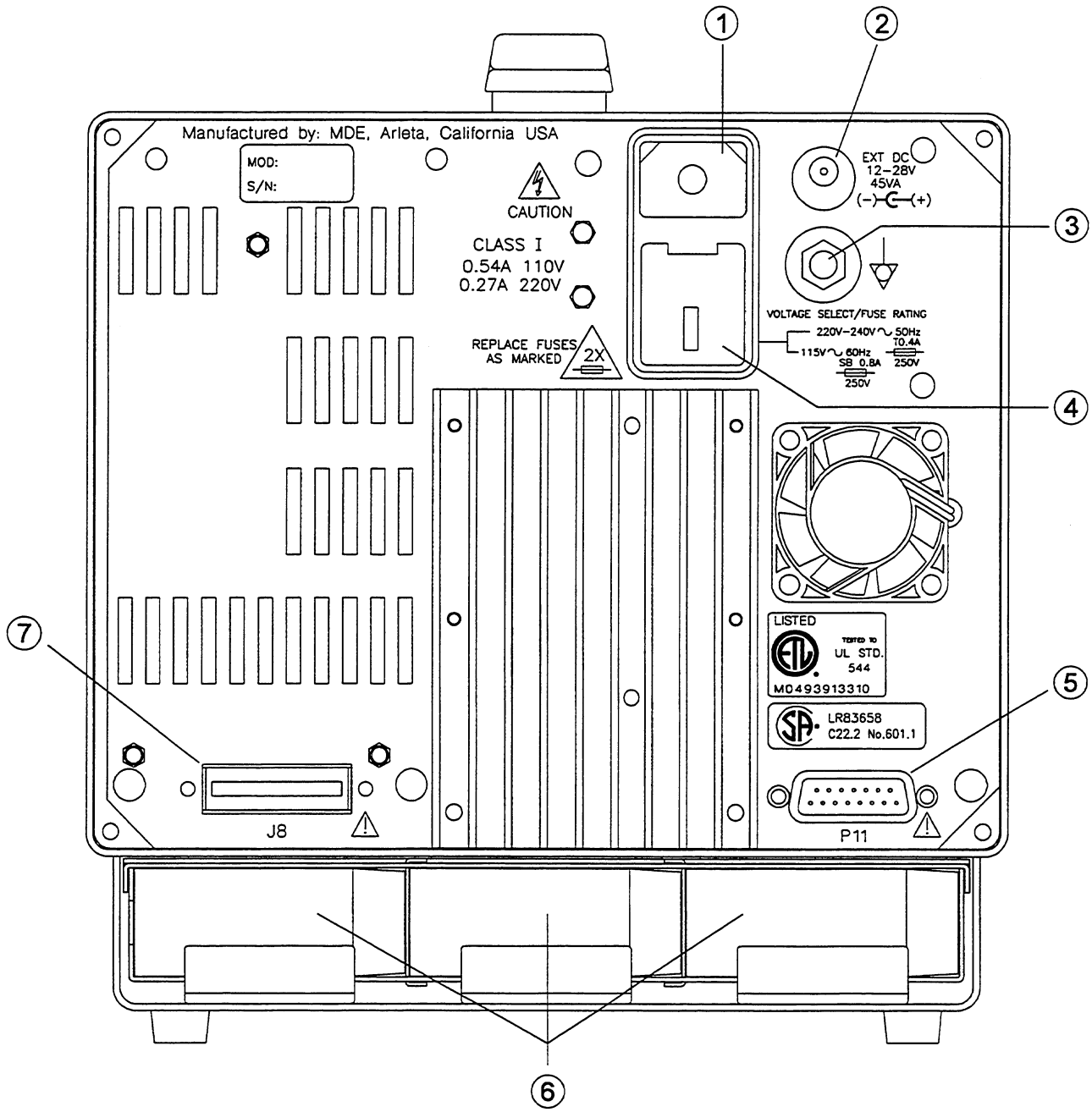
The module in Figure 2-3 is configured for several parameters; your Multiparameter Module may be configured for fewer parameters. This module may be interchanged with any ESCORT II monitor within your facility.

Recorder Module Release

Allows the Recorder module to be released from the ESCORT II housing by pushing the button.

2.4 Rear Panel

Figure 2-4 presents the ESCORT II 100 rear panel. Brief descriptions are provided for the areas indicated.



1. AC Power Cord Input Connector
2. External DC Input Connector
3. Equipotential Connector
4. Fuse Holder/Voltage Selector
5. Auxiliary Output Connector
6. Batteries/Battery Housing (Optional)
7. Transceiver/Telemetry Connector

Figure 2-4: ESCORT II 100 Rear Panel

AC Power Cord Input Connector and Optional Power Cord Mounting Bracket

Allows connection of the AC power cord to the monitor. In addition, the AC power cord must be plugged into an AC source before the monitor can operate on AC power and before the batteries can be charged.

For permanent connection, the MDE power cord bracket should be installed. See Figure 2-5 for instructions on installing the power cord mounting bracket.

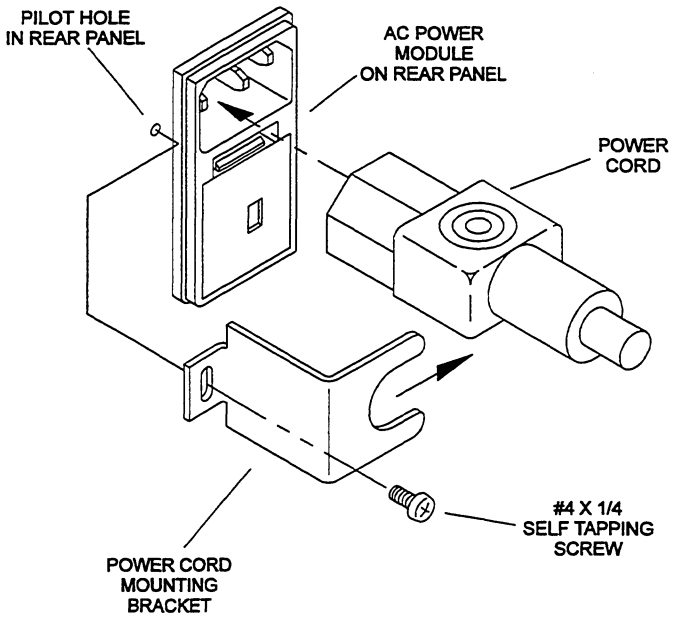


Figure 2-5: AC Power Cord Bracket Installation

External DC Input (12 - 28V) Connector

Allows an external DC power source to be connected for extended use during transport where AC power is not available.

Equipotential Connector

Provides grounding for the monitor when the monitor is used with other medical equipment. It must be used as a protective ground terminal when the monitor is operated with external DC power.

Fuse Holder/Voltage Selector and Fuse Replacement

The fuse holder contains the fuses and the voltage selector for the monitor. Open the door of this holder to replace fuses or to configure the voltage selection block — 115 VAC or 230 VAC. The present voltage setting can be read through the small rectangular window on the door of the holder. It is recommended that qualified technical service personnel replace fuses or change the voltage selection when necessary.

> **WARNING: For protection against fire, replace fuse only with one of the same type and rating.**

The ESCORT II 20100 requires two identical slow blow 0.8A fuses for 115 VAC operation, or two 0.4A fuses for 220 VAC operation. Ensure that the AC power cord has been disconnected before replacing fuses. Carefully open the door of the fuse holder with a short 1/8" flat screwdriver. Replace the blown or defective fuse with one of the same type and rating. Noting orientation, gently slide the fuse holder back until it locks snugly into its original place. After the fuse replacement, connect the AC power cord to the ESCORT II. The unit is now ready for operation.

Auxiliary Output Connector

Provides analog waveform or alarm relay closure interface signals from the ESCORT II to other clinical instruments.

> **WARNING: When connecting the ESCORT II to any other instrument, verify proper operation before clinical use. Refer to the other instrument's operation manual for complete instructions.**

Batteries/Battery Housing

These three slots contain modular batteries which are optionally available with the monitor.

Transceiver/Telemetry Connector

If a transceiver module is connected here, wireless communications between the monitor and the ESCORT - LINK Central Station can be established.

If a telemetry receiver module is connected, communication between the monitor and an ambulatory transmitter can be established.

2.5 Power Sources

Determine Power Source

> **WARNING: Always locate the ESCORT II and its power cord away from any electrosurgery equipment and its power cord and cables.**

There are three options for providing power to the ESCORT II monitor: AC, battery, and external DC power. These options and their requirements are described below.

AC Power

> **WARNING: When operating the ESCORT II from an AC power source, the wall receptacle must be a three-wire, grounded, hospital grade outlet. Use only ESCORT II's original hospital grade AC power plug and cord, or an equivalent hospital grade plug and cord. If in doubt about the integrity of the grounding of the main supply connection, the unit must be operated by battery power.**

If the ESCORT II monitor is operated by AC power alone, make sure the following requirements are met:

1. The fuses and voltage selected in the fuse holder on the rear panel must be appropriate for the line power to which the monitor is connected — 115 VAC or 230 VAC (the present voltage setting can be read through the small rectangular window on the fuse holder door).
2. The ESCORT II monitor power cord is connected to both the monitor and a live power source.

Note: For permanent connection, the MDE power cord bracket should be installed.

If the above requirements are met, the AC ON LED should be illuminated. If the above requirements are met and the LED is not illuminated, technical service personnel should inspect the monitor and connection.

Battery Option

Power to the ESCORT II monitor may be supplied by utilizing the Battery Option (Option 15). The Battery Option transforms the ESCORT II into a fully functional, portable monitor available for use in various transport situations.

The batteries utilized in the ESCORT II Model 20100 monitor are 12 VDC sealed lead-acid type rated at 2.3 AH. Fully charged batteries should measure approximately 13.0 to 13.5 Volts DC with an open load.

The ESCORT II will indicate battery status on screen as BATTERY HI, MID, LOW or VERY LOW. Battery status may be viewed from the TEST page when SW STAT INFO is selected and the monitor is running on battery power.

To ensure proper installation of batteries, note the arrows on the battery label and install as indicated.

Battery charging circuitry is located on the Model 20100 Power Supply Board (P/N 401855-0000). See Chapter 3, "Power Supply Board," for details.

Note: ***Never discharge the batteries completely. To ensure long battery life, always re-charge batteries immediately after use. An optional battery charger (MDE Part Number: E2700-12) is recommended. Batteries should be replaced every two (2) years regardless of test results. Used batteries should be recycled or disposed of properly.***

When included with the ESCORT II, the Battery Option is attached to the bottom of the monitor and interfaces electrically with the ESCORT II via the Battery Interface Board.

The ESCORT II accommodates up to three (3) rechargeable sealed lead-acid batteries (MDE Part Number E2700-37). Figure 2-6 displays the Battery Option Assembly.

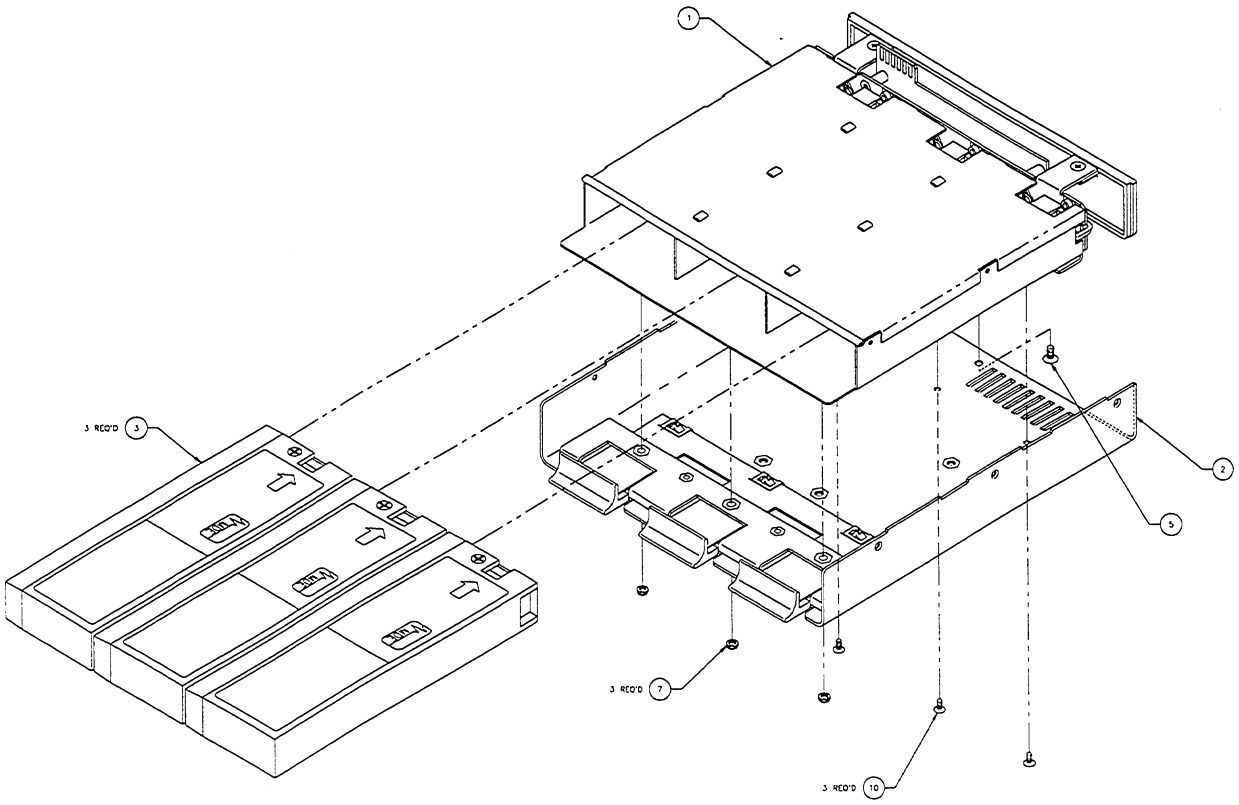


Figure 2-6: Battery Option Assembly

Table 2-1: Parts Listing, P/N 500264, Battery Option Assembly

MDE Part Number	Description	Quantity	Reference
358100-0012A	SCR, 4-40 X 3/16,PH PNHD ZINC	4	6
358100-0062A	SCR, 6-32 x 1/4, PHL.FLTHD. 100 DEG. S.S.	1	5-FRONT COVER
358100-0123A	SCR, 4-40 x 1/8~LG,82DEG,UNDERCUT SS	6	8-BATT SKIN BRKT
358100-0133A	SCR, TAPTITE,4 x 3/16~LG,100DEG,FLH PHL STL Zn PLT	3	10-SPRING BD
358200-0007A	WSHR, #4 INT TOOTH	4	11
360500-0038A	NUT, #6-32,ELASTIC STOP,THIN PTTRN	3	7-BATT HSNG
401247-0000	E3 BATTERY PACK W/ LABEL ASSY REV. A	3	3
401762-0000	BATTERY SKIN MTG BRKT E2B REV D (E1855)	2	4
401961-0000	E2B SKIN ASSY. REV E (E1801)	1	12
401963-0000	E2B BATTERY HOUSING ASSY. REV C (E1672)	1	1
401964-0000	E2B BATTERY SKIN ASSY. REV D (E1814)	1	2
402355-0000	FAB PAINT SCR #2-56X3/16~LG 82 DEG FLH REV B(E1748	8	9-BRKT&SKIN

The following guidelines apply when operating the ESCORT II with battery power:

- Operating time with three fully charged batteries is 1.75 to 2.5 hours, depending upon monitor configuration.
- Use of the monitor's recorder will shorten battery operating time 5 minutes for every minute the recorder runs.
- Battery operating time will shorten 5 minutes for every minute that the NIBP pump runs.
- The batteries will automatically recharge if the monitor's AC power cord is plugged into a live power source. The front panel AC ON LED will illuminate when the monitor is connected to AC power. The front panel CHARGING LED will illuminate when the batteries are charging and will be OFF when the batteries are 90% charged.

Note: ***Neither the AC ON nor the CHARGING LED will be illuminated when the monitor operates on battery power alone.***

- ESCORT II charges fully depleted batteries to a 90% charge in 5 hours. Alternatively, the ESCORT II battery packs can be removed and replaced with fully charged battery packs.
- Batteries can be externally charged with ESCORT II's optional external Multiple Battery Charger (E2700-12). The Multiple Battery Charger can fully charge as many as three fully depleted batteries within three hours.

- When you turn the monitor ON and it is powered by battery alone, the ESCORT II displays one of the battery level messages listed in Table 2-2. The message will be displayed for thirty (30) seconds on the system message line.

Note: ***Battery cycle life (operating time) is dependent on battery usage and maintenance. To maximize battery cycle life, do the following:***

1. Operate the ESCORT II monitor with AC power whenever possible.
2. Always charge the batteries when the ESCORT II is not being used.
3. Immediately charge the batteries if the level reads LOW or VERY LOW.
4. If possible, alternate usage of batteries with an additional set. Ensure the alternate set always contains a full charge.
5. Replace batteries after two years of use.

Table 2-2: Battery Power Levels

MESSAGE	BATTERY LEVEL
MONITOR BAT HI	> 60% Charge
MONITOR BAT MID	20-60% Charge
MONITOR BAT LOW	< 20% Charge
BATTERY VERY LOW (Intermittent Alarm Tone Sounds)	Approximately 10 minutes of battery life remains

Battery Interface Board

The ESCORT II Model 20100 Battery Housing Assembly includes the Battery Interface Board (P/N 401862-0000). The Battery Interface Board provides the connection for battery power to enter the monitor, while also suppling a route for battery charging. A board layout, parts listing, and schematic are provided below and on the following page.

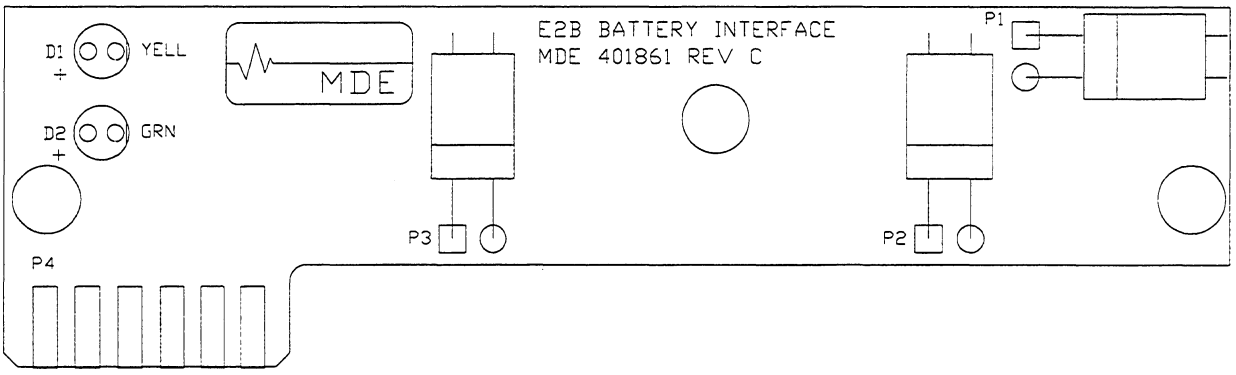


Figure 2-7: Battery Interface Board Layout

Table 2-3: Parts Listing, PCBA P/N 401862-0000, Battery Interface Board

MDE Part Number	Description	Quantity	Reference
354000-0313A	CONN, 2-P,M,R/A,HDR	3	P1, 2, 3
360500-0110A	SPCR, #6 x 7/16~LG x 1/4~ DIA NYL	2	2 - LED SPACERS
362000-0010A	L.E.D., GREEN, LITE ON	1	D2
362000-0011A	L.E.D., YELLOW, LITE ON	1	D1
401861-0000	PCB, BATTERY INTERFACE - E2B REV C (E1600)	1	

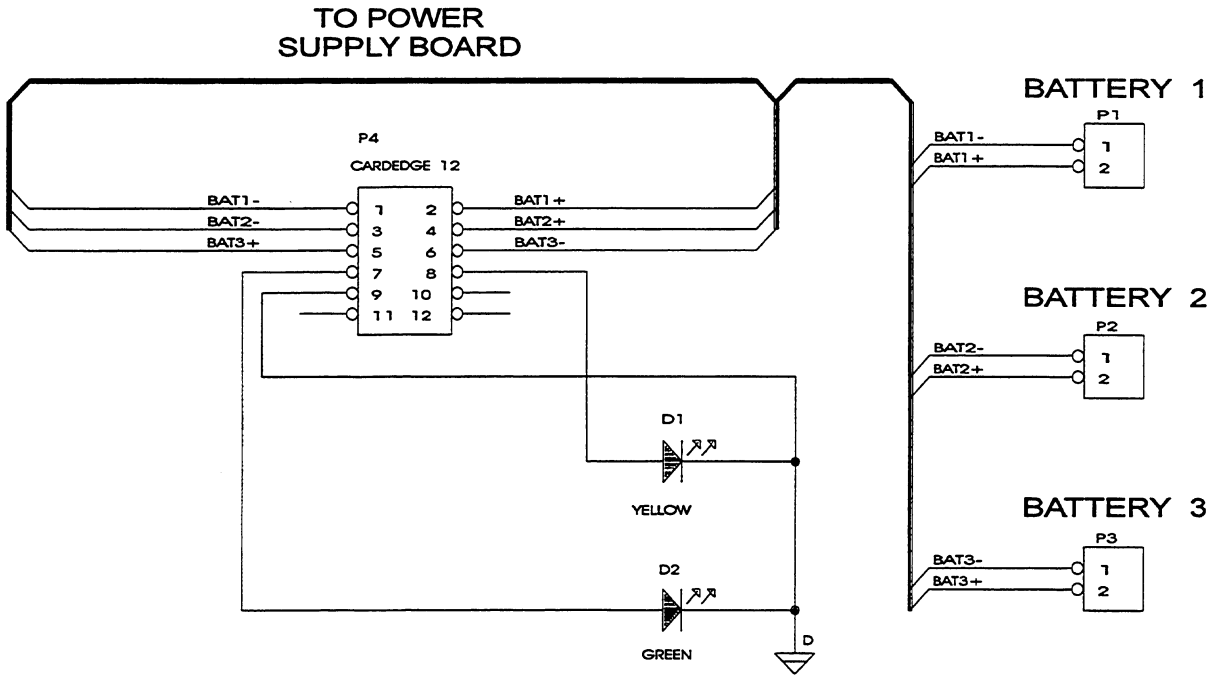


Figure 2-8: Battery Interface Board Schematic

External DC Connector

An auxiliary connector (center pin positive) labeled EXT DC 12-28V, 45 VA is located on the rear panel of the ESCORT II. This allows connection to an external DC power source when AC power is not available.

WARNING: When using an external DC power source, the equipotential connector must be used as a protective ground terminal.

Turning on the Monitor

Take the following steps to turn on the monitor:

1. Make sure you have chosen your power source (AC, battery, or external DC), and have followed the guidelines and requirements in the appropriate section.
2. Press the ON key on the ESCORT II's front panel. You should see the ESCORT II display screen and hear two beeps.

Note: ***The first time the monitor is turned ON, after delivery from the factory, or whenever ALL default settings are set back to factory, a message will be displayed on the monitor screen indicating that all defaults are set to factory. To remove the display of the message, press the ALARM SET UP key.***

3 Power Supply Board

3 Power Supply Board

3.1 Overview

The ESCORT II Model 20100 Power Supply Board provides the flexibility to operate the ESCORT II via three separate input circuits. See Section 2.5, "Power Sources," for details. The Power Supply Board is used to generate the regulated DC voltages that are used throughout the monitor. Battery monitoring and charging are also accomplished on the Power Supply Board by use of a programmable microcontroller.

The available outputs are +5V, ±15V, +25V, and +30VDC.

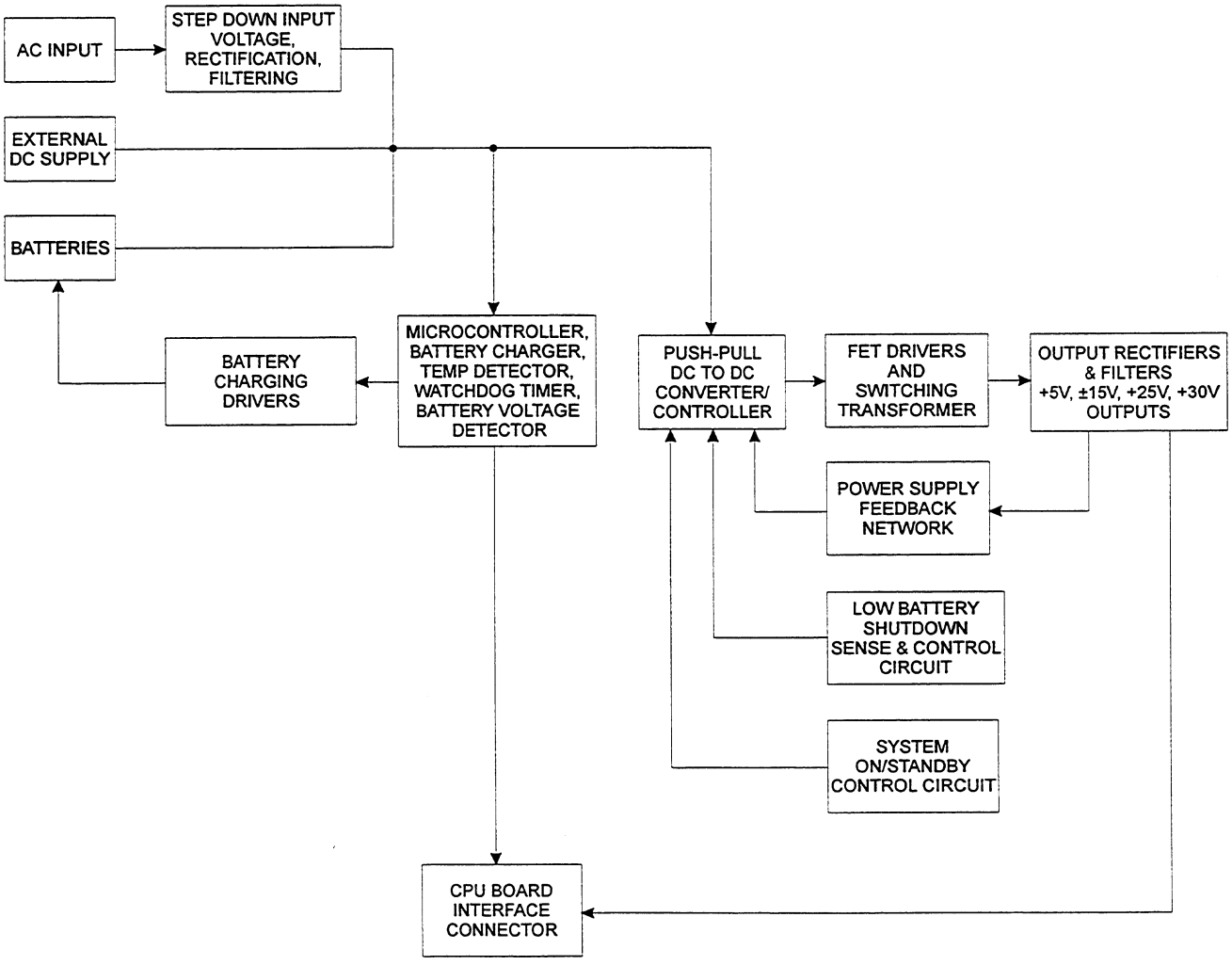


Figure 3-1: Model 20100 Power Supply Block Diagram

3.2 Input Circuits

The ESCORT II bedside monitor can be powered by AC, an optional battery pack, or an external DC power source. Each of these methods are described in the following paragraphs.

3.2.1 AC Power

When using AC power, [V+] and [VRAW] are formed using the monitor's internal power transformer which provides line current isolation and steps the voltage down to approximately 17 VAC. [VRAW] is also used to provide power to the transceiver when the monitor, in STANDBY, is plugged into an AC source. L3 is used for common mode rejection (CMR) and full wave bridge rectifier, BR1, provides pulsating DC to an LC circuit consisting of L2, C5 and C1, forming the DC level. C2, C3, C4, C6 and C7 provide filtering at each stage.

The [AC_DET] signal is extracted from BR1 and is used by the system CPU board to determine the line frequency. This signal is also used to illuminate the [AC_LED] on the front panel.

3.2.2 Batteries

When the ESCORT II battery option has been included, the monitor is capable of mobile monitoring. Three (3) 12 VDC batteries are installed in the battery housing. The positive terminals of the batteries are wired OR together to provide operating voltage from one, two, or all three batteries. The battery current flows through L1 and TH1, charges C8, and is filtered by C9 while producing [V+]. TH1 is a *Positive Temperature Coefficient (PTC)* resistor which functions as a current switch that will open the current path in the event of an over current condition. TH1 will remain open until the high current source has been removed.

3.2.3 External DC Supply

The external DC input circuitry creates [V+]. Two blocking diodes, D1 and D2, provide double protection against reverse polarity inputs. TH1 is used for over-current protection as described above. C8 is used as a storage capacitor and C9 provides filtering. This input accommodates 12-28 Volts DC and is rated at 45 VA.

3.3 Output DC Voltage Development

The Power Supply is activated with [ON_SW] which applies a ground reference to the solid-state relay, K1-5. The application of the ground to K1-5 closes the contacts between K1-3 and K1-4 allowing the input [V+] to pass to the output on K1-4 creating [VA]. [VA] is applied to the voltage regulator, U12-3. The output of U12 (+12V) is the *turn on* voltage to the Pulse Width Modulator, U5.

The Pulse Width Modulator is biased with C29 and R39 to provide a 200 kHz free oscillating frequency. C17, R15 and R13 compensate for and stabilize the frequency. [PS SYNC], on U5-3, is a 250 kHz synchronizing input signal from the CPU board that will preempt the internal oscillator once the power up sequence is complete. This signal assists in reducing beat frequency noise on ECG and other circuits by switching all internal power supplies on the same edge. C22 slowly charges and provides a soft start at power up. The modulated outputs (U5-11 and U5-14) drive the high power MOSFETs, Q5 and Q6. They in turn drive the custom wound transformer, T1. Zener diodes, D25 and D26, provide spike protection for Q5 and Q6. Through mutual inductance the voltages are transferred to the secondary of the transformer. The voltages derived from T1 are [VX], +30V, +25V, +5V, +15V and -15V.

Diodes D16 and D17 rectify the voltage between T1-4 and T1-9. L4F and C30 convert the pulsating DC to a steady DC level creating [VX], which is used to power the pulse width modulator. Therefore, after the momentary application of [ON_SW], [VX] will supply the operating voltage to U5.

To provide a steady voltage to the CRT, the +30V output circuit has the addition of regulator U8. R55 and R56 are precision resistors (1%) used to bias this regulator.

The +5V is used to power most of the solid state devices used throughout the monitor. It is sampled by the pulse width modulator U5-1 for voltage regulation. Using an internally generated 5.1V reference voltage [VREF], U5 will compare the +5V output and vary the duty cycle of its outputs at U5-11 and U5-14 to maintain the +5V output.

Each of the output circuits has separate rectification and LC circuits to provide DC voltages. Using the +25V output as an example, D7 is used to rectify the voltage from T1, and an LC circuit consisting of L4B and C34 converts the pulsating DC to a steady DC level. C39 filters high frequency noise from the DC voltage and R41 serves as a load or bleeder resistor. The other outputs have similar circuits.

The power supply is deactivated with [STANDBY] which applies a ground reference to the relay, K1-6. The application of the ground to K1-6 opens the connection between K1-3 and K1-4 and closes the contacts between K1-8 and K1-9. This applies a ground potential to U5-8 and turns the pulse width modulator off.

A low voltage detection and shutdown circuit is formed by comparing [VA] to [VREF] using comparators U4A and U4B. If [VA] falls below 8.6V, U4B-7 will apply a ground potential to U5-8 and turn the modulator off.

3.4 Battery Charging

The batteries are charged using the programmable microcontroller U10. A crystal oscillator X1 provides a 16 MHz input frequency. [VIN] on U10-13 and [VBAT1-3] on U10-14, U10-15 and U10-17 are used to determine the battery potential and provide information used in the battery charging algorithm. U9 monitors the ambient temperature inside the ESCORT II monitor and applies [VTEMP] to pin 16. When the temperature increases, the battery charge current is reduced to prevent battery overheating. Using this variable in the battery charging algorithm extends battery life. [CHRG_SYN] is a 15.625 kHz signal that is used to keep battery charging in sync with the other subsystems in the ESCORT II.

[CHG_CTRL] is used by the system CPU board to disable battery charging when the recorder is in use. Battery charging is disabled while the recorder is in use to reduce total current consumption. [BAT_CFG0] sets the battery charging current. When [BAT_CFG0] = 1, the batteries charge at approximately 50 mA. If [BAT_CFG0] = 0, the batteries will charge at approximately 100mA. When the unit is in STANDBY, the absence of [CHRG_SYN] will trigger charging at approximately 400mA.

The watchdog timer U7 monitors a programmable strobe output of about 300 ms from U10-23. If the strobe stops, the timer will time out and reset U10. The outputs of U10-3 to U10-5 provide a pulse width modulated output current through buffers U3 and U6 to MOSFETs Q1 to Q3 for battery charging. The battery charging current is filtered using RC circuits consisting of C14 to C16 and R5 to R7. When battery charging stops, the magnetic field around L1 collapses and induces current into the circuit. Diodes D8-D11 provide a path for this current back to source. The output of U10-2 is buffered through U3 and creates [BAT_CHG], which is used to illuminate the battery charging LED on the front panel. U10 also determines the battery condition and reports this information to the system CPU board using [BAT_CON0] and [BAT_CON1], see Table 3-1 for details.

[VRAW] or +15V is regulated down to +12V by U1 and provides the operating voltage for U3 and U6. The +12V is regulated down to +5B by U2 and provides the operating voltage for U9 and U10. It is necessary to develop these voltages for the operation of U9, U10, U3, and U6 when the ESCORT II is in the STANDBY mode.

Additional information on battery characteristics and charging information may be found in Section 2.5, "Power Sources."

Table 3-1: Battery Conditions

BAT_CON0 (U10-1)	BAT_CON1 (U10-27)	ESCORT II Battery Condition	Battery Level
0	0	Very Low (Intermittent alarm tone sounds)	Approximately 10 minutes of battery life remains
1	0	Low	< 20% Charge
0	1	Mid	20-60% Charge
1	1	High	> 60% Charge

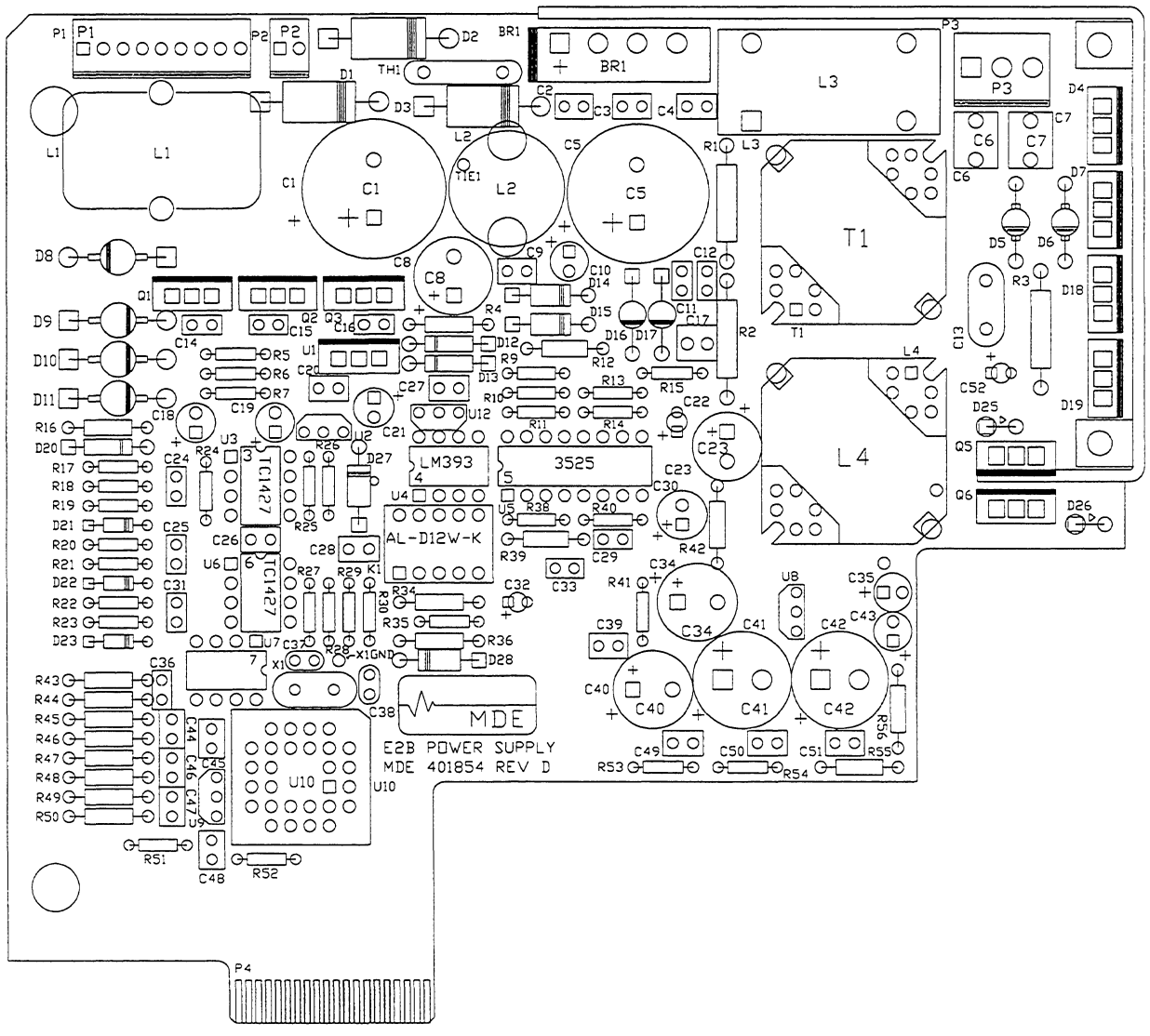


Figure 3-2: Model 20100 Power Supply Board Layout

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Figure 3-3: Power Supply Schematic

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Table 3-2: Parts Listing, PCBA P/N 401855-0000, Model 20100 Power Supply (1 of 3)

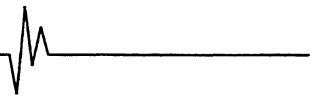
MDE Part Number	Description	Quantity	Reference
352100-0150A	CAP, 15PF,50V,10%,RAD,NPO EDPT TAPE & REEL	2	C37, 38
352102-0151A	CAP, 150pF,20%,400VAC,2500V,CS,CER DISC,INT'L APPR	1	C13
352200-0127A	CAP, 120uF,35V,20%,LOW ESR,.15/.35,ELECT	1	C23
352200-0226A	CAP, 22UF,63V,RAD,ELECT 2.5mm LEAD SPACE TAPE&REEL	1	C18
352200-0476A	CAP, 47UF,25V,RAD,ELECT 2.5mm LEAD SPACE	2	C19, 21
352201-0106A	CAP, 10uF,20%,50V,LOW ESR,RAD,5x11mm,ELECT	2	C35, 43
352201-0108A	CAP, 1000uF,25V,LOW ESR,ELECT(12.5 x 25mm)-BULK	2	C41, 42
352201-0477A	CAP, 470uF,25V,20%,LOW ESR,RAD,ELECT	1	C40
352201-0478A	CAP, 4700 UF, 35V, ELECT. (18X40MM) **BULK**	2	C1, 5
352202-0107A	CAP, 100uF,20%,25V,6.3x11mm,RAD,ELECT	1	30
352202-0337A	CAP, 330UF,35V,10X16MM,ELECT,RAD	2	8, 34
352300-0010A	CAP., 1000pF,5%,MYLAR SORT FROM 352300-0007A	1	29
352300-0020A	CAP., 1UF,63V,5%,MYLAR	2	C6, 7
352300-0103A	CAP, .01UF,50V,20%,RAD,MYLAR	6	C14, 15, 16, 24, 25, 31
352300-0104A	CAP, .1UF,50V,20%,RAD,MYLAR	16	C2, 3, 4, 9, 20, 26, 28, 39, 44, 45, 46, 47, 48, 49, 50, 51
352300-0472A	CAP, 4700pF,50V,20%,MYLAR,RADIAL, LEAD SPACE .1IN	3	C11, 12, 36
352300-0473A	CAP, .047UF,50V,20%,MYLAR	1	C27
352300-0474A	CAP, .47UF, 50V,20%,RAD,MYLAR(METALLIZED POLYESTR)	1	C17
352301-0222A	CAP, 2200PF,50V,20%,MYLAR	1	C33
352400-0105A	CAP,1UF,50V,20%,RAD,TANT, MAX:HT .28; O.D. .16 T&R	1	C52
352400-0475A	CAP, 4.7UF,16V,20%,RAD,TANT	2	C22, 32
352401-0106A	CAP, 10UF,35V,20%,RAD,TANT TAPE & REEL	1	C10
354000-0085A	CONN, 3-PIN,M,STRT LCK,.156 CTR	1	P3
354000-0138A	CONN, 2-P,M,STRT LOCK,.1 CTR,HDR	1	P2
354000-0332A	CONN, 9-PIN,M,STRT LOCK,.1 CTR,GOLD PLATE	1	P1
356000-0026A	XTAL, 16MHZ, LOW PROFILE, .142IN X .425IN	1	X1
364000-0064A	IC, LM317LZ,VOLT. REGULATOR	1	U8
364000-0091A	IC, SG 3525	1	U5
364000-0107A	IC, 7812 CT	1	U1
364000-0109A	IC, 78LO5 +5V REG. TO-92 PKG.	1	U2
364000-0144A	IC, LM393N,DUAL COMP	1	U4

Table 3-2: Parts Listing, PCBA P/N 401855-0000, Model 20100 Power Supply (2 of 3)

MDE Part Number	Description	Quantity	Reference
364000-0207A	IC, LM78L12ACZ,+ 12V REG TO92	1	U12
364000-0213A	IC, WATCHDOG,8-PIN DIP	1	U7
364000-0224A	S*IC, 87C752 16MHZ(AFTER PROG LBL BC V.01)	1	U10
364000-0225A	IC, LM34DZ,PRES FAHRENHEIT TEMP SENSOR TO-92	1	U9
364000-0227A	IC, TC4427CPA,DUAL HIGH SPEED MOS FET DRIVER	2	U3, 6
365000-0008A	SKT, 8-POS,DIP,TIN PLATE,L.P.	4	SU3, 4, 6, 7
365000-0016A	SKT, 16-POS,DIP,TIN PLATE,L.P.	1	SU5
365000-0328A	S*SKT, 28-PIN,PLCC THRU HOLE	1	
370100-0100A	RES, 10,1/4W,5%,CF TAPE & REEL	1	R12
370100-0241A	RES, 240,1/4W,5%,CF TAPE & REEL	1	R42
370100-0302A	RES, 3K,1/4W,5%,CF TAPE & REEL	1	R16
370100-0510A	RES, 51,1/4W,5%,CF TAPE & REEL	1	R4
370101-0100A	RES, 10,1/8W,5%,CF TAPE & REEL	2	R11, 38
370101-0102A	RES, 1K,1/8W,5%,CF TAPE & REEL	1	R10
370101-0103A	RES, 10K,1/8W,5%,CF TAPE & REEL	4	R14, 29, 40, 53
370101-0104A	RES, 100K,1/8W,5%,CF TAPE & REEL	3	R9, 13, 30
370101-0152A	RES, 1.5K,1/8W,5%,CF TAPE & REEL	1	R26
370101-0153A	RES, 15K,1/8W,5%,CF TAPE & REEL	1	R41
370101-0202A	RES, 2K,1/8W,5%,CF TAPE & REEL	1	R15
370101-0221A	RES, 220,1/8W,5%,CF TAPE & REEL	3	R5, 6, 7
370101-0244A	RES, 240K,1/8W,5%,CF TAPE & REEL	1	R35
370101-0270A	RES, 27,1/8W,5%,CF TAPE & REEL	3	R25, 27, 28
370101-0332A	RES, 3.3K,1/8W,5%,CF TAPE & REEL	4	R18, 20, 22, 24
370101-0472A	RES, 4.7K,1/8W,5%,CF TAPE & REEL	2	R17, 52
370101-0512A	RES, 5.1K,1/8W,5%,CF TAPE & REEL	1	R54
370101-0560A	RES, 56,1/8W,5%,CF TAPE & REEL	1	R51
370101-0682A	RES, 6.8K,1/8W,5%,CF TAPE & REEL	3	R19, 21, 23
370102-0200A	RES, 20,1/2W,5%,CF TAPE & REEL	2	R1, 2
370102-0331A	RES, 330,1/2W,5%,CF TAPE & REEL	1	R3
370200-1003A	RES, 100K,1/4W,1%,MF TAPE & REEL	4	R43, 46, 48, 50
370200-2002A	RES, 20K,1/4W,1%,MF TAPE & REEL	4	R44, 45, 47, 49
370200-3010A	RES, 301,1/4W,1%,MF TAPE & REEL	1	R56

Table 3-2: Parts Listing, PCBA P/N 401855-0000, Model 20100 Power Supply (3 of 3)

MDE Part Number	Description	Quantity	Reference
370200-6341A	RES, 6.34K,1/4W,1%,MF TAPE & REEL	1	R39
370200-6342A	RES, 63.4K,1/4W,1%,MF TAPE & REEL	1	R34
370200-6811A	RES, 6.81K,1/4W,1%,MF TAPE & REEL	1	R55
370200-8452A	RES, 84.5K,1/4W,1%,MF TAPE & REEL	1	R36
376000-0017A	XSTR, BUK456-100A,(OR IRF 540) (TO-220)MOSFET ONLY	2	Q5, 6
376000-0031A	XSTR, IRFZ44,PWR MOSFET,60V,35A	3	Q1, 2, 3
378000-0002A	DIO, 1N4002GP,RCTFR, (MOT ONLY) T&R	6	D12, 13, 15, 20, 27, 28
378000-0005A	DIO, 1N914,SIGNAL T&R	3	D21, 22, 23
378000-0032A	DIO, FEN16DT,150V,16A,RCTFR,ULTRAFAST,COM ANOD	1	D19
378000-0033A	DIO, MUR1620CT,200V,16A,RCTFR,ULTRAFAST,COM CATH	1	D18
378000-0036A	DIO, 1N5819,1AMP,SCHOTTKY T&R	1	D14
378000-0041A	DIO, BYV27-200 T&R	2	D16, 17
378000-0052A	RECTIFIER, 8AMP BRIDGE 200V	1	BR1
378000-0060A	DIO, BYV26B RECT. TAPE & REEL	2	D5, 6
378000-0061A	DIO, 1N4762A,82V,1W,ZENER TAPE & REEL	2	D25, 26
378000-0070A	DIO, BYV34-400 400V ULTRAFAST 20A REC. DOUBLE	1	D7
378000-0077A	DIO, MBR20100CT,PWR REC,SCHOTTKY,20A,100V,TO-220	1	D4
380000-0036A	SW, RUE500,POLY,RESETTABLE FUSE PTC DEV	1	TH1
380000-0039A	RELAY, 10-PIN,DIP,2FORMC,MICROMINI LATCHING,12V	1	K1
382200-0025A	CHOKE, 1mH,6 AMP,COMMON MODE	1	L3
382200-0031A	INDCTR, 27uH POWER LINE	1	L2
385000-0048A	INSULATOR, THERMALLY CONDUCTIVE	3	REGULATORS
401854-0000	PCB, E2B PWR SPPLY REV D (E1600)	1	-
401859-0000	HTSNK, PWR SPPLY E2B REV B (E1430)	1	-
401863-0000	FAB.,DIO 80SQ035 8A RECT.(OR 040/045) REV A (D319)	3	D1, 2, 3
401864-0000	FAB.,DIO, FE3D,200V,3A,FAST *PREPPED* REV A (D319)	4	D8, 9, 10, 11
401973-0000	HEATSINK PLATE 3-POS E2B PWR SPPLY REV B (E1430)	1	-
402010-0000	XFMR, SWITCHING E2B PWR SPPLY REV A4 (D551)	1	T1
402011-0000	MULTI-INDCTR, SWITCHING E2B PWR SPPLY REV A3(D551)	1	L4
402012-0000	INDCTR,49uh,E2B/E3B P/S BATT CHRGR REV A (E1430)	1	L1
402241-0000	INSULATOR, THERM. COND.-E2B PWR SPPLY REV B(E1647)	2	15



4 CPU Board

4 CPU Board

4.1 Overview

The ESCORT II Model 20100 monitor is controlled by the CPU Board. The Central Processing Unit (CPU) used is an 8-bit processor, type Z8S180. The CPU board retains system configuration in battery backup RAM and generates all timing and synchronization signals to make the ESCORT II monitor an intelligent and efficient monitoring device. The CPU board communicates directly with all parameter cards and configurations through software commands transmitted across a common bus. The CPU board also provides a real-time clock, a watchdog circuit, digital I/O, timer / counter circuits, keyboard decoding, 256K x 8 ROM, 128K x 8 RAM, electrically erasable (EE) programmable logic device (PLD), digital-to-analog converter, recorder interface, Multiparameter Module interface, defibrillator sync, high voltage power supply interface, and video control. The ESCORT II is equipped with a thermistor-controlled cooling fan which only turns on when the internal temperature exceeds 45° C.

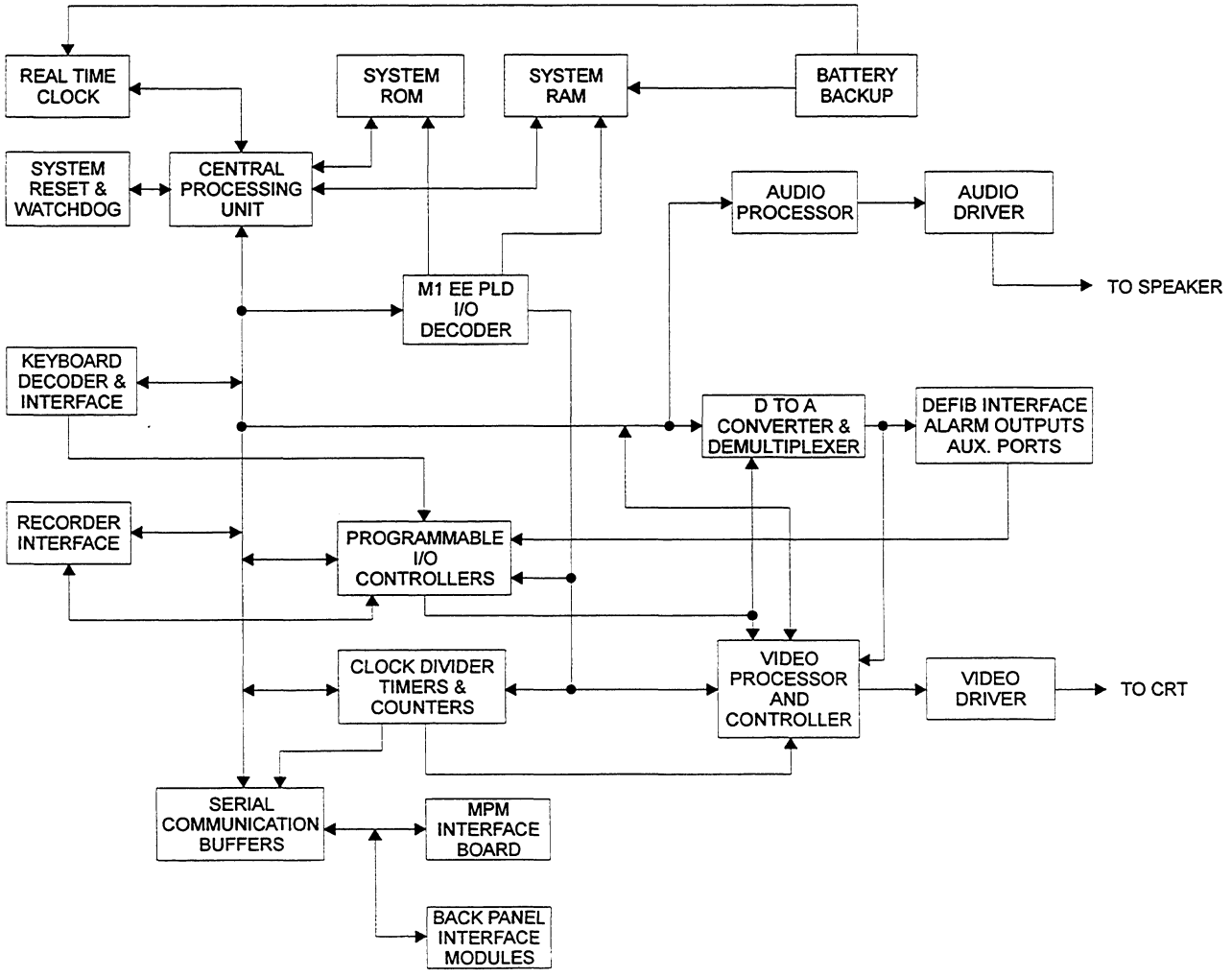


Figure 4-1: CPU Board Block Diagram

4.2 System Processing

4.2.1 Microprocessor

The microprocessor (U18) used on the CPU Board is a Z180 type which includes internal memory management and DMA control. An external clock is provided using Xl, a 32 MHz crystal oscillator. The input frequency is internally divided by two and output on U18-68 as [CLKOUT]. Program instructions are carried on the address lines, A0-A18, and the data are transferred using data lines, D0-D7. The [DREQ0\], [RD\], [WR\], [BUSREQ\], and [WAIT\] are tied to +5V through resistor pack RP5G. [INTTICK\], [INTl\], and [HORZINT\] are interrupts to the CPU. When the CPU receives one of these interrupts, a program to service the interrupt needs to be run. [INTTICK\] on U18-10 is generated at EE PLD U17-26 and signals that [TIMETICK] has occurred. The [TIMETICK] signal is derived from the EE PLD U17-27. It is clocked by OUT2 of the timer at U30-20, [TTCLK]. The frequency of [TIMETICK] is equal to four times (4X) the AC line frequency. A typical 60 Hz system produces a [TIMETICK] frequency of 240 Hz while a 50 Hz system produces a [TIMETICK] frequency of 200 Hz.

The interrupt is cleared from U29-11 with [INT0CLR]. [INT1\] on U18-11 is produced at the EE PLD U17-41 and represents recorder synchronization timing. It is cleared from U11-13 with [INT1_CLR]. [HORZINT\] on U18-12 is generated at U17-18, and alerts the CPU that the CRT beam is back at the left side of the CRT screen and is ready to write new data. The Read [RD\], Write [WR\], Memory Enable [ME\], and I/O Enable [IOE\] lines are OR'd together to form the Memory and I/O Decode logic inside the M1 EE PLD (U34). [RESETP\] is an input from the watch-dog timer and is used to reset the CPU and other logic devices. [DREQ1\] is the direct memory access request line used by the Video Controller section. [DREQ1\] is generated by U17-43. [CPU_TX], [CPU_RX] and [RTS0\] are used to establish two way communication with the parameter cards.

4.2.2 Watchdog

The watchdog timer, U36, is strobed with the signal [WDOG] on U36-11. If the [WDOG] signal at U11-42 stops, the watchdog timer will time out and reset the CPU and digital I/Os using [RESETP\]. U36 also monitors the +5V. If the +5V falls below a critical operating level, U36 will generate a system reset and automatically apply the voltage from a 2.4-volt NiCad battery (BT1) to the static RAM (U21) to retain the configuration information and to the real-time clock to retain the correct time and date while the monitor is in STBY condition.

4.2.3 Electrically Erasable (EE) PLDs

There are two 44-pin EE PLDs on board. Each EE PLD is capable of having 38 inputs and 32 outputs. It also consists of 64 flip-flops. One of the EE PLD is designated as M1 (U34) and the other as M2 (U17). M1 functions as memory decode, I/O decode, peripheral address decoder, and some other logic functions. Since the device select lines of M1 are connected to the chip select (CS) pins of the peripherals, the CPU can selectively activate the peripherals using the address lines, A12-A15. M2 functions as clock divider and some other logic functions. M2 divides the 16 MHz output frequency from the CPU into four different output timing signals: 8 MHz, 4 MHz,125 kHz, and the battery charging synchronization signal, [CHG_SYN], which is approximately 15.6 kHz. These output frequencies are used as timing signals throughout the monitor.

4.2.4 I/O

The Programmable Peripheral Interfaces (PPI), U11 and U29, control the transfer of both data and control words to and from the CPU.

4.2.5 Memory

The 256K x 8 EPROM, U22, is factory programmed with the software necessary to control the options purchased with the ESCORT II monitors. The 128K x 8 static RAM functions as a scratch pad for the CPU and is used to store the users configuration information. The information stored in the static RAM is retained when the unit is turned off by using [VBACKUP] from the watchdog circuit.

4.2.6 Real-Time Clock

The Real-Time Clock (RTC), U35, has an internal crystal oscillator that will maintain the correct time of day, and the date. The time and date will be displayed on each recording strip and can be viewed on the ESCORT II's screen display. When the monitor is turned off, a 2.4-volt NiCad battery (BT1) produces [VBAT] which becomes [VBACKUP] after passing through the watchdog timer (U36). [VBACKUP] is used to keep the RTC running.

4.2.7 Alarm Tone Generation

A programmable microcontroller, U19, is used to generate all tones for the ESCORT II. The microcontroller is factory programmed, and uses one of its pulse-width modulated outputs to drive the speaker.

4.2.8 Timing

Timer / Counter #1, U30, is CPU controlled and uses 4 MHz as an input to create the power supply synchronization signal, [PS_SYNC], and [TTCLK] which drives U17-7 to produce the timing signal, [TIMETICK]. The [PS_SYNC] signal, clocked by the 4 MHz clock and synchronized by the [RESETP\] signal, is a 250 kHz signal that is applied to all system power supply generators to keep them switching on the same edge. This reduces beat frequency noise on the waveform signals. [TIMETICK] is the polling rate for the data from the parameter cards. The frequency of [TIMETICK] is four times the line frequency (i.e., a typical 60 Hz system produces a TIMETICK of 240 Hz). The AC detect signal, [AC_DET], after being filtered by the Schmidt trigger, U32D, goes to the CLK1 line, U30-15. The CPU will use this information to determine the line frequency and adjust the timing for proper operation. Timer / Counter #2, U25, is also CPU controlled, and uses the 8 MHz clock to create [12/28μS] and a combination of the 8 MHz and 125 kHz clocks to create [DMA_TIME]. Both of these signals are used by the Video Controller section to synchronize memory access time for the generation of the screen display information.

4.2.9 Keyboard Decoder

The keyboard decoder, U20, employs a 4 x 4 XY matrix that scans the keypad at a rate set by C58. C59 biases the internal debounce circuitry. With a key depression, the appropriate XY coordinate information will be loaded to the outputs U20-14 to U20-17 and the data available (DA) line will go low. The [KEYDATA\] signal is routed to the CPU via the digital I/O U11-20 and the CPU will respond to M1 (U34). M1 then latches the transfer of the XY coordinate information on to the data bus for processing.

4.2.10 Digital-to-Analog

The digital-to-analog conversion circuitry (U2) is used to convert digital messages from the CPU to an analog format that is routed to the auxiliary port or used by the Video Controller section. The analog output from U2 is demultiplexed by U1 and is routed to various areas. The demultiplexer is controlled by the PPI, U29, using the [MUX 1-3] lines, and the [INHIBIT] line.

4.2.11 Video Controller

The Video Controller consists of a First-In-First-Out (FIFO) controller (U23), an 8-bit multiplying digital-to-analog converter (U15), an EE PLD M2 (U17) containing various combinatorial logic gates and flip-flops, Schmidt triggers, analog switches, operational amplifiers, transistors, diodes, and numerous biasing components. The purpose is to produce the appropriate signals to drive the CRT.

4.2.11.1 X-Axis Outputs

The [SYNC_SWP] signal is synchronized with the [12/28µs] signal by U17 to start video processing. Two horizontal sweep signals, [HSWP1] and [HSWP2], drive the analog multiplexer, U28, which acts as the ramp-select and alpha/trace select. R84 [ALPHA], R86 [WF], and R100 [GRAT] set up the horizontal ramp waveform (also referred to as speed select). The signal from U28-3 is integrated by U15B. U15B-7 delivers the [XOUT] (also referred to as [XDRV]) signal, which is a ramp-up sawtooth voltage. See Figure 4-2 for details. This four-pulse train constitutes one cycle, which is determined by the line frequency. For a 60 Hz line frequency, the cycle time is about 16.7 ms. The four-pulse train is summed by the operational amplifier, U15A. Its size can be adjusted by VR6. The horizontal position adjustment is provided by VR7. The output of U15A is delivered to the analog switch, U9B, which is controlled by the CRT disable signal, [CRTDSBL\]. The output of the analog switch, U9B, is delivered to the yoke driver, U14, which delivers the horizontal yoke signals, [X_YOKE1] and [X_YOKE2].

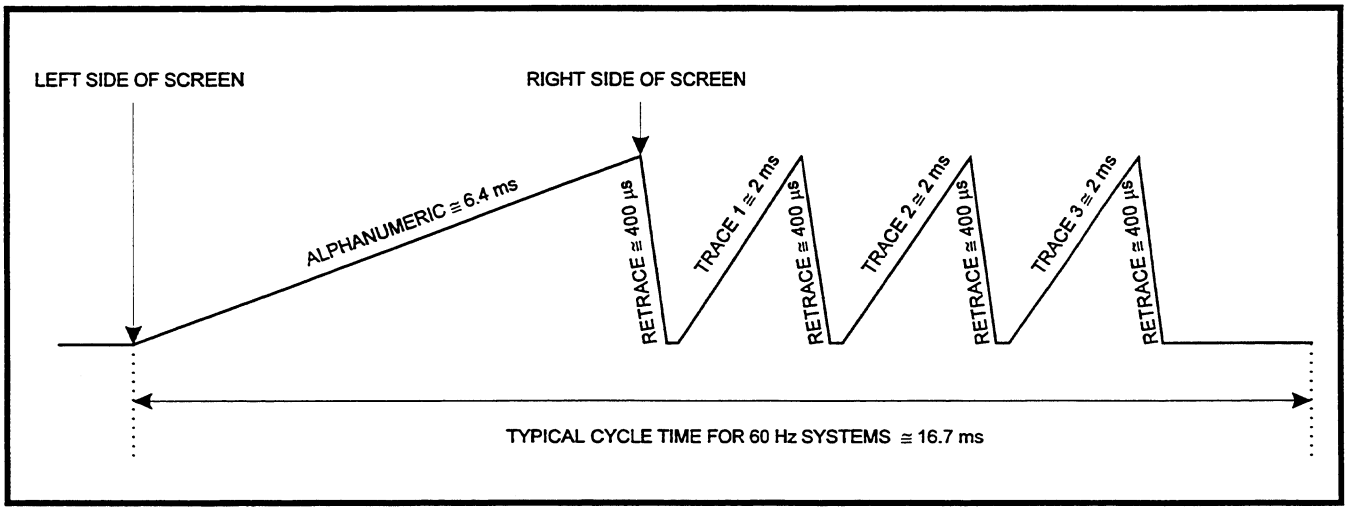


Figure 4-2: Horizontal Ramp Waveform (U15-7) — Indicates Approximate Timing of Alphanumeric, Retrace and Traces.

4.2.11.2 Z-Axis Output

The cathode on/off, or blanking drive signal, [ZOUT], is a rectangular pulse train with a maximum frequency of 4 MHz. It is delivered by the EE PLD U17-42, which combines the following four input signals: the blanking signal during retrace, [GRATBLK] at U17-38, the horizontal blanking signal from the right margin comparator, U24C-14, the left margin comparator, U24D-13, and an "off-1-byte-before-empty" signal from U23-12 [SO] and U23-31 [EF+1\]. The right margin comparator derives its inputs from the +5-volt reference, [+5VREF], and the horizontal ramp signal which is described in section 4.2.11.1. The left margin comparator derives its inputs from the horizontal ramp signal, and a modified [GRAT]. When either the [+5VREF] or the [-5VREF] signal is exceeded, the output at U17-42 is blanked, thus producing the blanking signal. A typical Z-axis output is described in Figure 4-3.

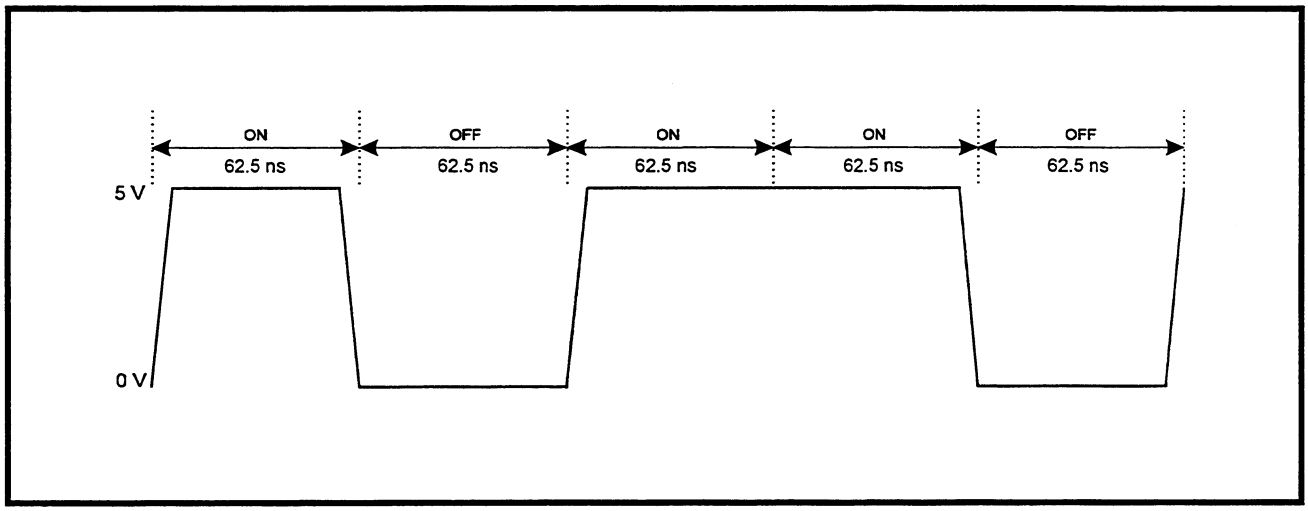


Figure 4-3: Typical Z-Axis Output Trace at U17-42

4.2.11.3 Y-Axis Outputs

The First-In-First-Out (FIFO), U23, receives 8-bit data transfer using a direct memory access scheme from the CPU, the [FIFOIN\] signal from the EE PLD (U34-2), the [FIFORES\] signal from the Digital I/O (U29-13), and the signal [FFRD\] from U17-20. The serial output clock pulse, U23-11, is provided by the EE PLD U17-25 [SOCP], which combines the [12/28µs] pulse with the 8 MHz clock to produce the shift rate. The outputs, Q0-Q7, are parallel waveform data which provide the trace information to the digital-to-analog converter, U15. The [ANUM] signal is low during sweep and supplies the U15-12 chip select line. The signal [DAC_SIZE], derived from U1-2, supplies the U15-15 reference line, and also provides trace gain to the summing amplifier U10B-7 which forms the [YDRV] signal. See Figure 4-4 for details on trace 1, trace 2, and trace 3 information. In the figure, trace 1 is ECG; trace 2 is BP1, and trace 3 is SpO_2. The vertical trace size can be adjusted by VR3, and the vertical position adjustments are provided by VR1. The offset signal [DAC_OFST], derived from U1-5, can be adjusted by the trace offset/waveform separation adjust, VR4. The resultant signal is delivered to the vertical summing amplifier, U10D-14. See Figure 4-5 for details of the vertical summing signal. This signal is delivered to the analog switch, U9C, which is controlled by the alphanumeric serial signal, [ANUM\]. The information is delivered to the vertical summing amplifier, U12, which delivers the [Y_YOKE1] drive. The [Y_YOKE1] signal is comprised of alphanumeric, trace 1, trace 2, and trace 3 data. The alphanumeric size adjust is provided by the potentiometer, VR2. The [12/28BUF] signal can be adjusted by the alphanumeric vertical position adjust, VR8. It is buffered by the Schmidt trigger (U31B-4) to produce the [12/28DLY], which enables the EE PLD (U17) to produce the signal raster drive, [RASDRV] at U17-15. The raster drive signal [RASDRV] is buffered by U13A and delivers the raster information needed for alphanumeric resonant drive. During resonant drive, U12 acts as a DC voltage supply source, the FET transistor, Q6, is switched on and off by the vertical scan rate [12/28µs]. Dots information is displayed during the time of 28 µs for one vertical line on the CRT. The capacitor C37 and the vertical yoke resonate to approximately third harmonic during the 12 µs trace, thus providing the necessary voltage to drive the retrace. The internal parasitic diode of the FET Q6 provides damper action and starts a new scan line. Zener diode TS2 provides overvoltage protection to the FET, Q6. During the period of waveform drive, the FET Q6 is constantly turned on; at the same time, U9D-14 and U9D-15 are set up to provide direct drive feedback. The vertical yoke, [Y_YOKE1], is then driven by the power amplifier U12 with signal derived from U10D-14. The entire operation is under program control by the CPU.

4.2.11.4 High Voltage Power Supply

The high voltage power supply (P/N 382000-0004A) delivers 7.5 kV to the anode of the CRT. It also provides +240 VDC and -60 VDC used by the Z-Axis board. This integrated high voltage module is controlled by +11 VDC which is regulated by U8 on the CPU board.

The details of disassembly is found in Chapter 11, "Mechanical Disassembly."

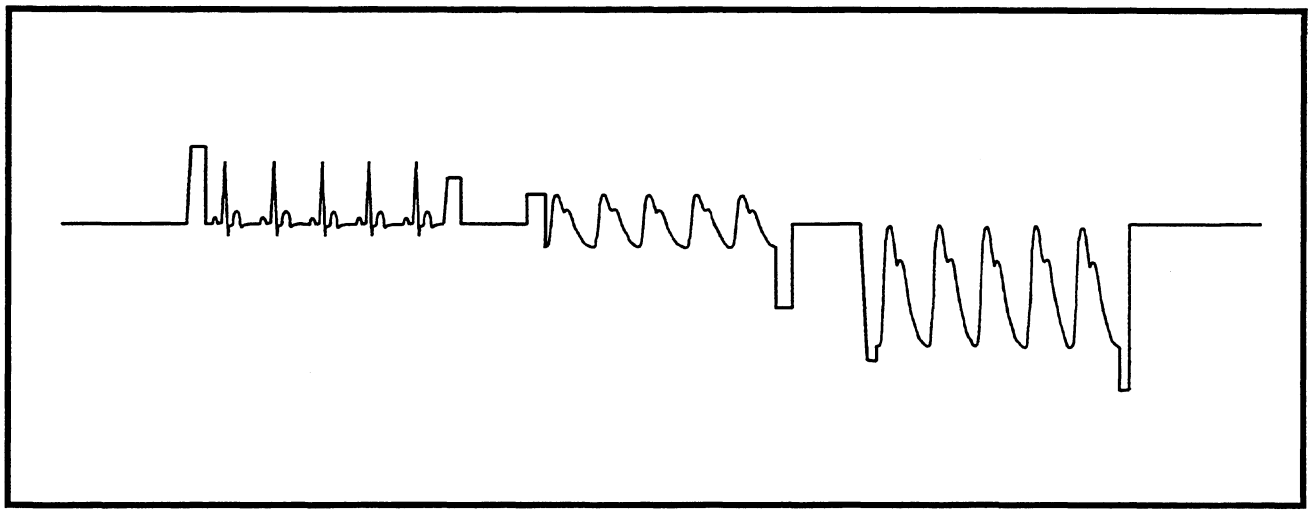


Figure 4-4: Vertical Trace Waveforms for Trace 1, Trace 2, and Trace 3 (U10-7)

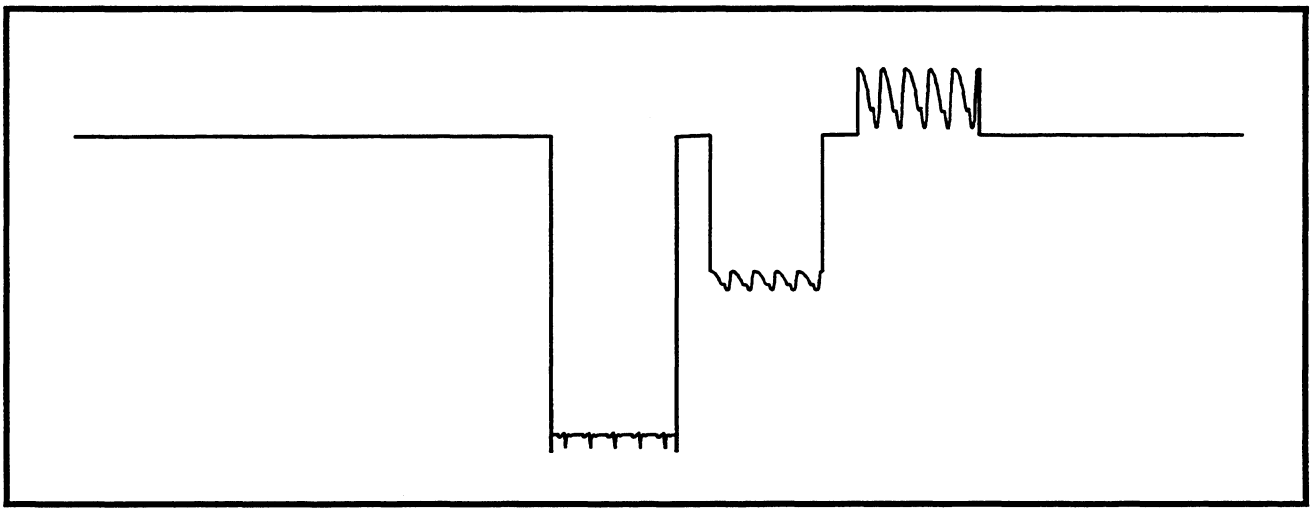


Figure 4-5: Vertical Summing Waveform (U10-14)

4.3 High Level Outputs

The ESCORT II allows programming and control of three output ports (PORT1, PORT2, and PORT3). These signals originate from the CPU board connector, P1, and are routed to the rear panel connector, P11. See Table 4-1 for pin designations. Each port may deliver any of three signal outputs. The signal can be a waveform output, an alarm-triggered output, or a record-triggered output. The signals can be sent to Nurse Call Panels, Remote Slave monitors, or various recording devices. Interfacing with many of these devices may require the use of the High Level Interface Module (HLIM), P/N E2900-33. Contact MDE Technical Support for ordering information.

The ESCORT II may also be connected to an external defibrillator. When [RING], the external QRS sync signal, goes high, it turns on Q1, which will pull the defibrillator flag signal, [DFIBFLG2], low. The [QRSOUT] signal, if present, can be monitored at P11-11. The analog ground is on P11-15, while the digital ground is on P11-14. The [SLEEVE] voltage level is tied to analog ground through R5. The [TIP], which is the ECG high level output signal, is connected to [HI_LEVEL] through R1. Both -15V and +15V are limited to 200 mA by TH1 and TH2.

Each port can be defined by accessing the CONFIG page using the ESCORT II's softkeys. Scaling factors, DC offsets, and coupling for each of the parameters are listed in Table 4-2. In addition, Table 4-3 outlines the types of signal outputs for which each port can be programmed.

Note: ***The outputs will be clipped if the displayed waveform is clipped. In addition, only one BP can be in full scale mode.***

Table 4-1: Rear Panel Connector — P11, Pin Designations

SIGNAL NAME	REAR PANEL (P11)	SIGNAL NAME	REAR PANEL (P11)
ALRM_O	1	RING	8
PORT1	2	+5 V	9 (limited to .5 A)
ALRM_NC	3	TIP/HI_LEVEL	10
PORT2	4	QRSOUT	11
ALRM_NO	5	DIGITAL GND	14
PORT3	6	ANALOG GND	15

Table 4-2: Parameter Scaling Factors, DC Offsets, and Coupling

PARAMETER	SCALE	DC OFFSET	COUPLING
ECG	1 V = 1 mV	2.5 V	DC
BP (PULSE)	1 V = 100 mmHg	1.6 V	DC
BP (SCALE)	1 V = 100 mmHg	0 V	DC
RESP	1 V = 1 ohm	2.5 V	DC
SPO2	4 V = 100%	0 V	DC
CO2	1 V = 10.1 mmHg	0.2 V	DC
TEMP	1 V = 10° C	0 V	DC
HR	1 V = 51 BPM	0 V	DC

Table 4-3: Programmable Outputs

OUTPUT	PARAMETER	DEFINITION
WF1	AUTO	Any trace displayed in waveform area 1 is output
WF2	AUTO	Any trace displayed in waveform area 2 is output
WF3	AUTO	Any trace displayed in waveform area 3 is output
WF	ECG	The ECG waveform is output
	BP1	The BP1 waveform is output
	BP2	The BP2 waveform is output
	CO2	The CO2 waveform is output
	PLETH	The SPO2 pleth waveform is output
	RESP	The Respiration waveform is output
	HR	The heart rate numeric is output
	SPO2	The SPO2 percentage numeric is output
	T1	The temperature numeric is output
ALARM	ANY	Enables on any alarm
	FLASH	Enables alternating ON/OFF (flashing) on any alarm
	ECG	Enables on any ECG alarm
	BP1	Enables on any BP1 alarm
	BP2	Enables on any BP2 alarm
	CO2	Enables on any CO2
	NIBP	Enables on any NIBP alarm
	SPO2	Enables on any SPO2 alarm
	RESP	Enables on any Respiration alarm
	T1	Enables on any Temperature alarm
KEY	REC	Enables when the RECORD key is pressed

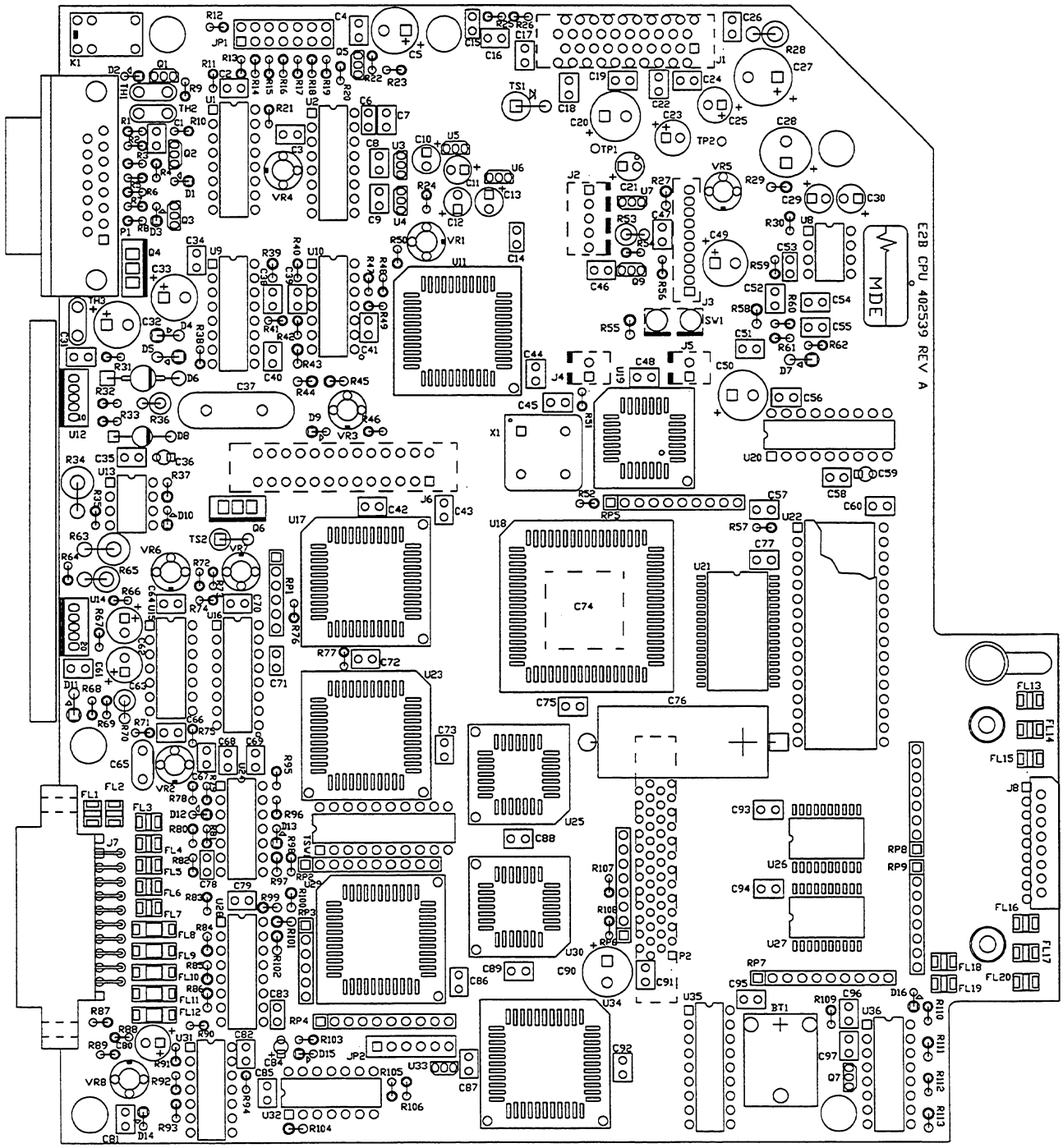


Figure 4-6: CPU Board Layout

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Figure 4-7: CPU Schematic

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Table 4-4: Parts Listing, PCBA P/N 402540-0000, CPU Board (1 of 5)

MDE Part Number	Description	Quantity	Reference
352100-0101A	CAP, 100PF,25V,10%,RAD,NPO - .1 LEAD SPACING T & R	1	C6
352100-0103A	CAP, .01UF,50V,10%,RAD,X7R TAPE & REEL	1	C15
352101-0470A	CAP, 47pF,50V,10%,NPO,CER,RAD TAPE & REEL	1	C81
352101-0470A	CAP, 47pF,50V,10%,NPO,CER,RAD TAPE & REEL	2	C71, 78
352200-0107A	CAP, 100UF,50V,RAD,ELECT,LS TYPE 3.5MM LD T&R	1	C80
352200-0127A	CAP, 120uF,35V,20%,LOW ESR,.15/.35,ELECT	2	C5, 49
352200-0157A	CAP,150uF,25V,20%,RAD,ELECT,8mm x 12mm,3.5mm LD	1	C28
352200-0157A	CAP,150uF,25V,20%,RAD,ELECT,8mm x 12mm,3.5mm LD	2	C32, 33
352200-0476A	CAP, 47UF,25V,RAD,ELECT 2.5mm LEAD SPACE	3	C11, 12, 21
352202-0107A	CAP, 100uF,20%,25V,6.3x11mm,RAD,ELECT	4	C23, 25, 62, 63
352202-0228A	CAP, 2200uF,16V,AX,ELECT,12x30mm	1	C76
352202-0337A	CAP, 330UF,35V,10X16MM,ELECT,RAD	1	C27
352203-0227A	CAP, 220uF,16V,20%.RAD,ELECT,8mm x 12mm T&R	3	C20, 50, 90
352300-0014A	CAP, .022UF,5%,MYLAR	1	C53
352300-0015A	CAP, .22UF,10%,MYLAR	3	C52, 54, 55
352300-0102A	CAP, 1000PF,50V,20%,RAD,MYLAR	2	C14, 83
352300-0104A	CAP, .1UF,50V,20%,RAD,MYLAR	52	C1, 2, 3, 4, 8, 9, 16, 17, 18, C19, 22, 24, 26, 34, 38, 39, C40, 41, 42, 43, 44, 45, 46, C47, 48, 56, 57, 60, 64, 66, C67, 68, 69, 70, 72, 73, 75, C77, 79, 82, 85, 86, 87, 88, C89, 91, 92, 93, 94, 95, 96, 97
352300-0224A	CAP, .22UF,50V,20%,MYLAR	4	C31, 35, 58, 61
352300-0473A	CAP, .047UF,50V,20%,MYLAR	2	C7, 51
352401-0106A	CAP, 10UF,35V,20%,RAD,TANT TAPE & REEL	4	C10, 13, 29, 30
352401-0225A	CAP, 2.2UF,35V,20%,TANT TAPE & REEL	2	C36, 84
352600-0039A	CAP, .068uF,5%,200V,POLYPRO	1	C37
352600-0040A	CAP, 0.1uF,5%,63V,POLYCARB	1	C65
352600-0045A	CAP, 0.039uF,DECOUPLING FOR DIP32	1	C98
352600-0046A	CAP, 0.018uF,DECOUPLING FOR PLCC68	1	C74
354000-0031A	CONN, 5-P,M,STRT LOCK,.1 CTR	1	J2
354000-0104A	CONN, SGL ROW,STRT,SGL PINS,SNAP-AWAY 36 PINS	6	JP2
354000-0106A	CONN, DBL ROW,STRT,SGL PIN,SNAP-AWAY 36-PINS	14	JP1
354000-0138A	CONN, 2-P,M,STRT LOCK,.1 CTR,HDR	2	J4, 5
354000-0199A	CONN, 50-PIN,HIGH DENSITY,MALE	1	P2
354000-0277A	CONN, 17-POS,STRT,FFC,.049 CTR	1	J8
354000-0278A	CONN, 20x2 CE40/05FB,HDR	1	J1

Table 4-4: Parts Listing, PCBA P/N 402540-0000, CPU Board (2 of 5)

MDE Part Number	Description	Quantity	Reference
354000-0279A	CONN, 20-PIN,CE20,CARD EDGE	1	J7
354000-0312A	CONN, 26-P,CARD EDGE,CE26	1	J6
354000-0335A	CONN, 10-POS,HSNG,M,HDR,.079 CTR	1	J3
354000-0413A	CONN, 15-PIN,F,D-SUB,SHIELDED,R/A PCB W/ BD LOCKS	1	P1
356000-0043A	OSCILLATOR, 32.000MHZ,DIP METAL CAN	1	X1
358100-0036A	SCR, 4-40 X 1/4,PH PNHD,ZINC OR ANY	2	6
358200-0001A	WSHR, SHLDR	2	7
358200-0004A	WSHR, #4 FLAT STL ZINC,(.125ID,9/32OD,.025THK)	2	5
358200-0007A	WSHR, #4 INT TOOTH	2	8
360500-0101A	STNDOFF, .250,PRESS-IN	2	3
360500-0151A	SPCR, .095W x .190L,RECT.	1	9
364000-0008A	IC, DG212CJ	1	U9
364000-0010A	IC, LM339	1	U24
364000-0013A	IC, LM675	2	U12, 14
364000-0062A	IC, 74C922	1	U20
364000-0109A	IC, 78LO5 +5V REG. TO-92 PKG.	2	U6, 7
364000-0110A	IC, 79LO5 ACP -5V REG.	1	U5
364000-0123A	IC, RTC 72421A	1	U35
364000-0197A	IC, SMP08	1	U1
364000-0200A	IC, 74AC14	2	U31, 32
364000-0203A	IC, MAX696	1	U36
364000-0207A	IC, LM78L12ACZ,+ 12V REG TO92	1	U3
364000-0208A	IC, LM79L12ACZ NEGATIVE 12V VOLTAGE REG LOW PWR	1	U4
364000-0221A	IC, AD7524 CMOS 8BIT BUFFERED MULTIPLYING DAC	2	U2, 16
364000-0223A	IC, DS2400, SERIAL I.D.	1	U33
364000-0224A	S*IC, 87C752 16MHZ(AFTER PROG LBL BC V.01)	1	U19
364000-0227A	IC, TC4427CPA,DUAL HIGH SPEED MOS FET DRIVER	1	U13
364000-0232A	S*IC, 82C55-PLCC,8 MHZ 200 NANO SEC. OR FASTER SMD	2	U11, 29
364000-0235A	S*IC, IDT 72103,FIFO,PLCC	1	U23
364000-0237A	IC, Z8S180 18 OR 20 MHZ,PLCC *ZILOG ONLY*	1	U18
364000-0245A	IC, M27C2001-XX(100ns OR FAST),EPROM,2MEG,DIP32	1	U22
364000-0266A	S*IC, CXK581000M,8BIT,HS STATIC RAM,32-PIN,SOP	1	U21
364000-0268A	IC, MC34184P FET OP AMP	2	U10, 15
364000-0270A	IC, LM386N-4,LOW VOLTAGE AUDIO AMPLIFIER	1	U8

Table 4-4: Parts Listing, PCBA P/N 402540-0000, CPU Board (3 of 5)

MDE Part Number	Description	Quantity	Reference
364000-0295A	IC, PAL MACH210 - Programmable Logic Device (PLD)	2	U17, 34
364000-0299A	IC, 74HC4052, DIP	1	U28
364000-0302A	S*IC, 74ACTQ245SC BIDIRECTIONAL XCVR SOIC20	2	U26, 27
364000-0304A	IC, 82C54,PLCC28,10MHZ	2	U25, 30
365000-0008A	SKT, 8-POS,DIP,TIN PLATE,L.P.	2	SU8, 13
365000-0014A	SKT, 14-POS,DIP,TIN PLATE,L.P.	5	SU10, 15, 24, 31, 32
365000-0016A	SKT, 16-POS,DIP,TIN PLATE,L.P.	6	SU1, 2, 9, 16, 28, 36
365000-0018A	SKT, 18-POS,DIP,TIN PLATE,L.P.	2	SU20, 35
365000-0032A	SKT, 32-PIN LOW PROFILE	1	SU22
365000-0144A	S*SKT, 44-PIN,LOW PROF,PLCC W/ LOCATING POSTS	5	SU11, 17, 23, 29, 34
365000-0168A	S*SKT, 68-PIN,LOW PROF,PLCC W/ LOCATING POSTS,SMD	1	SU18
365000-0428A	S*SKT, 28-PIN,LOW PROF,PLCC W/ LOCATING POSTS,SMD	3	SU19, 25, 30
370100-0100A	RES, 10,1/4W,5%,CF TAPE & REEL	2	R27, 58
370100-0101A	RES, 100,1/4W,5%,CF TAPE & REEL	1	R104
370100-0200A	RES, 20,1/4W,5%,CF TAPE & REEL	3	R29, 37, 55
370101-0101A	RES, 100,1/8W,5%,CF TAPE & REEL	4	R1, 7, 11, 90
370101-0102A	RES, 1K,1/8W,5%,CF TAPE & REEL	2	R30, 54
370101-0103A	RES, 10K,1/8W,5%,CF TAPE & REEL	12	R21, 22, 31, 33, 35, 40, 50, R57, 59, 79, 95, 105
370101-0105A	RES, 1M,1/8W,5%,CF TAPE & REEL	1	R98
370101-0122A	RES, 1.2K,1/8W,5%,CF TAPE & REEL	2	R68, 109
370101-0124A	RES, 120K, 1/8W,5%,CF TAPE & REEL	1	R32
370101-0151A	RES, 150,1/8W,5%,CF TAPE & REEL	6	R12, 14, 15, 16, 17, 18
370101-0152A	RES, 1.5K,1/8W,5%,CF TAPE & REEL	2	R41,81
370101-0153A	RES, 15K,1/8W,5%,CF TAPE & REEL	3	R23, 38, 72
370101-0183A	RES, 18K,1/8W,5%,CF TAPE & REEL	1	R75
370101-0201A	RES, 200,1/8W,5%,CF TAPE & REEL	1	R66
370101-0203A	RES, 20K,1/8W,5%,CF TAPE & REEL	9	R20, 47, 48, 51, 74, 78, 96, R106, 112
370101-0221A	RES, 220,1/8W,5%,CF TAPE & REEL	3	R5, 9, 94
370101-0223A	RES, 22K,1/8W,5%,CF TAPE & REEL	1	R87
370101-0244A	RES, 240K,1/8W,5%,CF TAPE & REEL	1	R82
370101-0270A	RES, 27,1/8W,5%,CF TAPE & REEL	2	R19, 56
370101-0302A	RES, 3K,1/8W,5%,CF TAPE & REEL	1	R83

Table 4-4: Parts Listing, PCBA P/N 402540-0000, CPU Board (4 of 5)

MDE Part Number	Description	Quantity	Reference
370101-0331A	RES, 330,1/8W,5%,CF TAPE & REEL	5	R13, 61, 91, 92, 93
370101-0332A	RES, 3.3K,1/8W,5%,CF TAPE & REEL	2	R60, 62
370101-0334A	RES, 330K,1/8W,5%,CF TAPE & REEL	2	R10, 103
370101-0392A	RES, 3.9K,1/8W,5%,CF TAPE & REEL	2	R24, 42
370101-0394A	RES, 390K,1/8W,5%,CF TAPE & REEL	1	R80
370101-0470A	RES, 47,1/8W,5%,CF TAPE & REEL	3	R3, 6, 8
370101-0470A	RES, 47,1/8W,5%,CF TAPE & REEL	3	R52, 76, 77
370101-0471A	RES, 470,1/8W,5%,CF TAPE & REEL	1	R88
370101-0472A	RES, 4.7K,1/8W,5%,CF TAPE & REEL	4	R49, 69, 89, 110
370101-0473A	RES, 47K,1/8W,5%,CF TAPE & REEL	5	R2, 4, 64, 107, 108
370101-0513A	RES, 51K,1/8W,5%,CF TAPE & REEL	2	R25, 26
370101-0561A	RES, 560,1/8W,5%,CF TAPE & REEL	1	R46
370101-0683A	RES, 68K,1/8W,5%,CF TAPE & REEL	1	R73
370101-0751A	RES, 750,1/8W,5%,CF TAPE & REEL	1	R67
370101-0822A	RES, 8.2K,1/8W,5%,CF TAPE & REEL	1	R71
370102-0010A	RES, 1,1/2W,5%,CF TAPE & REEL	3	R36, 53, 70
370200-1002A	RES, 10K,1/4W,1%,MF TAPE & REEL	5	R43, 45, 86, 99, 113
370200-1331A	RES, 1.33K,1/4W,1%,MF TAPE AND REEL	1	R39
370200-2002A	RES, 20K,1/4W,1%,MF TAPE & REEL	2	R44, 101
370200-2103A	RES, 210K,1/4W,1%,MF TAPE & REEL	1	R85
370200-2211A	RES, 2.21K,1/4W,1%,MF TAPE & REEL	1	R100
370200-2432A	RES, 24.3K,1/4W,1%,MF TAPE & REEL	1	R111
370200-3011A	RES, 3.01K,1/4W,1%,MF TAPE & REEL	1	R97
370200-3571A	RES, 3.57K,1/4W,1%,MF TAPE & REEL	1	R102
370200-3572A	RES, 35.7K,1/4W,1%,MF TAPE & REEL	1	R84
370201-0010A	RES, 1,1W,M.O. TAPE & REEL	1	R28
370201-0151A	RES, 150,1W,5%,M.O. TAPE & REEL	1	R65
370201-4700A	RES, 0.47,1W,M.O. TAPE & REEL	1	R63
370201-6800A	RES, 0.68,1W,5%,M.O. TAPE & REEL	1	R34
370300-0003A	RES, SIP,100K,10P,NTWK,9	1	RP2
370300-0003A	RES, SIP,100K,10P,NTWK,9	1	RP7
370300-0006A	RES, NETWORK,10K,8-PIN,ISOL RES,LOW PROF,SIP	2	RP8, 9
370300-0011A	RES, SIP,10K,5%,COMMON,6-PIN,5-COMP,NETWRK	1	RP1
370300-0018A	RES, 1.0K,SIP,8-PIN,ISOL	1	RP6

Table 4-4: Parts Listing, PCBA P/N 402540-0000, CPU Board (5 of 5)

MDE Part Number	Description	Quantity	Reference
370300-0019A	RES, 4.7K,SIP,6-PIN,BUSSED	1	RP3
370300-0020A	RES, 4.7K,SIP,10-PIN,BUSSED	2	RP4, 5
374000-0102A	POT, 1K,TRIM,TOP ADJ,OFF CTR LEADS,CERMET	1	VR5
374000-0103A	POT, 10K,TRIM,TOP ADJ,OFF CTR LEADS,CERMET	4	VR1, 2, 4, 6
374000-0203A	POT, 20K,TRIM,TOP ADJ,OFF CTR LEADS,CERMET	3	VR3, 7, 8
376000-0003A	XSTR, 2N3904	1	Q5
376000-0010A	XSTR, TIP 125,DARLINGTON PWR XSTR	1	Q4
376000-0011A	XSTR, 2N3906,SIGNAL	1	Q7
376000-0019A	XSTR, 2N7000,FET	4	Q1, 2, 3, 9
376000-0030A	XSTR, IRF644,250V,N-CHANNEL,TO-220	1	Q6
378000-0001A	DIO, 1N270 T&R	1	D11
378000-0005A	DIO, 1N914,SIGNAL T&R	6	D2, 12, 13, 14, 15, 16
378000-0009A	DIO, 1N754A,6.8V,ZENER T&R ***MOT ONLY***	3	D1, 3, 9
378000-0020A	DIO, 1N4622,3.9V,10%,ZENER	1	D7
378000-0041A	DIO, BYV27-200 T&R	2	D4, 5
378000-0060A	DIO, BYV26B RECT. TAPE & REEL	1	D8
378000-0084A	DIO, 1N4746A,18V ZENER	1	D10
380000-0030A	RELAY, SPDT,5V	1	K1
380000-0033A	SW, THERMAL 45 DEG C,N.O.(COLD),TO220	1	SW1
380000-0043A	SW, OVERCURRENT,0.2AMPS	2	TH1, 2
380000-0044A	SW, 10-POS,DIP20	1	TSW1
382000-0049A	EMI FILTER 220pF, 200MHZ, CHIP	-	FL15, 16, 17, 18, 19, 20
382000-0049A	EMI FILTER 220pF, 200MHZ, CHIP	15	FL1, 2, 3, 4, 5, 6, 7, 13, 14
382000-0051A	EMI SUPRESSION FILTER 4700pF,2A,50V	5	FL8, 9, 10, 11, 12
384000-0125A	THERMALCOTE THERMAL JOINT COMPOUND - 2 OZ. TUBE	-	10 - AS REQUIRED
384000-0156A	THERMISTOR, PTC RES DEV FOR CIRCUIT PROTECT	1	TH3
384000-0226A	TRANSIENT VOLT SUPPRESSOR, BIDIRECTIONAL 600W 110V	1	TS2
384000-0227A	TRANSIENT VOLT SUPPRESSOR, UNIDIRECTIONAL 1500W 5V	1	TS1
401767-0000	HEATSINK PLATE LM675 E2B REV C (E1883)	1	2
401864-0000	FAB.,DIO, FE3D,200V,3A,FAST *PREPPED* REV A (D319)	1	D6
402242-0000	INSULATOR, THERM. COND. - E2B CPU REV B (E1648)	1	4
402539-0000	PCB, NEW E2B CPU REV. A (E1909)	1	1

4.4 Z-Axis Board

The Z-Axis board receives [ZOUT] information from the CPU. [ZOUT], together with the [ANUM\] information, is inverted and amplified to deliver a 30-volt amplitude signal to the cathode of the CRT. The zener diode, D1, provides protection for the FET transistor, Q1. Similarly, the zener diode, D2, provides protection for the FET transistor, Q2.

The Z-Axis board also provides a means of adjusting the CRT screen attributes (i.e., trace intensity, screen brightness, and screen focus). This board is located directly behind the CRT and offers easy access to the potentiometers that adjust the mentioned screen attributes. The board also routes the necessary voltages to the CRT. A board layout, board schematic, and parts listing are included in the following pages.

VR1 is a 2 MΩ potentiometer, which adjusts the overall screen FOCUS. VR2 is also a 2 MΩ potentiometer, which adjusts the overall screen BRIGHTNESS. VR3 is 10 kΩ potentiometer, which adjusts the INTENSITY of the TRACES only.

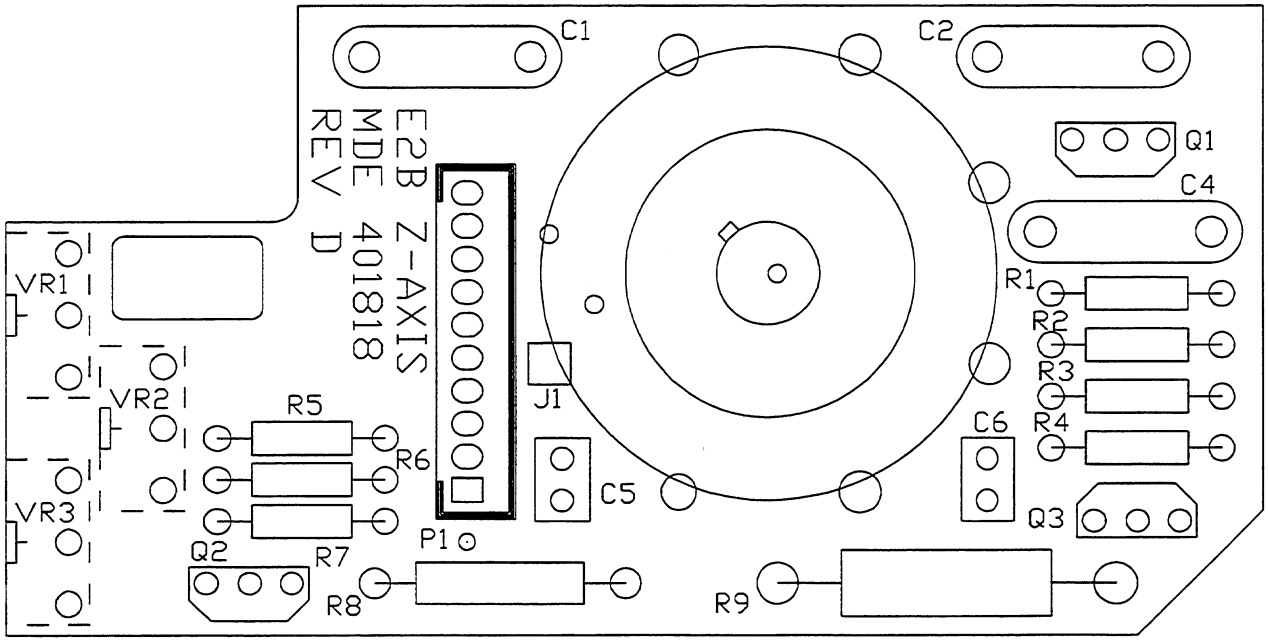

Figure 4-8: Z-Axis Board Layout

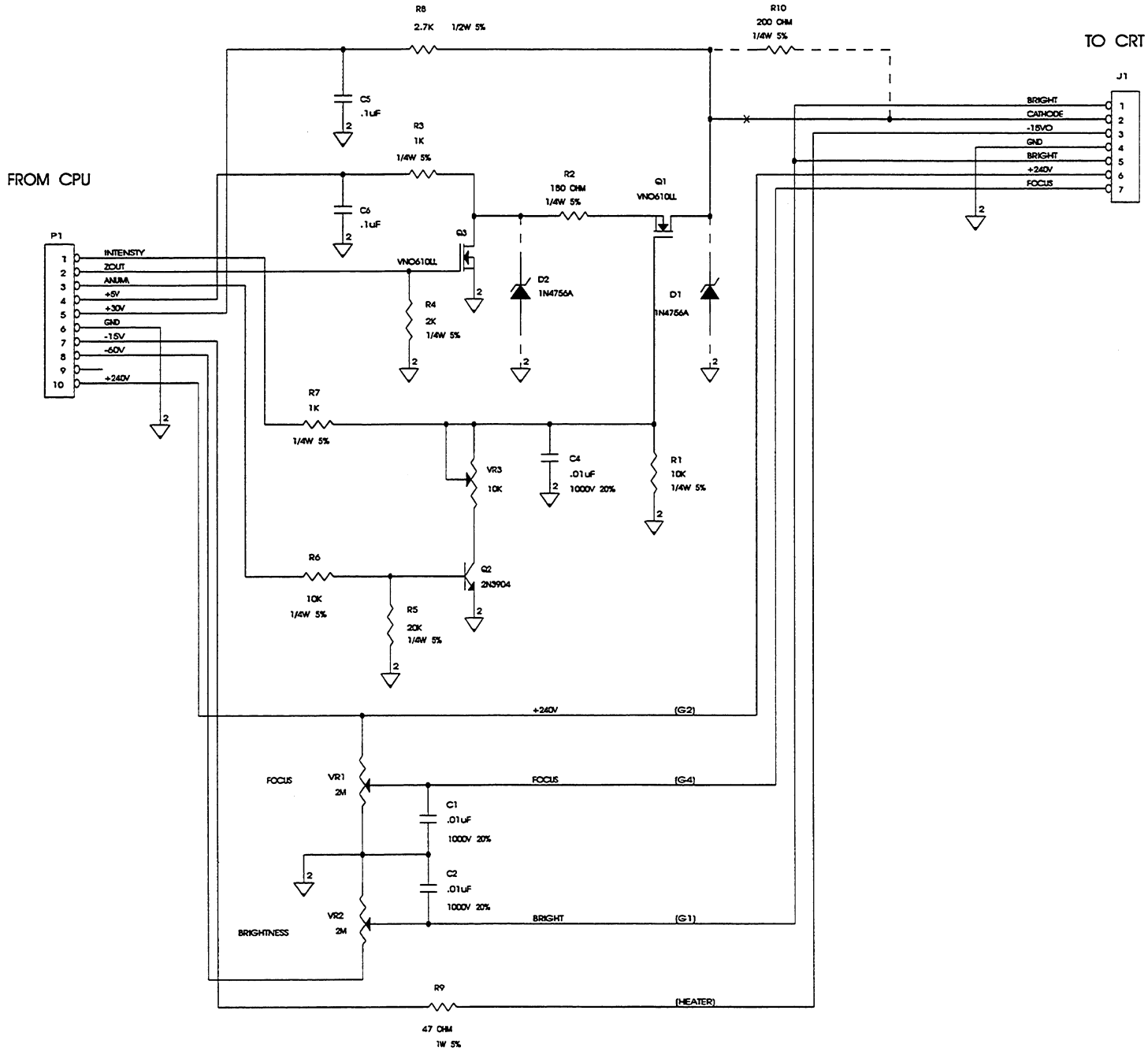

Figure 4-9: Z-Axis Schematic

Table 4-5: Parts Listing, PCBA P/N 401819-0000, Z-Axis Board

MDE Part Number	Description	Quantity	Reference
352300-0104A	CAP, .1UF,50V,20%,RAD,MYLAR	2	C5, 6
352600-0019A	CAP,.01UF,1000V,-0/+22%,Z5U,CER DISC,BULK	3	C1, 2, 4
354000-0335A	CONN, 10-POS,HSNG,M,HDR,.079 CTR	1	P1
365000-0149A	CRT SOCKET, 7 PIN PC MOUNT WITH SPARK GAP	1	J1
370100-0102A	RES, 1K,1/4W,5%,CF TAPE & REEL	2	R3, 7
370100-0103A	RES, 10K,1/4W,5%,CF TAPE & REEL	2	R1, 6
370100-0181A	RES, 180,1/4W,5%,CF TAPE & REEL	1	R2
370100-0202A	RES, 2K,1/4W,5%,CF TAPE & REEL	1	R4
370100-0203A	RES, 20K,1/4W,5%,CF TAPE & REEL	1	R5
370102-0272A	RES, 2.7K,1/2W,5%,CF TAPE & REEL	1	R8
370201-0470A	RES, 47,1W,M.O. TAPE & REEL	1	R9
374300-0103A	POT, 10K,TRIM,SIDE ADJ,CERMET,3/8 IN.QR,.15LS	1	VR3
374300-0205A	POT, 2M,TRIM,SIDE ADJ,CERMET,3/8 SQR,.15LS	2	VR1, 2
376000-0003A	XSTR, 2N3904	1	Q2
376000-0026A	XSTR, VN0610LL FET N CHANNEL SILICONIX ONLY	2	Q1, 3
401818-0000	PCB, E2B Z-AXIS REV D (E1643)	1	-

5 Multiparameter Module (MPM)

5.1 Overview

The ESCORT II Model 20001 Multiparameter Module (MPM) houses all installed parameter boards, and provides easy accessibility to each. A fully loaded MPM can accommodate ECG, Respiration, SpO_2, two (2) Invasive Blood Pressures, Noninvasive Blood Pressure, Temperature, Mainstream/Sidestream CO_2, and Cardiac Output.

The MPM is easily removed by grasping the two tabs on either side of the MPM and squeezing inward while pulling the MPM straight out of the ESCORT II monitor. The parameter boards are then accessible by removing the four Phillips screws securing the MPM cover plate and removing the cover plate.

5.2 MPM Options

Table 5-1 presents the options available for the Multiparameter Module. To add a new parameter, contact MDE Technical Support. Figures 5-1 through 5-10 present the various parameter options listed. Each parameter board is discussed in one of the following chapters.

Table 5-1: Multiparameter Module Options

Model 20001 Multiparameter Module with Dual Vector ECG	
Option	**Description**
27	Add Respiration
28	Add Noninvasive Blood Pressure (NIBP)
29	Add Noninvasive Blood Pressure (NIBP) and Temperature
30	Add SpO2
31	Add One (1) Invasive Blood Pressure (IBP)
32	Add One (1) Invasive Blood Pressure (IBP) and Temperature
33	Add Two (2) Invasive Blood Pressure (IBP)
34	Add Two (2) Invasive Blood Pressure (IBP) and Temperature
35	Add Temperature
36	Add CO2 (Note: Requires Mainstream or Sidestream ETCO2 sensor, sold separately)
38	Add HP Merlin Connectors (ECG and IBP only)
39	Add Cardiac Output (CO)

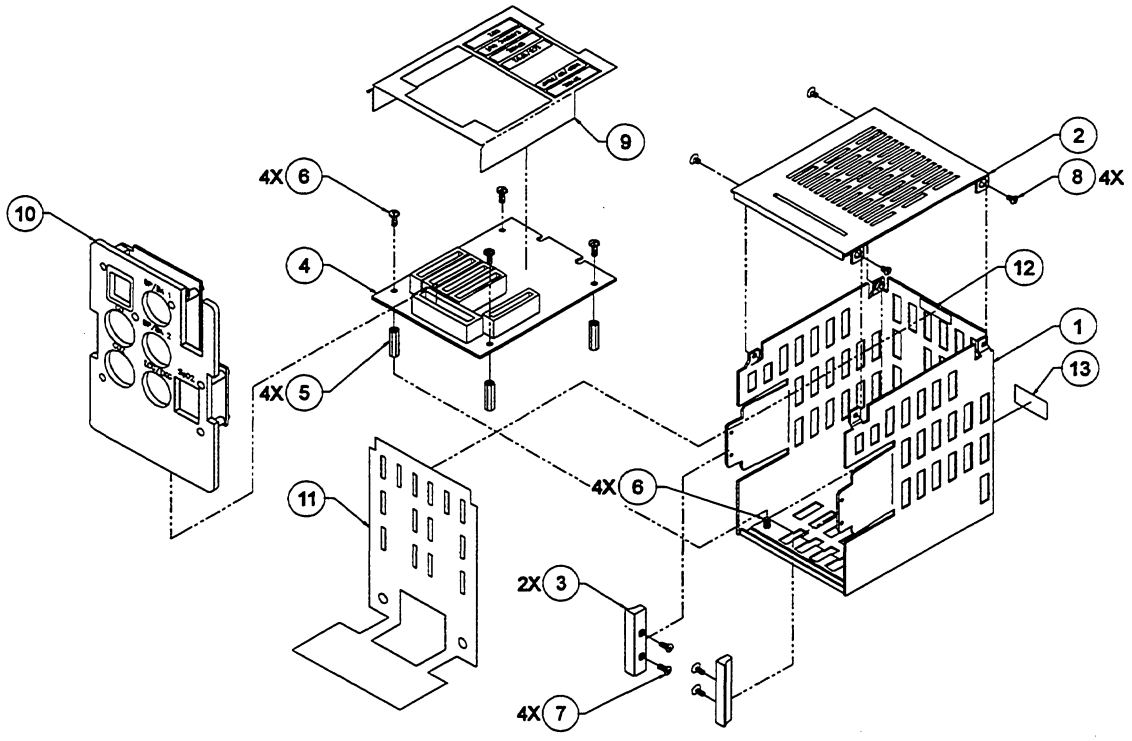

Figure 5-1: Multiparameter Module - Exploded View

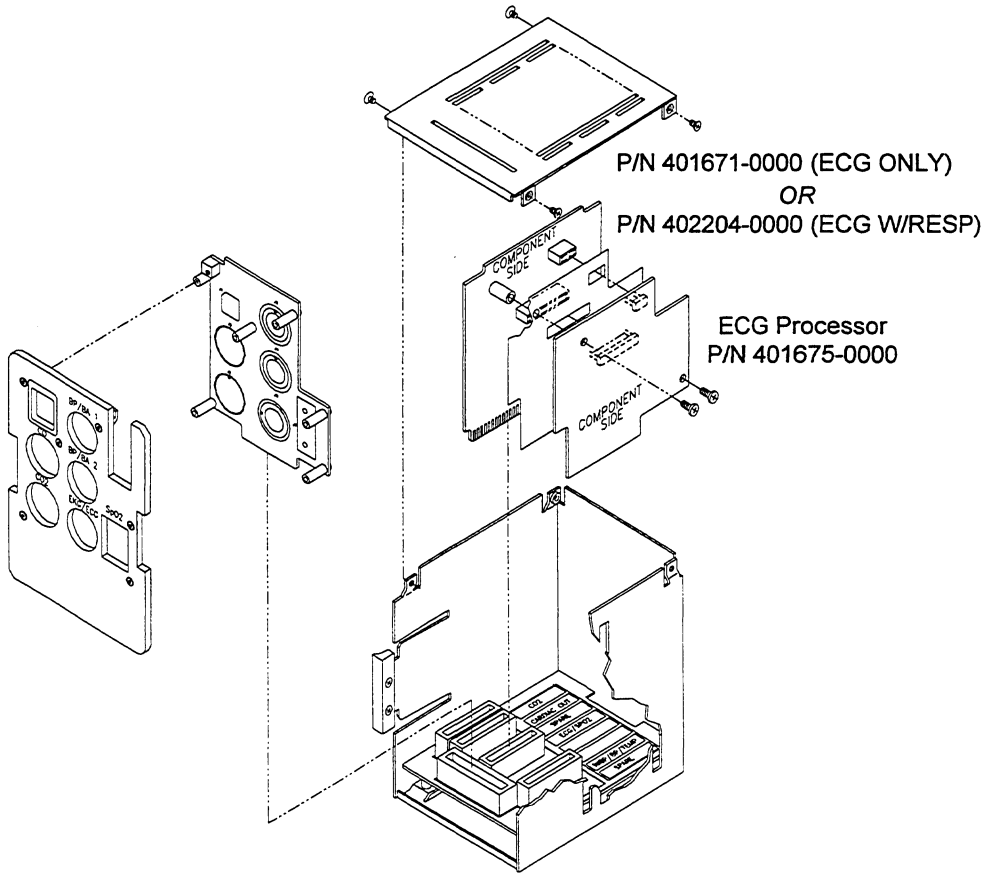

Figure 5-2: ECG Only & ECG/Respiration Options - Exploded View

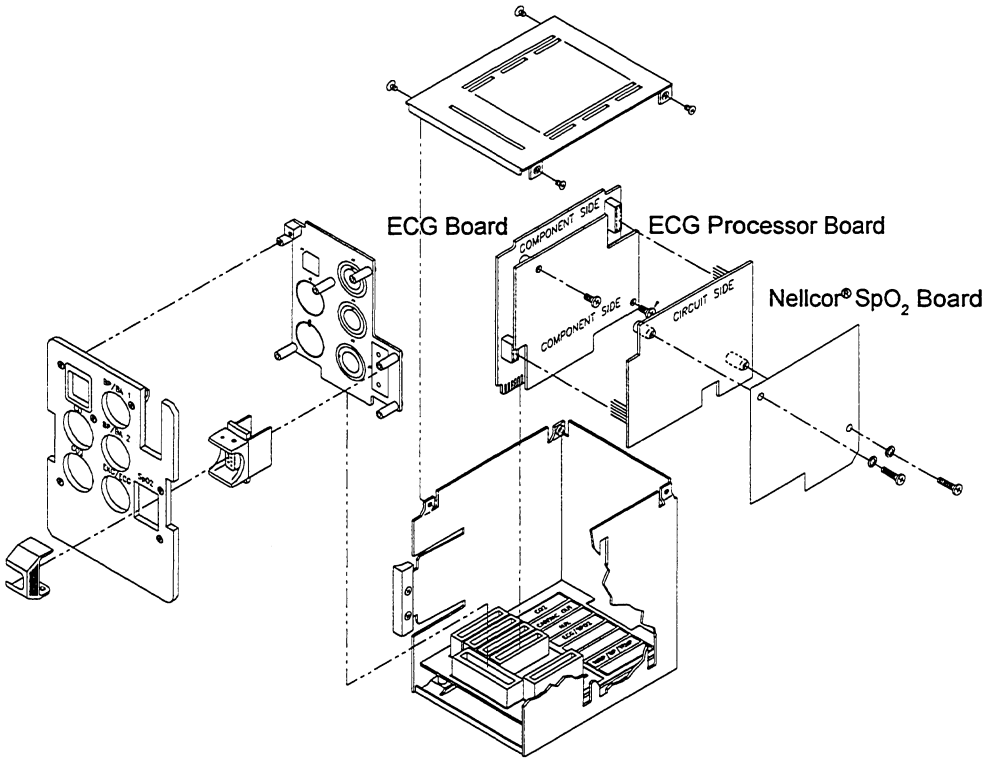

Figure 5-3: SpO_2 Option - Exploded View

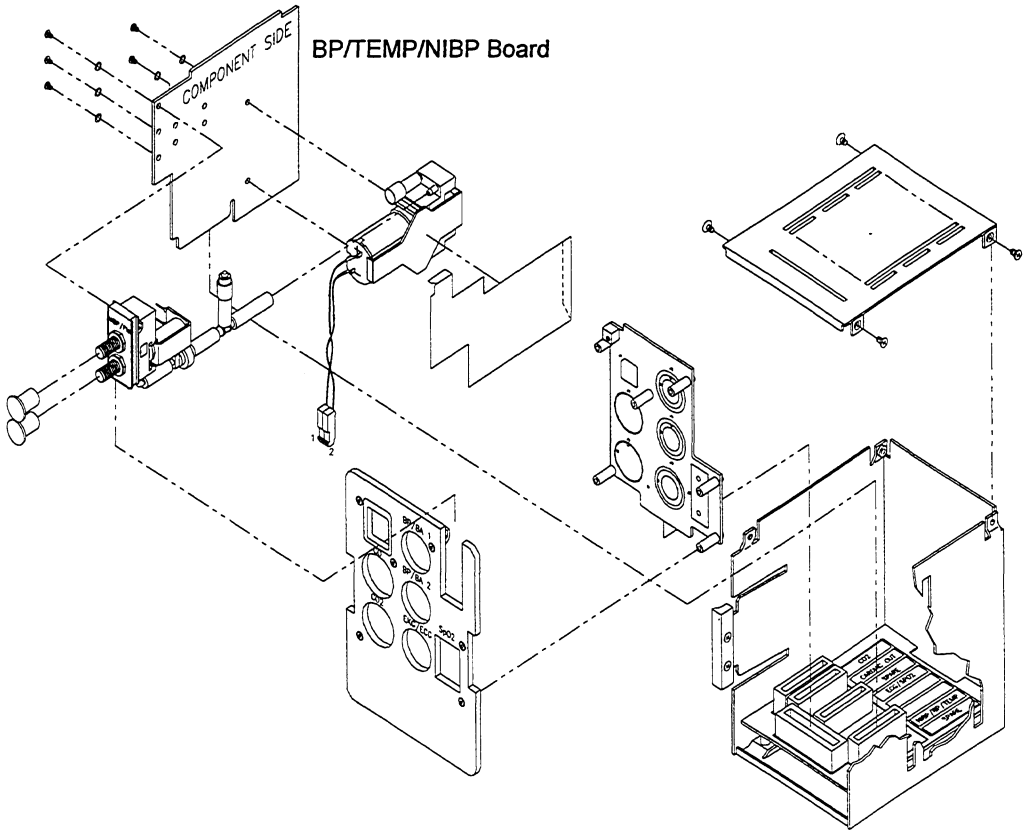

Figure 5-4: Noninvasive Blood Pressure Option - Exploded View

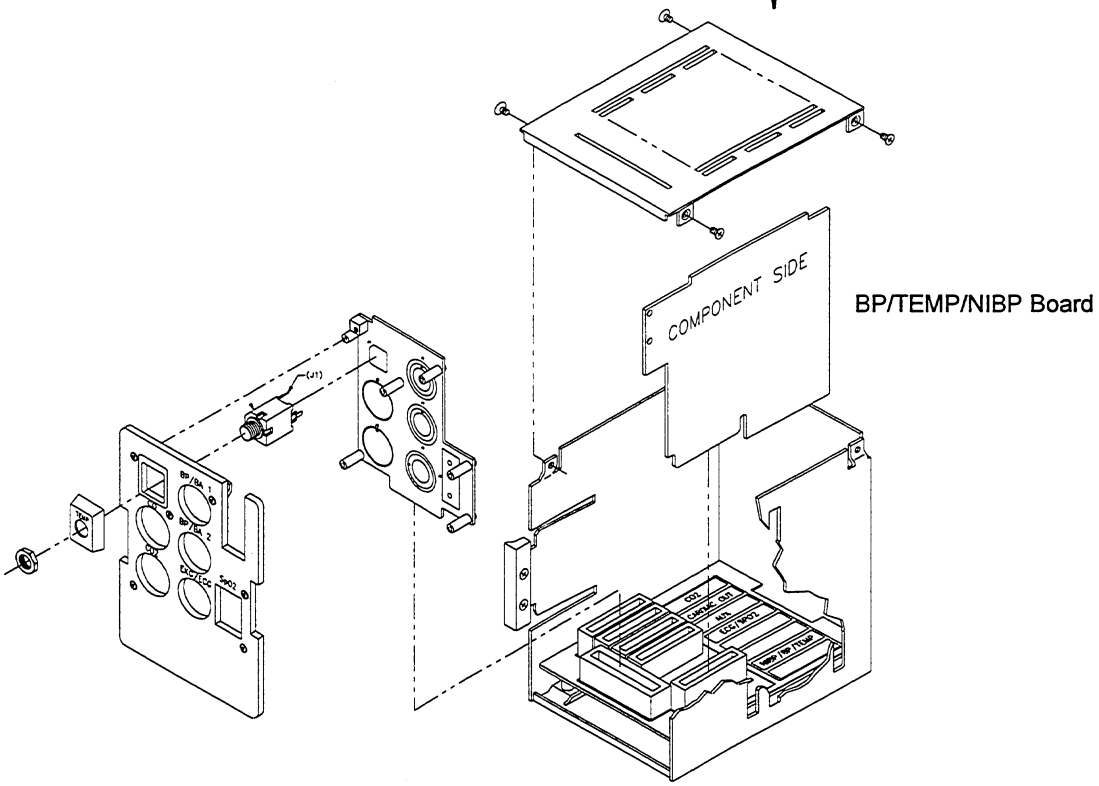

Figure 5-5: Temperature Option

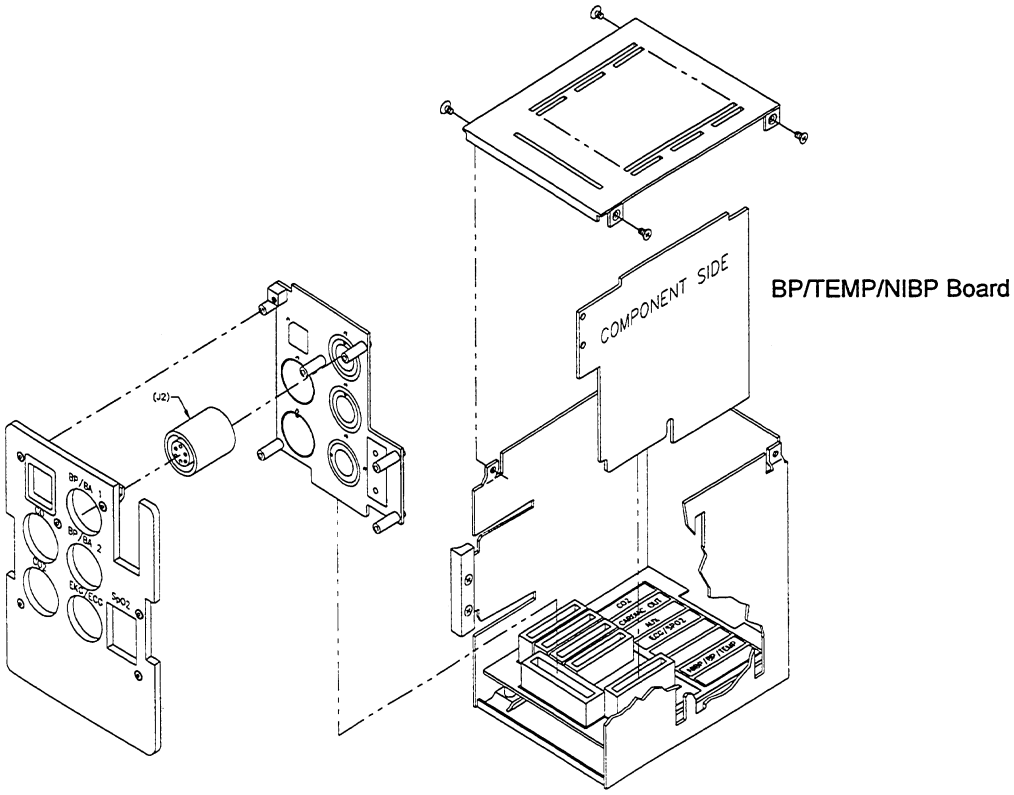

Figure 5-6: One Invasive Blood Pressure Option

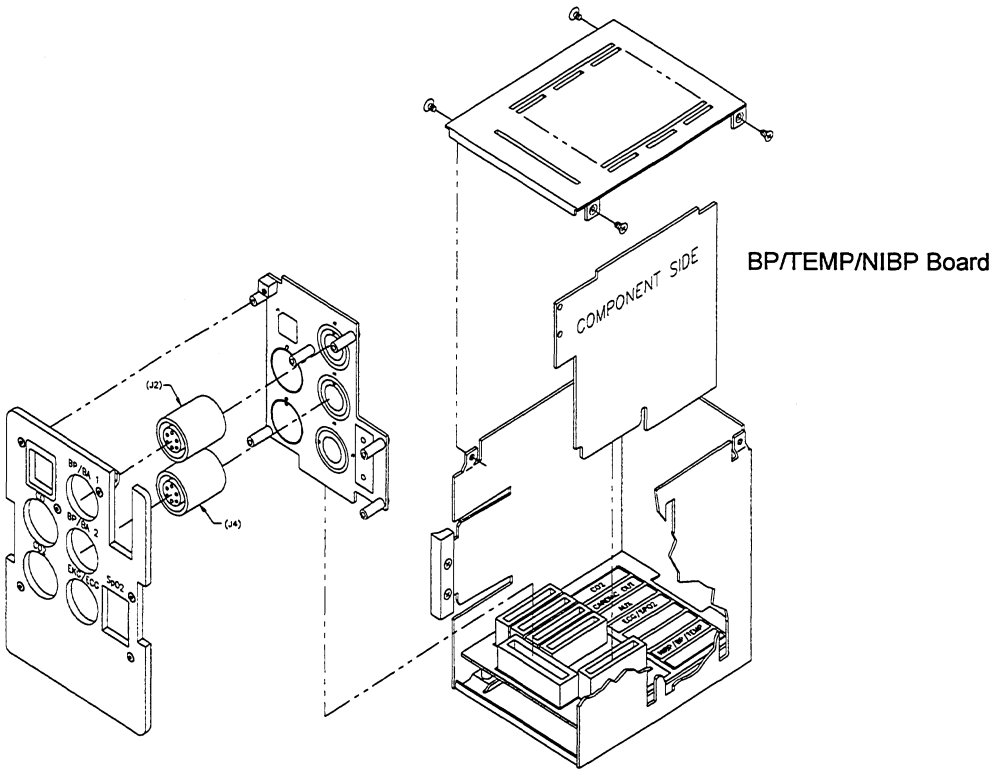

Figure 5-7: Two Invasive Blood Pressure Option

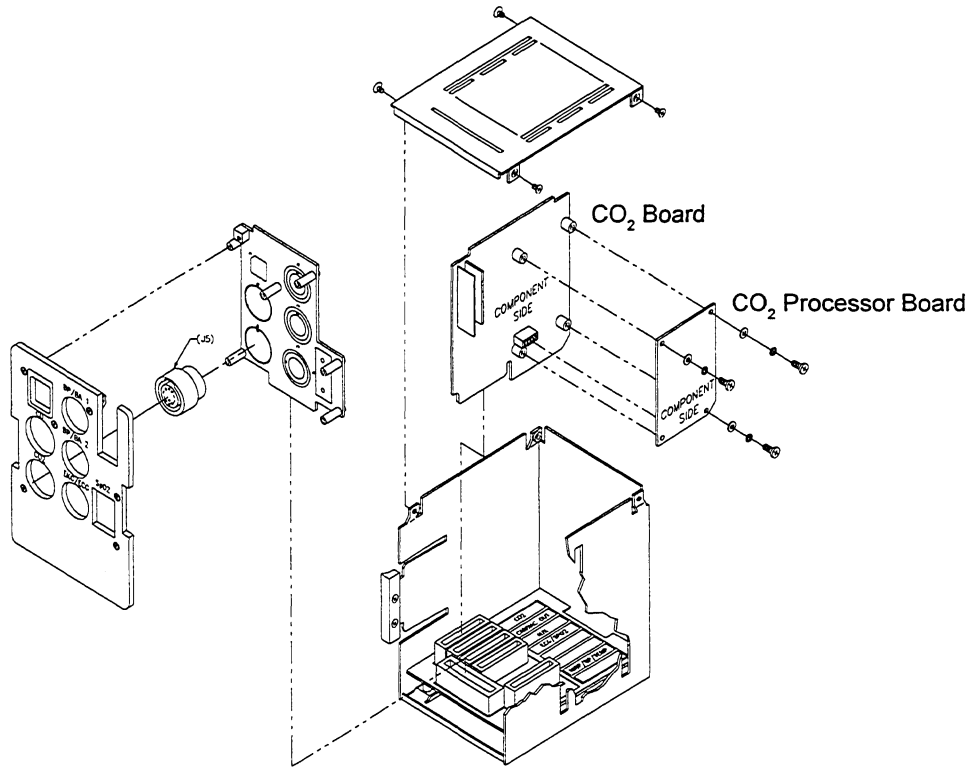

Figure 5-8: CO_2 Option - Exploded View

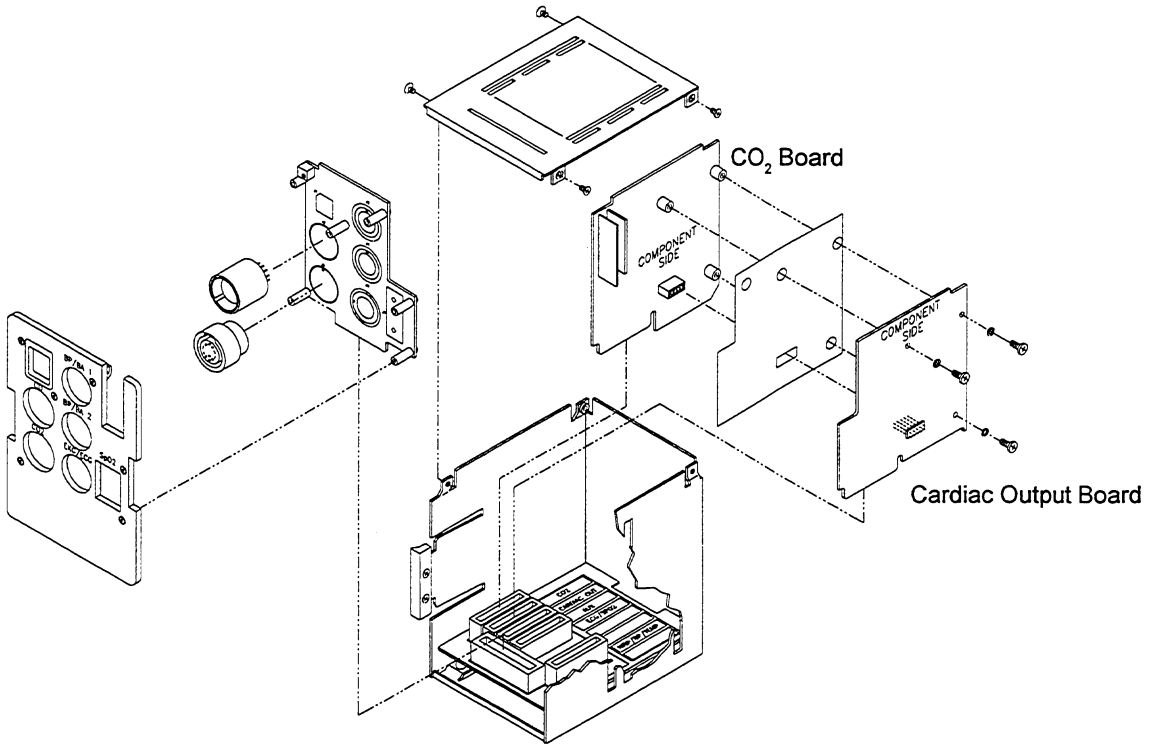

Figure 5-9: CO_2 with Cardiac Output Option - Exploded View

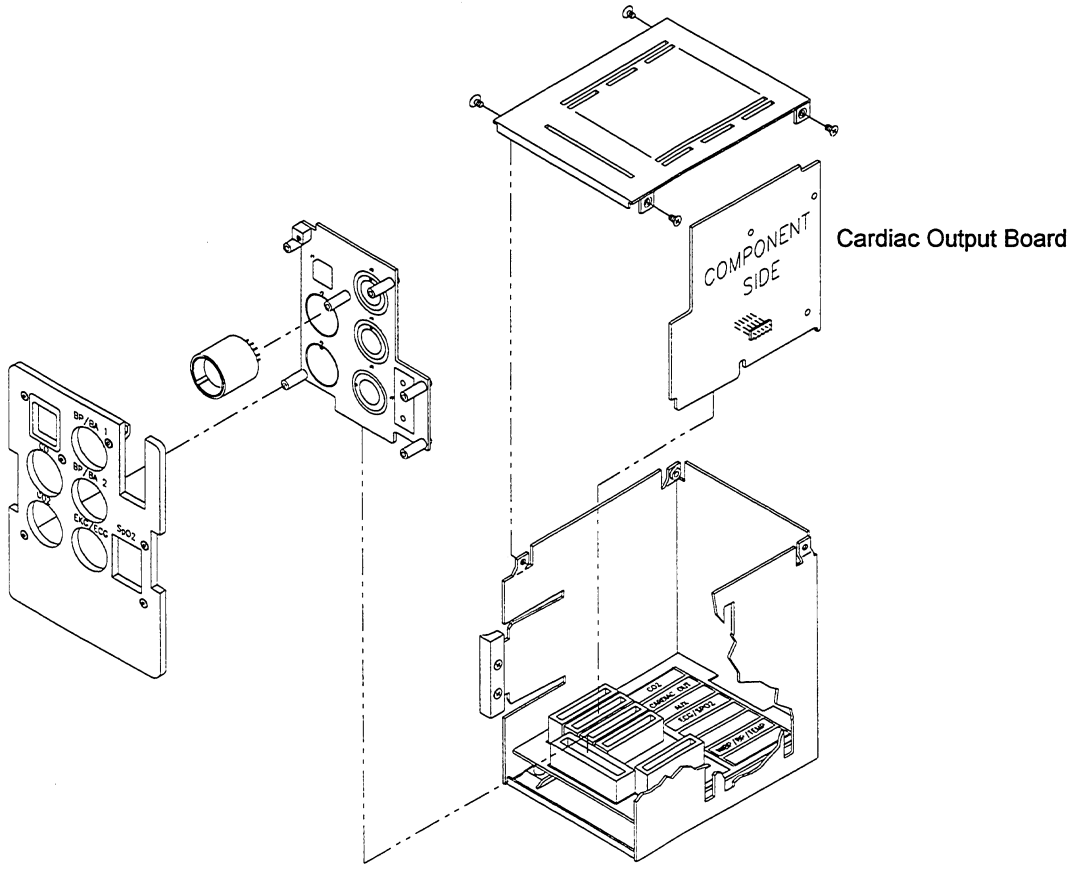

Figure 5-10: Cardiac Output Option - Exploded View

Table 5-2: MPM Housing Assembly (reference Figure 5-1)

MDE Part Number	Description	Quantity	Reference
358100-0036A	SCR, 4-40 X 1/4,PH PNHD,ZINC OR ANY	4	6 - PCBA
358100-0130A	SCR, PLASTITE,2 x 3/16~LG, 82 DEG,FLH PHL STL BLK	4	7 - HANDLE
358100-0151A	SCR, 4-40 x 3/16~LG 82DEG.FLH PHL SS	4	8 - COVER
360500-0149A	SPCR, NYLON 4-40 THREADED THRU 3/16~DIAx 11/16	4	5 - PCBA
384000-0176A	TAPE, ADHESIVE TRANSFER 1/4~ WIDE X 60 YD ROLL	0	12 - 1 PC
401688-0000	BRICK HANDLE MOLDED E3B/E2B REV B (E1432)	2	3
401700-0000	BRICK HOUSING E2B/E3B REV E (E1857)	1	1
401702-0000	BRICK COVER MOLDED E3B/E2B REV C (E1527)	1	2
401714-0000	PCBA, BRICK ISOLATION POWER SUPPLY REV H (E1626A)	1	4
401977-0000	FISH PAPER, BRICK ISO PWR SPPLY REV C (E1559)	1	9
401978-0000	LBL, SERIAL #, 1/2~ x 1~,E2B/E3B REV. B (E1612)	1	13
402205-0000	BRICK CONNECTOR PLATE ASSY REV E (E1828)	1	10
402247-0000	FISH PAPER BRICK HSNG REV A (E1559)	1	11

5.3 Connector Plate Assembly

The Connector Plate Assembly includes the MPM Connector Board, connectors to support all purchased parameter options, and the connector plate itself. The MPM Connector Plate may also be configured for use with Hewlett-Packard Merlin type connectors (ECG and IBP only).

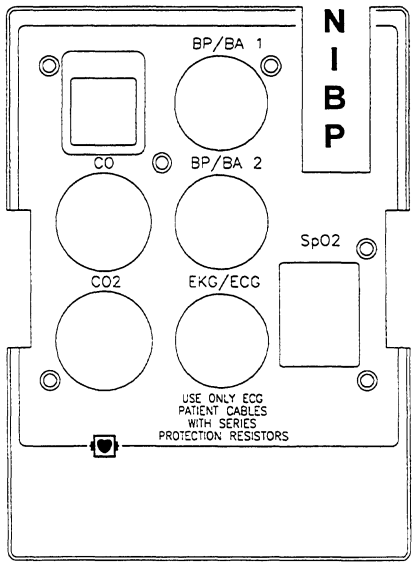

Figure 5-11: MPM Connector Plate (ECG, SpO_2, 2 BPs, TEMP, CO_2, CO, NIBP)

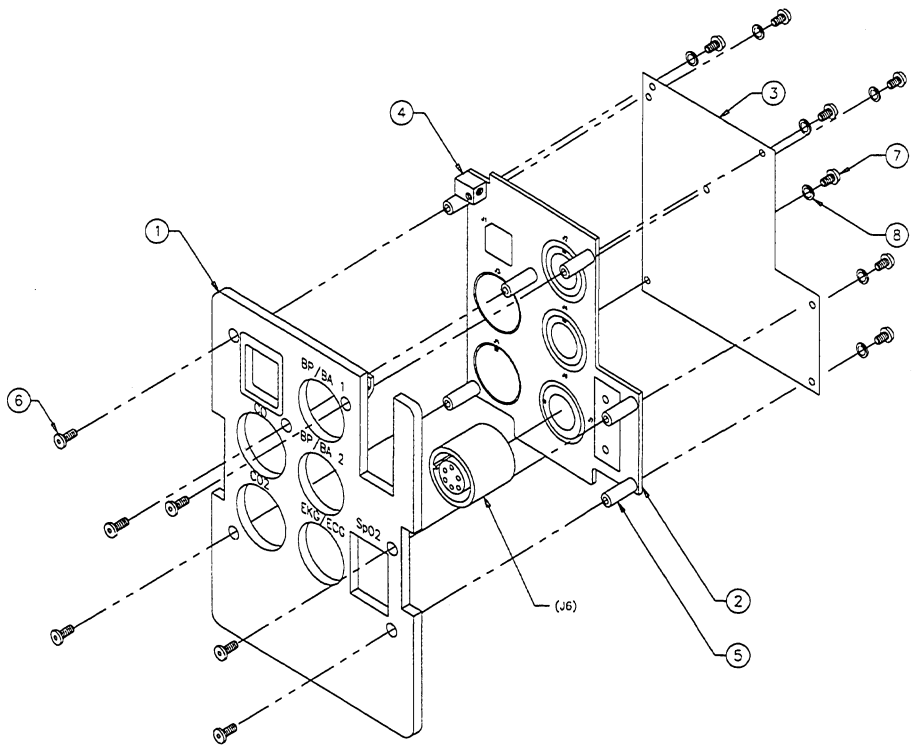

Figure 5-12: Connector Plate Assembly

Table 5-3: Parts Listing, P/N 402205-0000, Model 20001 Connector Plate Assembly

MDE Part Number	Description	Quantity	Reference
358100-0036A	SCR, 4-40 X 1/4,PH PNHD,ZINC OR ANY	7	7
358100-0126A	SCR, 4-40 x 3/16~LG,SKTHD BLK	6	6
360500-0109A	STNDOFF, 4-40 x .540LG x 3/16~ DIA NYL	6	5
401488-0000	CONN, ECG,F,6-P,PCMNT,MOLDED,E2B/E3B REV. B (E1432)	1	J6
401868-0000	CHASSIS GROUND BLOCK, BRICK REV. A (E1333)	1	4
401923-0000	PCBA, BRICK CONNECTOR REV G (E1781)	1	2
401942-0000	FAB*CONN PLT 3LD ECG,2BP,1T,SaO2,CO2,CO REV. D (1856)	1	1
402022-0000	FISH PAPER, BRICK CONNECTOR BD. REV B (E1559)	1	3

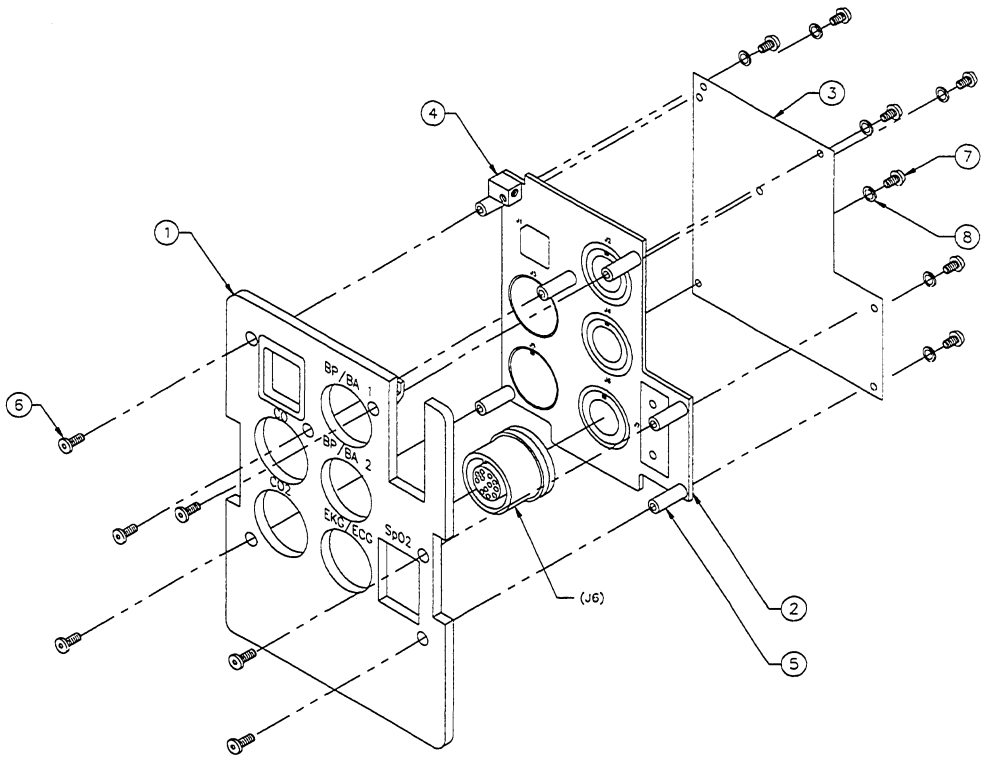

Figure 5-13: Hewlett-Packard Connector Plate Assembly

Table 5-4: Parts Listing, P/N 402290-0000, Model 20001 HP Connector Plate Assembly

MDE Part Number	Description	Quantity	Reference
358100-0036A	SCR, 4-40 X 1/4,PH PNHD,ZINC OR ANY	7	7
358100-0126A	SCR, 4-40 x 3/16~LG,SKTHD BLK	6	6
360500-0109A	STNDOFF, 4-40 x .540LG x 3/16~ DIA NYL	6	5
401868-0000	CHASSIS GROUND BLOCK, BRICK REV. A(E1333)	1	4
401942-0000	CONN PLATE 3LD ECG,2BP,1T,SaO2,CO2,CO REV D (1856)	1	1
402022-0000	FISH PAPER, BRICK CONNECTOR BD. REV B (E1559)	1	3
402212-0000	PCBA, HP BRICK CONN REV D (E1781)	1	2
402288-0000	FAB CONN HP MERLIN ECG - BRICK REV. A (E1588)	1	J6

5.3.1 MPM Connector Board

The MPM Connector Board acts as an interface between patient cable connections and the ESCORT II monitor. All signals are routed from the various input connectors to the cardedge connector P1 which connects to the MPM ISO Power Supply.

ECG inputs are protected by surge arrestors DS2 - DS6 against possible external potentials of up to 80 VAC. DS1 connects between each surge arrestor and the isolation barrier, providing a discharge path. DS1 is also used to complete protection to the IBP and Temperature inputs. Diodes D1, D7, and D8 provide protection against an external potential of 24 VAC for IBP Channel 1. D13, D14, and D15 give protection for IBP Channel 2. Diodes D6, D9, and D11 render protection for the Temperature inputs. L1 - L55 are EMI suppression filters.

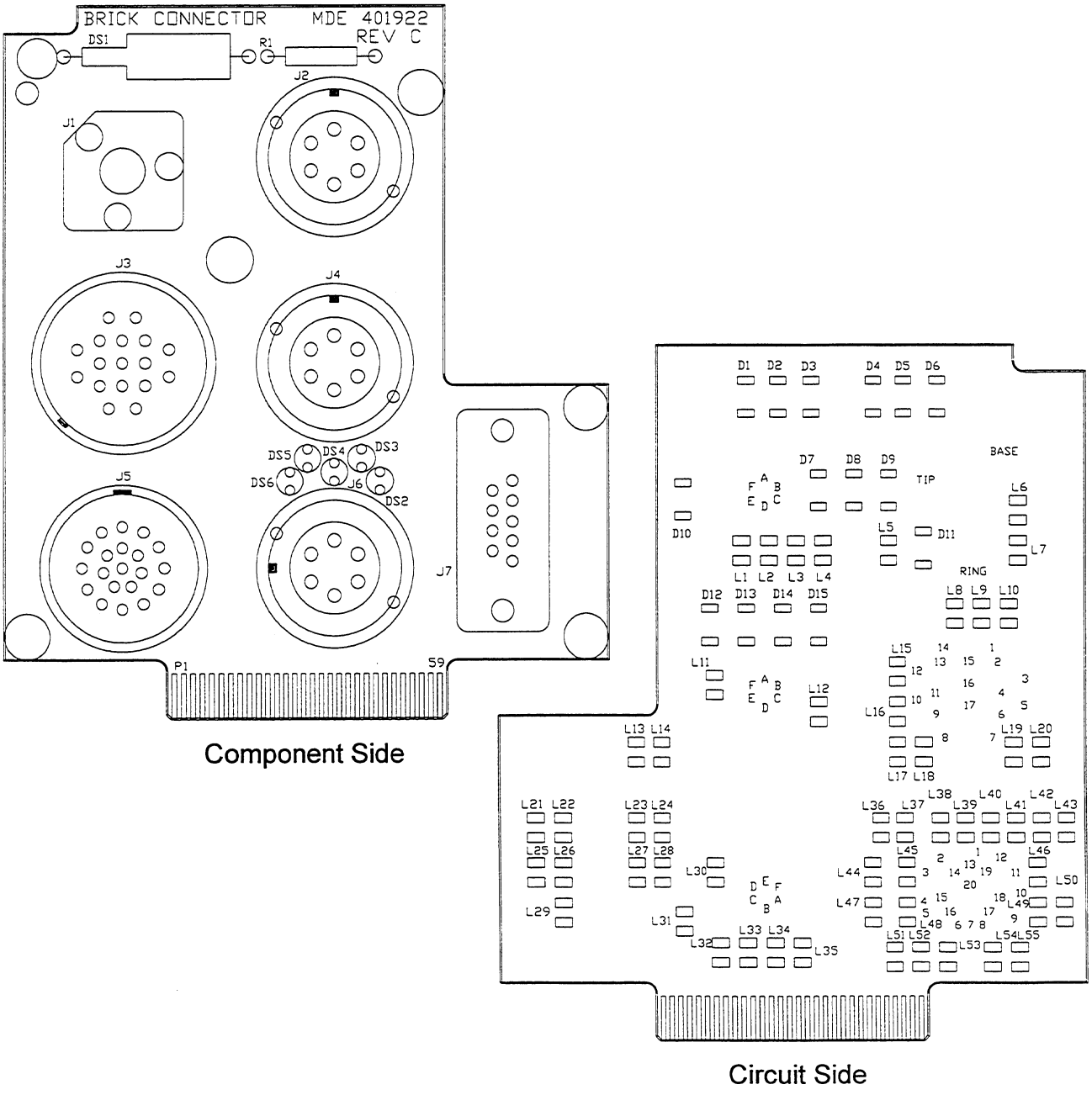

Figure 5-14: MPM Connector Board

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Figure 5-15: MPM Connector Board Schematic

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Table 5-5: Parts Listing, PCBA P/N 401923-0000, MPM Connector Board

MDE Part Number	Description	Quantity	Reference
360600-0002A	HARDWARE, TEFLON FEEDTHRU	2	TP1, TP2
370102-0100A	RES, 10,1/2W,5%,CF TAPE & REEL	1	R1
378000-0064A	DIODE, 1N4001 SMD	6	D2, 3, 4, 5, 10, 12
378000-0067A	DIODE,SMB5934BTS / 1N4749ASMD 24VZ,DO213AB CASE	9	D1, 6, 7, 8, 9, 11, 13, 14, 15
382000-0048A	SEMICONDUCTOR EMI SUPPRESSION FILTER SMD BLM32A06	55	L1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55
384000-0209A	SURGE ARRESTOR GT-RLSA80DSS	5	DS2, 3, 4, 5, 6
384000-0210A	SURGE ARRESTOR CG3-6.5L	1	DS1
385000-0041A	TAPE, KAPTON, INSULATING 3/8 IN	1	1 PC
401922-0000	PCB, BRICK CONNECTOR REV C (E1600)	1	1

Table 5-6: Parts Listing, PCBA P/N 402212-0000, MPM HP Connector Board

MDE Part Number	Description	Quantity	Reference
360600-0002A	HARDWARE, TEFLON FEEDTHRU	2	TP1, TP2
370102-0100A	RES, 10,1/2W,5%,CF TAPE & REEL	1	R1
378000-0064A	DIODE, 1N4001 SMD	6	D2, 3, 4, 5, 10, 12
378000-0067A	DIODE, SMB5934BTS / 1N4749ASMD 24VZ,DO213AB CASE	9	D1, 6, 7, 8, 9, 11, 13, 14, 15
382000-0048A	EMI SUPPRESSION FILTER SMD BLM32A06	55	L1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55
384000-0209A	SURGE ARRESTOR GT-RLSA80DSS	5	DS2, 3, 4, 5, 6
384000-0210A	SURGE ARRESTER CG3-6.5L	1	DS1
385000-0041A	TAPE, KAPTON, INSULATING 3/8 IN	1	1 PC
402211-0000	PCB, HP BRICK CONN REV. A(E1588)	1	-

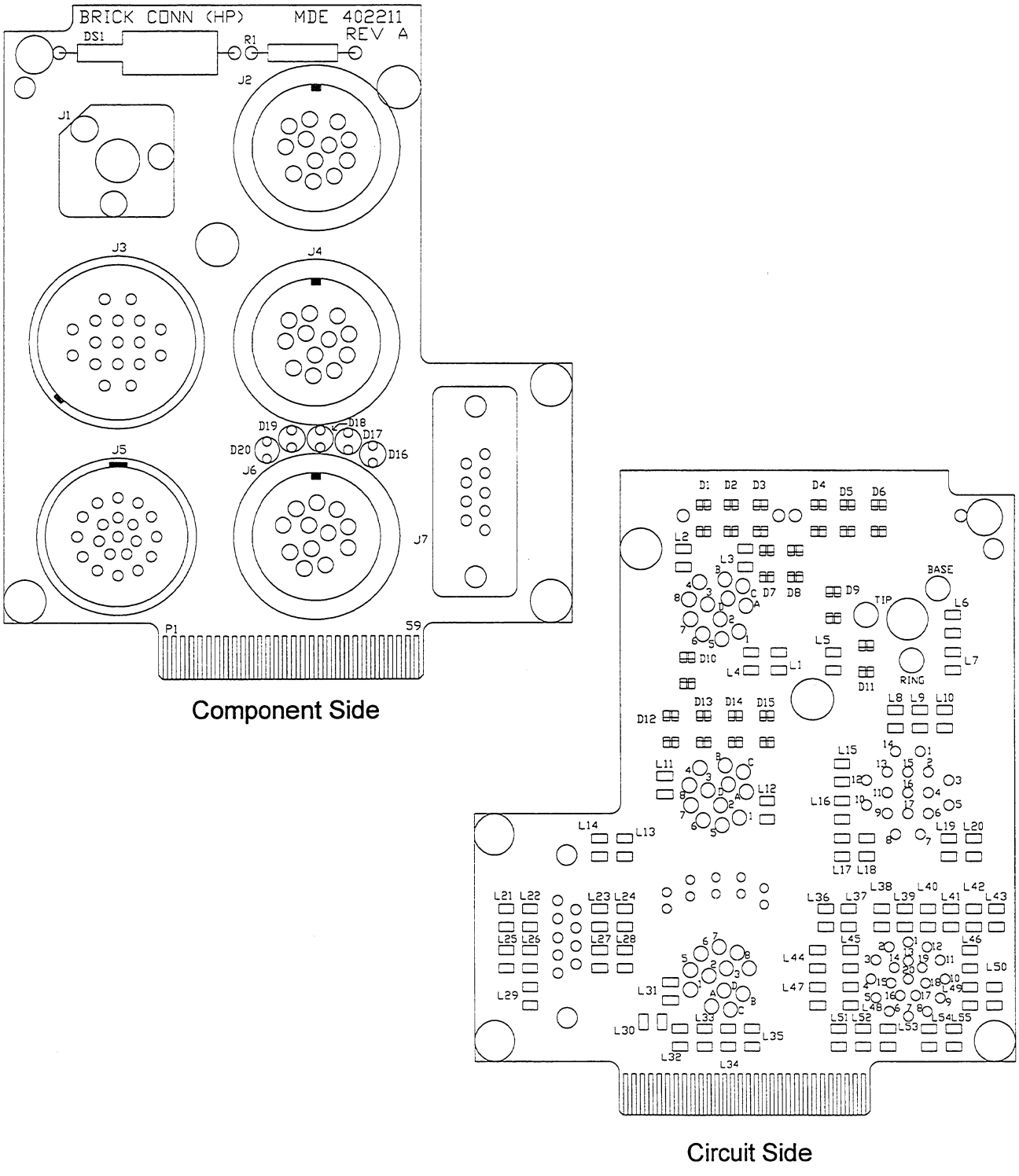

Figure 5-16: MPM HP Connector Board

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Figure 5-17: MPM Hewlett-Packard Connector Board Schematic

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5.4 MPM Interface Board

The ESCORT II Model 20001 Multiparameter Module interfaces with the monitor through the MPM Interface Board (P/N 401873-0000). CPU transmit and receive lines, synchronization signals, and a non-isolated +15V are routed from the main CPU Board (see Chapter 4 for details) to the MPM ISO Power Supply. [Y_YOKE1], [Y_YOKE2], [X_YOKE1], and [X_YOKE2], which originate in the video controller section of the main CPU Board are routed through the MPM Interface Board to the CRT yoke via connector J2.

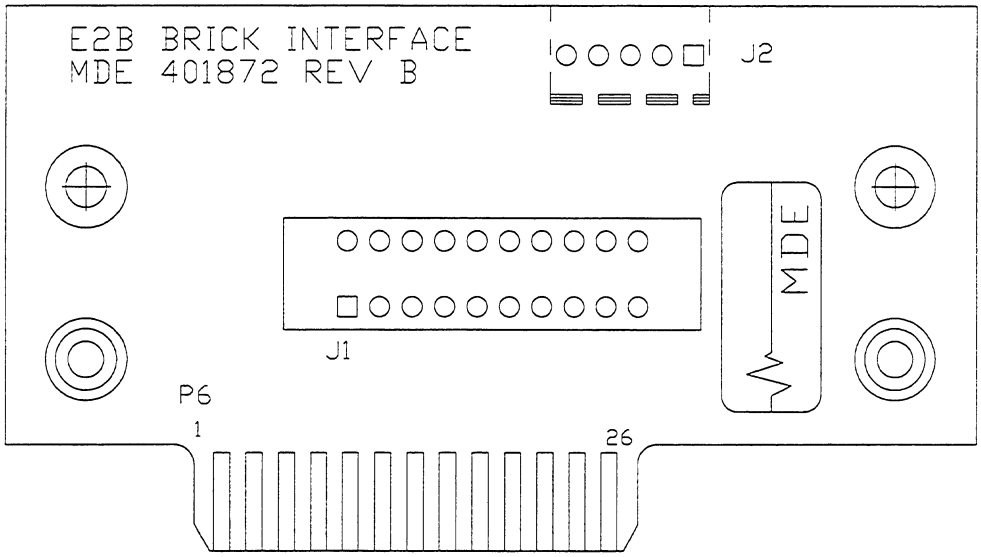

Figure 5-18: Multiparameter Module Interface Board Layout

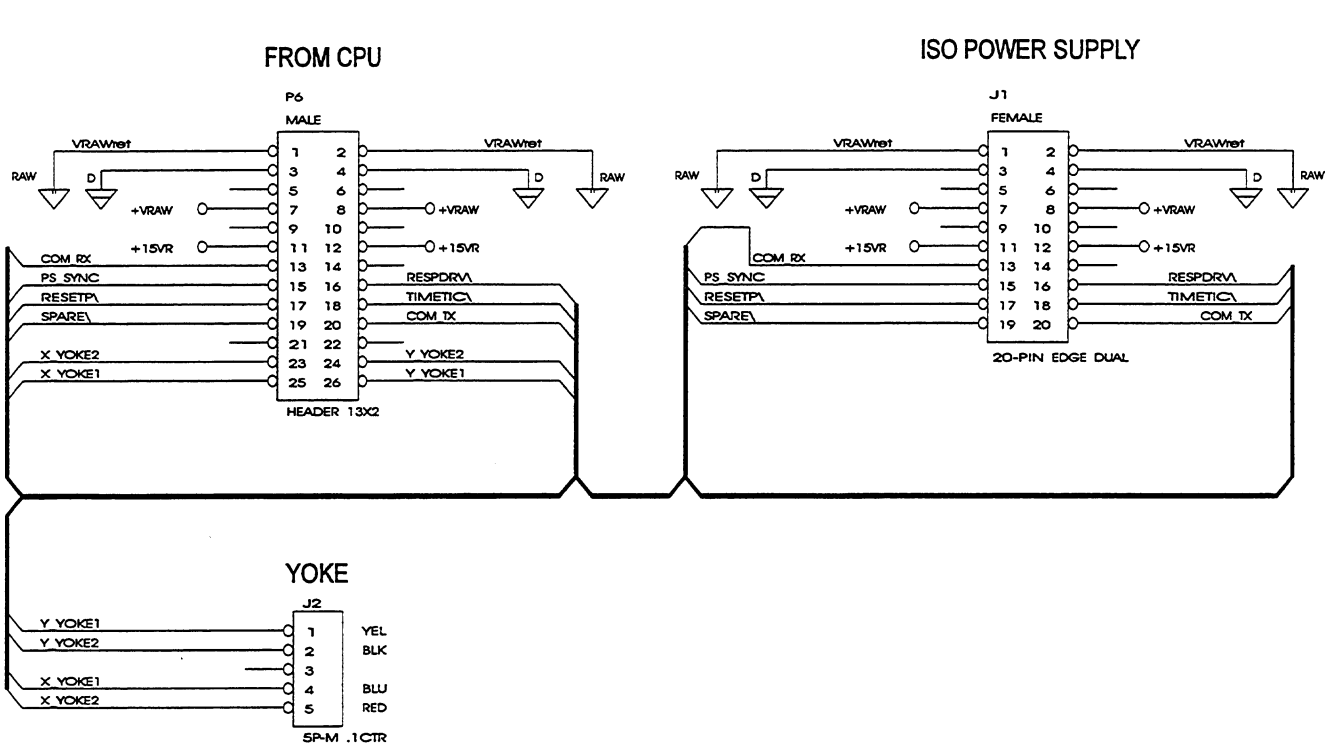

Figure 5-19: MPM Interface Board Schematic

Table 5-7: Parts Listing, PCBA P/N 401873-0000, Multiparameter Module Interface Board

MDE Part Number	Description	Quantity	Reference
354000-0031A	CONN, 5-P,M,STRT LOCK,.1 CTR	1	J2
354000-0200A	CONN, 20-PIN,EDGE,DUAL 10	1	J1
358100-0153A	SCR, 4-40 X 7/16 PHL PNHD SS	2	4
358200-0009A	WSHR, #4 SPLIT LOCK	2	6
360500-0046A	SPCR, SWAGE #4 X 1/8IN LG X .188 SHANK X1/4 IN DIA	2	5
360500-0085A	STDOFF, 4-40 x 1/8 IN LG,SWAGE	2	3
401684-0000	GUIDE PIN E3B/E2B REV. A(E1331)	2	2
401872-0000	PCB, E2B BRICK INTERFACE REV B (E1430)	1	1

5.5 ISO Power Supply

The MPM (Multiparameter Module) ISO Power Supply board provides electrical isolation between the patient and the ESCORT II monitor. All control signals are isolated through opto-isolators U2, U4, and U5. Isolated voltages are produced across T1.

An isolation boundary of approximately 7.5 kVDC is formed by the opto-isolators with more than 4 kVAC of isolation through T1. A 1000-MΩ resistor (R4) is installed to bleed off any static potential between the isolated and non-isolated sections. The voltages produced by the ISO Power Supply are +5V ISO, +15V ISO, -15V ISO. All CPU communications are routed through the ISO Power Supply to the installed parameter boards (e.g., ECG, BP, CO_2, etc.).

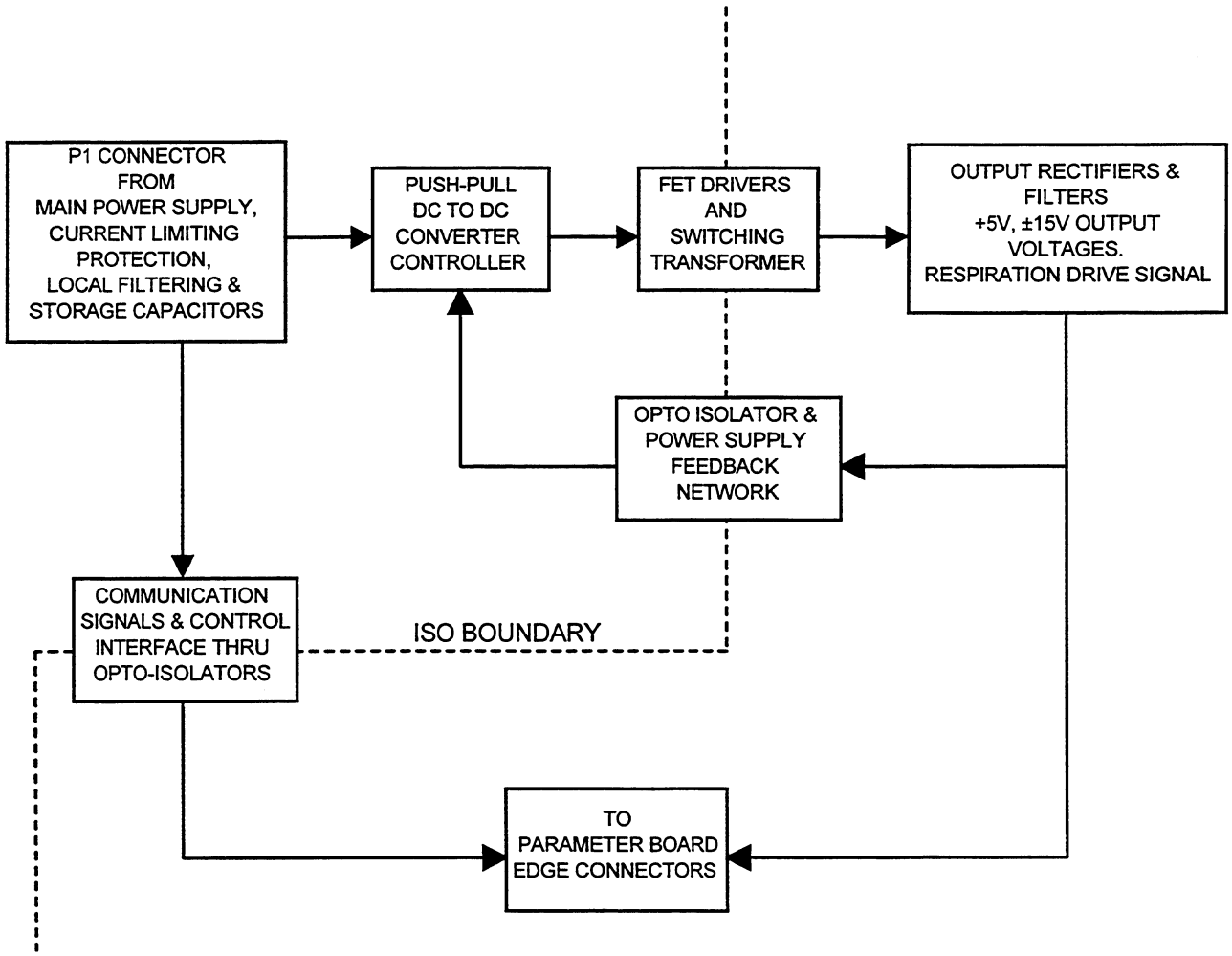

Figure 5-20: MPM ISO Power Supply Block Diagram

5.5.1 Circuit Operation

The ISO Power Supply is comprised of a non-isolated section, an isolated section, and a series of cardedge connectors which interface with the installed parameter boards.

5.5.1.1 Non-Isolated Section

The non-isolated section of the ISO Power Supply is the electrical interface between the parameter boards and the CPU Board via the P1 connector. Also located in the non-isolated section of the ISO Power Supply is a pulse width modulator (U6), two high power MOSFETs (Q3 and Q4) and the primary side of transformer, T1.

V+, which originates on the ESCORT II's main power supply (see Chapter 3), is used as the voltage source on the primary side of the transformer. +15V, which is also developed on the main power supply, is used to provide operating power for the Pulse Width Modulator (U6). The Pulse Width Modulator has an internal oscillator that is biased with C16 and R24 to provide a free oscillating frequency of approximately 200 kHz. C13 compensates for and stabilizes the frequency. [PS_SYNC] on pin 3 is a 250 kHz synchronizing input signal from the CPU board that will preempt the internal oscillator after the power up sequence is complete. This signal assists in reducing beat frequency noise on the ECG and other circuits by switching all internal power supplies on the same edge. C18 slowly charges and provides a soft start at power up. The modulated outputs (pins 11 and 14) drive the high power MOSFETs, Q3 and Q4. They in turn drive the custom wound transformer, T1. Zener diodes, D8 and D9, provide spike protection for Q3 and Q4. The voltages are then applied to the primary side of T1.

5.5.1.2 Isolated Section

Through mutual inductance, the voltages developed on the non-isolated side of the ISO Power Supply Board are transferred to the secondary of the transformer. The voltages derived from T1 are +15VISO, -15VISO, and +5VISO.

+5VISO is divided to 2.5 V by a voltage divider which is formed by R7 and R8. The divided voltage is then sampled by D7 (adjustable precision shunt). D7 is configured on the output side of the isolated section to modulate the photo diode current of opto-isolator U2B. The transistor portion of U2B is connected to U6-2 (error amplifier). Variations in the output voltage are then optically transferred back to the pulse width modulator (U6) controller for correction. The objective is to produce a reliable and steady +5VISO and VREF.

The +15ISO and -15VISO output circuits have separate rectification and LC circuits to provide DC voltages. Using the +15VISO output as an example, D2 and D4 are used to rectify the voltage from T1 and an LC circuit consisting of L1 and C9 convert the pulsating DC to a steady DC level. C4 filters the DC voltage and R15 serves as a load or bleeder resistor. The -15VISO output is developed with a similar circuit.

The combination of VR1 and C19 is used to reduce EMI. VR1 is set at the factory for the least amount of EMI. VR1 is adjusted to insure that less than 200 mV of noise exists between ISO ground and chassis ground.

The signal [RESPDRVI] originates at pin 8 of T1. [RESPDRVI] is a 125 kHz square wave that is used by the respiration circuitry to generate the patient's respiratory waveform.

Opto-isolators U2, U4 and U5 couple the signals [VPP_ENA], [CPU_RXB], [CPU_TX\] and [TIMETIK\] across the isolation barrier. [VPP_ENA] is regulated with U1 to form [VPP] (+12V). [VPP] is used by the system CPU to apply power to the parameter board EPROMs.

All communication to and from the system CPU and the parameter cards is in the form of a serial bit stream. [CPU_RXB] and [CPU_TX\] are the receive and transmit lines for the serial data. The system CPU Board controls the sample rate using the signal [TIMETIK\]. [TIMETIK\] is a square wave equal to four times (4X) the AC line frequency (i.e., a typical 60 Hz system produces a [TIMETIK\] frequency of 240 Hz, while a 50 Hz system produces a 200 Hz signal). [TIMETIK\] becomes [TIMETIKI] after passing over the isolation barrier.

5.5.1.3 Connections

All parameter board connections to the ISO Power Supply are made using 30-pin cardedge connectors (J1, J2, J5, J6, J7, and J8). All connectors are clearly labeled within the MPM for easy replacement in the event a parameter board is removed from the MPM.

The ISO Power Supply connects to the MPM Connector Board using cardedge connector J10.

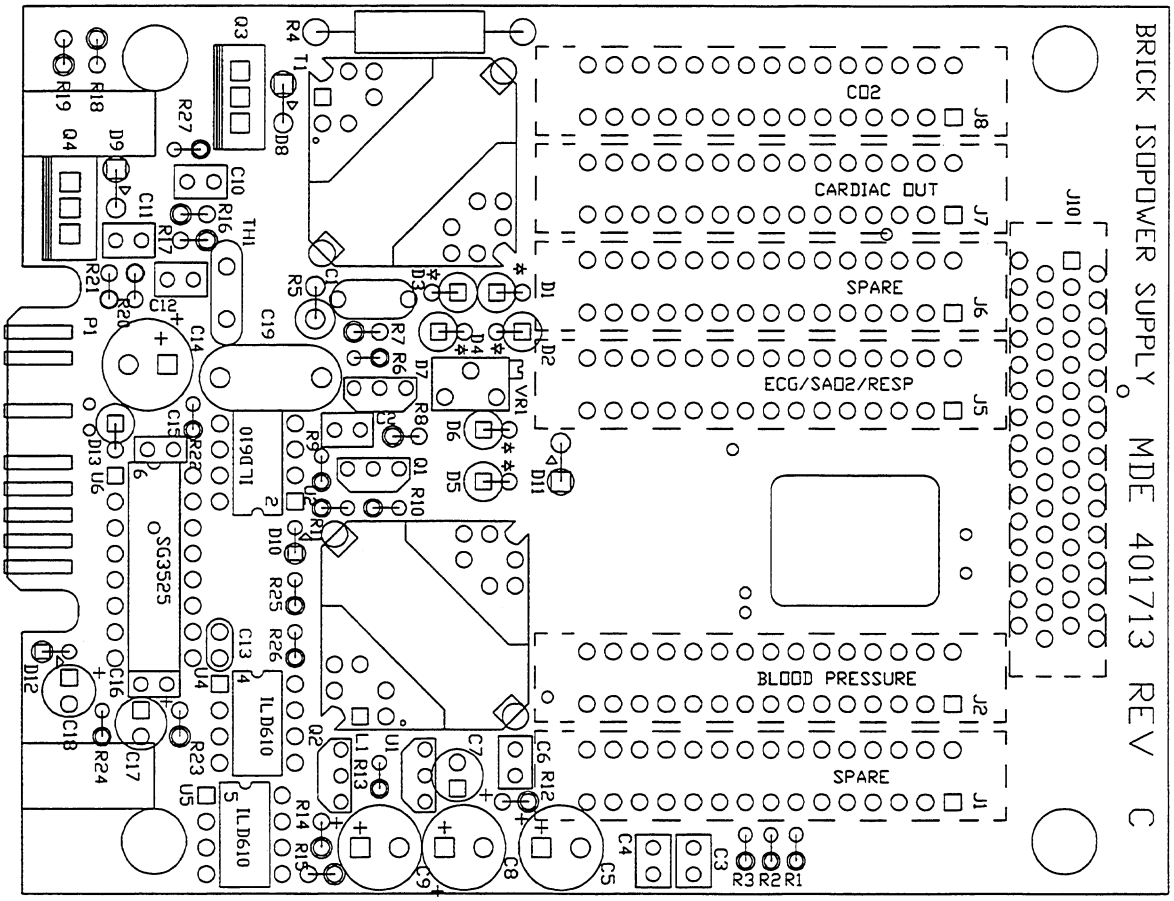

Figure 5-21: MPM ISO Power Supply - Board Layout

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Figure 5-22: MPM ISO Power Supply Schematic

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Table 5-8: Parts Listing, PCBA P/N 401714-0000, MPM ISO Power Supply (1 of 2)

MDE Part Number	Description	Quantity	Reference
352101-0331A	CAP, 330pF,50V,10%,NPO,CER,RAD TAPE & REEL	1	C13
352102-0151A	CAP, 150pF,20%,400VAC,2500V,CS,CER DISC,INT'L APPR	1	C1
352102-0220A	CAP, 22pF,20%,6kV,CER,DISC BULK	1	C19
352200-0127A	CAP, 120uF,35V,20%,LOW ESR,.15/.35,ELECT	1	C14
352201-0337A	CAP, 330UF,16V,ELEC,RAD 3.5mm LEAD SPACE	1	C5
352206-0227A	CAP, 220uF,20%,25V,ELECT,LOW ESR,8x16mm RAD	2	C8, 9
352300-0010A	CAP., 1000pF,5%,MYLAR SORT FROM 352300-0007A	1	C16
352300-0104A	CAP, .1UF,50V,20%,RAD,MYLAR	4	C3, 4, 6, 12
352300-0224A	CAP, .22UF,50V,20%,MYLAR	1	C2
352300-0332A	CAP, .0033UF,50V,20%,RAD,MYLAR,.1 L.S.	2	C10, 11
352301-0222A	CAP, 2200PF,50V,20%,MYLAR	1	C15
352401-0106A	CAP, 10UF,35V,20%,RAD,TANT TAPE & REEL	1	C17
352401-0225A	CAP, 2.2UF,35V,20%,TANT TAPE & REEL	2	C7, 18
354000-0298A	CONN, 30-PIN,F,CARD EDGE	4	J2, 5, 7, 8
354000-0299A	CONN, F,HIGH DENSITY,.050 CNTR,4 ROW	1	J10
364000-0091A	IC, SG 3525	1	U6
364000-0207A	IC, LM78L12ACZ,+ 12V REG TO92	1	U1
364000-0238A	IC, ILD610-1 OPTO ISOLATOR, 2 CHANNEL, DIP 8	3	U2, 4, 5
364000-0240A	IC, TL431ACLP ADJ PRECISION SHUNT DC REG TO-92	1	D7
365000-0008A	SKT, 8-POS,DIP,TIN PLATE,L.P.	3	SU2, 4, 5
365000-0016A	SKT, 16-POS,DIP,TIN PLATE,L.P.	1	SU6
370100-0222A	RES, 2.2K,1/4W,5%,CF TAPE & REEL	2	R12,15
370100-0330A	RES, 33,1/4W,5%,CF TAPE & REEL	1	R23
370101-0100A	RES, 10,1/8W,5%,CF TAPE & REEL	2	R20, 21
370101-0122A	RES, 1.2K,1/8W,5%,CF TAPE & REEL	1	R26
370101-0122A	RES, 1.2K,1/8W,5%,CF TAPE & REEL	3	R1, 2, 3
370101-0151A	RES, 150,1/8W,5%,CF TAPE & REEL	1	R9
370101-0152A	RES, 1.5K,1/8W,5%,CF TAPE & REEL	2	R6, 25
370101-0331A	RES, 330,1/8W,5%,CF TAPE & REEL	1	R11
370101-0472A	RES, 4.7K,1/8W,5%,CF TAPE & REEL	2	R10, 13

Table 5-8: Parts Listing, PCBA P/N 401714-0000, MPM ISO Power Supply (2 of 2)

MDE Part Number	Description	Quantity	Reference
370101-0622A	RES, 6.2K,1/8W,5%,CF TAPE & REEL	2	R22, 24
370101-0753A	RES, 75K,1/8W,5%,CF TAPE & REEL	1	R27
370102-0390A	RES, 39,1/2W,5%,CF TAPE & REEL	2	R16, 17
370200-1002A	RES, 10K,1/4W,1%,MF TAPE & REEL	3	R14, 18, 19
370200-2000A	RES, 200,1/4W,1%,MF TAPE & REEL	2	R7, 8
370201-0241A	RES, 240,5%,1W,M.O. TAPE & REEL	1	R5
370401-0108A	RES, 1000M,1W,5%,2500V	1	R4
374402-0202A	POT, 2K,10-TURN,SIDE ADJ	1	VR1
376000-0011A	XSTR, 2N3906,SIGNAL	2	Q1, 2
376000-0017A	XSTR, BUK456-100A,(OR IRF 540) (TO-220)MOSFET ONLY	2	Q3, 4
378000-0001A	DIO, 1N270 T&R	1	D11
378000-0005A	DIO, 1N914,SIGNAL T&R	2	D10, 12
378000-0041A	DIO, BYV27-200 T&R	7	D1, 2, 3, 4, 5, 6, 13
378000-0061A	DIO, 1N4762A,82V,1W,ZENER TAPE & REEL	2	D8, 9
384000-0192A	THERMISTOR (PCT) RUE185	1	TH1
401713-0000	PCB, BRICK ISOLATION POWER SUPPLY REV C (E1600)	1	-
401905-0000	XFMR, SWITCHING, BRICK PWR SPPLY REV B1 (D551)	1	T1
401906-0000	MULTI-INDCTR,SWTCHNG BRICK/LAB P/S REV A3 (D551)	1	L1

6 ECG/$Sp0_2$/RESP &ECG Processor

6

ECG/SpO_2/RESP & ECG Processor

6.1 Overview

The ESCORT II provides monitoring capability of ECG, Respiration, and SpO_2 while inhabiting a single slot inside the Multiparameter Module (MPM). The board will include ECG as a minimum, with optional Respiration and SpO_2 when purchased.

ECG signals are developed on the ECG/SpO_2/Resp main board (P/N 401671-0000). The signals are then converted to digital format and routed to the ECG Processor Board (P/N 401675-0000). The digital information is then sent to the ESCORT II's main CPU Board (see Chapter 4 for details).

Respiration is also available on the ECG/SpO_2/Resp main board with the addition of the necessary respiration components and applicable software (P/N 402204-0000).

Pulse Oximetry (SpO_2) monitoring is available with the Nellcor SpO_2 module. This board connects directly to the main ECG/SpO_2/Resp board via the onboard connectors, J2A and J2B.

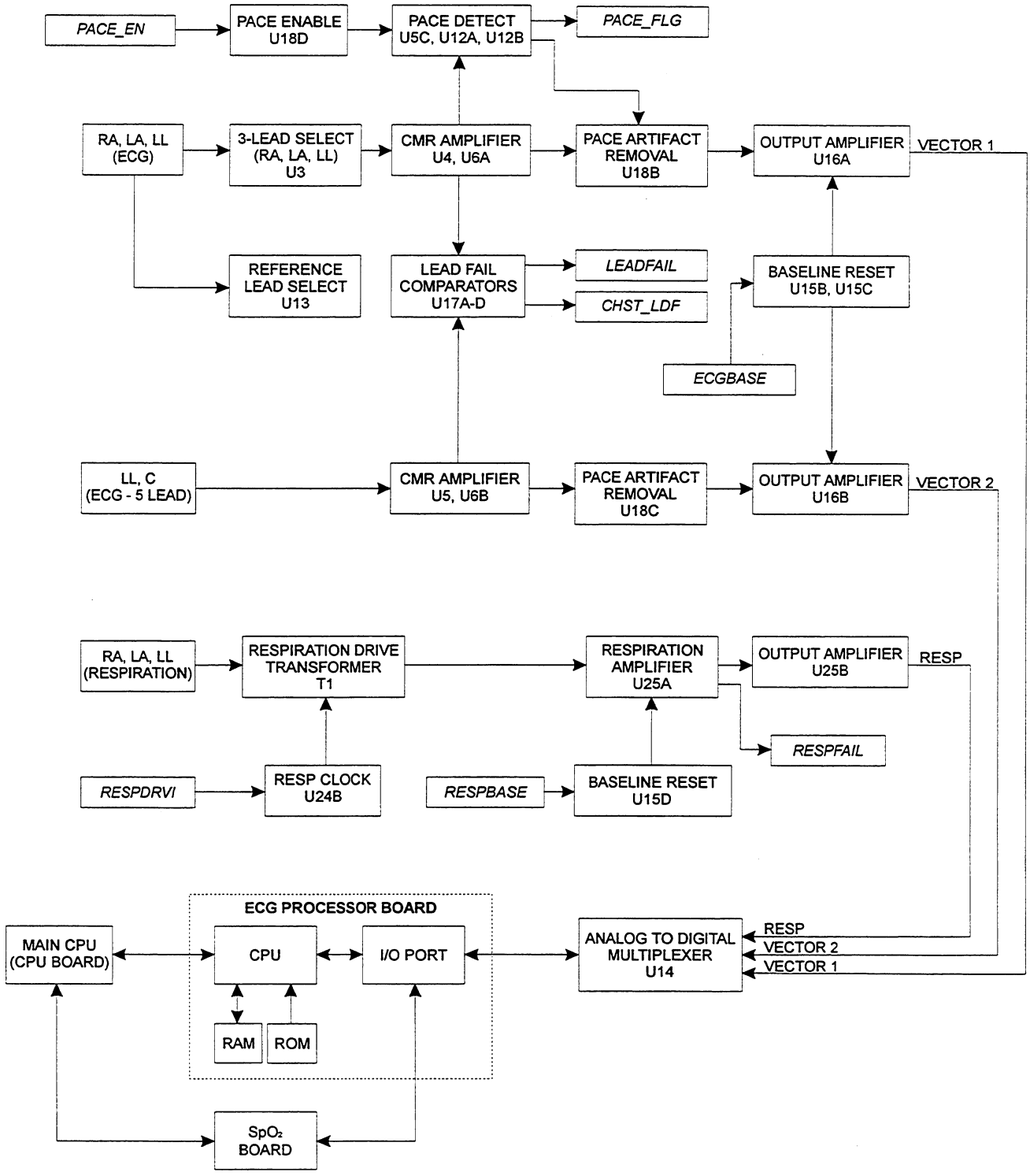

Figure 6-1: ECG/SpO_2/RESP Block Diagram

Note: ***Italicized entries indicate signal names.***

6.2 ECG and Respiration Monitoring

The following sections detail the various circuits utilized on the ECG/SpO$_2$/Resp Board. Lead select, common mode rejection, amplification, pacer detection, external pacer protection, lead fail, output amplification, respiration, and analog to digital processing are all discussed.

6.2.1 Lead Select Circuit

Lead selection on the ESCORT II is achieved through software via a softkey on the ECG menu. In 3-lead mode, vectors I, II, and III are available. Vector V is available when 5-lead mode is selected. The appropriate lead is selected by the analog switch U3 through the [VSEL0] and [VSEL1] lines, which originate on the ECG Processor Board (see paragraph 6.3). The reference lead is selected by analog switch, U13. Leads LA, RA, LL, and C are buffered by U9A through U9D.

6.2.2 Common Mode Rejection (CMR)

The ECG/SpO$_2$/Resp Board has circuitry to reject any common mode interference due to outside noise sources (e.g., 60 Hz power line). In 3-lead mode, a differential amplifier (U4) is used for common mode rejection. CMR adjustments are made with VR2. In 5-lead mode, U5 is the differential amplifier and adjustments are made with VR1.

6.2.3 Pacer Pulse Detect Circuit

When the PACE softkey has been set to *ON*, the ESCORT II will reject any pacer artifact and insert a pacer flag into the ECG waveform. The analog ECG signal is available at U4-6 and routed through a band-pass filter comprised of R8, R11, C3, C4, and L1. This filter stage only passes signals with rise times between 16 µs and 20 µs on to U6C, which is used to recognize a pacer pulse. If a fast pulse occurs, it passes through U6C to U12A and U12B. U12A and U12B will determine the polarity of the pulse. If the pulse is positive, U12B becomes active and outputs a 2 ms pulse at U12-7. If the pulse is negative, U12A becomes active and outputs a 2 ms pulse at U12-1. The 2 ms pulse is called [PACE_FLG].

Once a pacer pulse is detected, [PACE_FLG] turns off U18B and U18C blocking the pacer artifact from reaching the ECG output amplifiers. [PACE_FLG] is used by the ECG Processor Board to add a flag to the ECG waveform at the location the pacer was detected.

6.2.4 Lead Fail

In 3-lead mode R15, R3, and R28 (100 MΩ) are used as pull-up resistors. When the ECG inputs are connected to a patient, the voltage at the ECG inputs is approximately 0 VDC with an ECG signal of approximately 1 mV. When a lead becomes disconnected, the pull-up resistor drives the input to +12 volts. Depending on the lead, or combination of leads which disconnect, the output of U4 (pin 6) will either go to +15V or -15V. After passing through U6A, it is routed to the window detector U17C and U17D. If a positive lead fail condition occurs, U17 pin 14 is driven low. If a negative lead fail occurs, U17 pin 13 is driven low. This low level becomes the signal [LEADFAIL], and is sent to the ECG Processor Board.

If the chest lead becomes disconnected, R30 pulls the signal line to +12V. The output of U5 (pin 6) is then driven to either +15V or -15V, and is routed to the window detector U17A and U17B from U6B. The result is the signal [CHST_LDF], which is sent to the ECG Processor Board.

6.2.5 Output Amplifiers

U6A provides the first ECG gain stage (U6B in the chest circuit). The gain of each amplifier is approximately thirty (30). U16A and U16B (VECTOR1 and VECTOR2) are the output amplifiers for the ECG signal. They each produce a gain of approximately 40.

The ECG Processor Board detects any slow baseline shifting, and if necessary, initiates the pulse [ECGBASE] which closes analog switches U15B and U15C. When this switch is activated, a low impedance path is provided on the noninverting inputs of U16A and U16B. This allows the inputs to quickly settle back to their quiescent operating point, and the baseline returns to normal.

6.2.6 Respiration

Respiration is detected by the change in impedance across the patient side of transformer, T1. This is accomplished by injecting a 125 kHz pulse train [RESPDRVI] into Q2, then routing it to a D Flip-Flop (U24B) where it is divided by two producing an operating frequency of 62.5 kHz. This pulse train is then routed into T1. Respiration may then be determined by observing the loading caused by the impedance changes on the patient side. The result is a modulated envelope. The high frequency component is filtered out by R71 and C43. The remaining signal is the Respiration waveform. This signal is then amplified by U25A. If a lead fail condition is present, the [RESPFAIL] signal becomes active and is routed to the ECG Processor Board.

U15D provides the baseline reset pulse into the output amplifier U25B when activated by the signal [RESPBASE]. VR3 is used to zero the output of U25B with no respiration signal applied. The output of U25B is sent to U14, which is an A/D Multiplexer.

6.2.7 Analog-to-Digital Processing

The ECG and Respiration analog signals [VECTOR1], [VECTOR2], and [RESP] are inputs to the Analog to Digital/Multiplexer, U14. U14 is controlled by the ECG Processor via the *DIN* line. Analog information from the inputs are clocked in by the *ACLK* line at 4 MHz. The multiplexed and digitized representation of the analog signals are output at 9600 baud on the *DOUT* line and is sent to the ECG Processor Board. The *SCLK* signal provides the 9600 baud clock.

6.2.8 External Defibrillator and Pacer Protection

The ECG/SpO_2/Resp Board includes a series of opto-isolators which provide electrical protection for the ESCORT II monitor. This protection is supplied to prevent damage to the ECG circuitry when the monitor is connected to an external defibrillator/pacer (Model 20300 only) ***or*** when the monitor is in use and a patient is subjected to defibrillation (Model 20100 and 20300).

The defibrillator provides a signal to the ESCORT II CPU Board during pacer time. This signal is decoded by the ECG Processor Board and is called [EXT_PCBK]. When [EXT_PCBK] is active (low), Q1 turns off creating an open across the source/drain junction and activates [PACE_FLG] through D14. This opens the ground connection from the opto-isolators (U1, U2, U7, U8) internal LEDs. The opto-isolators then open, blocking signals from passing through, as well as providing protection for the ECG input circuit from high current spikes caused by the pacer.

6.2.9 Clock Generator

U10 and U11 derive 4 MHz and 153 kHz clocks. The microprocessor on the ECG Processor Board supplies an 8 MHz clock which is injected into U11A-3. U11A divides the clock frequency by two, producing a 4 MHz clock signal called [ACLK]. [ACLK] is used in two areas, as the clock for the analog to digital/multiplexer (U14) and for the divide by thirteen circuit (U10). U10 divides the 4 MHz down to 306 kHz which is then routed to U11B-11 and divided by two, resulting in a 153 kHz clock. The 153 kHz clock is used as the serial clock (CKA1) on the ECG Processor Board's microprocessor (see paragraph 6.3).

6.2.10 Voltage Regulators

U19, U20, U21, U22, and U23 are three terminal voltage regulators. They provide precision regulation for local use in the analog sections of the ECG/SpO$_2$/Resp Board. R46, R47, and R48 comprise a voltage divider which is used to produce reference voltages of +10 V and -10 V. These reference voltages are used by the comparator U17 to determine the lead fail threshold.

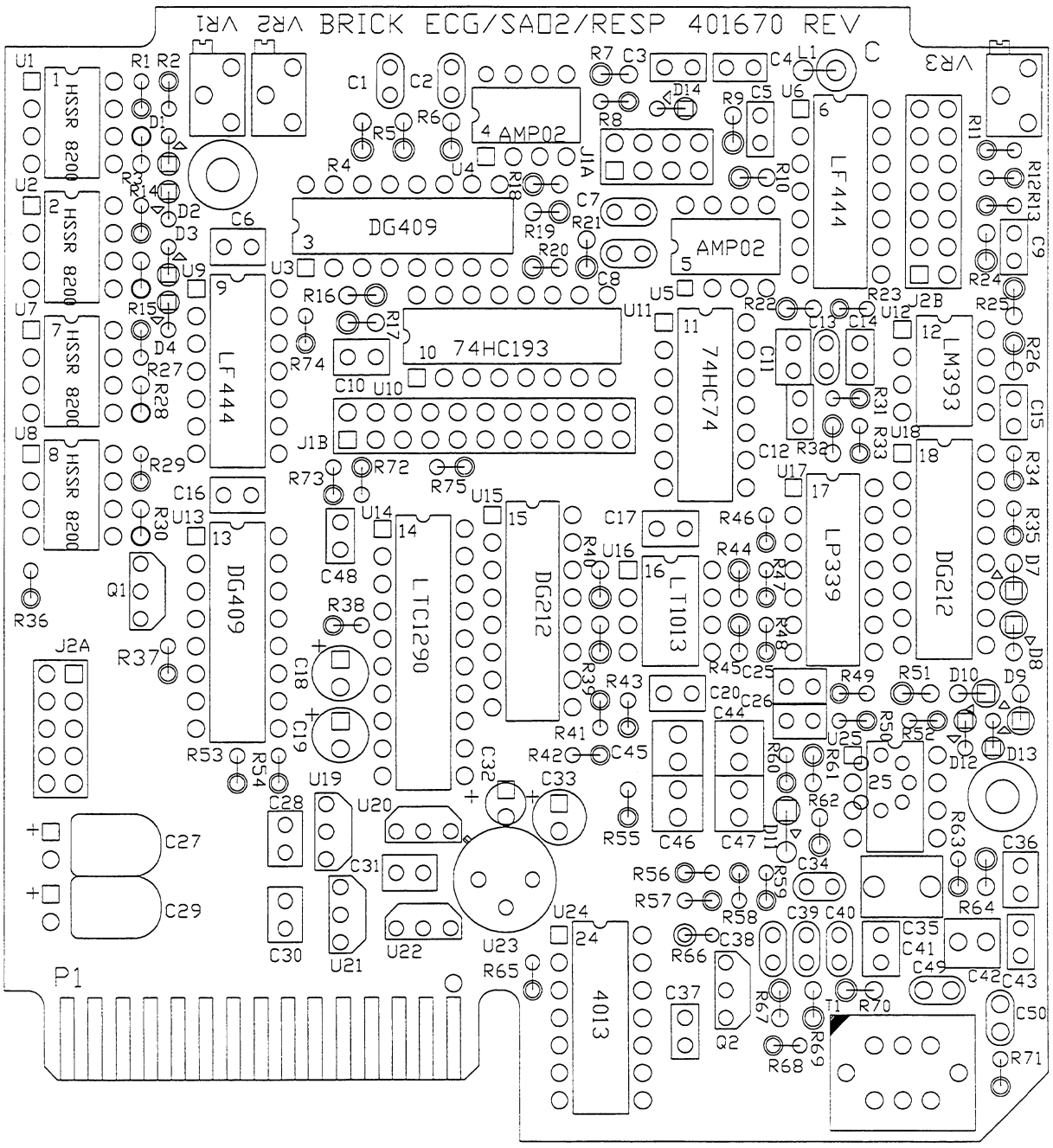

Figure 6-2: ECG Board Layout

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Figure 6-3: ECG/SpO_2/RESP Board Schematic

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6.3 ECG Processor Board

The ECG Processor Board is the interface between the ECG/SpO_2/Resp Board and the ESCORT II CPU Board. The four main sections are the microprocessor (U2), memory, I/O, and a watchdog timer.

6.3.1 Microprocessor

The microprocessor (U2) is a Z8S180 running at 16 MHz which is determined by crystal X1 (connected to pins 3 and 4). The frequency is divided internally by two, providing an operating frequency of 8 MHz at U2-68. The microprocessor provides I/O control between the ECG/SpO_2/ Resp board and the ESCORT II CPU Board. The microprocessor also generates control signals that are used on the ECG/SpO_2/Resp Board.

Synchronization to the ESCORT II system is accomplished by the signal [TIMETIKI] which is equal to four times the line frequency (i.e., a typical 60 Hz system produces a frequency of 240 Hz, while a 50 Hz system produces a 200 Hz signal).

The CPU is the source of the read [RD\] and write [WR\] signals, and the memory enable [ME\] and [IOE\] signals. These signals are used for memory and I/O decoding and routed to U5 and U6.

The signal [TX_SAO2] is used by the CPU for control of the Nellcor SpO_2 OEM board. The SpO_2 patient information is returned to the microprocessor via the signal [RX_SAO2].

Communication to the ECG/SpO_2/Resp Board is accomplished with the signals [DIN] and [DOUT]. Communication to the ESCORT II CPU Board is carried out via the [CPU_RXI] and [CPU_TXI] lines.

The signals [TX_SAO2], [RX_SAO2], [DIN], [DOUT], [CPU_RXI], and [CPU_TXI] are serial communication signals and are clocked at a baud rate of 153 kHz, which is determined by the serial clock on pin 54.

6.3.2 Memory

The memory section of the ECG Processor Board is comprised of EPROM (U1) and RAM (U4). U1 is a 128K Flash EPROM which contains the operating software for the ECG/SpO_2/Resp Board. U4 is a 32Kx8 Static RAM which stores operating parameters and variables while also providing a *scratch pad* for the microprocessor.

6.3.3 I/O Port

I/O Port (U7) is a programmable input/output device (PIO). It provides the main interface between the ECG/SpO_2/Resp and ECG Processor boards.

[VSEL0] and [VSEL1] select the lead configuration for ECG monitoring. [VSEL2] is not used. [LD_SEL0] and [LD_SEL1] determine the reference lead. [ECGBASE] and [RESPBASE] are the ECG and Respiration baseline reset lines. [AD_CS] is the select line for U14, the analog to digital/ multiplexer. [EXT_PCBK] controls the external pacer blocking circuit. [PACE_EN] turns the pacer artifact removal and detection circuitry on or off. [SAO2_INS] and [ECG_SYNC] are used for communications with the Nellcor OEM SpO_2 Board. [LDFAIL] and [CHLDFAIL] are indicators of lead fail conditions on the ECG leads. They are the result of the [LEADFAIL] and [CHST_LDF] signals after being filtered by the combination of R9 and C7 for [LEADFAIL] and the combination of R7 and C6 for [CHST_LDF] to remove any high frequency noise.

U3A and U3B are comparators which insure that the [PACE_FLGA] and [RSPFAIL] signals achieve acceptable TTL levels. These signals are derived from the [PACE_FLG] and [RESPFAIL] signals respectively.

6.3.4 Watchdog Timer

The watchdog timer (U8) is used to halt and restart the microprocessor (U2) in the event it becomes unstable or inactive. The watchdog timer is strobed continually by the signal [STROB] which originates at the PIO (U7). If the watchdog is not strobed for more than 150 ms, the [RESET] and [RESET\] lines become active, resetting the microprocessor.

The watchdog will also reset when the main CPU Board issues the signal [RESETI\]. When [RESETI\] goes low, the signals [RESET] and [RESET\] are activated, resetting the microprocessor on the ECG Processor Board.

The watchdog timer also functions as a power monitor. If the supply voltage (+5VISO) falls below 4.5 volts, the [RESET] and [RESET\] signals become active, causing the microprocessor to halt operation until the supply voltage returns to normal.

6.4 NELLCOR® SpO_2 Board (Option 30)

The ESCORT II SpO_2 option provides an automatically calibrated measurement of blood oxygen content as well as deriving a pulse rate. The pulse oximeter utilizes spectrophotometric oximetry and plethysmography principles to obtain these readings.

The SpO_2 finger sensor (NELLCOR Durasensor, MDE P/N E2800-51) utilizes two LEDs as light sources. One emits a red light (approximate wavelength of 660 nm) and the other emits an infrared light (approximate wavelength of 920 nm). A photo detector located on the other end of the finger sensor measures the light that has passed through the sensor point. These values are then used by the pulse oximeter to calculate how much red and infrared light has been absorbed. This information is used to derive the percent of functional hemoglobin that is saturated with oxygen.

Auto-calibration may occur several times in the first minute or two of SpO_2 monitoring, so as to establish a reliable and accurate baseline. Thereafter, the parameter will auto-calibrate about every fifteen (15) minutes. During the calibration sequence, the SpO_2 waveform will appear as a straight line on the ESCORT II screen. Alarms will not be triggered by the calibration sequence.

Communications between the SpO_2 Board and the ECG Processor Board are accomplished with the signals [TX_SAO2] and [RX_SAO2]. The [RESETI\] is used to reset the SpO_2 Board when a system reset is executed. The signal [ECG_SYNC] is provided to support the NELLCOR C-LOCK feature. The [ECG_SYNC] synchronizes the saturation measurements for the best time to perform a SpO_2 reading. If the [ECG_SYNC] is not present, the C-LOCK will not be operational.

The NELLCOR SpO_2 Board is connected to the main ECG/SpO_2/Resp board via connectors, J2A and J2B.

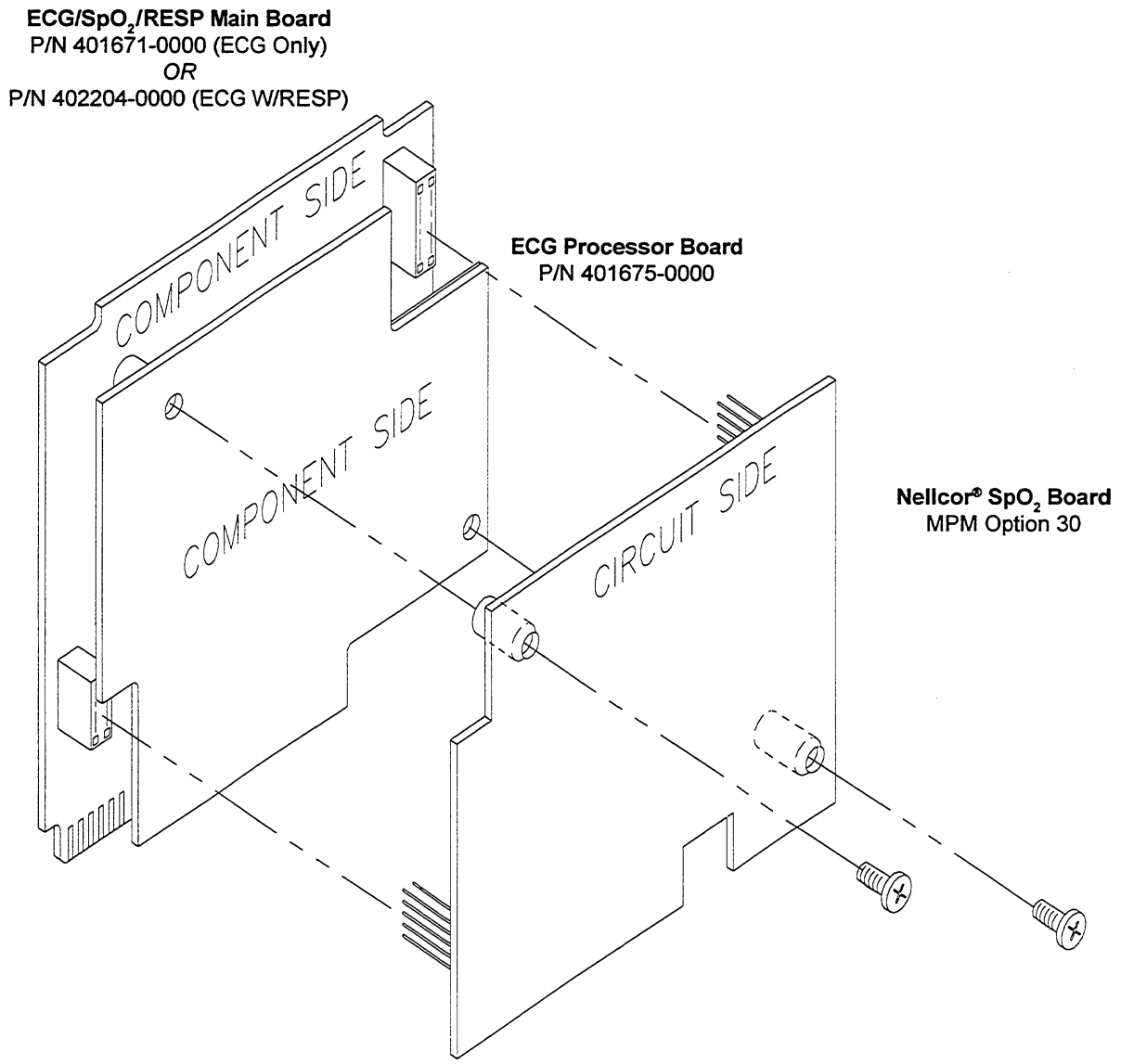

Figure 6-4: ECG/SpO$_2$/Resp Board - PCBA Configuration

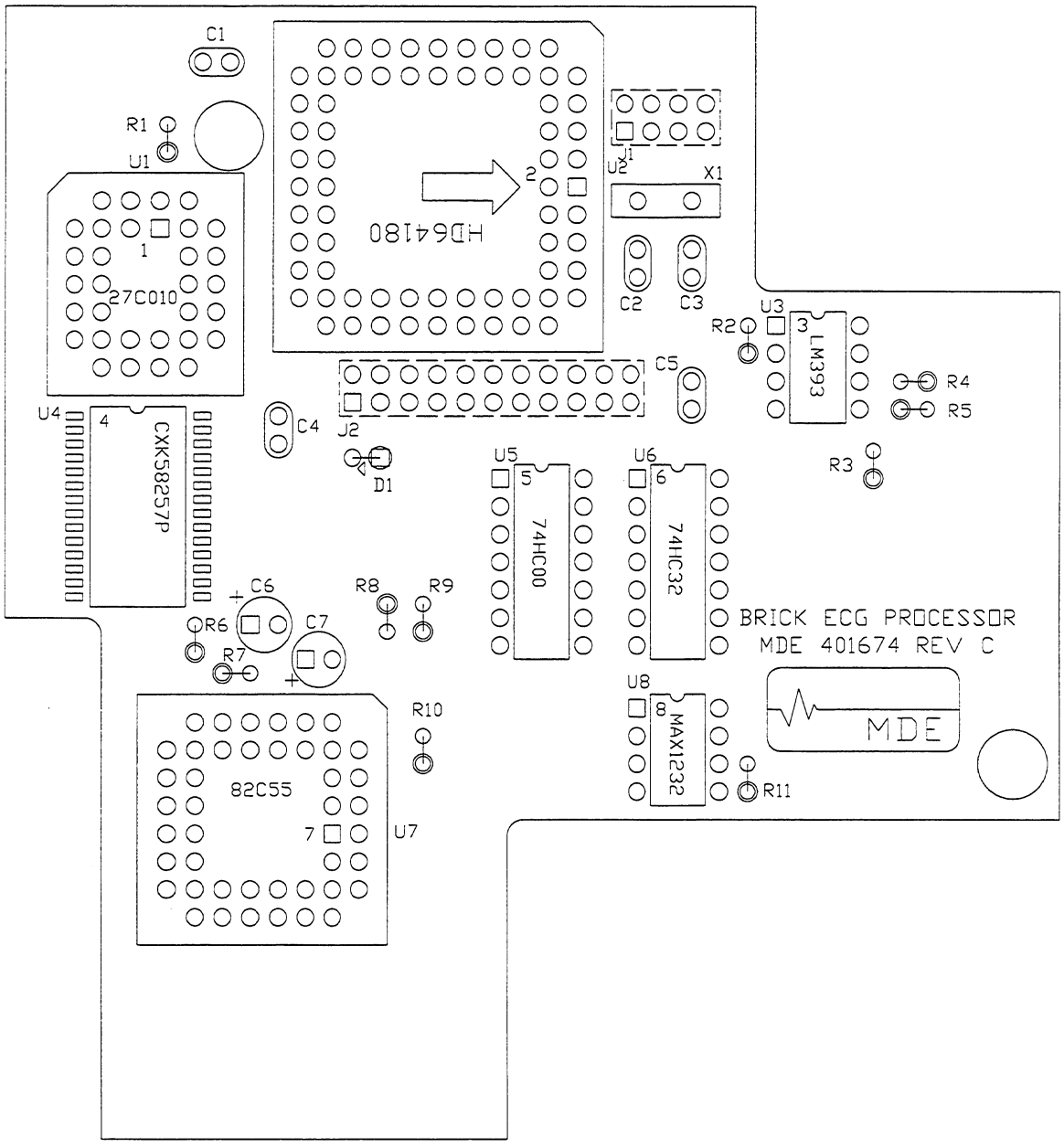

Figure 6-5: ECG Processor Board Layout

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Figure 6-6: ECG Processor Board Schematic

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Table 6-1: Parts Listing, PCBA P/N 401671-0000, ECG Only Board (1 of 3)

MDE Part Number	Description	Quantity	Reference
352100-0121A	CAP, 120PF,100V,10%,RAD,NPO TAPE & REEL	1	C34
352100-0221A	CAP, 220PF,10%,X7R,.1 L.S. BULK	1	C13
352101-0221A	CAP, 220pF,50V,10%,NPO,CER,RAD TAPE & REEL	1	C43
352101-0471A	CAP, 470pF,10%,50V,RAD,NPO TAPE & REEL	2	C49, 50
352200-0476A	CAP, 47UF,25V,RAD,ELECT 2.5mm LEAD SPACE	1	C51
352300-0007A	CAP, .001UF,10%, MYLAR	1	C48
352300-0008A	CAP, .01UF,5%,MYLAR	1	C14
352300-0008A	CAP, .01UF,5%,MYLAR	3	C3, 4, 37
352300-0010A	CAP., 1000pF,5%,MYLAR SORT FROM 352300-0007A	4	C5, 9, 12, 15
352300-0016A	CAP, .22UF,5%,MYLAR	1	C11
352300-0017A	CAP, .0047UF,10%,MYLAR	3	C38 ,39, 40
352300-0018A	CAP, .47UF,10%,MYLAR	5	C42, 44, 45, 46, 47
352300-0020A	CAP., 1UF,63V,5%,MYLAR	1	C35
352300-0104A	CAP, .1UF,50V,20%,RAD,MYLAR	12	C6 ,10, 16, 17, 20, 25, 26, 28, 30, 31, 36, 41
352400-0105A	CAP,1UF,50V,20%,RAD,TANT, MAX:HT .28; O.D. .16 T&R	2	C18, 19
352400-0106A	CAP, 10UF,25V,20%,RAD,TANT	1	C33
352400-0226A	CAP, 22UF,25V,20%,TANT T & R	2	C27, 29
352400-0335A	CAP, 3.3UF,20V,20%,RAD,TANT TAPE & REEL	1	C32
352600-0044A	CAP, 470pF,1%,50V MIN., NPO	4	C1, 2, 7, 8
354000-0304A	CONN, 72-PIN,F,.1 CTR,D-ROW SOLDER SNAP-AWAY	8	J1A 4x2
354000-0304A	CONN, 72-PIN,F,.1 CTR,D-ROW SOLDER SNAP-AWAY	22	J1B 11x2
354000-0314A	CONN, 10-PIN,F,DUAL ROW,.1 CTR	1	J2A
354000-0315A	CONN, 7-PIN,F,DBL ROW,.1 CTR,.435 HIGH	1	J2B
360500-0118A	STNDOFF, 4-40 x 3/8LG,1/4 DIA ALUM SWAGE	2	2
364000-0008A	IC, DG212CJ	2	U15, 18
364000-0010A	IC, LM339	1	U17
364000-0028A	IC, 74HC74	1	U11
364000-0109A	IC, 78LO5 +5V REG. TO-92 PKG.	1	U21
364000-0110A	IC, 79LO5 ACP -5V REG.	1	U19
364000-0130A	IC, LF347 (SCREENED TO +/- 1.5mV), NATIONAL ONLY	1	U9
364000-0132A	IC, LF444 NATIONAL ONLY	1	U6

Table 6-1: Parts Listing, PCBA P/N 401671-0000, ECG Only Board (2 of 3)

MDE Part Number	Description	Quantity	Reference
364000-0133A	IC, TL062ACP	1	U16
364000-0144A	IC, LM393N,DUAL COMP	1	U12
364000-0175A	IC, HSSR-8200 PHOTOCOUPLER	4	U1, 2, 7, 8
364000-0188A	IC, MC14013B OR 4013B,DIGITAL,DUAL TYPE D FLIPFLOP	1	U24
364000-0207A	IC, LM78L12ACZ,+ 12V REG TO92	1	U22
364000-0208A	IC, LM79L12ACZ NEGATIVE 12V VOLTAGE REG LOW PWR	1	U20
364000-0209A	IC, 74HC193 UP,DOWN COUNTER	1	U10
364000-0210A	IC, LTC1290CCN	1	U14
364000-0211A	IC, AD620BN OP AMP	2	U4, 5
364000-0212A	IC, DG409 ANALOG SWITCH	2	U3, 13
365000-0008A	SKT, 8-POS,DIP,TIN PLATE,L.P.	8	SU1, 2, 4, 5, 7, 8, 12, 16
365000-0014A	SKT, 14-POS,DIP,TIN PLATE,L.P.	5	SU6, 9, 11, 17, 24
365000-0016A	SKT, 16-POS,DIP,TIN PLATE,L.P.	4	SU10, 13, 15, 18
370100-0104A	RES, 100K,1/4W,5%,CF TAPE & REEL	1	R69
370100-0331A	RES, 330,1/4W,5%,CF TAPE & REEL	2	R67, 70
370100-0435A	RES, 4.3M,1/4W,5%,CF TAPE & REEL	2	R42, 55
370100-0681A	RES, 680,1/4W,5%,CF TAPE & REEL	1	R66
370101-0101A	RES, 100,1/8W,5%,CF TAPE & REEL	4	R38, 41, 43, 54
370101-0103A	RES, 10K,1/8W,5%,CF TAPE & REEL	4	R72, 73, 74, 75
370101-0104A	RES, 100K,1/8W,5%,CF TAPE & REEL	2	R23, 33
370101-0152A	RES, 1.5K,1/8W,5%,CF TAPE & REEL	1	R36
370101-0154A	RES, 150K,1/8W,5%,CF TAPE & REEL	2	R34, 58
370101-0155A	RES, 1.5M,1/8W,5%,CF TAPE & REEL	1	R56
370101-0163A	RES, 16K,1/8W,5%,CF TAPE & REEL	2	R49, 50
370101-0202A	RES, 2K,1/8W,5%,CF TAPE & REEL	1	R65
370101-0203A	RES, 20K,1/8W,5%,CF TAPE & REEL	4	R11, 31, 57, 59
370101-0204A	RES, 200K,1/8W,5%,CF TAPE & REEL	1	R47
370101-0432A	RES, 4.3K,1/8W,5%,CF TAPE & REEL	1	R8
370101-0473A	RES, 47K,1/8W,5%,CF TAPE & REEL	1	R35
370101-0511A	RES, 510,1/8W,5%,CF TAPE & REEL	1	R52
370101-0512A	RES, 5.1K,1/8W,5%,CF TAPE & REEL	1	R53
370101-0513A	RES, 51K,1/8W,5%,CF TAPE & REEL	3	R46, 48, 60
370101-0511A	RES, 510,1/8W,5%,CF TAPE & REEL	1	R52

Table 6-1: Parts Listing, PCBA P/N 401671-0000, ECG Only Board (3 of 3)

MDE Part Number	Description	Quantity	Reference
370101-0512A	RES, 5.1K,1/8W,5%,CF TAPE & REEL	1	R53
370101-0513A	RES, 51K,1/8W,5%,CF TAPE & REEL	3	R46, 48, 60
370101-0514A	RES, 510K,1/8W,5%,CF TAPE & REEL	1	R63
370101-0622A	RES, 6.2K,1/8W,5%,CF TAPE & REEL	1	R71
370101-0682A	RES, 6.8K,1/8W,5%,CF TAPE & REEL	1	R68
370101-0753A	RES, 75K,1/8W,5%,CF TAPE & REEL	1	R2
370200-0100A	RES, 10,1/4W,1%,MF TAPE & REEL	1	R16
370200-1001A	RES, 1K,1/4W,1%,MF TAPE & REEL	2	R39, 45
370200-1002A	RES, 10K,1/4W,1%,MF TAPE & REEL	3	R18, 19, 20
370200-1003A	RES, 100K,1/4W,1%,MF TAPE & REEL	1	R17
370200-1211A	RES, 1.21K,1/4W,1%,MF TAPE & REEL	2	R7, 10
370200-2001A	RES, 2K,1/4W,1%,MF TAPE & REEL	1	R62
370200-2493A	RES, 249K,1/4W,1%,MF TAPE & REEL	2	R25, 32
370200-3012A	RES, 30.1K,1/4W,1%,MF TAPE & REEL	2	R9, 24
370200-4022A	RES, 40.2K,1/4W,1%,MF TAPE & REEL	2	R40, 44
370200-4422A	RES, 44.2K,1/4,1%,MF TAPE & REEL	2	R6, 21
370200-4750A	RES, 47.5,1/4W,1%,MF TAPE & REEL	1	R51
370200-4991A	RES, 4.99K,1/4W,1%,MF TAPE & REEL	2	R22, 26
370200-5622A	RES, 56.2K,1/4W,1%,MF TAPE & REEL	1	R64
370200-6040A	RES, 604,1/4W,1%,MF TAPE & REEL	1	R13
370202-4022A	RES, 40.2K,1/8W,1%,MF TAPE & REEL	2	R4, 5
370202-7321A	RES, 7.32K,1/8W,1%,MF TAPE & REEL	1	R61
370202-8452A	RES, 84.5K,1/8W,1%,MF TAPE & REEL	1	R12
370403-0103A	RES, 10K,1/4W,5%,CC	5	R1, 14, 27, 29, 37
370500-0107A	RES, 100M,1/4W,5%,M.O. (OR M.G.)	4	R3, 15, 28, 30
374401-0103A	POT, 10K,TRIMM,MULTI-TURN,CERMET FILM (860X)	2	VR1, 2
376000-0019A	XSTR, 2N7000,FET	2	Q1,2
378000-0005A	DIO, 1N914,SIGNAL T&R	2	D11, 14
378000-0009A	DIO, 1N754A,6.8V,ZENER T&R ***MOT ONLY***	4	D1, 2, 3, 4
378000-0020A	DIO, 1N4622,3.9V,10%,ZENER	2	D12, 13
378000-0035A	DIO, 1N4742,12V,+/-5%,ZENER,MOTOROLA	4	D7, 8, 9, 10
382200-0030A	INDCTR, 680uH SHIELDED	1	L1
401670-0000	PCB, SaO2 ECG-B W/RESP BRICK REV C (E1600)	1	-

Table 6-2: Parts Listing, PCBA P/N 402204-0000, ECG with Respiration Board

MDE Part Number	Description	Quantity	Reference
360500-0034A	SPCR, TO-5,PERMA-PAD	1	FOR U23
364000-0205A	IC, OP249 DUAL OP AMP	1	U25
364000-0206A	IC, AD 581 POSITIVE 10V VOLTAGE REGULATOR	1	U23
374402-0204A	POT, 200K,MULTI-TURN,VAR.RES,SIDE-ADJ,CARBON	1	VR3
401671-0000	PCBA, BRICK SpO2 ECG ONLY REV M (E1832)	1	-
401722-0000	XFMR, RESP DRIVE(BRICK) E3B REV A1(D501)	1	T1
402115-0000	SHLD, ECG RESP DRIVE XFMR IN-HSE FAB REV B (E1517)	1	-

Table 6-3: Parts Listing, PCBA P/N 401675-0000, ECG Processor Board

MDE Part Number	Description	Quantity	Reference
352100-0104A	CAP, .1UF,50V,10%,RAD,X7R TAPE & REEL	3	C1, 4, 5
352101-0330A	CAP, 33PF,100V,5%,RAD,NPO TAPE & REEL	2	C2, 3
352400-0105A	CAP,1UF,50V,20%,RAD,TANT, MAX:HT .28; O.D. .16 T&R	2	C6, 7
354000-0106A	CONN, DBL ROW,STRT,SGL PIN,SNAP-AWAY 36-PINS	8	J1 4x2
354000-0106A	CONN, DBL ROW,STRT,SGL PIN,SNAP-AWAY 36-PINS	22	J2 11x2
356000-0026A	XTAL, 16MHZ, LOW PROFILE, .142IN X .425IN	1	X1
364000-0024A	IC, 74HC00	1	U5
364000-0027A	IC, 74HC32	1	U6
364000-0144A	IC, LM393N,DUAL COMP	1	U3
364000-0199A	S*IC, Z80180 8/10MHZ PLCC	1	U2
364000-0213A	IC, WATCHDOG,8-PIN DIP	1	U8
364000-0232A	S*IC, 82C55-PLCC,8 MHZ 200 NANO SEC. OR FASTER SMD	1	U7
364000-0246A	S*IC,51256,SRAM,SMD,32KX8,120NS,SOP28-P-450	1	U4
364000-0278A	S*IC, 1 MEG,UNSECT FLASH PROM PLCC 32,SMD	1	U1 - NEEDS PROGRAM
365000-0044A	S*SKT, 44-PIN,PLCC	1	SU7
365000-0068A	S*SKT, 68-PIN PLCC	1	SU2
365000-0132A	S*SKT, 32-PIN, PLCC	1	SU1
370101-0103A	RES, 10K,1/8W,5%,CF TAPE & REEL	5	R2, 3, 4, 5, 11
370101-0203A	RES, 20K,1/8W,5%,CF TAPE & REEL	4	R1, 7, 9, 10
370101-0473A	RES, 47K,1/8W,5%,CF TAPE & REEL	2	R6, 8
378000-0005A	DIO, 1N914,SIGNAL T&R	1	D1
384000-0182A	TAPE, PRESSURE SENSITIVE MYLAR/POLYESTER	-	AS REQUIRED
401674-0000	PCB, BRICK ECG PROCESSOR REV D (E1723)	1	-

7 BP/TEMP/NIBP Board

7 BP/TEMP/NIBP Board

7.1 Overview

The BP/TEMP/NIBP Board provides monitoring capability of up to three parameters in eleven different configurations. Available parameters include monitoring of one or two Invasive Blood Pressures (IBP), Temperature (TEMP), and Noninvasive Blood Pressure (NIBP).

Invasive Blood Pressure monitoring is compatible with all **5 µV/V/mmHg** type external pressure transducers. Temperature monitoring utilizes YSI-400 and YSI-700 autosensing circuitry, and is compatible with either type of probe. Noninvasive Blood Pressure monitoring is accomplished using a traditional dual-lumen hose and cuff.

The BP/TEMP/NIBP Board is comprised of five main sections IBP, TEMP, NIBP, NIBP Pneumatics, and Digital Processing.

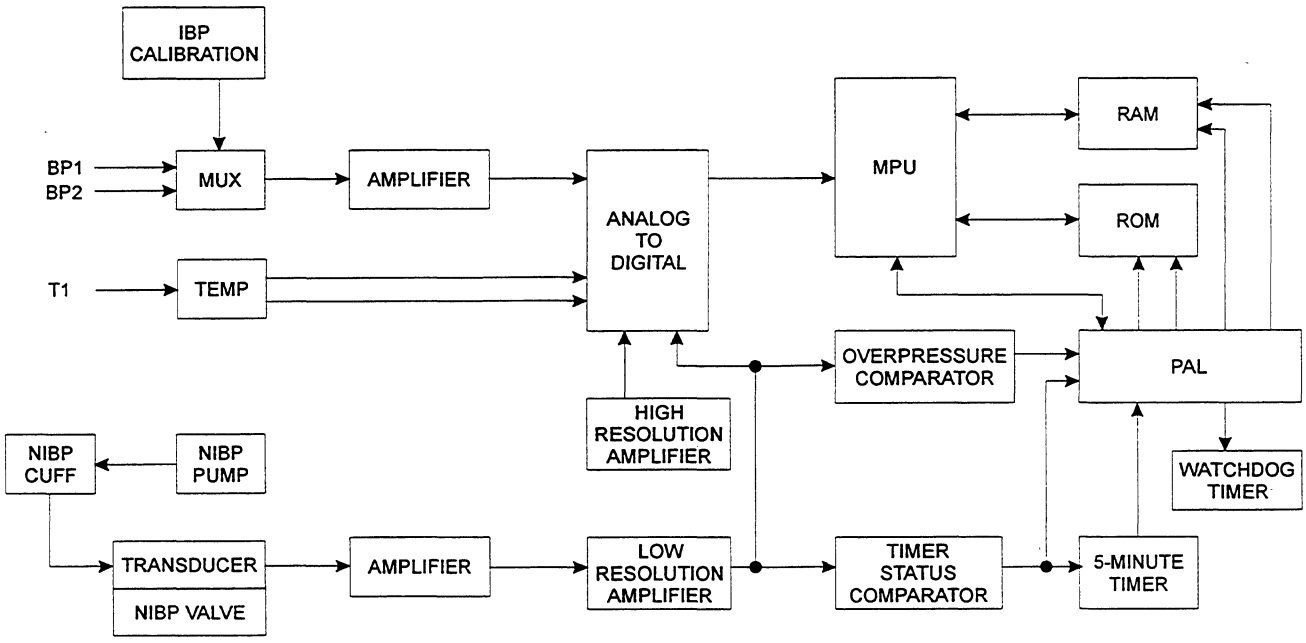

Figure 7-1: BP/TEMP/NIBP Block Diagram

7.2 Invasive Blood Pressure

The BP/TEMP/NIBP Board provides monitoring capability of one or two invasive blood pressures. Excitation voltage (+5 V) to the external IBP transducers is supplied via [+5V_REF], which is a precision reference generated locally on the BP/TEMP/NIBP Board (see paragraph 7.6). The transducer output from IBP Channel 1 enters the circuit via the signals [P_1C] and [P_1A]. IBP Channel 2 utilizes the signals [P_2C] and [P_2A]. Transducer ground is referenced to analog ground using [IBP_GND] for both channels.

The output from the IBP transducer passes through low resistance, series resistors R41 and R42 (IBP Channel 1). R43 and R44 provide the low resistance path for IBP Channel 2. Input filtering is accomplished using C7, C8, and C11 for Channel 1. C9, C10, and C12 provide the filtering for Channel 2. The transducer signals are then routed to a four-channel multiplexer (U9). The multiplexer is controlled by the signals [MUXA] and [MUXB] on pins 10 and 9 respectively.

IBP Channel 1 is connected to multiplexer inputs 0X and 0Y. IBP Channel 2 is connected to inputs 3X and 3Y. The X and Y inputs of the third channel (2X, 2Y) are tied together. When the third channel is selected, the internal resistance of the multiplexer is applied across the inputs of the instrumentation amplifier (U8). The output of the amplifier then establishes the zero reference, *MUX Ground*. The fourth channel of the multiplexer (1X, 1Y) is connected to a voltage divider which is used for IBP calibration. The voltage divider is comprised of precision resistors R2, R3, R4, R5, R6, and variable resistor VR2. The voltage divider supplies approximately 1 to 2 mV which simulates a pressure reading of 100 mmHg. This is used for gain correction and establishes *MUX Reference*. When no IBP transducer is connected, the output of the instrumentation amplifier is driven to +5 V by R32 and R33.

The multiplexed signals are sampled at two different rates; *MUX Ground* and *MUX Reference* are sampled at 30 Hz, and the IBP channels are sampled at 120 Hz. All signals pass through the instrumentation amplifier (U8), which supplies a gain of 414. The resulting data string is the signal [BP], and includes *MUX Ground*, *MUX Reference* and the IBP data. [BP] is then sent to the analog-to-digital converter (U19-1).

7.3 Temperature

Temperature monitoring on the BP/TEMP/NIBP Board supports both YSI-400 and YSI-700 type temperature probes. Temperatures between 20° C and 50° C may be accurately measured in 0.1° C increments. When no probe is present, 0° C is sent to the ESCORT II CPU Board and dashes are displayed on the screen in place of temperature digits. Temperature readings that are out of range (i.e., below 20° C *or* above 50° C) will also display dashes on the ESCORT II screen.

The probe ring voltage determines the presence of a probe and the probe type. A ring voltage of 20 mV or less indicates that a YSI-400 type probe is connected. A ring voltage higher than 20 mV indicates a YSI-700 type probe. [T1_RING] represents the probe ring voltage and is pulled to +5 V by R45 when no probe is connected. [T1_RING] is then sent to an analog-to-digital converter (U19-2).

Temperature measurements are derived from the probe tip voltage which is measured with the signal [T1_TIP]. [T1_TIP] is connected to +5 V through precision resistor R47 and is routed to the analog-to-digital converter (U19-3). The tip voltage is sampled at a rate of 30 Hz. Every sixteen (16) samples are averaged and compared to a table in the temperature software which spans the temperature range. [T1_BASE] is connected to analog ground.

7.4 Noninvasive Blood Pressure (NIBP)

NIBP uses a pressure transducer referenced to +5 V with an output of 50 μV/mmHg. The output of the transducer is connected to the inputs of an instrumentation amplifier (U2). This is the same type of amplifier used in the IBP circuit. The amplifier is referenced to -1.2 V via the voltage divider formed by R11 and zener diode Dl. The gain is adjusted with VR1. When correctly referenced and adjusted, the output of U2 should be -1.24 VDC when zero pressure is applied to the transducer. The nominal gain of the amplifier is approximately 250. The NIBP offset is provided by the potentiometer VR3.

The output of U2 is connected through R22 and R19 to the high and low resolution channels of the circuit. The high resolution channel consists of a low gain amplifier (U3D) with a gain of about 50. A digital-to-analog converter (DAC), U4, is used as a level control loop to center the output pulse waveform at a fixed position in a 0 V to 5 V window. The low resolution channel is made up of a unity gain amplifier (U3C). The total gain output of the high resolution channel is approximately 12,500. The total gain of the low resolution channel is about 250.

The high resolution channel is used to detect the pulse waveform and pulse amplitude. In ADULT mode, the cuff is deflated in 8 mmHg steps. After each step, the DAC level control loop recenters the pulse waveform in the 0 V to 5 V window, essentially mapping each 8 mmHg step into the window. The resolution of this channel is about 625 mV/mmHg or about 512 counts/mmHg at the DAC. In PED and NEO modes, the cuff is also deflated in 8 mmHg steps. However, when the cuff pressure goes below 28 mmHg, the cuff is deflated in 4 mmHg steps.

The low resolution channel provides an output voltage which corresponds to the actual cuff pressure. The signal from the high gain amplifier (U2) is connected through the unity gain amplifier (U3C) to output a signal between 0 V and 5 V. The resolution of this channel is about 12.5 mV/mmHg or 10.2 counts/mmHg. The output of the low resolution channel is also connected to the input of the overpressure and timer control comparators (U3A and U3B).

The comparators U3A and U3B monitor the hardware safety features of the NIBP parameter. U3A is referenced to a voltage equivalent to 15 mmHg. Whenever the input signal from the low resolution channel is equal to or greater than the reference, the 5-Minute Timer Circuit (U5) is started. The [STRT5MIN] flag is set at the Programmable Array Logic (PAL) Decoder (U7) when the 5-Minute Timer is started. The [TIME_OUT] flag is set when the timer times out, and the PAL sends the [FAIL_INT] to the microprocessor unit (MPU), U13. The 5-Minute Timer is reset when the cuff pressure falls below 15 mmHg through D2 and D3. U3B is referenced to the [ADT/NEO\] select line to sense for overpressure conditions. When the [ADT/NEO\] signal is high, the ESCORT II is in either ADULT or PED mode; when low, it is in the NEO mode. The ADULT mode references pressures from 265 to 275 mmHg. The NEO reference is equal to 160 mmHg. The [FAIL_OP] flag is set at the PAL when the overpressure limit is violated, and immediately it sends the [FAIL_INT] signal to the MPU.

7.4.1 NIBP Pneumatics

The NIBP pneumatics section includes the Pneumatics Assembly (P/N 402446-0000) and the Pump Assembly (P/N 402445-0000). The two assemblies are controlled by the NIBP circuitry to inflate and vent the NIBP cuff. The NIBP pneumatics section is detailed in Figure 7-2.

When the NIBP **START** softkey is pressed, power (approximately 12 VDC) is applied to the pump (P2) and to the cuff valve (VAL1), allowing the cuff to inflate through the bottom NIBP hose connector. A check valve is included in the pneumatics assembly and is used to maintain the cuff pressure after inflation.

Cuff pressure is sensed by the pressure transducer (U1) which is installed in the NIBP manifold adjacent to the top NIBP hose connector.

Overpressure protection is provided by the pump's relief valve which will open at 330 mmHg and vent the system.

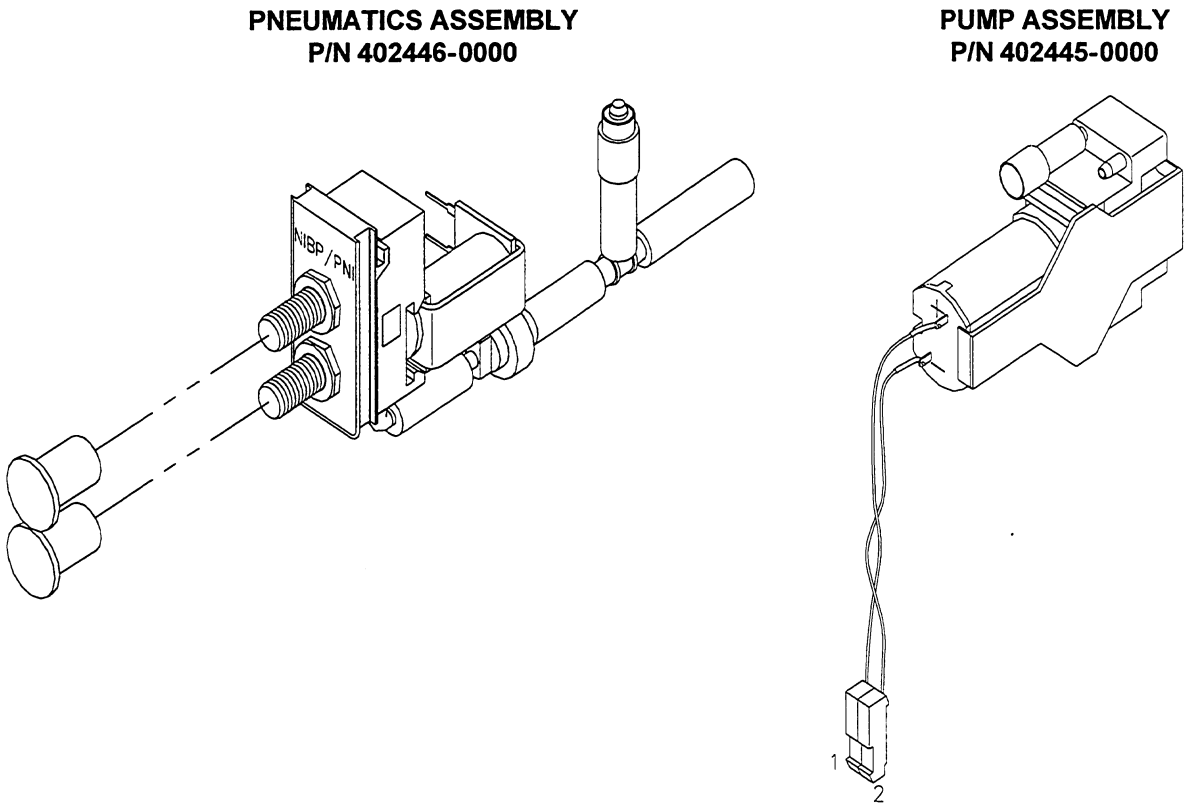

Figure 7-2: NIBP Pneumatics

7.5 Digital Processing

The BP/TEMP/NIBP digital section consists of a microprocessor (U13), PAL decoder (U7), watchdog timer (U15), memories (U6, U14), latched drivers (U17, U18), digital-to-analog converter (U4), and the analog-to-digital converter (U19).

7.5.1 Microprocessor

The microprocessor (U13) is a Z8S180 running at 16 MHz which is determined by crystal X1 (connected to pins 3 and 4). The frequency is divided internally by two, producing an operating frequency [ACLK] of 8 MHz at U13-68, and as [SCLK] at U13-57. The signal [TIMETIKI] maintains synchronization in the Multiparameter Module (MPM) and is shared by all parameter boards within the MPM.

[TIMETIKI] is the isolated version of [TIMETIC] whose frequency is equal to four times (4X) the AC line frequency. A typical 60 Hz system produces a [TIMETIC] frequency of 240 Hz while a 50 Hz system produces a [TIMETIC] frequency of 200 Hz. [TIMETIKI] is connected to the microprocessor INT1 line (U13-11).

7.5.2 PAL Decoder

The BP/TEMP/NIBP parameter board uses a Programmable Array Logic (PAL) Decoder (U7) to process signals from the microprocessor and the NIBP circuitry. The PAL receives the [TIME_OUT], [FAIL_OP], and [STRT5MIN] signals directly from the NIBP circuitry. It outputs [FAILINT\] to the microprocessor INT0 (U13-10) when either [TIME_OUT] or [FAIL_OP] is received from NIBP. The PAL controls the output enable on the latched drivers (U17 and U18) through the OE line (U17-14 and U18-14) with the [OE5800\] signal, which is also sent to the high current driver (U16A) for the NIBP pump and valve. At the same time, the PAL also sends the [LD5800] signal for strobing the latched drivers. In addition, the PAL controls the onboard memories with [RAM_WR\], [RAM_OE\], [FLSH_WR\] and [FLSH_OE\]. The PAL strobes the Watchdog Timer with [WD_ST\] every 1.2 seconds, which indicates that the board is operating correctly and it does not need to be reset. The PAL is involved in taking NIBP readings by adjusting the high resolution channel with the signal [DAC_LD\] to the DAC (U4).

7.5.3 Watchdog Timer

The Watchdog Timer circuit (WD) is strobed by the [WD_ST\] signal line at U15-7 every 1.2 seconds. This signal originates at the PAL Decoder (U7). If the [WD_ST\] signal does not occur, then the Watchdog Timer will reset the microprocessor, and the latched drivers with signals [WD_RST\] and [WD_RST]. The resistor R37 and capacitor C18 form an RC timer circuit that holds the latched drivers in reset state for 16 seconds after a reset signal from [WD_RST]. The system resets the entire BP/TEMP/NIBP parameter board using the [RESETI\] signal into the PBRST input on the watchdog timer (U15-2).

7.5.4 Memory

The BP/TEMP/NIBP board is programmed with a Flash EEPROM (28F010), U6 via [FLSH_OE\] and [FLSH_WR\] provided by the PAL Decoder, U7. The board uses a 1 megabyte RAM (CXK581000M), U14 via [RAM_OE\] and [RAM_WR\] provided by the PAL Decoder, U7. It consists of seventeen (17) address lines and eight (8) data lines. The memory works in concert with the microprocessor, U13.

7.5.5 Latched Drivers

All the parameters on the board are driven by signals switched through the latched drivers U17 and U18. Each latch has four outputs. U18 outputs, [OUT1] and [OUT2], control the select bits [MUXA] and [MUXB] to the multiplexer (U9), used in the Invasive Blood Pressure (IBP) parameter. U18-10, [OUT3], controls the Noninvasive Blood Pressure (NIBP) pump, and [OUT4] delivers the [ADULT/NEO] select line for the NIBP. U17 outputs, [OUT1], [OUT2], and [OUT3] are not used. U17-9, [OUT4], controls the NIBP valve. U16-7 is the high side voltage switch for the pump and valve. U16 is controlled by the [OE5800\] line from the PAL decoder.

7.5.6 Analog-to-Digital Converter

The analog voltage outputs from different parameters run to the 8-channel analog-to-digital converter (ADC), U19. The ADC is controlled by the microprocessor through [DIN] from the TXS (U13-55) on the microprocessor. The ADC uses the [SCLK] and [ACLK] signals for timing in converting the analog data to digital and for communicating with the DBUS interface. The output of the converter is a serial digital data line [DOUT], which is connected to the MPU's RXS line, U13-56. The microprocessor signals the ADC that it is ready to receive data from RTSO\ (U13-45) through the signal [ADCS\], which is connected to CS\, (U19-15).

7.6 Regulators

U10 and U11 are used to regulate -15 V and +15 V down to -12 V and +12 V respectively. The ±12 V supplies are used throughout the BP/TEMP/NIBP Board. The +12 V is further regulated to +5 V_REF by U12.

7.7 NIBP Diagnostics

The following procedures present basic diagnostic tests that should be performed to verify the integrity of the NIBP parameter.

7.7.1 Calibration Check Procedure

Calibration of the monitor should be checked at least once a year, or when there is doubt about the validity of the pressure readings. The test procedure is designed to confirm the accuracy of the monitor as well as to diagnose pneumatic leaks.

> **WARNING: Calibration tubing should always be kept dry and free of particulate matter. Moisture or foreign substances introduced into the pneumatic system can cause damage to the unit.**

The following equipment will be necessary to perform the calibration check procedure:

- A calibrated Mercury (Hg) Manometer
- MDE Calibration Kit
- NIBP Cuff & Hoses

To perform a calibration check, follow these steps:

1. Make sure the NIBP parameter is displayed in one of the waveform display areas. If you need instructions on displaying a parameter in a waveform area, see Chapter 5, "Setup and Operation" of the ESCORT II 100 Operator's Manual.
2. Locate the NIBP calibration kit that was supplied with the ESCORT II.
3. Connect a mercury manometer to the monitor using the calibration kit as shown in Figure 7-3.
4. Wrap the NIBP cuff around a sturdy cylindrical device.
5. Press the NEXT PAGE key twice to display the second SYSTEM SETUP page.
6. Press the TEST softkey.
7. Press the NIBP TEST softkey twice, until CHECK is highlighted.
8. Press the PAGE HOME key. The following is displayed in the NIBP message field:

   CHECK CUF = *XX* (Note: *XX* indicates any numeric value)

9. Open manometer to air and verify that the message displayed on the monitor is as follows:

   CUFF = 00

10. Close the valve on the manometer inflation bulb.

11. Using the inflation bulb, manually pump up the pressure to 100 mmHg. The display message should now read:

    CUFF = 100 (± 2%)

12. Using the inflation bulb, manually pump up the pressure to 200 mmHg. The display message should now read:

    CUFF = 200 (± 2%)

13. Repeat the test if pressures indicated are not within the specified tolerances. If the results continue to be out of tolerance, the monitor needs to be recalibrated and should be referred to qualified technical service personnel.

14. To exit the CHECK mode, press PAGE HOME then repeat steps 4 and 5 followed by pressing NIBP TEST until OFF is selected.

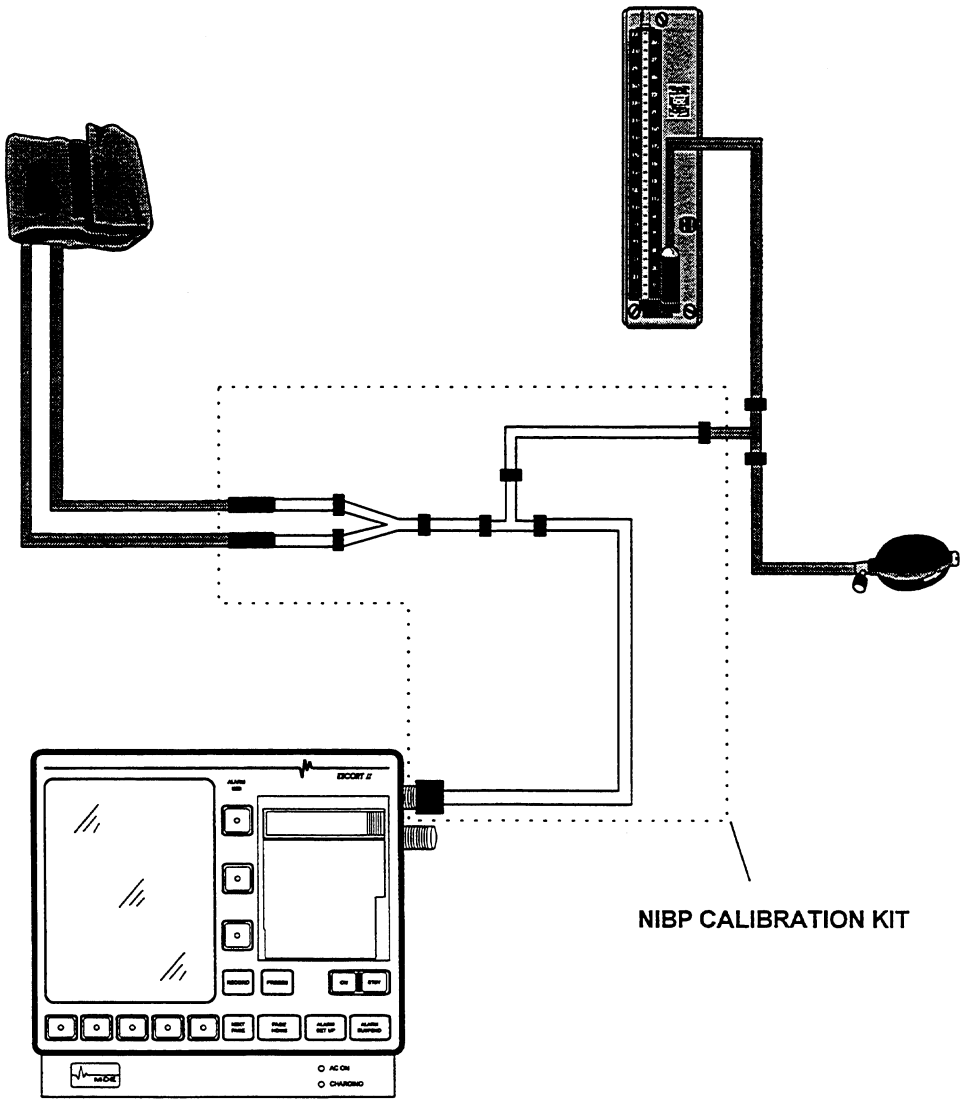

Figure 7-3: NIBP Calibration Check Setup

7.7.2 Leak Test Procedure

If a leak is suspected, use the cuff and hose in question and take the following steps:

1. Wrap the cuff tightly on itself.
2. Press the NEXT PAGE key twice to display the second SYSTEM SETUP page.
3. Press the TEST softkey.
4. Press the NIBP TEST softkey until LEAK is displayed in the highlighted area of the function key.
5. Press the PAGE HOME key.
6. Press the NIBP softkey to display the first NIBP SETUP page.
7. Press the START softkey. The following message is displayed:

   LEAK TEST

8. The ESCORT II will inflate the cuff to 240 mmHg. Be careful not to touch the cuff during inflation. It will then automatically check for a leak. If no leak is detected, a **NO LEAK** message is displayed. If a leak is detected, a **LEAK** message is displayed, and the cuff/hose should be replaced or repaired by technical service personnel before using it to monitor a patient.
9. To exit the LEAK test mode, press PAGE HOME and then repeat steps 2 and 3 followed by pressing NIBP TEST until OFF is selected.

7.7.3 Oscillation Waveform Test Procedure

If the ESCORT II is configured with a recorder, the oscillation waveform and other analysis data can be recorded by taking the following steps:

1. Take an NIBP reading.
2. Press the NEXT PAGE key twice to display the second SYSTEM SETUP page.
3. Press the TEST softkey.
4. Press the NIBP REC START softkey.
5. The oscillation waveform and analysis data will record for the most recent NIBP reading. The record strip will be long and will automatically stop when the analysis is done. The strip should be given to qualified technical service personnel for interpretation.
6. Repeat the above steps for oscillation waveform analyses of any successive NIBP readings.
7. To exit the Oscillation Waveform Test, press the PAGE HOME and then repeat steps 2 and 3 followed by pressing the NIBP TEST key until OFF is selected.

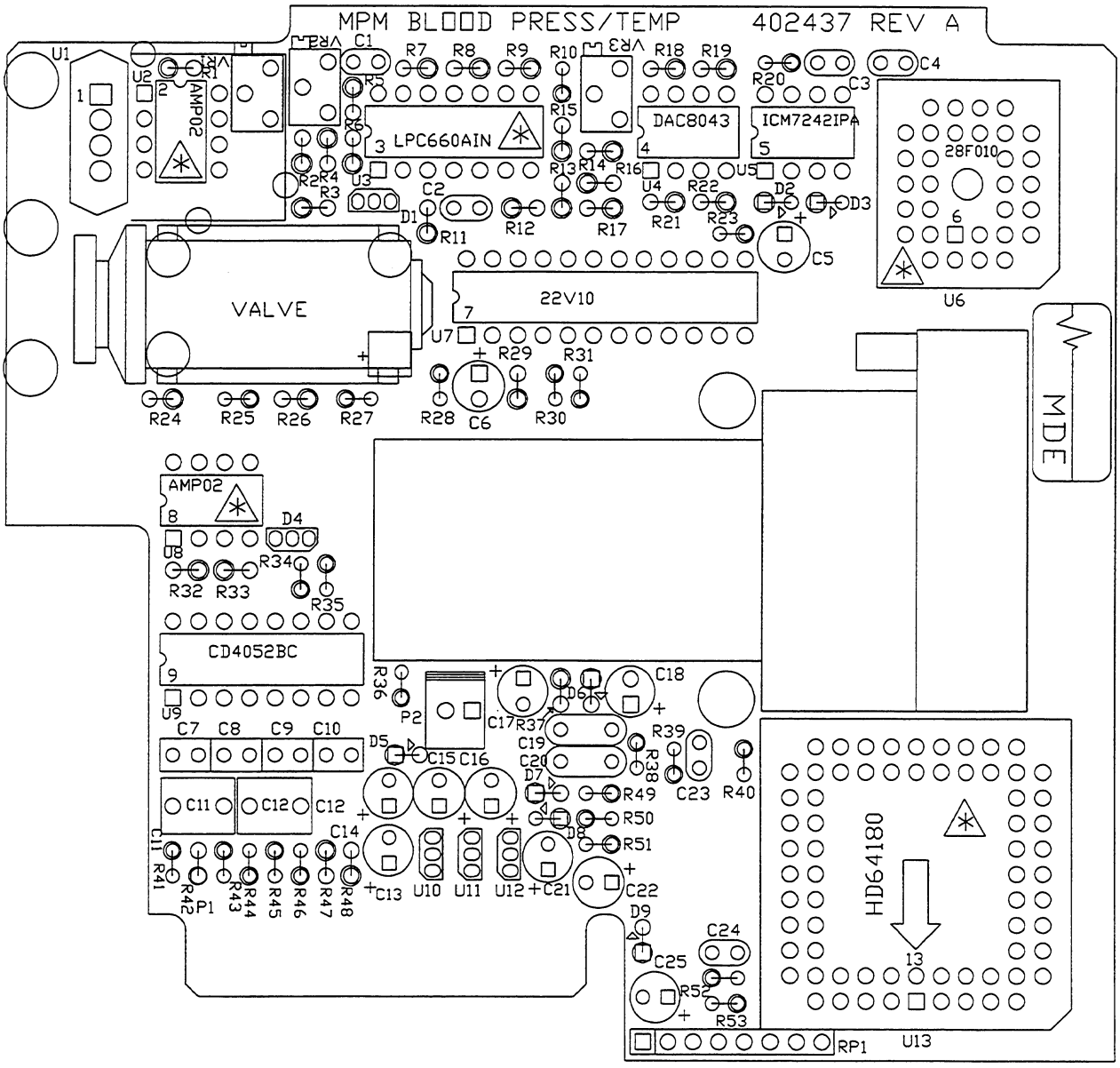

Figure 7-4: BP/TEMP/NIBP Board Layout

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Figure 7-5: BP/TEMP/NIBP Board Schematic

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Table 7-1: Parts Listing, PCBA P/N 402438-0000, BP/TEMP/NIBP Board (1 of 3)

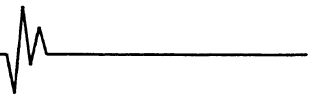
MDE Part Number	Description	Quantity	Reference
352100-0101A	CAP, 100PF,25V,10%,RAD,NPO - .1 LEAD SPACING T & R	1	C4
352100-0150A	CAP, 15PF,50V,10%,RAD,NPO EDPT TAPE & REEL	1	C1
352100-0224A	CAP, .22UF,50V,10%,RAD,X7R TAPE & REEL	2	C19, 20
352101-0150A	S*CAP, 15pF,5%,50V,CER NPO 0805	4	C28, 29, 36, 37
352103-0220A	S*CAP, 22pF,5%,50V,CER,NPO,0805,SMD	2	C39, 40
352300-0020A	CAP., 1UF,63V,5%,MYLAR	2	C11, 12
352300-0102A	CAP, 1000PF,50V,20%,RAD,MYLAR	1	C24
352300-0104A	CAP, .1UF,50V,20%,RAD,MYLAR	6	C2, 7, 8, 9, 10, 23
352301-0104A	CAP, .1UF,5%,MYLAR BULK ONLY	1	C3
352400-0105A	CAP,1UF,50V,20%,RAD,TANT, MAX:HT .28; O.D. .16 T&R	4	C5, 17, 18, 21
352400-0106A	CAP, 10UF,25V,20%,RAD,TANT	5	C6, 13, 14, 15, 16
352400-0226A	CAP, 22UF,25V,20%,TANT T & R	2	C22, 25
352600-0043A	S*CAP, 0.1uF,10%,50V,CER X7R 1206	9	C26, 27, 30-35, 38
354000-0138A	CONN, 2-P,M,STRT LOCK,.1 CTR,HDR	1	P2
356000-0041A	S*XTAL, 16 MHZ,MICROPROCESSOR,LOW PROFILE SMD	1	X1
364000-0055A	IC, CD4052,DIP	1	U9
364000-0109A	IC, 78LO5 +5V REG. TO-92 PKG.	1	U12
364000-0207A	IC, LM78L12ACZ,+ 12V REG TO92	1	U11
364000-0208A	IC, LM79L12ACZ NEGATIVE 12V VOLTAGE REG LOW PWR	1	U10
364000-0211A	IC, AD620BN OP AMP	2	U2, 8
364000-0237A	IC, Z8S180 18 OR 20 MHZ,PLCC *ZILOG ONLY*	1	U13
364000-0249A	IC, LPC660AIN, CMOS QUAD OP AMP 8PIN DIP PKG	1	U3
364000-0250A	IC, 22V10-10,PAL,24-PIN DIP	1	U7
364000-0251A	IC, ICM7242IPA,TIMER COUNTER 8-PIN DIP PKG	1	U5
364000-0252A	IC, DAC8043GP,DIG TO ANAL CONV,8PIN DIP(P OR Z PK)	1	U4
364000-0253A	IC, TC4426COA,1.5A DUAL HIGH DRIVER 8PI SOIC PKG	1	U16
364000-0266A	S*IC, CXK581000M,8BIT,HS STATIC RAM,32-PIN,SOP	1	U14
364000-0278A	S*IC, 1 MEG,UNSECT FLASH PROM PLCC 32,SMD	1	U6
364000-0292A	S*IC, MAX1232 WATCHDOG TIMER SOIC SMD	1	U15
364000-0300A	IC, UCN5800L,QUAD,LATCHED,SINK DRVR,SOIC14 PKG	2	U17, 18

Table 7-1: Parts Listing, PCBA P/N 402438-0000, BP/TEMP/NIBP Board (2 of 3)

MDE Part Number	Description	Quantity	Reference
364000-0301A	S*IC, LTC1290 A TO D CONVERTER 12-BIT,8 CH,SOIC20	1	U19
365000-0008A	SKT, 8-POS,DIP,TIN PLATE,L.P.	2	SU2, 8
365000-0014A	SKT, 14-POS,DIP,TIN PLATE,L.P.	1	SU3
365000-0068A	S*SKT, 68-PIN PLCC	1	SU13
365000-0132A	S*SKT, 32-PIN, PLCC	1	SU6
370100-0166A	RES, 16M,1/4W,5%,CF TAPE & REEL	3	R32, 33, 37
370100-0201A	RES, 200,1/4W,5%,CF TAPE & REEL	1	R29
370100-0226A	RES, 22M,1/4W,5%,CF TAPE & REEL	1	R20
370100-0304A	RES, 300K,1/4W,5%,CF TAPE & REEL	1	R18
370101-0102A	RES, 1K,1/8W,5%,CF TAPE & REEL	1	R40
370101-0103A	RES, 10K,1/8W,5%,CF TAPE & REEL	6	R23, 27, 31, 34, 35, 36
370101-0104A	RES, 100K,1/8W,5%,CF TAPE & REEL	1	R53
370101-0181A	RES, 180,1/8W,5%,CF TAPE & REEL	1	R25
370101-0303A	RES, 30K,1/8W,5%,CF TAPE & REEL	2	R45, 46
370101-0511A	RES, 510,1/8W,5%,CF TAPE & REEL	6	R10, 38, 39, 49, 50, 51
370101-0512A	RES, 5.1K,1/8W,5%,CF TAPE & REEL	1	R52
370101-0514A	RES, 510K,1/8W,5%,CF TAPE & REEL	2	R28, 30
370200-1001A	RES, 1K,1/4W,1%,MF TAPE & REEL	3	R2, 3, 17
370200-1002A	RES, 10K,1/4W,1%,MF TAPE & REEL	4	R9, 15, 19, 22
370200-1003A	RES, 100K,1/4W,1%,MF TAPE & REEL	1	R8
370200-1103A	RES, 110K,1/4W,1%,MF TAPE & REEL	2	R4, 5
370200-1210A	RES, 121,1/4W,1%,MF TAPE & REEL	1	R24
370200-1242A	RES, 12.4K,1/4W,1%,MF TAPE & REEL	1	R14
370200-1500A	RES, 150,1/4W,1%,MF TAPE & REEL	1	R1
370200-1821A	RES, 1.82K,1/4W,1%,MF TAPE & REEL	1	R12
370200-4022A	RES, 40.2K,1/4W,1%,MF TAPE & REEL	1	R7
370200-4420A	RES, 442,1/4W,1%,MF TAPE AND REEL	1	R6
370200-4753A	RES, 475K,1/4W,1%,MF TAPE & REEL	1	R21
370200-5361A	RES, 5.36K,1/4W,1%,MF TAPE & REEL	2	R11, 26
370200-6490A	RES, 649,1/4W,1%,MF TAPE & REEL	1	R13

Table 7-1: Parts Listing, PCBA P/N 402438-0000, BP/TEMP/NIBP Board (3 of 3)

MDE Part Number	Description	Quantity	Reference
370202-1000A	RES, 10,1/8W,1%,MF TAPE & REEL	4	R41, 42, 43, 44
370202-4991A	RES, 4.99K,1/8W,1%,MF TAPE & REEL	1	R16
370204-5901A	RES, 5.90K,1/4W,0.1%,MF TAPE & REEL	2	R47, 48
370300-0017A	RES, SIP,10K,5%,8-LEAD,7-COMP,COMMON	1	RP1
374300-0101A	POT, 100,10-TURN,VAR,SIDE-ADJ	1	VR1
374401-0103A	POT, 10K,TRIMM,MULTI-TURN,CERMET FILM (860X)	1	VR3
374402-0102A	POT, 1K,10-TURN,SIDE ADJ	1	VR2
378000-0001A	DIO, 1N270 T&R	3	D7, 8, 9
378000-0005A	DIO, 1N914,SIGNAL T&R	4	D2, 3, 5, 6
378000-0068A	DIO, LM385Z-1.2,LOW PWR VOLT REF	2	D1, 4
402254-0000	B-SERIES NIBP PAL	0	U7
402255-0000	B-SERIES TEMP ROM VERS. 1.0.0 (S050)	0	U6
402257-0000	B-SERIES BP ROM VERS. 1.0.0 (S050)	0	U6
402258-0000	B-SERIES BP/TEMP ROM VERS. 1.0.0 (S050)	0	U6
402259-0000	B-SERIES 2BP ROM VERS. 1.0.0 (S050)	0	U6
402260-0000	B-SERIES 2BP/TEMP ROM VERS. 1.0.0 (S050)	0	U6
402261-0000	B-SERIES NIBP ROM VERS. 1.0.0 (S041)	0	U6
402262-0000	B-SERIES NIBP/TEMP ROM VERS. 1.0.0(S050)	0	U6
402263-0000	B-SERIES NIBP/BP ROM VERS. 1.0.0 (S042)	0	U6
402264-0000	B-SERIES NIBP/BP/TEMP ROM VERS. 1.0.0 (S050)	0	U6
402265-0000	B-SERIES NIBP/2BP ROM VERS. 1.0.0 (S050)	0	U6
402266-0000	B-SERIES NIBP/2BP/TEMP ROM VERS. 1.0.0 (S050)	0	U6
402437-0000	PCB, BRICK NIBP/BP/TEMP-NEW REV. A(E1818)	1	1



8 CO_2 & CO_2 Processor Boards

8

CO_2 & CO_2 Processor Boards

8.1 Overview

The ESCORT II CO_2 system is comprised of three major components, as listed below.

- Optical Bench (CO_2 Sensor)
- CO_2 Main Board
- CO_2 Processor Board

The Optical Bench, or CO_2 sensor, is the interface between the patient and the ESCORT II bedside monitor, and is placed in the patient airway. The CO_2 Board processes the $ETCO_2$ information received from the Optical Bench while also providing sensor heat-up and control. The CO_2 Processor Board is the digital interface between the CO_2 board and the ESCORT II's main CPU board.

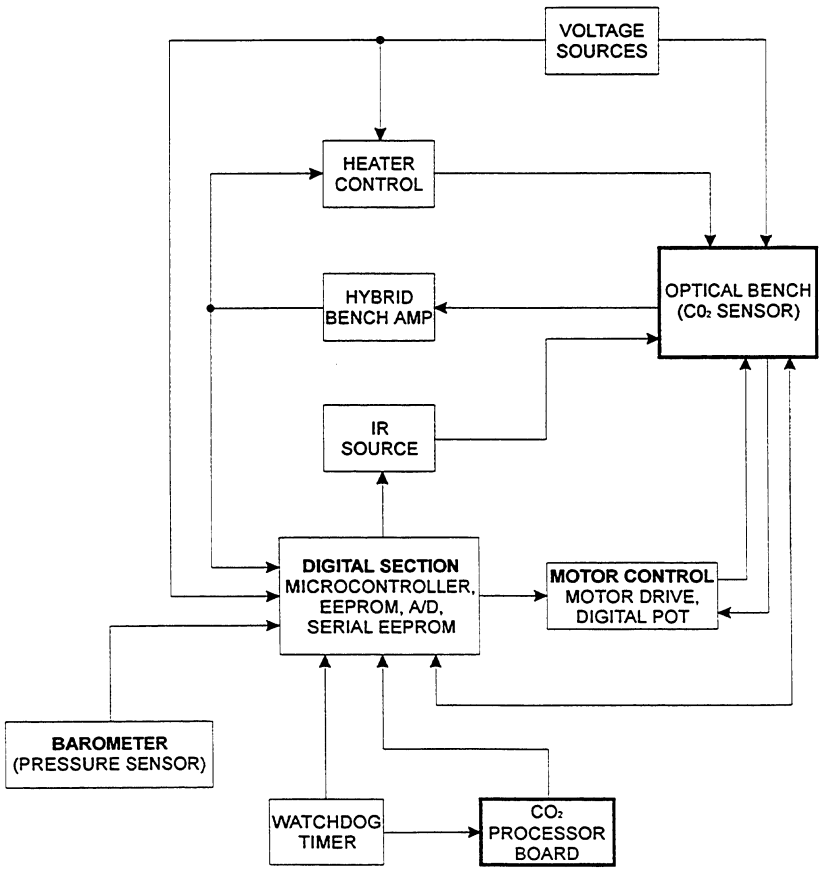


Figure 8-1: CO_2 Block Diagram

8.2 Optical Bench (CO_2 Sensor)

The CO_2 sensor consists of a light source, a photo detector, an infrared filter, and chopper wheel which contains a sample gas cell. The same type of CO_2 sensor is used in both mainstream and sidestream applications. The sensor is factory calibrated to characterize its response to CO_2. At 42° C, the sensor is exposed to known CO_2 concentrations and the resulting measurements are sent to the CO_2 processor, along with the ambient barometric pressure. The sensor's CO_2 measurements are then compared to the known concentrations, yielding sensor specific calibration coefficients. These coefficients become part of the calibration equation that is used to determine CO_2 levels during patient monitoring. All calculations are performed by internal software.

WARNING: Great care must be exercised in handling the CO_2 sensor. There are no serviceable parts inside the sensor. If the sensor malfunctions, contact MDE Technical Support.

WARNING: DO NOT immerse, gas sterilize, or autoclave the sensor; doing so will cause damage to the sensor which is NOT COVERED by the product warranty.

8.3 CO_2 Board

The CO_2 Board consists of eight sections, each section is listed below and discussed in the following text.

- Bench Amplifier Hybrid
- Heater Control
- Motor Drive Hybrid
- Barometer Sensor
- IR LED / IR Source
- Digital Section
- Watchdog Timer
- Regulators/Converters

8.3.1 Bench Amplifier Hybrid

The Bench Amplifier Hybrid (J2) is an OEM module which functions as an interface between the Optical Bench (CO_2 Sensor) and the CO_2 Board. The Bench Amplifier's functions include amplification of the sensor detector output, and accurate biasing of the detector so that its output is zero referenced and within the range of the analog-to-digital converter (U4). The Bench Amplifier Hybrid module is soldered directly to the CO_2 Board. It is not a serviceable assembly, and is replaced as a module if defective.

The actual CO_2 data originates on the Optical Bench (CO_2 sensor). It is a rounded trilevel signal, and is called [DETECT]. See Figure 8-2 for details. The three levels of the [DETECT] signal are REFERENCE, DARK, and KIDNEY. The voltage level of the REFERENCE signal is approximately 0.8 VDC; DARK is about 0 V, and KIDNEY is approximately 1.5 VDC, depending on actual CO_2 level. The [DETECT] signal is routed to the Hybrid Bench Amp where it is amplified and filtered before being routed back into the CO_2 Board as [VSIG] at (J2-10). [VSIG] is sent to the microcontroller (U10-1) and is used to produce the [DARK] signal (U10-7). [DARK] is sent back into the Bench Amp Hybrid at (J2-11) and is used to control [-BIASDRV].

[-BIASDRV] is an output from the Bench Amp (J2-14) which is controlled by the [DETECT] and [DARK] signals. Its voltage level varies according to the [DETECT] and [DARK] signals to compensate for the changes in measurements. However, the ratio of the measurements does not change. This feature is crucial in obtaining stable and reliable measurements despite normal variability in system components. The [-BIASDRV] is photo-coupled to U13 and filtered by C18 and C19 to produce the [-BIAS] signal. The [-BIAS] signal varies from -36 V to 0 VDC, with a typical level being in the -10 V range.

The temperature of the sensor is fed back into the Bench Amplifier Hybrid as the signal [THERM] at J2-2. It is a low level signal of approximately 0.7 VDC. On the Bench Amplifier Hybrid, [THERM] is amplified and exits as [TEMP], which has a level between 0 V and approximately 2.5 VDC, with the level being approximately 2.4 VDC at 42° C.

The Bench Amplifier Hybrid receives its supply voltages of +5 VA and -5 VA from the main CO_2 Board.

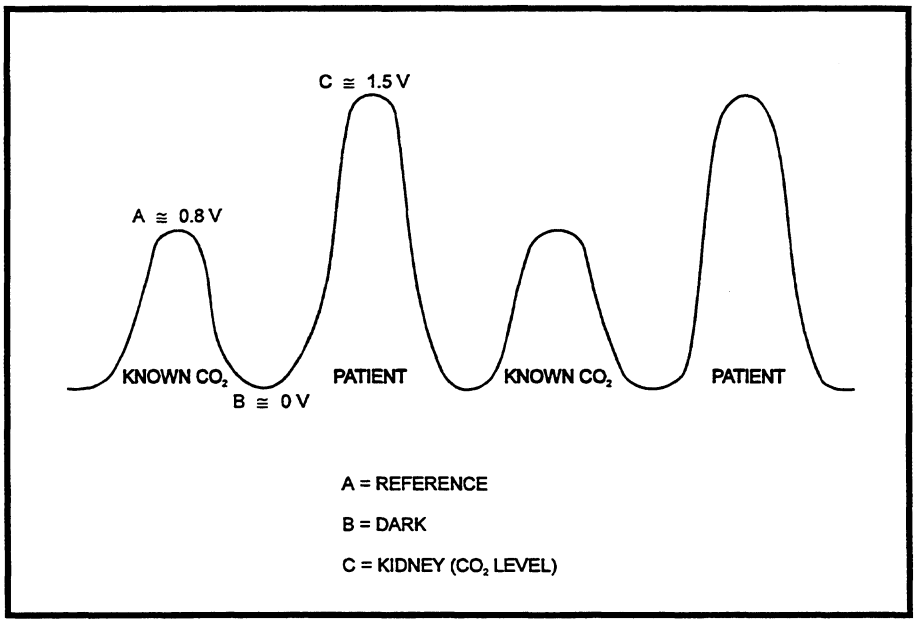


Figure 8-2: CO_2 Output Signal

8.3.2 Heater Control

The Heater Control is provided by the signals [HEATPWM] and [HFLT]. The pulse width modulator [HEATPWM] signal is originated from the microcontroller U10-4 under program control. The [HEATPWM] signal is used to drive the heater in the sensor. It goes into the inverter (U17B) and, if the heater temperature is between 0° C and 48° C, it passes through U17B, and is then inverted by U17D. The current driver (U18) outputs current to drive the heater. It is then EMI-filtered by L1 and C24, and is routed to the sensor heater as the signal [HEATER].

U6A and U6B are window detectors for the sensor's heater temperature. If the [TEMP] signal at the inverting input of U6A rises above 2.85 VDC (which is the reference voltage set at U6-3 that corresponds to 48° C at the sensor), the output at U6-1 goes low. U6B is used to detect a temperature approaching 0° C, which is an indication that there is no sensor connected. If the [TEMP] signal goes below 0.8 VDC (the reference voltage set at U6-6), the output at U6-7 goes low. U6-1 and U6-3 are then inverted by U17A, and become the signal [HFLT]. If [HFLT] goes high, it blocks the [HEATPWM] signal from passing through U17B. Furthermore, [HFLT] is then routed to the microcontroller (U10) to stop the [HEATPWM] output at U10-4.

8.3.3 Motor Drive Hybrid

The Motor Drive Hybrid (J1) is an OEM module which functions as an interface between the optical bench motor and the CO_2 Board. The microcontroller (U10) on the CO_2 Board routes control signals to the optical bench motor through the Motor Drive Hybrid. It takes in [DRIVE], [SENSE], [KICK], [MTRGATE], [MTRCLK], [VH], [VREF], and [VW] signals. The signal [KICK] comes from the microcontroller (U10-8). When the microcontroller prepares to start the motor, it generates a short pulse called [KICK], which enters the hybrid motor driver at J1-2, and outputs to the motor driver at J1-1, [DRIVE]. The purpose of [KICK] is to align the motor in the sensor so that it spins in the right direction, and it occurs only once during the start-up phase of the CO_2 process.

The amplitude of the motor drive signal is controlled by the digital potentiometer, U2. [VH] is the high side of the digital potentiometer and is a result of the processing of [VREF] on the motor drive hybrid. The wiper setting, [VW], is programmed into the serial EEPROM (U5) during factory configuration. The actual driving of the motor is done via the output of the motor drive hybrid at J1-5, where it goes through the current drivers Q2 and Q3. The output of Q2 and Q3 become the signal [DRIVE], and is the actual driver for the motor in the sensor.

Once the [KICK] signal occurs, it is detected by the microcontroller (U10), which then generates a pulse train [MTRCLK]. [MTRCLK] is the reference for the motor speed control on the motor drive hybrid. The signal [DRIVE], in addition to driving the motor, is fed back to the hybrid motor driver, and is compared to the signal [SENSE]. [SENSE] is a low level ramp which is generated by a sense coil on the sensor motor assembly.

When the motor is spinning, the signal [MTRGATE], originating from the microcontroller (U10-9), is at 0 VDC. If the microcontroller detects an error, [MTRGATE] goes to +5 VDC, blocking the motor drive signal on the hybrid motor driver, and shutting down the motor.

8.3.4 Barometer Sensor

The Barometer Sensor circuit generates a voltage proportional to the atmospheric pressure by applying a constant current source to the pressure transducer (U1). U7A generates an output voltage proportional to the atmospheric pressure. The current inputs at U1-4, while U7-2 provides a return path. Internally, U1 is a resistive bridge. The internal connections of U1-4 to U1-3, and U1-1 to U1-2 produce fixed resistances. The internal connections of U1-4 to U1-1, and U1-1 to U1-2 produce variable resistances. U1-3 develops a reference voltage of 7.3 VDC. U1-1 is a voltage proportional to the atmospheric pressure. This is buffered by U7B, and is summed at U7D. U7-14 delivers a voltage proportional to the pressure level which is applied to the microcontroller (U10-64) for calculations of the barometric pressure.

8.3.5 IR LED / IR Source

An infrared LED resides in the sensor head. It is the source used for generating the [DETECT] signal. Once the sensor motor reaches optimal speed, U10 activates the [SOURCEON] line at U10-10. U10 does not have the capability to drive the IR LED, therefore [SOURCEON] is used as a control signal for U8, which is a constant current source. When [SOURCEON] goes high (active), it turns on U10, which outputs the signal [SOURCE] which drives the IR LED. The [SOURCE] signal is approximately 1.25 VDC, and supplies the IR LED with about 83 mA.

8.3.6 Digital Section

The Digital Section consists of a microcontroller (U10), which operates at about 11.059 MHz. It also consists of a 1-megabyte flash PROM (U16), an octal address latch with tri-state outputs (U11), a 1024-bit serial EEPROM (U5), an analog-to-digital converter (U4), and some discrete logic gates.

The microcontroller, U10, has five addressable ports. Each of which consists of eight lines. Port 0 consists of eight data lines, [AD0 through AD7]. It is the multiplexed low order address bus and data bus. During the address cycle, the address latch (U11) receives the address, and is latched on its Q outputs by the [ALE] signal from U10-48.

Port 1 consists of four capture timing input signals for timer T2. Only CT0 is used on the main CO_2 board as [MTRCLK], the other three capture timing inputs are left open. The T2 event input produces the output [I2CCLK] on U10-20; the T2 timer reset signal outputs [I2CDAT] on U10-21; the serial port clock line outputs [EECLK] on U10-22; and the serial port data line outputs [EEDAT] on U10-23.

Port 2 outputs eight high order address bytes used during external memory accesses. The address and data lines communicate with the flash PROM (U16), which contains the CO_2 control program.

Only three lines are used in Port 3 for our application, namely, receive data line on U10-24, transmit data line on U10-25, and timer 1 external input line on U10-29, which is the signal [HFLT].

Port 4 is used by timer 2. The first five lines of Port 4 are used by timer T2 to compare and set/ reset outputs on a match with timer T2. In our case, these five lines are [DARK] on U10-7, [KICK] on U10-8, [MTRGATE] on U10-9, [SOURCEON] on U10-10, and [NVCS] on U10-11. The other three lines in Port 4 are used to compare and toggle outputs on a match with timer T2. These three lines are [POTCS] on U10-12, [ADCS] on U10-13, and [EECS] on U10-14.

Port 5 consists of eight analog-to-digital converter inputs. Only six lines are used: [VSIG] on U10-1, [TEMP] on U10-68, [SOURCE] on U10-67, [+BIAS] on U10-66, [HEATER] on U10-65, and [PRESSURE SENSOR] on U10-64. Port 5 receives controls signals for its closed loop operations. [HEATER] is the feedback for [HEATPWM]. [SOURCE] is the feedback for [SOURCEON], and [+BIAS] is the feedback for [BIASPWM]. U10-29 is an input which monitors the [HFLT] line. When [HFLT] is high, it shuts down the [HEATPWM] signal. U10-68 monitors the sensor temperature via the [TEMP] signal.

The Address Latch Enable line, [ALE], is on U10-48. It latches on the low byte of the address during accesses to external memory. It is activated every six oscillator periods. During an external data memory access, one ALE pulse is skipped. The Program Store Enable line, [PSEN\], is on U10-47. When it is low, it reads strobe to external program memory. The PROM, U16, and the octal latch, U11, work in concert with these two lines to provide the microcontroller, U10, with proper instructions.

U10 also performs the task of controlling the A/D converter, serial EEPROM (U5), and the digital potentiometer (U2). The A/D converts the [VSIG] information, which is the CO_2 data, into 10-bit serial information, which is then supplied to the microcontroller at U10-21 as [I2CDAT]. [VSIG] also supplies the microcontroller at U10-1, and is used as a signal reference.

The serial EEPROM (U5) contains the sensor probe compensation information and is programmed by the factory. During CO_2 start-up, this information is placed on the serial bus [I2CDAT], and is selected by the signal [NVCS].

8.3.7 Watchdog Timer

The watchdog timer (U19) is used to reset the microcontroller (U10) if it becomes stuck or inactive. It is strobed continually by the signal [TXD], which originates on the CO_2 Processor Board. If the watchdog is not strobed once every 1.2 seconds, [RESET] and [RESET\] become active, resetting the microcontroller.

The watchdog timer also functions as a power monitor. If the supply voltage (+5 VDC) falls below 4.5 VDC, [RESET] and [RESET\] become active, causing the microcontroller to halt operation until the supply voltage returns to normal.

8.3.8 Regulators/Converters

There are four voltages generated on the CO_2 Board, which are derived from the +5 VA voltage and the -15 VISO voltage. U14, U12, and U9 are DC to DC voltage converters.

The voltage level, [-15VISO], is converted to -30 V by the CMOS voltage converter, U14. The -30 V is again converted to -45 V by the CMOS voltage converter, U12. The -45 V is used to bias the opto-isolator, U13, which produces the [-BIAS] signal. D5 blocks any positive voltages from entering and damaging U12. D4 is a 36-volt zener diode, which brings the -45 V line down to -36 VDC, to be used in the -BIAS circuit on the sensor head.

U9 is a voltage inverter, which utilizes the +5 VA at its input, and outputs -5 VA, which is also used on the sensor head.

U3 is a reference voltage generator. It supplies a voltage of about 4.75 VDC to its output at U3-6, [VREF], based on the voltage divider, R2 and R3, at U3-5.

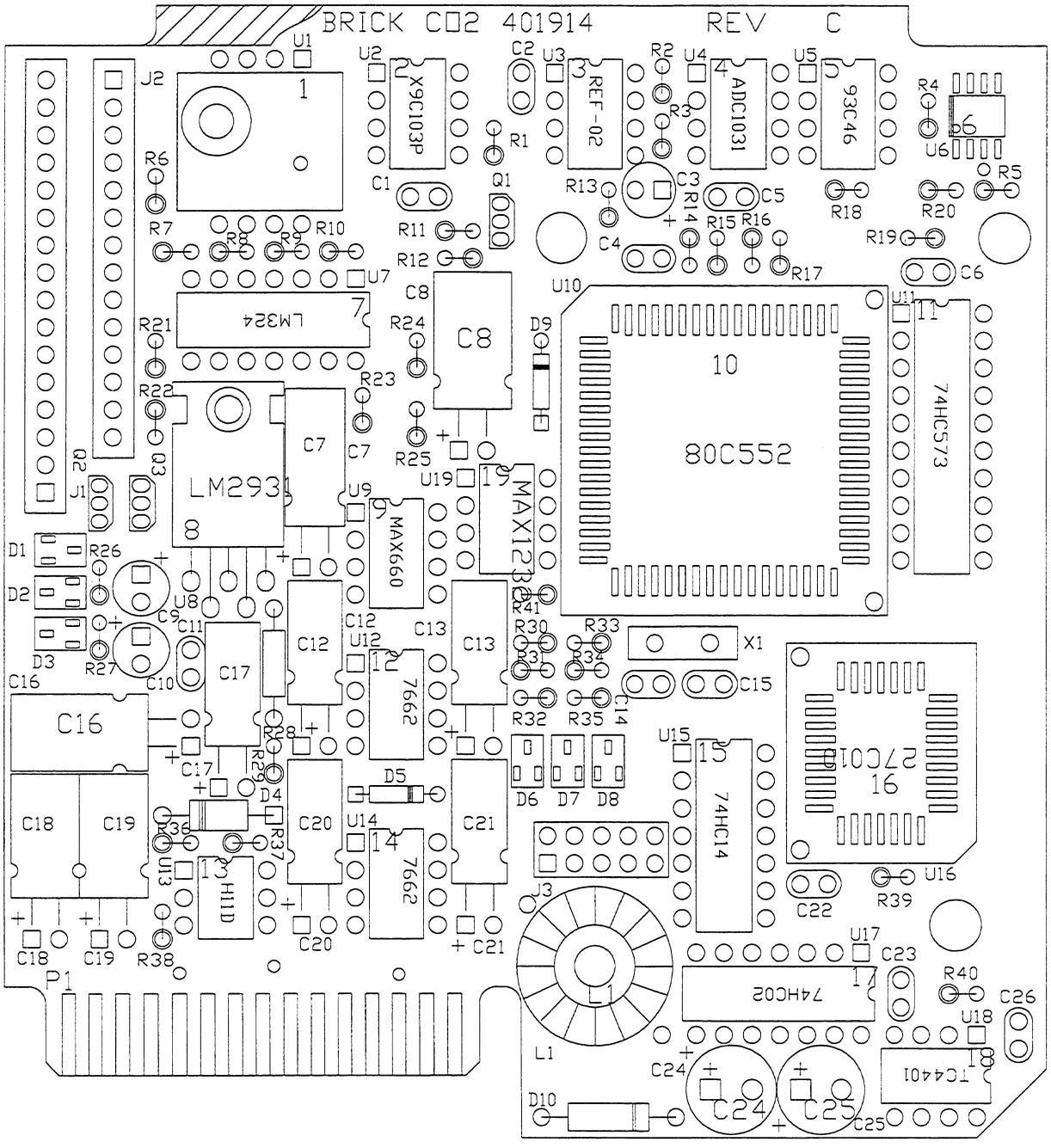


Figure 8-3: CO_2 Board Layout

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Figure 8-4: CO_2 Board Schematic

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8.4 CO_2 Processor Board

The CO_2 Processor board acts as an interface between the main CO_2 board and the ESCORT II's main CPU board (see Chapter 4). This board is attached directly to the CO_2 main board and is connected by J1 (CO_2 Processor Board) to J3 (main CO_2 Board).

A 64180 MPU (U4) is employed in conjunction with a 128K EPROM (U3) and a 32K Static RAM (U5). The signal [CLKOUT] is the 8 MHz output of the MPU and may be measured at U4-68. That signal is then routed into U1A-3 and is divided by two producing a 4 MHz square wave at U1A-6. This 4 MHz signal is now referred to as [UP] and serves as an input to U2-5, which is an Up/Down Counter. The [UP] signal gets divided by thirteen to produce an output of approximately 307.69 kHz at U2-12, referred to as [LOAD]. The [LOAD] signal is then used for the clock input to U1B-11. U1B divides [LOAD] by two for the output signal [CKA1] which is approximately 153.8 kHz and is utilized as a signal baud rate generator.

Communication to the main CO_2 board is accomplished by the signals [TXD] and [RXD], (U4-51 & U4-53 respectively) at a baud rate of 9600. Communication to the ESCORT II main CPU board is done with the signals [CPU_TXI] and [CPU_RXI] (U4-48 & U4-49 respectively).

The signal [TIMETIKI] maintains synchronization in the Multiparameter Module (MPM) and is shared by all parameter boards within the MPM. [TIMETIKI] is the isolated version of [TIMETIC] whose frequency is equal to four times (4X) the AC line frequency. A typical 60 Hz system produces a [TIMETIC] frequency of 240 Hz while a 50 Hz system produces a [TIMETIC] frequency of 200 Hz.

8.5 CO_2 Processor with Cardiac Output Board

If the ESCORT II is equipped with both the CO_2 and Cardiac Output options, then the entire CO_2 Processor capability is embedded in the Cardiac Output Board with minor modifications. See Chapter 9 for details on Cardiac Output.

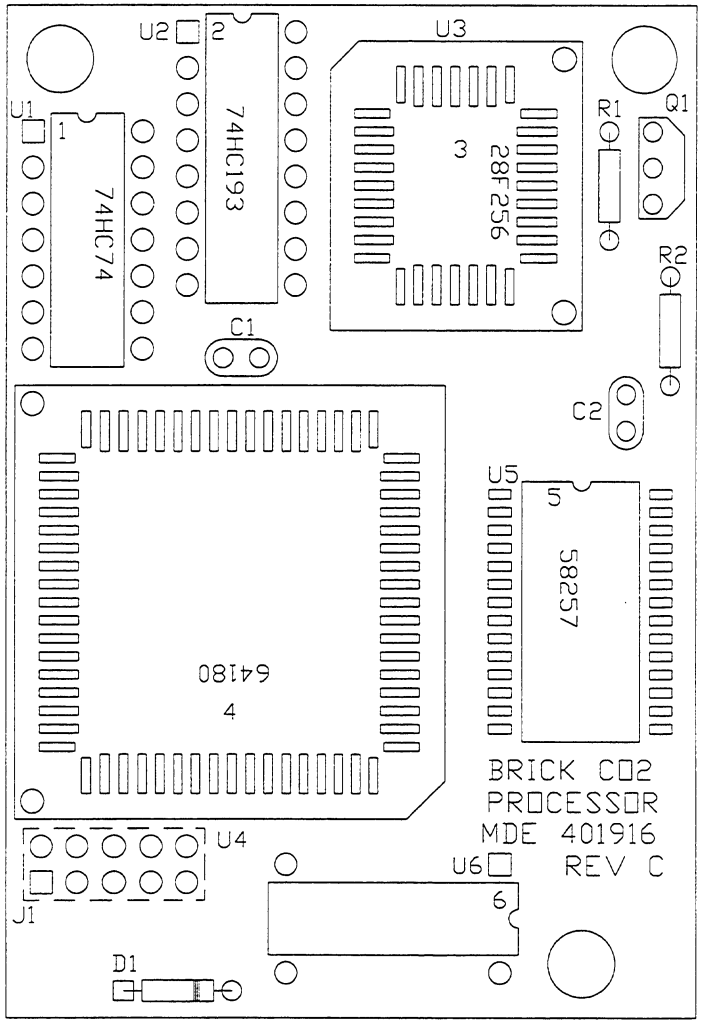

Figure 8-5: CO_2 Processor Board Layout

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Figure 8-6: CO_2 Processor Schematic

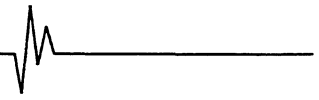

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Table 8-1: Parts Listing, PCBA P/N 401915-0000, CO_2 Board (1 of 3)

MDE Part Number	Description	Quantity	Reference
352100-0104A	CAP, .1UF,50V,10%,RAD,X7R TAPE & REEL	9	C1, 2, 4, 5, 6, 11, 22, 23, 26
352100-0220A	CAP, 22PF,50V,10%,RAD,NPO EDPT TAPE & REEL	2	C14, 15
352200-0476A	CAP, 47UF,25V,RAD,ELECT 2.5mm LEAD SPACE	2	C18, 19
352201-0106A	CAP, 10uF,20%,50V,LOW ESR,RAD,5x11mm,ELECT	1	C17
352201-0106A	CAP, 10uF,20%,50V,LOW ESR,RAD,5x11mm,ELECT	4	C12, 13, 20, 21
352201-0107A	CAP,100UF,10V,RAD,ELECT,.197X.433 CS 2mm LD BULK	1	C7
352201-0337A	CAP, 330UF,16V,ELEC,RAD 3.5mm LEAD SPACE	2	C24, 25
352202-0477A	CAP, 470UF,10V,20%,6.3mmx11mm,RAD,ELECT	2	C8, 16
352400-0105A	CAP,1UF,50V,20%,RAD,TANT, MAX:HT .28; O.D. .16 T&R	1	C3
352400-0106A	CAP, 10UF,25V,20%,RAD,TANT	2	C9, 10
354000-0304A	CONN, 72-PIN,F,.1 CTR,D-ROW SOLDER SNAP-AWAY	5	J3
356000-0027A	XTAL, 11.059 MHZ,LOW PROFILE,HC495 PKG	1	X1
358100-0145A	SCR, 6-32x1/2~LG,NYL,FLT SLT HD 82DEG	1	-
360500-0130A	NUT, HEX,NYLON,6-32	1	-
360500-0141A	STDOFF, 4-40 x 3/16DIA x 5/16LG AL SWAGE GOLD IR	3	-
364000-0057A	IC, LM324, LINEAR	1	U7
364000-0163A	IC, 74HC02	1	U17
364000-0169A	IC, 74HC14	1	U15
364000-0213A	IC, WATCHDOG,8-PIN DIP	1	U19
364000-0254A	IC, 80C552,MICROCONTROLLER,8-BIT,PLCC,16 MHZ	1	U10
364000-0255A	IC, H11D4,OPTO-ISOLATOR,HI VOLTAGE	1	U13
364000-0256A	IC, 74HC573J,OCTAL LATCH,TRI-STATE OUTPUT,DIP	1	U11
364000-0257A	IC, LM2931ACT REGULATOR	1	U8
364000-0258A	IC, ADC1031BIN,A TO D CONVERTOR,10 BIT SERIAL I/O	1	U4
364000-0259A	IC, REF-02CZ,VOLTAGE REF/TEMP XDUCER	1	U3
364000-0260A	IC, ICL7662CPA,CMOS VOLTAGE CONVERTER	2	U12, 14
364000-0261A	IC, TC4401CPA,6 AMP,MOSFET DRIVER,OPEN DRAIN	1	U18
364000-0262A	IC, 93CS46N,EEPROM,1024 BIT SERIAL 8 PIN DIP	1	U5
364000-0264A	IC, MAX660CPA,CMOS VOLTAGE CONVERTER	1	U9

Table 8-1: Parts Listing, PCBA P/N 401915-0000, CO_2 Board (2 of 3)

MDE Part Number	Description	Quantity	Reference
364000-0265A	IC, X9C103P,DIGITAL POT	1	U2
364000-0278A	S*IC, 1 MEG,UNSECT FLASH PROM PLCC 32,SMD	1	U16 - NEEDS PROGRAM
364000-0291A	S*IC, LM393N M08A DUAL VOLT COMPARATOR SMD	1	U6
365000-0168A	S*SKT, 68-PIN,LOW PROF,PLCC W/ LOCATING POSTS,SMD	1	SU10
365000-0232A	S*SKT, 32-PIN,LOW PROF,PLCC W/ LOCATING POSTS,SMD	1	SU16
370101-0102A	RES, 1K,1/8W,5%,CF TAPE & REEL	2	R12, 40
370101-0103A	RES, 10K,1/8W,5%,CF TAPE & REEL	10	R11, 14, 15, 19, 37, 38, 39, 41, 42, 43
370101-0105A	RES, 1M,1/8W,5%,CF TAPE & REEL	1	R29
370101-0201A	RES, 200,1/8W,5%,CF TAPE & REEL	3	R30, 31, 32
370101-0272A	RES, 2.7K,1/8W,5%,CF TAPE & REEL	4	R13, 33, 34, 35
370101-0472A	RES, 4.7K,1/8W,5%,CF TAPE & REEL	2	R4, 24
370101-0473A	RES, 47K,1/8W,5%,CF TAPE & REEL	1	R25
370101-05R0A	RES, 5,1/8W,5%,CF,TAPE & REEL	2	R26, 27
370101-8253A	RES, 82.5K,1/8W,5%,CF,TAPE & REEL	1	R6
370200-15R0A	RES, 15,1/4W,1%,MF,TAPE & REEL	1	R28
370202-1002A	RES, 10K,1/8W,1%,MF TAPE & REEL	1	R1
370202-1003A	RES, 100K,1/8W,1%,MF TAPE & REEL	2	R8, 22
370202-1782A	RES, 17.8K,1/8W,1%,MF TAPE & REEL	1	R20
370202-2003A	RES, 200K,1/8W,1%,MF TAPE & REEL	2	R9,21
370202-3483A	RES, 348K,1/8W,1%,MF TAPE & REEL	2	R7,23
370202-3571A	RES, 3.57K,1/8W,1%,MF TAPE & REEL	1	R2
370202-3741A	RES, 3.74K,1/8W,1%,MF TAPE & REEL	1	R3
370202-4021A	RES, 4.02K,1/8W,1%,MF TAPE & REEL	1	R17
370202-4022A	RES, 40.2K,1/8W,1%,MF TAPE & REEL	1	R18
370202-4222A	RES, 42.2K,1/8W,1%,MF TAPE & REEL	1	R5
370202-4751A	RES, 4.75K,1/8W,1%,MF TAPE & REEL	1	R10
370202-6041A	RES, 6.04K,1/8W,1%,MF TAPE & REEL	1	R36
370202-8061A	RES, 8.06K,1/8W,1%,MF TAPE & REEL (8.05K OK)	1	R16
376000-0033A	XSTR, 2N4401,NPN,GENERAL PURPOSE	2	Q1,2

Table 8-1: Parts Listing, PCBA P/N 401915-0000, CO_2 Board (3 of 3)

MDE Part Number	Description	Quantity	Reference
376000-0034A	XSTR, 2N4403,PNP,GENERAL PURPOSE	1	Q3
378000-0005A	DIO, 1N914,SIGNAL T&R	2	D5, 9
378000-0071A	DIO, 1N5258B,ZENER	1	D4
378000-0072A	DIO, BAV99,HIGH SPEED	6	D1, 2, 3, 6, 7, 8
378000-0073A	DIO, MUR110,RECTIFIER,ULTRA FAST	1	D10
384000-0189A	PRESSURE SENSOR 1210-A-015-A-3S	1	U1
401914-0000	PCB, BRICK PRYON CO2,E2B/E3B REV C (E1678)	1	-
402003-0000	HYBRID, 2300 BENCH AMPLIFIER	1	J2
402004-0000	HYBRID, 2301 ANALOG MOTOR DRIVE	1	J1
402244-0000	INDCTR, TORROID - CO2	1	L1

Table 8-2: Parts Listing, PCBA P/N 401917-0000, CO_2 Processor Board

MDE Part Number	Description	Quantity	Reference
352100-0104A	CAP, .1UF,50V,10%,RAD,X7R TAPE & REEL	2	C1, 2
354000-0317A	CONN, 5-PIN,M,DBL ROW,.1 CTR	1	J1
356000-0021A	XTAL, 16MHZ OSC IC	1	U6
364000-0028A	IC, 74HC74	1	U1
364000-0199A	S*IC, Z80180 8/10MHZ PLCC	1	U4
364000-0209A	IC, 74HC193 UP,DOWN COUNTER	1	U2
364000-0246A	S*IC,51256,SRAM,SMD,32KX8,120NS,SOP28-P-450	1	U5
364000-0278A	S*IC, 1 MEG,UNSECT FLASH PROM PLCC 32,SMD	1	U3 - NEEDS PROGRAM
365000-0168A	S*SKT, 68-PIN,LOW PROF,PLCC W/ LOCATING POSTS,SMD	1	SU4
365000-0232A	S*SKT, 32-PIN,LOW PROF,PLCC W/ LOCATING POSTS,SMD	1	SU3
370101-0101A	RES, 100,1/8W,5%,CF TAPE & REEL	1	R1
370101-0202A	RES, 2K,1/8W,5%,CF TAPE & REEL	1	R2
376000-0019A	XSTR, 2N7000,FET	1	Q1
378000-0005A	DIO, 1N914,SIGNAL T&R	1	D1
401916-0000	PCB, BRICK CO2 PROCESSOR,E2B/E3B REV C (E1600)	1	PCB1

9 Cardiac Output Board

9 Cardiac Output Board

9.1 Overview

The ESCORT II Cardiac Output system consists of a bifurcated Cardiac Output (CO) cable and the Cardiac Output board. The bifurcated CO cable is comprised of two individual cables — one with a blue connector which connects to the thermistor on the catheter to take blood temperatures, the other with a four-pin female plug which connects to an open bath temperature probe or an injectate flow through probe. The Cardiac Output board includes sensitive amplifiers, an analog-to-digital converter, digital signal processing, and voltage regulators.

The process of performing Cardiac Output measurements starts with a certain amount of injectate with a known temperature. The injectate is diluted with an unknown amount of blood inside the right ventricle of the heart. Temperatures are continuously monitored. Cardiac output, right ejection fraction (REF), stroke volume (SV), end systolic volume (ESV) and end diastolic volume (EDV) are calculated using algorithms stored inside the EPROM. The EEPROM stores the calibration coefficients for each channel. Each board has a different set of coefficients. The resistance changes on the probes are converted to voltage values with the analog amplifiers in each one of the three channels. The amplified signals are digitized by an analog-to-digital converter. The software will take these voltage values and process them through algorithms to calculate the temperature values first, and then the CO and REF values.

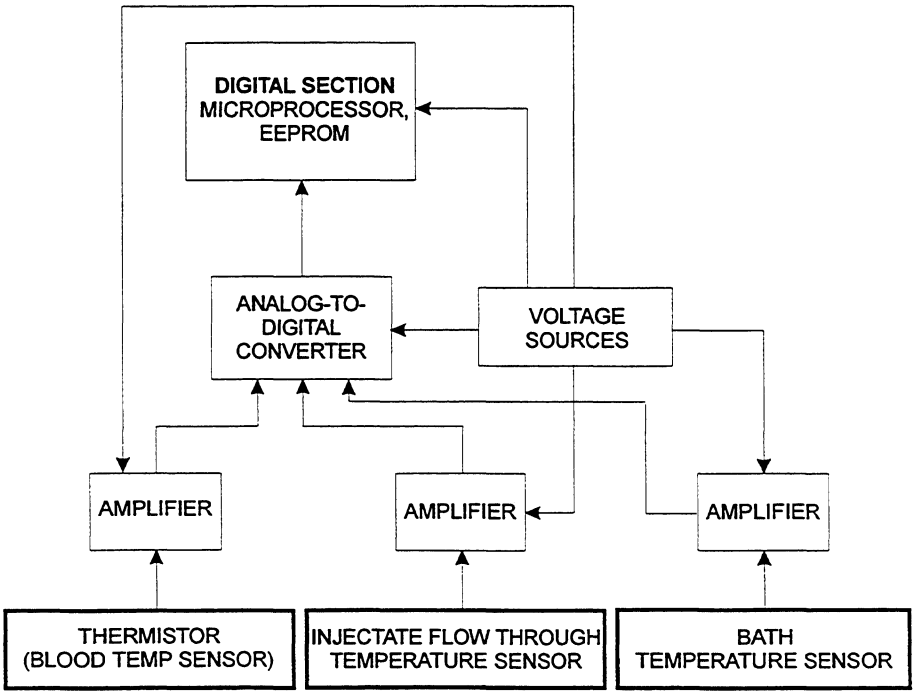

Figure 9-1: Cardiac Output Board Block Diagram

9.2 Bifurcated Cardiac Output (CO) Cable

Sensitive thermistors are mounted at the end of the catheter, the bath probe or the injectate probe. The thermistors are calibrated devices whose resistances vary in known manners with varying temperatures. The blue end of the CO cable is connected to the catheter of the CO system. The metallic connector of the CO cable is connected to a reference bath probe or an injectate sensor probe. The entire CO cable, if found to be defective, must be replaced as an assembly. The pin designations of the CO Patient Cable Connector are defined in Table 9-1.

The bifurcated cardiac output cable used with the ESCORT II is available from Baxter-Edwards, reference P/N COM-2CC.

Table 9-1: CO Patient Cable Connector

PIN NUMBER	COLOR	NAME
1	BLACK	BAB
2	BLACK	THB
3	RED	BAC
4	NOT USED	-
5	SHIELD	AI
6	NOT USED	-
7	BROWN	THD
8	RED	THA
9	ORANGE	THC
10	WHITE	BAA
11 TO 13	NOT USED	-
14	GREEN	FL

9.3 Cardiac Output Board

The CO Board may be summarized into the following sections, each section is listed below and discussed in the following text.

- Thermistor Amplifiers
- Bath Amplifier
- Flow Through or Injectate Amplifiers
- Analog-to-Digital Converter
- Microprocessor Unit
- EEPROMs and Other Memories
- Voltage Regulators

9.3.1 Thermistor Amplifiers

Thermistor signals are picked up by [THA], [THB], and [THD]. [THA] is connected to analog ground. Between the [THB] and the [THD], the resistance values changes depending on the temperature of blood samples taken inside the heart. The changes in resistances also cause changes in voltage input levels of amplifier U8B. High frequency noise is filtered out by 0.1 μF capacitors at the inputs of the operational amplifiers U8A and U8B. U8A is a voltage follower fed by -2.5 VDC. R39 and R30 provide the catheter thermistor of about -0.1 VDC. The diodes D5, D6, D7, D8, D9, D10, and D12 limit the voltage applied to the catheter to 0.7 and -1.4 VDC. R28, R25, and R24 limit the current applied to the catheter to 10 μA. Inside the catheter, a 9.76 kΩ resistor is connected between [THB] and [THA]. This resistor and the thermistor form a voltage divider. This voltage is applied to the non-inverting stage of U8B with a gain of about 1.98. R24 and C25 make a low pass filter with a cutoff frequency of about 10 Hz. The output of U8B is scaled at U4D with a 5 VDC in order to match the channel 1 input range of U5, the sigma delta analog to digital converter, which requires a signal amplitude between 0 and 5 V. U4D provides a voltage gain of about 70. The amplified output goes to the analog-to-digital converter U5-7.

9.3.2 Bath Amplifier

Bath temperatures are sensed by the temperature probe. The temperatures are converted to resistance values at [BAA], [BAB], and [BAC]. The resistance values change the voltage levels at the input of the operational amplifier U4B, which has a voltage gain of about 38. The bath probe, connected between [BAB], [BAA], and [BAC], is part of a feedback network of U8D fed by -2.5 VDC through R40. The output of U8D is scaled at U4C with -2.5 VDC in order to match the channel 3 input range of U5, the sigma delta analog to digital converter, which requires a signal amplitude between 0 and 5 V. The output of U4B goes to the analog-to-digital converter U5-9.

9.3.3 Flow Through or Injectate Amplifiers

U8C and U8D are flow through amplifiers. The flow through probe, connected between [FL] and [BAB], is part of a feedback network of U8C fed by 5 VDC through R34. The signal [FL] is connected to the flow through probe, which sends a constant current through this port and the signal [BAB]. Whenever there is a temperature change, it will cause a voltage change at the output of the U8C. The output of U8C is scaled at U4B with 5 VDC in order to match the channel 2 input range of U5, the sigma delta analog to digital converter, which requires a signal amplitude between 0 and 5 V. The signal [BAB] is connected to the bath temperature probe, which has a different constant current flowing through [BAB], [BAA], and [BAC]. A change in temperature will cause a voltage change at the output of U8D.

9.3.4 Analog-to-Digital Converter

U5 is a three-channel, gain programmable sigma delta A/D converter with bidirectional serial interface. The MODE line of the converter is tied to ground, therefore, the internal serial clock, SCLK, at U5-1 is in external clocking mode, and the SCLK line acts as an input. The signal, [SCLK_OUT], originates from the Gate Array Logic (GAL), U6. This signal contains the clocks needed to run the cardiac output acquisitions and calculations and is input to the A/D at U5-1. The master clock signal MCLKIN, at U5-2, is a 2 MHz clock pulse train, which originates from the GAL (U6-20). SYNC\ (U5-5) and STNBY\ (U5-11) are pulled up to 5 volts. DRDY\ (U5-21) is a logic output. A falling edge indicates that a new output word is available for transmission. DRDY\ will return high upon completion of transmission of a full output word. [RFS\] on U5-20, derived from U6-23, is the line for Receive Frame Synchronization. In our application, if this line goes low, the serial data output SDATA (U5-22) becomes active. [TFS\] on U5-19, derived from U6-21, is designed for Transmit Frame Synchronization. Active low logic input is used to write serial data to the device. It must go low before the first bit of the data word is written to the A/D. U5-4, the Address Input (A0), is tied to U5-19 [TFS\]. If U5-4 is low, reading and writing goes to the control register of the device. If U5-4 is high, access goes either to the data register or the calibration register of the device. U5-22 serial data, SDATA, can be either input or output. If it acts as an input, then it writes either to the control register or to the calibration register. If it acts as an output, serial data is accessed from the control register, calibration register, or the data register. During a read operation, serial data becomes active after [RFS\] goes low. During a write operation, valid serial data is expected on the rising edges of SCLK when [TFS\] is low.

The sampling rates are programmable: two channels at 12 Hz, and one channel at 24 Hz. The input range is from 0 to 5 V. The word length is 16 bits with an accuracy of 0.000644° C.

9.3.5 Microprocessor Unit

The microprocessor (U3) is a Hitachi HD64180 chip or equivalent which is pin-for-pin compatible with the Zilog Z8S180 microprocessor. It runs on an external crystal resonator of about 16 MHz at U3-3 and U3-4. It also provides an 8-MHz clock to U3-58, which is also known as CLK0. U3 pins 14 to 22 output the low-byte address lines [A0 - A7]. U3 pins 23 to 30 output the high-byte address lines [A8 - A15]. U3-31 outputs [A16], which is connected to the EPROM, U15-2. U3-32 outputs [A17], which is connected to the GAL at U6-4. U3-7, the BUSREQ\ line, and U3-5, the WAIT\ line, are tied to +5 VISO. U3 pins 37 to 44, [D0 - D7], constitute an 8-bit bidirectional data bus, used for the transfer of information to and from I/O and memory devices. The data bus enters the high impedance state during reset and external bus acknowledge cycles. U3-9, NMI\, the non-maskable interrupt, is tied to +5 VISO. U3-10, [TIMETIKI], is the maskable interrupt request 0, which provides the time base for software synchronization. This signal comes from the main CPU board of the ESCORT II. The processor acknowledges this interrupt request with an interrupt acknowledge cycle. U3-11, INT1\, the maskable interrupt request 1, is tied to +5 VISO. U3-12, INT2\, the maskable interrupt request 2, is connected to the analog-to-digital converter U5-9, DRDY\. U3-67, RD\ (the read line), is connected to the Flash EPROM, U15-24, the SRAM, U7-22, and the 8K x 8-bit EEPROM, U14-22. Depending on the address selected, the microprocessor may get data from any one of these memory devices. U3-66, WR\ (the write line), is generated by the GAL U6-27. It is connected to the Flash EPROM, U15-31, the 32K SRAM U7-27, and the 8K x 8 bit EEPROM, U14-27. U3-63, [ME\], the memory enable line, is connected to U6-13. It is low when active. U3-52, [IOE\], the input/output enable line, is connected to U6-6. It is also low when active. U3-8, [RST1], is generated by U13-6, which in turn is controlled by [RESETI\], generated from the mother board CPU. U3-51, [TXD], transmit data 1, outputs ASCI channel data to P2 header pin 1. Transmitted data changes are with respect to the falling edges of the transmit clock. U3-54, [CKA1], is the transmit and receive clock for the synchronous channel. U3-48, [CPU_RXI], outputs data to the motherboard CPU from the ASCI channel of the processor, and it is connected to P1 cardedge pin 15. U3-49, [CPU_TX1], receives data from the motherboard CPU, and is connected to P1 cardedge pin 17.

The [CPU_TX1] and [CPU_RX1] signals are serial communications signals (Dbus Interface) between the CO parameter and the main CPU board of the ESCORT II monitor.

9.3.6 EEPROMs and Other Memories

The CO board contains a 128K Flash EPROM (U15), an 8K x 8 bit EEPROM (U14), a 32K static RAM (U7), and an GAL 6001 (U6) for dedicated cardiac output algorithms and calibration coefficients. The Flash EPROM contains data from address locations 00000 to 1FFFF hexadecimal, while the SRAM takes in data from address locations 20000 to 27FFF hexadecimal. Under program control, these memory devices supply data to the motherboard CPU and deliver proper information to the ESCORT II display screen.

9.3.7 Voltage Regulators

+15VISO is delivered by the P1 cardedge pins 23, 24 and 25. The +15 VDC line is connected to the voltage regulator U12 input. The voltage is regulated to +8 VDC, which is further regulated down to +5 VDC by U10. -15VISO is also delivered by the P1 cardedge pins 21 and 22. The -15VDC is connected to the negative regulator U9 input, which is regulated down to -5 VDC. The -5 VDC, together with the +5 VDC from U1 is divided down to -2.5 VDC by U4A. The -2.5 VDC supplies the inputs to U8A and U8D.

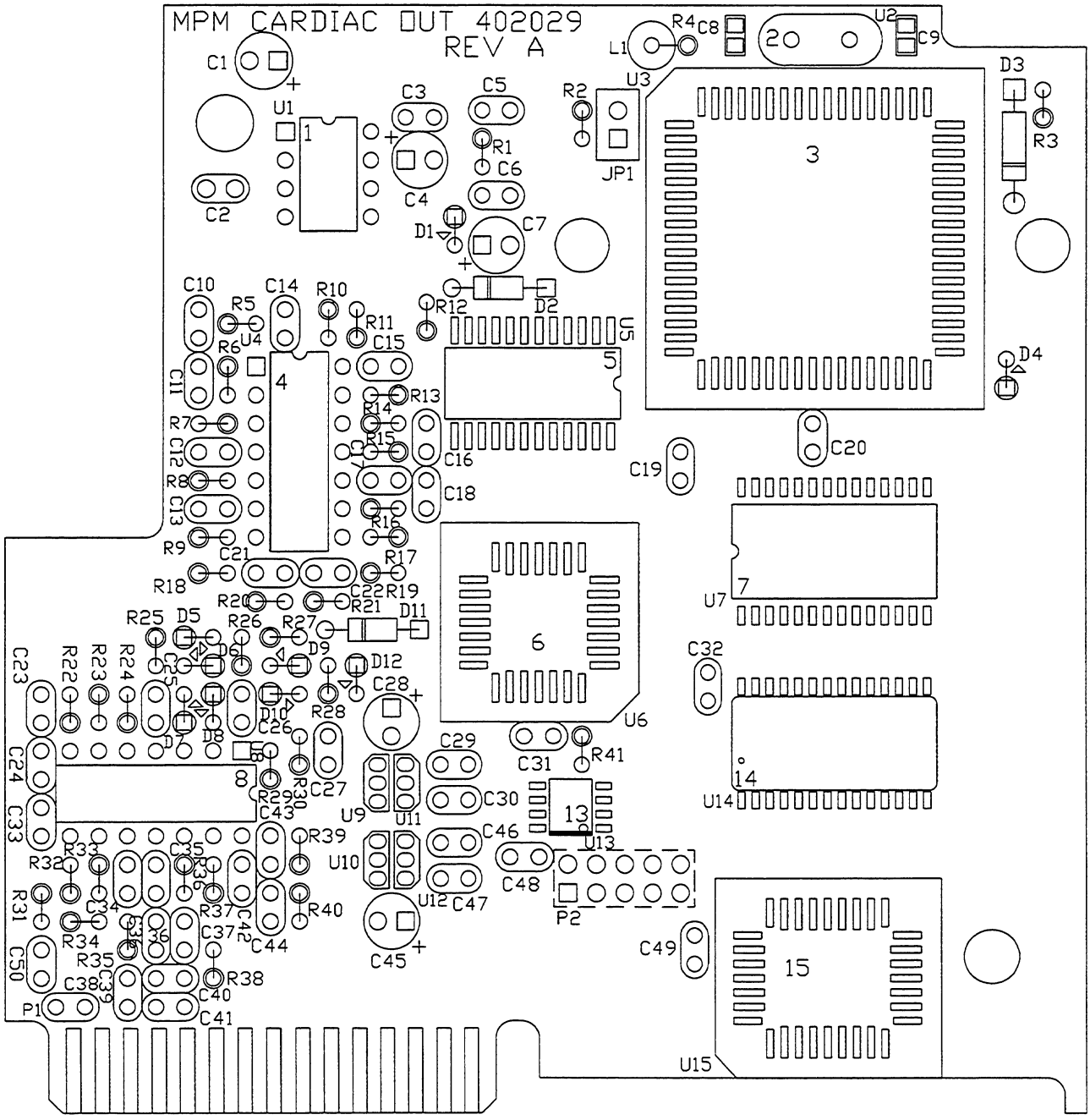

Figure 9-2: CO Board Layout

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Figure 9-3: Cardiac Output Schematic

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Table 9-2: Parts Listing, PCBA P/N 402030-0000, Cardiac Output Board (1 of 2)

MDE Part Number	Description	Quantity	Reference
352100-0102A	CAP, 1000PF,50V,10%,RAD,X7R TAPE & REEL	5	C15, 18, 23, 26, 37
352100-0103A	CAP, .01UF,50V,10%,RAD,X7R TAPE & REEL	5	C10, 22, 36, 39, 42
352100-0104A	CAP, .1UF,50V,10%,RAD,X7R TAPE & REEL	32	C2, 3, 5, 6, 11, 12, 13, 14, 16, 17, 19, 20, 24, 25, 27, 29, 30, 31, 32, 33, 34, 35, 38, 40, 41, 43, 44, 46, 47, 48, 49, 50
352100-0150A	CAP, 15PF,50V,10%,RAD,NPO EDPT TAPE & REEL	2	C8, 9
352100-0474A	CAP, .47UF,50V,10%,RAD,X7R TAPE & REEL	1	C21
352400-0106A	CAP, 10UF,25V,20%,RAD,TANT	5	C1, 4, 7, 28, 45
354000-0106A	CONN, DBL ROW,STRT,SGL PIN,SNAP-AWAY 36-PINS	2	JP1
354000-0317A	CONN, 5-PIN,M,DBL ROW,.1 CTR	1	P2
356000-0026A	XTAL, 16MHZ, LOW PROFILE, .142IN X .425IN	1	U2
364000-0109A	IC, 78LO5 +5V REG. TO-92 PKG.	1	U10
364000-0110A	IC, 79LO5 ACP -5V REG.	1	U11
364000-0208A	IC, LM79L12ACZ NEGATIVE 12V VOLTAGE REG LOW PWR	1	U9
364000-0237A	IC, Z8S180 18 OR 20 MHZ,PLCC	1	U3
364000-0246A	S*IC,51256,SRAM,SMD,32KX8,120NS,SOP28-P-450	1	U7
364000-0273A	IC, LT1021CCN8-5 PLASTIC DIP 8	1	U1
364000-0274A	IC, LT1079ACN PLASTIC DIP 14	2	U4, 8
364000-0278A	S*IC, 1 MEG,UNSECT FLASH PROM PLCC 32,SMD	1	U15
364000-0288A	S*IC, AD7713AR ANALOG TO DIG CONVRTR SOIC	1	U5
364000-0289A	S*IC, GAL 6001 PLCC	1	U6
364000-0290A	S*IC, HN58C65FP EEPROM SOP	1	U14
364000-0292A	S*IC, MAX1232 WATCHDOG TIMER SOIC SMD	1	U13
364000-0293A	IC, LM78L08ACZ VOLTAGE REGULATOR 8V TO92 LOW PWR	1	U12
365000-0168A	S*SKT, 68-PIN,LOW PROF,PLCC W/ LOCATING POSTS,SMD	1	SU3
365000-0232A	S*SKT, 32-PIN,LOW PROF,PLCC W/ LOCATING POSTS,SMD	1	SU15
365000-0428A	S*SKT, 28-PIN,LOW PROF,PLCC W/ LOCATING POSTS,SMD	1	SU6
370101-0100A	RES, 10,1/8W,5%,CF TAPE & REEL	1	R1
370101-0102A	RES, 1K,1/8W,5%,CF TAPE & REEL	2	R14, 21

Table 9-2: Parts Listing, PCBA P/N 402030-0000, Cardiac Output Board (2 of 2)

MDE Part Number	Description	Quantity	Reference
370101-0103A	RES, 10K,1/8W,5%,CF TAPE & REEL	3	R12, 15, 41
370101-0104A	RES, 100K,1/8W,5%,CF TAPE & REEL	2	R36, 37
370101-0152A	RES, 1.5K,1/8W,5%,CF TAPE & REEL	1	R8
370101-0154A	RES, 150K,1/8W,5%,CF TAPE & REEL	2	R24, 26
370101-0202A	RES, 2K,1/8W,5%,CF TAPE & REEL	1	R27
370101-0204A	RES, 200K,1/8W,5%,CF TAPE & REEL	1	R33
370101-0470A	RES, 47,1/8W,5%,CF TAPE & REEL	1	R4
370101-0470A	RES, 47,1/8W,5%,CF TAPE & REEL	2	R29, 31
370101-0512A	RES, 5.1K,1/8W,5%,CF TAPE & REEL	3	R2, 3, 28
370101-0683A	RES, 68K,1/8W,5%,CF TAPE & REEL	1	R7
370202-1653A	RES, 165K,1/8W,1%,MF TAPE & REEL	1	R25
370202-4993A	RES, 499K,1/8W,1% TAPE & REEL	1	R32
370205-1002A	RES, 10K,1/10W,0.1%,MF	1	R30
370205-1003A	RES, 100K,1/10W,0.1%,MF	5	R5, 11, 19, 20, 22
370205-1023A	RES, 102K,1/10W,0.1%,MF	1	R23
370205-1421A	RES, 1.42K,1/10W,0.1%,MF	1	R13
370205-1822A	RES, 18.2K,1/10W,0.1%,MF	1	R16
370205-2002A	RES, 20K,1/10W,0.1%,MF	2	R35, 40
370205-2003A	RES, 200K,1/10W,0.1%,MF	1	R6
370205-2052A	RES, 20.5K,1/10W,0.1%,MF	1	R17
370205-2103A	RES, 210K,1/10W,0.1%,MF	1	R10
370205-2373A	RES, 237K,1/10W,0.1%,MF	1	R39
370205-2611A	RES, 2.61K,1/10W,0.1%,MF	1	R9
370205-2801A	RES, 2.8K,1/10W,0.1%,MF	1	R18
370205-7503A	RES, 750K,1/10W,0.1%,MF	2	R34, 38
378000-0001A	DIO, 1N270 T&R	1	D3
378000-0005A	DIO, 1N914,SIGNAL T&R	2	D1, 4
378000-0075A	DIO, FDH 333, LOW LEAKAGE D035 PACKAGE	7	D5, 6, 7, 8, 9, 10, 12
378000-0080A	DIO, SD103C SCHOTTKY	2	D2,11
382000-0027A	FERRITE BEADS, .163 OD x .063 ID x .250 HEIGHT	1	L1
402029-0000	PCB, BRICK CARDIAC OUTPUT REV. A(E1820)	1	-

10

Recorder Option

10.1 Overview

Model 20100 and 20300 ESCORT II monitors may be equipped with an optional thermal recorder (Model 20002), see Figure 10-1. All alphanumeric and waveform data displayed on the monitor's screen may be sent to the recorder for printing.

If the recorder option is not included, a non-recorder configuration is installed to fill the recorder cavity in the ESCORT II monitor. The non-recorder configuration is shown in Figure 10-2.

ESCORT II monitors that do not include the Thermal Recorder option may be easily upgraded by replacing the non-recorder assembly with the Model 20002 Thermal Recorder.

Instructions for removing the Recorder Module may be found in Chapter 14, "ESCORT II Modules."

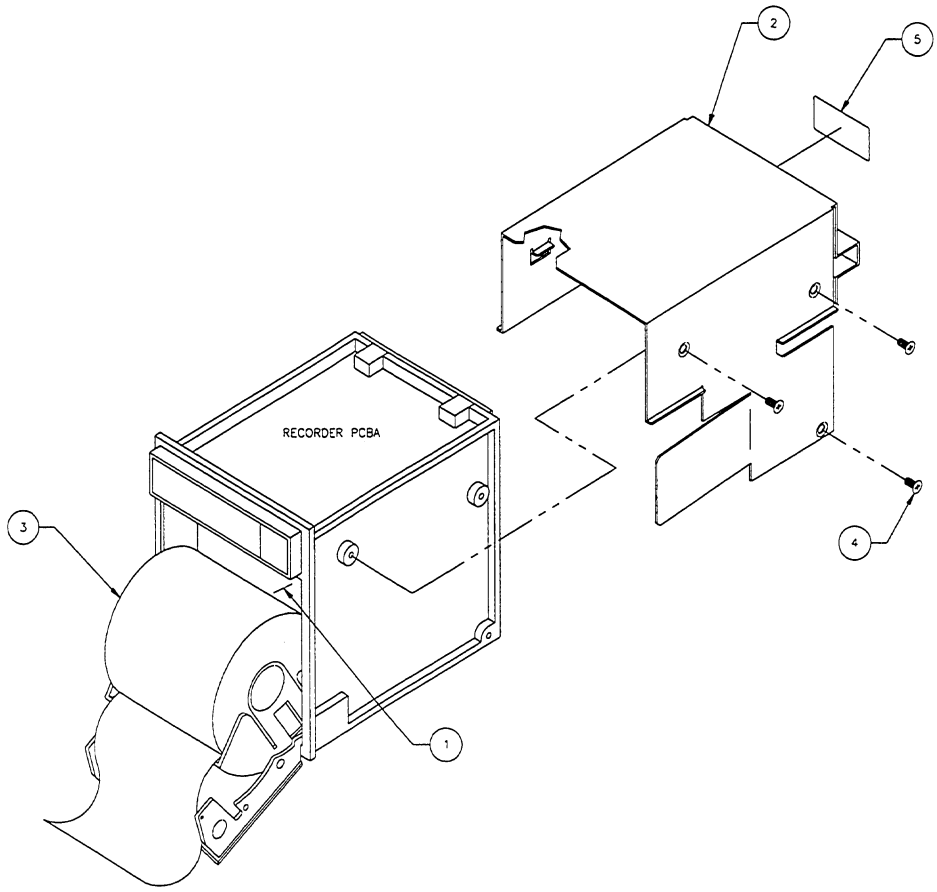


Figure 10-1: Model 20002 Thermal Recorder Option Assembly

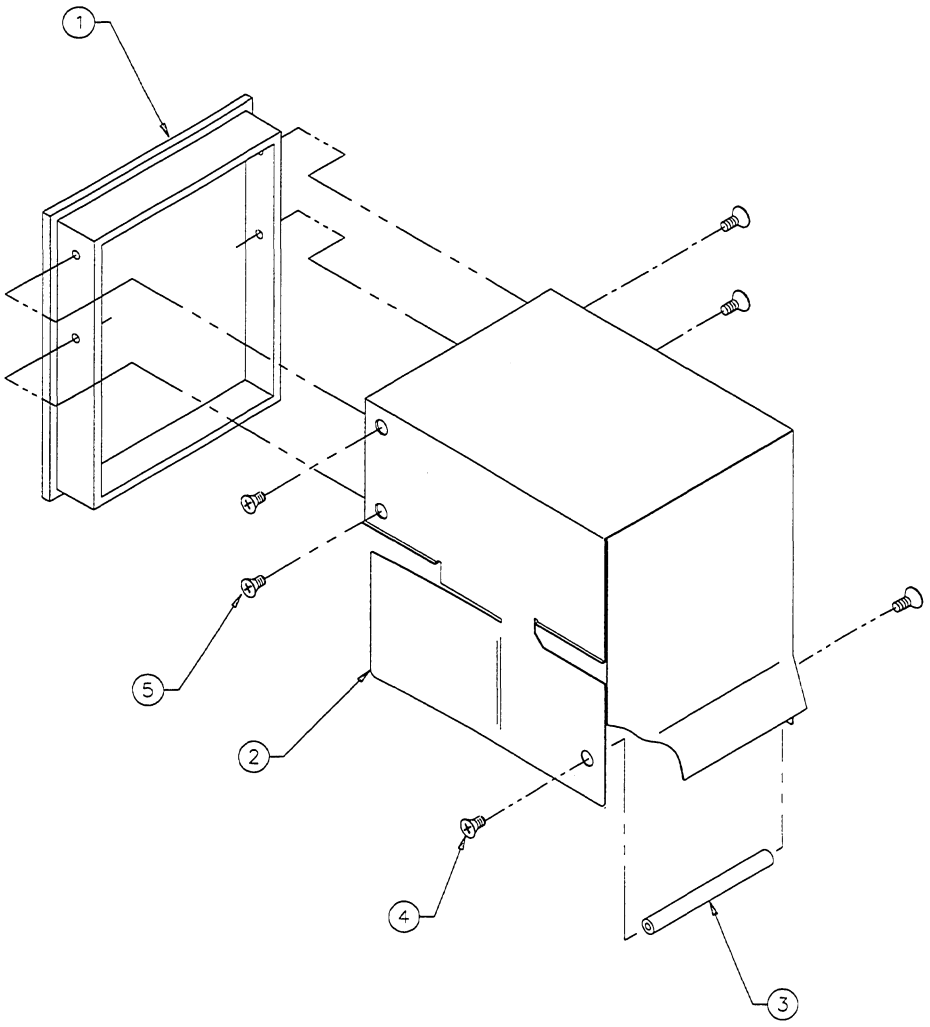
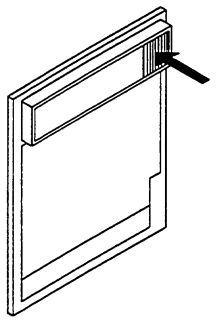


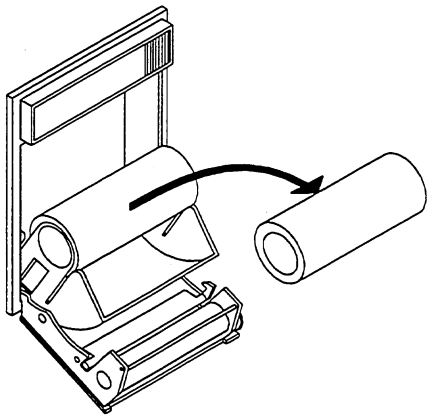
Figure 10-2: Model 20100/20300 Non-Recorder Assembly

10.2 Paper Removal and Replacement

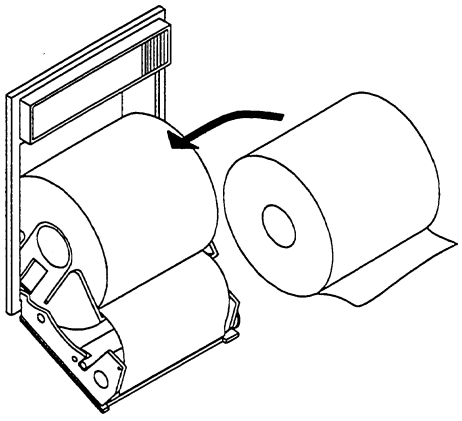
Perform the steps below to remove an empty paper spool and install a new roll of paper.



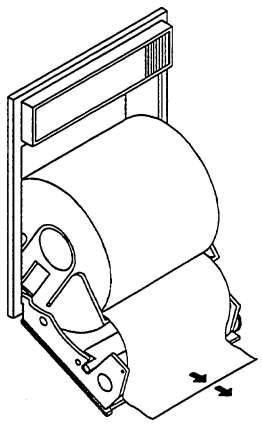
Step 1 - Depress the door release as indicated to open the recorder



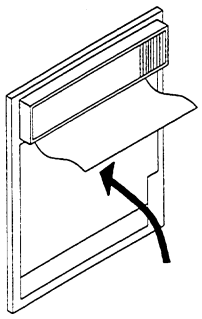
Step 2 - Remove the empty spool as shown



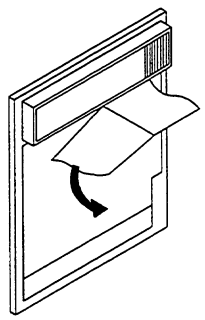
Step 3 - Install the new roll of paper as shown (note orientation)



Step 4 - Pull out 3 inches of paper and position paper between the paper guides



Step 5 - Close the recorder door; insure that the paper remains between the paper guides



Step 6 - Tear excess paper using downward motion as indicated (always tear the paper using this method)

Table 10-1: Parts Listing, Model 20002 Recorder Option Assembly, P/N 500260

MDE Part Number	Description	Quantity	Reference
358100-0133A	SCR, TAPTITE,4 x 3/16~LG,100DEG,FLH PHL STL Zn PLT	3	4
360600-0018A	#4 BENT GROUND LUG	1	7
366000-0008A	THERM.RCDR.PAPER,50MM WIDE, NO GRID, KANZAKI C692	1	3 - TO TEST
366000-0015A	RECORDER, MODEL AR42	1	1
378000-0036A	DIO, 1N5819,1AMP,SCHOTTKY T&R	1	6
399100-0010A	WIRE, BLACK 22GA. PVC, HOOK-UP 5000' MIN PER ROLL	-	8
401682-0000	RECORDER COVER E3B/E2B REV D (E1858)	1	2
401978-0000	LBL, SERIAL #, 1/2~ x 1~,E2B/E3B REV. B(E1612)	1	5

Table 10-2: Parts Listing, Non-Recorder Assembly, P/N 500261

MDE Part Number	Description	Quantity	Reference
358100-0043A	SCR, 4-40 X 3/16,PH,FLTHD,82DEG,S.S. UNDERCUT HEAD	2	4
358100-0119A	SCR, PLASTITE 4 x 3/8~LG,100DEG,FLHPHL STL ZN PLT	4	5
360500-0104A	STNDOFF, 4-40 X 2.625 LG, 1/4 ROUND	1	3
401705-0000	NON-RCRDR COVER PLATE MOLDED E3B/E2B REV C (E1584)	1	1
401869-0000	NON-RECORDER HOUSING - E2B/E3B REV D (E1858)	1	2

Table 10-3: Model 20002 Thermal Recorder Replacement Parts

MDE Part Number	Description
358100-0022A	AR42 CHASSIS
358100-0023A	AR42 DRIVE ROLLER ASSY
358100-0024A	AR42 RECORDER DOOR
358100-0025A	PAPER HOLDER
358100-0026A	AR42 PRINTED CIRCUIT ASSY
358100-0027A	AR42 MOTOR ASSY
358100-0028A	AR42 PRINTHEAD
358100-0029A	AR42 PRINTHEAD BRACKET
358100-0030A	PAPER SENSOR BRACKET
358100-0031A	ACTUATOR
358100-0032A	COVER
358100-0033A	ANTI-STATIC BRUSH
358100-0034A	PRINTHEAD BRUSH
358100-0035A	PIVOT
358100-0036A	PIVOT SCREW
358100-0037A	PRINTHEAD ADJUST SPRING
358100-0038A	EJECTOR
358100-0039A	LATCH
358100-0040A	PAPER GUIDE
358100-0041A	ROLLER SHAFT
358100-0042A	ROLLER GEAR
358100-0043A	SWITCH CABLE ASSY

11 Mechanical Diassembly

11 Mechanical Disassembly

11.1 Overview

This chapter provides the drawings and procedures necessary to disassemble the Model 20100 ESCORT II monitor. Perform these procedures in reverse order to reassemble the monitor.

> **WARNING: High voltages may be present! Use caution when handling electrical parts and assemblies as injury could occur. Technicians should wear a grounding wrist or ankle strap to increase personal safety and to avoid possible damage to the monitor. Read all disassembly instructions prior to performing any removal of parts.**

Figures 11-1 and 11-2 present two different exploded views of the ESCORT II 20100 Monitor. Refer to these figures when disassembling the monitor. Figure 11-3 displays the ESCORT II 20100 interconnection diagram.

11.2 Fuse Holder/Voltage Selector and Fuse Replacement

The fuse holder contains the fuses and the voltage selector for the monitor. Open the door of this holder to replace fuses or to configure the voltage selection block (i.e., 115 VAC or 230 VAC). The present voltage setting can be read through the small rectangular window on the door of the holder. It is recommended that qualified technical service personnel replace fuses or change the voltage selection when necessary.

> **WARNING: For protection against fire, replace fuse only with one of the same type and rating.**

The ESCORT II 20100 requires two identical slow blow 0.8A fuses for 115 VAC operation, or two 0.4A fuses for 220 VAC operation. Ensure that the AC power cord has been disconnected before replacing fuses. Carefully open the door of the fuse holder with a short 1/8" flat screwdriver. Replace the blown or defective fuse with one of the same type and rating. Noting orientation, gently slide the fuse holder back until it locks snugly into its original place. After the fuse replacement, the monitor may be reconnected to AC power.

11.3 Disassembly

For mechanical disassembly, always ensure that the AC power cord has been disconnected from the ESCORT II 100, and that the batteries have been removed. To remove a battery, press the battery lock downward until the battery is released from its slot. Then, gently pull the battery completely out from the slot. Repeat this procedure for the other batteries. See Chapter 14, "ESCORT II Modules," for details on removing batteries.

11.3.1 Outer Shell

Remove the Multiparameter Module (MPM), the recorder module, the battery module, and any add-on modules (e.g., transceiver or telemetry modules) that are installed. See Chapter 14, "ESCORT II Modules," for details.

Using a Phillips screwdriver, remove the four screws located at the rear corners of the unit. Also remove the two Phillips screws adjacent to the MPM cavity. Save the screws and washers for future reassembly. Holding the outer shell, push the ESCORT II 100 out of the outer shell. The unit is now ready for further disassembly.

11.3.2 Power Supply Board Removal

Remove outer shell first.

Disconnect P1, P2, and P3 connectors on top of the power supply board. Remove the two Phillips screws above the fan at the back of the ESCORT II 100. Also remove the two Phillips screws which attach to the back side of the power supply board. Disconnect the J1 connector on the CPU board. The power supply board can now be lifted out of the chassis for replacement or service.

11.3.3 CPU Board Removal

Remove outer shell first, and then remove the power supply board.

Remove the two Phillips screws which connect to the external P11 connector (P1 on CPU board). Likewise, remove the two Phillips screws which connect to the external J8 connector which is labeled as J7 on CPU board. Remove the Phillips screw which mounts to U10 on the back of the heatsink. Similarly, remove the Phillips screw which mounts U20 to the same heatsink. Remove the seven Phillips screws on the four sides of the CPU board. Four of these are grounding screws. Remove the two Phillips screws of the edge connector that normally connects to the battery module. Gently pull the ribbon cable out from the J8 connector on the CPU board. Disconnect the J1 connector from the power supply board. Disconnect the J3 connector from the CRT. Disconnect the J2 connector from the high voltage supply with a pair of long nose pliers. Disconnect the J4 connector from the fan with a pair of long nose pliers. Disconnect the J5 connector from the speaker. Disconnect the J6 connector from the MPM interface board. Disconnect the P2 connector from the recorder. The board is now ready for replacement and service. Save all screws and washers for future reinstallation.

11.3.4 Front Bezel and Recorder Housing Removal

Remove outer shell first.

Remove the two Phillips screws at the back of the recorder housing. Also remove the two Phillips screws on top of the bezel and the two Phillips screws on the bottom of the bezel. Gently disconnect the ribbon cable from the recorder connector. The front bezel and recording housing can now be removed.

11.3.5 High Voltage Power Supply Removal

Remove outer shell, power supply board, front bezel, and recorder housing.

Refer to Figure 11-4, "Chassis Assembly," for location of high voltage power supply. Once the front bezel and recorder housing have been removed, the high voltage supply will be exposed. Disconnect the anode terminal from the CRT. Also disconnect the CRT connector, J3, from the CPU board with a pair of long nose pliers. The high voltage power supply is now ready to be removed with a Phillips screwdriver.

11.3.6 Fan Removal

Remove outer shell first, and then remove power supply board.

Disconnect the fan connector (J4) from the CPU board with a pair of long nose pliers. Remove the two Phillips screws from the opposite corners of the fan. The fan may now be removed from the chassis.

11.3.7 Speaker Removal

Remove outer shell first, and then remove power supply board.

Remove the four Phillips screws from the four corners of the speaker mounting brackets. Disconnect the J5 connector from the CPU board with a pair of long nose pliers. The speaker may now be removed from the chassis.

11.3.8 CRT Removal

Remove outer shell, power supply board, front bezel, and recorder housing.

Disconnect the anode cable of the high voltage supply. Remove the four Phillips screws from the four corners of the CRT. Also disconnect the CRT connector (J3) from the CPU board with a pair of long nose pliers. The CRT is now ready for service or replacement.

11.3.9 Z-Axis Board Removal

Remove outer shell, power supply board, front bezel, recording housing, and CRT.

With the CRT has been removed from the ESCORT II 100, the Z-axis board can be disconnected from the back of the CRT by gently pulling it away from the J1 connector.

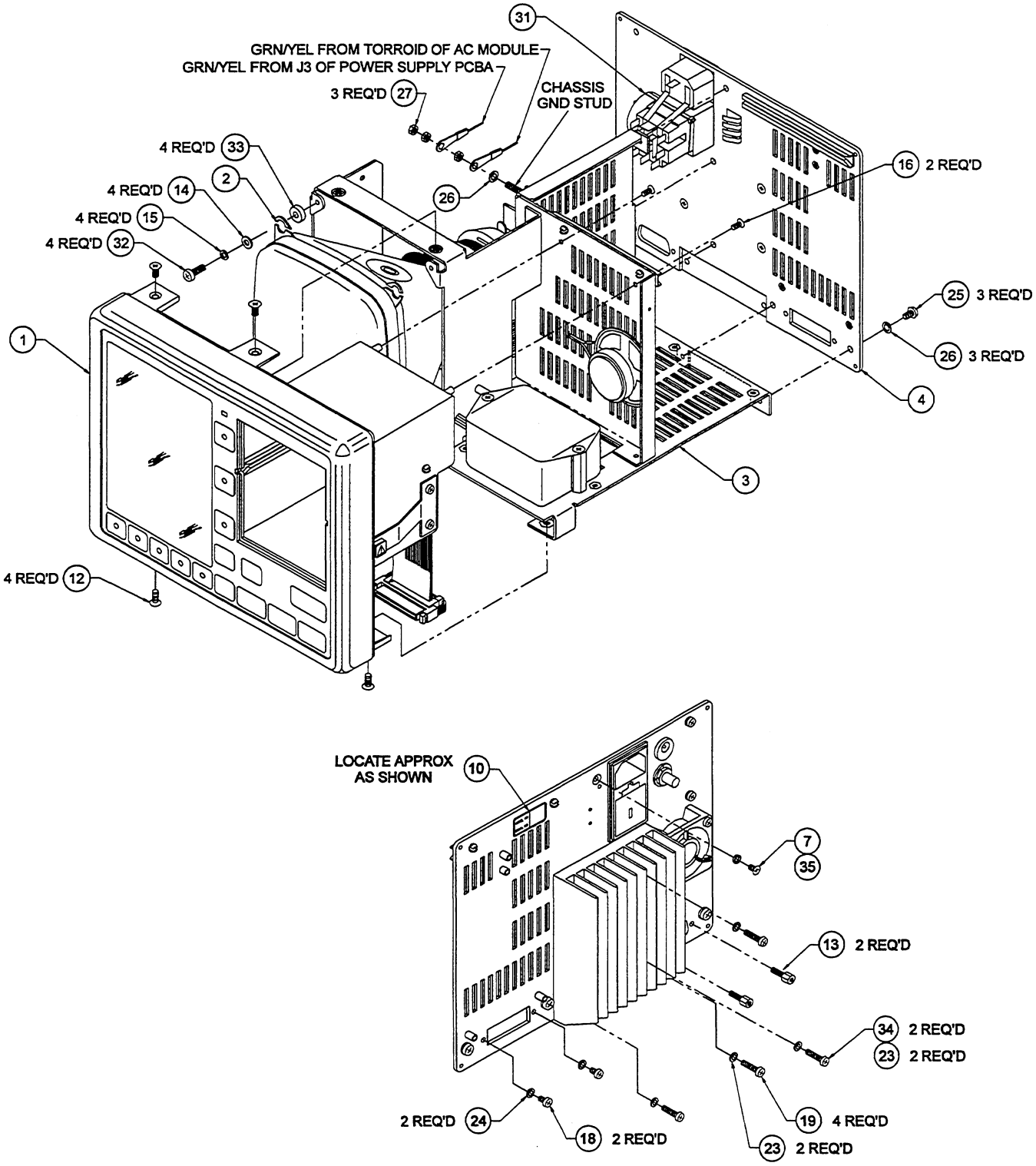


Figure 11-1: Model 20100 - Exploded View (Mechanical Assembly)

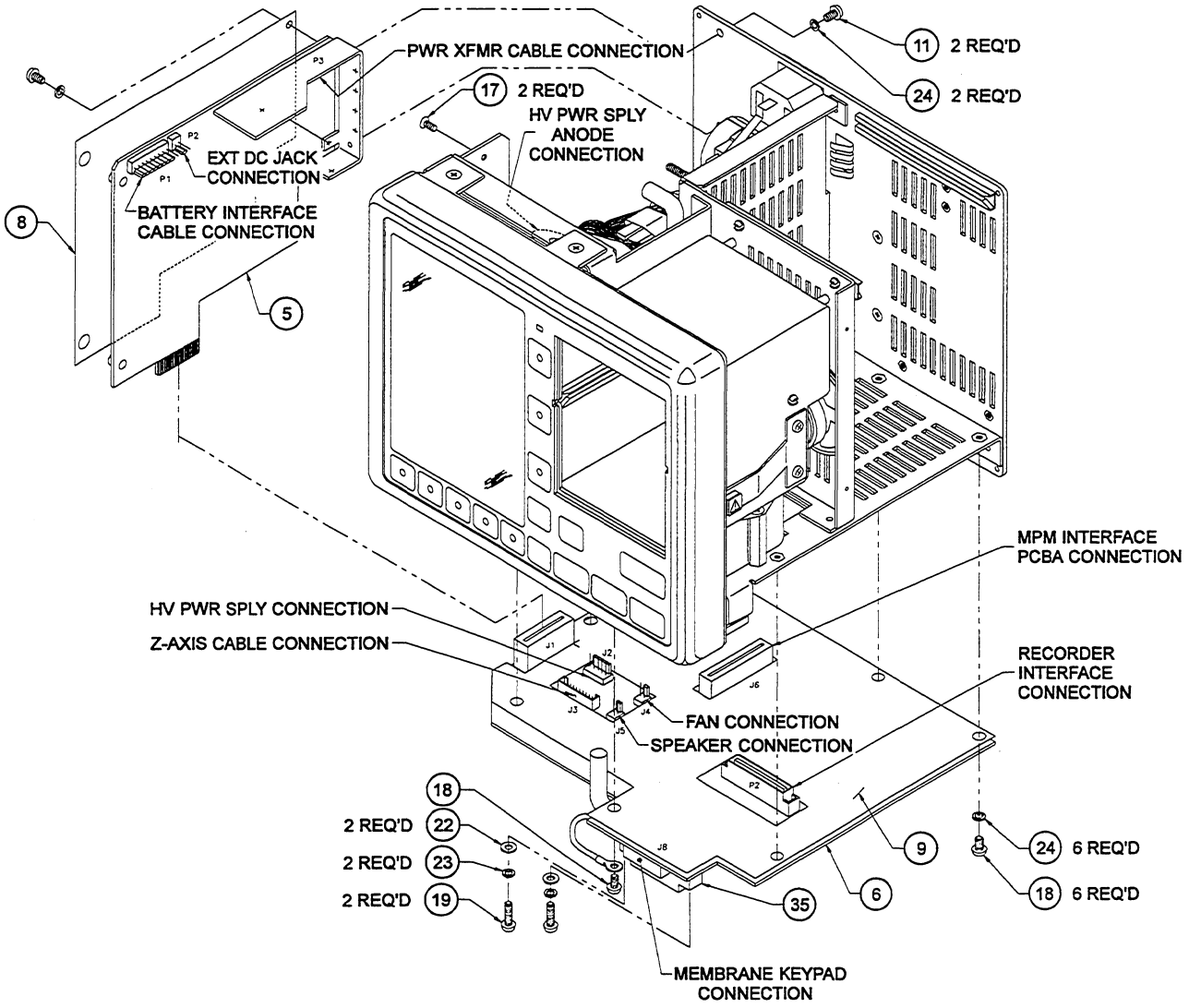
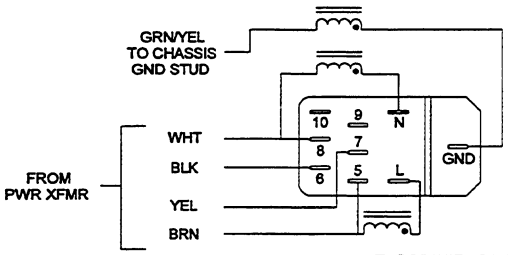
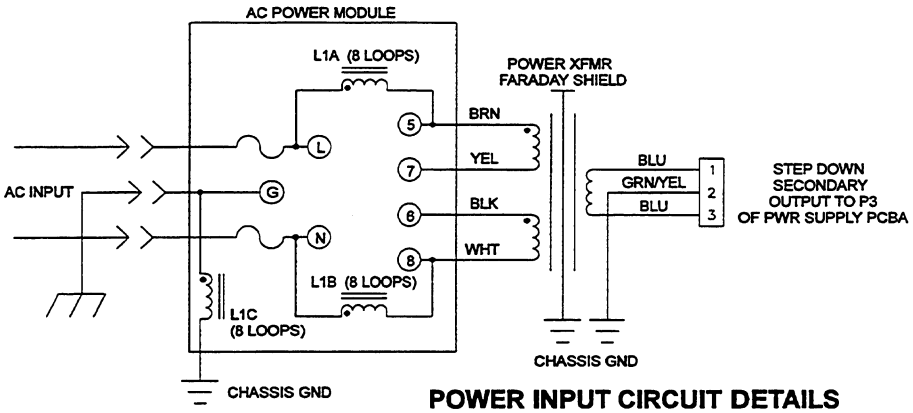


Figure 11-2: Model 20100 - Exploded View (PCBA Location)



POWER MODULE WIRING



POWER INPUT CIRCUIT DETAILS

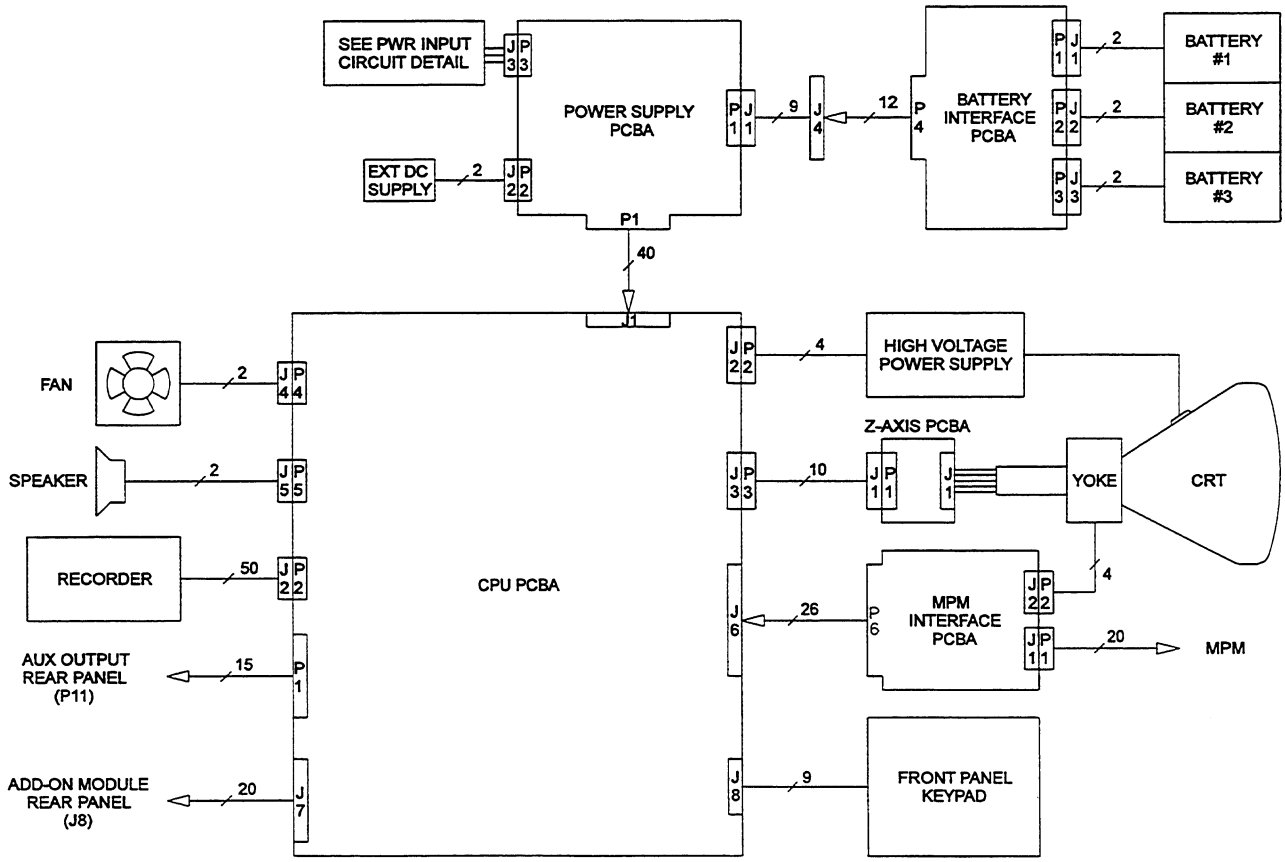


Figure 11-3: Model 20100 - Interconnection Diagram

Table 11-1: Parts Listing, Model 20100 Chassis Assembly P/N 500263

MDE Part Number	Description	Quantity	Reference
358100-0004A	SCR, 4-40 X 3/8,PH FLTHD,SS,100 DEG.	2	16
358100-0010A	SCR, 4-40 X 1/2,PH PNHD ZINC	4	19
358100-0021A	SCR, 4-40 X 1/4,PH FLTHD,100 DEG,ZN	2	17
358100-0036A	SCR, 4-40 X 1/4,PH PNHD,ZINC OR ANY	9	18
358100-0062A	SCR, 6-32 x 1/4, PHL.FLTHD. 100 DEG. S.S.	4	12
58100-0133A	SCR, TAPTITE,4 x 3/16~LG,100DEG,FLH PHL STL Zn PLT	1	7
358100-0134A	SCR, TAPTITE,#4 x 1/4~LG,PHL PNH STL ZN PLATE	2	11
358100-0138A	SCR, TAPTITE,#6 x 1/4~LG,PHL PNH STL ZN PLATE	3	25
358100-0144A	SCR, TAPTITE #6 x 3/8~LG PHL PNH STL ZN PLATE	4	32
358100-0146A	SCR, TAPTITE #4 x 5/8~LG PHLPNH STL Zn	2	34
358200-0004A	WSHR, #4 FLAT STL ZINC,(.125ID,9/32OD,.025THK)	2	22
358200-0006A	WSHR, #6 FLT STL ZINC	4	14
358200-0007A	WSHR, #4 INT TOOTH	10	24
358200-0009A	WSHR, #4 SPLIT LOCK	7	23-CPU
358200-0010A	WSHR, #6 SPLT LCK	4	15-CRT
358200-0018A	WSHR, #6 INT TOOTH STEEL	4	26 - R/P
358200-0031A	WSHR,#4 EXT TOOTH 100DEG COUNTERSINK LCK STLCAD/ZN	1	35
360500-0007A	HARDWARE, SCREWLOCK KIT	2	13
360500-0023A	NUT, #6 HEX,LRG PTRN	3	27
360500-0129A	SPCR, #6 x 1/8~LG x 3/8~DIA AL	4	33
385000-0051A	TY-WRAP, 11.4 IN x 0.14 IN,NYL 6/6 94V-2	1	31
401768-0000	FISH PAPER E2B PWR SPPLY PCBA REV B (E1430)	1	8
401777-0000	PCBA, E2B CPU REV Z (E1868)	1	6
401849-0000	FISH PAPER E2B CPU REV B (E1430)	1	9
401855-0000	PCBA, E2B PWR SPPLY REV J (E1840)	1	5
401951-0000	E2B BEZEL ASSY. REV E (E1858)	1	1
401953-0000	E2B CRT ASSY. REV D (E1842)	1	2
401955-0000	E2B SUB-CHASSIS ASSY. REV E (E1836)	1	3
401958-0000	E2B BACK PANEL ASSY. REV B1(D495)	1	4
401960-0000	E2B BATTERY INTERFACE CABLE ASSY. REV D (E1833)	1	35
401978-0000	LBL, SERIAL #, 1/2~ x 1~,E2B/E3B REV. B(E1612)	1	10

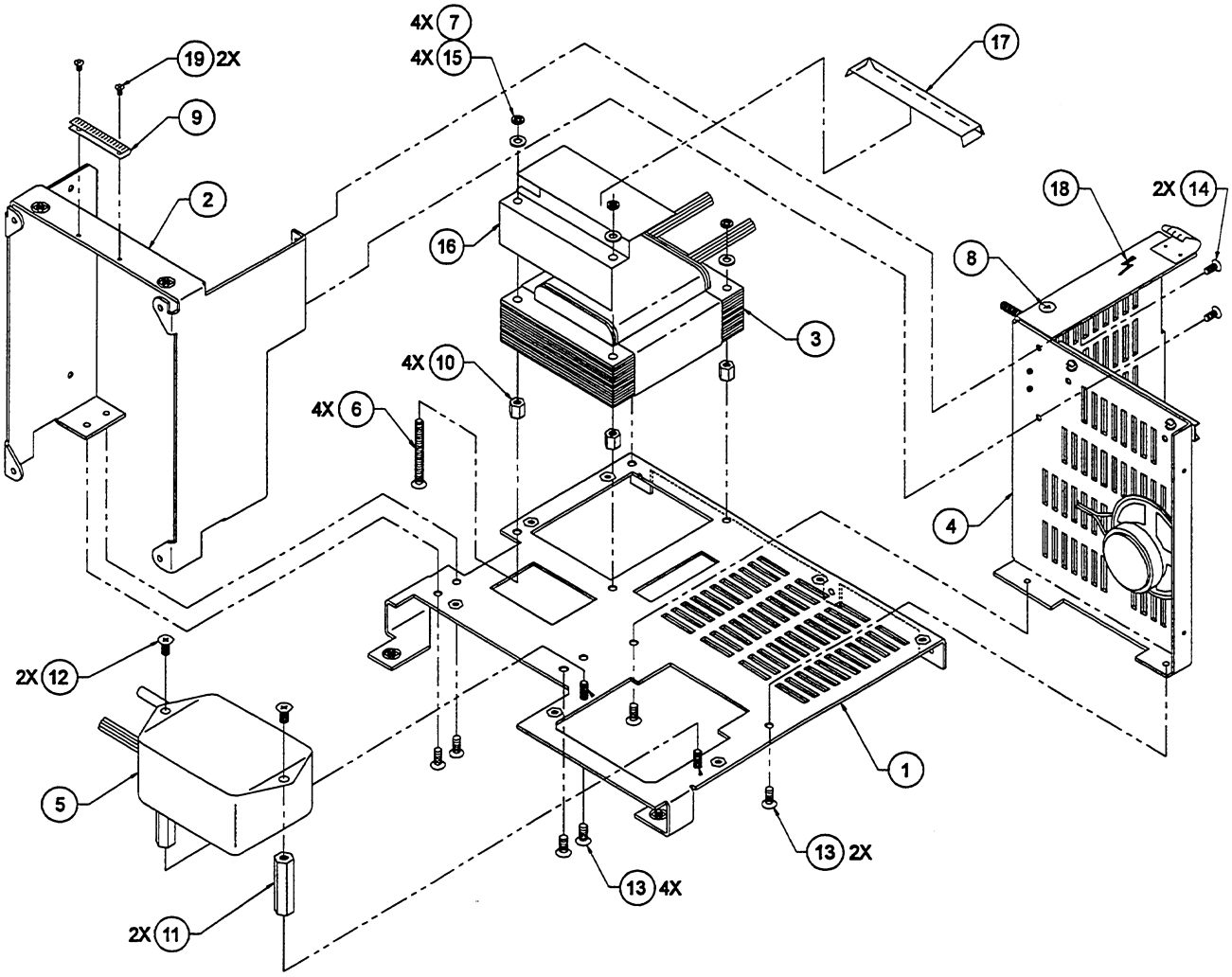


Figure 11-4: Model 20100 - Chassis Assembly

Table 11-2: Parts Listing, Model 20100 Chassis Assembly P/N 401955

MDE Part Number	Description	Quantity	Reference
358100-0062A	SCR, 6-32 x 1/4, PHL.FLTHD. 100 DEG. S.S.	2	12-HVPS
358100-0122A	SCR, 6-32 x 1 3/8~LG,100DEG,FLH PHL STL	4	6 - XFMR
358100-0128A	SCR, TAPTITE,#2 x 3/16~LG,PHL,82DEG,FLH,Zn PLT STL	2	19
358100-0133A	SCR, TAPTITE,4 x 3/16~LG,100DEG,FLH PHL STL Zn PLT	2	14
358100-0139A	SCR, TAPTITE,#6 x 3/16~LG,100DEG,PHLFLH STL Zn PLT	6	13
358200-0051A	WSHR, #6,.15ID x .31 OD x .03THK FLT FIBER	4	15
360500-0023A	NUT, #6 HEX,LRG PTRN	4	7 - XFMR
360500-0091A	STDOFF, 6-32x1/4 LGx1/4 HEX,AL,GOLD IRIDITE	4	10 - XFMR
360500-0114A	STNDOFF, 6-32 x 1 1/8~LG x 1/4~ HEX SS	2	11 - HVPS
382000-0004A	MAGNETIC, PWR SUPPLY, HI VOLT**(FIFO)**REV B(E767)	1	5
385000-0042A	TAPE, KAPTON, INSULATING 3/4 IN	4	17-1 PC=3.5
401745-0000	CHASSIS E2B REV C (E1858)	1	1
401750-0000	CRT MTG BRACKET E2B REV D (E1883)	1	2
401805-0000	STAMP, GROUND SYMBOL	-	8-STAMP USING BLACK
401805-0000	STAMP, GROUND SYMBOL	-	INK
401957-0000	E2B WALL ASSY. REV E (E1883)	1	4
402116-0000	SHIELD, E2B PWR XFMR REV A (E1430)	1	16
402135-0000	E2B POWER TRANSFORMER ASSY REV D (E1812)	1	3
402472-0000	~DANGEROUS VOLTAGE~ SYMBOL STAMP	-	18
402512-0000	E2B EMI FINGER CRT/RCDR TOP REV. A (E1883)	1	9

12 Performance Check

12 Performance Check

12.1 Overview

MDE recommends a yearly performance check to verify all functions on the ESCORT II 100 monitor. Perform only the tests necessary for the options and parameters installed in your monitor. A checklist is included at the back of this section which may be photocopied and completed each time the performance check is done. At the conclusion of the performance check, turn power off and back on again. Ensure that all default settings return.

The following equipment (or equivalent) is necessary to do the performance tests. Refer to the manufacturer's operating procedures for detailed information. All test equipment used should be in good working condition and calibrated, if necessary.

MDE Datasim 6000 Patient Simulator

Resistive 3-lead and 5-lead ECG cables and leads

IEC-601.1 Continuity Tester

ECG shorting plug (All leads shorted together)

IBP shorting plug (All leads shorted together)

TEMP shorting plug (All leads shorted together)

Hipotronics AC Hipot Tester Model HA 3ATC with Hipotronics Safety Switch

Ohmic Instruments, Biomedical Electrical Test Set Model BET-300A

Variac/current box

DC power supply with 3.5 mm connector

Invasive blood pressure cable

NELLCOR PT-2500 simulator and patient cable with finger sensor DS-100A

Dynatech Nevada CuffLink NIBP Analyzer with cuff and hoses

Digimanometer Electro-Diagnostic Model DGM-2 with 250 mL volume cannister

Fogg Temperature Simulator TP400/700

Fogg BP Simulator BP-600

Stopwatch

CO_2 sensor cable with disposable airway adapter

Precision resistance (1%) boxes, two required (used for Cardiac Output testing)

Begin with a thorough visual inspection of the unit. Inspect the power cord for cracks or exposed conductors. Replace power cord, if defective.

12.2 Leakage Test

WARNING: Disconnect the AC power cord, remove all batteries (if installed), and disconnect all cables connected to the ESCORT II before performing the leakage test.

12.2.1 MPM Leakage/Hipot Test

Connect the ECG shorting plug to the ECG input on the monitor. Connect the ground lead of the AC Hipot Tester to the ground pin at the AC power input of the ESCORT II. Connect the Hipot "hot" lead to the ECG shorting plug. Press the Safety HV switch and turn on the Hipot Tester and set leakage knob to full clockwise position. Turn output dial slowly to 2,600 V and wait for 10 seconds. Ensure that there is no cracking or arcing inside the ESCORT II monitor, and that the Hipot Tester alarm does not sound. At the conclusion of this test, turn output dial to zero, and remove the shorting plug.

If the monitor is equipped with the IBP option, repeat the above test using an IBP shorting plug. If the monitor is equipped with the TEMP option, repeat the above test using the TEMP shorting plug. Remove any shorting plugs at the conclusion of the test.

12.2.2 Patient Input Leakage

Connect the ECG shorting plug to the ESCORT II's ECG input. Set the Biomedical Electrical Test Set to read patient input leakage. Connect the AC outlet of the Test Set to the AC input of the ESCORT II monitor. Connect the Test Set's RL clip lead to the ECG shorting plug. Select LEADS TO GND on the Test Set. Press the ALL LEADS button on the Test Set. Ensure that the leakage current is less than 10 μA. Select CASE TO GND and NORM on the Test Set. Ensure that the leakage current is less than 20 μA (The maximum allowable current at the end of the shorting cable). Switch NORM to REV on the Test Set. Ensure that the leakage current is less than 20 μA. Disconnect the shorting plug attached to the ESCORT II monitor at the end of this test.

12.3 Safety Test

WARNING: Disconnect the AC power cord and remove all batteries (if installed) before performing the safety test.

12.3.1 Chassis Ground Resistance Test

Connect the AC plug of the IEC-601.1 Continuity Tester to the AC input of the ESCORT II monitor. Using the test probe of the Continuity Tester, make contact to unpainted metal on the monitor. Turn the tester to ON, and ensure that the green PASS LED is illuminated. Remove the recorder, if installed. See Chapter 13, "ESCORT II Modules," for details on removing the recorder. Repeat the chassis ground resistance test to the recorder guide posts, and other unpainted metal portions on the monitor. Disconnect the AC plug at the conclusion of this test.

12.3.2 Chassis Leakage/Hipot Test

Connect the plug of the Hipot/chassis interface cable (regular AC power cord) to the High Voltage socket of the Hipotronics Safety Switch. Connect the socket end of the Hipot/chassis interface cable to the AC receptacle located on the rear panel of the ESCORT II. Set the leakage knob of the Hipot Tester to maximum clockwise position. Press the High Voltage button and slowly turn the Hipot Tester to 1500 VAC for a duration of 5 seconds. Ensure that the Hipot Tester alarm does not sound.

12.4 Keypad Check

Turn the ESCORT II on and ensure that every key initiates its specified function. Verify that there is an audio click when each key is pressed. Perform this test on every key.

12.5 Mainframe Check

12.5.1 Mainframe Software

Press the **PAGE HOME** function key. Press the **NEXT PAGE** function key twice. Press the **TEST** softkey. Each parameter listed is followed by a communications code and its software version. Communication status codes are as follows:

- ***OK*** - No faults detected; normal operating state
- ***I*** - Parameter is INHIBITED by user configuration in monitor (parameter selection; i.e., RESP vs. RESPCO2, indicating that only one source of respiration may be active at a given time, e.g., Respiration via impedance pneumography vs. Respiration via $ETCO_2$)
- ***D*** - Parameter is DISABLED by user configuration in monitor (PRAM AVAIL field in power-up defaults)
- ***V*** - Version (protocol revision) mismatch between parameter and monitor; contact MDE Technical Support
- *#* - Any numeric codes displayed for COMM status should be relayed to MDE Technical Support for further direction

12.5.2 Date and Time Check

Press the **PAGE HOME** function key. Press the **NEXT PAGE** function key twice. Press **TEST**, and then press the **STAT INFO** softkey to highlight **SW**. Check the ESCORT II for correct date and time. Make changes as necessary. Refer to the ESCORT II 300 Operator's Manual to change the date and time.

12.5.3 Line Frequency Check

While the monitor is set to the **STAT INFO SW** page, ensure that the AC line frequency is 60 ± 0.05 Hz. For 50 Hz systems, ensure that the AC line frequency is 50 ± 0.05 Hz.

12.5.4 System AC Current Check

Release the batteries from their slots. Plug the power cord of the ESCORT II into a variac. Set the variac at 115 VAC. Ensure that the current meter reads less than 500 mA. Reinstall the batteries into the slots of the ESCORT II when complete.

12.5.5 External DC Operation

Remove the AC power source from the ESCORT II monitor. Remove the batteries, if present, from their slots. Set an external DC power supply (rated at a minimum of 45 VA) to 20 ± 8 VDC. Connect the DC output to the external DC connector at the back of the monitor using the 3.5 mm connector (center pin positive). Ensure that the monitor operates normally.

12.6 Batteries Check

Note: ***Never discharge the batteries completely. To ensure long battery life, always re-charge batteries immediately after use. An optional battery charger (MDE Part Number: E2700-12) is recommended. Batteries should be replaced every two (2) years regardless of test results. Used batteries should be recycled or disposed of properly.***

12.6.1 Battery Operation

Note: ***Battery test should be performed on recently charged batteries.***

Remove the AC power source from the ESCORT II monitor. Ensure that both the AC ON and BATTERY CHARGING LEDs are off. Press the **PAGE HOME** function key. Press the **NEXT PAGE** function key twice. Press **TEST**, and then press the **STAT INFO** softkey to highlight **SW**. With one (1) battery installed, ensure that the battery level indication is displayed and that the ESCORT II monitor operates properly. Switch the location of the battery by releasing the installed battery and inserting the same battery into each of the other slots. Repeat the above test for each available battery.

12.7 Recorder Check

Note: ***Ensure that an adequate amount of paper is installed in the recorder. See Chapter 10, "Recorder Option," for details on installing a new roll of paper, if necessary.***

12.7.1 Single Parameter Recording Check

Press the **PAGE HOME** key. Then press the **RECORD** function key for a 16-second strip of ECG waveform. To specify other parameters to record, press the softkey of the desired parameter within two seconds *after* pressing the **RECORD** key. Ensure that the recorder prints a single channel. Verify that tick marks are printed every 7.5 cm at the bottom of the strip (when the sweep speed is set to 25 mm/sec). Figure 12-1 shows a typical single parameter recording.

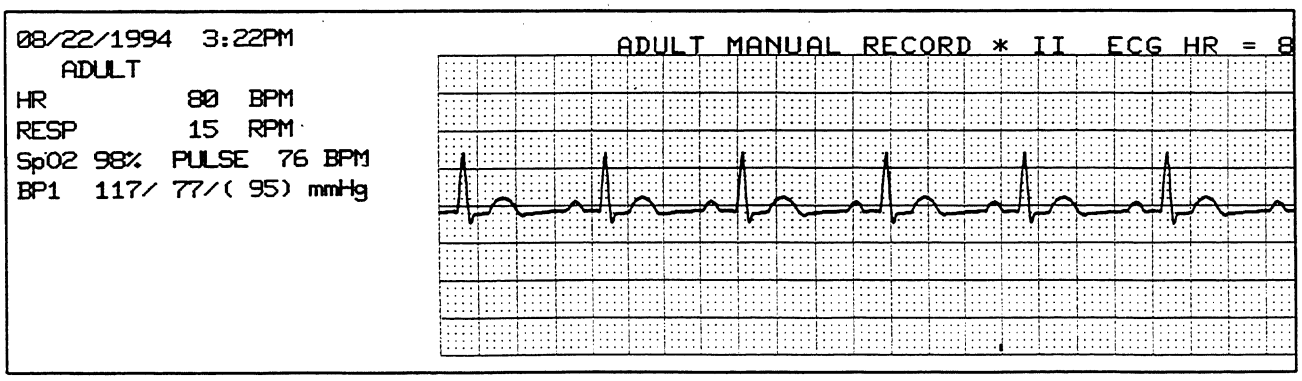


Figure 12-1: Single Parameter Recording

12.7.2 Dual Parameter Recording Check

Dual parameter recordings may be accomplished by pressing the **RECORD** key followed by pressing the softkeys of each of the two desired parameters (within two seconds). The first parameter selected will be printed on the top recording trace and will determine the sweep speed of the recording strip. Ensure that the recorder prints two (2) traces. Verify that tick marks are printed every 7.5 cm at the bottom of the strip (when the sweep speed is set to 25 mm/sec). Figure 12-2 presents a dual parameter recording.

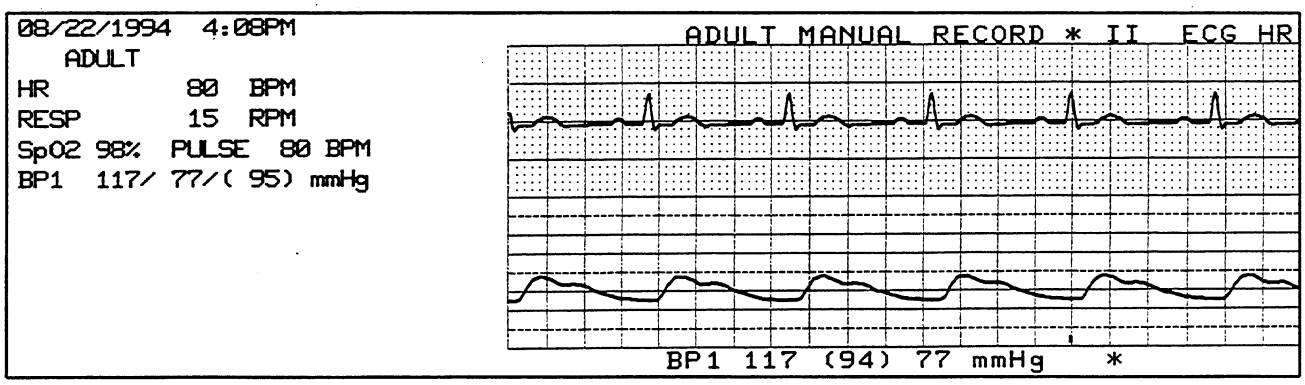


Figure 12-2: A Dual Parameter Recording

12.7.3 Trend Check

After parameter data has been accumulated, press the **PAGE HOME** key. Then press the **NEXT PAGE** key twice. On the **SYSTEM SETUP** page, press the **TREND** key to display graphical trends.

12.8 ECG Tests

Note: ***When using a patient simulator, the tolerance factor of the simulator must be considered in determining if the monitor is within tolerance.***

12.8.1 ECG Lead Check

Connect a 5-lead ECG cable to a calibrated patient simulator. Connect the ECG cable to the ECG connector of the ESCORT II monitor. Press the **PAGE HOME** function key. Press the softkey adjacent to the ECG label. Set the sweep speed to 25 mm/sec. Press the **LEAD SEL** softkey. Select 5-lead mode. Ensure that an acceptable ECG waveform is displayed. Refer again to Figure 12-1.

12.8.2 Lead Fail and Baseline Reset Tests

Ensure that the ESCORT II is still set to 5-lead mode. Remove one lead from the patient simulator. Observe **CHK LEADS** message on the monitor's screen. Repeat for LL, LA, RA, RL, and V leads. Ensure that when any patient lead is disconnected and reconnected, the baseline returns to normal within two (2) seconds.

The ECG waveform may continue to be displayed upon disconnecting a given lead. This case arises when a 5-lead cable is used and a lead which is not used to extract the ECG waveform is disconnected (e.g., RL disconnected when monitoring Lead II). A "reset flag" will be temporarily displayed on the ECG waveform when the lead(s) become disconnected, as shown in Figure 12-3. The reset flag will disappear in a few seconds, and the ECG waveform will appear again.

Connect a 3-lead ECG cable to the patient simulator. Select 3-lead mode and ensure that Lead II is selected. Remove one lead from the patient simulator. Observe the **CHK LEADS** message on the screen. Repeat for LL, LA, and RA leads.

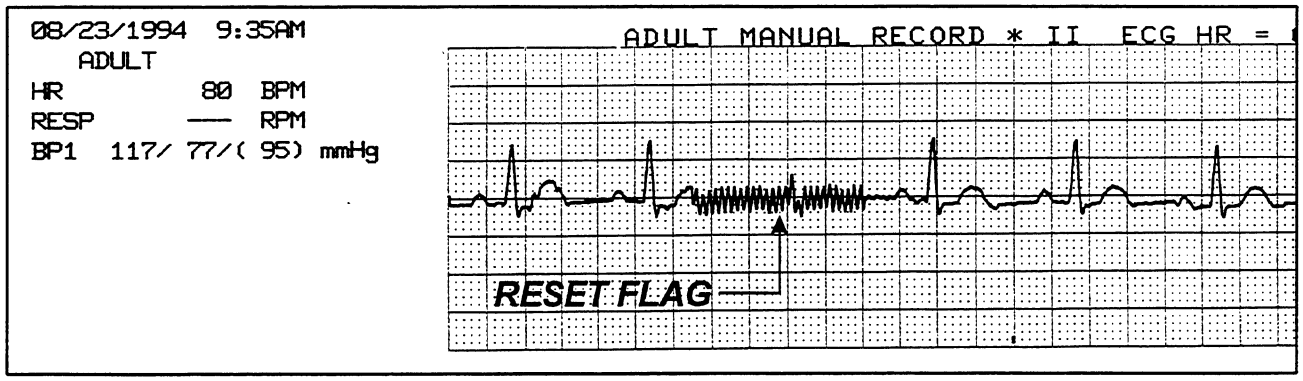


Figure 12-3: Check Leads Condition with Valid ECG Waveform

12.8.3 High/Low Alarm Function Check

Turn on ECG alarms using the **ALARM ON/OFF** softkey. Set the ECG output of the patient simulator higher than the high alarm limit. Ensure that the alarm tone sounds. Set the patient simulator ECG output lower than the low alarm limit. Ensure that the alarm tone sounds. If the monitor is equipped with a recorder, observe alarm recording. Ensure that the red ALARM LED is flashing.

12.8.4 Pacer Flag Insertion Check

Press the **PAGE HOME** function key. Press the softkey adjacent to the ECG label. Press the **NEXT PAGE** function key. Set simulator to output a paced waveform. Set the **PACE ON/OFF** softkey to ON. Ensure that the pace spikes are replaced with uniform pacer flags and that the heart rate indicated on the ESCORT II returns to the simulator rate.

12.8.5 ECG Calibration

*Note: **Disconnect all parameter cables (except the ECG cable) during this test. Ensure that ECG is set to monitor Lead II.***

Press the **PAGE HOME** function key. Press the softkey adjacent to the ECG label. Press the **NEXT PAGE** function key. Press the **CAL** softkey and verify the calibration pulse on the monitor's screen. Increase the waveform size, using the **SIZE** softkey, if necessary. Run a recorder strip and verify that the R-wave amplitude is 1 mV peak-to-peak from the isoelectric line to the R-wave peak ± 0.1 mV.

If the ESCORT II is not equipped with a recorder, press the **CAL** softkey. Ensure that a calibration pulse is generated on the screen and that the ECG amplitude is within 15% of the calibration pulse amplitude. Refer to Figure 12-4 for details.

12.8.6 QRS Tone Check

Ensure that the heart rate source is set to **AUTO** or **ECG**. Refer to the ESCORT II 300 Operator's Manual for details on setting the heart rate source. Press the **PAGE HOME** function key. Press the softkey adjacent to the ECG label. Press the **NEXT PAGE** function key. Set the **TONE ON/OFF** softkey to ON. Ensure that a tone sounds which corresponds to each R-wave in the ECG waveform. Silence the tone by pressing the **TONE ON/OFF** softkey again.

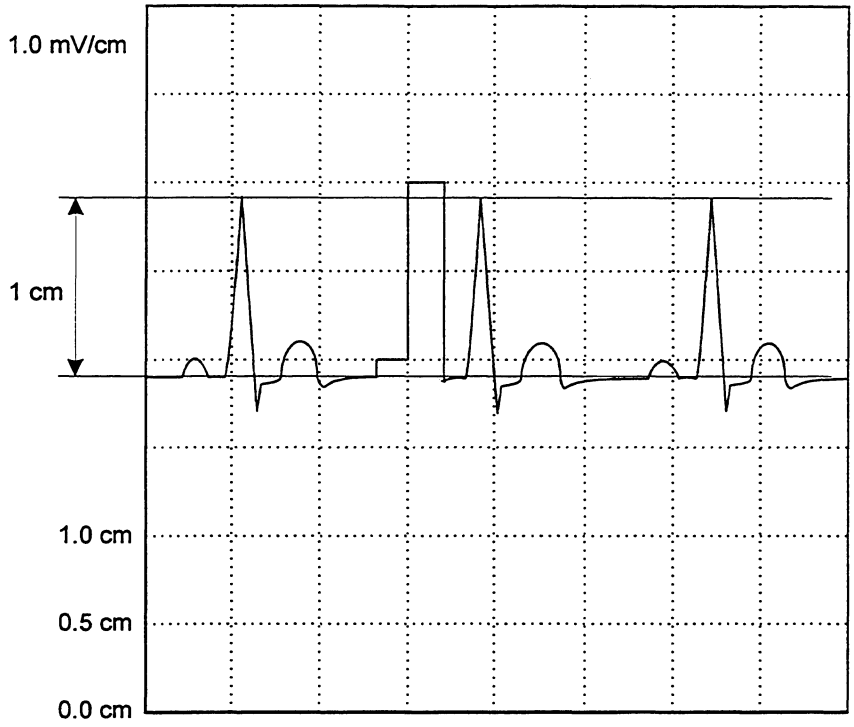


Figure 12-4: ECG Calibration Pulse

12.9 Respiration Tests

12.9.1 RESP Calibration Check

Press the **PAGE HOME** function key. Press the softkey adjacent to the **RESP** label. Press the **ALARM SUSPEND** function key. Configure an available trace to display the RESP waveform. Press the **SIZE** softkey. Increase the waveform size, using the **SIZE** ^^ softkey, if necessary. Press the **CAL** softkey. Ensure that a pulse appears on the **RESP** waveform. Pressing the **CAL** softkey repeatedly will present successive pulses on the RESP waveform.

If the ESCORT II is equipped with a recorder, verify that the respiration waveform on the recording strip is 2 ± 0.8 cm peak-to-peak amplitude.

12.9.2 RESP Baseline Reset Check

When the LA lead is disconnected and reconnected, ensure that the baseline returns to normal at the center of the RESP trace.

12.9.3 Pacer Artifact Check

Set the simulator to output a paced waveform. Select the ECG function. Turn on the ECG pacer function using the **PACE ON/OFF** softkey (as described in paragraph 12.8.4). Check that the pacer flags are not counted on the Respiration waveform.

12.9.4 Apnea Alarm Check

Set the simulator to produce an apnea greater than 10 seconds. On the **RESPIRATION SETUP** menu of the ESCORT II monitor, set alarms on. Set the **APNEA DELAY** to 10 seconds, ensure that the alarm sounds after the delay indicated. Verify that the front panel ALARM LED flashes while the alarm is in progress. Return the simulator respiration rate to 15 or 20 BPM.

12.9.5 High/Low Alarm Function Check

Turn on RESP alarms using the **ALARM ON/OFF** softkey. Set the RESP output of the patient simulator higher than the high alarm limit. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing. Set the patient simulator RESP output lower than the low alarm limit. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing.

12.10 SpO_2 Tests

12.10.1 Reference Saturation Check

Disconnect the ECG cable. Connect the NELLCOR PT-2500 Simulator to the SpO_2 connector. Configure an available trace to display the SpO_2 waveform. Press the **PAGE HOME** function key. Press the softkey adjacent to the **SPO2** label. Press the **ALARM SUSPEND** function key. Ensure that a saturation reading of 81 ± 2% is observed. If the ESCORT II is equipped with a recorder, press the **RECORD** function key followed by pressing the **SPO2** softkey. Ensure that a square wave is present on the recording strip.

12.10.2 Reference Pulse Check

With the NELLCOR PT-2500 connected, ensure that a pulse reading of 40 ± 2 BPM is displayed. Press the **SPO2** softkey. Press the **LOCK ON/OFF** softkey until ON is highlighted. Ensure that the **NO C-LOCK** message is displayed.

12.10.3 C-LOCK Message Check

Reconnect the ECG cable. Ensure that the **NO C-LOCK** message goes away after a few seconds. If alarms are still suspended, press the **ALARM SUSPEND** key again to enable alarms.

12.10.4 Finger Sensor Check

Disconnect the NELLCOR PT-2500 Simulator from the ESCORT II. Ensure that **NO SENSOR** message flashes on the screen. Connect a NELLCOR Finger Sensor. Ensure that the **SPO2 SRCH** message appears on the screen. Insert an index finger into the sensor clip. Ensure that the SpO_2 waveform and saturation reading appear on the screen after a few seconds.

12.10.5 High/Low Alarm Function Check

With the finger sensor connected to the ESCORT II, insert an index finger into the sensor clip. Set the high alarm limit to 70. Turn on SpO_2 alarms by using the **ALARM ON/OFF** softkey. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing. Set the SpO_2 alarms to OFF by using the **ALARM ON/OFF** softkey. Disconnect the finger sensor. Connect the NELLCOR PT-2500 Simulator to the monitor's input. Set the low alarm limit to 85. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing.

12.11 NIBP Tests

Note: All NIBP tests must be run when the monitor's NIBP test setting is in the CHECK mode.

12.11.1 Inflation Time and Maximum Pressure Check

Connect a digital manometer to the bottom NIBP fitting. Press the **PAGE HOME** function key. Press the **NEXT PAGE** function key twice. On the **SYSTEM SETUP** menu, select the **TEST** softkey. Cycle the **NIBP TEST** softkey until **CHECK** mode is highlighted. Press **PAGE HOME**, followed by pressing the softkey adjacent to the **NIBP** label. Simultaneously, start a stopwatch and press the **START** softkey. Observe the stopwatch timer and the manometer readings; ensure that the time is less than or equal to 9 seconds when the manometer reads 250 mmHg. Allow the pump to continue to run for an additional 15 seconds. Ensure that the pump pressure never exceeds 330 mmHg.

12.11.2 Overpressure Detection Check

Verify that the ESCORT II is configured in **ADULT** mode. Connect the manometer using a 'Y' adapter to both bulkhead connectors on the ESCORT II. Press **PAGE HOME**, followed by pressing the softkey adjacent to the **NIBP** label. Press the **START** softkey. Wait until the pump stops and then continue to pump the system using the manometer's inflation bulb. Ensure that the overpressure switch activates and vents the system between 255 and 280 mmHg. Press the **STOP** key, and bleed off any additional air from the system.

Configure the monitor to **NEO** mode and return to the NIBP menu. Press the **START** softkey. Wait until the pump stops and then continue to pump the system using the manometer's inflation bulb. Ensure that the overpressure switch activates and vents the system between 155 and 170 mmHg. Press the **STOP** key, and bleed off any additional air from the system. Switch monitor back to **ADULT** mode.

12.11.3 Five-Minute Time-out Check

Press the **PAGE HOME** function key, followed by pressing the softkey adjacent to the **NIBP** label. Connect the manometer to top fitting and pump to 60 to 70 mmHg and start the stopwatch. Observe that after 3:54 minutes to 5:24 minutes, the **CHECK CUF** message appears. Open the valve on the pressure bulb to bleed off the pressure and observe that the message goes away.

12.11.4 Additional NIBP Tests

Perform the Calibration Check, Leak Test, and Oscillation Waveform Test. These procedures are presented in section 7.7, "NIBP Diagnostics."

12.11.5 High/Low Alarm Function Check

Connect the Dynatech NIBP Analyzer with a 'Y' adapter to both bulkhead connectors on the ESCORT II. Press the **PAGE HOME** function key. Press the **NEXT PAGE** function key twice. On the **SYSTEM SETUP** menu, select the **TEST** softkey. Cycle the **NIBP TEST** softkey until the **OFF** mode is highlighted. Press **PAGE HOME** again. Press the softkey adjacent to the **NIBP** label. Press **NEXT PAGE**. Turn on the NIBP alarms by using the **ALARM ON/OFF** softkey. Set the systolic alarm of the ESCORT II to 140. Set the analyzer's systolic pressure higher than 140. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing. Set the analyzer's systolic pressure lower than the low alarm limit. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing. Repeat for diastolic and mean alarms.

12.12 Temperature Tests

12.12.1 Temperature Check

Press the **PAGE HOME** function key. Press the softkey below the **TEMP** label. Check for no temperature indication (dashed lines on the screen). Connect the temperature simulator to the TEMP input of the monitor. Set the simulator to 25° C. Check that the temperature on monitor reads within 0.2° for both YSI 400 and YSI 700 type probes. Repeat the above for 37° C and 40° C.

12.12.2 High/Low Alarm Function Check

Turn on the TEMP alarms by using the **ALARM ON/OFF** softkey. Set the temperature simulator output higher than the high alarm limit. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing. Set the temperature simulator output lower than the low alarm limit. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing.

12.13 IBP Tests

12.13.1 ZERO Check

Configure an available trace for BP1. Press the **PAGE HOME** function key. Press the softkey adjacent to the **BP1** label. Plug the waveform simulator into the monitor's BP1 connector. Ensure that a flashing **ZERO BP1** message appears. Set the simulator to zero pressure. Press the **ZERO** softkey. Ensure that the flashing **ZERO BP1** message disappears. Repeat the above procedure for BP2, if installed.

12.13.2 Waveform Check

Set the simulator to output dynamic pressure (e.g., 120/80). Ensure that a standard invasive blood pressure waveform is present.

12.13.3 Static Gain Accuracy Check

Rezero the IBP waveform. Set the simulator to output a static pressure of 100 mmHg. Ensure that a reading of 100 mmHg is displayed on the monitor with an accuracy of 1 mmHg.

12.13.4 High/Low Alarm Function Check

Turn on BP1 alarms by using the **ALARM ON/OFF** softkey. Set the patient simulator BP1 output higher than the high alarm limit. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing. Set the patient simulator BP1 output lower than the low alarm limit. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing. Repeat all IBP tests for BP2 (if installed).

12.14 End Tidal CO_2 Tests

12.14.1 "No Sensor" Check

Connect the simulator to the ECG input on the ESCORT II. Set ECG to 80 BPM and RESP to 15 BPM. Configure RESP and CO_2 for traces 2 and 3 respectively. Set Respiration Rate source to AUTO. Press the **PAGE HOME** function key. Press the softkey adjacent to the CO2 label. Verify that the **NO SENSOR** message appears on the CO_2 trace. Verify that the RESP rate is equal to the simulator rate.

12.14.2 CO_2 Power-Up Sequence Check

Plug in a CO_2 sensor to the monitor. Ensure that the **WARM UP** message is displayed. After a few seconds, the **WARM UP** message will be replaced by the **START UP** message. Wait about 60 seconds and ensure that the sensor light illuminates.

12.14.3 CO_2 Operation Check

Breathe into the disposable airway adapter on the CO_2 sensor. Ensure that a normal CO_2 capnogram appears on the CO_2 trace with a value between 30 and 60 mmHg. Ensure also that the RESP count is equal to the breath rate.

12.14.4 High/Low Alarm Function Check

Set the ESCORT II CO_2 high alarm limit to 20. Breathe into the disposable airway adapter until a value greater than 20 is displayed. Turn on the CO_2 alarms using the **ALARM ON/OFF** softkey. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing. Turn the CO_2 alarms OFF. Set the high alarm limit to 80 and set the low alarm limit to 50. Breathe into the disposable airway adapter again and turn the CO_2 alarms ON. Ensure that the alarm tone sounds while the front panel ALARM LED is flashing.

12.14.5 Respiration Source Check

Turn off the CO_2 parameter using the **CO2 ON/OFF** softkey and verify the RESP count returns to the simulator rate after a few seconds. Discard the disposable airway adapter at the conclusion of the tests.

12.15 Cardiac Output (CO) Tests

Note: ***To perform the following Cardiac Output tests, precision resistance (1%) must be applied to the reference designations at the ESCORT II's CO connector, as indicated for each test. See Figure 12-5 for details.***

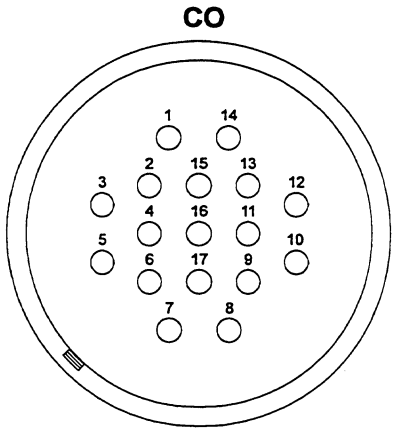


Figure 12-5: Cardiac Output Connector Designations

12.15.1 Blood Temperature (Tb) Tolerance Check

Configure Trace 3 for CO. Press the **PAGE HOME** function key. Press the softkey adjacent to the **CO** label. Using Table 12-1 as a guide, set the resistance values across THA and THB and across THB and THD, as indicated. Observe that for each setup, the blood temperature (Tb) displayed on the ESCORT II's screen is within tolerance.

Table 12-1: Cardiac Output Calibration Values for Blood Temperatures

RESISTANCE ACROSS THA-THB	RESISTANCE ACROSS THB-THD	BLOOD TEMPERATURE
9.76 kohms	30.484 kohms	17.0 ± 0.1° C
9.76 kohms	14.000 kohms	37.0 ± 0.1° C
9.76 kohms	11.304 kohms	43.0 ± 0.1° C

12.15.2 Flow Through (Ti) Tolerance Check

Configure Trace 3 for CO. Press the **PAGE HOME** function key. Press the softkey adjacent to the **CO** label. Using Table 12-2 as a guide, set the resistance values across BAB and FL, as indicated. Observe that for each setup, the flow through temperature (Ti) displayed on the ESCORT II's screen is within tolerance.

Table 12-2: Cardiac Output Calibration Values for Flow Through Temperatures

RESISTANCE ACROSS BAB-FL	FLOW THROUGH TEMPERATURE
84.510 kohms	5.0 ± 0.1° C
78.850 kohms	10.0 ± 0.1° C
62.760 kohms	25.0 ± 0.1° C

12.15.3 Bath Tolerance Check

Configure Trace 3 for CO. Press the **PAGE HOME** function key. Press the softkey adjacent to the **CO** label. Using Table 12-3 as a guide, set the resistance values across BAA and BAC and across BAB and BAC, as indicated. Observe that for each setup, the bath temperature displayed on the ESCORT II's screen is within tolerance.

Table 12-3: Cardiac Output Calibration Values for Bath Temperatures

RESISTANCE ACROSS BAA-BAC	RESISTANCE ACROSS BAB-BAC	BATH TEMPERATURE
94.980 kohms	19.500 kohms	0.0 ± 0.1° C
58.750 kohms	11.940 kohms	10.0 ± 0.1° C
30.000 kohms	6.000 kohms	25.5 ± 0.1° C

PERFORMANCE CHECK LIST

MODEL: _____ **TECHNICIAN:** _____

SERIAL NUMBER: _____ **DATE:** _____

LEAKAGE TEST

MPM Leakage/Hipot ..... OK_____
Patient Input Leakage — ALL LEADS ..... < 10 µA_____
Patient Input Leakage — CASE TO GND to NORM ..... < 20 µA_____
Patient Input Leakage — NORM to REV ..... < 20 µA_____

SAFETY TEST

Chassis Ground Resistance Test ..... OK_____
Chassis Leakage/Hipot ..... OK_____

KEYPAD CHECK

Keypad Check ..... OK_____

MAINFRAME CHECK

Mainframe Software ..... OK_____
Date and Time Check ..... OK_____
Line Frequency Check ..... OK_____
System AC Current Check ..... OK_____
External DC Operation ..... OK_____

BATTERY CHECK

Batteries #1 ..... OK_____
Batteries #2 ..... OK_____
Batteries #3 ..... OK_____

RECORDER CHECK

Single Parameter Recording Check ..... OK_____
Dual Parameter Recording Check ..... OK_____
Trend Check ..... OK_____

ECG TESTS

ECG Lead Check ..... OK_____
Lead Fail and Baseline Reset Tests ..... OK_____
High/Low Alarm Function Check ..... OK_____
Pacer Flag Insertion Check ..... OK_____
ECG Calibration ..... OK_____
QRS Tone Check ..... OK_____

RESPIRATION TESTS

RESP Calibration Check ..... OK_____
RESP Baseline Reset Check ..... OK_____
Pacer Artifact Check ..... OK_____
Apnea Alarm Check ..... OK_____
High/Low Alarm Function Check ..... OK_____

SpO_2 TESTS

Reference Saturation Check ..... OK_____
Reference Pulse Check ..... OK_____
C-LOCK Message Check ..... OK_____
Finger Sensor Check ..... OK_____
High/Low Alarm Function Check ..... OK_____

NIBP TESTS

Inflation Time and Maximum Pressure Check ..... OK_____
Overpressure Detection Check ..... OK_____
Five-Minute Time-out Check ..... OK_____
Additional NIBP Tests ..... OK_____
High/Low Alarm Function Check ..... OK_____

TEMPERATURE TESTS

Temperature Check ..... OK _____
High/Low Alarm Function Check ..... OK_____

IBP TESTS

ZERO Check ..... OK_____
Waveform Check ..... OK_____
Static Gain Accuracy Check ..... OK_____
High/Low Alarm Function Check ..... OK_____

END TIDAL CO_2 TESTS

"No Sensor" Check ..... OK_____
CO_2 Power-Up Sequence Check ..... OK_____
CO_2 Operation Check ..... OK_____
High/Low Alarm Function Check ..... OK_____
Respiration Source Check ..... OK_____

CARDIAC OUTPUT TESTS

Blood Temperature (Tb) Tolerance Check ..... OK_____
Flow Through (Ti) Tolerance Check ..... OK_____
Bath Tolerance Check ..... OK_____

13 Care and Cleaning

13

CARE and CLEANING

WARNING: To avoid electric shock, unplug the AC power cord before cleaning.

WARNING: Do not immerse the instrument or its accessories in liquids. Do not use caustic or abrasive cleaners that will damage the housing.

13.1 Guidelines for Cleaning the Monitor

Use the following guidelines and considerations when cleaning the ESCORT II monitor:

- Periodically, the monitor, cuffs, and hoses should all be cleaned. Only use a lint free, nonabrasive cloth which has been slightly dampened with a mild detergent.
- Avoid harsh cleaning solutions which might harm plastic surfaces.
- Do not immerse monitor, cuffs, or hoses in liquids.
- Do not clean with isopropyl alcohol or other solvents that may harm plastics.
- Do not spray or pour liquids directly onto the monitor or its accessories.
- Do not allow any liquid to come into contact with the power connector, fuse holder, or switches.
- Do not allow any liquids to penetrate connectors or the monitor chassis.

13.2 Repacking and Shipping the Monitor

Use the following guidelines if you need to ship the ESCORT II monitor for repair or relocation.

Note: ***Failure to follow the guidelines below may result in damage or loss. Equipment damaged due to improper packaging is not covered in the monitor's warranty, nor is the loss of equipment due to improper or inadequate shipping procedures.***

- The equipment must be packed carefully, ideally using the original shipping carton with foam packing material.
- If the original carton is not available, use a similar carton. Place the equipment in a plastic bag or air bubble cushioning material. Fill the bottom of the carton with approximately five (5) centimeters of polystyrene packing material. Place the equipment on the layer of packing material, and then fill all the remaining space in the carton with packing material.
- Seal the carton adequately.
- If shipping to Medical Data Electronic for repair, a Return Material Authorization number (RMA#) must be obtained. To obtain an RMA number, call MDE Technical Support at one of the telephone numbers listed at the front of this manual. It is necessary to have the model number and serial number of the equipment at hand along with a detailed description of the reason(s) why it needs to be returned to the factory.

14

ESCORT II MODULES

14.1 Introduction

There are several modular (user-movable) components that can be shared by all ESCORT II monitors.

- The **Multiparameter Module (MPM)** - Allows you to share various configurations of parameters between monitors.
- The **Multichannel Recorder Module** - Provides manual and alarm recordings of any one or two waveforms simultaneously.
- The **Battery Module** - Supplies battery power to the ESCORT II monitor for operation in transport situations, or when AC power is not available.
- The **Transceiver Module** - Provides you with a quick and flexible way to include any ESCORT II monitor in the AutoNet™ wireless network.
- The **Telemetry Module** - Enables the ESCORT II monitor to be used with ambulatory ECG transmitters.

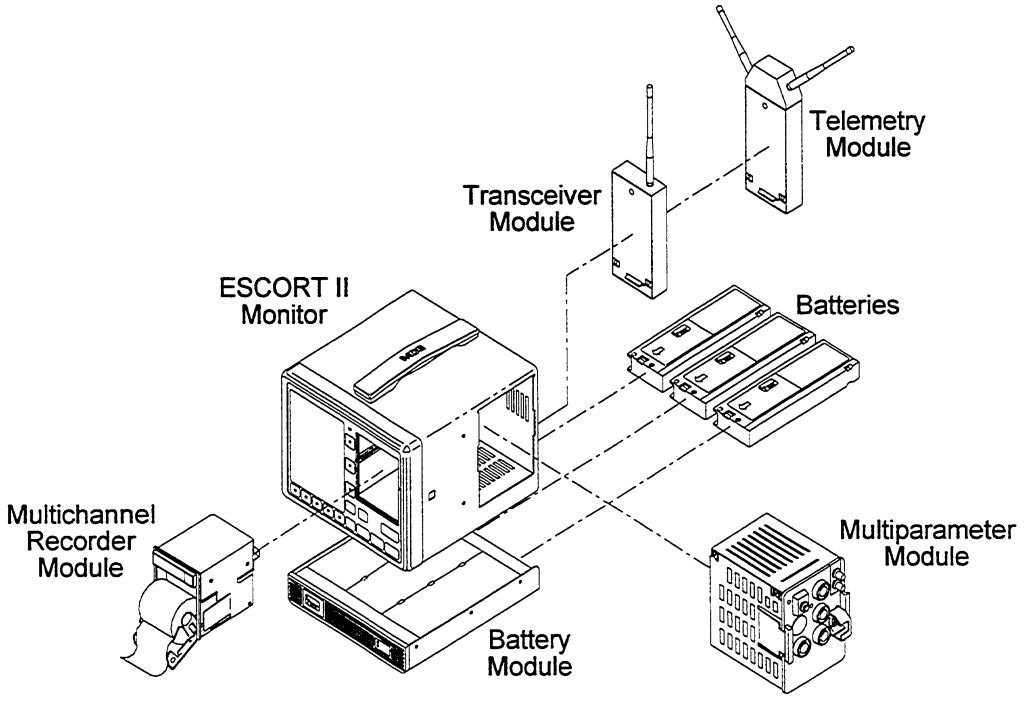


Figure 14-1: ESCORT II 100 Modularity

14.2 Multiparameter Module

Removing the Multiparameter Module

1. Release the Multiparameter Module by squeezing the side handles toward the center of the module (see Figure 14-2, below).
2. Continue to squeeze the handles while pulling the module straight out of the monitor.

Installing the Multiparameter Module

1. Align the Multiparameter Module so that the front panel parameter labels are facing you and are right-side up. Additionally, ensure the edges of the module are square with the edges of the monitor housing.
2. Push the Multiparameter Module into the monitor until it clicks into place.
3. To turn the monitor ON, press the ON (ON/STBY) fixed function key. After a few seconds, you should see parameter labels and associated data on the monitor display.

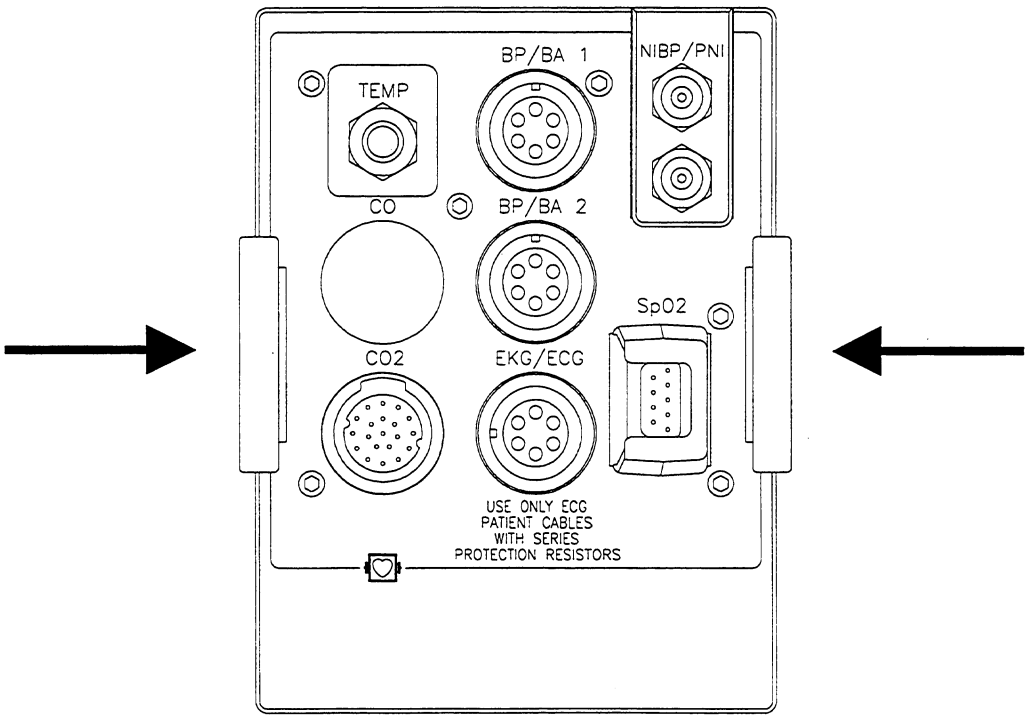


Figure 14-2: Removing the Multiparameter Module

Hewlett-Packard Merlin Connectors Option (ECG, BP1, BP2)

The Multiparameter Module can be optionally configured with HP Merlin connectors for ECG and Invasive Blood Pressure. Figure 14-3 illustrates the Multiparameter Module with HP Merlin connectors installed.

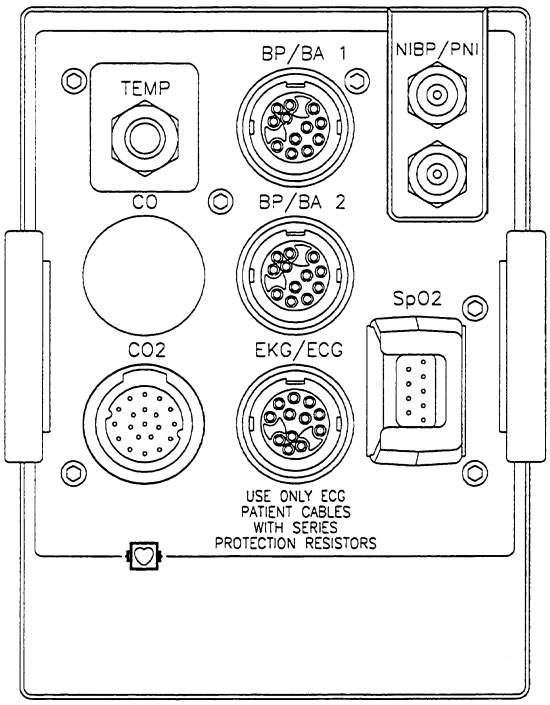
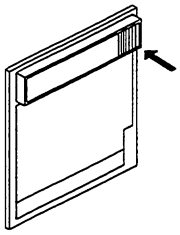


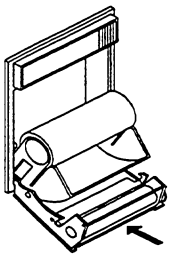
Figure 14-3: Multiparameter Module with HP Connectors (ECG, BP1, BP2)

14.3 Multichannel Recorder Module

Removing the Multichannel Recorder Module



1. Open the recorder door by pressing the ridged end of the recorder door release.



2. Grasp the recorder door at the end closest to you. *Do not* attempt to remove the recorder module at this time.

3. Insert the blunt end of an instrument into the Multichannel Recorder Module's release slot, located on the right side of the monitor. Press inward while pulling the Multichannel Recorder Module toward you. Once the module is approximately one half inch (½") out of the monitor housing, you no longer need to press the release slot.

Note: ***Do not press the recorder's release slot with any instrument that may break or cause damage, such as the lead end of a pencil.***

4. Continue pulling the recorder module toward you until it is completely out of the monitor.

Installing the Multichannel Recorder Module

Note: ***The monitor may reset when you install the Multichannel Recorder Module, and any patient data stored in the bedside monitor's memory may be lost.***

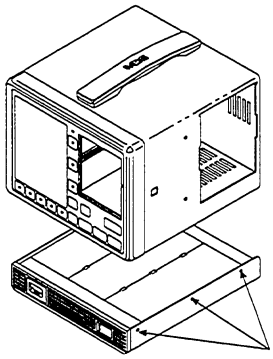
1. Align the recorder module so the recorder door is facing you, the door release is at the top, and the edges of the module line up with the edges of the monitor's housing.
2. Push the Multichannel Recorder Module straight into the monitor until it is securely in place (i.e., it cannot be removed unless the release is pressed again).

14.4 Battery Module

The battery module consists of three (3) individual 12V/2.3AH DC batteries capable of delivering power to the ESCORT II monitor for 1.75 to 2.5 hours of operation, depending on the monitor's configuration. Batteries may be recharged to 90% of their capacity within five (5) hours.

Note: ***Never discharge the batteries completely. To ensure long battery life, always recharge batteries immediately after use. An optional battery charger (MDE Part Number: E2700-12) is recommended. Batteries should be replaced every two (2) years regardless of test results. Used batteries should be recycled or disposed of properly.***

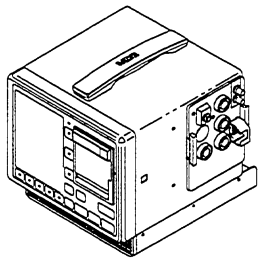
Removing the Battery Module



Screw Locations

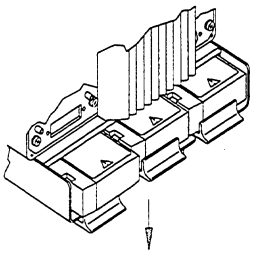
1. Remove the screws at the locations indicated (3 each side) with a Phillips screwdriver.
2. Lift up the ESCORT II monitor and set on a soft surface away from the battery module.

Installing the Battery Module

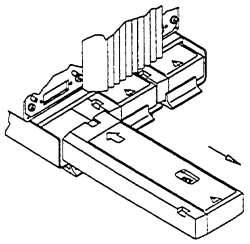


1. Align the battery module to the bottom of the ESCORT II monitor.
2. Ensure that the screw holes of the battery module line up with those of the ESCORT II.
3. Install and tighten each of the six (6) screws with a Phillips screwdriver accordingly.

Removing Individual Battery from Battery Module

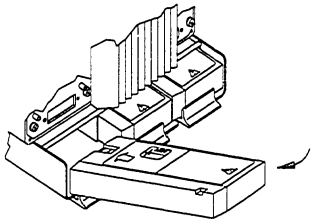


1. Press the battery lock at the rear of the battery module.

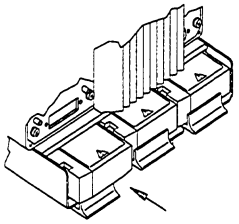


2. Gently slide the battery out from the battery slot.

Installing Individual Battery into Battery Module



1. Place the battery into the battery slot as indicated.



2. Gently slide the battery into the battery slot until it locks firmly in place.

Note: ***To avoid corrosion, remove the batteries if the ESCORT II monitor is disconnected from AC power for an extended period of time.***

14.5 Transceiver Module

> **WARNING: The monitor power should be OFF and the power cord should be disconnected from its AC source when you attach or remove a Transceiver Module. Do not open the module. Refer all servicing to qualified technical personnel.**

Attaching the Transceiver Module to the ESCORT II Monitor

1. Turn the monitor power OFF by pressing the STBY key and disconnect from AC power source. Proceed with the following steps after the monitor power has been turned off for approximately twenty (20) seconds.
2. Plug the transceiver into the J8 connector on the back of the monitor, making sure to line up the three screws on the transceiver with the three screw holes on the back of the monitor.
3. Use a flat head screwdriver or 3/16"-hex nut driver to turn each of the three screws until the transceiver is attached snugly to the back of the monitor.
4. Ensure that the transceiver antenna is screwed into place on the top of the transceiver.
5. Connect the ESCORT II monitor to an AC power source.
6. Turn the monitor power on by pressing the ON key.
7. The green LED on the transceiver indicates the transceiver's communication status.
   - **ON** - If the LED is ON (except for a momentary flicker approximately every 20 seconds), the transceiver has established a communication link.
   - **OFF** - If the LED is OFF, there is currently no communication to or from the transceiver.
   - **Flashing** - If the LED is flashing, the transceiver is attempting to communicate information, but no steady communication link with a central station has been established.

Setting Up Transceiver Communications

Each transceiver has a unique ID code (a four-digit alphanumeric code) which is assigned at the factory. There are seven channels through which the transceiver can send and receive data. The transceiver ID and the channel in use must be recognized by both the monitor and central station with which it is communicating. The following steps ensure the monitor recognizes the transceiver information. See the ESCORT-LINK E3200B Central Station Operator's Manual for information on setting up communications.

Step 1: Verify/Set the Transceiver Channel

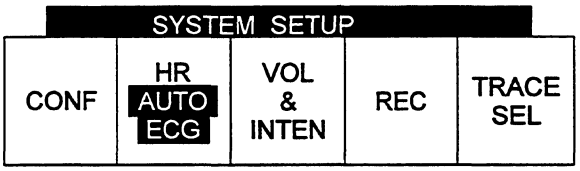
To optimize communication between ESCORT II bedside monitors and the central station, a few network configuration issues should be considered. These considerations include assigning the proper operating channel and mode of the monitor's transceiver:

- If the ESCORT II is going to communicate alternately with two or more central stations, it should be in AUTO mode. This mode allows the ESCORT II's transceiver to constantly be in a search mode of all seven operating channels until it locks in on a central station's channel to which it is currently assigned. Thus, changes in the monitor's central station assignments only require user configuration changes at the central station.

- If you know the ESCORT II will always be communicating with a specific central station, the transceiver should be assigned to the central station's current operating channel. See the ESCORT-LINK E3200B Central Station Operator's Manual for information on setting up the communication channel at the central station.

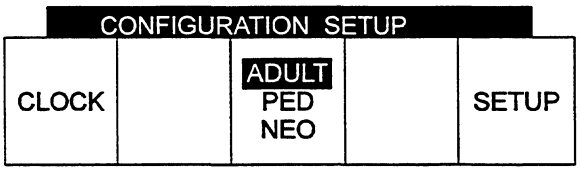
The following steps describe how to verify and/or change your monitor's frequency mode:

1. From the HOME PAGE state, press the NEXT PAGE key. The following SYSTEM SETUP page is displayed:



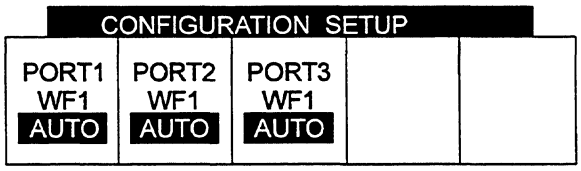
2. Press the CONF key.

3. Press the YES softkey when prompted "ARE YOU SURE?". The following CONFIGURATION SETUP page will be displayed:

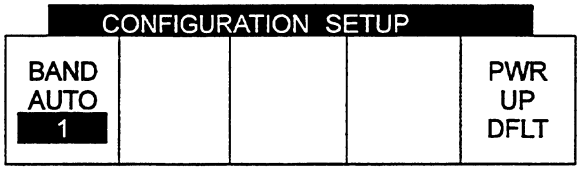


4. Press the SETUP softkey.

5. Press the YES softkey when prompted "ARE YOU SURE?". The following CONFIGURATION SETUP page will be displayed:



6. Press the NEXT PAGE key. The following CONFIGURATION SETUP page will be displayed:



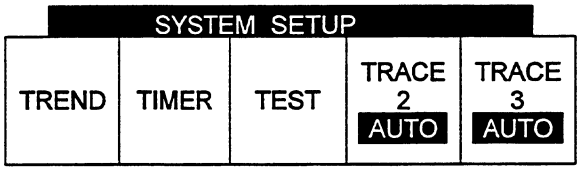
7. Press the BAND softkey to choose channels 1 - 7 or AUTO.

8. Press PAGE HOME to return to the main monitoring screen. Changes will take effect *without* the need to cycle the monitor on and off. Allow additional time (up to approximately two minutes) to establish communications if the ESCORT II has been set to AUTO.

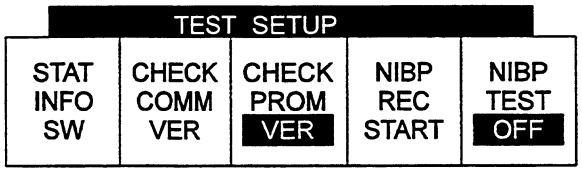
Step 2: Verify the Transceiver Communication Status

Perform the following steps to verify acceptable communications:

1. From the main monitoring screen, press NEXT PAGE twice. The following SYSTEM SETUP page will be displayed:



2. Press the TEST softkey. The following TEST SETUP page is displayed:



3. Press the STAT INFO (Status Information) softkey twice. NET should be displayed in reverse video, and the ESCORT II screen should appear as indicated in Figure 14-4.

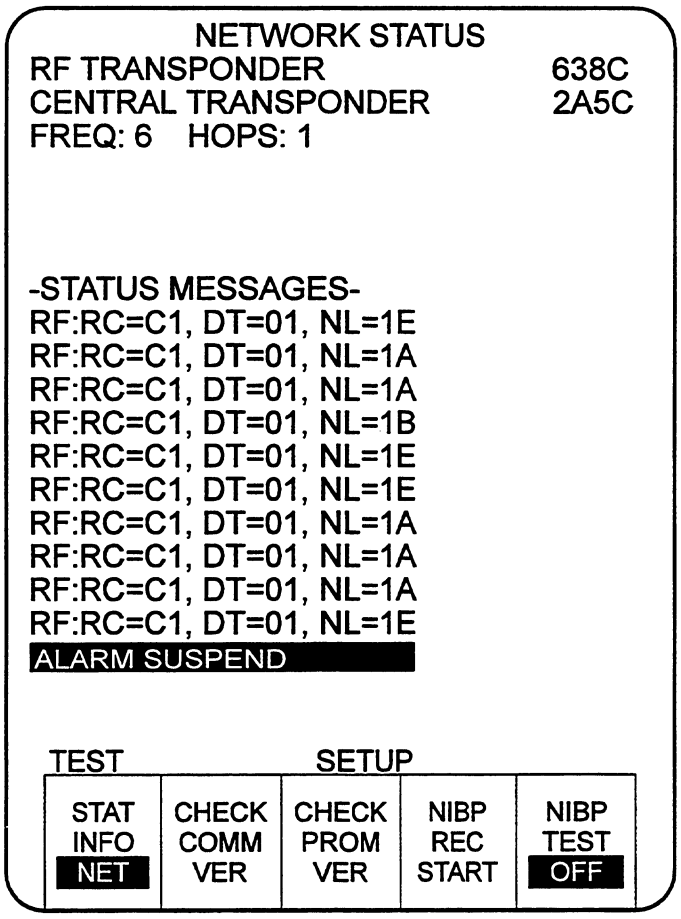


Figure 14-4: Network Status Page

4. Refer to the first three lines of information displayed on the ESCORT II screen. Each message is described in the following paragraphs. The *STATUS MESSAGE* area of the screen presents additional information for use by technical personnel.

   - **RF TRANSPONDER**: The four-digit alphanumeric number on the far right of this line is the transceiver ID number. It identifies the transceiver connected to the monitor. If you have not installed a transceiver on the monitor or its connection with the monitor is not adequate, this line will read "NO RF TRANSPONDER."

   - **CENTRAL TRANSPONDER**: The four-digit alphanumeric number on the far right of this line is the central station's transceiver ID number. It identifies the transceiver connected to the central station with which the monitor is currently communicating. If the monitor's frequency mode is set to AUTO and its transceiver is searching for a central station, but has not yet established communication, or if the monitor's transceiver ID is not associated with any central station, this line will read "NO LINK TO CENTRAL."

   - **FREQ**: The number to the right of FREQ is the current monitor frequency, or operating channel. If the monitor is in AUTO mode, this number may change as various channels are checked; otherwise the number should not change.

   - **HOPS**: The number to the right of HOPS indicates the number of transceivers/ repeaters this monitor's transceiver is sending data to in order to reach the central station.

Note: ***HOPS will not appear if the monitor is in AUTO mode and communications are not established with a central station.***

Removing the Transceiver Module

1. Turn the monitor power OFF by pressing the STBY key and disconnect from AC power source. Allow the monitor power to be OFF for approximately 20 seconds before proceeding with these steps.

2. Use a flat head screwdriver or 3/16"-hex nut driver to turn each of the three screws on the transceiver until the transceiver is unscrewed from the back of the monitor.

3. Unplug the transceiver from the connector on the back of the monitor.

14.6 Telemetry Module

WARNING: The monitor power should be OFF and the power cord should be disconnected from its AC source when a Telemetry Module is installed or removed. Do not open the module. Refer all servicing to qualified technical personnel.

Attaching the Telemetry Module to the ESCORT II Monitor

1. Turn the monitor power OFF by pressing the STBY key and disconnect from AC power source. Proceed with the following steps after the monitor power has been turned off for approximately twenty (20) seconds.
2. Plug the telemetry module into the J8 connector of the ESCORT II 100 monitor, making sure to line up the three screws on the telemetry module with those on the back of the monitor. Depending on the monitor's configuration, the telemetry module may be connected directly to the rear panel of the ESCORT II monitor or to other *add-on modules* (e.g., a transceiver module).
3. Use a flat head screwdriver or 3/16"-hex nut driver to turn each of the three screws until the telemetry module is attached snugly to the back of the monitor/add-on module.
4. Ensure that the two telemetry antennae are BNC-mounted into place at approximately 45 degrees to the vertical, on top of the telemetry module.
5. Connect the ESCORT II monitor to an AC power source.
6. Turn the monitor power on by pressing the ON key.

Setting Up Telemetry Communications

The telemetry module can receive ECG signals from any one of approximately 200 different remote transmitters. Each remote telemetry transmitter is assigned a unique ID number at the factory. The transmitter ID must be recognized by the telemetry module in order to display the patient's ECG waveform on the monitor's screen. The following procedure is used to setup telemetry communications with the ESCORT II monitor.

Configuration

The Telemetry Module allows the user to select the transmitter type. MDD (MDE Digital UHF), MDE (MDE Analog UHF), and HP (HP Analog UHF) type transmitters may be used. Each of these transmitters has different capabilities. The following table presents the features of each transmitter type.

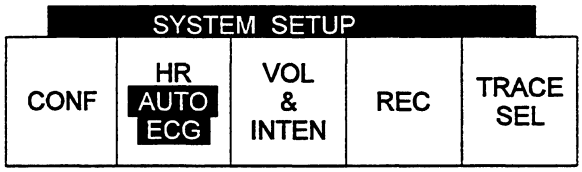
Table 14-1: Telemetry Transmitter Features

TRANSMITTER TYPE	SCREEN TEXT	PACER DETECT	REMOTE RECORD	LOW BATTERY	CHECK LEADS	3-LEAD/ 5-LEAD
MDE Digital UHF	MDD	Yes	Yes	Yes	Yes	Both
MDE Analog UHF	MDE	Yes	Yes	Yes	No	3-lead
HP Analog UHF	HP	No	No	No	No	3-lead

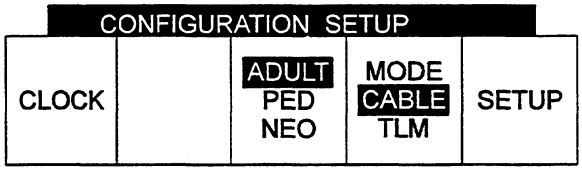
Note: ***Synchronization with an external defibrillator is not possible when an MDE Digital Transmitter is used as the source for the ECG waveform.***

To access these channels, perform the following steps:

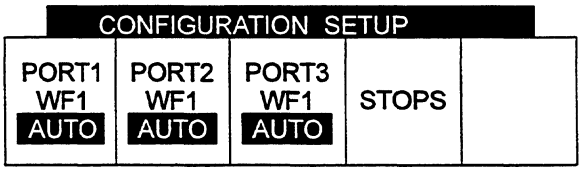
1. Press the NEXT PAGE softkey. The following SYSTEM SETUP menu will appear:



2. Press the CONF softkey.
3. Press the YES softkey when prompted "ARE YOU SURE?". The following CONFIGURATION SETUP page is displayed:



4. Press the SETUP softkey.
5. Press the YES softkey when prompted "ARE YOU SURE?". The following CONFIGURATION SETUP page is displayed:



6. Press the STOPS softkey. The following page appears:

MDE		CH	ALL	SET
MFG ∧∧		CHAN ∧∧	CHAN ∨∨	STOP CLR SET

7. Press the MFG softkey to select the desired transmitter type, as described in the beginning of this section. Press the CHAN ∧∧ softkey to select higher channel numbers or the CHAN ∨∨ softkey to select the lower channel numbers. Press the STOP softkey to select CLR or SET channel.

Note: ***To clear all stops stored in memory, press the NEXT PAGE function key, and then press the CLEAR ALL STOPS softkey. When prompted "ARE YOU SURE?", press the YES softkey. Pressing the EDIT STOPS softkey will revert to the previous telemetry setup page.***

Verify/Set the Telemetry Channel

Note: ***The "telemetry-monitored" patient must be adequately prepared for proper telemetry function. Hospital personnel has the option of using either 3-lead or 5-lead monitoring depending on the type of transmitter used (see Table 14-1). In either case, proper lead attachment must be achieved with correct ECG electrodes. After the patient has been prepared, the transmitter is strapped onto the body of the patient using a transmitter pouch.***

The following steps describe how to verify and/or change the monitor's frequency mode:

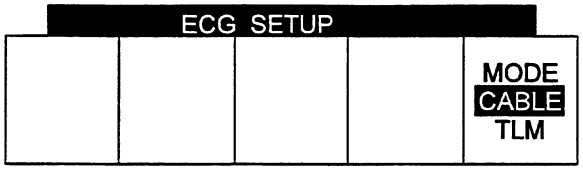
1. From the HOME PAGE state, press the softkey that corresponds to ECG. The following ECG SETUP page is displayed:

ECG SETUP				
ALM ON OFF	ALM LIM	SIZE	LEAD SEL	MM/S 25 12.5

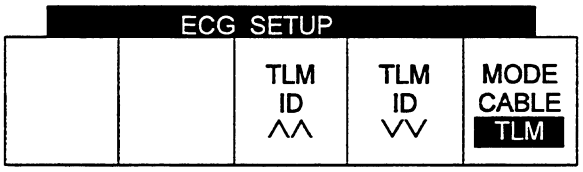
2. Press the NEXT PAGE softkey. The following ECG SETUP page is displayed:

ECG SETUP				
TONE ON OFF	CAL	PACE ON OFF	FILT ON OFF	ECG ON OFF

3. Press the NEXT PAGE softkey again. The following ECG SETUP page is displayed:



4. Press the MODE softkey to select TLM (Telemetry). The following ECG SETUP page is displayed:



5. Press the TLM ID ∧∧/∨∨ softkey to select the transmitter ID of the patient.

Allow a couple of seconds for each channel to settle. The ECG waveform of the patient being monitored will appear on the display together with the heart rate.

The channel ID of the transmitter is displayed in the upper area of the monitor's screen, just to the right of the ADULT/NEO/PED mode indication. If the receiver loses communication with the transmitter, the SIGNAL message will be displayed. After communication is established, the SIGNAL message will disappear from the parameter message area for the ECG parameter.

WARNING: Telemetry ID and lead selection on the monitor must be identical to that of the remote transmitter. Incorrect settings may cause the ESCORT II to display ECG information from a different patient that is assigned to another telemetry ID number.

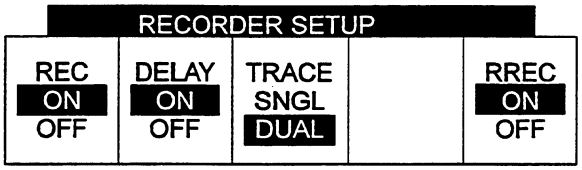
*Note: **The ESCORT II monitor will display a squelch, or triangular, waveform when excessive signal noise is present, when the transmitter is out of range, or when the transmitter battery is depleted. This waveform is displayed in lieu of a noisy ECG waveform which could cause unnecessary alarms.***

*Note: **The ESCORT II monitor can default to CABLE (standard ECG cable with electrodes), TELM (telemetry), or LAST via system setup. See Chapter 15, "System Defaults & Messages," for details. If LAST is selected, the ESCORT II will power-up to either CABLE or TELM depending on what was last used as an ECG source.***

Recording the Telemetry ECG Waveform

A push button is provided at the top of the patient's transmitter. To record the ECG output waveform, press the push button. A pulse is sent to the telemetry module to initiate a 16-second remote recording. The time, date, transmitter ID, ECG waveform, and additional information will be printed on the recording strip.

Remote recording must first be enabled at the ESCORT II monitor from the RECORDER SETUP page, which appears as follows:



Press the RREC (Remote Record) softkey to select ON. Telemetry recording will now be activated.

Note: ***The factory default for the remote record feature is set to OFF. The default may be configured to power up in the ON status. See Chapter 15, "System Defaults & Messages," for details on changing the power up defaults.***

Note: ***For detailed recorder setup, see Chapter 5, "Setup and Operation," in the ESCORT II 100 Operator's Manual.***

15 SYSTEM DEFAULTS & MESSAGES

15.1 Default Settings

When the ESCORT II monitor is powered on for the first time, it will be in the Neonatal mode, and all parameters will be set to their factory defaults. Factory defaults are tabulated for each parameter on the following pages. Furthermore, each parameter's defaults are listed for adult, pediatric, and neonatal modes (ADULT, PED, NEO). All parameter and system defaults may be user-configured. Configuration is discussed in section 15.2, "Changing Parameter and System Defaults."

WARNING: The alarms for some parameters are factory set to default to the OFF setting. This may not be consistent with the policies of your institution or the type of patients being monitored by the ESCORT II.

Table 15-1: System Factory Defaults

SYSTEM DEFAULTS	SCREEN MESSAGE	ADULT	PEDIATRIC	NEONATAL
Factory Defaults	FACTORY DEFAULTS	NO	NO	NO
Record Delay Time	RECD DELAY	ON	ON	ON
Alarm Recording	ALRM RECDNG	ON	ON	ON
Dual Recording	DUAL RECDNG	ON	ON	ON
Alarm Volume	ALRM VOLUME	7	7	7
Tone Volume	TONE VOLUME	4	4	4
Trace 2	TRACE 2	Auto	Auto	Auto
Trace 3	TRACE 3	Auto	Auto	Auto
HR Source	HR SOURCE	Auto	Auto	Auto
Alarm Suspend	ALM SUSPND	180	90	60
Parameter Labels	PRAM LABELS	ON	ON	ON
Clock Display	CLOCK DISPLY	OFF	OFF	OFF
Cable/Telemetry	CABLE/TELM	CABLE	CABLE	CABLE
Remote Record	REMOTE RECD	OFF	OFF	OFF
Alarm Flash	ALARM FLASH	ON	ON	ON
Intensity	INTENSITY	5	5	5

Table 15-2: ECG Factory Defaults

ECG DEFAULTS	SCREEN MESSAGE	ADULT	PEDIATRIC	NEONATAL
Alarms	ALARMS	ON	ON	ON
Latch Alarms	LATCH ALARMS	OFF	OFF	OFF
High Limit	HIGH LIMIT	140	180	200
Low Limit	LOW LIMIT	50	80	100
Parameter Available	PRAM AVAIL	ON	ON	ON
Parameter ON/OFF	PRAM ON/OFF	ON	ON	ON
Record On Alarm	RCD ON ALARM	WF	WF	WF
Filter	FILTER	ON	ON	ON
Size Vector 1	SIZE VCTR 1	1.00	0.80	0.80
Size Vector 2	SIZE VCTR 2	1.00	0.80	0.80
Sweep Speed	SWEEP SPEED	25	25	25
Pace Detect	PACE DETECT	OFF	OFF	OFF
Lead Select	LEAD SELECT	II	II	II
5 Lead	5 LEAD	OFF	OFF	OFF
QRS Tone	QRS TONE	OFF	OFF	OFF
Waveform On	WAVEFORM ON	ON	ON	ON

Table 15-3: Respiration Factory Defaults

RESPIRATION DEFAULTS	SCREEN MESSAGE	ADULT	PEDIATRIC	NEONATAL
Alarms	ALARMS	OFF	ON	ON
Latch Alarms	LATCH ALARMS	OFF	OFF	OFF
High Limit	HIGH LIMIT	OFF	OFF	OFF
Low Limit	LOW LIMIT	5	5	5
Parameter Available	PRAM AVAIL	ON	ON	ON
Parameter ON/OFF	PRAM ON/OFF	OFF	ON	ON
Record On Alarm	RCD ON ALARM	WF	WF	WF
Respiration Size	RESP SIZE	1.00	0.77	0.57
Sweep Speed	SWEEP SPEED	12.5	12.5	12.5
Apnea Delay	APNEA DELAY	20	20	20
CVA	CVA	ON	ON	ON
Tone	TONE	OFF	OFF	OFF
CRG Scales	CRG SCALES	ON	ON	ON

Table 15-4: SpO_2 Factory Defaults

SPO2 DEFAULTS	SCREEN MESSAGE	ADULT	PEDIATRIC	NEONATAL
Alarms	ALARMS	OFF	ON	ON
Latch Alarms	LATCH ALARMS	OFF	OFF	OFF
Alarm Tone	ALARM TONE	STD	STD	STD
High Limit	HIGH LIMIT	100	100	95
Low Limit	LOW LIMIT	85	85	80
Parameter Available	PRAM AVAIL	ON	ON	ON
Parameter ON/OFF	PRAM ON/OFF	OFF	ON	ON
Record On Alarm	RCD ON ALARM	WF	WF	WF
Tone	TONE	OFF	OFF	OFF
Tone Range	TONE RANGE	WIDE	WIDE	WIDE
Mode	MODE	NORM	NORM	NORM
C-Lock	C-LOCK	OFF	OFF	OFF

Table 15-5: Invasive Blood Pressure #1 (BP1) Factory Defaults

BP1 DEFAULTS	SCREEN MESSAGE	ADULT	PEDIATRIC	NEONATAL
Alarms	ALARMS	OFF	OFF	OFF
Latch Alarms	LATCH ALARMS	OFF	OFF	OFF
Systolic High Limit	SYS HI LIMIT	170	130	100
Systolic Low Limit	SYS LO LIMIT	90	65	50
Diastolic High Limit	DIA HI LIMIT	100	90	70
Diastolic Low Limit	DIA LO LIMIT	50	40	30
Mean High Limit	MN HI LIMIT	120	100	80
Mean Low Limit	MN LO LIMIT	60	50	35
Parameter Available	PRAM AVAIL	ON	ON	ON
Parameter ON/OFF	PRAM ON/OFF	OFF	OFF	OFF
Record On Alarm	RCD ON ALARM	WF	WF	WF
Size	SIZE	180	180	180
Scale	SCALE	OFF	OFF	OFF
Displayed Values	DISPD VALUES	S/D	S/D	S/D

Table 15-6: Invasive Blood Pressure #2 (BP2) Factory Defaults

BP2 DEFAULTS	SCREEN MESSAGE	ADULT	PEDIATRIC	NEONATAL
Alarms	ALARMS	OFF	OFF	OFF
Latch Alarms	LATCH ALARMS	OFF	OFF	OFF
Systolic High Limit	SYS HI LIMIT	50	40	20
Systolic Low Limit	SYS LO LIMIT	20	5	5
Diastolic High Limit	DIA HI LIMIT	25	15	10
Diastolic Low Limit	DIA LO LIMIT	5	00	00
Mean High Limit	MN HI LIMIT	30	25	15
Mean Low Limit	MN LO LIMIT	10	5	5
Parameter Available	PRAM AVAIL	ON	ON	ON
Parameter ON/OFF	PRAM ON/OFF	OFF	OFF	OFF
Record On Alarm	RCD ON ALARM	WF	WF	WF
Size	SIZE	30	30	30
Scale	SCALE	OFF	OFF	OFF
Displayed Values	DISPD VALUES	S/D	S/D	MEAN

Table 15-7: Noninvasive Blood Pressure (NIBP) Factory Defaults

NIBP DEFAULTS	SCREEN MESSAGE	ADULT	PEDIATRIC	NEONATAL
Alarms	ALARMS	OFF	OFF	OFF
Latch Alarms	LATCH ALARMS	OFF	OFF	OFF
Systolic High Limit	SYS HI LIMIT	170	130	100
Systolic Low Limit	SYS LO LIMIT	90	65	50
Diastolic High Limit	DIA HI LIMIT	100	90	70
Diastolic Low Limit	DIA LO LIMIT	50	40	30
Mean High Limit	MN HI LIMIT	120	100	80
Mean Low Limit	MN LO LIMIT	60	50	35
Parameter Available	PRAM AVAIL	ON	ON	ON
Parameter ON/OFF	PRAM ON/OFF	ON	ON	ON
Record On Alarm	RCD ON ALARM	WF	WF	WF
Auto	AUTO	OFF	OFF	OFF
Interval	INTERVAL	5 Min	5 Min	5 Min
1st Inflate	1ST INFLATE	170	140	90
Table Display	TABLE DSPLY	OFF	OFF	OFF
Displayed Values	DISPD VALUES	S/D	S/D	S/D
Tone	TONE	ON	ON	ON

Table 15-8: $ETCO_2$ Factory Defaults

ETCO2 DEFAULTS	SCREEN MESSAGE	ADULT	PEDIATRIC	NEONATAL
Alarms	ALARMS	OFF	OFF	OFF
Latch Alarms	LATCH ALARMS	OFF	OFF	OFF
High Limit	HIGH LIMIT	50	50	50
Low Limit	LOW LIMIT	25	25	25
ICO2 Limit	ICO2 LIMIT	8	8	8
Parameter Available	PRAM AVAIL	ON	ON	ON
Parameter ON/OFF	PRAM ON/OFF	OFF	OFF	OFF
Record On Alarm	RCD ON ALARM	WF	WF	WF
Scale	SCALE	50	50	50
Units	UNITS	mmHg	mmHg	mmHg
O2 Compensate	O2 COMPNSAT	OFF	OFF	OFF
N2O Compensate	N2O COMPNSAT	OFF	OFF	OFF

Table 15-9: Temperature Factory Defaults

TEMPERATURE DEFAULTS	SCREEN MESSAGE	ADULT	PEDIATRIC	NEONATAL
Alarms	ALARMS	OFF	OFF	OFF
Latch Alarms	LATCH ALARMS	OFF	OFF	OFF
High Limit	HIGH LIMIT	38.0° C	38.0° C	37.5° C
Low Limit	LOW LIMIT	36.0° C	36.0° C	36.0° C
Parameter Available	PRAM AVAIL	ON	ON	ON
Parameter ON/OFF	PRAM ON/OFF	OFF	OFF	OFF

Table 15-10: Cardiac Output Factory Defaults

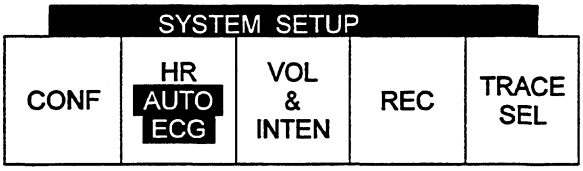
CO DEFAULTS	SCREEN MESSAGE	ADULT	PEDIATRIC	NEONATAL
Parameter Available	PRAM AVAIL	ON	ON	ON
Computational Constant	CONSTANT	0.470	0.470	0.470
Parameter On/Off	PRAM ON/OFF	OFF	OFF	OFF
Right Ejection Fraction	REF ON/OFF	ON	ON	ON
Display Timeout	DISP TIMEOUT	OFF	OFF	OFF

15.2 Changing the Parameter and System Defaults

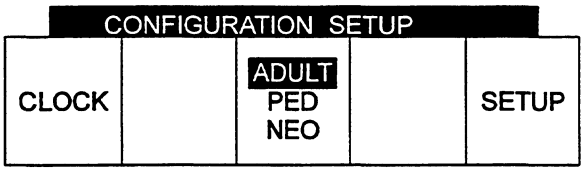
The ESCORT II 100 monitor allows you to tailor the parameter and system default settings to suit your specific monitoring needs. It is important to recognize that changes made to these functions determine the status of those functions upon every subsequent power-up. As a result, default settings should not be changed unless the setting will be desired on a regular basis.

Perform the following steps to access the CONFIGURATION SETUP pages:

1. Press the PAGE HOME key to ensure the ESCORT II's home page is displayed.
2. Press the NEXT PAGE key to access the setup page listed below.

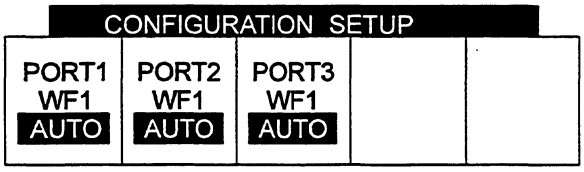


3. Press the CONF softkey.
4. Press the YES softkey to access the setup page listed below.



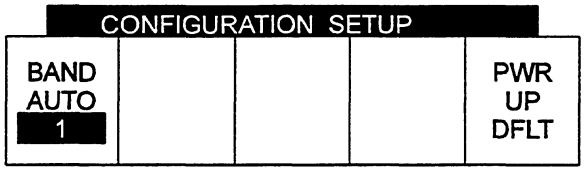
Note: See Chapter 5 of the ESCORT II 100 Operator's Manual, "Setup and Operation," for instructions pertaining to the CLOCK and ADULT/PED/NEO functions.

5. Press the SETUP softkey.
6. Press the YES softkey to access the setup page listed below.



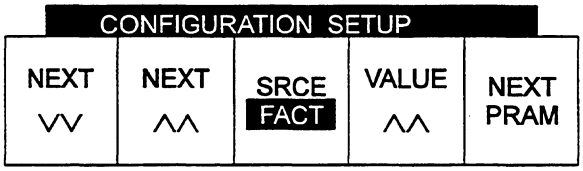
Note: See Section 4.3, "High Level Outputs," for instructions pertaining to the PORT 1/2/3 functions.

7. While the PORT 1/2/3 softkeys are displayed, press the NEXT PAGE key. The following configuration page will be displayed.



Note: See Chapter 14, "ESCORT II Modules," for instructions pertaining to the BAND function.

8. Press the PWR UP DFLT softkey to access the CONFIGURATION SETUP page shown below. This page contains function keys which may be used to modify the factory defaults to a user-defined configuration. Each of the available softkeys are explained in the following paragraphs.



- Use the NEXT VV and NEXT AA softkeys to move vertically through the list of default functions until you have highlighted the function you want to change.
- The SRCE (Source) softkey toggles between FACT (Factory) and CONF (user-configured) values for each default function. Pressing the VALUE AA softkey for any function which currently has a factory setting will automatically change the SRCE key from FACT to CONF. The SRCE softkey is especially useful for returning any functions currently with a user-configured value back to the factory default; simply press the SRCE softkey to toggle the SRCE label to FACT, and the configured default value will return to the factory default setting.
- Use the VALUE AA softkey to change the setting of the highlighted parameter function. The VALUE AA softkey toggles between two possible settings, such as ON/OFF, or adjusts a numeric value. Once a numeric value reaches its maximum value, the setting rolls over to start at the minimum level.
- Use the NEXT PRAM softkey to display the configuration page for the next parameter. There is a CONFIGURATION SETUP page for each parameter as well as a general SYSTEM SETUP page that does not apply to any one specific parameter.

*Note: **The display of the configuration pages will timeout and return you to HOME PAGE state if you do not use a function key within a three minute interval. If you have completed your default changes and want to return to HOME PAGE state, press either the PAGE HOME key or the NEXT PAGE key. Remember, these settings apply to power-up defaults; therefore any changes made will not be implemented until you have first powered down the monitor, and then turned it back ON.***

15.3 System and Parameter Messages

System and parameter messages remind, prompt, or warn you about the current condition of the monitor or its parameters. These messages are displayed in reverse video and may flash on and off to get your attention.

System Messages

The system messages, explained in Table 15-11, are displayed in the lower left area of the screen, just above the numeric display zone. They apply to conditions of the monitor that are not specific to any one parameter.

Table 15-11: System Messages

SYSTEM MESSAGE	MEANING
RECORDER PAPER	The recorder is out of paper, or the paper is installed incorrectly.
REC DISABLES FREEZE	You are trying to freeze waveforms while recording is in progress. You can only freeze waveforms when they are not being recorded.
REC IN CONT RUN MODE	Indicates that you have pressed and held the RECORD key so that the recorder will run continuously. Press the RECORD key again to end continuous recording.
FREZ RELEASES FREZ	Waveforms are currently frozen. To release the frozen waveforms, you must press either the FREEZE or the RECORD key.
LINK RECORD SENT	A recording has been sent to the ESCORT - LINK Central Station because the recorder at the ESCORT II monitor is either not present or out of paper.
ALARM SUSPEND XXX	You have pressed the ALARM SUSPEND key, disabling all alarm tones for the number of seconds (XXX) displayed. To enable alarm tones before the suspend time has expired, press the ALARM SUSPEND key again. The ALARM SUSPEND function is also enabled at power-up.

Battery Messages

When the ESCORT II is operating on battery power, one of the following messages will be temporarily displayed on the system message line when the monitor is turned ON. Battery messages may also be viewed within the TEST SETUP menu. See Section 2.5, "Power Sources," for details.

Table 15-12: Battery Messages

MESSAGE	BATTERY LEVEL
MONITOR BAT HI	> 60% Charge
MONITOR BAT MID	20-60% Charge
MONITOR BAT LOW	< 20% Charge
BATTERY VERY LOW (Intermittent Alarm Tone Sounds)	Approximately 10 minutes of battery life remains

Parameter Messages

The following tables explain messages that are parameter specific. Messages that apply to parameters in the waveform display area are displayed just to the right of the numerics for that parameter. All messages that apply to parameters in the numeric-only zone are displayed in the numeric display area. See Chapter 2, "Controls and Indicators," for details.

Table 15-13: ECG/Respiration Messages

ECG/RESP MESSAGE	MEANING
CVA	Cardiovascular artifact (CVA) coincidence has been detected on respiration. Respiration will reject coincident respiration while the message is displayed. At least 8 out of 10 coincident respirations are required to initiate and maintain the CVA message.
APNEA	The apnea alarm limits have been exceeded.
APN ALM OFF	Respiration alarms are on, but apnea alarm is OFF.
CHK LEADS	One or more electrodes or lead wires may be dry or loose. In addition to the message, the ECG waveform and the respiration waveform, if it is displayed, become dotted lines.

Table 15-14: SpO_2 Messages

SPO2 MESSAGE	MEANING
SPO2 SRCH	The monitor cannot locate the patient's pulse. The patient's perfusion may be too poor to detect an acceptable pulse. Confirm proper application of the sensor; make sure the ECG parameter is available for C-LOCK synchronization; try another sensor site; or try the OXISENSOR II R-15 sensor.
NO C-LOCK	Indicates loss of synchronization between the ECG and SPO2 pulse waveform. Take steps to eliminate ECG artifact, or if the R-wave amplitude is less than 4 mm, increase the ECG waveform size by using the ECG SIZE function key.
NO SENSOR	The SPO2 parameter is ON, but the sensor and/or sensor cable are not connected to the monitor.
SPO2 CAL	The monitor is performing automatic self-calibration. The calibration range is 50 to 100%.

Table 15-15: Invasive Blood Pressure (BP1/BP2) Messages

BP1/BP2 MESSAGE	MEANING
NO XDUCER	The pressure transducer is not connected to the monitor.
ZERO BP1 ZERO BP2	Message flashes until the pressure channel is zeroed as a reminder that pressures must be zeroed prior to use.
NO ZERO: PULSE DETECT	Displayed over the BP SETUP page to indicate that either a pulse or electrical noise was detected which precluded zeroing the transducer. Confirm that the transducer is vented to air before pressing the ZERO key.
ZERO OUT OF RANGE	Displayed over the BP SETUP page to indicate that a transducer's offset exceeds the zero range (±100 mmHg) of the monitor. Confirm that the transducer is vented to air and attempt to zero again.

Table 15-16: Noninvasive Blood Pressure (NIBP) Messages

NIBP MESSAGE	MEANING
ET = MM:SS	Indicates elapsed time (ET) since last NIBP measurement.
AET = MM:SS	Indicates elapsed time since last NIBP measurement while auto timer is on.
AUTO	Monitor is in NIBP AUTO mode.
CUFF = XXX	Displays as the cuff inflates and deflates, giving the pressure in mmHg.
LOW OSCIL	Oscillation amplitudes are too low to obtain measurement.
ARTIFACT	Excessive artifact precluded measurement within a 145 second timeout.
MAX 2 LOW	Cuff inflation was too low to take a reading. May indicate either incorrect operating mode (ADULT, PED, NEO) or a need to increase the initial inflation.
CHECK CUF	40 second timeout exceeded for inflation to at least 20 mmHg.

Table 15-17: Mainstream $ETCO_2$ Messages

ETCO2 MESSAGE	MEANING
NO SENSOR	No sensor connected.
WARM UP	Sensor is warming up to operating temperature of 42° C.
START UP	Sensor is starting to take initial readings.
LOW SIG	Probable obstruction of airway adapter.
OCCLUSION	Foreign matter in airway adapter.
BAD SENSOR	Hardware problem with the sensor.
CO2 ERROR	The CO2 parameter hardware is not functioning properly.

Table 15-18: Sidestream $ETCO_2$ Messages

ETCO2 MESSAGE	MEANING
NO SENSOR	No sensor connected.
WARM UP	Sensor is warming up to operating temperature of 42° C.
START UP	Sensor is starting to take initial readings.
LOW SIG	Probable obstruction of airway adapter.
OCCLUSION	Foreign matter in airway adapter.
BAD SENSOR	Hardware problem with the sensor.
CO2 ERROR	The CO2 parameter hardware is not functioning properly.
NO FILTER	No watertrap filter.
FILT OCCU	Filter occlusion.
EXH OCCU	Exhaust occlusion.
PUMP ERR	Pump error.
5V FAULT	5V power supply fault.
GEN FAULT	Hardware error.

Table 15-19: Cardiac Output (CO) Messages

CO MESSAGE	MEANING
NO CATH	No catheter connected to the monitor.
NO PROBE	No temperature probe (bath or injectate) connected to the monitor.
^^RANGE ^^	Signal over range.
VVRANGE VV	Signal under range.
<< RANGE >>	Cardiac output out of range.
BASELINE	Noisy baseline detected.
IRG CURVE	Irregular curve detected.
PEAKS	Multiple curve peaks detected.
INJ LATE	Delayed injection detected.
DRIFT	Excessive thermal drift detected.
SHORT CUR	Short thermodilution curve detected.
LONG CURV	Long thermodilution curve detected.
WARM H2O	Warm H2O for injectate or bath detected.
NO ECG	No ECG signal detected by the monitor.
<< EF HR >>	REF HR out of range.
IRG ECG	Irregular rhythm.
<< CO EF >>	REF out of range.
FAST DROP	Fast drop curve.
EF EARLY	Premature beat.
EF LATE	Delayed beat.
<< BOLUS >>	REF post bolus out of range.
RUNS FULL	Maximum number of runs performed.
DELETED	Measurement run deleted.

A Spcifications

Appendix A

SPECIFICATIONS

DISPLAY

Type: CRT non-fade P31
Size: 6" (15.2 cm) diagonal
Number of Traces: 3
Trace Length: 3.2 sec @ 25 mm/sec

FRONT PANEL KEY FUNCTIONS

Freeze, Record, Alarm Suspend, Alarm Set Up, Page Home,
Next Page, 8 Softkeys, On/Standby

ECG

Range: 10 to 300 BPM
Accuracy: ± 2% or ± 2 BPM
Sweep Speed: 12.5, 25, 50 mm/sec selectable

High Alarm Limit Range:	50 to 250 BPM in 5 BPM steps	ADULT
	60 to 255 BPM in 5 BPM steps	PED/NEO
Low Alarm Limit Range:	20 to 150 BPM in 5 BPM steps	ADULT
	20 to 150 BPM in 5 BPM steps	PED/NEO

Bandwidth: 0.5 to 40 Hz (monitor); 0.05 to 100 Hz (diagnostic)
Leads: 3 lead: I, II, or III selectable
5 lead, dual vector: I, II, or III, and V selectable
Sensitivity: 0.25 to 3 mV/cm selectable (12 levels)
Pacer Rejection: 0.1 to 2 msec; 2 to 700 mV
Heart Rate Source: ECG, Pleth, IBP
Defibrillation Tolerance: 400 joule with 50 ohm series lead impedance
Connector: Standard 6 pin MS
Isolation: Full electrical isolation

RESPIRATION

Range: 4 to 200 BPM
Accuracy: ± 2% or ± 2 BPM
Lead: RA to LA
Sensitivity: 0.25 to 3 ohm/cm selectable

High Alarm Limit Range:	30 to 150, OFF	ADULT
	50 to 200, OFF	PED/NEO
Low Alarm Limit Range:	5 to 50, OFF	ADULT
	5 to 80, OFF	PED/NEO
Apnea Delay Alarms:	10, 15, 20, 30, 40 seconds, and OFF	ADULT
	10, 15, 20 seconds, and OFF	PED/NEO

Sweep Speed: 1.56, 6.25, 12.5, 25 mm/sec selectable
Respiration Rate Source: $ETCO_2$ or Leads
CVA Rejection: Rejects most cardiovascular coincidence

SpO_2

Display: % SpO_2, Plethysmographic Waveform or Pulse Amplitude Bar
SpO_2 Range: 20 to 100%
SpO_2 Accuracy: Adult 70 to 100% ± 2%; 50 to 69% ± 3%
Neonatal 70 to 94% ± 3%
Pulse Rate Range: 35 to 250 BPM
Pulse Rate Accuracy: ± 3 BPM
High Alarm Limit Range: 70 to 100% ADULT/PED/NEO
Low Alarm Limit Range: 50 to 99% ADULT/PED/NEO
Sensors: Neonatal to Adult (NELLCOR)
Pulse Tone: Pitch varies with SpO_2
ECG Sync: NELLCOR C-Lock®

INVASIVE BLOOD PRESSURE

Channels: 1 or 2
Range: -40 to 300 mmHg
Accuracy: ± 1 % or ± 1 mmHg
Alarms: SYS, DIAS, and MEAN selectable in 5 mmHg steps

Systolic Alarm Limit Range:	High	40 to 240 mmHg	ADULT
		5 to 210 mmHg	PED/NEO
	Low	0 to 150 mmHg	ADULT
		0 to 120 mmHg	PED/NEO
Diastolic Alarm Limit Range:	High	20 to 180 mmHg	ADULT
		5 to 150 mmHg	PED/NEO
	Low	0 to 120 mmHg	ADULT
		0 to 90 mmHg	PED/NEO
Mean Alarm Limit Range:	High	20 to 200 mmHg	ADULT
		5 to 170 mmHg	PED/NEO
	Low	0 to 130 mmHg	ADULT
		0 to 100 mmHg	PED/NEO

Sweep Speed: 12.5, 25, 50 mm/sec selectable
Display Scale: 15, 30, 60, 120, 180, 240 mmHg selectable
Input Connector: Standard 6 pin MS; 5 µV/V/mmHg

NIBP

Measurement method: Oscillometric

Measurement range:	Systolic	30 to 270 mmHg	ADULT
		30 to 145 mmHg	PED/NEO
	Diastolic	20 to 240 mmHg	ADULT
		20 to 130 mmHg	PED/NEO
	Pulse Rate	30 to 250 BPM	ADULT/PED/NEO

Measurement time: 40 seconds typical
Manual Operation: initiated via START key.
Automatic Operation: STAT, 1, 2, 3, 4, 5, 10, 15, 30, 45 minutes,
1, 2, 3, 4 hours

1st Cuff Inflation:	90 to 220 mmHg selectable	ADULT
	60 to 150 mmHg selectable	PED/NEO

Subsequent Inflations: Systolic +25 mmHg
Alarms: SYS, DIAS, and MEAN selectable in 5 mmHg steps

Systolic Alarm Limit Range:	High	100 to 240 mmHg	ADULT
		70 to 210 mmHg	PED/NEO
	Low	50 to 150 mmHg	ADULT
		25 to 120 mmHg	PED/NEO
Diastolic Alarm Limit Range:	High	80 to 180 mmHg	ADULT
		50 to 150 mmHg	PED/NEO
	Low	30 to 120 mmHg	ADULT
		10 to 90 mmHg	PED/NEO

Mean Alarm Limit Range:	High	90 to 200 mmHg	ADULT
		60 to 170 mmHg	PED/NEO
	Low	40 to 130 mmHg	ADULT
		15 to 100 mmHg	PED/NEO

System Accuracy: ± 5 mmHg Mean; ± 8 mmHg Standard Deviation
Cuff sizes: Thigh, Large Adult, Adult, Child, Infant, Neo sizes 1, 2, 3, 4

Mainstream $ETCO_2$

Type: Mainstream, NDIR single-beam, ratiometric
Sensor Size: 0.78 x 1.036 x 1.003 inches/1.98 x 2.63 x 2.55 cm (LWD)
Sensor Weight: < 10 gm, excluding cable
Airway Adapter Dead Volume: < 6 cc (Std); 0.6 cc (Neo)
Altitude/Barometric Pressure Compensation: Automatic
Warm Up: 45 seconds typical
Range: 0 to 99 mmHg
Accuracy: ± 2 mmHg or ± 5% of reading
Sweep Speed: 1.56, 6.25, 12.5, 25 mm/sec selectable
Display Scale: 50, 75, 100 mmHg

High Alarm Limit Range:	20 to 100 mmHg	ADULT/PED/NEO
	3 to 13 %	ADULT/PED/NEO
Low Alarm Limit Range:	5 to 50 mmHg	ADULT/PED/NEO
	1 to 7%	ADULT/PED/NEO

High Limit Inspired CO_2: 4 to 12 mmHg, selectable
Response Time: < 60 msec max, 30 msec typical
Calibration: None required; annual check recommended
O_2 and N_2O Compensation: Independently selectable

Sidestream $ETCO_2$

Type: Sidestream, NDIR single-beam, ratiometric
Sensor Size: 6.3 x 3.15 x 2.17 inches/160 x 80 x 55 cm (LWD)
Sensor Weight: 1.5 lbs/680 mg including cable
Altitude/Barometric Pressure Compensation: Automatic
Warm Up: 45 seconds typical
Range: 0 to 99 mmHg
Accuracy: ± 2 mmHg or ± 5% of reading below 77 mmHg, 10% above 77 mmHg
Respiration Rate: 0 to 40 breaths per minute
Sweep Speed: 1.56, 6.25, 12.5, 25 mm/sec selectable
Display Scale: 50, 75, 100 mmHg

High Alarm Limit Range:	20 to 100 mmHg	ADULT/PED/NEO
	3 to 13 %	ADULT/PED/NEO
Low Alarm Limit Range:	5 to 50 mmHg	ADULT/PED/NEO
	1 to 7%	ADULT/PED/NEO

High Limit Inspired CO_2: 4 to 12 mmHg, selectable
Sampling Flow Rate: 150 cc/min
Response Time: < 100 msec max
Calibration: None required; annual check recommended
O_2 and N_2O Compensation: Independently selectable

TEMPERATURE

Range: 20 to 50° C
Accuracy: ± 0.1° C

High Alarm Limit Range:	0.1 to 44.0° C	ADULT/PED/NEO
Low Alarm Limit Range:	0.1 to 44.0° C	ADULT/PED/NEO

Probe: YSI 400 or 700, autosensing
Connector: ¼" (0.6 cm) stereo phono jack

CARDIAC OUTPUT (CO)

CO Range: 00.01 to 19.99 liters/minute
CO Accuracy: ± 2% or 0.2 l/m from the mean value whichever is greater
Right Heart Ejection Fraction (REF) Range: 1 to 85%
REF Accuracy: ± 2% as measured by electronically generated pulsatile curves
Stroke Volume (SV): 00 to 500 ml/beat
SV Accuracy: ± 2% (derived from CO)
End Systolic Volume (ESV): 00 to 333 ml
ESV Accuracy: ± 2% (derived from EDV and SV)
End Diastolic Volume (EDV): 00 to 833 ml
EDV Accuracy: ± 2% (derived from SV and REF)
Injectate Temperature (Ti) Range: 00.0 to 27.0° C
Ti Accuracy: ± 0.3° C from 0 to 25° C; ± 0.5° C from 25.5 to 27° C
Blood Temperature (Tb) Range: 17.5 to 43.0° C
Tb Accuracy: ± 0.5° C from 17.5 to 31° C; ± 0.3° C from 31 to 43° C

RECORDER MODULE

Print Method: Thermal array
Channels: Any 1 or 2 waveforms, user selectable
Resolution: 8 dots/mm vertical, 32 dots/mm horizontal
Paper: 40 mm grid; 50 mm width, 100 feet nominal
Sweep Speed: 6.25, 12.5, 25, 50 mm/sec; 1 mm/sec Trend
Manual Record Duration: 16 seconds, 12 seconds memory
Annotation: Time, date, all parameter values, scales, source, speed, alarming parameter

TREND

Parameters: HR, RR, IBP, NIBP, SpO_2, T, $ETCO_2$
Time: 1, 8, 24 hours
OxyCRG Mode: 60 seconds of compressed respiration waveform displayed and recorded with HR & SpO_2 trend
OxyCRG Events: Stores OxyCRG alarm events

HEWLETT-PACKARD CONNECTORS

ECG Connector: 12 pin HP Merlin
Pressure Connector: 12 pin HP (5 µV/V/mmHg)

ESCORT-LINK AutoNet™ TRANSCEIVER MODULE

Indicator: Green light indicates communication status with Central Station
Frequency/Power: Spread Spectrum 902 to 928 MHz/50 mW
Transmission: Bidirectional with seamless auto retry

ESCORT-LINK UHF TRANSCEIVER MODULE

Indicator: Green light indicates communication status with Central Station
Frequency/Power: UHF 450 to 470 MHz/50 mW
Transmission: Bidirectional digital FSK

TELEMETRY ECG RECEIVER MODULE

Frequency Range: 430 to 470 MHz
Sensitivity: 1 µV typical
Available Transmitters: MDE models 1200LR-01, 20013, & 20014

TELEMETRY ECG TRANSMITTER

3-Lead Transmitter (Model 1200LR-01; 450 to 470 MHz)
5-Lead, Dual Vector Transmitter (Model 20013; 450 to 470 MHz)
5-Lead, Dual Vector Transmitter (Model 20014; 430 to 450 MHz)
Power Output: 5 mW (1200LR-01, 20013, 20014)
Signal Outputs: Lead fail, low battery, remote record, pacer
Frequency Response: 0.5 to 40 Hz (standard) 0.05 to 40 Hz (diagnostic)
Size: 1200LR-01: 3.75 x 2.38 x 1 inches/9.5 x 6.1 x 2.5 cm (HWD)
20013 & 20014: 4.5 x 2.9 x 0.9 inches/11.4 x 7.4 x 2.3 cm (HWD)
Weight: 1200LR-01: 0.38 lb (173 gm)
20013, 20014: 0.4 lb (182 gm)
Battery Life: 2 to 4 days, depending upon battery type

POWER

Modular Batteries: 3 each @ 12V, 2.3 AH sealed lead acid, rechargeable
Battery Capacity: 1.75 to 2.5 hours, depending upon configuration
Battery Charge Time: 5 hrs to 90%
AC Main: 115/230 VAC selectable, 48 to 62 Hz autosensing
AC Current: 0.54 A @ 115 VAC; 0.27 A @ 230 VAC
Fuses: Slow blow 800 mA (115 VAC); T400 mA (230 VAC)
External DC In: 12 to 28 VDC, 45 VA
Power: 40 watts

PHYSICAL

Size: 6.75 x 8.5 x 8.5 inches/17.2 x 21.6 x 21.6 cm (HWD)
8.13 x 8.5 x 9.5 inches/20.6 x 21.6 x 24.1 cm (HWD) with batteries
Weight: 12.4 lb (5.6 kg)
Battery Option: Add 6 lb (2.72 kg)
SpO_2 Option: Add 0.13 lb (0.059 kg)
NIBP Option: Add 0.5 lb (0.23 kg)
$ETCO_2$ Option: Add 0.25 lb (0.11 kg)
Recorder Option: Add 1 lb (0.45 kg)
AutoNet™ Spread Spectrum Transceiver Option: Add 0.56 lb (0.26 kg)
ESCORT-LINK UHF Transceiver Option: Add 1.1 lb (0.52 kg)
ECG Telemetry Receiver Option: Add 0.56 lb (0.26 kg)

ENVIRONMENTAL

Operating Temperature: 5 to 40° C
Relative Humidity: 0 to 90% noncondensing
Telemetry Transmitter Operating Temperature: 15 to 40° C
Atmospheric Pressure: 700 to 1060 mbar

STORAGE AND TRANSPORT ENVIRONMENT

Temperature: -40° C to +70° C
Humidity: 10 to 100%, including condensation
Atmospheric Pressure: 500 to 1060 mbar

EQUIPMENT CLASSIFICATION

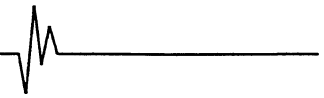
Mode of Operation: Continuous
Type of Protection from Electric Shock: IEC Class I, internally or externally powered
Degree of Protection from Electric Shock: Type CF defibrillation-proof
Degree of Protection from Water: Ordinary equipment

LEAKAGE CURRENT

Ground: < 100 µA
Patient: < 10 µA

ISOLATION VOLTAGE

Patient Isolation Voltage: < 4000 Vrms @ 60 Hz



B Supplies and Accessories

Appendix B

SUPPLIES and ACCESSORIES

The supplies and accessories listed in this section can be ordered by calling Medical Data Electronics at one of the following phone numbers:

(800) 237-5243
or
(818) 768-6411

To make the ordering process smoother, note the model number of the item(s) you are ordering, and be prepared to give the number to MDE personnel.

ITEM DESCRIPTION	PART NUMBER
Recorder Paper (box of 10 rolls)	E2700-32
Recorder Paper (case of 100 rolls)	E2700-54
Monitor Accessory Pouch	E2700-14
Battery (2.3 AH, 12 volt)	E2700-37
External Multiple Battery Charger (110 V)	E2700-12
AC Power Cord Mounting Bracket	E2900-30
NIBP Cuff—Adult Thigh (40.9 - 61.5 cm)	E2800-01
NIBP Cuff—Large Adult (33.0 cm - 50.8 cm)	E2800-02
NIBP Cuff—Adult (27.9 - 41.7 cm)	E2800-03
NIBP Cuff—Pediatric (19.6 - 28.7 cm)	E2800-04
NIBP Cuff—Infant (14.0 - 19.9 cm)	E2800-05
Neonatal Disposable NIBP Cuffs, size 1 (4.4 - 8.3 cm) (box of 10)	E2800-07
Neonatal Disposable NIBP Cuffs, size 2 (4.9 - 9.2 cm) (box of 10)	E2800-08
Neonatal Disposable NIBP Cuffs, size 3 (6.4 - 12.0 cm) (box of 10)	E2800-09
Neonatal Disposable NIBP Cuffs, size 4 (7.0 - 13.1 cm) (box of 10)	E2800-10
Adult/Pediatric Hose Assembly (12 ft.)	E2800-06
Neonatal Hose Assembly (8 ft.)	E2800-11
20100/Defibrillator Interface Cable	E2900-32

ITEM DESCRIPTION	PART NUMBER
NELLCOR® DURASENSOR™	E2800-50
SpO2 Sensor Extension Cable	E2800-63
ETCO2 Airway Adapter - Standard (single use, 10 each)	E2900-20
ETCO2 Airway Adapter - Neonatal (single use, 10 each)	E2900-21
Wall Mount (Complete - channel and arm) (GCX#VB5P-01)	E2700-10
Wall Mount (Less wall channel) (GCX#VB5P-13)	E2700-34
6" Wall Mount Utility Basket (GCX#PS-WB6)	E2700-35
Rolling Stand (GCX#RS5P)	E2700-11
6" Rolling Stand Utility Basket (GCX#RS-WB6)	E2700-36
Patient ECG Cable (Safety 3-Lead) USA (Bl, W, R)	E2900-01
Patient ECG Cable (Safety 5-Lead) USA (Bl, W, R, G, Br)	E2900-02
HP ECG Cable (Safety 3-Lead) (for Option 38) USA (Bl, W, R)	E2700-24
HP ECG Cable (Safety 5-Lead) (for Option 38) USA (Bl, W, R, G, Br)	E2700-25
24" Lead Wires (Safety 3-Lead) (10 sets for E2900-01) USA (Bl, W, R)	E2700-78
24" Lead Wires (Safety 5-Lead) (10 sets for E2900-02) USA (Bl, W, R, G, Br)	E2700-77
24" Neonatal Pinch Clip Lead Wires (Safety 3-Lead) (5 sets) USA (Bl, W, R)	E2700-62
24" Neonatal Pinch Clip Lead Wires (Safety 5-Lead) (5 sets) USA (Bl, W, R, G, Br)	E2700-75
Patient ECG Cable (Safety 3-Lead), IEC (R, Y, G)	E2900-03
Patient ECG Cable (Safety 5-Lead), IEC (R, Y, G, Bl, Br)	E2900-04
24" Lead Wires (Safety 3-Lead) (10 sets for E2900-03), IEC (R, Y, G)	E2700-60
24" Lead Wires (Safety 5-Lead) (10 sets for E2900-04), IEC (R, Y, G, Bl, Br)	E2700-61
24" Neonatal Pinch Clip Lead Wires (Safety 3-Lead) (5 sets), IEC (R, Y, G)	E2700-63
24" Neonatal Pinch Clip Lead Wires (Safety 5-Lead) (5 sets), IEC (R, Y, G, Bl, Br)	E2700-76

ITEM DESCRIPTION	PART NUMBER
ESIS Patient Cable, 5-Lead, USA	E2800-15
ESIS Leadwire Set, 5-Lead, 24", Snap, USA	E2800-26
ESIS Leadwire Set, 3-Lead, 24", Snap, USA	E2800-27
ESIS Patient Cable Substitution for Standard Cable	E2800-15S
9V Lithium Battery (box of 24)	E2700-99
Transmitter Tele-Tote	E2700-09
8.4V Mercury Battery (box of 24)	E2700-04
3-Lead Transmitter Set (for Model 20013)	E2900-09
5-Lead Transmitter Set (for Model 20013)	E2900-10
24" 3-Lead Safety Leadwires for Model 1200LR (10 sets)	E2700-78
Nurse Call Interface Cable (unterminated)	E2900-31
High Level Interface Module	E2900-33
ESCORT II 100 Operator's Manual, English	E9030-50
ESCORT II 100 AT-A-GLANCE Reference Guide, English	E9030-55
ESCORT II 100/300 Inservice Video (1/2" VHS), English	E9030-60
ESCORT II 100/300 Inservice Video (1/2" PAL), English	E9030-61
ESCORT II 100 Service Manual, English	E9040-50