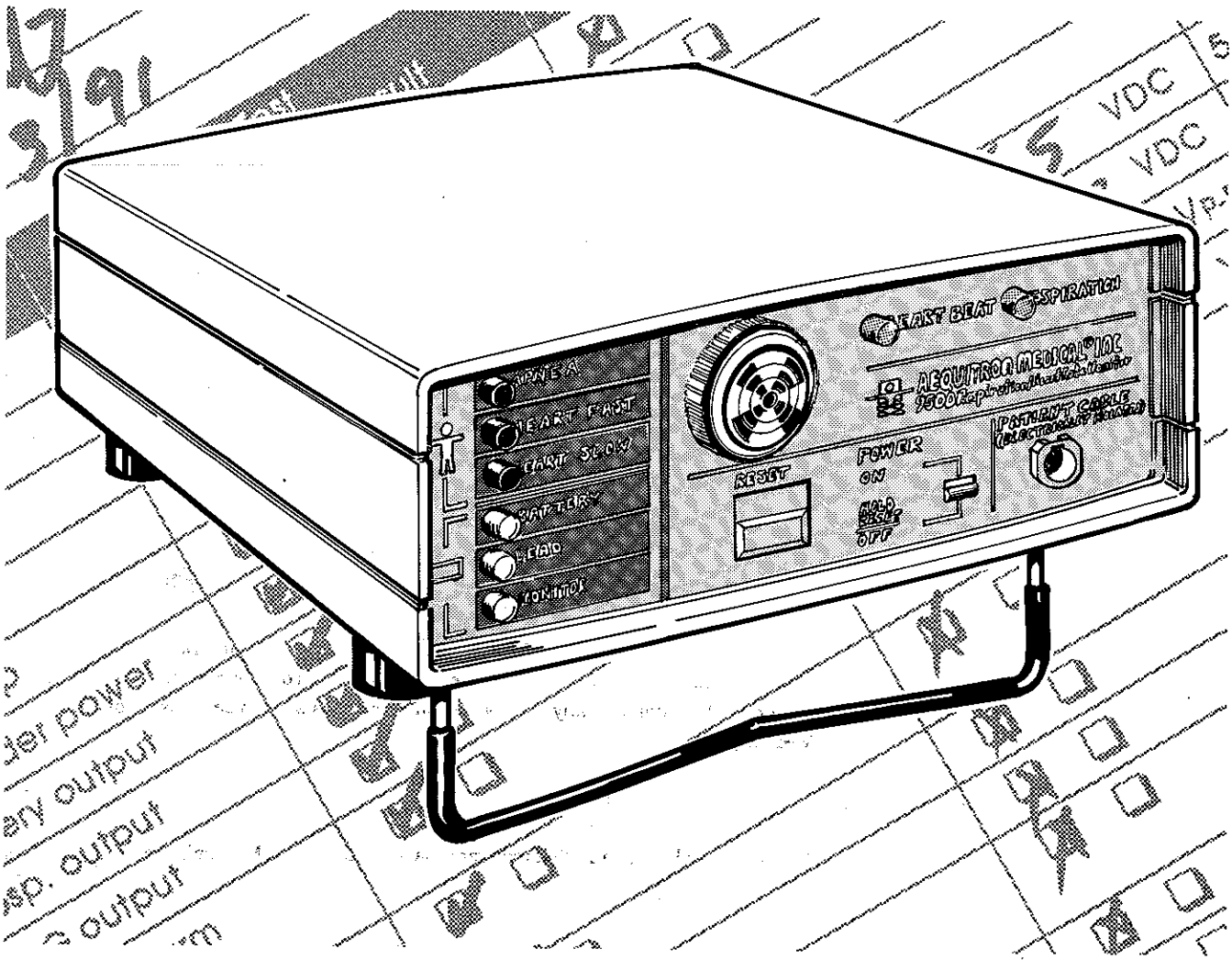
Model 9500/9550
Respiration/Heart Rate Monitor
Technical Manual



AEQUITRON MEDICAL® INC
MINNEAPOLIS, MINNESOTA 55447 U.S.A.

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Contents

Introduction

This manual presents technical and service information about Aequitron Medical Models 9500, 9550, and 9550/50 Respiration/Heart Rate monitors. This manual is intended for use by competent biomedical technicians who have been trained on this product by Aequitron Medical,® Inc. For information on the operation and application of the monitors, see the Dealer's, User's, and Reports Manuals.

Aequitron Medical believes the information herein is complete and accurate, but accepts no liability for errors, omissions, or misrepresentations.

AEQUITRON MEDICAL FURTHER DECLINES ANY WARRANTIES, EXPRESSED OR IMPLIED, FOR THE REPAIRED PRODUCT, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

It is the user's responsibility to ensure that the product is properly maintained and that it is in safe and proper operating condition before it is put into use.

Refer any adjustments or procedures that exceed the scope of this manual to an Aequitron Technical Service Representative by calling:

(800) 497-3787

Chapters

Following is a list of this manual's chapters, with a summary of each. Use this list to guide you to the area of interest.

Theory of Operation A detailed review of the operation of the monitor's circuitry. This chapter describes the monitor down to the functional-block level.

Inspection A procedure to test and verify the operation of all major functions of the monitor. Use this procedure before and after any repairs to a monitor, and as part of periodic inspections of the monitors.

Disassembly A pictorial representation, with accompanying text, of the disassembly of a monitor. Disassembly is shown to the replaceable module level supported by Aequitron Medical.

Schematics Electrical schematics, component locators, and mechanical drawings for the major sub-assemblies of the monitors.

Conventions

Notes, Cautions, and Warnings mean the following throughout this technical manual:

Note Directions that make it easier to use or service the monitor.

Caution Directions that prevent damaging the equipment.

Warning **Directions that warn of hazards to the patient, to a caregiver, or to service personnel.**

Description

The monitor sounds a warning alarm and turns on the appropriate light on the front panel to indicate which alarm occurred. More than one alarm can occur at the same time. In this case, a light turns on for each alarm.

The monitor sounds alarms when it detects:

- A long pause in the patient's breathing effort
- A heart rate that is too fast or too slow
- An equipment problem

Your monitor is a warning system. It does not prevent problems with breathing or heart rate. It sounds an alarm and indicates where the problem is, but YOU must take the necessary action.

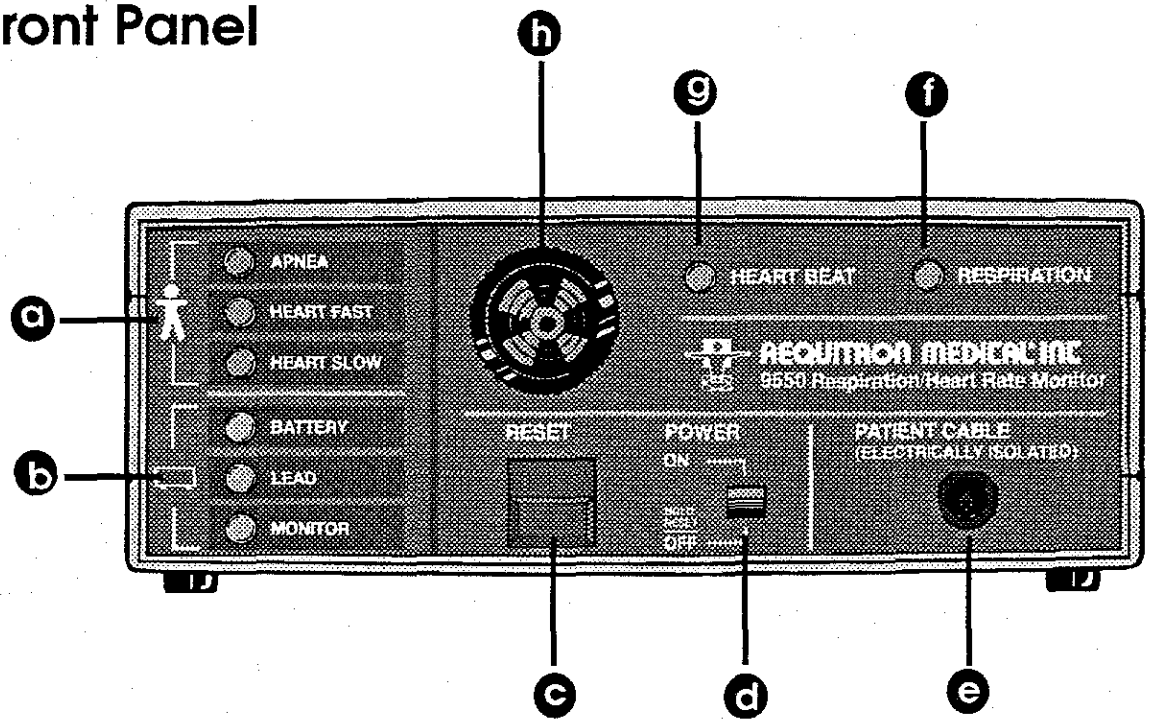
The front panel has:

- Lights for human and equipment alarms
- **RESET** button
- **POWER** switch
- Patient cable jack
- Green lights for breathing effort and heart beat
- Alarm speaker

The back panel has:

- Battery charger jack
- Green charger light
- Other jacks and controls for your doctor or homecare dealer

Front Panel



a Human Alarm Lights

Human alarms sound when the monitor detects a pause in the patient's breathing effort or a heart rate that is too fast or too slow.

During a human alarm the alarm beeps and a red light turns on to show you which alarm occurred.

b Equipment Alarm Lights

Equipment alarms sound when a problem occurs with the battery, with a connection to the patient, or with the monitor itself. During most equipment alarms the alarm sounds constantly. A yellow light turns on to show you which alarm occurred.

c Reset

Use this button to turn off the Human and **LEAD** alarm lights after an alarm condition is over. Also, hold this button in while moving the **POWER** switch to turn the monitor off.

d Power On/Off

To turn the monitor on, slide this switch to On. To turn the monitor off, hold in the **RESET** button and move the **POWER** switch to **OFF**. If you move the **POWER** switch to **OFF** without holding in the **RESET** button, an alarm will sound.

e Patient Cable Jack

Plug the patient cable into this jack.

f Respiration Light

This green light blinks once each time the monitor detects breathing effort.

g Heart Beat Light

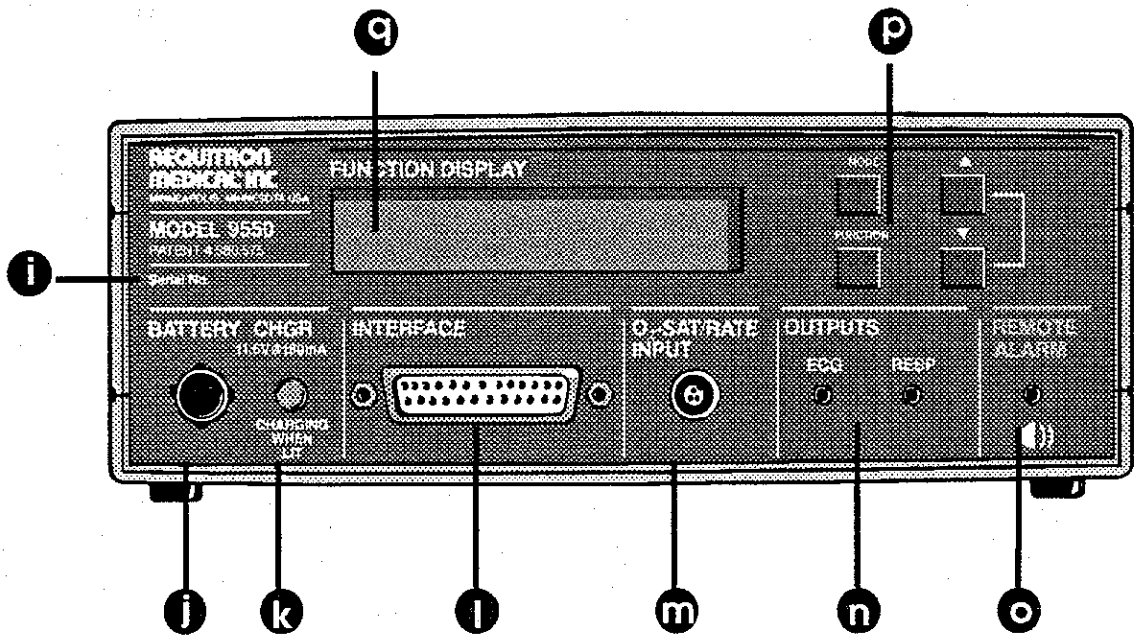
This green light blinks once each time the monitor detects a heart beat.

h Alarm Speaker

The alarm sounds come from here.

WARNING Do not cover the alarm speaker (h), or you may not hear the alarm.

Back Panel



i Serial Number

j Battery Charger Jack
This is where you plug in the battery charger.

k Battery Charger Light
This green light turns on to indicate that the battery charger is properly connected.

l Interface
This output is used for recording respiration and heart rate. Other accessories may also be connected to this output.

m O_2 Sat/Rate (9550 series only)
On the Model 9550, this is the input for a pulse oximeter that your doctor may have you use with the monitor. Instructions for use are included with this device.

n ECG and RESP Outputs
These are outputs for accessories.

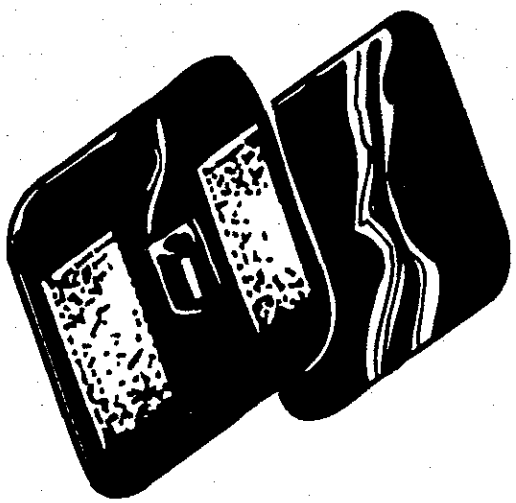
o Remote Alarm Jack
This jack is for an optional alarm.

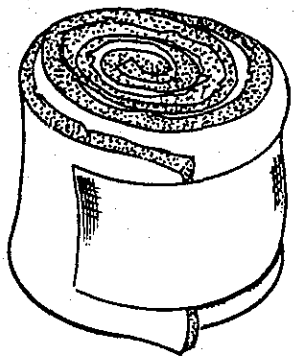
p Controls
These controls are used with the display to set the alarm limits for breathing and heart rate. Never change these settings unless the doctor or homecare dealer tells you to.

q Function Display
When you first turn on your monitor, this display will show the limits for alarms and memory status. If the display shows the message, "Memory Full," follow your homecare dealer's instructions.

Accessories

These accessories pick up the patient's breathing and heart beat signals and carry them to your monitor. Use only Aequitron approved accessories.





Electrode Pads

The black electrode pads pick up the breathing and heart beat signals from the patient.

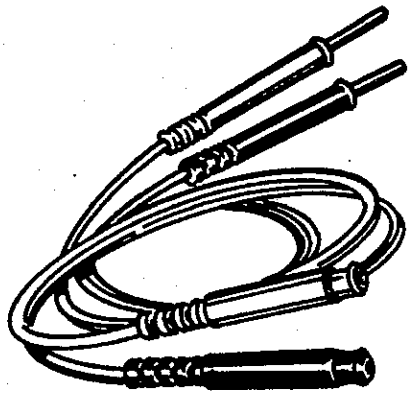
Rinse the flat sides of the pads with water each day. Do not use soap or detergent on the pads because both interfere with breath and heart beat signals.

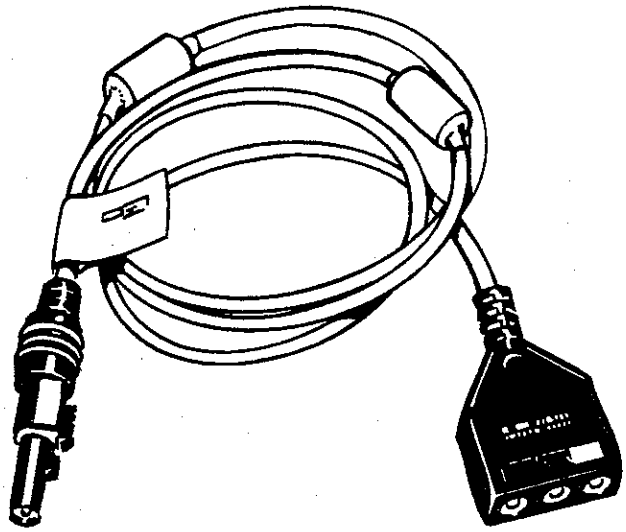
Rinse all soap off the patient after a bath. Do not use oil, powder, or lotions on the patient where the electrodes will be placed. All these can interfere with picking up breath and heart beat signals.

Belt

The soft foam belt holds the electrode pads in place. The belt goes around the chest and is fastened with a Velcro strip.

Remove the electrode pads before washing the belt. You can wash belts by hand or in the washing machine using the delicate cycle. Use lukewarm water, a mild detergent, and no bleach. Rinse well to remove all detergent because leftover detergent can cause a skin rash. Air dry the belts. Never dry them in the automatic dryer because heat damages the inside of the belt.





Lead Wires

The lead wires pick up the breath and heart beat signals from the electrodes and carry them to the patient cable. Always hold the lead wires by the plastic ends when you are connecting or disconnecting them; otherwise, you can damage the wires inside the lead wires.

New lead wires come joined together. When you connect the patient to the monitor, pull gently to separate the lead wires as much as you need to.

Patient Cable

The patient cable picks up the breath and heart beat signals from the lead wires and carries the signals to the monitor. The cable has a locking connector where it attaches to the monitor. Hold the patient cable at the end when you are connecting or disconnecting it. Never pull on the cable's cord because you can damage the wires inside.

Theory of Operation

The monitors are intended for use with infants through adults. It detects and alarms for central apnea, tachycardia and bradycardia. Human events, equipment alarms and monitor on/off times are logged. Trend and waveform data for human events are also recorded. The 9550 series monitors also detect, record and validate oxygen desaturations when used in conjunction with an external pulse oximeter.

The monitor has an audible alarm (minimum of 79 dB(A) at 2 feet). It also has circuitry which detects the loss of any or all of the power rails. A watchdog circuit ensures that the microprocessor is running and is executing the software program correctly.

The monitor consists of five separate assemblies: the front panel, the analog board, the digital board, the back panel, and the battery. The phone jack board and key switch board are separate boards that plug into the back panel board.

For this theory, we will divide the monitor into four main parts: the power system, the isolated section, the analog system, and the digital system. The power system provides the power rails for the monitor. The isolated section provides patient isolation, supplies the drive current for respiration detection, and separates the ECG and respiratory signals. The analog section processes the ECG and respiratory signals, and digitizes them. The digital section performs calculations, detects events, and stores data.

Refer to the Block Diagram on page 3-9. On the block diagrams, the letters *A*, *D*, *R*, and *F* indicate the board where the particular circuit is located: A = analog board, D = digital board, R = rear (or back) panel, and F = front panel.

Power System

Refer to the Block Diagram on page 3-10.

The Model 9271 battery charger is a three-prong charger that provides 11.6 VDC at 180 mA. The charging (or operating) current is provided through diode CR1, which prevents a shorted input jack from damaging the device. The tranzorb, Z1, prevents voltage spikes (greater than ±15 V) from damaging the unit or resetting the microprocessor.

The battery consists of eight nickel-cadmium (NiCad) cells connected in series. It is rated at 2000 mAH (milli-amp hours). Fully charged battery voltage is between 11 and 12 VDC. The monitor will operate up to three days on a fully charged battery alone. The battery can be recharged in about 18 hours.

The battery voltage, V_B, passes through a parallel set of switches (Q11 and the front-panel **POWER** switch), after which it is known as V_A. V_A powers the alarm circuitry. Q11 will maintain power in the monitor (and set off the alarm) if the **POWER** switch is turned off without holding in the **RESET** switch. The fuse, F1, protects the rest of the circuitry from excessive current. The voltage on the protected side of the fuse is called V_P. V_M is derived from V_B and provides continuous power to the RAM chips and real time clock.

V_P provides the voltage for the various regulators in the monitor: +5.4 V for the Holter-type recorder, +5 V supplies, V+ and V- for the analog section. V_P is regulated down to V_S (+5 V) by VR2.

Note that circuit ground and chassis ground are tied together on the back panel board. They are also connected together (with back-to-back diodes) on the analog board.

Oscillator U4 is an astable multivibrator operating at approximately 30 kHz. The frequency is set by R34 and C19. The output at U4-10 has a 50% duty cycle. This signal drives Q1 which drives the primary of T1. T1 provides the negative voltage V-, filtered by C30 and rectified by CR12. T1 also couples the 30 kHz through to the isolated section where it provides the power and carrier frequency for the patient signal.

Isolated Section

Power for the isolated section is derived from the 30 kHz provided by T1. The diodes, CR16-CR19, form a full-wave rectifier, which develops the positive and negative power for the isolated section. The isolated positive power rail is filtered by R71 and C41. The isolated negative power rail is filtered by R70 and C38.

Resistors R64 and R63 limit the 30 kHz current for the zener diodes (CR14 and CR15). These diodes set the drive voltage to approximately ± 10 VDC. C39 and C40 block any low frequency modulation of the patient drive. R65 and R66 limit the patient current to approximately 50 uA. Since R65 and R66 are significantly larger than the patient impedance (typically 500 to 1000 ohms), the patient drive is essentially a constant-current source. Therefore, changes in the patient impedance amplitude-modulate the 30 kHz voltage across RA and LA. The respiration-modulated 30 kHz signal and the ECG appear across R67. The patient ECG signal can be thought of as a voltage source within the patient generating signals between 0.1 and 2 mV in amplitude. The respiration signal can be thought of as a small change in impedance (0.2 to 3 ohms) out of a total body impedance of 500 to 1000 ohms. The change in impedance amplitude-modulates the 30 kHz carrier signal.

R78, R79 and diodes CR23–CR30 provide input protection to the instrumentation amp. Surge arrestors E1, E2, and E3 provide protection to the circuitry if an electrostatic discharge is delivered to the patient or to the patient cable input.

The instrumentation amp U8 (pins 1,2,3, 5,6,7, 8,9,10) provides an extremely high input impedance, with a differential gain of 5 for both the ECG and respiratory signal.

C33 and R56 form a high pass filter. This couples the respiration-modulated 30 kHz signal to the primary of T2 and blocks the ECG signal. T2 couples the respiration signal to the non-isolated section.

C36 blocks DC while the network of L1, R74 and C37 provides a low-pass filter. This filters out the 30 kHz carrier leaving the ECG signal. U8-12,13,14 provides a gain of about nine, while C35 provides low-pass filtering with an f_c of 100 Hz.

Q2 and Q3 provide a full-wave chopper (at 30 kHz) that acts as the carrier for the ECG signal. T3 couples it to the non-isolated section of the analog board. R57 and R39 form a high impedance connection between isolated and non-isolated grounds to limit offset voltage build-up.

Analog System

The analog system consists of the ECG and respiration channels, and, in the 9550 series, the oximeter channel. The analog system processes the ECG and respiratory signals. It supplies signals for the monitor's outputs and the digital system's inputs.

ECG Channel

Refer to the Block Diagram on page 3-11.

R35 and C21 provide a 90° phase shift in the 30 kHz signal so it can be used to demodulate the ECG signal. The demodulator signal controls analog switch U5-3,4. The ECG signal is demodulated and filtered (R40 and C22), and DC blocked (C23).

U6-1,2,3 provides variable, non-inverting gain from 13 to 31, adjustable via R93. C42 rolls the signal off at about 50 Hz. R95 sets the DC offset for the rest of the ECG channel.

U6-12,13,14 and U6-5,6,7 form a line-frequency notch filter. U6-12,13,14 is a bandpass filter whose passband can be tuned to 50 or 60 Hz with R94 acting as the tuning element. The output of U6-12,13,14 is 180° out-of-phase with the 50 or 60 Hz noise signal at U6-1. U6-5,6,7 sums the signals from U6-1 and TP9 (the inverted signal at 50 or 60 Hz) to provide a signal at TP10 that has limited AC line-frequency noise. R92 is used to adjust the summing of the two signals.

U6-8,9,10 R56, C44, R55, C28, R52 and C43 form a third-order Butterworth low pass filter with unity gain. The corner frequency is about 40 Hz. The output of this section is sent to the back panel Interface connector (J5) through R48 (ECG High). The signal is also divided by R47 and R46 and again sent to the Interface connector J5 (ECG Low) for use by Holter-type recorders.

U7-1,2,3 acts as a bandpass filter (center frequency of about 40 Hz) with gain of about 24. This filter is lightly damped (i.e., the output will ring) and will detect heartbeats whether RA/LA leads are correct or reversed.

U7-8,9,10 is a peak detector. Positive voltages (heartbeats) at U7-8 will pass through CR22 and be held on the capacitor C48. The voltages held on C48 decay off through R96 if there is no positive voltage at U7-10.

U7-12,13,14 and V- provide the ECG signal with a DC offset. R23 and C5 filter the ECG signal at U3-2 such that it can be compared with the unfiltered version at U3-3. The output, U3-1, changes from low to high when a heartbeat is detected.

The ECG signal (high or low) arrives on the digital board at connector J12-5 and controls the gate of Q1, which is fed into Port A. The microprocessor receives the signal via its data bus.

LEAD Alarm

Refer to the Block Diagram on page 3-12.

U1-5,6,7 acts as a peak detector providing a voltage at TP2 that corresponds to the impedance across the patient leads. This voltage is divided by R2 and R104, then sent to input 3 of the A/D via J12-6. It's then transmitted over the data bus to the microprocessor. Nominally, patient impedances greater than 1800 ohms will cause a lead alarm.

Respiration Channel

Refer to the Block Diagram on page 3-12. R35 and C21 provide a 90° phase shift in the 30 kHz signal . This is used to demodulate the respiratory signal. The demodulator signal controls the analog switch U5-1,2. R28 and C14 filter the respiratory signal. U2-1,2,3 provides non-inverting gain of gain of about 18.

R11, C13, R15, C16, R29, C15 and U2-5,6,7 form a third-order Butterworth low-pass filter with unity gain. The corner frequency is about 5 Hz.

U2-12,13,14 provides an inverting gain of between 300 and 600, depending on the adjustment of R20.

CR1 and CR2 are 5.1 V zener diodes. The current flowing through these two diodes and R7 keeps the voltage output of U2-14 from going into saturation, hence, allowing it to recover quickly from large swings in its output. If the output of U2-7 (between C17 and R19) makes large swings, the diodes CR3 and CR4, the zeners CR1 and CR2, and the signal inversion in U2-12,13,14 combine to keep the output (U2-14) from saturating.

U2-8,9,10 functions as a bandpass filter and as a buffer for the fast recovery amp (U2-12,13,14). C12 and R9 give a lower corner frequency of 0.07 Hz and R14 and C7 give an upper corner frequency of about 9 Hz. The output of U2-8 goes out to the back panel Interface connector, J5, via R50 as the RESP High signal. The output also is filtered by the C24, C25, R30, R32 network and again goes out to the Interface connector, J5 (Resp Filtered). In addition, the output

is divided by R49 and R51, DC blocked by C29 and delivered to the back panel as the RESP Low signal for use by Holter-type recorders.

R1 and R8 provide a DC offset at U1-14 and at U1-8. C8 and C9 roll off the respiratory signal at 10 Hz. The signal is filtered by R27 and C11, and buffered by U1-1,2,3. From here the signal goes to input 0 of the A/D (U10) via P12-4. It is converted and transferred into the microprocessor via the data bus.

Oximeter Channel

Refer to the Block Diagram on page 3-13.

The oximeter sends out two signals. One is a voltage proportional to the percentage of oxygen saturation (O_2 SAT). The second is a voltage proportional to the heart rate (Pulse Rate). These two signals are fed directly back out on the Interface connector (J5).

U2-1,2,3 and U2-12,13,14 act as buffer op amps with nominal gains of 4 to prepare the Pulse Rate and O_2 SAT signal for the A/D. O_2 SAT is on input 4 of the A/D and Pulse Rate goes in on input 5. The signals are converted and transferred to the microprocessor via the data bus.

Digital System

Refer to the Block Diagram on page 3-14.

The digital system consists of a microprocessor with its support chips, the system memory, a watchdog circuit, a real-time clock, a serial port, and input/output hardware. The monitor provides battery back-up for portions of the digital system. The digital system performs calculations, detects events, and stores data in the monitor's memory.

Microprocessor

The 65C02 microprocessor is a low-power device using an 8 bit data bus and 16 bit address bus. It runs at a 1 MHz clock rate provided by crystal Y1 and the U4 oscillator circuit.

U14 provides time and date information to the microprocessor via the data bus.

U10 is an eight input, eight bit A/D converter. A0, A1, A2 are decoded to select one of the eight inputs. It uses the microprocessor 1 MHz clock as its timing reference. It uses a 5 V reference which means that eight bits can define 256 different voltage levels leading to each distinct voltage level being about 19 mV.

U2 is a Versatile Interface Adaptor (VIA). This chip provides two bidirectional, eight bit ports for the microprocessor. The VIA also provides the timing for the interrupt cycle.

Two ports, U7 and U8, are output ports used for controlling the LEDs and the LCD via the data bus.

U9 provides the interface to communicate with a personal computer via a serial communications port in a standard RS-232C format. In general, the six signals sent and received by this chip allow communications between the microprocessor and the computer.

Memory

The two RAM chips, U11 and U12, provide storage space for events that are recorded by the monitor. About 44 kB of these chips' 64 kB of available storage space is used.

The software for the system is stored in the socketed EPROM chip, U13. The serial number for the unit is also stored in the EPROM so that the checksum for each EPROM is unique.

Watchdog

The watchdog circuit causes an alarm if the microprocessor fails to operate properly. The watchdog circuit consists of two retriggerable one-shots (U17), and a flip-flop (U16-4,5,6,8,9,10). On start-up, C32 keeps U16-5 low and U16-4 high for about four seconds. The high at U16-4 turns on Q12. Q12 turns on Q11 and ensures that power will be supplied to the circuitry (V_B to V_A) even if the on/off switch is turned off. R36 and C31 provide a delay at start-up to ensure that the **MONITOR** LED is turned off initially. Every 16 mSec (nominally) the microprocessor toggles the watchdog circuit input through Port B (PB-7). This signal triggers the first one-shot output (U17-7) to go low for 12 mSec. The output of the first one-shot (U17-7) triggers the second one-shot output (U17-10) to go high for 50 mSec. The continuous high output of the second one-shot (U17-10) is sent to the active low SET line (U16-8) of the flip-flop. If the microprocessor toggles the watchdog input faster than 12 mSec or slower than 50 mSec, then the one-shots time out, U16-8 goes low, U16-10 goes high (which ultimately turns on the **MONITOR** LED on the front panel) and the audible alarm is turned on via U16-11,12,13 and Q10.

LED and Alarm Drivers

Refer to the Block Diagram on page 3-15. The **RESPIRATION** LED blinks each time the monitor detects breathing effort. The microprocessor generates a signal on the data bus. It is sent out through Port B (PB-3). A high turns on Q6. Q6 drives the **RESPIRATION** LED and the Resp sense line of the Interface connector (J5).

The **HEARTBEAT** LED blinks each time the monitor detects a heart beat. The microprocessor generates a signal on the data bus. It is sent through Port B (PB-4). A high turns on Q5. Q5 drives the **HEART BEAT** LED and the ECG sense line of the Interface connector (J5).

Human alarm conditions (apnea, heart slow, or heart fast) cause a loud alarm at one second intervals. Equipment failure conditions (battery, lead or monitor) cause a loud, continuous alarm. The soft audio signal notifies the user of actions taken (for example, when a button is pressed), of a battery caution alarm, or of an invalid limits alarm.

The audio alarm can be turned on by the watchdog circuit. Normally, U16-4 is a high which means U16-11 is low (assume U16-12 is high). Q10 is off and no alarm sounds. If the watchdog times out, U16-4 goes low, U16-11 goes high, Q10 turns on and drives the alarm.

The loud alarm can be turned on by a low from the microprocessor, sent out through Port B (PB-5), putting a low at U16-12 and turning on Q10. Q10 drives the audio alarm.

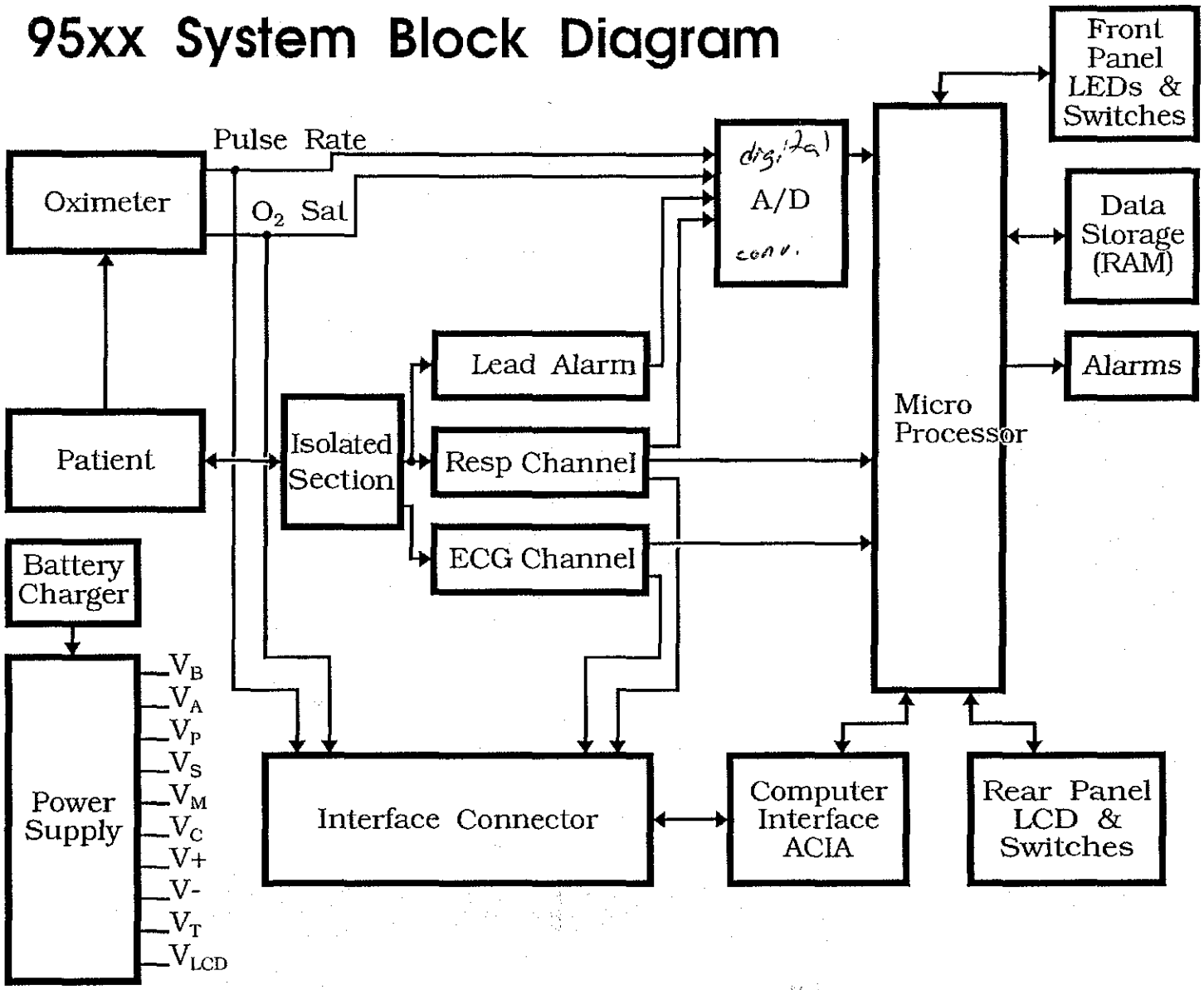
The soft audio alarm is turned on by a low generated by the microprocessor, sent out through Port B (PB-6). This is inverted by U23-1,2, which turns on Q9 with a high at its gate. Q9 drives the audio alarm through R45, which limits the current flow through the alarm, hence, reducing the alarms sound output level.

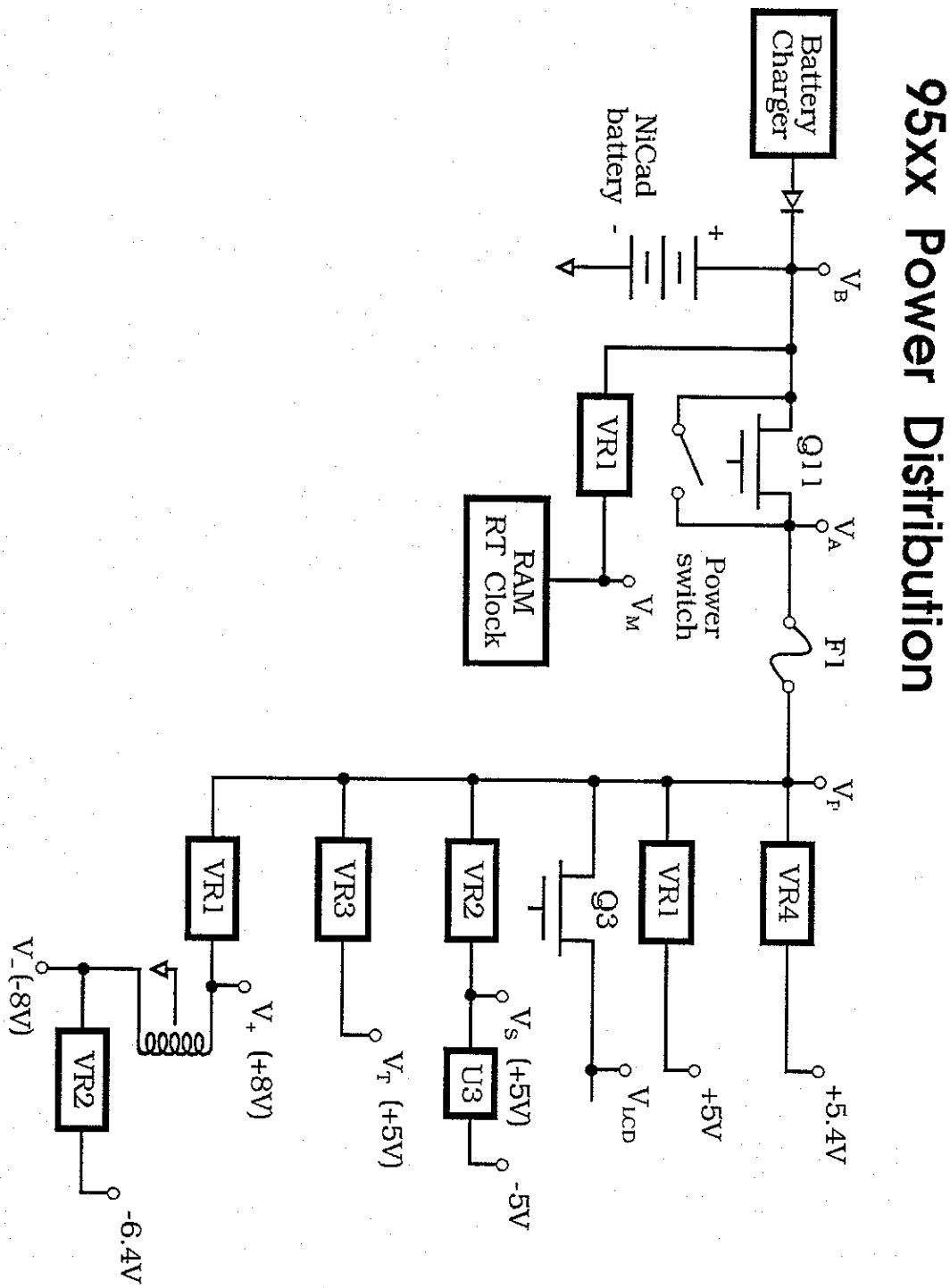
A loud audio alarm will also be generated if V_P or V_S are pulled low. If this happens, U15-7 goes high, turning on Q8, which drives the audio alarm. This will occur if the internal fuse (F1) blows.

A fault sensed by the watchdog timer will turn on the **MONITOR** LED as described earlier. The final drive circuitry (U5-13,11 and U23-12,13) is also driven by a signal generated by the microprocessor and fed through Port B (PB-2). The **MONITOR** LED will flash for an invalid limits alarm.

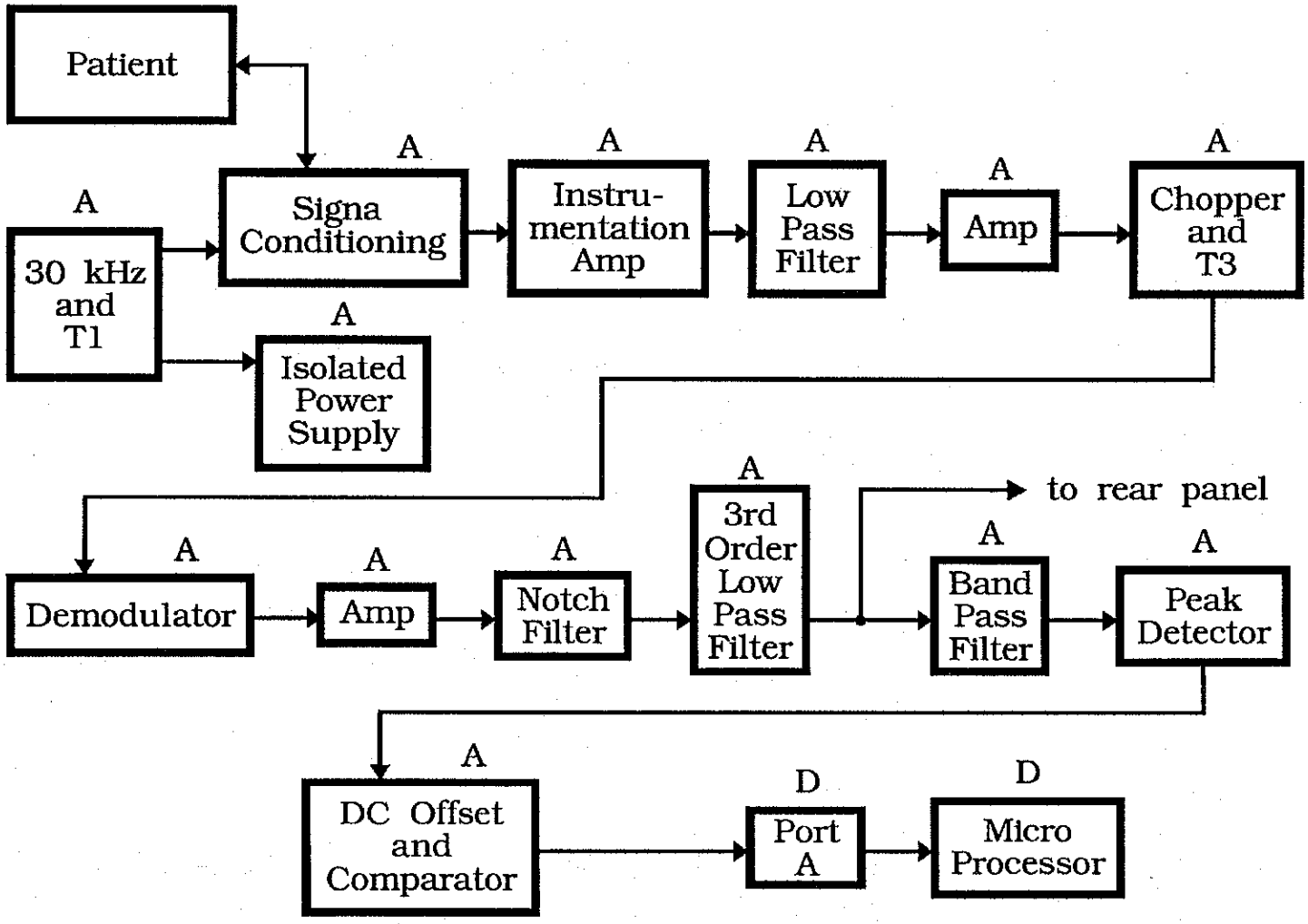
Alarm conditions are detected through software in the monitor. The drive for the alarm LEDs is provided by the microprocessor data bus through Port C. A low at the output pin of Port C will turn on the front panel LED.

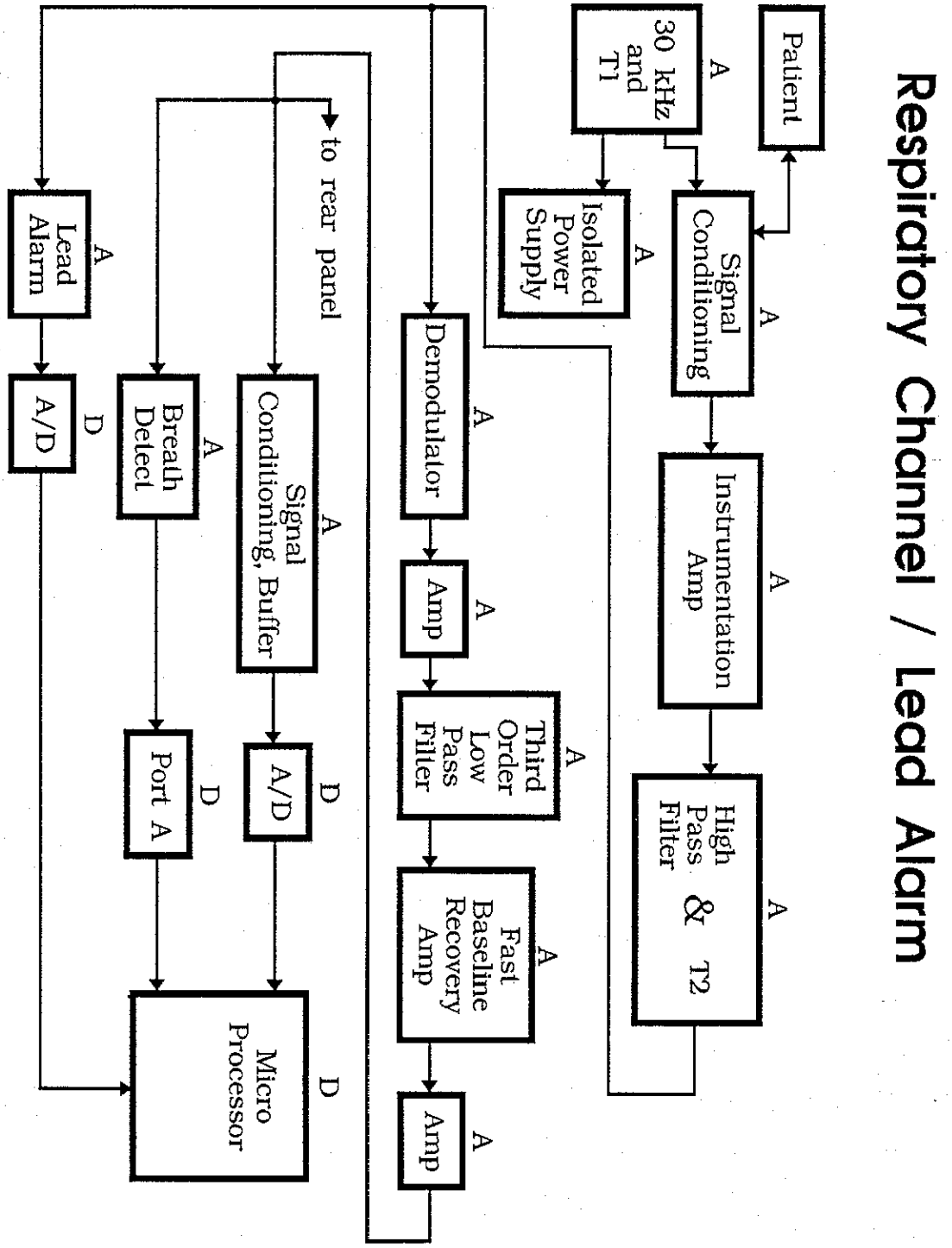
95xx System Block Diagram

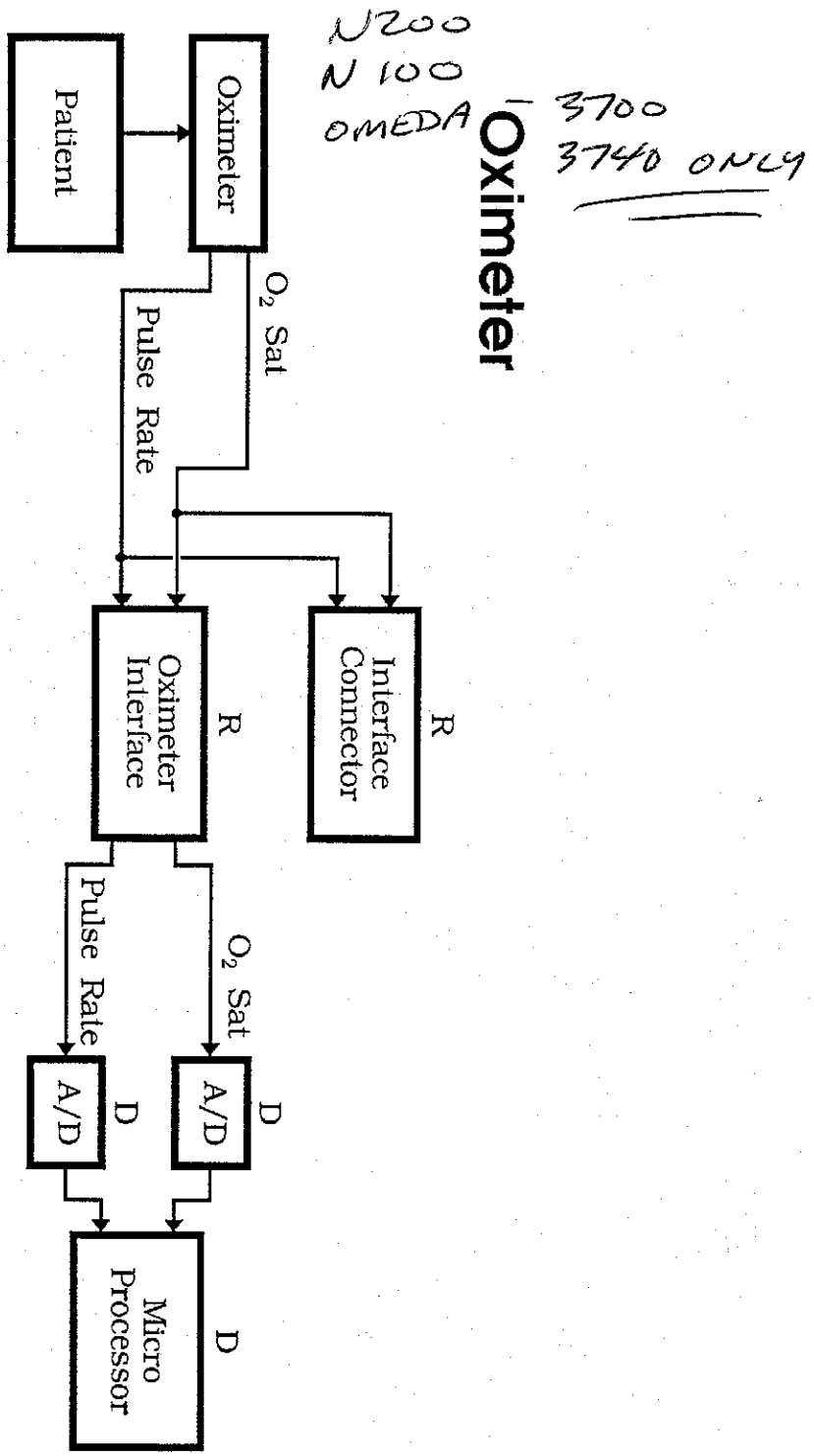



95xx Power Distribution
Battery Charger
NiCad battery
+
-
V_B
VR1
Q11
V_A
Power switch
F1
RAM RT Clock
V_M
V_F
VR4
+5.4V
VR1
+5V
Q3
V_{LCD}
VR2
U3
V_S (+5V)
-5V
VR3
V_T (+5V)
VR1
V_+ (+8V)
V_- (-8V)
VR2
-6.4V

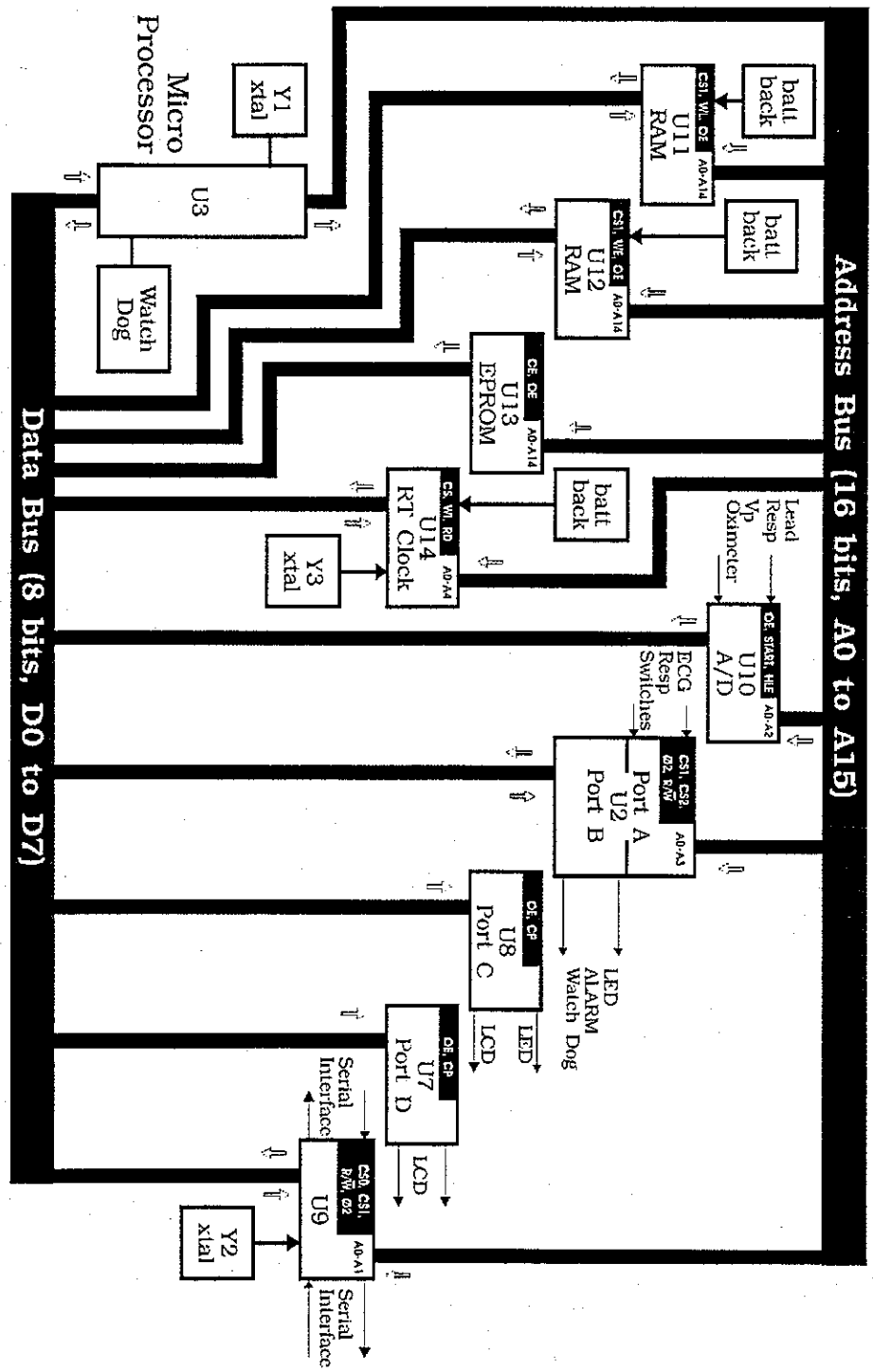
ECG Channel


Patient
A
Signa Conditioning
A
Instru-mentation Amp
A
Low Pass Filter
A
Amp
A
Chopper and T3
A
30 kHz and T1
A
Isolated Power Supply
to rear panel
A
Demodulator
A
Amp
A
Notch Filter
A
3rd Order Low Pass Filter
A
Band Pass Filter
A
Peak Detector
A
DC Offset and Comparator
D
Port A
D
Micro Processor

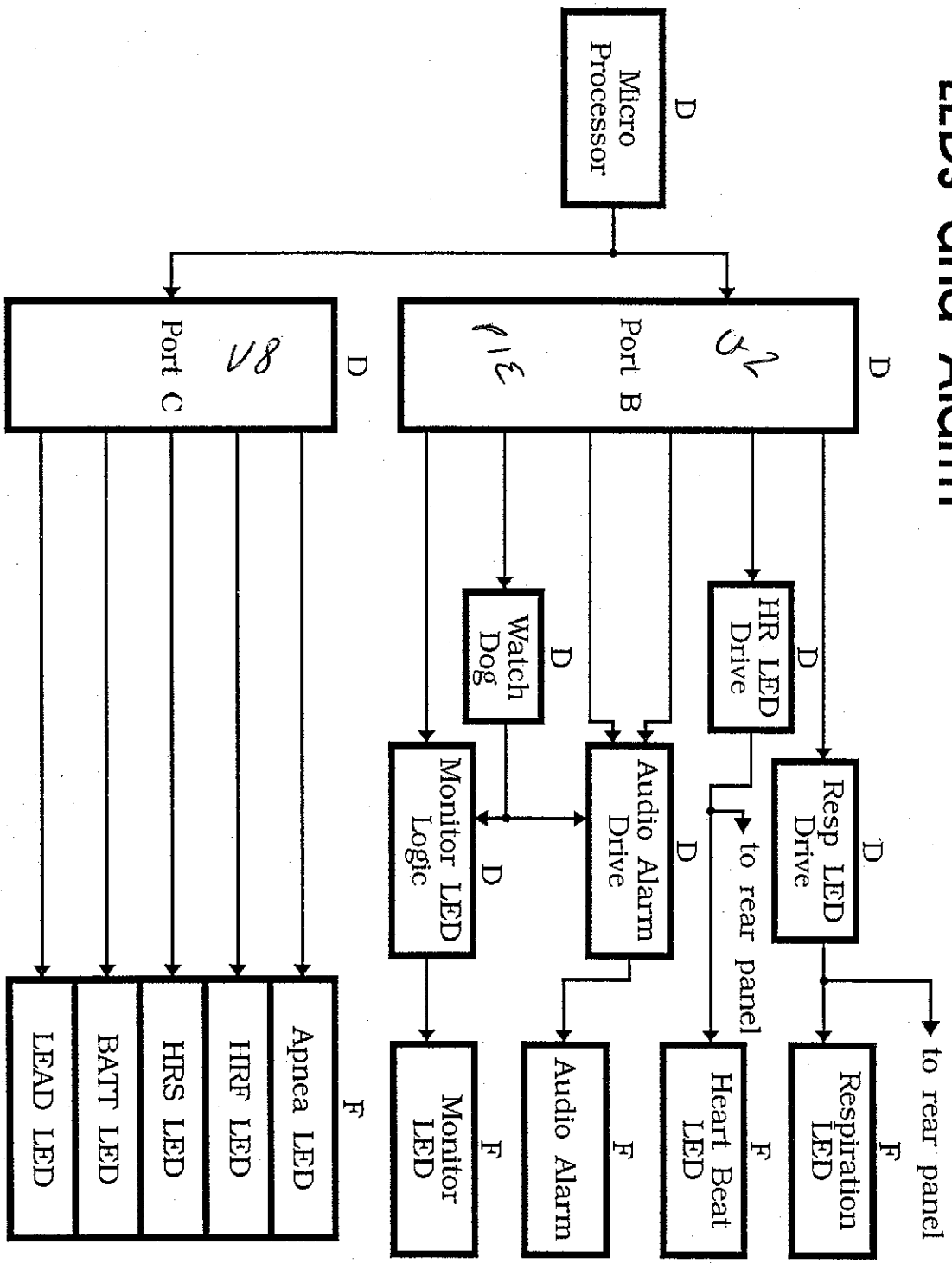

Respiratory Channel / Lead Alarm
Patient
30 kHz and T1
A
Signal Conditioning
A
Isolated Power Supply
A
Instrumentation Amp
A
High Pass & T2 Filter
A
Demodulator
A
Amp
A
Third Order Low Pass Filter
A
Fast Baseline Recovery Amp
A
Amp
A
to rear panel
Lead Alarm
A
A/D
D
Breath Detect
A
Signal Conditioning, Buffer
A
A/D
D
Port A
D
Micro Processor
D


N200
N 100
OMEDA
3700
3740 ONLY
Oximeter
Patient
Oximeter
O_2 Sat
Pulse Rate
Oximeter Interface
R
Interface Connector
R
Pulse Rate
O_2 Sat
A/D
D
A/D
D
Micro Processor
D

Microprocessor Hardware



LEDs and Alarm



Inspection

The following inspection procedure tests all major functions of 9500 or 9550 series monitors. Perform this procedure before and after you repair any monitor. Standard operating procedure may also require that you perform this test at additional intervals to ensure continued, optimum operation of the monitor.

Throughout this procedure, enter the test results called for on the Inspection Data Sheet. You will find a sample of this sheet at the end of this chapter. You may copy this sample as needed for use during all monitor checkout procedures.

Perform the procedure before repairing a monitor, entering your results in the Initial Test column of the data sheet. This may help you isolate the defective assembly. After repair, repeat the procedure, entering your results in the Final Test column of the data sheet.

Headings in the procedure correspond to the tests listed on the data sheet. Perform all the tests, in the order listed. If a monitor fails any test, or any part of any test, that monitor fails the entire procedure.

Warning

Do not use any monitor that does not pass all parts of the inspection procedure. For assistance, contact Aequitron at (800) 497-3787.

If the **MONITOR** alarm LED comes on at any time, except during the power-up LED test, reject the unit.

Equipment

To complete this procedure, you will need the following equipment:

- Aequitron Model 8310 or Model 9310 Simulator
- Aequitron Model 8237 Patient Cable
- Aequitron Model 8245 Lead Wires
- Aequitron Model 9271 Battery Charger
- Aequitron Model 8200-14 70 dB Cap
- Final Test Junction Box[1]
- Co-axial cable
- Digital multimeter (DMM)
- Oscilloscope (scope) with digital storage—
  The oscilloscope must have a time-base range of at least 50 msec. per division to 0.5 sec. per division, and a vertical input range of at least 5 mV per division to 2 V per division.

Caution An Aequitron Model 8310/50 or Model 9310/50 simulator must be used to test a 9550/50 monitor. A 50 Hz power supply should be used. An Aequitron Model 9271/50 battery charger is to be used with a 9550/50 monitor.

Note The monitors are designed to meet AAMI "Safe Current Limits for Electromedical Apparatus," July 9, 1985.

1 The Final Test Junction Box is available only to persons who complete the Model 9500/9550 repair training.

Inspection Procedure

Serial # Read the serial number on the back of the monitor and enter it on the Inspection Data Sheet. Write your name and today's date in the appropriate blanks on the data sheet.

Case Assembly Visually inspect the monitor for proper case assembly. All parts of the case must fit securely, with no gaps between components. Wires must not protrude between case components.

Mechanical Verify the operation of all switches and the bail. Inspect all hardware, including jacks. Switches must operate smoothly throughout their ranges. The bail must secure in an upright position. All hardware must be tight and secure. All jacks must accept and hold their respective plugs without undue resistance.

Alarm With no connections to the monitor, and with the face of the audible alarm free of any obstructions, turn the monitor on. The alarm must sound with a clear, audible tone. Turn the monitor off.

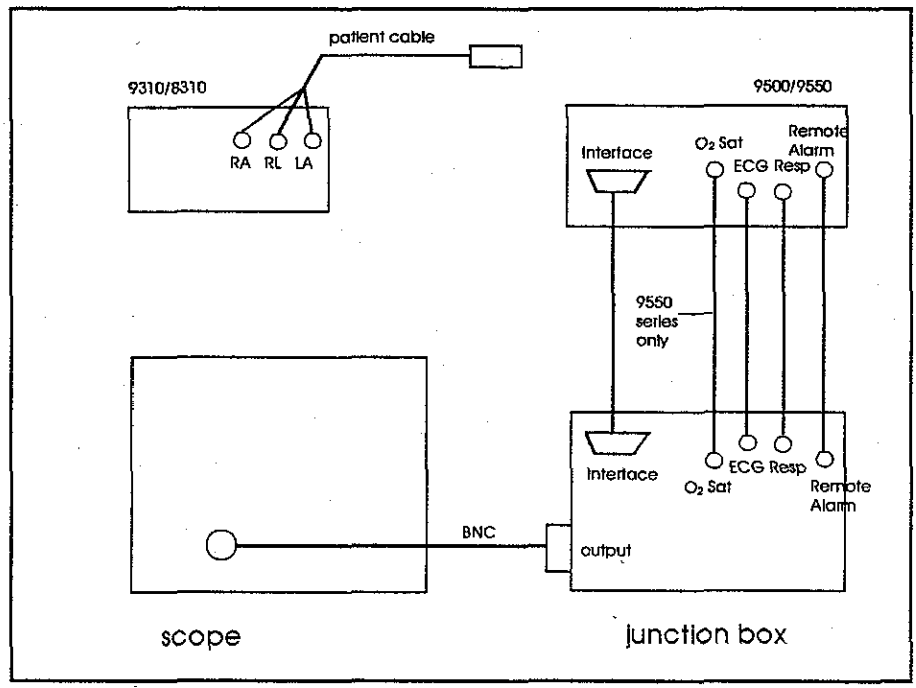


Figure 4.1 **Test equipment connections** *Beginning with the Power up test, connect the equipment as shown. Note that the patient cable is not yet connected to the monitor.*

Power Up

Connect the equipment as shown in Figure 4.1. Note that the patient cable is not yet connected to the monitor. You may place a Model 8200-14 70 dB cap over the alarm face to muffle the audible alarm. **You must remove the cap before you return the monitor to service.** Set the equipment controls as listed in Table 4.1.

Turn on the monitor. All alarm LEDs (front panel) must light and turn off sequentially. There will be an approximately two second delay before the audible lead alarm sounds. Hold down the Remote Alarm button on the Junction Box. The Junction Box alarm must sound while you press the button. Release the Audible Alarm button. The monitor's audible alarm and **LEAD** LED remain on.

Connect the patient cable to the monitor. The audible alarm turns off. Then the monitor alarms for apnea and heart slow within 12 seconds. The audible alarm beeps once each second. The **HEART BEAT** and **RESPIRATION** LEDs are off; the **APNEA**, **HEART SLOW**, and **LEAD** LEDs are on.

On the simulator, press Resp. Rate to end the apnea, and set ECG Amplitude to 1 mV. The monitor's alarm must be silent. The **HEART BEAT** and **RESPIRATION** LEDs blink. The **APNEA**, **HEART SLOW**, and **LEAD** LEDs remain on. On the monitor, press **RESET**. The **APNEA**, **HEART SLOW**, and **LEAD** LEDs turn off. Turn off the monitor.

Table 4.1 **Initial test equipment settings**
Set the equipment controls as listed before the power up test.

Equipment	Settings
Simulator	Power: On; Respiration Rate: Apnea (Inf.); Respiration Impedance: 1 Ω; Electrode Impedance: 500 Ω; ECG Rate: 165 BPM; ECG Ampl: 0 mV
Monitor	Power: Off; Apnea: 10 sec; Heart Fast: Off; Heart Slow: 40 BPM;
Junction Box	Selector: Recorder Power

Recorder Power

Set the junction box selector to Recorder. With the scope/DMM, measure the recorder power output. The voltage level must be 5.4 ± 0.5 VDC.

Note: If monitor is being checked for annual recertification, the battery should be replaced. 2 YRS

Battery Output

Change the selector on the Junction Box to Battery. With the scope, measure the battery output. The battery voltage must be greater than 10.0 VDC.

Resp. Output

Set the Junction Box selector to Resp. With the scope, verify the output is 2.0 ± 0.2 V_{P-P}, with a maximum offset of 1 VDC.

ECG Output

Set the Junction Box selector to ECG. With the scope, verify the output is 3.0 ± 0.3 V_{Pk}, from the ECG baseline to the top of the R-wave.

Infant Alarm Settings

Set the monitor as follows in Table 4.2:

Table 4.2 Infant Alarm Settings *Set the monitor and simulator.*

Equipment	Settings		
Monitor	New Patient		
	Infant		
	Monitor Alarm Limits	Apnea	10 sec
		Heart Fast	300 BPM
		Heart Slow	130 BPM
Simulator	ECG rate		165 BPM
	ECG amplitude		1 mV
	Resp rate		30 BPM
	Resp impedance		1.0 Ω
	Electrode impedance		500 Ω

Table 4.3 Verify Infant Alarms *Verify that all alarms are working correctly at each setting.*

Set:	Setting	Verify Alarm:	Action
ECG rate	315 BPM	Heart Fast alarm acitvates	none
	290 BPM	Audible alarm is off and **HEART FAST** LED is on.	Press **RESET** to turn LED off.
	115 BPM	Heart Slow alarm activates.	none
	140 BPM	Audible alarm is off and **HEART SLOW** LED is on.	Press **RESET** to turn LED off.
Simulator	Inf Apnea, and press Enter.	Apnea alarm after 8.5 to 11.5 seconds.	none
	Press Resp Rate on simulator.	Audible alarm is off and **APNEA** LED is on.	Press **RESET** to turn LED off.

Adult Alarm Settings

Table 4.4 Adult Alarm Settings
Set the monitor and simulator.

Equipment	Settings		
Monitor	New Patient		
	Adult		
	Patient Name	Enter your initials	
	Patient Number	1234	
	Monitor Alarm Limits	Apnea	60 sec
		Heart Fast	100 BPM
		Heart Slow	30 BPM
	Event Log Limits	Apnea	45 sec
		Heart Fast	100 BPM
		Heart Slow	30 BPM
		O2 Sat (9550 series only)	80%
	Displayed Events (9550 series only)	Priority 1	Apnea
		Priority 2	Desat
		Priority 3	HR Slow
	Verify that "SAT %" = 83 ± 2% and "Pulse" = 165 ± 3 BPM. (9550 series only) Pulse can be adjusted with Pulse knob on the junction box.		
	Time/Date		current time and date
Simulator	ECG rate		95 BPM
	ECG amplitude		1 mV
	Resp rate		10 BPM
	Resp impedance		1.0 Ω
	Electrode impedance		500 Ω

Adult Alarm Settings, continued

Table 4.5 Verify Adult Alarms
Verify that all alarms are working correctly at each setting.

Set:	Setting	Verify Alarm:	Action
ECG rate	105 BPM	Heart Fast alarm acitvates	none
	95 BPM	Audible alarm is off and **HEART FAST** LED is on.	Press **RESET** to turn LED off.
	25 BPM	Heart Slow alarm activates.	none
	35 BPM	Audible alarm is off and **HEART SLOW** LED is on.	Press **RESET** to turn LED off.
Simulator	Inf Apnea, and press Enter.	Apnea alarm after 58.5 to 61.5 seconds. (Start this timing after the last Resp pulse.)	none
	Press Resp Rate on simulator.	Audible alarm is off and **APNEA** LED is on.	Press **RESET** to turn LED off.

ECG Response

Table 4.6 **ECG Response Settings** *Make the following changes to the monitor settings:*

Equipment	Settings		
Monitor	Monitor Alarm Limits	Apnea	10 sec
		Heart Fast	off
		Heart Slow	30 BPM
	Event Log Limits	Apnea	10 sec
		Heart Fast	off
		Heart Slow	30 BPM
		O_2 Sat (9550 series only)	80%
Junction Box Switch	ECG		

Table 4.7 **ECG Response Verification** *Set the simulator for the following ECG rates and amplitudes.*

Equipment	ECG Rate	ECG Amplitude	Verify:
Simulator	35 BPM	0.2 mV	Verify 10 beats at each setting. Each setting should have no missing beats or double beats. Verify that no alarms are activated.
	315 BPM	0.2 mV	
	315 BPM	5.0 mV	
	35 BPM	5.0 mV	

Inverted Polarity

Table 4.8 **Inverted Polarity Connections** *Make the following changes to the simulator lead connections:*

Equipment	Leads	Verify
Simulator	Disconnect the RA and LA leads from the simulator.	Lead alarm acitvates
	Connect the RA lead to the LA simulator socket. Connect the LA lead to the RA simulator socket.	Audible alarm is off. Press **RESET** to turn **LEAD** LED off.

Table 4.9 **Inverted Polarity Verification** *Set the simulator for the following ECG rates and amplitudes.*

Equipment	ECG Rate	ECG Amplitude	Verify:
Simulator	35 BPM	5 mV	Verify 10 beats at each setting. Each setting should have no missing beats or double beats. Verify that no alarms are activated.
	315 BPM	5 mV	
	315 BPM	0.5 mV	
	35 BPM	0.5 mV	
	35 BPM	0.2 mV	
	215 BPM	0.2 mV	
Lead Connections	Return the RA lead to the RA simulator socket. Return the LA lead to the LA simulator socket.		

Heart rate = Resp.

Table 4.10 Heart rate = Resp. *Check the monitor and simulator by following the steps in this table.*

Equipment	Settings:	Verify
1. Simulator	ECG Rate = 95 BPM Resp Rate = 75 BPM Resp Impedance = 0.5 Ω	
2. Monitor	Press **RESET**.	
3. Simulator	ECG Rate = 75 BPM	The monitor's **APNEA** LED and audible alarm must turn on.
4. Simulator	Resp Rate = 50 BPM	The monitor's audible alarm must be silent, The **APNEA** LED must remain on.
5. Monitor	Press **RESET**.	The **APNEA** LED must turn off.

Lead Output

Table 4.11 Lead Output *Set the simulator for the following Electrode Impedance settings and verify the alarms.*

Electrode Impedance Setting:	Verify:	Action
3000 Ω	Lead Alarm activates	
1500 Ω	Audible alarm turns off.	Press **RESET** to turn off the **LEAD** LED
1000 Ω	Normal operation of the monitor (no alarms).	
500 Ω	Normal operation of the monitor (no alarms).	

Respiration Response

Table 4.14 **Respiration Response** *Set the junction box and simulator for the following initial settings.*

Equipment	Settings:
Junction Box switch	Resp
Simulator	ECG rate = 165 BPM
	ECG Amplitude = 1.0 mV
	Electrode Impedance = 500 Ω

Table 4.15 **Respiration Response** *Set the simulator for the following Respiration rates and Respiration Impedance settings.*

Equipment	Resp Rate	Resp Impedance	Verify
Simulator	50 BPM	0.2 Ω	Verify 6 breaths at each setting. Each setting should have no missing breaths or double breaths. Verify that no alarms are activated.
	20 BPM	0.2 Ω	
	15 BPM	0.4 Ω	
	10 BPM	0.5 Ω	
	75 BPM	0.5 Ω	
	75 BPM	5.0 Ω	
	10 BPM	5.0 Ω	
Simulator	Resp Rate = 30 BPM	Resp Impedance = 1 Ω	

Oxygen Desat

Table 4.15 Oxygen DeSat

Equipment	Setting:
Junction Box switch (9550 series only)	Press the O_2 Sat switch for approximately 10 seconds, then release.

Interface Test

Transfer the data from the monitor to a personal computer that has the Report Generator software.

Page 4-14 outlines the basics of transferring data from the monitor to a computer. Refer to the Report Generator Manual for further details.

Verify that events simulated during testing were accurately transferred by reviewing the printed Summary Report and Event Log.

Examples of a 9550 Summary Report and Event Log are on page 4-15 and 4-16.

Examples of a 9500 Summary Report and Event Log are on page 4-17 and 4-18.

Generating a 9500/9550 Report/Printout

Computer	9500/9550 Monitor
1. 25 pin D connector cable between 9500/9550 and computer	
2. Turn on computer, and type **CD\RG. Press Enter.**	
3. Turn on printer.	
4. Insert formatted patient diskette.	
5. Type **MAIN.**	
	6. Turn on while holding "Function" and "Up" buttons.
7. Type **R** for "Receive Monitor Data."	
8. Type **D** for "Direct Connect."	
	9. Press "Down" button.
10. Press the Space Bar.	
	11. Three beeps means it's o.k.
12. Type **E** for "Examine Patient Data."	
13. Press **Enter.**	
14. Type **S** to view a summary report.	
15. Type **P** to print summary report.	
16. Type **E** to view an event log.	
17. Type **P** to print an event log.	
18. Type **L** to leave the program.	

Summary Report 9550 Sample

```
PRELIMINARY REPORT       ** MODEL 9550 **       SUMMARY REPORT

MONITOR INFORMATION      YOUR INITIALS            Adult
                         1234

**  EVENT RECORDING TIME  **      Time             Date

Event Recording Start            16:14:44        06/30/93
Event Recording Stop             16:28:10        06/30/93
Total Recording Time             14 Mins

Total Monitor On Time            12 Mins
% of Total Recording Time        85 %

**  APNEAS  **

Monitor Alarm Apneas >= 10 seconds          2
Event Logging Apneas >= 10 seconds          2

Longest Apnea lasted 69 secs at 16:17:03 on 06/30
Min Heart Rate (3 beat Avg) : 34 BPM    Min O2 Sat :  Invalid

**  BRADYCARDIAS  **

Monitor Alarm Bradycardias (= 30 BPM        1
Event Logging Bradycardias (= 30 BPM        1

Lowest Heart Rate lasted 14 secs at 16:16:40 on 06/30
Min Heart Rate (3 beat Avg) : 23 BPM    Min O2 Sat :  Invalid

**  TACHYCARDIAS  **

Monitor Alarm Tachycardias     OFF
Event Logging Tachycardias     OFF

Highest Heart Rate lasted 7 secs at 16:16:24 on 06/30
Max Heart Rate (3 beat Avg) : 105 BPM   Min O2 Sat :  Invalid

**  DESATURATIONS  **

Event Logging Desaturations       1

Lowest O2 Saturation lasted 13 secs at 16:25:50 on 06/30
Min Heart Rate (3 beat Avg) : 165 BPM   Min O2 Sat :  77 %

**  EQUIPMENT ALARMS  **

Loose Lead Alarms              3 Alarms
Low Battery Alarms             -

**  DISPLAYED EVENTS  **   )) Are Not Reviewed ((

Priority #1  (20)  Apnea       2 Found
Priority #2  (10)  Desat       1 Found
Priority #3  (10)  Brady       1 Found

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Event Log 9550 Sample

AEQUITRON MEDICAL INC. ** MODEL 9500 ** EVENTS LOG

Patient Name: YOUR INITIALS Number: 1234

	Event Type	Time	Date	Duration	HR(BPM) (3 beat Avg)	
1.	Switch Change	Monitor Alarm		Event Logger		
	Apnea Limit	60 secs		45 secs		
	Tachy Limit	100 BPM		100 BPM		
	Brady Limit	30 BPM		30 BPM		
2.	Monitor On	16:17:59	07/31	2 Mins		
3.	Tachycardia	16:18:36	07/31	8 Secs	105	*
4.	Bradycardia	16:18:51 ++	07/31	14 Secs	23	*
5.	Apnea	16:19:24 ++	07/31	1 Min 12 Secs	35	*
6.	Monitor Off	16:20:52	07/31	1 Min		
7.	Switch Change	Monitor Alarm		Event Logger		
	Apnea Limit	10 secs		10 secs		
	Tachy Limit	OFF		OFF		
	Brady Limit	30 BPM		30 BPM		
8.	Monitor On	16:21:46	07/31	6 Mins		
9.	Loose Lead	16:23:13	07/31	4 Secs		
10.	Loose Lead	16:25:08	07/31	4 Secs		
11.	Apnea	16:25:35 ++	07/31	18 Secs	75	*
12.	Loose Lead	16:26:20	07/31	4 Secs		
13.	Monitor Off	16:27:59	07/31	11 Mins		

End of Logged Events Copyright (c) 1989,92 Aequitron Medical Inc.

Summary Report 9500 Sample

```
PRELIMINARY REPORT      ** MODEL 9500 **      SUMMARY REPORT

MONITOR INFORMATION     YOUR INITIALS          Adult
                        1234

**  EVENT RECORDING TIME  **      Time           Date

Event Recording Start           16:17:59       07/31/93
Event Recording Stop            16:27:59       07/31/93
Total Recording Time            10 Mins

Total Monitor On Time           9 Mins
% of Total Recording Time       90 %

**  APNEAS  **

Monitor Alarm Apneas )= 10 seconds          2
Event Logging Apneas )= 10 seconds          2

Longest Apnea lasted 72 secs at 16:19:24 on 07/31
Min Heart Rate (3 beat Avg) : 35 BPM

**  BRADYCARDIAS  **

Monitor Alarm Bradycardias (= 30 BPM        1
Event Logging Bradycardias (= 30 BPM        1

Lowest Heart Rate lasted 14 secs at 16:18:51 on 07/31
Min Heart Rate (3 beat Avg) : 23 BPM

**  TACHYCARDIAS  **

Monitor Alarm Tachycardias     OFF
Event Logging Tachycardias     OFF

Highest Heart Rate lasted 8 secs at 16:18:36 on 07/31
Max Heart Rate (3 beat Avg) : 105 BPM

**  EQUIPMENT ALARMS  **

Loose Lead Alarms              3 Alarms
Low Battery Alarms             -

**  DISPLAYED EVENTS  **   )) Are Not Reviewed ((

Priority #1  (20)  Apnea       2 Found
Priority #2  (10)  Brady       1 Found
Priority #3  (10)  Brady       -

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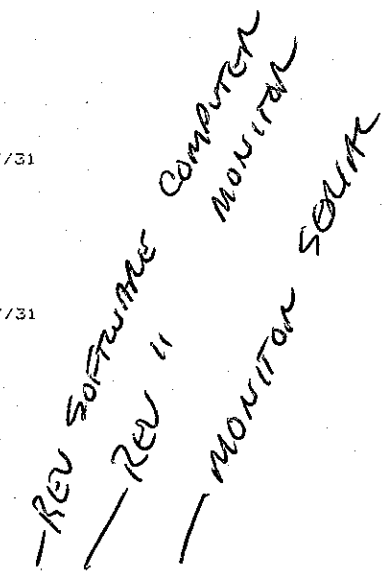


Event Log 9500 Sample

AEQUITRON MEDICAL INC. ** MODEL 9550 ** EVENTS LOG

Patient Name: YOUR INITIALS Number: 1234

	Event Type	Time	Date	Duration	HR(BPM) (3 beat Avg)	O2(%)	
1.	Switch Change	Monitor Alarm		Event Logger			
	Apnea Limit	60 secs		45 secs			
	Tachy Limit	100 BPM		100 BPM			
	Brady Limit	30 BPM		30 BPM	O2 Sat Limit 80%		
2.	Monitor On	16:14:44	06/30	3 Mins			
3.	Tachycardia	16:16:24	06/30	7 Secs	105	INV	*
4.	Bradycardia	16:16:40 ++	06/30	14 Secs	23	INV	*
5.	Apnea	16:17:02 ++	06/30	1 Min 9 Secs	34	INV	*
6.	Monitor Off	16:18:22	06/30	1 Min			
7.	Switch Change	Monitor Alarm		Event Logger			
	Apnea Limit	10 secs		10 secs			
	Tachy Limit	OFF		OFF			
	Brady Limit	30 BPM		30 BPM	O2 Sat Limit 80%		
8.	Monitor On	16:19:14	06/30	8 Mins			
9.	Loose Lead	16:20:58	06/30	4 Secs			
10.	Loose Lead	16:22:18	06/30	3 Secs			
11.	Apnea	16:22:49 ++	06/30	15 Secs	75	INV	*
12.	Loose Lead	16:23:28	06/30	3 Secs			
13.	Desaturation	16:25:50 ++	06/30	13 Secs	165	77	
14.	Monitor Off	16:28:10	06/30	6 Mins			

End of Logged Events Copyright (c) 1989,92 Aequitron Medical Inc.

Charging Light

Turn off the monitor and disconnect all equipment. Plug battery charger into monitor (back panel) and verify that the green charge LED lights. Disconnect the battery charger.

Ground Wire Resistance

Using a digital multimeter, measure the resistance between the shell of the Interface "D" connector on the back panel and the exposed metal of either the ECG or Resp output on the back panel. Resistance should be one ohm or less.

Warning

Do not use the exposed metal of the REMOTE ALARM connector on the back panel for the groundwire resistance check.

Sub-D Conn. = tighten
if fails

Model _____

Model 9500/9550 Inspection Data Sheet

Serial No._____

Initial Inspection ❑ Pass ❑ Fail **Final Inspection** ❑ Pass ❑ Fail

Inspected By: _____ Inspected By: _____

Inspection Date: _____ Inspection Date: _____

Test	Initial Test Pass/Fail	Initial Test Result	Final Test Pass/Fail	Final Test Result	Spec.
Serial #	❑ ❑		❑ ❑		
Case assembly	❑ ❑		❑ ❑		
Mechanical	❑ ❑		❑ ❑		
Alarm	❑ ❑		❑ ❑		
Power up	❑ ❑		❑ ❑		
Recorder power	❑ ❑	VDC	❑ ❑	VDC	5.4 ± 0.5 VDC
Battery output	❑ ❑	VDC	❑ ❑	VDC	>10.0 VDC
Resp. output	❑ ❑	V_{P-P}	❑ ❑	V_{P-P}	2.0 ± 0.2 V_{P-P}
ECG output	❑ ❑	V_{Pk}	❑ ❑	V_{Pk}	3.0 ± 0.3 V_{Pk}
Infant Alarm Settings	❑ ❑		❑ ❑		
Adult Alarm Settings	❑ ❑		❑ ❑		
ECG Response	❑ ❑		❑ ❑		
Inverted Polarity	❑ ❑		❑ ❑		
Heart Rate = Resp.	❑ ❑		❑ ❑		
Lead Output	❑ ❑		❑ ❑		
Respiration Response	❑ ❑		❑ ❑		
Oxygen Desat	❑ ❑		❑ ❑		9550 Only
Interface Test	❑ ❑		❑ ❑		
Charging light	❑ ❑		❑ ❑		
Ground Wire Resistance	❑ ❑		❑ ❑		≤ 1 ohm

Notes:

Disassembly

The following is a description of the disassembly process for a Model 9500 or Model 9550 monitor. It breaks the monitor into sub-assemblies that you can replace with Aequitron-supplied replacement parts. Disassembly beyond the level shown here will void all warranties and support contracts for that monitor.

Caution

You must always disassemble monitors only at a properly grounded workstation. Always wear a ground strap when disassembling monitors.

You will need the following tools to disassemble the monitor:

- A large flat-blade screwdriver
- A small knife
- One #2 cross-blade screwdriver
- One #0 cross-blade screwdriver
- One 1/4" nut driver
- One 3/16" nut driver

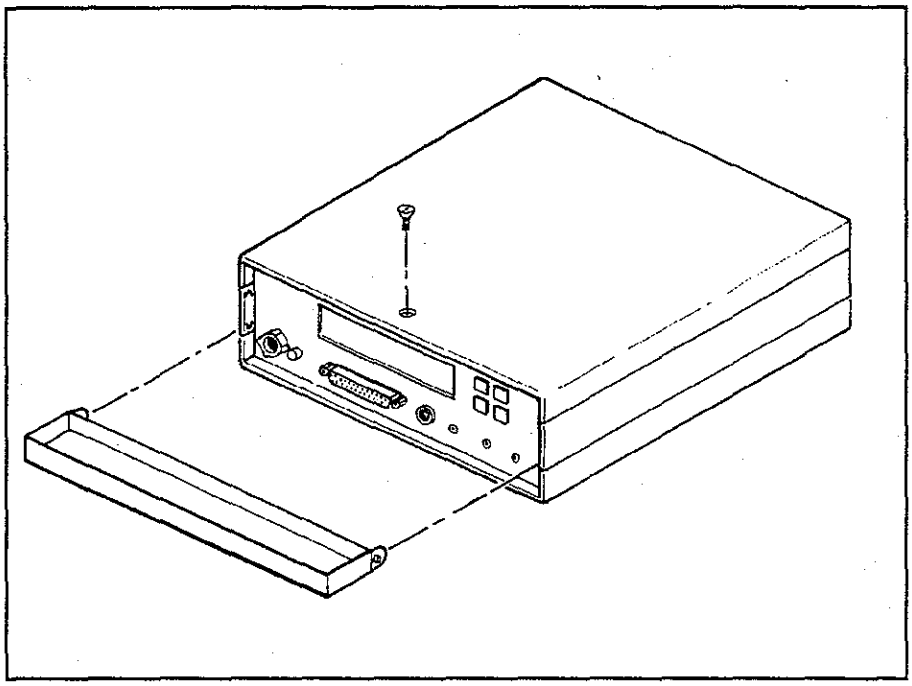


Figure 5.1 Protective Panel
With a flat-blade screwdriver, remove the nylon screw from the back of the monitor top. Swing down the top of the protective panel. Pull the protective panel off of the monitor's back panel.

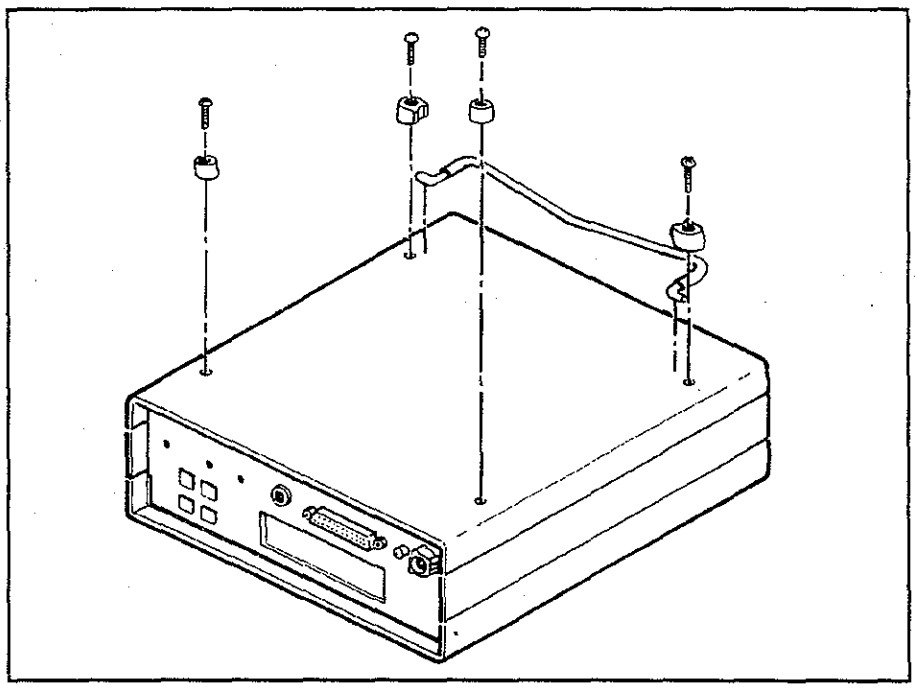


Figure 5.2 Feet and Ball
Turn the monitor upside-down. With a small knife, remove the silicon plugs from the feet. Use a #2 cross-blade screwdriver to remove the screw from each foot. Remove the feet and the ball from the bottom of the monitor.

Figure 5.3

Remove the bottom and set it beside the unit. Disconnect the battery cable from the rear panel. Disconnect the four ground wires from the two studs on the battery cover. Lift off the two side panels.

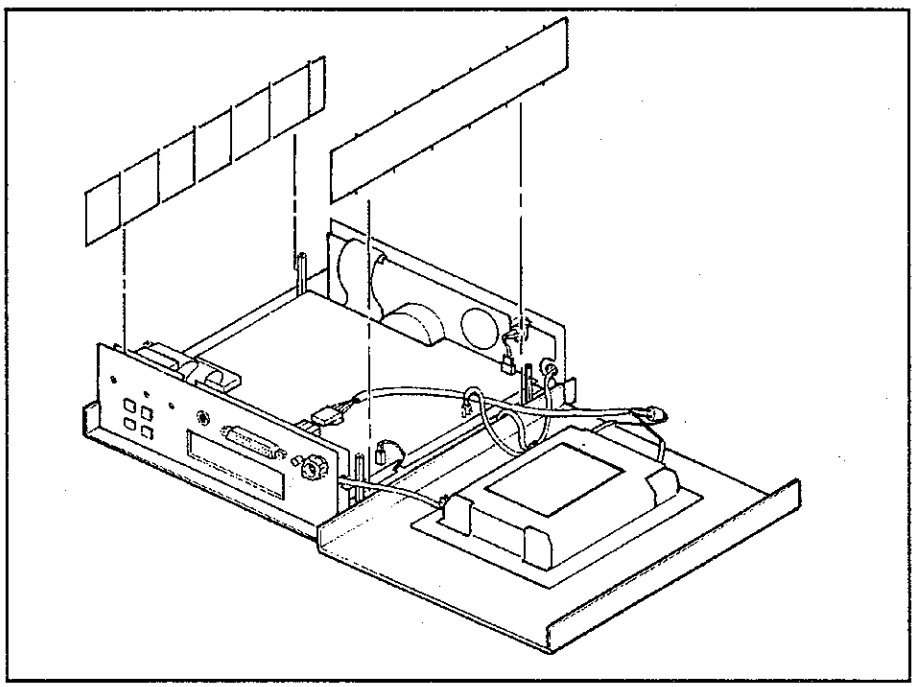


Figure 5.4

Remove seven screws from the analog board. Disconnect J14, J15, and J19 from the analog board. Lift out the analog board.

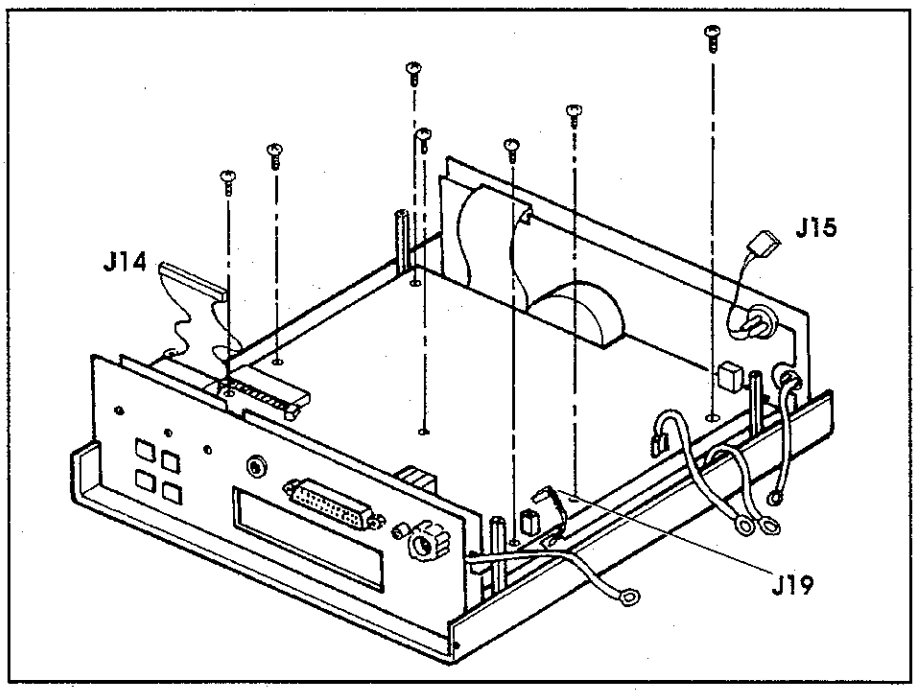


Figure 5.5

Remove seven studs and lift out the shield. Remove the next seven studs and lift out the digital board with the front and rear panels.

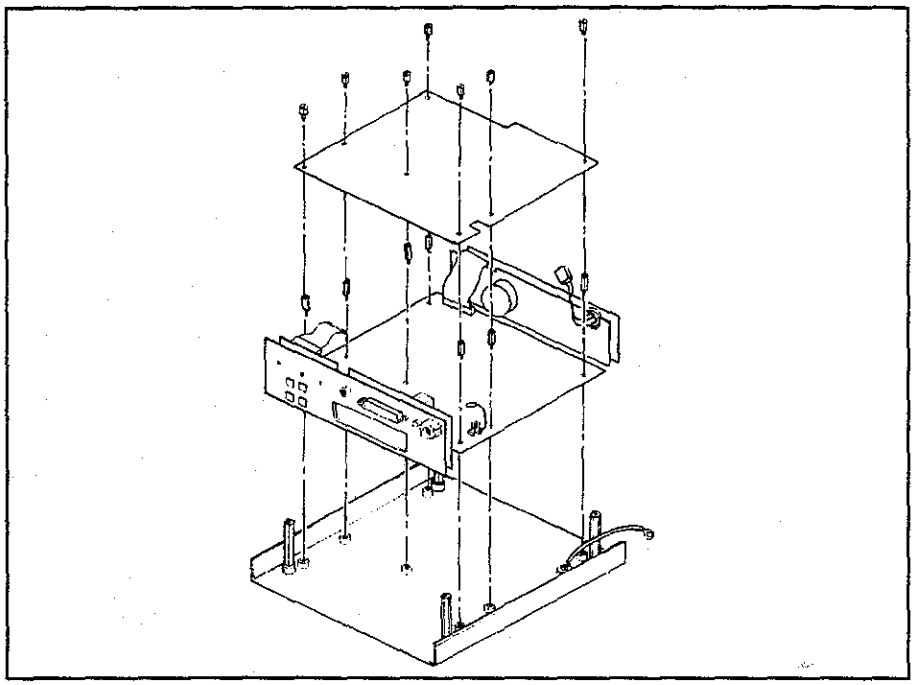
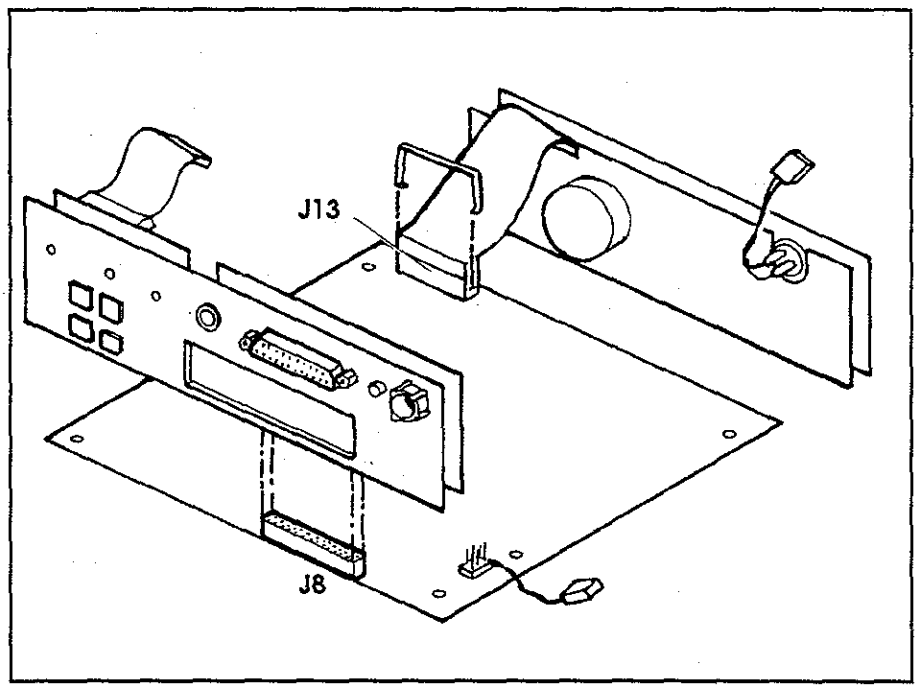


Figure 5.6

Disconnect J13 from the digital board and remove the front panel. Lift the rear panel to disconnect J8 from the digital board.



Schematics

Following are the mechanical drawings, component locators, and electrical schematics for the final assembly of the monitors, and for their major subassemblies. For information on the disassembly of the monitors, see the Disassembly Chapter of this manual. For information on replacement parts, contact Aequitron's Technical Service Department by calling:

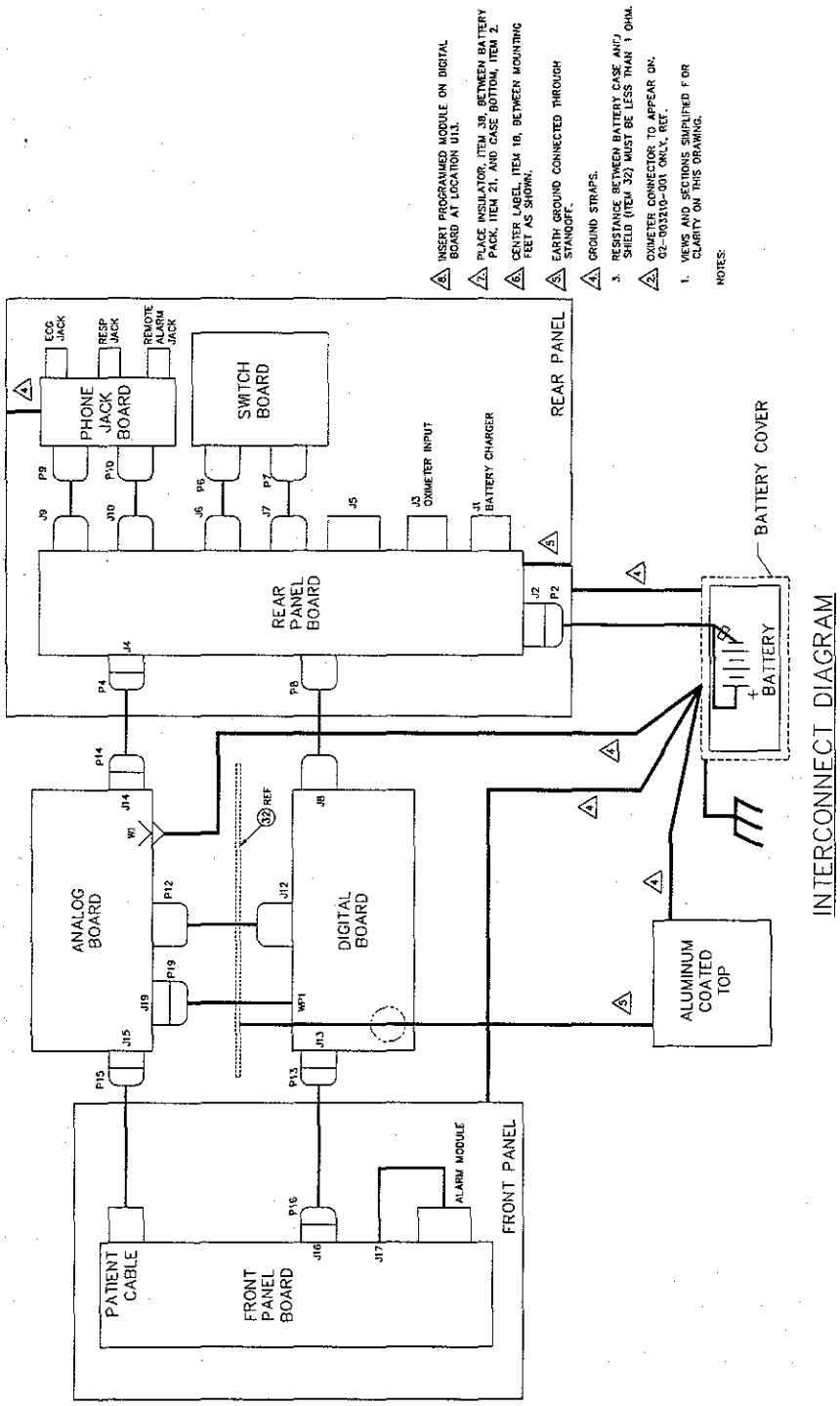
(800) 497-3787

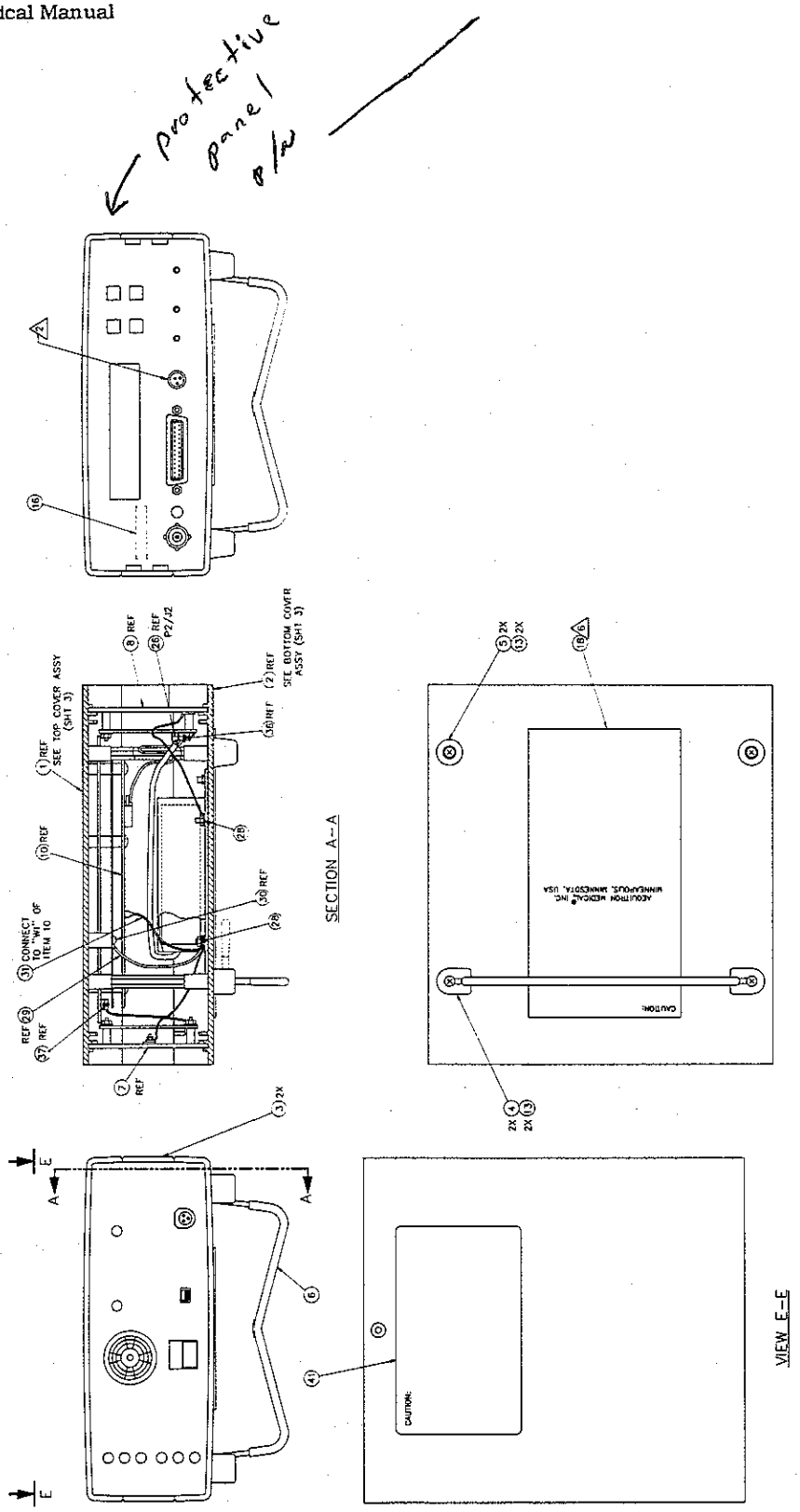
The following service kits are used to replace defective assemblies in the monitors:

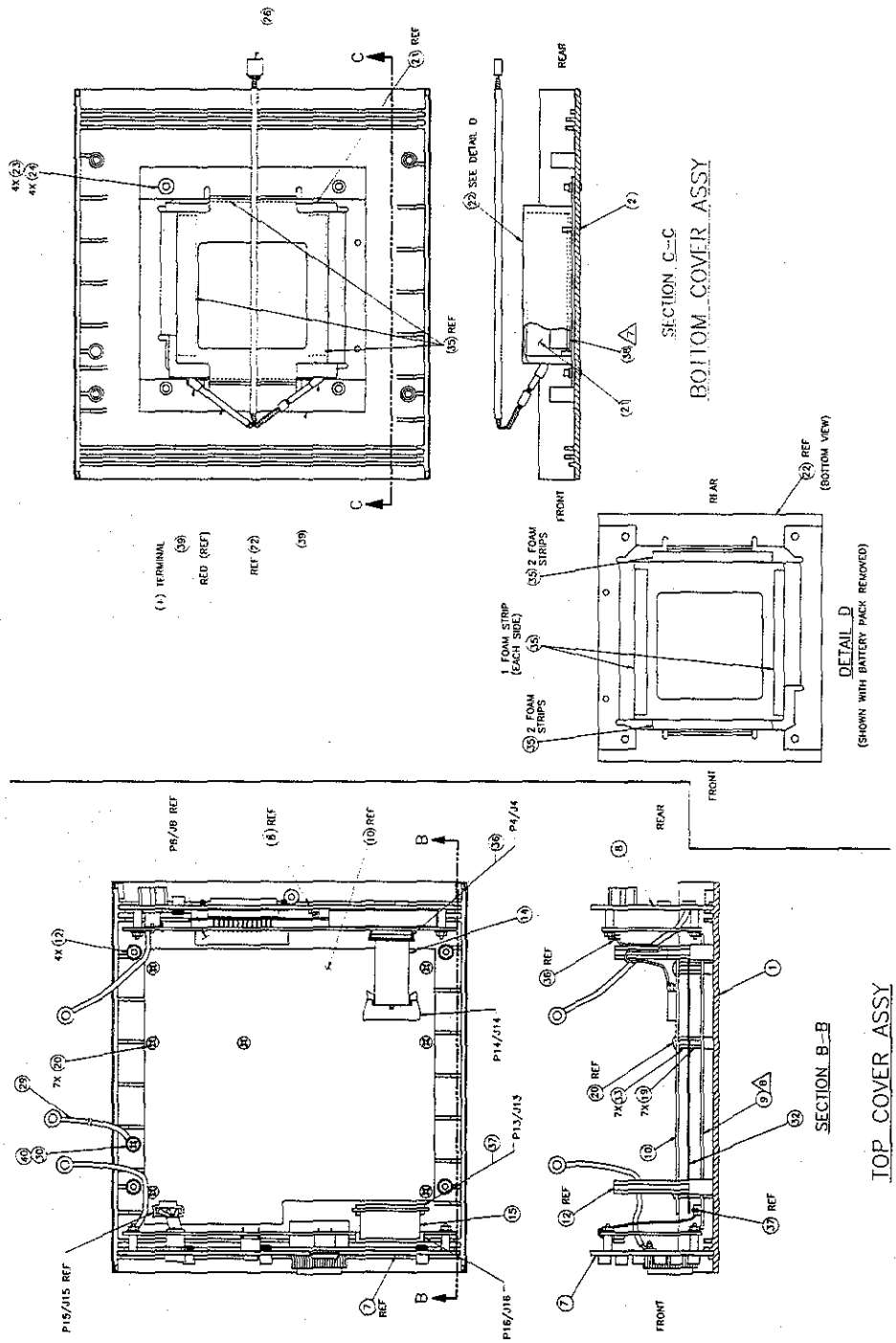
Monitor	Service Kit	Board
9500	1061	Digital Board
	1057	Analog Board
	1059	Front Panel
9550	1061	Digital Board
	1057	Analog Board
	1060	Front Panel
9550/50	1061	Digital Board
	1058	Analog Board
	1060	Front Panel

Note Back panels are not field-serviceable. Units with defective back panels must be returned to Aequitron Medical for service.

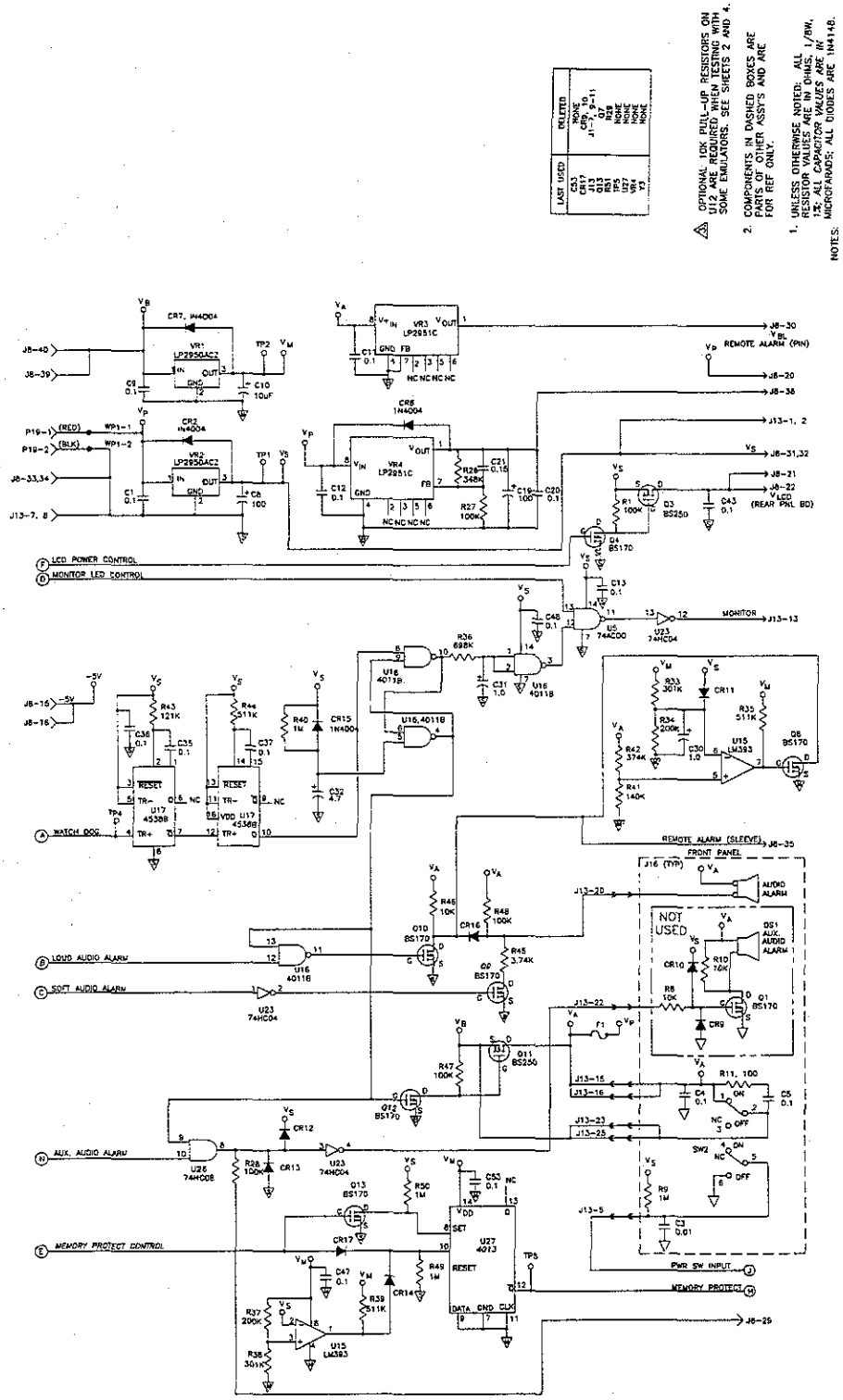
Final Assembly

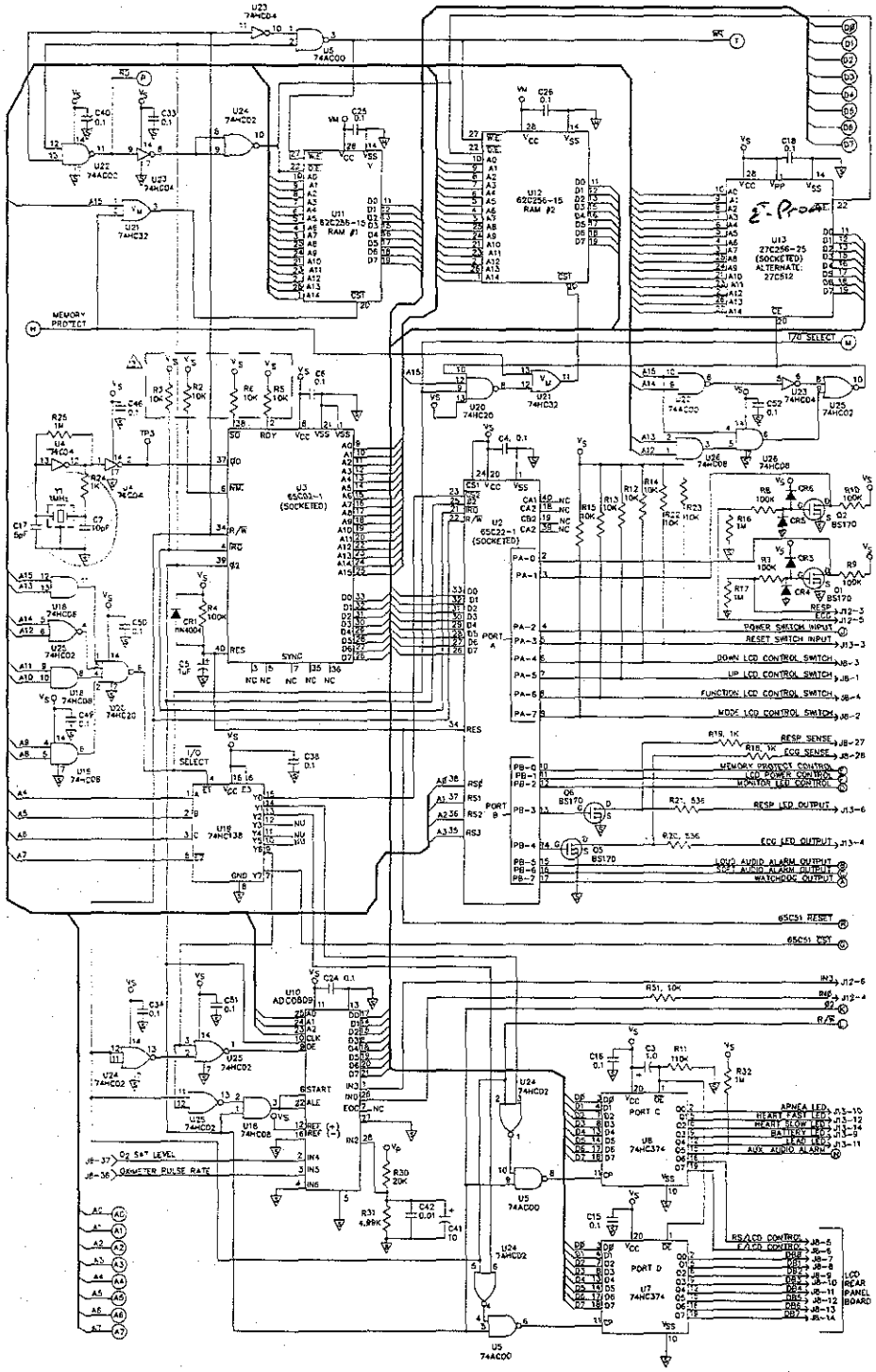


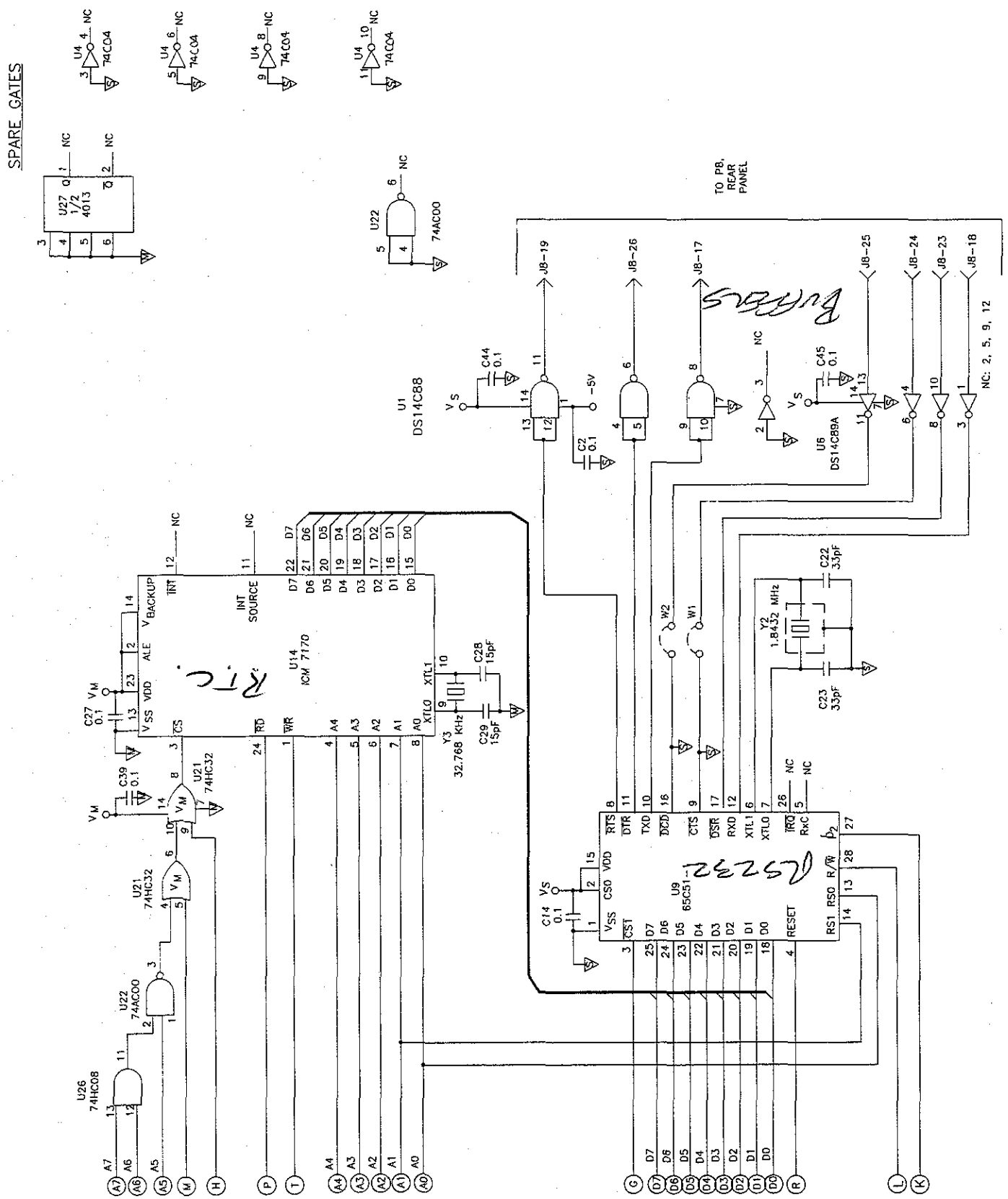

protective panel
SECTION A-A
VIEW E-E
CAUTION:

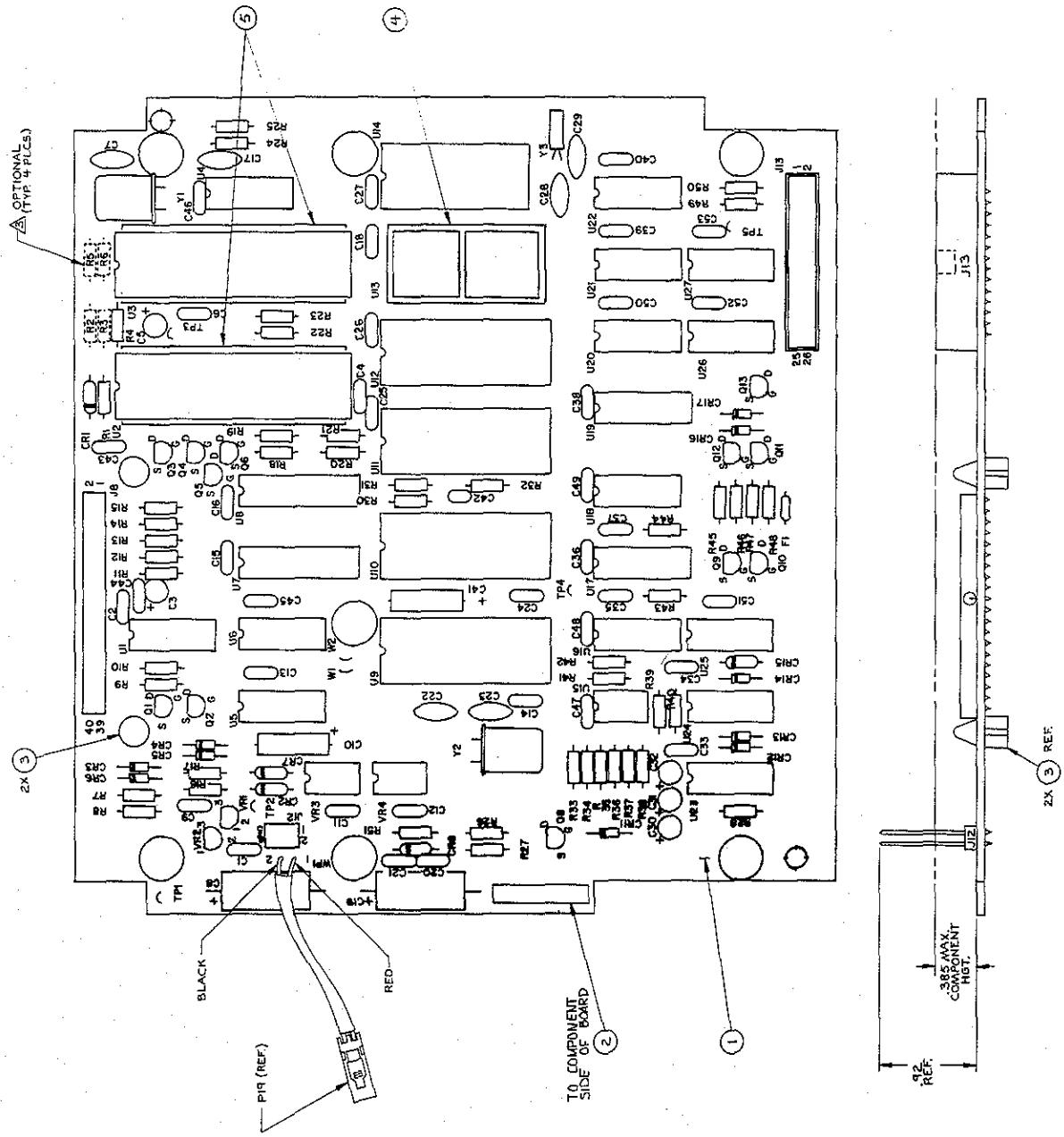

BOTTOM COVER ASSY
SECTION C–C
DETAIL D
(SHOWN WITH BATTERY PACK REMOVED)
TOP COVER ASSY
SECTION B–B
FRONT
REAR
(+) TERMINAL
RED (REF)
REF (72)
SEE DETAIL D
2 FOAM STRIPS
1 FOAM STRIP (EACH SIDE)
P15/J15 REF
P16/J16
P14/J14
P13/J13
P4/J4
P5/J5 REF

Digital Board

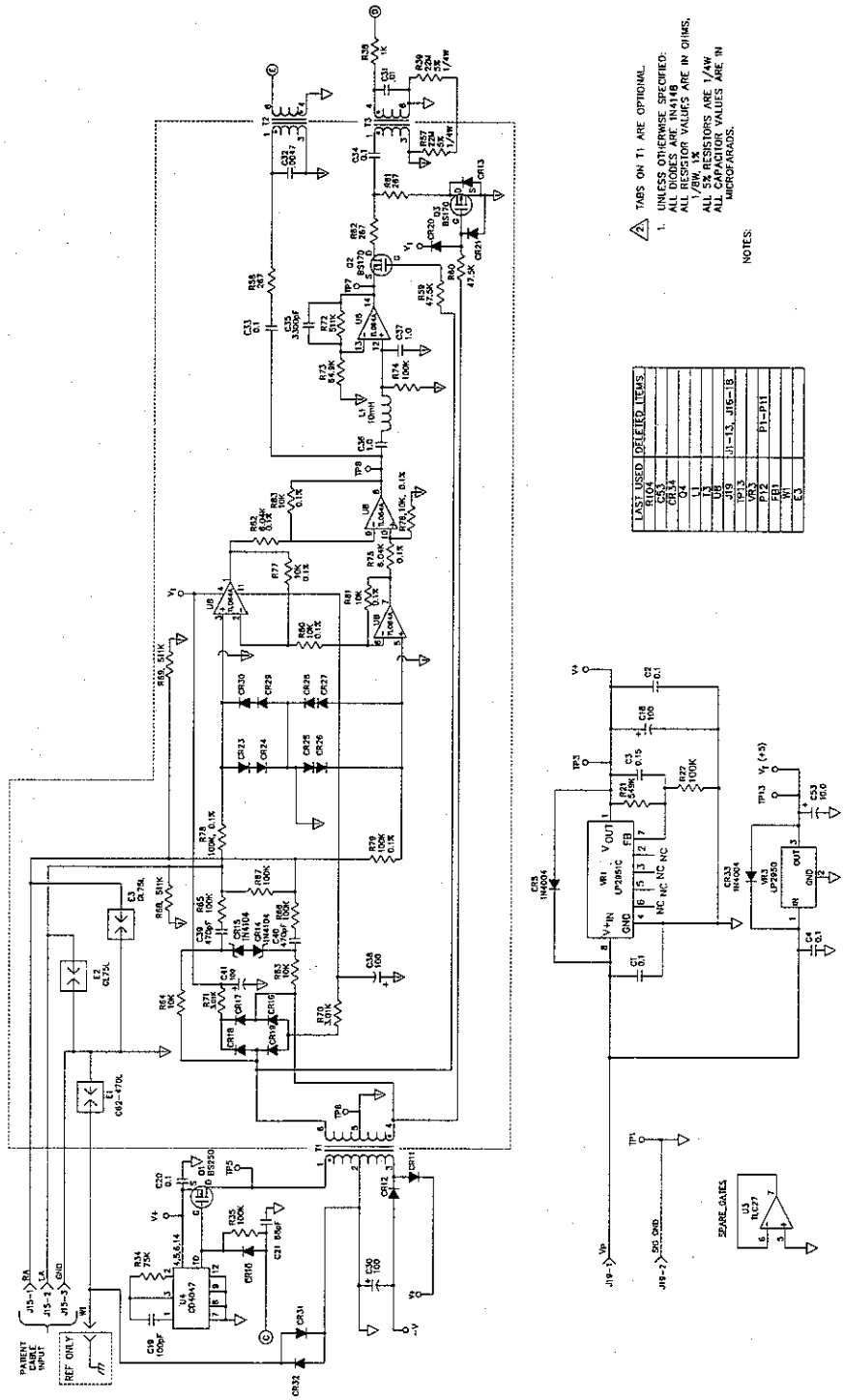


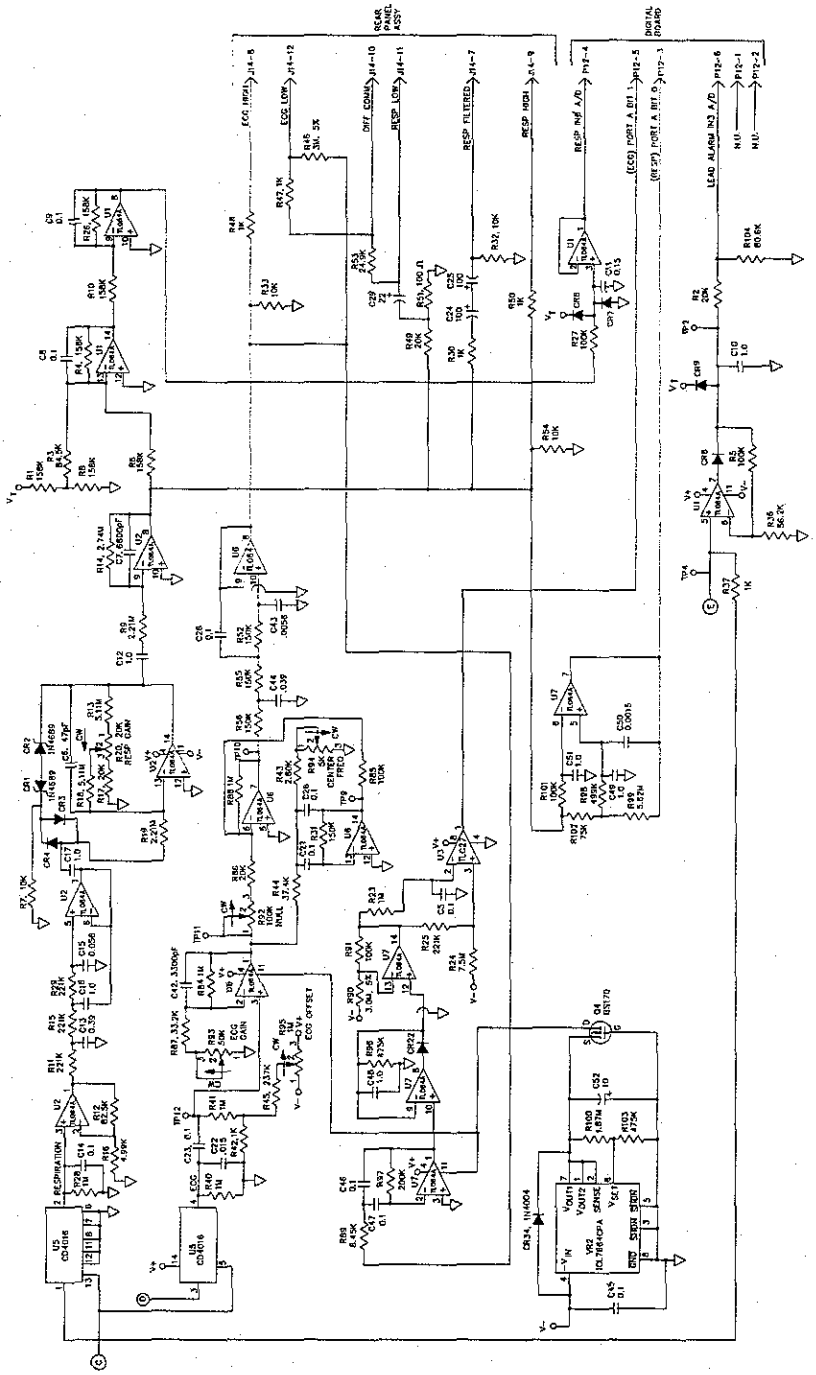


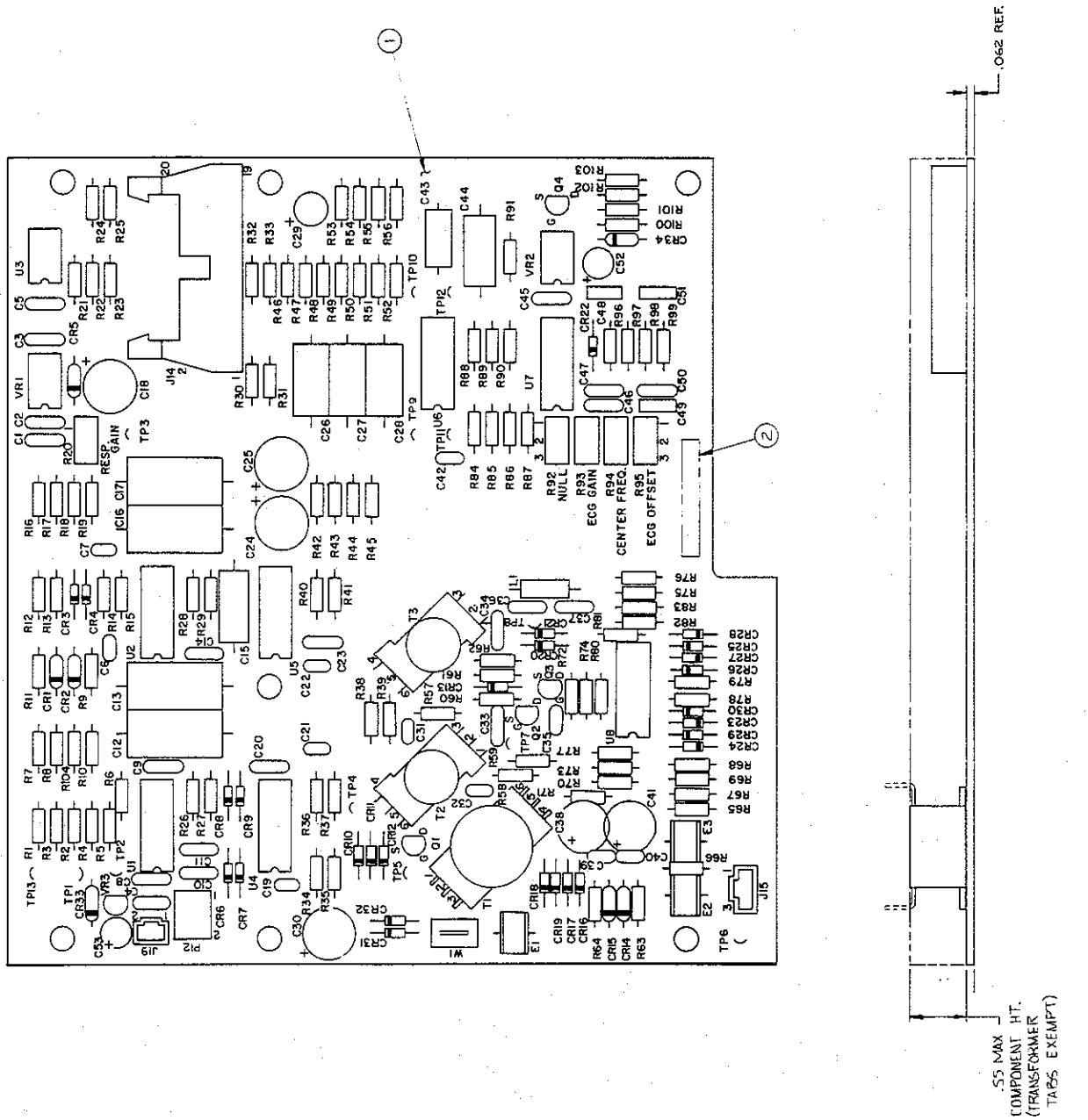

SPARE GATES
U4 74C04
U27 1/2 4013
U22 74AC00
TO P8, REAR PANEL
U1 DS14C88
U6 DS14C89A
U14 ICM 7170
U9 65C51
RS232
U21 74HC32
U26 74HC08
Y2 1.8432 MHz
Y3 32.768 KHz
C22 33pF
C23 33pF
C28 15pF
C29 15pF
NC: 2, 5, 9, 12


OPTIONAL (TYP 4 PLCS.)
2X
BLACK
RED
P19 (REF.)
TO COMPONENT SIDE OF BOARD
.385 MAX. COMPONENT HGT.
.92 REF.
2X REF.

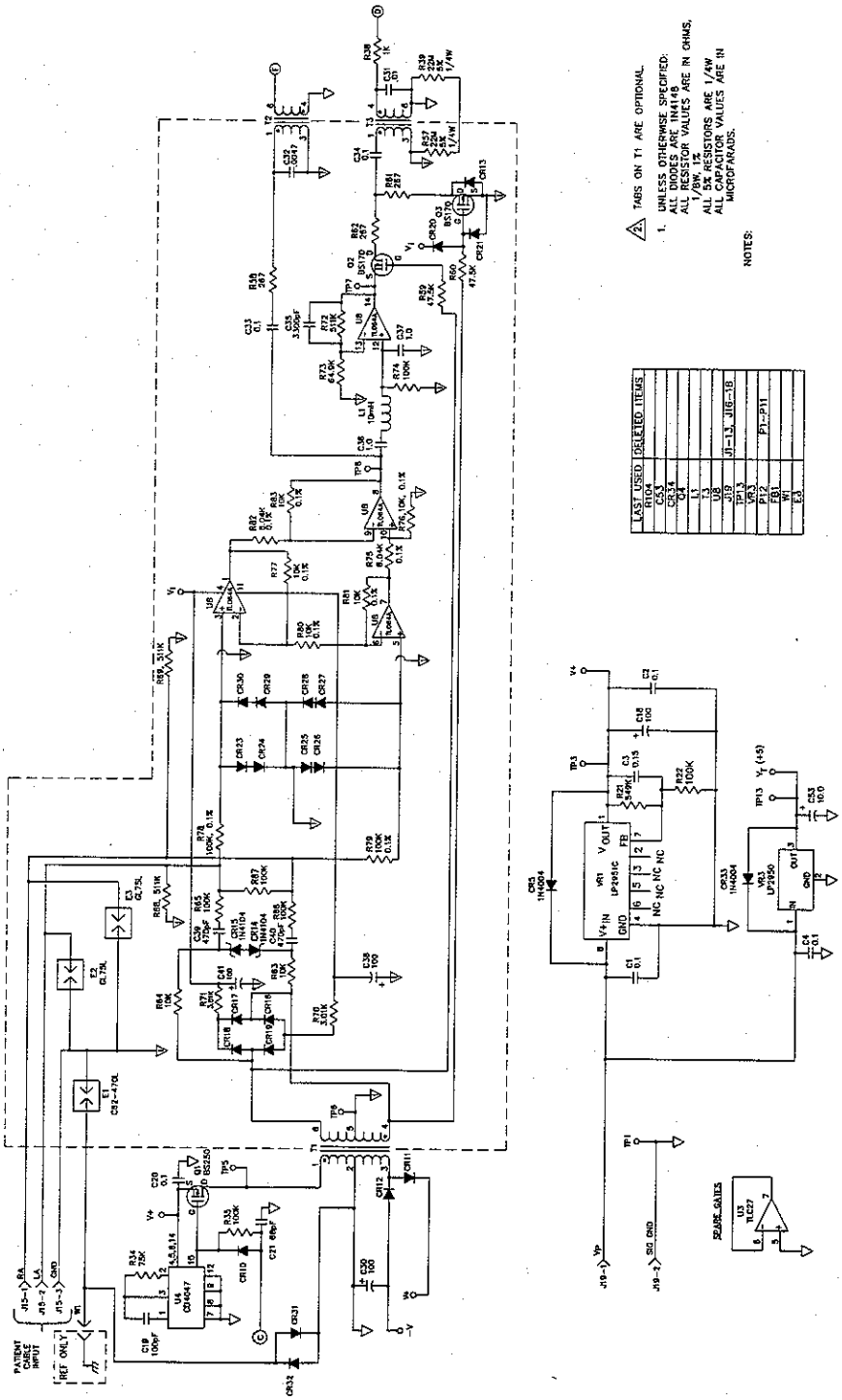
Analog Board

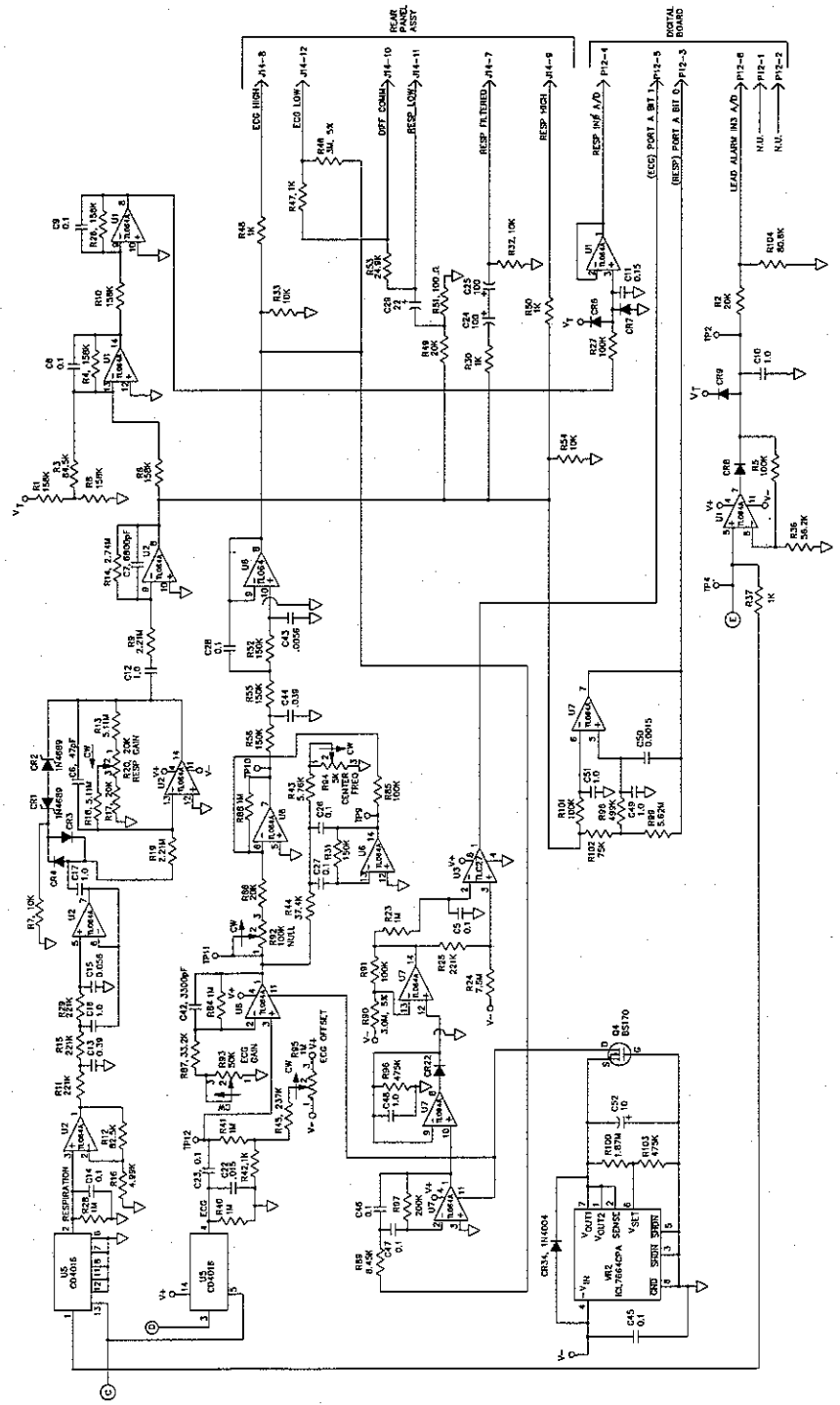


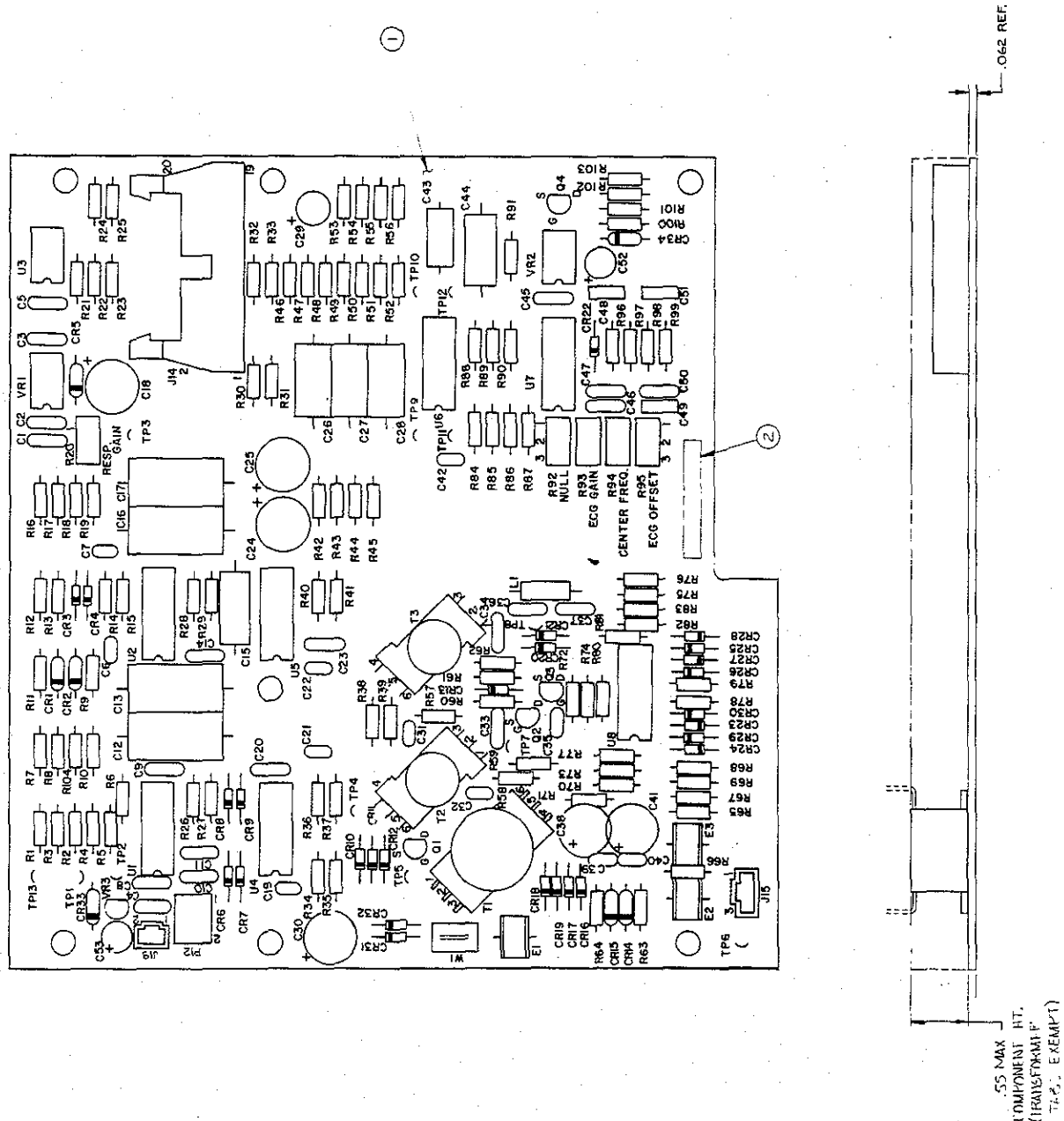



1
2
.062 REF.
.55 MAX HT.
COMPONENT HT.
(TRANSFORMER
TABS EXEMPT)

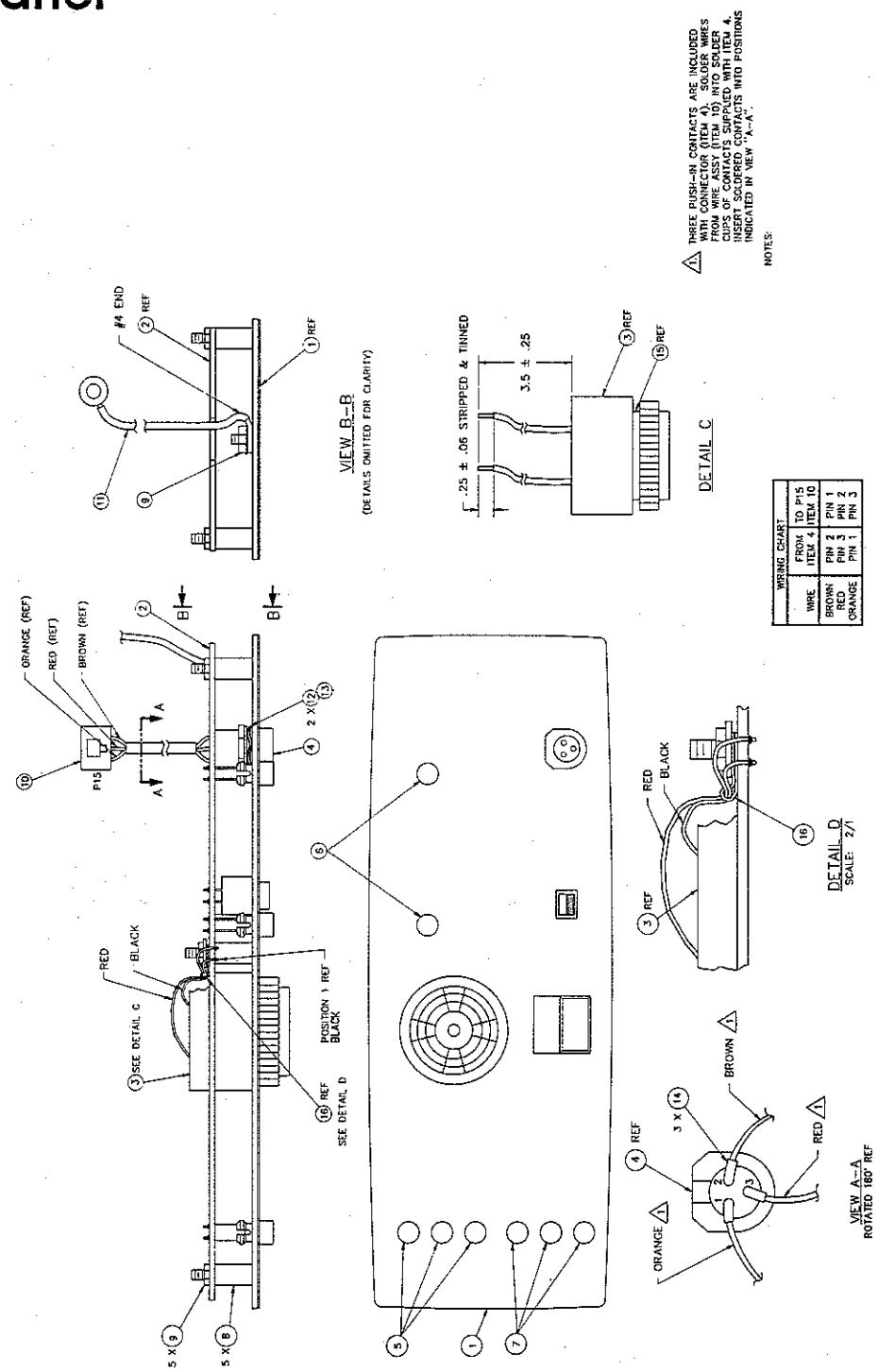
Analog Board (50Hz)



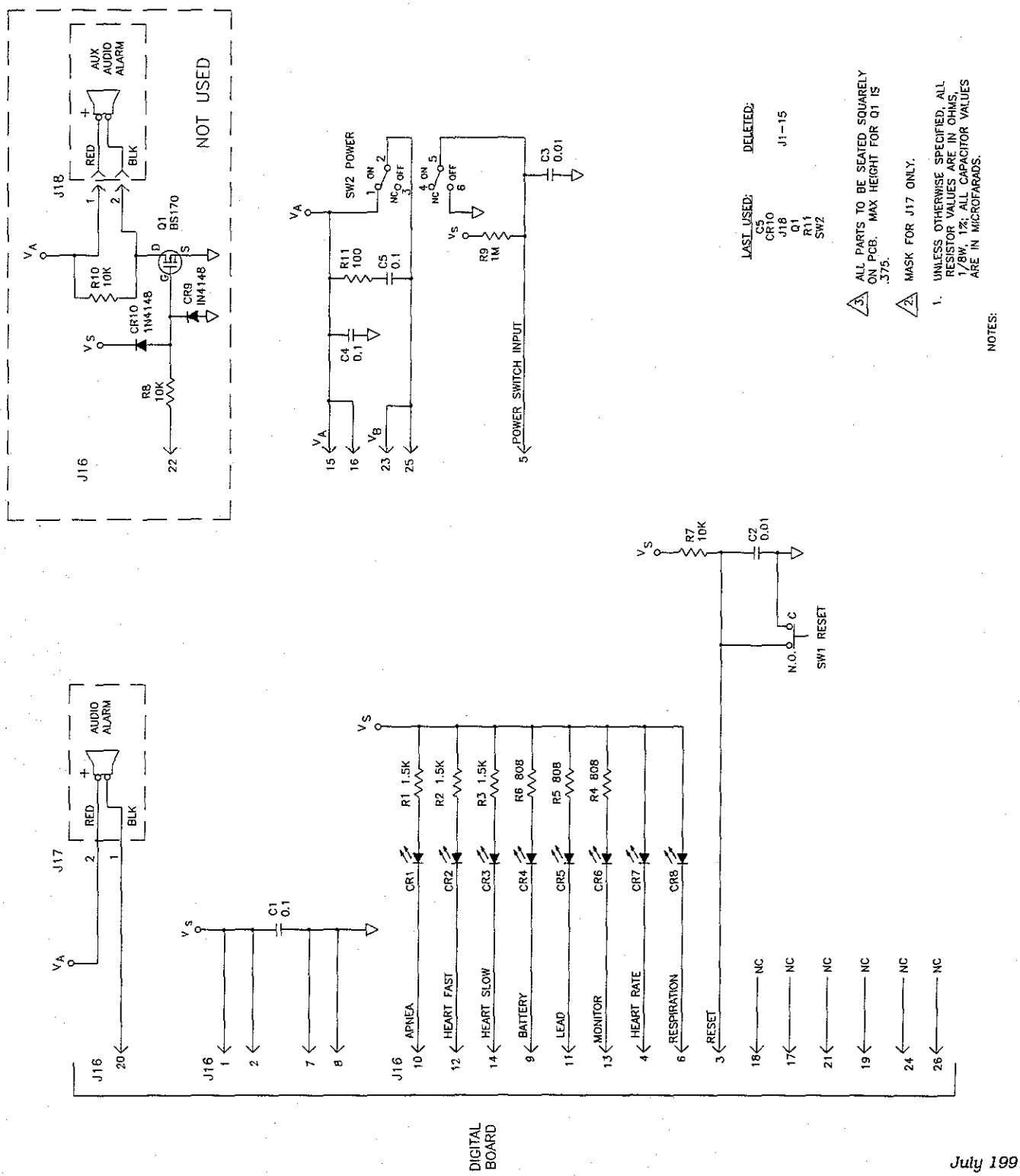


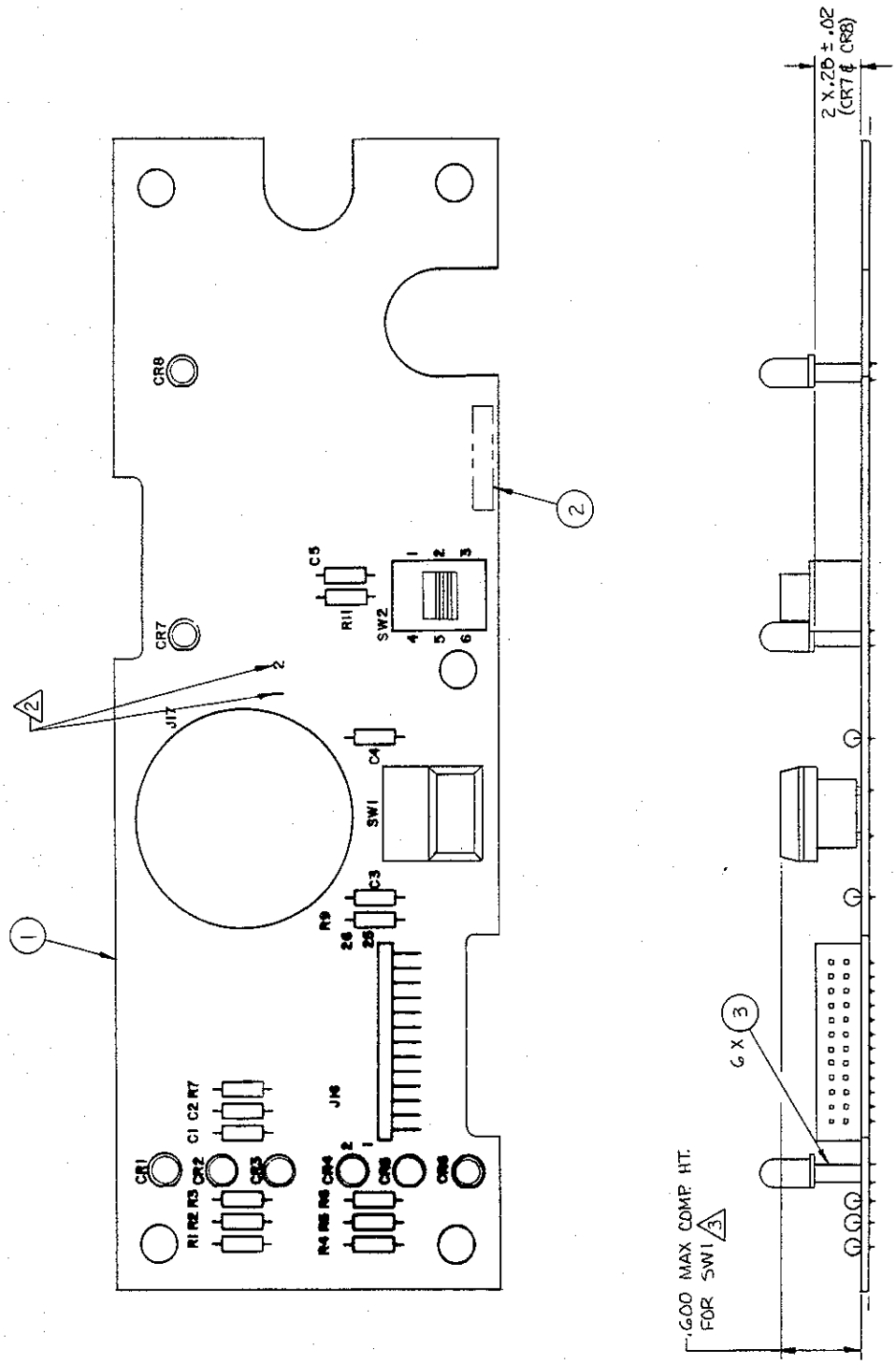

.062 REF.
.55 MAX
(COMPONENT HT.
(TRANSFORMER
EXEMPT)

Front Panel

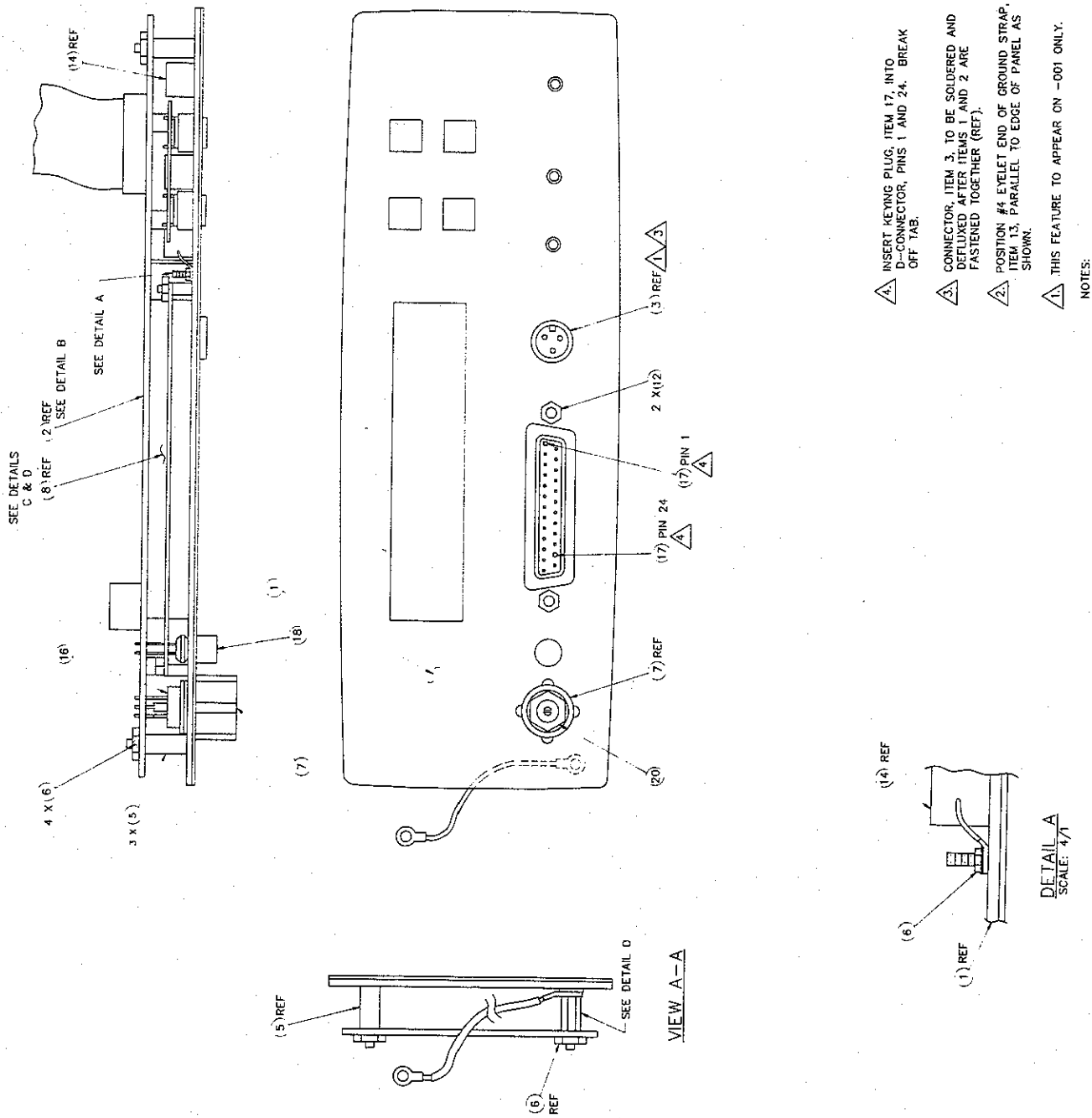

THREE PUSH-IN CONTACTS ARE INCLUDED WITH CONNECTOR (ITEM 4). SOLDER WIRES FROM WIRE ASSY (ITEM 10) INTO SOLDER CUPS OF CONTACTS SUPPLIED WITH ITEM 4. INSERT SOLDERED CONTACTS INTO POSITIONS INDICATED IN VIEW "A-A".
NOTES:
WIRING CHART
WIRE
FROM ITEM 4
TO P15 ITEM 10
BROWN
PIN 2
PIN 1
RED
PIN 3
PIN 2
ORANGE
PIN 1
PIN 3
VIEW B-B
(DETAILS OMITTED FOR CLARITY)
#4 END
DETAIL C
.25 ± .06 STRIPPED & TINNED
3.5 ± .25
DETAIL D
SCALE: 2/1
VIEW A-A
ROTATED 180° REF
ORANGE (REF)
RED (REF)
BROWN (REF)
P15
SEE DETAIL C
SEE DETAIL D
POSITION 1 REF
BLACK
RED
BROWN
ORANGE
5 X
2 X

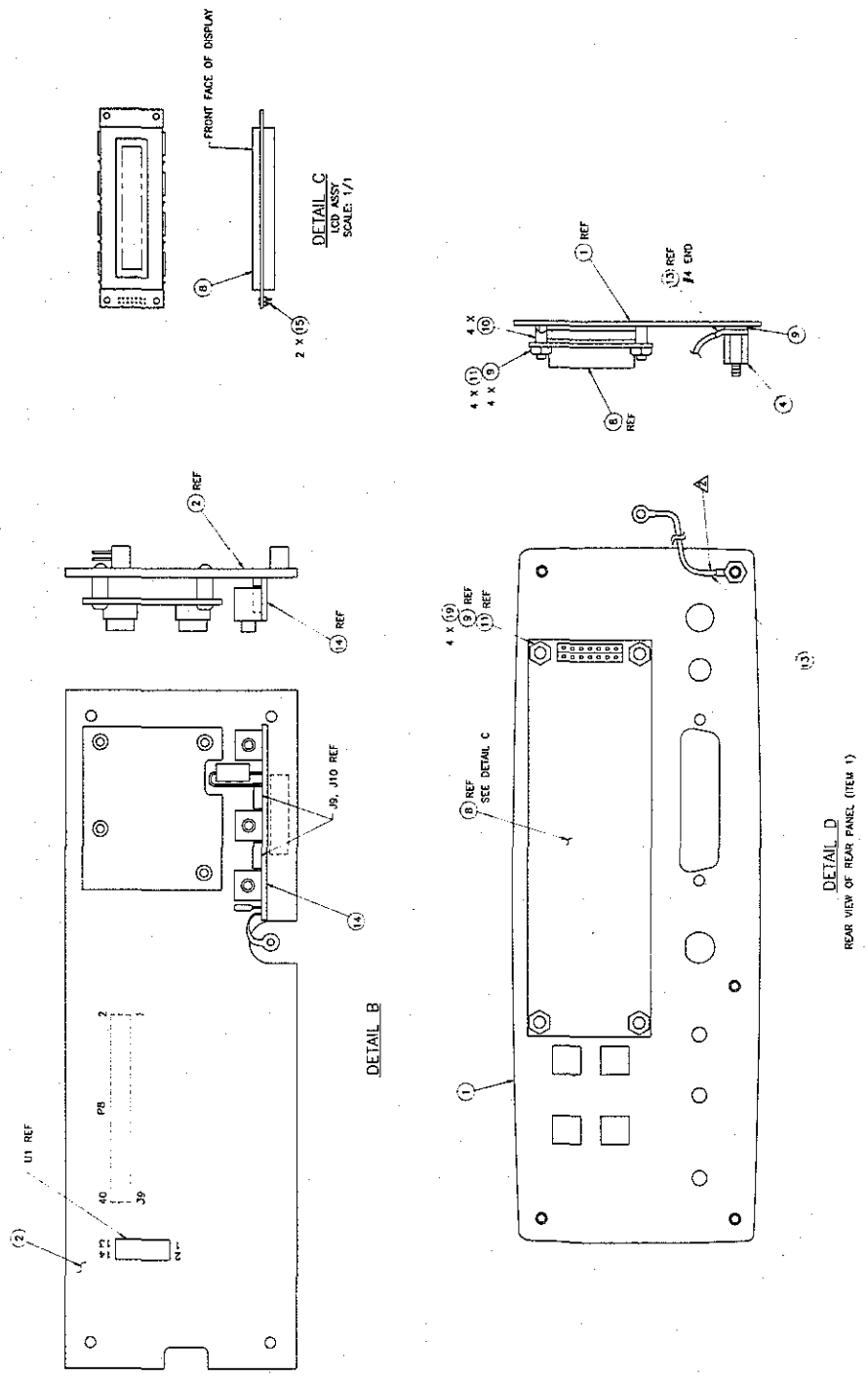
Front Panel Board



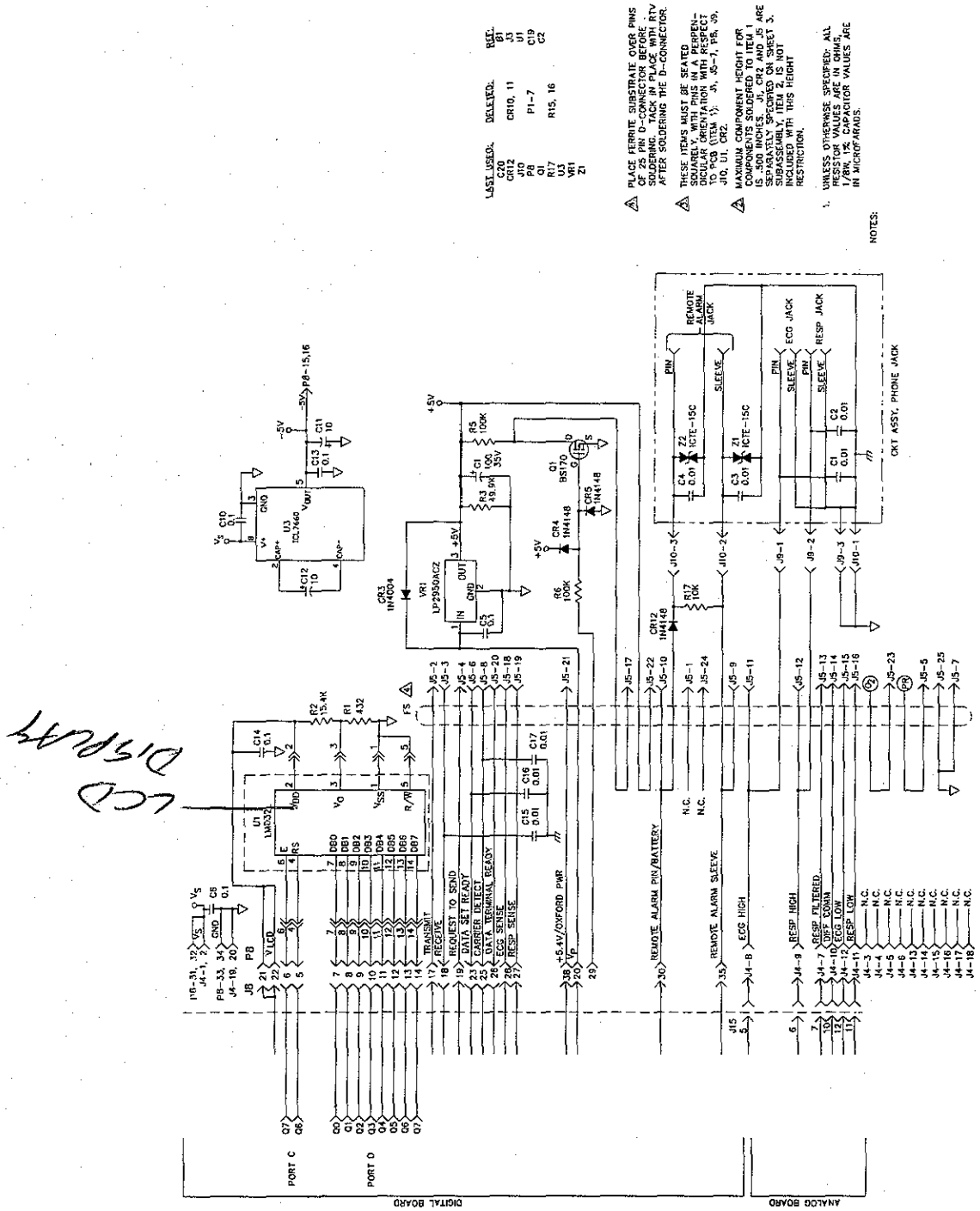

CR8
CR7
C5
R11
SW2
J17
C4
SW1
C3
R9
J16
C1 C2 R7
2 X .25 ± .02
(CR7 & CR8)
6 X
.600 MAX COMP. HT.
FOR SW1

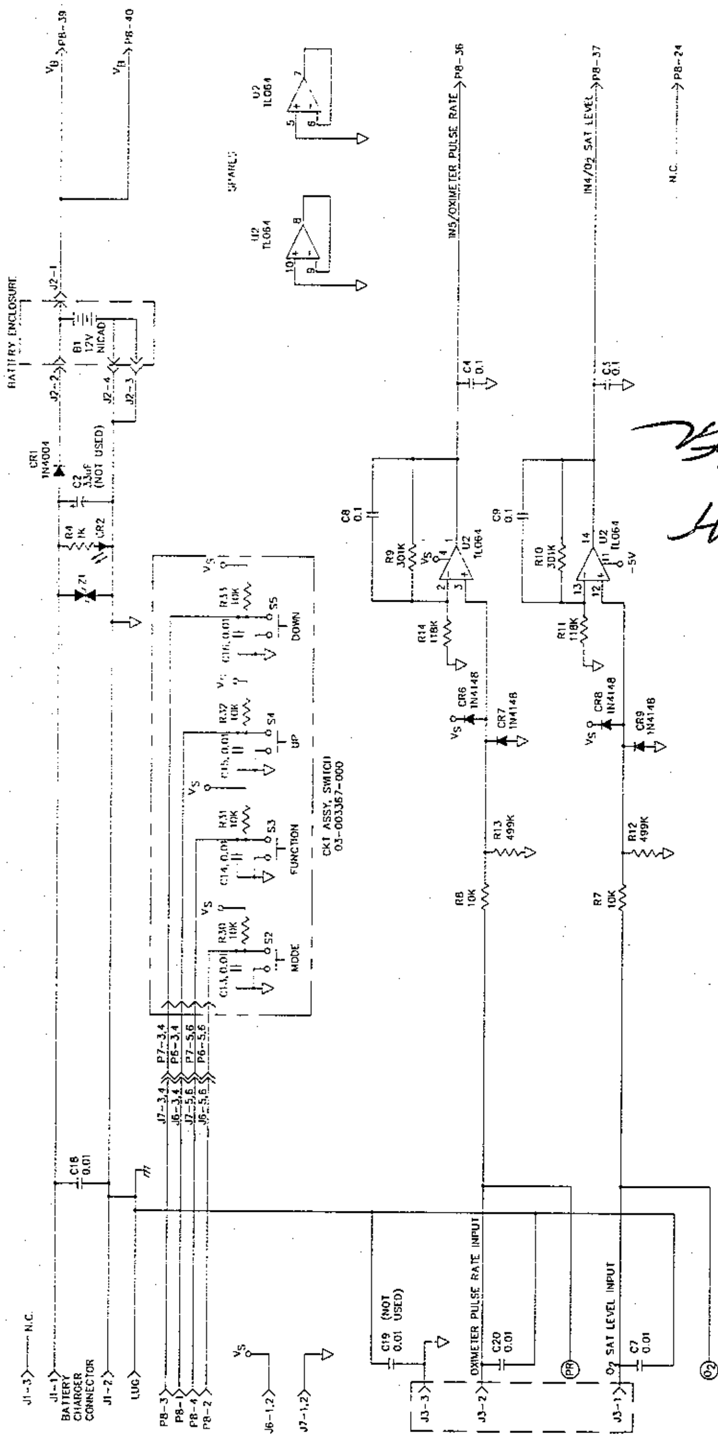
Back Panel

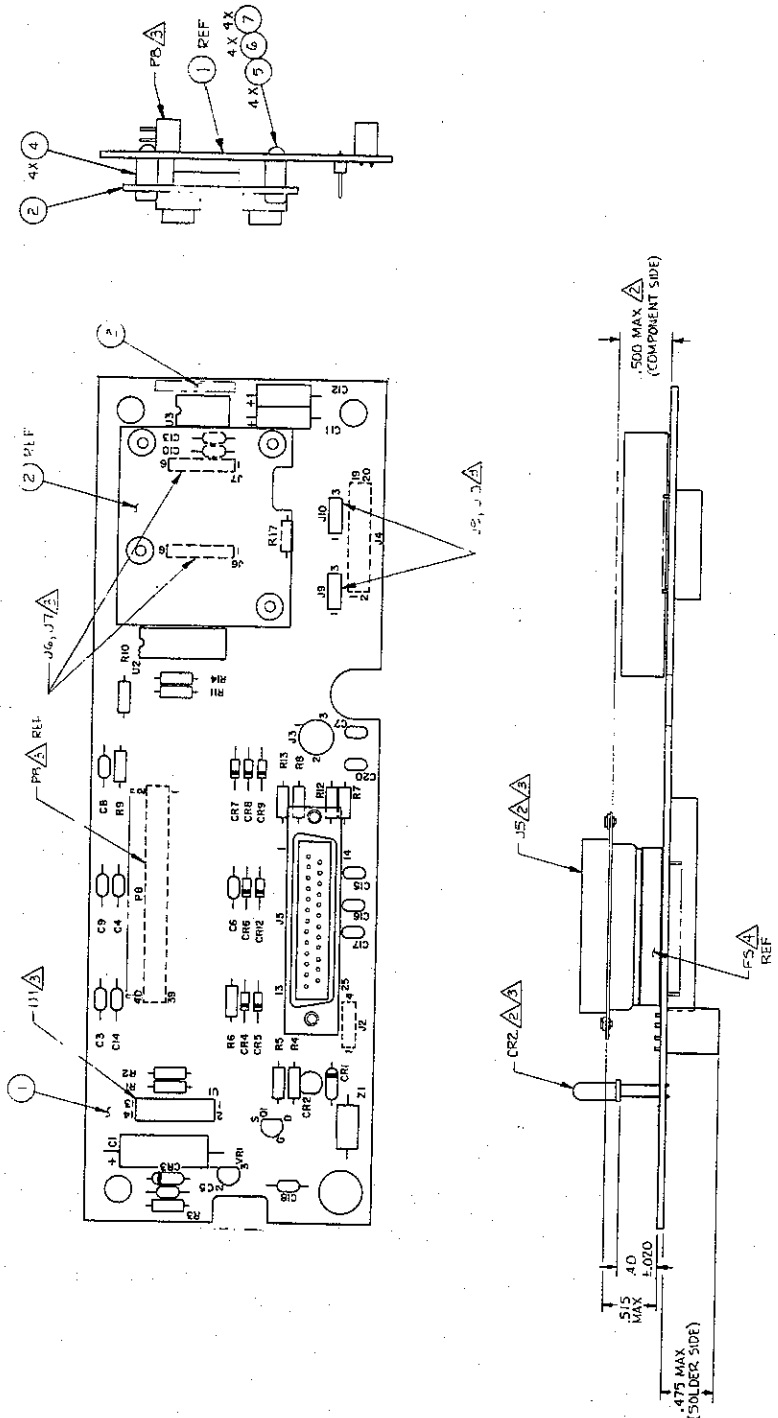

(14) REF
SEE DETAIL A
SEE DETAIL B
(2) REF
SEE DETAILS C & D
(8) REF
(16)
(18)
(1)
4 X (6)
3 X (5)
(7)
(3) REF
2 X (12)
(17) PIN 1
(17) PIN 24
(7) REF
(20)
(5) REF
SEE DETAIL D
(6) REF
VIEW A-A
(4) INSERT KEYING PLUG, ITEM 17, INTO D-CONNECTOR, PINS 1 AND 24. BREAK OFF TAB.
(3) CONNECTOR, ITEM 3, TO BE SOLDERED AND DEFLUXED AFTER ITEMS 1 AND 2 ARE FASTENED TOGETHER (REF).
(2) POSITION #4 EYELET END OF GROUND STRAP, ITEM 13, PARALLEL TO EDGE OF PANEL AS SHOWN.
(1) THIS FEATURE TO APPEAR ON -001 ONLY.
NOTES:
(14) REF
(6)
(1) REF
DETAIL A
SCALE: 4/1


FRONT FACE OF DISPLAY
DETAIL C
LCD ASSY
SCALE: 1/1
2 X (15)
(8)
(1) REF
(15) REF
#4 GND
4 X (10)
4 X (11)
4 X (5)
(6) REF
(9)
(4)
(2) REF
(14) REF
J9, J10 REF
(14)
DETAIL B
U1 REF
(2)
P8
2
1
40
39
4 X (9)
(9) REF
(11) REF
(3)
(8) REF
SEE DETAIL C
(1)
DETAIL D
REAR VIEW OF REAR PANEL (ITEM 1)

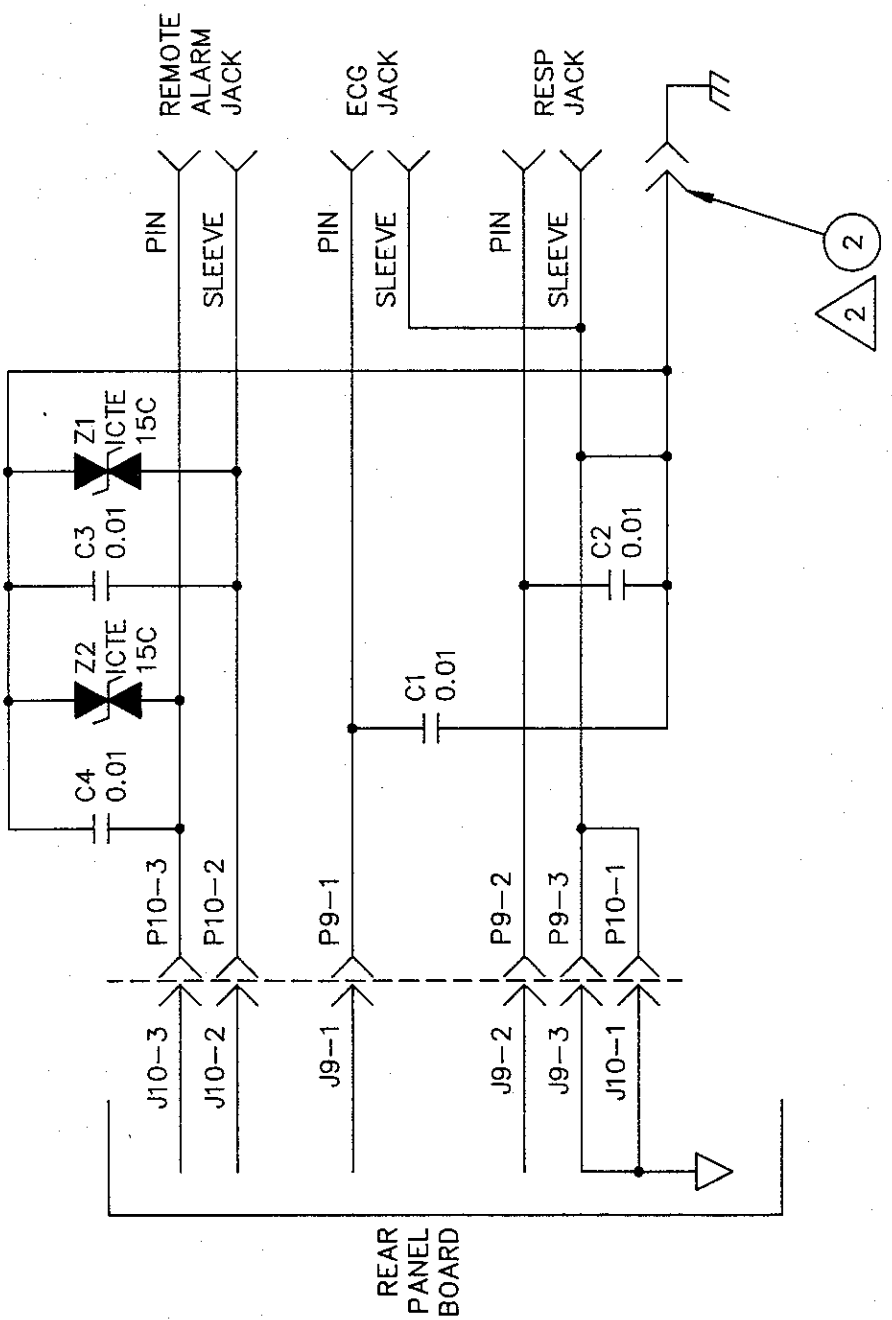
Back Panel Board







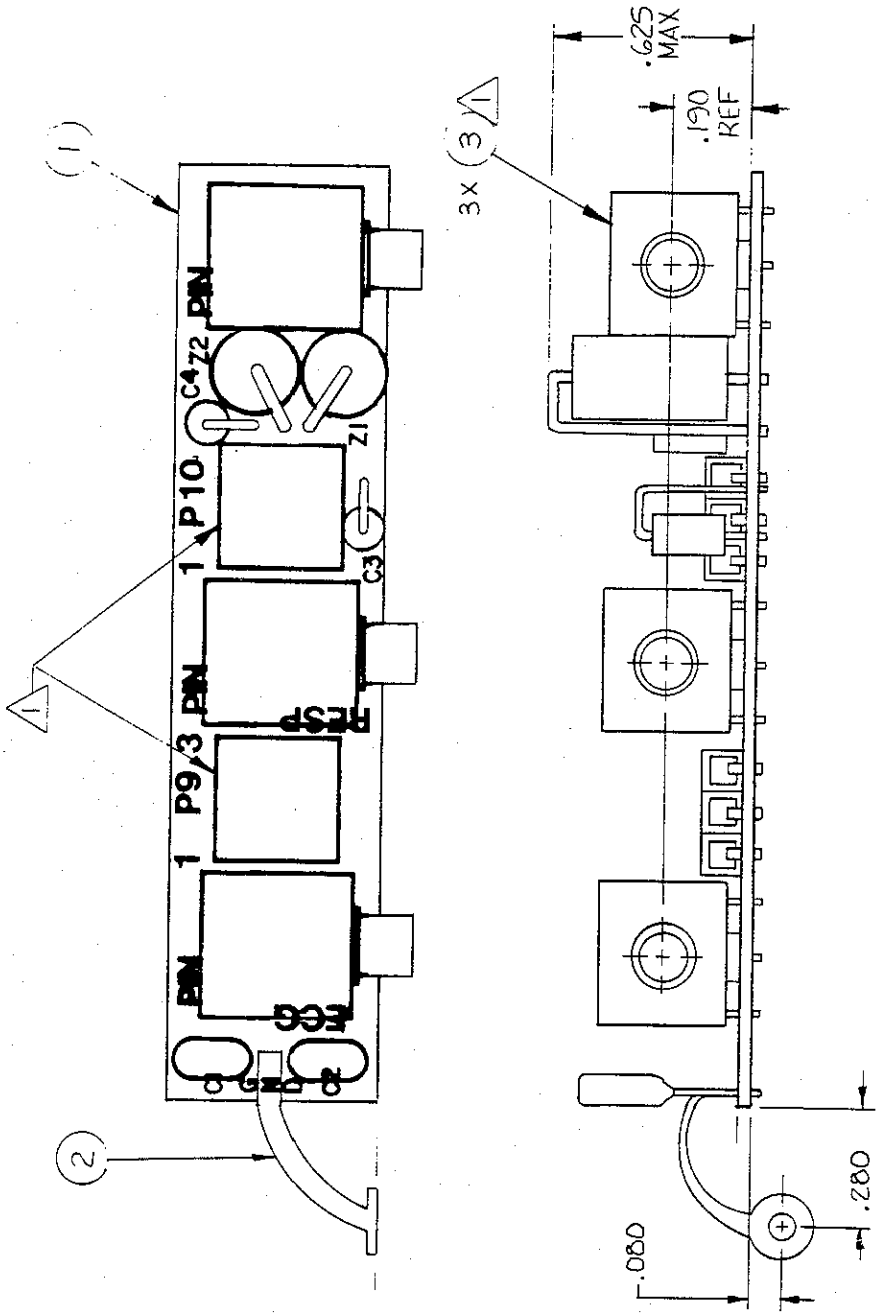
Phone Jack Board



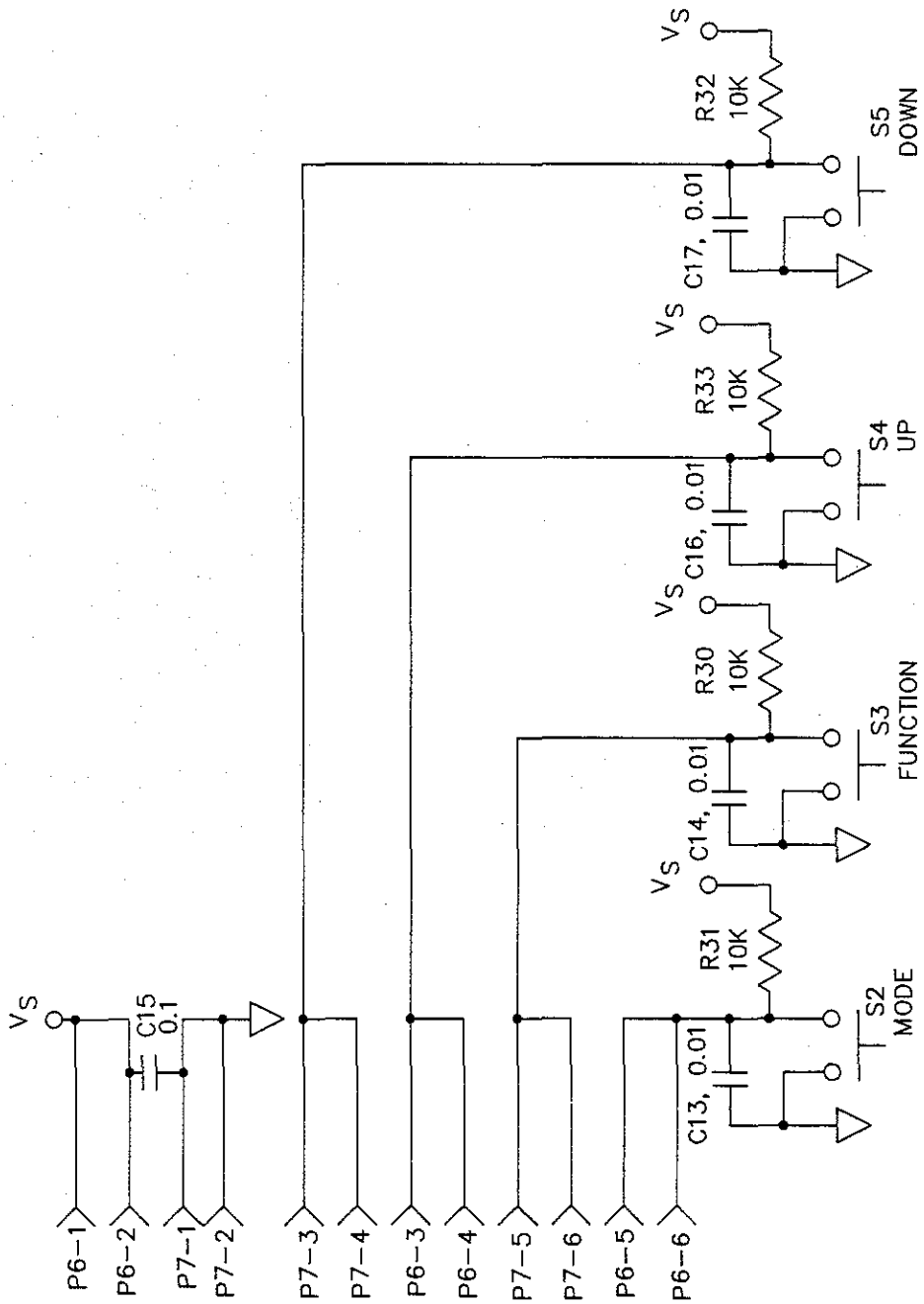
NOTES:

1. THESE ITEMS MUST BE SEATED SQUARELY ON PCB (ITEM 1). SKEWING OR CANTING OF PARTS IS NOT ACCEPTABLE.

2. ITEM 2, EARTH TERMINAL CONNECTION, TO BE ATTACHED TO REAR PANEL STUD.


.625
MAX
.190
REF
3X
3
1
P10
1
P9
3
1
PIN
PIN
PIN
C4
72
C3
Z1
RCSP
RCG
2
.280
.080

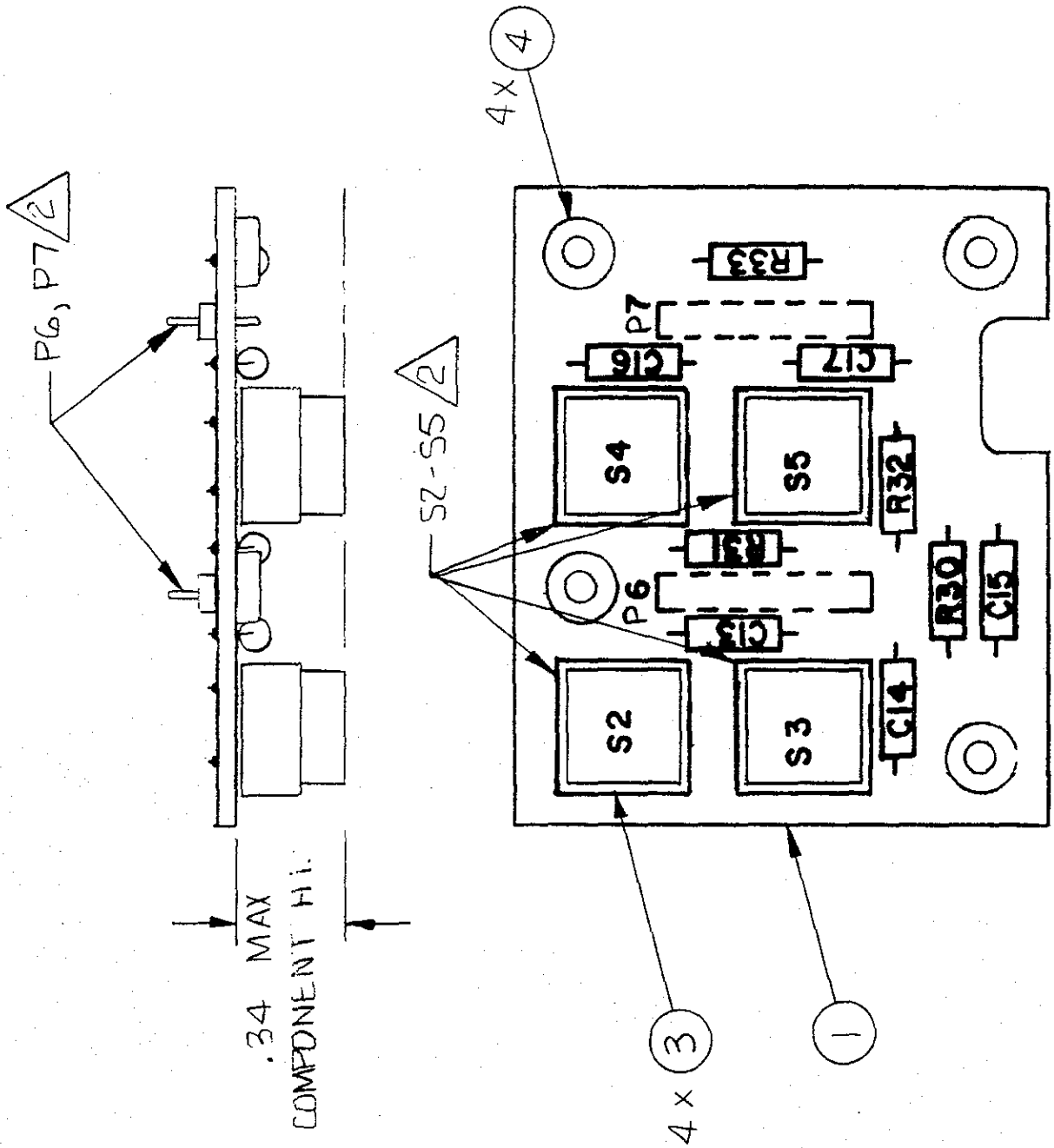
Key Switch Board



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/8W, 1%; ALL CAPACITOR VALUES ARE IN MICROFARADS.

2. THESE ITEM MUST BE SEATED SQUARELY ON PCB (ITEM 1). P6 & P7 PINS SHOULD BE PERPENDICULAR TO PCB SURFACE. S2 – S5 CANNOT BE TILTED.


4 x 4
P6, P7
2
S2-S5
2
R33
P7
C16
C17
S4
S5
R32
R31
P6
C13
R30
C15
S2
S3
C14
4 x 3
1
.34 MAX
COMPONENT HI.

Model _____

Model 9500/9550 Inspection Data Sheet

Serial No._____

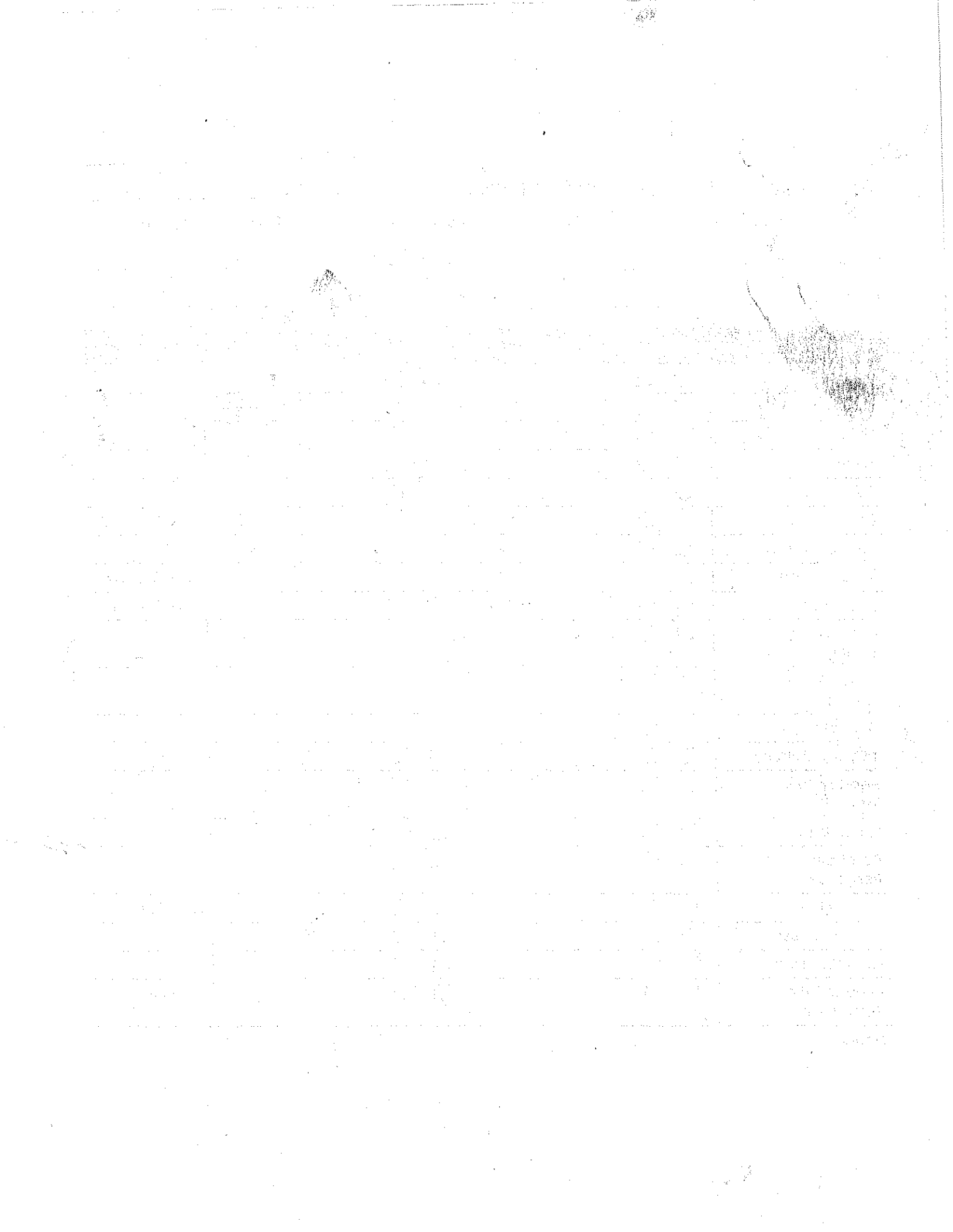
Initial Inspection ☐ Pass ☐ Fail **Final Inspection** ☐ Pass ☐ Fail

Inspected By:_____ Inspected By: _____

Inspection Date:_____ Inspection Date: _____

Test	Initial Test Pass/Fail	Result	Final Test Pass/Fail	Result	Spec.
Serial #	☐ ☐		☐ ☐		
Case assembly	☐ ☐		☐ ☐		
Mechanical	☐ ☐		☐ ☐		
Alarm	☐ ☐		☐ ☐		
Power up	☐ ☐		☐ ☐		
Recorder power	☐ ☐	VDC	☐ ☐	VDC	5.4 ± 0.5 VDC
Battery output	☐ ☐	VDC	☐ ☐	VDC	>10.0 VDC
Resp. output	☐ ☐	V_{P-P}	☐ ☐	V_{P-P}	2.0 ± 0.2 V_{P-P}
ECG output	☐ ☐	V_{Pk}	☐ ☐	V_{Pk}	3.0 ± 0.3 V_{Pk}
Infant Alarm Settings	☐ ☐		☐ ☐		
Adult Alarm Settings	☐ ☐		☐ ☐		
ECG Response	☐ ☐		☐ ☐		
Inverted Polarity	☐ ☐		☐ ☐		
Heart Rate = Resp.	☐ ☐		☐ ☐		
Lead Output	☐ ☐		☐ ☐		
Respiration Response	☐ ☐		☐ ☐		
Oxygen Desat	☐ ☐		☐ ☐		9550 Only
Interface Test	☐ ☐		☐ ☐		
Charging light	☐ ☐		☐ ☐		
Ground Wire Resistance	☐ ☐		☐ ☐		≤ 1 ohm

Notes:



AEQUITRON MEDICAL INC
14800 28TH AVENUE NORTH, MINNEAPOLIS, MN 55447-4834 U.S.A.
(612) 557-9200 FAX (612) 557-8200

MODEL 9500/9550 MONITOR ALARM QUESTION & ANSWER SUMMARY

Please refer to pages 11, 23 and 29 of the 9500 Dealers Manual and page 22 of the 9500 Users Manual for further discussion of these issues.

Q: What type of Monitor alarms are there?

A: 2 types. In the first, the monitor light (on the front panel) is on continuously and the audible alarm is sounding continuously. In the second, the monitor light is blinking once per second and the audible alarm is sounding once every 30 seconds.

Q: Under what conditions will the first condition occur (Monitor light on continuously, audible alarm sounding continuously)?

A: The microprocessor in the monitor continuously checks itself (via circuitry called a 'watchdog'). If the circuitry detects a potential error condition it will turn on the monitor light/alarm. Sometimes these conditions are transient and at others times the damage is permanent. The following are conditions under which this type of alarm might occur: electronics parts failure, battery discharged to extremely low levels, a large electrostatic discharge or a violent drop (of the monitor).

Q: What should I do when a continuous Monitor alarm occurs?

A: Turn the monitor off and then on again. If the problem was transient then the monitor will go through a normal start-up sequence and start to pick up heart and respiration signals. If the monitor goes into a second continuous Monitor alarm condition, we recommend that the monitor be returned for further evaluation. If you have any doubts at all about the integrity of the monitor please return it for evaluation.

Q: Under what circumstances will the second condition occur (the monitor light is blinking (once per second) and the audible alarm is sounding once every 30 seconds)?

A: The monitor stores its settings in several different locations in its internal memory. It regularly checks to see that these various locations agree. If the locations don't agree then it returns all the settings to their 'default' values (specifically, infant default settings) and it turns on the blinking Monitor light and beeps once every 30 seconds. The monitor continues to operate properly, however it may not be using the prescribed settings. A disruption to part (or all) of the internal memory could cause this to happen. The disruptions could be a result of any of the following: electronics parts failure (intermittent), battery discharged to extremely low levels, electrostatic discharge (of large magnitude) or a violent drop (of the monitor).

Q: What should I do if the monitor goes into this default condition (the monitor light is blinking once per second and the audible alarm is sounding once every 30 seconds)?

A: Under these conditions, the monitor is quite capable of continuing to safely monitor the patient, however, you must be aware that the alarm and logging limit settings may not be the prescribed ones. We recommend that you 'clear' the memory and re-enter the patient name/number and settings. Again, if you have any doubts as to whether or not the monitor is operating correctly, please call one of our tech service reps or return the monitor for further evaluation.

AEQUITRON MEDICAL, INC.