microSpan® 3040G PULSE OXIMETER

SERVICE MANUAL

BIOCHEM

BIOCHEM INTERNATIONAL INC.

Warnings

Federal law restricts the use or sale of this device by, or on the order of, a physician.

Verify that the 3040G Oximeter is set to the proper AC line voltage setting for your installation. The AC line voltage setting is shown on the rear panel of the 3040G Oximeter. If the AC line voltage setting is incorrect, refer to the "Changing the AC Line Voltage Setting" section on page 43.

The 3040G Oximeter is intended for use by persons trained in professional health care.

This device should not be used in the presence of flammable anesthetics.

Operation may be affected in the presence of strong electromagnetic sources, such as electrosurgery equipment.

Operation may be affected in the presence of imaging equipment, such as Magnetic Resonance Imaging (MRI), and Computed Tomagraph (CT) devices, etc. It is the facility's responsibility to verify performance prior to installing equipment in any of these environments.

Do not autoclave, ethylene oxide sterilize, or immerse in liquid. Unplug before cleaning or disinfecting.

Significant levels of dysfunctional hemoglobins, such as carboxyhemoglobin or methemoglobin, will affect the accuracy of the SaO2 measurement.

Operation may be affected in the presence of high ambient light. Shield the probe area (with a surgical towel, for example) if necessary.

Dyes introduced into the bloodstream, such as methylene blue, indocyanine green, indigo carmine, and flourescein, may cause an inability to determine accurate SaO2 readings.

Any condition which restricts blood flow, such as use of a blood pressure cuff or extremes in systemic vascular resistance, may cause an inability to determine accurate pulse and SaO2 readings.

WARNING: ELECTRICAL SHOCK HAZARD when covers are removed.

Proprietary Notice

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Unpacking/Packing

Unpacking

Carefully remove the 3040G Oximeter and accessories from the shipping carton. Save the shipping carton and packing materials for use if the unit must be shipped or stored.

Checking the AC Line Voltage Setting

The 3040G Oximeter must be configured for the proper AC line voltage. Check the voltage rating plate on the rear of the 3040G Oximeter and verify the oximeter AC line voltage setting with the AC line voltage at the installation site. If the AC line voltage setting must be changed, refer to the "Changing the AC Line Voltage Setting" section on page 43.

Installation

The 3040G Oximeter is normally used as a stand-alone Oximeter, but can be interfaced to Biochem's 3045 Smart Printer or analog waveform viewing/storage devices from other manufacturers. This manual describes the 3040G Oximeter as a stand-alone unit.

TO PREVENT PERSONAL INJURY OR DAMAGE TO THE 3040G OXIMETER: Place the 3040G Oximeter on a flat, level surface. Locate cables connected to the 3040G away from areas where persons or equipment could become entangled. Prevent cables from being stepped-on by persons or rolled-over by equipment.

Refer to the 3045 Smart Printer Operations/Service Manual and follow the "Instructions for Use with the 3040 Pulse Oximeter" section if the 3040G Oximeter is used with the 3045 Smart Printer.

Refer to the "Rear Panel" section on page 13 if the 3040G Oximeter is used with analog waveform viewing/storage devices.

Packing

To pack the 3040G Oximeter for shipping or storage, remove all cables connected to the rear of the unit. Set the "BATTERY" switch on the unit's rear panel to "DISCONNECTED". Pack the 3040G Oximeter and accessories in the original shipping materials and shipping carton.

Applications Description

The 3040G Oximeter is used in many different fields of health care where blood oxygen saturation, pulse rate, and pulse strength information is required. The 3040G is used in operating rooms, intensive care units, outpatient clinics, emergency rooms, emergency land/air transport, and other areas of health care. The 3040G is used on patients of all age groups, from neonatal to adult.

General Description

The Biochem microSpan 3040G Pulse Oximeter is a portable, compact, and lightweight monitor that noninvasively and continuously monitors arterial blood oxygen saturation (SaO2) and pulse rate.

SaO2 and pulse rate information is conveyed both visually and audibly. A custom high contrast Liquid Crystal Display (LCD) with Electroluminescent (EL) backlighting indicates the SaO2, pulse rate, pulse signal strength, and system messages. The monitor's tone generator "beeps" with each pulse beat. The pulse "beep" momentarily changes to a lower-tone double "beep" when there is a decrease in SaO2.

The 3040G Oximeter has a flexible alarm system with audible and visual indicators. The high and low alarm limits for SaO2 and pulse rate are user adjustable. The audible alarm and pulse "beep" volume can be adjusted or inhibited by the user.

The 3040G Oximeter operates on power from the AC line or its internal battery.

Theory of Operation

The 3040G Oximeter determines SaO2 and pulse rate by passing two wavelengths of light, one red and one infrared, through body tissue to a photodetector. Pulse identification is accomplished by using plethysmographic techniques, and oxygen saturation measurements are determined using spectrophotometric oximetry principles. During measurement, the signal strength resulting from each light source depends on the color and thickness of the body tissue, the sensor placement, the intensity of the light sources, and the absorption of the arterial and venous blood (including the time varying effects of the pulse) in the body tissues.

The 3040G Oximeter processes these signals, separating the time invariant parameters (tissue thickness, skin color, light intensity, and venous blood) from the time variant parameters (arterial volume and SaO2) to identify the pulse and calculate oxygen saturation. Oxygen saturation calculations can be performed because blood saturated with oxygen predictably absorbs less red light than oxygen

depleted blood.

Since measurement of SaO2 depends on a pulsating vascular bed, any condition which restricts blood flow, such as use of a blood pressure cuff or extremes in systemic vascular resistance, may cause an inability to determine accurate pulse and SaO2 readings.

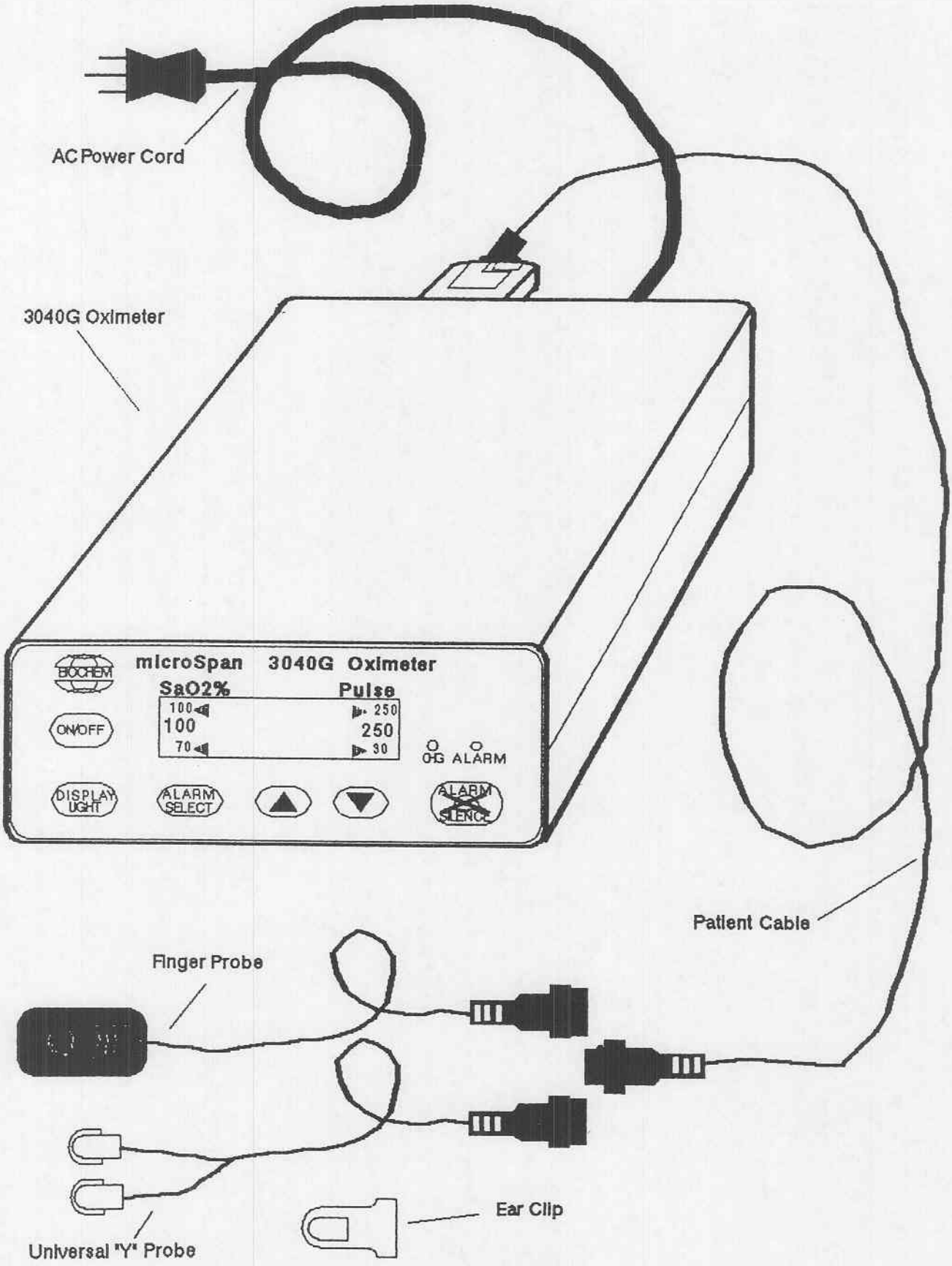


Figure 1. Composite Illustration.

Front Panel Displays, Indicators, and Keys

A high contrast LCD with EL backlighting provides a comprehensive visual interface with the 3040G Oximeter. Touchpad keys control the 3040G Oximeter. Refer to Figure 2.

Item		Description
1	SaO2% Pulse	SaO2 and Pulse Rate are shown in large numerals. Smaller numerals show the high alarm limit (above) and low alarm limit (below) each display.
2	Triangular Indicators	The triangular indicators point to the alarm limits to indicate the alarm is selected for setting or flash to indicate the alarm limit has been violated. "H" indicates high and "L" indicates low alarm limit.
3	Bargraph	The vertical bargraph has eight segments to display pulse activity and strength. The bargraph is logarithmically scaled to indicate a wide range of pulse strengths.
4	LOW BATT	Indicates the battery voltage is low.
	LOW PULSE	The pulse level is low enough that the reading may be unreliable. May indicate improper probe positioning.
	PULSE SEARCH	The monitor is automatically adjusting signal processing and probe LED drive levels to achieve acceptable signal levels, and is interpreting the signal to detect the pulse.
	ALARM	Indicates the alarm volume is being adjusted with the Up/Down arrow keys.
	BEEP	Indicates the pulse "beep" volume is being adjusted with the Up/Down arrow keys.
	ALARM SILENCED	Flashing indicates the alarm has been silenced with automatic two minute reset. Not flashing (continuous) indicates the alarm has been silenced indefinitely.
	BEEP SILENCED	This is displayed for 1-2 seconds when the pulse "beep" volume is adjusted to off.
	CHECK SENSOR	Indicates the probe is off the patient, needs to be repositioned on the patient, or is not connected to the monitor.

5	ON/OFF	Turns the monitor on and off. The internal battery charger is on when AC power is supplied and the BATTERY switch is in the NORMAL position.
6	DISPLAY LIGHT	Toggles the display backlight on and off.
7	ALARM SELECT	Pressing ALARM SELECT steps through each of the four alarm limits for setting, and back to none selected. If either the Up/Down arrows or the ALARM SELECT key is not pressed for approximately 20 seconds, the monitor returns to none selected.
8	Up/Down Arrows	When an alarm limit is not selected, these keys increase/decrease either the alarm volume (when the alarm is not silenced) or the pulse "beep" volume (when the alarm is silenced). When an alarm limit is selected, these keys control scrolling up and down through the alarm limits' setting. The Up/Down Arrow keys are also used to select 4 or 16 pulse averaging for %SaO2 measurement (the default is 8 pulse averaging). Refer to the "Starting" section on page 13 for details.
9	ALARM SILENCE	Pressing ALARM SILENCE turns the audible alarm off for two minutes or until ALARM SILENCE is pressed again. Pressing and holding ALARM SILENCE for 3 seconds turns the alarm off until ALARM SILENCE is pressed again or the monitor is turned off and on.
10	ALARM	The red "ALARM" LED indicates a patient or system alarm. The LED flashes or remains steady depending on the alarm condition. See "Alarms and Indicators".
11	CHG	The green "CHG" LED indicates the battery is charging.

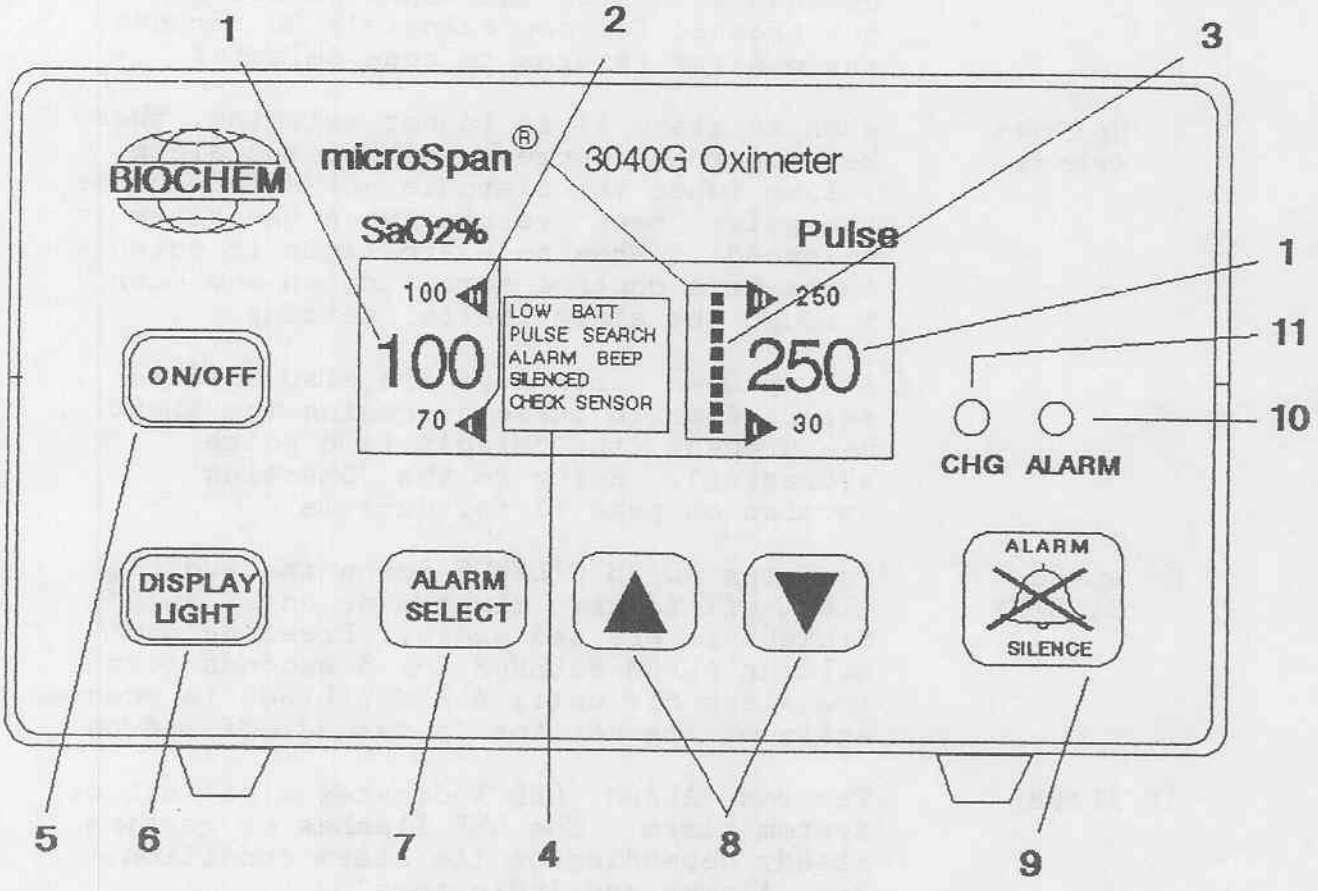


Figure 2. Front Panel Displays, Indicators and Keys.

Rear Panel Connectors and Switch

Refer to Figure 3.

Label		Description
1	PATIENT CABLE/PROBE	The Patient Cable is typically plugged into this connector. The Finger and Universal "Y" adapter probes may be directly plugged into this connector if the additional length of the patient cable is not required.
2	BATTERY	The BATTERY switch is set to NORMAL for operation and DISCONNECTED for shipping and long-term storage. The battery is charging when the green "CHG" LED on the front panel is lit.
3	SERIAL DATA	The 3040G Oximeter is interfaced to the optional 3045 microSpan "Smart" printer through this connector. The 3040G Oximeter can be interfaced to any computer that supports the 3040G communication protocol and whose serial input port responds to 0-5 V levels. 3040G communication protocol information is in the "Serial Port 0 Communication Protocol" section on page 34.
4	VAC RATING	This is the AC line voltage input setting and current rating. Verify that the 3040G Oximeter is set to the proper AC line voltage setting for your installation. If the AC line voltage setting is incorrect, do not use the 3040G Oximeter. Contact an authorized service center.
5	AC LINE	The AC Power Cord is plugged into this connector.
6	PULSE RATE	The PULSE RATE from 0-250 beats/minute is represented as 0.00 VDC to 2.50 VDC.
7	SaO2	The SaO2 level from 0 to 100% is represented as 0.00 VDC to 1.00 VDC.
8	PLETH.	The PLETH. (plethysmogram) is represented as 0.0 V to 2.0 V centered at 1.0 V.

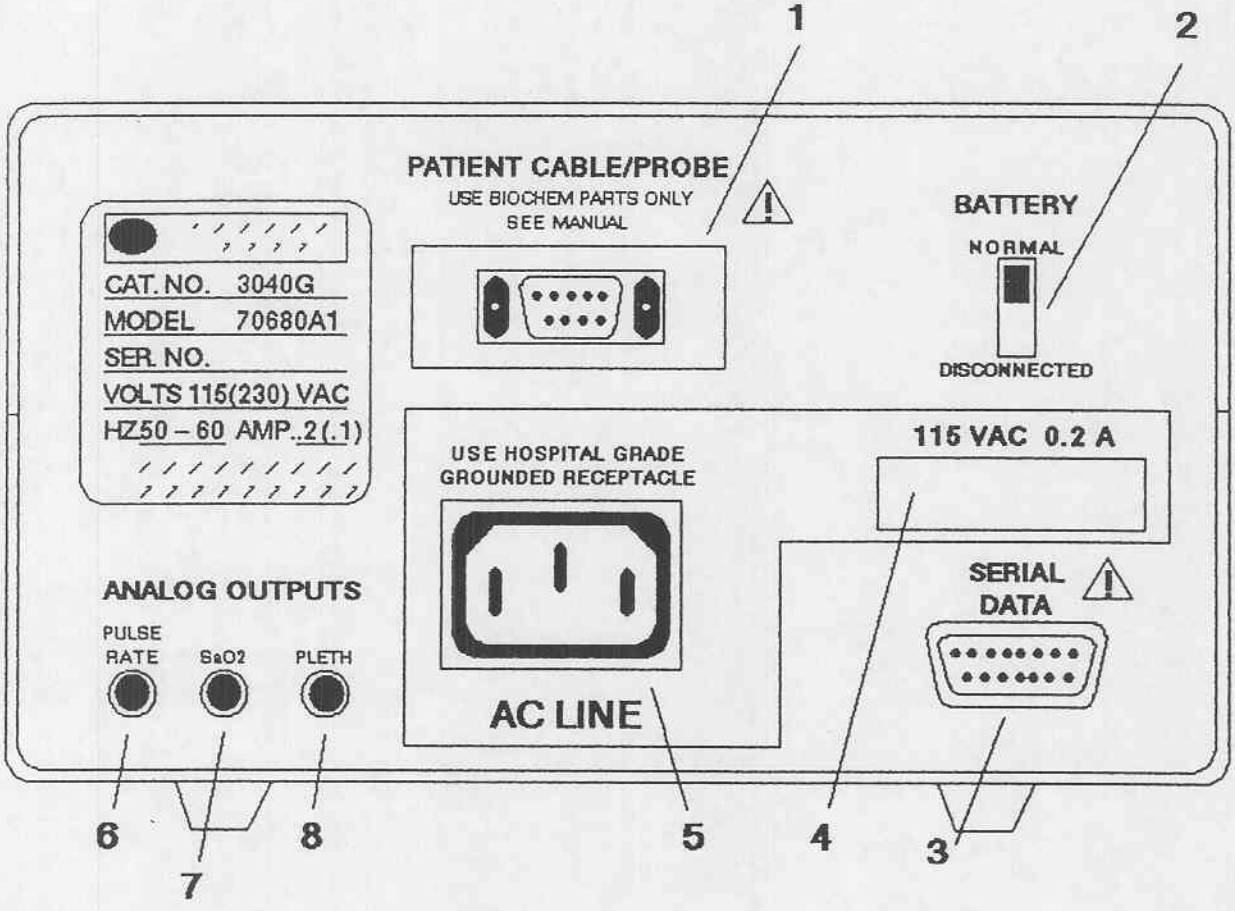


Figure 3. Rear Panel Connectors and Switch.

Alarms and Indicators

Patient Alarms and Indicators

Condition	Alarm/Indicator
Pulse Beat Detect	A short "beep" sounds each time a pulse beat is detected. The volume is adjustable (including off) independently from the alarm volume.
Matched or Exceeded Alarm Limit	A two-tone alarm sounds (when the alarm is not silenced), the red "ALARM" LED flashes, and the triangular indicator for the violated alarm limit flashes.
Low Pulse Amplitude	LOW PULSE is displayed.
Drop in SaO2	A lower-tone double "beep" sounds.

System Alarms and Indicators

Condition	Alarm/Indicator
Probe Off Patient or not Connected to Monitor	A double "beep" sounds every second (when the alarm is not silenced), CHECK SENSOR is displayed, and the red "ALARM" LED lights continuously.
Searching too long for pulse	A double "beep" sounds every second (when the alarm is not silenced), PULSE SEARCH is displayed, and the red "ALARM" LED lights continuously.
Low Battery Voltage	A short burst of "beeps" sounds when a low battery voltage condition is first detected. LOW BATT is displayed continuously.
Battery Charging	The green "CHG" LED is lit.

Using the 3040G Oximeter

Setting Up

Set the BATTERY switch (on the rear of the monitor) to NORMAL. If AC power is available, connect the AC Power cord to the AC LINE connector on the 3040G Oximeter and then to a hospital grade outlet.

Connect the patient cable to the PATIENT CABLE/PROBE connector on the rear of the 3040G Oximeter.

Refer to Figures 4-9 and choose either the Finger Probe or the Universal "Y" Probe for use based on application requirements.

Connect the probe to the Patient Cable.

Caution: Use only Biochem Finger Probe, Catalog No. 3044 or Universal "Y" Probe, Catalog No. 3043, with the microSpan 3040G Oximeter.

Starting

Press the front panel On/Off key. The 3040G Oximeter performs a self-test, lights all display legends, and displays the software revision. The 3040G Oximeter then enters the monitoring mode.

The 3040G Oximeter defaults to an eight (8) pulse averaging mode for SaO2 measurement, but four (4) or sixteen (16) pulse averaging is available. To put the monitor in the 4 pulse averaging mode, press and hold the DOWN arrow key while turning the monitor on. The number 4 appears for a moment in the SaO2 portion of the LCD display. To put the monitor in the 16 pulse averaging mode, press and hold the UP arrow key while turning the monitor on. The number 16 appears for a moment in the SaO2 portion of the LCD display. To return the monitor to the 8 pulse averaging mode, turn the monitor off and on.

The 3040G Oximeter uses an 8 second pulse rate average in the 4 or 8 pulse SaO2 averaging mode and a 16 second pulse rate average in the 16 pulse SaO2 averaging mode.

Attaching the Sensor

Both the Finger Probe and the Universal "Y" Probes are reuseable. See the "User's Maintenance" section on page 20 for probe cleaning instructions.

Finger Probe: Attach the probe to the finger as shown in Figure 4 so the cable protrudes along the palm of the hand. Very long finger nails may make positioning of the probe difficult, resulting in a poor pulse signal. Use the Universal "Y" Probe, as shown in Figure 6, for patients with very long finger nails.

Universal "Y" Probe: Attach the probe to the patient as shown in Figures 5, 6, 8, or 9, using adhesive strips as necessary. When using the Universal "Y" Probe on the finger, attach the LED (light source) portion of the sensor to the finger nail side of the finger.

Ear Probe Attachment: The Universal "Y" Probe can be adapted for use as an ear probe with the Ear Clip. The Universal "Y" Probe is attached to the Ear Clip as shown in Figure 7. The Ear Clip is then attached to the patient's ear lobe as shown in Figure 5.

Verifying the Sensor Placement

Once the probe is attached to the patient, allow several pulse beats for the monitor to stabilize. Observe the pulse bar graph located on the LCD Display. If the pulse signal strength is low, the probe position may need adjustment.

Measuring the Pulse Rate and SaO2

After approximately four or five pulse beats, the Pulse Rate and SaO2 values are displayed.

The pulse "beep" sounds with each pulse beat when the pulse tone is enabled.

A lower-tone double "beep" sounds when a drop in SaO2 is detected.

Setting the Alarms

Alarms are still active while setting, but the "H" and "L" triangular indicators do not flash for violated alarms. The "H" and "L" trianglular indicators act as a cursor to identify the limit selected for adjustment.

Press the ALARM SELECT key until the cursor is positioned at the alarm parameter you are setting (High SaO2, Low SaO2, High Pulse Rate, Low Pulse Rate).

Press the Up/Down arrow keys to increase or decrease the selected alarm value. "--" in the alarm display indicates the alarm parameter is set to OFF.

Note: The alarms in the 3040G Oximeter are non-overlapping. You cannot set the low alarm higher than the high alarm or the high alarm lower than the low alarm.

Interpreting the Patient Alarms

When an alarm limit is violated, a two-tone alarm sounds (when the alarm is not silenced), the red "ALARM" LED flashes, and the triangular indicator for the violated alarm limit flashes. The alarms stop when the alarm limit is no longer violated.

Press the ALARM SILENCE key to silence the alarm for two (2) minutes. ALARM SILENCED flashes on the display. Press the ALARM SILENCE key again to end the two minute alarm silence.

Press and hold the ALARM SILENCE key for three (3) seconds to silence the alarm indefinitely. ALARM SILENCED is displayed continuously. Press the ALARM SILENCE key again to end the indefinite alarm silence mode.

LOW PULSE is displayed when the pulse amplitude is low.

A lower-tone double "beep" sounds when a drop in SaO2 is detected.

Adjusting the Audio Volume

Alarms: Use the Up/Down arrow keys to adjust the audio alarm volume (when not setting the alarm limits and the alarm is not silenced).

Pulse "Beep": Silence the audio alarms by pressing the ALARM SILENCE key (be sure ALARM SILENCED is displayed). Now use the Up/Down arrow keys to set the pulse "beep" volume (when not setting the alarm limits). BEEP SILENCED is momentarily displayed when the pulse "beep" volume reaches off.

Stopping

Press the front panel On/Off key to turn the monitor off. If the green "CHG" LED is lit, the battery charging circuit is recharging the battery.

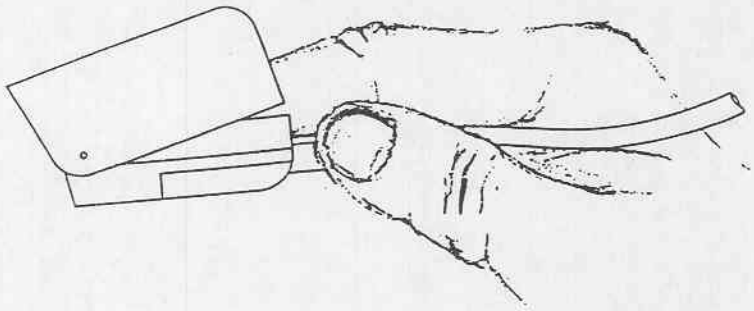


Figure 4. Finger Probe Application for Adults.

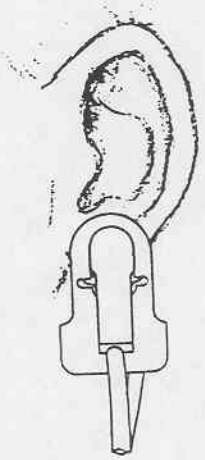


Figure 5. Universal "Y" Probe Application for Adults - Ear.

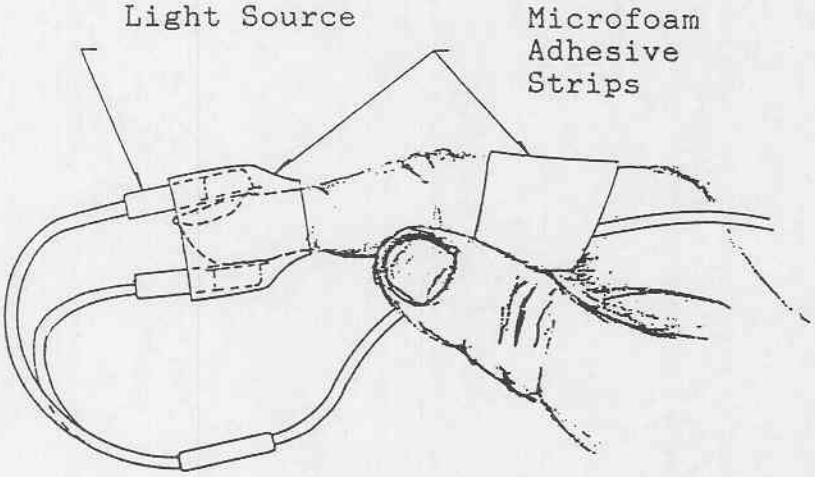


Figure 6. Universal "Y" Probe Application for Adults - Finger.

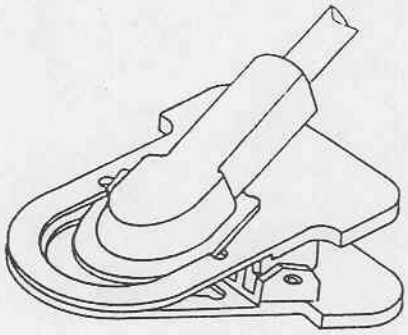


Figure 7. Universal "Y" Probe Ear Clip Attachment.

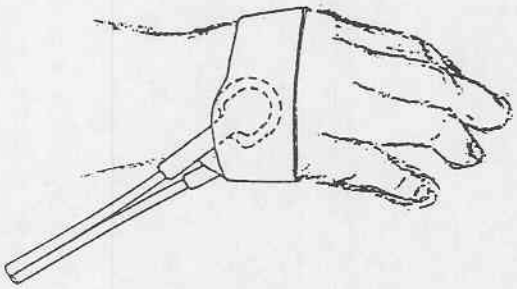


Figure 8. Universal "Y" Probe Application for Infants - Hand.

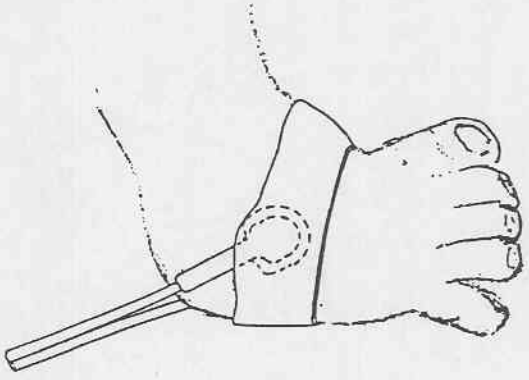


Figure 9. Universal "Y" Probe Application for Infants - Foot.

User's Maintenance

The microSpan 3040G Oximeter and the sensors do not require routine maintenance other than charging the battery. The battery should be charged after the 3040G is used under battery operation, when the BATT LOW message is displayed on the LCD, or after long term storage.

Cleaning and Disinfecting

CAUTION: Do not immerse the 3040G Oximeter or probes in liquid. Do not autoclave or ethylene oxide sterilize the 3040G Oximeter or probes. Unplug the AC power cord before cleaning or disinfecting the 3040G Oximeter or probes.

Clean the surfaces of the microSpan 3040G Oximeter and probes with a soft cloth moistened in a mild soap solution. If disinfection is required, wipe the surfaces with isopropyl alcohol or glutaraldehyde.

Charging the Battery

Connect the AC Power Cord to the AC LINE connector on the 3040G Oximeter and then to a hospital grade outlet. Set the BATTERY switch (on the rear of the 3040G Oximeter) to NORMAL. Verify the green "CHG" LED is lit.

Ten hours of charging (with the monitor OFF) fully charges the battery. A fully charged battery generally provides 4 hours of operation (5 hours with the backlight OFF).

Long Term Storage

Storage Facility	Indoor
Temperature	50-105 degrees F
Relative Humidity	10-90%
Preservation	Storage Temp. / Charging interval 65 degrees F / every 12 months 85 degrees F / every 6 months 105 degrees F / every 3 months
Periodic Inspection	None required.
Special Procedures	Set the rear panel BATTERY switch to the DISCONNECTED position. Store the 3040G Oximeter and accessories in the original packing materials and shipping carton.

Supplies and Accessories

Standard Supplies and Accessories

Catalog No.	Qty.	Description
3040G	1	microSpan Oximeter
3043	1	Universal "Y" Probe
3044	1	Finger Probe
3047	1	Patient Cable (10 ft.)
3046	1	AC Power Cord
3042	1	Ear Clip for Universal "Y" Probe
3053	1	Operation Manual - 3040G Oximeter
3054	1	3040G Service Manual
	1	Microfoam Adhesive Strips Starter Kit

Optional Supplies and Accessories

Catalog No.	Qty.	Description
3049	1	Microfoam Adhesive Strips
3056	1	3040G Oximeter Carrying Case
3057	1	3040G Oximeter Litter Mount
3058	1	3040G Oximeter Pole Mount
3045	1	microSpan "Smart" Printer
3062	1	3040G Operator's Training Manual
3063	1	3040G Operator's Training Instructor's Manual
3059	1	3040G Service Training Manual
3051	1	3040G Service Training Instructor's Manual

Product Specifications

General

Display	LCD with Electro Luminescent (EL) Backlight. Large digital display of SaO2 & Pulse Rate. Continuous display of high/low alarm limits. Pulse strength activity logarithmic bargraph.	
SaO2	User selectable 8 or 4 beat average.	
Range	0-100%	
Accuracy	+/- 2% at 70-100%	
	+/- 3% at 50-69%	
Alarm Ranges	Low	50-99% (in 1% steps) and OFF
	High	50-100% (in 1% steps) and OFF
Pulse Rate	8 second pulse rate averaging with 4 or 8 beat SaO2 averaging. 16 second pulse rate averaging with 16 beat SaO2 averaging.	
Range	30-254 bpm	
Accuracy	+/- 2% at 30-100 bpm	
Alarm Ranges	Low	5-195 (in 5 bpm steps) and OFF
	High	5-250 (in 5 bpm steps) and OFF
Inputs/Outputs		
Digital	Serial - SaO2, Pulse Rate, Signal Strength, Plethysmogram, status indication, alarm settings, and trend data in response to single character commands. Can output 9 hour trend of SaO2, pulse rate, pulse strength, and event data.	
Analog	SaO2	0-100% = 0-1.00 VDC
	Pulse Rate	30-254 bpm = 0.30-2.54 VDC
	Plethysmogram	0.0-2.0 VDC. Centered at 1.0 VDC.

Power Requirements

AC Input	115 VAC 50/60Hz 0.2 A
	230 VAC 50/60Hz 0.1 A
Battery	4 to 5 hour operation with 10 hour recharge.
Dimensions	Height = 4", Width = 6.5", Depth = 9.5"
Weight	4 lbs. 8 oz.

Environmental Specifications

Temperature	50-105 degrees F (operating)
	40-110 degrees F (storage)
Relative Humidity	20-80 % (operating)
	10-90% (storage)

Block Level Description

Refer to the System Block Diagram on page 73 while reading this description.

The 3040G Oximeter contains three main assemblies; the Single Board Oximeter (SBOX), the Controller board, and the Display board.

In general, the SBOX collects and calculates the patient data from the probe and sends the data to the Controller board. The Controller board sends the required data to the Display board, maintains alarm limits, responds to key presses, interfaces the optional 3045 Smart Printer, and controls the Analog Outputs. The Display board contains the LCD Display and it's associated controller chip, the ALARM and CHG LEDs, and interconnects the touchpad controls to the Controller board.

Single Board Oximeter

The probe is detected by the Probe Detect signal. Software adjusts the probe LEDs drive level to obtain the optimal photodetector signal. The photodetector signal is input to the first stage amplifier.

The first amplifier block provides differential transconductance (current to voltage) conversion and software adjusted gain. The adjusted gain signal is routed to the Sample and Hold amplifiers. The differential output of the Sample and Hold amplifiers is amplified, offset-adjusted, and routed to the A/D converter.

SBOX software uses the digital signal levels to calculate the SaO2, pulse rate, pulse strength, and plethysmogram data. SBOX software uses the Probe Detect signal to determine if the probe is connected to the monitor. SBOX software uses the photodetector levels to determine if the probe is off the patient. The patient and probe data is sent to the Controller board through the SBOX's serial port 0.

Controller board

The Controller board receives the patient and probe data from the SBOX through serial port 1. The Controller board sends the SaO2, pulse rate, and pulse strength data to the Display board.

The Controller board maintains, adjusts, and checks the alarm limit thresholds. When an alarm limit is matched or exceeded, the Controller board activates the ALARM LED and alarm tones.

The Controller board generates tones for alarms, key

presses, and pulse "beeps" with the Tone Generator circuit.

The Input Buffer reads the front panel keys, the LCDRDY signal from the LCD controller chip, and the low battery (LOWBAT) condition.

The Controller board sends SaO2, pulse rate, and plethysmogram information to the D/A Converter and Analog Demultiplexer. The outputs of the Analog Demultiplexer are routed to the Sample and Hold circuits for the Analog Outputs.

The Controller board sends SBOX and Controller board data to the optional 3045 Smart printer through serial port 0.

The Battery Charging circuit is always on when the AC Line Cord is plugged in and the BATTERY switch on the rear of the monitor is in the NORMAL position. The Power Control circuit turns the monitor function on and off and controls the Isolated Supply Generator for the SBOX. The regulator generates +5V from the battery voltage and the inverter generates -5V from the +5V supply.

The EL Power Supply generates the voltage required for the LCD backlight. The EL Power Supply is controlled by the Output Latch in response to the front panel key DISPLAY BACKLIGHT.

Display board

Information received from the Controller board is decoded and displayed by the Display board. The "CHG" and "ALARM" LEDs are controlled by the Controller board. The front panel keys are wired through the Display board to the Controller board.

Single Board Oximeter

Circuit Description

Refer to the Single Board Oximeter schematics and components layout on pages 75-78 while reading this description.

Power Supply Circuitry

Power to H1 of the the SBOX is supplied by isolation transformer T1 on the Controller board. Full wave rectified positive and negative voltages are generated with the center tapped secondary of the transformer and diode bridge DB1. The SBOX has its own regulators. The +5 VDC supply is regulated by U18 and the -5 VDC supply is regulated by U20. Separate filtering is provided for the analog +5 V (ANA+5) by C54, C55, and C56. ANA+5 is separated from the digital +5 V (DIG+5) by ferrite bead L1.

There are three separate ground paths on the SBOX: power ground, digital ground, and analog ground. They are electrically common at the voltage regulators only.

Reset Circuitry

A typical power on reset circuit uses the delay of C1 charging through R1 to generate the active high reset signal RST at U10C and the active low reset signal RESET at U10B.

On power down, Q1 turns on. C1 supplies base current to turn Q2 on. When Q2 is on, the input of U10B is low, which generates active RST and RESET signals.

Microprocessor Kernel

Microprocessor U2, EPROM U1, and RAM U6 forms the microcomputer that controls the SBOX, computes the pulse rate and SaO2, and transmits the information to the Controller board. A15 and ME are gated through U3A, U3B, and U10A to locate EPROM U1 at 0000h to 7FFFh and RAM U6 at A000h to BFFFh.

The PHI output of U2 (3.072 MHz) is half the crystal frequency (6.144 MHz). PHI is divided in half by U5B to generate the CLK signal for the A/D converter U9.

Serial Communication Ports

U22 and U23 provide optically isolated bidirectional serial communication with the Controller board. Q1 and its related circuitry provide logic inversion and high current drive for the outgoing TXA0 signal. Refer to the "Serial Communications Protocol" section on page 28 for more detailed information on serial port 0.

An unused second serial channel (TXA1 and RXA1) is buffered by U10E and U10D.

I/O Port Decoding

Four I/O strobe signals are decoded by U4. The LED select line (I/O address CXXXh) loads the drive level for the LEDs into D/A converter U7 from the data bus. OFST (I/O address 8XXXh) loads the offset value for the amplifer into D/A converter U8 from the data bus. U4 pin 12 is gated with WR by U3C to generate LATCH (Output address 6XXXh). LATCH enables the eight bit addressable latch U17. ADC (I/O address AXXXh) enables reads and writes at the A/D converter U9.

LED Drive Circuitry

The desired LED drive level is calculated by the microprocessor and then converted to a voltage (DRIVE LVL 0.00 V to 2.55 V) by D/A converter U7. DRIVE LVL is voltage to current converted by U12 and Q6 and their associated circuitry. The current level is directed through the red LED if U17 pin 13 is high, and through the infrared LED if U17 pin 14 is high. The bridge of Q3, Q2, Q4, and Q5 allows the current to be reversed through the back to back connected LEDs. When the red LED is selected, the LED current flows from ANA+5V through Q3, the red LED, Q5, then through Q6 and R17 to ground. Similarly, when the infrared LED is selected, the current flows from ANA+5V through Q2, the infrared LED, Q4, then through Q6 and R17 to ground.

Signal Processing Circuitry

The differential transconductance amplifier formed by U13 and U15A converts the photodetector current output to a voltage (TP2). U15B, U16, and the associated resistor ladder forms a programmable gain amplifer. The gain (Av=2, 4, 8, or 16) is selected by two control lines from the addressable latch (U17 pin 1 and U17 pin 15).

The output of the programmable gain amplifier (TP3) is routed by analog switch U14 to the sample and hold circuits U11B and U11A. The difference of the two sample and hold circuits is generated by U11C (TP5). U11D amplifies (Av=10) the difference between TP5 and the calculated OFFSET level (from D/A converter U8) to produce the signal at TP8.

U24 selects the input signal to the A/D converter U9.

A/D Conversion

Writing to A/D converter U9 starts a conversion. When the conversion is completed (about 100 usec), U9 pin 15 generates an active low interrupt request to the

microprocessor (INT0). The interrupt request is cleared when data is read from U9. Two successive reads transfer first the low byte then the high byte of the 12 bit signed (2's complement) conversion.

Memory Map and I/O Ports

Memory Map

Device	Address
ROM	0000h to 0FFFh
RAM	A000h to BFFFh

Input/Output Ports

Port	Addr	Data	Signal	Description
LATCH	6XXXh	00h		Sets U17 Q0 low
		01h		Sets U17 Q0 high
		02h		Sets U17 Q1 low
		03h		Sets U17 Q1 high
		04h		Sets U17 Q2 low
		05h		Sets u17 Q2 high
		06h		Sets U17 Q3 low
		07h		Sets U17 Q3 high
		08h		Sets U17 Q4 low
		09h		Sets U17 Q4 high
		0Ah		Sets U17 Q5 low
		0Bh		Sets U17 Q5 high
		0Ch		Sets U17 Q6 low
		0Dh		Sets U17 Q6 high
		0Eh		Sets U17 Q7 low
		0Fh		Sets U17 Q7 high
OFST	8XXXh	00h-FFh	OFFSET	Sets output of offset DAC U8 0.00 VDC to 2.55 VDC 10 mV/step increments
LED	CXXXh	00h-FFh	DRIVE LVL	Sets output of LED drive level DAC U7 0.00 VDC to 2.55 VDC 10 mV/step increments
ADC	AXXXh	N/A		Output: Initiated A/D conversion.
		00h-FFh	SIGNAL	Input: Digital value of photodetector level.

Serial Port 0 Communications Protocol

Communication begins automatically after power up.

Protocol	4800 Baud one start bit eight data bits one odd parity bit one stop bit
Transmitted Data	5-byte data format 60 samples per second
Received Data	Single character commands

Transmitted Data

Synchronized by bit 7 ("1" in byte 1, "0" in bytes 2-5).

Byte	Bit	Description	
1	0	Signal Strength 0	< 3 indicates low pulse
	1	¦	0-8 = valid data
	2	¦	15 = bad data
	3	Signal Strength 3	
	4	1 = searching too long	
	5	1 = drop in SaO2	
	6	1 = pulse beep	
	7	1 (Sync bit)	

Byte	Bit	Description	
2	0	Plethysmogram 0	0-99 = valid data
	¦	¦	127 = data unavailable
	6	Plethysmogram 6	
	7	0 (Sync bit)	

Byte	Bit	Description	
3	0	Bargraph 0	0-15 = valid data
	¦	¦	
	3	Bargraph 3	
	4	1 = no sensor or sensor off	
	5	1 = searching for pulse	
	6	Rate 7 (see byte 4)	
	7	0 (Sync bit)	

Byte	Bit	Description	
4	0	Rate 0	0-254 = valid data
	¦	¦	255 = bad data
	6	Rate 6	
	7	0 (Sync bit)	

Byte	Bit	Description	
5	0	SaO2 0	0-100 = valid data
	¦	¦	127 = invalid data
	6	SaO2 6	
	7	0 (Sync bit)	

Received Data

Synchronizing the Plethysmogram - The plethysmogram scale and offset is automatically adjusted every 256 samples. Sending "A" ASCII to the SBOX synchronizes the plethysmogram scale and offset to the next sample. Subsequent offset adjustments will also occur when the plethysmogram value exceeds the range 0-99.

Setting SaO2 Averaging - Sending "B" ASCII to the SBOX sets the SaO2 computation to a 4 beat average. Sending "C" ASCII to the SBOX sets the SaO2 computation to an 8 beat average.

Single Board Oximeter Specifications

General

Input Voltage/Current	12 to 15 VAC at 100 mA or 8 to 12 VDC at 90 mA -8 to -12 VDC at 10 mA
Leakage Current	< 10 uA
Dimensions	4" x 8.5" x 1.5"
Inputs/Outputs	Serial Port 0 - Calculated oximeter data and other related data. Refer to the "Serial Port 0 Communications Protocol" section on page 28 for details.

Controller board and Display board

Circuit Description

Refer to the Controller board and Display board schematics and component layouts on pages 79-83 while reading this description.

AC Input and Voltage Selection

The incomming AC line is fused at F2 for 115 VAC operation and at F1 and F4 for 230 VAC operation. SW1 selects 115 or 230 VAC operation in a typical configuration of dual-winding transformer T1.

Battery Charging Cicuit

U13 and it's associated discrete components form the battery charging circuit. U13's output current limiting level is adjusted with VR2, and U13's output voltage level is adjusted with VR3. Refer to "Adjusting the Battery Charging Circuit" section on page 43 for details on adjusting VR2 and VR3. Q1 increases the output current driving capabilities of U13. The output of U13 goes through D4, F3, and H5 to the BATTERY switch, and then to the battery.

D4 insures the battery does not discharge through the charging circuit when the power cord is disconnected. F3 provides abnormally high battery discharge protection.

The BATTERY switch connects (NORMAL position) or disconnects (DISCONNECTED position) the battery from the Display Controller board and the green "CHG" LED from the battery charging voltage.

Low Battery Voltage Detection

Voltage comparator U17A compares a voltage divider reference from VCC (R34 and R35) to a voltage divider reference from the battery voltage (R36 and R37). If the battery voltage drops below +5.8 VDC, the signal LOWBAT goes high. The battery voltage must increase to +6.2 VDC to make LOWBAT go low again. LOWBAT is read by the microprocessor through input buffer U6.

On/Off Control

U14B and U14C and their associated discrete components form a flip-flop. When the front panel On/Off key is pressed, the PWSW signal goes low at the input of U14B. This causes the output of U14B to go high, making the output of U14C go low. The low output of U14C turns on VCC voltage regulator U15. The high output of U14B enables the switching power supply for the Single Board Oximeter. A second pressing of

the On/Off key is read by the software. The software writes to I/O Address 4XXFh to reset the flip-flop and turn the monitor off.

Supply Voltages

VBATT is regulated to VCC (+5 VDC) by regulator U15. VDD and ANA+5 are connected to VCC at the output U15 only through ferrite bead L1. VEE is generated by converting VCC to -5 VDC with voltage inverter U16.

Switching Power Supply

T2, Q4, U14D, U14A, and their associated discrete components form a switching power supply for the Single Board Oximeter. When the output of U14B is high (monitor on), the oscillator formed by U14D, U14A, R28, R29, and C21 is enabled. The oscillator drives power FET Q4, which drives the primary winding of T2. The secondary winding of T2 is connected through H6 to the power supply of the Single Board Oximeter.

Backlight Control

When output latch U12 sets the BKLT signal high, FET Q3 turns on. This turns Q2 on, supplying the input voltage for the Electro Luminescent (EL) backlight power supply PS1. Output latch U12 sets the BKLT signal low to turn the display backlight off.

Reset Circuit

U15, U9C, U8F, R1, and C6 form the reset circuit. On power up, the open-collector ERR signal at U15 is held low until U15 is regulating. When ERR goes to the high impedance state, C6 charges through R1 at the input of U9C. When the input of U9C reaches its high input threshold, RST and RESET go to the inactive state. On power down, the ERR signal from U15 goes low, generating a reset condition through U9C and U8F.

Microprocessor Kernel

U4, U1, U2, and U5A form a typical microcomputer configuration of microprocessor, EPROM, RAM, and memory decoding. U5A decodes the memory addresses: EPROM at 0000h to 7FFFh and RAM at 8000h to FFFFh. U5A also decodes two unused memory addresses: ROM2 at 10000h to 10FFFh and RAM2 at 18000h to 1FFFFh.

I/O Decoding

U5B decodes the I/O addresses: EXTIO at 0XXXH, IO at 4XXXh, DAC at 8XXXh, and LCD at CXXXh.

Input Buffer

Input buffer U6 reads the front panel touchpad keys, the LOWBAT indicator from the low battery voltage detector, and the LCDRDY handshaking signal from the LCD display. U6 is enabled by the IO and RD signals.

Output Latch

Addressable latch U12 controls the output selection of the D/A demux, the "ALARM" LED, the display backlight, and the monitor off condition. A1, A2, and A3 select the output to be latched (Q0-Q7), and A0 defines the state of the output. U12 is enabled (latched) by the IO and WR signals.

D/A Converter and Analog Demux

The output of single channel D/A converter U3 is input to analog demux U7. U7 demultiplexes the analog output of U3 to provide the PLETH, SaO2, and RATE analog outputs, and the VOL signal for the Alarm/Tone Generator. U3 is enabled by the DAC and WR signals. U7 is demultiplexed and enabled by output latch U12 lines Q0-Q3.

Analog Outputs

The values for PLET, SaO2, and RATE are converted to analog voltages by D/A converter U3. U7 demultiplexes the output of the D/A converter and routes the analog output to the "sample and hold" circuits for the three analog outputs formed by U10B, U10C, U10D, and their discrete components.

Alarm/Tone Generator

U11A and U11B and their associated discrete components form a bipolar driver for the speaker. The VOL signal from D/A U3 and demux U7 controls the volume of the speaker, and the TONE signal from the microprocessor controls the frequency of the speaker.

Serial Ports

The microprocessor has two internal serial ports. Serial port 0 is used by the 3045 Smart Printer, or any other device that supports the 3040G communications protocol and whose serial input port responds to 0-5 V levels. Serial port 1 is used to communicate with the Single Board Oximeter.

Unused I/O Connector

Spare analog and digital signals are routed to the unused connector location H2.

Memory Map and I/O Ports

Memory Map

Device	Address
EPROM	0000h to 0FFFh
RAM	8000h to FFFFh
ROM2	10000h to 10FFFh (unused)
RAM2	18000h to 1FFFFh (unused)

Input Ports

Port	Addr	Data	Signal	Description
IO	4XXXh	D0	PWSW	On/Off key*
		D1	BLSW	Display Backlight key*
		D2	UPSW	Up Arrow key*
		D3	DNSW	Down Arrow key*
		D4	ALSESW	Alarm Select key*
		D5	ALSISW	Alarm Silence key* * 0 = pressed 1 = not pressed
		D6	LOWBAT	0=Battery voltage OK 1=Battery voltage low
		D7	LCDRDY	0=Display ready for cmd 1=Display not ready for cmd

Output Ports

Port	Addr	Data	Signal	Description
EXTIO	0XXXh	N/A	EXTIO	Unused I/O port.
IO	4XX0h	N/A		Set U7 BCD input "A" low*
	4XX1h	N/A		Set U7 BCD input "A" high*
	4XX2h	N/A		Set U7 BCD input "B" low*
	4XX3h	N/A		Set U7 BCD input "B" high*
	4XX4h	N/A		Set U7 BCD input "C" low*
	4XX5h	N/A		Set U7 BCD input "C" high*
	4XX6h	N/A		Enable analog demux U7
	4XX7h	N/A		Disable analog demux U7
	4XX8h	N/A		spare output
	4XX9h	N/A		spare output
	4XXAh	N/A	ALARM	"ALARM" LED off
	4XXBh	N/A	ALARM	"ALARM" LED on
	4XXCh	N/A	BKLT	Display backlight off
	4XXDh	N/A	BKLT	Display backlight on
	4XXEh	N/A	PWR-DN	Turns monitor on
	4XXFh	N/A	PWR-DN	Allows monitor to be off
DAC	8XXXh	0-255		D/A converter U3. Data 00h to FFh = 0.00 VDC to 2.55 VDC at 10 mV/count.

LCD	CXXXh	D0-D7	LCD display data

* U7 Analog Demux

CBA Input	Selected Output
000	PLETH analog output
001	SaO2 analog output
010	RATE analog output
011	VOL output for speaker volume
100	DAC4 output for spare unused EXTAN signal
101	DAC5 output (spare unused)
110	DAC6 output (spare unused)
111	DAC7 output (spare unused)

Port 0 Communication Protocol

Protocol	4800 Baud bidirectional one start bit eight data bits odd parity bit one stop bit

The external device controls the data output from the Controller board by sending single byte commands to the Controller board.

Send a RESET and a BEGIN command to the Controller board if either a RESET command was the last command sent or if no data has been received from the Controller board for 2 seconds. Do not send any commands after BEGIN until the OK response is received. Repeat the RESET/BEGIN command sequence if OK is not received within one second of RESET/BEGIN.

The CONFIG command (I) and the "i" response data are used by the Biochem 3045 Smart Printer.

The basic DATA response is sent by the Controller board once a second after the initial responses to the BEGIN command. The SETTINGS response is sent whenever there is a change in the values (or if the SETUP command is issued). Response to the REALTM or the HISTORY command causes both of these commands to be ignored until the response has been completed or is terminated.

DATA responses are inhibited during a HISTORY dump, but resume immediately after (allowing the current block of data to continue with new data).

Commands and Responses

Commands and response identifiers (lead character in a string of data) are sent as the ASCII code for the shown

letter, with bit seven set to 1. Data is less than 127; 127 represents unusable (invalid or unavailable) data. Information requiring counts greater than 126 are sent in L (low) and H (high) nibbles. Nibbles are sent high nibble first, low nibble last.

Commands	ASCII	Response(s)
RESET	A	All transmissions from the Display Controller board are halted. Only the BEGIN command generates a response.
BEGIN	B	OK then SETTINGS then DATA. After the first response, DATA is sent once a second and SETTINGS is sent when changes occur.
SETUP	C	SETTINGS
REALTM	D	SIGLEV is sent initally and when it changes, WAVE is sent 60 times per second.
STOPREALTM	E	REALTM mode is halted, SIGLEV and WAVE responses are inhibited.
STOPHIST	F	HISTORY dump is halted, HEADER and HDATA responses are stopped.
CLEARHIST	G	History data collection is restarted (old data is ignored).
HISTORY	H	HEADER and HDATA
CONFIG	I	See CONFIG under Responses
LOG	J	Controller board resets MinSaO2 detection.

Responses	ASCII	Description
OK	g	1 = identifying code for 3040G Oximeter.
SETTINGS	b	LoSaO2, HiSaO2, LoRateH, LoRateL, HiRateH, HiRateL
DATA	a	SaO2, RateH, RateL, SignalLevel, Events, MinSaO2
SIGLEV	d	SignalLevel. The SignalLevel is a signal strength indication where each count (0-8) represents a doubling of the average pulse

		height. It is used to scale the PlethData with each count representing halving of the gain applied to the normalized infrared signal.
WAVE	c	PlethData. Normalized plethysmogram signal, 0-99 counts, with 50 counts representing DC level.
HEADER	f	#SamplesH, #SamplesM, #SamplesL Note: #SamplesX = 127 except for a current block of data where the number may be used to calculate back from current time so the presentation may have clock time annotation.
HDATA	e	SaO2, RateH, RateL, SignalLevel, Events

Events

bit 0	low SaO2 alarm
bit 1	high SaO2 alarm
bit 2	low pulse rate alarm
bit 3	high pulse rate alarm
bit 4	check probe
bit 5	low pulse amplitude
bit 6	searching for pulse
bit 7	0 (always 0 for a data byte)

CONFIG — See following description.

Item	# & type	ASCII in "quotes", decimal in (parenthesis)
i	1 ascii+128	(233)
Product	1 binary	(1)
Flag	1	(7)
Header	32 ascii	" BIOCHEM microSpan 3040G Oximeter"
Event1	8 ascii	"Lo SaO2 "
Event2	8 ascii	"Hi SaO2 "
Event3	8 ascii	"Lo Rate "
Event4	8 ascii	"Hi Rate "
Event5	8 ascii	"Probe ! "
Event6	8 ascii	"Pulse Lo"
Event7	8 ascii	"Search'g"
SnapS	6 ascii	" PLETH"
SnapL	16 ascii	" PLETHYSMOGRAM "
SnapBot	3 ascii	" "
SnapMid	3 ascii	" "
SnapTop	3 ascii	" "
Label1-8	8 ascii	" Signal "
Label1S	6 ascii	" SAO2 "
Label1L	16 ascii	" SAO2"
Units1	16 ascii	" % O2 Sat. "

```
Bytes1     1 binary      (1)
Range11    19            "0-100 " "  0" " 50" "100" (0) (1) (1) (0)
Range12    19            "80-100" " 80" " 90" "100" (80) (5) (1) (0)
Range13    19            "50-100" " 50" " 75" "100" (50) (2) (1) (0)
Label2S    6 ascii       " RATE "
Label2L    16 ascii      "      PULSE RATE"
Units2     16 ascii      "Beats per Minute"
Bytes2     1 binary      (2)
Range21    19            "0-100 " "  0" " 50" "100" (0) (1) (1) (0)
Range22    19            "0-200 " "  0" "100" "200" (0) (1) (2) (0)
Range23    19            "0-300 " "  0" "150" "300" (0) (1) (3) (0)
Label3     16 ascii      "    Signal Level"
Bytes3     1 binary      (1)
Label4     16 ascii      "    Minimum SaO2"
Bytes4     1 binary      (1)
Set1       16 ascii      "        SaO2 Low"
Set1#      1 binary      (1)
Set2       16 ascii      "       SaO2 High"
Set2#      1 binary      (1)
Set3       16 ascii      "  Pulse Rate Low"
Set3#      1 binary      (2)
Set4       16 ascii      " Pulse Rate High"
Set4#      1 binary      (2)
Set5       16 ascii      "                "
Set5#      1 binary      (0)
Set6       16 ascii      "                "
Set6#      1 binary      (0)
Set7       16 ascii      "                "
Set7#      1 binary      (0)
Set8       16 ascii      "                "
Set8#      1 binary      (0)
```

Controller board Specifications

Input Voltage/Current	115 VAC at .2 A or 230 VAC at .1 A (Jumper-selectable)
Leakage Current	< 10 uA
Dielectric Strength	2.5 KV withstand
Dimensions	8-3/4 L x 5-3/4 W (max) x 1-3/8 H
Inputs/Outputs	Serial Port 0 - Serial interface to the 3045 Smart Printer or any other serial device that supports the 3040G communications protocol and whose serial port responds to 0-5 V logic levels. Serial Port 1 - Serial interface to the Single Board Oximeter.

Maintenance

Warnings

WARNING: ELECTRICAL SHOCK HAZARD. AC line voltage is present in the power entry area of the Controller board. Approximately 100 VAC is present at the backlight converter PS1 on the controller board.

CAUTION: CONTAINS STATIC SENSITIVE DEVICES. Use an anti-static workstation and appropriate grounding techniques to prevent equipment damage when servicing.

Refer to the Cabling and Interconnection Diagram on page 74 while disassembling and reassembling the 3040G Oximeter.

Test Equipment and Tools Required

Oscilloscope - Tektronix 475 or Tektronix 2215 or Equivelent
DVM - Western Reserve Electronics 303MA or Fluke 8050A or Equivelent
Leakage Current Meter - Nevada-Dynatech 431-1D or Equivelent
High Voltage Potential Tester - Associated Research 4045 or Equivelent

#2 Phillips Screwdriver
#4 Flat Blade Screwdriver
Needle Nose Pliers
Diagonal Cutters
5/64" Allen Wrench
3/16" Nut Driver (#2)
3/16" Nut Driver (#4 Small)
1/4" Nut Driver (#4 Large)

Clip Leads (2)
Potentiometer Adjustment Tool
47-56 ohm, 1 watt resistor

Disassembly/Assembly Instructions

1. Refer to Figure 10. Disconnect the AC Line Cord, the Patient Cable or Probe, and any other cables connected to the rear of the unit.

2. Refer to Figure 10. Set the "BATTERY" switch to "DISCONNECTED".

3. Refer to Figure 10. Remove the four top cover screws with a 5/64" allen head wrench. Lift the top cover from the unit.

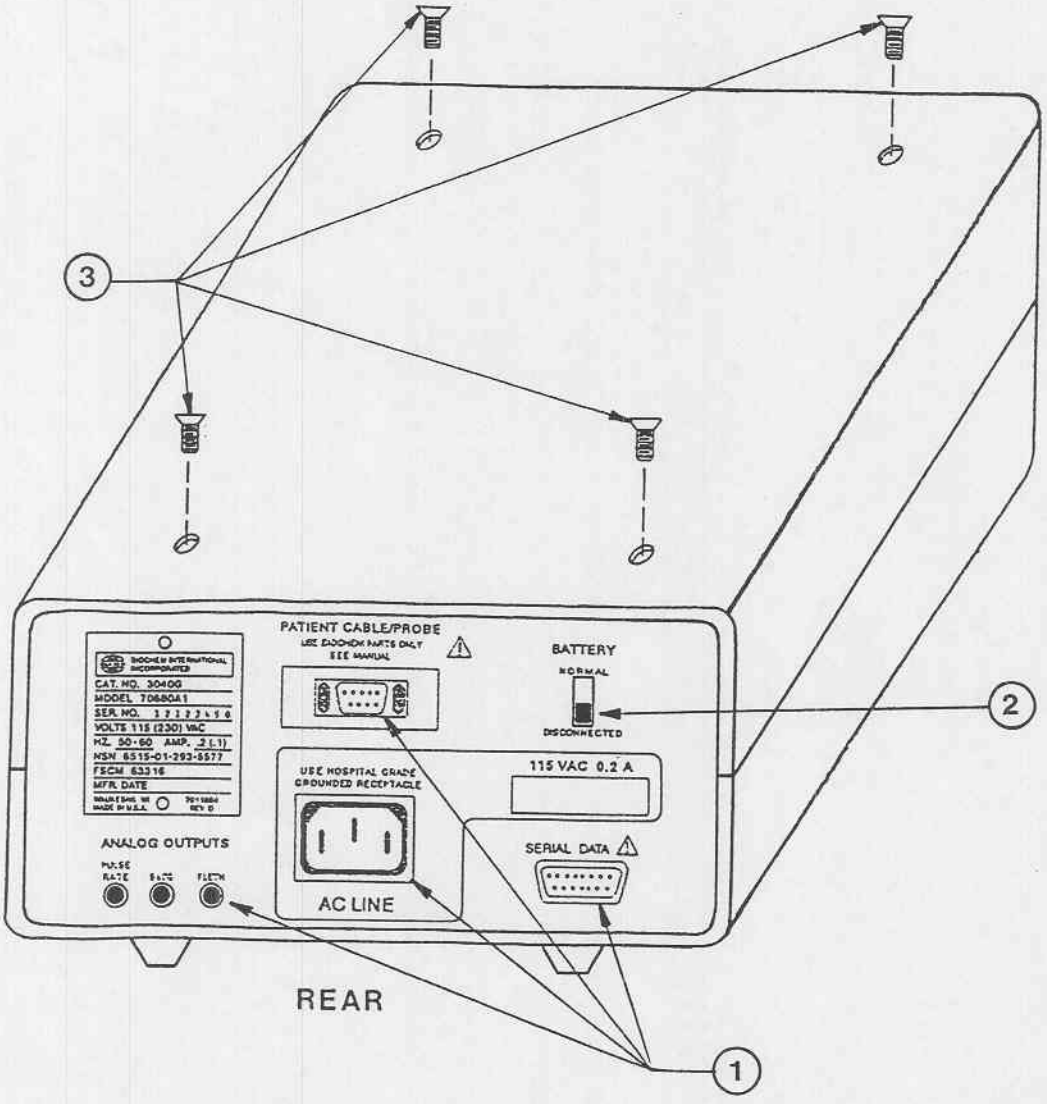


Figure 10. Remove the top cover.

Note: Stop here if you are only changing the AC Line Voltage Setting. You now have access to the AC Line Voltage Selection Swith and Voltage Rating Plate.

4. Refer to Figure 11. Remove the two cables connected to H1 and H2 on the Single Board Oximeter.

5. Refer to Figure 11. Remove the six (#2 phillips head) screws and nylon washers that secure the Single Board Oximeter to the nylon standoffs. Lift the Single board Oximeter from the unit.

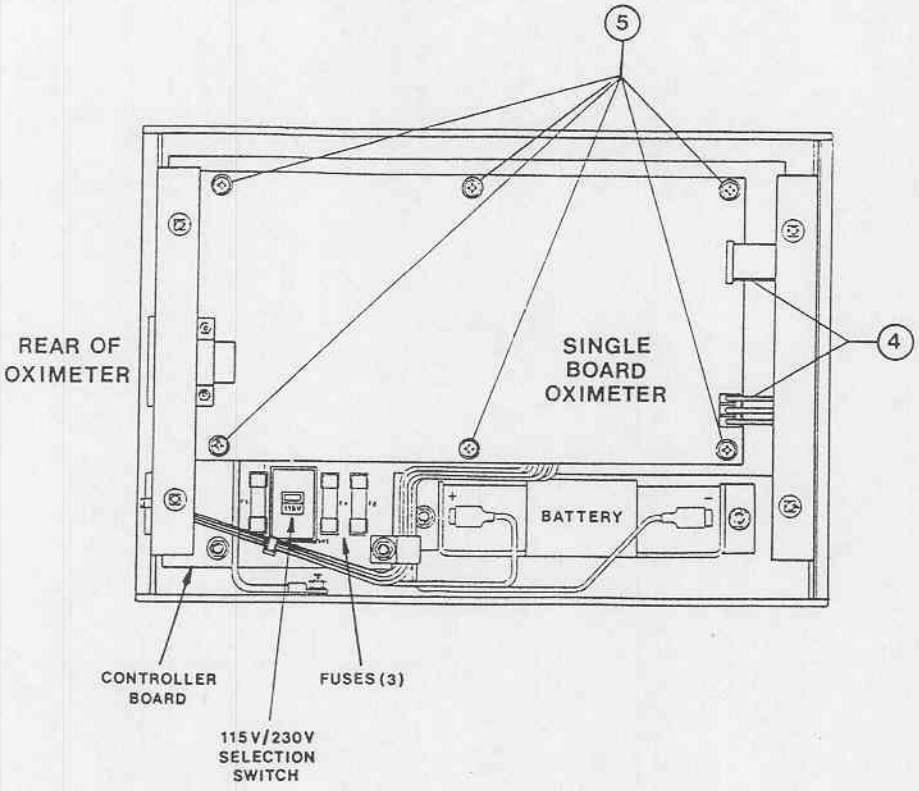


Figure 11. Remove the Single Board Oximeter.

6. Refer to Figure 12. Remove the cables connected to H4 and H5 of the Controller board. Remove the cable connected to H1 and H4 of the Display board. Remove the two slip-on connectors from the battery.

7. Refer to Figure 12. Remove the nut (1/4") and lockwashers that secure the earth ground cable to the bottom cover. Remove the ring terminal from the stud on the bottom cover.

8. Refer to Figure 12. Remove the two (1/4") nuts and lockwashers and 1 cable clamp from the Controller board.

9. Refer to Figure 12. Remove the six (1/4") nylon standoffs that secure the Controller board to the bottom cover.

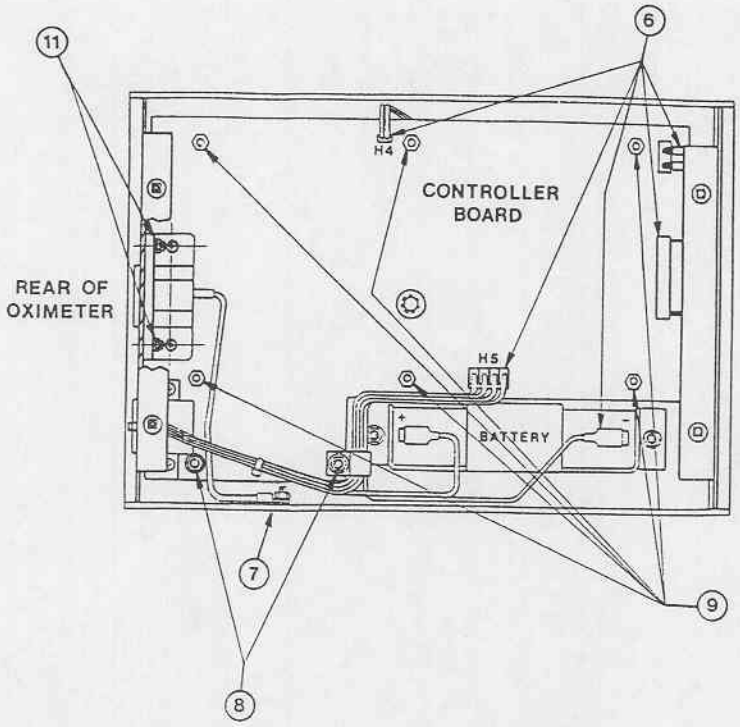


Figure 12. Remove the Controller board hardware.

10. Refer to Figure 13. Remove the two (#2 phillips) screws and lockwashers that secure the rear panel to the bottom cover. Lift the Controller board and rear panel from the bottom cover. Remove the eight spacers on the bottom cover mounting studs.

11. Refer to Figure 12. Remove the two (1/4") nuts and lockwashers that secure the AC Input connector to the rear panel. Lift the controller board from the rear panel.

12. Refer to Figure 13. Remove the two (#2 phillips) screws and lockwashers that secure the front panel to the bottom cover. Lift the front panel from the bottom cover.

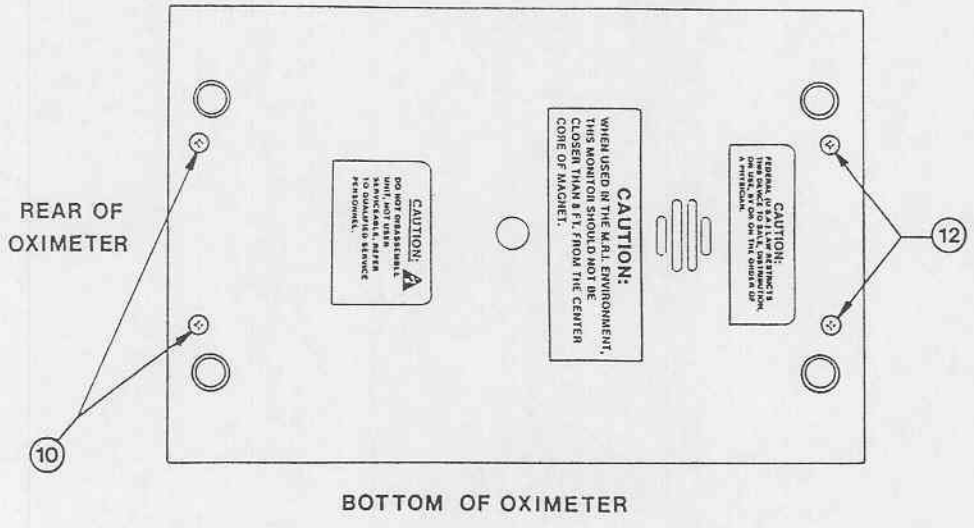


Figure 13. Remove the Rear Panel/Controller board and the Front Panel.

13. Refer to Figure 14. Remove the cable connected to H5 of the Display board.

14. Refer to Figure 14. Remove the four (3/16") nuts and washers that secure the Display board to the front panel. Lift the Disply board from the front panel. Remove the four spacers on the front panel mounting studs.

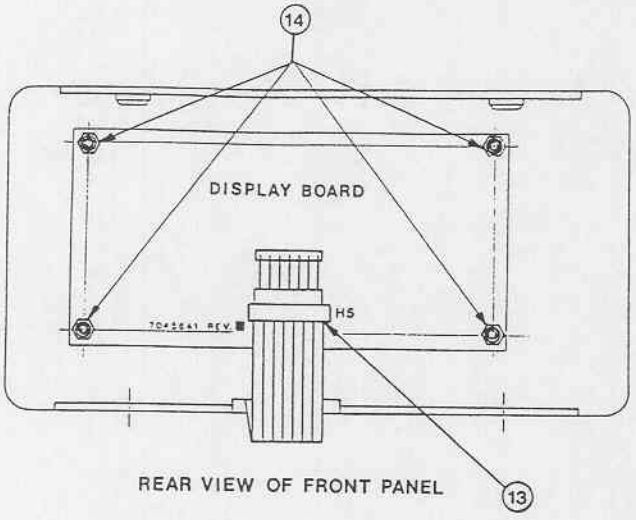


Figure 14. Remove the Display board.

Assemble the 3040G Oximeter in the reverse order of disassembly.

Schedule of Maintenance and Adjustments

The battery should be charged after the 3040G Oximeter is used under battery operation, or when the BATT LOW message is displayed on the LCD. A fully charged battery generally provides 4 hours of operation (5 hours with backlight OFF).

There are two potentiometers on the Controller board. VR2 adjusts the maximum battery charging current and VR3 adjusts the battery charging voltage. The potentiometers are set at the factory and do not require adjustment under normal operating conditions. VR2 and VR3 should only be adjusted if a malfunction associated with the battery charging circuit is diagnosed.

There is one potentiometer on the Display board. RV1 adjusts the viewing angle of the LCD display. RV1 is set at the factory and does not require adjustment under normal operating conditions. RV1 should only be adjusted if a malfunction associated with the LCD display is diagnosed or if a change in the viewing angle is desired.

The AC Line voltage can be set (internally) for either 115 VAC or 230 VAC operation. The AC Line voltage setting is

shown on the rear panel of the 3040G Oximeter. If the setting must be changed, refer to "Changing the AC Line Voltage Setting" on page 43.

Charging the Battery

Refer to the "Charging the Battery" section on page 20 for details on charging the battery.

Adjusting the Battery Charging Circuit

Follow steps 1-5 of the "Disassembly/Assembly Instructions" on page 38.

Remove the battery connector to H5 of the Controller board. Connect (with clip leads) the 47-56 ohm, 1 watt resistor between pins 3 and 4 of H5. Connect a voltmeter across the 47-56 ohm resistor.

Connect the AC Power Cord to the 3040G. Adjust VR3 for 6.85 VDC +/- 0.05 VDC across the 47-56 ohm resistor.

Remove the 47-56 ohm resistor. Connect an ammeter to pins 3 and 4 of H5. Adjust VR2 for 500 mA +/- 50 mA.

Unplug the AC Power Cord from the 3040G Oximeter and assemble in reverse order of disassembly.

Refer to the "Safety Inspections" section on page 53 and perform a leakage current and high voltage potential test.

Adjusting the Display board Viewing Angle

Follow steps 1-3 of the "Disassembly/Assembly Instructions" section on page 38.

Connect the AC Power Cord to the 3040G and turn the monitor on. Adjust the potentiometer RV1 on the Display board until the display is at the preferred viewing angle.

Unplug the AC Power Cord from the 3040G Oximeter and assemble in reverse order of disassembly.

Changing the AC Line Voltage Setting

Follow steps 1-3 of the "Disassembly/Assembly Instructions" section on page 38. Locate SW1 on the Controller board. Slide the switch to the desired voltage setting as shown on the switch.

Remove the two nuts and lockwashers from the studs that secure the voltage rating plate to the rear panel. Remove the voltage rating plate, turn it upside down, and reinstall it with the lockwashers and nuts. Verify the new voltage setting is correctly shown on the rear panel.

Assemble in reverse order of disassembly.

Refer to the "Safety Inspections" section on page 53 and perform a leakage current and high voltage potential test.

Replacing the AC Line Fuse(s)

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

Follow steps 1-3 of the "Disassembly/Assembly Instructions" section on page 38.

Replace F1, F2, and/or F4 with the same type and rating of fuse.

Refer to the "Safety Inspections" section on page 53 and perform a leakage current and high voltage potential test.

Performance Checks - Single Board Oximeter

Refer to the Single Board Oximeter schematics on pages 75-78.

Voltages and Signals

Verify the voltages and signals at the following points.

Supply Voltages	DIG+5	+5 VDC +/-0.2 VDC
	ANA+5	+5 VDC +/-0.2 VDC
	ANA-5	-5 VDC +/-0.2 VDC
Reset	RST at U10C pin 6 low (< 0.2 V)	
	RESET at U10B pin 4 high (> 4.5 V)	
Clock signals	PHI at U2 pin 64 3.072 MHz	
	JP2 pin 1 1.536 MHz	
RAM enable	U1 pin 20 active*	
ROM enable	U6 pin 20 active*	
I/O enable	U4 pin 12 active*	
	OFST at U4 pin 11 active*	
	ADC at U4 pin 10 active*	
	LED U4 pin 9 active*	
Received data	U2 pin 46 active*	
Transmitted data	U2 pin 45 active*	

* 0-5 volt TTL logic level switching activity should be observed at these points.

Waveforms

Verify the waveforms at the following points. Refer to Figure 15 - Single Board Oximeter Amplifier Timing Diagram. Note: Measured values on the timing diagram are nominal.

TP9 RED SELECT - Turns on the red probe LED.

U17 pin 14 IRED Select - Turns on the infrared probe LED.

U7 pin 16 DRIVE LVL - This DAC output is used to adjust both the RED and IRED drive current levels.

TP7 DRIVE I SENSE - This is the voltage drop across R17 developed by the red LED current or IRED LED current. This voltage is used by U12 to regulate the LED drive current.

TP2 RAW SIG - This is the differential signal from the finger probe at the output of the first stage amplifier.

TP3 AMP SIG - Output of the second stage amplifier. Selectable gain of Av=2, 4, 8, or 16.

U14 pin 1 Signal S/H - Closes the analog switch to charge the capacitor in the signal sample and hold circuit.

U14 pin 9 Reference Sample and Hold - Closes the analog switch to charge the capacitor in the reference S/H circuit.

U24 pin 8 CAP-GND - Closes the analog switch to discharge the capacitor between the first and second stage amplifiers.

TP1 SIG S/H - This is the peak value of the RED/IRED signal that was stored on the sample and hold cap. This value is the voltage developed in response to the LED light level (signal) and ambient light.

TP4 REF S/H - Not shown (normally near 0 V).

TP5 SIG-REF - LED light level minus the reference level.

U8 pin 16 OFFSET - This is the calculated level that is subtract from the SIG-AMB level to produce the SIG-OFFSET signal for the A/D converter.

TP8 SIG-OFFSET - This is the final analog signal level sent to the A/D converter. SIG-OFFSET is SIG-AMB minus the OFFSET value amplified by 10. The OFFSET value may be continuously adjusted and will cause SIG-OFFSET to range between +2.5 V and -2.5 V.

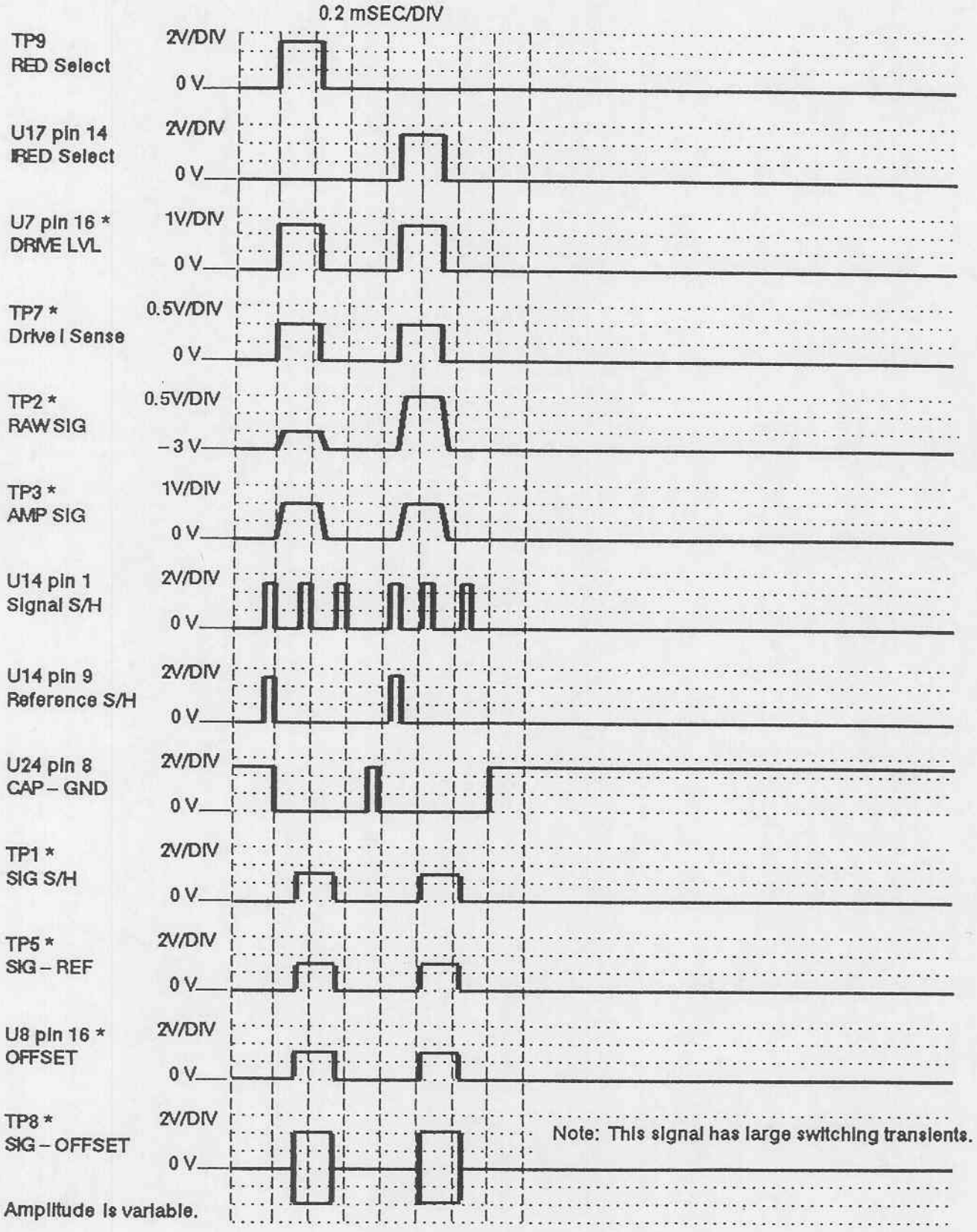


Figure 15. Single Board Oximeter Amplifier Timing Diagram.

Performance Checks - Controller board

Refer to the Controller board schematics on pages 79-81.

Voltages and Signals

Verify the voltages and signals at the following points.

Battery Voltage	6.8 VDC +/-0.2 VDC (fully charged open circuit)
Charging Voltage	6.85 VDC +/-0.05 VDC at VBATT referenced to GND TP. (battery fully charged)
Charging Current	500 mA +/-0.050 mA
Supply Voltages	VCC +5 VDC +/-0.2 VDC VDD +5 VDC +/-0.2 VDC VEE -4.7 VDC +/-0.2 VDC
Reset	RST at U9 pin 10 low (< 0.2 V) RESET at U8 pin 15 high (> 4.5 V)
RAM enable	U2 pin 20 active*
ROM enable	U1 pin 20 active*
I/O enable signals	EXTIO at U5 pin 12 active* IO at U5 pin 11 active* DAC at U5 pin 10 active* LCD at U5 pin 9 active*

* 0-5 volt TTL logic level switching activity should be observed at these points.

Waveforms

Verify the waveforms at the following points.

Figure 16. Power-on Reset.

Figure 17. VEE Inverter Oscillator.

Figure 18. Switching Power Supply Oscillator.

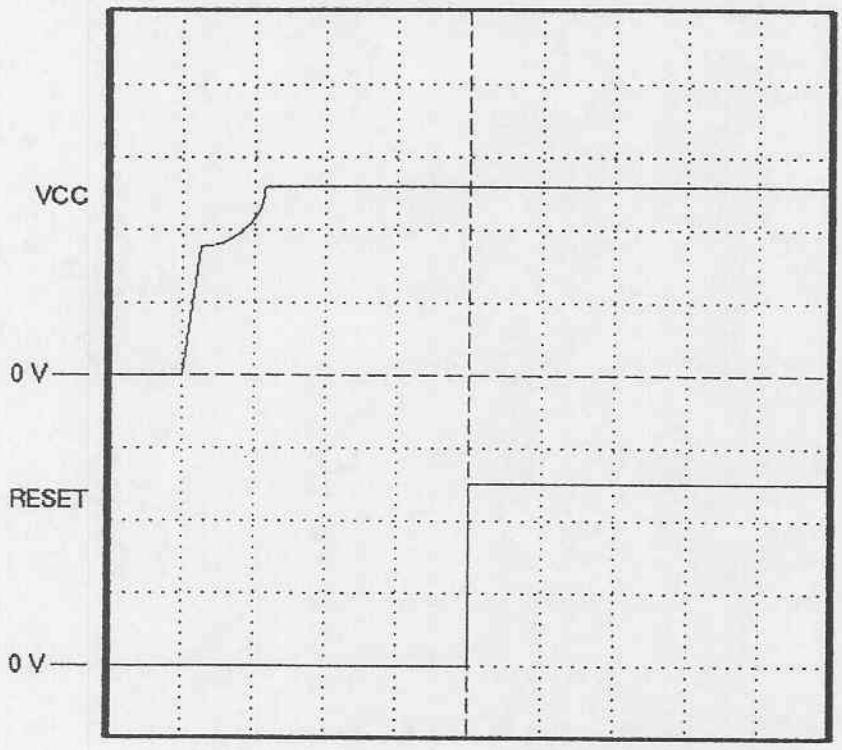
Figure 19. Switching Power Supply Driver.

Figure 20. Crystal and Clock Signals.

Figure 21. Serial Port 1 Communications Signals.

Figure 22. Speaker "ALARM" Signal.

Figure 23. PLETH. Analog Output.

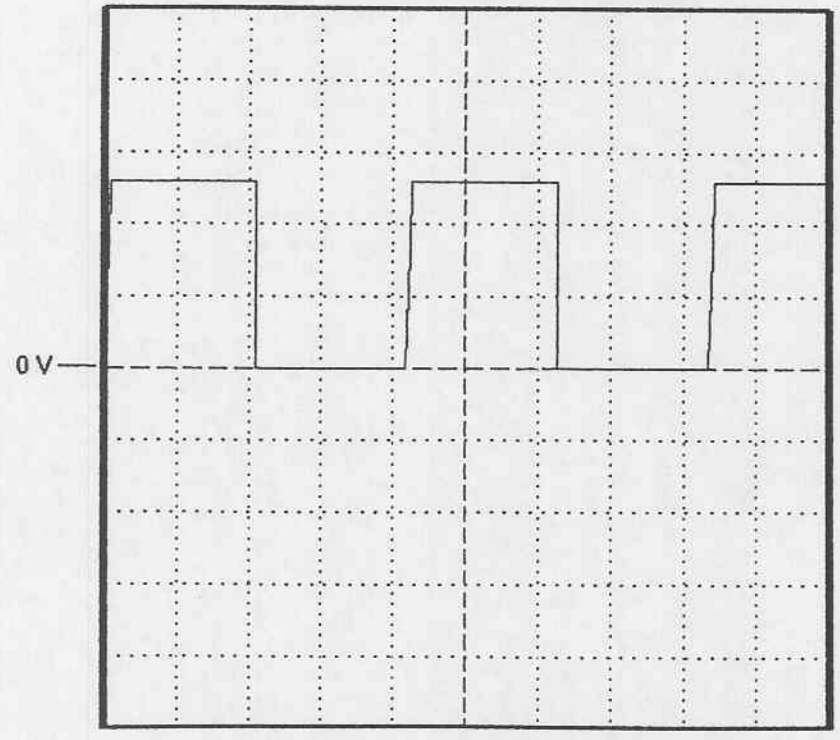


Settings:
2 V/DIV
.1 sec/DIV
DC Coupling

Inputs:
VCC referenced to DGND.
RESET referenced to DGND.

Notes:
Trigger the scope on the rising edge of VCC. Turn the power from off to on.

Figure 16. Power-on Reset.



Settings:
2 V/DIV
50 usec/DIV
DC Coupling

Input:
U16 pin 2 referenced to AGND

Figure 17. VEE Inverter Oscillator.

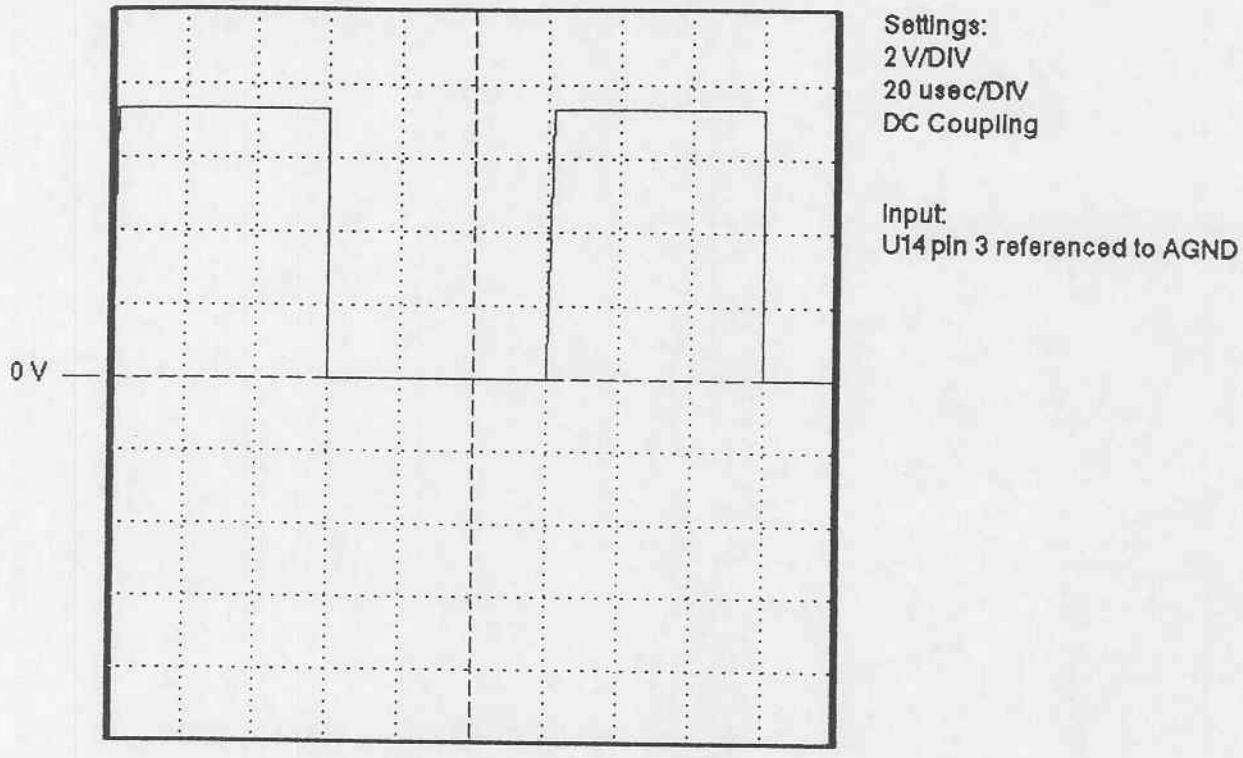


Figure 18. Switching Power Supply Oscillator.

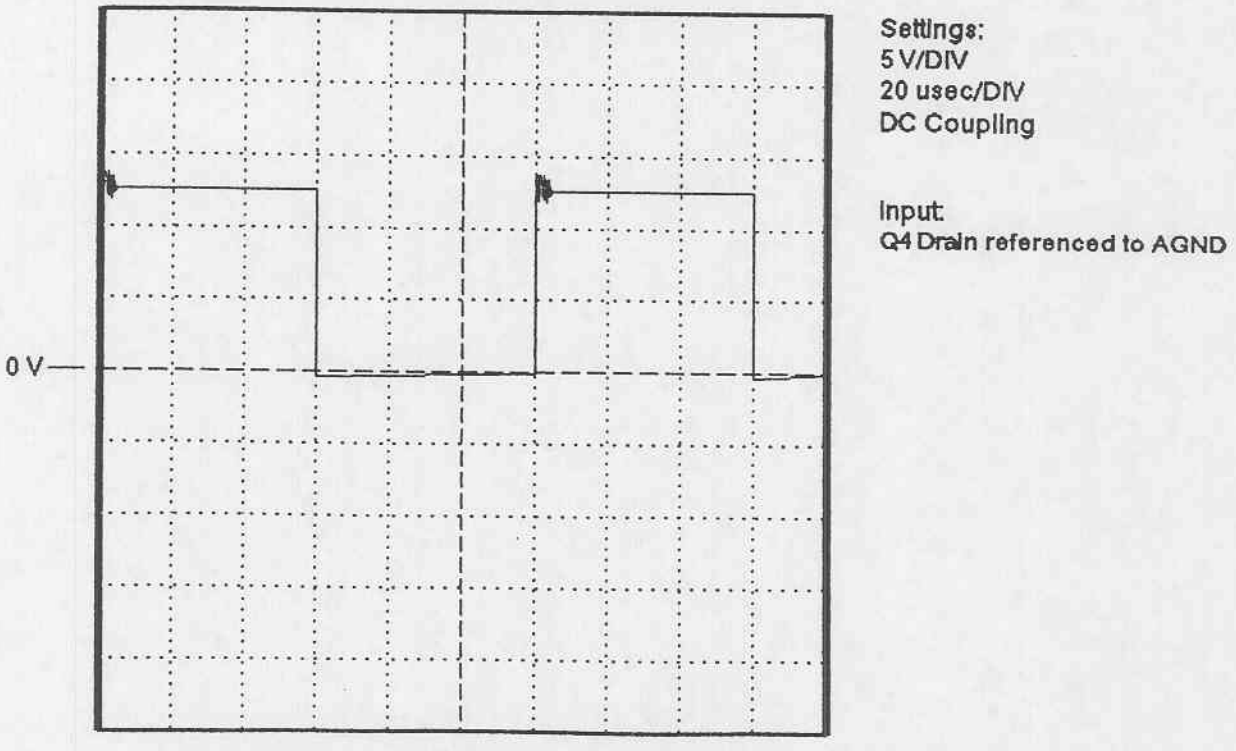
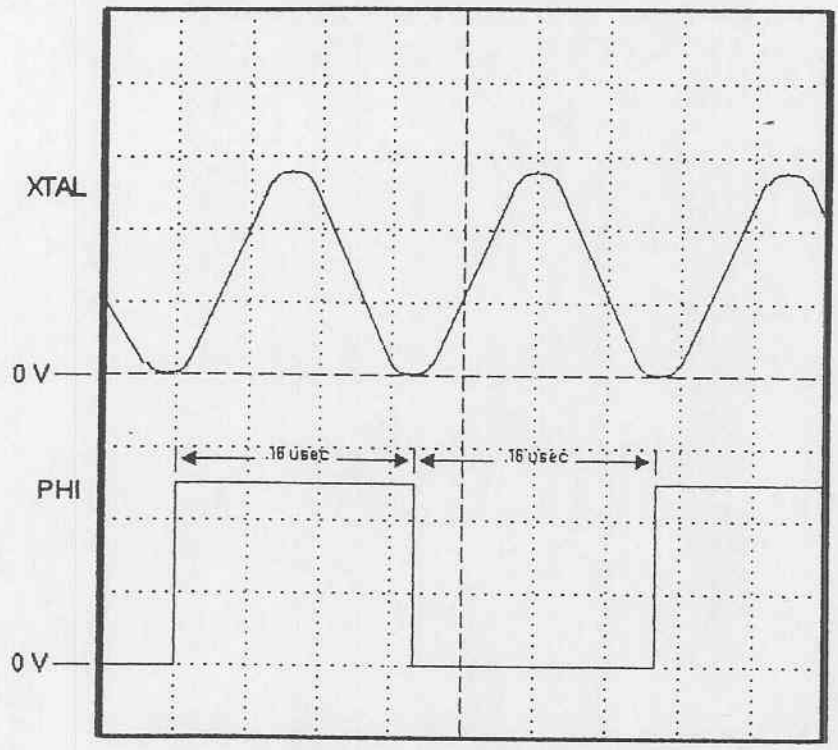


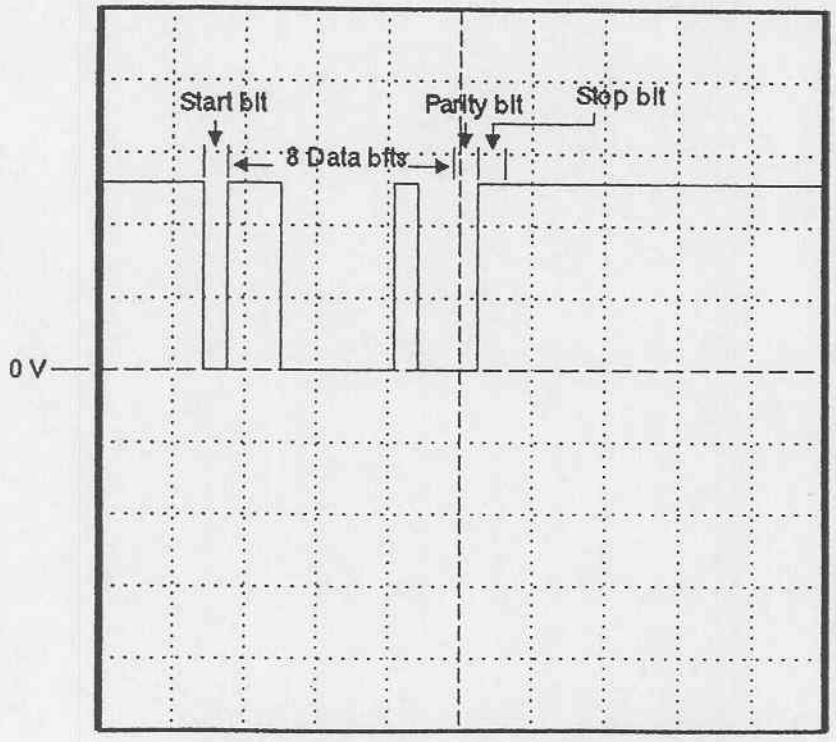
Figure 19. Switching Power Supply Driver.



Settings:
2 V/DIV
.05 usec/DIV
DC Coupling

Inputs:
U4 pin 2 (XTAL) referenced to DGND.
U4 pin 64 (PHI) referenced to DGND.

Figure 20. Crystal and Clock Signals.

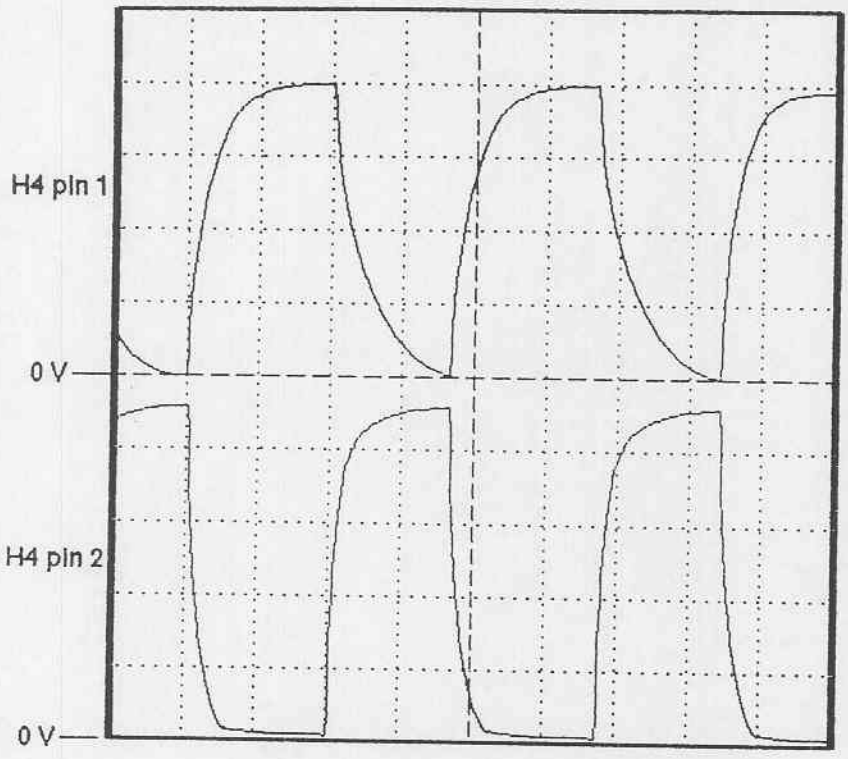


Settings:
2 V/DIV
.5 msec/DIV
DC Coupling

Input:
U8 pin 7 referenced to DGND.

Notes:
TXA1 (U8 pin 7) transmits an uppercase ASCII "B" on power up. This occurs shortly after the LCD display test. The ASCII code for an uppercase "B" in binary is 11000010. 1 start bit, 8 data bits, 1 parity bit, and 1 stop bit.

Figure 21. Serial Port 1 Communications Signals.

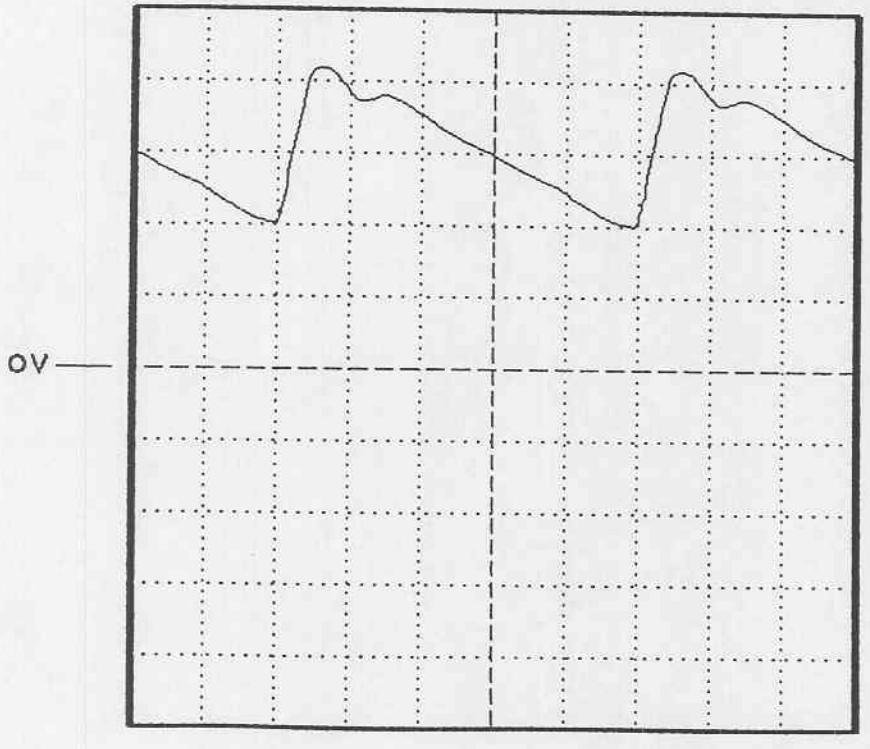


Settings:
1 V/DIV
.2 msec/DIV
DC Coupling

Inputs:
H4 pin1 referenced to AGND.
H4 pin 2 referenced to AGND.

Notes:
Measurements made with speaker connected and alarm volume at maximum. Decreasing the alarm volume to its lowest amplitude produces a waveform of approximately 0.5 V p – p for each of the waveforms.

Figure 22. Speaker "ALARM" Signal.



Settings:
.5 V/DIV
.2 sec/DIV
DC Coupling

Input:
PLETH. Analog Output referenced to AGND

Figure 23. PLETH. Analog Output.

Checking Operator Controls and Functions

Use each function of the 3040G Oximeter as described in the "Using the 3040G Oximeter" section on page 16. Each function should work as described in the text.

Safety Inspections

Perform a leakage current test and a high voltage potential test whenever the unit has been disassembled, repaired, or the AC Line voltage setting has been changed.

Leakage Current Test

Disconnect the Patient Cable or Probe from the 3040G Oximeter. Connect the test lead of the Leakage Current Meter to pin 7 of the PATIENT CABLE/PROBE connector on the rear of the 3040G Oximeter. Connect the AC Power cord to the AC LINE connector on the rear of the 3040G Oximeter and then to the Leakage Current Meter. Connect the Leakage Current Meter to a hospital grade outlet. Turn the 3040G Oximeter on. Verify the following parameters with the Leakage Current Meter:

Correct Polarity without EGND	< 10 uA
Reverse Polarity without EGND	< 10 uA
Correct Polarity with EGND	< 10 uA
Reverse Polarity with EGND	< 10 uA

Connect the test lead of the Leakage Current Meter to one of the 3040G Oximeter cover screws. Verify the following parameters with the Leakage Current Meter:

Correct Polarity without EGND	< 100 uA
Reverse Polarity without EGND	< 100 uA
Correct Polarity with EGND	< 100 uA
Reverse Polarity with EGND	< 100 uA

High Voltage Potential Test

WARNING: ELECTRICAL SHOCK HAZARD. Read the Operator's Manual for the High Potential tester you are using and follow the manufacturer's safety precautions and operating procedures.

Disconnect the Patient Cable or Probe from the 3040G Oximeter. Connect the test lead of the High Potential tester to pin 7 of the PATIENT CABLE/PROBE connector on the rear of the 3040G Oximeter. Connect the AC Power cord to the AC LINE connector on the rear of the 3040G Oximeter and then to the appropriate connector on the High Potential tester. Connect the High Potential tester to an appropriate AC power outlet. Verify with the High Potential tester that there is no high voltage break-down at the following parameter:

2500 VAC for 60 seconds

Turn the High Potential tester off and unplug the tester from the AC power outlet. Connect the test lead of the High Potential tester to one of the 3040G Oximeter cover screws. Connect the High Potential tester to an appropriate AC power outlet. Verify with the High Potential tester that there is no high voltage break-down at the following parameter:

1500 VAC for 60 seconds

Checklist of Inspections and Adjustments

All items on this checklist must meet the specifications in the "Performance Checks" sections on pages 45 and 48.

All items on this checklist must be performed after the 3040G Oximeter has been serviced.

Controller Board

___ Battery Voltage (open circuit)
___ Battery Charging Voltage
___ Battery Charging Current
___ Supply Voltages
    ___ VCC
    ___ VDD
    ___ VEE

Single Board Oximeter

___ Supply Voltages
    ___ DIG+5
    ___ ANA+5
    ___ ANA-5

System

___ Leakage Current
___ High Voltage Potential
___ All front panel keys operational
___ Sa02 and pulse readings accurate
___ Finger Probe(s) functioning properly
___ Universal "Y" Probe(s) functioning properly
___ Analog Outputs accurate

Troubleshooting

General Troubleshooting Procedures

Most 3040G failures can be diagnosed and repaired by following these general procedures.

1. Determine the circuit board at fault.
2. Check the power supplies.
3. Check the RESET signals.
4. Check all of the CLOCK signals.
5. Check the Communication Port(s) if applicable.

For the Single Board Oximeter, these additional procedures are helpful:

6a. Check the LED DRIVE enable and level circuits.
7a. Check the Amplifier stages (start at the first stage and work towards the A/D converter).
8a. Check the Memory Decode circuit.
9a. Check the I/O Decode circuit.
10a. Check the Microprocessor Address and Data lines.

For the Controller board, these additional procedures are helpful:

6b. Check the Chip Select signal to the D/A converter. The D/A converter is updated each time data is received from the Single Board Oximeter.
7b. Check the enable signal to the display (LCD).
8b. Check the Memory Decode circuit.
9b. Check the I/O Decode circuit.
10b. Check the Microprocessor Address and Data lines.

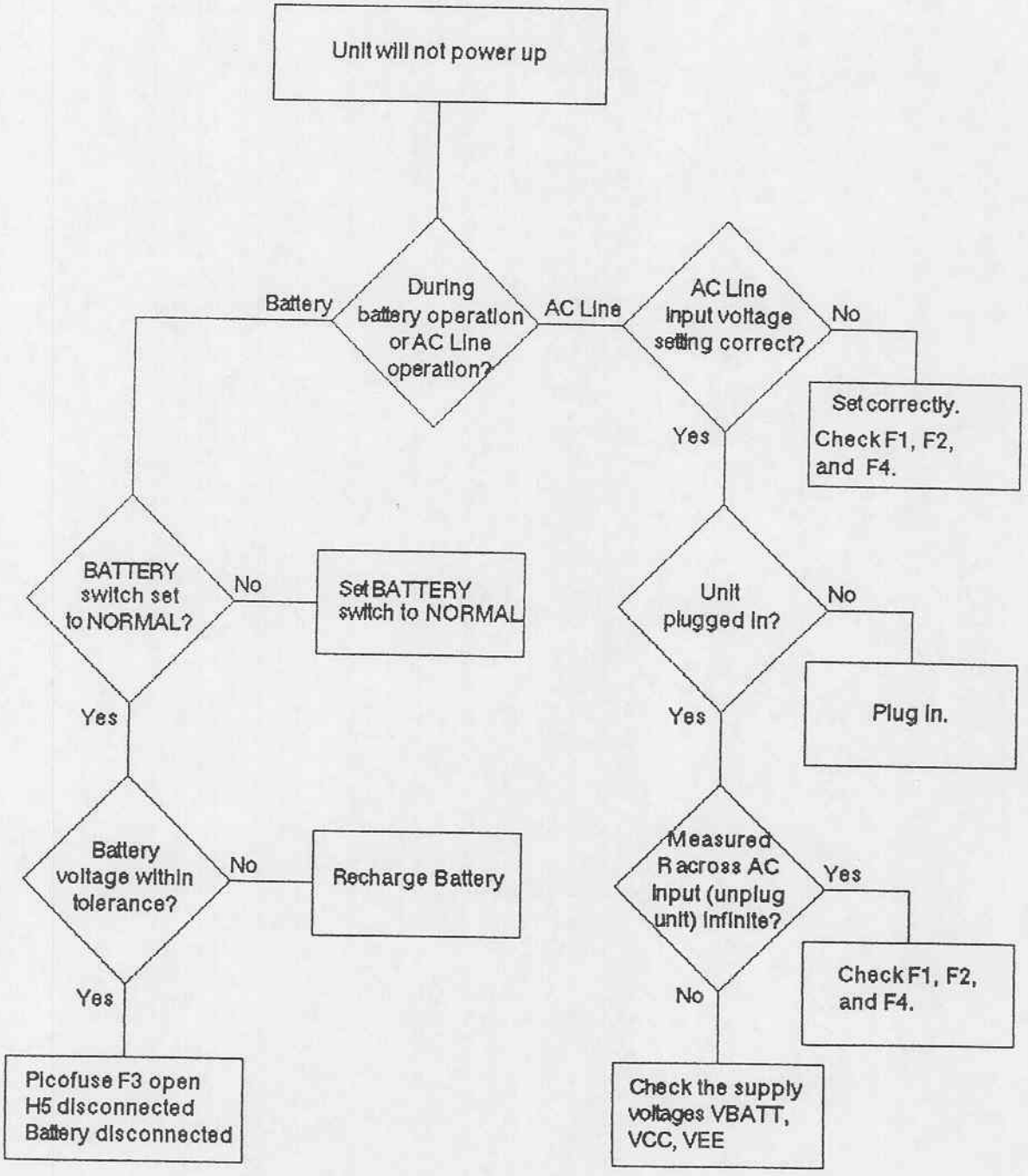


Figure 24. Unit Will Not Power Up.

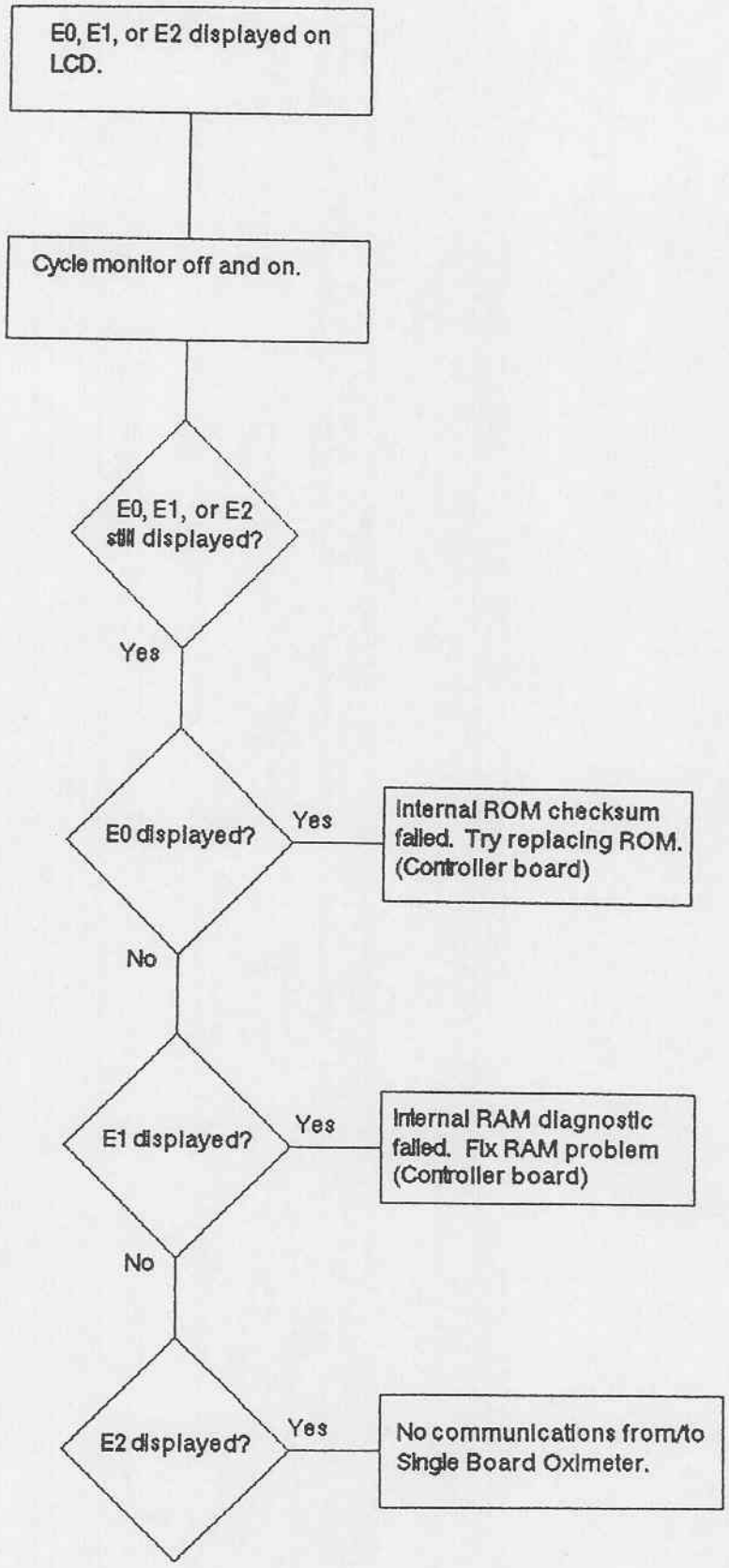


Figure 27. E0, E1, or E2 Displayed on LCD.

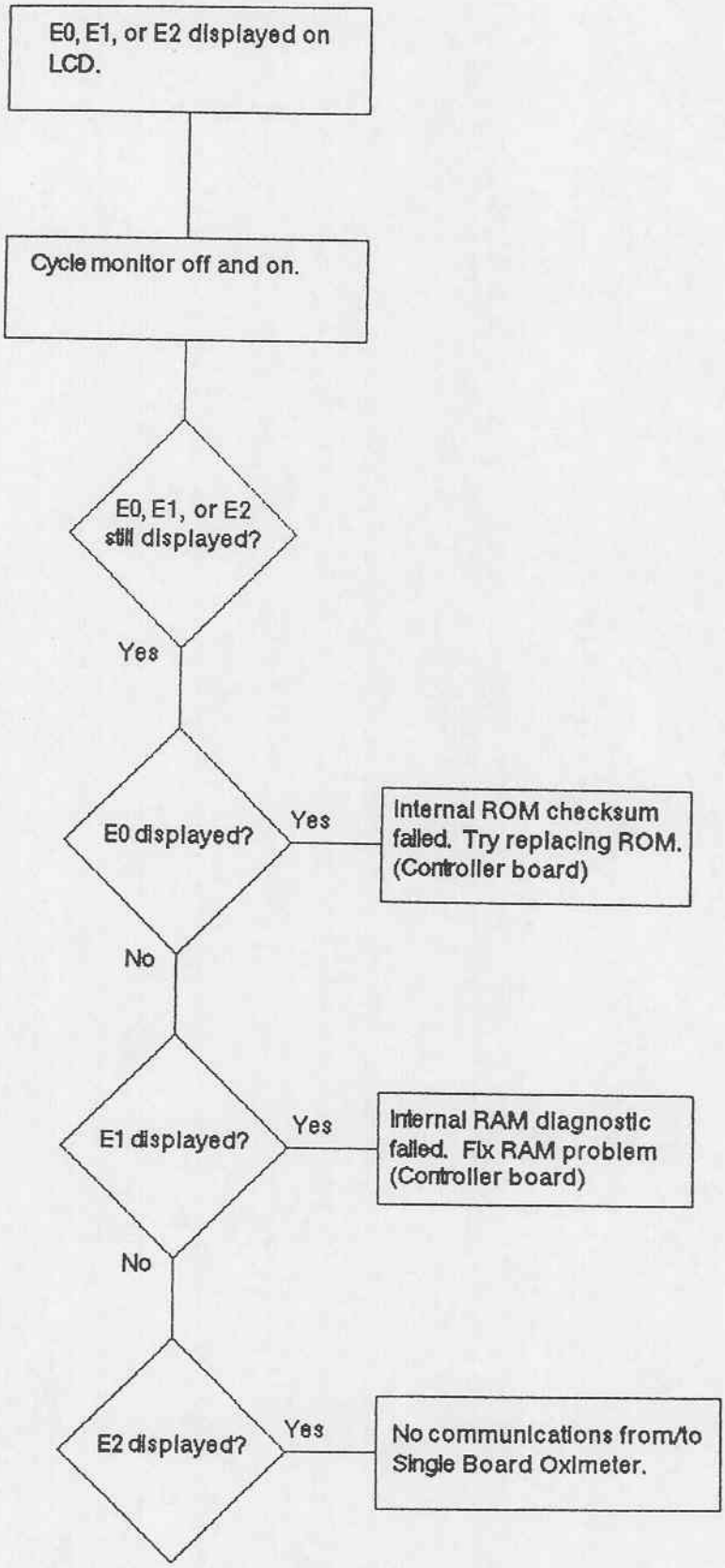


Figure 27. E0, E1, or E2 Displayed on LCD.

70664A1 PWB ASM SINGLE BOARD OXIMETER

PART NO.	DESCRIPTION	QTY.	DESIGNATION
10001B111	RESISTOR 5% 1/4W 270	2	R3,R40
10001B117	RESISTOR 1% 1/8W 7.50	1	R17
10001B2273	RESISTOR 5% 1/4W 27K	1	R1
10001B48	RESISTOR 5% 1//4W 47	2	R29,R30
10001B49	RESISTOR 5% 1/4W 470	1	R8
10002B1003	RESISTOR 1% 1/8W 100K	10	R10,R11,R12, R14,R25,R26,R28 R31,R32,35
10002B1004	RESISTOR 1% 1/8W 1M	2	R18,R24
10002B1472	RESISTOR 1% 1/8W 14.7K	1	R41
10002B2002	RESISTOR 1% 1/8W 20K	1	R36
10002B8062	RESISTOR 1% 1/8W 80.6K	1	R39
10004B0271	CAPAC CERAMIC 10% 50V 270 PF	1	C18
10006B102	RESISTOR 1% 1/8W 365K	2	R48,R49
10006B215	RESISTOR 1% 1/8W 909	1	R46
10006B39	RESISTOR 1% 1/8W 40.2K	1	R38
10006B65	RESISTOR 1% 1/8W 9.09K	1	R15
11001B10	IC 74HC138 3 TO 8 DEMUXR	1	U4
11008B14	IC 40-71 QUAD 2-INPUT OR	1	U3
11008B23	IC 40106 HEX SCHMITT	1	U10
11008B25	IC 40-51 SINGLE 8-CHN DEMUX	1	U16
11008B27	IC 40-99B SER TO PAR LATCH	1	U17
11009B9	IC 74HC-74N QUAD D FLIP FLOP	1	U5
11011B1	IC OP AMP DUAL LF353	2	U13,U15

12005B6	SCREW PHMS 4-40 X 5/16 ST STL (PHILLIPS)	2	406
13000B13	CAPAC MONO. CER. 10% 50V .1MF	26	C4,C5,C6,C8, C9,C10,C11,C12, C13,C14,C15,C16, C17,C24,C25,C26, C29,C34,C44,C46, C48,C51,C52,C55, C61,C71
13000B20	CAPACITOR MONO CERAMIC RADIAL 10% 50V 1000PF	5	C49,C56,C62,C63, C64
13000B21	CAPACITOR MONO CERAMIC RADIAL 10% 50V 10PF	8	C2,C3,C19,C21, C36,C37,C38,C39
13000B23	CAPACITOR MONO CERAMIC RADIAL 10% 50V 22PF	2	C22,C23
13000B25	CAPACITOR MONO CERAMIC RADIAL 10% 50V 33PF	1	C20
13000B9	CAPACITOR MONO CERAMIC RADIAL 10% 50V .01MF	8	C7,C27,C31,32, C43,C65,C69,C70
13003B3	CAPAC TANT 25V 10MF	2	C1,C72
13004B7	CAPAC AL-ELECT 35V 470MF RADIAL -10+50	4	C28,C45,C50,C58
46038B	CAPAC TANT 10% 10V 100MF	5	C35,C47,C42,C53, C54
48032B	DIODE RECTIFIER 1N4148	1	D3
48073B	RESISTOR 5% 1/4W 10K	5	R9,R23,R66, R67,R69
48085B	RESISTOR 5% 1/4W 100K	3	R7, R42, R68
48088B	RESISTOR 5% 1/4W 1K	5	R2,R43,R44, R45,R70
48090B	RESISTOR 5% 1/4W 4.7K	1	R6
48163B	RESISTOR 1% 1/8W 10K	3	R13,R27,R37
49041B2	NUT HEX 4-40 SMALL .18 ACROSS FLATS	2	407
49080B	TUBING SHRINK 3/16 ID	A/R	405
53047B	WASHER LOCK INT #4 ST STL	2	408

54010B	IC REFERENCE 2.5V LM336Z	1	U21
56207B1	CAPAC AL-ELEC 35V 10MF RADIAL	1	C60
56278B1	WIRE SOLID TINNED BUS BAR #22AWG	A/R	404
56290B1	TRANSISTOR NPN 2N3904 TO-92	2	Q6,Q8
56352B1	IC OPTOISOLATOR H11AV1 4 KV RMS	2	U22,U23
58027B1	TRANSISTOR PNP 2N3906	2	Q1,Q7
58034B1	SOCKET IC 28 PIN	1	403
68530B1	CONN HEADER .156 CTR 3	1	H1
70026B1	CONN HEADER SIL 4 PIN	1	H3
70026B8	CONN HEADER SIL 6 PIN	1	H2
70046B3	RESISTOR NETWORK 100K	2	R4,R5
70058B1	CAPAC FILM/FOIL .01MF 5%	2	C40,C41
70187B1	DIODE 1N5818 SCHOTTKY	1	D4
70220B1	IC A/D ADC1205	1	U9
70238B1	FET N-CHANNEL 2N7000	1	Q9
70307B1	IC PROCESSOR #HM64180	1	U2
70319B1	IC RAM STATIC 8K X 8 HD6264	1	U6
70350B1	SOCKET IC 64 PIN .70 L/S	1	402
70445B1	IC VOLT REG LM7805	1	U18
70474B2	DIODE BRIDGE 100V 1A	1	DB1
70480B1	CRYSTAL 6.144MHZ	1	X1
70484B1	IC D/A AD558	2	U7,U8
70487B1	IC OP AMP QUAD TLC274CN	1	U11
70524B1	IC OP AMP TLC271CN	1	U12
70525B1	INDUCTOR FERRITE BEAD	1	FB

70570B1	COVER SHIELD TOP OXIMETER	1	401
70577B1	CONN D 9 PIN FEMALE W/HOLDERS PWB-MT	1	CONN1
70578B1	IC ANA SW DG308A CMOS	1	U24
70593B1	TERMINAL SOLDER TURRET	9	TP1,TP2,TP3,TP4, TP5,TP6,TP7,TP8, TP9
70649B2	FILTER COMMON MODE PWB-MT	1	T1
70663B1	PWB FAB OXIMETER 9090	1	400
70667B1	IC VOLT REG -5V LM79L05	1	U20
70718B1	FET N-CHN VNO300L	2	Q4,Q5
70722B1	FET P-CHN TPO602N3	2	Q2,Q3

70688A1 PWB 3040G CONTROLLER BOARD

PART NO.	DESCRIPTION	QTY.	DESIGNATION
10001B111	RESISTOR 5% 1/4W 270	1	R18
10001B115	RESISTOR 5% 1/4W 1.1M	1	R24
10001B2273	RESISTOR 5% 1/4W 27K	1	R1
10001B46	RESISTOR 5% 1/4W 39K	1	R29
10001B48	RESISTOR 5% 1/4W 47	2	R3, R10
10001B49	RESISTOR 5% 1/4W 470	1	R8
10001B80	RESISTOR 5% 1/4W 150K	4	R5,R6,R7,R22
10002B1003	RESISTOR 1% 1/8W 100K	2	R36,R37
10002B2002	RESISTOR 1% 1/8W 20K	1	R34
10002B22	RESISTOR 5% 1/2W 1 OHM	1	R27
10002B3012	RESISTOR 1% 1/8W 30 .1K	1	R35
10006B212	RESISTOR 1% 1/8W 249K	1	R38
11008B13	IC 40-93 QUAD 2-INPUT NAND	1	U9
11008B15	IC 40-11B QUAD 2-INPUT NAND	1	U14
11008B25	IC 40-51 SINGLE 8-CHN DEMUX	1	U7
11008B26	IC 40-49 HEX INVERTING	1	U8
11008B27	IC 40-99B SER TO PAR LATCH	1	U12
11009B19	IC 74HC139 DUAL 2 to 4	1	U5
11009B22	IC 74HC541 OCTAL 3-STATE	1	U6
12004B17	SCREW PHMS 4-40 X 1-3/8	2	413
12005B6	SCREW PHMS 4-40 x 5/16 ST STL (PHILLIPS)	6	403
13000B13	CAPAC MONO. CER 10% 50V .1MF	9	C3,C4,C5,C9,C10, C11,C16,C20,C22
13000B20	CAPACITOR MONO CERAMIC RADIAL 10% 50V 1000PF	1	C21
13000B21	CAPACITOR MONO CERAMIC RADIAL 10% 50V 10PF	2	C1, C2

13000B34	CAPACITOR MONO CERAMIC RADIAL 10% 50V .033MF	1	C17
13000B9	CAPACITOR MONO CERAMIC RADIAL 10% 50V .01MF	5	C28,C32,C35,C36, C37
13003B3	CAPAC TANT 25V 10MF	4	C6,C18,C29,C30
13004B12	CAPAC AL-ELECT 25V 100MF RADIAL -10+50%	1	C24
13004B15	CAPAC AL-ELEC 25V 2200MF RAD.	1	C19
13004B7	CAPAC AL-ELECT 35V 470MF RADIAL -10+50	1	C23
13004B9	CAPAC AL-ELEC 25V 1000MF RAD.	1	C31
13011B4	CAPAC MONO CER. 200V 10000PF	1	C25
15003B2	POT 3/4 TURN PWB-MT 10K	1	VR2
20107B1	CAPAC CERAMIC 5% 50V 330PF	2	C7,C8
20304B2	POT PWB-MT 3/4 TURN 100K	1	VR3
30401B1	CONN HEADER LOCKING 4 POS .156 CTR	1	H5
46012B	RESISTOR 5% 1/4W 330	1	R41
46022B	RESISTOR 5% 1/4W 200	1	R23
48031B	DIODE RECTIFIER 50V 1N4001	3	D2,D3,D4
48032B	DIODE RECTIFIER 1N4148	1	D1
48073B	RESISTOR 5% 1/4W 10K	2	R33,R40
48075B	RESISTOR 5% 1/4W 1M	1	R28
48085B	RESISTOR 5% 1/4W 100K	8	R2,R4,R9,R20,R21, R30,R42,R43
48088B	RESISTOR 5% 1/4W 1K	8	R11,R12,R13,R14, R15,R16,R17,R32
48090B	RESISTOR 5% 1/4W 4.7K	1	R19
48165B	RESISTOR 1% 1/8W 200K	1	R26

49041B2	NUT HEX 4-40 SMALL .18 ACROSS FLATS	8	404
49080B	TUBING SHRINK ID .188	A/R	412
53047B	WASHER LOC INT #4 ST STL	6	405
53055B	WASHER FLAT #6 NYLON	2	418
56083B3	CONN HEADER PWB MT 2-13 POS	1	H3
56207B1	CAPAC AL-ELEC 35V 10MF	2	C26,C27
56221B1	TRANSISTOR NPN TIP41C	1	Q1
56278B1	WIRE SOLID TINNED BUS BAR #22AWG	A/R	410
56285B4	FUSE SUBMINATURE 2A 125V	1	F3
57119B1	IC VOLT REG LP2951CN	1	U15
57959B1	TAPE KAPTON	A/R	419
58027B1	TRANSISTOR PNP 2N3906	1	Q2
58034B1	SOCKET IC 28 PIN	1	401
68530B1	CONN HEADER .156 CTR 3 POS	1	H6
70012B1	IC VOLT. CONV. ICL7660CPA	1	U16
70026B4	CONN HEADER SIL 2 PIN	1	H4
70026B8	CONN HEADER SIL 6 PIN	1	H1
70046B3	RESISTOR NETWORK 100K SIP	2	RP1, RP2
70058B1	CAPAC FILM POLY/FOI .01MF 15%	3	C13,C14, C15
70064B1	HEAT SINK TO-220 MICROSPAN	1	406
70238B1	TRANSISTOR FET N-CHN 2N7000	2	Q3,Q5
70263B1	CONNECTOR AC POWER PWB-MT	1	J4
70271B1	IC RAM STATIC 43256 32k X 8	1	U2
70307B1	IC PROCESSOR #HM64180	1	U4
70314B1	IC TLC372CP DIFF.	1	U17
70338B1	IC OP AMP DUAL TLC27M2	1	U11

70350B1	SOCKET IC 64 PIN .70 L/S	1	402
70418B1	CLIP FUSE 5MM DIA PWB MT	6	417
70419B1	FUSE .1A 250V SLO-BLO 5X20	2	F1,F4
70419B2	FUSE .2A 250V SLO-BLO 5X20	1	F2
70472B1	IC VOLT REG ICL7663	1	U13
70480B1	CRYSTAL 6.144MHZ	1	X1
70484B1	IC D/A AD558	1	U3
70487B1	IC TLC274CN	1	U10
70492B2	CONN PWB-MT D 15 PIN FEMALE	1	P1
70498B1	SOCKET W/BATT BACKUP CIRCUITRY 28 PIN	1	409
70525B1	INDUCTOR FERRITE BEAD	1	L1
70593B1	TERMINAL SOLDER TURRET	1	TP1
70679B1	TRANSISTOR FET MTP3055	1	Q4
70686B1	JACK STEREO PHONE 3.5MM	3	J1,J2,J3
70687B1	PWB FAB POWER SUPPLY 3040G	1	400
70689B1	TRANSFORMER 10VA 16VCT @ .62A 8V @ 1.25A	1	T1
70691B1	TRANSFORMER ISOLATION 8.46MH	1	T2
70692B1	INVERTER DC-AC 6VDC INPUT	1	PS1
70697B1	CONNECTOR ASM BACKLIGHT 3040G	1	415
70699B1	WIRE GROUND ASM 3040G	1	416
70717B1	VARNISH, INSULATING	A/R	420
70724B1	SWITCH DPDT 115/230 SELECT	1	SW1

70734A1 PWB ASM 3040G DISPLAY BOARD

PART NO.	DESCRIPTION	QTY.	DESIGNATION
70477B2	LAMP, ELECTROLUMINESCENT	1	401
70597B1	LCD, CUSTOM, OXIMETER	1	LCD1
70730B1	IC, DISP. DRIVER, SED1540	1	U1

70690A1 PLATE FRONT ASM 3040G OXIMETER

PART NO.	DESCRIPTION	QTY.	DESIGNATION
49041B2	NUT HEX 4-40 SMALL .18 ACROSS FLATS	4	4
54021B	SPACER .25 OD .14 ID x .125 FIBER	4	5
70734A1	PWB ASM DISPLAY OXIMETER 3040G	1	2
70596B1	LENS FRONT 3040G OXIMETER	1	3
70681B1	PLATE FRONT 3040G	1	1

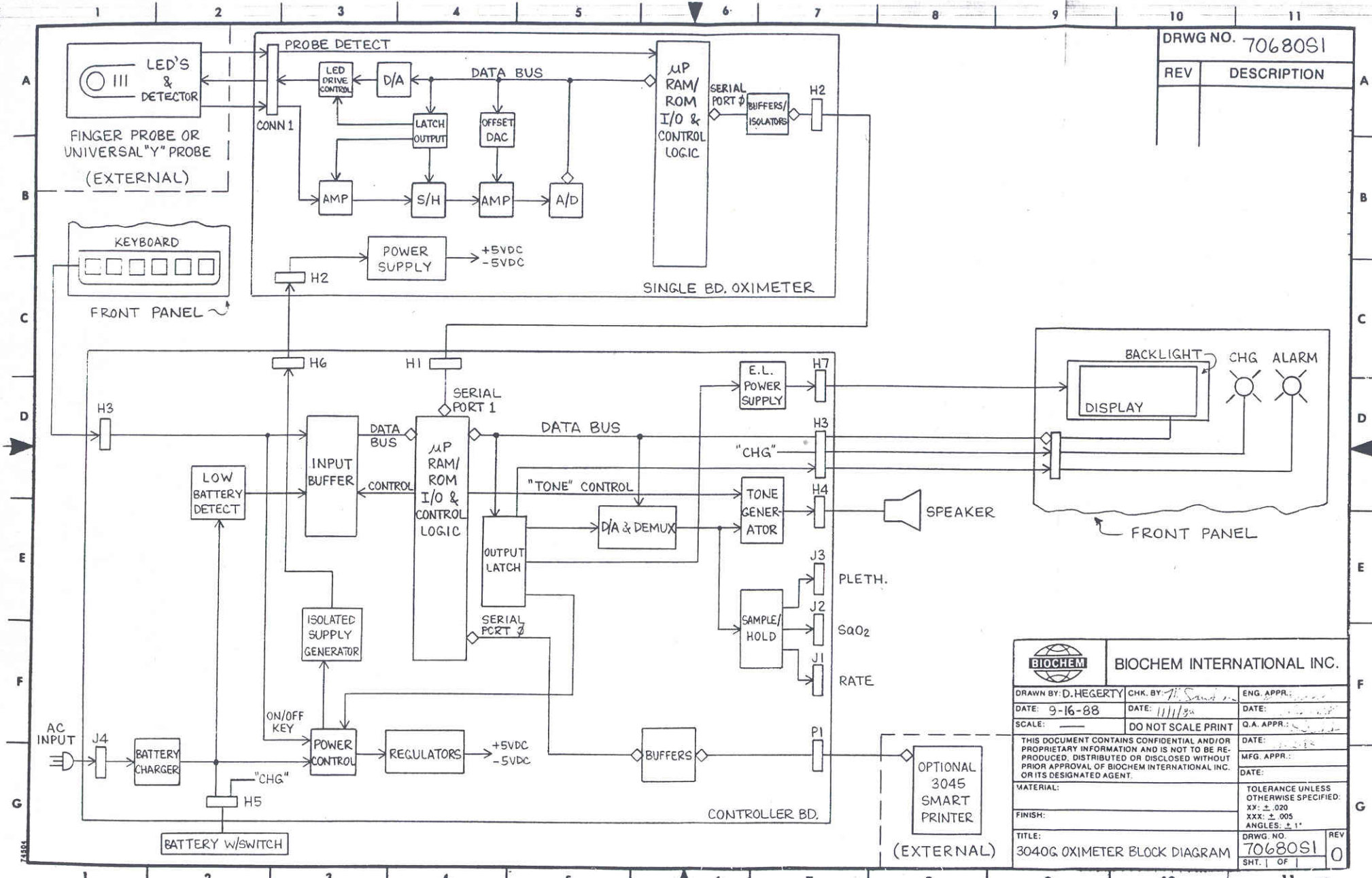
70694A1 CHASSIS ASM 3040G OXIMETER

PART. NO.	DESCRIPTION	QTY.	DESIGNATION
12005B6	SCREW PHMS 4-40 x 5/16 ST STL (PHILLIPS)	4	25
12005B8	SCREW PHMS 6-32 x 1/4 ST STL (PHILLIPS)	10	15
12010B7	WASHER LOCK INT TOOTH #2 ST STEEL	2	13
12021B5	SPACER .25 OD .14 ID x 7/32 NYLON	8	5
20097B1	FOOT, RUBBER	4	9
20332B1	BATTERY 6V PANASONIC	1	6
48186B	NUT HEX 2-56 ST STL	2	12
48188B	NUT HEX 6-32 ST STL	5	23
48220B	WASHER LOCK INT #6 ST STL	10	16
49031B	CLAMP NYLON 3/16" DIA MTG	1	17
49041B	NUT HEX 4-40 ST.STL LRG.	2	11
53047B	WASHER LOCK INT #4 ST STL	2	14
53055B	WASHER NYLON #6	6	27
56103B10	CABLE ASM IDC SKT/SKT 26 POS 4"	1	24
56366B1	LABEL FUSE RATING	1	22
57136B1	SWITCH ASM BATTERY 3040G	1	7
57137B1	SPACER F-F HEX #6 x 1.75 NYLON	6	26
57217B1	ADHESIVE, RTV, DC738	A/R	21
57833B1	NUT, KEPS, 4-40 STEEL	2	28
70495B1	SPEAKER ASM 3040G OXIMETER	1	10
70664A1	PWB ASM SINGLE BOARD OXIMETER	1	8
70682B1	PLATE BACK 3040G SCREENED	1	18

70684B1	BRACKET BATTERY 3040G	1	2
70685B1	CHASSIS 3040G PAINTED	1	1
70688A1	PWB ASM CONTROLLER 3040G	1	4
70690A1	PLATE FRONT ASM 3040G OXIMETER	1	3
70696B1	CABLE ASM IDC SKT 6-POS 3" LG.	1	19
70698B1	CONN ASM SINGLE BD OXIMETER TO CONTROLLER BD. 3040G	1	20

70680A1 MON F/ASM OXIMETER 3040G

PART NO.	DESCRIPTION	QTY.	DESIGNATION
12010B7	WASHER LOCK INT TOOTH #2 ST STEEL	2	10
20354B1	LABEL M.R.I. CAUTION	1	15
48186B	NUT HEX 2-56 ST STL	2	11
53043B1	CABLE ASM PWR CORD 6-1/2'	1	6
70103B1	LABEL EXPLOSION HAZARD WARNING MICROSPAN	1	13
70104B1	LABEL SALE RESTRICTION WARNING MICROSPAN BLACK	1	14
70105B1	LABEL CAUTION & SERVICE NOTES BLK TEXT	1	5
70118B4	LABEL SERIAL # MODEL # AND RATING	1	3
70357B1	SCREW #6-32 x 3/8" FH SOCKET BLK	4	4
70391A1	TAPE UNIVERSAL Y PROBE 20 SHTS	1	7
70394B8	LABEL OPERATING INSTRUC-TIONS 3040G OXIMETER	1	16
70504A5	SOFTWARE ASM 3040G OXIMETER	1	8
70678A2	SOFTWARE ASM SINGLE BD OXIMETER	1	12
70683B1	COVER 3040G PAINTED	1	2
70694A1	CHASSIS ASM 3040G OXIMETER	1	1
70695B1	PLATE RATING COVER 3040G	1	9



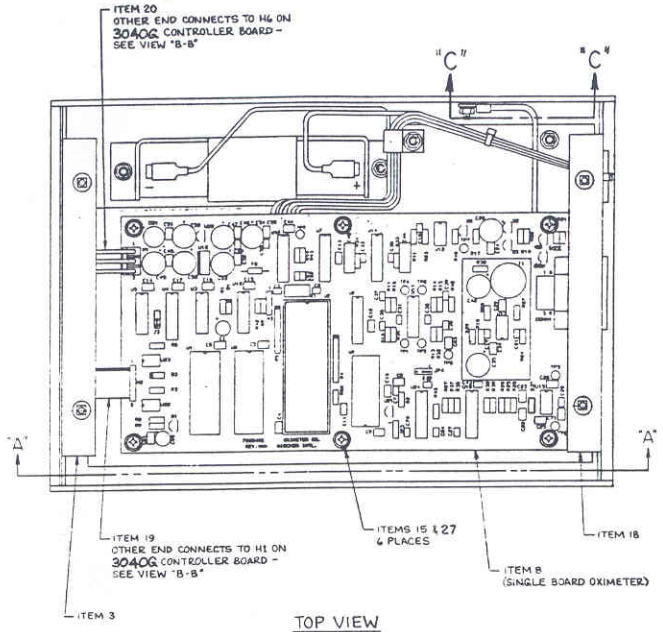
DRWG NO. 70680S1	
REV	DESCRIPTION

BIOCHEM INTERNATIONAL INC.

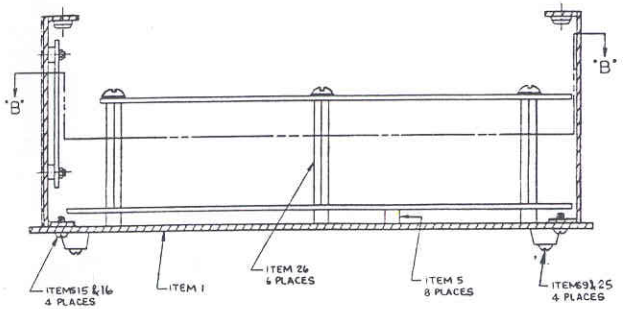
DRAWN BY: D. HEGERTY	CHK. BY:	ENG. APPR.:
DATE: 9-16-88	DATE:	DATE:
SCALE: ——	DO NOT SCALE PRINT	Q.A. APPR.:
		DATE:
		MFG. APPR.:
		DATE:

MATERIAL:	TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH:	
TITLE: 3040G OXIMETER BLOCK DIAGRAM	DRWG. NO. 70680S1 REV 0
	SHT. | OF |

DRWG NO. 70694A1	
REV	DESCRIPTION
1	RELOCATED IT. 22; REPOSITIONED SPEAKER; IT. 28 WAS ITEMS 11 & 14; ADDED IT. 21. C/N 993. 3-17-99

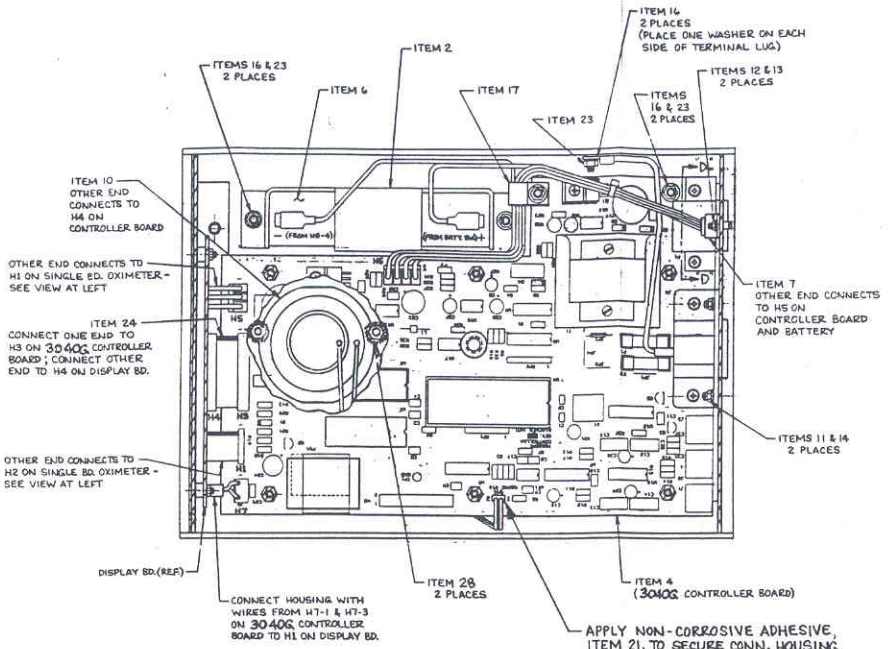


TOP VIEW

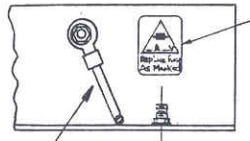


VIEW "A-A"

(NOTE: SIMPLIFIED VIEW - BOARDS SHOWN WITHOUT COMPONENTS)

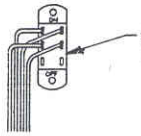


VIEW "B-B"



VIEW "C-C"

NOTE: ROUTE GROUND WIRE SO THAT IT DOES NOT OBSCURE LABEL.



VIEW "D-D"

BIOCHEM	BIOCHEM INTERNATIONAL INC.	
DRAWN BY: D. HEGERTY	CHK. BY:	ENG. APPR.:
DATE: 9-21-88	DATE:	DATE:
SCALE: 1:1	DO NOT SCALE PRINT	Q.A. APPR.:
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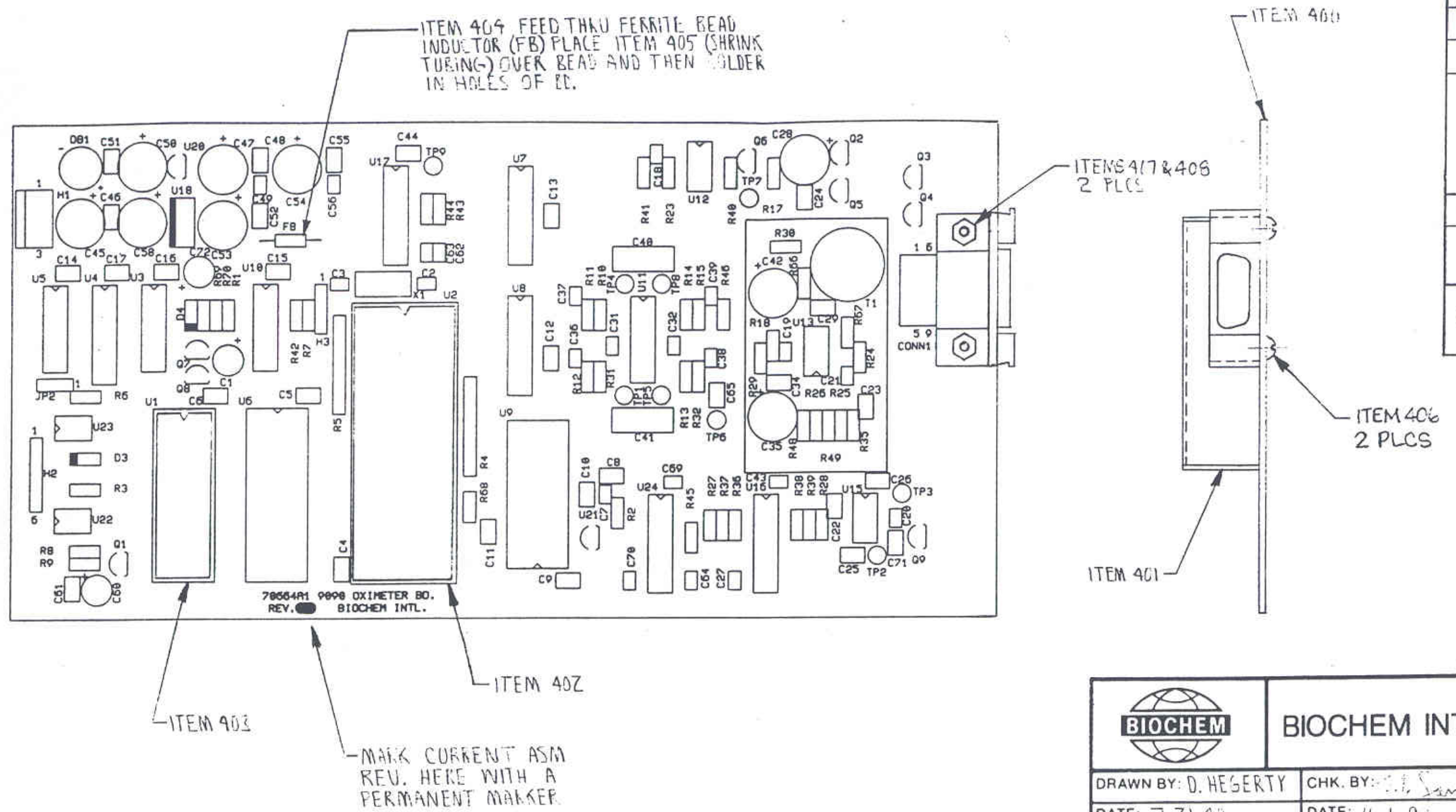
MATERIAL:		MFG. APPR.:
FINISH:		DATE:
TITLE: CHASSIS ASM 3040G OXIMETER		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
		DRWG. NO. 70694A1 REV. 1
		SHT. 1 OF 1



DRWG NO. 70664A1	
REV	DESCRIPTION
B	ADDED IT. 405-40? MS 12 AUG 88
C	ADDED NOTE ABOUT JP4 DH 8-25-88
D	ADDED R69, R70, Q7, Q8, D4 & C72 MS 27 SEP 88
E	DELETED NOTES CONCERNING CUTTING & JUMPERING OF JP3 & JP4; ADDED NOTE 1; ADDED DETAIL "A-A"; ADDED ITEMS 405 & 409. C/N 916 DH 10/28/88
1	ADDED R48 & R49 ADDED SHT 2 CN 92? MS ?NOV 88
2	REVISED TO REFLECT CIRCUITRY CHANGES. C/N 941. DH 11-18-88
NR	REVERSED POSITIONS OF ITEMS 406 AND 407 & 408 DUE TO CIRCUIT PATH LOCATION. DH 1-6-89

BIOCHEM INTERNATIONAL INC.

DRAWN BY: D. HEGERTY	CHK. BY: [signature]	ENG. APPR.: [signature]
DATE: 7-21-88	DATE: 11-1-88	DATE: 11-1-88
SCALE: 1:1	DO NOT SCALE PRINT	Q.A. APPR.: [signature]
		DATE: [illegible]
		MFG. APPR.: [signature]
		DATE: 11-2-88

MATERIAL:

FINISH:

TOLERANCE UNLESS OTHERWISE SPECIFIED:
XX: ± .020
XXX: ± .005
ANGLES: ± 1°

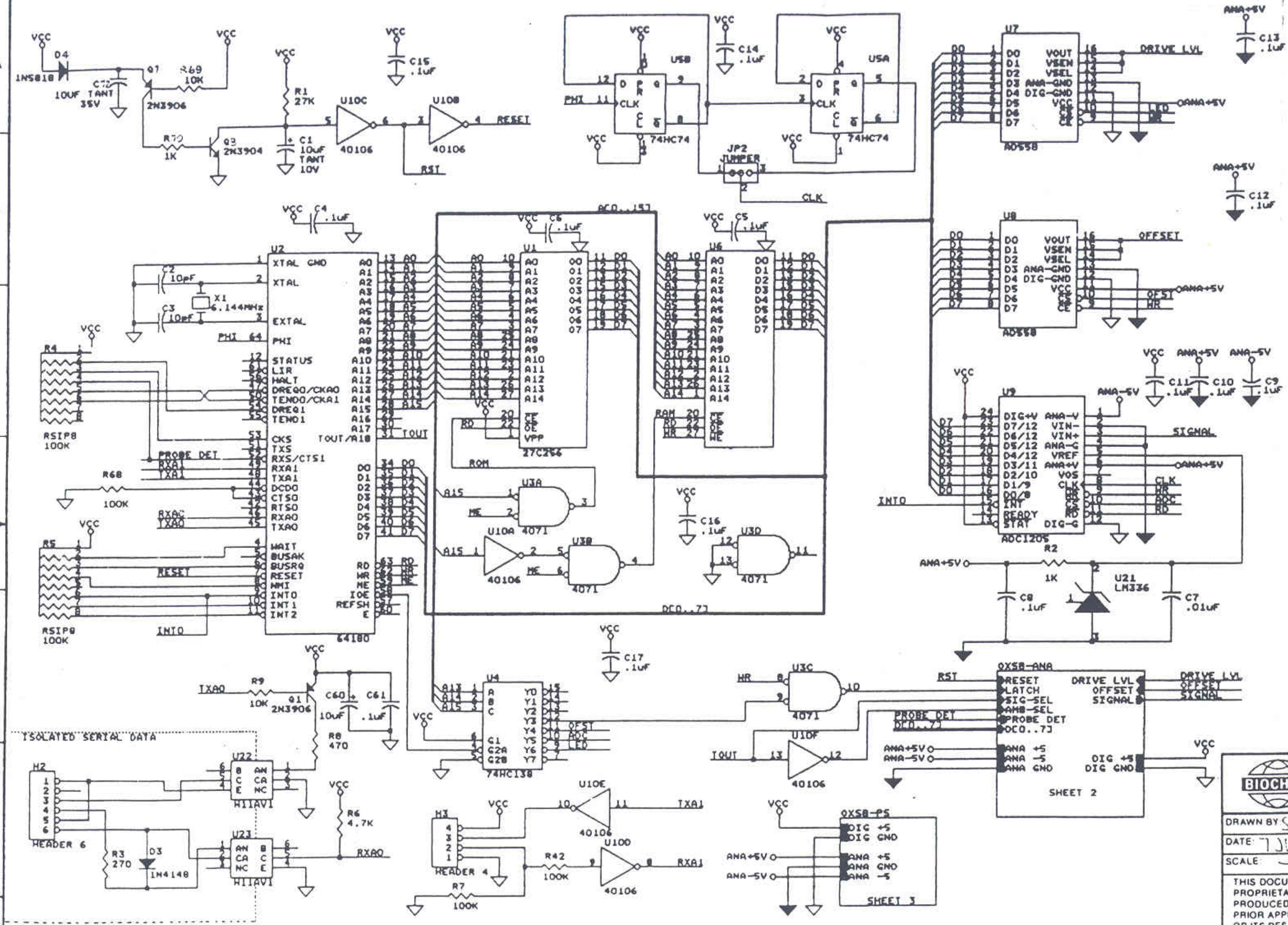
TITLE: PWB ASM SINGLE BD. OXIMETER

DRWG. NO. 70664A1 | REV 2 | SHT. 1 OF 1

74504

DRWG NO. 706645I

REV	DESCRIPTION
B	REVISED CIRCUITRY MS 11AUG88
C	SEE SHT. 2 DH 8-25-88
D	ADDED RESET GUARANTEE CIRCUITRY MS 20SEP88
E	D4 WAS D1; C72 WAS C1; Q7 WAS Q1; R69 WAS R1; R70 WAS R2; Q8 WAS Q2. (DWG. CORRECTION) DH 9-27-88
F	SEE SHT. 2 DH 10-28-88
1	SEE SHT. 2 MS CN9734776 7NOV89
2	SEE SHT 2 CN941 MS 17N...



BIOCHEM INTERNATIONAL INC.

DRAWN BY: SANDERSON	CHK. BY:	ENG. APPR.	
DATE: 7 JUN 88	DATE: 11-3-88	DATE:	
SCALE: —	DO NOT SCALE PRINT	Q.A. APPR.	
		DATE: 11-2-88	
		MFG. APPR.	
		DATE:	

MATERIAL

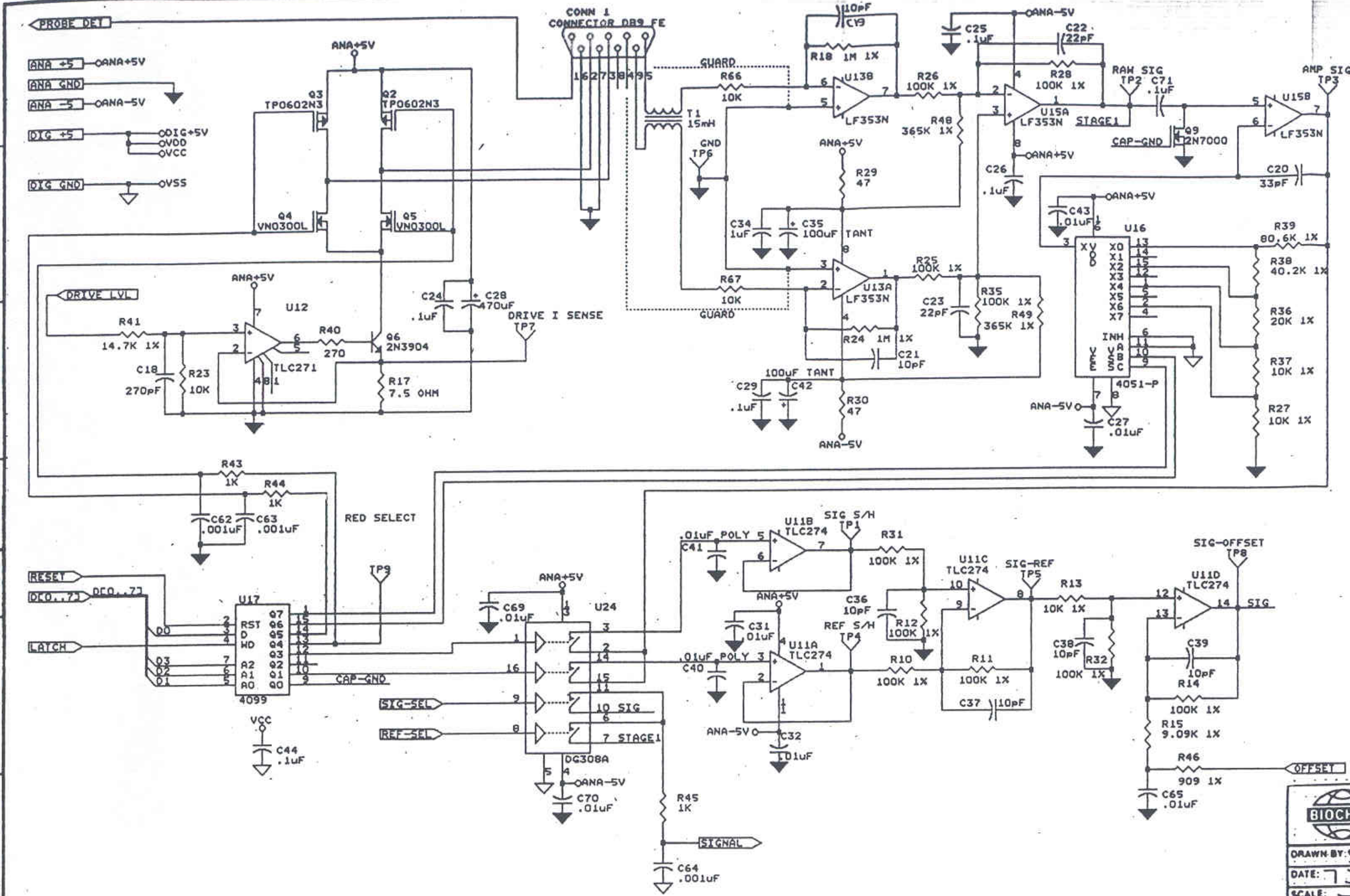
FINISH

TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°

TITLE: SCHEMATIC SINGLE BOARD OXIMETER

DRWG. NO. 706645I REV 2

SHT. 1 OF 3



DRWG NO. 7066451

REV	DESCRIPTION
B	REVISED CIRCUITRY MS 11AUG88
C	C65 WAS 1 MF DH 8-25-88
D	SEE SHT 1 MS 20SEP88
E	SEE SHT 1 DH 9-27-88
F	Q4 & Q5 WERE 2N7000; Q2 & Q3 WERE 2N3906; DELETED R19, R20, R21, R22, R33 & R34. R17 WAS 1% 1/8W 2.74Ω; R41 WAS 54.9K; C71 INSTALLED (NO JUMPER). C/N #916 DH 10/28/88
1	R40 WAS 1K CN923 ADDED R48, R49 Q3 & Q2 WERE VP0300L CN926 MS 7NOV91
2	DELETED U14 C30 C33 ADDED Q9 CN941 MS 17NOV88

BIOCHEM INTERNATIONAL INC.

DRAWN BY: SANDERSON	CHK. BY: D. Hegarty	ENG. APPR. [illegible]
DATE: 7 JUN 88	DATE: 11-3-88	DATE: 11-4-88
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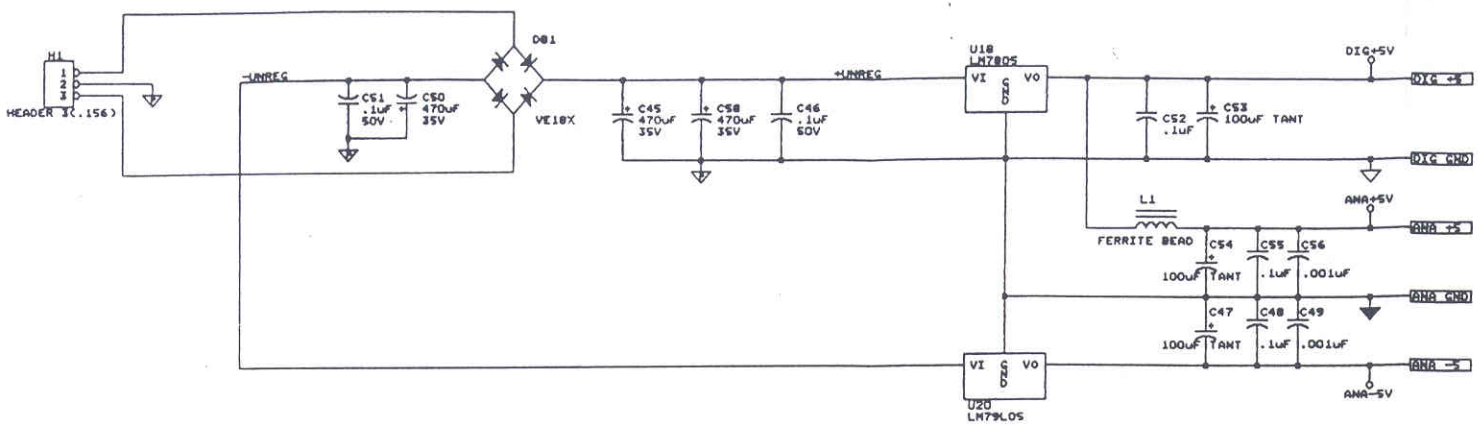
		DATE: 11-2-88

MFG. APPR.
DATE:
MATERIAL:
FINISH:

TOLERANCE UNLESS OTHERWISE SPECIFIED
XX: ± .020
XXX: ± .005
ANGLES: ± 1°

TITLE: SCHEMATIC SINGLE BOARD OXIMETER

DRWG NO. 7066451 REV 2
SHT 2 OF 13



DRWG NO. 706645I

REV	DESCRIPTION
B	REVISED CIRCUITRY MS 11AUG88
C	SEE SHT. 2 DH 8-25-88
D	SEE SHT 1 MS 20SEP88
E	SEE SHT. 1 DH 9-27-88
F	SEE SHT. 2 DH 10-28-88
1	SEE SHT 2 EN975-926 MS 7NOV88
2	SEE SHT 2 EN941 MS 17NOV88

BIOCHEM INTERNATIONAL INC.

DRAWN BY: SANDERSON	CHK. BY: D. Hegarty	ENG. APPR.
DATE 7 JUN 88	DATE 11-3-88	DATE
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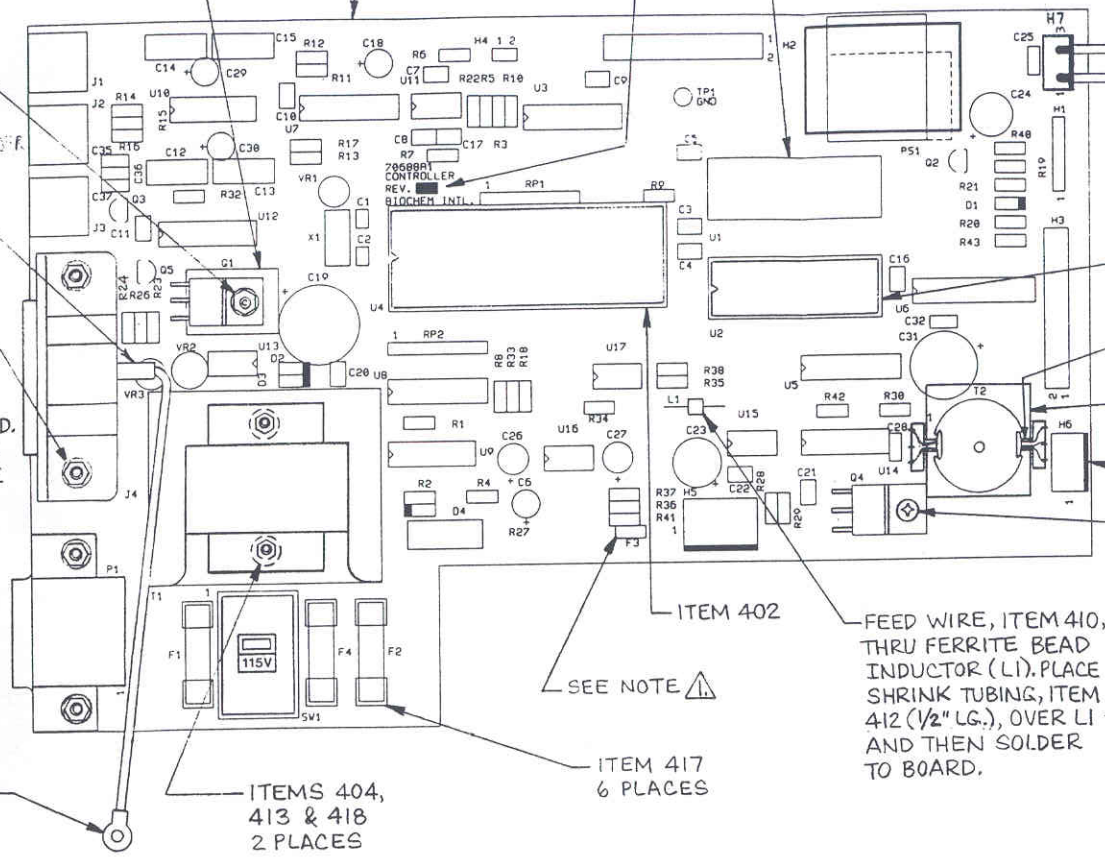
		MFG. APPR.
		DATE
MATERIAL		TOLERANCE UNLESS OTHERWISE SPECIFIED XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH		
TITLE: SCHEMATIC SINGLE BOARD OXIMETER	DRWG NO. 706645I	REV 2
	SHT 3 OF 3	



DRWG NO. 70688A1	
REV	DESCRIPTION
B	ADDED ITEMS 415 & 416; DELETED ITEMS 407 & 408. DH 9-19-88
C	ADDED ITEM 417. DH 9-27-88
D	ADDED ITEMS 419 & 420. DH 10-19-88
1	REVISED TO REFLECT NEW PWB ARTWORK. C/N 942. DH 11-30-88
2	ADDED DETAIL OF SW1; RELOCATED ITEMS 403, 404, 405 FOR P1 & J4. C/N 988. DH 2-28-89
NR	REVERSED HARDWARE ON G1 MC 21MAR89

NOTES:

(1) F3 TO BE INSTALLED AFTER WAVE SOLDERING.

(2) LOCATE ITEM 415 IN H7 HOLES 1 & 3 (PIN 2 "OPEN") AS SHOWN. (H7 NOT INSTALLED.)

BIOCHEM INTERNATIONAL INC.

DRAWN BY: D. HEGERTY	CHK. BY: [illegible]	ENG. APPR. [illegible]
DATE: 9-12-88	DATE: 11-1-88	DATE 11-1-88
SCALE: 1:1	DO NOT SCALE PRINT	Q.A. APPR: [illegible]
		DATE: [illegible]
		MFG. APPR. [illegible]
		DATE: 11-2-88

MATERIAL:

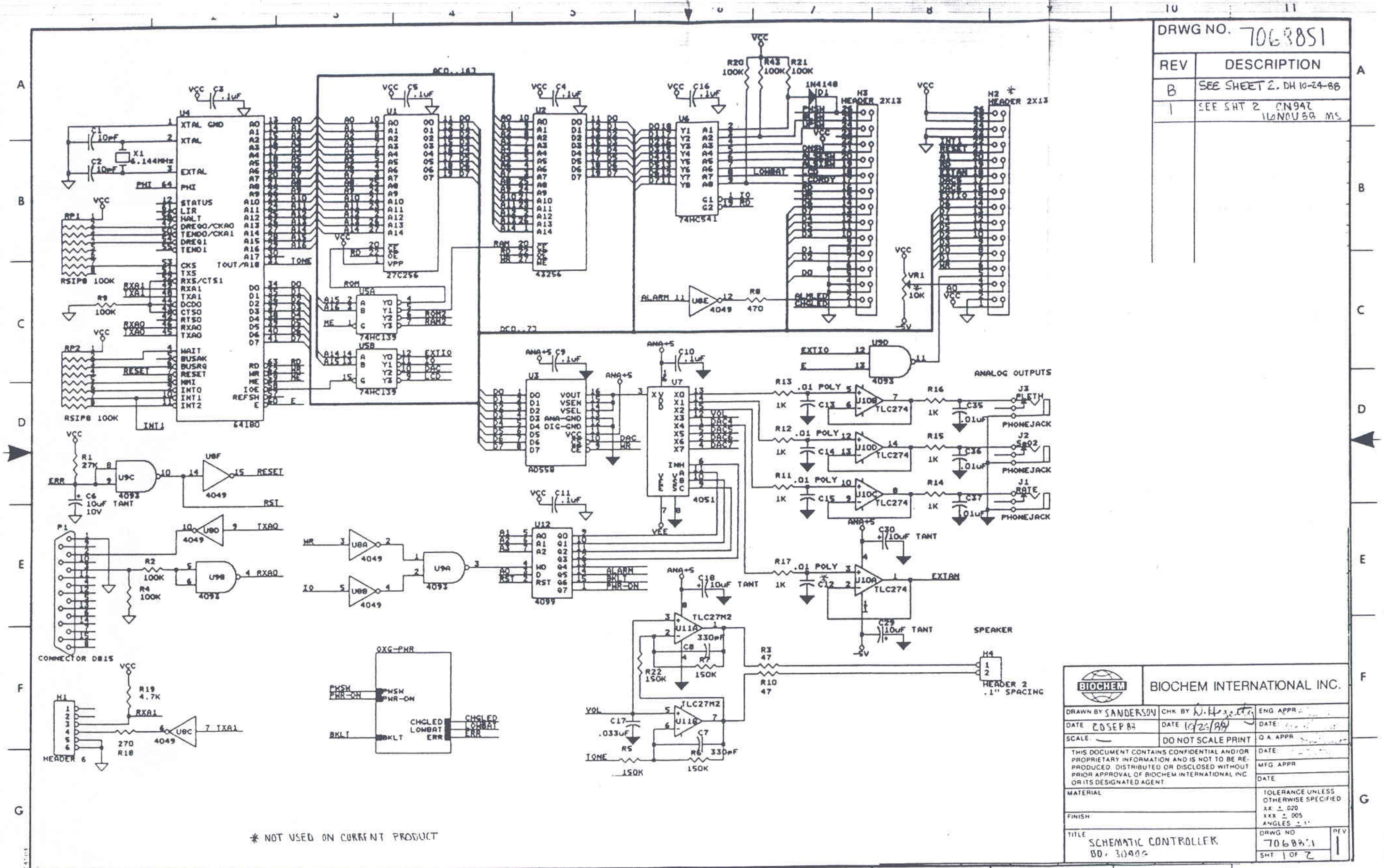
FINISH:

TOLERANCE UNLESS OTHERWISE SPECIFIED
XX: ± .020
XXX: ± .005
ANGLES: ± 1°

TITLE: PWB ASM CONTROLLER 3040G OXIMETER

DRWG. NO. 70688A1 REV 2

SHT. | OF |


DRWG NO. 7068851
REV
DESCRIPTION
B
SEE SHEET 2. DH 10-24-88
1
SEE SHT 2 CN947 16NOV88 MS
ANALOG OUTPUTS
SPEAKER
BIOCHEM
BIOCHEM INTERNATIONAL INC.
DRAWN BY SANDERSON
DATE 20 SEP 87
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MATERIAL
FINISH
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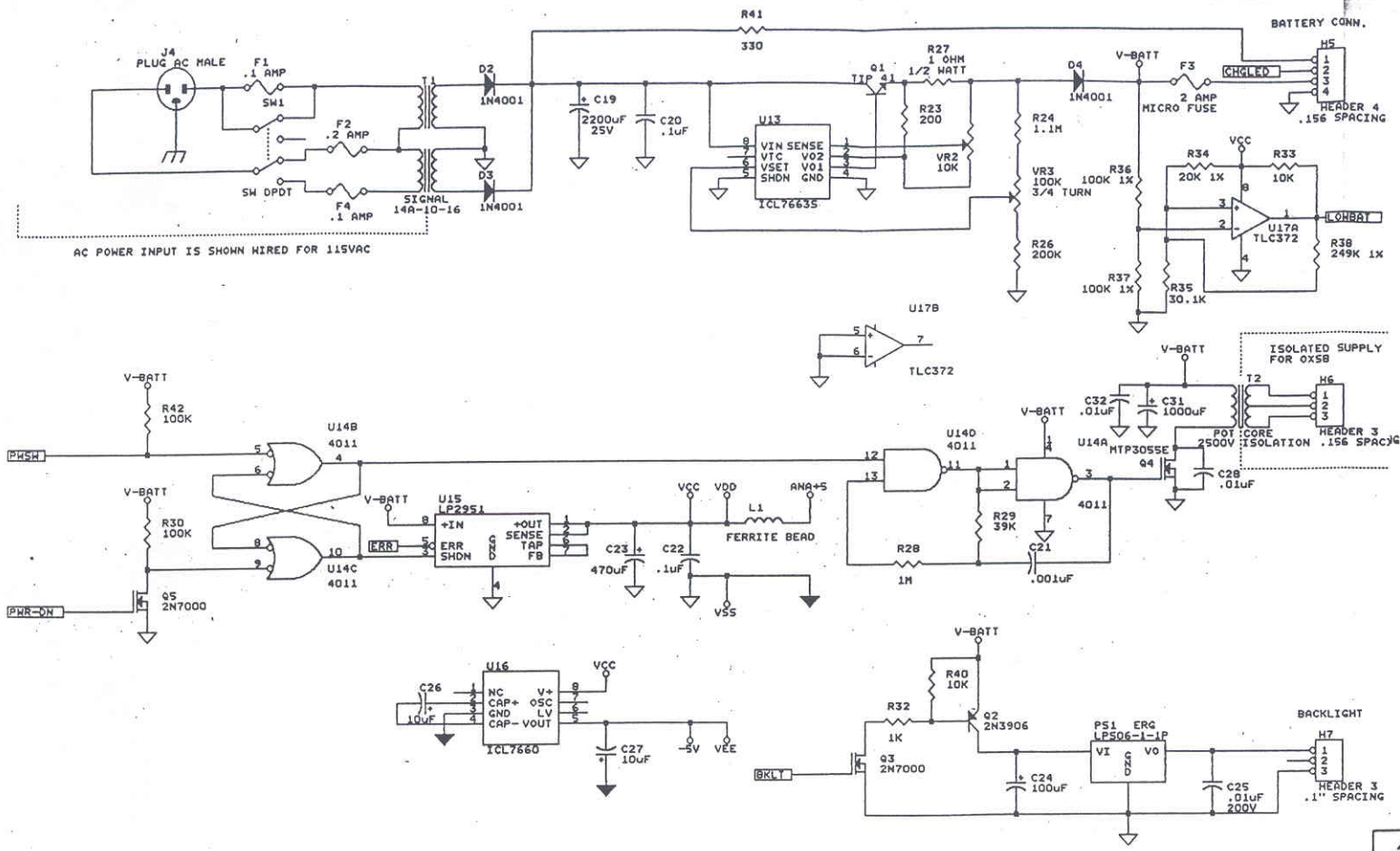
TITLE
SCHEMATIC CONTROLLER
SHT 1 OF 2
* NOT USED ON CURRENT PRODUCT



DRWG NO. 7068851	
REV	DESCRIPTION
B	REVISED FUSE CIRCUITRY. DH 10-24-88
1	ADDED SW1's F4 CN 992 16NOV88 MS

BIOCHEM INTERNATIONAL INC.

DRAWN BY SANDERSON	CHK BY D. Hegarty	ENG. APPR.	
DATE 20SEP88	DATE 10/26/88	DATE: 11-4-88	
SCALE: —	DO NOT SCALE PRINT	Q.A. APPR:	
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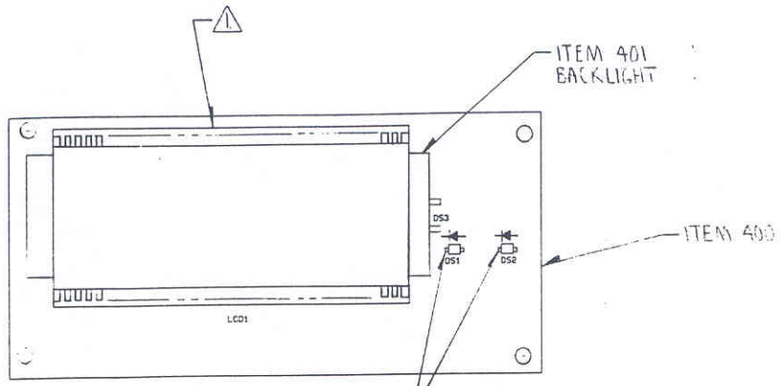
		MFG. APPR.	
		DATE:	
MATERIAL		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°	
FINISH			
TITLE SCHEMATIC CONTROLLER BD 30406		DRWG NO 7068851	REV 1
		SHT 2 OF 2	

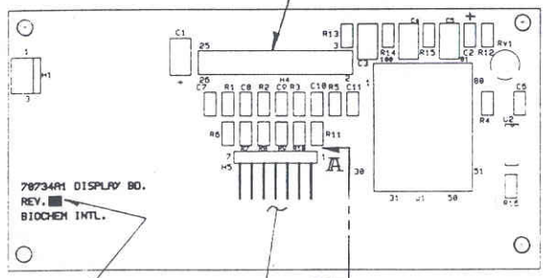
DRWG NO. 70734A1	
REV	DESCRIPTION



NOTES:
1. ⚠ BEFORE INSERTING LCD1 ATTACH ITEM 401 TO THE BACK OF IT.

CATHODE DENOTED BY BLK MARKED LEAD

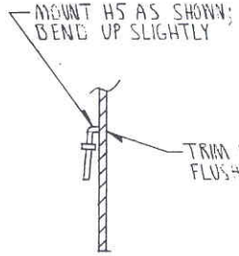
LCD SIDE OF LD



MARK CURRENT ASM REV. HERE WITH A PERMANENT MARKER.

TRIM ANY LEADS DIRECTLY BELOW H5 FLUSH W/BOARD

COMP. SIDE OF BD.

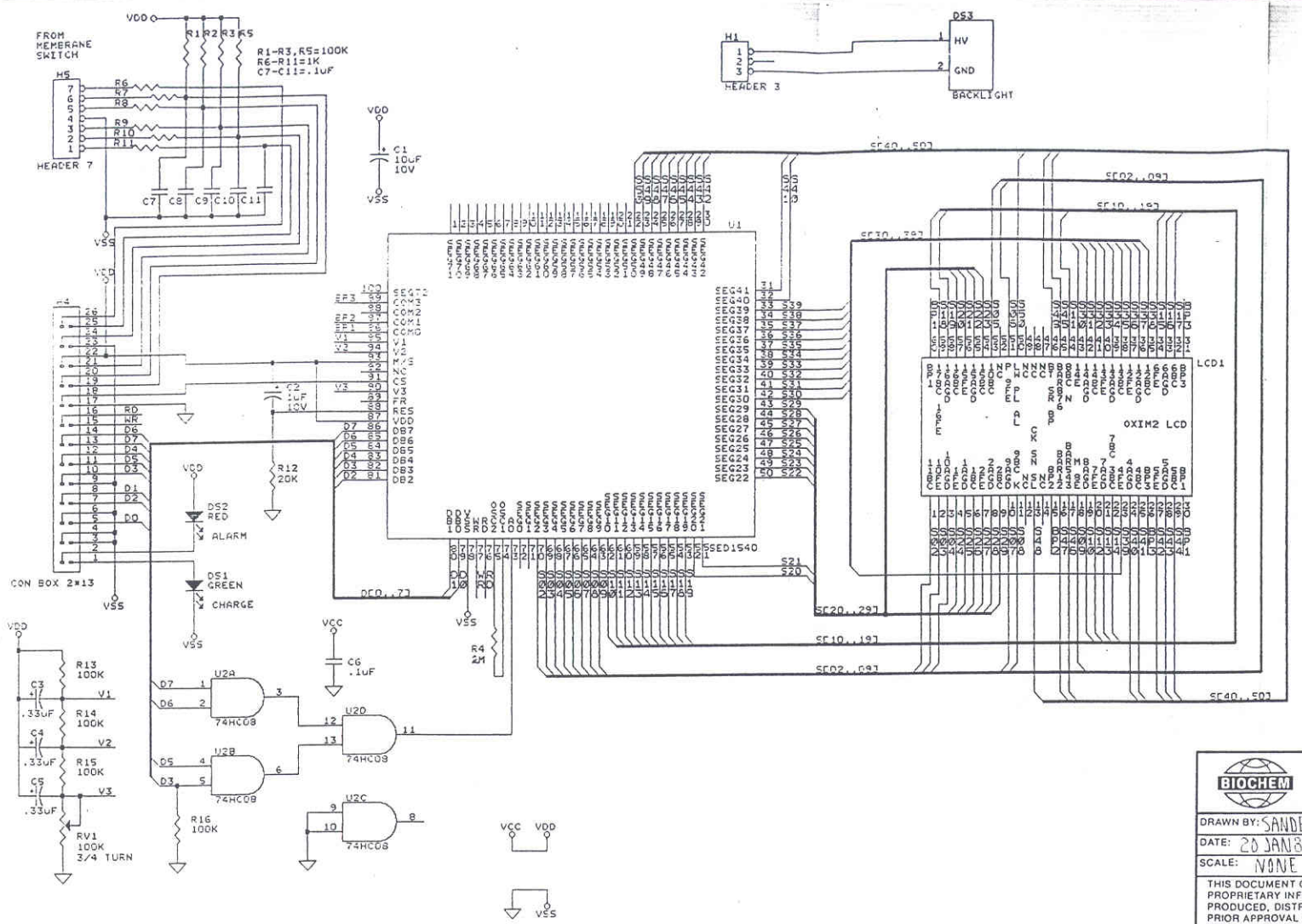


SECT A-A

BIOCHEM	BIOCHEM INTERNATIONAL INC.	
DRAWN BY: SANDERSON	CHK. BY: D. Hegarty	ENG. APPR.: [illegible]
DATE: 20 JAN 89	DATE: 3-31-89	DATE: 3-31-89
SCALE: 1:1	DO NOT SCALE PRINT	Q.A. APPR.: [illegible]
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BIOCHEM INTERNATIONAL INC. OR ITS DESIGNATED AGENT.		DATE: 3-31-89
		MFG. APPR.: [illegible]
		DATE: 3-31-89
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: PWB ASM DISPLAY 3040G OXIMETER (W/SED1540)	DRWG. NO. 70734A1	REV 0
	SHT. 1 OF 1	

516374

82



DRWG NO. 7073451	
REV	DESCRIPTION
B	R4 WAS 1M MS 21MAR89

BIOCHEM INTERNATIONAL INC.

DRAWN BY: SANDERSON	CHK. BY: D. Hegarty	ENG. APPR.: R.M.
DATE: 20 JAN 89	DATE: 3-31-89	DATE: 3/31/89
SCALE: NONE	DO NOT SCALE PRINT	Q.A. APPR.: [illegible]
		DATE: 3-31-89
		MFG. APPR.: F. Kamarec
		DATE: 3-31-89

MATERIAL:

FINISH:

TOLERANCE UNLESS OTHERWISE SPECIFIED:
XX: ± .020
XXX: ± .005
ANGLES: ± 1°

TITLE: SCHEMATIC DISPLAY BD 30906 OXIMETER

DRWG. NO. 7073451 REV 0

SHT. 1 OF 1

516374