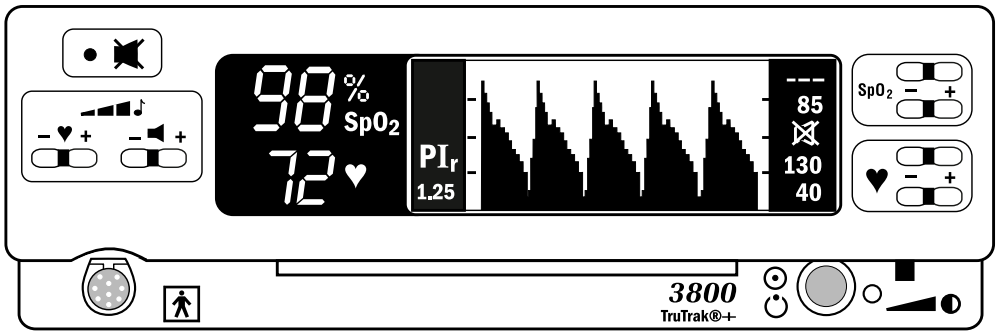
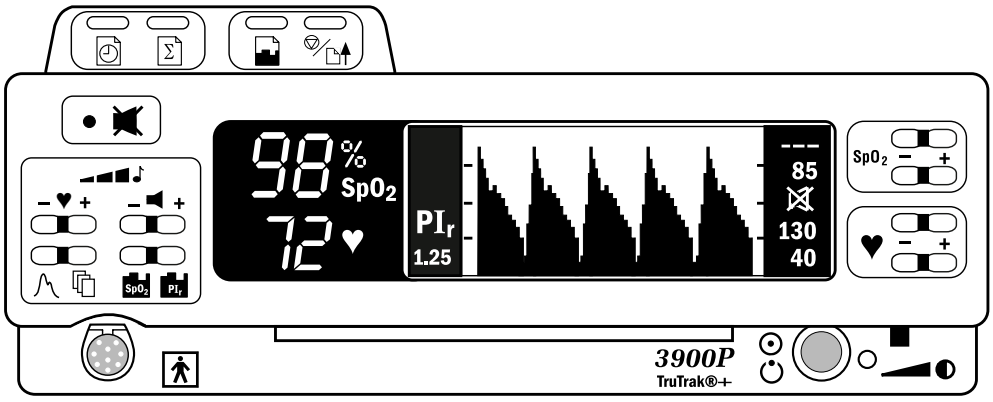
GE Healthcare

3800/3900/3900P Pulse Oximeter

With/Without TruTrak®+

Technical Reference Manual





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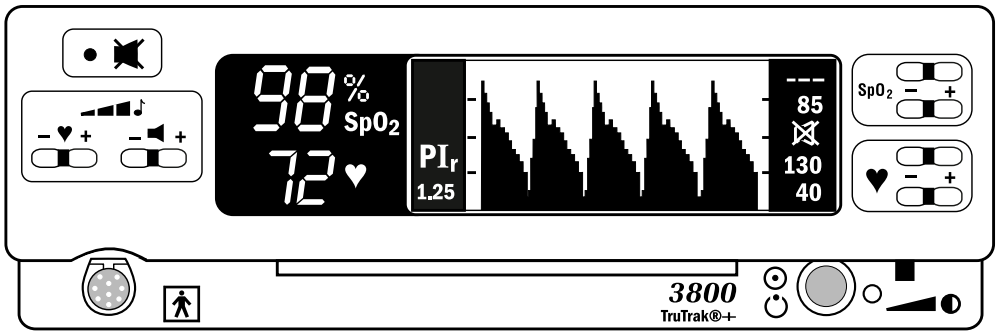

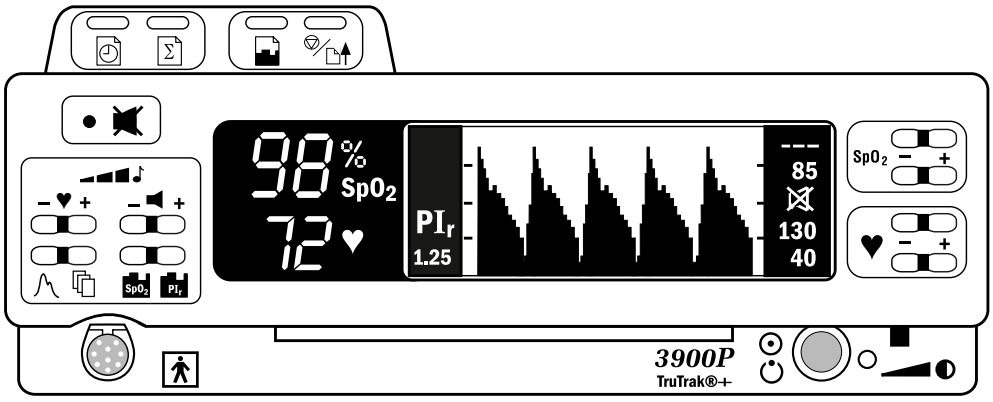

6050-0006-404
March 2005

Important

Rx Only (USA)

Attention! Consult the accompanying instructions, including all safety precautions, before using or servicing this device.

Responsibility of the manufacturer

The safety, reliability, and performance of this device can be assured only under the following conditions:

- Fittings, extensions, readjustments, changes, or repairs are carried out by authorized personnel.
- The electrical installation complies with relevant standards and regulations.
- The device is used according to the accompanying operating instructions and is serviced and maintained in accordance with this manual.

Service and repair

Service and repair procedures must be performed by authorized service personnel. Repair this device or its parts only in accordance with instructions provided by the manufacturer. To order replacement parts or for assistance, contact an authorized service office. When shipping the monitor for repair, clean the monitor, allow it to dry completely, and pack it for shipment in the original shipping container, if possible.

Trademarks

Datex®, Ohmeda®, OxyTip®, TruTrak®, PerfTrak®, TeleOximetry®, and PI_r™ are the property of GE Healthcare Finland Oy. All other product and company names are the property of their respective owners.

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Contents

1/Overview

Contents

2/Theory of Operations

Contents

6/Illustrated Parts

1/Overview

This manual provides instructions for servicing all Model 3800, Model 3900, and Model 3900P pulse oximeters. This includes models with TruTrak®+ technology, the patented technology for enhanced performance during conditions of clinical patient motion.

Important: Only OxyTip®+ sensors can be used with TruTrak+ monitors.

The 3900P is identical to the 3900, except that it contains an integral printer. All references to printer functions and components are for the 3900P only.

This chapter contains:

- A general description of the oximeter and its main components.
- Oximeter specifications.
- Precautions, including specific warnings and cautions you must follow when servicing the oximeter.
- Safety procedures you must follow when handling or repairing equipment that may be contaminated.

Related information

For a detailed description of your monitor's components, functions, general operating guidelines, and RS-232 interface, see the *3900/3900P Pulse Oximeter User's Manual* or the *3800 Pulse Oximeter User's Manual*.

If you need to reference printed circuit board schematics and component lists, purchase and refer to the information contained in the *3800/3900/3900P PCA Drawings Service Kit*. See chapter 6 for a description and order number.

For information related to sensors (sensor application and cleaning, for example), refer to the instructions for the sensor.

Technical competence

CAUTION: Only qualified service personnel should perform the procedures described in this manual.

Only trained service personnel or competent individuals who are experienced with servicing medical devices of this nature should perform the procedures described in this service manual.

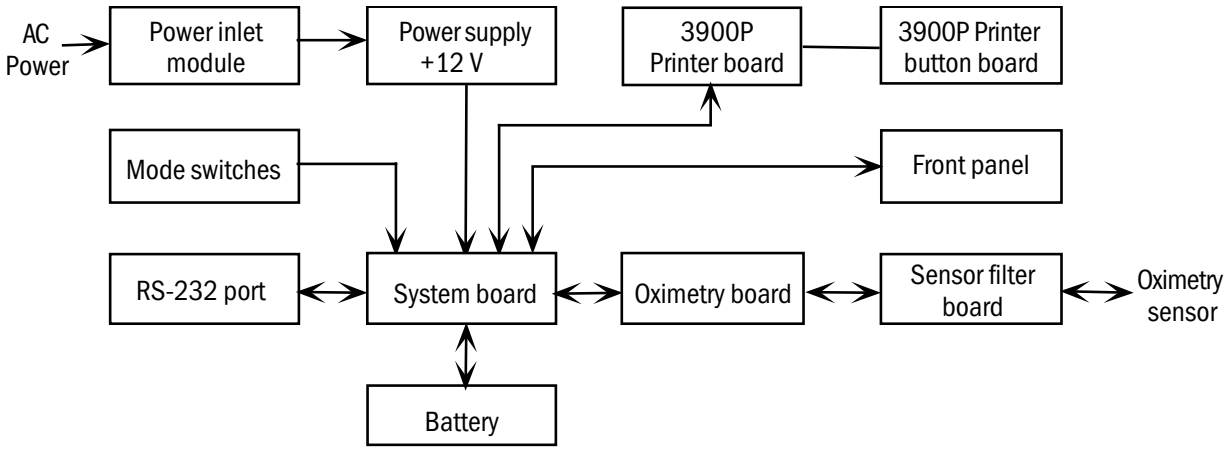
1.1 General description

The 3800, 3900, and 3900P pulse oximeters are noninvasive, arterial oxygen saturation and pulse rate monitors. Through the use of a sensor applied to the patient and connected to the monitor, these pulse oximeters measure the absorption of selected wavelengths of light to calculate pulse rate and arterial oxygen saturation. The light generated in the sensor passes through the tissue and is converted into an electronic signal by a photodetector in the sensor. The electronic signal passes to the oximeter and is amplified. Analog and digital signal processing convert the light intensity information into SpO_2 and pulse rate values.

Both models feature two easy-to-read displays that present patient data and status information.

- The numeric LEDs (light-emitting diodes) show the SpO_2 and pulse rate values.
- The LCD (liquid crystal display) shows alarm messages, the plethysmographic waveform (or data), and the high and low SpO_2 and pulse rate limit settings. This display also shows the Relative Perfusion Index (PI_r®) pulsatile value and menus as appropriate for the monitor.

1.1.1 Major components, block interconnect diagram



1.1.2 General subassembly description

The descriptions that follow discuss the interaction of major components within the pulse oximeter. More detailed information for each component is found in chapter 2.

Power inlet module

The primary function of the power inlet module is to allow the oximeter to be connected to an AC power source. It also serves as a filter for electromagnetic compatibility (EMC) compliance and contains fuses to limit the current flow. This module is connected to the power supply.

Power supply

The power supply converts power from any AC source between 90 and 264 VAC at 47 to 63 Hz to +12 VDC. It also provides the necessary isolation between the patient and the mains. The +12 VDC is connected to the system board for further conditioning.

Battery

Power for the unit, when it is not connected to the AC mains power, is supplied by the battery. The nominal battery voltage is 8 V. The battery is connected to the system board, which conditions the battery and charges the battery when the unit is connected to the AC mains power.

System board

This board conditions power from the +12 V power supply and the battery. It charges the battery when supplied with a DC voltage from the power supply. On power up it reads the position of the mode switches on the back panel. It communicates through the RS-232 port. The board sends data to the front panel for display and monitors the button switches. An upgrade socket on the board provides a means of upgrading the software. The board monitors and sends commands to the oximetry board via a serial interface and a few discrete digital lines.

The board communicates printer functions to the 3900P printer board. It also contains a real-time clock for use in 3900/3900P monitors.

Oximetry board

This board drives the LEDs in the oximetry sensor and receives the photodetector signals. The signals pass through the sensor filter board. The photodetector signal is conditioned and processed on the oximetry board and the output is used to determine patient oxygen saturation, perfusion, and pulse rate. The output is sent to the system board.

Sensor filter board

This board filters out unwanted electrical signals (EMC, surges, noise, etc.). These are internal signals that should not leave the unit and external signals that should not enter the unit.

Front panel

This panel displays information sent to it by the system board: saturation, pulse rate, plethysmographic waveform, alarm messages, and alarm indicators. The panel also contains the primary user-interface switches. It displays the AC power status and contains the power/standby switch.

3900P printer

The printer board and printer button board interface to the system board. The system board controls the 3900P printer to provide printed output of current monitoring data, stored trend, and summary data.

1.2 Compliance with standards

Compliance with standards The presence on the monitor of any symbol described below indicates compliance with the standard represented by that symbol.

Medical Device Directive 93/42/EEC of the European Union for a class I (with a measuring function), IIa, IIb, or III device.

Medical electrical equipment classified in the US and Canada with respect to electric shock, fire, and mechanical hazards only, in accordance with the Canadian Standards Association CAN/CSA C22.2 No. 601.1 and Underwriters Laboratories Inc. UL 2601-1.

Medical electrical equipment classified with respect to electric shock, fire, and mechanical hazards only, in accordance with the Canadian Standards Association CAN/CSA C22.2 No. 601.1.

Medical electrical equipment classified with respect to electric shock, fire, and mechanical hazards only, in accordance with Underwriters Laboratories Inc. UL 2601-1.

1.2.1 General safety requirements

The 3800, 3900, and 3900P pulse oximeters comply with the requirements of EN 60601-1 Part 1: General requirements for safety of medical electrical equipment.

Type BF applied part.

Type of protection against electric shock: Class I/Internal electrical power source

Degree of protection against ingress of liquids: Ordinary (IPX0)

Mode of operation: Continuous

The oximeter also complies with the following:

EN 865 Pulse oximeters – Particular requirements

EN 475 Medical devices – Electrically-generated alarm signals.

Safety checks for software

Software design controls include performance of a risk analysis using methods consistent with EN 1441 Medical devices – Risk analysis.

To ensure proper operation of the software, the monitor employs three separate watchdog circuits for the microprocessors, power-on self-tests (including memory checksum and calibration verification), and memory tests during monitoring. The software continuously monitors the patient sensor and, if a failure is detected, discontinues power to the sensor.

1.2.2 Electromagnetic compatibility (EMC)

The 3800, 3900, and 3900P pulse oximeters comply with the requirements of EN 60601-1-2: Electromagnetic compatibility - Requirements and tests.

Emissions EN 55011 Group I, Class B

The 3800, 3900, and 3900P oximeters were tested with no peripheral devices when operating on battery power.

The 3800 pulse oximeter was tested with an RS-232 cable attached when operating on AC power.

The 3900 and 3900P pulse oximeters were tested with an RS-232 cable and analog output cables attached when operating on AC power. A USRobotics Sportster Fax Modem was connected to the 3900 when Electrical Safety and EMC testing was performed. The analog output was measured using a fiber optic link during testing.

When installing and using this monitor, take precautions to ensure electromagnetic compatibility.

Table 1-1. Guidance and manufacturer's declaration - electromagnetic emissions

The 3800/3900/3900P TruTrak+ is suitable for use in the electromagnetic environment specified below. The customer or the user of the 3800/3900/3900P TruTrak+ should assure that it is used in such an environment.

Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	The 3800/3900/3900P TruTrak+ uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The 3800/3900/3900P TruTrak+ is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/flicker emissions IEC 61000-3-3	Complies	

Table 1-2 Guidance and manufacturer's declaration - electromagnetic immunity			
The 3800/3900/3900P TruTrak+ is intended for use in the electromagnetic environment specified below. The customer or the user of the 3800/3900/3900P TruTrak+ should assure that it is used in such an environment:			
Immunity test	**IEC 60601-1-2 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/output lines	± 2 kV for power supply lines ± 1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	< 5 % U_T (> 95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles < 5 % U_T (> 95 % dip in U_T) for 5 sec	< 5 % U_T (> 95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles < 5 % U_T (> 95 % dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of the 3800/3900/3900P TruTrak+ requires continued operation during power mains interruptions, it is recommended that the 3800/3900/3900P TruTrak+ be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE: U_T is the a.c. mains voltage prior to application of the test level.			

Table 1-3 Guidance and manufacturer's declaration - electromagnetic Immunity

The 3800/3900/3900P TruTrak+ is intended for use in the electromagnetic environment specified below. The customer or the user of the 3800/3900/3900P TruTrak+ should assure that it is used in such an environment:

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Conducted RF IEC 61000-4-6 Radiated RF IEC 61000-4-3	3 Vrms 150 kHz to 80 MHz 3 V/m 80 MHz to 2,5 GHz	5 V 5 V/m	Portable and mobile RF communications equipment should be used no closer to any part of the 3800/3900/3900P TruTrak+, including cables, than the recommended separation distance calculated from the equation applicable for the frequency of the transmitter. **Recommended Separation Distance** $d = 0.70\sqrt{P}$ $d = 0.70\sqrt{P}$ 80 MHz to 800 MHz $d = 1.40\sqrt{P}$ 800 MHz to 2,5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, [a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 

NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the 3800/3900/3900P TruTrak+ is used exceeds the applicable RF compliance level above, the 3800/3900/3900P TruTrak+ should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the 3800/3900/3900P TruTrak+.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 5 V/m.

Electromagnetic effects

Electromagnetic interference, including interference from portable and mobile radio frequency (RF) communications equipment, can affect this monitor.

Table 1-4 Recommended Separation Distances between Portable and Mobile RF Communications Equipment and the 3800/3900/3900P TruTrak+

The 3800/3900/3900P TruTrak+ is intended for use in an electromagnetic environment in which RF disturbances are controlled. The customer or the user of the 3800/3900/3900P TruTrak+ can prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the 3800/3900/3900P TruTrak+ as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	Separation distance according to the frequency of the transmitter m		
	150 kHz to 80 MHz $d = 0.70\sqrt{P}$	80 MHz to 800 MHz $d = 0.70\sqrt{P}$	800 MHz to 2,5 GHz $d = 1.40\sqrt{P}$
0.01	0.07	0.07	0.14
0.1	0.22	0.22	0.44
1	0.70	0.70	1.40
10	2.2	2.2	4.4
100	7.0	7.0	14.0

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Indications that the monitor is experiencing electromagnetic interference include the following:

- Variations in the PerfTrak waveform display.
- Sudden increases or decreases in the waveform height that do not correlate to the physiological condition of the patient.
- Sensor-related messages that are not resolved by the instructions found in this manual.
- The display of dashes on numeric LEDs when a valid physiological signal is present.
- (**3900P**) Printed output that is garbled, solid black, or missing.

This interference may be intermittent and careful correlation between the effect and its possible source is important. Indications of interference should not occur if the monitor is used within its intended electromagnetic environment.

1.3 Specifications

Unless otherwise indicated, all specifications are nominal and are subject to change without notice.

1.3.1 General

Circuitry

Microprocessor-controlled

Automatic self-test of oximeter when powered on

Automatic setting of default parameters

Automatic alarm messages

(**3800**) Up to 12 hours of stored trend data output through the RS-232 serial port for SpO_2, pulse rate, and alarm messages

(**3900/3900P**) Real-time data output or up to 24 hours of stored trend data output through the RS-232 port for SpO_2, pulse rate, PI_r pulsatile value, and alarm messages; SpO_2 and pulse rate output through two analog channels

Displays

The displayed SpO_2, pulse rate, and PI_r values are updated every second. The plethysmographic waveform sweep is updated every 4 seconds.

Numeric display (Light Emitting Diodes—LEDs)

Arterial oxygen saturation (SpO_2) reading

Pulse rate reading

Graphic display (Liquid Crystal Display—LCD)

Plethysmographic waveform

High and low SpO_2 and pulse rate alarm limits settings

Sensor condition alarms

Messages—alarm messages and system operational status messages

Contrast adjustment

(**All monitors except 3800 without TruTrak+**) PI_r pulsatile value

(**3900/3900P**) SpO_2 real-time or stored data graph

(**3900/3900P**) PI_r pulsatile value real-time or stored data graph

Audio indicators

Adjustable-volume pulse beep; pitch modulation reflects changing SpO_2 levels

Adjustable-volume alarm tone

Alarm silence (120 seconds); all mute (continuous silence)

Out-of-limits alarms for SpO_2 and pulse rate

Sensor-condition, system-failure, and recharge-battery alarms

Dimensions and weight

(3800/3900) height x width x depth: 9.4 cm (3.7 in) x 24.4 cm (9.5 in) x 22.5 cm (8.9 in)

(3900P) height x width x depth: 10.4 cm (4.1 in) x 24.4 cm (9.5 in) x 22.5 cm (8.9 in)

Weight: **3800/3900**—2.9 kg (6.5 lbs); **3900P**—3.2 kg (7.0 lbs)

1.3.2 Factory settings

Parameter	3900/3900P	3800
High SpO_2 limit	OFF (appears as – – –)	OFF (appears as – – –)
Low SpO_2 limit	85%	85%
High pulse rate	130 bpm	Adult mode: 130 bpm Neonate mode: 200 bpm
Low pulse rate	40 bpm	Adult mode: 40 bpm Neonate mode: 100 bpm
Alarm volume	3	3
Pulse volume	2	2
Save limits	No	Not applicable
Data output mode (printer and modem)	SpO_2	Not applicable
Data output resolution	6-second	Not applicable
All mute	Yes	Not applicable
Serial transmission baud rate	9600	Not applicable
Analog	0.0 V	Not applicable
Print contrast	5	Not applicable
Date format	DD/MM/YY	Not applicable
Time format	HH MM	Not applicable

Mode switches

Switch	3900/3900P options	3800 options
Language	Danish, Dutch, English (factory setting), Finnish, French, German, Italian, Japanese, Norwegian, Portuguese, Polish, Spanish, and Swedish	English (factory setting), French, German, Italian, Japanese, Portuguese, Spanish, and Swedish
Averaging mode	Long / TruTrak+ (12 sec. factory setting), Medium (6 sec.), and Short (3 sec.)	Long / TruTrak+ (12 sec. factory setting), Medium (6 sec.), and Short (3 sec.)
Patient mode	Not applicable	Adult (factory setting) and Neonate
(**TruTrak + monitors**) PI_r pulsatile value display	Yes (factory setting) and No	Yes (factory setting) and No
(**Monitors without TruTrak +**) SpO_2 calibration	Fractional (factory setting) and functional	Fractional (factory setting) and functional
EMI line frequency	60 Hz	60 Hz

1.3.3 Measurement

SpO_2	TruTrak+ monitors	Monitors without TruTrak+
Calibration	Functional	Fractional or Functional
Range	0 to 100%	0 to 100%
Accuracy, A_{rms} (previously represented by 1 SD)	70 to 100% ± 2 digits 70 to 100% ± 3 digits during conditions of clinical patient motion (with TruTrak+ enabled) Below 70% unspecified	
Accuracy, 1 SD		80 to 100% ± 2% 60 to 79% ± 3% Below 60% unspecified
Resolution	1%	1%

Pulse rate	TruTrak+ monitors	Monitors without TruTrak+
Range	30 to 250 bpm	20 to 255 bpm
Accuracy (assuming a constant pulse rate)	± 2% or ± 2 bpm (whichever is greater) Accuracy during conditions of clinical patient motion: unspecified	40 to 235 bpm ± 1.7% of reading
Resolution	1 bpm	1 bpm

PI_r pulsatile value	TruTrak+ monitors and 3900/3900P without TruTrak+	3800 without TruTrak+
Range	0.00 to 9.99	Not applicable
Averaging interval	12 seconds	Not applicable
Resolution	0.01	Not applicable

Interfering substances

Carboxyhemoglobin may erroneously increase readings. The level of increase is approximately equal to the amount of carboxyhemoglobin present. Dyes, or any substances containing dyes, that change usual arterial pigmentation may cause erroneous readings.

Sensor emitter wavelength ranges

Red LED peak wavelength range: 650 to 670 nm

Infrared (IR) LED peak wavelength range: 930 to 950 nm

Average power: ≤ 1 mW

1.3.4 Alarms

Audible alarms

Setting levels available:
Alarm: 1 through 5
Pulse beep: OFF and 1 through 5

Volume intensity at 1-meter distance:
Setting of 1: 45 decibels (minimum)
Setting of 5: 85 decibels (maximum)

Alarm limits

SpO_2 alarm limit range:
High = 50 to 100%, or OFF
Low = OFF, or 50 to 100%

Pulse rate alarm limit range in beats per minute (bpm):

TruTrak + monitors	**Monitors without TruTrak +**
High = 30 to 235, or OFF	High = 40 to 235, or OFF
Low = OFF, or 30 to 235	Low = OFF, or 40 to 235

1.3.5 Environmental

Parameter	Operating	Transport and Storage
Temperature	0 to 50 ºC (32 to 122 ºF)	–40 to 70 ºC (–40 to 158 ºF) 3900P with printer paper: –20 to 45 °C (4 to 113 °F)
Relative humidity, noncondensing	20% to 95%	5% to 95%
Pressure	1060 to 697 hPa	1060 to 188 hPa
Approximate elevation	–378 to 3048 m (–1240 to 10,000 ft.)	–378 to 12.2 km (–1240 to 40,000 ft.)

1.3.6 Electrical

Power

Consumption (typical): 15 watts (3900P—20 watts)

Input voltage range: 90 to 264 VAC at 47-63 Hz

Current (typical): 0.45 A_{rms} at 100 V, 0.37 A_{rms} at 120 V, 0.25 A_{rms} at 220/230/240 V

Current leakage

With power on, forward or reverse polarity: 100 microamperes maximum

Ground resistance: less than 0.1 Ω

Fuse

T2.0AH/250V, 5mm (OD) x 20 mm (Length)

Battery

Type: 8 volt, sealed lead-acid

Capacity: 3.2 ampere hours

Operation time for a new battery at normal operating temperatures:
At least 5 1/2 hours (with all functions operative from a fully charged battery).
3900P—approximately 4 hours when printing.

Low battery indicator (**LOW BATTERY**): indicates the remaining battery capacity is between 5 and 15 minutes.

> **Important:** To prevent permanent damage to the battery, recharge a discharged battery within eight hours after **LOW BATTERY** is displayed.

Charge time:
4 hours = 80% capacity
8 hours = 100% capacity

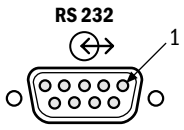
Life: several hundred charge/discharge cycles

Shelf life: 6 months (maximum if not recharged) when stored at room temperature; batteries stored for extended periods of time should be recharged every six months to maintain the charging capacity.

1.3.7 RS-232 connector

Connector type: 9-pin standard D, female
3900/3900P—pins 1 and 4 are not used.
3800—pins 1, 4, 6 and 9 are not used.

Serial output



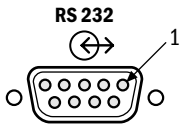
2 = oximeter receives data
3 = oximeter transmits data
5 = signal ground
7 = RTS (Request To Send)
8 = CTS (Clear To Send)

Data output every 2 seconds (auto-output mode) or 6 seconds (trend-output mode):

- (**All monitors**) SpO_2, pulse rate, alarm limit violation messages, and displayed alarm messages
- (**3900/3900P**) Relative Perfusion Index, time stamp, and custom patient label

Baud rate: **3800**—9600 baud; **3900/3900P**—9600, 19.2 K, 38.4 K, or 57.6 K baud
Full duplex; no parity
8 bits per character; 1 start bit; 1 stop bit
Handshaking: CTS/RTS

(3900/3900P) Analog output



5 = signal ground
6 = SpO_2 (0 to 1 Vdc ± 20 mV = 0 to 100% ± 2.0%)
9 = Pulse rate (0 to 1 Vdc ± 20 mV = 0 to 255 bpm ± 2.0%)

1.4 Precautions

Two types of precautions appear in this manual: Warnings and cautions.

- A **WARNING** indicates the possibility of injury to the patient or operator.
- A **CAUTION** indicates a condition that may cause equipment damage or malfunction.

(**3900/3900P**) If you connect a modem, refer to the precautions contained in the instructions that accompanied your modem.

1.4.1 Warnings

Battery replacement

To ensure proper operation, replace only with the recommended battery.

Failure of operation

If the oximeter fails any part of the checkout procedures or current leakage test, remove it from operation until qualified service personnel have corrected the situation.

Data validity

Conditions that may cause inaccurate readings and impact alarms include interfering substances, excessive ambient light, electrical interference, excessive motion, low perfusion, low signal strength, incorrect sensor placement, poor sensor fit, and movement of the sensor on the patient.

To prevent erroneous readings, do not use an inflated blood pressure cuff or arterial blood pressure measurement device on the same limb as the oximeter sensor.

Electrical shock hazard

Measure the oximeter's leakage current in accordance with applicable standards after completing any repair procedure.

This equipment must be properly grounded.

- Electrical safety specifications (e.g., current leakage and ground resistance) can be assured only when the oximeter is connected to a three-wire, grounded, receptacle without the use of extension cords or adapters.
- If there is any doubt about the integrity of the AC power supply protective earth conductor, operate the oximeter on internal battery power.
- Because the unit is not grounded when it is operating on battery power, do not connect any equipment to the RS-232 port on the rear panel unless the unit is connected to the AC power supply.

Before cleaning or repairing the monitor, turn it off and disconnect it from AC mains power.

Fire/explosion hazard

Replace fuses only with fuses of the same type and voltage rating.

Do not use the monitor in the presence of any flammable anesthetic mixture.

Patient safety

Never test or perform maintenance on the oximeter while it is being used to monitor a patient.

Sensors

To prevent injury or equipment damage, use only oximeter sensors approved for use with this oximeter. For complete information about the safe and appropriate use of a sensor, consult the instructions for that sensor.

Discard a damaged sensor immediately. Do not repair a damaged sensor or use a sensor repaired by others.

1.4.2 Cautions

General

US Federal law restricts this device to sale by or on the order of a licensed medical practitioner.

Only qualified service personnel should perform the procedures described in this manual.

Handle the monitor with care. Improper handling can cause damage or inaccurate results.

Static sensitivity

Internal electronic components are susceptible to damage by electrostatic discharge. To avoid damage when disassembling the oximeter, observe the standard precautions and procedures for handling static-sensitive components.

(**3900P**) To avoid damage to the print head from electrostatic discharge, take special care when servicing the 3900P printer.

Sensors

Do not apply tension to the sensor cable; sensor damage may result.

Cleaning

Do not autoclave, pressure sterilize, or gas sterilize this oximeter.

Use cleaning solution sparingly. Do not soak or immerse the oximeter in liquid. Excessive solution can flow into the oximeter and damage internal components.

When cleaning the display area, do not use abrasive cleaning compounds or other materials that could damage the screen.

Do not use petroleum-based solutions, acetone solutions, or other harsh solvents to clean the oximeter. These substances may damage the oximeter and cause a malfunction.

(**3900P**) Do not allow cleaning solution to get into the printer mechanism.

Disposal

Dispose of this medical device and its packaging according to local requirements.

Dispose of the battery, which contains lead and acid, through an approved hazardous materials disposal facility.

1.5 Safety guidelines

Before you start any procedure that involves disassembly of the oximeter, review these guidelines to ensure the proper and safe completion of the procedure.

WARNING: Patient safety. Never test or perform maintenance on the oximeter while it is being used to monitor a patient.

WARNING: Electrical shock hazard. Before cleaning or repairing the monitor, turn it off and disconnect it from AC mains power.

1. Power off and disconnect the unit from the AC power supply.
2. Disconnect the sensor from the unit.
3. Clean the unit—see section 1.5.1.
4. Read and follow each step of all test and repair procedures. Give special attention to all warnings and cautions.

Important: After repairs are complete, test the unit as directed at the end of each procedure to verify that it is functioning properly.

1.5.1 Cleaning

You must clean the oximeter,

- Before you start any procedure that involves disassembly of the oximeter.
- Before you send the oximeter for repair.

CAUTION: Cleaning

- Do not autoclave, pressure sterilize, or gas sterilize the oximeter.
- Use cleaning solution sparingly. Do not soak or immerse the monitor in liquid. Excessive solution can flow into the monitor and damage internal components.
- When cleaning the display area, do not use abrasive cleaning compounds or other materials that could damage the screen.
- Do not use petroleum-based solutions, acetone solutions, or other harsh solvents to clean the oximeter. These substances may damage the oximeter and cause a malfunction.
- To prevent damage to the 3900P printer, do not allow cleaning solution to get into the printer mechanism.

1. Turn off the oximeter and disconnect it from AC mains power.
2. Gently wipe the display panel with a cotton swab moistened with isopropyl alcohol (70 vol%).
3. To clean the outer surface of the oximeter, use a soft cloth dampened with a mild soap and water solution or one of the following solutions:

Mild detergent solution	0.5% sodium hypochlorite (bleach)
70% isopropyl alcohol	Quarternary germicides (Virex®)
1.6% phenol (Sporicidin®)	3.4% glutaraldehyde (Cidex® Plus)

2/Theory of Operations

This chapter covers the theory of operations for the following components:

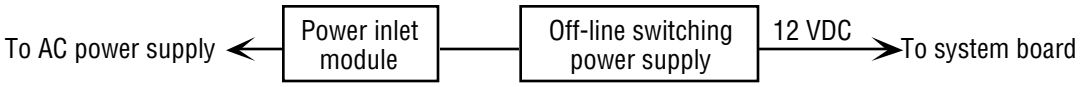
- Power supply and power inlet module
- System board
- Switch board
- Oximetry board
- Passive filtering
- 3900P printer interface

2.1 Power supply and power inlet module

The power supply converts power from an AC power source to +12 VDC. It also provides the necessary isolation between the patient and the AC power supply. It is connected to the system board for further conditioning.

The power inlet module contains the three-contact power connector and the fuses.

Block diagram



2.2 System board

The system board has two major components:

- Data management section
- Power management section

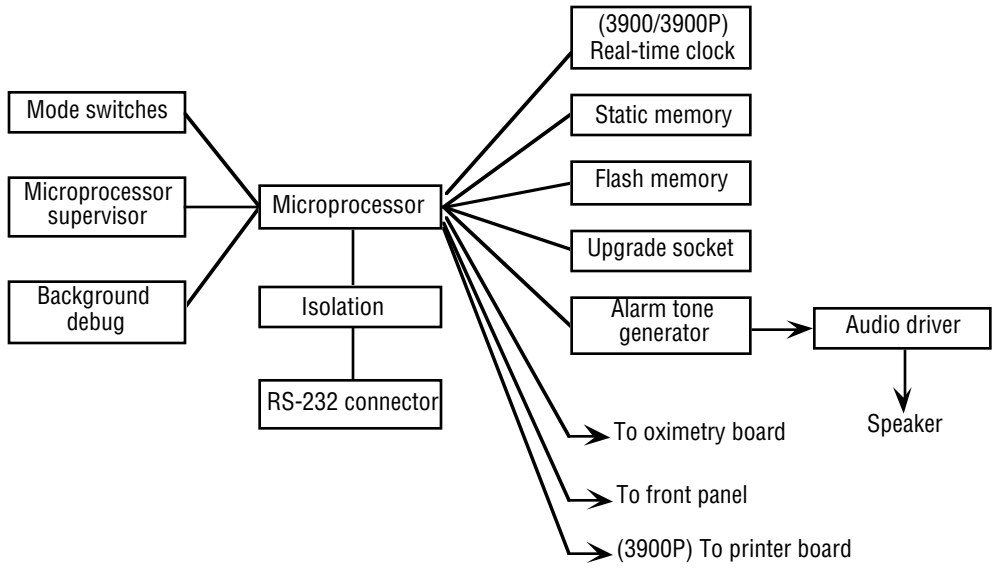
System board functions

- Condition power from the AC power supply and the battery.
- Charge the battery when supplied with a DC voltage from the power supply.
- Monitor language mode switch positions.
- Provide bi-directional communication through the RS-232 connector.
- Send data to the front panel for display.
- Monitor front panel button presses.
- Allow for software upgrades.
- Monitor and send commands to the oximetry board via a serial interface and a few discrete digital lines.
- **(3900/3900P**) Send analog SpO_2 and pulse rate data to analog outputs.
- **(3900/3900P)** Provide real-time clock capability.
- **(3900P)** Provide control for printer output.

2.2.1 System board data management

The digital section of the system board provides data management. The digital section contains the microprocessor, SRAM, Flash memory, a software upgrade socket, the RS-232 interface, mode switches, alarm signal generator, audio amplifier, microprocessor supervision, 3900/3900P real-time clock capability, and 3900P printer interface.

Block diagram



Microprocessor

The microprocessor is a Motorola 68332 that operates at 16 MHz. It uses a crystal that operates at 32.768 KHz. Several ports can be configured by software. A 16-channel timer processing unit can be programmed to execute various timing functions, including a serial communication port. A background debug feature allows full access to the processor through a 10-pin connector. Communication to the oximetry board is accomplished primarily through a dedicated serial port.

SRAM

The static RAM is 128 K x 8 bits. The SRAM is powered when the unit is in standby mode, which allows data to be retained when the digital system is powered down.

Flash memory and software upgrade socket

The Flash memory (512 K x 8 bits) contains the application code software, which runs the oximeter. An upgrade socket allows download of revisions to the application code software. The software upgrade socket accepts a memory chip with the same pinout as the onboard Flash memory. A super cap provides flash memory backup while the battery is disconnected.

RS-232 connector interface

This port, which operates at 9600 baud (**3800**) or 9600, 19.2K, 38.4K, or 57.6K baud (**3900/3900P**), allows for transmission of oximetry data to other serial devices. It has optoisolators and an isolated power supply so that there is no ohmic connection between the connector and the digital system.

(3900/3900P) Two analog outputs allow SpO_2 and pulse rate outputs in analog form, at 0 to 1 volt full scale.

Mode switch

The mode switch settings determine the modes of operation for the oximeter, such as the averaging mode, for example. The switches are ESD-protected by a 14-channel dual SCR chip connected to the power supply. The positions of the switches are read directly through 8 of the TPU channels.

Alarm signal and pulse tone generator

This is a sawtooth generator. The circuit produces a signal that is rich in harmonics. A resistor in the feedback loop controls the slope of the rising edge while another resistor controls the slope of the falling edge. The frequency is set to about 800 Hz. Volume is controlled by the microprocessor using pulse width modulation (PWM). Another PWM channel on the microprocessor generates pulse tones; the microprocessor controls the frequency of this tone. Discrete logic is incorporated to produce an alarm tone at full volume in the event that the microprocessor is not operating.

Microprocessor supervisor

This chip monitors the power supply, contains a watchdog, has battery switchover circuitry, generates reset pulses, and disables the SRAM during power down. If the power supply voltage is too low, this circuit holds the reset on the processor until the correct voltage is restored. It also switches the SRAM supply power to the Vbatt input and disables RAM when the supply voltage is low. If the microprocessor does not pulse the watchdog input occasionally, the chip issues a reset pulse. It also enables the alarm tones if the watchdog is active.

Audio amplifier

This is a single chip that amplifies the audio tones. It has a bipolar output that allows for maximum volume with a single supply. The amplifier has a low-pass pole at 17.5 KHz to reduce noise which may be picked up at the input to the amplifier.

Front panel interface

Switches on the front panel are read via various discrete I/O lines on the processor. They are scanned via an output port on the front panel circuit board (the switch board). The numeric displays on the front panel are sent data via the serial peripheral interface of the processor.

Background debug

A 10-pin connector allows direct connection to the microprocessor. All microprocessor functions can be accessed through this interface.

Boot code and application code can be downloaded via this connector.

(3900/3900P) Real-time clock

This is a single chip connected to the microprocessor. It provides time, month, day, and year for the display and for printed trend data. A super cap provides backup while the battery is disconnected.

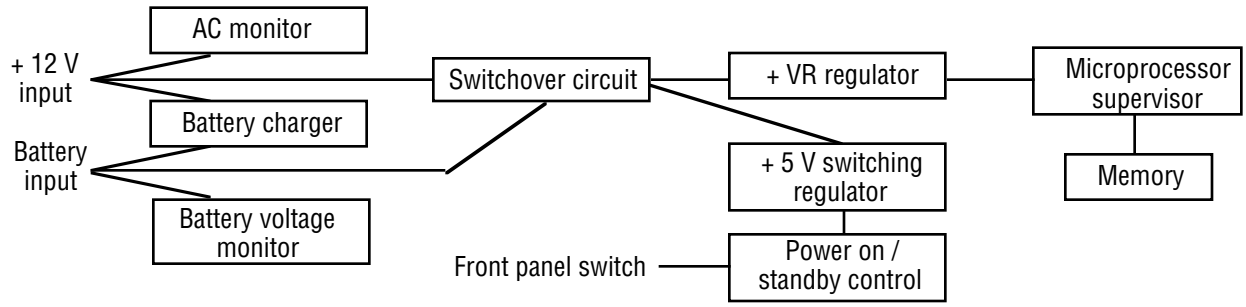
(3900P) Printer interface

A connector and port allow the microprocessor to control printer functions. Handshaking lines synchronize the printer to the microprocessor. The microprocessor directly controls the printhead patterns for text and graphic images.

2.2.2 System board power management

The power management section generates + 5 V, switches between the + 12 V and battery supplies, charges and monitors the battery voltage, and controls power on and standby modes.

Block diagram



+ 5 V supply

+ 5 V is generated by a buck-switching regulator that operates at 52 KHz. The input voltage is between about + 6.7 and + 12 V. This supplies power to the digital section, the front panel, and the oximetry board.

Battery charger

The battery charger is designed specifically for lead-acid batteries. If the battery voltage is less than 6.52 V, the circuit charges the battery at a low current. After the battery reaches voltage 6.52 V, it charges the battery at 625 mA. When the battery reaches 9.8 V, the charger changes to a constant voltage charger. When the charging current is less than 31 mA, the charger goes into a float state holding the battery voltage at 9.4 V.

Battery monitor

The battery is monitored for low voltage and recharge. The low voltage trip point is set at 7.3 V, and the recharge-battery-voltage trip point is set at 7.0 V. The low battery signal is sent to the microprocessor. The recharge battery signal is latched with discrete logic. In the event that a recharge battery condition is reached, the unit must be connected to AC mains power to reset the recharge battery latch.

AC monitor

+ 12 V is used to indicate that the unit is connected to AC mains power. This signal is level shifted to + 5 V and sent to the processor.

+ VR supply

+ VR is generated by a low power linear regulator set as about 4 V. This voltage is routed to the microprocessor supervisor Vbatt input. It supplies power to the power on/standby circuitry, SRAM, and the recharge battery latch when the unit is in standby mode. It also supplies power to the real-time clock. This supply is backed up by a super cap during periods when the battery is disconnected.

Power on/standby circuitry

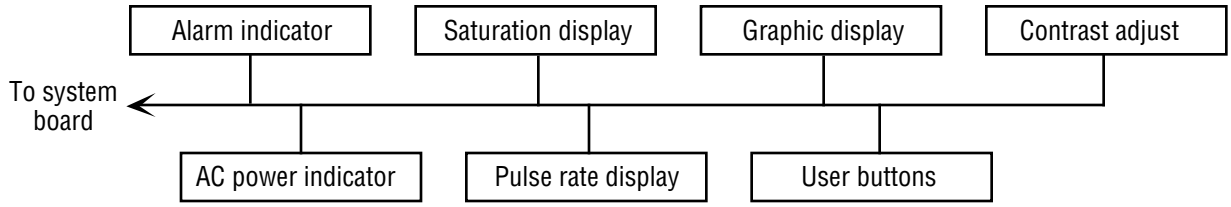
The input to the + 5 V switching regulator is controlled by a P channel FET. The gate of the FET is controlled by a transistor whose base is connected to a flip-flop. The state of this flip-flop determines the on or standby state of the unit. The circuit senses when the front panel power switch is depressed. When this switch is closed, a flip-flop is toggled. If the unit was in standby, the unit changes to the on state. If the unit is on, the circuit generates a power-down request. This signal then goes to the microprocessor.

After the microprocessor finishes any tasks deemed necessary, the microprocessor issues a power-down command. This signal then clears both flip-flops and puts the unit in the standby mode. In the event that the microprocessor does not respond with a power-down command within about 800 ms, the circuit times out and clears the flip-flops.

2.3 Switch board

The switch board provides the interface between the system board and the liquid crystal display (LCD), the drive electronics for the light emitting diode (LED) numeric displays, and the user interface switches. It also interfaces the bicolor alarm LED, the power/standby switch, and the LCD contrast adjustment potentiometer.

Block diagram



The LCD is controlled by the system board over the data bus. A hardware line, RESET, blanks the display. The user controls the contrast (or viewing angle) of the LCD by the position of potentiometer R6.

The LED numeric displays are driven by an LED interface chip that is controlled by the system board over a synchronous serial interface. The maximum intensity of the displays is set by a resistor. One end of the resistor is controlled by a latch to allow the LEDs to be blanked when the latch is reset.

The alarm LED is bicolor (red and yellow) and is controlled by two bits of a latch.

The mains power indicator is a green LED that is lit when the oximeter is plugged into AC mains power.

The user interface switches are configured in a matrix and are scanned by the system board.

The power/standby switch is a momentary contact switch that is wired through to the system board.

2.4 Oximetry board

The oximetry board has three major sections:

- Power supply
- Digital section
- Analog section

2.4.1 Oximetry board power supply section

The power supply section filters the +V supply and provides –V and –Probe.

+5_IN is filtered by capacitors and inductors in a pi configuration. –V and –Probe are generated on board by an inverting switching regulator. This regulator uses current-limited pulse-frequency modulation. The output is split into two supplies. –Probe is used to supply power to the sensor LEDs and –V is used to provide power to the rest of the circuit. The output is set to –5 V.

2.4.2 Oximetry board digital section

The digital section contains the microprocessor, the Flash code memory, static random access memory (SRAM), a DAC, an ADC, and supporting logic. All communication to the host system is through a serial interface and a few discrete digital lines.

Microprocessor

The microprocessor is clocked at 7.3728 MHz. It includes a 16-bit CPU, an ADC, a serial port, timer/counters, and input/output ports. The high speed output port controls all oximetry timing signals (RLT, IRLT, IR, and RED, for example). In TruTrak+ monitors, the microprocessor also includes Flash memory, SRAM, and a DAC.

Flash memory

The Flash memory contains two major sections of code: boot code and application code. The application code performs oximetry. In TruTrak+ monitors, the Flash memory is internal to the microprocessor on the oximetry board.

SRAM

The processor uses the SRAM for temporary storage of information. No data are retained in this memory when power is disconnected from the board. In TruTrak+ monitors, the SRAM is internal to the microprocessor on the oximetry board.

DAC

The D/A converter is connected to an amplifier that scales and inverts the DAC output. The range of the amplifier output is 0 to –2.5 V. The DAC controls the current flow in the LEDs. In TruTrak+ monitors, the DAC is internal to the microprocessor on the oximetry board.

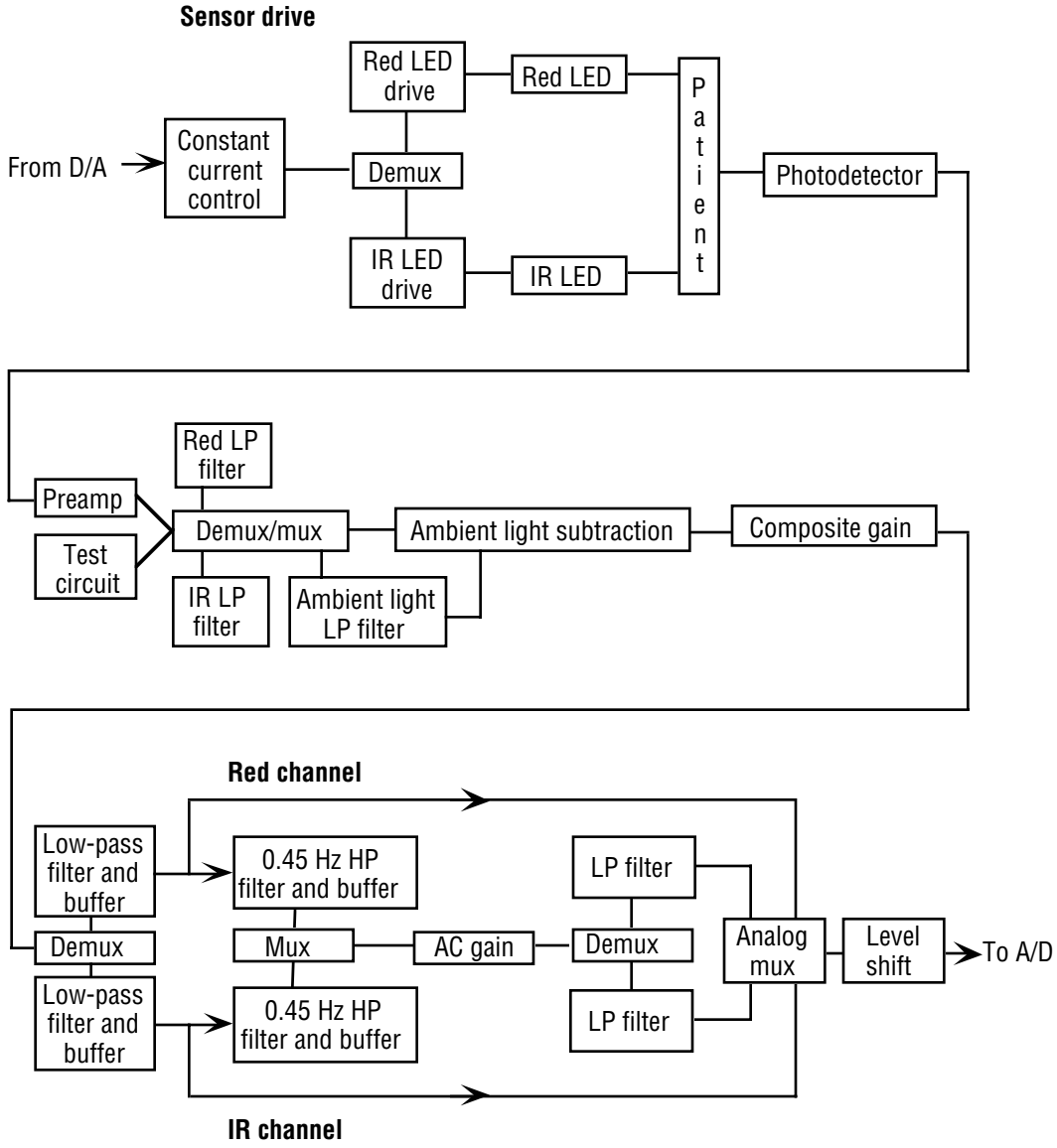
Reset circuit

The reset circuit is an open collector topology to allow the microprocessor to activate the reset line. The responsibility for reset control falls primarily on the host system.

2.4.3 Oximetry board analog section

The analog section provides analog processing of the detector signal, sensor LED drive, detection of interfering signals and fault monitoring of the sensor. It also has components to enhance electromagnetic compatibility and protect the board from electrostatic discharge.

Block diagram



Detector preamplifier

The signal from the detector is converted to a voltage with a gain of about 49,900 µV/µA. The amplifier is in a balanced input configuration. The gain rolls off at about 14 KHz. Other components are added to reduce susceptibility to RF signals.

Interference detect

The interference detection circuit selectively triggers on those signals with modulations or frequencies which would cause interference by aliasing with the oximeter's multiplexing frequency. The input stage of the circuit is a high-pass filter at 5600 Hz followed by a low-pass filter at 11.6 Hz. Under classical filter analysis, very little would be expected to pass through these filters. However, since this filter has a switching element, frequencies that come through the high-pass filter are aliased onto the low-pass filter. These aliased signals are amplified, filtered, detected, and held. The DC output of the circuit is compared to a fixed threshold to notify the processor of the presence of interference.

Multiplexed low-pass filter

Under normal operation, the signal from the preamplifier is demultiplexed, low-pass filtered at 10 Hz, and multiplexed. A separate filter exists for each of the multiplexed signals.

Test circuit

The signal into the multiplexed low-pass filter can optionally be connected to a test signal. The test signal is generated by the DAC, which usually controls the LED intensity. This signal is used to verify operation of the majority of the analog signal path by injecting a known signal.

Ambient light subtraction

The signal during the dark time is subtracted from the signal while the red LED is on and while the infrared LED is on.

Composite gain stage

The gain of this amplifier stage is controlled by the microprocessor and is optimized for the analog-to-digital converter. The entire multiplexed signal is amplified by this stage.

Demultiplex and low-pass filter

The signals are demultiplexed into red and infrared channels. The channels are low-pass filtered at 11.6 Hz. These signals are inputs to the analog multiplexor, as Red DC and Infrared DC, and also to the AC gain process.

High-pass filter and multiplex

The red and infrared channels are normally high-pass filtered at 0.47 Hz. This pole can be changed by the microprocessor to 16 Hz. This allows the filters to stabilize rapidly if the overall composite levels of the red and infrared signals have a large change. The channels are then multiplexed together for further amplification.

AC gain stage

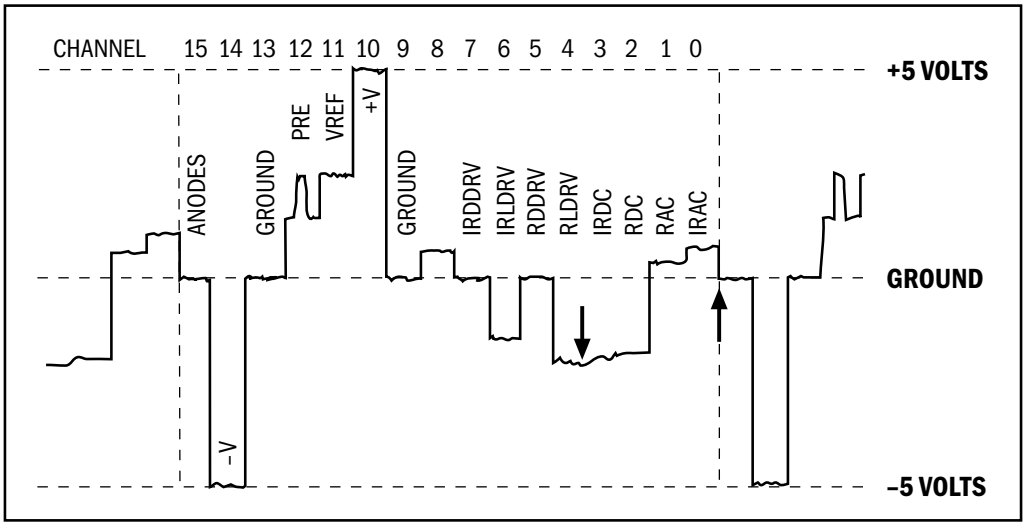
The signal path for both the red and infrared channels is through the same amplifier. This amplifier is microprocessor controlled to optimize the range of the ADC. This stage amplifies the AC component of the red and infrared signals.

Demultiplex low pass

The red and infrared channels are demultiplexed, low-pass filtered at 1160 Hz, and fed into low-pass filters. These are switched filters with the pole at 10 Hz. The outputs of these filters go to the analog multiplexor.

Analog multiplexor and buffer

The LED drive signals, preamp, red channels, infrared channels, and power supply voltages are multiplexed into an amplifier that shifts the signals from a range of (–5 V to +5 V) to (0 to + 5 V).



Multiplexor

Channel (hex)	Signal description
0	Infrared AC signal
1	Red AC signal
2	Red DC signal
3	Infrared DC signal
4	LED sense (RED LIGHT)
5	LED sense (RED DARK)
6	LED sense (IR LIGHT)
7	LED sense (IR DARK)
8	Filtered preamp output
9	Analog ground
A	Plus V supply rail
B	Reference voltage
C	Detector preamp output
D	Analog ground
E	Minus V supply rail
F	Anodes

LED drive

The LED drive currents are controlled by a DAC connected to the microprocessor. The anodes of the LEDs are common and connected to ground through a current sense resistor and switch. Each LED has a drive transistor that controls the current in the LED. The current for the LED being driven is part of a feedback loop that holds the current relatively constant.

The voltages across the LEDs during different phases of drive are fed into the analog multiplexor. These voltages are monitored for various fault conditions that may exist in the sensor.

Sensor monitor

The LED current is monitored by the sensor monitor. The voltage across the resistor that connects the anodes to ground is amplified by a factor of 50 and low passed at 2 Hz. The overall LED current is monitored by the microprocessor. The LEDs can be disconnected from ground by the microprocessor via the FET in series with the anodes.

Sensor identification

Certain LED characteristics are identified via a resistor in the sensor. This resistor value is determined by a resistor-divider circuit that is connected to the ADC reference of the microprocessor. The middle of the resistor divider is connected to a buffer which then goes directly to the ADC.

2.5 Passive filtering (sensor filter board or flex cable)

Passive filtering components provide the interface between the oximetry board and the sensor connector on the front panel. Passive filtering to the sensor connections is intended to protect the oximeter electronics from electromagnetic interference.

The components used for passive filtering depend on the oximetry used by the monitor:

- The *Sensor filter board* is used only in monitors *without* TruTrak+ oximetry.
- The *Sensor filter flex cable* is used only in monitors *with* TruTrak+ oximetry.

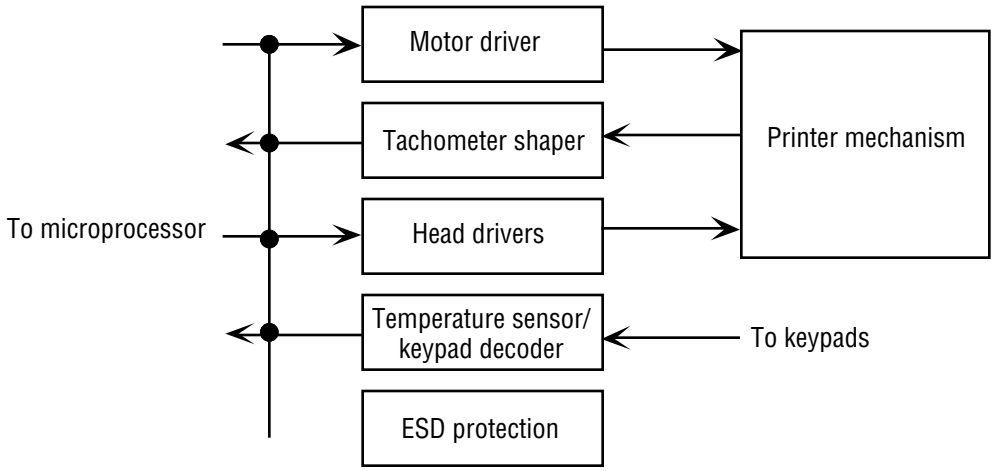
Important: The *Sensor filter board* and the *Sensor filter flex cable* are not interchangeable.

2.6 3900P Printer interface

2.6.1 Printer board

The printer board contains the motor driver, tachometer shaper, head drivers, and temperature sensor/keypad decoder. The printer interface provides the circuitry required to drive the printer mechanism with outputs from the microprocessor. It also provides signal condition for handshake signals going to the microprocessor.

Block diagram



Motor driver

The motor control signal from the microprocessor turns on a FET transistor that shorts one side of the motor to a ground potential. The other side of the motor is tied to +5 V, which allows the motor to run. When the motor control signal from the microprocessor turns off, the two-transistor array turns on, which shunts across the motor causing it to brake and stop quickly. The motor is used to sweep the printhead across the paper.

Tachometer shaper

The input to the tachometer circuit is a sinusoidal waveform. The circuit on the printer board rectifies the signal, then drives a transistor stage to deliver a square wave to the microprocessor. This signal is an interrupt to the microprocessor.

Head drivers

The eight printheads are thermal elements. One side of each printhead is tied to +5 V. The other side is selectively switched to ground, under control of the microprocessor. As a head is energized, it heats up and exposes the thermal paper to produce a pixel dot. The duty cycle at which the head is driven determines the lightness or darkness of the dot. As the head moves across a line on the paper, it synchronously prints a pattern of dots to represent text or graphic images.

ESD protection

Two devices, SP720 and SP721, were added to protect the signals from the microprocessor from being damaged by ESD discharge or over-voltage stress. These devices do not affect the performance of the circuits to which they are connected.

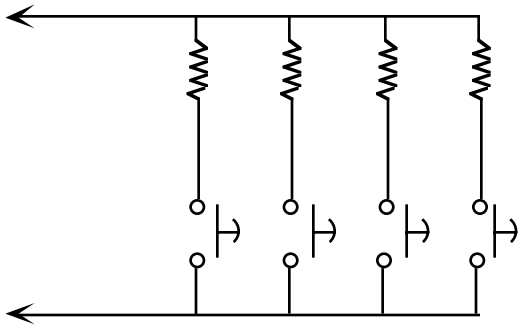
Temperature sensor/keypad decoder

The LT1392 has a built-in temperature sensor and a built-in A/D converter. Both of these values are read by the microprocessor through a serial link. The microprocessor uses the temperature to determine the proper contrast setting to drive the printhead. The A/D converter decodes which button has been pressed on the keypad. Pressing one of the four buttons on the printer button board selects a different resistor to change the ratio of a voltage divider. The analog voltage generated by the voltage divider is converted by the A/D converter, and the microprocessor interprets the button that was pressed.

2.6.2 Printer button board

The printer button board has four buttons and four resistors. This board connects to the printer board, which, in turn, communicates which button was pressed to the microprocessor.

Block diagram



Two wires go off the button board. Each of the four button switches selects one of four resistors with different values to be applied across the two output wires. On the printer board, this resistor becomes the bottom leg of a voltage divider, with another resistor on the printer board. The four different analog levels produced by the four switch closures are converted by an A/D converter on the printer board that is tied to the microprocessor. The microprocessor determines which switch was selected.

3/Test and Upgrade Procedures

This chapter provides procedures to

- Verify that the oximeter and its buttons are functioning properly.
- (**3900P**) Verify that the printer is functioning properly.
- Perform an electrical safety check.
- Upgrade the software.

WARNING: Patient safety. Never test or perform maintenance on the oximeter while it is being used to monitor a patient.

NOTE: Preventative maintenance and/or calibration are not required for any 3800, 3900, or 3900P monitor.

3.1 Functional check

WARNING: Failure of operation. If the oximeter fails any part of the checkout procedures or current leakage tests, remove it from operation until qualified service personnel have corrected the situation.

WARNING: Explosion hazard. Do not use the monitor in the presence of any flammable anesthetic mixture.

WARNING: Electrical shock hazard. This equipment must be properly grounded.

- **Electrical safety specifications (e.g., current leakage and ground resistance) can be assured only when the monitor is connected to a three-wire, grounded receptacle without the use of extension cords or adapters.**
- **If there is any doubt about the integrity of the AC power supply protective earth conductor, operate the monitor on internal battery power.**
- **Because the unit is not grounded when it is operating on battery power, do not connect any equipment to the RS-232 connector on the rear panel unless the unit is connected to the AC power supply.**

1. Inspect the oximeter case for damage. Make sure the display area is clean.
2. Connect the power cord to the rear panel connector and to AC mains power.

   Important (**TruTrak+ monitors**): For TruTrak+ performance, the rear panel Mode Switch for SpO_2 averaging must be set to Long (12 seconds).

3. Before connecting a sensor, verify that it is approved for use with the oximeter. For example, only OxyTip+ sensors can be used with TruTrak+ monitors.

If you're using a reusable sensor, make sure it opens and closes smoothly. Remove substances that may interfere with the transmission of light between the sensor light source and detector.

WARNING: Sensors

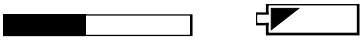
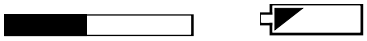
- **Discard a damaged sensor immediately. Do not repair a damaged sensor or use a sensor repaired by others.**
- **To prevent patient injury or equipment damage, use only Datex-Ohmeda oximeter sensors approved for use with this oximeter. For complete information about the safe and appropriate use of a sensor, consult the instructions for that sensor.**

CAUTION: Do **not** apply tension to the sensor cable; sensor damage may result.

4. Connect the sensor cable to the sensor connector. Make sure the connection is firm and that the sensor cable is not twisted, sliced, or frayed.
5. Verify oximeter operation:
   - Press the power button to turn on the oximeter. Verify that the model name that is displayed on the screen (Model 3800, Model 3900, or Model 3900P) matches your oximeter. If it does not match, refer to section 4.3.
   - Check that the red LED on the sensor is on.
   - Attach the sensor to a finger or an ear, as appropriate for the sensor.
6. Verify that the following appears on the screen during the power-on sequence:

   (**3900/3900P**) If the saved low SpO_2 alarm limit is below 80%, a message shows the saved alarm limit (or OFF) and the saved alarm volume setting.

   See below for examples of the screen that shows the modes in effect, the progress of the self-test, and an icon that indicates the battery charge status.

3800	3900/3900P
Averaging Mode: Long	**Averaging Mode: Long**
Patient Mode: Adult	**SpO_2 Calibration: Functional**
Self-test in progress . . .	**Self-test in progress . . .**
	

   Below the bar graph, the software version numbers appear as X.XXX/YY.YYY. X.XXX represents the system software version; YY.YYY represents the oximetry software version.
7. As the self-test progresses, verify that all LEDs illuminate and that a beep sounds.

   During the diagnostic self-test, which lasts for about 10 seconds, electronics, battery status, analog signal path integrity, and calibration are checked and the default parameters are set. For details, see section 3.1.2.

   Upon successful completion of all self-tests, the monitor is considered to be in calibration and begins normal operation. This message is displayed for all monitors (except the 3800 without TruTrak+):

   Test passed. In calibration.

If a problem is discovered during the self-test, the monitoring screen will not appear and the monitor is inoperable. To identify the problem, see chapter 4.

8. Verify that the SpO_2, pulse rate, and PI_r pulsatile values and alarm limits display within 15 seconds after the self-test is complete. Dashes (- - -) may appear for the values until the readings have stabilized and for alarm limits set to OFF.

   NOTE: The audible alarm feature for all alarm conditions is silenced for the first two minutes after powering on.

9. When two minutes have elapsed since you powered on, remove the sensor from the finger (or ear) and verify that the **SENSOR OFF** or **CHECK SENSOR SITE** message appears, the alarm tone sounds, and an alarm light flashes.
10. Press the alarm silence button and verify that the alarm is silenced.
11. Randomly adjust an alarm limit and a volume limit to verify button function.
12. To verify oximeter operation on battery power, power off the oximeter and disconnect it from AC mains power. Then, repeat steps 5 through 11.

    NOTE: If the remaining battery power is not sufficient to power on the unit, a low-battery icon is displayed and the monitor shuts off. Recharge the battery and continue with the checkout.

3.1.1 Printer test (3900P)

1. Power on the oximeter and hold down the left-most button on the printer until the Datex-Ohmeda logo (oximeter identification) screen appears.

   The printer prints a test sheet similar to the one shown below until you press the printer's stop button.

Figure 3-1. Printer test sheet

2. To stop the self-test, press  .
3. Verify that the header information prints correctly and that the text is legible. If the self-test was not successful, replace the printer board; see section 5.7.1.

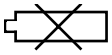
3.1.2 Diagnostic self-test

The following self-tests are performed during power-on:

- All external static RAM and the processors' SIM RAM are completely tested for functionality.
- FLASH ROM memory is CRC tested to verify unit software integrity.
- User-interface features (switches, display, and audio) are exercised in a prescribed manner.
- A start-up tone sequence that tests the audio circuit is followed by illumination of all display LEDs and the LCD backlight, which are then blanked.
- The alarm LED toggles between red and yellow while a numeric countdown from 9 to 0 occurs on each 7-segment LED display, ending with a decimal point.
- A battery icon appears on the mode status screen of the LCD to indicate the battery condition as follows:

   **Fully charged**

   **Low**

   **Depleted, not installed, or defective**

- Oximeter circuit tests include supply and reference voltage checks, followed by a test signal generated by the sensor LED drive circuit, which is routed through the oximetry signal path to check for errors and verify calibration.

  The resultant calculated value, which is sensitive to both offset and phase errors in the circuitry, is compared to established criteria.

3.2 Electrical safety check

Perform this test after removing the oximeter cover to perform any service procedure.:

WARNING: Measure the leakage current in accordance with applicable standards after completing any repair procedure.

1. With the power cord connected **only to the oximeter,** measure the resistance from the power plug ground connector to all exposed metal on the chassis. The measured resistance must not exceed 0.15 Ω.
2. Measure the leakage current following the instructions supplied with the leakage current tester.
3. Record the results for reference in future resistance/leakage tests. A significant change may indicate a pending failure.

3.3 Software upgrade

An IC (integrated circuit) chip is used to upgrade software. The IC chip is inserted into a socket on the system board. During the upgrade, the software is sent from the IC chip to the system board (or oximetry board for monitors without TruTrak+).

- (**TruTrak+ monitors**) The system board software can be upgraded. An oximetry board software upgrade is not available for TruTrak+ monitors.
- (**Monitors without TruTrak+**) The system board software and the oximetry board software can be upgraded.

Important—3800: If system board software version 2.0 or higher is not installed on your 3800, installation of the software upgrades listed below must be performed at a Datex-Ohmeda service center only:

- System board software version 2.000 or higher.
- Oximetry board software version 3.000 or higher.

Upgrade kit contents

The upgrade kit contains a jumper plug that is used for the 3900/3900P system software upgrade. It also includes four software IC chips whose functions are described below.

IC Chip	Software Upgrade	Header J11 on System Board	Model
U-LOADER	System board	**YES**	Any 3800/3900/3900P containing this system board, including all 3800/3900/3900P with TruTrak+
LOADER	System board	**NO**	3900/3900P without TruTrak+
SYS	System board	**NO**	3800 without TruTrak+
OXY	Oximetry board	**Not applicable**	3800/3900/3900P without TruTrak+

NOTE: The system board in TruTrak+ monitors (6050-0005-742) is also used as the replacement board for any 3800/3900/3900P without TruTrak+. This board contains header J11 (see Figure 3-2), which is not present on earlier system boards.

- If header J11 **is** on the system board in your monitor, use the **U-LOADER** chip.
- If header J11 **is not** on the system board in your **3900/3900P**, use the **LOADER** chip.
- If header J11 **is not** on the system board in your **3800**, use the **SYS** chip.

Tools

- Phillips screwdriver, #1
- Flash IC extraction tool (PLCC extractor), REF 0380-1500-124

3.3.1 Remove the cover and identify the system board

WARNING: Electrical shock hazard. Before cleaning or repairing the oximeter, turn it off and disconnect it from AC mains power.

CAUTION: Static sensitivity. Internal electronic components are susceptible to damage by electrostatic discharge. To avoid damage when disassembling the oximeter, observe the standard precautions and procedures for handling static-sensitive components.

1. Turn off the oximeter and disconnect the power cord from the rear of the chassis.
2. Remove the two screws that secure the cover to the rear of the chassis.
3. Firmly press down on the cover and push it away from the front panel until it slips out of the locks on each side of the chassis.
4. To release the cover from the slots on the chassis, grasp both sides of the cover near the lower front corners and pull *firmly* outward. Lift the cover up; keep the sides free of the chassis.
5. (**3900P**) Continue with the following steps:
   - Disconnect the printer cable from the printer board. Set the cover aside.
   - Remove the two nuts from the screws that hold the catch tray to the chassis. Remove the two screws from the catch tray and chassis.
   - Slowly pull the catch tray straight up and remove it from the unit.
6. (*If you know whether or not your system board contains J11, skip this step.*)
   Look for J11 on the system board (refer to Figure 3-2 for the location of J11).
   - If necessary, loosen the oximetry board by removing the four screws that hold the board to the standoffs. Slowly lift the board until you can see the part of the system board where J11 is located.

     NOTE: If J11 is present, a jumper will be installed on it for the 3800; a jumper is not installed on J11 for the 3900/3900P.
   - Reinstall the four screws that secure the oximetry board to the standoffs. Check to be sure all cables are securely fastened.
7. Connect the power cord to the oximeter.

3.3.2 (Optional) Check the installed software versions

You can determine if an upgrade is needed by checking the version number of the software that is currently installed on your oximeter.

1. Turn on the oximeter.
   The version numbers are displayed below the self-test bar graph in this form:

   Version X.XXX/YY.YYY

   Note the version number of the installed software:

   X.XXX (system software version number) = _____

   YY.YYY (oximetry software version number) = _____
2. Turn off the oximeter.
3. If the installed software version is *below* the version shown on the corresponding IC chip, upgrade the software.

3.3.3 System software upgrade using the U-LOADER or LOADER chip

If you are upgrading the system software, select the appropriate IC chip based on your monitor and the system board it contains:

- **U-LOADER**—use to upgrade a 3800, 3900, or 3900P whose system board contains header J11.
- **LOADER**—use to upgrade a 3900 or 3900P whose system board does *not* contain header J11.

NOTE: To upgrade a *3800* whose system board does *not* contain header J11, go to section 3.3.4.

To upgrade the system software, you install the appropriate IC chip on the system board, then power on the unit to download the software.

1. (**3900/3900P**) Install a jumper plug on J10 on the system board.

   NOTE: A jumper is not used when upgrading the 3800 system software.

2. Locate the upgrade socket (U19) on the system board near the rear of the monitor.

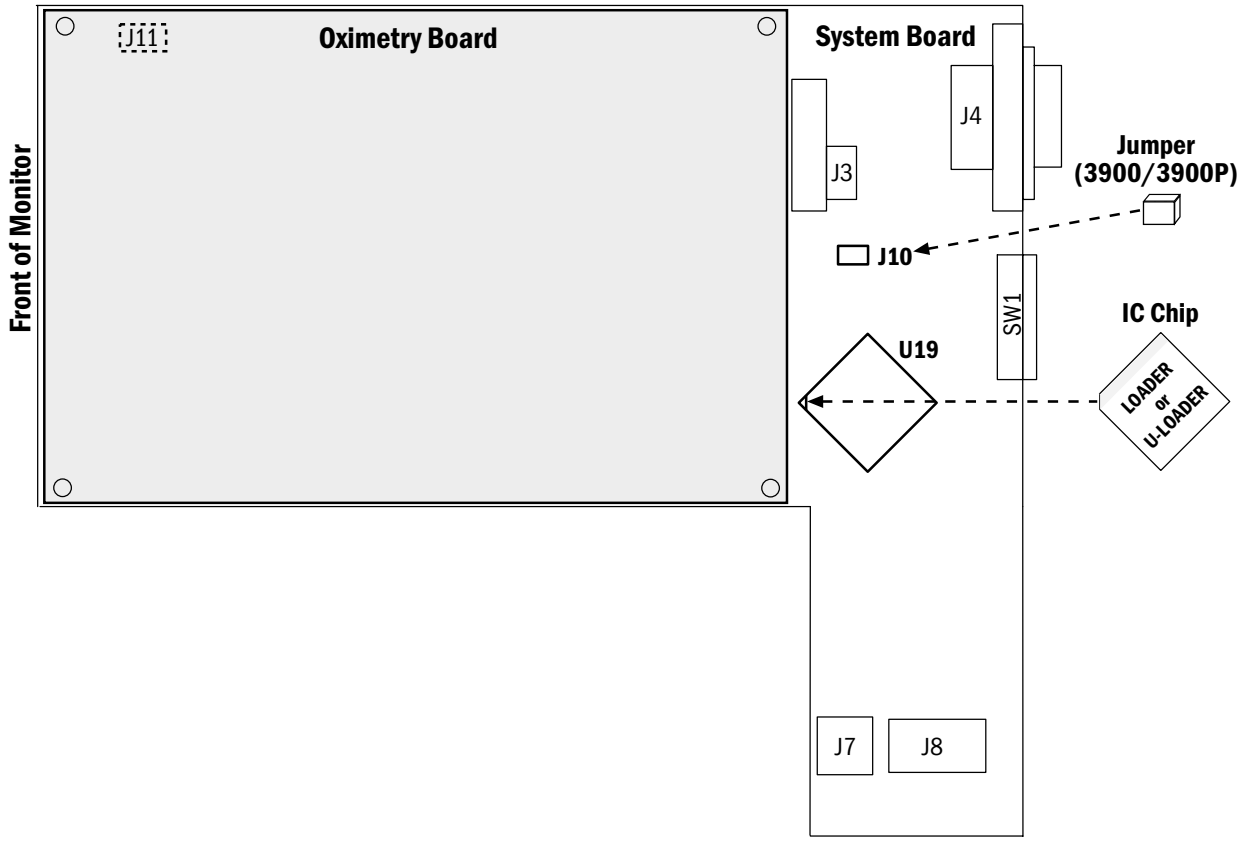


Figure 3-2. Jumper plug, upgrade socket, and LOADER/U-LOADER IC chip

3. *Carefully* align the notch on the appropriate system software upgrade chip with the notch on socket U19. Then, insert the chip into the socket.

4. Turn on the oximeter. Messages similar to those shown below are displayed.

System Loader VX.XXX...
Testing

Updating System to VX.XXX
Size (bytes): XXXXX
Press to begin →

NOTE: (**3900/3900P only**) If the jumper is missing or incorrectly installed, you will see the normal power-on screens and messages. The system software will not be upgraded. Power off and begin again, starting with step 1.

The arrow means press the pulse rate low alarm limit button (either side) to start the system upgrade.

Updating System to VX.XXX
Size (bytes): XXXXX
Erasing...

Updating System to VX.XXX
Size (bytes): XXXXX
Programming XXXX

Updated to Version VX.000
SUCCESS!
Cycle power ...

NOTE: Contact Datex-Ohmeda to obtain a new upgrade chip if the upgrade does not proceed as described above and the **CRC BAD!** or **INCOMPATIBLE!** error message is displayed.

- **CRC BAD!** indicates an incorrect or damaged IC chip.
- **INCOMPATIBLE!** means the upgrade software is not compatible with your oximeter.

These errors do not affect the previously-installed software. You can stop the system upgrade and the monitor will return to its prior operating condition. You may upgrade the oximetry software if you had planned to do so.

If either message appears, turn off the oximeter. Then, go to step 6.

5. When the **Cycle power** message is displayed, turn off the oximeter.
6. Use an IC chip extraction tool to remove the IC chip from the socket.
7. (**3900/3900P**) Remove the jumper plug from J10.
8. (**Monitors without TruTrak+**) To upgrade the oximetry software, go to section 3.3.5.

   or

   Go to section 3.3.6 to install the cover and check the installation.

3.3.4 System software upgrade using the SYS chip

If the system board in your 3800 does not contain header J11, install the **SYS** chip on the system board, then power on to download the software.

1. Locate the upgrade socket (U19) on the system board near the rear of the monitor.

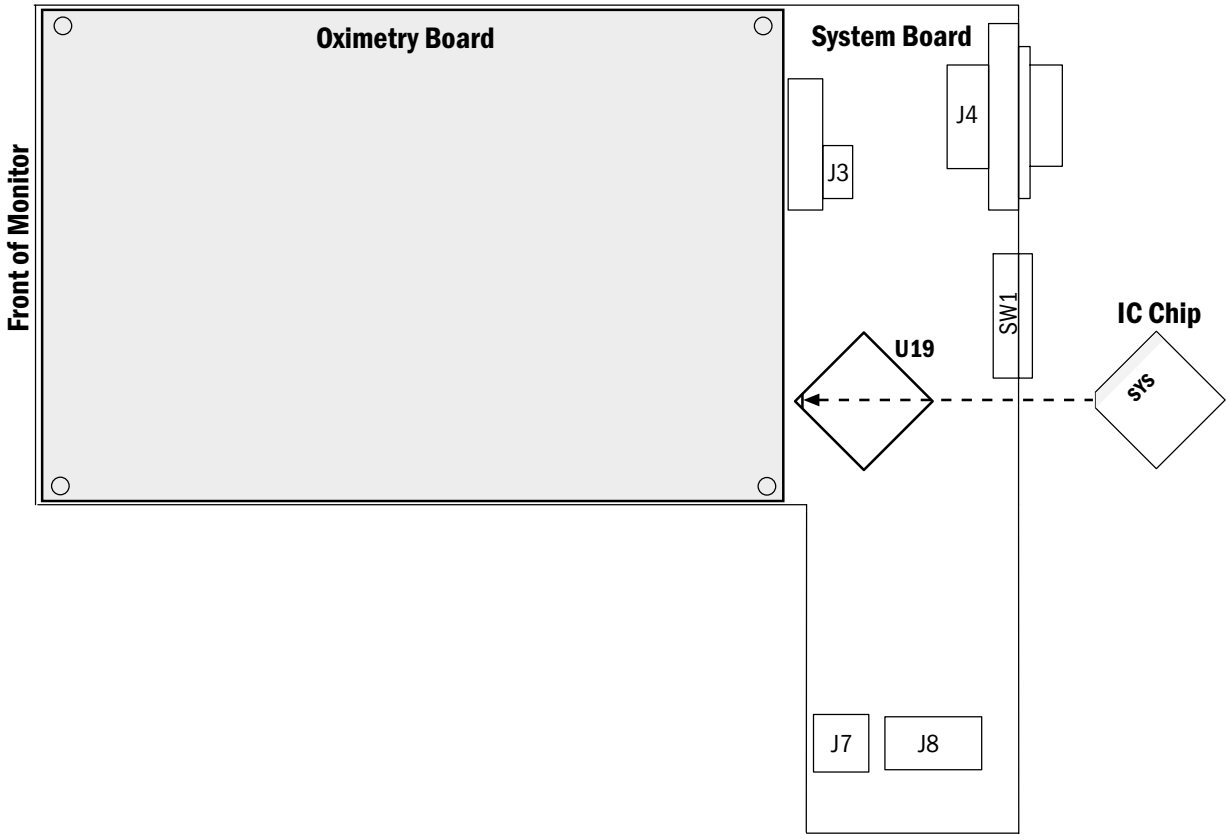


Figure 3-3. Upgrade socket and SYS IC chip

2. *Carefully* align the notch on upgrade chip **SYS X.XXX** with the notch on socket U19. Then, insert the chip into the socket.
3. Turn on the oximeter. Messages similar to those shown below are displayed.

System Download in Progress...
Erasing...

System Download in Progress...
Progress: XX%
Retries: XX

CYCLE POWER
Progress: 100%
Retries: XX
Updated to Ver Y.YYY

NOTE: Contact Datex-Ohmeda to obtain a new upgrade chip if the upgrade does not proceed as described above and the **CRC BAD!** or **INCOMPATIBLE!** error message is displayed.

- **CRC BAD!** indicates an incorrect or damaged IC chip.
- **INCOMPATIBLE!** means the upgrade software is not compatible with your oximeter.

These errors do not affect the previously-installed software. You can stop the system upgrade and the monitor will return to its prior operating condition. You may upgrade the oximetry software if you had planned to do so.

If either message appears, turn off the oximeter. Then, go to step 5.

4. When the **Cycle power** message is displayed, turn off the oximeter.
5. Use an IC chip extraction tool to remove the IC chip from the socket.
6. To upgrade the oximetry software, go to section 3.3.5.

   or

   Go to section 3.3.6 to install the cover and check the installation.

3.3.5 Oximetry software upgrade (monitors without TruTrak+)

To upgrade the oximetry software, you install the **OXY Y.YYY** IC chip on the system board and power on the unit to download the software to the oximetry board.

1. Locate the upgrade socket (U19) on the system board near the rear of the monitor.

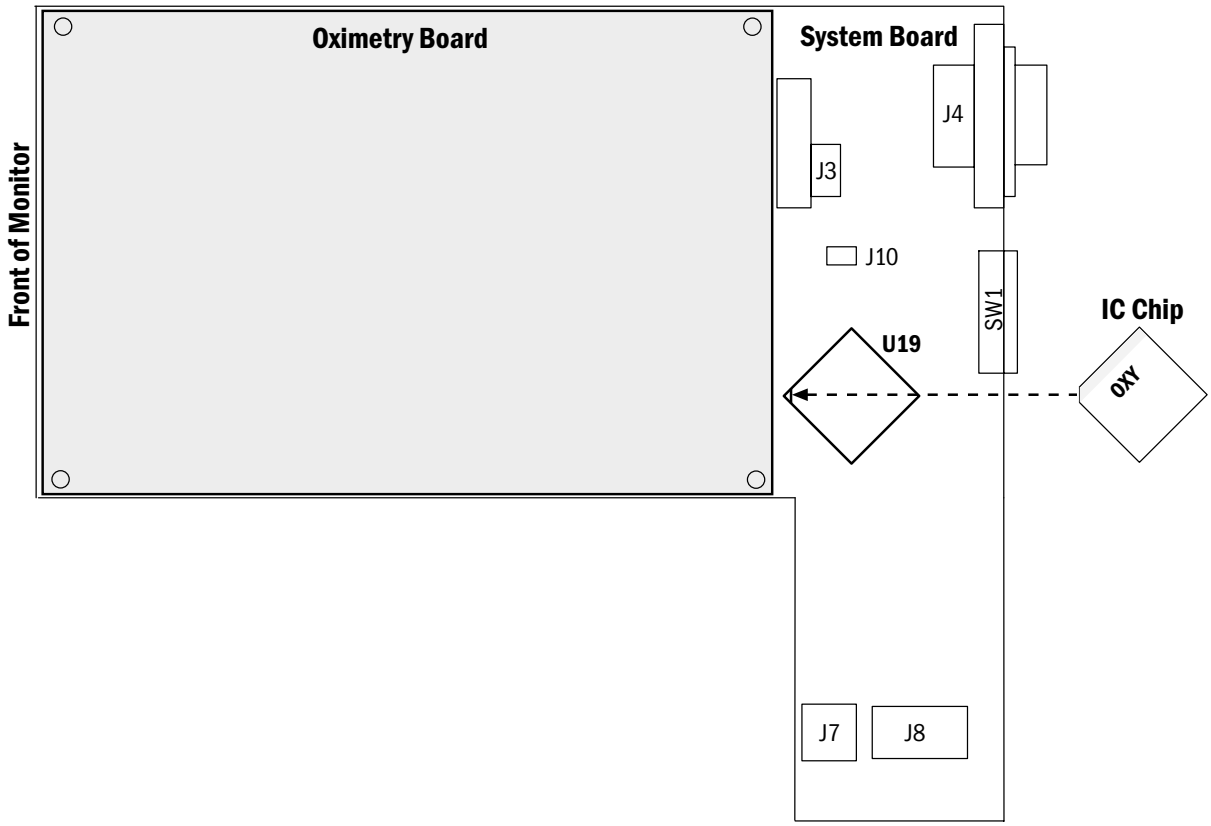


Figure 3-4. Upgrade socket and OXY IC chip

2. *Carefully* align the notch on upgrade chip **OXY Y.YYY** with the notch on socket U19. Then, insert the chip into the socket.
3. Turn on the oximeter. Messages similar to those listed below are displayed.

Oximetry Download in Progress **Progress: Erasing** **Retries: XX**
Oximetry Download in Progress **Progress: XX%** **Retries: XX**
CYCLE POWER **Progress: 100%** **Retries: XX** **Updated to Ver Y.YYY**

(**3900/3900P**) If a jumper is installed on J10, an alarm sounds and the screen remains blank. The jumper is for 3900/3900P system software upgrades only and should not be used for oximetry software upgrades.

To correct this situation:

- Turn off the oximeter.
- Remove the jumper from J10.
- Turn on the oximeter.

NOTE: Contact Datex-Ohmeda to obtain a new upgrade chip if the upgrade does not proceed as described above and the **CRC BAD!** or **INCOMPATIBLE!** error message is displayed.

- **CRC BAD!** indicates an incorrect or damaged IC chip.
- **INCOMPATIBLE!** means the upgrade software is not compatible with your oximeter.

These errors do not affect the previously-installed software. You can stop the system upgrade and the monitor will return to its prior operating condition. You may upgrade the oximetry software if you had planned to do so.

If either message appears, turn off the oximeter. Then, go to step 5.

4. When the **CYCLE POWER** message is displayed, turn off the oximeter.
5. Use an IC chip extraction tool to remove the IC chip from the socket.
   Then, go to section 3.3.6 to install the cover and check the installation.

3.3.6 Install the cover and check the installation

1. (3900P) Replace the catch tray and connect the printer cable:
   - Place the catch tray tube directly over the hole in the bottom of the chassis.
   - Align the holes in the catch tray with the holes in the chassis. Reinstall the two screws through the chassis and the catch tray. Make sure the tube remains in the chassis hole.
   - Reinstall the two nuts to the screws to anchor the catch tray to the chassis.
   - Position the cover above the chassis and connect the printer cable to the printer board.
   - To avoid disconnecting the printer cable, position the cover so that the tabs on each side of the cover are directly above the capture slots on the chassis.
2. Grasp both sides of the cover near the lower front corners; firmly pull outward. Lower the cover until the tabs on each side of the cover drop into the slots on the chassis.
3. Push the cover forward until it “locks” into place against the front panel.
4. Reinstall the two screws that secure the cover to the rear of the chassis.
5. To verify the software installation, turn on the oximeter.

   The version numbers for the installed system and oximetry software appear on the screen during the power-on sequence.

   (**3900P**) If Model 3900 (not Model 3900P) is displayed when you turn on the 3900P, you may have disconnected the printer cable while installing the cover. To reconnect the cable:

   - Turn off the oximeter.
   - Remove the cover, connect the cable to the printer board, and reinstall the cover.
   - Power on the oximeter and verify that **Model 3900P** is displayed.

Important: Perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2).

4/Troubleshooting

This chapter contains:

- An alphabetical list of the messages that may appear while using the oximeter and the 3900P printer.
- A list of the error codes that appear with a **SYSTEM FAILURE** message.
- A troubleshooting guide for the oximeter and the 3900P printer.
- 3900/3900P TeleOximetry® messages and troubleshooting guide.
- Test points on the System and Oximetry boards.

4.1 Messages

The following chart alphabetically lists the messages that may appear on the oximeter, why the message appears, and the action(s) to take if the message indicates a problem.

NOTE: Messages that may be displayed while using the 3900/3900P TeleOximetry feature are described in section 4.4.

Message	Cause	Action
 Appears in the graphic display alarm limit area.	The all mute feature is activated.	No action required. (Press the alarm silence button once to deactivate.)
  Appear on status screen during power-on sequence and on right side of LCD during battery operation.	Indicates a fully charged battery. Indicates a low-charged battery.	No action required. To recharge, plug the unit into AC mains power.
 Appears on status screen during power-on sequence.	Indicates battery failure, a depleted battery, or a missing battery.	To recharge, plug the unit into AC mains power. If the condition persists, the unit requires service.
 Appears in the graphic display message area.	The alarm or pulse tone volume is being adjusted.	No action required. To adjust audio volume, refer to the *User's Manual*.

Message	Cause	Action
AMBIENT LIGHT	Excessive ambient light.	Relocate the sensor to a site more shielded from light or reduce the amount of light shining on the sensor.
BUTTON STUCK	Something is up against the front of the oximeter.	Make sure nothing is pressing against a button.
	The last button you pressed has not released properly or has been pressed for more than 30 seconds.	Press the button again. If it doesn't release, cycle power. If it doesn't release, determine if the button pad needs to be cleaned or replaced (section 5.2). Also see section 4.3.
CHECK SENSOR SITE	SpO_2 readings may be invalid due to motion, an unacceptable sensor site, poor placement, low perfusion, or when the sensor is off the patient.	For all causes, reposition or relocate the sensor, and/or increase perfusion (refer to the instructions for the sensor).
	Detector failure.	Replace sensor.
Clear Trend Data? **YES/NO?**	**3800 oximeter** The alarm silence button is held down while you're turning on the 3800 pulse oximeter.	**3800 oximeter** Press a high SpO_2 alarm limit button (+ or -) to clear trend data from memory (YES). Press a low pulse rate alarm limit button (+ or -) to retain trend data in memory (NO).
CONNECT UNIT TO LINE POWER	The battery needs immediate recharging.	Plug the oximeter into the AC power supply; otherwise the unit will turn itself off in 5 seconds.
INSUFFICIENT LIGHT	Dirt on sensor emitter, sensor detector, or sensor site.	Clean the sensor (if reusable) or sensor site.
	Insufficient light penetrating the tissue site due to dark pigmentation or incorrectly positioned sensor.	Reposition the sensor or select a different site.
	Fingernail polish present.	Remove polish or select a new site.
	Detector failure.	Replace the sensor.
	Sensor connector failure.	See section 4.3.
INTERFERENCE DETECTED	The signal is too erratic to be processed. Possible cause is strong radio frequency (RF) interference generated by electrosurgery.	No action required. Readings do not change during interference. Readings change to dashes if interference persists. Signal processing resumes when interference ends.

Message	Cause	Action
LOW BATTERY	5 to 15 minutes of battery operation remain; i.e., battery voltage < 7.3 V.	Plug oximeter into the AC power supply to recharge the battery. **Important:** To prevent permanent damage to the battery, recharge a discharged battery within eight hours after the **LOW BATTERY** message is displayed.
LOW QUALITY SIGNAL	Sensor off patient.	Reattach the sensor.
	Perfusion insufficient for valid readings.	Check patient and oximeter setup; reposition or relocate sensor.
	Motion at sensor site, electrical noise, or incorrect sensor placement.	Check patient and oximeter setup; eliminate source of motion/noise.
Model 3800 Pulse Oximeter ***or*** **Model 3900 Pulse Oximeter** ***or*** **Model 3900P Pulse Oximeter (on product identification screen)** **Version X.XXX/YY.YYY** **(on second power-up screen)**	Appears briefly when you power on the oximeter. • X.XXX represents the current system software version. • YY.YYY represents the current oximetry software version.	No action required.
	(**3900P**) If **Model 3900** (not **Model 3900P**) is displayed, the printer cable may be disconnected.	(**3900P**) Reconnect the printer cable: • Turn off the oximeter. • Remove the cover, reconnect the cable, and reinstall the cover. • Power on the oximeter and verify that **Model 3900P** is displayed.
NO SENSOR **(also see CHECK SENSOR SITE)**	Sensor not fully inserted into the sensor connector.	Insert sensor plug into the connector.
	May be an incorrect sensor.	Refer to the instructions for the sensor.
PRINTER FAILURE	**3900P printer** Printer paper jam.	**3900P printer** Remove the jammed paper. Refer to the *3900/3900P User's Manual*
	Printer has failed.	Service printer; see section 5.7.

Message	Cause	Action
SENSOR FAILURE	The connected sensor is not an OxyTip+ sensor.	Use only OxyTip+ sensors.
	Oximeter can't identify the connected sensor.	Replace the sensor. Refer to the instructions for the sensor.
	Inoperative LEDs or broken sensor cable wire; the sensor has failed.	Replace sensor.
	Oximeter's sensor circuitry has failed.	Replace the oximetry board; see section 5.6.
SENSOR OFF	Sensor off patient.	Reattach the sensor.
	Oximeter's sensor circuitry failed.	Replace sensor. If the condition persists, replace the oximetry board; see section 5.6.
SYSTEM FAILURE #XXX: SERVICE UNIT	Internal component has failed. XXX = error code for the type of system failure.	See section 4.2.
TruTrak+ OFF	**TruTrak+ monitors**	**TruTrak+ monitors**
	TruTrak+ is not active; the averaging mode is not set to Long.	Set the Mode Switch to the Long averaging mode (refer to the *User's Manual* for instructions).
WAITING FOR SOFTWARE DOWNLOAD	**Monitors without TruTrak+**	**Monitors without TruTrak+**
	Software upgrade is in progress.	No action required.
	Oximetry board has no software; the software download was not completed.	Reload the oximetry board software; see section 3.3.

4.2 System failure error codes

4.2.1 Nonfatal errors—the system continues running

Error code	Meaning	Cause	Action
4	Erase flash failure	Software could not erase a sector of the system board Flash memory.	Replace system board.; see section 5.5.
20	Buffer full failure	Software buffer overflow.	No action necessary.
21	Queue full failure	Software buffer overflow.	Check the connection between the unit and communicating device. Verify serial communication setup (baud rate, stop/start bit, and parity).
52	Oximeter response failure	Communications error between system and oximetry boards.	Upgrade system and/or oximetry software as applicable for your monitor; see section 3.3.
53	Oximeter timeout failure	Oximetry board failed to respond within the appropriate amount of time.	Check the connection between the oximetry board and the system board. (**Monitors without TruTrak+**) Upgrade oximetry software; see section 3.3. Replace oximetry board; see section 5.6.
55	Oximeter user error failure	Improper communications from system to oximetry board. Incompatible system and oximetry software versions.	Upgrade system and/or oximetry software as applicable for your monitor; see section 3.3.
57	Oximeter value failure	Communications error between system and oximetry boards. Incompatible system and oximetry software versions.	Upgrade system and/or oximetry software as applicable for your monitor; see section 3.3.

4.2.2 Fatal errors—the system sounds an alarm tone and halts

Error code	Meaning	Cause	Action
101	Appl CRC failure	System board application code corrupted or not programmed.	Reinstall system board software; see section 3.3. Replace system board; see section 5.5.
102	Boot CRC failure	Invalid system boot code.	Replace system board; see section 5.5.
103	RAM failure	Error in system board RAM.	If the error occurs only occasionally, may be random causes (e.g., static discharge). If it occurs repeatedly, replace system board; see section 5.5.
110	Execution failure	Error in system board RAM or the data/address buses.	If the error occurs only occasionally, may be random causes (e.g., static discharge). If it occurs repeatedly, replace system board; see section 5.5.
111	Reset failure	System board processor was reset due to a bus error.	If the error occurs only occasionally, may be random causes (e.g., static discharge). If it occurs repeatedly, replace system board; see section 5.5.
112	Unused interrupt failure	Error in system board RAM or the data/address buses.	If the error occurs only occasionally, may be random causes (e.g., static discharge). If it occurs repeatedly, replace system board; see section 5.5.
113	Watchdog failure	System board software timing failure.	Upgrade system board software; see section 3.3. Replace system board; see section 5.5.
114	Guard-dog failure		
120	Buffer full failure	Internal system software check failed.	Upgrade the system board software; see section 3.3.
122	Value failure		
130	Event signal failure		
131	Event wait failure		
132	Mail create failure		
133	Mail send failure		
134	Mail wait failure		
135	Resource get failure		
136	Resource release failure		
137	Resource reserve failure		
138	Task create failure		
139	Task stack failure		
140	Task trig failure		
141	Task wait failure		
142	Timer create failure		
143	Timer start failure		
144	Timeout failure		

Error code	Meaning	Cause	Action
150	Oximeter error count failure	Too many errors in oximeter communications.	Check cable connection between system and oximeter board. If the error occurs only occasionally, may be random causes (e.g., static discharge). (**Monitors without TruTrak+**) Upgrade oximetry software if error occurs repeatedly; see section 3.3. If the error persists, replace the oximetry board; see section 5.6.
151	Oximeter command failure	System board attempted to transmit an invalid command to the oximetry board.	Check cable connection between system and oximeter board. If the error occurs only occasionally, may be random causes (e.g., static discharge). If it occurs repeatedly, upgrade system board software; see section 3.3. If the error persists, replace the system board; see section 5.5.
154	Oximeter sysfail failure	Oximetry board detected an internal error and halted operation.	Check cable connection between system and oximeter board. If the error occurs only occasionally, may be random causes (e.g., static discharge). (**Monitors without TruTrak+**) Upgrade oximetry software if error occurs repeatedly; see section 3.3. If the error persists, replace the oximetry board; see section 5.6.
156	Oximeter reset failure	Oximetry board fails to communicate at all.	Check cable connection between system and oximeter board. (**Monitors without TruTrak+**) Reinstall oximetry software, see section 3.3. Replace the oximetry board; see section 5.6.
157	Oximeter value failure	System board receives invalid data from oximeter board.	Check cable connection between system and oximeter board If the error occurs only occasionally, may be random causes (e.g., static discharge). (**Monitors without TruTrak+**) Upgrade oximetry software if error occurs repeatedly; see section 3.3. If the error persists, replace the oximetry board; see section 5.6.

4.3 Troubleshooting guide

The following chart lists situations that may occur while using the oximeter and the 3900P printer. These situations do not generate a message. Follow the recommended action(s) in the order listed until the cause is isolated and corrected.

NOTE: Situations that may occur while using the 3900/3900P TeleOximetry feature are described in section 4.4.

Situation/Cause	Action
Unit does not power on.	
Battery discharged	Plug the unit into AC power; verify that the green power light is on.
Fuses blown	Check the fuses. Replace if necessary; see section 5.3.4.
Power supply failure	Remove the cover; see section 5.1.1. Check the power connection to the system board. Check for +12 V at J8, pin 4 (+) to J8, pin1 (-).
Battery failure	Check the battery connections. Measure the voltages between the power supply and the battery; see section 4.5.1. Replace the battery; see section 5.3.5.
Switch board failure	To check the power button on the switch board, • Remove the front panel assembly; see section 5.2. • Unplug the switch board ribbon cable from the system board. • Check the power button switch on pins 16 and 44 on the ribbon cable. • Replace the switch board; see section 5.2.
System board failure	Replace the system board; see section 5.5.
Unit powers on but the graphic display is blank or black.	
Viewing contrast incorrect	Adjust viewing contrast slider.
LCD failure	Remove the front panel assembly; see section 5.2. Check the resistance of the viewing contrast potentiometer at J1; must be between 0 and 50 kΩ. Check the LCD connector pins and the switch board LCD connector for damage. Replace the switch board LCD; see section 5.2.
Switch board failure	Replace the switch board; see section 5.2.
System board failure	Replace the system board; see section 5.5.

Situation/Cause	Action
Unit powers on, an audible beep sounds, but there are no displays.	
Switch board failure	Remove the front panel assembly; see section 5.2. Check the ribbon cable from the switch board to the system board for proper seating in the connector, for bent pins, or for damage. On the system board, check at J1, pin 1 to pin 4, for +5 V. Replace the switch board; see section 5.2.
System board failure	Replace the system board; see section 5.5.
Unit powers on but no audible beep.	
Speaker disconnected	Remove the cover; see section 5.1.1. Check speaker connection to system board; see section 5.4.
Speaker failure	Replace the speaker; see section 5.4.
System board failure	Replace the system board; see section 5.5.
Model name displayed at power on is not correct.	
(**3900P**) Printer cable is disconnected	Turn off oximeter, remove cover, reconnect printer cable, and reinstall cover. Verify that **Model 3900P** is displayed at power on.
Model ID jumper on system board is/is not installed for model	Check J11 on system board for presence/absence of jumper: • Model 3800—jumper should be installed on J11. • Models 3900 and 3900P—jumper should **not** be installed on J11.
Continuous speaker tone.	
System board failure	Replace the system board; see section 5.5.
BUTTON STUCK message or button(s) not working.	
Dirty/worn buttons	Remove the front panel assembly; see section 5.2. Check button pads. Clean the button pads, check for damage; replace if necessary; see section 5.2.
Switch board failure	Replace the switch board; see section 5.2.
System board failure	Replace the system board; see section 5.5.
Fuses fail shortly after replacement.	
Shorts or power supply failure.	Remove the cover; see section 5.1.1. Disconnect the power inlet module from the power supply; see section 5.3.3. Check for shorts between the wires from the power inlet module. Replace the power supply; see section 5.3.1.
System board failure	Replace the system board; see section 5.5.

Situation/Cause	Action
No response or wrong response from dip switch setting(s).	
Dip switch failure	Replace the system board; see section 5.5.
Battery won't charge.	
Battery failure	Plug the unit into AC power; verify that the green power light is on. Remove the cover; see section 5.1.1. Check battery connections. Measure the battery voltages across 1 red and 1 black wire; should be between 6.5 and 9.5 volts. Replace the battery; see section 5.3.5.
System board failure	Replace the system board; see section 5.5.
Green power light remains off when unit is connected to AC power.	
Fuses blown	Check the fuses. Replace if necessary; see section 5.3.4.
Power cord failure	Check the power cord; replace if necessary.
Power supply failure	Remove the cover; see section 5.1.1. Check the power supply voltages; see section 4.5.1. Replace power supply; see section 5.3.1.
Switch board failure	Remove the front panel assembly; see section 5.2. Disconnect the ribbon cable from the system board. Test for voltage on J1 on the ACLED pin, pin 14, on the system board. Replace the switch board; see section 5.2.
System board failure	Replace the system board; see section 5.5.
Green power light remains on when unit is disconnected from AC power.	
System board failure	Replace the system board; see section 5.5.
Unit will not enter standby mode.	
Switch board failure	Remove the cover; see section 5.1.1. To check the power button on the switch board, • Remove the front panel assembly; see section 5.2. • Unplug the switch board's ribbon cable from the system board. • Check power button switch on pins 16 and 44 on the ribbon cable. • Replace the switch board; see section 5.2.
System board failure	Replace the system board; see section 5.5.

Situation/Cause	Action
No communication through the RS-232 port.	
Cable failure	Check the signal voltages and the wiring on the cable from the oximeter to the connected device; pin assignments are shown in section 1.3.7. Check the RTS (Request To Send) and CTS (Clear To Send) lines for + voltage, pins 7 and 8, respectively.
Connector failure	Replace the system board; see section 5.5.
(3900/3900P) Times in reports do not match.	
Reports generated at different times or different ways	No action required. Times stated in reports (i.e., PC downloads, printouts, InstaReports) may vary depending on when/how the report is generated, however, the clinical information, including duration, is accurate.
(3900P) Printer buttons do not initiate an action.	
Button may be locked (print trend button only)	To unlock, refer to the *3900/3900P User's Manual*.
Printer cable may be disconnected	Reconnect the printer cable.
Printer button board failure	Remove the printer bucket; see section 5.7.2. Check that there are no broken wires on J1 of the printer button board, or that J4 on the printer board has not come unplugged. Replace the printer button board; see section 5.7.2.
Printer board failure	Remove the cover; see section 5.1.1 Check that J9 is plugged into the system board. Replace the printer board; see section 5.7.1.
System board failure	Replace the system board; see section 5.5.

4.4 3900/3900P TeleOximetry messages and troubleshooting

4.4.1 TeleOximetry status messages

These messages may be displayed on the oximeter when you send data to a remote computer or to a fax machine, using a modem (or fax modem) connected to the oximeter. The meaning and response (if applicable) for each message is included.

NOTE: For status messages and error messages related to using the TeleOximetry PC Access software, refer to the instructions located on the TeleOximetry CD.

Status message (oximeter)	Meaning/Response
BUSY	The fax machine or phone line is busy. The modem redials the number until the fax machine or phone line is no longer busy or until you press CANCEL.
CONNECTING...	The FAX machine has answered the phone.
CONNECTION FAILURE	The modem cannot contact the fax machine or remote computer. Verify that the phone number was entered correctly and the remote equipment (fax machine, modem and/or computer) is powered on. If the message persists, the phone system used by the oximeter modem may require a guard tone. To set the guard tone, see the *3900/3900P User's Manual*.
DIAL REMOTE COMPUTER	The modem is dialing the number of the modem associated with the remote computer.
DIALING REMOTE FAX	The modem is dialing the number you entered for the fax machine.
FAX CANCELED	When you cancel a fax transmission, this message is displayed on the screen and transmitted to the fax machine.
FAX DONE	Fax transmission is complete. The modem disconnects the phone line. Press ◄┘ to return to the SEND screen.
FAX ERROR	A nonrecoverable error occurred during transmission of a fax. This message indicates a problem with your modem, the phone line, or the fax machine. Check the connection, setup, and function of all these components. Verify that you are faxing to a Group 3 fax machine.
FOUND	The oximeter detected the modem that is connected to the oximeter.
INITIALIZATION STRING FAILURE	The modem rejected the initialization string. Make sure you entered the initialization string correctly (see the *3900/3900P User's Manual*). If the entry is correct, consult the instructions for your modem.
NO ANSWER	There is no answer after the number is dialed. Verify that you entered the number correctly and the remote equipment (fax machine, modem and/or computer) is powered on.
NO DATA	You tried to send a fax that covered **only** hours during which no numeric data were collected. For example, if numeric data were collected two hours earlier, but not during the last hour of operation, you can send two or more hours of data, but not one. This eliminates the possibility of sending an InstaReport that contains no numeric data.

Status message (oximeter)	Meaning/Response
NO DIAL TONE	The modem cannot find a dial tone when attempting to call the number. Verify that the modem is properly connected to the correct phone line..
NOT FOUND: CONNECT MODEM	The oximeter modem was not detected by the oximeter. Check and correct all connections between the oximeter and modem. Power on the modem. If the message persists, refer to section 4.4.2.
SEARCHING...	The oximeter is searching for the modem (you selected MODEM at the MENU screen).
SENDING FAX...	The connection process is complete and the fax is being sent.
SENDING DATA...	REMOTE COMPUTER option: Data is being sent to a remote computer. *or* WAIT FOR CALL option: Your modem received the call and is sending data to the remote computer.
TRANSMISSION CANCELED	You canceled a remote computer transmission. This message is transmitted to the remote computer.
TRANSMISSION DONE	Transmission to a remote computer (using the REMOTE COMPUTER or the WAIT FOR CALL option on the oximeter SEND screen) is complete. The modem disconnects the phone line. Press ◄┘ to return to the SEND screen.
TRANSMISSION ERROR	A nonrecoverable error occurred during transmission of data to a remote computer. This message indicates a problem with your modem, the phone line, the remote modem, or the remote computer. Check the connections, setup, and function of all these components.
WAITING FOR CALL	The modem is waiting for an incoming call. You may not use the 3900P printer while the modem is active. To cancel the transmission, press CANCEL.

4.4.2 TeleOximetry troubleshooting guide

The situations listed below may occur while using a modem that is connected to the 3900 or 3900P.

NOTE: Situations related to using the TeleOximetry PC Access software on your PC are described in the instructions located on the TeleOximetry CD.

Situation	Cause	Action
No communication through the modem that is connected to the oximeter.	Incorrect cable used to connect modem to oximeter.	Use only the Datex-Ohmeda modem/analog cable. Refer to section 6.1.
	Modem is powered off or not properly connected. Phone line failure.	Check and correct all modem connections. Power on the modem. Check the phone line.
	Incorrect or improperly entered modem initialization string.	Check initialization string entry. Verify the accuracy of the string. *3900/3900P User's Manual*.
	Your phone system may require a guard tone.	Enter a guard tone, if needed. Refer to the *3900/3900P User's Manual*.
	Mismatched baud rate.	For some older modems, the oximeter's baud rate must be set to match the modem's baud rate. To set the oximeter's baud rate, refer to the *3900/3900P User's Manual*.
	Modem failure.	Contact the modem manufacturer for assistance.
Data transmission from the oximeter is very slow or fails repeatedly.	The data transfer rate of the modem connected to the oximeter is too low.	Use a 56K modem or fax modem.

4.5 Test points

4.5.1 System board test points

See section 6.5 for the placement of test points on the system board.

NOTE: TP2, TP3, TP4, TP7, and TP8 are not used.

Test point	Signal name	Description
TP1	LOWBAT'	Battery voltage has dropped below 7.3 V
TP5	ISOLATED GND	Isolated circuit reference
TP6	RECHRG'	Battery voltage has dropped below 7.0 V (reset by mains power applied)
TP9	AUDIO AMP IN	Sawtooth (alarms)/square wave (pulse)
TP10	SAWTOOTH OUT	Sawtooth waveform at approx. 8 kHz
TP11	RXD'	Received oximeter board data
TP12	TXD'	Data transmitted to oximeter board
TP13	DGND	Digital ground reference
TP14	+VSW	If on battery, then battery voltage –0.3 V else 11.5 V (unit operating)
TP15	+VRAM	+5 V with unit operating, +4 V in standby mode
TP16	+VR	+4 V in standby mode
TP17	ON	High when unit is on, low when unit is in standby
TP18	RST'	Normally high, low when processor is being reset
TP19	RECHRG	Battery voltage is above 7 V
TP20	+5D	+5 V
TP21	DGND	Digital ground reference

4.5.2 Oximetry board test points

See section 6.6 for the placement of test points on the oximetry board(s).

Oximetry board in TruTrak+ monitors (REF 6050-0006-066)

Test point	Signal name	Description
TP1	PRE	Detector preamp output
TP2	TEST SIG	Test signal amplifier output
TP3	LPF1 OUT	LP filtered detector or test signal
TP4	INTF	Output of interference detection amplifier and integrator
TP5	COMP GAIN OUT	Multiplexed detector signal after composite gain (varies based on detector signal)
TP6	RDC	Red composite signal after LP filter
TP7	IRDC	Infrared composite signal after LP filter
TP8	IRDCHP	IRDC after HP filter
TP9	RDCHP	RDC after HP filter
TP10	RESET	Normally low/high when processor being reset
TP11	AC GAIN IN	Input to AC gain amplifier (multiplexed RDCHP and IRDCHP)
TP12	AC GAIN OUT	Output of AC gain amplifier (multiplexed RAC and IRAC)
TP13	RAC	Red photoplethysmographic waveform
TP14	IRAC	Infrared photoplethysmographic waveform
TP15	AD MUX OUT	A/D multiplexed signal for all channels, scaled by 0.78
TP16	AMUX	A/D multiplexor output, scaled by 0.39 and level-shifted
TP17	VREF	+ 4.1 volt reference voltage

Oximetry board in monitors without TruTrak+ (REF 6050-0003-745)

Test point	Signal name	Description
TP1	COMP GAIN OUT	Multiplexed detector signal after composite gain (varies based on detector signal)
TP2	IRDC	Infrared composite signal after LP filter
TP3	IRDCHP	IRDC after HP filter with variable pole
TP4	RDCHP	RDC after HP filter with variable pole
TP5	RDC	Red composite signal after LP filter
TP6	AD MUX OUT	A/D multiplexed signal for all channels
TP7	IRAC	Infrared photoplethysmographic waveform
TP8	SCCLOCK	Switched capacitor filter clock (1 kHz)
TP9	AC GAIN OUT	Multiplexed RDCHP and IRDCHP after gain
TP10	LP PREA	LP filtered detector or test signal
TP11	TEST SIG	Test signal amplifier output
TP12	MUX3’	Low when U16 A/D MUX is selected
TP13	RAC	Red photoplethysmographic waveform
TP14	AC GAIN IN	Input to AC gain amplifier, multiplexed
TP15	AGND	Analog ground reference
TP16	RESET’	Normally high, low when processor being reset
TP17	SRAM_CE	Low when static ram is enabled
TP18	BUFF AD MUX OUT	Buffered A/D multiplexor output
TP19	DAC_CE’	Low when D/A converter is enabled
TP20	AGND	Analog ground reference
TP21	PGM	High when flash memory is being programmed
TP22	INST	High during instruction fetches
TP23	A16	Address bus line 16
TP24	AGND	Analog ground reference

5/Repair and Replacement Procedures

This chapter contains:

- Oximeter cover, removal and replacement.
- Replacement of front panel components:
  Front panel
  Sensor connector
  (**Monitors without TruTrak+**) Sensor filter board
  (**TruTrak + monitors**) Sensor filter flex cable
  Switch board LCD
  Button pads
  Switch board
- Replacement of power-related components:
  Power supply
  Equipotential ground connector
  Power inlet module
  Fuses
  Battery
- Speaker replacement
- System board replacement
- Oximetry board replacement
- Replacement of 3900P printer components:
  Printer board
  Printer button board

CAUTION: Only qualified service personnel should perform the procedures described in this manual.

(**3900/3900P**) Datex-Ohmeda does not warrant or service modems. Contact the manufacturer of your modem for service.

Refer to chapter 6 for service kit contents, part numbers, assembly drawings, and board layout drawings.

Important: If the cover is removed for any test or repair procedure, always perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2) before returning the unit for patient monitoring.

5.1 Oximeter cover

Important: If the cover is removed for any test or repair procedure, always perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2) before returning the unit for patient monitoring.

Tool: Phillips screwdriver, #1

5.1.1 Removing the cover

WARNING: Electrical shock hazard. Before cleaning or repairing the oximeter, turn it off and disconnect it from AC mains power.

CAUTION: Static sensitivity. Internal electronic components are susceptible to damage by electrostatic discharge. To avoid damage when disassembling the oximeter, observe the standard precautions and procedures for handling static-sensitive components.

1. Turn off the oximeter and disconnect the power cord from the rear of the chassis.
2. Remove the two screws that secure the cover to the rear of the chassis.
3. Firmly press down on the cover and push it away from the front panel until it slips out of the locks on each side of the chassis.
4. To release the cover from the slots on the chassis, grasp both sides of the cover near the lower front corners and pull *firmly* outward.
5. Lift the cover up; keep the sides free of the oximeter chassis.
6. (**3900P**) Disconnect the printer cable from the printer board.
7. Remove the cover.

5.1.2 Replacing the cover

1. (**3900P**) Position the cover above the chassis and connect the printer cable to the printer board.
2. (**3900P**) To avoid disconnecting the printer cable, position the cover so that the tabs on each side of the cover are directly above the capture slots on the chassis.
3. Grasp both sides of the cover near the lower front corners and firmly pull outward. Lower the cover until the tabs on each side of the cover drop into the slots on the chassis.
4. Push the cover forward until it “locks” into place against the front panel.
5. Reinstall the 2 screws that secure the cover to the rear of the chassis.

5.2 Front panel assembly

The front panel assembly contains the following replaceable parts:

- Front bezel, pressure plate, and sensor connector
- (**Monitors without TruTrak+**) Sensor filter board
- (**TruTrak+ monitors**) Sensor filter flex cable
- Switch board, switch board LCD, and button pads

Important: The procedures in section 5.2.2 through section 5.2.6 assume the front panel assembly has been disassembled (partially or completely) as directed in section 5.2.1, then reassembled as directed in section 5.2.7.

5.2.1 Front panel, remove and disassemble

Tool: Phillips screwdriver, #1

1. Remove the cover (observe all warnings and cautions); see section 5.1.1.
2. Remove the two screws on the sides of the chassis that hold the front panel assembly in place and slide the front panel assembly away from the chassis.
3. (**Monitors without TruTrak+**) Disconnect the sensor filter board connector from J1 on the oximetry board.
4. (**TruTrak+ monitors**) Disconnect the sensor filter flex cable from J6 on the oximetry board.
5. Disconnect the switch board ribbon cable from J1 on the system board.
6. Gently pull back on the 9-pin connector to disconnect it from the back of the sensor connector on the front panel.

NOTE: If you are replacing only the sensor filter (board or flex cable), you do not need to remove the metal pressure plate or the switch board; go to section 5.2.2.

7. To remove the metal pressure plate on the back of the front panel, remove the screw on each side of the plate and lift the plate off. Retain the screws and the standoffs that sit between the plate and the switch board for reinstallation.

NOTE: If you are replacing only the switch board LCD, you do not need to remove the switch board; go to section 5.2.3. Continue below if you plan to replace the sensor connector, button pads, or switch board.

Important: The viewing contrast slider may be damaged if the switch board is not removed from the bezel correctly.

8. When removing the switch board from the front panel,
   - To avoid breaking the viewing contrast slider, make sure the viewing contrast slider, which is inserted through a slot just above the power button, is as close to the nearest edge of the switch board as possible.
   - Gently grasp the ribbon cable at the top of the switch board.
   - Pull the top of the board back slightly and lift while easing the viewing contrast slider up and out of the slot.

5.2.2 Sensor filter replacement (board or flex cable)

Sensor filter board

1. Remove the four screws that hold the sensor filter board to the pressure plate.
2. Press the 9-pin connector on the bottom of the sensor filter board firmly but carefully into the back of the sensor connector on the front panel.
3. Position the new sensor filter board over the pressure plate and install the four screws that hold the board to the pressure plate.

Sensor filter flex cable

1. Remove the two screws that hold the sensor filter flex cable to the pressure plate.
2. Press the 9-pin connector at the end of the flex cable firmly but carefully into the back of the sensor connector on the front panel.
3. Position the new sensor filter flex cable over the pressure plate and install the two screws that hold it to the pressure plate.

5.2.3 Sensor connector replacement

Tool: Needle-nose pliers (or sensor socket wrench)

1. Use the needle-nose pliers to remove the nut on the back of the sensor connector that secures it to the front bezel.
2. Remove the toroid from the back of the connector. Then, push the connector out through the front of the bezel.
3. Insert the new connector.
4. Place the toroid on the back of the connector and secure the connector to the front bezel with the nut.

5.2.4 Switch board LCD replacement

The switch board LCD connects to the switch board on the right side (looking down on the back of the switch board) through a 19-pin connector.

1. Lift the LCD straight up off the switch board and the connector.
2. Put the new LCD in place carefully; do not bend the connector pins.

5.2.5 Button pad replacement

If a button pad has become torn, too dirty to properly clean, or otherwise damaged, you can replace the button pad. However, if a button switch on the switch board is broken, you must replace the switch board; see section 5.2.6.

Each button pad (power, alarm, volume, and limits) sits on small posts that hold it against the front bezel.

1. Gently pull the button pad straight up until it is free of the posts.
2. To install the new button pad, align the small holes in the pad with the matching posts and firmly press it into place.

5.2.6 Switch board replacement

NOTE: These instructions are not applicable to the 3800 REF 6051-0000-064.

1. Make sure the button pads are properly seated on their retaining posts.
2. Make sure the viewing contrast slider on the switch board is pushed to the far edge of the board.
3. Insert the viewing contrast slider carefully down through the slot in the front bezel above the power button.
4. Place the new switch board flush against the front bezel.
5. Place the two standoffs between the pressure plate and the switch board. Then, place the pressure plate over the switch board, with the foam side against the board.
6. **Before reinstalling the screws** on either side of the pressure plate (which also secure the switch board), turn the bezel over and make sure the viewing contrast slider is through the slot and visible on the outside of the bezel.
7. Reinstall the two screws (going through the standoffs) that hold the pressure plate and switch board to the front bezel.
8. Check all button pads for proper orientation, alignment, and function.

5.2.7 Front panel, reassemble and reinstall

NOTE: Reassembly depends on the part(s) you replaced. Assuming you completely disassembled the front panel, all the steps needed to reassemble the panel and attach it to the chassis are provided below—begin where appropriate.

Complete steps 1 through 8 if the switch board is not installed; otherwise, start with step 9.

1. Make sure the button pads are properly seated on their retaining posts.
2. Make sure the viewing contrast slider on the switch board is pushed to the far edge of the board.
3. Insert the viewing contrast slider carefully down through the slot in the front bezel above the power button.
4. Place the switch board flush against the front bezel.
5. Place the two standoffs between the pressure plate and the switch board. Then place the pressure plate over the switch board, with the foam side against the board.
6. Before reinstalling the screws on either side of the pressure plate (which also secure the switch board), turn the bezel over and make sure the viewing contrast slider is through the slot and visible on the outside of the bezel.
7. Reinstall the two screws (going through the standoffs) that hold the pressure plate and switch board to the front bezel.
8. Check all button pads for proper orientation, alignment, and function.
9. Make sure the 9-pin connector from the sensor filter (board or flex cable) is firmly connected to the back of the sensor connector on the front panel.
10. Connect the switch board ribbon cable to J1 on the system board.

11. (**Monitors without TruTrak+**) Connect the sensor filter board connector (P2) to J1 on the oximetry board.
12. (**TruTrak+ monitors**) Connect the sensor filter flex cable (P2) to J6 on the oximetry board.
13. Slide the front panel assembly onto the oximeter chassis until it is in place.
14. Reinstall the two screws that hold the front panel assembly to the sides of the chassis.
15. (**Monitors without TruTrak+**) Make sure the two loop fasteners used with the sensor filter board are each wrapped around two small ferrites and pressed against the hook-and-loop fastener on the side of the chassis.
16. Reinstall the cover; see section 5.1.2.
17. Perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2).

5.3 Power-related components

5.3.1 Power supply replacement

Tool: Phillips screwdriver, #1

1. Remove the cover (observe all warnings and cautions); see section 5.1.1.
2. Disconnect the green wire spade lug on the power inlet module from the ground on the power supply.
3. Disconnect the blue/brown primaries from the power inlet module from J1 on the power supply.
4. Release the toroid from the rear panel and remove the toroid from the secondaries.
5. Disconnect the secondaries from J8 on the system board.
6. Remove the two screws from the inner side of the power supply.
7. While rotating slightly to release the power supply from the chassis bracket, lift the power supply out of the chassis.
8. Place the new power supply in the chassis, making sure it is secure in the chassis bracket.
9. Reinstall the two screws that hold the power supply to the chassis bottom.
10. Clamp the toroid around the secondaries and fasten to the rear panel.
11. Connect the secondaries to J8 on the system board.
12. Connect the blue/brown primaries from the power inlet module to J1 on the new power supply.
13. Connect the green wire spade lug from the power inlet module to the ground on the power supply.
14. Reinstall the cover; see section 5.1.2.
15. Perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2).

5.3.2 Equipotential ground connector replacement

Tools:

- Phillips screwdriver, #1
- 10 mm open-ended wrench
- Needle-nose pliers

1. Remove the cover (observe all warnings and cautions); see section 5.1.1.
2. To disconnect the ground wire (green/yellow) from the power inlet module to the equipotential ground connector:
   - Use the open-ended wrench to remove the end nuts (hex M6 with captive washers) from the equipotential ground connector.
   - Slide the ground wire off.
3. Use the needle-nose pliers to loosen the equipotential ground connector ring from the rear chassis (insert the ends of the pliers into the two grooves on the inside of the ring); remove the equipotential ground connector.

4. Place the new equipotential ground connector through the hole in the rear chassis with the green/yellow ring on the outside.
5. Use the needle-nose pliers to tighten the equipotential ground connector ring against the rear chassis.
6. Slide the ground wire (green/yellow) from the power inlet module over the equipotential ground connector.
7. Place the two nuts with captive washers (washers toward the rear of the chassis) on the equipotential ground connector and tighten with the open-ended wrench.
8. Reinstall the cover; see section 5.1.2.
9. Perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2).

5.3.3 Power inlet module replacement

Tools:

- Phillips screwdriver, #1
- 10 mm open-ended wrench

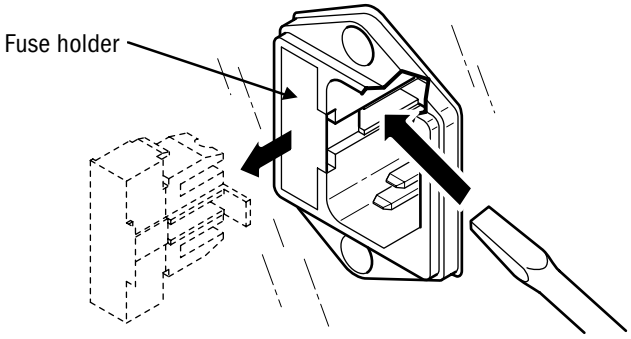
1. Remove the cover (observe all warnings and cautions); see section 5.1.1.
2. Disconnect the green wire spade lug connector from the ground on the power supply.
3. Disconnect the blue/brown primaries connector from J1 on the power supply.
4. To disconnect the ground wires (green/yellow) from the equipotential ground connector:
   - Use the open-ended wrench to remove the end nuts (with captive washers) from the ground stud attached to the chassis and from the equipotential ground connector.
   - Slide the ground wires off.
5. Remove the two screws holding the power inlet module to the rear of the chassis.
6. Push the module out through the rear of the chassis.
7. Insert the new power inlet module into the rear of the chassis.
8. Reinstall the two screws that hold the module to the chassis.
9. Slide one ground wire connector from the module onto the ground stud and the other onto the equipotential ground connector.
10. Reinstall the nuts on the ground stud and equipotential ground connector.
    - Make sure the captive washers point toward the rear of the chassis.
    - Use the wrench to tighten the nuts securely.
11. Reconnect the blue/brown primaries connector to J1 on the power supply.
12. Reconnect the green wire spade lug connector to the ground on the power supply.
13. Make sure there are two fuses in the power inlet module. Replace the fuses if necessary; see section 5.3.4.
14. Reinstall the oximeter cover; see section 5.1.2.
15. Perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2).

5.3.4 Fuse replacement

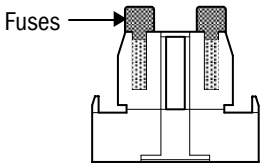
Tool: Small flat-blade screwdriver, 5 mm (3/16 inch)

WARNING: To protect against fire hazard, replace only with fuses of the same type and voltage rating.

1. Turn off the oximeter and unplug the power cord from the back of the oximeter.
2. Insert the small flat-blade screwdriver into the center slot of the fuse holder. Gently pry loose and remove the fuse holder.



3. Note how the fuses are placed in the fuse holder for installation of the new fuses.

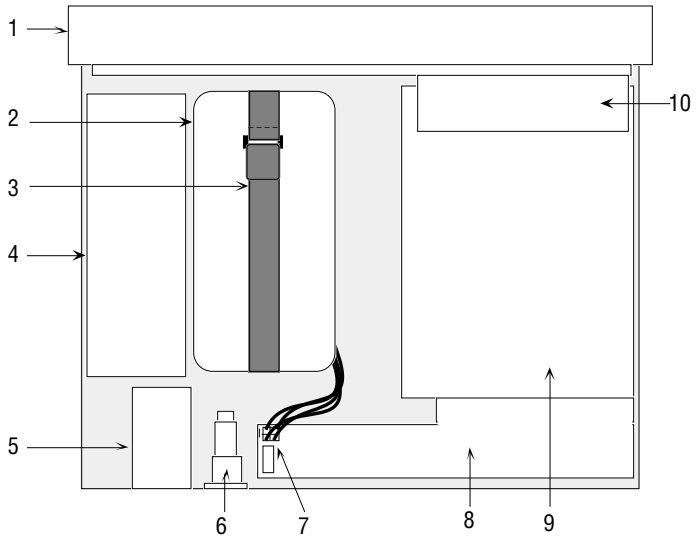


4. To remove the fuses from the fuse holder, use the edge of the screwdriver blade to pry against the bottom of the metal portion of the fuse where it is secured to the glass portion of the fuse.
5. Place the new fuse(s) (T2.0AH/250V) in the fuse holder.
6. Slide the fuse holder back into the power entry module and press firmly to make sure it is fully inserted.
7. Perform the *Functional check*; see section 3.1.

NOTE: If the fuses blow shortly after replacement, the unit requires additional service; see section 4.3.

5.3.5 Battery replacement

Tool: Phillips screwdriver, #1



1 Front of unit
2 Battery pack
3 Hook-and-loop strap
4 Power supply
5 Power entry module
6 Ground connector
7 Battery wire connector
8 System board
9 Oximetry board
10 Ribbon cable to front panel

1. Remove the cover (observe all warnings and cautions); see section 5.1.1.
2. Undo the hook-and-loop straps to release the battery pack.
3. Remove the battery wire connector (red and black wires to a white connector) from the system board at the rear of the oximeter.
4. Being careful to contact no other internal components, carefully remove the used battery pack from its tray in the unit.
5. Place the new battery pack in the battery tray with the connector toward the rear of the unit and near the system board.
6. Firmly secure the battery pack with the hook-and-loop straps.
7. Press the battery wire connector firmly into the connector on the system board. The connector is constructed so it will only go on one way, with the white flange toward the power entry module.
8. After checking that no wires are out of place or could be pinched, reinstall the cover; see section 5.1.2.
9. Perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2).

(**3900/3900P**) Turn on the oximeter and check the settings (time, alarm limits, etc.) before using for patient monitoring.

5.4 Speaker replacement

Tool: Phillips screwdriver, #1

1. Remove the cover (observe all warnings and cautions); see section 5.1.1.
2. Remove the power supply.
   - Disconnect the green wire spade lug on the power inlet module from the ground on the power supply.
   - Disconnect the blue/brown primaries from the power inlet module from J1 on the power supply.
   - Release the toroid from the rear panel and remove the toroid from the secondaries.
   - Disconnect the secondaries from J8 on the system board.
   - Remove the two screws from the inner side of the power supply.
   - While rotating slightly to release the power supply from the chassis bracket, lift the power supply out of the chassis.
3. Disconnect the speaker connector from J3 on the system board.
4. Remove the O-ring that secures the speaker within the three retaining pins that hold the speaker in place.
5. Lift the speaker straight up.
6. Put the new speaker in place; make sure it is properly seated within the three retaining pins.
7. Reinstall the O-ring around the outside of the three retaining pins.
8. Connect the speaker connector to J3 on the system board.
9. Reinstall the power supply.
   - Place the new power supply in the chassis, making sure it is secure in the chassis bracket.
   - Reinstall the two screws that hold the power supply to the chassis bottom.
   - Clamp the toroid around the secondaries and fasten to the rear panel.
   - Connect the secondaries to J8 on the system board.
   - Connect the blue/brown primaries from the power inlet module to J1 on the new power supply.
   - Connect the green wire spade lug from the power inlet module to the ground on the power supply.
10. Reinstall the cover; see section 5.1.2.
11. Perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2).

5.5 System board replacement

The bank of mode switches and the RS-232 connector are part of the system board. If either needs to be replaced, you must replace the entire system board.

Tool: Phillips screwdriver, #1

Important: Before installing the system board, check J11 on the **new** board:

- (**3800**) Verify that a jumper is installed on J11. Install a jumper if necessary.
- (**3900/3900P**) Verify that a jumper is **not** installed on J11. If a jumper is installed, remove it.

1. Remove the cover (observe all warnings and cautions); see section 5.1.1.
2. (**3900P**) Remove the catch tray:
   - Remove the two nuts from the screws that hold the catch tray to the chassis. Remove the two screws from the catch tray and chassis.
   - Slowly pull the catch tray straight up and remove it from the unit.
3. Remove the front panel assembly:
   - Remove the two screws on the sides of the chassis that hold the front panel assembly in place and slide the assembly off the chassis.
   - (**Monitors without TruTrak+**) Disconnect the sensor filter board connector from J1 on the oximetry board.
   - (**TruTrak+ monitors**) Disconnect the sensor filter flex cable from J6 on the oximetry board.
   - Disconnect the switch board ribbon cable from J1 on the system board.
4. Remove the oximetry board.
   - Disconnect the ribbon cable from J6 on the system board.
   - Remove the four screws that secure the oximetry and system boards to the standoffs on the chassis.
   - Lift the oximetry board off the system board.
5. Remove the two jack screws on the outside of the rear chassis from the RS-232 connector.
6. Remove the screw holding the heat sink against the rear chassis.
7. On the system board, disconnect the following:
   - Speaker locking connector from J3.
   - Battery locking connector from J7.
   - Secondaries on the power supply from J8.
   - (**3900P**) Printer cable from J9.
8. Slide the system board toward the front of the oximeter and lift straight up.

9. Check header J11 on the **new** system board:
   - (**3800**) Verify that a jumper is installed on J11.
   - (**3900/3900P**) Verify that a jumper is **not** installed on J11.
10. Holding the new system board as far toward the front of the oximeter as possible, position the board's holding slots over the standoffs, place it down on the chassis, and slide back to hold in place.
11. Connect the following to the system board:
    - Secondaries on the power supply to J8.
    - Battery's locking connector to J7.
    - Speaker's locking connector to J3.
    - (**3900P**) Printer cable to J9.
12. Reinstall the screw that holds the heat sink to the rear chassis.
13. Reinstall the two jack screws on the RS-232 connector.
14. Place the oximetry board on the system board and reinstall the four screws that hold them to the standoffs on the chassis.
15. Connect the oximetry board ribbon cable to J6 on the system board:
16. Reinstall the front panel assembly:
    - Connect the switch board ribbon cable to J1 on the system board.
    - (**Monitors without TruTrak+**) Connect the sensor filter board connector to J1 on the oximetry board.
    - (**TruTrak+ monitors**) Connect the sensor filter flex cable to J6 on the oximetry board.
    - Slide the front panel assembly onto the oximeter chassis until it is in place.
    - Reinstall the two screws that hold the front panel assembly to the sides of the chassis.
    - (**Monitors without TruTrak+**) Make sure the two loop fasteners used with the sensor filter board are each wrapped around two small ferrites and pressed against the hook-and-loop fastener on the side of the chassis.
17. (**3900P**) Replace the catch tray:
    - Place the catch tray tube directly over the hole in the bottom of the chassis.
    - Align the holes in the catch tray with the holes in the chassis. Reinstall the two screws through the chassis and the catch tray. Make sure the tube remains in the chassis hole.
    - Reinstall the two nuts to the screws to anchor the catch tray to the chassis.
18. Reinstall the cover; see section 5.1.2.
19. Perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2).

NOTE: When you power on the monitor, if the model that displays (Model 3800, Model 3900 or Model 3900P) does not match your oximeter, the presence or absence of a jumper on J11 may be the cause. If your system board contains J11, a jumper should be installed on it for Model 3800 only.

5.6 Oximetry board replacement

Tool: Phillips screwdriver, #1

1. Remove the cover (observe all warnings and cautions); see section 5.1.1.
2. (**3900P**) Remove the catch tray:
   - Remove the two nuts from the screws that hold the catch tray to the chassis. Remove the two screws from the catch tray and chassis.
   - Slowly pull the catch tray straight up and remove it from the unit.
3. (**Monitors without TruTrak+**) Disconnect the sensor filter board connector from J1 on the oximetry board.
4. (**TruTrak+ monitors**) Disconnect the sensor filter flex cable from J6 on the oximetry board.
5. Disconnect the system board ribbon cable from the oximetry board.
6. Remove the four screws that hold the oximetry board and system board to the standoffs on the chassis.
7. Lift the oximetry board off of the system board.
8. Place the new oximetry board on the system board and reinstall the four screws that hold the boards to the chassis.
9. Connect the system board ribbon cable to the oximetry board:
   - (**Monitors without TruTrak+**) Connect the ribbon cable to J2.
   - (**TruTrak+ monitors**) Connect the ribbon cable to J7.
10. Connect the sensor filter to the oximetry board:
    - (**Monitors without TruTrak+**) Connect the sensor filter board connector to J1.
    - (**TruTrak+ monitors**) Connect the sensor filter flex cable to J6.
11. (**3900P**) Replace the catch tray:
    - Place the catch tray's tube directly over the hole in the bottom of the chassis.
    - Align the holes in the catch tray with the holes in the chassis. Reinstall the two screws through the chassis and the catch tray. Make sure the tube remains in the chassis hole.
    - Reinstall the two nuts to the screws to anchor the catch tray to the chassis.
12. Reinstall the cover; see section 5.1.2.
13. Perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2).

5.7 3900P Printer repair

Tool: Phillips screwdriver, #1

5.7.1 Printer board replacement

1. Remove the cover (observe all warnings and cautions); see section 5.1.1.
2. Remove the four screws that hold the old printer board to the oximeter cover—one at each corner.
3. Lift up the old printer board and disconnect the printer button board cable that is plugged into the printer board.
4. Remove the old printer board.
5. Plug the printer button board connector into the new printer board.
6. Reinstall the four screws that hold the printer board to the oximeter cover.
7. Reinstall the cover; see section 5.1.2.
8. Perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2).

5.7.2 Printer button board replacement

1. Remove the cover (observe all warnings and cautions); see section 5.1.1.
2. Remove the four screws that hold the old printer board to the oximeter cover—one at each corner.
3. Lift up the old printer board and disconnect the printer button board cable that is plugged into the printer board.
4. Lift the printer bucket (plastic) away from the printer lid to expose the printer button board.
5. Lift out the old printer button board.
6. Install the new printer button board in the same location.
7. Lower the printer lid onto the printer bucket.
8. Plug the new printer button board connector in the printer board.
9. Reinstall the four screws that hold the printer board to the oximeter cover.
10. Reinstall the cover; see section 5.1.2.
11. Perform the *Functional check* (section 3.1) and the *Electrical safety check* (section 3.2).

6/Illustrated Parts

This chapter contains the following information:

- List of available service kits and other orderable parts
- Front panel parts list and assembly drawing
- Oximeter chassis parts list and assembly drawings
- System board components and layout
- Oximetry board components and layout
- Switch board components and layout
- Sensor filter board components and layout
- 3900P Printer board components and layout
- 3900P Printer button board components and layout

Important:

- Section 6.1 contains part numbers for individual items and for service kits that contain multiple items. If a part number is not listed for an item, that item is not available for order separately.
- The item number in each list of parts identifies the part in the associated drawing.
- (**3800**) Replacement parts for two versions of the 3800 are listed: 6051-0000-163 and 6051-0000-064 (an earlier version).
  Please check the order number (REF) of your 3800 before ordering parts.
- Board schematics and component lists can be obtained by ordering the 3800/3900/3900P PCA Drawings Service Kit.

6.1 Service kits

3800/3900/3900P PCA Drawings Service Kit 6050-0006-476

3800 Switch board schematic/components
3900/3900P Switch board schematic/components
3900P Printer board schematic/components
3900P Printer button board schematic/components
Oximetry board schematic/components
Sensor filter board schematic/components
System board schematic/components

Battery 6050-0004-277

Cable, 3900/3900P modem/analog 6050-0005-132

Cable, 3900/3900P RS-232 serial 6001-0000-181

Cable, 3900/3900P serial/analog, 10 cm/4 inches (black) 6050-0005-131

Cable, flex—see *Sensor filter flex cable*

Chassis base, assembly with 3800/3900 lid 6050-0004-280

Cover kit—3800 and 3900 6050-0005-309

Cover
EMI seal
Replacement label
Screw, M3 x 8 STL ZnPl PFH (2)

Cover kit—3900P 6050-0005-135

Cover
EMI seal
Replacement label
Screw, M3 x 8 STL ZnPl PFH (2)

Equipotential ground connector 6050-0003-755

Ground lug
Nut, SST Hex M6 (2)

Extender feet kit 6050-0005-045

Extender foot (2)
Nut, M3 locking (2)

Ferrite kit 6050-0005-313

Ferrite half, small (4)
Hook/loop fastener (5)
Sensor connector ferrite
Split core cable ferrite with holder

Front bezel assembly—3800 (REF 6051-0000-064).....6050-0005-837

NOTE: Upgrades the 3800 REF 6051-0000-064 to the 3800 REF 6051-0000-163.
Bezel with label, foot strip, sensor connector, toroid, switch board with ribbon cable, and these buttons: Volume, Limits, Alarm, and Power
Pressure plate with foam
EMI seal
Replacement serial number label
Attachment hardware

Front bezel assembly—3800 (REF 6051-0000-163).....6050-0003-756

Bezel with label, foot strip, volume button
EMI seal
Attachment hardware

Front bezel assembly—3800 with TruTrak+ (REF 6051-0000-169).....6050-0006-535

Bezel with label, foot strip, volume button
EMI seal
Attachment hardware

Front bezel assembly—3900 (REF 6051-0000-122).....6050-0005-138

Bezel with label, foot strip
EMI seal
Attachment hardware

Front bezel assembly—3900 with TruTrak+ (REF 6051-0000-168).....6050-0006-536

Bezel with label, foot strip
EMI seal
Attachment hardware

Front bezel assembly—3900P (REF 6051-0000-124).....6050-0005-023

Bezel with label, foot strip
EMI seal
Attachment hardware

Front bezel assembly—3900P with TruTrak+ (REF 6051-0000-167) 6050-0006-537

Bezel with label, foot strip
EMI seal
Attachment hardware

Fuse, T2.0AH, 250V, 5 mm x 20 mm (1).....6090-0409-019

Hardware kit.....6050-0005-136

Fuse (2)
Battery strap
Foot strip
Rear feet (2)
Screw STL ZnPl PFH M3 x 8 (9)
Screw STL ZnPl PPH M3 x 8 (10)
Screw STL ZnPl PPH M3 x 16 (6)
Serial jack nut (2)
Spacer (2)
Nut, SST Kep M6 (3)
Nut, M3 locking, (2)

IC chip extraction tool (PLCC extractor) **0380-1500-124**

Keypad button kit—3800 ..... **6050-0003-759**

Volume, Limits, Alarm, and Power buttons

Keypad button kit—3900/3900P **6050-0005-139**

Volume, Menu, Limits, Alarm, Power, and Printer buttons

LCD assembly **6050-0004-279**

Oximetry board—monitors without TruTrak+ **6050-0005-022**

Oximetry board—TruTrak+ monitors **6050-0006-532**

Power button **6050-0003-750**

Power inlet module **6050-0005-310**

Power supply **6050-0004-281**

Pressure plate—3800 (REF 6051-0000-064)

Order Front bezel assembly 6050-0005-837

Pressure plate—all monitors except 3800 (REF 6051-0000-064) **6050-0005-311**

Pressure plate with foam
Gaskets and EMI seal
Attachment hardware

Printer board (with gasket) kit—3900P **6050-0005-141**

Printer bucket kit—3900P **6050-0005-143**

Printer button board kit—3900P **6050-0005-142**

Printer cable (printer to system board)—3900P **6050-0005-101**

Printer catch tray kit—3900P **6050-0005-046**

Catch tray
Nut (2), M3 locking
Screw, M3 x 8 STL ZnPl PPH FLH (2)

Printer paper lid and tear bar kit—3900P **6050-0005-144**

Printer upgrade kit for 3900 ..... **6050-0005-145**

Cover with printer, 3900P
Printer cable
Screw (2), M3 x 8 PHH FLH
Catch tray
Nut (2), M3 locking
Upgrade instructions
Printer paper, 5 pk
Replacement label
Front bezel label, 3900P

Sensor connector kit **6050-0003-760**

Sensor receptacle
Pins (9)
Toroid

Sensor filter board—monitors without TruTrak+ **6050-0004-284**

Sensor filter flex cable—TruTrak+ monitors **6050-0006-530**

Software upgrade kit—all monitors **6050-0006-528**

Speaker assembly with O-ring **6050-0004-286**

Switch board—3800 (REF 6051-0000-064)
Order Front bezel assembly 6050-0005-837

Switch board with ribbon cable—all monitors except 3800 (REF 6051-0000-064) 6050-0005-312

System board—all monitors 6050-0006-531

TeleOximetry cable interface kit (2 cables)—3900/3900P 6050-0005-833

Datex-Ohmeda modem/analog cable (61 cm/2 ft.); dark gray cable with one RS-232 connector and two analog connectors (1 red, 1 white)
RS-232 serial cable, DB-9 male/female (1.8 m/6 ft.)

TeleOximetry PC Access Software—3900/3900P 6050-0006-529

This PC program, available at no charge, lets users access trend data stored on a 3900/3900P and transfer the data to their PC. The user can view the transferred data file or use it to generate a report. The software, a demonstration program, and instructions are provided on a compact disk (CD). The instructions and interface (menus, messages, etc.) are in English only.

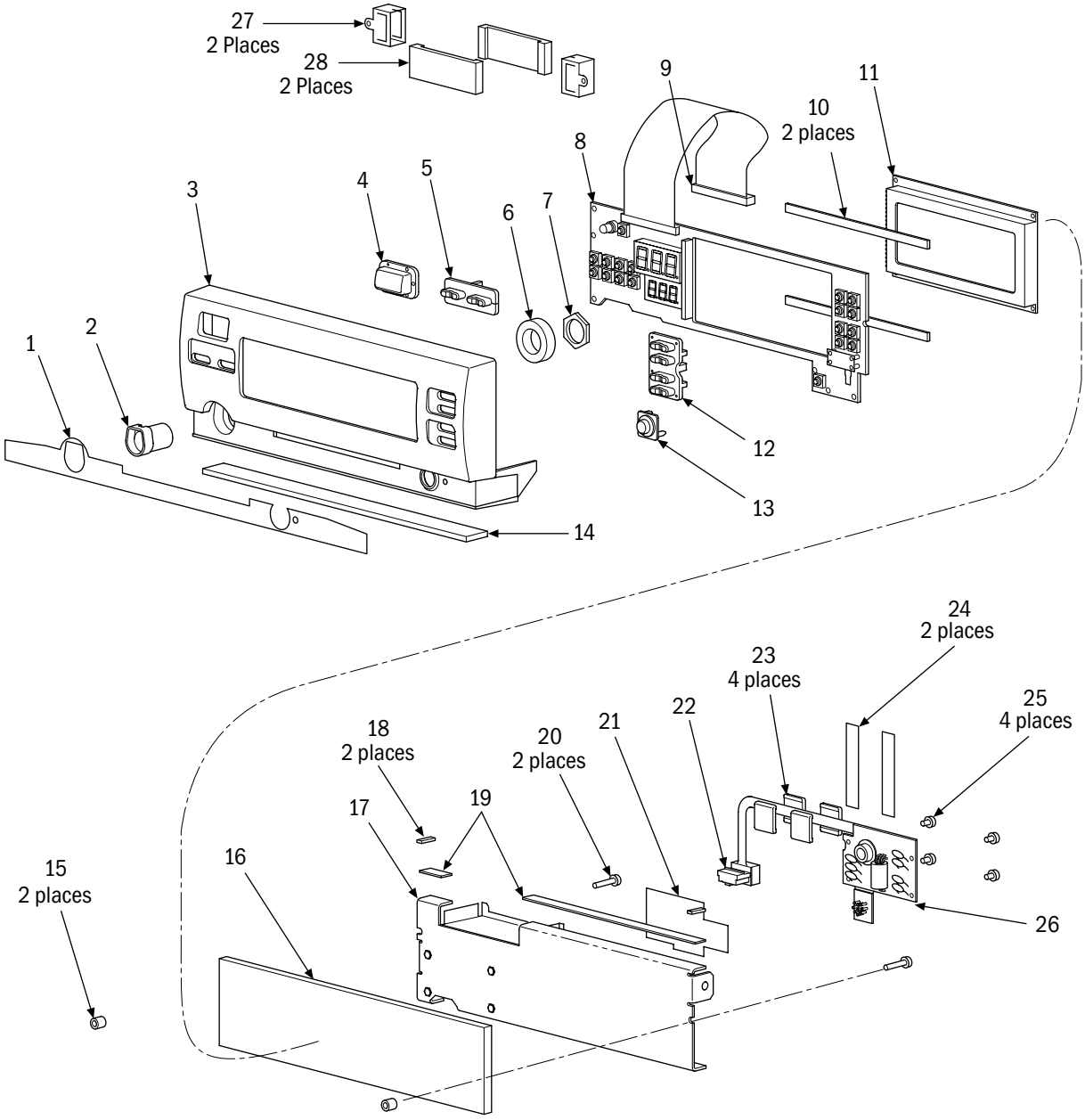
6.2 Front panel assembly

6.2.1 Front panel components

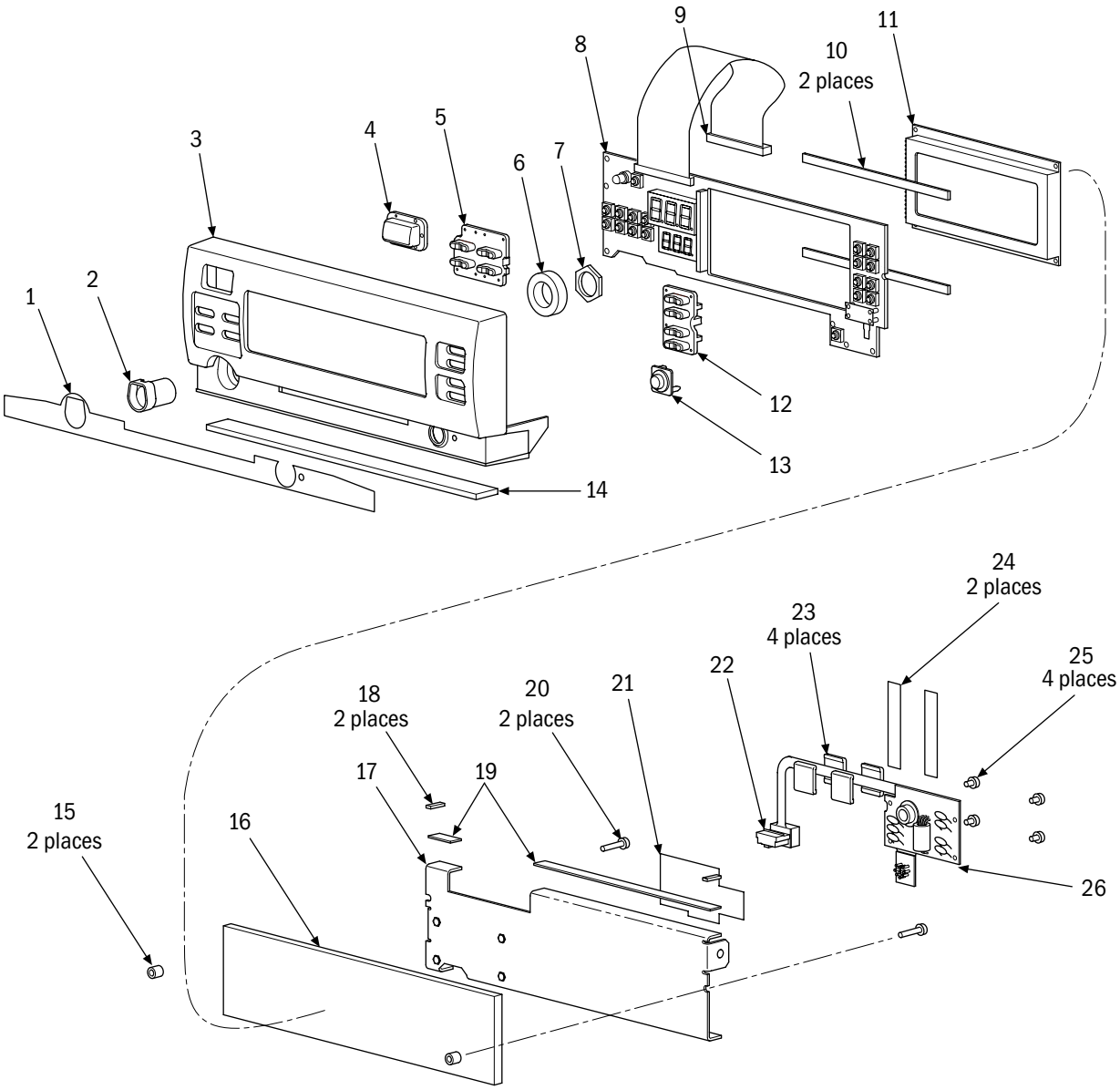
Item	Description
1	Front bezel label
2	Sensor connector
3	Front bezel
4	Silicone alarm button
5	Silicone volume button (3800); Silicone volume/menu button (3900/3900P)
6	Sensor connector ferrite (toroid)
7	Sensor connector nut
8	Switch board
9	Interconnect to system board
10	LCD foam (2)
11	LCD assembly
12	Silicone alarm limits buttons
13	Silicone power button
14	Foot strip, elastomer
15	Standoff (2)
16	Pressure plate foam
17	Pressure plate, sheet metal • Plate shown in section 6.2.2 is used in 3800 (REF 6051-0000-064) only. • Plate shown in section 6.2.3 is used in the 3800 (REF 6051-0000-163) and the 3800 with TruTrak+.
18	Foam corner seal (2) NOTE: Not used or needed in monitors that have EMI seal in cover.
19	Foam seal strip (2) NOTE: Not used or needed in monitors that have EMI seal in cover.
20	Screw, ZnPl, PPH, M3 x 16 (2)
21	Filter board insulator film
22	Interconnect to oximetry board—see NOTE below
23	Split shell cable ferrite (4)—see NOTE below
24	Loop fastener (2)—see NOTE below
25	Screw, ZnPl PPH, M3 x 8 (4)—see NOTE below
26	Sensor filter board—see NOTE below
27	Plastic ferrite end clip (2)—used in 3800 (REF 6051-0000-064) only
28	Ferrite half (2)—used in 3800 (REF 6051-0000-064) only

NOTE: Items 22 through 26 are used only in monitors without TruTrak+. The *Sensor filter flex cable* shown in section 6.8 is used in all TruTrak+ monitors.

6.2.2 Front panel assembly drawing (3800)



6.2.3 Front panel assembly drawing (3900/3900P)

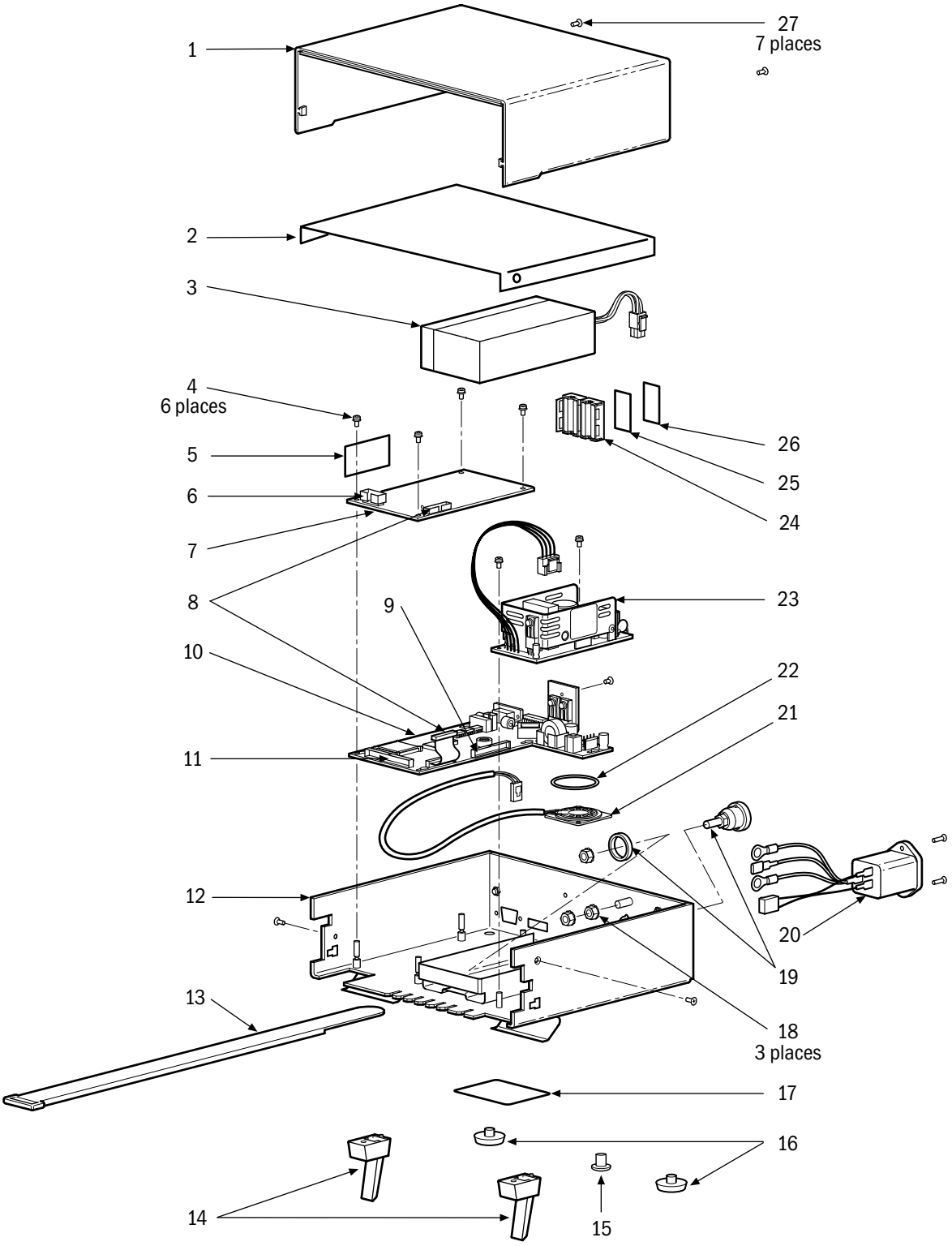


6.3 Chassis assembly

6.3.1 Chassis components

Item	Description
1	Oximeter cover (with EMI seal) for 3800 or 3900
2	Cover shield, EMI—used in 3800 (REF 6051-0000-064) only
3	Battery
4	Screw, ZnPl, PPH, M3 x 8 (6)
5	Loop fastener
6	Interconnect from filter board
7	Oximetry board
8	Interconnect between system board and oximetry board
9	Interconnect to 3900P printer board
10	System board
11	Interconnect to front panel board
12	Chassis, sheet metal
13	Battery strap
14	Extender feet (2)
15	Hole plug—not used in 3900P
16	Feet, with drive pin (2)
17	Label, serial number and product ID
18	Nut, ZnPl hex, with lock washers M6 (3)
19	Equipotential ground lug
20	Power inlet module
21	Speaker
22	Speaker O-ring
23	Power supply
24	Split core cable ferrite with holder—not used in 3800 (REF 6051-0000-064)
25	Hook fastener—not used in 3800 (REF 6051-0000-064)
26	Loop fastener—not used in 3800 (REF 6051-0000-064)
27	Screw, ZnPl, PFH, M3 x 8 (7)

6.3.2 Chassis assembly drawing

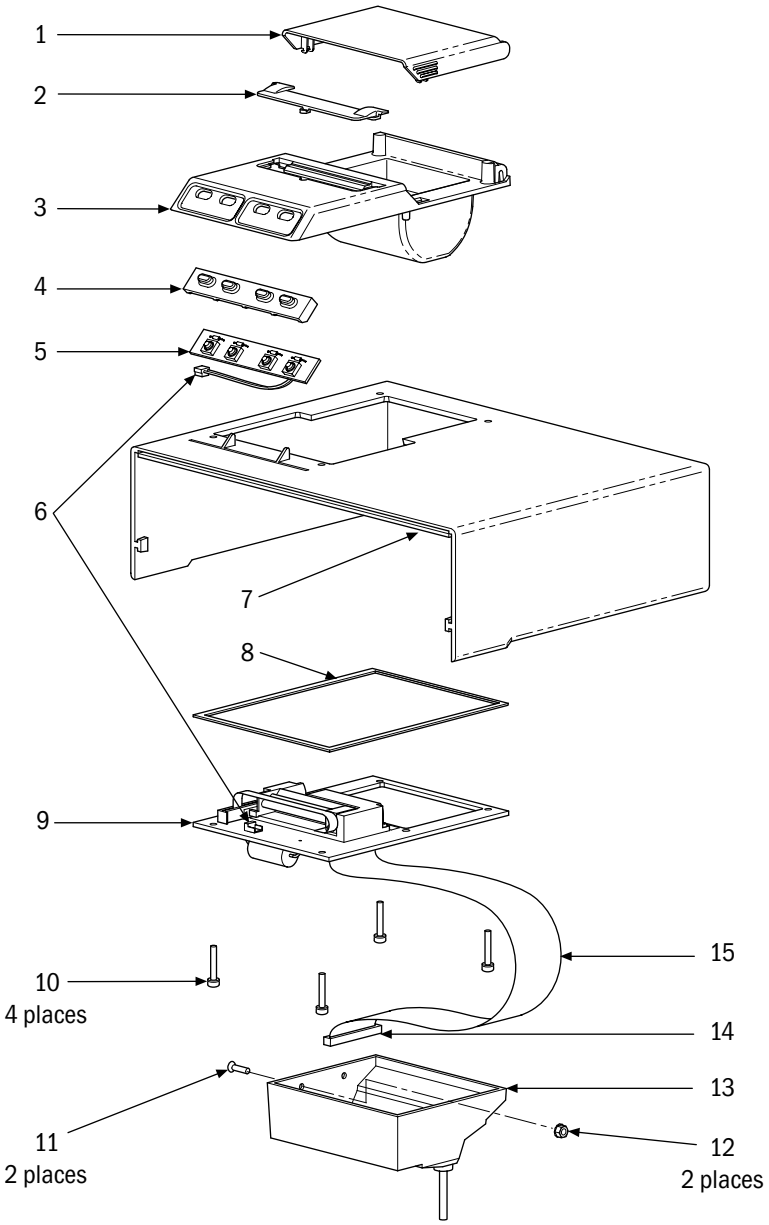


6.4 Printer/cover assembly (3900P)

6.4.1 Printer/cover components

Item	Description
1	Paper cover lid
2	Removable tear bar
3	Printer bucket bezel with insulator film
4	Silicone printer buttons
5	Printer button board
6	Interconnect to printer board
7	Oximeter cover (with EMI seal) for printer
8	Printer board gasket
9	Printer board
10	Screw, ZnPl, PPH M3 x 12 (4)
11	Screw, ZnPl, PPH FLH M3 x 8 (2)
12	Nut, M3 Locking (2)
13	Catch tray
14	Interconnect from system board
15	Printer cable

6.4.2 Printer/cover assembly drawing



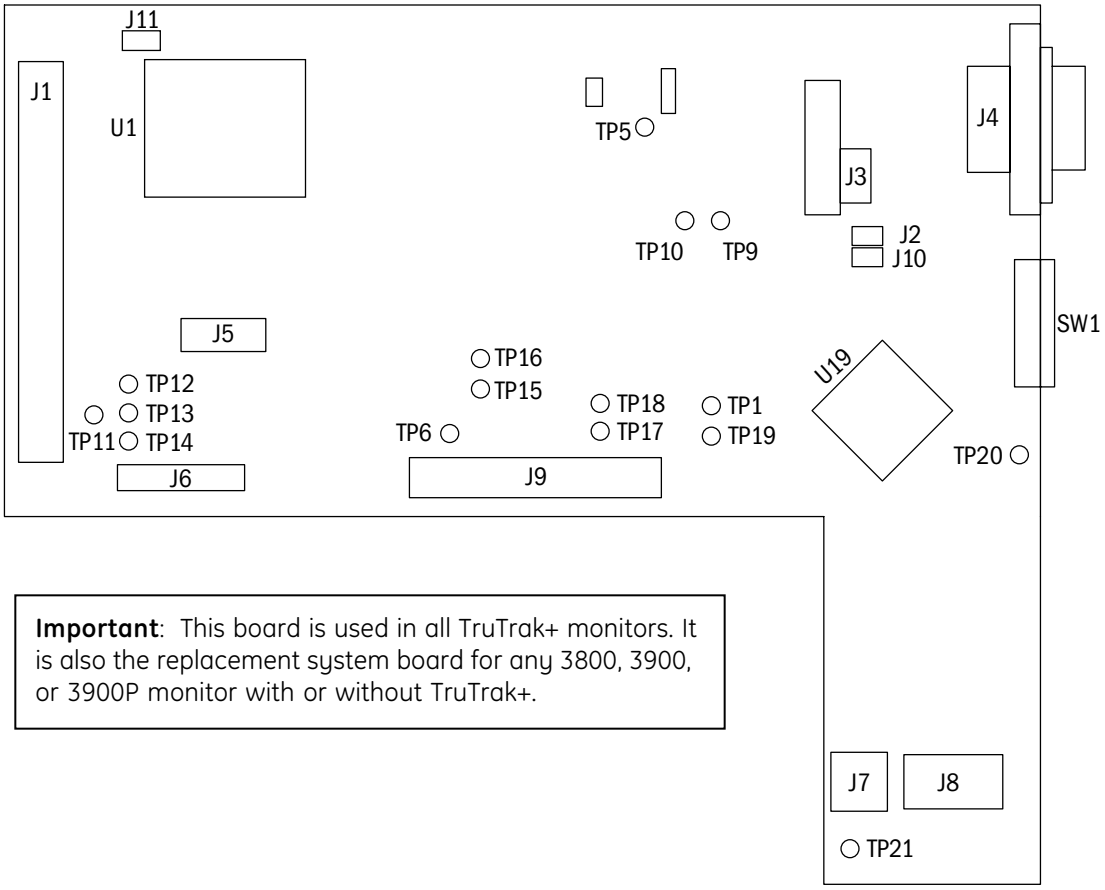
6.5 System board

NOTE: See section 4.5.1 for specific test point (TP) functions.

6.5.1 System board components shown

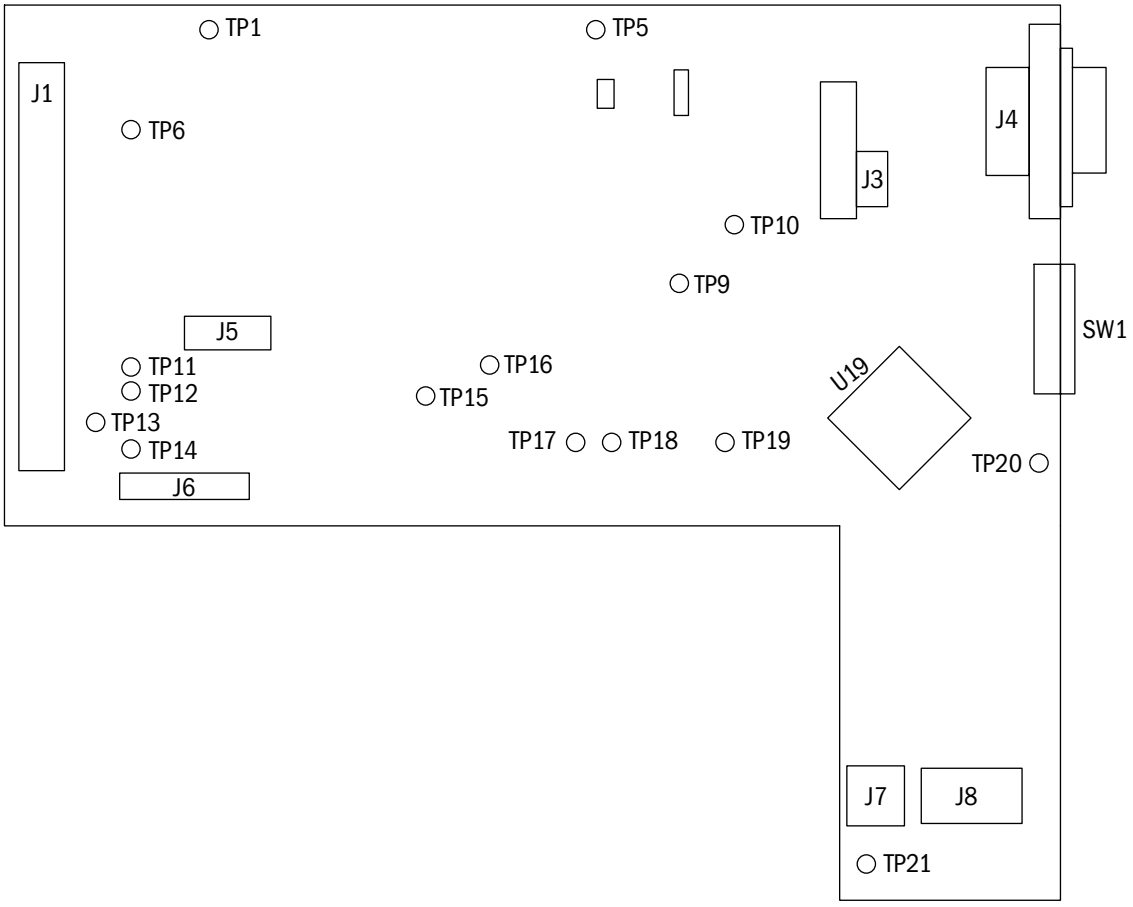
J1	Connector, header, R/A, shrouded, 2mm, 2 row, 44-pin—switch board, W1
J2	Not used—open
J3	Header, 3-pin, locking—speaker
J4	Connector, 9-pin, "D", 90 deg., PC—RS-232/analog outputs
J5	Connector, dual row, 10-pin, LW prf socket strip—background debug port
J6	Cable assy, ribbon, 20 cond, 2mm IDC bd mt IDC fem—oximetry board, J2
J7	Connector, header, str., locking, 2 row, 4-pin—battery
J8	Header, 1 row, 4-pin, shrouded—power supply
J9	Connector, header-shrouded, 2 x 17 rt angle, 2mm P PCB—printer board, J1
J10	(TruTrak+ monitors, 3900/3900P without TruTrak+, and replacement system boards only) Header, str., open, 2-pin—programming jumper
J11	(TruTrak+ monitors and replacement system boards only) Jumper NOTE: Jumper is installed for 3800; not installed for 3900/3900P.
SW1	Switch, dip, 8 position, rt angle—user settable
U1	Microprocessor
U19	Socket for software upgrade IC chip

6.5.2 System board layout (all monitors except 3800 without TruTrak+)



Important: This board is used in all TruTrak+ monitors. It is also the replacement system board for any 3800, 3900, or 3900P monitor with or without TruTrak+.

6.5.3 System board layout (3800 REF 6051-0000-064 and 6051-0000-163)

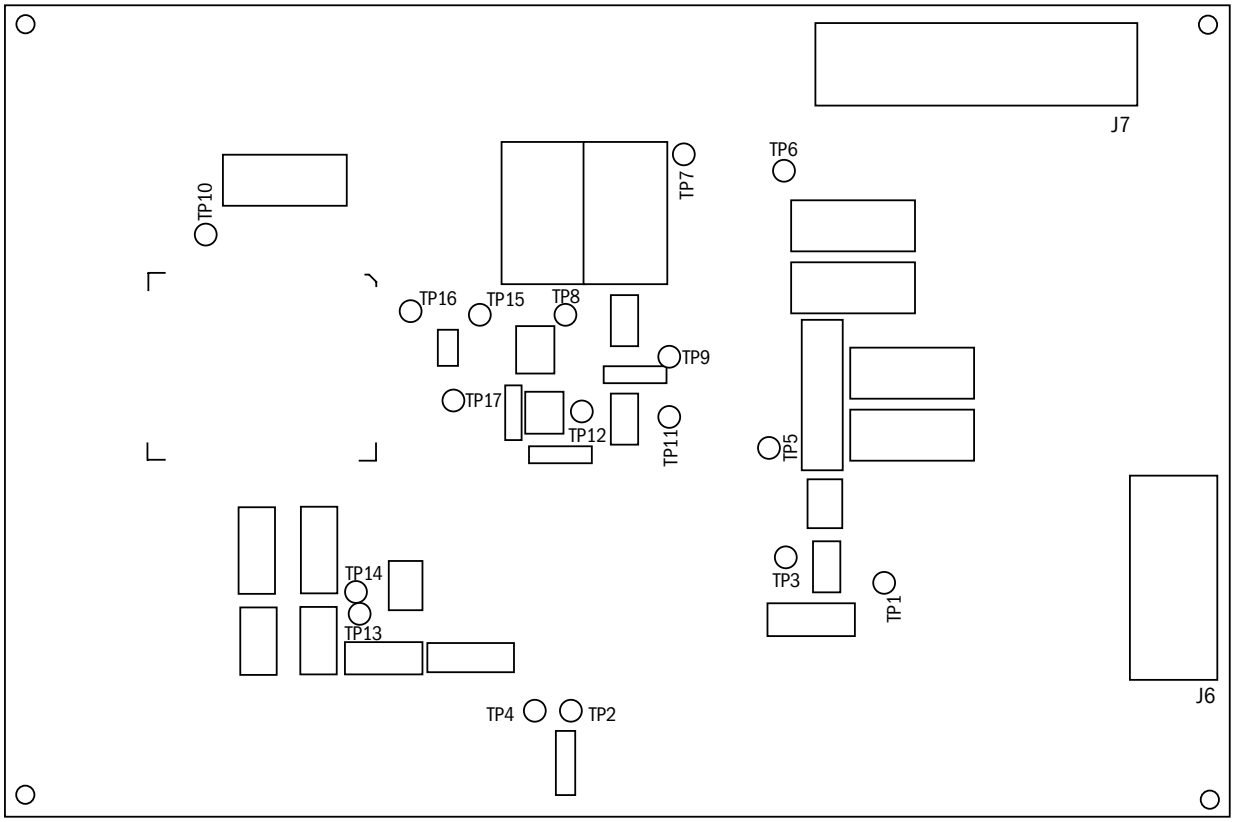


6.6 Oximetry board

NOTE: See section 4.5.2 for specific test point (TP) functions.

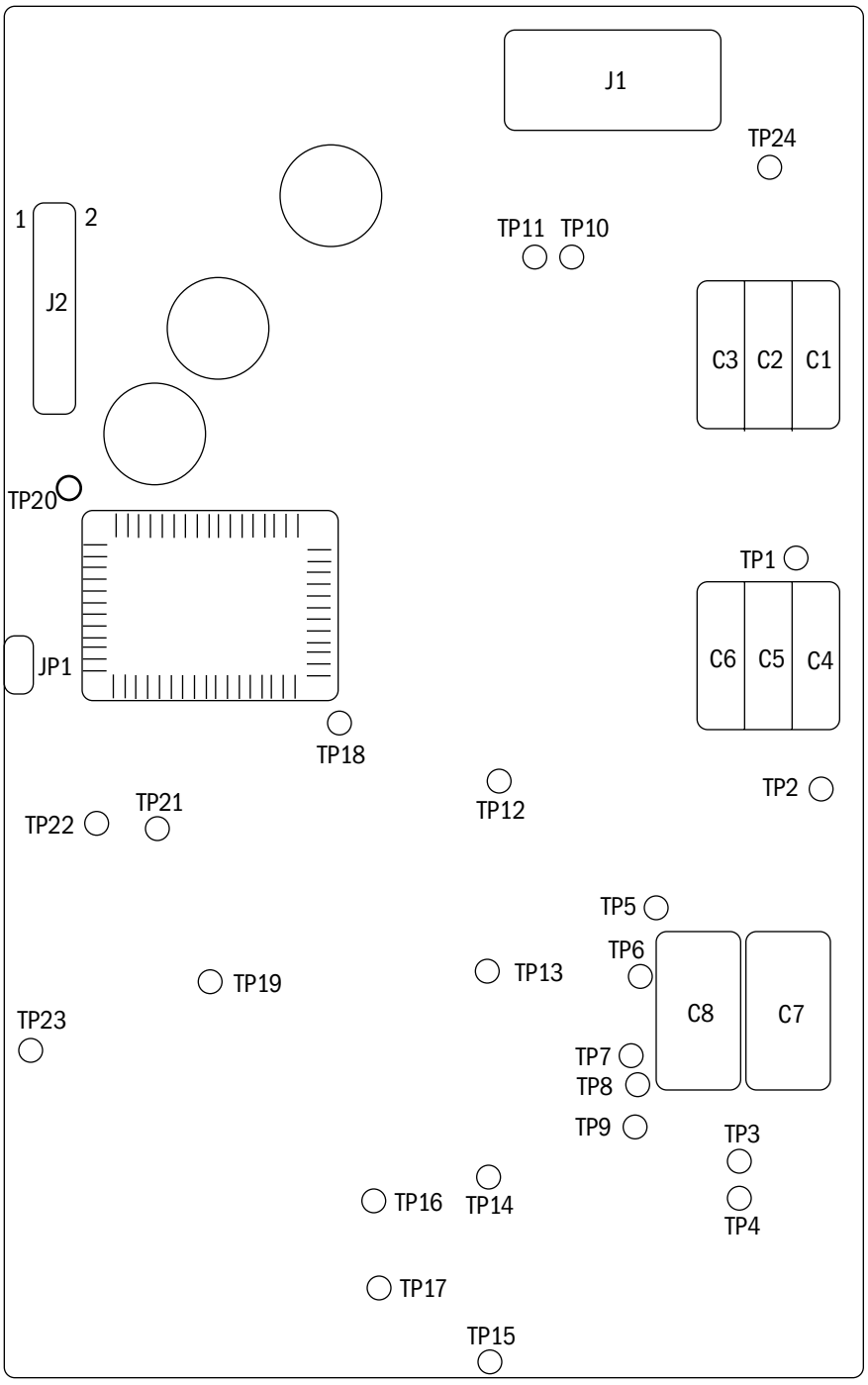
6.6.1 Oximetry board layout (TruTrak+ monitors)

J6 Connector, header-shrouded, 0.1 pitch 10-pin—TruTrak+ flex cable, P2
J7 Connector, header-shrouded, 2mm 20-pin—system board, J6



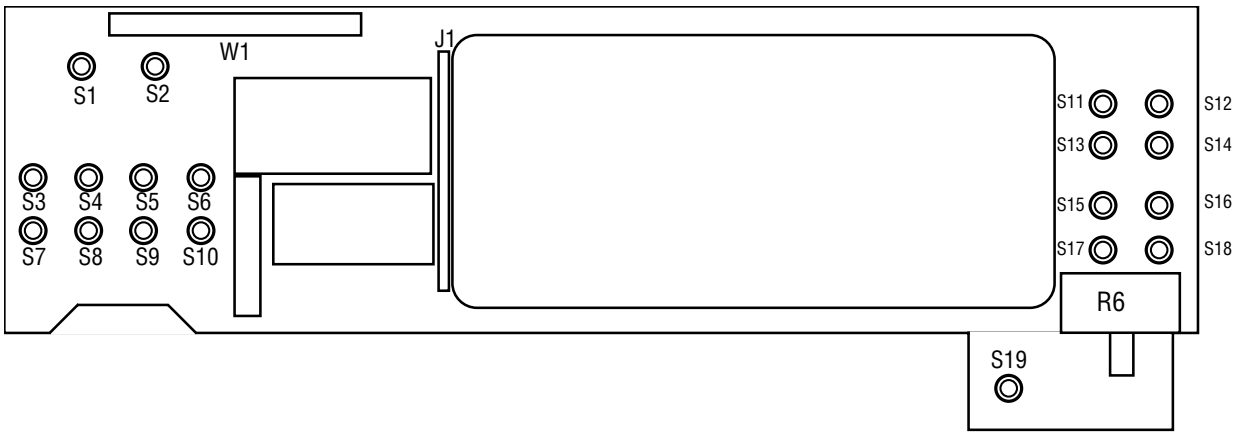
6.6.2 Oximetry board layout (monitors without TruTrak+)

J1 Connector, header-shrouded, 0.1 pitch 10-pin—sensor filter board, P2
J2 Connector, header-shrouded, 2mm 20-pin—system board, J6
JP1 Not used—open



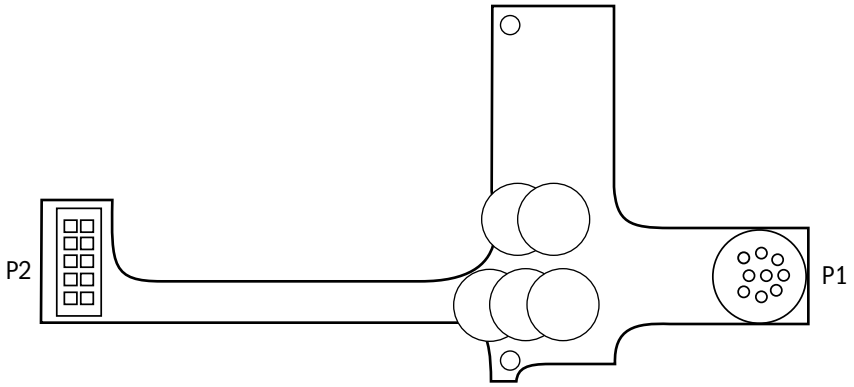
6.7 Switch board

J1	Connector, female, single row, 19-pin, bottom mount—display board
S1	Not used—not stuffed
S2	SPSTtactile PC mount—alarm silence
S3	SPSTtactile PC mount—pulse beat volume down
S4	SPSTtactile PC mount—pulse beat volume up
S5	SPSTtactile PC mount—alarm volume down
S6	SPSTtactile PC mount—alarm volume up
S7	(3900/3900P; not used in 3800) SPSTtactile PC mount—waveform screen
S8	(3900/3900P; not used in 3800) SPSTtactile PC mount—menu screen
S9	(3900/3900P; not used in 3800) SPSTtactile PC mount—SpO_2 trend screen
S10	(3900/3900P; not used in 3800) SPSTtactile PC mount—PI_r trend screen
S11	SPSTtactile PC mount—SpO_2 high alarm limit down
S12	SPSTtactile PC mount—SpO_2 high alarm limit up
S13	SPSTtactile PC mount—SpO_2 low alarm limit down
S14	SPSTtactile PC mount—SpO_2 low alarm limit up
S15	SPSTtactile PC mount—pulse high alarm limit down
S16	SPSTtactile PC mount—pulse high alarm limit up
S17	SPSTtactile PC mount—pulse low alarm limit down
S18	SPSTtactile PC mount—pulse low alarm limit up
S19	SPSTtactile PC mount—power ON/OFF
R6	Display contrast
W1	Cable assy, ribbon, 44 cnd, 2mm—system board, J1



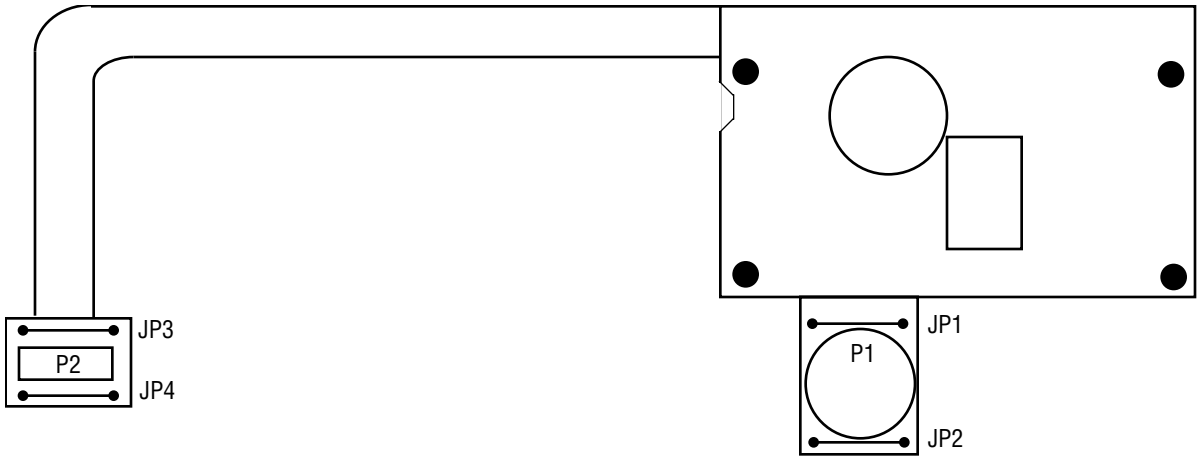
6.8 Sensor filter flex cable (TruTrak+ monitors)

P1 9-Pin, socket—patient sensor
P2 Socket, 10-pin, center key—oximetry board, J6



6.9 Sensor filter board (monitors without TruTrak+)

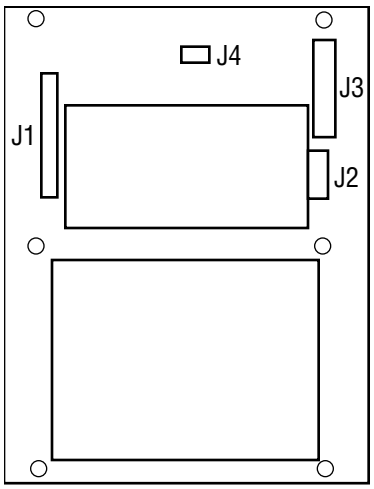
JP1 through 4	Wire buss, 24 AWG, uninsulated—board stiffeners
P1	9-Pin, socket—patient sensor
P2	Socket, 10-pin, center key—oximetry board, J1



6.9 3900P Printer boards

6.9.1 3900P Printer board

J1 Connector, header-shrouded, 2 x 17, str, 2mm, P PCB—system board, J9
J2 Connector, header, 1 x 5, rt angle, PCB mt--printer tach/motor connector
J3 Connector, header-shrouded, 1 x 9, str, 0.1 in, P flex ckt th—printer head leads
J4 Connector, header-shrouded, 1 x 2, rt angle, 2mm P PCB mt—printer button board, P1



6.9.2 3900P Printer button board

J1 Connector, 0.1 pitch, not stuffed—hard soldered wires to P1
P1 Connector, 2-wire, 2mm-printer board, J4