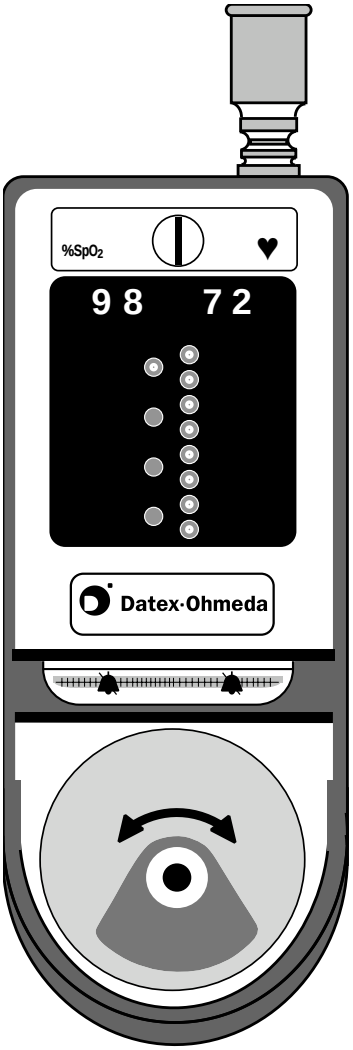
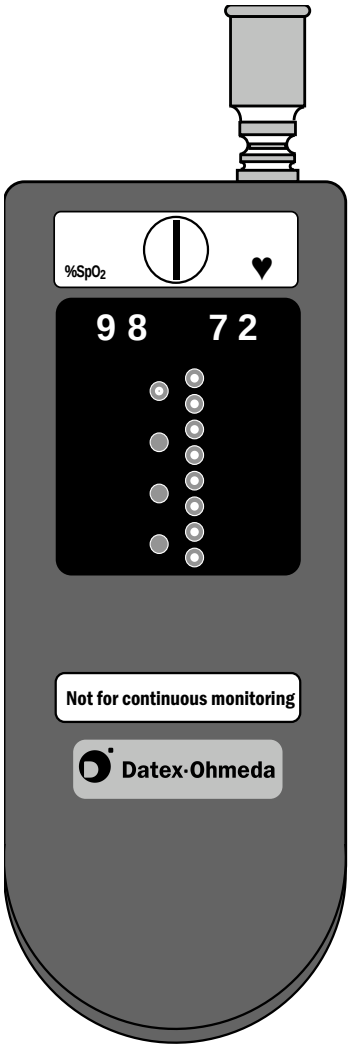
Datex·Ohmeda

3770/3775 Pulse Oximeter

Service Manual





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Datex·Ohmeda

3770/3775 Pulse Oximeter

Service Manual

Important

This manual is subject to periodic review, update, and revision. Customers are cautioned to verify that the information in this manual applies to the software and hardware present in the equipment.

Attention! Consult the accompanying instructions before using this device.

This device performs as described in this manual, and in accompanying labels and inserts, when assembled, operated, maintained, and repaired in accordance with the instructions provided.

This device must be cleaned and checked periodically. Do not use a defective device. Parts that are broken, missing, plainly worn, distorted, or contaminated should be replaced immediately. If repair or replacement become necessary, request service advice from Datex-Ohmeda (information is listed on the back cover). Do not repair this device or any of its parts other than in accordance with written instructions provided by Datex-Ohmeda.

The user of this device shall have the sole responsibility for any malfunction that results from improper use, faulty maintenance, improper repair, unauthorized service, damage, or alteration by anyone other than Datex-Ohmeda.

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

- If it is used according to the accompanying operating instructions.
- If fittings, extensions, readjustments, changes, or repairs are carried out by agents authorized by Datex-Ohmeda.
- If it is used in buildings having ground equalization wiring that complies with relevant local standards and regulations.

Trademarks

Text revised: May 2000

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1/Overview

This manual contains instructions for servicing the Datex-Ohmeda 3770 and 3775 Pulse Oximeters.

This chapter contains:

- A general description of the oximeter and its functional components.
- Oximeter and battery pack specifications.
- Precautions, including specific warnings and cautions, you must follow when servicing the oximeter.

Related information

The content of this manual assumes you are familiar with how the unit operates. For a detailed description of the unit's components, key functions, and general operating guidelines, see the *Datex-Ohmeda 3770/3775P Pulse Oximeter User's Manual.* General maintenance procedures contained in that manual, such as how to replace batteries in the AA battery pack, are **not** repeated in this manual.

If you need to reference printed circuit board schematics and component lists, purchase and refer to the information contained in the 3770/3775 PCA Drawings Service Kit, REF 6050-0005-558.

You'll find detailed instructions for servicing and repairing the battery charger monitoring station in the *Battery Charger Monitoring Station Service Manual* (REF 6050-0003-861). If you need to replace fuses or change the voltage selection for the monitoring station, refer to that manual.

Note: The NiCd and AA battery packs, the single-station battery charger, and the Hewlett-Packard® (HP) printer are not serviceable accessories.

For information on sensor application and cleaning (reusable sensors only), see the instructions for the sensor.

Technical competence

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

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

General description

Two models of the oximeter are available: the 3770 and the 3775. Both oximeters operate on power supplied by a battery pack. In addition, either oximeter, when a nickel-cadmium (NiCd) battery pack is attached, can be positioned in the battery charger monitoring station and operated using the station's DC (from AC mains) power supply.

- The 3770 oximeter is designed specifically for spot checking SpO_2 and pulse rate. It has no alarms or user-definable parameters and is not intended for continuous monitoring.
- The 3775 oximeter is a full-featured model designed for spot checking in addition to short- and long-term continuous SpO_2 and pulse rate monitoring. This model can print trend data, through an infrared link, to the optional Hewlett-Packard® (HP) printer.

Note: Throughout this manual, components and features available on both oximeter models and those found only on the 3775 oximeter are discussed. If you are working on the 3770, references to components specific to the 3775 do not apply.

Theory of operation

The oximeter uses a two-wavelength pulsatile system—red and infrared light—to distinguish between oxygenated (O_2Hb) and reduced (HHb) hemoglobin, each of which absorbs different amounts of light emitted from the oximeter sensor. The system then calculates the relative percentage of these two constituents and SpO_2.

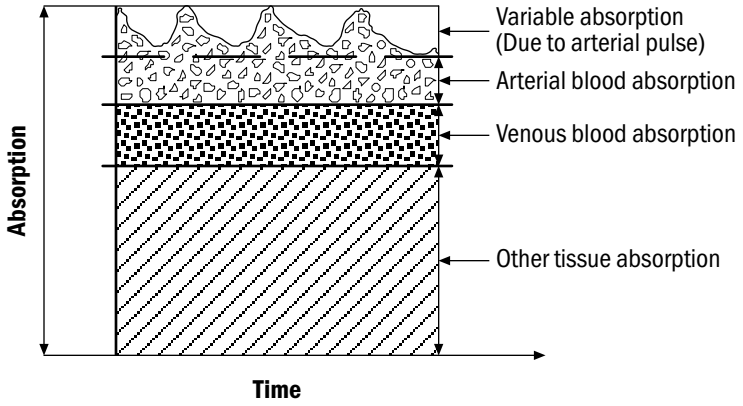


Figure 1-1. Signal composite

Arterial blood pulsation at the test site modulates the transmission of the oximeter sensor's light. Since other fluids and tissues present generally don't pulsate, they don't modulate the light passing through that location. The pulsatile portion of the incoming signal is used to detect and isolate the reduction of light energy due to arterial blood flow.

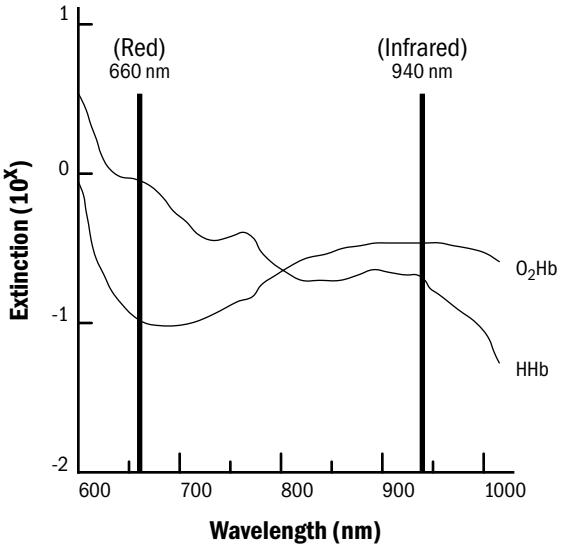


Figure 1-2. Extinction vs. wavelength

The sensor's photodetector converts the light, which is partially absorbed and modulated as it passes through the tissue sample, into an electronic signal. Since O_2Hb and HHb allow different amounts of light to reach the photodetector at the selected wavelengths, the electronic signal varies according to the light source that is "on" and the oxygenation of the arterial hemoglobin. Analog and digital signal processing then convert the light-intensity information into SpO_2 and pulse rate values for display on the monitor.

Calibration

Datex-Ohmeda pulse oximeters use two wavelength ranges, 650 nm to 665 nm and 930 nm to 950 nm, both with an average power of less than 1 mW. These wavelengths are used to calculate the presence of oxyhemoglobin (O_2Hb) and reduced hemoglobin (HHb). A CO-oximeter typically uses four or more wavelengths of light and calculates reduced hemoglobin (HHb), oxyhemoglobin (O_2Hb), carboxyhemoglobin (COHb), and methemoglobin (MetHb). Because of this, pulse oximetry readings and CO-oximetry readings will differ in situations where a patient's COHb or MetHb are increased.

Two different methods of calibration are currently used by oximeter manufacturers: fractional and functional.

- The fractional saturation is determined by dividing the oxyhemoglobin by the total hemoglobin, represented mathematically as

$$\text{Fractional } SpO_2 = \left(\frac{O_2Hb}{Hb_{TOTAL}}\right) \times 100 = \left(\frac{O_2Hb}{O_2Hb + HHb + COHb + MetHb}\right) \times 100$$

  i.e., the percentage of the total amount of hemoglobin carrying oxygen.

- The functional saturation is represented mathematically as

$$\text{Functional } SpO_2 = \left(\frac{O_2Hb}{Hb_{TOTAL} - COHb - MetHb}\right) \times 100 = \left(\frac{O_2Hb}{O_2Hb + HHb}\right) \times 100$$

  i.e., the percentage of hemoglobin capable of carrying oxygen that is carrying oxygen.

The calculation of SpO_2 assumes 1.6% carboxyhemoglobin (COHb), 0.4% methemoglobin (MetHb), and no other pigments. Appreciable variation from these values will influence SpO_2 accuracy. These values are based on the Datex-Ohmeda Pulse Oximeter Empirical Calibration Study.

The 3700/3775 uses the *fractional* calibration method.

Functional components

Figure 1-3 illustrates the relationship between each functional component.

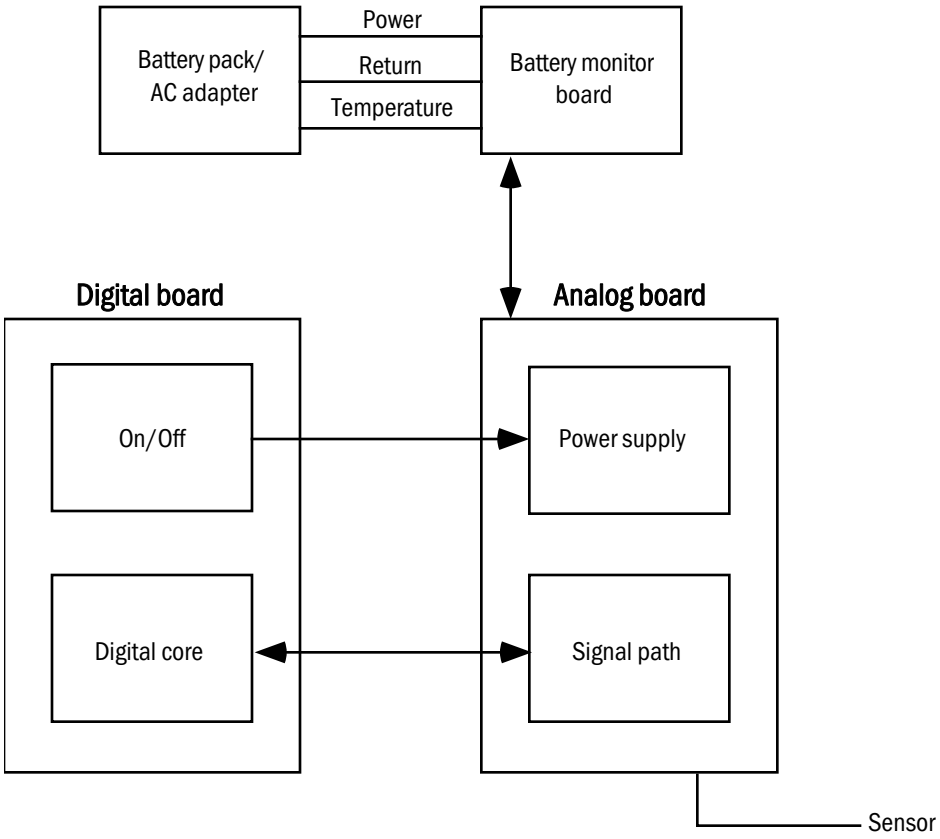


Figure 1-3. System block diagram

A complete oximetry system requires digital and analog processing. The digital board provides signal acquisition, numerical processing, and user interface for the oximeter. The analog board amplifies and conditions the biological signal. The digital board then samples the conditioned signal, performs the oximetry algorithm, and displays the results on numeric and graphic LED displays.

The user interface features an eight-character dot-addressable LED display, a 24-segment LED driver, a variable frequency audio driver, and (for the printer option) an infrared wireless transmitter.

Digital board

The core processing of the digital board is provided by a 16-bit processor, nonvolatile FLASH memory, semivolatile SRAM, and a Real Time Clock. For signal acquisition, it has an A-to-D converter (which is internal to the processor), I/O ports for timing and control, and an 8-bit D-to-A converter.

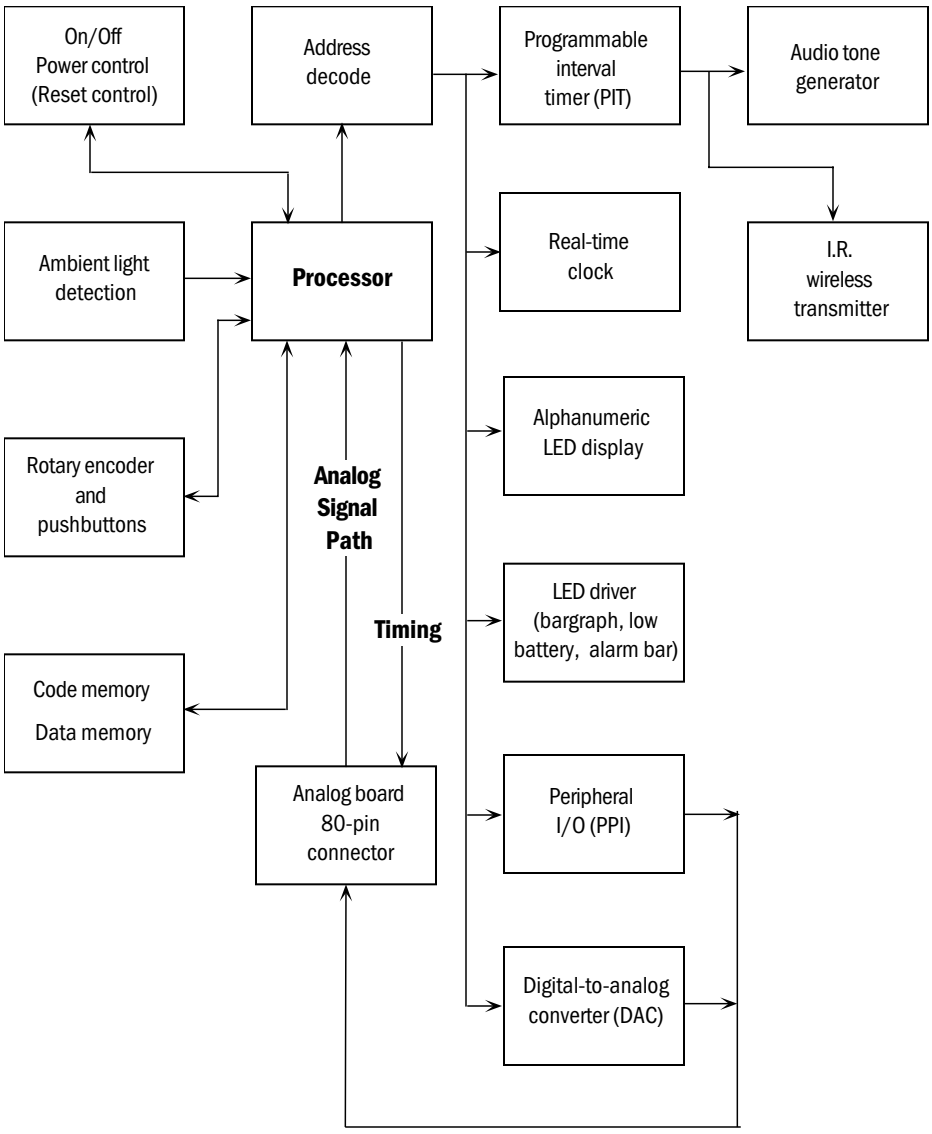


Figure 1-4. Digital system block diagram.

80-pin board-to-board connector

The 80-pin board-to-board connector interfaces with the analog board and contains signals shared by both boards: power supplies, rotary encoder signals, oximetry timing and control, and many ground connections.

Analog board

The analog board provides the oximetry analog signal processing, sensor LED drive, detection of interfering signals, housekeeping and fault monitoring, standby and operational power, power switching, and battery interface. It also provides structural support for the digital board and the battery contacts. It contains attachments for the sensor connector, rotary encoder, and serial port. It also provides the grounding system for the case shield with EMC capacitors to shunt high-frequency currents.

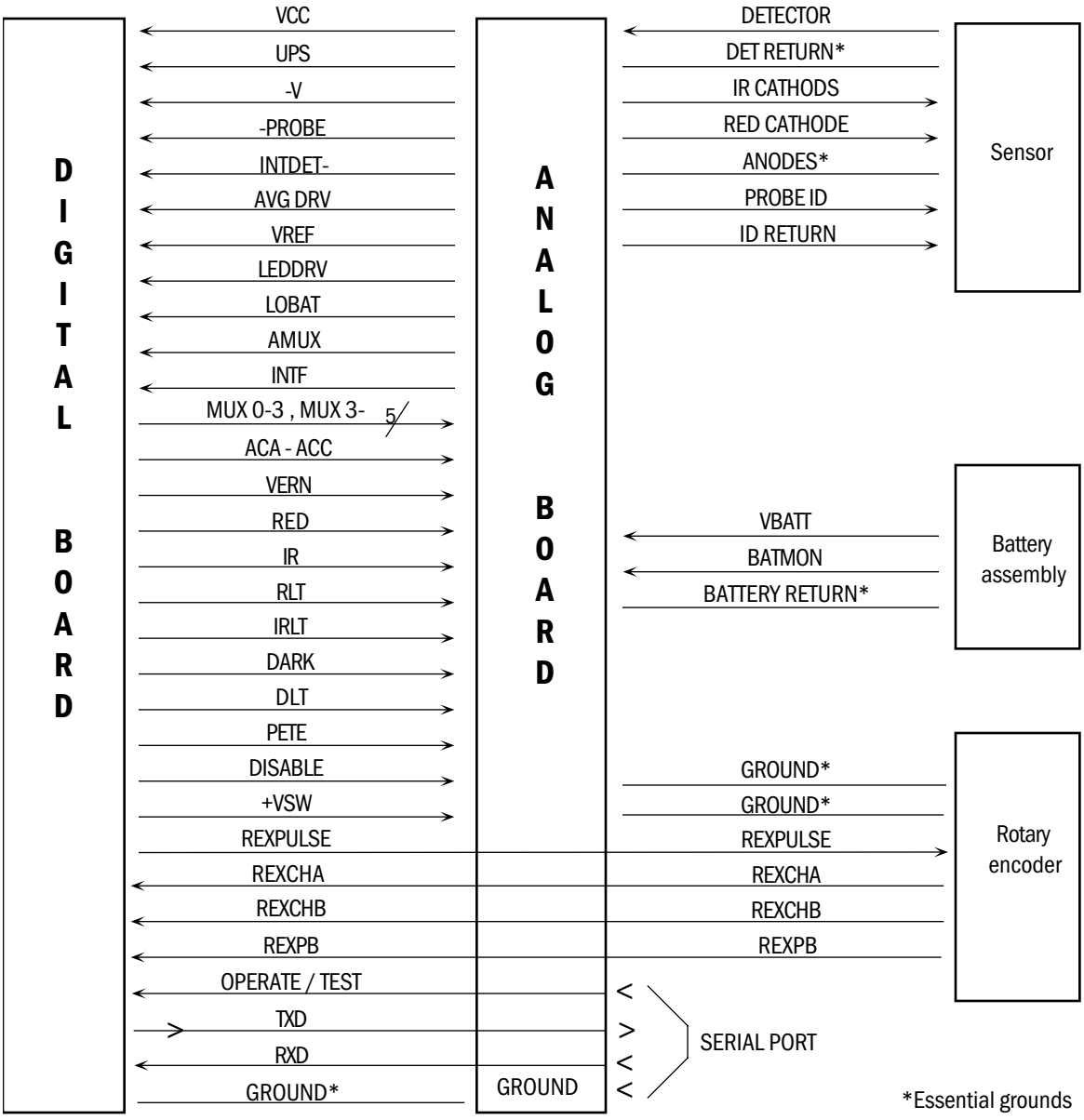


Figure 1-5. Analog board and digital board system

Note: The rotary encoder is installed on the 3775 analog board only; in all other respects the 3770 and 3775 analog boards and their components are identical.

Specifications

Unless otherwise indicated, all specifications are nominal and are subject to change without notice. Unless otherwise indicated, the specifications below apply to both oximeters.

Electromagnetic effects

The 3770 or the 3775 when used with a LR6 (AA) battery pack, a NiCd battery pack, or a NiCd battery pack in a battery charger monitoring station are referred to as the "system" for EMC purposes.

- Indications that the system is experiencing electromagnetic interference include:
- Variations in the display (pleth bar does not correlate to physiological signals).
- Sudden increases or decreases in the signal strength indicator that do not correlate to physiological condition of the patient.
- PROBE? messages that are not resolved by the instructions found in the *3770/3775 Pulse Oximeter User's Manua.*
- *T*he display of "rolling dots" when a valid physiological signal is present.

This interference may be intermittent and careful correlation between the effect and its possible source is important. The system will not display any of these indications if it is used within its intended electromagnetic environment.

Environment

Suitable for use in the environment described in IEC/EN 60601-1-2 (1993).

EMC performance

The system complies with the requirements of IEC/EN 60601-1-2 (Electromagnetic compatibility - Requirements and tests). The following basic EMC standards were applied to verify conformance.

Emissions: IEC/EN 55011 Group I, Class B (1997)

Immunity: IEC/EN 61000-4-2 (1995), 8 kV air, 3kV contact
IEC/EN 61000-4-3 (1995), 3 V/m
IEC/EN 61000-4-4 (1995), 2 kV power, 1kV I/O
IEC/EN 61000-4-5(1995), 2 kV line to earth, 1 kV line to line

International Electrotechnical Commission (IEC) classifications

The oximeter complies with the requirements of IEC/EN 60601-1 (1988) Part 1: General requirements for safety of medical electrical equipment:

Degree of protection against electric shock: Type BF applied part

IPX3 *Degree of protection against ingress of liquids:* Sprayproof (IEC/EN 60529)

Type of protection against electric shock: Internally powered equipment/Class II

Mode of operation: Continuous

Compliance with standards

The presence on the device 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 with respect to electric shock, fire, and mechanical hazards only, in accordance with the Canadian Standards Association CAN/CSA C22.2 No. 601.1 (1990).

Medical electrical equipment classified with respect to electric shock, fire, and mechanical hazards only, in accordance with Underwriters Laboratories Inc. UL 2601-1 (1994).

Oximeter

Default settings

Each time you power on the oximeter the following system settings are in effect:

- Low-SpO_2 alarm limit = 85
- High-SpO_2 alarm limit = On
- Alarm volume = On
- Pulse beat volume = Off
- SpO_2 averaging interval = 12 seconds

Settings for time, date, and language are retained when the system is powered off as long as a battery is in place.

General

Visual displays and indicators

The displayed SpO2 and pulse rate values are updated every second. The plethysmographic waveform sweep is updated every 4 seconds.
Main display: 8-character alpha-numeric; green; variable intensity dependent on ambient light conditions
Waveform display: 8 green LEDs
Signal strength indicator bar: 4 LEDs (1 dark green, 1 yellow green, 1 yellow, and 1 orange)
Low battery indicator: 1 orange LED
Alarm bar (3775 only): red
Display update interval: 0.5 seconds
Display hold interval: 12 seconds

Dimensions

Height: 18.54 cm (7.3 inches; 9.5 inches including FlexConnect™)
Width: 7.62 cm (3.0 in.)
Depth: 5.33 cm (2.1 in.)
Weight: 0.33 kg (9.6 oz.) without battery pack

Power

Typical consumption: 1.6 W
Typical current: 180 mAmps

Circuitry

Microprocessor controlled
Automatic self-test at power on
Automatic setting of default parameters (3775 only)
Automatic alarm messages
Automatic/continuous system diagnostics

Sensor emitter wavelength ranges

Red LED peak wavelength range: 650 to 665 nm
Infrared (IR) LED peak wavelength range: 930 to 950 nm
Average power: ≤ 1 mW

(3775 only) Audio indicators

Alarm volume: On (default) and off
Pulse rate volume: On and off (default)
Pitch modulation to reflect changing SpO_2 levels
Alarm silence (120 seconds)
Low- and high-SpO_2 out-of-limits alarm
Sensor condition alarms
System failure alarms

SpO_2

Range: 0 to 100%

Accuracy (±1 standard deviation)

80 to 100%	± 2%
60 to 79%	± 3%
Below 60%	unspecified

Calibration: fractional

Interfering substances

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

(3775 only) Alarm limits

Low = 60 to 99%
High = 61 to 100% and OFF

Pulse rate

Range	40 to 235 beats per minute
Accuracy	± 1.7% of current reading (accuracy calculations assume a constant pulse rate)

Environmental

Operating

Temperature:	0 to 50 °C (32 to 122 °F)
Humidity:	0 to 95% RH, noncondensing
Atmospheric pressure:	550 to 1,060 hPa (8 to 15.4 psia)
Vibration:	Meets or exceeds: ASTM 4728, (Method C) MIL-STD-810E, Method 514.4, Section I.3.4.3 IEC/EN 60068-2-37
Drop/shock:	Meets or exceeds: IEC/EN 60068-2-32 (Procedure 1) MIL-STD 810E, Method 516.4, Section I.3.6

Storage

Temperature:	–40 to 70 °C (–40 to 158 °F)
Humidity:	0 to 95% RH, noncondensing
Atmospheric pressure:	496 to 1,060 hPa (7.2 to 15.4 psia)
Vibration:	Meets or exceeds: ASTM 4728, (Method C) MIL-STD-810E, Method 514.4, Section I.3.4.3
Drop/shock:	Meets or exceeds: IEC/EN 60068-2-32 (Procedure 1) MIL-STD 810E, Method 516.4, Section I-3.6

Battery packs

The operation time depends on the monitoring technizue (long monitoring cycles or short, spot-checks).

AA battery pack

Weight: 0.12 kg (4.4 oz.) without cells; 0.26 kg (9.3 oz.) with cells.

Capacity, operation time, charge time, and life cycle depend on the battery cell.

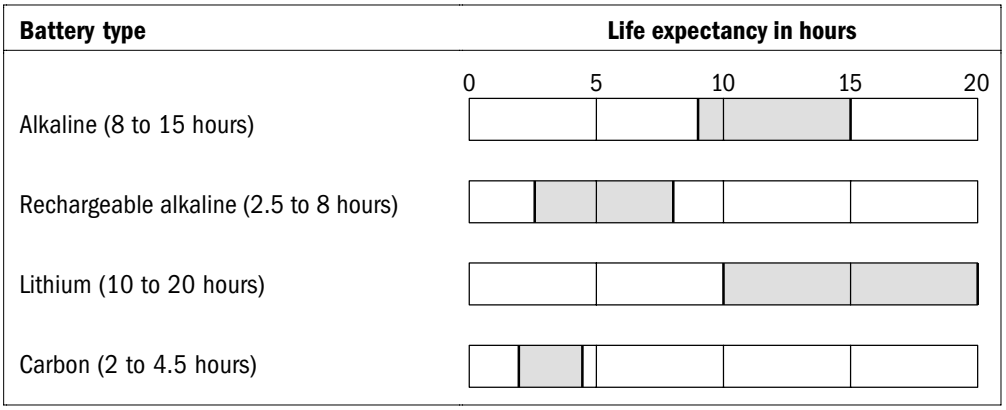


Figure 1-6. AA battery life cycles

Low battery indicator LED lights depending on the battery cell, as follows:

Alkaline	<2.5 hours
Alkaline rechargeable	<1 hour
Carbon	<2 hours
Lithium	<1 hour

Recommended brands

Alkaline	Lithium	Carbon
Duracell ™	Eveready	Eveready
Eveready™		Rayovac
Kodak™		
Panasonic™		
Rayovac®, including rechargeable "Renewal®"		
Top Crest™		

NiCd rechargeable battery pack

Weight:	0.43 kg (12.5 oz.)
Power:	9.6 V, sealed nickel-cadmium (8 cells)
Capacity:	1.4 A-hours
Operation time:	8 hours
Charge time:	2 hours
Life cycle:	1 year (500 cycles)

Low battery indicator LED illuminates when battery usage time is at or below ~15 minutes.

Environmental—NiCd and AA

Operating

Temperature:	0 to 50° C (32 to 122 °F) – NiCd 0 to 40° C (32 to 104 °F) – AA
Humidity:	0 to 95% RH, noncondensing
Atmospheric pressure:	550 to 1,060 hPa (8 to 15.4 psia)
Vibration:	Meets or exceeds: ASTM 4728 (Method C) MIL-STD-810E, Method 514.4, Section I.3.4.3 IEC/EN 60068-2-37
Drop/shock:	Meets or exceeds: IEC/EN 60068-2-32 (Procedure 1) (NiCd) MIL-STD 810E, Method 516.4, Section I-3.6

Storage

Temperature:	–40 to 50 °C (–40 to +122 °F)
Humidity:	0 to 65% RH (±20%) noncondensing
Atmospheric pressure:	496 to 1,060 hPa (7.2 to 15.4 psia)
Vibration:	Meets or exceeds: ASTM 4728 (Method C) MIL-STD-810E, Method 514.4, Section I.3.4.3
Drop:	Meets or exceeds: IEC/EN 60068-2-32 (Procedure 1)

Precautions

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

- A **WARNING** indicates a potentially harmful situation that may cause injury to a patient or operator.
- A **CAUTION** indicates a condition that may lead to equipment damage or malfunction.

Read this section fully and carefully before using or servicing the oximeter and its accessories.

Warnings

Handling

Handle the oximeter and its accessories with care. Improper handling can cause damage or inaccurate operation of these devices.

Failure of operation

If the oximeter fails to respond as described, do not use it until qualified personnel have corrected the situation or the unit has been serviced.

Explosion hazard

Do not use the oximeter, printer, or battery charger in the presence of flammable anesthetics or other flammable substances in combination with air, an oxygen-enriched environment, or nitrous oxide.

Use only a 3770/3775 battery pack as part of the oximeter.

Cadmium is a hazardous substance. Do not incinerate or burn a NiCd battery pack. Dispose of a battery pack through an approved hazardous material disposal facility or by returning it to Datex-Ohmeda for reclamation.

Use only a Datex-Ohmeda battery charger to recharge or condition a Datex-Ohmeda NiCd battery pack. Do not use a Datex-Ohmeda battery charger to recharge or condition a NiCd battery pack that is not made by Datex-Ohmeda.

Do not expose a battery pack to any temperature that is hotter than you can tolerate to touch.

Fire hazard

To protect against fire hazard, replace the fuses in the battery charger only with fuses of the same type and local line voltage rating.

Electrical shock and flammability hazard

Before cleaning or servicing the oximeter, always turn it off.

Before cleaning or servicing the printer, always turn it off and disconnect the power cord from the AC mains power supply.

Before cleaning or servicing the battery charger, always disconnect the power cord from the AC mains power supply.

Electrical shock hazard

To protect yourself from possible electric discharge when the cover of the unit is removed and the unit is receiving power, avoid contact with internal components.

Do not attempt to repair the printer, battery pack, or single-station battery charger. They are not serviceable parts.

The battery charger must be properly grounded.

- Insert the three-connector plug on the power cord into a three-wire, grounded hospital-grade receptacle only. If a three-wire receptacle is not available, a qualified electrician must install one in accordance with the governing electrical code.
- Never remove the grounding connector from the power plug. The power cord and plug must be intact and undamaged.
- Do not use extension cords or adapters.

Patient safety

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

Operator safety

Do not handle hot or leaking battery packs or batteries.

Sensors

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

To prevent 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.

Data validity

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.

Interfering substances, excessive ambient light, excessive motion, low perfusion, low signal strength, incorrect sensor placement, or electrical interference at the sensor site can result in the display of inaccurate SpO_2 data.

Cautions

US Federal and Canadian laws restrict this device to sale by or on the order of a licensed medical practitioner.

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

Static sensitivity

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

Battery packs

To prevent battery pack damage,

- Never attempt to take a battery pack apart. Access only the battery compartment for replacing batteries in the AA battery pack.
- Never attempt to replace a cell in the NiCd battery pack. The set of eight cells is matched for capacity and improper operation could occur.
- Do not put a battery pack where it can be short-circuited by contact with metal objects, such as in a pocket with keys.
- Use only batteries recommended by Datex-Ohmeda in the LR6(AA) battery pack.

Service diagnostic mode is to be used by Datex-Ohmeda service personnel only.

Cleaning

Do not autoclave, pressure sterilize, or gas sterilize the oximeter, printer, battery pack, or battery charger.

Use cleaning solution sparingly. Do not immerse the oximeter, printer, battery pack, or battery charger in liquid. Excessive solution can flow into the device and cause damage to internal components.

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

Do not use petroleum-based solutions or solutions containing acetone, ethanol, freon, trichloroethylene, or harsh solvents to clean the oximeter, printer, battery pack, battery charger, or the protective covering on these devices. These substances attack the devices' materials and device failure may result.

When cleaning reusable oximeter sensors, follow all warnings and cautions stated in the sensor user instructions.

Disposable sensors are intended for single patient use only.

HP printer

To avoid damage to the printer, use only an AC adapter recommended by and available from Datex-Ohmeda.

Disposal

When the oximeter has reached the end of its useful life, dispose of it in accordance with local procedures and regulations.

2/Troubleshooting

This chapter contains:

- Tables containing messages that may be displayed on the oximeter and conditions that may occur while using the oximeter.
- A list of the possible causes for the message or condition.
- Recommended actions for responding to the message or to correct the condition. These actions include troubleshooting procedures to help you determine what needs to be done to correct the condition.

The tables in this chapter include the instruction to *swap boards*. This means you should replace one board at a time with a like board you know is functioning correctly to determine which board has failed. In most cases you are instructed to start with a specific board.

Also included in the tables are references to *possible failure points*. This information suggests component areas on a specific board that may have caused the malfunction. To repair the unit, always replace the board. Do not attempt to repair the board at the component level.

3770/3775 pulse oximeter

Message	Cause(s)	Recommended action(s)
BOOTCODE	The unit failed the power-on sequence of diagnostics.	Replace the digital board. See chapter 3.
PRINT <XX (3775 only)	Trend is printing to the printer. XX represents the amount of time remaining (in minutes) to complete printing.	No action required.
PROBE?	The sensor is not attached or not properly applied.	Attach the sensor.
	The sensor is not connected to the oximeter.	Check the sensor site; make sure the sensor is properly applied. Connect the sensor cable to the sensor connector on the oximeter.
	The sensor is not compatible with the oximeter.	Use a Datex-Ohmeda sensor that is compatible with the 3770/3775 oximeters.
	The sensor has failed.	Use another sensor. If the PROBE? message is continuous, check the wiring contacts between the sensor connector and the analog board. If the condition persists, swap boards, starting with the analog board. Replace the failed board. See chapter 3. Possible failure points: *Analog board:* Analog path *Digital board:* A/D converter
SERVICE (alternates repeatedly with an error code/type message)	The system or one of its components has failed.	**Note:** If this message occurs **during printing**, power the oximeter off and then on. If you can't restart printing and the message appears again, see below. Swap boards and replace the failed board. See chapter 3.

3770/3775 pulse oximeter (continued)

Condition	Cause(s)	Recommended action(s)
No display.	Unit not receiving power.	Make sure a battery pack is correctly inserted in the oximeter and press the on/off button on the front panel of the oximeter.
	NiCd battery pack needs recharging or AA pack needs new batteries.	Insert a charged battery pack.
	If using the battery charger to power the oximeter, the NiCd battery pack's contacts are not in contact with the power contacts in the battery charger.	Make sure the oximeter is inserted correctly in the battery charger. A beep sounds when correct contact is made. If the condition persists, swap boards, starting with the analog board. Replace the failed board. See chapter 3.
Oximeter alpha-numeric display switches on/off continually.	Faulty battery pack.	Install a known functioning, fully charged battery pack. If the new battery pack corrects the condition, discard and recycle the failed pack.
	Defective components on analog or digital board.	If the condition persists, swap boards, starting with the analog board. Replace the failed board. See chapter 3. Possible failure points: *Analog board:* Power supplies *Digital board:* Power on reset (POR)
Displayed SpO_2 value flashes.	The low SpO_2 or high SpO_2 alarm limit has been violated.	Flashing ceases when the alarm condition is cleared. Make sure the alarm limit is within the high and low limits.
Low battery light flashes every three seconds.	This alert indicates that not much full-power time remains on the batteries.	Remove the battery pack and replace it with a new, fully charged NiCd pack or AA pack with new batteries. NiCd pack only—Recharge the battery pack by itself or by placing it, together with the oximeter, into the battery charger.
Waveform bar LEDs and signal strength indicator darken, then "rolling dots" appear in the main display.	Loss of signal quality has occurred. Low perfusion, electrosurgery device, or other interference has been detected.	Check sensor site. Increase perfusion or relocate sensor. Remove any device that may be causing signal interference.

3770/3775 pulse oximeter (continued)

Condition	Cause(s)	Recommended action(s)
Oximeter sounds a constant tone.	Oximeter component failure.	Swap boards, starting with the digital board. Replace the failed board. See chapter 3. Possible failure points: *Digital board:* Microprocessor Speaker External guard dog *Analog board*: Power
(3775 only) Can't access menus.	Faulty component or area on the analog board.	Replace the analog board. See chapter 3. Possible failure point: *Analog board:* Rotary encoder assembly
Oximeter is not functioning at all.	Faulty battery pack.	Install a known functioning, fully charged battery pack. If the new battery pack corrects the condition, discard and recycle the failed pack. Possible failure points: *Analog board:* PETE Power supplies *Digital board:* On/Off circuit; Power on reset (POR)

Printer

Condition	Cause(s)	Recommended action(s)
Printer won't print.	Printer not powered on.	Make sure the printer AC adapter is properly connected to the printer and to the AC power supply. Slide the I/O printer button to I (on).
	No data in the trend buffer.	No action required. No data to print.
	Printer and oximeter are not properly aligned; transmission is not being received at the printer.	Make sure the printer and oximeter are properly positioned for infrared transmission. See the *3770/3775 Pulse Oximeter User's Manual.*
	Printer malfunction.	Replace the printer. If the new printer corrects the condition, discard the failed printer. The printer is not a serviceable part. If the condition persists, the oximeter is malfunctioning. Swap boards, starting with the digital board. Replace the failed board. See chapter 3.
Printer prints the symbol that represents lost information: ◪	Printer cannot print fast enough to keep up with the data transfer rate of the oximeter. The printer battery power is running low.	Install new batteries. Always use AC power whenever possible.
Prints repeatedly over a single line.	Paper jam.	Pull paper out and reload.
Print head scans but no characters are printed.	Printer malfunction: defective print head assembly thermal control.	Replace and dispose of the malfunctioning printer. The printer is not a serviceable part.
Print head does not move while unit is powered on.	Printer malfunction: jammed print head assembly.	Replace and dispose of the malfunctioning printer. The printer is not a serviceable part.
Red LED behind printer IR window is not lit when power is on.	Batteries are dead.	Install new batteries.
	No AC power.	Ensure that the AC adapter is plugged into the printer and into the AC power source.
	Malfunctioning AC power adapter.	Check/replace the AC power adapter.
	Printer malfunction.	Replace and dispose of the malfunctioning printer. The printer is not a serviceable part.

Battery charger monitoring station

Condition	Cause(s)	Recommended action(s)
Battery charge status indicator is a steady red light after a battery pack is inserted.	The NiCd battery pack is above or below the allowable temperature charging range.	The charger will automatically start charging with a flashing green light when the battery pack reaches the proper range.
Battery charge status indicator is not lit after battery pack is inserted.	Oximeter and/or NiCd battery pack is not inserted into the charger correctly.	Reinsert the oximeter and/or NiCd battery pack, aligning it so you can hear a beep from the charger station and the light is lit.
	NiCd battery pack is not in place on the oximeter and/or in its slot in the monitoring station.	Install a NiCd battery pack on the oximeter and reinsert it.
	Voltage selected for the charger does not match the available local voltage.	Remove voltage selection drum and set correctly. Refer to the *Battery Charger Monitoring Station Service Manual.*
	NiCd battery pack is completely dead.	Replace NiCd battery pack with a new one.
Battery charge status indicator is a steady yellow light after a battery pack is inserted.	The NiCd battery pack is above or below the allowable voltage charging range.	The charger will automatically start charging with a flashing green light when the battery pack reaches the proper range.
	The battery pack may be fully charged already.	Remove the battery pack from the charger.
Battery charge status indicator is a flashing yellow light after a battery pack is inserted.	Charger is in conditioning mode.	The charger will automatically start charging with a flashing green light when the discharge cycle is complete.
	Faulty conditioning switch or malfunctioning circuitry.	The monitoring station requires service. Refer to the *Battery Charger Monitoring Station Service Manual.*
Green power light is on but there is a continuous beep.	Voltage selection drum in the power module is not set for correct voltage.	Remove voltage selection drum and set correctly. Refer to the *Battery Charger Monitoring Station Service Manual.*
Charger is “chirping.”	Voltage selection drum in the power module is not set for correct voltage.	Remove voltage selection drum and set correctly. Refer to the *Battery Charger Monitoring Station Service Manual.*

Battery charger monitoring station (continued)

Condition	Cause(s)	Recommended action(s)
Green LED power indicator is not lit. Unit is not functioning.	Monitoring station is not connected to AC power.	Ensure that the power cord is plugged into the monitoring station and the AC power source.
	Fuse(s) are blown.	Replace the fuse(s) in the power inlet module. Refer to the *Battery Charger Monitoring Station Service Manual.*
	Voltage selection drum in the power module is not set for correct voltage.	Remove the voltage selection drum and set correctly. Refer to the *Battery Charger Monitoring Station Service Manual.*
	Damaged contacts.	Inspect the contacts. If the fuses, voltage selection setting, and contacts are not causing the condition, open the charger and troubleshoot from inside. Refer to the *Battery Charger Monitoring Station Service Manual.*
Charger is functioning but slot not charging or conditioning as expected.	Damaged contacts.	Inspect the contacts. All four prongs should protrude equally. If not, replace the contacts. Refer to the *Battery Charger Monitoring Station Service Manual.*
	If the LED stays at steady yellow when charging batteries, the battery pack may already be fully charged.	No action is required.
	When conditioning batteries and the LEDs don't go to flashing yellow, the conditioning switch may be faulty.	Replace the conditioning switch. Refer to the *Battery Charger Monitoring Station Service Manual.*
Charger is not functioning at all.	Fuse(s) are blown or contacts are damaged.	Inspect the contacts. Replace the fuse(s) in the power inlet module. Refer to the *Battery Charger Monitoring Station Service Manual.*
	Voltage selection drum in the power module is not set for correct voltage.	Remove the voltage selection drum and set correctly. Refer to the *Battery Charger Monitoring Station Service Manual.* If the condition persists, open the charger and troubleshoot from inside. Refer to the *Battery Charger Monitoring Station Service Manual.*

Battery charger (single)

Condition	Cause(s)	Recommended action(s)
Battery charger status indicator is not lit after a battery pack is inserted.	NiCd battery pack is not inserted correctly.	Reinsert NiCd battery pack.
	Damaged contacts.	Inspect contacts. All three prongs should protrude equally. If contacts are broken, discard charger. The charger is not a serviceable part.
	Yellow LED is burned out.	Discard charger.
	Internal failure.	Discard charger.
Battery charger status indicator is flashing slowly after a battery pack is installed.	The NiCd battery pack is above or below the allowable temperature or voltage charging range.	The charger automatically starts charging with a steady yellow light when the battery pack reaches the proper range.
	The battery pack may be fully charged already.	Remove the battery pack from the charger.
	Defective battery pack.	If the indicator continues to flash slowly, replace the battery pack.
Battery charger status indicator is flashing rapidly after a battery pack is inserted.	The battery pack may be fully charged already.	Remove the battery pack.
Green power indicator is not lit.	Charger is not connected to AC power.	Ensure that the power cord is plugged into the battery charger and the AC power source.
	Fuse(s) are blown.	Discard charger. The charger is not a serviceable part.
Green power indicator is flashing.	The battery pack is defective.	Remove and replace the battery pack.

3/Service Policy and Repair Procedures

This chapter contains:

- The Datex-Ohmeda service policy and the procedures to follow for obtaining service.
- Safety procedures you must follow when handling equipment that may be contaminated and when making repairs.
- Instructions for cleaning the oximeter, durable sensors, battery packs, and battery chargers.
- Procedures for inspecting the oximeter and replacing these parts:

  Alarm bar

  Analog board

  Bezels

  Digital board

  IR lens

  Menu select wheel and label
- Instructions for checking the normal operation of the oximeter.

Service policy

Warranty repair and service must be performed by Datex-Ohmeda. When the warranty is not applicable, repairs are made by Datex-Ohmeda at the current list price for replacement parts plus a reasonable labor charge.

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

Do not use malfunctioning equipment. Make all necessary repairs or have the monitor repaired by a Datex-Ohmeda service representative. For all repairs, use only genuine replacement parts and service kits sold by Datex-Ohmeda.

Ordering parts and obtaining service

Contact Datex-Ohmeda or your authorized service representative (see the back cover of this manual) to order parts or for assistance.

Packaging and returning equipment

If you are instructed to ship the monitor to Datex-Ohmeda or an authorized service office for repair, follow these steps:

1. Clean the monitor. See *Cleaning procedures* later in this chapter. Make sure the monitor is completely dry before you pack it for shipment.
2. Package the monitor carefully for shipment (in the original shipping container, if possible). Enclose these items:
3. You may be required to include the following items (when you call for assistance, verify the shipping requirements):
    - A letter describing the problem in detail.
    - Person (name, telephone or fax number, and country) to contact for questions about necessary repairs.
    - *Ship to* and *Bill to* information.
    - Warranty information (a copy of the invoice or other applicable documentation).
    - Purchase order number to cover repairs (if out of warranty) or for tracking purposes.
4. Ship the monitor as directed by your service office.

Safety guidelines

Read and follow each step of all test and repair procedures to ensure their proper and safe completion. Give special attention to all **WARNINGS** and **CAUTIONS**.

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

WARNING: Electrical shock and flammability hazard. Before cleaning or servicing the oximeter, always turn it off.

Before you start any procedure that involves disassembly of the oximeter, be sure to

- Power off and disconnect the unit from any power supply.
- Disconnect the sensor from the unit.
- Clean the unit (see below).

After repairs are complete, verify that the device is functioning correctly. See *Checking normal operation* later in this chapter.

Cleaning procedures

Oximeter, battery packs, and battery chargers

CAUTIONS:

- Do not autoclave, pressure sterilize, or gas sterilize the oximeter, printer, battery pack, or battery charger.
- Use cleaning solution sparingly. Do not immerse the oximeter, printer, battery pack, or battery charger in liquid. Excessive solution can flow into the device and cause damage to internal components.
- When cleaning the display lens, do not use abrasive cleaning compounds or other materials that could damage the lens.
- Do not use petroleum-based solutions or solutions containing acetone, ethanol, freon, trichloroethylene, or harsh solvents to clean the oximeter, printer, battery pack, battery charger, or the protective covering on these devices. These substances attack the devices' materials and device failure may result.

Cleaning agents

Warm water	Hydrogen peroxide solution	Cidex®
Liquid soap/mild detergent	Gluteraldehyde (4% or less)	Windex®
Mild chlorine bleach solution	Isopropyl alcohol	Formula 409®

Never Use:

Acetone * Butyl alcohol * Denatured ethanol * Freon * Trichloroethylene

WARNING: Electrical shock and flammability hazard. Before cleaning or servicing the oximeter, always turn it off.

To clean the oximeter, power it off. Then, wipe it gently with a soft cloth dampened with any of the *cleaning agents* listed above.

WARNING: Electric shock and flammability hazard. Before cleaning the battery charger, always disconnect the power cord from the AC mains power supply.

Before cleaning the battery pack or battery charger, disconnect it from any power supply. Then wipe it gently with a soft cloth dampened with any of the *cleaning agents* listed above (do not spray the agent directly on any device).

Sensors

To clean Datex-Ohmeda reusable oximeter sensors, follow the instructions provided with the sensor.

CAUTION: When cleaning oximeter sensors, follow all warnings and cautions stated in the sensor user instructions.

CAUTION: Disposable sensors are intended for single patient use only.

After cleaning a sensor, verify that it is functioning correctly. See *Checking normal operation* later in this chapter.

Inspecting the oximeter and replacing parts

Refer to chapter 4 for illustrations.

Follow the procedures in this section to inspect the oximeter for damage and replace defective parts.

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

Tools and equipment

- #1 Phillips screwdriver
- Clear silicone rubber adhesive sealant (Dow Corning RTV 3145)

Disassembling the oximeter

Important: As you disassemble the oximeter, carefully set aside each part you plan to reinstall when you assemble the oximeter.

1. Turn off the oximeter and remove the battery pack.
2. Turn the oximeter face down and remove the four screws that secure the bottom bezel to the top bezel.
3. Remove the bottom bezel.
4. Inspect the top and bottom bezels. If either bezel is damaged, replace it during reassembly.
5. Inspect the interior for loose or broken parts and for foreign materials. Remove foreign material and note those parts that need replacement.
6. Grasp the FlexConnect™ sensor connector and lift up to loosen it from the top bezel.
7. **3770 oximeter:** Lift out the board set.
8. **3775 oximeter:**
   - Remove the IR lens (plastic window).

     Note: If the lens is held in place with sealant, remove the lens only if you are replacing the lens and/or the top bezel **or** if the sealant is not intact.
   - Turn the oximeter face up and gently pry off the menu select wheel.
   - Remove the rotary encoder nut.
   - Lift the top bezel off the board set.
9. To separate the analog and digital boards from each other, grasp the board set near the horizontal center and pull gently but firmly.

   3775 oximeter: Avoid stressing the ribbon cable and its connection to the analog board. Do not flex the ribbon cable any more than absolutely necessary.
10. If you plan to replace the alarm bar or the top bezel, turn the bezel face up and push the alarm bar through the bezel.

Replacing parts

When the oximeter is disassembled, you can replace any part listed below with a new part as you assemble the oximeter:

- Alarm bar
- Analog board
- Bezels
- Digital board
- IR lens
- Menu select wheel and label

Assembling the oximeter

Important: During the manufacture of some 3770/3775 oximeters, a bead of silicone sealant was applied to the IR window and sensor connector cutouts on the top and bottom bezels (see Figures 3-1 and 3-2). The sealant was applied to ensure the waterproof integrity of these oximeters.

You may need to reapply sealant during assembly if disassembly of the oximeter results in loss of the original sealant or if the sealant is no longer intact. Follow the instructions in this section to check the oximeter for the presence of sealant and, if necessary, reapply sealant.

1. Make sure the rotary encoder, FlexConnect wires, the power on/off switch, the alarm bar switch, all display and alphanumeric LEDs, and all other component parts are securely in place on their respective boards.
2. If you separated the alarm bar and top bezel during disassembly, position the alarm bar in the underside of the bezel, and press it into place.
3. Gently but firmly connect the analog and digital boards to each other.
4. Turn the top bezel face down. Place the board set into the top bezel with the digital board facing down.
5. **3775 oximeter**:
   - Turn the oximeter face up.
   - Place the rotary encoder nut on the rotary encoder and tighten it.
   - Place the menu select wheel firmly on the encoder's stem.
   - Turn the oximeter face down.
6. Push the FlexConnect sensor connector firmly into position in the top bezel.

7. Check the oximeter for the presence of sealant. If sealant is **not** present, go to the next step.
   - If the sealant on the top bezel is not intact, apply new clear silicone rubber adhesive sealant (Dow Corning RTV 3145) to the top bezel above the sensor connector. See Figure 3-1.

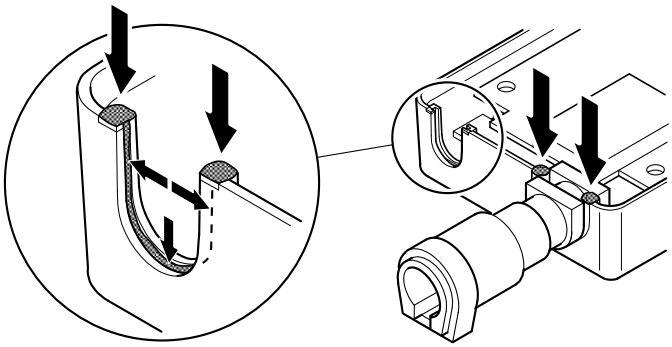


Figure 3-1. Applying sealant to the top bezel

   - **3775 oximeter:** Add sealant in the IR lens cutout on the top bezel, if necessary.
   - If the sealant on the bottom bezel is not intact, add sealant to the sensor connector cutouts. See Figure 3-2.

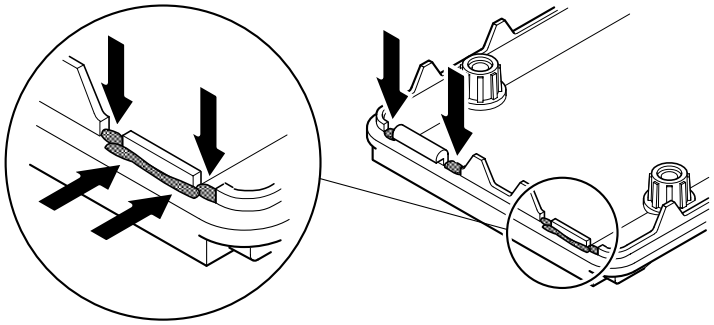


Figure 3-2. Applying sealant to the bottom bezel

   - **3775 oximeter:** Add sealant to the IR lens cutouts on the bottom bezel, if necessary.
8. **3775 oximeter:** Slide the IR lens into its slot on the top bezel.
9. Position the FlexConnect wires so that they will not be crushed between the ground ring on the analog board and the conductive boss that extends from the bezel.
10. Make sure there are no loose parts inside the top bezel. Then, place the bottom bezel on the top bezel and install the screws that connect the bezels:
    - For the 3770, use four 4-20 x 0.5L screws.
    - For the 3775, use four 4-20 x 5/8L screws.
11. Check the operation of the oximeter. See *Checking normal operation* on the next page.

Checking normal operation

1. Install a battery pack on the oximeter. Power on the oximeter.

   3775 oximeter: No alarms sound for the first two minutes after powering on the unit.

2. Verify that the low-battery light is not lit.
3. Plug the sensor cable into the sensor cable connector on the oximeter.
4. Place the sensor on a finger and wait until the SpO_2 and pulse rate values appear in the main display.
5. Unplug the sensor cable from the oximeter.

   3770 oximeter: Verify that dashes (- - -) are displayed.

   3775 oximeter: Verify that the PROBE? message appears on the main display.

6. Plug the sensor cable back into the oximeter and wait for monitoring data to reappear on the main display.
7. Remove the sensor from the finger.

   3770 oximeter: Verify that dashes (- - -) are displayed.

   3775 oximeter: Verify that the PROBE? message appears on the main display.

8. Reattach the sensor to the finger.
9. Verify that the signal strength is good to adequate (green or yellow signal strength indicator is illuminated).

   For more information, see *Data validity and signal strength* in the *3770/3775 Pulse Oximeter User's Manual.*

4/Illustrated Parts

This chapter contains a list of service kits, a list of parts, and assembly illustrations for each oximeter.

Service kits—3770 and 3775 oximeters

Kit, PCA drawings 6050-0005-558
Includes board drawing, list of components, and schematics for the analog and digital boards

Kit, "Not for continuous monitoring" labels 6050-0003-466
Danish, Finnish, French, German, Italian, Spanish, Swedish

Kit, analog board, tested, 3775 6050-0003-667
PCA, analog board, 3775
Spacer, foam 0.25 x 0.125 x 0.75 in. (2)
Spacer, foam 0.50 x 0.125 x 1.0 in.
Spacer, foam 0.75 x 0.25 x 1.0 in.

Kit, analog board, tested, 3770 6050-0003-486
PCA, analog board, 3770
Spacer, foam 0.25 x 0.125 x 0.75 in.
Spacer, foam 0.50 x 0.125 x 1.0 in.
Spacer, foam 0.75 x 0.25 x 1.0 in.

Kit, digital board, tested, 3775 6050-0003-480
PCA, digital board, 3775

Kit, digital board, tested, 3770 6050-0003-481
PCA, digital board, 3770

Kit, bezel, bottom, 3770/3775 6050-0004-078

Kit, bezel, top, 3775 6050-0002-889
Note: This kit does *not* include the alarm bar, on/off label, or wheel assembly.

Kit, bezel, top, 3770 6050-0002-886

Assembly, alarm bar, 3775 6050-0002-600

Assembly, nut, bearing, 3775 6050-0002-888

On/Off Label, 3775 6050-0002-593

Kit, wheel/label, 3775 6050-0003-666
Assy, wheel
Wheel/select label

Kit, hardware, 3770/3775 6050-0003-780
Screw, tri-rnd, 4-20 x 0.5/8L (4)
Screw, tri-rnd, 4-20 x 0.5L (4)
Lens, IR

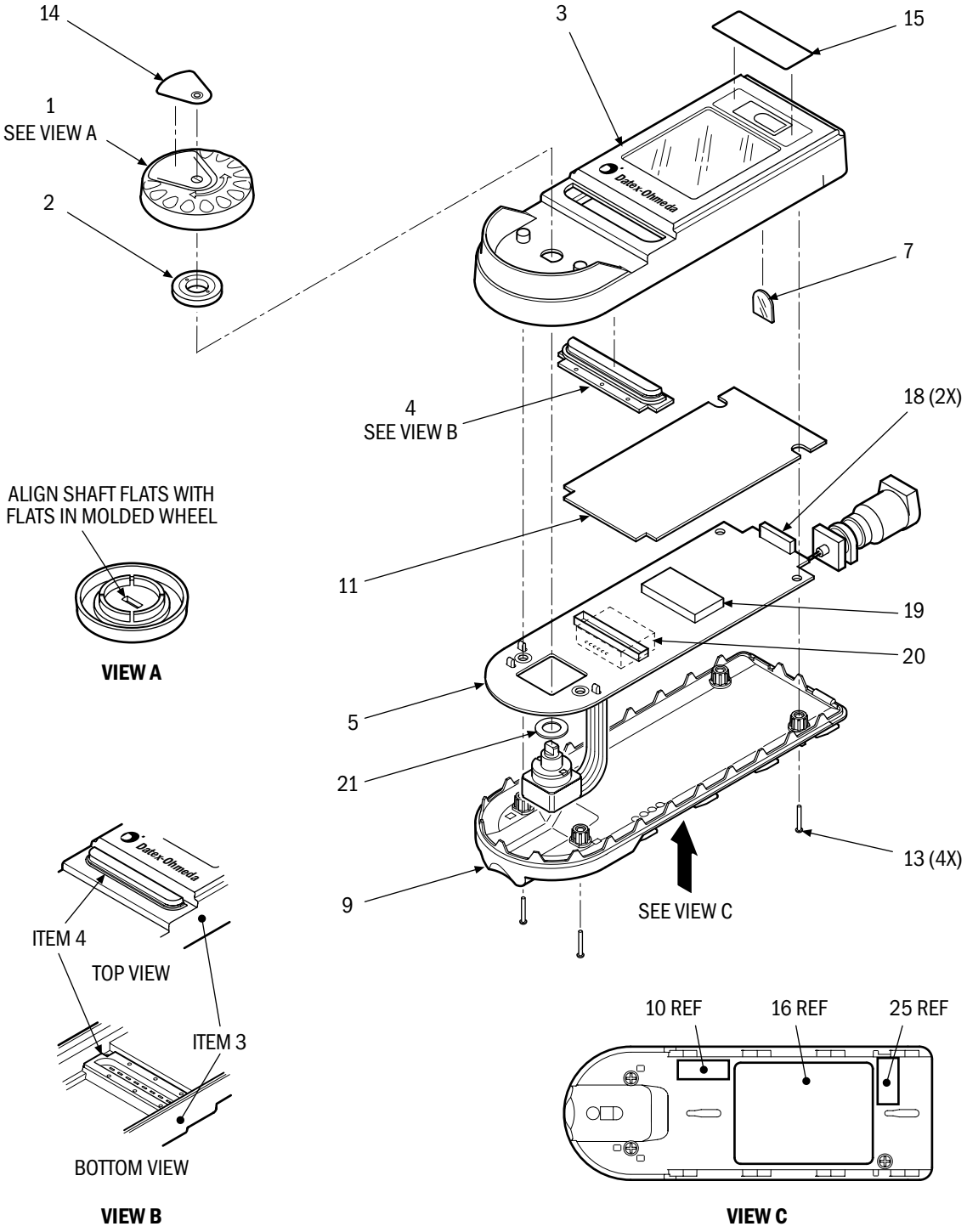
3775 oximeter assembly (REF 6050-0002-601, Rev. P)

3775 assembly parts

Each item number listed below identifies a component in the assembly illustration that follows.

Item	Description
1	Assy, wheel, 3775
2	Assy, nut, bearing
3	Assy, top bezel, 3775
4	Assy, alarm bar
5	PCA, analog board, 3775
	Includes: Rotary encoder switch
7	Lens, IR, 3775
9	Bezel, bottom
10	Label, serial port (not shown)
11	PCA, digital board, 3775
	Includes: Speaker, 5 V, 0.354 inch diameter
13	Screw, tri-rnd, #4-20 x 5/8L, plastite (4)
14	Label, wheel/select
15	Label, on/off
16	Label, serial REF, 2.75 x 1.68 in. (not shown)
18	Spacer, foam, 0.25 x 0.125 x 0.75 in. (2)
19	Spacer, foam, 0.50 x 0.125 x 1.0 in.
20	Spacer, foam, 0.75 x 0.25 x 1.0 in.
21	O-ring seal 0.354 in. ID , .040 in. wall
25	Label, warranty void, 3770/3775

3775 assembly illustration



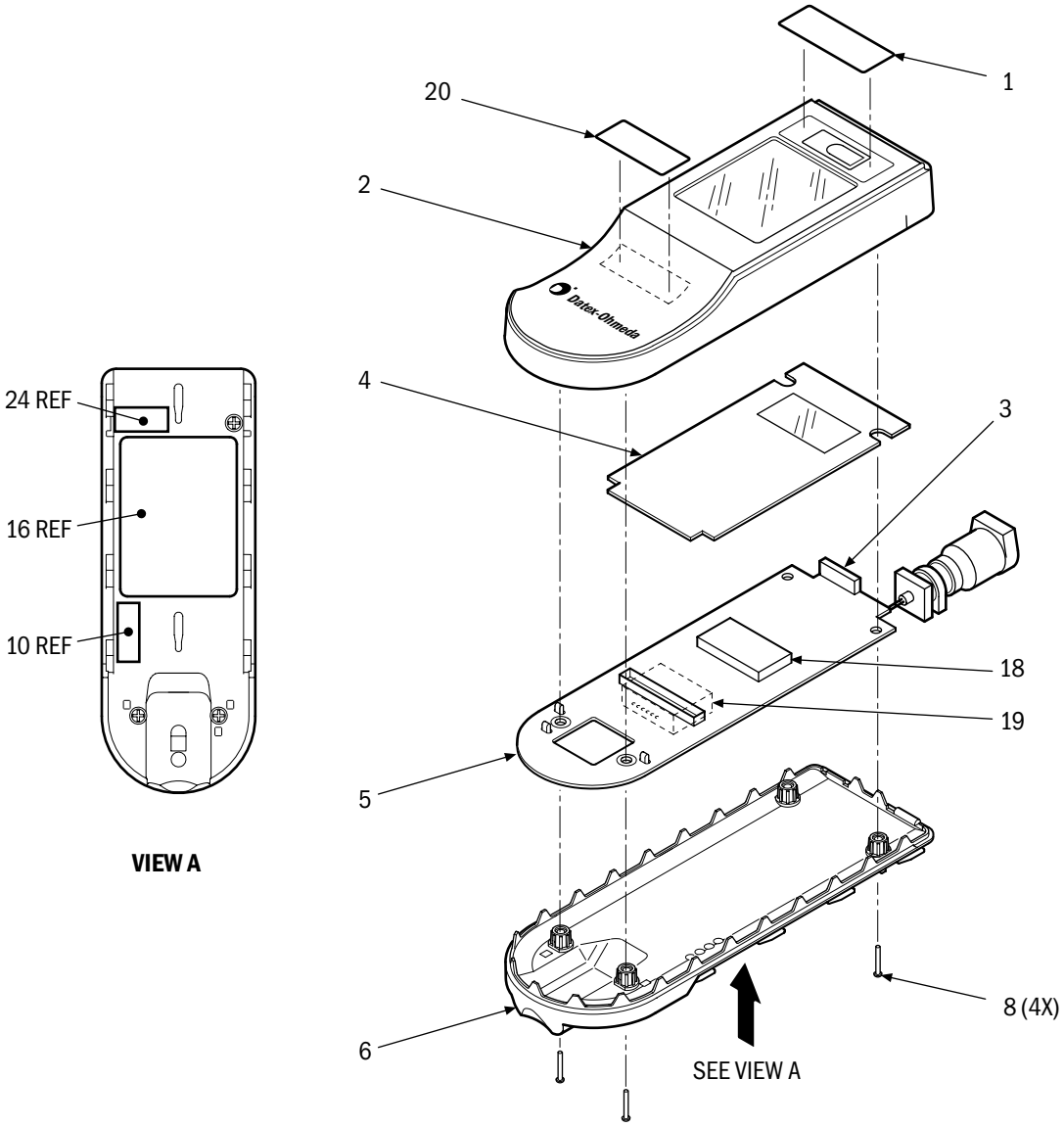
3770 oximeter assembly (REF 6050-0002-632, Rev. H)

3770 assembly parts

Each item number listed below identifies a component in the assembly illustration that follows.

Item	Description
1	Label, On/Off
2	Assy, top bezel, 3770
3	Spacer, foam, 0.25 x 0.125 x 0.75
4	PCA, digital, 3770
5	PCA, analog, 3770
6	Bezel, bottom
8	Screw, tri-rnd, #4-20 x 0.5L, plastite (4)
10	Label, serial port
16	Label, serial REF, 2.75 x 1.68 in. (not shown)
18	Spacer, foam, 0.50 x 0.125 x 1.0 in.
19	Spacer, foam, 0.75 x 0.25 x 1.0 in.
20	Label, use warning, 3770
24	Label, warranty void, 3770/3775

3770 assembly illustration



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