



Operator's Manual

2500 *PalmSAT*®

Pulse Oximeter



English

About the Manual

There are many contraindications, warnings, and cautions throughout this manual. Read them carefully; they are important to the use of the product.

The information in this manual has been carefully checked and is believed to be accurate. In the interest of ongoing product development, NONIN reserves the right to make changes and improvements to this manual and the products it describes at any time, without notice or obligation.

CAUTION! Federal law (USA) restricts this device to sale by or on the order of a physician.

CAUTION! Read this entire manual carefully before using the PalmSAT Pulse Oximeter.

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References to “NONIN” in this manual shall imply Nonin Medical, Inc.





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Guide to Symbols

Front Panel Symbols	
	Percent Oxygen Saturation
	Pulse Rate
	Pulse Quality (tricolor LED)
	Low Battery

Front Panel Switches	
	On/Off
	Advance

Other Symbols	
	ATTENTION: See Instructions for Use
	Not for Continuous Monitoring (No Alarm for SpO ₂)
	Type BF Applied Part (Patient isolation from electrical shock)
	UL Mark for Canada and the United States with respect to electric shock, fire, and mechanical hazards only in accordance with UL 2601-1 and CAN/CSA C22.1 No. 601.1
	CE Marking indicating conformance to EC directive No. 93/42/EEC concerning medical devices
	Serial Number (located under the battery cover)

Precautions for Use


Contraindications

- Do not use the PalmSAT in an MRI environment.
- The PalmSAT has no alarms; do not use when alarms are required.

Warnings

- Explosion hazard. Do not use the PalmSAT in an explosive atmosphere.
- The PalmSAT is intended only as an adjunct in patient assessment. It must be used in conjunction with other methods of assessing clinical signs and symptoms.
- Use only NONIN-manufactured pulse oximeter sensors. These sensors are manufactured to meet the accuracy specifications for NONIN Pulse Oximeters. Using other manufacturers' sensors may cause improper pulse oximeter performance.
- As with all medical equipment, carefully route patient cabling to reduce the possibility of patient entanglement or strangulation.
- Check the pulse oximeter sensor application site frequently to determine the positioning of the sensor and the circulation and skin sensitivity of the patient. Each patient's sensitivity to NONIN sensors may vary depending on their medical status or skin condition.
- Discontinue use of adhesive tape strips if the patient exhibits an allergic reaction to the adhesive material.
- Do not stretch the adhesive tape while applying the pulse oximeter sensor. This may cause inaccurate readings or skin blisters.
- General operation of the PalmSAT may be affected by the use of an electro-surgical unit (ESU).
- Do not use a damaged sensor.

Cautions

- Federal law (USA) restricts this device to sale by or on the order of a physician.
- Read this entire manual carefully before using the PalmSAT.
- Before use, carefully read the package insert provided with the sensors.
- The PalmSAT Pulse Oximeter is intended for spot-checking or monitoring by an attending healthcare professional. Because the PalmSAT has no SpO₂ alarms, international labeling requirements (EN 865) dictate it be labeled *not for continuous monitoring*, as indicated by the  symbol.
- The PalmSAT Pulse Oximeter is not an apnea monitor.
- Verify that all visible indicators illuminate during the startup (initialization) sequence. If any indicator is not lit, do not use the PalmSAT. Contact NONIN Customer Support for repair or replacement.

Cautions (Continued)

- Some nail polish colors (particularly dark shades) or artificial nails may reduce light transmission and affect SpO₂ accuracy. Remove any nail polish or artificial nails before using the PalmSAT.
- The PalmSAT may not work on all patients. If you are unable to achieve stable readings, discontinue use.
- The PalmSAT may misinterpret motion as good pulse quality (as indicated by a green pulse quality display). Minimize patient motion as much as possible.
- The PalmSAT Pulse Oximeter is designed to determine the percentage of arterial oxygen saturation of functional hemoglobin. Significant levels of dysfunctional hemoglobin, such as carboxyhemoglobin or methemoglobin, may affect the accuracy of the measurement.
- Cardiogreen and other intravascular dyes, depending on the concentration, may affect the accuracy of the SpO₂ measurement.
- Ear Clip and Reflectance pulse oximeter sensors are not recommended for pediatric or neonatal use. The accuracy of these sensors has not been established for pediatric or neonatal use.
- Do not immerse the PalmSAT or NONIN sensors in liquid.
- Do not use caustic or abrasive cleaning agents on the PalmSAT or the sensors.
- The PalmSAT Pulse Oximeter is a precision electronic instrument and must be repaired by trained NONIN personnel only.
- Do not use different types of batteries at the same time. Do not mix fully charged and partially charged batteries at the same time. These actions may cause the batteries to leak.
- Do not remove any covers other than the battery cover when replacing batteries. There are no user-serviceable parts inside other than the replaceable batteries.
- Follow local governing ordinances and recycling instructions regarding disposal or recycling of the device and device components, including batteries.
- Batteries may leak or explode if used or disposed of improperly.
- Remove the batteries if the PalmSAT will be stored for more than 1 month.
- This equipment complies with International Standard EN 60601-1-2:1993 for electromagnetic compatibility for medical electrical equipment and/or systems. This standard is designed to provide reasonable protection against harmful interference in a typical medical installation. However, because of the proliferation of radio-frequency transmitting equipment and other sources of electrical noise in healthcare and other environments (for example cellular phones, mobile two-way radios, electrical appliances), it is possible that high levels of such interference due to close proximity or strength of a source may result in disruption of performance of this device.

Introduction

Indications for Use

The NONIN® PalmSAT® Model 2500 Pulse Oximeter (Figure 1) is indicated for use in measuring and displaying functional oxygen saturation of arterial hemoglobin (SpO₂) and pulse rate for adult, pediatric, and neonatal patients in hospital, ambulatory, home, and EMS (emergency medical service) environments. The PalmSAT is intended for spot-checking and/or continuous monitoring when attended by a trained healthcare professional.

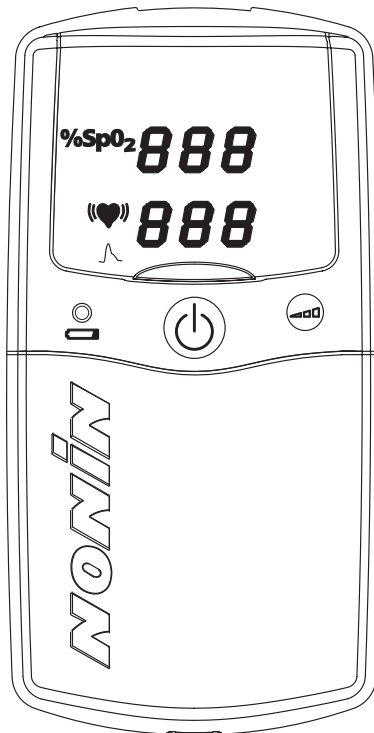


Figure 1. The PalmSAT Model 2500 Pulse Oximeter.

General Description

The PalmSAT is a digital handheld pulse oximeter that displays numerical values for blood oxygen saturation and pulse rate (Figure 2).

The PalmSAT will typically operate for 100 hours continuously between alkaline battery replacements, or for 45 hours with the Model 2500B Rechargeable NiMH (Nickel Metal Hydride) Battery Pack (optional). The PalmSAT requires no routine calibration or maintenance other than replacement of alkaline batteries or recharging the optional battery pack. (Refer to the Model 2500C Operator's Manual.)

The pulse oximeter determines functional oxygen saturation of arterial hemoglobin (SpO₂) by measuring the absorption of red and infrared light passing through perfused tissue. Changes in absorption caused by the pulsation of blood in the vascular bed are used to determine oxygen saturation and pulse rate.

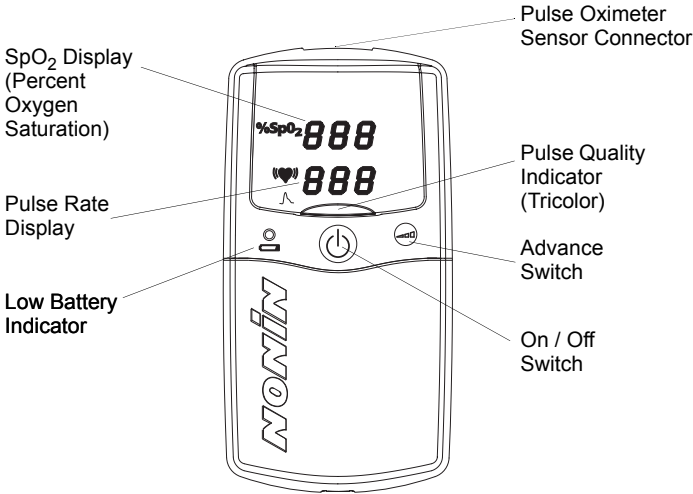


Figure 2. PalmSAT displays, indicators, and switches.

Oxygen saturation and pulse rate values are displayed by light-emitting diode (LED) digital displays. On each detected pulse, the pulse quality LED blinks. Patient pulse quality signals are graded as good, marginal, or inadequate and are indicated as such by the pulse quality indicator blinking green, yellow, or red, respectively. This simple method gives the user a pulse-by-pulse visual indication of waveform signal quality without requiring the user to perform complex waveform analysis.

The PalmSAT Pulse Oximeter may be used with a variety of NONIN pulse oximeter sensors.

Because the PalmSAT has no patient alarms, SpO₂ and pulse rate displays must be observed frequently.

A sensor disconnect or malfunction is indicated by a lack of good pulse quality blinking and/or a dash to the left of the SpO₂ value on the LED display. When adequate pulse signals are not received, the SpO₂ and/or pulse rate numerical values will be replaced by dashes. Low and critically low battery conditions will be indicated by the low battery LED.

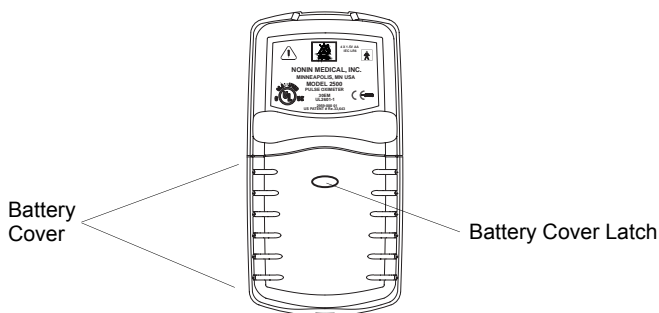


Figure 3. Rear view of the PalmSAT.

Unpacking the PalmSAT

The PalmSAT complete system includes the following items:

- 1 PalmSAT Model 2500 Pulse Oximeter
- 1 Model 2500INS Operator's Manual
- 1 NONIN Pulse Oximeter Sensor
- 4 AA-Size Alkaline Batteries

Confirm that the items listed are packed with the PalmSAT system. If any item on this list is missing or damaged, contact your distributor. Contact the carrier immediately if the shipping carton is damaged.

Basic Operation

Installing and Using the Batteries

The PalmSAT Handheld Pulse Oximeter can be powered by 4 AA-size alkaline batteries (which will typically provide 100 hours of continuous operation), or by the optional Rechargeable NiMH Battery Pack. (See “Accessories” on page 23.) *Nonin does not recommend any other battery types.*

When the batteries are low, the low battery indicator (a yellow LED) will be steadily illuminated. (See Figure 2 on page 4.) Replace the batteries as soon as possible. When the batteries are critically low, the low battery indicator will flash and the pulse oximeter will not operate. The digital displays will go blank, and the pulse quality indicator will blink yellow or red, but not green. Replace the batteries immediately.

1. Press the battery cover latch, and remove the battery cover on the bottom of the PalmSAT.
2. Insert four new AA-size alkaline batteries or a Rechargeable NiMH Battery Pack. Be sure to insert the batteries in the correct position, as indicated by the polarity markings (+ and -) inside the battery compartment. *Proper battery positioning is essential for correct operation.*
3. Replace the battery cover and turn on the PalmSAT. If the unit does not turn on, see “Troubleshooting Guide” on page 25.

NOTE: After removing batteries from the PalmSAT, you will have approximately 2 minutes to replace them before losing data stored in memory and the clock and calendar settings. Replace the batteries immediately to avoid the loss of stored data.

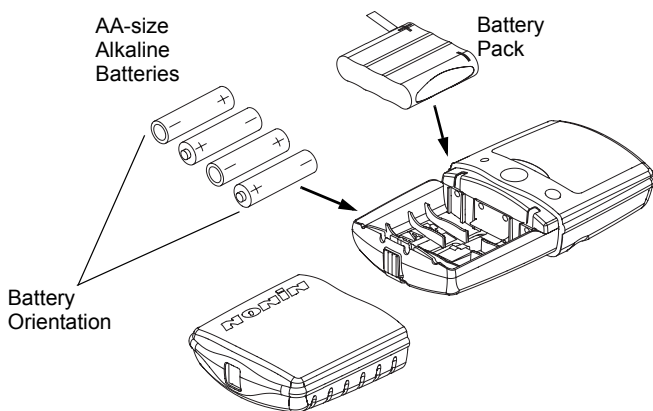


Figure 4. Installing batteries in the PalmSAT.

Important Notes about Battery Use

Four AA alkaline batteries provide the PalmSAT with approximately 100 hours of continuous operation, while the Rechargeable NiMH Battery Pack provides the PalmSAT with approximately 45 hours of continuous operation.

Clock/calendar settings can significantly affect battery storage life.

Batteries drain during storage, but they drain much more quickly when the unit's clock/calendar functions are set. Refer to "Calendar and Clock Settings" on page 14 for more information.

With AA Batteries

- If the clock/calendar is *not* set when the unit is stored, alkaline batteries will need replacement in 10-12 months *if the unit has not been used*.
- If the clock/calendar *is* set when the unit is stored, alkaline batteries will require replacement in about 6 weeks *if the unit has not been used*.
- Using the oximeter will shorten the required replacement time.

With Rechargeable NiMH Battery Pack

- If the clock/calendar is *not* set when the unit is stored, the Rechargeable NiMH Battery Pack will need recharging at least every 2 months *if the unit has not been used*.
- If the clock/calendar *is* set when the unit is stored, the Rechargeable NiMH Battery Pack will need recharging at least every 3 weeks *if the unit has not been used*.
- Using the oximeter will shorten the required recharging time.

Recharging Batteries (NiMH Battery Pack Only)

- Completely recharging the NiMH battery pack requires approximately 90 minutes when the unit is completely discharged.
- The expected useful life of the Rechargeable NiMH battery pack is 500 charge/discharge cycles, or approximately 10 years, whichever is first. The battery pack must be charged at least once each year to maintain optimal battery life.
- AA alkaline batteries cannot be recharged in the charging stand.

Connecting the Sensor

Connect the pulse oximeter sensor (with the NONIN logo facing up) to the top of the PalmSAT as shown in Figure 5. Ensure that the sensor is firmly plugged in. Refer to “Specifications” on page 20 or to the specific sensor package insert for pulse oximeter sensor positioning information.

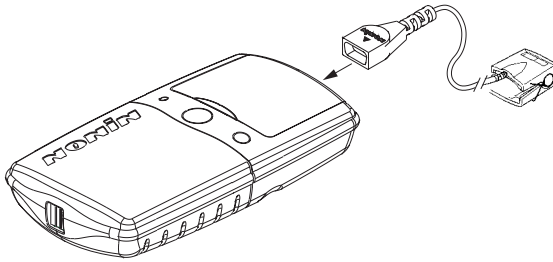




Figure 5. Connecting a sensor to the PalmSAT.

Power On/Off

Turn on the PalmSAT by pressing and releasing the on/off switch  on the front of the unit. Turn off the unit by pressing and holding this switch for approximately 2 seconds. Refer to Figure 2 on page 4 for a detailed illustration of the switches and indicators. Refer to “Detailed Operation” on page 11 for detailed information on entering setup mode and on general operation of the PalmSAT.

Power On Self-Test

When the PalmSAT is powered on for normal operation by pressing and releasing the on/off switch , the unit will cycle through a startup (or initialization) sequence before displaying valid data values.

During startup, always check for any missing indicators or LED display segments. If any indicator is not lit, do not use the PalmSAT. Contact NONIN Customer Support for repair or replacement.

At normal startup (when not entering the setup mode), with fresh batteries, the PalmSAT will cycle through the following sequence:

- **888**
- **888** will appear briefly in the SpO₂ and pulse rate displays.
- the yellow low battery indicator will turn on steadily for a few seconds.
- the pulse quality indicator will turn on red for 1 second, then green for 1 second, and then begin to blink.
- the clock time currently set in the memory (in hours and minutes, $\overline{04}$ $\overline{1}$ for example) appears briefly in the displays.
- the software revision number (the letter “r” followed by a 3-digit number, $\overline{018}$ for example) appears briefly in the displays.
- $\overline{\quad}$ (two dashes) will appear in the displays until a valid pulse signal is detected.

NOTE: When entering setup mode at power on (for memory clear, calendar, or clock settings), the PalmSAT will cycle through a startup sequence similar to the above, with the following exceptions: 1) The pulse quality indicator will first turn on red for 1 second, then green for 1 second, but will then turn off and not blink until after exiting setup mode; 2) the software revision number will not appear; and 3) the two dashes will appear only after exiting setup mode.

Overview of Monitoring

Verify that the pulse oximeter sensor is properly positioned (on a finger, for example). Ensure that the pulse oximeter is sensing adequate pulse quality by:

- verifying that the pulse quality indicator is blinking green *and*
- verifying that the pulse rate and SpO₂ displays are showing readings *and*
- verifying that the pulse quality indicator blinking is correlated to the pulse rate for at least 10 seconds

If the pulse quality indicator light is blinking red or yellow or is blinking erratically, reposition the pulse oximeter sensor or try a different sensor.

If a finger, toe, etc., is not properly inserted into the pulse oximeter sensor, or no pulse oximeter sensor is attached to the pulse oximeter after startup (a few seconds after powering on), both the SpO₂ and pulse rate displays will display a single dash until a valid pulse signal is detected.

Cleaning the Pulse Oximeter

Clean the PalmSAT Pulse Oximeter separately from the sensors. For instructions on cleaning pulse oximeter sensors, refer to the respective pulse oximeter sensor package inserts.



CAUTION! Do not immerse the PalmSAT in liquid, and do not use caustic or abrasive cleaning agents on the PalmSAT.

Clean the PalmSAT with a soft cloth dampened with isopropyl alcohol. Do not pour or spray any liquids onto the PalmSAT, and do not allow any liquid to enter any openings in the device. Allow the PalmSAT to dry thoroughly before reusing.


Detailed Operation

CAUTION! Read this manual carefully before using the PalmSAT.

Switches and Functions

All functions of the PalmSAT are controlled by the on/off  and advance  switches found on the front of the unit. Refer to Figure 2 on page 4 for an illustration of the switches and indicators.



Power

Turn on the PalmSAT by pressing and releasing the on/off switch  on the front of the unit. Turn off the unit by pressing and holding this switch for approximately 2 seconds. Refer to “Power On Self-Test” on page 9 for important information about PalmSAT startup.

In order to conserve battery life, the PalmSAT will automatically power off after 10 minutes of inactivity. Inactivity is indicated by dashes on the displays and may be caused by the following conditions:



- the sensor is not connected to the pulse oximeter
- the sensor is not attached to the patient
- the patient pulse signal is inadequate

Setup Mode

Setup mode is used to set 1) the memory clear function, 2) the calendar and clock, and 3) the memory playback function. (To initiate the memory playback, refer to “Memory Playback” on page 19.) In setup mode, the advance switch  and the on/off switch  are used to make the selections.

NOTE: Setting the month to “00” disables the calendar and clock functions and helps conserve battery life.

Entering Setup Mode

1. With the unit off, press and hold the advance switch  while pressing and then releasing the on/off switch .
2. Release the advance switch when $\begin{matrix} 888 \\ 888 \end{matrix}$ is displayed on the SpO₂ and pulse rate displays. The clock time currently set in the memory, $\begin{matrix} 04 \\ 41 \end{matrix}$ for example, appears briefly in the displays, and then $\begin{matrix} CL \\ no \end{matrix}$ appears.

Making Selections in Setup Mode:

1. Upon entering setup mode, the displays will show $\begin{matrix} \text{CLR} \\ \text{no} \end{matrix}$. (Memory clear and the default value “no”, the first setting. See Table 1.) Press and release the advance switch (or press and hold to quickly scroll) to change the value for this setting.

NOTE: The menu starts at the current value stored in memory for the setting. The menu will cycle through the range of values for that setting (listed in Table 1).

2. When the desired value appears, press and release the on/off switch to store the value and advance to the next sequential setting (year, month, etc.), as listed in Table 1.
3. Continue this process until all settings are chosen.

When the setting sequence has been completed, the PalmSAT exits the setup mode and then displays -- (two dashes). The unit is then ready to begin normal operation.

Table 1. Memory Clear, Calendar, and Clock Settings

Setting	Appears in SpO₂ Display:	Range of Values Appears in Pulse Rate Display:	Default Value
Memory Clear ^a	CLR	YES or no	no
Delete (confirm clear)	DEL	YES or no	no
Year	y	00 - 99	00
Month	nn	00 - 12	00
Day	d	01 - 31	00
Hour	h	00 - 23	00
Minute	nn	00 - 59	00
(Not available) ^b	Prn	00-15	00

^a Choosing “yes” for both the CLR and DEL settings (the memory clear function) will clear the memory and exit setup mode.

^b Prn settings 00 to 15 are not used at this time. Setting these values will not affect the operation of the PalmSAT.

Memory Clear

Upon entering setup mode, **CLr** will appear in the SpO₂ display, indicating the memory clear function. (Refer to “Setup Mode” on page 11.) This function allows you to delete all data currently stored in memory. Refer to Figure 6 below for a diagram describing the memory clear settings.

Choosing Memory Clear Settings

1. **CLr** may be set to **no** or **YES**.

If **no** is entered in response to **CLr** (indicating that you do not want to clear the memory), the setup mode will continue directly to the calendar and clock settings. (Refer to “Calendar and Clock Settings” on page 14.)

If **YES** is entered in response to **CLr**, then **dEL** will next appear in the SpO₂ display, again with a choice of **no** or **YES**. This prompting gives you a second opportunity to avoid clearing the memory.

Make the **CLr** selection. Use the advance switch to scroll through the values. Use the on/off switch to accept a value and move to the next setting.

2. If **no** is entered in response to **dEL**, the setup mode continues to the calendar and clock settings.

If **YES** is entered in response to **dEL**, (confirming that you do want to clear the memory), then **dnE CLr** will briefly appear in the displays indicating that the memory is cleared. The PalmSAT will then exit setup mode and is ready to begin normal operation.

Make the **dEL** selection.

Use the advance switch to scroll through the values.



Use the on/off switch to accept a value and move to the next setting.

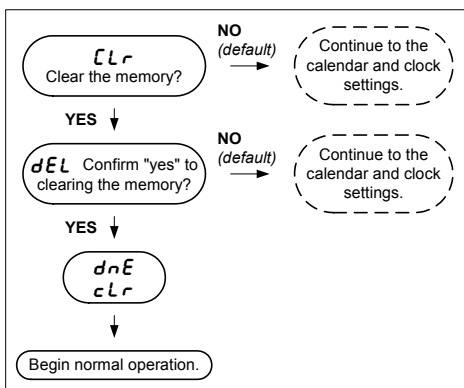


Figure 6. Choosing memory clear settings.

Calendar and Clock Settings

NOTE: Setting the month to “00” disables the calendar and clock functions and helps conserve battery life.

Refer to Figure 7 below for a diagram describing the calendar and clock settings.

Choosing Calendar and Clock Settings:

1. After selecting **no** in the memory clear settings (see “Memory Clear” on page 13), **y** will appear in the SpO₂ display indicating the calendar year setting.
2. Make the year, month, day, hour, and minute selections. Use the advance switch to scroll through the values. Use the on/off switch to accept a value and move to the next setting.
3. After selecting the minutes, **Prrn** will appear in the SpO₂ display. However, the **Prrn** setting is not used at this time.
4. Press and release the on/off switch to exit setup mode.

When the setting sequence has been completed, the PalmSAT displays **--** (two dashes). The unit is then ready to begin normal operation.

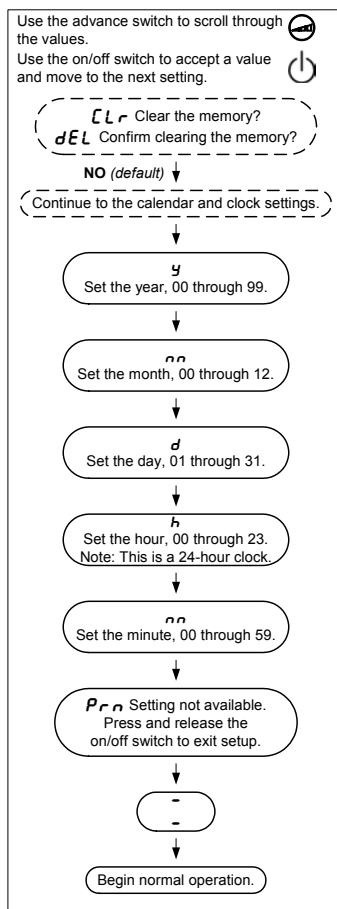


Figure 7. Choosing calendar and clock settings.

Displays and Indicators

SpO₂ Display

The SpO₂ display is the upper numeric display. (Identified by the %SpO₂ symbol; see Figure 2 on page 4.) This 3-digit light-emitting diode (LED) display shows the current oxygen saturation percentage.

Pulse Rate Display

The pulse rate display is the lower numeric display. (Identified by the ♥ symbol; see Figure 2 on page 4.) This 3-digit LED display shows the pulse rate in pulses per minute.

Pulse Quality Indicator

The pulse quality indicator, a tricolor LED, blinks once for each detected pulse. (Identified by the \sphericalangle symbol; see Figure 2 on page 4.) The pulse quality indicator changes color to indicate changes in the pulse waveform signal that may affect the SpO₂ data.

The pulse quality indicator may blink green, yellow, or red.

- **Green** indicates that the pulse waveform signal is of good quality and the SpO₂ and pulse rate data are accurate.
- **Yellow** indicates that the pulse waveform amplitude is marginal or that the pulse oximeter has detected artifact. Although the SpO₂ and pulse rate data may be acceptable, corrective measures should be considered if the indicator blinks yellow frequently. To improve signal quality, try repositioning the sensor, try a different sensor type, eliminate patient movement, or improve circulation at the site by massaging the area.
- **Red** indicates that the pulse waveform amplitude is inadequate. While the pulse quality indicator is red, SpO₂ and pulse rate values are frozen (not updated). After approximately 20 seconds, the values are replaced with dashes, indicating that SpO₂ and pulse rate measurements are not possible.

CAUTION! The PalmSAT might misinterpret motion as good pulse quality. Minimize patient motion as much as possible.

Low Battery Indicator

When the batteries are low, the low battery indicator, a yellow LED, will be steadily illuminated. Replace the batteries as soon as possible.

When the batteries are critically low, the low battery indicator will flash and the pulse oximeter will not operate. The digital displays will go blank, and the pulse quality indicator will blink yellow or red, but not green. Replace the batteries immediately.

Sensor Fault Indication

If the PalmSAT determines that a sensor fault exists (a sensor disconnect or failure) or if a pulse oximeter sensor signal is no longer detected, a dash (-) appears in the left-most digit of the SpO₂ display. The readings that are displayed will freeze for 10 seconds if the pulse oximeter sensor fault or the inadequate signal continues.

If the sensor fault or the inadequate signal is not corrected, the frozen readings and the left-most dash will be replaced by dashes in the middle digit of both the SpO₂ and the pulse rate displays, 10 seconds after the first dash appeared.

When the sensor fault or the inadequate signal is corrected, the SpO₂ and pulse rate displays will return to normal operation.

Communications

Serial Output

The PalmSAT provides real-time data output capability via the pulse oximeter sensor connector (a 9-pin Sub-D connector). (See Figure 2 on page 4.) The pulse oximeter sensor connector pin assignments are listed in Table 2.

Table 2. Pulse Oximeter Sensor Connector Pin Assignments

Pin Number	Assignment
1	Battery Voltage
2	Infrared Anode, Red Cathode
3	Infrared Cathode, Red Anode
4	Serial Data, TTL Levels
5	Detector Anode
6	Sensor Type
7	Cable Shield (Ground)
8	Ground
9	Detector Cathode, +5 V

The information from the PalmSAT in the real-time mode is sent in an ASCII serial format at 9600 baud with 9 data bits, 1 start bit, and 1 stop bit. The data are output at a rate of once per second.

NOTE: The 9th data bit is used for odd parity in memory playback mode. In real-time mode, it is always set to the mark condition. Therefore the real-time data may be read as 8 data bits, no parity.

Real-time data may be printed or displayed by devices other than the pulse oximeter. On power up a header is sent identifying the format and the time and date. Thereafter, the data are sent once per second by the PalmSAT in the following format:

SPO2=XXX HR=YYY

where “XXX” represents the SpO₂ value, and “YYY” represents the pulse rate. The SpO₂ and pulse rate will be displayed as “---” if there are no data available for the data reading.

Memory

The PalmSAT can collect and store up to 72 hours of SpO₂ and pulse rate information.

NONIN nVISION[®] data retrieval software is available for use with Microsoft[®] Windows[®] 95/98/2000/NT 4.0 operating systems. Refer to “Accessories” on page 23.

The memory in the PalmSAT functions as an “endless loop.” When the memory fills up, the unit begins overwriting the oldest data with the newest.

Each time the PalmSAT is turned on, the current time/date information (if the clock is set properly) is stored in memory to allow quick differentiation of recording sessions. Patient SpO₂ and pulse rate are sampled and stored every 4 seconds.

Oxygen saturation values are stored in 1% increments in the range of 0 to 100%.

The stored pulse rate ranges from 18 to 300 pulses per minute. The stored values are in increments of 1 pulse per minute in the interval from 18 to 200 pulses per minute, and increments of 2 pulses per minute in the interval from 201 to 300 pulses per minute.

During the printing of the data, the last data recorded are the first data printed. For example, the last 4 minutes of data recorded would be the first 4 minutes of printout.

Recording Sessions

Each time the PalmSAT is turned on (except during setup mode) data are automatically collected in memory.



NOTE: Only recording sessions longer than 1 minute are stored in memory. Memory will clear approximately 2 minutes after removing the batteries. Replace batteries immediately to avoid losing stored data.

Memory Playback

NOTE: Playing back the data in memory does not clear any data from the memory.

NOTE: The keypad sequence for starting memory playback is identical to the sequence used for entering setup mode.

Playing Back the Data Stored in PalmSAT Memory

1. With the unit off, press and hold the advance switch  while pressing and then releasing the on/off switch .
2. Release the advance switch when $\begin{matrix} \text{888} \\ \text{888} \end{matrix}$ is displayed on the SpO₂ and pulse rate displays. The clock time currently set in the memory ($\begin{matrix} 04 \\ 41 \end{matrix}$ for example) appears briefly in the displays, and then $\begin{matrix} \text{CLR} \\ \text{no} \end{matrix}$ appears.
3. Data will be automatically played back from the memory. Data are played back at a rate of 20 minutes of collected data per second. A 72-hour recording session (the maximum memory saved) is played back in approximately 3.5 minutes.
4. After all data are played back, the PalmSAT should be shut off prior to collecting new patient data. The patient information is held in memory as long as the batteries are sufficiently charged, so if the memory must be cleared, use the memory clear function. (See “Memory Clear” on page 13.)

Specifications

Oxygen Saturation Range (SpO₂)	0 to 100%
Pulse Rate Range	18 to 300 Pulses Per Minute
Accuracy	
SpO ₂ (± 1 Standard Deviation)*	70 - 100% ± 2 digits for adults using Finger Clip Sensors 70 - 100% ± 3 digits for adults using Flex, Flexi-Form, or Reflectance Sensors 70 - 100% ± 4 digits using Ear Clip Sensors 70 - 95% ± 3 digits for neonates using infant or neonatal sensors Below 70% is not specified for all sensors
Pulse Rate	± 3%
Measurement Wavelengths and Output Power	
Red	660 nanometers @ 3 mw nominal
Infrared	910 nanometers @ 3 mw nominal
Indicators	
Pulse Quality Indicator	LED, tricolor
Numeric Displays	3-digit 7-segment LEDs, red
Low Battery Indicator	Dedicated icon, yellow
Temperature	
Operating	-20 to +50°C (-4 to +122°F)
Storage/Transportation	-30 to +50°C (-22 to +122°F)
Humidity	
Operating	10 to 90% noncondensing
Storage/Transportation	10 to 95% noncondensing
Altitude	
Operating Altitude	Up to 12,000 meters (40,000 feet)
Hyperbaric Pressure	Up to 4 atmospheres
Power Requirements	
	Four 1.5V AA-size alkaline batteries (100 hours typical operation) or NiMH rechargeable battery pack (45 hours typical operation)
Dimensions	
	13.8 cm H x 7.0 cm W x 3.2 cm D (5.4 in H x 2.8 in W x 1.3 in D)
Weight	
	210 g (7.4 oz) (with alkaline batteries) 230 g (8.1 oz) (with NiMH rechargeable battery pack)
Classifications per IEC 60601-1 / CSA601.1 / UL2601-1	
Type of Protection	Internally powered (on battery power)
Degree of Protection	Type BF-Applied Part
Mode of Operation	Continuous

* Standard Deviation is a statistical measure: up to 32% of the readings may fall outside these limits.

Service

CAUTION! The PalmSAT Pulse Oximeter is a precision electronic instrument and must be repaired by trained NONIN personnel only.

NOTE: Any sign or evidence of opening the system, field service by non-NONIN personnel, tampering, or any kind of misuse or abuse of the system, shall void the warranty in its entirety.

The advanced digital circuitry within the PalmSAT requires no periodic maintenance or calibration.

Nonin does not recommend field repair of the PalmSAT. The circuit board in the PalmSAT is a multi-layer board using very narrow traces. Due to the very small trace size, extreme care must be used when replacing components to prevent permanent, non-repairable damage to the circuit board. Most components are surface-mounted and require special hot-air jet soldering and desoldering equipment. After any repairs are made, the PalmSAT must be tested to ensure correct operation.

For additional technical information contact NONIN's Customer Support department at:

Nonin Medical, Inc.

2605 Fernbrook Lane North
Plymouth, Minnesota 55447-4755 USA

(800) 356-8874 (USA and Canada)

(763) 553-9968

Fax (763) 553-7807

E-mail: info@nonin.com

www.nonin.com

All non-warranty work shall be done according to NONIN standard rates and charges in effect at the time of delivery to NONIN. All repairs include a complete retest of the PalmSAT using factory test fixtures.

Warranty

NONIN MEDICAL, INCORPORATED, (NONIN) warrants to the purchaser, for a period of three years from the date of purchase, each PalmSAT® Model 2500 Pulse Oximeter exclusive of sensors, cables, and batteries. (Refer to the individual package inserts for specific warranty information for sensors, cables, and other accessories.) NONIN shall repair or replace any PalmSAT found to be defective in accordance with this warranty, free of charge, for which NONIN has been notified by the purchaser by serial number that there is a defect, provided said notification occurs within the applicable warranty period. This warranty shall be the sole and exclusive remedy by the purchaser hereunder for any PalmSAT delivered to the purchaser which is found to be defective in any manner whether such remedies be in contract, tort or by law.

This warranty excludes cost of delivery to and from NONIN. All repaired units shall be received by the purchaser at NONIN's place of business. For any PalmSAT sent to NONIN for warranty repair which is found to be within specification, the purchaser agrees to pay \$100.00 (US dollars).

The PalmSAT is a precision electronic instrument and must be repaired by knowledgeable and specially trained NONIN personnel only. Accordingly, any sign or evidence of opening the PalmSAT, field service by non-NONIN personnel, tampering, or any kind of misuse or abuse of the PalmSAT, shall void the warranty in its entirety.

All non-warranty work shall be done according to NONIN standard rates and charges in effect at the time of delivery to NONIN.

DISCLAIMER/EXCLUSIVITY OF WARRANTY:

THE EXPRESS WARRANTIES SET FORTH IN THIS MANUAL ARE EXCLUSIVE AND NO OTHER WARRANTIES OF ANY KIND, WHETHER STATUTORY, WRITTEN, ORAL, OR IMPLIED INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY SHALL APPLY.

Accessories

The following NONIN accessories function with the PalmSAT:

Model Number	Description
2500B	Rechargeable NiMH Battery Pack
2500C	Charger Stand
300PS-NA	Charger Stand Power Supply - North America/Japan
300PS-UNIV	Charger Stand Power Supply - Universal
Contact your distributor or NONIN for options	Charger Stand Power Cord - Universal
2500CC	Carrying Case (Blue)
2500INS	Operator's Manual for the PalmSAT
2500C-INS	Operator's Manual for the Model 2500C Charger Stand
Pulse Oximeter Reusable Sensors	
8000AA-1	Adult Articulated Finger Clip Sensor (1 meter)
8000AA-3	Adult Articulated Finger Clip Sensor (3 meter)
8000K2	Adult Finger Clip Sensor
8000AP	Pediatric Finger Clip Sensor
8000J	Adult Flex Sensor
8008J	Infant Flex Sensor
8001J	Neonatal Flex Sensor
8000Q	Ear Clip Sensor
8000R	Reflectance Sensor
Pulse Oximeter Disposable Sensors	
7000A	Adult Finger Flexi-Form [®] II Sensor, 10 per box
7000P	Pediatric Finger Flexi-Form [®] II Sensor, 10 per box
7000I	Infant Toe Flexi-Form [®] II Sensor, 10 per box
7000N	Neonatal Foot Flexi-Form [®] II Sensor, 10 per box
7000D	Flexi-Form Sensor Assortment Pack, 10 per box

Model Number	Description
	Other Accessories
nVISION	nVision Software for Microsoft Windows 95/98/2000/NT 4.0 operating systems
8000JFW	Adult FlexiWrap Sensor Wrap
8008JFW	Infant FlexiWrap Sensor Wrap
8001JFW	Neonatal FlexiWrap Sensor Wrap
8000H	Reflectance Sensor Holder System
8000T	Sensor Attachment Tape, 100 per box
8000TH	Hydrogel Tape Strips, 25 per bag
8500I	Patient Extension Cable (1 meter)
8000S	Patient Simulator
9440	Finger Phantom® Pulse Oximeter Tester
1000MC	Memory Cable (for use between the PalmSAT and a PC running Microsoft Windows 95/98 operating systems)
1000RTC	Real-Time and Memory Cable (for use between the PalmSAT and a PC running Microsoft Windows 95/98 operating systems)

For more information about NONIN parts and accessories contact your distributor, or contact NONIN at (800) 356-8874 (USA and Canada) or (763) 553-9968.

Troubleshooting Guide

Table 3. Troubleshooting Guide

Problem	Possible Cause	Possible Solution
<i>The PalmSAT will not turn on.</i>	The batteries are completely depleted.	Replace all 4 batteries of the PalmSAT.
	An incorrect battery installation.	Verify correct battery orientations. Refer to Figure 4: Installing batteries in the PalmSAT.
	A metal contact in the battery compartment is missing or damaged.	Contact NONIN Customer Support.
<i>A dash appears in the left digit of the SpO₂ display.</i>	A sensor fault exists. The sensor may have become dislodged from the PalmSAT or from the patient.	Verify that the sensor is correctly connected to the PalmSAT and the patient; try a new sensor if the condition persists.
<i>The middle digits display dashes in both the SpO₂ and pulse rate displays.</i>	No signal is detected because the sensor is not plugged in.	Verify the sensor connections.
	A sensor failure.	Replace the sensor.
<i>The displayed pulse rate does not correlate to the pulse rate displayed on the ECG monitor.</i>	Excessive motion at the sensor site may be prohibiting the PalmSAT from acquiring a consistent pulse signal.	Eliminate or reduce the cause of the motion artifact or reposition the sensor to a new sensor site where motion is not present.
	The patient may have an arrhythmia resulting in some heart beats that do not yield a pulse quality signal at the sensor site.	Examine the patient: the condition may persist even though both monitors are functioning properly if the patient's arrhythmia persists.
	A non-NONIN sensor is being used.	Replace the sensor with a NONIN sensor.
	The ECG monitor may not be functioning properly.	Examine the patient: replace the ECG monitor or refer to the operator's manual for the ECG monitor.
<i>An erratic pulse rate display and/or a yellow pulse quality indicator during the concurrent use of electrosurgical equipment (ESU).</i>	The ESU may be interfering with the pulse oximeter performance.	Examine the patient: move the PalmSAT, cables, and sensors as far away from the ESU as possible or refer to the ESU operator's manual.
<i>The pulse quality indicator is blinking yellow with each pulse.</i>	The quality of the pulse signal at the sensor site is marginal.	Examine the patient: reposition the sensor or select an alternate sensor site.

Table 3. Troubleshooting Guide (Continued)

Problem	Possible Cause	Possible Solution
<i>You are unable to obtain a green blinking pulse quality display.</i>	Low patient pulse strength; or the sensor site is poorly perfused; or the sensor is not correctly positioned.	Reposition the sensor on the patient.
	The sensor is attached too tightly, or tape or other items are restricting the pulse quality at the sensor site.	Reapply the sensor, select an alternate sensor site, or remove the restrictive material from the sensor site.
	Circulation is reduced due to excess pressure between the sensor and a hard surface.	Allow the sensor and finger, foot, etc., to rest comfortably on the surface.
	Excessive ambient light.	Reduce the ambient light.
	Excessive patient motion.	Reduce the patient motion.
	The sensor is applied to a polished finger or toe nail.	Remove the nail polish.
	Interference from: <ul style="list-style-type: none"> • arterial catheter • blood pressure cuff • electrosurgical procedure • infusion line 	Reduce or eliminate the interference.
<i>The pulse quality indicator is blinking red and the SpO₂ and/or pulse rate displays show dashes.</i>	An inadequate signal at the sensor site.	Examine the patient: reposition the sensor or select an alternate sensor site.
	Excessive motion at the sensor site may be prohibiting the PalmSAT from acquiring a consistent pulse signal.	Eliminate or reduce the cause of the motion artifact or reposition the sensor to a sensor site where motion is not present.
	A sensor failure.	Replace the sensor.
<i>Segments of the SpO₂ or pulse rate displays are missing.</i>	Defective LED displays.	Displayed values may not be reliable; discontinue use of the PalmSAT.
<i>Disruption in the PalmSAT performance.</i>	Electromagnetic interference (EMI).	Remove the PalmSAT from the EMI environment.

If these solutions do not correct the problem with your PalmSAT, please contact NONIN Customer Support at (800) 356-8874 (USA and Canada) or (763) 553-9968.