

ZOLL E SERIES OPERATOR'S GUIDE

Option Insert:

Pulse Oximetry (SpO₂)

The issue date or revision level for this operation guide is shown on the front cover.

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PULSE OXIMETRY (SpO₂)

General Information

Product Description

The E Series™ pulse oximeter (SpO₂) continuously and noninvasively measures the oxygen saturation of arteriolar hemoglobin at a peripheral measurement site, (i.e. foot, toe or finger). SpO₂ monitoring gives information about both the cardiac and respiratory systems, and provides details of oxygen transportation in the body. It is widely used because it is noninvasive, continuous, easily applied and painless.

The E Series pulse oximetry option is intended for use only with ZOLL / Masimo LNOP® sensors. The oximetry sensor contains two light-emitting diodes (LEDs) that transmit red and infrared light through the body's extremities. The transmitted light is then received by a photodetector.

Oxygen-saturated blood absorbs light differently than unsaturated blood. Thus the amount of red and infrared light absorbed by blood flowing through a suitable peripheral area of the body, typically the finger in adults and the foot in neonates, can be used to calculate the ratio of oxygenated hemoglobin to total hemoglobin in arterial blood. The monitor displays this ratio as percent SpO₂. Normal values typically range from 95% to 100% at sea level.

The quality of SpO₂ measurements depends on correct size and application of the sensor, adequate blood flow through the sensor site, and the sensor's exposure to ambient light. For correct placement and location of the sensors, refer to *Directions for Use* included with all LNOP oximetry sensor packages.

How to Use This Manual

This insert describes how to set up, use and maintain the pulse oximetry option on the E Series unit.

Important safety information relating to the general use of the E Series pulse oximeter appears in "Safety Considerations" on page 2 of this document. Other important safety information is located in the "Safety Considerations" section of the LNOP oximetry sensor packages. The *E Series Operator's Guide* provides the information that you need to know for the safe and effective use and care of the E Series products. It is important that you read and understand all the information contained therein before operating your E Series product.

Please thoroughly read both the safety consideration sections before operating your E Series product.

Safety Considerations

Warnings

General

- Before use, carefully read the *E Series Operator's Guide*, these operating instructions, and the *Directions for Use* included with each LNOP sensor.
- Only qualified personnel should operate the E Series Pulse Oximeter.
- Do not use the pulse oximeter as an apnea monitor.
- Do not immerse the E Series device, patient cables, or sensors in water, solvents, or cleaning solutions.
- Consider a pulse oximeter an early warning device. As a trend toward patient deoxygenation is indicated, blood samples should be analyzed by a laboratory co-oximeter to completely understand the patient's condition.
- If an alarm occurs while the audio alarms are suspended, the suspended alarm indications will only be visual displays and symbols.
- Interfering Substances: Carboxyhemoglobin and methemoglobin may erroneously alter SpO₂ readings. The level of change is approximately equal to the amount of carboxyhemoglobin or methemoglobin present. Dyes, or any substance containing dyes, that alter arterial pigmentation may cause erroneous readings.
- Do not use the E Series pulse oximeter or LNOP sensors during magnetic resonance imaging (MRI). Induced current could potentially cause burns. The E Series pulse oximeter may affect the MRI image, and the MRI unit may affect the accuracy of the oximetry measurements.
- Carefully route patient cabling to reduce the possibility of patient entanglement or strangulation.

Sensors

- Use only ZOLL / Masimo LNOP oximetry sensors for SpO₂ measurements. Other manufacturers' sensors may cause improper oximeter performance.
- Tissue damage can result from incorrect application or use of an LNOP sensor (for example, by wrapping the sensor too tightly). Inspect the sensor site as directed in *Directions for Use* (included with each LNOP sensor) to ensure skin integrity, correct positioning and sensor adhesion.
- Do not use damaged LNOP sensors or cables.
- Do not use an LNOP sensor with exposed optical components.
- Do not sterilize the sensor by irradiation, steam, or ethylene oxide. See the cleaning instructions included with each LNOP sensor.
- Do not allow the sensor to remain on one site for a prolonged period of time, especially when monitoring neonates. Check the application site at regular intervals - at least every two hours - and change the site if any compromise in skin quality occurs. Refer to the *Directions for Use* included with each LNOP sensor.
- Do not attach the SpO₂ sensor to a limb being monitored with a blood pressure cuff or with restricted blood flow.
- A poorly applied sensor may give incorrect saturation values. The signal strength indicator can be used to identify a poorly applied sensor or poorly chosen site.
- Choose a site with sufficient perfusion to ensure accurate oximetry values.
- Certain nail aberrations, nail polish, fungus, etc. may cause inaccurate oximetry readings. Remove the nail polish and/or move the sensor to an unaffected digit.
- High ambient light sources such as surgical lights (especially those with xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps, and direct sunlight can affect the accuracy of SpO₂ readings. To prevent interference from ambient light, ensure that the sensor is properly applied and cover the sensor with opaque material if required.

SpO₂ Indication for Use

The ZOLL E Series pulse oximeter, with Masimo SET technology and the LNOP series of sensors, is indicated for the continuous noninvasive monitoring of arterial oxygen saturation (SpO₂) and pulse rate. The pulse oximeter is indicated for use on adult, pediatric, and neonatal patients who are stationary or in motion in a hospital or prehospital environment.

Oxygen saturation measurements using pulse oximetry are highly dependent on proper placement of the sensor and patient conditions. Patient conditions such as smoke inhalation may result in erroneous oxygen saturation readings. If pulse oximetry measurements are suspect, verify the reading using another clinically accepted measurement method, such as arterial blood gas measurements.

Measurement Complications

If the accuracy of any reading is suspect, first check the patient's vital signs by alternate means and then check the E Series pulse oximeter for proper functioning.

Inaccurate measurements may be caused by:

- Incorrect sensor application or use.
- Significant levels of dysfunctional hemoglobins (e.g., carboxyhemoglobin or methemoglobin).
- Intravascular dyes such as indocyanine green or methylene blue.
- Exposure to excessive illumination, such as surgical lamps (especially those with a xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps, or direct sunlight; exposure to excessive illumination can be corrected by covering the sensor with a dark or opaque material.
- Excessive patient movement.
- Venous pulsations.
- Placement of a sensor on an extremity with a blood pressure cuff, arterial catheter, or intravascular line.

Loss of pulse signal can occur when:

- The sensor is applied too tightly.
- There is excessive illumination from light sources such as a surgical lamp, a bilirubin lamp, or sunlight.
- A blood pressure cuff is inflated on the same extremity as the one with a SpO₂ sensor attached.
- There is excessive patient movement.
- The patient has hypotension, severe vasoconstriction, or hypothermia.
- There is arterial occlusion proximal to the sensor.
- The patient is in cardiac arrest or shock.

SpO₂ Connector and Sensors

The SpO₂ connector is located on the rear panel of the E Series unit (see Figure 1). You can use only ZOLL or Masimo accessories and sensors with the E Series Pulse Oximetry option.

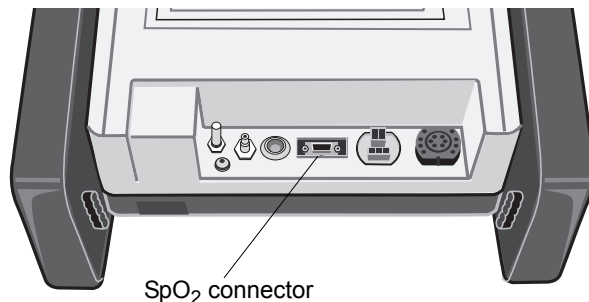


Figure 1

Each sensor is designed for application to a specific anatomical site on patients within a certain weight range.

To ensure optimal performance:

- Use an appropriate sensor.
- Apply the sensor as described in *Directions for Use* included with each LNOP sensor.

Tissue damage can result from incorrect application or use of a sensor (e.g., wrapping the sensor too tightly, applying supplemental tape, failing to periodically inspect the sensor site).

SpO₂ Setup

Set up the SpO₂ option as follows:

1. Inspect the E Series case and SpO₂ cables for damage.
2. Ensure that the sensor and cable are compatible models before connecting it to the E Series unit (see "SpO₂ Accessories" on page 9).
3. Attach the sensor to the patient and connect the sensor to the SpO₂ patient cable (see "Applying a Reusable DCI Sensor" on page 4 or "Applying a Disposable Sensor" on page 5).
If using a reusable sensor, make sure it opens and closes smoothly and check for foreign material such as tape or cotton on the emitter and detector windows. Remove any substances that may interfere with the transmission of light between the sensor's light source and detector.
4. Connect the patient cable to the SpO₂ connector at the back of the E Series unit (see Figure 2).

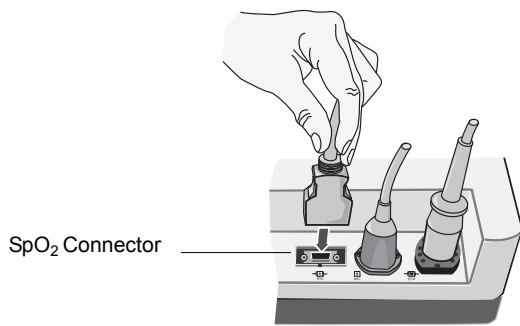


Figure 2

5. Turn the selector switch to MONITOR (ON for AED units).
The SpO₂ parameter box will appear momentarily on the screen.
6. Verify that the sensor's red LED is on. The oximeter is now fully operational.
A dashed line is displayed in the SpO₂ field until a pulse is detected. Once the measurement has been established, the saturation values are displayed in the numeric field (e.g., 98).
7. Ensure that appropriate oxygen saturation values are displayed and that the signal strength bar indicates the presence of a strong signal associated with each heartbeat.
8. Adjust the alarm limits and enable SpO₂ alarms if desired.

Note: If ECG leads are not attached, the patient's pulse rate as measured by the SpO₂ sensor is displayed as the Heart Rate (HR) in the ECG field and the heart symbol does not flash.

If the unit displays a *SpO2 FAULT XX* message shortly after power-up, the SpO₂ monitoring subsystem of the unit has failed. Contact the ZOLL Technical Service Department.

Selecting a Sensor and Patient Cable

When selecting a sensor, consider the patient's weight, the adequacy of perfusion, the available sensor sites, and the anticipated duration of monitoring. For more information, refer to the following table or contact ZOLL Medical Corporation.

Sensor	Type	Patient Weight
LNOP Adt	Single Use	Adults > 30 kg
LNOP Pdt	Single Use	Pediatrics and Slender Adults > 10 kg and < 50 kg
LNOP Neo	Single Use	Neonates < 10 kg
LNOP NeoPt	Single Use	Neonates < 1 kg

Sensor	Type	Patient Weight
LNOP DCI	Reusable	Adults and Pediatrics > 30 kg
LNOP YI	Reusable	Adults > 30 kg
LNOP TC-I	Reusable	Adults > 30 kg
LNOP TF-I	Reusable	Adults > 30 kg
LNOP DCSC	Reusable	Adults > 30 kg
LNOP DC-195	Reusable	Adults > 30 kg

ZOLL offers three reusable patient cables designed to work exclusively with LNOP sensors and with the E Series pulse oximeter:

- PC 04 (4' cable)
- PC 08 (8' cable)
- PC 12 (12' cable)

Selecting a Sensor Application Site

Choose a site that is well perfused and restricts a conscious patient's movements the least. The ring finger or middle finger of the nondominant hand is preferred.

Alternatively, you can use the other digits on the nondominant hand. Be sure the sensor's detector is fully covered by flesh. You can use the great toe or long toe (next to the great toe) on restrained patients or patients whose hands are unavailable.

To prevent interference from ambient light, ensure that the sensor is properly applied, and cover the sensor site with opaque material, if required. Failure to take this precaution in high ambient light conditions may result in inaccurate measurements.

Applying a Reusable DCI Sensor

Note: These instructions describe how to apply a reusable DCI sensor. For all other reusable sensors, refer to the sensor packaging for application instructions.

Note: The reusable sensor is not intended for use on the thumb or across a child's hand or foot.

1. Place the selected digit over the sensor window of the reusable DCI sensor, making sure that the sensor cable runs over the top of the patient's hand, and that the shiny contacts on the sensor's connecting tab are pointed up.

The fleshiest part of the digit should cover the detector window in the lower half of the DCI sensor (see Figure 3).

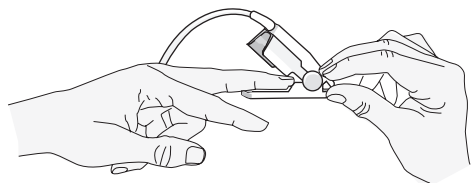


Figure 3

2. On finger sites, make sure the tip of the finger touches or extends beyond the raised digit stop inside the DCI sensor (see Figure 4).



Figure 4

Note: With smaller digits, the digit may not need to be pushed all the way to the stop to completely cover the detector window.

3. Check the sensor position to ensure that the top and bottom halves of the DCI sensor are parallel. To ensure accurate data, you must have complete coverage of the detector window (see Figure 4).
4. Match the Masimo SET logo on the DCI sensor to the logo on the SpO₂ patient cable, and slide the sensor tab into the patient cable until it clicks into place (see Figure 5).

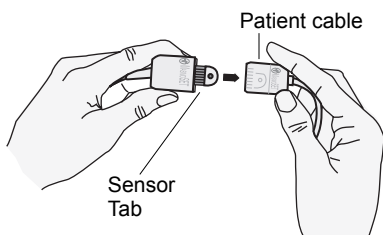


Figure 5

5. Gently tug on the connectors to ensure a positive contact. If required, use tape to secure the cable to the patient for ease of movement.
6. Connect the SpO₂ patient cable to the SpO₂ connector on the back of the E Series unit as shown in Figure 2 on page 4.

Applying a Disposable Sensor

You can use a disposable LNOP sensor for SpO₂ monitoring. Do not wrap the adhesive too tightly as this can cause venous pulsations that could lead to inaccurate saturation measurements.

You can reapply a disposable sensor to the same patient if the emitter and detector windows are clear and the adhesive still adheres to the skin.

You can partially rejuvenate the adhesive by wiping it with an alcohol wipe and allowing the sensor to thoroughly air dry prior to replacement on the patient.

Note: LNOP Adt sensors are not intended for use across a child's hand or foot. For instructions on proper application of neonatal sensors, refer to the *Directions for Use* included with each LNOP sensor.

1. Open the pouch, and remove the sensor.
2. Holding the sensor with the tan printed side downward, bend the sensor backward and remove backing material from the sensor.
3. Orient the sensor so that the digit can be attached to the detector side of the sensor first (see Figure 6).

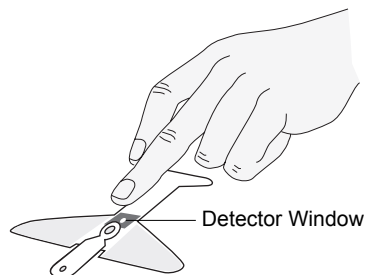


Figure 6

4. Press the detector onto the fleshy part of the finger near the tip of the finger. To ensure accurate data, you must have complete coverage of the detector window.
5. With the emitter positioned over the fingernail, secure the wings around the finger (see Figure 7).

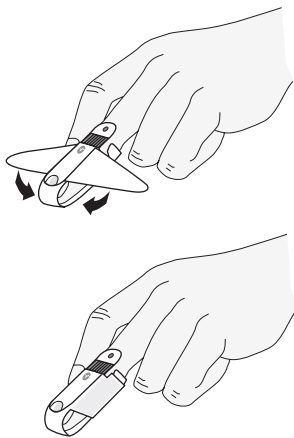


Figure 7

When positioned properly, the:

- emitter and detector are vertically aligned
 - digit completely covers the detector window
 - connector tab is located on the top side of the finger
 - shiny contacts on the sensor are facing up
6. Match the Masimo SET logo on the sensor to the logo on the SpO₂ patient cable, and slide the sensor tab into the patient cable until it clicks into place (see Figure 8).

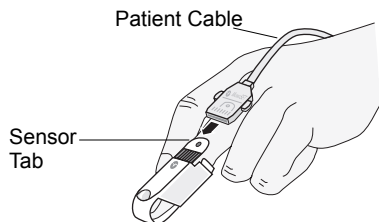


Figure 8

7. Gently tug on the connectors to ensure a positive contact. If required, use tape to secure the cable to the patient for ease of movement.
8. Connect the SpO₂ patient cable to the SpO₂ connector on the back of the E Series unit as shown in Figure 2 on page 4.

Ensuring Accurate SpO₂ Monitoring

The following points aid in ensuring oximetry monitoring success:

- Choose a site that is well perfused and allows for proper alignment of the light emitter and detector.
- Select a site that has unrestricted blood flow.
- Ensure that blood flow is not restricted when securing a sensor with tape.
- Select a site which is not near potential sources of electrical interference (electrical cords, for example).

- Use only sensors which show no obvious damage or exposed electrical circuits.
- Ensure that the sensor site is not subject to excessive motion. Excessive motion may adversely affect the performance of the sensor.
- Inspect the SpO₂ sensor site at least once every two (2) hours to ensure adhesion, skin integrity, and correct alignment of the light emitter and detector. Should alterations of skin integrity occur, remove the sensor and reapply at another recommended site. Avoid application of the sensor to edematous or fragile tissue.
- Remove and reposition the sensor every eight (8) hours and, if indicated by circulatory condition or skin integrity, reapply to a different monitoring site.
- Avoid creating venous pulsations caused by overly tight adhesive or by using additional tape to secure the sensor. Venous pulsations could potentially lead to inaccurate saturation measurements.
- Reposition the sensor or choose a different monitoring site if the sensor fails to track the pulse consistently, as the sensors may be incorrectly positioned.
- Ensure that the signal strength bar graph indicates the presence of a strong signal associated with each heart beat.
- Avoid placing the SpO₂ sensor on any extremity with an arterial catheter, blood pressure cuff, or intravascular line.

Cleaning and Reuse of Sensors

Reusable sensors can be cleaned as follows:

1. Disconnect the sensor from the patient cable.
2. Wipe the entire sensor clean with a 70% isopropyl alcohol moistened pad.
3. Allow the sensor to air dry before returning it to use.

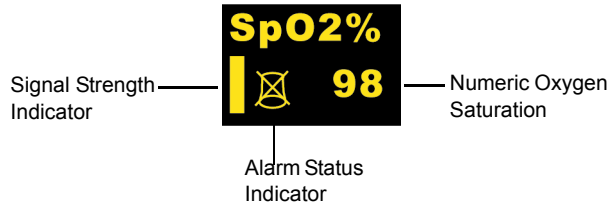
Cleaning and Reuse of Patient Cables

Patient cables can be cleaned as follows:

1. Disconnect the sensor from the patient cable (if attached).
2. Disconnect the cable from the rear of the E Series unit.
3. Wipe the cable clean with a 70% isopropyl alcohol moistened pad.
4. Allow the cable to dry before using it.

How SpO₂ is Displayed

The pulse oximetry option displays a plethysmograph waveform derived from data supplied by the sensor. The oxygen saturation value is displayed as "SpO₂%". A signal strength indicator, left of the SpO₂ field, shows the relative change in the pulsatile signal (see below).



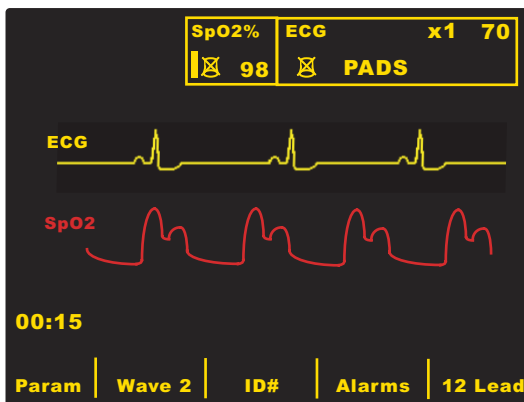
Note: The SpO₂ numeric displays dashes (----) in the oxygen saturation field whenever pulse oximetry values are likely to be contaminated due to the presence of excessive ambient light, inadequate perfusion, high signal artifact, a defective or disconnected sensor, etc.

Displaying the Plethysmographic Waveform

The E Series unit can display one or two waveforms in MONITOR, DEFIB, or MANUAL (AED) mode, as long as the defibrillator is not charging or ECG analysis is not in progress. The unit displays only one waveform in PACER mode.

With SpO₂ monitoring, the unit can display a plethysmographic waveform below the ECG trace for a visual indicator of SpO₂ monitoring.

From the physiological monitoring menu, press the **Wave 2** softkey to cycle the display from the capnogram waveform, to the plethysmograph waveform, to no second waveform displayed.



The unit temporarily removes the second waveform from the display when you press the **CHARGE**, **ANALYZE**, or **ENERGY SELECT** buttons, or the **Sync On/Off** softkey. The unit restores the second waveform to the display 4 seconds after:

- A shock is delivered.
- A shockable rhythm analysis is completed, unless the defibrillator is charging.
- **ENERGY SELECT** button is pressed.
- Sync mode is turned off.

Physiological Monitoring

When you turn the E Series unit to MONITOR (ON for AED units), the physiological monitoring menu is displayed with the following softkeys: **Param**, **Wave 2**, **ID#**, **Alarms** and **12 Lead** (if installed).



Param Softkey

When the **Param** softkey is pressed, the following softkeys appear: **Select**, **Enter**, and **Return**.



Press the **Select** softkey to scroll the highlight area among the different available physiological parameters.

Press the **Enter** softkey to select the highlighted parameter.

Press the **Return** softkey to return to the physiological monitoring menu.

When you select the SpO₂ parameter, the following softkeys appear: **Sens.**, **Average**, **Alarms** and **Return**.



Sens. (Sensitivity) Softkey

The **Sens.** softkey allows you to select either Normal or High sensitivity for SpO₂ monitoring.

- The Normal sensitivity setting is the recommended setting; select it for most patients.
- The High sensitivity setting allows you to monitor SpO₂ even under very low perfusion conditions. Such conditions may include severe hypotension or shock. With the High sensitivity setting, however, SpO₂ results are more easily contaminated by artifact. To ensure accuracy of SpO₂ readings when using the High sensitivity setting, observe the patient carefully and continuously.

To select the sensitivity mode, press the **Sens.** softkey to toggle between the modes, then press the **Enter** softkey to select the highlighted mode.



Press the **Return** softkey to return to the SpO₂ submenu.

Average Softkey

The E Series provides three (3) different time periods over which SpO₂ values are averaged: 4 seconds, 8 seconds (default), and 16 seconds.

The averaging period is rarely changed from the 8 second default setting. For high risk patients with rapidly changing SpO₂ conditions, use the 4 second setting. Use the 16 second setting only when the 8 second setting (default) is inadequate due to extremely high artifact conditions.

To select the averaging period (4, 8, or 16 seconds), first press the **Average** softkey on the SpO₂ submenu. The following softkeys appear: **Average**, **Enter** and **Return**.



Press the **Average** softkey again to scroll through the different averaging periods, then press the **Enter** softkey to select the highlighted averaging period. Press the **Return** softkey to return to the SpO₂ submenu.

Alarms

The E Series SpO₂ option provides user programmable “out of range” alarms for both SpO₂ and heart rate. See “Default Settings” on page 9 for low and high alarm limit default values and ranges.

When monitoring a patient's heart rate using ECG, the high heart rate alarm limit range is 60 to 280 bpm, with a default setting of 150 bpm. When monitoring the heart rate using pulse oximetry, however, the maximum high heart rate alarm limit is automatically lowered to 235 bpm if it was previously set higher for ECG monitoring. The unit restores the original high heart rate alarm limit setting when ECG monitoring resumes.

When the SpO₂ alarm state is set to AUTO, the unit automatically sets the alarm limits to 95% and 105% of the patient's currently measured saturation (the maximum setting being 100%). The auto alarm limits are set only if valid measurements are present for the vital sign.

See the *E Series Operator's Guide* for details on enabling, disabling, and suspending alarm functions on the E Series unit.

Automated External Defibrillator (AED) Operation

E Series AED units equipped with pulse oximetry operate in a slightly different way when in Semi-Automatic Mode:

- The plethysmographic waveform cannot be displayed.
- Heart rate alarm functions are disabled (although SpO₂ alarm functions are operational). Background ECG analysis functions continue to operate as described in the AED section of the *E Series Operator's Guide*.
- You cannot change alarm limit settings; only the default alarm limits are available.

Checkout Procedure

Perform the following checkout procedure daily to ensure that the SpO₂ option is functioning properly. Use a reusable SpO₂ sensor when performing this procedure.

1. Attach the SpO₂ sensor to your finger and connect the SpO₂ patient cable to the SpO₂ connector at the back of the E Series unit (as described in “Applying a Reusable DCI Sensor” on page 4).
2. Turn the selector switch to MONITOR (ON for AED units, then select Manual mode).
3. With alarms enabled, verify that the patient alarms are functional by adjusting the high and low limits until the unit:
 - Emits a continuous audio tone.
 - Highlights the alarming parameter's value and flashes the alarm bell on the display.
4. Disconnect the ECG cable and verify that your pulse rate is equal to the rate that appears on the E Series heart rate display.
5. Verify the sensor alarms are functional by unplugging the sensor from the E Series unit. Make sure the unit:
 - Displays the *CHECK SPO2 SENSOR* message.
 - Emits a two-beep audio tone.
6. Verify the plethysmographic waveform display by pressing the **Wave 2** softkey and ensuring that the waveform repeats at your pulse rate.

Default Settings

When the pulse oximeter is turned on, the following default settings are automatically selected and remain in operation until changed.

Parameter	Default Setting	Range
Averaging Mode	8 seconds (medium)	4 seconds (short) 8 seconds (medium) 16 seconds (long)
Sensitivity	Normal	Normal or High
High SpO ₂ Alarm Limit	OFF (appears as: ---)	50% to 100% or OFF
Low SpO ₂ Alarm Limit	85%	50% to 100% or OFF
High Heart Rate Alarm Limit	150 bpm (beats/minute)	60 to 280 bpm (beats/minute) - monitoring via ECG 60 to 235 bpm (beats/minute) - monitoring via Pulse Oximetry
Low Heart Rate Alarm Limit	30 bpm (beats/minute)	20 to 100 bpm (beats/minute)

Note: Only the default settings are available in AED Semi-Automatic operation. Default alarm limit setting may be adjusted in System Configuration mode. See the *E Series Configuration Guide* for more information.

SpO₂ Accessories

The following table describes each of the SpO₂ accessories.

Item	Description	Part #
LNOP Adt	Single use sensor for patients > 30 kg	8000-0041
LNOP Pdt	Single use sensor for Pediatrics and Slender Adults > 10 kg and < 50 kg	8000-0044
LNOP Neo	Single use sensor for Neonates < 10 kg	8000-0042
LNOP NeoPt	Single use sensor for Neonates < 1 kg (Pre-term)	8000-0043
LNOP DCI	Reusable sensor for Adults and Pediatrics > 30 kg	8000-0045
LNOP YI	Multisite reusable sensor	8000-0282
LNOP TC-I	Tip clip reusable sensor	8000-0283
LNOP TF-I	Transflectance forehead reusable sensor	8000-0284
LNOP DCSC	Adult reusable spot check sensor	8000-0285
LNOP DC-195	Reusable sensor	8000-0286
Standard Multisite Wrap	Adult/Pediatric/Neonatal adhesive attachment wraps for LNOP YI multisite reusable sensor	8000-0287
Masimo Headband	Headband for LNOP TF-I	8000-0288
PC 04	4' Reusable Patient Cable	8000-0250
PC 08	8' Reusable Patient Cable	8000-0046
PC 12	12' Reusable Patient Cable	8000-0047

Messages and Troubleshooting

The following table lists the error messages associated with the SpO₂ option, and the corresponding corrective action(s). Read this section carefully before using the oximeter for patient monitoring.

Message	Possible Cause(s)	Recommended Action(s)
<i>CHECK SpO2 SENSOR</i>	The SpO ₂ readings may be invalid due to excessive motion, inappropriate sensor site, poor placement, low perfusion, or sensor is not attached.	For all causes, reposition or relocate the sensor and/or increase perfusion.
<i>SPO2 AMBIENT LIGHT/ CHECK SPO2 SENSOR</i>	Excessive ambient light.	Relocate the sensor to a site shielded from light or reduce the amount of light shining on the sensor.
<i>SPO2 FAULT XX</i>	The SpO ₂ subsystem of the unit has failed.	Call ZOLL Technical Service Department.
<i>SPO2 PULSE SEARCH</i>	The oximeter cannot detect a patient's pulse.	Reposition or relocate the sensor and/or increase perfusion.
Dashes (-----) appear in place of SpO ₂ numeric and do not change to a real number.	Excessive ambient light, inadequate perfusion, high signal artifact, a defective or disconnected sensor, etc.	Reposition or relocate the sensor and/or increase perfusion.

Specifications

General					
Saturation (% SpO₂) Range	1% - 100%				
Pulse Rate (bpm) Range	25 - 240 bpm (beats per minute)				
Saturation (% SpO₂) Accuracy During No Motion Conditions	<table border="0"> <tr> <td>Adults/Pediatrics</td> <td>70% - 100%, ±2 digits 0% - 69%, unspecified</td> </tr> <tr> <td>Neonates</td> <td>70% - 100%, ±3 digits 0% - 69%, unspecified</td> </tr> </table>	Adults/Pediatrics	70% - 100%, ±2 digits 0% - 69%, unspecified	Neonates	70% - 100%, ±3 digits 0% - 69%, unspecified
Adults/Pediatrics	70% - 100%, ±2 digits 0% - 69%, unspecified				
Neonates	70% - 100%, ±3 digits 0% - 69%, unspecified				
Saturation (% SpO₂) Accuracy During Motion Conditions	Adults/Pediatrics/Neonates 70% - 100%, ±3 digits 0% - 69%, unspecified				
Pulse Rate (bpm) Accuracy During No Motion Conditions	±3 bpm				
Pulse Rate (bpm) Accuracy During Motion Conditions	±5 bpm				
SpO₂ Alarm Limits	On/Off displayed on monitor. User selectable. High 72 - 100% saturation, Low 70 - 98% saturation				
Pulse Rate Alarm Limits	On/Off displayed on monitor. User selectable. High 60 - 235 beats per minute, Low 20 - 100 beats per minute				
Saturation (% SpO₂) Resolution	1%				
Pulse Rate Resolution	1 bpm (beats per minute)				
Bio-Compatibility	Patient contacting material meets requirements of ISO 10993-1, Biological Evaluation of Medical Device - Part I, for external devices, intact surfaces and short-term exposure				
Environmental	Operating Temperature: 0° to 40° C (32° to 104° F) Storage Temperature: -40° to 70° C (-40° to 158° F) Note: The E Series device may not perform to specifications when stored at the upper or lower extreme limits of storage temperature and immediately put into use				
Electromagnetic Immunity (SpO₂ Option Only)	AAMI DF-80; EN61000-4-3:2002 to 20 V/m				
Operating Time	For a new, fully charged PD4410 battery pack at 20°C (68°F): <ul style="list-style-type: none"> • 35 defibrillator discharges at maximum energy (200 J), or • 2.0 hours minimum of continuous ECG monitoring, or • 1.75 hours of continuous ECG monitoring/pacing at 60 mA, 70 beats per minute. 				

Note: The E Series Pulse Oximetry Option is calibrated for functional saturation.

